Skaneateles Lake Watershed Nine Element Plan for Phosphorus

PRELIMINARY DRAFT – MARCH 2024

NEW YORK STATE OF OPPORTUNITY. Department of State

NEW YORK STATE OF OPPORTUNITY Department of Environmental Conservation

TOWN OF SKANEATELES INCORPORATED 1830

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RPDB

This 9E Plan was prepared with funding provided by the New York State Department of State under Title 11 of the Environmental Protection Fund.

March 2024

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SKANEATELES LAKE WATERSHED NINE ELEMENT PLAN FOR PHOSPHORUS

Prepared for:

Town of Skaneateles

Prepared by:

Central New York Regional Planning and Development Board

Ramboll, Inc.

Executive Summary

The Skaneateles Lake Watershed Nine Element Plan for Phosphorus (9E Plan) is a community-led water quality plan that assesses current conditions in the lake and watershed, looks forward to future conditions, and provides a suite of recommendations to maintain the lake's already exceptional water quality.

Because Skaneateles Lake is the unfiltered drinking water source for the City of Syracuse, it has been the focus of a robust, proactive, and effective water quality protection program for more than 25 years. And because the lake and its surrounding communities and landscape offer a high quality of life, it is an area that encourages and rewards engagement by municipalities, citizens' groups, and non-profit organizations in conservation activities. Additionally, the watershed is relatively small and there are no wastewater treatment plants or other point sources of water pollution in the watershed. As a result of these factors, Skaneateles Lake has, by all key metrics, the best water quality of the 11 Finger Lakes.

In 2017, Harmful Algal Blooms (HABs) were documented in the lake for the first time. HABs can be triggered by a range of factors, but nutrient levels – specifically levels of phosphorus – are one of the only factors that can be controlled by direct action in the watershed. As a result, the focus of this plan is on measuring existing total phosphorus (TP) inputs and evaluating expected lake conditions based on estimated TP levels under various future scenarios.

Estimates of existing and future TP loading relied on a pair of quantitative tools: the Soil and Water Assessment Tool (SWAT), which creates a digital model of conditions in the watershed, and the Loading Estimator of Nutrient Sources (LENS) tool, which captures the relative magnitude of phosphorus loading from individual on-site wastewater disposal systems (septic systems) adjacent to surface waters within the Skaneateles Watershed.

A third quantitative tool, the CE-QUAL-W2 model, was used to evaluate conditions in Skaneateles Lake under both existing conditions and various future scenarios. The in-lake model provides three key metrics of the lake's overall water quality: total phosphorus level, chlorophyll-a level, and cyanobacteria concentrations.

Key findings from the modeling include:

- Current annual phosphorus loading in the Skaneateles Lake Watershed is relatively low; loading rates by subwatershed range from .12 lbs./acre/year to 0.64 lbs./acre/year. Nationally, phosphorus loading is typically on the order of 1.0 to 1.5 lbs./acre/year.
- The total annual phosphorus load to the lake is estimated at approximately 13,000 pounds.
- Climate change and development are expected to increase total phosphorus loading by approximately 820 pounds per year.
- The scenario that was most effective in reducing phosphorus and cyanobacteria levels in the lake was a scenario that combined the effects of implementing multiple BMPs, including expanded agricultural BMPs, filter strips along riparian corridors, and reduced septic system failures.
- Completing approximately 3.15 miles of streambank stabilization work over the next 30 years would offset the nutrient loading anticipated to result from climate change.

Overall, the modeling suggests that watershed stakeholders should continue to work together to implement projects, policies, and programs to increase hydrologic resilience – that is, to reduce the

amount and rate of stormwater runoff to the lake. In addition to the modeled BMPs, the 9E Plan includes a range of recommendations that can be implemented by homeowners, municipalities, farmers, nonprofits, and other watershed stakeholders. These recommendations extend beyond nutrient loading, and into areas such as public education and invasive species management.

Following approval of the 9E Plan, the Central New York Regional Planning and Development Board (CNY RPDB) will convene an Implementation Team that will be comprised of members of the existing WAC, as well as other organizations, such as academic institutions, that were not part of the WAC but are likely to support project implementation in the watershed. Quarterly meetings of this group will ensure that watershed stakeholders are able to collaborate on project ideas and remain aware of ongoing activities in and around Skaneateles Lake.

Skaneateles Lake has long been prized as a one-of-a-kind asset. In 1870, former Secretary of State William Seward told a group of visitors from Skaneateles: “Your own Skaneateles was the first lake I ever saw. I have since seen many others in North America, and some elsewhere. Nevertheless, I still think your little lake, with the smiling village of Skaneateles reflected in its blue waters, is about the finest one I ever saw” (New York Times, 1870). Mr. Seward’s words are a reminder that we are temporary custodians of the lake and that we have a duty to future generations to work together to protect it.

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Abbreviations

9E	Nine Element Plan
AEM	Agricultural Environmental Management
BMP	Best Management Practice
CAFO	Concentrated Animal Feeding Operation
CALM	Consolidated Assessment and Listing Methodology
CCE	Cornell Cooperative Extension
CE-QUAL-W2	Army Corps of Engineers Water Quality Model in 2 Dimensions (In-Lake Model)
CSLAP	Citizens Statewide Lake Assessment Program
DBP	Disinfection Byproduct
ELAP	Environmental Laboratory Accreditation Program
FLLT	Finger Lakes Land Trust
FL-PRISM	Finger Lakes Partnership for Regional Invasive Species Management
HAB	Harmful Algal Bloom
HRU	Hydrologic Response Unit
HUC	Hydrologic Unit Code
HWA	Hemlock Wooly Adelgid
LENS	Loading Estimator of Nutrient Sources
MCL	Maximum Contaminant Level
MS4	Municipal Separate Storm Sewer Systems
NLCD	National Land Cover Database
NOAA	National Oceanic and Atmospheric Administration
NYSAGM	New York State Department of Agriculture and Markets
NYSDEC / DEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSDOS / DOS	New York State Department of State
OGS	New York State Office of General Services
OWTS	Onsite Wastewater Treatment Systems
QAPP	Quality Assurance Project Plan
SLA	Skaneateles Lake Association
SLWAP	Skaneateles Lake Watershed Agricultural Program
SPDES	State Pollutant Discharge Elimination System

SWAT	Soil & Water Assessment Tool (Watershed Model)
SWCD	Soil and Water Conservation District
TN	Total Nitrogen
TNC	The Nature Conservancy
TP	Total Phosphorus
TS	Trout Spawning
UFI	Upstate Freshwater Institute
USACE	United States Army Corp of Engineers
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VHS	Viral Hemorrhagic Septicemia
WAC	Watershed Advisory Committee
WI/PWL	Waterbody Inventory/Priority Waterbodies List
WISPA	New York State Watercraft Inspection Steward Program Application

1. Introduction

More than two million years ago, glaciers moved across the landscape of what we now know as Upstate New York. Glacial action carved out the basins of the eleven Finger Lakes, including Skaneateles Lake, the subject of this plan. Skaneateles Lake is situated on the eastern end of the Finger Lakes region, with its watershed extending into three counties: Onondaga, Cayuga, and Cortland.

Skaneateles Lake is part of the Seneca-Oswego-Oneida Basin, which drains an area of more than 5,000 square miles. The lake's outlet is at its northern end, in the Village of Skaneateles, where Skaneateles Creek begins its 14-mile run to meet the Seneca River. The Seneca River watershed contains several of the eastern Finger Lakes (Figure 1.1). The Seneca and Oneida Rivers meet in Central New York at Three Rivers, where they form the Oswego River, which flows north to Lake Ontario.

Skaneateles Lake is a remarkable resource for the Central New York region: a water source of such high quality that the water does not need an expensive treatment system to be potable. Careful management over the past 30 years combined with a relatively small, relatively undeveloped watershed have ensured that human activities have not diminished the lake's water quality.

But Skaneateles Lake's future may be more complicated than its past. Invasive species, both terrestrial and aquatic, have altered the lake and threaten to change the landscape. Climate change has already affected weather patterns in the watershed and may mean that the frequency of severe weather events increases in coming decades, overwhelming existing infrastructure.

The purpose of this Nine Element (9E) Plan is to provide a data-driven basis for actions in the watershed to ensure that the lake continues to meet the highest water quality standards. This plan provides a starting point for an adaptive management approach to the Skaneateles Lake watershed; over time, the effects of project implementation will be evaluated and implementation strategies will be adjusted as needed.

1.1. Watershed Profile

Issues Impacting the Watershed

Skaneateles Lake is a highly valued water resource that supports multiple uses. In New York, all surface waters are classified by best use based on stream flow, water quality, habitat, land use, and other considerations. Skaneateles Lake (Segment ID, 0707-0004) is classified by the New York State Department of Environmental Conservation (DEC) as an AA lake, meaning that it meets that State's standards as a source of water supply for drinking, culinary, or food processing purposes, as well as for primary and secondary contact recreation, and for fishing.

The most recent NYSDEC Waterbody Segment Assessment Fact Sheet (dated December 7, 2021) lists Skaneateles Lake as "fully supported" for both primary recreation (such as swimming) and secondary contact recreation (where contact with the water is incidental, such as boating).

The assessment lists the lake as "stressed" as a water supply source, based on data from the 2017 Citizens Statewide Lake Assessment Program (CSLAP). The 2017 CSLAP report for Skaneateles Lake identifies the

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Figure 1.1 – Skaneateles Watershed Boundary & Seneca Watershed

Esri, TomTom, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, USFWS, Esri, USGS, CHS, Esri, GEBCO, Garmin, NaturalVue

Coordinate System: NAD 1983 UTM Zone 18N

presence of Harmful Algal Blooms (HABs) as the reason for the "stressed" rating (NYSDEC, 2017). Note that all the assessments in the updated fact sheet are categorized as "unconfirmed."

Since 2017, Skaneateles Lake has experienced algal blooms and documented multiple occurrences of cyanobacterial blooms. As NYSDEC's *Harmful Algal Bloom Action Plan for Skaneateles Lake* states: "HABs were first documented in Skaneateles Lake on September 12, 2017, then again on September 16 and 25, and finally on October 2. (NYS DEC, 2020)" However, the *HAB Action Plan* also notes that:

> Cyanobacteria commonly occur in all lakes at low concentrations that do not pose a health concern. NYSDEC and other researchers are continuing to evaluate whether blooms reported in 2017 represent surface shoreline concentrations of "normal" cyanobacteria densities usually distributed throughout the water column, or an unprecedented rise in cyanobacteria growth. (NYS DEC, 2020)

Several factors are thought to be related to the occurrence of HABs in a lake, including total phosphorus levels, the presence of dreissenid mussels, the maximum lake fetch length, and the lake compass orientation of the maximum fetch length.

According to the *HAB Action Plan for Skaneateles Lake*, "for every 0.01 mg/L increase in total phosphorus levels, the probability that a lake in New York will have a HAB in a given year increases by about 10% to 18%" (NYSDEC, 2020).

Research shows that the presence of dreissenid mussels is associated with an increase in the annual HAB probability of 18% to 66%. Research indicates that mussels selectively feed on algae, filtering out harmful cyanobacteria. This can lead to increased concentrations of HABs in lakes with substantial mussel populations.

Lakes with long fetch lengths (long expanses of open water that allow the wind to blow without interruption) are also associated with HABs formation. The *HAB Action Plan* states that "for every mile of increased fetch length, lakes are associated with up to a 20% increase in the annual probability of HABs" (NYS DEC, 2020). Lakes with a northwest orientation along their longest fetch are also more likely to see HABs than other lakes.

Skaneateles Lake has three of the four factors described above: the presence of dreissenid mussels, a northwest orientation, and a relatively long fetch length. However, the lake's phosphorus levels are relatively low. The *HAB Action Plan* hypothesizes that the occurrence of HABs in 2017 may have resulted from the combination of an unusually wet growing season, warm surface water, a period of calm winds, and increased daily precipitation in early September.

Of the risk factors identified that are associated with the occurrence of HABs, only phosphorus loading can be meaningfully altered through human action at the local level. The *HAB Action Plan for Skaneateles Lake* identified a wide range of actions that would reduce the probability of future HABs, including development of a 9E plan (NYS DEC, 2020).

1.2. Existing Plans and Initiatives

Water Resources Planning and Related Documents

- *Harmful Algal Bloom Action Plan – Skaneateles Lake*, New York State Department of Environmental Conservation

- *Skaneateles Lake Watershed Plan*
- *Skaneateles Lake Data Review and Gap Analysis*, New York State Department of Environmental Conservation
- *Water quality and flow of ten tributaries to Skaneateles Lake*, CNY RPDB
- *Water quality and limnological monitoring of Skaneateles Lake*, Town of Skaneateles

1.3.9E Plan Development Process

What is a Watershed Plan?

A watershed plan is a community-based effort to address the water quality issues in a given water body by improving conditions on the landscape surrounding that water body. Because watershed boundaries often span municipal boundaries and can include heavily developed areas, pristine natural settings, and everything in between, watershed plans are necessarily collaborative and intermunicipal, involving a variety of stakeholders.

The goals of a watershed plan are to document existing conditions, identify major issues in the watershed (i.e., point and non-point sources of pollution), and develop consensus around a set of recommendations to improve conditions in the watershed. This can include going beyond problem-solving to improve existing resources, such as wildlife habitat, or to otherwise enhance the community's enjoyment of the watershed or water body.

What is a 9E Plan?

The 9E Plan structure was developed by the US Environmental Protection Agency, and includes certain analytical components not always utilized in watershed plans. A 9E Plan can include the components of a traditional watershed plan, but it must include these additional quantitative elements to be approved as a 9E Plan. NYS DEC provides guidance on the 9E process and reviews and approves the final document. The analytical elements relate primarily to the means of quantifying pollutant levels and pollutant sources in the watershed, identifying a water quality target, and identifying the best management practices (BMPs) that will help to achieve the pollutant reductions needed to meet the water quality target.

The nine minimum elements in a 9E Plan are intended to ensure that the contributing causes and sources of nonpoint source pollution are identified, that key stakeholders are involved in the planning process, and that restoration and protection strategies are identified that will address the water quality concerns.

Table 1.1 provides the location (by section) of each of the nine minimum elements in the 9E Plan document.

Table 1.1 – Location of the Nine Element Plan Components in the Document

Nine Element Criteria	NYS DEC / US EPA Definition	Location in Document (Section)
Element A	Identify and quantify sources of pollution in the watershed	3.3
Element B	Identify water quality target or goal and pollutant reductions needed to achieve this goal	4.1 & 4.2
Element C	Identify the best management practices (BMPs) that will help to achieve the reductions needed to meet water quality goal/target	4.3, 4.4, Table 5.1
Element D	Describe the financial and technical assistance needed to implement the BMPs identified in Element C	6.4
Element E	Describe the outreach to stakeholders and how their input was incorporated and the role of stakeholders in implementing the plan	1.4
Element F	Estimate a schedule to implement the BMPs identified in plan	6.5
Element G	Describe the milestones and estimated time frames for the implementation of BMPs	6.5
Element H	Identify the criteria that will be used to assess water quality improvement as the plan is implemented	7.0
Element I	Describe the monitoring plan that will collect water quality data needed to measure water quality improvement (the criteria identified in Element H)	7.1 & 7.2

Agencies and Organizations

The New York State Department of State (NYSDOS) provided funding for this project under Title 11 of the Environmental Protection Fund. NYSDOS contracted with the Town of Skaneateles to provide funding to the Central New York Regional Planning and Development Board (CNY RPDB) to provide project management services on this project. The CNY RPDB is responsible for coordination with the NYSDOS, other state, regional, and local entities, and consultants.

A Watershed Advisory Committee (WAC) was assembled to provide input on the plan throughout its development. WAC members included representative from the following municipalities, organizations, firms, and agencies:

- Cayuga County Department of Planning and Economic Development
- Cayuga County Soil and Water Conservation District
- City of Syracuse
- Central New York Land Trust (CNY Land Trust)
- Cornell Cooperative Extension (CCE)
- Cortland County Soil and Water Conservation District (SWCD)
- Anchor QEA
- Finger Lakes Land Trust (FLLT)
- New York State DEC (NYSDEC)
- New York State Department of State (NYSDOS)

- Onondaga County Office of the Environment
- Onondaga County Department of Planning
- Onondaga County Legislature
- Onondaga County Soil & Water Conservation District (SWCD)
- Ramboll
- Skaneateles Lake Association (SLA)
- Skaneateles Lake Watershed Agricultural Program (SLWAP)
- The Nature Conservancy (TNC)
- Town of Niles
- Town of Scott
- Town of Sempronius
- Town of Skaneateles
- Town of Spafford
- Upstate Freshwater Institute
- Village of Skaneateles

NYSDOS reviewed and approved project deliverables, as well as provided guidance to the WAC and the Modeling Team. NYSDEC reviewed and approved the 9E Plan to ensure that the report included all the required elements. NYSDEC also funded development of the digital models used to analyze the watershed and assess the results of various scenarios.

Local Match

The Skaneateles Lake Association (SLA) and the Town of Skaneateles provided a portion of the local match for the NYS DOS grant that funded preparation of this 9E Plan. This funding supported UFI's tributary monitoring, which was utilized to calibrate the modeling in the plan.

Modeling Team

The 9E Planning process is organized around the development of digital models that are calibrated to existing watershed conditions and that can be used to test the water quality implications of changes in the watershed. In the case of the Skaneateles 9E, this meant the development of two models: one to simulate conditions in the watershed (the Watershed Model) and another to provide detailed information on the lake itself (the In-Lake Model). Additionally, nutrient loading from on-site wastewater disposal systems (septic systems) was estimated using the Loading Estimator of Nutrient Sources (LENS) tool.

Modeling activities for this plan were coordinated by staff from Ramboll. The In-Lake Model was prepared by the Upstate Freshwater Institute, based in Syracuse. The Watershed Model was prepared by LimnoTech, a firm based in Michigan.

To ensure that the modeling process proceeded with input from the WAC, a Modeling Team met monthly to discuss data collection, data processing, ideas and concerns from the WAC, and the development of modeling scenarios.

Modeling Team members included representatives from the following agencies and firms:

- NYSDOS
- NYSDEC
- New York State Office of General Services (OGS)

- Ramboll
- LimnoTech
- Upstate Freshwater Institute (UFI)
- AnchorQEA
- CNY RPDB

Pollutant of Concern: Phosphorus

HABs are a significant concern for all Skaneateles Lake stakeholders. As noted in Section 1.1, the exact cause of HABs can be difficult to determine, and the causes of HABs may vary from one location to another. But it is clear that cyanobacteria thrive in a mix warm temperatures, sunlight, and high levels of nutrients – phosphorus and nitrogen. According to data from the New York Climate Change Science Clearinghouse, temperatures will continue to increase over the next 40 to 50 years, with the severity of rainfall events increasing (NYSERDA, 2022). With increased rainfall will come increased stormwater runoff from the land uses in the watershed. Action at the watershed cannot alter air temperature or the amount of rain that falls, but it can alter what runs off the land into the water – most importantly, the amount of the critical nutrient phosphorus.

Because phosphorus levels are so important to the overall health of Skaneateles Lake, the focus of this plan is on ensuring that total phosphorus levels in the lake remain at or near existing levels in the future, even as climate change increases precipitation levels and nutrient runoff.

Quality Assurance Project Plans (QAPPs)

New York State-funded projects that involve collection of environmental data and/or use modeling require development and formal approval of a Quality Assurance Project Plan (QAPP). Three QAPPs were required for this project. David A. Matthews, PhD., prepared the tributary monitoring QAPP (Appendix A), which was critical to providing sufficient data to support the 9E. Dr. Matthews also prepared the QAPP for the In-Lake Model (Appendix B). This document describes the methods and quality assurance practices to be used in the development of the CE-QUAL-W2 (Version 4.1) model used to simulate bathymetry, chemistry, meteorological conditions, and other factors influencing the water quality of Skaneateles Lake.

Cheslie Boles, project manager for LimnoTech, prepared the QAPP for the Watershed Model (Appendix C). This document provides details on the assumptions made, data to be used, and methods to be applied to ensure that the watershed model, the Soil and Water Assessment Tool (SWAT) reflects conditions in the Skaneateles Lake Watershed to the greatest extent possible.

CE-QUAL-W2

The In-Lake Model selected for this project is known as 'CE-QUAL-W2', an acronym that refers to its origins with the Army of Corps of Engineers (CE) in the 1980s and 1990s, its focus on water quality (QUAL), and its use of width averaging in two dimensions (W2). CE-QUAL-W2 is a public domain two-dimensional hydrothermal/transport and eutrophication model. This model was selected because its structural features are a good fit for Skaneateles Lake's long and narrow basin (long and relatively narrow) and because an earlier version of CE-QUAL-W2 was successful in simulating thermal features of the lake. CE-QUAL-W2 is also the most widely used hydrothermal/transport model in the US and one that UFI has successfully used on other similar lakes.

Soil and Water Assessment Tool (SWAT)

The 9E Plan approach relies on a quantitative watershed model that predicts the transport of pollutants to the water body and that can be used to make recommendations to meet the 9E targets. SWAT is a model that is designed to simulate the movement of both particulate and dissolved phosphorus from the watershed to surface water; these biologically available nutrient inputs affect the proliferation of algae and cyanobacteria.

SWAT is a public domain model that has been the subject of more than 2,000 scientific journal articles. Though SWAT is typically employed at the scale of a watershed, many calculations are carried out on smaller land units called hydrologic response units (HRUs). These HRUs represent unique combinations of soil type, slope, and land use (LU). In a large model, HRUs may be very general and represent only the most dominant combinations of these factors; however, fine scale models can retain a large number of these unique soil-slope-land combinations. SWAT is capable of representing a range of agricultural crops and management conditions, and it provides outputs for hydrology, nutrients, sediment, and pesticides at a daily time step.

The SWAT model approach has been successfully used to model other Finger Lakes watersheds, including Seneca and Keuka Lakes, Cayuga Lake, Canandaigua Lake, and Owasco Lake.

LENS Screening Tool

The SWAT model is widely accepted as a model to estimate movement of water and materials from the landscape to the waterways, but it is less frequently used to simulate the movement of nutrients through groundwater. The Modeling Team used the NYSDEC's Loading Estimator of Nutrient Sources (LENS) tool to capture the relative magnitude of phosphorus load from individual on-site wastewater disposal systems (septic systems) adjacent to surface waters within the Skaneateles Watershed. LENS combines several simple steady state models into a single screening tool that can be used to estimate the relative contribution of phosphorus to a receiving water (Stainbrook, Ross, Davis, & Townley, 2022).

1.4. Public Participation and Outreach

A *Public Participation Plan* was developed for this project in conjunction with the NYSDOS, NYSDEC, and project stakeholders. This plan outlines the public participation strategy that was used in the development of this plan, specifically:

- Convening the WAC
- Regular meetings of the Modeling Team
- The role of the Public Outreach Subcommittee
- Development of a project website (https://skaneateles9e.cnyrpdb.org/)
- A minimum of three public meetings.

