DRAINAGE REPORT

For

SLV Ashland, LLC

PROPOSED

Redevelopment

50 Main Street
Ashland, Massachusetts
Middlesex County

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I. EXECUTIVE SUMMARY

This report examines the changes in drainage that can be expected as the result of the proposed redevelopment located at 50 Main Street, consisting of a proposed 250-unit apartment building with associated site improvements. The site, which contains approximately 7.8 acres of land, contains an existing former mill complex with associated paved areas.

The proposed project includes the construction of a new 54,050± square-foot residential building along with new paved parking areas, landscaping, storm water management components and associated utilities. This report addresses a comparative analysis of the pre- and post-development site runoff conditions. Additionally, this report provides calculations documenting the design of the proposed stormwater conveyance/management system as illustrated within the accompanying Site Development Plans prepared by Bohler as well as compensatory flood storage calculations. The project will also provide erosion and sedimentation controls during the demolition and construction periods, as well as long term stabilization of the site.

For the purposes of this report, the limits of the study area are coincidental with the previously disturbed areas on-site, primarily south of the existing retaining wall. Pre- and post-development drainage conditions were analyzed at one (1) "design point" where stormwater runoff currently drains to under existing conditions. These design points are described in further detail in **Section II** below. A summary of the existing and proposed conditions peak runoff rates for the 2-, 10-, 25-, and 100-year storms can be found in **Table 1.1** below. In addition, the project has been designed to comply with the Stormwater Management Standards as applicable to redevelopment projects and detailed further herein.

Table 1.1: Design Point Peak Runoff Rate Summary

Point of Analysis	2-Year Storm			10-Year Storm			25-Year Storm			100-Year Storm		
	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ
DP1	15.98	15.09	**-0.89**	25.84	24.89	**-0.95**	31.99	31.04	**-0.95**	41.53	40.61	**-0.92**

**Flows are represented in cubic feet per second (cfs)*

II. EXISTING SITE CONDITIONS

Existing Site Description

The subject site is located at 10-50 Main Street in the Town of Ashland, MA and futher identified as Parcel IDs 14-128 on the Town of Ashland Assessors maps. The project is comprised of land totaling approximately 340,142 square feet (7.8 acres). The site is located on the eastern side of Main Street and Myrtle Street with a small portion of the property falling on the western side of Concord Street.

The site contains an existing mill that is approximately 91,050 square feet and has a gross floor area of approximately 177,000 square feet. Over the years, the existing mill has been converted into a complex that houses several businesses. The Sudbury River is adjacent to the eastern property line and an existing wetland resource area is located to the south of the existing developed area. The associated buffer zones to wetland areas typically fall within previously developed areas onsite that are largely impervious. The Flood Insurance Rate Maps (FIRM) (Map Number 25017C0514F) for the project site (dated July 7, 2014) indicates the site falls within Zones A and AE associated with the Sudbury River. An Order of Resource Area Delineation (ORAD) was issued on November 17, 2020 (MassDEP File #95-0948), based upon a plan entitled "Existing Conditions of #10-50 Main Street In Ashland, MA", prepared by Cornerstone Engineering, Inc., dated September 14, 2020, affirming the limits of the Bordering Land Subject to Flooding. It's notable that the site is bounded by an existing wall along the river that holds back the flood elevation until elevation 185+/-.

On-Site Soil Information

Soils within the analyzed area consist of those noted in Table 2.1 as classified by the Natural Resource Conservation Service (NRCS). Refer to **Appendix C** for additional information.

Table 2.1: Existing Soil Information

Soil Unit Symbol	Soil Name / Description	Hydrologic Soil Group (HSG)
6A	Scarboro mucky fine sandy loam	A/D
656	Udorthents-Urban land complex	N/A

It is notable that the existing site contains environmentally impacted soils and the ability to provide stormwater management and infiltration on site is limited due to the soils. Impacts to stormwater management compliance are outlined further herein. A RAM Plan has been prepared and

previously submitted to the Town of Ashland. The RAM Plan discusses current site conditions and future plans for the management of soils on site. The Project LSP, in coordination with the geotechnical engineering team and the general contractor, will prepare a Soil Management Plan once the Site Development Plans and Building Plans are developed post permitting, when the project has entered the Construction Document stage. The RAM Plan can be provided to the Conservation Commission for review prior to construction.

Existing Collection and Conveyance

An existing retaining wall is located on site adjacent to the Sudbury River. The purpose of this retaining wall is to act as a barrier from the river when water levels are elevated. This wall is constructed to an elevation of 185+/-. The majority of the stormwater generated onsite ultimately drains overland toward this retaining wall and discharges to the river through one of three outlet pipes in the wall. There is an existing pump house on site which historically would pump water, routed through an existing catch basin, to the Sudbury River, however this pump house is no longer in use. A small portion at the front of the Site drains overland to the Main Street right-of-way drainage system. There is currently no stormwater management or treatment systems on the site. The site topography consists of elevations ranging from 180'-192'.

There is an existing raceway on-site located along Main Street which outlets to the east. The status of the raceway was reviewed with multiple Town officials as part of the Zoning Board Comprehensive Permit application process. As such it is our understanding that the culvert is blocked with flowable fill preventing water from moving between the north and south side of the street. However, as part of the discussions during the ZBA permit it was noted that there is a suspected Sanitary Sewer Overflow (SSO) in the area and that the Town is actively investigating to determine the location of the SSO. As such the plans note that the contractor shall coordinate with the Ashland DPW prior to and during the excavation and removal of the raceway to address any, and all concerns discovered. For the purposes of this study, the proposed project is designed presuming the culverts removal.

Existing Watersheds and Design Point Information

For the purposes of this analysis, the pre- and post-development drainage conditions were analyzed at one (1) "design point" as described below where stormwater runoff currently drains to under existing conditions. The existing site is considered a single sub catchment, as described below, to analyze existing and proposed flow rates at the design point. The minimum time of concentration for all proposed areas is calculated as 6 minutes (0.1 hr.).

Design Point #1 (DP1) is the Sudbury River. Under existing conditions, this design point receives stormwater flows from the entirety of the site, designated as watershed "E1". Refer to Table 2.2 below for additional detail.

Table 2.2: Existing Sub-Catchment Summary

Sub-catchment Name	Total Area (acres)	Cover Description	Time of Concentration (Tc, minutes)
ED1.1	5.3±	Rooftops, paved parking, grass	6.0

Refer to **Appendix D** and the Drainage Area Maps in the appendices of this report for a graphical representation of the existing drainage areas.

III. PROPOSED SITE CONDITIONS

Proposed Development Description

The proposed project consists of the demolition of the existing mill complex, except for a 7,790± square-foot building and a 3,600± square-foot building portion to remain. The project also proposes the construction of a 54,050± square-foot residential building, which is proposed to contain 250 apartment units, including paved parking areas, amenity areas, landscaping, associated utilities, and a new stormwater management system. Additionally, the existing wall will be reinforced with the construction of a new retaining wall immediately adjacent to the existing wall on the project side. All work is proposed to occur in previously developed areas of the site with the exception of stormwater outlet protections to improve the existing conditions.

Proposed Development Collection and Conveyance

As this is an existing mill site, redevelopment options are limited based on the abutting floodplain, high groundwater, proximity to the Sudbury River, and environmentally impacted soils on-site that preclude our ability to provide recharge and infiltration. As such, we've looked to work within these parameters while providing improvements to existing conditions to the maximum extent practicable. The drainage areas are as described below.

The proposed project has been designed to stay within the limits of previously disturbed areas and will also provide a net decrease of impervious surface of approximately 19,341± square feet. The project is naturally reducing flows to the river as a result of the reduction in impervious area.

Much of the paved parking areas are designed to convey stormwater to the rear of the site for treatment and discharge to the Sudbury River. Portions of the paved parking area are designed to be conveyed to a Rain Guardian Turret or Contech CDS water quality unit for treatment prior to discharge. The remaining areas drain to vegetated filter strips and paved drainage channels prior to discharging through one of four (4) proposed overflow pipes through the retaining wall to the Sudbury River.

The parking area along the western side of the building will drain to a deep sump catch basin and water quality unit to provide water quality treatment prior to discharge.

A small portion at the front of the Site drains overland to the Main Street right-of-way drainage system. Proposed entrances will be graded with a ridge line on the back side of the pedestrian crosswalks in order to maintain the existing gutter flow in Main Street and direct stormwater runoff into the site for stormwater management.

The outlet pipes directed to the Sudbury River noted above will be retrofitted or constructed with TideFlex check valves to ensure that water leaves the site but not allow backflow from the Sudbury River during higher storm events, refer to Compensatory Flood Storage section below for additional information.

During said higher storm events, an underground stormwater chamber system and pump system is proposed to be provided to discharge stormwater from the site toward a higher elevation to the south of the site as shown on the plans. It is noted that the stormwater pump is not intended for peak rate mitigation but intended to help minimize ponding of stormwater in the rear parking area as well as the adjacent parking garage when the height of the river won't allow drainage to leave the site. Under lower storm events, stormwater runoff will be directed to the culverts in the wall which mimic the existing site conditions. Stormwater inlets are set at an elevation above the discharge pipes in the wall and when stormwater rises above these inlets, runoff will be collected and conveyed into the tanks for additional storage then pumped via the pump station. The pump system will consist of concrete chambers with a duplex pump setup and a backup generator. Each pump has been sized to discharge at a rate of up to 7.24 CFS and discharge to a velocity dissipator pad at the discharge point. A preliminary detail of the tank and pump system are included in the plans to indicate the general intent of the design.

This project is a redevelopment, and the best management practices (BMPs) incorporated into the proposed stormwater management system have been designed to meet the standards set forth in the Massachusetts Department of Environmental Protection Stormwater Handbook to the maximum extent practicable given the extensive floodplain requirements and AUL limitations both of which limit the feasibility of stormwater management as detailed further herein. It is notable that the existing site does not currently contain any stormwater management or water quality treatment, and the proposed development will provide a significant improvement over existing conditions with the proposed BMPs and reductions in impervious area. Refer to **Section V** for additional information.

Proposed Watersheds and Design Point Information

The project has been designed to maintain existing drainage watersheds to the greatest extent possible, with the same design points described in **Section II** above. The site is comprised of a single sub catchment for the proposed conditions as described below. The minimum time of concentration for all proposed areas is calculated as 6 minutes (0.1 hr.).

Under proposed conditions DP#1 receives stormwater flows from the entirety of the site, designated as watershed "P-1". Refer to Table 3.1 below for additional detail.

Table 3.1: Proposed Sub-catchment Summary

Sub-catchment Name	Total Area (acres)	Cover Description	Time of Concentration (Tc, minutes)
PD1.1	5.3±	Rooftops, paved parking, grass	6.0

For additional hydrologic information, refer to **Appendix E** and the Drainage Area Maps in the appendices of this report for a graphical representation of the proposed drainage areas.

IV. METHODOLOGY

Peak Flow Calculations

Methodology utilized to design the proposed stormwater management system includes compliance with the guidelines set forth in the latest edition of the Massachusetts DEP Stormwater Handbook. The pre- and post-development runoff rates being discharged from the site were computed using the HydroCAD computer program. The drainage area and outlet information were entered into the program, which routes storm flows based on NRCS TR-20 and

TR-55 methods. The other components of the model were determined following standard NRCS procedures for Curve Numbers (CNs) and times of concentrations documented in the appendices of this report. The rainfall data utilized and listed below in table 4.1 for stormwater calculations is based on the NOAA Atlas. Refer to **Appendix F** for more information.

Table 4.1: NOAA Rainfall Intensities

Frequency	2-year	10-year	25-year	100-year
Rainfall* (inches)	3.35	5.24	6.41	8.22

*Values derived from NOAA ATLAS on 03/10/2025

The proposed stormwater management as designed will provide a decrease in peak rates of runoff from the proposed facility for the 2-, 10-, 25- and 100-year design storm events.

Compensatory Flood Storage

The proposed design accounts for the 100 year- flood elevation of 187.0 as previously approved under the ORAD issued on November 17, 2020 (MassDEP File #95-0948). Work proposed within the mapped BLSF includes the removal of the existing buildings and associated paved areas in support of the proposed development.

The project will provide compensatory floodplain storage within the proposed development footprint exceeding the existing floodplain storage on-site. The project is calculated to provide approximately 23,235± cubic yards of compensatory flood storage, exceeding the requirement of approximately 20,890± cubic yards of storage. Proposed compensatory flood storage is provided on-site, including portions of the paved parking area as well as a portion of the proposed underground garage. The pre- and post-development flood storage volumes on an incremental elevation basis are outlined in Table 4.2 below. Note that existing flood storage below elevation 185 is calculated as a total volume and not on an elevation-by-elevation basis due to the retaining wall providing a physical restriction between the site and the river preventing this area being used as flood storage as flood water rise until flood elevations exceed the height of the wall at elevation 185. Refer to **Appendix H** for graphical representations of the flood storage areas.

Table 4.2: Compensatory Flood Storage Calculations

Elevation Interval	Existing Volume Provided (CY	Proposed Volume Provided (CY)	Net Volume Provided (CY)
< 185	13,151	13,797	+646
185 - 186	3,849	4,649	+800
186 - 187	3,890	4,789	+899
Total	**20,890**	**23,235**	**+2,345**

As noted above, the existing retaining wall provides a physical restriction between the site and the river and prevents the on-stie elevations below 185 being used for flood storage until such time flows overtop the wall.

Stormwater Check Valves

As mentioned earlier the outlet pipes directed to the Sudbury River will be retrofitted or constructed with TideFlex valves to ensure that water leaves the site but not allow backflow from the Sudbury River during higher storm events. Per the manufacturer, the cracking pressure for the TideFlex valve is 1-2 inches and the valve will increasingly open with more head. At about 14 inches of head, it will snap to full flow. Refer to **Appendix H** for additional data from the manufacturer.

V. STORMWATER MANAGEMENT STANDARDS

Standard #1: No New Untreated Discharges

The existing site is completely paved and has no stormwater management system. The proposed project has been designed to reduce impervious areas thereby providing an inherent increase to water quality. Discharges are proposed to be treated to the maximum extent practicable due to site limitations from the impacted soils and floodplain requirements, refer to Standard #4 below.

Standard #2: Peak Rate Attenuation

Due to the decrease in impervious area the post-development peak rates of runoff are below pre-development conditions under all storm events. As outlined in **Table 1.1**, the development of the site and the proposed stormwater management system, have been designed so that post-development peak rates of runoff are below pre-development conditions for the 2-, 10-, 25- and 100-year storm events at all design points.

Standard #3: Recharge

The project proposes to increase pervious areas on site by approximately 0.44 acres compared to the existing site conditions. However, the proposed BMPs are not designed to infiltrate due to environmentally impacted soils on site. This is consistent with Standard #3 which allows for infiltration to the maximum extent practicable for sites that are adjacent to areas that are contaminated and where infiltration may contribute to groundwater contamination.

Standard #4: Water Quality

The existing site is completely paved and has no stormwater management system. The proposed project has been designed to reduce impervious areas thereby providing an inherent increase to water quality.

Much of the paved parking areas are designed to convey stormwater to the rear of the site for treatment and discharge to the Sudbury River. Portions of the paved parking area are designed to be conveyed to a Rain Guardian Turret or Contech CDS water quality unit for treatment prior to discharge. The remaining areas drain to vegetated filter strips and paved drainage channels prior to discharging through one of four (4) proposed overflow pipes through the retaining wall to the Sudbury River.

The parking area along the western side of the building will drain to a deep sump catch basin and water quality unit to provide water quality treatment to provide the required water quality volume treatment and 80% TSS removal prior to discharge.

A small portion at the front of the Site drains overland to the Main Street right-of-way drainage system. Proposed entrances will be graded with a ridge line on the back side of the pedestrian crosswalks in order to maintain the existing gutter flow in Main Street and direct stormwater runoff into the site for stormwater management.

Refer to **Appendix F** for additional information.

Standard #5: Land Use with Higher Potential Pollutant Loads

The project will trigger this requirement based on traffic generation. As described above, based on the existing site constraints, the project is providing water quality improvements to the extent practicable, and providing water quality treatment above what exists on site today. Water quality units are sized for one (1) inch of water quality volume treatment.

Standard #6: Critical Areas

The Sudbury River is located adjacent to the site to the east. The proposed project is designed to reduce peak flows to the Sudbury River, as well as to provide increased treatment to stormwater prior to entering the river in comparison to existing conditions. Water quality BMPs including deep sump catch basins, proprietary separators and a Rain Guardian Turret are provided where practicable.

Standard #7: Redevelopment

This project is a redevelopment and has been designed to meet the standards set forth in the Massachusetts Department of Environmental Protection Stormwater Handbook standards to the maximum extent practicable. Refer to the Checklist for Redevelopment Projects in **Appendix A** for a full outline of how the project complies with the standards as they relate to redevelopment.

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

The proposed project will provide construction period erosion and sedimentation controls as indicated within the site plan set provided for this project. This includes a proposed construction exit, protection for stormwater inlets, protection around temporary material stock piles and various other techniques as outlined on the erosion and sediment control sheets. Additionally, the project is required to file a Notice of Intent with the US EPA and implement a Stormwater Pollution Prevention Plan (SWPPP) during the construction period. The SWPPP will be prepared prior to the start of construction and will be implemented by the site contractor under the guidance and responsibility of the project's proponent.

Standard #9: Operation and Maintenance Plan (O&M Plan)

An Operation and Maintenance (O&M) Plan for this site has been prepared and is included in **Appendix G** of this report. The O&M Plan outlines procedures and timetables for the long-term operation and maintenance of the proposed site stormwater management system, including initial inspections upon completion of construction, and periodic monitoring of the system components, in accordance with established practices and the manufacturer's recommendations. The O&M Plan includes a list of responsible parties.

Standard #10: Prohibition of Illicit Discharges

The proposed stormwater system will only convey allowable non-stormwater discharges (firefighting waters, irrigation, air conditioning condensates, etc.) and will not contain any illicit discharges from prohibited sources. An Illicit Discharge Statement is included in **Appendix G** of this report.

VI. SUMMARY

In summary, the proposed stormwater management system illustrated on the drawings prepared by Bohler results in a reduction in peak rates of runoff from the subject site when compared to pre-development conditions for the 2-, 10-, 25- and 100-year storm frequencies. In addition, the proposed best management practices will result in increased treatment of post-development runoff where none exists today. As previously mentioned, the project also proposes to increase pervious areas on site and will result in a net decrease in the impervious area as designed. Additionally, the project meets or exceeds the MADEP Stormwater Management Standards as described further herein.

APPENDIX A: STORMWATER CHECKLISTS

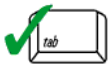
- *MASS DEP STORMWATER CHECKLIST*
- *MASS DEP CHECKLIST FOR REDEVELOPMENTS*

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

1/16/2026

Signature and Date

Checklist

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

☐ New development

☒ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

☒ No disturbance to any Wetland Resource Areas

☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)

☒ Reduced Impervious Area (Redevelopment Only)

☒ Minimizing disturbance to existing trees and shrubs

☐ LID Site Design Credit Requested:

- ☐ Credit 1
- ☐ Credit 2
- ☐ Credit 3

☐ Use of "country drainage" versus curb and gutter conveyance and pipe

☐ Bioretention Cells (includes Rain Gardens)

☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)

☐ Treebox Filter

☐ Water Quality Swale

☐ Grass Channel

☐ Green Roof

☐ Other (describe): _____

Standard 1: No New Untreated Discharges

☒ No new untreated discharges

☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth

☒ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☐ Soil Analysis provided.

☐ Required Recharge Volume calculation provided.

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

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

☐ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☒ An Illicit Discharge Compliance Statement is attached;

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

Chapter 3

Checklist for Redevelopment Projects

Standard 7: A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural stormwater best management practice requirements of Standards 4, 5, and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions.

Redevelopment is defined to include

- Maintenance and improvement of existing roadways, including widening less than a single lane, adding shoulders, correcting substandard intersections, improving existing drainage systems, and repaving;
- Development rehabilitation, expansion and phased projects on previously developed sites, provided the redevelopment results in no net increase in impervious area; and
- Remedial projects specifically designed to provide improved stormwater management, such as projects to separate storm drains and sanitary sewers, and stormwater retrofit projects.

Components of redevelopment projects that include development of previously undeveloped sites do not meet this definition. The portion of the project located in a previously developed area must meet Standard 7, but project components within undeveloped areas must meet all the Standards.

MassDEP recognizes that site constraints often make it difficult to comply with all the Standards at a redevelopment site. These constraints are as follows:

Lack of space. Because of the presence of existing structures, on-site subsurface sewage disposal systems, stormwater best management practices, and water bodies and wetlands, and easements, the space available for the installation of additional stormwater BMPs may be quite limited. On many suites it may be difficult or impossible to use space-intensive BMPs such as wet detention basins.

Soils: The presence of bedrock or clay can limit the effectiveness of infiltration or detention BMPs. Often soils at redevelopment sites have been compacted by buildings and heavy traffic, impairing their ability to infiltrate stormwater into the ground.

Underground utilities. The presence of underground utilities including gas and water mains, sewer pipes and electric cable conduits can greatly reduce the amount of land available for BMPs.

This chapter provides specific guidance and checklists to ensure that the applicant has met his/her obligations under Standard 7. Because it may be difficult for a redevelopment project to comply with all the Stormwater Management Standards, Standard 7 provides that a redevelopment project is required to comply with the following Standards only "to the maximum extent practicable": Standard 2, Standard 3, and the pretreatment and structural stormwater best management practice requirements of Standards 4, 5, and 6. Existing outfalls shall be brought into compliance with Standard 1 only to the maximum extent practicable.

As set forth in Standard 7, the phrase "to the maximum extent practicable" means that:

(1) Proponents of redevelopment projects have made all reasonable efforts to meet the requirements of Standards 2 and 3 and the pretreatment and structural stormwater best management practices requirements of Standards 4, 5, and 6 and to bring existing outfalls into compliance with Standard 1.

(2) They have made a complete evaluation of possible stormwater management measures, including environmentally sensitive site design that minimizes land disturbance and impervious surfaces, low impact development techniques and structural stormwater BMPs; and

(3) If not in full compliance with Standard 1 for existing outfalls, Standards 2 and 3 and the pretreatment and structural stormwater best management practice requirements of Standards 4, 5, and 6, they are implementing the highest practicable level of stormwater management.

Generally, an alternative is practicable if it can be implemented within the site being redeveloped, taking into consideration cost, land area requirements, soils and other site constraints. However, offsite alternatives may also be practicable. Proponents must document the evaluation of practicable alternatives with sufficient information to support the conclusions of the analysis.

At the same time, stormwater runoff from redevelopment projects must be properly managed. To this end, Standard 7 provides that redevelopment projects shall comply with all other requirements of the Stormwater Management Standards, including, without limitation, the pollution prevention requirements of Standards 4, 5, and 6, the erosion and sedimentation control requirements of Standard 8, the operation and maintenance requirements of Standard 9, and the prohibition of illicit discharge set forth in Standard 10. Proponents must also improve existing conditions.

Proponents of redevelopment projects shall document their compliance with these requirements. To assist proponents and reviewers in determining whether a redevelopment project complies with Standard 7, MassDEP has prepared the following redevelopment checklist.

[*Proponents of MassHighway redevelopment projects and Conservation Commissions reviewing such projects may follow the guidelines for redevelopment provided in the MassHighway Stormwater Handbook for Highways and Bridges (May 2004 or latest version) in lieu of the guidance set forth in this chapter.*[1] *The MassHighway Stormwater Handbook was developed by the Massachusetts Highway Department and issued by joint correspondence of May 7, 2004 by MassHighway and MassDEP. It provides detailed guidance on the evaluation and implementation of stormwater management practices for MassHighway road and bridge redevelopment projects, including a methodology for screening and selecting Best Management Practices (BMPs). Proponents and reviewers of other public roadway redevelopment projects may find useful information in the MassHighway Stormwater Handbook*.]

[1] The MassHighway Handbook published in 2004 must be revised to make it consistent with this Handbook.

