Upper Saranac Watershed Management Plan - 2022

VISION STATEMENT

The Upper Saranac Watershed Management Plan guides a vision of a watershed that sustains exceptional water quality and healthy ecosystems that are managed and protected through science-based decisions, advocacy, and collaboration. The actions in the plan support the freshwater and terrestrial resources and promote social and economic benefits for the residents and visitors of the watershed.

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1. Acknowledgements

The Upper Saranac Watershed management plan was developed in 2022 and facilitated by the Upper Saranac Foundation with funding from the New York State Department of Environmental Conservation (NYS DEC) Invasive Species Management Grant Program. The NYS DEC awarded Upper Saranac Foundation $68,075 to build on and update the 1998 Upper Saranac Lake Management plan with a specific emphasis on invasive species management. The Upper Saranac Foundation contracted with the Paul Smith's College Adirondack Watershed Institute to complete the plan.

We'd like to acknowledge the group of advisors who helped guide the plan early on. This includes:

- Adirondack Park Agency, Freshwater Resources, A.P. Project Analyst, Leigh Walrath
- Adirondack Partnership for Regional Invasive Species Management (PRISM), Adirondack Park Invasive Plant Program, Aquatic Project Coordinator, Erin Vennie-Vollrath
- Franklin County Soil and Water Conservation District Manager, Chastity Miller
- NYS Department of Environmental Conservation, Region 5 Forester, Steve Guglielmi
- Upper Saranac Lake Association, Susan Hearn
- Town of Santa Clara Planning Board Chair, Scottie Adams
- Purdue University, Department of Agricultural Economics, and Upper Saranac Lake shoreowner, Otto Doering

We'd like to thank Joseph Viscardo, who conducted research on local and state jurisdictions and compiled information for the plan. Joe served as an intern with the Upper Saranac Foundation in 2020 and 2021 and is a graduate of St. Lawrence University. We also thank the Town of Harrietstown and Town of Santa Clara code officer, Todd David, for his time and expertise related to local laws and ordinances in the watershed. We also thank the towns of Chester, Schroon, and Horicon, whose watershed plan we referenced during the development of this plan. The hard work that went into the Schroon Lake Watershed Plan is evident and we thank them for dedication and stewardship.

And finally, we'd like to thank the NYS DEC for their ongoing commitment to freshwater protection and especially invasive species management. This report was prepared for the NYS Department of State with funds provided under Title 11 of the Environmental Protection Fund.

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Seward Range and Upper Saranac Lake from St Regis Mountain – photo from Wikimedia Commons

2. Executive Summary

The Upper Saranac Watershed is part of the ancestral lands of the Mohawk Tribe, one of the five nations that constituted the Haudenosaunee Confederacy or "The People of the Long House". The Mohawk people arrived in the Adirondack region between 1,200 and 4,000 years ago and today the federally recognized tribe in the Adirondack region are the St Regis Mohawk Indians.

Falls colors and shoreline at Upper Saranac Lake – photo by Diana Robinson

Modern European settlements began in the watershed about 170 years ago.

In 1991 Upper Saranac Lake suffered a noted decline in water quality from lake-wide blooms of cyanobacteria. Soon after, the New York State Department of Environmental Conservation (DEC) and Paul Smith's College began a large-scale study of the lake and its tributaries to measure phosphorus loading. In 1996 an Upper Saranac Lake Citizens Advisory Committee was formed and as a result, an Upper Saranac Lake Management Plan was completed in 1998.

In 2019 the NYS DEC Invasive Species Management Grant Program awarded Upper Saranac Foundation (USF) a grant to build on and update the 1998 plan. USF contracted with the Paul Smith's College Adirondack Watershed Institute (AWI) to develop an Upper Saranac Watershed Management Plan. The document contains a comprehensive review of the state of Upper Saranac Lake and its watershed drawn from decades of monitoring and management activities on the lakes. Through a stakeholder survey, targeted interviews, and public comments, the plan defines the community's priorities and associated actions, and presents a recommendation summary identifying partners, timelines and costs needed to implement the plan.

The Upper Saranac Watershed Management Plan guides a vision of a watershed that sustains exceptional water quality and healthy ecosystems that are managed and protected through science-based decisions, advocacy, and collaboration. The goals and associated actions in the plan support the freshwater and terrestrial resources and promote social and economic benefits for the residents and visitors of the watershed.

The goals of the plan are: (1) Protect the quality and ecological function of water resources for drinking water, recreation, public health and safety, and climate resilience; (2) Maintain habitat for native plants and animals to ensure their long-term viability in the watershed; (3) Promote wise stewardship and responsible use of recreational resources in the watershed; (4) Protect and enhance the aesthetic values and special characteristics of the watershed; (5) Address priority watershed issues through improved local planning, regulatory programs and other municipal actions that are integrated, collaborative, and forward thinking; (6) Increase awareness about best management practices and lake stewardship through targeted outreach and communication to stakeholders within the watershed; and (7) Encourage a culture of community and a greater sense of involvement in guiding the future of the Upper Saranac watershed.

Upper Saranac Foundation guided the development of the plan; however, it reflects the concerns and interests of stakeholders across the watershed. Much of the task related work falls on the shoulders of the USF Lake Manager and its board. However, for the plan to be successfully implemented USF is relying on the support, guidance and participation from important partners including Upper Saranac Lake Association and other lake associations in the watershed, the towns of Santa Clara and Harrietstown, NYS DEC, Franklin County Soil and Water Conservation District, AWI, Adirondack Park Invasive Plant Program, and other organizations, funders, and agencies.

3. Introduction

3.1. History & Overview

The Upper Saranac Watershed is part of the ancestral lands of the Mohawk Tribe, one of the five nations that constituted the Haudenosaunee Confederacy or "The People of the Long House." The Haudenosaunee Confederacy was a participatory democracy that served as a model for the American Constitution, and they believed that law, society, and nature were equal partners. The Mohawk people arrived in the Adirondack region between 1,200 and 4,000 years ago, though Paleo-Indian sites have been found in the region dating to 9,000 B.C. Today, the federally recognized tribe in the Adirondack region is the St Regis Mohawk Tribe, and the lands of the Upper Saranac Watershed were theirs long before European settlement.

This plan draws from a rich history of environmental stewardship and work done in the Upper Saranac Watershed. Though indigenous people have traversed the Upper Saranac Watershed for thousands of years, modern settlement began about 170 years ago in the forms of logging, road construction, tourism, and residential development. The cumulative impacts of modern settlement were first observed by residents in the 1970's, but dense surface blooms of cyanobacteria that persisted in Upper Saranac Lake for nine months in 1989-1990 spurred the lake community into action. Residents immediately supported initiation of a comprehensive water quality monitoring program, and the lake and its main tributaries have been under continuous surveillance since 1990.


Cyanobacteria bloom in Lake Champlain, photo from Conservation Law Foundation

In 1996 an Upper Saranac Lake Citizens Advisory Committee was formed to address water quality issues in Upper Saranac Lake. The result was a management plan that was guided by a number of interests on the Lake including Franklin County Water Quality Coordinating Committee, the Towns of Santa Clara and Harrietstown, the Saranac Lake Fish and Game Club, the Upper Saranac Lake Association, the Wawbeek Inn, Adirondack Council, Franklin County Federation of Fish and Game Clubs and the Lake Champlain Chapter of Trout Unlimited, Holmes & Associates, the Adirondack Park Agency (APA), and the NYSDEC. Upper Saranac Foundation and the Adirondack Aquatic Institute (now the Adirondack Watershed Institute) led the effort. The result was a management plan completed in 1998 that addressed several water quality issues on Upper Saranac Lake. The plan was endorsed by the NYS DEC, APA, and municipal governments.

In 2019 the New York State Department of Environmental Conservation Invasive Species Management Grant Program awarded Upper Saranac Foundation $68,075 to build on and update the 1998 plan with a specific emphasis on invasive species management. USF contracted with the Paul Smith's College Adirondack Watershed Institute and what results is the Upper Saranac Management Plan presented here. In this plan you will find a comprehensive review of the state of Upper Saranac Lake and its watershed drawn from decades of monitoring and management activities on the lakes. Through a stakeholder survey, targeted interviews, and public comments, the plan defines the community's priorities and associated actions. And as a result, we present a set of recommendations to protect the lake against current and future threats to its water quality, ecology, and social and cultural resources.

3.2. Planning Purpose & Process

3.2.1. Planning Team

The planning team worked on the day-to-day oversight and development of the plan.

Grant Manager:

Upper Saranac Foundation, Guy Middleton, Lake Manager, P.O. Box 564, Saranac Lake, NY 12983. lakemanager@usfoundation.net

Upper Saranac Foundation seeks to preserve, enhance, and protect the natural beauty, environmental quality, and recreational enjoyment of the Upper Saranac Lake (USL) region through the selective support of projects consistent with those objectives. USF's website is a valuable resource for information about the many services provided. Please access the website at www.usfoundation.net

3. Introduction

Project Consultants:

Paul Smith's College Adirondack Watershed Institute, Zoë Smith and Dan Kelting, PO Box 265, Paul Smiths, NY 12970. Zsmith1@paulsmiths.edu and dkelting@paulsmiths.edu.

Paul Smith's College Adirondack Watershed Institute's mission is to protect clean water, conserve habitat and support the health and well-being of people in the Adirondacks through scientific inquiry, stewardship, and real-world experiences for students. www.adkwatershed.org

Project Intern: Joseph Viscardo, St. Lawrence University 2020

3.2.2. Advisory Team

The project advisors provided early input and helped to frame important issues. They also generously reviewed documents during the project period. We acknowledge their expertise and dedication to the watershed resources and protecting clean water. The group of advisors included:

- Adirondack Park Agency, Freshwater Resources, A.P. Project Analyst, Leigh Walrath
- Adirondack Partnership for Regional Invasive Species Management (PRISM), Adirondack Park Invasive Plant Program, Aquatic Project Coordinator, Erin Vennie-Vollrath
- Franklin County Soil and Water Conservation District Manager, Chastity Miller
- NYS Department of Environmental Conservation, Region 5 Forester, Steve Guglielmi
- Upper Saranac Lake Association, Susan Hearn
- Town of Santa Clara Planning Board Chair, Scottie Adams
- Purdue University, Department of Agricultural Economics, and Upper Saranac Lake shoreowner, Otto Doering


The Wawbeek Inn

3.2.3. Public Participation

The planning team sought public input to help shape the plan. It was our goal to understand the public's opinions of the watershed and gather the public's thoughts and ideas on actions that could help improve the future of the watershed. The planning team developed a survey for lake users, residents, visitors, and partner organizations. It was distributed to approximately 3,000 individuals through social media, email lists, newsletters and press releases to media. In addition, the public had the opportunity to attend two public meetings to provide input on how they use the watershed resources, raise concerns and ideas, and provide feedback on the process during the project period. Both meetings were held via Zoom due to the Covid-19 pandemic; however, 190 people registered for the meetings and just over 100 people participated. As a result, the public became familiar with the planning process and had the opportunity to share recommendations and feedback. Throughout the planning process we collected public feedback via email and have collected 23 comments that are reflected in the appendix. And finally, a project website was created to help the public find information about the planning process. Here we posted meeting announcements and notes as well as contact information. adkwatershed.org/upper-saranac-lake-management-plan.

4. Watershed Description

4.1. Physical Features

4.1.1. Watershed Boundaries

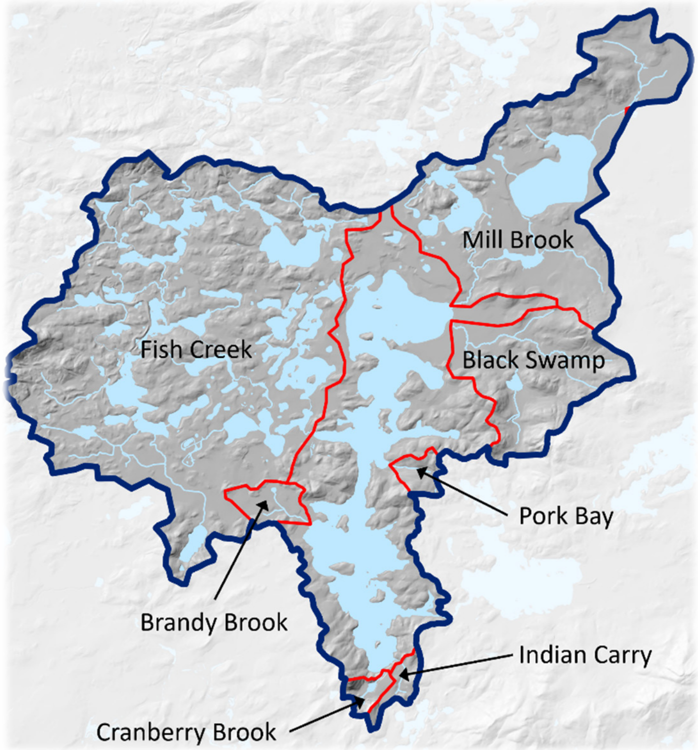
The Upper Saranac Watershed forms the headwaters of the Saranac River, which is one of the major drainages within the Lake Champlain Basin. The watershed is 48,597 acres in size and has seven subwatersheds (Map 1). The Fish Creek subwatershed to the west is the largest, occupying 43.7% of the total watershed area. To the north lies the Mill Brook subwatershed which occupies 19.3% of the total watershed area. Just south of the Mill Brook subwatershed is the Black Swamp subwatershed which occupies 7.2% of the total watershed area. There is a small tributary that drains into Pork Bay, whose subwatershed occupies 0.7% of the total watershed area. At the very south end of Upper Saranac Lake are two other small tributaries, Cranberry Brook and Indian Carry, whose subwatersheds occupy 0.6 and 0.7%, respectively, of the total watershed area. The final subwatershed is Brandy Brook located on the western shore of Upper Saranac Lake and occupying 1.2% of the total watershed area. The remaining 26.1% of the total watershed area is occupied by Upper Saranac Lake and lands draining to the lake via intermittent streams and direct runoff, with these lands representing 16% of the total watershed area.

4.1.2. Topography

The Upper Saranac Watershed is dominated by relatively gentle topography, with most lands being within the 0 - 3 and 3 - 15% slope classes (Map 2). Steeper land is mainly found along the watershed divide, though there are some hills within the watershed with steeper slopes. The middle and southern basins of Upper Saranac Lake have some steeper shorelines, with some approaching 35%. In contrast, the lands surrounding Lake Clear have more gentle slopes.

4.1.3. Geology & Soils

The bedrock geology of the Upper Saranac Watershed is anorthosite, a coarse-grained igneous intrusive rock that formed over one billion years ago. Exposures of this bedrock can be seen in road cuts and cliff faces throughout the watershed, but for the most part it is largely buried underneath many feet of surficial deposits of glacial till and outwash that are the result of multiple advances of continental glaciers across Canada and the northerly portions of the United States (Warner and Ayotte 2014). Glacial outwash consists largely of sorted sand while glacial till is a mixture of particle sizes from silt to boulders. Glacial



outwash is found on low lying areas and broad plains while glacial till is found on hillslopes.

The Upper Saranac Watershed is dominated by soils formed from glacial till (Map 3), which constitutes 60.5% of the total land area. Of the remaining land area, glacial outwash soils occupy 31.7% and soils formed in organic deposits occupy 7.9%. Though glacial till soils are finer textured than glacial outwash soils, both are still coarse textured soils with high percolation rates. Given this characteristic, most soils within the Upper Saranac Watershed are within the moderately well to well drained and somewhat excessively well to excessively well drained classes (Map 4), with soils within these two drainage classes occupying 78.1% of the land area. Organic materials retain water and have very low percolation rates, thus all the organic soils within the watershed are poorly drained. Most of the remaining poorly drained soils are glacial outwash soils in low lying areas on nearly level terrain, so topography is the limiting factor for drainage of these soils.

4.1.4. Climate & Precipitation

Annual precipitation ranges from 32 to 42 inches, with a long-term average of 37 inches. About 8 inches of annual precipitation occurs as snow with the remainder being rain. Rainfall is higher during the growing season, with June being the wettest month at an average of 4.2 inches (Figure 1). Monthly average temperature peaks in July at 63°F with a low of 15°F in January. Long term weather data shows considerable variation in total summer rainfall, with lows around 8 inches and the highest of 18 inches recorded in 2013 (Figure 2). The period of record for total summer rainfall shows both long-term trends in increasing rainfall and in variability in rainfall, both consistent with predictions related to climate change. A shorter period of record for annual growing degree days also exhibits an increasing trend, which is consistent with warming related to climate change.

Table 1. Surface waters in the Upper Saranac Watershed.

