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Year 6 Massachusetts Small Municipal Separate Storm System Permit – Updates to Oxford's Lake Phosphorus Control Plan

Nitsch Engineering

Submitted to the Town of Oxford
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Nitsch #14845

Table of Contents

1 Introduction 6
2 Overview of LPCP Milestones 7
3 Community Characterization and Lake/Pond Watershed Description 9
3.1 Buffumville Lake 14
3.2 Hudson Pond 16
3.3 Lowes Pond 17
3.4 McKinstry Pond 19
3.5 Robinson Pond 21
3.6 Texas Pond 23
4 LPCP Load Reduction Targets 25
4.1 LPCP Areas 25
4.2 Baseline Phosphorus Load, Allowable Phosphorus Load, and Stormwater Phosphorus Reduction Requirement 25
5 Non-Structural Controls 28
5.1 Current Non-Structural BMPs 28
5.2 Planned Non-Structural BMPs 29
6 Structural Controls 31
6.1 Current Structural BMPs 31
6.2 Planned Structural BMPs 31
6.3 High Priority Structural BMPs 34
6.4 Road Assessment & Pavement Management Plan 41
7 Operation and Maintenance (O&M) Program 43
8 LPCP Implementation Schedule 44
8.1 Buffumville Lake 44
8.2 Lowes Pond 45
8.3 McKinstry Pond 46
8.4 Robinson Pond 47
8.5 Texas Pond 48
9 Estimated Cost for LPCP Implementation & Funding Source Assessment 49
10 Performance Evaluation 50
10.1 Year 6 Updates (2023-2024) 50
11 Conclusion and Recommendations 51

Appendix A – Calculation & GIS Methods

Appendix B – Lake Phosphorus Control Planning Memo

Appendix C – Phosphorus Loading Calculation Spreadsheets

Appendix D – Phosphorus Loading Maps

Appendix E – Street Sweeping Log

Appendix F – Non-Structural BMP Calculations

Appendix G – BMP Assessment Methodology

Appendix H – BMP Assessment Results

Appendix I – Phosphorus Control BMP sites & maps

Appendix J – Roadway BMP Calculations

Appendix K – O&M Program Updates

Appendix L – LPCP Implementation Schedule

Appendix M – Installed Projects

Appendix N – Estimated Cost for LPCP Implementation

List of Tables

Table 1. General LPCP Implementation Timeline for Lake and Pond Communities 6
Table 2. LPCP Component Deadlines 7
Table 3. Lake/Pond Phosphorus Reduction Requirements 9
Table 4. LPCP Reduction Requirements for Buffumville Lake 26
Table 5. LPCP Reduction Requirements for Lowes Pond 26
Table 6. LPCP Reduction Requirements for McKinstry Pond 26
Table 7. LPCP Reduction Requirements for Robinson Pond 27
Table 8. LPCP Reduction Requirements for Texas Pond 27
Table 9. Planned Non-Structural Control Summary for Buffumville Lake 30
Table 10. Planned Non-Structural Control Summary for Lowes Pond 30
Table 11. Planned Non-Structural Control Summary for McKinstry Pond 30
Table 12. Planned Non-Structural Control Summary for Robinson Pond 30
Table 13. Planned Non-Structural Control Summary for Texas Pond 30
Table 14. Summary of potential Phosphorus removal along Town-owned roadways within each LPCP watershed 41
Table 15. LPCP Implementation Schedule for Buffumville Lake. 44
Table 16. LPCP Implementation Schedule for Lowes Pond. 45
Table 17. LPCP Implementation Schedule for McKinstry Pond. 46
Table 18. LPCP Implementation Schedule for Robinson Pond. 47
Table 19. LPCP Implementation Schedule for Texas Pond. 48

List of Figures

Figure 1. Town of Oxford's lakes and ponds subject to a TMDL 11
Figure 2. MS4-Regulated Area in the Town of Oxford used to calculate Baseline Phosphorus Load 13
Figure 3. Buffumville Lake's watershed and LPCP Area's land use/land cover map 15
Figure 4. Lowes Pond's watershed and LPCP Area's land use/land cover map 18
Figure 5. McKinstry Pond's watershed and LPCP Area's land use/land cover map 20
Figure 6. Robinson Pond's watershed and LPCP Area's land use/land cover map 22
Figure 7. Texas Pond's watershed and LPCP Area's land use/land cover map 24
Figure 8. Potential BMP locations at 0 Maple Road. The lavender diagonal hatch represents the Lowes Pond watershed. The blue/green hatch outlined in blue represents the catchment area for the BMP location. 35
Figure 9. Potential BMP location at 3 Barton Street. The lavender diagonal hatch represents the Lowes Pond watershed. The blue/green hatch outlined in blue represents the catchment area for the BMP location. 36
Figure 10. Potential BMP location at 325 Main Street. The lavender diagonal hatch represents the Lowes Pond watershed. The blue/green hatch outlined in blue represents the catchment area for the BMP location. 37
Figure 11. Potential BMP location at 339 Main Street. The lavender diagonal hatch represents the Lowes Pond watershed. The blue/green hatch outlined in blue represents the catchment area for the BMP location. 38
Figure 12. Potential BMP location at 450 Main Street. The lavender diagonal hatch represents the Lowes Pond watershed. The blue/green hatch outlined in blue represents the catchment area for the BMP location. 39
Figure 13. Potential BMP locations at 350/352 Main Street. The lavender diagonal hatch represents the Lowes Pond watershed. The blue/green hatch outlined in blue represents the catchment area for the BMP location. 40

1 Introduction

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 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 thirteen approved TMDLs covering 78 lakes and ponds located in the Commonwealth of Massachusetts. As an element of the Permit's WQBEL provisions, communities that discharge to one or more of the waterbodies included in the TMDLs are obligated to address phosphorus impairments through the development and implementation of a Lake Phosphorus Control Plan (LPCP). Appendix F of the MS4 Permit describes specific requirements of the LPCP, implementation of which is anticipated to achieve the TMDL-established targeted phosphorus reductions over a 15-year timeframe. LPCP implementation includes structural and non-structural best management practices (BMPs) executed through programs, projects, and policies. The LPCP must be fully implemented within 15 years of the Permit effective date (i.e., by June 30, 2033), as illustrated in Table 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 15-year schedule.

Table 1. General LPCP Implementation Timeline for Lake and Pond Communities

Timeframe	Deadline (End of Fiscal Year)	Phosphorus Reduction Requirement (% of Total)
0-8 years	2026	20%
5-10 years	2028	40%
10-13 years	2031	70%
13-15 years	2033	100%

2 Overview of LPCP Milestones

This report covers sections of the LPCP required in Years 2-6. The final LPCP will be completed in Year 15, and will outline all the major milestones as required by the Permit Appendix F. The final LPCP must mitigate the phosphorus load reduction requirement within these 15 years, with interim milestones of achieving the first 20% of phosphorus load reduction by Year 8 (i.e., by June 30, 2026), 40% by Year 10 (i.e., by June 30, 2028), and 70% by Year 13 (i.e., by June 30, 2031). The detailed components of the final LPCP are outlined in Table 2.

Table 2. LPCP Component Deadlines

Permit Year #	Year-End (June 30th)	LPCP Component(s) Due
Year 1	2019	None
Year 2	2020	Legal Analysis
Year 3	2021	Funding Source Assessment
Year 4	2022	LPCP Scope; calculate Baseline Phosphorus, Allowable Phosphorus Load, and Phosphorus Reduction Requirement
Year 5	2023	Descriptions of the following items: - Nonstructural controls - Structural controls - O&M program for structural controls - Implementation schedule - Cost and Funding Source Assessment - Written LPCP
Year 6	2024	Full implementation of nonstructural controls 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	Update written LPCP Performance Evaluation Implementation of structural controls to achieve 40% of target phosphorus reduction
Year 11	2029	Performance Evaluation
Year 12	2030	Performance Evaluation
Year 13	2031	Performance Evaluation Implementation of structural controls to achieve 70% of target phosphorus reduction
Year 14	2032	Performance Evaluation
Year 15	2033	Performance Evaluation Implementation of structural controls to achieve 100% of target phosphorus reduction

The Town of Oxford acknowledges that to meet the phosphorus reduction deadlines set forth in the MS4 Permit, significant preparation is required. In order to plan, design, and construct structural controls to meet the Year 8, Year 10, Year 13, and Year 15 reduction deadlines, there is significant work to be completed during the initial years of LPCP 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 taken into account in the implementation schedule.

Based on this schedule, this Year 6 Report serves as a complete written LPCP, continuing the work from Years 2-5, and includes the following items:

- Establishing the LPCP Scope Area for each lake/pond;
- Calculating the Baseline Phosphorus, Allowable Phosphorus Load, and Phosphorus Reduction Requirements for each lake/pond;
- Description of planned non-structural and structural stormwater controls
- Description of Operations & Maintenance (O&M) Program
- Implementation Schedule
- Cost and Funding Source Assessment
- Performance Evaluation

3 Community Characterization and Lake/Pond Watershed Description

The Town of Oxford, Massachusetts, located in Worcester County, is approximately 27.5 square miles with a population of over 13,000 people. The urban center is located along Route 12 (Main Street) which runs north-south. The Massachusetts Turnpike (Interstate 90) runs east-west in the northern portion of Oxford with Interstate 395 running north-south through the center of Oxford, just east of Route 12. The Urbanized Area comprises approximately 53% of the Town's total area. The MS4-Regulated Area is the area within the Urbanized Area that is managed by drainage infrastructure, including catch basins, pipes, outfalls, swales, and Low Impact Development (LID) approaches. The majority of land cover in the Urbanized Area is single family residential, developed open space, or forested area. Table 3 lists the lakes and ponds (and corresponding required Phosphorus percent reduction) within Oxford's municipal boundary subject to one or more of the TMDLs completed by MassDEP listed in the MS4 Permit Appendix F Part II.1. Figure 1 depicts the Town's boundaries and the watershed (as defined by USGS) for each of the six lakes and ponds subject to a TMDL. These water bodies are located in the French River Watershed which eventually flow to the Thames River in Connecticut and ultimately to the Long Island Sound.

Table 3. Lake/Pond Phosphorus Reduction Requirements

Lake/Pond Name	Required Percent Reduction of Phosphorus
Buffumville Lake	28%
Hudson Pond	37%
Lowes Pond	51%
McKinstry Pond	79%
Robinson Pond	8%
Texas Pond	21%

In a memorandum to the Town of Oxford prepared by Tighe & Bond in November 2020, Tighe & Bond noted the following status of TMDLs:

"Because of the potentially high costs associating with planning and implementing the LPCP, Tighe & Bond reviewed the current water quality standards that apply to the Town of Oxford's waterbodies subject to the TMDL and found there are some waterbodies to which the TMDL no longer should apply… Given the recent change in impaired waterbody status that delists ***Buffumville Lake, Robinson Pond, and Texas Pond*** *from being subject to the May 2002 TMDL for Phosphorus for Selected French Basin Lakes, advice from EPA, and the substantial planning, capital, operational, and administrative costs associating with preparing and undertaking the LPCP, we recommend the Town of Oxford engage Town Counsel to prepare a persuasive letter to MassDEP to request an update to the TMDL to remove Buffumville Lake, Robinson Pond, and Texas Pond. The Town may wish to coordinate this effort with the Town of Charlton Town Administrator and legal counsel."*

The Town of Oxford was informed by the Massachusetts Department of Environmental Protection (MassDEP) in February 2022 that because the Lakes and Ponds Phosphorus TMDL includes Buffumville Lake, Robinson Pond, and Texas Pond and the permit outlines requirements to meet the TMDL for those waters, the requirements in the 2016 Small MS4 permit will remain in effect. Therefore, these Ponds are included in this Permit Year's LPCP updated report.

In 2024, the Town of Oxford contacted MassDEP to inquire about the status of the TMDLs for Oxford's lakes and ponds, noting that the EPA had indicated that MassDEP would be able to inform when the TMDLs would be updated. The Town received the following response on April 24, 2024:

"Robinson Pond (Assessment Unit ID: MA42047), Buffumville Lake (MA42005), and Texas Pond (formerly designated MA42058 and is now part of French River MA42-03) are not listed as impaired in MassDEP's most recent Integrated List of Waters, but the EPA-approved TMDLs associated with these waterbodies are still in effect as protective TMDLs. A protective TMDL establishes a pollution limit and outlines corrective actions to achieve that goal in order to prevent further degradation in water quality and to ensure that the waterbody meets state water quality standards. The Integrated List of Waters does not retain information on protective TMDLs. Lowes Pond (MA42034) and McKinstry Pond (MA42035) are listed as impaired due to "Nutrient/Eutrophication Biological Indicators" (NEBI) beginning with the 2016 reporting cycle. The 2002 Total Maximum Daily Loads of Phosphorus for Selected French Basin Lakes remains associated with the NEBI impairments."

Additional requirements for the LPCP, including the legal analysis and funding source assessment, are also found in the Tighe & Bond Memo attached as Appendix B.

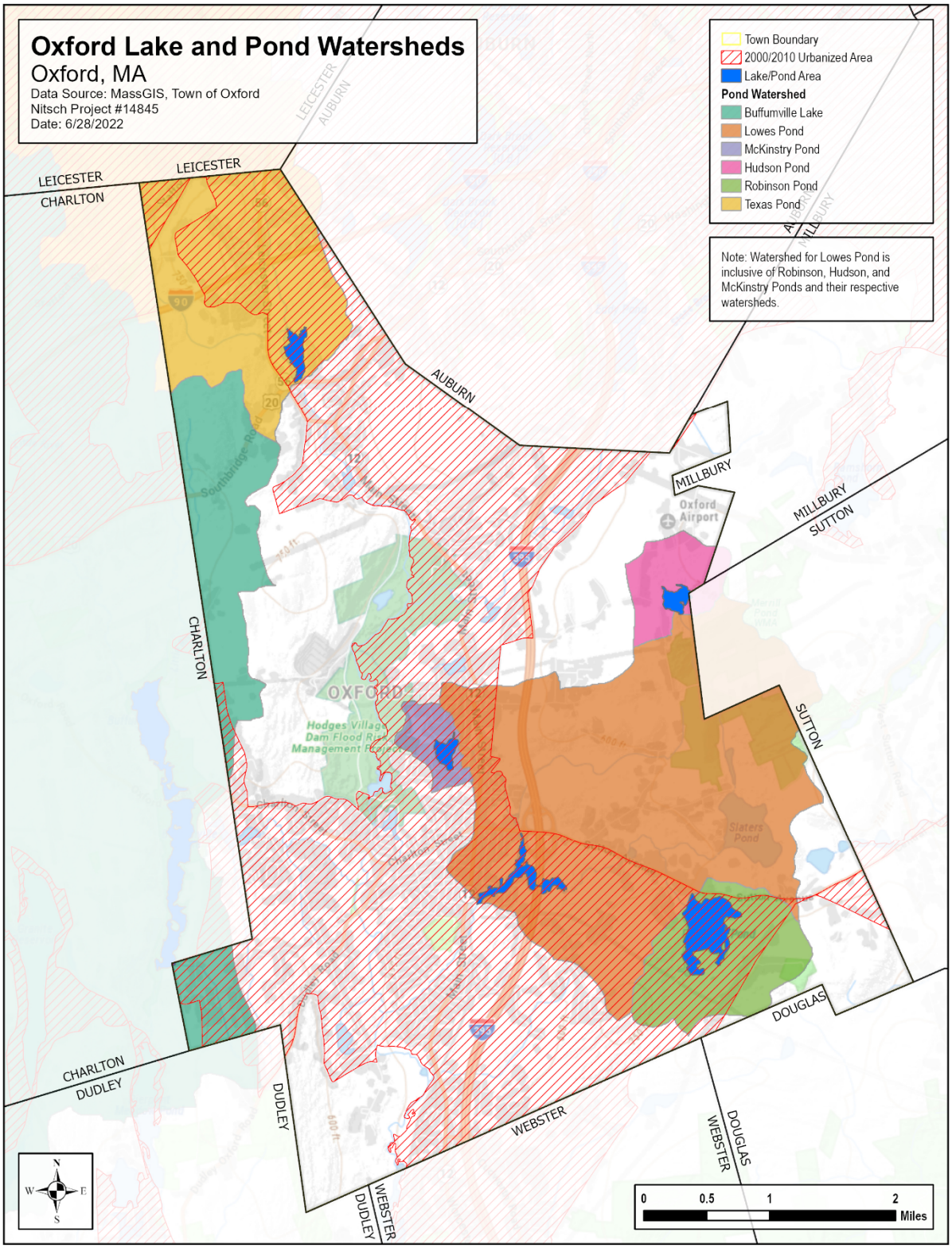


Figure 1. Town of Oxford's lakes and ponds subject to a TMDL

Initial efforts to calculate Phosphorus loading, conducted in Permit Years 4 and 5, were based on entire pond watersheds (delineated by StreamStats) within the Urbanized Area. Late in Permit Year 5, the EPA clarified the MS4 Regulated Area is the area of catchments managed by drainage infrastructure, including areas draining to catch basins, pipes, outfalls, swales, and LID approaches.

In response to this clarification, Nitsch re-defined the Town of Oxford's LPCP Area to include only areas managed by drainage infrastructure located within pond watersheds and within the Urbanized Area as well as revised the LPCP phosphorous calculations during Year 6. This analysis results in a revision to the Baseline Phosphorus Load calculations as well as revisiting potential BMP locations on town-owned parcels. This LPCP document has been updated to include these revisions.

Field work and updated mapping efforts were conducted by the Town of Oxford in the winter of 2023/2024. Nitsch Engineering received final mapping and GIS data from the Town on May 9, 2024. This data was used to delineate catchment areas for known outfalls within the Town of Oxford's MS4 Regulated Area. Data and methodology utilized in the delineation of outfall subcatchments are further described in Appendix A. Although complete Phase II mapping of the MS4 system is not required until Permit Year 10, Nitsch Engineering and the Town of Oxford utilized the best available mapping at the time of this analysis to produce the most accurate Phosphorus loading calculations for the purposes of this Lake Phosphorus Control Plan. Additional outfall locations and connected inlets will need to be mapped by Year 10 as part of Phase II mapping, these updates can be used to further refine the Phosphorous Loading calculations. A map showing the MS4 Regulated Areas contributing to the Phosphorus Baseline Loading calculations and Phosphorous reduction targets is shown in Figure 2.

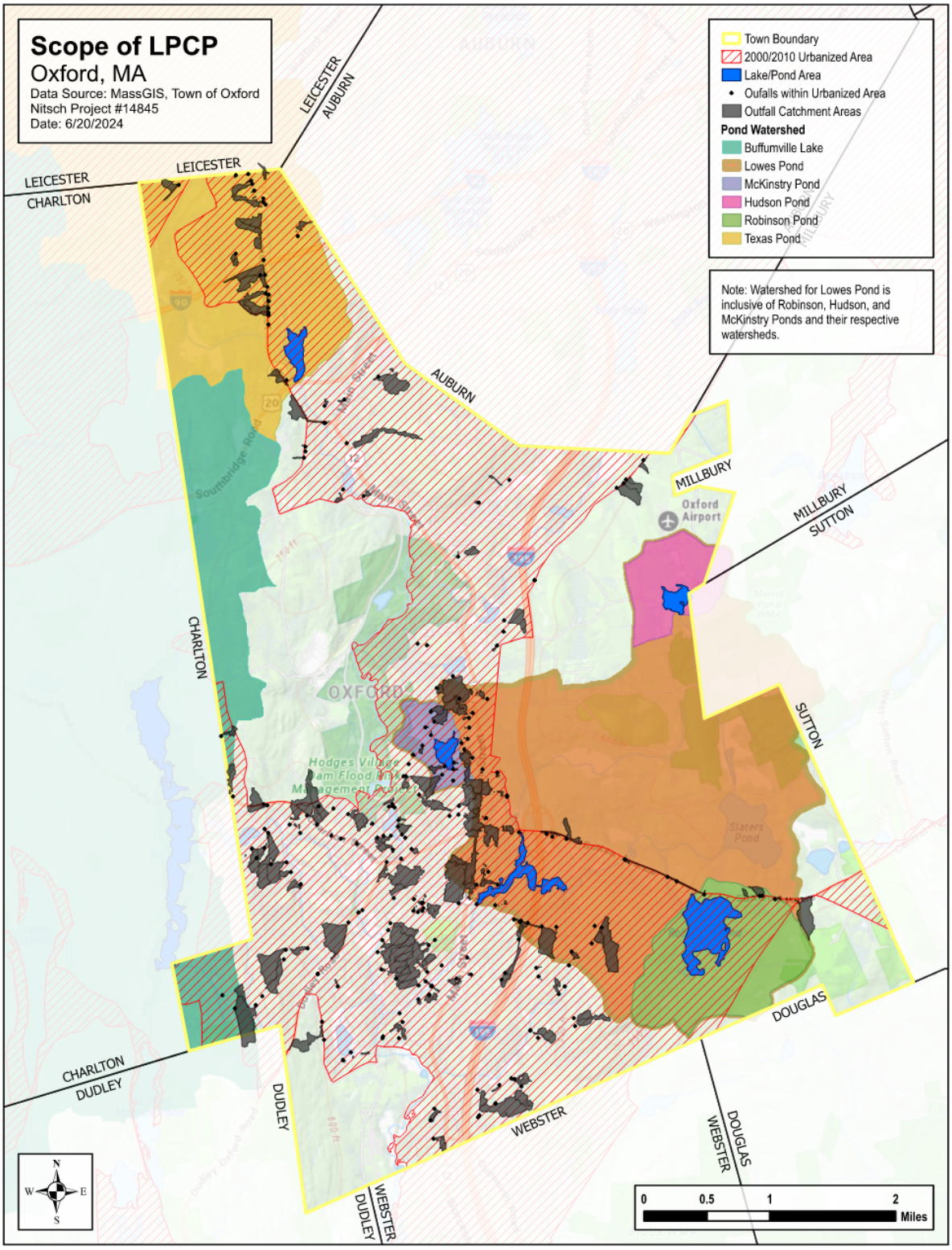


Figure 2. MS4-Regulated Area in the Town of Oxford used to calculate Baseline Phosphorus Load

The following sections present information on each lake and pond in the Town of Oxford that is subject to a TMDL. Information presented is from the MassDEP watershed-based planning tool and supplemented by local information as appropriate.

3.1 Buffumville Lake

Buffumville Lake (MA42005) is approximately 199 acres with two subbasins that are separated by Oxford Road located along the western border of Oxford. The total watershed area for the lake is approximately 16,384 acres. The watershed for nearby Buffum Pond is not considered part of the watershed for Buffumville Lake. Approximately 1,120 acres of Buffumville Lake's watershed is located within the Town of Oxford, with the majority of the lake's watershed located within the Town of Charlton.

A report on TMDLs of Phosphorus for Selected French Basin Lakes published in 2002 noted the presence of non-native, noxious aquatic plant *Myriophyllum heterophyllum.* Buffumville Lake was deemed a category 4a in the Final Massachusetts Integrated List of Waters for the Clean Water Act 2018/2020 Reporting Cycle, which means all pollutants contributing to impairment are addressed in an EPA-approved TMDL. Additional impairments noted in the Integrated List of Waters include mercury in fish tissue and excess algal growth. In the 2022 Reporting Cycle, impairments listed were non-native aquatic plants and mercury in fish tissue and the category remained "4a".

The total LPCP Area contributing to the Baseline Phosphorus Loads for Buffumville Lake is approximately 32.06 acres. This area includes the catchment areas for drainage infrastructure discharging to the lake via outfalls located with the lake's watershed as defined by USGS StreamStats. The majority land uses in the Buffumville Lake watershed are single family and multi-family residential. See Figure 3.

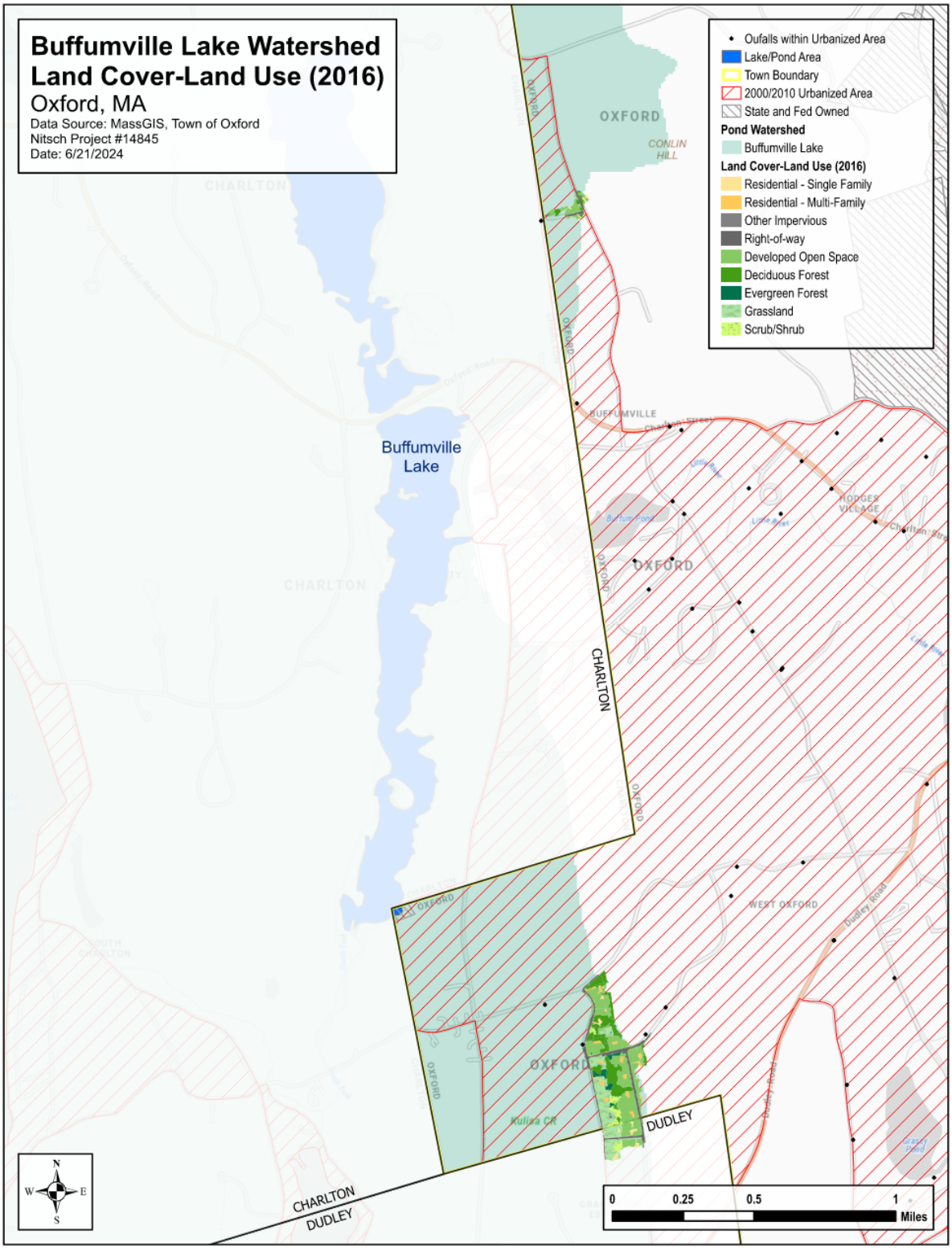


Figure 3. Buffumville Lake's watershed and LPCP Area's land use/land cover map

3.2 Hudson Pond

Hudson Pond (MA42029) is in the northeast corner of Oxford and is approximately 15 acres. Total watershed area for the pond is approximately 295 acres. Majority land uses are: 60% agriculture, 14% recreation, and 12% single family residential. Approximately 254 acres of the watershed for Hudson Pond is in the Town of Oxford and the rest is in the Town of Sutton. Hudson Pond was deemed a category 4a in the Final Massachusetts Integrated List of Waters for the Clean Water Act 2018/2020 Reporting Cycle and the 2022 Reporting Cycle. A TMDL is completed/determined. Impairments noted are Aquatic Plants (Macrophytes) and Nutrient/Eutrophication Biologic Indicators. Hudson Pond is not within the MS4 Permit regulated area (Urbanized Area) therefore Phosphorus loading calculations and reduction requirements were not conducted for the Lake Phosphorus Control Plan.

3.3 Lowes Pond

Lowes Pond (MA42034) is approximately 33 acres located in the southern central portion of Oxford. The total watershed area for the pond is approximately 4,960 acres. The watershed for Lowes Pond is inclusive of Robinson, McKinstry, and Hudson Ponds and their respective watersheds. Approximately 3,427 acres of Lowes Pond's watershed is located within the Town of Oxford, the rest is in the Town of Sutton.

As described in the report titled "Total Maximum Daily Loads of Phosphorus for Selected French Basin Lakes" published in 2002 by the Commonwealth of Massachusetts, models used to determine Phosphorus TMDLs for these Lowes Pond considered the entirety of the Lowes Pond watershed which included McKinstry Pond and Robinson Pond watersheds. Nitsch Engineering calculated phosphorus loading for Lowes Pond by adding loads from outfalls that discharged directly to Lowes and adding the loads from outfalls that discharged directly to McKinstry Pond or Robinson Pond. This creates a conservative estimate for Total Phosphorus entering Lowes Pond, as the calculations assume that pollutant loads to McKinstry and Robinson also contribute to Lowes Pond, which aligns with the methodology described in the TMDL study. Therefore, any BMPs installed in the McKinstry or Robinson Pond watersheds will also be considered as credits toward phosphorus removal in Lowes Pond as well.

Lowes Pond was deemed a category 4a in the Final Massachusetts Integrated List of Waters for the Clean Water Act 2018/2020 Reporting Cycle and 2022 Reporting Cycle. A TMDL is completed/determined. Nutrient/Eutrophication Biologic Indicators are noted as the impairment. A survey from the mid-1990s also indicated that 75% to 100% of the pond was covered with aquatic plants.

The total LPCP Area contributing to the Baseline Phosphorus Loads for Lowes Pond is approximately 181.2 acres. This area includes the catchment areas for drainage infrastructure discharging to the pond via outfalls located within the Lowes Pond, McKinstry Pond, and Robinson Pond's watersheds as defined by USGS StreamStats. The majority land uses are open land (wetland, forest, grassland, developed open space), single family residential, and multi-family residential. See Figure 4.

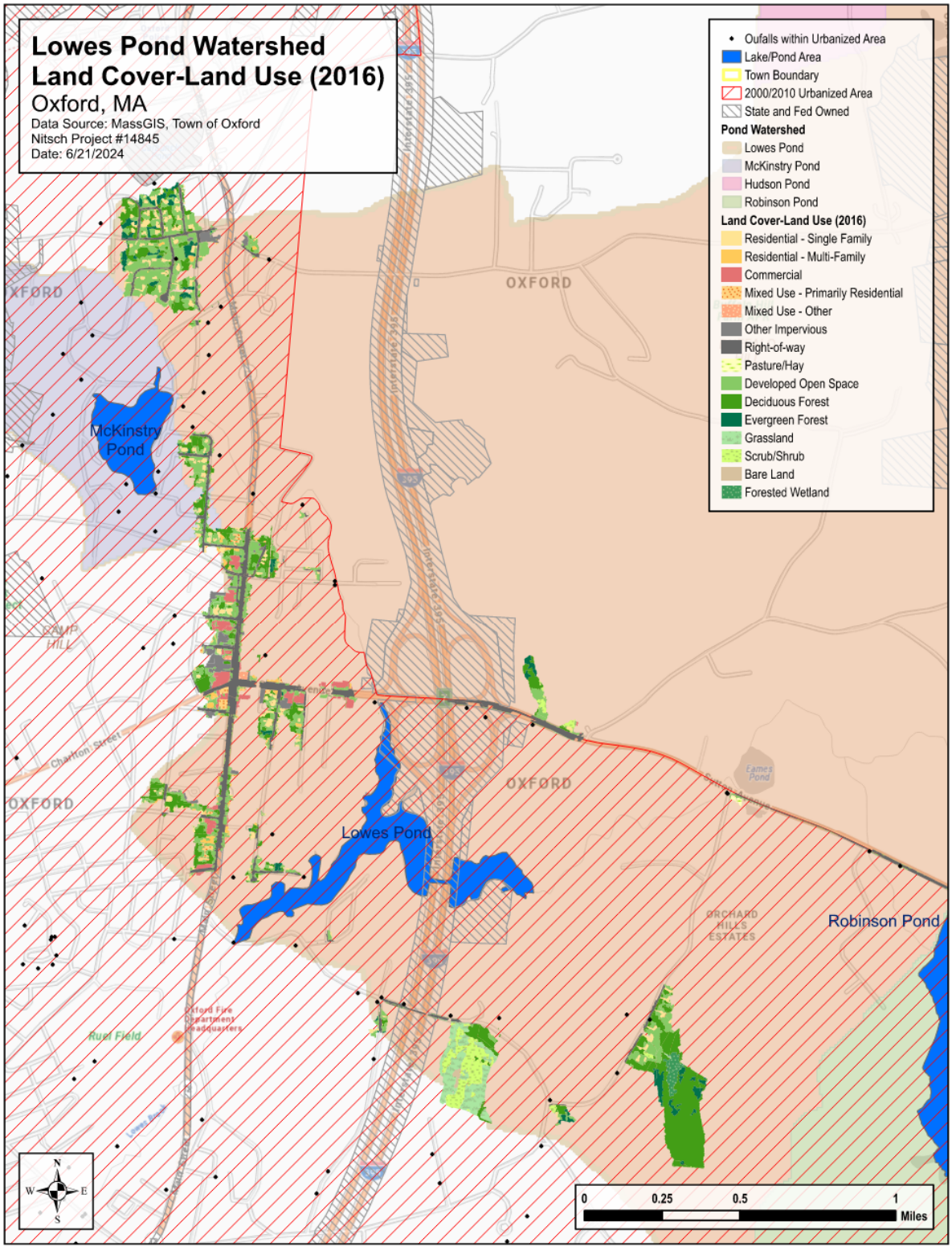


Figure 4. Lowes Pond's watershed and LPCP Area's land use/land cover map

3.4 McKinstry Pond

McKinstry Pond (MA42035) is approximately 16 acres and is located close to the Town's urban center, just northwest of the intersection of Route 12 and Charlton Street/Sutton Avenue. The total watershed area for the pond is approximately 161 acres. The watershed is entirely within the MS4-regulated urbanized area in the Town of Oxford.

McKinstry Pond was deemed a category 4a in the Final Massachusetts Integrated List of Waters for the Clean Water Act 2018/2020 Reporting Cycle and the 2022 Reporting Cycle. A TMDL is completed/determined. Nutrient/Eutrophication Biologic Indicators are noted as an impairment.

The total LPCP Area contributing to the Baseline Phosphorus Loads for McKinstry Pond is approximately 16.1 acres which includes the catchment areas for drainage infrastructure discharging to the pond via outfalls located within the pond's watershed as defined by USGS StreamStats. The majority land uses are single family residential and open land (wetland, forest, water). See Figure 5.

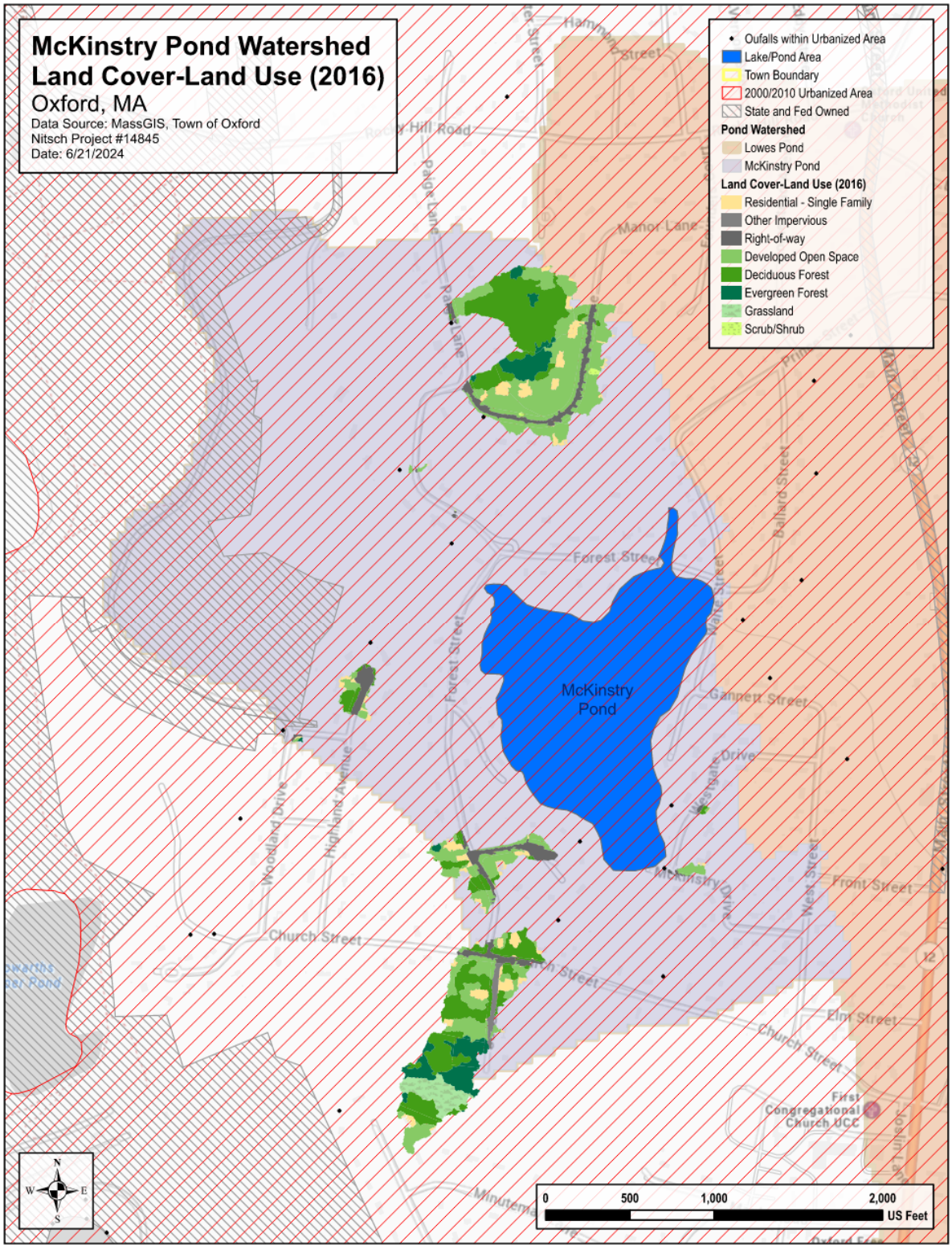


Figure 5. McKinstry Pond's watershed and LPCP Area's land use/land cover map

3.5 Robinson Pond

Robinson Pond (MA42047) is approximately 99 acres and is in the southeast corner of the Town of Oxford. The total watershed area for the pond is approximately 752 acres. The majority of the pond's entire watershed is located within the Town of Oxford with just over 1 acre located in the Town of Douglas.

Robinson Pond was deemed a category 3 in the Final Massachusetts Integrated List of Waters for the Clean Water Act 2018/2020 Reporting Cycle and the 2022 Reporting Cycle, which means the waterbody was not assessed for any individual designated uses for this listing cycle. This pond was found to have historically moderate total phosphorus levels by MassDEP in 1994 where very dense growths of aquatic macrophytes covered the pond.

The total LPCP Area contributing to the Baseline Phosphorus Loads for Robinson Pond is approximately 20.7 acres. This area includes the catchment areas for drainage infrastructure discharging to the pond via outfalls located within the pond's watershed as defined by USGS StreamStats. The majority land uses are open land (wetland, forest, grassland, developed open space), multi-family residential, and single family residential. See Figure 6.

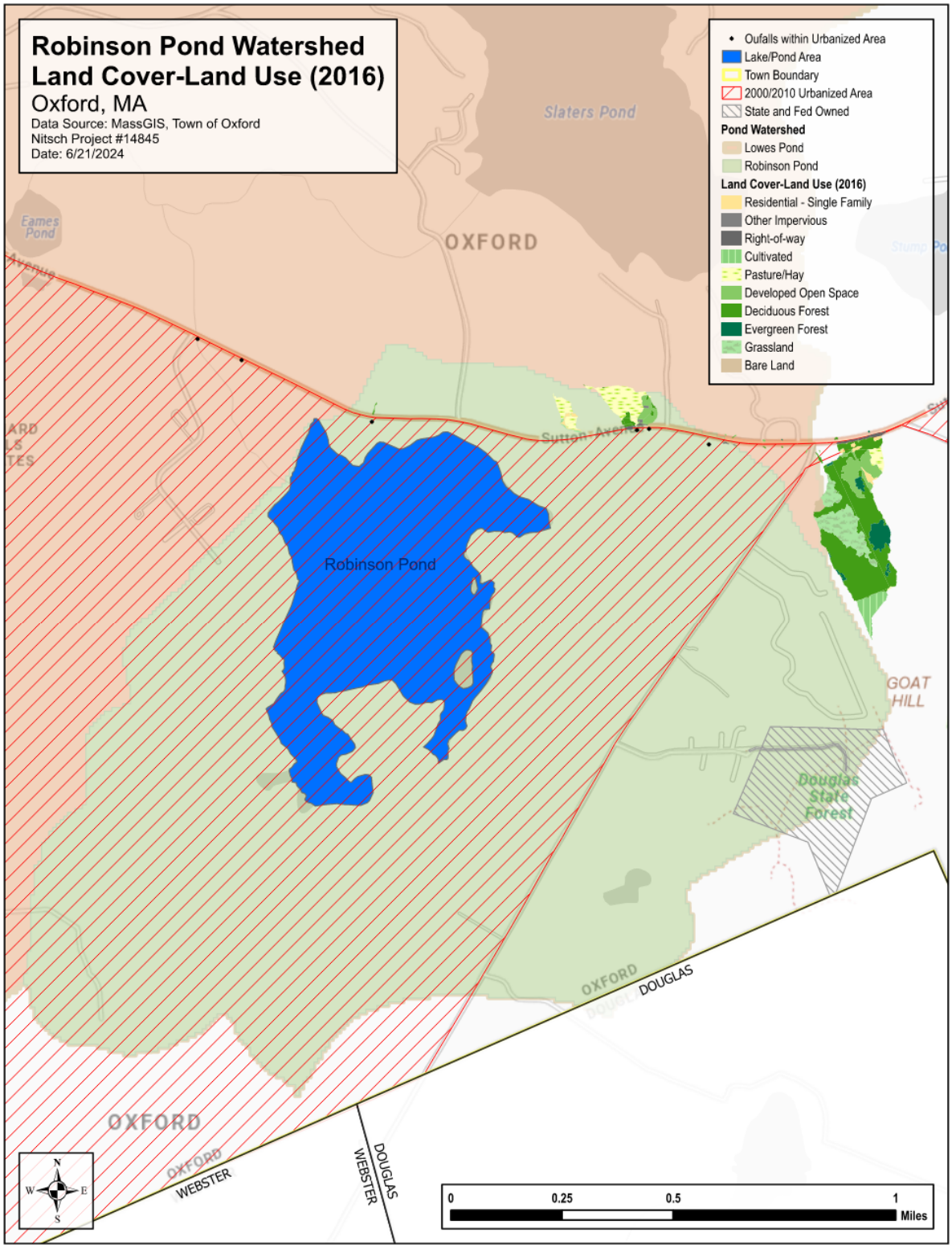


Figure 6. Robinson Pond's watershed and LPCP Area's land use/land cover map

3.6 Texas Pond

Texas Pond (MA42058) is approximately 28 acres and is in the northwest corner of Oxford. The total watershed area for the pond is approximately 13,780 acres. The majority of Texas Pond's watershed is located with the Town of Leicester. Approximately 1,500 acres of the total watershed area are located in the Town of Oxford; the rest located in either the Towns of Charlton or Auburn. Texas Pond is also located downstream of the Oxford-Rochdale Wastewater Treatment Plant (WWTP) and the Leicester WWTP. A significant portion of the pond's watershed within the Town of Oxford includes Massachusetts State Highways Route 56, Route 20, and Interstate 90.

In the Final Massachusetts Integrated List of Waters for the Clean Water Act 2018/2020 Reporting Cycle, Texas Pond was assessed as a part of the French River (MA42-03). The French River was deemed a category 5 which are waters requiring a TMDL. The French River remained a category 5 in the 2022 Reporting Cycle. Mercury in Fish Tissue was noted as an impairment for the river. An assessment in 1994 by MassDEP noted very dense aquatic macrophyte growth and historically very high total phosphorus levels and suspended solids.

The total LPCP Area contributing to the Baseline Phosphorus Loads for Texas Pond is approximately 66.9 acres. This area includes the catchment areas for drainage infrastructure discharging to the lake via outfalls located with the pond's watershed as defined by USGS StreamStats. The majority land uses are multi-family residential, single family residential, and open land (wetland, forest, pasture, grassland, water). See Figure 7.

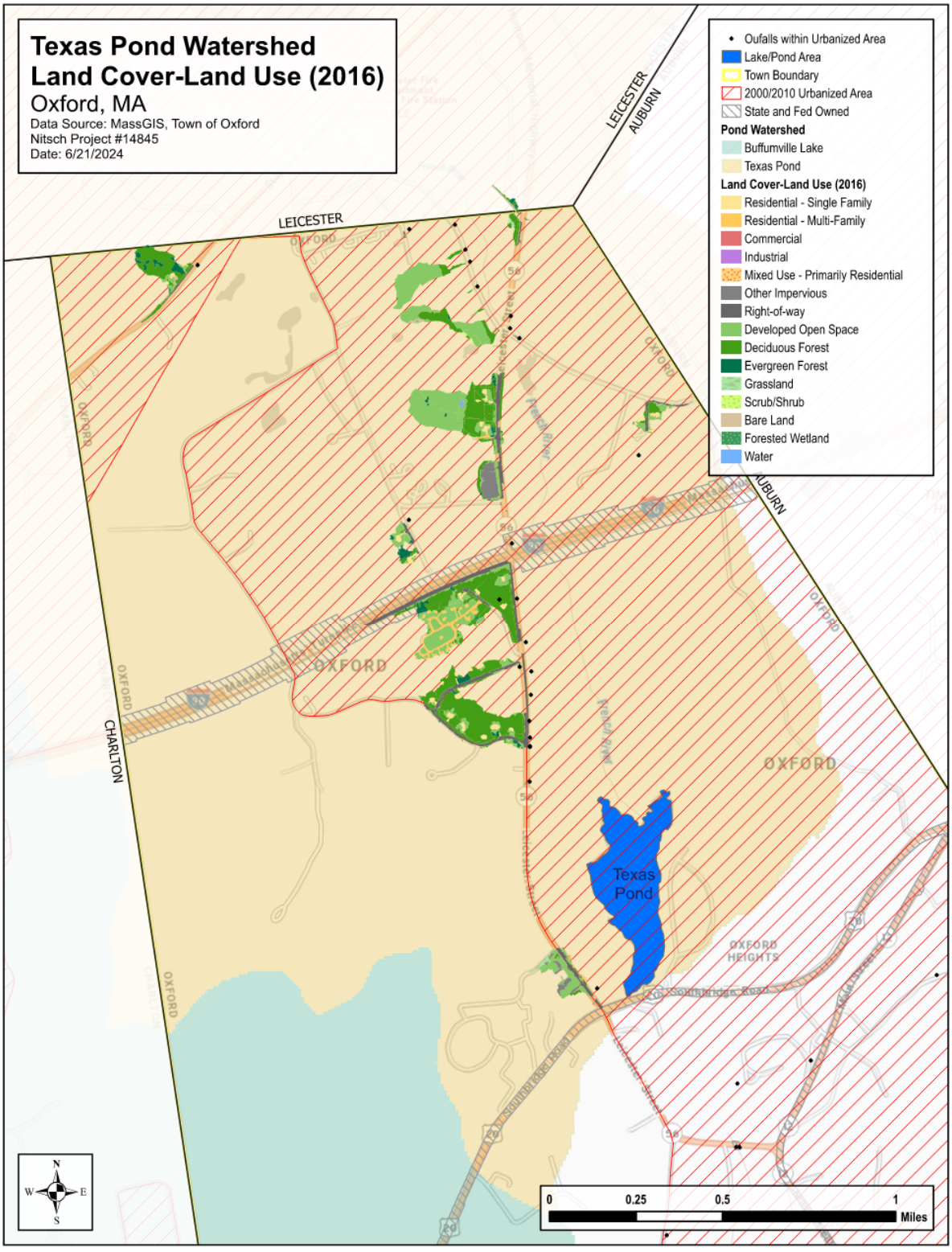


Figure 7. Texas Pond's watershed and LPCP Area's land use/land cover map

4 LPCP Load Reduction Targets

4.1 LPCP Areas

Per Section II.1.i.c. of Appendix F of the MS4 Permit, the Town of Oxford has two (2) options for the LPCP Scope Area:

- Set the LPCP Scope Area as the entirety of the community that falls within each lake or pond watershed, or
- Set the LPCP Scope Area to include only the MS4-regulated area of the community within each lake or pond watershed.

Based on an assessment of factors relevant to the selection criteria, Oxford will implement the LPCP in the MS4-Regulated (Urbanized) Area for all lakes and ponds and therefore calculate the Baseline Phosphorus Load within the corresponding watershed. The Reduction Requirement Percentage will be applied to this Baseline Load.

Oxford is opting to implement the LPCP within the MS4-regulated (urbanized) area because the urbanized area focuses on the areas with the highest potential pollutant loading and opportunities for focused stormwater management. The Town anticipates having the available space within this area to meet the MS4 Permit phosphorus reduction requirements. It can be anticipated, 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. It is understood that these improvements will not count towards the Town of Oxford's phosphorus reduction requirement under the LPCP.

4.2 Baseline Phosphorus Load, Allowable Phosphorus Load, and Stormwater Phosphorus Reduction Requirement

Nitsch Engineering has calculated the Baseline Phosphorus Load in conformance with Attachment 1 to Appendix F of the MS4 Permit, using the phosphorus loading export rates (PLERs) supplied in Table 1-2 of Attachment 1 to Appendix F. The baseline was calculated using methodology described in Appendix A to this report. As described in Section 3, the Baseline Phosphorous Load calculations have been revised to reflect the MS4 Regulated Area definition as catchment areas for drainage infrastructure located within the lake/pond watersheds and Urbanized Area.

Baseline Phosphorus Loads for each pond or lake watershed were calculated using 2016 land use & land cover data and hydrologic soil group data from MassGIS. (The approach of using 2016 data, as opposed to 2005 data, was approved by the EPA and MassDEP during a conference call with Nitsch Engineering in May 2022.) This Baseline Load represents the estimated annual phosphorus loading based on land use and soil types and it does not include any existing structural or non-structural BMPs already implemented. These will be accounted for in future efforts for the LPCP.

Detailed Baseline Phosphorous Load calculations are attached as Appendix C to this report.

Once the Baseline Load is calculated, the Required Percent Reduction of Phosphorus in Table F-6 of MS4 Permit Appendix F is used to determine the Stormwater Phosphorus Load Reduction Requirement, Allowable Phosphorus Load, and then each of the interim milestones that must be met through the LPCP. These values are summarized in Table 4 through Table 8. Maps showing Baseline Phosphorus Load for each watershed are attached as Appendix D to this report.

To achieve the target of reducing phosphorus loads by 2033, the Town of Oxford will be planning and implementing a series of structural and non-structural BMPs, updating regulatory mechanisms 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.

Table 4. LPCP Reduction Requirements for Buffumville Lake

Buffumville Lake	
Condition	**Load Value**
Baseline P-Load, lbs/yr	15.21
Allowable P-Load, lbs/yr	10.95
Stormwater P-Load Reduction Requirement, lbs/yr	4.26
Year 8 Milestone: 20% of Reduction, in lbs/yr	0.85
Year 10 Milestone: 40% of Reduction, in lbs/yr	1.70
Year 13 Milestone: 70% of Reduction, in lbs/yr	2.98
Year 15 Milestone: 100% of Reduction, in lbs/yr	4.26

Table 5. LPCP Reduction Requirements for Lowes Pond

Lowes Pond	
Condition	**Load Value**
Baseline P-Load, lbs/yr	111.40
Allowable P-Load, lbs/yr	54.59
Stormwater P-Load Reduction Requirement, lbs/yr	56.81
Year 8 Milestone: 20% of Reduction, in lbs/yr	11.36
Year 10 Milestone: 40% of Reduction, in lbs/yr	22.72
Year 13 Milestone: 70% of Reduction, in lbs/yr	39.77
Year 15 Milestone: 100% of Reduction, in lbs/yr	56.81

Table 6. LPCP Reduction Requirements for McKinstry Pond

McKinstry Pond	
Condition	**Load Value**
Baseline P-Load, lbs/yr	6.63
Allowable P-Load, lbs/yr	1.39
Stormwater P-Load Reduction Requirement, lbs/yr	5.24
Year 8 Milestone: 20% of Reduction, in lbs/yr	1.05
Year 10 Milestone: 40% of Reduction, in lbs/yr	2.10
Year 13 Milestone: 70% of Reduction, in lbs/yr	3.67
Year 15 Milestone: 100% of Reduction, in lbs/yr	5.24

Table 7. LPCP Reduction Requirements for Robinson Pond

Robinson Pond	
Condition	**Load Value**
Baseline P-Load, lbs/yr	5.89
Allowable P-Load, lbs/yr	5.42
Stormwater P-Load Reduction Requirement, lbs/yr	0.47
Year 8 Milestone: 20% of Reduction, in lbs/yr	0.09
Year 10 Milestone: 40% of Reduction, in lbs/yr	0.19
Year 13 Milestone: 70% of Reduction, in lbs/yr	0.33
Year 15 Milestone: 100% of Reduction, in lbs/yr	0.47

Table 8. LPCP Reduction Requirements for Texas Pond

Texas Pond	
Condition	**Load Value**
Baseline P-Load, lbs/yr	34.35
Allowable P-Load, lbs/yr	27.14
Stormwater P-Load Reduction Requirement, lbs/yr	7.21
Year 8 Milestone: 20% of Reduction, in lbs/yr	1.44
Year 10 Milestone: 40% of Reduction, in lbs/yr	2.89
Year 13 Milestone: 70% of Reduction, in lbs/yr	5.05
Year 15 Milestone: 100% of Reduction, in lbs/yr	7.21

5 Non-Structural Controls

The Town of Oxford's approach for non-structural BMP implementation for LPCP compliance is detailed in this section. Non-structural BMPs include street sweeping, catch basin cleaning, as well as enhanced organic waste (yard waste) and leaf litter collection. Annual phosphorus reduction from non-structural BMPs were calculated consistent with Attachment 2 to Appendix F of the MS4 Permit.

5.1 Current Non-Structural BMPs

Current non-structural BMPs are those that are anticipated to continue at current resource levels, or 'business as usual'. The Town of Oxford has already implemented non-structural BMPs such as street sweeping and catch basin cleaning. Based on the details of these current practices and available data, it was decided to approach this analysis by assuming that current street sweeping practices will be replaced with practices described in the "Planned Non-Structural BMPs" section of this document.

The town's street sweeping log for Fiscal Years 2019, 2020, 2021, & 2022 document streets swept and total volume of material collected in cubic yards (Refer to Appendix E). Currently the town conducts street sweeping once per year using mechanical broom equipment (Elgin Pelican). In lieu of a method to translate volume of material removed in a group of streets to pounds of phosphorus removed per year, methods outlined in Attachment 2 to Appendix F of the MS4 Permit were used to quantify potential phosphorus reduction credits related to enhanced street sweeping practices.

Similarly, the Town of Oxford maintains records related to the volume of material removed from catch basins when cleaned, but each catchment area was not delineated per catch basin. Calculating pounds of phosphorus removed annually was not feasible for this analysis. Therefore, this analysis assumes that the town will maintain the practice of annual catch basin inspections and cleaning any catch basins that are more than 50% full. Methods outlined in Attachment 2 to Appendix F were used to quantity potential phosphorus reduction credits related to catch basin cleaning.

For enhanced organic waste and leaf litter collection, the Town of Oxford offers residence a location to drop off yard waste, leaf litter and grass clippings. However, this current practice does not capture the quantity of material collected or translate this effort into pounds of phosphorus removed. Methods outlined in Attachment 2 to Appendix F were used to quantify potential phosphorus reduction credits related to enhanced organic waste and leaf litter collection program.

In summary, the existing non-structural controls practiced during and prior to Year 4 are not considered to be contributing to the annual phosphorus reduction requirement. All non-structural BMP credits that could contribute to the phosphorus reduction requirement are outlined in the following section – Planned Non-Structural BMPs.

5.2 Planned Non-Structural BMPs

The Town of Oxford has implemented changes to the non-structure controls starting in permit Year 6. Calculated phosphorus reductions per lake or pond are presented in the following tables. Annual phosphorus reduction from non-structural BMPs were calculated consistent with Attachment 2 to Appendix F of the MS4 Permit. Detailed calculations can be found in Appendix F of this document.

Calculations for non-structural phosphorus reduction credits are based on land use and land cover data from 2016 which was also used to calculate phosphorus loading. All calculations assumed that the town would continue to sweep streets, clean catch basins, and maintain the enhanced leaf litter program within each pond watershed for the following land uses:

- Right of Way
- Multi-Family Residential
- Single Family Residential
- Commercial
- Industrial
- Mixed use (primarily residential & other)

Phosphorus Loading Export Rates (PLERs) for each land use were taken from Table 1-2 of Attachment 1 to Appendix F of the MS4 Permit.

Additional assumptions for the non-structural phosphorus reduction credits:

Enhanced Sweeping Program – Calculations were based on the use of a mechanical broom used with a frequency of twice per year (spring and fall). A Phosphorus Reduction Factor (PRF) for sweeping of 0.01 was used per Attachment 2 to Appendix F of the MS4 Permit.

Catch Basin Cleaning – Calculations assumed that the Town of Oxford will remove accumulated materials from catch basins in each pond watershed such that a minimum sump storage capacity of 50% is maintained throughout the year. A Phosphorus Reduction Factor (PRF) for catch basin cleaning of 0.02 was used per Attachment 2 to Appendix F of the MS4 Permit.

Enhanced Organic Waste and Leaf Litter Collection Program – This program assumes the Town of Oxford will perform regular gathering, removal and disposal of landscaping wastes, organic debris, and leaf litter from imperious surfaces from which runoff discharges to a lake or pond. The Town of Oxford will collect organic waste at least once per week during the period of September 1 to December 1 of each year. The Town of Oxford will ensure that the disposal of these materials will not contribute pollutants to any surface water discharges. A nutrient reduction factor of 0.05 (5%) was used for organic waste and leaf litter collection program calculations per Attachment 2 to Appendix F of the MS4 Permit.

Table 9. Planned Non-Structural Control Summary for Buffumville Lake

Buffumville Lake		
Planned Non-Structural BMP	**Average Annual Impervious Acres Managed**	**Average Annual P-Reduction (lbs/yr)**
Street Sweeping	4.90	0.10
Catch Basin Cleaning	4.90	0.20
Leaf Litter Program	4.90	0.50
		Total: 0.88

Table 10. Planned Non-Structural Control Summary for Lowes Pond

Lowes Pond		
Planned Non-Structural BMP	**Average Annual Impervious Acres Managed**	**Average Annual P-Reduction (lbs/yr)**
Street Sweeping	44.03	0.86
Catch Basin Cleaning	44.03	1.72
Leaf Litter Program	44.03	4.31
		Total: 6.89

Table 11. Planned Non-Structural Control Summary for McKinstry Pond

McKinstry Pond		
Planned Non-Structural BMP	**Average Annual Impervious Acres Managed**	**Average Annual P-Reduction (lbs/yr)**
Street Sweeping	2.46	0.05
Catch Basin Cleaning	2.46	0.10
Leaf Litter Program	2.46	0.24
		Total: 0.39

Table 12. Planned Non-Structural Control Summary for Robinson Pond

Robinson Pond		
Planned Non-Structural BMP	**Average Annual Impervious Acres Managed**	**Average Annual P-Reduction (lbs/yr)**
Street Sweeping	0.68	0.01
Catch Basin Cleaning	0.68	0.03
Leaf Litter Program	0.68	0.07
		Total: 0.11

Table 13. Planned Non-Structural Control Summary for Texas Pond

Texas Pond		
Planned Non-Structural BMP	**Average Annual Impervious Acres Managed**	**Average Annual P-Reduction (lbs/yr)**
Street Sweeping	11.34	0.23
Catch Basin Cleaning	11.34	0.46
Leaf Litter Program	11.34	1.14
		Total: 1.83

6 Structural Controls

The Town of Oxford 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. 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.

Structural BMPs historically have been incorporated in Oxford via stormwater compliance projects (for public and private development projects) or as part of the capital infrastructure program.

To support LPCP development, it was 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 LPCP, that is presented below.

The following sections describe the assessment, performance, and implementation of Current, Planned, or Proposed Structural BMPs.

6.1 Current Structural BMPs

The Town of Oxford currently maintains structural BMPs as described in the Municipal Stormwater Infrastructure Operation and Maintenance Plan, dated August 2020. There are 12 stormwater detention basins within the urbanized area. While all are town-maintained only three are on town-owned property. In addition, the Town owns and maintains two rain gardens: one at the Town Hall Parking Lot and one at Carbuncle Beach Park. Details for all current structural BMPs can be found in Appendices of the Municipal Stormwater Infrastructure Operation and Maintenance Plan, dated August 2020.

For the purposes of this analysis and calculating phosphorus reduction credits, it was assumed any current structural BMPs were installed prior to 2016 and therefore included in the Baseline Phosphorus Load calculations conducted in permit Year 4. This assumption was verified using Google Earth imagery. Additional calculations of phosphorus reduction for each current structural BMP were not conducted as it was assumed that any reduction benefit from existing BMPs were considered in calculating baseline loads. However, it is recommended that the Town of Oxford evaluate the potential of retrofitting the existing detention basins to determine if they can be expanded or enhanced to remove more phosphorus than the existing condition.

6.2 Planned Structural BMPs

BMP Suitability Assessment

A high-level BMP suitability assessment was conducted on all town-owned parcels to determine what structural BMPs could be implemented to mitigate both nitrogen and phosphorus within the Town of Oxford. The detailed methodology and GIS data used in this assessment can be found

in Appendix G. Sites were initially categorized into three groups:

- Sites unsuitable for BMP implementation
- Sites suitable for “Type 1” BMP implementation (infiltrative BMPs such as infiltration trenches or infiltrative bioretention)
- Sites suitable for “Type 2” BMP implementation (non-infiltrative BMPs)

The analysis produced a total of 96 potential BMP sites on 60 town-owned parcels. The following criteria were used to determine the suitability of a site for BMP implementation:

1) Topography/Slope - Sites with a slope of greater than 5% were considered unsuitable for implementation of a BMP for this initial analysis.
2) Soil type – Sites with a majority of soil classified as Hydrologic Soil Group (HSG) A, B, or C were considered suitable for an infiltrative BMP (Type 1) whereas sites with majority soils classified as HSG D, A/D, B/D, C/D, or unknown were considered suitable for non-infiltrative BMPs (Type 2).
3) Depth to groundwater – Sites where groundwater was greater than 4 feet were considered suitable for infiltrative BMPs (Type 1); sites where the depth to groundwater was known to be less than 4 feet were considered suitable for non-infiltrative BMPs (Type 2); in cases where the depth to groundwater was unknown, these sites were analyzed as non-infiltrative BMPs (Type 2).
4) Proximity to buildings – Building footprints were mapped in GIS and were not considered as sites for implementation of BMPs; sites within 10 feet of a MassGIS inventoried building were also not considered as sites for implementation of BMPs.
5) Adjacent to MassDOT roads – Sites within 100 feet of a MassDOT road were considered as sites for implementation of BMPs as they will readily allow for construction and maintenance access.
6) Proximity to wetland resource areas – Sites within 25 feet of MassDEP wetlands were not considered as sites for implementation of BMPs.
7) Watersheds that did not contain impervious area were considered unsuitable for BMP implementation.

The annual Total Phosphorus (TP) and Total Nitrogen (TN) reduction for each potential BMP was calculated using the performance curves for each of the BMP types found in Attachment 3 to Appendix F of the MS4 Permit. The final set of BMP sites were then reviewed for potential implementation of structural phosphorus controls as well as for use in nitrogen reduction as explained in more detail in the Town of Oxford’s Nitrogen Source Identification Report.

Priority Ranking for Potential implementation of Structural Phosphorus Controls

The Town of Oxford developed a priority ranking of areas and infrastructure within the municipality for potential implementation of structural phosphorus controls (structural BMPs).

A total of 60 town-owned parcels containing 96 potential BMP locations which were ranked based on potential implementation of phosphorus control practices. Rankings are defined as:

High Priority = site very suitable for BMP implementation, likely to be constructed before year 8, would provide co-benefits with green infrastructure installation, and should be further

analyzed for more conceptual BMP design

Medium Priority = favorable site conditions for BMP implementation and would provide some co-benefit with green infrastructure installation, likely to be constructed before year 15

Low Priority = least favorable site conditions for BMP implementation, not likely to be considered for phosphorus control practices in the near term; includes sites outside the LPCP area, those outside a pond watershed area, and town cemeteries

The following criteria was used to determine ranking of potential BMP sites for phosphorus controls:

1) Phosphorus loading (lb/year) - Phosphorus loads were calculated for each individual potential BMP's watershed; sites were ranked higher in priority based on higher phosphorus loading. Available field screening and monitoring results to-date did not include phosphorus concentrations; these will be incorporated as available to refine priority rankings in future years.
2) Total Phosphorus (TP) removed – Sites achieving higher phosphorus removal were ranked a higher priority.
3) Location within Urbanized/LPCP area & Pond Watershed – Sites located outside the LPCP area and/or outside a pond watershed were categorized as "Low" priority for BMP implementation.
4) Proximity to outfalls – using the existing MS4 mapping, sites located closer to the downstream end of large drainage areas gave sites higher priority over areas located at the top of a lake or pond watershed.
5) Opportunities for public use and education – Sites located near elementary, middle and high schools, as well as sites often visited by the public, such as town hall and parks, were prioritized over sites that would see less interaction from town residents and visitors.
6) Capital Plans & Pavement Management Plan – The Town of Oxford routinely updates their planning efforts to anticipate funding needs for upcoming fiscal years. As part of the LPCP assessment, these plans were reviewed to understand upcoming planned projects and how they could incorporate stormwater BMPs and improve water quality. Refer to Section 2.3 for further information about potential stormwater BMP integration into upcoming municipal roadway projects.
7) Discharges to water quality limited waters, first or second order streams, public swimming beaches, drinking water supply sources, etc. – Sites located near any of these water bodies were given priority because of additional public health benefits improved water quality can provide.

Results of the analysis for BMP suitability can be found in Appendix H. A full list of priority sites for phosphorus controls with their determined ranking can also be found in Appendix I which includes maps of each site.

6.3 High Priority Structural BMPs

After LPCP Areas were re-delineated, Nitsch re-evaluated the list of potential BMP locations in the previous version of the LPCP and re-prioritized these BMPs based on their proximity to outfall catchment areas as well as their feasibility and constructability. Several potential BMP locations were moved from a “high” or “medium” priority to “low” priority based on the following criteria:

- the potential BMP’s proximity to known outfalls within the lake or pond watersheds,
- the potential BMP’s location being too far from a known inlet connection, or
- the potential BMP’s size being too small to capture a significant portion of impervious area near a known inlet connection.

The final list of high priority potential BMP locations was edited to include 12 potential BMP locations on 8 town-owned parcels. All 12 of these BMPs are located within the Lowes Pond watershed. The estimated total potential Phosphorus removal for all potential BMPs is 36.1 lb/yr, as shown in Appendix I. The results of this assessment are reflected in the LPCP Implementation Schedule for Lowes Pond.

The following section describes each potential BMP site ranked as High Priority to be further investigated to meet the Phosphorus Reduction Milestones identified in Section 4. Many town-owned properties are within catchments draining to outfall OF-134, which has a calculated baseline phosphorus loading of 8.68 lbs/year. Implementing BMPs within the catchment areas contributing to OF-34 which would contribute to a phosphorous removal greater than 8.68 lbs/year were not recommended as high priority.

BMP Location ID: F_556403_2869246_09; F_556403_2869246_07; F_556403_2869246_08; F_556403_2869246_10; F_556403_2869246_11

Site Address: 0 MAPLE RD; Oxford Community Center

Within Urbanized Area: YES

Within Pond Watershed: Lowes Pond

Outfall Catchment(s): OF-134

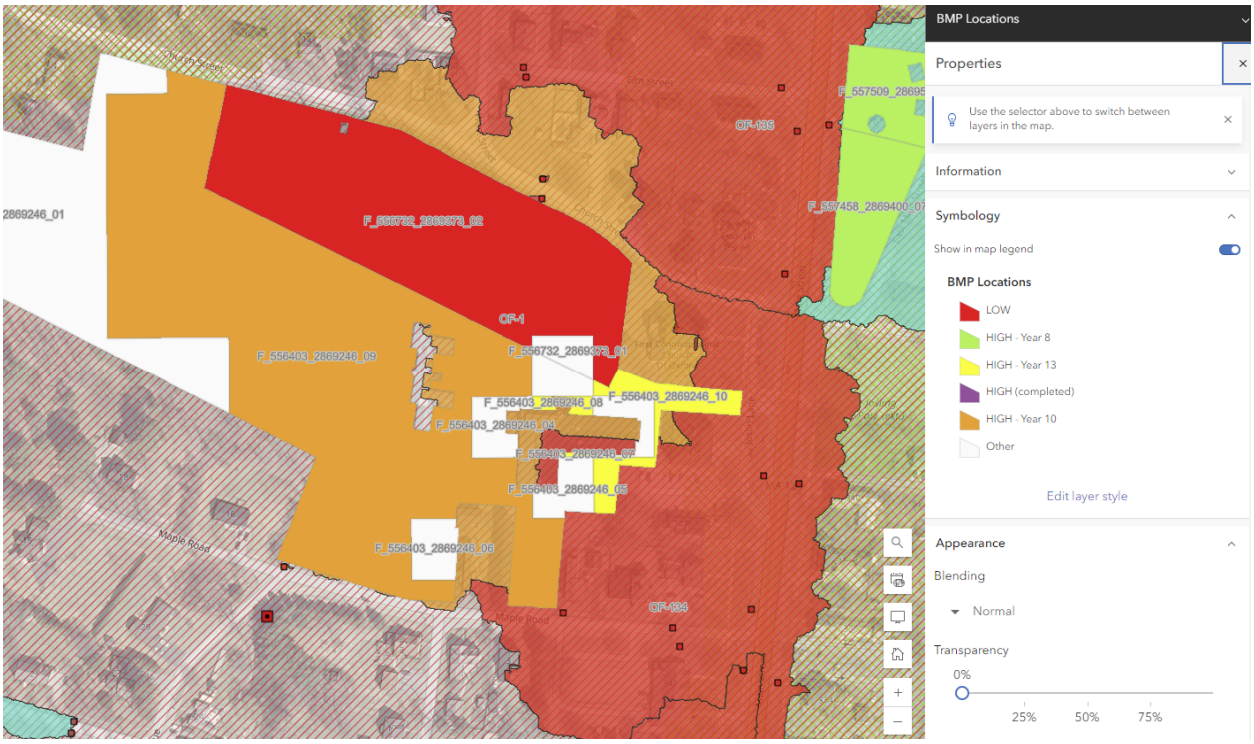


Figure 8. Potential BMP locations at 0 Maple Road. The lavender diagonal hatch represents the Lowes Pond watershed. The blue/green hatch outlined in blue represents the catchment area for the BMP location.

BMP Location ID: F_556901_2867471_01

Site Address: 3 BARTON ST; Facilities Maintenance Engineering Building

Within Urbanized Area: YES

Within Pond Watershed: Lowes Pond

Outfall Catchment(s): OF-142

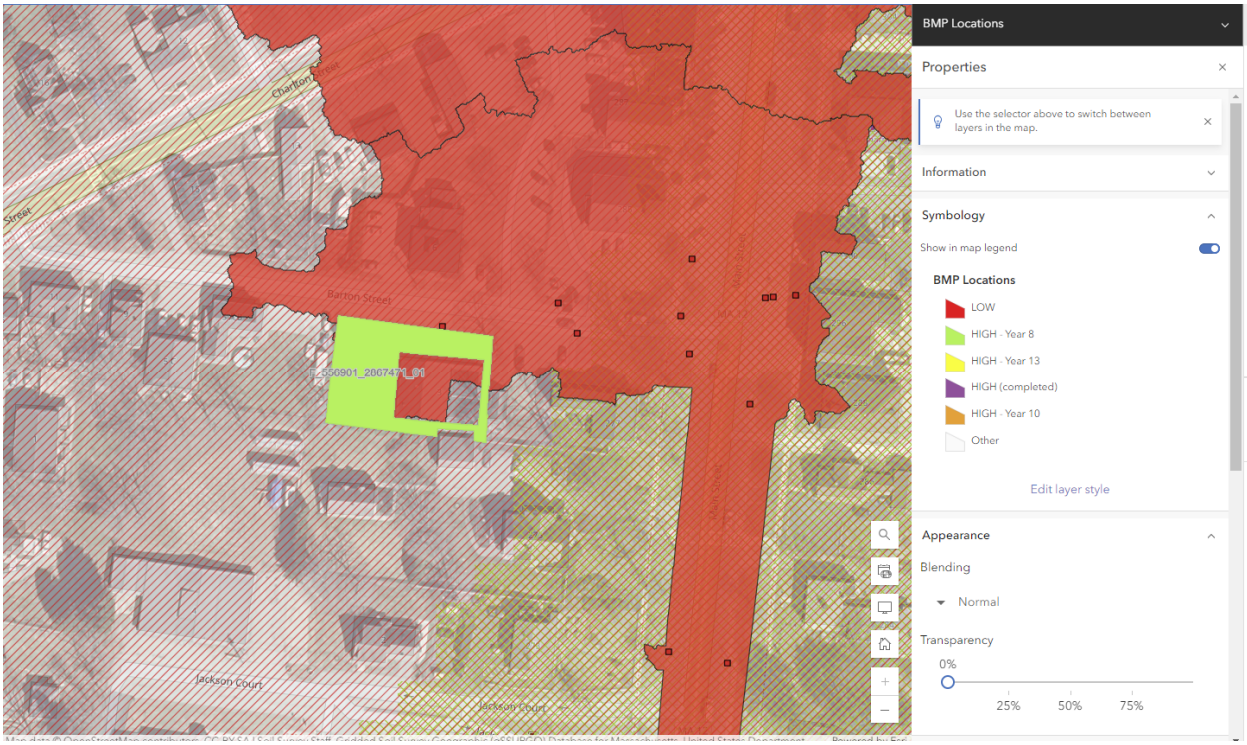


Figure 9. Potential BMP location at 3 Barton Street. The lavender diagonal hatch represents the Lowes Pond watershed. The blue/green hatch outlined in blue represents the catchment area for the BMP location.