Redevelopment Checklist

Existing Conditions

- On-site: For all redevelopment projects, proponents should document existing conditions, including a description of extent of impervious surfaces, soil types, existing land uses with higher potential pollutant loads, and current onsite stormwater management practices.
  Bohler: Refer to stormwater report narrative for description of the existing conditions.

- Watershed: Proponents should determine whether the project is located in a watershed or subwatershed, where flooding, low streamflow or poor water quality is an issue.
- Bohler: Refer to stormwater report narrative for description of the existing conditions.

The Project

Is the project a redevelopment project? Bohler: Yes, redevelopment of a previously developed site.

- Maintenance and improvement of existing roadways
- Development of rehabilitation, expansion or phased project on redeveloped site, or
- Remedial stormwater project

For non-roadway projects, is any portion of the project outside the definition of redevelopment?

- Development of previously undeveloped area Bohler: No
- Increase in impervious surface Bohler: Decrease of 0.69 acres of impervious surface

If a component of the project is not a redevelopment project, the proponent shall use the checklist set forth below to document that at a minimum the proposed stormwater management system fully meets each Standard for that component. The proponent shall also document that the proposed stormwater management system meets the requirements of Standard 7 for the remainder of the project.

The Stormwater Management Standards

The redevelopment checklist reviews compliance with each of the Stormwater Management Standards in order.

Standard 1: (Untreated discharges)
No new stormwater conveyances (e.g., outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.
Same rule applies for new developments and redevelopments.

Full compliance with Standard 1 is required for new outfalls.

- What BMPs are proposed to ensure that all new discharges associated with the discharge are adequately treated? Bohler: The only new point source discharge is from the western parking field at the front of the building. TSS (80%) and water quality treatment (1") are provided via a deep sump catch basin and proprietary treatment unit.

- What BMPs are proposed to ensure that no new discharges cause erosion in wetlands or waters of the Commonwealth? Bohler: The new point source discharge will discharge to a proposed headwall at the end of the existing raceway that is to be removed.
- Will the proposed discharge comply with all applicable requirements of the Massachusetts Clean Waters Act and the regulations promulgated thereunder at 314 CMR 3.00, 314 CMR 4.00 and 314 CMR 5.00? Bohler: Yes, except that 314 CMR5.00: Ground Water Discharge Permit Program does not apply to this project as there is no groundwater discharge due to impacted soils.

Existing outfalls shall be brought into compliance with Standard 1 to the maximum extent practicable.

- Are there any existing discharges associated with the redevelopment project for which new treatment could be provided? Bohler: Yes
- If so, the proponent shall specify the stormwater BMP retrofit measures that have been considered to ensure that the discharges are adequately treated and indicate the reasons for adopting or rejecting those measures. (See Section entitled "Retrofit of Existing BMPs".) Bohler: The project is providing stormwater improvements to the maximum extent practicable due to the floodplain requirements and AUL limitations both of which limit the feasibility of stormwater management. The environmentally impacted soils prohibit the use of infiltration for improving stormwater treatment at existing discharges. In addition, almost the entirety of the existing project is within the floodplain to the Sudbury River and is close to the same elevation as the river bank. There is minimal room to adjust the proposed elevations on site without negatively impacting the floodplain storage on site which restricts the proposed grades at or near existing conditions. Due to the floodplain restriction, there is not enough vertical elevation to install mechanical or proprietary stormwater treatment devices prior to the existing discharge locations. Potential proprietary or mechanical treatment devices that were evaluated were hydrodynamic separators (e.g. Stormceptor), membrane filtering units (e.g. Jellyfish) and biofiltration units (e.g. Focal Point).
- What BMPs have been considered to prevent erosion from existing stormwater discharges? Bohler: Rip rap is proposed at the discharge locations, where feasible without causing wetland alteration or disturbance, to prevent erosion. This will be discussed further with the Conservation Commission during the NOI process.

<u>Standard 2: (Peak rate control and flood prevention)</u>
Stormwater management systems must be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for land subject to coastal storm flowage.
Full compliance for any component that is not a redevelopment

Compliance to the Maximum Extent Practicable:

- Does the redevelopment design meet Standard 2, comparing post-development to pre-development conditions? Bohler: Yes
- If not, the applicant shall document an analysis of alternative approaches for meeting the Standard. (See Menu of Strategies to Reduce Runoff and Peak Flows and/or Increase Recharge Menu included at the end of this chapter.)

Improvement of existing conditions:

- Does the project reduce the volume and/or rate of runoff to less than current estimated conditions? Has the applicant considered all the alternatives for reducing the volume and/or rate of runoff from the site? (See Menu.) Bohler: The project reduces total impervious area by 0.69 acres which will reduce the volume and peak rates of runoff to the river. Refer to stormwater narrative for flow rate calculations.

- Is the project located within a watershed subject to damage by flooding during the 2-year or 10-year 24-hour storm event? If so, does the project design provide for attenuation of the 2-year and 10-year 24-hour storm event to less than current estimated conditions? Have measures been implemented to reduce the volume of runoff from the site resulting from the 2 year or 10 year 24 hour storm event? (See Menu.) Bohler: The project reduces total impervious area by 0.69 acres which will reduce the volume and peak rates of runoff to the river. Refer to stormwater narrative for flow rate calculations.
- Is the project located adjacent to a water body or watercourse subject to adverse impacts from flooding during the 100-year 24-hour storm event? If so, are portions of the site available to increase flood storage adjacent to existing Bordering Land Subject to Flooding (BLSF)? Bohler: The project is located within the 100 year flood plain per the FEMA FIRM Map. Detailed compensatory flood storage calculations have been provided to show that the project will not reduce the amount of BLSF on the site.
- Have measures been implemented to attenuate peak rates of discharge during the 100-year 24-hour storm event to less than the peak rates under current estimated conditions? Have measures been implemented to reduce the volume of runoff from the site resulting from the 100-year 24-hour storm event? (See Menu.) Bohler: The project reduces total impervious area by 0.69 acres which will reduce the volume and peak rates of runoff to the river. Refer to stormwater narrative for flow rate calculations.

Standard 3: (Recharge to Ground water)

Loss of annual recharge to ground water shall be eliminated or minimized through the use of infiltration measures, including environmentally sensitive site design, low impact development techniques, best management practices, and good operation and maintenance. At a minimum, the annual recharge from the post-development site shall approximate the annual recharge from the pre-development conditions based on soil type. This Standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusettss Stormwater Handbook.

Full compliance for any component that is not a redevelopment

Compliance to the Maximum Extent Practicable:

- Does the redevelopment design meet Standard 3, comparing post-development to pre-development conditions? Bohler: The site contains environmentally impacted soils and therefore recharge of stormwater runoff is not feasible nor proposed.
- If not, the applicant shall document an analysis of alternative approaches for meeting the Standard? Bohler: The site contains environmentally impacted soils and therefore recharge of stormwater runoff is not feasible nor proposed.
- What soil types are present on the site? Is the site is comprised solely of C and D soils and bedrock at the land surface? Bohler. Soils on site are mapped as Udorthents – Urban Land Complex with an unidentified hydrologic soil group rating.
- Does the project include sites where recharge is proposed at or adjacent to an area classified as contaminated, sites where contamination has been capped in place, sites that have an Activity and Use Limitation (AUL) that precludes inducing runoff to the groundwater, pursuant to MGL Chapter 21E and the Massachusetts Contingency Plan 310 CMR 40.0000; sites that are the location of a solid waste landfill as defined in 310 CMR 19.000; or sites where groundwater from

the recharge location flows directly toward a solid waste landfill or 21E site?[2] Bohler: The site contains environmentally impacted soils and therefore recharge of stormwater runoff is not feasible nor proposed.

- Is the stormwater runoff from a land use with a higher potential pollutant load? Bohler: Yes, due to traffic generation.
- Is the discharge to the ground located within the Zone II or Interim Wellhead Protection Area of a public water supply? Bohler: No, the site is not located within an Zone II or IWPA.
- Does the site have an infiltration rate greater than 2.4 inches per hour? Bohler: No, the site contains environmentally impacted soils and therefore recharge of stormwater runoff is not feasible nor proposed.

Improvements to Existing Conditions:

- Does the project increase the required recharge volume over existing (developed) conditions? If so, can the project be redesigned to reduce the required recharge volume by decreasing impervious surfaces (make building higher, put parking under the building, narrower roads, sidewalks on only one side of street, etc.) or using low impact development techniques such as porous pavement? Bohler: The site contains environmentally impacted soils and therefore recharge of stormwater runoff is not feasible nor proposed.
- Is the project located within a basin or sub-basin that has been categorized as under high or medium stress by the Massachusetts Water Resources Commission, or where there is other evidence that there are rivers and streams experiencing low flow problems? If so, have measures been considered to replace the natural recharge lost as a result of the prior development? (See Menu.) Bohler: The site contains environmentally impacted soils and therefore recharge of stormwater runoff is not feasible nor proposed.
- Has the applicant evaluated measures for reducing site runoff? (See Menu.) Bohler: The project reduces total impervious area by 0.69 acres which will reduce the volume and peak rates of runoff to the river. As noted previously, almost the entirety of the existing project is within the floodplain to the Sudbury River and is close to the same elevation as the river bank. There is minimal room to adjust the proposed elevations on site without negatively impacting the floodplain storage on site which restricts the proposed grades at or near existing conditions. Due to the floodplain restriction, there is not enough vertical elevation to install additional BMPs (such as retention ponds) to further reduce the peak rates and/or volume of runoff.

Standard 4: (80% TSS Removal)

Stormwater management systems must be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This standard is met when:

a. Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan and thereafter are implemented and maintained;

b. Stormwater BMPs are sized to capture the required water quality volume determined in accordance with the Massachusetts Stormwater Handbook; and

c. Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.

Full compliance for any component that is not a redevelopment
Full compliance with the long-term pollution plan requirement for new developments and redevelopments.

- Has the proponent developed a long-term pollution plan that fully meets the requirements of Standard 4? Bohler: Yes, refer to Appendix B of the report.
- Does the pollution prevention plan include the following source control measures?

[2] A mounding analysis is needed if a site falls within this category. See Volume 3.

- Street sweeping Bohler: Yes
- Proper management of snow, salt, sand and other deicing chemicals Bohler: Yes
- Proper management of fertilizers, herbicides and pesticides Bohler: Yes
- Stabilization of existing eroding surfaces Bohler: The entirety of the existing developed area will be redeveloped and stabilized in accordance with the design plans.

Compliance to the Maximum Extent Practicable for the other requirements:

- Does the redevelopment design provide for treatment of all runoff from existing (as well as new) impervious areas to achieve 80% TSS removal? If 80% TSS removal is not achieved, has the stormwater management system been designed to remove TSS to the maximum extent practicable? Bohler: The existing site is completed paved and has no stormwater management system. The proposed project has been designed to reduce impervious areas thereby providing an inherent increase to water quality. The northeastern and southeastern portions of the site are designed to convey stormwater over vegetated filter strips, a water quality unit and Rain Guardian turret for treatment prior to discharging through one of four (4) proposed overflow pipes through the retaining wall to the Sudbury River. Stormwater runoff collected within the western parking field at the front of the building will pass through a deep sump hooded catch basin and water quality unit to provide the required water quality volume (1") treatment and 80% TSS removal.

  In addition, almost the entirety of the existing project is within the floodplain to the Sudbury River and is close to the same elevation as the river bank. There is minimal room to adjust the proposed elevations on site without negatively impacting the floodplain storage on site which restricts the proposed grades at or near existing conditions. Due to the floodplain restriction, there is not enough vertical elevation to install mechanical or proprietary stormwater treatment devices prior to the existing discharge locations. Potential proprietary or mechanical treatment devices that were evaluated were hydrodynamic separators (e.g. Stormceptor), membrane filtering units (e.g. Jellyfish) and biofiltration units (e.g. Focal Point).
- Have the proposed stormwater BMPs been properly sized to capture the prescribed runoff volume? Bohler: The proprietary units have been sized to treat 1" of water quality volume due to the LUHPPL classification.
  - One inch rule applies for discharge
    - within a Zone II or Interim Wellhead Protection Area,
    - near or to another critical area,
    - from a land use with a higher potential pollutant load
    - to the ground where the infiltration rate is greater than 2.4 inches per hour
- Has adequate pretreatment been proposed? Bohler: Not applicable. The site contains environmentally impacted soils and therefore recharge of stormwater runoff is not feasible nor proposed.
  - 44% TSS Removal Pretreatment Requirement applies if:
    - Stormwater runoff is from a land use with a higher potential pollutant load
    - Stormwater is discharged
      - To the ground within the Zone II or Interim Wellhead Protection Area of a Public Water Supply
      - To the ground with an infiltration rate greater than 2.4 inches per hour
      - Near or to an Outstanding Resource Water, Special Resource Water, Cold-Water Fishery, Shellfish Growing Area, or Bathing Beach.

- If the stormwater BMPs do not meet all the requirements set forth above, the applicant shall document an analysis of alternative approaches for meeting these requirements. (See Section on

Retrofitting Existing BMPs (the "Retrofit Section"). Bohler: Refer to Retrofitting Existing BMPs section.

Improvements to Existing Conditions:

- Have measures been provided to achieve at least partial compliance with the TSS removal standard? Bohler: Yes, partial TSS removal is provided at the rear of the site via the proposed filter strips, water quality unit and Rain Guardian Turret. Full compliance is achieved for the western parking area at the front of the building through a new deep sump catch basin and hydrodynamic separator.
- Have any of the best management practices in the Retrofit Section been considered? Bohler: Yes, see retrofit section.
- Have any of the following pollution prevention measures been considered?
  - Reduction or elimination of winter sanding, where safe and prudent to do so Bohler: Yes, refer to Long Term Pollution Prevention Plan in Appendix B.
  - Tighter controls over the application of fertilizers, herbicides, and pesticides Bohler: Yes, refer to Long Term Pollution Prevention Plan in Appendix B.
  - Landscaping that reduces the need for fertilizer, herbicides and pesticides Bohler: It is anticipated that the application of fertilizer, herbicides and pesticides will be minimal based upon the limited landscape areas.
  - High frequency sweeping of paved surfaces using vacuum sweepers
  - Improved catch basin cleaning Bohler: The site can only accommodate the one catch basin as noted and it will be cleaned four times per year in accordance with the stormwater handbook. Given the minimal watershed that drains to this BMP an increased cleaning schedule is not anticipated to provide a significant improvement.
  - Waterfowl control programs Bohler: Not at this time.
- Are there any discharges (new or existing) to impaired waters? If so, see TMDL section. Bohler: The Sudbury River is listed as a water requiring a TMDL. The list of causes of impairment include mercury in fish tissue, water chestnut and E.Coli. None of the impairments are due to nutrients or sediment.

<u>Standard 5 (Higher Potential Pollutant Loads (HPPL)</u>

For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable. If through source control and/or pollution prevention, all land uses with higher potential pollutant loads cannot be completely protected from exposure to rain, snow, snow melt and stormwater runoff, the proponent shall use the specific stormwater BMPs determined by the Department to be suitable for such use as provided in the Massachusetts Stormwater Handbook. Stormwater discharges from land uses with higher potential pollutant loads shall also comply with the requirements of the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26-53, and the regulations promulgated thereunder at 314 CMR 3.00, 314 CMR 4.00 and 314 CMR 5.00.

Full compliance for any component that is not a redevelopment.
Full compliance with pollution prevention requirements for new developments and redevelopments.

Pollution Prevention

- Has the proponent considered any of the following operational source control measures? Bohler: The Operation and Maintenance Plan, Long Term Pollution Prevention Plan and Spill Prevention and Response Procedures in Appendix G outline the various methods considered below.
  - Formation of a pollution prevention team,
  - Good housekeeping practices,
  - Preventive maintenance procedures,

  - Spill prevention and clean up,
  - Employee training, and
  - Regular inspection of pollutant sources.

- Has the proponent considered implementation of any of the following operational changes to reduce the quantity of pollutants on site?
  - Process changes,
  - Raw material changes,
  - Product changes, or
  - Recycling. Bohler: The project will comply with all applicable Federal, State and local requirements regarding the handling, recycling and disposal of solid waste generated by the project. To the extent feasible, demolition materials will be segregated on site for ruse and disposal. Construction materials that can be recycled (brick, concrete, gypsum wallboard, wood, metal and asphalt roofing) will be to the extent feasible. This recycling will help reduce greenhouse gases produced by the project.

- Has the proponent considered making capital improvements to protect the land uses with higher potential pollutant loads from exposure to rain, snow, snow melt, and stormwater runoff?

  - Enclosing and/or covering pollutant sources (e.g. placing pollutant sources within a building or other enclosure, placing a roof over storage and working areas, placing tarps under pollutant source) Bohler: The project is a LUHPPL Soley due to traffic generation. There are no anticipated sources of exterior storage that would contribute pollutants if exposed to runoff.
  - Installing a containment system with an emergency shutoff to contain spills? The project is a LUHPPL Soley due to traffic generation. There are no anticipated sources of exterior storage that would contribute pollutants if exposed to runoff, therefore there are not any anticipated contaminants that would require an emergency shutoff to contain spills.
  - Physically segregating the pollutant source to prevent run-on of uncontaminated stormwater? Bohler: The project is a LUHPPL Soley due to traffic generation. There are no anticipated sources of exterior storage that would contribute pollutants if exposed to runoff.

Treatment

- If applicable, compliance with the treatment and pretreatment requirements of Standard 5 only to the Maximum Extent Practicable by directing the stormwater runoff from land uses with higher potential pollutant loads to appropriate stormwater BMPs? Bohler: The project is providing stormwater improvements to the maximum extent practicable due to the floodplain requirements and AUL limitations both of which limit the feasibility of stormwater management. Therefore BMPs are proposed to the maximum extent practicable in feasible locations.

  - Are the BMPs selected capable of removing the pollutants associated with the higher potential pollutant load land ("LUHPPL") use? Bohler: The project is providing stormwater improvements to the maximum extent practicable due to the floodplain requirements and AUL limitations both of which limit the feasibility of stormwater management. The environmentally impacted soils prohibit the use of infiltration of stormwater which eliminates the use of infiltration BMPS noted within the LUHPPL list. Also, much of the parking is in a covered garage and will not generate stormwater.

    In addition, almost the entirety of the existing project is within the floodplain to the Sudbury River and is close to the same elevation as the river bank. There is minimal room to adjust the proposed elevations on site without negatively impacting the

floodplain storage on site which restricts the proposed grades at or near existing conditions. Due to the floodplain restriction, there is not enough vertical elevation to install the pretreatment and treatment BMPs noted within the LUHPPL list.

- Is the land use likely to generate stormwater with high concentrations of oil and grease? If so has an oil grit separator, sand filter, filtering bioretention area or equivalent been proposed for pretreatment? Bohler: The project is a LUHPPL due to traffic generation. Hydrodynamic separator units are proposed within the treatment train where feasible to remove oil and grease. However, as noted the remainder of the site is restricted by the floodplain and implementation of additional oil and grease separators, sand filters, filtering bioretention or equivalent is prohibitive due to the elevation constraints. Also, much of the parking is in a covered garage and will not generate stormwater.

Improvement of Existing Conditions.

- If the redevelopment converts a site from a non-LUHPPL use to a LUHPPL use, the applicant shall document how the stormwater BMPs shall be modified or replaced to come into compliance with Standard 5. Bohler: Refer to treatment section above. The project is providing BMPs to the maximum extent practicable due to the soils and floodplain constraints.

- What specific measures have been considered to offset the anticipated impacts of land uses with higher potential pollutant loads? Bohler: Filter strips, a Rain Guardian Turret and a water quality unit are proposed to treat runoff in the rear parking areas. Runoff from the western parking area will be treated via a deep sump hooded catch basin and a hydrodynamic separator.

- If the redevelopment proposal is a brownfield project, the applicant shall demonstrate how the stormwater management measures have been designed to prevent mobilization or remobilization of soil and groundwater contamination. (See Brownfield section) Bohler: Not applicable.

Other Requirements

- Does the discharge comply with all applicable requirements of the Massachusetts Clean Waters Act, 314 CMR 3.00, 314 CMR 4.00 and 314 CMR 5.00? Bohler: Yes, except that 314 CMR5.00: Ground Water Discharge Permit Program does not apply to this project as there is no groundwater discharge due to impacted soils.

Standard 6 (Critical Areas)

Stormwater discharges to a Zone II or Interim Wellhead Protection Area of a public water supply and stormwater discharges near or any other critical area require the use of the specific source control and pollution prevention measures and the specific stormwater best management practices determined by the Department to be suitable for managing discharges to such area, as provided in the Massachusetts Stormwater Handbook. A discharge is near a critical area if there is a strong likelihood of a significant impact occurring to said area, taking into account site-specific factors. Stormwater discharges to Outstanding Resource Waters or Special Resource Waters shall be set back from the receiving water and receive the highest and best practical method of treatment. A "stormwater discharge," as defined in 314 CMR 3.04(2)(a)1. or (b), to an Outstanding Resource Water or Special Resource Water shall comply with 314 CMR 3.00 and 314 CMR 4.00. Stormwater discharges to a Zone I or Zone A are prohibited unless essential to the operation of the public water supply.

Full compliance for component of project that is not a redevelopment

Full compliance with pollution prevention requirements for new developments and redevelopments.

If applicable, compliance to the Maximum Extent Practicable with the pretreatment and treatment requirements of Standard 6:

- Does the redevelopment project utilize the pretreatment, treatment and infiltration BMPs approved for discharges near or to critical areas? Bohler: The project is providing stormwater improvements to the maximum extent practicable due to the floodplain requirements and AUL limitations both of which limit the feasibility of stormwater management. The environmentally impacted soils prohibit the use of infiltration of stormwater which eliminates the use of infiltration BMPS noted within the critical area list.

  In addition, almost the entirety of the existing project is within the floodplain to the Sudbury River and is close to the same elevation as the river bank. There is minimal room to adjust the proposed elevations on site without negatively impacting the floodplain storage on site which restricts the proposed grades at or near existing conditions. Due to the floodplain restriction, there is not enough vertical elevation to install the pretreatment and treatment BMPs noted within the critical area list.

- If the redevelopment project does not comply with Standard 6, the applicant shall document an analysis of alternative measures for meeting Standard 6. (See Section on Specific Redevelopment Projects.) The project is providing stormwater improvements to the maximum extent practicable due to the floodplain requirements and AUL limitations both of which limit the feasibility of stormwater management. The environmentally impacted soils prohibit the use of infiltration for improving stormwater treatment at existing discharges. In addition, almost the entirety of the existing project is within the floodplain to the Sudbury River and is close to the same elevation as the river bank. There is minimal room to adjust the proposed elevations on site without negatively impacting the floodplain storage on site which restricts the proposed grades at or near existing conditions. Due to the floodplain restriction, there is not enough vertical elevation to install mechanical or proprietary stormwater treatment devices prior to the existing discharge locations. Potential proprietary or mechanical treatment devices that were evaluated were hydrodynamic separators (e.g. Stormceptor), membrane filtering units (e.g. Jellyfish) and biofiltration units (e.g. Focal Point). In addition, as noted above, these constraints also prohibit the use of the traditional pretreatment and treatment BMPs outlined within the handbook.

Improvements to Existing Conditions:

- Have measures to protect critical areas been considered, including additional pollution prevention measures and structural and non-structural BMPs? Bohler: Yes, pollutant prevention measures and non-structural BMPs practices are outlined in the Operation and Maintenance Plan and Long-Term Pollution Prevention Plan contained in Appendix G. As noted, the existing constraints limit the amount of structural and non-structural BMPs to those proposed on the plan which consist of the filter strip, deep sump catch basin and hydrodynamic separator.

Other Requirements

- Does the discharge comply with the Massachusetts Clean Waters Act, 314 CMR 3.00, 314 CMR 4.00, and 314 CMR 5.00? Bohler: Yes, except that 314 CMR5.00: Ground Water Discharge Permit Program does not apply to this project as there is no groundwater discharge due to impacted soils.

<u>Standard 8: (Erosion, Sediment Control)</u>

A plan to control construction-related impacts, including erosion sedimentation and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan), must be developed and implemented.

