SEBASTICOOK LAKE

NEWPORT, MAINE

WATERSHED-BASED MANAGEMENT PLAN

(2025-2034)

MARCH 2025

SEBASTICOOK LAKE
WATERSHED-BASED MANAGEMENT PLAN

Prepared for:

Town of Newport

23 Water Street

Newport, ME 04953

newportme.org

Prepared by:

Ecological Instincts

P.O. Box 682

Manchester, ME 04351

ecoinstincts.com

Cover Photo Credit: *Ecological Instincts*

Acknowledgments

The following people and organizations were instrumental in helping with the Sebasticook Lake 9-Element Watershed-Based Management Plan:

Sebasticook Lake WBMP Steering Committee

Linda Bacon	Maine DEP
Greg Beane	Maine DEP
Scott Emery	Sebasticook Lake Association
Deborah Ferrell	Sebasticook Lake Association
Donnie Gross	Sebasticook Lake Association
Cedric Harkins	Lake Resident
Jennifer Jespersen	Ecological Instincts
Lois Jones	Town of Corinna
Trampus King	Town of Dexter
Maxine "Muffy" Pare	Sebasticook Lake Association
Amy Polyot	Penobscot County SWCD
Adam Vashon	Sebasticook Lake Association
Allen Whitaker	Sebasticook Lake Association
Brian Wilson	Sebasticook Lake Association

Sebasticook Lake WBMP Technical Advisory Committee

Linda Bacon	Maine DEP
Jeff Dennis	Maine DEP
Jennifer Jespersen	Ecological Instincts
Donnie Gross	Sebasticook Lake Association
Jim Ricker	Town of Newport
Ken Wagner	Water Resource Services
Allen Whitaker	Sebasticook Lake Association

Other Technical Support

Ryan Burton	Maine DEP (Sediment Sampling)
Katie Goodwin	Ecological Instincts (Watershed Survey, Mapping, Modeling, Technical Writing)
Josh Noles	Maine DEP (Sediment Sampling)
Abby Quinn	Ecological Instincts (GIS Mapping & Writing)
US EPA	(Bathymetric Contour Map)
Alex Wong	Maine DEP (Watershed Survey & WBMP Guidance)

Other Project Support

Sebasticook Lake Association volunteers for assisting with the Watershed Survey, Septic Survey, water quality monitoring, and general education and outreach, **Town of Newport** for general project support, hosting the public meeting, and preparing the Septic System Database, **Donnie Gross & Allen Whitaker** for a full season of water quality data, **St. Joseph's College** (Dr. Emily Lesher & students) for assisting with the sediment analysis, **Ken Wagner** for analysis of the phytoplankton data and internal loading analysis, **Maine DEP** for general project support and funding.

Special thanks to the Sebasticook Lake Watershed Community for supporting efforts to improve the water quality of Sebasticook Lake today and for future generations.

Funding: The Sebasticook Lake WBMP project was funded in part by the United States Environmental Protection Agency under Section 604(b) of the Clean Water Act and in partnership with the Maine Department of Environmental Protection. Additional support was provided by the Town of Newport, and the Sebasticook Lake Association. In-kind support was provided by numerous volunteers and project steering committee members.

Commonly Used Acronyms

The following are used throughout this document:

AF	Anoxic Factor
BMP	Best Management Practice
CBI	Courtesy Boat Inspection
Chl-a	Chlorophyll a
DO	Dissolved Oxygen
HAB	Harmful Algal Bloom
LLRM	Lake Loading Response Model
LSM VLMP	Lake Stewards of Maine Volunteer Lake Monitoring Program
Maine DEP	Maine Department of Environmental Protection
NPS	Nonpoint Source (Pollution)
ppb	Parts Per Billion
ppm	Parts Per Million
SDT	Secchi Disk Transparency
PCSWCD	Penobscot County Soil & Water Conservation District
SLA	Sebasticook Lake Association
TP/P	Total Phosphorus/Phosphorus
USDA/NRCS	U.S. Department of Agriculture/Natural Resources Conservation Service
US EPA	United States Environmental Protection Agency
WBMP	Watershed-Based Management Plan
WRS	Water Resource Services

SEBASTICOOK LAKE
WATERSHED-BASED MANAGEMENT PLAN (2025-2034)

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

Executive Summary

Purpose

The Sebasticook Lake Watershed-Based Management Plan (WBMP) provides details about current water quality conditions, watershed characteristics, and steps that can be taken to improve water quality in Sebasticook Lake over the next 10 years as part of a long-term restoration strategy. Implementation is estimated to cost $3.45 million through state, federal and local resources over the 10-year time frame. The plan outlines management strategies and an activity schedule (2025 – 2034), establishes water quality goals and objectives, and describes actions needed to achieve these goals. This includes strategies to:

Photo Credit: Ecological Instincts

A. **Reduce the external phosphorus load** by addressing existing nonpoint source (NPS) pollution from agricultural land, urbanized areas, and septic systems in the Sebasticook Lake watershed to reduce the amount of phosphorus available for algae in the lake;

B. **Manage the internal phosphorus load** by improving the timing of the drawdown to provide the highest possible phosphorus reduction benefits to improve the lake's trophic state and prevent future nuisance algal blooms;

C. **Reduce New Sources of NPS Pollution** from getting into Sebasticook Lake by strengthening and enforcing municipal ordinances to prevent any increase in P loading from existing and future development, improving municipal standards and practices for roadways and providing additional training for road crews and contractors, investing in land conservation, and focusing on climate change adaptation planning;

D. **Raise public awareness** about the connection between land use, phosphorus, and algal blooms, as well as water quality improvement goals and strategies, by increasing local education, outreach, and communication efforts to increase participation among municipalities and watershed residents;

E. **Build local capacity** through partnership building across multiple community groups, engaging steering committee members, increasing organizational capacity for watershed tasks, and developing a robust fundraising strategy;

F. **Monitor and assess improvements** in Sebasticook Lake's water quality over time. This includes monitoring in-lake water quality, streams, NPS pollution, invasive aquatic plants, and monitoring during the drawdowns.

THE GOAL

A team of scientists and local stakeholders worked collaboratively over two years with input from the public to set a water quality goal for Sebasticook Lake that would improve water quality and reduce the probability of nuisance algal blooms. Findings from this evaluation indicate that the current annual drawdown regime is not sufficient on its own to meet desired water quality goals. Reducing P loading from the direct and indirect watershed of Sebasticook Lake will be important to restoring the lake. Improving the timing and tracking of drawdowns will help to maximize the P reduction benefits that they provide.

WATER QUALITY GOAL

Sebasticook Lake exhibits improving water quality trends & reduced frequency of algal blooms

Current In-Lake Concentration= 21.7 ppb
In-Lake Phosphorus Goal= 18.2 ppb
Reduction In-Lake Concentration= 3.5 ppb

"P" REDUCTIONS NEEDED

Direct Watershed: - 515 kg/yr
- 318 kg/yr agriculture
- 153 kg/yr urban development
- 44 kg/yr septic systems

Indirect Watershed: - 485 kg/yr
- 331 kg/yr agriculture
- 154 kg/yr urban development

Total P Reduction: 1,000 kg/yr

Timeframe: 2025- 2034

What P load reductions are needed to meet the 10-year planning goal?

A total P load reduction of 1,000 kg/yr is needed to achieve the water quality goal of 18.2 ppb set for this plan. This includes reducing the P load from the direct watershed of Sebasticook Lake by 515 kg/yr and reducing the P load from the indirect watershed by 485 kg/yr. Meeting these goals will require an estimated reduction of 648 kg/yr from agricultural lands, 307 kg/yr from urban development, and 44 kg/yr from septic systems. These reductions are expected to **reduce the average in-lake total P concentration in Sebasticook Lake by 3.5 ppb, from the current level of 21.7 ppb, reduce bloom probability by 16% and increase water clarity by 1 foot.** Achieving this goal will be a challenge and will require a coordinated effort with participation from landowners and stakeholders throughout the watershed in order to be successful.

What actions are needed to achieve the goal?

The Sebasticook Lake WBMP outlines 88 individual action items within six core planning categories to achieve the 10-year water quality goal. Planning recommendations, developed with input from the project's steering committee, are outlined in the plan. The action plan provides current, science-based solutions for restoring the water quality in Sebasticook Lake while simultaneously promoting communication between watershed groups, municipalities, residents, business owners, and agricultural landowners. The action plan outlines pollution reduction targets, responsible parties, potential funding sources, approximate costs, and an implementation schedule for each task within each of the six categories.

How will the plan be funded?

The Sebasticook Lake WBMP is expected to cost **$3.45M over a 10-year period.** Therefore, a sustainable funding strategy is needed within the first year that includes diverse funding sources. The funding strategy will be led by the Sebasticook Lake Association (SLA) in coordination with the Town of Newport and other watershed partners in the watershed. The combined resources of municipalities, private landowners, and lake association members expect to be leveraged to support watershed implementation projects in addition to state, federal, and local grants. The funding strategy will be revisited on at least an annual basis by an engaged steering committee. The action plan (Sections 7 & 8) is divided into the following six major planning objectives along with estimated load reductions and estimated costs to complete the work:

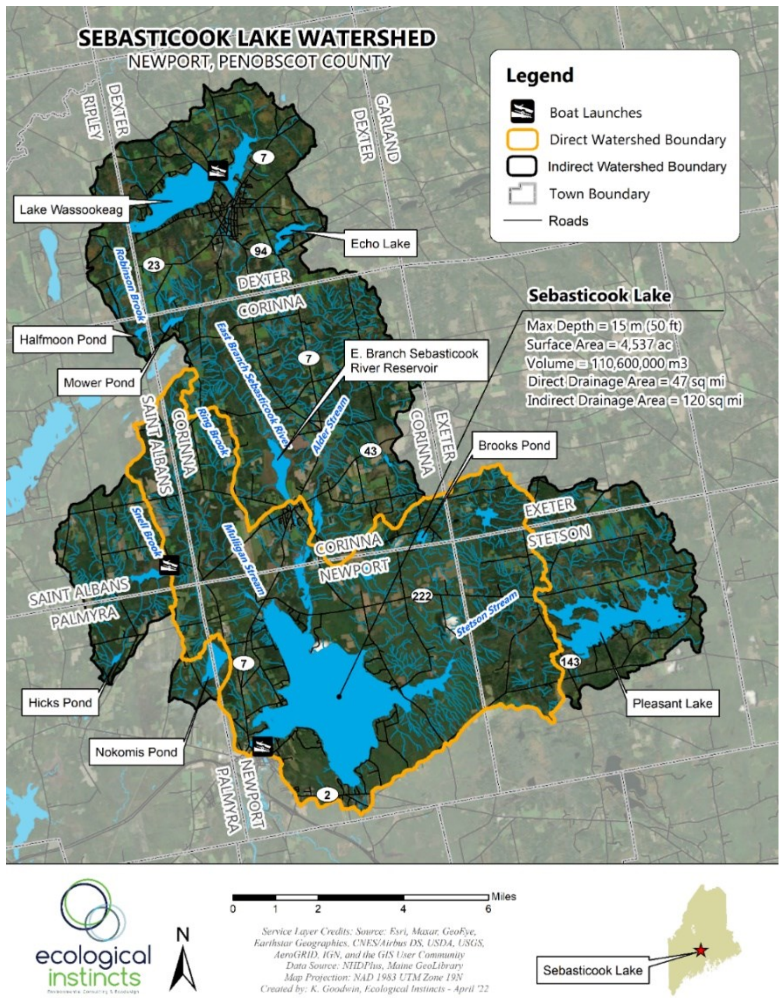
Planning Objective	Planning Action (2025-2034)	P Load Reduction Target[1]	Cost
A	**Reduce the External P Load** (Agriculture, timber harvesting, NPS sites, septic systems, LakeSmart, buffer campaign)	1000 kg/yr	$2,414,800
B	**Continue to Manage the Internal Load** (Improved drawdown protocols, additional sediment analysis)	800-1000 kg/yr	$7,500
C	**Reduce New Sources of NPS Pollution** (NPS sites, culvert upgrades, land conservation, ordinance updates, training for public works, enforcement of SLZ rules, climate change adaptation)	n/a	$515,000
D	**Education, Outreach & Communications** (Public meetings, town meetings, WBMP webpage, press releases, targeted outreach, buffer campaign, workshops)	n/a	$83,000
E	**Build Local Capacity** (Funding plan, steering committee, grant writing, relationship building- including town government, contractors landscapers and scientists)	n/a	$262,500
F	**Long-Term Monitoring & Assessment** (Baseline monitoring, NPS pollution, streams/dam monitoring, invasive plants, etc.)	n/a	$168,750
	Target P Reduction	**1000 kg/yr**	**$3,451,550**

[1]The annual fall drawdown has been effective at removing between 800 – 1000 kg of phosphorus from Sebasticook Lake each year based on historical water quality data. This long-term strategy to reduce internal loading has been slow, but effective at improving water quality at a low-cost to the community. The total P load reduction target of 1000 kg/yr in this 10-year plan is exclusive of the P load reductions resulting from the ongoing annual drawdown.

How will success be measured?

Environmental, social, and programmatic milestones were developed to reflect how well implementation activities are working and provide a means by which to track progress toward the established goals (Section 9). The steering committee will review the milestones on an annual basis, at a minimum, to determine if progress is being made, and will then determine if the watershed plan needs to be revised if the targets, including decreasing P concentration or reduction in algal blooms, are not being met.

THE LAKE & WATERSHED



Sebasticook Lake (MIDAS 2264)[1] is a 4,537-acre lake (Class GPA)[2] located in Penobscot County, in the Town of Newport. Sebasticook Lake is unique, as the largest lake in Maine located entirely within a single township. The lake has a large drainage area covering 120 mi^2 including both the direct (47 mi^2) and indirect watersheds (73 mi^2) excluding the surface area of Sebasticook Lake.

The direct watershed includes portions of the Towns of Newport, Corinna, Saint Albans, Stetson, Exeter and Palmyra. The indirect watershed additionally includes Dexter and Ripley. Large lakes, Pleasant Lake and Lake Wassookeag, drain into Sebasticook Lake as well as smaller lakes, Echo Lake, Brooks Pond, Hicks Pond, Halfmoon Pond and Mower Pond.

The East Branch Sebasticook River, Stetson Stream and Mulligan Stream are major tributaries to the lake. Additional named tributaries in the indirect watershed include Alder Stream, Snell Brook, and Robinson Brook. Water flows southwest out of the lake into the East Branch, then into the Sebasticook River, which flows to the Kennebec River and into the Gulf of Maine. The indirect watershed includes 508 miles of streams, 7,418 acres of wetlands, and 22,160 acres of riparian habitat bordering lakes, ponds, streams, and wetlands.

[1] The unique 4-digit code assigned to a lake.

[2] Defined by MRSA Title 38 §465-A, Maine Standards for Classification of Lakes and Ponds: Class GPA is the sole classification of Great Ponds and natural lakes and ponds <10 acres in size.

The lake has a maximum depth of 18.3 m (60 ft), and an average depth of 6.2 m (21 ft) and a flushing rate of 1.47 flushes/year. The deepest part of the lake is in the north central section of the lake, close to the cove near Darlings Road.

Water level in Sebasticook Lake is controlled by natural fluctuations in precipitation and evaporation, and through management of the dam at the southwest end of the lake which flows into the East Branch Sebasticook River. The water level has been controlled to allow the fall drawdown and export of phosphorus from the lake since 1982. A fish ladder at the dam provides fish access from downstream waterbodies

What is the current status of development in the watershed?

There are an estimated 371 developed lots on the shoreline of Sebasticook Lake and three large commercial campgrounds- two on the south end, and a relatively new 100 site campground on the north end of the lake off Route 7. Other commercial developments are concentrated along state roads and town centers in Newport, Corinna, and Dexter.

Forestland accounts for the greatest area of land in the watershed, accounting for 55% of the land area. The watershed also includes large areas of open water and wetlands (21% of the watershed, not including the area of Sebasticook Lake), much of which consists of forested wetlands surrounding Stetson Stream, East Branch Sebasticook River, and Mulligan Stream and smaller tributaries throughout the watershed.

Agriculture, including row crops, grazing, and hayfield, makes up another 15% of the watershed area. There are approximately 181 farms in the direct watershed growing a variety of crops producing hay, corn, and potatoes as well as dairy farms.

Urban development accounts for 8% of the land in the watershed, and is primarily located along major roadways and around the shoreline, with the highest concentrations of commercial and high-density residential development around the urban centers of Newport, Corinna, and Dexter. Much of the development in the watershed is low-density residential development. A network of state, town, and private roads (including numerous gravel roads that provide access to the shoreline) encircle the lake. The large watershed area and high levels of agricultural and urban/suburban development indicate that Sebasticook Lake is susceptible to significant phosphorus inputs from its watershed.

Public access to the lake includes a state-owned public boat launch on the southwest shore of Sebasticook Lake on Boat Access Rd, along with two carry-in launches (on the East Branch on County Woods Rd at the north end of the lake, and off Durham Bridge Rd on the northwest shore). Additional state-owned public launches in the watershed include one on Lake Wassookeag in Dexter, and a carry-in launch on Mulligan Bog in St. Albans.

The Problem

Sebasticook Lake is listed as "Impaired" on the **Maine DEP's NPS Priority Watersheds List** due to cultural eutrophication stemming from NPS pollution and historical industrial water and municipal wastewater discharges that resulted in a drastic deterioration in water quality in the 1950s. Sebasticook Lake is also listed as "Most at Risk from New Development" under Chapter 502 of the Maine Stormwater Law.

Sebasticook Lake has been experiencing occasional algal blooms since the 1950s and in 1966 a report described the "green paint" along the shoreline and the "pig-pen" odors from the decaying algal blooms. Since then many of the sources of pollution have been addressed. The last point source of pollution was removed in 2005 and since 1982 seasonal lake drawdowns have been used to release phosphorus from lake sediments. Significant reductions of agricultural inputs between 1981-2014 and three phases of 319 grants between 2002-2007 addressing other watershed runoff have also helped slowly improve the water quality since 1970, when monitoring began (US EPA, 2022). The lake had consistent nuisance algal blooms (minimum clarity lower than 2m) from 1974-1997. Six out of the last 25 years (1998-2023) have been free from nuisance algal blooms.[3]

Land use in the Sebasticook Lake watershed has historically included large areas of agricultural land as well as smaller areas of residential and commercial development delivering nonpoint source (NPS) pollutants stemming from stormwater runoff, soil erosion, fertilizers, and animal waste, among other pollutants. Though historical point sources of pollution have been minimized, legacy pollutants that have built up in the lake's bottom sediments combined with current sources of NPS pollution from developed land including agricultural use, forestry activities, residential shoreline development, commercial development, and roads remain a threat to water quality.

Water quality data have been collected in Sebasticook Lake at the deep hole (Station 1) since 1972. There are three years in which no data is available (1973, 1976, and 2021). A water quality trend analysis was completed as part of the WBMP including an analysis of the long-term (1972-2023) and short-term (last 10 years) datasets using data collected by certified monitors from Lake Stewards of Maine, SLA, and Maine DEP. The historical trends in water quality were analyzed and the results of this analysis indicate:

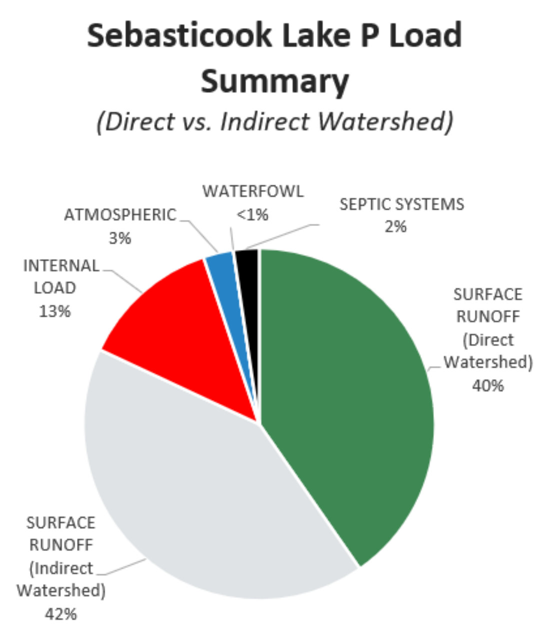
- ☐ **Current average annual water clarity, Chl-a and TP classify Sebasticook Lake as eutrophic,** even though there have been significant decreases in all three parameters in long-term data.
- ☐ **Water clarity exhibits a strong, significant increase since sampling began in the 1970s.** While the water clarity readings in Sebasticook Lake have fallen below 2 m in 42 of the 48 years on record (depth threshold indicating a nuisance algal bloom is occurring), the water clarity trend is improving. Of the six years when readings did not drop to 2 m or less, six were between 2014-2023. The long-term annual average water clarity is 2.2 m compared to 2.7 m over the last 10 years.
- ☐ **Chlorophyll-a concentrations have shown a strong significant decreasing trend** in Sebasticook Lake since 1977. Chl-a provides a relative estimate of algal biomass in the lake (higher Chl-a equates to more algae) meaning that there are less algae now in Sebasticook lake than when sampling began. However, there is no significant trend in Chl-a over the past 10 years. Median Chl-a over the past 10 years is 11.3 ppb.

[3] Excluding 2021 as Secchi data were not collected.

- ☐ **Surface and bottom grab total phosphorus concentrations have decreased** since 1977, with a strong significant decreasing trend in both surface and bottom TP over the long-term dataset. There were no significant trends observed in the 10-year surface and bottom TP data. There was no trend in epilimnetic TP, but this is likely due in part to a large gap in collection of epilimnetic cores between 1979 and 1998.
- ☐ **Water temperature data exhibits a statistically significant increase in surface water temperatures through the entire time series starting in 1972.** There has been a significant increase in surface temperatures for all the summer months (May-September) except June. These numbers are in line with warmer summer temperatures across Maine.
- ☐ **Low levels of dissolved oxygen have been documented in larger volumes of water for longer periods at the bottom of Sebasticook Lake.** Low levels of oxygen (<2 ppm) result in the release of stored P in bottom sediments into the water column and provide food for bottom-dwelling cyanobacteria that carry P up into the water column resulting in cycles of algal growth caused by internal P loading. Depth of stratification in Sebasticook Lake varies depending on seasonal weather patterns, but there seems to be an overall increase in the area and length of time that anoxia is occurring in the lake each year, leaving greater portions of bottom sediment exposed to anoxia now than in the past.
- ☐ **Toxins produced by cyanobacteria have not been documented above US EPA criteria for recreational water.** A Maine DEP study documented microcystin levels in Sebasticook Lake that would be considered too high in drinking water for young children, but below safe drinking levels for school aged children and adults. In the last year of data collected (2020), all samples were below the advisory for safe drinking water for young children.

What are the primary sources of P?

Watershed modeling was used to estimate current sources of P in Sebasticook Lake. The model estimates a total annual P load to Sebasticook Lake of 6,286 kg/yr. The watershed load is the greatest source of P to Sebasticook Lake, representing approximately 82% of the total P load to the lake (40% direct watershed, 42% indirect watersheds) followed by internal loading, which contributes approximately 13% of the total P load. Septic systems make up an estimated 2% of the total P load, while waterfowl are estimated to make up <1% of the total load. The remaining 3% of the load is from atmospheric deposition.[4]



[4] P loading estimates could vary by plus or minus 10-20% among years as a function of weather and measurement limitations.

Watershed modeling was also used to estimate pre-development water quality conditions in the lake. The pre-development watershed P load to Sebasticook Lake is estimated at 2,085 kg/yr, representing about a third of the current watershed load to the lake, with a predicted in-lake TP concentration of 7.2 ppb. Changes in the landscape for agriculture, forestry, and residential and commercial development in the watershed and on the shoreline have resulted in a tripling of the watershed's natural P load, and a tripling of the concentration of P in the lake (10-year average TP is 21.7 ppb). Setting a realistic water quality target that is closer to pre-development conditions is an exceedingly difficult challenge given the large size of the watershed and present level of developed land (including agriculture) in the watershed.

Why do we need to address nonpoint source pollution?

Addressing NPS pollution from watershed sources is an important part of a multi-step, multi-year process to make a significant difference to restore water quality in Sebasticook Lake. Addressing the external load will require ongoing work annually over a ten-year period and beyond, both in the direct and indirect watersheds. Success of this work will depend on cooperation from landowners, towns, and businesses to reduce the watershed load by 1000 kg P/yr.

Lack of shoreline buffers and fertilizer use results in delivery of excess phosphorus to Sebasticook Lake.

The 2023 watershed[5] survey identified:

- ☐ **172 sites** across the watershed that are active sources of erosion across eleven different land uses.
- ☐ Only 17 sites were ranked **high impact**, with 8 of the 17 sites located on town roads and private roads..
- ☐ **Residential NPS sites** accounted for the greatest number of sites, accounting for 31% of all sites, including 25% of medium and 40% of low-impact sites.
- ☐ **Town roads** account for the greatest number of sites behind residential sites making up 28% of all NPS sites and 24% of medium impact sites. Private roads and driveways account for an additional 20% of all NPS sites.

The action plan includes strategies for **reducing the watershed load by 16%** which includes addressing 17 high impact, 91 medium impact, and 29 low impact NPS sites over the next 10 years. The plan also includes significant **P reductions on agricultural land and active timber harvests** by developing a National Water Quality Initiative (NWQI) project and through direct outreach to agriculture and forestry landowners. Finally, the plan recommends **taking steps to mitigate impacts from "at-risk" septic systems**- specifically the 492 parcels on areas of at-risk soils within 150 feet of Sebasticook Lake, intermittent streams, perennial streams, or smaller ponds and wetlands. Septic systems on these parcels

[5] The 2023 watershed survey focused on shoreline development and roads in the direct watershed. A separate assessment of agricultural land in the direct watershed was conducted by PCSWCD.

are susceptible to short-circuiting of the leach field and may be contributing excess P to the lake via groundwater. The action plan recommends initiating a LakeSmart program on Sebasticook Lake, with a **goal of 20 new LakeSmart evaluations completed** by 2034.[6]

Why do we need to address internal P loading?

Sebasticook Lake outlet dam.
Photo credit: Bowman Construction

Addressing watershed sources alone will not be enough to prevent recurring nuisance algal blooms in the lake but is one part of a larger effort to meet water quality goals to improve water quality. The 2024 analysis revealed that P release is occurring from the sediments during periods of low DO, although it is not the annual dominant source of P in Sebasticook Lake, it occurs in the summer during the most opportune time for algae growth. While internal loading appears to have decreased markedly since the 1980s, a consequence of both reduction of P loading from the watershed and effects of the annual drawdown, the increase in area and length of time of anoxia, and the fact that P reductions from the annual drawdown has leveled off in recent years indicates the need for ongoing management of the internal load. **The action plan recommends continuing the annual lake drawdowns, which are estimated to remove 800-1000 kg P/yr from Sebasticook Lake, but is not enough on its own to restore the lake.** The plan recommends improving the timing and monitoring of drawdowns to ensure that the maximum benefit is gained.

What about future development & climate change?

While Penobscot County and Somerset County are slowly losing population, changing patterns in where people are living within the watershed can also affect water quality. Proximity to the lake as well as streams feeding the lake all change the relative impact of development. Changes in how properties are used may also be contributing to increased impacts from development on the lake. Seasonal properties being converted to year-round homes can increase loading from septic systems, as older systems designed for seasonal use are used more frequently. Seasonal to year-round conversions and new development will also contribute to increased impacts from gravel roads and other developed areas. While overall populations trends in Newport appear to be on the decline, the town has experienced an increase in the number of new building permits in the shoreland zone of the lake.[7] As water quality in the lake improves, Sebasticook

[6] LakeSmart is an education and outreach program that rewards lakefront homeowners who manage their land to protect water quality. The program is free, non-regulatory, and voluntary. Participating homeowners receive individualized suggestions for keeping pollutants from stormwater out of lake waters. Visit lakes.me/lakesmart for more information.

[7] Personal communication, Jim Ricker, Town Manager, Town of Newport.

Lake will continue to be an even more desirable place to live and to visit, resulting in new development on the shoreline and throughout the watershed.

Preventing new sources of P from getting into the lake is imperative to the success of the WBMP. Future development is estimated to increase the in-lake P concentration by 0.5 ppb. Climate change will additionally exacerbate the problem by increasing P loading by another 2.2 ppb. **If nothing is done to adapt to climate change and prevent new sources of P from getting into the lake, then much of the effort to reduce existing sources of P may be offset, and goals may not be achieved**. Prevention strategies will need to include more robust municipal planning and enforcement, ongoing public education, land conservation, and climate mitigation strategies.

Administering The Plan

The Sebasticook Lake WBMP provides a framework for restoring water quality in Sebasticook Lake so that it meets state water quality standards. The plan will be led by the Town of Newport with guidance and support from other watershed steering committee members comprised of SLA, Maine DEP, Maine Lakes, PCSWCD, USDA/NRCS, the towns of Corinna, Dexter, St. Albans, Exeter and Stetson, local businesses, and landowners. The formation of subcommittees that focus on the six main watershed action categories will result in more efficient implementation of the plan.

Incorporating US EPA's 9 Elements

The US EPA has identified nine key elements that are critical for achieving improvements in water quality. An approved nine-element plan is a prerequisite for future Clean Water Act section 319 funded work in impaired watersheds. The nine elements are designed to provide a robust framework by which to restore waters impaired by NPS pollution through characterization of the watershed, partnership building, development of an implementation plan (actions, schedule, costs), goal setting, and monitoring. The nine elements can be found in the following locations within the Sebasticook Lake WBMP. https://www.epa.gov/system/files/documents/2024-06/2024_section_319_guidelines_final_1.pdf

Planning Element	WBMP Section	Description
a) **Identify Causes & Sources**	Section 1	Highlights programs and research that have helped frame the water quality problem.
	Section 2	Describes the characteristics of the lake and watershed that have contributed to the changes in water quality.
	Section 3	Provides an analysis of water quality data to describe changes in water quality.

Planning Element	WBMP Section	Description
	Sections 4 & 5	Provides an estimate of watershed loading including current and future sources of NPS pollution.
	Section 7 & Appx. D	Summarizes current NPS sites in the Sebasticook Lake watershed.
b) An estimate of the load reductions expected from management measures	Sections 4 & 6 & Appx. C	Provides an overview of water quality and phosphorus (P) reduction targets to reduce annual P loading to Sebasticook Lake from both external loading (watershed sources) and internal loading (in-lake sources) over the next ten years and methods used to estimate P reductions.
c) Description of Management Measures & critical areas in which measures will be implemented	Sections 6, 7 and 8	Identifies ways to achieve the estimated P load reduction and reach water quality targets described in (g) below. The action plan covers six major topic areas that focus on NPS pollution, including: reducing the watershed load, continuing to manage the internal load, preventing new sources of P, education and outreach, building local capacity, and conducting long-term monitoring and assessment.
d) Estimate of Technical & Financial Assistance & Relevant Authorities Implementing the Plan	Sections 7 - 10	Provides a description of the associated costs, sources of funding, and organizations responsible for plan implementation. The estimated cost to address NPS pollution and reduce P in Sebasticook Lake is estimated at $3.45M over the next ten years.
e) Information & Education & Outreach	Section 7	Describes how the education and outreach component of the plan should be implemented to enhance public understanding of the project. This includes leadership from watershed partners to promote lake/watershed stewardship with a focus on general outreach, targeted outreach, and workshops.
f) Schedule for Addressing the NPS Management Measures	Section 7	Provides a list of strategies and a set schedule that defines the timeline for each action. The schedule should be reviewed and adjusted by the steering committee on at least an annual basis.
g) Description of Interim Measurable Milestones	Section 9 (Tables 17 – 19)	Lists milestones that measure implementation success that will be tracked annually, makes the plan relevant, and helps promote implementation of action items. The milestones are broken down into three categories: programmatic, social, and environmental.

Planning Element	WBMP Section	Description
h) Set of Criteria	Section 9 (Table 17)	Provides a list of criteria and benchmarks for determining whether load reductions are being achieved over time, and if substantial progress is being made towards water quality objectives. Environmental milestones are a direct measure of environmental conditions, such as improvement a decrease in phosphorus concentrations to help determine whether this plan needs to be revised.
i) Monitoring Component	Section 7 (Action Plan) & 8	Provides a description of planned monitoring activities for Sebasticook Lake to evaluate the effectiveness of implementation efforts over time as measured against the criteria in (h) above.

1. Background

Sebasticook Lake, located entirely within the Town of Newport, Maine (Figure 1) has a history of poor water quality documented in the 1950s. A number of discharges delivered point source pollution directly to Sebasticook Lake and upstream waterbodies, along with non-point source pollution from agricultural and urban development in the watershed. Despite removal of all known point sources and initiation of fall drawdowns to flush out excess phosphorus, water quality in Sebasticook Lake remains below average, and the lake frequently experiences nuisance algal blooms.

Sebasticook Lake is listed on the state's 303(d) Nonpoint Source Priority List as Impaired due to its ongoing history of poor water quality and algal blooms. Nokomis Pond, which flows into Sebasticook Lake through Mulligan Stream, and Lake Wassookeag, which flows to Sebasticook Lake through the East Branch Sebasticook River, are both listed as "threatened" because they are used as public water sources. Lake Wassookeag also exhibits declining water clarity and has sediment chemistry that makes it susceptible to internal phosphorus loading.

Maine DEP's Nonpoint Source Priority Watersheds List *includes 22 "Impaired" lakes, including Sebasticook Lake. These lakes are included on the State's 303(d) list of impaired waters because they do not meet state water quality standards. An additional 178 lakes are considered "Threatened"*

The Sebasticook Lake watershed has historically included large areas of agricultural, residential, and commercial development. Nonpoint source pollution (NPS) stemming from stormwater runoff, soil erosion, fertilizers, and animal waste, among other pollutants has washed into the lake, which, along with historical point sources, resulted in a build-up of phosphorus (P) in lake sediments. Because of continued input of P from development (agriculture, timber harvesting, residential and commercial development, and roads) and accumulated P in lake sediments, Sebasticook Lake has elevated P concentrations, which provide an excessive nutrient supply for algae in the lake.

Development of this plan included a water quality trend analysis utilizing the most current data available, watershed modeling (including an internal loading analysis), bathymetric mapping, sediment analysis, a watershed NPS survey, septic system survey, septic vulnerability analysis, development of updated watershed maps, multiple steering committee and technical advisory committee meetings to develop an updated action plan, and a public meeting to inform the community about the state of water quality and actions needed to improve water quality over the next 10 years. Since P is the nutrient driving poor water quality in the lake, it was used as the primary parameter for setting the water quality goal.

PURPOSE

The Sebasticook Lake WBMP provides details about current water quality conditions, watershed characteristics, and steps that can be taken to improve water quality in the lake over the next 10 years as part of a long-term strategy to restore water quality in the lake. The cost of the 10-year plan is estimated to cost $3.45 million to complete through a combination of state, federal and local contributions over this time period. The plan outlines management strategies and an activity schedule (2025 – 2034), establishes water quality goals and objectives, and describes actions needed to achieve these goals. This includes strategies to:

1. **Reduce the external phosphorus load** by implementing practices to reduce NPS pollution from soil erosion and stormwater runoff on developed land, agriculture, and forestry, and improving septic systems;
2. **Continue managing the internal phosphorus load** through improvement of annual drawdown protocols and inactivation of P in bottom sediments;
3. **Prevent new sources** of NPS pollution from getting into Sebasticook Lake by conducting regular road maintenance, improving and enforcing municipal ordinances, and increasing land conservation efforts;
4. **Raise public awareness** about lake protection strategies by increasing local education, outreach, and communication efforts through targeted outreach and workshops to increase participation among municipalities and watershed residents;
5. **Build local capacity** through partnership building across multiple community groups, engaging steering committee members, and developing a robust fundraising strategy;
6. **Monitor and assess improvements** in Sebasticook Lake's water quality over time. This includes annual baseline monitoring, plankton and cyanobacteria monitoring, tracking NPS pollution, stream monitoring, and monitoring for invasive aquatic plants.

STATEMENT OF GOAL

The goal of this plan is to improve water quality in Sebasticook Lake over the next 10 years as part of a long-term strategy to restore the lake. This includes reducing phosphorus inputs to the lake from the direct watershed (external load) and septic systems, and continuing to manage the internal load. Planning recommendations include reducing the phosphorus load by an additional 1000 kg/yr thereby reducing the average annual phosphorus concentration by 3.5 ppb over the next 10 years.

WATERSHED PLANNING GOALS

(2025-2034)

1. **REDUCE P INPUTS FROM DEVELOPED LAND IN THE WATERSHED**
2. **MANAGE INTERNAL LOADING IN THE LAKE**
3. **REDUCE THE PROBABILITY OF ALGAL BLOOMS**
4. **IMPROVING WATER QUALITY TRENDS**

PLAN DEVELOPMENT & COMMUNITY PARTICIPATION

The Sebasticook Lake WBMP was developed with input from a diverse group of local stakeholders and scientists over a period of two years (2023-2024). Plan recommendations are the result of multiple steering committee meetings, technical advisory committee meetings and subcommittee meetings

(Watershed Survey, NPS prioritization). The plan update was led by Ecological Instincts in partnership with the Town of Newport (grantee), Sebasticook Lake Association (SLA), the towns of Corinna and Dexter, Penobscot County SWCD, and Maine DEP. Technical support was provided by Ecological Instincts, Water Resource Services (WRS, Inc.), US EPA (bathymetric mapping), and St. Joseph's College (sediment analysis).

Community participation included public presentations at the 2023 and 2024 SLA annual meetings and a public forum held on August 15, 2024 at the Town of Newport Public Safety Building to present the Sebasticook Lake WBMP, which drew 54 attendees. The meeting highlighted the history of water quality issues and improvement measures, as well current water quality trends and recommended actions needed to continue to improve water quality in the lake over the next 10 years. The public forum included several breakout groups to help identify and refine priorities outlined in the draft watershed Action Plan.

WATERSHED PROJECTS, PROGRAMS & RESEARCH

There is a long history of planning, research, and implementation to improve water quality in Sebasticook Lake that spans over four decades. This work has resulted in strong partnerships involving numerous watershed partners working together to identify the best management strategies to reduce nonpoint source pollution from the watershed and internal phosphorus loading in the lake. However, despite these efforts, there is still enough phosphorus in the lake to support algal blooms. While the drawdown has been effective at slowly removing excess phosphorus from bottom sediments to address internal loading, this load is still large enough to influence algal bloom development during summer months. Runoff from developed land in the watershed continues to provide excess phosphorus to the lake and contributes to the build-up of phosphorus in the sediment which feeds the internal load. A higher-level of effort is needed to manage both of these primary sources of phosphorus loading to the lake.

A list of recent and/or relevant watershed projects is presented below.

PLANNING/RESEARCH

(1979) External Loading and Internal Recycling Report – Maine DEP prepared a report outlining the major sources of phosphorus in the lake and watershed, and recommendations for improving water quality. The study recommended eliminating or reducing known point source discharges, increasing the annual drawdown at the outlet dam to reduce internal loading, and identifying controllable sources of NPS pollution in the watershed.

(1998) Sebasticook Lake Watershed Survey – A US EPA CWA s.319 grant-funded survey of the Sebasticook Lake watershed was conducted in 1998, identifying sources of NPS pollution throughout the watershed. The survey identified 96 NPS sites in the watershed. These sites were targeted for improvements as part of a subsequent US EPA 319 grant funded watershed improvement project.

(2001) Sebasticook Lake TMDL – The 2001 TMDL estimated phosphorus inputs to the lake from various sources, finding that agricultural land makes up the greatest portion of the external phosphorus load to the lake (45%), but makes up only 16% of the watershed area. Residential development was estimated to make up only 5% of the watershed area but 15% of the phosphorus load, while roadways were estimated to make up 2% of the watershed area and 19% of the phosphorus load. The TMDL set a total phosphorus goal of 15 ppb for Sebasticook Lake and developed management recommendations to help reach this goal including adopting earlier and longer lake drawdowns to address the internal load, providing technical assistance to targeted agricultural landowners through NRCS programs, initiating a buffer program, and installing BMPs at residential, road and other NPS sites.

(**2003) Septic Survey** – in 2003, a survey was conducted to assess the state of septic systems on the shoreline of Sebasticook Lake and their possible impacts on water quality. Information and associated data from this survey are no longer available.

(2022) Septic System Database – The Town of Newport recently conducted an inventory of septic systems records within 250 feet of Sebasticook Lake. The database was developed to track changes in septic systems within the shoreland zone over time and to better understand the condition of existing systems. Preliminary findings from this inventory found that only 40% of developed properties have septic system records, thereby indicating a need for additional research to determine the status of the remaining 60% of systems.

(2023) Sebasticook Lake Watershed NPS Survey – As part of the development of the 9-element Watershed-Based Management Plan, the Town of Newport conducted a watershed survey to document current sources of NPS pollution in the Sebasticook Lake watershed. The survey identified 172 erosion sites across 10 ten land-use types throughout the watershed. Funding for the survey was provided by the US EPA through a CWA s.604(b) grant.

ANNUAL LAKE DRAWDOWNS

Annual lake drawdowns were initiated in 1982 in order to export phosphorus built up in bottom sediments as a result of NPS pollution. In 1988 the dam outlet was reconstructed using CWA Section 314 (Clean Lakes Program) matching funds to increase the annual drawdown and phosphorus export. The onset and duration of drawdowns has changed over time but is generally conducted annually from mid-September to mid-November to correspond with fall turnover. Annual drawdowns have resulted in a significant reduction of the sediment-derived phosphorus available for internal recycling. A local dam committee meets regularly to review protocols and to determine timing of the annual drawdown.

CLEAN WATER ACT SECTION 319 FUNDS

In 2002 and 2003, three CWA s.319 implementation grants (Phases I, II, and III) supported installing Best Management Practices (BMPs) on high-priority NPS sites identified in the 1998 Sebasticook Lake Watershed Survey. These projects resulted in the installation of BMPs at a total of 49 NPS sites and are estimated to have reduced the annual pollutant loading to the lake by more than 189 tons of sediment and 186 pounds of phosphorus. An educational brochure was produced and distributed to lakeshore landowners as part of these projects to help them improve buffers on their properties.

USDA/NRCS FUNDS

The USDA natural Resources Conservation Services (NRCS) has led over three decades of work to reduce phosphorus export from farming activities in the watershed. Between 1981-1992, 22 manure storage systems were installed, and 5,500 acres were treated with conservation tillage, cover crops and other practices. In 1997 and 2001, NRCS carried out targeted Environmental Quality Incentives Program (EQIP) work in the watershed and funded animal waste, nutrient management, and cropland erosion projects. From 2004-2014, NRCS applied 1,471 practices on dairy farms and cropland including 7 waste storage facilities and 18,000 acres of cropland and nutrient management BMPs. From 2012-2014, the National Water Quality Initiative (NWQI) implemented cover crop, crop rotation and forage/biomass plantings on 1,500 acres on farms in the Alder Brook subwatershed. The Sebasticook Lake-Alder Stream National Water Quality Initiative resulted in $495,990 in funding for cover crops, residue management, conservation crop rotation and forage and biomass plantings on four cropland and/or dairy farms in the Alder Brook watershed (NRCS, 2014). NRCS will provide ongoing financial and technical support to agricultural producers to meet phosphorus reduction goals in the watershed as part of this 10-year plan.

PUBLIC OUTREACH

SLA and the Town of Newport are the primary entities conducting public outreach in the watershed. SLA hosts an annual meeting each summer for all interested watershed residents, provides watershed updates on its website and Facebook page (894 followers), and distributes two annual newsletters to lake association members. The Town of Newport maintains a page on their website with information about Sebasticook Lake where they provide notices about the timing of annual drawdowns. General and targeted outreach activities are presented in Section 7.

WATER QUALITY MONITORING

Water quality data have been collected at Sebasticook Lake by Maine DEP and Lake Stewards of Maine Volunteer Lake Monitoring Program since 1972 in the deepest part of the lake (Station 1). Additional data was collected by Maine DEP at Station 2 between 1972-2008, as well as four years of data at Station 3 and 3 years of data at Station 4. Volunteers from SLA have been trained as certified water quality monitors to collect routine water quality data throughout the summer. Water quality will be discussed in Section 3.

2. Lake & Watershed Characteristics

LAKE & WATERSHED FACTS

Watershed Towns:	Newport, Corinna, Stetson, Exeter, Saint Albans, Palmyra, Dexter, Ripley
Total Watershed Area:	120 mi^2
Direct Watershed Area:	47 mi^2
Surface Area:	7 mi^2 (4,537 acres)
Max Depth:	60 ft (18.3 m)
Mean Depth:	21 ft (6.2 m)
Flushing Rate:	1.47 flushes/yr[8]
Lake Elevation:	203 ft
Peak Elevation:	586 ft, 930ft
Avg. Clarity:	2.7 m (2014-2023)

Sebasticook Lake outlet dam.
(Photo credit: Bowman Constructors)

Sebasticook Lake (MIDAS 2264)[9], is a 4,537-acre lake (Class GPA)[10] located in Penobscot County, in the central Maine town of Newport (Figure 1). The lake has a maximum depth of 18.3 m (60 ft), and an average depth of 6.2 m (21 ft) and a flushing rate of 1.47 flushes/year. The deepest part of the lake is in the north central section of the lake, close to the cove near Darlings Road.

The lake has a large drainage area covering 120 mi^2 including both the direct (47 mi^2) and indirect watersheds (73 mi^2), but not including the surface area of Sebasticook Lake. The watershed includes portions of eight towns across two counties including the towns of Newport, Corinna, Stetson, Exeter, Dexter (Penobscot County), Saint Albans, Palmyra, and Ripley (Somerset County) (Figure 1).

The indirect watershed includes two large lakes – Pleasant Lake in Stetson, and Lake Wassookeag in Dexter, along with multiple smaller lakes and ponds including Echo Lake, Brooks Pond, Nokomis Pond, Hicks Pond, Newport, Lake, Halfmoon Pond, and Mower Pond. The Sebasticook Lake Watershed encompasses the headwaters of the East Branch Sebasticook River and is a major part of the Sebasticook River drainage system. Major tributaries in the Sebasticook Lake watershed include the East Branch Sebasticook River to the north, Stetson Stream to the east, and Mulligan Stream (impaired) which flows in from the northwest. Additional named tributaries in the indirect watershed include Alder Stream, Snell Brook, and Robinson Brook.

---

8 As calculated by the Lake Loading Response Model (LLRM) in 2023, described in Section 4.
9 The unique 4-digit code assigned to a lake.
10 Defined by MRSA Title 38 §465-A, Maine Standards for Classification of Lakes and Ponds: Class GPA is the sole classification of Great Ponds (>10 acres) and natural lakes and ponds <10 acres in size.

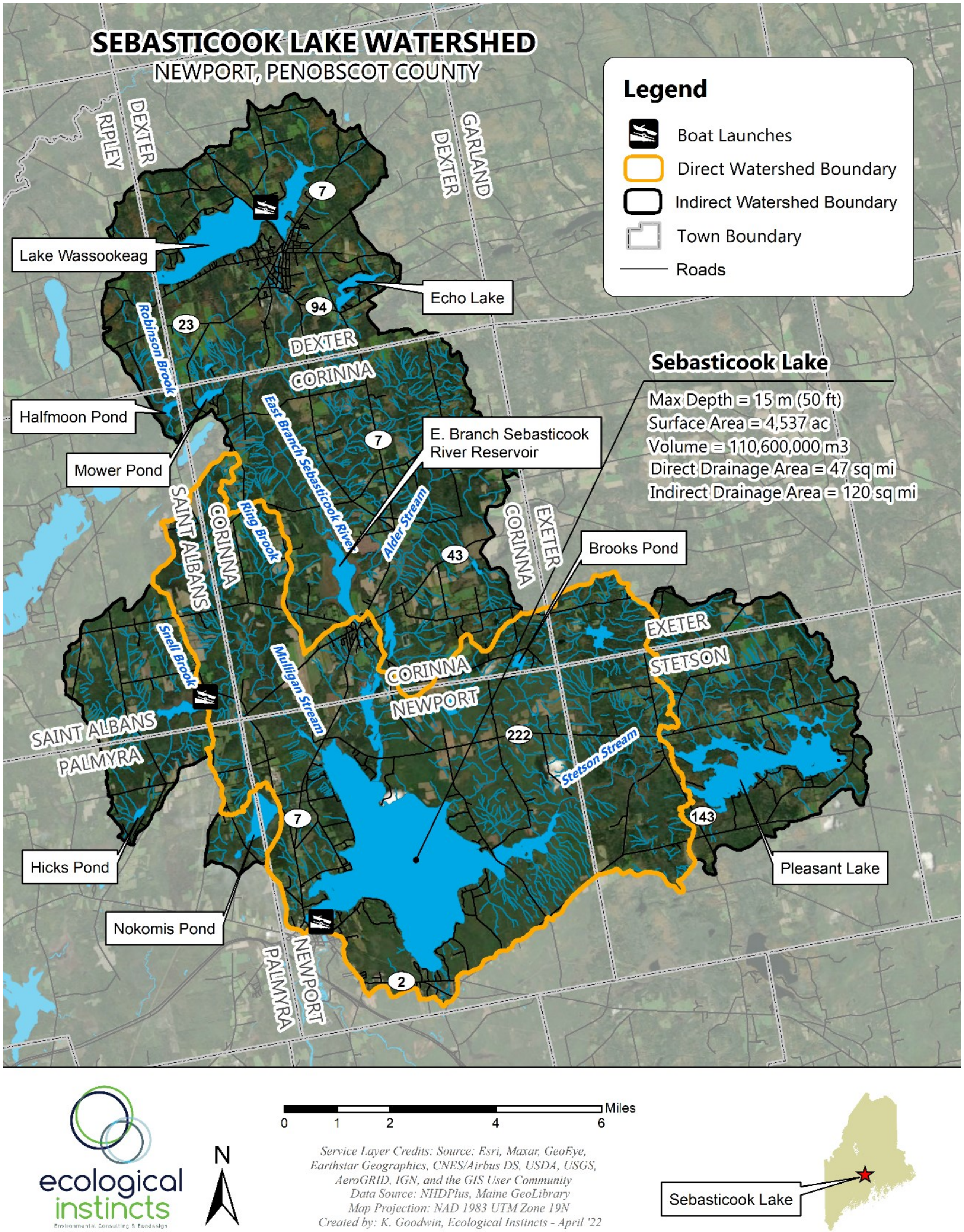


Figure 1. Map of the Sebasticook Lake direct and indirect watersheds.

