WATERSHED-BASED PLAN

Moose Meadow Brook

June 2021

Prepared By:

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Prepared For:

MassDEP
Commonwealth of Massachusetts
Department of Environmental Protection

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Contents

Executive Summary

Introduction: The purpose of a Massachusetts Watershed-Based Plan (WBP) is to organize information about Massachusetts' watersheds, and present the information in a format that will enhance the development and implementation of projects that will restore water quality and beneficial uses in the Commonwealth. The Massachusetts WBP follows the United States Environmental Protection Agency's (EPA's) recommended format for "nine-element" watershed plans. This WBP was developed by Geosyntec Consultants, Inc. (Geosyntec) under the direction of the Massachusetts Association of Conservation Districts (MACD) with funding, input, and collaboration from the Massachusetts Department of Environmental Protection (MassDEP).

This WBP was prepared for the approximately 8-square mile Moose Meadow Brook watershed (a tributary to the Westfield River) located in the Town of Montgomery and in the City of Westfield. Moose Meadow Brook flows through Westfield Reservoir in Montgomery and continues south where it flows through a culvert underneath the Massachusetts Turnpike (I-90) and through a culvert underneath a railroad track approximately 2 miles and 1,000 feet before the confluence with the Westfield River, respectively.

Impairments and Pollution Sources: Moose Meadow Brook is divided into two segments on the 2016 Massachusetts Integrated List of Waters (303(d) list). The upstream segment of Moose Meadow Brook (MA32-40) ends at the outlet of the Westfield Reservoir. The downstream segment (MA32-41) of Moose Meadow Brook begins at the outlet of Westfield Reservoir and ends at the confluence with the Westfield River. The downstream segment of Moose Meadow Brook (MA32-41) is identified as a category 5 water body on the 303(d) list due to Escherichia coli (*E. coli*) and Fecal Coliform from "agriculture" and "grazing in riparian or shoreline zones" sources. Water quality data from 2001, 2006, and 2014 indicated elevated levels of bacteria and Total Phosphorus (TP) [above the Massachusetts Water Quality Standards and EPA's "Gold Book"] in the downstream segment of Moose Meadow Brook (MA32-41). The upstream segment of Moose Meadow Brook (MA32-40) is not listed as impaired on the 303(d) list.

Goals, Management Measures, and Funding: The long-term goal of this WBP is to reduce *E. coli* and TP loading to Moose Meadow Brook, eventually leading to the delisting of Moose Meadow Brook from the 303(d) list by 2036. It is expected that these pollutant load reductions will result in improvements to other water quality parameters throughout the watershed as well.

It is expected that these goals will be accomplished primarily through installation of agricultural Best Management Practices (BMPs) to capture runoff and reduce *E. coli* loading as well as implementation of non-structural BMPs (e.g., street sweeping and catch basin cleaning), and watershed education and outreach to achieve additional pollutant load reductions. Agricultural BMP planning and implementation will initially be performed at various farms in the watershed, with funding from the Fiscal Year 2021 Section 319 grant program (MACD, 2020). MACD was awarded this funding to conduct outreach and education to farmers in the Moose Meadow Brook watershed; develop conservation plans outlining BMPs to reduce pollutant runoff; assist landowners in obtaining access to financial resources; and ensure farmers follow operation and maintenance practices (MACD, 2020).

It is expected that additional funding for management measures will be obtained from a variety of sources including Section 319 funding, Massachusetts Environmental Trust (MET) grants, the Agricultural Environmental Enhancement Program (AEEP), the Agricultural Produce Safety Improvement Program (APSIP), Town capital funds, volunteer efforts, and Natural Resources Conservation Service (NRCS) grants including the Environmental Quality Incentives Program (EQIP) and the Agricultural Management Assistance (AMA) program.

Public Education and Outreach: Goals of public education and outreach are to provide information about proposed stormwater improvements and their anticipated benefits and to promote watershed stewardship.

MACD will engage in outreach and dialogue with farmers in the Moose Meadow Brook watershed and share information about the availability of funds from MassDEP, the Massachusetts Department of Agricultural Resources (MDAR) and NRCS to implement BMPs to reduce contaminated runoff from agricultural operations. An initial stakeholder and outreach meeting was held on May 5, 2021, which included core stakeholders in the Moose Meadow Brook watershed, to introduce stakeholders to one another and gain consensus on elements of this WBP.

Implementation Schedule and Evaluation Criteria: The implementation schedule includes milestones for outreach and education; monitoring; development and implementation of farm conservation plans; assisting farmers in obtaining access to financial resources; and operation and maintenance plans and BMP implementation.

A water quality monitoring program will be established to understand the water quality in Moose Meadow Brook, including determining sources of pollution and tracking achievements toward water quality goals. The samples collected should primarily be analyzed for *E. coli* and TP. Additional parameters such as chlorophyll-a, dissolved oxygen, temperature, conductivity, pH, dissolved phosphorus, and flow rate could provide additional data to better understand the health of the watershed and Moose Meadow Brook. The water quality monitoring program should be focused in Moose Meadow Brook downstream of I-90.

The WBP will be re-evaluated and adjusted, as needed, once every three years to assess progress and determine whether modifications are required to meet the established goal.

Introduction

What is a Watershed-Based Plan?

Purpose & Need

The purpose of a Massachusetts Watershed-Based Plan (WBP) is to organize information about Massachusetts' watersheds, and present the information in a format that will enhance the development and implementation of projects that will restore water quality and beneficial uses in the Commonwealth. The Massachusetts WBP follows the United States Environmental Protection Agency's (EPA's) recommended format for "nine-element" watershed plans, as described below.

All states are required to develop WBPs, but not all states have taken the same approach. Most states develop WBPs only for selected watersheds. Massachusetts Department of Environmental Protection's (MassDEP's) approach has been to develop a tool to support statewide development of WBPs, so **that good projects in all areas of the state may be eligible for federal watershed implementation grant funds** under Section 319 of the Clean Water Act.

EPA guidelines promote the use of Section 319 funding for developing and implementing WBPs. WBPs are required for all projects implemented with Section 319 funds, and are recommended for all watershed projects, whether they are designed to protect unimpaired waters, restore impaired waters, or both.

Watershed-Based Plan Outline

This WBP for the Moose Meadow Brook watershed includes nine elements (a through i) in accordance with EPA Guidelines:

a) An **identification of the causes and sources** or groups of similar sources that will need to be controlled to achieve the load reductions estimated in this WBP (and to achieve any other watershed goals identified in the WBP), as discussed in item (b) immediately below.

b) An **estimate of the load reductions** expected for the management measures described under paragraph (c) below, recognizing the natural variability and the difficulty in precisely predicting the performance of management measures over time.

c) A **description of the nonpoint source management measures** needed to achieve the load reductions estimated under paragraph (b) above (as well as to achieve other watershed goals identified in this WBP, and an identification (using a map or a description) of the critical areas in which those measures will be needed to implement this plan.

d) An **estimate of the amounts of technical and financial assistance needed**, associated costs, and/or the sources and authorities that will be relied upon, to implement this plan. As sources of funding, States should consider the use of their Section 319 programs, State Revolving Funds, United States Department of Agriculture's (USDA's) Environmental Quality Incentives Program and Conservation Reserve Program, and other relevant federal, state, local and private funds that may be available to assist in implementing this plan.

e) An **information/education component** that will be used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the NPS management measures that will be implemented.

f) A **schedule for implementing the NPS management measures** identified in this plan that is reasonably expeditious.

g) A description of **interim, measurable milestones** for determining whether NPS management measures or other control actions are being implemented.

h) A set of **criteria to determine if loading reductions are being achieved** over time and substantial progress is being made towards attaining water quality standards and, if not, the criteria for determining whether this WBP needs to be revised or, if a nonpoint source Total Maximum Daily Load (TMDL) has been established, whether the TMDL needs to be revised.

i) A **monitoring component** to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item (h) immediately above.

Project Partners and Stakeholder Input

This WBP was developed by Geosyntec under the direction of the Massachusetts Association of Conservation Districts (MACD) with funding, input, and collaboration from MassDEP. This WBP was developed using funds from the Section 319 program to assist grantees in developing technically robust WBPs using MassDEP's Watershed-Based Planning Tool (WBP Tool). The MACD was a recipient of Section 319 funding in Fiscal Year 2021 to implement public outreach and education as well as farm conservation plans and agricultural BMPs in the Moose Meadow Brook Watershed.

The following are core project stakeholders:

- Michael Leff – MACD
- Dr. David Doe – Westfield Conservation Commission; Westfield State University Biology Department
- Meredith Borenstein – Westfield Conservation Commission
- Mark Damon – Westfield River Watershed Association (WRWA)
- Dianne Vedeo – WRWA
- Moe Boisseau – Moose Meadow Brook Farm, Westfield
- Jason Kappel – Peckham (subsidiary of John S. Lane & Son)
- Pete Barrett – Peckham (subsidiary of John S. Lane & Son)
- Peter Simoneau – Peckham (subsidiary of John S. Lane & Son)
- Matthew Reardon – MassDEP

This WBP was developed as part of an iterative process as outlined below:

- The Geosyntec project team first collected and reviewed existing data from MACD and other available sources.
- Subsequently, a stakeholder meeting was held on May 5, 2021 to solicit additional input and gain consensus on elements included in the plan (i.e., identifying problem areas, BMP projects, water quality goals, public outreach activities, etc.). The meeting minutes from the stakeholder conference call are included in **Appendix A**.
- Next, a WBP was drafted and reviewed by MassDEP.

- The WBP was then finalized based on MassDEP input.

Data Sources

This WBP was developed using the framework and data sources provided by MassDEP's WBP Tool and supplemented by information provided in the Section 319 grant application for "Western Massachusetts Agricultural Nonpoint Source Program" (MACD, 2020).

Element A: Identify Causes of Impairment & Pollution Sources

Element A: Identify the causes and sources or groups of similar sources that need to be controlled to achieve the necessary pollutant load reductions estimated in the watershed based plan (WBP).

General Watershed Information

This WBP was prepared for the Moose Meadow Brook watershed (a tributary to the Westfield River) located in the Town of Montgomery and in the City of Westfield. Moose Meadow Brook flows through Westfield Reservoir in Montgomery and continues south where it flows through a culvert underneath the Massachusetts Turnpike (I-90) and through a culvert underneath a railroad track approximately 2 miles and 1,000 feet before the confluence with the Westfield River, respectively. The total area of Moose Meadow Brook watershed is approximately 5,091 acres (approximately 8 square miles).

Moose Meadow Brook is divided into two segments on the 2016 Massachusetts Integrated List of Waters (303(d) list). The upstream segment of Moose Meadow Brook (MA32-40) ends at the outlet of the Westfield Reservoir. The downstream segment (MA32-41) of Moose Meadow Brook begins at the outlet of Westfield Reservoir and ends at the confluence with the Westfield River.

Table A-1 presents the general watershed information for the Moose Meadow Brook watershed[1] and **Figure A-1** includes a map of the watershed boundary.

Table A-1: General Watershed Information

Watershed Name (Assessment Unit ID):	Moose Meadow Brook (MA32-40, MA32-41)
Major Basin:	Westfield
Watershed Area (within MA):	5,091 acres

[1] Watersheds are defined by the WBP-tool by using MassGIS drainage sub-basins.

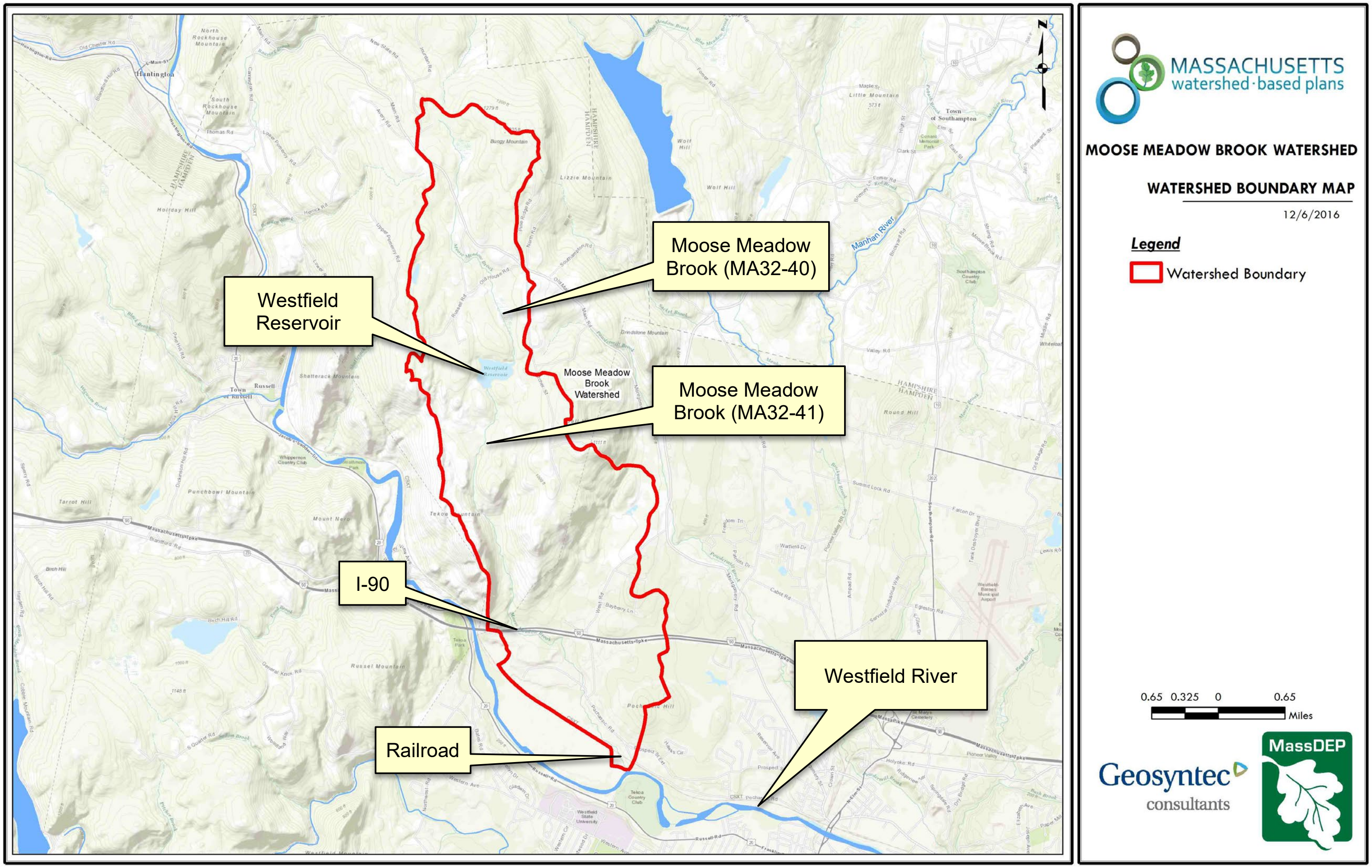

Figure A-1: Watershed Boundary Map

(MassGIS, 2007; MassGIS, 1999; MassGIS, 2001; USGS, 2016)

