MASSACHUSETTS
watershed·based plans

WATERSHED-BASED PLAN

Lake Wyola (MA34103)

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Prepared For:

MassDEP
Commonwealth of Massachusetts
Department of Environmental Protection

Contents

Executive Summary

Introduction

The purpose of a Massachusetts Watershed-Based Plan (WBP) is to organize information about Massachusetts' watersheds, and present the information in a format that will enhance the development and implementation of projects that will restore water quality and beneficial uses in the Commonwealth. The Massachusetts WBP follows the United States Environmental Protection Agency's (EPA's) recommended format for "nine-element" watershed plans. The Franklin Regional Council of Governments (FRCOG) developed this WBP with funding, input, and collaboration from the Massachusetts Department of Environmental Protection (MassDEP).

This WBP was prepared for the Lake Wyola watershed (MA34103), which is in the towns of Shutesbury and Wendell, Massachusetts (with a very small portion in Montague and Leverett). Lake Wyola is a 124-acre lake with a watershed area of 4,295 acres. It receives water from four perennial streams: Skerry Brook, Fiske Brook, Ames Brook, and South Brook.

This WBP for Lake Wyola builds on 25 years of assessment, planning, and Best Management Practice (BMP) implementation to improve water quality in Lake Wyola. Most notably, this plan builds on the 2000 s.319-funded work of the Department of Environmental Management (00-16/319), and incorporates the studies and community dialogue that has occurred in the interim. Comprehensive Environmental Inc. conducted field screenings at locations within the Lake Wyola watershed in April of 2022 to assist the FRCOG with the identification of potential BMP implementation opportunities.

Impairments and Pollution Sources

Lake Wyola is a category 4A water on draft 2022 Massachusetts Integrated List of Waters 303(d) list due to phosphorus and nutrient/eutrophication impairments. Volunteer monitoring has indicated that the lake has very low total phosphorus and the DEP has acknowledged the validity of volunteer data over DEP data.[1] Based on anecdotal evidence, biological indicators for eutrophication are also no longer present in the lake. A "preventative" Total Maximum Daily Load (TMDL) for phosphorus was completed for this lake in 2001 and approved by the USEPA in April 2002.

Community feedback gathered to date indicates a concern about excess sediment mobilization and deposition at several locations in the lake. Increased sediment loading is also a concern because of sediment's potential as a carrier of phosphorus. For any phosphorus and sediment loading that is occurring, stormwater runoff from nearby roads, lawns, and piped stormwater outfalls, erosion of nearby unpaved roads, and stream erosion from fluvial geomorphic impairments are likely a direct source. Other possible sources of pollution considered in the analysis include agriculture and resource extraction sites, forest, septic systems, boat wakes, and underground storage tanks. Groundwater withdrawal is also assessed as a potential driver of pollutant concentrations.

Goals, Management Measures, and Funding

Water quality goals for this WBP are focused on reducing phosphorus and sediment loading to Lake Wyola. This WBP includes an adaptive sequence to establish and track specific water quality goals. First, an interim goal has been established to reduce sediment loading by 5.6 tons and to reduce phosphorus loading by any amount in the next 5 years.

[1] MassDEP 2002

It is expected that goals will be accomplished primarily through installation of structural BMPs to capture stormwater runoff and reduce pollutant loading, as well as implementation of non-structural BMPs (e.g., road maintenance and BMP management), and watershed education and outreach. Engineering studies will be needed to determine the location of and types of structural BMPs.

Funding for both structural and nonstructural BMPs could be obtained from a variety of sources, including grant funding, Town funds, volunteer efforts, and other sources.

Public Education and Outreach

Public education and outreach will be aimed at educating Shutesbury Town staff and residents about the health of Lake Wyola, including the potential sources of nonpoint source pollution (contaminants released in a wide area rather than from one single source, such as a pipe) and fluvial geomorphic impairments (disturbance to stream channel shape, water flow, and sediment movement in a stream channel). Education and outreach will help to promote a comprehensive approach to ongoing stormwater management, including road BMPs and residential BMPs.

The public education and outreach goals can be achieved by engaging Town of Shutesbury and Wendell staff, members of the Lake Wyola Association (LWA)[2] and Lake Wyola Advisory Committee (LWAC),[3] Lake Wyola-area residents, including renters and those who are not members of the lake association, and town-wide residents of Shutesbury and Wendell through online resources, a local presentation, in-situ informational signage and tours, and a variety of other means. It is expected that these programs will be evaluated by tracking attendance at events and other tools applicable to the type of outreach performed. The LWA and LWAC can be leveraged to liaison with community members.

Implementation Schedule and Evaluation Criteria

Project activities will be implemented based on the information outlined in the following elements for inspection, implementation of structural BMPs, public education and outreach activities, and a schedule for periodic updates to the WBP. Other indirect evaluation metrics are also included, such as the number/hours/miles of road management and BMP management. The long-term goal of this WBP is to delist Lake Wyola from the Massachusetts Integrated List of Waters 303(d) list, as well as to greatly reduce the amount of stormwater and mobilized sediment entering the lake.

[2] The Lake Wyola Association (LWA) is a private non-profit, membership-based organization. Membership is voluntary. Not all property owners around the lake are members of the LWA.

[3] The purpose of the LWAC is to serve as a liaison between Town government, the Lake Wyola Association, and the lake community as a whole. It aims to promote the preservation, maintenance, and enhancement of the lake as a natural and recreational resource. Its purview includes protection of water quality from septic systems and other sources of contamination, nuisance weed and sediment removal, erosion and runoff control, and dam safety. Regular water quality assessment and oversight of the dam are also the responsibility of the committee.

Introduction

What is a Watershed-Based Plan?

Purpose & Need

The purpose of a Massachusetts watershed-based plan (WBP) is to identify past and current water quality conditions and known and likely causes and sources of nonpoint source pollution (NPS) in a watershed. It will also help stakeholders to recognize data gaps, prioritize the NPS problems, identify appropriate best management practices and watershed-based strategies for addressing the problems, and develop proposals to fund the work using 319 nonpoint source competitive grant funds or similar programs. The goal of WBPs and projects aimed at reducing nonpoint source pollution is to 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) 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.

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 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.

General Watershed Information

This WBP was prepared for waterbodies located within the Lake Wyola watershed in Shutesbury, Wendell, Leverett, and Montague. The watershed is an FY 2022 319 priority waterbody with a Recovery Potential Index score of 57.[4] Waterbodies include Lake Wyola (MA34103), Skelly Brook, Fiske Brook, Plympton Brook, Fiske Pond, McAvoy Pond, Tyler Pond, Ames Brook, Ames Pond, South Brook, and Footit's Bog. The entire watershed measures 4,285 acres (approximately 6.7 square miles).

Table A-1: General Watershed Information

Watershed Name (Assessment Unit ID):	Lake Wyola (MA34103)
Major Basin:	CONNECTICUT
Watershed Area (within MA):	4285.4 (ac)
Water Body Size:	128 (ac)

[4] The Recovery Potential Screening Tool was developed by the U.S. EPA Office of Water to support prioritization planning for watershed restoration and protection Massachusetts. Recovery potential is the likelihood of an impaired water to attain a desired condition given its ecological capacity, exposure to stressors, and the social context affecting restoration efforts. Lake Wyola's score of 57 was the third highest of the ten scored water resources in Franklin County in the FY 2022 s.319 RFR cycle. Scoring higher on the index suggests a waterbody can recover quickly from the impairment. Lake Wyola was ranked based on the assumption that it currently has a phosphorus impairment, which evidence presented in this WBP suggests it does not.

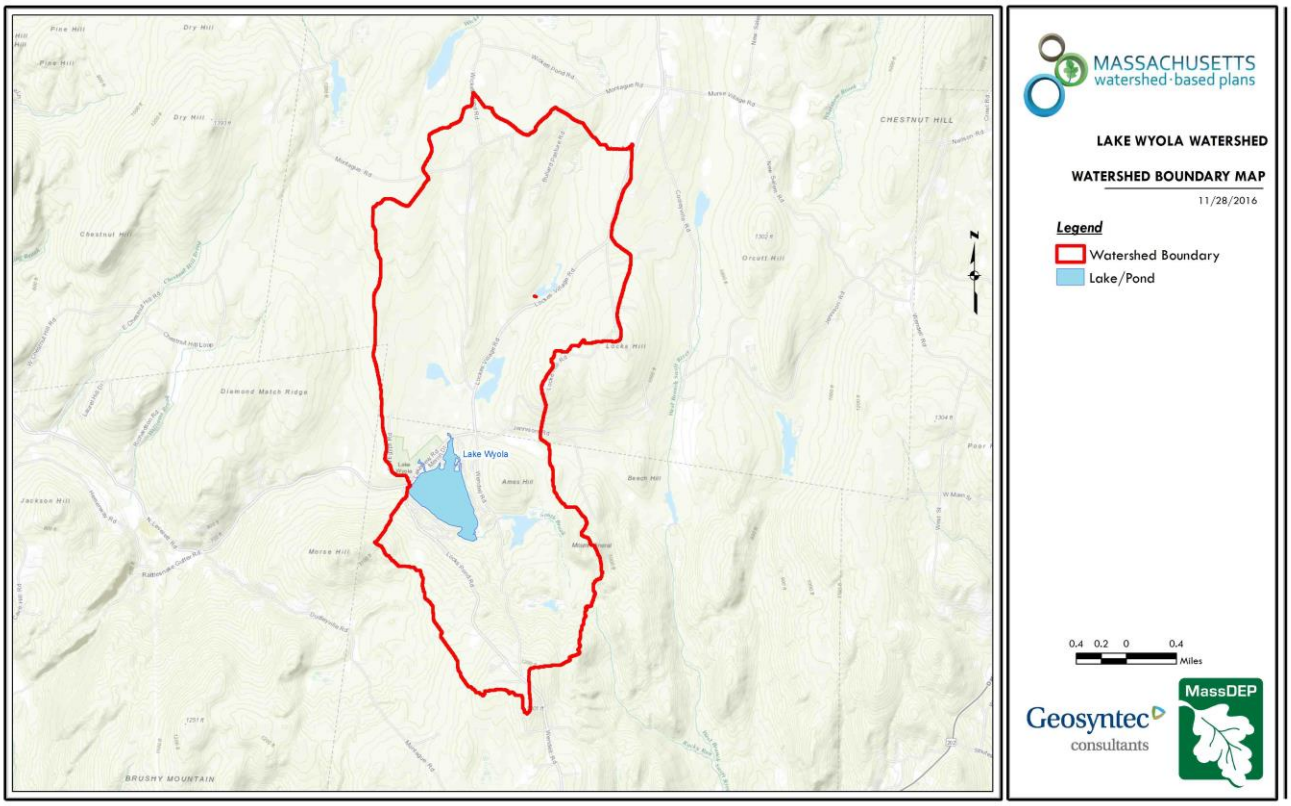

Figure A-1: Watershed Boundary Map (MassGIS, 1999; MassGIS, 2001; USGS, 2016)

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

Lake Wyola is a 128-acre recreational lake located in the northwest corner of Shutesbury (see **Figure A-1**). It is considered a Class B water[5] and a warm water fishery. The area surrounding the lake is relatively densely settled and supports a variety of water and ice-based recreation. The area of the original lake was approximately doubled when the Lake Wyola Dam was constructed in 1883. The lake has a maximum depth of 33 feet, although most of the lake is relatively shallow, averaging only 11 feet (see Figure A-2). The water is typically transparent to roughly 8 feet. The bottom is most often mud, with scattered areas of gravel.[6]

A public boat ramp and small park/beach (Elliot Park) at the South Brook Conservation Area provide public access at the southern end of the lake and the small, municipal Top of the Lake Park will one day provide a canoe and kayak launch area at the northern end. The 40-acre Lake Wyola State Park Recreation Area provides public beach access on the northern shore. One additional, very small Town-owned parcel called the Garbiel Gift provides shoreline access in the northeast corner. The LWA maintains three private beaches on the west, north, and east (a.k.a. Hans Bietsch Beach) sides of the lake for Association members. See Figure A-3 for a map of locations of important Lake Wyola landmarks.

[5] According to the Massachusetts Water Quality Standards, the Class B waters are designed as habitat for fish, other aquatic life, and wildlife, and for primary and secondary recreation. Class B waters shall be suitable for irrigation and other agricultural uses and for compatible industrial cooling and process uses. These waters shall have consistently good aesthetic value.

[6] MassWildlife 2016

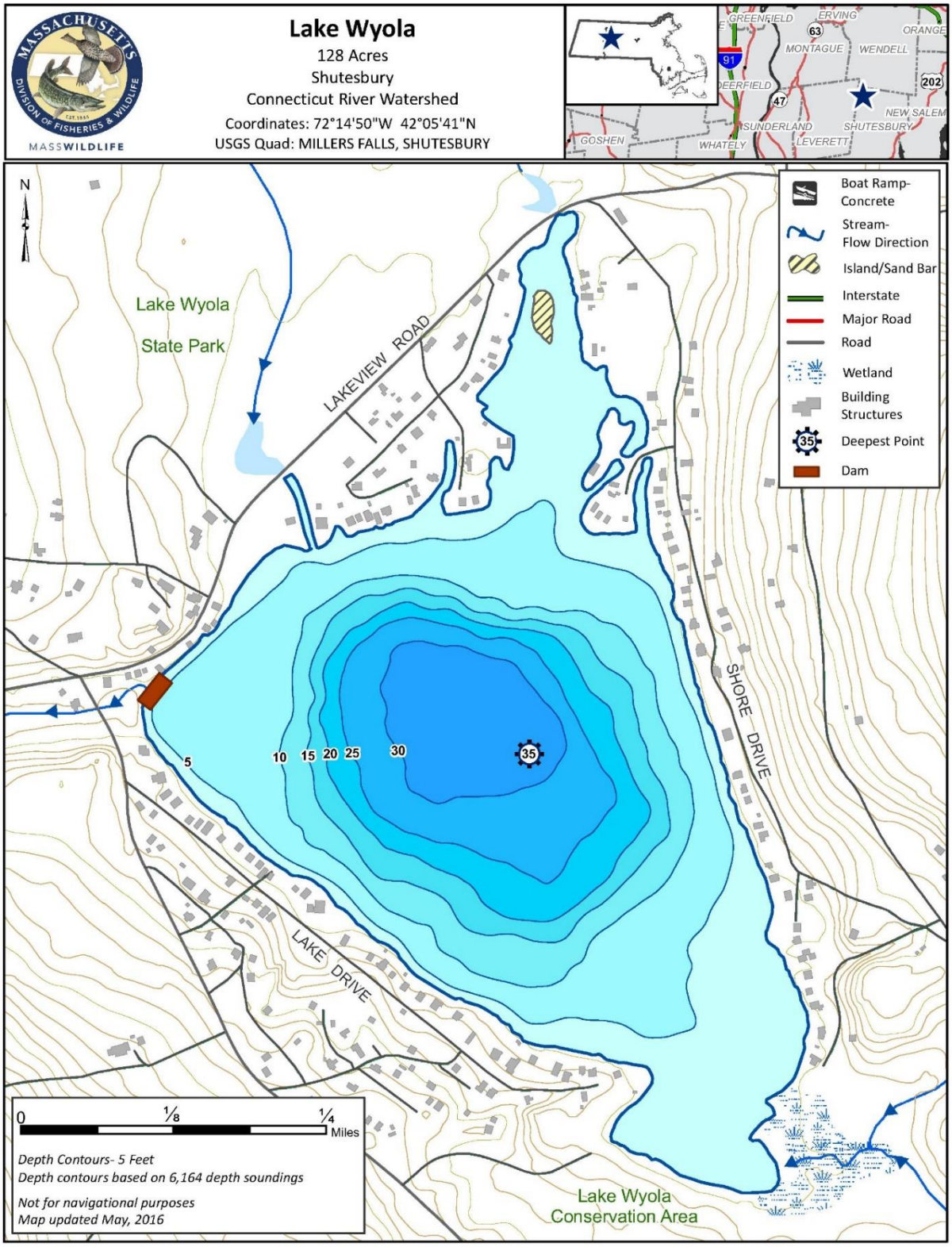

Figure A-2: Lake Wyola Bathometry Map

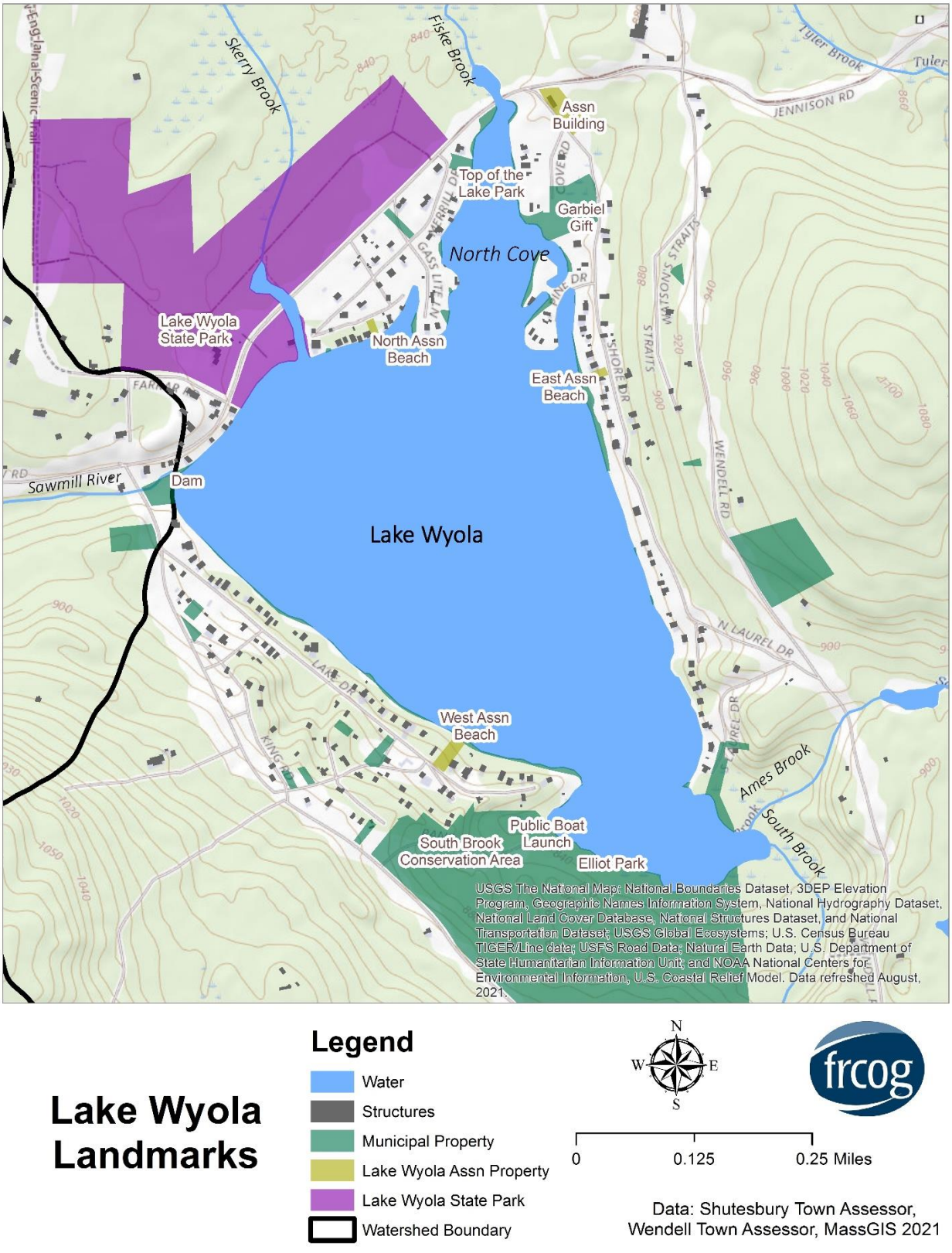

Figure A-3: Lake Wyola Water and Landmarks

The southern half of the watershed is in Shutesbury and the northern half is in Wendell. The lake itself sits just south of the Wendell Town boundary. Medium- and high-density development of year-round homes and summer cottages comprises 80 percent of the shoreline.[7] Beyond the lake's shoreline neighborhoods, the watershed is rural and heavily forested, crossed by a few rural roads and roadside residential development. Approximately 37.6 percent of the watershed land is permanently protected. One state-owned and three Town-owned riverfront properties comprise approximately 140 acres of permanently protected land adjacent to the shore. A high percentage of the wetlands in the watershed are also permanently protected.

Numerous streams and five wetlands drain into Lake Wyola. Skerry Brook discharges into Lake Wyola from the northwest through the Lake Wyola State Park Recreation Area. Fiske Brook feeds Fiske Pond from the north and discharges into the North Cove of Lake Wyola. Just upstream where Fiske Brook enters Lake Wyola, emergent and scrub-shrub wetland vegetation is present. From the Shutesbury portion of the watershed, Ames Pond drains from the east via a small brook into the lake's South Cove. South Brook drains to the same location from Footit's Bog to the southeast. Lake Wyola discharges at the Lake Wyola Dam into the Sawmill River (MA34-40). See Figure A-3 for important waterbodies and waterways in the watershed.

The lake's water level is controlled by a manually activated dam capable of drawing down the lake as much as eight feet. A two-foot drawdown occurs every November 1st – April 1st to protect the shoreline and shoreline infrastructure from ice damage, as well as to inspect the dam. Lake-level drawdown has the added benefit of controlling weeds. The Lake Wyola Advisory Committee also cooperates with the Conservation Commission on a timeline for the lowering of the lake that allows wildlife to move to safety.[8] In the past, ending sometime in the 1990s, the lake level was drawn down the full eight feet and residents regularly used the opportunity to dredge their shoreline areas with shovels or backhoes.

Topography, soils, and rare species presence may pose only minor limitations to BMP selection. Shallow depth to bedrock is present along the middle section of the lake's east side, from Ames Hill down to North Laurel and Shore Drives. Soils around the lake are typically loamy sands or sandy loams, well draining, and with a depth to groundwater of nine feet or greater everywhere except the south end of the lake where it is undeveloped and permanently protected. Lake Wyola and many of the other ponds in the watershed are identified as Natural Heritage and Endangered Species Program (NHESP) Priority Habitat of rare species. Those habitat areas are delineated by a small buffer around the water's edge and surrounding wetlands.[9]

Paved roads within the watershed are minimal, taking the form of a handful of two-lane Town-owned roads. The majority of roads in close proximity to Lake Wyola are 1.5-lane roads surfaced with gravel, or in many cases, material with a high content of sand and fine-grained aggregate. Drainage infrastructure within close proximity to the lake is largely nonexistent, with stormwater mostly reaching the lake through pipes or a series of informally constructed swales. The stormwater and erosion control improvements constructed within and around the Lake Wyola State Park with funding from the 2000 s.319 grant were observed by the consulting engineers CEI for this WBP and were deemed to be in good condition and functioning properly.[10]

[7] MassWildlife 2016; see also Figure A-10: Watershed Land Use Map
[8] Town of Shutesbury 2022
[9] MassGIS 2021
[10] CEI 2022

Description of the Problem

Lake Wyola is listed as a Category 4A water for total phosphorus (TP) and nutrient/eutrophication biological indicators based on data collected by DEP in the summer of 1994.[11,12] Documentation from MassDEP shows, however, that the data serving as the basis for the listing was inaccurate and Lake Wyola has never had phosphorus readings to suggest that it is impaired for phosphorus. The nutrient/eutrophication biological indicators impairment appears to be based on the same 1994 data and assessment, which reported very dense growths of aquatic macrophytes (primarily *Utricularia* sp.) in the north and south ends of the lake. There have been no recent studies of eutrophication biological indicators that would indicate the status of this impairment.

According to the final 2001 *Total Maximum Daily Loads of Phosphorus for Selected Connecticut Basin Lakes*, the following public comment was given at an October 9, 2001 public meeting or a subsequent public meeting: "**Comment**: Volunteer monitoring[13] indicates TP in single digit ppb [parts per billion, or 1 mg/L] range. This lake should not be on TMDL list; it is a good quality temperate lake." The DEP responded in the final draft of the TMDL with the following comment and decision:

> **Response:** The Department agrees that the lake has very low TP and should not be listed for nutrients. Earlier total phosphorus measurements by the Department were biased high due to a high detection limit at the laboratory. The lake also has a balanced plant community that is not causing nuisance conditions. In addition, the low dissolved oxygen in the hypolimnion is typical of temperate lakes in the region and should not be viewed as an impairment on the 303d list. We will recommend that it be removed from the next 303d list. Even if removed from the 303d list, this TMDL for phosphorus will continue to be in effect as a protective TMDL to ensure maintenance of good water quality in the lake.[14]

In acknowledgement of the listing error, a "preventative" TMDL for phosphorus was completed for the lake. The TMDL establishes 0.015 mg/L as the total phosphorus criteria. The preventative TMDL acknowledges that water quality was for the most part good, but it acknowledges that development occurring around the lake increases the need for stormwater BMPs that are selected to maximize phosphorus removal and the need to have regular phosphorus testing done. Erosion and runoff are the main ways phosphorus is transported to surface waters because phosphorus attaches to soil and sediment particles. Anecdotal evidence of an uptick of sediment accumulation in the lake is reason to be aware that phosphorus levels could become a concern.

Community Concerns

The Shutesbury community values Lake Wyola for its beauty, for its importance as an ecosystem, and for the recreation opportunities it provides. Although Lake Wyola is not listed for sediment, there is visual indication and copious anecdotal evidence that sediment loading to the lake is high and this is of great concern to the lakeside and greater communities. Community members have observed that stormwater runoff via surface flow and culverts appears to be transporting sediment.[15] Residents regularly see strong stormwater flow wash out unpaved roads in lakeside neighborhoods, especially on the west and east sides of the lake. Many of these lakeside roads are constructed with a mix of sand and gravel and are privately owned by the LWA or by a private resident, and all repairs and maintenance (besides plowing and sanding) repairs are funded by the LWA.

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[11] Category 4A waters are impaired for one or more designated uses but do not require the development of a TMDL because the TMDL has been completed.
[12] MassDEP 2002
[13] A source of the volunteer monitoring data is not given in the TMDL
[14] MassDEP 2002
[15] Town of Shutesbury 2022

Sediment also appears to be entering the lake from Fiske Brook via the part of the lake called North Cove. The process of sedimentation has been conspicuous to lakeside landowners since the late 1990s.[16] In the process of developing this WBP for Lake Wyola, a representative of LWAC identified the restoration of the lake's North Cove to historical depths as a goal for the watershed, citing that many Lake Wyola-area residents and people who use the lake dislike the aesthetic and recreational conditions created by sedimentation in the cove. In 2018, Community Preservation Act funds were allocated to the "Lake Wyola Silt Removal" project for the creation of a "comprehensive plan for removal of accumulated silt in the North Cove of Lake Wyola and restoration of Cove to historical depths." The project has not yet been implemented because it was identified that the scope of the project should include a system that settles sediment in the wetland upstream of the Lakeview Road culvert, so as to minimize sedimentation in North Cove in the future. The proposal of a dredging project illustrates the degree of concern about and support for addressing sedimentation in the lake.

The 2019 Lake Wyola Wildlife Habitat Assessment noted an absence of freshwater mussels and clams during the 2019 site visits, which would be expected to be present in the lake.[17] The report hypothesized that the timing, depth, and rate of historic drawdown practice may have had an adverse (fatal) effect on the freshwater mollusk population due to their low mobility. The report recommends a water monitoring protocol to further assess the impact of annual dam drawdown.

Summary of Completed and Ongoing Work

This WBP for Lake Wyola builds on 25 years of assessment, planning, and BMP implementation to protect and improve water quality in Lake Wyola.

1997 Management Plan for Lake Wyola

A lake management plan was completed in 1997.[18] The four primary management concerns identified in the plan included the draw down practice and lake level, aquatic vegetation, sediment, and bank stability. The plan identified sediment loading from road management, shoreline erosion, soil erosion on private property, and lack of riparian buffers as major sources of sediment in the lake. Table A-2 lists recommendations from this plan and their completion status.

2002 TMDL and 2000 Lake Wyola TMDL Implementation Project

In 2002, a Total Maximum Daily Load (TMDL) for phosphorus was completed for Lake Wyola as part of the TMDL of phosphorus for selected Connecticut Basin Lakes. The details of the TMDL can be found in the General Watershed Information section and the MassDEP Water Quality Assessment Report and TMDL Review section. Table A-2 lists the phosphorus and bacteria management recommendations that accompanied the TMDL report and their completion status.

In 2000, the Department of Environmental Management (DEM)[19] was awarded an s.319 implementation grant to address phosphorus loading in the watershed (00-16/319). Focused on dense residential land use and septic systems, the grant funded the installation of a number of BMPs on Lakeview Road and at the Lake Wyola State Park public beach, and facilitated multiple residential BMP installation and education projects throughout the Lake Wyola area. Although the neighborhood west of the lake (e.g., Locks Pond Road, Great Pines Drive, and

[16] NRCS 2005
[17] Stockman Associates, LLC 2019.
[18] New England Environmental 1997
[19] Now the Department of Conservation and Recreation (DCR)

Lake Drive) was identified as a potential focus area for BMPs, the DEM decided to focus on improvements in the state and town beach areas instead. The improvements were completed in 2003.

2005 Lake Wyola Inventory and Evaluation, Shutesbury, MA

In 2005, the Natural Resources Conservation Service (NRCS) prepared a report titled *Lake Wyola Inventory and Evaluation, Shutesbury, MA* that identified road sand along Lakeview Drive and erosion from Fiske Brook and Fiske Pond due to beaver activity and hurricanes as the likely sources of sedimentation of the lake's North Cove. As of 2005, sediment had accumulated up to four feet over the cove's estimated baseline. Table A-2 lists recommendations from this plan and their completion status.