Water flows southwest out of the lake into the East Branch, then into the Sebasticook River, which flows to the Kennebec River and into the Gulf of Maine. The indirect watershed includes 508 miles of streams, 7,418 acres of wetlands, and 22,160 acres of riparian habitat bordering lakes, ponds, streams, and wetlands.

Water level in Sebasticook Lake is controlled by natural fluctuations in precipitation and evaporation, and through management of the dam at the southwest end of the lake which flows into the East Branch Sebasticook River. The water level has been controlled to allow the fall drawdown and export of phosphorus from the lake since 1982. A fish ladder at the dam provides fish access from downstream waterbodies.

Sebasticook Lake is listed on the state's 303(d) list of impaired lakes due to the long history of poor water quality and presence of nuisance algal blooms. Despite management actions taken to reduce the amount of phosphorus in the lake over the last 40 years, which has improved for the better, the lake still experiences summertime algal blooms. The watershed is mostly undeveloped (76%), consisting of rolling hills with forests, wetlands and waterbodies, but also includes large areas of agriculture including large tracts of farmland as well as urban development. Sebasticook Lake's shoreline is surrounded by a network of state, town and private roads. Many unimproved roads and private roads run perpendicular to the shoreline servicing areas of high-density residential shoreline development.

There are an estimated 371 developed lots on the shoreline of Sebasticook Lake and three large commercial campgrounds- two on the south end, and a relatively new 100 site campground on the north end of the lake off Route 7. Other commercial developments are concentrated along state roads and town centers in Newport, Corinna, and Dexter. The watershed also contains large areas of agricultural land dominated by hayland, corn, and potatoes as well as large dairy farms in both the direct and indirect watersheds. The 2001 TMDL estimated agriculture to comprise approximately 16% of the watershed area with 68 operating farms including 21 commercial farms (dairy/beef, potato, poultry) at that time. More recent estimates show the number of farms in the direct watershed at 181 with approximately 5,068 acres dominated by hay (2,358 acres) and corn (1,412 acres), followed by pasture (580 acres) and potatoes (429 acres) (PCSWCD, 2023).

Public access to the lake includes a state-owned public boat launch on the southwest shore of Sebasticook Lake on Boat Access Rd, along with two carry-in launches (on the East Branch on County Woods Rd at the north end of the lake, and off Durham Bridge Rd on the northwest shore). Additional state-owned public launches in the watershed include one on Lake Wassookeag in Dexter, and a carry-in launch on Mulligan Bog in St. Albans.

POPULATION, GROWTH, & MUNICIPAL ORDINANCES

POPULATION

Sebasticook Lake provides excellent recreational opportunities including swimming, fishing, camping and boating, and is considered one of the most valuable recreational assets in the region. Commercial businesses in the watershed benefit from its draw as a regional recreational destination, as well as the Town of Newport that relies on the tax base from shoreline development. A study on 36 Maine lakes found that lakes with 1 m greater clarities have higher property values on the order of 2.6% - 6.5%. Similarly, lakes with a 1 m decrease in minimum transparencies cause property values to decrease anywhere from 3.1% to 8.5% (Boyle and Bouchard, 2003).

Population and demographics are important factors in watershed planning because large increases in unplanned population growth, and consequently development, could negatively affect water quality. Conversion of seasonal or second homes to year-round homes would result in a significant change in use on the shoreline, increasing the potential for more stormwater runoff and impacts from septic systems among other factors.

According to the Maine Office of the State Economist, the population of Penobscot and Somerset Counties in 2020 was 152,199 and 50,477, respectively, representing a decrease in population by 1% in Kennebec County, and a 3% decrease in population in Somerset County since 2010 (Table 1). The only towns within the watershed that grew between 2010 and 2020 were Corinna and St. Albans, by 1% and 2%, respectively. Exeter shrank by 12%, the largest population change in any town in the watershed during that period. As Penobscot and Somerset Counties shrank, the population of the State of Maine increased by 3% between 2010 and 2020.

Table 1. *Population demographics and 2025 projections for the towns of Newport, Corinna, Stetson, Exeter, St. Albans and Palmyra, Kennebec and Somerset Counties, and the State of Maine.*

Town	Population*				
	2010	2015	2020	Projected 2025	% Change 2010-2020
Newport (Penobscot County)	3,278	3,175	3,133	3,166	-4%
Corinna (Penobscot County)	2,205	2,227	2,221	2,225	1%
Stetson (Penobscot County)	1,200	1,202	1,186	1,168	-1%
Exeter (Penobscot County)	1,089	1,012	963	903	-12%
St. Albans (Somerset County)	2,011	2,000	2,045	2,090	2%
Palmyra (Somerset County)	1,984	1,936	1,924	1,900	-3%
Penobscot County	153,923	152,275	152,199	152,059	-1%
Somerset County	52,228	50,654	50,477	49,889	-3%
State of Maine	1,328,361	1,335,777	1,362,359	1,374,728	3%

**2010, 2020, and % change values from the 2020 Census (Maine State Economist, 2023a). 2015 and 2025 projected values from Maine State Economist (2023b). The 2020 population numbers are inconsistent between these two sources, where the observed 2020 values used for the projected data are slightly lower than the census data in both Penobscot and Somerset counties.*

The population of Penobscot County is expected to fluctuate but remain consistent with a 0.9% ten-year percent change, and -2.2% twenty-year percent change (Maine State Economist, 2024b). Somerset County is expected to slowly decline in population, although the decline slows. The population decreased by 3% between 2010 and 2020 but is expected to slow to 1.2% between 2020 and 2030 (Maine State Economist, 2024a and 2024b). The Census recorded 152,199 people in Penobscot County in 2020 but the observed 2020 value for the projections was 152,007. Somerset County and Maine populations had similar discrepancies (<100 people). While these are small differences, the predicted change in population is gradual enough in Penobscot County that it represents a small increase in population projected into 2025 instead of a decrease. These trends indicate that Corinna and St. Albans in the watershed may continue to grow, but the overall watershed is experiencing a slow decline in population.

While Penobscot County and Somerset County are slowly shrinking, changing patterns in where people are living within the watershed can also affect water quality. Proximity to the lake as well as streams feeding the lake all change the relative impact of development. Changes in how properties are used may also be contributing to increased impacts from development on the lake. Seasonal properties being converted to year-round homes can increase loading from septic systems, as older systems designed for seasonal use are used more frequently. Seasonal to year-round conversions can also contribute to increased impacts from gravel roads and other developed areas. While overall populations trends in Newport appear to be on the decline, the town has experienced an increase in the number of new building permits in the shoreland zone of the lake.[11] Tracking these types of changes can be just as important to understanding the changing threats to Sebasticook Lake as tracking population demographics.

MUNICIPAL ORDINANCES

Protecting natural resources starts with good municipal ordinances that meet or exceed the minimum state requirements. Ordinances that are up to date, provide clear consistent criteria and guidelines for development, and are adequately enforced provide the means by which to protect lake water quality through responsible development. As the watershed continues to develop over time, erosion from disturbed areas will deliver new and previously unaccounted for P into the lake, thereby affecting the success of planned management strategies to restore water quality.

Probably the most important ordinance for lake protection is administration and enforcement of local shoreland zoning regulations, required through the Mandatory Shoreland Zoning Act (MSZA). The State created Chapter 1000 Guidelines for Municipal Shoreland Zoning Ordinances[12] to provide guidance that towns can choose to use for their own ordinances, or as guidance for adopting more stringent ordinances- as long as they are equally or more effective in achieving the purposes of the MSZA.

The shoreland zone *is defined as all land areas within 250 feet, horizontal distance, of the normal high-water line of any great pond or river, upland edge of a coastal wetland, including all areas affected by tidal action, upland edge of defined freshwater wetlands, and all land areas within 75 feet, horizontal distance, of the normal high-water line of certain streams.*

Only three of the towns in the direct watershed have Shoreland Zoning ordinances available publicly on their websites, and three have prepared a comprehensive plan (Table 2). The Town of Newport is in the process of updating their Comprehensive Plan. Towns should consider working collaboratively to develop consistent ordinance language across the watershed and to ensure that all ordinances are easily accessible to the public.

[11] Personal communication, Jim Ricker, Town Manager, Town of Newport.

[12] CMR 06-096, Department Rules Chapter 1000. A model regulation adopted in January 1988 and amended through January 2015.

***Table 2**. Status of shoreland zoning and comprehensive plans in the s towns in the Sebasticook Lake direct watershed, and percentage of the lake and watershed area in each town.*

Town	% of watershed	SLZ ordinance available online?	Comprehensive Plan
Newport	49%	Yes (2010)	Yes (2008)
Corinna	20%	No	No
Stetson	17%	No	No
Saint Albans	7%	Yes (2018)	Yes (2016)
Exeter	5%	No	Yes (2011)
Palmyra	2%	Yes (2012)	No

Given the large areas of buildable land in the watershed and the potential increase in P from new development, there is an immediate need to reduce the amount of P getting to the lake from both existing development and future development. As the watershed continues to develop over time, erosion from disturbed areas will deliver new and previously unaccounted for P into the lake, thereby affecting the success of planned management strategies to restore water quality. Recommended actions to improve watersed planning and ordinances are outlined in Section 7.

LAND COVER

Land cover is the essential element in determining the extent of nutrients and sediments entering a lake from its watershed. For example, more intensive development such as agriculture and areas containing large areas of impervious land such as commercial or industrial development can contribute more runoff than a low-density residential property with natural landscaping. In addition, changes in land cover occur over time in a watershed as forests are cleared for lumber or agriculture, agricultural land is left fallow or developed, and infill development occurs along the shoreline and existing roads. The most recent available data from the USGS National Land Cover Database (NLCD) (updated 2021) was used to determine land cover in the Sebasticook Lake Watershed.[13] The most recent version of the data (updated 2021) was used in the analysis (Figure 2).

Forestland accounts for the greatest area of land in the watershed, accounting for 55% of the land area (Figure 3 & Figure 4). The watershed also includes large areas of open water and wetlands (21% of the watershed, not including the area of Sebasticook Lake), much of which consists of forested wetlands surrounding Stetson Stream, East Branch Sebasticook River, and Mulligan Stream and smaller tributaries thoughout the watershed. Agriculture, including row crops, grazing, and hayfield, makes up another 15% of the watershed area. Urban development, accounts for 8% of the land in the watershed, and is primarily located along major roadways and around the shoreline, with the highest concentrations of commercial and high-density residential development around the urban centers of Newport, Corinna, and Dexter. Much of the development in the watershed is low-density residential development. A network of state, town, and private roads (including numerous gravel roads that provide access the shoreline) encircle the lake.

[13] For modeling purposes, the land cover analysis includes all land in the direct and indirect watersheds.

The large watershed area and high levels of agricultural and urban/suburban development indicate that Sebasticook Lake is susceptible to significant phosphorus inputs from its watershed.

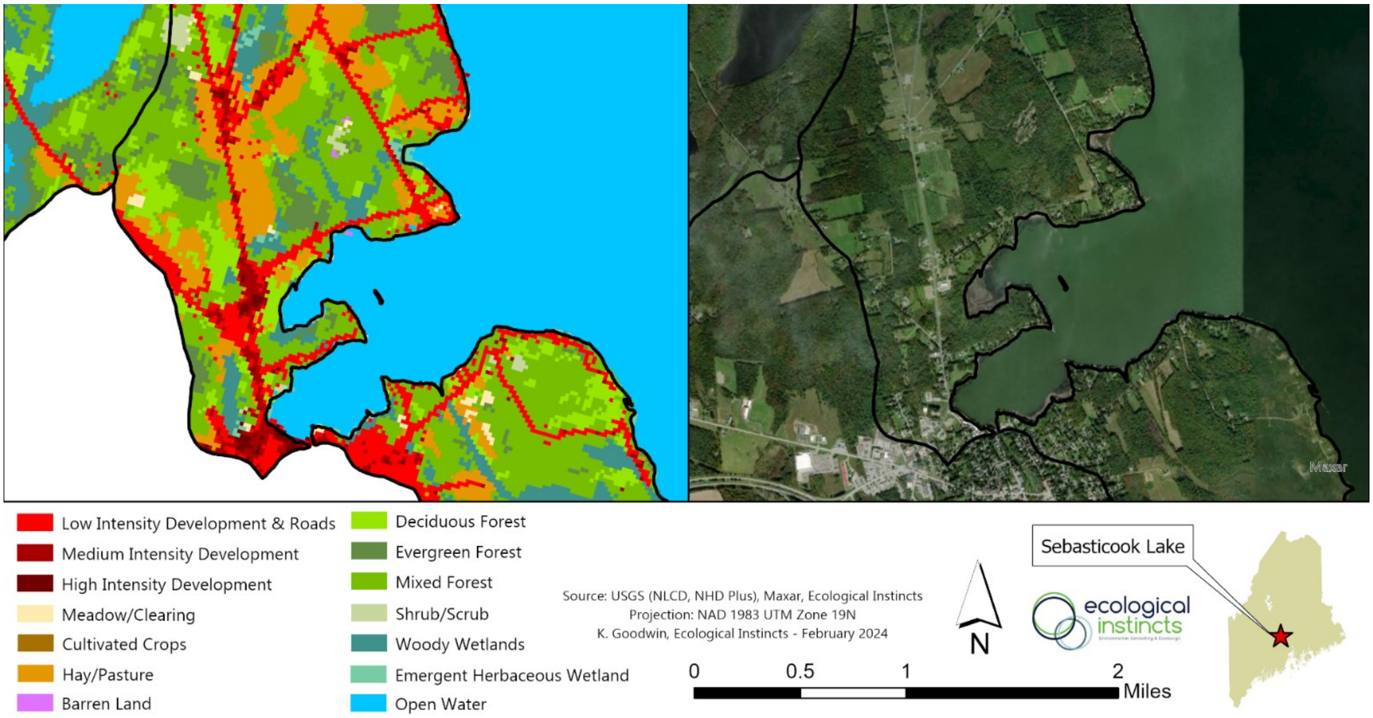


***Figure 2**. NLCD Land Cover data (left) vs aerial imagery (right) for a section of the Sebasticook Lake watershed.*

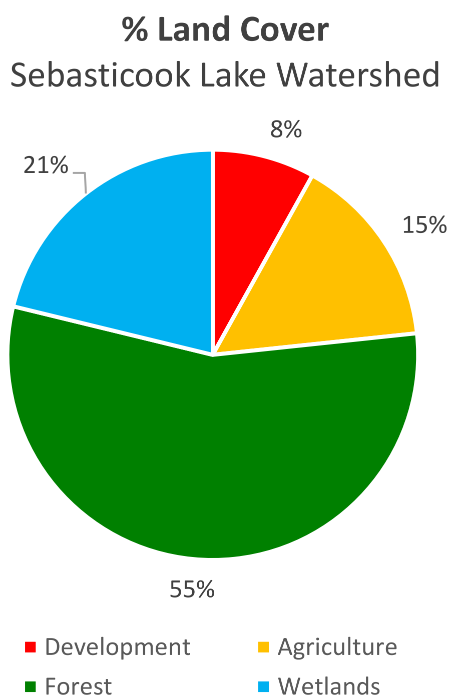


***Figure 3.** Land cover by percent cover in the Sebasticook Lake Watershed.*

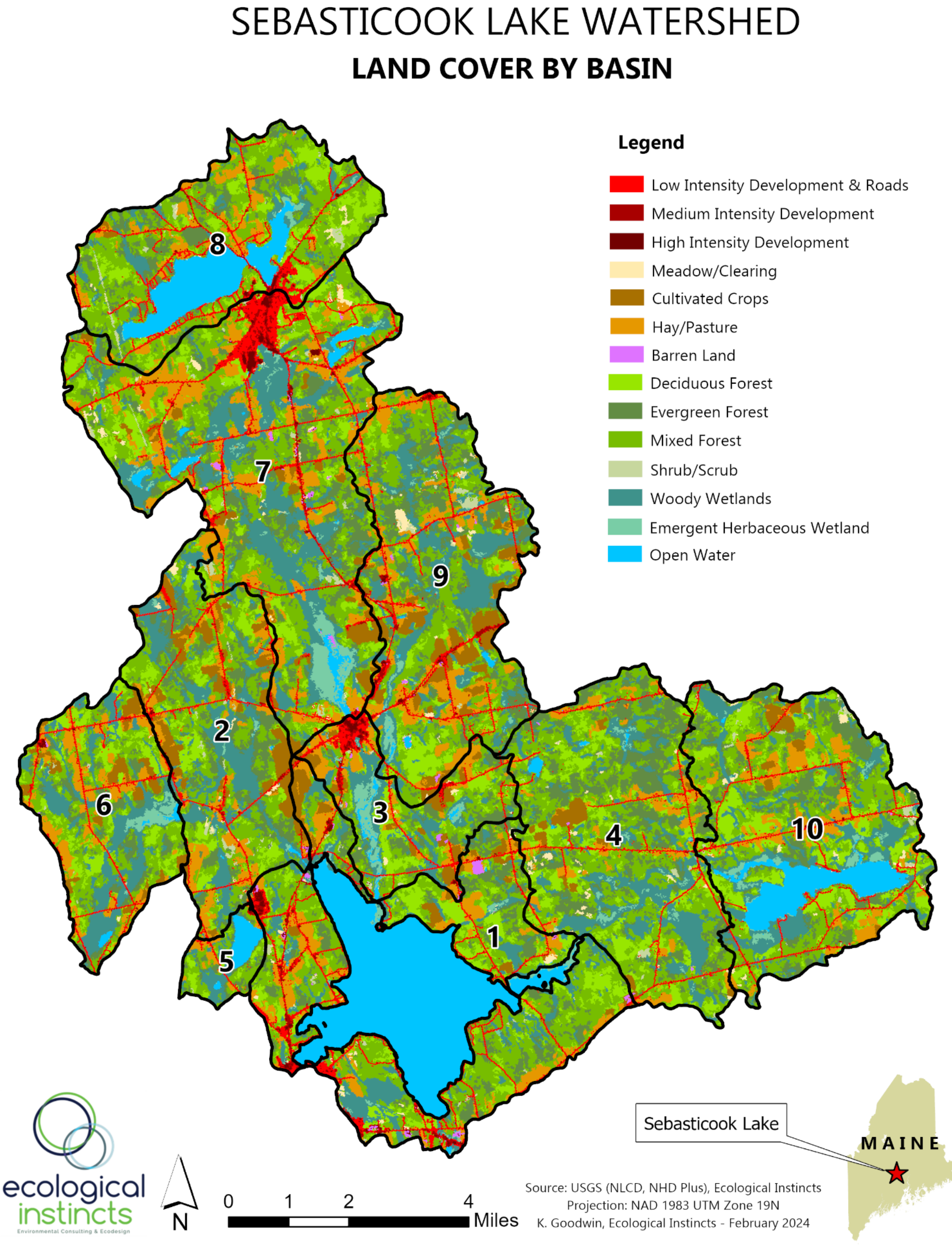


***Figure 4**. Land cover map for the Sebasticook Lake Watershed.*

SOILS

Factors such as topography, soil type, erosive potential, and land alteration all influence the degree to which soil erosion occurs. The topography of the Sebasticook Lake watershed is relatively flat with small hills throughout the watershed, with a few steeper areas to the north of Lake Wassookeag.

Soils in the watershed are primarily derived from glacial till, a result of the glaciers that covered Maine more than 12,500 years ago. The Sebasticook Lake watershed is predominantly coarse-loamy lodgment till (13.7%), loamy lodgment till (26.2%) and coarse-loamy subglacial till (26.3%).[14] Monarda soils are the dominant soil type in the watershed, which are considered poorly drained loamy soil over a loamy basal till that restricts downward movement of water (Ferwerda et. al., 1997). The composition of each soil type dictates the amount of phosphorus, iron, and aluminum exported to the lake from the watershed soils, and therefore define the chemical makeup of sediment that has settled at the bottom of the lake.

AT-RISK SOILS AND SUBSURFACE WASTEWATER SYSTEMS

Soil type also affects the suitability for infrastructure, specifically for septic systems. Coarse, sandy, and shallow to bedrock soils are considered “at-risk soils,” due to the rapid permeability of these soils that may result in septic system leach field effluent “short-circuiting” to groundwater. Short-circuiting occurs when septic tank effluent is not properly treated in the leach field because the soils are coarse and porous, which allows the effluent to move through them too quickly. Additionally, soils with shallow water tables and shallow-to-bedrock soils that abut or are hydrologically connected to the lake are also considered at-risk due to lack of treatment area where the leach field might rest on fractured bedrock resulting in no treatment of effluent before reaching groundwater which might then flow into the lake. Septic systems that are located on unsuitable soil types may also be at risk of failure due to outside factors, such as age of the systems, maintenance, and changes in use.

Ecological Instincts (2023b) conducted a septic risk analysis of soils in the Sebasticook Lake watershed. Soils that met the characteristics of “at-risk” were cross-referenced with tax maps to identify developed properties on sensitive soils located within the shoreland zone of Sebasticook Lake or its tributaries. The results of the septic system vulnerability analysis indicate that close to half (13,684 acres, 46%) of the soils in the Sebasticook Lake watershed are considered sensitive soils at risk of septic system short circuiting (Table 3). High-risk shallow-to-bedrock soils account for 40% of the total area of sensitive soils (8,084 acres), compared to just 100 acres of very high-risk soils (<1% of the total sensitive soils). This includes 79 acres of very high-risk coarse soils (0.6%) (Figure 5).

A total of 927 parcels (55% of all parcels within the Town of Newport) were identified as being located on either at-risk or shallow to bedrock soils within the watershed. Of these 927 parcels, 492 include areas of at-risk soils within 150 feet of Sebasticook Lake, intermittent streams, perennial streams, or smaller ponds and wetlands.

[14] Soils data sourced from USDA/NRCS Web Soil Survey: https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

***Table 3**. Area of sensitive soils by town in the Sebasticook Lake watershed*

Town	Watershed Area (ac)	Sensitive Soil Area (ac)	% of Town on Sensitive Soils
Exeter	1,625	1,040	64%
Corinna	5,906	3,167	54%
Stetson	5,025	2,471	49%
Newport	14,415	6,325	44%
Saint Albans	1,973	595	30%
Palmyra	675	86	13%
Total Watershed	**29,619**	**13,684**	**46%**

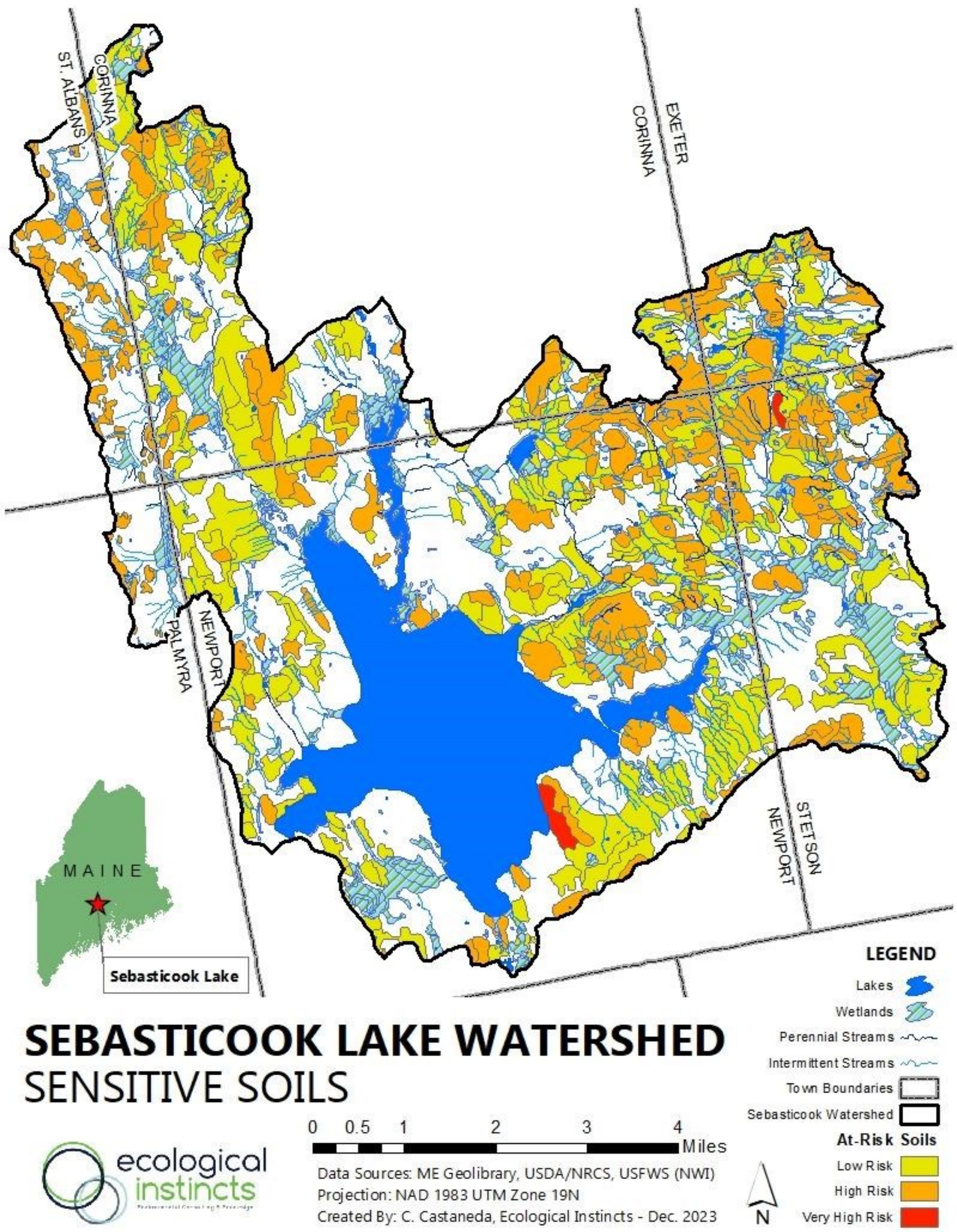


***Figure 5**. At-risk soils and associated parcels in the Sebasticook Lake direct watershed.*

The Town of Newport developed a septic system database to support the 2009 Shoreland Septic System Compliance Program (repealed in June 2012). The database was updated by the town in 2023 to support the WBMP development. The septic system database is a useful tool for tracking the type and condition of septic systems in the watershed to raise community awareness about the potential impacts from septic systems, protect the health and safety of the drinking water supply, and ultimately, improve water quality.

Results from the septic database and septic system vulnerability analysis can be used to prioritize outreach to landowners who have systems that might be malfunctioning. Older systems on sensitive soils should be prioritized for upgrades and undeveloped parcels on sensitive soils should be flagged to ensure septic systems are designed and installed properly. Local ordinances should be updated to improve septic system installations and proof should be required that septic systems have been installed up to code, particularly on sensitive soils. Regular inspections for existing systems, especially those transitioning from seasonal to year-round use, are crucial. Collaboration with neighboring towns to digitize parcel data and integrate septic information will enable better assessment and prioritization of system vulnerabilities. Additionally, educating landowners about available grants for septic system improvements and tracking inspections during property transactions will further promote water quality and community awareness.

BATHYMETRY

The morphology (shape) and morphometry (measurement of shape) of lakes have been shown to be good predictors of water clarity and lake ecology, where large, deep lakes are typically clearer than small shallow lakes. Bathymetric data is useful for estimating the mass of P by depth, for assessing internal loading, and examining changes in the Anoxic Factor (AF) in the lake which requires a reliable bathymetric map. The most recent bathymetric map for Sebasticook Lake was created by US EPA (Figure 6).

The deepest area of the lake is located northeast of the lake's center between the inlets of the East Branch Sebasticook River and Stetson Stream. Sebasticook Lake is a relatively shallow lake, with roughly 60% of the total area of the lake in water shallower than 8 m. In comparison, roughly 52% of the lake area and 14% of the lake volume is in water deeper than 7 m, vs. 60% of the lake area and 23% of the lake volume in water deeper than 6 m.

WATER RESOURCES AND WILDLIFE HABITAT

The indirect Sebasticook Lake watershed includes two public drinking sources, Nokomis Pond and Lake Wassookeag. Although many of the residents of the greater watershed receive their water from ground wells, Newport residents located in the village obtain their drinking water from Nokomis Pond (Town of Newport, 2023). Residents of Dexter obtain their drinking water from Lake Wassookeag (Dexter Water District, 2020). Maintaining water quality both in surficial and groundwater affects both the people and wildlife of the Sebasticook Lake watershed and the surrounding areas.

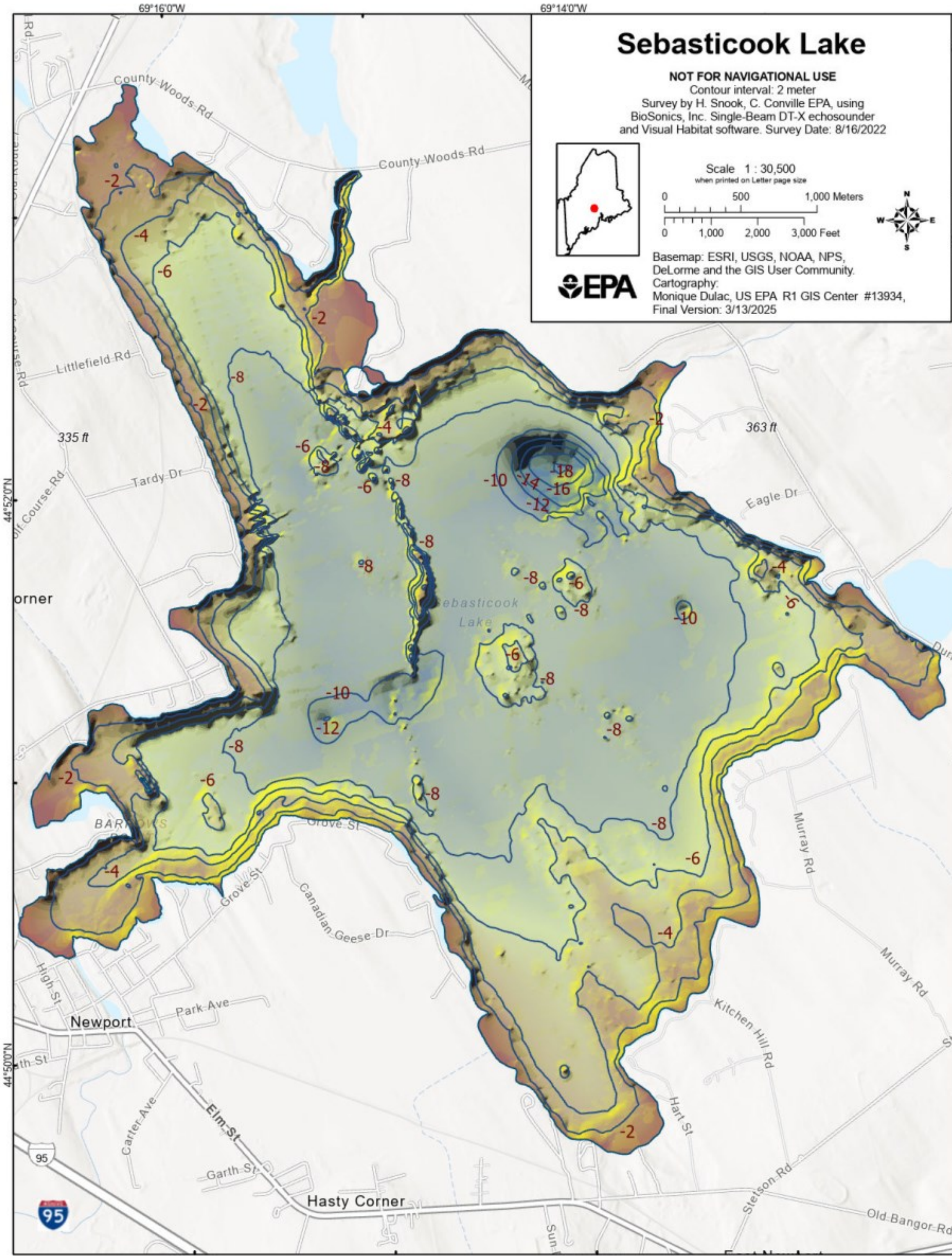


***Figure 6**. Bathymetric map for Sebasticook Lake. (Source: US EPA)*

Fish and wildlife require suitable upland habitat, as well as healthy riparian buffers, wetlands, and large undeveloped habitat blocks strategically linked to provide movement of wildlife. An assessment of water resources and wildlife habitat was completed for the indirect Sebasticook Lake watershed (Figure 7 & Figure 8) using Beginning with Habitat (BwH) data.[15]

[15] Beginning with Habitat: https://www.maine.gov/ifw/fish-wildlife/wildlife/beginning-with-habitat/index.html

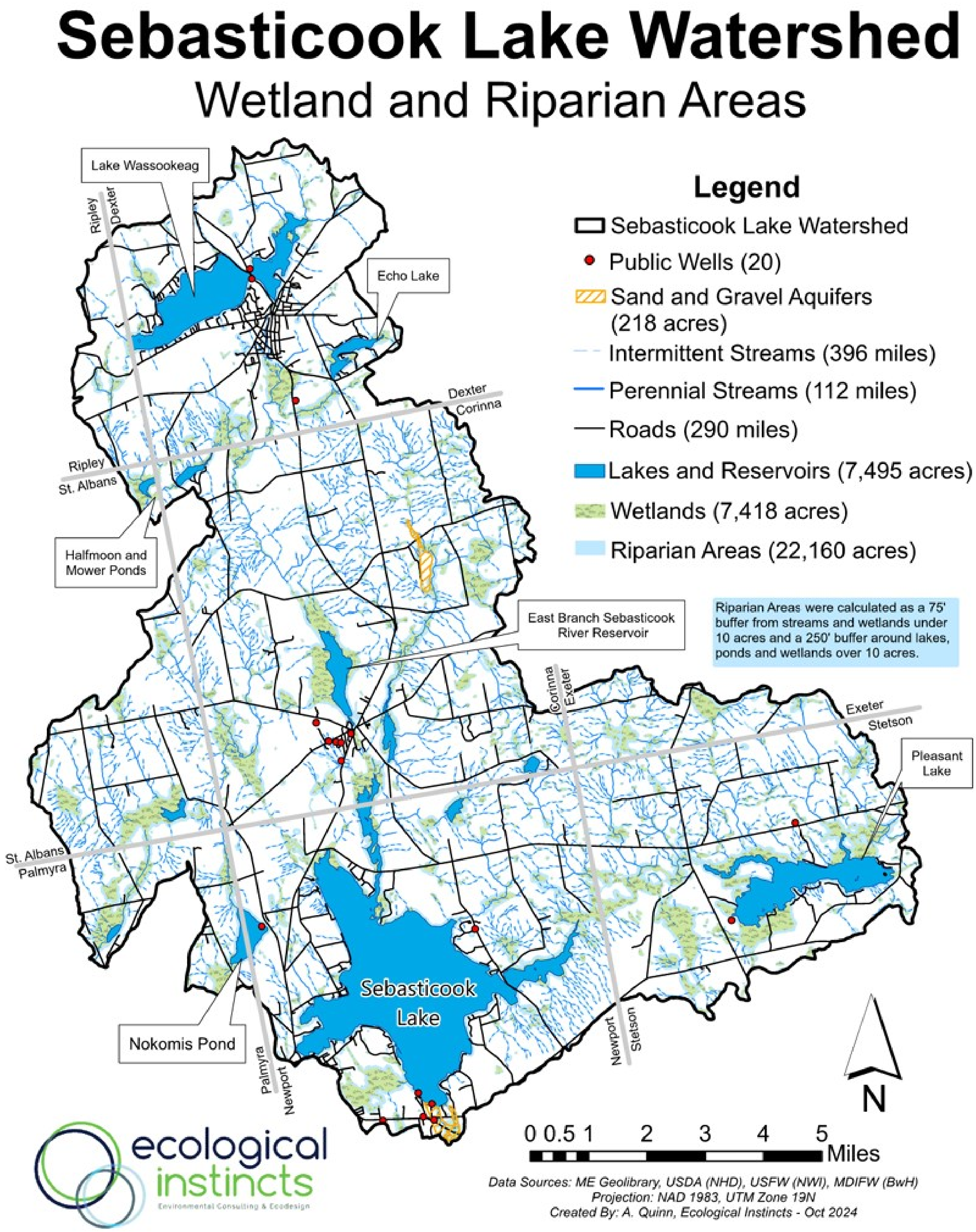


Figure 7. *Water resources in the Sebasticook Lake watershed.*

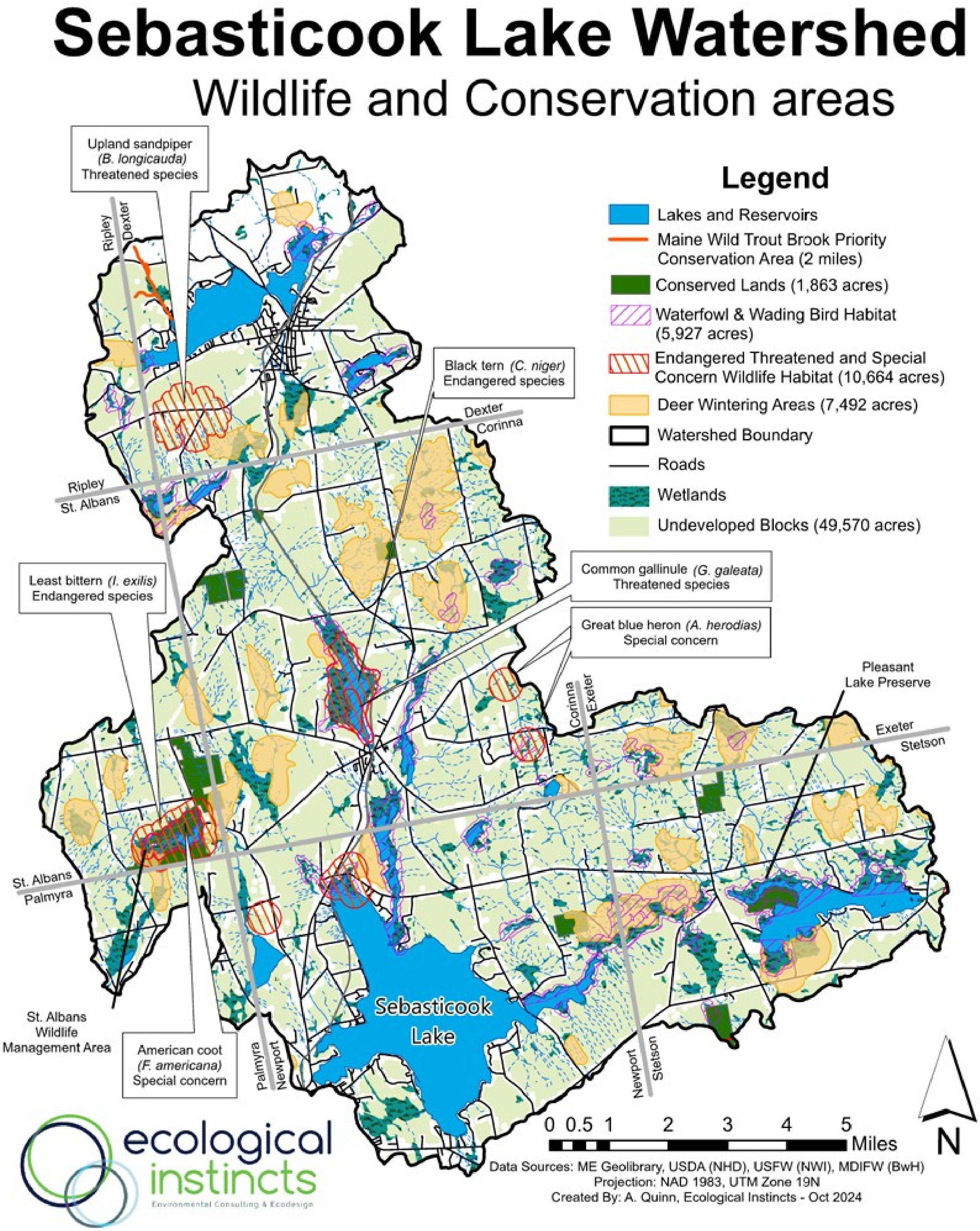


Figure 8. *Wildlife habitat in the Sebasticook Lake watershed.*

Results of the assessment highlight the wealth of water resources in the watershed, including 7,418 acres of wetlands, 508 miles of streams, 7,495 acres of open water (including the surface area of Sebasticook Lake), and 22,160 acres of riparian habitat within the total indirect watershed. Healthy riparian zones are not only important for water quality but are essential for more than 60 species of Maine wildlife. (ME Audubon, 2006)

Riparian habitat is the transitional area between aquatic habitats and dry, upland areas.

More animals live in riparian zones than in any other habitat type in Maine, with hundreds of species depending on riparian zones for survival (ME Audubon, 2006). Sections of the riparian habitat in the watershed have been impacted by development and roads, especially along the shoreline. As development continues, this valuable habitat will diminish - underlining the need for strong protection of the shoreland zone and conservation of undeveloped land within the watershed.

The Sebasticook Lake watershed provides habitat for a number of different rare plant and animal species of special concern. MDIFW documented six species of threatened, endangered, or species of special concern in the watershed, great blue heron, common gallinule, black tern, least bittern, American coot and upland sandpiper. Many of these bird species are found in wetlands within the Sebasticook watershed (Figure 8).

Other locally important wildlife species present in Sebasticook Lake include the common loon (*Gavia immer*). A symbol of summertime on Maine lakes, loons are regularly present on Sebasticook Lake, with 42 adults and 1 chick counted on the lake in 2023 (Maine Audubon, 2023).

According to Beginning with Habitat, large undeveloped forest blocks cover 61% or 49,570 acres of the watershed. There are 38 areas of inland wading bird and waterfowl habitat (IWWH) in the watershed. The largest is on the east side of Sebasticook Lake around Stetson Stream connecting it to Pleasant Lake. Areas of deer wintering habitat are located throughout the watershed, amounting to 9% (7,492 acres) of the total indirect watershed. Protecting the land and water resources in the watershed is vital for maintaining this high-value wildlife habitat.

FISHERIES

Sebasticook Lake contains 19 species of fish including both native and introduced species (Table 4). The lake provides an excellent warm water fishery due to its abundant shallow weedy areas. Primary fisheries include robust populations of largemouth and smallmouth bass, black crappie and white perch. Although Maine IF&W does not stock Sebasticook Lake, Sebasticook River, the East Branch of Sebasticook River and Lake Wassookeag are all stocked with brown trout which may make it to Sebasticook Lake (Maine IF&W 2023).

After 2008, the Sebasticook River was returned to an open system allowing for the passage of alewives, after the removal of dams and introduction of fish passages on the Kennebec and Sebasticook rivers. In 1999 the Edwards dam on the Kennebec River was removed.

Table 4. *Fish species in Sebasticook Lake. (Source: Lakes of Maine).*

Species	Scientific Name	Introduced
American eel	*Anguilla rostrata*	
Black crappie	*Pomoxis nigromaculatus*	*X*
Bluegill	*Lepomis macrochires*	
Brown bullhead	*Ameirus nebulosus*	
Burbot	*Lota lota*	
Chain pickerel	*Esox niger*	
Common shiner	*Luxilus cornutus*	
Fallfish	*Semotilus corporalis*	
Golden shiner	*Notemigonus crysoleucas*	
Largemouth bass	*Micropterus salmoides*	*X*
Pumpkinseed	*Lepomis gibbosus*	
Rainbow smelt	*Osmoerus mordax*	
Redbreast sunfish	*Lepomis auratus*	
Sea-run alewife	*Alosa pseudoharengus*	
Smallmouth bass	*Mircopterus dolomieu*	
Threespine stickleback	*Gasterosteus aculeatus*	
White perch	*Morone americana*	
White sucker	*Catostomus commersoni*	
Yellow perch	*Perca flavescens*	

In 2002, on the Sebasticook River, the Main Street Dam was removed, and a fish ladder was constructed around the North Street Dam. In 2008, a small dam at the outlet of the Sebasticook River was removed. As the passage to Sebasticook Lake has been cleared, the alewife population has soared and the Sebasticook River now supports a commercial harvest mostly for lobster bait. Runs, including all river herring, now average out at 3 million a year at Benton Falls and were as high as 6.5 million in 2024. There remain barriers to fish passage on the East Branch Sebasticook River between Corundel Lake and Sebasticook Lake. Corundel Lake is stocked with alewives as they are not able to reach the lake (Maine IF&W, 2023).

FISH CONSUMPTION ADVISORIES

The Maine Center for Disease Control and Prevention (CDC) has posted a fish consumption advisory for all freshwater fish in inland waters in Maine due to mercury contamination. The advisory warns pregnant and nursing women, women who may get pregnant and children under age 8 not to eat any freshwater fish from Maine's inland water except brook trout and landlocked salmon (one meal/month is safe). All other adults and children older than eight years old can eat two freshwater fish meals/month and for brook trout and landlocked salmon the limit is one meal/week.

The Sebasticook River (East Branch, West Branch and Maine Stem) has been issued an additional fish consumption advisory for PCBs, Dioxins, and/or DDT. This advisory recommends eating no more than 2 meals a month of any fish species (Maine IF&W, 2024).

PFAS

An emerging issue for Maine lakes is PFAS (per- and polyfluoroalkyl substances). PFAS are a group of chemicals that have been used in household and industrial products since the 1940's to repel water and resist stains and grease. These chemicals have been found to persist for a very long time once released into the environment, and they can build up in the bodies of people and animals over time. Current research suggests that high levels of exposure to PFAS can have negative effects on human health, including increased risk of some cancers, reduced ability of the body's immune system to fight infections, increased cholesterol levels and can cause changes in liver enzyme levels. Children and pregnant women experience heightened risks with increased risk of high blood pressure and pre-eclampsia in pregnant women and children may experience developmental delays (Maine DHHS, 2022; US EPA, 2024a). More research is underway to better understand these health effects and how they are affected by different levels of exposure (US EPA, 2024a). Sources of PFAS in the environment include historical use of firefighting foams, industrial sites that used or processed PFAS, and fields with a history of land-spreading materials used for fertilizer that likely contained PFAS (Maine DHHS, 2022).

Fish that live in waterbodies contaminated with PFAS can accumulate these chemicals in their bodies. An advisory may be issued for a waterbody if fish cannot be safely consumed at a rate of at least one meal per week, which corresponds to a fish tissue action level (FTAL) of 3.5 nanograms per gram (ng/g). However, mercury consumption guidelines generally protect against PFAS contamination up to 7.5 ng/g and advisories are therefore usually not issued until PFAS levels in fish tissues exceed these levels.

