PHOSPHORUS CONTROL PLAN (PCP) FOR THE TOWN OF SHERBORN

DRAFT TEMPLATE -
CHARLES RIVER WATERSHED ASSOCIATION

DRAFT: September 1, 2023

A Report Prepared for: Sherborn

By: AECOM using template developed by Kleinfelder

TABLE OF CONTENTS

E. Operations and Maintenance Program (or documentation of location(s) stored)
F. Priority Ranking of BMPs and Implementation Planning
G. Documentation of Public Comment Process and Comments Received
H. Alternative Schedule Request (if submitted)

PHOSPHORUS CONTROL PLAN (PCP)

DRAFT TEMPLATE V1

1 PHASE 1

The 2016 National Pollutant Discharge Elimination System General Permit for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems (MS4) in Massachusetts ("MS4 Permit" or "the Permit") took effect on July 1, 2018. The Permit was subsequently modified on December 7, 2020. The MS4 Permit conditions the operation, regulation, and management of MS4s in subject Massachusetts municipalities. Terms and conditions include requirements across six Minimum Control Measures (also referred to as Maximum Extent Practicable or MEP provisions), and water quality-based effluent limitations (WQBEL), including requirements for waterbodies with approved Total Maximum Daily Loads (TMDLs) and other water quality-limited waters.

There are two approved nutrient TMDLs for the Charles River; one for the Lower Charles River Basin, published in 2007[1], and one for the Upper/Middle Charles River Basin, published in 2011[2]. As an element of the Permit's WQBEL provisions, communities within the Charles River watershed are obligated to address phosphorus impairments through the development and implementation of a Phosphorus Control Plan (PCP). Appendix F of the MS4 Permit describes specific requirements of the PCP, implementation of which is anticipated to achieve the TMDL-established targeted phosphorus reductions over a 20-year timeframe. PCP implementation includes structural and non-structural best management practices (BMPs) executed through programs, projects, and policies. The PCP must be fully implemented within 20 years of the Permit effective date (i.e., by 2038), as illustrated in Table 1-1. The targeted phosphorus reductions are broken out into interim mandatory milestones, culminating in achievement of the allowable TMDL phosphorus loads for each municipality at the end of the 20-year schedule.

Table 1-1. General PCP Implementation Timeline for Charles River Watershed Communities

1-5 years after permit effective date [2018-2023]	**5-10 years after permit effective date [2023-2028]**	**10-15 years after permit effective date [2028-2033]**	**15-20 years after permit effective date [2033-2038]**
Create Phase 1 Plan	Implement Phase 1 Plan		
	Create Phase 2 Plan	Implement Phase 2 Plan	
		Create Phase 3 Plan	Implement Phase 3 Plan

[1] *Massachusetts Department of Environmental Protection. 2007. Final TMDL for Nutrients in the Lower Charles River Basin. CN 301.1*

[2] *Massachusetts Department of Environmental Protection. 2011. Total Maximum Daily Load for Nutrients in the Upper/Middle Charles River Basin, Massachusetts. CN 272.0*

1.1 OVERVIEW OF ALL PCP PHASE 1 MILESTONES

Phase 1 of the PCP must achieve the first 25% of each permitee's phosphorus load reduction requirement within 10 years (i.e., by June 30, 2028), with an interim milestone of achieving the first 20% of phosphorus load reduction by Year 8 (i.e., by June 30, 2026). The detailed components of the PCP due within Phase 1 are outlined in Table 1-2.

Table 1-2. Phase 1 Component Deadlines

Permit Year #	Year-End (June 30th)	PCP Component(s) Due
Year 1	2019	N/A
Year 2	2020	Legal Analysis
Year 3	2021	Funding Source Assessment
Year 4	2022	PCP Scope
Year 5	2023	Descriptions of the following Phase 1 items: - Nonstructural controls - Structural controls - O&M program for structural controls - Implementation schedule - Phase 1 cost estimate - Written Phase 1 PCP - Full implementation of nonstructural controls
Year 6	2024	Performance Evaluation
Year 7	2025	Performance Evaluation
Year 8	2026	Performance Evaluation & Implementation of structural controls to achieve 20% of target phosphorus reduction
Year 9	2027	Performance Evaluation
Year 10	2028	Performance Evaluation & Implementation of structural controls to achieve 25% of target phosphorus reduction

Sherborn acknowledges that to meet the phosphorus reduction deadlines set forth in the MS4 Permit, significant preparation is required. To plan, allocate funds to, design, and construct structural controls to meet the Year 8 and Year 10 reduction deadlines, there is significant work to be completed during the initial years of PCP implementation. Some controls that rely on local bylaw or regulatory updates, or engaging landowners directly through incentives, may take even longer to implement. This is considered in the Phase 1 implementation schedule.

1.2 WATERSHED AND COMMUNITY CHARACTERIZATION

The Charles River collects water from a total land area of 308 square miles. The River twists and turns on an 80-mile route from Hopkinton to Boston Harbor. The River flows through 23 communities and the total watershed encompasses 35 communities, adding many political complexities to watershed management. Some 80 brooks and streams, and several major aquifers, feed the Charles River. The watershed contains many lakes and ponds, most of them manmade, many through the construction of dams. The river drops about 350 feet in its unhurried journey to the sea. Lacking speed and force, the slow-moving Charles River is naturally brownish in color, because the water steeps like tea through the abundant wetlands along its path.

The Charles River watershed is home to over a million residents. Classified as an urban river, it is impaired for multiple pollutants and has areas along its length with altered and degraded habitat. Three Total Maximum Daily Loads (TMDLs) have been developed for the watershed: two for nutrients and one for bacteria. The river has borne the brunt of much of the development in the greater Boston area through damming, pollution, and traditional development practices. A nearly five-decade cleanup effort has resulted in water quality improvements, primarily from elimination of industrial discharges and a significant reduction in untreated sewage flowing into the river. The primary challenge facing the river today is stormwater runoff. Phosphorus loading in stormwater runoff is a particular challenge to the river, leading to summertime cyanobacteria blooms and overgrowth of invasive aquatic plants in many areas of the watershed.

Sherborn has long valued the environmental benefits of its natural resources. 5,500 acres are forested, more than half of the town's 10,328 total acres. Of the remaining 4,828 acres, 1,000 acres are wetlands and 1,700 acres of open fields, meadows and farmland. With only 20% of land developed, the challenges of capturing and treating runoff are different than most other municipalities within the Charles River watershed. The U.S. Army Corps of Engineers owns 92.18 acres (nearly 1% of town) of wetlands to protect flood-storage capacities in the Sewall Brook basin and reduce the potential effects of flooding along the Charles River. For these reasons, the future efforts to achieve the level of P reduction required by the permit will most likely force the town to use areas that will require deforesting of our preserved town forest or modify areas under the jurisdiction of the Conservation Commission. The areas managed by the Conservation Commission will require alterations in both the inner and outer buffer areas of Sherborn's protected wetlands. It appears that the open land within Sherborn does not receive the appropriate credit for Phosphorus treatment. The Town has invested a tremendous amount of money to preserve of the amount of open, undeveloped land. The commitment to Town open space was a financial investment that could become a financial burden if open land and wetlands must be altered to meet Phosphorous reduction requirements.

1.3 PCP LOAD REDUCTION TARGETS

1.3.1 PCP Area, Baseline Phosphorus Load, Allowable Phosphorus Load, and Stormwater Phosphorus Reduction Requirement from MS4 Permit

Sherborn has the option to implement its PCP either within the entirety of the community that falls within the Charles River watershed, or just the MS4-regulated area of our community within the Charles River watershed. Based on an assessment of factors relevant to the selection criteria, Sherborn will implement the PCP on just the MS4-regulated area and therefore be held to the

Allowable Phosphorus Load reported in TABLE F-3 of the MS4 Permit. The Allowable Phosphorus Load reported in TABLE F-3 of Appendix F for Sherborn is shown below in Table 1-3.

Sherborn is opting to implement the PCP within the MS4-regulated (urbanized) area because it is a smaller load and a smaller, more manageable area. We anticipate having the available space within this area to meet our MS4 Permit phosphorus reduction requirements. We do anticipate, however, that there will be improvements to stormwater management practices outside of this designated area as well due to the adoption of new stormwater policies and requirements that will be implemented at the municipal scale. We understand that these improvements will not count towards Sherborn's phosphorus reduction requirement.

Table 1-3. PCP Timeline of Phase 1 Reduction Requirements

Condition	From Permit[1]
Baseline P-Load, lbs/yr	*447*
Allowable P-Load, lbs/yr	*333*
Stormwater P-Load Reduction Requirement, lbs/yr[3]	*115*
Year 8 Milestone: 20% of Reduction, in lbs/yr	*23*
Year 10 Milestone: 25% of Reduction, in lbs/yr	*28.75*

To achieve the target of reducing phosphorus loads by 28.75 lbs/yr by 2028, Sherborn will be planning and implementing a series of structural and non-structural BMPs, updating regulatory mechanisms as necessary to aid with achieving these goals, evaluating funding mechanisms and costs, and developing its O&M and recordkeeping programs to ensure continued compliance and functionality of all installed BMPs.

1.4 LEGAL ANALYSIS

Appendix F of the MS4 Permit requires Sherborn to develop and implement an analysis that identifies existing regulatory mechanisms available to the MS4 such as bylaws and ordinances and describes any changes to regulatory mechanisms that may be necessary to effectively implement the entire PCP (the "Legal Analysis"). This may include the creation or amendment of financial and regulatory authorities. The legal analysis for Sherborn has been developed and submitted with the Year 2 - Annual Report. Sherborn's Legal Analysis has been revised in March 2023, the revised version is attached as Appendix A.

1.5 FUNDING SOURCE ASSESSMENT

Appendix F of the MS4 Permit requires Sherborn to describe known and anticipated funding mechanisms (e.g., general funding, enterprise funding, stormwater utilities) that will be used to fund PCP implementation (the "Funding Source Assessment"). Sherborn must describe the steps it will take to implement its funding plan. This may include but is not limited to conceptual development, outreach to affected parties, and development of legal authorities. Sherborn's Funding Source Assessment is attached as Appendix B.

The cost estimate for the implementation of the Permit has been estimated at this time using the cost developed by other communities within the Charles River Watershed, Bellingham and

Franklin. Given the denser developments in these two towns, the costs have been scaled by the P-removal requirements, which corelate with the impervious cover.

A second estimate has been developed using cost data from a study for Burlington, VM which is based on cost analyses using the cost information from the Cape Cod Commission Technology Matrix. The costs varies between $7 MM and $45 MM and will be refined in the future as the stormwater plan is further developed and more cost data becomes available.

Potential funding sources were discussed in two workshops attended by nine departments and commissions represented by town employees and volunteers. The funding source identified include property taxes / general fund; grants and loans; and stormwater utility. Appendix B of this document includes the detailed Funding Source Assessment.

1.6 NON-STRUCTURAL CONTROLS

Sherborn's approach for non-structural BMP implementation for PCP compliance is detailed in this section.

1.6.1 Current Non-Structural BMPs

Sherborn has already implemented enhanced non-structural BMPs, which can qualify for phosphorus reduction credits. These are presented in Table 1-3. Credits were calculated using the updated phosphorus load export rates reported in Attachment 2 to Appendix F. These credits will count towards the required phosphorus reduction outlined in . Current non-structural BMPs are those that are anticipated to continue at current resource levels, or 'business as usual'. The information presented in Table 1-3 is further detailed in Appendix C and our Stormwater Management Plan (SWMP).

Table 1-3. Existing Non-Structural BMPs

Planned Non-Structural BMP	Implementation Levels	Average Annual P-Reduction (lbs/yr)
Street Sweeping	100%	1.22
CB Cleaning	100%	1.58
Leaf Litter Program	100%	6.08
Total Existing Non-Structural Credit		8.88

The existing non-structural controls have already contributed 8.88 lbs/yr to the annual phosphorus reduction requirement of 115 lbs/yr. Sherborn is planning on making the following changes to our non-structural controls starting in permit year 6:

> *Street Sweeping:* Current swiping frequency is twice per year (spring and fall). Starting in Year 6, Sherborn commits to implement an enhanced sweeping program of weekly sweeping from September 1st to December 1st to gather and remove all landscaping wastes, organic debris, and leaf litter from all impervious roadways and parking lots throughout the urbanized area.

CB Cleaning: This is performed semi-annually, and the schedule will be maintained, as the low sediment loads in Sherborn would not justify more frequent CB cleaning.

Leaf Litter Program: Starting with year 6, Sherborn commits to gather and remove all landscaping wastes, organic debris, and leaf litter from all impervious roadways and parking lots at least once per week during the period of September 1 to December 1 of each year.