2007 Locks Pond Road and Lake Wyola Subwatershed Stormwater Improvement Study, Shutesbury Massachusetts

In January 2007, Department of Conservation and Recreation (DCR) engineer Scott Campbell evaluated stormwater issues on the western side of the lake stemming from surface runoff from the eastern and northeastern slopes of Morse Hill. Uncontrolled stormwater from Morse Hill was flowing over Locks Pond Road and impacting the adjacent residential area, LWA-owned roads in the residential area, and the lake itself. The report proposed specific best management practices along roads and at residences, with diagrams of proposed locations. The 2022 Shutesbury Open Space and Recreation Plan states that these specific measures have proved challenging to implement because they "require regular maintenance to remain effective, some require acquisition of easements on undeveloped private land in order to construct some of the stormwater management structures, and all would require homeowner understanding of the structures' proper functioning."[20] The plan also cites funding as a constraint. Table A-2 lists recommendations from this plan and their completion status.

2019 Wildlife Habitat Evaluation Report, Lake Wyola, Shutesbury, MA

As part of the issuing of the most recent permit for the annual dam-controlled drawdown of the Lake Wyola water level, the Conservation Commission requested a Detailed Wildlife Habitat Evaluation under their authority granted by the Wetlands Protection Act (310 CMR 10.60). In 2019, Stockman Associates, LLC performed a wildlife habitat evaluation that included a Conceptual Wildlife Habitat Assessment Plan depicting potential impact areas and an Adverse Effects Analysis and guidance on how to improve the drawdown procedure to protect wildlife.

Ongoing Lake Wyola Association Road Maintenance

The Town of Shutesbury plows all roads, but the LWA and private residents are responsible for road maintenance around the lake on all private roads, which are owned by the LWA and in the case of North and South Laurel Roads, a single individual who lives out-of-state. LWA plans several large road maintenance or repair projects per year as needed after a spring review of all road conditions, including winter damage. Projects are conducted after review and prioritization by the LWA Board of Directors. The contractor who currently does much of the heavy-duty work on the roads also plows LWA roads. The road budget is about one third of LWA's total budget. Membership in the LWA is voluntary, with about half of residents in the lake area paying dues, so membership dues do not necessarily represent a significant or reliable funding source. More funds are spent on roads than in the past, but not enough funds are available for comprehensive work. There are piles of gravel situated around the lake for use by residents to maintain their ditches and repair potholes. Residents are also

[20] Town of Shutesbury 2022

encouraged to participate in a fall Road Work Day to prepare roads for winter. Recent road BMPs installed by the LWA or residents in the last five years includes:

- Installation/repair of a rock-lined ditch, driveway culvert, and settling basin along Pine Drive.
- Installation of a rock-lined ditch and multiple level catchment areas/settling basins along North Laurel Drive.
- Installation of two broad-based ditches and turnouts, with additional turnouts, on South Laurel Drive.
- Turnouts along Great Pines Drive
- A rock-lined ditch along Great Pines Drive leading to a waterbar across Shore Road, leading to a
- Removal of sediment from ditches, turnouts, and catchments/settling basins

Table A-2: Lake Wyola Proposed Nonpoint Source Pollution Mitigation Projects and Completion Status

LOCATION	NPS ISSUE	PROPOSED PROJECT	COMPLETION STATUS
1997 Management Plan for Lake Wyola LWAC, Town of Shutesbury, New England Environmental, Inc.			
Public boat ramp access road and parking area on Randall Road	Silt/sediment	Dredging	Unknown.
		Siltation barriers	Not completed.
		Regrade and pave parking lot	Completed.
		Install drainage swale or detention basin	Completed: road runoff directed to a swale and detention basin.
Inlet at Fiske Brook	Silt/sediment from a) Fiske Brook, (although this report notes that it is probably normal levels and not the result of erosion) and b) winter sands washing in from Lakeview Road	20-year dredging schedule of North Cove	Dredging schedule not implemented.
		Shallow underwater berm across the inlet of Fiske Brook (south of Riverview Road) with sediment basin	Not completed.
		Installation of catch basins with deep sumps (4') at the intersection of Lakeview Road and Fiske Brook	Not completed, as approval was too complicated. Catch basins with deep sumps installed at Farrar Road intersection instead.
Lake Wyola State Park Beach	Silt/sediment	Pervious pavers in driveways	Not completed; however, DCR installed a detention basin to control stormwater runoff at the beach.
Elliot Park (beach) (formerly Town Beach)	Silt/sediment	Construction of a small retaining wall to slow the flow of sand from the beach into lake	Unknown, however the beach is no longer used as a beach and is vegetated to the lake's edge.
	Nutrients	Toilets	Completed; composting Clivus toilets installed.
Various sources of sediment and erosion from roads and houses	Silt/sediment	Road sweeping	Ongoing.
		Water bar maintenance on dirt roads	Ongoing; inconsistent.
		Public education	Some public education completed as part of 2003 319 grant deliverables.

LOCATION	NPS ISSUE	PROPOSED PROJECT	COMPLETION STATUS
Various areas	Bank erosion from a) cutting of vegetation on banks, b) boat wakes, and c) prevailing winds		As of 2003, the boating speed limit on Lake Wyola is 30 mph during the day and 5 mph 150 feet from the shore and at night.
2002 Connecticut River Lakes Phosphorus TMDL MassDEP			
Lakewide	Phosphorus	Public education	Some public education completed as part of 2003 319 grant deliverables.
		NPS survey	NPS survey completed as part of 2003 319 grant deliverables.
		Lake Management Plan	Lake Wyola had an existing LMP from 1997.
		Forest BMPs	Not completed.
		Residential BMPs	Three residential BMP demonstration sites completed as part of 2003 319 grant deliverables.
		Septic System Maintenance	Systems that are failing or are associated with home renovations are upgraded and replaced with tight-tanks and/or on-site processing systems.
		In-Lake Management	Unknown.
	Bacteria from waterfowl	Prevent feeding of wildfowl	Waterfowl managed starting in the 2010s through a contract with the USDA, management is believed to be ongoing.

LOCATION	NPS ISSUE	PROPOSED PROJECT	COMPLETION STATUS
2005 Lake Wyola Inventory and Evaluation, Shutesbury, Massachusetts NRCS			
North Cove and below Lakeview Road	Sediment accumulation in lake from beaver activity in upstream ponds and brooks and from several recent storm events, including microburst in early 2000s, Hurricane Bertha in 1997, Hurricane Floyd in 1999, and annual spring runoff events.	Periodically inspect and remove accumulated debris at spillway outlet structures at Fiske Pond, McAvoy Pond, and Tyler Pond.	Partially completed. A beaver deceiver was installed several years ago at McAvoy Pond dam, which has for the most part mitigated beaver debris on the spillway and is cleared of debris one to three times per year.
		Inspect spillway to ensure water is not flowing around the ends of the spillway and eroding the abutment.	Inspections are completed on a regular basis on McAvoy Dam. In 2018, several trees were removed to improve the embankments of the dam, and there is a plan to add more rip rap to prevent slope erosion on the pond side of the dam.
		Install streambank and channel protection measures along the eroded outlet channel below the spillway outlet structure at Fiske Pond.	Not completed.
		Conduct hydraulic analysis of Fiske Pond Dam to evaluate the capacity of the spillway and the safety of the dam from overtopping.	Not completed.
		Install log boom structure upstream of the spillway to prevent the debris dams at the spillway of Fiske Pond and McAvoy Pond.	Beaver deceiver currently seems to adequately prevent accumulation of debris on the spillway.
		Install beaver control measures at the active beaver areas downstream on Fiske Brook.	Not completed.
Lakeview Road and bridge, Locks Pond Road, Shore Drive, Pine Drive, other dirt roads around the lake	Runoff from road sand and salt; street sweeping doesn't capture it all	Minimize amount of sand applied to the road around Lake Wyola during winter months.	Unknown.
		Develop regular road sweeping program for cleaning in the spring and during the summer and fall, as needed; remove excess accumulations of sand along the shoulders of Lakeview Road.	Ongoing.

LOCATION	NPS ISSUE	PROPOSED PROJECT	COMPLETION STATUS
		Install curbs or berms along the edges of the roads to direct the road runoff into constructed sediment basins, which can be periodically cleaned out.	Partially completed. Some berms have been installed on Lake Drive that have caused runoff to be a problem down the hill, as there is no provision to deal with the runoff. The Conservation Commission is currently discouraging berms.
Lake community	Sediment from landowners adding sand to their beaches	Minimize the amount of sand used for beach replenishment around the lake.	Completed; sand is only added at Lake Wyola State Park beach.
Lakewide	Bank erosion	Install vegetative and/or structural shoreline protection measures along exposed and eroding shoreline areas to control wave action from boats and reduce the amount of sand washing into the lake.	One demonstration site completed as part of 2003 319 grant deliverables. Bank erosion is reportedly minimal at present. The Conservation Commission strongly encourages a vegetated buffer strip at the lake edge when site work is done on a property under an RDA or NOI and, on a case-by-case basis, may require it
2007 Locks Pond Road and Lake Wyola Subwatershed Stormwater Improvement Study, Shutesbury, Massachusetts Scott Campbell, DCR			
Locks Pond Road and lake's western neighborhood	**Locks Pond Road Stormwater Controls** Runoff carried by and across Locks Pond Road is funneled and concentrated by a series of makeshift berms constructed by residents on the east side of the	Regulations that require driveway runoff to be directed away from travel lanes of principal roads and into roadside ditches.	Issue has changed, as Locks Pond Road now has a better crown and much of the runoff collected on the west side of the road is now ditched and funneled under Locks Pond Road by a series of culverts, rather than across the road. Erosion of private driveways is still an issue.
		Non-erosive asphalt berm along Locks Pond Road that sends outfall down a paved chute or rock-lined splash pad into vegetated roadside areas.	Runoff on west side is directed into into ditches leading to culverts. Where drainage comes off Locks Pond Road on east side, (i.e. through culverts or turnouts) there are no paved chutes or rock lined splash pads.
		Regularly inspect and maintain the small water bars across the LWA's gravel roads.	Occasional inspections completed.

LOCATION	NPS ISSUE	PROPOSED PROJECT	COMPLETION STATUS
	road; pitch of driveways on the west side of Locks Pond Road funnel water directly onto and across the road.	Develop bioretention areas in small tracts of undeveloped land at the intersection of King Road and Great Pines Road.	Not completed. Small turnout is present.
Two subwatershed areas for Lake Wyola bisected by Locks Pond Road	**Locks Pond Road Stormwater Diversion** Catchment A drains 58 acres via two 18" culverts (perennial and intermittent streams) and a 12" culvert pipe (seasonal flow). Catchment B drains 39 acres via an earthen ditch 5' wide and 8" deep, transitions into two 12" culvert pipes that funnel water across Locks Pond Road above and below the King Road intersection.	Proposal to redirect flow off Morse Hill to Sawmill must establish controls on frequently occurring storms to limit peak flows and quantities (detain for up to 12 to 24 hours the quantity of runoff produced from 2-yr-storm or 3" rainfall). An area of privately held land located above the lower 12-inch culvert pipe is presently undeveloped and has suitable slope and land area to accommodate a small basin; acquiring an easement to construct and maintain a basin on this property would also prove beneficial by settling out suspended solids largely introduced during wintertime road maintenance activities.	Not completed
		Existing earth-lined roadside ditch on west side of Locks Pond Road is not of sufficient size or lined with appropriate cover to receive increased flows. Increase width and armor; this will require reconstruction of driveway culverts to fit the new channel.	Completed in sections.

LOCATION	NPS ISSUE	PROPOSED PROJECT	COMPLETION STATUS
Rooftops/driveways	Stormwater from residences quickly funneled into roads; roads only slightly crowned and lacking roadside ditches.	Generally: exaggerate crown of road, pitch road towards one side, or intercept water inside roadside ditches.	Some LWA roads have been crowned.
		Lake Drive: exaggerate crown; install small ditch on west side of road.	Crowned and a section of ditch established in 2021.
		Capture roof water runoff.	Not widely installed.
		Use pervious pavers in driveways.	Not widely installed.
Intersection of Great Pines Drive and Lake Drive	Stormwater carried by Great Pines Drive is washing out the road as a meandering ditch is forming that carves across Great Pines and spills across Lake Drive before cascading down to the LWA Beach.	Install stone-lined ditches where road is presently washing out.	Some ditches along Great Pines drive are stone-lined.
		Increase crown of road to 9 inches.	Great Pines Drive crowned in 2021 to improve drainage at Kings Road and Lake Drive intersections.
		Install 12-inch cross culverts at the intersection with King Road.	Not completed.
		Place a sunken infiltrating catch basin structure.	Not completed.
		Install riprap plunge pool and leaching catch basin.	Detention basin installed on LWA beach off Lake Drive. No leaching catch basin installed.
2003 319 Grant DEM			
Watershed	Sheet flow from Farrar Road collected by two standard catch basins at the intersection with Lakeview Road; catch basins are	Replace catch basins with deep sump catch basins.	Completed.
		Install vegetated water quality swale along 300' of north shoulder of the road with two turnouts	Completed.
		Operation and Maintenance Plan for catch basins and swale.	There is no operation and maintenance plan in place with the LWA.

LOCATION	NPS ISSUE	PROPOSED PROJECT	COMPLETION STATUS
	piped to discharge onto a grassed picnic area on DEM property that flows directly into the lake. North shoulder of the road is eroded from runoff and consists of unvegetated soils. Catch basins are clogged and during high flow, runoff flows along the side of the road and carries sediment directly to the lake.		
Lake community	General issues; phosphorus	Install up to six demonstration residential LID retrofits around the lake and throughout watershed.	Three residential BMP demonstration sites completed.
		Tour of demonstration homes	Completed.
		Voluntary lawn audit of up to 10 homes	Unknown.
		Flyer of watershed and BMP information	Completed.
		Three workshops on BMPs	Unknown.

LOCATION	NPS ISSUE	PROPOSED PROJECT	COMPLETION STATUS
		Lake Wyola 319 project survey to determine level of knowledge and awareness of watershed and NPS issues before and after the project.	Completed.
	Bacteria	Develop a comprehensive watershed program for inspecting and managing septic systems (quarter time Shutesbury employee to run an inspection and maintenance program). Program includes a brochure.	According to the Board of Health, systems that are failing or are associated with home renovations are upgraded and replaced with tight-tanks and/or on-site processing systems.

Watershed-Based Plan Development

Project Partners and Stakeholder Input

This WBP was developed by the Franklin Regional Council of Governments (FRCOG) with input and collaboration from the Town of Shutesbury, LWAC, Shutesbury Conservation Commission and MassDEP and with technical assistance from Comprehensive Environmental, Inc. (CEI). This WBP was developed using funds from the Section 319 program to assist grantees in developing technically robust WBPs using MassDEP's Watershed-Based Planning Tool. The FRCOG was the recipient of Section 319 funding in Fiscal Year 2020 to serve as the Regional Nonpoint Source Coordinator for Franklin County for the purpose of developing competitive s.319 Nonpoint Source Pollution grant proposals.

Core project stakeholders and their points of contact include:

- Town of Shutesbury
    - Becky Torres, *Town Administrator*
    - Tim Hunting, *Highway Superintendent*
- Lake Wyola Advisory Committee
    - Mark Rivers, *Chair*
- Shutesbury Conservation Commission
    - Miriam DeFant, *Chair*
- MassDEP:
    - Padmini Das, *Nonpoint Source Pollution Section Chief*
    - Malcolm Harper, *319 Grant Program Manager*
    - Judith Rondeau, *Nonpoint Source Pollution Watershed Specialist and Outreach Coordinator*
    - Meghan Selby, *604b Grant Program Manager*
    - Matthew Reardon, *TMDL Program Manager*

While the FRCOG worked with the aforementioned core stakeholders on the drafting of the plan, the FRCOG engaged a broad range of stakeholders during the public review period, including Shutesbury residents, members of the LWA, DCR, and the Wendell Conservation Commission, who owns large parcels in the upper watershed. The Town will want to continue broader outreach and input into the plan and implementation in the future to ensure the support of public and private landowners.

This WBP was developed as part of an iterative process. An initial meeting was held with a representative of the Lake Wyola Advisory Committee in December of 2021. The FRCOG team then collected and reviewed existing data on the watershed to develop a preliminary WBP. In January 2022, FRCOG staff completed a walking and driving tour of the watershed (hereafter referred to as the FRCOG's *Nonpoint Source Field Assessment of the Lake Wyola Watershed*) with the chair of LWAC and a Selectboard member. The areas of concern identified in FRCOG's field assessment were shared with consultant Comprehensive Engineering, Inc., who in April 2022 completed a field inspection of the priority areas with the chair of LWAC. A completed first draft of the WBP was shared with the Conservation Commission and Lake Wyola Advisory Committee for their feedback. A revised public review draft was shared with the community, including the LWA, Wendell Conservation Commission, and DCR in June 2023 to solicit feedback on elements of the plan such as water quality goals, best management practice (BMP) priority implementation locations, and public outreach. On August 12, 2023, two FRCOG staff led

a two and a half hour field walk with the public attended by 21 Shutesbury residents. No attendance was taken for this event. However, FRCOG staff noted that at least one member of the Select Board, one member of the Conservation Commission, and multiple members of the Lake Wyola Association Roads and Buildings Committee were present. A large number of attendees were members of the Lake Wyola Association. FRCOG continued to receive and incorporate public comment after this event through the end of August.

Water Quality Monitoring and NPS Pollution Source Area Data Sources

This WBP was developed using the framework and data sources provided by MassDEP's WBP Tool and supplemented by data from additional studies and a watershed field investigation. The 2000 Lake Wyola s.319 Project (00-16/319) Final Report was not available from the DEP, DCR, or the consultant who worked on the project. Sources reviewed included:

- CEI (Comprehensive Environmental Inc.). *Stormwater Improvement Opportunities – Lake Wyola Watershed Technical Memorandum*. May 10, 2022.

  This report was created to support the Lake Wyola WBP and is included in Appendix B.

- FRCOG (Franklin Regional Council of Governments). *Nonpoint Source Field Assessment of the Lake Wyola Watershed.* January 28, 2022.

  This report was created to support the Lake Wyola WBP and is included in Appendix C.

- MassDEP (Massachusetts Department of Environmental Protection). *Underground Storage Tank Facility Search database*. Last accessed 1/4/2021. https://ma-ust.windsorcloud.com/ust/facility/search?1

- MassDEP (Massachusetts Department of Environmental Protection). 2002. *Total Maximum Daily Loads of Phosphorus for Selected Connecticut Basin Lakes*. DEP, DWM TMDL Report MA34002-2001-4. https://www.mass.gov/doc/final-tmdls-of-phosphorus-for-selected-connecticut-basin-lakes/download

- New England Environmental, Inc. 1997. *Management Plan for Lake Wyola Shutesbury, MA*. Prepared for the Lake Wyola Advisory Committee and the Town of Shutesbury. https://www.shutesbury.org/sites/default/files/offices_committees/lwac/Management%20Plan%20for%20Lake%20Wyola_1997.pdf

- NRCS (Natural Resources Conservation Service). 2005. *Lake Wyola Inventory and Evaluation, Shutesbury, MA.* https://www.shutesbury.org/sites/default/files/offices_committees/lwac/Lake%20Wyola%20Inventory%20and%20Evaluation_2005.pdf

- Campbell, S. 2007. *Locks Pond Road and Lake Wyola Subwatershed Stormwater Improvement Study, Shutesbury, Massachusetts*. Massachusetts Department of Conservation and Recreation, Division of Water Supply Protection Draft Report.

https://www.shutesbury.org/sites/default/files/offices_committees/lwac/Stormwater%20Improvement%20Study_2007.pdf

- University of Massachusetts Amherst lab reports (hardcopy) covering the years 2000, 2001, 2002, 2005. Provided by the Shutesbury Board of Health.

- University of Massachusetts Amherst Environmental Analysis Lab. 2014. “Lake Wyola Analytical Report.” Data collected by Mark Rivers, Lake Wyola Association. www.wrrceal.com.

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).

Water Quality Impairments

Known water quality impairments, as documented in the MassDEP 2022 Massachusetts Integrated List of Waters, are listed below. Impairment categories from the Integrated List are as follows: [21]

Table A-3: 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.

Table A-4: Water Quality Impairments

Assessment Unit ID	Waterbody	Integrated List Category	Designated Use	Impairment Cause	Impairment Source
MA34103	Lake Wyola	4A	Fish, other Aquatic Life and Wildlife	Nutrient/Eutrophication Biological Indicators	Internal Nutrient Recycling
MA34103	Lake Wyola	4A	Fish, other Aquatic Life and Wildlife	Nutrient/Eutrophication Biological Indicators	Source Unknown
MA34103	Lake Wyola	4A	Fish, other Aquatic Life and Wildlife	Phosphorus, Total	Internal Nutrient Recycling
MA34103	Lake Wyola	4A	Fish, other Aquatic Life and Wildlife	Phosphorus, Total	Source Unknown

[21] MassDEP 2022b

Water Quality Goals

A water quality goal is a quantitative or qualitative target pollution level in a water body. 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[22] (also known as the "Gold Book"). The Gold Book states that TP should not exceed 50 µg/L in any stream at the point where it enters any lake or reservoir, nor 25 µg/L within a lake or reservoir. For the purposes of developing WBPs, MassDEP has adopted 50 µg/L as the TP target for all streams at their downstream discharge point, regardless of which type of water body the stream discharges to.

c.) Massachusetts Surface Water Quality Standards (314 CMR 4.00, 2024) prescribe the minimum water quality criteria required to sustain a waterbody's designated uses. Lake Wyola is a Class 'B' waterbody (see Tables A-5 and A-6). The water quality goal for fecal coliform bacteria is based on the Massachusetts Surface Water Quality Standards.

Table A-5: Surface Water Quality Classification by Assessment Unit

Assessment Unit ID	Waterbody	Class
MA34103	Lake Wyola	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.).

Table A-6: Water Quality Goals

Pollutant	Goal	Source
Total Phosphorus (TP)	0.015 mg/L (15 µg/L)	Total Maximum Daily Loads of Phosphorus

[22] USEPA 1986

Pollutant	Goal	Source
		for Selected Connecticut Basin Lakes
Total Suspended Solids (TSS)	**Class B Standard** These waters shall be free from floating, suspended and settleable solids in concentrations and combinations that would impair anyuse assigned to this Class, that would cause aesthetically objectionable conditions, or that would impair the benthic biota or degrade the chemical composition of the bottom.	Massachusetts Surface Water Quality Standards (314 CMR 4.00, 2024)

MassDEP Water Quality Assessment Report and TMDL Review

A Water Quality Assessment Report is a detailed report on the condition of a watershed that assesses watershed conditions, perceived problems, and provides recommendations for each MassDEP-defined stream segment of a watershed. The section below summarizes the findings of the Connecticut River Watershed 2003 Water Quality Assessment Report and the Total Maximum Daily Loads of Phosphorus for Selected Connecticut Basin Lakes that relate to water quality and water quality impairments. Select excerpts from this document relating to the water quality in the watershed are included below (note: relevant information is included directly from these documents for informational purposes and has not been modified).

Connecticut River Watershed 2003 Water Quality Assessment Report (MA34103 - Lake Wyola)
PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS USES There are two beaches along the shoreline of Lake Wyola: Lake Wyola State Park Beach and a town beach.[23] No recent data are available for Lake Wyola, thus all uses are not assessed. **CONNECTICUT RIVER WATERSHED – LAKE SEGMENTS ASSESSED** Currently there is uncertainty associated with the accurate reporting of freshwater beach closure information to MA DPH, which is required as part of the Beaches Bill. Therefore, no Primary Contact Recreational Use assessments (either support or impairment) decisions are being made using Beaches Bill data for these waterbodies. Bathing beaches located in this watershed are listed in their respective lake segments. **Report Recommendations:** Conduct water quality monitoring to evaluate designated uses, particularly bacteria monitoring to assess the Primary and Secondary Contact Recreation uses observed in Lake Wyola.

[23] The swimming beaches as of 2022 are the State Park beach and Lake Association beaches. The former Town Beach is now Elliot Park and is still used as a beach.

Lake Wyola is a Category 4A water. Lake Wyola has a completed "preventative" phosphorus TMDL that sets the TP limit at 0.015 mg/L.[24] The TMDL was changed to "preventative" status in the final draft of the report when the DEP agreed that the listing was based on flawed measurements.[25]

Total Maximum Daily Loads of Phosphorus for Selected Connecticut Basin Lakes (MA34103 - Lake Wyola)

Lake Wyola in Shutesbury is a large lake of approximately 129 acres. The area of the original natural lake was approximately doubled as a result of a dam created a century ago. The watershed is 86 percent forested, 6 percent water and wetlands, 6 percent rural and the remainder consists of urban (high density residential) land use. Populations in Shutesbury ranged between 1,049 and 1,561 from 1980 to the 1990 census. Miser predictions on growth are 2,179 for the year 2000 and 2,937 for the year 2010 with an estimated 20-year growth rate of about 88 percent. With such a high population growth rate, and presumably changes in land use, the current loading of phosphorus is probably higher than reported here; however, the target and the TMDL to protect water quality will remain the same. Secchi disk transparency was recorded at 4.2 m in a DEP baseline survey in 1988. Lake Wyola was assessed by DEP in the summer of 1994 and the assessment comments reported: "Moderate total phosphorus levels, oxygen depletion from 6 to 10 meters (< 1 mg./l below 8 meters), and very dense growths of aquatic macrophytes (primarily Utricularia sp.) occur on the north and south ends of the lake." However, recent citizen volunteer data indicate total phosphorus levels are very low, averaging less than 10 ppb with Secchi disk transparency ranging between 4 and 5 meters during July and August with one anomalous reading of 1 m in June. A management plan was developed to address four issues 1) occasional lake drawdown for maintenance of dam and lakeshore areas 2) aquatic vegetation control 3) sediment removal and control and 4) bank stabilization.

The pollutant stressors reported on the 1998 303d list which are related to this phosphorus TMDL are listed in the table below.

Table 1. Pollutant Stressors listed on 1998 303d list.

WBID	Lake Name	Town	Area	303d list pollutant/stressor
MA34002	Aldrich Lake East	Granby	18.5	Noxious plants
MA34106	Aldrich Lake West	Granby	10.7	Noxious plants
MA34042	Leverett Pond	Leverett	65	Noxious plants;Turbidity
MA34045	Loon Pond	Springfield	25.4	Nutrients;Noxious plants
MA34098	Lake Warner	Hadley	68	Nutrients; Low DO;Noxious plants;Turbidity
MA34103	Lake Wyola	Shutesbury	129	Nutrients; Low DO;Noxious plants

Unfortunately, no detailed study of the nutrient sources within the watersheds has been conducted to date. Thus, nutrient sources were estimated based on land use modeling within the DEP's NPSLAKE model. The NPSLAKE model of Mattson and Isaac (1999) was designed to estimate watershed loading rates of phosphorus to lakes. The phosphorus loading estimates from the model are used with estimates of water runoff and these are used as inputs into a water quality model of Reckhow (1979). A brief description of the NPSLAKE model and data inputs is given here. MassGIS digital maps of land use within the watershed were used to calculate areas of land use within three major types: Forest, rural and urban land use. This model takes the area in hectares of land use within each of three categories and applies an export coefficient to each to predict the annual external loading of phosphorus to the lake from the watershed. Because much of the land use data is based on old (1985) aerial photographs, the current land uses within the watershed may be different today. This can be important in the development of the TMDL because different land uses can result in different phosphorus loadings to the waterbody in question. For many rural areas, land use changes often result in conversion of open or agricultural lands to low density housing, in which case, the export coefficients of the NPSLAKE model are the same and no change in loading is predicted to occur. However, in cases where development changes forests to residential areas or rural land uses to urban land uses, phosphorus loadings are predicted to increase. In some cases, loadings are predicted to decrease if additional agricultural land is abandoned and forest regrowth

[24] Category 4A waters are impaired for one or more designated uses but do not require the development of a TMDL because the TMDL has been completed.
[25] MassDEP 2002

occurs. To account for this uncertainty in land use changes, a conservative target is chosen. In addition, the MassGIS land use maps are scheduled to be updated with current aerial photos and the TMDL can be modified as additional information is obtained.

Other phosphorus sources, such as septic system inputs of phosphorus, are estimated from an export coefficient multiplied by the number of homes within 100 meters of the lake. Point sources are estimated manually based on discharge information and site-specific information for uptake and storage. Other sources such as atmospheric deposition to lakes was determined to be small and not significant in the NPSLAKE model, perhaps because lakes tend to be sinks rather than sources of phosphorus (Mattson and Isaac, 1999). For similar reasons wetlands were also not considered to be significant sources of phosphorus following (Mattson and Isaac, 1999). Other, non-land use sources of phosphorus such as inputs from waterfowl were not included, but can be added as additional information becomes available. If large numbers of waterfowl are using the lake the total phosphorus budget may be an underestimate, and control measures should be considered.

Internal sources (recycling) of phosphorus is not included because it is not considered as a net external load to the lake, but rather a seasonal recycling of phosphorus already present in the lake. In cases where this internal source is large it may result in surface concentrations higher than predicted from land use loading models and may contribute to water quality violations during the critical summer period. As additional monitoring data become available, these lakes will be assessed for internal contributions and possibly control of these sources by alum or other means. The major sources according to the land use analysis are shown for the lake in the following table (from “Total Maximum Daily Loads of Phosphorus for Selected Connecticut Basin Lakes”, 2002).