According to the Maine DEP's PFAS Investigation Map, there are a number of known potential sources of PFAS contamination in the Sebasticook Lake watershed, including numerous fields where sludge spreading has occurred just north of the lake.[16] Open water samples were also collected in Sebasticook Lake in 2023. The sum of 6 PFAS result for this sample was 7.45 ppt. The Maine CDC's current standard for drinking water of no more than 20 ppt for 6 PFAS, meaning that PFAS levels in Sebasticook Lake are currently considered safe. (Maine CDC, 2024). Maine DEP also collected fish tissue samples for PFAS in June 2024, but results of these tests are not yet available.[17]

INVASIVE AQUATIC PLANTS

While some lakes in Maine are struggling with invasive plants, many remain unaffected. The most common invasive aquatic plant in Maine is variable-leaf milfoil (VLM), which is found in 49 waterways in the state. Other documented species include curly leaf pondweed, Eurasian watermilfoil, European frogbit, European naiad, hydrilla, parrot feather and swollen bladderwort. To prevent the spread of these plants boat owners should clean their boats, trailers and motors and then allow the boat to drain and dry fully before entering a new waterbody (LEA, 2024).

[16] Maine DEP PFAS Investigation, Maine DEP 2024.
https://www.arcgis.com/apps/webappviewer/index.html?id=468a9f7ddcd54309bc1ae8ba173965c7#
[17] Personal communication. Tom Danielson, Maine DEP. July 29, 2024

According to an invasive aquatic plant model created by the Maine DEP, **Sebasticook Lake is at high risk of invasive aquatic plants being introduced** (Maine DEP, 2019). The score is based on the volume of use, proximity to infested water and the area of the lake conducive to the plant's growth. Sebasticook Lake scored particularly high risk due to the volume of use and area within the lake where invasive aquatic plants could grow.

There are currently no reports of invasive aquatic plants in Sebasticook Lake, although the numerous shallow areas and recreational uses make it highly susceptible to accidental introductions. There is no established Courtesy Boat Inspection (CBI) program to conduct boat inspections at the public boat launch. Initiating a CBI program would help to remove any plant material from boats entering Sebasticook Lake, thereby preventing the spread of invasive aquatic plants.

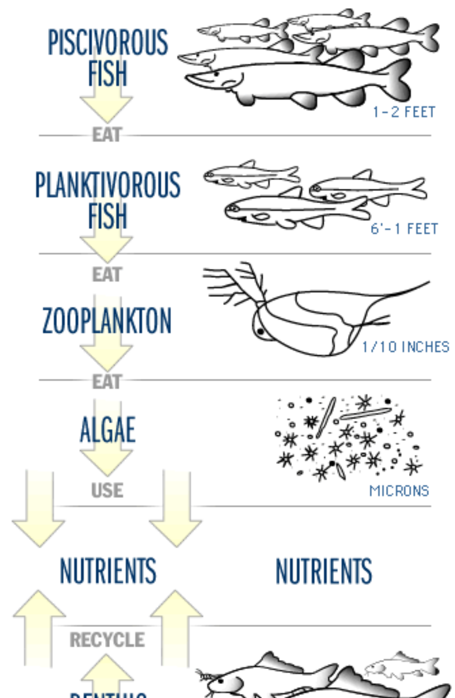
Curly-Leaf Pondweed.
(Source: Dennis Roberge)

PLANKTON AND CYANOBACTERIA

Tiny aquatic plants (algae, aka phytoplankton) and animals (zooplankton) are the primary and secondary source of food and energy in a lake food web and play a key role in lake ecosystems. Because plankton float in the water column, they influence the transparency of the water throughout the season and from year-to-year as these communities undergo both seasonal and annual growth cycles. These growth cycles vary over the course of the year as a result of changes in temperature, light and nutrient availability.

PHYTOPLANKTON

Phytoplankton are microscopic algae and bacteria that photosynthesize using the sun's energy to turn carbon dioxide, nutrients and water into food for organisms higher in the food web such as zooplankton and small fish. Phytoplankton are sensitive to changes in lake ecosystems. The effects of environmental and watershed impacts can often be detected in changes in the plankton community species composition, abundance, and biomass.



A typical food web.
(Source: www.waterontheweb.com)

Monthly phytoplankton samples were collected by SLA volunteers at Station 1 between June and September 2023 and analyzed by Dr. Ken Wagner of WRS (Figure 9). Green algae dominated the phytoplankton biomass at the end of June. The end of July marked the highest phytoplankton biomass and cyanobacteria was dominant. *Aphanizomenon* and *Ceratium* were the most common cyanobacteria in the water column, both of which are taste and odor producuers. *Aphanizomenon* is also capable of producing toxins, although this alga was not present in 2023 at densities indicative of possible toxin issues. By the end of August, diatoms dominanted the biomass with high quantities of single *Fragilaria* and *Synedra*. In September, the highest biomass was cyanobacteria again with a more even distribution of subgroups. Throughout the season there was a high cell density of *Planktolyngbya*, another type of cyanobacteria, with a small cell size than other cyanobacteria.

Previous phytoplankton sampling has been conducted at Sebasticook Lake as far back as 1968 where summer blooms were reported to be dominated by *Microsystis* and *Anabaena* (now *Dolichospermum*) (Mackenthun et al., 1968; Rock et al., 1984). However, sampling of the phytoplankton community has not been a consistent part of water quality sampling in Sebasticook Lake. More consistent, ongoing sampling of plankton species composition and abundance (including zooplankton) will help increase knowledge of water quality changes, and track the of successes of water quality improvement efforts.

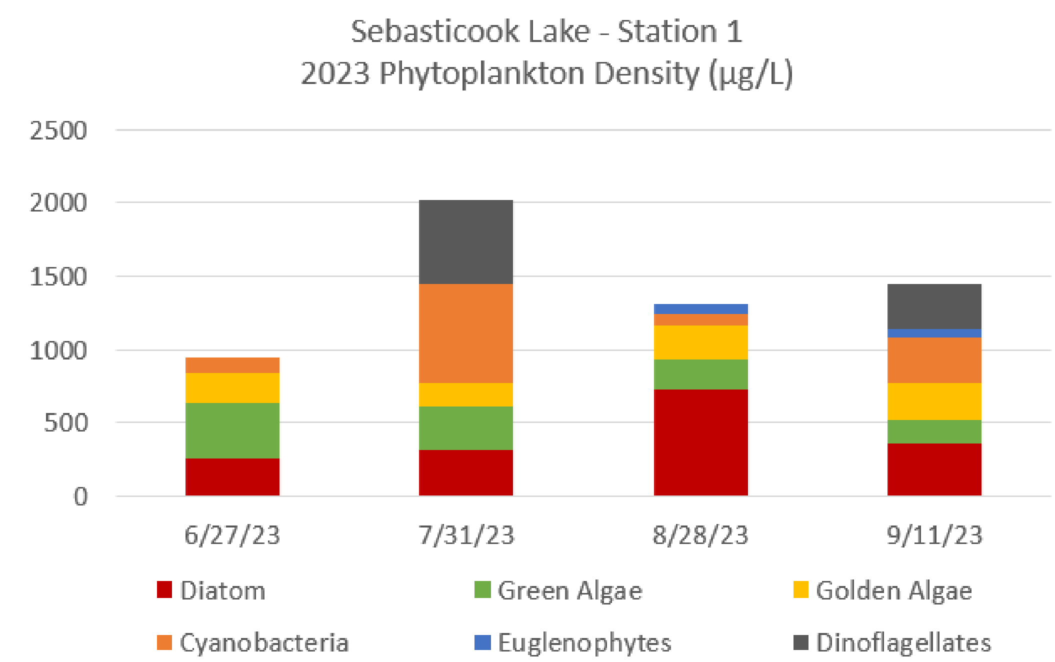


***Figure 9**. 2023 phytoplankton results in Sebasticook Lake.*

CYANOBACTERIA

Cyanobacteria are a type of phytoplankton present in Sebasticook Lake and in lakes all around the world. Their presence, species composition, and abundance can be used as an indicator of water quality. Cyanobacteria are not like other algae but are actually photosynthetic bacteria that can form dense growths (blooms) in lakes when nutrients are plentiful, water temperature is warm, and sunlight is abundant. These blooms are an indication that the ecology of the lake is out of balance.

Some forms of cyanobacteria initiate growth on the bottom, then form gas pockets in their cells and rise to the surface almost synchronously. Those cells tend to accumulate excess P, and once in the upper waters, this supply of P, adequate sunlight, and warm temperatures, allow rapid growth. When cells die, some portion of the P is released into the upper waters that can support other algae growth. Blooms that start on the bottom and move to the surface are therefore not just symptoms of increasing fertility, but vectors of it. Areas of fertile sediment subject to low oxygen that also recieve adequate light can be "nurseries" for cyanobacteria blooms. Consequently, release of P from sediment exposed to low oxygen can fuel blooms without dissolved P ever moving into the water column. The cyanobacteria rising in the water column will cause an increase in measured P by virtue of what they bring with them from the bottom.

The effects of toxins produced by cyanobacteria (cyanotoxins) on humans, domestic animals, and wildlife, are closely associated with the occurrence of Harmful Algal Blooms (HABs) (US EPA, 2019). The effects are well documented, and can affect kidney, brain, liver and nervous system function. Not all blue-green algae blooms are toxic. Microcystis is one of the most common bloom-forming genera and almost always produces toxins (US EPA, 2017). *Dolichospermum* (formerly *Anabaena*), the most common blooming cyanobacteria in Maine, is also capable of producing toxic blooms. Neither of these cyanobacteria were found in Sebasticook Lake in 2023.

Microcystin is the most common measured and detected cyanotoxin and it is produced by *Microcystis, Dolichospermum*, *Aphanizomenon* and other common blooming cyanobacteria species (US EPA, 2024b). *Aphanizomenon* was documented in Sebasticook Lake along with two other species of cyanobacteria including *Limnothrix* and *Planktolyngbya*. However, the biomass of the documented species was considered very low in all four samples collected between June and September suggesting that 2023 was a good year in terms of minimized cyanobacteria blooms, likely due to the cool, wet summer.

> The US EPA 10-day health advisory value for microcystin in **Drinking Water** is 0.3 µg/L for bottle-fed infants and pre-school children and 1.6 µg/L for school-age children and adults. US EPA criteria for microcystin in **Recreational Water** is 8 µg/L for all ages. These recommendations stem from studies that consider magnitude, duration and frequency of exposure that are considered protective of human health. For more information on how to avoid exposure, visit the following pages at the Maine DEP website:
>
> https://www.maine.gov/dep/water/lakes/cyanobacteria.html
>
> https://www.maine.gov/dep/water/lakes/algalbloom.html

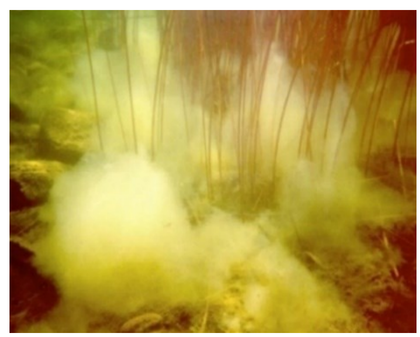
Microcystin samples were collected on various lakes throughout central Maine by Maine DEP between 2014 and 2020, and Sebasticook Lake was included in this study. Samples were collected at the deep hole, near the shore and in scum. None of the samples were above the US EPA criteria for recreational water (8 µg/L). Elevated levels of microcystin were found according to the drinking water for infants and pre-school children EPA advisory at the deep hole in 2014 and 2015 and near shore from 2014 to 2019. The highest level was found at the deep hole on October 14, 2014, at 1.57 µg/L, and levels seem to generally be decreasing over time. The only time scum was recorded was in 2019 and the microcystin levels were 1.18 µg/L. On August 25, 2020, all the samples were below the drinking water advisory. All the samples were below the advisory for recreational water and for drinking water for school-age children and adults.

GLOEOTRICHIA

Gloeotrichia *echinulata (magnified) (Source: Jonathan Dufresne, UNH)*

A type of cyanobacterium common in lakes across Maine is *Gloeotrichia echinulata* or *"Gloeo,"* which forms small spheres and are big enough to be seen by the naked eye. *Gloeo* grows at the sediment-water interface and then rises through the water column to the surface waters where it completes its life cycle, dies, and sinks back down to the bottom of the lake where it will stay through the winter months until conditions are again suitable for growth (King & Laliberte, 2005). Researchers that study Gloeo are concerned that it may be increasing nutrient levels and algae growth in lakes by moving phosphorus from the bottom of the lake up into the water column where it can be used by other algae. *Gloeo* grows in relatively shallow areas where lake sediments have abundant available P and there is also adequate light for photosynthesis. It has been observed in Maine lakes for many years, but blooms have increased in lakes throughout the northeast in recent decades. *Gloeo* blooms have been observed in lakes all over the world with a wide range of trophic states and conditions. Gloeo are capable of producing toxins that are harmful to animals and human. **To date, there have not been any reports of *Gloeo* in Sebasticook Lake**, though there has been no formal survey to document its presence.

METAPHYTON & BENTHIC MATS



Metaphyton mass. (Source: LSM, Betsy & Dick Enright)

Metaphyton is filamentous algae typically found in wetlands, floodplains, and the littoral zones of lakes and ponds. It forms loosely aggregated masses that are either attached to benthic substrates or vegetation and are suspended in the water column. Metaphyton begins to form within sheltered littoral areas in a lake shortly after ice-out, persists through the summer months, and begins to degrade in late summer when they break apart and sink to the bottom to decompose. Most species that make up metaphyton are not cyanobacteria and do not produce toxins.

Benthic mats develop on the bottom and can rise to the water surface when oxygen bubbles form within the mass as a result of photosynthesis. In moving water (streams and due to wave action in lakes) colonies can detach, wash into the shore, decompose and release offensive odors. Some benthic mats are cyanobacteria species, which can produce toxins, but most are not.

Though common throughout the state, implications of an increasing trend are not well understood. There is also limited understanding of the physical, chemical, and biological role these algae play in aquatic ecosystem (Shute & Wilson, 2013). LSM has developed a standardized monitoring protocol[18] to help lake

[18] https://www.lakestewardsofmaine.org/metaphyton/

associations identify and document the location and density of metaphyton growth in their lake, but **to date, this monitoring protocol has not been implemented in Sebasticook Lake. The presence and extent of metaphyton in Sebasticook Lake is currently unknown.** A volunteer led survey of the littoral zone could be conducted in the future to document whether metaphyton is present in Sebasticook Lake and to what extent, as well as to document changes in metaphyton in shallow areas of the lake over time.

An ongoing concern among shoreline residents is the increasing presence of a terrestrial moss that has formed over time in the exposed sediments between the land and the water during the fall drawdown. Large quantities of the moss have been reportedly washing up on the shoreline at the east end of the lake.[19] Identifying this moss and its preferred growth habits, mapping its quantity and extent, and the appropriate strategy for managing it should be considered to alleviate landowner concerns and provide a mechanism for addressing concern among the shoreline residents.

ZOOPLANKTON

Zooplankton are microscopic animals that feed on phytoplankton, helping keep the algae biomass in balance (clearer lakes), and providing food for newly hatched fish each year. Zooplankton species can be grazers (feeding on phytoplankton) or predatory (feeding on smaller zooplankton). The species of zooplankton present in a lake generally remain stable over time, however, the appearance of new species or sudden changes in quantities of existing species can indicate changes in nutrient input, dominant fish species, aquatic invaders, or a pollution source. No zooplankton data are currently available for Sebasticook Lake. Initiating regular zooplankton sampling to document baseline conditions would help to understand the current state of the zooplankton community, as well as to track changes that could signal greater shifts in the lake's ecosystem.

Keratella sp. (Rotifera) (Source: CFB.UNH.edu)

[19] Personal communication. Donnie Gross, Sebasticook Lake Association, via email on October 25, 2024.

3. Water Quality Assessment

Water quality data have been collected in Sebasticook Lake at the deep hole (Station 1) since in 1972 (Figure 10). There are three years in which no data is available (1973, 1976, and 2021). Data collection at Station 2 has been less consistent and is limited to 32 years, ending in 2008. Limited data sets are available for two additional stations, with four years of data at Station 3, and three years of data at Station 4. Due to limited data available for Stations 2, 3, and 4, these stations were not included in the water quality trend analysis for the WBMP, though the datasets for these stations provide valuable information for comparing to Station 1 results.

The water quality trend analysis included an analysis of the long-term (1972-2023) and short-term (last 10 years) dataset using data collected by certified monitors from Lake Stewards of Maine, SLA, and Maine DEP (Ecological Instincts, 2024a).

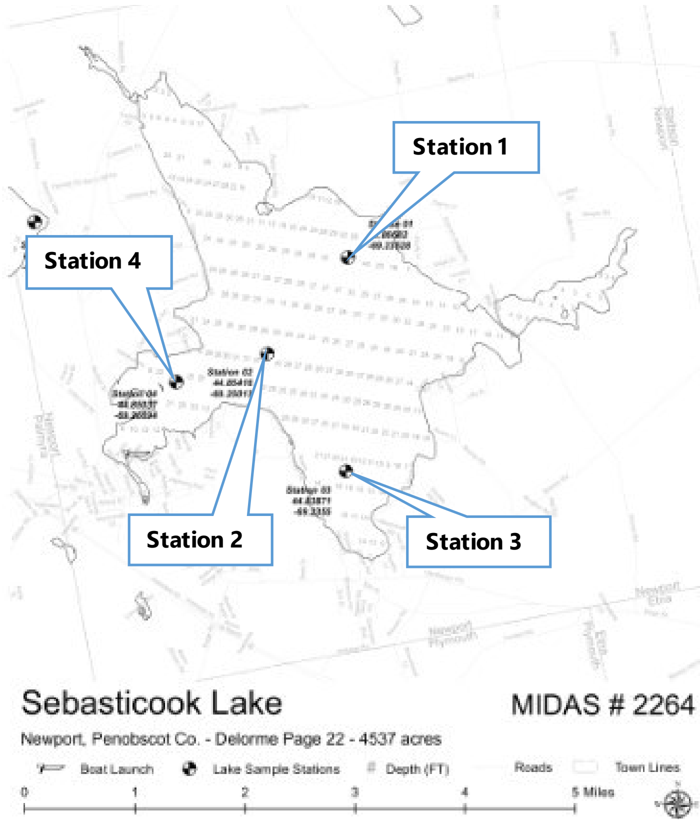


Figure 10. *Water quality monitoring stations in Sebasticook Lake*

An analysis of the condition classifications for Maine lakes indicates that Sebasticook Lake is classified as a "Coastal deep lake" (Deeds, et al, 2020). Specific conductivity and phosphorus levels in the lake both fall within the "altered" condition class (Table 5).

Table 5. *Coastal Deep Lake Type: Water Quality Parameter Ranges (Source: Deeds, et al., 2020).*

	Condition Classes*			Sebasticook Lake**
Parameter	**Reference**	**Intermediate**	**Altered**	
Specific Conductivity (µS/cm)	< 34.2	34.2 – 66.3	≥ 66.3	**119**
Total Phosphorus - Epilimnion Core (ppb)	< 8.3	8.3 – 13.4	≥ 13.4	**22**

*The reference, intermediate, and altered values for each condition class shown above do not include standard errors. Refer to Deeds, et al., 2020 for additional information on the threshold values for each lake type.

** 10-year average (2014-2023) for Sebasticook Lake, Station 1.

Maine has a single standard for the classification of Great Ponds and natural lakes and ponds > 10 acres in size, referred to as Class GPA waters. Class GPA waters must:

- Be of such quality that they are suitable for the designated uses of drinking water after disinfection, recreation in and on the water, fishing, agriculture, industrial process and cooling water supply, hydroelectric power generation, navigation and as habitat for fish and other aquatic life. The habitat must be characterized as natural.
- Be described by their trophic state based on measures of the chlorophyll "a" content, Secchi disk transparency, total phosphorus content and other appropriate criteria.
- Have a stable or decreasing trophic state, subject only to natural fluctuations, and must
- Be free of culturally induced algal blooms that impair their use and enjoyment.
- Not have any new direct discharge of pollutants.

WATER QUALITY TRENDS

WATER CLARITY

Water clarity readings have been collected at Station 1 in Sebasticook Lake since 1974, with 48 years of data collected over the sampling period. Clarity is measured by lowering a black and white disk called a Secchi disk into the water column and measuring the depth at which the disk is no longer visible, referred to as Sechhi Disk Transparency (SDT).

Algae in Sebasticook Lake, June 2023. (Photo credit: Donnie Gross, SLA)

Water clarity readings of 2 m or less indicate that an algal bloom is actively occurring in a lake. **Water clarity readings in Sebasticook Lake have fallen below 2 m in 42 of the 48 years on record** (89%). Of the five years when readings did not drop to 2 m or less, four were within the last 10 years. Generally, SDT readings <2 m begin in July or August and continue into September.

Water clarity readings in Sebasticook Lake have ranged from a low of 0.3 m (August 1992) to a high of 4.7 m (June 1975 and July 2013). The long-term annual average water clarity is 2.2 m compared to 2.7 m over the last 10 years. Statistically, there is a **strong, significant increase in water clarity in Sebasticook Lake** since sampling began in the early 1970s. However, no trend was observed in the last 10 years (Figure 11). The worst clarity was observed in the 1970s, with the highest clarity in the 2020s, aligning with the general trend of increasing clarity since the 1970s. Long-term monitoring of SDT is an easy and reliable method for tracking changes in water quality over time.

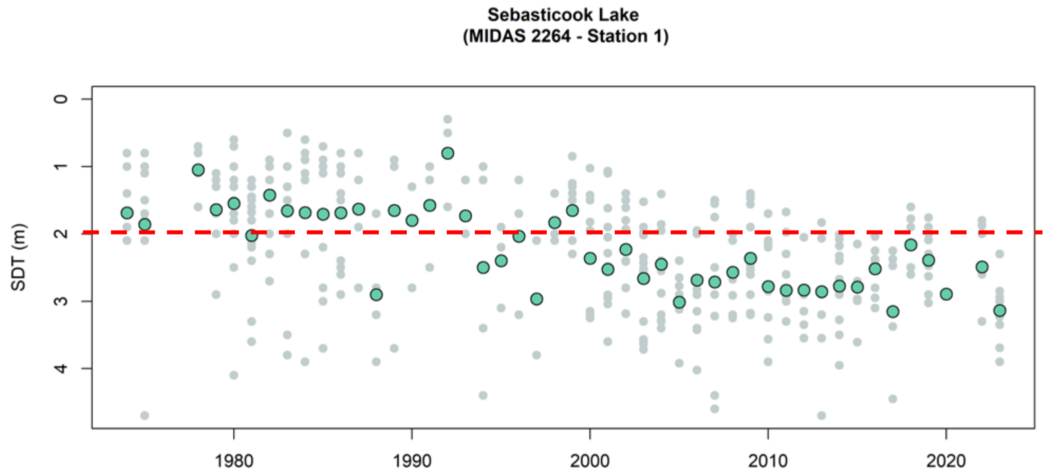


Figure 11. Historical water clarity readings in Sebasticook Lake 1974 – 2023. (Green circles indicate the average SDT reading for each year and gray circles represent the range in actual readings collected each year. SDT readings above the red line indicate algal bloom conditions.)

CHLOROPHYLL A

Chlorophyll-a (Chl-a) data have been collected since 1977 at Station 1, with 36 years of data collected over this period. Chl-a measures the green pigment found in all plants, including microscopic plants such as algae. [20] At Sebasticook Lake, Chl-a has ranged from a low of 2.5 ppb (June 1980) to a high of 93.3 ppb (September 1978). Statistically, Chl-a has decreased in Sebasticook Lake since sampling began in the early 1970s with a **strong significant decreasing trend in Chl-a over the long-term dataset**. Similar to water clarity (an indirect measure of algal biomass), there is no significant trend over the past 10 years. Median Chl-a over the past 10 years is 11.3 ppb (Table 6).

TOTAL PHOSPHORUS

Total phosphorus (TP) is the concentration of phosphorus in the water including organic and inorganic forms. Humans add phosphorus (P) to a lake through stormwater runoff, lawn or garden fertilizers, agricultural runoff and leaky or poorly maintained septic systems. P can also be released from the lake's bottom sediments when there is no oxygen at the sediment water interface (internal loading); it can eventually reach the upper layers of the lake profile through mixing or diffusion, where it fuels algal growth. Some cyanobacteria species can carry sediment-derived P from sediments to upper layers of the water column.

Phosphorus (P) is one of the major nutrients needed for plant growth and is generally present in small amounts in freshwater, thereby limiting plant (and algae) growth. As TP increases in a lake, generally the amount of algae also increases.

[20] Chlorophyll-a (Chl-a) is a measure of the green pigment found in all plants including microscopic plants such as algae. Chl-a provides a relative estimate of algal biomass where higher Chl-a equates with a higher concentration of algae in the lake. Chl-a and water clarity often track closely since water clarity is an indirect measure of algal abundance. Chl-a is typically collected as an integrated core from the epilimnion as this is typically where temperatures are warmest, light penetration strongest, and where plants, including algae, grow.

Three different types of TP data were utilized for the water quality analysis including epilimnetic TP, surface TP, and bottom TP.[21] Epilimnetic TP data collected between 1978 – 2023 was used for the analysis. Epilimnetic TP ranged from a low of 9 ppb (August 2023) to a high of 61 ppb (August 1978) with a long-term annual average of 22.2 ppb and a 10-year annual average of 22 ppb. There are **no significant trends in epilimnetic TP over either the long-term or the short-term monitoring period**.

Surface TP and bottom TP were collected either as individual grab samples or as part of TP profiles, where TP grabs are collected at discrete depths (e.g., every other meter) through the water column. Surface TP data is available for a total of 45 years between 1972-2023. The highest surface TP on record was 220 ppb in August 1980. **There is a strong, significant decreasing trend in surface TP in the long-term dataset**, but **no significant trend over the last 10 years**. Bottom grab data for TP is available for a total of 39 years between 1972-2023. The lowest bottom grab TP on record was 14 ppb (July 2023), while the highest bottom grab TP on record was 3,000 ppb (September 1979). **There is a strong, significant decreasing trend in bottom TP in the long-term dataset,** but **no significant trend over the last 10 years.**

Table 6. *Long and short-term (10-years) trend analysis results for the three primary trophic state parameters for Sebasticook Lake, Station 1.*

Water Quality Parameter	Average Annual Water Quality	Trend (Long-Term)	Trend (10-Year)
Water Clarity (m) Long-term 10-year	**2.2** **2.7**	**Strong increasing trend over long-term**	No trend
Chlorophyll A (ppb) Long-term 10-year	**19.5** **11.3**	**Strong decreasing trend over long-term**	No trend
Total Phosphorus (Epilimnetic core) (ppb) Long-term 10-year	**22.2** **22.0**	No trend	No trend

When compared to the numerical guidelines for evaluation of trophic state in Maine, Sebasticook Lake is considered eutrophic. Eutrophic lakes have elevated nutrient levels and are highly productive. They tend to be murky and muddy, with elevated plant and algae growth. Sebasticook Lake falls well within the eutrophic range for all three parameters (Table 7).

[21] The epilimnion is the upper layer of a thermally stratified lake. The epilimnion is typically warm as a result of the sun penetrating the water's surface and high in oxygen due to mixing from wind.

Table 7. *Ten-year averages for primary trophic state parameters in Sebasticook Lake compared to numerical guidelines for evaluation of trophic status in Maine.*

	Sebasticook Lake 10-Yr Average (& Historical Range)	**ME DEP Trophic Status Indicators**			**Sebasticook Lake Classification (2018-2022)**
		Oligotrophic	**Mesotrophic**	**Eutrophic**	
Water Clarity (m)	**2.7** (0.3 – 4.7)	**> 8**	**4 – 8**	**< 4**	**Eutrophic**
Chlorophyll-a (ppb)	**11.3** (2.5 – 93.3)	**< 1.5**	**1.5 – 7**	**> 7**	**Eutrophic**
Total Phosphorus (ppb)	**22** (11 - 61)	**< 4.5**	**4.5 – 20**	**> 20**	**Eutrophic**

OTHER CHEMISTRY TRENDS

In addition to the three trophic state parameters described above, pH, color, conductivity, alkalinity, surface temperature, precipitation, and dissolved oxygen (presented below) were also evaluated for long and short-term water quality trends. **A strong, significant, increasing alkalinity trend was observed over the full time series**. No significant trends were observed in pH, color, or conductivity.

DISSOLVED OXYGEN & TEMPERATURE

Dissolved oxygen (DO) refers to the concentration of oxygen dissolved in the water, which is vital to fish, zooplankton, vertebrates, and chemical reactions that support lake functioning. DO concentrations less than 5 ppm can stress some species of coldwater fish, and over time reduce habitat for sensitive coldwater species. DO concentrations less than 2 ppm are defined as anoxic.

Thermal stratification, anoxia, and sediment chemistry can result in the release of P from the sediments (internal loading) which can fuel algal growth and lead to persistent, recurring nuisance algal blooms.

DO concentrations in lake water are influenced by several factors, including water temperature, stratification, concentration of algae and other plants in the water, decomposition, and the amount of nutrients and organic matter flowing into the lake as runoff from the watershed. Summer DO concentrations can change dramatically with lake depth, as oxygen is produced in the top portion of the lake where sunlight drives photosynthesis and winds continuously mix water and air. Oxygen consumption dominates near the bottom of the lake where organic matter accumulates and decomposes. In seasonally stratified lakes, the DO concentrations from top to bottom can be very different, with high levels of oxygen near the surface and little to no oxygen near the bottom, especially during the summer when water temperature and decomposition are at their highest. Microbial respiration (microbes breaking down decaying plant and animal matter) at the bottom of the lake consumes oxygen, the combination of which results in loss of DO in these deep areas of the lake (anoxia). Anoxic waters over sediments can result in P release from the lake bottom, which due to diffusion and/or wind action, can move to the upper waters and fuel algal growth.

Dissolved oxygen and temperature profiles have been collected at Station 1 since 1974, with 47 years of data over the historical monitoring period. Based on these data:

- Onset of anoxia typically begins in July and continues through September with the greatest extent of anoxia occurring most frequently in August.
- The water column remains stratified at the deep hole throughout the summer until it begins to turn over (mix) in late September resulting in an increase in phosphorus in the water column in the late summer and fall.
- DO drops below 2 ppm at around 5-7 m deep, and historically as shallow as 4 m.
- Anoxia has been documented during the winter under the ice, dropping below 2 ppm in March 2011 at 9 m. More winter data is needed to better understand the extent and duration of anoxia during the winter.

A full summer series of DO and temperature profiles were collected at Station 1 in 2023 (Figure 12). This dataset provides information about the current onset and extent of anoxia across the open water sampling season and throughout the water column as well as its influence on internal phosphorus loading.

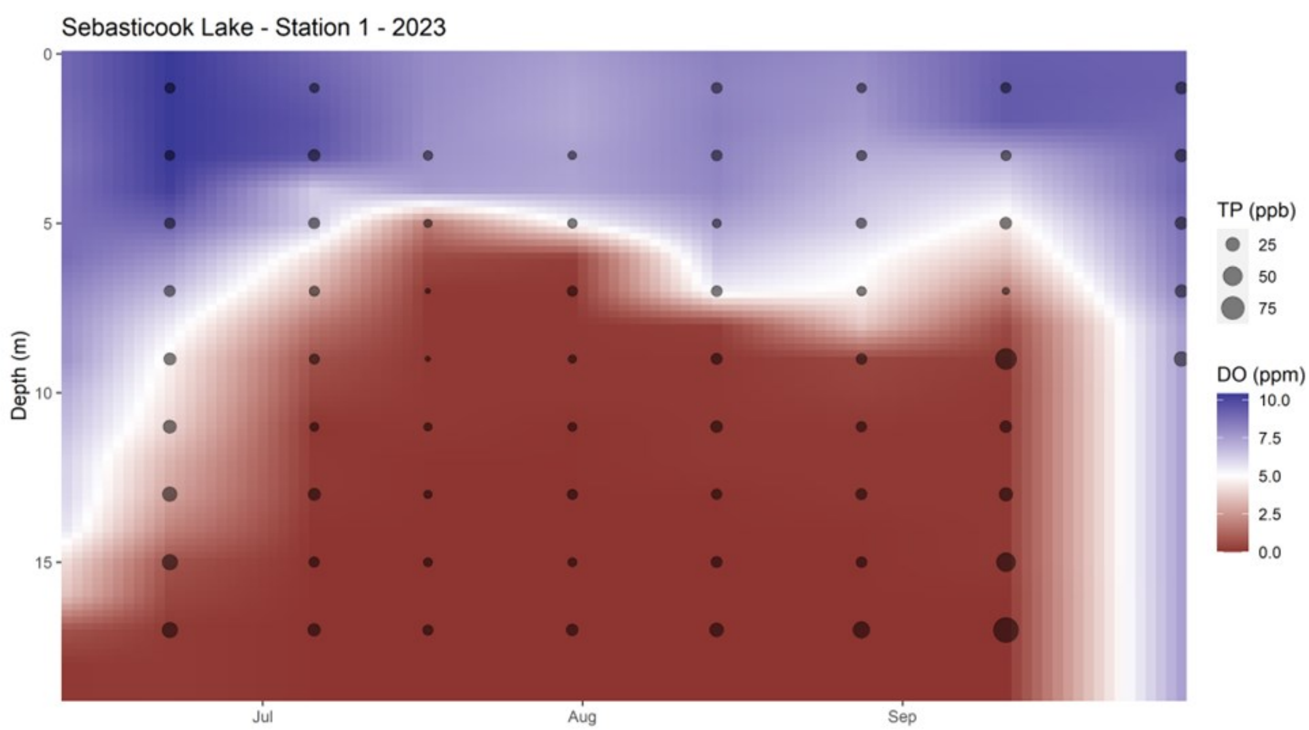


Figure 12. *2023 DO and TP concentrations by depth in Sebasticook Lake, Station 1. (Gray circles represent the concentration of TP at each depth in the water column, period of low DO are represented by dark red areas)*

Based on DO and TP data collected in Sebasticook Lake in 2023:

- Anoxia was documented at 17 m in early June, and continued to rise in the water column as summer progressed. The greatest extent of anoxia in 2023 occurred in mid-July (2 ppm at 5 m and 0 ppm at 12 m on July 17). TP concentrations increased at the bottom of the lake during this period.
- The highest TP concentration was recorded on September 11, 2023, with a reading of 15 ppb at 1 m and 90 ppb at 1 m from the lake bottom. This increase in TP occurred just before fall turnover, allowing TP at the bottom of the lake to move up through the water column.
- 2023 was an unusually cool, wet year with record rainfall across the state which helped suppress algae growth. The Town of Newport opened the gates on the dam multiple times throughout open water season of 2023 to help keep the water level in the lake down which also helped suppress algal growth by flushing phosphorus out of the lake washing in from the watershed.

Anoxic factor (AF) and minimum anoxic depth (MAD) were calculated for Sebasticook Lake as part of the internal loading analysis and water quality analysis for the WBMP. AF is a metric that combines the volume of anoxic water (DO <2 ppm) and the length of time that the lake is anoxic, while MAD is the shallowest depth where DO is <2 ppm. MAD is an indicator of the volume of anoxic water in lakes- the shallower the MAD, the larger the anoxic volume. Profile measurements of DO were used to compute AF and MAD in a given year.

There is an increasing trend in summer AF over the whole time series, although the trend was not statistically significant. AF has been greater than 10, which is considered a water quality threshold, in a majority of years sampled, and has not been below 10 since 1986. No trend was observed in winter AF.

There is a **significant decreasing trend in MAD over the whole time series**. This shift is likely a function of the seasonal weather patterns in any particular year which influences the minimum depth of the bottom of the epilimnion, rather than an increase in algal production driving oxygen demand. Combined, AF and MAD trends point to an increase in the area and length of time that anoxia is occurring in Sebasticook Lake each year which leads to a greater area of bottom sediment exposed to anoxia now than in the past.

WEATHER TRENDS

Surface temperature data have been collected at Sebasticook Lake from 1974-2023 along with dissolved oxygen profiles. Trends in surface temperature over the historical monitoring period for the period April-October were analyzed to assess the potential impacts of climate change on temperatures in Sebasticook Lake. Surface temperatures for each summer month individually (May-September) were also analyzed to determine how changing weather patterns may affect different parts of the year.

A **strong, significant increasing trend was observed in summer surface temperature over the whole time series, as well as for all summer months individually except June**, coinciding with a trend of warmer summer temperatures across Maine. The Maine Climate Council reports an average increase of 3°C in surface temperatures in Maine lakes since 1980 (Maine Climate Council, 2020). Precipitation data collected at the nearby Bangor International Airport reveals no significant trends in either precipitation or snow totals from 1973-2023, although both appear to have increased slightly over time.

WATER QUALITY ANALYSIS SUMMARY

The 52-year record of water quality data for Sebasticook Lake (1972-2023) has allowed for a detailed examination of water quality trends for the three primary trophic state indicators and other water chemistry parameters. The long-term trends show an increase in water clarity and a decrease in Chl-a, surface TP, and bottom TP.

- These trends indicate an improvement in water quality since the 1970s, primarily associated with a significant reduction in point source pollution in the watershed, and the initiation of fall drawdowns. However, there are no trends in any of the short-term datasets analyzed, indicating that water quality trends have levelled off, and are not continuing to improve at the rate that they did in the past.
- Measurements of SDT, Chl-a, and phosphorus follow patterns of rapidly improving trends between the 1970s-1990s before levelling off to present day. Despite the overall improvements, water quality is still considered poor in Sebasticook Lake, with water clarity dropping to less than 2 m in six of the last 10 years, and an average water clarity of 2.7 m over that period. TP and Chl-a are also considered high, with an average epilimnetic TP of 22 ppb over the past 10 years and a Chl-a concentration of 11.3 ppb. Based on these three parameters, Sebasticook Lake is still considered to be eutrophic.
- Despite the improvements measured in SDT, Chl-a, and TP over the historical sampling period, measures of anoxia in Sebasticook Lake show trends of increasing area and length of time that anoxia is occurring throughout the summer as well as periods of anoxia during the winter. Surface temperature has also increased since the 1970s, which may be contributing to algae growth and cycles of anoxia and internal phosphorus loading from the lake sediments.

STREAM MONITORING

Water quality data have been collected for a number of stream in the Sebasticook Lake watershed through the Maine DEP biological monitoring program. Data have been collected as far back as 1983 at five sites on the East Branch Sebasticook River, since 2010 at one site on an unnamed tributary to Alder Stream, and at two sites in Mulligan Stream in 2006.

Recent biological samples from the East Branch Sebasticook River and the unnamed tributary to Alder Stream both attain standards for their statutory Class (C and B, respectively). Occasional P data available for the East Branch Sebasticook indicate that P levels are elevated in the stream, similar to Sebasticook Lake (25 ppb in June 2016 and 22 ppb in August 2017 at Station 194, just below Corundel Bog). Biological monitoring at a wetland station just north of the East Branch outlet into Sebasticook Lake was most recently sampled in 2012 with P measured at 30 ppb. The portion of Mulligan Stream between the impoundment and Sebasticook Lake is considered impaired by the Maine DEP due to inadequate DO levels (Maine DEP, 2022). The Mulligan Stream Impoundment is a Class GPA wetland and did not meet Class GPA standards based on sampling in 2002, 2007, 2012, and 2017.

4. Watershed Modeling

The Lake Loading Response Model (LLRM) is an Excel-based model that uses environmental data to develop a water and P loading budget for lakes. Water and P loads (in the form of mass and concentration) are traced from various sources in the watershed to the lake. The model requires detailed and accurate information about the waterbody, including the type and area of land cover, water quality data, lake volume, septic systems, and internal loading estimates, among other important information. Additional LLRM inputs and limitations are provided in Appendix A.

The following section provides an overview of the process by which these critical inputs were determined and utilized for the Sebasticook Lake LLRM using available resources and presents predicted outputs including how much and where P is coming from in the watershed, as well as in-lake annual average predictions of TP, Chl-a, and SDT. The outcome of this model can be used to identify current and future pollution sources, estimate pollution limits, set water quality goals, provide insight on where future monitoring is needed, and guide prioritization of on-the-ground watershed improvement projects (Ecological Instincts, 2024b).

WATERSHED AND SUB-BASIN DELINEATIONS

Ten major basins were included in the model to estimate P loading at different scales within the Sebasticook Lake watershed (Figure 13). With basins 1-4 representing the direct watershed. The basin approach helps watershed managers prioritize on-the-ground conservation planning and target education and outreach in the basins that contribute the greatest amounts of P.

Sub-basin delineations were completed in ArcMap by Ecological Instincts (2024b). Larger drainage basins were divided into smaller sub-basins where one sub-basin passes through another sub-basin to help guide prioritization of areas with higher nutrient loads within a drainage basin. For Sebasticook Lake, Basin 5 and (Nokomis Pond) and Basin 6 (Mulligan Stream) were set up to pass through Basin 2 (Lower Mulligan Stream/Harrison White Brook). Basin 7 (East Branch Upper), and Basin 9 (Alder Brook) pass through Basin 3 (East Branch Lower), while Basin 8 (Lake Wassookeag) passes through Basin 7. Finally, Basin 10 (Pleasant Lake) passes through Basin 4 (Stetson Stream).

LAND COVER

The drainage basins layer was combined with the updated land cover layer (Section 2) to create a land cover breakdown for each basin for use in the watershed model. Table 8 presents land cover types and their associated P export coefficients for the Sebasticook Lake watershed model while Figure 14 presents the percentage each land cover type in the direct & indirect watersheds and the corresponding P load.

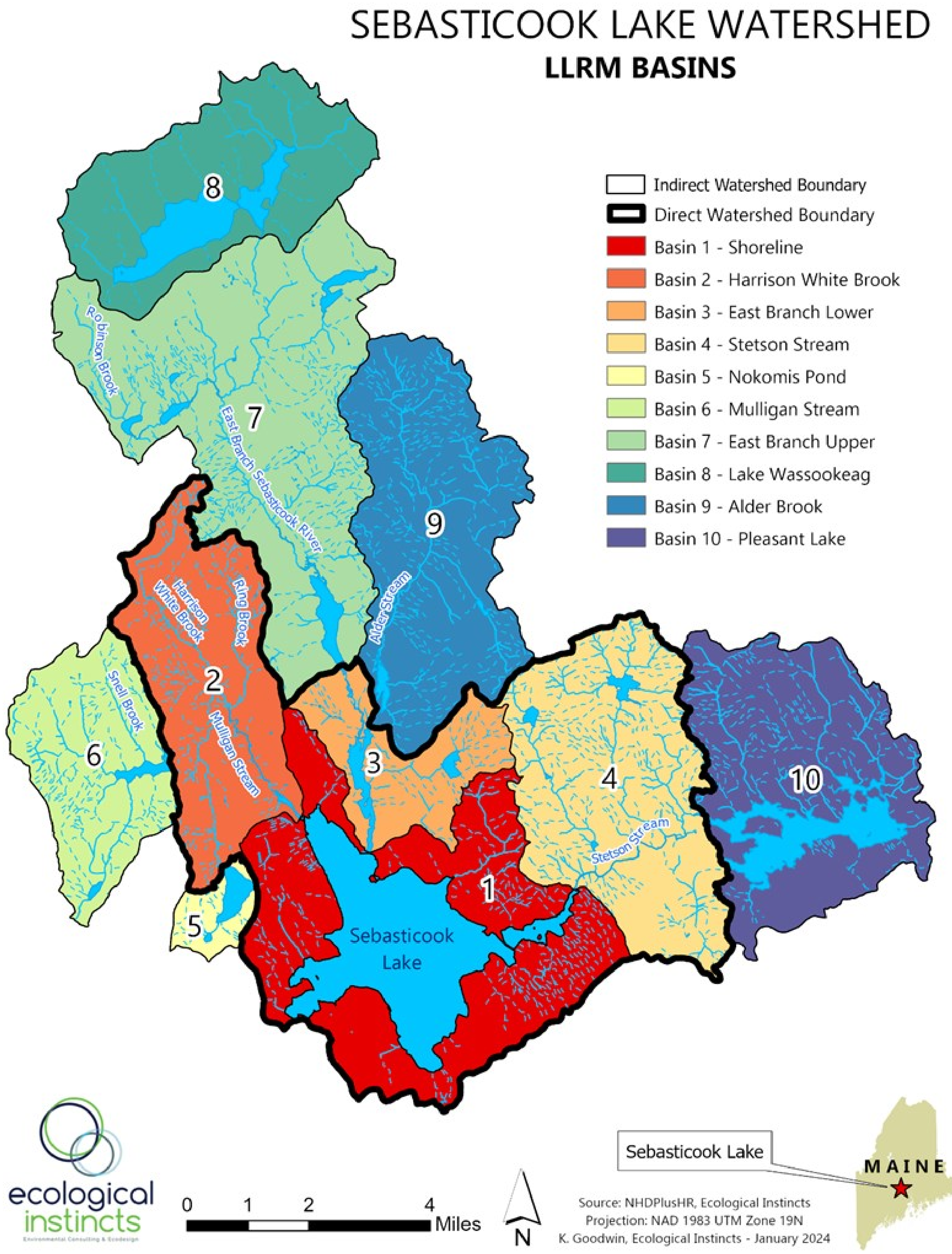


Figure 13. *Drainage basins used in the Sebasticook Lake LLRM.*

r

***Table 8**. P coefficients and total land area by land cover type for the Sebasticook Lake LLRM.*

LAND COVER TYPE	Runoff P export coefficient (kg/ha/yr)	Baseflow P export coefficient (kg/ha/yr)	Area (ha) Sebasticook Lake Watershed
Forest 1 (Upland Forest)	0.08	0.005	16900
Forest 4 (Forested Wetland)	0.10	0.005	4842
Forest 5 (Scrub-Shrub)	0.10	0.005	213
Agric 2 (Row Crops)	1.00	0.010	1443
Agric 3 (Hay/Grazing)	0.55	0.010	3263
Open 1 (Open Water)	0.10	0.005	1122
Open 2 (Meadow/Clearing)	0.20	0.005	200
Open 3 (Excavation/Bare Soil)	0.80	0.010	66
Other 1 (Freshwater Emergent Wetland)	0.15	0.005	575
Urban 1 (LDR/Residential)	0.90	0.010	871
Urban 2 (MDR/Commercial)	1.00	0.010	369
Urban 3 (Paved Roads)	1.10	0.010	92
Urban 5 (Developed Open Space)	0.60	0.010	1088
TOTAL			**31,046**

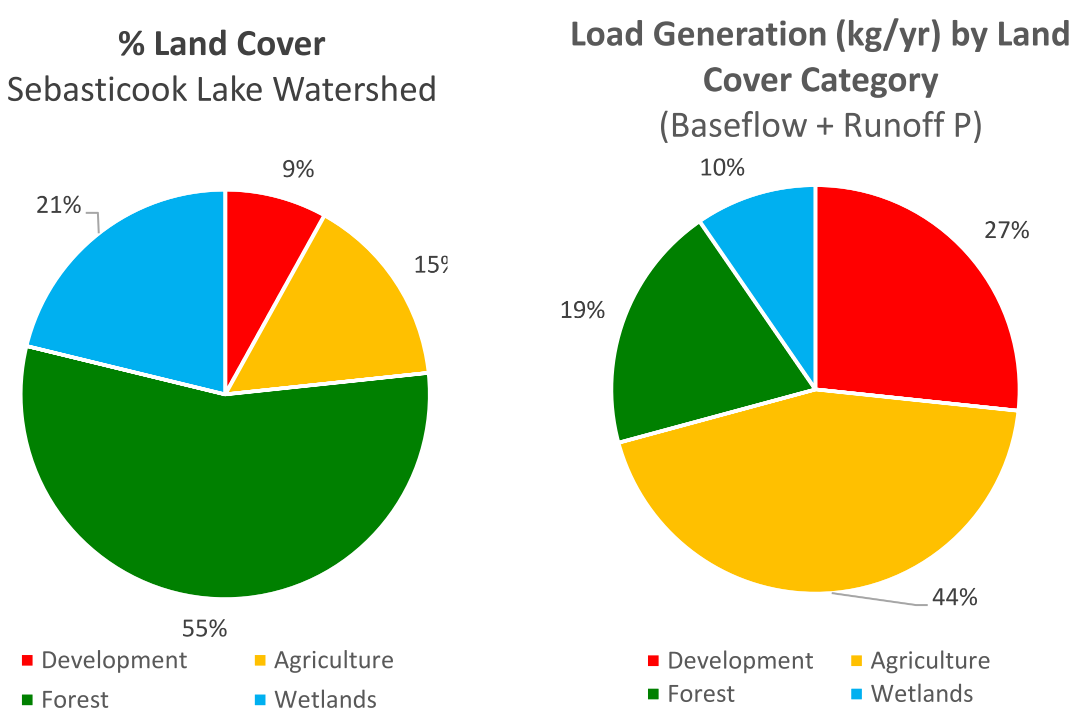


***Figure 14**. Watershed land cover area by category and TP load by land cover type for the Sebasticook Lake watershed.*

Notably, agricultural land accounts for 15% of the watershed and approximately 44% of the watershed P load. Similarly, developed land (development and roads) accounts for 9% of the land area in the direct watershed but accounts for about a quarter (27%) of the total watershed P load (runoff and baseflow). On the other hand, undeveloped land, including forests and wetlands, cumulatively covers 76% of the watershed but only 29% of the watershed P load (Figure 14).