Subwatershed Name	Lakes & Ponds (Number & Acres)					Streams (miles)
	No.	Min	Max	Sum	Class AA*	
Black Brook	2	0.1	41.9	42.1	2	9.4
Brandy Brook	1			5.6	1	1.4
Cranberry Brook	2	0.4	15.2	15.6	2	0.5
Fish Creek	90	0.1	490.4	3,932.9	55	20.1
Indian Carry						0.8
Mill Brook	24	0.1	973.7	1,587.1	13	9.6
Pork Bay	2	1.2	2.2	3.4	1	0.7
Upper Saranac	12	0.3	4,844.0	4,899.4	6	
Grand Total	133			10,486.2	80	42.6

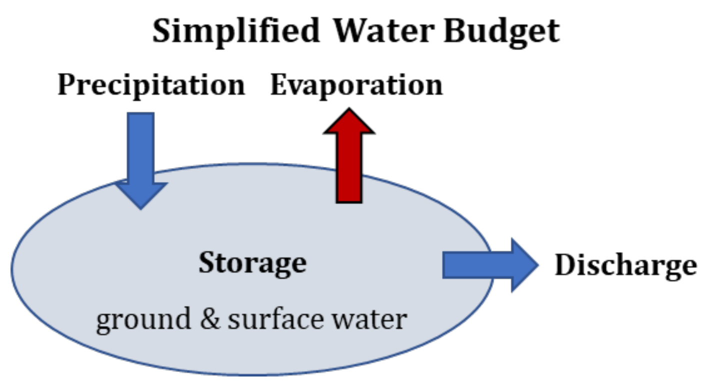
*Class AA is a designated use assigned to waterbodies (see Table 4 for definitions)

4.1.5. Surface Water

There are 133 lakes and ponds ranging in size from less than one acre to 4,844 acres in the Upper Saranac Watershed (Table 1). Most lakes and ponds are in the Fish Creek subwatershed, which has 90 waterbodies totaling 3,933 acres with Follensby Clear Pond being the largest at 490 acres. The Mill Brook subwatershed contains the second largest number of lakes and ponds with 24 waterbodies totaling 1,587 acres, with Lake Clear the largest at 974 acres. The Upper Saranac subwatershed is third with 12 waterbodies with Upper Saranac Lake dominating at 4,844 acres. Collectively, lakes and ponds occupy 10,486 acres of the Upper Saranac Watershed which constitutes 21.6% of the total watershed area.

The Upper Saranac Watershed contains 42.6 miles of streams, 20.1 miles of which are within the Fish Creek subwatershed (Table 1). Of the remainder, 19 miles are nearly equally split between the Black and Mill Brook subwatersheds. The other subwatersheds have very short stream segments. These streams collectively discharge about 74,000 acre-feet of water to Upper Saranac Lake per year, with considerable variation year-to-year dependent on precipitation (Figure 3). The differences in discharge between the subwatersheds reflects their size, with the greatest capture and discharge occurring in the largest subwatersheds. Thus, Fish Creek has the highest discharge followed second by Mill Brook, with these two subwatersheds contributing over 90% of the streamflow to Upper Saranac Lake.

The Upper Saranac Watershed annual water budget was estimated using the Thornthwaite Model (Thornthwaite and Mather 1957), the most common model for estimating water budgets (Black 2007). Thornthwaite uses a combination of mean monthly temperatures and day length to estimate monthly evaporation. Water surplus (that available to recharge ground and surface water) was then estimated by subtracting monthly evaporation from monthly precipitation, and then summed to produce annual estimates. The historical weather data was used in this analysis.



Based on measured precipitation, the Upper Saranac Watershed receives an average of 149,429acre-ft of total precipitation (rain plus snow) per year, of this total an estimated 77,327acre-ft/year is returned to the atmosphere as evaporation, leaving 72,101acre-ft/year as surplus. So, just under half the precipitation captured by the watershed is available to recharge and maintain the ground and surface water resources in the watershed.

Upper Saranac Lake has a total volume of approximately 55,549acre-ft. If all the 72,101acre-ft/yr of surplus water entered the lake it would flush 1.3 times per year, for an average water retention time of 0.77 years. Given that some of this water would be retained in the soil and percolated downward to recharge groundwater, the actual flushing rate is likely less than once per year.

4.1.6. Ground Water

The Adirondack Park is within the vast glacial aquifer system formed in surficial deposits that are the result of multiple advances of continental glaciers across Canada and the northerly portions of the United States (Warner and Ayotte 2014). These surficial deposits vary greatly in texture, depth, and density with these three factors largely determining groundwater recharge and residence times. Though groundwater underlies most of the Adirondack Park, about 1 million acres of major unconfined surficial aquifers have been mapped, noting that these are mainly formed in glacial outwash, and this is a rough approximation based on the 1:250,000 scale data available through the USGS and NYSDEC. The Upper Saranac Watershed contains 12,780 acres of these unconfined surficial aquifers oriented in a wide band that extends from the southwest to the most northerly border of the watershed (Map 5).

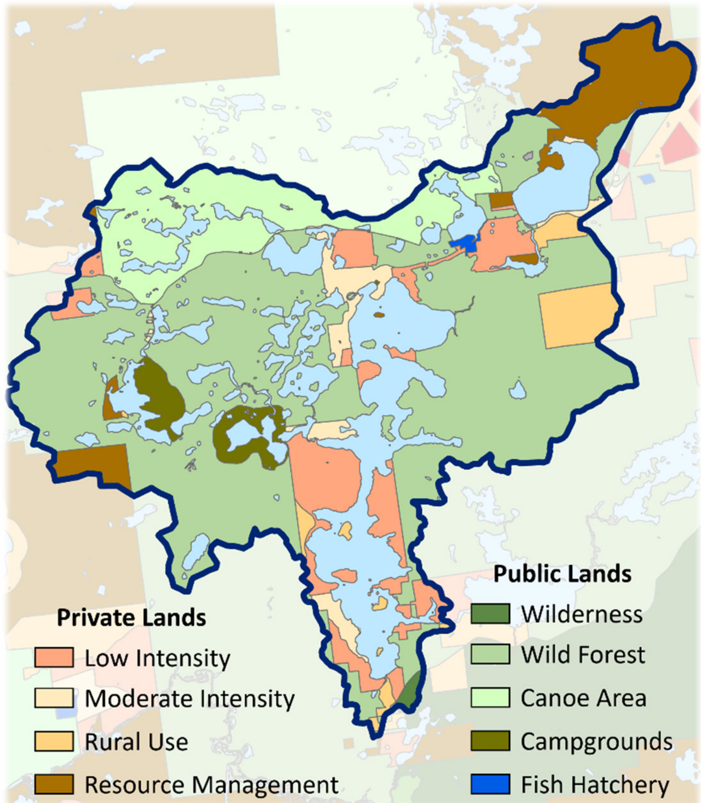
4.2. Land Use & Land Cover

4.2.1 Political Boundaries

The Upper Saranac Watershed occupies portions of four towns (Map 6). Most of the watershed at 63% is within Santa Clara, followed by Harrietstown and Altamont at 28 and 8%, respectively. A small sliver of the most northerly portion of the watershed is located within Brighton. Most of Upper Saranac Lake is contained within Santa Clara, with its most southerly portion being within Harrietstown. All of Lake Clear and Lake Clear Outlet are contained within Harrietstown.

4.2.2. APA Land Classifications

Most of the lands within the Upper Saranac Watershed are publicly owned, with these lands constituting 58.5% of the watershed area (Map 7). Wild Forest is the dominant land classification at 45.8% followed by Canoe Area at 10.1%. The DEC managed Campgrounds and Fish Hatchery, and a small amount of Wilderness, round out the publicly owned lands. Privately owned lands make up 20.4% of the watershed area. Of these lands, Low Intensity Use is most common at 8.2% followed by Resource Management at 6.5 percent. Most of the land around the southern half of Upper Saranac Lake is in private ownership, while much of the land around the northern half of the lake is public and classified as Wild Forest. Lake Clear also has a mix of public and private lands along its shoreline with Resource Management lands dominating the northerly drainage of the Lake Clear watershed.



4.2.3. Relevant Authorities

Understanding local and state regulatory jurisdictions in the Adirondacks as it relates to watershed management can be complicated. This section presents and a brief overview of local planning and zoning laws in two municipalities in which the majority of watershed is located (Santa Clara and Harrietstown). The lands located in the towns of Brighton and Altamont are not included in the full analysis. We also touch on state and federal jurisdictions. Jurisdictional regulations within the Upper Saranac Lake Watershed are summarized in Table 2.

The main purpose is to provide a baseline of information for the implementation of the watershed management plan. This section also begins to explore what other lake associations and watershed groups have implemented as a means to shed light on future ideas for local decisions in the Upper Saranac watershed. This section is meant to identify opportunities to further help protect the resources of the watershed that are important to the community and the state. This review is not meant to be a comprehensive analysis.

Local Home Rule. Maintaining clean water and healthy watersheds requires public participation and community stewardship. Appropriate land use laws and regulations are necessary to help guide residents and

Table 2. Summary table of jurisdictional regulations within the Upper Saranac Lake Watershed. Municipalities include Town of Santa Clara and Town of Harrietstown.

Regulated Item	Santa Clara	Harrietstown
APA Approved Local Land Use Program	No	No
Town Planning Board	Yes	Yes
Local Zoning Laws	Yes	Yes
Site Plan Review	Yes	Yes
Subdivision Regulations	Yes	Yes
Stormwater Management	Site Plan Review	Site Plan Review
Shoreline Cutting Regulations	APA & Town	APA
Waterfront Setbacks	APA & Town	APA & Town
Wetland Regulations	APA	APA & Town
Erosion Control	Yes	Yes
Septic Regulations	DOH	DOH & Town
Mandated Septic Inspection	No	No
Code Enforcement and Zoning Staff	1 Full-time & 1 Part-time	1 Full-time
Junk Storage Laws	NYS	NYS & Town
Timber Harvest	No	No
Dock Regulations	APA & Town	APA
Boathouse Regulations	APA, DEC & Town	APA, DEC & Town
Climate Smart Community	No	No

municipalities as they make decisions about land use choices. In a watershed that encompasses several municipalities such as Upper Saranac does, it can be useful to implement consistent regulations across the municipalities. However, this is rarely done. Municipalities have ordinances and regulations to guide land use and resource protection under New York Home Rule Law which gives them the authority to adopt and amend local laws that are consistent with the state constitution. This "home rule" standard in New York State is very strong, and every municipality sets its own land use codes and regulations as they best see fit. The municipalities in the Upper Saranac watershed vary in size, demographics and their local planning and zoning laws. Both municipalities administer their own local laws and ordinances and adhere to state laws and federal guidelines to protect the watershed. For example, towns are responsible for administering the State Environmental Quality Review Act (SEQRA) for development projects. SEQRA guides local municipal governing boards and requires them to take environmental impacts into consideration when approving projects in the watershed.

County Governance and Planning. Franklin County Legislature is comprised of seven elected members, each representing one of seven districts of equal population across multiple municipalities in the county. The legislature establishes county policies, appropriates funding, and enacts resolutions and local laws, some of which may have a bearing on resource protection. While Franklin County does not have a planning board, the Franklin County Economic Development Corporation serves as a resource for business planning, workforce development, tourism promotion, and providing financial assistance to municipalities and businesses in the county. The Franklin County Soil and Water Conservation District provides educational programming and technical assistance for natural resource protection to landowners and municipalities in Franklin County. It is one of 58 Conservation Districts across New York.

State and Federal Resources and Jurisdiction. Land use management is a shared responsibility between local municipalities, New York State, and the US Federal Government. The Adirondack Park Agency and the New York State Department of Environmental Conservation are the principal state agencies which regulate use on private and public lands in New York State, including waterbodies and wetlands. The NYS Department of Health is responsible for providing safe, quality drinking water to New Yorkers. The Department of Transportation mitigates transportation infrastructure impacts to natural resources including stormwater management.

The Department of State Division of Local Government Services and Adirondack Park Agency Local Government Services Unit provide resources and assistance to local government in areas of planning, zoning, local land use regulations, resource protection, and other topics.

Several federal agencies including the U.S. Army Corps of Engineers and the US Fish and Wildlife Service review projects, regulate activities on waterbodies and wetlands, and provide guidance to help minimize impacts to natural resources from development and other land uses.

Town of Santa Clara. The Town of Santa Clara holds the majority of jurisdiction in the Upper Saranac watershed including most of Upper Saranac Lake. While all town departments impact the lands and waters of the town and the people who live there, the Code Enforcement department, Planning Board, and a Zoning Board of Appeals/Variance Board set policy, review permits, and ensure ordinance compliance for land use and development. The Town employs one full-time land code use officer as well as one-part time employee. The town's land use code was developed in 2000 and recently updated in 2022. The land use code includes regulations for waterfront protection, preservation of open space, on-site wastewater treatment, site plan review, the process for project review, and much more. Resources including requirements from the Department of Health, APA, and State Environmental Quality Review Act (SEQR) are also included.

Town of Harrietstown. The Town of Harrietstown has a smaller geographic representation in the watershed. The Town of Harrietstown shares a land use code officer with the Town of Santa Clara. Its governing departments that have an influence on the use and development of lands and waters within the watershed are the Building and Planning Department, which employs the zoning and code enforcement officer, and the Town Planning Board and Zoning Board of Appeals. The town's land use code was developed in 1993. The Town's website includes information on relevant state agency jurisdiction permitting and regulations for things such as boathouse and dock regulations and shoreline setbacks, however the town does not have their own local ordinances related to all these land uses. The town has extensive regulations for private water supply and on-site wastewater treatment.

Local Resources and Model Programs. There are many examples of programs, ordinances and other local initiatives that can serve as a model for the Upper Saranac watershed's planning efforts. Below are a few that can either be expanded upon, distributed more widely within the watershed, or adopted for use.

The Upper Saranac Foundation's Lake Friendly Living webpage contains relevant resources such as the Homeowners Guide to a Healthy Lake. This provides information on stormwater runoff management, shoreline buffers, rain gardens, native plantings, invasive species and more. Resources are also available to help limit impacts to the lake such as shoreline erosion, and light pollution. The website also contains guidelines for managing swimming floats and buoys, protecting loon habitat and septic maintenance. Each section goes into depth about ways citizens can maintain a positive impact on the lake environment.

The Upper Saranac Lake Association has a helpful list of recommendations included in their Around the Lake web page, including A Resident Guide, information on boating safety, fishing opportunities, ways residents can protect clean water, and more.

The Lake George Waterkeeper program supports scientific research, compliance with existing laws, and other actions that continue the protection of the Lake George watershed. The Waterkeeper has been on the leading edge of implementing innovative local programs to protect the waters in Lake George including the Lake George Safe Septic Systems Program which provide guidance and resources for homeowners and businesses to maintain or upgrade septic systems. Their Low Impact Development Certification Program helps to reduce runoff and minimize stormwater pollution. The water quality reporting tool provides a mechanism for anyone to report water quality concerns.

Great Camp Wenonah – photo from Wikimedia Commons

Adirondack Park Invasive Plant Program provides technical resources and volunteer opportunities for communities to help protect lakes. And the Paul Smith's College Adirondack Watershed Institute has resources and programs for students, homeowners, visitors and community leaders who are interested in helping to protect clean water and learn about the science that informs policies and management decisions in the watershed.

There are a several other examples of programs implemented in the region and around the country to help watershed organizations, municipalities and homeowners reduce impacts to their natural, social, and recreational assets. The Lake Champlain Basin Program and the Lake Champlain Sea Grant are two such notable organizations worth further exploration.

4.2.4. Land Cover Types

Ten different land cover types occur within the Upper Saranac Watershed (Map 8). The most prevalent land cover type is deciduous forest at 31.2% followed by evergreen forest at 27.6%, and with the addition of mixed forest, upland forests collectively cover 64.6% of the watershed. Wetlands collectively cover 10.7% of the watershed. Developed lands collectively occupy 2.7% of the watershed, with development concentrated along the paved road network and private shoreline. Included in developed lands are 35.4 miles of public roads that are maintained year-round. State Route 3 maintained by the NYS Department of Transportation constitutes 16.4 of these miles. Of the remaining roads, 10.8 miles are town roads, and 8.2 miles are county roads.

4.3. Plants & Animals

4.3.1. Invasive Species

4.3.1.1. Terrestrial

The Upper Saranac Watershed contains several terrestrial and aquatic invasive species, the majority of them plants. Terrestrial plants documented by NatureServe on iMapInvasives include Japanese knotweed (*Reynoutria japonica var japonica*), common reedgrass (*Phragmites australis ssp. australis*), reed canarygrass (*Phalaris arundinacea*), yellow iris (*Iris pseudacorus*), honeysuckle (*Lonicera spp*), burning bush (*Euonymus alatus*), autumn olive (*Elaeagnus umbellata*), garlic mustard (*Alliaria petiolata*), purple loosestrife (*Lythrum salicaria*), Norway maple (*Acer plantanoides*), wall lettuce (*Mycelis muralis*), and common speedwell (*Veronica officinalis*; iMapInvasives 2022). Among them, several have a NatureServe invasive rank of Very High and are legally regulated including Japanese knotweed, common reedgrass, burning bush, autumn olive, garlic mustard, purple loosestrife, and Norway maple. The Fish Creek campground is a hotspot for several species, and there are noted infestations of individual species including knotweed and common reed grass primarily associated with roadways including Route 30 south of Lake Clear, the Floodwood Road at the north end of Floodwood Pond, and locations along County Route 45 south of Wawbeek (iMapInvasives 2022).