Public meetings were held on the following dates:

- June 15, 2022 – In-person meeting at Lourdes Camp, Town of Spafford
- June 22, 2022 – Virtual public meeting (held via Zoom)
- January 30, 2024 – In-person meeting, Town of Skaneateles Town Hall
- Public Meeting #3 - TBD

Project Vision

The following vision statement was the product of discussions with the WAC and input from meeting attendees at the public meetings in 2022:

Maintain the excellent water quality in Skaneateles Lake to ensure continued enjoyment and use of the lake for drinking water, recreation, aesthetic, social, and community value as well as habitat for a diverse assortment of native species. Implement sustainable watershed management practices to improve the ecological integrity of the land and water for all forms of life.

Project Goals

Building on input from the public, the WAC condensed a range of goals and areas of concern for the watershed to the following areas:

Land Use and Stormwater Management Goals

- Enhance measures to capture and infiltrate stormwater across the landscape.
- Continue the work that is being done with the agricultural community through the Skaneateles Lake Watershed Agricultural Program.
- Best Management Practice (BMP) selection and design will factor in projected changes in climate and rainfall.

Residential Inputs

- Work with residents / property owners to implement BMPs that will improve water quality.
- Continue to promote lake-friendly living practices among watershed residents.

Roadway Maintenance

- Work with State DOT and local highway departments to implement maintenance practices to minimize adverse water quality impacts.

Invasive Species Management

- Implement programs in prevention, early detection, and rapid response to aquatic and terrestrial invasive species.

Education & Outreach

- Continue to educate watershed stakeholders on issues, opportunities to participate in water quality improvement, and ongoing lake protection activities.
- Continue to build community awareness of how human activities affect the future of the Skaneateles Lake Watershed.

2. Watershed Characterization

2.1. Physical and Natural Features

2.2. Lake Origin and Geographic Location

Skaneateles Lake was formed more than 2 million years ago during the Pleistocene Epoch. Glacial scouring carved deep slices into the land through the area, moving land and rocks southward. As the ice gradually melted and the glaciers receded, valleys of water dammed by unconsolidated glacial debris were left, which are now the Finger Lakes (NYS DEC 2020).

Skaneateles Lake takes its name from the Haudenosaunee for "long lake". It is one of the 11 Finger Lakes located in Central New York. It is the third deepest, has the fourth largest volume and is the fifth smallest by surface area of the Finger Lakes (Upstate Freshwater Institute 2019). The Skaneateles Lake Watershed encompasses portions of Cortland, Cayuga, and Onondaga counties. It is within the Oswego River Drainage Basin Series, specifically the Skaneateles Creek Drainage Basin, encompassing approximately 59 square miles (37,760 acres) (Skaneateles Lake Association 2015).

2.3. Lake Morphology

Skaneateles Lake is 16 miles long with a northwest orientation, a maximum width of 1.5 miles, average width of 0.75 miles and approximately 34 miles of shoreline (Figure 2.1). The lake is bordered along portions of its length by steep cliffs. It is topographically elevated at 863 feet above mean sea level and has a surface area of 13.6 square miles (8,704 acres), which is approximately one fourth of the basin area. This relatively low watershed-to-lake ratio is often associated with higher water retention times as well as relatively low sedimentation rates and land-based loading of phosphorus. Skaneateles Lake has a volume of 413 billion gallons, a maximum depth of approximately 315 feet and an average depth of 145 feet (NYS DEC 2020). The deepest waters in Skaneateles Lake are located approximately mid-lake from north to south, offshore of the Hamlet of Mandana, in the lake's central channel. Due to its steeply sloping, "U"-shaped bathymetry, the lake has a small littoral zone (i.e., nearshore zone of full sunlight penetration), and 80 percent of the lake exceeds 30 feet in depth. There is no primary inlet, but many tributaries and a single natural outflow at the northern end of the Lake, Skaneateles Creek. The lake is classified as oligotrophic, characterized by low levels of nutrients and elevated dissolved oxygen (NYS DEC 2020).

2.4. Soils

The major soil associations found in the northern two-thirds of the watershed are: Honeoye-Lima, Lansing-Conesus, Honeoye-Lansing, and Aurora-Angola-Darien. These associations are generally characterized as deep, medium textured silt loams and gravelly silt loams. Permeability is slow to moderate and seasonal groundwater is generally 15 inches to less than 36 inches.

The Langford-Erie Association comprises the southwestern portion of the watershed. It is considered a deep, medium textured silt loam. The soils are slowly to moderately permeable. Seasonal groundwater and bedrock are shallow at between six and 20 inches for the Langford Series, and between 20 and 40 inches for the Erie series.

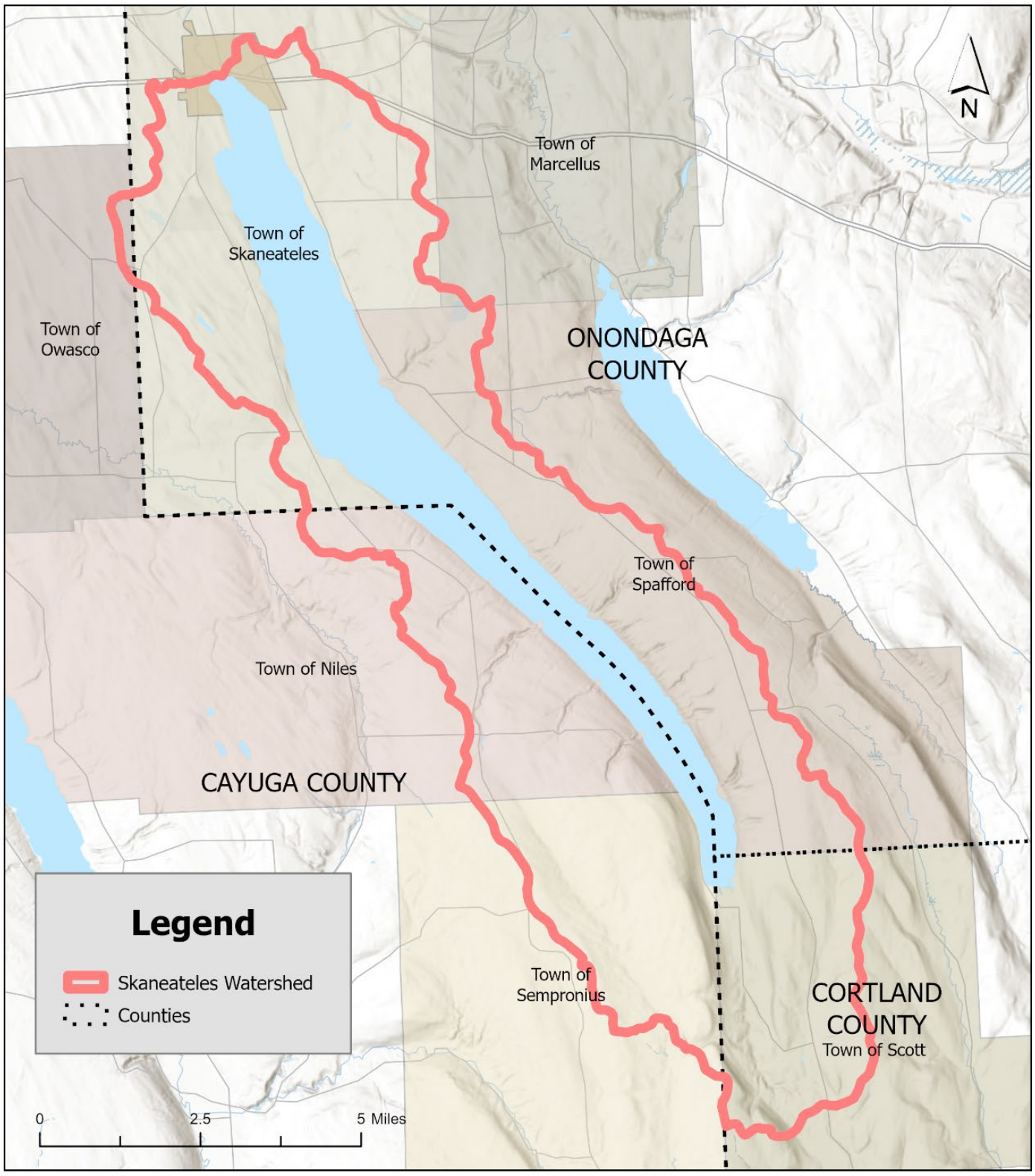


Figure 2.1 – Skaneateles Watershed Boundary

Esri, NASA, NGA, USGS, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, USDA, Esri, USGS

Coordinate System: NAD 1983 UTM Zone 18N

There are three associations found primarily within Cortland County (the southeastern portion of the watershed): Valois-Langford-Lansing, Volusia-Mardin-Lordstown, and Lordstown-Volusia-Mardin. The soils are medium textured silt loams and gravelly silt loams. Slopes can be extreme and can exceed 55 percent. They are poorly to well drained and very slowly to moderately permeable. Seasonal groundwater ranges from 18 inches to 60 inches (City of Syracuse 2020).

All soils in the watershed pose a severe risk of erosion if left bare, with increasing degree of slope compounding the potential for soil loss. The use of conventional onsite wastewater treatment systems (OWTS) is severely limited due to high seasonal groundwater, degree of slope, and poor permeability (City of Syracuse 2020).

2.5. Topography

Much of the lake's shoreline is steeply sloped, especially at the southern end of the lake where cliffs can exceed 100 feet in height (Figure 2.2). Generally, the elevation is higher and the slopes are steeper in the southern portion of the watershed as compared to the northern area. The highest elevation is found in the southeastern watershed at 1,980 feet above sea level (City of Syracuse 2022).

2.6. Hydrology

Skaneateles Lake's hydraulic retention time, or the average amount of time it takes water to pass through the lake, is relatively long: approximately 18 years on a fully mixed basis (Upstate Freshwater Institute 2019). The lake drains north to Skaneateles Creek, which flows into the Seneca River, and from there to Lake Ontario.

2.7. Water Quality Classifications

All surface waters in New York State are classified according to their best uses, such as drinking water, swimming, boating, and fishing, with each classification assigned a specific letter rating (A, B, C, and D – see Table 2.1). Water quality standards associated with each classification define the maximum allowable levels of chemical pollutants for that class. Standards are intended to ensure that water bodies can continue to be used for their best uses. New York State Regulation 6 Part 703 defines these standards.

Skaneateles Lake and Skaneateles Creek

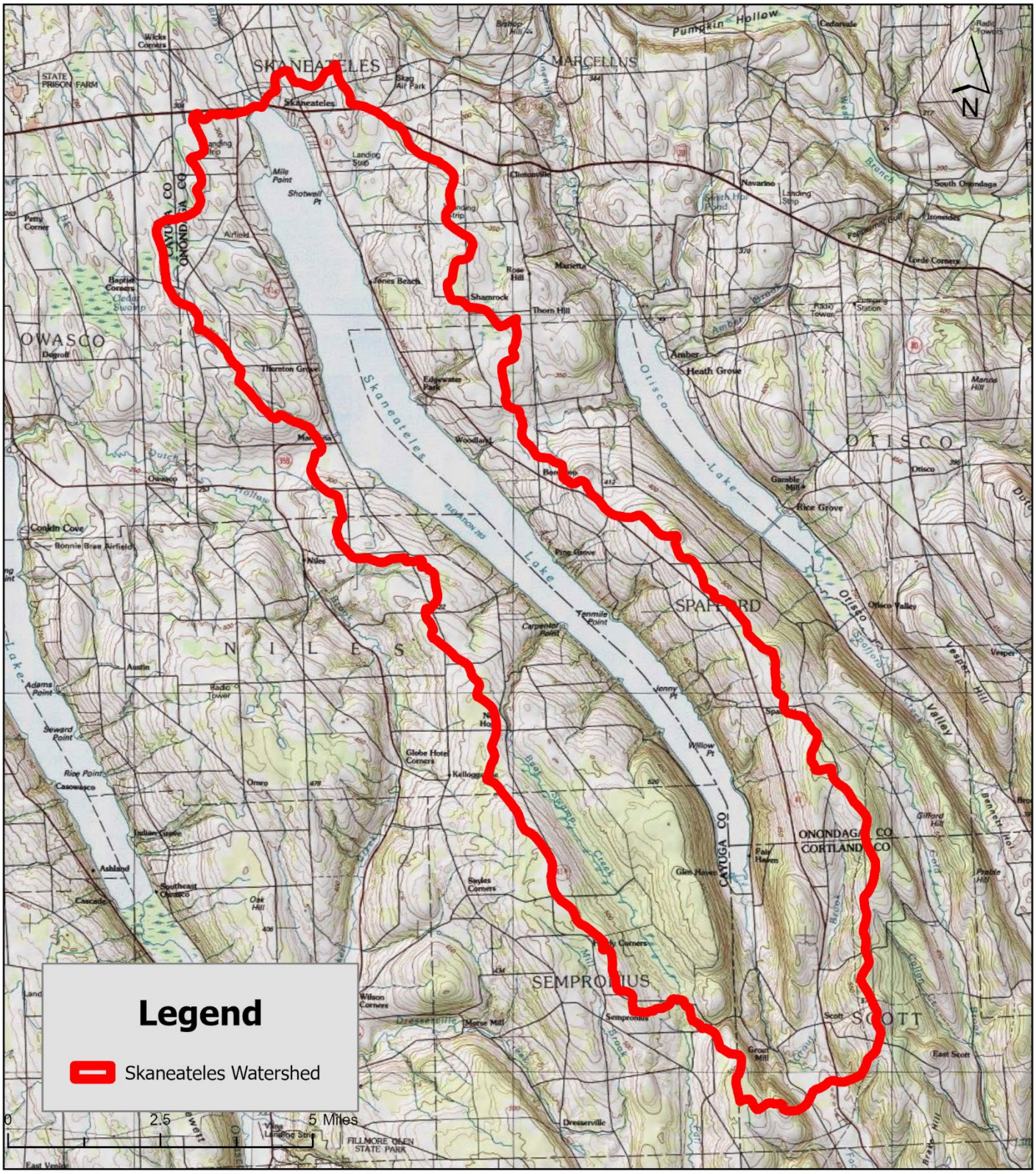
Skaneateles Lake is a Class AA waterbody, best utilized for drinking water, culinary or food processing purposes, primary and secondary contact recreation, and fishing. Class AA waters, if subjected to approved disinfection treatment, with additional treatment (if necessary) will meet New York State Department of Health (NYSDOH) drinking water standards (New York State 2021). Skaneateles Lake is the unfiltered water supply for the City of Syracuse.

Skaneateles Creek is a Class C(T) watercourse, indicating it is best used for fishing, fish propagation and survival, primary and secondary contact recreation, and must meet water quality standards set for trout survival (see Table 2.2).

Major Tributaries

The four largest tributaries to Skaneateles Lake, in terms of the surface area they drain, are:

- Bear Swamp Creek,
- Grout Brook,



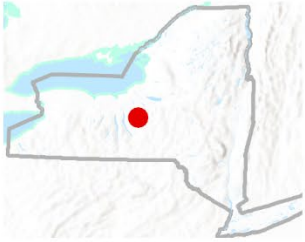


Figure 2.2 – Skaneateles Watershed Topography

ESRI, Esri, NASA, NGA, USGS, FEMA, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, USDA, Esri, USGS

Coordinate System: NAD 1983 UTM Zone 18N

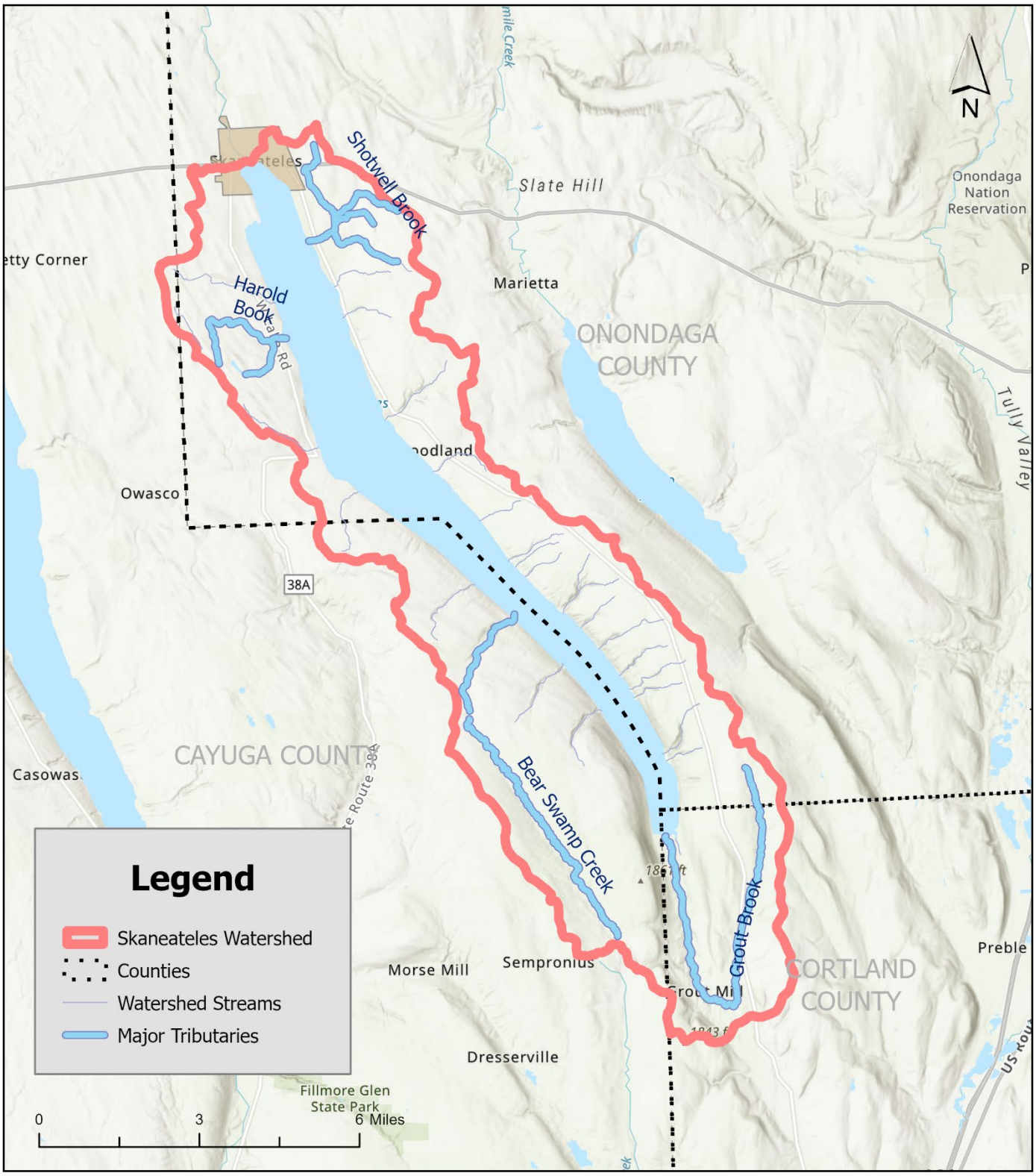


Figure 2.3 – Major Tributaries

Esri, CGIAR, USGS, Esri, USGS, Esri, TomTom, Garmin, SafeGraph, METI/NASA, USGS, EPA, NPS, USDA, USFWS

Coordinate System: NAD 1983 UTM Zone 18N

- Shotwell Brook, and
- Harold Brook.

Between them, these four streams drain approximately 60 percent of the lake's watershed (Upstate Freshwater Institute 2019). Figure 2.3 shows the location of these major tributaries.

Bear Swamp Creek

Bear Swamp Creek is a Class AA(T), second order stream. It originates from an extensive, but narrow, wetland complex in the southwest portion of the Skaneateles Lake Watershed in Bear Swamp State Forest. The creek meets Skaneateles Lake at Carpenter Point. The drainage area is nine square miles, of which 62 percent is forested.

Bear Swamp Creek runs north from the uplands on the southwest side of the lake, forming Carpenters Falls on its way to its outlet on the west side of Skaneateles Lake. The Bear Swamp Creek Subwatershed has some of the steepest slopes in the watershed, with a maximum slope of 151 percent. Mean slope is 8 percent, and 11 percent of the subwatershed is made up of steep slopes.

Grout Brook

Grout Brook is a Class AA(T) stream that originates south of Skaneateles Lake, entering the lake in the Town of Scott in Cortland County. Grout Brook's drainage area is approximately ten square miles – the largest area of the four major tributaries. The bulk of this area (60 percent) is forested. Agricultural uses are concentrated in the eastern part of this subwatershed.

The topography of the Grout Brook subwatershed is a mix of steep slopes and gentle terrain. Over a third of the subwatershed is comprised of steep slopes, and Grout Brook has the highest average slope of any of the major or minor watersheds: 15 percent. Grout Brook starts in the uplands to the east of the lake and runs due south through steep terrain, before turning north to run through the relatively gentle terrain in the flatlands south of the lake.

Shotwell Brook

Shotwell Brook enters Skaneateles Lake in the northeast corner of the lake, approximately one mile south-southeast of the Village of Skaneateles and the City of Syracuse's drinking water intakes; the creek flows under Highway 20 east of the Village of Skaneateles.

Shotwell Brook has the third largest watershed of the major tributaries (3.5 square miles). Shotwell Brook's watershed has the largest percentage of developed land of the major tributaries (7 percent); more than two-thirds of this drainage area is used for agriculture (64 percent). The Shotwell Brook subwatershed is characterized by gently sloping terrain. The average slope gradient is 5 percent, and the average slope for the subwatershed is 3 percent.

Harold Brook

Harold Brook is a second order stream located in the northwest region of the lake; it enters Skaneateles Lake approximately 2.5 miles southwest of the drinking water intakes. Of the lake's four major tributaries, Harold Brook has the smallest drainage area (two square miles), but it has the largest percentage of agricultural land (73 percent) (Upstate Freshwater Institute 2019). The Harold Brook subwatershed is characterized by gentle slopes; the average slope is 5.6 percent.