BMP Location ID: F_557059_2868110_01

Site Address: 325 MAIN ST; Town Hall

Within Urbanized Area: YES

Within Pond Watershed: Lowes Pond

Outfall Catchment(s): OF-134

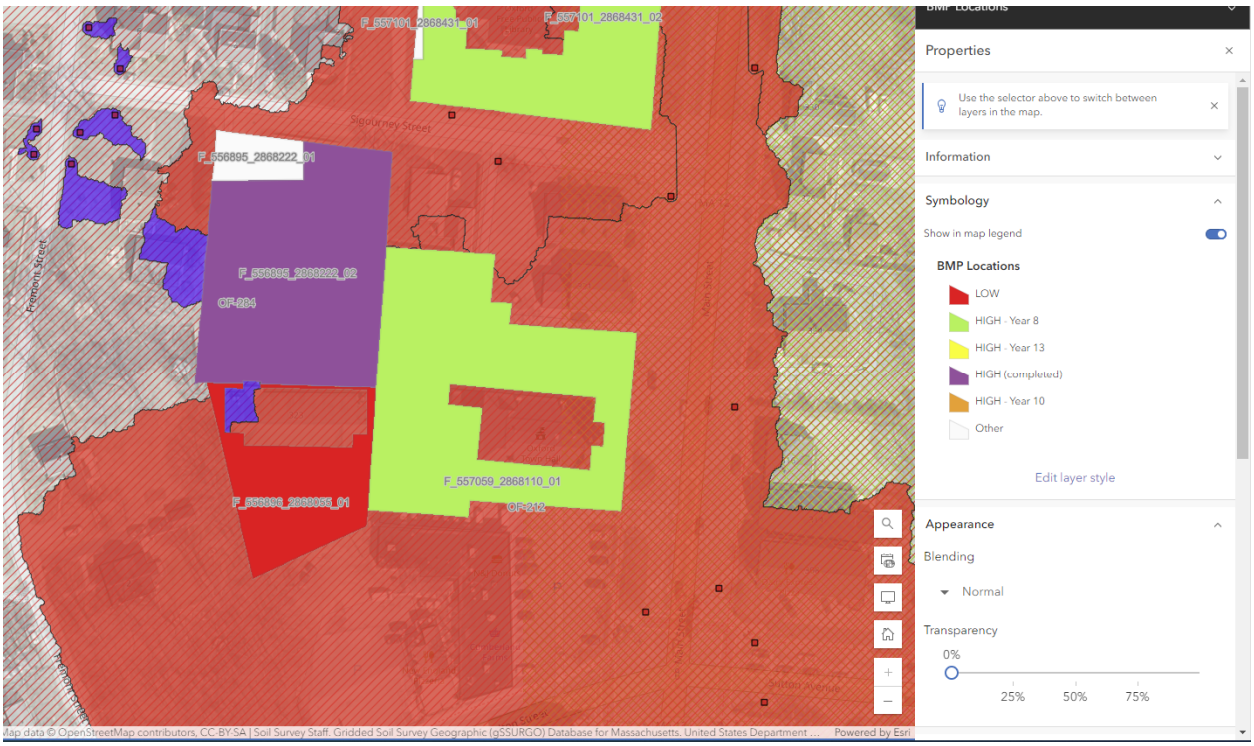


Figure 10. Potential BMP location at 325 Main Street. The lavender diagonal hatch represents the Lowes Pond watershed. The blue/green hatch outlined in blue represents the catchment area for the BMP location.

BMP Location ID: F_557101_2868431_02

Site Address: 339 MAIN ST; Library

Within Urbanized Area: YES

Within Pond Watershed: Lowes Pond

Outfall Catchment(s): OF-134

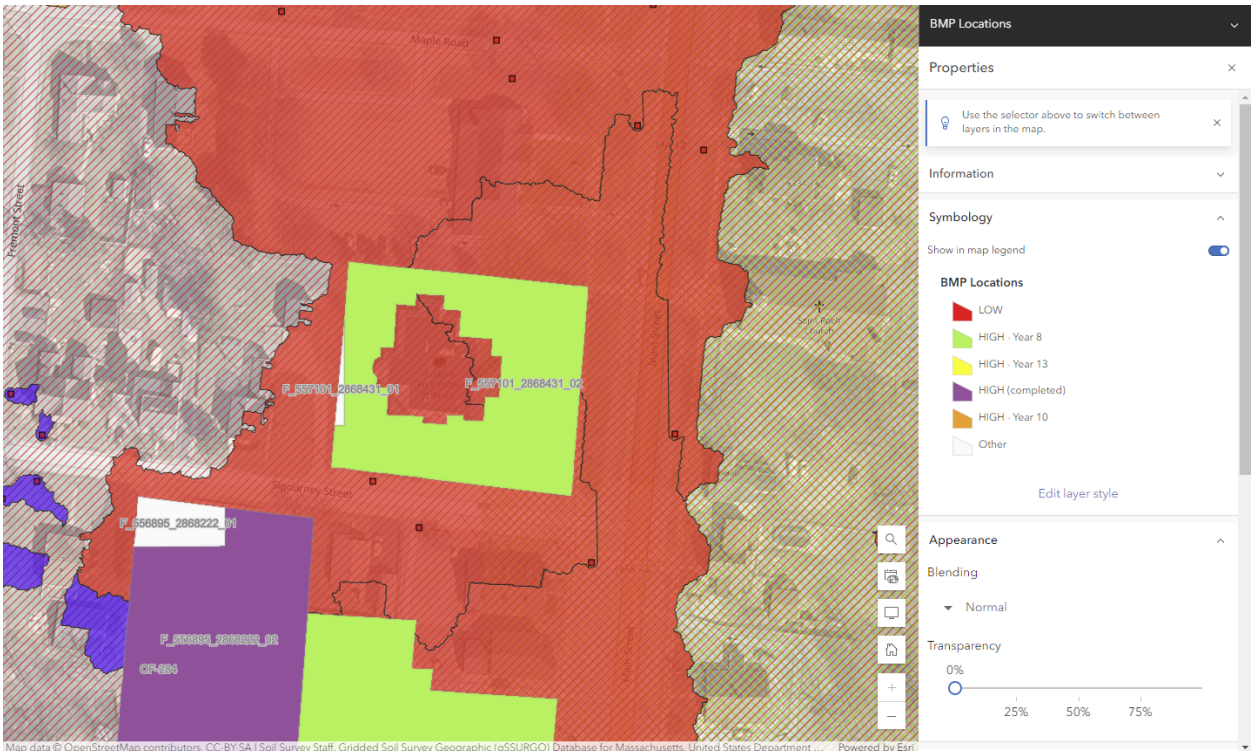


Figure 11. Potential BMP location at 339 Main Street. The lavender diagonal hatch represents the Lowes Pond watershed. The blue/green hatch outlined in blue represents the catchment area for the BMP location.

BMP Location ID: F_557338_2873475_01

Site Address: 450 MAIN ST; DPW Headquarters

Within Urbanized Area: YES

Within Pond Watershed: Lowes Pond

Outfall Catchment(s): OF-240

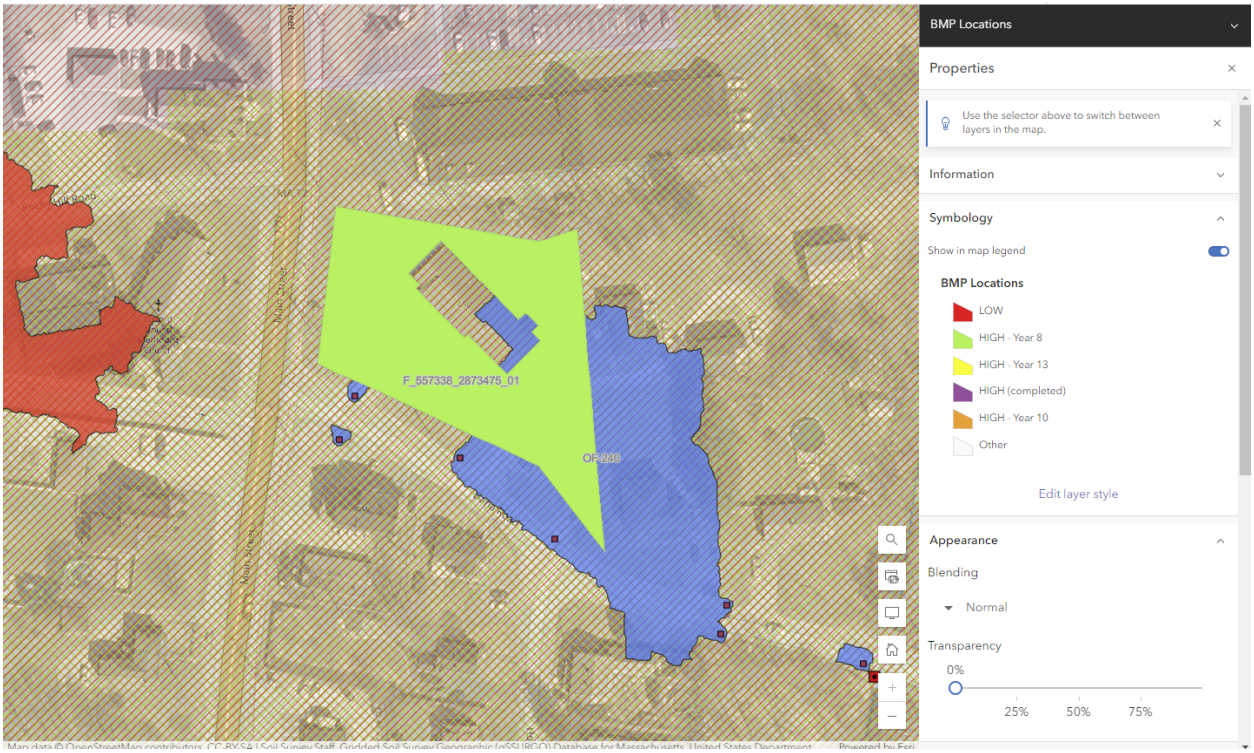


Figure 12. Potential BMP location at 450 Main Street. The lavender diagonal hatch represents the Lowes Pond watershed. The blue/green hatch outlined in blue represents the catchment area for the BMP location.

BMP Location ID: F_557458_2869400_07; F_557509_2869588_01

Site Address: 350/352 MAIN ST; Joslin Park

Within Urbanized Area: YES

Within Pond Watershed: Lowes Pond

Outfall Catchment(s): OF-135 or OF-229

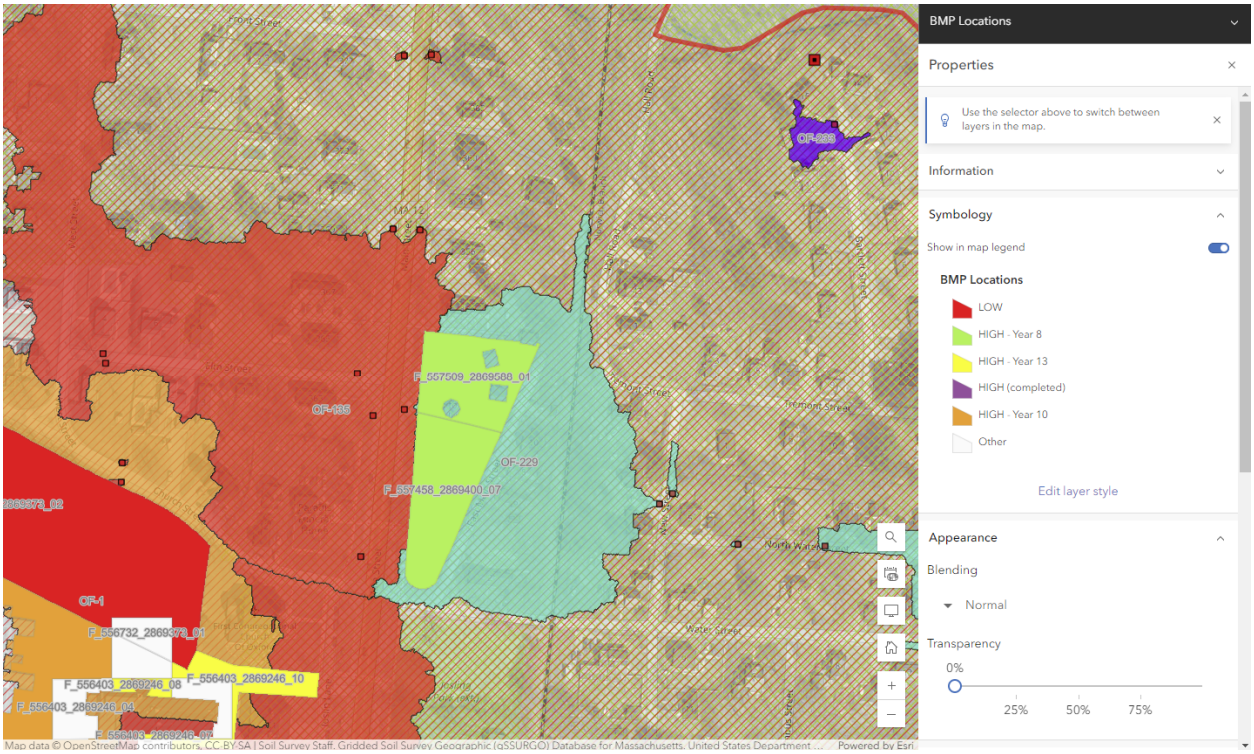


Figure 13. Potential BMP locations at 350/352 Main Street. The lavender diagonal hatch represents the Lowes Pond watershed. The blue/green hatch outlined in blue represents the catchment area for the BMP location.

6.4 Road Assessment & Pavement Management Plan

To supplement the potential phosphorus load reductions associated with structural stormwater BMP installation on municipal-owned properties and non-structural enhancements (catch basin cleaning, leaf litter cleanup, and street sweeping), the Town of Oxford evaluated the potential for increased pollutant removal from municipal-owned roadways. For the intent of the LPCP, this analysis focused on the municipal-owned roadways (designated as "right of way" land use according to 2016 Land Use and Land Cover from MassDEP GIS data) within the LPCP Area.

A range of phosphorus load reductions for roadway retrofits was estimated using two (2) representative stormwater best management practices (BMPs):

- Infiltration Trenches, conservatively assuming Type C soils (0.17 in/hr infiltration rate)
- Rain Gardens, filtration-based practice to be implemented in areas with limited infiltration potential

Phosphorus load reductions for both BMP types were assumed based on treatment of the 1.0-inch water quality storm. The resulting potential phosphorous load reductions are estimated to be 53% (low) for non-infiltrating rain gardens and 90% (high) for infiltration trenches.

The length of roadway needed to achieve the necessary load reductions for each incremental reduction goal was estimated by calculating acres of impervious area in the right of way with an assumed street width of 30 feet. Phosphorus load for the resulting acreage was calculated using a PLER of 1.95 lbs/acre/year (from the Crosswalk of 2016 Land Use and Land Cover categories and 2016 Small MS4 Pollutant Loading Export Rates provided by MassDEP and EPA Region 1). Table 14 below shows the total amount of roads that would need to be treated by Year 15 to reach the 100% reduction milestone goal.

Table 14. Summary of potential Phosphorus removal along Town-owned roadways within each LPCP watershed

Watershed	Town Roads to be Treated by Year 15 (LF)	Total Phosphorus Load for Roads to be Treated by Year 15 (lb/year)	Potential Phosphorus Removal (53%, Low) (lb/yr)	Potential Phosphorus Removal (90%, High) (lb/yr)
Buffumville Lake	4,750	6.38	3.38	5.74
Lowes Pond	55,440	74.45	39.46	67.01
McKinstry Pond	6,810	9.15	4.85	8.23
Robinson Pond	500	0.67	0.36	0.60
Texas Pond	7,560	10.15	5.38	9.14

Results from the road assessment were incorporated into the Implementation Plan provided in Section 8 of this report. Refer to the spreadsheet in Appendix J for additional information.

The Town of Oxford developed a series of structural BMP details to facilitate future stormwater improvements in routine roadway projects. These details include:

- Bioretention Basin
- Bioretention Basin with Subsurface Storage
- Perforated Pipe in Stone Trench (infiltration)
- Porous Asphalt Sidewalk
- Roadside Shoulder Filtration Trench
- Water Quality Swale
- Dry Well

The Bioretention Basin with Subsurface Storage, Porous Asphalt Sidewalk, and Perforated Pipe in Stone Trench (infiltration) were utilized at the Sigourney/Fremont pilot project, as summarized in Section 8.2.

7 Operation and Maintenance (O&M) Program

In compliance with Section 2.3.7 of the Permit, the Town of Oxford developed written O&M procedures to formalize the maintenance activities that are being undertaken to address stormwater infrastructure O&M requirements of the 2016 Massachusetts MS4 Permit. Refer to the Town of Oxford Municipal Stormwater Infrastructure Operation and Maintenance Plan for the procedures relative to each of the referenced maintenance activities:

https://www.oxfordma.us/sites/g/files/vyhlif4836/f/uploads/municipal_stormwater_infrastructure_om_plan.pdf

This document is intended to expand upon the Town of Oxford Municipal Stormwater Infrastructure Operation and Maintenance Plan to include potential future stormwater best management practices. As required in Appendix F of the Permit, this Plan provides an Operation and Maintenance Program for all structural BMPs being claimed for phosphorus reduction credit. This includes BMPs implemented to date as well as BMPs to be implemented. This Operation and Maintenance Program shall become part of the LPCP and will continue to be updated as BMPs are implemented to include: (1) inspection and maintenance schedule for each installed BMP according to BMP design or manufacturer specification and (2) program or department responsible for BMP maintenance.

The Town of Oxford's Municipal Stormwater Operations and Maintenance Program is documented in Appendix K.

8 LPCP Implementation Schedule

The Town of Oxford has prepared an implementation schedule of the Lake Phosphorus Control Plan. The full schedule is included in Appendix L. Additional details are available upon request from the Oxford Department of Public Works.

8.1 Buffumville Lake

Buffumville Lake is required to achieve 28% reduction, which translates to 4.26 lbs/yr by Year 15. By Year 15:

- Non-Structural BMPs are anticipated to reduce a total of 0.88 lbs/yr of phosphorus, or 21% of the target phosphorus reduction.
- Structural and semi-structural BMPs adjacent to town roads are anticipated to reduce a total of 3.38 lbs/yr of phosphorus, or 79% of the target phosphorus reduction using the mechanisms described above.
- Based on these estimates, the Year 15 milestone is expected to be achieved with these non-structural and structural BMP strategies. Further analysis and refined design calculations will be performed during Years 8-15 to ensure each milestone will be met.

Table 15. LPCP Implementation Schedule for Buffumville Lake.

LPCP Implementation Schedule - BUFFUMVILLE LAKE									
Milestone	Phosphorus Reduction Goal (lb/yr)	Structural BMP Credits for town-owned properties (lb/yr)	Non-Structural BMP Credits (lb/yr)	Structural BMPs adjacent to Roadways Credits (lb/yr)	Total BMP Credits (lb/year)	Percent of Milestone Goal	LF of Road Needing Treatment	Acres of Road Needing Treatment	Total "Right of Way" Impervious Acres in Watershed
Year 8 (2026)	0.85	0	0.88	0.00	**0.88**	104%	n/a		
Year 10 (2028)	1.70	0	0.88	0.82	**1.70**	100%	1,150		
Year 13 (2031)	2.98	0	0.88	2.10	**2.98**	100%	2,950		
Year 15 (2033)	4.26	0	0.88	3.38	**4.26**	100%	4,750	3.27	3.13

8.2 Lowes Pond

Lowes Pond is required to achieve 51% reduction, which translates to 56.81 lbs/yr by Year 15. By Year 15:

- Non-Structural BMPs are anticipated to reduce a total of 6.89 lbs/yr of phosphorus, or 12% of the target phosphorus reduction.
- Structural and semi-structural BMPs on town-owned properties and adjacent to town roads are anticipated to reduce a total of 49.92 lbs/yr of phosphorus, or 88% of the target phosphorus reduction using the mechanisms described above.
- Based on these estimates, the Year 15 milestone is **not** expected to be achieved with only these non-structural and structural BMP strategies. Further analysis and refined design calculations will be performed to identify additional options and strategies that will meet required milestones.

Table 16. LPCP Implementation Schedule for Lowes Pond.

LPCP Implementation Schedule - LOWES POND									
Milestone	Phosphorus Reduction Goal (lb/yr)	Structural BMP Credits for town-owned properties (lb/yr)*	Non-Structural BMP Credits (lb/yr)	Structural BMPs adjacent to Roadways Credits (lb/yr)	Total BMP Credits (lb/year)	Percent of Milestone Goal	LF of Road Needing Treatment	Acres of Road Needing Treatment	Total "Right of Way" Impervious Acres in Watershed (L, McK, & R)
Year 8 (2026)	11.36	5.48	6.89	0.00	**12.37**	109%	n/a		
Year 10 (2028)	22.72	13.04	6.89	2.79	**22.72**	100%	3,920		
Year 13 (2031)	39.77	13.04	6.89	19.84	**39.77**	100%	27,880	19.20	24.98
Year 15 (2033)	56.81	13.04	6.89	36.88	**56.81**	100%	51,810	35.68	24.98

*total of 12 potential BMP locations with estimated total potential removal of 10.46; note that OF-134 was considered "maxed out" at 8.68 lb/yr; see BMP prioritization; Year 8 Structural BMP Credits includes installed Sigourney/Fremont Project (1.45 lb/yr), Lowes Pond Dam Repair Project (0.12 lb/yr), & 2 Church Street Drywells (1.01 lb/yr)

A demonstration project was installed in the Lowes Pond watershed during Permit Year 6 (summer of 2023) and is expected to reduce phosphorus loading by 1.45 lbs/year. Also, two catch basins on Church Street were replaced with dry wells and are expected to reduce phosphorus loading by a total of 1.01 lbs/year. These projects area described in Appendix M. In addition, the Lowes Dam Repair Project is anticipated to reduce phosphorus loading by 0.12 lb/year when completed by 2026.

8.3 McKinstry Pond

McKinstry Pond is required to achieve 79% reduction, which translates to 5.24 lbs/yr by Year 15. By Year 15:

- Non-Structural BMPs are anticipated to reduce a total of 0.39 lbs/yr of phosphorus, or 7% of the target phosphorus reduction.
- Structural and semi-structural BMPs adjacent to town roads are anticipated to reduce a total of 4.85 lbs/yr of phosphorus, or 93% of the target phosphorus reduction using the mechanisms described above.
- Based on these estimates, Year 13 & 15 milestones are **not** expected to be achieved with only these non-structural and structural BMP strategies. Further analysis and refined design calculations will be performed to identify additional options and strategies that will meet required milestones.

Table 17. LPCP Implementation Schedule for McKinstry Pond.

LPCP Implementation Schedule - MCKINSTRY POND									
Milestone	Phosphorus Reduction Goal (lb/yr)	Structural BMP Credits for town-owned properties (lb/yr)	Non-Structural BMP Credits (lb/yr)	Structural BMPs adjacent to Roadways Credits (lb/yr)	Total BMP Credits (lb/year)	Percent of Milestone Goal	LF of Road Needing Treatment	Acres of Road Needing Treatment	Total "Right of Way" Impervious Acres in Watershed
Year 8 (2026)	1.05	0	0.39	0.66	**1.05**	100%	930	0.64	1.45
Year 10 (2028)	2.10	0	0.39	1.71	**2.10**	100%	2,400	1.65	1.45
Year 13 (2031)	3.67	0	0.39	3.28	**3.67**	100%	4,610	3.17	1.45
Year 15 (2033)	5.24	0	0.39	4.85	**5.24**	100%	6,810	4.69	1.45

8.4 Robinson Pond

Robinson Pond is required to achieve 8% reduction, which translates to 0.47 lbs/yr by Year 15. By Year 15:

- Non-Structural BMPs are anticipated to reduce a total of 0.11 lbs/yr of phosphorus, or 23% of the target phosphorus reduction.
- Structural and semi-structural BMPs adjacent to town roads are anticipated to reduce a total of 0.36 lbs/yr of phosphorus, or 77% of the target phosphorus reduction using the mechanisms described above.
- Based on these estimates, the Year 15 milestone is expected to be achieved with these non-structural and structural BMP strategies. Further analysis and refined design calculations will be performed during Years 8-15 to ensure each milestone will be met.

Table 18. LPCP Implementation Schedule for Robinson Pond.

LPCP Implementation Schedule - ROBINSON POND									
Milestone	Phosphorus Reduction Goal (lb/yr)	Structural BMP Credits for town-owned properties (lb/yr)	Non-Structural BMP Credits (lb/yr)	Structural BMPs adjacent to Roadways Credits (lb/yr)	Total BMP Credits (lb/year)	Percent of Milestone Goal	LF of Road Needing Treatment	Acres of Road Needing Treatment	Total "Right of Way" Impervious Acres in Watershed
Year 8 (2026)	0.09	0	0.11	0.00	**0.11**	122%	n/a		
Year 10 (2028)	0.19	0	0.11	0.08	**0.19**	100%	110		
Year 13 (2031)	0.33	0	0.11	0.22	**0.33**	100%	310		
Year 15 (2033)	0.47	0	0.11	0.36	**0.47**	100%	500	0.34	0.29

8.5 Texas Pond

Texas Pond is required to achieve 21% reduction, which translates to 7.21 lbs/yr by Year 15. By Year 15:

- Non-Structural BMPs are anticipated to reduce a total of 1.83 lbs/yr of phosphorus, or 25% of the target phosphorus reduction.
- Structural and semi-structural BMPs adjacent to town roads are anticipated to reduce a total of 5.38 lbs/yr of phosphorus, or 75% of the target phosphorus reduction using the mechanisms described above.
- Based on these estimates, the Year 15 milestone is expected to be achieved with these non-structural and structural BMP strategies. Further analysis and refined design calculations will be performed during Years 8-15 to ensure each milestone will be met.

Table 19. LPCP Implementation Schedule for Texas Pond.

LPCP Implementation Schedule - TEXAS POND									
Milestone	Phosphorus Reduction Goal (lb/yr)	Structural BMP Credits for town-owned properties (lb/yr)	Non-Structural BMP Credits (lb/yr)	Structural BMPs adjacent to Roadways Credits (lb/yr)	Total BMP Credits (lb/year)	Percent of Milestone Goal	LF of Road Needing Treatment	Acres of Road Needing Treatment	Total "Right of Way" Impervious Acres in Watershed
Year 8 (2026)	1.44	0	1.83	0.00	**1.83**	127%	n/a		
Year 10 (2028)	2.89	0	1.83	1.06	**2.89**	100%	1,490		
Year 13 (2031)	5.05	0	1.83	3.22	**5.05**	100%	4,530		
Year 15 (2033)	7.21	0	1.83	5.38	**7.21**	100%	7,560	5.21	7.47

9 Estimated Cost for LPCP Implementation & Funding Source Assessment

The Town of Oxford has developed an estimated cost to implement the LPCP through Permit Year 8. This cost estimate is included in Appendix N.

As previously noted, a funding source assessment was conducted by Tighe & Bond and can be found in the 2020 memo attached as Appendix B. Property taxes paid into the General Fund are the current source of funding for stormwater management efforts. Potential funding sources include Massachusetts Municipal Water Infrastructure Investment Fund, Stormwater Enterprise Fund, along with loans and grants.

The Town of Oxford is willing to partner with neighboring towns or watershed associations for additional grant funding opportunities.

10 Performance Evaluation

From Appendix F of the MS4 Permit: "Performance Evaluation – The permittee shall evaluate the effectiveness of the LPCP by tracking the phosphorus reductions achieved through implementation of structural and non-structural BMPs and tracking increases in phosphorus loading from the LPCP Area beginning six years after the effective date of the permit. Phosphorus reductions shall be calculated consistent with Attachment 2 (non-structural BMP performance), Attachment 3 (structural BMP performance) and Attachment 1 (reductions through land use change), to Appendix F for all BMPs implemented to date. Phosphorus load increases resulting from development shall be calculated consistent with Attachment 1 to Appendix F. Phosphorus loading increases and reductions in units of mass/yr shall be added or subtracted from the calculated Baseline Phosphorus Load to estimate the yearly phosphorous export rate from the LPCP Area in mass/yr. The permittee shall also include all information required in part II.2 of this Appendix in each performance evaluation."

10.1 Year 6 Updates (2023-2024)

The updates to the LPCP efforts in Year 6 encompass the requirements of the Performance Evaluation. Significant reductions achieved through the implementation of structural and non-structural controls are incorporated into the LPCP Implementation Schedule in Section 8. No projects implemented from 2026 to 2023 have contributed to a significant increase in Phosphorus loading. All calculations were done consistent with the methods outlined in the MS4 Permit Appendix F.

11 Conclusion and Recommendations

The Town of Oxford will continue to coordinate with MassDEP and EPA on the status and requirements of the ponds that have been removed from the 2022 303(d) Integrated Lists of Waters (impairments for phosphorus) but remain part of the 1999 TMDL. These include Buffumville Lake, Robinson Pond, and Texas Pond. The Town of Oxford maintains that priority for resource allocation should go to water bodies that are currently impaired for phosphorus, while continuing to work with DEP on the requirements for non-impaired water bodies.

The Town of Oxford will continue to evaluate potential funding sources for LPCP implementation. Currently, potential sources include Massachusetts Municipal Water Infrastructure Investment Fund, Stormwater Enterprise Fund, along with additional loans and grants available through local, state or federal programs. The Town of Oxford is willing to partner with neighboring towns or watershed associations for additional grant funding opportunities.

Additional work for the Lake Phosphorus Control Plan will be conducted in subsequent years to meet requirements of the MS4 Permit Appendix F.

Appendix A – Calculation & GIS Methods

Appendix A - Calculation Methods

Year 4 Oxford MS4 Permit Analysis

This document serves as Appendix A to the Town of Oxford's Year 4 Nutrient Source Identification Report and Phosphorus Control Plan updates as required by the 2016 MA Small MS4 Permit. This document outlines the methodology utilized for the nutrient analysis in both documents, which were performed using ArcGIS Pro 2.8.0.

1. Data Sources

- Pond Watersheds - StreamStats (usgs.gov)
- 2000 Urbanized Areas - Layer: Urbanized Areas (ID: 4) (census.gov)
- 2010 Urbanized Areas - Layer: Urbanized Areas (ID: 1) (census.gov)
- 2016 Land Cover Land Use (four blocks) - MassGIS Data: 2016 Land Cover/Land Use | Mass.gov
- Hydrologic Soil Groups - MassGIS Data: Soils SSURGO-Certified NRCS | Mass.gov
- Tax Parcels from Oxford, MA - Judy Lochner jlochner@oxfordma.us
- Oxford MA MS4 year 3 drainage catchment area – Town of Oxford (received 2/10/2022)
- Municipal Boundaries - MassGIS Data: Municipalities | Mass.gov
- MassDEP Wellhead Protection Areas (Zone II, Zone I, IWPA) - MassGIS Data: MassDEP Wellhead Protection Areas (Zone II, Zone I, IWPA) | Mass.gov
- Surface Water Supply Protection Areas (ZONE A, B, C) - MassGIS Data: Surface Water Supply Protection Areas (ZONE A, B, C) | Mass.gov
- NHESP Certified Vernal Pools - MassGIS Data: NHESP Certified Vernal Pools | Mass.gov
- BioMap2 - MassGIS: BioMap2 | Mass.gov
- Building Structures (2-D) - MassGIS Data: Building Structures (2-D) | Mass.gov
- MassDEP Wetlands (2005) - MassGIS Data: MassDEP Wetlands (2005) | Mass.gov
- 2020 Environmental Justice Populations - MassGIS Data: 2020 Environmental Justice Populations | Mass.gov
- Public Water Supplies - MassGIS Data: Public Water Supplies | Mass.gov
- Lidar DEM and Shaded Relief - MassGIS Data: Lidar DEM and Shaded Relief | Mass.gov

2. Creation of Base Shapefiles for Phosphorus and Nitrogen Calculations

To define the area of analysis for Phosphorus and Nitrogen calculations, pond watersheds, urbanized area, land cover land use, NRCS soils, and MassDOT road inventory datasets where clipped within the

Oxford, MA municipal boundary. The MassDOT road inventory was used to find State and Federal roads which, when overlayed on the Oxford tax parcel dataset, distinguished right-of-way parcels under State and Federal jurisdiction and therefore not included in the Phosphorus and Nitrogen calculation area. Similarly, Federal and State-owned tax parcels were identified from the attributes of the Oxford tax parcel dataset and removed from the Phosphorus and Nitrogen calculation area. Finally, the urbanized area dataset was used as the boundary of the area considered for Phosphorus and Nitrogen calculations.

To create the base shapefiles for phosphorus and nitrogen loading calculations, 2016 Land Use/Land Cover data from MassGIS was combined with NRCS SSURGO-Certified Soils data. The union of the two datasets created small "records" that were referenced in calculations to find specific Nitrogen or Phosphorus Loads. Each record in the shapefile represents an area with a specific land cover, land use, and soil type.

3. Phosphorus Load Calculations

Annual Phosphorus Load for each record was determined using methodology found in Attachment 1 to Appendix F of the 2016 MS4 Permit. Phosphorus Loading Export rates (PLERs) were determined using crosswalk in the document entitled "2016 Massachusetts Small MS4 Permit Pollutant Loading Export Rates applied to the 2016 Massachusetts Land Use/Land Cover GIS Dataset" published by MassDEP and EPA Region 1.

Watershed areas of the Oxford's lakes and ponds identified in the MS4 Permit were created with USGS's Stream Stats program, using a single pour point at the lowest end of each pond. The pond watersheds dataset was used as the clip feature in a "Clip" function targeted at the land cover/land use/NRCS soils dataset described in the last section. The resulting shapefile limits the information contained in the broader town-wide Phosphorus load to only what occurs in each of Oxford's pond watersheds of concern, allowing further pond-specific analysis of Phosphorus loading.

In the shapefiles produced, a field entitled "Acres" was added to the attribute table. The "Calculate Geometry" function was used, in acre area (geodesic), to populate the field with individual land cover/land use/NRCS soil record areas. This field allowed for the calculation of each record's phosphorus load in pounds per year when multiplied by the "PLER" field.

In the shapefiles, a field entitled "PLER" was added to the attribute table. For the "PLER" field, a "Field Calculator" function was used to provide a Phosphorus Loading Export Rate (PLER) for each record. PLER is measured in pounds phosphorus per acre per year. PLER was determined using the MassDEP and EPA Region 1 developed crosswalk between the 2016 land use land cover dataset and the EPA Region 1 Pollutant Load Export Rates developed as part of the 2016 MS4 permit. The Table below was prepared by MassDEP and EPA Region 1 to ensure consistency of PLER across records. Using the table, a python script was created for the field calculator.

LAND USE CLASSES	LAND COVER CLASSES																
	IMPERVIOUS	DEVELOPED SPACE OPEN	CULTIVATED	PASTURE/ HAY	GRASSLAND	DECIDUOUS	EVERGREEN	SHRUB/ SCRUB	FORESTED PALUSTRINE	SHRUB/SCRUB PALUSTRINE	EMERGENT PALUSTRINE	FORESTED ESTUARINE	SHRUB/SCRUB ESTUARINE	EMERGENT ESTUARINE	SHORED UNCONSOLIDATE	BARE	WATER	BED AQUATIC PALUSTRINE	BED AQUATIC ESTUARINE
UNKNOWN	1.52	0.03 - 0.37 *by HSG	0.45	0.45	0.03 - 0.37 *by HSG	0.13	0.13	0.13	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	Water	Water	Water
OPEN LAND	1.52	0.03 - 0.37 *by HSG	0.45	0.45	0.03 - 0.37 *by HSG	0.13	0.13	0.13	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	Water	Water	Water
COMMERCIAL	1.78	0.03 - 0.37 *by HSG	0.45	0.45	0.03 - 0.37 *by HSG	0.13	0.13	0.13	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	Water	Water	Water
INDUSTRIAL	1.78	0.03 - 0.37 *by HSG	0.45	0.45	0.03 - 0.37 *by HSG	0.13	0.13	0.13	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	Water	Water	Water
FOREST	1.52	0.13	0.13	0.45	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	Water	Water	Water
AGRICULTURAL	1.52	0.45	0.45	0.45	0.45	0.13	0.13	0.13	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	Water	Water	Water
RECREATIONAL	1.52	0.03 - 0.37 *by HSG	0.45	0.45	0.03 - 0.37 *by HSG	0.13	0.13	0.13	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	Water	Water	Water
TAX EXEMPT	1.78	0.03 - 0.37 *by HSG	0.45	0.45	0.03 - 0.37 *by HSG	0.13	0.13	0.13	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	Water	Water	Water
MIXED-PRIMARILY RESIDENTIAL	2.32	0.03 - 0.37 *by HSG	0.45	0.45	0.03 - 0.37 *by HSG	0.13	0.13	0.13	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	Water	Water	Water
SINGLE FAMILY RESIDENTIAL	1.96	0.03 - 0.37 *by HSG	0.45	0.45	0.03 - 0.37 *by HSG	0.13	0.13	0.13	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	Water	Water	Water
MULTI-FAMILY RESIDENTIAL	2.32	0.03 - 0.37 *by HSG	0.45	0.45	0.03 - 0.37 *by HSG	0.13	0.13	0.13	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	Water	Water	Water
OTHER RESIDENTIAL	1.96	0.03 - 0.37 *by HSG	0.45	0.45	0.03 - 0.37 *by HSG	0.13	0.13	0.13	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	Water	Water	Water
MIXED OTHER	1.78	0.03 - 0.37 *by HSG	0.45	0.45	0.03 - 0.37 *by HSG	0.13	0.13	0.13	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	Water	Water	Water
MIXED COMMMERCIAL	1.78	0.03 - 0.37 *by HSG	0.45	0.45	0.03 - 0.37 *by HSG	0.13	0.13	0.13	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	Water	Water	Water
RIGHT OF WAY	1.95	0.03 - 0.37 *by HSG	0.45	0.45	0.03 - 0.37 *by HSG	0.13	0.13	0.13	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	Water	Water	Water
WATER	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water

Figure 1. Crosswalk of 2016 Land Use and Land Cover categories and PLERs in lbs/acre/year from MassDEP & EPA Region 1 (Note: Hydrologic Soil Group (HSG) A and A/D have a PLER of 0.03, HSG B and B/D have a PLER of 0.12, HSG C and C/D and Unknown have a PLER of 0.21, and HSG D has a PLER of 0.37)

In the shapefiles, a field entitled “PLoadLbYr” was added to the attribute table. For the “PLoadLbYr” field, a “Field Calculator” function was used to provide a Phosphorus Loading Pounds Per Year for each record. By multiplying the record’s acre area (from the “Acre” field) by the record’s PLER (from the “PLER” field) the record’s pounds phosphorus per year was calculated. Using the “Dissolve” function, all records were dissolved together by pond watershed name, with a “SUM” field statistics option selected for the “PLoadLbYr” field. The resulting shapefiles contained a simple table of the pond watershed name and the Phosphorus Loading Pounds per Year associated with the land it encompassed. Further details and the exact steps in this workflow can be found in the “Nitrogen & Phosphorus Loading Calculation Workflow” section of this document.

4. Nitrogen Load Calculations

Annual Nitrogen Load for each record was determined using methodology described in a document entitled “Nutrient Source Identification Report Addendum: Methods” dated June 10, 2021 and prepared by Neponset River Watershed Association. For the Nitrogen loading analysis, a “Loading Export Rate” field was created, along with a field containing the area of a record and final “Loading Pound Per Year” amount.

Nitrogen loads were calculated for each record in the “Oxford MA MS4 year 3 drainage catchment area” model. The catchment area dataset was used as the clip feature in a “Clip” function targeted at the land cover/land use/NRCS soils dataset described in the last section. The resulting shapefile limits the information contained in the larger town-wide Nitrogen load calculation to only what occurs in each drainage catchment area, allowing catchment-specific analysis of Nitrogen loading.

In the shapefiles produced, a field entitled “Acres” was added to the attribute table. The “Calculate Geometry” function was used, in acre area (geodesic), to populate the field with individual land cover/land

use/NRCS soil record areas. This field would allow for the calculation of each records nitrogen loading pounds per year when multiplied by the field described below.

In the shapefiles, a field entitled “NLER” was added to the attribute table. For the “NLER” field, a “Field Calculator” function was used to provide a Nitrogen Loading Export Rate (NLER) for each record. NLER is measured in pounds nitrogen per acre per year. NLER was determined using the Nitrogen Source Categories and nitrogen load export rates shown in Table 1 of Attachment 1 to Appendix H of the 2016 Massachusetts Small MS4 General Permit. Using the table as reference, a python script was created for the field calculator that assigns a nitrogen loading category to each record and matches it to its corresponding NLER. The Table below was prepared by the Neponset River Watershed Association to demonstrate Land Cover’s link to Nitrogen Source Categories.

Table 1. Nitrogen Loading Export Rates

Land Cover	Soil Type	Nitrogen Source Category
Impervious	All	All Impervious Cover
Water	All	None, rate was set to 0 for records that represented surface water.
Non-Impervious, Non-Water	A	Developed Land Pervious (DevPERV)-HSG A
Non-Impervious, Non-Water	B	Developed Land Pervious (DevPERV)-HSG B
Non-Impervious, Non-Water	C	Developed Land Pervious (DevPERV)-HSG C
Non-Impervious, Non-Water	D	Developed Land Pervious (DevPERV)-HSG D
Non-Impervious, Non-Water	A/D	Developed Land Pervious (DevPERV)-HSG A
Non-Impervious, Non-Water	B/D	Developed Land Pervious (DevPERV)-HSG B
Non-Impervious, Non-Water	C/D	Developed Land Pervious (DevPERV)-HSG C/D

In the shapefiles, a field entitled “NLoadLbYr” was added to the attribute table. For the “NLoadLbYr” field, a “Field Calculator” function was used to provide a Nitrogen Loading Pounds Per Year for each record. By multiplying the record’s acre area, from the “Acre” field, by the record’s NLER, from the “NLER” field, the record’s pounds nitrogen per year was calculated. Using the “Dissolve” function, all records were dissolved together by catchment ID, with a “SUM” field statistics option selected for the “NLoadLbYr” field. The resulting shapefiles contained a simple table of the catchment ID and the Nitrogen Loading Pounds per Year associated with the land it encompassed. Further details and the exact steps in this workflow can be found in the “Nitrogen & Phosphorus Loading Calculation Workflow” section (Section 7) of this document.

5. Impervious Calculation for Catchment Areas

Impervious area within each catchment area was calculated using the land cover, land use, soil type records shapefile described in the Creation of Base Shapefiles for Phosphorus and Nitrogen Calculations section. Note that records outside the Urbanized Area and parcels identified as Federal or State-owned land were not included in the calculations.

The 'Oxford MA MS4 year 3 drainage catchment area" shapefile contains polygons of areas within each catchment with like land cover, land use, and soil type. To begin, the "Oxford MA MS4 year 3 drainage catchment area" was queried so that only polygons with an entry of "Impervious" for the "CoverName" field were shown. Then, the Calculate Geometry tool was used on those queried records to display the area of each impervious polygon in acres. These results were eventually summed for overall catchment totals of impervious area.

To further illustrate impervious cover statistics and for use in Directly Connected Impervious Area (DCIA) calculation, the impervious cover in each polygon was also calculated as a percentage of each catchment. For this measurement, the Field Calculator tool was used on the "ImpPercent" field to divide the impervious area of each polygon ("ImpAreaAcre") by the total catchment size ("CatchAreaAcre", created when preparing the catchment shapefile). This figure was then multiplied by 100 to obtain a percent.

6. DCIA Calculation

Directly Connected Impervious Area (DCIA) estimates were based on the Sutherland equations within the EPA guidance document entitled "Estimating Change in Impervious Area (IA) and Directly Connected Impervious Areas (DCIA) for Massachusetts Small MS4 Permit" (Revised April 2014). Table 2 below shows the relation between various land uses in the watershed, the chosen "connectedness" category, and the associated Sutherland equation used in the DCIA estimate. Note that these estimates only occurred on polygons that contained an "Impervious" entry in the CoverName field, as DCIA only exists where impervious area exists.

Table 2. DCIA Calculations per land use

USEGENNAME	"Connectedness" Category	Sutherland Equation
Agriculture	Mostly Disconnected	$DCIA=0.01(IA)^2$
Commercial	Average	$DCIA=0.1(IA)^{1.5}$
Forest	Mostly Disconnected	$DCIA=0.01(IA)^2$
Industrial	Average	$DCIA=0.1(IA)^{1.5}$
Mixed use, other	Average	$DCIA=0.1(IA)^{1.5}$
Mixed use, primarily commercial	Average	$DCIA=0.1(IA)^{1.5}$
Mixed use, primarily residential	Average	$DCIA=0.1(IA)^{1.5}$
Open land	Average	$DCIA=0.1(IA)^{1.5}$
Recreation	Average	$DCIA=0.1(IA)^{1.5}$
Residential - multi-family	Highly Connected	$DCIA=0.4(IA)^{1.2}$
Residential - other	Average	$DCIA=0.1(IA)^{1.5}$
Residential - single family	Average	$DCIA=0.1(IA)^{1.5}$
Right-of-way	Average	$DCIA=0.1(IA)^{1.5}$
Tax exempt	Average	$DCIA=0.1(IA)^{1.5}$
Unknown	Average	$DCIA=0.1(IA)^{1.5}$
Water	Average	$DCIA=0.1(IA)^{1.5}$

In the “Oxford MA MS4 year 3 drainage catchment area” shapefile, a field entitled “TotalArea” was added to the attribute table. For the “TotalArea” field, a “Calculate Geometry” function was used, in acre area (geodesic), to populate the field with acre areas of the entire associated catchment area. A “Union” function was run between the catchment area shapefile and the land cover, land use, soil type records shapefile described in the Creation of Base Shapefiles for Phosphorus and Nitrogen Calculations section. The unioned dataset was queried so that no polygons with an entry of “<Null>” for the “Catchment ID” field were shown. Only records within the catchment boundaries were displayed.

In these equations, the percentage of impervious cover for a given area is used to determine the percentage of DCIA in the same area. Thus, DCIA percent was calculated in the “DCIAPercent” field

using Field Calculator. In this calculation, the impervious percentage represented by the polygon ("ImpPercent") was raised to the power shown in the appropriate equation (already entered in the "DCIA_E" field when preparing the base shapefile) and multiplied by the factor shown (already entered in the "DCIA_M" field when preparing the base shapefile).

The Field Calculator equation was: "DCIAPercent" = ("ImpPercent" ^ "DCIA_E") * "DCIA_M".

These results were eventually summed for overall catchment totals of impervious area. Finally, the estimated acreage of DCIA for each polygon was calculated in the "DCIAAcre" field using Field Calculator. In this calculation, "DCIAPercent" was divided by 100 and multiplied by the overall catchment size ("CatchAreaAcr" or "CatchAreaA").

7. Nitrogen & Phosphorus Loading Calculation Workflow

1. Download Data:
    - Pond Watersheds (from points which are included in download folders)- StreamStats (usgs.gov)
    - 2000 Urbanized Areas - Layer: Urbanized Areas (ID: 4) (census.gov)
    - 2010 Urbanized Areas - Layer: Urbanized Areas (ID: 1) (census.gov)
    - 2016 Land Cover Land Use (four blocks) - MassGIS Data: 2016 Land Cover/Land Use | Mass.gov
    - Hydrologic Soil Groups - MassGIS Data: Soils SSURGO-Certified NRCS | Mass.gov
    - Utilities from PeopleGIS - www.mapsonline.net/oxfordma/dpw.php
        . Open Drains
        i. Manholes
        ii. Inlets
        iii. Gravity Drains
        iv. Discharge Points
        v. Crossings
        vi. Crossing End Points
    - Tax Parcels from Oxford, MA - Judy Lochner <jlochner@oxfordma.us>
    - MassDOT Road Inventory - Road Inventory 2020 | MassDOT Open Data Portal (arcgis.com)
    - Municipal Boundaries - MassGIS Data: Municipalities | Mass.gov
    - Outfall Catchments (all pipes) - Judy Lochner <jlochner@oxfordma.us>

2. GIS Analysis:
    a. To get Oxford boundary, in (1.i.) properties DEF QUERY Town="Oxford"
    b. BATCH PAIRWISE CLIP (2.b.) areas from
        i. (1.a.)
        ii. (1.b.)
        iii. (1.c.)
        iv. (1.d.)
        v. (1.e.)
        vi. (1.h.)
    c. To get road areas belonging to State and Federal Organizations
        i. In (1.h.) properties DEF QUERY "Jurisdictn" does not include the value(s) "0","2","H" AND "Jurisdictn" is not null
        ii. Overlay (2.c.i.) over (1.g.)
        iii. CREATE SHAPEFILE to hold state/fed road polygons
        iv. CREATE FEATURES to trace (1.g.) parcel boundaries containing (2.c.i.)
    d. To get Federal Owned Parcels:
        i. In (1.g.) properties DEF QUERY "OWNER1" contains the text "UNITED STATES OF AMERICA" OR "LOC_ID" is equal to "F_551778_2870612"
    e. To get State Owned Parcels:

i. In (1.g.) properties DEF QUERY "OWNER1" contains the text "COMMONWEALTH OF MASS"

f. To get total urbanized area, UNION (2.b.ii.) and (2.b.iii.)
g. To get single pond watersheds shapefile, UNION (2.b.i.)
h. To get 2016 land cover land use within Oxford, UNION (2.b.iv)
i. To get land use/land cover/hydr soil groups, outfall catchments, and pond watersheds within urbanized area
    i. UNION (2.h.) and (2.b.v)
    ii. BATCH PAIRWISE ERASE (2.c.), (2.d.), and (2.e.) from
        1. (2.j.i.)
        2. (1.j.)
        3. (2.g.)
    iii. BATCH CLIP (2.f.) from
        1. (2.i.ii.1.)
        2. (2.i.ii.2.)
        3. (2.i.ii.3.)

j. <u>To get Nitrogen Load Export Rate per Outfall Catchment Area</u>

i. To get outfall catchment acre area attribute in (2.i.iii.2.) table
    1. ADD A NEW FIELD "TotalAcres" [double]
    2. CALCULATE GEOMETRY [Area (geodesic), Acres, NAD83 MA Mainland Feet]
ii. UNION (2.i.iii.1.) and (2.j.i.)
iii. To get acre area attribute in (2.j.ii.) table
    1. ADD A NEW FIELD "Acres" [double]
    2. CALCULATE GEOMETRY [Area (geodesic), Acres, NAD83 MA Mainland Feet]
iv. To get impervious acre area in (2.j.iii.) table
    1. ADD A NEW FIELD called "ImpervAcres" [double]
    2. CALCULATE FIELD "ImpervAcres" = 0
    3. SELECT BY ATTRIBUTES Where "COVERNAME" is equal to "Impervious"
    4. CALCULATE GEOMETRY [Area (geodesic), Acres, NAD83 MA Mainland Feet]
v. To get an estimate of percent of catchment area's directly connected impervious area represented by a record in (2.j.iv.) table
    1. ADD A NEW FIELD called "DCIAPercent" [double]
    2. CALCULATE FIELD "DCIAPercent" = DCIAPercent.CAL
vi. To get an estimate the area of directly connected impervious area associated with a record in (2.j.v.) table
    1. ADD A NEW FIELD called "DCIAAcres" [double]
    2. CALCULATE FIELD "DCIAAcres" = ("DCIAPercent"/100) * "TotalAcres"
vii. To get the numerical nitrogen loading rate assigned to a record. The value originates from Table 1 in Attachment 1 of Appendix H of the 2016 Massachusetts Small MS4 General Permit. A/D Hydrologic Soil Group was given a value of (A value * D value)/2. B/D Hydrologic Soil Group was given a value of (B value * D value)/2. Water was given no value.
    1. ADD A NEW FIELD called "NLER" [double]
    2. CALCULATE FIELD "NLER" = 2016 Land Cover Land Use TO NLER.CAL
viii. To get the estimated nitrogen load from a record in (2.j.vii.) table
    1. ADD A NEW FIELD called "NLoadLbYr" [double]
    2. CALCULATE FIELD "NLoadLbYr" = "NLER" * "Acres"
ix. To get Nitrogen Load Export Rate per Outfall Catchment Area table
    1. PAIRWISE DISSOLVE (2.j.viii.) Dissolve_Field = "Outfall_ID" and Statistics Fields = ["Acres" : SUM], ["ImpervAcres" : SUM], ["DCIAAcres" : SUM], ["NLoadLbYr" : SUM]

k. **To get Phosphorus Load Export Rate per Pond Watershed Area**

i. To get pond watershed acre area attribute in (2.i.iii.3.) table
   1. ADD A NEW FIELD "TotalAcres" [double]
   2. CALCULATE GEOMETRY [Area (geodesic), Acres, NAD83 MA Mainland Feet]

ii. UNION (2.i.iii.1.) and (2.k.i.)

iii. To get acre area attribute in (2.k.ii.) table
   1. ADD A NEW FIELD "Acres" [double]
   2. CALCULATE GEOMETRY [Area (geodesic), Acres, NAD83 MA Mainland Feet]

iv. To get impervious acre area in (2.k.iii.) table
   1. ADD A NEW FIELD called "ImpervAcres" [double]
   2. CALCULATE FIELD "ImpervAcres" = 0
   3. SELECT BY ATTRIBUTES Where "COVERNAME" is equal to "Impervious"
   4. CALCULATE GEOMETRY [Area (geodesic), Acres, NAD83 MA Mainland Feet]

v. To get an estimate of percent of watershed's directly connected impervious area represented by a record in (2.k.iv.) table
   1. ADD A NEW FIELD called "DCIAPercent" [double]
   2. CALCULATE FIELD "DCIAPercent" = DCIAPercent.CAL

vi. To get an estimate the area of directly connected impervious area associated with a record in (2.k.v.) table
   1. ADD A NEW FIELD called "DCIAAcres" [double]
   2. CALCULATE FIELD "DCIAAcres" = ("DCIAPercent"/100) * "TotalAcres"

vii. To get the numerical phosphorus loading rate assigned to a record. The value originates from MassGIS's "2016 Massachusetts Small MS4 Permit Pollutant Loading Export Rates applied to the 2016 Massachusetts Land Use/Land Cover GIS Dataset" (download (mass.gov))
   1. ADD A NEW FIELD called "PLER" [double]
   2. CALCULATE FIELD "PLER" = 2016 Land Cover Land Use TO PLER.CAL

viii. To get the estimated phosphorus load from a record in (2.k.vii.) table
   1. ADD A NEW FIELD called "PLoadLbYr" [double]
   2. CALCULATE FIELD "PLoadLbYr" = "PLER" * "Acres"

ix. To get Phosphorus Load Export Rate per Pond Watershed Area table
   1. PAIRWISE DISSOLVE (2.j.viii.) Dissolve_Field = "Outfall_ID" and Statistics Fields = ["Acres" : SUM], ["ImpervAcres" : SUM], ["DCIAAcres" : SUM], ["PLoadLbYr" : SUM]

Year 6 Oxford MS4 Permit Outfall Catchment Re-delineation & Phosphorus Load Updates

Data Collection and Sources

The following data sources were utilized for the re-delineation of outfall catchments and phosphorus load updates:

1. Pond Watersheds - StreamStats (USGS)
2. 2000 Urbanized Areas - Layer: Urbanized Areas (ID: 4) (Census.gov)
3. 2010 Urbanized Areas - Layer: Urbanized Areas (ID: 1) (Census.gov)

4. 2016 Land Cover Land Use (four blocks) - MassGIS Data: 2016 Land Cover/Land Use | Mass.gov
5. Hydrologic Soil Groups - MassGIS Data: Soils SSURGO-Certified NRCS | Mass.gov
6. Oxford MA MS4 Year 3 Drainage Catchment Area – Town of Oxford (received 2/10/2022)
7. Lidar DEM and Shaded Relief - MassGIS Data: Lidar DEM and Shaded Relief | Mass.gov
8. Stormwater Utility Assets from Town of Oxford's SimpliCity account (5/9/2024)

These datasets were sourced from USGS, NOAA, MassGIS, and the Town of Oxford, ensuring reliable and comprehensive spatial data coverage.

GIS Software and Tools

The analysis was conducted using ArcGIS Pro, leveraging the capabilities of Model Builder within it for automating processes. The Spatial Analyst extension was critical for performing advanced spatial analysis and hydrological modeling.

Catchment Re-delineation Process

The delineation of catchment areas primarily relied on a high-resolution ½ft pixel DEM Raster derived from the USGS 2021 LiDAR. The process involved several key steps:

DEM and Utility Preparation:

To prepare the DEM, the USGS 2021 LiDAR data for the entire area of Oxford, MA, was downloaded as LAS files in NAD83 Ft and NAVD88 Ft, split into three sections for ease of download. An LAS dataset was created from the downloaded files, filtering the dataset to include only LiDAR categorized as buildings, ground, water, and bridges, along with the last return type.

Using the LAS Dataset to Raster tool, a DEM for the entire Oxford area was created with the following parameters: value field as Elevation, interpolation type as Binning, cell assignment as Average, void fill method as linear, output data type as floating point, sampling type as cell size, sampling value as 0.5, and z factor as 1. The Fill tool was applied to remove potential sinks in the DEM, with a Z Limit of 3 determined through extensive trial and error to produce the most accurate watersheds across the town's landscape. The Flow Direction tool was then used to create a flow direction DEM with the following parameters: force all edge cells to flow outward checked, flow direction type as D8, and the processing extent as the LAS Dataset.

Preparation of Oxford's Stormwater Utility Data:

After downloading the latest available stormwater utility geodatabase (as of May 9, 2024) from Oxford's SimpliCity utility portal, it was determined that stormwater outfalls would act as focal points for phosphorus and nitrogen loads. To link stormwater inlet watersheds to outfalls, it was necessary to trace the pipe connections upstream from each outfall.

First, all crossings, gravity drains, open drains, and pressure drains polylines were merged into one feature class. A 5ft radius buffer was then created around the stormwater polyline feature class using the Pairwise Buffer tool. This buffer accounted for positional error when linking point features (inlets and outlets) to their pipe networks. The buffers were dissolved into singlepart features using the Pairwise Dissolve tool to ensure pipes outside the 5ft spatial error limit were not incorrectly flagged as continuous.

Stormwater outlet points within the 2000 and 2010 Urbanized Areas were selected using the Select by Location tool, as any outlets outside of the Urbanized Areas are not privy to MS4 regulations. These points were then joined to the 5ft stormwater polyline buffers via the Spatial Join tool, using the Outfall ID

attribute (p_facilityid) to link outlet points to their respective networks. A further Spatial Join was performed to link the inlet points to the stormwater polyline buffers containing the Outfall ID, resulting in a dataset of inlet points with a known outlet points attribute.

In preparation for modelling the watershed of each outlet connected inlet, a 5ft radius buffer was created around each inlet. 5ft was chosen to account for any positional error regarding the locations of inlet points, and to create a larger area for the watershed model to pour to. If only the inlet coordinate was used as a pour point, inaccuracies could occur where inlets do not line up with the slope of pavement correctly and therefore produce an undersized watershed in the model. Finally, the buffers were converted to a raster format to serve as the input for the Watershed tool.

Watershed Modeling:
The Watershed tool was utilized to model the stormwater inlet buffer raster, using the prepared Flow Direction DEM and rasterized inlet buffers with the following parameters: input D8 flow direction raster as the Flow Direction DEM, input raster or feature pour point data as the rasterized 5ft inlet buffers, pour point field as Value, and processing extent as the LAS Dataset. The output was converted to polygons using the Raster to Polygon tool. These polygons were then joined with the stormwater inlet points and their associated Outfall IDs using the Spatial Join tool.

Final Integration and Calculation:
The watershed feature class was united with the 2016 Land Cover Land Use and Hydrologic Soil Groups datasets using the Union tool. Areas without Outfall IDs were excluded, focusing the analysis on relevant catchment areas. The final steps involved nitrogen and phosphorus load calculations, following the procedures outlined in GIS Analysis steps “To Get Nitrogen Load Export Rate per Outfall Catchment Area” and “To get Phosphorus Load Export Rate Per Pond Watershed Area.”

Quality Control and Validation
Automated watershed delineation quality control was conducted by experts using 1ft USGS 2021 contours and high-resolution aerial imagery as reference. Manual adjustments were made to some watersheds, especially those in areas of high impervious land cover. Ten high priority watersheds were determined to be inaccurate due to their disproportionate size (too large or small). They were hand-delineated based on detailed reviews and as-built plans. This review also identified that a Fill tool Z Limit of 3 produced the most accurate automated delineation results. Additionally, any holes in the automated watershed delineation were filled before calculating phosphorus and nitrogen loads.

To ensure accuracy and reliability, not all inlets (catch basins) were included in the analysis. Only those with a clear or reasonably assumed connection to a known outfall were considered. Ground truthing of inlet and outlet locations, as well as pipe connections, was conducted by the Town of Oxford, further validating the data used in this analysis.

Updates to outfall catchment delineation during Year 6 included in the following assumptions:

1) a 5-foot buffer was added around stormwater lines;
2) not all inlets (catch basins) are included in this analysis, those that do not have a clear or reasonably assumed connection to a known outfall are excluded, however in some cases, the catchment delineation includes known inlets, especially in highly urbanized areas (i.e. OF-99; OF-113 & 114)
3) Nitsch Engineering hand-delineated ten catchments after GIS delineation showed them as “too large” or “too small”

Appendix B – Lake Phosphorus Control Planning Memo

"Legal Authority" and "Funding Sources Assessment" in support of the Small Municipal Separate Storm Sewer System (MS4) General Permit "Lake Phosphorus Control Plan (LPCP)" Requirement for Lakes and Ponds in the French River Watershed

TO: Town of Oxford, MA

FROM: Janet Moonan, PE, and Kristin Dippold, Project Planner, Tighe & Bond

DATE: November 16, 2020

Tighe & Bond is providing this memorandum to the Town of Oxford to document compliance with requirements related to the reduction of phosphorus to certain waterbodies in Town per the U.S Environmental Protection Agency's (EPA's) *General Permits for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems* (MS4GP), specifically, Appendix F Part A.II of the MS4GP. The Town of Oxford is subject to the Lake and Pond Phosphorus TMDL Requirements for waterbodies in the French River watershed in Oxford and therefore must develop and implement a Lake Phosphorous Control Plan (LPCP) per the MS4GP.

EPA's Lake and Pond Phosphorus Reduction Requirements

Between 1999 and 2010, EPA has approved 13 Lake Total Maximum Daily Loads (TMDLs) (a.k.a. "pollution budget") completed by the Massachusetts Department of Environmental Protection (MassDEP) covering 78 lakes and ponds within the Commonwealth of Massachusetts. Any permittee that discharges to a waterbody segment in Appendix F Table F-6 of the MS4GP, including the Town of Oxford, is subject to the Lake and Pond Phosphorus TMDL Requirements.

Almost the entirety of the Town of Oxford's MS4 discharges to the French River Watershed. The area of the French River watershed is 71,737 acres (17% in CT, 83% in MA). The French River begins in Leicester, MA and flows into the Quinebaug River below the West Thompson Lake Dam in Thompson, CT. Figure 1 shows the overall French River watershed relative to Oxford's municipal boundaries.

One of the 13 TMDLs is to manage the pollutant phosphorus and applies to select waterbodies (lakes and ponds) in the French River Watershed, including six waterbodies in Oxford. This TMDL[1] was approved in May 2002.

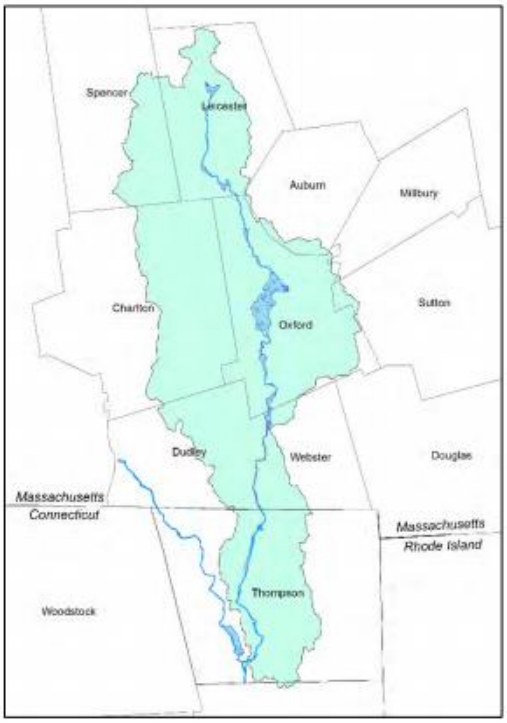


Figure 1. The French River watershed in Massachusetts and Connecticut

[1] https://www.mass.gov/doc/final-tmdls-of-phosphorus-for-selected-french-basin-lakes/download

Phosphorus is a nutrient that, when present at high levels in natural waterbodies, can cause overgrowth of aquatic plants, increase harmful algal blooms, decrease light in a waterbody, and decrease levels of dissolved oxygen, thereby impairing designated uses (aquatic life, fish consumption, primary and secondary contact, and aesthetics) per the Commonwealth's Surface Water Quality Standards (314 CMR 4.00). Phosphorus is a common pollutant in stormwater, with sources including leaf litter, pet waste, road salt, fertilizer, and atmospheric deposition. A variety of structural (infiltration and treatment structures) and non-structural (such as street sweeping and catch basin cleaning) Best Management Practices (BMPs) can be effective at reducing phosphorus loads from stormwater.

In order to address the phosphorus reductions, the MS4GP requires Oxford to develop the previously mentioned LPCP and fully implement all control measures identified in that Plan as soon as possible but no later than June 30, 2033 (15 years from effective date of MS4GP). The LPCP includes the elements presented in Table 1.

TABLE 1
LPCP Deadlines and Components

Deadline	Component
June 30, 2020	Legal analysis
June 30, 2021	Funding source assessment
June 30, 2022	Define LPCP scope/area and calculate baseline phosphorus, allowable phosphorus load, and phosphorus reduction requirement
June 30, 2023	Describe planned nonstructural and structural controls, operation & maintenance (O&M) program, implementation schedule, costs, funding sources assessment (update), and prepare a fully written LPCP
June 30, 2024	Fully initiate non-structural controls and evaluate performance, begin iterative implementation and evaluation process [1]
June 30, 2033	Achieve required phosphorus reduction

Notes
[1] The MS4GP assumes phosphorus will first be addressed with non-structural controls (street sweeping, catch basin cleaning, and enhanced leaf litter pickup), assessing performance of those controls, and then adding structural controls (such as retention systems, swales, pollution control boxes) and assessing overall performance every two years to iteratively achieve reduction requirements.

The phosphorus reduction requirements for each waterbody in the Town of Oxford are listed in Table 2. **While percent reduction may not seem concerning at a first glance, these values translate into actual annual pounds per year of phosphorus necessary to reduce, and therefore have an associated dollar value, which, depending on the loading in the watershed, can add up to many hundreds of thousands of dollars.**

TABLE 2
MS4GP Required Phosphorus Reductions for the Town of Oxford

Waterbody Name	Required Percent Reduction	Waterbody Name	Required Percent Reduction
Buffumville Lake	28%	McKinstry Pond	79%
Hudson Pond	37%	Robinson Pond	8%
Lowes Pond	51%	Texas Pond	21%

Water Quality in the Town of Oxford's Lakes and Ponds Subject to the Phosphorus Requirements of the MS4GP

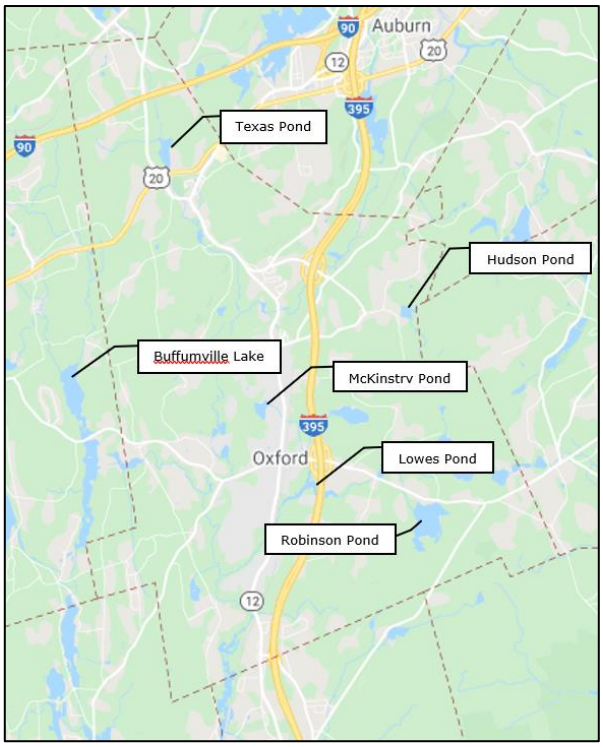


Figure 2. Location of ponds and lakes within the Town of Oxford covered by the TMDL for Phosphorus for Selected French Basin Lakes

The May 2002 TMDL for Phosphorus for Selected French Basin Lakes includes Hudson Pond, Lowes Pond, McKinstry Pond, Robinson Pond, and Texas Pond in Oxford and Buffumville Lake in Charlton/Oxford, along with other waterbodies located in Leicester, Charlton, Dutton, Dudley, and Spencer. Figure 2 shows the location of the identified lakes and ponds in Oxford. Hudson Pond and its entire watershed is not located within the MS4 Regulated Area[2], nor do any Town MS4 outfalls discharge to it, and therefore it is not subject to the MS4GP requirements.

These waterbodies were included in the TMDL because they were identified in the Final Massachusetts 1998 Integrated List of Waters ("List") as being impaired by a variety of pollutants and stressors including low dissolved oxygen, turbidity, nutrients, and an over-abundance of nuisance aquatic plants. These pollutants and stressors are indicators of nutrient-enriched systems becoming eutrophied, which, in freshwater systems, is caused by phosphorus. Inclusion in the 1998 List was based on very limited data collected by MassDEP only in summer of 1994. The intent of the TMDL is to prevent further degradation in water quality and to ensure that each waterbody meets state water quality standards by establishing a phosphorus limit and outlining corrective actions to achieve that goal. However, it should be noted that many TMDLs developed in the early 2000s rely on extremely limited field data collected over a short duration and on theoretical modeling that is based on contributing land use, and may not reflect actual in-waterbody conditions or loading to the lake or pond.

Since approval of the TMDL in May 2002, assessment of water quality in the lakes and ponds has been re-evaluated and updated by MassDEP as part of the Integrated List of Waters process, which occurs every two years. Correspondence with NPDES permit writers at EPA Region 1 indicates that an update to the Integrated List of Waters, which may remove an impairment covered by the TMDL, does not supersede a TMDL and a state can only change a TMDL by updating or withdrawing it. Each community remains subject to that TMDL and the MS4GP permit conditions until the applicable TMDL is updated by the Commonwealth. **Because of the potentially high costs associating with planning and implementing the LPCP, Tighe & Bond reviewed the current water quality standards that apply to the Town of Oxford's waterbodies subject to the TMDL and found there are some waterbodies to which the TMDL no longer should apply. The following explains the basis for that evaluation and provides a recommendation for the Town of Oxford to potentially reduce its overall compliance burden.**

[2] https://www3.epa.gov/region1/npdes/stormwater/ma/ram/oxford.pdf

Table 3 below lists the waterbodies within the Town of Oxford subject to the May 2002 TMDL and associated status per the most recent (Final) Integrated List of Waters ("List"), which was dated 2016 and approved by EPA in January 2020. Applicable excerpts from the 2008, 2010, 2012, 2014, and 2016 Lists are enclosed with this memorandum.

TABLE 3
Status of waterbodies in Town of Oxford Previously Subject to Phosphorus TMDL

Waterbody (Segment ID)	Category	Current Pollutant (2016 Integrated List)	TMDL for Phosphorus still Applies? (Y/N)	Comments
Buffumville Lake (MA42005)	4a (TMDL completed)[1]	Non-Native Aquatic Plants * [2]	No	According to Appendix 3 of the 2016 List, applicable water quality standards (WQS) are attained (reason for recovery was unspecified). Therefore, the "excess algal growth" impairment is removed from categories 4 or 5 of the List.
Hudson Pond (MA42029)	4a (TMDL completed)	Aquatic Plants (Macrophytes)* [2] Nutrient/Eutrophication Biological Indicators	Yes	Hudson Pond is not within the MS4 Regulated Area and therefore the TMDL does not have to be addressed through the MS4GP at this time.
Lowes Pond (MA42034)	4a (TMDL completed)	Nutrient/Eutrophication Biological Indicators	Yes	
McKinstry Pond (MA42035)	4a (TMDL completed)	Nutrient/Eutrophication Biological Indicators	Yes	
Robinson Pond (MA42047)	3 (no uses assessed)	None listed	No	In the 2010 List, this waterbody was delisted from Category 4a (TMDL completed) to Category 2 Water (Attaining some uses; other uses not assessed). In the 2016 List, this waterbody was adjusted to be Category 3 (no uses assessed). No reasoning is provided.
Texas Pond (MA42058) [2]	5 (The 303(d) List – "Waters requiring a TMDL")	Mercury in Fish Tissue	No	In the 2010 List, segment was moved to be included as part of French River (segment MA42-03). According to Appendix 3 of the 2016 List, applicable WQS are attained (according to new assessment method and due to restoration activities), and therefore, the "aquatic plants (macrophytes)" impairment covered by the TMDL (2357), along with total phosphorus and turbidity, are all is removed as being listed under Categories 4 or 5 of the List.

Table notes:
[1] State-wide Mercury in Fish Tissue TMDL 33880 still applies. The Northeast Regional Mercury TMDL does not specify a wasteload allocation or other requirements either individually or categorically for the MS4 discharges and specifies that load reductions are to be achieved through reduction in atmospheric deposition sources. No requirements related to this TMDL are imposed on MS4 discharges under this part. However, if the permittee becomes aware, or EPA or MassDEP determines, that an MS4 discharge is causing or contributing to such impairment to an extent that cannot be explained by atmospheric deposition (e.g. chemical spill, acid landfill leachate or other sources), the permittee shall comply with the requirements of part 2.1.1.d and 2.3.4 of the permit.
[2] *impairment does not require a TMDL because this is considered a non-pollutant.

Given the recent change in impaired waterbody status that delists Buffumville Lake, Robinson Pond, and Texas Pond from being subject to the May 2002 TMDL for Phosphorus for Selected French Basin Lakes, advice from EPA, and the substantial planning, capital, operational, and administrative costs associating with preparing and undertaking the LPCP, we recommend the Town of Oxford engage Town Counsel to prepare a persuasive letter to MassDEP to request an update to the TMDL to remove Buffumville Lake, Robinson Pond, and Texas Pond. The Town may wish to coordinate this effort with the Town of Charlton Town Administrator and legal counsel.

LCPC "Legal Analysis"

Achieving the phosphorus reduction required by EPA for each waterbody subject to the MS4GP LPCP requirements (see Table 2) is not only expensive for a community but cannot always be achieved on public land alone. Because of this, it is in the Town's best interest to utilize opportunities presented through new development and redevelopment to offset the Town's effort associated with planning and implementing the LPCP.

Requirements

According to Appendix F, as part of developing and implementing a LPCP designed to reduce the amount of phosphorus in stormwater discharges from the MS4 to identified water bodies and its tributaries, Oxford must conduct an analysis of local legal authority that may be necessary to effectively implement the entire LPCP (termed by EPA as a "legal analysis"). A description of the Phase 1 PCP Legal Analysis, as stated in the MS4GP, reads as follows:

> *The permittee shall develop and implement an analysis that identifies existing regulatory mechanisms available to the MS4 such as by-laws and ordinances and describes any changes to these regulatory mechanisms that may be necessary to effectively implement the LPCP. This may include the creation or amendment of financial and regulatory authorities. The permittee shall adopt necessary regulatory changes by the end of the permit term.*

Tighe & Bond has prepared the LPCP "Legal Analysis" to identify existing regulatory mechanisms available to the Town (e.g., bylaws, regulations, and guidance) and any changes to regulatory mechanisms that may be necessary to effectively implement the entire LPCP. The following includes an analysis of available non-structural[3], structural[4], and semi-structural[5] phosphorus reduction actions; current legal authority of the Town to implement those actions on both public and private property; and future changes that would be required to fully implement the LPCP.