MODEL RESULTS

The current phosphorus load to Sebasticook Lake is estimated at 6,286 kg/yr. The watershed load is the greatest source of P to Sebasticook Lake, representing approximately 82% of the total P load to the lake (40% direct watershed, 42% indirect watersheds) followed by internal loading, which contributes approximately 13% of the total P load. Septic systems make up an estimated 2% of the total P load, while waterfowl are estimated to make up <1% of the total load. The remaining 3% of the load is from atmospheric deposition. (Figure 15).

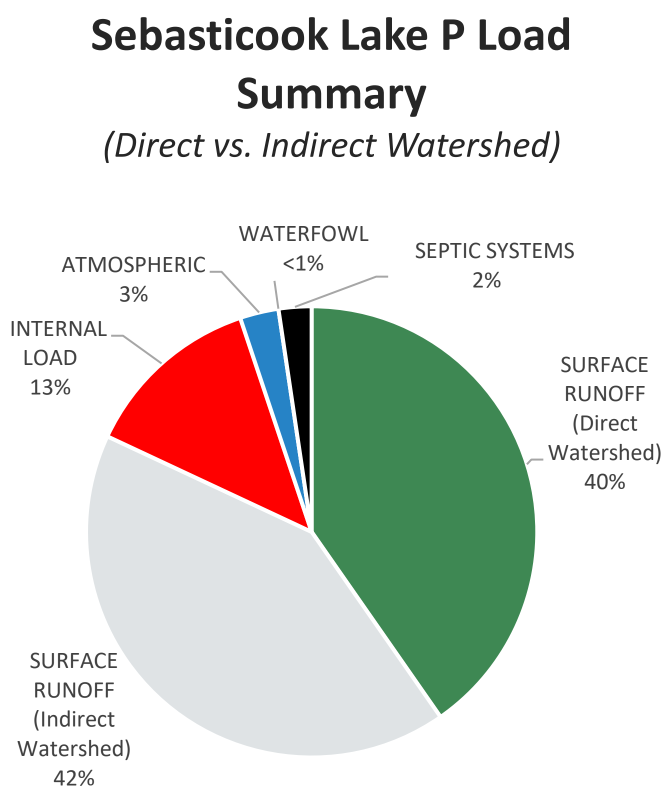


Figure 15. *Percent of the total P load by category for Sebasticook Lake.*

SUB-BASIN PHOSPHORUS LOADING

The drainage of the Upper East Branch Sebasticook River is estimated to contribute the largest total P load (1,103 kg/yr) to Sebasticook Lake, followed by the direct shoreline drainage and the Alder Brook drainage (944 kg/yr and 773 kg/yr respectively). The East Branch Upper drainage is also the largest basin by area, followed by the direct shoreline drainage and Pleasant Lake Nokomis Pond, Lake Wassookeag, and Mulligan Stream are estimated to contribute the lowest overall P load. (Table 9, Figure 16).

Table 9*. Summary of land area and total phosphorus by sub-basin for Sebasticook Lake.*

Sub-Basin	Basin Area (ha)	Total P Load (kg/yr)	P Load by Area (kg/ha/yr)
Basin 1- Shoreline	3,998	944	0.24
Basin 2- Harrison White Brook	2,933	657	0.22
Basin 3- East Branch Lower	1,430	403	0.28
Basin 4- Stetson Stream	3,793	522	0.14
Basin 5- Nokomis Pond	391	26	0.07
Basin 6- Mulligan Stream	2,091	264	0.13
Basin 7- East Branch Upper	5,785	1103	0.19
Basin 8- Lake Wassookeag	3,039	212	0.07
Basin 9- Alder Brook	3,759	773	0.21
Basin 10- Pleasant Lake	3,826	231	0.06

On an areal basis, the sub-basins with the greatest P load per hectare are the lower East Branch Sebasticook River drainage (Basin 3), the direct shoreline drainage (Basin 1) and the Harrison White Brook drainage (Basin 2) (Figure 17). Basin 3 contains large areas of high- and medium-intensity development associated with downtown Corinna, and Basin 1 contains shoreline development as well as portions of high- and medium-intensity development associated with downtown Newport. While the Harrison White Brook drainage doesn't contain large amounts of urban development, it is tied with Basin 9 (Alder Brook) for the highest percentage of agricultural land (21%). All of the three basins with the highest P load by area are considered direct drainages to Sebasticook Lake. Drainage areas directly adjacent to waterbodies do not have adequate treatment time and are often most desired for development in a lake watershed, which increases the possibility for greater P export now and in the future. Basin 9 (Alder Brook), which closely follows Basin 2 in terms of P load by basin, is not considered part of the direct watershed but also experiences relatively low levels of attenuation while flowing through Basin 3 on its way to Sebasticook Lake.

Basins with highest annual P export in the Sebasticook Lake watershed also have more development (i.e., shoreline development, roads, agriculture). This reinforces the fact that developed land, and other human-related impacts, can result in an increased export of P to the lake. Maps showing phosphorus loading results are presented in Appendix B.

Addressing erosion and nutrient management in sub-basins with the highest estimated phosphorus loading and adding effective natural buffers to disturbed shorelines on Sebasticook Lake will help reduce the amount of sediment and P entering the lake. Conducting water quality monitoring in stream watersheds with the highest estimated phosphorus load should be prioritized as part of the 10-year plan in order to collect current data to support this analysis.

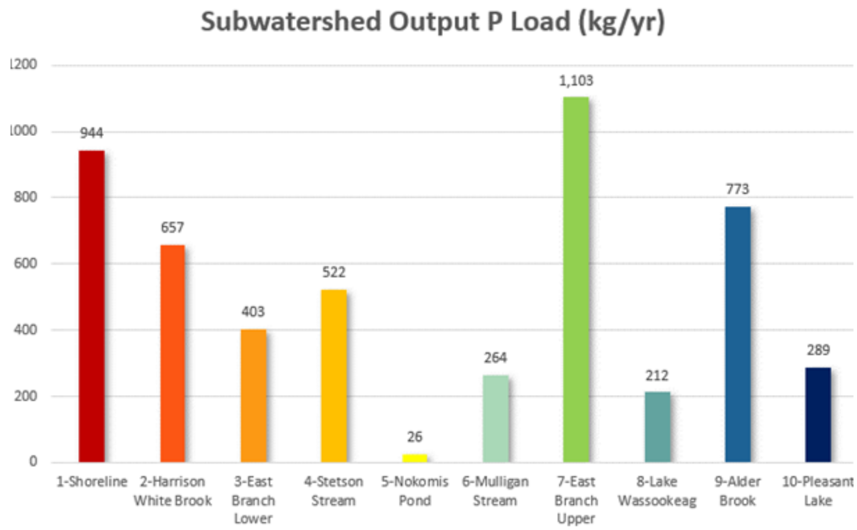


Figure 16. *Phosphorus load by sub-basin in the Sebasticook Lake watershed.*

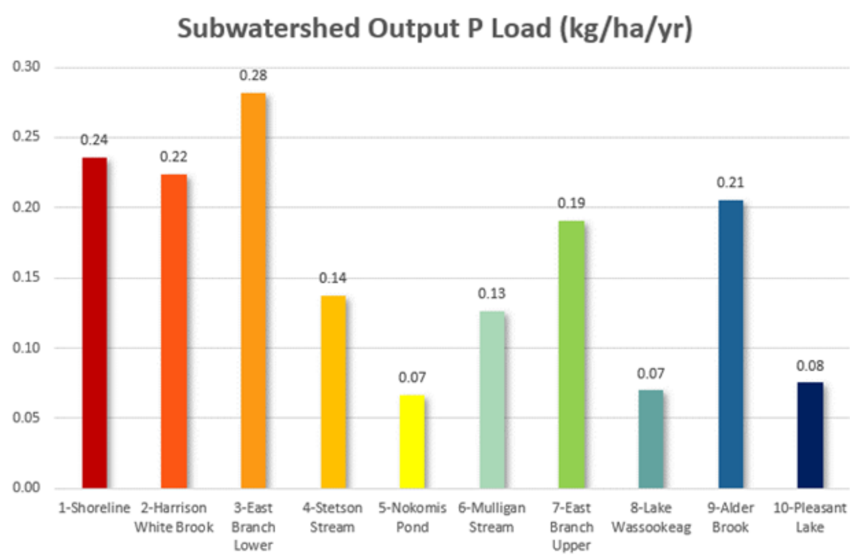


Figure 17*. Phosphorus load by sub-basin and area in the Sebasticook Lake watershed.*

PRE-DEVELOPMENT (BACKGROUND CONDITIONS)

Once the model was calibrated for the current in=lake P concentration in Sebasticook Lake (22 ppb), land cover and other factors that affect model estimates were modified to estimate pre-development (background conditions), representing the best possible water quality for the lake before the watershed was developed. The pre-development watershed P load to Sebasticook Lake is estimated at 2,085 kg/yr, representing about a third of the current watershed load to the lake (Table 10, Figure 18), with a predicted in-lake TP concentration of 7.2 ppb.

Table 10. *Total phosphorus and water loading summary by source for Sebasticook Lake for pre-development, current, and future watershed conditions.*

SOURCE CATEGORY	PRE-DEVELOPMENT			CURRENT			FUTURE		
	P (kg/yr)	%	Water (m^3/yr)	P (kg/yr)	%	Water (m^3/yr)	P (kg/yr)	%	Water (m^3/yr)
ATMOSPHERIC	174	8%	18,933,425	174	3%	18,933,425	174	2%	20,827,845
INTERNAL LOAD	40	2%	0	809	13%	0	890	12%	0
WATERFOWL	20	<1%	0	20	<1%	0	20	<1%	0
SEPTIC SYSTEMS	0	0%	0	148	2%	46,134	158	2%	49,259
SURFACE RUNOFF	1851	89%	141,113,643	5136	82%	142,627,493	6153	83%	156,898,359
TOTAL LOAD TO LAKE	**2085**	**100%**	**160,047,068**	**6286**	**100%**	**161,607,052**	**7395**	**100%**	**177,775,463**

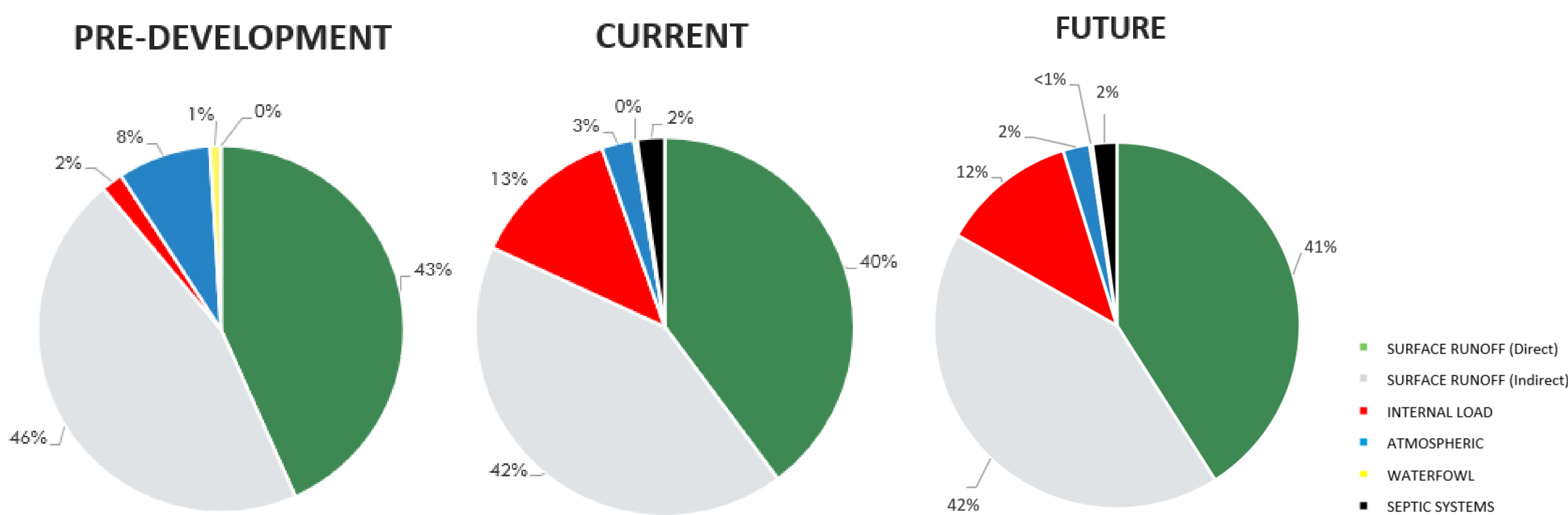


Figure 18. *Percentage of total phosphorus loading (kg/yr) by source to Sebasticook Lake under pre-development conditions (left), current conditions (center), and future conditions (development & climate change) (right).*

This exercise indicates a significant increase in not only the watershed P load to Sebasticook Lake from pre-development to present, but also a significant increase in the internal P load from just 2% of the total load to 13% under current conditions.

FUTURE DEVELOPMENT & CLIMATE CHANGE

Primary climate change impacts to lakes include variation in both precipitation and temperature. Higher precipitation periods, usually involving more intense storms, lead to more runoff and greater nutrient loading. Higher (air and water) temperatures lead to increased algal growth, greater oxygen demand due to decomposition, lower oxygen near the lake bottom, and increased P release from surficial sediments where iron is a major P binder (internal loading). The approximate influence of climate change can be evaluated in the LLRM by varying the inputs in accordance with projected climate change effects, generally set at a 10-20% increase based on long-term trends of lakes in the northeast. Climate change's influence on internal loading can be similarly evaluated by increasing the LLRM inputs in accordance with expected oxygen depletion rates, affected areas, and the period of release.

The predicted P increase in Sebasticook Lake from climate change is based on a 10% increase for precipitation, runoff coefficients for all developed land cover types, the overall watershed load, and the affected area of the internal load. An increase of 954 kg P/yr is estimated based on these conditions. This includes 873 kg/year from the watershed and 81 kg/yr from internal loading.

Additional loading includes a conservative estimate of 145 kg/yr (or a 0.5 ppb in-lake concentration increase) to reflect loading from future development, and 10 kg/yr from septic systems.[22] In addition to new development on the shoreline, population growth (and an increase in the developed land area in watershed) is expected in the form of conversion of small seasonal camps to larger year-round homes on the shoreline and residential and commercial development outside of the shoreland zone, all of which will ultimately lead to new sources of P to Sebasticook Lake. Combined, climate change and future development are estimated to increase the in-lake P concentration in Sebasticook Lake by 2.2 ppb, and the probability of experiencing an algal bloom under future development and climate change scenarios is estimated to increase by 18% from current conditions (Table 13).

MODEL PREDICTIONS

There was little difference within the model between the observed median TP in Sebasticook Lake (22 ppb) and the predicted average TP of 21.7 ppb (Table 11), The model predicted a lower average chlorophyll-a concentration (8.5 ppb) compared to the observed 10-year median (11.3 ppb) and a slightly lower water clarity (2.2 m) compared to the mean (2.7 m) and median (2.8 m) clarity for the last 10 years. With a high amount of variability in water quality over the past 10 years, the median may be the best value to compare to model predictions.

The general empirical equations used in the LLRM do not fully account for all biogeochemical processes occurring within Sebasticook Lake that contribute to the overall water quality. In particular, processing of

[22] For modeling purposes, an increase of 20 new properties was used in the septic module (10 year-round and 15 seasonal systems).

nutrients within the lake may vary substantially depending on biological components such as zooplankton and the fish community, neither of which are addressed in the model. Production of algae at the sediment-water interface could allow for greater Chl-a than average upper water column P concentrations would suggest through the model.

For pre-development conditions, the model predicted substantially lower P and chlorophyll-a concentrations and deeper mean water clarity (average SDT of 5 m) compared to current conditions (Table 11). These values fall within the bounds of the classification for a naturally mesotrophic lake.[23] The model predicted an increase in TP by 2.2 ppb and a 1.1 ppb increase in chlorophyll-a, and a 0.2 m increase in water clarity as a result of future development and climate change.

***Table 11**. In-lake water quality predictions for Sebasticook Lake.*

LLRM Water Quality Predictions	Median TP (ppb)	Predicted Average TP (ppb)	Median Chl-a (ppb)	Predicted Average Chl-a (ppb)	Mean SDT (m)	Predicted Average SDT (m)
PRE-DEVELOPMENT	-	7.2	-	1.9	-	5.0
CURRENT **	22	21.7	11.3	8.3	2.7	2.2
FUTURE	-	23.9	-	9.4	-	2.0

ASSESSMENT OF THE INTERNAL LOAD

An analysis of potential internal loading of P to Sebasticook Lake was conducted by WRS, Inc. (2024) using all available water quality data collected between 1972 and 2023. The analysis revealed that P release is occurring from the sediments during periods of low DO, although it is not the major source of P in Sebasticook Lake. Internal loading appears to have decreased markedly since the 1980s, a consequence of both reduction of P loading from the watershed and effects of the annual drawdown. However, there has been little reduction in watershed sources since the 2000s and the overall loading reduction from the watershed and from the annual drawdown has leveled off in recent years. Below is a brief description of the three methods used to assess the internal load.

ANALYSIS OF P MASS IN SEBASTICOOK LAKE

The mass of P at discrete depth intervals within Sebasticook Lake was plotted using water quality data collected from June through October 2023 (Figure 19). In typical stratified lakes there is an accumulation of P in the deeper layers over the summer as internal loading proceeds, generally increasing as oxygen is lost from the bottom up, with anoxia sometimes occurring near the thermocline. In Sebasticook Lake in 2023, there was an observable accumulation of P in deeper water, although the overall P mass of this accumulation remained low due to the small volume of water deeper than 8-10 m. The overall P concentration in the water column rises from mid-July through late September, consistent with oxygen loss

[23] Numerical guidelines for evaluation of trophic status in Maine lists mesotrophic lakes as having average SDT readings of 4 – 8 m, Chl-a from 1.7 – 7 ppb, and TP of 4.5 – 20 ppb. Current conditions in Sebasticook Lake fall within the eutrophic classification due to elevated levels of TP >20 ppb, and Chl-a >7 ppb.

over an increasing portion of the lake bottom during that time allowing for release of P from the sediments. The increasing P concentration in in water <5 m deep may be largely a function of uptake by algae[24] at the sediment-water interface which then rise in the water column, bringing excess P with them. Some of this overall P mass increase in 2023 may also be due to watershed loading, especially since summer 2023 experienced a higher-than-average amount of precipitation.

From the low point of P mass in mid-July (1,286 kg), the P mass increased over the next two and a half months to a peak (2,241 kg) that represented a net increase of 955 kg. Though some of this may be attributed to watershed runoff with a number of significant storms occurring during the period of P mass increase, much of the P increase is believed to have been released from sediments exposed to low oxygen. The range of internal loading based on 2023 P mass data is between 559 kg and 1000 kg.

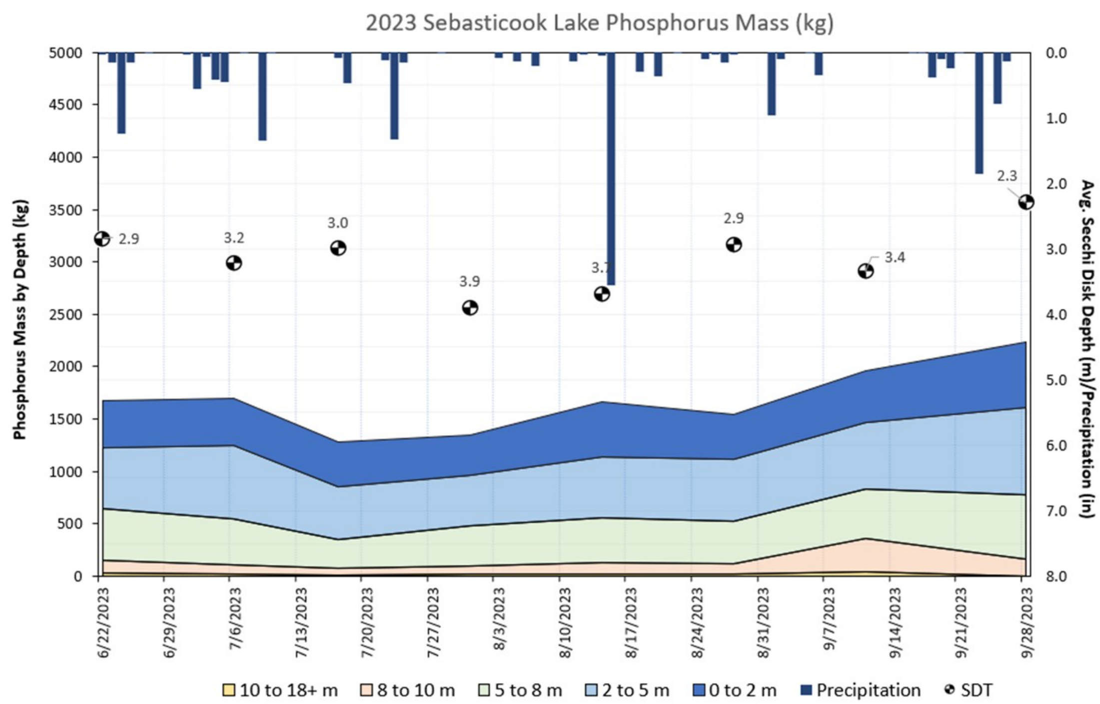


Figure 19. *P Mass at discrete depths in Sebasticook Lake between June - September 2023. (Source: Ecological Instincts)*

For comparison, P profile data from 1980 was used to create a P mass graph similar to 2023 (Figure 20). In 1980, the commencement of the annual drawdown had not yet occurred, and the bulk of early watershed actions had not yet been completed. The mass of P in Sebasticook Lake in 1980 was significantly higher than it is today, the internal load was much higher, and water clarity readings were lower.

While there are multiple ways by which internal loading of P can occur, the dominant one in New England is for P bound by iron (Fe) to be released under low oxygen conditions. Redox reactions result in both Fe and P being released into the overlying water. If a lake is stratified, much of the released P is trapped in the deeper water. If the distance between the point of anoxia (defined as DO<2 ppm) and the point of light

[24] Notably cyanobacteria, but other algae use this mechanism as well.

penetration into the lake is far enough apart (at least 3 m), available P may not move upward and be used by algae.

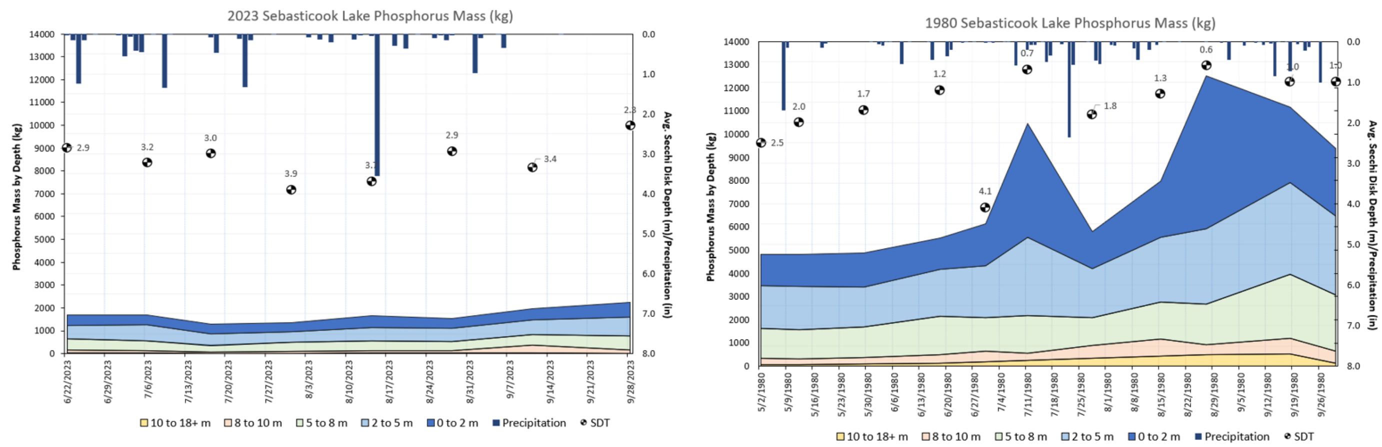


***Figure 20**. P Mass at discrete depths in Sebasticook Lake in 2023 (left) and 1980 (right). (Source: Ecological Instincts)*

However, mixing events, algae that move in the water column, and algae that grow at the sediment-water interface with just enough light to grow can all result in internally loaded P reaching the upper waters. Weather patterns can create substantial variation among years, so the portion of internally loaded P that becomes part of the "effective" P load to the lake will vary.

Based on a review of P mass over several decades:

- Stratification sets up in the spring and continues until early September, when surface temperatures decrease and the lake mixes.
- Substantial areas of anoxia generally develop in June and the lake bottom remains exposed to anoxia until the water column mixes in early September.
- The extent of anoxia in Sebasticook Lake that the lake experiences through the summer months along with the lake's sediment chemistry (discussed below) are causing P release from the sediments throughout the summer.
- While substantial reductions in P mass have occurred since the 1980s, there is still enough P in the lake during the summer to support algal blooms, and while internal loading is not the dominant source of P, it comes at a key time and is disproportionately influential on bloom development, especially by cyanobacteria (WRS, 2024).

SEDIMENT PHOSPHORUS EVALUATION

Sediment samples were collected at nine sampling sites by Maine DEP in May 2023 (Figure 21), representing the upper 10 cm of sediment at various depth intervals across the lake. Samples were evaluated by St. Joseph's College in order to quantify the differences in potential P release from the sediments in the lake at different depths. A Psenner analysis, which provides information about the various P fractions in a sample was completed along with an analysis of sediment density and percent solids for each sample. Sample results were organized based on the water depth over the sampling sites and then combined based on depth and duration of exposure to anoxia.

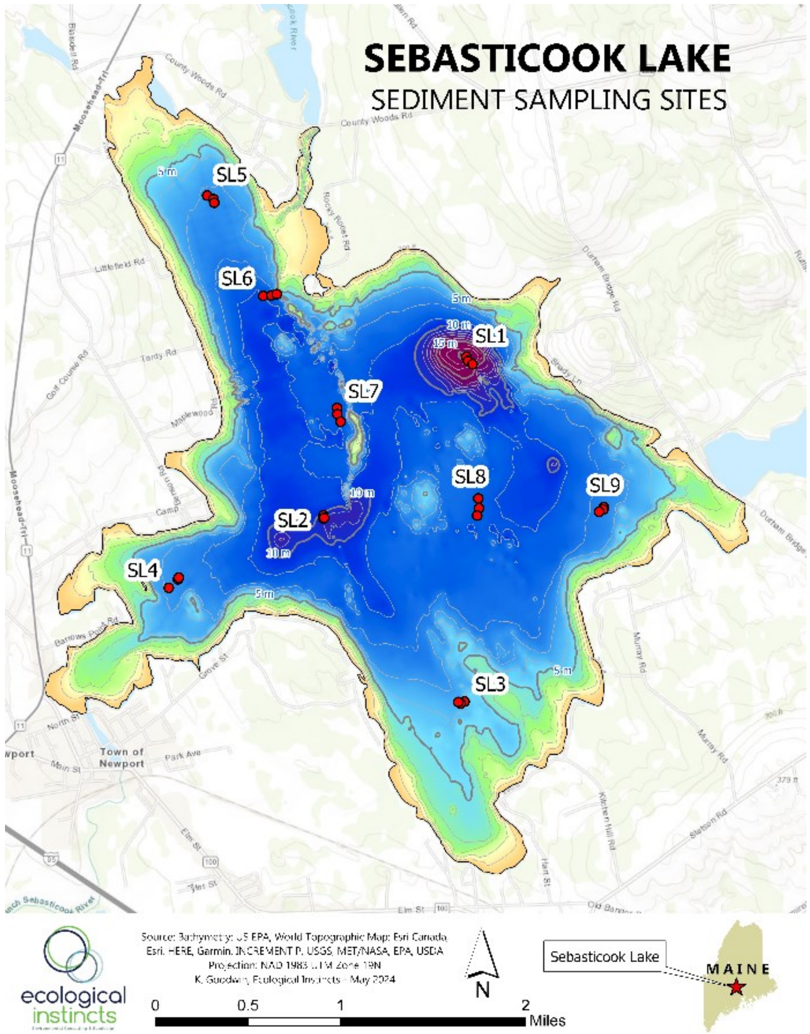


Figure 21. *Sediment sampling locations in Sebasticook Lake.*

Results of this analysis indicate:

- The actual mass of available P ranges from 0.88 g/m2 to 3.12 g/m^2 (Table 12), which is considered relatively low in the areas subject to anoxia. However, the larger area and duration of anoxia combine to make internal P loading a significant source of P to the lake.
- Concentrations for the deepest site (>11 m) was distinctly higher than values for other sampling sites. However, it represents just 3% of the potential contributory area, but it will be exposed to anoxia longer than the other depth zones.
- The 5-7 m zone, representing the shallowest contributary zone, has the second greatest available P after the >11 m zone; the potential for this area to affect overall P release is very high and dependent on exposure to anoxia. Based on historical data for the past 50 years, the probability of the 5-7 m deep zone to be exposed to anoxia has increased but year to year variation is high. Just

how long this zone is exposed to anoxia in any given year is likely to be a major determinant of the overall magnitude of internal loading (WRS, 2024).

- The 8-9 m zone has the lowest available P but is much larger than any other zone, and is therefore an important contributor to the internal P load in Sebasticook Lake as it is exposed to anoxia for an extended period of time in most years.
- The mass of available P is relatively low compared to other impaired lakes in the portion of Sebasticook Lake that is regularly subjected to anoxia, but the large area and duration of anoxia make P loading a meaningful source of P to the lake.
- The expected average release for P from the sediments during the open water season is estimated at 740 kg/yr; this estimate is similar to other approaches for estimating the internal load.
- Winter loading estimates is limited to data collected prior to the past 15 years and estimated at 100 – 300 kg/yr with an average of 198 kg/yr; therefore, the total internal load is estimated between 500-1100 kg/yr with an average of around 800 kg/yr.
- Weather patterns have a large influence on the internal P load in Sebasticook Lake in any given year.

***Table 12**. Average available phosphorus in Sebasticook Lake sediments by area and depth (Source: WRS, Inc., 2023)*

Water Depth Increment (m)	*Affected Area (ha)*	*Contributory Area*	*P Mass for Lake Zone (kg)*	*Exposure to Anoxia in 2023 (days)*	*Avg. Available P (g/m2 in top 10 cm)*	*P Load for Lake Zone (kg/yr)*
>11	33	3%	1040	127	3.12	88
9 – 11	248	21%	324	85	1.31	184
8 – 9	415	35%	364	85	0.88	206
7 – 8	204	17%	277	71	1.36	131
5 – 7	274	23%	725	27	2.64	130

LAKE LOADING RESPONSE MODEL ESTIMATE

A third method for estimating internal loading is to model it based on assigned release rates and duration of release based using the available empirical data. WRS utilized the Lake Loading Response Model (LLRM), setting duration of anoxia at 20-100 days depending on the water depth, and 30 days for the winter anoxic period. A release rate of 1.14 mg/m^2/day was used for all depth intervals. The LLRM estimates an **internal load of 809 kg/yr** (Table 13).

Based on the analysis of P mass, sediment chemistry, and watershed modeling, **internal loading accounts for approximately 13% of the total P load to Sebasticook Lake.** That cyanobacteria are likely utilizing the P released by sediment before it ever enters the water column makes the transfer into the water column very efficient. This is an important consideration for managing internal phosphorus loading in order to prevent cyanobacteria blooms.

***Table 13**. Estimated internal P load in Sebasticook Lake based on the LLRM method. (Source: WRS, 2024)*

Source	Affected Lake Area (ha)	Period of Release (days)	P Rate of Release (mg/m2/day)	P Load (kg/yr)
5-7 m summer	274.5	20	1.14	62.6
7-8 m summer	204	45	1.14	104.5
8-9 m summer	415	50	1.14	236.5
9-11 m summer	248	60	1.14	169.3
>11 m summer	33	100	1.14	38.0
Winter	579	30	1.14	198.0
Total				**808.9**

EVALUATION OF REMEDIATION OPTIONS TO ADDRESS THE INTERNAL LOAD

An evaluation of remediation options and costs for addressing the internal load and preventing algal blooms from occurring was conducted by WRS (2024). Options that were considered included selective withdrawal, dredging, oxygenation, and P inactivation. Selective withdrawal and P inactivation were the two primary remediation options considered for this plan.

Selective Withdrawal (a.k.a. Drawdown)- Selective withdrawal requires removing water higher in nutrients to improve the quality of the remaining water in the lake to limit the amount of P that moves back into the sediments that could be recycled later. The summer/fall drawdown initiated in 1982 that has been in effect for more than 40 years at Sebasticook Lake is a form of selective withdrawal, whereby water level is lowered 8.5 ft when the lake de-stratifies; when the surface water tends to have the highest P concentrations. Below are some recommendations for the drawdown:

- P data indicate that the drawdown has been started too early in some years and too late in others, but in most cases a significant amount of P has been discharged. Monitoring water temperature to determine onset of de-stratification and lowering water level just before the lake destratifies by monitoring temperature profiles every week leading up to the drawdown will increase the effectiveness of this management strategy.
- Drawing down the lake enough to flush high P water out for a short duration during peak summertime algal blooms in July/August when P concentrations are high will also benefit water quality.
- The P concentration in the upper layers of Sebasticook Lake was quite high when the drawdown first began, but has diminished over time, and has become fairly stable over the last decade at about 28% of what was achieved in the first 10 years of the drawdown (WRS, 2024).[25]

[25] The P concentration has been lowered from near 100 ppb in the 1980s to no more than 30 ppb in recent years.

- The amount of P discharged each year from the drawdown is <1000 kg/yr. With ongoing loading from the watershed, the drawdown cannot be expected to lower internal loading more than it has; it will help conditions from getting worse, but will not improve the further.

P Inactivation (a.k.a. Alum Treatment)- P inactivation can be used to bind P in surficial sediments and make reserves less susceptible to release under anoxic conditions. According to WRS (2024), the most advantageous approach for P inactivation at Sebasticook Lake would be a treatment of the sediment area subject to anoxia with a P binder such as aluminum sulfate (alum).

- A reduction of internal loading of about 90% would be expected from a full treatment, reducing the internal P load from the projected value of about 800 kg/yr to a level near 80 kg/yr.
- Successful P inactivation of all sediment under water >5 m deep could reduce the average P concentration in the lake by about 12%. This would not be enough to prevent all algal blooms in Sebasticook Lake, as internal loading is not the dominant source of P to this lake, but it should greatly reduce summer and fall cyanobacteria blooms by virtue of load control and N:P ratios at that critical time of year.
- The greatest drawback is that without further control of watershed inputs, the duration of benefits will not be longer than a decade and may only be a few years, as watershed inputs will rebuild internal load reserves.
- The cost to treat all areas of Sebasticook Lake >5 m with alum should provide close to a 90% reduction in internal P loading for close to two decades, based on the individual zone calculations of needed dose, is close to $4 million. Any effort to control internal P loading will be relatively short-lived without a substantial reduction in loading from the watershed.
- The cost of addressing the internal load in Sebasticook Lake is approximately the same as the cost to address external phosphorus loading from the watershed over the next 10 years. Yet, both will be needed to restore water quality in the lake over the long-term.
- Because of the large price tag and relatively short duration of expected benefits, additional analysis should be completed to better characterize P mass in the sediments before an alum treatment is considered.

With the external P load at about 80% of the total P load to the lake, watershed management is a critical long-term improvement management strategy for the lake. The efforts of the 1970s through 1990s greatly improved lake conditions, and the ongoing drawdown has helped maintain those improved conditions. However, further reductions in P loading are needed. Addressing the current internal load would greatly reduce the probability of cyanobacteria blooms, but without corresponding work to reduce P inputs from the watershed, internal load control would be a maintenance effort, requiring repeated application at great cost to maintain conditions.

WATER QUALITY TARGET SELECTION

The LLRM was used to evaluate possible water quality targets for the Sebasticook Lake WBMP. This required calculating practical watershed P reductions (and resulting in-lake P concentrations) that will result in meaningful water quality improvements. The approach was guided by watershed partners including members of the project's Technical Advisory Committee. Load reduction estimates were calculated for 2023 watershed survey sites, and the DEP relational method for P reductions was used to derive estimated load reductions for developed land in the direct and indirect watersheds. The methods for estimating P load reductions for the Sebasticook Lake WBMP is provided in Appendix C.

For Sebasticook Lake, with an estimated pre-development P concentration of 7.2 ppb, and current P concentration of 21.7 ppb, the difference is quite large. However, moving the lake substantially toward pre-development conditions will be an exceedingly difficult challenge given the large size of the watershed and present level of development in the watershed. The LLRM was used to set an in-lake phosphorus target for Sebasticook Lake based on achievable P load reductions over the next 10 years (Table 14). **An in-lake TP concentration of 18.2 ppb is recommended for Sebasticook Lake, which will require a 16% P reduction (-3.5 ppb) over the next 10 years.** This is equivalent to a 1,000 kg P/yr reduction in the total P load to Sebasticook Lake from direct and indirect watersheds. Additional phosphorus reductions will be needed and a new water quality goal will need to be set following completion of this plan to move the lake toward full restoration. Addressing the watershed load by itself will not restore the lake, but will improve water quality over the next 10 years and set the stage for implementing additional watershed work and in-lake remediation efforts in the next 10-year planning cycle.

Achieving this goal will require a 44% reduction in the watershed load by 1000 kg P/yr (471 kg/yr direct and 485 kg/yr indirect watersheds, respectively), and a 50% reduction in the septic system load (44 kg/yr). The greatest percentage of the target P reduction is on agricultural land in the direct and indirect watersheds (68% of the total P reduction needed) compared to 32% for urban development and 4% from septic systems. Significant effort will be needed to engage with agricultural landowners to reach these targets.

Table 14. *Modeled water quality and P loading predictions under future development and climate change scenarios, current conditions, various target load reduction conditions, and pre-development (background conditions) for Sebasticook Lake.*

In-lake P concentration	**23.9**	**21.7**	**19.2**	**18.2**	**17.0**	**15.3**	**7.2**
Reduction (kg/yr) from Current Total P Load	*+1109*	*0*	*-728*	*-1000*	*-1367*	*-1861*	*-4201*
	Future Development & 10% Climate Change Scenario	**Current**	**Internal Load (Full Alum Treatment) (12%)**	**External Load Reduction (16%)**	**External Load & Internal Load (Partial Alum Treatment) (22%)**	**External Load & Internal Load (Full Alum Treatment) (30%)**	**Background Conditions***
Atmospheric	174	**174**	174	174	174	**174**	174
Internal Load	890	**809**	81	809	445	81	40
Waterfowl	20	**20**	20	20	20	20	20
Septic Systems	158	**148**	148	104	104	104	0
Watershed Load	6153	**5136**	5136	4180	4177	4047	1851
TOTAL LOAD TO LAKE	**7395**	**6286**	**5558**	**5286**	**4919**	**4425**	**2085**
SDT Avg	2.0	**2.2**	2.4	2.5	2.6	2.9	**2.7**
SDT Max	4.0	**4.1**	4.3	4.3	4.4	4.6	3.2
Chl-a Avg	9.4	**8.3**	7.1	6.6	6.0	5.2	1.9
Chl-a Max	32	**28**	24	23	21	19	7.3
Bloom Probability	53%	**43%**	31%	27%	21%	14%	0.1%
Flushing Rate	1.61	1.47	1.47	1.47	1.47	1.47	1.45

5. Climate Change Adaptation

Current Maine DEP guidance calls for developing watershed management plans that incorporate climate change considerations. This guidance would be addressed to a large extent by any plan that aims to reduce nonpoint source pollution and minimze the internal P load. The primary climate change impacts on lakes are variation in precipitation and temperature. Higher precipitation periods, usually involving more intense storms, lead to more runoff and greater nutrient loading.

Higher air and water temperatures lead to earlier ice-out and later ice-in, resulting in longer and stronger stratification periods, which leads to increased algal growth, greater oxygen demand due to decomposition on the lake bottom, lower oxygen near the lake bottom, and increased P release from surficial sediments where iron is a major P binder (internal loading). Warmer water temperatures and increased P also favor invasive species, cyanobacteria, and harmful algal blooms (HABs) that produce toxins harmful to humans and wildlife. Increasing temperature and dissolved organic carbon (DOC) in lakes has a direct effect on thermal and biological dynamics, ultimately favoring nutrient-loving species (like toxin-producing cyanobacteria) over species adapted to cooler water temperatures.

Between 2015 – 2020, the Gulf of Maine experienced its warmest 5-year period on record (Pershing et. al., 2021), warming at a rate seven times faster than the rest of the ocean. A 2020 report from the Maine Climate Council confirms that over the last several decades, air and surface water temperatures have been increasing in Maine. Surface water temperatures in northern New England increased 1.4 °F per decade from 1984-2014, which is faster than the worldwide average, with Maine lakes warming on average by nearly 5.5 °F during this time. The statistical analysis of water quality data in Sebasticook Lake indicates a significant increase in the surface water temperatures of Sebasticook Lake since 1974, especially in August and September (Ecological Instincts, 2024a).

Movement toward bigger and more frequent storms presents another challenge for watershed management and exacerbates the internal loading problem as more intense rainfall will increase the amount of nutrient transport to the lake from the watershed via stormwater runoff that will be available for algal growth. P loading is very strongly connected to precipitation, and disrupting that relationship is not an easy task.

These climate-related changes are likely to exacerbate water quality issues in Sebasticook Lake, necessitating additional P load reductions from watershed sources to offset the anticipated increases due to climate change. Though water quality in many Maine lakes has improved as a result of laws and regulations that protect water quality by mitigating the effects of human development, the effects of climate change threaten the effectiveness of these dated laws that may need adjusting to adequately protect natural resources in the future (MCC, 2020).

Watershed modeling estimates **an additional 1109 kg P/yr could be delivered to Sebasticook Lake due to climate change,**[26] **unless actions are taken to mitigate this additional loading.** It is important to remember that the watershed is not a static system, and the P load will continue increasing over time without taking actions to address these changes. The estimated increase above could be exceeded with just a few unforeseen large-scale climatic events that deliver a lot of sediment to the lake in a single pulse. Climate change adaptation planning, such as upgrading infrastructure on roads (i.e., undersized culverts), infiltrating stormwater runoff on commercial and residential properties, planting buffers, and conserving undeveloped land, can help to counteract the effects of the anticipated increase in precipitation. Infiltration of stormwater runoff reduces runoff volume, decreases P through filtration and adsorption, and importantly, decreases the temperature of the runoff water.

Many of the actions proposed throughout the Watershed Action Plan (Section 7, Table 16) will help to mitigate and/or monitor the impacts of climate change on Sebasticook Lake, especially those focused on preventing future sources of NPS pollution. Specific actions focusing on climate change adaptation include ensuring that all watershed towns are enrolled in the State's Climate Resiliency Partnership (CRP) (action E3), providing educational workshops about climate change adaptation for landowners (action D5), and improving road maintenance and infrastructure to withstand the effects of more frequent and intense storms (actions C2-C4).

[26] Model inputs included a 10% increase in precipitation, 10% increase in runoff coefficients for developed land uses, an overall watershed load increase of 10% and a 10% increase in the affected area of internal loading. This includes an additional 20 kg/yr from internal loading.

6. Establishment of Water Quality Goals

Findings from the current evaluation of water quality data and watershed modeling indicate that **reducing P loading from the watershed is the most important component of the long-term strategy to restore water quality in Sebasticook Lake**. Internal P loading is not the major source of P loading in Sebasticook Lake, but it does make a significant contribution to the overall P load in the lake. Addressing the internal P load would not restore the lake on its own, but could help to temporarily reduce the annual P load while improvements are made in the watershed.

WATER QUALITY GOAL

Sebasticook Lake exhibits improving water quality trends & reduced frequency of algal blooms

Current In-Lake Concentration= 21.7 ppb
In-Lake Phosphorus Goal= 18.2 ppb
Reduction In-Lake Concentration= 3.5 ppb

"P" REDUCTIONS NEEDED

Direct Watershed: - 515 kg/yr
- 318 kg/yr agriculture
- 153 kg/yr urban development
- 44 kg/yr septic systems

Indirect Watershed: - 485 kg/yr
- 331 kg/yr agriculture
- 154 kg/yr urban development

Total P Reduction: 1000 kg/yr

Timeframe: 2025- 2034

A team of scientists and local stakeholders worked collaboratively over two years to set a water quality goal for Sebasticook Lake that would improve water quality in Sebasticook Lake as part of a long-term restoration strategy. Specifically, the committee reviewed the results of the water quality analysis (Ecological Instincts, 2024a), watershed modeling and future loading scenarios (Ecological Instincts, 2024b), and internal loading analysis (WRS, 2024) to set the goal. Watershed assessment work, including the 2023 NPS Watershed Survey (Ecological Instincts, 2023a), and the Ag/Forestry Survey (PCSWCD, 2023) were evaluated to determine if revised water quality goals could be met based on past performance and proposed load reduction estimates.

The goal of this plan is to reduce the current P load by approximately 16% resulting in a reduction in the average annual in-lake TP concentration by 3.5 ppb (from 21.7 ppb to 18.2 ppb), which equates to a P reduction of 1000 kg/yr. This can be achieved by:

- Reducing the external load in the direct and indirect watershed by 956 kg/yr (649 kg/yr agriculture, 307 kg/yr urban development); and
- Reduce P loading from septic systems by 44 kg/yr.

7. Watershed Action Plan & Management Measures

The Sebasticook Lake WBMP provides strategies for achieving the water quality goal. These recommendations are outlined in detail in the plan and were presented to the steering committee and the public for review and feedback. The action plan represents solutions for improving water quality in Sebasticook Lake based on the best available science. The plan is divided into six major objectives (A-F). Task descriptions in each of these sections include a description of how the task will be implemented, a description of potential funding sources, and a list of project partners assigned to each task (Table 16). The objectives focus on:

- **A) Reduce the External P Load**
- **B) Manage the Internal P Load**
- **C) Reduce New Sources of NPS Pollution**
- **D) Education, Outreach & Communications**
- **E) Build Local Capacity**
- **F) Conduct Long-Term Monitoring & Assessment**

REDUCING THE EXTERNAL LOAD

Addressing NPS pollution from watershed sources is an important part of a multi-step, multi-year process to make a significant difference to restore the current state of water quality in Sebasticook Lake. Addressing the external load will require ongoing work annually over a ten-year period and beyond, both in the direct and indirect watersheds. Success of this work will depend on cooperation from landowners, towns, and businesses to reduce the watershed load by 1000 kg P/yr.

Load reductions were estimated for Sebasticook Lake using three different models to develop the best estimates. A summary of methods for calculating load reductions is provided in Appendix C. A combination of the three models was used to set the water quality goal. While the three methods yielded slightly different results, they paint an overall picture of the challenge ahead. External load reductions needed to reach water quality goals include the following three priorities (in order of importance):

1. **Agriculture**- Address 44% of P loading from all agricultural land uses (649 kg P/yr);
2. **Urban Development-** Address 44% of P loading from urban development, including residential development, commercial development, and roads (307 kg P/yr);
3. **Septic Systems-** Address 50% of loading from septic systems on the shoreline (44 kg P/yr).

WATERSHED NPS SITES

In April 2023, volunteers and technical staff completed a survey of the Sebasticook Lake watershed to identify sites in the watershed that contribute nonpoint source (NPS) pollution to Sebasticook Lake (Ecological Instincts, 2023a). The survey identified a total of 172 erosion sites that are likely contributing to excess P inputs to Sebasticook Lake (Appendix D). NPS sites were documented across 11 different land uses (Table 15), with the highest number of sites being located on residential properties, followed closely by town roads. The impact that documented NPS sites may have on the water quality of Sebasticook Lake was determined during the survey based on the proximity to a waterbody and the magnitude of the problem. Factors such as slope, amount of eroding soil, and buffer size were also considered. Out of the 172 documented sites, only 17 ranked high impact compared to 91 medium, and 64 low impact sites. The majority of high impact sites were located on town roads, followed by residential sites and private roads.