The only documented terrestrial invasive animal species in the Upper Saranac watershed is the European starling (*Sturnus vulgaris*). It is not ranked or tracked by NatureServe but is among the most numerous birds on the continent, first brought to North America in 1890 by Shakespeare enthusiasts. It competes strongly for nest cavities and anecdotal evidence suggests it has had a detrimental effect on several native species (Cabe 2020). Starlings are closely associated with human settlements and are documented in numerous locations in the watershed including Lake Clear, Upper Saranac Lake, and Fish Creek Ponds.

Japanese knotweed – photo from Wikimedia Commons

4.3.1.2. Aquatic

There are ten invasive aquatic plant species and seven invasive aquatic animal species identified as species of concern for our region (Table 3). A species of concern is a non-native organism that has the potential to cause significant damage to the environment, economies, or human health. Of the ten invasive aquatic plant species, only Brazilian elodea and Hydrilla are yet to be detected in our region. Of the seven invasive aquatic animals, fishhook waterflea, Quagga mussel, and Round goby are yet to be detected in our region.

Quagga mussels – photo from Wikimedia Commons

Table 3. Invasive aquatic plant and animal species of concern for the Adirondack region (APIPP 2014).

Aquatic Plants		Aquatic Animals	
Common Name	Scientific Name	Common Name	Scientific Name
Brazilian elodea	*Egeria densa*	Alewife	*Alosa pseudoharengus*
Brittle naiad	*Najas minor*	Asian clam	*Corbicula fluminea*
Curly leaf pondweed	*Potamogeton crispus*	Fishhook waterflea	*Cercopagis pengoi*
Eurasian watermilfoil	*Myriophyllum spicatum*	Quagga mussel	*Dreissena bugensis*
European frogbit	*Hydrocharis morsus-ranae*	Round goby	*Apollonia melanostomus*
Fanwort	*Cabomba caroliniana*	Spiny water flea	*Bythotrephes longimanus*
Hydrilla	*Hydrilla verticillata*	Zebra mussel	*Dreissena polymorpha*
Variable-leaf milfoil	*Myriophyllum heterophyllum*		
Water chestnut	*Trapa natans*		
Yellow floating heart	*Nymphoides peltata*		

The ten aquatic plant species of concern are ordered in Figure 4 based on their NYS Invasive Species Ranking. The NYS Invasive Species Ranking is a 0 to 100 numerical score derived from four broad categories (ecological impacts, biological characteristics, distribution, and difficulty to control) (Jordan et al. 2012). The purpose of this ranking system is to distill these complex categories into a single number to compare the relative potential impacts of these organisms. Note, only rankings for aquatic plants were available. Eurasian watermilfoil has the highest ranking, followed closely by Variable-leaf milfoil. Hydrilla is ranked third and has not yet been detected in the Adirondack Park.

Eurasian watermilfoil – photo by Leslie Mehroff

Aquatic invasive plants in the Upper Saranac Watershed are limited to the 2 milfoil species, Eurasian watermilfoil (*Myriophyllum spicatum*) and variable or broadleaf watermilfoil (*Myriophyllum heterophyllum*). These are the 2 most widely distributed aquatic invasive species in the Adirondack Park and are both legally regulated. Eurasian watermilfoil is documented by NatureServe in Follensby Clear Pond, Square Pond, Copperas Pond, Fish Creek Pond, and Upper Saranac Lake. Variable watermilfoil is currently documented only in Fish Creek Pond (iMapInvasives 2022).

The sole aquatic invasive animal recorded in the Upper Saranac Watershed is the alewife (*Alosa pseudoharengus*), a species of ocean herring which is capable of inhabiting freshwater lakes where they spawn and which has spread far beyond its original migratory boundaries in New York State. Considered native in the marine district of New York but invasive in other regions, alewife have had significant negative impacts to the ecology of the Great Lakes (Fuller et al. 2022).

Though not reported within the Upper Saranac Watershed, the Chinese mystery snail (*Bellamya chinensis*) was reported both downstream in Weller Pond and in the adjacent St Regis Watershed in 2020 (iMapInvasives 2022). This aquatic invertebrate is listed as an invasive species and its introduction is prohibited under Part 575 of New York Codes, Rules and Regulations (NYCRR). The Chinese mystery snail was first reported in New York waters in 1920 and has since become widely distributed across the state and beyond. Though an invasive species and capable of forming dense populations that impact native snail communities, researchers in Wisconsin concluded that native snail communities were not significantly impacted by the presence of this organism (Solomon et al. 2009). This report is consistent with anecdotal observations of lack of significant impacts in Adirondack waters, still, this does not preclude the fact that the Chinese mystery snail is a prohibited species and, as with all invasive species, efforts should be made to limit its spread.

White perch (*Morone americana*) has been recently detected and caught by anglers in Upper Saranac Lake. Though native to New York's coastal waters, its introduction to the state's inland freshwaters has the potential to impact the recreational fishery as it competes with native fish for food resources as well as preys on their eggs. Establishment of white perch has also been linked to increased cyanobacteria dominance as this fish selectively feeds on the zooplankton that in turn feed on the phytoplankton (Coulture and Watzin 2008). This species is not listed as prohibited under Part 575 and thus its movements are not regulated, but its presence in the watershed is a cause for concern and points to the need to educate anglers on the potential negative consequences of introducing new fish species, regardless of their status.

4.3.2. Wildlife

With the exception of birds, records of occurrence for most terrestrial wildlife species are difficult to obtain because most species are not regularly tracked. Nevertheless, information about available habitats in the watershed can be used to ascertain the species likely to occur. Approximately 77% of the Upper Saranac Watershed consists of terrestrial and wetland habitat types, with the remainder made up of lake and river systems (Ferree and Anderson 2013). Among the terrestrial habitats in the watershed, the most common are Northern Hardwood and Conifer and Boreal Upland Forest, each of which are macrogroups consisting of several specific habitat types (Anderson et al. 2013). Northern Hardwood and Conifer is an extensive habitat type and the dominant forest throughout the Adirondack Park. These wooded uplands of the north-temperate northeast are characterized by northern hardwoods, pines, hemlock (Tsuga canadensis), or red spruce (Picea rubens) and are associated with 203 species, or approximately 71% of all terrestrial


Boreal forest – photo from Wikimedia Commons


Gray jays – photo by Dan Strickland

Adirondack vertebrates (Glennon and Curran 2013). Boreal Upland Forest makes up approximately 30% of the Upper Saranac Watershed and consist of northern uplands characterized by black spruce (Picea mariana) or jack pine (Pinus banksiana). These forests are associated with 146 species, many of which are Species of Greatest Conservation Need (SGCN) in New York and icons of the Northern Forest Region (Glennon and Curran 2013, New York State Department of Environmental Conservation 2015, Appendix Table 1). SGCN are defined as species whose populations are rare, declining, or vulnerable and are the subject of New York's State Wildlife Action Plan, which aims to protect these species and prevent them from becoming threatened or endangered. The U.S. Fish and Wildlife Service (USFWS) State Wildlife Grants (SWG) Program was initiated by Congress in 2001 provides states with federal funding to implement projects identified in state wildlife action plans; these plans must be revised at least every 10 years to remain eligible for State Wildlife Grants funding.The Upper Saranac Watershed also contains a significant amount of wetland habitat including Northern Swamp, Northern Peatland, and Emergent Marsh (Anderson et al. 2013). Northern Swamp is represented to the largest degree and is associated with 132 different terrestrial vertebrate species, many of them SGCN (Appendix Table 1). Like Boreal Upland Forest and Northern Peatlands, Northern Swamp is particularly important to numerous boreal species and provides habitat for several responsibility species in the Adirondack Park (Glennon and Curran 2013). Responsibility species are those species found nowhere else in the state and hence, species for which their future in NY depends on what occurs in the Park. These habitats are likely to be highly threatened by climate change because they are decidedly northern, adapted to cool, wet summers and cold winters, nutrient poor, and maintained in some places by northern processes like ice buildup on river shores (Jenkins 2010).

4. Watershed Description

Based on available habitat types, the Upper Saranac Lake watershed is likely to support most terrestrial vertebrate species known to occur in the Adirondack Park, including a significant number of Species of Greatest Conservation Need (Appendix Table 1). AWI monitors several of these species in the Upper Saranac Lake Watershed and throughout the park (Glennon et al. 2019a,b).

There are several significant threats to wildlife that should be considered to protect the wildlife resources in the watershed, these are summarized in Appendix 13.2.

4.3.3. Fisheries

Upper Saranac Lake and most lakes in the USL watershed are classified as very cold, oligotrophic or mesotrophic systems with low alkalinity (Laxson et al. 2017, Olivero-Sheldon and Anderson 2016). These are generally acidic, clear lakes characterized by high dissolved oxygen content and low to moderate levels of biological productivity, inhabited by a biota tolerant of acidic waters. The majority of these lakes stratify into a warm upper layer (epilimnion) supportive of warmwater fish species such as largemouth bass and a cold lower layer (hypolimnion) critical for cold water fish species like lake trout and brook trout (Olivero-Sheldon and Anderson 2016). These lakes support a vibrant fishery and provide habitat for a variety of species (Appendix Table 2).

The Upper Saranac Lake Association manages a voluntary angler diary program to monitor the lake's fishery. The number of anglers who participate in this program is quite low, and the USLA is looking for ways to increase participation (e.g., have the watercraft inspection stewards hand out information cards). Despite the low participation rate, the program does provide useful information about the fishery and the amount of effort taken to catch various species of fish. The eight anglers who participated in the program in 2021 collectively caught 147 smallmouth bass, 80 largemouth bass, 2 lake trout, 3 northern pike, 22 yellow perch, and 9 white perch (Nashett 2022). The report author described the bass fishery as exceptional and recommended encouraging responsible fish handling techniques (e.g., catch and release) and reporting any observed habitat destruction (e.g., disturbance of near shore spawning areas).

4.3.4. Endangered Species

Documented occurrence information for endangered species in the watershed are not readily available for most taxa including several species of NYS endangered molluscs, insects, and plants. One endangered fish, the round whitefish (*Prosopium cylindraceum*), occurs in Ledge Pond and Little Green Pond according to Sportsmen's Connection (2016). Based on available habitat, several other endangered vertebrate species have the potential to occur including the golden eagle (*Aquila chrysaetos*), peregrine falcon (*Falco peregrinus*), spruce grouse (*Canachites canadensis*), and Indiana bat (*Myotis sodalis*). Golden eagle and peregrine falcon are documented in the watershed (ebird.org). The bald eagle (*Haliaeetus leucocephalus*), Northern harrier (*Circus hudsonius*), and pied-billed grebe (*Podilymbus podiceps*) are listed as Threatened in New York and are documented in the watershed. Multiple species that have Special Concern status in New York are also documented including common nighthawk (*Chordeiles minor*), Cooper's hawk (*Accipiter cooperii*), Northern goshawk (*Accipiter gentilis*), red-shouldered hawk (*Buteo lineatus*), sharp-shinned hawk (*Accipiter striatus*), American bittern (*Botaurus lentiginosus*), common loon (*Gavia immer*), and osprey (*Pandion haliaetus*). Other potential Special Concern species in the watershed include Eastern small-footed bat (*Myotis leibii*) and wood turtle (*Glyptemys insculpta*).

Brook trout – National Park Service photo from Flickr

4.4. Demographics & Cultural Resources

4.4.1. Populations

The watershed is comprised of small, rural hamlets and dispersed development as well as denser shoreline development on the lake shores. Some of the largest population centers in the Adirondacks are in close proximity to the watershed, i.e., villages of Saranac Lake and Tupper Lake, however there is no major population center in the watershed. It is comprised of year-round homes, seasonal homes, vacation rentals, and several locally owned businesses. According to the 2020 US Census Bureau, the entire population of the Town of Santa Clara is 332 and the Town of Harrietstown population is 5,075. The Town of Brighton population is 1,435 and the population of the entire Town of Tupper Lake is 5,039.

The Upper Saranac watershed has several lake and homeowner associations that take responsibility for helping to steward the resources in the watershed. These mostly volunteer groups invest time and financial resources into educating homeowners and visitors, providing opportunities for public involvement, facilitating water quality monitoring, supporting scientific research, conducting political advocacy and investing in resource management to help secure a viable future for the Upper Saranac watershed. Year round and seasonal residents and visitors to the watershed all play an important role in protecting the natural resources, supporting the economy, and maintaining the tranquility of the watershed. There are many active organizations that work in the watershed including the Adirondack Park Invasive Plant Program, Franklin County Soil and Water Conservation District, Lake Champlain Basin Program, and the Paul Smith's College Adirondack Watershed Institute. These entities are dedicated to protecting the resources and supporting the communities in the Upper Saranac watershed.

4.4.2. Economics

The region's economy relies heavily on businesses that service tourists and seasonal homeowners. Motels, restaurants, grocery stores, gas stations, guide services, summer camps, boat liveries and marinas, car and boat repair service stations, contractors and construction suppliers, and caretaker and cleaning businesses provide important employment opportunities. Paul Smith's College employs nearly 200 people and many people work in state agency or public school jobs in Franklin County.

Kayaking in the Saranac Chain – photo from Adirondack Lakes & Trails Outfitters

4.4.3. Recreation

The Upper Saranac Watershed contains several major public and private recreational assets (Map 9). These assets include the NYSDEC campgrounds at Fish Creek and Rollins Pond, Adirondack Rail Trail, St Regis Canoe Area, NYS DEC Fish Hatchery, the Saranac Inn Golf Course and the Upper Saranac Lake Marina.

One of the most heavily used section of watershed is between Floodwood Road and Fish Creek Campground which contain public campsites, trail access points, and boat launches. According to the NYS DEC Saranac Lake Wild Forest Unit Management Plan, which was updated in 2019 and outlines opportunities to protect important resources and provide recreational opportunities, between the years 2004 and 2011 the average yearly attendance at Fish Creek Pond Campground was 110,576 people and at Rollins Pond Campground it was 62,527.

Upper Saranac watershed is a popular destination for paddling. The waterways provide plenty of opportunities for day trips or extended multi-day trips on several waterbodies. Upper Saranac Lake is the intersection of several important canoe routes, the most notable example is the Northern Forest Canoe Trail, which extends from Old Forge, NY to Fort Kent, Maine. The Saint Regis Canoe Area also provides options for paddlers to extend to long-distance multi-day paddling trips. Canoes and kayaks can access the waters at a number of hand launches in the watershed. Motorboats can access via boat launches with hard surface ramps, such as those found at Saranac Inn Boat Launch (Upper

Saranac Lake), and NYS DEC Campgrounds at Fish Creek and Rollins Pond.

Many backcountry campsites in the watershed can only be reached by watercraft. Popular camping areas include Follensby Clear Pond, Floodwood Pond, and Upper Saranac Lake. There is also roadside camping, most of which is located along Floodwood Road and at Little Green Pond. The NYS DEC has constructed a few American with Disabilities Act (ADA) compliant sites in the SLWF located at East Pine Pond, Follensby Clear Pond, Indian Carry, Whey Pond, and Upper Saranac Boat Launch. The updated SLWF UMP provides new opportunities for persons with disabilities.

Mountain bike trails include Deer Pond Loop Trails and Little Square Pond Trail and the updated SLWF UMP also proposes construction of 35 miles of new mountain bike trails. The Adirondack Rail Trail is being completed in phases starting in 2023. Once completed this trail will provide long-distance, off-road biking opportunities. There are a number of hiking trails in the watershed including the trail up Floodwood Mountain and Panther Mountain. Snowmobiling is allowed on the Forest Preserve only on designated snowmobile trails in Saranac Lakes Wild Forest. All hiking, mountain biking, and snowmobile trails are also available in the winter for cross-country skiing and snowshoeing. Cross country skiing and snowshoeing is popular on the Deer Pond Loop.

There are opportunities in the watershed to fish in remote brook trout ponds, lakes with large lake trout, land-locked Atlantic salmon, and largemouth and smallmouth bass. There are also opportunities for trout fishing in streams.

Due to proximity of main roads, good access to deer and bear hunting exists in the watershed. Small game hunting for snowshoe hare, ruffed grouse, and wild turkey can be found in areas where the forest has been disturbed by blowdown, or around wetland areas. There are also opportunities for trapping.

The SLWF also proposes support for developing a framework for monitoring wildlands to assess the effects of management actions and public use, and proposes to establish conditions to determine and measure carrying capacity on waterbodies which is a priority of this plan.

Jumping into Rollins Pond – photo by Jarek Tuszyński

5. Watershed Conditions

5.1. Water Quality Standards

5.1.1. Background

All surface waters (rivers, streams, lakes, and ponds) in New York State are classified according to their Best Uses(s) by the NYSDEC in accordance with Environmental Conservation Law to protect their uses for drinking, culinary and food processing, swimming, boating, and fishing. NYSDEC has four Best Use(s) classifications for fresh waters denoted by letters A, B, C, and D, with classification A having 4 subclassifications (Table 4). The NYSDEC uses water quality standards to assess the condition of state waters relative to meeting their classified Best Use(s) and assesses state waters on a rotating basis to determine if these standards are being met.