Table 2f. Lake Wyola MA34103

Total Estimated Nonpoint Source Pollution loads based on GIS Landuse

Watershed Area=	1770.9 Ha (6.8 mi2)
Average Annual Water Load =	10795301.9 m3/yr (12.2 cfs)
Average Runoff=	61.0 cm/yr (24.0 in/yr)
Lake area=	50.4 Ha. (124.6ac)
Areal water loading to lake: q=	21.4 m/yr.
Homes with septic systems within 100m of lake.=	165.0
Other P inputs =	0.0 kg/yr

Estimate of annual Nonpoint Source Pollution Loads by land use

Land use	Area Ha (%)	P Load kg/yr (%)	N Load kg/yr	TSS Load kg/yr
Forest category				
Forest:	1528.4 (86.3)	198.7 (50.4)	3821.1	36682.7
Rural category				
Agriculture:	28.8 (1.6)	8.6 (2.2)	199.1	5696.8
Open land:	16.4 (0.9)	4.9 (1.2)	85.1	2384.5
Residential Low:	63.4 (3.6)	19.0 (4.8)	348.6	24588.9
Urban category				
Residential High:	32.8 (1.9)	80.2 (20.4)	275.6	18694.5
Comm - Ind:	0.0 (0.0)	0.0 (0.0)	0.0	0.0
Other Landuses				
Water:	76.4 (4.3)	0.0 (0.0)	0.0	0.0
Wetlands:	24.7 (1.4)	0.0 (0.0)	0.0	1306.9
Subtotal	1770.9	311.4	4729.6	89354.1
Other P inputs:	NA	0.0 (0.0)		
165.0 Septics:	NA	82.5 (20.9)		
Total	1770.9 (100.0)	393.9(100)	4729.6	89354.1

Summary of Lake Total Phosphorus Modeling Results

Areal P loading L= 0.8 g/m2/yr.
Reckhow (1979) model predicts lake TP = L/(11.6+1.2q)*1000 = 20.9 ppb.
Predicted transparency = 2.3 meters.

If all land were forested, P export would be 217.1 kg/yr,
and the forested condition lake TP would be 11.5 ppb.

The NPSLAKE model assumes land uses are accurately represented by the MassGIS digital maps and that land use has not changed appreciably since the maps were compiled in 1985. The predicted loading is based on the equation:

P Loading (kg/yr)= 0.5* septics + 0.13* forest ha + 0.3* rural ha + 14* (urban ha)0.5

The coefficients of the model are based on a combination of values estimated with the aid of multiple regression on a Massachusetts data set and of typical values reported in previous diagnostic/feasibility studies in Massachusetts.

All coefficients fall within the range of values reported in other studies. Further details on the methods, assumptions, calibration and validation of the NPSLAKE model can be found in Mattson and Isaac (1999). The overall standard error of the model is approximately 172 kg/yr. If not data is available for internal loading a rough estimate of the magnitude of this sources can be estimated from the Reckhow model by substitution of the in-lake concentration for TP. The difference in predicted loadings from this approach and the land use approach is the best estimate of internal loading.

The NPSLAKE model also generates predictions of estimated yearly average water runoff to the lake based on total watershed area and runoff maps of Massachusetts (Mattson and Isaac, 1999). Other estimates of nitrogen and total suspended solid (TSS) loading rates are estimates based on Reckhow et al.(1980), and are provided here for informational and comparison purposes only.

Because of the general nature of the land use loading approach, natural background is included in land use based export coefficients. Natural background can be estimated based on the forest export coefficient of 0.13 kg/ha/yr multiplied by the hectares of the watershed assuming the watershed to be entirely forested. Without site specific information regarding soil phosphorus and natural erosion rates the accuracy of this estimate would be uncertain and would add little value to the analysis.

Mattson, M.D. and R.A. Isaac. 1999. Calibration of Phosphorus Export coefficients for Total Maximum Daily Loads of Massachusetts Lakes. Lake and Reservoir Man. 15(3):209-219.
Reckhow, K.H. 1979. Uncertainty Analysis Applied to Vollenweider's Phosphorus Loading Criteria. J. Water Poll. Control Fed. 51(8):2123-2128.
Reckhow, K.H., M.N. Beaulac, J.T. Simpson. 1980. Modeling Phosphorus Loading and Lake Response Under Uncertainty: A Manual and Compilation of Export Coefficients. U.S.E.P.A. Washington DC. EPA 440/5-80-011.

The final *2018/2020 Integrated List of Waters Appendix 15: Connecticut River Watershed Assessment and Listing Decision Summary* states that there are no new water quality data available for Lake Wyola so the Aquatic Life Use will continue to be assessed as Not Supporting with the Nutrient/Eutrophication Biological Indicators and the total phosphorus impairments being carried forward from the previous Integrated List of Waters. [26] There is no listing information in the 2022 Integrated List of Waters.

Historical and current Technical Memoranda (TM) produced by the MassDEP Watershed Planning Program (WPP) are available here: Water Quality Technical Memoranda | Mass.gov 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). Many of these TMs have helped inform Clean Water Act 305(b) assessment and 303(d) listing decisions.

Water Quality Data

Hard copies of lab reports for total phosphorus and total nitrogen between the years 2000 and 2005 were provided by the Shutesbury Board of Health (Table A-7). Lab analysis was conducted by UMass Amherst. Amherst. The mean TP value across all samples was 7.12 µg/L. The mean TN value across all samples was 0.019 mg/L. The mean value of phosphorus in sediment across all samples was 100.78 mg/L.

[26] MassDEP 2022a

Table A-7: Lake Wyola Phosphorus and Nitrogen Monitoring data, 2000, 2001, 2002, 2005

Sample Location	Total phosphorus (µg/L or ppb)	Total nitrogen (mg/L)	Phosphorus in sediment (mg/L or ppm)
10/20/00			
Ames Brook Trib			87.2
Fiske Brook Trib			79.1
Skerry Brook Trib			81.6
South Brook Trib			24.3
10/21/00			
Bessies Stream			169.0
Boat Launch Cove			100.4
Boat Launch Cove DUP			106.2
Boat Launch Cove SPK			108.4
Center			143.4
Fiske Brook			119.5
Skerry Brook			105.5
South Ames Cove 1			95.1
South Ames Cove 2			87.2
10/26/00			
Bessies Stream Trib 1			152.7
Bessies Stream Trib 2			140.0
Boat Launch Stream Trib			151.2
4/21/00			
Center 1m		0.003	
Center 8m		0.006	
Center 8m		0.102	
5/17/01			
Ames Brook Trib TO2A		0.012	97.2
Ames Brook Trib TO2B		0.012	–
Bessies Brook Trib TO6		–	188.9
Boat Launch Stream Trib TO7		–	86.0
Dam Culvert TO8A		0.002	77.07
Dam Culvert TO8B		0.000	–
Fiske Brook TO4A		0.003	65.6
Fiske Brook TO4B		0.010	66.8
Fiske Brook TO4C		0.009	–
Skerry Brook TO5A		0.000	62.3
Skerry Brook TO5B		0.000	–
South Brook TO3		0.061	24.2
5/19/01			
Bessies Inlet L06	6	–	
Boat Launch Inlet L07	5	–	

Sample Location	Total phosphorus (µg/L or ppb)	Total nitrogen (mg/L)	Phosphorus in sediment (mg/L or ppm)
Center 1m L01A	5	0.000	
Center 1m L01B	6	0.000	
Center 8m L01	4	0.062	
Dam L02	4	0.000	
Fiske Inlet L04	8	0.024	
Skerry Inlet L05	6	0.003	
South Inlet L03	7	0.028	
6/11/01			
Ames Brook TO2	8	0.022	
Boat Launch Brook TO7	8	–	
Dam Culvert TO8	5	0.01-0	
Fiske Brook TO4A	6	0.027	
Fiske Brook TO4B	6	0.026	
Skerry Brook TO5	14	0.018	
South Brook TO3	10	0.103	
6/15/01			
Bessies Inlet L06	6	–	
Boat Launch Inlet L07	7	–	
Center 1m L01A	5	0.002	
Center 1m L01B	4	0.002	
Center 8m L01	4	0.050	
Dam Inlet L02	3	0.004	
Fiske Inlet L04	6	0.005	
Skerry Inlet L05	5	0.003	
South Inlet L03	5	0.023	
6/16/01			
Ames Brook TO2A	7	0.012	
Boat Launch Brook TO7	10	–	
Dam Culvert TO8A	4	0.004	
Fiske Brook TO4A	6	0.010	
Skerry Brook TO5A	17	0.000	
South Brook TO3A	7	0.084	
7/14/01			
Lake Wyola Center 1m	4	–	
Lake Wyola Center 8m	8	–	
9/15/01			
Lake Wyola Center 1m	2	BDL*	
Lake Wyola Center 8m	4	0.007	
5/25/02			
Lake Wyola Center 1m	11	0.007	
Lake Wyola Center 8m	10	0.017	
6/20/02			

Sample Location	Total phosphorus (µg/L or ppb)		Total nitrogen (mg/L)	Phosphorus in sediment (mg/L or ppm)
Lake Wyola Center 1m	6		BDL	
Lake Wyola Center 8m	11		0.013	
6/22/02				
Lake Wyola Center 1m	4		BDL	
Lake Wyola Center 8m	3		0.025	
8/19/02				
Lake Wyola Center 1m	8		BDL	
Lake Wyola Center 8m	21		BDL	
8/24/02				
Dam	5			
9/24/02				
Lake Wyola Center 1m	5		BDL	
Lake Wyola Center 8m	5		BDL	
4/23/05				
Lake Wyola Center 1m	4 TP-EAL**	7 TP-DEP***	0.027	
Lake Wyola Center 8m	3 TP-EAL	7 TP-DEP	0.079	
5/21/05				
Lake Wyola Center 1m	6 TP-EAL	6 TP-DEP	0.002	
Lake Wyola Center 8m	5 TP-EAL	11 TP-DEP	0.063	
6/16/05				
Lake Wyola Center 1m	5 TP-EAL	6 TP-DEP	BDL	
Lake Wyola Center 8m	7 TP-EAL	10 TP-DEP	0.028	
8/20/05				
Lake Wyola Center 1m	–	6 TP-DEP	BDL	
Lake Wyola Center 8m	–	15 TP-DEP	BDL	
9/16/05				
Lake Wyola Center 1m	–	11 TP-DEP	BDL	
Lake Wyola Center 8m	–	21 TP-DEP	BDL	

*Below Detection Limit

**TP-EAL = suspended total phosphorus, sample not mixed before analysis

***TP-DEP = total phosphorus, sample thorough mixed before analysis

Note: It is not known whether data other TP data presented in this section with no sample type indicated is TP-EAL or TP-DEP

UMass Environmental Analysis Lab Data, 2014[27]

In 2014, an analysis of the total phosphorus content in nine water samples was performed by the Environmental Analysis Lab at UMass (Table A-8), Amherst. The mean TP value across the eight sampling locations with detectable measurements was 7.57 µg/L.

[27] UMass 2014

Table A-8: Lake Wyola Phosphorus Monitoring data, 2014

Sample Location	Sample date	Total phosphorus (µg/L or ppb)
Boat Ramp	8/10/14	8.9
West Beach	8/10/14	7.9
North side stream new 42 Lake	8/10/14	BDL*
Dam	8/10/14	7.0
Steam on East Side of State Beach	8/10/14	7.0
North Cove	8/10/14	6.3
East Beach	8/10/14	8.9
East side near 9 North Laurel Drive Extension	8/10/14	4.1
Center of the Lake	8/10/14	10.5

*Below Detection Limit of 3.3 µg/L

The Environmental Analysis Lab at UMass, Amherst, also performed chlorophyll and phaeophytin[28] analysis on four water samples. At that time, the chlorophyll levels < 4 mg/L were considered excellent (Table A-9).

Table A-9: Lake Wyola Chlorophyll and Phaeophytin Monitoring data, 2014

Site Number	Collection Date	Amount Filtered (mL)	Chlorophyll *a* (µg/L)	Phaeophytin *a* (µg/L)
Wyola 1- Dam	9/21/14	500	2	3
Wyola 2- Cove	9/21/14	500	2	4
Wyola 3- Lake Center	9/21/14	500	2	4
Wyola 4- Boat Ramp	9/21/14	500	1	4

[28] One of the breakdown products of chlorophyll.

Lake Wyola Advisory Committee monitoring data[29]

The Lake Wyola Association runs a bacteria-monitoring program at its three Association beaches. Sampling frequency has varied, but samples were generally taken late May through end of August, once a week or once every two weeks. Data is available from 2011. Data from 2016, with the exception of 2020 (first year of COVID-19 pandemic), is shown in Table A-10. Data on temperature, dissolved oxygen, conductivity, and pH is shown in Table A-11.

Table A-10: Lake Wyola Bacteria Monitoring data, 2016-2022

Location: Lake Wyola Association Beaches

Year	E. Coli (CFU/100 mL)																Geo Mean (CFU/ 100 mL)
2022	**5/23**	**5/29**	**6/6**	**6/13**	**6/20**	**6/26**	**7/5**	**7/10**	**7/18**	**7/25**	**8/1**	**8/8**	**8/15**	**8/23**			
East Beach	5	82	3		6	5	1	3	28	6	2	41	4	5			
West Beach	20	10	ND		5	8	1	12	66	4	2	4	2	4			
North Beach	14	52	18		1	45	2	2	28	9	6	4	4	2			
2021	**5/25**	**6/1**	**6/7**	**6/15**	**6/22**	**6/30**	**7/6**	**7/12**	**7/19**	**7/21**	**7/26**	**8/2**	**8/9**	**8/16**	**8/25**	**8/30**	
East Beach	2	8	8	4	32	45	10	6	221		4	2	21	>2	39	17	**10.53**
West Beach	<2	13	6	<2	13	32	4	2	232		8	8	8	2	6	<2	**6.78**
North Beach	4	6	2	6	24	4	8	4	288	40	8	4	17	<2	6	15	**8.65**
2019	**5/28**	**6/3**	**6/10**	**6/17**	**6/24**	**7/1**	**7/8**	**7/15**	**7/22**	**7/29**	**8/5**	**8/12**	**8/19**	**8/26**			
East Beach	<2	54	<2	8	2	13	4	<2	2			4	4	2			**5.2**
West Beach	2	8	4	6	4	<2	10	4	4			<2	4	<2			**4.6**
North Beach	<2	5	<2	19	2	4	4	<2	<2			2	2	4			**3.9**
2018	**5/21**	**5/29**	**6/4**	**6/11**	**6/18**	**6/25**	**7/2**	**7/16**	**7/23**	**8/6**	**8/13**	**8/20**					
East Beach	20	41	52	31	10			10	10	20	<10	<10					**20.1**
West Beach	20	31	63	31	41			10	<10	<10	<10	20					**31.6**
North Beach	41	10	30	20	41			<10	<10	10	10	<10					**19.3**
2017	**5/30**	**6/5**	**6/13**	**6/19**	**6/26**	**7/5**	**7/10**	**7/17**	**7/24**	**7/31**	**8/7**	**8/14**	**8/21**	**8/28**			
East Beach	<10	10	<10	<10	<10	41	30	10	2	8	16	7	4	4			**9.0**
West Beach	<10	<10	<10	<10	30	20	20	20	9	3	14	1	8	4			**8.8**

[29] LWAC, 2001 - 2019

Year	E. Coli (CFU/100 mL)																Geo Mean (CFU/ 100 mL)
North Beach	<10	<10	10	10	10	10	<10	<10	3	8	21	0	8	2			**8.4**
2016	**5/23**	**5/31**	**6/6**	**6/13**	**6/20**	**6/27**	**7/5**	**7/11**	**7/18**	**7/27**	**8/1**	**8/8**	**8/17**	**8/22**	**8/29**		
East Beach	12	20	18	6	20	2	10	30	14	56	8	4	48	6	18		**12.8**
West Beach	12	10	10	12	12	2	10	12	6	14	2	20	18	6	1		**7.5**
North Beach	2	6	10	6	12	20	20	10	12	36	2	2	4	1	2		**6.0**

MA water quality standard for public beaches

Not to exceed **126 CFU/100 mL** as the geometric mean of all samples collected within any 90-day or smaller interval

Not to exceed **235 CFU/100 mL** in a single sample

Cells with results in exceedance of water quality standards are highlighted in red

Table A-11: Lake Wyola monitoring data 2001 – 2021

Location: Lake center, 5-meter depth

Year	Date	Temperature (Celsius)	D.O. (mg/L)	D.O. (%)	Conductivity	pH
2021	7/7/21	17.9	5.2	54	36.5	5.51
	8/27/21	20			33.3	5.14
2020	9/26/20	17.3	7.9	83	40.8	6.65
	10/15/20	14.9	8.5	84	38.8	6.66
2019	05/09/19	10.2	9.5	85	26.2	4.87
2016	06/03/16	14.3		9.5	38	4.96
	07/05/16	20.8		7.3	46.5	6.05
	08/21/16	26		7.1	56.3	5.89
2015	08/03/15	20.5	4	4	46	4.31
2011	06/11/11	13	8.35	8.35	33.3	5.45
	07/16/11	15.4	7.32	7.32	35.4	5.62
	08/21/11	20.2	4.9	4.9	40.9	5.76
2010	07/17/10	20	7.9	7.9	44.6	5.95
2008	06/08/08	15.8	9.9	9.9	46.4	4.88
	06/28/08	16.4	8.42	8.42	46.6	4.72
	7/19/08	18.3	10.17	10.17	47	
	08/17/08	19.5	5.82	5.82	46.4	5.31
2007	7/14/07	17	6.97	6.97	37.8	5.67
	09/15/07	20.5	8.52	8.52	45.7	6.45
2006	05/20/06	12.1	8.88	8.88	40.3	5.26
	06/17/06	14.1	8.21	8.21	40.7	5.77
	07/22/06	16.8	7.32	7.32	41.4	5.62
	08/19/06	19.6	5.9	5.9	42	5.62
	09/16/06	18.8	7.75	7.75	46.3	6.61
	10/21/06	12.5	8.33	8.33	44.3	6.44
2005	04/23/05	8.5	9.9	9.9	33.7	
	05/21/05	11.6	9.75	9.75	33.9	
	06/18/05	13.4	9.02	9.02	45.4	
	07/16/05	14.3	6.76	6.76	46.3	
	08/05/21	16.3	5.58	5.58	47.3	
	09/17/05	19	4.28	4.28	47.5	
2004	05/22/04	12.8	9.05	9.05	33.3	
	06/19/04	15.5	7.68	7.68	37.1	
	10/17/04	13.9	8.86	8.86	38.1	

Year	Date	Temperature (Celsius)	D.O. (mg/L)	D.O. (%)	Conductivity	pH
2003	05/17/03	11.5	9.98		40.7	5.22
	06/21/03	13.6	8.88		42.7	3.88
	07/19/03	15.6	7.1		45.2	6.9
	08/09/03	18.2	6.25		47.7	
	09/20/03	20.7	7.16		50.2	
	10/18/03	12.3	8.59		37.3	
2002	07/21/02	20.4	6.02		48.6	
2001	05/19/01	9.7	9.93		29.7	0.7
	07/15/01	13.3	8.92		32.5	5.24

MA water quality standard
Temperature: Not more than 20°C over a 7-day period
Dissolved Oxygen: No less than 5.0 mg/L
pH: 6.5 to 8.3 standard units and not more than 0.5 units outside of the natural background range (background range for Lake Wyola unknown)

Cells with results in exceedance of water quality standards are highlighted in red

The vast majority of pH testing shows levels outside of the standard range (pH is too low), even though MassDEP has not listed the lake as impaired for pH. Imbalance in pH can occur in fresher waters due to acid precipitation or less frequently, naturally occurring organic acids, which can be found in bogs and some wetlands.

Evidence of Sedimentation in Lake Wyola

Watershed residents are concerned about sedimentation in Lake Wyola, with the North Cove and the west and east side of the lake of particular concern. On the west side and east sides, images support the anecdotal evidence that untreated stormwater is reaching the lake (Figure A-4), that it is transporting sediment (Figure A-5), and that sediment deposition at stormwater outfall areas contains road material (Figure A-6). According to the NRCS 2005 *Lake Wyola Inventory and Evaluation*, one homeowner reported that around 1990 the lake depth near their house was over six feet and by 2005, it was less than two feet.[30] Another homeowner submitted public comment stating that in the past five years they have witnessed a marked change in water depths, siltation of the lake bottom, reduced water clarity, and new presence of plants like lily pads growing near the entrance of North Cove. Photos of North Cove likely taken in 2008 when the lake level was lowered 8 feet to accommodate repair of the dam show the relative depth of the cove to the rest of the lake during a draw down and the remaining channel (see Figures A-7 and A-8). The area on the north side of the Lakeview Drive culvert where Fiske Brook meets North Cove has similarly filled in with silt and sediment, as shown in Figure A-9**.** The degree to which sediment accumulation in North Cove or anywhere else is anthropomorphic or part of natural

[30] NRCS 2005

processes is not fully understood, but can be studied by conducting hydraulic and hydrologic (H&H) and a fluvial geomorphic studies of the watershed.

Figure A-4: Untreated stormwater entering Lake Wyola during heavy rainfall via piped and surface flow through a residential property at low point in the road

Figure A-5: Sediment plumes from two drainage pipes on west side of Lake Wyola after heavy rainfall, July 14, 2021

Figure A-6: Road material deposition in lake

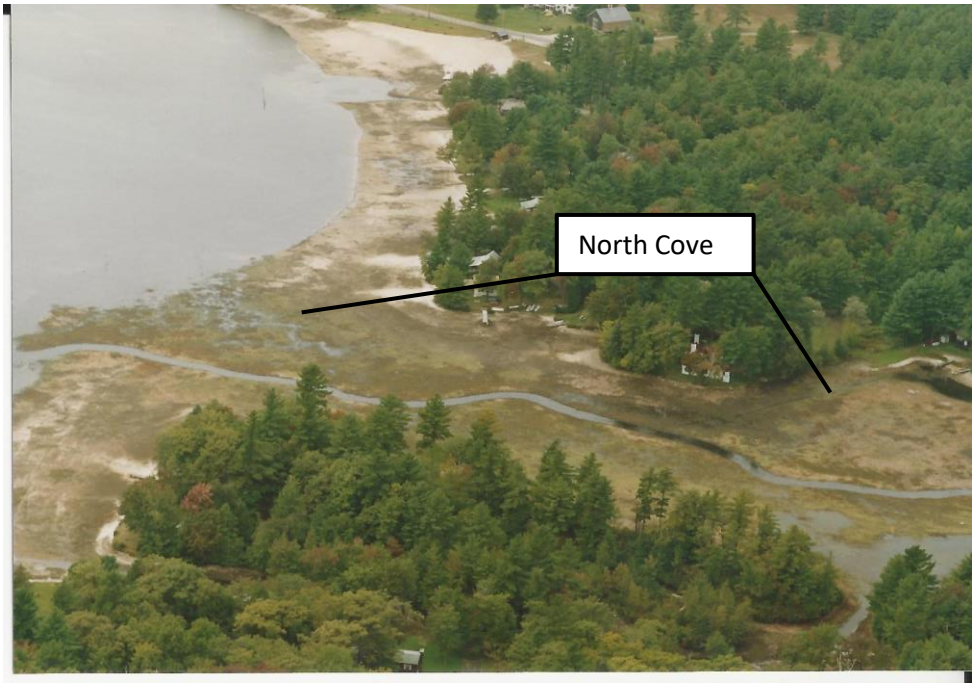

Figure A-7: Sediment in North Cove as seen from the east

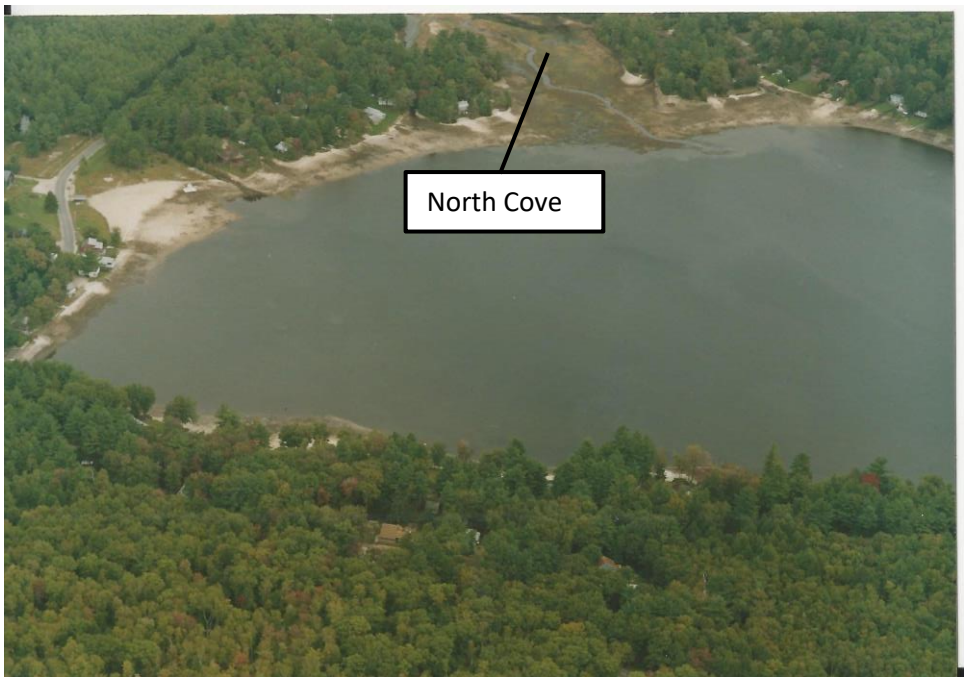

Figure A-8: Sediment in North Cove as seen from the southwest

Figure A-9: Channel of Fiske Brook flowing through area North Cove north of Lakeview Drive, as seen from Lakeview Drive

Data Gaps

Nutrient monitoring data in Lake Wyola is available for intermittent years between 2000 and2014, and no new data is available since 2014. Phosphorus measurements at the various locations across the years 2000 to 2005 had a mean of 7.12 µg/L. Phosphorus levels at the eight 2014 monitoring locations with detectable levels had a mean of 7.57 µg/L. All sampling to date has met both the TMDL criteria of 15 µg/L and the EPA water quality standards of 25 µg/L. These data are what is available as baseline data.

More current phosphorus sampling and biological analysis is needed to establish the impact of sediment loading on phosphorus loading in the lake. More phosphorus data that includes depth profiles, particularly samples from the hypolimnion at the deep spot, would be helpful in developing/calibrating a trophic response model. It is not expected that internal phosphorus load is a major factor in the lake, but additional data could confirm or refute this assumption.[31]

While sediment loading is a primary concern to the watershed community, there is no TSS monitoring data for Lake Wyola.[32] The Town and Association could collect information about sediment accumulation in existing BMPs around the lake to provide a baseline. Anecdotal evidence for sediment accumulation can also act as a guide. A study to assess the quantity and quality of sediment loading to the lake from existing sources could help identify sediment management projects for the lake and watershed lands.

Land Use and Impervious Cover Information

Land use information and impervious cover is presented in tables and figures below. Land use source data is from 2005 and was obtained from MassGIS (2009b).[33]

[31] CEI 2022

[32] TSS is measured in a lab tests that filters and weighs small particles.

[33] 2005 land use data was used in the place of 2016 data because it is the dataset used in the pollutant loading modeling.