All redevelopment projects shall fully comply with Standard 8.

- Has the proponent submitted a construction period erosion, sedimentation and pollution prevention plan that meets the requirements of Standard 8? Bohler: The proposed project will provide construction period erosion and sedimentation controls appropriate for this project, refer to Site Development Plans. This includes a proposed construction exit, protection for stormwater inlets, protection around temporary material stockpiles and various other techniques. Additionally, the project is required to file a Notice of Intent with the US EPA and implement a Stormwater Pollution Prevention Plan (SWPPP) during the construction period. The SWPPP will be prepared prior to the start of construction and will be implemented by the site contractor under the guidance and responsibility of the project's proponent.

Standard 9: (Operation and Maintenance)
A long-term operation and maintenance plan must be developed and implemented to ensure that stormwater management systems function as designed.
All redevelopment projects shall fully comply with Standard 9.

- Has the proponent submitted a long-term Operation and Maintenance plan that meets the requirements of Standard 9? Bohler: An Operation and Maintenance (O&M) Plan for this site has been prepared and is included in Appendix G of the report. The O&M Plan outlines procedures and timetables for the long-term operation and maintenance of the proposed site stormwater management system, including initial inspections upon completion of construction, and periodic monitoring of the system components, in accordance with established practices and the manufacturer's recommendations. The O&M Plan includes a list of responsible parties.

Standard 10 (Illicit Discharges)
All illicit discharges to the stormwater management system are prohibited.
All redevelopment projects shall fully comply with Standard 10.

- Are there any known or suspected illicit discharges to the stormwater management system at the redevelopment project site? Bohler: None known at this time.
- Has an illicit connection detection program been implemented using visual screening, dye or smoke testing? Bohler: Not at this time.
- Have an Illicit Discharge Compliance Statement and associated site map been submitted verifying that there are no illicit discharges to the stormwater management system at the site? Bohler: Refer to Appendix B for illicit discharge statement.

Improvements to Existing Conditions:

- Once all illicit discharges are removed, has the proponent implemented any measures to prevent additional illicit discharges? Bohler: The project does not propose any illicit discharges as part of the project.

Figure 5-1

Menu of Strategies to Reduce Runoff or Peak Flows and/or Increase Recharge

- Rehabilitate the soils Bohler: Not applicable due to environmentally impacted soils.
- Plant trees and other vegetation Bohler: The amount of onsite vegetation will be increased, refer to Landscape Plan sheet L0101.
- Install a green roof Bohler: Green roofs are not proposed as part of the project.
- Maximize naturally vegetated areas Bohler: The project will provide an increase in pervious/vegetated areas of 0.69 acres.
- Reduce impervious surfaces Bohler: The project will provide a 0.69 acre decrease in impervious area.
- Disconnect roof runoff from direct discharge to the drainage system Bohler: Due to site constraints there is a minimal drainage system. Roof runoff will be collected and discharged via a separate point source discharge or will discharge to grade.
- Disconnect other existing paved areas from direct discharge to the drainage system, allowing controlled flow over pervious areas or through BMPs providing at least partial recharge Bohler: Not applicable due to environmentally impacted soils.
- Install porous pavement and/or other recharge measures (where sustainable and maintainable for promoting infiltration) Bohler: Not applicable due to environmentally impacted soils.
- Apply LID techniques for runoff reduction Bohler: As noted, the project is providing stormwater improvements to the maximum extent practicable due to the floodplain requirements and AUL limitations both of which limit the feasibility of stormwater management. The environmentally impacted soils prohibit the use of infiltration for improving stormwater treatment. In addition, almost the entirety of the existing project is within the floodplain to the Sudbury River and is close to the same elevation as the river bank. There is minimal room to adjust the proposed elevations on site without negatively impacting the floodplain storage on site which restricts the proposed grades at or near existing conditions. Both constraints prohibit the use of LID techniques which require substantially more space and/or infiltration to be feasible.
- Install additional structural BMPs that are appropriate for redevelopment sites including infiltration trenches, subsurface structures, oil-grit separators, proprietary BMPs Bohler: As noted above, the existing constraints preclude the installation of many stormwater BMPs. Proposed BMPs include the filter strips, Rain Guardian turret, deep sump catch basin and hydrodynamic separators (proprietary BMP and oil/grit separation).
- Retrofit existing BMPs Bohler: The site does not contain any existing BMPs to retrofit.

Retrofitting Existing BMPs

Many BMPs can be effectively retrofitted depending on site conditions and the water quantity or quality objectives trying to be achieved.[3] The objective of stormwater retrofitting is to remedy problems associated with, and improve water quality mitigation functions of, older, poorly designed, or poorly maintained stormwater management systems. Prior to the development of the stormwater standards, site drainage design did not require stormwater detention for controlling post-development peak flows. As a result, drainage, flooding, and erosion problems can be common in many older developed areas of the state. Furthermore, a majority of the dry detention basins throughout the state have been designed to control peak flows, without regard to water quality mitigation. Therefore, many existing dry detention basins provide only minimal water quality benefit. Incorporating stormwater retrofits into existing developed sites or into redevelopment projects can reduce the adverse impacts of uncontrolled stormwater runoff.

Bioretention Area Retrofits - can be used as a stormwater retrofit, by modifying existing landscaped areas, or if a parking lot is being resurfaced. In highly urban watersheds, they are one of the few practical retrofit options. Bohler: Prohibitive due to elevation and environmentally impacted soil constraints.

Catch Basin Retrofits or Reconstruction - Older catch basins without sumps can be replaced with catch basins having four foot-deep sumps. Sumps provide storage volume for coarse sediments, assuming that accumulated sediment is removed on a regular basis. Hooded outlets, which are covers over the catch basin outlets that extend below the standing water line, can also be used to trap litter and other floatable materials. Leaching catch basins can be installed adjacent to deep sump catch basins to achieve 80% TSS removal. Be aware, however, that many products are being touted as catch basin inserts, but the effectiveness of these devices can vary significantly. Bohler: Not applicable, no existing catch basins on site. Leaching catch basins are not feasible due to environmentally impacted soil constraints.

Dry Detention Basin Retrofits - Traditional dry detention basins can be modified to become extended dry detention basins, wet basins, or constructed stormwater wetlands for enhanced pollutant removal. This is one of the most commonly and easily implemented retrofits, since it typically requires little or no additional land area, capitalizes on an existing facility for which there is already some resident acceptance of stormwater management, and involves minimal impacts to environmental resources (Claytor, Center for Watershed Protection, 2000). Bohler: Not applicable, no existing dry detention basins.

There are numerous retrofit options that will enhance the removal of pollutants in detention basins:

- Excavate the basin bottom to create more permanent pool storage.
- Raise the basin embankment to obtain additional storage for extended detention.
- Modify the outfall structure to create a two-stage release to better control small storms while not significantly compromising flood control detention for large storms.
- Increase the flow path from inflow to outflow and eliminate short-circuiting by using baffles, earthen berms or micro-pond topography to increase residence time.
- Incorporate stilling basins at inlets and outlets.
- Regrade the basin bottom to create a wetland area near the basin outlet or revegetate parts of the basin bottom with wetland vegetation to enhance pollutant removal, reduce mowing, and improve aesthetics.
- Create a wetland shelf along the perimeter of a wet basin to improve shoreline stabilization, enhance pollutant filtering, and enhance aesthetic and habitat functions.

[3] Additional information on retrofitting stormwater BMPs can be found in the Urban Stormwater Retrofit Practices Manual. See http://www.cwp.org/Downloads/ELC_USRM3app.pdf.

- Create a low maintenance "no-mow" wildflower ecosystem in the drier portions of the basin.
- Provide a high flow bypass to avoid resuspension of captured sediments/pollutants during high flows.
- Eliminate low-flow bypasses.

Drainage Channel Retrofits - Existing channelized streams and drainage conveyances such as drainage channels can be modified to reduce flow velocities and enhance pollutant removal. Weir walls or riprap check dams placed across a channel create opportunities for ponding, infiltration, and establishment of wetland vegetation upstream of the retrofit. In-stream retrofit practices include stream bank stabilization of eroded areas and placement of habitat improvement structures (i.e., flow deflectors, boulders, pools/riffles, and low-flow channels) in natural streams and along stream banks. In-stream retrofits may require an evaluation of potential flooding and floodplain impacts resulting from altered channel conveyance, as well as requirements for local, state, or federal approval for work in wetlands and watercourses. Bohler: Not applicable, no existing drainage channels. There are existing drainage discharge pipes which will have a filter strip added upstream for treatment and rip rap added at the discharge to help prevent erosion. One discharge pipe will also have a Rain Guardian turret upstream for additional treatment.

Parking Lots and Roadways- Parking lots offer ideal opportunities for a wide range of stormwater retrofits:

1. Incorporate bioretention areas into parking lot islands and landscaped areas; tree planter boxes can be converted into functional bioretention areas, rain gardens, or treebox filters to reduce and treat stormwater runoff. Bohler: Prohibitive due to elevation and environmentally impacted soil constraints. Tree Box filters or other similar BMPs were considered but there is inadequate elevation to install and ensure the units are properly drained. Improper drainage will lead to the plants dying and reducing the effectiveness of the units.
2. Remove curbing and add slotted curb stops. Curbs along the edges of parking lots can sometimes be removed or slotted to re-route runoff to vegetated filter strips, water quality swales, grass channels, or bioretention facilities. The capacity of existing swales may need to be evaluated and expanded as part of this retrofit option. Bohler: The rear parking area has been designed so runoff will sheet flow off the parking area and across filter strips or through the Rain Guardian Turret prior to discharging through the drainage pipes at the wall.
3. Incorporate new treatment practices such as bioretention areas, sand filters, and constructed stormwater wetlands at the edges of parking lots. Bohler: Prohibitive due to elevation and environmentally impacted soil constraints.
4. In overflow parking or other low-traffic areas, asphalt can be replaced with porous pavement. Bohler: Prohibitive due to environmentally impacted soil constraints.

Sand Filter Retrofits - are suitable where space is limited, because they consume little surface space and have few site restrictions. Since sand filters cannot treat large drainage areas, retrofitting many small individual sites may be the only option. This option may be expensive. Bohler: Prohibitive due to elevation constraints.

Storm Drain Outfalls - New stormwater treatment practices can be constructed at the outfalls of existing drainage systems. The new stormwater treatment practices are commonly designed as *off-line devices* to treat the first flush volume and bypass larger storms. Water quality swales, bioretention areas, sand filters, constructed stormwater wetlands, and wet basins are commonly used for this type of retrofit. Other stormwater treatment practices may also be used if there is enough space for construction and maintenance. Bohler: Prohibitive due to elevation constraints.

Specific Redevelopment Projects

Redevelopment projects present unique challenges for controlling stormwater. It is possible that site constraints may prevent a redevelopment project from complying with one or more of the Stormwater Management Standards. Even if a redevelopment project cannot meet all of the Standards, there may be ample opportunity to improve existing site conditions depending on the other water quality or quantity issues in the watershed. The following special considerations provide unique opportunities for identifying how existing conditions may be improved:

A. Groundwater Recharge Areas - Redevelopment projects located within these areas (Zone II, Interim Wellhead Protection Areas (IWPA), aquifer protection districts, etc.) should place a high priority on ground water recharge BMPs. Bohler: Not applicable, the site is not within a Zone II, IWPA or aquifer protection district. In addition, environmentally impacted soils prevent recharge of stormwater.
   1) Disconnecting Rooftop Runoff – In some instances, building roof drains connected to the stormwater drainage system can be disconnected and re-directed to vegetated filter strips, bioretention facilities, or infiltration structures (dry wells or infiltration trenches).
   2) Use of Porous Paving Materials - Existing impermeable pavement in overflow parking or other low-traffic areas can sometimes be replaced with alternative permeable materials such as modular concrete paving blocks, modular concrete or plastic lattice, or cast-in-place concrete grids. Site-specific factors including traffic volumes, soil permeability, maintenance, sediment loads, and land use must be carefully considered prior to selection.

B. Cold-Water Fisheries - Redevelopment projects adjacent to these areas should place a high priority on mitigating potential thermal impacts. Techniques to consider include: Bohler: Not applicable, the site does not discharge to a cold-water fishery.

   1) Maintain Time of Concentration - Time of concentration (Tc) is based on the flow path and length, ground cover, slope and channel shape. When development occurs, Tc is often shortened due to the impervious area, causing greater flows to occur over a shorter period of time. Increasing the Tc will help to reduce the thermal impact of stormwater runoff from warm surface areas. Options to consider include:
      - Increasing the length of the runoff flow path
      - Increasing the surface roughness of the flow path
      - Detaining flows on site
      - Minimizing land disturbance
      - Creating flatter slopes.
   2) Disconnecting impervious areas – Breaking up large impervious expanses with vegetated zones will reduce the potential temperature increases of stormwater flowing across hot pavement.

.

C. Brownfield Redevelopment – Redeveloping urban and non-urban brownfield sites (which in Massachusetts includes most “disposal sites” under the Massachusetts Contingency Plan [MCP]) are a Commonwealth priority, with ramifications for urban sprawl as well as the remediation of historically contaminated properties. Proponents of brownfield redevelopment projects should evaluate BMPs that will prevent the significant uncontrolled mobilization or remobilization of

soil or ground water contamination. BMP considerations at these sites should consider such factors as: Bohler: Not applicable, the site is not a Brownfield Redevelopment.

- The location of stormwater infiltration units with respect to contaminated areas
- Ground water mounding effects on the rate and direction of migration of ground water contaminants
- The location of outfalls
- Water quality BMPs.

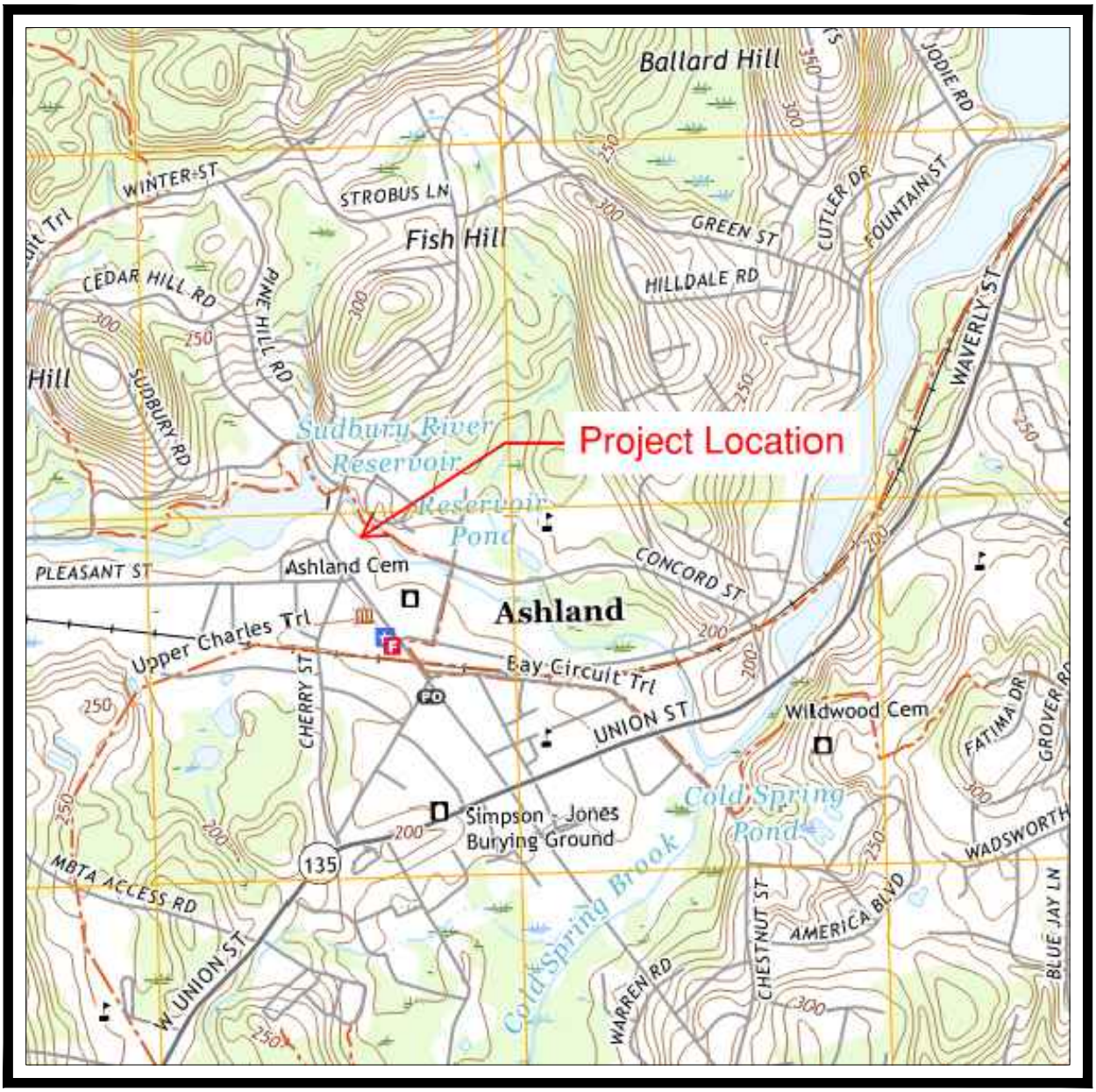
D. Runoff to Impaired Water Bodies – If MassDEP has issued a Total Maximum Daily Load (TMDL) that establishes a waste load allocation for stormwater discharge and/or a TMDL Implementation Plan that identifies remedies aimed at reducing the amount of pollutants from stormwater discharges, proponents may be required to install stormwater BMPs that are consistent with the TMDL. Bohler: The Sudbury River is listed as a water requiring a TMDL. The list of causes of impairment include mercury in fish tissue, water chestnut and E.Coli. None of the impairments are due to nutrients or sediment.

E. Runoff to Areas of Localized Flooding – Project proponents must also understand the potential impacts of stormwater runoff in areas prone to localized flooding. When completing the checklist, proponents should consider the capacity of the receiving water and/or storm drainage system. When evaluating discharges to areas subject to localized flooding, the proponent should evaluate the ability to maintain and/or improve existing site cover and reduce runoff volume. Bohler: The project reduces total impervious area by 0.69 acres which will reduce the volume and peak rates of runoff to the river. Refer to stormwater narrative for flow rate calculations.

The project is located within the 100-year flood plain per the FEMA FIRM Map. Detailed compensatory flood storage calculations have been provided to show that the project will not reduce the amount of BLSF on the site.

APPENDIX B: PROJECT LOCATION MAPS

- *USGS MAP*
- *FEMA FIRMETTE*



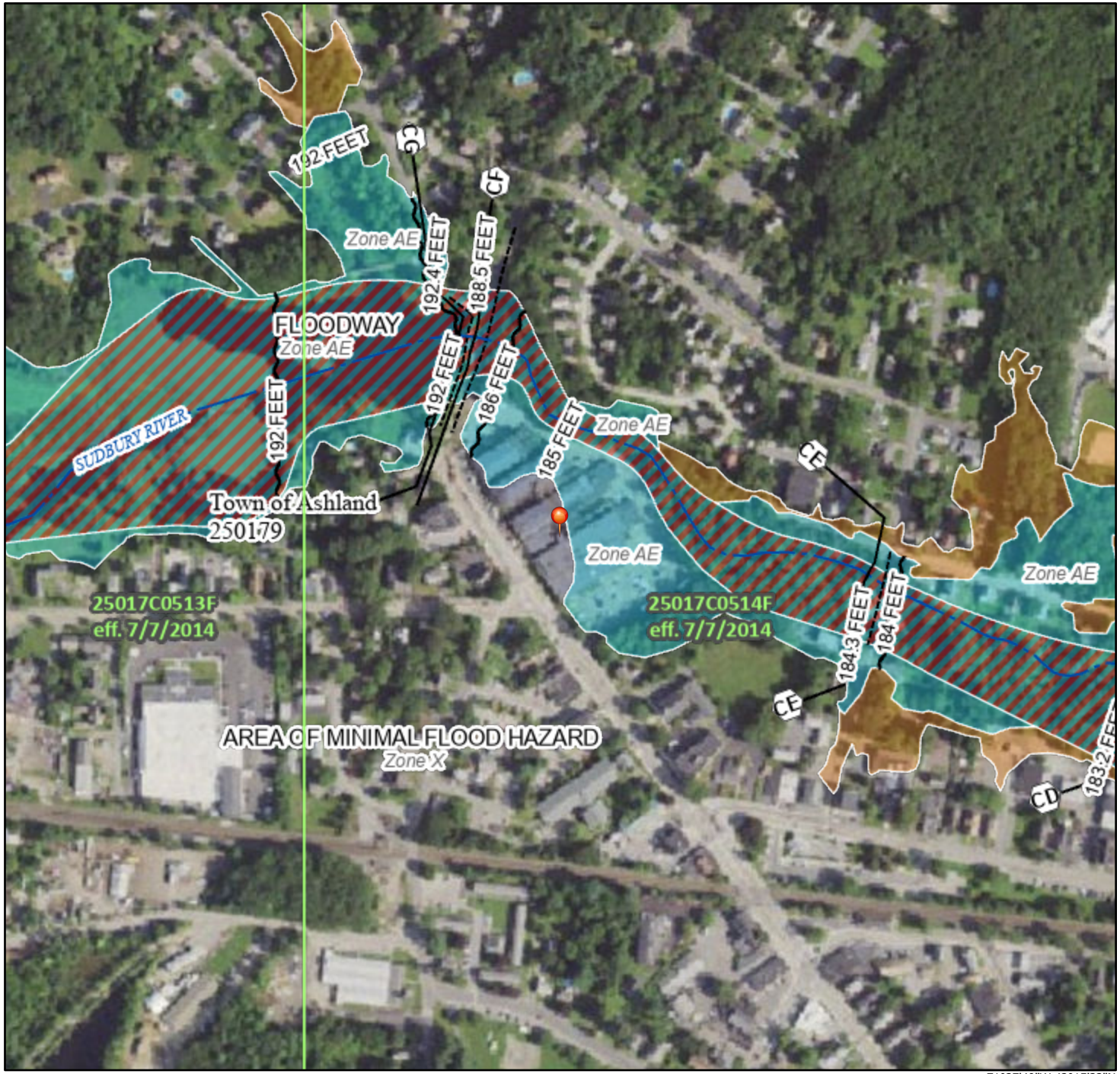
USGS MAP

SOURCE: FRAMINGHAM QUADRANGLE

National Flood Hazard Layer FIRMette

FEMA

71°28'18"W 42°15'58"N



71°27'40"W 42°15'32"N

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

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

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

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

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

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

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

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

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

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 11/11/2024 at 8:41 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

APPENDIX C: SOIL INFORMATION

- *NCRS CUSTOM SOIL RESOURCE REPORT*

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for Middlesex County, Massachusetts

November 27, 2023

Preface

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

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

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

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

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

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

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How Soil Surveys Are Made

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

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

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

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

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

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

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

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

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

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

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

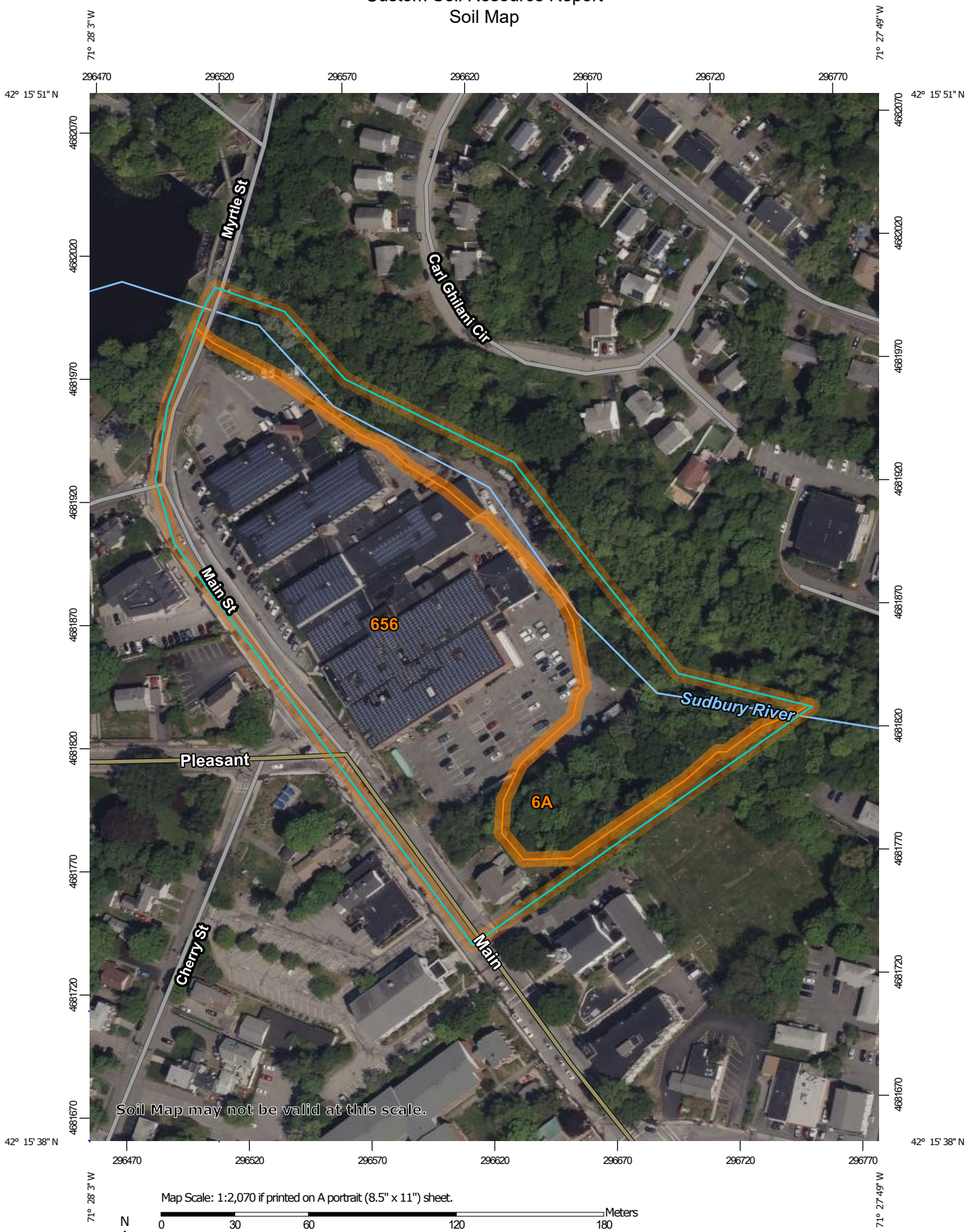
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

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

Soil Map

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

Custom Soil Resource Report
Soil Map



Map Scale: 1:2,070 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 30 60 120 180

Feet: 0 100 200 400 600

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 1:24,000.