All fresh groundwater in New York State is designated Class GA by NYSDEC, the Best Use of Class GA groundwater is as a source of potable water supply.

5.1.2. Designated Uses

Eighty of the 133 lakes and ponds within the Upper Saranac Watershed and all the streams are classified as AA waters by NYSDEC. There are no waters classified as B, C, or D in the watershed. So, most waters within the Upper Saranac Watershed are designated to support all best uses from sources of water for drinking to fishing, this includes all the named waterbodies (e.g., Lake Clear and Upper Saranac Lake).

Table 4. New York State Water Classification and Best Use(s) for Fresh Waters.

Classification	Best Use(s)
A, AA, A-Special, AA-Special	Source of water supply for drinking, culinary, or food processing purposes; primary and secondary contact recreation; and fishing
B	Primary and secondary contact recreation, and fishing
C	Secondary contact recreation and fishing
D	Fishing

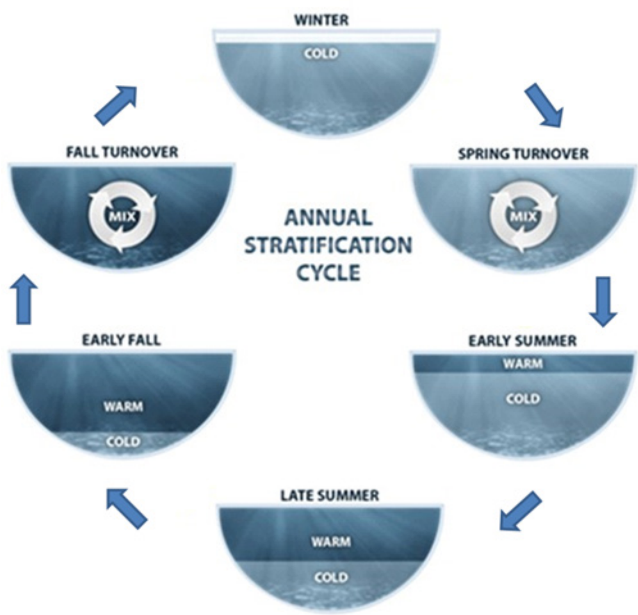
5.2. State of Water Resources

5.2.1. Lake Water Quality

There exist a long and diverse history of both scientific research and water quality monitoring for Upper Saranac Lake and it is among the most studied lakes in the Adirondacks. A summary of this history is in Appendix 13.4. The following narrative describes the key water quality indicators monitored and their long-term trends.

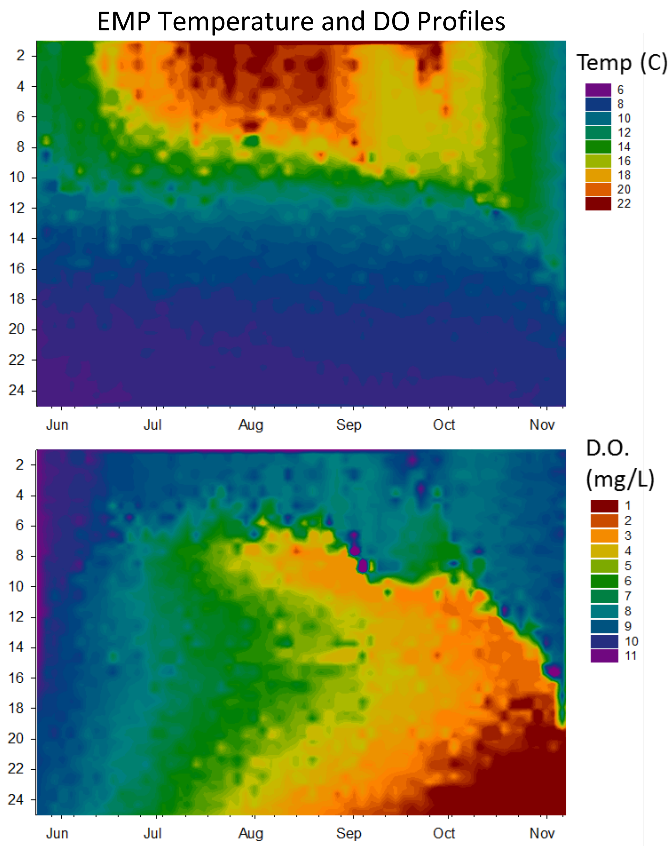
Overview of Dissolved Oxygen

Dissolved oxygen has been described as the most fundamental parameter of a lake, aside from the water itself (Wetzel 2001). Available oxygen is essential for aerobic metabolism and non-biotic chemical reactions. In addition, the presence or absence of oxygen directly affects the solubility of nutrients such as phosphorus. The primary source of oxygen in a lake is the atmosphere, thus, in lakes that are thermally stratified, the hypolimnion is isolated from the oxygen source. When lake sediments contain high amounts of organic material, bacterial decomposition consumes all the dissolved oxygen resulting in hypolimnetic hypoxia (very low O_2 in hypolimnion). In some lakes a certain amount of hypolimnetic hypoxia may be natural; however nutrient enrichment resulting from human activities stimulates algal productivity and subsequent algal settlement, decomposition, and oxygen loss (i.e., Bertram 1993). Several ecological processes are influenced by hypolimnetic hypoxia. The most obvious impact is loss to the fishery. Hypoxia has the potential to negatively affect individual fish growth, survival, reproduction, and ultimately population growth (Wu 2009). A second important impact of bottom water hypoxia is that it results in internal loading of phosphorus. Lack of oxygen in the hypolimnion influences the solubility of phosphorus and allows the release of dissolved reactive phosphorus from the lake sediments. During fall turnover the phosphorus can then get distributed through the entire water column (Wetzel 2001).



Long Term Spatial Trend in Dissolved Oxygen

In 1990, during the period of high nutrient inputs and frequent algae blooms, the hypolimnion was largely anoxic across the entirety of Upper Saranac Lake (Figure 5). Following the onset of nutrient management at the fish hatchery, dissolved oxygen concentrations in the hypolimnion improved rapidly and dramatically. Now anoxia is less common in the south basin, though anoxic and hypoxic conditions still occur in the north basin. It is quite possible that hypolimnetic oxygen depletion is a natural occurrence in the north basin of Upper Saranac. During thermal stratification the thermocline serves as a barrier to vertical oxygen transport from the atmosphere; as a result, the hypolimnion is a closed oxygen system, which means it only has as much oxygen as moved in during the spring turnover. When the volume of the hypolimnion is small relative to the sediment surface area, oxygen depletion will occur regardless of trophic condition. For example, Mathias and Barica (1980) examined oxygen depletion in 70 Canadian lakes under the ice and found that the ratio of the lakes sediment surface area to hypolimnion volume (SSA:HV) accounted for 72% of the variation in oxygen depletion rates in eutrophic lakes, and 78% of the variation in oligotrophic lakes. We believe that the SSA:HV plays the controlling role in oxygen depletion in the north basin of Upper Saranac; however, long term nutrient pollution would certainly exacerbate the situation.



Environmental Monitoring Platform – photo by PSC AWI

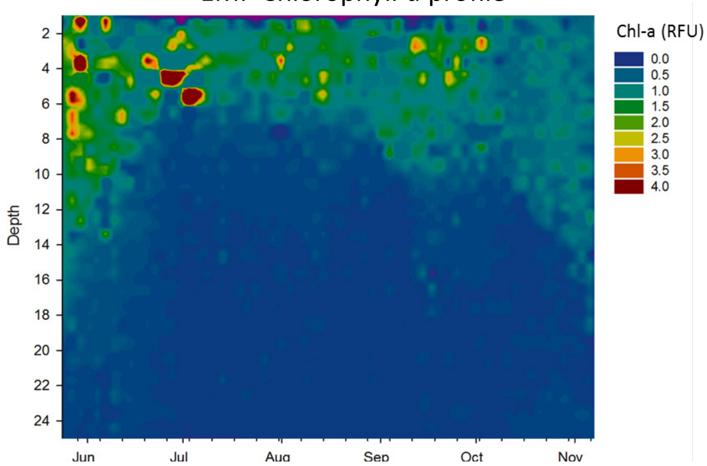
Environmental Monitoring Platform

A significant advancement in lake monitoring capabilities occurred in 2017 with the launch of the Upper Saranac Lake Environmental Monitoring Platform (EMP). The EMP is an autonomous in-lake monitoring station that measures temperature, dissolved oxygen, pH, conductivity, turbidity, chlorophyll-a, and cyanobacterial presence in surface water and down through the water column. The station also contains a full meteorological array that gathers instantaneous data on air temperature, humidity, pressure, precipitation, wind speed, wind direction, and incoming solar radiation. Data from the EMP can be viewed in near real time at https://adkwatershed.shinyapps.io/UpperSaranacLake/. The EMP is an incredibly valuable tool for the Upper Saranac Lake community for the following reasons: (1) it provides high frequency data on the physical, chemical and biological characteristics of the lake as well as the meteorological drivers, thereby enhancing our understanding of the lake ecosystem in support of lake management (e.g., harmful algal blooms); (2) it fosters collaboration with researchers and environmental professionals from around the world; and (3) it engages citizen involvement in lake management by providing real time information to the general public.

Overview of Productivity Indicators (total phosphorus, chlorophyll-a, and transparency)

Phosphorus is of major importance to the structure and metabolism of all organisms, but its availability is low compared to other essential nutrients in freshwater systems. Because of low availability, phosphorus is often the limiting nutrient in aquatic systems and the addition of extra phosphorus allows production to increase greatly because all other essential elements are typically available in excess (Schindler 1974, Wetzel 2001); therefore, phosphorus is considered the most important contributor to reduced water quality in lakes (Søndergaard et al. 2003). Natural weathering releases phosphorus from rocks and soils, and it also enters our watersheds in fertilizers, human waste, and atmospheric deposition. Phosphorus exists in several forms in aquatic systems, including readily available dissolved phosphorus, and organically and inorganically bound phosphorus. Total phosphorus is all the forms of phosphorus combined and serves as an important indicator of overall trophic status of a lake. Lakes of low productivity (oligotrophic) have total phosphorus concentrations less than 10 µg/L, while highly productive lakes (eutrophic) have total phosphorus concentrations greater than 20 µg/L ([NYS DEC CSLAP Fact Sheets]).

EMP Chlorophyll-*a* profile



Chlorophyll-a is the primary photosynthetic pigment found in all freshwater species of algae and cyanobacteria. A measurement of chlorophyll-a is relatively simple and inexpensive and can provide a surrogate measure of algal productivity (Wetzel 2001). Chlorophyll-a is not a direct measure of algal biomass as the concentration of chlorophyll varies somewhat by species and environmental conditions. This said, increases in chlorophyll are generally associated with increased algal production, and the concentration of chlorophyll is widely considered as the most direct measure of the trophic state of lakes. Algal biomass is affected by the interaction of nutrient availability, light, water temperature, and grazing so there can be considerable variation in chlorophyll concentrations throughout the year depending on which of these factors is limiting growth at a particular time. Typically, major changes in algal biomass (e.g., an algae bloom), and thus chlorophyll, are usually related to changes in the availability of phosphorus, nitrogen, silica, or inorganic carbon (Wetzel 2001).

Transparency is a measure of water clarity in lakes. It is measured by lowering a 20 cm black and white disk (Secchi disk) to the depth where it is no longer visible from the surface. The transparency of a lake is influenced by many factors, including algal abundance, turbidity, suspended sediments, and dissolved organic matter (Hutchinson 1957). Transparency can serve as an important indicator of overall trophic condition of a lake as well as influencing human perception of water quality. In general, lakes that have low productivity and low algal abundance have greater secchi transparencies. As algal productivity increases, secchi depths become much shallower. Transparency can also be influenced by the amount of dissolved organic material in the water. Dissolved organic matter rapidly attenuates light, resulting in lower transparencies.

Long Term Trends in Productivity Indicators

Total phosphorus concentration in the surface waters of the north and south basins of Upper Saranac Lake has declined markedly from the historic highs measured in the 1980s when concentrations often exceeded the 20ppb threshold for eutrophic lakes (Figure 6). Total phosphorus concentration has not exceeded this threshold for the last seven years in the north basin and fifteen years in the south basin. Indeed, concentrations below the 10ppb oligotrophic threshold are now common, particularly in the south basin. Chlorophyll-a concentration has followed the same trend as total phosphorus, though the 8ppb threshold for eutrophic lakes has been exceeded in both the north and south basins within the last three years. As with total phosphorus, chlorophyll-a concentrations tend to be lower in the south basin. The higher concentrations of total phosphorus and chlorophyll-a in the north basin reflect a combination of historically higher nutrient loadings to the north basin from the fish hatchery combined with greater anoxia experienced in the shallower waters of the north basin. Secchi transparency has been declining steadily in both the north and south basins since 1990. If transparency was related to algal abundance and productivity, then we would have expected it to increase over this period, not decrease. The explanation for the trend in transparency centers around dissolved organic carbon, which has been increasing in northern lakes likely due to a

Secchi disk – photo from USACE

combination of watershed recovery from acid deposition and accelerated decomposition due to climate change.

Overview of acidity (pH), conductivity, and chloride

In chemistry, pH is used to communicate the acidity of a solution. Technically pH is a surrogate measure of the concentration of hydrogen ions in water. Hydrogen ions are very active, and their interaction with other molecules determines the solubility and biological activity of gasses, nutrients, and heavy metals; thus, pH is considered a master variable for its influence on chemical processes and aquatic life. pH exists on a logarithmic scale from 0-14, with 7 being neutral. pH values less than 7 indicate increasing acidity, whereas pH values greater than 7 indicate increasingly alkaline conditions. Because pH exists on a logarithmic scale a decrease in 1 pH unit represents a 10-fold increase in hydrogen ion activity. Lakes can become acidified when they are influenced by organic acids from wetlands and bogs or when acidic precipitation falls on a poorly buffered watershed (Driscoll et al. 2003, Wetzel 2001).

Conductivity is a measurement of the ability of a water sample to conduct electricity. Pure H_2O is a poor conductor of electricity. The ability of water to conduct electricity increases as the concentration of dissolved ions in the water increases. Thus, conductivity is considered a strong indicator of the concentration of dissolved ions in water. The conductivity of an undeveloped lake in the Adirondacks is usually in the range of 15-25 μS/cm (Laxson et al. 2016). Elevated conductance may be indicative of road salt pollution, faulty septic systems or the influence of bogs and wetlands in the watershed.

Lakes in the Adirondack region have naturally low concentrations of chloride, with an average background concentration of 0.2 mg/L (Kelting et al. 2012). However, widespread use of road deicers (primarily sodium chloride) has significantly increased the concentration of chloride in the environment. Kelting et al. (2012) highlighted that chloride concentrations in Adirondack lakes are directly proportional to the density of state roads within their watersheds. Rising chloride concentrations are a cause for concern as recent research has demonstrated significant negative impacts of chloride on zooplankton communities at concentrations as low as 5ppm (Arnott et al. 2020; Palmer and Yan 2013). Such impacts may produce trophic cascades with profound effects on the entire lake ecosystem (Hintz and Relyea 2019).

Road salting – photo by David Gonzalez and MnDOT

Long-term trends in acidity (pH), conductivity, and chloride

Upper Saranac Lake is a circumneutral water body and is not degraded by acid deposition. The surface water pH is similar between the two study basins and averaged 7.3 in the north basin and 7.1 in the south basin. The annual average pH of the lake has been relatively stable since monitoring began with no significant trend detected in the surface water of either basin (Figure 7). Conductivity of the surface water has been increasing by approximately 0.5 μS/cm/year in both the north and south basins of the lake. The conductance of Upper Saranac Lake is approximately two to three times greater than the value of least impacted Adirondack lakes (15-25 μS/cm). The elevated conductance is due to several sources including road salt, development run off, septic input, and permitted discharge. The earliest surface conductivity measurement of the lake was reported by the NYS Department of Health in 1971 as 38μS/cm, suggesting that the lake was already noticeably impacted by dissolved ions 50 years ago. As with conductance, the chloride concentration of surface waters has also been increasing, though a large time gap exists in the time series. In 1990 the chloride concentration was around 2.5ppm, while the average concentration in 2021 was 9.5mg/L, or a 380% increase over the last 30 years.

Lake Water Quality Comparison

Long term water quality data is not available for Lake Clear, but more recent information is available on the same indicators as above through the Adirondack Lake Assessment Program so that Upper Saranac Lake and Lake Clear can be compared. Median secchi transparency and concentrations of total phosphorus and chlorophyll-a from 2017 to 2021 all indicate that Lake Clear is a low productivity oligotrophic lake while Upper Saranac Lake is a moderately productive mesotrophic lake (Table 5). Lake Clear had 2.4 meters greater depth of transparency and one-half the chlorophyll-a concentration of Upper Saranac Lake. This difference partly reflects the fact that Lake Clear has less contributing land area for its size compared to Upper Saranac Lake, which means that the nutrient load to

Lake Clear is naturally lower. In contrast to the productivity indicators, median conductivity and chloride are twice as high in Lake Clear, with the chloride concentration in Lake Clear being among the highest measured in Adirondack lakes. This difference reflects the much higher density of state roads that receive road salt in winter in the Lake Clear watershed compared to the Upper Saranac Lake watershed.