Table 2.1 – New York State Water Quality Classifications

Classification	Best Uses
A, AA, A-S, AA-S	Source of drinking water, swimming and other recreation, and fishing
B	Swimming and other recreation, and fishing
C	Fishing
D	Fishing (but these waters will not support fish propagation)
Additional Designations	
(T)	Suitable for Trout
(TS)	Suitable for Trout Spawning

Table 2.2 – Waterbody Classifications and Standards for the Skaneateles Creek Drainage

Surface Water Body	Description	Class	Standards
Skaneateles Lake	Located at source of Skaneateles Creek and extending southeasterly of Village of Skaneateles for a length of approximately fifteen miles.	AA	AA
Tribs. of Skaneateles Lake	Enters Skaneateles Lake from generally easterly directions in section beginning at Village of Skaneateles and extending along easterly side of lake to Fivemile Point.	AA	AA
Trib. of Skaneateles Lake	Enters Skaneateles Lake from northeast at Fivemile Point and 5.5 miles southeast of Skaneateles.	AA	AA
Tribs. of trib. 14 of Skaneateles Lake	Enter trib. 14 of Skaneateles Lake from east and northeast 0.7 and 1.0 mile upstream from mouth respectively and 1.8 and 1.5 miles southwest of Thorn Hill.	AA	AA
Tribs. of Skaneateles Lake	Enter Skaneateles Lake from generally easterly directions in section beginning at Hardscrabble Point and extending along easterly side to southerly end of Lake.	AA	AA
Grout Brook	Enters southerly end of Skaneateles Lake from south 1.5 miles south of Spafford Landing.	AA	AA(T)
Tribs. of Grout Brook	Enter Grout Brook in section beginning 1.0 mile upstream from mouth and 3.7 miles south of Spafford and extending upstream to source.	AA	AA
Tribs. of Skaneateles Lake	Enter Skaneateles Lake from generally westerly directions in section beginning at southerly end and extending along the westerly side of lake to Carpenter Point.	AA	AA
Skaneateles Creek	Enters Seneca River from east 0.2 mile east of Bonta Bridge and 2.0 miles northwest of center of Jordan. From mouth to Penn Central Railroad Bridge north of Village of Jordan.	C	C
Skaneateles Creek	From the Penn Central Railroad Bridge north of Village of Jordan to outlet of Skaneateles Lake (P 193).	C	C(T)

*Source: Table 1, **6 CRR-NY 896.4NY-CRR; https://govt.westlaw.com/; current through April 15, 2021***

Minor Tributaries

In addition to the four major tributaries to Skaneateles Lake, there are more than 140 smaller tributaries, many of which are ephemeral (meaning that they only carry water during, and for a short period after, precipitation events). While each of the lake's minor tributaries has a relatively small impact on total water quality, the aggregate effect of these streams' inputs is substantial.

Inflows and Outflows

Skaneateles Lake does not have one primary inlet; it has many tributaries that constitute the lake's inflows.

There is one main outflow at the lake's northern end: Skaneateles Creek. The City of Syracuse controls outflows through a dam (NY00414) located on Skaneateles Creek. Approximately 9.0 billion gallons are discharged through the outlet of the lake to Skaneateles Creek annually in order to maintain water levels that satisfy many lake uses including water supply, fisheries and recreation. The rate of discharge is determined based on three criteria through the lake's outlet for lake elevation management: current levels as compared to the drawdown guideline levels, current rates of precipitation, and the amount of water stored in the snowpack (NYS DEC, 2020).

2.8. Climate

Current Averages

The Skaneateles Lake Watershed's weather is temperate, characterized by warm summers and cold, snowy winters as is typical to Central New York and the Finger Lakes Regions. Average annual rainfall is 45 inches and average annual snowfall exceeds 100 inches. The average high temperature in July is 81 degrees Fahrenheit (°F) with an average summer temperature (over June, July, and August) of 69°F. The average low temperature in January is 15°F, and the average overall winter temperature is 26°F (National Oceanic Atmospheric Administration - National Centers for Environmental Information, 2022).

Table 2.3– Average Temperatures and Precipitation Levels, Skaneateles, and Auburn, 1991 - 2020

Climate Monitoring Station	Elevation	Avg Winter Temperature	Avg Summer Temperature	Annual Average Rain	Annual Average Snowfall
Auburn	771 ft.	26.0° F	68.7° F	44.3 in.	109.4 in.
Skaneateles	875 ft.	n/a	n/a	45.64 in.	105.7 in.

Source: NOAA NCEI Climate Normals, 1991 – 2020, for Skaneateles and Auburn, https://www.ncei.noaa.gov/access/us-climate-normals

Climate Change

Anthropogenic climate change has been well documented in scientific literature for decades. As a result of increased carbon and methane emissions released into the atmosphere, the average global temperature is increasing. This warming leads to changes in weather patterns including, but not limited to, seasonal air temperatures, precipitation volumes and intensity. It has also introduced more instances of extreme storms, precipitation, and high temperature events (USGCRP, 2023).

The New York Climate Change Science Clearinghouse (NYCCSC) is one of the best available sources of data on future climate conditions in New York State (NYSERDA 2022). This data draws on the Coupled Model Intercomparison Project Phase 5 (CMIP5), which compiles the output of 35 climate change models to provide a range of projected future levels (maximum, minimum, and weighted average) for annual average

temperature and total precipitation. This data has been downscaled to the county level; results for Onondaga County for the periods 2018 – 2022 and 2048 – 2052 are shown in Tables 2.4 and 2.5.[1]

The NYCCSC climate change scenario for Onondaga County projects that, by 2052, the average annual temperature in Onondaga County will increase by a total of between 1.5˚F and 4.3°F Total annual precipitation will also change, with some models showing a decrease of as much as 2.7 inches and others showing an increase as high as 4.6 inches. The weighted average projected by the CMIP5 models is a 30-year annual average temperature increase of 3°F and a total precipitation increase of 1.3 inches (NYSERDA 2022).

Table 2.4 – Annual Average Temperature – Modeled 2022 and 2052 Levels for Onondaga County

Year / Range	Modeled Min (°F)	Modeled Max (°F)	Modeled Mean (°F)
2022 / 2018 – 2022	46.9	51.9	49.5
2052 / 2048 - 2052	48.4	56.23	52.5
2022 - 2052: Total Change	1.6	4.3	3.0
2022 - 2052: Average Annual Change	0.05	0.14	0.10
2022 - 2052: Total Percent Change	3.3%	8.3%	6.1%

Source: New York Climate Change Science Clearinghouse RCP 8.5 for Onondaga County (https://www.nyclimatescience.org/)

Table 2.5 – Total Annual Precipitation – Modeled 2022 and 2052 Levels for Onondaga County

Year / Range	Modeled Min (in.)	Modeled Max (in.)	Modeled Mean (in.)
2022 / 2018 – 2022	33.0	53.0	41.6
2052 / 2048 - 2052	30.2	57.7	42.9
2022 - 2052: Total Change	-2.7	4.6	1.3
2022 - 2052: Average Annual Change	-0.09	0.15	0.04
2022 - 2052: Total Percent Change	-8.3%	8.8%	3.2%

Source: New York Climate Change Science Clearinghouse RCP 8.5 for Onondaga County (https://www.nyclimatescience.org/)

[1] The New York Climate Change Science Clearinghouse presents data under two future scenarios for greenhouse gas concentrations. These scenarios, known as Representative Concentration Pathways (RCP) encapsulate possible future greenhouse gas emission levels: RCP 4.5 and RCP 8.5. As California's Energy Commission reports, "RCP 4.5 is a 'medium' emissions scenario that models a future where societies attempt to reduce greenhouse gas emissions, while RCP 8.5 is more of a 'business as usual' scenario" (State of California Energy Commission 2018). To assess potential impacts to Skaneateles Lake and its watershed, we will utilize the RCP 8.5 scenario.

2.9. Habitat

Fish and Wildlife

Many taxa of birds and mammals rely on Skaneateles Lake and its shoreline as high-quality foraging, roosting, and nesting habitat. While resident birds stay in the area year-round, the majority are found seasonally during breeding and migration seasons. Herons, loons, grebes, ducks, and geese are often observed utilizing the lake's resources. Mammals that depend on the lake for foraging and den habitat include muskrat, mink, beaver, and river otter.

The southern end of Skaneateles Lake is designated as an Audubon Important Bird Area due to the habitat for many species of bird provided in the wetlands and forest. At-risk bird species supported in this area include (The National Audubon Society, 2018):

- American Bittern,
- Northern Harrier,
- Sharp-shinned Hawk,
- Cooper's Hawk,
- Northern Goshawk,
- Red-shouldered Hawk,
- Broad-winged Hawk,
- American Woodcock,
- Wood Thrush,
- Golden-winged Warbler,
- Cerulean Warbler, and
- Canada Warbler.

Aquatic Life

Skaneateles Lake is designated as a Class AA water, suitable for fish propagation and survival. Despite providing habitat for salmonid species such as rainbow trout, brown trout, lake trout, and Atlantic salmon, the lake is not designated with the standard "T" (supporting naturally reproducing trout populations) and therefore specific requirements for sustaining these sensitive fisheries resources are not applicable. A variety of both warmwater and coldwater fish species are established in Skaneateles Lake. Lake trout populations have been reported to be stable in the lake; however, the cisco population has declined precipitously since the late 1980s. In 2007, an outbreak of viral hemorrhagic septicemia (VHS) killed Skaneateles Lake smallmouth bass and rock bass (NYS DEC, 2020).

2.10. Invasive Species

Invasive species are non-native species that can cause harm to an ecosystem, the economy, or human health. Invasive species are often aggressive and crowd out or cause direct harm to existing species in the ecosystem they invade.

Species of particular concern to the Skaneateles Lake Watershed include hemlock woolly adelgid (HWA), Eurasian watermilfoil, zebra and quagga Mussels, and starry stonewort.

Aquatic Invasive Species Prevention Programs

In August 2012, the Skaneateles Lake Association (SLA) instituted an Invasive Species Prevention Program. Monitoring stewards were positioned at the New York State DEC Boat Launch on West Lake Road and the Skaneateles Town Boat Launch in Mandana. Currently the boat stewards cover four of the lake's primary boat launch sites.

Monitoring stewards hired for the boating season are primarily high school and college students who receive training through Cornell Cooperative Extension. Stewards learn about the invasive species currently found in Skaneateles Lake and the species that have the potential to be imported from other water bodies. Stewards' duties include asking permission from boaters to allow a visual inspection of their trailers and the exterior of their watercraft for any attached marine life. Any vegetation is then removed. Most boaters allow these inspections.

The stewards also educate recreational boaters and anglers on the value of launching a clean, drained, and dry boat. The stewards then record data on each boat as part of the New York State Watercraft Inspection Steward Program Application (WISPA).

2.11. USGS Hydrologic Units

The United State Geological Survey (USGS) divides the landmass of the United States into a hierarchical system of "hydrologic units" based on surface hydrological features and topography. Each of these hydrologic units is assigned a code (a hydrologic unit code, or HUC) of two to twelve digits, with the twelve-digit subwatershed level (HUC-12) being the smallest geographic unit in the system.

The Skaneateles Lake Watershed (HUC 0414020116) is split into two HUC-12 subwatersheds:

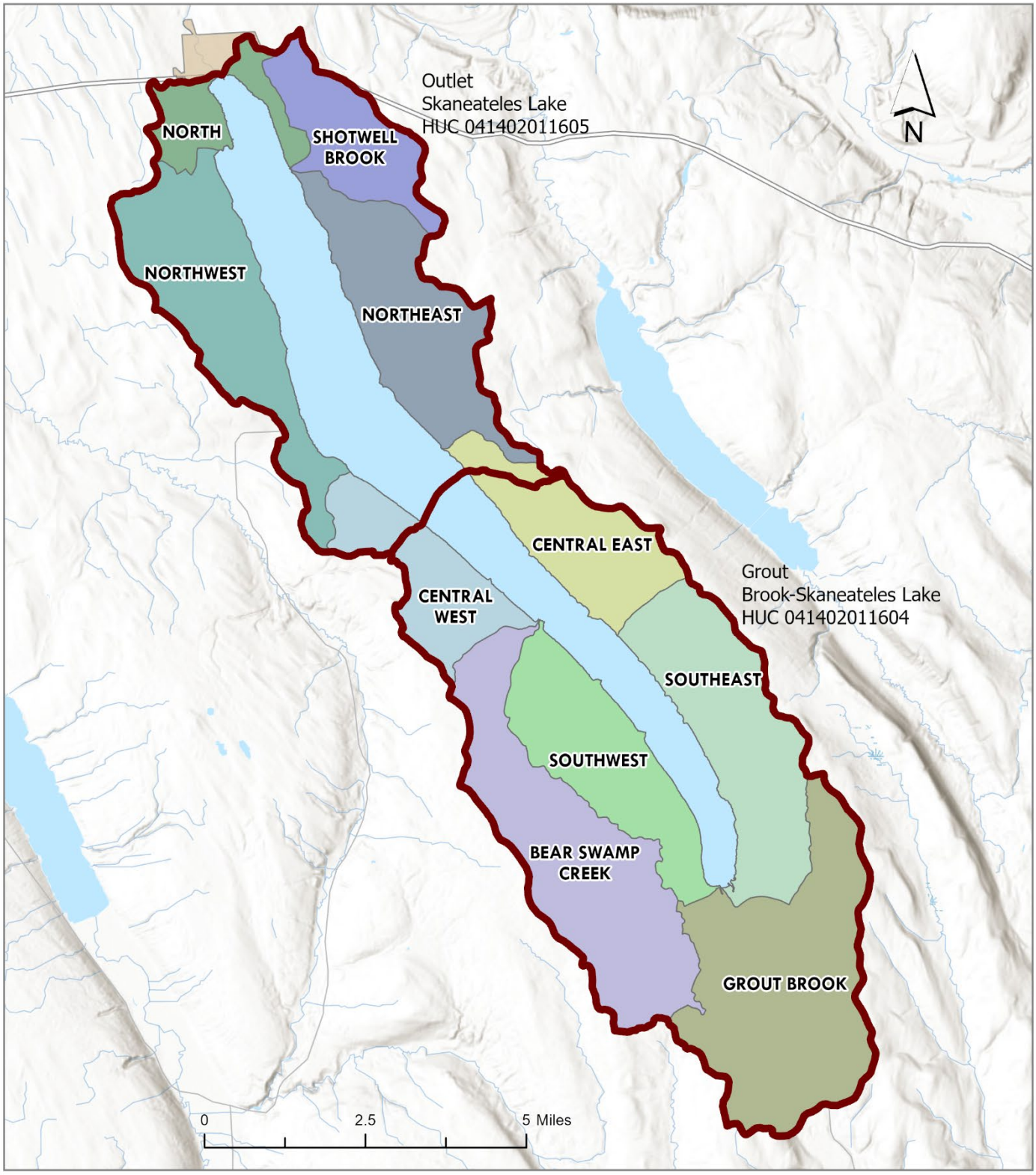
- Skaneateles Lake Outlet (HUC 041402011605): northern half of the watershed
- Grout Brook (HUC 041402011604): southern half of the watershed

The Skaneateles Lake Outlet subwatershed is just under 12,500 acres and takes in much of the Village of Skaneateles, as well as the relatively heavily developed residential areas on the lake's shore, including the Skaneateles Country Club and lake front homes accessed by minor roads branching off State Routes 41 and 41A on the east and west sides of the lake. This area's topography tends to be less steep than the southern half of the watershed, making it more conducive to development.

The Grout Brook-Skaneateles Lake subwatershed is approximately 24,800 acres and is characterized by forested areas and steep slopes.

Subwatersheds

The SWAT model divides the watershed into hydrologic response units (HRUs), which are relatively small geographically. In order to have a manageable number of subwatersheds, this 9E Plan aggregates the HRUs into ten subwatersheds, shown in Figure 2.4. Table 2.6 provides basic information about these subwatersheds.



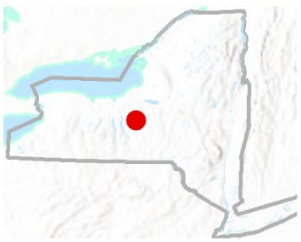


Figure 2.4 – HUC 12s and Aggregated Subwatersheds from SWAT Modeling

GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, USDA, USFWS, Esri, USGS

Coordinate System: NAD 1983 UTM Zone 18N

Table 2.6 – Subwatersheds from Watershed Modeling

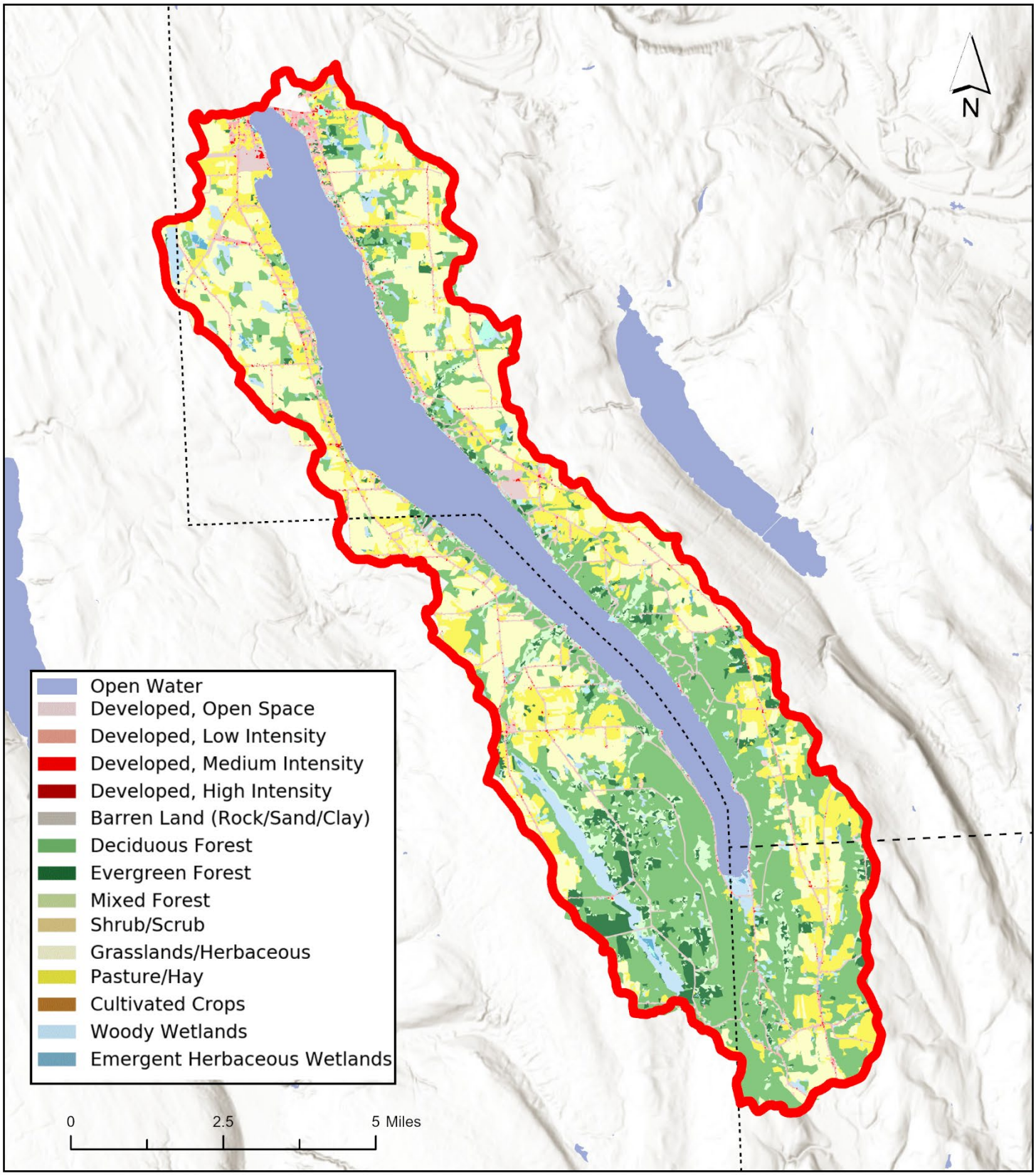
HUC-12	Subwatershed	Acres
Skaneateles Lake Outlet	Northeast	3,981
	Northwest	4,643
	Shotwell Brook	2,230
	North	1,326
Grout Brook	Center East*	2,871
	Center West*	2,450
	Bear Swamp Creek	5,811
	Grout Brook	6,590
	Southeast	4,456
	Southwest	3,458
Total	**Total**	**37,816**
**The Center East and Center West subwatersheds include small portions in the Skaneateles Lake Outlet HUC-12.*		

2.12. Land Cover

Skaneateles Lake has a total watershed area of approximately 37,300 acres, with a watershed-to-lake ratio of approximately 4.3 acres of watershed land to each acre of lake. Most of the land in the watershed (86%) is either forested or used for agriculture (see Figure 2.5 and Table 2.7). Agriculture, in the form of both cultivated crops and pasture, is the largest land cover in the watershed, occupying more than 16,000 acres (44%) of the watershed's area. Agricultural uses are found on both the eastern and western sides of the watershed, between the developed village area on the north and the forested area on the south.

Forested areas – including deciduous, evergreen, and mixed forests – make up 42% of the watershed. Forested areas are found throughout the watershed but are the dominant land cover on the lake's southern end. Bear Swamp State Forest covers more than 3,500 acres in the watershed's southwestern corner. This includes the largest single wetland in the watershed (Bear Swamp), but there are more than 1,200 acres of wetland scattered throughout the watershed, including a large wetland area at the mouth of Grout Brook in the Town of Scott.

Very little of the watershed is developed – roughly 1,100 acres (3%) is categorized as being in medium- or low-intensity development (there are no areas of high-intensity development in the watershed). An additional 2,160 acres is categorized as "open space" development, including parks, golf courses, and residential land (lawns).



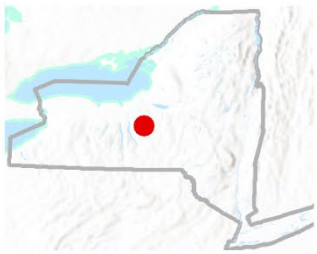


Figure 2.5 – Land Cover

2019 National Land Cover Database

Esri, NASA, NGA, USGS, FEMA, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, USDA, Esri, USGS

Coordinate System: NAD 1983 UTM Zone 18N

Table 2.7 - Land Cover by HUC-12 Subwatershed

Land Cover	Skaneateles Lake Outlet HUC 041402011605		Grout Brook HUC 041402011604		Total	
	Acres	*Percent*	*Acres*	*Percent*	*Acres*	*Percent*
Cultivated Crops	5892	46%	4900	20%	10792	29%
Deciduous Forest	1829	14%	10661	43%	12490	33%
Developed - Low Intensity	604	5%	342	1%	946	3%
Developed - Medium Intensity	110	1%	61	0.2%	171	0%
Developed - Open Space	800	6%	1361	5%	2161	6%
Evergreen Forest	282	2%	1514	6%	1796	5%
Hay/Pasture	2089	16%	3527	14%	5616	15%
Mixed Forest	163	1%	1375	5%	1538	4%
Shrub/Scrub	201	2%	331	1%	532	1%
Woody Wetlands	510	4%	765	3%	1275	3%
TOTALS	**12480**	**100%**	**24837**	**100%**	**37317**	**100%**

Source: USGS National Land Cover Database, 2019

2.13. Municipalities and Population

There are 4,158 people residing within the watershed across 2,819 dwelling units. Approximately 1,065 of these dwellings are on the lakeshore (City of Syracuse, 2022).

The watershed spans three counties:

- Onondaga County,
- Cayuga County, and
- Cortland County.

It also includes portions of seven towns:

- Niles,
- Sempronius,
- Spafford,
- Skaneateles,
- Scott,
- Owasco, and
- Marcellus.

It includes one village: the Village of Skaneateles.