Watershed Land Uses

Table A-12: Watershed Land Uses

Land Use	Area (acres)	% of Watershed
Agriculture	32.65	0.8
Commercial	4.35	0.1
Forest	3879.15	90.5
High Density Residential	11.48	0.3
Highway	0	0
Industrial	0.69	0
Low Density Residential	113	2.6
Medium Density Residential	39.43	0.9
Open Land	30.63	0.7
Water	174.04	4.1

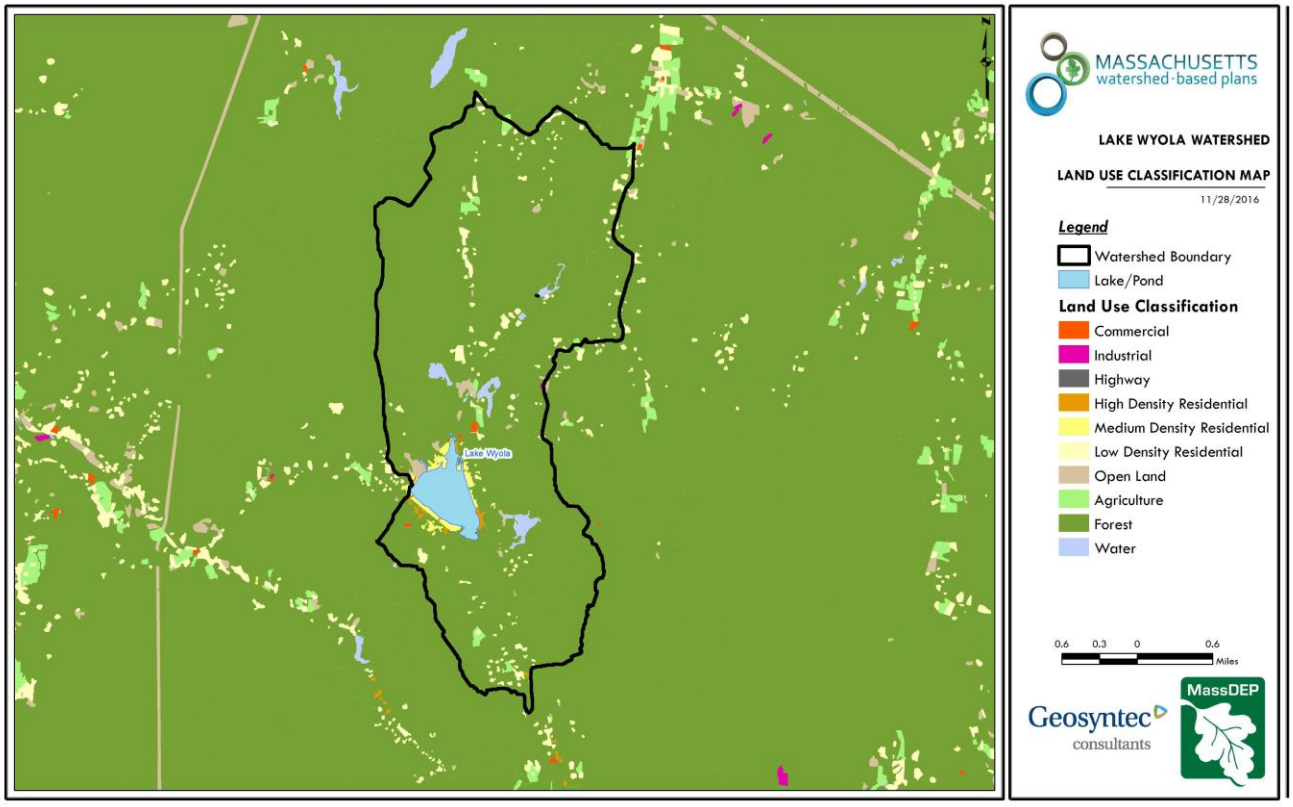

Figure A-10: Watershed Land Use Map (MassGIS, 2009b; MassGIS, 1999; MassGIS, 2001; USGS, 2016)

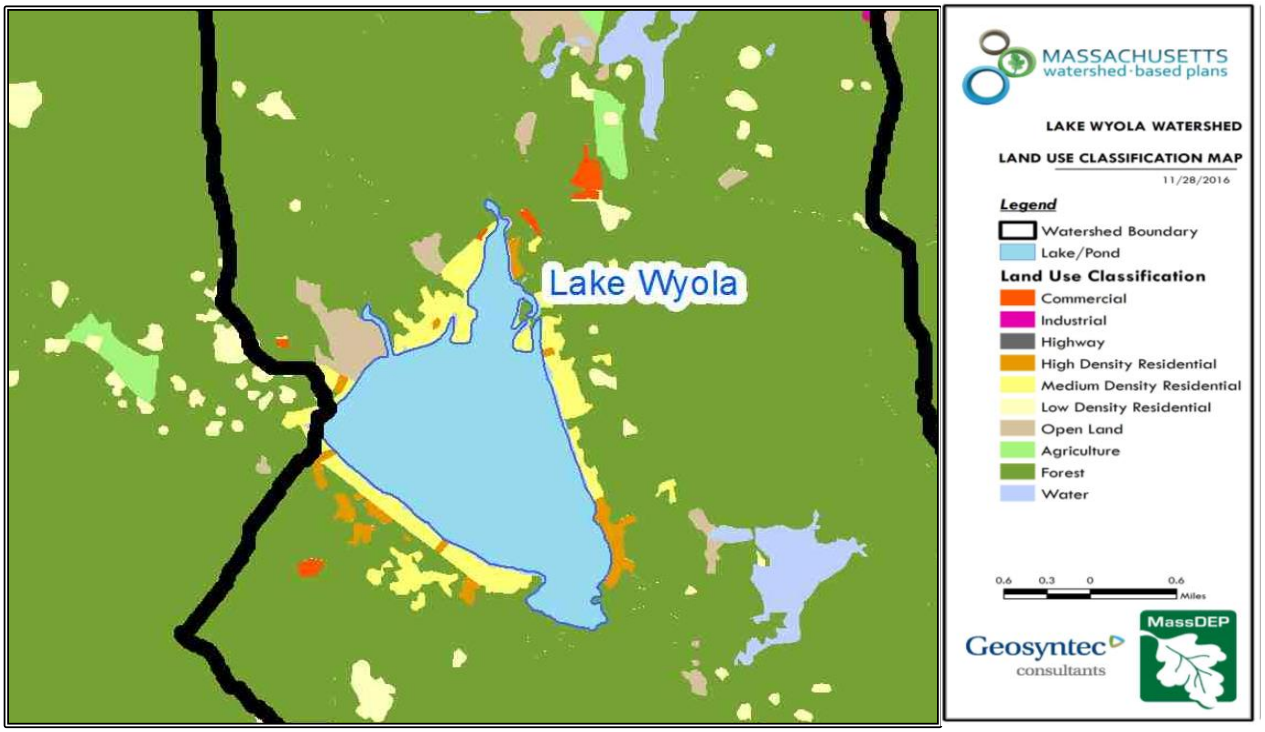

Figure A-11: Land Use Map of Area Immediately Around Lake Wyola (MassGIS, 2009b; MassGIS, 1999; MassGIS, 2001; USGS, 2016)

Watershed Impervious Cover

There is a strong link between impervious land cover and stream water quality. Impervious cover includes land surfaces that prevent the infiltration of water into the ground, such as paved roads and parking lots, roofs, basketball courts, etc.

Impervious 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. The Sutherland equations estimate the proportion of impervious to pervious surface based on land use classifications for a given area.[34] USEPA provides guidance[35] on the use of the Sutherland equations to predict relative levels of connection and disconnection based on the type of stormwater infrastructure within the total impervious area (TIA) of a watershed. The total land use areas were summed and used to calculate the percent TIA.

[34] Sutherland 1995
[35] USEPA 2010

Table A-13: TIA and DCIA Values for the Watershed

	Estimated TIA (%)	Estimated DCIA (%)
Lake Wyola	2.3	1.8

The relationship between TIA and water quality can generally be categorized as low in impervious cover (0-10%), shown in Table A-14, which is characterized by high-quality water and typified by stable channels, excellent habitat structure, good to excellent water quality, and diverse communities of both fish and aquatic insects.[36] A significant amount of the watershed's impervious surface is concentrated around the lake, especially on the west side of the lake.

Table A-14: Relationship between Total Impervious Area (TIA) and water quality

% 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.

[36] Schueler et al. 2009

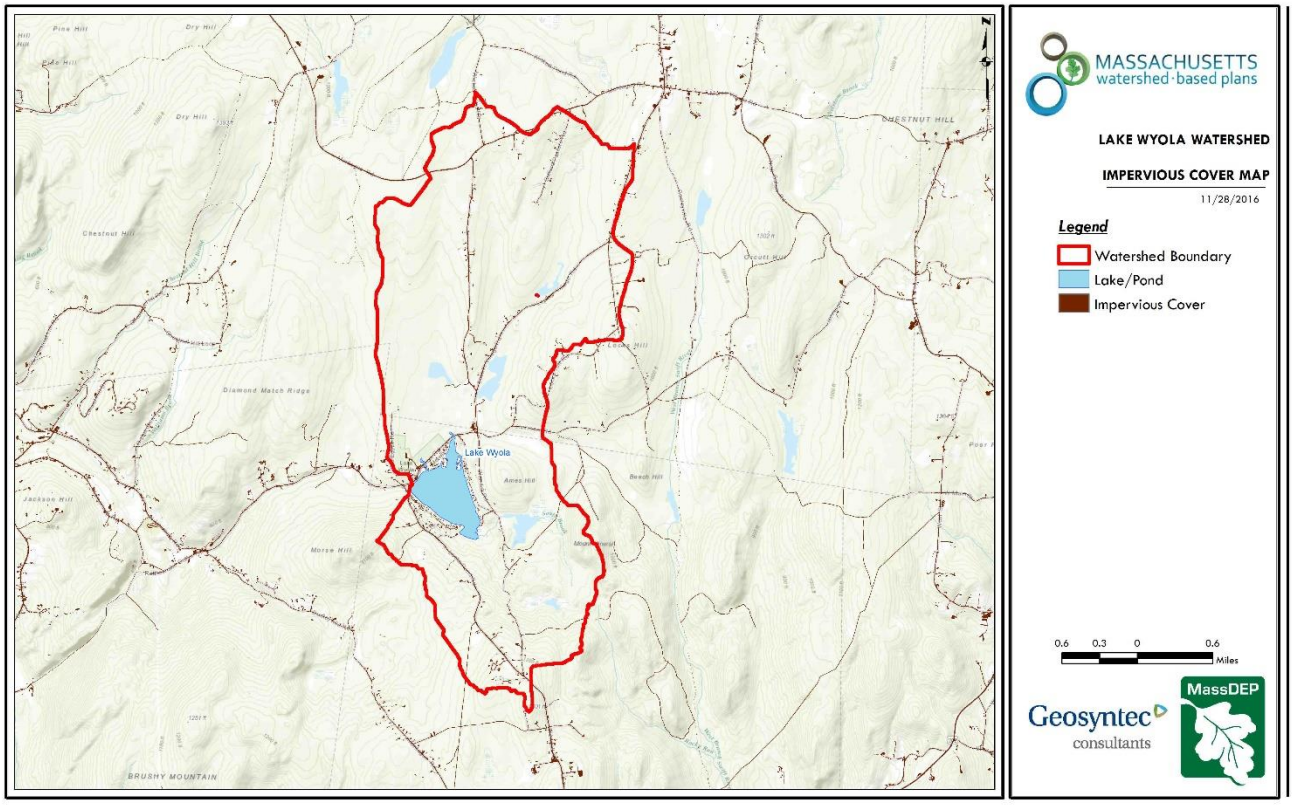

Figure A-12: Watershed Impervious Surface Map (MassGIS, 2009b; MassGIS, 1999; MassGIS, 2001; USGS, 2016)

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

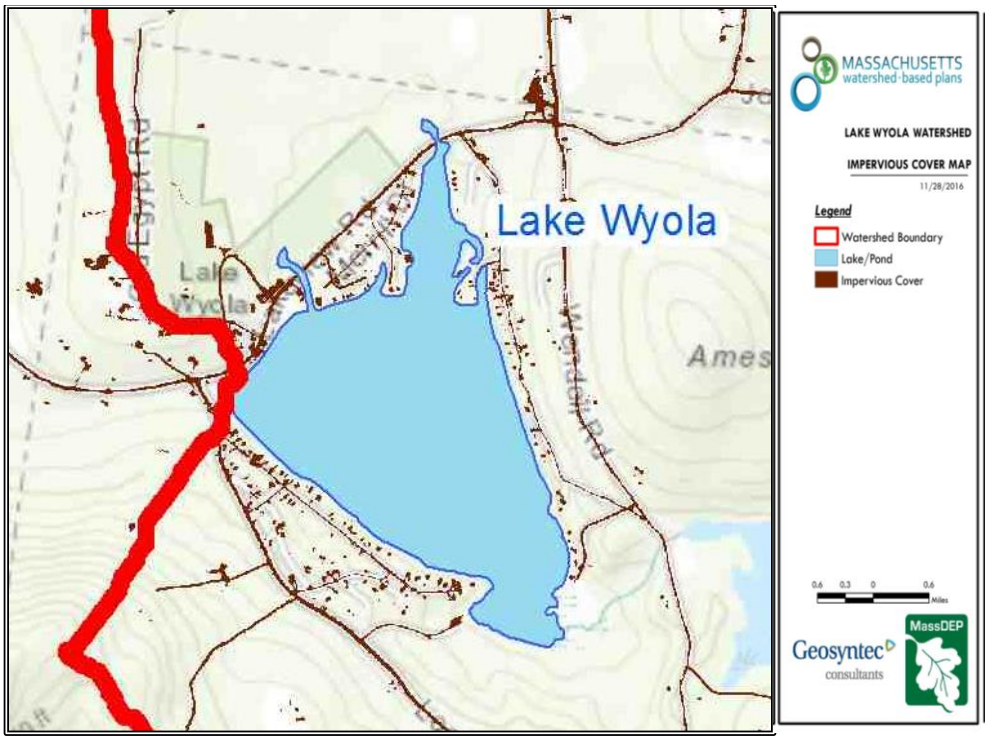

Figure A-13: Watershed Impervious Surface Map (MassGIS, 2009b; MassGIS, 1999; MassGIS, 2001; USGS, 2016)

Pollution Sources

The majority of the Lake Wyola watershed is undeveloped forest, but the steep slopes, roads, and residential land use directly around Lake Wyola transport high volumes of untreated stormwater runoff directly to Lake Wyola. Over the past 30 years, redevelopment of summer cottages into year-round homes around the lake has steadily increased over time.

Agriculture and Resource Extraction

Based on desktop and field observation, agricultural land use is limited to backyard animals in three or four locations. There are no active mining sites in the watershed. Agriculture, forestry, and mining are not suspected sources of nutrients or sediment.

Forest

Forests are identified in Table A-15 as the primary contributor of TP in the watershed. Forests are a natural source of phosphorus not generally considered a problem. Human-caused sources of phosphorus, such as untreated stormwater runoff from developed land, are where pollutants can best be mitigated.

Groundwater Withdrawal

Groundwater withdrawal can impact streamflow and lake recharge from groundwater: when groundwater withdrawal significantly reduces streamflow and subsurface flow, pollutant levels become more concentrated than under normal flow conditions because there is less water available to dilute the pollutant load. The Lake Wyola watershed does not appear on MassDEP maps as an area of a high groundwater withdrawal or depleted

groundwater.[37] This demonstrates that Lake Wyola generally maintains the level of flow expected for a watershed its size, and suggests that groundwater withdrawals are not contributing to elevated pollutant levels, if there were to be any.

Lawns

Lawn fertilizers and dog waste are potential sources of nutrient loading, especially phosphorus. Residential parcels around Lake Wyola are small and yards are often separated by lines of trees. Sandy soil and heavy pine-dominated forest cover may inhibit the growth of a classic lawn look. It is unknown how prevalent the use of lawn fertilizers is in the immediate neighborhood. Shoreline vegetated buffers and diversity are important measures for protecting water quality and habitat value from runoff coming from lawns.

Dog waste may be another potential source of nutrient loading. It is unknown how many dogs use yards or what the sanitation practices of dog owners are. Very few shoreline homeowners have planted buffers along the shoreline, so fertilizers and dog waste could be reaching the lake during storm events.

Roads[38]

The majority of the roads that immediately surround Lake Wyola are dirt, sand, or gravel roads in private ownership under the LWA or another private owner. These roads were likely onetime "camp" roads, but their use has intensified since structures around the lake have become year-round housing. Camp roads can be particularly difficult to manage because they were not originally designed to be used year-round or to carry heavier traffic loads.[39] The road material appears to contain more sand than compact gravel, as compared to other dirt roads in town. The sand is more easily mobilized during rain events, flowing down the roads and eventually towards the lake. The western side of Lake Wyola has the largest number of houses and roads in close proximity to the lake.

Despite improvements in recent years, there are ongoing flooding and erosion problems affecting the LWA and other dirt roads around the lake (see Appendix C – FRCOG Nonpoint Source Field Assessment and Appendix D – Public Comment).[40] A representative of the LWAC on the FRCOG Field Assessment walk stated that there has been an increase in the rate of erosion of these LWA roads.[41] Extensive areas of erosion were observed by CEI during their April 2022 site visit along nearly all roads on this side of the lake, including Lake Drive, Great Pines Drive, King Road, and others. While some ditching and some turnouts are present, drainage infrastructure such as catch basins, connecting pipes, ditches, and outlet protection are largely absent from this area with few exceptions. There are many locations around the lake where residents have developed and landscaped their properties in ways that alter natural runoff patterns, including adding berms (raised barriers) along the roads that keep runoff on the road and prevent a more dispersed sheet flow of stormwater. Some of the observed berms appear to be within the footprint of the privately owned dirt roads, which may mean they fall under the jurisdiction of the LWA.

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[37] MassDEP Sustainable Water Management Initiative (SWMI) Interactive GIS Map

[38] This section on roads contains observations and language from CEI's 2022 *Stormwater Improvement Opportunities – Lake Wyola Watershed Technical Memorandum*.

[39] https://www.maine.gov/dep/land/watershed/camp/road/gravel_road_manual.pdf

[40] Resident feedback, see Appendix D – Public Comment

[41] See Appendix C – FRCOG Nonpoint Source Field Assessment

Locks Pond Road

The 2007 *Locks Pond Road and Lake Wyola Subwatershed Stormwater Improvement Study* notes that at the time of the study, runoff carried by and across the Town-owned Locks Pond Road was a large concern.[42] Steep driveways on the west side (situated on Morse Hill) were the source of the runoff, and makeshift berms constructed by residents with driveways on the east side of Locks Pond Road were funneling and concentrating stormwater to discharge points downhill along intersecting roads.

Since the 2007 stormwater improvement study, the Town of Shutesbury Highway Department has crowned Locks Pond Road, installed culverts under some of the west-side driveways, deepened the roadside ditch on the west side (no materials added), and installed additional culverts under Locks Pond Road. The majority of the stormwater flowing off Morse Hill now drains under Locks Pond Road via at least five culverts. During the FRCOG's January 2022 field investigation, it was noted that there is erosion occurring in at least one of the drainage channels.[43] Sediment, likely a high proportion of which is winter road sand, appears to be coming off of Locks Pond Road into driveways and drainage areas.

King Road

King Road runs parallel to Locks Pond Road and Lake Drive, between Great Pines Drive and Stebbins Row. The maintenance of a middle section of King Road has been abandoned as a result of ongoing erosion issues, such that a car cannot travel from one end of King Road to the other.

Great Pines Drive

Great Pines Drive runs almost straight downhill and was observed to have erosion channels across the road where the road is poorly crowned and slopes send water across the road. Great Pines Drive at the intersections with Haskins Way/Birch Drive and Lake Drive frequently experience moderate to severe erosion. Toward the bottom of the road, a ditch on the south side is experiencing significant erosion, even where there is some rock lining the ditch. South side runoff is being directed across the street to a BMP on the LWA West Beach. Runoff on its north side is likely ending up along Shore Road.

Recently, the LWA had Great Pines Drive and Lake Drive crowned and constructed a water bar at the intersection of Great Pines Drive and Lake Drive that diverts water into a basin on the LWA's West Beach property. During the August 2023 Field walk, the water bar and basin were in need of maintenance. It is not known what the LWA's plan is for maintaining these installations or other stormwater drainage infrastructure they own.

Lake Drive

Lake Drive runs parallel to Lake Wyola about 100 – 150 feet from the shore. Drainage coming off of the upslope properties is rarely intentionally captured on the upslope side and thus most of it reaches the road. As mentioned previously, drainage from the road rarely makes its way to properties on the downslope side either because the lawns or driveways are bermed, or because the road is becoming entrenched as more road material is leaving the road than is being replaced.

[42] Campbell 2007
[43] FRCOG 2022

The road profile is somewhat rolling, so that water draining along Lake Drive collects can leave the road at a few low points along the road. One of these low points is 66 Lake Drive, where stormwater is captured on either sides of the roads via pipe inlets and piped to the lake. During heavy storms, water also drains on the surface following the same path as the pipe. The Conservation Commission has issued an NOI for this property owner to remove the drainage structure, and there is currently no alternative plan for how to manage stormwater at this location.

At the other low points, there is at least one intermittent stream and about four drainage pipes that cross Lake Drive and outlet into Lake Wyola. At the intermittent stream, it was noted in the August 2023 field walk that a large turnout on Lake Drive is directly connected to this stream and road material can be observed to be reaching the stream. One of the gravel piles provided by LWA for resident use for road repairs was also situated next to this turnout.

During the January 2022 FRCOG Field Assessment and August 2023 Field Walk, erosion and/or sediment deposition was noted around the inlet to multiple pipes inlets on the west side of Lake Drive.

Locks Pond Road at Lake Wyola Dam and Sawmill River

According to the Shutesbury Highway Superintendent,[44] there is a small amount of erosion along Locks Pond Road near the Sawmill River culvert. Riprap is currently in place to mitigate the issue. The Superintendent anticipates that the installation of the new Locks Pond-Sawmill River culvert, scheduled for 2023, will resolve this issue.

Farrar Road and Lake Wyola State Park

The stormwater BMPs on Farrar Road (deep sump catch basis and vegetated water quality swale) and in the Lake Wyola State Park (detention basin at beach) installed as part Lake Wyola TMDL Implementation Project (00-16/319) appear to be functioning as intended. The catch basin at the bottom of Farrar Road captures a large amount of sediment, which the Town has to clean out yearly. [45]

Shore Drive and Pine Drive

The eastern side of Lake Wyola is somewhat less developed than the western side and has fewer roads. Much of Shore Drive flows off the steep hillside to a swale along the eastern side of the road where it is piped under the road at a few locations. In general, the ditch on the upslope side of Shore Road was observed during the August 2023 Field Walk to have experienced some erosion from the July 2023 rains and sediment was heavily present around the driveway culverts. . In 2021, LWA funded the repair and regrading of Shore Drive and Pine Drive to construct swales along both sides of the road, to clear plugged culverts, to armor a ditch alongside Pine Drive that receives the outflow of one of the drainage culverts, and establish a settling basin for that drainage before it reaches the lake. Drainage infrastructure such as catch basins and stormwater retention and filtration BMPs are largely absent form this area, and there may not be a sufficient number of right-sized drainage culverts.

North and South Laurel Drives

North and South Laurel Drives are steep, privately owned roads owned by a private, out-of-state resident

[44] Shutesbury Highway Superintendent, personal communication February 3, 2022
[45] Shutesbury Highway Superintendent, personal communication February 3, 2022

located on the east side of the lake. North and South Laurel Drives run perpendicular to the lake as they approach the residences along the lakeshore, then turn and run parallel to the shore. Both roads showed evidence of erosion along the roadside and across the road where they turn. South Laurel Drive has been regraded into broad-based dips to channel stormwater discharges into the woods rather than down the road, however, some stormwater from this area still appears to flow down the road towards the lake. Where South Laurel Drive turns to follow the lakeshore, water and sediment cross the road and flow down a residential driveway toward the lake. At the end of South Laurel Road, road material is washing into a wetland.

On North Laurel Drive, a large roadside ditch has been created and lined with rock. While the road is sloped, multiple level basins have been created where sediment settles. Residents in this area say, however, that during heavy rain events, the sediment is blown out of these catchment areas, through the drainage culvert under North Laurel, and across a residential yard to the lake.

With each of the roads, the sections that run parallel to the shore are sandwiched between the slope and the lakeside residences, making it more difficult to convey stormwater to adjacent vegetated areas for pollutant attenuation. Drainage infrastructure such as catch basins, pipes, formalized swales, and other are somewhat absent from this area.

Wendell Road

Wendell Road is on the lake's east side. Overall, the road material of this road appears to have a higher content of gravel than the roads along the east side and is much more compacted. According to the Highway Superintendent, there is a catch basin at the top of the road that drains very slowly because the planned outfall ran into ledge. In the field investigation, it was noted that there is a soft, wet spot (possibly caused by an underground spring) on the road and erosion in the ditch about 800 feet north of Freeman Road (A-11c). A major culvert over South Brook was replaced on the road several years ago that is working well.

Randall Road

Randall Road is a seasonal Town road that provides access to the public boat launch. The 1997 *Management Plan for Lake Wyola* identified silt and sediment in the lake from erosion around the boat launch, parking lot, and Randall Road. The boat launch has since been paved and Randall Road crowned. The installation of a drainage swale and retention basin appear to have reduced sedimentation in the lake at the end of this road. The Shutesbury Highway Superintendent also reports that the catch basin at the bottom of Randall Road does not fill fast. However, a culvert did clog and washout the road during the July 2023 rains, causing significant damage to the road.

Road Maintenance Practices

Based on community feedback and field observations, it appears that local residents have attempted to mitigate some erosion problems by creating drainage channels across and adjacent to several roads using materials such as sand and gravel. Channels typically flow off the roads and into the woods where feasible. Some wooded areas appear to be successfully trapping sediment before it reaches the lake, while other areas appear to convey the sediment further down the hill where it likely eventually enters the lake.

Analysis of Roads as Source of Nonpoint Source Pollution

Sedimentation and drainage problems in this area are likely due to the following:

- Roads appear to be surfaced in many locations with a layer of loose sand that is highly erodible and readily transported further downgradient during rain events. Some areas with larger stone were observed, and these areas did not appear to be exhibiting the same degree of erosion.
- Roads are typically located at topographic low points. This makes it difficult to convey stormwater to another location (e.g., nearby forest) for pollutant attenuation in many areas, as the road is located at a lower elevation than the surrounding vegetated areas that could allow for stormwater treatment and infiltration.
- Development patterns around the lake have resulted in stormwater flow patterns that are predominantly along driveways and roads, where stormwater then flows directly to the lake rather than being dispersed across the landscape where it can more easily infiltrate.

Based on what is known of the site, possible causes of an increase in erosion include:

- Increased runoff due to changes in precipitation;
- Lack of road maintenance and impacts from snow plowing;
- Increased impervious surface (roofs, driveway, and lawn) due to conversion of seasonal homes to year-round homes; and
- Increased use of the roads due to conversion of seasonal homes to year-round homes.

Septic

All houses in Shutesbury and Wendell use on-site septic systems for wastewater disposal. The information provided to the FRCOG by the Board of Health indicates that the Board's assessment is that septic systems are having minimal impact on E. coli levels in the lake.[46] This opinion is based on LWAC's testing of E. coli at LWA beaches (see Table A-9) and approximately 30 years of private drinking water well testing for coliform, VOCs, and nitrate.[47]. All three beaches are located in areas of concentrated residences, and are at least 1,000 feet from the lake's major inlet and outlet (see Figure A-3). When failures are detected during Title V inspections, those failures are typically corrected by installing tight tanks, and occasionally conventional systems.[48]

Only residents with the footage from their well required under Title V regulations are permitted to install a conventional system, which around Lake Wyola typically requires owning two to three adjacent parcels. However, there is always potential that septic systems in the shoreline neighborhoods could become a source of pollution due to inadequate maintenance, age, or overuse.

Underground Storage Tanks

There were underground storage tanks in the watershed at the Wendell General Store on Lockes Village Road and another at the AT&T facility on Locke Hill Road that have been removed. There are no underground storage tanks in the Shutesbury portion of the watershed.[49]

[46] Shutesbury Board of Health, phone call July 4, 2023
[47] Note: the Board of Health has not sponsored its well-testing program since 2020.
[48] Shutesbury Board of Health, email communication March 2, 2022
[49] MassDEP Underground Storage Tank Facility Search database, accessed 1/4/2022

Stormwater Outfalls in Lake

According to DCR's 2007 Locks Pond Road and Lake Wyola Subwatershed Stormwater Improvement Study, there are four stormwater outfalls. At least one of these outfalls directs a significant amount of stormwater from Locks Pond Road into the lake. These outfalls represent opportunities to reduce sedimentation, either by installing pre-treatment BMPs upstream of these culverts, or by redirecting runoff away from these culverts.

Boat wakes

According to their public comment, the Conservation Commission has received anecdotal reports of increased turbidity and bank erosion being caused by recreational wake boats and other kinds of motorboats and that wave action from boats may be contributing to counterclockwise migration of sediments to protected cove areas.[50] Shutesbury bylaws regulate boat speed on the lake and boats are required to stay 150 feet from the shore while moving faster than 5 mph. According to additional public comment, enforcement of the law occurs about once per year when the Massachusetts Environmental Police visit the lake. There are no limits on wakeboards or horsepower. More study is needed on this topic to clarify boat wakes' role in streamline erosion and sand bars.

Waterways

Fiske Brook and Pond

Fiske Brook flows into North Cove at the northernmost point of the lake. There is a box culvert where Lakeview Road crosses the very top of the North Cove. The lake and the wetland at the mouth of Fiske Brook have both experienced significant siltation and sedimentation since the late 1990s. A 2005 NRCS evaluation[51] posited that the high level of sediment was caused by road sand around the lake area and erosion from banks and streambed of Fiske Brook accelerated by high-powered storms and by intermittent breaching of beaver dams or debris accumulated at the outlet spillway of Fiske Pond and likely other ponds in the watershed (McAvoy Pond, Tyler Pond, and smaller waterbodies). The sedimentation issue appears to be ongoing, though road sand is no longer considered a major source of sediment according to a representative of the LWA and the Shutesbury Highway Superintendent.

An earthen dam on the southernmost edge of the pond impounds the Fiske Pond to a depth of five to ten feet. On their field visit in April 2022, CEI observed some seepage along the base of the dam that flowed into an adjacent forested wetland area. The outlet pipe appears to be located at the top of an approximate 4-foot-high beaver dam and is equipped with a screen to discourage blockage from debris or beaver activity. The receiving streambed was observed to be stony and free of sediment.

There is concern in the Lake Wyola community that the presence of beaver dams above and below the Fisk Pond Dam could lead to a large amount of sediment entering the lake if they were to fail.[52] Beaver activity in the Fiske Pond area has drastically changed the landscape; beavers have built a sizeable 2 – 3 food tall dam on Camp Anderson land.

[50] Concern and analysis raised by Conservation Commission in comments submitted on 5/12/2023.
[51] NRCS 2005
[52] Concern raised by LWAC in emails dated 4/27/22 and 5/25/22.

Other residents have suggested that beaver populations may add to flood resilience in the Fiske Brook watershed. An H&H study is needed to determine whether and how much risk there is that upstream beaver and manmade dam failures would impact the downstream community. In combination with a fluvial geomorphic assessment, an H&H study would likely also identify what other factors in the Fiske Brook watershed may be contributing to the sedimentation of North Cove.

Waterfowl

Historically, episodic issues with waterfowl have been a source of E. coli in the lake, especially around the state park beach. For many years, geese populations were kept in check with an egg-addling program. In recent years, the nests have been harder to find and the USDA has been involved with managing the live geese population.

A flock of ducks was noted in the open water under the Lakeview Road culvert during the January 2022 FRCOG field investigation. Community members accompanying FRCOG on the field walk do not know whether feeding of waterfowl occurs. If it does, it should be discouraged.