[3] Per EPA, non-structural BMPs consist of street sweeping, catch basin cleaning, and an enhanced Organic Waste and Leaf Litter Collection program.

[4] Per EPA, structural BMPs consist of infiltration trenches, infiltration basins or other surface infiltration practices, bio-filtration practices, gravel wetland systems, porous pavement, wet pond or wet detention basins, dry pond or detention basins, and dry water quality swale/grass swales.

[5] Per EPA, semi-structural BMPs include impervious area disconnection through storage (e.g., rain barrels, cisterns, etc.), impervious area disconnection, conversion of impervious area to permeable pervious area, and soil amendments to enhance permeability of pervious areas.

Overview of the Town of Oxford Legal Authority Related to Phosphorus Controls

Tighe & Bond's has reviewed the following publicly available documents:

- Town of Oxford General By-Laws (June 12, 2018), with particular focus on Chapter 23 (Conservation Commission), Chapter 31 (Streets and Sidewalks), Chapter 35 (Barriers and Excavation), Chapter 65 (Discharges to the Municipal Storm Drain System), Chapter 66 (Stormwater Management and Land Disturbance), and Chapter 67 (Stormwater Management Requirements);
- Town of Oxford Zoning By-Law (May 1, 2019);
- Town of Oxford Chapter 67 – Stormwater Management Requirements Applicability Rule (February 1, 2016);
- Rules and Regulations Governing the Subdivision of Land in the Town of Oxford, Massachusetts (received May 21, 2015 by the Office of the Town Clerk);
- Town of Oxford Conservation Commission website with particular focus on Plan Requirements (July 23, 2020), Notice of Intent Filing Instructions, and Downloadable Forms (including Applications and Policies);
- Town of Oxford Zoning Board of Appeals website including downloadable forms; and
- Town of Oxford Planning Board website including downloadable forms.

We will note that the Town of Oxford enforces the Commonwealth's standards for wetlands protection and therefore does not have a local Wetlands By-law or Town-specific Wetlands Regulations. In addition, Chapter 65 (Discharges to the Municipal Storm Drain System), Chapter 66 (Stormwater Management and Land Disturbance), and Chapter 67 (Stormwater Management Requirements) are all-inclusive of language that would typically be either in the bylaw or in separate regulations and therefore there are not supporting regulations, only guidance and forms.

The documents and resources listed above show that the Town has the authority further described in the following sections. Note that the following evaluation is meant to be a general overview and may not account for every possible scenario that could occur.

Legal Authority to Implement the LPCP on Public Property

Current Authority

The Town of Oxford has authority to undertake all non-structural controls on public property on an ongoing basis, and construct and maintain structural and semi-structural BMPs, because the Town collectively owns the land. Public property consists of Town owned or operated parcels including parking lots, as well as municipal roadways and the right of way. Oxford can complete street sweeping, catch basin cleaning, and, enhanced Organic Waste and Leaf Litter Collection program, on an annual or more frequent basis (which is required for phosphorus credit), both now and in the future. Oxford has legal authority to install structural or semi-structural BMPs on Town-owned lands and to maintain those BMPs on an ongoing basis.

Changes Needed

There are no legal changes necessary to implement the LPCP on public property. However, requiring all public new and redevelopment projects to implement structural BMPs, beyond those required by current local code, necessitates buy-in from elected and appointed officials for the overall approach and municipal staff (as various departments, boards, and committees may have decision-making control over specific parcels), along with planning for these efforts in capital and operational budgets.

Legal Authority to Implement the LPCP on Private Property

Current Authority

Considerations are organized by type of BMP:

- Enhanced sweeping: Oxford has no authority to physically sweep on private individual properties. Ongoing/annual sweeping completed by a private entity on a private property would typically only be associated with a porous pavement/pavers type BMP, and can only be required and enforced by the Town for projects that undergo permitting through the Commonwealth's Wetlands Protection Act and obtain an Order of Conditions (per Chapter 23 of the General By-laws) or through Chapter 67 (Stormwater Management Requirements) of the Town's General By-Laws and violate the submitted Operation & Maintenance (O&M) Plan.[6]

- Catch Basin Cleaning: Annual/ongoing catch basin cleaning completed by a private entity on a private property can only be required and enforced by the Town for new projects that undergo permitting through the Commonwealth's Wetlands Protection Act and obtain an Order of Conditions (per Chapter 23 of the General By-laws) or through Chapter 67 (Stormwater Management Requirements) of the Town's General By-Laws. Catch basin cleaning O&M would only likely apply to new/replaced structures, not existing structures.[6]

- Organic Waste and Leaf Litter Collection program: Oxford has no existing authority to require this work on private property; further, the Town has no control over the method of disposal on private individual properties. While Oxford does have the Rocky Hill Road Yard Waste Drop-Off Facility, per requirements in Appendix F of the MS4GP, to obtain a credit for an enhanced collection program, all landscaping wastes, organic debris, and leaf litter must be gathered and removed from impervious roadways and parking lots at least once per week during the period of September 1 to December 1 of each year.

- Structural and Semi-Structural BMPs: Installation and O&M of structural and semi-structural BMPs on private properties is currently only applicable to new and redevelopment projects that are subject to the Town of Oxford General By-Laws Chapter 67 (Stormwater Management Requirements) or the Commonwealth's Wetlands Protection Act and Regulations (310 CMR 10.00). The local Stormwater Management Requirements bylaw applies to all projects 10,000 square feet or greater, which is far more stringent than EPA's minimum threshold of one or more acres of disturbance (or a common plan of development that ultimately disturbs this amount

[6] Monitoring compliance with an O&M plan is challenging, however, should a violation be found, the Town does have enforcement authority through local code referenced above. In addition, if the Town identified a private site that had previously obtained a local permit and was subject to an O&M plan, and is contributing a pollutant to the MS4 (note that sediment and sand are pollutants), there is also enforcement authority under Chapter 65 (Discharges to the Municipal Storm Drain System).

of area). The Commonwealth's Wetlands Protection Act and Regulations have specific jurisdiction un-related to disturbance area. **Currently, it is impossible under local code for the Town to require a completed new or redevelopment project to retrofit the drainage system to add structural and/or semi-structural BMPs.** Note that EPA considers rain barrels to be a semi-structural BMP that reduces phosphorus loading. Oxford does have a Community Rain Barrel Program. Currently, residents can purchase a 55-gallon barrel for $69. Fifty barrels were sold in 2019 and thirty barrels were sold in 2020. The limited phosphorus reduction achieved by these structures does not outweigh the burden associated with tracking pollutant reductions. At this time, we do not recommend the Town proceed with modifications to the Community Rain Barrel Program.

Changes Needed & Considerations

To fully implement the LPCP on private property, there would need to be significant changes to local code and/or state and federal permitting. The following offers recommendations to consider:

1. Chapter 67 of the Town's General By-Laws could be updated to specify enhanced requirements for phosphorus/nutrient reduction. Other pollutants of concern should be included, as well, for overall compliance with the MS4GP. Based on our review of the local code, we recommend a holistic update to Chapter 66 (Stormwater Management and Land Disturbance) and Chapter 67 (Stormwater Management Requirements), that generally consists of consolidation of the two chapters into one, clarifications to applicability, additions and updates to the definitions, and reduction in overall text by developing Stormwater Management Regulations that can be more easily updated as standards change.

2. Because projects "wholly within jurisdiction of the Conservation Commission and requiring an Order of Conditions" are exempt from Chapter 67, consider developing Town-specific wetlands protection regulations that also specify enhanced requirements for phosphorus/nutrient reduction. Other pollutants of concern should be included, as well, for overall compliance with the MS4GP.

3. Changes to roadway width, parking, and other related requirements in zoning and subdivision that result in creation of impervious cover should be assessed. The MS4GP requires an evaluation of these requirements be completed in Permit Year 4 (FY22). Nutrients, and other pollutants of concern, should be considered during this process.

4. Phosphorus reduction credits for enhanced sweeping (1 to 10% depending on sweeper type and frequency), catch basin cleaning (2%), and enhanced organic waste and leaf litter collection (5%) are limited and may not, politically, be worth pushing on to private properties, due to high costs of the actions compared to low value in a credit system set by EPA and administrative burden associated with monitoring compliance.

5. If the Town were to pursue a Stormwater Utility and set up an Enterprise Fund, private sites can be incentivized to take their own actions to reduce pollutants through a credit system.

6. Politically, it will be very challenging if not impossible to require private properties to retrofit a site without some form of construction otherwise occurring. EPA Region 1

has been petitioned to take Residual Designation Authority (RDA)[7] of various watersheds. Oxford can consider supporting a RDA petition, if desired, for the French River watershed. However, elected officials and decision makers should carefully consider balancing Town needs to reduce phosphorus with the rights of private landowners and the Town's overall economy.

LPCP "Funding Source Assessment"

Requirements

According to Appendix F, as part of developing and implementing a LPCP designed to reduce the amount of phosphorus in stormwater discharges from the MS4 to identified water bodies and its tributaries, Oxford must conduct a funding source assessment that may be necessary to effectively implement the entire LPCP (termed by EPA as a "legal analysis"). A description of the Phase 1 PCP Funding Source Assessment, as stated in the MS4GP, reads 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.*

Municipalities across the country employ a number of methods to fund stormwater programs, including the community's general fund, fees, fines, or service charges. Funds can also be in the form of non-cash resources (e.g., available educational materials or volunteers), one-time cash resources (e.g., grants, loans, bonds), or can be in the form of ongoing revenue (e.g., general fund from property taxes, user fees from a utility).

Current Funding Sources

Currently, the Town of Oxford funds stormwater management through property taxes paid into the General Fund.

[7] EPA and the authorized states regulate stormwater discharges from regulated (urbanized) municipal separate storm sewer systems (MS4s), industrial activities, and construction sites under section 402(p) of the Clean Water Act. EPA can use its "residual designation" authority under 40 CFR 122.26(a)(9)(i)(C) and (D) to require NPDES permits for other stormwater discharges or category of discharges on a case-by-case basis when it determines that:

- the discharges contribute to a violation of water quality standards,
- are a significant contributor of pollutant to federally protected surface waters, or
- controls are needed for the discharge based on wasteload allocations that are part of "total maximum daily loads" (TMDLs) that address the pollutant(s) of concern.

EPA can designate small MS4s that are not already required to have NPDES permit coverage under 40 CFR 123.35(b). In addition, designation can be requested by petition.

Potential Funding Sources

Alternatives to existing funding sources consist of:

- Massachusetts Municipal Water Infrastructure Investment Fund
- Stormwater Enterprise Fund
- Loans and grants

These sources are further described in the following sections.

Massachusetts Municipal Water Infrastructure Investment Fund[8]: The August 2014 updates to Massachusetts General Law (MGL) Chapter 259, titled "An Act Improving Drinking Water and Wastewater Infrastructure," have created an opportunity for cities and towns to adopt a significant new revenue stream for municipal funding of drinking water, wastewater, and stormwater infrastructure planning, operations, and improvements. This legislation creates an alternative to traditional funding methods that is similar to the Community Preservation Act of 2000. Essentially, communities are now allowed to adopt the law and then impose a surcharge on real property at a rate up to 3% of the real estate tax levy against real property.

To establish the Fund and collect money from the surcharge, a municipality must follow the two-step process to adopt the state law:

- Step 1: The Town's legislative body must vote by a majority to accept the statute and designate the surcharge percentage (from over 0% to 3%).
- Step 2: Voters must vote to accept the law at the next regular municipal or state election.

If approved, the Fund can be in effect (and the surcharge will be imposed) on July 1 of the next fiscal year, or a later fiscal year as the Town may designate. Note that a community may revoke acceptance of the fund or amend the amount of the surcharge with the same public process.

The money collected must be deposited in a separate account called a Municipal Water Infrastructure Investment Fund, and expenditures must be used exclusively for maintenance, improvements, and investments to municipal drinking, wastewater and stormwater infrastructure assets.

There are some benefits and drawbacks to adopting this method. Funds can be used for water and sewer infrastructure as well, and therefore may provide an opportunity to support other town-wide needed services without rate increases in years stormwater management is less costly. As with the CPA, revenues collected through the surcharge are not counted for the purpose of establishing the limit on local tax levy imposed by Proposition 2 ½. However, the funds will not capture properties that are tax-exempt but may have large impervious

[8] More detailed information about the Municipal Water Infrastructure Investment Fund from the Massachusetts Department of Revenue online at:

https://www.mass.gov/files/documents/2016/08/wn/igr16-102.pdf

areas (e.g., schools, churches, medical facilities). In addition, there will be a large range in fees for residential parcels, as there is a range in assessed values, which may be perceived as uneven by many residents. Finally, this Fund is intended for planned capital expenditures, not the day-to-day cost to administer the stormwater program such as Town staff labor, training programs, public outreach, and other MS4GP compliance activities and reporting.

Stormwater Enterprise Fund: A Stormwater Enterprise Fund is similar to the funding mechanism for both water and sewer utilities, in that it creates a fund and provides a dedicated and stable source to finance local services by generating revenue through user fees. However, unlike water and sewer utilities where flow can be metered, stormwater runoff cannot be directly measured and therefore is typically estimated using impervious area as a surrogate measurement for flow. Essentially, "the more you pave, the more you pay." The owner of a business with a large parking area would pay more than the owner of a residential home.

There are many reasons for municipalities to create a Stormwater Enterprise Fund. The key reasons are because a Stormwater Enterprise Fund is S.A.F.E.[9]:

- It is Stable – utility revenue is not as dependent on the uncertain annual budget process as tax revenue is.
- It is Adequate – stormwater fees are based on an advance planned stormwater program that meets the needs of the community.
- It is Flexible – the utility can adapt to changing program and funding needs over time.
- It is Equitable – stormwater fees are calculated on the basis of impact on the drainage system and receiving waters, not property value or land use.

Municipalities across the country are electing to establish Stormwater Enterprise Funds in order to provide stable and dedicated funding for their stormwater management programs. While there are many drivers for the increase in the number of Stormwater Enterprise Funds, the main driver is the cost of new or significantly expanded requirements to meet increasingly prescriptive Federal and State regulations and to protect public health and the environment. Requirements such as adoption and implementation of a stormwater management bylaw, finding and eliminating illegal connections to the drainage system, and operations, maintenance, and inspection programs are not able to be supported by overextended municipal budgets.

In Massachusetts, the drivers are no different. Over 20 municipalities have adopted active stormwater utilities, the first being in 1998.[10] 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.

Once a Stormwater Enterprise Fund is established, all of the revenue is dedicated to an Enterprise Fund. The dedicated funds are used for stormwater operations, maintenance, capital improvements, planning, permitting, and compliance. Funds can pay for all related

[9] The acronym S.A.F.E. is widely used in Stormwater Enterprise Fund informational presentations and materials from a variety of sources.

[10] https://www.mass.gov/doc/massachusetts-stormwater-fee-summary/download

program expenses, including staff salaries, equipment and supplies, software, outside contractors, and more. An important distinction between stormwater fees and real estate taxes is that fees are user based and are tied to stormwater management services provided by the utility, whereas taxes are not tied to specific services. Stormwater enterprise funds do not compete with Police, Fire, Schools, or other Public Services for funding.

Loans and Grants: The Commonwealth of Massachusetts provides information on federal and state grant and loan programs that fund stormwater and water quality projects in Massachusetts.[11] The following programs may be applicable to the Town of Oxford:

- Section 319 Nonpoint Source Competitive Grants
- Section 604b Water Quality Management Planning Grants
- Clean Water State Revolving Fund Loans
- MEMA/FEMA Hazard Mitigation Grants including new Building Resilient Infrastructure and Communities (BRIC) program[12] (not mentioned on the website referenced above)
- Municipal Vulnerability and Preparedness Action Grant Program, assuming the community has first achieved MVP Designation through a planning grant process.
- Massachusetts Environmental Trust (MET) Grants
- Stormwater MS4 Municipal Assistance Grant Program
- MassWorks Infrastructure Grants (would require significant project)

More detail about these programs, including eligible projects, application requirements, timelines, and local commitment is available online.

Funding Sources Assessment Next Steps

To understand the magnitude of actually undertaking a 15-year phosphorus reduction program to comply with the MS4GP LPCP, we recommend the Town soon proceed with completing calculations (i.e., Baseline Phosphorus, Allowable Phosphorus Load, and Phosphorus Reduction Requirement due by June 30, 2022) to identify the following:

1. Baseline Phosphorus: Phosphorus loading estimates using EPA's methodology presented in the MS4GP Appendix F Attachment 1. This includes gathering the most up-to-date land use in each sub-watershed for waterbodies in which the MS4GP and TMDL require reduction of phosphorus and the impervious and pervious areas within each land use, as well as soils data. Attached are the maps from the Massachusetts Watershed-based Plans Toolkit[13] for Lowes Pond, McKinstry Pond, Robinson Pond, and Texas Pond in Oxford and Buffumville Lake in Charlton/Oxford. Note that, while Hudson Pond is outside the Regulated MS4 area, we also included the map to show the watershed is completely outside as well.

[11] https://www.mass.gov/service-details/available-funding-for-stormwater-projects-in-massachusetts
[12] https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities
[13] http://prj.geosyntec.com/MassDEPWBP

2. Phosphorus Reduction Requirement and Allowable Phosphorus Load: The annual pounds of phosphorus to be reduced by June 30, 2033, based on the required reduction rates in Table 2, and the amount allow to be discharged.

3. Available Land: Public land available for BMPs and associated potential reduction.

4. Work completed to date: Private land that has been developed or redeveloped and associated reduction or increase of phosphorus discharge.

5. Costs: Approximate associated capital and O&M costs to implement the overall program, based on publicly available information on non-structural, semi-structural, and structural BMP costs.

Attachments

1. Excerpts from Massachusetts Year 2008, 2010, 2012, 2014, and 2016 Integrated List of Waters

2. Subwatershed maps for Waterbodies Subject to May 2002 TMDL for Phosphorus for Selected French Basin Lakes

Tighe&Bond
Engineers | Environmental Specialists

ATTACHMENT 1

Massachusetts Category 4c Waters
"Impairment not Caused by a Pollutant"

NAME	SEGMENT ID	DESCRIPTION	SIZE	IMPAIRMENT CAUSE [EPA APPROVAL DATE-DOCUMENT CONTROL NUMBER]
North Great Meadows (82084)	MA82084_2008	Concord	73.5 acres	-(Exotic species*)
Rocky Pond (82095)	MA82095_2008	Boylston	61.8 acres	-(Exotic species*)
Russell Millpond (82096)	MA82096_2008	Chelmsford	32.9 acres	-(Flow alteration*) -(Exotic species*)
Warners Pond (82110)	MA82110_2008	Concord	59.3 acres	-Metals [12/20/2007-NEHgTMDL] -(Exotic species*)
Winning Pond (82123)	MA82123_2008	Billerica	22.2 acres	-(Exotic species*)
Connecticut				
Lake Bray (34013)	MA34013_2008	Holyoke	10.3 acres	-(Non-Native Aquatic Plants*)
Cranberry Pond (34018)	MA34018_2008	Sunderland	28.1 acres	-(Eurasian Water Milfoil, Myriophyllum spicatum*)
Lake Holland (34035)	MA34035_2008	Belchertown	10.6 acres	-(Non-Native Aquatic Plants*)
Ingraham Brook Pond (34037)	MA34037_2008	Granby	4.6 acres	-(Non-Native Aquatic Plants*)
Leverett Pond (34042)	MA34042_2008	Leverett	90.7 acres	-(Eurasian Water Milfoil, Myriophyllum spicatum*) -(Non-Native Aquatic Plants*) -Nutrient/Eutrophication Biological Indicators [4/12/2002-CN112.0]
Lower Mill Pond (34048)	MA34048_2008	Easthampton	29.6 acres	-(Non-Native Aquatic Plants*)
Lower Van Horn Park Pond (34129)	MA34129_2008	Springfield	11.1 acres	-(Non-Native Aquatic Plants*)
Oxbow Cutoff (34067)	MA34067_2008	The waterbody north of Island Road and south of Oxbow Road (between Routes 91and 5), Northampton.	48.8 acres	-(Non-Native Aquatic Plants*)
Lake Warner (34098)	MA34098_2008	Hadley	65.1 acres	-Excess Algal Growth [4/12/2002-CN112.0] -(Non-Native Aquatic Plants*) -Oxygen, Dissolved [4/12/2002-CN112.0] -Turbidity [4/12/2002-CN112.0] -Phosphorus (Total) [4/12/2002-CN112.0]
Whiting Street Reservoir (34101)	MA34101_2008	Holyoke	102 acres	-(Eurasian Water Milfoil, Myriophyllum spicatum*)
Deerfield				
Tannery Pond (33020)	MA33020_2008	Savoy	0.52 acres	-(Flow alteration*)
Farmington				
Benton Pond (31003)	MA31003_2008	Otis	61.4 acres	-(Exotic species*)
Noyes Pond (31026)	MA31026_2008	Tolland	166 acres	-(Exotic species*)
French				
Bouchard Pond (42003)	MA42003_2008	Leicester	2.5 acres	-(Exotic species*)
Buffum Pond (42004)	MA42004_2008	Charlton/Oxford	23.2 acres	-(Exotic species*)
Buffumville Lake (42005)	MA42005_2008	Charlton/Oxford	199 acres	-Metals [12/20/2007-NEHgTMDL] -Noxious aquatic plants [7/12/2002-CN110.0] -(Exotic species*)
Cedar Meadow Pond (42009)	MA42009_2008	Leicester	140 acres	-Noxious aquatic plants [7/12/2002-CN110.0] -(Exotic species*)
Gore Pond (42018)	MA42018_2008	Dudley/Charlton	169 acres	-Organic enrichment/Low DO [7/12/2002-CN110.0] -Noxious aquatic plants [7/12/2002-CN110.0] -Turbidity [7/12/2002-CN110.0] -(Exotic species*)
Granite Reservoir (42019)	MA42019_2008	Charlton	207 acres	-Noxious aquatic plants [7/12/2002-CN110.0] -(Exotic species*)

* - non Pollutant
[ ] – TMDL (Restorative)
< > – TMDL (Protective)

Massachusetts Category 4a Waters
"TMDL is Completed"

NAME	SEGMENT ID	DESCRIPTION	SIZE	POLLUTANT(S) ADDRESSED BY TMDL or OTHER POLLUTION CONTROLS [EPA APPROVAL DATE-DOCUMENT CONTROL NUMBER]
Charles				
Bogastow Brook (7239775)	MA72-16_2008	Headwaters, outlet Factory Pond, Holliston to inlet South End Pond, Millis.	9.5 miles	-Fecal Coliform [5/22/2007-CN156.0]
Echo Lake (72035)	MA72035_2008	Milford/Hopkinton	72.3 acres	-Mercury in Fish Tissue [12/20/2007-NEHgTMDL]
Unnamed Tributary (7239078)	MA72-32_2008	Locally known as Sawins Brook - emerges east of Elm Street, Watertown to confluence with the Charles River, Watertown (sections culverted).	0.54 miles	-Escherichia coli [5/22/2007-CN156.0]
Chicopee				
Long Pond (36083)	MA36083_2008	Springfield	13.7 acres	-Noxious aquatic plants [4/12/2002-CN118.0]
Minechoag Pond (36093)	MA36093_2008	Ludlow	20.8 acres	-Noxious aquatic plants [4/12/2002-CN118.0]
Mona Lake (36094)	MA36094_2008	Springfield	10.7 acres	-Noxious aquatic plants [4/12/2002-CN118.0]
Pottapaug Pond (36125)	MA36125_2008	Petersham/Hardwick	568 acres	-Metals [12/20/2007-NEHgTMDL]
Quabbin Reservoir (36129)	MA36129_2008	Petersham/Pelham/Ware/Hardwick/Shutesbury/Belchertown/New Salem	24012 acres	-Metals [12/20/2007-NEHgTMDL]
Spectacle Pond (36142)	MA36142_2008	Wilbraham	8.5 acres	-Noxious aquatic plants [4/12/2002-CN118.0]
Sugden Reservoir (36150)	MA36150_2008	Spencer	85.3 acres	-Nutrients [4/12/2002-CN118.0] -Organic enrichment/Low DO [4/12/2002-CN118.0] -Turbidity <4/12/2002-CN118.0>
Wickaboag Pond (36166)	MA36166_2008	West Brookfield	315 acres	-Metals [12/20/2007-NEHgTMDL] -Noxious aquatic plants [4/12/2002-CN118.0] -Turbidity [4/12/2002-CN118.0]
Concord				
Nutting Lake (82124)	MA82124_2008	[West Basin] Billerica	51.4 acres	-Metals [12/20/2007-NEHgTMDL]
Sudbury Reservoir (82106)	MA82106_2008	Southborough/Marlborough	1178 acres	-Metals [12/20/2007-NEHgTMDL]
Walden Pond (82109)	MA82109_2008	Concord	62.9 acres	-Metals [12/20/2007-NEHgTMDL]
Connecticut				
Bachelor Brook (3418000)	MA34-07_2008	Outlet Forge Pond, Granby to confluence with Connecticut River, South Hadley (through former segments Aldrich Lake [East Basin] MA34002 and Aldrich Lake [West Basin] MA34106).	11.6 miles	-Nutrient/Eutrophication Biological Indicators [4/12/2002-CN112.0]
Loon Pond (34045)	MA34045_2008	Springfield	25.1 acres	-Nutrient/Eutrophication Biological Indicators [4/12/2002-CN112.0]
Lake Wyola (34103)	MA34103_2008	Shutesbury	126 acres	-Nutrient/Eutrophication Biological Indicators [4/12/2002-CN112.0] -Phosphorus (Total) [4/12/2002-CN112.0]
Deerfield				
Plainfield Pond (33017)	MA33017_2008	Plainfield	59.6 acres	-Metals [12/20/2007-NEHgTMDL]
Farmington				
Otis Reservoir (31027)	MA31027_2008	Otis/Tolland/Blandford	989 acres	-Metals [12/20/2007-NEHgTMDL]
French				
Dresser Hill Pond (42014)	MA42014_2008	Charlton	8.1 acres	-Turbidity [7/12/2002-CN110.0]
Dutton Pond (42015)	MA42015_2008	Leicester	6.0 acres	-Nutrients [7/12/2002-CN110.0] -Noxious aquatic plants [7/12/2002-CN110.0]
Greenville Pond (42023)	MA42023_2008	Leicester	30.5 acres	-Turbidity [7/12/2002-CN110.0]
Hudson Pond (42029)	MA42029_2008	Oxford	15.4 acres	-Noxious aquatic plants [7/12/2002-CN110.0]

Massachusetts Category 4a Waters
"TMDL is Completed"

NAME	SEGMENT ID	DESCRIPTION	SIZE	POLLUTANT(S) ADDRESSED BY TMDL or OTHER POLLUTION CONTROLS [EPA APPROVAL DATE-DOCUMENT CONTROL NUMBER]
Jones Pond (42030)	MA42030_2008	Charlton/Spencer	30.2 acres	-Noxious aquatic plants [7/12/2002-CN110.0]
Lowes Pond (42034)	MA42034_2008	Oxford	33.4 acres	-Noxious aquatic plants [7/12/2002-CN110.0]
Mckinstry Pond (42035)	MA42035_2008	Oxford	15.9 acres	-Noxious aquatic plants [7/12/2002-CN110.0]
Mosquito Pond (42060)	MA42060_2008	Dudley	10.5 acres	-Noxious aquatic plants [7/12/2002-CN110.0]
New Pond (42037)	MA42037_2008	Dudley	32.6 acres	-Noxious aquatic plants [7/12/2002-CN110.0]
Peter Pond (42042)	MA42042_2008	Dudley	42.3 acres	-Nutrients [7/12/2002-CN110.0] -Organic enrichment/Low DO [7/12/2002-CN110.0]
Pikes Pond (42044)	MA42044_2008	Charlton	28.2 acres	-Turbidity [7/12/2002-CN110.0]
Robinson Pond (42047)	MA42047_2008	Oxford	99.3 acres	-Noxious aquatic plants [7/12/2002-CN110.0]
Rochdale Pond (42048)	MA42048_2008	Leicester	42.6 acres	-Nutrients [7/12/2002-CN110.0] -Organic enrichment/Low DO [7/12/2002-CN110.0] -Noxious aquatic plants [7/12/2002-CN110.0]
Shepherd Pond (42051)	MA42051_2008	Dudley	15.8 acres	-Noxious aquatic plants [7/12/2002-CN110.0]
Wallis Pond (42062)	MA42062_2008	Dudley	23.8 acres	-Organic enrichment/Low DO [7/12/2002-CN110.0] -Noxious aquatic plants [7/12/2002-CN110.0]
Ipswich				
Hood Pond (92025)	MA92025_2008	Ipswich/Topsfield	67.4 acres	-Metals [12/20/2007-NEHgTMDL]
Mill Pond (92041)	MA92041_2008	Burlington	59.1 acres	-Metals [12/20/2007-NEHgTMDL]
Islands				
Gibbs Pond (97028)	MA97028_2008	Nantucket	34.0 acres	-Metals [12/20/2007-NEHgTMDL]
Miacomet Pond (97055)	MA97055_2008	Nantucket	34.2 acres	-Metals [12/20/2007-NEHgTMDL]
Tom Nevers Pond (97097)	MA97097_2008	Nantucket	11.2 acres	-Metals [12/20/2007-NEHgTMDL]
Merrimack				
Forge Pond (84015)	MA84015_2008	Westford/Littleton	203 acres	-Metals [12/20/2007-NEHgTMDL]
Locust Pond (84031)	MA84031_2008	Tyngsborough	16.1 acres	-Metals [12/20/2007-NEHgTMDL]
Nabnasset Pond (84044)	MA84044_2008	Westford	136 acres	-Metals [12/20/2007-NEHgTMDL]
Millers				
Bents Pond (35007)	MA35007_2008	Gardner	6.2 acres	-Noxious aquatic plants [2/5/2003-CN123.2] -Turbidity [2/5/2003-CN123.2]
Bourn-Hadley Pond (35008)	MA35008_2008	Templeton	25.8 acres	-Noxious aquatic plants [2/5/2003-CN123.2]
Brazell Pond (35010)	MA35010_2008	Templeton	14.7 acres	-Noxious aquatic plants [2/5/2003-CN123.2]
Lake Denison (35017)	MA35017_2008	Winchendon	83.5 acres	-Metals [12/20/2007-NEHgTMDL] -Organic enrichment/Low DO [2/5/2003-CN123.2]
Depot Pond (35018)	MA35018_2008	(Railroad Pond) Templeton	15.2 acres	-Noxious aquatic plants [2/5/2003-CN123.2]
Greenwood Pond (35026)	MA35026_2008	Templeton	12.5 acres	-Noxious aquatic plants [2/5/2003-CN123.2]
Hilchey Pond (35029)	MA35029_2008	Gardner	7.6 acres	-Turbidity [2/5/2003-CN123.2]
Ramsdall Pond (35062)	MA35062_2008	Gardner	2.1 acres	-Noxious aquatic plants [2/5/2003-CN123.2]
Reservoir No. 1 (35063)	MA35063_2008	Athol	7.7 acres	-Noxious aquatic plants [2/5/2003-CN123.2]
Stoddard Pond (35083)	MA35083_2008	Winchendon	51.8 acres	-Noxious aquatic plants [2/5/2003-CN123.2]
Upper Naukeag Lake (35090)	MA35090_2008	Ashburnham	305 acres	-Metals [12/20/2007-NEHgTMDL]
Upper Reservoir (35091)	MA35091_2008	Westminster	41.6 acres	-Metals [12/20/2007-NEHgTMDL]
Whites Mill Pond (35099)	MA35099_2008	Winchendon	42.4 acres	-Noxious aquatic plants [2/5/2003-CN123.2]

Massachusetts Category 5 Waters
"Waters requiring a TMDL"

NAME	SEGMENT ID	DESCRIPTION	SIZE	POLLUTANT NEEDING TMDL [EPA APPROVAL DATE-DOCUMENT CONTROL NUMBER]
French River (4230075)	MA42-05_2008	Dam at North Village to Webster/Dudley WWTP, Webster/Dudley.	2.4 miles	-Organic enrichment/Low DO -(Other habitat alterations*) -Pathogens -Taste, odor and color -(Objectionable deposits*)
French River (4230075)	MA42-06_2008	Webster-Dudley WWTP to Connecticut state line.	0.92 miles	-Nutrients -Organic enrichment/Low DO -(Other habitat alterations*) -Pathogens -Taste, odor and color -Turbidity -(Objectionable deposits*)
Little River (4230275)	MA42-09_2008	Outlet Pikes Pond, Charlton to confluence with French River, Oxford.	7.1 miles	-Metals
Texas Pond (42058)	MA42058_2008	Oxford	27.9 acres	-Metals -Noxious aquatic plants [7/12/2002-CN110.0]
Thayers Pond (42059)	MA42059_2008	Oxford	6.4 acres	-Metals -Nutrients -Turbidity
Hoosic				
Cheshire Reservoir (11002)	MA11002_2008	[North Basin] Cheshire	284 acres	-(Eurasian Water Milfoil, Myriophyllum spicatum*) -(Non-Native Aquatic Plants*) -Turbidity -Nutrient/Eutrophication Biological Indicators -Aquatic Plants (Macrophytes)
Cheshire Reservoir (11018)	MA11018_2008	[Middle Basin] Cheshire/Lanesborough	186 acres	-(Eurasian Water Milfoil, Myriophyllum spicatum*) -(Non-Native Aquatic Plants*) -Aquatic Plants (Macrophytes)
Cheshire Reservoir (11019)	MA11019_2008	[South Basin] Cheshire/Lanesborough	91.7 acres	-(Eurasian Water Milfoil, Myriophyllum spicatum*) -Excess Algal Growth -(Non-Native Aquatic Plants*)
Green River (1100650)	MA11-06_2008	Headwaters southwest of Sugarloaf Mountain (west of Ingraham Road), New Ashford to confluence with Hoosic River, Williamstown.	12.5 miles	-Fecal Coliform
Hoosic River (1100500)	MA11-03_2008	Headwaters, outlet Cheshire Reservoir, Cheshire to Adams WWTP discharge, Adams.	8.8 miles	-(Other flow regime alterations*) -(Physical substrate habitat alterations*) -Temperature, water -Fecal Coliform -(Alteration in stream-side or littoral vegetative covers*) -Ambient Bioassays -- Chronic Aquatic Toxicity
Hoosic River (1100500)	MA11-04_2008	Adams WWTP discharge, Adams to confluence with North Branch Hoosic River, North Adams.	5.4 miles	-(Other flow regime alterations*) -Fecal Coliform -(Alteration in stream-side or littoral vegetative covers*)

Massachusetts Category 4a Waters
"TMDL is Completed"

NAME	SEGMENT ID	DESCRIPTION	SIZE	POLLUTANTS ADDRESSED BY TMDL	EPA TMDL NO.
Connecticut					
Leverett Pond	MA34042	Leverett	90.709 ACRES		
				Nutrient/Eutrophication Biological Indicators	675
				(Eurasian Water Milfoil, Myriophyllum spicatum*)	
				(Non-Native Aquatic Plants*)	
Loon Pond	MA34045	Springfield	25.104 ACRES		
				Nutrient/Eutrophication Biological Indicators	726
Bachelor Brook	MA34-07	Outlet Forge Pond, Granby to confluence with Connecticut River, South Hadley (through former segments Aldrich Lake [East Basin] MA34002 and Aldrich Lake [West Basin] MA34106).	11.606 MILES		
				Nutrient/Eutrophication Biological Indicators	5, 6
Lake Warner	MA34098	Hadley	65.132 ACRES		
				(Non-Native Aquatic Plants*)	
				Excess Algal Growth	651
				Oxygen, Dissolved	651
				Phosphorus (Total)	651
				Turbidity	651
Lake Wyola	MA34103	Shutesbury	126.119 ACRES		
				Phosphorus (Total)	653
				Nutrient/Eutrophication Biological Indicators	653
Deerfield					
Plainfield Pond	MA33017	Plainfield	59.616 ACRES		
				Mercury in Fish Tissue	33880
Farmington					
Otis Reservoir	MA31027	Otis/Tolland/Blandford	988.88 ACRES		
				Mercury in Fish Tissue	33880
French					
Buffumville Lake	MA42005	Charlton/Oxford	199 ACRES		
				Mercury in Fish Tissue	33880
				Excess Algal Growth	2358
				(Non-Native Aquatic Plants*)	
Cedar Meadow Pond	MA42009	Leicester	140 ACRES		

* TMDL not required (Non-Pollutant)

Massachusetts Category 4a Waters
"TMDL is Completed"

NAME	SEGMENT ID	DESCRIPTION	SIZE	POLLUTANTS ADDRESSED BY TMDL	EPA TMDL NO.
				Aquatic Plants (Macrophytes)	2359
				(Non-Native Aquatic Plants*)	
Dresser Hill Pond	MA42014	Charlton	8 ACRES		
				Turbidity	2360
Dutton Pond	MA42015	Leicester	6 ACRES		
				Phosphorus (Total)	2354
				Nutrient/Eutrophication Biological Indicators	2354
Gore Pond	MA42018	Dudley/Charlton	169 ACRES		
				Oxygen, Dissolved	2361
				Turbidity	2361
				(Non-Native Aquatic Plants*)	
				Excess Algal Growth	2361
Granite Reservoir	MA42019	Charlton	207 ACRES		
				(Non-Native Aquatic Plants*)	
				Aquatic Plants (Macrophytes)	2362
Greenville Pond	MA42023	Leicester	31 ACRES		
				Turbidity	2355
Hudson Pond	MA42029	Oxford/Sutton	15 ACRES		
				Aquatic Plants (Macrophytes)	2363
Jones Pond	MA42030	Charlton/Spencer	30 ACRES		
				Aquatic Plants (Macrophytes)	2364
Lowes Pond	MA42034	Oxford	33 ACRES		
				Aquatic Plants (Macrophytes)	2366
McKinstry Pond	MA42035	Oxford	16 ACRES		
				Aquatic Plants (Macrophytes)	2367
New Pond	MA42037	Dudley	33 ACRES		
				Aquatic Plants (Macrophytes)	2368
Peter Pond	MA42042	Dudley	42 ACRES		
				Phosphorus (Total)	2369
				Oxygen, Dissolved	2369
Pierpoint Meadow Pond	MA42043	Dudley/Charlton	95 ACRES		
				Aquatic Plants (Macrophytes)	2370
				(Non-Native Aquatic Plants*)	
Pikes Pond	MA42044	Charlton	28 ACRES		
				Turbidity	2371

Massachusetts Category 2 Waters
"Attaining Some Uses; other Uses Not Assessed"

NAME	SEGMENT ID	DESCRIPTION	SIZE	USES ATTAINED
				Aesthetic
Hubbard Brook	MA31-16	Confluence Babcock Brook and Hall Pond Brook, Tolland to border of Granville, Massachusetts/Hartland, Connecticut.	4.0271 MILES	
				Fish, other Aquatic Life and Wildlife
				Aesthetic
French				
Unnamed Tributary	MA42-01	Unnamed tributary to Town Meadow Brook, outlet Sargent Pond, Leicester to inlet Dutton Pond, Leicester.	0.5 MILES	
				Fish, other Aquatic Life and Wildlife
Robinson Pond	MA42047	Oxford	99 ACRES	
				Aesthetic
Mill Brook	MA42-10	Headwaters, outlet Webster Lake, Webster to confluence with French River, Webster.	1.2 MILES	
				Fish, other Aquatic Life and Wildlife
				Aesthetic
Wellington Brook	MA42-11	Headwaters south of Cedar Street, Auburn to confluence with French River, Oxford.	3.4 MILES	
				Secondary Contact Recreation
				Primary Contact Recreation
				Fish, other Aquatic Life and Wildlife
				Aesthetic
Mine Brook	MA42-16	Headwaters, Webster to inlet Club Pond, Webster.	1.4 MILES	
				Secondary Contact Recreation
				Primary Contact Recreation
				Fish, other Aquatic Life and Wildlife
				Aesthetic
Unnamed Tributary	MA42-19	Unnamed tributary to the French River on the 1982 USGS quad as 'Lowes Brook' , from the outlet of Lowes Pond, Oxford to the confluence with the French River, Oxford.	1.3 MILES	
				Aesthetic
				Fish, other Aquatic Life and Wildlife
				Secondary Contact Recreation
				Primary Contact Recreation
Unnamed Tributary	MA42-20	Unnamed tributary to South Fork locally known as 'Potters Brook', from outlet of Old Mill Pond Dam (MA01833), Charlton to the confluence with South Fork, Charlton.	0.9 MILES	
				Primary Contact Recreation
				Fish, other Aquatic Life and Wildlife

Massachusetts Category 5 Waters
"Waters requiring a TMDL"

NAME	SEGMENT ID	DESCRIPTION	SIZE	IMPAIRMENT CAUSE [EPA TMDL No.]
				Oxygen, Dissolved
French				
French River	MA42-03	Headwaters, outlet Greenville Pond, Leicester to the outlet of Thayer Pond, Oxford (excluding approximately 0.6 miles through Rochdale Pond segment MA42048) (through former pond segments Texas Pond MA42058 and Thayers Pond MA42059).	3.8 MILES	
				Phosphorus (Total)
				Mercury in Fish Tissue
				Turbidity
				Aquatic Plants (Macrophytes) [2357]
French River	MA42-04	From dam just upstream of Clara Barton Road, Oxford, to dam at North Village, Webster/Dudley.	9.6 MILES	
				Mercury in Fish Tissue
French River	MA42-05	Dam at North Village, Webster/Dudley to Webster WWTP outfall, Webster/Dudley.	2.4 MILES	
				(Debris/Floatables/Trash*)
				(Other flow regime alterations*)
				Aquatic Macroinvertebrate Bioassessments
				Fecal Coliform
French River	MA42-06	Webster WWTP outfall, Webster/Dudley to state line, Dudley, MA/Thompson,CT.	1 MILES	
				Other
				Fecal Coliform
				Sediment Screening Value (Exceedence)
				Taste and Odor
				Turbidity
				Aquatic Macroinvertebrate Bioassessments
				(Debris/Floatables/Trash*)
Burncoat Brook	MA42-07	Headwaters, outlet Bouchard Pond, Leicester to confluence with Town Meadow Brook, Leicester (through former pond segment Ballard Hill Pond MA42069).	1 MILES	
				Aquatic Macroinvertebrate Bioassessments
				Escherichia coli
Little River	MA42-13	Headwaters, outlet Pikes Pond, Charlton to inlet Buffumville Lake, Charlton (formerly part of segment MA42-09).	3.5 MILES	
				Oxygen, Dissolved

* TMDL not required (Non-Pollutant)

Massachusetts Category 2 Waters
"Attaining some uses; other uses not assessed"

NAME	SEGMENT ID	DESCRIPTION	SIZE	UNITS	USES ATTAINED*				
					Aesthetic	Fish, other Aquatic Life and Wildlife	Primary Contact Recreation	Secondary Contact Recreation	Shellfish Harvesting
Buck River	MA31-12	Headwaters draining wetland just south of Morley Hill and Cronk Road, Sandisfield to confluence with the Clam River, Sandisfield.	6.398259	MILES	X	X			
Clam River	MA31-03	Outlet of Royal Pond, Otis to confluence with West Branch Farmington River, Sandisfield.	9.542	MILES	X	X			
Cone Brook	MA31-08	Drainage from Angerman Swamp in Beartown State Forest, Otis to Hayden Pond, Otis.	2.101	MILES	X	X			
Fall River	MA31-02	Outlet Larkum Pond, Otis to confluence with West Branch Farmington River, Otis.	0.761	MILES	X	X			
Hubbard Brook	MA31-16	Confluence Babcock Brook and Hall Pond Brook, Tolland to border of Granville, Massachusetts/Hartland, Connecticut.	4.0271	MILES	X	X			
Sandy Brook	MA31-14	Outlet York Lake, New Marlborough to border of Sandisfield, Massachusetts/Norfolk, Connecticut.	4.977348	MILES	X	X			
Valley Brook	MA31-15	Source, northwest of Holden Hill, Granville to border of Granville, Massachusetts/Hartland, Connecticut.	5.894326	MILES	X	X			
French									
Mill Brook	MA42-10	Headwaters, outlet Webster Lake, Webster to confluence with French River, Webster.	1.2	MILES	X	X			
Mine Brook	MA42-16	Headwaters, Webster to inlet Club Pond, Webster.	1.4	MILES	X	X	X	X	
Robinson Pond	MA42047	Oxford	99	ACRES	X				
Unnamed Tributary	MA42-01	Unnamed tributary to Town Meadow Brook, outlet Sargent Pond, Leicester to inlet Dutton Pond, Leicester.	0.5	MILES		X			
Unnamed Tributary	MA42-19	Unnamed tributary to the French River on the 1982 USGS quad as 'Lowes Brook' , from the outlet of Lowes Pond, Oxford to the confluence with the French River, Oxford.	1.3	MILES	X	X	X	X	
Unnamed Tributary	MA42-20	Unnamed tributary to South Fork locally known as 'Potters Brook', from outlet of Old Mill Pond Dam (MA01833), Charlton to the confluence with South Fork, Charlton.	0.9	MILES	X	X	X	X	
Wellington Brook	MA42-11	Headwaters south of Cedar Street, Auburn to confluence with French River, Oxford.	3.4	MILES	X	X	X	X	
Hoosic									
Dry Brook	MA11-13	Headwaters, west of Jackson Road (in Savoy Wildlife Management Area), Savoy to confluence with Hoosic River, Adams.	6.702	MILES	X	X	X	X	
East Branch Green River	MA11-21	Headwaters, northeast of Sugarloaf Mountain, New Ashford to confluence with Green River, New Ashford.	2.227	MILES	X	X			
Hemlock Brook	MA11-09	Headwaters, south of Route 2 in the Taconic Trail State Park to confluence with the Hoosic River, Wiliamstown.	7.083	MILES	X	X	X	X	

* Attained uses denoted by "X"

Massachusetts Category 4a Waters
"TMDL is completed"

NAME	SEGMENT ID	DESCRIPTION	SIZE	UNITS	POLLUTANTS ADDRESSED BY TMDL	EPA TMDL NO.
Warners Pond	MA82110	Concord	59.338	ACRES	(Non-Native Aquatic Plants*)	
					Mercury in Fish Tissue	33880
Connecticut						
Bachelor Brook	MA34-07	Outlet Forge Pond, Granby to confluence with Connecticut River, South Hadley (through former segments Aldrich Lake [East Basin] MA34002 and Aldrich Lake [West Basin] MA34106).	11.606	MILES	Nutrient/Eutrophication Biological Indicators	5
					Nutrient/Eutrophication Biological Indicators	6
Lake Warner	MA34098	Hadley	65.132	ACRES	(Non-Native Aquatic Plants*)	
					Excess Algal Growth	651
					Oxygen, Dissolved	651
					Phosphorus (Total)	651
					Turbidity	651
Lake Wyola	MA34103	Shutesbury	126.119	ACRES	Nutrient/Eutrophication Biological Indicators	653
					Phosphorus (Total)	653
Leverett Pond	MA34042	Leverett	90.709	ACRES	(Eurasian Water Milfoil, Myriophyllum spicatum*)	
					(Non-Native Aquatic Plants*)	
					Nutrient/Eutrophication Biological Indicators	675
Loon Pond	MA34045	Springfield	25.104	ACRES	Nutrient/Eutrophication Biological Indicators	726
Deerfield						
Ashfield Pond	MA33001	Ashfield	38.041	ACRES	Mercury in Fish Tissue	42397
Plainfield Pond	MA33017	Plainfield	59.616	ACRES	Mercury in Fish Tissue	33880
Farmington						
Otis Reservoir	MA31027	Otis/Tolland/Blandford	988.88	ACRES	Mercury in Fish Tissue	33880
French						
Buffumville Lake	MA42005	Charlton/Oxford	199	ACRES	(Non-Native Aquatic Plants*)	
					Excess Algal Growth	2358
					Mercury in Fish Tissue	33880
Cedar Meadow Pond	MA42009	Leicester	140	ACRES	(Non-Native Aquatic Plants*)	
					Aquatic Plants (Macrophytes)	2359
Dresser Hill Pond	MA42014	Charlton	8	ACRES	Turbidity	2360
Dutton Pond	MA42015	Leicester	6	ACRES	Nutrient/Eutrophication Biological Indicators	2354
					Phosphorus (Total)	2354

* TMDL not required (Non-pollutant)

Massachusetts Category 4a Waters
"TMDL is completed"

NAME	SEGMENT ID	DESCRIPTION	SIZE	UNITS	POLLUTANTS ADDRESSED BY TMDL	EPA TMDL NO.
Gore Pond	MA42018	Dudley/Charlton	169	ACRES	(Non-Native Aquatic Plants*)	
					Excess Algal Growth	2361
					Oxygen, Dissolved	2361
					Turbidity	2361
Granite Reservoir	MA42019	Charlton	207	ACRES	(Non-Native Aquatic Plants*)	
					Aquatic Plants (Macrophytes)	2362
Greenville Pond	MA42023	Leicester	31	ACRES	Turbidity	2355
Hudson Pond	MA42029	Oxford/Sutton	15	ACRES	Aquatic Plants (Macrophytes)	2363
Jones Pond	MA42030	Charlton/Spencer	30	ACRES	Aquatic Plants (Macrophytes)	2364
Larner Pond	MA42068	Dudley	27	ACRES	(Non-Native Aquatic Plants*)	
					Aquatic Plants (Macrophytes)	2365
Lowes Pond	MA42034	Oxford	33	ACRES	Aquatic Plants (Macrophytes)	2366
McKinstry Pond	MA42035	Oxford	16	ACRES	Aquatic Plants (Macrophytes)	2367
Mosquito Pond	MA42060	Dudley	11	ACRES	Aquatic Plants (Macrophytes)	2374
New Pond	MA42037	Dudley	33	ACRES	Aquatic Plants (Macrophytes)	2368
Peter Pond	MA42042	Dudley	42	ACRES	Oxygen, Dissolved	2369
					Phosphorus (Total)	2369
Pierpoint Meadow Pond	MA42043	Dudley/Charlton	95	ACRES	(Non-Native Aquatic Plants*)	
					Aquatic Plants (Macrophytes)	2370
Pikes Pond	MA42044	Charlton	28	ACRES	Turbidity	2371
Rochdale Pond	MA42048	Leicester	43	ACRES	Nutrient/Eutrophication Biological Indicators	2356
Shepherd Pond	MA42051	Dudley	16	ACRES	Aquatic Plants (Macrophytes)	2373
Wallis Pond	MA42062	Dudley	24	ACRES	Aquatic Plants (Macrophytes)	2375
					Oxygen, Dissolved	2375
Housatonic						
Stockbridge Bowl	MA21105	Stockbridge	383.495	ACRES	(Eurasian Water Milfoil, Myriophyllum spicatum*)	
					Mercury in Fish Tissue	33880
Ipswich						
Hood Pond	MA92025	Ipswich/Topsfield	67.446	ACRES	Mercury in Fish Tissue	33880
Mill Pond	MA92041	Burlington	59.084	ACRES	Mercury in Fish Tissue	33880

* TMDL not required (Non-pollutant)

Massachusetts Category 5 Waters
"Waters requiring a TMDL"

NAME	SEGMENT ID	DESCRIPTION	SIZE	UNITS	IMPAIRMENT CAUSE	EPA TMDL NO.
Green River	MA33-30	From Greenfield swimming pool dam (northwest of Nashs Mill Road), Greenfield to confluence with the Deerfield River, Greenfield . (formerly segment MA33-10 and part of segment MA33-09)	3.735	MILES	Fecal Coliform	
Sherman Reservoir	MA33018	Massachusetts portion only. Rowe/Monroe/Whitingham, Vt.	72.437	ACRES	Mercury in Fish Tissue	
South River	MA33-08	Emments Road Ashfield to confluence with Deerfield River, Conway (through South River Impoundment formerly segment MA33022).	12.957	MILES	(Physical substrate habitat alterations*)	
					Fecal Coliform	
Farmington						
Big Pond	MA31004	Otis	325.203	ACRES	Mercury in Fish Tissue	33880
					Oxygen, Dissolved	
Shaw Pond	MA31036	Becket/Otis	80.431	ACRES	(Eurasian Water Milfoil, Myriophyllum spicatum*)	
					Oxygen, Dissolved	
Upper Spectacle Pond	MA31044	Sandisfield/Otis	52.655	ACRES	Oxygen, Dissolved	
West Branch Farmington River	MA31-01	Outlet of Hayden Pond, Otis to Sandisfield/Tolland, Massachusetts and Colebrook, Connecticut in the Colebrook Reservoir.	16.134	MILES	Lack of a coldwater assemblage	
York Lake	MA31052	New Marlborough	28.763	ACRES	Oxygen, Dissolved	
French						
Burncoat Brook	MA42-07	Headwaters, outlet Bouchard Pond, Leicester to confluence with Town Meadow Brook, Leicester (through former pond segment Ballard Hill Pond MA42069).	1	MILES	Aquatic Macroinvertebrate Bioassessments	
					Escherichia coli	
French River	MA42-03	Headwaters, outlet Greenville Pond, Leicester to the outlet of Thayer Pond, Oxford (excluding approximately 0.6 miles through Rochdale Pond segment MA42048) (through former pond segments Texas Pond MA42058 and Thayers Pond MA42059).	3.8	MILES	Aquatic Plants (Macrophytes)	2357
					Mercury in Fish Tissue	
					Phosphorus (Total)	
					Turbidity	
French River	MA42-04	From dam just upstream of Clara Barton Road, Oxford, to dam at North Village, Webster/Dudley.	9.6	MILES	Mercury in Fish Tissue	
French River	MA42-05	Dam at North Village, Webster/Dudley to Webster WWTP outfall, Webster/Dudley.	2.4	MILES	(Debris/Floatables/Trash*)	
					(Other flow regime alterations*)	
					Aquatic Macroinvertebrate Bioassessments	
					Fecal Coliform	

* TMDL not required (Non-pollutant)

Massachusetts Category 2 Waters
"Attaining some uses; other uses not assessed"

NAME	SEGMENT ID	DESCRIPTION	SIZE	UNITS	USES ATTAINED*				
					Aesthetic	Fish, other Aquatic Life and Wildlife	Primary Contact Recreation	Secondary Contact Recreation	Shellfish Harvesting
Valley Brook	MA31-15	Source, northwest of Holden Hill, Granville to border of Granville, Massachusetts/Hartland, Connecticut.	5.894326	MILES	X	X			
French									
Mill Brook	MA42-10	Headwaters, outlet Webster Lake, Webster to confluence with French River, Webster.	1.2	MILES	X	X			
Mine Brook	MA42-16	Headwaters, Webster to inlet Club Pond, Webster.	1.4	MILES	X	X	X	X	
Robinson Pond	MA42047	Oxford	99	ACRES	X				
Unnamed Tributary	MA42-01	Unnamed tributary to Town Meadow Brook, outlet Sargent Pond, Leicester to inlet Dutton Pond, Leicester.	0.5	MILES		X			
Unnamed Tributary	MA42-19	Unnamed tributary to the French River on the 1982 USGS quad as 'Lowes Brook' , from the outlet of Lowes Pond, Oxford to the confluence with the French River, Oxford.	1.3	MILES	X	X	X	X	
Unnamed Tributary	MA42-20	Unnamed tributary to South Fork locally known as 'Potters Brook', from outlet of Old Mill Pond Dam (MA01833), Charlton to the confluence with South Fork, Charlton.	0.9	MILES	X	X	X	X	
Wellington Brook	MA42-11	Headwaters south of Cedar Street, Auburn to confluence with French River, Oxford.	3.4	MILES	X	X	X	X	
Housatonic									
Cady Brook	MA21-12	Source, Peru to the inlet of Windsor Reservoir, Hinsdale.	3.507	MILES	X	X			
Cleveland Brook	MA21-08	Headwaters, outlet of Cleveland Brook Reservoir, Hinsdale to confluence with East Branch Housatonic River, Dalton.	1.927	MILES	X	X			
Furnace Brook	MA21-21	Headwaters south of Route 295 (Canaan Road), Richmond to inlet Mud Ponds, West Stockbridge.	3.649	MILES		X			
Goose Pond Brook	MA21-07	Outlet of Goose Pond, Tyringham to confluence with the Housatonic River, Lee.	3.252	MILES	X	X	X	X	
Green River	MA21-23	Alford, Massachusetts/Hillsdale, New York border southwest of Route 71 to confluence with the Housatonic River, Great Barrington.	10.139	MILES	X	X	X	X	
Greenwater Brook	MA21-27	Headwaters, outlet of Greenwater Pond, Becket to the confluence with Goose Pond Brook, Lee	4.435	MILES	X	X	X	X	

Massachusetts Category 4a Waters
"TMDL is completed"

NAME	SEGMENT ID	DESCRIPTION	SIZE	UNITS	POLLUTANTS ADDRESSED BY TMDL	EPA TMDL NUMBER
Warners Pond	MA82110	Concord	59.338	ACRES	(Non-Native Aquatic Plants*)	
					Mercury in Fish Tissue	33880
Connecticut						
Bachelor Brook	MA34-07	Outlet Forge Pond, Granby to confluence with Connecticut River, South Hadley (through former segments Aldrich Lake [East Basin] MA34002 and Aldrich Lake [West Basin] MA34106).	11.606	MILES	Nutrient/Eutrophication Biological Indicators	5
					Nutrient/Eutrophication Biological Indicators	6
Lake Warner	MA34098	Hadley	65.132	ACRES	(Non-Native Aquatic Plants*)	
					Excess Algal Growth	651
					Oxygen, Dissolved	651
					Phosphorus (Total)	651
					Turbidity	651
Lake Wyola	MA34103	Shutesbury	126.119	ACRES	Nutrient/Eutrophication Biological Indicators	653
					Phosphorus (Total)	653
Leverett Pond	MA34042	Leverett	90.709	ACRES	(Eurasian Water Milfoil, Myriophyllum spicatum*)	
					(Non-Native Aquatic Plants*)	
					Nutrient/Eutrophication Biological Indicators	675
Loon Pond	MA34045	Springfield	25.104	ACRES	Nutrient/Eutrophication Biological Indicators	726
Deerfield						
Ashfield Pond	MA33001	Ashfield	38.041	ACRES	Mercury in Fish Tissue	42397
Plainfield Pond	MA33017	Plainfield	59.616	ACRES	Mercury in Fish Tissue	33880
Farmington						
Otis Reservoir	MA31027	Otis/Tolland/Blandford	988.88	ACRES	Mercury in Fish Tissue	33880
French						
Buffumville Lake	MA42005	Charlton/Oxford	199	ACRES	(Non-Native Aquatic Plants*)	
					Excess Algal Growth	2358
					Mercury in Fish Tissue	33880
Cedar Meadow Pond	MA42009	Leicester	140	ACRES	(Non-Native Aquatic Plants*)	
					Aquatic Plants (Macrophytes)	2359
Dresser Hill Pond	MA42014	Charlton	8	ACRES	Turbidity	2360
Dutton Pond	MA42015	Leicester	6	ACRES	Nutrient/Eutrophication Biological Indicators	2354
					Phosphorus (Total)	2354

Massachusetts Category 4a Waters
"TMDL is completed"

NAME	SEGMENT ID	DESCRIPTION	SIZE	UNITS	POLLUTANTS ADDRESSED BY TMDL	EPA TMDL NUMBER
Gore Pond	MA42018	Dudley/Charlton	169	ACRES	(Non-Native Aquatic Plants*)	
					Excess Algal Growth	2361
					Oxygen, Dissolved	2361
					Turbidity	2361
Granite Reservoir	MA42019	Charlton	207	ACRES	(Non-Native Aquatic Plants*)	
					Aquatic Plants (Macrophytes)	2362
Greenville Pond	MA42023	Leicester	31	ACRES	Turbidity	2355
Hudson Pond	MA42029	Oxford/Sutton	15	ACRES	Aquatic Plants (Macrophytes)	2363
Jones Pond	MA42030	Charlton/Spencer	30	ACRES	Aquatic Plants (Macrophytes)	2364
Larner Pond	MA42068	Dudley	27	ACRES	(Non-Native Aquatic Plants*)	
					Aquatic Plants (Macrophytes)	2365
Lowes Pond	MA42034	Oxford	33	ACRES	Aquatic Plants (Macrophytes)	2366
McKinstry Pond	MA42035	Oxford	16	ACRES	Aquatic Plants (Macrophytes)	2367
Mosquito Pond	MA42060	Dudley	11	ACRES	Aquatic Plants (Macrophytes)	2374
New Pond	MA42037	Dudley	33	ACRES	Aquatic Plants (Macrophytes)	2368
Peter Pond	MA42042	Dudley	42	ACRES	Oxygen, Dissolved	2369
					Phosphorus (Total)	2369
Pierpoint Meadow Pond	MA42043	Dudley/Charlton	95	ACRES	(Non-Native Aquatic Plants*)	
					Aquatic Plants (Macrophytes)	2370
Pikes Pond	MA42044	Charlton	28	ACRES	Turbidity	2371
Rochdale Pond	MA42048	Leicester	43	ACRES	Nutrient/Eutrophication Biological Indicators	2356
Shepherd Pond	MA42051	Dudley	16	ACRES	Aquatic Plants (Macrophytes)	2373
Wallis Pond	MA42062	Dudley	24	ACRES	Aquatic Plants (Macrophytes)	2375
					Oxygen, Dissolved	2375
Housatonic						
Stockbridge Bowl	MA21105	Stockbridge	383.495	ACRES	(Eurasian Water Milfoil, Myriophyllum spicatum*)	
					Mercury in Fish Tissue	33880
Ipswich						
Hood Pond	MA92025	Ipswich/Topsfield	67.446	ACRES	Mercury in Fish Tissue	33880
Mill Pond	MA92041	Burlington	59.084	ACRES	Mercury in Fish Tissue	33880
Islands						

Massachusetts Category 5 Waters
"Waters requiring a TMDL"

NAME	SEGMENT ID	DESCRIPTION	SIZE	UNITS	IMPAIRMENT CAUSE	EPA TMDL NO.
French River	MA42-03	Headwaters, outlet Greenville Pond, Leicester to the outlet of Thayer Pond, Oxford (excluding approximately 0.6 miles through Rochdale Pond segment MA42048) (through former pond segments Texas Pond MA42058 and Thayers Pond MA42059).	3.8	MILES	Aquatic Plants (Macrophytes)	2357
					Mercury in Fish Tissue	
					Phosphorus (Total)	
					Turbidity	
French River	MA42-04	From dam just upstream of Clara Barton Road, Oxford, to dam at North Village, Webster/Dudley.	9.6	MILES	Mercury in Fish Tissue	
French River	MA42-05	Dam at North Village, Webster/Dudley to Webster WWTP outfall, Webster/Dudley.	2.4	MILES	(Debris/Floatables/Trash*)	
					(Other flow regime alterations*)	
					Aquatic Macroinvertebrate Bioassessments	
					Fecal Coliform	
French River	MA42-06	Webster WWTP outfall, Webster/Dudley to state line, Dudley, MA/Thompson,CT.	1	MILES	(Debris/Floatables/Trash*)	
					Aquatic Macroinvertebrate Bioassessments	
					Fecal Coliform	
					Other	
					Sediment Screening Value (Exceedence)	
					Taste and Odor	
					Turbidity	
Grindstone Brook	MA42-18	Headwaters outlet Henshaw Pond, Leicester to inlet Rochdale Pond, Leicester.	2.3	MILES	Escherichia coli	
Little River	MA42-13	Headwaters, outlet Pikes Pond, Charlton to inlet Buffumville Lake, Charlton (formerly part of segment MA42-09).	3.5	MILES	Aquatic Macroinvertebrate Bioassessments	
					Oxygen, Dissolved	
Sucker Brook	MA42-15	Headwaters, outlet Nipmuck Pond, Webster to inlet Club Pond, Webster	1.7	MILES	Aquatic Macroinvertebrate Bioassessments	
					Escherichia coli	
Housatonic						
East Branch Housatonic River	MA21-01	Outlet of Muddy Pond, Washington to the outlet of Center Pond, Dalton.	11.251	MILES	Fecal Coliform	
					PCB in Fish Tissue	
East Branch Housatonic River	MA21-02	Outlet of Center Pond, Dalton to confluence with the Housatonic River, Pittsfield.	8.019	MILES	Fecal Coliform	
					PCB in Fish Tissue	
Goodrich Pond	MA21042	Pittsfield	15.355	ACRES	PCB in Fish Tissue	
Housatonic River	MA21-04	Confluence of Southwest Branch Housatonic River and West Branch Housatonic River, Pittsfield to outlet of Woods Pond, Lee/Lenox (pond was formerly segment MA21120).	12.322	MILES	(Non-Native Aquatic Plants*)	
					Fecal Coliform	
					PCB in Fish Tissue	
					Polychlorinated biphenyls	

Category 3 waters listed alphabetically by major watershed
"No uses assessed"

Water Body	Segment ID	Description	Size	Units
Putnam Pond	MA42046	Charlton.	20.00	Acres
Robinson Pond	MA42047	Oxford.	99.00	Acres
Slaters Pond	MA42053	Oxford.	105.00	Acres
Snow Pond	MA42054	Charlton.	1.00	Acres
Stiles Reservoir	MA42055	Spencer/Leicester.	309.00	Acres
Town Meadow Brook	MA42-02	Headwaters, outlet Dutton Pond, Leicester to mouth at inlet Greenville Pond, Leicester.	1.90	Miles
Unnamed Tributary	MA42-12	Unnamed tributary to Wellington Brook, perennial portion from Depot Road, Oxford to confluence with Wellington Brook, Oxford.	0.20	Miles
Unnamed Tributary	MA42-19	Unnamed tributary to the French River on the 1982 USGS quad as 'Lowes Brook' , from the outlet of Lowes Pond, Oxford to mouth at confluence with French River, Oxford.	1.30	Miles
Unnamed Tributary	MA42-20	Unnamed tributary to South Fork locally known as 'Potters Brook', from outlet of Old Mill Pond Dam ((NAT ID: MA01833), Charlton to mouth at confluence with South Fork, Charlton.	0.90	Miles
Watson Millpond	MA42063	Spencer.	2.00	Acres
Wee Laddie Pond	MA42065	Charlton.	6.00	Acres
Housatonic				
Anthony Brook	MA21-10	Headwaters, outlet Anthony Pond, Dalton to mouth at confluence with Wahconah Falls Brook, Dalton.	2.60	Miles
Ashley Lake	MA21003	Washington.	94.00	Acres
Card Pond	MA21015	West Stockbridge.	11.00	Acres
Churchill Brook	MA21-34	Headwaters, perennial portion in the Pittsfield State Forest, Hancock (north of Honwee Mountain, Lanesborough) to mouth at inlet Onota Lake, Pittsfield.	2.80	Miles
Cleveland Brook Reservoir	MA21019	Hinsdale.	155.00	Acres
Cookson Pond	MA21021	New Marlborough.	67.00	Acres
Crane Lake	MA21025	West Stockbridge.	27.00	Acres
East Indies Pond	MA21029	New Marlborough.	72.00	Acres
Farnham Reservoir	MA21033	Washington.	41.00	Acres
Fenton Brook	MA21-35	Headwaters south of Jug End Road, Egremont (west of Mt. Bushnell, Sheffield), to mouth at confluence with Karner Brook, Egremont.	2.40	Miles
Hayes Pond	MA21051	Otis.	46.00	Acres
Mill Pond	MA21069	Egremont.	10.00	Acres
Seekonk Brook	MA21-22	Headwaters, outlet of small impoundment east of West Road, Alford to mouth at confluence with the Green River, Great Barrington.	4.80	Miles
Tyler Brook	MA21-32	Headwaters, northwest of Driscoll Road, Windsor to mouth at confluence with Windsor Brook, Windsor.	2.60	Miles
Unnamed Tributary	MA21-24	Headwaters, outlet Mill Pond, Egremont to mouth at confluence with Hubbard Brook, Egremont.	1.50	Miles
Upper Sackett Reservoir	MA21113	Hinsdale.	19.00	Acres
Welch Brook	MA21-33	Headwaters, northeast of Tully Mountain, Hinsdale to mouth at confluence with unnamed tributary to Plunkett Reservoir, Hinsdale.	1.70	Miles
Windsor Reservoir	MA21119	Hinsdale/Windsor.	74.00	Acres
Hudson: Hoosic				
Hemlock Brook	MA11-09	Headwaters, perennial portion, south of Route 2 in the Taconic Trail State Park, Williamstown to mouth at confluence with the Hoosic River, Wiliamstown.	7.10	Miles

Category 4a waters listed alphabetically by major watershed
"TMDL is completed"

Water Body	Segment ID	Description	Size	Units	Pollutants Addressed By TMDL	EPA TMDL No.
Boons Pond	MA82011	Stow/Hudson.	174.00	Acres	(Non-Native Aquatic Plants*)	
					Algae	2353
					Mercury in Fish Tissue	33880
Nutting Lake	MA82124	[West Basin] Billerica.	51.00	Acres	Mercury in Fish Tissue	33880
Sudbury Reservoir	MA82106	Southborough/Marlborough.	1181.00	Acres	Mercury in Fish Tissue	33880
Walden Pond	MA82109	Concord.	63.00	Acres	Mercury in Fish Tissue	33880
Warners Pond	MA82110	Concord.	59.00	Acres	(Non-Native Aquatic Plants*)	
					Mercury in Fish Tissue	33880
Connecticut						
Lake Warner	MA34098	Hadley.	65.00	Acres	(Non-Native Aquatic Plants*)	
					Algae	651
					Dissolved Oxygen	651
					Phosphorus, Total	651
					Turbidity	651
Lake Wyola	MA34103	Shutesbury.	124.00	Acres	Nutrient/Eutrophication Biological Indicators	653
					Phosphorus, Total	653
Leverett Pond	MA34042	Leverett.	91.00	Acres	(Eurasian Water Milfoil, Myriophyllum spicatum*)	
					(Non-Native Aquatic Plants*)	
					Nutrient/Eutrophication Biological Indicators	675
Deerfield						
Ashfield Pond	MA33001	Ashfield.	38.00	Acres	Mercury in Fish Tissue	42397
Plainfield Pond	MA33017	Plainfield.	60.00	Acres	Mercury in Fish Tissue	33880
Farmington						
Otis Reservoir	MA31027	Otis/Tolland/Blandford.	989.00	Acres	Mercury in Fish Tissue	33880
French						
Buffumville Lake	MA42005	Charlton/Oxford.	199.00	Acres	(Non-Native Aquatic Plants*)	
					Mercury in Fish Tissue	33880
Dresser Hill Pond	MA42014	Charlton.	8.00	Acres	Turbidity	2360
Dutton Pond	MA42015	Leicester.	6.00	Acres	Nutrient/Eutrophication Biological Indicators	2354
					Phosphorus, Total	2354
Gore Pond	MA42018	Dudley/Charlton.	169.00	Acres	(Non-Native Aquatic Plants*)	
					Algae	2361
					Dissolved Oxygen	2361
					Turbidity	2361
Greenville Pond	MA42023	Leicester.	31.00	Acres	Turbidity	2355

Category 4a waters listed alphabetically by major watershed
"TMDL is completed"

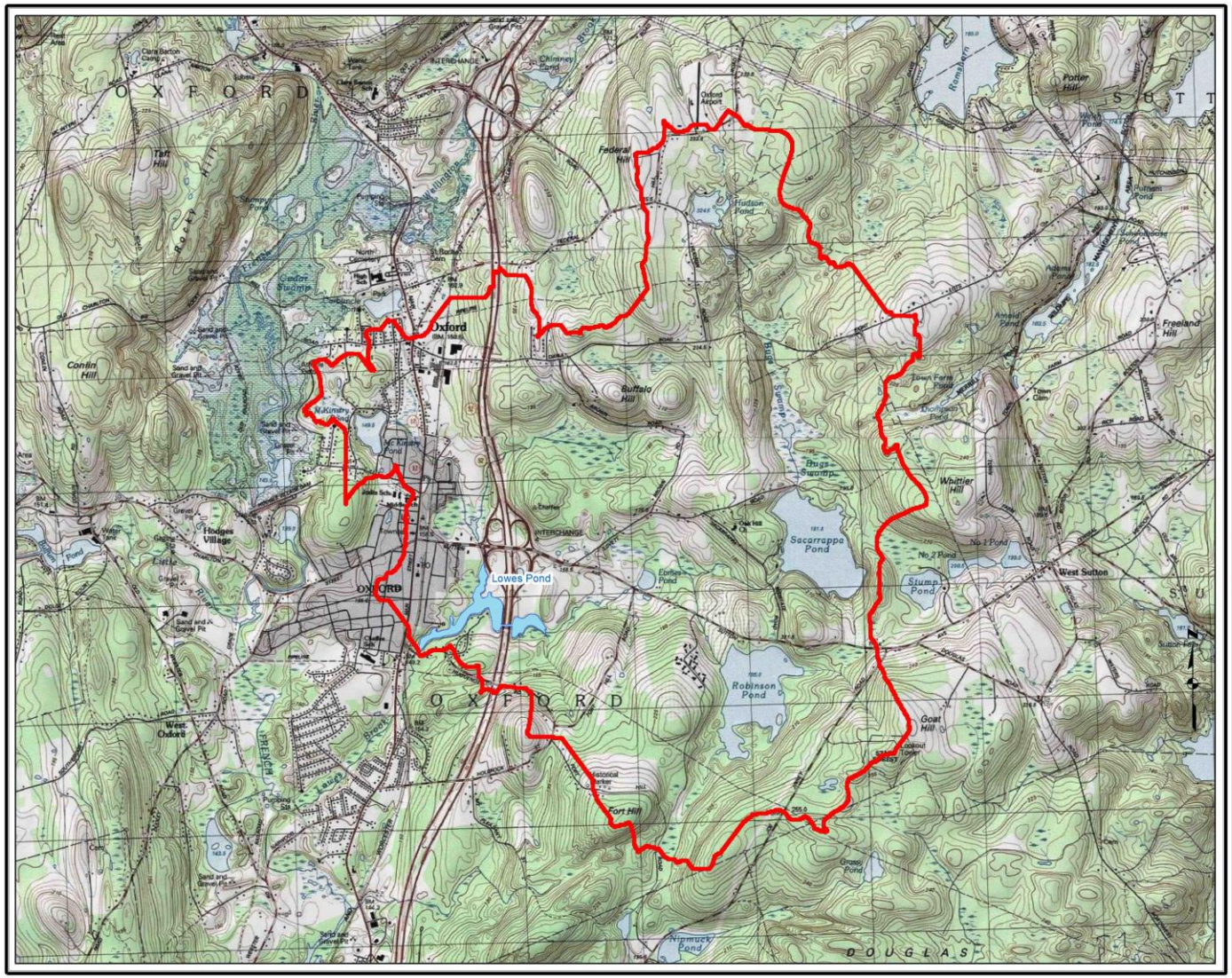
Water Body	Segment ID	Description	Size	Units	Pollutants Addressed By TMDL	EPA TMDL No.
Hudson Pond	MA42029	Oxford/Sutton.	15.00	Acres	(Aquatic Plants (Macrophytes)*)	
					Nutrient/Eutrophication Biological Indicators	2363
Jones Pond	MA42030	Charlton/Spencer.	30.00	Acres	(Aquatic Plants (Macrophytes)*)	
					Nutrient/Eutrophication Biological Indicators	2364
Lowes Pond	MA42034	Oxford.	33.00	Acres	Nutrient/Eutrophication Biological Indicators	2366
Mckinstry Pond	MA42035	Oxford.	16.00	Acres	Nutrient/Eutrophication Biological Indicators	2367
Pikes Pond	MA42044	Charlton.	28.00	Acres	Turbidity	2371
Rochdale Pond	MA42048	Leicester.	43.00	Acres	Nutrient/Eutrophication Biological Indicators	2356
Wallis Pond	MA42062	Dudley.	24.00	Acres	(Aquatic Plants (Macrophytes)*)	
					Dissolved Oxygen	2375
					Nutrient/Eutrophication Biological Indicators	2375
Housatonic						
Pontoosuc Lake	MA21083	Lanesborough/Pittsfield.	500.00	Acres	(Eurasian Water Milfoil, Myriophyllum spicatum*)	
					(Non-Native Aquatic Plants*)	
					Mercury in Fish Tissue	33880
Stockbridge Bowl	MA21105	Stockbridge.	384.00	Acres	(Eurasian Water Milfoil, Myriophyllum spicatum*)	
					Mercury in Fish Tissue	33880
Ipswich						
Hood Pond	MA92025	Ipswich/Topsfield.	68.00	Acres	Mercury in Fish Tissue	33880
Mill Pond	MA92041	Burlington.	59.00	Acres	Mercury in Fish Tissue	33880
Islands						
Edgartown Great Pond	MA97-17	excluding Jacobs Pond (PALIS# 97038) Edgartown, Martha's Vineyard.	1.35	Square Miles	Estuarine Bioassessments	64380
					Nitrogen, Total	64380
					Nutrient/Eutrophication Biological Indicators	64380
Farm Pond	MA97-30	Oak Bluffs.	0.05	Square Miles	Dissolved Oxygen	64662
					Estuarine Bioassessments	64662
					Nitrogen, Total	64662
					Nutrient/Eutrophication Biological Indicators	64662
Gibbs Pond	MA97028	Nantucket.	34.00	Acres	Mercury in Fish Tissue	33880