Table 5. Comparison of water quality of Lake Clear and Upper Saranac Lake, 2017 to 2021.

Variable	Lake Clear			Upper Saranac Lake		
	Min	Median	Max	Min	Median	Max
Total phosphorus (ppb)	3.2	7.5	23.2	6.0	10.0	19.3
Secchi Transparency (m)	4.0	5.3	6.6	2.1	2.9	4.6
Chlorophyll-a (ppb)	0.9	1.8	4.7	1.2	4.1	13.0
Trophic State		oligotrophic			mesotrophic	
pH	6.5	7.3	7.8	6.4	6.8	7.8
Conductivity (µS/cm)	92.4	109.5	119.7	46.1	56.5	68.2
Chloride (ppm)	20.2	21.8	23.7	7.4	8.9	10.1

5.2.2. Stream Water Quality

Water quality has been monitored continuously in six of the seven tributaries and Little Clear Outlet within the Mill Brook subwatershed since 2013. Median total phosphorus concentrations were highest in Black Swamp and Brandy Brook, followed by Indian Carry, Little Clear Outlet, and Mill Brook, with Cranberry Brook and Fish Creek being lowest (Figure 8). Acidity (pH) varied by a factor of 10 across the tributaries, with the lowest pH in Brandy Brook and the highest pH in Fish Creek, Little Clear Outlet, and Mill Brook. Conductivity of Black Swamp and Fish Creek was similar to background, but was elevated in the remaining tributaries, particularly Brandy Brook, Cranberry Brook, and Indian Carry. Chloride showed the same pattern as conductivity, with Cranberry Brook and Indian Carry having extremely high concentrations of 82 and 121ppm, respectively, followed by Brandy Brook at 26ppm. These chloride concentrations reflect the high densities of state roads in these small subwatersheds, though Brandy Brook may receive significant chloride input from the wastewater facility maintained by Young Life in the Brandy Brook subwatershed.

Stream discharge measurement at Black Swamp
photo by PSC AWI

Table 6. Estimated total phosphorus loads to Upper Saranac Lake from its subwatersheds (from Kelting and Laxson 2014).

Subwatershed	Phosphorus Load (lbs/yr)	Land Area (acres)	Loading Coefficient (lbs/ac/year)
Black Swamp	568	3,672	0.15
Brandy Brook	180	595	0.30
Cranberry	21	274	0.08
Fish Creek	1,607	17,303	0.09
Indian Carry	43	351	0.12
Mill Brook	788	7,783	0.10
Total	3,207		

One of the main objectives behind the stream monitoring program was to estimate total phosphorus loads to Upper Saranac Lake from its subwatersheds. This total load was estimated to be about 3,207 pounds of phosphorus per year, with Fish Creek being the largest contributor followed by Mill Brook and Black Swamp (Table 6). The load contributed by each subwatershed largely reflects acreage, so to compare loads on an equivalent basis loading coefficients that express the load on a per acre basis were computed. When expressing the load in this manner Brandy Brook has the highest loading coefficient followed by Black Swamp and Indian Carry. The high loading coefficient for Brandy Brook likely reflects additional phosphorus input from the Young Life wastewater facility.

5.2.3. Ground Water Quality

PSCAWI combined a dataset of 500 wells sampled by homeowners who participated in a voluntary well survey with 94 wells sampled by NYSDEC to produce a dataset of 594 wells to access the impacts of road runoff on groundwater quality. The road runoff generation model published by Regalado and Kelting (2015) was used to code and summarize the observations based on the type of road runoff received. Observations were coded 'none' for no road runoff received, 'local' for only local road runoff received, and 'state' for only state road runoff received.

The median chloride concentration for wells not receiving any road runoff was 1.2ppm (n=224). The median chloride concentration for wells receiving local road runoff was significantly higher at 8.6ppm (n=191), and for those receiving state road runoff it was much higher at 91.6ppm (n=178). Note that no wells received both local and state road runoff. The median sodium concentration for wells not receiving any road runoff was 3.4ppm, while the median for wells receiving local road runoff was 6.6ppm, and for those receiving state road runoff it was 33.1ppm. These differences observed in groundwater also reflect the general difference in how local and state roads are managed in winter, with the much larger differences and higher concentrations when compared to surface waters reflecting the lack of opportunities for dilution to occur.

The maximum sodium concentration observed for wells receiving local road runoff was 403 mg/L and 44 of these wells exceeded the 20 mg/L guidance value for individuals on very restricted sodium diets (NYSDOH Salt and Drinking Water). The maximum sodium concentration observed for wells receiving state road runoff was 1,917 mg/L and 111 of these wells exceeded the 20 mg/L guidance value. For people on moderately restricted sodium diets the recommended guidance value is 270 mg/L, with 2 wells receiving local road runoff and 13 wells receiving state road runoff exceeded this guidance value.

Chloride may be the larger concern with road salt, as this highly corrosive element contributes to the gradual deterioration of pipes and plumbing fixtures, resulting in their failure and/or leaching of heavy metals such as lead into drinking water (Pieper et al. 2018). Most wells receiving state road runoff (69%) had corrosive water, while only 29% of wells receiving local road runoff had corrosive water, and only 5% of wells not receiving road runoff had corrosive water as determined using the Larson-Skold corrosivity index (Larson and Skold 1958).

Table 7. Chloride and corrosivity of well water in the Upper Saranac Watershed. Corrosivity based on Larson and Skold (1958)

Runoff Types	No. of Wells	Chloride (ppm)			Corrosive Water (%)
		Min	Median	Max	
None	23	0.1	1.7	6.3	4%
Local Roads	15	1.0	3.6	40.7	20%
State Roads	27	0.4	313	1,680	85%

The Upper Saranac Watershed had 65 homeowners participate in the well study, with most of the wells located in the Lake Clear area (Map 10). Of these 65 wells, 23 did not receive road runoff, 15 received local road runoff, and 27 received state road runoff (Table 7). The median chloride concentration in wells not receiving road runoff was 1.7ppm and only 4% of these wells had corrosive water. Wells receiving local road runoff had slightly higher chloride concentrations and 20% of these wells had corrosive water. Though one well receiving state road runoff had a very low chloride concentration, the median was 313ppm and one well had a chloride concentration of 1,680ppm, and 85% of these wells had corrosive water.

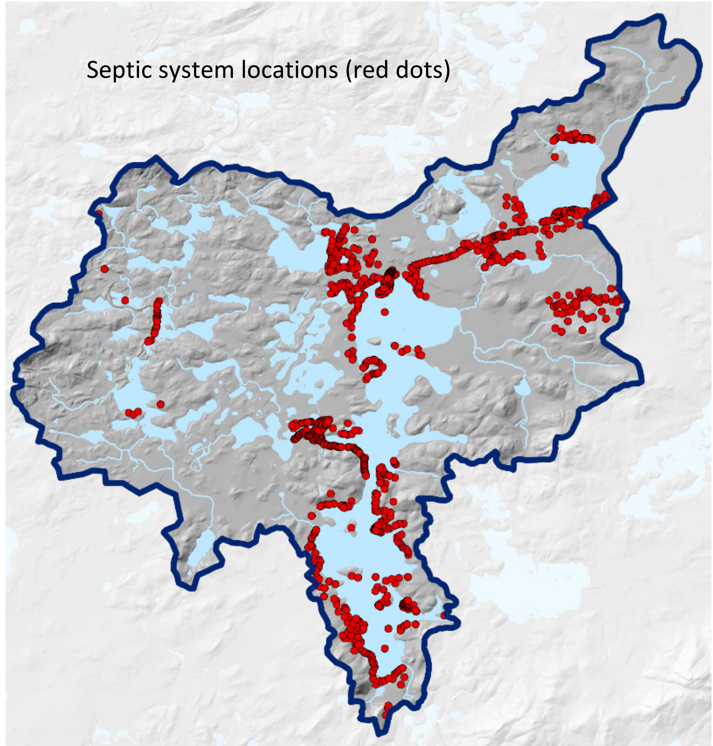
In a 2017 stakeholder survey of property owners around Upper Saranac Lake conducted by the Upper Saranac Foundation, 71.5% of respondents (98 people) obtained their drinking water from a well. Protecting groundwater from road salt contamination should therefore be an important concern for homeowners in the watershed.

Salted highway – photo by Tyson Dudley

6. Pollutant Source Assessment

6.1. Nonpoint Sources

6.1.1. Septic Systems



Based on 2019 home ownership data obtained from the Office of Real Properties, there are 980 homes with septic systems in the Upper Saranac Watershed (Map 11). Of these homes, 193 are in the Fish Creek subwatershed, 249 are in the Mill Brook subwatershed, 8 are in the Black Swamp subwatershed, 4 are in the Indian Carry subwatershed, and 3 are in the Cranberry Brook subwatershed. The remaining 523 homes are in the Upper Saranac direct drainage area. The 980 homes collectively have 2,290 bedrooms and 1,377 bathrooms. The median home construction year was 1975, with 25% of homes built before 1935 and 25% of homes built after 1987 (Figure 9). Given the number of homes, their ages, high permeability soils, and proximity to shoreline, there is significant potential for water pollution from septic systems.

In the same stakeholder survey mentioned in 5.2.3., 90.9% of respondents (129 people) selected "individual septic tank with drain field" as their answer to the question "what type of wastewater disposal system do you have in your household?" Of these respondents, 41.6% had their septic systems installed within the last 15 years, 46.5% had their systems installed between 15 and 50 years ago, 4.2% had systems great than 50 years old, and 7.8% of respondents didn't know how old their system was. Most respondents (65.3%, 92 people) had their system serviced within the last three years and 18.4% (26 people) had their system serviced within the last three to seven years. Many respondents felt that current wastewater treatment practices impacted water quality with 41.6% (59 people) thinking that practices needed to be improved, while 47.9% (68 people) were unsure, and only 10.5% (15 people) thought that current practices were satisfactory for protecting water quality.

6.1.2. Road Runoff

Of the 980 homes in the Upper Saranac Watershed, 190 receive runoff from local roads and 113 receive runoff from state roads (Map 12). The remaining 677 homes do not receive road runoff. Given the results of the well study, there is significant potential for salt contamination of private wells in the watershed, and depending on the type of road runoff, this contamination is both a concern for human health and direct damage to property from corrosion.

The Adirondack Road Salt Reduction Task Force recommends a threshold maximum surface water chloride concentration of 40ppm for stress to aquatic life (based on Hébert et al. 2022; Hintz et al. 2022; Arnott et al. 2020), noting this literature-based threshold aligns with NYSDEC existing Consolidated Assessment and Listing Methodology values of 42.7ppm for flowing waters and 30.9ppm for ponded waters applied to A, A-S, AA, and AA-S class waters for health (water source), The task force further recommends a target surface water chloride concentration of 10ppm as protective of aquatic life (based on 10ppm being 20 times higher than baseline and near the lower limit of toxicity to aquatic life – Arnott et al. 2020). Median chloride concentrations in Brandy Brook, Cranberry Brook, Indian Carry, Mill Brook, and Lake Clear exceed the 10ppm target concentration and Upper Saranac Lake is trending to exceed this concentration in the next few years.

6.1.3. Atmospheric Deposition

Coal fired power plants were identified as the source of high amounts of nitrate in precipitation in the Adirondacks and beyond in the 1960s. In 1990 the Clean Air Act was amended and regulations were developed that cut the emissions that were responsible for the high amounts of nitrate. The results have been dramatic and are a great example of how science has informed policy and long-term monitoring demonstrated success. Atmospheric deposition of nitrate prior to 1990 ranged from 13 to 18lbs/ac/yr, with nitrate deposition falling steadily since 1990, averaging 4lbs/ac/yr in 2020 (Figure 10). With this reduction, atmospheric deposition is currently a minor source of nitrate in the Upper Saranac Watershed.

6.2. Point Sources

6.2.1. SPDES Permitted Facilities

There are 14 facilities in the Upper Saranac Watershed with SPDES permits for wastewater, two for Private/Commercial/Institutional (PCI) SPDES discharges to surface water, one for industrial discharges to surface water (Adirondack Fish Culture Station), and eleven PCI SPDES discharges to groundwater. All discharges to surface water requires a SPDES permit, while only facilities discharging more than 1,000 gallons per day (gpd) of treated sanitary waste to groundwater require a SPDES permit.

All the groundwater SPDES discharges are operating under "General Permits for Groundwater Discharge of Treated Sanitary Sewage" which are issued to facilities discharging between 1,000 and 30,000gpd. To operate under this general permit, a professional engineer licensed in New York must certify that the facility design and site plan meet NYSDEC required design standards. Permits are good for 10 years and do not require end-of-pipe sampling nor do they impose numeric limitations on effluent. Note that groundwater monitoring wells and water quality reporting are required for systems exceeding 30,000gpd. Conditions under a general permit require annual inspections and regular pump outs to prevent sludge and scum from escaping the tank(s). Facility operators must also to keep records of inspections, pump outs, maintenance, and repairs.

The Point Resort is permitted to discharge up to 2,500gpd of treated sanitary waste directly into Upper Saranac Lake. Regular monitoring and reporting are requirements of the permit, and The Point Resort reported 6.5lbs/yr of phosphorus discharge into Upper Saranac Lake in 2021.

The Adirondack Fish Culture Station (the hatchery) located at Little Clear Outlet is permitted to discharge phosphorus into Little Clear Outlet. As part of permitting, the hatchery is required to monitor and report on the amount of phosphorus discharged to the brook as part of its operations. The hatchery was a major source of phosphorus to Upper Saranac Lake in the 1990s and earlier, and water quality suffered tremendously from this additional phosphorus. Since that time, the hatchery has altered their operations to reduce their phosphorus load to Little Clear Outlet, with these alterations being clear in the long-term phosphorus discharge data (Figure 11). Over the last seven years annual phosphorus discharge has ranged from 42 to 65lbs/yr, which is significantly below their maximum allowable discharge of 164lbs/yr. Little Clear Outlet still has one of the highest median phosphorus concentrations of the tributaries in the Upper Saranac Watershed, which is directly related to the point source, but it is encouraging to see the consistently lower phosphorus discharge coming from the hatchery.

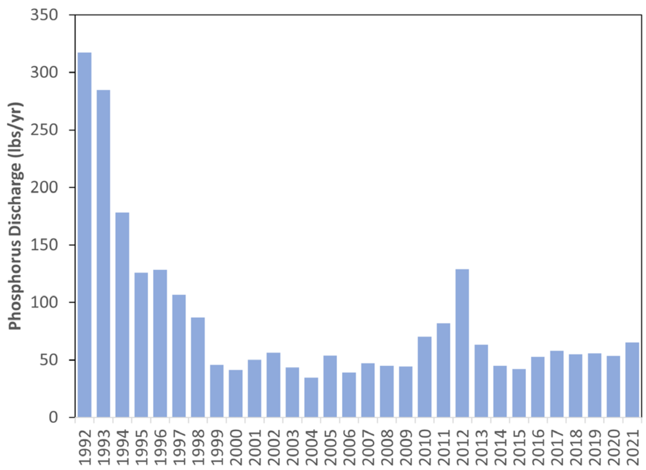
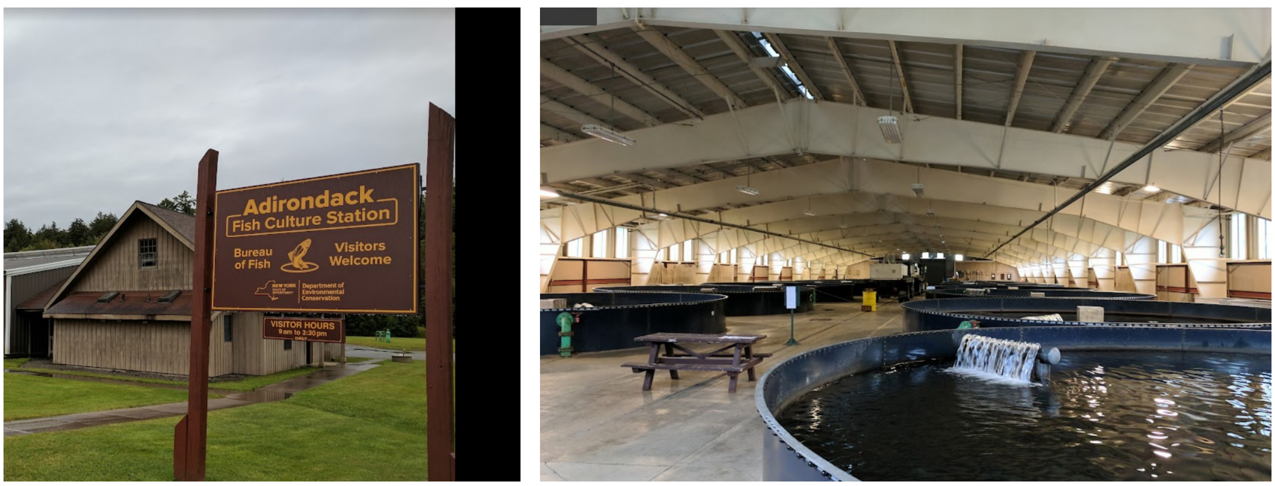


Figure 11. Phosphorus discharge from the hatchery.