Pollutant Loading

A Geographic Information System (GIS) was used for the pollutant loading analysis. The land use data was intersected with impervious cover data[53] and United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) soils data[54] 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.

Directly connected impervious area was estimated using the Sutherland equation. Any reduction in impervious area due to disconnection—the area difference between total impervious area (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 (see values provided in Appendix A).[55] Table A-155 presents the estimated land-use based TN, TP and TSS pollutant loading in the watershed.

Table A-15: Estimated Pollutant Loading for Key Nonpoint Source Pollutants

Land Use Type	Pollutant Loading[1]		
	Total Phosphorus (TP) (lbs/yr)	Total Nitrogen (TN) (lbs/yr)	Total Suspended Solids (TSS) (tons/yr)
Agriculture	16	100	1.24
Commercial	3	29	0.37
Forest	531	2,700	104.36
High Density Residential	5	35	0.51
Highway	0	0	0.00
Industrial	0	1	0.01
Low Density Residential	31	314	4.20

[53] MassGIS 2009a
[54] USDA NRCS and MassGIS 2012
[55] USEPA 2020; UNHSC 2018, Tetra Tech 2015

Land Use Type	Pollutant Loading[1]		
	Total Phosphorus (TP) (lbs/yr)	Total Nitrogen (TN) (lbs/yr)	Total Suspended Solids (TSS) (tons/yr)
Medium Density Residential	10	92	1.27
Open Land	8	73	1.52
TOTAL	606	3,345	113.47

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

Analysis of Phosphorus Loading

The estimated annual loading of phosphorus-to-receiving-waters within the watershed area is 606 pounds per year, as presented by Table A-15. The largest estimated contributor of the land-use based phosphorus, nitrogen, and TSS are areas designated as forest (88% of TP loading, 81% of TN loading, and 92% of the TSS loading). Nutrients generated from forested areas are a result of natural processes such as decomposition of leaf litter and other organic material. Combined, the residential use areas account for 7.5% of TP loading, 13% of TN loading, and 5% of TSS loading. It is assumed that the TSS and phosphorus loading is higher than estimated in Table A-15 due to ongoing erosion of roads and lack of adequate drainage infrastructure in lakeside neighborhoods. Phosphorus tends to bind to soil particles and therefore is often transported to waterbodies by stormwater runoff carrying sediment.

Loading estimates may also fail to capture high rates of fluvial erosion in forested parts of the watershed, which may elevate the phosphorus and sediment-loading rate. Upland watershed stormwater management practices, including floodplain reconnection and wood loading, could reduce sediment and nutrient loading from Fiske Brook and other streams.

CEI noted that, without the use of a trophic response model to characterize the relationship between P load and in-lake P concentration, goal setting for in-lake P concentration and establishment of a numeric “Required Load Reduction” (lbs of P/year) is arbitrary. CEI noted that the simplest approach to solving this problem is to use existing water quality data, watershed data, and land use data to develop a simple trophic response model (e.g., Vollenweider, Nürnberg).

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

Element B of your WBP should:

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

Estimated Pollutant Loads

Estimated pollutant loads for TP (606 lbs/year), TN (3,345 lbs/year), and TSS (113.47 tons/year) were previously presented in Table A-15 of this WBP.

Water Quality Goals

Pollutant load reduction goals for WBPs can be based on water quality criteria, surface water standards, existing monitoring data, existing TMDL criteria, or other data. Water quality goals for this WBP are focused on reducing TP and TSS loading to Lake Wyola. The most recent (2014) TP monitoring data for Lake Wyola indicates that the phosphorus level is currently below the criteria set by the lake's TMDL, so a protective load reduction goal of simply reducing current phosphorus loading has been set to maintain current good water quality. An annual long-term sediment load reduction goal was calculated using the pre-development land cover (100% forested watershed) load as a target. Sediment load reduction is expected to aid with bacteria and nutrient load reduction. A description of criteria for each water quality goal is described by Table B-1.

The following adaptive sequence is recommended to establish and track water quality goals specific to Lake Wyola:

1. Establish an interim goal to reduce sediment loading by 2.8 tons per year (half of the long-term goal of 5.6 tons per year) and any reduction in phosphorus loading achievable with the installation of management measures.
2. Implement a water-quality monitoring program in accordance with recommendations from Elements H&I. Use monitoring results to perform trend analysis to identify if proposed Element C management measures are resulting in improvements.
3. Establish further goals to meet the long-term sediment load reduction goal of 5.6 tons per year.
4. Meet all applicable water quality standards over the next 10 years, leading to the delisting of Lake Wyola from the 303(d) list and to improved year-to-year conditions of Lake Wyola Association roads.

Table B-1: Pollutant Load Reductions Needed

Pollutant	Existing Estimated Total Load	Water Quality Goal	Required Load Reduction
Total Phosphorus	Table A-15 loading model estimate: 606 lbs/year. Lake Wyola TMDL estimate: 3,880 lbs/yr (1760 kg/yr)	TMDL of 0.015 mg/L	Any reduction is desirable in order to protect existing high-quality waters.
Total Suspended Solids	113 tons/yr	**Class B Standards** These waters shall be free from floating, suspended and settleable solids in concentrations and combinations that would impair any use assigned to this Class, that would cause aesthetically objectionable conditions, or that would impair the benthic biota or degrade the chemical composition of the bottom. Estimated pre-development loading rate is 107.4 tons/year.	5.6 tons/yr (long term goal) (Estimated existing load of 113 tons minus estimated pre-development load of 107.37 tons)

TMDL Pollutant Load Criteria Development

The 2002 *Connecticut River Lakes Phosphorus TMDL* outlines the following pollutant load criteria development (excerpted):

> There are no numeric models available to predict the growth of rooted aquatic macrophytes as a function of nutrient loading estimates, therefore the control of nuisance aquatic plants is based on best professional judgment. However, the goal of the TMDL is to prevent future eutrophication from occurring, thus the nutrient loading still needs to be controlled. To control eutrophication, the Carlson Trophic State Index (TSI) (1977) predicts a lake should have total phosphorus concentrations of about 40 ppb to meet the 4-foot transparency requirement for swimming beaches in Massachusetts and targets are set lower than this. Due to the lack of data on mean depth and other parameters, a simple water quality model was used to link watershed phosphorus loading to in-lake total phosphorus concentration targets. Based on the NPSLAKE model phosphorus loading output and predicted water runoff volumes, an estimated in-lake total phosphorus (TP) concentration was derived based on the Reckhow (1979) model:
>
> **TP=L/(11.6+1.2*q)*1000**
>
> where TP= the predicted average total phosphorus concentration (mg/l) in the lake.

L= Phosphorus loading in g/m2/yr (the total loading in grams divided by lake area in meters).
q= The areal water loading in m/yr from total water runoff in m3/yr divided by lake area in m^2.

Similarly, by setting the TP to the target total phosphorus concentration, a target load was estimated by solving the equation above. The Reckhow (1979) model was developed on similar, north temperate lakes and most Massachusetts lakes will fall within the range of phosphorus loading and hydrology of the calibration data set.

[For most lakes], point source wasteload allocation is zero. The margin of safety is set by establishing a target that is below that expected to meet the 4-foot swimming standard (about 40 ppb). Loading allocations are based on the NPSLAKE land use modeled phosphorus budget. The TMDL is the sum of the wasteload allocations (WLA) from point sources (e.g., sewage treatment plants) plus load allocations (LA) from nonpoint sources (e.g., land use sources) plus a margin of safety (MOS). Thus, the TMDL can be written as:

TMDL = WLA + LA + MOS

Seasonality: As the term implies, TMDLs are often expressed as maximum daily loads. However, as specified in 40 CFR 130.2(I), TMDLs may be expressed in other terms when appropriate. For this case, the TMDL is expressed in terms of allowable annual loadings of phosphorus. Although critical conditions occur during the summer season when weed growth is more likely to interfere with uses, water quality in many lakes is generally not sensitive to daily or short term loading, but is more a function of loadings that occur over longer periods of time (e.g. annually). Therefore, seasonal variation is taken into account with the estimation of annual loads. In addition, evaluating the effectiveness of nonpoint source controls can be more easily accomplished on an annual basis rather than a daily basis.

For most lakes, it is appropriate and justifiable to express a nutrient TMDL in terms of allowable annual loadings. The annual load should inherently account for seasonal variations by being protective of the most sensitive time of year. The most sensitive time of year in most lakes occurs during summer, when the frequency and occurrence of nuisance algal blooms and macrophyte growth are usually greatest. Because these phosphorus TMDLs were established to be protective of the most environmentally sensitive period (i.e., the summer season), it will also be protective of water quality during all other seasons. Additionally, the targeted reduction in annual phosphorus load to the ponds will result in the application of phosphorus controls that also address seasonal variation. For example, certain control practices such as stabilizing eroding drainage ways or maintaining septic systems will be in place throughout the year while others will be in effect during the times the sources are active (e.g., application of lawn fertilizer).

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.

Recent field visits, past studies, and this WBP's loading model suggest that stormwater runoff and sediment from forests, residential areas, and roads around the lake are likely the largest contributors of phosphorus and sediment loading in Lake Wyola. Management measures around Lake Wyola could therefore be selected and designed to stabilize roads, slow stormwater flow, and capture sediment.

Opportunities for Management Measures

The following section outlines general site characteristics and a general proposal for management measures for the Lake Wyola watershed. Recommendations fall into the categories of watershed management/capacity building, structural BMPs, and nonstructural BMPs. *Structural BMPs* are designed to remove pollutants from stormwater runoff or reduce the volume of stormwater runoff. *Nonstructural BMPs* are focused on pollutant reduction, management of pollutants, and preservation of natural features through management and maintenance practices. Further study will be essential to solving water quality challenges in this watershed.

This WBP proposes implementation of structural BMPs within seven sites to reduce phosphorus and sediment loading to Lake Wyola (Figure C-1) based on desktop analysis, site visits by the FRCOG (2022, 2023) and CEI (2022), and the DCR/Scott Campbell stormwater study published in 2007. Recommended structural BMP types should focus on slowing and spreading the flow of surface waters (surface runoff and stream flow) around the lake and reducing any areas of erosion in the uplands. In order to properly design and prioritize these structural measures, it is recommended to fund an H&H study of the entire watershed, an engineering study of Sites 1 through 6, and a fluvial geomorphic study of Site 7 to identify the best location and type of BMPs. BMPs for Sites 1 through 4 and 7 are high priority relative to sites 5 and 6 due to the likely amount of phosphorus and sediment loading and the annual costs incurred by damage to roads in these areas. A number of recommended nonstructural BMPs focus on maintenance of roads and existing structural BMPs and on reducing pollution at its source.

Sites 1 through 6 are almost entirely privately owned. In general, funding and constructing water quality improvement and protection projects such as stormwater BMPs will happen more readily on Town-owned properties because there are several grants programs the Town of Shutesbury can access and the Town has full control over site selection, design, construction and maintenance on Town-owned land. While some grants will fund these types of projects on private property as part of a public/private partnership, the grant funder will

typically require an access agreement (stormwater easement) that has been negotiated with a willing landowner to ensure the structures can be inspected and maintained. If there are municipally owned parcels located in Sites 1 – 6, these would be the best place to consider for BMPs. Otherwise, the Town's would need to work with LWA and with private landowners who voluntarily agree to have stormwater BMPs on their land with public access agreements that are maintained by the Town. The LWA and private residents would sign an agreement to have their property surveyed for site suitability and provide permission for installation when funding is secured. The LWA could pursue funding for BMPs on their own property as well, but funding availability is more limited for private organizations.

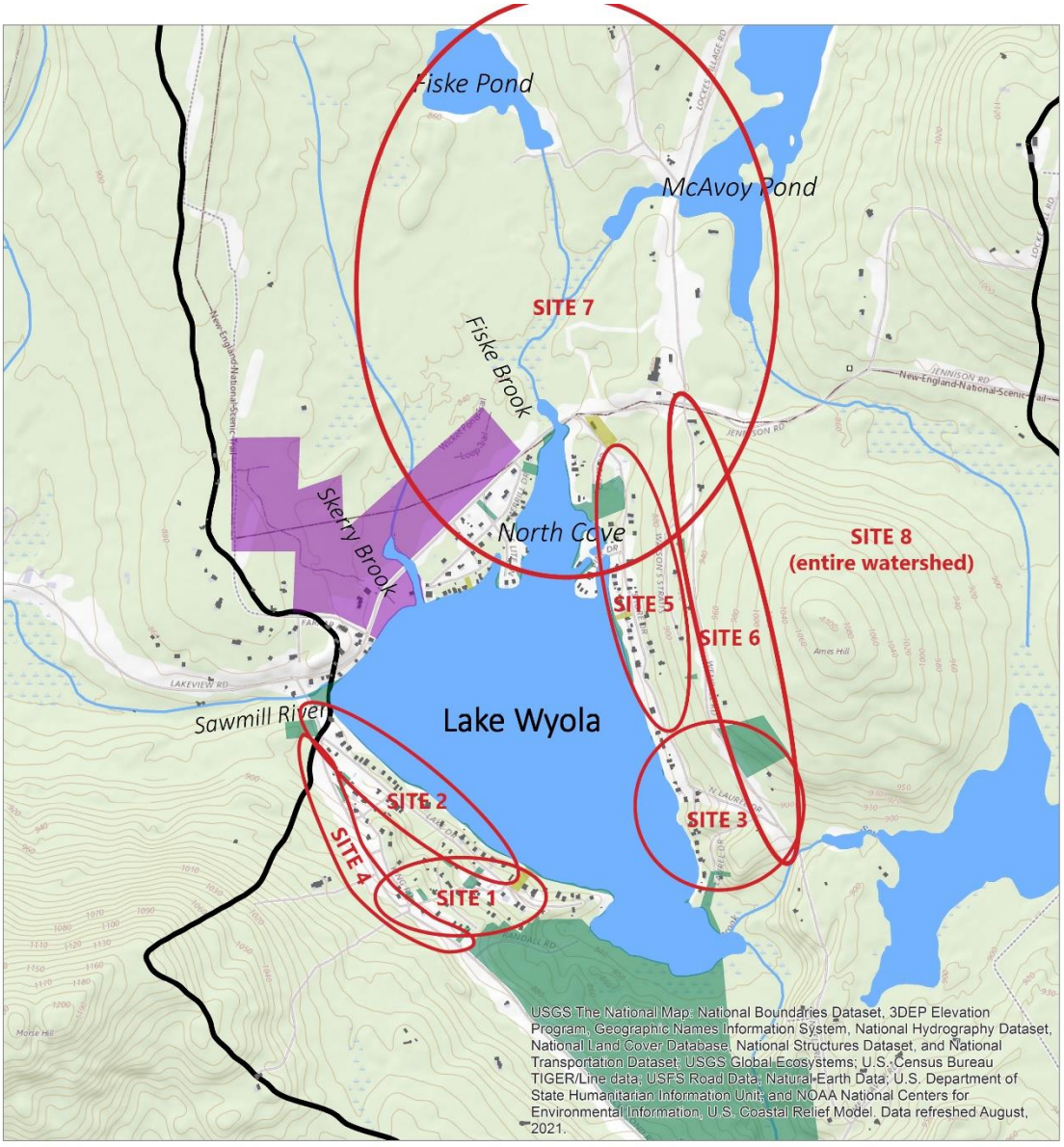

Figure C-1: Proposed BMP implementation sites (approximate)

Structural BMPs

General site characteristics and a general proposal for management measures are listed for each site shown (approximately) in Figure C-1. Conceptual-level recommendations for Sites 1 through 6 were developed by CEI (2022), Campbell (2007), and FRCOG staff. The recommendations of the 2007 Campbell report were brought forward in general terms because it is assumed that determination of specific BMPs would need to incorporate new climate and precipitation data, design standards, and any changes in hydrology in the 15 years since the report was written. Recommendations for Site 7 were developed by the FRCOG in consultation with CEI. A list of all of the potential BMPs and their pollutant load removal percentage rating is included in Table C-1 at the end of the Structural BMPs section.

Structural BMPs generally fall into the categories of conveyance, pretreatment, and treatment. Treatment BMPs filter pollutants, typically using soils (often engineered) and vegetation (often native). Pretreatment techniques keep a treatment BMP from being overloaded by slowing the flow and settling out sediment and other solids before stormwater reaches a treatment BMP. Pretreatment can be especially helpful when phosphorus pollution is a result of sedimentation. Pretreatment BMPs can include deep sump catch basins, vegetative filter strips, oil/grit separators, and sediment forebays. A treatment train is a sequence of stormwater BMPs that include both pretreatment and treatment.

Volume 2 of the Massachusetts Stormwater Handbook provides a wealth of information on structural BMPs both pretreatment, treatment, and conveyance. Outlined here are a few of the most effective BMPs for removing phosphorus:

Vegetated Stream Buffers

An excellent BMP for lake or streamside homeowners is to install a vegetative buffer along their shoreline. Vegetative buffers can be anywhere between 10 ft. and 100 ft. wide and typically are a mix of upload trees and shrubs down to riparian herbaceous plant species.

Rain Gardens

Rain gardens are depressions in the ground filled with sand, soil media, and mulch intended to filter runoff that's directed into it. Rain gardens can remove up to 90% of phosphorus when designed large enough and/or paired with pretreatment systems. These structures can be lined and piped to prevent infiltration in high pollutant areas or left unlined to allow for exfiltration and groundwater recharge (MassDEP, 2016b). A co-benefits of rain gardens is the opportunity to install pollinator friendly plant species and provide native habitat. These systems are especially effective at treating the "first flush" aka initial runoff of stormwater, which contains the most amount of nutrient pollution.[56]

Infiltration Basins

Infiltration basins are impounded sections that catch stormwater runoff, usually by way of a pretreatment basin. As the name suggests, these systems allow stormwater to infiltrate and are sometimes constructed with more than one chamber to catch varying amounts of volume. Infiltration basins are estimated to remove 60%-70% of phosphorus if constructed properly. It should be noted that

[56] Zeng 2019

infiltration basins should be sited some distance away from steep gradients (15% or more) in order to properly capture and retain stormwater.

Bioswales aka Water Quality Swales

Bioswales are shallow linear depressions that collect, slow down, and absorb stormwater from nearby areas. Bioswales can be landscaped with native plants, or simply seeded with grass to reduce maintenance need. At times, rock veins or rip rap are installed along the bioswale to reduce stormwater velocity, allowing more of the water to infiltrate and alleviate flashy flow conditions. Bioswales can be one of the most effective ways to remove phosphorus with an estimated removal rate similar to rain gardens and bioretention basins (20% - 90%). They are excellent ways to capture water along roadsides and driveways with curb cutting or sheet flow directed into them.

Infiltration Trenches

In situations where space is limited, an infiltration trench can remove significant phosphorus (40% - 70%). Infiltration trenches are typically linear rectangular trenches filled with sand, gravel, and stone substrate that runoff is directed into and allowed to exfiltrate through the bottom into the subsoil.

Media Filters (Sand, Organic or Proprietary Media Mix)

For a less visible BMP, media filters provide filtration of stormwater underground in a two-chamber concrete system filled with media tailored to remove phosphorous. This media could be a mix of sand, loam, peat, mulch or other removal material such as steel wool.

BMPs can be designed for future storm sizes. In 2020, the MassDEP Stormwater Advisory Committee presented recommendations for updating the MassDEP Wetlands Regulations and Stormwater Handbook that included replacing the use of the Rainfall Frequency Atlas (TP40) with NOAA Atlas 14 and calculating stormwater estimates based on 90% of the upper bound of the 90th percentile confidence interval (a method referred to as NOAA14+).[57] Some communities are practicing NOAA14++ and basing stormwater estimates on the upper bound of the 90th percentile confidence interval. Using the New Salem, MA weather station, the NOAA14+ method estimates the following rainfall amounts for 24-hour storms:

100-year interval/24-hour storm:	10.8 inches
10-year interval/24-hour storm:	5.57 inches
2-year interval/24-hour storm:	3.47 inches

NOTE: Some of the sites described below include private property. Discussions with landowners and the identification of landowners willing to have a stormwater BMP on their property will be key to the success of a project that involves private property.

[57] MassDEP Stormwater Advisory Committee 2020

Site 1: Great Pines Drive, King Road, Birch Drive, Haskins Way, and Oak Knoll

Construct a series of water bars, new rock-lined swales (ditches), and turnouts with sediment-trapping features along these roads to reduce the channelization, erosion and sedimentation from stormwater runoff. Redirect stormwater runoff to wooded areas as best as possible. Follow dirt roads best management practices outlined in the FRCOG's Dirt Roads Management Toolkit (2024).

The 2007 Campbell report recommends 12-inch drainage cross culverts at the intersection of Great Pines Drive and King Road. Since the Campbell report is now 15 years old and updated precipitation data is available, the recommended size of these culverts (12-inch) should be reevaluated to ensure the structures would be climate resilient. It is likely that the cross culverts would need to have a larger diameter.

Continue to re-crown roads at this site to maintain a proper crown, defined as having a modified "A" cross-section crown with a ½ inch to ¾ inch per linear foot of road width.[58]

The portion of King Road where road maintenance has been discontinued due to perennial erosion could be considered as an area for a multi-BMP treatment train, depending on the status of the drainage under the Wetlands Protection Act. The Lake Wyola Association owns the former road segment, but the surrounding parcels are privately owned, so the support and participation of the landowners would be needed for this approach.

A system of infiltration, conveyance, and pretreatment is needed for the intersection of Great Pines Drive and Lake Drive, such as the combination of deep-sump or leaching catch basins, underground conveyance, and rip rap plunge pool and leaching basin proposed by the 2007 Campbell report, or other treatment trains determined by an engineering study.

Conveyances that drain stormwater directly toward the lake from this area should be retrofitted with pretreatment BMPs or full treatment trains that filter out pollutants and infiltrate runoff. In cases where those conveyances become underground pipes, those treatment trains would have to be upstream of the pipe inlet. The Conservation Commission reports that they do not currently know where all of the outfalls cited in the 2007 Campbell report are, so identification of those outfall locations would be a component of an H&H study.

Site 2: Lake Drive

Disburse water off the road more often than under current design. Methods could include:

- Building up the elevation of the road to meet grade of residential lawns and recrown so water is dispersed off the side of the road along the length of the road.
- Construct water bars and swales to disburse stormwater more often. Make sure water bars are directed to areas appropriate for disbursing or capturing stormwater.
- Install deep-sump and or leaching catch basins where feasible.

Disconnect turnouts from streams or places where water often drains. Turnouts can be curved back 180 degrees to capture sediment and re-disperse water without it reaching a waterbody.

[58] Vermont gravel road standard for crowns: VTrans 2019

Identify willing landowners who are interested in working with the Town of Shutesbury and/or Lake Wyola Association for the placement of BMPs on private property.

Study the existing stormwater infrastructure on the LWA Beach to see if there are opportunities for improvement. The 2007 Campbell report recommends a leaching catch basin on the Lake Association beach property, and if an outlet is needed for this catch basin, a riprap plunge pool and leaching basin. This could be tied into the existing LWA basin.

Locate LWA-provided gravel piles away from streams and places where water often drains.

Site 3: North and South Laurel Drive

Install water bars across driveways in close proximity to Lake Wyola to reduce direct contributions of stormwater runoff to the waterbody.

Remove sediment from existing turnouts along North and South Laurel Drive and install additional turnouts (as adjacent grades allow), particularly on the sections of road nearer the lake.

Install a rock-lined ditch and sediment filtration basin on the upslope side of South Laurel Drive where it runs parallel to the lake.

Site 4: Locks Pond Road

Work with owners of private driveways on the west side of Locks Pond Road to install more waterbars and turnouts to direct water off their driveways into adjacent woods.

Install water bars or similar diversion structures at the intersections with nearby roads, such as Great Pines Drive, Stebbins Pond Road, Dove Lane, King Road, and Randall Road, to reduce concentrated flows down these roads and direct stormwater instead to wooded areas. Install turnouts at the end of water bars to enhance sediment capture. These sediment traps would ideally be rock-lined and flow into naturally vegetated roadside areas.

According to the 2007 Campbell report, the outlets of the culverts that convey water under Locks Pond Road lack armoring and should be considered for BMPs such as rock-lined splash pads or outlet sediment traps. Because many of these culverts convey water that eventually reaches the outfalls along the lake, the culvert outlets and downstream areas are ideal locations for BMPs that slow and infiltrate the flow, such as check dams, and pre-treatment BMPS, such as sand filters.

Site 5: Shore Road and Pine Drive

Recrown Shore Road, enlarge ditches, and fully armor ditches on the east side of the Shore Road.

Install water bars in driveways along the west side of Shore Road to divert stormwater away from Shore Drive and into vegetated or rock-lined BMPs on private property, such as rain gardens or biofiltration swales. For efficient and longer-term functioning, waterbars should connect to rock-lined or vegetated turnouts or rain gardens in private yards. Most driveways appeared to be in acceptable condition in 2023, although several could benefit from these low-cost retrofits.

Consider adding additional treatment train elements to the existing ditch and sediment basin alongside Pine Drive, such as check dams or turnouts with outlet protection.

Site 6: Wendell Road

Ensure through proper crowning and grading that road drainage sheet flows off into the woods with minimal channelization. Areas where channelization is occurring could be retrofitted with turnouts designed to capture sediment.

Table C-1: Potential BMPs for Sites 1 – 6

BMP Type	TP Loading Reduction Potential (%)	TSS Loading Reduction Potential (%)[59]
Bioretention basin	30 to 90%	90% when combined with pretreatment
Bioretention/water quality swale	20 to 90%	70% when combined with pretreatment
Culvert	N/A	N/A
Deep sump catch basin	Insufficient data	25%
Leaching catch basin	Insufficient data	80%
Sand and organic media filters	10 to 50%	80% when combined with pretreatment
Road regrading/crowning	N/A	N/A
Rock-lined splash pad	N/A	N/A
Outlet sediment trap	Insufficient data	25%
Check dam	N/A	N/A
Sediment forebay	Insufficient data	25%
Turnout with level spreader	N/A	N/A
Waterbar	N/A	N/A

All Sites 1 thru 6

Complete a full engineering study, including any necessary hydraulic and hydrologic (H&H) modeling of anticipated future storm events using NOAA Atlas 14+ design storms to identify and correctly design and size BMPs for Sites 1 thru 6. Evaluate existing structural BMPs for whether they are functioning as designed or need retrofitting.

Encourage appropriately sized and aesthetically pleasing structural BMPs in private residential and public yards to control pollution at the source and reduce runoff:

[59] Load removal estimates provided by the Massachusetts Clean Water Toolkit and UNH Stormwater Center

- Install rain barrels to catch roof runoff
- Install pervious driveways
- Disconnect downspouts from impervious surfaces and encourage it and any other water flow from house and driveway into vegetated areas
- Encourage installation of rain gardens, vegetated swales, and riparian buffers to provide storage, infiltration, and cleansing of stormwater
- Seed bare spots to reduce erosion
- Replace turf grass with native plants and shrubs
- Discourage waterfowl feeding
- Pick up dog waste

Site 7: Fiske Brook Watershed

With the goal of restoring the historical depth of and reducing the rate of sedimentation in Lake Wyola in mind, LWAC asked the FRCOG to consider Fiske Brook and the confluence of Fiske Brook with Lake Wyola as a focus area for nonpoint source pollution BMPs. The FRCOG consulted with CEI, who concluded that from a wetlands permitting perspective, it is explicitly not permissible to put stormwater BMPs in the wetland north of Lakeview Road. It is possible that with the purchase of land and excavation, there could be an opportunity to create a sedimentation settling/storage BMP adjacent to the wetland north of Lakeview Road. A feasibility study for this kind of project would cost an estimated $15,000 to $20,000 and the installation of the BMP itself over $1 million, according to CEI's estimate. Currently, North Cove functions as a settling basin for the rest of the lake, so dredging North Cove and increasing its storage capacity would serve the same function as creating more sediment storage capacity upstream of North Cove.

An important approach to reducing sedimentation is to better understand and address the various sources of sediment in the Fiske Brook watershed. A comprehensive fluvial geomorphic study would help identify causes of channel instability and erosion, sedimentation, and habitat degradation. It would also assess road-stream crossings for whether these structures are properly sized and designed for their location in the stream. It could also identify projects that use Nature-Based Solutions (sustainable management and use of natural features) for the upland watershed area (entirety of Fiske Brook). These types of projects slow and spread the stormwater runoff and trap sediment, protect and restore water quality, enhance habitat, and provide flood resiliency benefits.

Site 8: General watershed

The entire Lake Wyola watershed would strongly benefit from a Hydrologic and Hydraulic (H&H) study that estimates peak flow, floodwater elevations, flow velocities, and flow paths under current and projected future conditions under climate change and a sediment study that assess the quality and quantity of sediment loading to the lake. The results would inform the sizing and type of stormwater. Done in conjunction with a fluvial geomorphic assessment, an H&H study could project the risk of future storms on the manmade and beaver dams in the Fiske Brook watershed and the potential downstream impact of those storms.

Nonstructural BMPs

A recommendation to modify or develop stormwater regulations was not included in this plan because it is understood that the area directly surrounding Lake Wyola is mostly built out and because stormwater regulations would not apply to the predominantly private roads around the lake. Management measures that could be written into stormwater regulations can alternatively be described and recommended as residential BMPs for residences and dirt road BMPs for public and private road managers.

Water Quality Monitoring

Develop a QAPP and expanded water quality monitoring plan for Lake Wyola. Water quality testing should include the three Lake Wyola Association beaches and any historic testing sites. Coordinating the Town's monitoring program with DCR sampling at the Lake Wyola State Park Beach would provide a more full picture of the lake; obtaining previous beach testing data from DCR would provide an important baseline. E. coli sampling test types that can identify human versus animal bacteria would aid in efforts to discern between any high E. coli levels coming from dogs, beaver, or waterfowl as opposed to human sources.

