MASSACHUSETTS watershed·based plans

WATERSHED-BASED PLAN

Chicopee Brook Watershed

AUID MA36-21

August 2025

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Executive Summary

Introduction

The purpose of a Massachusetts Watershed-Based Plan (WBP) is to organize information about Massachusetts' watersheds and present it 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 (USEPA) recommended format for "nine-element" watershed plans. This WBP was developed by the Pioneer Valley Planning Commission (PVPC) and the Town of Monson with funding, input, and collaboration with the Massachusetts Department of Environmental Protection (MassDEP). The Chicopee Brook watershed includes approximately 15,500 acres of land in southeastern Massachusetts. This WBP focuses specifically on the Chicopee Brook watershed within the Town of Monson.

Impairments and Pollution Sources

Chicopee Brook (MA36-21) is currently listed in the 2022 Integrated List of Waters as a Category 5 water requiring a Total Maximum Daily Load (TMDL) for *Escherichia coli* (*E.coli)* and temperature impairments. Potential current and future pollution sources include nonpoint source pollution from stormwater, on-site septic systems, and agricultural operations.

Goals, Management Measures, and Funding

Water quality goals for this WBP focus on reducing phosphorus to Chicopee Brook. An initial goal of reducing phosphorus by 9% (from 16.5 ug/L to 15 ug/L). Though Chicopee Brook does not currently have a phosphorus impairment, actions taken to reduce phosphorus in the watershed will allow *E.coli* and temperature goals (based on meeting water quality standards) to be met. From there, focus will be shifted to the long-term goal of delisting Chicopee Brook based on adaptively adjusting goals based on ongoing monitoring results.

It is expected that these goals will be accomplished primarily through installation of structural BMPs to capture runoff and reduce loading, as well as implementation of non-structural BMPs (e.g., stormwater management measures and reduction of impervious area), and watershed education and outreach. It is expected that funding for management measures will be obtained from a variety of sources including grant funding, capital funds, volunteer efforts, and other sources.

Public Education and Outreach

Goals of public education and outreach are to promote watershed stewardship by emphasizing the benefits of improving the water quality of Chicopee Brook watershed and the importance of protecting the health of the watershed in the future. In particular, the Town aims to engage watershed residents, businesses, and other community stakeholders about the impacts of animal waste and litter, overwatering lawns, and the proper application of fertilizers, and a variety of other means. It is expected that these programs will be evaluated by tracking attendance at educational events, tracking numbers of signs and educational materials distributed, and other tools applicable to the type of outreach performed.

Implementation Schedule and Evaluation Criteria

Project activities will be implemented based on information outlined in the following elements for monitoring, implementation of structural BMPs, and public education and outreach activities. In addition to water quality monitoring to ensure that water quality standards are being protected, indirect evaluation metrics are recommended, including quantifying reduction of connected impervious area within the watershed. The long-term goal of this WBP is to improve the health of the Chicopee Brook subwatershed. The WBP will be re-evaluated and adjusted, as needed, once every three years.

Introduction

What is a Watershed-Based Plan?

Purpose and 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 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 (NPS) 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 toward attaining water quality standards and, if not, the criteria for determining whether this WBP needs to be revised or, if a NPS 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 the Pioneer Valley Planning Commission (PVPC) in collaboration with the Town of Monson, with funding, input, and collaboration from the MassDEP and technical assistance from Comprehensive Environmental, Inc. (CEI). This WBP was developed using funds from the Section 319 program to the PVPC as part of a Regional Nonpoint Source Coordinator Program to, in part, assist grantees in developing technically robust WBPs using MassDEP's Watershed-Based Planning Tool.

Core project stakeholders included:

- Toni Uliana, Conservation Agent – Town of Monson
- Benjamin Murphy, Highway Surveyor and Tree Warden – Town of Monson
- Jennifer Wolowicz, Town Administrator – Town of Monson
- Patty Gambarini, Chief Environmental Planner – Pioneer Valley Planning Commission
- Malcolm Harper, Environmental Analyst/Regional Planner IV, Clean Water Act s.319 – MassDEP
- Meghan Selby, Clean Water Act s.604(b) Program – MassDEP

This WBP was developed as part of an iterative process. The PVPC and CEI project team collected and reviewed existing data from the Town of Monson. This information was then used to develop a preliminary WBP for review by core project stakeholders. A stakeholder conference call was then held by CEI to solicit input and gain consensus on elements included in the plan (e.g., water quality goals, public outreach activities, etc.). The WBP was finalized once stakeholder consensus was obtained for all elements.

Data Sources

This WBP was developed using the framework and data sources provided by MassDEP's WBP Tool. Additional data sources were reviewed and are summarized in subsequent sections of this WBP, as listed by Table 1.

Table 1: Supplemental Data Sources

Title/Description	Source	Date
Final Massachusetts Integrated List of Waters for the Clean Water Act 2022 Reporting Cycle	MassDEP	2023
2018/2020 Integrated List of Waters Appendix 13: Chicopee River Watershed Assessment and Listing Decision Summary	MassDEP	2021
Stormwater Management Plan	Town of Monson	2022
Open Space and Recreation Plan	Town of Monson	2014
Monson Master Plan	Town of Monson	2004
Final Restoration Plan and Environmental Assessment: PSC Resources Superfund Site Palmer, Massachusetts USFWS, EEA	USFWS, EEA	2008
Municipal Vulnerability Preparedness (MVP) Community Resilience Building Workshop Summary of Findings	Town of Monson	2019
FY23 MVP Action Grant – Chicopee Brook Flood Resilience	Town of Monson	2023
Hazard Mitigation Plan Update	PVPC	2016, 2023

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

As shown in Figure 1and Table 2, the Chicopee Brook watershed extends from the Quaboag River south to the headwaters of tributaries that include Conant Brook (MA36-45) and Vinica Brook. This WBP is primarily focused on addressing water quality within Chicopee Brook, particularly from the portion of the watershed within the Town of Monson.

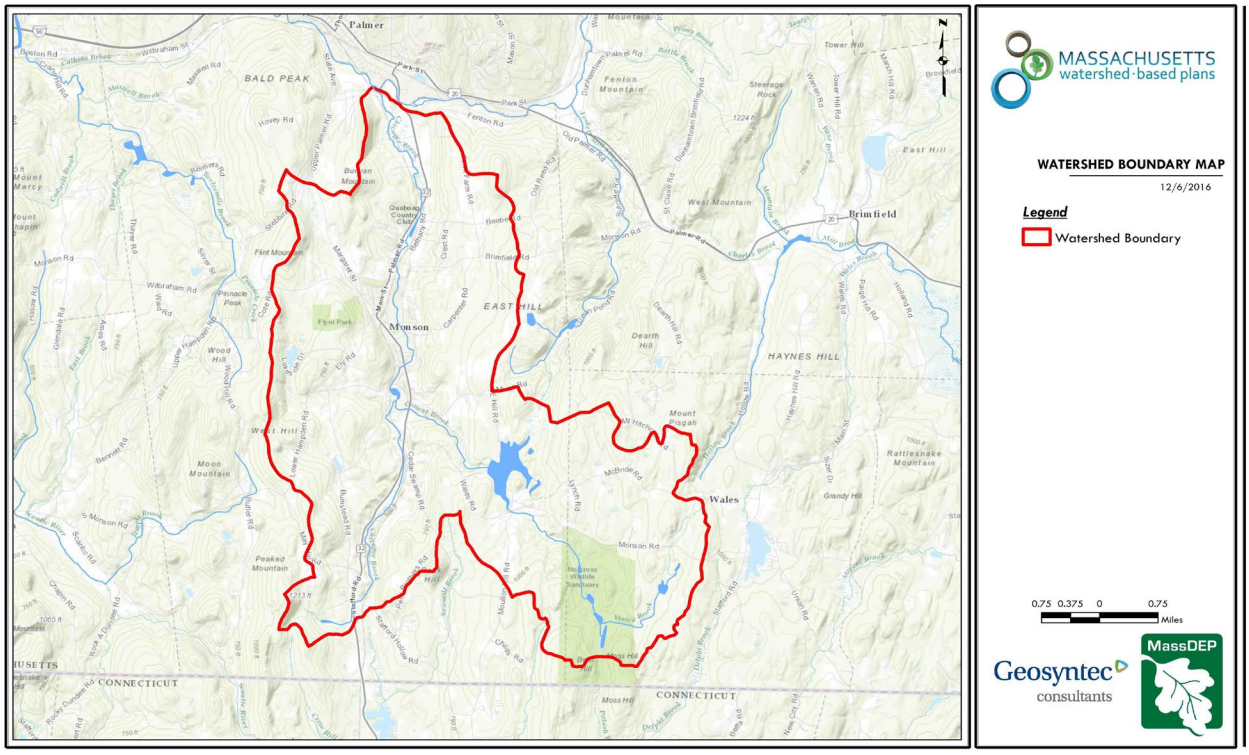


Figure 1: Watershed Boundary Map (MassGIS, 2007; MassGIS, 1999; MassGIS, 2001; USGS, 2016)

Ctrl + Click on the map to view a full sized image in your web browser.

Table 2: General Watershed Information

Watershed Name (Assessment Unit ID):	Chicopee Brook (MA36-21); Conant Brook (MA36-45); Vinica Brook
Major Basin:	Chicopee River
Watershed Area (within MA):	15419.5 (ac)

Most of the Chicopee Brook watershed is located within the Town of Monson. Chicopee Brook's flow runs south to north through the central valley of Monson Center to the Quaboag River. The Quaboag River then joins the Swift and Ware Rivers to form the Chicopee River, a principal tributary of the Connecticut River. While Chicopee Brook was once valued for industrial uses, it is being reassessed and appreciated for its aesthetic, recreational and wildlife sustaining qualities.

Flooding Concerns

The Town of Monson's 2016 Hazard Mitigation Plan update characterized flooding as a high hazard for Monson, noting that the area of potential flood occurrence is large, the probability of future flooding events is high, and the impacts from such flooding would be critical. Through the MVP Planning process (2019), Monson identified the development of a Flood Damage Reduction Plan emphasizing nature-based solutions as one of the highest priorities to increase resilience and identified erosion on the banks of the Chicopee Brook as a concern, and that woody debris in within the streambed increases incidents of localized flooding on adjacent property and roadways. As a follow-up to the MVP Planning process, Monson received an MVP Action Grant to complete a hydrologic and hydraulic (H&H) flood modeling study of the Chicopee Brook corridor and develop potential improvement scenarios at several key locations adjacent to the downtown area and within the downstream Environmental Justice community, including the Bunyan Road crossing, Veterans and Cushman Fields, Bliss Street Dam, and the Maple Street crossing.

Drinking Water Supply

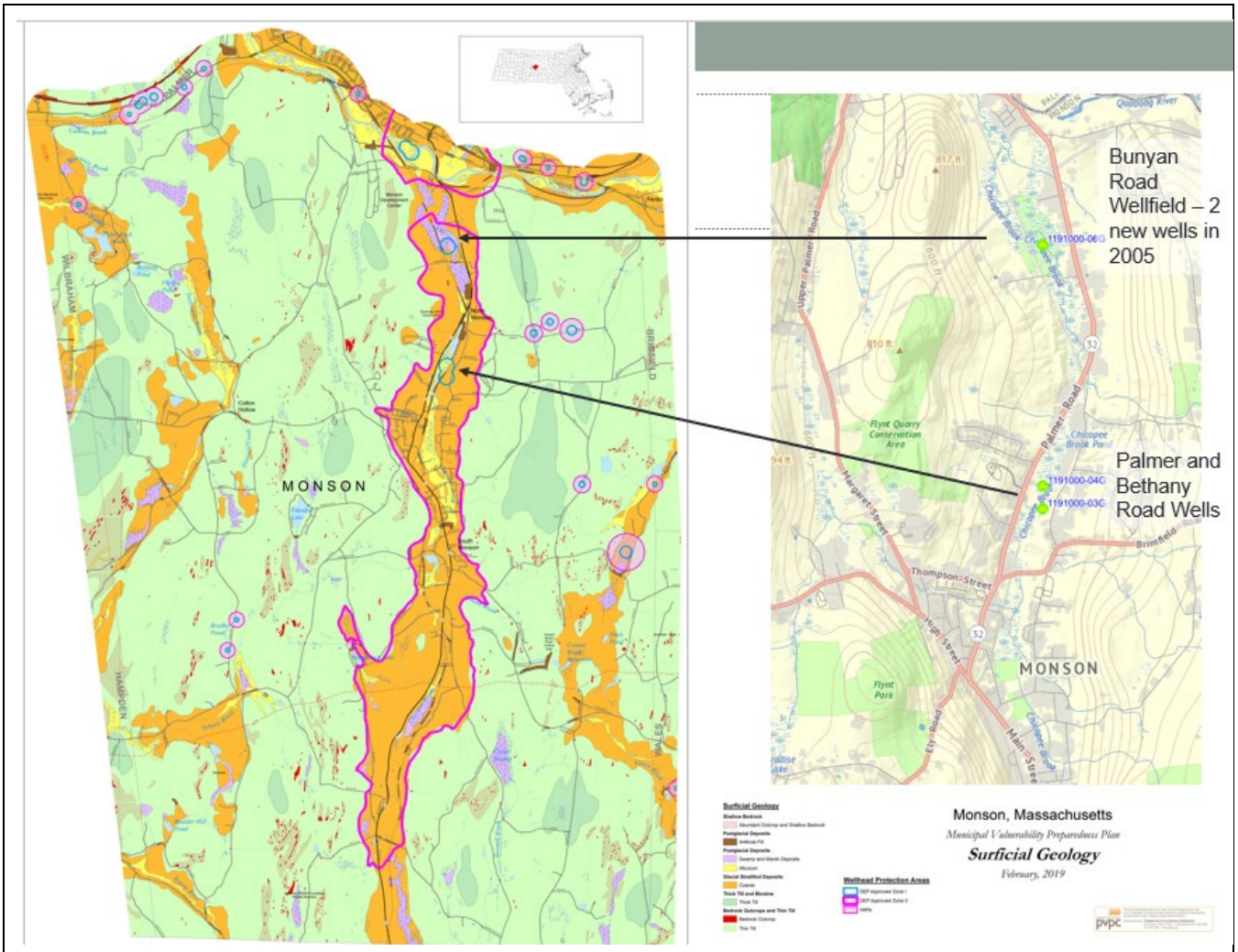
Maintaining groundwater quality is an important issue in Monson, according to the 2021 Open Space and Recreation Plan and the 2009, 2016, and 2023 Hazard Mitigation Plans. The MVP FY24 grant for the relocation and restoration of Bunyan Road includes a task to purchase the land with the goal of protecting water supply lands from development.

Monson is fortunate in that its geology and its land cover (to date) allow it to pull 100% of its drinking water supply from groundwater sources. About 47% of the population is served by public water supply, while the rest of the population relies on private wells. Monson's public wells are located along Chicopee Brook and include 2 wells, one at Palmer Road and another at Bethany Road, and 2 wells in the Bunyan Road wellfield (Figure 2).

Given the well locations, much of Chicopee Brook and its riparian areas are located within the MassDEP approved Zone II Aquifer Recharge Area. Monson's zoning bylaws currently incorporate a water supply protection overlay district that covers this Zone II recharge area. The bylaw prohibits and restricts potentially polluting land uses. Yet surface and groundwater pollution occur due to runoff from road salt, agricultural fertilizers, and some industries along Chicopee Brook.

The Mass DEP-approved Zone 1 Well Head Protection Areas are located around the wells themselves. The Zone II Aquifer Recharge Area extends from just south of the Quaboag River southward all along Chicopee Brook, through the center of town just south of Chicopee Brook's crossing with Stafford Hollow Road.

Because these areas correspond with the town's drinking water supply, and because the Source Water Protection Plan also notes that there is no protective clay layer to filter pollution with this aquifer, additional acquisition and protection of land (particularly around the Palmer Road and Bethany Road Wells) is needed. At the same time, any improvements to the quality of stormwater flows to Chicopee Brook would also likely be protective of drinking water supply.



Monson surficial geology map showing location of public drinking water supply wells and delineations of the Zone 1 wellhead protection areas and Zone II aquifer recharge area.

Figure 2: Drinking Water Supply and Associated Zone I and Zone II Wellhead Protection Areas

Soils

It is important to note that HSG A soils (high infiltration rates) run the length of the Zone 2 area. Rainfall tends to infiltrate quickly through these soils, which can leave groundwater more susceptible to contamination. The high susceptibility of the drinking water supply system to contamination is based on land uses, including septic systems, road salting practices, and herbicide spraying (SWPP 2006, also cited in MVP Statement of Findings). Spraying is associated with railway activities, one company for rail line along Chicopee Brook and the other for a rail line along Monson border with Palmer.

Dams

There are a large number of dams located throughout the Chicopee Brook corridor. Dams and their impoundments (the body of water created behind a dam) can impact water quality of the streams on which they are located. High temperatures and low oxygen levels can cause substantial harm to important stream wildlife. A list of dams and their status are provided below (from the 2023 Hazard Mitigation Plan update for Monson).

Table 3: Dam location and status in Monson (from the 2023 Hazard Mitigation Plan Update)

National ID #	Dam Name	Primary Owner	Hazard Potential	Most Recent Formal Phase I Inspection Date	Condition	Dam Purpose	Regulatory Authority
MA01920	Aldrich Pond Dam	No Record for Privately Owned Non-Jurisdictional Dam *	N/A			Aesthetic	Non-Jurisdictional
MA01923	Anderson Pond Dam	No Record for Privately Owned Non-Jurisdictional Dam *	N/A			Aesthetic	Non-Jurisdictional
MA01921	B.C.P. Bradway Pond Dam	No Record for Privately Owned Non-Jurisdictional Dam	N/A			Aesthetic	Non-Jurisdictional
MA00725	Baldwin Pond Dam	Jean E. Shepard III & Charles B. Shepard & Anne S. King	Low Hazard			Recreation	Office of Dam Safety
MA01926	Shepard Lower Pond Dam	No Record for Privately Owned Non-Jurisdictional Dam*	N/A			Recreation	Non-Jurisdictional
MA01928	Shepard Upper Pond Dam	Jean E. Shepard III & Charles B. Shepard & Anne S. King	Low Hazard	8/24/2009	Poor	Recreation	Office of Dam Safety
MA00727	Boulder Hill Pond Dam	Boulder Hill Development LLC	Significant Hazard	11/18/2011	Fair	Recreation	Office of Dam Safety
MA00556	Bradway Pond Dam	No Record for Privately Owned Non-Jurisdictional Dam*	N/A			Recreation/Aesthetic	Non-Jurisdictional
MA02720	C.P. Bradway Lower Pond Dam	No Record for Privately Owned Non-Jurisdictional Dam*	N/A			Aesthetic	Non-Jurisdictional
MA01003	Calkins Pond Dam	Old Stagecoach Lake Association, Inc.	Significant Hazard	1/28/2014	Satisfactory	Recreation	Office of Dam Safety
MA01332	Calkins Pond Upper Dam	Ownership disputed**	Significant Hazard			Unknown	Office of Dam Safety

National ID #	Dam Name	Primary Owner	Hazard Potential	Most Recent Formal Phase I Inspection Date	Condition	Dam Purpose	Regulatory Authority
MA00614	Church Manufacturing Company Dam	RJA Realty Holdings, Inc.	Low Hazard	10/20/2005	Fair	Recreation	Office of Dam Safety
MA00965	Conant Brook Dam	US Army Corps of Engineers, Contact USACOE for up to date record information	High Hazard				Army Corps of Engineers
MA01924	Dr. Schimmel Pond Dam	No Record for Privately Owned Non-Jurisdictional Dam *	N/A				Non-Jurisdictional
MA00555	Lunden Dam	The Trustees of Reservation, Inc.	Significant Hazard	7/13/2010	Fair	Recreation	Office of Dam Safety
MA01925	Monson Association Pond Dam	No Record for Privately Owned Non-Jurisdictional Dam	N/A				Non-Jurisdictional
MA02718	Monson Water Works Dam	Town of Monson, Water and Sewer Department	Low Hazard	10/2/2019	Satisfactory	Recreation	Office of Dam Safety
MA00728	Moulton Pond Dam #1	No Record for Privately Owned Non-Jurisdictional Dam*	N/A				Non-Jurisdictional
MA00711	Paradise Lake Dam	No Record for Privately Owned Non-Jurisdictional Dam *	N/A				Non-Jurisdictional
MA00552	Pulpit Rock Pond Main Dam	Pulpit Rock Pond Preservation Trust, Inc.	Significant Hazard	6/19/2013	Poor	Recreation	Office of Dam Safety
MA00554	Pulpit Rock Pond Small Dam	No Record for Privately Owned Non-Jurisdictional Dam*	N/A				Non-Jurisdictional
MA00553	Pulpit Rock Pond West Dam	Pulpit Rock Pond Preservation Trust, Inc.	Significant Hazard	6/20/2012	Poor	Recreation	Office of Dam Safety