MassDEP Water Quality Assessment Report and TMDL Review

Appendix B includes select excerpts from the Westfield River Watershed 2001 Water Quality Assessment Report (MassDEP, 2001) relating to water quality data and recommendations for Moose Meadow Brook (MA32-40, MA32-41)[2]. As detailed in **Appendix B**, surface water quality sampling data was collected from the downstream section of Moose Meadow Brook (MA32-41) and the sample result concentrations of TP and Fecal coliform were elevated above the EPA "Gold Book" standard for TP (EPA, 1986) and the Massachusetts Surface Water Quality Standards ((314 CMR 4.00, 2013). This report also recommended that landowners be encouraged to implement agricultural BMPs in this watershed to protect riparian areas and prevent agricultural runoff and streambank erosion. In addition, the report recommended to continue conducting bacteria monitoring to assess the Primary and Secondary Contact Recreational uses and to evaluate the bacteria reduction effectiveness of agricultural BMPs that are put into practice. The report also recommended that Moose Meadow Brook should be considered for designation as a Cold Water (CW) fishery in the next revision of the Massachusetts Surface Water Quality Standards.

Moose Meadow Brook watershed does not have a TMDL.

Water Quality Impairments and Pollution Sources

Impairment categories from the 2016 303(d) list are listed in **Table A-2**. Known water quality impairments for Moose Meadow Brook, as documented in the 2016 303(d) list are listed in **Table A-3,** which indicates that the downstream segment of Moose Meadow Brook (MA32-41) is identified as a category 5 water body due to Escherichia coli *(E. coli*) and Fecal Coliform from "agriculture" and "grazing in riparian or shoreline zones" sources. The upstream segment of Moose Meadow Brook is not listed as impaired on the 303(d) list.

In addition to the agricultural and grazing sources, other potential pollution sources to Moose Meadow Brook that were discussed during the stakeholder meeting on May 5, 2021 (meeting minutes included in **Appendix A**) included stormwater discharges from municipal separate storm sewer system (MS4) outfalls and septic systems. The quarry in the southwestern portion of the watershed could also be a potential source, but representatives of Peckham indicated during the stakeholder meeting that the quarry has been graded to eliminate any discharges to Moose Meadow Brook, and they maintain a series of BMPs internal to their property. Additionally, according to an observation that was stated during the stakeholder meeting, there is visible evidence of elevated levels of salt in Moose Meadow Brook downstream of I-90 due to road salting of this highway. Finally, there was and possibly still is a sizable pigeon population that roosts underneath the bridge on Pochassic Road (Westfield State University, 2014).

[2] Moose Meadow Brook was formerly identified with Assessment Unit ID MA32-23; in the 2016 revision of the 303(d) List, it was divided into two segments: MA32-40 and MA32-41.

Table A-2: 2016 MA Integrated List of Waters Categories

Integrated List Category	Description
1	Unimpaired and not threatened for all designated uses.
2	Unimpaired for some uses and not assessed for others.
3	Insufficient information to make assessments for any uses.
4	Impaired or threatened for one or more uses, but not requiring calculation of a Total Maximum Daily Load (TMDL), including: 4a: TMDL is completed 4b: Impairment controlled by alternative pollution control requirements 4c: Impairment not caused by a pollutant - TMDL not required
5	Impaired or threatened for one or more uses and requiring preparation of a TMDL.

Table A-3: 2016 MA Integrated List of Waters Water Quality Impairments

Assessment Unit ID	Waterbody	Integrated List Category	Designated Use	Impairment Cause	Impairment Source
MA32-41	**Moose Meadow Brook**	**5**	**Primary Contact Recreation**	**Escherichia Coli (E. Coli)**	**Agriculture**
MA32-41	**Moose Meadow Brook**	**5**	**Primary Contact Recreation**	**Escherichia Coli (E. Coli)**	**Grazing in Riparian or Shoreline Zones**
MA32-41	**Moose Meadow Brook**	**5**	**Primary Contact Recreation**	**Fecal Coliform**	**Agriculture**
MA32-41	**Moose Meadow Brook**	**5**	**Primary Contact Recreation**	**Fecal Coliform**	**Grazing in Riparian or Shoreline Zones**
MA32-41	**Moose Meadow Brook**	**5**	**Secondary Contact Recreation**	**Escherichia Coli (E. Coli)**	**Agriculture**
MA32-41	**Moose Meadow Brook**	**5**	**Secondary Contact Recreation**	**Escherichia Coli (E. Coli)**	**Grazing in Riparian or Shoreline Zones**
MA32-41	**Moose Meadow Brook**	**5**	**Secondary Contact Recreation**	**Fecal Coliform**	**Agriculture**
MA32-41	**Moose Meadow Brook**	**5**	**Secondary Contact Recreation**	**Fecal Coliform**	**Grazing in Riparian or Shoreline Zones**

Additional Water Quality Data

Additional water quality data collected by MassDEP from 2005 through 2011 (MassDEP, 2012; MassDEP, 2017, and MassDEP, Undated), as well as water quality data collected by Crystal Birdsall, a student at Westfield State University (Westfield State University, 2014), is described below. The MassDEP samples were collected at Station ID W0812, which is located at the mouth of Moose Meadow Brook where it enters the Westfield River.

MassDEP collected five *E. coli* water quality samples at Station W0812, from May 9, 2006 through October 3, 2006, and the results are presented in **Table A-4**. The geometric mean of the five samples exceeded the Massachusetts Surface Water Quality Standards (314 CMR 4.00, 2013) for *E. coli,* which indicate that the geometric mean of samples from most recent 6 months shall not exceed 126 colonies/100 ml (typically based on min. 5 samples) and no single sample shall exceed 235 colonies/100 ml.

MassDEP also collected dissolved oxygen (DO) water quality samples for three five-day periods in 2006 at Station W0812, and the results are presented in **Table A-5**. The results from the July and August sampling events had minimum DO concentrations that did not meet the Massachusetts Surface Water Quality Standards for cold water fisheries (CW), which states that DO should not be less than 6.0 milligrams per liter (mg/L). However, the daily mean minimum DO concentrations did meet these standards.

In addition, MassDEP collected total phosphorus (TP) water quality samples in 2006, and results are presented in **Table A-6**. The average TP concentration was below the TP EPA "Gold Book" (EPA, 1986) standard of 50 micrograms per liter (µg/L). The maximum TP concentration from the five samples exceeded this standard.

Crystal Birdsall, a student at Westfield State University, collected water quality samples for *E. Coli* in the Moose Meadow Brook watershed at the locations shown in **Figure A-2** and **Figure A-3** from June through August 2014. Results from the sampling are shown below in **Table A-7**. Many of the samples exceeded the Massachusetts Surface Water Quality Standards (314 CMR 4.00, 2013) for *E. coli*.

Table A-4: Moose Meadow Brook Water Quality Data (*E. coli)*

Station ID	Year	Date First Sample	Date Last Sample	Sample Count	Geometric Mean (colonies/100 mL)
W0812	2006	5/9/2006	10/3/2006	5	1,261

Sources: MassDEP, 2012; MassDEP, 2017

"colonies/100mL" = colony forming units per 100 milliliters

Table A-5: Moose Meadow Brook Water Quality Data (Dissolved Oxygen)

Station ID	Start Date	Days	Minimum DO (mg/L)	Daily Mean Minimum DO (mg/L)	Maximum Daily DO Shift (mg/L)	Mean DO (mg/L)	Maximum Saturation (%)
W0812	6/9/2006	5	8.5	8.85	1.13	9.38	100.8
W0812	7/21/2006	5	3.98	5.72	3.67	7.03	94.9
W0812	8/25/2006	5	4.62	5.98	3.21	7.26	85.6

Sources: MassDEP, Undated; MassDEP, 2017

"mg/L' = milligrams per Liter.

Table A-6: Moose Meadow Brook Water Quality Data (Total Phosphorus)

Station ID	Year	Sample Count	TP Average (µg/L)	TP Max (µg/L)
W0812	2006	5	42	84

Sources: MassDEP, Undated; MassDEP, 2017

"µg/L' = micrograms per Liter.

Figure A-2: Moose Meadow Brook Sampling Locations

(Westfield State University, 2014)

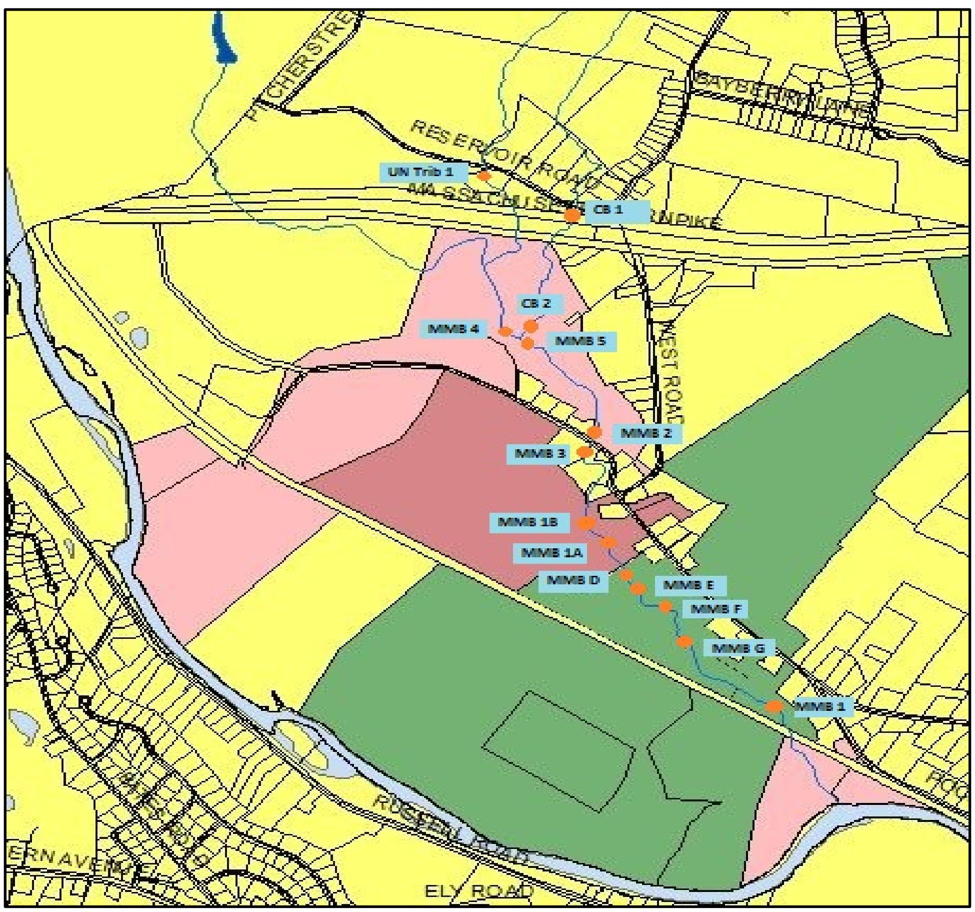

Figure A-3: Moose Meadow Brook, Cooley Brook, and Unnamed Tributary Sampling Locations

(Westfield State University, 2014)

Table A-7: Moose Meadow Brook, Cooley Brook, and Unnamed Tributary Water Quality Data

Site	Date	Actual Number of *E. coli* (colonies/100 ml)
MMB 1	6/10/14	665.3
MMB 1	6/10/14	1,011.2
MMB 1	6/26/14	2,317.6
MMB 1	6/26/14	1,513.6
MMB 1	7/7/14	10,170
MMB 1	7/7/14	2,661.2
MMB 1	8/12/14	615.2
MMB 1	8/12/14	750
MMB 1	8/12/14	456.4
MMB 1	8/12/14	1,100
MMB 1A	8/4/14	2,240
MMB 1A	8/4/14	2,022.4
MMB 1B	8/4/14	860
MMB 1B	8/4/14	270.8
MMB 1D	8/12/14	4,839.2
MMB 1D	8/12/14	10,190
MMB 1E	8/12/14	3,972.6
MMB 1E	8/12/14	8,130
MMB 1F	8/12/14	976.8
MMB 1F	8/12/14	1,990
MMB 1F	8/12/14	976.8
MMB 1F	8/12/14	2,790
MMB 1G	8/12/14	689.6
MMB 1G	8/12/14	2,010
MMB 2	6/10/14	51.2
MMB 2	6/26/14	227.9
MMB 2	7/7/14	218.7
MMB 3	6/10/14	71.7
MMB 3	6/26/14	1,046.2
MMB 3	7/7/14	201.4
MMB 3	7/7/14	260.3
MMB 3	8/4/14	214.2
MMB 3	8/4/14	270
MMB 4	6/26/14	123.6
MMB 4	7/7/14	85.7
MMB 4	8/4/14	59.1
MMB 4	8/4/14	63.1
MMB 5	6/26/14	107.6
MMB 5	7/7/14	55.6
MMB 6	6/26/14	107.6
MMB 6	6/26/14	95.9
MMB 6	7/7/14	37.3
MMB 6	8/4/14	15.8
CB 1	6/10/14	29.1