Further Assessment

As previously mentioned, background engineering studies are needed to better understand the area's hydrology and sediment movement. Prior to selecting and structural BMPs, this plan recommends an H&H study of the whole watershed, a sediment loading study, a study of existing BMPs, and a fluvial geomorphic study of Fiske Brook. Several of these studies could be combined for cost savings.

The majority of roads in close proximity to Lake Wyola are gravel, or in many cases surfaced with a material with a high content of sand and fine-grained aggregate. Drainage infrastructure within close proximity to the pond is largely nonexistent, with stormwater mostly reaching the lake through pipes (with not all pipe outlet locations known) or a series of informally constructed swales. Road erosion has been identified as a potentially significant source of sediment contribution to Lake Wyola.

Complete a comprehensive road evaluation study to identify road segments that would benefit from installation of road surface material more resistant to stormwater erosion. Road retrofits would be expected to consist of stony material, or possibly pavement in some places. This project would likely include developing a road resurfacing specification and/or detail for use on existing sand and gravel roads, and could be used by both the Town and private entities who maintain private roads. Primary candidate roads include nearly all roads along the western side of the lake (Lake Drive, Great Pines Drive, Oak Knoll, Birch Drive, Haskins Way, King Road, and Stebbins ROW), as well as North and South Laurel Drive on the eastern side of the lake. Although road ownership is complicated in this area, applications for funding are often strengthened by having a number of cooperating stakeholders.

Stormwater Bylaws

Study existing zoning and subdivision for opportunities to update stormwater standards for development.

Road and BMP Management and Maintenance

Work with existing resources, including FRCOG's Dirt Roads Toolkit (2024) and the *Gravel Road Maintenance Manual: A Guide for Landowners on Camp and Other Gravel Roads*,[60] and consultants such as FRCOG, Bay State Roads, the Shutesbury Highway Superintendent, and other experienced groups to identify improvements to the LWA and residents' dirt road maintenance practices. For example, potholes may not be able to be repaired by residents filling them in, but may need to be regraded for successful repair.

Develop an Operation and Maintenance Plan (O&M Plan) for existing and proposed BMPs and road management on LWA roads to ensure the BMPs function as designed and to identify the responsible parties that have agreed to implement the O&M Plan. For example, water bars on private driveways can be an effective, inexpensive measure but also require regular inspection and frequent cleaning to protect against failure due to overtopping and sediment build-up. Other BMPs will also need regular inspection and maintenance to ensure proper functioning and longevity.

Consider forming a Roads Association that includes members and non-members of LWA to manage roads and create a funding structure for road management.

Continue municipal street sweeping, catch basin cleaning, and reduced salt and sand application on applicable roads around the lake (Locks Pond Road and Lakeview Road). Evaluate these road management BMPs to see if potential improvements, such as increased frequency or improved technology, can be implemented to achieve higher pollutant load reductions. For example, if catch basins or culverts are filling more frequently than once or twice a year, the Highway Department could implement a policy to check and clean them more frequently, or if there are improved standards for salt and sand application, or street sweeping, implement the higher standards.

Wildlife Management

Consider a beaver management policy or hire a consultant to create a comprehensive beaver management plan for the watershed that is grounded in Nature-Based Solutions. A beaver management plan could help the watershed community better manage flood resiliency and possibly water quality. Given the location of beaver in the Wendell portion of the watershed, the Town of Wendell should be consulted in this action.

Continue existing waterfowl (geese) control practices. Encourage residents and visitors not to feed waterfowl.

Education and Outreach

Expand on the residential education conducted as part of the 2000 s.319 project (00-16/319) by providing outreach materials about lake-friendly landscaping, including structural BMPs and practices that property owners can adopt to protect water quality, listed above under All Sites 1 – 6. Residential projects would be very helpful to showcase these practices and increase homeowner interest.

Conduct educational site visits to State Park beach and residential properties with pre-existing or newly install BMPs.

[60] Maine DEP 2016

Continue Board of Health outreach to landowners on proper septic design, maintenance, and financial assistance opportunities for system owners looking to repair, replace, or upgrade failed septic systems.[61]

[61] https://www.mass.gov/guides/title-5septic-systems-financial-assistance-opportunities-for-system-owners

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.

The WBP template includes Table D-1, which presents the funding needed to implement some of the management measures presented in this watershed plan. The table includes costs for structural and non-structural BMPs, operation and maintenance activities, information/education measures, and monitoring/evaluation activities. Cost estimates for funding needed to implement the management measures have been estimated based on similar projects that FRCOG is familiar with, but these costs could likely increase as time passes. This table will be updated to include further detail once the described studies are completed.

When the Town of Shutesbury is listed as the Relevant Authority, this would include the Highway Department, Conservation Commission, Select Board, Board of Health, and LWAC, as appropriate. The purpose of the LWAC is to serve as a liaison between Town government, the Lake Wyola Association (Association), and the lake community as a whole. It aims to promote the preservation, maintenance, and enhancement of the lake as a natural and recreational resource. Its purview includes protection of water quality from septic systems and other sources of contamination, nuisance weed and sediment removal, erosion and runoff control, and dam safety. Regular water quality assessment and oversight of the dam are also the responsibility of the committee.

Table D-1: Summary of Funding Needed to Implement the Watershed Plan.

Management Measures	Capital Costs	Operation & Maintenance Costs	Relevant Authorities	Technical Assistance Needed	Funding Needed	Notes
Structural and Non-Structural BMPs (from Element C)						
Watershed Hydraulic & Hydrologic (H&H) Study	Not applicable	Not applicable	Towns of Shutesbury and Wendell, LWA	Engineering consultant	$30,000	Engineering studies, with the exception of the road surface study, could be combined into single study for cost savings.

Management Measures	Capital Costs	Operation & Maintenance Costs	Relevant Authorities	Technical Assistance Needed	Funding Needed	Notes
Sediment loading study	Not applicable	Not applicable	Towns of Shutesbury and Wendell, LWA	Engineering consultant	To be determined	Engineering studies, with the exception of the road surface study, could be combined into single study for cost savings.
Fiske Brook Fluvial Geomorphic Assessment	Not applicable	Not applicable	Towns of Shutesbury and Wendell, LWA	Fluvial geomorphic engineering consultant	$35,000	Engineering studies, with the exception of the road surface study, could be combined into single study for cost savings.
Evaluation of existing structural stormwater BMPs	Not applicable	Not applicable	Town of Shutesbury, LWA	Engineering consultant	To be determined	Engineering studies, with the exception of the road surface study, could be combined into single study for cost savings.
Engineering study of potential stormwater BMPs	Not applicable	Not applicable	Town of Shutesbury, LWA	Engineering consultant	To be determined	Engineering studies, with the exception of the road surface study, could be combined into single study for cost savings.
Road surface study	Not applicable	Not applicable	Town of Shutesbury, LWA	Road engineering consultant	To be determined	
Installation of new structural stormwater BMPs	To be determined	To be determined	Town of Shutesbury, LWA	Engineering consultant, Contractor	To be determined	Stormwater BMPs and costs for design and installation will be determined by future studies.
Lake Wyola Association road and BMP operation and maintenance (O&M) plan	To be determined	To be determined	LWA	Engineering consultant	To be determined	The O&M Plan for the stormwater and road maintenance BMPs would identify capital costs and O&M costs.
Beaver Management Plan	To be determined	To be determined	Town of Shutesbury	Engineering consultants	To be determined	
Shutesbury Highway Department best practices: street sweeping, catch basin cleaning, reduced salt application.	Potentially, if equipment is needed	To be determined	Town of Shutesbury	Engineering consultant	To be determined	An engineering consultant could develop an O&M plan for Town roads.
Waterfowl control practices when needed	Not applicable	Likely minimal	DCR	None	To be determined	

Management Measures	Capital Costs	Operation & Maintenance Costs	Relevant Authorities	Technical Assistance Needed	Funding Needed	Notes
			Town of Shutesbury, LWA			
Information/Education (see Element E)						
Signage	$3,000 – $10,000	Not applicable	Town of Shutesbury, LWA	Consultant, FRCOG	$3,000 – $10,000	
Project updates (website and social media posts)	Not applicable	To be determined	Town of Shutesbury, LWA	None	Not applicable	
Educational materials and/or presentation for residents	$1,500	To be determined	Town of Shutesbury, LWA	Consultant, FRCOG	$1,500	
Public education site visits to demonstration projects	Not applicable	To be determined	Town of Shutesbury, LWA	Consultant, FRCOG	To be determined	
Road management best practices training to private and public road maintenance staff	Not applicable	To be determined	Town of Shutesbury, LWA	Consultant	To be determined	
Monitoring and Evaluation (see Element H/I)						
Sampling QAPP	Not applicable	Not applicable	Town of Shutesbury, LWA	$6,000	$6,000	Estimated cost; will vary widely depending on level of detail
Annual water quality sampling	Not applicable	Not applicable	Town of Shutesbury, LWA	$10,000	$10,000	Extent of sampling program TBD, this is placeholder estimate
BMP monitoring	Not applicable unless specific equipment was needed as recommended in the O&M Plan	To be determined. Estimates of annual costs would be	Town of Shutesbury, LWA, land owners and volunteers	Training of volunteers might be needed. Town staff might need training on BMPs for stormwater	$2,500 for annual training and printing of outreach materials	Funding for the O&M Plan implementation could come from the Town's Chapter 90 Program funding and Lake Wyola Association dues

Management Measures	Capital Costs	Operation & Maintenance Costs	Relevant Authorities	Technical Assistance Needed	Funding Needed	Notes
		provided in the O&M Plan.		and road maintenance		
				Total Funding Needed	**To be determined**	

Potential Funding Sources:

- 604b Water Quality Management Planning Grant Program
- Section 319 Nonpoint Source Competitive Grant Program
- Municipal Vulnerability Preparedness (MVP) Action Grant Program (only the Town is eligible to apply)
- Long Island Sound Futures Fund (LISFF) through the National Fish and Wildlife Foundation (NFWF)
- Lake Wyola Association Environmental Fund
- Lake Wyola Association dues
- Town Ch. 90 funds
- Town Capital Funds
- Town Wetland Funds (i.e., filing fees to enforce Massachusetts Wetlands Protection Act)
- Town Community Preservation Act Funds
- Massachusetts Environmental Trust
- FEMA Hazard Mitigation Grant
- Volunteer time for public outreach and monitoring

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.

Step 1: Goals and Objectives

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

1. Educate Town staff and residents about the health of Lake Wyola, including the potential sources of nonpoint source pollution and geomorphic impairments. Ensure that outreach is inclusive of residents that do not receive information from the Lake Wyola Association and includes renters.
2. Promote a comprehensive approach to ongoing stormwater management, including road BMPs and residential BMPs.
3. Incorporate water quality and stormwater management principles and practices into local school curriculum.

Step 2: Target Audience

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

1. Lake Wyola Association and Lake Wyola Advisory Committee
2. Lake Wyola-area residents
3. Town of Shutesbury staff, including the Highway Department
4. Shutesbury and Wendell Elementary School students

Step 3: Outreach Products and Distribution

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

1. Provide general information about nonpoint source pollution, sources, and mitigation in Franklin County via promotion of the Franklin County Healthy and Climate Resilient Rivers online StoryMap.
2. Work with the Lake Wyola Association and Lake Wyola Advisory Committee to develop educational outreach, in the form of materials or presentations, to lake residents about the risk of increased heavy precipitation events and stormwater runoff, and about structural and nonstructural residential BMPs to residents. Use the Lake Association's mailing list and Town newsletter.
3. Lake Wyola Association host best road management practices workshops for residents on a regular basis. This could be paired with the annual Road Work Party.
4. Develop and post informational signs at completed BMP locations.

5. Conduct three tours of installed BMPs, open to the public.
6. Post this WBP and project information on the Town of Shutesbury website and on the Lake Wyola Association Facebook page.
7. When completed, obtain the FRCOG's Dirt Roads Toolkit for the Town of Shutesbury Highway Department and Lake Wyola Association to inform good dirt road maintenance and stormwater management. Attend FRCOG workshop to train Highway Departments on dirt road management BMPs and the use of the Dirt Roads Toolkit.

Step 4: Evaluate Information/Education Program

Information and education efforts and how they will be evaluated.

1. Track the number of educational materials distributed in hardcopy or by email.
2. Attach a counter to websites and other social media to evaluate visits and download of materials.
3. Track the number of BMPs installed.
4. Track the number of informational signs installed.
5. Track the number of site visits/presentations conducted and attendees.

Elements F & G: Implementation Schedule and Measurable Milestones

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

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

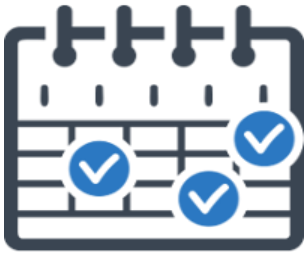

Table FG-1 provides a preliminary schedule for implementation of recommendations provided by this WBP. It is expected that the WBP will be re-evaluated and updated at least once every three (3) years, or as needed, based on ongoing monitoring results and other ongoing efforts.

Table FG-1: Implementation Schedule and Interim Measurable Milestones

Category	Action	Estimated Cost	Year(s)
Monitoring /Evaluation	Write Quality Assurance Project Plan (QAPP) for sampling and establish water quality monitoring program.	$6,000	2025
	Document estimated pollutant removals from existing BMPs in the watershed	TBD	Annual
	Recruit and train volunteers for monitoring program.	$2,500	Annual
	Perform annual water quality sampling and BMP monitoring per Element H&I monitoring guidance.	TBD	TBD
	Distribute water quality and BMP monitoring results through annual report card.	TBD	Annual
Structural BMPs	Obtain funding for and implement 3 to 9 BMPs in the four priority areas (average 1 to 3 BMPs per year)	TBD	2026 – 2028
Nonstructural BMPs	Watershed hydraulic and hydrologic engineering study (H&H)	$30,000	2024
	Sediment loading study	TBD	2024
	Fiske Brook fluvial geomorphology study (FGM)	$35,000	2024
	Evaluation of existing structural stormwater BMPs	TBD	2024
	Engineering study of potential stormwater BMPs	TBD	2024
	Road surface study	TBD	2024
	Lake Wyola Association road and BMP Operation & Management (O&M) Plan	TBD	2025
	Study zoning and subdivision bylaws for opportunities to update stormwater requirements for new development.	TBD	2024
	Ongoing Shutesbury road maintenance BMPs	TBD	2025 and ongoing
	Waterfowl control	TBD	As needed
Public Education and Outreach *(See Element E)*	Signage	$3,000 – $10,00	2026
	Project updates (website posts)	N/A	On-going
	Educational Materials and/or presentation	$1,500	Annual
	Site visits	TBD	2026
	Road management best practices training to private and public road maintenance	TBD	2025 – 2026
Adaptive Management and Plan Updates	Charge a group with establishing a working group comprised of stakeholders and other interested parties to implement recommendations and track progress. Meet at least twice per year.	Volunteer	2024
	Re-evaluate Watershed-Based Plan at least once every three (3) years and adjust goals and plan, as needed, based on monitoring results and other observations and experiences.	**TBD**	**Every 3 years from beginning of WBP implement ation**
	Delist Lake Wyola from the 303(d) list.	--	**As soon as possible**

Elements H & I: Progress Evaluation Criteria and Monitoring

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

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

The water quality target concentrations are presented under Element A of this plan. To achieve this target concentration, the annual loading must be reduced to the amount described in Element B. Element C of this plan describes the various management measures that will be implemented to achieve this targeted load reduction. The evaluation criteria and monitoring program described below will measure the effectiveness of the proposed management measures (described in Element C) in protecting and improving the water quality of Lake Wyola.

Direct Measurements

Direct measurements are generally expected to be performed as described below. Prior to implementing a direct measurement program, a quality assurance project plan (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; however, it is noted that an organization of volunteers would still require funding.

In-Lake Phosphorus and Water Quality Monitoring

Based on a literature review and communication with stakeholders summarized in Element A of this plan, Lake Wyola does not have a monitoring plan. The most recent known water quality sampling for TP was analyzed by the UMass Amherst Environmental Analysis Lab on behalf of the Lake Wyola Advisory Committee (2014). Regular in-lake phosphorus measurements will provide the most direct means of evaluating the effects of the measures in the plan than have been proposed specifically to reduce phosphorus loading. It is recommended that sampling be performed at the same locations as prior sampling. Additional stations could also be included at locations of interest.

Abiotic and Biotic Monitoring

Water quality monitoring for recreation and to assess the impacts of drawdown are additional goals of the community. If the Town were to move forward with a monitoring program, it may consider consulting the DEP about the creation of a monitoring program that serves multiple community goals and provides reliable data for the state to use in their 303(d) listing process.

It is recommended that water quality testing data be coordinated by a single stakeholder and reported to a single, publicly accessible location.

BMP, TSS, and Flow Monitoring

As feasible, the effectiveness of existing and proposed structural BMPs will be evaluated by routine inspection during and after storm events to measure amounts of sediment collected (i.e., sediment traps, catch basins, etc.). As feasible, TSS and discharge will also be periodically measured at the watershed's major outfalls to the lake in the Lake Drive neighborhood during notable storm events with a goal to capture up to four events per year. TSS and discharge measurements can later be converted to estimates of annual loading to the lake. Results from this monitoring effort will aid in better characterizing base loading to the lake.

Indirect Indicators of Load Reduction

Potential load reductions from non-structural BMPs, such as street sweeping and catch basin cleaning, can be estimated from indirect indicators, such as the number of miles of streets swept or the number of catch basins cleaned. As indicated by Element C, it is recommended that potential pollutant removal from these ongoing activities be estimated, particularly for TSS. Next, it is recommended that ongoing activities be evaluated to see if potential improvements can be implemented to achieve higher pollutant load reductions with increased frequency or improved technology.

Additionally, since there is significant erosion of the largely sand-based Lake Wyola Association roads, it is recommended that road condition be tracked. The LWA pays for maintenance (grading and fill) of these roads annually, so these locations and costs can be tracked over time.

Project Specific Indicators

To be determined by the BMP engineering study described in Element C.

TMDL Criteria

Lake Wyola currently meets the TMDL criteria for TP established in the 2002 *Total Maximum Daily Loads of Phosphorus for Selected Connecticut Basin Lakes*.

Adaptive Management

As discussed by Section 3 of Element B, the baseline monitoring program will be used to establish a long-term (i.e., 10 year) 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 total phosphorus concentrations measured within Lake Wyola, the management measures and loading reduction analysis (Elements A through D) will be revisited and modified accordingly.

The working group charged with stewarding the Lake Wyola WBP will implement recommendations from this WBP and track overall progress. The working group will continue to prepare an annual “snapshot” progress report for dissemination to the public. The progress report will re-iterate goals of this WBP, will summarize indirect indicators, project-specific indicators (once they have been established), and direct measurements as they relate to established water quality goals, and will provide an indication of ongoing outreach efforts and overall next steps.

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Water Quality Assessment Reports

"*Connecticut River Watershed 2003 Water Quality Assessment Report*"

TMDL

"*Total Maximum Daily Loads of Phosphorus for Selected Connecticut Basin Lakes* "

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
INDUSTRIAL, HSG B	0.12	29.4	1.2

Land Use & Cover[1]	PLERs lb/acre/year)		
	TP)	TSS)	TN)
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			

Appendix B – CEI *Stormwater Improvement Opportunities* Technical Memorandum

Technical Memorandum

To: Kimberly Noake McPhee, Franklin Regional Council of Governments (FRCOG)
Tamsin Flanders, FRCOG

From: Nick Cristofori, P.E., Comprehensive Environmental Inc. (CEI)
Bob Hartzel, CEI

Date: May 10, 2022

Subject: Stormwater Improvement Opportunities – Lake Wyola Watershed (Shutesbury, MA)

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1. INTRODUCTION

1.1 Project Overview

Lake Wyola is a 124-acre lake located in Shutesbury, MA. Lake Wyola is listed in the Massachusetts 2018/2020 Integrated List of Waters for a Total Phosphorus impairment. A related Total Maximum Daily Load (TMDL) for this Lake was completed and approved by the USEPA in April 2002. Stormwater pollution is a direct source of phosphorus to Lake Wyola. In response, CEI is currently under contract to assist the Franklin Regional Council of Governments (FRCOG) with identifying potential stormwater improvement projects for funding through the Massachusetts 319 Nonpoint Source Competitive Grant Program (319 Program). Stormwater improvement projects are anticipated to consist of structural Best Management Practices (BMPs) such as check dams, rain gardens, water quality swales, etc., which are designed to remove pollutants such as phosphorous, nitrogen, sediment, and bacteria from stormwater prior to discharging into waterbodies. This memorandum summarizes our findings and recommended next steps.

1.2 Field Inspections

In order to better understand the watershed and potential BMP implementation opportunities, Nick Cristofori from CEI conducted field inspections at locations within the Lake Wyola watershed on April 14, 2022. CEI was joined by representatives from the Lake Wyola Association. The purpose of the field inspections was to observe the watershed in general, existing conditions of areas immediately surrounding the lake, and opportunities to provide improved stormwater treatment and/or erosion control. General conditions were documented, such as local topography, available space for retrofits, estimated contributing watershed area, etc. using a combination of field notes, sketches, and photographs. Existing conditions as observed are documented in the following sections.

2. EXISTING CONDITIONS

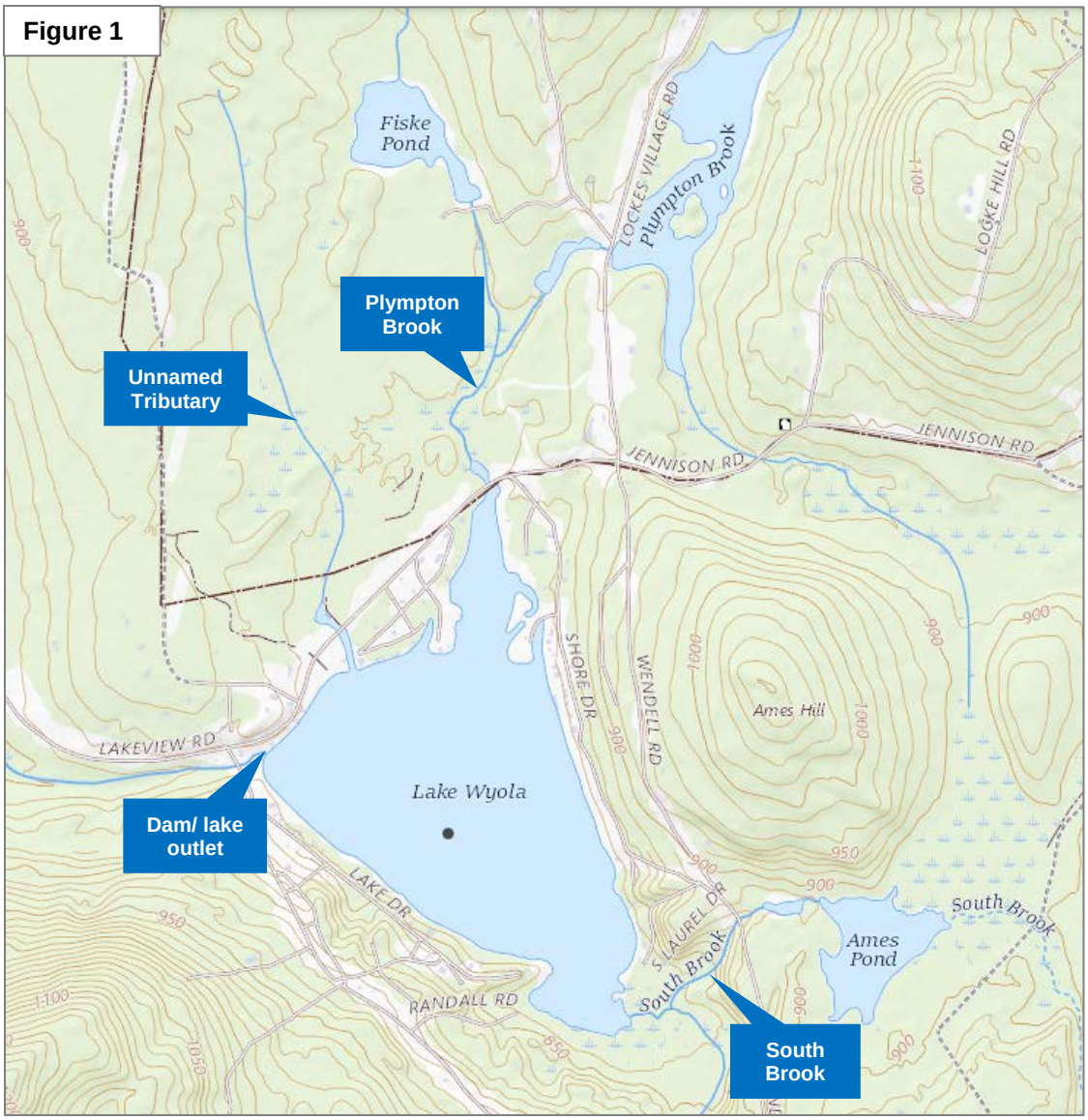
2.1 General

With the exception of the area immediately surrounding the lake, the watershed is heavily forested (61%) with lesser amounts of low density residential (29%). Remaining land cover consists mostly of water (4%) and high density residential (2%). Lake Wyola is fed primarily by Plympton Brook (known locally as Fiske Brook), the watershed for which includes Fiske Pond and its associated unnamed tributary to the north of Lake Wyola

(see Figure 1). Plympton Brook flows under Lakeview Road into a cove at the north end of Lake Wyola that has lost depth in during recent years due to (1) the natural process of sediment deposition in lakes from tributary streams and (2) the reported failure of a beaver dam several years ago which released a large volume of sediment that had accumulated behind the dam. Stakeholders indicated that the north cove used to be as deep as 6 feet, but is now has a depth closer to two feet.

The second largest tributary is South Brook, which includes Ames Pond and flows into Lake Wyola's southern tip from the southeast. A smaller, unnamed tributary flows from the northwest and joins Lake Wyola just east of the state park beach. All three tributaries to Lake Wyola drain land that is almost completely forested, with very small quantities of low-density residential area. Most residential areas in the watershed are around the perimeter of Lake Wyola. The lake's water level is controlled by a manually-activated dam capable of drawing down the lake by as much as eight feet. Lake Wyola State Park, including a public beach along the northwest shore of Lake Wyola, is located along Lakeview Road. Several stormwater and erosion control improvements were constructed in this area with funding from a 319 grant in 2007 and were observed to be in good condition and functioning properly.

Figure 1



Impervious roadways within the watershed are minimal, generally limited to two-lane town-owned feeder roads to the lightly developed Lake Wyola area. The majority of roadways in close proximity to Lake Wyola are 1.5-lane gravel, or in many cases surfaced with a material with a high content of sand and fine-grained aggregate. Drainage infrastructure within close proximity to the pond is largely non-existent, with stormwater mostly reaching the lake through a series of informally constructed swales.

2.2 Lake Wyola, West Side

The western side of Lake Wyola has the largest number of houses and roadways in close proximity to the lake. With the exception of Town-owned Locks Pond Road, remaining roadways are privately owned and constructed from a mix of gravel and sand. This area is heavily developed and relatively steeply sloped. Existing roadways are typically located at localized low points and thus serve to channelize stormwater down the slopes and towards the lake. Correspondingly, extensive areas of erosion were observed along nearly all roadways on this side of the lake, including Lake Drive, Great Pines Drive, King Road, and others. In particular, Great Pines Drive runs parallel to the slope and was observed to be highly channelized and is likely the primary source of sediment running from high points down towards the lake in this area. Drainage infrastructure such as catch basins, pipes, and formalized swales are largely absent from this area with few exceptions. Several small streams (shown as intermittent streams on USGS mapping) were also observed in this area.

Based on conversations with stakeholders and field observations, local residents have attempted to mitigate some erosion problems by creating drainage channels across and adjacent to several roadways using materials such as sand and gravel. Channels typically flow off of the roadways and into the woods where feasible. Some wooded areas appear to be successfully trapping sediment before it reaches the lake, while other areas appear to be simply moving the sediment further down the hill where it likely eventually enters the lake.

Sedimentation and drainage problems in this area appear to be two-fold:

1. Roadways appear to be surfaced in many locations with a layer of loose sand that is highly erodible and readily transported further downgradient during rain events. Some areas with larger stone were observed, and these areas did not appear to be exhibiting the same degree of erosion.
2. Roadways are typically located at topographic low points. This makes it difficult to convey stormwater to another location (e.g., nearby forest) for pollutant attenuation in many areas, as the roadway is located lower than the surrounding vegetated areas that could allow for stormwater treatment.

2.3 Lake Wyola, East Side

The eastern side of Lake Wyola is somewhat less developed than the western side and has fewer roads, most of which run perpendicular to the slope. Some erosion was observed, particularly in the vicinity of the intersection of Shore Drive and Cove Road and also along both North and South Laurel Drive. Much of Shore Drive flows to a swale along the eastern side of the road and away from the lake. However, some areas appear to either sheet flow or slightly channelize and flow towards the lake. Stormwater from Wendell Road appears to be mostly contained and channeled away from the lake. The surfacing material of these roads appears to have a higher content of gravel than along the east side, or in the case of Wendell Road, was much more compacted. Drainage infrastructure such as catch basins, pipes, and formalized swales are largely absent from this area with few exceptions.

Stakeholders indicated that much of the more recent work conducted in the watershed has been completed on this side of the lake. For instance, the intersection of Shore Drive and Cove Road was regraded to construct swales along both sides of the roadway to help collect stormwater runoff and sediment loads before reaching the lake. Additionally, North and South Laurel Drive were observed to have some areas regraded to channel stormwater discharges into the woods rather than down the roadways. However, stormwater from this area still appears to flow down the road towards the lake.