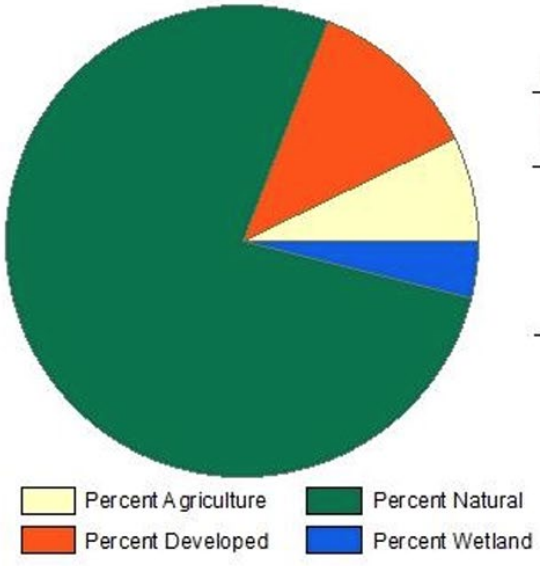
National ID #	Dam Name	Primary Owner	Hazard Potential	Most Recent Formal Phase I Inspection Date	Condition	Dam Purpose	Regulatory Authority
MA02719	R.S. Sutcliffe Dam & Dike	US Army Corps of Engineers, Contact USACOE for up-to-date record information	Low Hazard				Army Corps of Engineers
MA01927	Smith Pond Dam & Dike	No Record for Privately Owned Non-Jurisdictional Dam*	N/A				Non-Jurisdictional
MA01922	Springfield Sportsman's Club	Springfield Sportman's Club, Inc.	Significant Hazard	8/29/2014	Unsafe	Recreation/Aesthetic	Office of Dam Safety
MA00551	Zero Manufacturing Company Dam	Monson Mill Associates, Limited Partnership	Significant Hazard	6/12/2013	Fair	Recreation	Office of Dam Safety

MassDEP Water Quality Assessment Report and TMDL Review

2018/2020 Integrated List of Waters Appendix 13: Chicopee River Watershed Assessment and Listing Decision Summary: Appendix 13 of the 2018/2020 Integrated List of Waters includes information on land use and the listing decision associated with the Category 5 impairments for *E. coli* and temperature for Chicopee Brook (MA36-21) as follows (this information is directly from the Integrated List of Waters Report):

Chicopee Brook - MA36-21

Watershed Area: 24.01 square miles



Landuse Type	Entire Basin	5km Radius Proximal Subbasin	100m Stream Buffer	Proximal Stream Buffer
Land Use Area (square miles)	23.99	6.26	6.51	1.54
Agriculture	7.1%	7.8%	7.8%	8.9%
Developed	12%	19.6%	13.9%	22.7%
Natural	77.1%	66.3%	69.9%	51.3%
Wetland	3.8%	6.3%	8.5%	17.1%
Impervious Cover	4.9%			

Fish, Other Aquatic Life and Wildlife Use: Not Supporting

Benthic macroinvertebrates were collected by MassDEP biologists as part of the probabilistic wadeable streams monitoring project (MAP2) ~60m upstream from State Street (B0645) and at Rt 32 crossing nearest Green St in Monson (B0895) in summer 2014. These data were not analyzed using an RBPIII approach, but rather will be compared to biocriteria thresholds, which are currently under development, so these data will be utilized during a future IR reporting cycle. MassDEP staff conducted clean metals sampling in the brook west of Bliss Street, ~990 feet downstream from Oak Street, Monson (W2001) during summer 2008. No exceedances of any acute or chronic metals criteria occurred for either sample.

In Aug 2006, DFG biologists conducted backpack electrofishing upstream of the bridge at the road off Rt 32 south (Sample ID 1965). The sample was comprised entirely by fluvial specialists/dependents species including multiple age classes of Eastern brook trout.

MassDEP staff conducted water quality monitoring at other sites further downstream during the summer of 2008 with the following results: At State Street, Monson (W1853) the min DO during the three two-day continuous probe deployments in June, July, and Aug was 7.21mg/L, max daily DO shift was 1.4mg/L, with a max saturation of 98%. The max temperature during the June-Sept (115-day) thermistor deployment was 25.1°C (max 7DADM 23.8oC exceeding 20°C 62 times) and the max 24-hour rolling avg was 22.5°C (not exceeding the acute criterion

of 23.5°C). Discrete pH measurements ranged from 6.8-6.9SU (n=5). The seasonal avg TP concentration was low (0.02mg/L, max 0.045mg/L) and there were no observations of dense/very dense filamentous algae noted.

Further downstream but above Chicopee Brook Pond (W2002) the max temperature was 24.5°C during the June-Sept (115-day) thermistor deployment with a max 7DADM of 22.6oC (exceeding 20°C 50 times) and with a max 24-hour rolling avg of 21.9oC.

Downstream from the roll dam at outlet of Chicopee Brook Pond (W2003) the thermistor deployed from June-Sept (115-day) recorded a max temperature 26.4°C, the max 7DADM was 26.4oC (exceeding 20°C 95 times) and the max 24-hour rolling avg was 24.1oC (exceeding the acute criteria of 23.5°C).

The seasonal avg TP concentration in the brook at Route 32 crossing nearest Bunyan Road, Monson (W1871) was low (0.025mg/L, max 0.058mg/, n=5) and there were no observations of dense/very dense filamentous algae noted. Further downstream (450 ft u/s from Rt 32 & ~60 ft d/s of discharge MAG250376) the thermistor deployed between June and Sept (115-day) recorded a max temperature of 27.7°C. The max 7DADM was 26.3oC (exceeding 20°C 95 times) and the max daily mean was 24.1oC, violating both the acute and chronic and acute temperature criterion for a Cold Water.

Two-day continuous probes deployed in the brook in June and Aug at Bunyan Drive (W1854) recorded a min DO of 6.62mg/L and a max temperature of 25.7°C. The max saturation was 103%, and the max diel DO shift was 1.8mg/L. The max temperature during the June-Sept (107- day) thermistor deployment was 27.0°C (max 7DADM 25.1oC exceeding 20°C 83 times) and the max 24-hour rolling avg of 23.8°C was above the acute criterion of 23.5°C. Discrete pH measurements ranged from 6.5 to 6.8SU (n=6). The seasonal avg TP concentration was 0.026mg/L (max 0.06mg/L). No observations of dense or very dense filamentous algae were noted.

The Aquatic Life Use for Chicopee Brook is assessed as Not Supporting since temperatures exceeded the cold water criterion of 20°C at 5 sampling sites along the brook during summer 2008 even though all other data were indicative of excellent conditions (multiple age classes of Eastern brook trout and other fluvial fish were present and all other water quality data were indicative of excellent conditions). The temperature violations are not considered to be natural due to the presence of multiple dams along the brook.

Historical and current Technical Memoranda (TM) produced by the MassDEP Watershed Planning Program are available here and are organized by major watersheds in Massachusetts. Most of these TMs present the water chemistry and biological sampling results of WPP monitoring surveys. The TMs pertaining primarily to biological information (e.g., benthic macroinvertebrates, periphyton, fish populations) contain biological data and metrics that are currently not reported elsewhere. The data contained in the water quality TMs are also provided on the "Data" page (Water Quality Monitoring Program Data | Mass.gov).

Water Quality Data

The MassDEP-DWM, Watershed Planning Program (WPP) provides water quality laboratory data for sampling conducted between 2005-2020 online at: https://www.mass.gov/guides/water-quality-monitoring-program-data. Phosphorus and bacteria data from samples collected within Chicopee Brook is summarized below. Monitoring station locations are shown in Figure 3.

Table 4: Water Quality Sampling Stations on Chicopee Brook

Station	Station Description	Date Range	Sampling Frequency
W1853	State Street, Monson	5/20/2008 - 9/23/2008	Monthly during summer of 2008
W1854	Bunyan Drive, Monson	5/20/2008 - 9/23/2008	Monthly during summer of 2008
W1871	Route 32 crossing nearest Bunyan Road, Monson	5/20/2008 - 9/23/2008	Monthly during summer of 2008
W2350	Route 32 crossing nearest Green Street, Monson	5/6/2014 - 8/21/2014	Monthly during summer of 2014

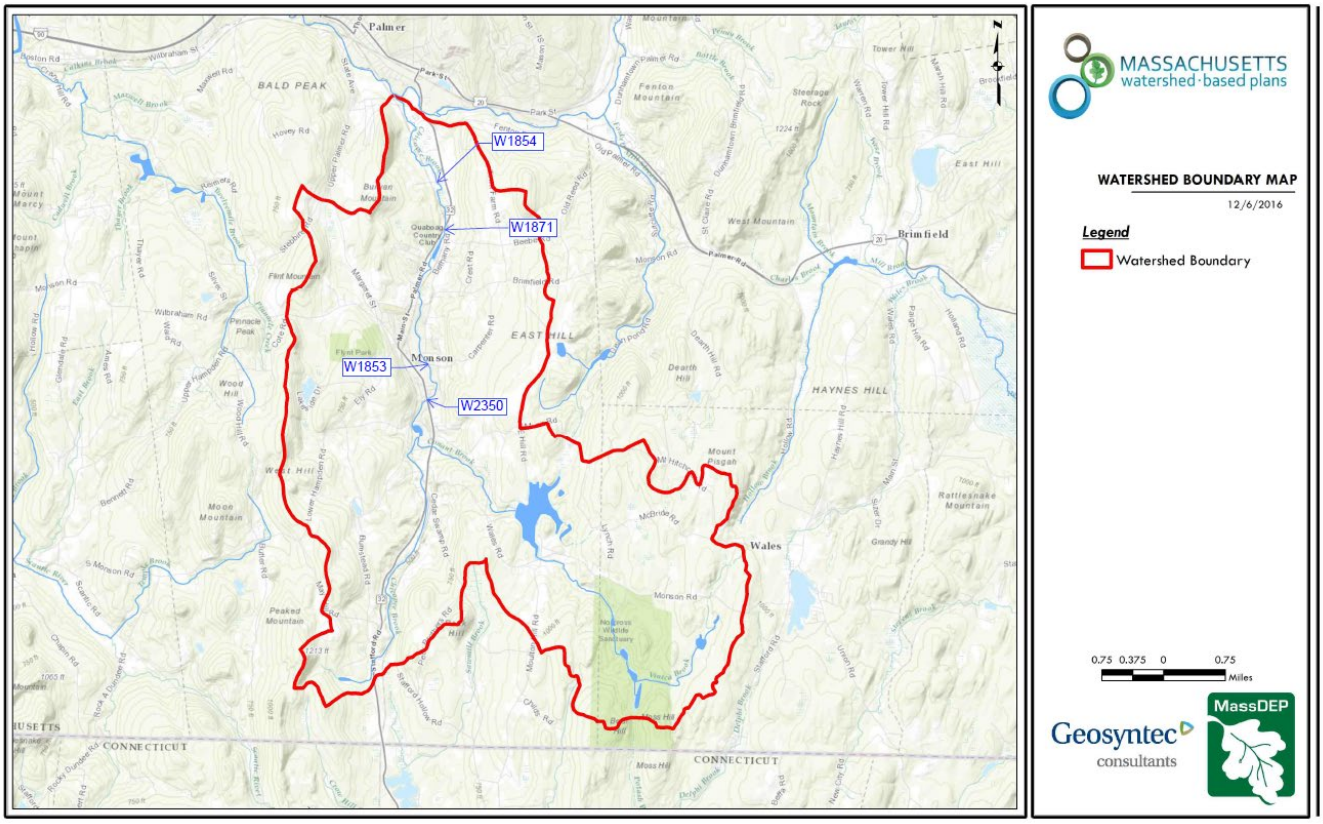


Figure 3: Water Quality Monitoring Stations in the Chicopee Brook Watershed (MassGIS, 2007; MassGIS, 1999; MassGIS, 2001; USGS, 2016)

Table 5: Total Phosphorus and *E.coli* Data for Chicopee Brook

Date	TP (ug/L)	*E.coli* (CFU/100mL)*	Station ID
5/20/2008	11	102	W1853
6/17/2008	45	200	
7/9/2008	--	260	
7/22/2008	17	440	
8/19/2008	14	310	
9/23/2008	11	40	
5/20/2008	12	138	W1854
6/17/2008	60	200	
7/9/2008	---	280	
7/22/2008	26	410	
8/19/2008	17	350	
9/23/2008	15	160	
5/20/2008	12	82	W1871
6/17/2008	58	200	
7/9/2008	--	230	
7/22/2008	29	410	
8/19/2008	16	800	
9/23/2008	12	220	
5/6/2014	6	44	W2350
6/2/2014	11	201	
7/2/2014	19	365	
7/29/2014	19	261	
8/21/2014	18	81	

* MA water quality standards for E. coli:
i. concentrations shall not exceed 126 colony-forming units (cfu) per 100 mL, calculated as the geometric mean of all samples collected within any 90-day or smaller interval; and
ii. no more than 10% of all such samples shall exceed 410 cfu per 100 mL (a statistical threshold value).Massachusetts Surface Water Quality Standards (314 CMR 4.00, 2021)

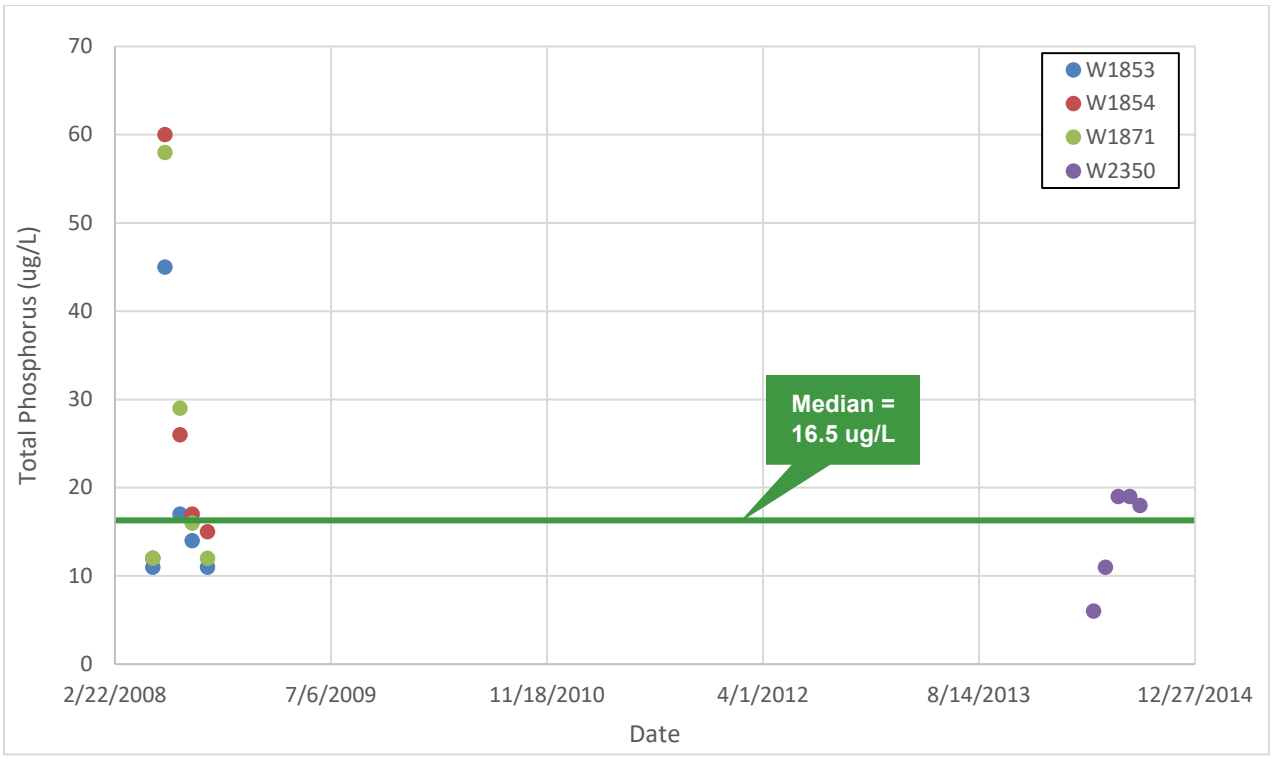


Figure 4: Chicopee Brook Total Phosphorus Data from 2008-2014

Figure 5: Chicopee Brook *E.coli* Data from 2008-2014

Water Quality Impairments

Water quality impairments for Chicopee Brook are listed in Table 6, as documented in MassDEP 2022 Massachusetts Integrated List of Waters (MassDEP, 2019). Listing categories from the Integrated List are shown in Table 7.

Table 6: Water Quality Impairments for Chicopee Brook (MassDEP 2022)

Assessment Unit ID	Waterbody	Integrated List Category	Designated Use	Impairment Cause	Impairment Source
MA36-21	Chicopee Brook	5	Fish, other Aquatic Life and Wildlife	Temperature	Dam Or Impoundment
MA36-21	Chicopee Brook	5	Primary Contact Recreation	*Escherichia Coli (E. Coli)*	Source Unknown

Table 7: 2022 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.

Land Use and Impervious Cover Information

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

Table 8: Watershed Land Uses

Land Use	Area (acres)	% of Watershed
Agriculture	1134.18	7.4
Commercial	121.72	0.8
Forest	12379.69	80.3
High Density Residential	139.22	0.9
Highway	39.45	0.3
Industrial	132.11	0.9
Low Density Residential	933.32	6.1
Medium Density Residential	189.46	1.2
Open Land	255.04	1.7
Water	95.31	0.6

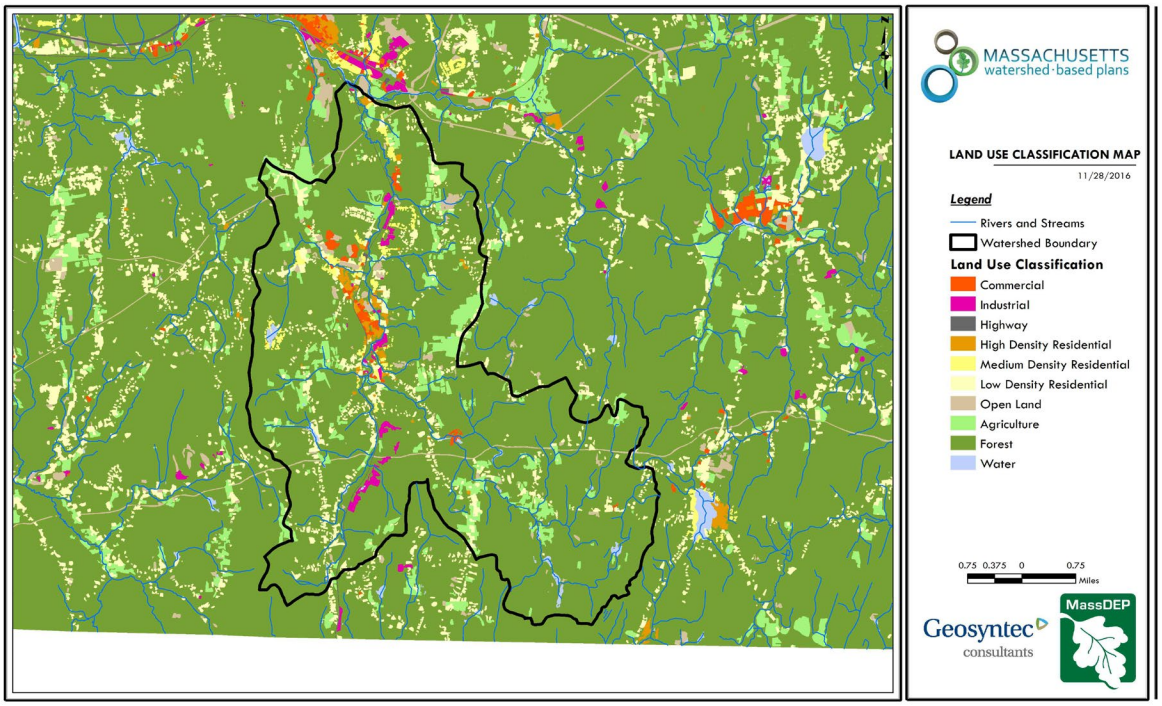


Figure 6: Watershed Land Use Map (MassGIS, 2007; MassGIS, 2009b; MassGIS, 1999; MassGIS, 2001; USGS, 2016)

Ctrl + Click on the map to view a full sized image in your web browser.

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 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. USEPA provides guidance (USEPA, 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.