Site	Date	Actual Number of *E. coli* (colonies/100 ml)
CB 1	6/10/14	32.7
CB 1	6/10/14	26.2
CB 1	6/26/14	325.5
CB 1	7/7/14	104.6
CB 1	7/7/14	93.3
CB 1	8/4/14	272.3
CB 2	8/4/14	125.9
CB 2	7/7/14	238.2
UNT 1	6/10/14	96
UNT 1	6/26/14	275.5
UNT 1	7/7/14	73.3
UNT 1	8/4/14	524.7
Minimum		15.8
Maximum		10,190.0
Median		271.6
Mean		1,227.7

Source: Westfield State University, 2014

Water Quality Goals

Water quality goals may be established for a variety of purposes, including the following:

a) For **waterbodies with known impairments**, a TMDL is established by MassDEP and EPA as the maximum amount of the target pollutant that the waterbody can receive and still safely meet water quality standards. If the waterbody has a TMDL for TP or total nitrogen (TN), or total suspended solids (TSS), that information is provided below and included as a water quality goal.
b) For **waterbodies without a TMDL for** TP, a default water quality goal for TP is based on target concentrations established in the Quality Criteria for Water (EPA, 1986) (also known as the "Gold Book"). The Gold Book states that TP should not exceed 50 µg/L in any stream at the point where it enters any lake or reservoir, nor should TP exceed 25 µg/L within a lake or reservoir. For the purposes of developing WBPs, MassDEP has adopted 50 µg/L as the TP target for all streams at their downstream discharge point, regardless of which type of water body the stream discharges to.
c) Massachusetts Surface Water Quality Standards (314 CMR 4.00, 2013) prescribe the minimum water quality criteria required to sustain a waterbody's designated uses. Moose Meadow Brook is a Class 'B' waterbody. The water quality goals for *E. coli* bacteria are based on the Massachusetts Surface Water Quality Standards.
d) **Other water quality goals set by the community** (e.g., protection of high-quality waters, in-lake TP concentration goal to reduce recurrence of cyanobacteria blooms, etc.).

Based on the Moose Meadow Brook impairment and water quality data identified above, water quality goals were identified for TP and bacteria (*E. coli*) and are listed in **Table A-8**. Element C of this WBP includes proposed management measures to address these water quality goals.

Table A-8: Water Quality Goals

Pollutant	Goal	Source
Total Phosphorus (TP)	Total phosphorus should not exceed: --50 ug/L in any stream --25 ug/L within any lake or reservoir	Quality Criteria for Water (USEPA, 1986)
Bacteria	**Class B Standards** • Public Bathing Beaches: For E. coli, geometric mean of 5 most recent samples shall not exceed 126 colonies/ 100 ml and no single sample during the bathing season shall exceed 235 colonies/100 ml. For enterococci, geometric mean of 5 most recent samples shall not exceed 33 colonies/100 ml and no single sample during bathing season shall exceed 61 colonies/100 ml; • Other Waters and Non-bathing Season at Bathing Beaches: For E. coli, geometric mean of samples from most recent 6 months shall not exceed 126 colonies/100 ml (typically based on min. 5 samples) and no single sample shall exceed 235 colonies/100 ml. For enterococci, geometric mean of samples from most recent 6 months shall not exceed 33 colonies/100 ml, and no single sample shall exceed 61 colonies/100 ml.	Massachusetts Surface Water Quality Standards (314 CMR 4.00, 2013)

Land Use Information

Land use information and impervious cover is presented in the below tables and figures. Land use source data is from 2005 and was obtained from MassGIS (2009a).

Watershed Land Uses

Land use in the Moose Meadow Brook watershed is mostly forested (approximately 83 percent); approximately 9 percent of the watershed is agricultural; approximately 4 percent of the watershed is low density residential; approximately 2 percent of the watershed is open land or water; approximately 2 percent of the watershed is industrial or commercial; and approximately 1 percent of the watershed is designated as highways (**Table A-9; Figure A-3**). The majority of the agricultural land is concentrated in the downstream portion of the watershed.

Table A-9: Subwatershed Land Uses

Land Use	Area (acres)	% of Watershed
Forest	4,207	82.6
Agriculture	451	8.9
Low Density Residential	206	4
Industrial	78	1.5
Water	56	1.1
Highway	52	1
Open Land	37	0.7
Commercial	4	0.1
High Density Residential	0	0
Medium Density Residential	0	0

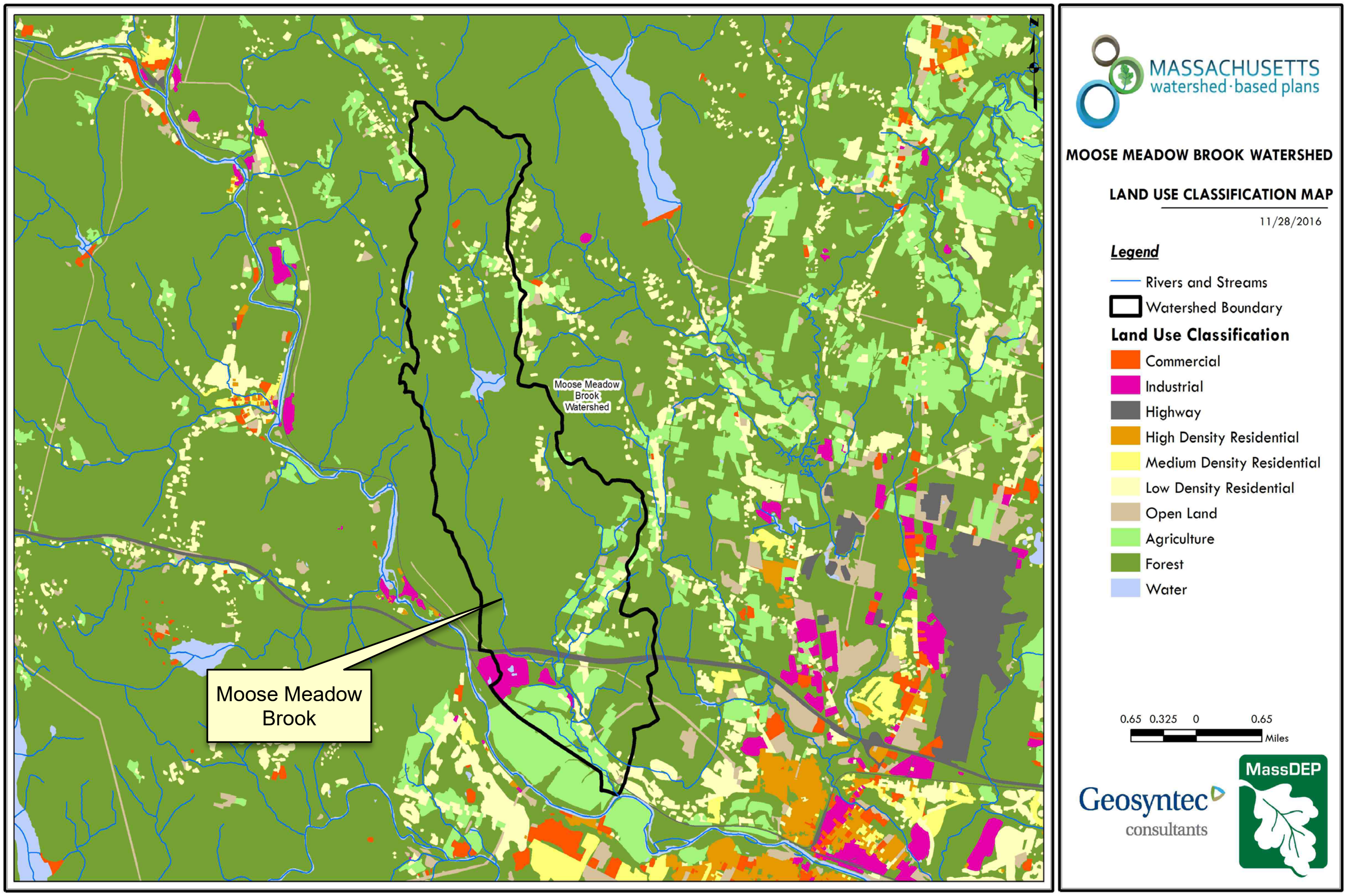

Figure A-3: Subwatershed Land Use Map

(MassGIS, 2007; MassGIS, 2009a; MassGIS, 1999; MassGIS, 2001; USGS, 2016)

Watershed Impervious Cover

There is a strong link between impervious land cover and stream water quality. Impervious cover includes land surfaces that prevent the infiltration of water into the ground, such as paved roads and parking lots, roofs, basketball courts, etc. Impervious area within the Moose Meadow Brook watershed is mainly associated with roadways. **Figure A-4** is an impervious cover map for Moose Meadow Brook watershed. The larger impervious area in the southwestern section corresponds to the John S. Lane and Son, Inc. quarry, which is mischaracterized as impervious and should be classified as pervious (since the surface of the quarry mainly consists of gravel, which is capable of infiltrating water)[3].

Impervious areas that are directly connected (DCIA) to receiving waters (via storm sewers, gutters, or other impervious drainage pathways) produce higher runoff volumes and transport stormwater pollutants with greater efficiency than disconnected impervious cover areas which are surrounded by vegetated, pervious land. Runoff volumes from disconnected impervious cover areas are reduced as stormwater infiltrates when it flows across adjacent pervious surfaces.

An estimate of DCIA for the watershed was calculated based on the Sutherland equations. EPA provides guidance (EPA, 2010) on the use of the Sutherland equations to predict relative levels of connection and disconnection based on the type of stormwater infrastructure within the total impervious area (TIA) of a watershed. The estimated TIA and DCIA for the Moose Meadow Brook watershed is 3.4 percent and 2.5 percent, respectively.

The relationship between TIA and water quality can generally be categorized as listed by **Table A-10** (Schueler et al. 2009). The TIA value for the watershed range is 3.4%; therefore, Moose Meadow Brook and its tributaries can be expected to show good to excellent water quality. It is likely there is better water quality in the upstream forested parts of the watershed while more downstream developed areas have poorer water quality.

[3] This was discussed during the stakeholder meeting that was held on May 5, 2021.

Table A-10: Relationship between Total Impervious Area (TIA) and water quality (Schueler et al. 2009)

% Watershed Impervious Cover	Stream Water Quality
0-10%	Typically high quality, and typified by stable channels, excellent habitat structure, good to excellent water quality, and diverse communities of both fish and aquatic insects.
11-25%	These streams show clear signs of degradation. Elevated storm flows begin to alter stream geometry, with evident erosion and channel widening. Streams banks become unstable, and physical stream habitat is degraded. Stream water quality shifts into the fair/good category during both storms and dry weather periods. Stream biodiversity declines to fair levels, with most sensitive fish and aquatic insects disappearing from the stream.
26-60%	These streams typically no longer support a diverse stream community. The stream channel becomes highly unstable, and many stream reaches experience severe widening, downcutting, and streambank erosion. Pool and riffle structure needed to sustain fish is diminished or eliminated and the substrate can no longer provide habitat for aquatic insects, or spawning areas for fish. Biological quality is typically poor, dominated by pollution tolerant insects and fish. Water quality is consistently rated as fair to poor, and water recreation is often no longer possible due to the presence of high bacteria levels.
>60%	These streams are typical of "urban drainage", with most ecological functions greatly impaired or absent, and the stream channel primarily functioning as a conveyance for stormwater flows.