Adirondack Fish Culture Station in Lake Clear – photo from NYSDEC

7. Pollutant Loads & Water Quality

7.1. Estimates of Existing Pollutant Loads

Phosphorus

The annual external phosphorus load (TPL) to Upper Saranac Lake was determined from the main sources based on the formula:

$$TPL = Natural\ Lands + Atmospheric\ Deposition + SPDES + Septic\ Effluent$$

Where, *Natural Lands* is load from forests and wetlands, *Atmospheric Deposition* is load from wet and dry deposition, *SPDES* is load from permitted surface water discharge, and *Septic Effluent* is load from septic systems.

Of the components of this formula, *TPL* for the subwatersheds was calculated from stream discharge to be 3,207lbs/year with 55lbs/year of this total being reported SPDES surface discharge (Table 8). Load from natural lands in the subwatersheds was estimated by applying published loading coefficients of 0.05lbs/ac/year for upland forests (Dillon and Kirchner 1974) and 0.13lbs/ac/year for wetlands (Dodd et al. 1992) to the total acreage of these cover types to arrive at 1,752lbs/year. Atmospheric deposition load was estimated by applying a phosphorus deposition coefficient of 0.01lbs/ac/year published for lakes in the Canadian Shield region (Eimers et al. 2018) to obtain 359lbs/year for the subwatersheds. Phosphorus load from septic effluent was taken as the residual load not accounted for by the other three major sources, which was 1,041lbs/year for the subwatersheds.

Unlike the subwatersheds, we are not able to measure the external phosphorus load directly to Upper Saranac Lake, so this load was estimated by applying the same coefficients used for the subwatersheds to the total area and area by forest and wetland cover types to arrive at 415lbs/year from natural lands and 127lbs/year from atmospheric deposition (Table 8). A

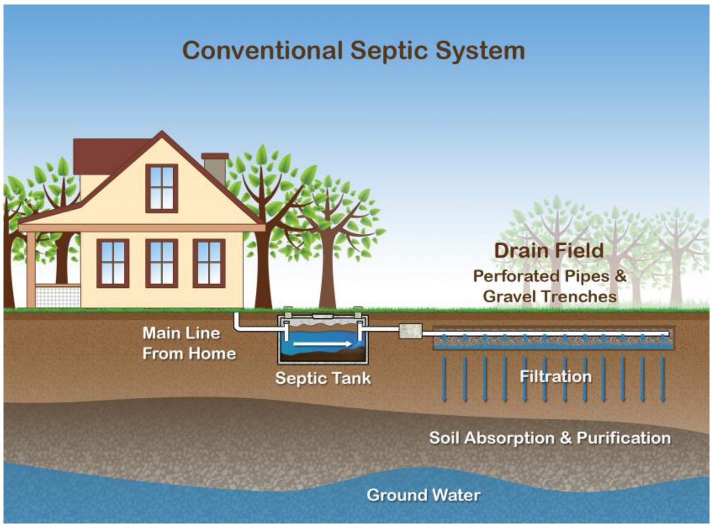


Table 8. External phosphorus loads by source to Upper Saranac Lake from its subwatersheds and direct drainage.

Load Source	Load (lbs/year)	% of Load	% of Total Load
Subwatersheds:			
• Natural Lands	1,752	55	35
• Atmospheric Deposition	359	11	7
• SPDES Surface Discharge	55	2	1
• Septic Effluent	1,041	32	21
Subtotal	3,207		64
Direct to Upper Saranac Lake:			
• Natural Lands	415	23	8
• Atmospheric Deposition	127	7	3
• SPDES Surface Discharge	10	<1	<1
• Septic Effluent	1,264	70	25
Subtotal	1,816		36
Subwatersheds plus Direct:			
• Natural Lands	2,167		43
• Atmospheric Deposition	486		10
• SPDES Surface Discharge	65		1
• Septic Effluent	2,305		46
Total Load	5,023		100

SPDES discharge value of 10lbs/year was used for the one surface water discharge permitted facility located on the lakefront.

Septic effluent load was estimated using a two-step process. First, total phosphorus loads from septic systems were estimated by taking Oldfield and others (2020) estimate of 1.78lbs of phosphorus per person per year for septic effluent and multiplying it by the total number of bedrooms in the subwatersheds and in the area draining directly to Upper Saranac Lake, with the assumption that the number of bedrooms approximates the number of people in a household. Using this approach, 1,841lbs/year of septic effluent was estimated from homes in the subwatersheds and 2,236lbs/year was estimated from homes around Upper Saranac Lake. Noting that these numbers reflect the estimated phosphorus discharge to soil, not surface water. Second, an estimate of the percent of septic effluent entering surface water was then obtained by taking the septic effluent load that was determined by difference from the subwatersheds (1,041lbs/year) and dividing it by the total septic effluent produced in the subwatersheds (1,841lbs/year), which gave an estimate of 57% of septic effluent entering surface water. This percentage was applied to the total septic effluent produced by homes around the lake to obtain the estimated septic effluent discharge directly to Upper Saranac Lake.

With estimates for all external phosphorus sources accounted for, the annual total phosphorus loading to Upper Saranac Lake was estimated to be 5,023lbs/year (2,283kg/year), which was very similar to the estimated 2,177kg/year reported by Martin (2004). At 46% of total load, septic effluent was the largest contributor, followed closely by natural lands at 43 percent. Atmospheric deposition contributed 10% and SPDES surface discharge contributed only 1 percent. Direct drainage of septic effluent into Upper Saranac Lake was estimated to be 25% of the total phosphorus load.

The general phosphorus loading model published by Vollenweider (1969) was used to predict the change in total phosphorus concentration across a range in reductions in phosphorus loadings from septic effluent. The Vollenweider model is:

$$TP = \frac{L}{\left[\frac{z}{(\sigma + \rho)}\right]}$$

Where, TP is lake total phosphorus concentration (mg/m^3), L is annual total phosphorus loading from the watershed per unit lake surface area (mg/m^2/year), z is mean lake depth (m), σ is a phosphorus sedimentation coefficient (year^{-1}), and ρ is lake flushing rate (times/year). The phosphorus sedimentation coefficient was estimated by rearranging the Vollenweider model to solve for σ.

Model input values were L = 116.5mg/m^2/year, z = 10.1m, σ = 0.35/year, and ρ = 0.9/year. The 10-year average surface water total phosphorus concentration of 9mg/m^3 was used for TP to estimate σ.

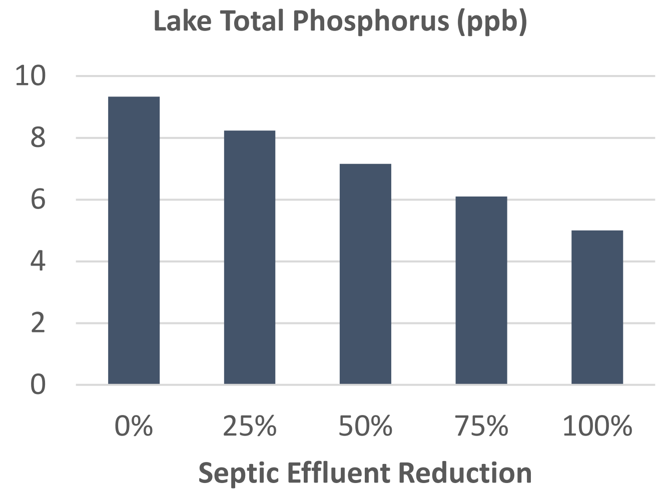
Removing the phosphorus inputs from SPDES surface discharge and septic effluent would yield a

Chloride

As already stated, there are 35.4 miles of public roads that are maintained year-round in the Upper Saranac Watershed, with NYSDOT maintained SR 3 constituting 16.4 of these miles. PSCAWI estimated that an average of 38 tons of road salt per lane-mile is applied to the state roads in the Adirondack Park each winter. As 1 mile of state route has 2 lane-miles, the 16.4 miles of state roads in the watershed receive and average of 1,246 tons of road salt per year. Road salt is 60.7% chloride by weight, so about 756 tons of chloride are applied to these roads each year. The local roads in the Upper Saranac Watershed are sanded with some salt mixed in, but the amount is not consequential when compared to the annual load from state roads. A general rule-of-thumb is 50% of salt runs off directly to surface water with the remainder entering soil and groundwater (Meriano et al. 2009). Surface waters in the Upper Saranac Watershed therefore receive about 378 tons of chloride load per year as direct runoff.

natural load of 2,653lbs/year. The Vollenweider model estimates a total phosphorus concentration of 5ppb in Upper Saranac Lake from this natural load, which is comparable to total phosphorus concentrations ranging from 4 to 6ppb reported for lakes and ponds in undeveloped subwatersheds in the area (Adirondack Lakes Survey 1984).

Reducing septic effluent discharge by 25% is estimated to reduce lake total phosphorus to 8.2ppb, a



50% reduction would reduce lake phosphorus to 7.2ppb, and a 75% reduction would reduce lake phosphorus to 6.1ppb.

Septic tank pump out – photo from Benny A. Moore Septic Tank Service, Inc.

7.2. Identification of Critical Areas

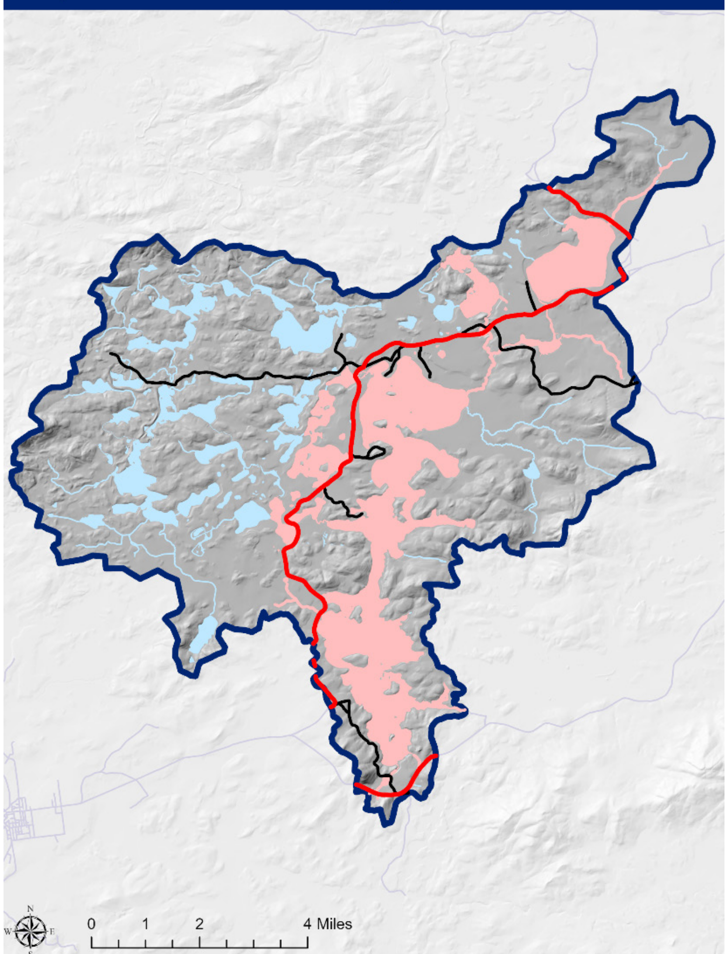
Phosphorus

Septic systems located in poorly drained soils as well as those located on steeper slopes are at greater risk of contaminating surface waters compared to systems on more well drained soils and on more gentle slopes. Also, systems that are closer to the water are at greater risk than those farther away. Within the Upper Saranac Watershed there are 64 properties with septic systems located on poorly drained soils, most of these properties are located along the southern shoreline of Fish Creek Pond but there are several located adjacent to State Route 3 just south of Camp Young Life. There are 328 properties with septic systems on slopes greater than 15 percent and nearly all of these are shoreline properties along Upper Saranac Lake. Prioritization should be given to reaching out to property owners with poorly drained soils or on steeper ground to assess the status of their septic systems.

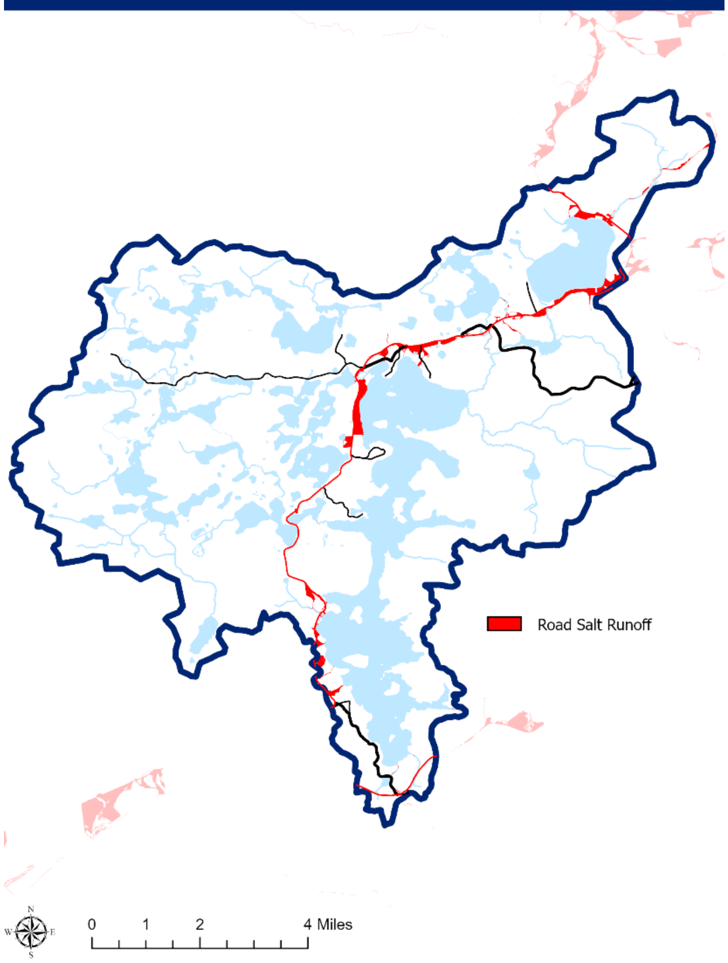
Chloride

Chloride runoff from State Route 3 impacts 15 lakes and ponds and 8.8 miles of streams (Map 12). In addition to the known measured impacts on Lake Clear and Upper Saranac Lake, Little Clear Pond, Green Pond, Follensby Clear Pond, and Fish Creek Ponds may also be impacted by road salt, though none of these other waterbodies are currently monitored. In addition to surface water impacts, all groundwater under private lands located downslope of State Route 3 is susceptible to road salt contamination. Notable locations for potentially significant groundwater contamination for larger numbers of homes are the north and south shores of Lake Clear and along the western shoreline of the north basin of Upper Saranac Lake (Map 13).

Map 12. Surface waters receiving chloride from state roads.



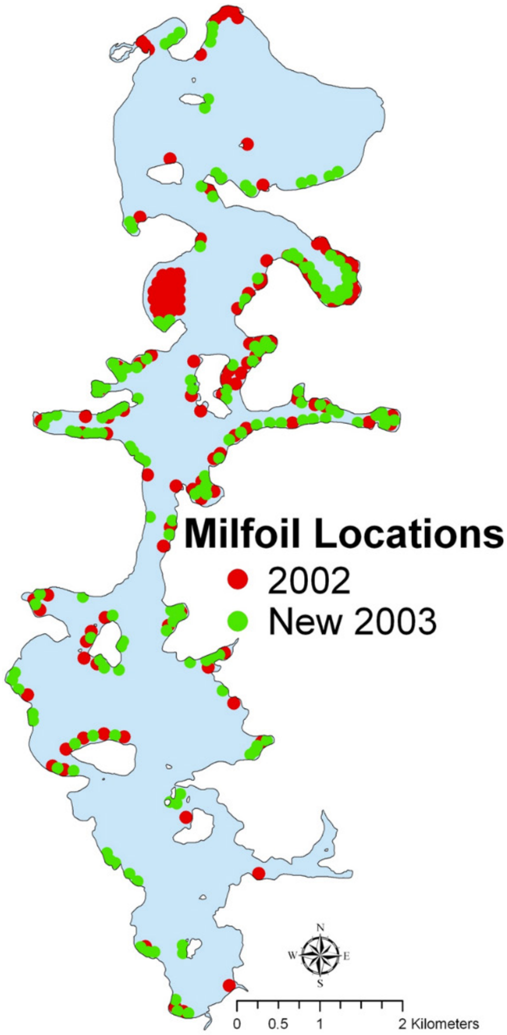
Map 13. Private lands receiving road salt runoff.