Two of the towns, Marcellus and Owasco, account for less than 300 acres, or < 1.0% of the total watershed area. Because these towns make up such a small proportion of the watershed, and such a small proportion of these municipalities are included in the watershed, they are not included in the data summary below (see Table 2.8).

Fifty-one percent of the watershed land area is within Onondaga County, and three-quarters of the watershed's population is in Onondaga County.

Thirty-four percent of the watershed's land and 10% of its population are in Cayuga County. This includes the towns of Niles and Sempronius. Twenty-nine percent of this county land area is agricultural. Most of the residential development in this county is on the lakeshore and seasonal. Much of the shoreline in Cayuga County is very steeply sloped.

A relatively small proportion, 15%, of the watershed is in Cortland County. The Town of Scott is the single town within this portion of the watershed. It has a population of 655 or approximately 16% of the total watershed population. Soil conditions and extreme topography of the area limit development (City of Syracuse, 2022).

Table 2.8 – Skaneateles Watershed Population Distribution and Watershed Land Area by Town

Town	Dwelling Units	Population in Watershed	Percent of Total Population	Percent of Watershed Land Area
Skaneateles	1,376	2,216	53%	26%
Spafford	689	843	20%	25%
Niles	365	371	9%	17%
Sempronius	76	73	2%	17%
Scott	313	655	16%	15%
Totals	**2,819**	**4,158**	**100%**	**100%**

Source: City of Syracuse 2022 (The Towns of Marcellus and Owasco make up less than 1% of the watershed's area)

2.14. State and Local Laws

In New York State, land use policy and regulations are primarily the responsibility of local government. Municipal decisions regarding how the landscape is developed will ultimately affect the quality and quantity of water in lakes and streams. Decisions related to density, impervious surfaces, open space protection, setbacks from waterways, aquifer protection, farmland protection, wastewater management, designation of critical environmental areas, and a host of other factors influence the transport of water and substances into Skaneateles Lake.

As part of the 9E Plan development process, the CNY RPDB worked with watershed municipalities to compile an *Institutional Framework and Assessment of Local Laws, Programs, and Practices Affecting Water Quality* for the Skaneateles Watershed. This report summarizes existing local laws and regulations, as well as state and federal regulations that protect water quality. Of note is the strength of the State Health Department's Watershed Rules and Regulations for Skaneateles, which are administered by the City of Syracuse. While the City of Syracuse does not lie within the Skaneateles Lake watershed, its residents rely on the lake and watershed for public health, economic, and recreational needs, including public water supply. Under the New York State Health Code (10 NYCRR 131.1) the City is responsible for inspection of the watershed and enforcement of the Skaneateles Lake Watershed Rules and Regulations.

The New York State Health Code includes rules and regulations that apply to the entire Skaneateles Lake watershed and are enforced and administered by the City of Syracuse Department of Water (City). Additionally, the City of Syracuse applied for and received a filtration avoidance waiver extension on June 28, 2004. The waiver has no termination date and will remain in effect for as long as the City complies with the conditions of that filtration avoidance waiver. The City operates several watershed protection programs, including working with the Onondaga County SWCD to implement the Skaneateles Lake Watershed Agricultural Program.

Zoning

Zoning is the single most effective tool that towns and villages have in controlling the type, size, density, and impacts of development in their jurisdictions. The Village of Skaneateles and the Towns of Skaneateles, Spafford, Otisco, and Scott have zoning; the Towns of Sempronius and Niles do not (see Figure 2.6).

The Town of Skaneateles utilizes a Lake Watershed Overlay District (LWOD) in its zoning code to provide enhanced water quality protection in the watershed. The impermeable surface coverage of new development in the watershed is limited to 5 percent in the watershed. Additionally, Skaneateles's zoning code protects water quality through an erosion and stormwater control plan requirement, wetland and watercourse protections, steep slope regulations, and stormwater criteria in special permit review, site plan review, and subdivision review. The Town of Spafford has a Skaneateles Lake District, which guides lakefront property development. The Town of Spafford also enacted regulations in 2022 to limit development on steep slopes to reduce soil erosion.

2.15. Water Quality Monitoring Efforts

Lake Monitoring

City of Syracuse

Because Skaneateles Lake is the drinking water source for the City of Syracuse, the City is responsible for complying with the New York State Sanitary Code's requirements for pollutant monitoring. Title 10, Part 5, Subpart 5-1 of the State's Codes, Rules and Regulations provide the Maximum Contaminant Levels (MCLs) for a variety of pollutants, including:

- Organic and inorganic chemicals, including volatile organic chemicals
- Radionuclides
- Microbiological contaminants, such as fecal coliform bacteria
- Turbidity
- Giardia and Cryptosporidium

The City of Syracuse provides monthly reports to the New York State Department of Health (DOH) on the quality of water at its two intake pipes.

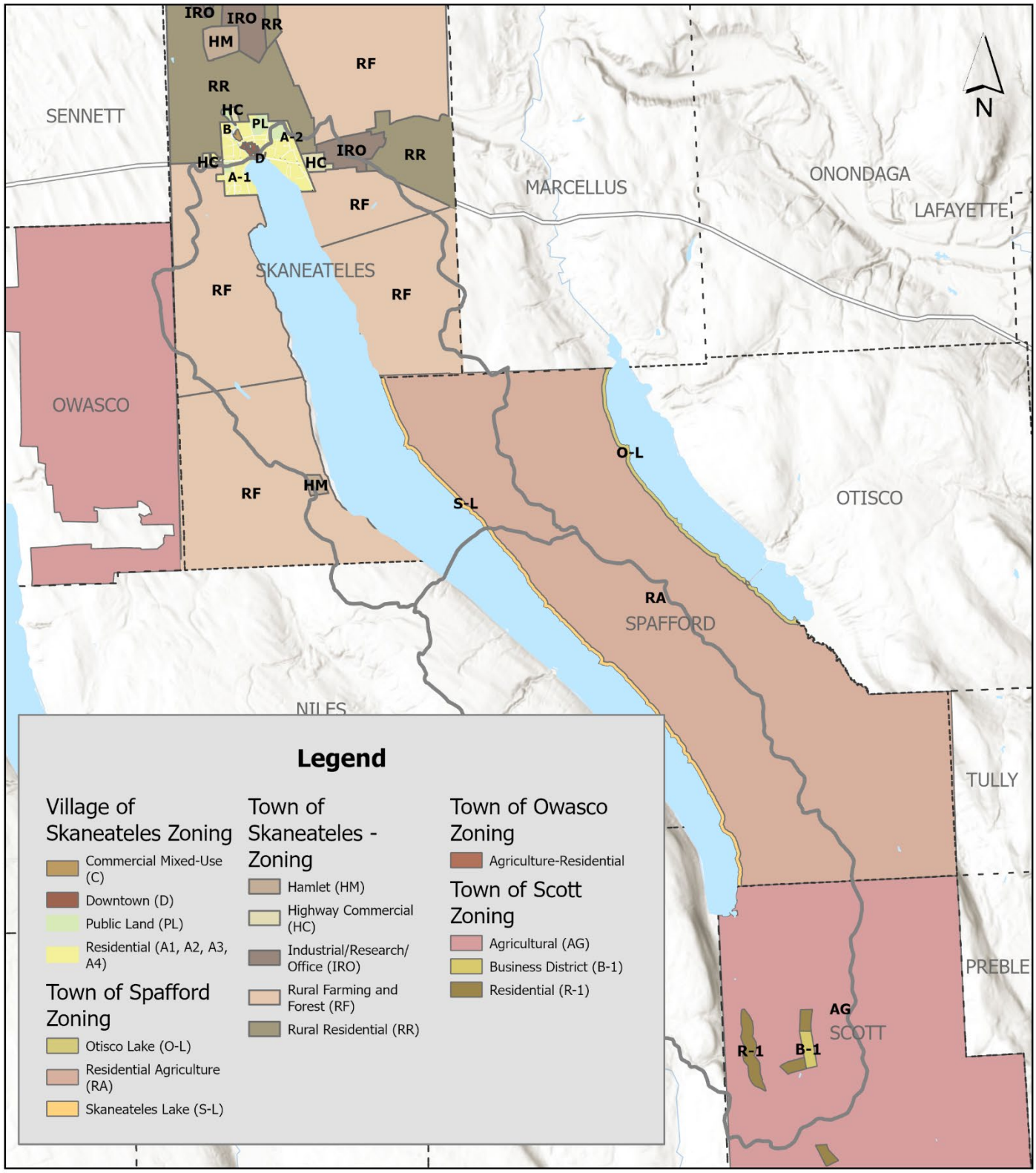


Figure 2.6 – Zoning Districts in the Skaneateles Watershed

Esri, NASA, NGA, USGS, Esri, USGS, Esri, TomTom, Garmin, SafeGraph, METI/NASA, USGS, EPA, NPS, USDA, USFWS

Coordinate System: NAD 1983 UTM Zone 18N

0 2 4 Miles

CSLAP

Water quality monitoring on Skaneateles Lake has been conducted as part of the NYSDEC's Citizens Statewide Lake Assessment Program (CSLAP) since 2017. A separate phase of CSLAP data collection took place between 1997 and 2001.

Figure 2.7 shows the two active CSLAP monitoring stations on Skaneateles Lake: Station 139.1 on the northern end and Station 139.2 on the southern end. Station 139 was the monitoring station for an earlier phase of CSLAP monitoring, from 1997 to 2001.

Figure 2.8 provides a comparison of data from Period 1, 1997 to 2001, and Period 2, the current period of monitoring, 2017 to 2022.

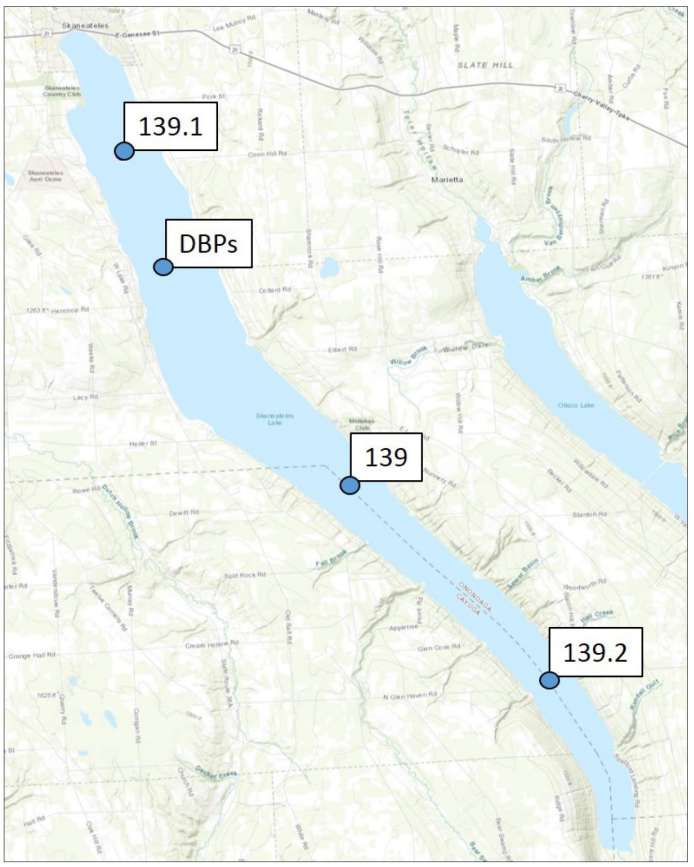


Figure 2.7 – CSLAP and DBP Monitoring Locations
Source: (NYS DEC, 2020)

Upstate Freshwater Institute

The Upstate Freshwater Institute (UFI) has a long history of lake monitoring activities on Skaneateles Lake. UFI conducted monitoring programs in Skaneateles Lake in 2007, 2008, 2011, 2014, and 2017 to document seasonal and long-term patterns in water quality conditions. Both in-situ and laboratory measurements were made to assess thermal stratification, trophic state, and optical characteristics. Monitoring was conducted monthly, typically from April to October, at multiple sites and depths. The monitoring efforts were funded by the Town of Skaneateles.

More recently, UFI partnered with NYSDEC to conduct monitoring on major and minor tributaries and with SLA to monitor various tributaries.

Other Data Collection

Other data collection efforts conducted in Skaneateles Lake include the NYSDEC Disinfection By-Products (DBPs) Study in 2004, the Finger Lakes Synoptic Water Quality Investigation (SWQI) in 1996, 1997, and 1999, the Finger Lakes Institutes Finger Lakes Survey (FLI/FLS), and monitoring conducted by Upstate Freshwater Institute (UFI) in 2007, 2008, 2011, 2014 and 2017 on behalf of the Town of Skaneateles. In addition to these recent monitoring efforts, water quality in the Finger Lakes was investigated during the 1910s, 1960s and 1970s (NYSDEC, 2020).

Tributary Monitoring

USGS Gaging Station

A United States Geological Survey (USGS) gaging station is present on the lake's outlet stream, Skaneateles Creek, approximately six miles north (downstream) of the lake. Discharge and gage height are recorded at this station. No USGS gaging stations are present on the lake's inflowing tributaries (NYSDEC, 2020).

UFI Monitoring

The Upstate Freshwater Institute conducted extensive monitoring of Shotwell Brook, a tributary in the northeastern section of the lake's watershed, during 2016 and 2017. This was followed by another monitoring program in 2018. The goal of this monitoring was to develop a baseline characterization of Shotwell Brook's hydrology and water quality and was funded by the Skaneateles Lake Association.

UFI also conducted extensive tributary monitoring in 2019 to provide a base of data for the 9E plan. The four major tributaries to Skaneateles Lake (Bear Swamp Creek, Grout Brook, Shotwell Brook, and Harold Brook) were monitored biweekly from May to November 2019. Additional monitoring was completed at all major tributaries during or shortly after three rain events during this period. Three additional sampling events at Shotwell Brook took place prior to May 2019 with funding from the Town of Skaneateles. Each monitoring event consisted of field measurements and water quality sample collection when it was safe to do so.

In addition to the major tributaries, six minor tributaries to Skaneateles Lake were also monitored approximately bi-weekly from May to November 2019. These minor tributaries were: One Mile Creek, Snow Brook, Five Mile Creek, Glen Cove, Randall Gulf, and an upstream portion of major tributary Bear Swamp Creek.

2.16. Current Water Quality Conditions

Lake Trophic Status

"Trophic state" is a concept that is used for classifying the overall condition of a lake, as measured by phytoplankton production. Lakes are generally placed in one of three categories:

- Oligotrophic: clear water with low nutrient levels and very little algae / phytoplankton production
- Mesotrophic: partially clouded water with moderate nutrient levels and some phytoplankton
- Eutrophic: clouded water with high nutrient levels and very high phytoplankton production

As shown in Table 2.9, there are standards of transparency, total phosphorus, and chlorophyll-a levels that are associated with each trophic state.

Table 2.9 – Trophic Classification Indicators

Parameter	Oligotrophic	Mesotrophic	Eutrophic
Transparency (m)	> 5	2-5	< 2
TP (µg/L)	< 10	10.0 – 20.0	> 20.0
Chlorophyll-a	< 2 µg/L	2 – 8 µg/L	> 8 µg/L

Skaneateles Lake is oligotrophic, with very low levels of algae and phytoplankton, and low levels of phosphorus, a nutrient that plants and all other living things depend on.

2.17. CSLAP Data: Historic vs. Current

As noted in Section 2.15, in addition to the current CSLAP data collection program on Skaneateles Lake, initiated in 2017, there is an older collection of data to draw on: data collected under the same protocols between 1997 and 2001.

For ease of reference, in the discussion below, the older CSLAP data (1997 – 2001) will be referred to as "Historic" data, and the current CSLAP data collection (2017 – 2022) will be referred to as "Current" data.

2.18. Secchi Disk Depths

A Secchi depth is a measure of a water body's clarity or transparency. It is obtained by lowering an eight-inch disk with alternating black and white quadrants (known as a Secchi disk) into the water and measuring the depth at which it is no longer visible. Oligotrophic lakes generally have Secchi depths greater than 5 meters. The annual average of Skaneateles Lake's Secchi depths is consistently above 5 meters and in 2001 reached an average of 10.9 meters (Figure 2.8). In the Current CSLAP period, annual averages have ranged from 5.9 to 8.6 meters.

2.19. Chlorophyll-a

Chlorophyll-a is the photosynthetic pigment in large plants and in algae. Lakes with large amounts of algae are often green in color because of the chlorophyll-a in the algae. Like phosphorus, chlorophyll-a is a natural part of a water body's chemistry. Measuring and tracking chlorophyll-a levels provides an important indicator of a water body's overall biological productivity. As shown in Table 2.9, chlorophyll-a levels over 8 µg/L typically indicate that a water body is eutrophic, levels under 2 µg/L indicate an oligotrophic water body, and levels between 2 and 8 µg/L indicate a mesotrophic water body.

As shown in Figure 2.8, Skaneateles Lake's chlorophyll-a levels are typically under 2 µg/L, which is consistent with Skaneateles Lake's status as an oligotrophic lake. Measurements from the Historic CSLAP period (1997 – 2001) show annual average chlorophyll-a levels ranging from 0.56 to 0.9 µg/L. For the Current CSLAP period, annual average chlorophyll-a levels range from 0.78 to 1.6 µg/L. For the period from 2020 to 2022, the average chlorophyll-a level was .99 µg/L.

Table 2.10 - Skaneateles Lake – Chlorophyll-a Levels (µg/L)
(Historic: 1997-2004; Current: 2017-2022)

	YEAR	N	Mean	Minimum	Median	Maximum
HISTORIC DATA	1997	8	0.56	0.35	0.53	1.04
	1998	8	0.90	0.46	0.91	1.46
	1999	8	0.78	0.39	0.75	1.21
	2000	7	0.85	0.42	0.66	2.18
	2001	8	0.78	0.38	0.75	1.64
	2004	4	0.72	0.60	0.75	0.80
		43	**0.77**	**0.35**	**0.70**	**2.18**
CURRENT DATA	2017	15	1.21	0.50	1.00	2.30
	2018	14	0.95	0.30	0.80	1.60
	2019	15	1.60	0.52	1.45	3.21
	2020	15	0.86	0.23	0.69	1.67
	2021	14	1.39	0.10	1.48	2.60
	2022	13	0.78	0.13	0.81	1.50
		86	**1.14**	**0.10**	**1.00**	**3.21**

Source: Citizens Statewide Lake Assessment Program, NYSDEC

2.20. Total Phosphorus

Phosphorus, like nitrogen, is a nutrient required for all life. Phosphorus is frequently the limiting nutrient for phytoplankton in lakes, rivers and ponds, because it is the least abundant of the nutrients needed to sustain life. Phosphorus is the limiting nutrient in Skaneateles Lake: the growth rate of algae and aquatic plants is controlled by how much phosphorus is available.

Total phosphorus (TP) levels are most easily understood as concentrations measured at the scale of micrograms (µg) per liter of water. A microgram is a millionth of a gram. For reference, the mass of a grain of sand is typically given as being on the order of 10 to 50 µg.

NYS DEC's 2018 *Finger Lakes Water Quality Report* provides data on TP for the 11 Finger Lakes. Based on data from 2017 and 2018, Skaneateles Lake's TP levels were the lowest among the Finger Lakes, and the Finger Lakes are, on average, well below the TP average for all lakes in New York for which CSLAP data is collected (NYS DEC, 2019).

Water bodies with TP levels under 10 µg/L are considered oligotrophic. As Table 2.11 shows, TP concentrations are typically less than 10 µg/L throughout Skaneateles Lake, indicating low productivity and oligotrophic conditions.

CSLAP data from the Historic period suggest that TP levels have been increasing slightly in Skaneateles Lake. Mean and median TP levels in the Current period are slightly above those in the Historic period. Nevertheless, annual average TP levels are consistently at or below 6 µg/L, well below the 10 µg/L threshold at which a lake is considered mesotrophic. Figure 2.8 shows CSLAP data from the Historic and Current periods.