Category 5 waters listed alphabetically by major watershed
The 303(d) List – "Waters requiring a TMDL"

Water Body	Segment ID	Description	Size	Units	Impairment	EPA TMDL No.
Cranberry Pond Brook	MA31-21	Headwaters, outlet Cranberry Pond, Tolland to mouth at confluence with Slocum Brook, Tolland.	1.60	Miles	Lack of a coldwater assemblage	
Palmer Brook	MA31-29	Headwaters, outlet Palmer Brook Dam (NATID: MA00205), Becket to mouth at inlet Ward Pond, Becket.	2.10	Miles	Lack of a coldwater assemblage	
Pond Brook	MA31-33	Headwaters, outlet Noyes Pond, Tolland to mouth at confluence with Babcock Brook, Tolland.	2.00	Miles	Lack of a coldwater assemblage	
Shaw Pond	MA31036	Becket/Otis.	80.00	Acres	(Eurasian Water Milfoil, Myriophyllum spicatum*)	
					Dissolved Oxygen	
Spectacle Pond Brook	MA31-27	Headwaters, south of West Center Road, Otis to mouth at inlet Upper Spectacle Pond, Otis.	1.50	Miles	Lack of a coldwater assemblage	
Thomas Brook	MA31-06	Headwaters, outlet Thomas Pond, Becket to mouth at confluence with unnamed tributary to Hayden Pond, Otis.	0.80	Miles	Lack of a coldwater assemblage	
Upper Spectacle Pond	MA31044	Sandisfield/Otis.	53.00	Acres	Dissolved Oxygen	
West Branch Farmington River	MA31-01	Headwaters, outlet Hayden Pond, Otis to the MA/CT border in the Colebrook Reservoir, Sandisfield/Tolland.	16.10	Miles	Lack of a coldwater assemblage	
					Temperature	
York Lake	MA31052	New Marlborough.	29.00	Acres	Dissolved Oxygen	
French						
Burncoat Brook	MA42-07	Headwaters, outlet Bouchard Pond, Leicester to mouth at confluence with Town Meadow Brook, Leicester (through former pond segment Ballard Hill Pond MA42069).	1.00	Miles	Benthic Macroinvertebrates	
					Escherichia Coli (E. Coli)	
Carbuncle Pond	MA42008	Oxford.	11.00	Acres	Harmful Algal Blooms	
French River	MA42-03	Headwaters, outlet Greenville Pond, Leicester to the outlet of Thayers Pond, Oxford (excluding approximately 0.6 miles through Rochdale Pond segment MA42048) (through former pond segments Texas Pond MA42058 and Thayers Pond MA42059).	3.80	Miles	Mercury in Fish Tissue	
French River	MA42-04	From dam (NAT ID: MA01946) just upstream of Clara Barton Road, Oxford, to dam (NAT ID: MA00108) at North Village, Webster/Dudley.	9.60	Miles	Mercury in Fish Tissue	
French River	MA42-05	Dam (NAT ID: MA00108) at North Village, Webster/Dudley to Webster WWTP outfall (NPDES: MA0100439) , Webster/Dudley.	2.40	Miles	(Flow Regime Modification*)	
					Benthic Macroinvertebrates	

Tighe&Bond
Engineers | Environmental Specialists

ATTACHMENT 2



MASSACHUSETTS watershed·based plans

LOWES POND WATERSHED

WATERSHED BOUNDARY MAP

11/28/2016

Legend

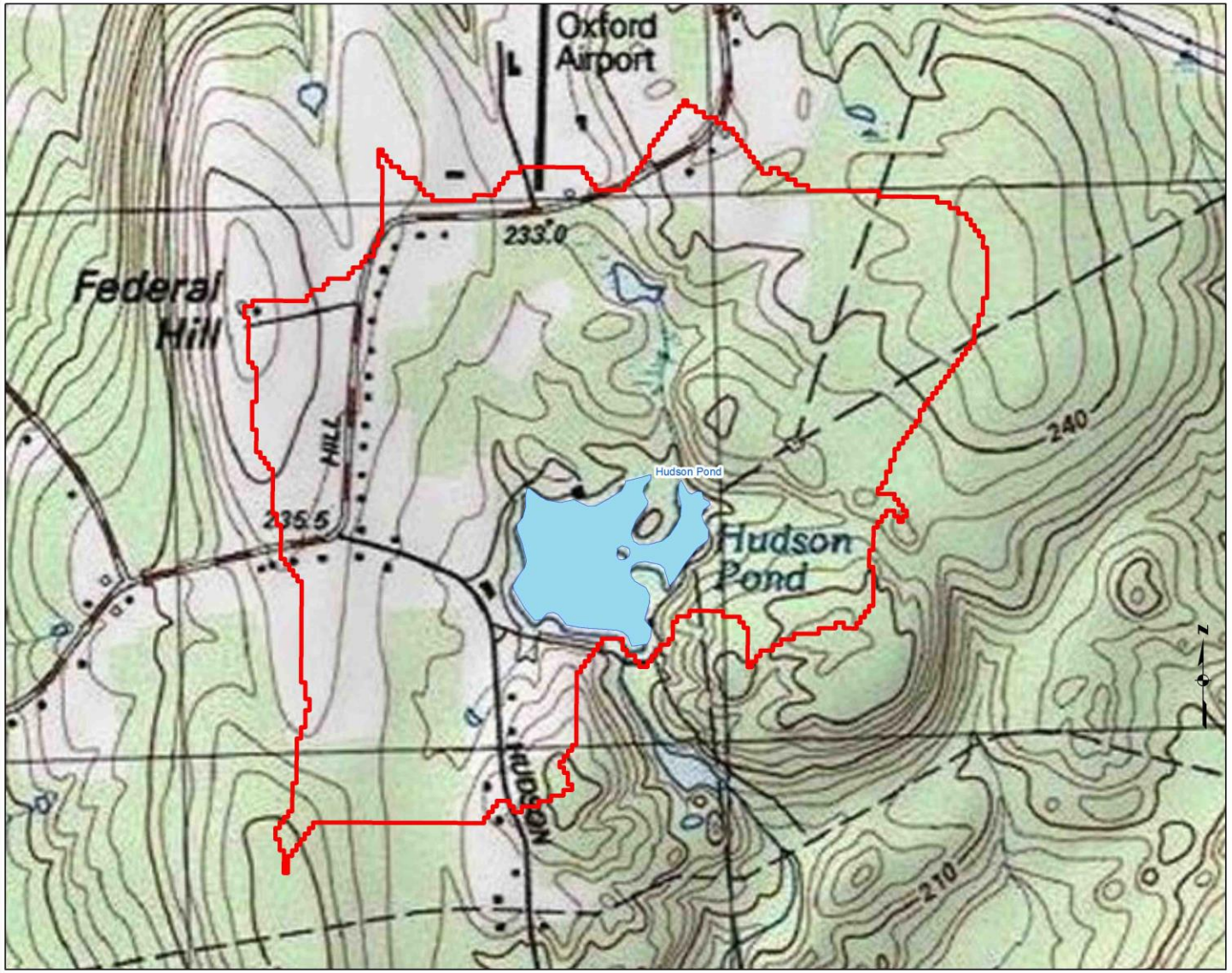
- Watershed Boundary
- Lake/Pond

0.35 0.175 0 0.35

Miles

Geosyntec consultants

MassDEP



MASSACHUSETTS
watershed·based plans

HUDSON POND WATERSHED

WATERSHED BOUNDARY MAP

11/28/2016

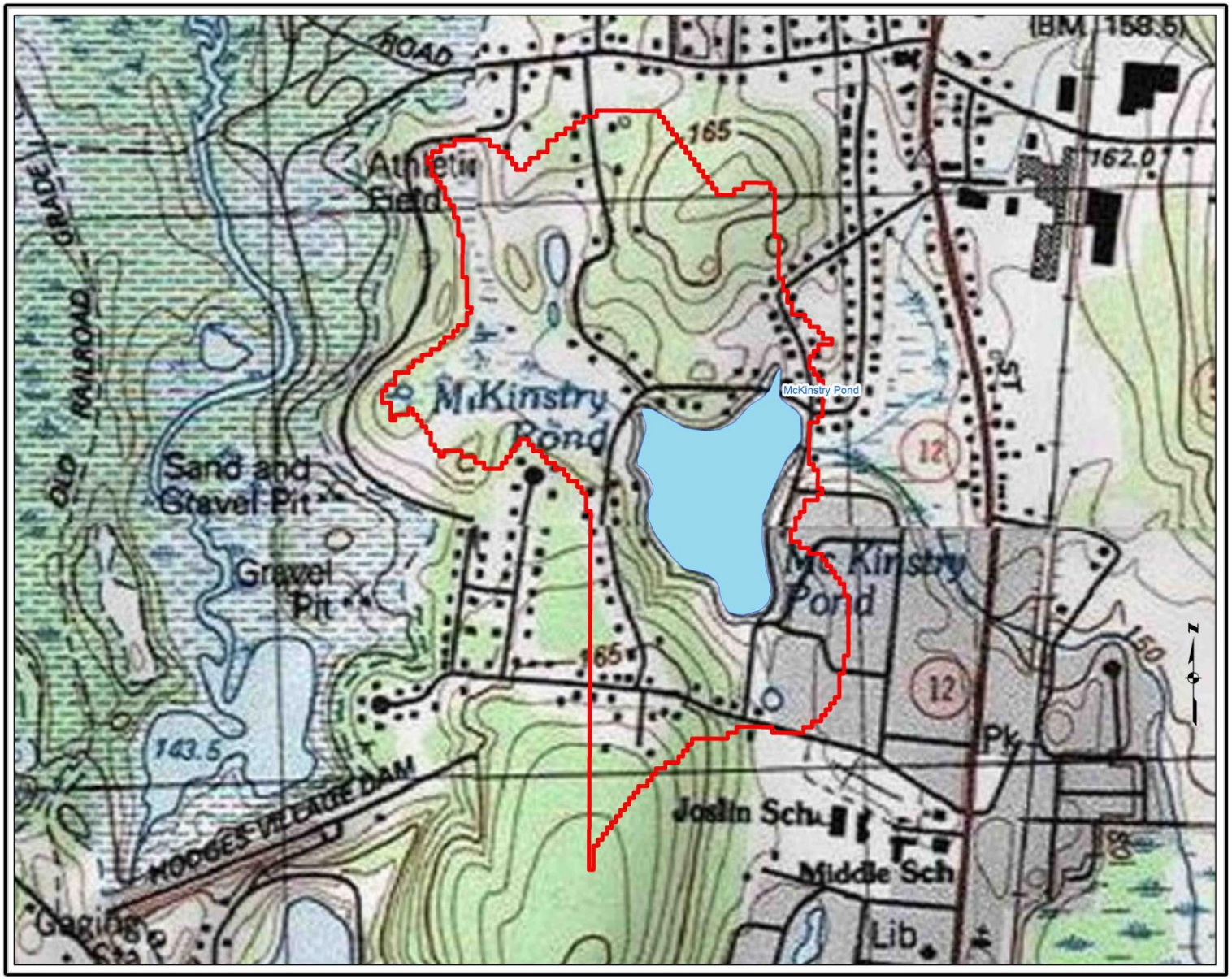
Legend

- Watershed Boundary
- Lake/Pond

0.08 0.04 0 0.08
Miles

Geosyntec
consultants

MassDEP



MASSACHUSETTS watershed·based plans

MCKINSTRY POND WATERSHED

WATERSHED BOUNDARY MAP

11/28/2016

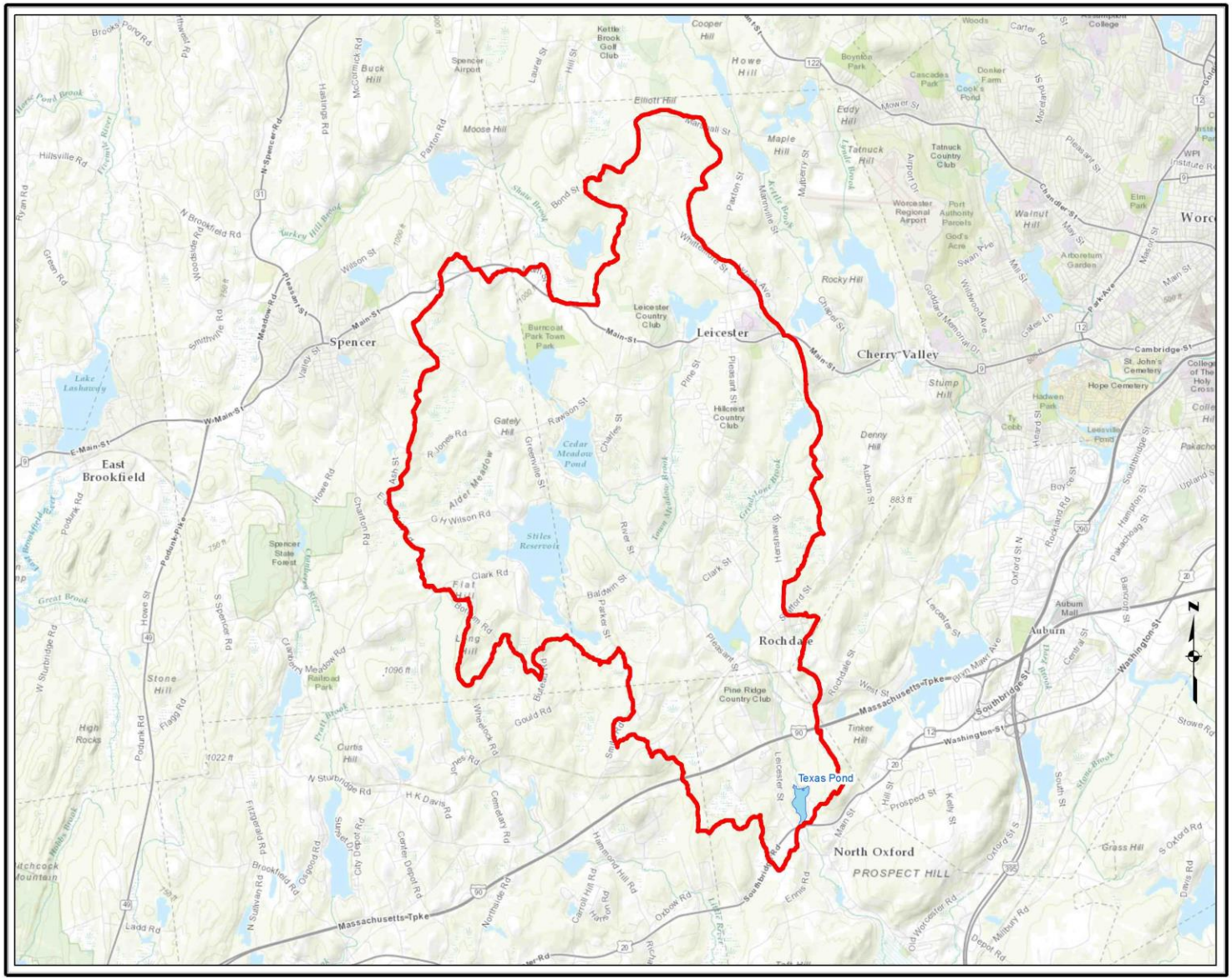
Legend

- Watershed Boundary
- Lake/Pond

0.07 0.035 0 0.07 Miles

Geosyntec consultants

MassDEP



MASSACHUSETTS watershed·based plans

TEXAS POND WATERSHED

WATERSHED BOUNDARY MAP

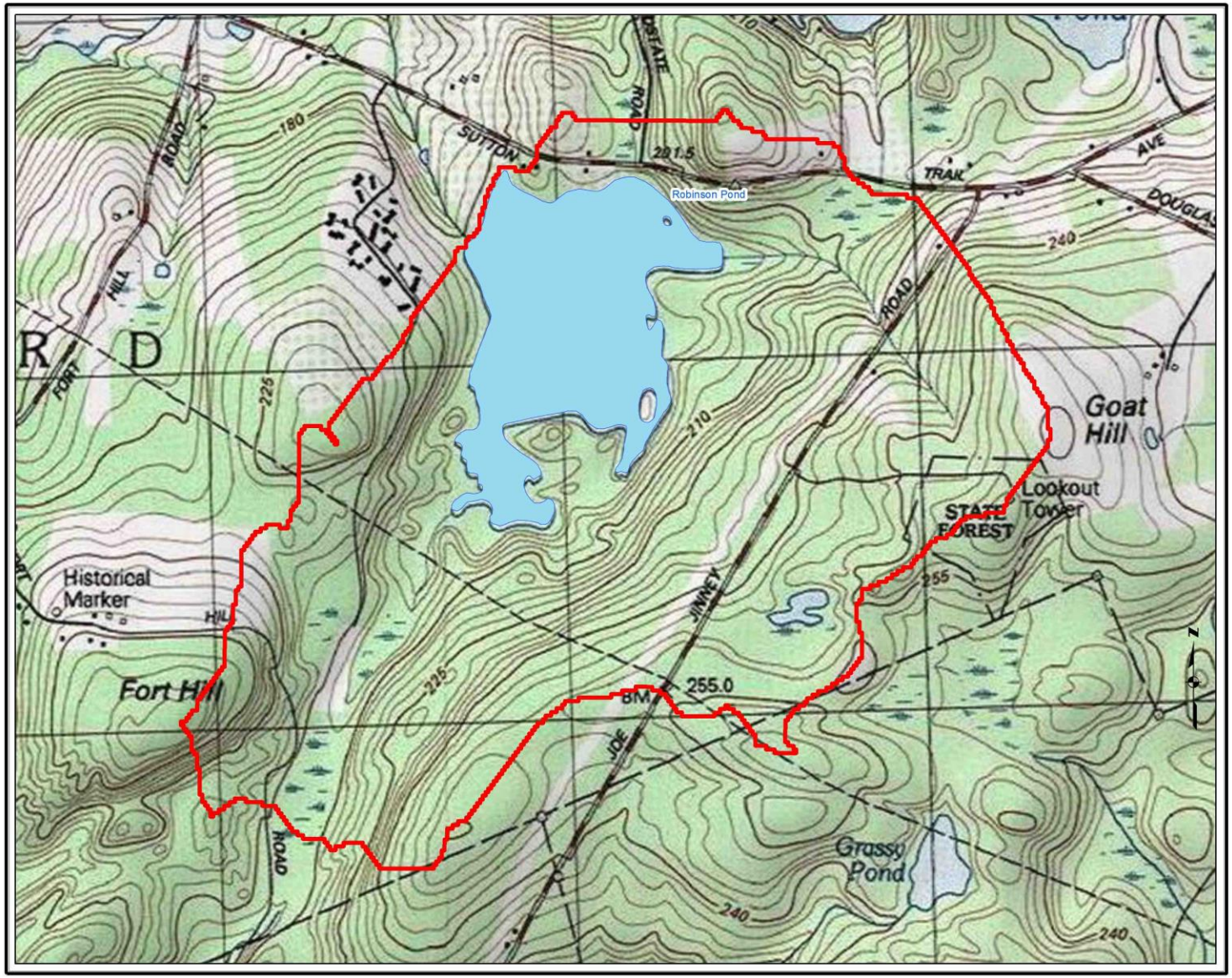
11/28/2016

Legend

- Watershed Boundary
- Lake/Pond

Geosyntec consultants

MassDEP



MASSACHUSETTS watershed·based plans

ROBINSON POND WATERSHED

WATERSHED BOUNDARY MAP

11/28/2016

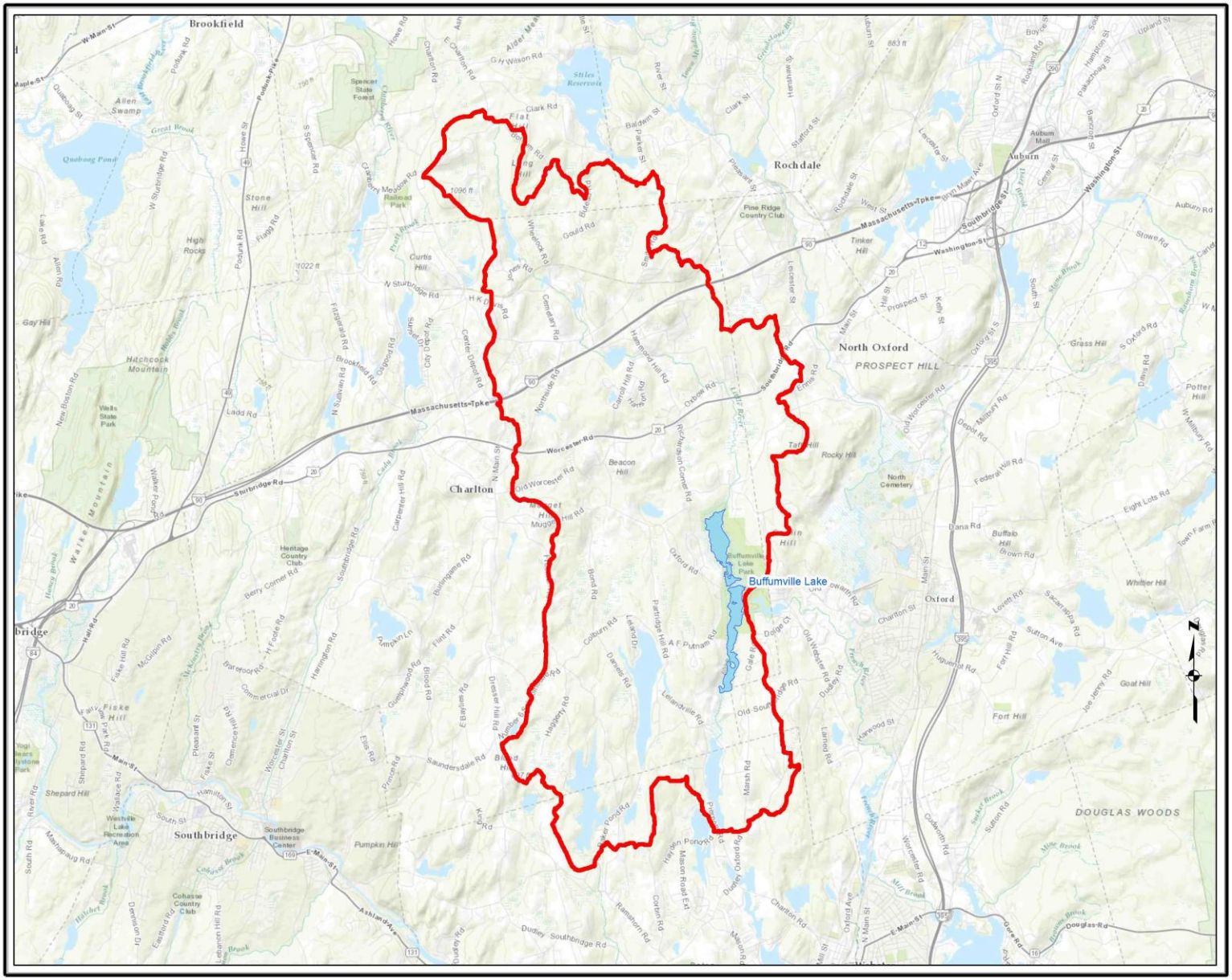
Legend

- Watershed Boundary
- Lake/Pond

0.1 0.05 0 0.1 Miles

Geosyntec consultants

MassDEP



MASSACHUSETTS watershed·based plans

BUFFUMVILLE LAKE WATERSHED

WATERSHED BOUNDARY MAP

11/28/2016

Legend

- Watershed Boundary
- Lake/Pond

0.85 0.425 0 0.85 Miles

Geosyntec consultants

MassDEP

Appendix C – Phosphorus Loading Calculation Spreadsheets

2024 Phosphorus Load Reduction Requirement Calculations - MS4 Permit Methods

			(1)				(2)		(3)				
Lake/Pond	LPCP Area	Total Area Analyzed (ac)	Baseline Phosphorus Loads, 2016 (lb/yr)	x	Percent Phosphorus Reduction Required (%)	=	Phosphorus Reduction Requirement (using 2016 Baseline)	(1)-(2)=(3)	Allowable Phosphorus Load (lb/yr)	Year 8 Milestone (20%)	Year 10 Milestone (40%)	Year 13 Milestone (70%)	Year 15 Mileston e (100%)
Buffumville Lake	Urban Watershed	32.06	15.21		0.28		4.26		**10.95**	0.85	1.70	2.98	4.26
Lowes Pond*	Urban Watershed	181.18	111.40		0.51		56.81		**54.59**	11.36	22.73	39.77	56.81
McKinstry Pond	Urban Watershed	16.10	6.63		0.79		5.24		**1.39**	1.05	2.10	3.67	5.24
Robinson Pond	Urban Watershed	20.73	5.89		0.08		0.47		**5.42**	0.09	0.19	0.33	0.47
Texas Pond	Urban Watershed	66.90	34.35		0.21		7.21		**27.14**	1.44	2.89	5.05	7.21

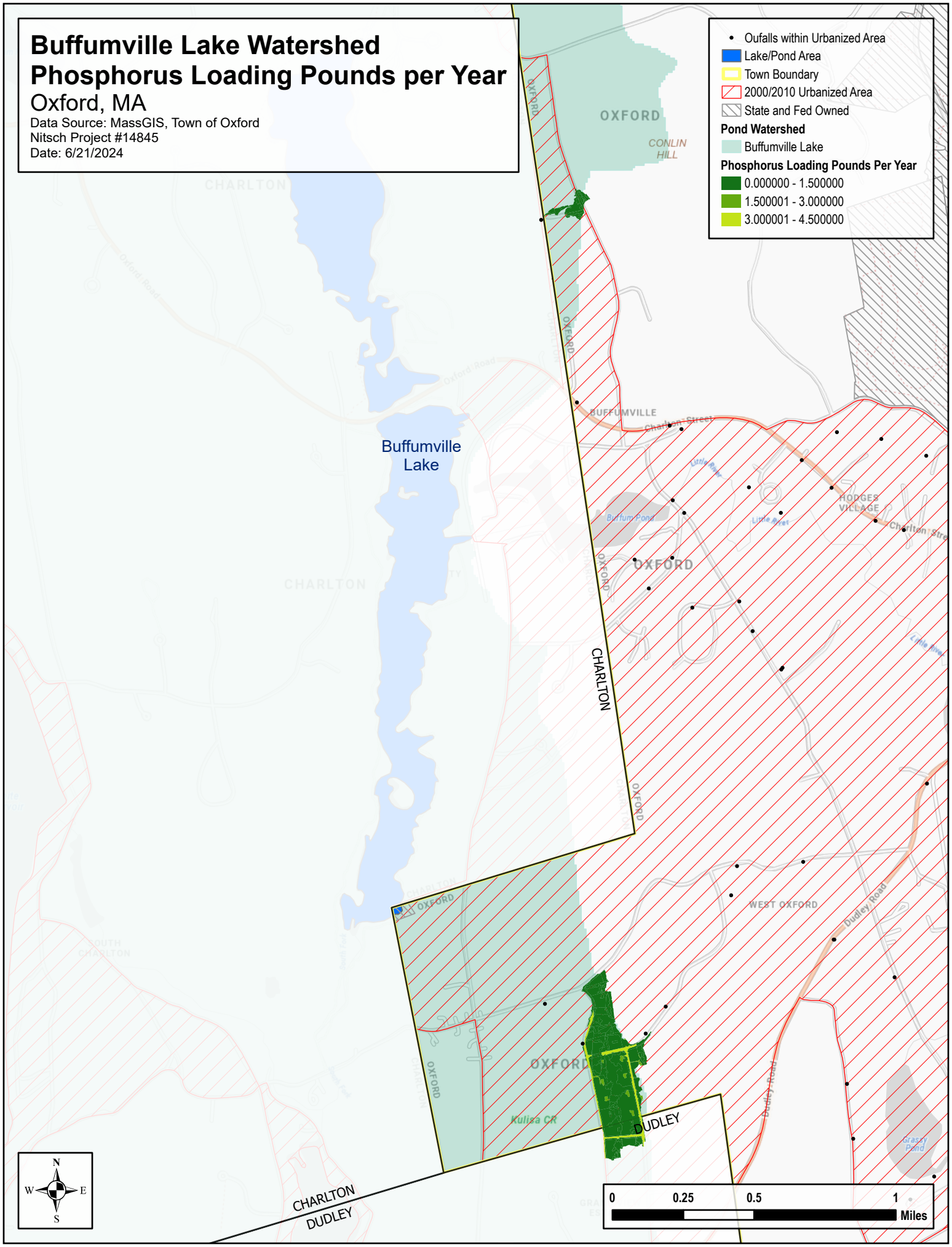
*totals for Lowes Pond include areas and P-loads for McKinstry & Robinson Ponds since both discharge to Lowes; this method is consistant with modeling methodolgy used to calculate TMDLs
According to Appendix F Attachment 1 - the Phosphorus Reduction Requirement is baseline multiplied by percent reduction

Appendix D – Phosphorus Loading Maps

Buffumville Lake Watershed
Phosphorus Loading Pounds per Year

Oxford, MA

Data Source: MassGIS, Town of Oxford
Nitsch Project #14845
Date: 6/21/2024



Lowes Pond Watershed
Phosphorus Loading Pounds per Year

Oxford, MA

Data Source: MassGIS, Town of Oxford
Nitsch Project #14845
Date: 6/21/2024

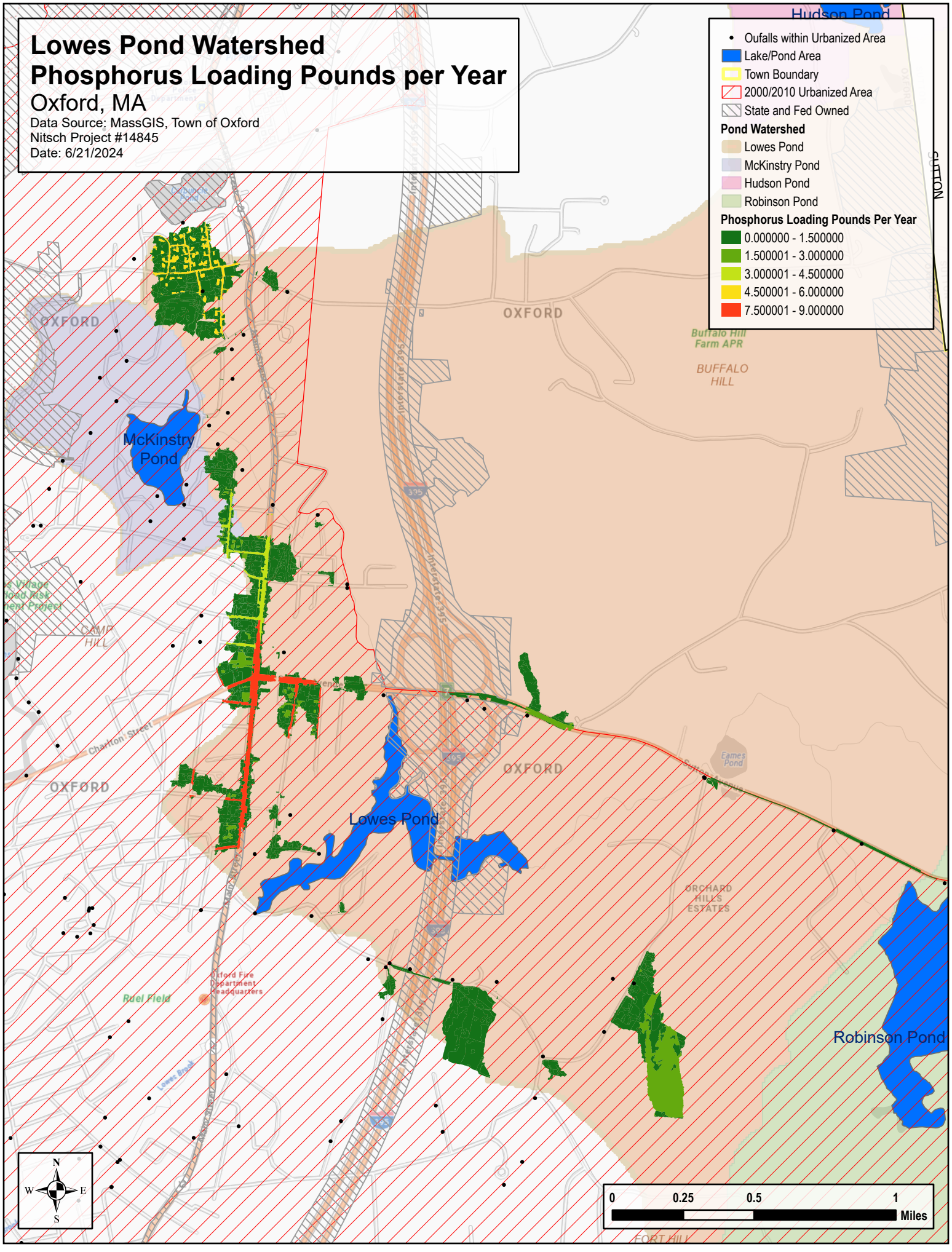
- Oufalls within Urbanized Area
- Lake/Pond Area
- Town Boundary
- 2000/2010 Urbanized Area
- State and Fed Owned

Pond Watershed

- Lowes Pond
- McKinstry Pond
- Hudson Pond
- Robinson Pond

Phosphorus Loading Pounds Per Year

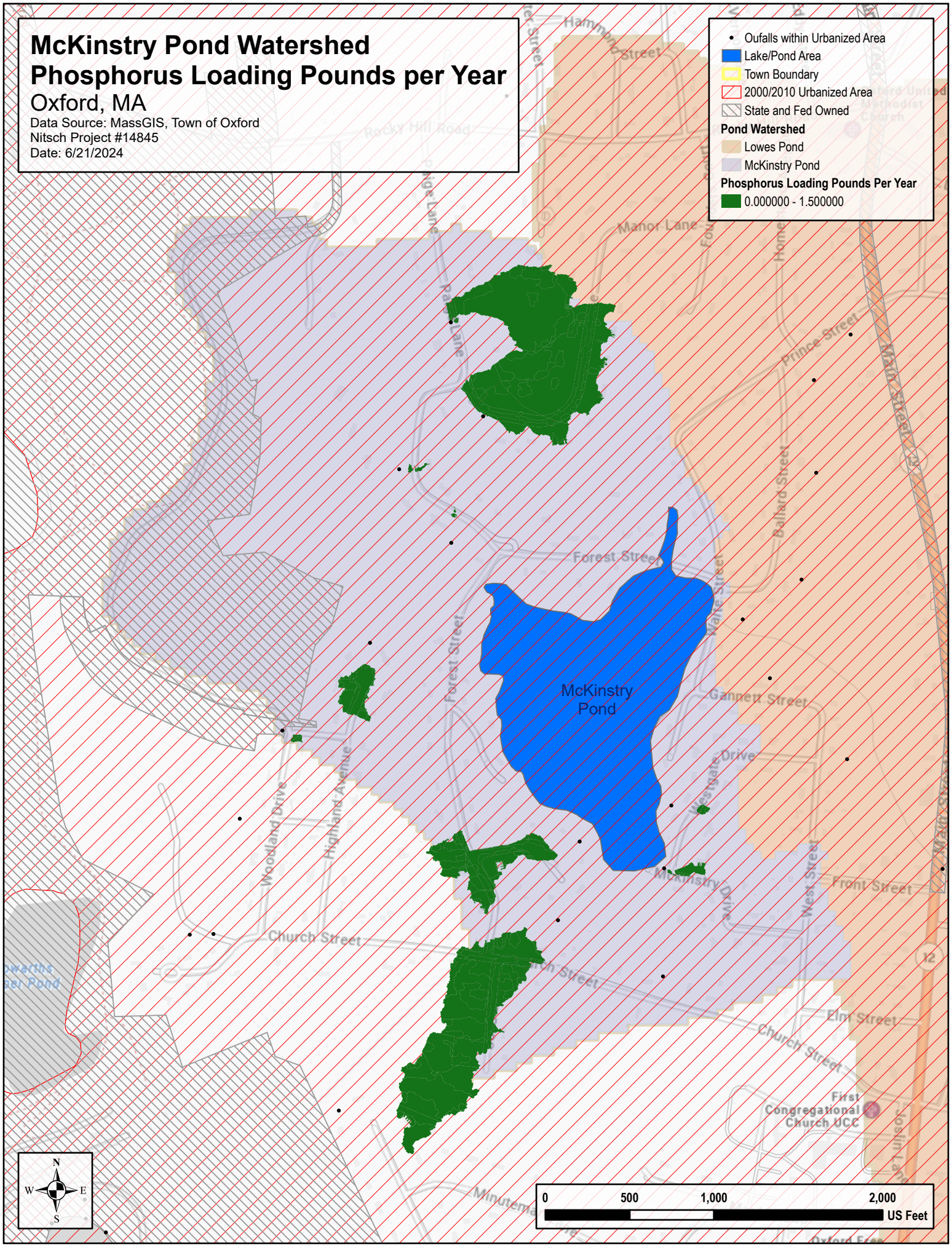
- 0.000000 - 1.500000
- 1.500001 - 3.000000
- 3.000001 - 4.500000
- 4.500001 - 6.000000
- 7.500001 - 9.000000

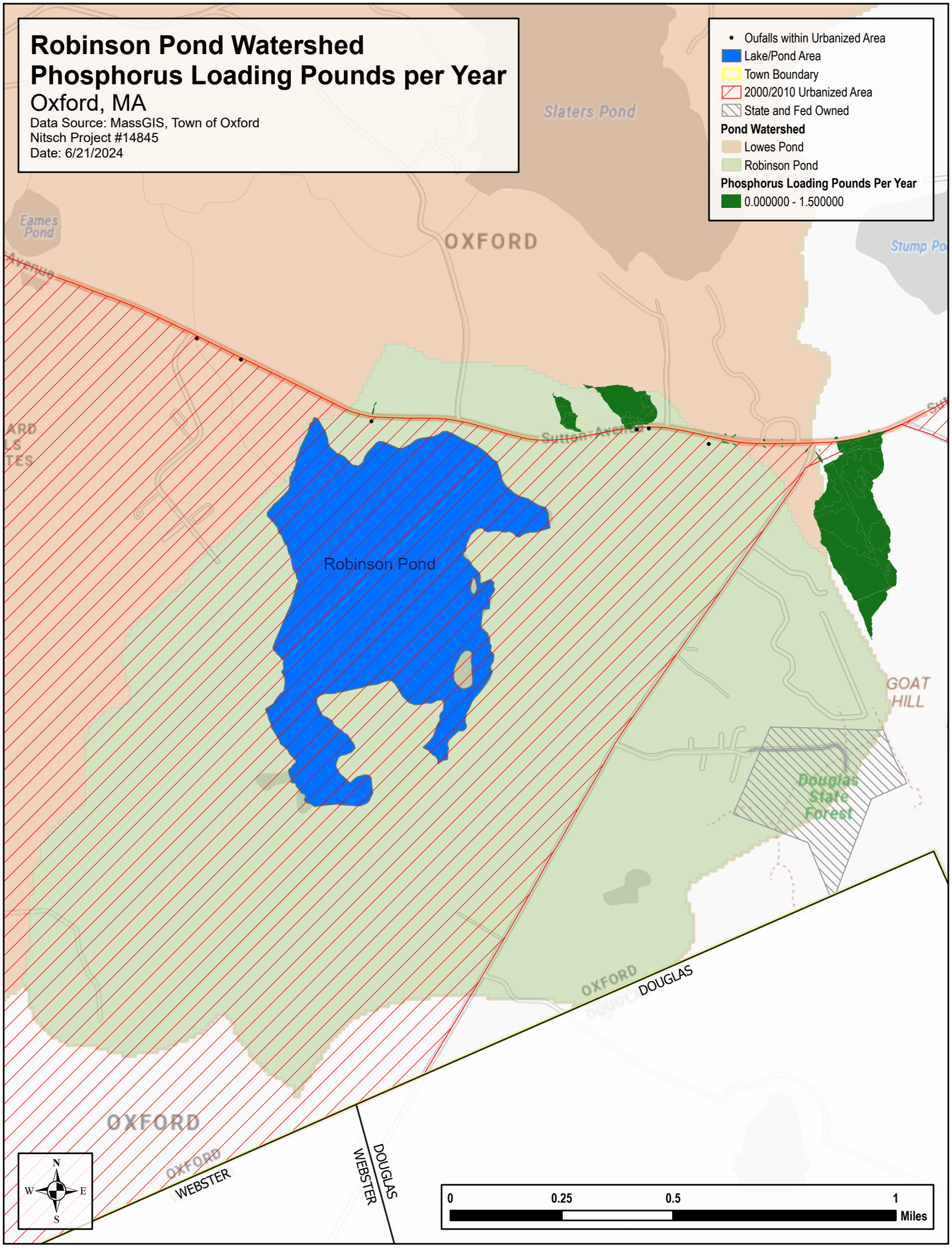


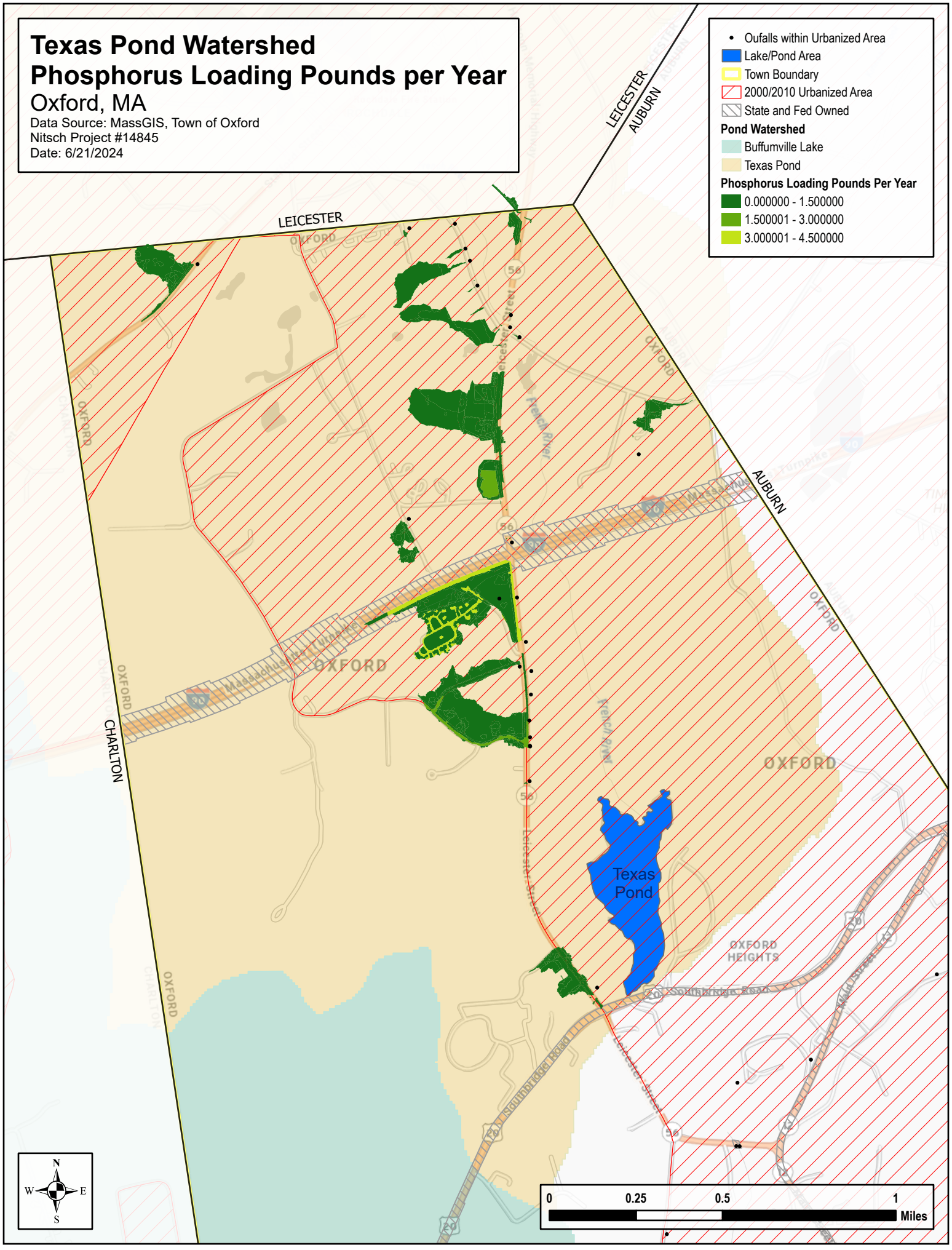
McKinstry Pond Watershed
Phosphorus Loading Pounds per Year

Oxford, MA

Data Source: MassGIS, Town of Oxford
Nitsch Project #14845
Date: 6/21/2024




Robinson Pond Watershed
Phosphorus Loading Pounds per Year
Oxford, MA
Data Source: MassGIS, Town of Oxford
Nitsch Project #14845
Date: 6/21/2024
Oufalls within Urbanized Area
Lake/Pond Area
Town Boundary
2000/2010 Urbanized Area
State and Fed Owned
Pond Watershed
Lowes Pond
Robinson Pond
Phosphorus Loading Pounds Per Year
0.000000 - 1.500000
Slaters Pond
Eames Pond
OXFORD
Sutton Avenue
Robinson Pond
GOAT HILL
Douglas State Forest
OXFORD
DOUGLAS
OXFORD
WEBSTER
DOUGLAS
WEBSTER
N
W
E
S
0
0.25
0.5
1
Miles


Texas Pond Watershed
Phosphorus Loading Pounds per Year
Oxford, MA
Data Source: MassGIS, Town of Oxford
Nitsch Project #14845
Date: 6/21/2024
Oufalls within Urbanized Area
Lake/Pond Area
Town Boundary
2000/2010 Urbanized Area
State and Fed Owned
Pond Watershed
Buffumville Lake
Texas Pond
Phosphorus Loading Pounds Per Year
0.000000 - 1.500000
1.500001 - 3.000000
3.000001 - 4.500000
LEICESTER
AUBURN
CHARLTON
OXFORD
Texas Pond
OXFORD HEIGHTS
Southbridge Road
French River
Massachusetts Turnpike
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0.25
0.5
1
Miles

Appendix E – Street Sweeping Log

FY 22 7/1/2021-6/30/2022 Street Sweeping Log		
Date	**Street**	**Volume (cubic Yards)**
4/13/2022	Sutton Ave(from Main St. to Cahills and from Market basket to Sacarrappa Rd.) Main St. (infront of Library) Maple Ave Rawson Ave	
4/21/2022	Clara Barton School Middle School High School Chaffee School Carbuncle Dr.	10
5/2/2022	Sunset Av Maid Marian Rd. Bounty Rd. Friar Tuck Ln. Holly St. Sherwood Dr. Little John Cir. Vine St. Hemlock St. Nttingham Rd. Cherry St. Aspen Dr. Beech St. Brook St. Lowes St. Matthew Cir Winward Dr. French River Cir Leeward Ln part of Locust St.	12
5/5/2022	Locust St. Wayne Ave Anythony Dr. School St. Ruel Field Carew Drive	12
5/10/2022	Clover St. Wild Rose St. Fairlawn Ave\Walnut St.\Oak St. Linden St. Willow St. Wheelock Ct Laurel St. Parts of Cypress, Pine, and Wheelock St.	12

5/11/2022	Old Dudley Rd Quobaug Ave May St Finished Pine St. Cypress St. Wheelock St. Housing Auth on Wheelock St.	12
5/26/2022	Main St Chalrton St. (from Main to Dudley Rd) Dudley Rd. (from Charlton St. to Old Webster) Sutton Ave (from Main St. to jug handle)	15
6/2/2022	Holbrook Rd. (from Rte 12 to Mt. Pleasant) Allen Ave Crescent St. George St. Rose Ln. Westview Dr.	24
6/6/2022	Finished Holbrook Rd Mt. Pleasant St. Chris Dr. Ester Cir Huguenot Rd0from Fort Hill to Westview)	18
6/8/2022	Upper Fort Hill Rd Garrison Hgts Rhonda Rheault Dr. Lower Fort Hill Rd Jasmine Dr	20
6/23/2022	Finished Huguenot Rd Howe Ave Russell Ln Harwood St	20
6/28/2022	Leicester St 9from Rte 20 to Town line) Comins Rd Spring St Ashworth Dr Mill St	12
6/29/2022	Pleasant Ct Laurelwood Dr Old Merriam Rd Suzanne Dr Michelle Ln Part of Merriam Rd	16

6/30/2022	Finished Merriam Rd Wells St Watch St Hartwell St Pleasant St Finished Leicester St.	16

TOTAL CUBIC YARDS: 199

FY 21 7/1/2020-6/30/2021 Street	
Date	**Street**
7/7/2020	Ennis Rd Cherdon Ln N. Water Dr
7/27/2020	Dana Rd (from rte 12 to Dana Dr) Holman St Dana Dr Hillcrest Dr Hillcrest Cir Rollingwood Dr Heritage Rd
8/17/2020	Douglas Rd Walters Dr Old Jenny Rd Joe Jenny Rd Tower Hill Rd
8/19/2020	Larned Rd Charlton St.(between Dudley and Old Dudley Rd)
9/5/2020	Middle School High School
10/7/2020	Main St- parts of Front st Maple Rd Charlton St Old Howarth Rd Conlin Rd Old Webster Rd
10/22/2020	Main St East Main St Front St Elm St West St Minute Ln Maple Rd History Dr Monument Dr

11/4/2020	Johnson Ln Carron Ln Sunset Ave Maid Marion Rd Bounty Rd Holly St Nottingham Rd Brook St Lowes St Cherry St. Little John Cir Sherwood Dr Vine St Hemlock St Beech St Aspen Dr. Locust St.
11/6/2020	Birch St Fairlawn Ave Parts of Pine St. Oak St Wheelock St. Cypress St Walnut St Laurel St
11/9/2020	Walnut St Willow St Old Dudley Rd Parts of Cypress St Pine St Wheelock Ave
11/24/2020	Merriam Rd(from Pleasant St to Suzanne Dr Old Merriam Rd
11/25/2020	Pleasant Ct Laurelwood Dr Old Worcester Rd
12/1/2020	Dolge Ct Drury Ln Marylin Dr Old Southbridge Rd (Misty Meadow to Dudley Rd)

12/2/2020	New St Tremont St Cedar St N. Water St East Main St Forest St Highland Ave Woodland Dr King St Queen St
3/9/2021	Main St Charlton St (from Rte 12 to Jillian Rose) Dudley Rd(from Charlton St to Old Webster Rd)
3/10/2021	Dudley Rd (from Old Webster to Dudley line)
3/11/2021	Lindwood St Hubbard St Lucy Drive Malden Sr Colony Ave Esposito Ct Woodlawn Ave Town Forest Rd Industrial Park East Harlem Dr Hawksley Dr
3/23/2021	Cudworth Rd Tanner Rd Old Cudworth Rd Industrial Park West Rd Pratt Ave Mayfair Cir Winter St
3/24/2021	Grasshopper Ln Fox run Kristen Lane Theresa Cir Jillian Rose Dr Buffum Dam Rd Oakwood Terr Charlton St(from Jillian Rose to Charlton Line)

3/29/2021	Old Webster Rd(from Buffum Dam to Aspahlt Plant) Doldge Ct Drury Ln Country Ln Sunny Hill Dr Sutton Ave from Fort Hill To Orchard Hill
3/30/2021	Finished Old Webster Rd(from Asphalt Plant to Dudley Rd) Marilyn Ln Sneade Dr Lambert Ct Lambert Cir Nelson St Patton St Bacon St Ashton St Hamilton St
4/2/2021	School St Jhonson Ln Carron Ln Marshall St Carey Ln Sunset Ave Maid Marion Rd Bounty Rd Friar Tuck Ln Nottingham Rd Brook St Lowes St Ruel Field

4/5/2021	Little John Cir Sherwood Dr Cherry St Beech St Aspen Dr Hemlock St Vine St Matthew Cir Winward Dr French River Cir Leeward Ln Holly St Clarence Dr Corey Dr Hazel Way Anthony Dr Wayne Ave Locust St (from Wayne Ave to Holly St)
4/7/2021	Little League Field N. Fire Station Pinehill Rd Thayer Ct Leicester St (from Rte 12 to Pleasant St)
4/8/2021	Liberty Ln Blueberry Ln Clover St Spruce St Birch St Wild Rose St June St Fairlawn Ave Finished Locust St Wheelock Ct Parts of Oak St Wheelock St Pine St Cypress St
4/21/2021	Middle School High School Carbuncle Dr

5/3/2021	Finished Pine St Cypress St Oak St Wheelock St Walnut St Quobaug Ave Linden St Old Dudley Rd Housing Authority on Wheelock St Willow St
5/26/2021	Elm St. Front St. Maple Rd. Rawson Ave. Freemont St. Sigourney St. Barton St. Jackson Ct. Sibley Ln. East Main St. Parts of Quobaug Ave. Fairlawn Ave Huguenot Rd. Water St. Church St. Behind Community Center
5/27/2021	Main St. Sutton Ave. (from Main St. to Cahills) Charlton St. (from Main St. to Barton St.)
6/1/2021	Rocky Hill Rd. Eddy St. Vernon St. Chaffee Ln. Hammond St. Foster St. Angel St. Paige Ln. Manor Ln. Founders Court Birchwood Terr. Homestead Ave. Rocky Hill Rd. ext

6/2/2021	West St. West Ct. Westgate Dr. Gannett St. Waite St. Ballard St. Prince St. Forest St. Spicebush Ln. Highland Ave. King St. Woodland Dr. Queen St. Saad Dr. Church St. (from playground to Forest St.) Playground - around basketball courts behind Community Center
6/7/2021	Millbury Blvd. Federal Hill Rd (from Rte 12 to Hudson Rd.).
8/4/2021	Charlton St. Sutton Ave
8/19/2021	Dudley Rd at Oakside Chalrton St at Conlin Charlton St at Buffum Dam Rd
8/20/2021	Prospect St Dudley Rd Old Webster Rd
8/24/2021	Chaffee School Cherry St Vine St Sherwood Dr Holly St Walnut St Old Dudley Rd Charlton St dana Rd Lovett Rd Sacarrappa Rd
8/28/2021	Chaffe Clara Barton High & Middle School
9/2/2021	Bottom of Lower Fort Hill Rd

9/3/2021	Rte 56 Prospect St Old Worcester Rd Millbury Rd Stuart St
10/26/2021	Main St Old Worcester Rd Parts of Charlton St Sutton Ave
11/8/2021	Main St West St Front St Elm St West Ct Westgate Dr Mckinstry Dr Church St Highland Ave Woodland Dr Queen St King St Spicebush Ln Parts of Forest St.
11/9/2021	Old Dudley Rd Linden St Oak St Laurel St Willow St Walnut St Parts of Locust St. Wheelock St Pine St Birch St Quobaug Ave
11/15/2021	Sacarrappa Rd
12/9/2021	Parts of Southbridge Rd Drury Ln

TOTAL CUBIC YARDS:

Sweeping Log

Volume (cubic Yards)
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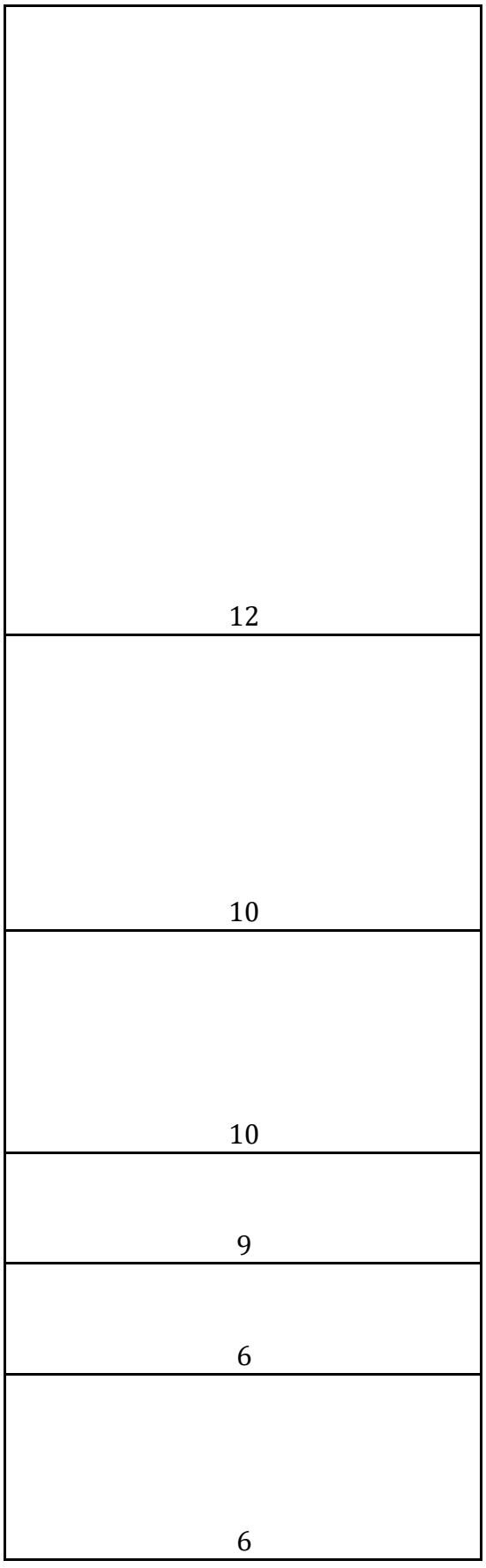
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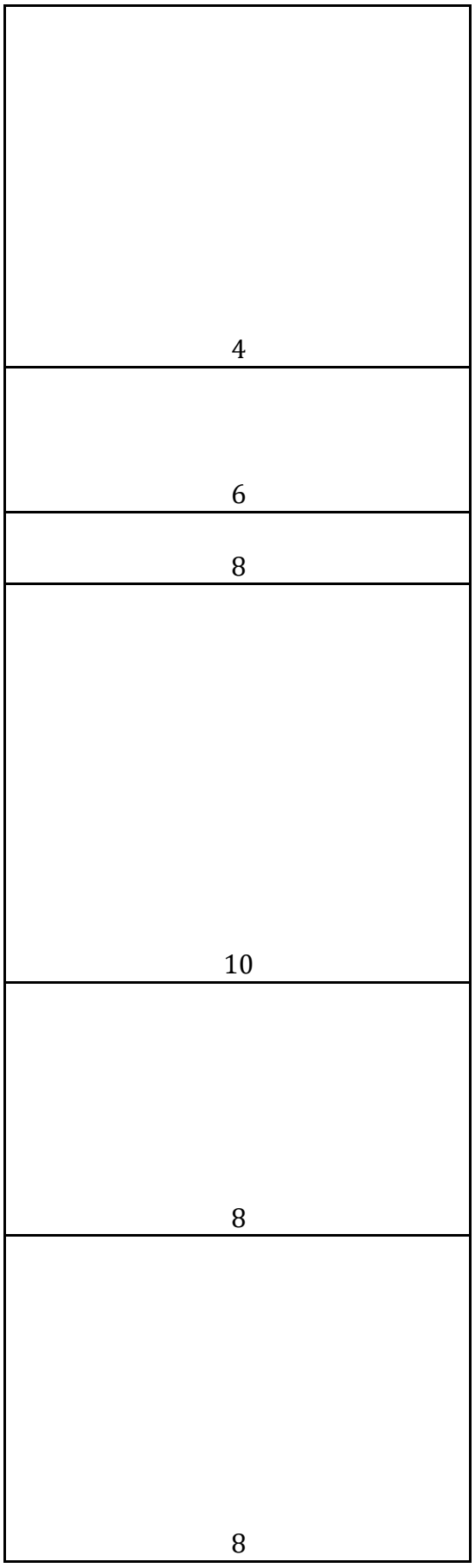
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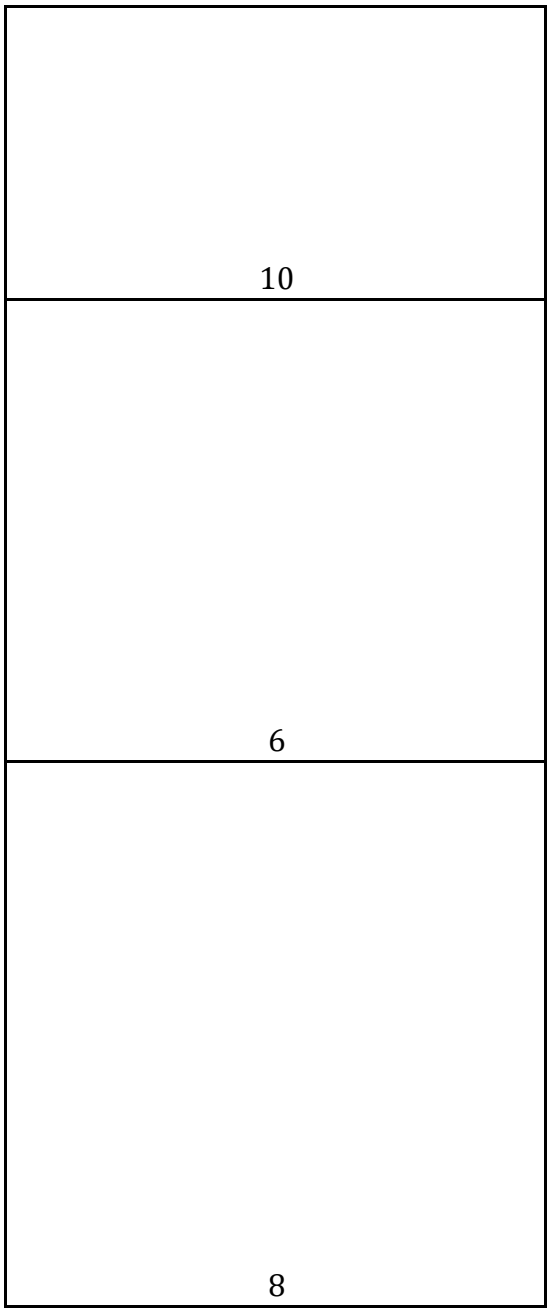
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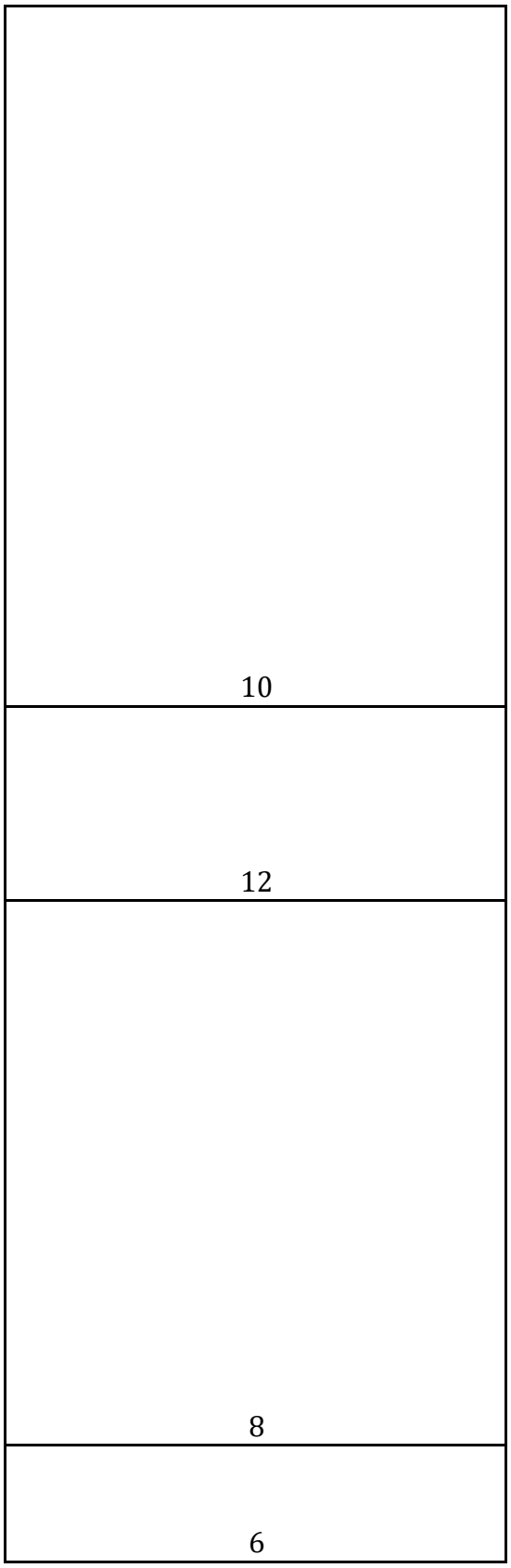
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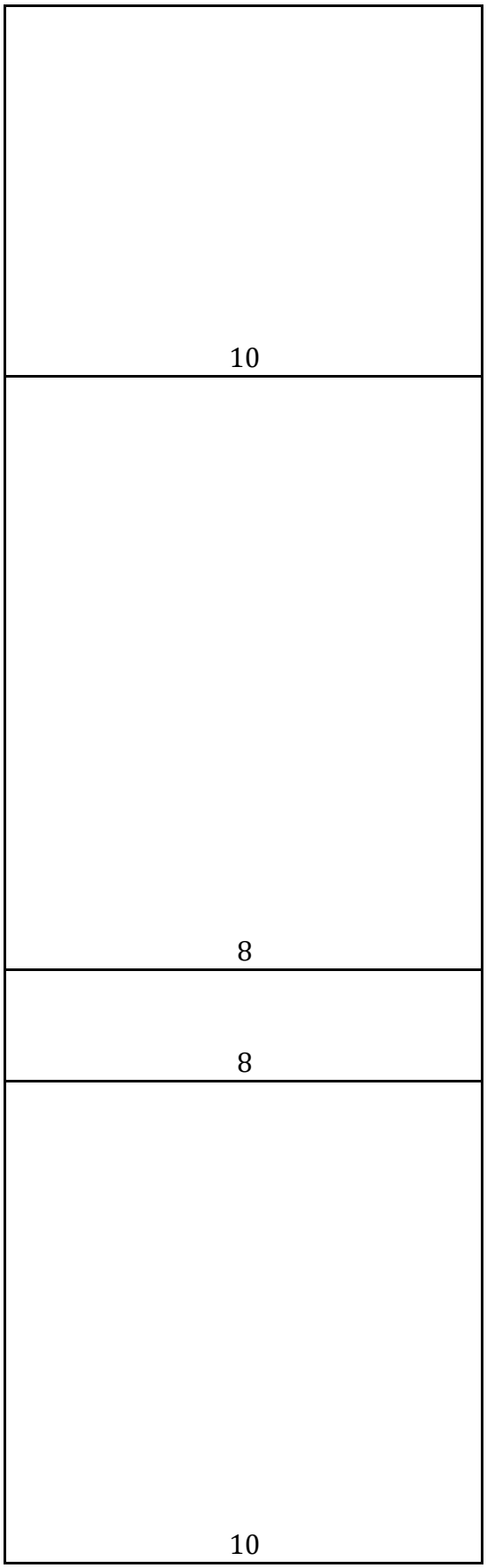
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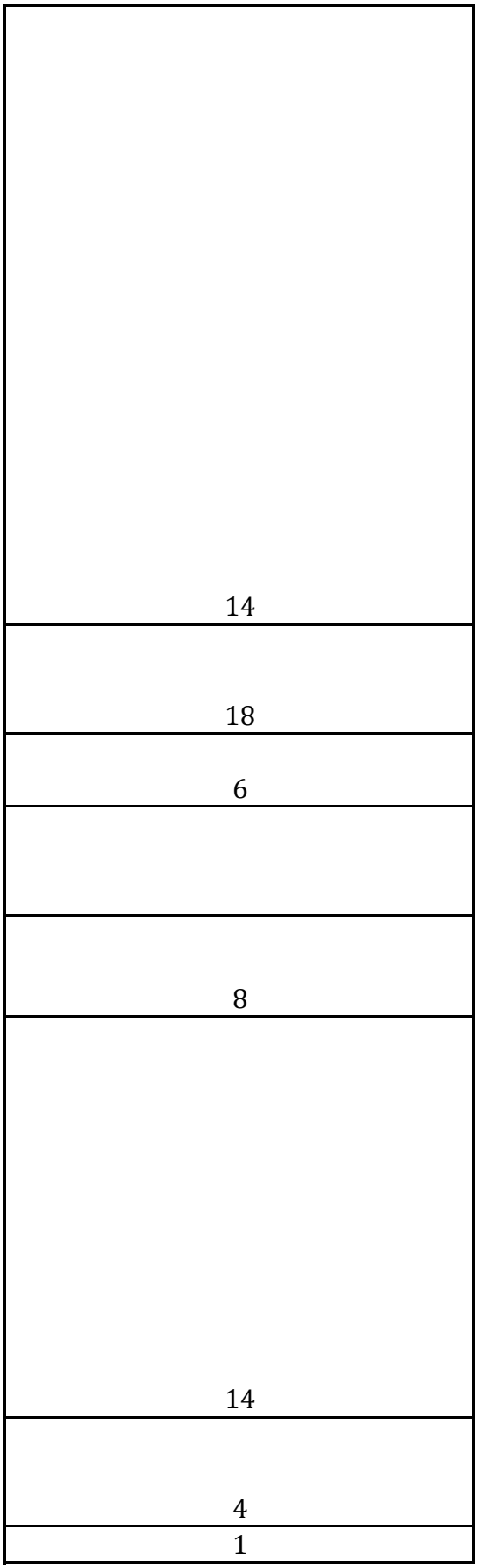
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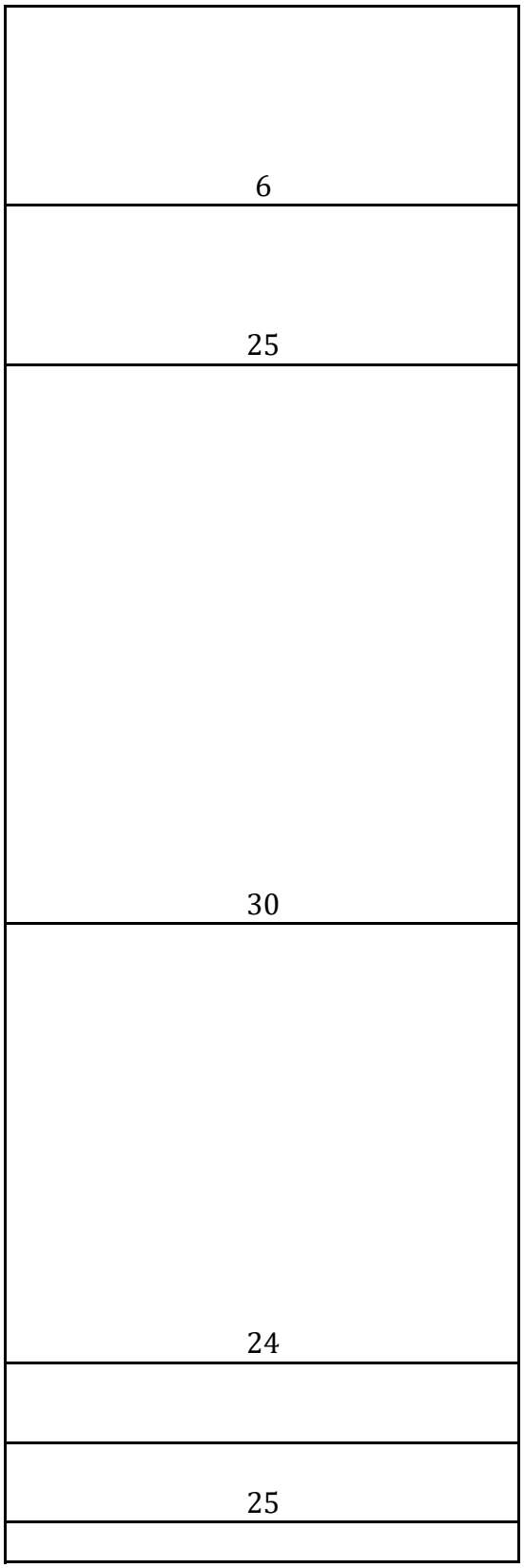
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FY20 Street Sweeping Lo

Date	Street
7/8/2019	Dana Dr Hillcrest Dr Hillcrest Cir Heritage Dr Dana Rd- Underbridge Rollingwood Dr.
7/10/2019	Pine Ridge Dr Old Howarth Rd-Partial Cricket Dr Melvin Dr Old Farm Rd Grasshopper Ln
7/22/2019	Fort Hill-Lower Jasmine Dr. FortHill Rd- Upper
7/24/2019	Holbrook Rd Ester Cir Chris Rd Westview Dr-Finished
7/30/2019	George St Rose Ln Allen Ave Crescent St. Sutton Ave Charlton St- for Pan Mass

8/8/2019	State St Marshall St Bacon St Hamilton St Ashton St Carey Ln Patton St Nelson St Lambert Ct Lambert Cir Hope Ave Bridge on Dudley Rd
8/13/2019	High School Clara Barton School Millbury Rd from Federal Hill Rd to bridge
8/14/2019	Spring St Ashworth Dr Mill St
8/26/2019	Old Howarth Rd Jillian Rose Dr Kritin Ln Theresa Cir Charlton St at bottom of Conlin Rd Buffum Dam Rd Oakwood Terr
8/29/2019	Maple Ave Virginian Ln Cherdon Ln Thayer Ct Pinehill Dr Leicester St(from rte 12 to rte 20)
9/4/2019	Doldge Ct Drury Ln Country Ln Sunny Hill Rd Old Webster Rd(from Buffum Dam Rd to Asphalt Plant)

9/10/2019	Gardner St Howarth Rd
9/24/2019	Leicester St
9/26/2019	Marilyn Ln Old Webster Rd (from Marilyn Ln to Dudley Line)
10/25/2019	Sunset Ave Maid Marion Rd Bounty Rd Friar Tuck Ln Holly St Sherwood Dr Little John Cir Vine St Hemlock St Nottingham Rd Cherry St Aspen Dr Beech St
10/28/2019	Main St Front St Elm St East Main St Part of Water St Charlton St(from the Center to Dudley Rd)
2/24/2020	Dudley Rd. (from 4 way to Dudley Line) Millings
2/26/2020	Dudley Rd. (from 4 way to Dudley Line) Charlton St. (from Dudley Rd to Main St)
3/2/2020	Main St Front St Elm St Sigourney St Parts of Quobaug Fairlawn Water St Maple Rd

3/3/2020	Charlton St Grasshopper Ln Fox Run Oakwood Terr Jillian Rose Dr Kristen Ln Theresa Cir
3/10/2020	Buffum Dam Rd Old Webster Rd (from Buffum Dam Rd to Dolge Ct) Drury Ln
3/12/2020	Dolge Ct Country Ln Sunny Hill Dr Old Webster Rd (from Doldge Ct to Asphalt Plant)
3/18/2020	Dudley Rd (from 4 way to Dudley Line) Old Webster Rd (from Dudley Rd to Asphalt Plant) Marilyn Ln around Islands in front of Comm. Center
3/20/2020	Sutton Ave (from Main St to Lower Forthill) Main St (in front of diner)
3/30/2020	Sunset Ave Maid Marion Rd Bounty Rd Friar Tuck Ln Nottingham Rd Sherwood Dr Little John Cir Lowes St. Brook St Parts of Cherry St
4/23/2020	Town Hall Parking lot Senior Center Parking Lot Sigourney St Freemont St Charlton St (from Barn to Dudley Rd.)