Phosphorus reductions are presented in Table 1-4. Supporting calculations for the managed areas are included in Appendix C.

Table 1-4. Planned Non-Structural Control Summary

Planned Non-Structural BMP	Average Annual Acres Managed	Average Annual P-Reduction (lbs/yr)	Anticipated Implementation
Street Sweeping	78	2.74	Permit Year 6
CB Cleaning	50.5	1.58	Current
Leaf Litter Program	78	6.08	Current
Total Non-Structural Credit		10.4	Permit Year 6

The enhanced schedule of non-structural controls, will increase the non-structural P-removal from 8.88 lbs/yr to 10.4 lbs/yr.

1.7 STRUCTURAL CONTROLS

Sherborn will employ structural BMPs to detain, treat, and better manage runoff from well-defined areas of impervious surface, such as roads, parking lots, or rooftops. Structural BMPs historically have been incorporated into Sherborn via stormwater compliance projects (for public and private development projects), using various sources of grant funding, or as part of our capital infrastructure program. Structural BMPs that have already been implemented are evaluated in Section 1.7.1.

Semi-structural BMPs are more passive stormwater management approaches that can still produce excellent water quality benefits such as rainwater harvesting, impervious area disconnection, conversion of impervious area to pervious, and enhancement of pervious areas. For the purposes of this document, the term structural controls refers to both structural and semi-structural BMPs.

Our planning in support of PCP development determined that a significant investment in structural BMPs will be required to achieve the required target phosphorus reductions. Structural BMP opportunities were evaluated to allow for adaptive management during the development and execution of the PCP, that is presented below. The following sections describe the assessment, performance and implementation of Planned Structural BMPs and Proposed Structural BMPs (those that were newly identified for PCP compliance or will be implemented after this written PCP is submitted).

1.7.1 Current Structural BMPs

Sherborn already employs a mix of regulatory, incentive programs and capital improvement programs to implement structural BMPs. Constructed structural BMPs have resulted in phosphorus reductions outlined in Table 1-5 and further detailed in Appendix D. The reductions in 9 are presented on a high-level for summary, and all of the calculations were performed following the equations and requirements in Attachment 3 to Appendix F of the Permit.

Table 1-5. Summary of Current Structural Controls

Current Structural BMP Type	Number of BMPs	Total Acres Managed	Total Annual P-Reduction (lbs/yr)
DPW Infiltration Basin	1	4.88	2.18
Police St. Infiltration basin	1	2.20	1.27
Total Phosphorus Credit from Current Structural BMPs			3.45

The two existing structural BMPs identified within the regulated area have contributed to an annual P-load reduction of 3.45 lbs/yr. While original design details are not available, the two BMPs appear to function well, with no signs of clogging or malfunctioning. The P-reductions included in Table 1-7 assume that these BMPs have been designed to manage the first inch of runoff. P-load reductions have been calculated using the OptiTool software.

1.7.2 Planned Structural BMPs

Sherborn developed a priority ranking of areas and infrastructure within the municipality for potential implementation of structural phosphorus controls during Phase 1. This priority ranking was based mainly on accessibility to the proposed BMP site, land ownership or anticipated ease to access and purchase the land, the amount of impervious cover disconnected, and anticipated P-load removal.

Implementation of structural BMPs is dependent on physical constraints and opportunities. Much of the phosphorus in Sherborn is coming from the following land uses: Low Density Residential, Commercial, and Open Land.

Additionally, a high-level BMP suitability assessment was conducted using the Opti-Tool software to determine what structural BMPs could be implemented to mitigate phosphorus and to help to prioritize an implementation schedule.

The planned structural BMPs are included in Appendix D and are summarized in Table 1-6. It is noteworthy to mention that the OptiTool software, which is recommended for computing for the P-load reduction, only gives treatment credit for runoff generated by impervious surfaces within the drainage areas of BMPs. While the overall P-load for Sherborn assumed that both pervious and impervious surfaces generate P, the provided tools do not account for treatment of pervious surfaces. This is significant for Sherborn, where low-density residential and open space are some of the biggest percentages of the land uses in Town and assumed to be the main contributors of P in the overall P load allocated to Sherborn through the permit.

Table 1-6. Planned Structural Control Summary

Planned Structural BMP (Address, Coordinates) or Site with Locations for Structural BMPs (Address)	BMP Type	Anticipated Acres Managed (Total Impervious and Pervious Area)	Potential/Estimated Annual P-Reduction (lbs/yr)
Leland Drive	Infiltration Basin	3.12	3.41
Parks Drive	Infiltration Basin	0.49	0.71
Pilgrim Church	Wet Pond	4.59	2.56
Deerfield Road	Wet Pond	3.69	1.21
Ivy Lane	Wet Pond	2.70	1.09
Total potential / estimated P-load reduction			9.31

1.8 DESCRIPTION OF OPERATION AND MAINTENANCE (O&M) PROGRAM FOR ALL PLANNED AND EXISTING STRUCTURAL BMPS

The successful implementation of the Phosphorus Control Plan (PCP) for Sherborn, MA, not only includes an appropriate design followed by construction of Best Management Practices (BMPs) but also a robust Operations and Maintenance (O&M) plan. The Town's Operation and Maintenance Program is accessible on the Town's website. This plan was completed in 2019 and it includes both structural and Non-structural BMPs and will be updated if other types of BMPs are implemented within the Town's limits. The Department of Public Works is responsible for O&M of all BMPs.

The implementation of the PCP anticipates an increase in BMPs over time, and this growth necessitates a corresponding increase in maintenance efforts. Guided by maintenance requirement guidelines from watershed planning tools, Sherborn will provide sufficient resources are available to meet a potential expanding BMP portfolio. Sherborn is committed to maintaining a high standard of BMP performance and will establish a clear and consistent communication protocol to convey maintenance guidance to responsible parties.

In accordance with the requirements outlined in the MS4 Permit Part 2.3.7.a. iii, Sherborn is committed to conducting annual inspections of all permittee-owned stormwater treatment structures. These inspections will be carried out to assess BMP conditions and identify any maintenance needs.

1.9 PHASE 1 IMPLEMENTATION SCHEDULE

Sherborn has implemented non-structural BMPs, which provide a P-reduction of approximately 10.4 lbs/yr of phosphorus, or 9.0% of the target phosphorus reduction. Sherborn recognizes that this number may change with future updates to the MS4 Permit.

Sherborn has prepared a preliminary implementation schedule for structural BMPs of the Phase 1 of the PCP as follows:

- Year 6: Introduce the BMP options to the Town and receive additional feedback and design consideration. The Town will also reassess options based on a future updated MS4 Permit.
- Year 7: Seek out funding support (see Section 1.9.1) and begin preliminary design of potential BMP options.
- Year 8: Continue design work, receive all necessary permits, and put all project work out to bid.
- Year 9 and 10: Implement BMPs.

By Year 10, structural and semi-structural BMPs are anticipated to provide a P-reduction of approximately 23.16lbs/yr of phosphorus in Phase 1 of the PCP, or 20.14% of the target phosphorus reduction using the mechanisms described above. The implementation schedule in Appendix F further details a possible implementation schedule for the BMP. This is 5.34 lbs/yr or 4.64% short from meeting the 25%-year target of 28.75 lbs/yr. It is noted however that further discussions and potential Permit updates will address Sherborn's concerns regarding Phosphorus loads and credits for open space areas and reach the required targets.

1.9.1 Funding Sources

Sherborn has identified the following potential funding sources for structural BMP options:

1. Massachusetts Clean Water Trust (MCWT) - Stormwater Management Program: MCWT offers financial assistance for stormwater management projects through low-interest loans, grants, and technical assistance.

2. Massachusetts Department of Environmental Protection (MassDEP) - 319 Nonpoint Source Competitive Grants: This program provides funding for projects that address nonpoint source pollution, including stormwater runoff.

3. Massachusetts Executive Office of Energy and Environmental Affairs (EEA) - Coastal Pollutant Remediation (CPR) Grant Program: This grant supports projects that reduce nonpoint source pollution to coastal waters, including stormwater management.

4. Massachusetts Department of Transportation (MassDOT) - Complete Streets Funding Program: While not exclusively for stormwater, this program funds infrastructure improvements that enhance pedestrian and bicycle safety, which could include stormwater management features.

1.10 ESTIMATED COST FOR IMPLEMENTING PHASE 1 OF THE PCP

Sherborn developed an estimated cost to implement the non-structural measures and the potential structural measures of the Phase 1 PCP, which is included in Appendix F. Using the unit cost estimates derived from the Calculation Support Worksheet and the identified BMPs and their phosphorus removal targets in the planning spreadsheet, a rough cost estimate for PCP implementation was developed for both non-structural and structural measures. To enhance the accuracy of the cost estimate, Sherborn used the OptiTool in addition to data specific to the municipality can also provide valuable insights into costs. This total cost amounted to $875,886

and includes a 30% contingency. Further breakdown of the cost by potential BMP option can be found in Appendix F.

This is a preliminary estimate based on the provided OptiTool, so construction costs, including labor, materials, equipment rental, and police detail, will vary significantly across communities and projects. The Town feels that there is not enough information for both the calculations and reductions using the OptiTool at this point in time and anticipates that the estimates are grossly understated for the region, and the constraints that will need to be dealt with in construction and permitting.

Currently, the non-structural efforts within the regulated area are costing the town about $50,000 per year. The break down is:

- Sweeping: $15,000
- Catch-basin Cleaning: $20,000
- Leaf Litter: $15,000

The cost of these programs will continue to change over time as the size of the programs change to reflect the phosphorous removal needs of the Town. For structural measures, it is important to note that further feasibility assessment (e.g., impacts to forested area) will be necessary to ensure Sherborn proceeds with alternatives that minimize environmental impacts.

Appendix A – Legal Analysis

Town of Sherborn - Phosphorus Control Plan Legal Analysis

1.0 Background

The Town of Sherborn is a Charles River Watershed community and as such, is subject to the Massachusetts Department of Environmental Protection's (MassDEP) 2007 *Final TMDL for Nutrients in the Upper Middle Charles River Basin.* It is additionally subject to specific phosphorus reduction requirements in the 2016 General Permit for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems in Massachusetts (the MS4 Permit) detailed in Permit Appendix F, Part A.I. To address phosphorus reduction requirements, the Town must develop a Phosphorus Control Plan (PCP) in three (3) distinct phases, each with multiple milestones and deadlines. The focus of this memorandum is on the initiation of Phase I of the PCP plan which is to be completed by the Town in Permit years 1 through 5 (July 1, 2018 – June 30, 2023). This memorandum satisfies the first requirement of the PCP, the "Legal Analysis" and provides guidance and recommendations for subsequent requirements.

2.0 Legal Analysis

The first element of the PCP, the legal analysis (**Item 1-1**), is required two (2) years after the Permit effective date or by June 30, 2020. The requirement is as follows:

> ***Legal Analysis: A.I.1.a.3 MS4 Permit***
> *'Legal analysis identifies existing regulatory mechanisms available to the MS4 such as by-laws and ordinances, and gaps (changes to regulatory mechanisms) that may be necessary to implement PCP. Adoption of necessary regulatory changes is required prior to the end of the permit term.'*

2.1 Applicable Regulatory Mechanisms

The Town has several different documents, regulations, ordinances, guidance documents, and permits that relate to the proper management of stormwater in the Town. To understand current requirements, the following documents were reviewed:

- *Zoning By-Laws of the Town of Sherborn, revised 2021*
- *Sherborn General By-Laws Chapter 25 – Comprehensive Stormwater management By-Law, added 2011, Amended 2019*
- *General By-Laws of the Town of Sherborn, revised 2021*
- *Rules and regulations of the Sherborn Planning Board, amended February 2011*
- *Sherborn General By-Laws Chapter 17– General Wetlands By-Law, added 1981.*

To adequately understand if the current regulatory mechanisms are sufficient, the Town will need to outline specific actions to be implemented to meet phosphorus reduction requirements. The Permit set a specific phosphorus reduction target for the Town and included potential best management practices (BMPs) for which phosphorus reduction credits would be obtained upon implementation.

Note that the legal analysis must address all aspects of "the entire" PCP implementation, which extends through additional phases over a period of 20 years. Realistically, this analysis can only address the likely approach undertaken by the Town in this initial phase. Phase 2 (beginning 5 – 10 years after the permit's effective date) includes an obligation to update the legal analysis given then-current conditions and programs.

2.2 Potential PCP Components

The Permit describes structural and non-structural BMPs, implementation of which will qualify for phosphorus credits. (**Attachments 2 and 3 to Appendix F**). It is important that these BMPs are not legally restricted. Potential BMPs that the Town may select and the current relevant action that the Town is taking, the local regulations that allow for the BMP, and an assessment of the adequacy of the enabling regulations are included in **Table 1**.