Table 15. *Summary of NPS sites in the Sebasticook Lake watershed by land use and impact.*

Land Use	High Impact	Medium Impact	Low Impact	Total	% Total
Residential	3	23	28	**54**	31%
Town Road	5	22	21	**48**	28%
Private Road	3	16	5	**24**	14%
Driveway	1	9	1	**11**	6%
State Road	2	7	3	**12**	7%
Trail or Path	0	3	4	**7**	4%
Boat Access	0	5	0	**5**	3%
Municipal / Public	1	2	2	**5**	3%
Commercial	0	3	0	**3**	2%
Beach Access	2	0	0	**2**	1%
Construction Site	0	1	0	**1**	1%
Total	**17**	**91**	**64**	**172**	**100%**

In order to provide technical and financial assistance to landowners for improving NPS issues on their properties, several phases of federal grants (particularly Clean Water Act Section 319 grants awarded by the US EPA to Maine DEP) will be sought to address NPS sites on commercial properties, driveways, and residential properties on the shoreline, with a focus on high and medium impact sites. This plan sets a goal of addressing all identified high impact sites (17 sites) and medium impact sites (91 sites), along with at least 29 low impact sites over the next 10 years at a cost of approximately $718,000.

BUFFERS

The 2023 watershed survey documented a general lack of adequate buffers on developed shoreline properties. Installing an effective shoreline buffer can be one of the easiest ways to help improve water quality. Natural vegetated shorelines are often the “last line of defense” for trapping and treating polluted runoff before it gets to the lake. A healthy, vegetated shoreline will not only act as a buffer between the lake and adjacent shoreline development but will also provide great benefit to wildlife as more species live in (and rely on) shoreline riparian zones than any other habitat type (Maine Audubon, 2006). Increasing development pressure throughout the watershed, and especially within the shoreland zone of Sebasticook Lake, and the effects of climate change (more frequent and more intense precipitation and increased volume and velocity of stormwater runoff) means that healthy, vegetated shoreline buffers will be even more important for achieving water quality goals and maintaining a healthy lake ecosystem.

Actions meant to improve shoreline buffers include training LakeSmart evaluators and providing free evaluations to landowners, especially those with NPS sites on their properties. Outreach efforts will include a buffer campaign with easy-to-follow guidance for installing effective shoreline buffers highlighting the importance of **buffer quality**- as a healthy and functioning shoreline buffer includes more than just the installation of native plantings.

A detailed description of each action, potential funding sources, and estimated costs for 14 actions related to addressing NPS sites is provided in the Action Plan (Table 16A). Environmental (E), Social (S), and Programmatic (P) milestones referenced within individual actions are related to the measurable milestones, indicators, and benchmarks in Section 9 (i.e., E1 refers to Environmental Milestone #1).

SEPTIC SYSTEMS

Septic systems are estimated to contribute 2% of the total P load to Sebasticook Lake. However, there are still many unknowns about their impact and the total load could actually be larger, depending on the state of these systems. Just one or two failing septic systems leaching nutrient-rich wastewater into the lake could result in localized water quality problems. With 927 parcels located on sensitive soils in the Town of Newport alone, it is likely that some of the septic systems in the watershed are short-circuiting and contributing P and Nitrogen (N) among other pollutants, directly to the lake.

This plan sets a goal of reducing P inputs from septic systems by 44 kg/yr through providing technical assistance to landowners including septic system inspections, and through providing incentives to help encourage landowners to upgrade and maintain their septic systems. A detailed description of each action, potential funding sources, and estimated costs for five related septic system actions is provided in the Action Plan (Table 16A). Environmental (E), Social (S), and Programmatic (P) milestones referenced within individual actions are related to the measurable milestones, indicators, and benchmarks in Section 9 (i.e., E1 refers to Environmental Milestone #1).

AGRICULTURE AND FORESTRY

An assessment of active agriculture and forestry operations in the watershed was completed in 2023 by the PCSWCD in partnership with USDA/NRCS (PCSWCD, 2023). There are 181 known farms in the watershed between both Penobscot and Somerset Counties, making up an estimated 5,068 acres of the watershed. The land cover layer based on NLCD 2021 data estimates a similar but slightly smaller amount of land in the watershed in agricultural production, at 4,706 acres. The most common uses for these lands are hay (2,358 acres), corn (1,412 acres), pasture (580 acres) and potatoes (429 acres).

Over the years, NRCS staff have worked with several foresters and farmers in the watershed to implement conservation practices that are protective of water quality through USDA programs. These programs provide financial support to farmers for the implementation of conservation practices through the

Environmental Quality Incentives Program (EQIP), among other initiatives. Between 2012 and 2023, there were 41 contracts between farmers and NRCS to install conservation practices on either agricultural or forestry operations in the Sebasticook Lake Watershed, impacting 6,605 acres of land. Practices installed include Additionally, PCSWCD met with the four largest agricultural producers in the watershed, all of whom have taken some action to reduce their farms' impacts on water quality and reduce erosion and runoff.

A detailed description of each action, potential funding sources, and estimated costs for actions to address NPS pollution from agricultural sources is provided in the Action Plan (Table 16A). Environmental (E), Social (S), and Programmatic (P) milestones referenced within individual actions are related to the measurable milestones, indicators, and benchmarks in Section 9 (i.e., E1 refers to Environmental Milestone #1). High priority actions include working with USDA and DEP to explore selection of a National Water Quality Initiative (NWQI) program and implementing conservation measures such as diverting runoff from agricultural land, converting conventional row crops to no-till, crop rotations, and cover crop seeding, working with producers to reduce NPS from feedlots by developing/updating nutrient management plans and installing practices that reduce runoff from manure, and conducting targeted outreach to hobby farms in the watershed.

MANAGING THE INTERNAL LOAD

Although the major source of loading to Sebasticook Lake is external loading, internal loading from sediments exposed to low oxygen contributes significant amounts of P to the overall load, making up an estimated 13% of the total. **Continuing to target the internal load through annual drawdowns is needed to help meet water quality targets for the lake over the next 10 years.** The annual drawdown is favored as a low-cost management strategy for helping reduce internal loading and is estimated to remove approximately 800-1000 kg of phosphorus from Sebasticook Lake each year. Without this continued removal of P from the surface waters, it is unlikely that watershed work alone could keep up with internal loading to prevent a buildup of excess P in the lake, and the probability of algal blooms would likely increase.

PRELIMINARY EVALUATION OF REMEDIATION OPTIONS

There are several ways to directly address algal blooms caused by internal P loading, but the focus of remediation should be on preventing blooms from occurring. **Selective withdrawl** (annual drawdowns) has been a successful strategy for reducing the impacts of internal loading in Sebasticook Lake for over the past 40 years. This plan recommends continuing the annual drawdown and improving protocols for drawdown timing to increase its impact. However, the amount of P reduced by the drawdown seem to have stabilized in recent years. A number of other options were considered to address the internal load, either as alternatives to the annual drawdown or as additive measures. Although none were determined to be effective enough to be recommended in this plan, **phosphorus inactivation** was recommended as the most cost effective and immediate method for reducing the internal load[27] and could be considered as an additional tool for treating the internal load in the future (WRS, 2024).

A large barge is used to conduct an aluminum treatment at upstream East Pond to address chronic internal P loading. (Photo credit, 7 Lakes Alliance)

The most advantageous approach to P inactivation in Sebasticook Lake was determined to be a treatment of the sediment area subject to anoxia with a P binder such as aluminum. The track record for such treatments is favorable, including past efforts in Maine, and alum is used extensively in water treatments worldwide. When applied in a lake, it is buffered to remain pH neutral and will not harm fish when applied properly.

In Sebasticook Lake, successful P inactivation of sediment under water >5 m deep could result in a reduction of at least 90% of the internal load, reducing the internal P load from the projected value of 800 kg/yr to a level near 80 kg/yr. This type of treatment could reduce the average P concentration in the lake by about 12%. This would not be enough to prevent all algal blooms in Sebasticook Lake, as internal loading is not the dominant source of P to this lake, but it would be expected to greatly reduce summer and fall cyanobacteria blooms. The greatest drawback to this type of treatment is that without further control of watershed inputs, the benefits of phosphorus inactivation are not expected to last for more than a decade and may only last a few years, as wateshed inputs will rebuild internal load reserves (WRS, 2024).

Watershed management by itself will not achieve desired water quality conditions in Sebasticook Lake but will provide protection for the future and increase the efficacy of both the annual drawdown and any in-lake treatments. Recommended actions for reducing the internal loading in Sebasticook Lake through continuing and improving protocols for the annual drawdown drawdown are provided in the Action Plan (Table 16B). Social (S), and Programmatic (P) milestones referenced within individual actions are related to the measurable milestones, indicators, and benchmarks in Section 9 (i.e., E1 refers to Environmental Milestone #1).

PREVENTING NEW SOURCES OF NPS POLLUTION

Preventing new sources of P from getting into the lake is imperative to the success of the management strategies described above. Future development and climate change are estimated to increase the total P load from the watershed (1017 kg/yr) and septic systems (10 kg/yr) resulting in an increase in the in-lake P concentration by 2.2 ppb. Combined, climate change and future development scenarios result in more new P being added to the lake than the P load reduction goals for in the direct and indirect watersheds. In other words, **if nothing is done to adapt to climate change and prevent new sources of P from getting into the lake, then much of the effort to reduce existing sources of P may be offset and goals may**

[27] Other management options considered for Sebasticook Lake include dredging, oxygenation, and biomanipulation.

not be achieved. As the water quality in the lake improves, Sebasticook Lake will continue to be an even more desirable place to live and to visit, resulting in new development in the watershed. Prevention strategies will need to include improved road maintenance strategies, more robust municipal planning and enforcement, and land conservation.

ROAD MAINTENANCE

A network of roads spans the Sebasticook Lake watershed including many gravel roads that provide access to shoreline development. The potential for excess P loading from these roads is high, especially with the frequency of large storms expected to increase due to climate change. Improving road maintenance strategies and upgrading infrastructure at key locations will help to reduce the impacts of future weather events and to prevent problems before they occur rater then reacting to problems as they arise.

FUTURE DEVELOPMENT & CONSERVATION

Though much of the land in the Sebasticook Lake watershed is undeveloped, there is potential for these undeveloped areas to be subject to future development. This plan recommends conducting a buildout analysis to determine how much of this land is available to be developed and to determine key areas where conservation of undeveloped lands will have the most impact. Watershed partners should coordinate with local groups including land trusts and conservation associations to focus their conservation efforts on watershed basins with the highest P loading.

MUNICIPAL PLANNING & ORDINANCES

While some towns in the watershed have taken steps to help protect lake water quality, only **three of the eight towns in the watershed have shoreland zoning ordinances available publicly on their websites**, and only one of those was updated more recently than the last update to the State's standards. **Only four towns in the watershed have a comprehensive plan**. Even in towns where ordinances are up to date it is likely that many older structures do not meet the current standards set by these ordinances. Along with new construction on the remaining undeveloped shoreline parcels, conversion of seasonal or second homes to year-round homes is the most likely shift in usage along the shoreline, thereby increasing the potential for additional stormwater runoff to the lake as a result of increased use (e.g., fertilizing, clearing vegetation, raking, compacted soil areas from vehicles and foot traffic), and related impacts from septic systems.

Ensuring that regulations are in place to address runoff from conversions of structures in the shoreland zone will be important for preventing new sources of P from getting into the lake. Protecting high-value riparian habitat through land conservation in order to safeguard small headwater streams and large areas of undeveloped forests and high-value habitat should be a priority, as should land conservation.

The major recommendations applicable to reducing impacts from future development are provided in Table 16C. Social (S), and Programmatic (P) milestones referenced within individual actions are related to the measurable milestones, indicators, and benchmarks in Section 9 (i.e., E1 refers to Environmental Milestone #1).

EDUCATION, OUTREACH & COMMUNICATIONS

Public education and outreach is an important and necessary component of meeting the water quality goals for the Sebasticook Lake WBMP. Implementation of education and outreach activities in the action plan will be led by a steering committee consisting of watershed partners that are actively conducting outreach will streamline outreach messaging, increase participation in watershed planning activities and support the adoption of long-term operation and maintenance of BMPs.

SLA and the Town of Newport both work to conduct public outreach about Sebasticook Lake and water quality issues to lake and watershed residents. (SLA hosts an annual meeting each summer for all interested watershed residents, provides watershed updates on its website and Facebook page (900 followers), and distributes two annual newsletters to lake association members. The Town of Newport maintains a page on their website with information about Sebasticook Lake where they provide notices about the timing of annual drawdowns. Coordination with other watershed towns will help expand these existing coordinated outreach efforts so that all watershed residents are aware and involved in the process. Actions to increase awareness of and participation in watershed projects include:

- Forming an outreach committee to oversee education and outreach activities
- Developing and maintaining a public WBMP web page to provide information and updates about the project
- Conducting targeted outreach to landowners with NPS sites on their properties
- Hosting workshops about buffer planting, road maintenance, and septic systems

The complete list of recommended actions for outreach, education and communications can be found in Table 16D. Environmental (E), Social (S), and Programmatic (P) milestones referenced within individual actions are related to the measurable milestones, indicators, and benchmarks in Section 9 (i.e., E1 refers to Environmental Milestone #1).

BUILDING LOCAL CAPACITY

The Town of Newport, in cooperation with watershed partners, will oversee plan implementation, which will require funding the plan, meeting annually with project partners, and strengthening relationships within the community among other tasks described below. A detailed planning schedule, potential funding sources, and estimated costs for each of the 10 capacity building actions is provided in Table 16E. Environmental (E), Social (S), and Programmatic (P) milestones referenced within individual actions are related to the measurable milestones, indicators, and benchmarks in Section 9 (i.e., E1 refers to Environmental Milestone #1).

***Table 16**. Sebasticook Lake Watershed Action Plan, 2025-2034.*

Sebasticook Lake Watershed Action Plan (2025-2034)							
	Action	**How**	**Who**	**Schedule**	**Priority**	**Potential Funding Sources**	**Estimated Total Cost (10 years)**
A. Reduce the External Phosphorus Load (1,000 kg P/yr)							
Address High Impact NPS Sites (17 sites) (-150 kg P/yr)							
A1	Fix NPS sites on high impact residential properties *Goal: 3 residential sites (Milestones: E1, P2)*	Provide technical assistance to landowners with high impact sites to install vegetative buffers. Provide cost-sharing grants to help fund BMP installation.	SLA, Town of Newport, PCSWCD	Years 1-3	HH	US EPA (319), Maine DEP, landowners	$15,000
A2	Fix NPS sites on high impact state, town, and private roads *Goal: 10 road sites* (Milestones: E1, S3, P2)	Provide technical assistance to private road associations, landowners towns, and DOT to enlarge and replace culverts, armor culvert inlets/outlets, install ditch turnouts, stabilize ditches, and reshape gravel roads. Provide cost-sharing grants to help fund BMP installation.	SLA, Watershed Towns, DOT, PCSWCD	Years 1-3	HH	US EPA (319), Maine DEP, Town of Newport, landowners	$80,000
A3	Fix all other identified high impact NPS sites (public, beach access & driveways) *Goal: 4 sites* (Milestones: E1, P2)	Provide technical assistance to landowners with high impact sites to install vegetative buffers, install runoff diverter, and stabilize shoreline. Provide cost-sharing grants to help fund BMP installation.	SLA, Town of Newport, PCSWCD	Years 1-5	HH	US EPA (319), Maine DEP, Town of Newport, landowners	$20,000
Address Medium Impact NPS Sites (91 sites) (-100 kg P/yr)							
A4	Fix NPS sites on medium impact residential properties *Goal: 23 sites* (Milestones: E1, P2)	Provide technical assistance to landowners with medium impact sites to install vegetative buffers, cover bare soil with ECM, install runoff diverters, and armor culvert inlets/outlets. Provide cost-sharing grants to help fund BMP installation.	SLA, Town of Newport, PCSWCD	Ongoing (Years 1-10)	H	US EPA (319), Maine DEP, landowners	$57,500
A5	Fix NPS sites on medium impact driveway sites *Goal: 9 sites* (Milestones: E1, P2)	Provide technical assistance to landowners with medium impact sites to install runoff diverters, reshape driveways, install plunge pools, and establish vegetative buffers. Provide cost-sharing grants to help fund BMP installation.	SLA, Town of Newport, PCSWCD	Ongoing (Years 1-10)	H	US EPA (319), Maine DEP, landowners	$45,000

Sebasticook Lake Watershed Action Plan (2025-2034)							
	Action	**How**	**Who**	**Schedule**	**Priority**	**Potential Funding Sources**	**Estimated Total Cost (10 years)**
A6	Fix NPS sites on medium impact town roads *Goal: 22 sites* (Milestones: E1, P2)	Work with the Town of Newport and other watershed towns to address medium impact sites on town roads by armoring culvert inlet/outlets, realigning or enlarging culverts, stabilizing ditches, installing ditch turnouts, and removing grader/plow berms. Provide cost-sharing grants to help fund BMP installation.	SLA, Watershed Towns, PCSWCD	Ongoing (Years 1-10)	H	US EPA (319), Maine DEP, watershed towns	$176,000
A7	Fix NPS sites on medium impact private roads *Goal: 16 sites* (Milestones: E1, S3, P2)	Provide technical assistance to road associations and landowners with medium impact sites to enlarge/replace culverts, armor culvert inlets/outlets, stabilize ditches, and resurface/reshape gravel roads. Provide cost-sharing grants to help fund BMP installation.	SLA, Town of Newport, PCSWCD	Ongoing (Years 1-10)	H	US EPA (319), Maine DEP, road associations, landowners	$128,000
A8	Fix NPS sites on medium impact state roads *Goal: 7 sites* (Milestones: E1, P2)	Work with DOT to address water quality issues on State roads including armoring culvert inlets/outlets, stabilizing ditches, and vegetating road shoulders. Provide cost-sharing grants to help fund BMP installation.	DOT, SLA, Town of Newport	Ongoing (Years 1-10)	H	US EPA (319), Maine DEP, watershed towns	$70,000
A9	Fix medium impact NPS sites on other land uses (municipal/public, beach access, trail or path, commercial, construction site) *Goal: 14 sites* (Milestones: E1, P2)	Provide technical assistance to landowners with medium impact sites to replace/enlarge culverts, armor culvert inlets/outlets, stabilize ditches, install runoff diverters, reshape/resurface trails (rail trail), and add/establish vegetative buffers. Provide cost-sharing grants to help fund BMP installation.	SLA, Town of Newport, PCSWCD	Ongoing (Years 1-10)	H	US EPA (319), Maine DEP, landowners	$70,000
Address Low Impact NPS Sites (29 sites) (-57 kg P/yr)							
A10	Fix low impact town road sites *Goal: 10 sites* (Milestones: E1, P2)	Work with the Town of Newport and other watershed towns to address low impact sites on town roads including realigning or enlarging	SLA, Watershed	Ongoing (Years 1-10)	M	US EPA (319), Maine DEP,	$30,000

Sebasticook Lake Watershed Action Plan (2025-2034)							
	Action	**How**	**Who**	**Schedule**	**Priority**	**Potential Funding Sources**	**Estimated Total Cost (10 years)**
		culverts, armoring culvert inlets/outlets, installing plunge pools, installing/reshaping/armoring ditches, and vegetating road shoulders. Provide cost-sharing grants to help fund BMP installation.	Towns, PCSWCD			watershed towns	
A11	Fix low impact sites on private roads and driveways *Goal: 6 sites* (Milestones: E1, P2)	Provide technical assistance to landowners with low impact sites including armoring culvert inlets/outlets, installing plunge pools, stabilizing ditches, removing plow berms, installing runoff diverters, and reshaping/resurfacing surface. Provide cost-sharing grants to help fund BMP installation.	SLA, Town of Newport, PCSWCD	Ongoing (Years 1-10)	M	US EPA (319), Maine DEP, landowners	$1,800
A12	Fix low impact sites on other land uses *Goal: 3 sites* (Milestones: E1, P2)	Provide technical assistance to landowners with low impact sites including removing clog in culverts and debris in ditches, reshaping ditches, and vegetating shoulder of rail trail. Provide cost-sharing grants to help fund BMP installation.	SLA, Town of Newport, PCSWCD	Ongoing (Years 1-10)	L	US EPA (319), Maine DEP, landowners	$4,500
A13	Work with residential property owners to address low-impact residential NPS sites *Goal: 10 sites* (Milestones: E1, P2)	Provide technical assistance to landowners with low impact sites including establishing/adding to shoreline buffer, spreading ECM on bare soil, installing a rain gardens, defining footpaths and runoff diverters. Provide cost-sharing grants to help fund BMP installation.	SLA, Town of Newport, PCSWCD	Ongoing (Years 1-10)	L	US EPA (319), Maine DEP, landowners	$20,000
A14	Encourage shorefront properties to get a LakeSmart evaluation *Goal: 3 evaluators trained, 20 new evaluations completed* (Milestones: S4, S5)	Recruit volunteers to be trained as LakeSmart evaluators. Set up a LakeSmart tracking spreadsheet to track evaluation requests and completed evaluations. Conduct outreach to shoreline landowners to encourage participation in the program and to offer site evaluations.	SLA	Ongoing (Years 1-10)	L	SLA, Maine Lakes	$5,000

Sebasticook Lake Watershed Action Plan (2025-2034)							
	Action	How	Who	Schedule	Priority	Potential Funding Sources	Estimated Total Cost (10 years)
Reduce NPS from Septic Systems (Upgrade 50% of old systems) (-44 kg P/yr)							
A15	Offer technical assistance to landowners with high risk systems. Goal: 15 free evaluations, 10 system designs (Milestones: E1, S4, S6)	Offer free septic evaluations and septic designs for high priority systems. Seek grants and local funding opportunities to fund evaluations and designs by local contractors.	SLA, Town of Newport	Years 3-5	H	Grants, SLA	$20,000
A16	Provide cost-share grants to assist landowners with replacing problem septic systems Goal: 10 systems (targeted outreach to landowners with systems >20 years old and/or failing or malfunctioning systems) (Milestones: E1, P5)	Seek funding opportunities including the DEP's Small Community Grants Program (SCG) and grants from local businesses and groups. Focus outreach on high priority systems. Target outreach about SCG opportunities to landowners who meet grant requirements.	SLA, Town of Newport	Years 5-8	H	Grants, landowners, SLA, Town of Newport	$80,000
A17	Prioritize the list of shoreland zone septic systems based on risk to water quality (E1)	Combine information from the septic survey and septic vulnerability analysis into the database to finalize the database. Use information about age and location of systems to prioritize outreach efforts.	SLA, Town of Newport	Years 1-2	M	Town of Newport, SLA	$1,500
A18	Provide incentives to encourage timely septic maintenance (Milestones: E1, S7)	Develop and implement a long-term septic inspection and pumping rebate program	SLA	Ongoing (Years 1-10)	L	SLA	$25,000
A19	Improve town ordinances and administrative capacity to track septic systems and ensure systems are installed to code (Milestones: P6)	Create a system for adequately tracking septic inspections conducted for all real estate transactions in the shoreland zone; this may include an ordinance that requires new homeowners to submit a copy of their inspection report to the town.	Town of Newport	Ongoing (Years 1-10)	L	Town of Newport	$15,000

Sebasticook Lake Watershed Action Plan (2025-2034)							
	Action	**How**	**Who**	**Schedule**	**Priority**	**Potential Funding Sources**	**Estimated Total Cost (10 years)**
Agriculture and Forestry (-649 kg P/yr)							
A20	Reduce P export from 44% (~ 2,100 acres) of agricultural land in the direct & indirect watershed, including cropland, hay, and pastures (Milestones: E1, S2, P1,)	Work with USDA and DEP to explore selection of a National Water Quality Initiative (NWQI) program. Implement conservation measures including manure management, installing gutters on buildings to divert runoff to a grass waterway, installing diversion ditches, upgrading irrigations systems, converting conventional row crops to no-till, implementing crop rotation and cover crop seeding, reduced tillage, split fertilizer applications.	USDA/NRCS, PCSWCD, agricultural producers	Ongoing (Years 1-10)	HH	USDA/NRCS, US EPA (319), Maine DEP	$1,250,000
A21	Reduce P export from feedlots (Milestones: E1, S2, P1)	Work with large producers to reduce NPS from feedlots by developing/updating manure management plans and closing in and/or installing manure storage and BMPs that reduce runoff such as diversion ditches (see F11).	USDA/NRCS, PCSWCD, large producers	Ongoing (Years 1-10)	HH	USDA/NRCSUS EPA (319), Maine DEP	$250,000
A22	Reduce P export from hobby farms (Milestones: E1, S2, P1,)	Conduct targeted outreach to hobby farms with educational information about nutrient management, riparian buffers, and other best management practices. Provide technical assistance to hobby farm owners to install BMPs on their properties.	SLA, Town of Newport, PCSWCD	Years 2-4 and ongoing	M	US EPA (319), USDA/NRCS, landowners	$50,000
A23	Reduce P export from timber harvests in the watershed (Milestones: E1)	Provide outreach to landowners regarding proper use of timber harvesting BMPs and conduct follow-up site visits for large harvests. Meet with District Forester to strategize on ways to reduce P runoff from timber harvests.	Maine Forest Service	Years 1-2 and ongoing	M	MFS	$500
						External Phosphorus Load Total	**$2,414,800**

Sebasticook Lake Watershed Action Plan (2025-2034)							
	Action	**How**	**Who**	**Schedule**	**Priority**	**Potential Funding Sources**	**Estimated Total Cost (10 years)**
B. Manage the Internal Phosphorus Load							
Annual Lake Drawdown							
B1	Improve timing of lake drawdown to closely target fall turnover and provide the highest possible phosphorus reduction benefits (current/ongoing P reduction of 800 - 1000 kg P/yr) (Milestones: E2)	Begin weekly temperature profile sampling in the first week of September to determine the timing of fall turnover and start the drawdown as soon as signs of turnover are detected. Consider initiating drawdowns during major summertime cyanobacteria blooms to flush out phosphorus that is brought to the surface by bottom-dwelling cyanobacteria.	Town of Newport, SLA	Year 1	HH	Town of Newport	$1,500
B2	Update current drawdown protocols (Milestones: E2)	Update existing drawdown management protocols to reflect recommendations from the WBMP while ensuring good communication with landowners in advance of drawdowns (e.g., provide 2 weeks' notice)	Town of Newport, SLA	Year 1	H	Town of Newport	$1,000
B3	Examine existing deep sediment cores collected in 1989 & 2009	Analyze available deep sediment cores to examine changes in P content and available P pre vs. post-development	SLA, Town of Newport, UMaine, SJ College	Year 2	L	SLA, grants	$5,000
						Internal Phosphorus Load Total	**$7,500**
C. Reduce New Sources of NPS Pollution							
Road Maintenance							
C1	Train town road crews and local contractors (Milestones: S4)	Ensure that town road crews and local contractors receive training and certification from Maine DEP in sediment and erosion control	Towns of Newport, Corinna, Dexter, Stetson, Exeter, Saint Albans,	Years 1-2 and ongoing	HH	Watershed towns, contractors, grants	$5,000

Sebasticook Lake Watershed Action Plan (2025-2034)							
	Action	**How**	**Who**	**Schedule**	**Priority**	**Potential Funding Sources**	**Estimated Total Cost (10 years)**
			Palmyra, local contractors				
C2	Work with landowners/road associations to conduct regular road maintenance on private gravel roads (Milestones: S3, S4)	Conduct regular outreach to landowners/road associations offering technical assistance to help identify problems or potential problems, and suggestions for improvements	SLA	Ongoing (Years 1-10)	H	SLA	$1,500
C3	Complete culvert upgrades where needed Conduct a culvert vulnerability assessment and replace undersized culverts	Work with watershed towns and the state to apply for grants to fund a vulnerability assessment and implement culvert upgrade projects, focusing on undersized culverts at risk of damage from large storm events	Watershed towns, DOT, PCSWCD	Years 3-8	H	Grants, watershed towns, Maine DEP, Maine DOT	$200,000
C4	Develop and maintain a culvert database	Create a database of stream crossings in the watershed and visit each culvert annually to identify new erosion issues or maintenance needs. Maintain a list of culverts that may be undersized and prioritize these for replacement.	Watershed towns	Year 1-2 and ongoing	M	Watershed towns	$25,000
C5	Work with town officials to minimize negative effects of winter sand and salt application (Milestone: S4)	Develop and implement a winter sand and salt application plan that includes guidance on how much sand and salt to use and when and where to apply to minimize excessive salt and sand use, along with guidance on road cleanup	Towns of Newport, Corinna, Dexter, Stetson, Exeter, Saint Albans, Palmyra	Ongoing (Years 1-10)	L	Town of Newport, watershed towns	$2,500
Future Development & Conservation							
C6	Work with landowners to protect 500 acres of undeveloped forest and	Work with local land trusts and conservation associations to prioritize land protection in the watershed, especially in tributary drainages	SLA, local land trusts	Years 1-5 and ongoing	H	Grants, donors	$3,000

Sebasticook Lake Watershed Action Plan (2025-2034)							
	Action	How	Who	Schedule	Priority	Potential Funding Sources	Estimated Total Cost (10 years)
	agricultural land throughout the watershed (Milestone: P8)	having with highest estimated P loading. Conduct outreach to landowners in high priority areas to encourage land conservation such as conservation easements.					
C7	Conduct a build-out analysis to quantify future development patterns and long-term P loading	Create a database of watershed parcels and their development status. Use information about parcel size, location, and zoning to assess the possibility and likelihood of the parcel being developed in the future.	SLA, watershed towns	Years 3-5	L	Grants, donors	$3,000
Municipal Planning/Ordinances							
C8	Increase accessibility to enforcement and public understanding of zoning and shoreland ordinances (Milestones: S1, S4)	Increase hours of part-time code enforcement to full-time in order to adequately monitor construction and enforce current ordinances. Ensure that all municipal ordinances, tax maps, and permitting information are available online for each watershed town to ensure that these documents are easily accessible to landowners.	Towns of Newport, Corinna, Dexter, Stetson, Exeter, Saint Albans, Palmyra	Ongoing (Years 1-10)	HH	Town of Newport, watershed towns	$200,000
C9	Expand municipal planning and Comprehensive Planning in the watershed (Milestones: S4, P6)	Work with all watershed towns to prepare up-to-date Comprehensive Plans to guide future development so that it is protective of water quality	Towns of Newport, Corinna, Dexter, Stetson, Exeter, Saint Albans, Palmyra	Years 1-3	H	Watershed towns, grants	$40,000
C10	Update standards for stormwater management for new development (Milestone: P6)	Incorporate/update references to the Maine Stormwater Management Design Manual Best Management Practices (Vol I & II) in existing development standards	Towns of Newport, Corinna, Dexter, Stetson, Exeter, Saint Albans, Palmyra	Years 1-3	H	Town of Newport, watershed towns	$5,000

Sebasticook Lake Watershed Action Plan (2025-2034)							
	Action	**How**	**Who**	**Schedule**	**Priority**	**Potential Funding Sources**	**Estimated Total Cost (10 years)**
C11	Update municipal ordinances to match state regulations about subsurface waste disposal systems and track system inspections (Milestone: P6)	Add language detailing the state mandated inspection requirements for subsurface waste disposal systems on properties in the Shoreland Zone (SLZ) by a certified inspector upon transfer of property to town ordinances. Require submission of septic inspection reports for town records and develop a database to track septic inspections.	Towns of Newport, Corinna, Dexter, Stetson, Exeter, Saint Albans, Palmyra	Years 1-3	H	Town of Newport, watershed towns	$5,000
C12	Expand standards to regulate Low Impact Development (LID) (Milestone: P6)	Develop a standards manual detailing Low Impact Development (LID) requirements and options for all new construction projects. Add LID design standards to new and existing ordinances where applicable (commercial, subdivision ordinances, etc.).	Towns of Newport, Corinna, Dexter, Stetson, Exeter, Saint Albans, Palmyra	Years 1-3	M	Watershed towns, grants	$10,000
C13	Revise ordinances to reduce P export from septic systems in the Shoreland Zone (Milestone: P6)	Require proof that septic systems have been installed to code when properties change from seasonal to year-round status, and requiring replacement if proof is not available. Create a permitting system and registration requirement for rental properties on the shoreline to minimize impacts from undersized septic systems. Improve town administration to digitize existing septic records and maintain records.	Towns of Newport, Corinna, Dexter, Stetson, Exeter, Saint Albans, Palmyra	Years 1-5	M	Town of Newport, watershed towns	$5,000
C14	Convene group/steering committee with towns to explore a watershed-wide P control ordinance for all new development (including single family residential units, roads,	Develop greater phosphorus controls for all construction projects in the Shoreland Zone (SLZ) of impaired waterbodies such as the Maine DEP per acre phosphorus allocations. Consider provisions for 3rd party site review,	Towns of Newport, Corinna, Dexter, Stetson, Exeter,	Years 3-5	L	Town of Newport, watershed towns	$10,000

Sebasticook Lake Watershed Action Plan (2025-2034)							
	Action	**How**	**Who**	**Schedule**	**Priority**	**Potential Funding Sources**	**Estimated Total Cost (10 years)**
	and seasonal to year-round conversions) (Milestone: P6)	and long-term maintenance as a requirement for building permits.	Saint Albans, Palmyra				
						Prevent New Sources of NPS Pollution Total	**$515,000**
D. Education, Outreach & Communications							
General Outreach							
D1	Develop an outreach strategy/communications committee to educate landowners about the effects of soil erosion (Milestone S11)	Meet annually to discuss plan objectives and develop strategies for community outreach that engages, landowners, school children, boaters, and residents	SLA, Town of Newport, interested stakeholders	Year 1 and ongoing	HH	SLA	$2,500
D2	Develop and maintain a WBMP web page for the public to access information about restoration strategies and progress	Add a page to the Sebasticook Lake Association website dedicated to updates on WBMP Progress. Link to the WBMP on the web page and provide updates on project tasks. Include links to the WBMP web page and regular project updates on partner websites.	SLA, Town of Newport	Ongoing (Years 1-10)	H	SLA, Town of Newport	$5,000
D3	Provide welcome packets to new property owners with water quality educational materials	Work with local realtors and towns to track property transfers and subdivisions and to distribute information about shoreland zoning laws. Send welcome packets that include information about ways to protect water quality and shoreland zoning regulations.	SLA, watershed towns	Ongoing (Years 1-10)	H	SLA, grants	$3,000
D4	Prepare and distribute press releases and newsletter articles about the project (Milestone: S11)	Prepare and distribute press releases and newsletter articles about watershed improvement activities, grant projects, and successful projects (Goal: 2/year). Distribute press releases to local newspapers and distribute newsletters through the SLA mailing	SLA	Ongoing (Years 1-10)	M	SLA	$5,000

Sebasticook Lake Watershed Action Plan (2025-2034)							
	Action	**How**	**Who**	**Schedule**	**Priority**	**Potential Funding Sources**	**Estimated Total Cost (10 years)**
		list, email lists, and local venues such as the cultural center.					
D5	Provide education to landowners about climate change adaptation (Milestone: S4)	Host climate change workshops or webinars to provide information about ways landowners can adapt to climate change and help protect water quality	Town of Newport, SLA, consultant	Years 2, 4, 7, 9	L	Grants	$10,000
Targeted Outreach							
D6	Send educational materials to landowners with NPS sites on their properties	Send outreach letters to landowners to share information about 2023 watershed survey results. Include educational materials about how erosion effects water quality.	SLA	Year 1	HH	SLA	$2,500
D7	Provide outreach to towns about NPS sites identified on town properties during the watershed survey (Milestone: P2)	Send outreach letters to towns to share information about 2023 watershed survey results	SLA, Town of Newport, watershed towns with NPS sites	Year 1	HH	SLA, watershed towns	$1,000
D8	Conduct outreach to road associations (Milestone: S3)	Meet with road associations with documented NPS problems on private roads to determine interest in future 319 grant cost-sharing opportunities and provide information about other educational opportunities (workshops) and strategies for maintaining roads to reduce erosion	SLA	Years 1-2	HH	SLA	$2,500

Sebasticook Lake Watershed Action Plan (2025-2034)							
	Action	**How**	**Who**	**Schedule**	**Priority**	**Potential Funding Sources**	**Estimated Total Cost (10 years)**
D9	Conduct outreach to farmers (Milestones: S2, P1)	Work with PCSWCD and USDA/NRCS to distribute information to help farmers reduce phosphorus from agricultural land in the watershed; Increase participation in NRCS agricultural programs through newspaper articles, NRCS sponsored workshops, and targeted outreach throughout the watershed (Goal: 5 new participating landowners).	SLA, PCSWCD, USDA/NRCS, towns	Years 2-5	HH	USDA/NRCS	$2,500
D10	Design a Buffer Campaign with easy to follow guidance/recipes for installing effective shoreline buffers (Milestones: S4, S8, P7)	Design and distribute a flyer about the importance of buffer plantings to watershed landowners. Offer incentives for buffer plantings such as discounted plants from a local nursery, or buffer bundles that landowners can buy and install.	SLA, Town of Newport	Years 2-3	M	SLA, grants	$10,000
D11	Provide watershed education in local schools (Milestone: S4)	Engage school-age children in watershed education through hands-on activities and workshops utilizing existing curriculums provided by statewide partners	SLA, PCSWCD, Maine Lakes	Years 2, 4, 6, 8	L	SLA, grants	$7,500
Workshops							
D12	Host ordinance workshops for landowners, developers, and realtors Goal: 3 workshops (Milestone: S4)	Host workshops or webinars to educate landowners, developers, and realtors about how shoreland zoning and ordinances affect what actions are permitted on shoreline properties. Conduct targeted outreach to these groups to advertise the workshops.	SLA	Years 2, 4, 6	HH	SLA, grants	$5,000
D13	Host biennial road workshops Goal: 4 workshops (Milestone: S4)	Host workshops for road associations, contractors, and town road crews to educate road managers about ways to reduce phosphorus loading from roads, culverts and	SLA, Town of Newport	Years 2, 4, 6, 8	H	SLA, Town of Newport, US EPA (319), Maine DEP	$14,000

Sebasticook Lake Watershed Action Plan (2025-2034)							
	Action	**How**	**Who**	**Schedule**	**Priority**	**Potential Funding Sources**	**Estimated Total Cost (10 years)**
		ditches in order to preserve water quality in streams and lakes (goal 1 every other year)					
D14	Host regular buffer workshops Goal: 3 workshops (Milestone: S4)	Host workshops to educate shoreline landowners about how and why to plant buffers and provide buffer planting demonstrations. Advertise workshops in newsletters and/or press releases.	SLA	Years 3, 5, 7	M	SLA, grants	$7,500
D15	Host septic workshops or webinars Goal: 2 workshops (Milestone: S4, S8)	Conduct workshops to educate shoreland zone landowners about proper maintenance of septic systems and the dangers of failing systems. Offer free septic inspections in conjunction with septic workshops.	SLA	Years 3, 5	M	SLA, grants	$5,000
Education, Outreach & Communications Total							**$83,000**

E. Build Local Capacity

Fundraising

E1	Develop a fundraising committee to help implement the plan (Milestone: S1)	Recruit volunteers to serve on a fundraising committee to find and apply for local, state, and federal grants to help implement water quality initiatives. Identify opportunities for improving fundraising through watershed towns and SLA and allocate funds towards water quality initiatives. Create a sustainable funding plan to pay for the cost of watershed implementation projects, erosion control program management, outreach and education, and long-term science and monitoring. Identify funding sources to hire a part-time watershed coordinator to oversee plan implementation.	SLA, Towns of Newport, Corinna, Dexter, Stetson, Exeter, Saint Albans, Palmyra	Year 1 and ongoing	HH	SLA	$2,500

Sebasticook Lake Watershed Action Plan (2025-2034)							
	Action	**How**	**Who**	**Schedule**	**Priority**	**Potential Funding Sources**	**Estimated Total Cost (10 years)**
E2	Apply for US EPA Clean Water Act Section 319 watershed implementation grants to address NPS sites Goal: 4 phases of 319 implementation projects (Milestone: P5)	Prepare and submit an application in year 1 of the plan (2025) for the first two-year round of funding (2026-2027). Additional applications should be submitted in 2027, 2030, and 2032 (see NPS Implementation Schedule).	SLA, Town of Newport	Ongoing (Years 1-10)	HH	SLA	$16,000
E3	Work with watershed towns to enroll in the State's Community Resiliency Partnership (CRP) (Milestone: P9)	Towns can enroll in the CRP program to become eligible for grants to fund climate change resiliency projects that help reduce phosphorus loading to the lake	fundraising committee, watershed towns	Years 1-3	HH	Watershed towns	$5,000
E4	Apply for other state, federal or private foundation grants that support planning recommendations (Milestone: P4)	Apply for additional grants as identified by the fundraising committee; SLA to consider applying for 501(c)(3) status.	SLA, fundraising committee	Years 2-10	H	Grants	$5,000
E5	Fundraise for septic system cost-sharing grants & septic rebate program (Milestone: S6)	Work with watershed towns to apply for the Small Community Grants (SCG) program to fund septic system installations for landowners. Seek additional funding to provide grants to landowners who don't qualify for SCG and consider tax rebates for landowners that submit pumping receipts.	SLA, watershed towns	Years 1-5	M	SLA, watershed towns	$1,500
Organizational Capacity							
E6	Hire a part-time watershed coordinator	Hire a part-time watershed coordinator to oversee implementation of WBMP and assist with grant writing	Town of Newport, SLA	Year 2	HH	Watershed towns, SLA, grants	$225,000
E7	Develop a Steering Committee to meet annually to discuss action items and goals (Milestone: S12, P3)	Recruit new potential Steering Committee members including town officials, local businesses, realtors, and septic inspectors who may have a diverse range of perspectives and skills to contribute to the project	SLA, watershed towns, interested stakeholders	Ongoing (Years 1-10)	HH	SLA	$3,000

Sebasticook Lake Watershed Action Plan (2025-2034)							
	Action	**How**	**Who**	**Schedule**	**Priority**	**Potential Funding Sources**	**Estimated Total Cost (10 years)**
Partnerships							
E8	Strengthen stakeholder relationships and bolster community support for restoration efforts (Milestones: S1, S4, S11)	Convene annual meetings with watershed towns, SLA, and other partner organizations. Attend regular Selectboard meetings to update towns about watershed activities and needs. Goal: Minimum 2 meetings/town/year	SLA, watershed towns	Ongoing (Years 1-10)	H	SLA, watershed towns	$2,500
E9	Build relationships with two local landscaping companies to increase capacity to do erosion control work in the watershed (Milestone: S4, P7)	Meet with area landscaping companies to discuss the goals of the project and gauge their interest and capacity to do erosion control work on the shoreline	SLA, Town of Newport	Years 2-4	M	SLA, Town of Newport	$500
E10	Seek opportunities for additional scientific research projects through academic institutions	Coordinate with academic institutions regarding ongoing scientific research projects	Town of Newport, SLA, University of Maine, St. Joseph's College	Ongoing (Years 1-10)	L	Watershed towns, SLA	$1,500
						Build Local Capacity Total	**$262,500**

F. Science - Conduct Long-Term Monitoring & Assessment							
Baseline Lake Monitoring							
F1	Continue bi-weekly volunteer in-lake water quality monitoring (Milestone: S13)	Continue collecting bi-weekly water quality data (SDT, DO/Temp) to inform long-term management actions (April-October).	SLA, Town of Newport	Ongoing (Years 1-10)	HH	SLA, Town of Newport, private donors, grants	$15,000
F2	Collect annual in-lake chemistry data including TP and Chl-a (Milestone: S13)	Collect epicore TP, Chl-a, and a TP bottom grab monthly July-Sept (more frequently if funding is available)	SLA, Town of Newport	Ongoing (Years 1-10)	HH	SLA, Town of Newport, private donors, grants	$20,000

Sebasticook Lake Watershed Action Plan (2025-2034)							
	Action	**How**	**Who**	**Schedule**	**Priority**	**Potential Funding Sources**	**Estimated Total Cost (10 years)**
F3	Recruit volunteers to assist with monitoring program (Milestone: S10, S13)	Build capacity for bi-weekly sampling by recruiting and training new volunteers to help with monitoring; train high school students to monitor rain events.	SLA, Town of Newport	Ongoing (Years 1-10)	H	SLA, Town of Newport, private donors, grants	$2,500
F4	Monitor the extent of winter anoxia and TP loading from the sediments during winter (Milestone: S13)	Conduct winter sampling for DO/Temp and P samples during ice-on to collect under ice profiles	SLA, Town of Newport	Ongoing (Years 1-10)	H	SLA, Town of Newport, private donors, grants	$1,500
F5	Install permanent monitoring buoy	Install a continuous monitoring buoy at Station 1 to collect DO/Temp data to assist with determining changes in stratification and timing of drawdown	SLA, Town of Newport, UMaine	Year 2 and ongoing	M	SLA, Town of Newport, private donors, grants	$15,000
F6	Monitor zooplankton and phytoplankton throughout the summer months (Milestone: S13)	Collect at least 5 years of monthly plankton samples through the summer to get a baseline of the plankton community. Collect weekly phytoplankton samples during bloom periods, and collect zooplankton samples quarterly in late May and August, or composited monthly to get 3-4 samples/year to build a baseline	SLA, Town of Newport	Years 1-5	M	SLA, Town of Newport, private donors, grants	$7,500
F7	Collect TP profiles monthly through the summer (Milestone: S13)	Collect TP profile grabs from surface to depth to track changes in TP through the water column at least once a month from June-October	SLA, Town of Newport	Ongoing (Years 1-10)	L	SLA, Town of Newport, private donors, grants	$27,000
F8	Expand DO and TP monitoring (Milestone: S13)	Collect DO/Temp profiles and TP profiles at shallower locations at least twice annually to help understand spatial differences in DO and TP levels throughout different areas of the lake	SLA, Town of Newport	Ongoing (Years 1-10)	L	SLA, Town of Newport, private donors, grants	$1,000
F9	Continue collecting annual conductivity data to examine long-term trends (Milestone: S13)	Collect at least one conductivity sample annually in August	SLA, Town of Newport	Ongoing (Years 1-10)	L	SLA, Town of Newport, private donors, grants	$750

Sebasticook Lake Watershed Action Plan (2025-2034)							
	Action	**How**	**Who**	**Schedule**	**Priority**	**Potential Funding Sources**	**Estimated Total Cost (10 years)**
NPS Pollution							
F10	Maintain an NPS Site Tracker (Milestone: P2)	Set up an NPS Site Tracker including the watershed survey sites & update annually	SLA, Town of Newport, consultant	Ongoing (Years 1-10)	HH	SLA, Town of Newport	$5,000
F11	Determine the current state of feedlots in the Sebasticook Lake watershed	Determine extent of feedlots in the direct and indirect watersheds, the management strategies being used at these sites, and the potential for NPS pollution from them	PCSWCD, watershed towns	Year 1	HH	SLA, watershed towns	$5,000
F12	Determine the current state of manure management practices	Gain a better understanding of manure management in the watershed including the extent of spreading on hay fields, inputs from cows/horses near tributary streams and/or the lake, and manure washing off roads	PCSWCD, USDA/NRCS, watershed towns	Years 1-3	HH	PCSWCD, USDA/NRCS, watershed towns	$2,500
F13	Conduct regular watershed survey updates	Conduct an informal watershed survey for new NPS sites 5 and 10 years after last survey	SLA, Town of Newport	Years 5 and 10	M	SLA, Town of Newport	$10,000
F14	Document buffer quality on the Sebasticook Lake shoreline	Complete a survey of buffers by collecting GIS-based shoreline photos (or drone images) from the water. Shoreline photos can be used to track changes and assist with compliance in the shoreland zone.	Town of Newport, SLA	Years 3-5	M	Town of Newport, SLA	$10,000
Stream Monitoring							
F15	Collect water quality data at targeted stream outlets to quantify P load from streams under different conditions throughout the year	Focus on storm sampling from concentrated agricultural areas, especially feedlots - monitor flow and collect P samples during storms. Consider use of passive samplers to collect samples during storm flows at these sites	SLA, Town of Newport, consultant	Years 1-10 (Create 3-year baseline)	HH	Grants, SLA	$13,500
F16	Set up a volunteer "stream watchers" program (Milestone: S13)	Train volunteer "stream watchers" to take pictures during storms or install game cameras; set up online repository for uploading photos; work with Maine DEP to train volunteers on how	Maine DEP, SLA, volunteers	Years 1-4	L	Grants, SLA	$3,000

Sebasticook Lake Watershed Action Plan (2025-2034)							
	Action	**How**	**Who**	**Schedule**	**Priority**	**Potential Funding Sources**	**Estimated Total Cost (10 years)**
		to collect storm samples to expand stream sampling capacity.					
Invasive Plants & HABs & Other Algae							
F17	Develop programs to prevent the spread of invasive aquatic plants in Sebasticook Lake (e.g., CBI, volunteer invasive plant surveys, etc.) (Milestone: S10)	Train volunteers to identify and monitor for invasive plants. Conduct regular invasive plant patrols led by volunteers to support early detection of new invasive species. Start a Courtesy Boat Inspection (CBI) program on Sebasticook Lake to prevent the introduction of new invasive species from boats coming into the lake.	SLA, Town of Newport	Ongoing (Years 1-10)	HH	SLA, Town of Newport, Maine Lakes	$10,000
F18	Initiate a volunteer cyanotoxin monitoring program (Milestone: S13)	Coordinate with the Maine Cyanobacteria Collective for ongoing testing materials and test for toxins during algae blooms	SLA, Town of Newport	Ongoing (Years 1-10)	M	SLA, Maine DEP	$5,000
F19	Survey for metaphyton in the littoral zone to create a baseline (Milestone: S13)	Train volunteer monitors to use the Lake Stewards of Maine's Metaphyton Tracking Form. Organize a survey effort to measure the current extent of metaphyton in the lake.	SLA	Year 2	L	SLA	$1,500
F20	Improve management of terrestrial invasive plant species in the Sebasticook Lake Watershed (Milestone: S10)	Distribute educational materials about management tools/best practices for identifying and removing invasive terrestrial plants on the shoreline	SLA	Years 5-10	L	SLA	$2,000
Water Level/Other							
F21	Conduct monitoring during drawdowns to better quantify the removal of phosphorus from Sebasticook Lake (Milestone: E2, E5)	Measure flow and phosphorus at the dam at least weekly once drawdown begins in the fall	SLA, Town of Newport	Year 1 and ongoing	M	Town of Newport	$3,000
F22	Monitor water level at the dam	Install continuous water level monitoring systems at the dam to document water level changes and track drawdowns	Town of Newport, SLA	Ongoing (Years 1-10)	M	Town of Newport	$7,500

Sebasticook Lake Watershed Action Plan (2025-2034)							
Action		How	Who	Schedule	Priority	Potential Funding Sources	Estimated Total Cost (10 years)
F23	Test for PFAS in Sebasticook Lake	Follow-up with Maine DEP regarding PFAS testing results for water and fish tissue sampling	Maine DEP, SLA, volunteers	Years 1-2	H	Maine DEP, SLA	$500
Conduct Long-Term Monitoring & Assessment Total							**$168,750**
Sebasticook Lake WBMP Project 10-Year Grand Total							**$3,451,550**

8. Monitoring Activity, Frequency and Parameters

Maine water quality standards require Sebasticook Lake to have a stable or improving trophic state and be free of culturally induced algal blooms. Measuring the water quality of the lake is a necessary component of successful watershed planning because results can be used to evaluate the effectiveness of watershed management measures. If improvements in water clarity, P, or other parameters are evident or if water quality is stable, then planning objectives are being met. If water quality gets worse, then additional management strategies may be needed.