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 23, Sep 12, 2023

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

Date(s) aerial images were photographed: May 22, 2022—Jun 5, 2022

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
6A	Scarboro mucky fine sandy loam, 0 to 3 percent slopes	2.4	30.8%
656	Udorthents-Urban land complex	5.4	69.2%
Totals for Area of Interest		**7.9**	**100.0%**

Map Unit Descriptions

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

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

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

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

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

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

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

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

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

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

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

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

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

Middlesex County, Massachusetts

6A—Scarboro mucky fine sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2svky
Elevation: 0 to 1,320 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Scarboro

Setting

Landform: Drainageways, outwash deltas, outwash terraces, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Sandy glaciofluvial deposits derived from schist and/or sandy glaciofluvial deposits derived from gneiss and/or sandy glaciofluvial deposits derived from granite

Typical profile

Oe - 0 to 3 inches: mucky peat
A - 3 to 11 inches: mucky fine sandy loam
Cg1 - 11 to 21 inches: sand
Cg2 - 21 to 65 inches: gravelly coarse sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (1.42 to 14.17 in/hr)
Depth to water table: About 0 to 2 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: A/D
Ecological site: F144AY031MA - Very Wet Outwash
Hydric soil rating: Yes

Minor Components

Swansea

Percent of map unit: 10 percent
Landform: Bogs, swamps
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Wareham

Percent of map unit: 5 percent
Landform: Depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Walpole

Percent of map unit: 5 percent
Landform: Deltas, depressions, outwash terraces, depressions, outwash plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

656—Udorthents-Urban land complex

Map Unit Setting

National map unit symbol: 995k
Elevation: 0 to 3,000 feet
Mean annual precipitation: 32 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 110 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents and similar soils: 45 percent
Urban land: 35 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents

Setting

Parent material: Loamy alluvium and/or sandy glaciofluvial deposits and/or loamy glaciolacustrine deposits and/or loamy marine deposits and/or loamy basal till and/or loamy lodgment till

Properties and qualities

Slope: 0 to 15 percent
Depth to restrictive feature: More than 80 inches
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Description of Urban Land

Setting

Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Excavated and filled land

Minor Components

Canton

Percent of map unit: 10 percent
Landform: Hills
Landform position (two-dimensional): Backslope, toeslope
Landform position (three-dimensional): Side slope, base slope
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

Paxton

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Summit, backslope
Landform position (three-dimensional): Head slope, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Merrimac

Percent of map unit: 5 percent
Landform: Terraces, plains
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Tread, rise
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Custom Soil Resource Report
Map—Hydrologic Soil Group

Map Scale: 1:2,070 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 30 60 120 180

Feet: 0 100 200 400 600

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 Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

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 1:24,000.

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 23, Sep 12, 2023

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

Date(s) aerial images were photographed: May 22, 2022—Jun 5, 2022

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

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
6A	Scarboro mucky fine sandy loam, 0 to 3 percent slopes	A/D	2.4	30.8%
656	Udorthents-Urban land complex		5.4	69.2%
Totals for Area of Interest			**7.9**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

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APPENDIX D: EXISTING CONDITIONS HYDROLOGIC ANALYSIS

- *EXISTING CONDITIONS DRAINAGE MAP*
- *EXISTING CONDITIONS HYDROCAD COMPUTATIONS*

LEGEND

EXISTING WATERSHED

DESIGN POINT	DP1 / DP1
SUBCATCHMENT ID	ED1.1 / ED1.1
OVERALL BOUNDARY	
SUBCATCHMENT BOUNDARY	
TIME OF CONCENTRATION PATH	
SOIL BOUNDARY WITH NRCS MAP UNIT AND HYDROLOGIC SOIL GROUP RATING	MapUnit / A

LEGEND

EXISTING COVER TYPES

BUILDING / CANOPY	
CONCRETE / WALK / PATIO PAVER / MISC IMPERVIOUS	
GRASS / SOD / LAWN	

P:\2023\MAA230359.00\CAD\DRAWINGS\PLAN SETS\DRAINAGE AREA MAPS\P-DMAP-HYDR-MAA230359.00-0A----->LAYOUT: PRED

BOHLER
50 WASHINGTON ST., SUITE 2000
WESTBOROUGH, MA 01581
Phone: (508) 480-9900
www.BohlerEngineering.com

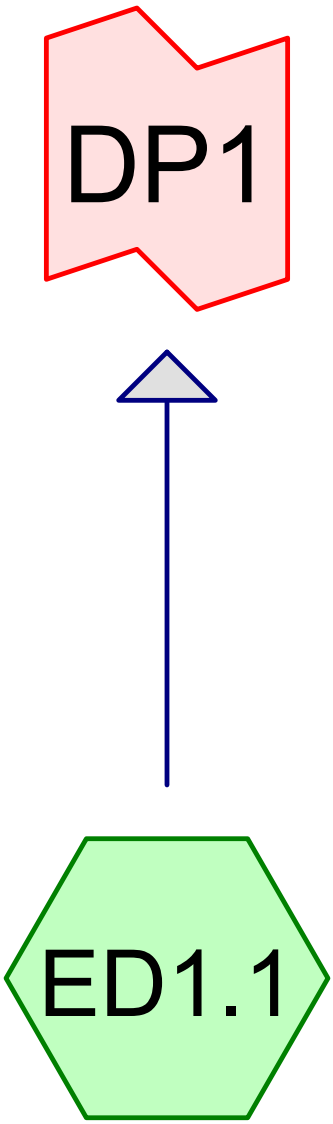
EXISTING CONDITIONS WATERSHED MAP

50 MAIN STREET
ASHLAND, MA 01721

12/16/2025 | CE | MAA230359.00 | REV 0a

80 40 20 0 50

SCALE: 1" = 80'



Subcat Reach Pond Link

Routing Diagram for PRED-MAA230359.00
Prepared by Bohler Engineering, PC, Printed 12/16/2025

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.675	74	>75% Grass cover, Good, HSG C (ED1.1)
2.628	98	Paved parking, HSG C (ED1.1)
2.017	98	Roofs, HSG C (ED1.1)
5.321	**95**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
5.321	HSG C	ED1.1
0.000	HSG D	
0.000	Other	
5.321		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.675	0.000	0.000	0.675	>75% Grass cover, Good	ED1.1
0.000	0.000	2.628	0.000	0.000	2.628	Paved parking	ED1.1
0.000	0.000	2.017	0.000	0.000	2.017	Roofs	ED1.1
0.000	**0.000**	**5.321**	**0.000**	**0.000**	**5.321**	**TOTAL AREA**	

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment ED1.1: Runoff Area=231,777 sf 87.31% Impervious Runoff Depth=2.87"
Tc=6.0 min CN=WQ Runoff=15.98 cfs 1.271 af

Link DP1: Inflow=15.98 cfs 1.271 af
Primary=15.98 cfs 1.271 af

Total Runoff Area = 5.321 ac Runoff Volume = 1.271 af Average Runoff Depth = 2.87"
12.69% Pervious = 0.675 ac 87.31% Impervious = 4.646 ac

Summary for Subcatchment ED1.1:

Runoff = 15.98 cfs @ 12.08 hrs, Volume= 1.271 af, Depth= 2.87"
Routed to Link DP1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.35"

Area (sf)	CN	Description
29,411	74	>75% Grass cover, Good, HSG C
114,484	98	Paved parking, HSG C
87,882	98	Roofs, HSG C
231,777		Weighted Average
29,411		12.69% Pervious Area
202,366		87.31% Impervious Area

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

Summary for Link DP1:

Inflow Area = 5.321 ac, 87.31% Impervious, Inflow Depth = 2.87" for 2-Year event
Inflow = 15.98 cfs @ 12.08 hrs, Volume= 1.271 af
Primary = 15.98 cfs @ 12.08 hrs, Volume= 1.271 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment ED1.1: Runoff Area=231,777 sf 87.31% Impervious Runoff Depth=4.69"
Tc=6.0 min CN=WQ Runoff=25.84 cfs 2.081 af

Link DP1: Inflow=25.84 cfs 2.081 af
Primary=25.84 cfs 2.081 af

Total Runoff Area = 5.321 ac Runoff Volume = 2.081 af Average Runoff Depth = 4.69"
12.69% Pervious = 0.675 ac 87.31% Impervious = 4.646 ac

Summary for Subcatchment ED1.1:

Runoff = 25.84 cfs @ 12.08 hrs, Volume= 2.081 af, Depth= 4.69"
Routed to Link DP1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.24"

Area (sf)	CN	Description
29,411	74	>75% Grass cover, Good, HSG C
114,484	98	Paved parking, HSG C
87,882	98	Roofs, HSG C
231,777		Weighted Average
29,411		12.69% Pervious Area
202,366		87.31% Impervious Area

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

Summary for Link DP1:

Inflow Area = 5.321 ac, 87.31% Impervious, Inflow Depth = 4.69" for 10-Year event
Inflow = 25.84 cfs @ 12.08 hrs, Volume= 2.081 af
Primary = 25.84 cfs @ 12.08 hrs, Volume= 2.081 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment ED1.1: Runoff Area=231,777 sf 87.31% Impervious Runoff Depth=5.84"
Tc=6.0 min CN=WQ Runoff=31.99 cfs 2.588 af

Link DP1: Inflow=31.99 cfs 2.588 af
Primary=31.99 cfs 2.588 af

Total Runoff Area = 5.321 ac Runoff Volume = 2.588 af Average Runoff Depth = 5.84"
12.69% Pervious = 0.675 ac 87.31% Impervious = 4.646 ac

Summary for Subcatchment ED1.1:

Runoff = 31.99 cfs @ 12.08 hrs, Volume= 2.588 af, Depth= 5.84"
Routed to Link DP1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.41"

Area (sf)	CN	Description
29,411	74	>75% Grass cover, Good, HSG C
114,484	98	Paved parking, HSG C
87,882	98	Roofs, HSG C
231,777		Weighted Average
29,411		12.69% Pervious Area
202,366		87.31% Impervious Area

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

Summary for Link DP1:

Inflow Area = 5.321 ac, 87.31% Impervious, Inflow Depth = 5.84" for 25-Year event
Inflow = 31.99 cfs @ 12.08 hrs, Volume= 2.588 af
Primary = 31.99 cfs @ 12.08 hrs, Volume= 2.588 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment ED1.1: Runoff Area=231,777 sf 87.31% Impervious Runoff Depth=7.62"
Tc=6.0 min CN=WQ Runoff=41.53 cfs 3.378 af

Link DP1: Inflow=41.53 cfs 3.378 af
Primary=41.53 cfs 3.378 af

Total Runoff Area = 5.321 ac Runoff Volume = 3.378 af Average Runoff Depth = 7.62"
12.69% Pervious = 0.675 ac 87.31% Impervious = 4.646 ac

Summary for Subcatchment ED1.1:

Runoff = 41.53 cfs @ 12.08 hrs, Volume= 3.378 af, Depth= 7.62"
Routed to Link DP1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.22"

Area (sf)	CN	Description
29,411	74	>75% Grass cover, Good, HSG C
114,484	98	Paved parking, HSG C
87,882	98	Roofs, HSG C
231,777		Weighted Average
29,411		12.69% Pervious Area
202,366		87.31% Impervious Area

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

Summary for Link DP1:

Inflow Area = 5.321 ac, 87.31% Impervious, Inflow Depth = 7.62" for 100-Year event
Inflow = 41.53 cfs @ 12.08 hrs, Volume= 3.378 af
Primary = 41.53 cfs @ 12.08 hrs, Volume= 3.378 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

APPENDIX E: PROPOSED CONDITIONS HYDROLOGIC ANALYSIS

- *PROPOSED CONDITIONS DRAINAGE MAP*
- *PROPOSED CONDITIONS HYDROCAD CALCULATIONS*

LEGEND

PROPOSED WATERSHED

DESIGN POINT	DP1 / DP1
SUBCATCHMENT ID	PD1.1 PD1.1
OVERALL BOUNDARY	
SUBCATCHMENT BOUNDARY	
TIME OF CONCENTRATION PATH	
SOIL BOUNDARY WITH NRCS MAP UNIT AND HYDROLOGIC SOIL GROUP RATING	MapUnit A

LEGEND

PROPOSED COVER TYPES

BUILDING / CANOPY	
CONCRETE / WALK / PATIO PAVERS / MISC IMPERVIOUS	
GRASS / SOD / LAWN	

P:\2023\MAA230359.00\CAD\DRAWINGS\PLAN SETS\DRAINAGE AREA MAPS\P-DMAP-HYDR-MAA230359.00-0A----->LAYOUT: PSTD

BOHLER
50 WASHINGTON ST., SUITE 2000
WESTBOROUGH, MA 01581
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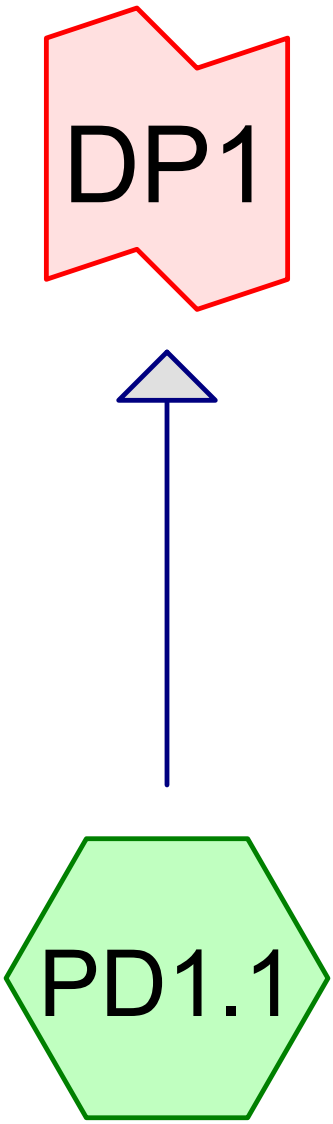
www.BohlerEngineering.com

PROPOSED CONDITIONS WATERSHED MAP

50 MAIN STREET
ASHLAND, MA 01721

12/16/2025 | CE | MAA230359.00 | REV 0a

80 40 20 0 50
SCALE: 1" = 80'



Subcat Reach Pond Link

Routing Diagram for PSTD-MAA230359.00
Prepared by Bohler Engineering, PC, Printed 12/18/2025

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.119	74	>75% Grass cover, Good, HSG C (PD1.1)
2.776	98	Paved parking, HSG C (PD1.1)
1.425	98	Roofs, HSG C (PD1.1)
5.321	**93**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
5.321	HSG C	PD1.1
0.000	HSG D	
0.000	Other	
5.321		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	1.119	0.000	0.000	1.119	>75% Grass cover, Good	PD1.1
0.000	0.000	2.776	0.000	0.000	2.776	Paved parking	PD1.1
0.000	0.000	1.425	0.000	0.000	1.425	Roofs	PD1.1
0.000	**0.000**	**5.321**	**0.000**	**0.000**	**5.321**	**TOTAL AREA**	

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment PD1.1: Runoff Area=231,777 sf 78.96% Impervious Runoff Depth=2.70"
Tc=6.0 min CN=WQ Runoff=15.09 cfs 1.197 af

Link DP1: Inflow=15.09 cfs 1.197 af
Primary=15.09 cfs 1.197 af

Total Runoff Area = 5.321 ac Runoff Volume = 1.197 af Average Runoff Depth = 2.70"
21.04% Pervious = 1.119 ac 78.96% Impervious = 4.201 ac

Summary for Subcatchment PD1.1:

Runoff = 15.09 cfs @ 12.08 hrs, Volume= 1.197 af, Depth= 2.70"
Routed to Link DP1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.35"

Area (sf)	CN	Description
48,764	74	>75% Grass cover, Good, HSG C
120,939	98	Paved parking, HSG C
62,074	98	Roofs, HSG C
231,777		Weighted Average
48,764		21.04% Pervious Area
183,013		78.96% Impervious Area

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

Summary for Link DP1:

Inflow Area = 5.321 ac, 78.96% Impervious, Inflow Depth = 2.70" for 2-Year event
Inflow = 15.09 cfs @ 12.08 hrs, Volume= 1.197 af
Primary = 15.09 cfs @ 12.08 hrs, Volume= 1.197 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment PD1.1: Runoff Area=231,777 sf 78.96% Impervious Runoff Depth=4.49"
Tc=6.0 min CN=WQ Runoff=24.89 cfs 1.990 af

Link DP1: Inflow=24.89 cfs 1.990 af
Primary=24.89 cfs 1.990 af

Total Runoff Area = 5.321 ac Runoff Volume = 1.990 af Average Runoff Depth = 4.49"
21.04% Pervious = 1.119 ac 78.96% Impervious = 4.201 ac

Summary for Subcatchment PD1.1:

Runoff = 24.89 cfs @ 12.08 hrs, Volume= 1.990 af, Depth= 4.49"
Routed to Link DP1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.24"

Area (sf)	CN	Description
48,764	74	>75% Grass cover, Good, HSG C
120,939	98	Paved parking, HSG C
62,074	98	Roofs, HSG C
231,777		Weighted Average
48,764		21.04% Pervious Area
183,013		78.96% Impervious Area

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

Summary for Link DP1:

Inflow Area = 5.321 ac, 78.96% Impervious, Inflow Depth = 4.49" for 10-Year event
Inflow = 24.89 cfs @ 12.08 hrs, Volume= 1.990 af
Primary = 24.89 cfs @ 12.08 hrs, Volume= 1.990 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment PD1.1: Runoff Area=231,777 sf 78.96% Impervious Runoff Depth=5.62"
Tc=6.0 min CN=WQ Runoff=31.04 cfs 2.490 af

Link DP1: Inflow=31.04 cfs 2.490 af
Primary=31.04 cfs 2.490 af

Total Runoff Area = 5.321 ac Runoff Volume = 2.490 af Average Runoff Depth = 5.62"
21.04% Pervious = 1.119 ac 78.96% Impervious = 4.201 ac

Summary for Subcatchment PD1.1:

Runoff = 31.04 cfs @ 12.08 hrs, Volume= 2.490 af, Depth= 5.62"
Routed to Link DP1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.41"

Area (sf)	CN	Description
48,764	74	>75% Grass cover, Good, HSG C
120,939	98	Paved parking, HSG C
62,074	98	Roofs, HSG C
231,777		Weighted Average
48,764		21.04% Pervious Area
183,013		78.96% Impervious Area

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

Summary for Link DP1:

Inflow Area = 5.321 ac, 78.96% Impervious, Inflow Depth = 5.62" for 25-Year event
Inflow = 31.04 cfs @ 12.08 hrs, Volume= 2.490 af
Primary = 31.04 cfs @ 12.08 hrs, Volume= 2.490 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment PD1.1: Runoff Area=231,777 sf 78.96% Impervious Runoff Depth=7.38"
Tc=6.0 min CN=WQ Runoff=40.61 cfs 3.272 af

Link DP1: Inflow=40.61 cfs 3.272 af
Primary=40.61 cfs 3.272 af

Total Runoff Area = 5.321 ac Runoff Volume = 3.272 af Average Runoff Depth = 7.38"
21.04% Pervious = 1.119 ac 78.96% Impervious = 4.201 ac

Summary for Subcatchment PD1.1:

Runoff = 40.61 cfs @ 12.08 hrs, Volume= 3.272 af, Depth= 7.38"
Routed to Link DP1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.22"

Area (sf)	CN	Description
48,764	74	>75% Grass cover, Good, HSG C
120,939	98	Paved parking, HSG C
62,074	98	Roofs, HSG C
231,777		Weighted Average
48,764		21.04% Pervious Area
183,013		78.96% Impervious Area

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

Summary for Link DP1:

Inflow Area = 5.321 ac, 78.96% Impervious, Inflow Depth = 7.38" for 100-Year event
Inflow = 40.61 cfs @ 12.08 hrs, Volume= 3.272 af
Primary = 40.61 cfs @ 12.08 hrs, Volume= 3.272 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

APPENDIX F: STORMWATER CALCULATIONS

- *MA STANDARD #4 – WATER QUALITY AND TSS REMOVAL*
- *TP40/NOAA/CORNELL RAINFALL DATA*

The Sanctuary at Ashland Mills
50 Main Street
Ashland, MA
Bohler Job Number: MAA230359.00
12/18/2025
1" Water Quality Volume to Flow Rate Calculation Sheet

Compute Water Quality Flow with the following Equation

WQF = (qu)(A)(WQV)

Site Plan Callout		qu (from 1" - qu Table)	Impervious Area (SF)	Ai (sq/mi)	WQV (inches)		**WQF (cfs)**
CDS Water Quality Unit (Upper Parking)	=	774	10319	0.000370	1	=	**0.29**
CDS Water Quality Unit (Lower Parking)	=	774	31037	0.001113	1	=	**0.86**

Water Quality Flow Rate = WQF
Water Quality Volume = WQV*
Unit peak discharge (csm/in) = qu**
Impervious Area in watershed (square miles) = Ai

*WQV is expressed in watershed inches (you must use 1.0-inches in all cases with this method and not 0.5-inches)
** calculate the qu based on the time of concentration (see 1" - qu Table)

Prepared By:
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352 Turnpike Road
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1" qu Sheet