5/11/2020	Vine St Hemlock St Finished Cherry St Beech St Aspen Dr Clarence Dr Corey Dr Hazel Way Holly St Matthew Cir Windward Dr French River Cir Leeward Ln Locust St(from Holly St to Wayne Ave)
5/12/2020	Wayne Ave Anthony Dr Liberty Ln Blueberry Ln Spruce St Clover St Finished Locust St Wild Rose St June St Birch St Parts of Cypress & Wheelock St
5/14/2020	Fairlawn Ave Walnut St Oak St Linden St Wheelock Ct Laurel St Willow St Parts of Weelock St Pine St Cypress St

5/18/2020	Old Dudley Rd May St Quobaug Ave Finished Cypress St Pine St Wheelock St Middle School Carbuncle Dr.-Senior Center
5/19/2020	Housing for Elderly on Wheelock St Water St New St Columbus St Sibley Cir N. Water St Cedar St Bartlett St Tremont St Senior Center Hall Rd Carlton Ct Part of Main St
5/20/2020	Rocky Hill Rd Eddy St Vernon St Hammond St Chaffee Ln Foster St Angel St Rocky Hill Rd Ext. Paige Ln Birchwood Terr Founders Ct Manor Ln Homestead Ave
5/21/2020	Main St Jackson Ct Barton St Maple Rd Island on Sutton Ave

5/26/2020	Prince St Waite St Gannett St Ballard St West St West Ct Mckinstry Dr Westgate Dr Front St Elm St Part of Forest St
5/27/2020	Finished Forest St Spicebush Ln Church St Saad Dr Woodland Dr King St Queen St Highland St Minuteman Ln History Ln Monument Dr
5/29/2020	Corbin Rd Camphill Dr Gardner St Howarth Rd Pineridge Dr Melvin Dr
6/16/2020	Clara Barton Rd (from Main St to Polonia Dr) Spots on Leicester St the bottom of driveway of dog park Old Depot & Rte 12 Clara Barton School driveway

6/17/2020	Spots Dudley Rd Charlton St Larnard Rd Dudley Rd Conlin Rd Charlton St Beverley St Belmont St Burbank St Bailey Rd Stuart St Depot Rd (from Old Worc to State Barn) Old Worc Rd (from Rte to Depot Rd)
6/18/2020	Finished Old Worc Rd Wellington Rd Shady Ln Harvard St Depot Rd(from School to 4 way stop)
6/24/2020	Newton Ave Carbuncle Dr High School
6/30/2020	Coughlin Rd

Total Sweepings Collected (cubic yards)

ıg

Volume (cubic yards)
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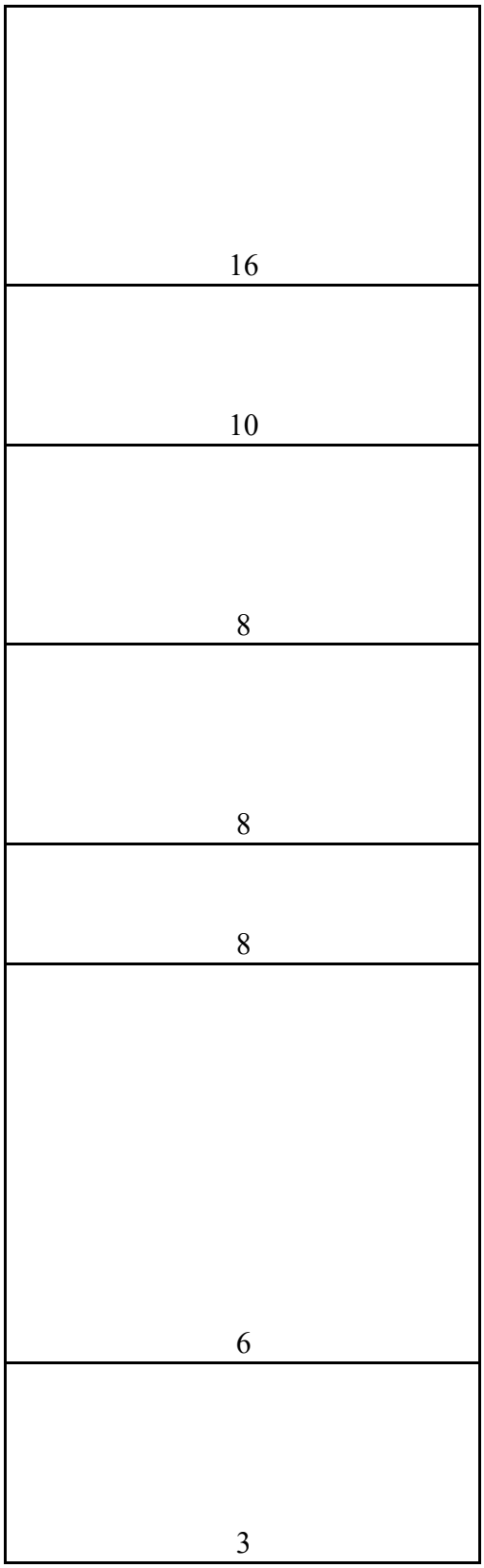
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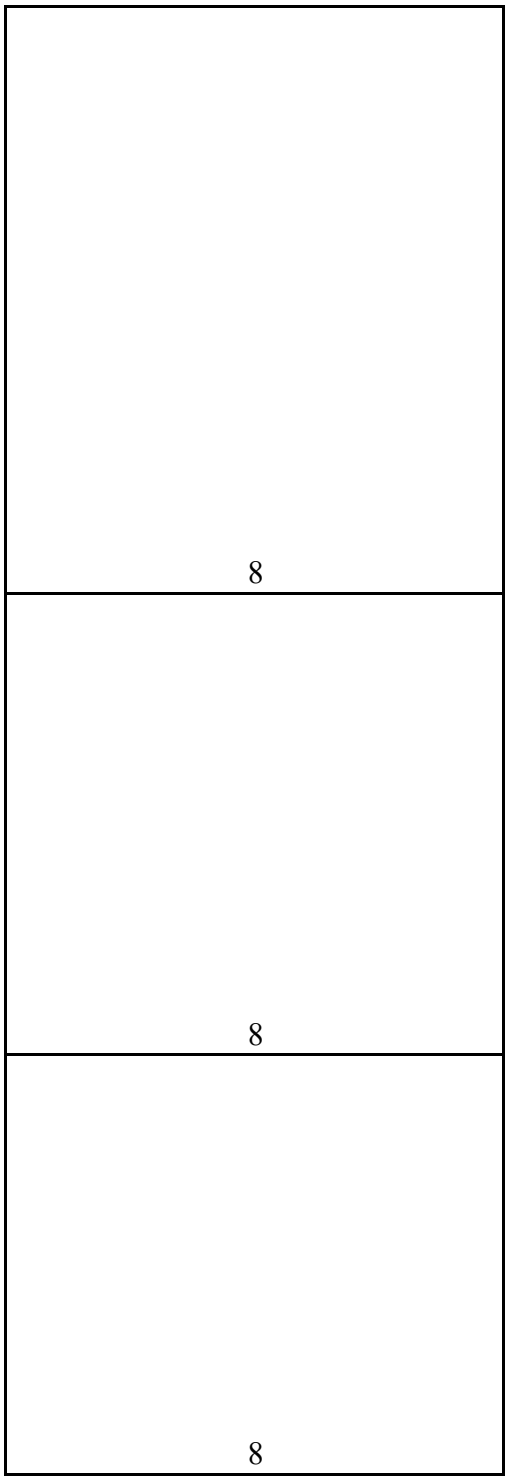
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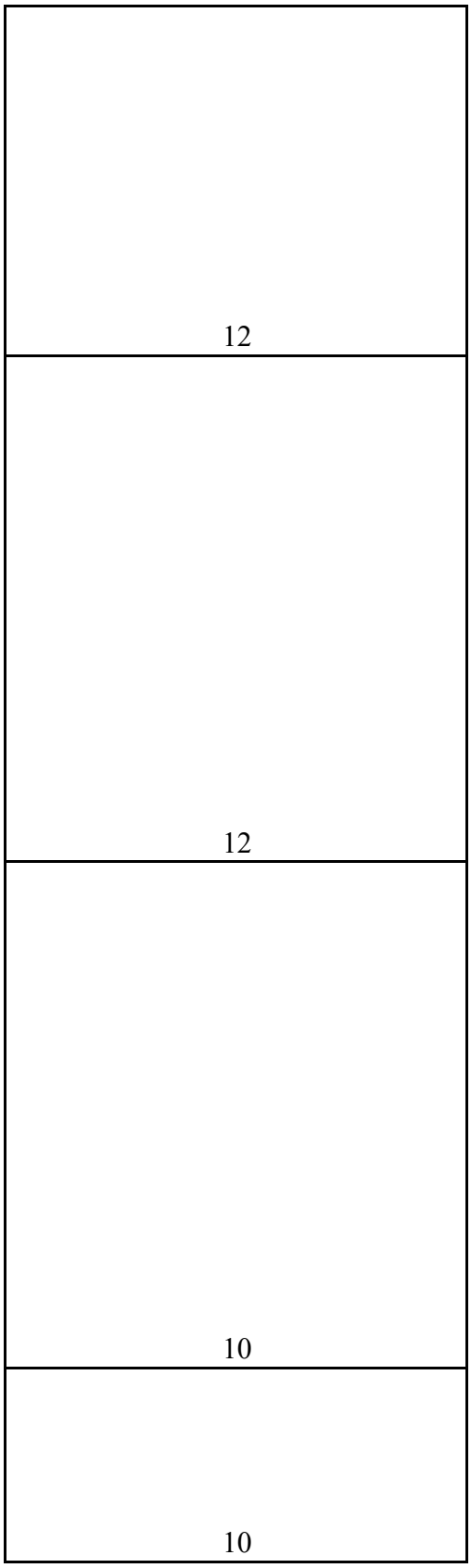
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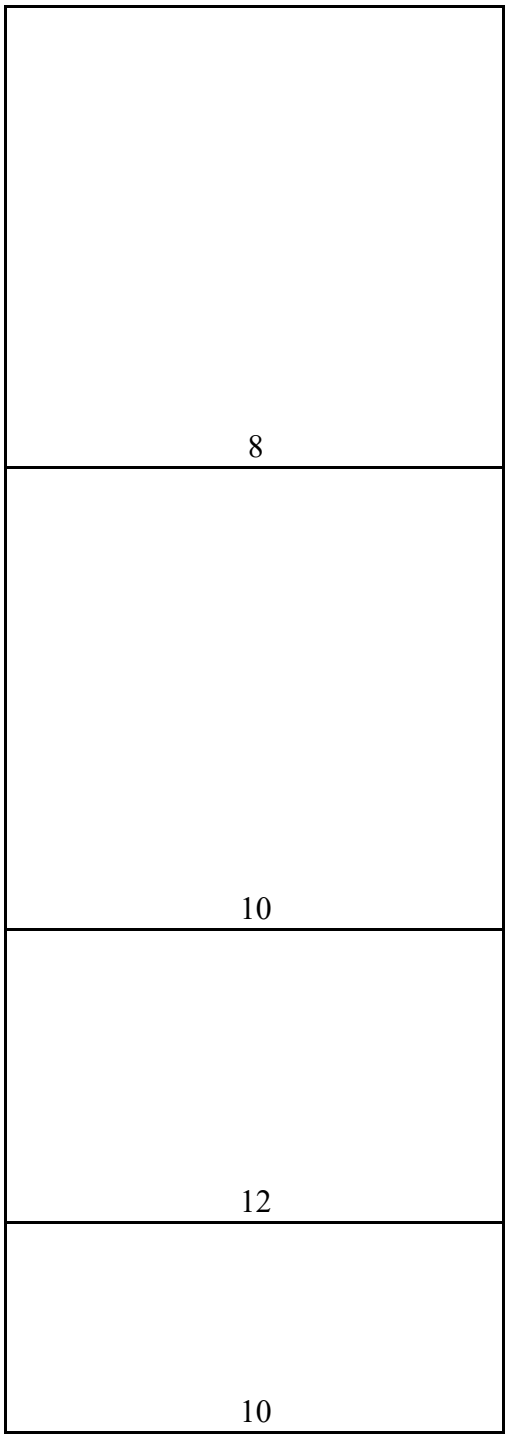
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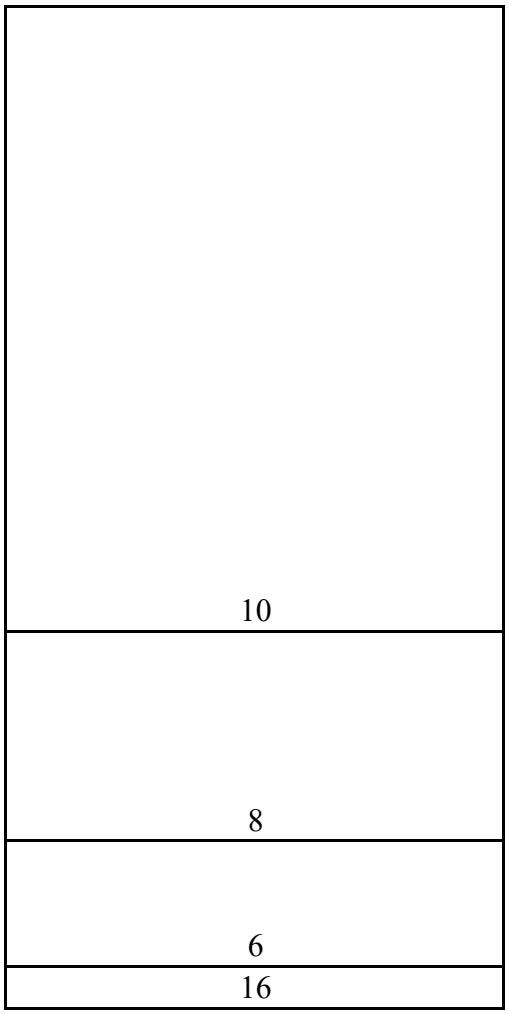

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2019 Street Sweeping Log		
Date	**Street**	**Volume** (cubic yards)
4/12/2019	Main St Front St Elm St	6
4/17/2019	High School Middle School Clara Barton School Carbuncle Dr	4
4/18/2019	Chaffee School Community Center	4
4/22/2019	Maid Marion Rd Bounty Rd Friar Tuck Ln Nottingham Rd Little John Cir Sherwood Dr Cherry St School St Ruel Field Main St - Partial	12
4/23/2019	Vine St Hemlock St Aspen Dr Holly St Matthew Cir Winward Dr	8
4/24/2019	French River Cir Leeward Ln Clarance Dr Corey Dr Hazel Way Locust St Wayne Ave Anthony Dr Birch St Spruce St Clover St	8

Date	Street	Volume (cubic yards)
4/25/2019	North Fire Station Little League Field Maple Ave - Partial	6
4/29/2019	Fairlwan Ave Liberty Ln Blueberry Ln Oak St Wheelock Ct Wheelock St - Partial Pine St Cypress St June St Wildrose St	10
5/1/2019	Linden St Walnut St Willow St Old Dudley Rd Laurel St	10
5/8/2019	Quobaug Ave Wheelock St Pine St May St Cypress St Housing for Elderly Camphill Dr Corbin Rd Monuent Dr Minuteman Ln History Dr	10
5/9/2019	Johnson Ln Carron Ln Winter St Mayfair Cir Pratt Ave Linwood St Hubbard St Lucy Dr Malden Dr Colony Ave Esposito Way Woodlawn Ave	8

Date	Street	Volume (cubic yards)
5/13/2019	Water St East Main St New St Columbus St Sibley Cir Cedar St N. Water St Tremont St Bartlett St Hall Rd Charlton Ct	12
5/14/2019	West St Gannette St Waite St Westgate Dr West Ct Mckinstry Dr Church St Saad Dr Spicebush Ln Forest St Woodland Dr Higland Ave King St Queen St	12
5/15/2019	Waite St Prince St Ballard St Homestead Ave Paige Ln Founders Ct Manor Ln	10

Date	Street	Volume (cubic yards)
5/17/2019	Rocky Hill Rd Eddy St Vernon St Chaffee Ln Hammond St Foster St Angell St Rocky Hill Rd Ext Birchwood Terr	10
5/20/2019	Beverly St Belmont St Burbank St Baily Rd Stuart St Shady Ln Wellington Rd	10
5/21/2019	Old Worcester Rd Old Depot Rd Newton Ave Depot Rd - from State pit to Rte 12 Harvard St	12
5/22/2019	Park St Pond St Walcott St Lind St Railroad Ave Freemont St Rawson Ave Maple Rd	10
5/23/2019	Main St Sutton Ave -Rt 12 to Jughandle Front St Elm St East Main St Church St- near cemetery wall	20
5/29/2019	Howe Ave Russell Ln Hugenot Rd- Partial Westview- Partial	12

Date	Street	Volume (cubic yards)
5/30/2019	Hugenot Rd - Finished Garrison Hgts Rhonda Rheault Dr	8
6/3/2019	Old Merriam Rd Suzanne Dr Michelle Ln	16
6/5/2019	Merriam Rd - finished Wells St Watch St Pleasant St Hartwell St Leicester St - Partial	12
6/6/2019	Pleasant Ct Laurelwood Dr Leicester St - Partial	12
6/12/2019	Old Southbridge Rd - one way only Dudley Rd - from Walnut St to Dudley Line	10
6/14/2019	Carbuncle Dr Carbuncle Parking Lot Millbury Blvd Federal Hill Rd - Rt 12 to RR tracks	4
7/8/2019	Dana Dr Hillcrest Dr Hillcrest Cir Heritage Dr Dana Rd- Underbridge Rollingwood Dr.	8
7/10/2019	Pine Ridge Dr Old Howarth Rd-Partial Cricket Dr Melvin Dr Old Farm Rd Grasshopper Ln	6
7/22/2019	Fort Hill-Lower Jasmine Dr. FortHill Rd- Upper	10

Date	Street	Volume (cubic yards)
7/24/2019	Holbrook Rd Ester Cir Chris Rd Westview Dr-Finished	12
7/30/2019	George St Rose Ln Allen Ave Crescent St. Sutton Ave Charlton St- for Pan Mass	10

TOTAL CUBIC YARDS: 302

2020 Street Sweeping Log		
Date	**Street**	**Volume** (cubic yards)
2/24/2020	Dudley Rd. (from 4 way to Dudley Line) Millings	25
2/26/2020	Dudley Rd. (from 4 way to Dudley Line) Charlton St. (from Dudley Rd to Main St)	8
3/2/2020	Main St Front St Elm St Sigourney St Parts of Quobaug Fairlawn Water St Maple Rd	8
3/3/2020	Charlton St Grasshopper Ln Fox Run Oakwood Terr Jillian Rose Dr Kristen Ln Theresa Cir	16
3/10/2020	Buffum Dam Rd Old Webster Rd (from Buffum Dam Rd to Dolge Ct) Drury Ln	10
3/12/2020	Dolge Ct Country Ln Sunny Hill Dr Old Webster Rd (from Doldge Ct to Asphalt Plant)	8
3/18/2020	Dudley Rd (from 4 way to Dudley Line) Old Webster Rd (from Dudley Rd to Asphalt Plant) Marilyn Ln around Islands in front of Comm. Center	8
3/20/2020	Sutton Ave (from Main St to Lower Forthill) Main St (in front of diner)	8

3/30/2020	Sunset Ave Maid Marion Rd Bounty Rd Friar Tuck Ln Nottingham Rd Sherwood Dr Little John Cir Lowes St. Brook St Parts of Cherry St	6
4/23/2020	Town Hall Parking lot Senior Center Parking Lot Sigourney St Freemont St Charlton St (from Barn to Dudley Rd.)	3
5/11/2020	Vine St Hemlock St Finished Cherry St Beech St Aspen Dr Clarence Dr Corey Dr Hazel Way Holly St Matthew Cir Windward Dr French River Cir Leeward Ln Locust St(from Holly St to Wayne Ave)	8
5/12/2020	Wayne Ave Anthony Dr Liberty Ln Blueberry Ln Spruce St Clover St Finished Locust St Wild Rose St June St Birch St Parts of Cypress & Wheelock St	8

5/14/2020	Fairlawn Ave Walnut St Oak St Linden St Wheelock Ct Laurel St Willow St Parts of Weelock St Pine St Cypress St	8
5/18/2020	Old Dudley Rd May St Quobaug Ave Finished Cypress St Pine St Wheelock St Middle School Carbuncle Dr.-Senior Center	12
5/19/2020	Housing for Elderly on Wheelock St Water St New St Columbus St Sibley Cir N. Water St Cedar St Bartlett St Tremont St Senior Center Hall Rd Carlton Ct Part of Main St	12

5/20/2020	Rocky Hill Rd Eddy St Vernon St Hammond St Chaffee Ln Foster St Angel St Rocky Hill Rd Ext. Paige Ln Birchwood Terr Founders Ct Manor Ln Homestead Ave	10
5/21/2020	Main St Jackson Ct Barton St Maple Rd Island on Sutton Ave	10
5/26/2020	Prince St Waite St Gannett St Ballard St West St West Ct Mckinstry Dr Westgate Dr Front St Elm St Part of Forest St	8
5/27/2020	Finished Forest St Spicebush Ln Church St Saad Dr Woodland Dr King St Queen St Highland St Minuteman Ln History Ln Monument Dr	10

5/29/2020	Corbin Rd Camphill Dr Gardner St Howarth Rd Pineridge Dr Melvin Dr	12
6/16/2020	Clara Barton Rd (from Main St to Polonia Dr) Spots on Leicester St the bottom of driveway of dog park Old Depot & Rte 12 Clara Barton School driveway	10
6/17/2020	Spots Dudley Rd Charlton St Larnard Rd Dudley Rd Conlin Rd Charlton St Beverley St Belmont St Burbank St Bailey Rd Stuart St Depot Rd (from Old Worc to State Barn) Old Worc Rd (from Rte to Depot Rd)	10
6/18/2020	Finished Old Worc Rd Wellington Rd Shady Ln Harvard St Depot Rd(from School to 4 way stop)	8
6/24/2020	Newton Ave Carbuncle Dr High School	6
6/30/2020	Coughlin Rd	16
7/6/2020	McIntyre Rd Clara Barton Rd Wallace Dr Polonia Dr	10
7/7/2020	Ennis Rd Cherdon Ln N. Water Dr	10

7/27/2020	Dana Rd (from rte 12 to Dana Dr) Holman St Dana Dr Hillcrest Dr Hillcrest Cir Rollingwood Dr Heritage Rd	8
8/17/2020	Douglas Rd Walters Dr Old Jenny Rd Joe Jenny Rd Tower Hill Rd	10
8/19/2020	Larned Rd Charlton St.(between Dudley and Old Dudley Rd)	10
9/5/2020	Middle School High School	4

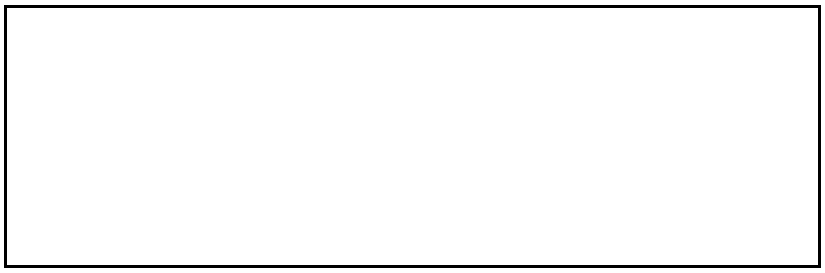
TOTAL CUBIC YARDS: 300

STREET SWEEPING LOG

Date	Street	Volume (cubic yards)
4/12/2019	Main St Front St Elm St	6
4/17/2019	High School Middle School Clara Barton School Carbuncle Dr	4
4/18/2019	Chaffee School Community Center	4
4/22/2019	Sunset Ave Maid Marion Bounty Rd	12
4/23/2019	VINE ST-HEMLOCK ST-ASPEN DR-HOLLY ST-MATTHEW CIR-WINWARD DR	8
4/24/2019	FRENCH RIVER CIR-LEEWARD LN-CLARANCE DR-COREY DR-HAZEL WAY-LOCUST ST-WAYNE AVE-ANTHONY DR-BIRCH ST-SPRUCE ST CLOVER ST	8
4/25/2019	N. FIRE STATION-LITTLE LEAGUE FIELD PART OF MAPLE AVE	6
4/29/2019	FAIRLAWN AVE-LIBERTY LN-BLUEBERRY LN-OAK ST-WHEELOCK CT-PARTS OF WHEELOCK-PINE ST-CYPRESS ST-JUNE ST-WILDROSE ST	10
5/1/2019	LINDEN ST-WALNUT ST-WILLOW ST-OLD DUDLEY RD-LAUREL ST	10

5/8/2019	QUOBAUG AVE-WHEELOCK ST-PINE ST-MAY ST-CYPRESS ST-HOUSING FOR ELDERLY-CAMPHILL DR-CORBIN RD-MONUMENT DR-MINUTEMAN LN-HISTORY DR	10
5/9/2019	JOHNSON LN-CARRON LN-WINTER ST-MAYFAIR CIR-PRATT AVE-LINWOOD ST-HUBBARD ST-LUCY DR-MALDEN ST-COLONY AVE-ESPOSITO CT-WOODAWN AVE	8
5/13/2019	WATER ST-EAST MAIN ST-NEW ST-COLUMBUS ST-SIBLEY CIR-CEDAR ST-N. WATER ST-TREMONT ST-BARTLETT ST-HALL RD-CARLTON CT	12
5/14/2019	WEST ST-GANNETTE ST-WAITE ST-WESTGATE DR-WEST CT-MCKINSTRY DR-CHURCH ST-SAAD DR-SPICEBUSH LN-FOREST ST-WOODLAND DR-HIGHLAND AVE-KING ST-QUEEN ST	12
5/15/2019	WAITE ST-PRINCE ST-BALLARD ST-HOMESTEAD AVE-PAIGE LN-FOUNDERS CT-MANOR LN	10
5/17/2019	ROCKYHILL RD-EDDY ST-VERNON ST-CHAFFEE LN-HAMMOND ST-FOSTER ST-ANGEL ST-ROCKYHILL RD EXT-BIRCHWOOD TERR	10
5/20/2019	BEVERLY ST-BELMONT ST-BURBNK ST-BAILY RD-STUART ST-SHADY LN-WELLINGTON RD	10
5/21/2019	OLD WORC RD-OLD DEPOT RD-NEWTON AVE-DEPOT RD(FROM STATE PIT TO RT 12) HARVARD ST	12

5/22/2019	PARK ST-POND CT-WALCOTT ST-LIND ST-RAILROAD AVE-FREEMONT ST-RAWSON AVE-MAPLE RD	10
5/23/2019	MAIN ST-SUTTON AVE-(FROM RT 12 TO JUG HANDLE)-FRONT ST-ELM ST-EAST MAIN ST-CHURCH ST (NEAR CEMETARY WALL)	20
5/29/2019	HOWE AVE-RUSSELL LN-PART OF HUGENOT RD-PART OF WESTVIEW DR	12
5/30/2019	FINISHED HUGENOT RD-GARRISON HGTS-RHONDA RHEAULT DR	8
6/3/2019	OLD MERRIAM RD-SUZANNE DR-MICHELLE LN-	16
6/5/2019	FINISHED MERRIAM RD-WELLS ST-WATCH ST-PLEASANT ST-HARTWELL ST-SOME OF RT 56	12
6/6/2019	PLEASANT CT-LAURELWOOD DR-LEICESTER ST(FROM RT 20 TO END OF SIDEWALK)	12
6/12/2019	OLD SOUTHBRIDGE RD (ONE WAY ONLY)-DUDLEY RD(FROM WALNUT ST TO DUDLEY LINE)	10
6/14/2019	CARBUNCLE DR-CARBUNCLE PARKING LOT-MILLBURY BLVD- FEDERAL HILL RD(FROM RT 12 TO TRACKS)	4
		256



Appendix F – Non-Structural BMP Calculations

Oxford Year 6 Non-structural Phosphorus Reduction Credit Calculations

Enhanced Street Sweeping Program

Pond Watershed	2016 Land Use (Land Cover=Impervious)	PLER (lb/acre/year)	IA (acres)	PRF	AF	Credit, sweeping (lbs/year)
Buffumville Lake	Right-of-way	1.95	3.1258	0.01	1	0.06
Buffumville Lake	Multi-Family Residential	2.32	1.1076	0.01	1	0.03
Buffumville Lake	Single Family Residential	1.96	0.6630	0.01	1	0.01
Buffumville Lake		**Total**	**4.8964**		**TOTAL**	**0.10**
Lowes Pond	Commercial	1.78	5.1639	0.01	1	0.09
Lowes Pond	Industrial	1.78	0.0000	0.01	1	0.00
Lowes Pond	Mixed use, other	1.78	0.5098	0.01	1	0.01
Lowes Pond	Mixed use, primarily residential	2.32	1.4334	0.01	1	0.03
Lowes Pond	Multi-Family Residential	2.32	1.9577	0.01	1	0.05
Lowes Pond	Single Family Residential	1.96	9.9793	0.01	1	0.20
Lowes Pond	Right-of-way	1.95	24.9824	0.01	1	0.49
Lowes Pond (includes totals for McKinstry & Robinson)		**Total**	**44.0265**		**TOTAL**	**0.86**
McKinstry Pond	Mixed use, primarily residential	2.32	0.0000	0.01	1	0.00
McKinstry Pond	Multi-Family Residential	2.32	0.0000	0.01	1	0.00
McKinstry Pond	Single Family Residential	1.96	1.0016	0.01	1	0.02
McKinstry Pond	Right-of-way	1.95	1.4545	0.01	1	0.03
McKinstry Pond		**Total**	**2.4562**		**TOTAL**	**0.05**
Robinson Pond	Commercial	1.78	0.0000	0.01	1	0.00
Robinson Pond	Multi-Family Residential	2.32	0.0000	0.01	1	0.00
Robinson Pond	Single Family Residential	1.96	0.3948	0.01	1	0.01
Robinson Pond	Right-of-way	1.95	0.2872	0.01	1	0.01
Robinson Pond		**Total**	**0.6820**		**TOTAL**	**0.01**
Texas Pond	Commercial	1.78	0.0127	0.01	1	0.00
Texas Pond	Industrial	1.78	0.0006	0.01	1	0.00
Texas Pond	Mixed use, primarily residential	2.32	0.0452	0.01	1	0.00
Texas Pond	Multi-Family Residential	2.32	1.8578	0.01	1	0.04
Texas Pond	Single Family Residential	1.96	1.9507	0.01	1	0.04
Texas Pond	Right-of-way	1.95	7.4736	0.01	1	0.15
Texas Pond		**Total**	**11.3407**		**TOTAL**	**0.23**

Oxford Year 6 Non-structural Phosphorus Reduction Credit Calculations

Catch Basin Cleaning

Pond Watershed	2016 Land Use (Land Cover=Impervious)	PLER (lb/acre/year)		IA (acres)	PRF, CB	Credit, CB cleaning (lbs/year)
Buffumville Lake	Right-of-way	1.95		3.1258	0.02	0.12
Buffumville Lake	Multi-Family Residential	2.32		1.1076	0.02	0.05
Buffumville Lake	Single Family Residential	1.96		0.6630	0.02	0.03
Buffumville Lake		**Total**		**4.90**	**TOTAL**	**0.20**
Lowes Pond	Commercial	1.78		5.1639	0.02	0.18
Lowes Pond	Industrial	1.78		0.0000	0.02	0.00
Lowes Pond	Mixed use, other	1.78		0.5098	0.02	0.02
Lowes Pond	Mixed use, primarily residential	2.32		1.4334	0.02	0.07
Lowes Pond	Multi-Family Residential	2.32		1.9577	0.02	0.09
Lowes Pond	Single Family Residential	1.96		9.9793	0.02	0.39
Lowes Pond	Right-of-way	1.95		24.9824	0.02	0.97
Lowes Pond		**Total**		**44.03**	**TOTAL**	**1.72**
McKinstry Pond	Mixed use, primarily residential	2.32		0.0000	0.02	0.00
McKinstry Pond	Multi-Family Residential	2.32		0.0000	0.02	0.00
McKinstry Pond	Single Family Residential	1.96		1.0016	0.02	0.04
McKinstry Pond	Right-of-way	1.95		1.4545	0.02	0.06
McKinstry Pond		**Total**		**2.46**	**TOTAL**	**0.10**
Robinson Pond	Commercial	1.78		0.0000	0.02	0.00
Robinson Pond	Multi-Family Residential	2.32		0.0000	0.02	0.00
Robinson Pond	Single Family Residential	1.96		0.3948	0.02	0.02
Robinson Pond	Right-of-way	1.95		0.2872	0.02	0.01
Robinson Pond		**Total**		**0.68**	**TOTAL**	**0.03**
Texas Pond	Commercial	1.78		0.0127	0.02	0.00
Texas Pond	Industrial	1.78		0.0006	0.02	0.00
Texas Pond	Mixed use, primarily residential	2.32		0.0452	0.02	0.00
Texas Pond	Multi-Family Residential	2.32		1.8578	0.02	0.09
Texas Pond	Single Family Residential	1.96		1.9507	0.02	0.08
Texas Pond	Right-of-way	1.95		7.4736	0.02	0.29
Texas Pond		**Total**		**11.34**	**TOTAL**	**0.46**

Oxford Year 6 Non-structural Phosphorus Reduction Credit Calculations

Enhanced Organic Waste and Leaf Litter Collection Program

Pond Watershed	2016 Land Use (Land Cover=Impervious)	PLER (lb/acre/year)	IA (acres)	0.05	Credit, sweeping (lbs/year)
Buffumville Lake	Right-of-way	1.95	3.1258	0.05	0.30
Buffumville Lake	Multi-Family Residential	2.32	1.1076	0.05	0.13
Buffumville Lake	Single Family Residential	1.96	0.6630	0.05	0.06
Buffumville Lake		**Total**	**4.90**		**0.50**
Lowes Pond	Commercial	1.78	5.1639	0.05	0.46
Lowes Pond	Industrial	1.78	0.0000	0.05	0.00
Lowes Pond	Mixed use, other	1.78	0.5098	0.05	0.05
Lowes Pond	Mixed use, primarily residential	2.32	1.4334	0.05	0.17
Lowes Pond	Multi-Family Residential	2.32	1.9577	0.05	0.23
Lowes Pond	Single Family Residential	1.96	9.9793	0.05	0.98
Lowes Pond	Right-of-way	1.95	24.9824	0.05	2.44
Lowes Pond		**Total**	**44.03**		**4.31**
McKinstry Pond	Mixed use, primarily residential	2.32	0.0000	0.05	0.00
McKinstry Pond	Multi-Family Residential	2.32	0.0000	0.05	0.00
McKinstry Pond	Single Family Residential	1.96	1.0016	0.05	0.10
McKinstry Pond	Right-of-way	1.95	1.4545	0.05	0.14
McKinstry Pond		**Total**	**2.46**		**0.24**
Robinson Pond	Commercial	1.78	0.0000	0.05	0.00
Robinson Pond	Multi-Family Residential	2.32	0.0000	0.05	0.00
Robinson Pond	Single Family Residential	1.96	0.3948	0.05	0.04
Robinson Pond	Right-of-way	1.95	0.2872	0.05	0.03
Robinson Pond		**Total**	**0.68**		**0.07**
Texas Pond	Commercial	1.78	0.0127	0.05	0.00
Texas Pond	Industrial	1.78	0.0006	0.05	0.00
Texas Pond	Mixed use, primarily residential	2.32	0.0452	0.05	0.01
Texas Pond	Multi-Family Residential	2.32	1.8578	0.05	0.22
Texas Pond	Single Family Residential	1.96	1.9507	0.05	0.19
Texas Pond	Right-of-way	1.95	7.4736	0.05	0.73
Texas Pond		**Total**	**11.34**		**1.14**

Appendix G – BMP Assessment Methodology

BMP Site Assessment

1.1 Methodology

In the fifth year of the Oxford MS4 report, Nitsch Engineering conducted a comprehensive evaluation of subdivisions of town-owned parcels to identify and prioritize potential stormwater BMP locations. Unlike previous years, this year's methodology did not involve a scoring system. Instead, the focus was on a detailed analysis of various criteria that could influence the success and efficiency of a BMP on a town-owned parcel.

Each town-owned parcel was evaluated based on several criteria, some of which were used for informational purposes only. These criteria played a significant role in decision-making processes related to BMP selection and design.

The phosphorus or nitrogen loading rates were calculated for individual BMP watersheds, instead of those of the encompassing town-owned parcel. The watershed was determined using the ArcGIS Pro "watershed" function, with a MassGIS Lidar DEM serving as a base for flow direction. Each BMP area was determined through a process of subdividing town-owned parcels by hydrologic soil group, depth to groundwater, and surface slope.

For local decision-making, the considerations in this analysis can be further supplemented and fine-tuned based on local priorities. For some areas, localized access and education could be an important additional consideration.

The stormwater retrofit prioritization will continue to be updated in future Permit years to adapt to local efforts in pursuit of the MS4 permit. This year's methodology builds upon the previous years' work, incorporating lessons learned and refining the process for identifying and prioritizing potential BMP areas.

1.2 Data Sources

- Pond Watersheds - StreamStats (usgs.gov)
- 2016 Land Cover Land Use (four blocks) - MassGIS Data: 2016 Land Cover/Land Use |
- Mass.gov
- Building Footprints - MassGIS Data: Building Structures (2-D) | Mass.gov
- Train Lines - MassGIS Data: Trains | Mass.gov
- Wetlands - MassGIS Data: MassDEP Wetlands (2005) | Mass.gov
- Hydrologic Soil Groups - MassGIS Data: Soils SSURGO-Certified NRCS | Mass.gov
- Tax Parcels from Oxford, MA - Judy Lochner jlochner@oxfordma.us
- LiDAR DEM - 2015 USGS Lidar: Maine & Massachusetts QL1 & QL2, 2013 - 2014 USGS Lidar: Post-Sandy (MA, NH, RI), and 2010 FEMA Lidar: MA & RI

ATTRIBUTE TYPE	DESCRIPTION	CODE (IF APPLICABLE)

LOC_ID_BMPLocations	This attribute is a unique identifier for each BMP location. It was created after identifying the best BMP areas within each town owned parcel, then dissolving together any identical BMP types that touched boundaries. within the parcel. The unique identifier is made up of the parcel's LOC_ID with "_**" count number after it. Besides LOC_ID and BMP, all attributes are uniquely calculated for each LOC_ID_BMPLocations.	# Calculates a sequential number
		# More calculator examples at
		esriurl.com/CalculatorExamples
		rec=0
		def SequentialNumber():
		global rec
		pStart = 1
		pInterval = 1
		if (rec == 0):
		rec = pStart
		else:
		rec = rec + pInterval
		return rec
		
		uniqueList = []
		def isDuplicate(inValue):
		if inValue in uniqueList:
		iteration = SequentialNumber()
		if iteration > 9:
		return inValue + "_" + str(iteration)
		else:
		return inValue + "_0" + str(iteration)
		else:
		global rec
		rec=0
		iteration = SequentialNumber()
		uniqueList.append(inValue)
		return inValue + "_0" + str(iteration)

LOC_ID	This attribute is the unique identified for each town owned parcel that the potential BMP areas are within. It was created by MassGIS.	
BMP	This attribute is the best fitting BMP type for the area. It was calculated by first erasing any areas within town owned parcels that were overlapped by a building, within 25ft of a train line, or within 25ft of a Wetland or stream. These three variables would make a BMP overly difficult to construct. Next, town owned parcels were subdivided by hydrologic soil group (HSG), 100sqrft slope area, and depth to groundwater area. Type 1 BMPs fit best where HSG is A, B, or C, slope is <5%, and depth to groundwater is >= 4 ft. Type 2 BMPs fit best where HSG is unknown, A/D, B/D, C/D, or D, slope is <5%, and depth to groundwater is <4ft or unknown. Any areas with slopes >5% in an averaged 100sqrft area where not given a potential BMP category as it would be overly expensive to grade the slope to a manageable %.	
BMP Area - Square Ft	This attribute is the square foot area of the unique potential BMP area within the town owned parcel.	
BMP Volume - Cubic Ft	This attribute is the cubic foot volume of the unique potential BMP area within the town owned parcel. All BMP's were assumed to have a 2ft depth.	
Hydrologic Soil Group With Largest Area in BMP	This attribute is the hydrologic soil group with the largest area within each potential BMP area. Some potential BMP areas contained more than one hydrologic soil group within them. Later calculations rely on this attribute to determine which subtype of BMP Type 1 is most appropriate at the potential BMP area.	

Watershed Area - Acres	This attribute is the area in acres of each potential BMP area's watershed. ArcGIS Pro's watershed tool was used in association with an elevation DEM made by combining 2015 USGS Lidar: Maine & Massachusetts QL1 & QL2, 2013 - 2014 USGS Lidar: Post-Sandy (MA, NH, RI), and 2010 FEMA Lidar: MA & RI. Each potential BMP area watershed was calculated iteratively.	
Watershed Impervious Area - Acres	This attribute is the area in acres of pervious land cover within each potential BMP area's watershed. It was calculated by subdividing the watershed by the MassGIS 2016 Land Cover Land Use dataset, selecting all areas with an Impervious land cover identifier, and adding together their individual acre area values.	
Watershed Pervious Area - Acres	This attribute is the area in acres of pervious land cover within each potential BMP area's watershed. It was calculated by subdividing the watershed by the MassGIS 2016 Land Cover Land Use dataset, selecting all areas without an Impervious land cover identifier, and adding together their individual acre area values.	
Unknown Type Hydrologic Soil Group Pervious Area (Watershed) - Acres	This attribute is the area in acres of unknown hydrologic soil groups (HSG) within the pervious area of the potential BMP's watershed. It was calculated by subdividing the watershed by MassGIS's 2016 Land Cover Land Use and SSURGO Soils dataset, selecting all areas without an Impervious land cover identifier and an Unknown HSG identifier, then adding together their individual acre area values.	
A Type Hydrologic Soil Group Pervious Area (Watershed) - Acres	This attribute is the area in acres of A hydrologic soil groups (HSG) within the pervious area of the potential BMP's watershed. It was calculated by subdividing the watershed by MassGIS's 2016 Land Cover Land Use and SSURGO Soils dataset, selecting all areas without an Impervious land cover identifier and an A HSG identifier, then adding together their individual acre area values.	
A/D Type Hydrologic Soil Group Pervious Area (Watershed) - Acres	This attribute is the area in acres of A/D hydrologic soil groups (HSG) within the pervious area of the potential BMP's watershed. It was calculated by subdividing the watershed by MassGIS's 2016 Land Cover Land Use and SSURGO Soils dataset, selecting all areas without an Impervious land cover identifier and an A/D HSG identifier, then adding together their individual acre area values.	
B Type Hydrologic Soil Group Pervious Area (Watershed) - Acres	This attribute is the area in acres of B hydrologic soil groups (HSG) within the pervious area of the potential BMP's watershed. It was calculated by subdividing the watershed by MassGIS's 2016 Land Cover Land Use and SSURGO Soils dataset, selecting all areas without an Impervious land cover identifier and an B HSG identifier, then adding together their individual acre area values.	

B/D Type Hydrologic Soil Group Pervious Area (Watershed) - Acres	This attribute is the area in acres of B/D hydrologic soil groups (HSG) within the pervious area of the potential BMP's watershed. It was calculated by subdividing the watershed by MassGIS's 2016 Land Cover Land Use and SSURGO Soils dataset, selecting all areas without an Impervious land cover identifier and an B/D HSG identifier, then adding together their individual acre area values.	
C Type Hydrologic Soil Group Pervious Area (Watershed) - Acres	This attribute is the area in acres of C hydrologic soil groups (HSG) within the pervious area of the potential BMP's watershed. It was calculated by subdividing the watershed by MassGIS's 2016 Land Cover Land Use and SSURGO Soils dataset, selecting all areas without an Impervious land cover identifier and an C HSG identifier, then adding together their individual acre area values.	
C/D Type Hydrologic Soil Group Pervious Area (Watershed) - Acres	This attribute is the area in acres of C/D hydrologic soil groups (HSG) within the pervious area of the potential BMP's watershed. It was calculated by subdividing the watershed by MassGIS's 2016 Land Cover Land Use and SSURGO Soils dataset, selecting all areas without an Impervious land cover identifier and an C/D HSG identifier, then adding together their individual acre area values.	
D Type Hydrologic Soil Group Pervious Area (Watershed) - Acres	This attribute is the area in acres of D hydrologic soil groups (HSG) within the pervious area of the potential BMP's watershed. It was calculated by subdividing the watershed by MassGIS's 2016 Land Cover Land Use and SSURGO Soils dataset, selecting all areas without an Impervious land cover identifier and an D HSG identifier, then adding together their subdivision acre area values.	

2 Inch Rainfall Watershed Pervious Volume Runoff - Cubic Ft	This attribute is the volume in cubic ft of runoff from the pervious area of the potential BMP's watershed during a 2 inch rainfall event. It was calculated by subdividing the watershed by MassGIS's 2016 Land Cover Land Use and SSURGO Soils dataset, selecting all areas without an Impervious land cover identifier, then depending on each subdivisions hydrologic soil group their area was multiplied by the associated runoff depth index (see below).
	
	Soil Group : ['Unknown', 'A', 'A/D', 'B', 'B/D' ,'C' ,'C/D' ,'D']
	2.0in rainfall : [0.69, 0.14, 1.08, 0.22, 1.08, 0.69, 0.89, 1.08]
	
	Subdivision calculations finally added together for the final runoff volume.
		def Runoff(UNKNWN, A, A_D, B, B_D, C, C_D, D):
		#for each rainfall option change the below rainfall depth
		RainfallDepth = **FILL DEPENDING ON RAINFALL EVENT, EX. 0.6**
		HSG_Runoff = {'Soil Group' : ['Unknown', 'A', 'A/D', 'B', 'B/D' ,'C' ,'C/D' ,'D'],
		0.1 : [0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0],
		0.2 : [0.01, 0.0, 0.02, 0.0, 0.02, 0.01, 0.02, 0.02],
		0.4 : [0.03, 0.0, 0.06, 0.0, 0.06, 0.03, 0.05, 0.06],
		0.5 : [0.05, 0.0, 0.09, 0.01, 0.09, 0.05, 0.07, 0.09],
		0.6 : [0.06, 0.01, 0.11, 0.02, 0.11, 0.06, 0.09, 0.11],
		0.8 : [0.09, 0.02, 0.16, 0.03, 0.16, 0.09, 0.13, 0.16],
		1.0 : [0.12, 0.03, 0.21, 0.04, 0.21, 0.12, 0.17, 0.21],
		1.2 : [0.14, 0.04, 0.39, 0.05, 0.39, 0.14, 0.27, 0.39],
		1.5 : [0.39, 0.08, 0.72, 0.11, 0.72, 0.39, 0.55, 0.72],
		2.0 : [0.69, 0.14, 1.08, 0.22, 1.08, 0.69, 0.89, 1.08]}
		
		RUNOFF_UNKNWN = 0
		RUNOFF_A = 0
		RUNOFF_A_D = 0
		RUNOFF_B = 0
		RUNOFF_B_D = 0
		RUNOFF_C = 0
		RUNOFF_C_D = 0
		RUNOFF_D = 0
		
		if UNKNWN != None and UNKNWN > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("Unknown")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_UNKNWN = (HSG_RainfallDepth/12) * (UNKNWN*43560)
		if A != None and A > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("A")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_A = (HSG_RainfallDepth/12) * (A*43560)
		if A_D != None and A_D > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("A/D")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_A_D = (HSG_RainfallDepth/12) * (A_D*43560)
		if B != None and B > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("B")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_B = (HSG_RainfallDepth/12) * (B*43560)
		if B_D != None and B_D > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("B/D")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_B_D = (HSG_RainfallDepth/12) * (B_D*43560)
		if C != None and C > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("C")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_C = (HSG_RainfallDepth/12) * (C*43560)
		if C_D != None and C_D > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("C/D")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_C_D = (HSG_RainfallDepth/12) * (C_D*43560)
		if D != None and D > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("D")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_D = (HSG_RainfallDepth/12) * (D*43560)
		
		RUNOFF_TOTAL = RUNOFF_UNKNWN + RUNOFF_A + RUNOFF_A_D + RUNOFF_B + RUNOFF_B_D + RUNOFF_C + RUNOFF_C_D + RUNOFF_D
		return RUNOFF_TOTAL

1.5 Inch Rainfall Watershed Pervious Area Runoff - Cubic Ft	This attribute is the volume in cubic ft of runoff from the pervious area of the potential BMP's watershed during a 1.5 inch rainfall event. It was calculated by subdividing the watershed by MassGIS's 2016 Land Cover Land Use and SSURGO Soils dataset, selecting all areas without an Impervious land cover identifier, then depending on each subdivisions hydrologic soil group their area was multiplied by the associated runoff depth index (see below).
	
	Soil Group : ['Unknown', 'A', 'A/D', 'B', 'B/D' ,'C' ,'C/D' ,'D']
	1.5in rainfall : [0.39, 0.08, 0.72, 0.11, 0.72, 0.39, 0.55, 0.72]
	
	Subdivision calculations finally added together for the final runoff volume.
		def Runoff(UNKNWN, A, A_D, B, B_D, C, C_D, D):
		#for each rainfall option change the below rainfall depth
		RainfallDepth = **FILL DEPENDING ON RAINFALL EVENT, EX. 0.6**
		HSG_Runoff = {'Soil Group' : ['Unknown', 'A', 'A/D', 'B', 'B/D' ,'C' ,'C/D' ,'D'],
		0.1 : [0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0],
		0.2 : [0.01, 0.0, 0.02, 0.0, 0.02, 0.01, 0.02, 0.02],
		0.4 : [0.03, 0.0, 0.06, 0.0, 0.06, 0.03, 0.05, 0.06],
		0.5 : [0.05, 0.0, 0.09, 0.01, 0.09, 0.05, 0.07, 0.09],
		0.6 : [0.06, 0.01, 0.11, 0.02, 0.11, 0.06, 0.09, 0.11],
		0.8 : [0.09, 0.02, 0.16, 0.03, 0.16, 0.09, 0.13, 0.16],
		1.0 : [0.12, 0.03, 0.21, 0.04, 0.21, 0.12, 0.17, 0.21],
		1.2 : [0.14, 0.04, 0.39, 0.05, 0.39, 0.14, 0.27, 0.39],
		1.5 : [0.39, 0.08, 0.72, 0.11, 0.72, 0.39, 0.55, 0.72],
		2.0 : [0.69, 0.14, 1.08, 0.22, 1.08, 0.69, 0.89, 1.08]}
		
		RUNOFF_UNKNWN = 0
		RUNOFF_A = 0
		RUNOFF_A_D = 0
		RUNOFF_B = 0
		RUNOFF_B_D = 0
		RUNOFF_C = 0
		RUNOFF_C_D = 0
		RUNOFF_D = 0
		
		if UNKNWN != None and UNKNWN > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("Unknown")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_UNKNWN = (HSG_RainfallDepth/12) * (UNKNWN*43560)
		if A != None and A > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("A")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_A = (HSG_RainfallDepth/12) * (A*43560)
		if A_D != None and A_D > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("A/D")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_A_D = (HSG_RainfallDepth/12) * (A_D*43560)
		if B != None and B > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("B")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_B = (HSG_RainfallDepth/12) * (B*43560)
		if B_D != None and B_D > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("B/D")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_B_D = (HSG_RainfallDepth/12) * (B_D*43560)
		if C != None and C > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("C")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_C = (HSG_RainfallDepth/12) * (C*43560)
		if C_D != None and C_D > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("C/D")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_C_D = (HSG_RainfallDepth/12) * (C_D*43560)
		if D != None and D > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("D")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_D = (HSG_RainfallDepth/12) * (D*43560)
		
		RUNOFF_TOTAL = RUNOFF_UNKNWN + RUNOFF_A + RUNOFF_A_D + RUNOFF_B + RUNOFF_B_D + RUNOFF_C + RUNOFF_C_D + RUNOFF_D
		return RUNOFF_TOTAL

1 Inch Rainfall Watershed Pervious Area Runoff - Cubic Ft	This attribute is the volume in cubic ft of runoff from the pervious area of the potential BMP's watershed during a 1 inch rainfall event. It was calculated by subdividing the watershed by MassGIS's 2016 Land Cover Land Use and SSURGO Soils dataset, selecting all areas without an Impervious land cover identifier, then depending on each subdivisions hydrologic soil group their area was multiplied by the associated runoff depth index (see below).
	
	Soil Group : ['Unknown', 'A', 'A/D', 'B', 'B/D' ,'C' ,'C/D' ,'D']
	1.0in rainfall : [0.12, 0.03, 0.21, 0.04, 0.21, 0.12, 0.17, 0.21]
	
	Subdivision calculations finally added together for the final runoff volume.
		def Runoff(UNKNWN, A, A_D, B, B_D, C, C_D, D):
		#for each rainfall option change the below rainfall depth
		RainfallDepth = **FILL DEPENDING ON RAINFALL EVENT, EX. 0.6**
		HSG_Runoff = {'Soil Group' : ['Unknown', 'A', 'A/D', 'B', 'B/D' ,'C' ,'C/D' ,'D'],
		0.1 : [0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0],
		0.2 : [0.01, 0.0, 0.02, 0.0, 0.02, 0.01, 0.02, 0.02],
		0.4 : [0.03, 0.0, 0.06, 0.0, 0.06, 0.03, 0.05, 0.06],
		0.5 : [0.05, 0.0, 0.09, 0.01, 0.09, 0.05, 0.07, 0.09],
		0.6 : [0.06, 0.01, 0.11, 0.02, 0.11, 0.06, 0.09, 0.11],
		0.8 : [0.09, 0.02, 0.16, 0.03, 0.16, 0.09, 0.13, 0.16],
		1.0 : [0.12, 0.03, 0.21, 0.04, 0.21, 0.12, 0.17, 0.21],
		1.2 : [0.14, 0.04, 0.39, 0.05, 0.39, 0.14, 0.27, 0.39],
		1.5 : [0.39, 0.08, 0.72, 0.11, 0.72, 0.39, 0.55, 0.72],
		2.0 : [0.69, 0.14, 1.08, 0.22, 1.08, 0.69, 0.89, 1.08]}
		
		RUNOFF_UNKNWN = 0
		RUNOFF_A = 0
		RUNOFF_A_D = 0
		RUNOFF_B = 0
		RUNOFF_B_D = 0
		RUNOFF_C = 0
		RUNOFF_C_D = 0
		RUNOFF_D = 0
		
		if UNKNWN != None and UNKNWN > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("Unknown")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_UNKNWN = (HSG_RainfallDepth/12) * (UNKNWN*43560)
		if A != None and A > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("A")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_A = (HSG_RainfallDepth/12) * (A*43560)
		if A_D != None and A_D > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("A/D")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_A_D = (HSG_RainfallDepth/12) * (A_D*43560)
		if B != None and B > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("B")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_B = (HSG_RainfallDepth/12) * (B*43560)
		if B_D != None and B_D > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("B/D")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_B_D = (HSG_RainfallDepth/12) * (B_D*43560)
		if C != None and C > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("C")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_C = (HSG_RainfallDepth/12) * (C*43560)
		if C_D != None and C_D > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("C/D")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_C_D = (HSG_RainfallDepth/12) * (C_D*43560)
		if D != None and D > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("D")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_D = (HSG_RainfallDepth/12) * (D*43560)
		
		RUNOFF_TOTAL = RUNOFF_UNKNWN + RUNOFF_A + RUNOFF_A_D + RUNOFF_B + RUNOFF_B_D + RUNOFF_C + RUNOFF_C_D + RUNOFF_D
		return RUNOFF_TOTAL

0.8 Inch Rainfall Watershed Pervious Area Runoff - Cubic Ft	This attribute is the volume in cubic ft of runoff from the pervious area of the potential BMP's watershed during a 0.8 inch rainfall event. It was calculated by subdividing the watershed by MassGIS's 2016 Land Cover Land Use and SSURGO Soils dataset, selecting all areas without an Impervious land cover identifier, then depending on each subdivisions hydrologic soil group their area was multiplied by the associated runoff depth index (see below).
	
	Soil Group : ['Unknown', 'A', 'A/D', 'B', 'B/D' ,'C' ,'C/D' ,'D']
	0.8in rainfall : [0.09, 0.02, 0.16, 0.03, 0.16, 0.09, 0.13, 0.16]
	
	Subdivision calculations finally added together for the final runoff volume.
		def Runoff(UNKNWN, A, A_D, B, B_D, C, C_D, D):
		#for each rainfall option change the below rainfall depth
		RainfallDepth = **FILL DEPENDING ON RAINFALL EVENT, EX. 0.6**
		HSG_Runoff = {'Soil Group' : ['Unknown', 'A', 'A/D', 'B', 'B/D' ,'C' ,'C/D' ,'D'],
		0.1 : [0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0],
		0.2 : [0.01, 0.0, 0.02, 0.0, 0.02, 0.01, 0.02, 0.02],
		0.4 : [0.03, 0.0, 0.06, 0.0, 0.06, 0.03, 0.05, 0.06],
		0.5 : [0.05, 0.0, 0.09, 0.01, 0.09, 0.05, 0.07, 0.09],
		0.6 : [0.06, 0.01, 0.11, 0.02, 0.11, 0.06, 0.09, 0.11],
		0.8 : [0.09, 0.02, 0.16, 0.03, 0.16, 0.09, 0.13, 0.16],
		1.0 : [0.12, 0.03, 0.21, 0.04, 0.21, 0.12, 0.17, 0.21],
		1.2 : [0.14, 0.04, 0.39, 0.05, 0.39, 0.14, 0.27, 0.39],
		1.5 : [0.39, 0.08, 0.72, 0.11, 0.72, 0.39, 0.55, 0.72],
		2.0 : [0.69, 0.14, 1.08, 0.22, 1.08, 0.69, 0.89, 1.08]}
		
		RUNOFF_UNKNWN = 0
		RUNOFF_A = 0
		RUNOFF_A_D = 0
		RUNOFF_B = 0
		RUNOFF_B_D = 0
		RUNOFF_C = 0
		RUNOFF_C_D = 0
		RUNOFF_D = 0
		
		if UNKNWN != None and UNKNWN > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("Unknown")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_UNKNWN = (HSG_RainfallDepth/12) * (UNKNWN*43560)
		if A != None and A > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("A")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_A = (HSG_RainfallDepth/12) * (A*43560)
		if A_D != None and A_D > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("A/D")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_A_D = (HSG_RainfallDepth/12) * (A_D*43560)
		if B != None and B > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("B")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_B = (HSG_RainfallDepth/12) * (B*43560)
		if B_D != None and B_D > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("B/D")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_B_D = (HSG_RainfallDepth/12) * (B_D*43560)
		if C != None and C > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("C")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_C = (HSG_RainfallDepth/12) * (C*43560)
		if C_D != None and C_D > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("C/D")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_C_D = (HSG_RainfallDepth/12) * (C_D*43560)
		if D != None and D > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("D")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_D = (HSG_RainfallDepth/12) * (D*43560)
		
		RUNOFF_TOTAL = RUNOFF_UNKNWN + RUNOFF_A + RUNOFF_A_D + RUNOFF_B + RUNOFF_B_D + RUNOFF_C + RUNOFF_C_D + RUNOFF_D
		return RUNOFF_TOTAL

0.6 Inch Rainfall Watershed Pervious Area Runoff - Cubic Ft	This attribute is the volume in cubic ft of runoff from the pervious area of the potential BMP's watershed during a 0.6 inch rainfall event. It was calculated by subdividing the watershed by MassGIS's 2016 Land Cover Land Use and SSURGO Soils dataset, selecting all areas without an Impervious land cover identifier, then depending on each subdivisions hydrologic soil group their area was multiplied by the associated runoff depth index (see below).
	
	Soil Group : ['Unknown', 'A', 'A/D', 'B', 'B/D' ,'C' ,'C/D' ,'D']
	0.6in rainfall : [0.06, 0.01, 0.11, 0.02, 0.11, 0.06, 0.09, 0.11]
	
	Subdivision calculations finally added together for the final runoff volume.
		def Runoff(UNKNWN, A, A_D, B, B_D, C, C_D, D):
		#for each rainfall option change the below rainfall depth
		RainfallDepth = **FILL DEPENDING ON RAINFALL EVENT, EX. 0.6**
		HSG_Runoff = {'Soil Group' : ['Unknown', 'A', 'A/D', 'B', 'B/D' ,'C' ,'C/D' ,'D'],
		0.1 : [0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0],
		0.2 : [0.01, 0.0, 0.02, 0.0, 0.02, 0.01, 0.02, 0.02],
		0.4 : [0.03, 0.0, 0.06, 0.0, 0.06, 0.03, 0.05, 0.06],
		0.5 : [0.05, 0.0, 0.09, 0.01, 0.09, 0.05, 0.07, 0.09],
		0.6 : [0.06, 0.01, 0.11, 0.02, 0.11, 0.06, 0.09, 0.11],
		0.8 : [0.09, 0.02, 0.16, 0.03, 0.16, 0.09, 0.13, 0.16],
		1.0 : [0.12, 0.03, 0.21, 0.04, 0.21, 0.12, 0.17, 0.21],
		1.2 : [0.14, 0.04, 0.39, 0.05, 0.39, 0.14, 0.27, 0.39],
		1.5 : [0.39, 0.08, 0.72, 0.11, 0.72, 0.39, 0.55, 0.72],
		2.0 : [0.69, 0.14, 1.08, 0.22, 1.08, 0.69, 0.89, 1.08]}
		
		RUNOFF_UNKNWN = 0
		RUNOFF_A = 0
		RUNOFF_A_D = 0
		RUNOFF_B = 0
		RUNOFF_B_D = 0
		RUNOFF_C = 0
		RUNOFF_C_D = 0
		RUNOFF_D = 0
		
		if UNKNWN != None and UNKNWN > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("Unknown")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_UNKNWN = (HSG_RainfallDepth/12) * (UNKNWN*43560)
		if A != None and A > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("A")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_A = (HSG_RainfallDepth/12) * (A*43560)
		if A_D != None and A_D > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("A/D")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_A_D = (HSG_RainfallDepth/12) * (A_D*43560)
		if B != None and B > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("B")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_B = (HSG_RainfallDepth/12) * (B*43560)
		if B_D != None and B_D > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("B/D")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_B_D = (HSG_RainfallDepth/12) * (B_D*43560)
		if C != None and C > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("C")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_C = (HSG_RainfallDepth/12) * (C*43560)
		if C_D != None and C_D > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("C/D")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_C_D = (HSG_RainfallDepth/12) * (C_D*43560)
		if D != None and D > 0:
		DepthIndex = HSG_Runoff['Soil Group'].index("D")
		HSG_RainfallDepth = HSG_Runoff[RainfallDepth][DepthIndex]
		RUNOFF_D = (HSG_RainfallDepth/12) * (D*43560)
		
		RUNOFF_TOTAL = RUNOFF_UNKNWN + RUNOFF_A + RUNOFF_A_D + RUNOFF_B + RUNOFF_B_D + RUNOFF_C + RUNOFF_C_D + RUNOFF_D
		return RUNOFF_TOTAL

BMP Capacity For Impervious Area Runoff During Largest Rainfall Allowable - Cubic Ft	This attribute is the potential BMP's capacity for impervious area runoff volume in cubic ft during the largest rainfall event it could contain. It uses the previously calculated Rainfall Watershed Pervious Area Runoff attributes (ex. 2.0 Inch Rainfall Watershed Pervious Area Runoff) to determine how much BMP volume is available to treat its watershed's impervious area runoff after all its watershed's pervious area runoff has been accounted for.
	
	An important factors in the calculation was whether the potential BMP's watershed contained any impervious area at all. By referencing the Watershed Impervious Area - Acres attribute, any BMP watersheds without impervious area were discounted from the calculation, as even with capacity there would be no impervious area for the BMP to treat.
	
	After calculation, the attribute contains three values:
	- The largest rainfall event in which the BMP can treat all watershed runoff from pervious areas while retaining capacity for watershed runoff from impervious areas.
	- The volume from the watershed's impervious area runoff that the BMP could treat during the above rainfall event.
	- The depth of water within the BMP's volume made up by the watershed's impervious area runoff during the above rainfall event.
	
	**Note: If the BMP's capacity could treat only less than 0.6in rainfall events runoff, it is flagged as such. Such a small capacity means the BMP would not be worth the effort of construction.
		def BMP_IA_VolumeFt_Capacity(BMP_Vol, IA_Area, PA_Vol_2inRF, PA_Vol_1pt5inRF, PA_Vol_1inRF, PA_Vol_pt8inRF, PA_Vol_pt6inRF):
		
		PA_Runoff_Volumes = { "2 Inches Rainfall":PA_Vol_2inRF, "1.5 Inches Rainfall":PA_Vol_1pt5inRF, "1 Inch Rainfall":PA_Vol_1inRF, "0.8 Inches Rainfall":PA_Vol_pt8inRF, "0.6 Inches Rainfall":PA_Vol_pt6inRF}
		
		for key, value in PA_Runoff_Volumes.items():
		IA_Volume = BMP_Vol - value
		RF_Depth = float(key.split(" ")[0])
		
		if IA_Area == 0 or IA_Area is None:
		return "No impervious area in watershed"
		
		BMP_IA_Runoff_Capacity = (IA_Volume/IA_Area)*(12/43560)
		if IA_Volume > 0 and IA_Area != 0:
		return key + ": " + str(IA_Volume) + " ft3, " + str(BMP_IA_Runoff_Capacity) + " inch IA runoff capacity"
		
		else:
		IA_Volume = 0
		
		return "Rainfall capacity less than 0.6in"

Watershed Phosphorus Load - Lb/Yr	This attribute is the potential BMP watershed's phosphorus load in pounds per year. It was calculated by subdividing the BMP's watershed by MassGIS's 2016 Land Cover Land Use and SSURGO Soils dataset, then assigning a PLER for each subdivision, referencing the EPA MS4 appendix, based on land cover, land use, and hydrologic soil group identifiers. Finally, the subdivisions are multiplied by their acre areas and then added together by BMP watershed. The result is a total yearly phosphorus load for the watershed.	def PLER(HydSoils, LU_Code, LC_Code):
		  WaterLC = [23,22,21]
		  WaterLU = [88]
		  Imperv_LU_01 = [10,12]
		  Imperv_LU_02 = [3,4,9,20,30]
		  Imperv_LU_03 = [55]
		  Imperv_LU_04 = [6]
		  Imperv_LU_05 = [7]
		  Imperv_LU_06 = [0,2,8]
		  Imperv_LU_07 = [13,11]
		  Perv_LC_01 = [9,10,12]
		  Perv_LU6LC_01 = [5,6,8,13,14,15,16,17,18]
		  Perv_LC_02 = [6,7]
		  Perv_LU7LC_01 = [5,8]
		  Perv_LC_03 = [5,8,13,14,15,16,17,18,19,20]
		  HydrSoils_01 = ["A"]
		  HydrSoils_02 = ["B", "B/D"]
		  HydrSoils_03 = ["C", "C/D"]
		  HydrSoils_04 = ["D"]
		  if LC_Code in WaterLC or LU_Code in WaterLU:
		  return 0
		  elif LC_Code is 2:
		  if LU_Code in Imperv_LU_01:
		  return 2.32
		  elif LU_Code in Imperv_LU_02:
		  return 1.78
		  elif LU_Code in Imperv_LU_03:
		  return 1.95
		  elif LU_Code in Imperv_LU_04:
		  return 1.52
		  elif LU_Code in Imperv_LU_05:
		  return 1.52
		  elif LU_Code in Imperv_LU_06:
		  return 1.52
		  elif LU_Code in Imperv_LU_07:
		  return 1.96
		  else:
		  return 100
		  elif LC_Code in Perv_LC_01:
		  return 0.13
		  elif LU_Code is 6 and LC_Code in Perv_LU6LC_01:
		  return 0.13
		  elif LC_Code in Perv_LC_02:
		  return 0.45
		  elif LU_Code is 7 and LC_Code in Perv_LU7LC_01:
		  return 0.45
		  elif LC_Code in Perv_LC_03:
		  if HydSoils in HydrSoils_01:
		  return 0.03
		  elif HydSoils in HydrSoils_02:
		  return 0.12
		  elif HydSoils in HydrSoils_03:
		  return 0.21
		  elif HydSoils in HydrSoils_04:
		  return 0.37
		  else:
		  return 0.21
		  elif LC_Code is 21 or LU_Code is 88:
		  return 0
		  else:
		  return 102

BMP Phosphorus Load Reduction Ability During Largest Rainfall Allowable - %	This attribute is the percent of phosphorus load that the potential BMP could reduce during the largest rainfall event in which the BMP can treat all watershed runoff from pervious areas while retaining capacity for watershed runoff from impervious areas.
	
	For BMP Type 1, percent reduction potential is dependent on the subtype of BMP at the location. The Hydrologic Soil Group With Largest Area in BMP attribute was used to determine the likely infiltration rate of the soil beneath the BMP, and from that a Type 1 subtype could be identified. BMP Type 1 areas with a majority hydrologic soil group (HSG) A were assumed to have a 2.41 surface infiltration rate. BMP Type 1 areas with a majority hydrologic soil group (HSG) B were assumed to have a 0.52 surface infiltration rate. BMP Type 1 areas with a majority hydrologic soil group (HSG) C were assumed to have a 0.17 surface infiltration rate.
	
	For BMP Type 2, there were no subtypes. The percent reduction is entirely dependent on the BMP Capacity For Impervious Area Runoff During Largest Rainfall Allowable attribute.
	
	Using the BMP Capacity For Impervious Area Runoff During Largest Rainfall Allowable attribute in association with the BMP's type, and referencing the EPA MS4 appendix, the percent that the BMP is able to reduce phosphorus load was determined. In general, the larger the rainfall event (ex. 2in) capacity the larger the percent reduction.
		def CumulativePhosLoadReduction(BMP_Capacity, PLoad, BMP,HSG):
		
		BMP_Capacity_Choice = BMP_Capacity.split(" ")[0]
		PLoadReduction = 0
		
		if BMP == "Type 2":
		Biofiltration_Phos_Performance_Table = { "0.6": .44, "0.8": .48, "1": .53, "1.5": .58, "2": .63}
		for key, value in Biofiltration_Phos_Performance_Table.items():
		if key == BMP_Capacity_Choice:
		PLoadReduction = str(round(value * 100,1))+"%"
		return PLoadReduction
		
		elif BMP == "Type 1":
		SurfaceInfil_pt17_Phos_Performance_Table = { "0.6": .82, "0.8": .88, "1": .92, "1.5": .97, "2": .99}
		SurfaceInfil_pt52_Phos_Performance_Table = { "0.6": .87, "0.8": .92, "1": .95, "1.5": .98, "2": .99}
		SurfaceInfil_2pt41_Phos_Performance_Table = { "0.6": .94, "0.8": .97, "1": .98, "1.5": 1.0, "2": 1.0}
		if HSG == "A":
		for key, value in SurfaceInfil_2pt41_Phos_Performance_Table.items():
		if key == BMP_Capacity_Choice:
		PLoadReduction = str(round(value * 100,1))+"%"
		return PLoadReduction
		if HSG == "B":
		for key, value in SurfaceInfil_pt52_Phos_Performance_Table.items():
		if key == BMP_Capacity_Choice:
		PLoadReduction = str(round(value * 100,1))+"%"
		return PLoadReduction
		if HSG == "C":
		for key, value in SurfaceInfil_pt17_Phos_Performance_Table.items():
		if key == BMP_Capacity_Choice:
		PLoadReduction = str(round(value * 100,1))+"%"
		return PLoadReduction
		
		else:
		return None

BMP Cumulative Phosphorus Load Reduction - Lb/Yr	This attribute is the potential BMP's cumulative phosphorus load reduction amount in pounds per year. It was calculated by multiplying the BMP Phosphorus Load Reduction Ability During Largest Rainfall Allowable attribute by the Watershed Phosphorus Load attribute. By identifying the load reduction that the BMP's construction could provide, it is possible to do a planning level cost analysis to determine which BMP areas would provide the most benefit to phosphorus load reduction within MS4 pond watersheds. **Note: The calculation assumes that a BMP would be constructed that covers the entire original area. If not the case, the BMP would need to have a depth larger than 2ft to make up for the volume decreased by a smaller than calculated surface area. Runoff would additionally need to be routed to the BMPs location, as the watershed calculated is for the entire original BMP area.	

Watershed Nitrogen Load - Lb/Yr	This attribute is the potential BMP watershed's nitrogen load in pounds per year. It was calculated by subdividing the BMP's watershed by MassGIS's 2016 Land Cover Land Use and SSURGO Soils dataset, then assigning a NLER for each subdivision, referencing the EPA MS4 appendix, based on land cover, land use, and hydrologic soil group identifiers. Finally, the subdivisions are multiplied by their acre areas and then added together by BMP watershed. The result is a total yearly nitrogen load for the watershed.	def NLER(LC_Code,LU_Code,HydrSoil):
		  Impervious = [2]
		  WaterLC = [23,22,21]
		  WaterLU = [88]
		  HydrSoils_01 = ["A", "A/D"]
		  HydrSoils_02 = ["B", "B/D"]
		  HydrSoils_03 = ["C"]
		  HydrSoils_06 = ["C/D"]
		  HydrSoils_04 = ["D"]
		  HydrSoils_05 = ["","," ",None]
		  if LC_Code in WaterLC or LU_Code in WaterLU:
		  return 0
		  elif LC_Code in Impervious:
		  return 14.1
		  else:
		  if HydrSoil in HydrSoils_05:
		  return 3.0
		  elif HydrSoil in HydrSoils_01:
		  return 0.3
		  elif HydrSoil in HydrSoils_02:
		  return 1.2
		  elif HydrSoil in HydrSoils_03:
		  return 2.4
		  elif HydrSoil in HydrSoils_06:
		  return 3.0
		  elif HydrSoil in HydrSoils_04:
		  return 3.7
		  else:
		  return 102

BMP Nitrogen Load Reduction Ability During Largest Rainfall Allowable - %	This attribute is the percent of nitrogen load that the potential BMP could reduce during the largest rainfall event in which the BMP can treat all watershed runoff from pervious areas while retaining capacity for watershed runoff from impervious areas.
	