Table 1 – Potential Best Management Practices

Potential Best management Practices for the Town's Phosphorus Control Plan	**Applicable Action or Regulation**	
Non-Structural BMPs		
Enhanced Sweeping program: *Increasing the sweeping frequency*	Town is already mechanically sweeping twice per year.	Current mechanism sufficient to allow enhancement if selected.
Catch Basin cleaning: *Increasing the frequency of catch basin cleaning when necessary to ensure that no CB is ever more than 50% full*	Town is developing a cleaning optimization program.	
Organic Waste and Leaf Litter Collection program: *Removing all landscaping wastes, organic debris, and leaf litter*	Town offers free weekly pick-up of yard waste in the spring and fall.	
Structural BMPs		
Infiltration Trench/Basin	Sherborn Planning Board Regulations for Site Plan Review, Stormwater drainage designs	Current mechanism sufficient to allow enhancement if selected.
Bioretention Areas and Rain Gardens		
Extended Dry Detention Basins		
Proprietary Media Filters		
Sand and Organic Filters		
Wet basins		
Dry wells		
Semi-Structural / Non-Structural BMPs		
Reduction of impervious area	Section 4.4.1 of the Sherborn Planning Board Regulations and Sherborn Zoning Bylaws	Current mechanism sufficient to allow enhancement if selected.
Impervious area disconnection through storage		
Impervious area disconnection		
Conversion of impervious area to Permeable Pavement		
Soil amendments to enhance permeability of pervious areas		

As summarized in the **Table 1**, many of these BMPs are already included in the Town's management of stormwater and their infrastructure. The Town operates a robust street cleaning program that includes mechanically sweeping each street in the Town twice per year, in the spring and fall. The Town developed and is actively working to implement a catch basin cleaning optimization program to meet the Permit requirements that none are ever over 50% full. The Town is currently working on implementing an enhanced sweeping program, that will include weekly mechanical sweeping of all streets and parking lots within the urbanized area from September 1st to December 1st, starting with year 6 of the Permit. In addition, some structural BMPs are already in use throughout the Town, both inside and outside the regulated area.

The *Zoning By-Laws of the Town of Sherborn,* and the *Sherborn General By-Laws,* regulates the Stormwater Control Permittee, and the Land Disturbance Permittee. The Sherborn By-Laws require compliance with The Massachusetts Stormwater Handbook, includes performance standards for all the possible structural BMPs and for the use of rain barrels/cisterns included in Section 1. Furthermore, the Zoning By-Laws include requirements and specific restrictions for Green Areas and Permeable Open Space. The regulations also include accommodations to include and promote green infrastructure features such as curb cuts, reduced roadway widths, green roofs, and permeable pavement areas.

The Permit allows the Town to receive credit for phosphorus reduction performed by third parties that install stormwater BMPs, such as private property owners and non-MS4 permit holders. The continued operation and maintenance of these BMPs is imperative to successful phosphorus reduction. Permittees under the Town's Stormwater Management Permit that are developing or redeveloping more than 1 acre of land must submit a Stormwater Report as required by the Massachusetts Stormwater Handbook. As part of the Report, the permittee must sign the Owner's Certification that includes accepting responsibility for maintenance of the BMPs, in the event of transfer of ownership, informing prospective new owners and filing a new O&M plan, funding the O&M activities, and understanding that Town DPW staff is authorized to conduct inspections and determine regulatory compliance.

At this time, the Town's regulations do not inhibit the implementation of any of the BMPs included in Massachusetts Stormwater Handbook. The Permit does require that this legal analysis be updated as part of Phase II of the PCP if necessary.

4.0 Next Steps

Based on the types of potential BMPs and the Town's current procedures, the Town does not require additional legal support for their PCP at this time. It is possible that enhancing regulations such as the Zoning Ordinance could promote new/redevelopment and increase the use of the structural BMPs and ultimately yield additional phosphorus reduction credits for the Town. Additionally, the Town plans to continue funding their stormwater management program through their current budgeting practices and extend this funding to cover the PCP.

Due to the size of Sherborn, many BMPs would likely be necessary to meet the Permit prescribed

phosphorus reductions. Creating and maintaining a way to manage and track these BMPs will be critical to a successful program. The Town has been maintaining a geodatabase program of existing drainage systems, outfalls, and existing BMPs in PeopleGIS and this will be used in the future for mapping and tracking new BMP types and locations.

As discussed, Appendix F of the MS4 Permit specifies a detailed, sequential list of items for the Town's development of their PCP. This memorandum meets the requirements for items, 1-1, the legal analysis assessment.

Appendix B – Funding Source Assessment

Funding Source Assessment for the Town of Sherborn

1 Introduction

Two workshop meetings were held to discuss Sherborn's initial approach to the Charles River TMDL requirements[1] with the ultimate goal of determining a financial source to reduce Sherborn's Phosphorus pollution contributions from stormwater. Nine departments and commissions were represented by town employees and volunteers. The first meeting (July 20th, 2021) focused on the technical and regulatory aspects of the Phosphorus Control Plan (PCP), while the second meeting (August 9th 2021) focused on the estimated cost of the program and identifying a financial source. The following memo is a summary of the conclusions from those meetings and serves to document Sherborn's progress on the PCP.

2 Technical Approach

Sherborn is currently in the Phase 1 planning stage of the PCP and is required to create a plan by September 2022 to reduce P by 25% of the requirement in the following 5 years (the Phase 1 implementation stage). The Phase 1 PCP requires a description of the non-structural and structural controls along with an implementation plan and a cost estimate. This technical approach description is developed to show progress towards the year 5 requirements and to provide a basis towards evaluating the cost of the program.

2.1 Baseline Phosphorus Loads and Existing Structural BMPs

The Community Annual load is distributed over a total paved acreage of approximately 156 acres, not including driveways. As shown in **Table 1** below, if Sherborn were to enact Phosphorus (P) reduction throughout the entire community area within the Charles River watershed, the P reduction required would be 18%, or 156 kg/year. Within the urbanized area, the paved area is approximately 79 acres. If Sherborn chose P reduction through just this area, it would require P reduction of 26% or 52 kg/year. The currently preferred alternative is to enact reduction only over the MS4 area, because it is a smaller load and a smaller, more manageable area.

[1] United States Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) General Permits for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems in Massachusetts- Appendix F.A.I.(Charles River Watershed Phosphorus TMDL Requirements). Modified December 7, 2020- Effective January 6, 2021.

Table 1: Required Annual Phosphorus Load Reduction

Treatment Area	Baseline Watershed Phosphorus Annual Load, kg/yr (lbs/yr)	Stormwater Phosphorus Load Reduction Requirement, kg/yr (lbs/yr)	Allowable Phosphorus Load, kg/yr (lbs/yr)	Stormwater Percent Reduction in Phosphorus Load (%)
Community Area	846 (1,865)	156 (344)	690 (1,521)	18
Urbanized (Regulated) Area	203 (447)	52 (115)	151 (333)	26

In addition to non-structural controls (eg. street sweeping, catch basin cleaning, leaf litter control/collection, and urban fertilizer reduction), the Town can receive credits for P removal achieved by existing BMPs such as vegetated swales, retention and detention systems, bioretention areas constructed on both public and private properties within the Charles River watershed inside the Town boundaries. While the existing BMPs are not currently all mapped/tracked, this process will take place within the following years and credit will be applied towards the 20% P reduction required by year 8 of the Permit. The credits will be computed per Appendix F - Attachment 3 guidelines.

2.2 Proposed Structural BMP controls

A comprehensive list of structural BMPs that can be used for P control are included in the *BMP Convention Crosswalk* as developed by the University of New Hampshire Stormwater Center (UNHSWC) and published by EPA, found here: https://www3.epa.gov/region1/npdes/stormwater/tools/bmp-crosswalk.pdf. While this list is not comprehensive, it includes the naming conventions for common BMPs as included in the NH and MA stormwater manuals.

Typical P removal efficiencies for these common BMPs can be developed using the *Stormwater Control Measures Nomographs with Pollutant Removal and Design Cost Estimates* developed by the UNHSWC in 2018 and published by EPA: https://www3.epa.gov/region1/npdes/stormwater/tools/ms4-permit-nomographs.pdf.

In addition to these common BMPs, more advanced BMPs have been developed to increase P removal efficiencies and decrease costs per pound of P removed. These more advanced technologies are design variations of typical bioretention systems that use soil amendments to fixate and remove P with higher efficiencies. More details on these designs are included in the Technologies Matrix developed by the Cape Cod Commission at the following link: https://www.capecodcommission.org/our-work/technologies-matrix/. We propose that these types of BMPs should be utilized wherever possible; especially for treatment of P hotspots such as agricultural or commercial areas.

2.3 Cost Estimate

The cost of implementation will mostly depend on the proposed types of structural BMPs and on the amount of credits that will be allocated to existing BMPs. At this early stage, cost estimates are based on PCP cost estimates developed for other towns within the Charles River watershed. It is noteworthy that other municipalities have much denser urban centers and higher impervious cover percentages, while Sherborn has more farmland and less dense residential developments. However, these cost estimates were scaled by the Phosphorus removal requirements that are generally correlated with impervious cover.

Table 2 below includes the scaled cost estimates for the Sherborn PCP, based on the available studies for Bellingham and Franklin, both located within the Charles River Watershed. The 2017 estimate is the most current and most closely considers the P requirements that are in effect today.

Table 2: Sherborn P Reduction Cost estimate based on other estimates of municipalities within the Charles River watershed

Town	Community Reduction Required	2009 Low Estimate[1]	2009 High Estimate[1]	2011 Estimate[2]	2017 Estimate[3]
Bellingham	398 kg/yr	$10 MM	$17 MM	$61 MM	-
Franklin	1012 kg/yr	$36 MM	$54 MM	$140 MM	$47 MM
Sherborn equivalent	156 kg/yr	$ 4-6 MM	$7-8 MM	$22-24 MM	**$7 MM**

[1] TetraTech (2009). Optimal Stormwater Management Plan Alternatives: A Demonstration Project in Three Upper Charles River Communities, Final Report. Prepared for United States Environmental Protection Agency and Massachusetts Department of Environmental Protection.

[2] Horsely Witten Group. (2011). Sustainable Stormwater Funding Evaluation for the Upper Charles River Communities of Bellingham, Franklin, and Milford, MA September 30, 2011. Prepared for United States Environmental Protection Agency.

[3] Wood Group. 2017. Upper Charles River Regional Stormwater Finance Phase II Feasibility Study. Prepared for United States Environmental Protection Agency.

Table 3 includes cost estimates according to a recent study performed by AECOM for Burlington, VT. This study included cost estimates for P removal program by small residential stormwater retrofits and other planned structural large scale BMPs for volume control. Other systems have been included in this study; however, those were not applicable to Sherborn so only estimates for Green Infrastructure technology were applied here.

Table 3 - Cost estimate based on the Burlington, VT estimate

Town	Community Reduction Required	GI only Estimate
Burlington (only GI technologies)	137 kg/yr	$16.2 MM
Sherborn equivalent	156 kg/yr	$18.5 MM

Table 4 includes cost estimates based on cost information and removal rates per the Cape Cod Commission Technology Matrix. The cost per kg of P removed was developed using capital costs and O&M cost per life cycle of 20 years. No costs were included for future replacement/upgrades.

Table 4 - Cost estimate based on Cape Cod Commission Technology Matrix Costs

	Cost/kg P removed / year ($)	Cost/kg P removed / 20 years ($)
Swales	$6,720	$134,400
Bioretention	$17,946	$358,920
Gravel wetland	$63,320	$1,266,400
Assume 30% swales + 70% bioretention systems	**$14,578**	**$291,564**
156 kg for Sherborn	$2,274,199	$45,483,984

The wide range of cost estimates between $7 MM and $45 MM is based on different assumptions and cost data specifically formulated for other towns and settings. This range is being provided for information on available cost data at the time of this report. The costs will be refined in the future as more information on the existing BMPs is collected and a more detailed P control strategy is developed for Sherborn.

2.4 Next steps

In order to refine the cost estimate, the following steps will be taken:

- Identify all existing stormwater BMPs on public and private properties throughout the Town and assign credits per permit allowances
- Identify hot spots in the stormwater system with the highest P removal potential in Town
- Select a range of best technologies for Sherborn and compute how many acres of development/impervious area need to be treated to reach the P reduction goal

- Develop a cost estimate for Sherborn based on selected technologies and available cost literature

3 Funding Source Assessment

One of the Phase 1 PCP requirements is a funding source assessment. The Massachusetts MS4 General Permit defines this requirement as follows:

> *"The permittee shall describe known and anticipated funding mechanisms (e.g. general funding, enterprise funding, stormwater utilities) that will be used to fund PCP implementation. The permittee shall describe the steps it will take to implement its funding plan. This may include but is not limited to conceptual development, outreach to affected parties, and development of legal authorities." (MS4 General Permit Appendix F, Section A.I.1.a.3)*

This section provides a summary of the initial funding source assessment that was conducted by the Town of Sherborn.