	Tc (hours)	qu (csm/in)
	0.01	835
	0.03	835
	0.05	831
	0.067	814
5 Minutes	0.083	795
	0.1	774
	0.116	755
	0.133	736
	0.15	717
10 minutes	0.167	700
	0.183	685
	0.2	669
	0.217	654
	0.233	641
15 minutes	0.25	628
	0.3	593
	0.333	572
	0.35	563
	0.4	536
	0.416	528
	0.5	491
	0.583	460
	0.6	454
	0.667	433
	0.7	424
	0.8	398
	0.9	376
	1	356
	1.1	339
	1.2	323
	1.3	309
	1.4	296
	1.5	285
	1.6	274
	1.7	264
	1.8	255
	1.9	247
	2	239
	2.1	232
	2.2	225
	2.3	219
	2.4	213
	2.5	207
	2.6	202

Tc (hours)	qu (csm/in)
2.7	197
2.8	192
2.9	187
3	183
3.1	179
3.2	175
3.3	171
3.4	168
3.5	164
3.6	161
3.7	158
3.8	155
3.9	152
4	149
4.1	146
4.2	144
4.3	141
4.4	139
4.5	137
4.6	134
4.7	132
4.8	130
4.9	128
5	126
5.1	124
5.2	122
5.3	120
5.4	119
5.5	117
5.6	115
5.7	114
5.8	112
5.9	111
6	109
6.1	108
6.2	106
6.3	105
6.4	104
6.5	102
6.6	101
6.7	100
6.8	99
6.9	98
7	96

Tc (hours)	qu (csm/in)
7.1	95
7.2	94
7.3	93
7.4	92
7.5	91
7.6	90
7.7	89
7.8	88
7.9	87
8	86
8.1	85
8.2	84
8.3	84
8.4	83
8.5	82
8.6	81
8.7	80
8.8	79
8.9	79
9	78
9.1	77
9.2	76
9.3	76
9.4	75
9.5	74
9.6	74
9.7	73
9.8	72
9.9	72
10	71

*Table of qu values for Ia/P Curve =0.034, listed by Tc, for Type III Storm Distribution
http://www.mass.gov/eea/docs/dep/water/resources/07v5/13wqvwqf.pdf

Available Models

CDS Model	Treatment Capacity[3] (cfs)	Maximum Sediment Storage Capacity (CF)
1515	1.0	26
w/ 1' added sump	1.0	33
w/ 2' added sump	1.0	40
w/ 3' added sump	1.0	47
2015_4	1.4	50
w/ 1' added sump	1.4	63
w/ 2' added sump	1.4	75
w/ 3' added sump	1.4	88
2015	1.4	79
w/ 1' added sump	1.4	98
w/ 2' added sump	1.4	118
2020	2.2	90
w/ 1' added sump	2.2	110
w/ 2' added sump	2.2	129
2025	3.2	97
w/ 1' added sump	3.2	117
w/ 2' added sump	3.2	136
3020	3.9	134
w/ 1' added sump	3.9	163
w/ 2' added sump	3.9	191
3030	6.1	157
w/ 1' added sump	6.1	185
w/ 2' added sump	6.1	213
4030	7.9	329
w/ 1' added sump	7.9	379
w/ 2' added sump	7.9	429
4040	12.4	381
w/ 1' added sump	12.4	431
w/ 2' added sump	12.4	482

1. Structure diameter represents the typical inside dimension of the concrete structure. Offline systems will require additional concrete diversion components
2. Depth below pipe can vary to accommodate site specific design. Depth below pipe invert represents the depth from the pipe invert to the inside bottom of concrete structure.
3. Treatment Capacity is based on laboratory testing using OK-110 (average d50 particle size of approximately 100 microns) and a 2400 micron screen.

Sediment Depths Indicating Required Servicing*			
CDS Model	Standard Sediment Depth (in.)	w/ 1' added Sump Sediment Depth (in.)	w/ 2' added Sump Sediment Depth (in.)
1515	18	27	36
2015_4	18	30	42
2015	18	30	42
2020	18	30	42
2025	18	30	42
3020	18	30	42
3030	18	39	42
4030	27	39	51
4040	27	39	51

* Based on 75% capacity of isolated sump.

The Sanctuary at Ashland Mills
50 Main Street
Ashland, MA
Bohler Job Number: MAA230359
December 2, 2025

MA DEP Standard 4: TSS Removal Calculation Worksheet

BMP Treatment Train: Retaining Wall Discharge Pipes

A BMP	B TSS Removal Rate	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Street Sweeping	**0.03**	**1.00**	**0.03**	**0.97**
Vegetated Filter Strip	**0.25**	**0.97**	**0.24**	**0.73**
		Total TSS Removal =	**27%**	

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

Prepared By:
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Southborough, MA 01772
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The Sanctuary at Ashland Mills
50 Main Street
Ashland, MA
Bohler Job Number: MAA230359
December 2, 2025

MA DEP Standard 4: TSS Removal Calculation Worksheet

BMP Treatment Train: Retaining Wall Discharge Pipes (Rain Guardian Turret)

A BMP	B TSS Removal Rate	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Street Sweeping	**0.03**	**1.00**	**0.03**	**0.97**
Rain Guardian Turrett	**0.25**	**0.97**	**0.24**	**0.73**
		Total TSS Removal =	**27%**	

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

Prepared By:
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352 Turnpike Road
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The Sanctuary at Ashland Mills
50 Main Street
Ashland, MA
Bohler Job Number: MAA230359
December 2, 2025

MA DEP Standard 4: TSS Removal Calculation Worksheet

BMP Treatment Train: Southern Parking Lot (New Point Source Discharge)

A BMP	B TSS Removal Rate	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Street Sweeping	**0.03**	**1.00**	**0.03**	**0.97**
Water Quality Unit	**0.80**	**0.97**	**0.78**	**0.19**
		Total TSS Removal =	**81%**	

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

Prepared By:
BOHLER
352 Turnpike Road
Southborough, MA 01772
(508) 480-9900

The Sanctuary at Ashland Mills
50 Main Street
Ashland, MA
Bohler Job Number: MAA230359
December 2, 2025

MA DEP Standard 4: TSS Removal Calculation Worksheet

BMP Treatment Train: Western Parking Lot (New Point Source Discharge)

A BMP	B TSS Removal Rate	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Street Sweeping	**0.03**	**1.00**	**0.03**	**0.97**
Deep Sump Hooded Catch Basin	**0.25**	**0.97**	**0.24**	**0.73**
Water Quality Unit	**0.80**	**0.73**	**0.58**	**0.15**
		Total TSS Removal =	**85%**	

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

Prepared By:
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NOAA Atlas 14, Volume 10, Version 3
Location name: Ashland, Massachusetts, USA*
Latitude: 42.2625°, Longitude: -71.4664°
Elevation: 187 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.332 (0.258-0.424)	0.400 (0.310-0.511)	0.511 (0.394-0.655)	0.602 (0.463-0.776)	0.728 (0.542-0.981)	0.823 (0.601-1.13)	0.922 (0.655-1.32)	1.03 (0.695-1.51)	1.20 (0.774-1.81)	1.33 (0.840-2.05)
10-min	0.471 (0.366-0.601)	0.566 (0.440-0.724)	0.722 (0.558-0.926)	0.852 (0.655-1.10)	1.03 (0.768-1.39)	1.16 (0.851-1.61)	1.31 (0.927-1.87)	1.46 (0.986-2.14)	1.69 (1.10-2.56)	1.88 (1.19-2.91)
15-min	0.554 (0.430-0.707)	0.666 (0.517-0.852)	0.850 (0.657-1.09)	1.00 (0.771-1.29)	1.21 (0.904-1.64)	1.37 (1.00-1.89)	1.54 (1.09-2.20)	1.72 (1.16-2.52)	1.99 (1.29-3.02)	2.21 (1.40-3.42)
30-min	0.760 (0.590-0.970)	0.913 (0.709-1.17)	1.16 (0.900-1.49)	1.37 (1.06-1.77)	1.66 (1.24-2.24)	1.88 (1.37-2.58)	2.10 (1.49-3.01)	2.36 (1.59-3.45)	2.72 (1.76-4.12)	3.02 (1.91-4.67)
60-min	0.965 (0.750-1.23)	1.16 (0.900-1.48)	1.48 (1.14-1.90)	1.74 (1.34-2.25)	2.11 (1.57-2.84)	2.38 (1.74-3.28)	2.67 (1.90-3.82)	2.99 (2.01-4.38)	3.45 (2.24-5.23)	3.83 (2.43-5.92)
2-hr	1.23 (0.960-1.56)	1.48 (1.16-1.88)	1.90 (1.48-2.42)	2.25 (1.74-2.88)	2.73 (2.05-3.66)	3.08 (2.27-4.24)	3.46 (2.49-4.96)	3.92 (2.65-5.70)	4.61 (3.00-6.94)	5.20 (3.30-7.98)
3-hr	1.41 (1.11-1.79)	1.71 (1.34-2.17)	2.20 (1.72-2.79)	2.61 (2.03-3.33)	3.17 (2.39-4.25)	3.58 (2.65-4.92)	4.03 (2.92-5.78)	4.58 (3.10-6.63)	5.43 (3.53-8.14)	6.16 (3.92-9.42)
6-hr	1.81 (1.43-2.27)	2.20 (1.74-2.76)	2.84 (2.23-3.57)	3.36 (2.63-4.26)	4.09 (3.11-5.45)	4.63 (3.45-6.32)	5.21 (3.80-7.44)	5.94 (4.03-8.54)	7.07 (4.62-10.5)	8.06 (5.14-12.2)
12-hr	2.30 (1.83-2.86)	2.80 (2.22-3.48)	3.62 (2.86-4.52)	4.29 (3.38-5.40)	5.23 (4.00-6.92)	5.92 (4.44-8.02)	6.67 (4.88-9.44)	7.60 (5.18-10.8)	9.03 (5.92-13.3)	10.3 (6.57-15.5)
24-hr	2.72 (2.19-3.37)	3.35 (2.69-4.15)	4.38 (3.50-5.44)	5.24 (4.15-6.54)	6.41 (4.93-8.43)	7.28 (5.49-9.80)	8.22 (6.05-11.6)	9.40 (6.44-13.3)	11.2 (7.39-16.5)	12.8 (8.23-19.2)
2-day	3.03 (2.45-3.72)	3.79 (3.05-4.65)	5.02 (4.04-6.19)	6.05 (4.83-7.50)	7.46 (5.79-9.77)	8.49 (6.46-11.4)	9.64 (7.17-13.6)	11.1 (7.63-15.6)	13.4 (8.86-19.6)	15.5 (9.97-23.0)
3-day	3.27 (2.66-4.00)	4.08 (3.31-5.00)	5.40 (4.36-6.64)	6.50 (5.21-8.02)	8.01 (6.23-10.4)	9.11 (6.96-12.2)	10.3 (7.71-14.5)	11.9 (8.19-16.7)	14.4 (9.51-20.9)	16.6 (10.7-24.5)
4-day	3.51 (2.86-4.28)	4.35 (3.53-5.31)	5.72 (4.63-7.00)	6.85 (5.51-8.43)	8.41 (6.56-10.9)	9.55 (7.31-12.7)	10.8 (8.07-15.1)	12.4 (8.57-17.4)	15.0 (9.91-21.7)	17.2 (11.1-25.4)
7-day	4.20 (3.44-5.10)	5.09 (4.16-6.17)	6.53 (5.32-7.95)	7.72 (6.25-9.46)	9.37 (7.34-12.1)	10.6 (8.12-14.0)	11.9 (8.89-16.4)	13.6 (9.39-18.8)	16.1 (10.7-23.1)	18.3 (11.9-26.8)
10-day	4.87 (4.00-5.88)	5.79 (4.75-6.99)	7.28 (5.95-8.82)	8.51 (6.91-10.4)	10.2 (8.02-13.1)	11.5 (8.81-15.0)	12.8 (9.57-17.5)	14.5 (10.1-20.0)	17.0 (11.3-24.3)	19.1 (12.4-27.9)
20-day	6.87 (5.68-8.23)	7.85 (6.49-9.42)	9.45 (7.78-11.4)	10.8 (8.82-13.0)	12.6 (9.93-15.9)	14.0 (10.8-18.0)	15.4 (11.4-20.6)	17.0 (11.9-23.3)	19.3 (12.9-27.4)	21.2 (13.8-30.6)
30-day	8.50 (7.07-10.2)	9.53 (7.91-11.4)	11.2 (9.26-13.4)	12.6 (10.3-15.2)	14.5 (11.4-18.1)	16.0 (12.3-20.4)	17.4 (12.9-23.0)	19.0 (13.3-25.8)	21.1 (14.1-29.7)	22.7 (14.8-32.7)
45-day	10.5 (8.78-12.5)	11.6 (9.65-13.8)	13.3 (11.1-15.9)	14.8 (12.2-17.7)	16.8 (13.3-20.8)	18.3 (14.1-23.2)	19.8 (14.6-25.8)	21.3 (15.0-28.8)	23.1 (15.6-32.4)	24.5 (16.0-35.1)
60-day	12.2 (10.2-14.4)	13.3 (11.1-15.7)	15.1 (12.5-17.9)	16.5 (13.7-19.8)	18.6 (14.7-23.0)	20.2 (15.6-25.4)	21.7 (16.0-28.1)	23.1 (16.3-31.2)	24.8 (16.7-34.6)	25.9 (16.9-37.0)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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PF graphical

Product Flow Rates

CASCADE

Model	Treatment Rate (cfs)	Sediment Capacity[1] (CF)
CS-4	2.00	19
CS-5	3.50	29
CS-6	5.60	42
CS-8	12.00	75
CS-10	18.00	118

CDS

Model	Treatment Rate[2] (cfs)	Sediment Capacity[1] (CF)
1515-3	1.00	14
2015-4	1.40	25
2015-5	1.40	39
2015-6	1.40	57
2020-5	2.20	39
2020-6	2.20	57
2025-5	3.20	39
2025-6	3.20	57
3020-6	3.90	57
3025-6	5.00	57
3030-6	5.70	57
3035-6	6.50	57
4030-8	7.50	151
4040-8	9.50	151

VORTECHS

Model	Treatment Rate (cfs)	Sediment Capacity[3] (CF)
1000	1.60	16
2000	2.80	32
3000	4.50	49
4000	6.00	65
5000	8.50	86
7000	11.00	108
9000	14.00	130
11000	17.5	151
16000	25	192

STORMCEPTOR STC

Model	Treatment Rate (cfs)	Sediment Capacity[1] (CF)
STC 450i	0.40	46
STC 900	0.89	89
STC 2400	1.58	205
STC 4800	2.47	543
STC 7200	3.56	839
STC 11000	4.94	1086
STC 16000	7.12	1677

1 Additional sediment storage capacity available – Check with your local representative for information.

2 Treatment Capacity is based on laboratory testing using OK-110 (average D50 particle size of approximately 100 microns) and a 2400 micron screen.

3 Maintenance recommended when sediment depth has accumulated to within 12-18 inches of the dry weather water surface elevation.

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www.RainGuardian.biz

TECHNICAL MEMORANDUM

Rain Guardian Pretreatment Chambers - Functionality, Capacity, and Effectiveness

December 1, 2022

To Whom It May Concern:

OVERVIEW

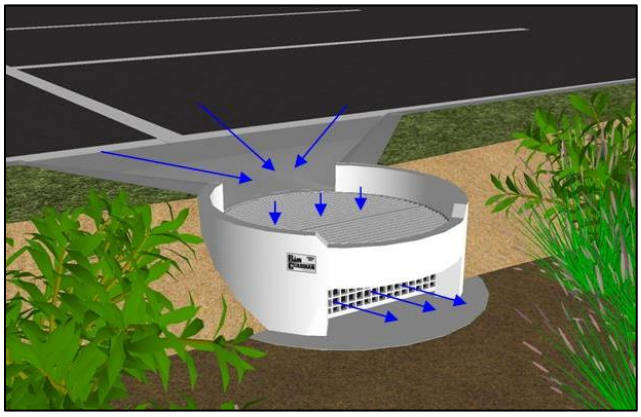
Rain Guardian pretreatment chambers were developed by Anoka Conservation District to address common inlet, pretreatment, and maintenance issues associated with stormwater BMPs. Typical inlet options for stormwater BMPs include grass filter strips and rock inlets, which are prone to erosion, require hours of maintenance, provide little or no pretreatment, and can actually cause water to bypass the practice because of their likelihood of clogging with debris. Rain Guardian pretreatment chambers provide a stable inlet to the BMP, pretreat stormwater, and simplify maintenance by capturing sediment and debris in a chamber that is quick and easy to clean.

Each Rain Guardian pretreatment chamber utilizes patented functional elements (US 8,501,016, US 8,858,804, and US 11,298,635). Therefore, each chamber operates in the same manner and has a similar flow path. The four patented functional elements and a brief description of their purpose are described below.

1. The water-impermeable sidewalls form a debris and sediment trap.
2. The filter sidewall allows the chamber to drain and dry between storm events.
3. The chamber grate captures gross solids.
4. The top debris walls capture and restrict floatables from entering or exiting the BMP.

FLOW PATH AND FUNCTIONALITY

Rain Guardian pretreatment chambers are positioned at BMP inlets. Stormwater is most commonly directed into the chamber via a curb-cut and inlet. Water passes through the top grate, which captures gross solids. Water then enters the chamber where the settling and capture of particulates occurs. The vertical filter wall positioned on the BMP side of the chamber allows the chamber to dry out between storm events. As the BMP fills, the water level rises and the top debris walls restrict floatable debris from entering or exiting the BMP. Accumulated sediment and debris are easily removed from the chamber by removing the top grate and shoveling the interior of the chamber. The vertical filter wall can be brushed or rinsed clean. Multiple outflow points exist in each chamber that allow water to exit the chamber and enter the BMP during high flows. The image to the right depicts the flow path of stormwater through the Rain Guardian Turret pretreatment chamber. The flow path through the Bunker, Fortress, and Foxhole is similar.



PONDING DEPTH, STORAGE CAPACITY, AND FLOW CAPACITY

Each Rain Guardian pretreatment chamber is designed for a specific BMP ponding depth. Bunkers are available in 9” and 12” ponding depths, the Turret is available in a 12” ponding depth, the Fortress is available in a 9” ponding depth, and the Foxhole is available in a 9” ponding depth. The ponding depths include a 1.5” drop within the inlet (gutter or apron) to each chamber.

Chamber flow capacity calculations are described in the text below and details specific to each chamber type are shown in the tables below.

Inflow is possible through one location for each chamber, the chamber inlet.

1) Chamber inlet capacity – calculated using a standard broad crested weir equation (i.e. Q=C*L*H^(3/2))

Outflow is possible through three locations for each chamber. Please note the vertical filter within the chamber was assumed to be 100% clogged because its primary function is to allow the chamber to dry out between rain events.

1) Filter overflow capacity – water can pass between the top of the filter and the bottom of the grate; calculated using the continuity equation (i.e. Q=V*A)
2) Grate overflow capacity– water can pass through the top grate beyond the vertical filter wall; calculated using an orifice equation (i.e. Q=0.0108*A*√d)
3) High volume overflow capacity– water can overtop the front debris wall onto the splash pad; calculated using a standard broad crested weir equation (i.e. Q=C*L*H^(3/2))

Rain Guardian Model	**Internal Storage Capacity (CF)**	**Inlet Flow Rate (CFS)**	**Outlet 1 - Filter Overflow Rate (CFS)**	**Outlet 2 - Grate Overflow Rate (CFS)**	**Outlet 3 – High Volume Overflow Rate (CFS)**	**Total Outlet Rate (CFS)**
Bunker	2.85	3.07	3.41	2.02	0.69	6.12
Turret	4.02	1.82	0.45	2.59	0.41	3.45
Fortress	1.36	4.12	3.92	2.46	1.47	7.85
Foxhole Inlet/Outlet Combination	1.73	2.00	1.15	2.72	0.52	4.39
Foxhole Middle Section	2.20	N/A	N/A	N/A	N/A	N/A

Values used for each structure in flow rate calculations

	INLET			**OUTLET**				
Rain Guardian Model	**C**	**L (FT)**	**H (FT)**	**C**	**L (FT)**	**H (FT)**	**FILTER OVERFLOW A (SF)**	**GRATE OVERFLOW A (SF)**
Bunker	3.087	3.438	0.438	3.087	4.021	0.146	0.528	0.580
Turret	3.087	2.190	0.417	3.087	2.406	0.146	0.128	0.745
Fortress	3.087	3.344	0.542	3.087	3.380	0.271	0.406	0.621
Foxhole Inlet/Outlet Combination	3.087	2.083	0.458	3.087	2.083	0.188	0.248	0.746

POLLUTANT REMOVAL EFFECTIVENESS

Rain Guardian Bunkers and Turrets were independently tested by the University of Minnesota St. Anthony Falls Laboratory. Removal of TSS and gross solids is included in the "*Capture of Gross Solids and Sediment by Pretreatment Practices for Bioretention*, Project Report No. 586, January 2019" and the results are summarized below.

- Bunker sediment capture –91.7% at 0.25 CFS and 75.6% at 0.5 CFS
- Bunker gross solids capture – 78.8% at 0.25 CFS and 61.4% at 0.5 CFS
- Turret sediment capture – 88.4% at 0.25 CFS and 79.1% at 0.5 CFS
- Turret gross solids capture – 86.7% at 0.25 CFS and 72.4% at 0.5 CFS

The particle size distribution of sand used in testing is summarized below in the screen captures from the report. Additional details are available in the report.

Capture of Gross Solids and Sediment by Pretreatment Practices for Bioretention
Final Report – January 2019

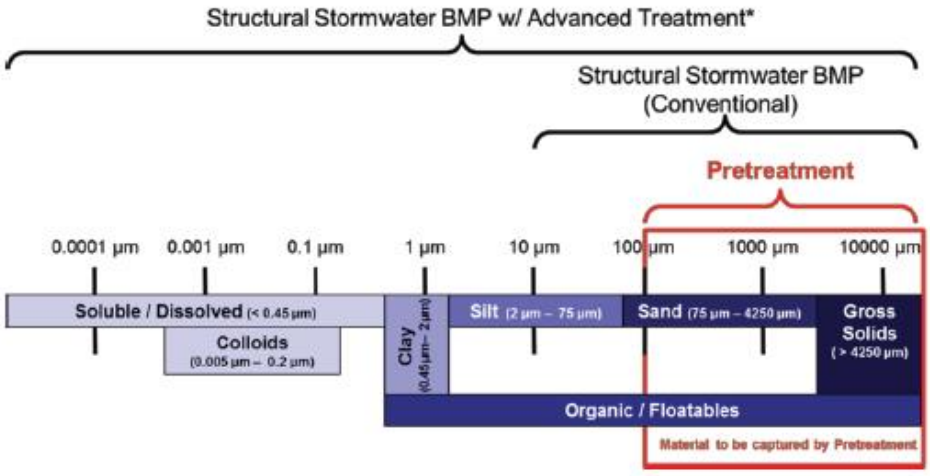


Figure 17. Pretreatment is intended to capture a portion of particles greater than 100µm (MPCA 2017b).

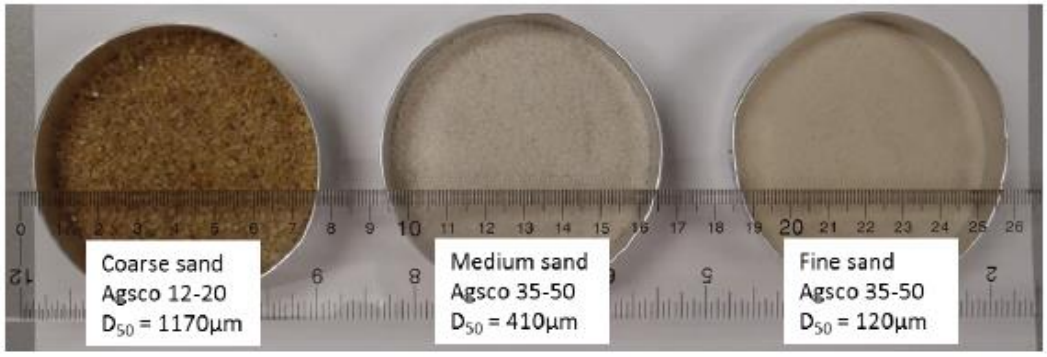


Figure 18. The three silica sands were blended in equal proportions by mass to create the sediment mix.