	For BMP Type 1, percent reduction potential is dependent on the subtype of BMP at the location. The Hydrologic Soil Group With Largest Area in BMP attribute was used to determine the likely infiltration rate of the soil beneath the BMP, and from that a Type 1 subtype could be identified. BMP Type 1 areas with a majority hydrologic soil group (HSG) A were assumed to have a 2.41 surface infiltration rate. BMP Type 1 areas with a majority hydrologic soil group (HSG) B were assumed to have a 0.52 surface infiltration rate. BMP Type 1 areas with a majority hydrologic soil group (HSG) C were assumed to have a 0.17 surface infiltration rate.
	
	For BMP Type 2, there were no subtypes. The percent reduction is entirely dependent on the BMP Capacity For Impervious Area Runoff During Largest Rainfall Allowable attribute.
	
	Using the BMP Capacity For Impervious Area Runoff During Largest Rainfall Allowable attribute in association with the BMP's type, and referencing the EPA MS4 appendix, the percent that the BMP is able to reduce nitrogen load was determined. In general, the larger the rainfall event (ex. 2in) capacity the larger the percent reduction.
		def CumulativeNitLoadReduction(BMP_Capacity, NLoad, BMP,HSG):
		
		  BMP_Capacity_Choice = BMP_Capacity.split(" ")[0]
		  NLoadReduction = 0
		
		  if BMP == "Type 2":
		  Biofiltration_Nit_Performance_Table = { "0.6": .28, "0.8": .31, "1": .32, "1.5": .37, "2": .40}
		  for key, value in Biofiltration_Nit_Performance_Table.items():
		  if key == BMP_Capacity_Choice:
		  NLoadReduction = str(round(value * 100,1))+"%"
		  return NLoadReduction
		
		  elif BMP == "Type 1":
		  SurfaceInfil_pt17_Nit_Performance_Table = { "0.6": .92, "0.8": .96, "1": .98, "1.5": .99, "2": 1.0}
		  SurfaceInfil_pt52_Nit_Performance_Table = { "0.6": .94, "0.8": .98, "1": .99, "1.5": 1.0, "2": 1.0}
		  SurfaceInfil_2pt41_Nit_Performance_Table = { "0.6": .98, "0.8": .99, "1": 1.0, "1.5": 1.0, "2": 1.0}
		  if HSG == "A":
		  for key, value in SurfaceInfil_2pt41_Nit_Performance_Table.items():
		  if key == BMP_Capacity_Choice:
		  NLoadReduction = str(round(value * 100,1))+"%"
		  return NLoadReduction
		  if HSG == "B":
		  for key, value in SurfaceInfil_pt52_Nit_Performance_Table.items():
		  if key == BMP_Capacity_Choice:
		  NLoadReduction = str(round(value * 100,1))+"%"
		  return NLoadReduction
		  if HSG == "C" or HSG == "C/D":
		  for key, value in SurfaceInfil_pt17_Nit_Performance_Table.items():
		  if key == BMP_Capacity_Choice:
		  NLoadReduction = str(round(value * 100,1))+"%"
		  return NLoadReduction
		  else:
		  return None

BMP Cumulative Nitrogen Load Reduction - Lb/Yr	This attribute is the potential BMP's cumulative nitrogen load reduction amount in pounds per year. It was calculated by multiplying the BMP Nitrogen Load Reduction Ability During Largest Rainfall Allowable attribute by the Watershed Nitrogen Load attribute. By identifying the load reduction that the BMP's construction could provide, it is possible to do a planning level cost analysis to determine which BMP areas would provide the most benefit to nitrogen load reduction within Oxford, MA. **Note: The calculation assumes that a BMP would be constructed that covers the entire original area. If not the case, the BMP would need to have a depth larger than 2ft to make up for the volume decreased by a smaller than calculated surface area. Runoff would additionally need to be routed to the BMPs location, as the watershed calculated is for the entire original BMP area.	
MS4 Pond Watershed Intersecting BMP	This attribute is what MS4 pond watershed intersects the BMP. MS4 phosphorus reduction requirements are pond watershed specific. For planning purposes, it is important to determine which pond watersheds contain which potential BMP areas. That way construction can be prioritized where high phosphorus reduction BMPs overlap pond watersheds with the highest phosphorus reduction requirements.	
Drainage Outfall Catchment Area Intersecting Watershed	This attribute is what Oxford drainage outfall catchment area intersects the BMP. MS4 nitrogen reduction requirements are undefined but lean on the town's drainage outfall catchment area nitrogen loads to help determine if nitrogen is at an adequate level. By identifying which, if any, outfall catchment areas intersect with the potential BMP's watershed, it is easier to prioritize where BMPs should be constructed for their nitrogen reduction ability.	
Watershed Intersects Drainage Network Flag	This attribute is a flag identifying potential BMPs whose watersheds intersect the Oxford drainage network. The importance of this flag is to associate relevant potential BMP areas with the ability to connect their watershed into the Oxford drainage network and increase its catchment area, therein increasing the BMP's phosphorus and nitrogen load reduction amount.	
Watershed Intersects MassDOT Road Flag	This attribute is a flag identifying potential BMPs whose watersheds intersect MassDOT inventoried roads. The importance of this flag is to associate relevant potential BMP areas with the ability to connect their watershed to road drainage systems that may have been missed by the ArcGIS Pro Watershed tool. Such a connection could either increase the amount of reduceable phosphorus and nitrogen load that reaches the BMP.	
BMP Intersects Urbanized Area Flag	This attribute is a flag identifying potential BMPs that intersect Urbanized Area. The importance of this flag is to provide context for changes in advised BMP construction locations if Oxford commits to only managing nitrogen reduction within the Urbanized Area.	

Appendix H – BMP Assessment Results

OBJECTID	LOC_ID	BMP	WithinStormShed	WithinStormBuilding	Shape_Length	Shape_Area	BMP_Volume(ft³)	BMP_Area(ft²)	BMP_Watershed_DA_Acres	BMP_Watershed_PA_Acres	BMP_Watershed_Acres	BMP_Watershed_Slope	WithinWatershed	ContainsRangeNetwork	InIrrigatedRoad	ContainsStreamCrossing	ContainsRangeNetwork	OutletEncroachmentInterfectingBMP	BMP_Watershed_Acres	NLoadLbYr	PLoadLbYr	BMP_DA_VolumeFt_Capacity	CumulativeNLoadReduction	CumulativePLoadReduction	NLoadReductionPercent	PLoadReductionPercent	LargestHSG	SITE_ADDR
82	S:43700 2892754	P:54700 2892754	Yes	0	0.5972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	
2	S:43700 2892754	P:54700 2892754			133.629629	5970.672673																						
4	S:43700 2892754	P:54700 2892754			421.9490417	7201.126233																						
6	S:43700 2892754	P:54700 2892754			1158.870404	8826.898548																						
8	S:43700 2892754	P:54700 2892754			1118.406132	601.3460364																						
10	S:43700 2892754	P:54700 2892754			77.46439806	2721.376759																						
9	S:43700 2892754	P:54700 2892754			97.07182569	2068.162245																						
11	S:43700 2892754	P:54700 2892754			144.6484265	961.9000708																						
7	S:43700 2892754	P:54700 2892754			2458.02716	102685.07171																						
8	S:43700 2892754	P:54700 2892754			900.3481230	2181.748613																						
5	S:43700 2892754	P:54700 2892754			697.1744629	1626.929562																						
4	S:43700 2892754	P:54700 2892754			421.9490417	7201.126233																						
2	S:43700 2892754	P:54700 2892754			133.629629	5970.672673																						
82	S:43700 2892754	P:54700 2892754	2254.956577	4113.172724	403.8980364	6230.363148	0.1048225	0.1048225	0.1048225	0.1048225	0.1048225	0.1048225	0	0	0	0	0	0	0.1048225	0.1048225	0.1048225	0.1048225	0.1048225	0.1048225	0.1048225	0.1048225	0	
84	S:43700 2892754	P:54700 2892754			1135.327255	4636.896548																						
86	S:43700 2892754	P:54700 2892754			1118.406132	601.3460364																						
88	S:43700 2892754	P:54700 2892754			915.5026944	468.6999407																						
87	S:43700 2892754	P:54700 2892754			915.5026944	3637.418627	0.0864575	0.0864575	0.0864575	0.0864575	0.0864575	0.0864575	0	0	0	0	0	0	0.0864575	0.0864575	0.0864575	0.0864575	0.0864575	0.0864575	0.0864575	0.0864575	0	
85	S:43700 2892754	P:54700 2892754	Yes	0	1118.406132	601.3460364																						
83	S:43700 2892754	P:54700 2892754			1135.327255	4636.896548																						
81	S:43700 2892754	P:54700 2892754			1464.705277	1963.705277																						
79	S:43700 2892754	P:54700 2892754			1464.705277	1963.705277																						
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115	S:43700 2892754	P:54700 2892754			1464.705277	1963.705277																						
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141	S:43700 2892754	P:54700 2892754			1464.705277	1963.705277																						
143	S:43700 2892754	P:54700 2892754			1464.705277	1963.705277																						
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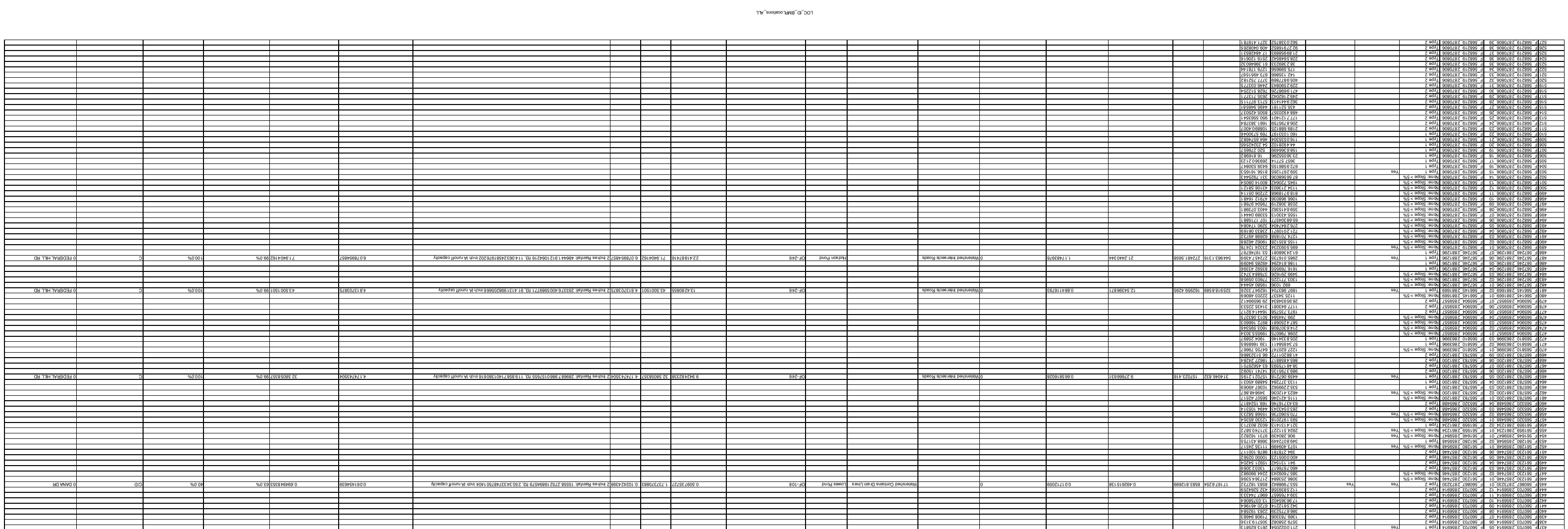
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Appendix I – Phosphorus Control BMP sites & maps

OBJECTID	LOC_ID	RANKING FOR LPCP	LOC_ID_BMPLocations	SITE_ADDR	LAND USE/NAME	URBANIZED AREA	WithinWatershed	nulativePhosLoadReduct	OutfallCatchmentIntersectingBMP	BMP_IA_VolumeFt_Capacity	PA_HSG_Unknown_Acres	PA_HSG_A_Acres	PA_HSG_A_D_Acres	PA_HSG_B_Acres	PA_HSG_B_D_Acres	PA_HSG_C_Acres	PA_HSG_C_D_Acres	PA_HSG_D_Acres	FtRunoff_2InRainfall	FtRunoff_1pt5InRainfall	FtRunoff_1InRainfall	FtRunoff_pt8InRainfall	FtRunoff_pt6InRainfall	Shape_Length	Shape_Area
1	F_546353_2893567	LOW	F_546353_2893567_02	0 MERRIAM DIST	GORE CEMETERY	YES	Texas Pond	0.002		2 Inches Rainfall: 31.11046242615316306 ft3, 6.739048346126245 inch IA runoff capacity	0	0	0	0	0	0	0.010825309	0	34.97324498	21.61272892	6.68029803	5.1084632	3.536628369	32.28890332	33.03942449
2	F_546353_2893567	LOW	F_546353_2893567_03	0 MERRIAM DIST	GORE CEMETERY	YES	Texas Pond	0.044	OF-270	2 Inches Rainfall: 12830.024675228291 ft3, 419.261227832973 inch IA runoff capacity	0	0	0	0	0	0	0.381110636	0	1231.254133	760.8873853	235.1833736	179.8461093	124.5088449	347.7605106	7030.111756
3	F_546353_2893567	LOW	F_546353_2893567_04	0 MERRIAM DIST	GORE CEMETERY	YES	Texas Pond	0.217	OF-270	2 Inches Rainfall: 16413.247183664427 ft3, 39.4750108675224 inch IA runoff capacity	0	0	0	0	0	0	0.668148912	0	2158.588691	1333.959304	412.3149838	315.2994717	218.2842497	570.2821863	9285.225984
4	F_546452_2869135	LOW	F_546452_2869135_01	75 OLD SOUTHBRIDGE RD	[+st mapped, not enough IA]	YES	NO	0.047	OF-146	Rainfall capacity less than 0.6in						6.316026123	1.939816779	2.353833546	3132.526058	1897.164897	574.1738835	434.7113403	297.1731253	1232.467182	
5	F_548642_2887754	LOW	F_548642_2887754_02	0 LEICESTER ST	multi-family residential	YES	NO	1.026		2 Inches Rainfall: 38217.379193143838 ft3, 26.891528551193552 inch IA runoff capacity	0	0	0	7.368650542	0	0	0	0	5884.604322	2942.302161	1069.928059	802.446044	534.9640293	764.8136086	22049.34537
6	F_549675_2883997	LOW	F_549675_2883997_03	0 PIONEER DR		NO	NO	0.037	OF-55	2 Inches Rainfall: 4820.429503409321 ft3, 5163.296767089322 inch IA runoff capacity	0	0	0	0.373145156	0	0.102669304	0	0	555.1495271	294.3457944	98.90342545	74.17756908	49.45171222	239.3343873	2687.589317
7	F_549675_2883997_04	LOW	F_549675_2883997_04	0 PIONEER DR		NO	NO	0.325	OF-55	1 Inch Rainfall: 292.09380790817986 ft3, 0.674229169070429 inch IA runoff capacity	0	0	0	0.992475974	0	1.433010366	0.941751712	0	7424.369613	4305.215725	1349.481808	1020.857753	691.8336978	338.8506956	820.7268614
8	F_549728_2886376	LOW	F_549728_2886376_02	0 SOUTHBRIDGE RD	commercial	YES	NO	0.197		2 Inches Rainfall: 8143.242288617702 ft3, 12.909254485717852 inch IA runoff capacity	0	0	0	0.104828811	0	0	0	0	83.71628842	41.85814421	15.22114335	11.41585751	7.610571675	283.8985028	4113.172724
9	F_551517_2884993	LOW	F_551517_2884993_02	0 PROSPECT ST	[triangle lot]	YES	NO	0.084		2 Inches Rainfall: 7231.311255211504 ft3, 26.201562533009408 inch IA runoff capacity	0	0.085647578	0	0	0	0	0	0	43.52609906	24.87205661	9.327021228	6.218014152	3.109007076	422.7081757	3637.146634
10	F_551920_2885413	LOW	F_551920_2885413_01	0 SNEADE DR	easement?	YES	NO	0.139	OF-129	2 Inches Rainfall: 19310.263859354392 ft3, 9.875750128712548 inch IA runoff capacity	0.296177352	0.296177352	0.296177352	0.296177352	0.296177352	0.296177352	0.296177352	0.296177352	6310.976629	3966.455536	1193.387403	903.1019981	612.8205585	441.4919395	4110.327492
11	F_552208_2853863	LOW	F_552208_2853863_05	15 OLD WEBSTER RD		NO	NO	0.002		2 Inches Rainfall: 180.50708318868928 ft3, 32.082932208344 inch IA runoff capacity	0	0	0	0.000469739	0	0	0	0	3.375133471	0.187566735	0.068206886	0.051154564	0.034103043	73.9564442	90.43480234
12	F_552208_2853863	LOW	F_552208_2853863_06	15 OLD WEBSTER RD		NO	NO	0.804		2 Inches Rainfall: 37084.157822790434 ft3, 638.855492835233 inch IA runoff capacity	0	0	0	10.0531149	0.085921717	0	0	0	8365.265054	4238.773777	1525.210408	1144.687545	764.1646829	740.0645153	22723.11051
13	F_552508_2883326_04	LOW	F_552508_2883326_04	656 MAIN ST	N. FIRE STATION, BALL FIELD, DOG PARK	YES	NO	2.046	OF-44	2 Inches Rainfall: 202281.17124207445 ft3, 32.037235503821 inch IA runoff capacity	0	0.971249679	0	1.228366784	0	0	0	0	2193.3028	1131.907918	414.807947	302.2918494	189.7579118	1956.519009	10229.05333
14	F_552508_2883166	LOW	F_552508_2883166_05	656 MAIN ST	N. FIRE STATION, BALL FIELD, DOG PARK	YES	NO	0.028		2 Inches Rainfall: 11526.675134257077 ft3, 400.699717989539 inch IA runoff capacity	0	0.001759929	0	0.245488332	0	0	0	0	196.9413775	98.53457417	35.83656201	26.86145015	17.8863383	323.8099479	5861.370824
15	F_552838_2858456	LOW	F_552838_2858456_02	0 HARWOOD ST	wedge lot	YES	NO	0.175	OF-137	2 Inches Rainfall: 5854.145611082684 ft3, 9.368810917472176 inch IA runoff capacity	0	0.159903152	0	0	0	0	0	0	81.26278167	46.43587524	17.41345222	11.60896881	5.804844405	279.6227343	2967.493523
16	F_552851_2858574	LOW	F_552851_2858574_01	0 LARNED RD	[triple lot]	YES	NO	0.148	OF-137	2 Inches Rainfall: 3592.727280381456 ft3, 78.047324759369 inch IA runoff capacity	0	0.432999573	0	0	0	0	0	0	220.0503833	125.743076	47.1563535	31.435769	15.71784451	773.6580701	18105.09985
17	F_553269_2858272	LOW	F_553269_2858272_02	80 OLD WEBSTER RD	just outside UA	NO	NO	1.063	OF-137	2 Inches Rainfall: 15245.474037253827 ft3, 5.347787077961251 inch IA runoff capacity	0.004251294	3.029953938	0.004251294	0.004251294	0.004251294	0.004251294	0.004251294	0.004251294	1628.249083	935.4545346	346.6287572	232.6290579	118.6293586	769.2553132	8436.253988
18	F_553560_2862781	LOW	F_553560_2862781_03	0 FRENCH RIVER CIR		NO	NO	0.164	OF-101	2 Inches Rainfall: 1669.691178048058 ft3, 1.362942431742162 inch IA runoff capacity	0	0.227287205	0	0	0	0	0	0	115.5073576	66.00420434	24.75157663	16.50105109	8.250251543	273.8700508	892.5358268
19	F_553560_2862781_04	LOW	F_553560_2862781_04	0 FRENCH RIVER CIR		NO	NO	0.016	OF-110	2 Inches Rainfall: 551.8105001679326 ft3, 11.247387137614409 inch IA runoff capacity	0	0.002088679	0	0	0	0	0	0	10.36152653	5.920872303	2.220327113	1.480218076	0.740109038	85.79653662	281.0657726
20	F_553906_2874229	LOW	F_553906_2874229_10	0 ROCKY HILL RD	stockpiles, yw collection	YES	NO	0.197	OF-108	Rainfall capacity less than 0.6in	880.8072417	2527.109712	897.3571794	3792.974149	2403.714562	8006.211825	2367.382922	2559.891774	57198288.5	34874454.46	10625852.12	8021127.812	5416403.505	4099.969879	321959.277
21	F_553938_2870622	LOW	F_553938_2870622_11	0 CHURCH ST		YES	NO	1.468	OF-277	2 Inches Rainfall: 24538.617371553616 ft3, 6.403436225764657 inch IA runoff capacity	0.01019505	2.786690579	0.01019505	1.307246799	0.01019505	0.01019505	0.01019505	0.01019505	2664.077705	1460.396624	531.7711931	373.9092581	216.0473232	671.751723	13600.3506
22	F_554692_2875377_05	LOW	F_554692_2875377_05	495 MAIN ST	OXFORD HIGH SCHOOL	YES	NO	1.001		2 Inches Rainfall: 17616.185472780955 ft3, 4.653052136093818 inch IA runoff capacity		0.350579735	0	0	0	0	0	0	178.2500808	101.8800462	38.19751732	25.46501155	12.73250577	397.4591253	8896.564497
23	F_554692_2875377	LOW	F_554692_2875377_11	495 MAIN ST	OXFORD HIGH SCHOOL	NO	NO	0.206		1 Inch Rainfall: 54751.36472425353 ft3, 88.251161058638 inch IA runoff capacity	0	1.180644561	0	0	0	0	0	0	600.003566	342.8591806	128.5721927	85.71479514	42.85739757	733.70338	27673.64383
24	F_554781_2871780	LOW	F_554781_2871780_02	0 FOREST ST	near McKinstry Pond	NO	NO	0.043		1 Inch Rainfall: 24.105267877699292 ft3, 0.187924224639592 inch IA runoff capacity	0	0.06427161	0	0	0	0.071126749	0	0	311.5081995	204.561347	61.21909918	45.97653477	30.73397036	34.00207241	42.65905648
25	F_554880_2876071_03	LOW	F_554880_2876071_03	0 MAIN ST	adj to north cemetery	YES	NO	0.248		2 Inches Rainfall: 14150.319626214226 ft3, 20.712031967438417 inch IA runoff capacity	0	1.465154811	0	0	0	0	0	0	744.5916751	425.4809572	159.5553589	113.8511965	53.18511965	360.4188571	7446.910261
26	F_554880_2876071	LOW	F_554880_2876071_04	0 MAIN ST	adj to north cemetery	YES	NO	0.077		2 Inches Rainfall: 46590.894431703333 ft3, 846.809107312876 inch IA runoff capacity	0	1.085315333	0	0	0	0	0	0	551.5572523	315.1755727	118.1908398	78.79389318	39.39694659	739.7911478	23569.53499
27	F_554880_2876071	LOW	F_554880_2876071_05	0 MAIN ST	adj to north cemetery	YES	NO	0.001		2 Inches Rainfall: 39.810973191645212 ft3, 9.70085166344817 inch IA runoff capacity	0	0.013314309	0	0	0	0	0	0	6.664491783	3.808395205	1.428148239	0.952098826	0.476049413	23.27501088	23.26114959
28	F_554880_2876071_07	LOW	F_554880_2876071_07	0 MAIN ST	adj to north cemetery	YES	NO	0.029		2 Inches Rainfall: 8222.648269333939 ft3, 107.969091003440407 inch IA runoff capacity	0	0.331539927	0	0	0	0	0	0	168.4784271	96.27338691	36.1025209	24.06834673	12.03417336	295.8018744	4195.255519
29	F_555002_2866202_03	LOW	F_555002_2866202_03	36 QUOBALAG AVE	residential	NO	NO	0.002	OF-98	2 Inches Rainfall: 1722.1126678934993 ft3, 1132.143169025132 inch IA runoff capacity	0	0.045176862	0	0	0	0	0	0	22.95888145	13.11936083	4.91976031	3.279840207	1.639920103	155.7108897	872.4723983
30	F_555002_2866202	LOW	F_555002_2866202_04	36 QUOBALAG AVE	residential	YES	NO	0.042	OF-98	2 Inches Rainfall: 3099.655639202866318 ft3, 24.774160751738936 inch IA runoff capacity	0	0.017315267	0	0	0	0	0	0	8.779618912	5.028353664	1.885632624	1.257088416	0.628544208	199.2208532	1554.11544
31	F_555058_2861222_01	LOW	F_555058_2861222_01	0 SUNSET AVE		YES	NO	0.1	OF-1	Rainfall capacity less than 0.6in	872.5854661	780.4231132	272.5854661	1120.774805	577.6197629	2212.957145	731.1434433	822.8103168	16438195.68	10025264.27	3056955.32	2302437.1	1550.393737	1765.58176	
32	F_555058_2861222	LOW	F_555058_2861222_08	0 SUNSET AVE		NO	NO	0.047	OF-106	Rainfall capacity less than 0.6in		47.4857754		51.90535478	8.171642821	22.21637075			153263.2053	87323.5794	28614.09549	21103.83398	13593.57247	215.469243	2431.664813	
33	F_555058_2861222	LOW	F_555058_2861222_09	0 SUNSET AVE		NO	NO	0.070	OF-107	2 Inches Rainfall: 3893.229945718373 ft3, 17.825279260492 inch IA runoff capacity	0	0.000217751	0	0	0	0.040014741	0	0	156.9844496	104.6457606	30.52694974	23.25636999	15.98579024	237.9847748	2024.9623
34	F_555399_2861526_13	LOW	F_555399_2861526_13	0 SUNSET AVE		YES	NO	3.418	OF-106	1 Inch Rainfall: 484.4008336084281 ft3, 0.041897995931290385 inch IA runoff capacity	0	1.088615211	0	0	0	0.161028644	0	0	4233.739047	2479.388322	894.7023319	621.6154697	373.8469952	689.5468339	
35	F_555399_2861526	LOW	F_555399_2861526_12	0 SUNSET AVE		NO	NO	0.457	OF-108	0.6 Inches Rainfall: 594.46882506316 ft3, 0.617295638276504 inch IA runoff capacity		1.251925906	0	0.203791105	4.012875412	0	0	0	16531.05309	10932.98425	3224.940126	2443.760712	1662.581297	199.8494226	1128.44403
36	F_555399_2861526	LOW	F_555399_2861526_14	0 SUNSET AVE		NO	NO	0.030	OF-108	Rainfall capacity less than 0.6in		0.064780292	0	0	0.334595861	0	0	0	1344.670954	893.3119366	262.1169979	199.0363247	135.9556515	34.05968712	48.02125458
37	F_555478_2875043_09	LOW	F_555478_2875043_09	100 CARBUNCLE DR	OXFORD HIGH SCHOOL	NO	NO	1.142		2 Inches Rainfall: 26767.612220058648 ft3, 6.152307426047349 inch IA runoff capacity		2.56003518	0	0	0	0	0	0	1301.009879	743.4342164	278.7873312	185.8585541	92.92927705	649.9096409	14933.27948
38	F_555478_2875043	LOW	F_555478_2875043_10	100 CARBUNCLE DR	OXFORD HIGH SCHOOL	NO	NO	0.526		2 Inches Rainfall: 3843.620507074966 ft3, 1.858716805608157 inch IA runoff capacity		0.347181547	0	0	0	0	0	0	176.4376624	100.8215214	37.80807052	25.20538034	12.60269017	385.013896	2009.880485
39	F_555478_2875043	LOW	F_555478_2875043_12	100 CARBUNCLE DR	OXFORD HIGH SCHOOL	NO	NO	6.271		2 Inches Rainfall: 934501.262136576763 ft3, 42.484721069139287 inch IA runoff capacity		18.60539081	0	0	0	0	0	0	9455.259609	5403.005491	2026.120599	1350.751373	675.3758864	5213.257101	47194.763
40	F_555478_2875043	LOW	F_555478_2875043_13	100 CARBUNCLE DR	OXFORD HIGH SCHOOL	NO	NO	0.176		2 Inches Rainfall: 4754.460885314016 ft3, 6.849440777961 inch IA runoff capacity		0.073539095	0	0	0	0	0	0	37.23731512	21.27642007	7.978657525	5.319105017	2.659552508	220.1180771	2395.670559
41	F_555650_2856051	LOW	F_555650_2856051_04	37 MAIN ST		NO	NO	0.558	OF-126	2 Inches Rainfall: 90398.40343293663 ft3, 67.038277352663 inch IA runoff capacity		1.649318582	0	0	0	0	0	0	838.1837034	478.9621162	179.6107936	119.7405291	59.87026453	1063.550486	45615.06805
42	F_555694_2867399	LOW	F_555694_2867399_02	38 CHARLTON ST	DPW GARAGE	YES	NO		OF-1	Rainfall capacity less than 0.6in	20.13097361	122.4082179	20.13097361	81.59563826	48.4609976	20.13097361	20.13097361	20.13097361	641112.5568	397226.271	122778.5451	91960.97705	61143.40902	627.742871	23258.19287
43	F_555694_2867399_04	LOW	F_555694_2867399_04	38 CHARLTON ST	DPW GARAGE	YES	NO	0.414		2 Inches Rainfall: 1315.807979000218892 ft3, 1.148020200588517 inch IA runoff capacity		0.005016548	0	0	0.594215271	0	0	0	477.0897272	238.7309643	86.82635981	63.00742468	43.32212955	129.7733267	896.3838681
44	F_555729_2875887	LOW	F_555729_2875887_09	505 MAIN ST	North Cemetery	NO	NO	3.623		2 Inches Rainfall: 1744932.1108707953 ft3, 164.428915697741 inch IA runoff capacity		17.87014428	0	0	0	0	0	0	9081.607321	5189.489898	1946.058712	1297.37474	648.6862372	5333.695747	876941.8962
45	F_555740_2876253	LOW	F_555740_2876253_02	0 MAIN ST	North Cemetery	NO	NO	0.838		2 Inches Rainfall: 1981.542917738042 ft3, 0.801041124800484 inch IA runoff capacity		2.514397634	0	0	0	0	0	0	1277.816878	730.1810729	273.8179024	182.5452682	91.27263412	182.6955037	1629.559792
46	F_555750_2863438	LOW	F_555750_2863438_07	27 LOCUST ST	RUEL FIELDS	YES	NO	1.528	OF-102	2 Inches Rainfall: 13981.876103374621 ft3, 384.046290482294 inch IA runoff capacity		18.13326624	0	0	0	0	0	0	9215.356393	5265.917939	1974.719227	1316.479485	658.2397424	533.1542867	703650.7057
47	F_555750_2863438	LOW	F_555750_2863438_09	27 LOCUST ST	RUEL FIELDS	NO	NO	0.225	OF-108	2 Inches Rainfall: 430.52192944541803 ft3, 0.718952195914486 inch IA runoff capacity		1.496819091	0	0	0	0	0	0	760.6834623	434.6762642	163.0035991	108.669066	54.33453302	209.4781195	595.5602092
48	F_555786_2855189_02	LOW	F_555786_2855189_02	23 MAIN ST	[triangle lot]	YES	NO	0.158		2 Inches Rainfall: 7853.418266367111 ft3, 55.572082930419409 inch IA runoff capacity		0.167091815	0	0	0	0	0	0	85.33278459	48.76159519	18.2855967	12.18559567	6.092598899	279.4720037	3969.094904
49	F_555871_2865801_02	LOW	F_555871_2865801_02	0 OAK GARAGE	CHARLTON ST	NO	NO	39.207	OF-1	6 Inches Rainfall: 23839.221655330697 ft3, 0.153795983027653 inch IA runoff capacity	20.13097361	121.2549443	20.13097361	81.4627223	48.4609976	20.13097361	20.13097361	20.13097361	637137.5756	396745.1078	122633.8874	91862.15697	61096.88656	1907.640996	464382
50	F_555896_2864398_07	LOW	F_555896_2864398_07	9 CLOVER ST	Alfred E. Chaffee School	NO	NO	0.169	OF-108	2 Inches Rainfall: 856.961472718570 ft3, 1.491350379852026 inch IA runoff capacity		0.01174099	0	0	0	0	0	0	5.966770938	3.409583393	1.278593772	0.852395848	0.426197924	108.0226348	431.4330519
51	F_555896_2864398_08	LOW	F_555896_2864398_08	9 CLOVER ST	Alfred E. Chaffee School	NO	NO	0.052	OF-108	2 Inches Rainfall: 1216.490214443169 ft3, 6.874122183629961 inch IA runoff capacity		0.012401117	0	0	0	0	0	0	6.302474429	3.601284245	1.350481932	0.900321661	0.450160651	115.4589862	611.352278
52	F_555896_2864398_09	LOW	F_555896_2864398_09	9 CLOVER ST	Alfred E. Chaffee School	NO	NO	7.116	OF-108	2 Inches Rainfall: 587241.884054185871 ft3, 26.535793686692802 inch IA runoff capacity		11.15529613	0	0	0	0	0	0	5669.116409	3239.495091	1214.810659	809.8737727	404.9368844	4910.874417	29644.0756
53	F_555896_2864398_10	LOW	F_555896_2864398_10	9 CLOVER ST	Alfred E. Chaffee School	NO	NO	0.127	OF-108	2 Inches Rainfall: 889.831484663945 ft3, 2.060029810160392 inch IA runoff capacity		0.004085664	0	0	0	0	0	0	2.075775285	1.186157306	0.44480899	0.296539326	0.148269663	87.12454811	445.9214593
54	F_555896_2864398_11	LOW	F_555896_2864398_11	9 CLOVER ST	Alfred E. Chaffee School	NO	NO	0.108	OF-108	2 Inches Rainfall: 481.899427248046 ft3, 3.944524265970085 inch IA runoff capacity		0.000693878	0	0	0	0	0	0	0.352809446	0.201621311	0.075605741	0.050403827	0.025201913	89.38524401	241.0353177
55	F_556065_2880446_04	LOW	F_556065_2880446_04	25 DEPOT RD	Clara Barton School	NO	NO	3.227	OF-280	2 Inches Rainfall: 4509.425544099525 ft3, 1.395279064206885 inch IA runoff capacity		1.210703557	0	0	0	0	0	0	614.8425763	351.4908295	131.5229613	93.59425944	46.79712972	474.179975	5480.007651
56	F_556065_2880446	LOW	F_556065_2880446_09	25 DEPOT RD	Clara Barton School	NO	NO	0.117		2 Inches Rainfall: 839.822275591112 ft3, 2.208927382453113 inch IA runoff capacity		0.229212401	0	0	0	0	0	0	116.4857422	66.56328127	24.96123048	16.64082032	8.320410518	136.5492127	478.1185739
57	F_556065_2880446_10	LOW	F_556065_2880446_10	25 DEPOT RD	Clara Barton School	NO	NO	0.230		2 Inches Rainfall: 1433.100535995228 ft3, 23.539816519647247 inch IA runoff capacity		0.262229449	0	0	0	0	0	0	5765.576785	3259.632003	1008.08927	753.6812225	609.1880388	499.2851707	9439.582347
58	F_556065_2880446_11	LOW	F_556065_2880446_11	25 DEPOT RD	Clara Barton School	NO	NO	2.407		2 Inches Rainfall: 207308.990302238124 ft3, 29.842052045218866 inch IA runoff capacity		4.842257638	0	0	0	0	0	0	5892.504593	1.370091932				1124.133902	799.1569386	474.179975	2296.645153	106592.8541
59	F_556091_2874903	LOW	F_556091_2874903_02	CARBUNCLE DR	TOWN BEACH	NO	NO	0.008		2 Inches Rainfall: 4863.152442108768 ft3, 509.178875547015 inch IA runoff capacity		0.087853798	0	0	0	0	0	0	44.64730003	25.51274287	9.567278578	6.378185718	3.189028859	241.8534542	2453.719465
60	F_556201_2871385_05	LOW	F_556201_2871385_05	0 FOREST ST	single family residential	YES	NO	0.030		2 Inches Rainfall: 539.323376683693 ft3, 7.420108765775673 inch IA runoff capacity		0.067237471	0	0	0	0.042963419	0	0	202.6038703	131.8185313	40.03137484	29.83454911	19.59601337	19.59601337	30.93641471
61	F_556201_2871585_07	LOW	F_556201_2871585_07	0 FOREST ST	single family residential	YES	McKinstry Pond	0.110901285		Rainfall capacity less than 0.6in		0.136925573	0.110901285	0.110901285	0.110901285	0.154112408	0.110901285	0.110901285	2545.726095	1601.957767	482.6284307	365.146581	247.6647313	51.82492689	76.25475112
62	F_556208_2878888_02	LOW	F_556208_2878888_02	579A MAIN ST		NO	NO	0.015		2 Inches Rainfall: 578.260779435426 ft3, 14.127883927583722 inch IA runoff capacity		0.045935355	0	0	0	0	0	0	23.34434505	13.33962574	5.002359653	3.334906435	1.667453218	83.96648816	300.7802928
63	F_556358_2861578_04	LOW	F_556358_2861578_04	0 MAIN ST		NO	NO	3.667	OF-108	2 Inches Rainfall: 8132.309804351389 ft3, 0.770163933880260 inch IA runoff capacity		0.543602092	0	0	0	0	0	0	276.1865204	157.8282558	59.18208688	39.45471129	19.72738921	394.552172	1972.270886	5446.694827
64	F_556403_2869246	HIGH - Year 10	F_556403_2869246_09	0 MAPLE RD	Oxford Community Center, basketball, field, pl	YES	Lowes Pond or none	30.676	OF-134 (Lowes) or OF-1 (none)	1.5 Inches Rainfall: 1863304.445420132202 ft3, 2.682836730657206? inch IA runoff capacity	20.13097361	92.58912917	20.13097361	52.98076924	44.74407388	20.13097361	20.13097361	588503.0786	367405.1685	112536.7818	84516.45823	56496.13465	4330.446557	276847.615
65	F_556403_2869246	HIGH - Year 13	F_556403_2869246_07	0 MAPLE RD	Oxford Community Center, basketball, field, pl	YES	Lowes Pond	0.020	OF-134	2 Inches Rainfall: 902.040054904989? ft3, 13.288650298898444 inch IA runoff capacity		0.000644668	0	0	0	0	0	0	0.327620219	0.187211553	0.070204333	0.046802888	0.023401444	129.7259118	451.1509193
66	F_556403_2869246	HIGH - Year 12	F_556403_2869246_08	0 MAPLE RD	Oxford Community Center, basketball, field, pl	YES	Lowes Pond	0.131	OF-134	2 Inches Rainfall: 1515.766957966108 ft3, 3.617673884855081 inch IA runoff capacity		0.014860331	0	0	0	0	0	0	7.553473386	4.317958506	1.619234449	1.079489627	0.539748133	118.2731881	795.6070048
67	F_556403_2869246	HIGH - Year 11	F_556403_2869246_10	0 MAPLE RD	Oxford Community Center, basketball, field, pl	YES	Lowes Pond	0.534	OF-134	2 Inches Rainfall: 28556.320102830778 ft3, 16.449116646034 inch IA runoff capacity		0.581048459	0	0	0	0	0	0	295.2888267	168.7364724	63.27617715	42.18411881	21.09205905	1134.081376	1442.75362
68	F_556403_2869246	HIGH - Year 13	F_556403_2869246_11	0 MAPLE RD	Oxford Community Center, basketball, field, pl	YES	Lowes Pond	0.010	OF-134	2 Inches Rainfall: 2160.812265968287 ft3, 67.797490935430 inch IA runoff capacity		0.039451972	0	0	0	0	0	0	20.04949238	11.45685279	4.296319796	2.864213197	1.432106599	208.8762188	1090.352141
69	F_556452_2875677_07	LOW	F_556452_2875677_07	503 MAIN ST	POLICE DEPARTMENT	NO	NO	0.012		2 Inches Rainfall: 1780.804778363607 ft3, 44.399609672072568 inch IA runoff capacity		0.027358958	0	0	0	0	0	0	13.90428037	7.945303068	2.979448865	1.986325787	0.993162883	223.8105468	877.2884414
70	F_556452_2875677	LOW	F_556452_2875677_03	503 MAIN ST	POLICE DEPARTMENT	YES	NO	0.167		2 Inches Rainfall: 24900.981998848316 ft3, 47.884650264783645 inch IA runoff capacity		1.069331497	0	0	0	0	0	0	543.4342668	310.5338667	116.4502	77.63366669	38.81673334	550.6527469	12721.27049
71	F_556456_2863446	LOW	F_556456_2863446_03	181 MAIN ST	FIRE-EMS HQ	NO	NO	0.910	OF-108	2 Inches Rainfall: 16251.255899692149 ft3, 7.053539697918092 inch IA runoff capacity		4.918730419	0	0	0	0	0	0	2499.698799	1428.399314	535.6497426	357.0998284	178.5499142	638.0724077	9374.80321
72	F_556456_2863446_04	LOW	F_556456_2863446_04	181 MAIN ST	FIRE-EMS HQ	NO	NO	0.380	OF-108	2 Inches Rainfall: 1891.407442568059 ft3, 1.565249433731965 inch IA runoff capacity		0.300703968	0	0	0	0	0	0	153.6665905	87.82443322	33.16955405	22.11303603	11.05651802	1022.53792	
73	F_556526_2876215	LOW	F_556526_2876215_03	66 PLANTATION RD	east of north cemetery	NO	NO	2.243	OF-108	2 Inches Rainfall: 87956.043116752515 ft3, 12.422807316526423 inch IA runoff capacity		2.893574741	0	0	0	0	0	0	1470.514683	840.2941048	314.1102893	210.0735262	105.0367631	1265.565623	44709.98028
74	F_556637_2880397	LOW	F_556637_2880397_01	0 OLD WORCESTER RD	triangle lot near school	NO	NO	0.175		2 Inches Rainfall: 22906.508120051234 ft3, 36.964473042068093 inch IA runoff capacity		0.215024346	0	0	0	0	0	0	109.2573726	62.44307005	23.41651127	15.61076751	7.805383757	568.3197383	11507.03303
75	F_556732_2869373	LOW	F_556732_2869373_02	0 CHURCH ST	SOUTH CEMETERY	YES	NO	2.512	OF-1	2 Inches Rainfall: 30145519136178063 ft3, 43.109712705925549 inch IA runoff capacity		1.693884412	0	0	0	0	0	0	860.2307956	492.1303295	184.6240918	123.0760606	61.53802955	1152.74397	15247.39
76	F_556901_2867471	HIGH - Year 8	F_556901_2867471_01	3 BARTON ST	FACILITIES MAINTENANCE ENG BLDG	YES	Lowes Pond	0.420	OF-142	2 Inches Rainfall: 16108.331347589321 ft3, 12.333523913760974 inch IA runoff capacity		0

OXFORD ANIMAL SHELTER

F_553560_2862781_04
0 FRENCH RIVER CIR
0.02 lbs/yr

F_553560_2862781_03
0 FRENCH RIVER CIR
0.16 lbs/yr

F_551920_2858411_01
0 SNEADE DR
0.14 lbs/yr

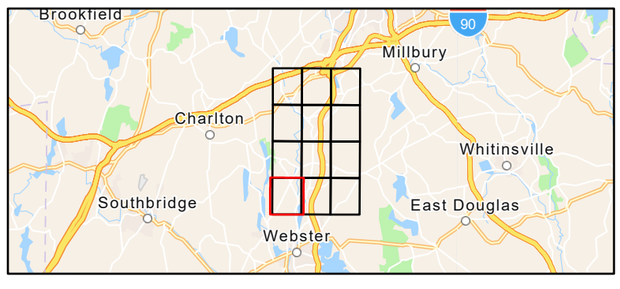
F_552838_2858456_02
0 HARWOOD ST
0.18 lbs/yr

F_553269_2858272_02
80 OLD WEBSTER RD
1.06 lbs/yr

F_552851_2858184_04
0 LARNED RD
0.15 lbs/yr

F_552208_2853863_06
15 OLD WEBSTER RD
0.8 lbs/yr

F_552208_2853863_05
15 OLD WEBSTER RD
0 lbs/yr



Town Owned Parcels
Urbanized Area
Town Boundary

Oxford Pond Watersheds
Buffumville Lake

Utilities
swGravityDrains
swOpenDrains
swInlets
Detention/Fire

Discharge Points

Cumulative Phosphorus Load Reduction
0.001445 - 2.500000
2.500001 - 8.500000
8.500001 - 40.000000

N
W E
S

Scale: 1"=750'
0 375 750 1,500 Feet

Path: P:\10000-14999\14845 Oxford MS4\Planning\GIS\14845_date20230108_Oxford MS4 Yr 5\14845_date20230110_Oxford MS4 Yr 5.aprx

Cumulative Phosphorus Load Reduction

Page 1 of 12

Oxford, MA
MS4 Year 5
Data Source: MassGIS
Nitsch Project #14845

6/25/2023
Modified 6/5/2024

Nitsch Engineering

RUEL FIELDS

FIRE-EMS HEADQUARTERS

F_556456_2863446_04
181 MAIN ST
0.38 lbs/yr

F_556456_2863446_03
181 MAIN ST
0.91 lbs/yr

F_555750_2863438_07
27 LOCUST ST
1.53 lbs/yr

F_553560_2862781_04
0 FRENCH RIVER CIR
0.02 lbs/yr

F_553560_2862781_03
0 FRENCH RIVER CIR
0.16 lbs/yr

F_558789_2862247_03
26 WESTVIEW DR
0.02 lbs/yr

F_556358_2861578_03
0 MAIN ST
3.67 lbs/yr

F_555399_2861526_12
0 SUNSET AVE
0.46 lbs/yr

F_555399_2861526_11
0 SUNSET AVE
3.42 lbs/yr

F_555058_2861222_09
0 SUNSET AVE
0.07 lbs/yr

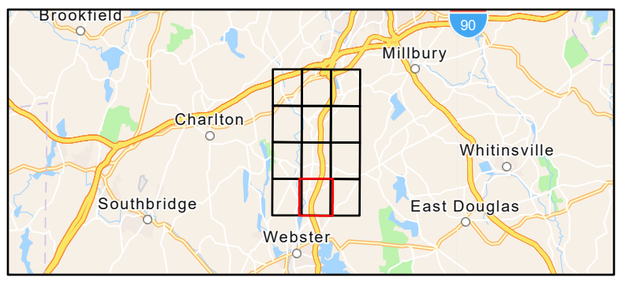
F_558185_2857434_09
0 INDUSTRIAL PARK EAST RD
7.65 lbs/yr

F_558185_2857434_06
0 INDUSTRIAL PARK EAST RD
20.92 lbs/yr

F_557838_2856679_05
53 INDUSTRIAL PARK EAST RD
0.47 lbs/yr

F_555650_2856051_04
37 MAIN ST
0.56 lbs/yr

F_555786_2855189_02
23 MAIN ST
0.06 lbs/yr



Town Owned Parcels
Urbanized Area
Town Boundary

Oxford Pond Watersheds
Lowes Pond

Utilities
swGravityDrains
swOpenDrains
swInlets
Detention/Fire

Discharge Points

Cumulative Phosphorus Load Reduction
0.001445 - 2.500000
2.500001 - 8.500000
8.500001 - 40.000000

N W E S

Scale: 1"=750'
0 375 750 1,500 Feet

Path: P:\10000-14999\14845 Oxford MS4\Planning\GIS\14845_date20230108_Oxford MS4 Yr 5\14845_date20230110_Oxford MS4 Yr 5.aprx

Cumulative Phosphorus Load Reduction

Page 2 of 12

Oxford, MA

MS4 Year 5

Data Source: MassGIS

Nitsch Project #14845

6/25/2023

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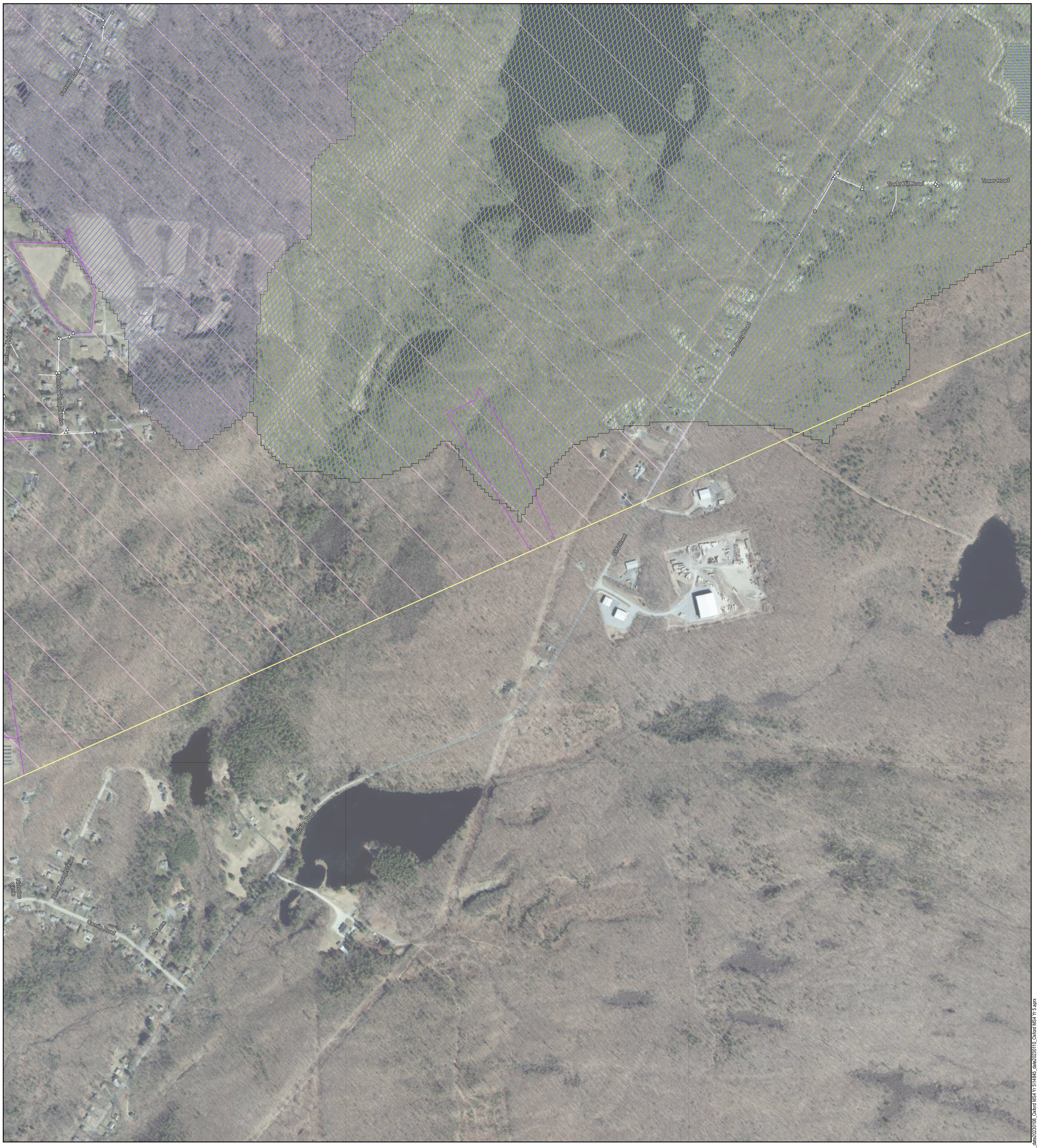
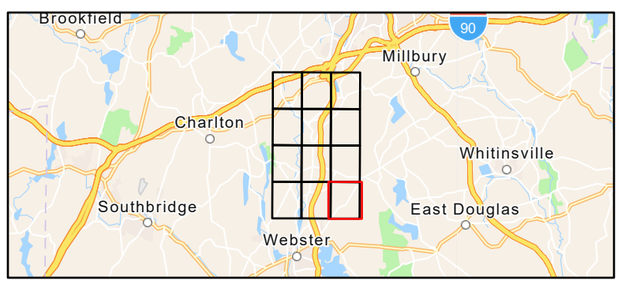
Nitsch Engineering





Town Owned Parcels
Urbanized Area
Town Boundary

Oxford Pond Watersheds
Lowes Pond
Robinson Pond

Utilities
swGravityDrains

swInlets
Discharge Points

Cumulative Phosphorus Load Reduction
0.001445 - 2.500000
2.500001 - 8.500000
8.500001 - 40.000000

N
W E
S

Scale: 1"=750'
0 375 750 1,500 Feet

Path: P:\10000-14999\14845 Oxford MS4\Planning\GIS\14845_date20230108_Oxford MS4 Yr 5\14845_date20230110_Oxford MS4 Yr 5.aprx

Cumulative Phosphorus Load Reduction

Page 3 of 12

Oxford, MA

MS4 Year 5

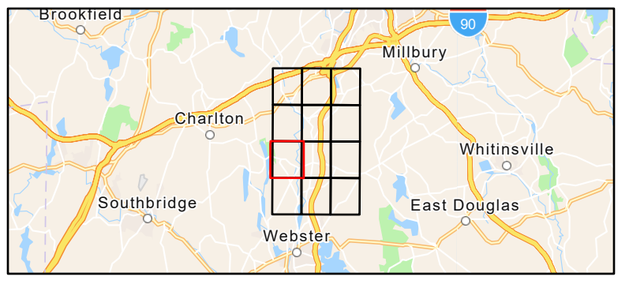
Data Source: MassGIS

Nitsch Project #14845

6/25/2023

Modified 6/5/2024

Nitsch Engineering



Town Owned Parcels
Urbanized Area
Town Boundary

Oxford Pond Watersheds
Buffumville Lake
Lowes Pond
McKinstry Pond

Utilities
swGravityDrains
swOpenDrains
swInlets
Detention

Discharge Points

Cumulative Phosphorus Load Reduction
0.001445 - 2.500000
2.500001 - 8.500000
8.500001 - 40.000000

N
W E
S

Scale: 1"=750'
0 375 750 1,500 Feet

Path: P:\10000-14999\14845 Oxford MS4\Planning\GIS\14845_date20230108_Oxford MS4 Yr 5\14845_date20230110_Oxford MS4 Yr 5.aprx

Cumulative Phosphorus Load Reduction

Page 4 of 12

Oxford, MA

MS4 Year 5

Data Source: MassGIS

Nitsch Project #14845

6/25/2023

Modified 6/5/2024

Nitsch Engineering

DPW HEADQUARTERS

F_557338_2873475_01
450 MAIN ST
0.61 lbs/yr

F_559665_2873361_02
61 DANA RD
8.54 lbs/yr

F_560867_2873230_01
0 DANA DR
0.06 lbs/yr

F_556201_2871585_06
0 FOREST ST
0.03 lbs/yr

F_554781_2871780_20
0 FOREST ST
0.04 lbs/yr

SOUTH CEMETERY

F_553938_2870622_11
0 CHURCH ST
1.47 lbs/yr

JOSLIN PARK

F_557509_2869588_01
352 MAIN ST
0.1 lbs/yr

F_556732_2869373_02
0 CHURCH ST
2.51 lbs/yr

F_559279_2869453_02
10 SIBLEY CIR
0.22 lbs/yr

COMMUNITY CENTER, FIELDS, PLAYGROUND

F_556403_2869246_10
0 MAPLE RD
0.53 lbs/yr

F_556403_2869246_09
0 MAPLE RD
30.68 lbs/yr

F_556403_2869246_11
0 MAPLE RD
0.01 lbs/yr

F_556403_2869246_07
0 MAPLE RD
0.02 lbs/yr

F_557458_2869400_07
350 MAIN ST
0.65 lbs/yr

TOWN HALL PARKING

F_556403_2869246_08
0 MAPLE RD
0.13 lbs/yr

LIBRARY

F_557101_2868431_02
339 MAIN ST
0.59 lbs/yr

F_556696_2868055_01
323 MAIN ST
0.2 lbs/yr

F_557059_2868110_01
325 MAIN ST
0.93 lbs/yr

TOWN HALL

F_556901_2867471_01
3 BARTON ST
0.42 lbs/yr

F_555694_2867399_03
38 CHARLTON ST
0.41 lbs/yr

F_556895_2868222_02
5 SIGOURNEY ST
0.63 lbs/yr

DPW GARAGE

F_555871_2867501_02
34 CHARLTON ST
39.21 lbs/yr

SENIOR CENTER

F_555002_2866202_04
36 QUOBAUG AVE
0.04 lbs/yr

F_555002_2866202_03
36 QUOBAUG AVE
0 lbs/yr

ALFRED E. CHAFFEE SCHOOL

F_555896_2864398_12
9 CLOVER ST
0.04 lbs/yr

F_555896_2864398_07
9 CLOVER ST
0.17 lbs/yr

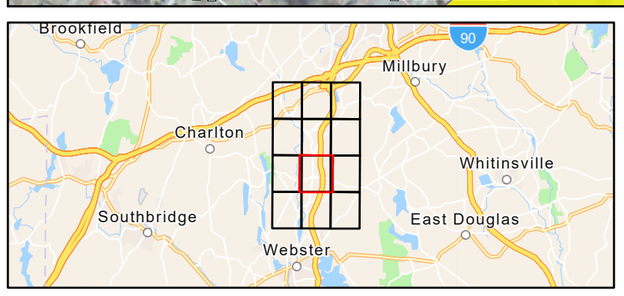
F_555750_2863438_07
27 LOCUST ST
1.53 lbs/yr

F_555896_2864398_10
9 CLOVER ST
0.13 lbs/yr

F_555896_2864398_08
9 CLOVER ST
0.05 lbs/yr

F_555750_2863438_09
27 LOCUST ST
0.22 lbs/yr

F_555896_2864398_09
9 CLOVER ST
7.12 lbs/yr



Town Owned Parcels
Urbanized Area
Town Boundary

Oxford Pond Watersheds
Lowes Pond
McKinstry Pond

Utilities
swGravityDrains
swOpenDrains
swInlets
Detention
Detention/Fire
Discharge Points

Cumulative Phosphorus Load Reduction
0.001445 - 2.500000
2.500001 - 8.500000
8.500001 - 40.000000

N
W
E
S

Scale: 1"=750'
0 375 750 1,500 Feet

Path: P:\10000-14999\14845 Oxford MS4\Planning\GIS\14845_data20230108_Oxford MS4 Yr 5\14845_data20230110_Oxford MS4 Yr 5.aprx

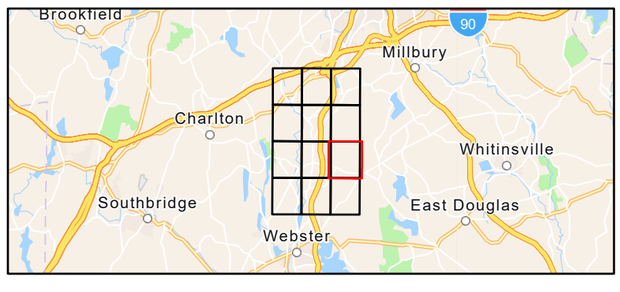
Cumulative Phosphorus Load Reduction

Page 5 of 12

Oxford, MA
MS4 Year 5
Data Source: MassGIS
Nitsch Project #14845

6/25/2023
Modified 6/5/2024

Nitsch Engineering



Town Owned Parcels
Urbanized Area
Town Boundary

Oxford Pond Watersheds
Lowes Pond
Robinson Pond

Utilities
swGravityDrains
swInlets
Detention

Detention/Fire
Discharge Points

Cumulative Phosphorus Load Reduction
0.001445 - 2.500000
2.500001 - 8.500000
8.500001 - 40.000000

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Scale: 1"=750'
0 375 750 1,500 Feet

Path: P:\10000-14999\14845 Oxford MS4\Planning\GIS\14845_date20230108_Oxford MS4 Yr 5\14845_date20230110_Oxford MS4 Yr 5.aprx

Cumulative Phosphorus Load Reduction

Page 6 of 12

Oxford, MA
MS4 Year 5
Data Source: MassGIS
Nitsch Project #14845

6/25/2023
Modified 6/5/2024

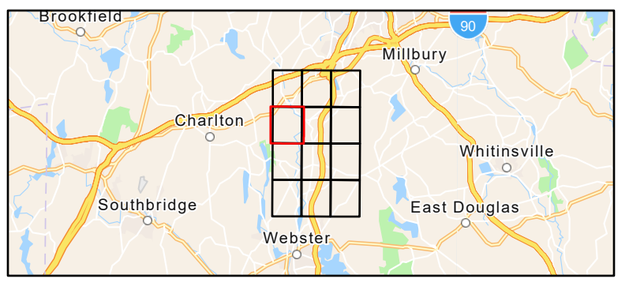
Nitsch Engineering

F_552508_2883166_05
656 MAIN ST
0.03 lbs/yr

F_552508_2883166_04
656 MAIN ST
2.05 lbs/yr

NORTH OXFORD
FIRE STATION, BALL
FIELD, DOG PARK

Oxbow Road
Southbridge Road
Ossoline
Ennis Road
Plymouth Drive
North Water Drive
Clara Barton Road
Wallace Court
Main Street
Manlyre Road
Coughlin Road
Turner Road
Burlum Road
Old Charlton Road
Coulin Road



Town Owned Parcels
Urbanized Area
Town Boundary

Oxford Pond Watersheds
Buffumville Lake

Utilities
swGravityDrains
swOpenDrains
swInlets
Detention

Discharge Points

Cumulative Phosphorus Load Reduction
0.001445 - 2.500000
2.500001 - 8.500000
8.500001 - 40.000000

N
W E
S

Scale: 1"=750'
0 375 750 1,500 Feet

Path: P:\10000-14999\14845 Oxford MS4\Planning\GIS\14845_date20230108_Oxford MS4 Yr 5\14845_date20230110_Oxford MS4 Yr 5.aprx

Cumulative Phosphorus Load Reduction

Page 7 of 12

Oxford, MA
MS4 Year 5
Data Source: MassGIS
Nitsch Project #14845

6/25/2023
Modified 6/5/2024

Nitsch Engineering

CLARA BARTON SCHOOL

NORTH CEMETERY

POLICE DEPT

OXFORD HIGH SCHOOL

OXFORD MIDDLE SCHOOL

TOWN BEACH

F_556065_2880446_08
25 DEPOT RD
3.23 lbs/yr

F_556637_2880397_01
0 OLD WORCESTER RD
0.18 lbs/yr

F_556065_2880446_10
25 DEPOT RD
0.39 lbs/yr

F_556065_2880446_09
25 DEPOT RD
0.12 lbs/yr

F_556065_2880446_11
25 DEPOT RD
2.41 lbs/yr

F_556208_2878888_02
579A MAIN ST
0.01 lbs/yr

F_554880_2876071_03
0 MAIN ST
0.25 lbs/yr

F_554880_2876071_05
0 MAIN ST
0 lbs/yr

F_554880_2876071_04
0 MAIN ST
0.08 lbs/yr

F_554880_2876071_07
0 MAIN ST
0.03 lbs/yr

F_555729_2875887_09
505 MAIN ST
3.62 lbs/yr

F_554692_2875377_11
495 MAIN ST
0.21 lbs/yr

F_554692_2875377_09
495 MAIN ST
1 lbs/yr

F_555740_2876253_02
0 MAIN ST
0.84 lbs/yr

F_555478_2875043_14
100 CARBUNCLE DR
0.16 lbs/yr

F_555478_2875043_10
100 CARBUNCLE DR
0.53 lbs/yr

F_555478_2875043_12
100 CARBUNCLE DR
6.27 lbs/yr

F_555478_2875043_09
100 CARBUNCLE DR
1.14 lbs/yr

F_556526_2876215_03
66 PLANTATION RD
2.24 lbs/yr

F_556452_2875677_02
503 MAIN ST
0.01 lbs/yr

F_556452_2875677_03
503 MAIN ST
0.17 lbs/yr

F_556091_2874903_02
CARBUNCLE DR
0.01 lbs/yr

F_556989_2873986_01
4 EDDY ST
3.37 lbs/yr

F_556989_2873986_02
4 EDDY ST
4.31 lbs/yr

F_558395_2876151_02
0 MILLBURY RD
1.82 lbs/yr

Old Worcester Road
Wallington Road
Ramp-rt395 Sb To Depot Rd
Depot Road
Ramp-rt395 Nb To Depot Rd
Prospect Hill Road
Old Depot Road
Sturbridge Road
Bailey Road
Burbank Street
Harvard Street
Beverly Street
Belmont Street
Plantation Road
Main Street
Ramp-depot Rd To Rt 395 Sb
Interstate 395
Millbury Road
Federal Hill Road
Park Avenue
East Avenue
Evergreen Avenue
Central Avenue
Linden Avenue
Maple Avenue
Main Avenue
Newton Avenue
Carbuncle Drive
Millbury Boulevard
Foster Street
Hammond Street
Vernon Street
Eddy Street
Heritage Road
Rollingwood Drive
Drake Drive
Hillcrest Drive
Hillcrest Circle

Brookfield
Millbury
Charlton
Whitinsville
Southbridge
East Douglas
Webster
90

Town Owned Parcels
Urbanized Area
Town Boundary

Oxford Pond Watersheds
Lowes Pond

Utilities
swGravityDrains
swOpenDrains
swInlets
Detention

Discharge Points

Cumulative Phosphorus Load Reduction
0.001445 - 2.500000
2.500001 - 8.500000
8.500001 - 40.000000

N
W
E
S

Scale: 1"=750'
0 375 750 1,500 Feet

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Cumulative Phosphorus Load Reduction

Page 8 of 12

Oxford, MA
MS4 Year 5
Data Source: MassGIS
Nitsch Project #14845

6/25/2023
Modified 6/5/2024

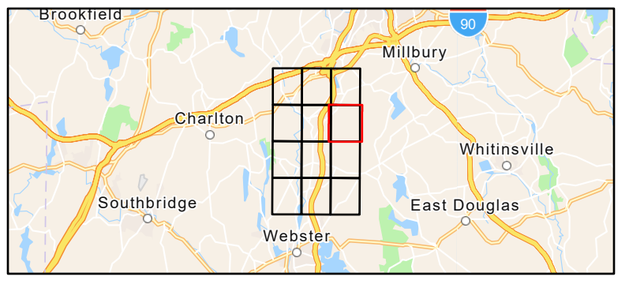
Nitsch Engineering

F_566145_2881669_02
0 FEDERAL HILL RD
4.81 lbs/yr

F_567246_2881296_06
0 FEDERAL HILL RD
6.08 lbs/yr

F_565783_2881200_05
0 FEDERAL HILL RD
4.17 lbs/yr

Interstate 395
South Street
Old Millbury Road
Wedgewood Lane
South Oxford Road
Millbury Road
Federal Hill Road
Pottle Drive
Depot Road
Hudson Road
Hillcrest Drive
Hillcrest Circle
Dana Road
Eight Lots Road



Town Owned Parcels
Urbanized Area
Town Boundary

Oxford Pond Watersheds
Hudson Pond
Lowes Pond

Utilities
swGravityDrains

swInlets
Discharge Points

Cumulative Phosphorus Load Reduction
0.001445 - 2.500000
2.500001 - 8.500000
8.500001 - 40.000000

N
W E
S

Scale: 1"=750'
0 375 750 1,500 Feet

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Cumulative Phosphorus Load Reduction

Page 9 of 12

Oxford, MA
MS4 Year 5
Data Source: MassGIS
Nitsch Project #14845

6/25/2023
Modified 6/5/2024

Nitsch Engineering

F_546353_2893567_02
0 MERRIAM DIST
0 lbs/yr

F_546353_2893567_03
0 MERRIAM DIST
0.04 lbs/yr

F_546353_2893567_04
0 MERRIAM DIST
0.22 lbs/yr

GORE
CEMETERY

F_548642_2887754_02
0 LEICESTER ST
1.03 lbs/yr

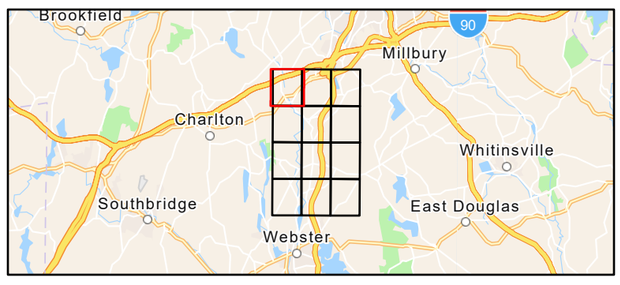
F_549728_2886376_02
0 SOUTHBRIDGE RD
0.2 lbs/yr

F_551517_2884993_02
0 PROSPECT ST
0.08 lbs/yr

F_549675_2883997_03
0 PIONEER DR
0.04 lbs/yr

F_549675_2883997_04
0 PIONEER DR
0.33 lbs/yr

Pedrick Drive
Themell Court
Pleasant Street
Whitinville Road
Marcam Village Road
Pleasant Court
Leatherwood Drive
Merriam District
Old Morgan Road
Stream Drive
Lane Michelle
Michelle Lane
Leicester Street
Sterling Way
Boulder Park Way
Buxton Drive
Comins Road
Spring Street
Bridge Street
Rochdale Street
Hemlock Lane
Massachusetts Turnpike
Ashworth Drive
Tinkerhill Road
Eames Drive
Elliott Street
Albert Street
Southbridge Street
Hill Street
Westcrest Drive
Thayer Pond Drive
Southbridge Road
Dean Hill Road
Main Street
Pinedale Drive
Prospect Street
Turner Road
Savery Crossing
Chestnut Hill Road
Thayer Court
Pine Hill Road
Ennis Road
Gordon Lane
Thayer Street
Norwood Court
Virginia Lane
Maple Avenue



Town Owned Parcels
Urbanized Area
Town Boundary

Oxford Pond Watersheds
Buffumville Lake

Texas Pond

Utilities
swGravityDrains
swOpenDrains
swInlets

Detention
Discharge Points

Cumulative Phosphorus Load Reduction
0.001445 - 2.500000
2.500001 - 8.500000
8.500001 - 40.000000

N
W E
S

Scale: 1"=750'
0 375 750 1,500 Feet

Path: P:\10000-14999\14845 Oxford MS4\Planning\GIS\14845_date20230108_Oxford MS4 Yr 5\14845_date20230110_Oxford MS4 Yr 5.aprx

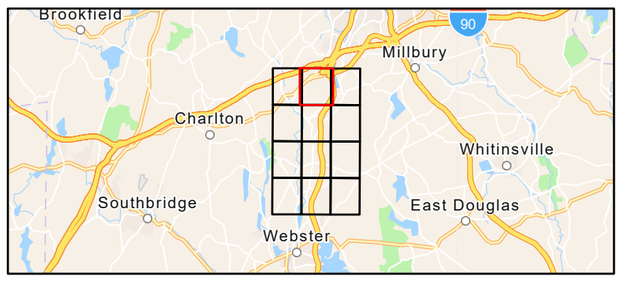
Cumulative Phosphorus Load Reduction

Page 10 of 12

Oxford, MA
MS4 Year 5
Data Source: MassGIS
Nitsch Project #14845

6/25/2023
Modified 6/5/2024

Nitsch Engineering



Town Owned Parcels
Urbanized Area
Town Boundary

Utilities
swGravityDrains
swOpenDrains
swInlets

Discharge Points

Cumulative Phosphorus Load Reduction
0.001445 - 2.500000
2.500001 - 8.500000
8.500001 - 40.000000

N
W E
S

Scale: 1"=750'
0 375 750 1,500 Feet

Path: P:\10000-14999\14845 Oxford MS4\Planning\GIS\14845_date\20230108_Oxford MS4 Yr 5\14845_date\20230110_Oxford MS4 Yr 5.aprx

Cumulative Phosphorus Load Reduction

Page 11 of 12

Oxford, MA

MS4 Year 5

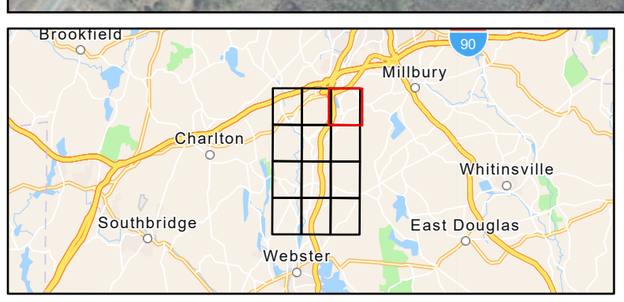
Data Source: MassGIS

Nitsch Project #14845

6/25/2023

Modified 6/5/2024

Nitsch Engineering



Urbanized Area
Town Boundary

Utilities
swGravityDrains

swInlets
Discharge Points

Cumulative Phosphorus Load Reduction
0.001445 - 2.500000
2.500001 - 8.500000
8.500001 - 40.000000

N
W E
S

Scale: 1"=750'
0 375 750 1,500 Feet

Path: P:\10000-14999\14845 Oxford MS4\Planning\GIS\14845_date20230108_Oxford MS4 Yr 5\14845_date20230110_Oxford MS4 Yr 5.aprx

Cumulative Phosphorus Load Reduction

Page 12 of 12

Oxford, MA

MS4 Year 5

Data Source: MassGIS

Nitsch Project #14845

6/25/2023

Nitsch Engineering

Appendix J – Roadway BMP Calculations

						Treat Town-Owned Roads Only							
Watershed	Town Roads (LF) in StreamStats Watershed	Town Roads (ac)* in StreamStats Watershed	Primary Land Cover Adjacent to Roadways	Existing Phosphorus Load (lb/yr)** in StreamStats Watershed	Enter LF of Road to be Treated (in LPCP areas)	Miles of Road to be Treated (in LPCP areas)	Acres of Road to be Treated (Assumed 30' width)	Total Phosphorus Load for Roads to be Treated (lb/year)**	% of Roads in StreamStats watershed to be Treated	Potential Phosphorus Removal (Low) (lb/yr)	Potential Phosphorus Removal (High) (lb/yr)	WQV to be treated (1 inch x Area)	Rain Garden Cost (2023 $)
Buffumville Lake - Year 10	27050	18.6	Residential (rural)	36.33	1150	0.22	0.79	1.54	4.25%	0.82	1.39	2,875.00	56,594.38
Buffumville Lake - Year 13	27050	18.6	Residential (rural)	36.33	2950	0.56	2.03	3.96	10.91%	2.10	3.57	7,375.00	145,176.88
Buffumville Lake - Year 15	27050	18.6	Residential (rural)	36.33	4750	0.90	3.27	6.38	17.56%	3.38	5.74	11,875.00	233,759.38
Lowes Pond - Year 10	149810	103.2	Residential (rural)	201.19	3920	0.74	2.70	5.26	2.62%	2.79	4.74	9,800.00	192,913.00
Lowes Pond - Year 13	149810	103.2	Residential (rural)	201.19	27880	5.28	19.20	37.44	18.61%	19.84	33.70	69,700.00	1,372,044.50
Lowes Pond - Year 15	149810	103.2	Residential (rural)	201.19	51810	9.81	35.68	69.58	34.58%	36.88	62.62	129,525.00	2,549,699.63
McKinstry Pond - Year 8	14980	10.3	Residential (rural)	20.12	930	0.18	0.64	1.25	6.21%	0.66	1.12	2,325.00	45,767.63
McKinstry Pond - Year 10	14980	10.3	Residential (rural)	20.12	2400	0.45	1.65	3.22	16.02%	1.71	2.90	6,000.00	118,110.00
McKinstry Pond - Year 13	14980	10.3	Residential (rural)	20.12	4610	0.87	3.17	6.19	30.77%	3.28	5.57	11,525.00	226,869.63
McKinstry Pond - Year 15	14980	10.3	Residential (rural)	20.12	6810	1.29	4.69	9.15	45.46%	4.85	8.23	17,025.00	335,137.13
Robinson Pond - Year 10	12300	8.5	Residential (rural)	16.52	110	0.02	0.08	0.15	0.89%	0.08	0.13	275.00	5,413.38
Robinson Pond - Year 13	12300	8.5	Residential (rural)	16.52	310	0.06	0.21	0.42	2.52%	0.22	0.37	775.00	15,255.88
Robinson Pond - Year 15	12300	8.5	Residential (rural)	16.52	500	0.09	0.34	0.67	4.07%	0.36	0.60	1,250.00	24,606.25
Texas Pond - Year 10	57170	39.4	Residential (rural)	76.78	1490	0.28	1.03	2.00	2.61%	1.06	1.80	3,725.00	73,326.63
Texas Pond - Year 13	57170	39.4	Residential (rural)	76.78	4530	0.86	3.12	6.08	7.92%	3.22	5.48	11,325.00	222,932.63
Texas Pond - Year 15	57170	39.4	Residential (rural)	76.78	7560	1.43	5.21	10.15	13.22%	5.38	9.14	18,900.00	372,046.50
Hudson Pond	8720	6.0	Residential (rural)	11.71	0	-	-	0.00	0.00%	0.00	0.00	-	-

**Estimated using PLER of 1.95 for Right of Way Impervious; see land cover/land use classes table below

Town Road Width 30 *Assumes average roadway width is 30 feet, accounting for 12-ft lanes and 3-ft shoulders

MassDOT Road Width 40

Inflation from 2016 to 2023 is 27%

Low Phosphorus based on Rain Garden (filtration), treating 1 inch runoff (53% P, 32% N reductions)

High Phosphorus based on Infiltration Trench, Type C soils, treating 1 inch runoff (90% P, 98%N reductions)

Table 3-1: Average annual distinct phosphorus (P) load export rates for use in estimating P load reduction credits in the MA MS4 Permit

Phosphorus Source Category by Land Use	Land Surface Cover	P Load Export Rate, lbs./acre/year	P Load Export Rate, kg/ha/yr.
Commercial (COM) and Industrial (IND)	Directly connected impervious	1.78	2.0
	Pervious	See* DevPERV	See* DevPERV
Multi-Family (MFR) and High-Density Residential (HDR)	Directly connected impervious	2.32	2.6
	Pervious	See* DevPERV	See* DevPERV
Medium -Density Residential (MDR)	Directly connected impervious	1.96	2.2
	Pervious	See* DevPERV	See* DevPERV
Low Density Residential (LDR) - "Rural"	Directly connected impervious	1.52	1.7
	Pervious	See* DevPERV	See* DevPERV
Highway (HWY)	Directly connected impervious	1.34	1.5
	Pervious	See* DevPERV	See* DevPERV
Forest (FOR)	Directly connected impervious	1.52	1.7
	Pervious	0.13	0.13
Open Land (OPEN)	Directly connected impervious	1.52	1.7
	Pervious	See* DevPERV	See* DevPERV
Agriculture (AG)	Directly connected impervious	1.52	1.7
	Pervious	0.45	0.5

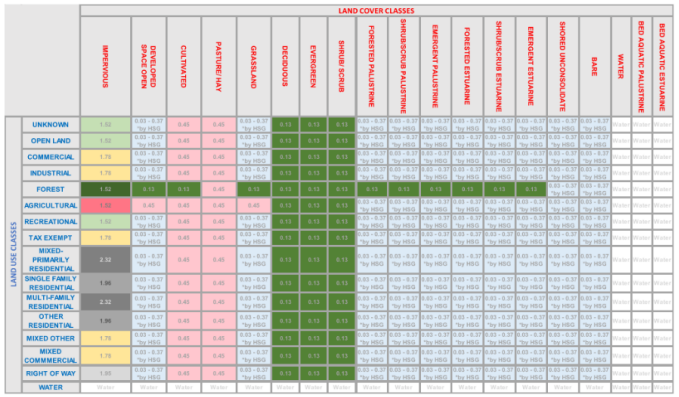


Figure 1. Crosswalk of 2016 Land Use and Land Cover categories and PLERs in lbs/acre/year from MassDEP & EPA Region 1 (Note: Hydrologic Soil Group (HSG) A and A/D have a PLER of 0.03, HSG B and B/D have a PLER of 0.12, HSG C and C/D and Unknown have a PLER of 0.21, and HSG D has a PLER of 0.37)

MA MS4 General Permit

use for BMP type 2 - non-infiltrative

Table 3-18: Bio-filtration BMP Performance Table

Bio-filtration BMP Performance Table: Long-Term Phosphorus & Nitrogen Load Reduction								
BMP Capacity: Depth of Runoff from Impervious Area (inches)	0.1	0.2	0.4	0.6	0.8	1.0	1.5	2.0
Cumulative Phosphorus Load Reduction	14%	25%	37%	44%	48%	53%	58%	63%
Cumulative Nitrogen Load Reduction	9%	16%	23%	28%	31%	32%	37%	40%

Figure 3- 13: BMP Performance Curve: Bio-filtration

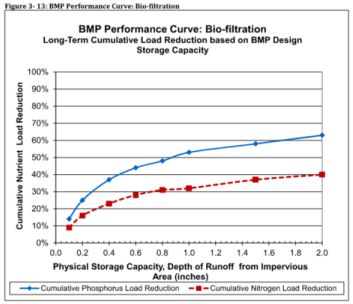
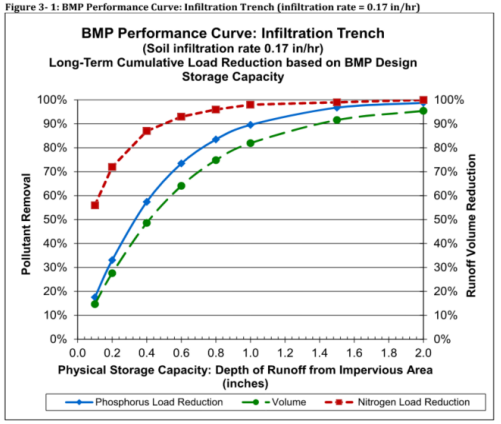


Table 3- 6: Infiltration Trench (IR = 0.17 in/hr) BMP Performance Table

Infiltration Trench (IR = 0.17 in/hr) BMP Performance Table: Long-Term Phosphorus & Nitrogen Load Reduction								
BMP Capacity: Depth of Runoff from Impervious Area (inches)	0.1	0.2	0.4	0.6	0.8	1.0	1.5	2.0
Runoff Volume Reduction	15%	28%	49%	64%	75%	82%	92%	95%
Cumulative Phosphorus Load Reduction	18%	33%	57%	73%	83%	90%	97%	99%
Cumulative Nitrogen Load Reduction	56%	72%	87%	93%	96%	98%	99%	100%

Figure 3- 1: BMP Performance Curve: Infiltration Trench (infiltration rate = 0.17 in/hr)



Appendix K – O&M Program Updates

MUNICIPAL STORMWATER RETROFIT OPERATIONS AND MAINTENANCE PROGRAM FOR TOWN OF OXFORD, MASSACHUSETTS

June 2023

Prepared by:

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Nitsch Project #14845

TABLE OF CONTENTS

1.0 Introduction 3
1.1 Massachusetts 2016 Small MS4 Permit Program 3
2.0 Stormwater Retrofit Operations and Maintenance 4
2.1 Deep Sump and Hooded Catch Basins 4
2.2 Porous Pavement 4
2.3 Area Drains 5
2.4 Water Quality Units (Proprietary Separators) 5
2.5 Tree Box Filters 6
2.6 Oil/Water Separators 6
2.7 Dry Wells 6
2.8 Vegetated Swales 7
2.9 Gravel Wetlands 7
2.10 Subsurface Detention/Infiltration Structures 9
2.11 Infiltration Basins 9
2.12 Detention Basin 10
2.13 Bioretention Areas 10
2.14 Stormwater Outfalls 11
2.15 Level Spreaders 11

1.0 Introduction

1.1 Massachusetts 2016 Small MS4 Permit Program

The Town of Oxford has formalized its Operations and Maintenance (O&M) activities into this written O&M Program as required in the United States Environmental Protection Agency's (EPA) 2016 National Pollutant Discharge Elimination System (NPDES) General Permit for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems (MS4) in Massachusetts, hereafter referred to as the "2016 Small MS4 Permit" or "the Permit."