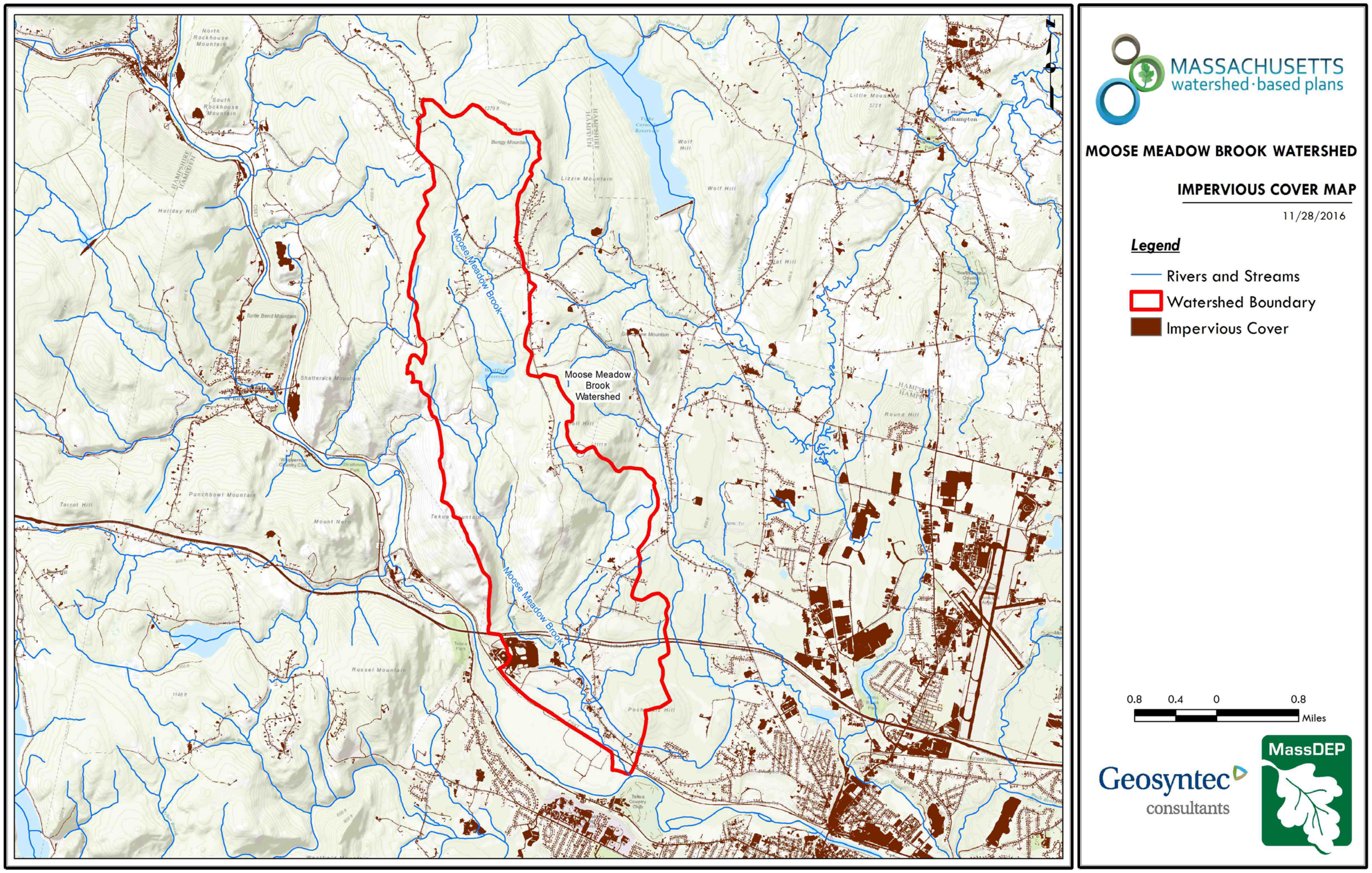

Figure A-4: Subwatershed Impervious Surface Map

(MassGIS, 2007; MassGIS, 2009b; MassGIS, 1999; MassGIS, 2001; USGS, 2016)

Pollutant Loading

The land use data (MassGIS, 2009a) was intersected with impervious cover data (MassGIS, 2009b) and United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) soils data (USDA NRCS and MassGIS, 2012) to create a combined land use/land cover grid. The grid was used to sum the total area of each unique land use/land cover type.

The amount of DCIA was estimated using the Sutherland equations as described above and any reduction in impervious area due to disconnection (i.e., the area difference between TIA and DCIA) was assigned to the pervious D soil category for that land use to simulate that some infiltration will likely occur after runoff from disconnected impervious surfaces passes over pervious surfaces.

Pollutant loading for key nonpoint source pollutants in the watershed was estimated by multiplying each land use/cover type area by its pollutant load export rate (PLER). The PLERs are an estimate of the annual total pollutant load exported via stormwater from a given unit area of a particular land cover type. The PLER values for TN, TP and TSS were obtained from USEPA (Voorhees, 2016b) (see documentation provided in **Appendix C**) as follows:

$$L_n = A_n * P_n$$

Where L_n = Loading of land use/cover type n (lbs/yr); A_n = area of land use/cover type n (acres); P_n = pollutant load export rate of land use/cover type n (lb/acre/yr)

The estimated land use-based TP loading to Moose Meadow Brook within the watershed area is 945 lbs/yr, as presented by **Table A-11**. The largest contributor of the land use-based TP, TN, and TSS load originates from areas designated as forested. TP and TN generated from forested areas is generally a result of natural processes such as decomposition of leaf litter and other organic material; therefore, the forested portions of the watershed are unlikely to provide opportunities for nutrient load reductions through BMPs. Agricultural areas are the second largest contributors of the land use-based TP and TN load in the watershed. Agricultural areas provide excellent opportunities for nutrient load reductions through agricultural BMPs as described in the sections below.

Table A-11: Estimated Pollutant Loading for Key Nonpoint Source Pollutants

Land Use Type	Pollutant Loading[1]		
	Total Phosphorus (TP) (lbs/yr)	Total Nitrogen (TN) (lbs/yr)	Total Suspended Solids (TSS) (tons/yr)
Forest	542	2,665	149.1
Agriculture	221	1,328	13.7
Industrial	88	759	9.5
Low Density Residential	61	611	8.2
Highway	22	189	9.6
Open Land	8	82	1.5
Commercial	4	34	0.4
High Density Residential	0	0	0
Medium Density Residential	0	0	0
TOTAL	945	5,667	192.0

[1]These estimates do not consider loads from point sources or septic systems.

It is important to note that pollutant loads presented in **Table A-11** do not consider loads from point sources or septic systems. In the Moose Meadow Brook watershed, septic systems have been identified as a potential source of pollutant loading since they are used in most of the watershed, except for a small area in the southeastern part of the watershed in Westfield, Massachusetts that is connected to the sanitary sewer system (Westfield GIS, 2021). Septic system sources should be separately evaluated to determine whether septic system upgrades or sanitary sewer system conversion would cost-effectively reduce bacteria and nutrient sources in the watershed.

Element B: Determine Pollutant Load Reductions Needed to Achieve Water Quality Goals

Element B of your WBP should:

Determine the pollutant load reductions needed to achieve the water quality goals established in Element A. The water quality goals should incorporate Total Maximum Daily Load (TMDL) goals, when applicable. For impaired water bodies, a TMDL establishes pollutant loading limits as needed to attain water quality standards.

Estimated Pollutant Loads

Estimated pollutant loads for TP (945 lbs/yr), TN (5,667 lbs/yr), and TSS (192 tons/yr) were previously presented in **Table A-12** of this WBP. *E. coli* loading has not been estimated for this WBP, because there are no known PLERs for *E. coli*.

Water Quality Goals and Required Load Reduction

There are many methodologies that can be used to set pollutant load reduction goals for a WBP. Goals can be based on water quality criteria, surface water standards, existing monitoring data, existing TMDL criteria, or other data. As discussed in Element A, water quality goals for this WBP are focused on reducing *E. coli* and TP loading to Moose Meadow Brook. The water quality goals and corresponding required loading reductions are included in **Table B-1**.

The method used in the WBP tool[4] for calculating a water quality goal for TP produces a water quality goal of 1,423 lbs/yr, which is greater than the estimated TP load of 945 lbs/yr. Given the iterative and adaptive nature of this WBP, the monitoring portion of this WBP (**Element I**) recommends that monitoring be performed to better understand the existing TP loading to Moose Meadow Brook, which may help establish a specific TP related water quality goal with the next update of the WBP (expected in 2024). In the interim, a 10 percent reduction in the estimated watershed loading to 850 lbs/yr is proposed to improve the water quality within Moose Meadow Brook.

[4] According to the USEPA Gold Book, TP should not exceed 50 ug/L in any stream at the point where it enters any lake or reservoir. The WBP tool estimated the water quality loading goal by multiplying this target maximum TP concentration (50 ug/L) by the estimated annual watershed discharge for the Moose Meadow Brook watershed. To estimate the annual watershed discharge, the mean flow was used, which was estimated based on United States Geological Survey (USGS) “Runoff Depth” estimates for Massachusetts (Cohen and Randall, 1998). Cohen and Randall (1998) provide statewide estimates of annual Precipitation (P), Evapotranspiration (ET), and Runoff (R) depths for the northeastern U.S. According to their method, Runoff Depth (R) is defined as all water reaching a discharge point (including surface and groundwater), and is calculated by: P - ET = R. A mean Runoff Depth R was determined for the watershed by calculating the average value of R within the watershed boundary.

The proposed projects described in this WBP are expected to reduce both *E. coli* and TP loads to Moose Meadow Brook; however, additional load reductions may be required to meet the water quality goals.

The following adaptive sequence is recommended to sequentially track and meet these load reduction goals:

1. Given current water quality conditions, establish an **interim goal** to reduce land use-based TP by 10 percent (95 lbs/yr) over the next 10 years (by 2031).

2. Given current water quality conditions, establish an **interim goal** to reduce the geometric mean concentration of *E. coli* by 50 percent over the next 10 years (by 2031).

3. Establish a baseline water quality monitoring program in accordance with **Element I**. Results from the monitoring program should advise if **Element C** management measures have been effective at addressing listed water quality impairments or water quality goals for other indicator parameters established by **Table A-5** of this WBP (e.g., TP and *E. coli*). Results can further be used to periodically inform or adjust load reduction goals.

4. Establish a **long-term reduction goal** to reduce land-use-based TP and *E. coli* over the next 15 years. Based on monitoring data, establish additional **long-term reduction goal(s)**, if needed, to lead to delisting of Moose Meadow Brook from the 303(d) list.

Table B-1: Pollutant Load Reductions Needed

Pollutant	Existing Estimated Total Load	Water Quality Goal	Required Load Reduction
Total Phosphorus[1]	945 lbs/yr	850 lbs/yr	95 lbs/yr
Bacteria (*E. coli*)[1]	*MSWQS for bacteria are concentration standards (e.g., colonies of fecal coliform bacteria per 100 ml), which are difficult to predict based on estimated annual loading.*	**Class B Standards** • Public Bathing Beaches: For E. coli, geometric mean of 5 most recent samples shall not exceed 126 colonies/ 100 ml and no single sample during the bathing season shall exceed 235 colonies/100 ml. For enterococci, geometric mean of 5 most recent samples shall not exceed 33 colonies/100 ml and no single sample during bathing season shall exceed 61 colonies/100 ml; • Other Waters and Non-bathing Season at Bathing Beaches: For E. coli, geometric mean of samples from most recent 6 months shall not exceed 126 colonies/100 ml (typically based on min. 5 samples) and no single sample shall exceed 235 colonies/100 ml. For enterococci, geometric mean of samples from most recent 6 months shall not exceed 33 colonies/100 ml, and no single sample shall exceed 61 colonies/100 ml.	50% - Concentration-based

1. *As noted in Element A, the E. coli water quality goal in the Moose Meadow Brook watershed is based on the Massachusetts Surface Water Quality Standards (MSWQS) (314 CMR 4.00, 2013) that apply to the Water Class of the selected water body. Both segments in the Moose Meadow Brook watershed are classified as "Class B" waterbodies.*

Element C: Describe management measures that will be implemented to achieve water quality goals

Element C: A description of the nonpoint source management measures needed to achieve the pollutant load reductions presented in Element B, and a description of the critical areas where those measures will be needed to implement this plan.

Ongoing Management Measures

Pollutant load modeling presented in Element A (**Table A-9**) indicated that roughly 25% of the total land-use based nutrient (TP and TN) loading in the watershed originates from agricultural areas. MACD was awarded Fiscal Year 2021 Section 319 grant funding for its "Western Massachusetts Agricultural Nonpoint Source Program", which includes implementing watershed-wide farm conservation practices and agricultural BMPs in the Moose Meadow Brook watershed to contribute to addressing this loading. The MACD's general strategy is to conduct outreach and education to farmers in the Moose Meadow Brook watershed; develop conservation plans outlining BMPs to reduce pollutant runoff; assist landowners in obtaining access to financial resources; and ensure farmers follow operation and maintenance practices recommended by MACD and/or NRCS (MACD, 2020). During the stakeholder meeting that was held on May 5, 2021, numerous farms in the Moose Meadow Brook watershed were identified for outreach and possible implementation of agricultural BMPs. These farms are identified in **Figure C-1**.

As discussed in **Element B**, it is recommended that future planning initially focus on water quality goals related to *E. coli* and TP in the Moose Meadow Brook watershed. The MACD technical providers will work with farmers to develop and implement comprehensive farm conservation plans that outline a full suite of water quality BMPs necessary to reduce nonpoint source pollution generated by farm activities. MACD will implement plans on each farm once the plan is completed and approved. Implementation of the plans may include construction of new BMPs and/or maintenance or renovation of existing BMPs. As feasible the farm conservation plans developed will be approved by the NRCS.