3.1 Current Funding

The Town of Sherborn's stormwater management program is funded through property taxes paid into the Town's General Fund. To date, this funding source has been sufficient to implement the Town's stormwater management program and comply with MS4 permit requirements.

3.2 Potential Future Funding Sources

While the Town's current practice of funding its stormwater management program through the General Fund is sufficient, future increased costs associated with implementation of the Town's PCP are anticipated to trigger the need for additional funding sources. Understanding this potential need, the Town included a funding source assessment module in a virtual PCP workshop that was conducted August 9, 2021 to provide an opportunity for Town employees and other stakeholders to discuss other funding options.

During this workshop, three primary funding options were discussed:

- Property taxes / General Fund
- Grants and loans
- Stormwater utility

Since workshop participants were familiar with the first two options, the majority of discussion focused on stormwater utilities. Stormwater utilities have been developed and implemented by many communities across the country (including several in Massachusetts) to equitably allocate the cost of stormwater management by a user fee based on:

- The cost of services provided, and

- The amount of stormwater runoff from each land parcel in the stormwater management service area.

In addition, a stormwater utility can provide a dedicated long-term funding mechanism necessary to meet the existing and future obligations related to the collection, treatment, storage, and conveyance of stormwater. Massachusetts General Law Chapter 83, Section 16 and Chapter 40, Section 1A authorize municipalities to create stormwater utilities, to set up an authority to manage stormwater, and to charge utility fees for managing stormwater. So, establishing a stormwater utility may be a viable option for the Town.

During the workshop, several questions about what a stormwater utility would look like for the Town and how it would be implemented were raised, including how agricultural lands would be accounted for since they contribute to phosphorus loading but typically have limited impervious cover. It was acknowledged that development and implementation of a stormwater utility would require detailed analysis to develop a fee structure as well as a thorough public planning process. The purpose of introducing the subject at the workshop was to initiate discussions and gauge the interest and need in further exploring this potential new funding source.

3.3 Next Steps

This initial funding source assessment will be revisited following development of the estimated cost for implementing Phase 1 of the PCP to determine if sufficient funding will be available to complete Phase 1. Since it is anticipated that additional funding will be required based on preliminary cost estimates, the Town will continue discussions regarding development of a stormwater utility and investigate initial questions that were raised during and following the August 2021 PCP workshop.

Appendix C – Supporting Calculations for Non-Structural Controls

Non-Structural BMPs for Phosphorous Reduction (Updated January 2023)

Sherborn, MA

AECOM Technical Services

Iulia Barbu, P.E.

_____

March 2023

1 Introduction

This memo summarizes types of non-structural phosphorous (P) reduction BMPs that could be implemented as part of the Phosphorus Control Plan (PCP) for the Town of Sherborn as included in the Massachusetts Small MS4 Permit. This memo also includes calculations of the potential P-reduction credits from non-structural BMPs for impervious surfaces in Sherborn. The regulated MS4 area and Town area within the Charles River Watershed (referred to as 'Charles River Watershed' hereafter) are options for the jurisdictional area of the PCP (referred to as 'PCP Area' hereafter). These findings are from previously developed tools, materials, procedures, and examples that estimate potential phosphorous load reduction. Parameters listed in the Permit Guidelines (Appendix F- Attachment 2, entitled 'Phosphorus Reduction Credits for Selected Enhanced Non-Structural BMPs in the Watershed') were used to determine loading and reduction rates for each land use as mapped in the land use layer developed by Massachusetts Division of Environmental Protection.

According to the current Permit as amended in 2020, the required annual phosphorous load reduction has been increased to the amounts in **Table 1**. Both options for spatial extent of the Phosphorus program are shown in the below.

Table 1: Required Phosphorous Load Reduction

PCP Area	Baseline Stormwater Phosphorus Load in kg/yr (lbs/yr)	Stormwater Phosphorus Load Reduction Requirement in kg/yr (lbs/yr)	Allowable Phosphorus Load in kg/yr (lbs/yr)	Stormwater Required Percent Reduction in Phosphorus Load
Charles River Watershed	846 (1,865)	156 (344)	690 (1,521)	18%
Regulated MS4 Area	203 (447)	52 (115)	151 (333)	26%

Roadways and parking lots that are managed by the Town of Sherborn were calculated as paved areas in each of the two spatial extent options as the PCP area. There are 156 acres of paved roadways within the Charles River Watershed. Phosphorus reduction target through the Charles River Watershed is 18%. Within the smaller regulated MS4 area, the paved area is 78 acres. Targeting this area would require P-reduction of 26%.

There are both cons and pros to selecting each of the extents as the PCP area. It would be less costly for the Town to complete the P-reduction only within the more concentrated MS4 regulated area but would be more equitable to implement the PCP across the Charles River Watershed area in Town. The watershed area is adjacent to the Charles River and the Farm Pond and any program to improve water quality would include land adjacent to those waterbodies. Applying Phosphorus Controls to a broader area allows more options for BMPs in an area with very little public land, but the load of P to remove would be greater than for the regulated MS4 area alone.

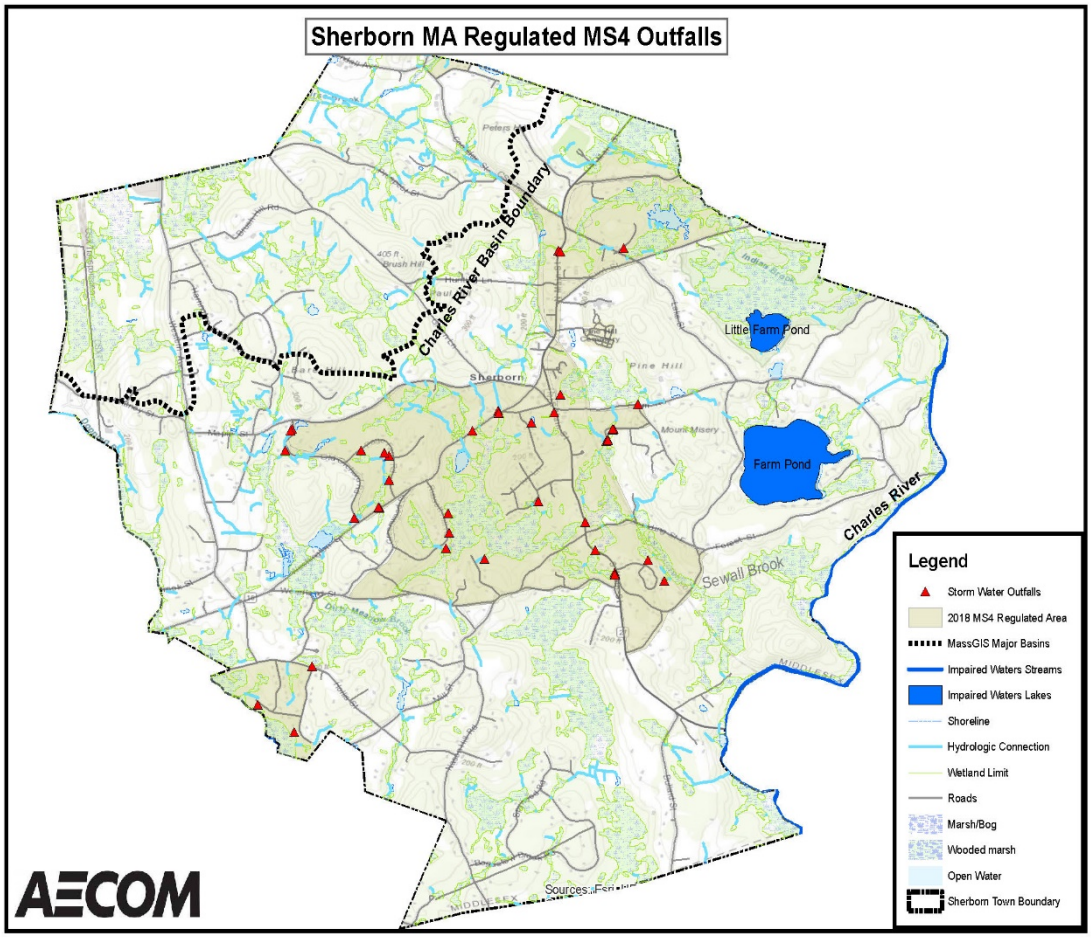

Figure 1. Charles River Watershed and the MS4 Regulated Area

If the Town were to apply the non-structural control measures for all of the town owned and managed paved areas, non-structural measures alone would not provide sufficient phosphorous reduction levels required to comply with permit regulations in **Table 1**. Thus structural BMPs will need to be implemented in private lands throughout the chosen extent to reach compliance. Potential structural BMPs have been identified and are included in Appendix D of the Phosphorus Control Plan (PCP) Report.

2 Non-Structural Control Measures for Stormwater Management

Non-structural BMPs focus on preserving and utilizing existing natural features and systems already available to the Town in order to manage current stormwater resources and prevent pollution. Non-structural BMPs analyzed for use in Sherborn are detailed in the following sections. It is important to note that the non-structural controls described below limit not only phosphorous, but also nitrogen, TSS, and bacteria loading, although this summary will be focusing solely on P-reduction.

A summary of non-structural control measures and their potential phosphorous load reductions are displayed in Table 2. Phosphorous reduction is based on a paved acreage of 156 acres for the entire community and 78 acres for the MS4 regulated area, with a weighted land use coefficient of 1.56 (lb/acre/yr)[1] for the urban area and 1.54 (lb/acre/yr)[1] for the entire community. A map of the Town's roadway extent and other information used for these calculations is included in Figure 2.

Table 2: Summary of Non-Structural BMPs for Phosphorous Removal

Non-Structural BMP	Regulated MS4 Area Phosphorous Load Reduction (lb/yr)	Community Wide Area Phosphorous Load Reduction (lb/yr)
Street sweeping	2.74	5.40
Catch Basin Cleaning	1.58	3.11
Leaf Litter Control and Collection	6.08	12.01
Total P-Reduction	**10.40**	**20.52**

2.1 Street sweeping

Sherborn may earn a phosphorus reduction credit for conducting an enhanced sweeping program of impervious surfaces. Table 2-1 below outlines the default phosphorus removal factors for enhanced sweeping programs. The credit shall be calculated by using the following equation:

Credit P sweeping = IA swept x PLER IC-land use x PRF sweeping x AF

Where:

Credit sweeping =	Amount of phosphorus load removed by enhanced sweeping program (lb/year)
IA swept =	Area of impervious surface that is swept under the enhanced sweeping program (acres)
PLER IC-land use =	Phosphorus Load Export Rate for impervious cover and specified land use (lb/acre/yr)
PRF sweeping =	Phosphorus Reduction Factor for sweeping based on sweeper type and frequency (see Table 2-1)

[1] MA MS4 Permit, Attachment 3 of Appendix F of MA EPA MS4 General Permit Guidelines. Table 3-1: Average annual distinct phosphorus (P) load export rates for use in estimating P load reduction credits

AF sweeping = Annual Frequency of sweeping. For example, if sweeping does not occur in December, January, and February, the AF would be 9 out of 12 months = 0.75. For year-round sweeping, AF=1.00.