The most notable source of sedimentation to the lake on this side is along North Laurel Drive and South Laurel Drive. Similar to Great Pines Drive on the west side, these roadways generally run parallel to the slope and appears to have a larger quantity of sand rather than more compact gravel. The sand is more easily mobilized during rain events where it flows down the roadways and eventually towards the lake. Particularly towards the bottom and closer to the lake, roadways are located at the localized low point, making it more difficult to convey stormwater to adjacent vegetated areas for pollutant attenuation.

2.4 Fiske Pond and Plympton Brook

CEI observed the outlet from Fiske Pond, which flows into Plympton Brook prior to its confluence with Lake Wyola. An earthen dam was observed along the southernmost edge of the dam, which appears to impound the Fiske Pond to a depth of five to ten feet. Some seepage was observed along the toe of slope which flows into an adjacent forested wetland area. The outlet pipe appears to be located at the top of an approximate 4-foot-high beaver dam (see Figure 2) and is equipped with a screen to discourage blockage from debris or beaver activity. The receiving streambed was observed to be stony and free of sediment.

Figure 2

3. RECOMMENDATIONS

It is recommended that the following two project opportunities be combined under a 604b and/or s319 grant:

1. Improve Stormwater Conveyances

Complete a comprehensive roadway evaluation to determine specific locations for installation or retrofitting of swales, water bars, and leak-off areas to better stabilize roadways and adjacent areas. Areas located in close proximity to roads that could potentially receive additional stormwater runoff from stormwater conveyances should also be identified. Several small municipally-owned parcels appear to be located directly adjacent to, or nearby, some areas with erosion and thus these parcels may potentially be utilized for watershed improvements. The following sites are identified as having potential stormwater retrofit opportunities, in order of recommendation:

Site 1: Great Pines Drive, King Road, Birch Drive, Haskins Way, and Oak Knoll

- Construct a series of water bars, new swales, and leak-off sediment traps along these roadways to reduce the heavy stormwater channelizing and sediment erosion of these areas. Redirect stormwater runoff to wooded areas as best as possible and construct leak-offs to capture sediment. Several municipally-owned parcels appear to be present along Great Pines Drive and could be used to construct leak-offs. Additional coordination with the Town of Shutesbury is recommended.

Site 2: Lake Drive

- Construct water bars and swales along the approximate center one-third of Lake Drive where the roadway is steepest to better control stormwater runoff and erosion.
- Install larger diameter stone along the existing privately-owned swale in this area, and convert the existing small yard drain adjacent to Lake Drive to a deep sump catch basin for additional sediment storage.

Site 3: North and South Laurel Drive

- Remove sediment from existing leak-off areas along North and South Laurel Drive.
- Install additional leak-off areas, particularly towards the bottom slope of both roadways as adjacent grades allow.
- Install water bars across driveways in close proximity to the lake to reduce direct contributions to the waterbody.

Site 4: Locks Pond Road

- Install water bars or similar diversion structures at the intersections with nearby roads, such as Great Pines Drive, Stebbins Pond Road, Dove Lane, King Road, and Randall Road to reduce concentrated flows down these roadways and instead direct stormwater to wooded areas.
- Install leak-off sediment traps at the end of water bars to enhance sediment capture.

Site 5: Shore Road and Pine Drive

- Install water bars along the tops of driveways along the west side of the roadway, where

stormwater concentrates and flows down to the lake. Most driveways appeared in acceptable condition, although several could benefit from these low-cost retrofits.

Site 6: Wendell Road

- Ensure that roadway drainage sheet flows off into the woods with minimal channelization. Areas where channelization is occurring could be retrofitted with leak-off areas designed to capture sediment before flowing further towards the lake.

2. Improve Roadway Erosion Resiliency

Complete a comprehensive roadway evaluation to determine roadway stretches that would benefit from installation of road surface material more resistant to stormwater erosion. Roadway retrofits are expected to consist of stony material, or possibly in some places, pavement. This project would likely include developing a roadway resurfacing specification and/or detail for use on existing sand and gravel roadways, and could be used by both the Town and private landowners who maintain private roads. Primary candidate roadways include nearly all roadways along the western side of the lake (Lake Drive, Great Pines Drive, Oak Knoll, Birch Drive, Haskins Way, King Road, and Stebbins ROW), as well as North and South Laurel Drive on the eastern side of the lake.

Appendix C – FRCOG Nonpoint Source Field Assessment of the Lake Wyola Watershed 1/28/22

Nonpoint Source Field Assessment of the Lake Wyola Watershed

FID	Latitude	Longitude	Altitude	CreationDa	Creator	Waypoint_I	Parcel_ID	Address	Public Y/N	Description	BMP potential
1	42.49819469	-72.43157144	249.951889	2022-01-28	rclary	1		Lake Drive	N	Lowpoint of Lake Drive, called a "septic diversion", water coming from patch of woods	Yes
2	0	0	0	2022-01-28	rclary	2		Lake Drive	N	Work done in 2021: crowned Great Pines Road, water bar across Lake Drive at intersection of Great Pines, detention basin on Association beach	Yes
3	42.49765045	-72.43217527	264.5986176	2022-01-28	rclary	3		Great Pines Road	N	Water coming down road being diverted into woods	Yes
4	42.49752786	-72.43260325	265.224411	2022-01-28	rclary	4		Great Pines Road	N	Water coming off of property being seperately diverted to Birch and Haskins	Yes
5	0	0	0	2022-01-28	rclary	5		King Road	N	Work done in 2021: big berm added to divert water into woods; crosses King Road.	Yes
6	42.49692244	-72.43343742	284.3698578	2022-01-28	rclary	6		Locks Pond Road	Y	Culvert	Yes
7	42.49701372	-72.4334401	275.5426483	2022-01-28	rclary	7		Locks Pond Road	Y	Culvert (goes with Waypoint 8 I believe)	Yes
8	42.49769844	-72.43437904	297.493515	2022-01-28	rclary	8		Locks Pond Road	Y	Culvert (goes with Waypoint 7 I believe)	Yes
9	42.4978043	-72.4345792	271.6710663	2022-01-28	rclary	9		Locks Pond Road	Y	Culvert - water flowing at this time	Yes
10	42.49936954	-72.435523	267.646286	2022-01-28	rclary	10		Locks Pond Road	Y	Culvert	Yes
11	42.50031158	-72.43650301	270.9282894	2022-01-28	rclary	11		Locks Pond Road	Y	Culvert - water flowing at this time; more erosion here	Yes
12	42.50183797	-72.43680183	253.0534165	2022-01-28	rclary	12		Locks Pond Road	Y	Dam	
13	42.50041321	-72.43570489	260.311285	2022-01-28	rclary	13		Lake Drive	N	Stormwater drainage point; erosion around pipe	Yes
14	42.50005153	-72.43487583	265.3724422	2022-01-28	rclary	14		Lake Drive	N	Can't see it, but think there's a pipe here	
15	42.49911619	-72.43311396	260.5666351	2022-01-28	rclary	15		Lake Drive	N	Culverted drainage flowing; result of flow from 3 streams	Yes
16	42.50794058	-72.42930765	262.0255184	2022-01-28	rclary	16		Wendell Road	Y	Fiske Brook and North Cove -- sites of heavy sedimentation and potential site of settling basin or other BMPs	Yes
17	42.50647127	-72.42742122	257.3621883	2022-01-28	rclary	17		Shore Drive	N	Culvert?	
18	42.50601857	-72.4275244	282.8096371	2022-01-28	rclary	18		Shore Drive	N	Culvert	Yes
19	42.50516835	-72.42757377	270.1644955	2022-01-28	rclary	19		Pine Drive	N	Water washed out road at this location. Culvert and armored ditch on both sides constructed in 2021; takes a high ratio of Shore Drive water becase people closed off other culverts	Yes
20	42.50454846	-72.42742851	280.7564754	2022-01-28	rclary	20		Shore Drive	N	Culvert; takes a high ratio of Shore Drive water becase people closed off other culverts	Yes
21	0	0	0	2022-01-28	rclary	21		North and South La	N	Water runs down these roads of Wendell Road; three water bars on S Laurel	Yes
22	42.49870544	-72.42455478	250.8831635	2022-01-28	rclary	22	A-23 (maybe)	21 South Laurel Ro	N	Water sheds down driveway; owners often asking for assistance; may have installed a silt fence	Yes
23	42.49969392	-72.4245526	270.8955536	2022-01-28	rclary	23		North Laurel Road	N	Erosion evident along Road	Yes
24	42.49976617	-72.42546489	274.1310272	2022-01-28	rclary	24		North Laurel Road	N	Culvert, rock swale at bottom of hill on North Laurel	
25	42.50497032	-72.43226261	243.6922665	2022-01-28	rclary	25		Merril and Beechwc	N	Road adjacent to wetland often needs additional fill	Yes
0	0	0	0	2022-01-28	rclary	26		Wendell Road	Y	Roadside ditch eroding and some slumping of road	Yes

Appendix D – Town of Shutesbury and Public Comment

Many thoughtful and detailed comments were received from community partners, including Town committees and residents. Comments ranged from general comments and personal observations, to specific questions and comments related to the plan. In all cases, FRCOG staff carefully reviewed comments and revised the plan or followed up with the commenter as needed. Comments from residents were received during the June 6, 2023 public forum that took place during a regular Selectboard meeting, the August 12, 2023 Lake Wyola Public Field Walk, and via email. Comments from Town entities were received via email. FRCOG staff also recorded observations during the Lake Wyola Public Field Walk.

Appendix D contents:

1) Lake Wyola Advisory Committee's May 12, 2023 comments on the preliminary draft plan

2) Shutesbury Conservation Commission's May 2023 comments on the preliminary draft plan

3) Shutesbury Selectboard Meeting June 6, 2023 agenda and minutes

4) Summary of Public Questions and Comments on the June 2023 Public Review Draft of the Lake Wyola Watershed-Based Plan (WBP) with Responses from the Franklin Regional Council of Governments (FRCOG)

5) FRCOG Staff Notes on the August 12, 2023 Lake Wyola Public Field Walk

Lake Wyola Advisory Committee (LWAC) Comments/Questions on Lake Wyola Watershed-based Plan

From: riversmarkh@gmail.com <riversmarkh@gmail.com>
Sent: Friday, May 12, 2023 12:07 PM
To: Tamsin Flanders <TFlanders@frcog.org>
Cc: Kimberly Noake MacPhee <KMacPhee@frcog.org>
Subject: RE: Lake Wyola Plan Public Review

Hi Tamsin,

Attached are LWAC's comments/questions on the draft watershed-based plan.

Thanks for letting us review it.

Regards

Mark

Contents of attachment:

1. Water Quality Monitoring

    a. E. Coli monitoring locations

        Can you define an optimal E. Coli monitoring plan? Currently, weekly E. Coli measurements are made at the three Association beaches during the swimming season. The State Park uses a different indicating organism, however, we do not see their test data. Should sampling be performed at other locations to provide a more accurate representation of the lake?

    b. Source of E.coli contamination

We currently use E. Coli measurements to determine when it is unsafe to use the Association beaches. Is E. Coli an indicating organism only for mammal-caused contamination or is it also effective for detecting avian contamination? If not, should an additional indicating organism be used to monitor contamination caused by waterfowl?

c. Currently, we do periodic tests including Temperature, Dissolved Oxygen, Conductivity, pH and Secchi Disk measurements at one-meter intervals from surface to the lake bottom (10 meters). The some of the data is listed in Table A-10 on page 33. Is there value in making these measurements or should other tests be performed? What other testing is recommended?

2. Preparation for, and effects of extreme Storms (page 55)

   What should we be doing to prepare for extreme (10-year or 100-year) storms, both proactively and reactively? In the event of a 5-10 inch storm, should there be an emergency plan to address a sudden inundation of stilt? Not necessarily a restoration plan but maybe just a roadmap to understand regulatory issues. For example, what authority does ConCom have during an emergency that is different from the usual regulatory processes? Does ConCom have the authority to immediately rectify the situation rather than wait months for the usual approval channel to be followed?

3. Total Phosphorus Measurements (page 50)

   The most recent Total Phosphorus data is from 2014. As TP is a key indicator of stormwater runoff, should that data be updated to establish a current baseline?

4. Pollution Sources (first paragraph on page 41)

   I don't believe the tone of the last sentence of the first paragraph is accurate. The sentence reads:

   "*Over the past 30 years, redevelopment of summer cottages into year-round homes around the lake may have increased the amount of impervious surfaces and intensified septic use".*

   Thanks to the Board of Health, redevelopment of summer cottages has coincided with upgrading/modernizing of their septic system. The "septic" discussion on page 45 better represents the watershed. Additionally, in corporation with ConCom, most increases in impervious surfaces have been accompanied by better storm water management.

5. Roads discussion (Page 42)

   The WBP may want to note that the LWA (Association) dues are voluntary and as such do not necessarily represent a reliable or significant funding source. Approximately half of residents in the lake area pay Association dues.

6. Potential Role of the Lake Wyola State Park

   Given the State Park's (DCR) significant use of and stake in the watershed, can they play a more active role in the Watershed-Based Plan?

7. Identifying Technical and Financial Assistance (page 61)

   Table D-1 lists the management measures and the funding that is needed to implement them; however, funding estimates for many action items was not available (To be determined). What is the process for obtaining these estimates? Can the WBP plan be expanded to include a Scope of Work that can be used for an RFQ?

8. Potential Funding Sources (Page 64)

   Potential funding sources are listed on page 64. Are resources available (Technical, Political, Governmental) to help apply for these grants?

9. TSS (Total Suspended Solids) Monitoring at Lake Drive (Page 69)

   I am not familiar with how TSS are measured. Could the WBP include an example of a "typical" measuring method?

Shutesbury Conservation Commission
P.O. Box 276
Shutesbury MA 01072

May 12, 2023

Dear FRCOG,

Thank you for sharing the draft Lake Wyola Watershed Plan with the Shutesbury Conservation Commission. We found this report to be highly informative and useful. We commend you for all of your hard work in producing such a detailed document!

Below are some comments gathered from the Conservation Commission about the draft. There are some suggested edits, questions, and topics for further discussion. We look forward to having a public meeting with other Town stakeholders to discuss further how this important document can be used to benefit our community.

Many thanks,

Miriam DeFant, Chair
Mary David
Robin Harrington
Scott Kahan
Beth Willson

Editing Comments

- Winter lake lowering is 2', not 8', from Nov 1 to April 1.
- Shore Drive is parallel to lake, not perpendicular.
- Laurel Drives may not be actually owned by LWA, but may be managed by LWA; may be a different owner; this needs to be checked.
- Lake Wyola Conservation Area is actually now referred to as South Brook Conservation Area; not sure it is properly identified on map.
- Who is doing the e. coli testing? It may be there are multiple parties testing.
- Page 19: the list of Stakeholders does not include the Lake Wyola Association (LWA) which is a non-profit that owns and manages the private dirt roads around the lake. The SCC encourages engagement with LWA as a stakeholder as any future action plans are

dependent to some extent on their involvement. Similarly, the Town of Wendell and the Wendell Conservation Commission are not listed as stakeholders, even though much of the watershed lies in Wendell conservation areas.

- Page 55: The discussion of municipally owned parcels on Site 1 may be no longer accurate due to a recent land transfer between the Town and a local landowner. This should be clarified.
- Page 56: Discussion of Site 2 privately owned yard drain is problematic. It is assumed that this refers to 66 Lake Drive. The SCC approved a Notice of Intent in 2022, allowing the landowner to disconnect the yard drain and restore his property after he provided evidence that the drain was putting his well and septic system at risk and was leading to sediment pollution in the lake. We advise removing any discussion of specific private properties as locations for BMPs. Rather, the WBP could recommend that the Town of Shutesbury and LWA seek acquisition of properties or easements for BMP placement.
- Under Recommendations, there is a recommendation for a comprehensive roadway evaluation under "**2. Improve Roadway Erosion Resiliency"**, but the roads identified are all private roads. It is not clear who would seek out this kind of assessment, how it would be paid for, and who the stakeholders would be. The Commission understands that LWA collects dues and accepts donations for road maintenance and environmental improvements around the lake. It would be helpful to have more information about LWA's priorities and maintenance activities.

Additional information that may be helpful:

- Water quality monitoring around the lake is not well coordinated and communicated. Different stakeholders do different kinds of testing, and there is no centralized location where the public can access water quality information in an understandable format. Similarly, water levels in the lake are monitored by the Town but are not reported to the public. It would be helpful if one stakeholder could collect all the data and develop one website where information can be accessed. Electronic monitoring might resolve some of these issues.
- 2019 Wildlife Habitat Evaluation may be useful in that it discusses effect of drawdown on sediment loading in lake and the lack of freshwater mussels in the lake.
- Wendell Conservation Commission should be solicited for input regarding Fiske Pond/Brook and the dam at Fiske Pond. It does not appear that they accompanied FRCOG on the site visit in 2022. Another joint site visit with all relevant stakeholders may be in order.
- Lake Wyola is Priority Habitat for NHESP as 2021.
- LWA is a private non-profit, membership-based organization. Membership is voluntary. The SCC has been told that LWA membership is less than 50% of those property owners around the lake. Future planning needs to include both LWA and non-LWA landowners

and residents, including residents who rent. At present, there is no systematic channel of communication that reaches all residents and landowners in the Lake Wyola District.

- One of the major challenges to the watershed is the fact that the roads around the lake are privately owned and maintained by LWA. The Commission is aware that there are resident complaints about insufficient private road repair and maintenance. LWA has told the Commission that they lack the funds to do all of the necessary work to maintain and improve the roads. Some of the current maintenance is conducted by individual residents around the lake, an approach that is inconsistent and unsustainable. Local residents have asked for a better maintenance plan and assistance for residents who are unable to perform the maintenance functions on their own. More information about LWA's priorities and planning for road improvements would be helpful.
- Total % of impervious cover in watershed may not be as meaningful at the micro-watershed level. On the west side of lake, the density of impervious cover is greater and is increasing as homes are updated for year-round use, plus the slopes contribute to runoff issues.
- When the SCC reviews projects under our jurisdiction, it looks to ensure that net decreases in pervious surfaces and changes in stormwater runoff patterns are addressed. The SCC, however, has no jurisdiction on projects outside of the 100-foot Buffer Zone of Protected Resource Areas. Development outside of jurisdictional areas is not regulated for stormwater management concerns.
- Concerns about beaver management at the lake is multi-faceted. Some residents and town officials have expressed concerns about beaver-related risks such as dam failure and culvert blockages. Some have suggested beaver populations add to stormwater resilience in the Fiske Brook watershed. More study of this issue is needed, as well as a coordinated beaver management plan.
- Gather updated information about the condition of Fiske Pond Dam, including the success of the flow protection device that has been installed.
- More information about development changes and recreational use patterns may be helpful. The SCC has received anecdotal reports of increased turbidity and bank erosion being caused by recreational wake boats and other kinds of motorboats. Wave action from boats would contribute to counterclockwise migration of sediments to protected cove areas. Shutesbury has a Bylaw that regulates speed but not horsepower on the lake. Due to staffing and budget issues, enforcement is very challenging. The current Bylaw limits on speed within 150 feet of shore may be inadequate in the case of wake boats. More study is needed on this topic.
- The SCC has received anecdotal information suggesting that land use is changing around the lake, with an increase in year-round residents and conversions of cottages. As far as we know, there are no good statistics on this, although the 2004 Master Plan discussed it. The SCC has reviewed several projects in just the past 3 years that involved cottages being converted to larger year-round residences with larger impervious footprints.While the SCC endeavors to ensure that there are no adverse impacts on the lake from

development projects, there is undoubtedly some cumulative impact that may be difficult to quantify.

- The SCC has observed many locations around the lake where residents have developed and landscaped their properties in ways that alter natural runoff patterns, including what has been described as roadside "berming", where raised barriers have been created along the roads. In some instances, these alterations concentrate runoff and decrease a more dispersed sheet flow of stormwater. Some of the observed "berms" appear to be within the footprint of the privately owned dirt roads, leading to the question as to whether LWA, who owns the roads, could play a greater role in ensuring that alterations do not contribute to sediment releases into the lake. The Commission often finds these alterations after the fact. If they are outside of Conservation Commission jurisdictional Resource Areas, the SCC has only a limited role to play.

Causes of Impairment and Pollution Sources

Total Phosphorus: The analysis regarding phosphorus loading is a bit confusing. If the data does not support the existence of significant phosphorus loading, then it is unclear why this is being prioritized or how a reduction in TP can be achieved. The last data from 2014 showed that the average TP value was 7.57 µg/L and the preventative goal is 15 µg/L. Some clarification on this would be helpful to the reader. Given that the forest is estimated to be the primary source of TP, it's unclear what action steps can and should follow from this analysis. Is more data needed to assess this issue?

The WBP references at least two stormwater outfalls on the west side of the lake that drain into the lake. It is not known when these outfalls were constructed or how many are in existence, but the SCC has been told there are several. At least one of these outfalls directs a significant amount of stormwater from Locks Pond Road. A comprehensive survey of these outfalls, including mapping their inlets, would be very helpful information. This survey could be accomplished during the winter drawdown. LWAC is likely to have more up-to-date information about the history and locations of these structures. To address sedimentation in the lake, it would be helpful to look for way to reduce sedimentation from these untreated sources, either by installing pre-treatment BMPs or by redirecting runoff.

Action Plan Suggestions:

The SCC has advocated for vegetated buffer strips along the shores of Lake Wyola, but many residents continue to landscape the lakeshore with turf lawns and little plant diversity. A community education program, perhaps with some pilot projects, would be very helpful to showcase lake-friendly landscaping and increase homeowner interest.

The 2007 DCR Lake Wyola Stormwater Plan has a number of recommended BMPs and action steps that have never been adopted and are still relevant. The SCC recommends that the Town and LWA revisit this study and look for low-hanging fruit, that is, clear action steps that can be developed in the short-term while larger-scale solutions are developed.

The SCC supports the recommendations for a fluvial geomorphic study would help clarify Fiske Brook sedimentation and erosion factors.

The SCC supports the recommendations for a hydrologic and hydraulic study would be useful to better understand sediment pathways.

A comprehensive Beaver Management Plan for the watershed that is grounded in Nature-based Solutions would be helpful.

In addition to dredging to address sedimentation from Fiske Brook, the SCC supports a study into sources of sedimentation, including stormwater impacts on roads and upstream sources of sedimentation on Fiske Brook.

In the section on action steps, it might be helpful to organize the possible steps by responsible parties (e.g., Town, LWA, private residents, etc.).

Meeting of Shutesbury, MA Select Board
Tuesday June 6, 2023 5:30 PM EDT

* Virtual Meeting

Topic: Selectboard Meeting 6/6/23
Time: Jun 6, 2023 05:30 PM Eastern Time (US and Canada)

Join Zoom Meeting
https://us02web.zoom.us
/j/85435489622?pwd=QW14bno0bCs3VW9KUVdoM3F0VFd
EZz09

Meeting ID: 854 3548 9622
Passcode: 1qjk8F
1-646-556-8656
Meeting ID: 854 3548 9622
Passcode: 669524
Find your local number: https://us02web.zoom.us/u/ktH2SXg6o

5:30pm Open meeting
5:30pm Review Agenda
5:35pm Public Comment
5:35pm Review Minutes of 5/9/23 if available
5:40pm Lake Wyola Watershed Based Plan report presentation by FRCOG
6:25pm Review Annual Town Meeting
6:30pm SES asphalt roof replacement Contract
6:35pm Town Administrator Updates
And any other issue not reasonably anticipated by the Chair of the Committee

Adjourn
Future Virtual Select Board Meetings:
June 20, 2023

Shutesbury Selectboard Meeting Minutes
June 6, 2023 Virtual Meeting Format

Selectboard members present: Rita Farrell/Chair, Melissa Makepeace-O'Neil and Eric Stocker
Staff present: Becky Torres/Town Administrator, Geneva Bickford/Administrative Secretary
Volunteers & Other Staff present: Mark Rivers, Miriam DeFant, Mary David, FRCOG1, Kimberly McPhee, Robert Kibler, April Stein
Guests: Ron Essig, Susie Mosher, Mary Lou Conca, Tracy McNaughton, Linda Bills, Daniel Leahy, Stephen Dallmus, Bob Douglas, Jennifer Wallace, Sandra's iPad, Su Hoyle, Katie Eagan, Joseph's iPad

Farrell calls the meeting to order at 5:30 pm.

Agenda Review: As posted. No minutes to review.

Public Comment: Mary Lou Conca is curious with recent activity on Lot O-32 regarding the Police Chief's "misbehavior" involving a senior citizen. Makepeace-O'Neil advises Conca this cannot be discussed in public. Farrell states the SB does not engage in public comment and currently there is litigation involved. Miriam DeFant mentions that ConCom does not have a quorum and did not post as a meeting and would like to know if there will be discussion regarding the watershed or will there be comments and questions? Susie Mosher appreciates all the work that went into getting through town meeting. Rob Kibler would like the SB to consider putting a solar power flashing stop sign at the end of Prescott Rd as he's seeing many close calls there.

Review of Minutes: No Minutes to review

Discussion Topics:

1. Lake Wyola Watershed Based Plan report presentation by FRCOG: Kimberly MacPhee and Tamsin Flanders are present from FRCOG and will be presenting a power point presentation regarding the Lake Wyola Watershed Based Plan. See Attached power point presentation. A draft of the plan will be posted on the Town's website by June 7. Public comment will open on June 7 and be open for 30 days. All questions, comments and pictures should be submitted to MacPhee at FRCOG. Once the plan is approved the town will be eligible for implementation funding and will fund projects that restore and protect waterbodies. It will also fund updates to zoning bylaws that are protective of water quality with a 40% match required. FRCOG currently has funding to assist with the preparation of grant proposals and would be happy to look at the plan and talk more about funding opportunities and how FRCOG can assist if the town is interested in moving forward. Concerns regarding sediment were from anecdotal information. There were also concerns regarding erosion of the roads around the lake. The town may partner with the Lake Wyola Association as there are funding sources that will support a public/private partnership. Concerns were raised regarding the lake water quality testing for phosphorus and the minimizing of the importance of septic systems and nutrient run off from the septic systems and FRCOG was encouraged to emphasize those issues in their documents. FRCOG did reach out the BOH regarding the septic systems and was led to believe septic might not be a likely source based on their oversight and is something for FRCOG to consider to be a recommendation in the plan. FRCOG will share these concerns with the BOH and have another conversation before any changes are made to the plan. ConCom would like to be informed when FRCOG will be sending an invitation to all town boards and committees when a watershed visit is scheduled. Questions were asked regarding the bylaw options available for communities looking to improve and protect water quality around lakes and questions were asked regarding the 319 Grant and what was required for a competitive project for the 319 Grant. It was explained the 319 Grant program can be forgiving in terms of the level of detail on conceptual designs. Storm water management structure would probably need to have a 30% design done. You would also need to know what size the drainage area will be that will be treated, what is the storm event and the size of the storm as well as the reoccurrence

interval. A 604B Grant, if further assessment is done, potentially generate 30% design level and then the town would be ready to apply for a 319 Grant. MVP will do project in phases and that could fund the assessment and conceptual design. As for zoning there are many things a community can do to manage new development such as flood resiliency, storm water runoff and protection of water quality. In this particular situation since much of the lake is already developed FRCOG is not sure what options might be available around the lake. FRCOG is currently working on a zoning project with Shelburne and Greenfield and will start working with Bernardston as well to update their zoning bylaws to be protective of water quality and storm water management. FRCOG is also working on a project to develop a tool kit for dirt road management for water quality. A concern was raised regarding LWA only reporting one date where water was out of safety standards in six years which goes against the state beach having to close multiple time. It was explained getting information from the state has been unsuccessful as they will not fulfill any requests made for information. Concerns were raised regarding the use of beaver management, meaning beaver removal or minimizing their dam as a lot of times Beaver Dam Analogs ("BDA") are used. Flanders explains beaver exclusion structures would only be used if needed and Fisk Brook could be a good place for something like that. FRCOG did send notice to the Lake Wyola Board and all the officers. Mark Rivers indicates there are three Lake Wyola owned beaches and those beaches are tested for ecoli every week for the swimming season at the cost of the association. Watershed management is the responsibility of local management as the state only manages their own land. The state does however provide various funding sources for communities who do watershed management work and FRCOG has been advocating for whole watershed work and whole watershed understanding as watersheds cross municipal boundaries. In an ideal world all parties involved would work together on this. If that is not possible the town can move on their own to do projects that are on town property or along road rights of way. FRCOG is available to help with grant writing for at least the next year and will continue talking about this particular watershed based plan with the community. After the site visit there may be more clarity and it will be up to the town to decide if they want to act on the plan or do nothing with it. The next 604B Grant is likely opening early this fall and if the town decides to move forward with the grant application FRCOG could assist with that and could help scope out the project. Everyone is reminded that the town cannot put out funding to repair private roads.

2. Review Annual Town Meeting: Kudos to Stocker for all the work he put into planning the audio, engineering and execution. Stocker raises the question about continuing to do Annual Town Meeting (ATM) outdoors and using other people's equipment as this is not the answer in the long run. ATM may be held at the school again next year as holding it outdoors is expensive and there is a lot more work involved and weather is a factor. No school budgets were available for people to look at and a suggestion is made that the school could do an information session before ATM. Questions arise about the camera for the school and how it got on the warrant. Jackie and Debbie Lee gave a full presentation to Capital Planning and the proper process was followed and the SES security cameras were approved unanimously by Capital Planning before going to FinCom. Stocker feels the Lake Wyola Dam Bylaw should have been earlier in the meeting. Farrell would like the SB to revisit the Lake Wyola Dam Bylaw.