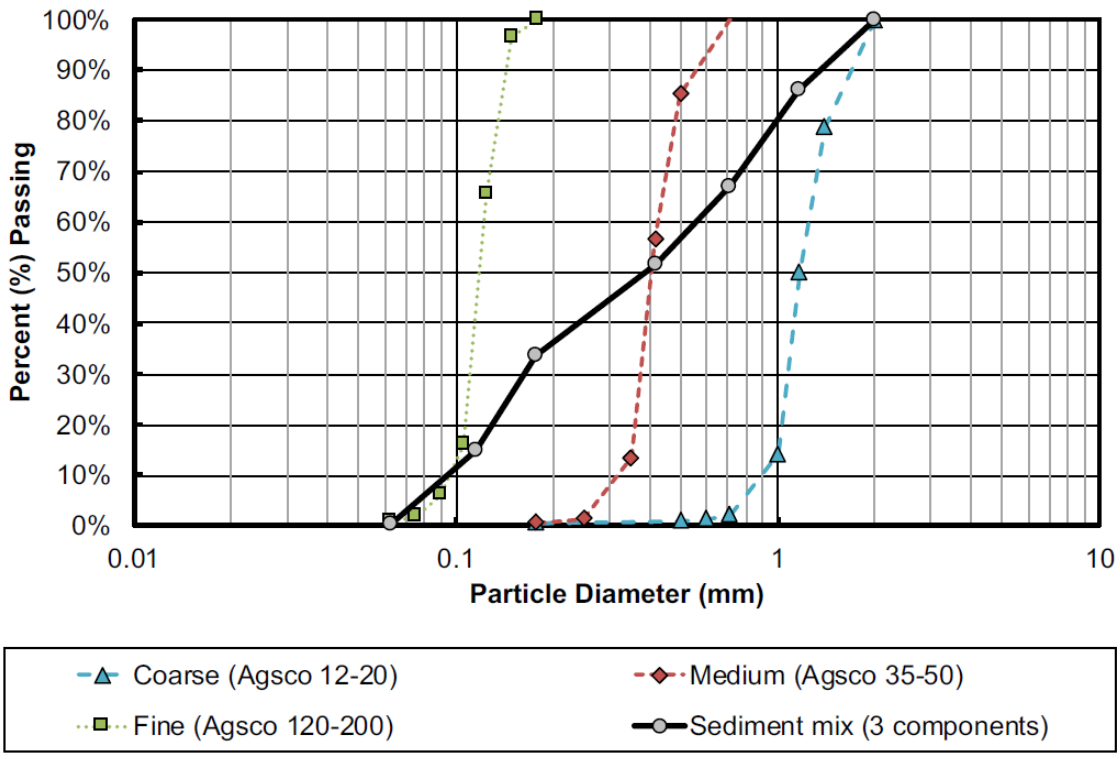


Figure 19. Particle size distribution chart of sand used in testing. Data from SAFL sieve testing.

Table 5. Sieve analysis of whole sediment mix and division of sediment classes

US Std. Sieve #	Opening size (mm)	Percent passing	Sediment Retained
10	2.00	100.0%	Foreign material
16	1.17	86.2%	Coarse
25	0.71	67.1%	Coarse
40	0.42	51.5%	Medium
80	0.18	33.5%	Medium
(140 or 120)	0.12	14.9%	Fine
Pan	--	--	Fine

Sincerely,

Mitch Haustein
Stormwater and Shoreland Specialist
Anoka Conservation District
1318 McKay Dr. NE, Suite 300
Ham Lake, MN 55304
(763) 434-2030 ext. 150
mitch.haustein@anokaswcd.org

APPENDIX G: OPERATION AND MAINTENANCE

- *STORMWATER OPERATION AND MAINTENANCE PLAN*
- *INSPECTION REPORT*
- *INSPECTION AND MAINTENANCE LOG FORM*
- *LONG-TERM POLLUTION PREVENTION PLAN*
- *ILLICIT DISCHARGE STATEMENT*
- *SPILL PREVENTION*
- *PROPOSED OPERATION AND MAINTENANCE MAP*
- *MANUFACTURER'S INSPECTION AND MAINTENANCE MANUALS*

STORMWATER OPERATION AND MAINTENANCE PLAN

Main Street Redevelopment
SLV Ashland, LLC
50 Main Street
Ashland, MA

RESPONSIBLE PARTY DURING CONSTRUCTION:

TBD

RESPONSIBLE PARTY POST CONSTRUCTION:

SLV Ashland, LLC
257 Hillside Avenue
Needham, MA 02492

Construction Phase

During the construction phase, all erosion control devices and measures shall be maintained in accordance with the final record plans, local/state approvals and conditions, the EPA Construction General Permit and the Stormwater Pollution Prevention Plan (SWPPP) if applicable. Additionally, the maintenance of all erosion / siltation control measures during construction shall be the responsibility of the general contractor. Contact information of the OWNER and CONTRACTOR shall be listed in the SWPPP for this site. The SWPPP also includes information regarding construction period allowable and illicit discharges, housekeeping and emergency response procedures. Upon proper notice to the property owner, the Town/City or its authorized designee shall be allowed to enter the property at a reasonable time and in a reasonable manner for the purposes of inspection.

Post Development Controls

Once construction is completed, the post development stormwater controls are to be operated and maintained in compliance with the following permanent procedures (note that the continued implementation of these procedures shall be the responsibility of the Owner or its assignee):

1. Parking lots: Sweep at least four (4) times per year and on a more frequent basis depending on sanding operations. All resulting sweepings shall be collected and properly disposed of offsite in accordance with MADEP and other applicable requirements.

2. Catch basins, yard drains, trench drains, manholes and piping: Inspect four (4) times per year and at the end of foliage and snow-removal seasons. These features shall be cleaned four (4) times per year or whenever the depth of deposits is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the catch basin or underground system. Accumulated sediment and hydrocarbons present must be removed and properly disposed of off-site in accordance with MADEP and other applicable requirements.

3. Riprap apron: Riprap should be checked at least annually and after every major storm event (generally equal or greater to 3.0 inches in 24 hours) for displaced stones, slumping, and erosion at edges, especially downstream or downslope. If the riprap is damaged, it should be

repaired before further damage can take place. Note and repair any erosion, stone displacement or low spots in the areas. Woody vegetation should be removed from the riprap annually.

4. Water Quality Unit (Proprietary Separator): Follow manufacturer's recommendations (attached).

5. Vegetated Filter Strip: Monitoring of recently planted vegetation to ensure the filter strip is establishing it properly. Regular mowing, trimming, watering, fertilizing and reseeding of the vegetation, as applicable to local conditions. Regular inspection of vegetation for damage from foot or vehicle traffic. Removal of accumulated sediment and debris at the toe, the term, and the strip itself. This monitoring is important to make sure preferential flow paths haven't developed and sheet flow is consistent. This should happen at least biannually or when sediment accumulates to a heigh of 2 inches or greater. Soil aeration if the drainage time of the filter strip becomes significantly slower than the original drainage time due to soil compaction.

6. Rain Guardian Turret: Follow manufacturer's recommendations (attached).

All components of the stormwater system will be accessible by the owner or their assignee.

STORMWATER MANAGEMENT SYSTEM

POST-CONSTRUCTION INSPECTION REPORT

LOCATION:

Main Street Redevelopment
50 Main Street
Ashland, MA

RESPONSIBLE PARTY:

SLV Ashland, LLC
257 Hillside Avenue
Needham, MA 02492

NAME OF INSPECTOR:	INSPECTION DATE:
Note Condition of the Following (sediment depth, debris, standing water, damage, etc.):	
Catch Basins:	
Discharge Points/ Flared End Sections / Rip Rap:	
Water Quality Units:	
Vegetated Filter Strips:	
Rain Guardian Turret:	

Other:
Other:
Note Recommended Actions to be taken on the Following (sediment and/or debris removal, repairs, etc.):
Catch Basins:
Discharge Points / Flared End Sections / Rip Rap:
Water Quality Units:
Vegetated Filter Strips:
Rain Guardian Turret:
Other:

Other:
Comments:

STORMWATER INSPECTION AND MAINTENANCE LOG FORM			
Main Street Redevelopment ***50 Main Street, Ashland, MA***			
Stormwater Management Practice	Responsible Party	Date	Maintenance Activity Performed

LONG-TERM POLLUTION PREVENTION PLAN

Main Street Redevelopment
SLV Ashland, LLC
50 Main Street
Ashland, MA

RESPONSIBLE PARTY DURING CONSTRUCTION:

TBD

RESPONSIBLE PARTY POST CONSTRUCTION:

SLV Ashland, LLC
257 Hillside Avenue
Needham, MA 02492

For this site, the Long-Term Pollution Prevention Plan will consist of the following:

- The property owner shall be responsible for "good housekeeping" including proper periodic maintenance of building and pavement areas, curbing, landscaping, etc.
- Proper storage and removal of solid waste (dumpsters).
- Sweeping of parking lots, drive aisles and access aisles a minimum of twice per year with a commercial cleaning unit. Any sediment removed shall be disposed of in accordance with applicable local and state requirements.
- Regular inspections and maintenance of Stormwater Management System as noted in the "O&M Plan".
- Snow removal shall be the responsibility of the property owner. Snow shall not be plowed, dumped and/or placed in designated "no snow storage" areas. Salting and/or sanding of pavement / walkway areas during winter conditions shall only be done in accordance with all state/local requirements and approvals.
- The amount of sand and deicing chemicals shall be kept at the minimum amount required to provide safe pedestrian and vehicle travel. If stored on-site, sand and deicing chemicals shall be stockpiled under covered storage facilities that prevent precipitation and adjacent runoff from coming into contact with deicing materials. Stockpile areas shall be located outside resource areas.
- Pesticides and/or herbicides of any type shall not be used for the establishment or maintenance of landscape plantings or lawns. Use of fertilizers shall be limited to organic-based, slow release fertilizers in compliance with the MA Plant Nutrient Application Requirements, 300 CMR 31.00. Fertilizer application rate shall not

exceed the most recent UMass Guidelines for Nutrient Management which currently specifies a maximum application rate of 2 pounds of Nitrogen (N) per 1,000 square feet of turf per year. This restriction shall be included in all landscape construction and maintenance contracts. To meet this requirement, the intent will be to comply with the following requirements:

  - Apply at a rate and in amounts consistent with manufacturer's specifications;
  - Apply at the appropriate time of year for your location, and preferably timed to coincide as closely as possible to the period of maximum vegetation uptake and growth;
  - Avoid applying before heavy rains that could cause excess nutrients to be discharged;
  - Never apply to frozen ground;
  - Never apply to stormwater conveyance channels with flowing water; and
  - Follow all other federal, state, tribal, and local requirements regarding fertilizer application.

- Trash and other debris shall be removed from all areas of the site at least twice yearly.

- Reseed any bare areas as soon as they occur. Erosion control measures shall be installed in these areas to prevent deposits of sediment from entering the drainage system.

- Pet waste shall be disposed of in accordance with local regulations. Pet waste shall not be disposed of in a storm drain or catch basin.

- Snow piles shall be located adjacent to or on pervious surfaces in upland areas. This will allow snow melt water to filter, leaving behind sand and debris which can be removed in the springtime.

- Snow storage to be stored in available areas and indicated on Preliminary Site Plan Documents. Any excess snow that cannot be stored on-site will be removed in accordance with state and local regulations.

- Snow shall be stored and managed such that it does not block nor impact the functionality of the outlet pipes or check valves. Snow shall not be stored over post development stormwater controls outlined in the Operation and Maintenance Plan.

- In no case shall snow be disposed of or stored in resource areas (wetlands, floodplain, streams, or other water bodies).

OPERATON AND MAINTENANCE TRAINING PROGRAM

The Owner will coordinate an annual in-house training session to discuss the Operations and Maintenance Plan, the Long-Term Pollution Prevention Plan, and the Spill Prevention Plan and response procedures. Annual training will include the following:

Discuss the Operations and Maintenance Plan:

- Explain the general operations of the stormwater management system and its BMPs
- Identify potential sources of stormwater pollution and measures / methods of reducing or eliminating that pollution
- Emphasize good housekeeping measures

Discuss the Spill Prevention and Response Procedures:

- Explain the process in the event of a spill
- Identify potential sources of spills and procedures for cleanup and /or reporting and notification
- Complete a yearly inventory or Materials Safety Data sheets of all tenants and confirm that no potentially harmful chemicals are in use.

ILLICIT DISCHARGE STATEMENT

Certain types of non-stormwater discharges are allowed under the U.S. Environmental Protection Agency Construction General Permit. These types of discharges will be allowed under the conditions that no pollutants will be allowed to come in contact with the water prior to or after its discharge. The control measures which have been outlined previously in this LTPPP will be strictly followed to ensure that no contamination of these non-storm water discharges takes place. Any existing illicit discharges, if discovered during the course of the work, will be reported to MassDEP and the local DPW, as applicable, to be addressed in accordance with their respective policies. No illicit discharges will be allowed in conjunction with the proposed improvements.

Duly Acknowledged:

_____

Name & Title Date

SPILL PREVENTION AND RESPONSE PROCEDURES (POST CONSTRUCTION)

In order to prevent or minimize the potential for a spill of Hazardous Substances or Oil or come into contact with stormwater, the following steps will be implemented:

1. All Hazardous Substances or Oil (such as pesticides, petroleum products, fertilizers, detergents, acids, paints, paint solvents, cleaning solvents, etc.) will be stored in a secure location, with their lids on, preferably under cover, when not in use.

2. The minimum practical quantity of all such materials will be kept on site.

3. A spill control and containment kit (containing, for example, absorbent materials, acid neutralizing powder, brooms, dust pans, mops, rags, gloves, goggles, plastic and metal trash containers, etc.) will be provided on site.

4. Manufacturer's recommended methods for spill cleanup will be clearly posted and site personnel will be trained regarding these procedures and the location of the information and cleanup supplies.

5. It is the OWNER's responsibility to ensure that all Hazardous Waste on site is disposed of properly by a licensed hazardous material disposal company. The OWNER is responsible for not exceeding Hazardous Waste storage requirements mandated by the EPA or state and local authorities.

In the event of a spill of Hazardous Substances or Oil, the following procedures should be followed:

1. All measures should be taken to contain and abate the spill and to prevent the discharge of the Hazardous Substance or Oil to stormwater or off-site. (The spill area should be kept well ventilated and personnel should wear appropriate protective clothing to prevent injury from contact with the Hazardous Substances.)

2. For spills of less than five (5) gallons of material, proceed with source control and containment, clean-up with absorbent materials or other applicable means unless an imminent hazard or other circumstances dictate that the spill should be treated by a professional emergency response contractor.

3. For spills greater than five (5) gallons of material immediately contact the MADEP at the toll-free 24-hour statewide emergency number: **1-888-304-1133**, the local fire department (**9-1-1**) and an approved emergency response contractor. Provide information on the type of material spilled, the location of the spill, the quantity spilled, and the time of the spill to the emergency response contractor or coordinator, and proceed with prevention, containment and/or clean-up if so desired. (Use the form provided, or similar).

4. If there is a Reportable Quantity (RQ) release, then the National Response Center should be notified immediately at (800) 424-8802; within 14 days a report should be submitted to the EPA regional office describing the release, the date and circumstances of the release and the steps taken to prevent another release. This Pollution Prevention Plan should be updated to reflect any such steps or actions taken and measures to prevent the same from reoccurring.

SPILL PREVENTION CONTROL AND COUNTERMEASURE FORM

Main Street Redevelopment
50 Main Street
Ashland, Massachusetts

Where a release containing a hazardous substance occurs, the following steps shall be taken by the facility manager and/or supervisor:

1. Immediately notify The Town of Ashland Fire Department (at **9-1-1**)

2. All measures must be taken to contain and abate the spill and to prevent the discharge of the pollutant(s) to off-site locations, receiving waters, wetlands and/or resource areas.

3. Notify the Town Health Department at (508) 881-0100 ext. 1975 and the Town Conservation Commission at (508) 532-7924.

4. Provide documentation from licensed contractor showing disposal and cleanup procedures were completed as well as details on chemicals that were spilled to the Town Health Department and Conservation Commission.

Date of spill:_____ Time:_____ Reported By:_____

Weather Conditions:_____

Material Spilled	**Location of Spill**	**Approximate Quantity of Spill (in gallons)**	**Agency(s) Notified**	**Date of Notification**

Cause of Spill: _____

_____

Measures Taken to Clean up Spill: _____

_____

Type of equipment: _____ Make: _____ Size: _____

License or S/N: _____

Location and Method of Disposal _____

_____

Procedures, method, and precautions instituted to prevent a similar occurrence from recurring: _____

_____

_____

Additional Contact Numbers:

- DEPARTMENT OF ENVIRONMENTAL PROTECTION (DEP) EMERGENCY PHONE: 1-888-304-1133
- NATIONAL RESPONSE CENTER PHONE: (800) 424-8802
- U.S. ENVIRONMENTAL PROTECTION AGENCY PHONE: (888) 372-7341

CONTECH®
ENGINEERED SOLUTIONS

CDS® Inspection and Maintenance Guide

CDS TECHNOLOGIES

Maintenance

The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit. For example, unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (e.g. spring and fall) however more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (cylinder and screen) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained outside the screen. For deep units, a single manhole access point would allows both sump cleanout and access outside the screen.

The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. If absorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine weather the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

Cleaning

Cleaning of a CDS systems should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should also be cleaned out if pollutant build-up exists in this area.

In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill should be cleaned out immediately. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. The screen should be power washed to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the CDS system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins or deep sump manholes.

CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	y^3	m^3
CDS1515	3	0.9	3.0	0.9	0.5	0.4
CDS2015	4	1.2	3.0	0.9	0.9	0.7
CDS2015	5	1.3	3.0	0.9	1.3	1.0
CDS2020	5	1.3	3.5	1.1	1.3	1.0
CDS2025	5	1.3	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3025	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3
CDS5640	10	3.0	6.3	1.9	8.7	6.7
CDS5653	10	3.0	7.7	2.3	8.7	6.7
CDS5668	10	3.0	9.3	2.8	8.7	6.7
CDS5678	10	3.0	10.3	3.1	8.7	6.7

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

Support

- Drawings and specifications are available at www.contechstormwater.com.
- Site-specific design support is available from our engineers.

Contech Engineered Solutions LLC provides site solutions for the civil engineering industry. Contech's portfolio includes bridges, drainage, sanitary sewer, stormwater, earth stabilization and wastewater treament products. For information, visit www.ContechES.com or call 800.338.1122

CONTECH®
ENGINEERED SOLUTIONS
800.925.5240
www.ContechES.com

CDS Inspection & Maintenance Log

CDS Model: _____ Location: _____

Date	Water depth to sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than the values listed in table 1 the system should be cleaned out. **Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.**

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

RAIN GUARDIAN

U.S. PATENT NOS. 8,501,016 AND 8,858,804


TURRET


FOXHOLE


BUNKER

PRETREATMENT FOR BIORETENTION

Rain Gardens • Swales • Filtration Basins • Infiltration Basins

Maintenance Guide

Rain Guardian pretreatment chambers simplify bioretention maintenance by collecting sand, leaves, grass clippings, and other debris in an easy to clean, confined location. Regularly maintaining the Rain Guardian sustains its functionality by maximizing storage and filtration capacities. Maintenance frequency is variable and depends on many factors such as rainfall frequency, drainage area size and land use type, and season of the year. The general cleaning process is similar for all Rain Guardian models (i.e. Bunker, Foxhole, and Turret).

Following rain events, inspect the pretreatment chamber for debris on the top grate, within the chamber, and on the vertical, drop-in filter wall. The maintenance steps described below should be completed if areas of the top grate are clogged, the chamber is >75% full, or the vertical filter wall is clogged. Maintenance should be completed when stormwater has completely drained from the bioretention practice. The filter wall allows the chamber to dry between rain events, which further simplifies maintenance by ensuring removed debris is largely dry. Ensure all debris collected during cleaning of the chamber is completely removed from the site and properly disposed of according to local environmental rules. Once cleaning is complete, reinstall the filter wall with filter fabric facing the inside of the chamber and replace the top grate. For the Foxhole, reinstall the top lid, including optional lid anchor screws if equipped.

Clear Debris from Top Grate

- Foxhole only—remove top lid, including optional lid anchor screws if equipped
- Leaf litter and garbage commonly accumulate on the top grate
- Simply remove and dispose of debris by hand or with a shovel prior to removing top grate

Remove Debris from Inside Chamber

- Remove top grate and place on paved inlet to avoid damage to nearby plants
- Remove and dispose of accumulated debris within chamber using a shovel

Clean Filter Wall

- Remove drop-in filter by lifting vertically
- Clean filter wall with a stiff bristled broom or rinse clean with pressurized water

www.RainGuardian.biz

ANOKA CONSERVATION DISTRICT
1318 McKay Dr. NE, Suite 300
Ham Lake, MN 55304
(763) 434-2030 (M-F 8:00-4:30)

- CATCH BASIN / STORMWATER INLET
- WATER QUALITY UNIT
- RAIN GUARDIAN TURRET
- VEGETATED FILTER STRIP
- STORMTRAP SYSTEM
- DISCHARGE POINTS / RIP RAP APRON / SCOUR HOLE
- PIPE INLET
- PAVED DRAINAGE CHANNEL

SUDBURY RIVER

PARCEL I
AREA=339,000± SQ. FT.
7.8± ACRES

PROP. RESIDENTIAL BUILDING (±54,150 SF)
FFE=194.00
GFE=184.50

PROP. NON-RESIDENTIAL BUILDING (±11,500 SF)
FFE=182.60

GFE=187.00

PROP. PUBLIC PLAZA

MYRTLE STREET
(PUBLIC WAY - VARIABLE WIDTH)

MAIN STREET
(PUBLIC WAY - VARIABLE WIDTH)
(1984 RELOCATION LAYOUT)

WATER STREET
(PUBLIC WAY - VARIABLE WIDTH)

PLEASANT STREET
(PUBLIC WAY - VARIABLE WIDTH)

100 YEAR FLOOD ELEVATION PER GRAD (TYP) ELEV 187.00

POTENTIAL PROP OUTLET PROTECTION AT EXISTING DISCHARGE LOCATION TO BE REVIEWED IN FIELD WITH CONSERVATION COMMISSION DURING NOI PROCESS TO DETERMINE APPROPRIATE MEASURES.

APPROXIMATE LOCATION OF PROP VEGETATED FILTER STRIP (TYP.)

WATERTIGHT CONNECTION TO EXIST 12" RCP, INV.=179.7±

REMOVE EXIST DRAIN PIPE WITH REPLACE WITH 7 LF 12"Ø HDPE PIPE @ 1.0% WITH TIDEFLEX CHECKMATE CHECK VALVE OR APPROVED EQUIVALENT

INV=179.6±

PROP LIMIT OF WORK (TYP)

APPROXIMATE LOCATION OF PROP PAVED DRAINAGE CHANNEL (TYP.)

PROP CATCH BASIN
RIM=180.10±
INV.=177.10

27 LF - 12" HDPE; S=0.024

INV=179.80±

PROP. DMH
RIM=180.45
INV. IN=176.45
INV. IN=176.45
INV. OUT=176.35

PROP 4" DIA SCH. 40 PVC FORCE MAIN

EXIST PIPE TO BE INFILLED WITH FLOWABLE FILL

201 LF - 12" HDPE; S=0.005

INV=180.1±

APPROXIMATE LOCATION OF PROP VEGETATED FILTER STRIP (TYP.)

POTENTIAL PROP OUTLET PROTECTION AT EXISTING DISCHARGE LOCATION TO BE REVIEWED IN FIELD WITH CONSERVATION COMMISSION DURING NOI PROCESS TO DETERMINE APPROPRIATE MEASURES.