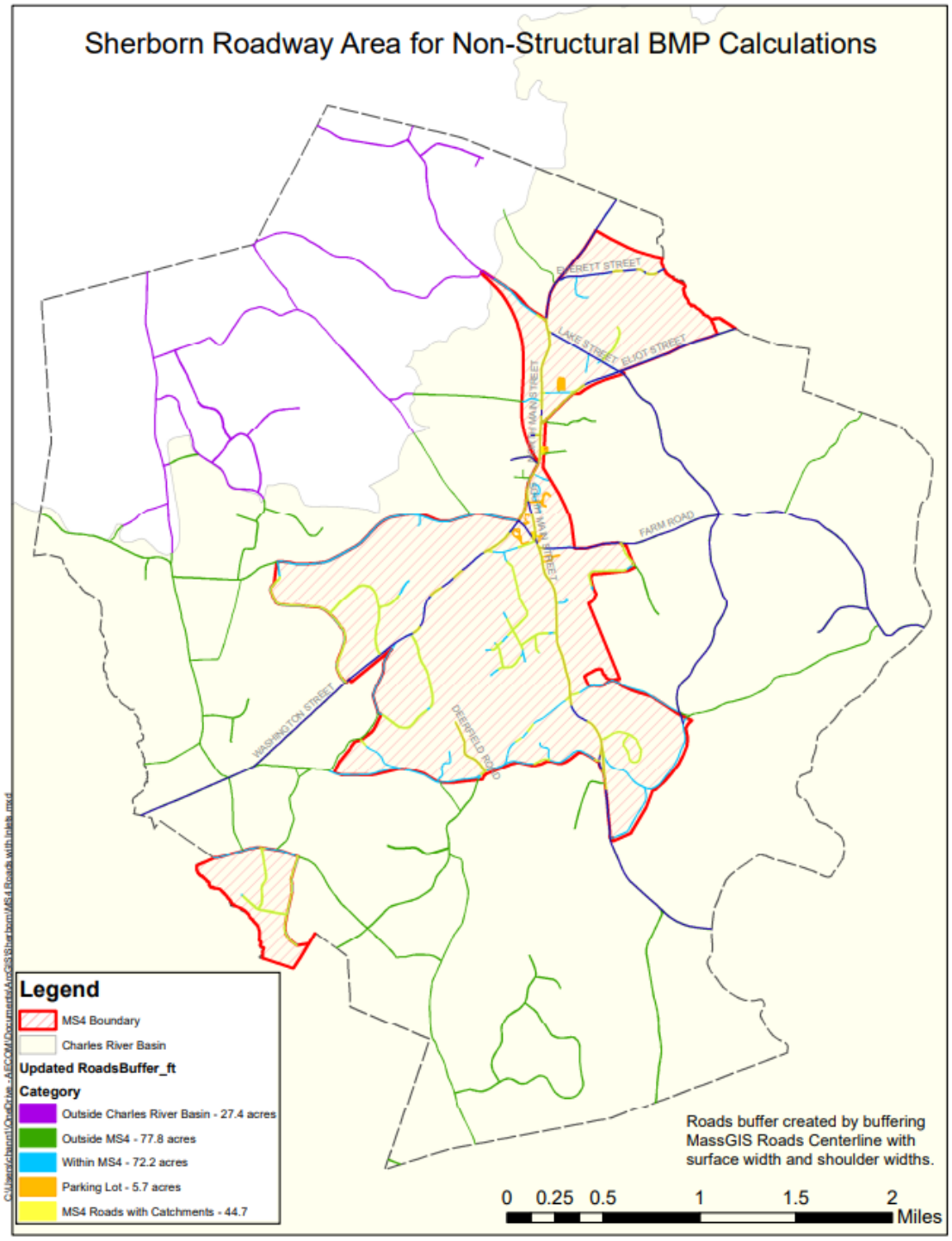

Figure 2 – Roadways and Parking lot areas owned by the Town of Sherborn that were used to calculate the Non-Structural BMP credits

Calculation based on a street sweeping frequency of two times a year for MS4 area and for the Charles River Watershed area:

Credit sweeping (lb/yr) = IA swept x PLER IC-land use x PRF sweeping x AF
Credit sweeping (lb/yr) = 78 acres x 1.56 x.01 x 1
Credit sweeping **MS4 Area** (lb/yr) = **1.22 lb/yr**

Credit sweeping (lb/yr) = IA swept x PLER IC-land use x PRF sweeping x AF
Credit sweeping (lb/yr) = 156 acres x 1.54 x.01 x 1
Credit sweeping **Charles River Watershed Area** (lb/yr) = **2.40 lb/yr**

In addition, beginning with permit year 6, Sherborn commits to implement an enhanced sweeping program of weekly sweeping from September 1st to December 1st to gather and remove all landscaping wastes, organic debris, and leaf litter from all impervious roadways and parking lots throughout the regulated MS4 area. Additional sweeping credits for the enhanced sweeping program is as below:

Credit sweeping (lb/yr) = IA swept x PLER IC-land use x PRF sweeping x AF
Credit sweeping (lb/yr) = 78 acres x 1.56 x.05 x 0.25
Credit sweeping **MS4 Area** (lb/yr) = **1.52 lb/yr**

Credit sweeping (lb/yr) = IA swept x PLER IC-land use x PRF sweeping x AF
Credit sweeping (lb/yr) = 156 acres x 1.54 x.05 x 0.25
Credit sweeping **Charles River Watershed Area** (lb/yr) = **3.00 lb/yr**

Table 2-1: Phosphorous Reduction Efficiency Factors (PRF sweeping) for Sweeping Impervious Areas

Frequency[1]	Sweeper Technology	$PRF_{sweeping}$
2/year (spring and fall)[2]	Mechanical Broom	0.01
2/year (spring and fall)[2]	Vacuum Assisted	0.02
2/year (spring and fall)[2]	High-Efficiency Regenerative Air-Vacuum	0.02
Monthly	Mechanical Broom	0.03
Monthly	Vacuum Assisted	0.04
Monthly	High Efficiency Regenerative Air-Vacuum	0.08
Weekly	Mechanical Broom	0.05
Weekly	Vacuum Assisted	0.08
Weekly	High Efficiency Regenerative Air-Vacuum	0.10

2.2 Catch Basin Cleaning

The permittee may earn phosphorus reduction credits by removing accumulated materials from catch basins (i.e., catch basin cleaning) in the PCP area. The catch basins would have to be maintained so that

the minimum sump storage capacity is 50% throughout the year. The credit shall be calculated by using the following equation:

Credit CB = IACB x PLE IC-land use x PRFCB

Where:

Credit CB =	Amount of phosphorus load removed by catch basin cleaning (lb/year)
IA CB =	Impervious drainage area to catch basins (acres)
PLE IC-land use =	Phosphorus Load Export Rate for impervious cover and specified land use (lb/acre/yr)
PRF CB =	Phosphorus Reduction Factor for catch basin cleaning (see Table 2-2)

Table 2-2: Phosphorus reduction efficiency factor (PRF CB) for semi-annual catch basin cleaning

Frequency	Practice	PRF
Semi-annual	Catch Basin Cleaning	0.02

The area of pavement being treated with catch basins within the regulated MS4 area is 50.5 acres, representing a 64.75% of the total 78 acres of pavement owned or managed by the Town. While the catch basin mapping for the entire community is not finalized, a 64.75% coverage is assumed at this time.

Credit Catch Basin Cleaning (lbs/yr) = IACB x PLE IC-land use x PRFCB
Credit Catch Basin Cleaning (lbs/yr) = 78 acres x 1.56 (lb/acre/yr) x (0.02) *0.6475
Credit Catch Basin **Cleaning MS4 Area** (lbs/yr) = **1.58 (lb/yr)**

Credit Catch Basin Cleaning (lbs/yr) = IACB x PLE IC-land use x PRFCB
Credit Catch Basin Cleaning (lbs/yr) = 156 acres x 1.54 (lb/acre/yr) x (0.02) *0.6475
Credit Catch Basin Cleaning **Charles River Watershed Area** (lbs/yr) = **3.11 (lb/yr)**

2.3 Leaf Litter Control and Collection Program

Leaf litter control has been proven to be an effective practice in reducing nutrient loading in stormwater and receiving waters, reducing phosphorous contributions in drainage systems up to 80%. These measures have been proven to be most effective in the fall, particularly before rainfall events. The practice of leaf litter control will go hand in hand with street cleaning. It is recommended the Town implement a leaf litter control program on it's roadways and potentially offer collection of yard waste to residents.

According to the Permit, "Town's can receive phosphorous reduction credit by performing regular gathering, removal, and disposal of landscaping wastes, organic debris, and leaf litter from impervious surfaces from which runoff discharges to the TMDL waterbody of its tributaries. In order to earn this credit, the permittee must gather and remove all landscaping wastes, organic debris, and leaf litter from

all impervious roadways and parking lots at least once per week during the period of September 1 to December 1 of each year. The gathering and removal shall occur immediately following any landscaping activities in the Watershed and at additional times when necessary to achieve a weekly cleaning frequency. The permittee must ensure that the disposal of these materials will not contribute pollutants to any surface water discharges. The permittee may use an enhanced sweeping program (e.g., weekly frequency) as part of earning this credit provided that the sweeping is effective at removing leaf litter and organic materials. "

The credit for leaf litter removal shall be determined by the following equation:

Credit leaf litter = (Watershed Area) x (PLE IC-land use) x (0.05)

Where:

Credit leaf litter =	Amount of phosphorus load reduction credit for organic waste and leaf litter collection program (lb/year)
Watershed Area =	All impervious area (acre) from which runoff discharges to the TMDL waterbody or its tributaries in the Watershed
PLE IC-land use =	Phosphorus Load Export Rate for impervious cover and specified land use (lbs/acre/yr)
0.05 Coefficient =	5% phosphorus reduction factor for organic waste and leaf litter collection program in the Watershed "

Credit leaf litter = (Watershed Area) x (PLE IC-land use) x (0.05)
Credit leaf litter (lb/yr) = 78 acres x 1.56 (lb/acre/yr) x (0.05)
Credit leaf litter **MS4 Area** (lb/yr) = **6.08 (lb/yr)**

Credit leaf litter = (Watershed Area) x (PLE IC-land use) x (0.05)
Credit leaf litter (lb/yr) = 156 acres x 1.54 (lb/acre/yr) x (0.05)
Credit leaf litter **Charles River Watershed Area** (lb/yr) = **12.01 (lb/yr)**

2.4 Urban Fertilizer Reduction

Another non-structural BMP that was considered in the 2014 Draft of the MA MS4 Permit was phosphorus reduction through urban fertilizer reduction. Phosphorus removal credit is given based on the total area of turf grass for which fertilizers containing phosphorus are no longer used (these must be areas where phosphorus-containing fertilizers were applied in the past). Massachusetts has introduced restricting regulations for the non-agricultural use of fertilizers containing phosphorus, nitrogen or potassium.

The credit for the not using fertilizer with phosphorus has not been included in the 2016 Permit or 2020 revision. However, EPA has indicated that this credit may be re-introduced in future permit releases. If this credit is implemented, Sherborn would receive a credit of 13.3 lbs of P-reduction according to the calculated weighted export rates and fertilizer credits from the 2014 Permit draft.

3 Structural Control Measures for Stormwater Management

Based on the results of the non-structural BMP calculations above, Sherborn will not meet the Charles River Watershed P-reduction goals with non-structural measures alone. Full implementation of non-structural BMPs, evaluated according to currently allowed credits, would only yield 10.40 lbs/year of P-reduction if implemented in the MS4 regulated area alone, and 20.52 lbs/year if implemented throughout the community wide area. For comparison, the P-reduction target for Year 8 of the permit is 23 lbs/year for the MS4 area and 68.8 for the community wide area. Similarly, the target for Year 10 of the permit is 28.75 lbs/year for the MS4 regulated area and 86.0 lbs/year for the community wide area. Thus, Sherborn will need to implement structural BMPs to achieve the P-reduction goals imposed by the permit. An investigation of structural BMPs within Town-owned properties is included in Appendix D of the PCP Report.

4 Sherborn Recommendations

It is recommended that Sherborn considers implementation of all non-structural BMPs discussed in this memorandum.

As part of the PCP process, Sherborn should identify locations where structural BMPs could be installed on Town-owned property and evaluate P-reductions at these locations. If Town-owned structural BMPs do not achieve the P-reduction level of control, the next step would be to partner with local businesses and property owners to install structural BMPs to meet P-reduction goals.

Appendix D – Supporting Calculations for Structural Controls

Analysis of Five Potential BMPs and Two Existing BMPs in Sherborn

Town of Sherborn, Massachusetts

December 2022

Prepared by:

AECOM

Analysis of Five Potential Structural BMPs in Sherborn for the Removal of Phosphorus and Other Pollutants

AECOM, on behalf of the Town of Sherborn, has chosen and evaluated five locations for stormwater Best Management Practices (BMPs) to improve the quality of stormwater discharge with the primary objective to remove phosphorus. This technical memorandum fulfills the MS4 Permit requirement to evaluate potential BMPs to remove phosphorus as part of the Phase I Phosphorus Control Plan. These BMPs would contribute to meeting required phosphorus load reductions along with non-structural BMPs. This report, in combination with the 'Analysis of Existing BMPs,' fulfills Section 2.3.6.d of the permit that requires Sherborn to "*identify a minimum of 5 permittee-owned properties that could potentially be modified or retrofitted with BMPs designed to reduce the frequency, volume, and pollutant loads of stormwater discharges to and from its MS4 through the reduction of impervious area.*"

The AECOM team performed an initial desktop investigation of town-owned land, followed by a field visit and additional desktop investigations to evaluate other potential locations. Five properties were identified to be further evaluated for implementation and were ranked based on a preliminary feasibility analysis. Two of the candidate sites are on town-owned land, two sites are on private property and one parcel is owned by the Rural Land Foundation. These potential locations are preliminary and are subject to further feasibility investigation before advancing to design and implementation.