Table 9:TIA and DCIA Values for the Chicopee Brook Watershed

	Estimated TIA (%)	Estimated DCIA (%)
Chicopee Brook Watershed	4.9	3.6

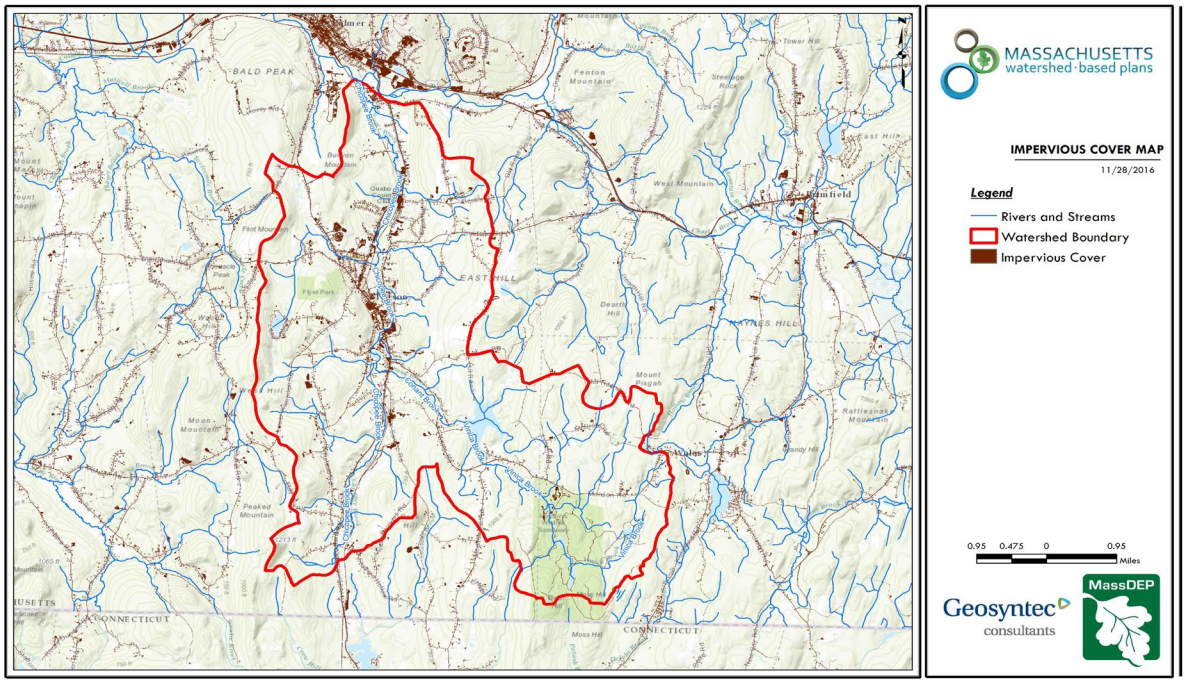


Figure 7 : Watershed Impervious Surface Map (MassGIS, 2007; MassGIS, 2009b; MassGIS, 1999; MassGIS, 2001; USGS, 2016)

Ctrl + Click on the map to view a full sized image in your web browser.

The impervious cover model developed by the Center for Watershed Protection in 1994 and affirmed through many studies since, correlates stream health to degree of imperviousness in a watershed. Although the model applies only to streams that are 3rd order or less, the model is often generalized to apply to larger watersheds. Given that Chicopee Brook is a 3rd order stream, the application of this model seems appropriate. It is important, however, to note in stretches of the watershed that are more heavily impervious, such as downtown Monson, there can be serious localized impacts.[1]

Table 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.

1 To understand which streams in the region are 3rd order or less, see Table 1. in *Gazetteer of Hydrologic Characteristics of Streams in Massachusetts— Connecticut River Basin* by S. William Wandle, Jr. of the U.S. Geological Survey, 1984. In using this Table, note that the Connecticut River itself is 6th order. Thus order is as follows: CT River (6th) – Chicopee River (5th) – Quaboag River (4th) – Chicopee Brook (3rd).

Pollutant Loading

Land use data was used as the basis for the pollutant loading analysis in this WBP. Land use data (MassGIS, 2009b) was intersected with impervious cover data (MassGIS, 2009a) 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) as follows:

$$L_n = A_n * P_n$$

where L_n = Loading of land use/cover type n (lb/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 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 (USEPA, 2020; UNHSC, 2018, Tetra Tech, 2015) (see values provided in Appendix A). **Table 11** presents the estimated land-use based TN, TP and TSS pollutant loading in the watershed.

Table 11: Estimated Pollutant Loading for Key Nonpoint Source Pollutants

Land Use Type	Acres	Total Phosphorus (TP)*		Other Pollutant Loading*	
		bs/year	lbs TP/acre	Total Nitrogen (TN) (lbs/yr)	Total Suspended Solids (TSS) (tons/yr)
Agriculture	1134	573	0.51	3,478	45
Commercial	122	120	0.98	1,032	13
Forest/Background	12380	1,685	0.14	8,549	347
High Density Residential	139	109	0.78	703	11
Highway	39	32	0.82	260	16
Industrial	132	100	0.76	883	11
Low Density Residential	933	276	0.30	2,781	38
Medium Density Residential	189	67	0.35	563	8
Open Land	255	87	0.34	768	16
TOTAL	15324	3,050	4.98	19,017	504.80

*These estimates do not consider loads from point sources or septic systems.

Additional Information from Existing Documents/Reports

Town of Monson Reports/Documents

MVP Action Grant – Flood Resilience Modeling of Chicopee Brook Corridor and Strategies for Reducing Flood Impacts (2023)

PROJECT DESCRIPTON

Monson received a $295,000 MVP Action Grant in FY23. The project included:

- Completed flood resilience modeling of Chicopee Brook corridor to identify optimal strategies for protecting against the impacts of flooding through the implementation of nature-based solutions ranging from rightsizing of culverts to increasing flood capacity through floodplain reconnection and green infrastructure.
- Developed illustrative conceptual plans for key flood resilience projects for priority sites along Chicopee Brook, including the Bunyan Road crossing, Cushman Field, Veterans Field, Bliss Street Dam, and Maple Street crossing.
- Modeled proposed conditions under future precipitation and flow conditions to:
    1. Identify future floodplain impacts.
    2. Quantify the flood reduction benefits that could be achieved through different combinations of resilience projects.
    3. Develop a strategy and sequencing for carrying out the implementation of improvements over time.

MVP Community Resilience Building Workshop Summary of Findings (2019)

AREAS OF CONCERN

- Infrastructure: significantly more flooding, frequent flooding of undersized culverts and ponding on Main St. impacts critical downtown facilities; Chestnut Street flooding, numerous dams throughout town, including two high-hazard dams; lack of maintenance resources for stormwater facilities
- Environmental: debris in Chicopee Brook increases flooding; downed trees increase wildland fire risk; increased intensity rainfall events increased erosion of Chicopee Brook; downed trees from 2011 tornado results in increased runoff; invasive species (Japanese knotweed and Gypsy Moth) damaging trees
- Societal: Colonial Village Senior housing facility on State Street is in flood zone; outreach and education is a challenge
- Built Environment: all town functions, including Town Hall, Police Department, and Fire Department, DPW, Senior Center, and Water Department are all located directly in flood zone and lack redundancy

SPECIFIC CATEGORIES OF CONCERNS & CHALLENGES - Transportation Infrastructure

- The greatest vulnerabilities to the transportation network in Monson are relative to undersized culverts and aging stormwater infrastructure that, in the face of higher intensity precipitation events, are leading to routine flooding and roadway damage.
- Participants noted that much of the road network around the town's historic center is vulnerable to flooding because of its proximity to the Chicopee Brook, which is reportedly flooding more frequently than even before.

- The most frequently cited location of concern was Main Street (Route 32), the town's major north-south evacuation route, where flood conditions could impede the town's ability to evacuate during an emergency. The Route 32 bridge at the Palmer town line is also routinely impacted by flooding. While the majority of Route 32 in town is owned and maintained by MassDOT, the 1.6 mile portion of Route 32 located in the town center where the majority of flood concerns are focused is town-owned and town-maintained.

HIGH PRIORITY ACTIONS

Category	Action
Stormwater Management and Nature Based Solutions	Continue to conserve land to address the source of flooding.
	Full culvert and stormwater study with recommendations for re-design based on new climate data. Should look at how flooding might impact rail lines and emergency support systems.
	Evaluate/rewrite bylaws regulating culverts on private property
	Prioritize upland stormwater solutions
	Commission Flood Damage Reduction Study
	Monitor/map hazardous materials in flood zone
	Create management plan for maintaining systems in place (water resources/detention basins)
	Develop local policy to assign responsibility for maintenance of Nature Based solutions
Transportation Infrastructure Assessment and Improvement—culverts/bridges	Identify problematic culverts - culvert inventory
	Create culvert replacement plan that prioritized nature-based solutions
	Establish clear standards for design, sizing, and material and collaborate/share with all jurisdictions (highway, municipal)
	Embankment improvement

Hazard Mitigation Plan Update (2016, 2023)

Monson was originally a part of Brimfield until 1775, when it was incorporated as a separate town. The Town began as a farming and lumbering community, but evolved into an industrial town early in the 18th century, when water power from Chicopee Brook and a transportation system based on the railroad, fueled a thriving textile industry. In the past few decades, the Town's industrial base has declined, and farming and lumbering have become more limited. At the same time, Monson has become a desirable location for new residences, especially for commuters, and portions of the Town have become more suburban in character as new development has spread out along existing public roads.

There are areas within the downtown with undersized stormwater drainage lines. As development continues and the amount of impervious (paved and building) surface increases, improvements to these systems will be needed.

Most of the economic and industrial activity in Monson is located along Route 32 and Chicopee Brook. Some of this economic and industrial activity is located in flood plains. Beaver activity has been increasing over the past decade. Beaver dam activity is concentrated along Chicopee Brook, particularly Bunyan, Nieske, Hospital, and Reimers Roads, and Silver and Thayer Streets. These are also rights-of-way that experience flooding.

In addition to road damage, flooding along Chicopee Brook causes concern due to prior hazardous waste spills and debris deposited in the river during the 2011 tornado. Industrial sites, including Superfund sites, line Chicopee Brook, exacerbating flood conditions with the potential for hazardous substance contamination. The most severe flooding to impact Monson in recent years was in October 2005, when general flooding occurred along Chicopee Brook. The most severe flooding occurred along Bunyan Drive, Fenton Road, and Pulpit Rock Pond. These areas had submerged bridges during the storm event, which resulted in the isolation of critical facilities.

In the 2023 update, Monson's priorities are focused more on climate resilience in response to increasing flood events and flashy storms over the past five years. Participation in the Municipal Vulnerability Preparedness (MVP) program

Small MS4 Permit Compliance

Stormwater Management Plan (2022 update)

- 15 regulated outfalls to Chicopee Brook, 1 to unnamed tributary to Chicopee Brook
- Top permittee-owned properties identified as having potential for modifications/retrofits with nitrogen reducing BMPs:
    - Outfall 6 (between Washington St and Main St)
    - Outfall 2 (at Hampden Ave)
    - Outfall 15 (at Harrison Ave)
    - Outfall 22 (at Lower Hampden Rd)
    - Outfall 3 (between Park Ave and Pease Ave)

Dry Weather Outfall Screening

The Town of Monson implements a stormwater management program under a small Municipal Separate Storm Sewer System (MS4) permit from the US Environmental Protection Agency (EPA). As part of MS4 compliance activities, the Town and its consultant, AECOM, completed dry weather screening of outfalls within the area of Town regulated under the MS4 permit. A memo summarizing the results can be found here.

Nitrogen Source Identification Report

The Town of Monson was required to develop a Nitrogen Source Identification Report under the MS4 Permit for the Connecticut River watershed. This type of plan includes calculating the total urbanized area within the Connecticut River, reviewing all outfall screening and monitoring results within this area, identifying potential catchments with high nutrient loading, and identifying potential retrofit opportunities for the installation of structural BMPs during redevelopment. The report can be found here.

Implementation of Demonstration Stormwater Management BMP in Permit Year 6

As a requirement under the MS4 Permit, the Town of Monson is required to install a structural demonstration BMP within the Nitrogen Source Area identified in the Nitrogen Source Identification Report. The town is currently working to determine the best location for this BMP. Potential locations include Hillcrest, Bliss Street, or a renovation of the Fire Station.

Open Space and Recreation Plan (2014, 2021)

In the past, Chicopee Brook powered many of Monson's mills and is now a scenic component throughout Monson's downtown core. The main aquifer recharge area in Monson lies beneath the central valley and the Hinckley-Merrimack-Windsor soils. DEP-approved Zone II Well Head Protection Areas are designated through the center of town along the Chicopee Brook Zone II recharge areas. A Groundwater Protection District includes Zone II areas just to the north of downtown near the Palmer, Bethany, and Bunyan Road well areas.

Because these areas correspond with the town's drinking supply, and because the Source Water Protection Plan also notes that there is no protective clay layer to filter pollution with this aquifer, additional acquisition and protection of land (particularly around the Palmer Road and Bethany Road Wells) is needed.

The 100- and 500-year flood plain maps were recently revised by the Federal Emergency Management Agency (FEMA) for Hampden County. Most of the flood zones are found along the northern portions of Chicopee Brook, which flows down the center of town, and along the border with Palmer. Fortunately, many of the flood zones overlap with conservation and recreation land, which leaves infrastructure and the built environment less prone to damage by flooding.

Surface and groundwater pollution occurs due to runoff from road salt, agricultural fertilizers, and some industries along the Chicopee Brook, which is also an aquifer recharge area. Monson zoning bylaws currently incorporate a water supply protection district that covers the Zone II aquifer recharge area. The bylaw prohibits and restricts potentially polluting land uses. Maintaining groundwater quality is an important issue in Monson due to underlying aquifers in the central valley and to the presence of many private wells in the uplands where sewer service is not possible.

Priorities within the OSRP that combine well with improving water quality in Chicopee Brook include:

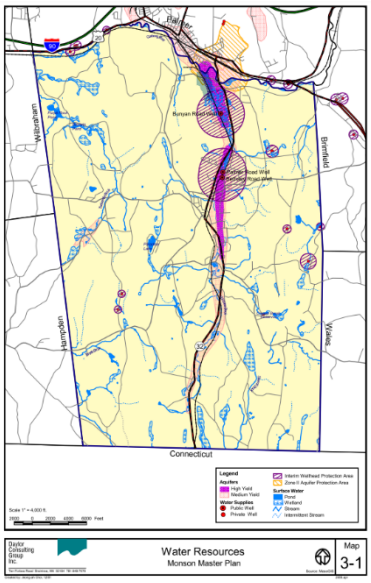
- Expand permanent protection in the zone 2 aquifer recharge, watersheds and water bodies throughout the town
- C4. Promote greater restrictions on development of steep driveways where erosion and runoff impacts the town roads and adjacent lands.
- Preserve and Protect open space around High and Medium output aquifers in Monson.
- Take an active role in promoting sound stormwater management.

There are also numerous recreational and trail enhancement recommendations could have a synergy with water quality improvement objectives in that by bringing people to Chicopee Brook there is a greater appreciation for the resource.

Master Plan (2004)

Monson's historic downtown—a local center for business, government, and civic life—is nestled in the valley of Chicopee Brook and surrounded by steep and rugged hills covered by forest and farms. Chicopee Brook is Monson's largest stream, and flows north to the Quaboag River. In the past, Chicopee Brook powered many of Monson's mills.

Monson's aquifers are located primarily along Chicopee Brook area. The Town's water supply currently consists of three groundwater wells: the Bunyan Road, the Palmer Road, and the Bethany Road wells (See Map 3-1). These three sources are located along Chicopee Brook. The water system has one water storage tank with a capacity of 1,000,000 gallons and the distribution system consists of about 36 miles of pipe. The majority of the distribution system consists of unlined cast iron pipe that is 100 years old in some places. Monson's Water and Sewer Department is currently updating the 2006 SWPP.



Other Documents/Reports

Final Restoration Plan and Environmental Assessment: PSC Resources Superfund Site Palmer, Massachusetts USFWS, EEA (2008)

The restoration plan for the PSC Resources Superfund Site in Palmer, MA identified several potential restoration projects, including a riparian restoration project along the Chicopee Brook in Monson:

- Chicopee Brook, a tributary of the Quaboag River, is a high gradient stream with boulders and pools that provides high quality brook trout habitat. The Monson Conservation Commission has proposed garbage cleanup, control of invasive species, and replanting of native vegetation along an approximately one mile section of the brook. The estimated cost for this project is approximately $41,000.00.
- The Chicopee Brook Restoration Site contains several riparian wetland restoration and enhancement opportunities, including trash removal, invasive species control, and replanting of native vegetation. Conducting these activities would enhance approximately one mile of riparian habitat, providing improved migratory bird wildlife habitat. Removal and control of several invasive species, including honeysuckle, multiflora rose, Japanese barberry, Japanese knotweed, and Asiatic bittersweet combined with planting of

native vegetation would improve floral species diversity and benefit wildlife. Additionally, walking trails are proposed for the Site, increasing opportunities for public recreation and wetland education. Required permits would be obtained prior to construction to comply with federal, state and local laws and regulations. It has been proposed that the project be undertaken in phases to accommodate the limitations imposed by currently available funds. Additional funds could potentially be raised through partnerships with other organizations. The project has considerable public support and this may also increase the potential for raising additional funds.

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.

Water Quality Goals

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

a.) For **water bodies with known impairments**, a Total Maximum Daily Load (TMDL) is established by MassDEP and the United States Environmental Protection Agency (USEPA) 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 total phosphorus (TP) or total nitrogen (TN), or total suspended solids (TSS), that information is provided below and included as a water quality goal.

b.) For **water bodies without a TMDL for total phosphorus** (TP), a default water quality goal for TP is based on target concentrations established in the Quality Criteria for Water (USEPA, 1986) (also known as the "Gold Book"). The Gold Book states that TP should not exceed 50 ug/L in any stream at the point where it enters any lake or reservoir, nor 25 ug/L within a lake or reservoir. For the purposes of developing WBPs, MassDEP has adopted 50 ug/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, 2021) prescribe the minimum water quality criteria required to sustain a waterbody's designated uses. This watershed is a Class 'B' waterbody. The water quality goal for fecal coliform bacteria is based on the Massachusetts Surface Water Quality Standards.

Table 12: Surface Water Quality Classification by Assessment Unit

Assessment Unit ID	Waterbody	Class
MA36-21	Chicopee Brook	B
MA36-45	Conant Brook	B

d.) **Other water quality goals set by the community** (e.g., protection of high quality waters, in-lake phosphorus concentration goal to reduce recurrence of cyanobacteria blooms, etc.).

Water Quality Goal Setting Meeting

A water quality goal setting meeting for the Chicopee Brook Watershed Based Plan was held on September 11, 2023. In attendance were members of the Pioneer Valley Planning Commission, representatives from the Town of Monson, and staff of Comprehensive Environmental, Inc. (CEI). The primary objective of the meeting was to review the water quality assessment and to discuss and establish water quality goals for total phosphorus, temperature, and *E.coli* for Chicopee Brook. A summary of the estimated phosphorus load based on the pollutant loading analysis (Table 11), current water quality data and goals, and notes/sources used to set the water quality goals are shown in Table 13.

Table 13: Water Quality Goals for Chicopee Brook

Pollutant	Existing Estimated Total Load	Water Quality Goal	Notes/Source
Total Phosphorus (TP)	3050 lbs P/yr	**Goal: 2776 lbs P/yr (9% reduction)** • Chicopee Brook mainstem median TP = 16.5 ug/L (2008-2014 data) ○ TP concentration Goal: Median TP of 15 ug/L (9% reduction in the 2008-2014 median TP)	MA does not have numeric nutrient criteria for phosphorus. Goal based on the Vermont Water Quality Standards (2022) criteria for Class A(2)/B(2) MHG streams (15 ug/L)
Temperature	--	Current: Chicopee Brook max temp exceedance 25.1 deg C Goal: Continuing to meet water quality standards	MA water quality standards for temperature for Class B waters: Not exceeding 20 deg C based on mean daily max temp (7 day) Massachusetts Surface Water Quality Standards (314 CMR 4.00, 2021)
Bacteria	--	Current (2008-2014 data): Chicopee Brook mainstem *E.coli* geomean of 201 colonies/100mL (exceeds geomean standard for *E. coli*) **Goal: Meet water quality standards for E. coli**	MA water quality standards for *E. coli:* i. concentrations shall not exceed 126 colony-forming units (cfu) per 100 mL, calculated as the geometric mean of all samples collected within any 90-day or smaller interval; and ii. no more than 10% of all such samples shall exceed 410 cfu per 100 mL (a statistical threshold value).Massachusetts Surface Water Quality Standards (314 CMR 4.00, 2021)

As shown in Table 13, the water quality goal for bacteria and temperature are based on the Massachusetts Surface Water Quality Standards (314 CMR 4.00, 2013) that apply to the Water Class of the selected water body. For phosphorus, as Massachusetts does not currently have numeric nutrient criteria, it was determined to set a reasonably protective goal based on the Vermont Water Quality Standards for Class B Medium High Gradient (MHG) streams. As there are no TMDLs for Chicopee Brook, no TMDL pollutant load reductions are included.

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.