In compliance with the provisions of the Clean Water Act (CWA) and the Massachusetts Clean Waters Act, as amended (M.G.L. Chap.21 §§ 26-53), the 2016 Small MS4 Permit was signed by EPA and the Massachusetts Department of Environmental Protection (MassDEP) on April 4, 2016, and became effective on July 1, 2018. The 2016 Small MS4 Permit replaces the 2003 Small MS4 Permit to regulate activities related to stormwater discharges and requires significantly more detail than the previous permit.

In compliance with Section 2.3.7 of the Permit, the Town of Oxford developed written O&M procedures to formalize the maintenance activities that are being undertaken to address stormwater infrastructure O&M requirements of the 2016 Massachusetts MS4 Permit. Refer to the Town of Oxford Municipal Stormwater Infrastructure Operation and Maintenance Plan for the procedures relative to each of the referenced maintenance activities:

https://www.oxfordma.us/sites/g/files/vyhlif4836/f/uploads/municipal_stormwater_infrastructure_om_plan.pdf

This document is intended to expand upon the Town of Oxford Municipal Stormwater Infrastructure Operation and Maintenance Plan to include potential future stormwater best management practices. As required in Appendix F of the Permit, this Plan provides an Operation and Maintenance Program for all structural BMPs being claimed for phosphorus reduction credit. This includes BMPs implemented to date as well as BMPs to be implemented. This Operation and Maintenance Program shall become part of the LPCP and will continue to be updated as BMPs are implemented to include: (1) inspection and maintenance schedule for each installed BMP according to BMP design or manufacturer specification and (2) program or department responsible for BMP maintenance.

2.0 Stormwater Retrofit Operations and Maintenance

Inspect and maintain the stormwater retrofits as directed below. Repairs to any component of the system shall be made as soon as possible to prevent any potential pollutants (including silt) from entering adjacent wetland resource areas or downstream closed drainage systems.

2.1 Deep Sump and Hooded Catch Basins

Inspect or clean catch basins four times per year and at the end of foliage and snow-removal seasons. Other inspection and maintenance requirements include:

1. Remove organic material, sediment and hydrocarbons four 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 basin.
2. Always clean out catch basins after street sweeping. If any evidence of hydrocarbons is found during inspection, immediately remove the material using absorbent pads or other suitable measures and dispose of legally. Remove other accumulated debris as necessary.
3. If handling runoff from land uses with higher potential pollutant loads or discharging runoff near or to a critical area, more frequent cleaning may be necessary.
4. Transport and disposal of accumulated sediment off-site shall be in accordance with applicable local, state and federal guidelines and regulations.

2.2 Porous Pavement

Frequent cleaning and maintenance of the porous pavement surface is critical to prevent clogging. Frequent vacuum sweeping along with jet washing of porous pavement is required. No winter sanding shall be conducted on the porous surface. For proper maintenance:

1. Post signs identifying porous pavement areas.
2. Minimize salt use during winter months.
3. No winter sanding is allowed.
4. Keep landscaped areas well maintained to prevent soil from being transported onto the pavement.
5. Regularly monitor the porous pavement surface to make sure that it drains properly after storm events. Inspect surface annually for deterioration or spalling.
6. At a minimum, the porous pavement shall be cleaned after the winter season and every three months thereafter. This requirement may be adjusted as needed, based on regular visual inspections of the porous pavement surface.

7. For porous asphalts and concretes, clean the surface using power washer to dislodge trapped particles and then vacuum sweep the area.
8. For paving stones, add joint material to replace material that has been transported. Reseed grass pavers to fill in bare spots.
9. Never reseal or repave with impermeable materials.
10. Once per year, the infiltrative capacity of the porous pavement should be tested by running a hose over each porous pavement area for 30 minutes.
11. Sections of damaged porous asphalt (rutting, etc.) can be repaired by heating and rerolling the asphalt.
12. When infiltrative capacity of porous pavement is reduced to less than the design rate, the porous pavement shall be replaced by milling to the choker course.
13. Attach rollers to the bottoms of snowplows to prevent them from catching on the edges of grass pavers and some paving stones.

2.3 Area Drains

Inspect area drains at least once per month and remove debris from the grate. Clean out accumulated sediments at least once per year and more frequently as necessary.

2.4 Water Quality Units (Proprietary Separators)

Maintain water quality units according the recommendations set forth by the manufacturer. General inspection and maintenance procedures for proprietary devices are provided below:

1. Inspect units following completion of construction, prior to being put into service.
2. Inspect units at least twice per year following installation and no less than once per year thereafter.
3. Inspect units immediately after any oil, fuel or chemical spill.
4. All inspections shall include checking the oil level and sediment depth in the unit. Removal of sediments/oils shall occur per manufacturer recommendations.
5. A licensed waste management company shall remove captured petroleum waste products from any oil, chemical or fuel spills and dispose.
6. OSHA confined space entry protocols shall be followed if entry into the unit is required.

2.5 Tree Box Filters

Tree box filters shall be inspected twice per year during the first year after construction. In subsequent years, the swales shall be inspected annually and after rain events greater than 3 inches in 24 hours. Inspection and maintenance procedures for tree box filters are provided below:

1. During and after storm events, the length of time standing water remains in the tree box filters shall be recorded:
    - If the time is greater than 72 hours, thoroughly inspect the basin for signs of clogging.
    - A corrective action plan shall be developed by a qualified professional to restore infiltrative function. Immediate action shall be taken to implement these corrective measures.
2. Inspect and remove trash from surface of filter.
3. Inspect surface of filter for erosion and repair as necessary. Remulch void areas. Rake media surface twice per year to maintain permeability.
4. Remove and replace all dead and diseased trees that cannot be treated. When a tree is replaced, the media should also be replaced.

2.6 Oil/Water Separators

At a minimum, inspect oil/water separators monthly, and clean them out at least twice per year. In the event of a hazardous waste spill, the oil/water separator should be cleaned immediately. Cleaning involves the removal of accumulated oil and grease and sediment using a vacuum truck. Polluted water or sediments removed from the oil/water separators shall be disposed of in accordance with all applicable local, state, and federal laws and regulations, including M.G.L.c. 21C and 310 CMR 30.00.

2.7 Dry Wells

The dry wells shall be inspected twice per year and after rain events greater than 3 inches in 24 hours. The inlets and outlets shall be inspected, and all debris that may clog the structure shall be removed.

2.8 Vegetated Swales

Vegetated swales shall be inspected twice per year during the first year after construction. In subsequent years, the swales shall be inspected annually and after rain events greater than 3 inches in 24 hours. Inspection and maintenance procedures for drainage channels are provided below:

1. Inspect the riprap on the channel bottom and side slopes for signs of erosion and formation of rills and gullies. Replace riprap as necessary.
2. Inspect channels the first few months after construction and twice per year thereafter to make sure vegetation is adequate and for signs of rilling and gullying. Repair any rills or gullies. Replace dead vegetation.
3. Remove accumulated trash and debris annually.
4. Remove sediment as needed at least once per year. Use hand methods (i.e. a person with a shovel) when cleaning to minimize disturbance to vegetation and underlying soils.
5. Mow as necessary. Grass height shall be between 3 and 6 inches.
6. Reseed as necessary.
7. Check Dams: Inspect check dams after every significant rainfall event. Repair damage as needed. Remove sediment as needed.

2.9 Gravel Wetlands

Maintenance is critical for the proper operation of subsurface gravel wetland systems. There are two separate inspection schedules for the gravel wetlands: (1) First Year Post-Construction, and (2) Post-Construction Routine Monitoring. First Year Post-Construction monitoring differs primarily by its increased frequency to assure proper vegetative establishment and system functioning.

First Year Post-Construction

1. Inspect the gravels wetlands after every major storm (>2.5 inches in 24 hours) in the first year following construction.
2. Monitor the gravel wetland to observe that the system drains within 24-72 hrs (within the design period, but also not so quickly as to minimize stormwater treatment).
3. Water plants as necessary during the first growing season.
4. Re-vegetate poorly established areas as necessary.
5. Treat diseased vegetation as necessary.
6. Inspect soil and repair eroded areas, especially on slopes.
7. Inspect inlets, outlets, and overflow spillway for blockage, structural integrity, and evidence of erosion.

Post-Construction Routine Monitoring

1. Inspection frequency should be at least every 6 months after the first year post-construction. Inspection frequency can be reduced to annual following 2 years of monitoring that indicates the rate of sediment accumulation is less than the cleaning criteria listed below.
2. Inspect the filter surface for dense, complete, root mat establishment across the wetland surface. Thorough revegetation with grasses, forbs, and shrubs is necessary.
3. Inspect the gravel wetland surface for standing water or other evidence of riser clogging, such as discolored or accumulated sediments.
4. Inspect the sediment forebay for sediment accumulation, trash, and debris.
5. Monitor the sediment forebay to observe if it drains within 24 to 72 hrs.
6. Inspect inlets, outlets, and overflow spillway for blockage, structural integrity, and evidence of erosion.
7. Remove decaying vegetation, litter, and debris.

Cleaning Criteria for Sediment Forebay

1. Remove sediment from the forebay when it accumulates to a depth of more than 12 inches (30 cm). Materials can be removed with heavy construction equipment; however this equipment should sediments should be dewatered (if necessary) and disposed of in an acceptable manner.
2. Remove vegetation from the forebay if persistent standing water and wetland vegetation becomes dominant.
3. The forebay and treatment cell outlet devices should be cleaned when drawdown times exceed 60 to 72 hours.

Cleaning Criteria for Gravel Wetland Treatment Cells

1. Sediment should be removed from the gravel wetland surface when it accumulates to a depth of several inches (>10 cm) across the wetland surface.
2. Materials should be removed with rakes rather than heavy construction equipment to avoid compaction of the gravel wetland surface.
3. Heavy equipment could be used if the system is designed with dimensions that allow equipment to be located outside the gravel wetland, while a backhoe shovel reaches inside the gravel wetland to remove sediment. Removed sediments should be dewatered (if necessary) and disposed of in an acceptable manner.

Draining and Flushing Gravel Wetland Treatment Cells

1. For maintenance it may be necessary to drain or flush the treatment cells. The optional drains will permit simpler maintenance of the system if needed.
2. The drains need to be closed during standard operation. Flushing of the risers and horizontal subdrains is most effective with the entire system drained. Flushed water and sediment should be collected and properly disposed.

2.10 Subsurface Detention/Infiltration Structures

1. Inspect subsurface detention/infiltration structures twice per year. Inspect the inlets and observation ports to determine if there is accumulated sediment within the system. Remove all debris and accumulated sediment that may clog the system.

2.11 Infiltration Basins

The infiltration basins shall be inspected and maintained after major storm events (rainfall totals greater than 2.5 inches in 24 hours) during the first three months of operation and twice a year and when there are discharges through the outlet control structure thereafter. Additionally, all pretreatment BMPs shall be inspected in accordance with the minimal requirements specified for those practices and after all major storm events. Inspections shall include the following measures:

1. During and after major storm events, the length of time standing water remains in the basin shall be recorded.
    - If the time is greater than 72 hours, thoroughly inspect the basin for signs of clogging.
    - A corrective action plan shall be developed by a qualified professional to restore infiltrative function. The Site Owner shall take immediate action to implement these corrective measures.
2. Examine the outlet structure for evidence of clogging or outflow release velocities that are greater than the design velocity.
3. Identify areas of sediment accumulation, differential settlement, cracking, and erosion within the basin.
4. Inspect embankments for leakage and tree growth.
5. Examine the health of the vegetation within the basin and on the embankments.
6. Examine condition of riprap.

Corrective measures shall be taken immediately as warranted by the inspections. If any evidence of hydrocarbons is found during inspection, the material shall be immediately removed using absorbent pads or other suitable measures and legally disposed.

Preventative maintenance shall be done at least twice per year and shall include the following activities:

1. Mow the buffer area and basin bottom and side slopes, if vegetated.
2. Rake, if stone bottom.
3. Remove trash, debris, and accumulated sediment that may clog the system.
4. Remove grass clippings and accumulated organic matter.
5. Use deep tilling to break up clogged surfaces and revegetate immediately.

2.12 Detention Basin

Inspect the detention basin at least once per year to ensure that the basin is operating as intended. Inspect the detention basin during and after major storms to determine if the basin is meeting the expected detention times.

1. Examine the outlet structure for evidence of clogging or outflow release velocities that are greater than design flow.
    - Potential problems that should be checked include: subsidence, erosion, cracking or tree growth on the embankment; damage to the emergency spillway; sediment accumulation around the outlet; inadequacy of the inlet/outlet channel erosion control measures; changes in the condition of the pilot channel; and erosion within the basin and banks. Make any necessary repairs immediately.
2. During inspections, note any changes to the extended dry detention basin or the contributing watershed, because these could affect basin performance.
3. Inspect basins to ensure they are operating as designed at least once per year
4. Mow the upper-stage, side slopes, embankment, and emergency spillway at least twice per year. Also remove trash and debris at this time.
5. Check the sediment forebay for accumulated sediment, trash and debris and remove it at least twice per year.
6. Remove sediment from the extended dry detention basin as necessary, but at least once every 5 years. Providing an on-site sediment disposal area will reduce the overall sediment removal costs.

2.13 Bioretention Areas

Perform annual maintenance of all components of the bioretention area, including plants, soil, and mulch. Table 1, below, outlines recommended maintenance activities.

Table 1. Bioretention area maintenance recommendations

Location	Description	Frequency	Time of Year
Surface	Inspect and remove trash	Monthly	Year round
Soil	Inspect and repair erosion	Monthly	Year round
Organic Layer	Remulch void areas	Annually	Spring
	Remove previous mulch layer before applying new layer (optional)	Annually	Spring
Plants	Water vegetation at end of day for 14 consecutive days after planting	Immediately after planting	As needed
	Fertilize	Annually	Spring
	Mow grass	2 to 12 times per year	As needed
	Remove and replace all dead and diseased vegetation that cannot be treated	Annually	Spring
	Treat all diseased trees and shrubs	As needed	Variable

During and after storm events, record the length of time standing water remains in the bioretention areas. If the time is greater than 72 hours, thoroughly inspect the basins for signs of clogging and develop a corrective action plan. The corrective action plan, prepared by a qualified professional, will outline procedures to restore infiltrative function. The owner of the site shall take immediate action to implement these corrective measures. Inspect pretreatment devices and bioretention cells regularly for sediment build-up, structural damage, and standing water. Never store snow in bioretention areas.

2.14 Stormwater Outfalls

Inspect flared end sections and associated riprap spillways at least once per year and after major storm events (rainfall totals greater than 2.5 inches in 24 hours) to ensure that the stability of the outlet area is maintained. Keep the outfall area clear of debris such as trash, branches, and sediment. Make repairs immediately if riprap displacement or downstream channel scour is observed.

2.15 Level Spreaders

Inspect level spreaders regularly, especially after major storm events (rainfall totals greater than 2.5 inches in 24 hours). Repair any erosion or low spots in the level spreader.

Appendix L – LPCP Implementation Schedule

LPCP Implementation Schedule - BUFFUMVILLE LAKE											
Milestone	Phosphorus Reduction Goal (lb/yr)	Structural BMP Credits for town-owned properties (lb/yr)	Non-Structural BMP Credits (lb/yr)	Structural BMPs adjacent to Roadways Credits (lb/yr)	Total BMP Credits (lb/year)	Percent of Milestone Goal	LF of Road Needing Treatment	Acres of Road Needing Treatment	Total "Right of Way" Impervious Acres in Watershed		
Year 8 (2026)	0.85	0	0.88	0.00	**0.88**	104%	n/a				
Year 10 (2028)	1.70	0	0.88	0.82	**1.70**	100%	1,150				
Year 13 (2031)	2.98	0	0.88	2.10	**2.98**	100%	2,950				
Year 15 (2033)	4.26	0	0.88	3.38	**4.26**	100%	4,750	3.27	3.13	good	

LPCP Implementation Schedule - LOWES POND											
Milestone	Phosphorus Reduction Goal (lb/yr)	Structural BMP Credits for town-owned properties (lb/yr)*	Non-Structural BMP Credits (lb/yr)	Structural BMPs adjacent to Roadways Credits (lb/yr)	Total BMP Credits (lb/year)	Percent of Milestone Goal	LF of Road Needing Treatment	Acres of Road Needing Treatment	Total "Right of Way" Impervious Acres in Watershed (L, McK, & R)		
Year 8 (2026)	11.36	5.48	6.89	0.00	**12.37**	109%	n/a				
Year 10 (2028)	22.72	13.04	6.89	2.79	**22.72**	100%	3,920				
Year 13 (2031)	39.77	13.04	6.89	19.84	**39.77**	100%	27,880	19.20	24.98	good	130%
Year 15 (2033)	56.81	13.04	6.89	36.88	**56.81**	100%	51,810	35.68	24.98	fair	70%

*total of 12 potential BMP locations with estimated total potential removal of 10.46; note that OF-134 was considered "maxed out" at 8.68 lb/yr; see BMP prioritization; Year 8 Structural BMP Credits includes installed Sigourney/Fremont Project (1.45 lb/yr), Lowes Pond Dam Repair Project (0.12 lb/yr), & 2 Church Street Drywells (1.01 lb/yr)

LPCP Implementation Schedule - MCKINSTRY POND											
Milestone	Phosphorus Reduction Goal (lb/yr)	Structural BMP Credits for town-owned properties (lb/yr)	Non-Structural BMP Credits (lb/yr)	Structural BMPs adjacent to Roadways Credits (lb/yr)	Total BMP Credits (lb/year)	Percent of Milestone Goal	LF of Road Needing Treatment	Acres of Road Needing Treatment	Total "Right of Way" Impervious Acres in Watershed		
Year 8 (2026)	1.05	0	0.39	0.66	**1.05**	100%	930	0.64	1.45	good	227%
Year 10 (2028)	2.10	0	0.39	1.71	**2.10**	100%	2,400	1.65	1.45	good	88%
Year 13 (2031)	3.67	0	0.39	3.28	**3.67**	100%	4,610	3.17	1.45	fair	46%
Year 15 (2033)	5.24	0	0.39	4.85	**5.24**	100%	6,810	4.69	1.45	poor	31%

LPCP Implementation Schedule - ROBINSON POND											
Milestone	Phosphorus Reduction Goal (lb/yr)	Structural BMP Credits for town-owned properties (lb/yr)	Non-Structural BMP Credits (lb/yr)	Structural BMPs adjacent to Roadways Credits (lb/yr)	Total BMP Credits (lb/year)	Percent of Milestone Goal	LF of Road Needing Treatment	Acres of Road Needing Treatment	Total "Right of Way" Impervious Acres in Watershed		
Year 8 (2026)	0.09	0	0.11	0.00	**0.11**	122%	n/a				
Year 10 (2028)	0.19	0	0.11	0.08	**0.19**	100%	110				
Year 13 (2031)	0.33	0	0.11	0.22	**0.33**	100%	310				
Year 15 (2033)	0.47	0	0.11	0.36	**0.47**	100%	500	0.34	0.29	good	83%

LPCP Implementation Schedule - TEXAS POND											
Milestone	Phosphorus Reduction Goal (lb/yr)	Structural BMP Credits for town-owned properties (lb/yr)	Non-Structural BMP Credits (lb/yr)	Structural BMPs adjacent to Roadways Credits (lb/yr)	Total BMP Credits (lb/year)	Percent of Milestone Goal	LF of Road Needing Treatment	Acres of Road Needing Treatment	Total "Right of Way" Impervious Acres in Watershed		
Year 8 (2026)	1.44	0	1.83	0.00	**1.83**	127%	n/a				
Year 10 (2028)	2.89	0	1.83	1.06	**2.89**	100%	1,490				
Year 13 (2031)	5.05	0	1.83	3.22	**5.05**	100%	4,530				
Year 15 (2033)	7.21	0	1.83	5.38	**7.21**	100%	7,560	5.21	7.47	good	144%

Options not considered in these calculations include: installation/certification of privately-owned/maintained BMPs, increasing non-structural BMP credits by street sweeping more frequently or using more effective equipment

A few potential structural BMP sites on town-owned properties were re-prioritized from "high" or "medium" to "low" based on proximity to re-defined outfall catchment areas and potential load reduction; Refer to Section 8.3 of this report and Appendix I for additional information.

Appendix M – Installed Projects

Oxford Pilot Project Summary – Sigourney/Fremont Street and Town Hall Complex

Sigourney Street and Fremont Street are located within the Town Center of Oxford, Massachusetts. Sigourney Street connects Fremont Street to Main Street and provides vehicular access to the Oxford Free Public Library and the Oxford Town Hall complex.

Nitsch Engineering worked with the Town of Oxford to update their MassDOT Tier 2 Complete Streets Prioritization Plan. This included working closely with the Town's Department of Public Works to develop goals for analyzing and improving the Town's existing Complete Street network. Nitsch reviewed existing planning studies, master plans, and projects to determine a list of potential projects, as well as a gap analysis of the Town's pedestrian network to identify potential projects.

After developing a preliminary project list, Nitsch conducted a binary ranking of all the potential projects. Each project was ranked on 10 factors that varied from distances from schools, network gaps, safety, cost, permitting, and public support.

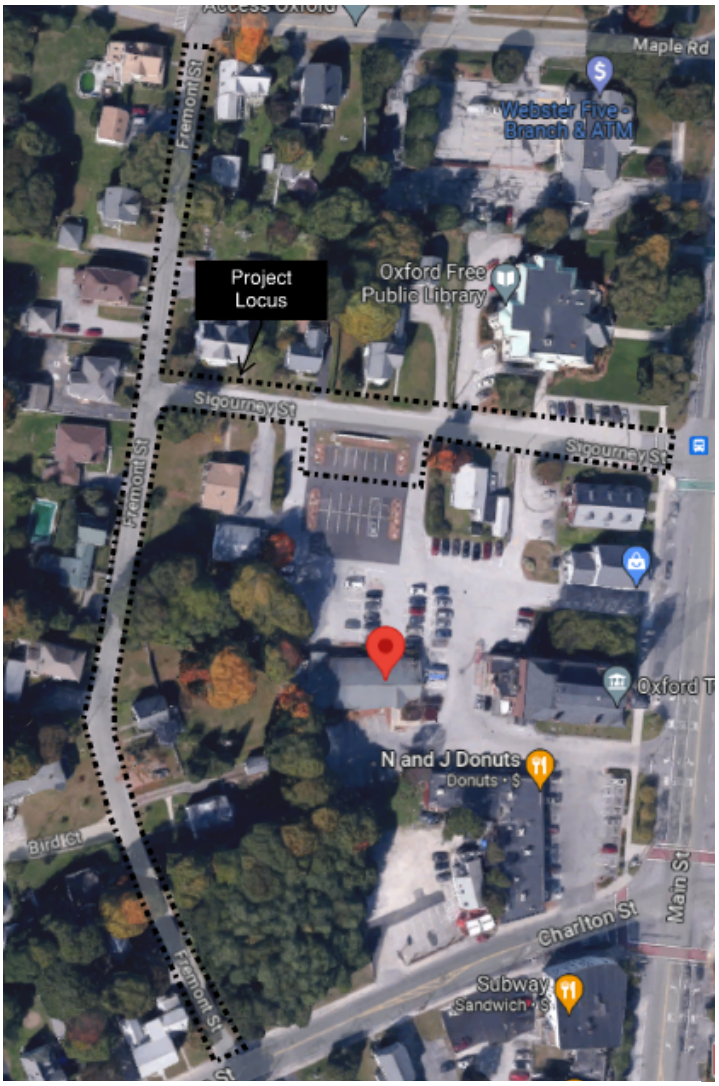


Figure 1. Project Locus

The top ranked project from the Complete Streets Prioritization Plan was Sigourney and Fremont Street (subsequently referred to as the Project). The Project was prioritized because the reconstruction of the roadways and addition of sidewalks provides a direct connection from residential properties to the Oxford Public Library and connects to the existing sidewalks on Main Street. This Project would help complete the sidewalk network directly within the Town Center area, increasing pedestrian accessibility to key destinations such as the Community Center and Town Hall. The Project is located within a quarter mile of the Oxford Community Center and within a mile of the A.M. Chaffee Elementary School.

Additionally, the existing roadways are very flat and experience drainage issues following rainfall events (Figures 2 and 3). The Project provides an opportunity to improve positive drainage to reduce ponding, as well as providing stormwater retrofit best management practices (BMPs) to reduce pollutant discharges to the Town's stormwater system.

Figures 2 and 3. Sigourney Street, left, and Fremont Street, right, in the preconstruction condition

The Project is located within a portion of Oxford that is prioritized for stormwater retrofits due to its urbanized location within both nitrogen and phosphorus impairment watershed. Most of the Project discharges towards the municipal stormwater system located in Main Street, which discharges towards Lowes Pond (Figure 4). Lowes Pond was categorized as "4A" in the Final Massachusetts Integrated List of Waters for the Clean Water Act 2018/2020 Reporting Cycle and a TMDL is completed/determined. Nutrient/Eutrophication Biologic Indicators are noted as an impairment. A survey from the mid-1990s also indicated that 75% to 100% of the Pond was covered with aquatic plants.

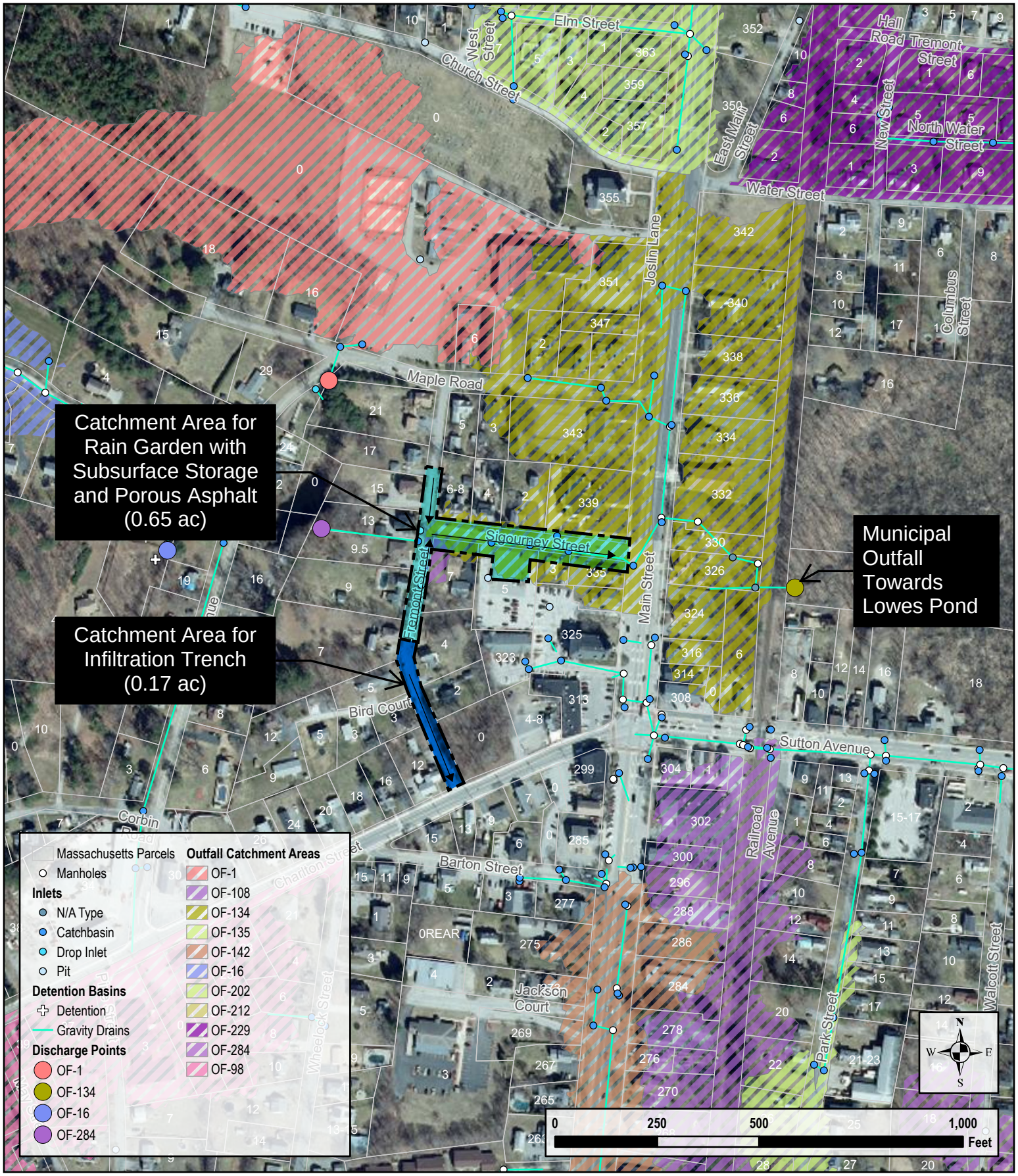
To meet the Project's stormwater water quality goals, several stormwater BMP retrofits were incorporated into the Project. These included: (1) a subsurface infiltration trench located at the southern end of Fremont Street, (2) a bioretention basin with enhanced subsurface storage at the entrance to the Town Hall Complex on Sigourney Street, and (3) porous asphalt sidewalks on Sigourney Street. The bioretention basin is an expansion of an existing rain garden to provide additional capacity both above and below grade (Figure 5).

The BMPs were designed to maximize treatment and storage and provide infiltration of up to the 25-year storm event. The BMPs were designed to accommodate greater than 2.0 inches BMP capacity and provide infiltration, therefore the estimated pollutant removal was determined based on the Subsurface Infiltration Trench (IR = 2.41 in./hr) BMP Performance Table from Appendix H Attachment 3 of the MA MS4 Permit. **This chart indicates both phosphorus and nitrogen load reductions of 100%, which equates to 1.45 lb/year and 10.46 lb/year, respectively.**

The Project issued 100% Construction Documents in March 2023 and is anticipated to be constructed in summer 2023. The Plans are attached for reference.

Figure 4. Catchment Areas with New Stormwater BMP for the Project

Figure 5. Town Hall Complex – Bioretention Basin with Enhanced Storage Stormwater Retrofit



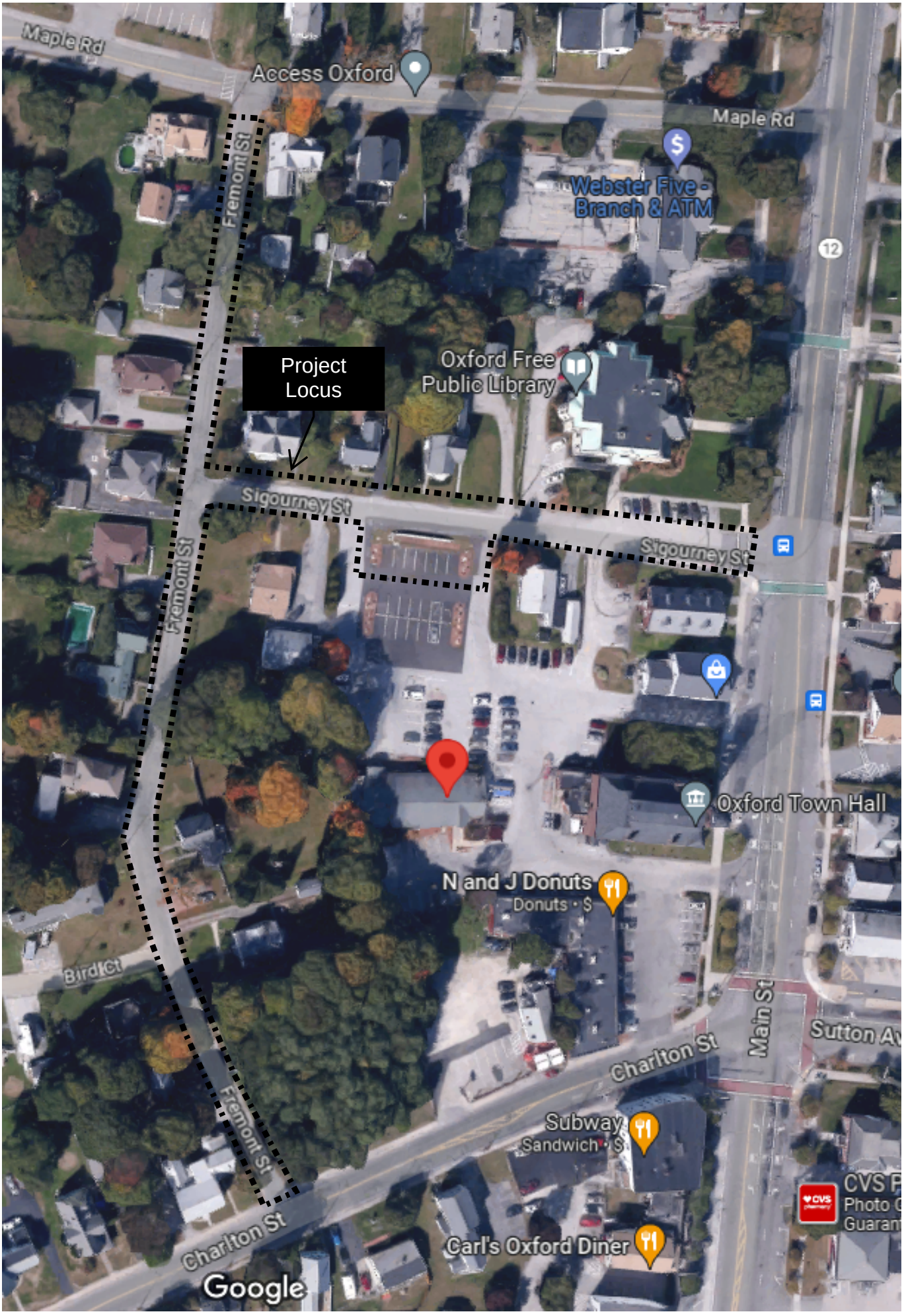
Drainage Network

Oxford, MA

7/28/2022

Data Source: MassGIS, Oxford MA

Nitsch Engineering


Maple Rd
Access Oxford
Maple Rd
Webster Five - Branch & ATM
12
Fremont St
Project Locus
Oxford Free Public Library
Sigourney St
Sigourney St
Fremont St
Oxford Town Hall
N and J Donuts
Donuts · $
Bird Ct
Main St
Sutton Av
Charlton St
Fremont St
Subway
Sandwich · $
CVS P
Photo
Guaran
Charlton St
Carl's Oxford Diner
Google

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TOWN OF OXFORD
DEPARTMENT OF PUBLIC WORKS

PLAN OF

SIGOURNEY STREET AND FREMONT STREET
SIDEWALK CONSTRUCTION

IN THE TOWN OF

OXFORD

WORCESTER COUNTY

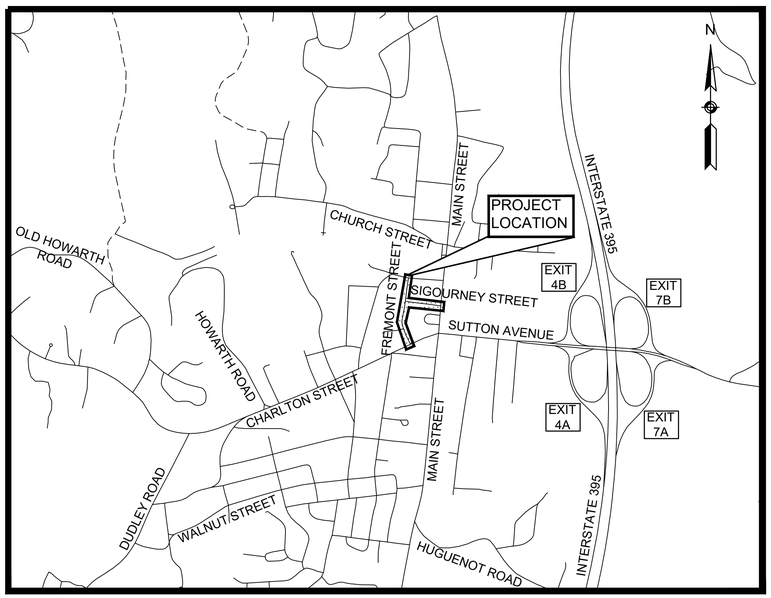
PROJECT NO.

H-23-08

THESE PLANS ARE SUPPLEMENTED BY THE OCTOBER 2017 CONSTRUCTION STANDARD DETAILS, THE 2015 OVERHEAD SIGNAL STRUCTURE AND FOUNDATION STANDARD DRAWINGS, MASSDOT TRAFFIC MANAGEMENT PLANS AND DETAIL DRAWINGS, THE 1990 STANDARD DRAWINGS FOR SIGNS AND SUPPORTS, THE 1968 STANDARD DRAWINGS FOR TRAFFIC SIGNALS AND HIGHWAY LIGHTING, AND THE LATEST EDITION OF THE AMERICAN STANDARD FOR NURSERY STOCK.

INDEX

SHEET NO.	DESCRIPTION
1	TITLE SHEET & INDEX
2	LEGEND & ABBREVIATIONS
3	KEY PLAN
4	GENERAL NOTES AND TYPICAL SECTIONS
5	BASELINE TIE PLAN
6 - 8	CONSTRUCTION PLANS AND PROFILES
9 - 11	CURB TIE PLANS
12 - 14	GRADING PLANS
15 - 17	DRAINAGE & UTILITY PLANS
18 - 21	SIGN & PAVEMENT MARKING PLANS
22	TEMPORARY TRAFFIC CONTROL PLAN
23 - 27	CONSTRUCTION DETAILS
28	BIORETENTION DETAILS



DESIGN DESIGNATION (MAIN STREET)

DESIGN SPEED	20 MPH
FUNCTIONAL CLASSIFICATION	LOCAL

DATE	DESCRIPTION	REV #

Oxford MS4 Pilot Project Plans - Select Stormwater Plans Provided

NITSCH PROJECT # 14521.3

COMMONWEALTH OF MASSACHUSETTS
MATTHEW J. SOLTYS
CIVIL
No. 53326
REGISTERED PROFESSIONAL ENGINEER

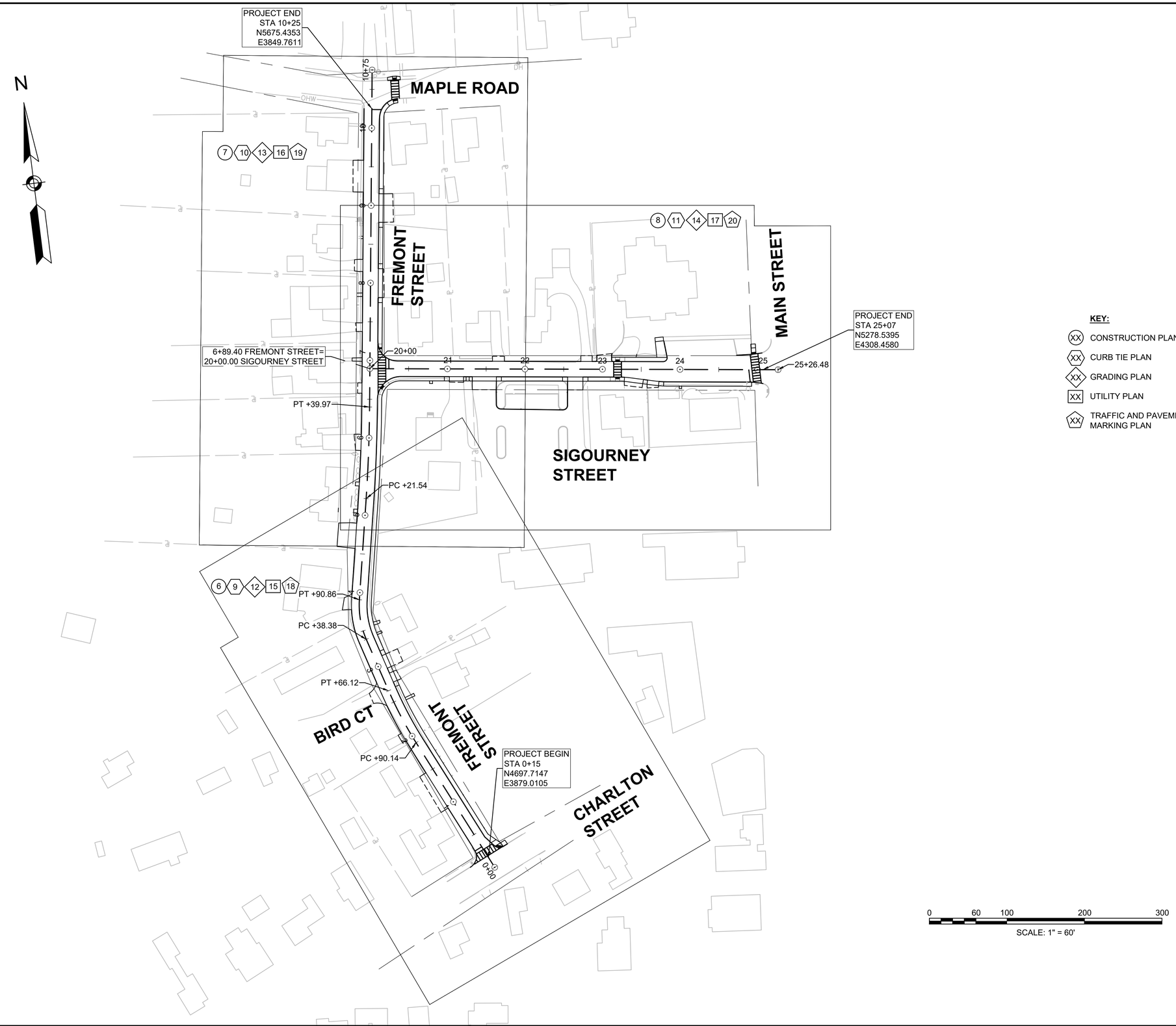
03/15/2023

Nitsch Engineering
www.nitscheng.com
120 Front Street, Suite 820
Worcester, MA 01608
T: (508) 365-1034
F: (617) 338-6472

- Civil Engineering
- Land Surveying
- Transportation Engineering
- Structural Engineering
- Green Infrastructure
- Planning
- GIS

OXFORD
SIGOURNEY STREET AND FREMONT STREET
SIDEWALK CONSTRUCTION
SHEET 3 OF 28
KEY PLAN

14521.3_HD_KEY.DWG Plotted on 14-Mar-2023 3:25 PM



KEY:

- XX — CONSTRUCTION PLAN
- XX — CURB TIE PLAN
- XX — GRADING PLAN
- XX — UTILITY PLAN
- XX — TRAFFIC AND PAVEMENT MARKING PLAN

0 60 100 200 300

SCALE: 1" = 60'

OXFORD
SIGOURNEY STREET AND FREMONT STREET
SIDEWALK CONSTRUCTION
SHEET 12 OF 28
GRADING PLANS

14521.3_HD_GRADING.DWG Plotted on 14-Mar-2023 3:27 PM

N

PROJECT BEGIN
STA 0+15
N4697.7147
E3879.0105

98.27
TC 99.36
BC 98.86
RIM = 98.66
EX TOWN LO
99.33
99.57
99.81
100.05
TC 100.78
BC 100.28
TC 101.00
BC 100.50
TC 100.93
BC 100.43
TC 100.60
BC 100.10
EX TOWN LO
100.63
100.30
TC 100.24
BC 99.74
99.94
99.57
TC 100.24
BC 99.74
TC 99.87
BC 99.37
CONTINUED ON SHEET NO. 13

0+00
98.49
98.65
RIM = 98.67
99.06
RIM = 98.98
99.53
99.77
100.01
TC 100.55
BC 100.05
100.25
100.48
100.28
100.70
TC 101.00
BC 100.50
TC 100.93
BC 100.43

FREMONT STREET

CHARLTON STREET

BIRD CT

EX TOWN LO

TC 99.36
BC 98.86
TC 99.20
BC 98.70
RIM = 98.64
98.55
TC 99.83
BC 99.33
TC 100.07
BC 99.57
TC 100.31
BC 99.81

EX TOWN LO

EX TOWN LO

0 20 50 100
SCALE: 1" = 20'

OXFORD
SIGOURNEY STREET AND FREMONT STREET
SIDEWALK CONSTRUCTION
SHEET 13 OF 28
GRADING PLANS

14521.3_HD_GRADING.DWG Plotted on 14-Mar-2023 3:27 PM

CONTINUED ON SHEET NO. 12

FREMONT STREET

SIGOURNEY STREET

MAPLE ROAD

TC 100.24
BC 99.74

TC 99.87
BC 99.37

RIM = 98.86

TC 99.32
BC 98.82

TC 99.56
BC 99.06

EX TOWN LO

TC 99.97
BC 99.47

TC 100.38
BC 99.88

TC 100.73
BC 100.23

TC 100.84
BC 100.34

TC 100.43
BC 99.93

EX TOWN LO

99.63

PROJECT END
STA 10+25
N5675.4353
E3849.7611

9 FREMONT ST
N/F
HENRY D.
HAGELAUER

9.5 FREMONT ST
N/F
ANTHONY KUZDZAL

13 FREMONT ST
N/F
RONALD
ANOSZKIEWICZ

15 FREMONT ST
N/F
ROSE SAAD

17 FREMONT ST
N/F
FREMONT REALTY
TRUST

21 FREMONT ST
N/F
ST. GEORGE
LIVING TRUST

5 99.94

99.57

6 99.01

RIM = 99.02

RIM = 98.82

99.18

20.00

7 99.26

99.06

RIM = 99.33

99.67

8 100.08

100.43

9 100.54

100.38

10 100.13

100.01

10+75

99.21

99.02

LP
6+47.20

RIM = 98.82

RIM = 99.07

98.98

TC 99.71
BC 99.21

TC 99.76
BC 99.26

EX TOWN LO

99.88

TC 100.73
BC 100.23

100.34

TC 100.80
BC 100.30

TC 100.63
BC 100.13

100.15

100.48

100.56

EX TOWN LO

TC 100.24
BC 99.74

TC 99.87
BC 99.37

TC 99.51
BC 99.01

TC 99.32
BC 98.82

TC 99.52
BC 99.02

RIM = 99.11

TC 99.64
BC 99.14

TC 99.55
BC 99.05

99.34

TC 99.97
BC 99.47

TC 99.32
BC 99.14

RIM = 99.11

RIM = 99.23

TC 99.64
BC 99.14

RIM = 99.37

EX TOWN LO

6–8 SIGOURNEY ST
N/F
MARY M.
DWYER-HURLEY

7 SIGOURNEY ST
N/F
ANDRE G. MAILHOT

5 MAPLE RD
N/F
SUSAN F. OLNEY

EX TOWN LO

99.79

TC 100.09
BC 99.59

TC 100.09
BC 99.59

99.87

TC 100.39
BC 99.89

TC 99.80
BC 99.30

TC 100.37
BC 99.87

100.07

99.89

TC 99.76
BC 99.26

HP +68.96
100.09

4 SIGOURNEY ST
N/F
JOSHUA A. BIANDO

100.03

LP
CURB CUT
99.15

0 20 50 100

SCALE: 1" = 20'

CONTINUED ON SHEET NO. 14

OXFORD
SIGOURNEY STREET AND FREMONT STREET
SIDEWALK CONSTRUCTION
SHEET 14 OF 28
GRADING PLANS

14521.3_HD_GRADING.DWG Plotted on 14-Mar-2023 3:28 PM

CONTINUED ON SHEET NO. 13

FREMONT STREET

SIGOURNEY STREET

FREMONT STREET

MAIN STREET

EX TOWN LO

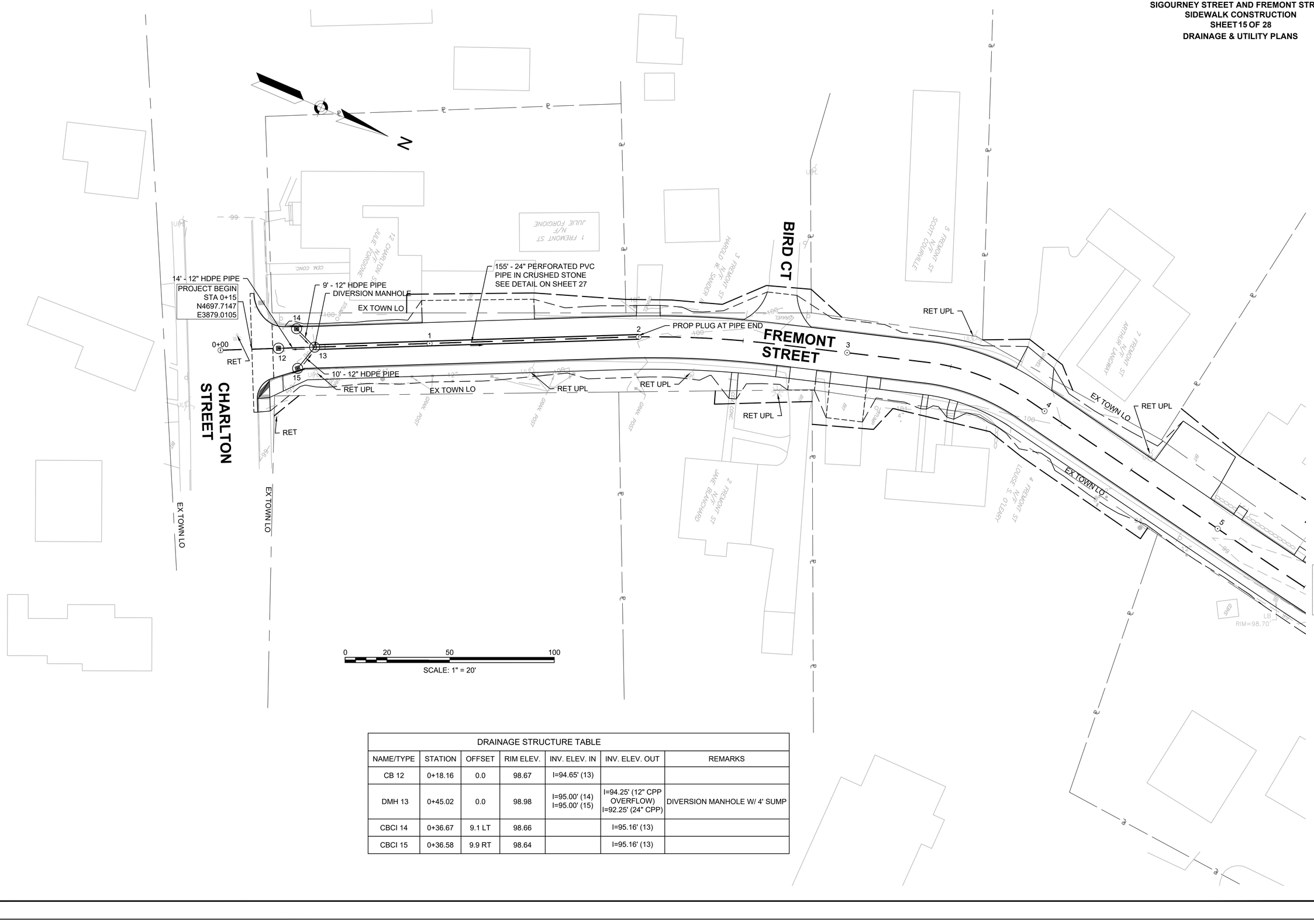
TC 100.84
BC 100.34
100.54
TC 100.73
BC 100.23
100.43
TC 100.73
BC 100.23
100.08
TC 100.38
BC 99.88
99.88
TC 99.97
BC 99.47
99.67
TC 99.97
BC 99.47
RIM = 99.33
TC 99.76
BC 99.26
TC 99.64
BC 99.14
TC 99.64
BC 99.14
TC 99.71
BC 99.21
99.26
99.06
RIM = 99.11
RIM = 99.23
RIM = 99.37
99.34
98.98
RIM = 99.11
RIM = 99.07
99.18
TC 99.56
BC 99.06
99.79
TC 100.09
BC 99.59
TC 100.37
BC 99.87
99.89
100.07
HP +68.96
100.09
100.03
TC 100.33
BC 99.83
TC 100.33
BC 99.83
TC 100.13
BC 99.63
99.83
TC 100.13
BC 99.63
99.63
TC 99.93
BC 99.43
RIM = 99.33
99.43
TC 99.74
BC 99.24
99.23
99.18
RIM = 99.19
RIM = 99.06
TC 99.41
BC 98.91
TC 99.14
BC 98.64
98.06
99.87
TC 100.39
BC 99.89
100.00
TC 99.80
BC 99.30
TC 99.76
BC 99.26
SEE SHEET 28
FOR BIORETENTION
DETAILS
LP
CURB CUT
99.15
99.00
98.00
97.00
TC 100.75
BC 100.25
TC 100.65
BC 100.15
TC 99.55
BC 99.05
TC 99.64
BC 99.14
TC 99.52
BC 99.02
TC 99.32
BC 98.82
RIM = 98.82
RIM = 99.02
RIM = 98.86
LP
6+47.20
99.02
RIM = 98.86
99.02
TC 99.32
BC 98.82
RIM = 98.82
99.01
TC 99.51
BC 99.01
99.12
TC 99.87
BC 99.37
99.57
TC 99.87
BC 99.37
TC 100.24
BC 99.74
99.94
TC 100.24
BC 99.74
100.63
100.74
TC 99.73
BC 99.23
99.26
TC 99.72
BC 99.22
99.13
98.89
98.43
97.77
98.96
98.12
97.87
PROJECT END
STA 25+07
N5278.5395
E4308.4580
25+26.48
DMH
RIM=97.53'
INV(a)=94.20'
INV(b)=94.86'
INV(c)=94.11'(OU
339 MAIN ST
TOWN OF OXFORD
335 MAIN ST
N/F
5-BNK OXFORD, LLC
4 SIGOURNEY ST
N/F
JOSHUA A. BIANDO
6-8 SIGOURNEY ST
N/F
NCY M. DWYER-HURLEY
7 SIGOURNEY ST
N/F
ANDRE G. MAILHOT
5 SIGOURNEY ST
TOWN OF OXFORD
3 SIGOURNEY ST
N/F
SCOTT A. CALLAHAN
9 FREMONT ST
N/F
HENRY D.
HAGELAUER
CB
RIM=99.28'
INV(a)=95.45'
INV(b)=95.45'
INV(c)=95.20'(OUT)
CB
RIM=99.44'
LB
RIM=98.70'
SIGN ON CONC. FND.
N

CONTINUED ON SHEET NO. 12

0 20 50 100
SCALE: 1" = 20'

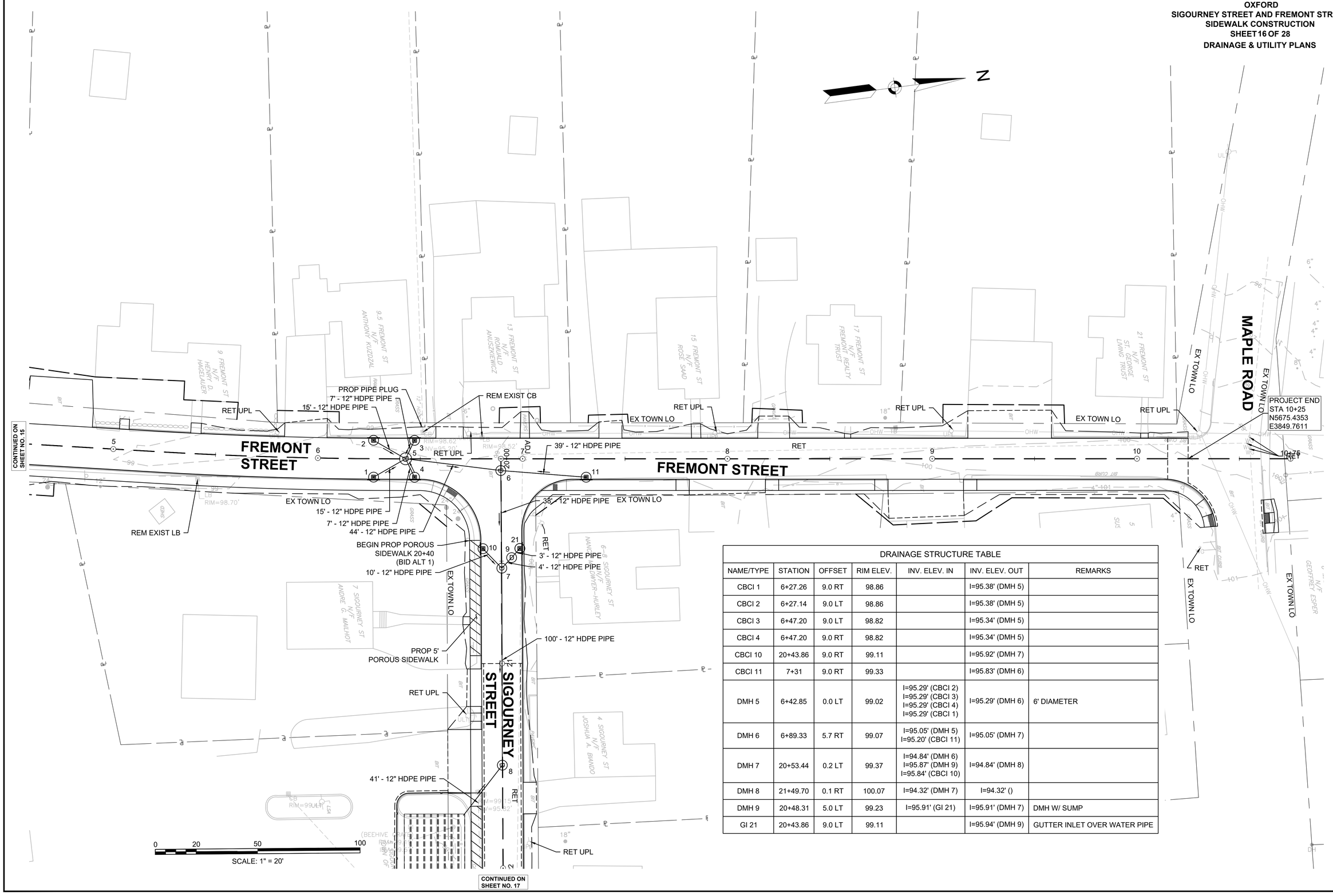
OXFORD
SIGOURNEY STREET AND FREMONT STREET
SIDEWALK CONSTRUCTION
SHEET 15 OF 28
DRAINAGE & UTILITY PLANS

14521.3_HD_DRAINAGE & UTILITY.DWG Plotted on 15-Mar-2023 3:14 PM



DRAINAGE STRUCTURE TABLE						
NAME/TYPE	STATION	OFFSET	RIM ELEV.	INV. ELEV. IN	INV. ELEV. OUT	REMARKS
CB 12	0+18.16	0.0	98.67	I=94.65' (13)		
DMH 13	0+45.02	0.0	98.98	I=95.00' (14) I=95.00' (15)	I=94.25' (12" CPP OVERFLOW) I=92.25' (24" CPP)	DIVERSION MANHOLE W/ 4' SUMP
CBCI 14	0+36.67	9.1 LT	98.66		I=95.16' (13)	
CBCI 15	0+36.58	9.9 RT	98.64		I=95.16' (13)	

14521.3_HD_DRAINAGE & UTILITY.DWG Plotted on 15-Mar-2023 3:14 PM



DRAINAGE STRUCTURE TABLE

NAME/TYPE	STATION	OFFSET	RIM ELEV.	INV. ELEV. IN	INV. ELEV. OUT	REMARKS
CBCI 1	6+27.26	9.0 RT	98.86		I=95.38' (DMH 5)	
CBCI 2	6+27.14	9.0 LT	98.86		I=95.38' (DMH 5)	
CBCI 3	6+47.20	9.0 LT	98.82		I=95.34' (DMH 5)	
CBCI 4	6+47.20	9.0 RT	98.82		I=95.34' (DMH 5)	
CBCI 10	20+43.86	9.0 RT	99.11		I=95.92' (DMH 7)	
CBCI 11	7+31	9.0 RT	99.33		I=95.83' (DMH 6)	
DMH 5	6+42.85	0.0 LT	99.02	I=95.29' (CBCI 2) I=95.29' (CBCI 3) I=95.29' (CBCI 4) I=95.29' (CBCI 1)	I=95.29' (DMH 6)	6' DIAMETER
DMH 6	6+89.33	5.7 RT	99.07	I=95.05' (DMH 5) I=95.20' (CBCI 11)	I=95.05' (DMH 7)	
DMH 7	20+53.44	0.2 LT	99.37	I=94.84' (DMH 6) I=95.87' (DMH 9) I=95.84' (CBCI 10)	I=94.84' (DMH 8)	
DMH 8	21+49.70	0.1 RT	100.07	I=94.32' (DMH 7)	I=94.32' ()	
DMH 9	20+48.31	5.0 LT	99.23	I=95.91' (GI 21)	I=95.91' (DMH 7)	DMH W/ SUMP
GI 21	20+43.86	9.0 LT	99.11		I=95.94' (DMH 9)	GUTTER INLET OVER WATER PIPE

OXFORD
SIGOURNEY STREET AND FREMONT STREET
SIDEWALK CONSTRUCTION
SHEET 17 OF 28
DRAINAGE & UTILITY PLANS

14521.3_HD_DRAINAGE & UTILITY.DWG Plotted on 15-Mar-2023 3:15 PM

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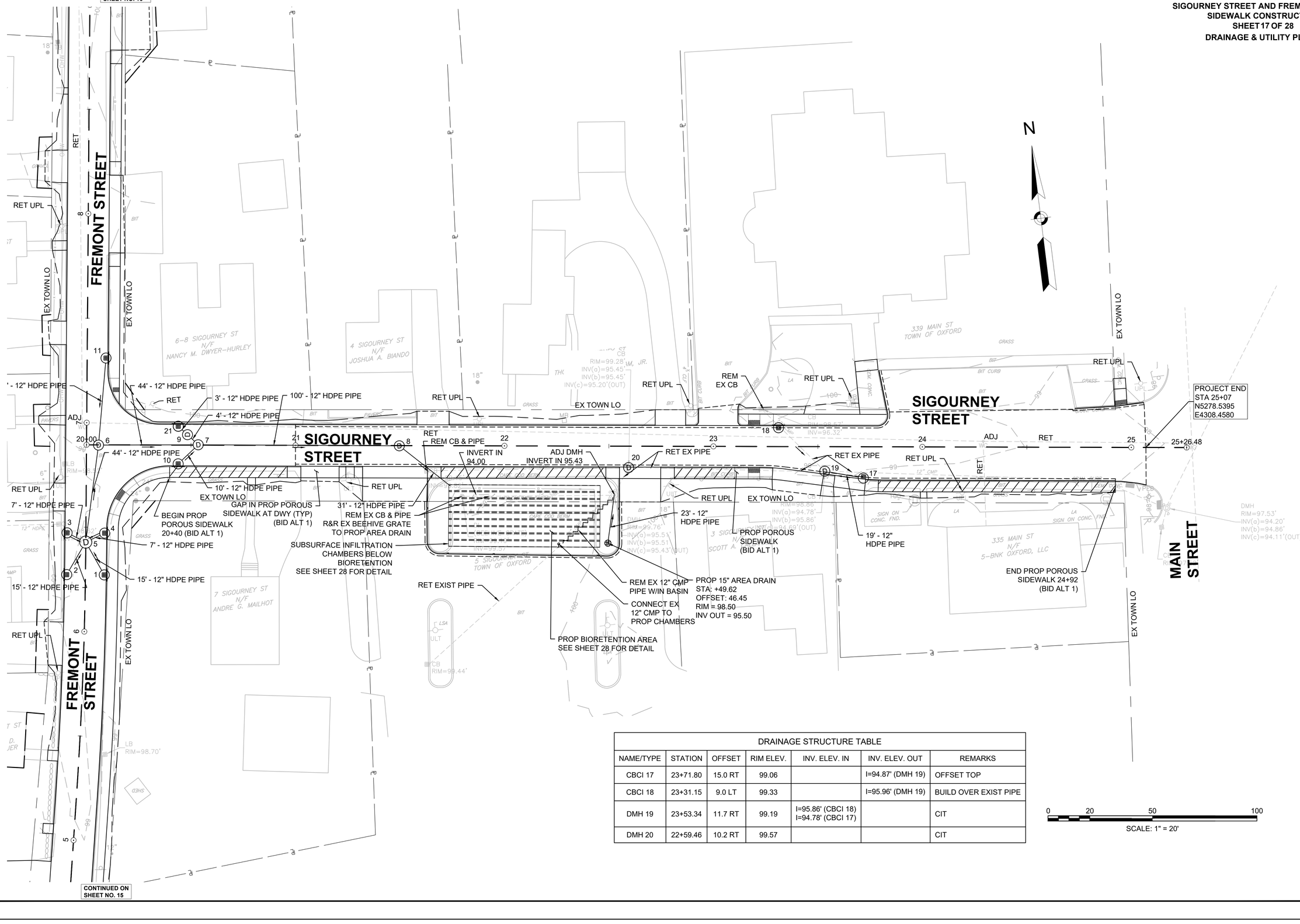

CONTINUED ON SHEET NO. 15

DRAINAGE STRUCTURE TABLE						
NAME/TYPE	STATION	OFFSET	RIM ELEV.	INV. ELEV. IN	INV. ELEV. OUT	REMARKS
CBCI 17	23+71.80	15.0 RT	99.06		I=94.87' (DMH 19)	OFFSET TOP
CBCI 18	23+31.15	9.0 LT	99.33		I=95.96' (DMH 19)	BUILD OVER EXIST PIPE
DMH 19	23+53.34	11.7 RT	99.19	I=95.86' (CBCI 18) I=94.78' (CBCI 17)		CIT
DMH 20	22+59.46	10.2 RT	99.57			CIT

0 20 50 100
SCALE: 1" = 20'

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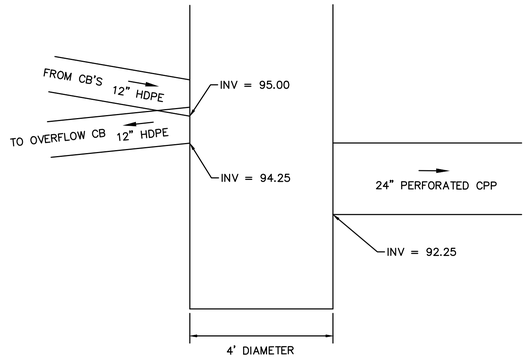
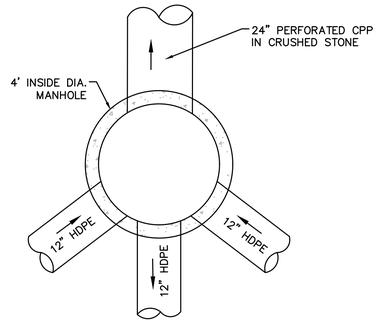
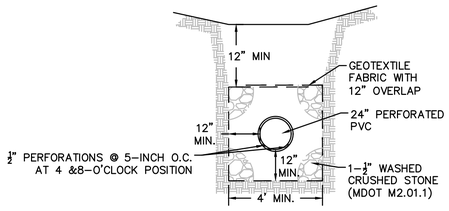
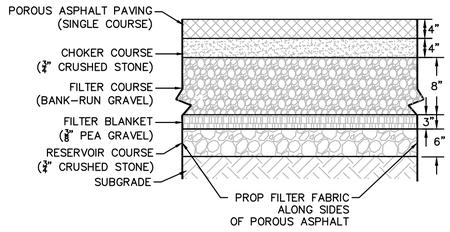




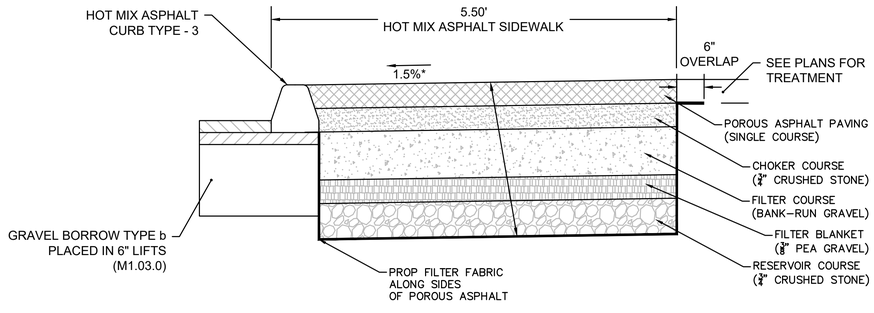
DIVERSION MANHOLE
NOT TO SCALE



24" PERFORATED CPP IN CRUSHED STONE
NOT TO SCALE



TYPICAL POROUS ASPHALT SECTION DETAIL
NOT TO SCALE



*= TOLERANCE FOR CONSTRUCTION ±0.5%

POROUS ASPHALT SECTION DETAIL AT SIDEWALK

NOTES:
1. EXCAVATION, POROUS MEDIA, GRADING, FILTER FABRIC, AND BACKFILL MATERIALS, FOR POROUS HOT MIX ASPHALT SHALL BE INCLUDED UNDER THE CONTRACT UNIT PRICE FOR ITEM 702.5 - POROUS ASPHALT SIDEWALK.
2. HMA CURB INSTALLATION SHALL BE MEASURED AND PAID FOR UNDER ITEM 570.3, HOT MIX ASPHALT CURB - TYPE 3.
3. GRAVEL BORROW UNDER THE CURB AND ROADWAY SHALL BE MEASURED AND PAID FOR UNDER ITEM 151, GRAVEL BORROW.
4. POROUS ASPHALT SHALL NOT BE USED IN VEHICULAR AREAS.
5. THE FULL PERMEABILITY OF THE PAVEMENT SURFACE SHALL BE TESTED BY APPLICATION OF CLEAN WATER AT THE RATE OF AT LEAST 5 GALLONS PER MINUTE (GPM) OVER THE SURFACE, USING A HOSE OR OTHER DISTRIBUTION DEVICE.