The Opti-Tool spreadsheet-based optimization tool was used to select the most optimal stormwater BMPs in terms of cost and pollutant removal efficiencies. Opti-Tool is a spreadsheet-based optimization tool designed to assist in preparing technically sound and cost-effective watershed SW management plans to achieve needed pollutant and volume reductions more affordably from developed landscapes throughout the New England Region. Using Opti-Tool, the BMPs are sized to manage the 1-inch rainfall depth and have been optimized for the storage capacity of each BMP. Infiltration basins are considered the best for BMPs for phosphorous removal and are proposed at locations where hydrological soil type allows (HSG - A and B)[1]. Otherwise, wet ponds which are considered the second-best option for phosphorus removal are recommended at locations where outfalls with large catchments are intercepted. Bioretention systems were initially considered but have not been presented here due to the high volume of flow from outfalls with large catchments which can cause scouring of the amended soils placed in these BMPs.

Each of the BMPs are described below. Tables with planning level estimates of phosphorus load removal, capacity, and cost are also included. Figures for each of the BMPs are included at the end of this document. Figures include preliminary locations of BMPs, catchments to

[1] Hydrological Soil Groups are classified based on the transmission rate of water through the soil. HSG-A is the most transmissive and HSG-D is the least transmissive.

each BMP, stormwater infrastructure, town-owned land, and MassDEP's estimated wetlands layer.

Potential BMP Descriptions

1. **Leland Drive** (See **Figure 1**) - The catchment (in yellow) for this potential BMP starts along Abbey Road and Village Way and continues southeast through a depression between Leland Drive and Village Way. The potential BMP (in blue) is just upgradient from a mapped wetland area and allows approximately 60 feet of buffer. The hydrologic soil group for the proposed location is HSG - A, making this location feasible for a BMP that uses infiltration. The proposed BMP is also located in a town-owned parcel, making it a top candidate for retrofitting. Although it should have a net positive impact on wetland resources, its potential proximity to wetlands will trigger Massachusetts Wetlands Protection Act permitting with the Sherborn Conservation Commission. The wetlands layers represented on the map are MassDEP's wetland layers as interpreted by aerial photography. On site delineation by a wetland scientist will determine proximity to wetlands.

2. **Parks Drive** (See **Figure 2**) – This location was selected as a potential retrofit due to the relative ease of intercepting an existing outfall discharging on a town-owned parcel. The BMP would accept drainage from a catchment with flows from Parks Drive. Detailed site investigations may find that the pervious catchment area extends further than what is mapped and may lead to more load reduction than what is estimated below. The hydrologic soil type at the location of the proposed BMP is HSG - B, with medium potential for infiltration. The BMP type selected for this location is an infiltration basin. Potential wetland permitting with the Sherborn Conservation Commission may be anticipated pending a delineation and further design.

3. **Pilgrim Church/Dunkin' Donuts** (See **Figure 3**)- This location was identified as a candidate due to the relative ease of intercepting an outfall discharging runoff collected from South Main Street, Sanger Street, and local business parking lots. This proposed BMP location is just upstream of an existing wetland that currently receives untreated runoff from this outfall. Although this location is not on town-owned land, the size of the drainage area and the high potential for phosphorus removal makes this location a good candidate for installation of a BMP. It may also help intercept flow from the gas station property at Sherborn Fuel. The hydrologic soil type at this location is HSG - C with low potential for infiltration, and would propose a wet pond as a best practice for this retrofit. Because of site constraints, wetland permitting with the Sherborn Conservation Commission should be anticipated.

4. **Deerfield Road** (See **Figure 4**)- This location has an outfall discharging runoff collected along Deerfield Road and part of Woodland Street. This proposed BMP location is just upgradient of an existing wetland that currently receives untreated runoff from this outfall. Although this location is not on town-owned land, there is a longitudinal easement from Deerfield Road to the wetlands that could be used for stormwater treatment. The hydrologic soil type at the location of the BMP is HSG - C with low potential for infiltration. A wet pond is proposed as a best practice at this location. Wetland permitting with the Sherborn Conservation Commission is likely here, although there is a possibility the design may be shifted outside of the 100-ft buffer zone based on a delineation of the wetlands resources on site including a potential small stream north of the site.

5. **Ivy Lane** (See **Figure 5**)- This location was selected as a potential retrofit site due to the relative ease of intercepting an existing outfall pipe discharging just upstream of an apparently impaired pond (covered with algae). The catchment collects runoff from the mapped portion of Ivy Lane and the hillside to the east. This parcel is not town-owned, but it is owned by the Rural Land Foundation and may not be developed for any other purposes in the future. The hydrologic soil group at the location of the proposed BMP is HSG - C/D, with low potential for infiltration. The BMP type selected for this location is a wet pond.

An initial analysis has been performed for the five BMPs using the Planning Level Analysis option in the Opti-Tool (Version 2) software. **Table 1** below includes a summary of the Opti-Tool results for the proposed five structural BMPs. The estimated load reduction of all five BMPs represents 8% of the current total phosphorus load reduction requirement for the entire 20-year program (115 lbs/yr[2]), and 40.5% of the required reduction in the near term (23 lbs/yr[2] due by July 1, 2026).

Table 1- OptiTool results showing planning level estimates of storage capacity and phosphorus load removal.

BMP Location	BMP Type	Storage Capacity (gal)	Initial P Load from catchment (lbs/yr)	P Load reduction (%)	P Load removed (lbs/year)
Leland Road	Infiltration Basin	55,123	3.69	92.4%	3.41
Parks Drive	Infiltration Basin	13,306	0.75	95.0%	0.71
Pilgrim Church	Wet Pond	76,304	5.16	49.7%	2.56
Deerfield Road	Wet Pond	39,645	2.69	45.2%	1.21
Ivy Lane	Wet Pond	36,658	2.32	47.0%	1.09
Total		**221,036**	**14.95**	**-**	**9.31**

[2] These reduction requirements will likely increase when the total development from the point when the loads were determined in 2005 to current times are accounted for.

NOTE: Design and cost information are preliminary and subject to change.

Table 2 below provides cost estimates for each BMP. Preliminary cost estimates are planning level costs and do not take into account all of the site-specific cost elements of a potential future project, such as land purchase or contamination mitigation. The Opti-Tool Opinion of Cost is in 2016 dollars. This cost is based on several data sources integrated in the Opti-Tool software. Costs can differ among different geographical locations, depending upon labor and material expenses and the constraints of a particular site.

The Opti-Tool costs were updated from ENR June 2016 (provided by Opti-tool) which was 10,337 and ENR November 2022, which was 13,175. The costs from November 2022 were then escalated to the assumed mid-point of construction using the ENR CCI indexes (end of 2025), using a 5% inflation rate, and costs were added to include 30% construction contingency and Contractor Profits of 22% (not already included in the Opti-Tool costs).

Table 2- Opti-Tool Opinion of Total Project Cost of the BMPs

BMP Location	BMP Type	OptiTool Opinion of BMP Cost 2016	BMP Total Project Cost at Mid-point of Construction 2025
Leland Road	Infiltration Basin	$92,000	$180,000 - $230,000
Deerfield Road	Wet Pond	$72,000	$145,000 - $185,000
Parks Drive	Infiltration Basin	$22,000	$40,000 - $60,000
Ivy Lane	Wet Pond	$67,000	$125,000 - $175,000
Pilgrim Church	Wet Pond	$139,000	$295,000 - $335,000

The costs are presented as estimated total project costs which include the following components and contingencies:

- Opinion of probable construction costs - The costs are planning-level estimates of materials, equipment, and labor (Included in Opti-tool cost estimate).
- Estimated total project cost - Opinion of probable construction cost plus allowances for engineering, Owner's contingency, and SRF loan administrative costs.
- Estimate contingency (30%) - Includes construction related items (i.e., piping, electrical conduits, etc.) not yet defined and modifications that would be further defined and quantified between the planning level and completion of bid documents (this was not included in the Opti-Tool estimate).
- Engineering and owner contingency (35%) - Engineering design and construction-related services plus an overall project contingency for items that are unforeseen (included in Opti-tool cost estimate).
- Contractor Profit 22% (this was not included in the Opti-Tool estimate).

The costs do not include the following activities and processes:

- Land Acquisition
- Easements/ROW
- Legal and Permitting
- Operations and Maintenance

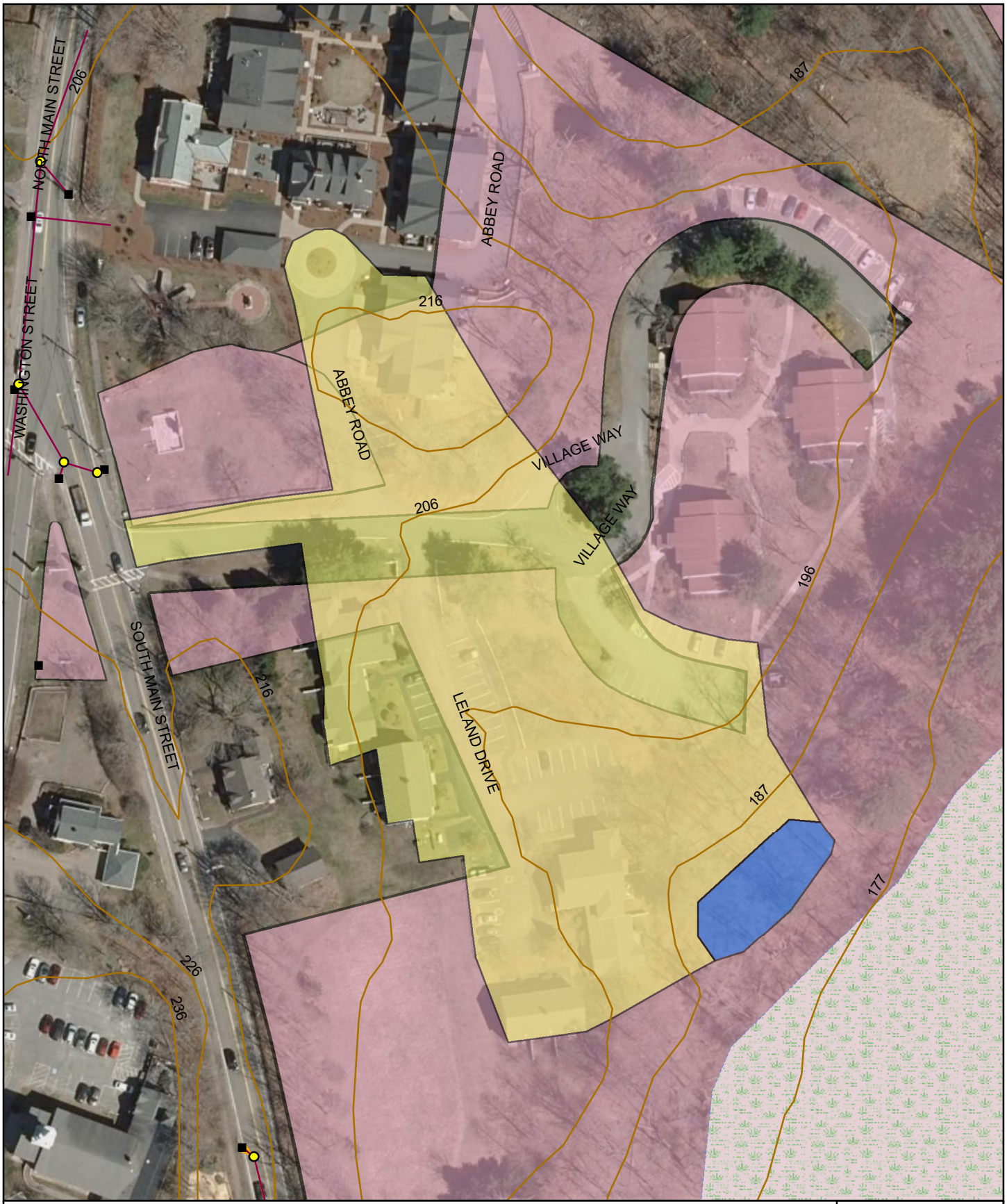

Figure 1 - Potential BMP Near Leland Drive, Sherborn

Legend

- BMP Footprint
- BMP Catchment
- Town Owned Land
- Marsh/Bog
- Wooded marsh
- Flow direction
- Manholes
- Inlets
- 10 FT Contours
- Gravity Drains