Filamentous algae growing on rocks near the shoreline of Sebasticook Lake. (Photo credit: SLA)

FUTURE BASELINE MONITORING

An assessment of existing water quality monitoring data in Sebasticook Lake was completed as part of the water quality analysis (1972-2023). The steering committee decided that ongoing annual monitoring efforts conducted by SLA should continue over the next 10 years in order to assess and track annual changes in water quality and the effects of actions to reduce P loading in the lake. Future monitoring should include, at a minimum, the four high and very high priority actions described in Table 16F. Medium and low priority monitoring actions should be added as deemed necessary to determine the effectiveness of plan implementation.

NPS POLLUTION

Additional NPS assessments following the 2023 Watershed Survey will be necessary for preventing new sources of NPS from getting into the lake, protecting water quality, and protecting the investments made to address current sources of P in the lake. Five actions are included in Table 16F to continue tracking NPS pollution in the watershed over the next 10 years.

STREAM MONITORING

The data currently available for streams in the Sebasticook Lake watershed are scattered and do not provide a comprehensive picture of P inputs from watershed streams, and do not target storm flows. Expanding stream monitoring to target basins with the highest areal P loading and to specifically quantify P levels during storm flows will improve our understanding of P loading from streams in the Sebasticook Lake watershed. Targeted stream monitoring should be prioritized for understanding the influence of large feedlots on downstream water quality (refer to Action F15 in Table 16).

AQUATIC INVASIVE PLANTS & HABs

In a eutrophic lake with a large littoral zone like Sebasticook Lake, keeping aquatic invasive plants (AIP) out of the lake is a high priority. Table 16F includes four actions to help prevent the introduction of AIP, and to monitor the presence of Harmful Algal Blooms (HABs). Other recommended monitoring actions focus on tracking water level at the dam, tracking the success of P removal through annual drawdowns, and testing for PFAS in the Sebasticook Lake.

9. Measurable Milestones, Indicators & Benchmarks

The following section provides a list of interim, measurable milestones to document progress in implementing management strategies outlined in the action plan (Section 8). These milestones are designed to help keep project partners on schedule. Additional criteria are outlined to measure the effectiveness of the plan by documenting loading reductions and changes in water quality over time thus providing the means by which the steering committee can reflect on how well implementation efforts are working to reach established goals.

Photo Credit: Maine DEP

Environmental, social, and programmatic indicators and proposed benchmarks represent short-term (1-2 years), mid-term (3-5 years), and long-term (6-10 years) targets for restoring the water quality in Sebasticook Lake. The steering committee will review the criteria for each milestone annually to determine if progress is being made, and then determine if the watershed plan needs to be revised if targets are not being met. This may include updating proposed management practices and the loading analysis, and/or reassessing the time it takes for phosphorus concentrations to respond to watershed and in-lake management strategies.

The high percentage of P loading from the direct and indirect watersheds of Sebasticook Lake makes it imperative to address the external watershed load before taking actions to address the internal load. However, actions to reduce the watershed load will result in smaller and less noticeable changes in lake trophic state, compared to an in-lake treatment with aluminum salts (i.e. alum treatment) which is expected to result in immediate noticeable changes in water quality, but at a great expense, and for a relatively short-period of time for the cost. For these reasons, and because of feedback from local stakeholders to focus on addressing the watershed load, the alum treatment was not included in the action plan or cost estimates for the 10-year plan, but may need to be considered in future planning phases to continue to restore water quality in Sebasticook Lake. **Actions outlined in the 10-year action plan to reduce the external P load support the long-term stabilization of the trophic state in Sebasticook Lake in the face of threats from current development, future development, and climate change.**

Environmental Milestones are a direct measure of environmental conditions. They are measurable quantities used to evaluate the relationship between pollutant sources and environmental conditions. Table 17 outlines the water quality benchmarks, and interim targets for improving the water quality in Sebasticook Lake over the next 10 years.

Social Milestones measure changes in social or cultural practices and behavior that lead to implementation of management measures and water quality improvements. Table 16 outlines the social indicators, benchmarks, and interim targets for the Sebasticook Lake WBMP.

Programmatic Milestones are indirect measures of watershed protection and improvement activities. Rather than indicating that water quality reductions are being met, these programmatic measurements list actions intended to meet the water quality goal. Table 19 outlines the programmatic indicators, benchmarks, and interim targets for the Sebasticook Lake WBMP.

Table 17. *Water quality benchmarks and interim targets for Sebasticook Lake.*

Environmental Milestones			
Water Quality Benchmarks	***Interim Targets****		
	Years 1-2	*Years 3-5*	*Years 6-10*
1) P loading reductions from external sources (471 direct watershed, 485 indirect watershed, 44 kg septic systems) **Current:** 6286 kg/yr **Goal:** 5286 kg P/yr (reduce by 1000 kg P/yr)	6086 kg/yr *(▼200 kg/yr)*	5786 kg/yr *(▼500 kg/yr)*	5286 kg/yr *(▼1000 kg/yr)*
2) Decrease average in-lake TP concentration **Current:** 21.7 ppb **Goal:** 18.2 ppb	21.5 ppb *(▼0.2 ppb)*	20 ppb *(▼1.7 ppb)*	18.2 ppb *(▼3.5 ppb)*
3) Increase in average water clarity **Current:** 2.7 m **Goal:** 3.0 m (increase by 0.3 m)	2.7 m *(▲0.1 m)*	2.8 m *(▲0.2 m)*	3.0 m *(▲0.3 m)*
4) Decrease in Chl-a **Current:** 11.3 ppb **Goal:** 9.6 ppb (reduce by 1.7 ppb)	11.1 ppb *(▼0.2 ppb)*	10.6 ppb *(▼0.7 ppb)*	.85 ppb *(▼1.7 ppb)*
5) Decrease algal bloom probability **Current:** 43% **Goal:** 27% (reduce by 16%)	40% *(▼3%)*	35% *(▼8%)*	27% *(▼16%)*

** Benchmarks are cumulative unless otherwise noted. Years 1-2 (2025-2026); Years 3-5 (2027-2029); Years 6-10 (2030-2034). (▲▼) arrows indicate a change in water quality up or down over the planning period.*

Table 18. Social indicators, benchmarks, and interim targets for Sebasticook Lake.

Social Milestones			
Indicators	***Benchmarks & Interim Targets****		
	Years 1-2	*Years 3-5*	*Years 6-10*
1) Number of community meetings organized (alum, realtors, homeowner associations, etc.)	2 meetings	3 meetings *(5 total)*	5 meetings (10 *total)*
2) Number of new participating agricultural landowners participating in NRCS programs	2	5	10
3) Number of road associations addressing NPS pollution on private road sites	2 participating road assoc.	5 participating road assoc.	8 participating road assoc.
4) Number of educational workshops held (gravel roads, buffers, LakeSmart, septic, climate change, ordinance)	3 workshops	8 workshops	16 workshops

Social Milestones			
Indicators	***Benchmarks & Interim Targets****		
	Years 1-2	*Years 3-5*	*Years 6-10*
5) Number of LakeSmart evaluations completed **Goal:** 20 new evaluations completed	3 evaluations	10 evaluations	20 evaluations
6) Number of landowners participating in septic system incentive program **Goal:** 15 evaluations, 10 septic designs, 10 upgrades	-	15 evaluations, 10 designs, 5 upgrades	5 upgrades
7) Number of landowners participating in septic pumping rebate program **Goal:** 25 rebates	5 rebates	10 rebates (15 total)	10 rebates (25 total)
8) Number of landowners planting buffers on the shoreline	10	20	40
9) Number of people viewing online video series	50 views	250 views	1,000 views
10) Number of trained volunteers monitoring for invasive aquatic plants	2	4	6
11) Number of press releases and newsletter articles distributed **Goal:** 2/year	4	10	20
12) Number of new Steering Committee members participating in WBMP Implementation	1	2	3
13) Number of trained volunteer water quality monitors	2	3	4

** Benchmarks are cumulative unless otherwise noted. Years 1-2 (2025-2026); Years 3-5 (2027-2029); Years 6-10 (2030-2034).*

Programmatic Milestones are indirect measures of watershed protection and improvement activities. Rather than indicating that water quality reductions are being met, these programmatic measurements list actions intended to meet the water quality goal. Table 19 (below) outlines the programmatic indicators, benchmarks and interim targets for the Sebasticook Lake WBMP.

Table 19. *Programmatic indicators, benchmarks, and interim targets for Sebasticook Lake.*

Programmatic Milestones			
Indicators	***Benchmarks & Interim Targets****		
	(Years 1-2)	*(Years 3-5)*	*(Years 6-10)*
1) Percentage of agricultural land addressed in the direct and indirect watershed	8%	20%	44%
2) Number of NPS sites addressed **Goal:** 17 high impact, 91 medium impact, and 29 low impact NPS sites (137 total)	20 sites	50 sites *(70 total)*	67 sites *(137 total)*
3) Number of steering committee meetings **Goal:** 1 meeting/year	2 meetings (2 total)	3 meetings *(5 total)*	5 meetings *(10 total)*
4) Amount of money spent on plan implementation. **Goal:** $3,45M	$500k	$1M *($1.5M total)*	$1.95M *($3.2M total)*

Programmatic Milestones			
Indicators	***Benchmarks & Interim Targets****		
	(Years 1-2)	*(Years 3-5)*	*(Years 6-10)*
5) Number of CWA Section 319 grants awarded **Goal:** Four 319 grants	1 grant	2 grants	4 grants
6) Number of new or revised ordinances passed that help protect water quality **Goal:** 5 ordinance updates	2 ordinances	4 ordinances	5 ordinances
7) Number of local nurseries/landscape centers providing discounts for buffer plantings	-	1	2
8) Amount of new land in permanent conservation **Goal:** 500 acres	50 acres	200 acres	250 acres
9) Number of watershed towns enrolled in the State's Climate Resiliency Partnership **Goal:** 5 towns	1 town	3 towns	5 towns

** Benchmarks are cumulative unless otherwise noted. Years 1-2 (2025-2026); Years 3-5 (2027-2029); Years 6-10 (2030-2034).*

POLLUTANT LOAD REDUCTIONS & COST ESTIMATES

The following pollutant load reductions and costs were estimated for the 10-year planning cycle beginning in 2025 based on six primary planning objectives outlined in the action plan:

Table 20. Sebasticook Lake planning objectives, P load reduction targets & cost.

Planning Objective	Planning Action (2022-2032)	P Load Reduction Target[1]	Cost[2]
A	**Reduce the External P Load** (Agriculture, timber harvesting, NPS sites, septic systems, LakeSmart, buffer campaign)	1000 kg/yr	$2,414,800
B	**Manage the Internal Load** (Improved drawdown protocols, additional sediment analysis)	800-1000 kg/yr	$7,500
C	**Reduce New Sources of NPS Pollution** (NPS sites, culvert upgrades, land conservation, ordinance updates, training for public works, enforcement of SLZ rules, climate change adaptation)	n/a	$515,000
D	**Education, Outreach & Communications** (Public meetings, town meetings, online videos, aluminum treatment outreach, targeted outreach, workshops)	n/a	$83,000
E	**Build Local Capacity** (Funding plan, steering committee, grant writing, relationship building- including town government, contractors and scientists)	n/a	$262,500
F	**Long-Term Monitoring & Assessment** (Baseline monitoring, NPS pollution, streams/dam monitoring, invasive plants, etc.)	n/a	$168,750
	Target P Reduction	**1000 kg/yr**	**$3,451,550**

[1] The annual fall drawdown has been effective at removing between 800 – 1000 kg of phosphorus from Sebasticook Lake each year based on historical water quality data. This long-term strategy to reduce internal loading has been slow, but effective at improving water quality at a low-cost to the community. The total P load reduction target of 1000 kg/yr in this 10-year plan is exclusive of the P load reductions resulting from the ongoing annual drawdown.

[2] The cost of implementing the plan can be further divided into three funding categories: outside funding/grants, local funding/landowner contributions, and in-kind volunteer contributions. Outside contributions are expected to account for 58% of the total cost (~$2M) compared to 28% local funding (~$1.32M) and 4% in-kind match (~$130K).

Actual pollutant load reductions will be documented as work is completed as outlined in this plan. This includes reductions for completed NPS sites to help demonstrate phosphorus and sediment load reductions as the result of BMP implementation. Pollutant loading reductions will be calculated using methods approved and recommended by Maine DEP and the US EPA and reported to Maine DEP for any work funded by 319 grants using an NPS site tracker.

10. Plan Oversight, Partner Roles, and Funding

PLAN OVERSIGHT

Implementation of a 10-year watershed plan cannot be accomplished without the help of a central organization to oversee the plan, and a diverse and dedicated group of project partners and the public to support the various aspects of the plan. The following organizations will be critical to the plan's success and are excellent candidates for the watershed plan steering committee. The committee will need to meet at least annually to update the action plan, to evaluate the plan's success, and to determine if the water quality goal is being met.

PARTNER ROLES

Town of Newport will oversee plan implementation and plan updates in coordination with project partners. The town will serve on the watershed steering committee, and may provide funding for water quality monitoring, match for watershed improvement projects, and 319 grant management and administration. The town will also play a key role in addressing any documented NPS sites on town roads and municipal/public property, providing training and education for municipal employees, community outreach, and support initiatives to reduce inputs from septic systems, and improving ordinances to be more protective of water quality locally and regionally.

Sebasticook Lake Association (SLA) will serve on the steering committee, provide ongoing education and outreach throughout the watershed, assist with fundraising efforts, provide volunteers for water quality monitoring, and serve as a liaison between watershed residents, the town, and technical advisors.

Penobscot County Soil & Water Conservation District (PCSWCD) will serve on the steering committee and support education and outreach efforts to landowners and agricultural producers in partnership with USDA/NRCS and other watershed partners.

Maine Lakes may provide support to the SLA to start a LakeSmart Program at Sebasticook Lake. This includes initial training for interested volunteers and ongoing program support.

USDA/Natural Resources Conservation Service (NRCS) will provide education and outreach including hosting workshops for agricultural producers, provide technical and financial assistance to agricultural producers in the watershed, and help initiate National Water Quality Initiative (NWQI) funding for agricultural producers in the watershed.

Landowners and Road Associations will address documented NPS sites on their properties and provide a private source of matching funds by contributing to fundraising efforts and participating in watershed projects and LakeSmart.

Maine Department of Environmental Protection will provide watershed partners with ongoing guidance, technical assistance and resources, and the opportunity for financial assistance through grants including the US EPA's 319 grant program. Maine DEP will also serve on the steering committee.

Towns of Corinna, Dexter, St. Albans, Exeter, and Stetson will serve on the watershed steering committee, address any documented NPS sites on town roads and municipal/public property, provide training and education for municipal employees, support long-term monitoring of upstream lakes, and improve ordinances to be more protective of water quality locally and regionally.

US Environmental Protection Agency will provide guidance on grant programs particularly Clean Water Act Section 319, work plan guidance, and selected project funding, pending acceptability of grant proposals, final workplans and availability of federal funds.

ACTION PLAN IMPLEMENTATION & FUNDING

The Watershed Plan Steering Committee, led by the Town of Newport, will develop and coordinate a sustainable fundraising plan and will coordinate and implement the proposed action plan. Expected partners are towns in the direct and indirect watersheds, SLA, PCSWCD, USDA/NRCS, Maine DEP, landowners, businesses, road associations, and private donors. Many of these partners have worked together for over 40 years to help improve water quality in Sebasticook Lake.

There are a number of opportunities for acquiring funding to support implementation of the watershed restoration plan. The list below contains a few of the better-known State and Federal funding options. Additional support from private foundation grants, local fundraising efforts, monetary contributions by participating landowners, and financial support from municipal partners will be needed to adequately fund this plan.

- **Land for Maine's Future Program** – Funding for land conservation that provides multiple public and natural resource benefits: https://www.maine.gov/dacf/lmf/
- **Maine DEP Courtesy Boat Inspection (CBI) Program Grants** – A cost-share program to help fund locally-supported CBI program: https://www.maine.gov/dep/water/grants/invasive/index.html
- **Maine DEP Invasive Aquatic Plant Removal Grants** – Administered by Maine DEP to assist communities planning and managing removal of invasive aquatic plant infestations: https://www.maine.gov/dep/water/grants/invasive/index.html
- **Maine DEP Lake Restoration Grants Program** – In 2024, Maine DEP announced a new grant for restoration of lakes using an in-lake aluminum treatment. Up to $200,000 in grant funding was available in the first year of the program. Funds are administered by the DEP Lake's Assessment Section.
- **Maine DEP Small Community Grant Program (SCG)** – Administered by Maine DEP, this program provides grants to Municipalities to help replace malfunctioning septic systems that are polluting a waterbody or causing a public nuisance: https://www.maine.gov/dep/water/grants/scgp.html
- **Maine DEP Stream Crossing Upgrade Grant Program** – A competitive grant program for the upgrade of municipal culverts and stream crossings that improve fish and wildlife habitats and

improve community safety: https://www.maine.gov/dep/land/grants/stream-crossing-upgrade.html

- **Maine DOT's Municipal Partnership Initiative (MPI)** – This program funds projects of municipal interest on state infrastructure working with Maine DOT as a partner to develop, fund, and build the project: https://www.maine.gov/mdot/pga/
- **Maine Governor's Office of Policy Innovation and the Future (GOPIF)** – Two types of grants are offered including Community Action Grants to support projects that reduce energy use and costs and/or make their community more resilient to climate change effects, such as flooding, extreme weather, drought, and public health impacts: https://www.maine.gov/future/climate/community-resilience-partnership/grants
- **Maine Natural Resource Conservation Program (MNRCP)** – A cooperative program between Maine DEP and US Army Corps of Engineers, administered by The Nature Conservancy, funding the restoration, enhancement, preservation, and creation of wetland habitat: https://www.maine.gov/dep/land/nrpa/ILF_and_NRCP/index.html
- **US EPA Clean Water Act (Section 319) Watershed Nonpoint Source (NPS) Grant Program** – Administered by Maine DEP, federal CWA 319 grants from EPA assist communities implementing a Watershed-Based Plan for waters named on Maine DEP's NPS Priority Watershed List: https://www.maine.gov/dep/water/grants/319.html
- **US EPA/Maine Clean Water State Revolving Fund (CWSRF)** – Provides financial assistance for a wide range of water infrastructure projects including control of nonpoint sources of pollution, and other water quality projects: https://www.epa.gov/cwsrf/learn-about-clean-water-state-revolving-fund-cwsrf
- **USDA/NRCS Financial Assistance** – NRCS offers voluntary programs to eligible landowners and agricultural producers to provide financial and technical assistance to help manage natural resources including financial assistance to help plan and implement conservation practices that address natural resource concerns or opportunities to help save energy, improve soil, water, plant, air, animal and related resources on agricultural lands and non-industrial private forest land: https://www.nrcs.usda.gov/wps/portal/nrcs/main/me/programs/financial/
- **USDA/NRCS National Water Quality Initiative (NWQI)-** The NWQI is a partnership between NRCS, Maine DEP, and the US EPA to identify and address impaired waterbodies through voluntary conservation efforts. NRCS provides funding and technical assistances to farmers to install conservation practices that help reduce erosion and lessen nutrient runoff in order to benefit natural resources while also enhancing agricultural profitability: https://www.nrcs.usda.gov/programs-initiatives/national-water-quality-initiative

11. References

Boyle, K., and Bouchard, R. (2003). Water Quality Effects on Property Prices in Northern New England. Lakeline 23(3), pp. 24-27.

Deeds, Jeremy, Aria Amirbahman, Stephen A. Norton & Linda C. Bacon (2020); A hydrogeomorphic and condition classification for Maine, USA, lakes, Lake and Reservoir Management: https://doi.org/10.1080/10402381.2020.1728597.

Dexter Utility District (2020). *2020 Annual Drinking Water Quality Report*. Accessed online: October 25, 2024: https://www.dextermaine.org/_files/ugd/f93c92_fee0615ad0b84b718e2e27485e878739.pdf

Ecological Instincts (2023a). *Sebasticook Lake Watershed Survey Report*. Prepared for the Town of Newport, October 2023. 46 pp.

Ecological Instincts (2023b). *2022 Sebasticook Lake Septic System Vulnerability Analysis.* Prepared for the Town of Newport, December 2023. 11 pp.

Ecological Instincts (2024a). *Sebasticook Lake Water Quality Monitoring Memo.* Prepared for Maine DEP and Town of Newport, October 2024. 28 pp.

Ecological Instincts (2024b). *Sebasticook Lake Watershed Model Spreadsheet & Memo.* Prepared for Maine DEP and Town of Newport, October 29, 2024. 26 pp.

Ferwerda, J.A., LaFlamme, K.J., Kalloch, N.R., and Rourke, R.V. (1997). *The Soils of Maine*. Maine Agricultural and Forest Experiment Station, University of Maine, Miscellaneous Report 402.

King, W. and Laliberte D.P. (2005). *Analysis of the Effects of Gloeotrichia echinulata on Great Pond and Long Pond, Maine*. May 12, 2005. Accessed online March 15, 2022, http://www.colby.edu/chemistry/Gloeotrichia/Gloeotricia%20Review%202005.pdf

Mackenthun, K.M., L.E. Keup and R.K. Stewart. (1968). Nutrients and algae in Sebasticook Lake, Maine. Water Pollut. Control Fed. pp. 72-81.

Maine Lakes Environmental Association (LEA). Invasive Aquatic Plants in Maine. Access online October 25, 2024: https://mainelakes.org/invasives/invasive-aquatic-plants-in-maine/

Maine Audubon (2023). *Loon Counts: Maine, 1983-2023*. Maine Audubon. Accessed online: https://www.gulfofmaine.org/kb/2.0/record.html?recordid=9175

Maine Audubon (2006). *Conserving Wildlife in Maine's Shoreland Habitats*. Maine Audubon. Accessed online March 15, 2022: https://www.maine.gov/ifw/docs/MEAud-Conserving-Wildlife-Shoreland-Habitats.pdf

Maine DEP (2019). Understanding the Vulnerability of Maine Lakes to Invasive Aquatic Plants. Access online: October 25, 2024: https://www.maine.gov/dep/water/invasives/vulnerability.html

Maine DEP (2022). Integrated Water Quality Monitoring and Assessment Report. Accessed online: https://www.epa.gov/system/files/documents/2022-06/2018-2022-me-integrated-report.pdf

Maine DHHS and Maine CDC (2022). *Frequently Asked Questions: PFAS in Recreationally Caught Freshwater Fish*. May 2022. Accessed online October 24, 2024: https://www.maine.gov/dhhs/mecdc/environmental-health/eohp/fish/documents/fish-advisory-faq-05052022.pdf

Maine CDC (2024). *PFAS in Public Water Systems*. Accessed online November 6, 2024: https://www.maine.gov/dhhs/mecdc/environmental-health/dwp/pws/pfas.shtml

Maine Inland Fisheries and Wildlife. *Annual Fish Stocking Report*. Accessed online October 23, 2024: https://www.maine.gov/ifw/docs/2023%20Annual%20Fish%20Stocking%20Report.pdf

Maine Inland Fisheries and Wildlife (2024). *Freshwater Fish Safe Eating Guidelines*. Accessed online, November 2024: https://www.maine.gov/ifw/fishing-boating/fishing/laws-rules/consumption-advisory.html

Maine Revised Statutes, §465-A. *Standards for classification of lakes and ponds*. Accessed online March 15, 2022, http://legislature.maine.gov/statutes/38/title38sec465-A.html

Maine State Economist (2024a). *Total Population in the State, Counties, and County Subdivisions. 2020 Census Results.* Accessed online September 6, 2024: https://www.maine.gov/dafs/economist/sites/maine.gov.dafs.economist/files/inline-files/Total%20Population_2020_3.xlsx

Maine State Economist (2024b). *Maine State and County Population Projections 2040. Demographic Projections – Data Files.* Accessed online September 6, 2024: https://www.maine.gov/dafs/economist/sites/maine.gov.dafs.economist/files/inline-files/MaineStateCountyPopulationProjections2040.pdf

MCC. (2020). *Scientific Assessment of Climate Change and Its Effects in Maine*. Maine Climate Council Scientific and Technical Subcommittee. August 2020. 130 pp. https://www.maine.gov/future/sites/maine.gov.future/files/inline-files/GOPIF_STS_REPORT_092320.pdf

NRCS (2024). *Forty Year Partnership Effort Improves Water Quality in Sebasticook Lake*. USDA/Natural Resources Conservation Service. March 28, 2014.

PCSWCD (2023). *Sebasticook Lake Watershed Agricultural Survey Memo.* Prepared by Amy Polyot, Penobscot County Soil & Water Conservation District. November 2, 2023. 8 pp.

Pershing, A. J., Alexander M.A., Brady, D.C., Brickman, D., Curchitser, E.N., Diamond, A.W., McClenachan, L., Mills, K.E., Nichols, O.C., Pendleton, D.E., Record, N.R., Scott, J.D., Staudinger, M.D., and Wang, Y. (2021). *Climate impacts on the Gulf of Maine ecosystem: A review of observed and expected changes in 2050 from rising temperatures.* Elem Sci Anth 9.1 (2021): 00076.

Rock, Chet, David Courtemanch & Thomas Hannula (1984) *Restoration Of Sebasticook Lake, Maine, By Seasonal Flushing*, Lake and Reservoir Management, 1:1, 502-507, DOI: 10.1080/07438148409354566

Shute, H. and Wilson, K. (2013). *Metaphyton in Our Maine Lakes*. University of Southern Maine: Portland, Maine. Accessed online March 15, 2022: https://www.mainevlmp.org/wp-content/uploads/2013/08/Metaphyton-by-Shute-2013.pdf

Town of Newport (2024). Water and Sewer. Accessed online October 22, 2024: https://newportme.org/water

US EPA (2017). *Nutrient Policy and Data; Cyanobacteria/Cyanotoxins.* Accessed online: https://www.epa.gov/cyanohabs/learn-about-cyanobacteria-and-cyanotoxins

US EPA (2019). Recommended Human Health Recreational Ambient Water Quality Criteria or Swimming Advisories for Microcystins and Cylindrospermopsin. EPA Document Number: 822-R-19-001. May 2019. Accessed online: https://www.epa.gov/sites/production/files/2019-05/documents/hh-rec-criteria-habs-document-2019.pdf

US EPA (2022). *Nonpoint Source Success Story: Agricultural Best Management Practices and Erosion Controls Improve Sebasticook Lake.* February 2022. EPA 841-22-001B. Accessed online February 15, 2025: https://www.epa.gov/system/files/documents/2022-02/me_sebasticook-lake_2009_508.pdf

US EPA (2024a). *Our Current Understanding of the Human Health and Environmental Risks of PFAS.* May 2024. Accessed online October 24, 2024: https://www.epa.gov/pfas/our-current-understanding-human-health-and-environmental-risks-pfas

US EPA (2024b). *Indicators: Cyanotoxins (microcystin).* Accessed online: October 25, 2024: https://www.epa.gov/national-aquatic-resource-surveys/indicators-cyanotoxins-microcystin#:~:text=While%20many%20varieties%20of%20cyanotoxins,pets%20that%20drink%20affected%20waters

WRS, Inc. (2024) *Internal loading to Sebasticook Lake.* Water Resource Services, Inc. May, 2024. 16 pp.

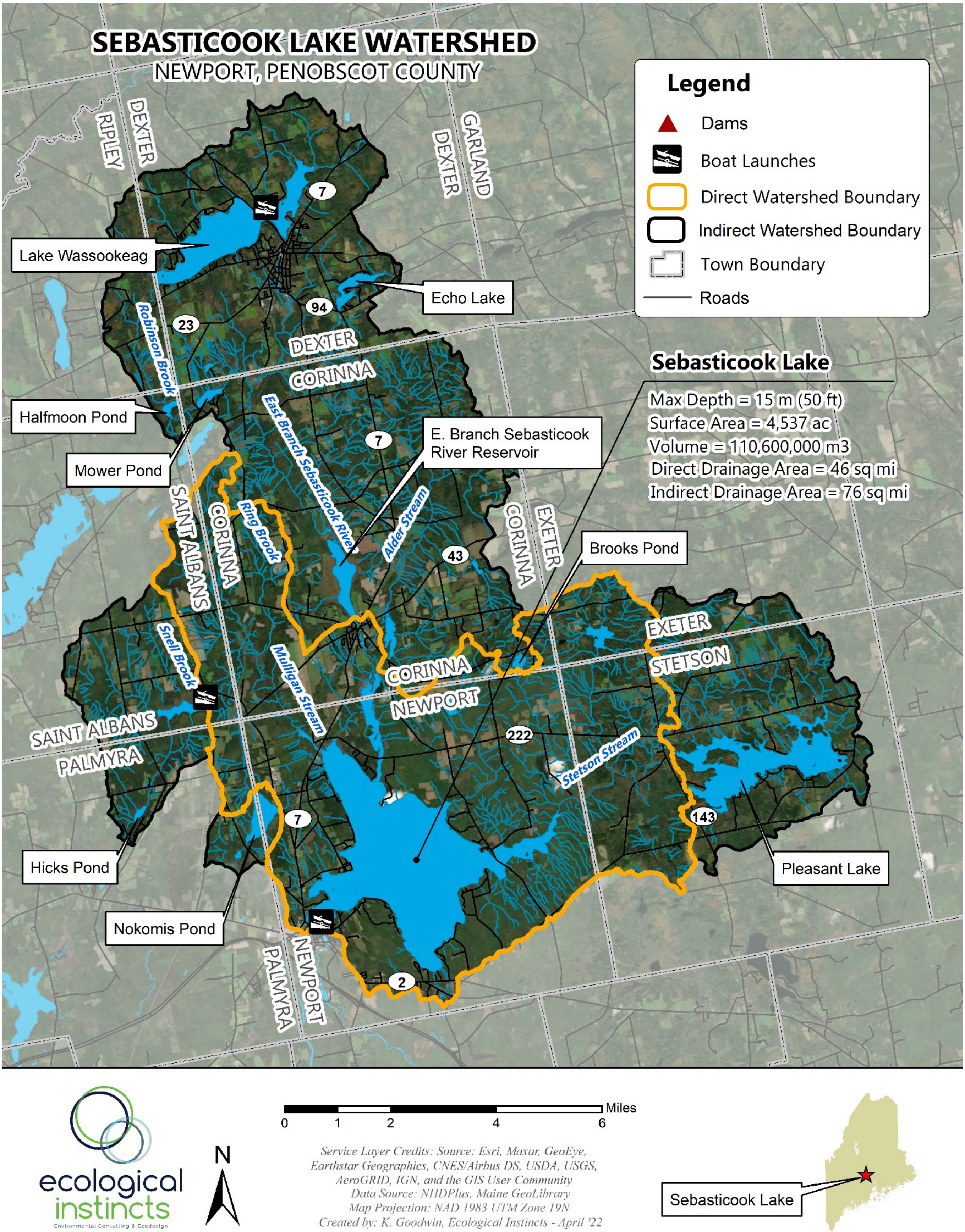
APPENDIX A. OTHER MAJOR LLRM INPUTS

- *Annual precipitation* data were obtained from NOAA National Climatic Data Center (NCDC) Bangor, ME station (Station ID: USC001179151) for the ten-year period 2014 - 2023 (annual average of 42.89 in or 1.09 m).
- *Atmospheric deposition* a P export coefficient of 0.1 kg/ha/yr was used in the model, which aligns with coefficients being used in current LLRM models for other Maine lakes with mainly forested watersheds.
- *Lake area* and volume estimates were obtained from bathymetry data collected in partnership by US EPA in 2023.
- *Routing Pattern* is a feature within the LLRM that allows larger drainage basins to be divided into smaller sub-basins where one sub-basin passes through another sub-basin. This guides prioritization of areas with higher nutrient loads within a drainage basin. For Sebasticook Lake, with a large indirect watershed, multiple basins passes through other sub-basins as follows:
    - Basins 1-4 (Sebasticook Lake direct shoreline drainage, Lower Mulligan Stream, Lower East branch Sebasticook River, and Stetson Stream) are considered part of the direct watershed. Basins 1-3 drain directly to the lake while Basin 4 (Stetson Stream) passes through Basin 1 (Shoreline).
    - Basins 5 (Nokomis Pond) and Basin 6 (Upper Mulligan Stream) pass through Basin 2 (Mulligan Stream).
    - Basin 8 (Lake Wassookeag) passes through Basin 7 (East Branch Sebasticook River)
    - Basin 9 (Alder Stream) passes through Basin 3 (Lower East Branch Sebasticook River)
    - Basin 10 (Pleasant Lake) passes through Basin 4 (Stetson Stream)
- *Septic system data* estimates were extrapolated from the Sebasticook Lake Association's 2023 Septic System Survey and the Town of Newport's Septic Database. Information used for the model included the days of occupancy (seasonal vs. year-round) distance of the system from the shoreline (<100' or >100') and number of people per dwelling (2.5 was used as a default across all categories). A phosphorus attenuation factor of 0.4 was used to account for the high percentage of at-risk soils in the watershed (shallow to bedrock). This value is slightly higher than used in other lake watershed model runs. Therefore, the P input from septic systems is not expected to be an underestimate.
- *Water quality data* were obtained from Maine DEP as well as SLA volunteer monitoring data collected in 2023. The 10-year median in-lake phosphorus concentration (2014-2023) was used for calibrating the model. Measured values during this time period ranged from 10 ppb to 26 ppb. The median of 22 ppb was used for the model, representing the median annual average TP concentration from epilimnetic core samples collected at Station 1 between April 15 – October 15.
- *Waterfowl counts* are based on a conservative estimate of 100 birds on the lake annually (default value). Waterfowl can be a direct source of nutrients to lakes. However, if they are eating from the

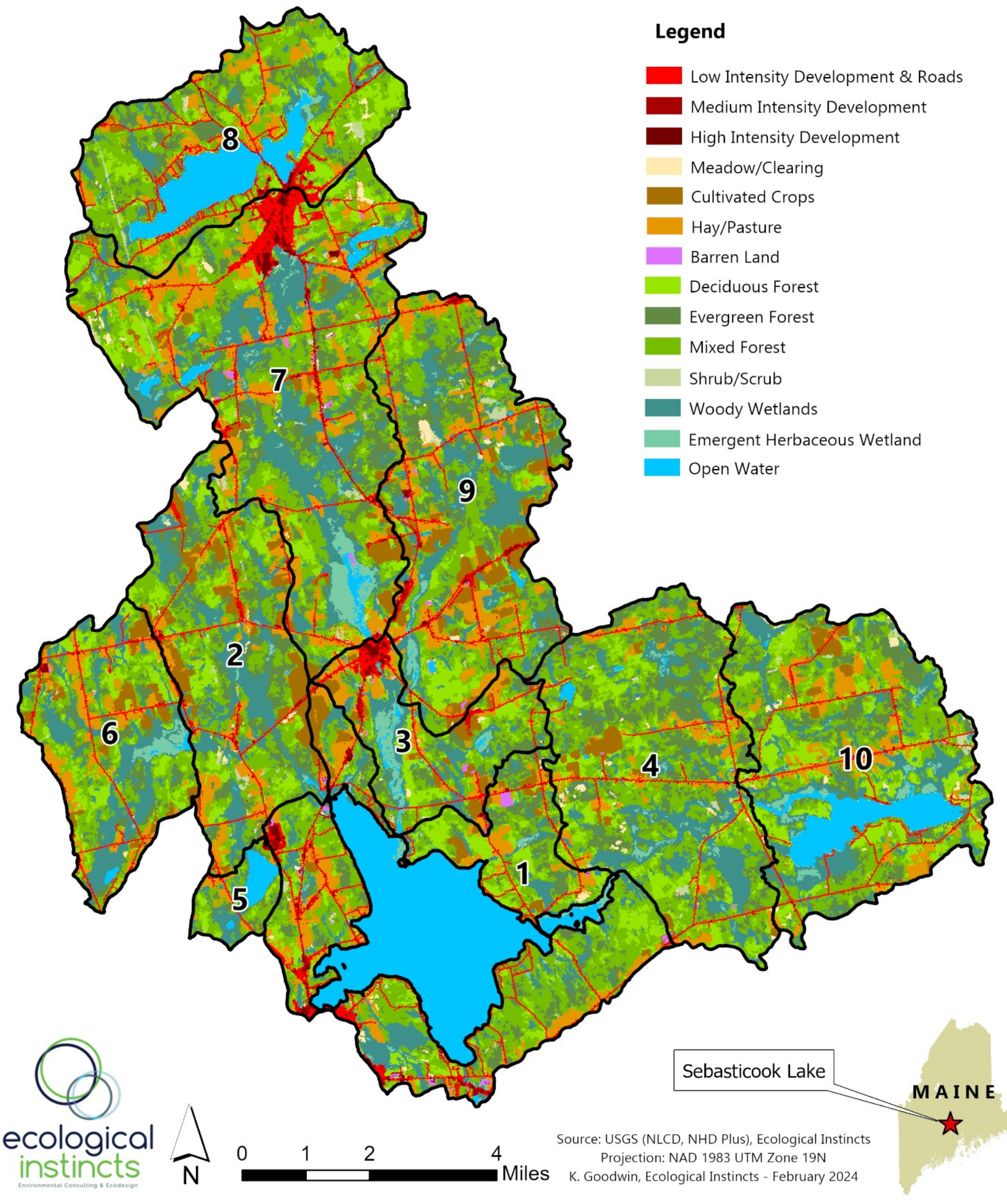
lake, and their waste returns to the lake, the net change may be less than might otherwise be assumed. Despite the fact that waterfowl may also be removing some phosphorus from the lake, the phosphorus excreted may be in a form that can readily be used by algae.

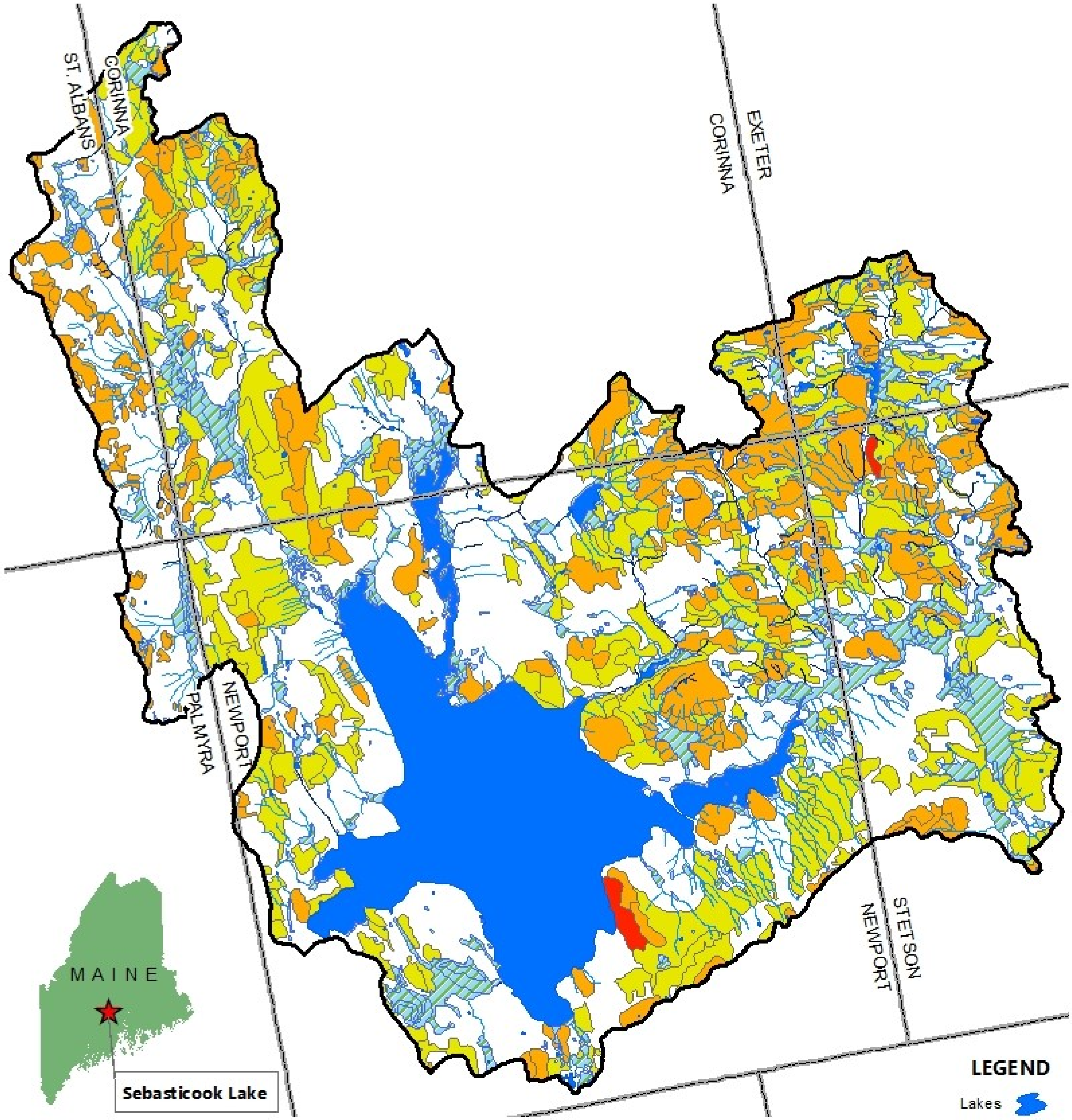
- *Internal phosphorus loading* was calculated by WRS, Inc. based on 2023 bathymetry data, all available water quality data, P mass calculations provided by Ecological Instincts, and sediment data provided by St. Joseph's College.