Table 2.11 – Skaneateles Lake - Total Phosphorus Data (µg/L)

(Historic: 1997-2004; Current: 2017-2022)

TP	YEAR	N	Mean	Minimum	Median	Maximum
HISTORIC DATA	1997	8	3.25	1.00	2.00	12.00
	1998	2	3.00	2.00	3.00	4.00
	1999	8	2.38	1.00	2.00	5.00
	2000	8	3.38	1.00	2.00	10.00
	2001	8	3.56	0.62	3.94	6.22
	2004	4	4.42	3.00	4.20	6.30
			3.27	**0.62**	**2.19**	**12.00**
CURRENT DATA	2017	15	5.87	3.70	5.90	8.90
	2018	14	3.87	1.90	3.30	7.30
	2019	2	4.74	4.36	4.74	5.11
	2020	15	4.17	2.61	3.65	7.89
	2021	10	6.16	4.91	5.73	8.35
	2022	13	3.64	2.55	3.23	5.96
			4.68	**1.9**	**4.32**	**8.9**

Source: Citizens Statewide Lake Assessment Program, NYSDEC

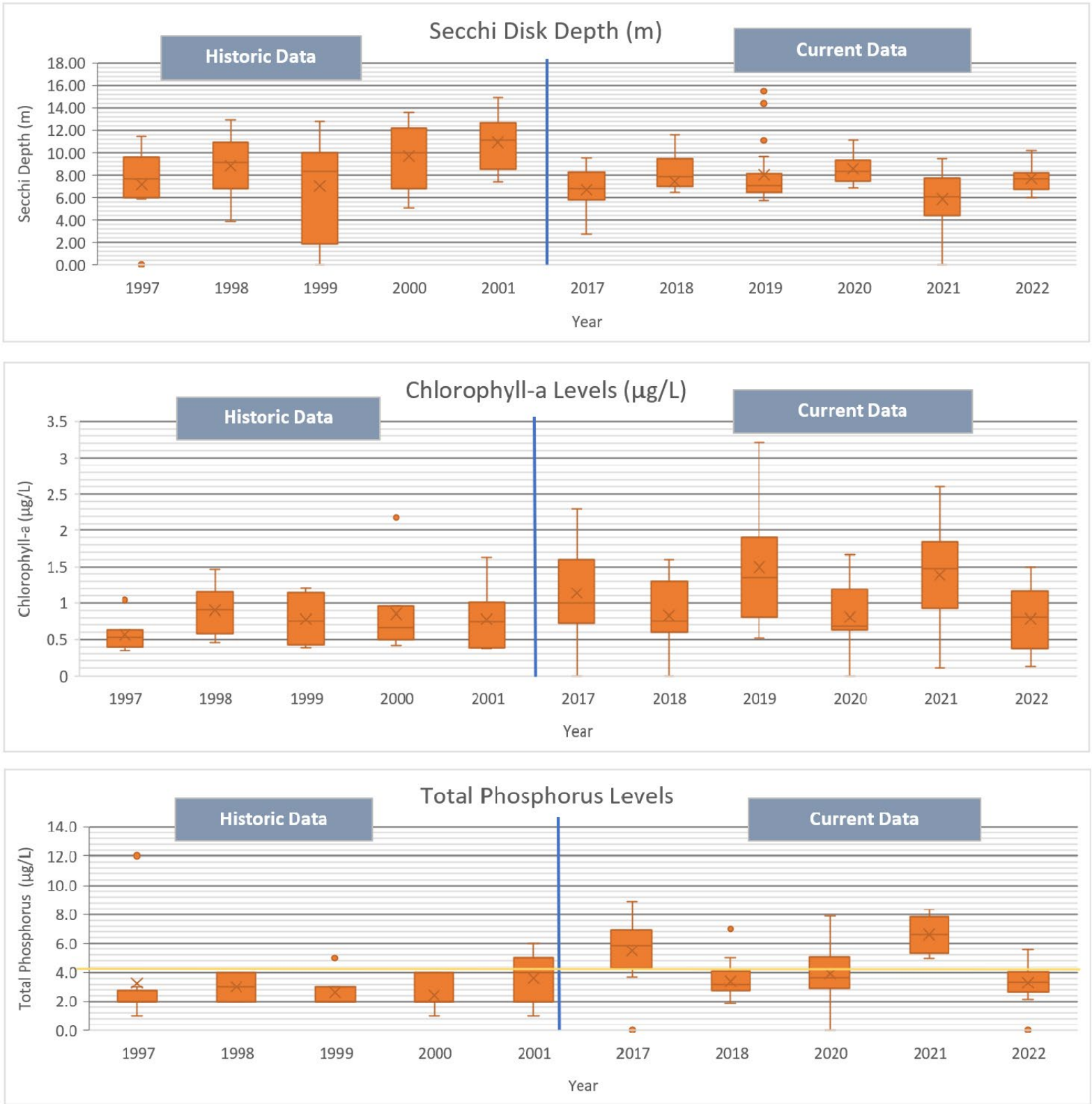


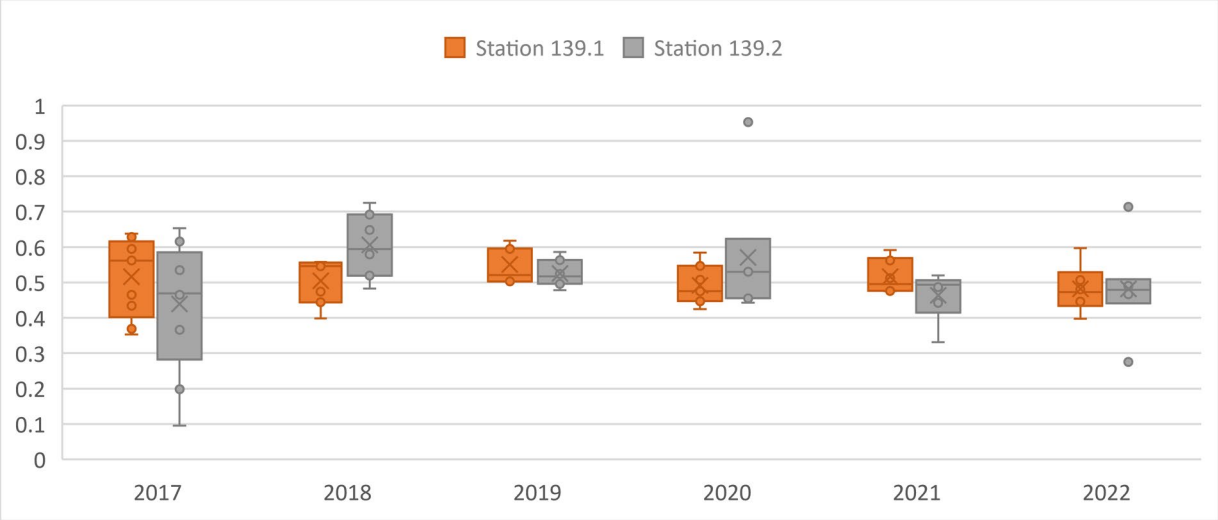
Figure 2.8 – CSLAP Data – Historic and Current

Secchi Disk Depths (top); **Chlorophyll-a Levels** (middle); **Total Phosphorus Levels** (bottom). Historic, 2017 – 2001, and Current Data, 2017 – 2022. Data from the Citizens Statewide Lake Assessment Program, measured at Station 139 (Historic Data) and Stations 139.1 and 139.2 (Current Data). Data shown are from epilimnion measurements. The yellow line on the Total Phosphorus Levels chart represents the most recent three-year average (4.5 µg/L).

2.21. Total Nitrogen

Like phosphorus, nitrogen is critical to the survival of all living organisms and, thus, a component of a water body's overall productivity, including the production of HABs. However, like many lakes, Skaneateles Lake has much more nitrogen than phosphorus. As shown in Table 2.10, total nitrogen (TN) levels in Skaneateles Lake between 2018 and 2022 ranged between 0.4 mg/L and 0.7 mg/L, or more than 100 times more abundant than phosphorus[2]

Figure 2.9 – Total Nitrogen Levels



[2] This is why phosphorus is considered the "limiting nutrient" for biological productivity: it is the scarcest natural resource that is critical to sustaining life.

3. Waterbody Impairments and Sources of Phosphorus

3.1. Known Impairments

Waterbody Inventory/Priority Waterbodies List

DEC's Waterbody Inventory / Priority Waterbodies List (WI/PWL) provides narrative assessments of New York's water bodies, based on available data and the DEC's Consolidated Assessment and Listing Methodology (CALM). WI/PWL data can be accessed through the DEC's Info Locator online mapping tool (https://gisservices.dec.ny.gov/gis/dil/). The WI/PWL provides the foundation for the development of the state Section 303(d) List of Impaired Waters Requiring a Total Maximum Daily Load (TMDL).

The PI/PWL listing for Skaneateles Lake identifies it as fully supported for primary and secondary contact recreation and stressed for drinking water. Skaneateles Lake and its tributaries are not included in the DEC's 303(d) list.

Skaneateles Creek (W/PWL ID 0707-0003) is on the current (2018) list for PCBs, due to industrial activity on land well downstream of the creek's outlet at the northern end of Skaneateles Lake. Skaneateles Creek appears in Part 3c, Waterbodies for which TMDLs Are Deferred (Pending Development / Implementation / Evaluation of Other Restoration Measures).

Public Drinking Water Intake Extension

The City of Syracuse is currently engaged in an extension of one its drinking water intake pipes in Skaneateles Lake to deeper water. The extension will mean that Water Intake #2 is at a depth of at least 60 feet, which is expected to ensure that contamination from HABs cannot reach the drinking water supply. The investment will help prevent the need to construct water treatment facilities for the City and the villages of Skaneateles, Jordan, and Elbridge at the cost of several hundred million dollars to state and local government.

Without the extension, the City water supply is susceptible to intake closures due to turbidity and HAB events. If continued or more serious violations of turbidity occur, the City has the potential to lose its New York State Health Department filtration waiver, which would require the construction of one or multiple water treatment plants to ensure the continued supply of public drinking water to approximately 200,000 local residents.

3.2. Skaneateles Lake Scorecard

The CSLAP program includes the development of a scorecard and summary of indicators for waterbodies. The following excerpts from the 2022 Skaneateles Lake Summary provide details on key aspects of the lake's water quality:

- Skaneateles Lake continues to be oligotrophic, or unproductive, based on high water clarity, low algae levels (chlorophyll a), and low nutrient (phosphorous) levels. Soluble nutrients were analyzed in 2022. The waterbody is highly alkaline or basic, with intermediate hardness water, low water color, and moderately low nitrogen levels.
- Compared to previous years, pH was higher in 2022. Compared to previous years, color, conductivity, and chloride were lower in 2022. Water clarity, chlorophyll-a, total phosphorus,

surface water temperature, deep water temperature, water quality evaluation, aquatic plant coverage and recreational evaluation in 2022 were similar to previous years.

- Compared to other New York lakes, this lake usually has higher water clarity, conductivity, and calcium. Compared to other New York lakes, this lake usually has lower chlorophyll-a, total phosphorus, color and chloride and more favorable water quality evaluation, and aquatic plant coverage.
- Over the past 6 years, pH has increased significantly.
- Water quality conditions generally indicate a low susceptibility to HABs, with frequent blooms along the shoreline or in the open water. The open water algal community in the lake is usually comprised of low cyanobacteria levels. This community is dominated by none. Typically, overall open water algae levels are low. Overall open water toxin levels are consistently below recreational levels of concern.
    - A note on toxin levels: the toxins produced by HABs are known as cyanotoxins. The cyanotoxin most commonly detected in New York is known as microcystin. NYSDEC's *Harmful Algal Blooms Program Guide* provides guidance on microcystin levels, which can be used to help determine whether or not a HAB is present, and to gauge the bloom's toxicity. When microcystin levels are at or below 4 µg/L, a HAB is not present. When microcystin levels are between 4 and 20 µg/L, a Confirmed Bloom is present. When microcystin levels reach 20 µg/L at the shoreline, or when open water samples show toxin levels greater than 10 µg/L, this is considered a Confirmed Bloom with High Toxins (NYSDEC, 2020). Blooms with High Toxins have been confirmed in Skaneateles Lake. According to the City of Syracuse's 2022 *Skaneateles Lake and Watershed Annual Report*, tests for microcystin in raw water samples from the City's water intake pipes ranged from 0.33 ug/L to 0.60 ug/L (City of Syracuse, 2023).

Figure 3.1 – CSLAP Report Card, 2022

	CSL1 - North		CSL2 - South	
Water Quality Indicators	**Average Year**	**2022**	**Average Year**	**2022**
Phosphorus	Oligotrophic	Oligotrophic	Oligotrophic	Oligotrophic
Chlorophyll A	Oligotrophic	Oligotrophic	Oligotrophic	Oligotrophic
Secchi	Oligotrophic	Oligotrophic	Oligotrophic	Oligotrophic
Lake Perception	Good	Good	Fair	Fair
Harmful Algal Blooms	Fair	Fair	Fair	Fair
Aquatic Invasive Species	Present		Present	

Source: NYSDEC, Citizens Statewide Lake Assessment Program; https://nysfola.org/cslap-report-search/

3.3. Sources of Phosphorus

A key component of this 9E Plan is quantifying the major sources of phosphorus in the Skaneateles Watershed. Phosphorus sources are categorized as nonpoint (diffuse) and point (associated with a defined outfall). Nonpoint sources of phosphorus within the watershed were characterized for the 9E Plan. The watershed has no point sources; under New York State's Watershed Rules and Regulations for Skaneateles Lake, "Point source discharges are prohibited" in the Skaneateles Watershed (New York State). Table 3.2 provides an overview of the major categories of phosphorus loading sources in the Skaneateles Watershed.

Table 3.2 – Phosphorus Sources in the Skaneateles Lake Watershed

Category	Source Name	Description	Estimated TP Contribution	How was this modeled?
Non-Point Sources	Land Cover	SWAT land use categories. See Table 3.3 for individual categories.	13,106 lbs./year	SWAT model values of TP by land cover, combined with local variables
	CAFOs in & adjacent to the watershed	Manure from CAFOs is spread on fields in the watershed	Included in Land Cover estimate	Input from SLWAP on manure handling practices of watershed CAFOs, including amount of material, nutrient content, and location of spreading was incorporated into the SWAT model
	Septic Systems	Nutrient-rich wastewater from septic tanks makes its way into the lake through groundwater	467 lbs./year	Modeled using LENS

Nonpoint source phosphorus sources include runoff from agricultural lands, forests, residential areas, commercial districts, and other developed land uses. These landscape sources of phosphorus were quantified using the SWAT model calibrated to site-specific conditions of the Skaneateles Watershed and tested using recent monitoring data collected under an approved QAPP and analyzed by a certified laboratory. Key data inputs to the SWAT model incorporate both underlying environmental conditions (soils, slope, hydrology, climate, land cover, etc.) and land management (major crops, fertilization rates and schedule, animal waste management, dates of planting and harvest, etc.).

Seepage from individual septic systems is also categorized as a nonpoint source of phosphorus. Septic contribution was estimated using the DEC LENS Tool. This estimation tool counts the number of systems within a specified distance of surface waters, estimates the population density of residences, estimates failure rate based on input from local sources, and assigns a phosphorus removal efficiency.

Point Sources

There are no point sources of pollution in the Skaneateles Watershed. There are no wastewater treatment plants or private industries that are permitted to discharge to Skaneateles Lake.

Nonpoint Sources

As described in Section 1.3, a SWAT model was used to derive estimates of phosphorus loading by land use and the LENS screening tool was used to estimate loading from septic systems. Based on the SWAT model outputs, agricultural lands – particularly row crops – are the greatest source of nutrients, in terms of total contribution to the lake, with approximately 9,400 pounds of phosphorus annually. Commercial agriculture requires the use of nutrient inputs to ensure robust crop productivity and it is not possible to ensure that these inputs remain entirely on agricultural fields (although it should be noted that farms in the watershed use a variety of measures to reduce fertilizer losses). Developed land is the second largest source of nutrients, with approximately 2,380 pounds of phosphorus annually. This is separate from the contribution of on-site residential wastewater systems (septic tanks), which are estimated to contribute less than 500 pounds of phosphorus annually.

On a per-acre basis, forested lands and wetlands have the smallest nutrient contributions. Because so much of the watershed is forested, natural sources of phosphorus make up approximately 10% of total annual phosphorus loading.

CAFOs

A CAFO is defined as a farm that meets certain animal size thresholds and that also confines those animals for 45 days or more in any 12-month period in an area that does not produce vegetation. Statewide, there are roughly 500 CAFOs, the majority of which are dairy farms with 300 or more cows and associated livestock operations.

CAFOs are regulated under the Statewide Pollution Discharge Elimination System (SPDES) Permit Program. To obtain a permit, CAFOs must meet certain standards set by the DEC to ensure that they are not acting as point sources of TP.

Permit requirements include:

- Filing a Comprehensive Nutrient Management Plan (CNMP) prepared by an Agricultural Environmental Management (AEM) Certified Planner. CNMPs ensure that CAFOs balance their operational needs while complying with regulatory guidelines. CNMPs address items such as manure management, field crop nutrients, and storm water runoff in a coordinated manner.
- Filing an Annual Compliance Report, which provides an inventory of the CAFO's operations.
- Filing Incident Report Forms whenever a discharge from the CAFO causes a water quality violation. This can include unintended releases of liquid manure and overflows in waste storage structures.

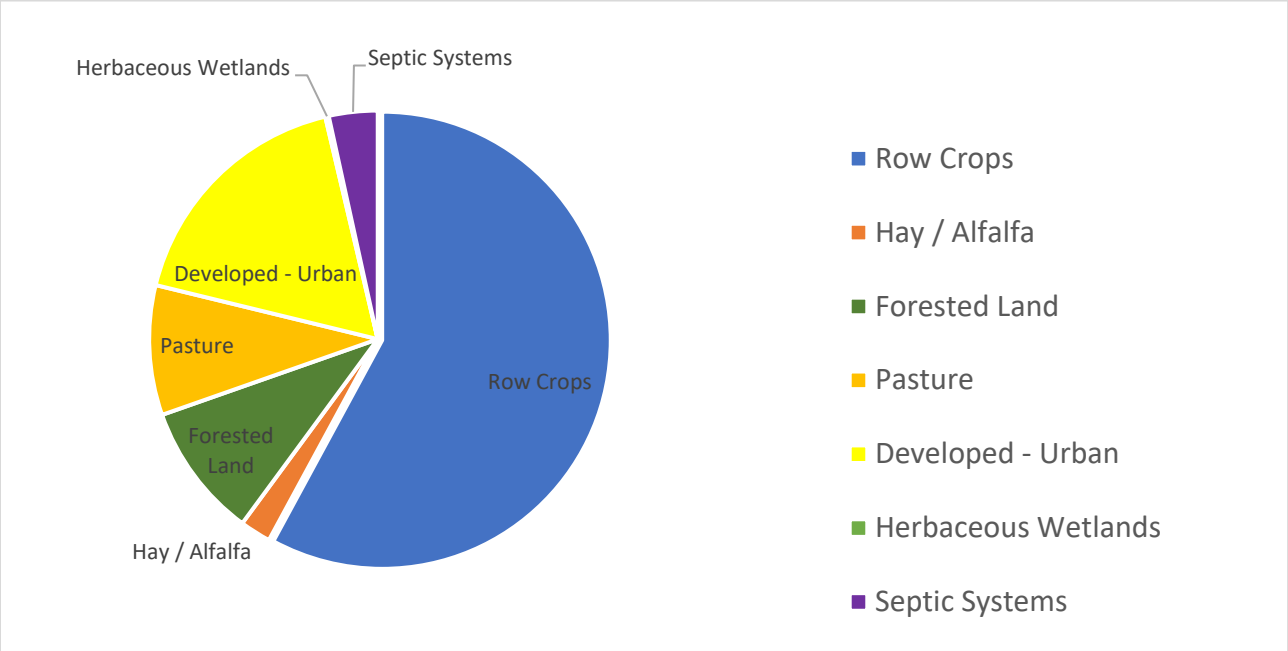
According to the DEC's online info Locator (https://gisservices.dec.ny.gov/gis/dil/), there is one Concentrated Animal Feeding Operation (CAFO) in the watershed and six others adjacent to the watershed. To account for the impacts of these operations in the watershed, SLWAP provided information on the manure handling practices of area CAFOs, including amount of material, nutrient content, and location of manure spreading. This information was incorporated into the SWAT model. The TP load from CAFOs is included in the estimates provided in Tables 3.3 and 3.4.

Table 3.3 – Phosphorus Loading by Land Cover

Land Use / Source Category	Percent of Watershed	Phosphorus Loading (lbs.)	Lbs. / Acre	Percent of Total Loading
Row Crops	13%	7,859	1.60	58%
Hay / Alfalfa	6%	298	0.13	2%
Forested Land	60%	1,293	0.06	10%
Pasture	14%	1,246	0.24	9%
Developed / Urban	6%	2,376	1.12	18%
Wetlands	2%	33	0.05	0.2%
Septic Systems	N/A	467	N/A	3%
TOTAL	**100%**	**13,573**		**100%**

Loading by land use is based on the Soil and Water Assessment Tool estimates, except for Septic Systems, which were estimated using the LENS tool

Figure 3.2 – Phosphorus Loading by Land Cover / Source (kg)



Loading by Subwatershed

The SWAT model's results were aggregated into data for ten subwatersheds as shown in Table 3.3 and Figure 3.4. Based on the SWAT model, the Northwest subwatershed contributes the most to the lake's annual nutrient load, both in terms of total pounds of phosphorus (2,962) and in terms of pounds per acre (0.64 lbs./acre/year). But the developed northern end of the lake is a close second in terms of pounds per acre, with 0.53 pounds of phosphorus per acre per year.

Table 3.4 – Subwatersheds by Land Use and Nutrient Loading

Subwatershed	Row Crops	Alfalfa	Forested Area	Pasture	Urban / Developed	Wetlands	Total Acreage	Lbs./Acre /Yr.	Phosphorus Loading (lbs.)
Northwest	29%	10%	31%	16%	11%	4%	4,643	0.64	2,962
Grout Brook	7%	0%	78%	14%	1%	0%	6,590	0.30	1,976
Northeast	23%	8%	40%	18%	6%	4%	3,981	0.47	1,879
Southeast	11%	5%	78%	5%	1%	0%	4,456	0.36	1,594
Central East	16%	5%	48%	17%	14%	0%	2,871	0.46	1,306
Central West	18%	15%	42%	18%	6%	0%	2,450	0.31	748
Bear Swamp Creek	5%	4%	82%	7%	0%	2%	5,811	0.13	731
Urban	2%	5%	12%	26%	54%	0%	1,326	0.53	698
Shotwell Brook	18%	9%	47%	17%	0%	9%	2,230	0.28	625
Southwest	3%	9%	73%	15%	0%	0%	3,458	0.17	583
Watershed Total	13%	6%	60%	14%	6%	2%	37,816	N/A	13,101

Land cover types and acreage are from the USDA's Cropland Data Layer; the SWAT model utilized crop rotations over the period from 2011 to 2020. Subwatersheds represent aggregated data for the SWAT model's hydrologic response units (HRUs). Note that loading from septic systems is not included.

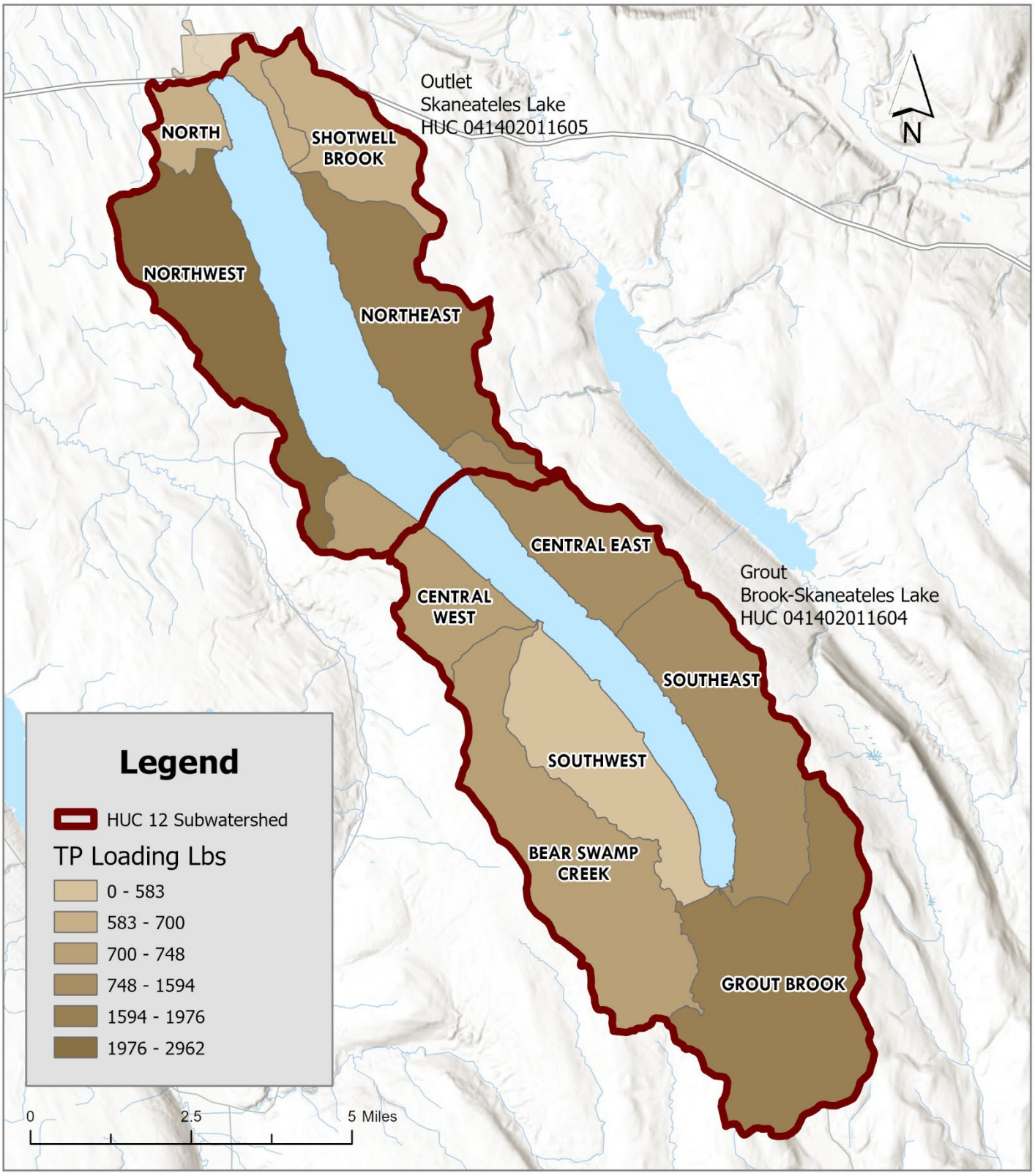


Figure 3.3 – Phosphorus Loading by Subwatershed

4. Target Levels

4.1. Total Phosphorus

The development of this 9E Plan was a recommendation of the DEC's *Harmful Algal Bloom Action Plan for Skaneateles Lake*, prepared in 2020. That plan listed three Priority 1 Projects for short-term implementation, the first of which was: "Perform modelling of both in-lake conditions and the contributing watershed for use in developing a 9E Plan" (NYS DEC, 2020).