Watershed Field Investigation

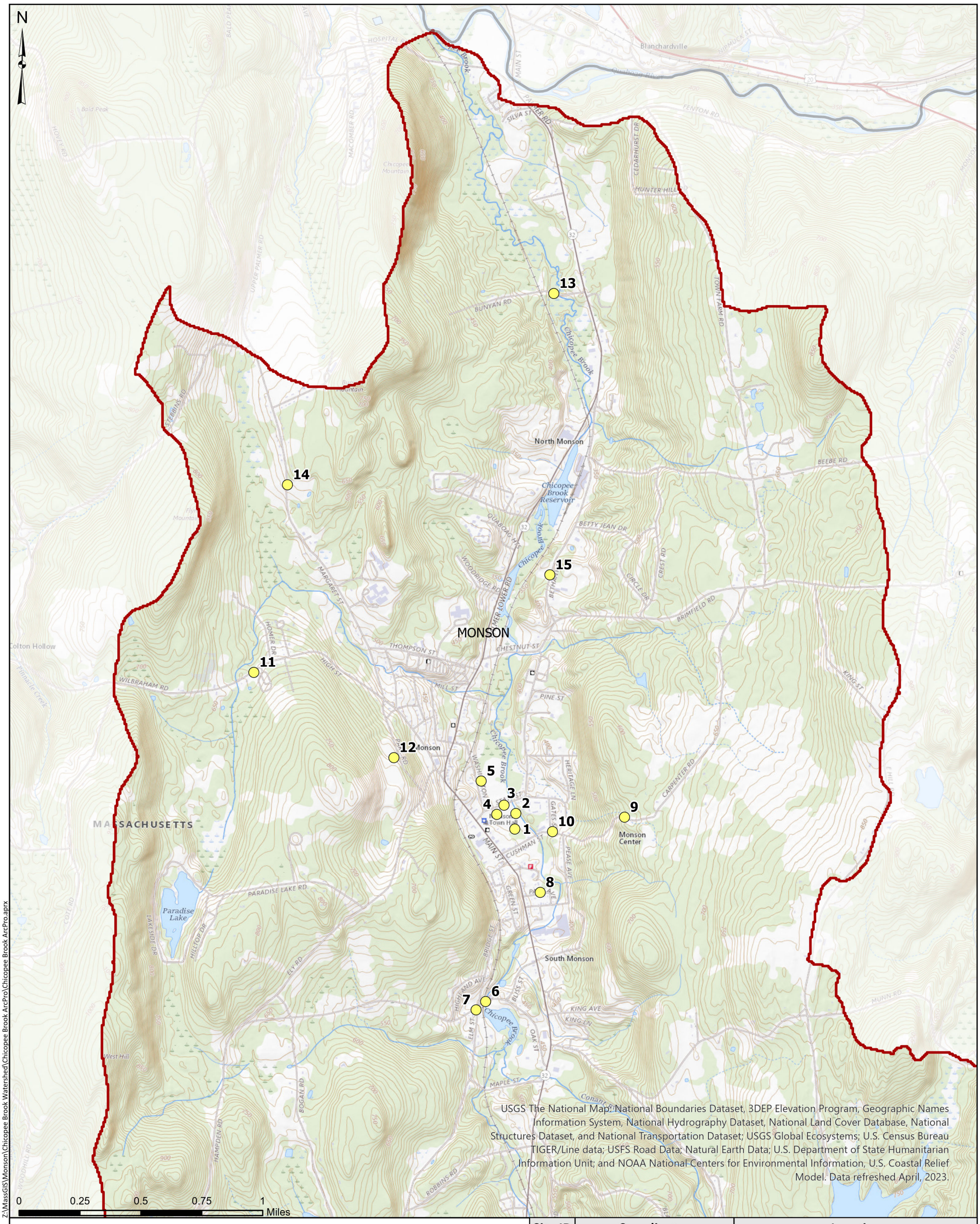
A watershed field investigation was conducted on October 10, 2023 to identify locations where structural BMPs and other restoration practices could be implemented to reduce pollutant loads within the Chicopee Brook watershed. To identify known problem areas within the watershed, Comprehensive Environmental Inc. (CEI) worked with the Pioneer Valley Planning Commission (PVPC) staff, and municipal officials from the Town of Monson before the watershed field investigation to ensure known "hotspots" were identified and included in the field investigation. Based on this information, CEI conducted both a desktop analysis and on the ground reconnaissance throughout the watershed. CEI was accompanied by PVPC staff and representatives from the Town of Monson on portions of the watershed field investigation. The potential structural BMP locations described in the sections below are not intended to be an all-inclusive listing of potential structural retrofit improvements possible within the watershed.

Summary of BMP Recommendations

Potential BMP improvement sites were identified based on findings from the field watershed investigation as summarized in Figure 8. A detailed description of each BMP recommendation is provided in the sections below, including:

- A site summary that describes the current conditions and stormwater drainage patterns;
- A description of proposed structural BMP(s);
- Estimated construction and engineering costs;
- Estimated cost per pound of phosphorus removed;
- Estimated annual phosphorus, nitrogen, and TSS load reduction for the proposed structural BMP, assuming that the practice is properly designed, installed, maintained according to guidelines provided in the Massachusetts Stormwater Handbook; and
- Recommended priority for BMP implementation (low, medium or high).

Table 14 provides a summary of estimated costs, estimated nutrient load reductions, and recommended priority for each proposed BMP. Construction of all of the proposed BMPs would reduce the annual total phosphorus load to the watershed by an **estimated 12.8 pounds per year at an estimated cost range of $372,960 to $559,440.** Proposed BMPs for the five High Priority sites would reduce annual total phosphorus loading by approximately 7.9 pounds at an estimated cost of $137,760 - $206,640.



USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; USGS Global Ecosystems; U.S. Census Bureau TIGER/Line data; USFS Road Data; Natural Earth Data; U.S. Department of State Humanitarian Information Unit; and NOAA National Centers for Environmental Information, U.S. Coastal Relief Model. Data refreshed April, 2023.

Z:\MassGIS\Monson\Chicopee Brook Watershed\Chicopee Brook ArcPro\Chicopee Brook ArcPro.aprx

Proposed Structural BMP Locations
Chicopee Brook Watershed
Monson, MA and Wales, MA

Comprehensive Environmental Incorporated

Legend

- Proposed BMP
- Chicopee Brook Watershed

Data Sources: ESRI, MassGIS, CEI

Site ID	Coordinates	Location
1	42.099466, -72.313043	Veterans Field
2	42.100392, -72.312971	Veterans Field
3	42.100879, -72.313921	Veterans Field
4	42.100329, -72.314492	Veterans Field
5	42.102302, -72.315766	Cushman Field
6	42.089178, -72.315242	Bliss Street
7	42.088677, -72.315997	Bridge Street
8	42.095689, -72.310963	Park Avenue
9	42.100235, -72.304289	Carpenter Road
10	42.099336, -72.310030	Gates Street
11	42.108628, -72.334005	Hillcrest Cemetery
12	42.103640, -72.322753	Flynt Park
13	42.131341, -72.310333	Bunyan Road
14	42.119799, -72.331466	Flynt Quarry
15	42.114596, -72.310436	Bethany Road

11/10/2023

Structural BMP Scoring and Prioritization Summary

February 2024

Area ID	Location	Existing Issues	Proposed Improvements	Estimated Load Reduction			Construction Cost ($)	Engineering Cost ($)	Capital Cost Range		Cost per lb of P ($)	Ranking Factors / Scoring					Score	Site Priority
				TP (lb/yr)	TN (lb/yr)	TSS (ton/yr)						TP Removal	Capital Cost	Waterbody Proximity	Imp. Complexity	Public Visibility		
1	Veterans Field	N/A - opportunistic implementation area.	Remove invasive vegetation and enhance the ditch (approx. 3,000 sf).	-	-	-	$17,000	$6,800	$19,040	$28,560	-	L	M	H	L	M	55	Low
2	Veterans Field	Minimal buffer along Chicopee Brook.	Develop a 10-ft “no-mow” zone along approx. 500 ft of Muddy Brook.	0.16	0.35	0.02	$9,000	$3,600	$10,080	$15,120	$78,750.00	L	H	H	L	M	65	High
3	Veterans Field	Loose sediment and erosion along the shoulder of State Street.	Remove gravel shoulder and install roadside swale (approx. 750 sf).	0.04	0.19	0.03	$10,000	$4,000	$11,200	$16,800	$350,000.00	L	H	H	M	H	75	High
4	Veterans Field	Erosion along edge of the parking lot, ponding in field.	Stabilize the surrounding area and install an approx. 500 sf biofiltration basin in existing low spot.	0.30	2.24	0.08	$29,000	$11,600	$32,480	$48,720	$135,333.33	M	M	M	M	H	60	Medium
5A	Cushman Field	Undersized drainage pipe and untreated runoff discharging to Chicopee Brook.	Install approx. 5,750 sf bioinfiltration basin and upsize the undersized drainage pipe.	3.38	24.17	0.51	$54,000	$21,600	$60,480	$90,720	$22,366.86	H	L	M	H	H	75	High
5B	Cushman Field	Access road has signs of erosion and sediment transport	Stabilize dirt access road.	0.50	1.00	0.60	$8,000	$3,200	$8,960	$13,440	$22,400.00	M	H	M	L	H	65	High
6	Bliss Street	Erosion and sediment buildup along shoulder of Bliss Street.	Stabilize road shoulder and install roadside swale.	0.15	0.94	0.18	$17,000	$6,800	$19,040	$28,560	$158,666.67	L	M	H	L	M	55	Low
7	Bridge Street	Untreated runoff discharges directly to Chicopee Brook.	Install approx. 750 sf infiltration basin at intersection of Lower Hampden and Elm Street.	1.88	17.46	0.36	$31,000	$12,400	$34,720	$52,080	$23,085.11	H	L	M	H	H	75	High
8	Park Avenue	N/A - opportunistic implementation area.	Install approx. 1500 sf infiltration basin in Vacant lot.	1.87	14.27	0.27	$23,000	$9,200	$25,760	$38,640	$17,219.25	H	M	L	M	M	60	Medium
9	Carpenter Road	Erosion and sediment buildup along shoulder of Carpenter Road.	Install roadside swales and sediment traps.	0.25	1.47	0.14	$12,000	$4,800	$13,440	$20,160	$67,200.00	L	H	H	L	L	60	Medium
10	Gates Street	N/A - opportunistic implementation area.	Install approx. 1000 sf sediment forebay in vacant lot.	-	-	-	$11,000	$4,400	$12,320	$18,480	-	L	H	L	L	L	45	Low
11	Hillcrest Cemetery	Erosion and sediment buildup along shoulder of Carpenter Road.	Stabilize roadway shoulder along Wilbraham Road and install a grass swale to redirect runoff to the downstream culvert.	1.92	10.57	1.18	$13,000	$5,200	$14,560	$21,840	$9,479.17	H	H	M	M	M	75	High
12	Flynt Park	N/A - opportunistic implementation area.	Enhance existing French drain; stabilize shoulders along access road; install approx. 800 sf bioinfiltration basin.	1.26	8.54	0.27	$41,000	$16,400	$45,920	$68,880	$45,555.56	H	L	L	M	H	60	Medium
13	Bunyan Road	Erosion along shoulder of Bunyan Road.	Stabilize roadway shoulder along Bunyan Road.	0.10	0.10	0.10	$7,000	$2,800	$7,840	$11,760	$98,000.00	L	H	H	L	L	60	Medium
14	Flynt Quarry	Erosion and sediment buildup along shoulder of Upper Palmer Road.	Stabilize roadway shoulder and install roadside swale.	0.90	2.30	0.89	$24,000	$9,600	$26,880	$40,320	$37,333.33	M	M	L	M	M	50	Low
15	Bethany Road	N/A - opportunistic implementation area.	Install approx. 900 sf bioretention basin in large grassed field surrounding utility building along Bethany Road.	0.11	0.61	0.06	$29,000	$11,600	$32,480	$48,720	$369,090.91	L	M	L	M	L	40	Low
				12.8	**84.2**	**4.7**	**$335,000**	**$134,000**	**$375,200**	**$562,800**								

Methodology

Potential sizing, costs, and pollutant load reductions were calculated for each recommended BMP based on a combination of tools, as summarized below.

- **Step 1 – Delineate Drainage Area and Determine Land Use Information**. Where applicable, the drainage area to proposed BMPs was delineated using two-foot contours obtained from MassGIS, aerial imagery, and best professional judgement based on field observations (e.g., observed drainage patterns, roadway grading, etc.). The land use / cover type within each delineated drainage area was estimated using classifications from the National Land Cover Database (NLCD) using GIS tools. Soil types within each delineated drainage area were determined by using the National Resources Conservation Service (NRCS) online Web Soil Survey (WSS) tool.

- **Step 2 – Determine Design Criteria for Sizing.** Each proposed BMP was designed to capture and treat as much site runoff as feasible based on-site constraints. A design objective for each proposed BMP should be to size the BMP to treat and potentially infiltrate the water quality volume (WQV) to the maximum extent practicable. The WQV is the minimum amount of stormwater runoff from a rainfall event that should be captured and treated to remove a majority of target stormwater pollutants on an average annual basis. The WQV is defined in the Massachusetts Stormwater Handbook as **1.0 inch of runoff** times the total impervious area of the post-development project site for a discharge from the following:
    - from a land use with a higher potential pollutant load;
    - within an area with a rapid infiltration rate (greater than 2.4 inches per hour);
    - within a Zone II or Interim Wellhead Protection Area;
    - near or to the following Critical Areas: Outstanding Resource Waters, Special Resource Waters, bathing beaches, shellfish growing areas, and cold-water fisheries.

  The required water quality volume equals **0.5 inches of runoff** times the total impervious area of the post-development site for all other discharges. However, each proposed BMP should be designed to get the most treatment that is practical given the size and constraints of each site.

- **Step 3 – Perform BMP Sizing**. Applicable structural BMPs were sized using Watershed Based Plans Tool (WBPT)[2] developed by the MassDEP. Required inputs include: BMP Type, storm size (i.e., treated runoff depth), drainage area, and land use. Outputs include: anticipated BMP footprint based on a typical cross section; estimated construction cost; and estimated load reduction for Total Suspended Solids (TSS), Total Phosphorus (TP), and Total Nitrogen (TN). All applicable BMPs were sized to treat a 1 inch or greater WQV.

- **Step 4 – Calculate Potential Pollutant Load Reductions.** The WBPT provides estimated pollutant load reductions for structural BMPs that have sufficient performance data. Pollutant loading estimates were calculated based on the WBPT for supported BMP types (i.e., bioretention). Bank and Gully stabilization are not supported by the MassDEP WBPT and were calculated based on the EPA Region 5 Spreadsheet Model for Estimating Load Reductions [2] or best professional judgement. The pollutant load reduction for implementation of riparian buffers was estimated based on performance curves from the *Credit for Going Green Project*[3]. The performance curves depict potential pollutant removal efficiency as a function of buffer width (i.e. 20 to 100 feet), soil type (HSG A, B, C, D), and buffer type (grassed or forested).

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[2] MassDEP WBPT, Element C BMP Selector Tool: http://prj.geosyntec.com/MassDEPWBP/Home.

[3] 2019 Credit for Going Green Project (UNH Stormwater Center / Great Bay National Estuarine Research Reserve): https://www.unh.edu/unhsc/https%3A//www.unh.edu/unhsc/news/credit-going-green.

- **Step 5 – Estimate Costs.** Construction costs for structural BMPs were first estimated using output from the MassDEP WBPT, then adjusted based on best professional judgement based on site size and complexity (i.e., inflated upwards for conservatism). BMPs not supported by the MassDEP WBPT were estimated using inflation-adjusted unit pricing from past projects. Once construction costs were calculated, engineering and design costs were conservatively calculated to be 40% of the estimated construction cost. Engineering and design costs represent approximate costs for engineering design and analysis, survey, design drawing preparation, and permitting. The 40% estimate may vary on a site-specific basis. An overall capital cost range for each structural BMP was then estimated by summing estimated construction and engineering costs and applying a contingency factor of ± 20%. Cost estimates do not include engineering services related to bidding and construction quality assurance.
- **Step 6 – Perform scoring and prioritization.** BMP recommendations were scored and prioritized based on factors described by Table 16. The lowest possible BMP score is 30 points, while the highest is 100 points. The top third of BMPs were assigned a priority ranking of "High", the middle third were assigned a priority ranking of "Medium", and the bottom third were assigned a priority ranking of "Low".

Table 15: Structural BMP Scoring Criteria

Factor	Criteria			Score		
	Low	Medium	High	Low	Medium	High
TP Removal	< 0.30 lb/yr	0.3 to 1.00 lb/yr	> 1.0 lb/yr	10	15	25
Capital Cost[1]	> $50k	$25k - $50k	< $25k	10	15	25
Waterbody Proximity	Not Near Waterbody	Within 100-ft of Waterbody	Within 50-ft of Waterbody	5	10	20
Implementation Complexity[2]	High	Moderate	Low	5	10	20
Public Visibility / Outreach	Low Potential Visibility	Moderate Potential Visibility	High Potential Visibility	0	5	10

Notes:

1. Capital cost is based on the high end of the estimate with a contingency factor of 20% applied.
2. Implementation complexity is a qualitative indicator based on the following criteria: property ownership, site access, potential for underground utility conflicts, potential for tree removal, potential for traffic impacts, and potential for wetland permitting. Scored based on professional judgement.

Site-specific recommendations are provided below.

AREA 1: Veterans Field

Location: Veterans Field
Owner: Town of Monson
Subwatershed: Chicopee Brook
Priority: Low

Site Description

There is an existing ditch along the southeastern side of Veterans Field. The ditch receives drainage from residential and commercial properties in the downtown area and outlets directly to Chicopee Brook. The drainage ditch is likely now jurisdictional wetland area and is currently overgrown with Japanese Knotweed. The Town of Monson currently has a grant to remove the invasive vegetation.

Photo 1-1: Japanese Knotweed in ditch looking upstream.

Photo 1-2: Overgrown ditch looking downstream towards Chicopee Brook.

Proposed Area 1 Improvements (see Photo 1-3)

1. Remove invasive vegetation within the ditch (approx. 300 LF).
2. Enhance the existing ditch by expanding the base of the ditch and planting native vegetation.
3. If permitting allows, consider installing check dams to slow down velocities and trap sediment.

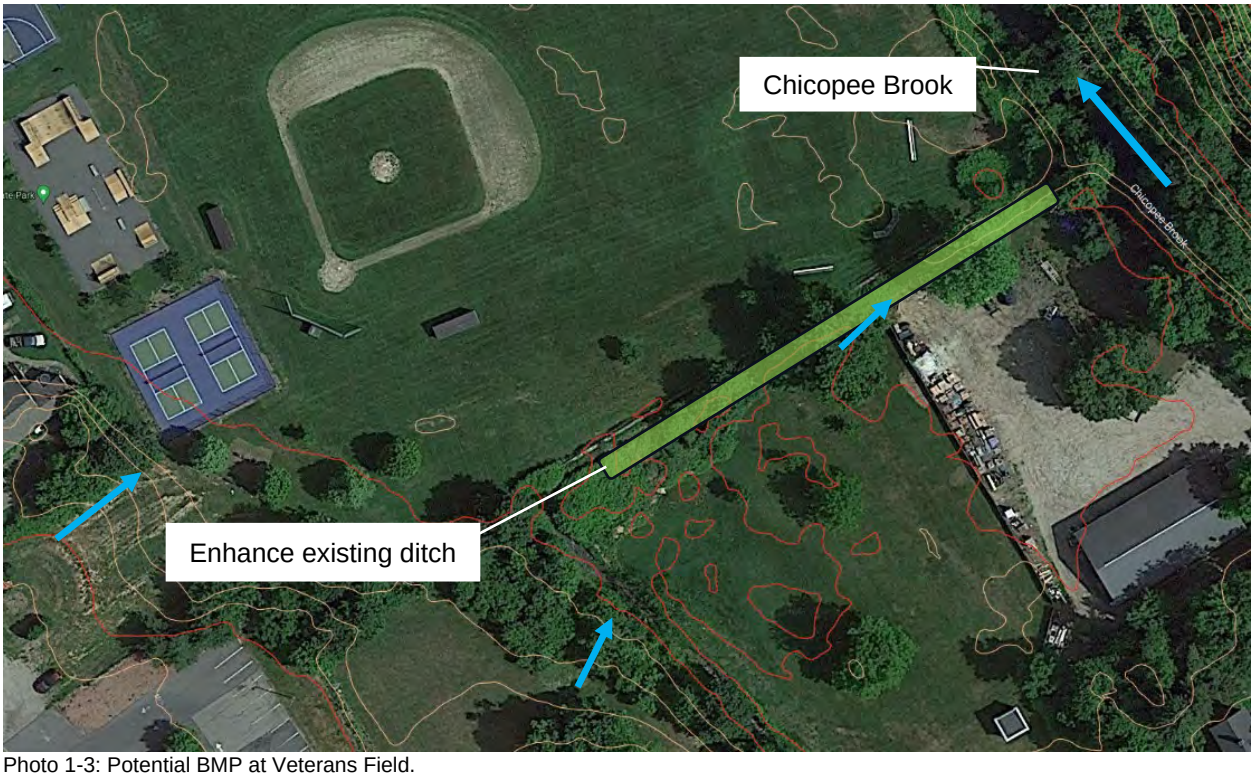

Photo 1-3: Potential BMP at Veterans Field.