APPENDIX B. WATERSHED MAPS


SEBASTICOOK LAKE WATERSHED
NEWPORT, PENOBSCOT COUNTY
Legend
Dams
Boat Launches
Direct Watershed Boundary
Indirect Watershed Boundary
Town Boundary
Roads
Sebasticook Lake
Max Depth = 15 m (50 ft)
Surface Area = 4,537 ac
Volume = 110,600,000 m3
Direct Drainage Area = 46 sq mi
Indirect Drainage Area = 76 sq mi
Lake Wassookeag
Echo Lake
Halfmoon Pond
Mower Pond
E. Branch Sebasticook River Reservoir
Brooks Pond
Hicks Pond
Nokomis Pond
Pleasant Lake
Robinson Brook
East Branch Sebasticook River
Alder Stream
Ring Brook
Snell Brook
Mulligan Stream
Stetson Stream
RIPLEY
DEXTER
GARLAND
CORINNA
SAINT ALBANS
EXETER
STETSON
NEWPORT
PALMYRA
7
94
23
43
222
143
2
Miles
0 1 2 4 6
N
Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Data Source: NHDPlus, Maine GeoLibrary
Map Projection: NAD 1983 UTM Zone 19N
Created by: K. Goodwin, Ecological Instincts - April '22
Sebasticook Lake
ecological instincts

SEBASTICOOK LAKE WATERSHED
LAND COVER BY BASIN





SEBASTICOOK LAKE WATERSHED
SENSITIVE SOILS

0 0.5 1 2 3 4 Miles

LEGEND

- Lakes
- Wetlands
- Perennial Streams
- Intermittent Streams
- Town Boundaries
- Sebasticook Watershed

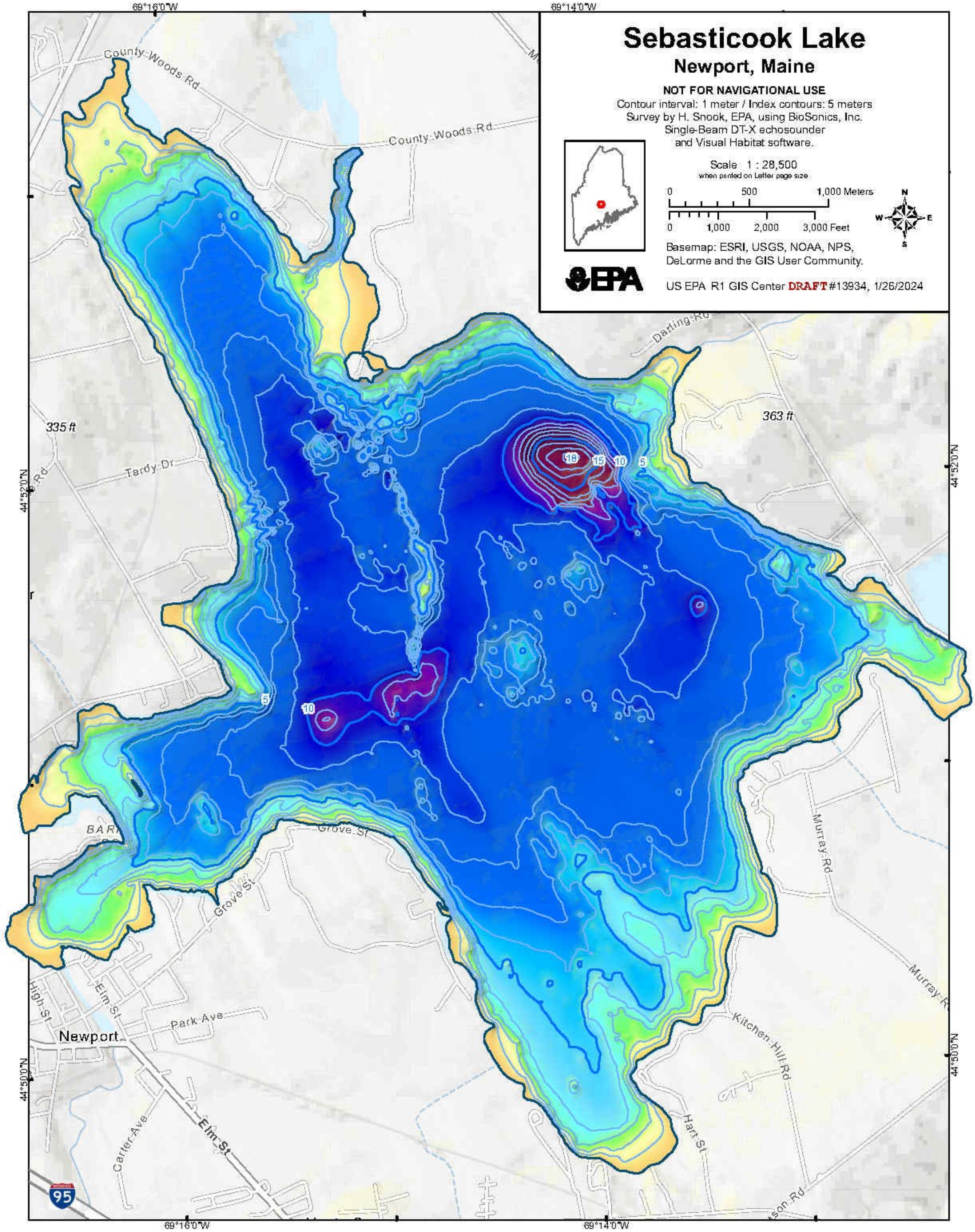
At-Risk Soils

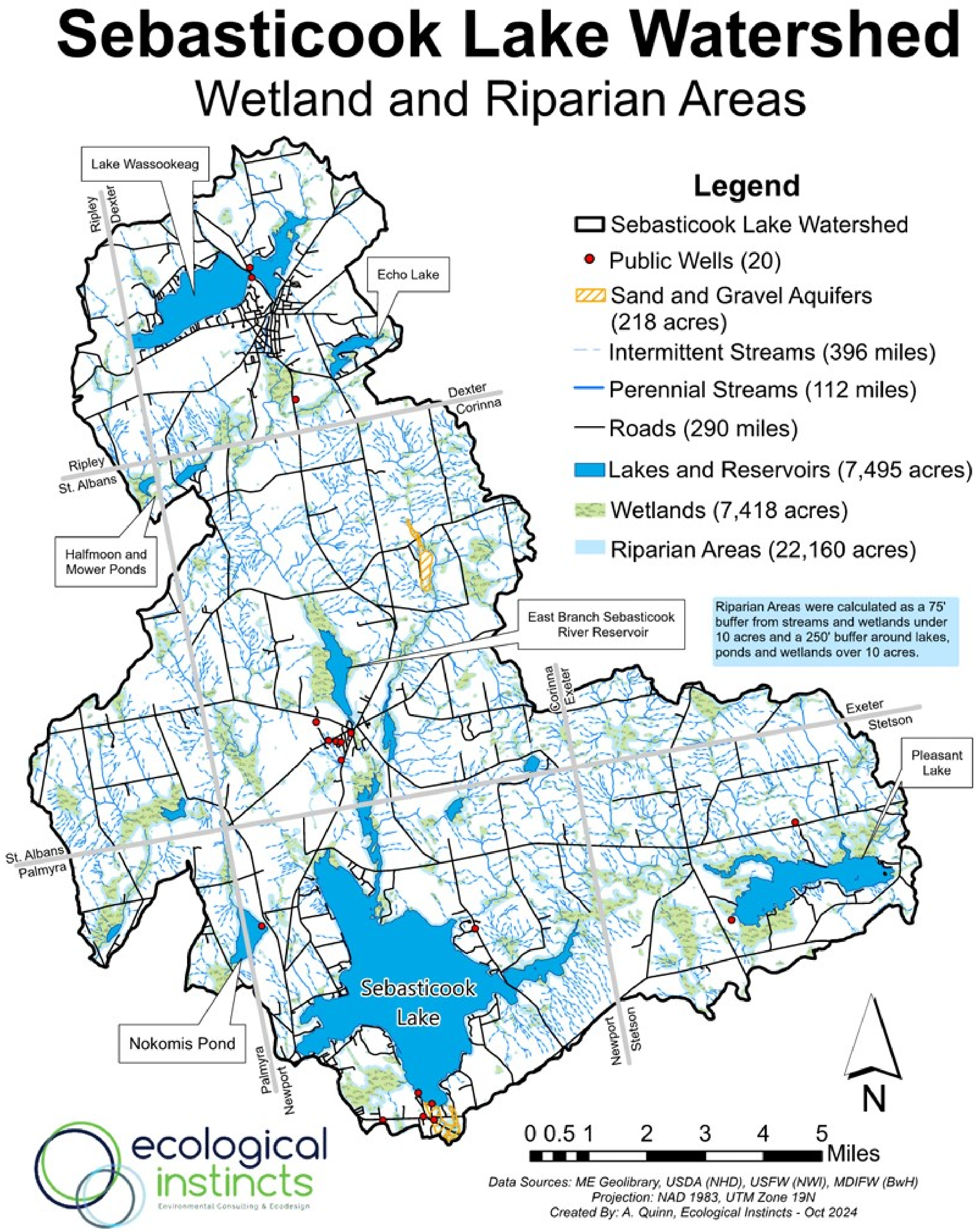
- Low Risk
- High Risk
- Very High Risk

N

ecological instincts

Data Sources: ME Geolibrary, USDA/NRCS, USFWS (NWI)
Projection: NAD 1983 UTM Zone 19N
Created By: C. Castaneda, Ecological Instincts - Dec. 2023

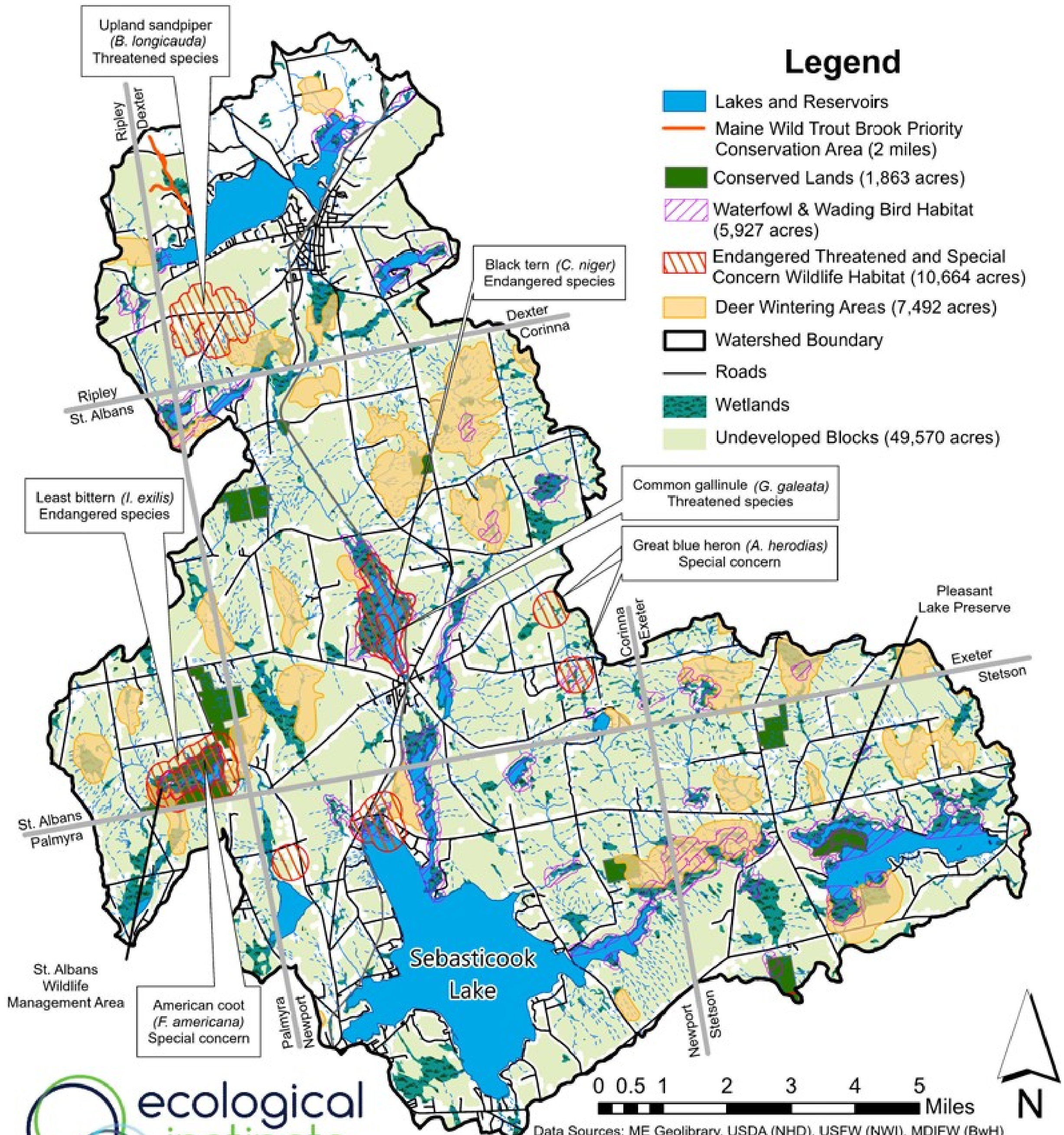

Sebasticook Lake
Newport, Maine
NOT FOR NAVIGATIONAL USE
Contour interval: 1 meter / Index contours: 5 meters
Survey by H. Snook, EPA, using BioSonics, Inc.
Single-Beam DT-X echosounder
and Visual Habitat software.
Scale 1 : 28,500
when printed on Letter page size
0 500 1,000 Meters
0 1,000 2,000 3,000 Feet
Basemap: ESRI, USGS, NOAA, NPS,
DeLorme and the GIS User Community.
EPA
US EPA R1 GIS Center DRAFT #13934, 1/26/2024
69°16'0"W
69°14'0"W
44°52'0"N
44°50'0"N
335 ft
363 ft
County Woods Rd
Tardy Dr
Darling Rd
Grove St
Park Ave
Newport
High St
Elm St
Carter Ave
Murray Rd
Kitchen Hill Rd
Hart St
95
18
15
10
5



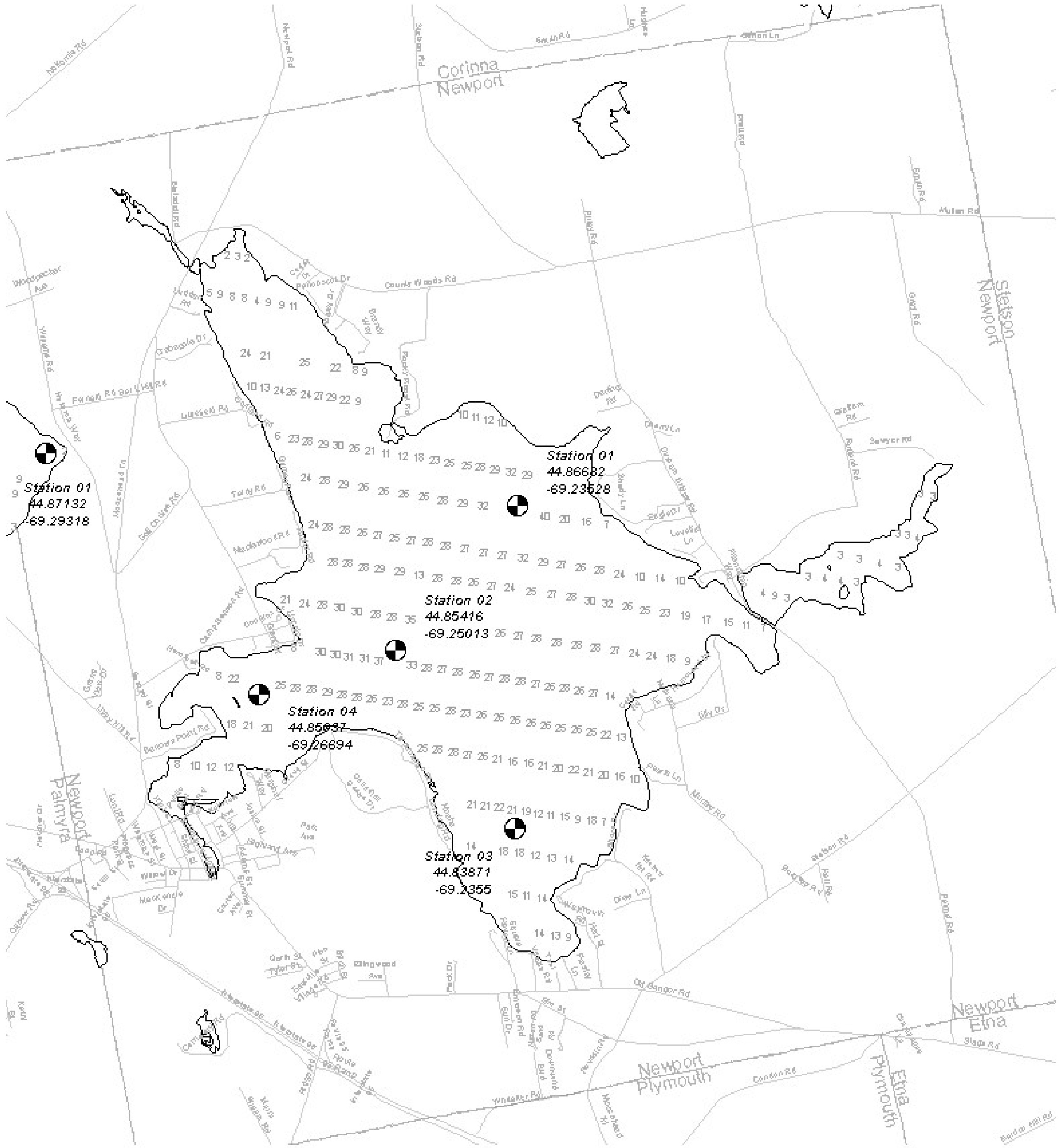
Sebasticook Lake Watershed
Wetland and Riparian Areas
Legend
Sebasticook Lake Watershed
Public Wells (20)
Sand and Gravel Aquifers (218 acres)
Intermittent Streams (396 miles)
Perennial Streams (112 miles)
Roads (290 miles)
Lakes and Reservoirs (7,495 acres)
Wetlands (7,418 acres)
Riparian Areas (22,160 acres)
Riparian Areas were calculated as a 75' buffer from streams and wetlands under 10 acres and a 250' buffer around lakes, ponds and wetlands over 10 acres.
Lake Wassookeag
Echo Lake
Halfmoon and Mower Ponds
East Branch Sebasticook River Reservoir
Pleasant Lake
Nokomis Pond
Sebasticook Lake
Ripley
Dexter
Corinna
St. Albans
Palmyra
Newport
Exeter
Stetson
N
0 0.5 1 2 3 4 5 Miles
Data Sources: ME Geolibrary, USDA (NHD), USFW (NWI), MDIFW (BwH)
Projection: NAD 1983, UTM Zone 19N
Created By: A. Quinn, Ecological Instincts - Oct 2024

Sebasticook Lake Watershed

Wildlife and Conservation areas



ecological instincts
Environmental Consulting & Ecodesign



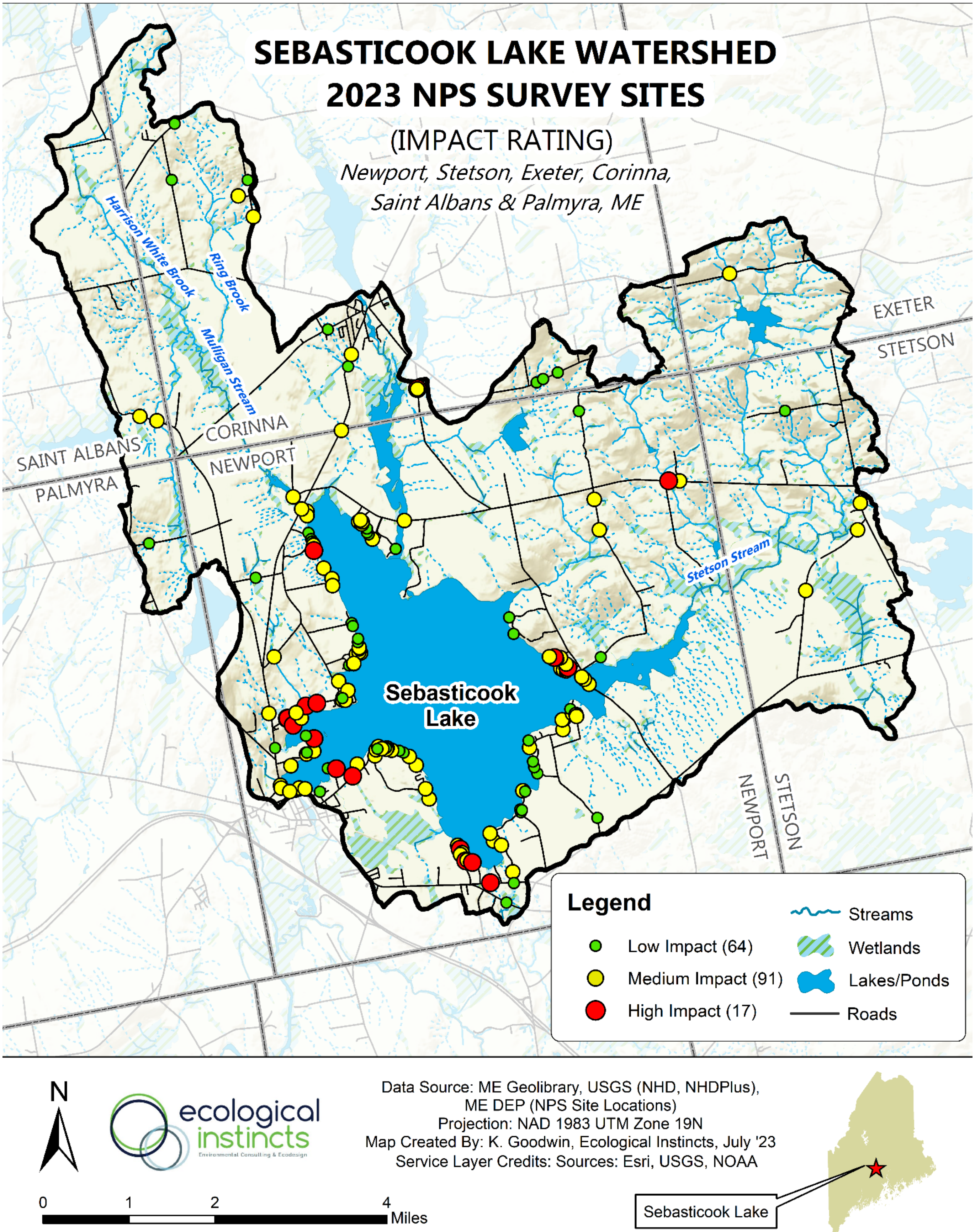
Sebasticook Lake

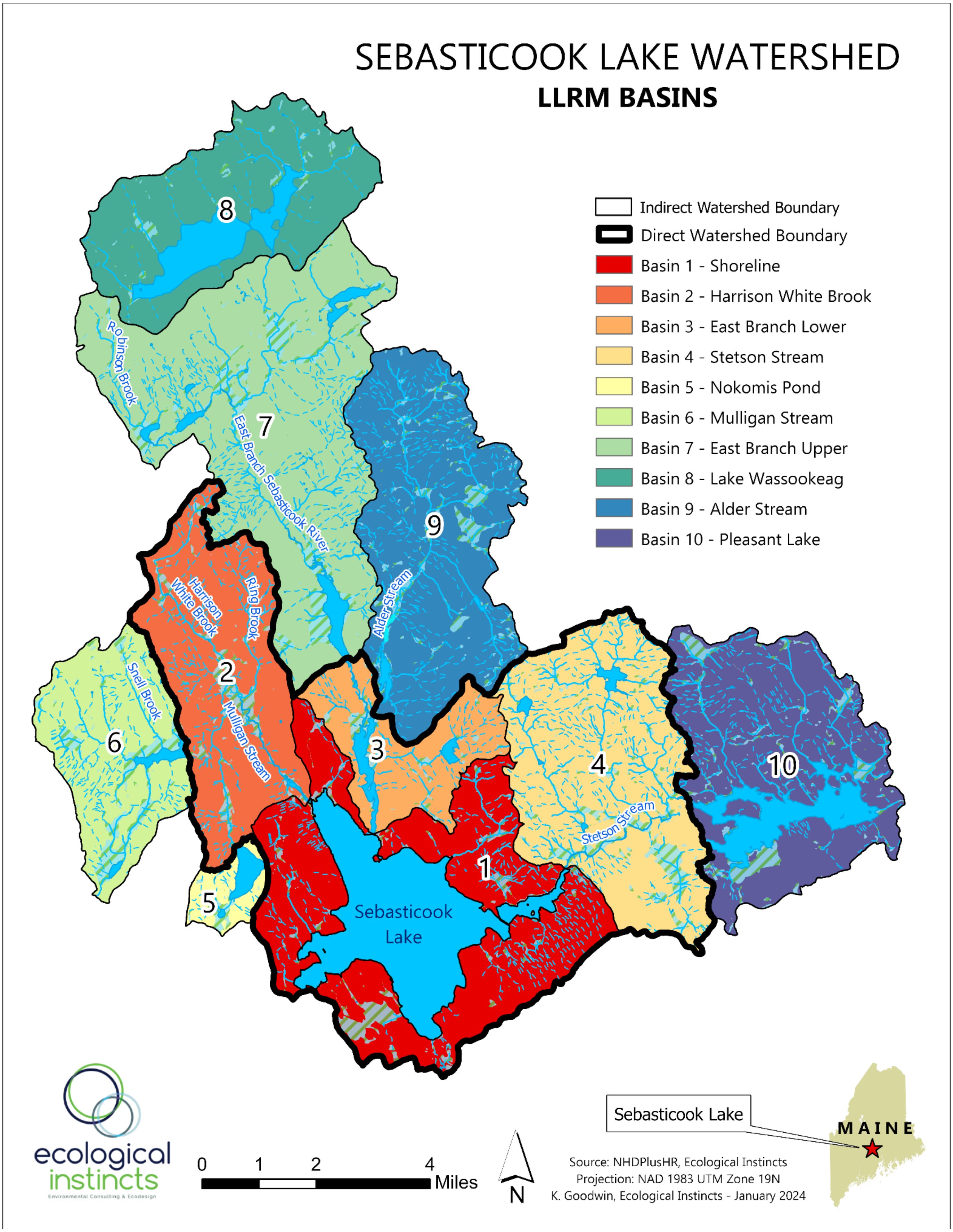
MIDAS # 2264

Newport, Penobscot Co. - Delorme Page 22 - 4537 acres

Boat Launch | Lake Sample Stations | # Depth (FT) | Roads | Town Lines

0 1 2 3 4 5 Miles


SEBASTICOOK LAKE WATERSHED
2023 NPS SURVEY SITES
(IMPACT RATING)
Newport, Stetson, Exeter, Corinna, Saint Albans & Palmyra, ME
Harrison White Brook
Ring Brook
Mulligan Stream
Stetson Stream
EXETER
STETSON
CORINNA
NEWPORT
SAINT ALBANS
PALMYRA
NEWPORT
STETSON
Sebasticook Lake
Legend
Low Impact (64)
Medium Impact (91)
High Impact (17)
Streams
Wetlands
Lakes/Ponds
Roads
N
ecological instincts
Environmental Consulting & Ecodesign
Data Source: ME Geolibrary, USGS (NHD, NHDPlus), ME DEP (NPS Site Locations)
Projection: NAD 1983 UTM Zone 19N
Map Created By: K. Goodwin, Ecological Instincts, July '23
Service Layer Credits: Sources: Esri, USGS, NOAA
0 1 2 4 Miles
Sebasticook Lake

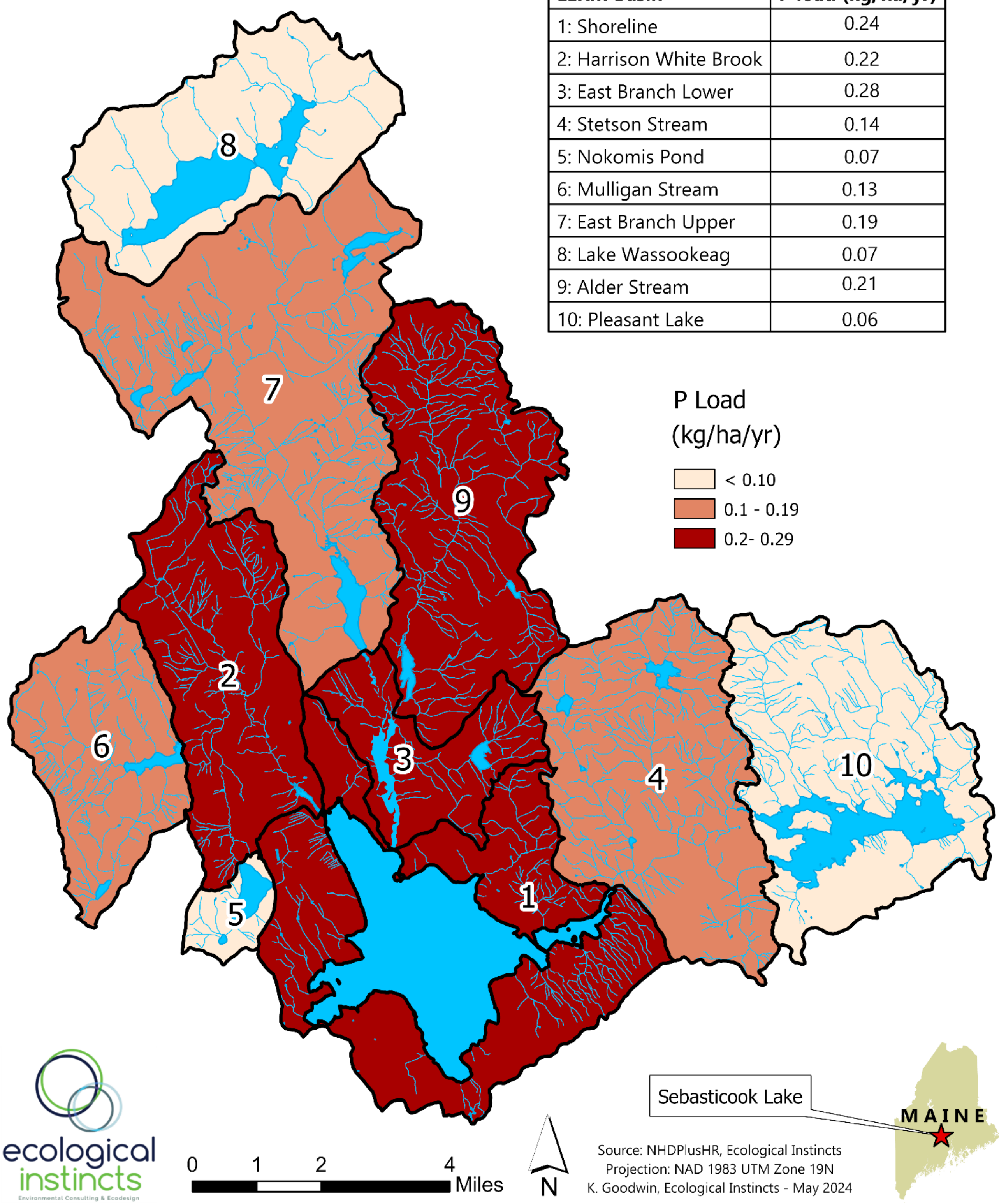


SEBASTICOOK LAKE WATERSHED
LLRM BASINS
Indirect Watershed Boundary
Direct Watershed Boundary
Basin 1 - Shoreline
Basin 2 - Harrison White Brook
Basin 3 - East Branch Lower
Basin 4 - Stetson Stream
Basin 5 - Nokomis Pond
Basin 6 - Mulligan Stream
Basin 7 - East Branch Upper
Basin 8 - Lake Wassookeag
Basin 9 - Alder Stream
Basin 10 - Pleasant Lake
8
7
9
2
6
3
4
10
1
5
Robinson Brook
East Branch Sebasticook River
Alder Stream
Harrison White Brook
Ring Brook
Snell Brook
Mulligan Stream
Stetson Stream
Sebasticook Lake
0 1 2 4
Miles
N
Source: NHDPlusHR, Ecological Instincts
Projection: NAD 1983 UTM Zone 19N
K. Goodwin, Ecological Instincts - January 2024
MAINE

SEBASTICOOK LAKE LLRM

P load - kg/ha/yr

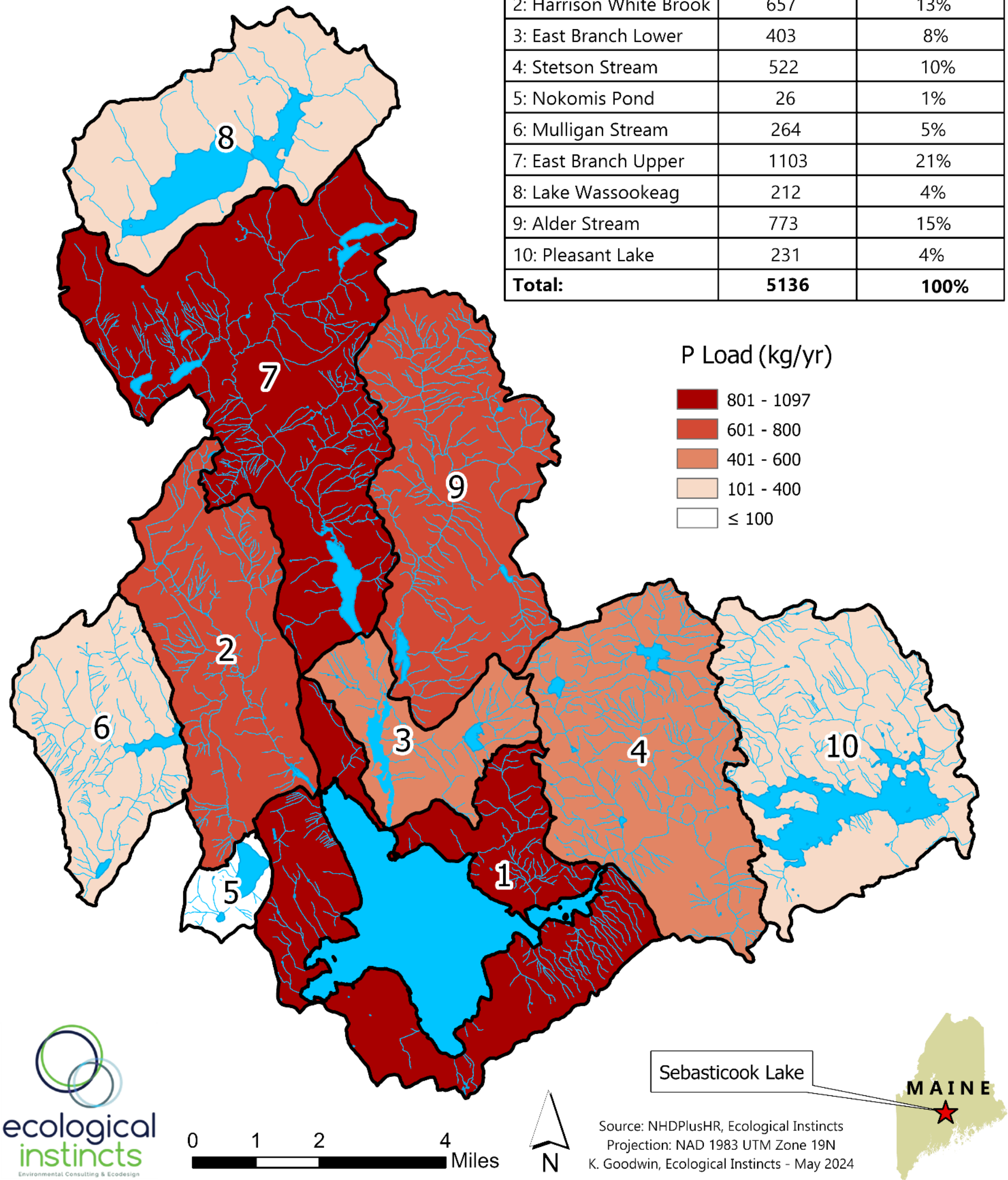
LLRM Basin	P load (kg/ha/yr)
1: Shoreline	0.24
2: Harrison White Brook	0.22
3: East Branch Lower	0.28
4: Stetson Stream	0.14
5: Nokomis Pond	0.07
6: Mulligan Stream	0.13
7: East Branch Upper	0.19
8: Lake Wassookeag	0.07
9: Alder Stream	0.21
10: Pleasant Lake	0.06



SEBASTICOOK LAKE LLRM

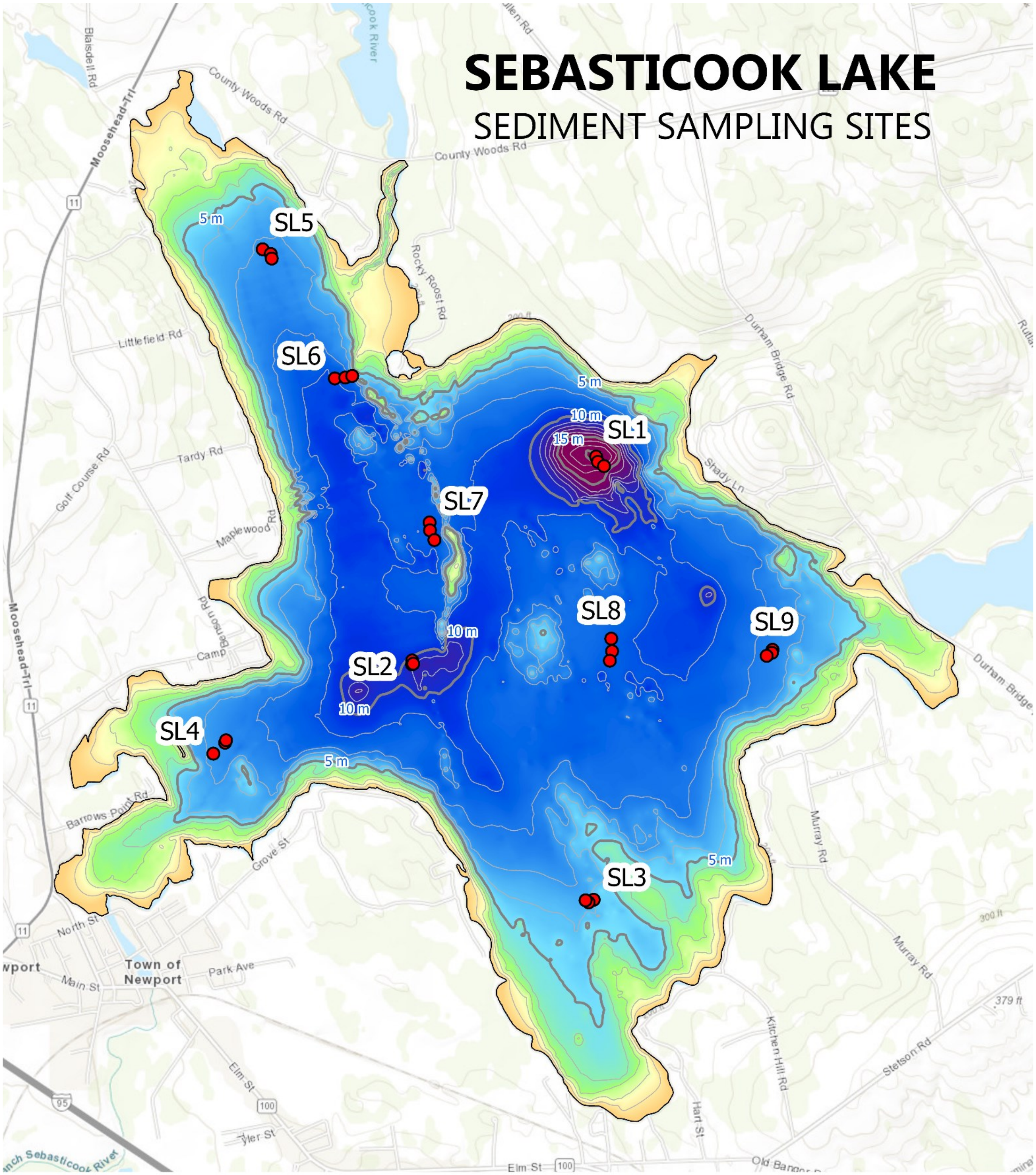
P load - kg/yr

LLRM Basin	P load (kg/yr)	% Total P Load
1: Shoreline	944	18%
2: Harrison White Brook	657	13%
3: East Branch Lower	403	8%
4: Stetson Stream	522	10%
5: Nokomis Pond	26	1%
6: Mulligan Stream	264	5%
7: East Branch Upper	1103	21%
8: Lake Wassookeag	212	4%
9: Alder Stream	773	15%
10: Pleasant Lake	231	4%
Total:	**5136**	**100%**

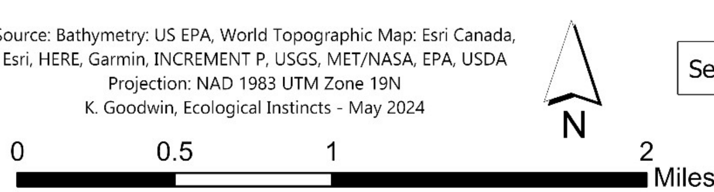


ecological instincts
Environmental Consulting & Ecodesign

Source: NHDPlusHR, Ecological Instincts
Projection: NAD 1983 UTM Zone 19N
K. Goodwin, Ecological Instincts - May 2024



Source: Bathymetry: US EPA, World Topographic Map: Esri Canada, Esri, HERE, Garmin, INCREMENT P, USGS, MET/NASA, EPA, USDA
Projection: NAD 1983 UTM Zone 19N
K. Goodwin, Ecological Instincts - May 2024



APPENDIX C. Phosphorus Reduction Estimates Methods

Load reduction estimates for the 2024 Sebasticook Lake WBMP were developed by Ecological Instincts based on three methods including: **1)** the US EPA Pollutant Load Estimation Tool (PLET) model to estimate P reductions that can be achieved by addressing NPS sites from the 2023 watershed survey, **2)** Maine DEP Relational Method to provide a rough estimate of load reductions across developed land cover types in the watershed as a percent of the total for each cover type, and **3)** use of an empirical watershed model (Lake Loading Response Model) to finalize load reduction estimates, predict in-lake water quality conditions under different load reduction scenarios, and provide water quality target scenarios for Steering Committee and Technical Advisory Committee members. Each step used to calculate load reductions was useful for preparing final load reduction estimates to help set the in-lake water quality target for Sebasticook Lake over the next 10 years. A brief summary of each method is provided below.

1) Pollution Load Estimation Tool (PLET)

The US EPA Pollutant Load Estimation Tool (PLET) Model[28] is an online model that provides estimates of sediment and nutrient load reductions from the implementation of Best Management Practices (BMPs). The PLET is the recommended method and is used extensively for developing Pollutants Controlled Reports (PCR) for US EPA 319 grant projects and incorporates local weather data that was not accounted for in the US EPA's Region 5 Model that was used for past WBMP projects.

Data used in the PLET model was compiled using a desktop assessment of available watershed survey data (site description, land use type, problems/solutions, area of exposed soil, and photos of the sites). Rather than calculating soil loss estimates for 172 individual sites identified during the 2023 watershed survey, a subset of representative sites was selected based on the total number of sites (or percentage of sites) by land use type within each of the three impact categories (high, medium, or low). This includes calculations for 50% of all high impact sites (9 sites), 20% of medium impact sites (18 sites), and 20% of low impact sites (13 sites).

The PLET Gullies and Streambanks tool was used for all sites. Soil nutrient concentrations are estimated in the model based on soil types, which was entered as silt loam for all sites based on the dominance of silt loam soil types in the watershed as mapped by the USDA Soil Survey Geographic Database (SSURGO). Lateral Recession Rates (LRR) were entered using the PLET categories of slight, moderate, severe, or very severe, and were adjusted based on the site description and photographs for each site. BMP efficiency was set at 0.85 for all sites to represent an ideal or high-end estimate for BMP efficiency.[29] A spreadsheet was prepared that includes variables used for each site sorted by impact. The average of each parameter (sediment, P, N) was multiplied by the total number of sites by impact and then summed to develop final

[28] https://www.epa.gov/nps/plet

[29] 0.85 was used as a default BMP efficiency for the recent Sebasticook Lake WBMP project, and was also used as the high end of a range of BMP efficiencies for soil loss estimates developed in 2024 by Ecological Instincts for NPS sites on Lake Auburn.

pollutant reduction estimates (113.2 tons/yr sediment, 31.5 kg/yr P, and 80.2 kg/yr N) for the NPS sites (Table 1).

Table 1. *PLET soil loss estimates for 2023 Sebasticook Lake watershed survey sites.*

Total: High Impact Sites (17 sites)		
Sediment (t/yr)	P (lbs/yr)	N (lbs/yr)
21.8	13.4	34.8
Total: Medium Impact Sites (91 sites)		
Sediment (t/yr)	P (lbs/yr)	N (lbs/yr)
80.6	49.5	124.6
Total: Low Impact Sites (64 Sites)		
Sediment (t/yr)	P (lbs/yr)	N (lbs/yr)
10.8	6.7	17.4

Total (P & N= lbs/yr)		
Sediment (t/yr)	P (lbs/yr)	N (lbs/yr)
113.2	69.5	176.8
Total (P & N= kg/yr)		
Sediment (t/yr)	P (kg/yr)	N (kg/yr)
113.2	**31.5**	**80.2**

2) DEP Relational Method

The *Relational Method for Estimating Required and Projected Load Reductions*[30] was used to estimate potential phosphorus load reductions that could be achieved in the Sebasticook Lake watershed. This model estimates the percentage of various sources of phosphorus in the watershed by land use type expressed as a fraction of the total contributing P sources times the fraction to be addressed times a BMP efficiency. The result is an estimate of the fraction of the load reduced for each land use type.

The USGS's NLCD data layer was used as a basis for calculating the area of each land cover type within the Sebasticook Lake watershed. To estimate load reductions, the P export coefficient assigned to each land cover type in the empirical model was used to estimate the P load from each land cover type, and the fraction of the total P load for each land cover category was calculated (Table 2).[31] "Fraction addressed" was applied to the P load for each land cover type to assess what percentage of that area would need to be addressed in order to achieve desired P reduction goals. Thirty percent was used as a starting point for the percentage of P that could be addressed on all developed land cover types and for septic systems. The fraction addressed was then increased to 50%, 75%, and 100% to get estimates of pollutants reduced at a higher fraction of land cover addressed (Table 3 & Table 4). The 30% fraction was removed from the final table as it did not result in the load reductions needed to make a meaningful difference in water quality. A

[30] *Jeff Dennis, Division of Watershed Management, MEDEP, n.d.*

[31] *The total load in the Relational Method is slightly higher than the total load in the empirical model because the model accounts for attenuation of P, where the Relational Method does not.*

final fraction addressed of 44% for developed land and 50% for septic systems was used to set the water quality target.

BMP efficiencies were applied for each land cover category based on various literature sources and values used for past WBMP projects. Other BMP efficiencies ranged from 0.58 (row crops) to 0.85 (urban development). The fractions addressed were multiplied by the BMP efficiencies to calculate the P load reduction by category. This exercise was completed first for the indirect watershed, and then reduction estimates for the indirect watershed were input into the direct watershed. This method ideally increases the accuracy of the relational method and allows for looking at the indirect and direct watersheds separately, since strategies for addressing P loading from watershed areas will likely be different for the two areas, and because only the direct watershed was surveyed in the 2023 NPS watershed survey.

Table 2. *Values used for the DEP Relational Method for the Sebasticook Lake watershed.*

Land Cover Type	P Export Coefficient (kg/ha/yr)	Total Area (ha)	P Load (kg/yr)	Fraction of Load
Hay/Grazing	0.55	1102	606	0.089
Row Crop	1.00	676	676	0.100
Developed, Low Intensity	0.75	330	247	0.036
Developed, Medium Intensity	0.90	159	143	0.021
Developed, High Intensity	1.20	38	46	0.007
Developed Open Space	0.40	7439	176	0.026
Upland Forest	0.08	7067	565	0.083
Open Water	0.10	65	6	0.001
Scrub/Shrub	0.10	65	6	0.001
Meadow/Clearing	0.20	81	16	0.002
Barren Land (Rock/Sand/Clay)	0.80	38	31	0.005
Forested Wetlands	0.10	1909	191	0.028
Emergent Herbaceous Wetlands	0.15	185	28	0.004
Septic Systems			118	0.017
Waterfowl			20	0.003
Atmospheric			429	0.063
Internal			809	0.119
Indirect Watershed			2667	0.393
TOTAL		**12155**	**6781**	**1.0**

The total phosphorus that could be reduced if 44% of all land cover along with 50% of all septic systems was addressed in both the direct and indirect watersheds was estimated at 1000 kg/yr, or 16% of the total P load to Sebasticook Lake. The estimated P load reductions increased to 1700 kg/yr (27%) if 75% of all developed land and septic systems are addressed, and to 2267 kg/yr (36%) if 100% of the developed land cover and septic systems are addressed (Table 3). These estimates do not include potential P load reductions that could be achieved by addressing the internal load, which could result in an additional reduction of 728 kg/yr (full treatment).

Table 3. *DEP Relational Method for estimating phosphorus reductions by land use category in the Sebasticook Lake watershed.*

Source Type	Sub-Type	Fraction of Total Load	Expected BMP Efficiency	Total P Reduced (kg/yr)			
				Fraction Addressed = 0.44	Fraction Addressed = 0.5	Fraction Addressed = 0.75	Fraction Addressed = 1
Agriculture							
	Row Crop	0.089	0.58	160	183.3	275.0	366.7
	Hay/Grazing	0.100	0.64	158	181	272	363
	Subtotal			**318**	**365**	**511**	729
Urban Development							
	Low Intensity Development	0.036	0.85	87	98	147	197
	Medium Intensity Development	0.021	0.85	50	57	85	114
	High Intensity Development	0.007	0.85	16	18	27	36
	Developed Open Space	0.026	0.40	0	0	0	0
	Meadow/Clearing	0.002	0.4	0	0	0	0
	Barren Land (Rock/Sand/Clay)	0.005	0.40	0	0	0	0
	Subtotal			**153**	**173**	**260**	347
Non-Developed Land							
	Upland Forest	0.083	0	0	0	0	0
	Open Water	0.001	0	0	0	0	0
	Scrub/Shrub	0.001	0	0	0	0	0
	Emergent Wetlands	0.004	0	0	0	0	0
	Forested Wetlands	0.028	0	0	0	0	0
	Subtotal			**0**	**0**	**0**	**0**
Other Load Types							
	Atmospheric	0.063	0	**0**	**0**	**0**	**0**
	Waterfowl	0.003	0	**0**	**0**	**0**	**0**
	Septic Systems	0.017	0.8	**44**	**44**	**66**	**88**
	Internal	0.120	0.9	**0**	**0**	**0**	**0**
	Indirect Watershed*	0.393	-	**485**	**551**	**827**	**1103**
	Total	**1.00**		**1000**	**1133**	**1700**	**2267**
	% Reduction			**16%**	**18%**	**27%**	**36%**

* The indirect watershed load was estimated using the relational method for the indirect watershed area. The output from that version of the relational method spreadsheet was then input as a separate reduction to the total watershed load.

3) Empirical Model Application

The Relational Method helped guide relative load reduction estimates for use in the empirical model. Within the empirical model, the following reductions were applied: direct watershed load (471 kg/yr), indirect watershed load (485 kg/yr), and septic systems (44 kg/yr). For reductions from the direct watershed, 318 kg/yr is estimated to come from agriculture, 153 kg/yr from urban development (largely low intensity shoreline development, roads, and medium intensity development), and 44 kg/yr from septic systems. Similarly, from the indirect watershed, 331 kg/yr from agriculture, and 154 kg/yr from urban development. Additional load reductions used in the water quality target table to reduce the internal load (not used for setting the water quality target for the 10-year WBMP) include 728 kg/yr for a full aluminum treatment, and 364 kg/yr for a partial aluminum treatment.

The total estimated P load reduction for Sebasticook Lake is 1000 kg/yr, a reduction of approximately 16% from the current estimated load of 6,286 kg/yr. This reduction is estimated to result in a 3.5 ppb decrease in the annual average in-lake TP concentration (from 21.7 ppb to 18.2 ppb). Based on these assumptions, the probability of Sebasticook Lake experiencing an algal bloom would decrease from 43% to 27%, average annual Secchi disk transparency is expected to improve by 0.3 m, and average Chl-a concentrations are expected to decrease by 1.5 ppb.