As noted in Section 1.1, HABs were first documented in Skaneateles Lake in September 2017. The occurrence of HABs in Skaneateles Lake demonstrated that, even with TP levels well below 10 µg/L, there were sufficient nutrients present to support high concentrations of cyanobacteria.

The precise mechanism behind a given HAB can be difficult to determine, and the causes of HABs may vary from one location to another (see Section 1.1). But cyanobacteria thrive in a mix of warm temperatures, sunlight, and elevated nutrient levels. According to data from the New York Climate Change Science Clearinghouse, temperatures will continue to increase over the next 40 to 50 years, with the severity of rainfall events increasing (NYSERDA, 2022). With increased rainfall will come increased stormwater runoff from the land uses in the watershed. Action at the watershed level cannot alter air temperature, the amount of rain that falls, or the lake's fetch or orientation, but it can alter the amount of phosphorus making its way to the lake.

For the purposes of this plan, phosphorus is considered a "pollutant" because it is the one factor in the development of HABs that watershed management efforts can meaningfully alter. Phosphorus levels in Skaneateles Lake are low, but CSLAP data from 1997 to 2001 (Section 2.20) demonstrate that TP levels have been slowly increasing over the last 20 years. This 9E Plan's target is to ensure that TP levels in Skaneateles Lake do not increase dramatically over the next 30 years, as climate change and weather patterns increase the potential for nutrients to make their way into the lake (USGCRP, 2023).

The current three-year average level of TP in Skaneateles Lake is 4.5 µg/L, based on CSLAP data. The 9E target is to maintain this TP level, based on a three-year rolling average of CSLAP measurements, taken during the summer months (mid-June to mid-September).

Note that this 9E Plan is not a regulatory document. This phosphorus target reflects the results of analyses and modeling and extended conversations with the stakeholder community. The 4.5 µg/L target represents a level that the WAC identified as achievable, given the anticipated increase in nutrient loading associated with climate change. A changing climate is likely to mean that, in the long-term, the effect of adding BMPs to the watershed will not be to lower TP levels but to maintain existing levels. The TP target level represents a goal of working to offset the effects of climate change and to prevent HABs from becoming significantly more severe as a result of warmer temperatures and increased precipitation.

4.2. Chlorophyll-a

Like phosphorus, chlorophyll-a is a natural part of a water body's chemistry. Unlike phosphorus, chlorophyll-a is not a limiting factor on how productive a body of water is – instead, chlorophyll-a levels are an indicator of algae levels.

Because chlorophyll-a is a measure of how much algae is present, it is often more important to stakeholders than other chemical indicators, such as phosphorus and nitrogen, which are not visible to the naked eye. Measuring and tracking chlorophyll-a levels provides an important indicator of a water body's overall biological productivity.

Chlorophyll-a levels in Skaneateles Lake for the period from 2017 to 2022 were at or slightly above 1.0 µg/L. Data from 1997 – 2001 indicate that, like TP, chlorophyll-a levels in the lake have been rising slowly over time. This plan's goal is to ensure that these levels do not continue to increase, given the effects of climate change. In this context, the target level for chlorophyll-a is to maintain a summertime average of 1.0 µg/L.

4.3. Development of Alternatives

Over the course of a series of WAC meetings, as well as meetings with the Soil and Water Conservation Districts in the watershed and members of the Skaneateles Watershed Agricultural Program, the WAC developed the scenarios described below, to be modeled using SWAT. The goal of this modeling exercise was to support the prioritization of projects and other investments of resources in the watershed.

Scenario 1- Future Conditions

Scenario 1 was used to understand how phosphorus loading will change if no additional best management practices (BMPs) are implemented in the watershed, given both climate change and increased development pressure over the next 30 years.

Other BMP scenarios were compared to this scenario to measure how selected actions may reduce phosphorus loading and decrease the impact that a changing climate and future development will have on the watershed.

Details

- Climate Scenario: based on data from New York Climate Change Science Clearinghouse (NYSERDA, 2022)
    - Temperature increase: +3˚F by 2052
    - Precipitation: 10% increase by 2052
- Future Development based on supporting information from the Town of Skaneateles, City of Syracuse *New Housing Starts Report*, and the New York Landscape Futures *Recent Trends Technical Report*:
    - 600 acres converted to developed land cover over 30 years

Scenario 2 – Additional Agricultural BMPs

The Skaneateles Lake Watershed is already at the forefront of agricultural BMP implementation in Upstate New York: the Skaneateles Lake Watershed Agricultural Program (SLWAP) has been connecting farmers with funding to implement a wide variety of BMPs for over 30 years.

This scenario captures the goals of selected BMP programs, through cooperation between the Soil and Water Conservation Districts in the watershed and farmers who are interested in increasing their efficiency and further reducing nutrient runoff.

Details

- 100% adoption of manure injection technology on corn silage fields, up from 67%.
    - By injecting manure into the soil, farmers reduce nutrient loss through volatilization and runoff, thus mitigating environmental impacts such as water pollution and greenhouse gas emissions. This method enhances nutrient utilization by crops, promotes soil health and structure, and reduces odors associated with surface application.
- 100% increase in cover crops (double the current amount).
    - Cover crops are (often) non-cash crops that are planted on fields in the fall, after the harvest of cash crops. The cover crops' dense root systems hold soil in place, preventing erosion and reducing sediment runoff through the fall and winter, while also taking up excess nutrients from the soil. Cover crops also increase soil organic matter, improving soil structure and water infiltration, which helps to reduce surface runoff and increase water retention in the soil.
- Precision Agriculture: increase in the use of precision agriculture from 42% of acreage to 80% of acreage with a 10% decrease in phosphorus application.
    - Precision agriculture is an advanced farming approach that utilizes technology (such as GPS, sensors, drones) as well as data analytics to optimize agricultural practices. By precisely tailoring inputs like water, fertilizers, pesticides, and seeds to the specific needs of different areas within a field, farmers can maximize efficiency and minimize waste. This targeted approach allows for more sustainable use of resources, reduces environmental impact, and can lead to increased yields and profitability.

Scenario 3 – Filter Strips

Scenario 3 proposes the addition of vegetated filter strips to the watershed along fields/open spaces that drain to Skaneateles Lake.

Filter strips, also known as vegetated buffer strips, are narrow strips of land adjacent to a water body that are planted with vegetation, typically grasses, shrubs, or even trees. Filter strips slow down, intercept, and filter out sediments, nutrients, pesticides, and other pollutants carried in surface runoff before they reach the water body. Filter strips help to protect water quality by trapping pollutants and preventing them from entering streams, rivers, lakes, or wetlands. They also provide habitat for wildlife and stabilize soil.

Within the SWAT model, this BMP will be represented using a filter strip ratio that allows for one acre of buffer strip area for every twenty acres of crop fields. (The modeling team randomly selected approximately 1,000 acres of agricultural land on which to add new filter strips.) While the total amount of modeled row crop area varies from year to year, the model assumes that roughly one quarter of agricultural lands in the watershed will adopt riparian filter strips ever year, resulting in about 50 acres of added filter strip area. (The width of filter strips will vary depending on slope and other considerations.)

Details

Approximately a 50/50 allocation between Northern and Southern halves of the watershed.

Note: Compensation for buffers on agricultural land typically reflects fair market value, not the total cost that the farmer pays (i.e., maintenance costs for reporting / contracting). This scenario assumes that a funding mechanism can be developed that makes this BMP sufficiently attractive to farmers to incentivize its use.

Scenario 4 – Reduce Residential Phosphorus Contributions

Scenario 4 models the effects of reducing the number of failing septic systems in the watershed.

Details

This scenario is intended to simulate a hypothetical boundary case: what if nutrient contributions from on-site wastewater systems could be dramatically reduced in the watershed? While this may not be a scenario that can be achieved given existing technologies and funding sources, the model can provide insight into how effective this approach could be in reducing nutrient levels.

Scenario 5 – Streambank Stabilization

This scenario simulates the effects of implementing streambank stabilization projects in the watershed. The idea behind this scenario is to "work backward" and develop an estimate of the total number of miles of streambank stabilization work that would be needed to offset the impacts of climate change and development, as modeled in Scenario 1.

This requires an estimate of the phosphorus reduction that can be expected for every foot of streambank stabilization work. There is no universally accepted measure of "pounds of phosphorus per foot of streambank stabilized"; the nutrient reduction impacts of streambank stabilization projects can vary widely from one setting to another. The Modeling Team conducted a review of the best available published studies to derive this estimate. Table 4.1 provides a summary of this research.

Based on the median of five peer-reviewed studies, the Skaneateles Lake watershed would need a total of 16,645 feet of streambank stabilization to offset the estimated 806 pounds per year of TP anticipated to result from climate change and development.

Table 4.1 – Data Sources for Scenario 5 Estimate

#	Source	Brief Description	Reduction	Length needed (ft.)
1	Great Lakes Restoration Initiative - Plum & Kankapot	Initial analysis of the practices that have been installed from 2015 to 2018 indicate the following average input reductions for streambank protection projects: 82 lbs./yr. of P	82 lbs./yr. reduced over 2178 feet = 0.0376 lbs./ft/yr. TP	21,436
2	Makarewicz et al., 2015	Model simulation of stream bank stabilization	34.3% reduction in phosphorus loading was estimated	No length provided
3	Lammers & Bledsoe, 2017	Summary of bank sediment and phosphorus loading rates from 11 select studies	Median of max and min P loading rates of all reported studies = 0.12 lb./ft/year	6,889
4	Langendoen et al., 2012	Three mitigation scenarios were analyzed to determine the percent reduction in loadings that can be obtained by stabilizing streambanks	From most conservative scenario result: 34% reduction; a reduction of 14.1 kg/km/yr.	85,318
5	Chesapeake Bay Program Quick Reference Guide for BMPs: D-5 Urban Stream Restoration	Summary of stream restoration protocols for nitrogen, phosphorus, and sediment reductions	TP reduction = 0.068 (lbs./ linear ft/year)	11,853
			MEDIAN	**16,645**

Scenario 6 – Combined Effects of Multiple Scenarios

Scenario 6 models the effect of implementing Scenarios 2, 3, and 4.

4.4. Modeling Results

The six scenarios described in Section 4.3 were evaluated using the SWAT and CE-QUAL-W2 models. The SWAT model's outputs include nutrient and sediment loading to Skaneateles Lake under existing and future conditions. The SWAT model's outputs for each scenario were then used as inputs to the In-Lake Model (CE-QUAL-W2). The In-Lake Model evaluated and estimated three key metrics of the lake's condition under existing and future conditions: total phosphorus levels, chlorophyll-a levels, and cyanobacteria levels. This was provided for current conditions, as well as future conditions under Scenarios 1, 2, 3, 4, and 6. A calculation for Scenario 5 was not completed with the SWAT model.

Understanding the Results

Skaneateles Lake has low TP levels. Stakeholders have been implementing, and will continue to implement, BMPs across the watershed. As seen in Sections 1.0, 1.1, 2.16, and 3.2, the lake's water quality metrics indicate an oligotrophic water body that is successfully serving as the unfiltered water supply for the City of Syracuse.

The effects of the proposed BMP scenarios are presented in the context of anticipated future conditions (climate change and increased development). The object of the modeling is to answer the question: given conditions under Scenario 1, how effective would each BMP scenario be in offsetting the anticipated *increase* in phosphorus, chlorophyll-a, and cyanobacteria that is expected to occur because of warming temperatures and increased precipitation? The results of Scenarios 2, 3, 4, and 6 shown in Figure 4.1 incorporate the results of Scenario 1 and use future conditions as their starting point.

For example, the results of Scenario 2 shown in Figure 4.1 represent the effectiveness of agricultural BMPs assuming that the lake and watershed are already experiencing the effects of Scenario 1. In Figure 4.1 (a), Total Phosphorus under Scenario 2 is shown increasing by four percent: this represents the effects of Scenario 1 *and* Scenario 2, indicating a four percent increase in TP relative to Baseline conditions. Since Scenario 1 produced a six percent increase in TP over Baseline conditions, the effect of Scenario 2 is to produce a two percent decrease in TP relative to Scenario 1.

Baseline

Under the Baseline condition, Skaneateles Lake's modeled TP level is approximately 4 µg/L, chlorophyll-a levels are approximately 1.0 µg/L, and cyanobacteria concentrations are slightly above 1 µg/L.

Scenario 1

Sceanario 1 represents anticipated conditions in the lake and watershed in 2052. Given climate change, as modeled in Scenario 1, TP concentrations increase by six percent, chlorophyll-a levels increase by nine percent, and cyanobacteria concentration increases by 85%. Clearly, the increase in cyanobacteria is not proportional to the increase in nutrient loading; cyanobacteria are adapted to thrive in warmer water temperatures.

Scenario 2

Scenario 2 anticipates increased adoption of selected agricultural BMPs in the context of climate change and development. These BMPs would reduce TP, chlorophyll-a, and cyanobacteria levels in Skaneateles

Lake, relative to Scenario 1. However, this scenario does not completely offset the increases resulting from climate change. Relative to Baseline conditions, Scenario 2 results in a four percent increase in TP, a six percent increase in chlorophyll-a, and a 76 percent increase in cyanobacteria concentrations.

Scenario 3

Scenario 3, which would increase filter strip implementation across the watershed, would be more effective than Scenario 2 in reducing phosphorus loading. Relative to Baseline conditions, however, it would still mean a one percent increase in TP, a four percent increase in chlorophyll-a levels, and a 69 percent increase in cyanobacteria concentrations.

Scenario 4

Scenario 4 models the result of reducing nutrient contributions from septic systems to near zero. Because the type of phosphorus that leeches out of septic systems can be readily absorbed by phytoplankton, reducing these inputs has a very positive effect on the lake's water quality. Scenario 4 reduces TP levels in the lake by two percent, more than offsetting the effects of climate change. It also reduces chlorophyll-a levels by one percent. However, the anticipated increase in cyanobacteria resulting from warmer temperatures and increased precipitation is so great that even reducing TP levels below Baseline conditions is insufficient to reduce cyanobacteria concentrations. Cyanobacteria levels are expected to increase by 54 percent.

Scenario 6

Scenario 6 models the effects of implementing all of the BMPs included in Scenarios 2, 3, and 4. Not surprisingly, this package of BMPs produces the most dramatic improvement in lake conditions, with a nine percent reduction in TP and chlorophyll-a over Baseline conditions, and a relatively modest 40 percent increase in cyanobacteria.

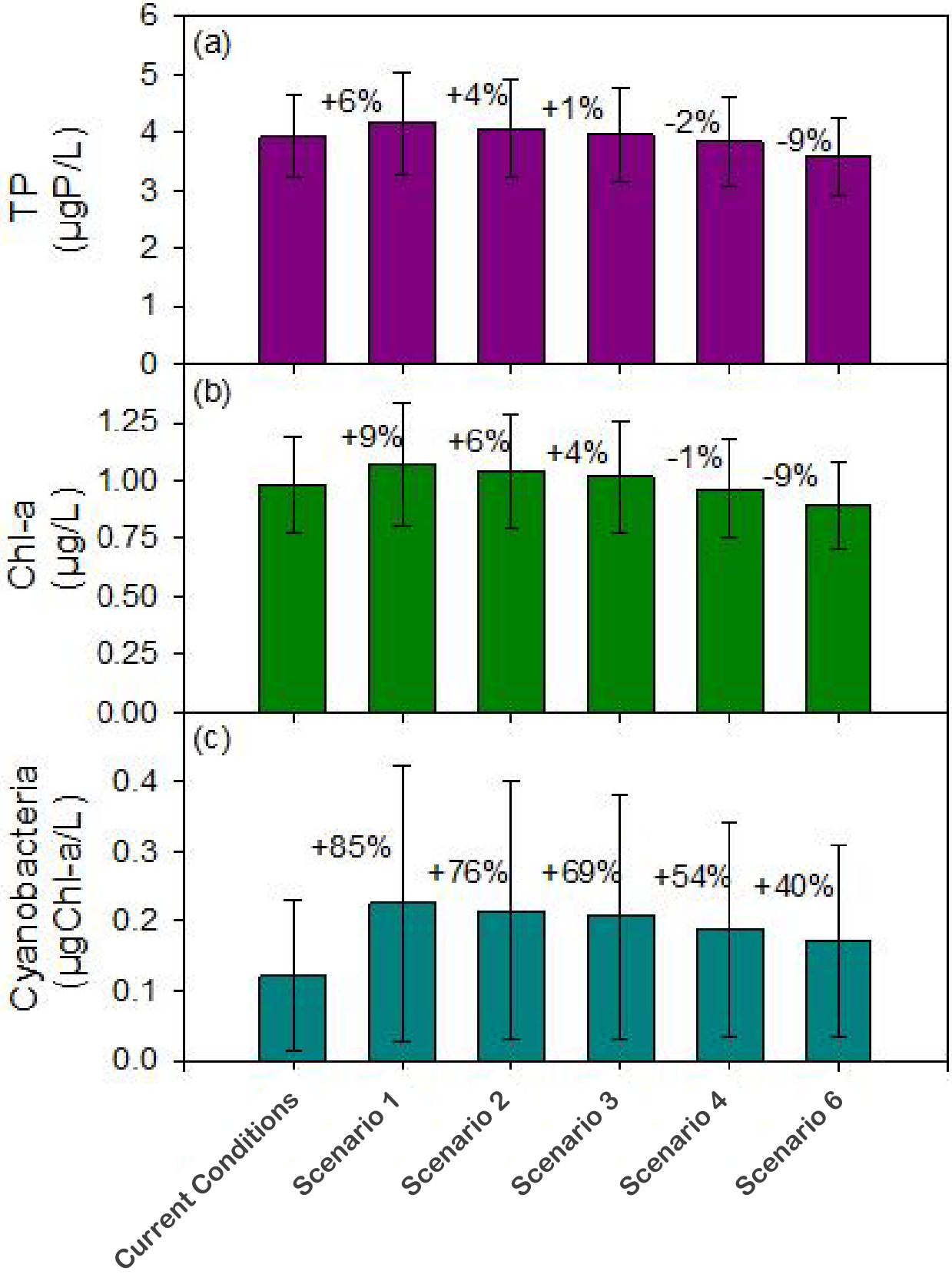


Figure 4.1 – In-Lake Model Results by Scenario

(Scenario 5's effects could not be directly modeled – see Section 4.3)

5. Water Quality Maintenance Strategies

The purpose of this 9E Plan is to ensure that, over time, Skaneateles Lake continues to maintain its current high level of water quality, through coordinated and collaborative actions across the watershed. This plan's recommendations focus on measures to ensure that, as rainfall events become more severe, nutrient levels remain where they currently are. These recommendations include municipal, residential, agricultural, and state-level actions to protect Skaneateles Lake's water quality.

The following recommendations are provided in two separate tables. Table 5.1 provides strategies and actions that have been demonstrated, through the SWAT and CE-QUAL-W2 models, to effectively reduce phosphorus loading.

Table 5.2 includes strategies, program ideas, and recommendations that are intended to promote water quality and watershed health, but which are not necessarily directly related to nutrient load reduction.