Estimated Costs: **$19,000 - $29,000**

Estimated Nutrient Load Reduction:

- Total Suspended Solids: N/A
- Total Phosphorus: N/A
- Total Nitrogen: N/A

AREA 2: Veterans Field

Location: Veterans Field
Owner: Town of Monson
Subwatershed: Chicopee Brook
Priority: High

Site Description

Veterans Field abuts directly next to Chicopee Brook. The existing vegetated buffer is thin and overgrown with invasive species such as Japanese Knotweed. Runoff from Veterans Field sheet flows directly to Chicopee Brook over the stream bank.

Photo 2-1: Embankment along Chicopee Brook seen from State Street Bridge.

Photo 2-2: Embankment along Chicopee Brook seen from Veterans Field.

Proposed Area 2 Improvements (see Photo 2-3)

1. Remove invasive vegetation along the stream embankment.
2. Widen and enhance the existing vegetative buffer (approx. 5000 SF).

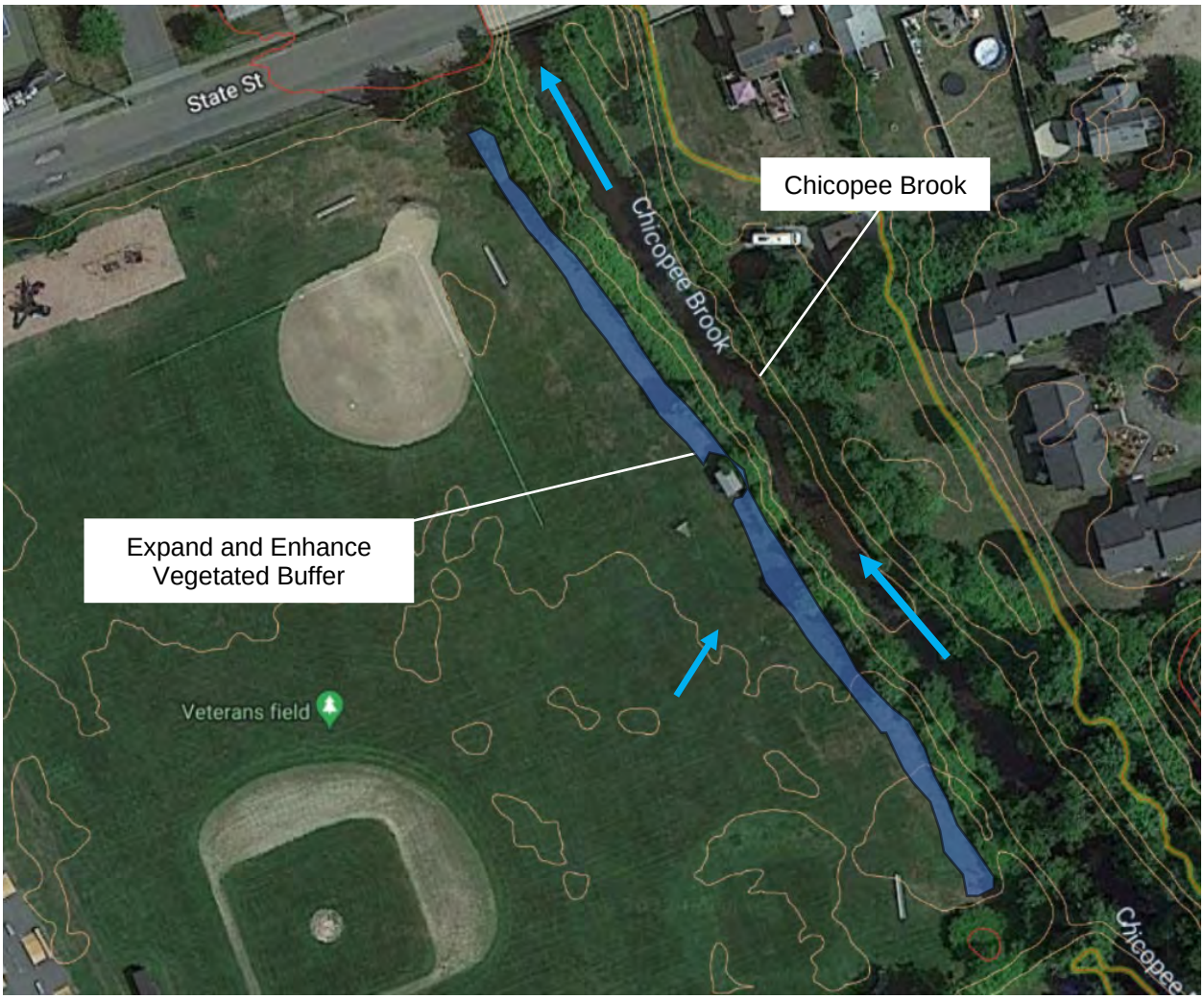

Photo 2-3: Potential BMP at Veterans Field along Chicopee Brook.

Estimated Costs: **$10,000 - $15,000**

Estimated Nutrient Load Reduction:

- Total Suspended Solids: 0.02 ton/yr
- Total Phosphorus: 0.16 lb/yr
- Total Nitrogen: 0.35 lb/yr

AREA 3: Veterans Field

Location: State Street
Owner: Town of Monson
Subwatershed: Chicopee Brook
Priority: High

Site Description

State Street currently has a loose gravel shoulder along Veterans Field. Two catch basins were observed along this stretch of road that collect runoff from north side of the road. Runoff from the south side of State Street sheds towards Veterans Field so all runoff goes through the gravel shoulder and onto Veterans Field.

Photo 3-1: Gravel shoulder along State Street and Veterans Field.

Photo 3-2: Runoff from State Street flows through the gravel shoulder and onto Veterans Field.

Proposed Area 3 Improvements (see Photo 3-3)

1. Excavate and remove existing asphalt/gravel shoulder (approx. 1300 SF).
2. Replace the existing shoulder with a bioswale to provide water quality treatment.

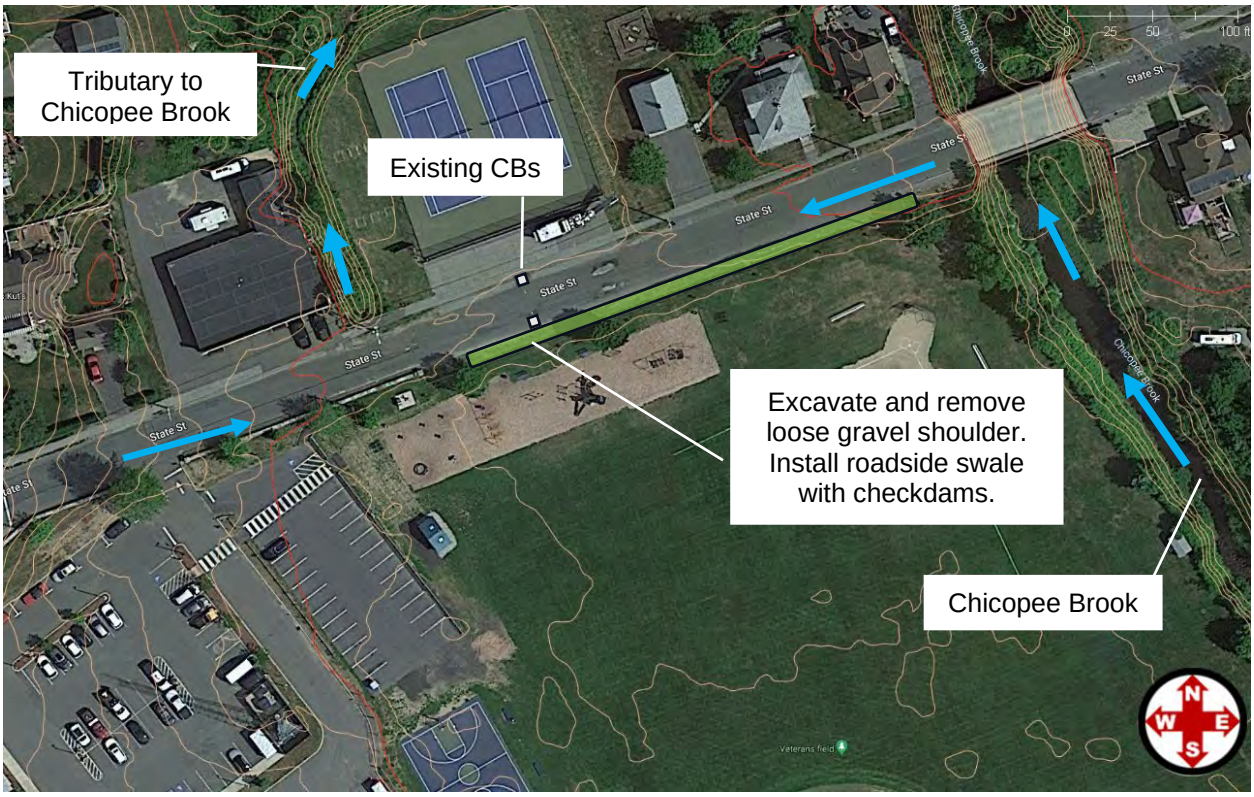

Photo 3-3: Potential BMP at Veterans Field along State Street.

Estimated Costs: **$11,000 - $17,000**

Estimated Nutrient Load Reduction:

- Total Suspended Solids: 0.03 ton/yr
- Total Phosphorus: 0.04 lb/yr
- Total Nitrogen: 0.19 lb/yr

AREA 4: Veterans Field

Location: Veterans Field
Owner: Town of Monson
Subwatershed: Chicopee Brook
Priority: Medium

Site Description

Runoff from the parking lot for Veterans Field is directed towards a low spot in the field causing erosion on the area surrounding the pavement. The grassed area surrounding the parking lot is very soft and muddy indicating limited infiltration potential. It appears that the town added wood chips to try and alleviate localized ponding, but issues remain.

Photo 4-1: Erosion around the parking lot.

Photo 4-2: Gravel on the south side of the parking lot and natural low point.

Proposed Area 4 Improvements (see Photo 4-3)

1. Stabilize the area surrounding the parking lot shoulder to avoid further erosion.
2. Consider paving the existing gravel parking area (approx. 3600 SF).
3. Install a biofiltration basin in the natural low point (approx. 500 SF).
4. Construct an asphalt berm along the northeast edge of the parking lot to convey stormwater to the new BMP.

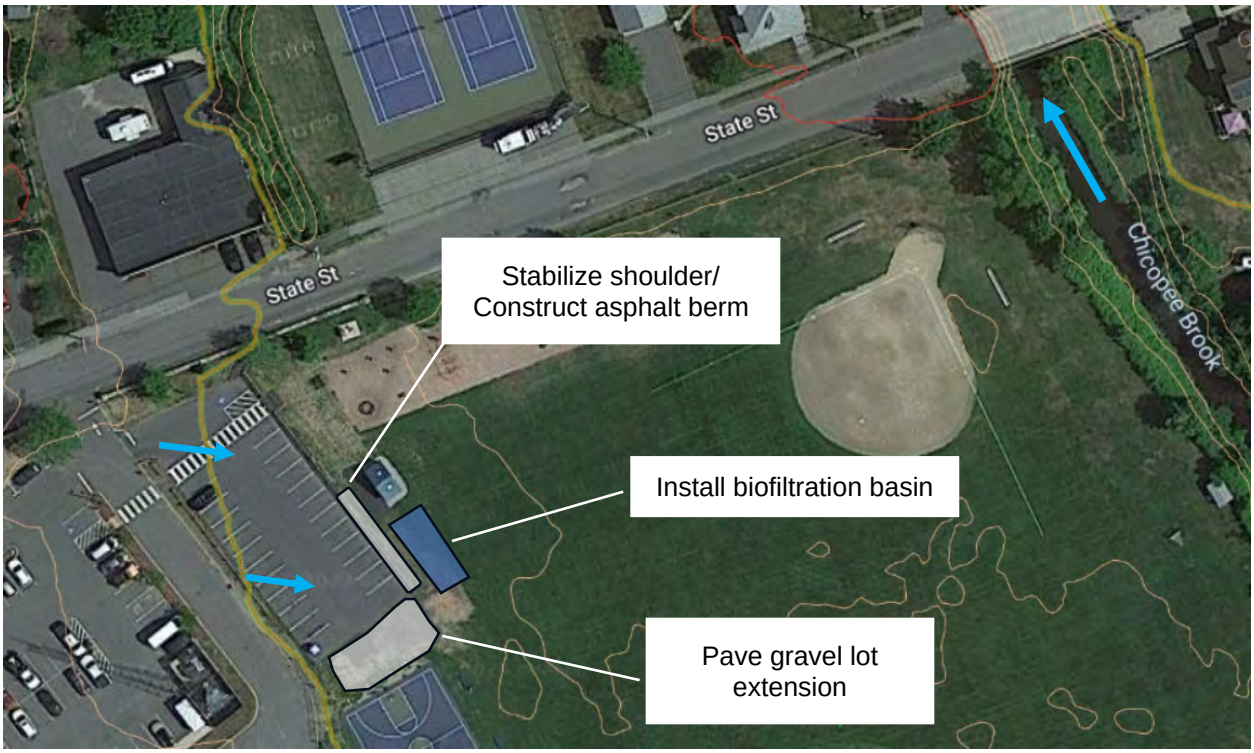

Photo 4-3: Potential BMP at Veterans Field.

Estimated Costs: **$33,000 - $49,000**

Estimated Nutrient Load Reduction:

- Total Suspended Solids: 0.08 ton/yr
- Total Phosphorus: 0.30 lb/yr
- Total Nitrogen: 2.24 lb/yr

AREA 5: Cushman Field

Location: Cushman Field
Owner: Town of Monson
Subwatershed: Chicopee Brook
Priority: High

Site Description

Runoff from portions of Main Street and Washington Street is collected in a series of catch basins and directed to a junction point at the intersection of Washington Street and an unpaved access road to Cushman Field. At this point, pipe size decreases causing large storms to flow through a bypass swale to the north. Remaining runoff flows east along Cushman Field through a wooded swale.

Photo 5-1: Headwall of culvert and unpaved access road to Cushman Field.

Photo 5-2: Bypass swale and potential infiltration basin location.

Proposed Area 5 Improvements (see Photo 5-3)

1. Install an infiltration basin near the entrance that can treat runoff from upstream areas (approx. 5750 SF).
2. Enhance the existing swale for increased water quality treatment.
3. Stabilize the access road to Cushman field with pavement or crushed stone.
4. Upsize the currently undersized culvert discharging beneath the access road.
5. Consider routing the overflow/bypass to the vegetated area to the north rather than through the wooded swale to the east, as this area is located further from the stream.

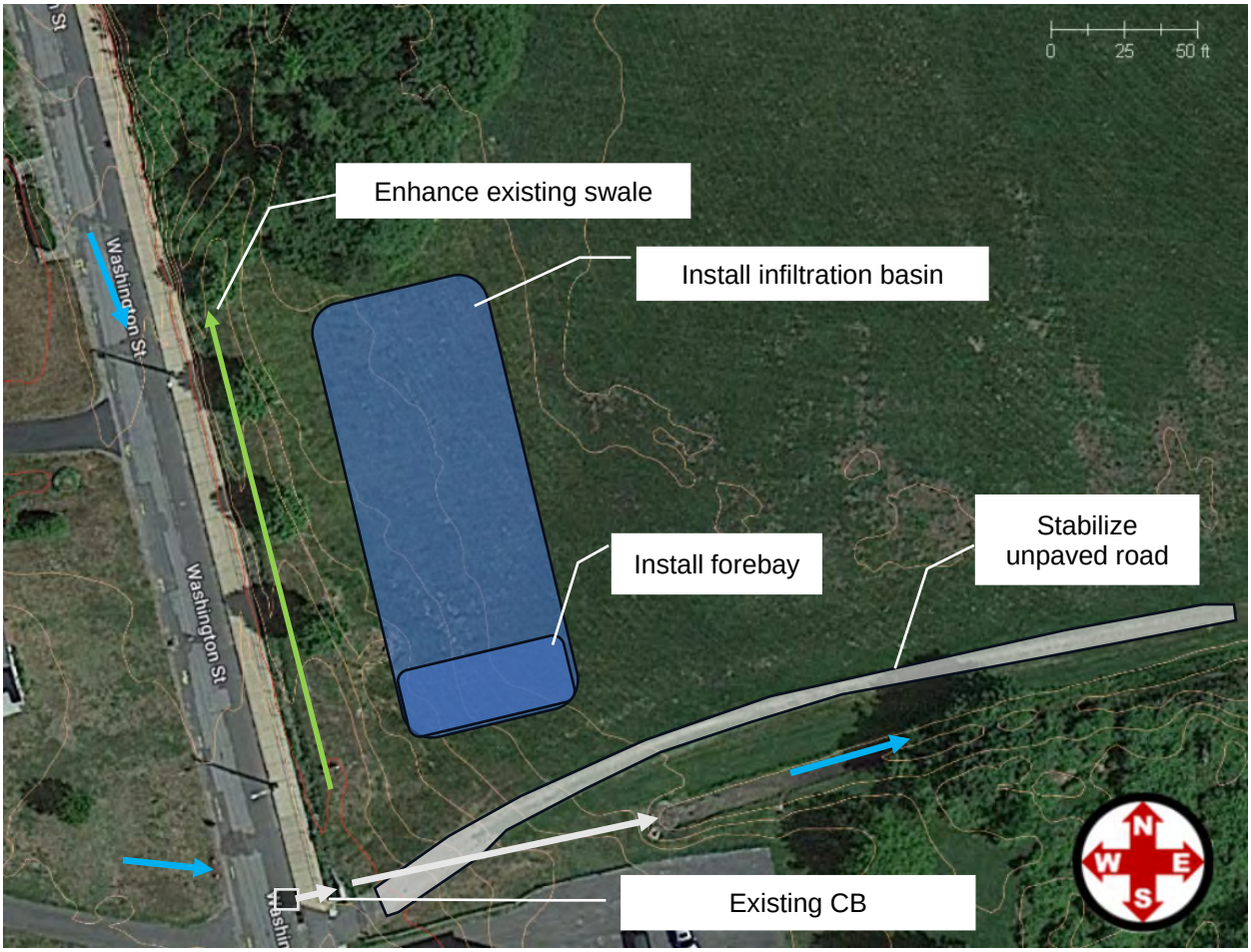

Photo 5-3: Potential BMP for Cushman Field.

Estimated Costs:	**$67,000 - $101,000**
Estimated Nutrient Load Reduction:	
• Total Suspended Solids:	1.11 ton/yr
• Total Phosphorus:	3.88 lb/yr
• Total Nitrogen:	25.17 lb/yr

AREA 6: Bliss Street

Location: Bliss Street
Owner: Town of Monson
Subwatershed: Chicopee Brook
Priority: Low

Site Description

East of the railroad crossing over Bliss Street, the roadway is bridged over Chicopee Brook. There is a gravel pull-off on the south side of the road for parking. It appears that sediment is tracking out of the pull-off area and into a catch basin adjacent to the railroad crossing. Runoff from the south side of Bliss Street and west of the railroad bridge channelizes along the shoulder before being captured by the same catch basin.

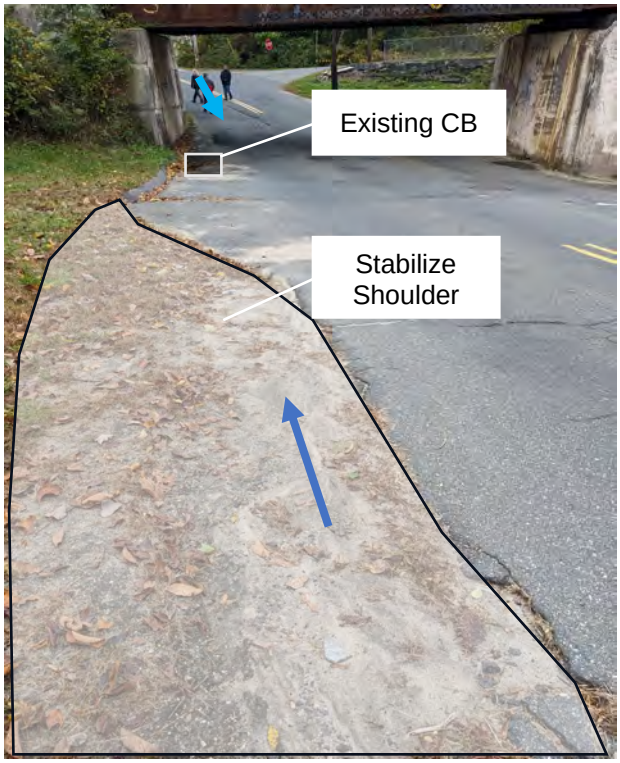

Photo 6-1: Dirt shoulder along Bliss Street with loose sediment.

Photo 6-2: West side of Bliss Street.

Proposed Area 6 Improvements (see Photo 6-3)

1. Stabilize the pull-off along Bliss Street (approx. 350 SF).
2. Install a roadside swale with check dams along the south side of Bliss Street west of the railroad bridge (approx. 150 LF).