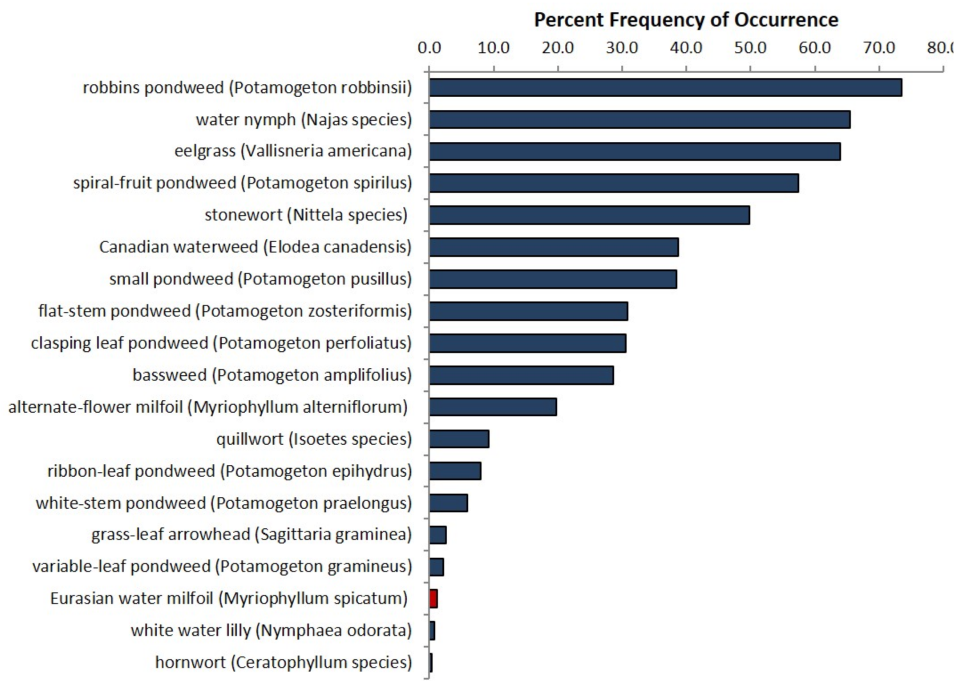
8. Aquatic Invasive Species Management

8.1. History

Aquatic invasive species management began in Upper Saranac Lake in 1999, three years after Eurasian watermilfoil (EWM) was first reported in the lake in 1996 (Martin 1998). The initial years of management were small in scale and scope, focused largely on waters adjacent to privately owned shoreline. About $55,000 per year was invested in control from 1999 to 2003 primarily using diver hand harvesting but also some benthic matting. This effort was successful in achieving local control over small areas, but annual aquatic plant surveys showed that EWM continued to expand throughout the lake. Recognizing the partial success of the control effort, but also seeing that the EWM population was continuing to expand, the lake community rallied around an unprecedented effort to achieve “whole lake” control within a three-year period. This effort was truly monumental in scale, employing over thirty divers who swam, and hand harvested the entire littoral zone of the lake two to three times each summer. The goal was to be able to shift back to a maintenance control level in 2007, whereby the EWM population could be maintained at a low density in perpetuity with a small hand harvesting crew each summer. Also unprecedented was the investment made in monitoring the control effort, with permanent underwater transects installed at thirteen locations throughout the lake. EWM presence and abundance, as well as presence of other aquatic plants, was measured along these transects monthly each summer from 2004 to 2019. Additional transects were installed in Fish Creek Pond in 2006 to observe milfoil growing in that waterbody. Results from the monitoring effort coupled with harvesting reports from the dive crew demonstrated that the management approach was very successful, and that diver hand harvesting was a viable technique for achieving whole-lake control (Kelting and Laxson 2010).



Aquatic Plants Observed Along the Transects in Upper Saranac Lake in 2017

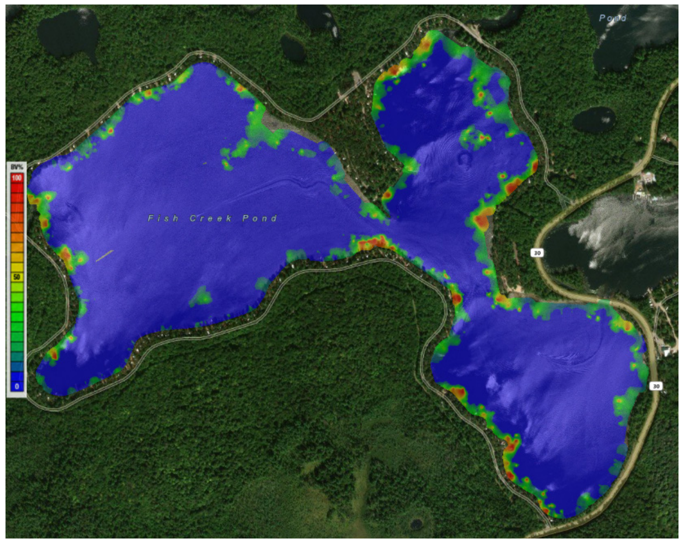


Eurasian watermilfoil was ranked 3rd from the bottom

8.2. Management

Diver hand harvesting has been conducted every summer in Upper Saranac Lake since 1999 using the same harvesting methodology but with improving efficiencies of the operation each year. Divers no longer spend valuable time swimming large areas of littoral zone searching for plants, rather they use a combination of historical knowledge of persistent regrowth areas and surface observation during calm mornings to locate new plants. Their efforts are supplemented by lake users who report EWM sightings which are verified and marked by the lake manager, who also scouts the lake for new plants throughout the summer. This combined effort translates to control being maintained at an even lower cost than was originally projected back in 2003. In 2004, the first summer of intensive management, 20 tons of milfoil were removed at a cost of $450/littoral acre versus in 2021 when only 100 pounds of milfoil were removed for $67/littoral acre (2021 Upper Saranac Lake Invasive Species Management Project Report).

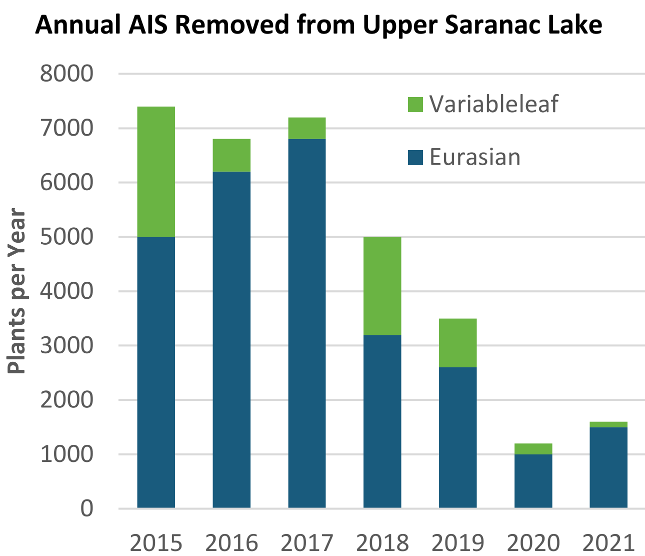
In addition to EWM management in Upper Saranac Lake, invasive species are being managed upstream in Fish Creek Ponds and Follensby Clear Pond, which creates a protective buffer that reduces the likelihood of transporting these AIS through Fish Creek into Upper Saranac Lake. VLM has also been detected in Upper Saranac Lake and is being managed aggressively therein to prevent the spread of this second aquatic invasive plant.



Aquatic plant biomass survey of Square and Fish Creek Ponds – map from USF

8.3. Monitoring

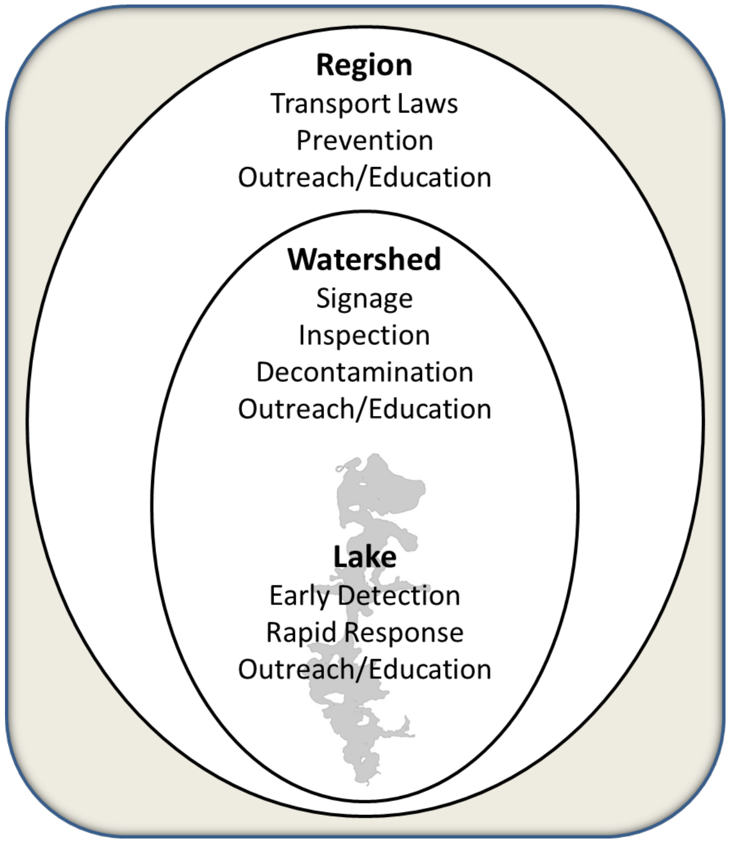
The underwater transect network was abandoned after 2019, as the density of EWM was so low it was no longer observed at any of the transects. The transect method was gradually replaced by the current monitoring approach which relies on a combination of comprehensive aquatic plant surveys and precision tracking of locations and amounts of AIS removed throughout the managed waters. The comprehensive aquatic plant survey is conducted throughout the growing season using a combination of grid and meandering search patterns to locate and map AIS using GPS, with any AIS found being marked with a buoy to assist divers in locating for removal. The lake is divided into 39 zones for tracking purposes, with plant harvests tallied and compared year to year by zone, allowing for precise spatial monitoring of management outcomes over time. In addition to keeping track of plant weight, divers started to count and report on the number of plants removed starting in 2015, as number of plants is a more sensitive measure at very low densities




Lobster buoy marking milfoil plant location – photo from USF

8.4. Spread Prevention

The Upper Saranac Foundation commissioned PSCAWI to develop a comprehensive AIS spread prevention plan in 2015 (Kelting 2015). This plan relies on preventative action at three scales, regional, watershed, and lake, to prevent new AIS from becoming established in Upper Saranac Lake. At the regional scale, the NYS AIS Prevention Law and efforts coordinated by the Adirondack Park Invasive Plant Program provide the first layer of protection. At the watershed scale, boat inspection stations at the DEC launches at Back Bay and Fish Creek Pond serve as active prevention, and a boat decontamination station at the Back Bay launch provides additional protection for boats not meeting the clean-drain-dry standard. The monitoring program conducted by the USF provides the third level of protection at the lake level, serving the vital tole of early detection if a new AIS is discovered in the lake.



The relative risk of invasive species entering Upper Saranac Lake from its six public access points was assessed and ranked from highest to lowest (Table 9, adapted from Kelting 2015). The DEC boat launch at Back Bay is ranked highest in terms of risk owing to its documented high use and number of boats launching from waters known to harbor AIS. Fish Creek is ranked second, though its actual risk as an entry point for AIS could be on par with Back Bay given the ability of boats to move freely between Fish Creek Pond and Upper Saranac Lake, noting that the VLM discover in Upper Saranac Lake in 2014 likely came through Fish Creek. The remaining four entry points are canoe carries and hand launches that do present a risk, albeit much lower than the two launches that accommodate motorized watercraft. This risk assessment provides the rationale for stationing watercraft inspection stewards at the boat launches at Back Bay and Fish Creek Campground and for controlling AIS in the waters upstream of Upper Saranac Lake to minimize opportunities for these organisms to move into the lake.

The stewardship program operated by AWI staffs the two DEC launches and the decontamination station with professional watercraft inspection and decontamination stewards from Memorial Day to Labor Day with extended weekend coverage through Columbus Day. Stewards at the Back Bay launch on Upper Saranac Lake inspected 2,190 boats in 2021, with 2.7% of these boats failing to meet the clean-drain-dry standard. Invasive plants and animals intercepted in 2021 were all on launching boats and included curly-leaf pondweed, zebra mussel, EWM, and VLM. All told, boats arrived at the Back Bay launch from 92 different waterbodies (Figure 12). The Fish Creek Pond launch has less boat traffic than the Back Bay launch, with 1,746 boats inspected in 2021, with 1.9% of these boats failing to meet the clean-drain-dry standard. Two launching boats and six retrieving boats had AIS, with EWM and VLM found on the retrieving boats. Note there has been a

Table 9. Relative risk of invasive species entering Upper Saranac Lake from each of the six public access points.

Risk	Access Point	Brief Rationale
Highest	Saranac Inn	NYS DEC trailered boat launch directly into lake; high use; boats coming from AIS infested waters
	Fish Creek	NYS DEC trailered boat launch indirectly into lake; moderate use; boats coming from AIS infested waters; AIS infested waters upstream
	Indian Carry	NYS DEC car top boat launch directly into lake; moderate use; boats coming from AIS infested waters; canoe carry links to AIS infested waters downstream
	Bartlett Carry	Short canoe carry links to AIS infested waters; AIS infested waters downstream
	Saginaw Bay	Long canoe carry links to AIS infested waters; AIS infested waters downstream
Lowest	Mill Brook	NYS DEC car top boat launch indirectly into lake; no AIS in waters upstream

marked decline over time in the percentage of retrieving boats with AIS, which reflects the successful AIS control efforts in Fish Creek Pond. Boats launching at Fish Creek came from 86 different waterbodies, with Lake Champlain being the most common (Figure 13). The high degree of connectivity between lakes throughout New York State and beyond through trailered watercraft depicted in Figure 12 and 13 illustrates the high risk of transporting AIS into the Adirondacks and the important role that watercraft inspection plays in reducing the number of new AIS entering our waterways.

There were 186 boats decontaminated at the Back Bay location in 2021, which ranked this location fifth out of 26 decontamination stations operated by AWI in terms of number of decontaminations performed.

NYSDEC boat launch in Fish Creek Ponds Campground – photo by PSC AWI

9. Public Survey

9.1. Approach

To gain public input and support for the plan, a survey was developed by PSCAWI with input from the Upper Saranac Foundation and a group of project advisors. Final survey questions were uploaded in the Survey Monkey app which was used to distribute and manage the survey. The survey was circulated from June to October 2020, via print in the Upper Saranac Lake Association newsletter, via email to listservs of USLA, Upper Saranac Foundation, and PSCAWI, regular email to specific groups, and lastly using USF and AWI social media. The following groups were sampled in the survey: USLA and USF members, DEC and APA staff, Franklin County SWCD staff, and the Adirondack Park Invasive Plant Program. We estimate that nearly 3,000 individuals received the survey. We received completed surveys from 169 individuals for an approximate response rate of 5.6%.

9.2. Summary

The detailed answers to the survey questions are provided in Appendix 13.3.; a high-level summary is provided here.

Most survey respondents were seasonal residents, were over 60 years old, and have owned waterfront property in the Upper Saranac Watershed for more than 20 years. These respondents had the following perceptions of water quality:

- 97% would describe overall water quality as good to excellent
- 89% believed that water quality is either staying the same or getting better
- Nearly equal numbers of respondents believed that land use and development patterns have had negative or positive impacts
- 37% believed that recreational use has had negative impacts in the watershed
- 82% believed that past management activities have had positive impacts in the watershed

The top five threats to the future of the watershed chosen by respondents were, in decreasing order of importance, aquatic invasive species (82.6%), climate change (62.3%), recreational use (47.6%), wastewater control (46.9%), and road salt (39.5%). The top five watershed resources respondents felt were most at risk were native plants and animals (72.8%), aesthetic enjoyment (60.9%), drinking water (55.1%), natural shoreline (54.8%), and the character of the lake community (46.1%).

There was strong support for watershed management activities focused on aquatic invasive species, general water quality, boater education, and land use and development, with over 80% of respondents supporting these activities. Respondents were also highly supportive of communication efforts by the USF (90.8%). Most respondents also supported increased law enforcement and the formation of special tax districts to support watershed management activities, though at 60%, support for these activities was less so than for the others.

Signage on display at the canoe launch at Indian Carry – photo by PSC AWI

10. Management Goals, Objectives, & Actions

The Upper Saranac Watershed Management Plan guides a vision of a watershed that sustains exceptional water quality and healthy ecosystems that are managed and protected through science-based decisions, advocacy, and collaboration. The following seven goals and their associated actions in the plan support the freshwater and terrestrial resources and promote social and economic benefits for the residents and visitors of the watershed.