3. SES Asphalt Roof Replacement Contract: Eight bids have been received and reviewed by the Building Committee for the roof project. Mike's Construction Company ("Mike's") out of Dudley, MA has been vetted by the engineering firm. All references from past projects were positive, stating work was very good, cleanest worksite and the work being well done. This is a standard contract that requires only one SB signature. Donna MacNicol has reviewed the contract and work will begin June 26. Work should be completed in 4-5 weeks.

   VOTE: Farrell makes a Motion to approve the contract between the Town of Shutesbury and Mikes Construction; Makepeace-O'Neil moves, Stocker seconds. Roll call vote: Makepeace-O'Neil: aye, Stocker: aye, and Farrell: aye; the motion carries.

4. Town Administrator Updates: There was a request at ATM to hold another PFAS presentation. Stocker thinks this should wait. Farrell said it would be for the public and would not bring Tighe & Bond back as that would cost the town. Tighe & Bond's presentation is available on the website. Makepeace-O'Neil suggests a public viewing of the presentation and then questions. Farrell would like to do this during the SB's meeting in July. Stocker believes the Fall would be better as many are not around in the Summer. The SB will make people aware of the presentation available and will have another meeting in September. A draft legal use policy has been sent out to the SB and the TA asks for feedback before the next meeting. There is also a lack of a social media policy and the TA asks the SB for support to work on that policy. The Covid Policy should also be updated. FRCOG has requested a committee be setup for a Pollinating Committee. The SB will vote at the next meeting regarding the Pollinating Committee.

   Meeting ended at 7:04 pm no vote taken by SB all members logged off before voting.

Administrative Actions:

1.

Documents and Other Items Used at the Meeting:

1.

Respectfully submitted,
Geneva Bickford,
Administrative Secretary

** A full version of the 6/6/23 SB meeting is available to view on the Town of Shutesbury's YouTube page at: https://www.youtube.com/channel/UC4ajoOcJsNzf5DBgMTZgcJA

Summary of Public Questions and Comments
on the June 2023 Presentation to the Select Board and Public Review Draft of the Lake Wyola Watershed-Based Plan (WBP) with Responses from the Franklin Regional Council of Governments (FRCOG)

On June 6, 2023, FRCOG staff presented the Lake Wyola Watershed-Based Plan (WBP) at a regular Shutesbury Select Board meeting. On June 7, 2023, FRCOG provided the Town with a public review draft of the Lake Wyola WBP that was posted to the Town of Shutesbury website. This public review draft included the feedback that had been provided by the Lake Wyola Advisory Committee and the Conservation Commission in May on a preliminary draft.

The following comments were provided to FRCOG:

- During the Public forum on the WBP held during the 6/6/23 Shutesbury Selectboard meeting
- Via email to FRCOG staff

Boats

Comment:	Other changes include the presence of at least 5 wake boats which has produced giant waves that contribute to shoreline erosion, gouging the banks. We are not sure if the large pine trees growing there are compromised or not, but there are holes under the bank now where soil has washed out. Additionally, when those boats come in close, we have watched the water turn a muddy brown because they are stirring up the already sedimented lake bottom.
Comment:	Mentions volunteer residential BMPs but omits any mention of what boaters can do to mitigate more erosion.
FRCOG Response:	*A boat wake study could identify possible options for changes in boating use/behavior, enforcement of regulations, etc. to help avoid or mitigate impacts, like shore erosion, in Lake Wyola.*
Comment:	Speed boats at high speeds – are there rules on great ponds?
Comment:	p. 13…there is no enforcement of the 150'rule, nor for the current request to extend that to 200' for wake boats.
Comment:	All boats (motorized and sail) are required to stay 150 feet from shore while underway (moving faster than 5 mph). This rule is included in the Shutesbury Town Bylaws. Yes, with exception of a "once per year" visit from the Mass

Environmental Police, there is no real governmental (police, etc.) enforcement of any of the town bylaws for Lake Wyola. However, there is significant enforcement of the lake rules by lake residents. Many lake residents do not hesitate to talk to someone how was behaving in an unsafe manner. Historically, Wyola has been a very safe lake and it is in everyone's best interest to keep it that way. Additionally, the LWA (Lake Wyola Association) has a "Safety Committee" which talks with boaters, swimmers, fishermen who are unaware of, or ignoring, the lake rules.

Comment: The Selectboard has had at least one complaint about wake boats; there is no "official" enforcement of the 150' rule by the town, as the Police do not own watercraft capable of doing it.

FRCOG Response: *Under M.G.L. c. 131, s. 45, a town may regulate boating on a great pond, and any local boating laws enacted must be approved by MassDEP. Shutesbury has exercised this right by prohibiting personal watercraft (also known as jet skiis), and enacting a daytime speed limit of 30 mph and a speed limit of 5 mph between sunset and sunrise. The speed limit within 150 feet of shore is 5 mph at all times. Shutesbury's town bylaws can be found at https://www.shutesbury.org/town_bylaws. Shutesbury residents can modify bylaws by town meeting vote if there is a desire to change this speed limit.*

Bylaws

Comment: What bylaws can be proposed?

FRCOG Response: *The WBP does not recommend any specific bylaws, but does recommend reviewing the Town bylaws to identify possible updates to better address stormwater. The Town has the option of amending its general bylaws, zoning bylaws, subdivision regulations, and/or creating a stormwater policy for residential development. Town Counsel would need to be consulted about the legality and efficacy of using local regulations to mitigate the impacts of stormwater runoff from private roads.*

E. Coli

Comment: I have read that the state will not share their water test results with anybody. Why was the lake closed most of last summer? And, here is a public records law, why does the state not have to follow this law?

Comment: LWA only reporting one date where water was out of safety standards in six years which goes against the state beach having to close multiple time.

FRCOG Response: *Under state public health regulations, public beaches in Massachusetts must have weekly bacteria analysis that determine whether bacterial levels are safe for swimming. DCR posts its reports annually at https://www.mass.gov/lists/water-quality-at-massachusetts-swimming-beaches*

The data document for 2022 indicates that DCR collected 17 samples in 2022 at their beach on Lake Wyola and there were 9 weeks that the sample exceeded state water quality standards for swimming. The beach was posted 63 days, which indicates that any time a sample exceeded the swimming standard, the beach was closed for the entire week until the next result came in.

For results during the swimming season, DCR maintains an Interactive Beach Water Quality Dashboard at https://www.mass.gov/info-details/interactive-beach-water-quality-dashboard. The graph for 2023 for Lake Wyola shows that the bacteria standard for swimming was exceeded on four occasions. This information is publicly accessible to all.

For any future water quality monitoring program conducted under the supervision of the Town, it would be helpful to coordinate the monitoring program with DCR and to have DCR's historical testing data as a baseline.

Education and outreach

Comment: It is suggested the LWA with LWAC will provide educational outreach to the community. Who will provide training to the LWA to be able to accurately educate the residents?

FRCOG Response: *The LWA and LWAC can access the abundant materials on stormwater management and dirt road management online and/or work with a consultant to help provide outreach and education. This work could be grant funded and included as part of a DEP grant application, for example.*

General

Comment: Your study makes a valuable contribution by presenting a baseline. It also, by referencing previous studies that identified similar issues and needs, points to the absence of consistent follow-up and leadership.

Great Pond status

Comment: It is stated that because Lake Wyola is a Great Pond public access is required. This is not true. Many Massachusetts Great Ponds are surrounded by private land and have no public access except for fishing, fowling or navigation through an undeveloped parcel - not an easy thing to find.

FRCOG Response: *Public access is required pursuant to Massachusetts General Law, Ch. 131, section 45 (https://malegislature.gov/Laws/GeneralLaws/PartI/TitleXIX/Chapter131/Section45) and there is public access to Lake Wyola via the DCR property and via Elliot Park and the public boat ramp.*

McAvoy Pond and Fiske Pond

Comment: In response to 2005 Lake Wyola Inventory and Evaluation recommendation to keep Fiske and McAvoy Pond spillways clear of debris: Beaver deceiver was installed several years ago at McAvoy Pond dam which has for the most part mitigated beaver debris on the spillway.

FRCOG Response: *Noted, will change in plan.*

Comment: In response to 2005 Lake Wyola Inventory and Evaluation recommendation to install a log boom for McAvoy Pond dam: seems like this was proposed without consulting dam owners; beaver deceiver currently seems to adequately prevent accumulation of debris on the spillway and is cleared of debris one to three times per year.

FRCOG Response: *Noted, will mention in plan.*

Comment: In 2018, several trees were removed to improve the embankments of the dam; there is a plan to add more rip rap to prevent slope erosion around on the pond side of the dam

FRCOG Response: *Noted, will mention in plan.*

Comment: Beaver activity in the Fiske Pond area has drastically changed the landscape; on Camp Anderson Land, off one of their trails, and near the border to the Fiske Pond Conservation Area, beavers have built a sizeable 2 – 3 food tall dam that is holding back a good deal of water and should probably be monitored

FRCOG Response: *Noted, will mention in plan.*

North Laurel Drive

Comment: Our home is on North Laurel Dr. At the bottom of the hill. The residence own the road by default. We own half of the road bordering our houses. The property owner across the street owns the other half. The Association on the lake helps us with grading but we are responsible for the road. The road culvert comes out on my property and goes into the lake. I have put small catch basins to slow sediment runoff but it fills so often and has to be removed manually. The road hill used to be paved and the runoff was not bad but a terrible storm years ago washed the road out and now road mix is constantly in the runoff. The associations grading helps but it's still a problem. The residents on Laurel have put money into the culvert restoration but it's hard for some to kick in for pavement replacement. The only way the grading will controll runoff direction is if it stays pitched properly. With the storms coming fast and furious the lake is filling in quickly. My waterfront depth has decreased a foot since we got here. Permission to dredge will take miracle to get and supposedly requires a $300,000. Study. In earlier times they lowered the lake every few years and people would muck out sediment by bulldozing. It worked but is no longer allowed.

FRCOG Response: *Drainage conditions in this area were noted during the field walk and the plan was updated.*

Other water quality topics

Comment: Why was there a dead fish smell up until this week? The water itself smelled, when I swam my bathing suit and skin smelled like dead fish. You could smell it from Lakeview Road near the dam with the breeze. I checked the two bodies of water in Wendell and they did not have that smell.

FRCOG Response: *FRCOG staff do not have information about a possible origin(s) of such a smell. In the future, the condition could be reported to the Shutesbury Board of Health and Conservation Commission.*

Comment: In the plan there is no mention of cyanobacteria (blue green algae) blooms in the lake. Have any been documented? I have personally seen green scum at the State Beach that typically is indicative of a bloom. I think this was in September last year. I hope this is not another example of failure to get information from Mass DCR on water quality at the beach.

FRCOG Response: *FRCOG staff have not seen any documentation or been told of any cyanobacteria blooms in the lake. Local health departments are the primary point of contact for responding to reports of cyanobacteria in recreational waterbodies. Massachusetts Department of Public Health provides technical support to local health departments and residents in response to reports of blooms. Concerns should be directed to the Shutesbury Board of Health.*

Planning process

Comment: Did you conduct a survey of watershed residents?

FRCOG Response: *No. Outreach was conducted to watershed residents to encourage review and comment on the draft plan during the public forum, the open comment period, and/or the field walk.*

Comment: Lots of studies have been conducted that recommend similar things, but no one constituent user takes responsibility for follow up on pursuing recommendations and/or funding and implementation…there is no partnership between town and lake residents, and no organization that can take ownership.

Comment: Pg 20. Stakeholders—most of the LWA board of directors are not full-time residents and do not vote in town elections. The Town Administrator has stated numerous times that the town does not believe it has the legal ability or financial requirement to help with erosion issues on private dirt roads. This

perspective does not recognize that ecosystems do not adjust to political boundaries. The two parties are "in this together" (actually three parties—if you count the watershed ecosystem as a stakeholder)—whether they see it or not.

Comment: It would seem that LWA, as a 501c3 with obligations to maintain roads and in recognition of it as an all-volunteer organization, could to take more aggressive action if it would partner with the town. To date, there is little recognition from the town that the lake is part of an ecological system that transcends political and civic ownership boundaries. A partnership between these two entities would have dramatic effects.

FRCOG Response: *The plan recommends that the LWA and Town consider partnering on grant applications, as some grantors are interested in working with public-private partnerships.*

Comment: 56.—Of 7 proposed sites for interventions, all of them have some -- if not all -- the area under LWA jurisdiction. However, the LWA does not have the staff, nor funding, to implement anything.

FRCOG Response: *See above response.*

Comment: LWA has 501©3 status – would that help with grants?

FRCOG Response: *There may be non-profit foundations that may fund this work. A consultant might be helpful in identifying these opportunities. See also the above response about public-private partnerships.*

Phosphorus

Comment: What is the recommended phosphorus levels that are healthy for Lake Wyola. Are there standards?

FRCOG Response: *The Lake Wyola Watershed-Based Plan describes that there is a protective Total Maximum Daily Load (TMDL) for the lake based on biological and physico-chemical indicators that are utilized for making nutrient-related impairment decisions for the Aquatic Life Use. Appendix C of the Consolidated Assessment and Listing Methodology Guidance Manual (CALM) describes in further detail the biological and physico-chemical indicators used in nutrient-impairment decisions.*

Comment: A single sampling date in 2014 is hardly enough to establish a baseline for phosphorus. The plan should more strongly recommend that more recent and rigorous testing be done.

FRCOG Response: *Water quality data, including phosphorus data, for the years 2000, 2001, 2002, 2003, and 2006 were obtained after the Public Review Draft of the WBP was published. These data were incorporated into the final plan draft submitted to DEP. The plan does recommend that the lake be tested under a State-approved Quality Assurance Project Plan so that the data can also be used in State analysis.*

Comment: It is stated that there are no biological data to suggest that phosphorus levels are rising since 2014. However, I see no evidence of any biological studies being done. So I'm guessing that it would be better to state that this is based on anecdotal evidence.

FRCOG Response: *Agreed, will change in plan.*

Comment: How and when were estimated loads measured? As you point out, there have been large gaps and inconsistent data gathering. This information should be made specific.

FRCOG Response: *Estimated loads are created through scientific modeling rather than with measurements.*

Randall Road

Comment: Town beach now called Elliot Park is still being used as a beach

FRCOG Response: *Noted, will mention in plan.*

Road maintenance

Comment: In the document it mentioned the LWA roads are not maintained which is one of the six reasons for sedimentation. Our Association has truly worked hard to concentrate on creating the best road conditions possible with a limited budget. How did that information become a part of this report?

FRCOG Response: *FRCOG staff will review the language in the report. During the site visit, the FRCOG learned more about the LWA's roads budget and maintenance practices (see comment below, for example) and will include this more detailed information in the final draft of the plan.*

Sedimentation

Comment: We have lived for 20 years on the point at the entrance of North Cove. It is one of the most shallow parts of the lake. In the past 5 years we have witnessed a marked change in water depths, siltiness of the bottom, reduced water clarity, & the new presence of plants like lily pads growing out in the lake proper past the cove entrance.

FRCOG Response: *This comment will be added to the anecdotal evidence of sediment level changes in North Cove that are already present in the plan.*

Comment: It would be nice if the town would facilitate regular lake draw downs and grants for owners to repair shorelines in keeping with sediment controlling measures.

Septic

Comment: It is stated that the Board of Health has no evidence of pollution from septic system failures. But this may just be e-coli since I am not aware of the BOH doing any other water testing. Title 5 systems are not designed to capture all phosphorus. So with the sandy loam soils, there could be a significant cumulative impact of P from the many houses ringing the lake. This would be from regular operation of properly maintained systems, not just failures.

FRCOG Response: *The information provided to the FRCOG by the Board of Health indicates that the Board's assessment is that septic systems are having minimal impact on E. coli levels in the lake. This opinion is based on LWAC's testing of E. coli at LWA beaches and ~30 years of private drinking water well testing for coliform, VOCs, and nitrate.*
Note: the Board of Health has not sponsored its well-testing program since 2020.

Comment: I would recommend that the septic BMP be modified to require tight tanks or innovative/alternative septic systems for any new construction/significant renovation within 300 feet of the lake shore.

FRCOG Response: *According to the Board of Health, all systems that don't meet the 50-foot setback requirements under Title V are installed as tight tanks. So unless a homeowner has two to three lots, a tight tank is almost always required.*

Stormwater runoff

Comment: Are there or should there be zoning on the size of houses; in reference to the roof runoff?

FRCOG Response: *Roof runoff can be voluntarily managed through the use of rain barrels and/or directing flow from gutter downspouts to rain gardens.*

West side LWA roads

Comment: **Timeline of changes to LWA roads & drainage on West Side of Lake Wyola**

2009-2017: LWA created a drainage system on West Beach to take stormwater from Great Pines Drive. The corner of Lake Dr. and Great Pines was profiled to channel the water to West Beach. This was maintained annually, and as needed, by the LWA Roads Committee.

Berming of property lines along Lake Drive with raised garden beds and bermed, asphalt driveways, and appearance of encroachment onto Lake Drive road bed took place sometime during this time. Several residents said it had occurred in the early 2010s. in addition, it was told to me by several residents that a swale on the property adjacent to 66 Lake Dr. was taken out during new construction, which forced runoff to 66 Lake's well.

2017-2018: An LWA member with a tractor changed the above drainage path from going to West Beach to instead travel, on both sides of the road, down Lake Drive to 66 Lake Drive, with a trench cut across the road from the non-lake side to the owner's septic bypass pipe at 66 Lake Drive. This was not authorized by the LWA Roads Committee in place at that time, according to them, but according to the non-roads committee LWA members involved with the change, it was authorized by LWA.

Fall, 2019: A slideshow with pictures and video was presented to the LWA BOD with recommendations for repair. This slideshow was also shared, in the more recent past, with the Shutesbury Conservation Committee. […] They were taken in the summer of 2019. The videos of the stormwater and silt running into the lake were taken by homeowners during the summer of 2018.

Summer, 2020: A property owner at the corner of Lake and Great Pines Drive tapped into an underground stream while constructing a new home. They remedied the flow into the Lake Drive road bed by putting in a culvert under the road and onto their other property on Lake Drive. This water had not been part of the original issue, and was therefore not part of an LWA remedy to the existing stormwater issue.

Summer, 2021: LWA reprofiled the corner of Great Pines and Lake Drive to channel stormwater from Great Pines back to West Beach. A retention pond was added to the system, and appears to have helped alleviate some of the water going to 66 Lake Drive. Annual maintenance of the corner is key to keeping the system working. Unfortunately, LWA's history of regular road maintenance is inconsistent, and unreliable. A retention pond and water bar were added to the property at the corner of Great Pines and Oak Knoll. Also, a water bar was put in at the top of Great Pines.

Summary: The issue of heavy stormwater runoff directed to, and concentrated at 66 Lake Drive was not addressed by LWA at any time from 2017 until the summer of 2021, despite numerous requests by residents, the Health Dept., and LWA BOD members. The remaining problem is the bermed properties along Lake Drive.

FRCOG Response: *The FRCOG recommends a Hydraulic & Hydrologic (H&H) engineering study to model stormwater runoff in the Lake Wyola watershed and to help identify potential stormwater management options throughout the watershed, including public and private roads.*

FRCOG Staff Notes

August 12, 2023 Lake Wyola Public Field Walk

On August 12, 2023, two FRCOG staff led a two and a half hour field walk with the public attended by 21 Shutesbury residents. No attendance was taken for this event, however, FRCOG staff noted that at least one member of the Select Board, one member of the Conservation Commission, and multiple members of the Lake Wyola Association's (LWA) Roads and Buildings Committee were present. A large number of attendees were members of the Lake Wyola Association. The tour visited the Shore Drive, Pine Drive, North Laurel Drive, South Laurel Drive, Locks Pond Road, Great Pines Drive, Lake Drive, King Road, and Stebbins Row. Notes are grouped by road.

Lake Wyola Association (LWA)

- The LWA owns and maintains many roads.
- Has 501c3 status – would that help with grants?
- Budget = membership dues from 140 – 150 dues-payers/year @ $150, plus any fundraising.
- LWA Roads and Buildings Committee oversees road projects.

Road maintenance

- Town plows snow for safety purposes (fire, police, and ambulance) but does not do other maintenance on private LWA roads.
- LWA plans several large road maintenance or repair projects/year as needed after a spring review of all road conditions including winter damage.
- Projects are conducted after review and prioritization by the LWA Board of Directors.
- Budget for roads is about one third of LWA's total budget.
- More funds are spent on roads now than in the past.
- Funds are not available for comprehensive work (for example, all stormwater projects needed around the lake, or paving roads).
- The contractor who does much of the work on the roads also plows LWA roads. His knowledge is beneficial.
- ~ 4 gravel piles are left around the lake by LWA for residents to use for road maintenance; these are often used to fill in potholes.
- Property owners are responsible for maintaining ditches abutting their property.
- Residents are encouraged to participate in a fall Road Work Day to prep for winter.

History of lake level lowering and shoreline maintenance by residents

- Lake level used to be lowered up until the 1990s. When it was lowered, residents would use backhoes and shovels to remove sediment along their shorelines and restore depth around their docks. With the lake level being lowered only 2 feet, not enough of a drop to do shoreline maintenance.
- Endangered species in pond are sensitive to warm water. Is sediment accumulation equally as bad for the species because it causes the lake to be more shallow?

Beaver activity (anecdotal; sites not visited)

- Beavers eating plants along lake shore.
- Beaver activity at Ames and South Brook.

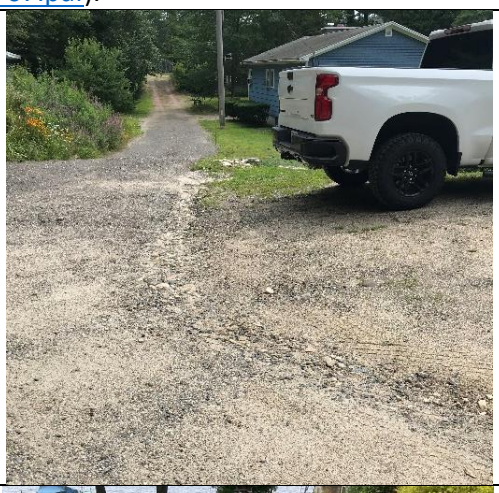
Shore Road	
• Runoff from Dawson Straights, across a residential property and along Shore Drive is causing erosion and depositing sediment.	
• Shore Road shoulder was been eroded away by July rain storms, and residents have been repairing with material from gravel piles.	
• Drainage from Shore Drive, down to Hans Bietsch beach (LWA east side beach) is eroding a channel.	

• Some residents have plugged road-crossing drainage pipes so that stormwater runoff is not draining onto their property.
• Resident on Shore Drive plans to close or relocate a drainage pipe that currently is underground on their property because they want to expand house to three lots and the pipe at the current location would go under the middle of the house.

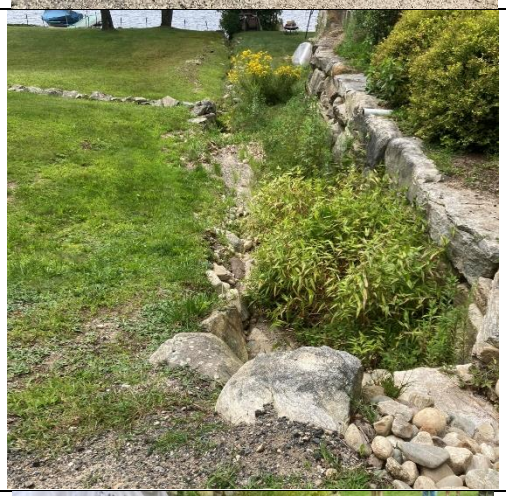
Pine Drive	
• Driveway pipe, swale, and catchment area have been working this summer. Two loads of sediment had developed at that point in the summer that required removal from the catchment pool.	

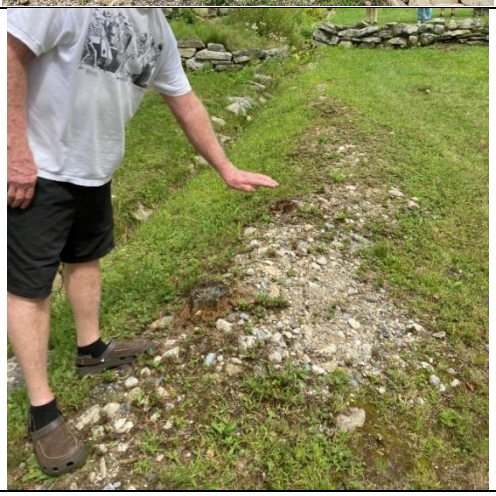
North Laurel Drive

- "Oily" road sheen coming from hillside when it rains. One resident mentioned the hillside was filled with buried wood chips, and the sheen may be coming from rotting wood chips. (FRCOG informed participants how to distinguish an oil bacteria sheen from a petroleum oil sheen– more info https://www.pca.state.mn.us/sites/default/files/c-er4-07.pdf).



- Corner of North Laurel Drive & North Laurel Extension is ditched from the north side of North Laurel Drive, piped under road, and water is conveyed down a yard drain on North Laurel Drive that sediment has to be shoveled out of "all the time". Sometimes the sediment piles up next to the yard drain at the level indicated by the resident in the below image.





• End of dock on North Laurel Drive used to be "diveable" but now only 2 – 3' deep; depth to bottom from the retaining wall at 5 inches during field walk.	
• Circa 2021, North Laurel Road ditches were enhanced, armored with riprap, and level catchment areas were installed in the ditch. Sediment is visible in these catchment areas.	

South Laurel Drive	
• LWA installed three broad-based dips with turnouts in 2022.	

- Sediment observed in all three turnouts, indicating they are working as planned.

- Erosion often occurs at the bottom of the hill on South Laurel Drive where it turns south.

- At very south end of South Laurel Drive, sediment is reaching a vegetated area bordering Ames Brook.

Locks Pond Road and King Road

- Locks Pond Road upslope side driveway culverts are still working, but ditch has good amount of sediment in it.

• Intersection of Locks Pond Road and Great Pines Drive in decent condition.	
• Stormwater sheets off Locks Pond Road and into a private driveway off Locks Pond Road. The driveway traps a lot of sand coming from Locks Pond Road; owner has had to deal with this influx of sand.	
• Residents report there is still a lot of water coming from Locks Pond Road.	
• Residents noted idea of the town managing stormwater upstream of Locks Pond Road so that residents downstream would not have to manage the volume that they do.	
• Winter sand coming from Locks Pond Road down drainage accumulating in or near unmaintained section of King Road.	
• King Road right of way is 25 ft. wide – FRCOG staff asked if a BMP could be put in King Road ROW where road was washed out; answers were unsure.	

Great Pines Drive and side streets	
• Turnout on Great Pines Drive is capturing sediment.	
• Turnout at corner of Great Pines Drive and King Road is capturing sediment.	
• Water crossing Great Pines Drive is directed into a turnout and a series of large basins just below Birch Drive. Basins were full of sediment.	

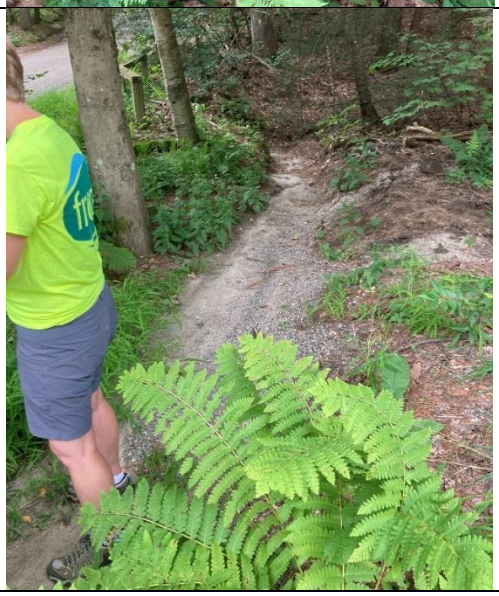
• Shoulders /ditches of Great Pines Drive lower section show signs of erosion and sedimentation; ditch on south side was filled with gravel/rip rap, now mostly covered with sediment.	

Stebbins Road	
• Erosion observed on Stebbins Road.	

Lake Drive	
• Berms were noted along Lake Drive roadside and driveway curb cuts. Berms direct water down the road rather than off the road. The road has also become entrenched as the road elevation is lower than the surrounding land and road material is eroded away by stormwater that is forced to travel down the road.	

- BMP on Association Beach, which takes water coming off of Great Pines Drive, is reported to be working and was filled with sediment at the time of visit.

- Residence on Lake Drive lies at a low point in the road and berming on neighboring properties has resulted in increased runoff being directed into property.

• Erosion noted on Lake Drive where runoff flows a distance to the low point.	
• A major drainage route coming from the direction of Locks Pond Road crosses Lake Drive through a double culvert. This culvert generally works well but can clog during extreme storm events.	
• Sediment present in turnout that is diverting water from both a neighboring driveway and Lake Drive. This turnout is directly connected to the drainage pictured above.	

• Pile of gravel provided by the LWA for residents to take to fill potholes. This is located adjacent to the turnout pictured above.	
• Residential BMP on Lake Drive	
• Inlet to existing stormwater drainage structure under Lake Drive.	

• Ditch and inlet to existing stormwater drainage structure under Lake Drive.	 

Merrill Drive (anecdotal; road not visited)
• Sedimentation is impeding recreation at their property; 2 huge sandbars have developed in the lake.

Randall Road (anecdotal; road not visited)
• Culvert backed up during July 2023 storms, created 4’ ruts, washed out road, caused huge sediment plume in South Cove.