Table 5.1 – Modeled Actions to Reduce Nutrient Loading

Scenario #	Recommended Action	Pollutants Addressed	Estimated Phosphorus Load Reduction (if quantifiable)	Estimated Cost	Lead Organizations & Partners	Potential Funding Sources	Priority or Schedule
2	•100% adoption of manure injection technology on corn silage fields, up from 67% •100% increase in cover crops (double the current amount) •Precision Agriculture: increase in the use of precision agriculture from 42% of acreage to 80% of acreage with a 10% decrease in phosphorus application.	Nitrogen, phosphorus, sediment	471 lbs./ year	Manure injection: Cover Crops: $50-$100 / acre Precision Ag: $16	SWCDs, SLWAP	NYSAGM, USEPA, City of Syracuse, USDA	High Priority (3 – 5 years)
3	Filter Strips: add approximately 50 acres of filter strips (varying widths) to the watershed	Nitrogen, phosphorus, sediment, dissolved contaminants	1,468 lbs./year	Varies by adjacent land use	SWCDs, SLWAP	NYSAGM, USEPA, City of Syracuse, USDA	High Priority (3 – 5 years)
4	Continue participation in New York State's Septic System Replacement Fund program and promote nutrient-treating septic systems, as they become available.	Phosphorus, Nitrogen, *E. coli*, Organics	52 lbs./year	$10,000 per unit	County Health Departments	DEC	High Priority (3 – 5 years, ongoing)
5	Streambank Stabilization Projects	Phosphorus, sediment	0.05 lbs./linear ft./year	$20- $150/ft of stabilization	SWCDs, SLA, Municipalities	WQIP	High Priority (3 – 5 years, ongoing)
6	Scenarios 2, 3, and 4	Nitrogen, phosphorus, sediment, dissolved contaminants, E. coli, Organics	1,848 lbs./year	Combined costs of scenarios 2, 3, and 4	All Watershed Partners	NYSAGM, USEPA, City of Syracuse, USDA, DEC	High Priority (3 – 5 years, ongoing)

Table 5.2 – Best Management Practices for the Skaneateles Watershed

BMP Name	BMP Description	Lead Organizations and Partners	Potential Funding Sources	Estimated Cost	Priority	Currently being implemented?
Stormwater & Landscape Management						
AEM Tier 3A	Continue to implement AEM Tier 3A Plans for crop farmers and Nutrient Management Plans (NMPs) for livestock operations	SWCDs and SLWAP	NYSAGM	Varies from farm to farm	High Priority (1 – 5 years, ongoing)	Yes
Crop Residue Mulching	Encourage crop residue mulching on row crop lands	SWCDs, SLWAP	NYSAGM	Low Cost	High Priority (1 – 5 years, ongoing)	Yes
Eastern Finger Lakes	Consider an allocation of funding directly to Soil and Water Conservation Districts for water quality projects in the Finger Lakes.	DEC, SWCDs	DEC		Complete / In Progress	No
Enhance Natural Lands	Enhance the economic, social, and health benefits of natural resources (through trail construction, habitat enhancements, trailhead development, etc.) to prevent land use conversion.	Land Trusts, DEC, DOS, SWCDs	Land Trusts, DEC, DOS, SWCDs		Low Priority (10 years +)	No
Floodplain Reconnection	Increase stormflow resilience of streams by reconnecting floodplains and/or constructing floodplain wetlands in areas frequently inundated with water.	SWCDs, SLA, Municipalities, Property Owners	DEC, DOS, EFC, USEPA, United States Department of Agriculture (USDA)	Wetland Creation – Floodplain: $475/acre	Low Priority (10 years +)	No
Green Infrastructure	Implement green infrastructure practices to intercept stormwater prior to entering waterways.	Town and Village of Skaneateles; NYSDOT; Local Public Works Departments	DEC, DOS, EFC, USEPA	Variable	Medium Priority (5 – 10 years)	No
Institutional Capacity	Expand the institutional capacity of the agricultural support agencies to provide technical and financial support to identify and implement best management practices appropriate for individual producers.	NYSAGM, SWCDs, DEC	NYSAGM, DEC		Medium Priority (5 – 10 years)	No
Land Trusts	Support the efforts of local land trusts to acquire lands in the watershed, particularly to create or protect natural buffers between development and surface waters. Conserve high value natural resources that provide resiliency to precipitation and flooding	FLLT, CNY Land Trust, DEC, DOS	DEC, DOS, USEPA, DOI, Private Conservation Program	$1,000 to $10,000 per acre	High Priority (1 – 5 years, ongoing)	Yes
Nitrogen Deposition	Support measures to reduce the atmospheric deposition of nitrogen.	NYSAGM, DEC, SWCDs, SLWAP	NYSAGM, DEC, SWCDs, SLWAP		Low Priority (10 years +)	No
Nutrient Management Plans	Continue to prepare NMPs that include manure storage management and financial and technical assistance for both CAFO and non-CAFO farms.	SWCDs, SLWAP	NYSAGM	CNMP: $5 - $10/acre (Canandaigua)	High Priority (1 – 5 years, ongoing)	Yes
Solar Farms	Discourage the development of solar power generation facilities (solar farms) on productive farmland, forested lands, and riparian areas.	Municipalities, SWCDs, County Planning Offices	Municipalities		Medium Priority (5 – 10 years)	No
Solar Farms - Forested Lands	Where forested land is converted to a solar farm, municipalities should consider requiring a replacement ratio of 2:1 (plant two trees for every tree removed).	Municipalities	Municipalities		Low Priority (10 years +)	No
Tree Planting	Actively seek out opportunities for tree planting in the watershed.	DEC, CNY RPDB, SWCDs, Municipalities	USFS, DEC, SWCDs	$250/tree	High Priority (1 – 5 years, ongoing)	No
Upland Water Retention	Increase upland retention through implementation of water storage BMPs (retention basins, wetlands, etc.).	SWCDs, CNY RPDB, SLA, Municipalities	DEC, DOS, EFC, USEPA, USDA, Private Conservation Programs		Medium Priority (5 – 10 years)	Yes
Voluntary Buyouts	Use voluntary buyouts on improved properties that see recurring flooding. Find or develop flexible funding sources that compensate owners for the full value of their property.	SLA, CNY RPDB, Municipalities	New York's Division of Housing and Community Renewal		Low Priority (10 years +)	No

Table 5.2 – Best Management Practices for the Skaneateles Watershed

BMP Name	BMP Description	Lead Organizations and Partners	Potential Funding Sources	Estimated Cost	Priority	Currently being implemented?
Watershed Agricultural Program	Continue to support the Skaneateles Lake Watershed Agricultural Program.	City of Syracuse, SWCDs, SLWAP, NYSAGM	City of Syracuse, SWCDs, SLWAP, NYSAGM		High Priority (1 – 5 years, ongoing)	Yes
Wetland Enhancement / Restoration	Construct wetlands or enhance/restore existing wetlands to reduce sediment and nutrient loads.	SWCDs, SLA, Municipalities	DEC, DOS, USFWS, USEPA	Wetland Enhancement: $225/acre Wetland Rehabilitation: $435/acre Wetland Creation – Floodplain: $475/acre	Medium Priority (5 – 10 years)	No
Residential Inputs						
Disconnect Downspouts and Other Drainages	Connect discharges from downspouts, sump-pumps, and other sources to designated pervious areas to reduce runoff rates.	SWCDs, CCE, SLA, Municipalities	DEC, DOS, USEPA	Site dependent: $0 - $11,000 / acre [CAST costs]	High Priority (1 – 5 years, ongoing)	No
Forested Acreage - Residential	Promote forest management education for residential property owners with forested acreage.				High Priority (1 – 5 years, ongoing)	No
Funding for Projects on Residential Land	Develop a program to encourage conservation and water quality improvement projects on private residential property, modeled on existing septic system replacement programs.				Medium Priority (5 – 10 years)	No
Impediments to Adoption	Use surveys and other tools to better understand impediments to residential BMP adoption, and ways to incentivize lake friendly living practices				Medium Priority (5 – 10 years)	No
Residential Waste - Community Collection Events	Prevent the potential for surface water and groundwater contamination by hazardous materials through community collection programs.				Medium Priority (5 – 10 years)	Yes
Septic Systems	Continue participation in New York State's Septic System Replacement Fund program and promote nutrient-treating septic systems, as they become available.	County Health Departments	DEC	$10,000 per unit	High Priority (1 – 5 years, ongoing)	Yes
Shoreline Properties	Provide educational opportunities on best practices for shoreline properties.				High Priority (1 – 5 years, ongoing)	No
Soil Testing	Educate residents of the availability of Cornell Cooperative Extension's no-cost residential soil testing service. Soil tests can tell property owners what nutrients are in your soil and what they may or may not need to add (in the form of fertilizer) for				Medium Priority (5 – 10 years)	Yes
Stormwater Management - Residential	Promote education and outreach to homeowners to encourage them to find ways to integrate stormwater management into their property management, through the use of rain gardens, biofilters, and ponds.				Medium Priority (5 – 10 years)	No
Trees for Tribs	Promote the NYS DEC's 'Trees for Tribs' program to encourage riparian buffer plantings in the Skaneateles Watershed; encourage tree planting on developed land (i.e., turf).	SWCDs, SLA, CCE, EFC, USDA, OPRH		$5 to $250 per tree	High Priority (1 – 5 years, ongoing)	Yes
Turf Lawns	Encourage the conversion of residential turf lawns to meadows dominated by native species with strong root systems.	SLA, CCE, Municipalities	Private property owners	$4,500/acre (based on 2006 cost of "well over $3K/acre", updated to 2023)	High Priority (1 – 5 years, ongoing)	Yes
Roadway Maintenance						
Add Cross-Drains	Conduct an analysis on the possible benefits of adding cross-drains to roadside drainage, to distribute water volumes more evenly across the landscape, and of daylighting buried drainage pipes.	Municipalities, State DOT, SWCDs, Cornell Local Roads	NYSDOT, USDOT, USFWS, Municipalities		Low Priority (10 years +)	No

Table 5.2 – Best Management Practices for the Skaneateles Watershed

BMP Name	BMP Description	Lead Organizations and Partners	Potential Funding Sources	Estimated Cost	Priority	Currently being implemented?
Culvert Assessment	Conduct a culvert assessment (using the North Atlantic Aquatic Connectivity Protocol) and right-size culverts to avoid headcuts and provide aquatic connectivity. (Already completed for Cayuga and Cortland Counties.)	SWCDs	DEC, NYSAGM		Medium Priority (5 – 10 years)	Yes
Disconnect Ditches	Where feasible, disconnect roadside ditches from waterways, without causing unintended consequences of new drainage patterns on downslope areas	Municipalities, State DOT, SWCDs, Cornell Local Roads	DEC, DOS, DOT, USEPA		Low Priority (10 years +)	No
Ditch Inventory	Develop a digital inventory of roadside drainage ditches to support future modeling and improvement efforts.	Municipalities, City of Syracuse, CNY RPDB	DEC		Medium Priority (5 – 10 years)	No
Roadside Ditches	Reduce flow velocities and promote sedimentation within road ditches through installation of check dams and other facilities.	Municipalities, State DOT, SWCD	DEC, DOS, DOT, USEPA	$50 to $1000 per unit	Medium Priority (5 – 10 years)	No
Salt Calibration Workshops	Continue the use of municipal salt calibration workshops.	NYSDOT, Municipalities, NYS Fair, SWCDs, CNY RPDB	NYSDOT, SWCDs		Medium Priority (5 – 10 years)	Yes
Snowplow Blades	Adopt practices and/or acquire equipment that can reduce the use and/or transport of road salt, such as live edge snowplow blade systems.				High Priority (1 – 5 years, ongoing)	No
Invasive Species Management						
Boat Decontamination	Expand boat decontamination infrastructure for invasive species around the watershed	SLA, Municipalities, PRISM, DEC, SWCDs	SLA, DEC, NYS DOS, US EPA		High Priority (1 – 5 years, ongoing)	Yes
Boat Stewards	Support and expand the Boat Launch Stewards program.	SLA, DEC	SLA, DEC, NYS DOS, US EPA		High Priority (1 – 5 years, ongoing)	Yes
Harbormaster Training	Provide invasive species training to harbormasters throughout the watershed.	SLA, Municipalities, PRISM, Marinas, DEC	SLA, DEC, NYS DOS, US EPA		Medium Priority (5 – 10 years)	No
HWA	Continue surveillance for and treatment of Hemlock Woolly Adelgid (HWA) in highly erodible steep gullies. Use systemic insecticides (imidacloprid and dinotefuran) and/or introduce natural enemies such as the predatory beetle Laricobius nigrinus.	SLA, SWCDs, Private Landowners	SLA, DEC, NYS DOS, US EPA		High Priority (1 – 5 years, ongoing)	Yes
Invasives Management	Continue to invest in programs that prevent the spread of aquatic invasive species and terrestrial invasive species that adversely affect water quality.	SLA, Municipalities, PRISM, DEC, SWCDs	SLA, DEC, NYS DOS, US EPA		Low Priority (10 years +)	Yes
Milfoil Management	Continue to use benthic matting to control the spread of Eurasian watermilfoil in Skaneateles Lake	SLA, Aquatic Invasives	DEC, SLA		High Priority (1 – 5 years, ongoing)	Yes
Private Access Points	Expand education and outreach to encourage decontamination and inspection at various private access points, such as marinas and short-term rentals with boat launches.	SLA, Municipalities, PRISM	SLA, DEC, NYS DOS, US EPA		Medium Priority (5 – 10 years)	No
Public Education and Outreach						
Demonstration Projects	Utilize public land to develop demonstration BMPs / projects with interpretive signage.				Medium Priority (5 – 10 years)	Yes
Education for Professionals	Provide training / educational materials for landscapers and other service providers in the watershed whose activities can affect water quality.				Medium Priority (5 – 10 years)	No
Educational Materials	Develop guidance manuals and other resources that can assist private landowners with implementing stormwater reduction projects.				High Priority (1 – 5 years, ongoing)	Yes

Table 5.2 – Best Management Practices for the Skaneateles Watershed

BMP Name	BMP Description	Lead Organizations and Partners	Potential Funding Sources	Estimated Cost	Priority	Currently being implemented?
Lake Friendly Living	Continue to participate in Lake Friendly Living program.	CCE, Lake Friendly Living partners, SLA, Municipalities			High Priority (1 – 5 years, ongoing)	Yes
Model Homes	Work with homeowners to develop a set of 'Model Homes' to demonstrate lake-friendly living practices.	SLA, CCE, Land Trusts			Medium Priority (5 – 10 years)	No
Municipal Employee Training	Provide / expand water quality training for municipal employees and volunteers, such as: • Firefighting practices • 'Good Housekeeping' practices for municipal facilities (modeled on MS4 Permit Requirements) • Incentive programs for municipal BMPs, similar to DEC's Climate Smart Communities				Medium Priority (5 – 10 years)	No
Volunteers	Continually engage watershed stakeholders across all groups and demographics in volunteer opportunities concerning water quality protection and improvement.				High Priority (1 – 5 years, ongoing)	Yes
Website	Continue to update 'skanlakeinfo.org', the central clearinghouse for information about Skaneateles Lake and its watershed (including adding information on the 9E process).	CCE, City of Syracuse			High Priority (1 – 5 years, ongoing)	Yes

6. Implementation Plan

6.1. Overview of the Implementation Plan: Adaptive Management

The 9E Plan establishes a consensus-based framework for decision-making within a given watershed. In the case of the Skaneateles Lake Watershed, multiple agencies and organizations have been actively working to protect the lake's water quality, through a range of actions, including public education, working with the agricultural community, managing invasive species, creating and enforcing local laws and regulations, and conserving land, to name only a few. The 9E Plan does not replace any of these activities, nor does its implementation in any way curb or control ongoing activities. The 9E Plan adds a measurable goal, maintaining TP and chlorophyll-a levels in the context of climate change, and a means of organizing the watershed activities that relate to this goal.

Adaptive management means that, over time, progress toward the measurable goals articulated in this plan can be tracked. As new information and issues emerge in the watershed, watershed stakeholders can work cooperatively to re-evaluate the Plan's implementation steps and adjust programs and projects accordingly. At the same time, it can take several years for the 'signal' of a long-term trend to be distinguishable from the 'noise' of a short-term shift in conditions. The CNY RPDB expects to review and update this plan within ten years.

The CNY RPDB was responsible for the development of this 9E Plan, in cooperation with the WAC. The CNY RPDB will continue to serve as the coordinator and convener of a 9E Plan Implementation Team, in conjunction with members of the WAC who wish to remain engaged in this process.

6.2. Metrics of Progress

In addition to directly tracking annual TP and chlorophyll-a levels in the lake, there are a variety of indirect indicators that will be tracked as data become available – many of which are already compiled and reported by the City of Syracuse, DEC, the SLA, CCE, and other watershed stakeholders:

- New housing starts
- HABs occurrences
- Septic system failures
- Land use / land cover changes
- BMP adoption
- Streambank stabilization project development
- Adoption of green infrastructure practices
- HWA control efforts
- Number of beach closures
- Adoption of local laws / regulations that intersect with nutrient loading levels

Continued trophic state monitoring using the CSLAP framework will also support long-term trend analysis.

Although the impact of some preventative measures cannot be directly quantified, continued partnerships and community engagement are key to protecting the Skaneateles Lake watershed for future generations. Measures such as education and outreach, and continued surveillance for impacts of invasive species on landscape stability can help manage nutrient and sediment loading to surface waters.

6.3. Implementation Team

Successful implementation of the 9E Plan will require the combined efforts of a range of watershed stakeholders, including many of those already represented on the existing Watershed Advisory Committee.

Central New York Regional Planning and Development Board: The CNY RPDB will take the lead on coordinating and convening the 9E Implementation Team and track the Plan's success, relative to the 9E's water quality targets.

City of Syracuse: The City of Syracuse will continue to be responsible for enforcing the State's Watershed Rules and Regulations in the Skaneateles Watershed, as well as providing support to Cornell Cooperative Extension's efforts in the watershed and providing funding for agricultural BMPs.

Onondaga County: Onondaga County will continue to be involved in supporting community planning in the Village of Skaneateles and the Towns of Skaneateles and Spafford. The County's Office of the Environment will be involved in water quality improvement project development and oversight, as well as in providing coordination between the Implementation Team and other County departments.

Cayuga County: The Cayuga County Department of Planning and Economic Development will continue to ensure coordination between the Implementation Team and stakeholders and resources in Cayuga County. As the coordinator of the Cayuga County Water Quality Management Agency (WQMA), the County facilitates the movement of information between the Skaneateles Watershed and Cayuga County stakeholders.

Skaneateles Municipal Partnership: The Skaneateles Municipal Partnership (SMP) is a forum that promotes the exchange of information and ideas between representatives of the towns and village in the watershed. The SMP will provide an important point of contact and coordination for funding opportunities, such as State grants, which require a municipal applicant.

New York State Department of Environmental Conservation: NYS DEC's continued involvement in this plan will be critical. DEC's Finger Lakes Hub is currently developing a Finger Lakes Action Plan, the recommendations of which will bear directly on how this 9E is integrated into water quality efforts across the region. DEC also coordinates the CSLAP program, which is the data source to be used in determining the three-year rolling averages for TP and chlorophyll-a levels. DEC administers numerous grant programs that will be critical in funding implementation projects in the watershed, particularly the Water Quality Improvement Program (WQIP).

Soil and Water Conservation Districts: The SWCDs in Onondaga, Cayuga, and Cortland Counties will be responsible for continuing to implement agricultural BMPs, in cooperation with farmers in the watershed. The Onondaga County SWCD supports the SLWAP and its efforts to ensure that farms in the watershed adopt the latest and most effective BMPs available. The SWCDs have also taken the lead on coordinating with public works departments to integrate water quality considerations into roadway maintenance and to assess culverts in the watershed. The Cayuga County SWCD recently completed a survey of culverts in the Cayuga County portion of the Skaneateles Watershed.

Cornell Cooperative Extension: CCE will be a key resource involved with implementing BMPs related to public education and outreach. As the administrator of the watershed's online information clearinghouse

(www.skanlakeinfo.org), CCE will have primary responsibility for communicating 9E Plan updates to the public.

Skaneateles Lake Association: The SLA manages a wide array of programs, including the Eurasian watermilfoil removal program, the Boat Stewards program, and Hemlock Wooly Adelgid control programs. Additionally, the SLA conducts and promotes scientific research on Skaneateles Lake and works with homeowners to promote water quality improvement actions at the residential level. This includes conducting streambank rehabilitation and other water quality improvements on private property.

FL-PRISM: The Finger Lakes Partnership for Regional Invasive Species Management (FL-PRISM) is the primary organization for invasive species detection, prevention, control, and education and outreach in the Finger Lakes region. The FL-PRISM will work collaboratively with its partners and the public to provide education and mitigate the impacts of invasive species in the Skaneateles Watershed.

Land Trusts: The Finger Lakes Land Trust and Central New York Land Trust will continue to work with individual property owners to ensure the conservation of private property in the watershed, either through the purchase of development rights, or through outright acquisition of parcels.

Colleges and Universities: The WAC did not include representatives of any of the region's many colleges and universities – some of which are actively engaged in research on Skaneateles Lake. Students and faculty from these schools can be instrumental in conducting research and developing projects and programs in the watershed. At a minimum, invitations to join the Implementation Team will be extended to representatives of the State University of New York College of Environmental Science and Forestry (SUNY ESF), Syracuse University (SU), and Hobart and William Smith Colleges, home of the Finger Lakes Institute (FLI).

6.4. Technical and Financial Assistance

Federal, state, and local resources are available to support the implementation of the recommendations in Tables 5.1 and 5.2.

Table 6.1 – Funding Sources for Watershed BMPs

Funding Source	Program	Description	Related Skaneateles Lake Watershed Recommendations
STATE			
New York State Department of Agriculture and Markets (NYSAGM)	Agricultural Nonpoint Source Abatement and Control Program (ANSACP)	Financial assistance program for projects led by SWCDs that involve planning, designing, and implementing priority BMPs. The program also provides cost-share funding to farmers to implement BMPs. For more info visit https://www.nys-soilandwater.org/aem/nonpoint.html.	Stormwater & Landscape Management
	Agricultural Environmental Management (AEM) Program	SWCDs engage local partners such Cooperative Extension, NRCS, AEM Certified Planners, Certified Crop Advisors, USDA Technical Service Providers, and agri-businesses to assist farmers in farm planning to reduce runoff and erosion.	Stormwater & Landscape Management
	Climate Resiliency Farming (CRF) Program	Assistance to reduce the impact of agriculture on climate change (mitigation) and increase resiliency of NYS farms in the face of a changing climate (adaptation).	Stormwater & Landscape Management
	Community Resiliency Training Program	Provides community and municipality-based training events to increase resiliency to future flooding and outbreaks of harmful algal blooms in high-risk waterbodies.	Stormwater & Landscape Management
	County Agricultural and Farmland Protection Planning Grants	Financial assistance for the development of County Agricultural and Farmland Protection Plans and assist implementation of such plans.	Stormwater & Landscape Management
	Source Water Buffer Program	Funding to support, expand or enhance water quality protection through the purchase of conservation easements on agriculture lands that preserves or establishes buffers for surface or ground waters.	Stormwater & Landscape Management
New York State Department of Environmental Conservation (NYSDEC)	Finger Lakes Watershed Grants Program	Funding for water quality monitoring and research, BMP planning and implementation, environmental education and stewardship.	Stormwater & Landscape Management, Residential Inputs, Public Education and Involvement
	Water Quality Improvement Project Program (WQIP)	For projects that reduce runoff, improve water quality, and restore habitat. Eligible applicants include municipalities, municipal corporations, and Soil and Water Conservation Districts	Stormwater & Landscape Management
	Climate Smart Communities (CSC) Grants	Provides 50/50 matching grants to municipalities for eligible climate mitigation and adaptation projects. This includes projects aimed at reducing flood-risk, increasing natural resiliency, extreme-event preparation, relocation or retrofit of critical infrastructure, and improving emergency preparedness.	Stormwater & Landscape Management

Funding Source	Program	Description	Related Skaneateles Lake Watershed Recommendations
	Community Forest Conservation Grant Program	Funds municipal land acquisition for community forests to protect habitat, improve air/water quality and provide for recreational opportunities	Stormwater & Landscape Management
	Non-Agricultural Nonpoint Source Planning and Municipal Separate Storm Sewer System (MS4) Mapping Grants	Provides up to 90/10 matching grants to local governments and Soil and Water Conservation Districts to help pay for initial planning of non-agriculture nonpoint source water quality improvement projects.	Stormwater & Landscape Management
	Invasive Species Grant Program	Designed to support projects that target both aquatic and terrestrial invasive species. The program allows applications for two new categories: Lake Management Planning and Aquatic and Terrestrial Invasive Species Research.	Invasive Species Management
	Trees for Tribs	Landowners who are the primary resident(s) of land in New York State with at least 50 feet along a stream or waterbody are eligible to receive a free bag of seedlings. Organizations or individuals with permission to plant on a given property with stream or waterbody access may also participate.	Stormwater & Landscape Management
	NYS Conservation Partnership Program	Funds to enable local organizations to strengthen urban, rural, and suburban, land conservation and public outreach programs, build community partnerships and implement BMPs.	Stormwater & Landscape Management
New York State Department of Environmental Conservation (NYSDEC)	Water Quality Management Planning Programs: Clean Water Act, Section 604(b) Funding	Funding is available to implement regional comprehensive water quality management planning activities, including tasks to determine the nature, extent and causes of point and nonpoint source water pollution problems, and to develop plans to resolve these problems.	9E Implementation
NYSDEC, OPRHP, Empire State Development Corporation, NYSDOS, NYSAGM	Environmental Protection Fund	Funds capital projects that protect the environment and enhance communities. Eligible projects include conserving farmland, restoring habitat, controlling invasive species, upgrading municipal sewage treatment plants, cleaning up waterfront property and creating public parks, purchasing land for the NYS Forest Preserve, and restoring historic sites.	Stormwater & Landscape Management, Invasive Species Management
NYSDEC, NY Sea Grant	NY's Great Lakes Basin Small Grants	Support stakeholder-driven efforts to restore and revitalize the state's Great Lakes region and demonstrate successful application of ecosystem-based management.	Floodplain and Stormwater Management, Invasive Species Management
NYSDEC / Land Trust Alliance	Forest Conservation Easements for Land Trusts Program	Public-private partnership funding provided to increase the pace of forested land conservation to combat climate changes.	Stormwater & Landscape Management