SUDBURY RIVER

WATERTIGHT CONNECTION TO EXIST 12" RCP, INV.=180.6±

REMOVE EXIST DRAIN PIPE AND REPLACE WITH 7 LF 12"Ø HDPE PIPE @ 1.0% WITH TIDEFLEX CHECKMATE CHECK VALVE OR APPROVED EQUIVALENT

INV=180.3±

INV=180.7±

APPROXIMATE LOCATION OF PROP PAVED DRAINAGE CHANNEL (TYP.)

PROP ACCESSIBLE PARKING AREA (TYP) MAX 2.0% IN ALL DIRECTIONS

PROP LIMIT OF WORK (TYP)

APPROXIMATE LOCATION OF PROP VEGETATED FILTER STRIP (TYP.)

POTENTIAL PROP OUTLET PROTECTION AT EXISTING DISCHARGE LOCATION TO BE REVIEWED IN FIELD WITH CONSERVATION COMMISSION DURING NOI PROCESS TO DETERMINE APPROPRIATE MEASURES.

SUMP 7 LF 12"Ø HDPE PIPE @ 1.4% WITH TIDEFLEX CHECKMATE CHECK VALVE OR APPROVED EQUIVALENT

INV=180.2±

PROP CATCH BASIN
RIM=181.00±
INV.=177.50

PROP RAIN GUARDIAN TURRET
CURB INLET ELEV=181.2
OUTLET ELEV=180.2

PROP ACCESSIBLE WALK (TYP)
MAX 2.0% CROSS SLOPE
MAX 5.0% RUNNING SLOPE

RIDGE

PROP UNDERGROUND STORMWATER STORAGE BASIN - 20 STORMTRAP SINGLE TRAP 5-0 CHAMBERS
INV. IN ELEV=176.25
INV. OUT ELEV.=172.50
BOT CHAMBERS=172.50
TOP CHAMBERS=178.00
[SEE DETAILS ON SHEET C-905]

PROP. PUMP STATION
[SEE DETAIL ON SHEET C-905]
INV. IN ELEV=172.25

PROP ACCESSIBLE PARKING AREA (TYP) MAX 2.0% IN ALL DIRECTIONS

PROP CATCH BASIN
RIM=191.85
INV.=188.85

191 LF - 12" HDPE; S=0.020

PROP PVMT SAWCUT (TYP)

PROP ACCESSIBLE WALK (TYP) MAX 2.0% CROSS SLOPE MAX 5.0% RUNNING SLOPE

PROP ACCESSIBLE RAMPS (TYP) GC SHALL CONSTRUCT RAMPS AND ASSOCIATED LANDINGS IN ACCORDANCE WITH ADA/AAB REQUIREMENTS.

PROP ACCESSIBLE SIDEWALK AND CROSSWALK. REFER TO "MADOT SIDEWALK THROUGH DRIVEWAYS WITH CURB RETURNS 2' CURB CORNERS" DETAIL FOR DESIGN INTENT.

PROP ACCESSIBLE SIDEWALK AND CROSSWALK. REFER TO "MADOT SIDEWALK THROUGH DRIVEWAYS WITH CURB RETURNS 2' CURB CORNERS" DETAIL FOR DESIGN INTENT.

APPROX. LOCATION EPA MONITORING WELL 'MW40/ MAIN'. MAINTAIN, PROTECT & RESET TO PROPOSED GRADE

APPROXIMATE LOCATION OF PROP PAVED DRAINAGE CHANNEL (TYP.)

APPROX. LOCATION EPA MONITORING WELL 'MW-405AD'. MAINTAIN, PROTECT & RESET TO PROPOSED GRADE

PROP RIP-RAP APRON (TYP.)

PROP FLARED END SECTION INV=180.0±

20 LF 12"Ø HDPE PIPE @ 1.0% WITH TIDEFLEX CHECKMATE CHECK VALVE OR APPROVED EQUIVALENT

APPROXIMATE LOCATION OF PROP VEGETATED FILTER STRIP (TYP.)

APPROX. LOCATION EPA MONITORING WELL 'MW-405BS'. MAINTAIN, PROTECT & RESET TO PROPOSED GRADE

INV=178.50±

PROP HEADWALL AND RIP-RAP APRON

90 LF - 12" HDPE; S=0.005

PROP TIDEFLEX CHECKMATE CHECK VALVE OR APPROVED EQUIVALENT

PROP CDS WATER QUALITY TREATMENT UNIT (SEE DETAIL)
RIM=181.75
INV.=178.95

PROP 4" DIA SCH. 40 PVC FORCE MAIN

PROP ACCESSIBLE WALK (TYP) MAX 2.0% CROSS SLOPE MAX 5.0% RUNNING SLOPE

PROP LIMIT OF WORK (TYP)

PROP. DMH
RIM=185.00
INV.IN=182.20
INV. OUT=182.10

27 LF - 12" HDPE; S=0.022

PROP. DMH
RIM=184.90
INV.IN=182.05
INV. OUT=181.95

19 LF - 12" HDPE; S=0.023

PROP TIDEFLEX CHECKMATE CHECK VALVE OR APPROVED EQUIVALENT (TYP OF 2)

PROP HEADWALL AND SCOUR HOLE

64 LF - 12" HDPE; S=0.023

PROP. DMH
RIM=189.60
INV. IN=183.60
INV. IN=183.60
INV. OUT=183.50

FFE=194.00
GFE=187.00

32 LF - 12" HDPE; S=0.005
(FINAL SIZE, MATERIAL, AND SLOPE TO BE DETERMINED AT FUTURE DATE)

APPROX LOCATION OF PROP ROOF DRAIN CONNECTION (REFER TO ARCH PLANS).
INV=183.7±
FINAL INVERT, LOCATION, SIZE, AND MATERIAL OF ROOF DRAIN TO BE DETERMINED AT FUTURE DATE

49 LF - 12" HDPE; S=0.026

PROP HEADWALL
INV.=181.50±

100 YEAR FLOOD ELEVATION PER GRAD (TYP) ELEV 187.00

PROP CDS WATER QUALITY UNIT (SEE DETAIL)
RIM=191.75
INV. IN=184.95
INV. OUT=184.85

PROP PVMT SAWCUT (TYP)

PROP ACCESSIBLE SIDEWALK AND CROSSWALK. REFER TO "MADOT SIDEWALK THROUGH DRIVEWAYS WITH CURB RETURNS 2' CURB CORNERS" DETAIL FOR DESIGN INTENT.

PROP LIMIT OF WORK (TYP)

PROP PVMT SAWCUT (TYP)

PROP ACCESSIBLE WALK (TYP) MAX 2.0% CROSS SLOPE MAX 5.0% RUNNING SLOPE

1c FLOOD ELEVATION PER GRAD (TYP) ELEV 187.00

30 15 7.5 0 30
SCALE: 1" = 30'

BOHLER

SITE CIVIL AND CONSULTING ENGINEERING
LAND SURVEYING
PROGRAM MANAGEMENT
LANDSCAPE ARCHITECTURE
ENVIRONMENTAL SERVICES
PERMITTING SERVICES
TRANSPORTATION SERVICES

REVISIONS

REV	DATE	COMMENT	DRAWN BY / CHECKED BY
2	08/01/2024	COMPREHENSIVE PERMIT	CSE / JAK
3	02/25/2025	TRAFFIC COMMENTS	LEC / JAK
4	03/12/2025	RESPONSE TO HANCOCK COMMENTS	EKR / JAK
5	03/19/2025	REVS TO DRIVEWAY & GARAGE	EKR / EGD
6	04/29/2025	RESPONSE TO MDM & HANCOCK	CSE / EGD
7	06/04/2025	290' SIGHT DISTANCE	CSE / EGD
8	08/07/2025	220' SIGHT DISTANCE	CSE / EGD
9	09/16/2025	PLAN SET OF RECORD	CSE / EGD
10	12/18/2025	NOTICE OF INTENT SUBMISSION	CSE / EGD

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It's fast. It's free. It's the law.

ISSUED FOR ENTITLEMENTS

THIS DRAWING IS INTENDED FOR MUNICIPAL AND/OR AGENCY REVIEW AND APPROVAL. IT IS NOT INTENDED AS A CONSTRUCTION DOCUMENT UNLESS INDICATED OTHERWISE.

PROJECT No.: MAA230359.00-10A
DRAWN BY: CSE
CHECKED BY: JAK
DATE: 02/25/2025
CAD I.D.: P-CIVL-PROP

PROJECT:

PRELIMINARY SITE DEVELOPMENT PLANS

FOR

SLV ASHLAND, LLC

PROPOSED
40B DEVELOPMENT
"THE SANCTUARY AT ASHLAND MILLS"

MAP: 14 | LOT: 128
50 MAIN STREET
TOWN OF ASHLAND
MASSACHUSETTS

BOHLER
352 TURNPIKE ROAD, 3rd FLOOR
SOUTHBOROUGH, MA 01772
Phone: (508) 480-9900
www.BohlerEngineering.com

J.A. KUCICH
PROFESSIONAL ENGINEER
MASSACHUSETTS LICENSE No. 41530
NEW HAMPSHIRE LICENSE No. 15476
CONNECTICUT LICENSE No. 26177
RHODE ISLAND LICENSE No. 9616
MAINE LICENSE No. 12553

SHEET TITLE:

OPERATION AND MAINTENANCE PLAN

SHEET NUMBER:

OM-1

REVISION 10 - 12/18/2025

P:\2023\MAA230359.00\CAD\DRAWINGS\PLAN SETS\CIVIL SITE PLANS\P-CIVL-PROP-MAA230359.00-10A-----><LAYOUT: C-401 GRAD ACE

APPENDIX H: COMPENSATORY FLOOD STORAGE

- *WPA FORM 4B – ORDER OF RESOURCE AREA DELINEATION (DEP FILE# 91-0948)*
- *EXISTING CONDITIONS PLAN OF #10-50 MAIN STREET IN ASHLAND, MA PREPARED BY CORNERSTONE ENGINEERING, INC., DATED 09/14/2020*
- *EXISTING FLOOD STORAGE EXHIBIT*
- *PROPOSED FLOOD STORAGE EXHIBIT*
- *FEMA FLOOD MAP EXHIBIT OUTLINING DOWNSTREAM FLOOD ELEVATIONS*
- *TIDEFLEX VALVE INFORMATION*

For Registry of Deeds Use Only

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Form 4B – Order of Resource Area Delineation

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

Provided by MassDEP:
95-0948
MassDEP File Number

eDEP Transaction Number

Ashland
City/Town

A. General Information

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

Note: Before completing this form consult your local Conservation Commission regarding any municipal bylaw or ordinance.

From: Ashland
1. Conservation Commission

2. This Issuance is for (check one):

a. ☒ Order of Resource Area Delineation

b. ☐ Amended Order of Resource Area Delineation

3. Applicant:

a. First Name | b. Last Name

Ashland Properties
c. Organization

330 Hopping Brook Road
d. Mailing Address

Holliston | MA. | 01746
e. City/Town | f. State | g. Zip Code

4. Property Owner (if different from applicant):

a. First Name | b. Last Name

c. Organization

d. Mailing Address

e. City/Town | f. State | g. Zip Code

5. Project Location:

10-50 Main Street | Ashland | 01721
a. Street Address | b. City/Town | c. Zip Code

Map 14 | Lot 128
d. Assessors Map/Plat Number | e. Parcel/Lot Number

Latitude and Longitude (in degrees, minutes, seconds): 42.26240 (f. Latitude) | -71.465520 (g. Longitude)

6. Dates: September 29, 2020 (a. Date ANRAD filed) | October 19, 2020 (b. Date Public Hearing Closed) | November 17, 2020 (c. Date of Issuance)

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Form 4B – Order of Resource Area Delineation

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

Provided by MassDEP:
95-0948
MassDEP File Number

eDEP Transaction Number

Ashland
City/Town

A. General Information (cont.)

7. Title and Date (or Revised Date if applicable) of Final Plans and Other Documents:

Existing Conditions Plan of #10-50 Main Street	10/19/2020
a. Title	b. Date
ANRAD with Attachments	11/21/2020
c. Title	d. Date

B. Order of Delineation

1. The Conservation Commission has determined the following (check whichever is applicable):

a. ☒ **Accurate**: The boundaries described on the referenced plan(s) above and in the Abbreviated Notice of Resource Area Delineation are accurately drawn for the following resource area(s):

1. ☒ Bordering Vegetated Wetlands
2. ☒ Other resource area(s), specifically:

a. Bordering Land Subject to Flooding, and bank.

b. ☐ **Modified**: The boundaries described on the plan(s) referenced above, as modified by the Conservation Commission from the plans contained in the Abbreviated Notice of Resource Area Delineation, are accurately drawn from the following resource area(s):

1. ☐ Bordering Vegetated Wetlands
2. ☐ Other resource area(s), specifically:

a.

c. ☐ **Inaccurate**: The boundaries described on the referenced plan(s) and in the Abbreviated Notice of Resource Area Delineation were found to be inaccurate and cannot be confirmed for the following resource area(s):

1. ☐ Bordering Vegetated Wetlands
2. ☐ Other resource area(s), specifically:

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Form 4B – Order of Resource Area Delineation

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

Provided by MassDEP:
95-0948
MassDEP File Number

eDEP Transaction Number

Ashland
City/Town

B. Order of Delineation (cont.)

3. ☐ The boundaries were determined to be inaccurate because:

C. Findings

This Order of Resource Area Delineation determines that the boundaries of those resource areas noted above, have been delineated and approved by the Commission and are binding as to all decisions rendered pursuant to the Massachusetts Wetlands Protection Act (M.G.L. c.131, § 40) and its regulations (310 CMR 10.00). This Order does not, however, determine the boundaries of any resource area or Buffer Zone to any resource area not specifically noted above, regardless of whether such boundaries are contained on the plans attached to this Order or to the Abbreviated Notice of Resource Area Delineation.

This Order must be signed by a majority of the Conservation Commission. The Order must be sent by certified mail (return receipt requested) or hand delivered to the applicant. A copy also must be mailed or hand delivered at the same time to the appropriate DEP Regional Office (see https://www.mass.gov/service-details/massdep-regional-offices-by-community).

D. Appeals

The applicant, the owner, any person aggrieved by this Order, any owner of land abutting the land subject to this Order, or any ten residents of the city or town in which such land is located, are hereby notified of their right to request the appropriate DEP Regional Office to issue a Superseding Order of Resource Area Delineation. When requested to issue a Superseding Order of Resource Area Delineation, the Department's review is limited to the objections to the resource area delineation(s) stated in the appeal request. The request must be made by certified mail or hand delivery to the Department, with the appropriate filing fee and a completed Request for Departmental Action Fee Transmittal Form, as provided in 310 CMR 10.03(7) within ten business days from the date of issuance of this Order. A copy of the request shall at the same time be sent by certified mail or hand delivery to the Conservation Commission and to the applicant, if he/she is not the appellant.

Any appellants seeking to appeal the Department's Superseding Order of Resource Area Delineation will be required to demonstrate prior participation in the review of this project. Previous participation in the permit proceeding means the submission of written information to the Conservation Commission prior to the close of the public hearing, requesting a Superseding Order or Determination, or providing written information to the Department prior to issuance of a Superseding Order or Determination.

The request shall state clearly and concisely the objections to the Order which is being appealed and how the Order does not contribute to the protection of the interests identified in the Massachusetts Wetlands Protection Act, (M.G.L. c. 131, § 40) and is inconsistent with the wetlands regulations (310 CMR 10.00). To the extent that the Order is based on a municipal bylaw or ordinance, and not on the Massachusetts Wetlands Protection Act or regulations, the Department of Environmental Protection has no appellate jurisdiction.

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Form 4B – Order of Resource Area Delineation

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

Provided by MassDEP:
95-0948
MassDEP File Number

eDEP Transaction Number

Ashland
City/Town

Date of Issuance

E. Signatures

Please indicate the number of members who will sign this form. 1. Number of Signers

Signatures

Signature of Conservation Commission Member	Printed Name
	Carl Hatanssen
	William Moulton
	CATHERINE VanLaucken
	Gabriel Toledo
	K G Nayeem

This Order is valid for three years from the date of issuance.

If this Order constitutes an Amended Order of Resource Area Delineation, this Order does not extend the issuance date of the original Final Order, which expires on unless extended in writing by the issuing authority.

This Order is issued to the applicant and the property owner (if different) as follows:

2. ☐ By hand delivery on

a. Date

3. ☑ By certified mail, return receipt requested on

11/17/2020

a. Date

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

Request for Departmental Action Fee Transmittal Form

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

DEP File Number:

Provided by DEP

A. Request Information

1. Location of Project

a. Street Address

b. City/Town, Zip

c. Check number

d. Fee amount

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

2. Person or party making request (if appropriate, name the citizen group's representative):

Name

Mailing Address

City/Town

State

Zip Code

Phone Number

Fax Number (if applicable)

3. Applicant (as shown on Determination of Applicability (Form 2), Order of Resource Area Delineation (Form 4B), Order of Conditions (Form 5), Restoration Order of Conditions (Form 5A), or Notice of Non-Significance (Form 6)):

Name

Mailing Address

City/Town

State

Zip Code

Phone Number

Fax Number (if applicable)

4. DEP File Number:

B. Instructions

1. When the Departmental action request is for (check one):

☐ Superseding Order of Conditions – Fee: $120.00 (single family house projects) or $245 (all other projects)

☐ Superseding Determination of Applicability – Fee: $120

☐ Superseding Order of Resource Area Delineation – Fee: $120

Send this form and check or money order, payable to the *Commonwealth of Massachusetts*, to:

Department of Environmental Protection
Box 4062
Boston, MA 02211

B. Instructions (cont.)

2. On a separate sheet attached to this form, state clearly and concisely the objections to the Determination or Order which is being appealed. To the extent that the Determination or Order is based on a municipal bylaw, and not on the Massachusetts Wetlands Protection Act or regulations, the Department has no appellate jurisdiction.

3. Send a **copy** of this form and a **copy** of the check or money order with the Request for a Superseding Determination or Order by certified mail or hand delivery to the appropriate DEP Regional Office (see https://www.mass.gov/service-details/massdep-regional-offices-by-community).

4. A copy of the request shall at the same time be sent by certified mail or hand delivery to the Conservation Commission and to the applicant, if he/she is not the appellant.

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Form 4B – Order of Resource Area Delineation

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

Provided by MassDEP:

MassDEP File Number

eDEP Transaction Number

City/Town

Recording Information

Prior to commencement of work, this Order of Resource Area Delineation must be recorded in the Registry of Deeds or the Land Court for the district in which the land is located, within the chain of title of the affected property. In the case of recorded land, the Final Order shall also be noted in the Registry's Grantor Index under the name of the owner of the land subject to the Order. In the case of registered land, this Order shall also be noted on the Land Court Certificate of Title of the owner of the land subject to the Order of Resource Area Delineation. The recording information on this page shall be submitted to the Conservation Commission listed below.

Conservation Commission

Detach on dotted line, have stamped by the Registry of Deeds and submit to the Conservation Commission.

To:

Conservation Commission

Please be advised that the Order of Resource Area Delineation for the Project at:

Project Location | MassDEP File Number

Has been recorded at the Registry of Deeds of:

County | Book | Page

For: Property Owner

and has been noted in the chain of title of the affected property in:

Book | Page

In accordance with the Order of Resource Area Delineation issued on:

Date

If recorded land, the instrument number identifying this transaction is:

Instrument Number

If registered land, the document number identifying this transaction is:

Document Number

Signature of Applicant

MYRTLE ST. 1924 C.L.O.

539.61' (TIE)

S32°14'21"E

RIVER

649.85' (TIE)

N79°04'57"W

RESIDENTIAL B ZONE
INDUSTRIAL ZONE

SUDBURY

RIVERFRONT AREA

MAHW-1 MAHW-2 MAHW-3 MAHW-4 MAHW-5 MAHW-6 MAHW-7 MAHW-8 MAHW-9 MAHW-10 MAHW-11 MAHW-12 MAHW-13 MAHW-14 MAHW-15 MAHW-16 MAHW-17 MAHW-18 MAHW-19 MAHW-20 MAHW-21 MAHW-22 MAHW-23 MAHW-24 MAHW-25 MAHW-26 MAHW-27 MAHW-28 MAHW-29 MAHW-30

TOP WALL=185.87

TOP WALL=185.72

TOP WALL=186.64

8"RCP INV=180.17

BENCHMARK BOLT ADJ. "OPEN" ELEV.=183.46 (NAVD 1988)

EXISTING PUMP HOUSE

CONC. PAD

PLAN DRAIN LOCATION (NOT FOUND)

100' BUFFER ZONE

200' RIVER FRONT BUFFER

BIT. PAVEMENT

TRAILER

CONCRETE OIL TANK

ENTRY

LOADING DOCK

8"CMP INV=181.49

CONCRETE OIL TANK

METAL ROOF

BRICK

STONE

CHIMNEY

CONC. PAD

OPEN ALLEY

WATER SHUTOFF

BORDERING LAND SUBJECT TO FLOODING 100 YEAR FLOOD ELEV.=187.0

EXISTING MILL COMPLEX
APPROX. BUILDING AREA = 91,050 S.F.
(2.1± ACRES)

APPROXIMATE LOCATION OF STONE TAILRACE

OUTLET 18"RCP INV.=179.53

CANAL

LAWN

EXISTING MULTI-FAMILY DWELLING #98

GRAVEL DRIVE

BIT. DRIVE

CONC. SIDEWALK

I.R.Fnd.