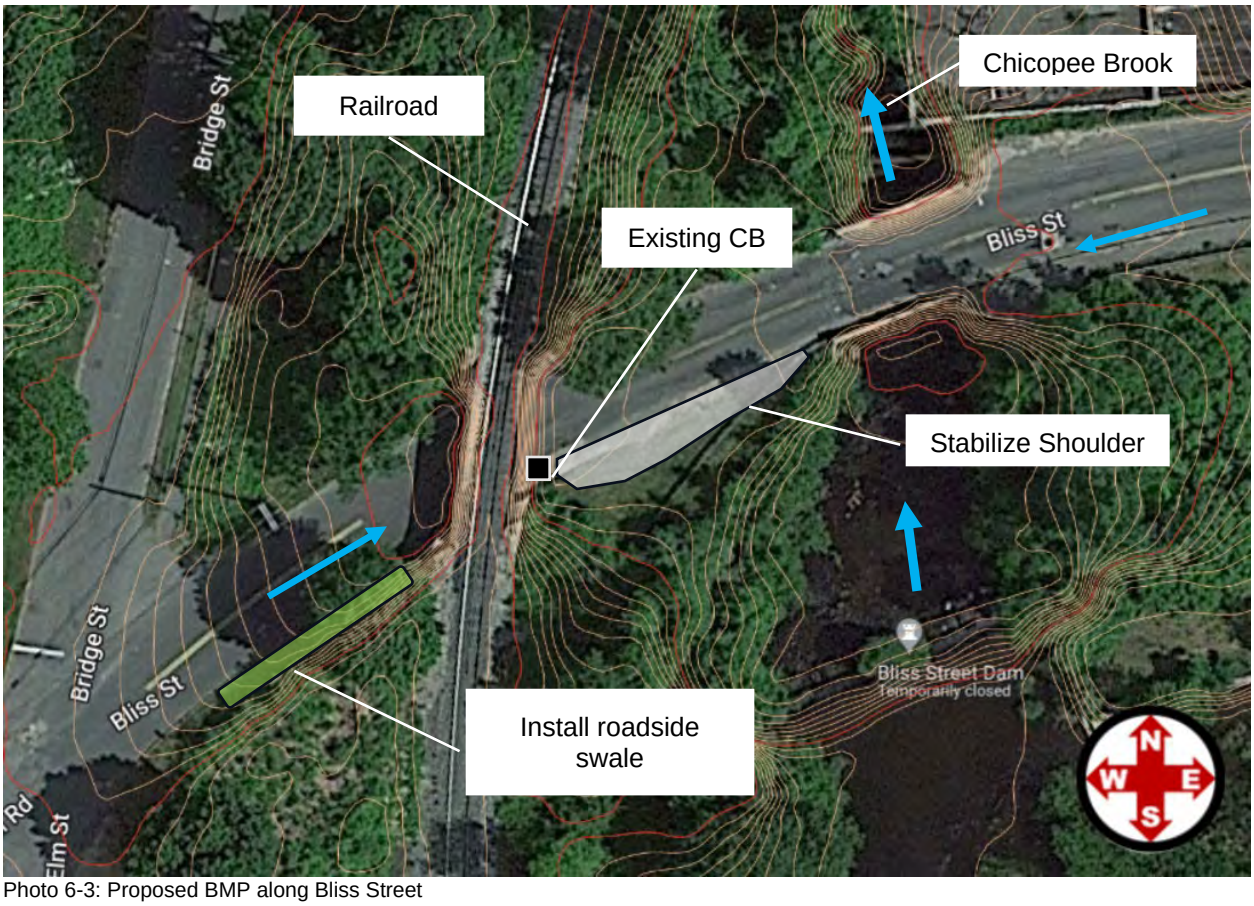

Photo 6-3: Proposed BMP along Bliss Street

Estimated Costs: **$19,000 - $29,000**

Estimated Nutrient Load Reduction:

- Total Suspended Solids: 0.18 ton/yr
- Total Phosphorus: 0.15 lb/yr
- Total Nitrogen: 0.94 lb/yr

AREA 7: Bridge Street

Location: Bridge Street
Owner: Town of Monson
Subwatershed: Chicopee Brook
Priority: High

Site Description

The intersection of Bridge Street and Lower Hampden Road has an island median with traffic routing along either side of the island. Runoff from portions of Elm Street and Lower Hampden currently channelizes towards Bliss Street towards an existing catch basin on Lower Hampden by the railroad crossing. An area of loose sediment associated with an access driveway is also present east of the grassed island.

Photo 7-1: Grassed island at the intersection of Bridge Street and Lower Hampden Road.

Photo 7-2: Loose sediment along the eastern shoulder of Elm Street.

Proposed Area 7 Improvements (see Photo 7-3)

1. Remove the median/island and portion of pavement associated with Elm Street (approx. 375 SF).
2. Create a small bioinfiltration basin to capture and treat runoff from Lower Hampden and Bridge Street (approx. 750 SF).
3. Stabilize the east side of Elm Street with crushed stone.
4. Create curb cut to direct stormwater to roadside swale identified under Proposed Area 6.

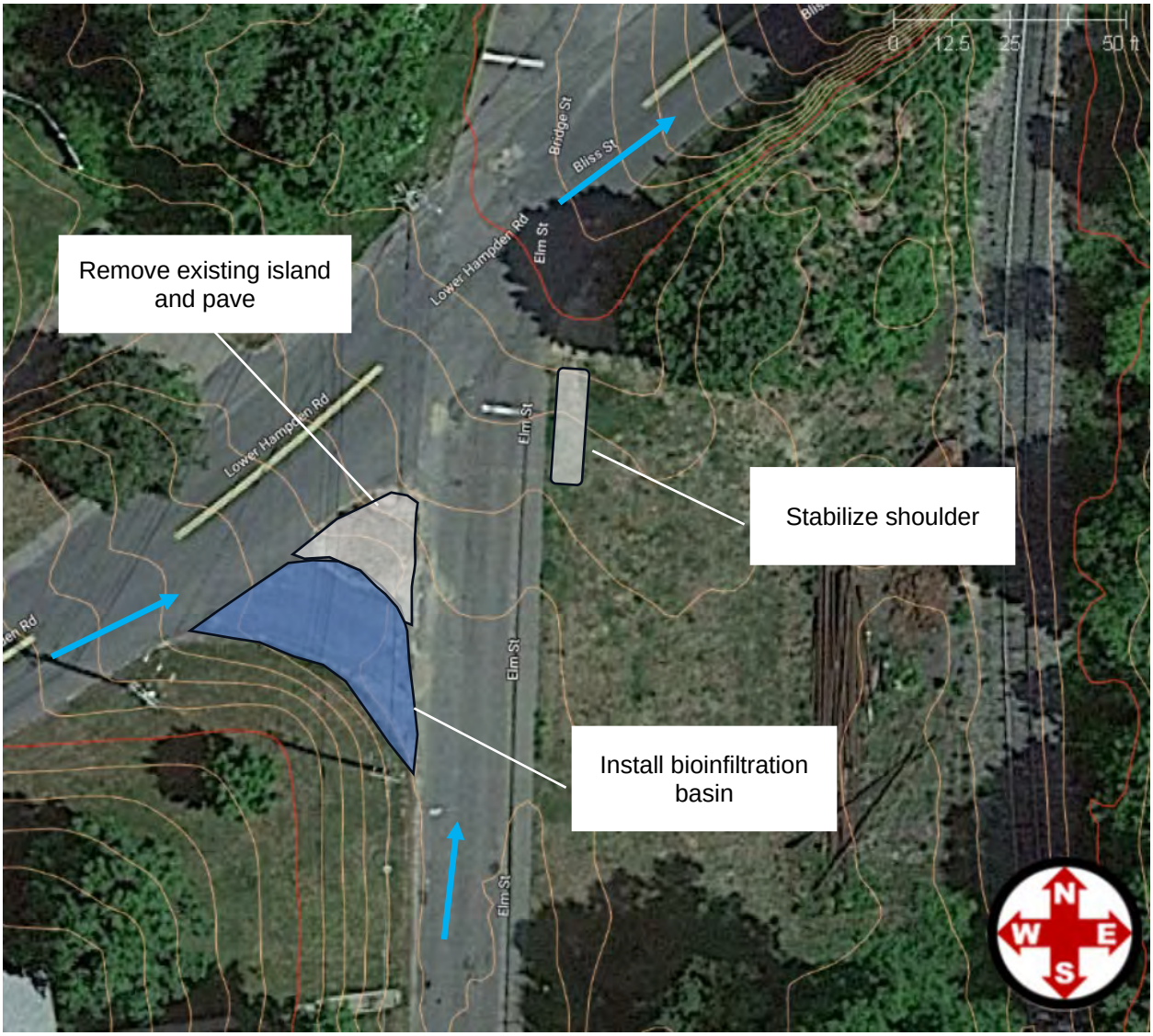

Photo 7-3: Potential BMP at Elm Street and Lower Hampden Road

Estimated Costs: **$35,000 - $52,000**

Estimated Nutrient Load Reduction:

- Total Suspended Solids: 0.36 ton/yr
- Total Phosphorus: 1.88 lb/yr
- Total Nitrogen: 17.46 lb/yr

AREA 8: Park Avenue

Location: Park Avenue
Owner: Town of Monson
Subwatershed: Chicopee Brook
Priority: Medium

Site Description

The parcel at Park Avenue is currently an undeveloped lot in a vegetated state which abuts the rear of the Town of Monson Fire Department. Stormwater from Park Avenue is collected in a series of catch basins and conveyed to Chicopee Brook to the east. Drainage infrastructure in this area has been newly constructed within the past several years.

Photo 8-1: Grassed area along the sidewalk of Park Avenue.

Photo 8-2: Grassed vacant lot along Park Avenue.

Proposed Area 8 Improvements (see Photo 8-3)

1. Create a bio-infiltration basin to capture runoff from Park Avenue (approx. 1500 SF).
2. Install a flow splitter in drainage system in Park Avenue to redirect some flow to basin.

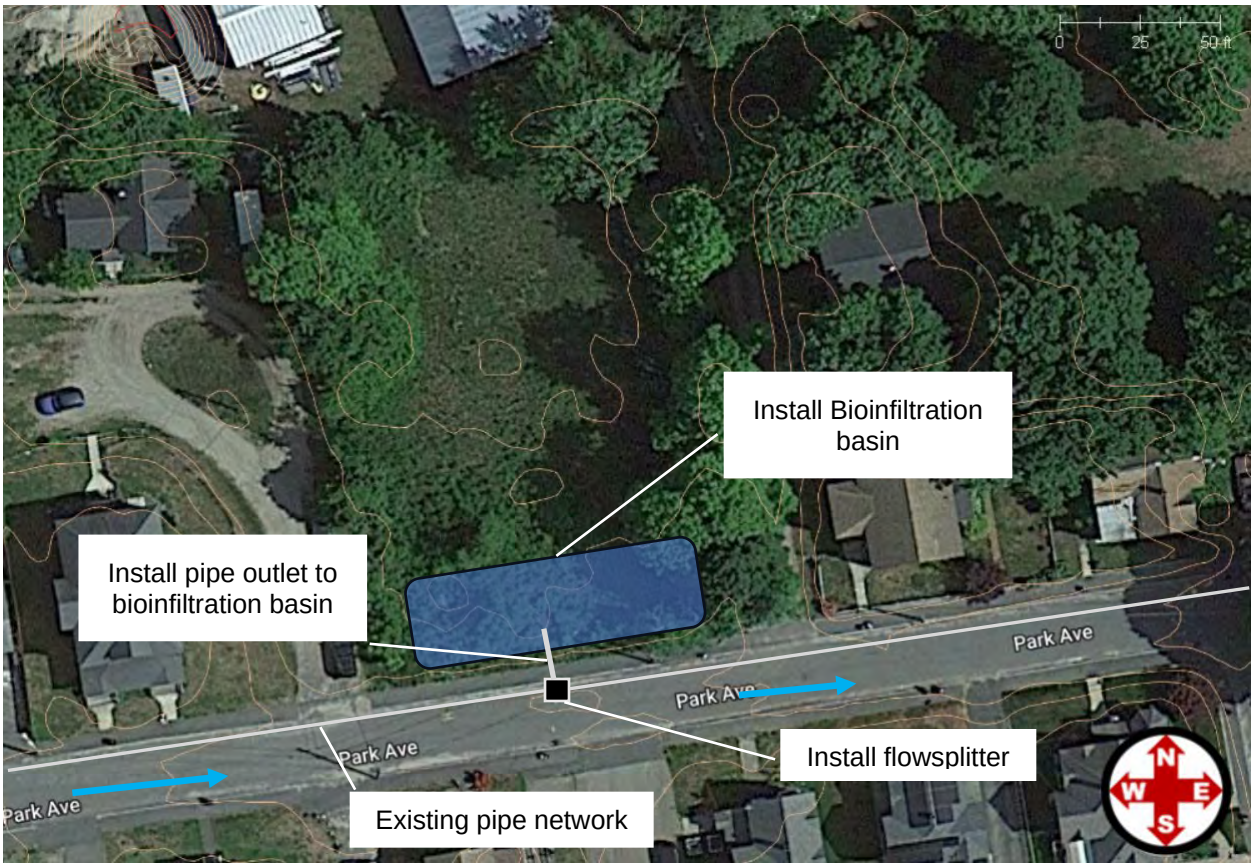

Photo 8-3: Potential BMP along Park Avenue

Estimated Costs: **$26,000 - $39,000**

Estimated Nutrient Load Reduction:

- Total Suspended Solids: 0.27 ton/yr
- Total Phosphorus: 1.87 lb/yr
- Total Nitrogen: 14.27 lb/yr

AREA 9: Carpenter Road

Location: Carpenter Road
Owner: Town of Monson
Subwatershed: Chicopee Brook
Priority: Medium

Site Description

A tributary to Chicopee Brook crosses Carpenter Road close to 20 Carpenter Road. Runoff from Carpenter Road currently flows off the road into the shoulder causing erosion along the shoulder. The runoff flows directly to the tributary of Chicopee Brook with no treatment.

Photo 9-1: Erosion at the culvert outlet at Carpenter Road.

Photo 9-2: Erosion along the shoulder of Carpenter Road.

Photo 9-3: Erosion along the shoulder of Carpenter Road.

Proposed Area 9 Improvements (see Photo 9-4)

1. Install vegetated swales and check dams along both sides of the roadway (approx. 800 SF).
2. Install sediment traps at the outlet of new swales.

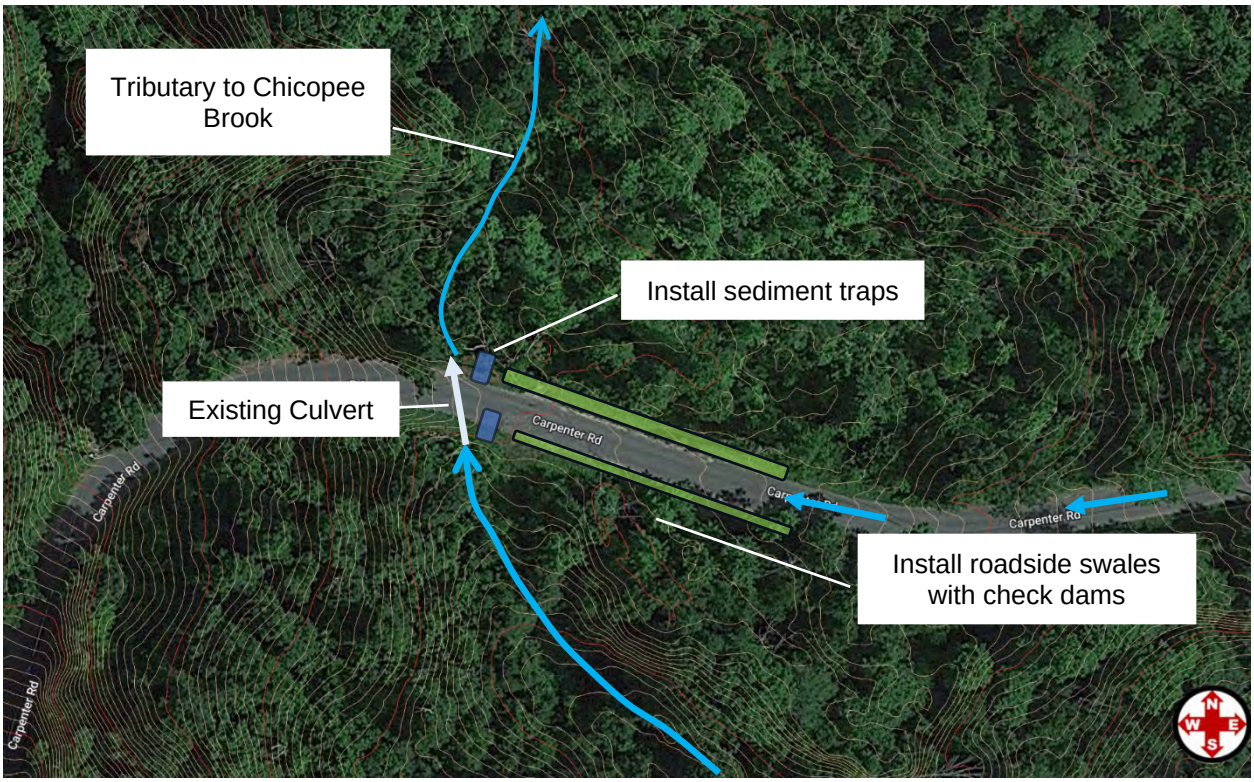

Photo 9-4: Proposed BMP on Carpenter Road

Estimated Costs: **$14,000 - $20,000**

Estimated Nutrient Load Reduction:

- Total Suspended Solids: 0.14 ton/yr
- Total Phosphorus: 0.25 lb/yr
- Total Nitrogen: 1.47 lb/yr

AREA 10: Gates Street

Location: Gates Street
Owner: Town of Monson
Subwatershed: Chicopee Brook
Priority: Low

Site Description

At the intersection of Gates Street and Carpenter Road there is a vacant lot that receives runoff from a single catch basin. Stormwater infiltrates into the ground and no outlet discharge point was observed. The grass and vegetation in the lot appear to be in fair condition.

Photo 10-1: Outlet for drainage system on Carpenter Road.

Photo 10-2: Existing grass basin at corner of Gates Street and Carpenter Road.

Proposed Area 10 Improvements (see Photo 10-3)

1. Install a sediment forebay at the basin inlet to provide pretreatment and ease of maintenance (approx. 1000 SF).

Photo 10-3: Proposed BMP at intersection of Carpenter Road and Gates Street

Estimated Costs: **$13,000 - $19,000**

Estimated Nutrient Load Reduction:

- Total Suspended Solids: N/A
- Total Phosphorus: N/A
- Total Nitrogen: N/A

AREA 11: Hillcrest Cemetery

Location: Wilbraham Road
Owner: Town of Monson
Subwatershed: Chicopee Brook
Priority: High

Site Description

Runoff from the south side of a portion of Wilbraham Road located just west of Hillcrest Cemetery currently sheds off into the shoulder. The runoff creates localized ponding along the road, as well as within a driveway associated with the cemetery maintenance facility. There are areas of erosion along Wilbraham Road particularly around the inlet to the culvert. The around surrounding the culvert is very soft and unstable. Areas surrounding the driveway to Hillcrest cemetery show signs of sediment transport from vehicles driving on the shoulder.

Photo 11-1: Erosion around the culvert.

Photo 11-2: Ponding in the shoulder along Wilbraham Road.

Photo 11-3: Loose sediment around the driveway to Hillcrest Cemetery.

Proposed Area 11 Improvements (see Photo 11-4)

1. Stabilize the roadway shoulders near the entrance to Hillcrest Cemetery (approx. 800 SF).
2. Install a shallow grassed channel from the Cemetery building driveway parallel to Wilbraham Road to the existing outfall to reduce ponding (approx. 500 SF).
3. Install a sediment trap just prior to the culvert inlet to trap sediment and facilitate easier maintenance.
4. Stabilize the culvert inlet at the Wilbraham Road crossing.