Funding Source	Program	Description	Related Skaneateles Lake Watershed Recommendations
NYSDEC / New York State Environmental Facilities Corporation (NYSEFC)	Clean Water State Revolving Fund	Provides interest-free or low-interest rate financing for wastewater and water quality improvement projects to municipalities. Eligible projects include stormwater management and habitat restoration and protection projects.	Stormwater & Landscape Management
	Wastewater Infrastructure Engineering Planning Grant	Provides grants to municipalities to help pay for the initial planning of eligible Clean Water State Revolving Fund water quality project.	Stormwater & Landscape Management
NYSEFC	Clean Water Infrastructure Act (CWIA) Grants	Funds municipal capital projects to improve water quality. *Consolidated Animal Feeding Operation Waste Storage and Transfer Program Grant* funds SWCDs to implement comprehensive nutrient management plans through the completion of agricultural waste storage and transfer systems on larger livestock farms. *CWIA Source Water Protection Land Acquisition Grant Program* funds municipalities, municipal corporations, SWCDs and not-for-profits (land trusts) for land acquisition projects providing source water protection. This program is administered as an important part of the WQIP program.	Stormwater & Landscape Management
	Green Innovation Grant Program (GIGP)	Provides municipalities, state agencies, private entities, as well as SWCDs with funds to install transformative green stormwater infrastructure.	Stormwater & Landscape Management
	Septic Replacement Fund	Provides participating counties with funds to reimburse a property owner for up to 50% of the costs (up to a max of $10,000) of their eligible septic system project. Eligible projects include replacement of a cesspool with a septic system; installation, replacement or upgrade of a septic system or components; installation of enhance treatment technologies.	Stormwater & Landscape Management
NYS Dept of State (NYSDOS)	Local Waterfront Revitalization Program (LWRP)	Funded projects match grants to revitalize communities and waterfronts. These projects may include green infrastructure components.	Stormwater & Landscape Management
	Smart Growth Comprehensive Planning Grant Program	Provides funding for eligible villages, towns, cities, counties, reginal planning entities, and not-for-profit organization to advance the preparation of municipal comprehensive plans to establish land use policies which support smart growth and clean energy principles.	Local Laws and Regulations

Funding Source	Program	Description	Related Skaneateles Lake Watershed Recommendations
NYS Dept of Transportation (NYSDOT)	Transportation Alternatives Program	Provides funding for roadway improvements and culvert and bridge replacements, as well as pedestrian and bicycle paths.	Roadway Maintenance
	Bridge NY Program	Funding available for local governments to rehabilitate and replace bridges and culverts statewide.	Roadway Maintenance
NYS Office of Parks, Recreation and Historic Preservation (NYSOPHRP)	Environmental Protection Fund Municipal Grants Program	Provides funding for acquisition, preservation, planning, development, and improvement of parks, historic properties, and heritage areas. Funding is available through the following grant categories: Park Acquisition, Development and Planning Program; Historic Property Acquisition, Preservation and Planning Program; Heritage Areas System Acquisition, Development and Planning Program.	Stormwater & Landscape Management
New York State Pollution Prevention Institute	Community Grants	Funding to projects that seek to improve the health, environmental quality, and economic vitality of communities across New York State. Designed to support public awareness and understanding that lead to adoption of sustainable practices.	Public Education and Outreach
Great Lakes Research Consortium	Small Grants Program	Provides funding dedicated to collaborative research and education on the Great Lakes and Great Lakes basin within New York State.	Public Education and Outreach
Finger Lakes-Lake Ontario Watershed Protection Alliance (FLLOWPA)	Funding and Technical Assistance	Provides funding to member counties for water quality improvement projects; FL-LOWPA funding has been used for a variety of purposes, including agriculture, septic systems, erosion and stormwater, invasive species, habitat protection, drinking water and more.	Stormwater & Landscape Management, Residential Inputs, Roadway Maintenance, Invasive Species Management
FEDERAL			
Federal Emergency Management Agency (FEMA)	Hazard Mitigation Grant Program	Helps communities implement hazard mitigation measures to protect against life and property damages.	Stormwater & Landscape Management
U.S. Department of Agriculture, Farm Service Agency (FSA)	Conservation Reserve Program (CRP)	A voluntary program for agricultural landowners that provides farmers with annual rental payments and cost- share assistance to establish long-term, resource covers on eligible farmland.	Stormwater & Landscape Management
	Farmable Wetlands Program	Voluntary program designed to restore previously farmed wetlands and wetland buffer to improve both vegetation and water flow.	Stormwater & Landscape Management
U.S. Department of Agriculture, Natural	Agricultural Conservation Easement Program (ACEP)	Provides financial and technical assistance to help conserve agricultural lands and wetlands and their related benefits.	Stormwater & Landscape Management

Funding Source	Program	Description	Related Skaneateles Lake Watershed Recommendations
Resources Conservation Service (USDA-NRCS)	Agricultural Management Assistance (AMA) Program	Provides financial and technical assistance to agricultural producers to voluntarily address issues such as water management, water quality, and erosion control by incorporating conservation into their farming operations.	Stormwater & Landscape Management
	Conservation Stewardship Program (CSP)	Voluntary program that provides financial and technical assistance to implement conservation practices on agricultural and forested lands.	Stormwater & Landscape Management
	Environmental Quality Incentives Program (EQIP)	Voluntary program that provides financial and technical assistance to agricultural producers to plan and implement conservation practices that improve soil, water, plant, animal, air and related natural resources on agricultural land.	Stormwater & Landscape Management
	Conservation Innovation Grants	Provides funding that supports the development of new tools, approaches, practices, and technologies to further natural resource conservation or private lands.	Stormwater & Landscape Management
	Wildlife Habitat Incentive Program (WHIP)	Voluntary program that provides financial and technical assistance to help participants develop fish and wildlife habitat on private agricultural land, non-industrial private forest land, and Indian land.	Invasive Species Management
U.S. National Oceanic and Atmospheric Administration	Environmental Literacy Grants	Funds to support the education of k-12 students and the public so they are knowledgeable of the ways in which their community can become more resilient to extreme weather events and/or other environmental hazards	Public Education & Outreach
U.S. Department of Agriculture, Rural Development	Water & Waste Disposal Loan & Grant Program	Provides funding for clean and reliable drinking water systems, sanitary sewage disposal, sanitary solid waste disposal, and storm water drainage to households and businesses in eligible rural areas.	Stormwater & Landscape Management
	Community Facilities Direct Loan & Grant Program	Provides funding to develop essential community facilities in rural areas.	Stormwater & Landscape Management
U.S. Department of Agriculture, U.S. Forest Service	Citizen Science Competitive Funding Program	Provides funding to support innovative projects that address science and resource management information needs while connecting people to the land and one another.	Public Education and Outreach
U.S. Environmental Protection Agency (USEPA) and US Forest Service	Great Lakes Restoration Initiative Forest Restoration	Funding to implement green infrastructure projects that improve habitat and other ecosystem function in the Great Lakes are eligible for funding.	Stormwater & Landscape Management
	Great Lakes Restoration Initiative Cooperative Weed Management	Funding to detect, prevent, eradicate, and/or control invasive plant species to promote resiliency, watershed stability, and biological diversity.	Invasive Species Management

Funding Source	Program	Description	Related Skaneateles Lake Watershed Recommendations
U.S. Fish and Wildlife Service (USFWS)	Partners for Fish and Wildlife Program	Assists landowners with technical and financial assistance to help protect, enhance, and restore wildlife habitat on privately owned lands. Activities include restoring wetlands, grasslands, in-stream habitats, stream banks, riparian areas, and floodplain areas.	Stormwater & Landscape Management
	North American Wetlands Conservation Act Grants	Funding to support long-term protection, restoration, and/or enhancement of wetlands and associated uplands habitat for the benefit of all wetlands-associated migratory birds	Stormwater & Landscape Management
U.S. Environmental Protection Agency (USEPA)	Clean Water Act Section 319 Nonpoint Source Management Program	Funding to support a variety of activities including technical assistance, financial assistance, education, training, technology transfer, demonstration projects and monitoring to assess the success of specific nonpoint source implementation projects.	Stormwater & Landscape Management
	EPA Environmental Education Grants	Supports environmental education projects and promote environmental awareness and stewardship.	Public Education and Outreach
	Water Research Grants	Funding to develop and support the science and tools necessary to develop sustainable solutions to 212st century water resource problems.	Public Education and Outreach
Great Lakes Commission	Sediment and Nutrient Reduction Program	Provides funding to reduce nutrients and sediments from entering the Great Lakes.	Stormwater & Landscape Management
LOCAL, REGIONAL & PRIVATE FOUNDATIONS			
Municipalities	Municipal Budgets	Provide labor and equipment from Departments of Highways and/or Public Works to do tasks such as clean debris from streams, culverts, storm drains, etc.	All
National Fish and Wildlife Foundation	Five Star and Urban Waters Restoration Grant Program	Provides funding to address water quality issues in priority watersheds, such as erosion due to unstable streambanks, pollution from stormwater runoff and degraded shorelines caused by development.	Stormwater & Landscape Management
	Sustain Our Great Lakes Program	Funding to support fish, wildlife, habitat and water quality improvement and protection within the Great Lakes Basin	Stormwater & Landscape Management
Wildlife Conservation Society	Climate Adaptation Fund	Funding to increase the pace and scale of impact in adaption for wildlife and ecosystems by increasing innovation, accelerating learning, and mainstreaming proven adaptation approaches.	Stormwater & Landscape Management
Freshwater Future	Project Grants Program	Provides financial support for activities led by community groups to promote river, lake, shoreline, wetland, groundwater, and drinking water protection in the Great Lakes basin through grassroots advocacy.	Stormwater & Landscape Management

Funding Source	Program	Description	Related Skaneateles Lake Watershed Recommendations
Great Lakes Basin States	Great Lakes Protection Fund	Provides funding to project that will create and advance the next generation of actions to protect and restore the ecological health of the Great Lakes	All
Northern Borders Regional Commission	Economic Infrastructure Grants	Funding provided to support critical infrastructure pertaining to water and wastewater systems and transportation networks anchoring regional economic development.	Stormwater & Landscape Management
Finger Lakes Partnership for Invasive Species Management (FL-PRISM)	Partner Project Program	FL-PRISM provides invasive species control support, including monitoring and chemical and mechanical control.	Invasive Species Management

6.5. Implementation Timeline

This plan proposes a combination of new ideas and continued support for existing programs, notably the SLWAP. Because this plan is organized around maintaining existing water quality into the future, rather than achieving significant reductions in TP and chlorophyll-a levels in the near-term, a sustained commitment to project and program implementation is even more critical than implementing a suite of programs immediately.

Plan implementation will capitalize on the fact that the watershed has a number of very proactive and engaged stakeholder organizations that are motivated to initiate water quality projects wherever opportunities can be found. This relies upon the cooperation of willing property owners; as a result, opportunities to implement specific BMPs tend to emerge asystematically.

Short-Term (1 to 5 years)

The first five years of plan implementation will be focused on developing working relationships within the 9E Implementation Team, as well as on the continuation of existing BMP implementation efforts. This will also be a period for assessing Implementation Team members' resources and determining how best to leverage existing resources to expand into new BMP areas.

Many of the recommendations developed through the 9E process relate to either public education or to developing materials for specific audiences, such as homeowners along the lake's shoreline. This is a relatively low-cost area for project development and implementation that can be realistically expanded upon in the short-term.

- Continue to implement agricultural BMPs in cooperation with the SLWAP, the Soil and Water Conservation Districts, and the City of Syracuse. The BMPs modeled in Scenario 2 should be emphasized, including:
    - Increased adoption of manure injection technology on corn silage fields,
    - Increased implementation of cover crops, and
    - Increased use of Precision Agriculture.
- Continue to implement other agricultural BMPs, including:

    - Crop residue mulching.
    - Develop and implement AEM Tier 3A Plans for crop farmers and Nutrient Management Plans (NMPs) for livestock operations.
- Investigate potential funding programs for filter strips adjacent to riparian corridors.
- Seek out opportunities for tree planting in the Skaneateles Watershed, particularly along the lake's shoreline and in riparian corridors (for example by promoting NYS DEC's 'Buffer in a Bag' program).
- Continue to advertise and implement the Environmental Facilities Corporation's Septic System Replacement Program, which can help to offset the costs of replacing aging and outdated septic systems.
- Implement 5,000 feet of streambank stabilization projects, including projects on Shotwell Brook and in the Winding Way subdivision.
- Continue to support the efforts of local land trusts to acquire lands in the watershed, particularly to create or protect natural buffers between development and surface waters. Conserve high value natural resources that provide resiliency to precipitation and flooding (such as steep slope forests, floodplains, wetlands, etc.) through the purchase of conservation easements.
- Expand outreach and education of invasive species through initiatives, signage, and programs, including:
    - Supporting and expanding the Boat Launch Stewards program.
    - Expanding boat decontamination infrastructure for invasive species around the watershed
    - Continuing surveillance for and treatment of Hemlock Woolly Adelgid (HWA) in highly erodible steep gullies.
- Continue to develop educational and outreach programs and materials to engage the community in water quality protection and improvement, including:
    - Utilizing the 'skanlakeinfo.org' website as the central clearinghouse for information about Skaneateles Lake and its watershed (including adding information on the 9E process).
    - Engaging watershed stakeholders across all groups and demographics in volunteer opportunities concerning water quality protection and improvement.
    - Continue participation in the Lake Friendly Living Program.
    - Develop educational materials specifically for owners of shoreline properties.
- Continue to work with residents in the watershed to promote residential-scale BMPS, such as:
    - Converting residential turf lawns to meadows dominated by native species with strong root systems.
    - Promoting forest management education for residential property owners with forested acreage.
    - Connecting discharges from downspouts, sump-pumps, and other sources to designated pervious areas to reduce runoff rates.
- Adopt practices and/or acquire equipment that can reduce the use and/or transport of road salt, such as live edge snowplow blade systems.

Mid-Term (5 – 10 years)

The second five years of 9E Plan implementation will include preparing for a re-evaluation of the 9E itself, including undertaking a more robust monitoring effort. It is expected that, with the benefit of five years of successful project development, implementation, and coordination, the 9E Implementation Team would have greater capacity to undertake more ambitious and complex efforts, such as working with public and

private landowners to develop demonstration projects to educate the public on residential BMP implementation.

- Tributary monitoring: replicate the major and minor tributary modeling undertaken in 2018 and 2019 to provide a base of data for a second Skaneateles 9E Plan.
- Implement 5,000 feet of streambank stabilization projects.
- Invest in projects to increase upland stormwater retention through the implementation of water storage BMPs (retention basins, wetlands, etc.).
- Promote the use of green infrastructure practices to intercept stormwater prior to entering waterways.
- Expand invasive species monitoring by using education and outreach to new audiences:
    - Provide invasive species training to harbormasters throughout the watershed.
    - Encourage decontamination and inspection at various private access points, such as marinas and short-term rentals with boat launches.
- Expand general water quality education to reach new audiences, and to provide property owners with concrete examples of how to implement BMPs:
    - Provide training / educational materials for landscapers and other service providers in the watershed whose activities can affect water quality.
    - Utilize public land to develop demonstration BMPs / projects with interpretive signage (e.g., the rain garden in front of the City's Water Building).
    - Work with homeowners to develop a set of 'Model Homes' to demonstrate lake-friendly living practices.
    - Educate residents of the availability of Cornell Cooperative Extension's no-cost residential soil testing service. Soil tests can tell property owners what nutrients are in your soil and what they may or may not need to add (in the form of fertilizer) for successful plant growth.
    - Promote education and outreach to homeowners to encourage them to find ways to integrate stormwater management into their property management, through the use of rain gardens, biofilters, and ponds.
- Apply for grant funding and explore other funding sources to develop a pool of resources for residential BMPs.
    - Develop a program to encourage conservation and water quality improvement projects on private residential property, modeled on existing septic system replacement programs.
- Use surveys and other tools to better understand impediments to residential BMP adoption, and ways to incentivize lake friendly living practices.
- Prevent the potential for surface water and groundwater contamination by hazardous materials through community collection programs.
- Work with municipal and State partners to evaluate and, as necessary, upgrade culverts and roadside ditches to reduce nutrient and other pollutant loading. This may include:
    - Develop a digital inventory of roadside drainage ditches to support future modeling and improvement efforts.
    - Reduce flow velocities and promote sedimentation within road ditches through installation of check dams and other facilities.

    - Conduct a culvert assessment (using the North Atlantic Aquatic Connectivity Protocol) and right-size culverts to avoid headcuts and provide aquatic connectivity.
- Promote enhancements to local regulations to discourage the development of solar power generation facilities (solar farms) on productive farmland, forested lands, and riparian areas.

Long-term (10 – 15 years)

A re-evaluation of the lake and watershed will likely have been completed (or be in progress) within ten years of the start of implementation of this 9E Plan. The following long-term recommendations assume that the water quality targets in this plan continue to be met and the Implementation Team has the capacity to handle more challenging projects.

- Implement 5,000 feet of streambank stabilization projects.
- Evaluate the feasibility of using anaerobic digesters in the Skaneateles Watershed to reduce nutrient loading and odors, and to produce renewable energy.
- Support measures to reduce the atmospheric deposition of nitrogen.
- Continue to work with municipal and State partners to improve the interface between public roads and major and minor tributaries to the lake:
    - Conduct an analysis on the possible benefits of adding cross-drains to roadside drainage, to distribute water volumes more evenly across the landscape, and of daylighting buried drainage pipes.
    - Where feasible, disconnect roadside ditches from waterways, without causing unintended consequences of new drainage patterns on downslope areas.
- Use voluntary buyouts on improved properties that see recurring flooding. Find or develop flexible funding sources that compensate owners for the full value of their property.

7. Monitoring Plan

7.1. Existing Data Sources

Several critical metrics of the lake and watershed's health are already compiled and published as part of existing program reporting. Collectively, these data sources form an invaluable source of information on the status of the lake and watershed. Existing data sources include, but are not limited to:

- DEC's CSLAP data, which provides key trophic state indicators:
  - TP
  - Chlorophyll-a
  - Secchi depth
- The skanlakeinfo.org website, which is the central clearinghouse for data on the lake and watershed (including several of the data sources listed below).
- The City of Syracuse's annual *Water Quality Report* and *Watershed Annual Report* which include:
  - Lake levels, precipitation levels, and dam discharge volumes by month,
  - Water quality analysis results,
  - Number and duration of water intake closures,
  - Analyses of algae present in the lake's water, by phylum and genus,
  - Water temperature,
  - Secchi depth,
  - Summary of reported and confirmed HABs events,
  - Onsite wastewater treatment inspection results,
  - Number of housing starts and building permits reviewed and issued in the watershed,
  - Number of erosion and sediment control plans reviewed,
  - Number and type of violations of the Watershed's Rules and Regulations recorded,
  - Results of the annual Agricultural Pesticide and Fertilizer Use Survey,
  - HWA control activities, and
  - Watershed personnel trainings, certifications, and presentations
- The SLWAP annual report, which provides information on agricultural BMPs implemented in the watershed.
- Cornell Cooperative Extension's *Wave Reviews* newsletter, which provides Skaneateles Lake residents with a summary and updates on important events, projects, and issues related to water quality in the Skaneateles Lake Watershed
- Annual reports and newsletters prepared by the Soil and Water Conservation Districts, County Health Departments, and County Planning Departments in the watershed.
- SLA's annual report, special reports, and periodic website updates.
- Website updates / press releases from other not-for-profit organizations active in the watershed, including the Finger Lakes Land Trust, the Central New York Land Trust, the Nature Conservancy, and other organizations.

The CNY RPDB will track data in these sources and provide annual updates on noteworthy trends and data points to the 9E Implementation Team.

7.2. Proposed Monitoring Activities

In addition to ongoing monitoring, the following monitoring activities will provide data that will inform future updates to the SWAT and CE-QUAL2 models:

- Major tributary sampling every five years, using the methodology in *Monitoring of Streamflow and Water Quality in the Four Largest Tributaries to Skaneateles Lake*, prepared by UFI for the SLA in 2019.
- Major and minor tributary sampling every 10 years, using the methodology in *Water quality and flow of ten tributaries to Skaneateles Lake*, prepared by UFI for the CNY RPDB in 2019.
- As needed, upstream and downstream water sampling will be done before and after BMP implementation on tributaries.

8. Conclusion

Skaneateles Lake and its surrounding area is one of Upstate New York's most valuable assets. Aside from its importance as an unfiltered drinking water supply for Upstate's third largest city, Skaneateles Lake is a source of visual beauty, recreation, and provides habitat for fish and wildlife. It benefits from its unusual topography: a relatively small "bowl" of a watershed enclosing a long, deep lake. The result is a body of water that is fed by more than a hundred small streams, most of which only flow during rainstorms or when snow is melting. Between these topographical assets and the vigilance of the many stakeholders devoted to its protection, Skaneateles Lake has the best water quality, by virtually any metric, of any of the Finger Lakes.

The purpose of the 9E Plan is to ensure that this continues to be the case going forward. Climate change, invasive species, and development pressure are constant threats to water bodies around the world, and Skaneateles Lake is no exception. The verification of a HAB outbreak in 2017 served as a reminder that even the best protected bodies of water are threatened by changing conditions.

This 9E Plan lays out a target for nutrient loading – specifically, the limiting factor in the lake's ability to sustain algal growth: phosphorus levels. The long-term goal for the lake is to hold TP levels at their current level, as measured by three-year rolling averages. Additionally, chlorophyll-a levels will be tracked, with the goal being to prevent these levels from moving above their current average level.

The CNY RPDB, working with a 9E Implementation Team, will work toward the implementation of the recommendations in this plan. A wide variety of monitoring activities are already in place, and others will be added over time. This flow of information will create a feedback loop, indicating how 9E implementation is affecting the lake. Using an adaptive management plan, the Implementation Team will adjust the implementation strategy as needed.

Skaneateles Lake is blessed with a wealth of resources, not the least of which is a group of proactive, dedicated stakeholders. Working together, this group has the ability to, not only meet, but exceed the expectations laid out in this 9E Plan.

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