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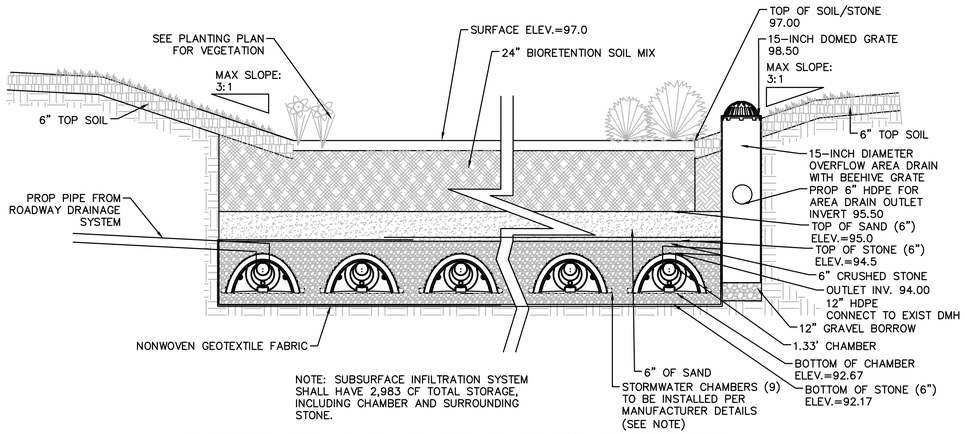
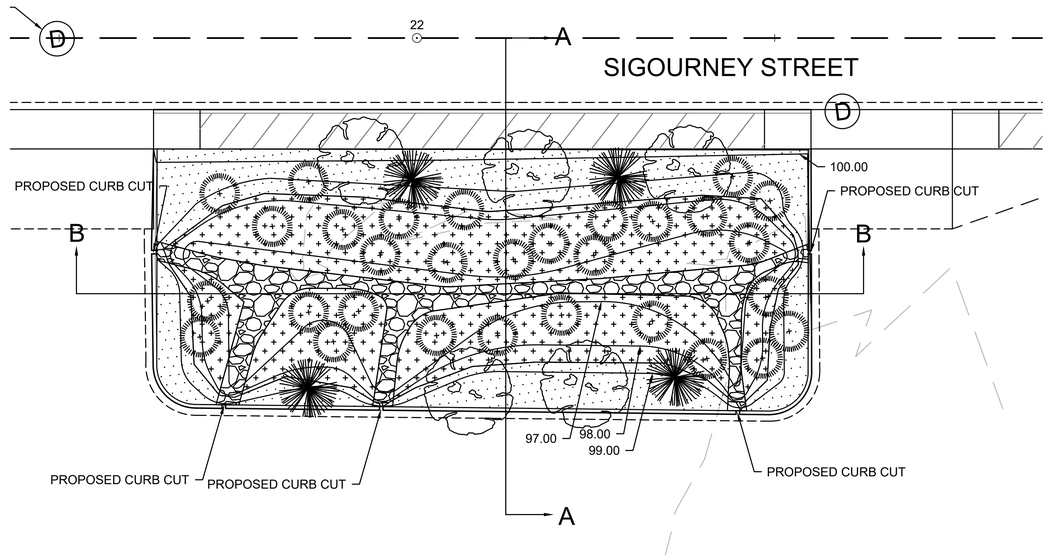


BIORETENTION BASIN #1 WITH SUBSURFACE STORAGE

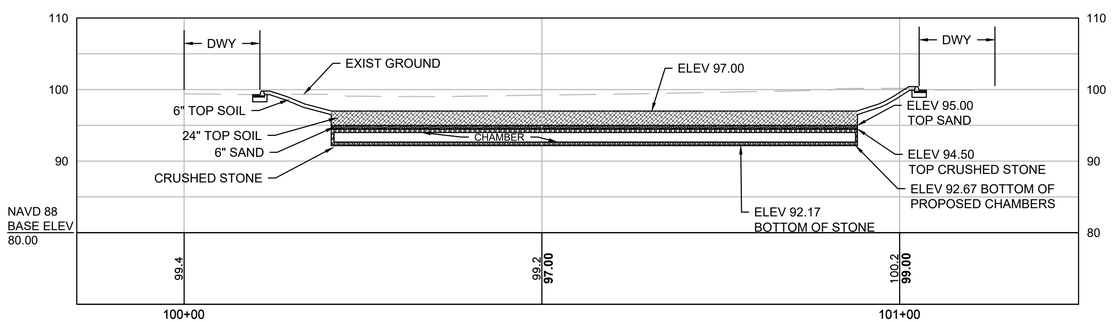
NOT TO SCALE

PLANTING SCHEDULE			
	SYMBOL	SPECIES	QUANTITY
SMALL DECIDUOUS TREES		BETULA NIGRA, CORNUS FLORIDA, PRUNUS VIRGINIANA	5
SMALL CONIFEROUS TREES		JUNIPERUS VIRGINIANA	4
SHRUBS		VIBURNUM DENTATUM, VACCINUM CORYMBOSUM, CORNUS AMOMUM, SAMBUCUS CANADENSIS	30
SEEDMIX A		SHORT ROADSIDE POLLINATOR MEADOW MIX * MODIFY TO ALL MA NATIVE SPECIES	1200 SF (ABOVE EL. 98.25)
SEEDMIX B		ROADSIDE RIVERBANK MIX	3100 SF (BELOW EL. 98.25)
MODIFIED ROCKFILL		8" ANGLED STONE	400 SF



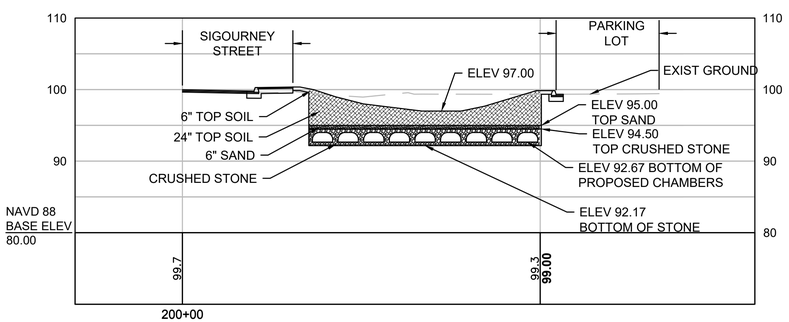
BIORETENTION PLAN VIEW
SCALE: 1" = 10'

BIORETENTION A-A



BIORTENTION SECTION VIEW A-A
(WEST TO EAST)
SCALE: 1" = 10'

BIORETENTION B-B



BIORETENTION SECTION VIEW B-B
(NORTH TO SOUTH)
SCALE: 1" = 10'

14521.2_HD_TITLE.DWG Plotted on 26-Aug-2022 9:51 AM

TOWN OF OXFORD
DEPARTMENT OF PUBLIC WORKS

PLAN OF

CHURCH STREET SIDEWALK CONSTRUCTION AND TRAFFIC CALMING

IN THE TOWN OF

OXFORD

WORCESTER COUNTY

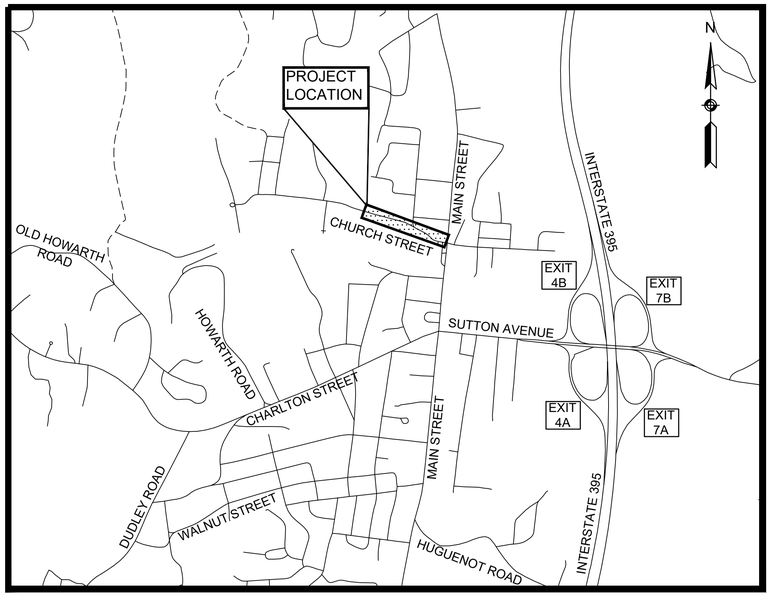
PROJECT NO.

14521.

THESE PLANS ARE SUPPLEMENTED BY THE OCTOBER 2017 CONSTRUCTION STANDARD DETAILS, THE 2015 OVERHEAD SIGNAL STRUCTURE AND FOUNDATION STANDARD DRAWINGS, MASSDOT TRAFFIC MANAGEMENT PLANS AND DETAIL DRAWINGS, THE 1990 STANDARD DRAWINGS FOR SIGNS AND SUPPORTS, THE 1968 STANDARD DRAWINGS FOR TRAFFIC SIGNALS AND HIGHWAY LIGHTING, AND THE LATEST EDITION OF THE AMERICAN STANDARD FOR NURSERY STOCK.

INDEX

SHEET NO.	DESCRIPTION
1	TITLE SHEET & INDEX
2	LEGEND & ABBREVIATIONS
3	GENERAL NOTES AND TYPICAL SECTIONS
4	CONSTRUCTION PLAN
5	TEMPORARY TRAFFIC CONTROL PLANS
6 - 7	CONSTRUCTION DETAILS



0 1,000 2,000 3,000 4,000

SCALE: 1" = 1,000'

DESIGN DESIGNATION (MAIN STREET)

DESIGN SPEED	25 MPH
FUNCTIONAL CLASSIFICATION	LOCAL

NITSCH PROJECT # 14521.2

COMMONWEALTH OF MASSACHUSETTS
MATTHEW J. SOLTYS
CIVIL
No. 53326
REGISTERED PROFESSIONAL ENGINEER

01/26/2023

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- Civil Engineering
- Land Surveying
- Transportation Engineering
- Structural Engineering
- Green Infrastructure
- Planning
- GIS

DATE	DESCRIPTION	REV #

GENERAL SYMBOLS

EXISTING	PROPOSED	DESCRIPTION
JB	JB	JERSEY BARRIER
CB	CB	CATCH BASIN
		CATCH BASIN CURB INLET
FP	FP	FLAG POLE
GP	GP	GAS PUMP
MB	MB	MAIL BOX
		POST SQUARE
		POST CIRCULAR
WELL	WELL	WELL
EHH	EHH	ELECTRIC HANDHOLE
		FENCE GATE POST
GG	GG	GAS GATE
BHL #	BHL #	BORING HOLE
MW #	MW #	MONITORING WELL
TP #	TP #	TEST PIT
		HYDRANT
		LIGHT POLE
CO.BD.		COUNTY BOUND
		GPS POINT
		CABLE MANHOLE
		DRAINAGE MANHOLE
		ELECTRIC MANHOLE
		GAS MANHOLE
		MISC MANHOLE
		SEWER MANHOLE
		TELEPHONE MANHOLE
		WATER MANHOLE
MHB	MHB	MASSACHUSETTS HIGHWAY BOUND
MON		MONUMENT
SB		STONE BOUND
TB		TOWN OR CITY BOUND
		TRAVERSE OR TRIANGULATION STATION
TPL or GUY	TPL or GUY	TROLLEY POLE OR GUY POLE
HTP		TRANSMISSION POLE
UFB	UFB	UTILITY POLE W/ FIREBOX
UPDL	UPDL	UTILITY POLE WITH DOUBLE LIGHT
ULT	ULT	UTILITY POLE W / 1 LIGHT
UPL	UPL	UTILITY POLE
		BUSH
SIZE & TYPE		TREE
		STUMP
		SWAMP / MARSH
WG	WG	WATER GATE
PM	PM	PARKING METER
		OVERHEAD CABLE/WIRE
		CURBING
100 99		CONTOURS (ON-THE-GROUND SURVEY DATA)
100 99		CONTOURS (PHOTOGRAMMETRIC DATA)
		UNDERGROUND DRAIN PIPE (DOUBLE LINE 24 INCH AND OVER)
		UNDERGROUND ELECTRIC DUCT (DOUBLE LINE 24 INCH AND OVER)
		UNDERGROUND GAS MAIN (DOUBLE LINE 24 INCH AND OVER)
		UNDERGROUND SEWER MAIN (DOUBLE LINE 24 INCH AND OVER)
		UNDERGROUND TELEPHONE DUCT (DOUBLE LINE 24 INCH AND OVER)
		UNDERGROUND WATER MAIN (DOUBLE LINE 24 INCH AND OVER)
		BALANCED STONE WALL
		GUARD RAIL - STEEL POSTS
		GUARD RAIL - WOOD POSTS
x	x	CHAIN LINK OR METAL FENCE
		WOOD FENCE
		HAY BALES/SILT FENCE
		TREE LINE
		SAWCUT LINE
		TOP OR BOTTOM OF SLOPE
		EDGE OF PAVEMENT
		LIMIT OF MICROMILLING AND OVERLAY
		BANK OF RIVER OR STREAM
		BORDER OF WETLAND
		100 FT WETLAND BUFFER
		200 FT RIVERFRONT BUFFER
		STATE HIGHWAY LAYOUT
		TOWN OR CITY LAYOUT
		COUNTY LAYOUT
		RAILROAD SIDELINE
		TOWN OR CITY BOUNDARY LINE
		PROPERTY LINE OR APPROXIMATE PROPERTY LINE
		EASEMENT

TRAFFIC SYMBOLS

EXISTING	PROPOSED	DESCRIPTION
1	1	CONTROLLER PHASE ACTUATED
		TRAFFIC SIGNAL HEAD (SIZE AS NOTED)
		WIRE LOOP DETECTOR (6' x 6' TYP UNLESS OTHERWISE SPECIFIED)
		VIDEO DETECTION CAMERA
		MICROWAVE DETECTOR
		PEDESTRIAN PUSH BUTTON, SIGN (DIRECTIONAL ARROW AS SHOWN) AND SADDLE
	*	EMERGENCY PREEMPTION CONFIRMATION STROBE LIGHT
		VEHICULAR SIGNAL HEAD
		VEHICULAR SIGNAL HEAD, OPTICALLY PROGRAMMED
		FLASHING BEACON
		PEDESTRIAN SIGNAL HEAD, (TYPE AS NOTED OR AS SPECIFIED)
RRSG	RRSG	RAILROAD SIGNAL
OR		SIGNAL POST AND BASE (ALPHA-NUMERIC DESIGNATION NOTED)
	20'	MAST ARM, SHAFT AND BASE (ARM LENGTH AS NOTED)
		HIGH MAST POLE OR TOWER
		SIGN AND POST
		SIGN AND POST (2 POSTS)
	20'	MAST ARM WITH LUMINAIRE
		OPTICAL PRE-EMPTION DETECTOR
		CONTROL CABINET, GROUND MOUNTED
		CONTROL CABINET, POLE MOUNTED
		FLASHING BEACON CONTROL AND METER PEDESTAL
		LOAD CENTER ASSEMBLY
		PULL BOX 12"x12" (OR AS NOTED)
		ELECTRIC HANDHOLE 12"x24" (OR AS NOTED)
		TRAFFIC SIGNAL CONDUIT

PAVEMENT MARKINGS SYMBOLS

EXISTING	PROPOSED	DESCRIPTION
		PAVEMENT ARROW - WHITE
ONLY	ONLY	LEGEND "ONLY" - WHITE
	SL	STOP LINE - 12" WIDE
	CW	CROSSWALK - 8' WIDE
	SWL	SOLID WHITE LINE - 6" WIDE
	SYL	SOLID YELLOW LINE - 6" WIDE
	BWL	BROKEN WHITE LINE - 6" WIDE - 10' LINE AND 30' GAP
	BYL	BROKEN YELLOW LINE - 6" WIDE - 10' LINE AND 30' GAP
	DWL	DOTTED WHITE LINE - 3' LINE AND 9' GAP
	DYL	DOTTED YELLOW LINE - 3' LINE AND 9' GAP
	DWLEx	DOTTED WHITE LINE EXTENSION - 6" WIDE - 2' LINE AND 6' GAP
	DYLEx	DOTTED YELLOW LINE EXTENSION - 6" WIDE - 2' LINE AND 6' GAP
	DBWL	DOUBLE WHITE LINE - 6" WIDE
	DBYL	DOUBLE YELLOW LINE - 6" WIDE

ABBREVIATIONS

GENERAL

AADT	ANNUAL AVERAGE DAILY TRAFFIC
ABAN	ABANDON
ADJ	ADJUST
APPROX.	APPROXIMATE
A.C.	ASPHALT CONCRETE
ACCM PIPE	ASPHALT COATED CORRUGATED METAL PIPE
BIT.	BITUMINOUS
BC	BOTTOM OF CURB
BD.	BOUND
BL	BASELINE
BLDG	BUILDING
BM	BENCHMARK
BO	BY OTHERS
BOS	BOTTOM OF SLOPE
BR.	BRIDGE
CB	CATCH BASIN
CBCI	CATCH BASIN WITH CURB INLET
CC	CEMENT CONCRETE
CCM	CEMENT CONCRETE MASONRY
CEM	CEMENT
CI	CURB INLET
CIP	CAST IRON PIPE
CLF	CHAIN LINK FENCE
CL	CENTERLINE
CMP	CORRUGATED METAL PIPE
CSP	CORRUGATED STEEL PIPE
CO.	COUNTY
CONC	CONCRETE
CONT	CONTINUOUS
CONST	CONSTRUCTION
CR GR	CROWN GRADE
DHV	DESIGN HOURLY VOLUME
DI	DROP INLET
DIA	DIAMETER
DIP	DUCTILE IRON PIPE
DW	STEADY DON'T WALK - PORTLAND ORANGE
DWY	DRIVEWAY
ELEV (or EL.)	ELEVATION
EMB	EMBANKMENT
EOP	EDGE OF PAVEMENT
EXIST (or EX)	EXISTING
EXC	EXCAVATION
F&C	FRAME AND COVER
F&G	FRAME AND GRATE
FDN.	FOUNDATION
FLDSTN	FIELDSTONE
GAR	GARAGE
GD	GROUND
GG	GAS GATE
GI	GUTTER INLET
GIP	GALVANIZED IRON PIPE
GRAN	GRANITE
GRAV	GRAVEL
GRD	GUARD
HDW	HEADWALL
HMA	HOT MIX ASPHALT
HOR	HORIZONTAL
HYD	HYDRANT
INV	INVERT
JCT	JUNCTION
L	LENGTH OF CURVE
LB	LEACH BASIN
LP	LIGHT POLE
LT	LEFT
MAX	MAXIMUM
MB	MAILBOX
MH	MANHOLE
MHB	MASSACHUSETTS HIGHWAY BOUND
MIN	MINIMUM
NIC	NOT IN CONTRACT
NO.	NUMBER
PC	POINT OF CURVATURE
PCC	POINT OF COMPOUND CURVATURE
PCR	PEDESTRIAN CURB RAMP
P.G.L.	PROFILE GRADE LINE
PI	POINT OF INTERSECTION
POC	POINT ON CURVE
POT	POINT ON TANGENT
PRC	POINT OF REVERSE CURVATURE
PROJ	PROJECT
PROP	PROPOSED
PSB	PLANTABLE SOIL BORROW
PT	POINT OF TANGENCY
PVC	POINT OF VERTICAL CURVATURE
PVI	POINT OF VERTICAL INTERSECTION
PVT	POINT OF VERTICAL TANGENCY
PVMT	PAVEMENT

ABBREVIATIONS (cont.)

GENERAL

PWW	PAVED WATER WAY
R	RADIUS OF CURVATURE
R&D	REMOVE AND DISPOSE
RCP	REINFORCED CONCRETE PIPE
RD	ROAD
RDWY	ROADWAY
REM	REMOVE
RET	RETAIN
RET WALL	RETAINING WALL
ROW	RIGHT OF WAY
RR	RAILROAD
R&R	REMOVE AND RESET
R&S	REMOVE AND STACK
RT	RIGHT
SB	STONE BOUND
SHLD	SHOULDER
SMH	SEWER MANHOLE
ST	STREET
STA	STATION
SSD	STOPPING SIGHT DISTANCE
SHLO	STATE HIGHWAY LAYOUT LINE
SW	SIDEWALK
T	TANGENT DISTANCE OF CURVE/TRUCK %
TAN	TANGENT
TEMP	TEMPORARY
TC	TOP OF CURB
TOS	TOP OF SLOPE
TYP	TYPICAL
UP	UTILITY POLE
VAR	VARIES
VERT	VERTICAL
VC	VERTICAL CURVE
WG	WATER GATE
WIP	WROUGHT IRON PIPE
WM	WATER METER/WATER MAIN
X-SECT	CROSS SECTION

TRAFFIC SIGNAL ABBREVIATIONS

CAB	CABINET
CCVE	CLOSED CIRCUIT VIDEO EQUIPMENT
DW	STEADY UPRAISED HAND
FDW	FLASHING UPRAISED HAND
FR	FLASHING CIRCULAR RED
FRL	FLASHING RED LEFT ARROW
FRR	FLASHING RED RIGHT ARROW
FY	FLASHING CIRCULAR YELLOW
FYL	FLASHING YELLOW LEFT ARROW
FYR	FLASHING YELLOW RIGHT ARROW
G	STEADY CIRCULAR GREEN
GL	STEADY GREEN LEFT ARROW
GR	STEADY GREEN RIGHT ARROW
GSL	STEADY GREEN SLASH LEFT ARROW
GSR	STEADY GREEN SLASH RIGHT ARROW
GV	STEADY GREEN VERTICAL ARROW
OL	OVERLAP
PED	PEDESTRIAN
PTZ	PAN, TILT, ZOOM
R	STEADY CIRCULAR RED
RL	STEADY RED LEFT ARROW
RR	STEADY RED RIGHT ARROW
TR SIG	TRAFFIC SIGNAL
TSC	TRAFFIC SIGNAL CONDUIT
W	STEADY WALKING PERSON
Y	STEADY CIRCULAR YELLOW
YL	STEADY YELLOW LEFT ARROW

OXFORD
CHURCH STREET SIDEWALK CONSTRUCTION AND TRAFFIC CALMING
SHEET 2 OF 7
LEGEND & ABBREVIATIONS

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GENERAL NOTES

1. THE EXISTING TOPOGRAPHIC CONDITIONS SHOWN ON THESE PLANS CONSIST OF INFORMATION OBTAINED FROM MASSMAPPER IN AUGUST OF 2022.
2. THE PROJECT WAS DEVELOPED USING GIS PLANS AND IS SCHEMATIC IN NATURE. THE CONTRACTOR SHALL BE RESPONSIBLE FOR CONFIRMING EXISTING CONDITIONS AND THE EXACT LOCATION OF THE IMPROVEMENTS WITH THE TOWN OF OXFORD PRIOR TO THE START OF WORK.
3. THE CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING EXISTING GRADES AND ELEVATIONS AT THE LOCATIONS WHERE PROPOSED WORK MEETS EXISTING CONDITIONS.
4. THE CONTRACTOR SHALL BE RESPONSIBLE TO MAKE THEIR OWN DETERMINATION OF SUBSURFACE CONDITIONS INCLUDING THE LOCATION OF ROCK AND THE ACTUAL LOCATION OF UTILITIES OR OTHER FEATURES WHICH MAY AFFECT THEIR WORK.
5. EXISTING UTILITIES SHOWN ON THESE PLANS ARE NOT GUARANTEED TO BE ACCURATE NOR IS IT GUARANTEED THAT ALL UTILITIES ARE SHOWN. NO SEPARATE OR ADDITIONAL COMPENSATION WILL BE ALLOWED TO THE CONTRACTOR DUE TO ANY VARIANCE BETWEEN THE DATA SHOWN ON THE PLANS AND ACTUAL FIELD CONDITIONS ENCOUNTERED. WHERE AN EXISTING UTILITY IS FOUND TO CONFLICT WITH THE PROPOSED WORK, THE LOCATION, ELEVATION AND SIZE OF THE UTILITY SHALL BE ACCURATELY DETERMINED WITHOUT DELAY BY THE CONTRACTOR AND THIS INFORMATION FURNISHED TO THE ENGINEER.
6. THE RELOCATION, INSTALLATION OR REMOVAL OF PRIVATE UTILITIES SHALL BE ACCOMPLISHED BY THEIR OWNERS, EXCEPT AS OTHERWISE NOTED. THE CONTRACTOR WILL BE REQUIRED TO COOPERATE WITH THE PRIVATE UTILITY COMPANIES AND ALLOW THEM ADEQUATE TIME TO COMPLETE THEIR WORK IN ADVANCE OF PERFORMING ANY PAVING OPERATIONS OR OTHER FINISHED WORK.
7. AREAS OUTSIDE OF THE LIMITS OF PROPOSED WORK DISTURBED BY THE CONTRACTOR'S OPERATIONS SHALL BE RESTORED BY THE CONTRACTOR AT THE CONTRACTOR'S EXPENSE TO THEIR ORIGINAL CONDITION AND TO THE SATISFACTION OF THE ENGINEER.
8. THE CONTRACTOR SHALL CONTACT "DIG SAFE" AT 1-888-DIG-SAFE AT LEAST 72 HOURS PRIOR TO COMMENCING WORK ON THE PROJECT.
9. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING AND FOR MAINTAINING COMPOST FILTER TUBES, SILT FENCE(S), AND OTHER EROSION CONTROL MEASURES THROUGHOUT THE DURATION OF THE CONTRACT AS SHOWN ON THE PLANS AND AS REQUIRED BY THE ENGINEER.
10. THE CONTRACTOR SHALL COMPLY WITH ALL APPLICABLE FEDERAL, STATE AND LOCAL SAFETY CODES AND LEGAL REQUIREMENTS, IN THE CONSTRUCTION OF IMPROVEMENTS.
11. UNLESS OTHERWISE NOTED OR APPROVED BY THE ENGINEER, THE CONTRACTOR SHALL MAINTAIN ALL EXISTING UTILITIES IN SERVICE AT ALL TIMES. IF THE CONTRACTOR DAMAGES UTILITY SYSTEMS, THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE RESPECTIVE UTILITY COMPANY AND SHALL REPAIR/REPLACE THE AFFECTED SYSTEM AT THEIR OWN EXPENSE.
12. ALL MATERIALS TO BE REMOVED AND DISCARDED SHALL BE DISPOSED OF IN ACCORDANCE WITH ALL APPLICABLE CODES AND REGULATIONS.
13. THE TEMPORARY TRAFFIC CONTROL PLANS INDICATE THE GENERAL REQUIREMENTS FOR THE VARIOUS PHASES OF WORK. THE CONTRACTOR SHALL SUBMIT DETAILED TRAFFIC MANAGEMENT PLANS TO THE ENGINEER FOR APPROVAL.
14. THE FLOW OF TRAFFIC THROUGH THE SITE MUST BE MAINTAINED AS SHOWN ON THE TRAFFIC CONTROL PLANS AND SPECIFIED IN THE SPECIAL PROVISIONS. CONSTRUCTION EQUIPMENT AND MATERIALS SHALL NOT BE PARKED OR STOCKPILED SO AS TO OBSTRUCT THE FLOW OF VEHICLES.
15. THE TERM "PROPOSED" (PROP) MEANS WORK TO BE CONSTRUCTED USING NEW MATERIALS OR, WHERE APPLICABLE, RE-USING EXISTING MATERIALS IN SUITABLE CONDITION IDENTIFIED AS "REMOVE AND RESET" (R&R).
16. SURFACE JOINTS BETWEEN NEW HOT MIX ASPHALT ROADWAY PAVEMENT AND SAWCUT EXISTING PAVEMENT SHALL BE SEALED WITH HMA JOINT SEALANT.
17. IN AREAS OF SIDEWALK RECONSTRUCTION WHERE PROPOSED MEETS EXISTING PAVEMENT, THE EXISTING PAVEMENT SHALL BE SAWCUT TO OBTAIN A CLEAN VERTICAL FACE.
18. THE CONSTRUCTION OF ALL NEW PEDESTRIAN RAMPS SHALL CONFORM TO ADA/AAB STANDARDS AND CURRENT MASSDOT STANDARDS AND DIRECTIVES.
19. THE CONTRACTOR SHALL PROVIDE INLET PROTECTION DURING CONSTRUCTION FOR ALL EXISTING AND PROPOSED CATCH BASINS/AREA DRAINS WITHIN THE LIMIT OF WORK. REFER TO THE DETAIL ENTITLED "CATCH BASIN WITH SILT SACK INLET PROTECTION" ON THE CONSTRUCTION DETAILS SHEET 7 OF 7.

PAVEMENT NOTES:

PROPOSED CEMENT CONCRETE PEDESTRIAN CURB RAMP

SURFACE: 4" CEMENT CONCRETE SIDEWALK (4000 PSI, ¾", 610)

SUBBASE: 8" GRAVEL BORROW, TYPE b*

PROPOSED HOT MIX ASPHALT SIDEWALK

SURFACE: 3.00" HOT MIX ASPHALT PLACED IN TWO LIFTS:
(1.25" SUPERPAVE SURFACE COURSE - 12.5 (SSC-12.5) OVER
1.75" SUPERPAVE INTERMEDIATE COURSE - 12.5 (SIC-12.5))

SUBBASE: 8" GRAVEL BORROW, TYPE b*

PROPOSED HOT MIX ASPHALT DRIVEWAY

SURFACE: 3.5" HOT MIX ASPHALT PLACED IN TWO LIFTS:
(1.5" SUPERPAVE SURFACE COURSE - 12.5 (SSC-12.5) OVER
2.50" SUPERPAVE INTERMEDIATE COURSE - 12.5 (SIC-12.5))

SUBBASE: 8" GRAVEL BORROW, TYPE b*

PROPOSED FULL DEPTH BOX WIDENING

SURFACE: 4" HOT MIX ASPHALT PLACED IN TWO LIFTS:
(2" SUPERPAVE SURFACE COURSE - 12.5 (SSC-12.5) OVER
2" SUPERPAVE INTERMEDIATE COURSE - 12.5 (SIC-12.5))

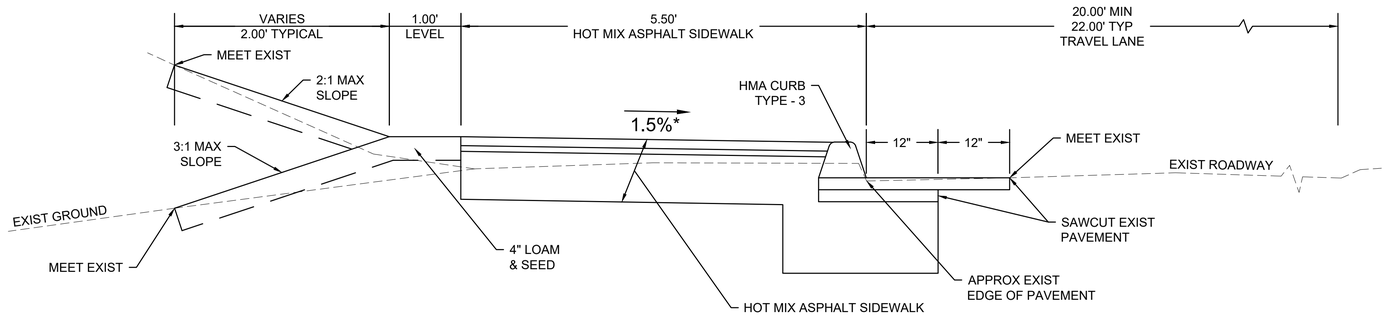
BASE: 4.00" SUPERPAVE BASE COURSE - 37.5 (SBC-37.5) OVER

SUBBASE: 8" GRAVEL BORROW, TYPE b*

*EXISTING GRAVEL BORROW SHALL BE RE-USED IF DETERMINED SUITABLE BY THE ENGINEER.

NOTES:

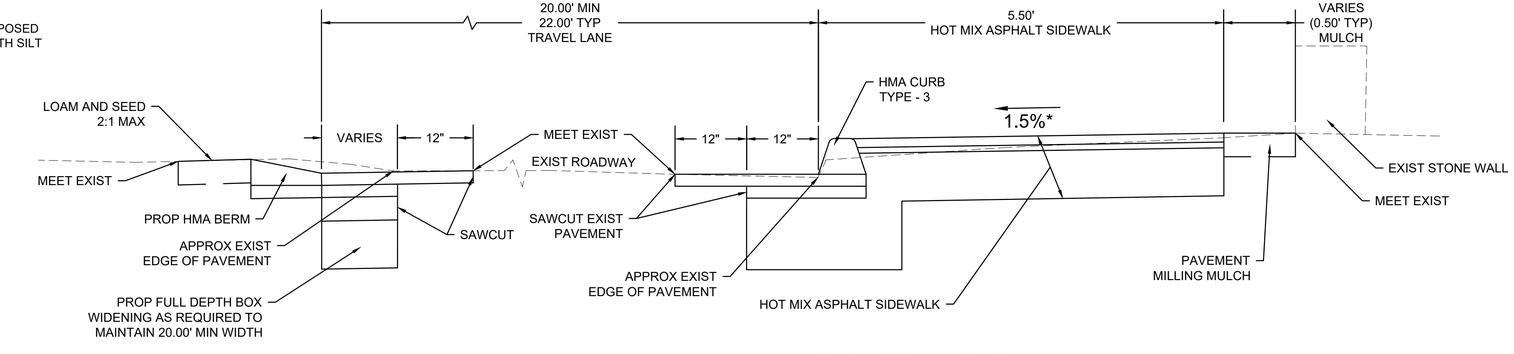
1. ASPHALT EMULSION FOR TACK COAT (ITEM 452.) SHALL BE APPLIED AT A RATE OF 0.07 GAL/SY OVER MILLED SURFACES AND 0.05 GAL/SY OVER SMOOTH SURFACES.
2. HMA JOINT SEALANT (ITEM 453.) SHALL BE APPLIED AT ALL SAWCUT JOINTS.



*= TOLERANCE FOR CONSTRUCTION ±0.5%

CHURCH STREET PROPOSED TYPICAL SECTION
STA 15+75+ TO 21+00±

NTS



*= TOLERANCE FOR CONSTRUCTION ±0.5%

CHURCH STREET PROPOSED TYPICAL SECTION
STA 11+00 TO 15+75±

NTS

OXFORD
CHURCH STREET SIDEWALK CONSTRUCTION AND TRAFFIC CALMING
SHEET 4 OF 7
CONSTRUCTION PLAN

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CONTINUED BELOW

CONTINUED ABOVE

CHURCH STREET

WEST STREET

MAIN STREET

JOSLIN LANE

APPROX. ROADWAY CENTERLINE

BEGIN DBYL STA 11+10

PROP LEACHING BASIN (BID ALT)

R&R "CAUTION CHILDREN" (BID ALT)

RET HYD

END CURB MEET EXIST

7' GRASS STRIP (BID ALT)

PROP 5' HMA SIDEWALK (BID ALT)

RET GUARDRAIL

PROP 4' HMA SIDEWALK (BID ALT)

RET CLF

RET CLF

END SIDEWALK AT PARK ENTRANCE (BID ALT)

PROP HMA CURB

DBYL

SAWCUT

PROP HMA DWY

RET GATE

PROP PCR (ONLY IF BID ALT NOT APPROVED)

RET TREES

6" DBYL IN CENTER OF ROADWAY

RET STONE WALL

PROP PAVEMENT MILLING MULCH BEHIND SIDEWALK (TYP)

PROP FULL DEPTH BOX WIDENING WHERE REQUIRED TO MAINTAIN 20' ROADWAY WIDTH

RET W15-1 W13-1P (20)

RET UP

MEET EXIST

PROP HMA BERM

PROP 5.5' HMA SIDEWALK

PROP HMA DWY

PROP 3' MIN AROUND POLE

RET UP

PROP 5.5' HMA SIDEWALK

SAWCUT

20' MIN

PI +04.51

PI +59.09

PC +02.91

PT +59.35

RET CB
PROP SILT SACK

END HMA BERM AT DRIVEWAY

REM EXIST PAVEMENT
PROP LOAM AND SEED

MEET EXIST

PROP HMA BERM

R&R R1-1 AND D3-1

R=25.00'

R=30.00'

SL

20+00

END DBYL STA 15+05

RET UP

RET WG (3)

REM EXIST GRASS ISLAND
PROP FULL DEPTH PAVEMENT

PROVIDE 3' MIN CLEARANCE BETWEEN STONE WALL AND UP

PROP CEM CONC PCR

BEGIN DBYL STA 15+72

W11-2 (2)
W16-7PL
W16-7PR

MEET EXIST

PROP HMA BERM

PROP HMA DWY

REM EXIST PAVEMENT
PROP LOAM AND SEED

END HMA BERM

W11-2 (2)
W16-7PL
W16-7PR

PROP CEM CONC PCR

PROP HMA CURB

CW

SAWCUT

0 20 50 100

SCALE: 1" = 20'

BEGIN HMA BERM

PROP HMA DWY

REM EXIST PAVEMENT
PROP LOAM AND SEED

W11-2 (2)
W16-7PL
W16-7PR

PROP CEM CONC PCR

PROP HMA CURB

SAWCUT

R=25.00'

R=30.00'

SL

20+00

END DBYL STA 15+05

PROP HMA BERM

PROVIDE 3' OF CLEARANCE BETWEEN STONE WALL AND UP

PROP CEM CONC PCR

BEGIN DBYL STA 15+72

W11-2 (2)
W16-7PL
W16-7PR

R&D EXIST CURB INLET REMODEL CB

PROP TREE TRIMMING

PROP HMA CURB

PROP HMA DWY

PROP 5.5' HMA SIDEWALK

PROP SILT SACK (2)

PC +53.73

PT +56.90

PI +66.26

PC +89.70

RET EXIST TREES (TYP)

PROP LEACHING BASIN AT LOW POINT

RET UP

PROP 3' MIN AROUND UP

MEET EXIST

PROP HMA DWY

PROP HMA DWY

PROP HMA DWY

PROP HMA DWY

PROP HMA DWY

PROP 5.5' HMA SIDEWALK

RET ROCK

PT +14.67

RET UP

R=10.00'

R=10.00'

R=10.00'

8.00'

PROP FDP (BID ALT)

PROP PARALLEL PARKING WITH HMA BERM (BID ALT)

RET EXIST WALK
SAWCUT
MEET EXIST PCR

PROP LANDSCAPE R&R FENCE

PROP HMA CURB
END DBYL STA 20+75

RET EXIST GRASS

PROP CEM CONC PCR

RET TREE

RET CURB

RET GRAN CURB

PROP CEM CONC PCR

MEET EXIST CONC

RET WALK

MEET EXIST

CW

SL

RET R1-1 AND D3-2

RET CURB

0 20 50 100

SCALE: 1" = 20'

14521.2_HD_TTCP.DWG Plotted on 26-Aug-2022 9:52 AM

TRAFFIC MANAGEMENT NOTES:

1. ALL TRAFFIC MANAGEMENT AND WORK ZONE TRAFFIC CONTROL MEASURES SHALL CONFORM TO THE REQUIREMENTS OF THE MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES (MUTCD) CURRENT EDITION WITH MASSACHUSETTS AMMENDMENTS, THE STANDARD SPECIFICATIONS, THE PROJECT SPECIAL PROVISIONS, AND THE FOLLOWING NOTES.
2. THE TRAFFIC MANAGEMENT PLANS CONTAINED HEREIN ARE GIVEN AS A GUIDE FOR TYPICAL WORK ZONE TRAFFIC CONTROL APPLICATIONS FOR THE TYPES OF WORK ANTICIPATED FOR THIS PROJECT. THEY ARE NOT INTENDED TO COVER ALL POSSIBLE CONSTRUCTION OPERATIONS WHICH THE CONTRACTOR MAY CHOOSE TO EMPLOY. WORK ZONE TRAFFIC CONTROL FOR OTHER CONSTRUCTION OPERATIONS OR OTHER TRAFFIC SITUATIONS IF APPLICABLE SHALL BE IN ACCORDANCE WITH THE MUTCD AND AS APPROVED OR DIRECTED BY THE ENGINEER.
3. NO CONSTRUCTION VEHICLES SHALL BE PARKED WITHIN THE TRAVEL WAY WITHOUT PROPER PROTECTION AND APPROVAL OF THE ENGINEER.
4. TEMPORARY CONSTRUCTION SIGNING AND ALL OTHER TRAFFIC CONTROL DEVICES SHALL BE IN PLACE PRIOR TO THE START OF ANY WORK.
5. ALL WARNING SIGNS SHALL BE BLACK LEGEND ON A REFLECTIVE ORANGE BACKGROUND AND IN ACCORDANCE WITH THE MUTCD. ALL REGULATORY SIGNS SHALL BE BLACK LEGEND ON A WHITE REFLECTIVE BACKGROUND. ALL CONSTRUCTION SIGNS SHALL BE ATTACHED TO THEIR OWN INDEPENDENT SUPPORTS UNLESS SHOWN OTHERWISE.
6. THE CONTRACTOR SHALL MAKE EVERY EFFORT TO AVOID PLACING TEMPORARY TRAFFIC CONTROL DEVICES ON PRIVATE PROPERTY. IF SUCH PLACEMENT ON PRIVATE PROPERTY IS UNAVOIDABLE, IT SHALL BE DONE WITH THE EXPLICIT APPROVAL OF THE PROPERTY OWNER AND THE ENGINEER.
7. ABUTTER ACCESS SHALL NOT BE CLOSED EXCEPT FOR SHORT PERIODS AND ONLY WITH THE APPROVAL OF THE ENGINEER. THE CONTRACTOR SHALL NOTIFY EACH ABUTTER AT LEAST 24 HOURS IN ADVANCE OF THE START OF ANY WORK THAT WILL REQUIRE THE TEMPORARY CLOSURE OF ACCESS, SUCH AS CONDUIT INSTALLATION, EXISTING PAVEMENT EXCAVATION, TEMPORARY DRIVEWAY PAVEMENT PLACEMENT AND SIMILAR OPERATIONS.
8. THE CONTRACTOR SHALL PROVIDE IMMEDIATE ACCESS TO EMERGENCY VEHICLES AT ALL TIMES.
9. GRADE DIFFERENCES IN EXCESS OF 2" DURING NON-WORKING HOURS WILL REQUIRE DELINEATION BY USE OF DRUMS.
10. GRADE DIFFERENCES IN EXCESS OF 4" DURING NON-WORKING HOURS SHALL BE PROTECTED BY BACKFILLING WITH A TRANSITION OF GRAVEL OR OTHER MATERIAL TO BE COMPACTED AT A 4:1 SLOPE, AND DELINEATED BY DRUMS.
11. CONSTRUCTION SIGNS NOT APPLICABLE TO VARIOUS STAGES OF CONSTRUCTION SHALL BE REMOVED OR COVERED.
12. USE MA-W20-7b SIGNS ONLY WHEN POLICE OFFICER IS DIRECTING TRAFFIC. THEY SHALL BE TAKEN DOWN OR COVERED AT THE CLOSE OF EACH OPERATION.
13. MAINTAIN PEDESTRIAN ACCESS THROUGH THE WORK AREA AT ALL TIMES. THE POLICE DETAIL SHALL PROVIDE CONTROL TO CROSS PEDESTRIANS ON ROADWAY TO SIDEWALK. PROVIDE TEMPORARY CROSSWALKS AND RAMPS AS NEEDED AND AS DIRECTED BY THE ENGINEER.
14. ALL CONSTRUCTION SIGNING AND OTHER TRAFFIC MAINTENANCE DEVICES SHALL CONFORM WITH THE 2009 MUTCD AS AMENDED, MASH, AND MASSDOT STANDARDS.
15. ADVANCE WARNING SIGNS NO LONGER APPLICABLE, WHICH MIGHT CREATE CONFUSION IN THE MINDS OF VEHICLE OPERATORS, SHALL EITHER BE COVERED OR REMOVED AS SOON AS POSSIBLE. NO SIGN SHALL BE VISIBLE TO TRAFFIC THAT MAY CONFLICT WITH ACTUAL ROADWAY CONDITIONS.
16. ALL DISTANCES MAY BE ADJUSTED TO FIT FIELD CONDITIONS AS DIRECTED BY THE ENGINEER.HOWEVER, MINIMUM DISTANCES, WHERE INDICATED, SHOULD BE MAINTAINED.
17. THE CONTRACTOR SHALL USE TEMPORARY PATCHING OR BEVELED STEEL PLATES TO COVER PIPE TRENCHES AND OTHER EXCAVATED HOLES NOT COMPLETED BY THE END OF EACH WORK DAY.
18. ALL DRUMS WITH FLASHERS, SIGNS AND SIGN SUPPORTS MUST PASS THE CRITERIA SET FORTH IN MASH RECOMMENDED PROCEDURES FOR THE SAFETY EVALUATION OF HIGHWAY FEATURES.
19. MINIMUM LANE WIDTH IS TO BE 10 FEET UNLESS OTHERWISE SHOWN. MINIMUM LANE WIDTH WILL BE MEASURED FROM THE EDGE OF DRUMS OR CONES.
20. ORANGE CONSTRUCTION FLAGS MAY BE USED ON ADVANCE WARNING SIGNS AS DIRECTED BY THE ENGINEER. FLAGS SHALL BE A MINIMUM OF 16" X 16".
21. MAINTAIN EXISTING PAVEMENT MARKINGS WHERE APPLICABLE. WHEN LANES SHIFT, IF NECESSARY, EXISTING MARKINGS SHALL BE REMOVED AND TEMPORARY PAVEMENT MARKING SHALL BE PROVIDED.
22. AT THE END OF EACH WORK DAY, NO TRAFFIC CONTROL DEVICES SHALL REMAIN IN THE ROADWAY AND ALL LANES SHALL BE OPEN FOR TRAFFIC FLOW.
23. THE CONTRACTOR MAY PROPOSE TO USE A DIFFERENT SEQUENCE OF WORK AREAS THAN WHAT IS BEING PROPOSED IN THESE DOCUMENTS. THE CONTRACTOR SHALL SUBMIT PHASING AND TRAFFIC MANAGEMENT PLANS FOR APPROVAL BY THE ENGINEER.
24. MAXIMUM SPACING OF CHANNELIZING DEVICES IN A TAPER IS EQUAL IN FEET TO THE SPEED LIMIT IN MPH. (20' SPACING TYPICAL ON TAPER, 35' SPACING TYPICAL ON TANGENTS.)
25. CHANNELIZATION WILL BE ACCOMPLISHED THROUGH THE USE OF REFLECTORIZED PLASTIC DRUMS OR CONES.
26. THE FIRST FIVE DRUMS OF A TAPER SHALL HAVE TYPE A LIGHTS.
27. POLICE DETAIL SHALL BE USED WHILE SETTING UP THE TEMPORARY TRAFFIC CONTROL DEVICES ON THE ROADWAY.
28. EACH WORK ZONE SHALL HAVE MA-R2-10a, MA-R2-10e, AND W-20 SERIES SIGNS WHERE APPLICABLE.
29. POLICE DETAILS SHALL BE EMPLOYED AND SHALL BE SUBSTITUTED WITH CERTIFIED ROADWAY FLAGGERS AS DIRECTED BY THE ENGINEER AND PER SECTION 850 "TRAFFIC CONTROLS FOR CONSTRUCTION AND MAINTENANCE OPERATIONS" IN THE MASSDOT SUPPLEMENTAL SPECIFICATIONS DATED JUNE 12, 2012.
30. THE ADVISORY SPEED LIMIT, IF REQUIRED, SHALL BE DETERMINED BY THE ENGINEER.
31. ALL DRIVEWAYS AND STREETS SHALL REMAIN OPEN AT ALL TIMES EXCEPT FOR SHORT PERIODS AS APPROVED BY THE ENGINEER.

SUGGESTED WORK ZONE WARNING SIGN SPACING

ROAD TYPE	DISTANCE BETWEEN SIGNS **		
	A	B	C
LOCAL OR LOW VOLUME ROADWAYS*	350 (100)	350 (100)	350 (100)
MOST OTHER ROADWAYS*	500 (150)	500 (150)	500 (150)
FREEWAYS AND EXPRESSWAYS*	1,000 (300)	1,500 (450)	2,640 (800)

* ROAD TYPE TO BE DETERMINED BY MASSDOT OFFICE OF TRANSPORTATION PLANNING.

** DISTANCES ARE SHOWN IN FEET (METERS). THE COLUMN HEADINGS A, B, AND C ARE THE DIMENSIONS SHOWN IN THE DETAIL/ TYPICAL SETUP FIGURES. THE A DIMENSION IS THE DISTANCE FROM THE TRANSITION OR POINT OF RESTRICTION TO THE FIRST SIGN. THE B DIMENSION IS THE DISTANCE BETWEEN THE FIRST AND SECOND SIGNS. THE C DIMENSION IS THE DISTANCE BETWEEN THE SECOND AND THIRD SIGNS. (THE "THIRD" SIGN IS THE FIRST ONE TYPICALLY ENCOUNTERED BY A DRIVER APPROACHING A TEMPORARY TRAFFIC CONTROL (TTC) ZONE.)

THE "THIRD" SIGN ABOVE IS TYPICALLY REFERRED TO AS AN "ADVANCE WARNING" SIGN ON THE TTCP SETUPS. THESE ADVANCE WARNING SIGNS ARE LOCATED PRIOR TO THE PROJECT LIMITS ON ALL APPROACHES (i.e. THE W20-1 SERIES (ROAD WORK XX FT) SIGNS), AND USUALLY REMAIN FOR THE DURATION OF THE PROJECT. ADDITIONAL SIGNS (i.e. "RIGHT LANE CLOSED 1 MILE" AND "LEFT LANE CLOSED 1 MILE") HAVE BEEN SHOWN IN SOME FIGURES AS EXAMPLES OF REINFORCEMENT SIGN PLACEMENT BUT ARE USED IN RARE OCCASIONS.

THE FIRST AND SECOND WARNING SIGNS ABOVE ARE REFERRED TO AS THE OPERATIONAL (DAY-TO-DAY) WORK ZONE SIGNS AND MAY BE MOVED DEPENDING ON WHERE THE SPECIFIC ROADWAY WORK FOR THAT DAY IS LOCATED.

R2-10a SIGNS SHALL BE PLACED BETWEEN THE SECOND AND THIRD SIGNS AS DESCRIBED ABOVE.

R2-10a, R2-10e, AND W20-1 SERIES SIGNS ARE TO BE INCLUDED ON ALL DETAILS/TYPICAL SETUPS.

TAPER LENGTH CRITERIA FOR TEMPORARY TRAFFIC CONTROL ZONES

TYPE OF TAPER	TAPER LENGTH (L)*
MERGING TAPER	AT LEAST L
SHIFTING TAPER	AT LEAST 0.5L
SHOULDER TAPER	AT LEAST 0.33L
ONE-LANE, TWO-WAY TRAFFIC TAPER	50 FT MIN.(15 m) 100 FT(30 m) MAX.
DOWNSTREAM TAPER	50 FT MIN.(15 m) 100 FT MAX.(30 m) PER LANE

FORMULAS FOR DETERMINING TAPER LENGTHS

SPEED LIMIT (S)	TAPER LENGTH (L) FEET
40 MPH OR LESS	$L = \frac{WS^2}{60}$
45 MPH OR MORE	$L = WS$

WHERE: L = TAPER LENGTH IN FEET

W = WIDTH OF OFFSET IN FEET

S = POSTED SPEED LIMIT, OR OFF-PEAK 85TH-PERCENTILE SPEED PRIOR TO WORK STARTING, OR THE ANTICAPATED OPERATING SPEED IN MPH (KM/H)

STOPPING SIGHT DISTANCE AS A FUNCTION OF SPEED

SPEED* (mph)	DISTANCE (ft)
20	115
25	155
30	200
35	250
40	305
45	360
50	425
55	495
60	570
65	645
70	730
75	820

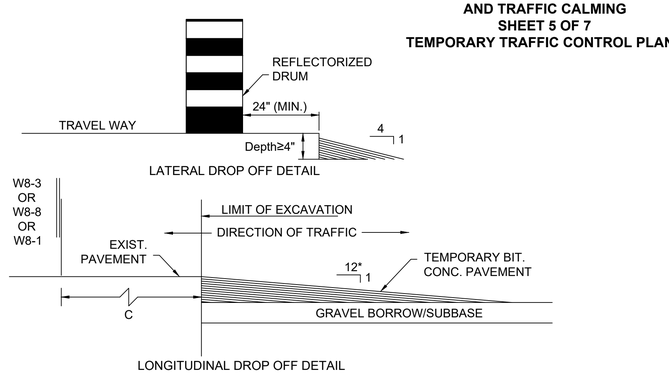
*POSTED SPEED, OFF-PEAK 85TH-PERCENTILE SPEED PRIOR TO WORK STARTING, OR THE ANTICIPATED OPERATING SPEED

THESE VALUES MAY BE USED TO DETERMINE THE LENGTH OF LONGITUDINAL BUFFER SPACES.

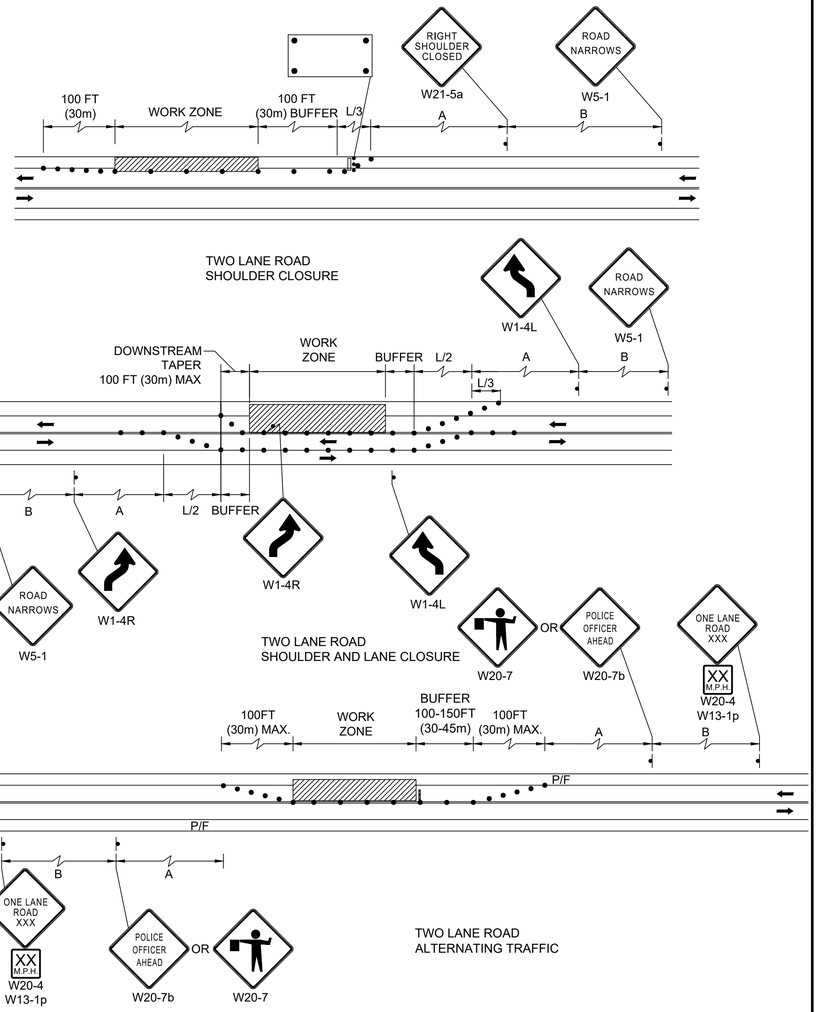
THE DISTANCES IN THE ABOVE CHART REPRESENT THE MINIMAL VALUES FOR BUFFER SPACING.

LEGEND:

- REFLECTORIZED PLASTIC DRUM OR 36" CONE
- P/F POLICE/FLAGGER DETAIL
- TYPE III BARRICADE
- CHANGEABLE MESSAGE SIGN
- ARROW BOARD
- WORK ZONE
- DIRECTION OF TRAFFIC
- IMPACT ATTENUATOR
- MEDIAN BARRIER
- MEDIAN BARRIER WITH WARNING LIGHTS
- WORK VEHICLE
- TRUCK MOUNTED ATTENUATOR
- TRAFFIC OR PEDESTRIAN SIGNAL
- SIGN



* - INCREASE SLOPE RATIO FOR HIGHER SPEEDS



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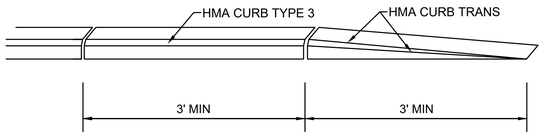
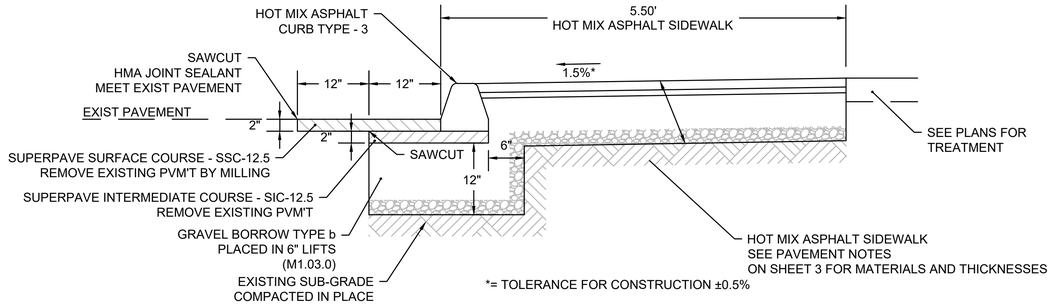


HOT MIX ASPHALT CURB TRANSITION

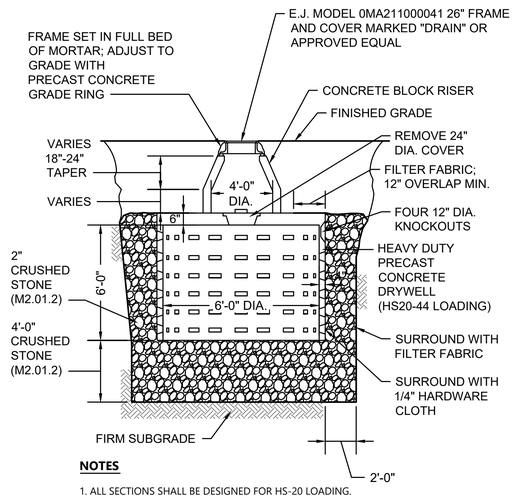
NTS



NOTES:
1. EXCAVATION, MILLING, AND GRAVEL BORROW, TYPE b FOR HMA CURB INSTALLATION SHALL BE INCLUDED UNDER THE CONTRACT UNIT PRICE FOR ITEM 570.3, HOT MIX ASPHALT CURB - TYPE 3.
2. HMA JOINT SEALANT SHALL BE PLACED AT ALL SAWCUT JOINTS WITH THE EXISTING PAVEMENT.
3. ASPHALT EMULSION FOR TACK COAT SHALL BE APPLIED AT A RATE OF 0.05 GAL/SY ON THE HMA INTERMEDIATE COURSES IMMEDIATELY BEFORE PLACEMENT OF THE HMA SURFACE COURSE. ASPHALT EMULSION FOR TACK COAT SHALL BE INCLUDED UNDER THE CONTRACT UNIT PRICE FOR ITEM 570.3, HOT MIX ASPHALT CURB - TYPE 3.
4. GRAVEL BORROW AND EXCAVATION FOR THE HMA SIDEWALK SHALL BE MEASURED AND PAID FOR UNDER ITEMS 120.1 & 151, RESPECTIVELY.
5. HMA SIDEWALK SHALL BE MEASURED AND PAID FOR UNDER ITEM 702.
6. LOAM BORROW AND SEEDING SHALL BE MEASURED AND PAID FOR UNDER ITEMS 751 & 765, RESPECTIVELY.

HMA CURB AND SIDEWALK IN EXISTING PAVEMENT

NTS

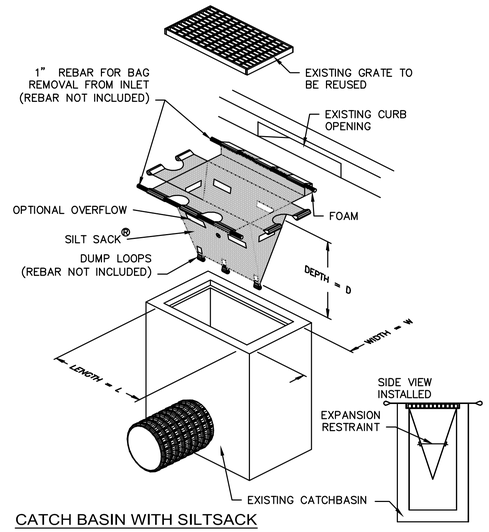


NOTES

1. ALL SECTIONS SHALL BE DESIGNED FOR HS-20 LOADING.
2. JOINT SEALANT BETWEEN PRECAST SECTIONS SHALL BE BUTYL RUBBER.
3. CRUSHED STONE, PRECAST CONCRETE DRYWELL, FILTER FABRIC, AND HARDWARE CLOTH SHALL BE INCLUDED IN THE UNIT BID PRICE FOR ITEM 205.

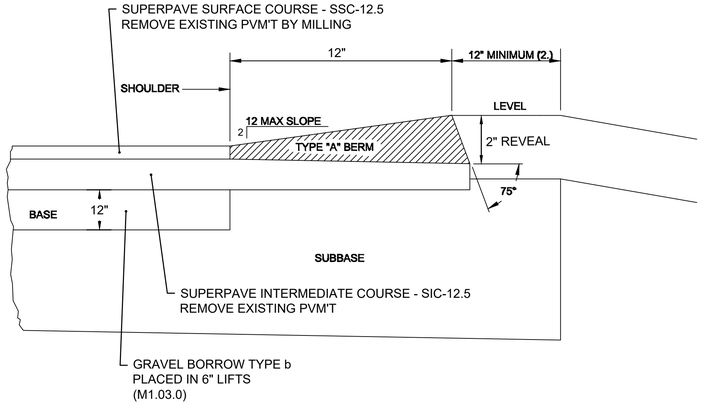
LEACHING BASIN

NTS



CATCH BASIN WITH SILTSACK
INLET PROTECTION

NOT TO SCALE



HOT MIX ASPHALT BERM

NTS

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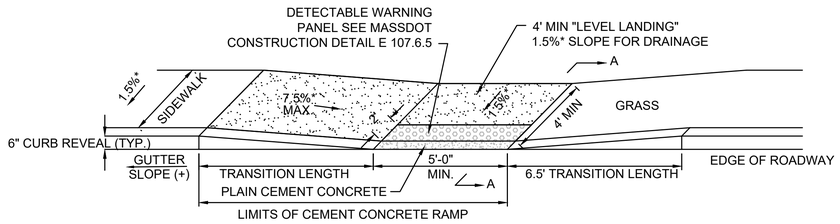
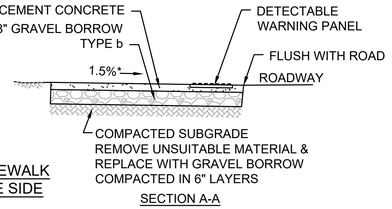


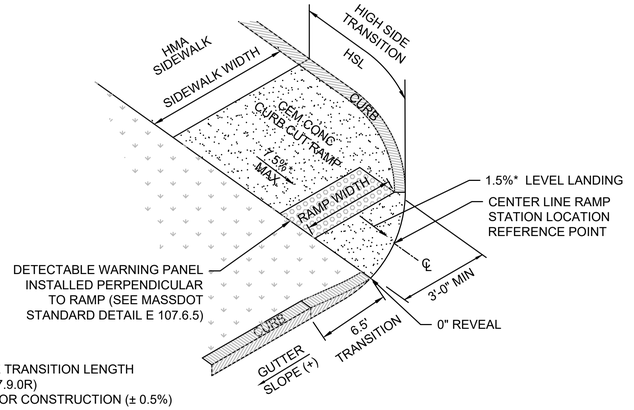
LEGEND
W = SIDEWALK WIDTH
* = TOLERANCE FOR CONSTRUCTION (± 0.5%)

NOTE:
1. SEE DRAWING E 107.2.1 AND E 107.6.5 OF THE MASSDOT CONSTRUCTION STANDARDS.



SECTION A-A

PEDESTRIAN CURB RAMP ON NARROW SIDEWALK
WITH DETECTABLE WARNING PANEL - ONE SIDE
NOT TO SCALE



LEGEND
HSL = HIGH SIDE TRANSITION LENGTH
(SEE E 107.9.0R)
* = TOLERANCE FOR CONSTRUCTION (± 0.5%)

PEDESTRIAN CURB RAMP FOR
ONE DIRECTION OF TRAVEL
NOT TO SCALE

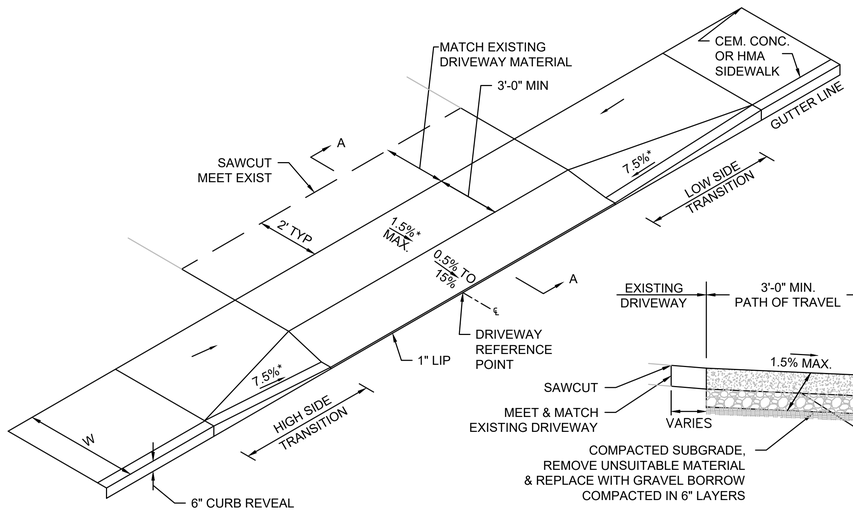
KEY:

AREA OF CEMENT CONCRETE PEDESTRIAN CURB RAMP (ITEM 701.2)

* TOLERANCE OF CONSTRUCTION ±0.5%

ROADWAY PROFILE GRADE %	HIGH SIDE TRANSITION LENGTH (FEET)
0	6'–6"
0–1	7'–8"
1–2	9'–0"
2–3	11'–0"
3–4	14'–0"
>4	15' (MAX.)

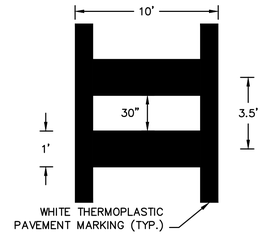
NOTE–BASED ON A DESIGN SLOPE OF 7.5% & A REVEAL OF 6"



SECTION A-A

LEGEND:
W = SIDEWALK WIDTH
CC = CEMENT CONCRETE
HMA = HOT MIX ASPHALT
HSL = HIGH SIDE TRANSITION LENGTH
(SEE MASSDOT STANDARD DETAIL E 107.9.0)
* = TOLERANCE FOR CONSTRUCTION (±0.5%)

SIDEWALK THROUGH DRIVEWAY
WITHOUT CURB RETURNS
NOT TO SCALE



STANDARD CROSSWALK
NOT TO SCALE

TRAFFIC SIGN SUMMARY

IDENTIFI–CATION NUMBER	SIZE OF SIGN		TEXT	TEXT DIMENSIONS (INCHES)			NUMBER OF SIGNS REQUIRED	COLOR			POST SIZE AND NUMBER REQUIRED	UNIT AREA (S.F.)	AREA IN SQUARE FEET
	WIDTH	HEIGHT		LETTER HEIGHT	VERTICAL SPACING	ARROW RTE. MKR.		BACK–GROUND	LEGEND	BORDER			
W11–2	30"	30"		PER LATEST MUTCD			4	FLOUR–ESCENT YELLOW/ GREEN	BLACK	BLACK	2	6.25	25.00
W16–7P(L)	24"	12"					2	FLOUR–ESCENT YELLOW/ GREEN	BLACK	BLACK	MOUNT W/ W11–2	2.00	4.00
W16–7P(R)	24"	12"					2	FLOUR–ESCENT YELLOW/ GREEN	BLACK	BLACK	MOUNT W/ W11–2	2.00	4.00

Appendix N – Estimated Cost for LPCP Implementation

Measure	Address/Location	Task/Action	Impervious Area (Acres)	LF of road (assumes 30-ft width)	Cost per LF	Total Cost	Total Cost by Year 8 (3 years)	Assumptions
Non-structural Controls								all streets swept 2x per year
Street Sweeping	Buffumville Lake	sweep streets once	4.8964	7,110	$ 0.02	$ 269.30	$ 807.91	assume $100 per curb mile
	Lowes Pond	sweep streets once	44.0265	63,926	$ 0.02	$ 2,421.46	$ 7,264.37	
	McKinstry Pond	sweep streets once	2.4562	3,566	$ 0.02	$ 135.09	$ 405.27	
	Robinson Pond	sweep streets once	0.6820	990	$ 0.02	$ 37.51	$ 112.53	
	Texas Pond	sweep streets once	11.3407	16,467	$ 0.02	$ 623.74	$ 1,871.22	
Catch Basin Cleaning	All pond watersheds	cleaning catch basins				$ 30,000.00	$ 90,000.00	assume $100 per structure; 287 structures cleaned in LPCP pond watersheds in 2022
Enhance leaf litter collection* (not necessarily street sweeping - "gather and remove all landscaeping wastes…")	Buffumville Lake	sweep streets once per week	4.8964	7,110	$ 0.02	$ 2,154.42	$ 6,463.25	sweep once per week for 16 weeks; assume $100 per curb mile
	Lowes Pond	sweep streets once per week	44.0265	63,926	$ 0.02	$ 19,371.66	$ 58,114.98	
	McKinstry Pond	sweep streets once per week	2.4562	3,566	$ 0.02	$ 1,080.73	$ 3,242.18	
	Robinson Pond	sweep streets once per week	0.6820	990	$ 0.02	$ 300.08	$ 900.24	
	Texas Pond	sweep streets once per week	11.3407	16,467	$ 0.02	$ 4,989.91	$ 14,969.72	
Subtotal - non-structural controls						**$ 61,383.89**	**$ 184,151.67**	
Structural Control - Town-owned Property	**Address/Location**	**Task/Action**		**runoff capacity (cu. Ft)**	**Cost per cu ft**	**Total Cost**	**Total Cost by Year 8**	**rain garden cost in 2023 = WQV to be treated * 19.685; does not include ongoing maintenance cost per year after construction**
Lowes Pond	F_556901_2867471_01 / 3 BARTON ST	construct BMP		16,108	$ 19.69	$ 317,085.98	$ 317,085.98	implement by year 8
Lowes Pond	F_557059_2868110_01 / 325 MAIN ST	construct BMP		63,776	$ 19.69	$ 1,255,430.56	$ 1,255,430.56	implement by year 8
Lowes Pond	F_557101_2868431_02 / 339 MAIN ST	construct BMP		53,250	$ 19.69	$ 1,048,226.25	$ 1,048,226.25	implement by year 8
Lowes Pond	F_557338_2873475_01 / 450 MAIN ST	construct BMP		66,878	$ 19.69	$ 1,316,493.43	$ 1,316,493.43	implement by year 8
Lowes Pond	F_557458_2869400_07 / 350 MAIN ST	construct BMP		54,024	$ 19.69	$ 1,063,462.44	$ 1,063,462.44	implement by year 8
Lowes Pond	F_557509_2869588_01 / 352 MAIN ST	construct BMP		45,170	$ 19.69	$ 889,171.45	$ 889,171.45	implement by year 8
Subtotal - structural controls, town-owned property						**$ 5,889,870.11**	**$ 5,889,870.11**	
Structural BMPs - Adjacent to Roads	**LF of Road in Watershed**	**Task/Action**		**WQV treated**	**Cost per cu ft**	**Total Cost**	**Total Cost by Year 8**	
Buffumville Pond	0	n/a		-	$ 19.69	$ -	$ -	
Lowes Pond	0	n/a		-	$ 19.69	$ -	$ -	
McKinstry Pond	930	construct BMP(s)		2,325.00	$ 19.69	$ 45,767.63	$ 45,767.63	
Robinson Pond	0	n/a		-	$ 19.69	$ -	$ -	
Texas Pond	0	n/a		-	$ 19.69	$ -	$ -	
Subtotal - structural controls adjacent to roadways						**$ -**	**$ -**	
GRAND TOTAL COST BY END OF YEAR 8							**$ 6,119,789.41**	