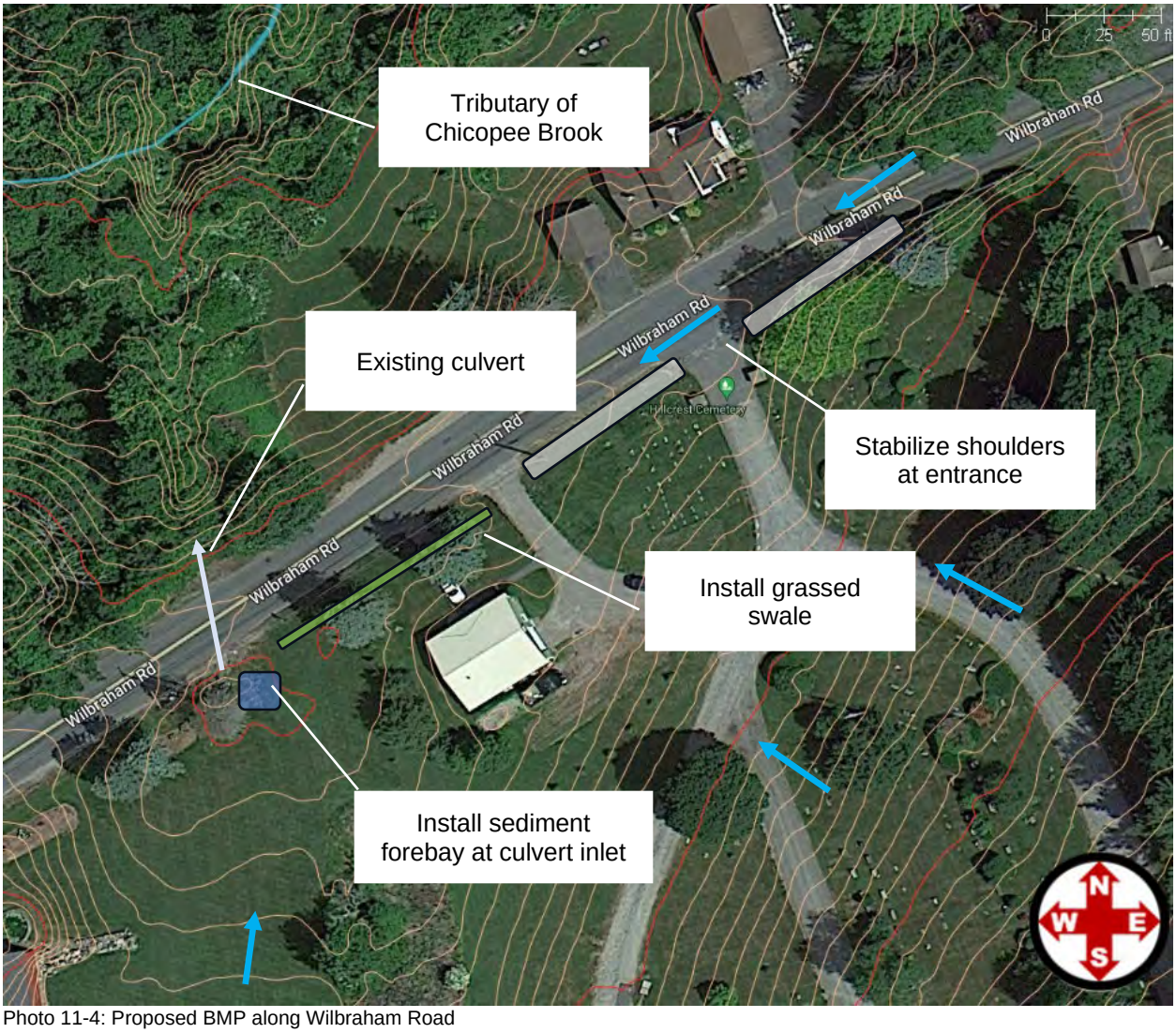

Photo 11-4: Proposed BMP along Wilbraham Road

Estimated Costs: **$15,000 - $22,000**

Estimated Nutrient Load Reduction:

- Total Suspended Solids: 1.18 ton/yr
- Total Phosphorus: 1.92 lb/yr
- Total Nitrogen: 10.57 lb/yr

AREA 12: Flynt Park

Location: Flynt Park
Owner: Town of Monson
Subwatershed: Chicopee Brook
Priority: Medium

Site Description

Flynt Park is a series of fields with steep surrounding topography. The fields currently receive runoff from upgradient Mount Ella. There is an existing French drain along the upgradient side of the lower field to redirect runoff away from the field. The French drain is connected to a catch basin that outlets at the roadside ditch along Park Road. Runoff from the area also flows down the paved access roadway and onto Park Road.

Photo 12-1: Existing French drain along upgradient side of field.

Photo 12-2: Shoulder erosion along the paved access roadway.

Proposed Area 12 Improvements (see Photo 12-3)

1. Enlarge the existing French to increase capacity (approx. 3800 SF).
2. Stabilize roadway shoulders along the park road.
3. Consider constructing an infiltration or detention basin just upgradient from the intersection with Park Road (approx. 800 SF).

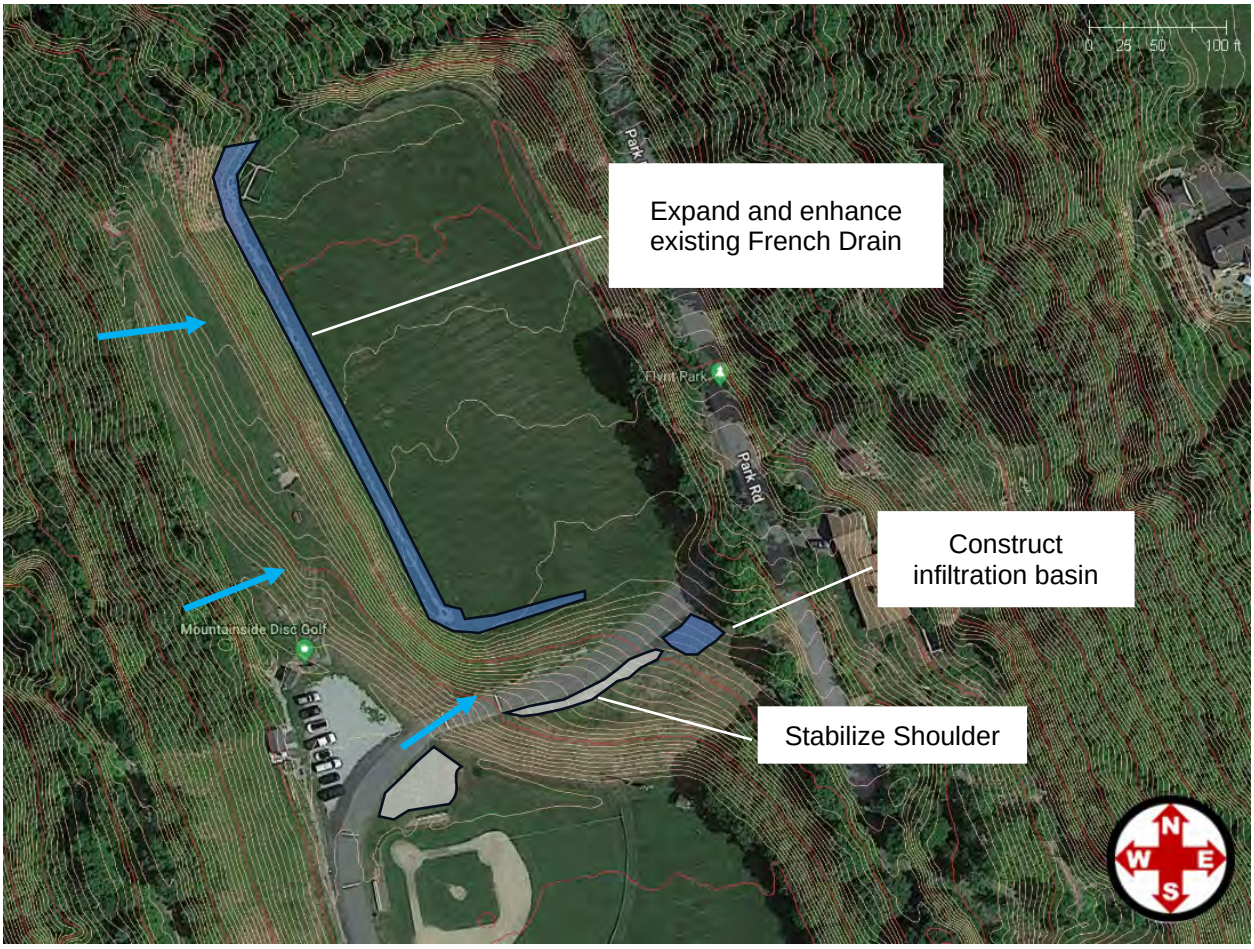

Photo 12-3: Proposed BMP at Flynt Park

Estimated Costs: **$46,000 - $69,000**

Estimated Nutrient Load Reduction:

- Total Suspended Solids: 0.27 ton/yr
- Total Phosphorus: 1.26 lb/yr
- Total Nitrogen: 8.54 lb/yr

AREA 13: Bunyan Road

Location: Bunyan Road
Owner: Town of Monson
Subwatershed: Chicopee Brook
Priority: Medium

Site Description

The shoulder pull-off adjacent to the Bunyan Road bridge is currently tracking sediment onto the roadway due to cars pulling on and off of the shoulder. Sediment can be seen both uphill and downhill from the pull-off. Runoff flows into an adjacent wetland area directly adjacent to Chicopee Brook.

Photo 13-1: Loose sediment along the southern shoulder of Bunyan Road.

Photo 13-2: Dirt pull-off eroding and washing into adjacent wetland.

Proposed Area 13 Improvements (see Photo 13-3)

1. Stabilize roadway shoulders along Bunyan Road (approx. 400 SF).

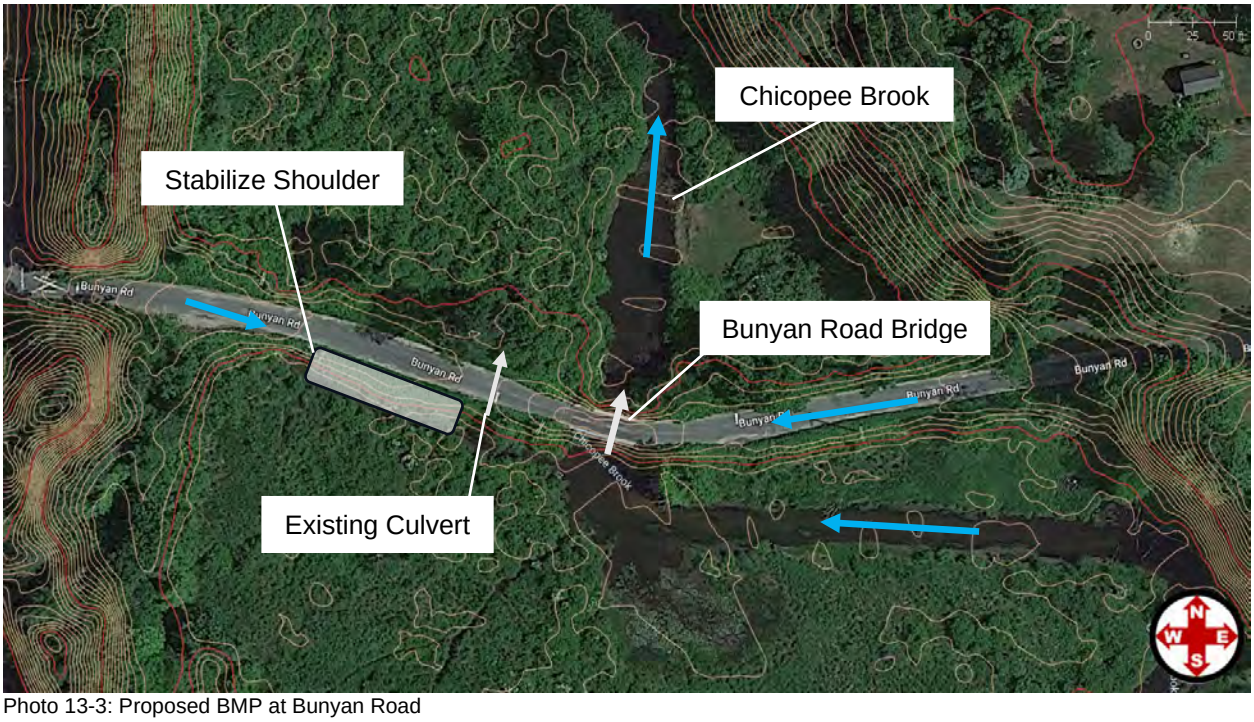

Photo 13-3: Proposed BMP at Bunyan Road

Estimated Costs: **$8,000 - $12,000**

Estimated Nutrient Load Reduction:

- Total Suspended Solids: 0.10 ton/yr
- Total Phosphorus: 0.10 lb/yr
- Total Nitrogen: 0.10 lb/yr

AREA 14: Flynt Quarry

Location: Flynt Quarry
Owner: Town of Monson
Subwatershed: Chicopee Brook
Priority: Low

Site Description

The Flynt Quarry is a recreational location with a gravel pullout for parking. There is evidence of sediment transport into Upper Palmer Road from vehicles pulling into and out of the shoulder. Stormwater currently flows south along the east side of Upper Palmer Road to a tributary located at the bottom of the hill. The Flynt Quarry is abutted by a capped landfill.

Photo 14-1: Dirt shoulder/parking area.


Photo 14-2: Loose sediment along the eastern shoulder of Upper Palmer Road.

Proposed Area 14 Improvements (see Photo 14-3)

1. Stabilize parking/shoulder along Upper Palmer Road (approx. 3250 SF).
2. Install roadside swale and checkdams along the eastern side of Upper Palmer Road (approx. 1000 SF).

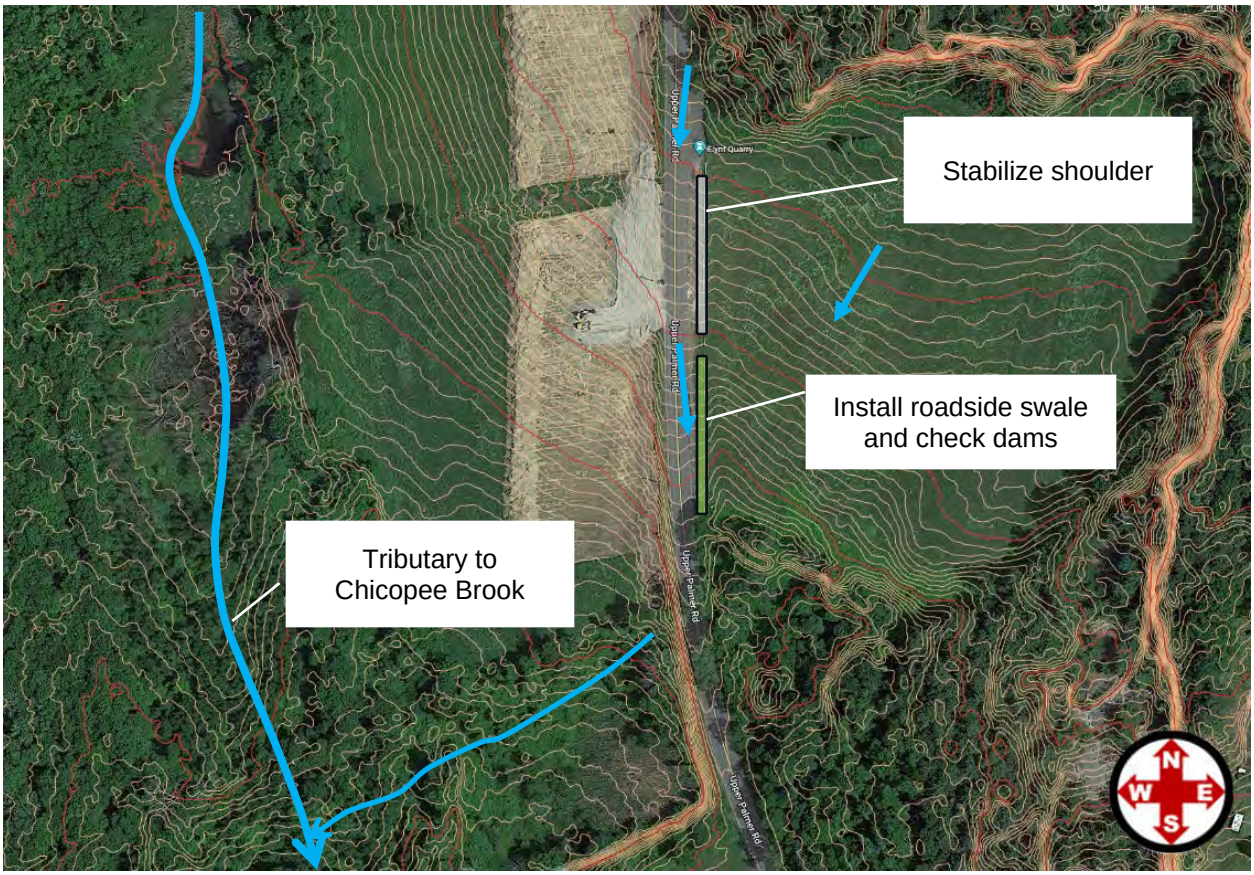

Photo 14-3: Proposed BMP at Flynt Quarry

Estimated Costs: **$27,000 - $41,000**

Estimated Nutrient Load Reduction:

- Total Suspended Solids: 0.89 ton/yr
- Total Phosphorus: 0.90 lb/yr
- Total Nitrogen: 2.30 lb/yr

AREA 15: Bethany Road

Location: 96 Bethany Road
Owner: Town of Monson
Subwatershed: Chicopee Brook
Priority: Low

Site Description

The utility building located on Bethany Road is surrounded by large vacant fields. Chicopee Brook runs along the rear of the utility building to the west. An existing drainage system runs along Bethany Road adjacent to the northeastern corner of the lot. Stormwater flows along Bethany Road and into a series of catchbasins that discharge to Chicopee Brook without treatment.

Photo 15-1: Outlet location for Bethany Road drainage system.

Photo 15-2: Grass field surrounding utility building.

Proposed Area 15 Improvements (see Photo 15-3)

1. Install bioinfiltration basin in the grassed areas along Bethany Road (approx. 900 SF).

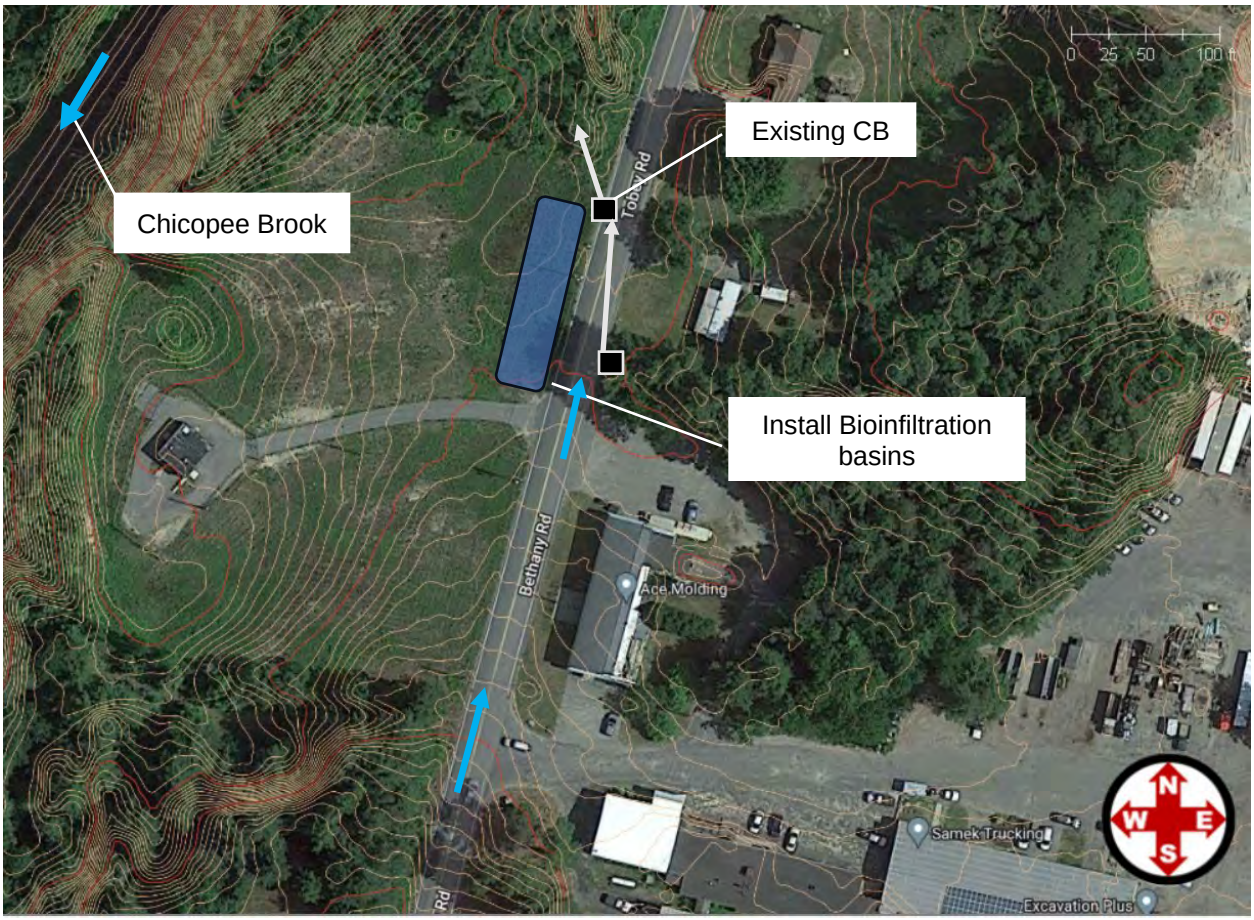

Photo 15-3: Proposed BMPs along Bethany Road

Estimated Costs: **$33,000 - $49,000**

Estimated Nutrient Load Reduction:

- Total Suspended Solids: 0.06 ton/yr
- Total Phosphorus: 0.11 lb/yr
- Total Nitrogen: 0.61 lb/yr

Upcoming Projects

Main Street (Route 32) Improvement Project

The project includes upgrading surface infrastructure assets and re-allocation of right-of-way to improve on-street parking and pedestrian and bicycle accommodations and increase safety for all users within the roadway by promoting lower vehicle speeds by using a Complete Streets design approach. This project is also intended to support local business by reinvigorating and revitalizing downtown infrastructure and will include stormwater retrofits. The project is currently at 25% design.