S65°37'45"W 53.48'

N23°58'46"W 222.99'

N27°57'37"W 55.27'

N22°16'53"W 272.45'

L=114.39'
R=110.00'

259.86'

106.17'

UP#29/3

UP#29/1

UP#26-6

#10 #20 #34 #50

MULCH LAWN WALK H.C.RAMP

MYRTLE STREET

MAIN STREET

WATER STREET

PLEASANT STREET

BENCHMARK
BONNET BOLT HYD, ADJ OPEN
ELEV.=194.53
(NAVD 1988)

BENCHMARK
MAG NAIL SET
ELEV.=192.48
(NAVD 1988)

(PUBLIC WAY – VARIABLE WIDTH)
1896 COUNTY LAYOUT AND 1984 RELOCATION LAYOUT

0+00 1+00 2+00 3+00 4+00 5+00 6+00 7+00 8+00

GRAPHIC SCALE: 1"=30'

0 10 20 30 40 50 75 100 125 150 FEET
0 5 10 15 20 25 30 35 40 45 METERS

LEGEND

- DRAIN MAN HOLE
- DRAINAGE LINE
- CATCH BASIN
- SEWER LINE
- SEWER MAN HOLE
- BITUMINOUS CURBING
- EDGE OF PAVEMENT
- GUARD RAIL
- WATERLINE
- HYDRANT
- WATERGATE
- WATER SERVICE/SHUTOFF
- GAS LINE
- GAS GATE
- UTILITY POLE & GUY WIRE
- TELEPHONE MAN HOLE
- STONEWALL
- CHAIN LINK FENCE
- ZONE LINE
- LIGHTPOST
- HANDICAP SPACE
- ELECTRIC TRANSFORMER
- SIGN
- BOLLARD
- VERTICAL BENCHMARK
- WELL
- DECIDUOUS TREE
- CONIFEROUS TREE
- TREELINE

OWNER:
BAYSTATE ENGINEERING
330 HOPPING BROOK ROAD, SUITE 1
HOLLISTON, MA

CONNORSTONE ENGINEERING INC.
CIVIL ENGINEERS AND LAND SURVEYORS
10 SOUTHWEST CUTOFF, SUITE 7
NORTHBOROUGH, MASSACHUSETTS 01532
PHONE: 508-393-9727 FAX: 508-393-5242

EXISTING CONDITIONS PLAN OF #10-50 MAIN STREET IN ASHLAND, MA

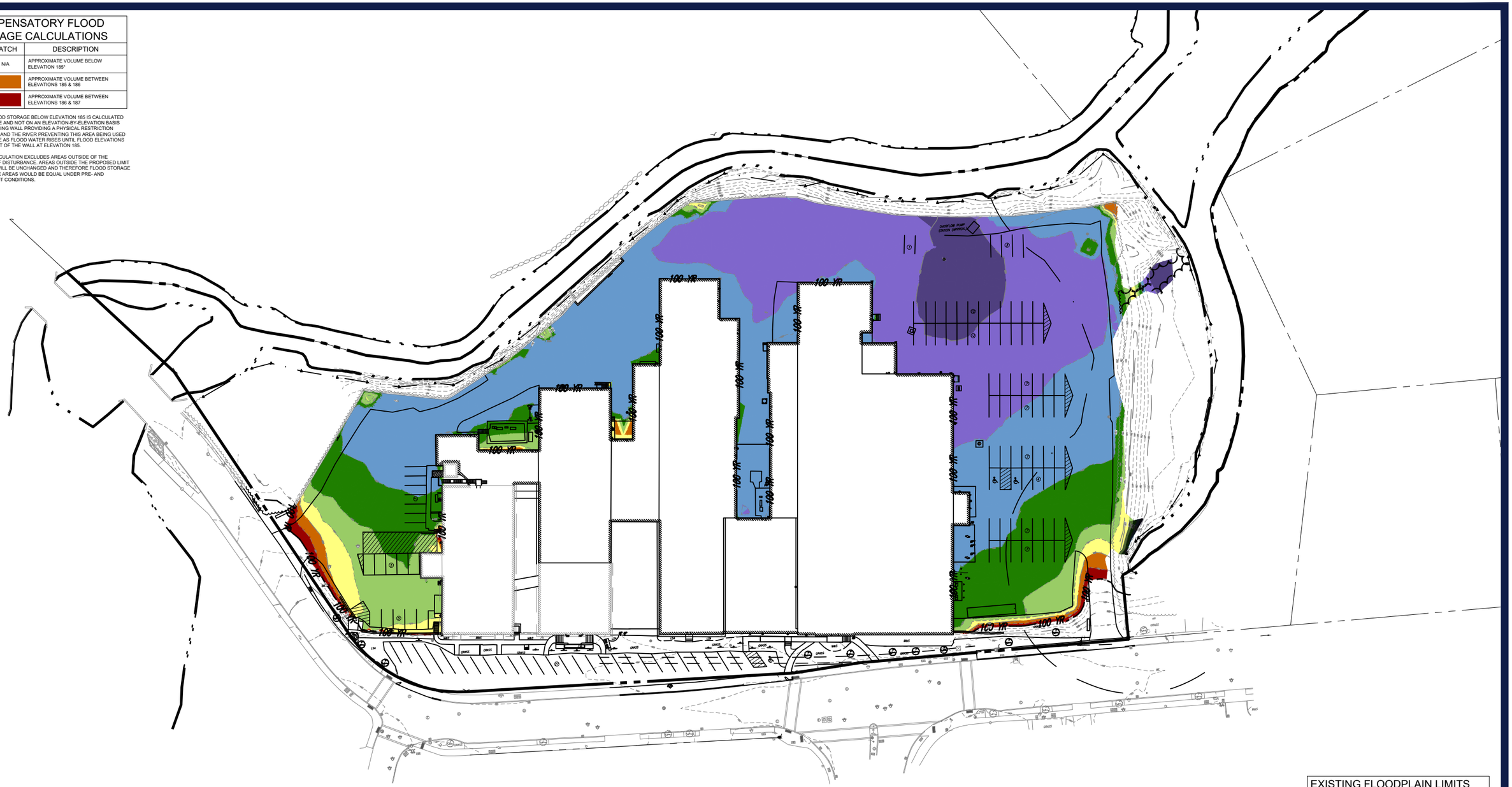
10-19-2020	MISC. EDITS
REVISED:	DESCRIPTION:
DRAWN BY: VHH	CHECK BY: REM
DATE: SEPTEMBER 14, 2020	
SCALE: 1"=30'	SHEET 1 OF 1.

COMMONWEALTH OF MASSACHUSETTS
VITO COLONNA
No. 47635
REGISTERED PROFESSIONAL ENGINEER
10-19-20

COMPENSATORY FLOOD STORAGE CALCULATIONS		
VOLUME	HATCH	DESCRIPTION
13,151± CY	N/A	APPROXIMATE VOLUME BELOW ELEVATION 185*
3,849± CY		APPROXIMATE VOLUME BETWEEN ELEVATIONS 185 & 186
3,890± CY		APPROXIMATE VOLUME BETWEEN ELEVATIONS 186 & 187

*THE EXISTING FLOOD STORAGE BELOW ELEVATION 185 IS CALCULATED AS A TOTAL VOLUME AND NOT ON AN ELEVATION-BY-ELEVATION BASIS DUE TO THE RETAINING WALL PROVIDING A PHYSICAL RESTRICTION BETWEEN THE SITE AND THE RIVER PREVENTING THIS AREA BEING USED AS FLOOD STORAGE AS FLOOD WATER RISES UNTIL FLOOD ELEVATIONS EXCEED THE HEIGHT OF THE WALL AT ELEVATION 185.

**THE AREA OF CALCULATION EXCLUDES AREAS OUTSIDE OF THE PROPOSED LIMIT OF DISTURBANCE. AREAS OUTSIDE THE PROPOSED LIMIT OF DISTURBANCE WILL BE UNCHANGED AND THEREFORE FLOOD STORAGE PROVIDED IN THESE AREAS WOULD BE EQUAL UNDER PRE- AND POST-DEVELOPMENT CONDITIONS.



EXISTING FLOODPLAIN LIMITS PER ORDER OF RESOURCE AREA DELINEATION (ORAD) DEP FILE #95-0948

M:\MA\2023\MAA230359.00\CAD\DRAWINGS\EXHIBITS\EXHIBIT 'A'\P-EXHA-FHVX-MAA230359.00-0B----->LAYOUT: C-001 FHVX-EXST

BOHLER

50 WASHINGTON ST., SUITE 2000
WESTBOROUGH, MA 01581
Phone: (508) 480-9900

www.BohlerEngineering.com

EXISTING FLOOD STORAGE EXHIBIT

12/16/2025 | CE | MAA230359.00 | REV 0b

SLV ASHLAND, LLC

ASHLAND, MA 01721

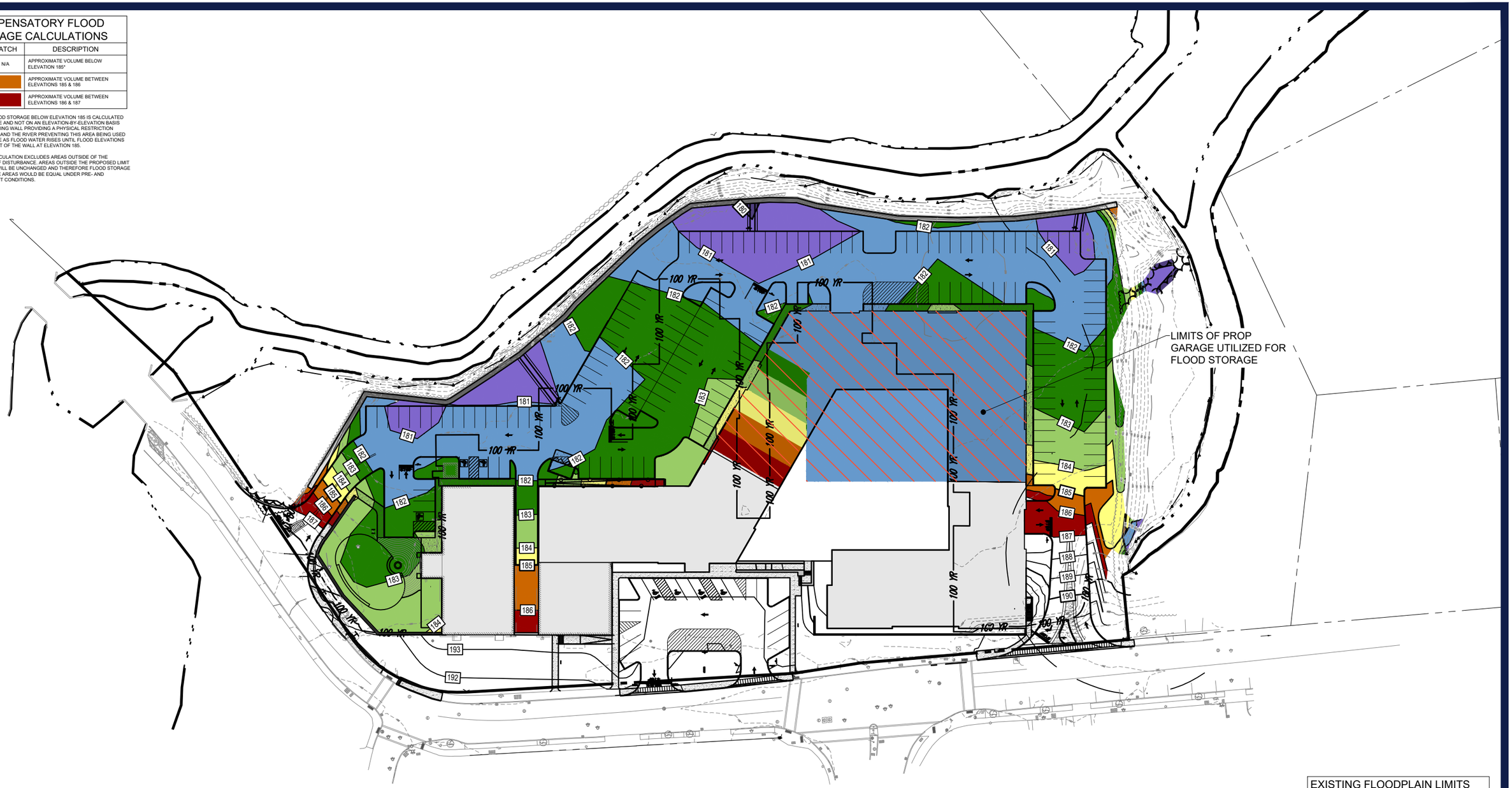
80 40 20 0 50

SCALE: 1" = 80'

COMPENSATORY FLOOD STORAGE CALCULATIONS		
VOLUME	HATCH	DESCRIPTION
13,797± CY	N/A	APPROXIMATE VOLUME BELOW ELEVATION 185*
4,649± CY		APPROXIMATE VOLUME BETWEEN ELEVATIONS 185 & 186
4,789± CY		APPROXIMATE VOLUME BETWEEN ELEVATIONS 186 & 187

*THE EXISTING FLOOD STORAGE BELOW ELEVATION 185 IS CALCULATED AS A TOTAL VOLUME AND NOT ON AN ELEVATION-BY-ELEVATION BASIS DUE TO THE RETAINING WALL PROVIDING A PHYSICAL RESTRICTION BETWEEN THE SITE AND THE RIVER PREVENTING THIS AREA BEING USED AS FLOOD STORAGE AS FLOOD WATER RISES UNTIL FLOOD ELEVATIONS EXCEED THE HEIGHT OF THE WALL AT ELEVATION 185.

**THE AREA OF CALCULATION EXCLUDES AREAS OUTSIDE OF THE PROPOSED LIMIT OF DISTURBANCE. AREAS OUTSIDE THE PROPOSED LIMIT OF DISTURBANCE WILL BE UNCHANGED AND THEREFORE FLOOD STORAGE PROVIDED IN THESE AREAS WOULD BE EQUAL UNDER PRE- AND POST-DEVELOPMENT CONDITIONS.



M:\MA\2023\MAA230359.00\CAD\DRAWINGS\EXHIBITS\EXHIBIT AXP-EXHA-FHVX-MAA230359.00-0B----->LAYOUT: C-001 FHVX-PROP

BOHLER

50 WASHINGTON ST., SUITE 2000
WESTBOROUGH, MA 01581
Phone: (508) 480-9900

www.BohlerEngineering.com

PROPOSED FLOOD STORAGE EXHIBIT

12/16/2025 | CE | MAA230359.00 | REV 0b

SLV ASHLAND, LLC

ASHLAND, MA 01721

80 40 20 0 50

SCALE: 1" = 80'

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Massachusetts State Plane Mainland Zone (FIPS zone 2001). The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713- 3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from orthophotography provided by MassGIS at a scale of 1:500 from photography dated April 2008.

The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

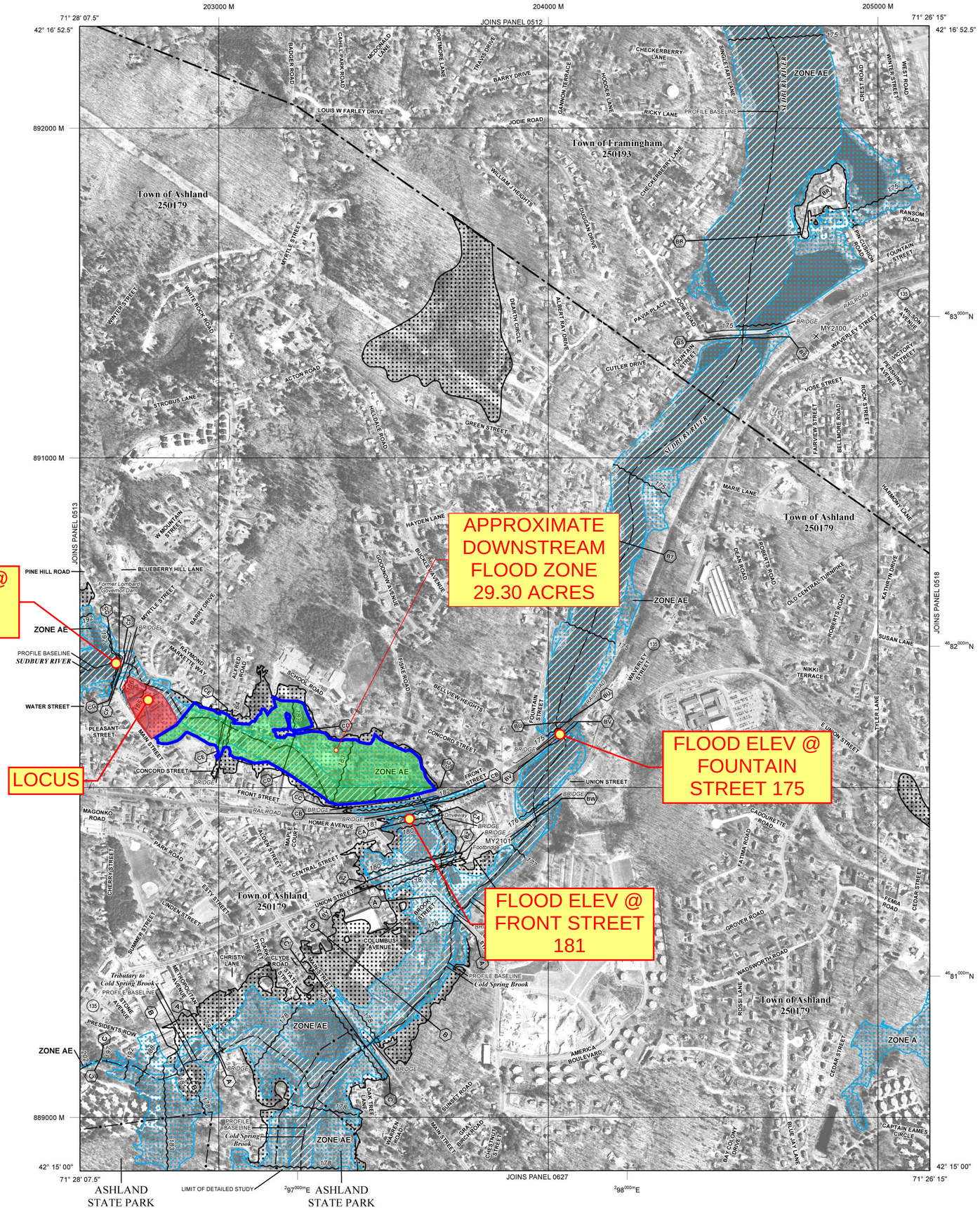
This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables for multiple streams in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map,** how to order products, or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX)** at **1-877-FEMA-MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

	1% Annual Chance Floodplain Boundary
	0.2% Annual Chance Floodplain Boundary
	Floodway boundary
	Zone D boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

A A	Cross section line
23 23	Transect line
45° 02' 08", 93° 02' 12"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
4989000 M	1000-meter ticks: Massachusetts State Plane Mainland Zone (FIPS Zone 2001), Lambert Conformal Conic projection
46 89 000m N	1000-meter Universal Transverse Mercator grid values, zone 19
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
June 4, 2010

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

July 7, 2014 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0514F

FIRM

FLOOD INSURANCE RATE MAP

MIDDLESEX COUNTY, MASSACHUSETTS
(ALL JURISDICTIONS)

PANEL 514 OF 656
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

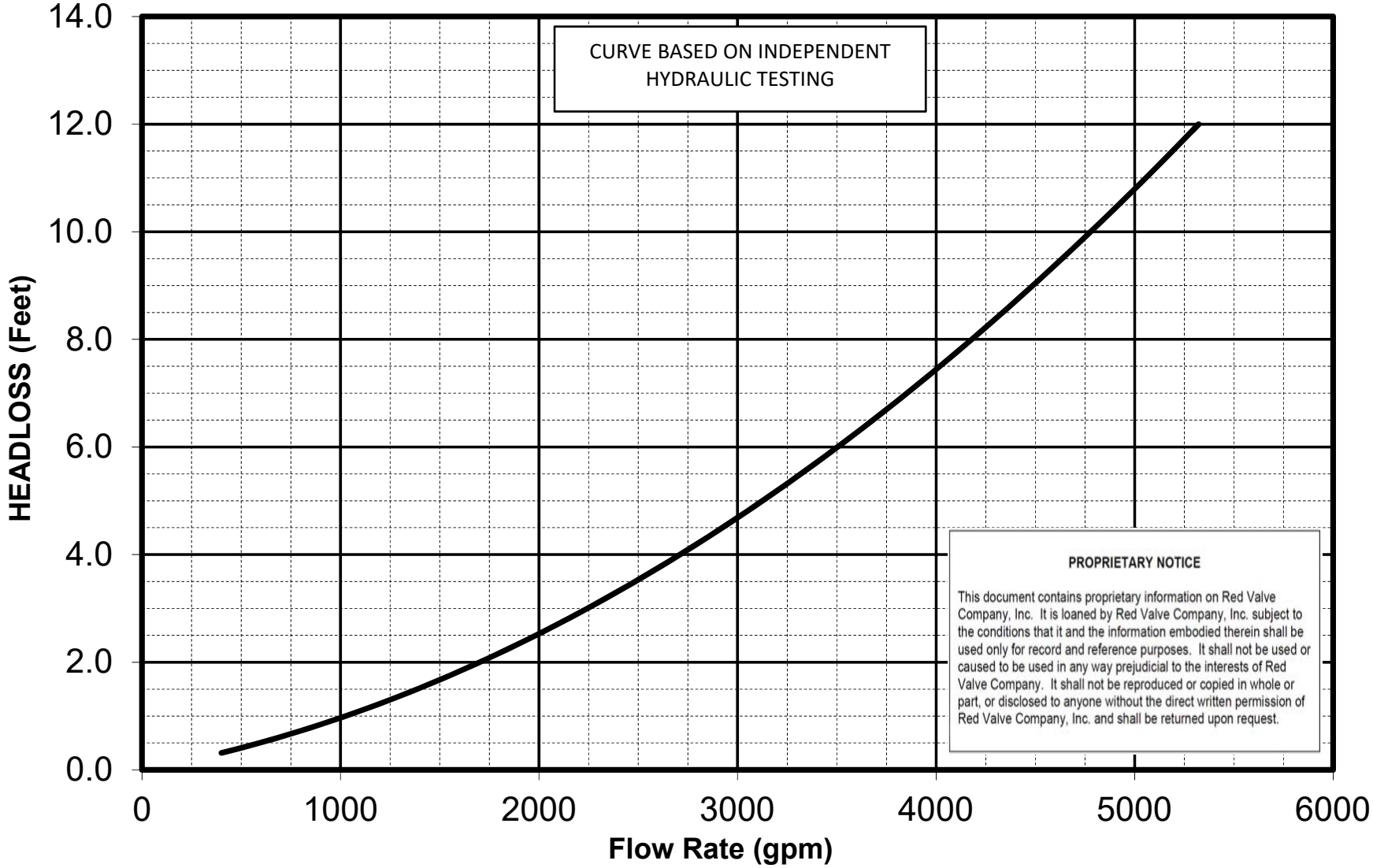
COMMUNITY	NUMBER	PANEL	SUFFIX
ASHLAND, TOWN OF	250179	0514	F
FRAMINGHAM, TOWN OF	250193	0514	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
25017C0514F
MAP REVISED
JULY 7, 2014

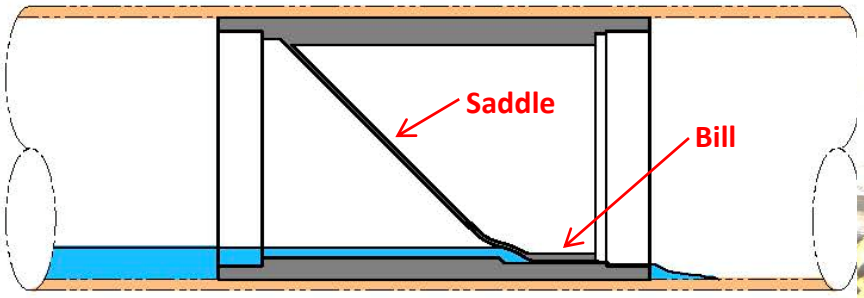
Federal Emergency Management Agency

12" Tideflex CheckMate UltraFlex Check Valve
Headloss vs. Flow Rate (Submerged Discharge)

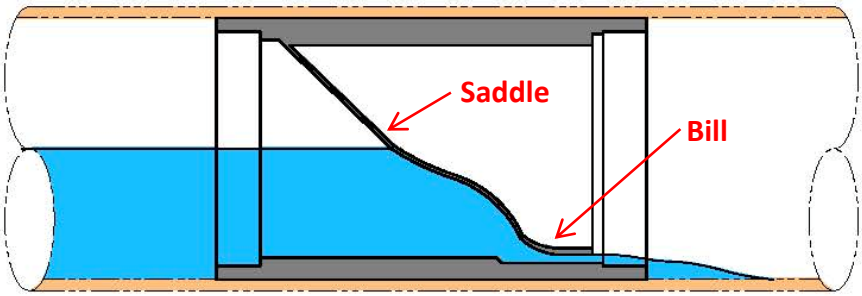


ISSUED: 3/22/2019

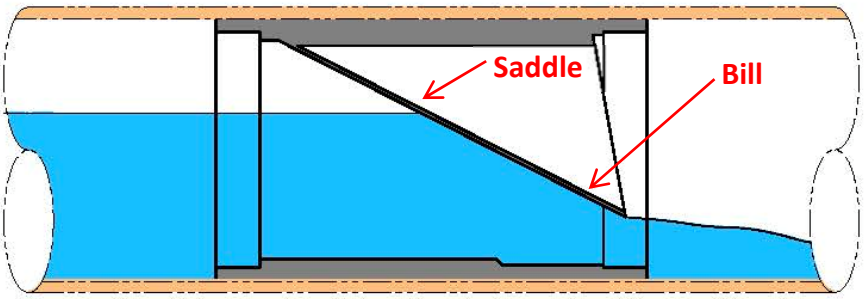
CheckMate Valve Snap Pressure



At low upstream head, there is little deflection in the saddle and bill but the Checkmate is still able to flow and drain.



As upstream head continues to increase, there is more deflection in the saddle, but the bill has not yet “snapped” open to a concave shape.



When the upstream head reaches a certain level, the bill “snaps” open into a concave shape and there will be substantially more flow with the same amount of head. The valve will progressively open with increase in head and flow rate.

4"-84" Checkmate Ultraflex Valve
Snap Open/Closed Pressures