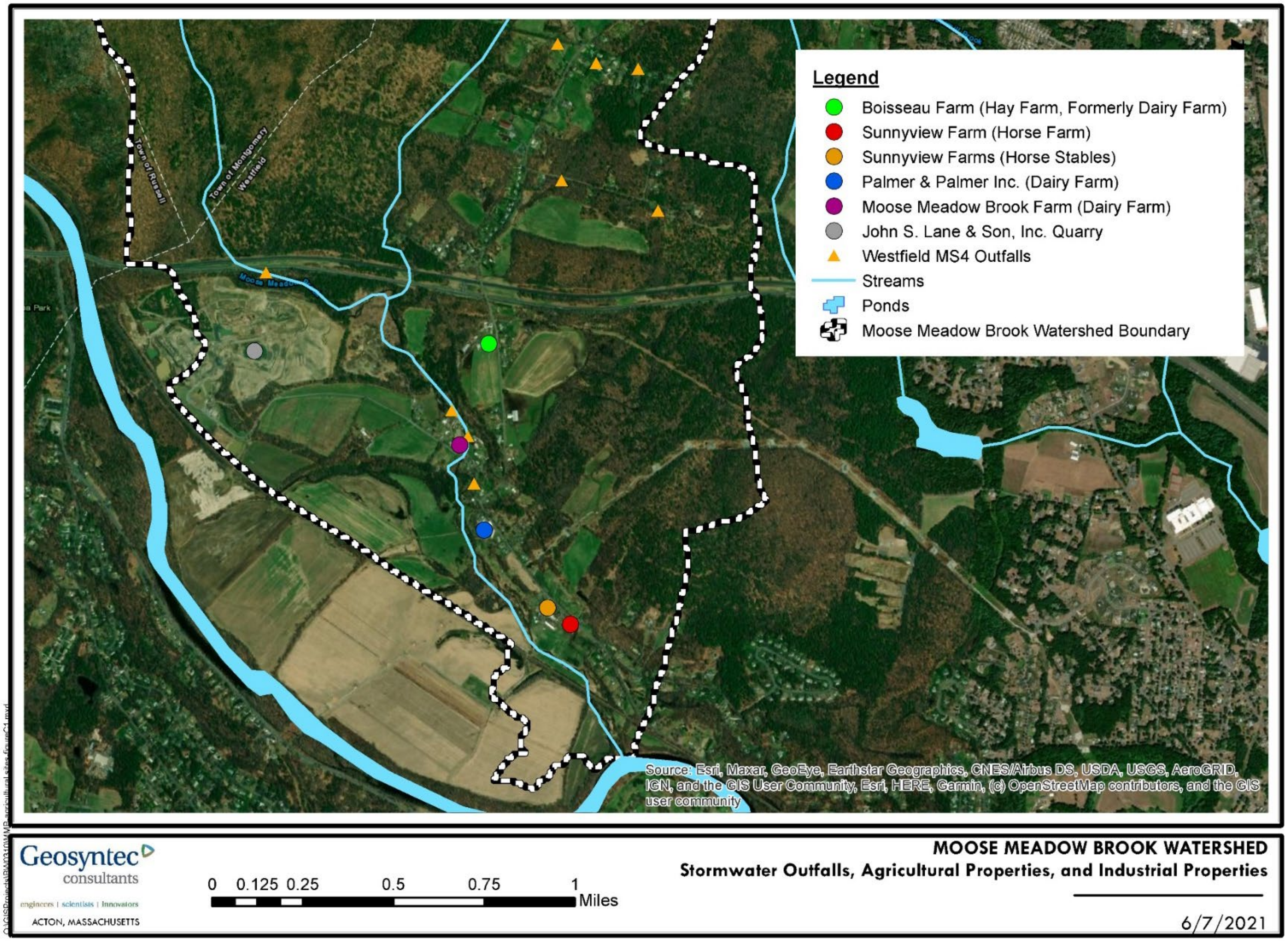

Figure C-1: Stormwater Outfalls, Agricultural Properties, and Industrial Properties in Moose Meadow Brook Watershed

Future Management Measures

Implementing agricultural BMPs, along with incorporating structural BMPs (e.g. LID practices) on new and existing development, and investigation and remediation of potential other sources such as failing septic systems will be necessary to achieve a measurable and sustainable improvement in water quality in the Moose Meadow Brook watershed. The following general sequence is recommended to identify and implement future structural BMPs. Note this approach applies largely to non-agricultural BMPs as MACD's project is to build relationships with the agricultural community, which would guide any future agricultural BMP implementation.

1. **Identify Potential Implementation Locations:** Perform a desktop analysis using aerial imagery and GIS data to develop a preliminary list of potentially feasible implementation locations based on land use; soil type (i.e., hydrologic soil groups A and B); available public open space (e.g., lawn area in front of a police station); potential redevelopment sites where additional public-private partnerships may be leveraged; and other factors such as proximity to receiving waters, known problem areas, or publicly owned right of ways or easements. See BMP Hotspot Map analysis below, which helps identify potential implementation locations.
2. **Visit Potential Implementation Locations:** Perform field reconnaissance, preferably during a period of active runoff-producing rainfall, to evaluate potential implementation locations, gauge feasibility, and identify potential BMP ideas. During field reconnaissance, assess identified locations for space constraints, potential accessibility issues, presence of mature vegetation that may cause conflicts (e.g., roots), potential utility conflicts, site-specific drainage patterns, and other factors that may cause issues during design, construction, or long-term maintenance.
3. **Develop BMP Concepts:** Once potential BMP locations are conceptualized, use the BMP-selector tool on the watershed-based planning tool to help develop concepts. Concepts can vary widely. One method is to develop 1-page fact sheets for each concept that includes a site description, including definition of the problem, a description of the proposed BMPs, annotated site photographs with conceptual BMP design details, and a discussion of potential conflicts such as property ownership, O&M requirements, and permitting constraints. The fact sheet can also include information obtained from the BMP-selector tool including cost estimates, load reduction estimates, and sizing information (i.e., BMP footprint, drainage area, etc.).
4. **Rank BMP Concepts:** Once BMP concepts are developed, perform a priority ranking based on site-specific factors to identify the implementation order. Ranking can include many factors including cost, expected pollutant load reductions, implementation complexity, potential outreach opportunities and visibility to public, accessibility, expected operation and maintenance effort, and others.

Prioritized BMP concepts should focus on reducing *E. coli* and TP loading to the Moose Meadow Brook watershed as summarized in **Element B.**

BMP Hotspot Map:

The following GIS-based analysis[5] was performed within the watershed to identify high priority parcels for BMP (also referred to as management measure) implementation:

- Each parcel within the watershed was evaluated based on ten different criteria accounting for the parcel ownership, social value, and implementation feasibility (See **Table C-1** for more detail below);
- Each criterion was then given a score from 0 to 5 to represent the priority for BMP implementation based on a metric corresponding to the criterion (e.g., a score of 0 would represent lowest priority for BMP implementation whereas a score of 5 would represent highest priority for BMP implementation);
- A multiplier was also assigned to each criterion, which reflected the weighted importance of the criterion (e.g., a criterion with a multiplier of 3 had greater weight on the overall prioritization of the parcel than a criterion with a multiplier of 1); and
- The weighted scores for all the criteria were then summed for each parcel to calculate a total BMP priority score.

Table C-1 presents the criteria, indicator type, metrics, scores, and multipliers that were used for this analysis. Parcels with total scores above 60 are recommended for further investigation for BMP implementation suitability. **Figure C-2** presents the resulting BMP Hotspot Map for the watershed. The following link includes a Microsoft Excel file with information for all parcels that have a score above 60: hotspots.

This analysis solely evaluated individual parcels for BMP implementation suitability and likelihood for the measures to perform effectively within the parcel's features. This analysis does not quantify the pollutant loading to these parcels from the parcel's upstream catchment. When further evaluating a parcel's BMP implementation suitability and cost-effectiveness of BMP implementation, the existing pollutant loading from the parcel's upstream catchment and potential pollutant load reduction from BMP implementation should be evaluated.

The large agricultural parcels in the downstream portion of the watershed received high hot spot scores above 60, which indicates that these properties provide opportunities for BMP implementation. The other areas that received high scores are in the large forested parcels in the upstream portion of the watershed. While these areas received high scores, they are less likely to provide opportunities for substantial pollutant load reductions through BMPs since BMP implementation in forested areas can be challenging and the upstream segment of Moose Meadow Brook (MA32-40), where the forested areas are primarily located, is not impaired, as indicated by the 303(d) list.

[5] GIS data used for the BMP Hotspot Map analysis included: MassGIS (2015a); MassGIS (2015b); MassGIS (2017a); MassGIS (2017b); MassGIS (2020); MA Department of Revenue Division of Local Services (2016); MassGIS (2005); ArcGIS (2020); MassGIS (2009b); MassGIS (2012); and ArcGIS (2020b).

Table C-1: Matrix for BMP Hotspot Map GIS-based Analysis

Criteria	Indicator Type	METRICS: Yes or No?		Hydrologic Soil Group				Land Use Type									Water Table Depth				Parcel Area			Parcel Average Slope					Multiplier	Maximum Potential Score
		Yes	No	A or A/D	B or B/D	C or C/D	D	Low and Medium Density Residential	High Density Residential	Commercial	Industrial	Highway	Agriculture	Forest	Open Land	Water	101-200 cm	62-100 cm	31-61 cm	0-30 cm	Greater than 2 acres	Between 1-2 acres	Less than 1 acre	Less than 2%	Between 2% and 15%	Greater than 15%	Less than 50%	Between 51% and 100%		
Is the parcel a school, fire station, police station, town hall or library?	**Ownership**	5	0																										2	10
Is the parcel's use code in the 900 series (i.e. public property or university)?	**Ownership**	5	0																										2	10
Is parcel fully or partially in an Environmental Justice Area?	**Social**	5	0																										2	10
Most favorable Hydrologic Soil Group within Parcel	**Implementation Feasibility**			5	3	0	0																						2	10
Most favorable Land Use in Parcel	**Implementation Feasibility**							1	2	4	2	4	5	1	4	**X[1]**													3	15
Most favorable Water Table Depth (deepest in Parcel)	**Implementation Feasibility**																5	4	3	0									2	10
Parcel Area	**Implementation Feasibility**																				5	4	1						3	15
Parcel Average Slope	**Implementation Feasibility**																							3	5	1			1	5
Percent Impervious Area in Parcel	**Implementation Feasibility**																										5	2.5	1	5
Within 100 ft buffer of receiving water (stream or lake/pond)?	**Implementation Feasibility**	5	2																										2	10

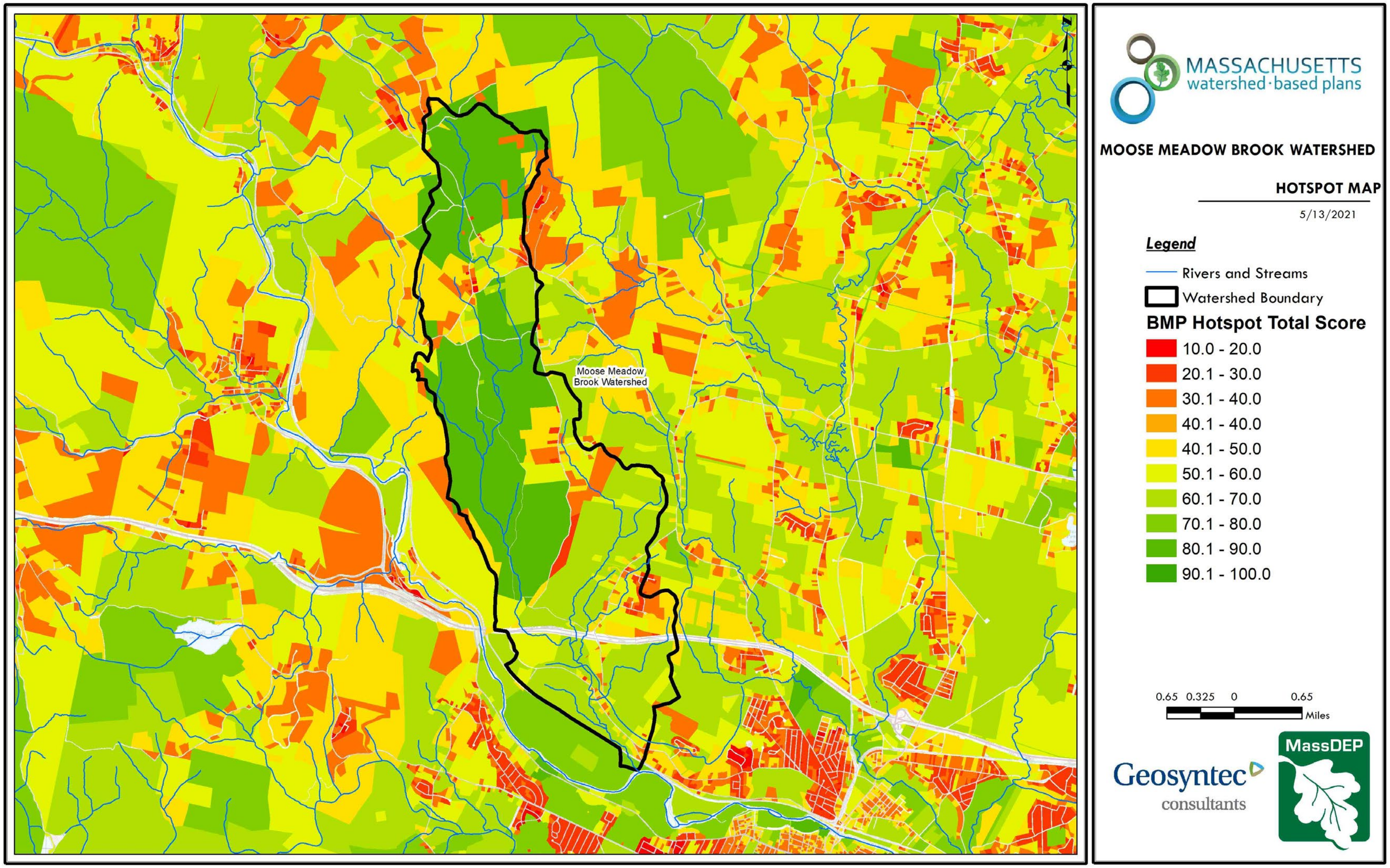

Figure C-2: Moose Meadow Brook Watershed BMP Hotspot Map

Additional Non-structural BMPs

It is recommended that nonstructural BMPs that the Town of Montgomery, City of Westfield, and Massachusetts Department of Transportation (MassDOT) currently implement, including street sweeping and catch basin cleaning, be evaluated and potentially optimized for removal of TP and bacteria. First, it is recommended that potential pollutant load removals from ongoing activities be calculated in accordance with **Elements H and I** of this document. Next, it is recommended that ongoing activities be evaluated to see if potential improvements can be implemented to achieve higher pollutant load reductions, such as increased frequency or improved technology.

Element D: Identify Technical and Financial Assistance Needed to Implement Plan

Element D: Estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement this plan.

Current and Future Management Measures

The funding needed to implement the MACD Western Massachusetts Agricultural Nonpoint Source Program (described in **Element C**) is presented in **Table D-1** (MACD, 2020). These costs will be divided between the Moose Meadow Brook watershed and three other watersheds in Western Massachusetts. The total cost for the program was estimated at $434,000.