N

0 30 60 120 Feet

AECOM

Overview Map

Date: 9/27/2022

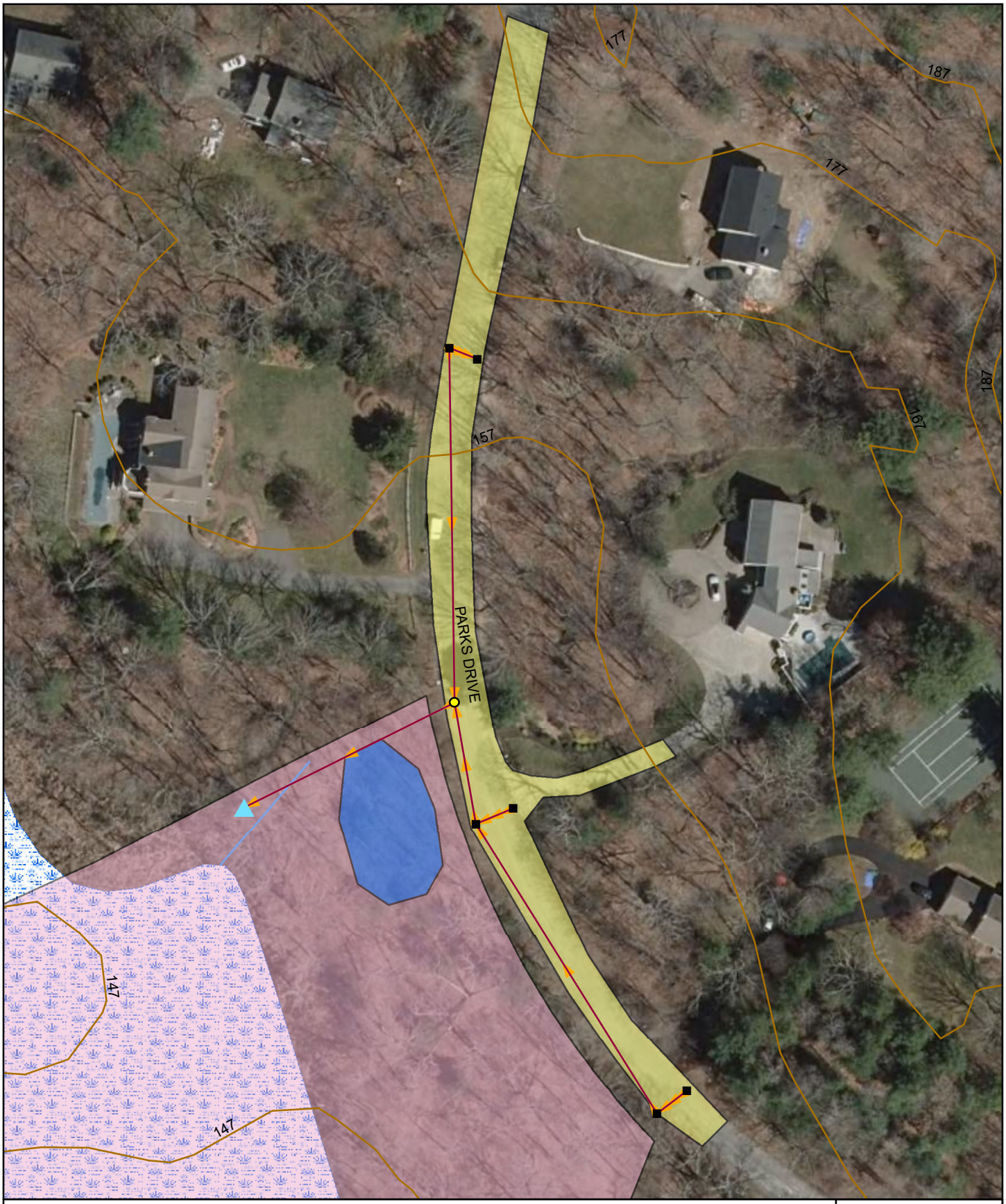

Figure 2 -Potential BMP Near Parks Drive, Sherborn

Legend

- BMP Footprint
- BMP Catchment
- Town Owned Land
- Marsh/Bog
- Flow direction
- Discharge Points
- Manholes
- Inlets
- Gravity Drains
- 10 FT Contours

N

0 25 50 100 Feet

AECOM

Overview Map

Date: 9/27/2022

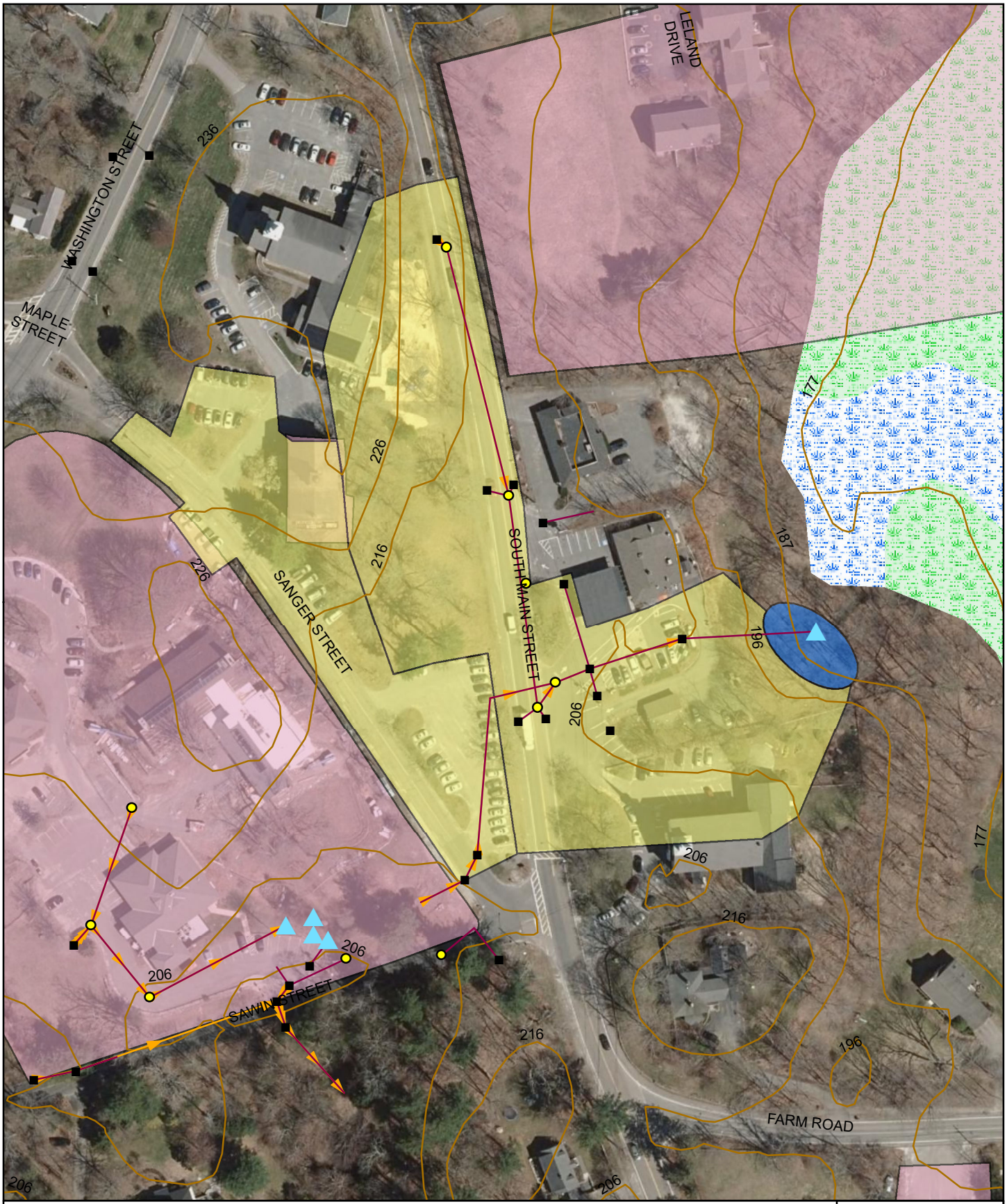

Figure 3 - Potential BMP Near South Main St, Sherborn

Legend

- BMP Footprint
- BMP Catchment
- Town Owned Land
- Marsh/Bog
- Wooded marsh
- Flow direction
- Discharge Points
- Manholes
- Inlets
- Gravity Drains
- 10 FT Contours

N

0 37.5 75 150 Feet

AECOM

Overview Map

Date: 9/27/2022

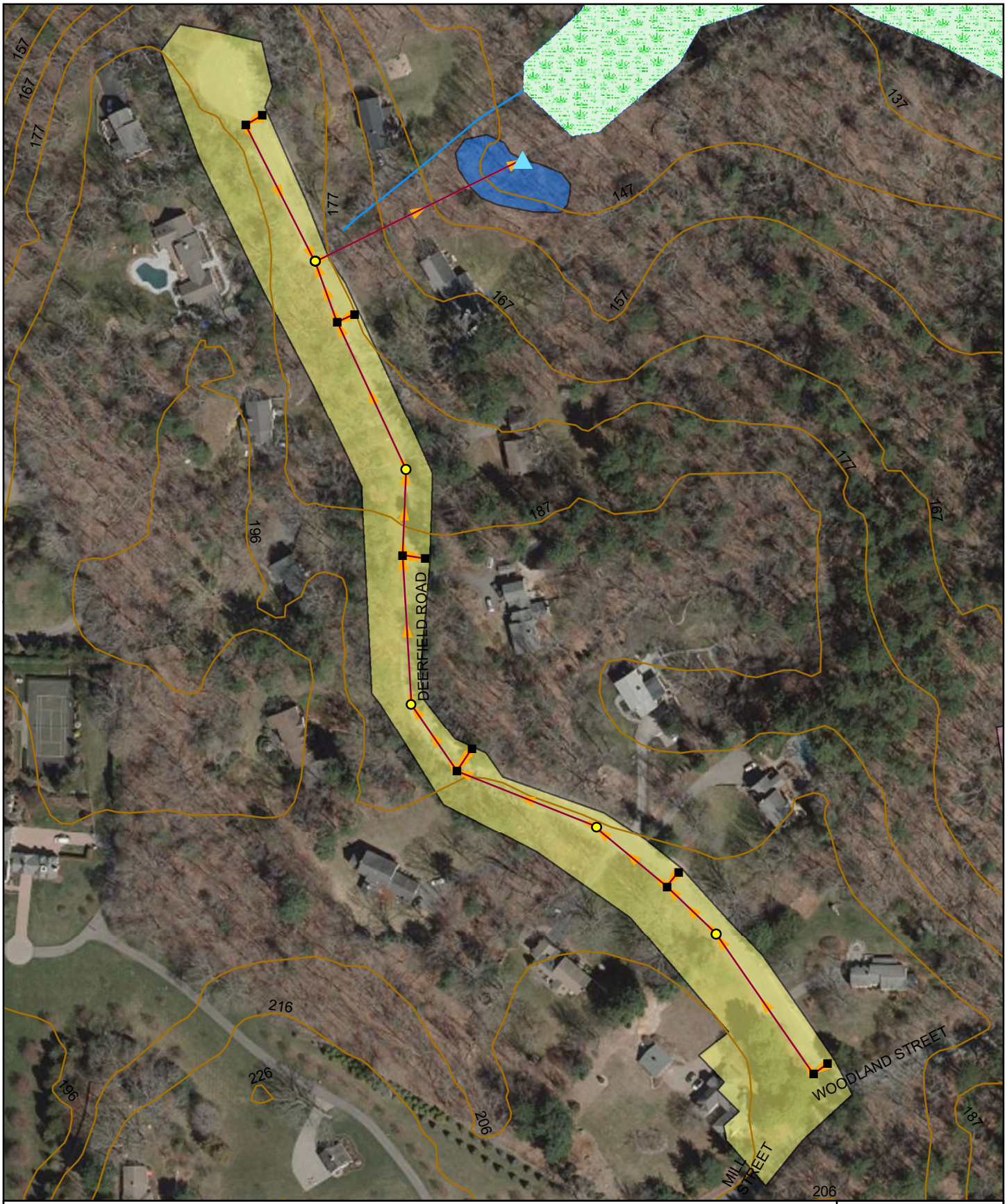

Figure 4 - Potential BMP Near Deerfield Rd, Sherborn

Legend

- BMP Footprint
- BMP Catchment
- Flow direction
- Town Owned Land
- Wooded marsh
- 10 FT Contours
- Discharge Points
- Manholes
- Inlets
- Gravity Drains

N

0 50 100 200 Feet

AECOM

Overview Map

Date: 9/27/2022

Figure 5 - Potential BMP Near Ivy Lane, Sherborn

Legend

- BMP Footprint
- BMP Catchment
- Town Owned Land
- 10 FT Contours
- Wooded marsh
- Open Water
- Flow direction
- Discharge Points
- Manholes
- Inlets
- Gravity Drains

N

0 30 60 120 Feet

AECOM

Overview Map

Date: 9/27/2022

December 2022

Analysis of Existing Town Owned BMPs Within Sherborn's MS4 Area

AECOM has identified two existing BMPs installed on town-owned property. They are mapped in the figures on the following pages. Yellow areas represent catchments and magenta areas represent the existing BMPs. The piping and topography is also represented.