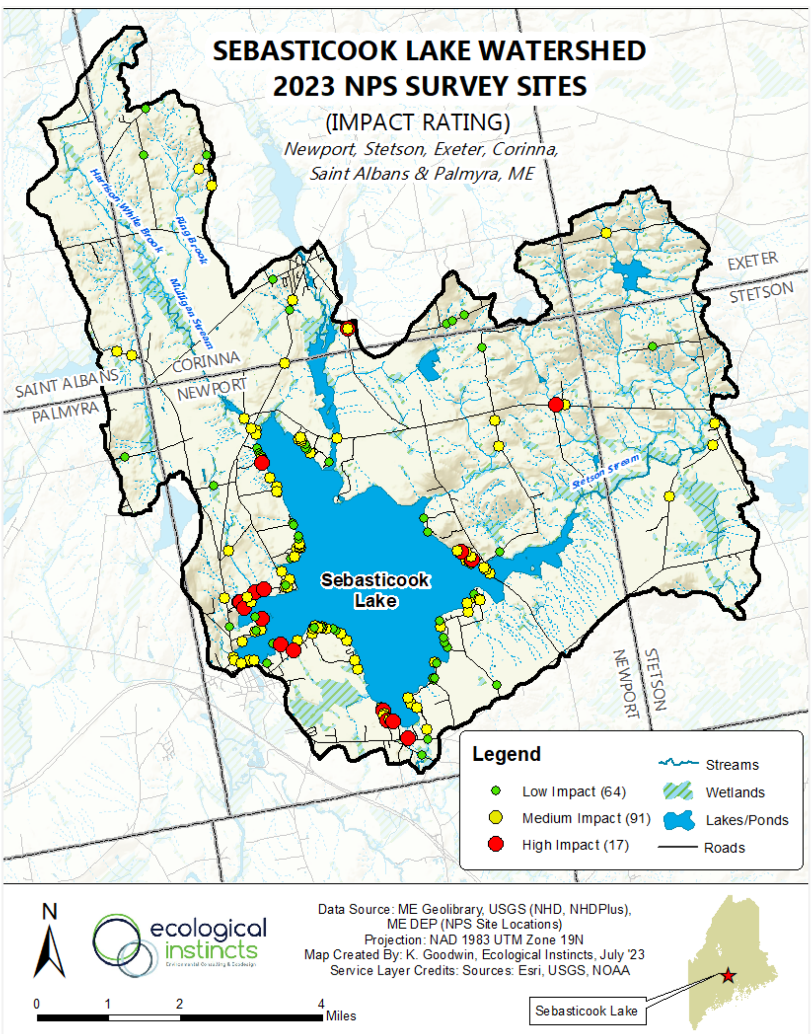
A 2.2 ppb increase (1,109 kg/yr) is anticipated a result of future development and climate change. This includes 145 kg/yr from new development, 10 kg/yr from septic systems, 873 kg/yr as a result of increased precipitation and runoff, and 81 kg/yr as a result of the increase in internal loading. Proactive efforts to counteract the effects of climate change and future development are essential for meeting the water quality goal of 18.2 ppb.

APPENDIX D. SEBASTICOOK LAKE NPS SITES

SEBASTICOOK LAKE NPS SITES (Ecological Instincts, 2023a)

A nonpoint source (NPS) assessment of the Sebasticook Lake watershed was completed by the Town of Newport with technical support from Ecological Instincts and Maine DEP, 17 local volunteers including members of the Sebasticook Lake Association (SLA) over the course of several days in April – May 2023. All roads in the watershed were surveyed along with developed properties within the shoreland zone of Sebasticook Lake. A total of 172 sites were documented on 11 different land-use types across the watershed (see map below and table on preceding pages). NPS sites were concentrated on the shoreline, and on roads near the shoreline or associated with stream crossings and ditches on state and town roads.

Impact of NPS Sites: The impact rating is an indicator of how much soil and phosphorus erodes into the lake from a given site. Factors such as slope, soil type, amount and severity of eroding soil, and buffer size are considered. Generally, low impact sites are those with limited transport of soil off-site, medium impact sites exhibit sediment transportation off-site, but the erosion does not reach high magnitude, and high impact sites are those with large areas of significant erosion and direct flow to water.



Site #	Land Use	Problems	Recommendations	Impact	Technical Level to Install
01-01	Municipal / Public	Surface Erosion-Sheet, Surface Erosion-Gully, Soil-Bare Shoreline-Undercut, Shoreline-Inadequate Shoreline Vegetation, Shoreline-Erosion	Establish Buffer	Medium	Medium
01-02	Boat Access	Surface Erosion-Sheet, Surface Erosion-Rill, Culvert-Clogged, Culvert-Crushed Broken, Ditch-Sheet Erosion	Replace, Remove Clog, Reshape Ditch, Remove debris/sediment, Vegetate	Medium	Medium
01-03	Town Road	Ditch-Sheet Erosion, Ditch-Rill Erosion, Road Shoulder Erosion-Rill	Reshape Ditch, Remove debris/sediment, Armor with Stone, Vegetate Shoulder	Low	Medium
01-04	Residential	Surface Erosion-Rill, Shoreline-Undercut, Shoreline-Inadequate Shoreline Vegetation, Shoreline-Erosion	Add to Buffer	Low	Low
01-05	Residential	Surface Erosion-Gully, Shoreline-Erosion, Shoreline-Unstable Access, Shoreline-Undercut, Shoreline-Inadequate Shoreline Vegetation, Other-Well located adjacent to the shore. Groundwater seeping out and eroding the shoreline. Also erosion from lawn runoff. Site is a short term rental property	Establish Buffer, Investigate well casing and water flow issues on the property	High	High
01-06	Residential	Surface Erosion-Gully, Ditch-Gully Erosion	Vegetate, Reshape Ditch, Septic Inspection, Potential septic or French drain outfall pipe next to shoreline.	Medium	Medium
01-07	Town Road	Surface Erosion-Gully, Culvert-Unstable inlet/outlet, Culvert-Crushed Broken, Road Shoulder Erosion-Gully, Soil-Winter Sand	Enlarge, Replace, Two culverts at stream crossing, sediment build up between the inlet culverts. Slightly crushed, town road caving in	High	High

Site #	Land Use	Problems	Recommendations	Impact	Technical Level to Install
01-08	Town Road	Surface Erosion-Gully, Culvert-Unstable inlet/outlet, Culvert-Diameter too small, Road Shoulder Erosion-Gully, Soil-Winter Sand	Replace, Enlarge, Culvert is collapsing with the road	Medium	High
01-09	Residential	Ditch-Bank Failure, Ditch-Gully Erosion, Other-Homeowner has modified stream. Loose excess sediment and gravel along bank. Talked to homeowner, is open to suggestions and wants to help the health of the lake. During storms brook become filled with sediment being washed through the culvert which is site 1-08. Pictures have wrong site name flip book it is site 01-09	Need stream hydrologist	Medium	High
01-10	Residential	Ditch-Gully Erosion, Shoreline-Erosion, Other-Culvert upstream	Reshape Ditch, Install Check Dams, Add to Buffer	Medium	Medium
02-01	Private Road	Surface Erosion-Rill, Culvert-Unstable inlet/outlet, Road Shoulder Erosion-Gully	Enlarge, Armor Inlet/Outlet, Vegetate, Armor with Stone, Build Up, Add gravel, Reshape (Crown), road is too low, runoff isn't making it to culvert it's eroding the bank. Road should we regraded and crowned before lowering culvert and stabilizing inlet	Medium	High
02-02	Private Road	Surface Erosion-Rill, Culvert-Clogged, Culvert-Too short/long, Culvert-Larger Drainage Issues, Ditch-Bank Failure, Road Shoulder Erosion-Sheet	Replace, Remove Clog, Build Up, Add gravel, Pave, Reshape (Crown), Road needs to be fixed first because road is low and overtopping. Culvert outlet is underground. Likely needs to be replaced	Medium	High
02-03	Driveway	Surface Erosion-Sheet, Culvert-Diameter too small, Other-Neighbor explained the runoff from this culvert flows to the lake as brown and full of sediment. This landowner cleared a	Install Plunge Pool, Vegetate, Install Sediment Pools, Install Turnouts, Establish Buffer, Add to Buffer, Slow the flow from upstream of culvert and replant to soak up the flow	Medium	Medium

Site #	Land Use	Problems	Recommendations	Impact	Technical Level to Install
		large area that impacted amount of runoff to culvert. Major parking area draining here too.			
02-04	Private Road	Surface Erosion-Rill, Culvert-Unstable inlet/outlet, Culvert-Clogged, Culvert-Crushed Broken, Ditch-Undersized, Ditch-Bank Failure	Enlarge, Replace, Build Up, Add gravel, Pave, Reshape (Crown), Add recycled asphalt, Remove Grader/Plow Berms, Road is much lower than banks. Washing into 304 Grove St. culvert is also buried	Medium	Medium
02-05	Town Road	Ditch-Sheet Erosion, Road Shoulder Erosion-Sheet, Soil-Winter Sand	Armor Inlet/Outlet, Install Ditch, Install Check Dams, Remove debris/sediment	Low	Medium
02-06	Town Road	Culvert-Unstable inlet/outlet, Culvert-Clogged, Culvert-Too short/long, Road Shoulder Erosion-Sheet	Armor Inlet/Outlet, Adjust Length, Vegetate Shoulder, Neighbor across the way plows winter sand into culvert outlet. Outlet needs to be stabilized. And road bank is steep and eroding. Dense vegetation because it can't be cut back	Low	Medium
02-07	Town Road	Road Shoulder Erosion-Sheet	Vegetate Shoulder, Add to Buffer, Widen ditch to allow for gradual slope and armor or plant	Medium	Medium
02-08	Residential	Surface Erosion-Gully	Add to Buffer, Establish Buffer, Mulch/Erosion Control Mix, Add more of the small stone and deal with culvert issue above to prevent future erosion	Medium	Medium
02-09	Town Road	Culvert-Unstable inlet/outlet, Culvert-Larger Drainage Issues, Road Shoulder Erosion-Sheet	Realign, Armor Inlet/Outlet, Assess Drainage Area, Install Plunge Pool, Install Ditch, Remove debris/sediment, large garage uphill has many pipes draining into this area. Need to deal with runoff uphill in addition to work at the culvert. Culvert is too high due to frost heave.	Medium	High
02-10	Residential	Surface Erosion-Rill	Establish Buffer, Add to Buffer, Deal with runoff from 2-09 to prevent beach washing out	Low	Low

Site #	Land Use	Problems	Recommendations	Impact	Technical Level to Install
02-11	Town Road	Culvert-Unstable inlet/outlet, Road Shoulder Erosion-Sheet	Install Plunge Pool, Armor Inlet/Outlet, Install Ditch, Armor with Stone, Vegetate, Ditch the entire road and possibly add more cross culverts or break up future ditch to decrease flow	Medium	High
02-12	Town Road	Culvert-Clogged, Culvert-Unstable inlet/outlet, Culvert-Misaligned, Road Shoulder Erosion-Sheet	Realign, Adjust Length, Install Plunge Pool, Assess Drainage Area, Armor with Stone, Reshape Ditch, Install Ditch, Install Check Dams, Remove debris/sediment, Install Sediment Pools, Vegetate, Some ditch exists but needs to be U-shaped, too steep	Low	High
03-01	Boat Access	Surface Erosion-Gully	Install Runoff Diverter (waterbar), Pre-cast concrete pads	Medium	Low
03-02	Beach Access	Surface Erosion-Gully		High	Low
03-03	Commercial	Surface Erosion-Sheet	Install Runoff Diverters-Broad-based Dip, Install Runoff Diverters-Open Top Culvert, Install Runoff Diverters-Rubber Razor, Install Runoff Diverters-Waterbar	Medium	Low
03-04	Commercial	Culvert-Larger Drainage Issues	Replace, Replace drainage culvert with larger culvert to prevent overtopping	Medium	Low
03-05	Private Road	Ditch-Gully Erosion	Armor with Stone	High	Low
03-06	Boat Access	Surface Erosion-Sheet, Soil-Bare	Install runoff diverter (waterbar), Private boat launch should be closed out and vegetated, use public boat launch instead	Medium	Low
03-07	Driveway	Surface Erosion-Gully	Vegetate Shoulder, Reshape (Crown), Build Up, Install Runoff Diverter (waterbar)	High	Medium

Site #	Land Use	Problems	Recommendations	Impact	Technical Level to Install
03-08	Driveway	Surface Erosion-Sheet, Construction runoff	Mulch, Silt Fence/EC Berms, Seed/Hay	Medium	Low
03-09	Driveway	Surface Erosion-Rill	Reshape (Crown)	Medium	Low
04-01	Private Road	Surface Erosion-Sheet, Culvert-Unstable inlet/outlet, Road Shoulder Erosion-Rill, Soil-Bare, Roadside Plow/Grader Berm	Armor Inlet/Outlet, Install Ditch, Install Sediment Pools, Remove Grader/Plow Berms, Vegetate Shoulder, Establish Buffer, Regrade driveway culvert (NOT SHOWN) to redirect flow to an existing ditch and into new sediment basin, add level spreader and buffer plantings. Also armor outlet of culvert. Add buffer on side of lot 30-5.	Low	High
04-02	Residential	Surface Erosion-Sheet, Soil-Bare	Establish Buffer, Add to Buffer, Reseed bare soil & thinning grass, Buffer planting along drainage on side of house	Low	Low
04-03	Private Road	Surface Erosion-Sheet, Culvert-Unstable inlet/outlet	Armor Inlet/Outlet, Realign, Enlarge, Triple culvert probably should be replaced with just 1	Low	High
04-04	Residential	Surface Erosion-Sheet, Soil-Bare	Install Runoff Diverters-Rubber Razor, Install Runoff Diverters-Waterbar, Break up flow down gravel drive, maybe add some ECM	Medium	Low
04-05	Private Road	Culvert-Unstable inlet/outlet, Culvert-Too short/long, Culvert-Hanging Outlet, Soil-Bare	Armor Inlet/Outlet, Adjust Length, Install Plunge Pool, 2 culverts about 15 feet apart, both are a little short, the one pictured is the worst	Low	High
04-06	Residential	Surface Erosion-Sheet	Infiltration Trench @ roof dripline, Establish Buffer, Add to Buffer, Mulch/Erosion Control Mix, Needs better buffer plants, photos show unstable slope, needs some retaining or ECM. Also note culvert outlet...Unclear inlet. Possibly a foundation drain out letting to the lake. Follow up investigation needed.	Low	Low

Site #	Land Use	Problems	Recommendations	Impact	Technical Level to Install
04-07	Residential	Surface Erosion-Sheet, Surface Erosion-Rill, Soil-Bare	Infiltration Trench @ roof dripline, Mulch/Erosion Control Mix, Install Runoff Diverter (waterbar), Needs extensive ECM. Spoke to landowner, said he would look into it.	Medium	Low
04-08	Private Road	Surface Erosion-Sheet, Culvert-Unstable inlet/outlet, Culvert-Crushed Broken, Ditch-Sheet Erosion, Road Shoulder Erosion-Sheet	Armor Inlet/Outlet, Replace, Adjust Length, Reshape (Crown)	Medium	High
04-09	Town Road	Culvert-Hanging Outlet	Realign	Low	High
04-10	Town Road	Culvert-Hanging Outlet, Culvert-Crushed Broken	Realign	High	High
05-01	Residential	Surface Erosion-Sheet, Soil-Bare, Shoreline-Lack of Shoreline Vegetation	Add gravel, Install Runoff Diverters-Waterbar, Reshape (Crown), Establish Buffer, No Raking, Reseed bare soil & thinning grass, Mulch/Erosion Control Mix	Low	Low
05-02	Residential	Surface Erosion-Sheet, Soil-Bare, Shoreline-Lack of Shoreline Vegetation, Shoreline-Erosion	Establish Buffer, Add to Buffer	Low	Low
05-03	Residential	Surface Erosion-Sheet, Soil-Bare, Shoreline-Lack of Shoreline Vegetation, Shoreline-Inadequate Shoreline Vegetation, Shoreline-Erosion	No Raking, Mulch/Erosion Control Mix, Move fire pit away from the shoreline, let ground cover grow in forested areas of the yard and stop raking those areas, or use erosion control mulch	Low	Low
05-04	Residential	Surface Erosion-Rill, Soil-Bare, Shoreline-Lack of Shoreline Vegetation, Shoreline-Erosion, Shoreline-Unstable Access	Define Foot Path, Stabilize Foot Path, Install Runoff Diverter (waterbar), Add to Buffer, Reseed bare soil & thinning grass, Mulch/Erosion Control Mix	Medium	Low

Site #	Land Use	Problems	Recommendations	Impact	Technical Level to Install
05-05	Residential	Surface Erosion-Sheet, Soil-Bare, Shoreline-Erosion	Define Foot Path, Erosion Control Mulch, Add to Buffer, Mulch/Erosion Control Mix, Define paths and seating areas, mulch, and plant edges	Low	Low
05-06	Private Road	Surface Erosion-Rill, Culvert-Diameter too small, Ditch-Rill Erosion, Road Shoulder Erosion-Rill	Enlarge, Install Culvert, Reshape (Crown), Install a second culvert about a hundred feet east of existing culvert where road is being overtopped where rills are forming. Reshape road.	Medium	High
05-07	Residential	Surface Erosion-Gully, Soil-Bare, Shoreline-Erosion	Add to Buffer, Plant boat launch area	Medium	Low
05-08	Residential	Surface Erosion-Rill	Armor Inlet/Outlet, Armor outlet of culvert. Plant buffer above armored outlet.	Medium	Medium
05-09	Residential	Surface Erosion-Sheet, Soil-Bare, Shoreline-Lack of Shoreline Vegetation, Shoreline-Inadequate Shoreline Vegetation, Shoreline-Erosion	Define Foot Path, Establish Buffer, Add to Buffer, Mulch/Erosion Control Mix	Low	Low
05-10	Private Road	Surface Erosion-Sheet, Culvert-Unstable inlet/outlet, Culvert-Crushed Broken, Culvert-Clogged, Culvert-Diameter too small, Culvert-Larger Drainage Issues, Road Shoulder Erosion-Sheet	Enlarge, Replace, Remove Clog, Assess Drainage Area, Remove Grader/Plow Berms, Reshape (Crown), Replace culverts, remove excess road material building up in wetland	Medium	High
05-11	Private Road	Surface Erosion-Rill, Culvert-Crushed Broken, Culvert-Unstable inlet/outlet, Culvert-Larger Drainage Issues	Replace, Enlarge, Reshape (Crown), Remove Grader/Plow Berms	Medium	Medium
05-12	Private Road	Surface Erosion-Sheet, Surface Erosion-Gully, Culvert-Larger Drainage Issues, Road Shoulder Erosion-Gully	Install Plunge Pool, Install Ditch, Reshape (Crown), Build Up	Low	High

Site #	Land Use	Problems	Recommendations	Impact	Technical Level to Install
06-01	Boat Access	Surface Erosion-Rill, Soil-Bare, Shoreline-Erosion, Shoreline-Unstable Access	Build Up, Add gravel, Install Runoff Diverter (waterbar)	Medium	Medium
06-02	Residential	Surface Erosion-Rill, Soil-Bare, Shoreline-Erosion, Roof Runoff Erosion	Define Foot Path, Erosion Control Mulch, Infiltration Trench @ roof dripline, Drywell @ gutter downspout, Add to Buffer	Medium	Low
06-03	Residential	Surface Erosion-Rill, Shoreline-Inadequate Shoreline Vegetation, Roof Runoff Erosion	Infiltration Trench @ roof dripline, Add to Buffer, Mulch/Erosion Control Mix, Walkway area could use mulch	Medium	Low
06-04	Residential	Surface Erosion-Rill, Shoreline-Erosion, Roof Runoff Erosion	Rain Barrel, Infiltration Trench @ roof dripline, Add to Buffer, Mulch/Erosion Control Mix, Add gutters and a rain barrel or downspout on the side closest to the lake, or infiltration trench if possible. Add mulch to bare soil on rocky garden area and around the base of the rocks and house	Medium	Low
06-05	Residential	Surface Erosion-Sheet, Road Shoulder Erosion-Sheet	Install Runoff Diverters-Waterbar, Add to Buffer, Add water bar to stabilize end of parking area, plant slope	Low	Low
06-06	Boat Access	Surface Erosion-Rill,, Surface Erosion-Sheet, Road Shoulder Erosion-Sheet, Soil-Bare, Shoreline-Unstable Access	Add gravel, Add to Buffer, Establish Buffer, If possible, stop using as a boat launch and establish buffer. If keeping as a boat launch add crushed stone, vegetate and re-seed grass where possible	Medium	Low
06-07	Residential	Surface Erosion-Sheet, Soil-Bare, Shoreline-Inadequate Shoreline Vegetation	Define Foot Path, Stabilize Foot Path, Mulch/Erosion Control Mix, Mulch seating areas and paths, define paths, add to buffer where possible	Low	Low
06-08	Residential	Surface Erosion-Sheet, Soil-Bare, Shoreline-Inadequate Shoreline Vegetation, Roof Runoff Erosion	Erosion Control Mulch, Define Foot Path, Infiltration Trench @ roof dripline, Reseed bare soil & thinning grass, Mulch/Erosion Control Mix	Low	Low

Site #	Land Use	Problems	Recommendations	Impact	Technical Level to Install
06-09	Private Road	Surface Erosion-Gully, Road Shoulder Erosion-Sheet	Install Culvert, Install Ditch, Install Turnouts, Build Up, Reshape (Crown), Long section of road is rutted leading down from two directions to a low wetland area that looks like it could use a culvert. Re-shape road to prevent water running down ditches from getting to wetland/stream	High	High
06-10	Residential	Surface Erosion-Sheet, Soil-Bare, Shoreline-Lack of Shoreline Vegetation, Shoreline-Inadequate Shoreline Vegetation	Establish Buffer, Add to Buffer, Reseed bare soil & thinning grass, Mulch/Erosion Control Mix	Medium	Low
06-11	Private Road	Surface Erosion-Gully, Culvert-Unstable inlet/outlet, Ditch-Gully Erosion, Road Shoulder Erosion-Sheet	Install Plunge Pool, Vegetate, Armor with Stone, Install Check Dams, Reshape Ditch, Stabilize ditch, install plunge pool at outlet	Medium	Medium
06-12	Residential	Shoreline-Erosion, Roof Runoff Erosion	Define Foot Path, Stabilize Foot Path, Infiltration Trench @ roof dripline, Establish Buffer, Add to Buffer, Mulch and stabilize any bare soil	Low	Low
06-13	Residential	Surface Erosion-Sheet, Shoreline-Inadequate Shoreline Vegetation	Reseed bare soil & thinning grass, Rain Garden-Rain garden in low area and add to buffer	Low	Low
06-14	Private Road	Surface Erosion-Gully, Culvert-Larger Drainage Issues	Armor Inlet/Outlet, Install Plunge Pool, Armor with Stone, Water Retention Swales, Lots of ditching from road and adjacent property leading to one ditch and small culvert, drainage through this property is overflowing a small culvert in the woods. Stabilize ditch and add water retention upstream, remove small culvert in woods	Medium	Medium
06-15	Residential	Surface Erosion-Gully, Shoreline-Erosion, Roof Runoff Erosion	Define Foot Path, Stabilize Foot Path, Install Runoff Diverter (waterbar), Add to Buffer, Lots of water	High	Low

Site #	Land Use	Problems	Recommendations	Impact	Technical Level to Install
			coming off overwhelmed drainage described from site 6-14, washing out yard and pathways		
06-16	Residential	Surface Erosion-Sheet, Soil-Bare, Shoreline-Erosion	Define Foot Path, Stabilize Foot Path, Establish Buffer, Add to Buffer, Reseed bare soil & thinning grass	Medium	Low
06-17	Residential	Surface Erosion-Sheet	Add to Buffer, Mulch/Erosion Control Mix	Low	Low
06-18	Residential	Surface Erosion-Sheet, Soil-Bare	Establish Buffer, Mulch/Erosion Control Mix, Rip Rap, Cover bare soil	Low	Low
07-01	Residential	Surface Erosion-Sheet, Roof Runoff Erosion	Infiltration Trench @ roof dripline, Establish Buffer	Low	Low
07-02	Residential	Surface Erosion-Sheet, Soil-Bare	Mulch, Silt Fence/EC Berms, Seed/Hay, Establish Buffer, Add to Buffer, Owner and address unclear need to verify	Medium	Low
07-03	Residential	Surface Erosion-Sheet, Soil-Bare, Shoreline-Erosion	Establish Buffer, Add to Buffer, Stabilize shoreline	Low	Low
07-04	Residential	Surface Erosion-Sheet, Soil-Bare	Establish Buffer, Add to Buffer, No Raking, Reseed bare soil & thinning grass, Shallow soils over bedrock, increase buffer upslope	Low	Low
07-05	Private Road	Ditch-Bank Failure	Armor with Stone, Reshape Ditch	Low	Medium
07-06	Residential	Surface Erosion-Sheet, Shoreline-Erosion, Shoreline-Lack of Shoreline Vegetation	Establish Buffer, Add to Buffer, Rip Rap	Low	Low
07-07	Residential	Ditch-Gully Erosion, Shoreline-Erosion, Shoreline-Lack of Shoreline Vegetation, Shoreline-Inadequate Shoreline Vegetation	Vegetate, Culvert inlet on Cedar Dr across from house. Flow into culvert much less than out. Origin of flow unclear, maybe groundwater from perimeter drains. Inlet pictures as next NPS site. Re-route road ditch and whatever is the source of flow.	Medium	High

Site #	Land Use	Problems	Recommendations	Impact	Technical Level to Install
07-07-01	Private Road	Culvert-Larger Drainage Issues	See site 7-7	Medium	High
07-08	Residential	Surface Erosion-Sheet, Shoreline-Lack of Shoreline Vegetation, Shoreline-Inadequate Shoreline Vegetation, Shoreline-Erosion, Shoreline-Unstable Access	Establish Buffer, Add to Buffer, Reseed bare soil & thinning grass	Low	Low
07-09	Residential	Surface Erosion-Gully, Ditch-Gully Erosion	Need to reroute rd culvert	Medium	High
07-10	Private Road	Ditch-Gully Erosion	Install Ditch, Need to re-route	Medium	High
07-11	Municipal / Public	Surface Erosion-Sheet, Surface Erosion-Rill, Road Shoulder Erosion-Sheet, Road Shoulder Erosion-Rill, Soil-Bare, Shoreline-Erosion	Vegetate Shoulder	Low	Low
08-01	Trail or Path	Surface Erosion-Gully, Shoreline-Erosion, Shoreline-Unstable Access	Erosion Control Mulch, Rip Rap	Medium	Medium
08-02	Trail or Path	Surface Erosion-Rill, Other-Surface erosion with potholes	Add gravel, Build Up, Reshape (Crown)	Medium	Medium
08-03	Trail or Path	Surface Erosion-Rill, Shoreline-Erosion, Shoreline-Unstable Access	Stabilize Foot Path, Mulch/Erosion Control Mix	Low	Low
08-04	Trail or Path	Surface Erosion-Rill	Erosion Control Mulch, Add to Buffer	Low	Low
08-05	Trail or Path	Surface Erosion-Rill, Shoreline-Unstable Access, Shoreline-Inadequate Shoreline Vegetation	Erosion Control Mulch, Add to Buffer	Low	Low
08-06	Residential	Surface Erosion-Sheet, Shoreline-Inadequate Shoreline Vegetation	Erosion Control Mulch, Add to Buffer, No Raking	Low	Low

Site #	Land Use	Problems	Recommendations	Impact	Technical Level to Install
08-06-01	Private Road	Culvert-Diameter too small, Culvert-Blown out, Culvert-Larger Drainage Issues	Enlarge, Assess Drainage Area, Possibly remove culvert and replace with small bridge	Medium	Medium
08-07	Trail or Path	Surface Erosion-Sheet, Road Shoulder Erosion-Gully	Reshape (Crown), Build Up	Low	Medium
08-09	Driveway	Surface Erosion-Sheet	Vegetate Shoulder, Install Runoff Diverters-Broad-based Dip, Install Runoff Diverters-Waterbar, Add to Buffer	Medium	Medium
08-10	Driveway	Surface Erosion-Rill	Install Runoff Diverters-Waterbar, Install Runoff Diverters-Rubber Razor	Medium	Medium
08-11	Private Road	Surface Erosion-Rill	Reshape Ditch, Install Turnouts, Reshape (Crown)	Medium	Medium
09-01	Driveway	Surface Erosion-Rill	Install Culvert, Reshape Ditch, Install Runoff Diverters-Broad-based Dip, Install Runoff Diverters-Open Top Culvert, Install Runoff Diverters-Rubber Razor, Install Runoff Diverters-Waterbar, Reshape (Crown), Driveway needs a culvert, siting isn’t easy. Alternately pitch driveway into ditch, install culvert with outlet stabilized or simple cheap solution could be runoff diverters. Flow is overtopping ditch and crossing road. Ditch could be deeper to prevent overtopping	Low	Medium
09-02	Residential	Surface Erosion-Sheet, Soil-Bare	Infiltration Trench @ roof dripline, Mulch/Erosion Control Mix	Low	Low
09-03	Driveway	Surface Erosion-Sheet, Soil-Bare, Other-Driveway is steep and wet at bottom, causing tire ruts and sheet erosion. Driveway ends 20' from shoreline with no buffer	Add gravel, Add recycled asphalt, Establish Buffer, Define parking. Area that is rutted could be gravel. Dig down and fill with gravel, line with timbers and plant buffer between driveway and lake	Medium	Medium

Site #	Land Use	Problems	Recommendations	Impact	Technical Level to Install
09-04	Town Road	Culvert-Unstable inlet/outlet, Culvert-Clogged, Culvert-Too short/long, Road Shoulder Erosion-Sheet	Armor Inlet/Outlet, Remove Clog, Replace, Enlarge, Realign	Low	Medium
09-05	Town Road	Surface Erosion-Sheet, Ditch-Sheet Erosion, Ditch-Bank Failure, Road Shoulder Erosion-Sheet, Roadside Plow/Grader Berm	Armor with Stone, Reshape Ditch, Install Turnouts, Install Check Dams, Remove debris/sediment, Build Up, Remove Grader/Plow Berms, Reshape (Crown), Water Retention Swales	Medium	High
09-06	Town Road	Ditch-Sheet Erosion, Ditch-Rill Erosion, Ditch-Gully Erosion, Ditch-Bank Failure, Ditch-Undersized, Road Shoulder Erosion-Sheet, Soil-Winter Sand	Reshape Ditch, Install Turnouts, Armor with Stone, Vegetate, Remove debris/sediment, Reshape (Crown), Build Up, Add gravel, Ditch needs to be dug out	Medium	High
09-07	Town Road	Culvert-Hanging Outlet, Roadside Plow/Grader Berm	Realign, Armor Inlet/Outlet, Install Ditch, Vegetate Shoulder, Reshape (Crown), Build Up, Culvert is too high for runoff to get through causing ponding, in an area where the road is very low. Overtopping is likely, about 50' from lake if it overtops. Culvert crossed street at 99 Maplewood but they opted out so cannot see outlet issues	Low	Medium
09-09	Residential	Surface Erosion-Sheet, Soil-Bare	Add gravel, Mulch, Seed/Hay, Establish Buffer, Mulch/Erosion Control Mix, Infiltration Trench, The road is pitched into house with no ditching so runoff will continue unless road is fixed. House appears to be under construction bare soil	Low	Medium
09-10	Driveway	Surface Erosion-Rill, Soil-Bare, Shoreline-Lack of Shoreline Vegetation	Build Up, Add recycled asphalt, Add gravel, Establish Buffer, Mulch/Erosion Control Mix, Driveway is steep off from road and continues to lake. Gravel driveway with buffer could work	Medium	Medium

Site #	Land Use	Problems	Recommendations	Impact	Technical Level to Install
09-11	Town Road	Culvert-Clogged, Culvert-Unstable inlet/outlet, Ditch-Undersized, Ditch-Bank Failure, Road Shoulder Erosion-Sheet, Other-Culvert outlet is under water, and road is too low so its overtopping and washing out the road.	Install Culvert, Remove Clog, Adjust Length, Install Ditch, Install Sediment Pools, Build Up, Add gravel, Reshape (Crown), plunge pool	Low	Medium
09-12	Residential	Surface Erosion-Sheet, Soil-Bare, Shoreline-Lack of Shoreline Vegetation, Shoreline-Erosion	Install Runoff Diverter (waterbar), Mulch/Erosion Control Mix, Runoff diverter into vegetated forested area	Low	Low
09-13	Residential	Surface Erosion-Rill, Soil-Bare; Either a result of construction or runoff from road	Mulch, Seed/Hay, Establish Buffer, Reseed bare soil & thinning grass, Mulch/Erosion Control Mix, raingarden	Low	Medium
09-14	Residential	Surface Erosion-Gully	Add gravel, Build Up, Driveway washed out due to lack of failed culvert uphill. Once that is fixed, then can fix driveway	Medium	Medium
09-15	Driveway	Surface Erosion-Rill, Culvert-Crushed Broken	Install Culvert, Install Plunge Pool, Enlarge, Replace, Culvert is sitting on top of road and runoff is washing out road below	Medium	Medium
09-16	Residential	Surface Erosion-Sheet, Soil-Bare, Other-Construction site. Land clearing, no erosion and sediment control measures.	Silt Fence/EC Berms, Seed/Hay, Mulch	Medium	Medium
10-01	Town Road	Culvert-Diameter too small, Ditch-Sheet Erosion	Vegetate, Remove Grader/Plow Berms	Medium	Low
10-02	Town Road	Surface Erosion-Gully, Road Shoulder Erosion-Gully, Roadside Plow/Grader Berm	Remove Grader/Plow Berms	High	Low
10-03	Driveway	Surface Erosion-Rill		Medium	Low

Site #	Land Use	Problems	Recommendations	Impact	Technical Level to Install
10-04	Private Road	Surface Erosion-Rill	Build Up, Reshape (Crown)	Medium	Medium
10-05	Town Road	Surface Erosion-Rill, Road Shoulder Erosion-Rill	Build Up, Add gravel, Reshape (Crown), Vegetate Shoulder	Medium	Medium
10-06	Private Road	Surface Erosion-Sheet, Roadside Plow/Grader Berm	Remove Grader/Plow Berms, Build Up, Reshape (Crown)	Medium	Medium
10-07	Town Road	Surface Erosion-Rill, Roadside Plow/Grader Berm	Remove Grader/Plow Berms, Add gravel, Reshape (Crown)	Medium	Medium
10-08	Private Road	Surface Erosion-Rill	Remove Grader/Plow Berms, Build Up, Add gravel, Reshape (Crown)	Medium	Medium
10-09	Town Road	Surface Erosion-Sheet, Ditch-Sheet Erosion, Road Shoulder Erosion-Sheet	Reshape Ditch, Install Catch Basin	Low	Medium
11-01	Municipal / Public	Surface Erosion-Gully, Soil-Bare, Shoreline-Unstable Access, Shoreline-Erosion, Other-Parking lot drainage being routed to lake	Vegetate, Armor with Stone, Remove debris/sediment, Add to Buffer, Reseed bare soil & thinning grass, Rain garden at corner of parking lot?	Medium	Low
11-02	Municipal / Public	Culvert-Diameter too small, Culvert-Larger Drainage Issues, Soil-Winter Sand, Shoreline-Undercut, Shoreline-Erosion, Other-Possible storm drain outfall	Remove Clog, Install Plunge Pool, Assess Drainage Area, Enlarge, Remove debris/sediment, Install Sediment Pools, Rip Rap, Assessment of storm drain system needed	Low	Medium
11-03	Construction Site	Surface Erosion-Rill, Culvert-Hanging Outlet, Road Shoulder Erosion-Sheet, Soil-Bare	Armor Inlet/Outlet, Vegetate Shoulder, Silt Fence/EC Berms, Seed/Hay, Reseed bare soil & thinning grass, Stabilize entrance area	Medium	Medium
11-04	Residential	Surface Erosion-Rill, Shoreline-Erosion, Shoreline-Lack of Shoreline Vegetation	Establish Buffer	Medium	Low

Site #	Land Use	Problems	Recommendations	Impact	Technical Level to Install
11-05	Residential	Surface Erosion-Gully, Soil-Bare, Roof Runoff Erosion, Other-HazMat, Old batteries	Drywell @ gutter downspout, Add to Buffer, Remove old batteries	Medium	Low
11-06	Residential	Surface Erosion-Sheet, Surface Erosion-Rill, Soil-Bare	Define Foot Path, Add to Buffer	Low	Low
11-07	Residential	Surface Erosion-Sheet, Soil-Bare, Shoreline-Inadequate Shoreline Vegetation, Shoreline-Erosion, Shoreline-Unstable Access, Other-Dog yard and significant dog waste	Reseed bare soil & thinning grass, Establish Buffer, Mulch/Erosion Control Mix	Medium	Low
11-08	Residential	Surface Erosion-Gully, Shoreline-Undercut, Other-Slumping unstable shoreline	Add to Buffer, Live staking, coir logs	High	Medium
11-09	Residential	Surface Erosion-Sheet, Soil-Bare, Shoreline-Undercut, Shoreline-Lack of Shoreline Vegetation, Shoreline-Erosion, Shoreline-Unstable Access	Establish Buffer, Reseed bare soil & thinning grass	Low	Low
11-10	Town Road	Surface Erosion-Gully, Culvert-Unstable inlet/outlet, Culvert-Misaligned, Culvert-Diameter too small, Culvert-Larger Drainage Issues, Culvert-Hanging Outlet, Ditch-Gully Erosion, Ditch-Bank Failure, Ditch-Undersized, Road Shoulder Erosion-Gully, Road Shoulder Erosion-Rill, Road Shoulder Erosion-Sheet, Soil-Bare, Soil-Winter Sand, Roof Runoff Erosion	Armor Inlet/Outlet, Enlarge, Realign, Armor with Stone, Reshape Ditch, Install Check Dams, Install Turnouts, Remove debris/sediment, Install Sediment Pools, Vegetate Shoulder, Remove Grader/Plow Berms	High	High
11-11	Trail or Path	Surface Erosion-Gully, Culvert-Unstable inlet/outlet, Culvert-Clogged, Culvert-Misaligned, Culvert-Hanging Outlet, Culvert-Diameter too small, Road Shoulder Erosion-	Remove Clog, Replace, Enlarge, Realign, Armor Inlet/Outlet, Recommend install arched culvert for fish passage	Medium	High

Site #	Land Use	Problems	Recommendations	Impact	Technical Level to Install
		Gully, Soil-Bare, Other-Two culverts both undersized creating erosion downstream			
11-12	Beach Access	Surface Erosion-Gully, Shoreline-Undercut, Shoreline-Inadequate Shoreline Vegetation, Shoreline-Erosion, Shoreline-Unstable Access, Other-Shoreline receding from undercut from hanging culvert	Establish Buffer, Rip Rap, Fix site 11-11	High	Medium
11-13	Residential	Surface Erosion-Sheet, Soil-Bare, Shoreline-Inadequate Shoreline Vegetation	Define Foot Path, Infiltration Trench @ roof dripline, Establish Buffer	Medium	Medium
11-14	Municipal / Public	Culvert-Clogged, Culvert-Larger Drainage Issues, Ditch-Gully Erosion, Ditch-Rill Erosion, Road Shoulder Erosion-Rill, Road Shoulder Erosion-Gully, Soil-Bare, Soil-Winter Sand, Roadside Plow/Grader Berm, Roof Runoff Erosion, Other-Culvert not evident, presence of beaver	Remove Clog, Replace, Enlarge, Install Culvert, Assess Drainage Area, Remove debris/sediment, Remove Grader/Plow Berms, Vegetate Shoulder, Establish Buffer, Remove Invasive Plants, Honeysuckle and or milfoil	High	High
A-01	State Road	Surface Erosion-Sheet, Culvert-Unstable inlet/outlet, Culvert-Blown out, Road Shoulder Erosion-Sheet	Reshape Ditch, Vegetate Shoulder, Slope/bank eroded, undercutting culvert on inlet side. Big hole. Photo 1	Low	High
A-03	Town Road	Surface Erosion-Sheet, Ditch-Sheet Erosion, Road Shoulder Erosion-Sheet, Soil-Bare	Reshape Ditch, Install Ditch, Rip Rap	Medium	High
A-04	Town Road	Surface Erosion-Sheet, Culvert-Unstable inlet/outlet, Road Shoulder Erosion-Sheet, Road Shoulder Erosion-Rill, Soil-Bare, Roadside Plow/Grader Berm	Armor Inlet/Outlet, Remove Clog, Reshape Ditch, Install Turnouts, Install Ditch, Remove Grader/Plow Berms	High	High

Site #	Land Use	Problems	Recommendations	Impact	Technical Level to Install
A-05	Town Road	Culvert-Hanging Outlet, Culvert-Unstable inlet/outlet, Road Shoulder Erosion-Sheet	Realign, Vegetate Shoulder, Very recent slope stabilization by town is evident. Rock used seems too small, needs vegetation, outlet hanging	Medium	High
A-06	State Road	Surface Erosion-Rill, Surface Erosion-Gully, Culvert-Unstable inlet/outlet, Culvert-Crushed Broken, Road Shoulder Erosion-Sheet	Armor Inlet/Outlet	Medium	High
A-07	Town Road	Surface Erosion-Sheet, Culvert-Unstable inlet/outlet, Road Shoulder Erosion-Sheet	Armor Inlet/Outlet	Low	High
A-08	Town Road	Surface Erosion-Sheet, Culvert-Clogged	Remove Clog	Low	Low
A-09	Private Road	Ditch-Gully Erosion, Soil-Bare	Vegetate, Install Check Dams	High	Medium
A-10	State Road	Surface Erosion-Sheet, Surface Erosion-Rill, Road Shoulder Erosion-Sheet, Road Shoulder Erosion-Rill	Vegetate Shoulder, Informal path to water along bridge abutment unstable. Needs vegetation	Medium	Low
A-11	Town Road	Road Shoulder Erosion-Gully, Shoreline-Undercut	Armor Inlet/Outlet, Armor with Stone, Define Foot Path, Establish Buffer, Install Runoff Diverter (waterbar), Old timber abutments being eroded and undermined from shoulder runoff	Medium	High
A-12	State Road	Culvert-Hanging Outlet	Realign	Medium	High
A-13	State Road	Surface Erosion-Sheet, Culvert-Hanging Outlet	Realign	Low	High
A-14	State Road	Surface Erosion-Sheet, Culvert-Unstable inlet/outlet, Culvert-Crushed Broken, Ditch-Rill Erosion, Ditch-Gully Erosion, Road Shoulder Erosion-Rill, Road Shoulder Erosion-Gully, Soil-Bare	Armor Inlet/Outlet, Replace	Medium	High

Site #	Land Use	Problems	Recommendations	Impact	Technical Level to Install
A-15	Town Road	Surface Erosion-Sheet, Culvert-Unstable inlet/outlet	Armor Inlet/Outlet	Low	High
A-16	Town Road	Surface Erosion-Gully, Road Shoulder Erosion-Gully, Road Shoulder Erosion-Rill, Soil-Bare	Install Ditch, Install Sediment Pools, Runoff from shoulder eroding slope along both sides of outlet	Medium	High
A-17	Town Road	Culvert-Diameter too small	Enlarge	Medium	High
A-18	Town Road	Surface Erosion-Sheet, Culvert-Too short/long, Road Shoulder Erosion-Sheet, Road Shoulder Erosion-Rill, Soil-Bare	Enlarge, Replace, Adjust Length	Medium	High
A-19	Town Road	Road Shoulder Erosion-Sheet, Soil-Bare, Roadside Plow/Grader Berm	Install Ditch, Install Turnouts, Remove Grader/Plow Berms	Medium	High
A-20	Town Road	Culvert-Hanging Outlet	Realign	Low	High
A-21	Town Road	Surface Erosion-Sheet, Road Shoulder Erosion-Sheet, Road Shoulder Erosion-Rill	Vegetate Shoulder	Low	Low
A-22	Town Road	Road Shoulder Erosion-Sheet, Soil-Bare	Vegetate Shoulder	Low	Low
A-23	State Road	Ditch-Gully Erosion, Ditch-Sheet Erosion, Ditch-Rill Erosion, Road Shoulder Erosion-Sheet, Road Shoulder Erosion-Rill, Road Shoulder Erosion-Gully, Soil-Bare	Vegetate	High	High
A-24	State Road	Surface Erosion-Sheet, Surface Erosion-Rill, Culvert-Clogged, Culvert-Unstable inlet/outlet, Road Shoulder Erosion-Sheet, Road Shoulder Erosion-Rill, Road Shoulder Erosion-Gully, Soil-Bare	Armor Inlet/Outlet, Remove Clog, Assess Drainage Area, Vegetate Shoulder	Medium	Medium

Site #	Land Use	Problems	Recommendations	Impact	Technical Level to Install
A-25	Town Road	Road Shoulder Erosion-Gully, Road Shoulder Erosion-Rill, Soil-Bare	Vegetate Shoulder, Stabilize Foot Path, Formalize and stabilize access for fishing for both sides of bridge	Medium	Low
B-01	Commercial	Surface Erosion-Rill, Shoreline-Inadequate Shoreline Vegetation, Shoreline-Erosion, Roof Runoff Erosion	Vegetate Shoulder, Infiltration Trench @ roof dripline, Add to Buffer, Mulch/Erosion Control Mix, Add to buffer, re-vegetate around boat launch areas no longer in use, potentially build up berm along the shoreline in areas that don't have a large berm. ECM on un-vegetated areas	Medium	Low
B-04	State Road	Surface Erosion-Sheet, Culvert-Unstable inlet/outlet, Ditch-Sheet Erosion, Soil-Bare	Armor Inlet/Outlet, Vegetate	Low	Low
B-06	Town Road	Surface Erosion-Gully, Culvert-Crushed Broken	Replace, Add gravel, Reshape (Crown)	Medium	Medium
B-07	Town Road	Surface Erosion-Gully, Culvert-Diameter too small, Ditch-Rill Erosion, Road Shoulder Erosion-Sheet	Enlarge, Armor with Stone, Reshape (Crown)	Medium	Medium
B-08	State Road	Surface Erosion-Sheet, Culvert-Unstable inlet/outlet, Road Shoulder Erosion-Rill	Armor Inlet/Outlet, Vegetate, Armor with Stone, Install Turnouts	Medium	Medium
B-09	Town Road	Surface Erosion-Gully, Culvert-Unstable inlet/outlet, Roadside Plow/Grader Berm	Armor Inlet/Outlet, Remove Grader/Plow Berms	Medium	Low
B-10	Town Road	Surface Erosion-Sheet, Culvert-Larger Drainage Issues, Road Shoulder Erosion-Sheet	Armor Inlet/Outlet, Vegetate, Armor with Stone	Low	Low
B-11	State Road	Surface Erosion-Gully, Culvert-Unstable inlet/outlet, Culvert-Clogged, Ditch-Sheet Erosion, Road Shoulder Erosion-Sheet	Vegetate, Armor with Stone, Install Turnouts	Medium	Low

Site #	Land Use	Problems	Recommendations	Impact	Technical Level to Install
B-12	State Road	Surface Erosion-Gully, Culvert-Unstable inlet/outlet, Ditch-Bank Failure, Road Shoulder Erosion-Gully	Armor Inlet/Outlet, Vegetate,, Reshape Ditch, Install Turnouts, Improve ditching along road sloping toward stream	High	Medium
B-13	Town Road	Surface Erosion-Gully, Culvert-Unstable inlet/outlet, Culvert-Diameter too small Road Shoulder Erosion-Gully, Roadside Plow/Grader Berm	Armor Inlet/Outlet, Enlarge, Install Ditch, Remove Grader/Plow Berms, Vegetate Shoulder	Medium	Low
B-14	Town Road	Surface Erosion-Gully, Culvert-Unstable inlet/outlet, Ditch-Gully Erosion, Road Shoulder Erosion-Sheet	Armor Inlet/Outlet, Reshape Ditch, Vegetate, Armor with Stone, Install Check Dams, Remove Grader/Plow Berms	Medium	Medium
B-15	Town Road	Surface Erosion-Sheet, Culvert-Unstable inlet/outlet	Armor Inlet/Outlet, Vegetate	Low	Low
B-16	Town Road	Surface Erosion-Rill, Ditch-Rill Erosion, Road Shoulder Erosion-Rill	Install Ditch, Armor with Stone, Add gravel	Low	Low:
B-17	Town Road	Surface Erosion-Sheet, Culvert-Unstable inlet/outlet, Culvert-Hanging Outlet, Ditch-Sheet Erosion, Road Shoulder Erosion-Sheet	Install Plunge Pool, Reshape (Crown)	Low	Low
B-18	Town Road	Surface Erosion-Rill, Culvert-Hanging Outlet, Ditch-Rill Erosion, Road Shoulder Erosion-Rill	Armor Inlet/Outlet, Install Plunge Pool	Low	Low
B-19	Town Road	Surface Erosion-Rill, Culvert-Hanging Outlet, Ditch-Rill Erosion, Road Shoulder Erosion-Sheet	Armor Inlet/Outlet, Install Plunge Pool	Low	Medium