Table D-1: Summary of Proposed BMPs Costs (Western Massachusetts Agricultural Nonpoint Source Program)

Expense Item	s.319 Amount	Non-Federal Match and Source	Total Amount
Salary and Wages			
Project Coordinator	$9,000	$2,000	$11,000
Sub-contractors	$81,000	$5,000	$86,000
Students Assistance	$3,882	$0	$3,882
Supplies			
BMP Materials and Supplies	$160,000	$0	$160,000
DMBE/DWBE		$168,000	$168,000
Travel	$750	$0	$750
Indirect Costs			
Overhead	$9,000	$0	$9,000
Totals	**$259,000**	**$175,000**	**$434,000**

Future Management Measures

Funding for future BMP installations to further reduce loads within the watershed may be provided by a variety of sources including Section 319 funding, Massachusetts Environmental Trust (MET) grants, the Agricultural Environmental Enhancement Program (AEEP), the Agricultural Produce Safety Improvement

Program (APSIP), Town and City capital funds, volunteer efforts, and Natural Resources Conservation Service (NRCS) grants including the Environmental Quality Incentives Program (EQIP) and the Agricultural Management Assistance (AMA) program. MACD has previously been successful with and will continue to pursue securing grant funding through various sources. Guidance is available to provide additional information on potential funding sources for nonpoint source pollution reduction efforts[6].

[6] Guidance on funding sources to address nonpoint source pollution: http://prj.geosyntec.com/prjMADEPWBP_Files/Guide/Element%20D%20-%20Funds%20and%20Resources%20Guide.pdf

Element E: Public Information and Education

Element E: Information and Education (I/E) component of the watershed plan used to:

1. Enhance public understanding of the project; and
2. Encourage early and continued public participation in selecting, designing, and implementing the NPS management measures that will be implemented.

Public information and education was one of the topics discussed during the stakeholder meeting of May 5, 2021 (**Appendix A**). A large component of the MACD Western Massachusetts Agricultural Nonpoint Source Program involves outreach to farmers. The components of the watershed public information and education program are described below. Additional outreach efforts will be determined when future management measures and activities are planned for implementation in the watershed. This section of the WBP will be updated when the plan is reevaluated in 2024 in accordance with elements F&G of this document.

Step 1: Goals and Objectives

The goals and objectives for the watershed information and education program.

1. Provide information and incentives to farmers on funding resources for BMP implementation
2. Provide information about farm conservation plans and agricultural BMPs and their anticipated water quality benefits.
3. Provide information to promote watershed stewardship.

Step 2: Target Audience

Target audiences that need to be reached to meet the goals and objectives identified above.

1. Farm-owners in the watershed (targeted through MACD), with a focus on farmers who have had previous contact with NRCS and/or MACD.
2. Watershed organizations and other user groups, including the WRWA.
3. Businesses, schools, and local government within the watershed.
4. All watershed residents.

Step 3: Outreach Products and Distribution

The outreach product(s) and distribution form(s) that will be used for each.

1. MACD will conduct outreach and education activities, including farm tours highlighting agricultural BMPs.

2. WRWA provides information about the watershed on their website (https://www.westfieldriver.org/) and typically hosts events such as river cleanups and cleanups of invasive species.

Step 4: Evaluate Information/Education Program

Information and education efforts and how they will be evaluated.

1. Track the number of workshops and farm tours and the attendance at each.
2. Track the number of materials and information, such as fact sheets and emails, and the size of the lists receiving these materials.
3. Track the farms who receive funding and from what sources.

Elements F & G: Implementation Schedule and Measurable Milestones

Element F: Schedule for implementing the nonpoint source management measures identified in this plan that is reasonably expeditious.

Element G: A description of interim measurable milestones for determining whether nonpoint source management measures or other control actions are being implemented.

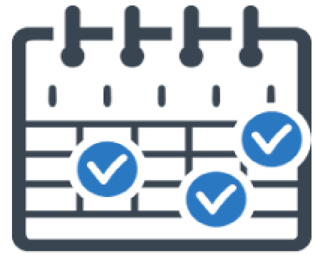

Table FG-1 provides a preliminary schedule for implementation of recommendations provided by this WBP. It is expected that the WBP will be re-evaluated and updated in 2024, or as needed, based on ongoing monitoring results and other ongoing efforts. New projects will be identified through future data analysis and stakeholder engagement and will be included in updates to the implementation schedule.

Table FG-1: Implementation Schedule and Interim Measurable Milestones

Category	Action	Cost Estimate	Year(s)
Monitoring	Establish water quality monitoring program and perform water quality sampling per Element H&I		Annual
Western Massachusetts Agricultural Nonpoint Source Program	MACD will provide a conservation planner and • Focus on farmers who have had previous contact with NRCS and MACD to engage as many as possible in the implementation of BMPs • Identify a second conservation planner to further scale outreach and BMP implementation practices in the Moose Meadow Brook watershed.	$108,500	2021—2022
Public Education and Outreach	MACD will conduct outreach and education activities, including farm tours highlighting agricultural BMPs.		2022
	WRWA river cleanup and cleanup of invasive species		Annual
Adaptive Management and Plan Updates	Establish a working group that includes stakeholders and other interested parties to implement recommendations and track progress. Meet at least twice per year.		2021
	Reevaluate WBP at least once every three years and adjust, as needed, based on ongoing efforts (e.g., based on monitoring results, 319 funding, etc.). – Next update, December 2024		2024
	Use monitoring results to reevaluate BMP effectiveness at reducing E. coli and TP and/or other indicator parameters in Moose Meadow Brook and establish additional long-term reduction goal(s), if needed.		**2031**
	Delist Moose Meadow Brook from the 303(d) list.		**2035**

Elements H & I: Progress Evaluation Criteria and Monitoring

Element H: A set of criteria used to determine (1) if loading reductions are being achieved over time and (2) if progress is being made toward attaining water quality goals. Element H asks "**how will you know if you are making progress towards water quality goals?**" The criteria established to track progress can be direct measurements (e.g., E. coli bacteria concentrations) or indirect indicators of load reduction (e.g., number of beach closings related to bacteria).

Element I: A monitoring component to evaluate the effectiveness of implementation efforts over time, as measured against the Element H criteria. Element I asks "**how, when, and where will you conduct monitoring?**"

The interim loading reduction goal is presented in Element B of this WBP. Element C of this plan describes management measures that will be implemented to help achieve this targeted load reduction. The evaluation criteria and monitoring program described below will be used to establish a baseline and measure the effectiveness of the proposed management measures (described in Element C) in improving the water quality of the Moose Meadow Brook and in making progress toward achieving the water quality goals.

Direct Measurements

Direct measurements are generally expected to be performed as described below. Prior to implementing a direct measurement program, an abbreviated Quality Assurance Program Plan (QAPP)[7] and/or Standard Operating Procedures (SOPs) should be established to outline the details of the program and establish best practices for sample collection and analysis. During the Stakeholder meeting on May 5, 2021, Peckham Industries, Inc. (Peckham) indicated that they would be interested in funding and performing the water quality monitoring program for the watershed. It is suggested that Peckham and WRWA may consider collaborating on this effort to perform the sampling outlined below. Water quality monitoring may also be performed through a volunteer training program to save on costs in accordance with established practices for MassDEP's water quality monitoring for volunteers[8]. MassDEP also provides support for water quality monitoring efforts through its Water Quality Monitoring Grant Program.

[7] Additional information is provided at: https://www.mass.gov/guides/water-quality-monitoring-quality-management-program

[8] Additional EPA guidance is provided at: https://www.epa.gov/sites/production/files/2015-06/documents/stream.pdf

Brook Sampling

Regular sampling will be established to understand the water quality in Moose Meadow Brook, including determining sources of pollution and tracking achievements toward water quality goals. Key features of the water quality monitoring program will include:

- Analytes: The samples collected should primarily be analyzed for *E. coli* and TP. Additional parameters such as chlorophyll-a, dissolved oxygen, temperature, conductivity, pH, dissolved phosphorus, and flow rate could provide additional data to better understand the health of the watershed and Moose Meadow Brook.
- Sampling Frequency: It is recommended that a minimum of five sampling events be completed during the months of May and October for the next three years. *E. coli* sampling which is aligned with proposed surface water quality standard revisions and MassDEP assessment requirements would provide the most value (sampling conducted every other week consistently between April 1st and October 15th, at a minimum sampling every other week June through September).
- Locations: The water quality monitoring program should be focused in Moose Meadow Brook downstream of I-90. If possible, samples should be collected within the Moose Meadow Brook directly downstream of implemented BMPs to determine the impact of BMPs within the watershed (samples at these locations prior to BMP implementation should also be collected to establish a baseline). Monitoring locations should ultimately be selected based on accessibility and representativeness and shall be appropriate to quantify water quality improvements in the watershed. BMP performance monitoring locations will be selected after BMPs have been identified for implementation.
- Planning: As noted above, based on the stakeholder meeting of May 5, 2021, it is suggested that the water quality monitoring program may be a collaboration between Peckham, WRWA, and possibly volunteers or may seek support through the MassDEP Water Quality Monitoring Grant Program.

Indirect Indicators of Load Reduction

Non-Structural BMPs

Potential load reductions from non-structural BMPs (i.e., street sweeping and catch basin cleaning) can be estimated from indirect indicators, such as the number of miles of streets swept or the number of catch basins cleaned. As summarized by Figure HI-1 and HI-2, Appendix F of the 2016 Massachusetts Small MS4 General Permit provides specific guidance for calculating phosphorus removal from these practices. As indicated by **Element C**, it is recommended that potential TP removal from these ongoing actives be estimated. Next, it is recommended that ongoing activities be evaluated to see if potential improvements can be implemented to achieve higher pollutant load reductions such as increased frequency or improved technology.

$$\text{Credit}_{\text{sweeping}} = \text{IA}_{\text{swept}} \times \text{PLE}_{\text{IC-land use}} \times \text{PRF}_{\text{sweeping}} \times \text{AF} \qquad \textbf{(Equation 2-1)}$$

Where:

$\text{Credit}_{\text{sweeping}}$	=	Amount of phosphorus load removed by enhanced sweeping program (lb/year)
IA_{swept}	=	Area of impervious surface that is swept under the enhanced sweeping program (acres)
$\text{PLE}_{\text{IC-land use}}$	=	Phosphorus Load Export Rate for impervious cover and specified land use (lb/acre/yr) (see Table 2-1)
$\text{PRF}_{\text{sweeping}}$	=	Phosphorus Reduction Factor for sweeping based on sweeper type and frequency (see Table 2-3).
AF	=	Annual Frequency of sweeping. For example, if sweeping does not occur in Dec/Jan/Feb, the AF would be 9 mo./12 mo. = 0.75. For year-round sweeping, AF=1.0[1]

As an alternative, the permittee may apply a credible sweeping model of the Watershed and perform continuous simulations reflecting build-up and wash-off of phosphorus using long-term local rainfall data.

Table 2-3: Phosphorus reduction efficiency factors ($\text{PRF}_{\text{sweeping}}$) for sweeping impervious areas

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

Figure HI-1. Street Sweeping Calculation Methodology

$$\text{Credit}_{\text{CB}} = \text{IA}_{\text{CB}} \times \text{PLE}_{\text{IC-land use}} \times \text{PRF}_{\text{CB}} \qquad \textbf{(Equation 2-2)}$$

Where:

$\text{Credit}_{\text{CB}}$	=	Amount of phosphorus load removed by catch basin cleaning (lb/year)
IA_{CB}	=	Impervious drainage area to catch basins (acres)
$\text{PLE}_{\text{IC-and use}}$	=	Phosphorus Load Export Rate for impervious cover and specified land use (lb/acre/yr) (see Table 2-1)
PRF_{CB}	=	Phosphorus Reduction Factor for catch basin cleaning (see Table 2-4)

Table 2-4: Phosphorus reduction efficiency factor (PRF_{CB}) for semi-annual catch basin cleaning

Frequency	Practice	PRF_{CB}
Semi-annual	Catch Basin Cleaning	0.02

Figure HI-2. Catch Basin Cleaning Calculation Methodology

Project-Specific Indicators

Number of BMPs Installed and Pollutant Reduction Estimates:

Anticipated pollutant load reductions from future BMPs will be tracked as BMPs are installed.

Adaptive Management

As discussed by Element B, the baseline monitoring program will be used to evaluate and establish a long-term (i.e., 15-year) *E. coli* and TP load reduction goals (or other parameter(s) depending on results). Long-term goals and the monitoring program will be re-evaluated at least **once every three years** and adaptively adjusted based on additional monitoring results and other indirect indicators. If monitoring results and indirect indicators do not show improvement to the *E. coli* and TP and TN concentrations and other indicators (e.g., DO) measured within the watershed, the management measures and loading reduction analysis (Elements A through D) will be revisited and modified accordingly.