MVP Action Grants

The Town has been awarded a FY24 EEA Municipal Vulnerability Preparedness Program Action Grant to complete 25% design plans and the EENF stage of the MEPA review process for a resilience project that could potentially reroute Bunyan Road out of the floodplain and Town Water Supply Lands. This would allow for the future removal of the existing Bunyan Road crossing and all associated road embankment fill out of the floodplain, as well as the potential removal of the abandoned downstream railway embankments, to allow for the future restoration of the surrounding wetland.

In addition, the Town of Monson is currently assembling a MVP FY25 application and plan to include land acquisition to protect water supply lands from development.

Non-Structural Best Management Practices

Unlike structural BMPs, non-structural BMPs do not involve construction of site-specific infrastructure and generally focus on reducing pollutant loads through the following:

1. **Public Information and Education:** Changing behavior and land use patterns through efforts to inform, educate, and engage the public on issues related to protection of water quality and aquatic habitat.

2. **Land Conservation:** Reducing pollutants at the source through natural systems, such as land conservation and protection of sensitive land areas through purchase, easements, etc.;

3. **Regulatory Tools:** Changing behavior and land use patterns through regulation (e.g., state laws, municipal ordinances)

4. **Institutional Practices and Programs:** Reducing pollutant loads through improved institutional practices such as enhanced street sweeping, catch basin cleaning, leaf litter pickup programs, etc.

The pollutant load reductions and costs associated with non-structural measures are generally more difficult to estimate than those for structural BMPs. Strategies for reducing pollutant loads in the Chicopee Brook watershed through non-structural BMPs are discussed in the sections below.

Public Outreach

Public outreach of the WBP is important to educate the public about both NPS pollution and the Chicopee Brook watershed and to coordinate efforts of the various entities working within the watershed. Specific public information and education (I/E) efforts associated with the Chicopee Brook WBP are expected to include the following (additional detail is provided under Element E - Public Education and Outreach):

- Education and outreach to pet owners and park/open space users regarding litter and pet waste
- Pet waste disposal signage at parks and open spaces
- Geese waste prevention letter to open space owners/managers
- Provide information to the Board of Health to use with inspections and communications with commercial, industrial, and residential properties with dumpsters
- Education and outreach to residential and institutional property owners/managers regarding the effects of over-watering lawns; proper use and application of irrigation systems; proper application of fertilizers
- Provide peer-led training and technical assistance for groundskeepers and managers of municipally controlled properties and sports fields.

Costs for developing a public education and information program are difficult to estimate. However, these types of programs typically range in cost from $5,000-$10,000 per year.

Land Conservation

Land conservation efforts can include strategies to protect and limit future development of highly sensitive parcels through purchase, donations, conservation easements, deed restrictions, and other real estate legal agreements. Efforts to protect land from future development can contribute to multiple long-term benefits, particularly: drinking water supply protection and meeting surface water quality goals established in this WBP.

Potential land conservation efforts may include:

- Prioritizing specific parcels for land conservation (working with Opacum Land Trust).

- Acquiring specific parcels for conservation.

Costs for land conservation efforts are difficult to estimate. Prioritization can be done in house and specific costs for acquiring parcels depend on the actual cost of the parcel.

Regulatory Tools

Local bylaws can provide effective protection against factors that impact water quality as they can ensure effective stormwater management and erosion and sediment controls to prevent adverse impacts from new or redevelopment projects. The Town of Monson is currently regulated under EPA's 2016 National Pollutant Discharge and Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Permit. The MS4 Permit requires municipalities to have certain regulations in place to address stormwater pollution including illicit discharge bylaws, construction-phase and post-construction regulations. Model standards such as the Post-Construction Stormwater Management Standards developed by the Southeast Watershed Alliance (SWA) in cooperation with the UNH Stormwater Center were developed to help guide the development of stronger local stormwater standards for protection of surface waters.

Other bylaws that may be amended to address nonpoint source pollution include zoning bylaws, specifically site plan review standards, and also subdivision regulations. At the same time, updating zoning protections for drinking water supply can also deliver co-benefits to the quality of stormwater flows if not updated already.

Costs related to regulatory changes depend on scale of review and recommended changes. Such work can be done by Town staff and knowledgeable boards, and/or with help from Pioneer Valley Planning Commission staff.

Institutional Practices and Programs

As noted, the Town of Monson is regulated under the MS4 Permit. The MS4 Permit addresses stormwater pollution from the storm drain system and requires permitted communities to develop programs to address this type of pollution through implementing institutional practices and programs that reduce pollutant loading. These practices include annual catch basin cleaning, enhanced street/pavement cleaning operations, and enhanced organic waste and leaf litter collection programs. Costs for these programs vary from year to year based on town priorities.

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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.

Technical Support

The structural BMPs described under Element C will require varying levels of technical support related to implementation complexity. Implementation complexity is a qualitative indicator based on the level of detail required for engineering designs (e.g., conceptual designs vs. detailed site design plan prepared by a registered professional engineer), construction (e.g., underground utility conflicts, site access, traffic impacts, etc.), and other factors (e.g., property ownership, potential for wetland permitting).

Types of technical support that may be required for the nonstructural measures outlined under Element C include:

- Graphic design and printing support for public outreach and educational materials;
- Legal assistance for conservation land real estate transactions and development of regulatory language for future municipal ordinances.

Financial Support

Site improvements and management recommendations outlined under Element C will require funding for implementation, including construction and ongoing maintenance. Specific costs for the design and installation of each proposed structural BMP are shown in Table 13. The actual implementation of structural and non-structural BMPs will be dependent on available funding. Potential funding sources may include local municipal budgets and/or loans and grants offered at the state and federal level. A summary of potential state and federal funding sources is listed in Table 16. Additional resources can be found on the MassDEP Grant Program Directory webpage.

Table 16. Summary of Potential Funding Programs

Funding Program	Description
Planning and Implementation Programs	
MassDEP Stormwater MS4 Municipal Assistance Grant Program	The MassDEP Stormwater MS4 Municipal Assistance Grant program is available for Massachusetts municipalities, Regional Planning Agencies, stormwater coalitions, and non-profit organizations for innovative projects that will assist multiple communities in meeting the requirements of the MS4 permit. Eligible projects include assessment tools for prioritizing retrofit sites, tracking tools for regional stormwater retrofits, development of templates, formation of new regional stormwater coalitions, and other tasks that benefit multiple Massachusetts municipalities in seeking compliance with their MS4 permit.
MassDEP Clean Water State Revolving Fund	The SRF Clean Water program provides a low-cost financing method to help communities meet water quality standards. The program addresses issues such as watershed management priorities, stormwater management, and green infrastructure. SRF also supplies financial assistance to address communities with septic systems.
MassDEP Watershed Assistance Grants	Water Quality Planning and 604(b) grants are available for water quality planning purposes. Other eligible projects include development of preliminary designs and implementation plans to address water quality impairments, and the development of green infrastructure projects. MassDEP also provides funding appropriated through the USEPA under Section 319 of the Clean Water Act to support local initiatives to restore impaired waters or protect high quality waters. 319-grant funds are targeted toward implementation of completed watershed-based plans. A minimum of 40% non-federal match is required for these grants. While 319 funds may not be used to fund work that is specifically required in the MS4 permit, work in the non-regulated area of town is eligible for these funds.
Division of Conservation Services Drinking Water Supply Protection Program	The DWSP grant program provides financial assistance to public water systems and municipal water departments for the purchase of land or interests in land for the following purposes: 1) protection of existing DEP-approved public drinking water supplies; 2) protection of planned future public drinking water supplies; or 3) groundwater recharge. It is a reimbursement program.
Division of Local Services Community Compact Cabinet Grants	The Community Compact is a voluntary, mutual agreement entered into between the Healey-Driscoll Administration and individual cities and towns of the Commonwealth. In a Community Compact, a community will agree to implement at least one best practice that they select from across a variety of areas. The community's chosen best practice(s) will be reviewed between the Commonwealth and the municipality to ensure that the best practice(s) chosen are unique to the municipality and reflect needed areas of improvement.
Climate Resiliency Programs	
Massachusetts Municipal Vulnerability Preparedness (MVP) Grant Program	The MVP grant program provides support for cities and towns in Massachusetts to being the process of planning for climate change resiliency and implementing priority projects. The state awards communities with funding to complete vulnerability assessments and develop action-oriented resiliency plans. Communities who complete an MVP planning grant become certified as an MVP community and are eligible for MVP Action Grant funding and other opportunities.

Funding Program	Description
Habitat Improvement Programs	
Massachusetts Division of Ecological Restoration (DER) Grant Programs	The Culvert Replacement Municipal Assistance Grant Program is for municipalities interested in replacing an undersized, perched, and/or degraded culvert located in an area of high ecological value. This funding is to encourage municipalities to replace aging culverts with better designed crossings that meet improved structural and environmental design standards and flood resiliency criteria. The Restoration and Revitalization Priority Projects Program selects projects that restore and protect Massachusetts rivers, wetlands, and watersheds for the benefit of people and the environment. The Priority Projects Program selects ecological and urban stream revitalization projects that present significant benefits to Massachusetts. Eligible applicants include restoration project site landowners, non-profit and/or non-governmental organizations, regional planning organizations, municipalities, and state and federal agencies. Current project focus is on cranberry bog wetland restoration, stream restoration, and urban stream and river revitalization.
NOAA Community-Based Restoration Program Partnership	Grant funding provided for stream barrier removal projects that help restore riverine ecosystems, enhance public safety and community resilience, and have clear and identifiable benefits to diadromous fish populations.
National Fish and Wildlife Foundation (NFWF) Grant Programs	NFWF Five Star and Urban Waters Restoration Program provides funds to local partnerships for wetland, forest, riparian and coastal habitat restoration, with a focus on urban waters and watersheds. Funds approximately $1,500,000 annually, with average grants between $25,000 to $35,000 and 1:1 match requirement. NFWF New England Forests and Rivers Fund dedicated to restoring and sustaining healthy forests and rivers that provide habitat for diverse native bird and freshwater fish populations. Annually awards grants ranging from $50,000 to $200,000 each.
Recreation and Trail Programs	
Community Preservation Act	The Community Preservation Act (CPA) is a smart growth tool that helps communities preserve open space and historic sites, create affordable housing, and develop outdoor recreational facilities. CPA also helps strengthen the state and local economies by expanding housing opportunities and construction jobs for the Commonwealth's workforce, and by supporting the tourism industry through preservation of the Commonwealth's historic and natural resources.
Fields Pond Foundation	Funds trail making and other enhancement of public access to conservation lands, land acquisitions for conservation, and establishing funds for stewardship. Funding levels: $25,000 maximum, $2,000 - $10,000 typical.
MassTrails Program	MassTrails provides matching grants to communities, public entities, Native nations, and non-profit organizations to plan, design, create, and maintain the diverse network of trails, trail systems, and trails experiences used and enjoyed by Massachusetts residents and visitors. Applications are accepted annually for a variety of well-planned trail projects benefiting communities across the state.
National Park Service – Rivers and Trails Program	Funds projects focused on protection of natural resources and enhancement of outdoor recreational opportunities.

Funding Program	Description
Agricultural Programs	
Mass Association of Conservation Districts	MACD has 319 grant funding to help address NPS impairment issues in surface waters that may have ties to agriculture. While not a funding program, MACD can help with technical assistance to move forward on analysis and implementation of such water quality issues.
Natural Resource Conservation Service (NRCS) Grant Programs	Environmental Quality Incentives Program (EQIP) provides financial and technical assistance to agricultural producers to address natural resources concerns and deliver environmental benefits such as improved water and air quality, conserved ground and surface water, reduced soil erosion, and improved wildlife habitat. Conservation Stewardship Program (CSP) is the largest conservation program in the United States with a goal of enhancing natural resources and improving agricultural operations. The program helps agricultural operations build on existing conservation efforts while strengthening their operations. The program focuses on improving grazing conditions, increasing crop yields, developing wildlife habitat, and increasing resilience to weather extremes.

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.

As noted under Element C, specific Public Information and Education tasks include:

- Education and outreach to pet owners and park/open space users regarding litter and pet waste
- Pet waste disposal signage at parks and open spaces
- Geese waste prevention letter to open space owners/managers
- Provide information to the Board of Health to use with inspections and communications with commercial, industrial, and residential properties with dumpsters.
- Education and outreach to residential and institutional property owners/managers regarding the effects of over-watering lawns; proper use and application of irrigation systems; proper application of fertilizers
- Education for groundskeepers and managers of municipally controlled properties and sports fields.

In addition, the Town of Monson is regulated under the MS4 Permit. The MS4 Permit requires public education and outreach on topics such as leaf litter pick up, lawn fertilization, pumping septic systems, and winter road maintenance.

The primary goals and objectives for an program are to educate Town residents and business owners on proper maintenance measures to minimize stormwater pollution associated with pet and geese waste, dumpsters, and lawn maintenance in order to decrease nonpoint sources of bacteria and total suspended solids. The target audience includes commercial property owners, industrial property owners, institutional property owners/managers, and residents. Specific metrics to evaluate the Information and Education Program include:

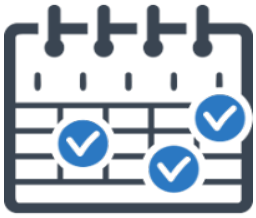
- Tracking the number of signs distributed to parks/open spaces.
- Tracking usage of pet waste disposal materials at parks/open spaces.
- Tracking the number of fact sheet emails and the size of the listserv receiving the emails.

Costs for developing a public education and information program are difficult to estimate. However, these types of programs typically range in cost from $5,000-$10,000 per year.

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.



The implementation schedule for the Chicopee Brook WBP is based on a five-year planning and implementation period from 2023-2028.

Structural BMPs

- Select priority sites for implementation: 2023-2024
- Prepare application for MassDEP Section 319 NPS Grant for final design/construction of priority BMP sites: 2023-2024
- Prepare priority BMP sites final designs and permitting (pending grant funding): 2025-2026
- Construct priority BMP sites: 2026-2028
- Obtain grant funding for additional BMPs: 2026-2028

Nonstructural BMPs

Nonstructural BMPs are ongoing practices that will occur throughout the period from 2023-2028. Where possible, specific practices such as catch basin cleaning and street sweeping will occur in conjunction with the Town of Monson's regularly scheduled MS4 practices. Other nonstructural BMPs will occur on a rolling basis throughout the period from 2023-2028, with an education program being developed in 2024-2025 (pending grant funding).

Additional Schedules and Milestones

Monitoring and adaptive management programs are described under Elements H & I of this WBP. Schedules for these programs include annual monitoring of Chicopee Brook and review of the progress towards meeting the WBP water quality targets and project-specific goals every three years, with updates to the WBP as needed.

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?**"

Water quality goals for Chicopee Brook are presented under Element B of the Plan. Element C of this plan describes the various management measures that will be implemented to work towards achieving this targeted load reduction. The evaluation criteria and monitoring program described below will be used to measure the effectiveness of the proposed management measures (described in Element C) in improving the water quality of Chicopee Brook.

Indirect Indicators of Load Reduction

Potential load reductions from non-structural BMPs (i.e., impervious area reduction, street sweeping, and catch basin cleaning) can be estimated from indirect indicators, such as the acreage of impervious area reduced, number of miles of streets swept, or the number of catch basins cleaned.

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 phosphorus 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. The Town of Monson currently performs street sweeping, catch basin cleaning, illicit discharge tracking, in addition to other non-structural BMPs as part of their MS4 Program.

Project-Specific Indicators

Anticipated pollutant load reductions from existing, ongoing (i.e., under construction), and future BMPs will be tracked as BMPs are installed.

Direct Measurements

Direct measurements are generally expected to be performed as described below. Prior to implementing a direct measurement program, an abbreviated QAPP and/or Standard Operating Procedures (SOPs) will be established to flesh out details of the program and establish best practices for sample collection and analysis. Water quality

monitoring may be performed through a volunteer training program to save on costs in accordance with established practices for MassDEP's environmental monitoring for volunteers.

Brook Sampling: Establish regular sampling of priority pollutants (TSS, fecal coliform and *E. coli*) in Chicopee Brook; potentially including analysis of other common NPS pollutants, such as total phosphorus, total nitrogen, and turbidity. Additional parameters such as temperature, conductivity, biochemical oxygen demand, salinity, dissolved oxygen, pH, chlorine, and flow rate could provide additional data for consideration. Monitoring locations will be selected to build upon existing water quality data. Additional monitoring locations may be selected based on accessibility and representativeness and shall be appropriate to quantify water quality improvements in the watershed.

Outfall Screening: Implement an outfall screening program to compare water quality screening criteria before and after implementation of BMPs. Parameters for screening would include temperature, conductivity, fecal coliform, *E. coli*, biochemical oxygen demand, TSS, salinity, dissolved oxygen, pH, chlorine, nutrients, and flow rate. Outfall screening is currently conducted under the Town of Monson's MS4 Permit. Results from any sampling conducted by municipalities within the Chicopee Brook watershed will be reviewed by PVPC.

Adaptive Management

As discussed in Element B (Recommended Load Reduction section), a baseline monitoring program (dependent on available funding) will be used to establish a long-term (i.e., 15-year) *E. coli* and total phosphorus load reduction goal (or other parameter(s) depending on results). Long-term goals 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 total phosphorus concentrations and other indicators (e.g., chlorophyll-*a*) 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 – Pollutant Load Export Rates (PLERs)

Land Use & Cover[1]	PLERs (lb/acre/year)		
	(TP)	(TSS)	(TN)
AGRICULTURE, HSG A	0.45	7.14	2.6
AGRICULTURE, HSG B	0.45	29.4	2.6
AGRICULTURE, HSG C	0.45	59.8	2.6
AGRICULTURE, HSG D	0.45	91	2.6
AGRICULTURE, IMPERVIOUS	1.52	650	11.3
COMMERCIAL, HSG A	0.03	7.14	0.3
COMMERCIAL, HSG B	0.12	29.4	1.2
COMMERCIAL, HSG C	0.21	59.8	2.4
COMMERCIAL, HSG D	0.37	91	3.7
COMMERCIAL, IMPERVIOUS	1.78	377	15.1
FOREST, HSG A	0.12	7.14	0.5
FOREST, HSG B	0.12	29.4	0.5
FOREST, HSG C	0.12	59.8	0.5
FOREST, HSG D	0.12	91	0.5
FOREST, HSG IMPERVIOUS	1.52	650	11.3
HIGH DENSITY RESIDENTIAL, HSG A	0.03	7.14	0.3
HIGH DENSITY RESIDENTIAL, HSG B	0.12	29.4	1.2
HIGH DENSITY RESIDENTIAL, HSG C	0.21	59.8	2.4
HIGH DENSITY RESIDENTIAL, HSG D	0.37	91	3.7
HIGH DENSITY RESIDENTIAL, IMPERVIOUS	2.32	439	14.1
HIGHWAY, HSG A	0.03	7.14	0.3
HIGHWAY, HSG B	0.12	29.4	1.2
HIGHWAY, HSG C	0.21	59.8	2.4
HIGHWAY, HSG D	0.37	91	3.7
HIGHWAY, IMPERVIOUS	1.34	1,480	10.5
INDUSTRIAL, HSG A	0.03	7.14	0.3

Land Use & Cover[1]	PLERs (lb/acre/year)		
	(TP)	(TSS)	(TN)
INDUSTRIAL, HSG B	0.12	29.4	1.2
INDUSTRIAL, HSG C	0.21	59.8	2.4
INDUSTRIAL, HSG D	0.37	91	3.7
INDUSTRIAL, IMPERVIOUS	1.78	377	15.1
LOW DENSITY RESIDENTIAL, HSG A	0.03	7.14	0.3
LOW DENSITY RESIDENTIAL, HSG B	0.12	29.4	1.2
LOW DENSITY RESIDENTIAL, HSG C	0.21	59.8	2.4
LOW DENSITY RESIDENTIAL, HSG D	0.37	91	3.7
LOW DENSITY RESIDENTIAL, IMPERVIOUS	1.52	439	14.1
MEDIUM DENSITY RESIDENTIAL, HSG A	0.03	7.14	0.3
MEDIUM DENSITY RESIDENTIAL, HSG B	0.12	29.4	1.2
MEDIUM DENSITY RESIDENTIAL, HSG C	0.21	59.8	2.4
MEDIUM DENSITY RESIDENTIAL, HSG D	0.37	91	3.7
MEDIUM DENSITY RESIDENTIAL, IMPERVIOUS	1.96	439	14.1
OPEN LAND, HSG A	0.03	7.14	0.3
OPEN LAND, HSG B	0.12	29.4	1.2
OPEN LAND, HSG C	0.21	59.8	2.4
OPEN LAND, HSG D	0.37	91	3.7
OPEN LAND, IMPERVIOUS	1.52	650	11.3
[1]HSG = Hydrologic Soil Group			