1. **An infiltration basin located behind the Department of Public Works building.** This BMP is located on town-owned land, in a high infiltrating soil (HSG A). Runoff is discharged to the BMP either through outfalls from the DPW site, or by surface sheet flow from the adjacent residential area as depicted in **Figure 1**. There is a proprietary Stormceptor® oil-grit separator BMP that pre-treats runoff to this basin. The facility is managed by a Stormwater Pollution Prevention Plan (SWPPP) including standard operating procedures and regular inspections.

2. **An infiltration basin located near the Police Station building.** This BMP is located on town-managed land, in a medium infiltrating soil (HSG B/C). This BMP has been reconstructed within the last few years and is performing as designed. Runoff is discharged through several outfalls as well as surface sheet flow as shown in **Figure 2**.

While the exact design parameters and sizing are not known at this time, the two BMPs appear to function well. There are no signs of clogging or malfunction. Analysis was performed for these two BMPs using the Opti-Tool software. It was assumed that these BMPs are designed to manage the first inch of rainfall and using an infiltration rate of 1.02 inch/hr for the DPW (HSG A) and 0.27 inch/hr for the BMP located at the Police Station (HSG B/C). Pollutant loads from the respective land uses and removal loads by the BMPs are included in the table below (assuming the BMPs were sized for the 1-inch rainfall over the catchment area):

Table 1. Pollutant reduction from existing structural BMPs in Sherborn.

BMP Location	BMP Type	Storage Capacity (gal)	Initial P Load (lbs/yr)	Total P Load reduction (%)	P Load removed (lbs/year)
DPW	Infiltration Basin	63,269	4.30	50.6%	2.18
Police Station	Infiltration Basin	31,771	2.38	53.3%	1.27
Total		**95,040**	**6.68**	**-**	**3.45**

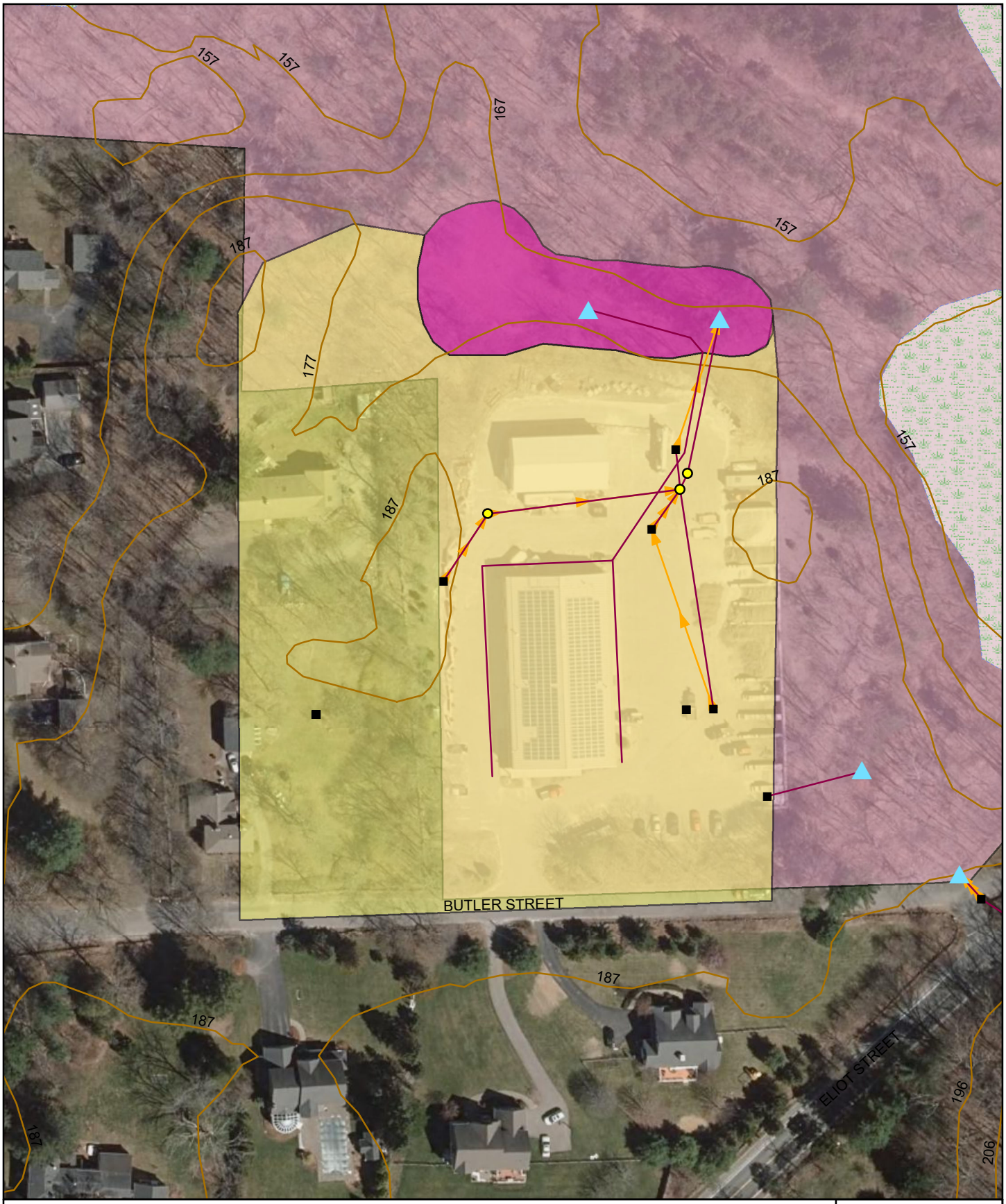

Figure 1 - Existing BMP at Sherborn DPW

Legend

- Existing BMP
- BMP Catchment
- Flow direction
- Town Owned Land
- Wooded marsh
- 10 FT Contours
- Discharge Points
- Manholes
- Inlets
- Gravity Drains

N

0 30 60 120 Feet

AECOM

Overview Map

Date: 9/27/2022

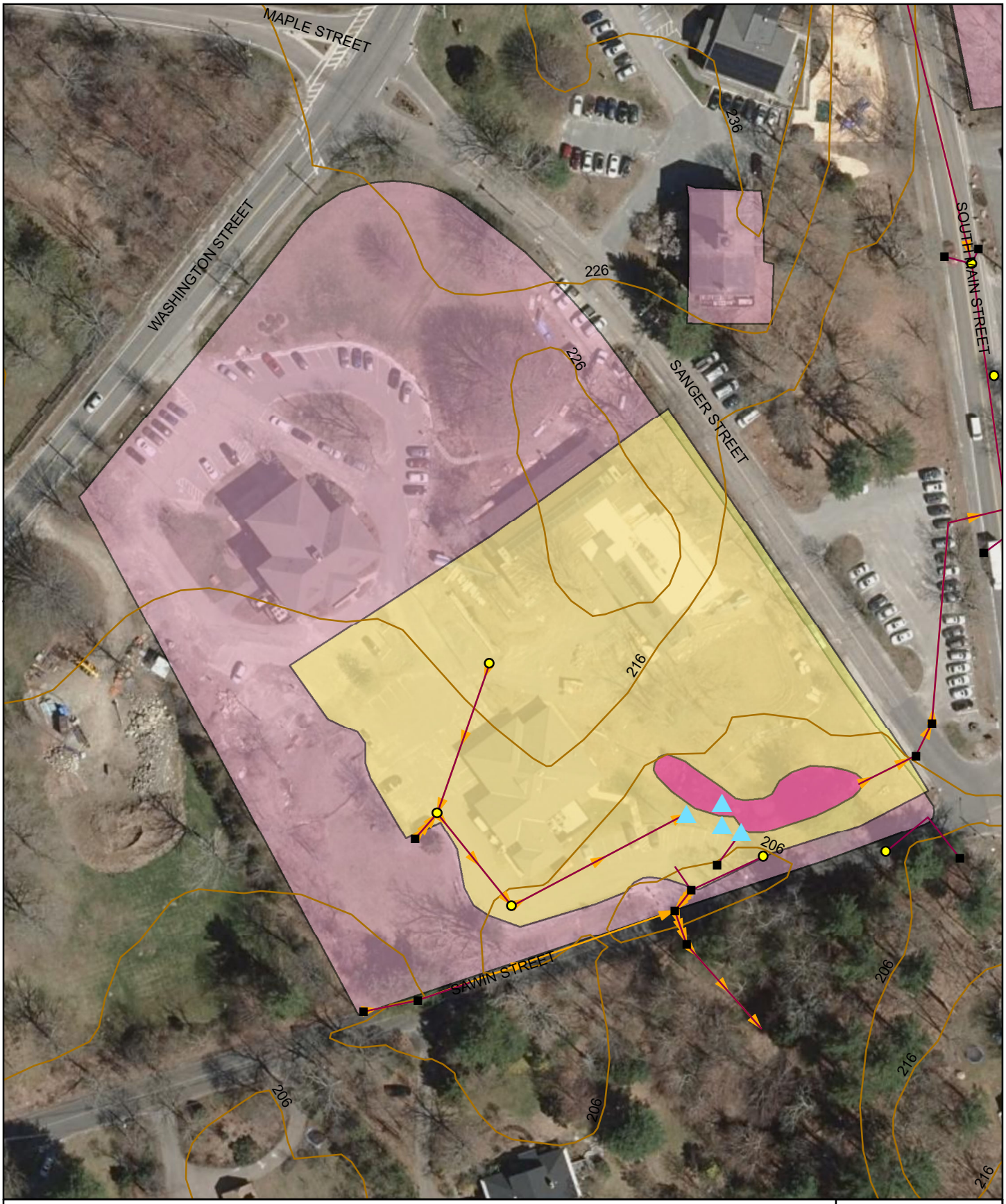

Figure 2 - Existing BMP at Sherborn Police Department

Legend

- BMP Catchment
- Town Owned Land
- Existing BMP
- Manholes
- Inlets
- Flow Direction
- Discharge Points
- 10 FT Contours
- Gravity Drains

N

0 30 60 120 Feet

AECOM

Overview Map

Date: 9/27/2022

Appendix E – Operations and Maintenance Program

The Operation and Maintenance program for the Town of Sherborn is available at:

https://www.sherbornma.org/sites/g/files/vyhlif1201/f/uploads/attach_d_om_sherborn_infrastructure.pdf.

Appendix F – Priority Ranking of BMPs and Implementation Planning

Proposed BMPs (In Order of Priority):

BMP Location	BMP Type	Storage Capacity (gal)	Total BMP Cost ($)
Leland Road	Infiltration Basin	55,123	91,964
Deerfield Road	Wet Pond	39,645	72,077
Parks Drive	Infiltration Basin	13,306	22,198
Ivy Lane	Wet Pond	36,658	66,647
Pilgrim Church	Wet Pond	76,304	138,724
Total		221,036	391,610

Existing BMPs:

BMP Location	BMP Type	Storage Capacity (gal)	Total BMP Cost ($)
DPW	Infiltration Basin	63,269	105,555
Police Station	Infiltration Basin	31,771	53,004
Total		95,040	158,559

Proposed BMPs:

BMP Location	BMP Type	OptiTool Opinion of BMP Cost ($) 2016	OptiTool Opinion of BMP Cost ($) => 2023 per CCI
Leland Road	Infiltration Basin	91,964	117,213
Deerfield Road	Wet Pond	72,077	91,866
Parks Drive	Infiltration Basin	22,198	28,292
Ivy Lane	Wet Pond	66,647	84,945
Pilgrim Church	Wet Pond	138,724	176,810
Total		391,610	499,126

ENR June 2016 *	10337
ENR Nov 2023*	13175
Increase (%)	27.45

*Based on CCI index

Escalation to mid-point of construction		Per year	Compound Rate
Assumed at:	Nov, 2022	5.00%	12.99%
Start date	6/1/2023		
End date	6/1/2028		
Mid-point	12/1/25		
Years to Mid-point	2.50		

Costs were developed with the below included:

- Opinion of Probable Construction Cost (Opti-tool)
- Engineering and contingencies during design at 35%
- Contingency of 30% during construction
- Profit 22%

The costs do not include:

- Land Acquisition
- Contractor Overhead and Profit at 22%
- Easments/ROW
- Legal and permitting