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Appendices

Appendix A – Stakeholder Meeting Minutes May 5, 2021

Meeting Minutes

SORENSEN

Project Name:	Moose Meadow Brook Watershed-Based Plan
Project #:	SP #1078
Location:	Moose Meadow Brook Watershed (Westfield, MA and Montgomery, MA)

Meeting Date, #:	2021-5-5	Meeting Time:	2:00 PM - 3:30 PM
Prepared By:	Marie Sorensen, RA	Meeting Location:	Zoom videoconference per Sorensen Partners invitation
Distribution:	All listed below		

Attendees:

Name	Organization	Contact Information
Michael Leff	Massachusetts Association of Conservation Districts (MACD)	mleffmacd@gmail.com
Dr. David Doe	Westfield Conservation Commission; Westfield State University Biology Department	daviddoe@comcast.net
Meredith Borenstein	Westfield Conservation Commission	meredith.borenstein@cityofwestfield.org, 413-572-6281
Mark Damon	Westfield River Watershed Association	markjdamon@gmail.com
Dianne Vedeo	Westfield River Watershed Association	diannevideo@yahoo.com, 413-562-6126
Moe Boisseau	Moose Meadow Brook Farm, Westfield	Moosemeadowbrookfarm@gmail.com
Jason Kappel	Peckham (John S. Lane & Son is subsidiary)	jkapp@peckham.com, 518-265-1126
Pete Barrett	Peckham (John S. Lane & Son is subsidiary)	pbarr@peckham.com
Peter Simoneau	Peckham (John S. Lane & Son is subsidiary)	psimo@peckham.com
Matt Reardon	Massachusetts Department of Environmental Protection (MassDEP)	Matthew.Reardon@state.ma.us
Julia Keay	Geosyntec Consultants, Inc.	jkeay@geosyntec.com
Emma Williamson	Geosyntec Consultants, Inc.	ewilliamson@geosyntec.com
Adam Questad	Geosyntec Consultants, Inc.	aquestad@geosyntec.com
Marie Sorensen	Sorensen Partners | Architects + Planners, Inc.	msorensen@sorensenpartners.com

"*This project has been financed with Federal Funds from the Environmental Protection Agency (EPA) to the Massachusetts Department of Environmental Protection (the Department) under an s. 319 competitive grant. The contents do not necessarily reflect the views and policies of EPA or of the Department, nor does the mention of trade names or commercial products constitute endorsement or recommendation for use.*"

Minutes to be considered final unless comments are received within five (5) business days.

AGENDA

- Greeting – Matt Reardon, MassDEP & Marie Sorensen, Sorensen Partners
- Watershed & Goals Overview (10 min) – Julia Keay & Adam Questad, Geosyntec
- Section 319 Grant Project Spotlight (15 min) – Michael Leff, MACD
- Brief Introductions from All Participants (15 min) – All
- Discussion of Completed, Ongoing, and Future Efforts (50 min) – All

WATERSHED & GOALS OVERVIEW/SECTION 319 GRANT PROJECT SPOTLIGHT
• Julia Keay of Geosyntec discussed the sources of contamination in the watershed, showed maps of the watershed including land use map and pervious/impervious cover map. Goals of watershed-based plan will be based on MA water quality standards for *E. Coli* • Michael Leff: Asks about a tributary along West Road, which has agriculture landuses and whether that is within the watershed? • Julia Keay: Yes • Jason Kappel: Why is the quarry characterized as impervious? Matt Reardon: Sometimes based on reflectivity from aerial photograph. Jason Kappel: the vast majority of that area is pervious and a correction that needs to be made. • Michael Leff presented an overview of the MACD s.319 grant-funded project. Lives in Western MA. Has worked on watershed-based plans (WBPs) for several watersheds. Moose Meadow Brook is one of three watersheds in Western MA within the Connecticut River watershed that are being looked at. The Mill River around Hadley and the East Branch North River are also being looked at. • Having identified priority areas for Best Management Practices (BMPs) to control runoff, etc., will be looking to identify parcels within those areas, then make contact with landowners who might want to implement BMPs, including through this s.319 grant. • Having a WBP is also essential for stakeholders within this watershed so others can pursue funding through DEP or other sources. Important to show you've already done this initial work of understanding the watershed through the creation of a WBP as a basis for receiving grants.

BRIEF INTRODUCTIONS FROM ALL PARTICIPANTS
Participants were asked to briefly address the following prompts: ⇒ Name? ⇒ Affiliation ⇒ Your connection to Moose Meadow Brook? ⇒ Specific projects, public outreach, and/or monitoring work you do or have done **Julia Keay, Geosyntec**. Will be helping to write the WBP along with Emma and Adam from Geosyntec. Is familiar with the area; went to Gateway Regional High School. Lives in Easthampton, MA. **Marie Sorensen, Sorensen Partners**. Working with Geosyntec and MassDEP to identify stakeholders and landowners who have an advocacy, scientific, or land-ownership interest in the watershed. **Michael Leff, ED, MACD**. Grantee for this s.319 grant project. **Mark Damon, Westfield River Watershed Association**. Trying to expand their monitoring of water quality. Has not personally been involved in Moose Meadow Brook. Mostly here as an observer. **David Doe. Chair, Westfield Conservation Commission.** Newly retired biology professor from Westfield State. In a 2007 sabbatical wrote a similar plan for Westfield Watershed with Bob Thompson who's also in the biology department. Looked at salinity, turbidity, temperature, *E.Coli*, for several months in 2008, in conjunction with Pioneer Valley Planning Commission. Wrote a report. Interested to see what projects are being done in this watershed. **Matt Reardon, MassDEP, Nonpoint Source Program Coordinator.** This WBP is to set the stage for Michael to do his outreach. The goal is to get some projects going to help restore the water quality. **Pete Barrett, John S. Lane (subsidiary of Peckham).** Landowners of the quarry/sand pit within the southern portion of the watershed. **Meredith Borenstein, Westfield Conservation Coordinator.** Works for the City and is in charge of helping the City implement the MA Wetlands Protection Act and the City's wetlands ordinance. Main responsibility is permitting. Excited to hear about potential for water quality improvement. If the Commission can help they are interested in doing that. If there are wetlands violations that play in, that's also something to consider that they can help make some changes.

Adam Questad, Engineer with Geosyntec.

Emma Williamson, Geosyntec. Recently joined the project team at Geosyntec.

Jason Kappel, Director of Technical Services with Peckham Industries (John S. Lane is subsidiary). Actively working with Sarah Cook and their team at the Wildlife Habitat Council to focus their efforts to partner with communities and government agencies to try to put their property and expertise whatever they have to offer in MA. Happy to have additional conversations. Interested in seeing how work with Wildlife Habitat Council can dovetail.

Peter Simoneau, Peckham Industries (John S. Lane is subsidiary). Works with Pete Barrett on operational side. Acquired 7-8 quarries and mines from Broomfield to West Stockbridge. Recognize they have a pretty big effect on land. Trying to do what they can to do the best job they can with respect to the environment.

Dianne Vedeo, Westfield River Watershed Association. Also doing research on native American history of this whole area, especially Moose Meadow Brook

Moe Boisseau, co-owner Moose Meadow Brook Farm. 380 acres on both sides of the brook. Starting from the turnpike, abutting Peckham Industries, down to the inlet of the river. Farm has been in the family for 110 years. Farm was previously a dairy farm with 100 head. Stopped dairy operation in 2000. Now haying.

DISCUSSION OF COMPLETED, ONGOING, AND FUTURE PROJECTS

A general discussion was held on the following topics:

1. Agricultural or Structural BMP Projects in watershed
2. Pollutant Load Reduction Estimates for BMP projects
3. Monitoring efforts
4. Sources of *E.Coli*/Fecal Coliform pollution (e.g., farms)
5. Public education and outreach
6. Additional grant funding available

Adam Questad. Looking to understand any work that's been done to reduce pollution, reduce erosion. Could be installing ponds. Could also be non-structural BMPs like street-sweeping, education. Any projects to reduce erosion and improve water quality.

Marie Sorensen. Could the landowners describe the land within their property? How steeply does it grade down to the brook? Is it vegetated, forested, etc.?

Jason Kappel. At John S. Lane site, they have graded the site to eliminate any discharge to the brook. They have a series of BMPs they use internally to their site to eliminate discharge to the brook. They maintain them actively to make sure they're in place. They are conveyance BMPs. In terms of monitoring efforts, if anyone needed access, they can arrange access.

Moe Boisseau. The farm is on both sides of the Moose Meadow Brook. As far as wash out or erosion or anything like that, doesn't see a lot of that happening. Their farms are hay fields, they usually put a cover crop on.

Julia Keay. Question to Moe. Do you know of any dairy farms currently still operating on the river?

Moe Boisseau. Only one farm, Palmer & Palmer, is still operating on Pochassic Road. Terry Palmer is running that.

Julia Keay. There's also Sunnyview Farm, a horse farm. Is that still active?

Moe Boisseau. Yes.

Mark Damon. How many years of *E.Coli* data do we have? Can we see a trend?

Julia Keay. We have some data from 2014, taken by a Westfield State student. We have some MassDEP data from 2006. If anyone has additional monitoring data that could be included in the plan, that would be helpful.

David Doe. Is there a monitoring project in place?

Julia Keay: No. But that may be a recommendation coming out of the WBP.

Moe Boisseau. Where were samples taken to get this information?

Julia Keay: The data was mostly taken downstream of the Mass Pike. There were no issues on the upstream section.

Moe Boisseau: If you come here in the summertime every rock turns pure white. Someone from MassDEP told them they were doing a study on the brook because it was so heavily salted.

Matt Reardon: Who did you talk to about the salt study?

Moe Boisseau: Someone from DEP was on their land where the brook and the river come together. They said above the turnpike there was no salt, below the turnpike it was loaded with salt. That was a number of years ago.

Matt Reardon: Will look into that.

Mark Damon: Is this due to the City or State salting?

Moe Boisseau. It's I-90. State. Can see the water runoff coming right off the turnpike bridge.

Adam Questad: Have you seen the downspouts of salts recently?

Moe Boisseau. Last summer when there was the drought and the brook dried up, all the rocks turned pure white.

Matt Reardon: Department of Fish and Game (DFG) sampled there in 2013. They did find some trout. It's supposed to be a cold water fishery stream.

Marie Sorensen: What does a success look like?

Matt Reardon: Reduce *E.Coli*, nutrients, sediments, nitrogen. If *E.Coli* is not as big an issue any more, whatever we could do that is helpful, let's do it. Could just being keeping trees along the stream bank to keep the stream cool for the brook trout.

Michael Leff: Having these connections and being able to follow up falls within what MACD does, and what the Hampshire-Hampden Conversation District does.

Jason Kappel: Sarah Cook and her team from the Wildlife Council are very adept at identifying projects. Might kick this study to them and see if they can brainstorm how they can play an active role in identifying projects.

Michael Leff: Would love to be connected with the conservation districts on that.

Jason Kappel: Would like to talk to Moe and see if there's anything they can do with their common properties.

David Doe: What is a 'Conservation District'?

Michael Leff: Conservation Districts are in every state. They are partnered with the National Resources Defense Council, which was started in the 1930s when all the soil was blowing and washing away. Generally organized by county. Largely volunteer, and supported by staff and grants and contributions. Varies, some mostly agricultural, some more municipal. They have boards of supervisors, meet monthly or every few months. A quasi-governmental agency, organization focused on protecting water, soil, air (natural resources).

David Doe: What are the goals of the grant that was funded?

Michael Leff: The grant is preparation for MACD's consultants going out and having discussions with farmers and other landowners to discuss their concerns, and connect them with an agency (for example, the Natural Resources Conservation Service (NRCS) or the Department of Agriculture) to determine what might be helpful to the farmer to make it a more sustainable situation, economically and environmentally. Would help the landowner do things they might not otherwise do on their own.

David Doe: Are you in contact with Conservation Commissions in trying to achieve your goals?

Michael Leff: Has varied within the counties. Interested in finding common ground.

Meredith Borenstein: Are there funds for landowners to do improvements, mitigation, adjacent to the streams?

Matt Reardon: Yes, however this grant includes only agricultural BMPs. If it's not agricultural, and we describe it in the watershed-based plan, we can put in another application for the s.319 grant program to fund non-agricultural BMPs.

Marie Sorensen: Julia, is there any other information you need for drafting the WBP?

Julia Keay: Has identified the major farms in the watershed. Interested in knowing if there are any other pollution sources other than agriculture and salting on the Mass Pike.

Meredith Borenstein: Would there be septic systems, or is this area on City sewer and water. Have you looked into that?

Julia Keay: Upstream portion of the water is pretty rural, assuming it's all septic in Montgomery.

Moe Boisseau. Most of Westfield is septic, except that the area from Atwater Street down is on City sewer.

Adam Questad: Some other potential sources could be concentrated areas of wildlife sources, packing plants, landfills, also pet waste where people walk their dogs a lot.

Mark Damon: Who will be doing the monitoring?

Julia Keay: Is anyone aware of any monitoring efforts planned?

Adam Questad: This plan is being developed to gather information, but Geosyntec and MassDEP and the s.319 grantee are not doing any monitoring as a part of this.

Mark Damon. Could suggest a few things. For anyone who's doing the monitoring, make sure they are doing monitoring right after a rainstorm. To monitor not just coliforms but also fecal streptococci, because you can look at the ratio between fecal coliforms and fecal streptococci so you can tell if it's coming from humans or something else. Will help you narrow down the source.

Michael Leff: While helping to see that BMPs are implemented, the grantee is not involved in monitoring.

Matt Reardon: We have a water quality monitoring grant program. Bob Smith of MassDEP will be taking that over next year. Pioneer Valley Planning Commission previously got a 604b grant to do water quality monitoring in the Westfield River watershed. If you do want to do any bacterial sampling, this grant is also a potential source of funds to do that kind of work.

Marie Sorensen: Does the Westfield Conservation suggest anyone you know in Montgomery who is a counterpart? We couldn't reach anyone.

Meredith Borenstein: Does have some contact information from Montgomery. Or suggests we could call the Town Clerk to get the name of the Conservation Commission Chair.

Meredith Borenstein: Other sources could be logging and forestry. Recently received a forest cutting plan for the quarry on some other property Peckham they have. Would logging impact water quality in general? It was up off of East Mountain Road.

Julia Keay: Not in this watershed.

Julia Keay: What about public outreach?

Dianne Vedeo: Westfield River Watershed Association does cleanups, advertises them to the public. Advocates for more public access to the public.

Mark Damon. They organize by a few places. They haven't done any in Moose Meadow Brook. They have one group working downstream in Agawam. A second group meets in Westfield and sends people along to various sites from there. A lot of it is dictated by where they have access.

Meredith Borenstein: Is the Tekoa Country Club (golf club) within this watershed?

Julia Keay: No.

Mark Damon: Is there any conservation land in the watershed?

Julia Keay: Looking at maps to see if there are conservation parcels in the watershed.

Moe Boisseau. That's the Montgomery drinking water supply land.

Emma Williamson: Could reach out to Westfield State University to see if any students are doing research or monitoring.

Dianne Vedeo: Is Moose Meadow Brook where they removed the dam?

Julia Keay: Yes.

Moe Boisseau: That was Montgomery Reservoir.

Dianne Vedeo: Is there public access?

Dianne Vedeo: There is an access point for hikers off of Reservoir Road. There is only parking for 2 cars.

Mark Damon: Also saw Tekoa Trail marked.

Meredith Borenstein: Looked at Westfield GIS. Doesn't see conservation land along the river in Westfield. Has many of the outfalls mapped, city sewer mapped.

Moe Boisseau. Identified property owned by relatives (Boisseaus), a haying operation, previously a dairy farm, stopped operations 5 years ago.

Pete Barrett: Identified other property owned by John S. Lane (about 200 acres); currently vacant and they haven't done anything with it.

Marie Sorensen: Are the contaminant levels very high in this watershed compared to others?

Julia Keay: Yes the levels were high, which is the basis of the impairment, based on the 2006 MassDEP data.

Jason Kappel: Peckham has geologists on staff, and can collect samples and send them to a lab for analysis. We shouldn't be working with 15-year-old data.

Adam Questad: Geosyntec can work with Jason to put together a specification for doing some sampling.

Contact: Julia Keay, JKeay@geosyntec.com
Adam Questad, AQuestad@geosyntec.com
Matt Reardon, Matthew.Reardon@state.ma.us

Appendix B – Select Excerpts from Water Quality Assessment Report (MassDEP, 2001)

(Note: relevant information is included directly from these documents for informational purposes and has not been modified).

Westfield River Watershed 2001 Water Quality Assessment Report (MA32-23[1] – Moose Meadow Brook)

USE ASSESSMENT
AQUATIC LIFE
Habitat and Flow
As part of the MA DEP Biocriteria Development Project, a habitat survey was performed by DWM in Moose Meadow Brook approximately 400 meters north (upstream) of Tekoa Reservoir in Westfield (Station BT06MOO) in September 1997. At the time of the survey the river was roughly 4m wide, with a depth of approximately 0.25 m in the riffle/runs and 0.5m in the pool. The substrates were comprised primarily of boulder, cobble, and gravel. The overall habitat score was 145 out 200 (MA DEP 1997). Habitat quality was limited most by the channel flow status, embeddedness, sediment deposition and the limited riparian vegetative cover on the right bank facing downstream.

Biology
As part of the MA DEP Biocriteria Development Project, MA DEP DWM biologists collected benthic macroinvertebrate samples from Moose Meadow Brook approximately 400 meters north (upstream) of Tekoa Reservoir in Westfield (Station BT06MOO) in September 1997 (Lotic 1999). Electrofishing was also conducted by DWM at this location on 24 September 1997 (ENSR 1997). Fish collected in order of abundance included: blacknose dace, eastern brook trout, golden shiner, and a creek chubsucker. Multiple age classes of eastern brook trout were found. The sample was dominated by fluvial specialists/dependants, one of which is intolerant (brook trout).

In August 2001 MDFW surveyed the fish population within Moose Meadow Brook (Richards 2003). The station was located near the Pochassic Road Bridge in Westfield. Nine fish species collected, in order of abundance, were blacknose dace, brown trout, longnosed dace, American eel, white sucker, tessellated darter, slimy sculpin, brook trout and creek chubsucker. Multiple age classes of brown trout and brook trout were included in the sample. The sample was dominated by fluvial specialists/dependants.

Chemistry – water
In-situ measurements (DO, %saturation, pH, temperature, conductivity, and turbidity) of Moose Meadow Brook approximately 400 meters north (upstream) of Tekoa Reservoir in Westfield (Station BT06MOO) were made on 24 September 1997 as part of the Biocriteria Development Project (Appendix G, Table G3).

Between 1 August and 3 October 2001 DWM collected in-situ measurements (n=4) from two stations on Moose Meadow Brook: Station MMBR02.4 approximately 250 feet downstream from Tekoa Reservoir, Montgomery, and Station MMBR00.5 at Farm Road (private road south off Pochassic Road) bridge, Westfield. Parameters measured included dissolved oxygen, pH, temperature, conductivity, and total dissolved solids (Appendix 2 of Appendix A). Grab samples were collected and analyzed for alkalinity, hardness, chloride, suspended solids and nutrients (Appendix 3 of Appendix A).

DO
The instream DO measured by DWM on Moose Meadow Brook at Station MMBR02.4 ranged from 8.9 to 10.8 mg/L (96% to 99% saturation), and at Station MMBR00.5 ranged from 4.7 to 10.1 mg/L (49% to 93% saturation).

Temperature
Temperatures recorded by DWM at Station MMBR02.4 ranged from 12.1 to 20.1°C and at Station MMBR00.5 ranged from 12.1 to 20.3°C.

pH
pH measurements recorded by DWM at Station MMBR02.4 ranged from 6.6 to 6.9 SU and at Station MMBR00.5 ranged from 6.7 to 7.0 SU.

Conductivity
Conductivity reported by DWM at Station MMBR02.4 ranged from 41.5 to 46.1 µS/cm and at Station MMBR00.5 ranged from 165 to 410 µS/cm.

Solids
The maximum total suspended solid concentrations reported by DWM at Station MMBR02.4 ranged from <1.0 to 1.5 mg/L and at Station MMBR00.5 ranged from <1.0 to 5.3 mg/L.

Alkalinity
The alkalinity reported by DWM at Station MMBR02.4 ranged from 7 to 8 mg/L and at Station MMBR00.5 ranged from 31 to 78 mg/L.

Hardness
Hardness was extremely low at Station MMBR02.4 ranging from 4 to 6 mg/L and was slightly higher at Station MMBR00.5 ranging from 14 to 53 mg/L.

Ammonia-Nitrogen (as N)
Ammonia-nitrogen concentrations reported by DWM at Station MMBR02.4 were below minimum detection limits and at Station MMBR00.5 ranged from <0.02 to 1.3 mg/L.

Total Phosphorus (as P)
Total phosphorus concentrations reported by DWM at Station MMBR02.4 ranged between 0.013 and 0.020 mg/L and at Station MMBR00.5 ranged between 0.049 and 0.29 mg/L.

The Aquatic Life Use is assessed as support based primarily on the fish population information, the limited water quality data, and best professional judgment. The presence of fluvial specialists/dependants, some of which are cold-water intolerant species, in both stream reaches sampled is indicative of high quality cold water. However, slightly low DO and elevated nutrients as well as the presence of the agricultural activities (grazing allowed in the riparian zone) result in the Aquatic Life Use being identified with an Alert Status for the lower 1.3-mile reach of the brook.

PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS
DWM collected fecal coliform bacteria samples from Moose Meadow Brook approximately 250 feet downstream of Tekoa Reservoir, Montgomery (Station MMBR02.4), between 1 August and 3 October 2001 (N=4). Sample results for fecal coliform ranged from <2 to 19 cfu/100 ml (Appendix 3 of Appendix A). Field survey crews did not note any objectionable odors, turbidity or deposits at this sampling location (MA DEP 2001b).

ESS collected fecal coliform bacteria samples from two tributaries to Moose Meadow Brook in 1999. The stations and results can be summarized as follows (ESS 2000).
Cooley Brook, north of Masspike, Westfield (Station SS-42) on 28 December - <10 cfu/100ml
Unnamed tributary, north of Masspike, Westfield (Station SS-41) on 28 December -150 cfu/100ml.

DWM collected fecal coliform bacteria samples from Moose Meadow Brook at a farm road (private access road to Conrail Line off Pochassic Road) bridge, Westfield (Station MMBR00.5) between 1 August and 3 October 2001 (N=4). Sample results for fecal coliform ranged from 3,300 to 24,000 cfu/100 ml (Appendix 3 of Appendix A). With the exception of one sampling event no objectionable odors, deposits or other conditions were noted by the field survey crews (MA DEP 2001b). However, water clarity in the brook was described as murky on one sampling occasion and there was evidence of cows having had access to the brook. ESS also collected fecal coliform bacteria samples from Moose Meadow Brook at the Conrail Bridge, Westfield (Station SS-5), on 3 November 1999. The fecal coliform bacteria result was 9,000 cfu/100ml (ESS 2000).

It should also be noted that DWM collected fecal coliform bacteria samples from Moose Meadow Brook near Pochassic Road, Westfield (Station MMBR01.1), in May and August 1996 (n=2) as part of the 1996 Westfield River Watershed monitoring survey (Appendix G, Table G4).

The upper 6.9-mile reach of Moose Meadow Brook is assessed as support for the Recreational and Aesthetic uses. However the lower 1.3-mile reach of the brook is assessed as impaired for the Recreational and Aesthetic Uses because of the elevated fecal coliform bacteria counts and turbidity. The source of impairment is agricultural activities associated with grazing in the riparian zone.

MDFW has proposed that Moose Meadow Brook be listed in the next revision of the SWQS as a cold water fishery (MDFW 2003).
WMA WATER WITHDRAWAL SUMMARY - See original document for authorized withdrawal (MGD)

Report Recommendations:
• Landowners should be encouraged to implement agricultural Best Management Practices (BMPs) in this subwatershed to protect riparian areas and prevent agricultural runoff and streambank erosion. The Natural Resources Conservation Service and Department of Agricultural Resources may be able to provide assistance.

• Continue to conduct bacteria monitoring to assess the Primary and Secondary Contact Recreational uses and to evaluate the implementation of any agricultural BMPs that are put into practice.

• Continue to conduct biological monitoring (habitat, benthic and fish community) to assess the status of the Aquatic Life Use.

• Moose Meadow Brook should be considered for designation as a Cold Water Fishery in the next revision of the Massachusetts SWQS.

[1] Moose Meadow Brook was formerly identified with Assessment Unit ID MA32-23; in the 2016 revision of the 303(d) List, it was divided into two segments: MA32-40 and MA32-41.

Appendix C– Pollutant Load Export Rates (PLERs)

Land Use & Cover[1]	PLERs (lb/acre/year)		
	(TP)	(TSS)	(TN)
AGRICULTURE, HSG A	0.45	7.14	2.59
AGRICULTURE, HSG B	0.45	29.4	2.59
AGRICULTURE, HSG C	0.45	59.8	2.59
AGRICULTURE, HSG D	0.45	91.0	2.59
AGRICULTURE, IMPERVIOUS	1.52	650	11.3
COMMERCIAL, HSG A	0.03	7.14	0.27
COMMERCIAL, HSG B	0.12	29.4	1.16
COMMERCIAL, HSG C	0.21	59.8	2.41
COMMERCIAL, HSG D	0.37	91.0	3.66
COMMERCIAL, IMPERVIOUS	1.78	377	15.1
FOREST, HSG A	0.12	7.14	0.54
FOREST, HSG B	0.12	29.4	0.54
FOREST, HSG C	0.12	59.8	0.54
FOREST, HSG D	0.12	91.0	0.54
FOREST, HSG IMPERVIOUS	1.52	650	11.3
HIGH DENSITY RESIDENTIAL, HSG A	0.03	7.14	0.27
HIGH DENSITY RESIDENTIAL, HSG B	0.12	29.4	1.16
HIGH DENSITY RESIDENTIAL, HSG C	0.21	59.8	2.41
HIGH DENSITY RESIDENTIAL, HSG D	0.37	91.0	3.66
HIGH DENSITY RESIDENTIAL, IMPERVIOUS	2.32	439	14.1
HIGHWAY, HSG A	0.03	7.14	0.27
HIGHWAY, HSG B	0.12	29.4	1.16
HIGHWAY, HSG C	0.21	59.8	2.41
HIGHWAY, HSG D	0.37	91.0	3.66
HIGHWAY, IMPERVIOUS	1.34	1,480	10.2
INDUSTRIAL, HSG A	0.03	7.14	0.27
INDUSTRIAL, HSG B	0.12	29.4	1.16
INDUSTRIAL, HSG C	0.21	59.8	2.41

Land Use & Cover[1]	PLERs (lb/acre/year)		
	(TP)	(TSS)	(TN)
INDUSTRIAL, HSG D	0.37	91.0	3.66
INDUSTRIAL, IMPERVIOUS	1.78	377	15.1
LOW DENSITY RESIDENTIAL, HSG A	0.03	7.14	0.27
LOW DENSITY RESIDENTIAL, HSG B	0.12	29.4	1.16
LOW DENSITY RESIDENTIAL, HSG C	0.21	59.8	2.41
LOW DENSITY RESIDENTIAL, HSG D	0.37	91.0	3.66
LOW DENSITY RESIDENTIAL, IMPERVIOUS	1.52	439	14.1
MEDIUM DENSITY RESIDENTIAL, HSG A	0.03	7.14	0.27
MEDIUM DENSITY RESIDENTIAL, HSG B	0.12	29.4	1.16
MEDIUM DENSITY RESIDENTIAL, HSG C	0.21	59.8	2.41
MEDIUM DENSITY RESIDENTIAL, HSG D	0.37	91.0	3.66
MEDIUM DENSITY RESIDENTIAL, IMPERVIOUS	1.96	439	14.1
OPEN LAND, HSG A	0.12	7.14	0.27
OPEN LAND, HSG B	0.12	29.4	1.16
OPEN LAND, HSG C	0.12	59.8	2.41
OPEN LAND, HSG D	0.12	91.0	3.66
OPEN LAND, IMPERVIOUS	1.52	650	11.3
[1]HSG = Hydrologic Soil Group			