1. Protect the quality and ecological function of water resources for drinking water, recreation, public health and safety, and climate resilience
   - 1.1. Invasive Species
     - 1.1.1. Support the recommendations in the Aquatic Invasive Species Prevention and Preparedness Plan for Upper Saranac Lake and update strategies for AIS containment, removal, spread prevention, monitoring and funding
     - 1.1.2. Maintain active AIS spread prevention at USL and Fish Creek Pond boat launches and educational efforts (signage, etc.) at other public access points and identify launches or other locations to further enhance spread prevention
     - 1.1.3. Continue management of established AIS in Upper Saranac Lake, Follensby Clear Pond, and Fish Creek Pond and expand to other priority locations and track and monitor AIS growth and removals to assess efficacy of control efforts
     - 1.1.4. Review opportunities for herbicide treatment as part of AIS management
     - 1.1.5. Improve communication and coordination with NYS DEC and watercraft inspectors regarding preventing introductions of AIS during bass and other fishing tournaments
     - 1.1.6. Work with private marinas and private launches to ensure compliance with *Memorandum of Understanding Among Private Boat Launch Owners Regarding Aquatic Invasive Species Prevention in the Upper Saranac Watershed* to ensure that any boat coming in from another waterbody is inspected for AIS by a watercraft inspector
     - 1.1.7. Work in partnership with APIPP to educate the public about AIS and encourage them to participate in the Lake Protector Program and to identify and manage terrestrial invasive species in the watershed
   - 1.2. Flood hazards and pollution runoff
     - 1.2.1. Assess erosion control and stormwater management activities within the watershed
     - 1.2.2. Review local laws that promote erosion control and stormwater management
     - 1.2.3. Encourage shore owners to implement best management practices for stormwater management and erosion control
   - 1.3. Shoreline protection
     - 1.3.1. Evaluate stability of current shoreline and riparian areas and develop recommendations for restoration
     - 1.3.2. Work with watershed stakeholders to help guide appropriate development along undeveloped shoreline and within upland properties
     - 1.3.3. Encourage shore owners to implement best practices and compliance with the applicable provisions of the APA Act for protecting shoreline, riparian and upland areas in the watershed

"Reflecting on another great Saranac Summer"
by E. Mayes – photo from USLA website

   - 1.4. Road salt and other pollutants
     - 1.4.1. Inform private well owners on the risks of contamination from pollutants like road salt and the importance of having their well water tested regularly
     - 1.4.2. Develop an inventory of sources of pollutants to ground and surface water (e.g. road salt, fuel, fertilizer, fire retardants)
     - 1.4.3. Engage with local highway departments, private applicators and NYS DOT on minimizing road salt runoff into ground and surface water in the watershed including adopting the "Clean Water, Safe Road Partnership" Municipal Pledge to reduce Road Salt

1.4.4. Work with the Town of Santa Clara to access funds for salt storage shed.

1.5. Disease causing pathogens

1.5.1. Inventory on-site wastewater treatment systems in the watershed, identify locations of greatest concern and reach out to homeowners to further understand potential issues

1.5.2. Evaluate model ordinances and established voluntary programs that support upgrades and replacement of on-site wastewater treatment, incentivize and track voluntary homeowner septic inspection, and consider adopting them in the watershed

1.5.3. Encourage shore owners to use phosphorus free fertilizer

1.5.4. Create a mailing to send to homeowners with information about maintaining and upgrading on-site septic wastewater treatment systems, including a list of septic companies that provide expertise for homeowners

1.5.5. Work collaboratively with NYS DEC to ensure that all SPDES permitted facilities are in compliance with the terms and conditions of their permits

1.6. Document environmental change

1.6.1. Continue long-term lake and tributary water quality monitoring programs and analyze water quality data on an annual basis

1.6.2. Evaluate the extent of contamination of water resources in the watershed by road salt

1.6.3. Incorporate harmful algal bloom (HAB) monitoring into established monitoring programs

1.6.4. Continue regular aquatic plant surveys in the watershed

2. Maintain habitat for native plants and animals to ensure their long-term viability in the watershed

2.1. Educate recreational users about protecting loons and aquatic habitat by maintaining distance, minimizing boater interaction with wildlife, picking up and properly disposing of fishing line, using non-lead sinkers and protecting loon nesting sites

2.2. Encourage homeowners to implement Lake Friendly practices that maintain shoreline vegetation and buffers, support pollinator habitat, and protect riparian corridors and wetlands to benefit wildlife

2.3. Safeguard boreal peatland and forest habitats in the watershed via education and careful management of recreation and development to protect the carbon storage capacity of these habitats and their critical role in supporting boreal wildlife species of concern in New York State

2.4. Maintain Bartlett Carry dam to ensure acceptable lake levels for aesthetic values, to maintain safe and enjoyable recreation, and ensure the persistence of freshwater riparian habitat for wildlife and climate resilience

Watercraft inspection steward – photo by PSC AWI

3. Promote wise stewardship and responsible use of recreational resources in the watershed

3.1. Develop a recreational study, similar to Lake George, to understand how the public and residents use and recreate on the lakes in the watershed and identify opportunities to increase safety and reduce conflicts on the lake while still maintaining recreational access

3.2. Establish a set of standards and identify a set of indicators and thresholds for accessing carrying capacity of the lakes based on the limits of acceptable change approach.

3.3. Review enforcement standards with NYS DEC to look for more opportunities for consistency and understand the role of local law (i.e. county) enforcement in monitoring the recreational use of waterbodies in the watershed

3.4. Develop a comprehensive outreach strategy that focuses on messaging about safety and stewardship to visitors via public access points, short term rental guests and campground visitors including Leave No Trace, AIS prevention, and boater safety.

- 3.5. Continue regular checking of working status of navigational aids, light beacons, buoys, etc., and report problems regularly
- 3.6. Promote responsible use of fishing tackle (no lead tackle, responsible fishing, minimizing the loss of fishing line) through public education and outreach
- 3.7. Explore opportunities to study wave action on the lake and understand impacts and management options

4. Protect and enhance the aesthetic values and special characteristics of the watershed
   - 4.1. Explore the development and/or implementation of local ordinances and state regulations that support the protection of lake characteristics and aesthetic values (e.g. noise criteria, lighting guidelines, and protection of viewsheds, natural shorelines and wildlife habitat)
   - 4.2. Advocate for more up-to-date and continuing review of land use regulations at all levels that guide land use and minimizes impacts to viewsheds, shoreline, wildlife and wetlands
   - 4.3. Explore partnerships with land trusts and other entities to understand best mechanisms for long term protection of shoreline and upland areas.
   - 4.4. Promote Lake Friendly Living objectives to help residents make informed decisions about their property that support water quality and protect the tranquility and aesthetic values of the lakes
5. Address priority watershed issues through improved local planning, regulatory programs and other municipal actions that are integrated, collaborative, and forward thinking
   - 5.1. Collaboration
     - 5.1.1. Support the role of the Lake Manager to strengthen partnerships among stakeholders in the watershed, understand the jurisdictional roles and agencies, act as point person for environmental concerns, facilitate communication among partners, and seek funding for priority projects.
     - 5.1.2. Strengthen relationships and engage meaningfully with state and local agencies, including Towns, to more effectively work together and to ensure integrated action in the watershed
     - 5.1.3. Continue to strengthen the working relationship between the Upper Saranac Foundation and the Upper Saranac Association and help to clarify each organization's roles to the public
     - 5.1.4. Continue to work closely with regional partners including APIPP, PSC AWI, Adirondack Lakes Alliance, and county and state agencies to understand, prevent and manage issues of regional concern
     - 5.1.5. Understand opportunities and actively pursue private and public funding for priorities in the plan
   - 5.2. Local and state laws and programs
     - 5.2.1. Review current local ordinances that support the protection of water quality and smart growth in the watershed to look for opportunities to strengthen laws and educate the public
     - 5.2.2. Inventory state regulations that protect water quality and shoreline and upland development and advocate for effective education, enforcement and implementation
     - 5.2.3. Explore opportunities and costs of creating jurisdictional authorities within the Upper Saranac Watershed (e.g., weed management districts)
6. Increase awareness about best management practices and lake stewardship through targeted outreach and communication to stakeholders within the watershed
   - 6.1. Develop a Public Relations Team to promote issues to all constituents
   - 6.2. Review results of the management plan's public survey to determine which educational messages are a priority for guests, visitors, and residents

Upper Saranac Lake Manager, Guy Middleton – photo by USF

6.3. Review existing materials, including the Homeowners Guide to a Healthy Lake, Homeowners Guide to Septic Maintenance, the Lake Friendly Living resources, social media platforms, and other sources of information and identify new opportunities
6.4. Develop and distribute information for new homeowners about the role of the Upper Saranac Foundation and ways in which they can help to protect the watershed and become stewards of the lakes

7. Encourage a culture of community and a greater sense of involvement in guiding the future of the Upper Saranac watershed
    7.1. Implementing the Plan and Taking Action
        7.1.1. Seek resolution of support of this plan by Towns, NYS DEC, NYS APA, and NYS DOT
        7.1.2. Create working groups to implement the plan and to keep the towns and other stakeholders abreast of the opportunities and needs of the watershed
        7.1.3. Seek funding for continued assistance to implement this plan
    7.2. Sense of community
        7.2.1. Encourage stewardship activities and involvement of young people in protecting the future of the watershed
        7.2.2. Create opportunities among lake and other local associations in the watershed to meet, exchange ideas, and work together
        7.2.3. Develop a creative thinkers group to identify and explore ways the communities around and across the lakes can work together, and ideas to welcome new residents and greet visitors


Young people learning about aquatic invasive species – photo by USF


Outing by members of the Upper Saranac Lake Association – photo from USLA website

11. Implementation Table

Task No.	Goal/Objective/Task Short Description	*Resources	†Timeline	‡Cost Estimates
Goal 1: Protect the quality and ecological function of water resources for drinking water, recreation, public health and safety, and climate resilience				
1.1. Invasive Species				
1.1.1.	Support the recommendations AIS prevention plan	AWI	ongoing	A
1.1.2.	Maintain current AIS spread prevention activities	USF	ongoing	E
1.1.3.	Continue managing AIS in the watershed	AWI	ongoing	F
1.1.4.	Review herbicide use for AIS control	AWI/DEC/APA	ongoing	A
1.1.5.	Improve AIS prevention during fishing tournaments	DEC/AWI/APIPP/LCBP	short	B
1.1.6.	Work with private launches on compliance with AIS MOU	AWI	ongoing	A
1.1.7.	Partner with APIPP on managing terrestrial IS	APIPP	ongoing	A
1.2. Flood hazards and pollution runoff				
1.2.1.	Assess erosion and stormwater management	SC/H/DOT/APA/DEC	ongoing	A
1.2.2.	Review local laws on erosion and stormwater control	SC/H/FC/APA/DOS/DEC/CWICNY	near	A
1.2.3.	Encourage shore owners to implement best practices	USLA/other assoc.	ongoing	B/C
1.3. Shoreline protection				
1.3.1.	Evaluate stability and develop recommendations	AWI/LCSG	near	D/E
1.3.2.	Work with stakeholders to guide development	USLA/APA/ALT/TNC/AWI/other assoc.	ongoing	unk
1.3.3.	Encourage shore owners to implement best practices	USLA/other assoc.	ongoing	A
1.4. Road salt and other pollutants				
1.4.1.	Inform private well owners on contamination risk	DOH/AWI	near	A
1.4.2.	Develop an inventory of sources of pollutants	AWI	ongoing	A
1.4.3.	Engage with applicators to reduce salt use and runoff	SC/H/DOT/Adk	ongoing	A
1.4.4.	Work with Town of Santa Clara on funds for salt storage	SC/WQIP	near	G
1.5. Disease causing pathogens				
1.5.1.	Inventory on-site wastewater treatment systems	AWI	near	D
1.5.2.	Evaluate model ordinances and voluntary programs	AWI/USLA/other assoc./SWCD/SC/H	ongoing	C/D
1.5.3.	Encourage use of phosphate free fertilizers	USLA/LCSG/other assoc.	ongoing	A
1.5.4.	Create and distribute informational mailing	AWI/LCSG	ongoing	B
1.5.5.	Ensure SPDES facilities are complying with their permits	DEC	ongoing	A
1.6. Document environmental change				
1.6.1.	Continue lake and tributary monitoring programs	AWI	ongoing	D
1.6.2.	Evaluate extent of watershed contamination by road salt	AWI	ongoing	A
1.6.3.	Incorporate HAB monitoring into established programs	AWI/DEC/DOH	short	A
1.6.4.	Continue regular aquatic plant surveys in watershed	AWI/APIPP	ongoing	A

11. Implementation Table

Goal/Objective/Task		*Resources	†Timeline	‡Cost Estimates
Task No.	Short Description			
Goal 2: Maintain habitat for native plants and animals to ensure their long-term viability in the watershed				
2.1.	Educate recreational users about protecting wildlife	USLA/ACLC/DEC/AWI	near	A
2.2.	Encourage adoption of "lake friendly" practices	USLA/other assoc.	near	A
2.3.	Safeguard boreal peatland and forest habitats	AWI/ALT/TNC	near	unk
2.4.	Maintain Bartlett Carry dam to manage lake levels	SC/H/FC	ongoing	I
Goal 3: Promote wise stewardship and responsible use of recreational resources in the watershed				
3.1.	Develop a study to understand recreational use on lakes	AWI/USLA/DEC/APA	near	E
3.2.	Identify indicators and thresholds for carrying capacity	AWI/USLA/DEC/APA	near	D/E
3.3.	Review law enforcement standards	SC/H/FC/DEC	near	A
3.4.	Develop a comprehensive outreach strategy	USLA/DEC/APIPP	near	A
3.5.	Continue regular checking of navigational aids	DEC	ongoing	A
3.6.	Promote responsible use of fishing tackle	ACLC/DEC/USLA	ongoing	A
3.7.	Explore opportunities to understand impacts of waves	AWI	long	A
Goal 4: Protect and enhance the aesthetic values and special characteristics of the watershed				
4.1.	Explore regulations that protect lake characteristics	SC/H/USLA/other assoc.	near	A
4.2.	Advocate for continued review of land use regulations	SC/H/USLA/other assoc./ALA	ongoing	A
4.3.	Explore partnerships with land trusts and other entities	ALT/TNC/ALA	near	A
4.4.	Promote "lake friendly living" practices	USLA/other assocs.	ongoing	C
Goal 5: Address priority watershed issues through improved local planning, regulatory programs and other municipal actions that are integrated, collaborative, and forward thinking				
5.1. Collaboration				
5.1.1.	Support the role of the Lake Manager	SC/H/USLA/other assoc.	ongoing	F
5.1.2.	Strengthen relationships with agencies & municipalities	SC/H/APA/DEC/DOT	ongoing	A
5.1.3.	Strengthen Foundation & Association relationship	USLA	ongoing	A
5.1.4.	Continue working closely with regional partners	USLA/AWI/APIPP/SC/H/SWCD/ALA/LCSG/LCBP	ongoing	A
5.1.5.	Understand and pursue private and public funding	LCBP/DEC/OPRHP/NBRC/LCSG/foundations	ongoing	C
5.2. Local and state laws and programs				
5.2.1.	Review local ordinances that protect water quality	SC/H	near	A
5.2.2.	Inventory state regulations on watershed protection	APA/DEC/DOT	near	A
5.2.3.	Explore costs/benefits of jurisdictional authorities	USLA/SC/H	near	B

11. Implementation Table

Goal/Objective/Task		*Resources	†Timeline	‡Cost Estimates
Task No.	Short Description			
Goal 6: Increase awareness about best management practices and lake stewardship through targeted outreach and communication to stakeholders within the watershed				
6.1.	Develop a Public Relations Team	USLA/other assoc.	short	A
6.2.	Review results of public survey to identify messages	USLA/other assoc.	short	A
6.3.	Review existing educational materials	USLA/other assoc.	short	A
6.4.	Develop an outreach program for new homeowners	USLA/other assoc.	near	C
Goal 7: Encourage a culture of community and a greater sense of involvement in guiding the future of the Upper Saranac watershed				
7.1. Implementing the Plan and Taking Action				
7.1.1.	Seek resolutions of support from agencies and towns	SC/H/FC/APA/DEC	short	A
7.1.2.	Create working groups to implement the plan	USLA/AWI/other assoc.	short	A
7.1.3.	Seek funding for plan implementation	USLA/AWI/SC/H/DEC	ongoing	variable
7.2. Sense of community				
7.2.1.	Encourage involvement of young people	USLA/other assoc.	ongoing	A
7.2.2.	Create opportunities to work together	USLA/other assoc.	ongoing	A
7.2.3.	Develop a creative thinkers group	USLA/other assoc.	ongoing	A

11. Implementation Table/Recommendations Summary

***Resources to provide assistance, collaboration, and funding for tasks**

ACLC	Adirondack Center for Loon Conservation	fnd	private foundations (e.g., Cloudsplitter)
Adk	ADK Action	H	Town of Harrietstown
ALA	Adirondack Lakes Alliance	LCBP	Lake Champlain Basin Program
ALT	Adirondack Land Trust	LCSG	Lake Champlain Sea Grant
APA	Adirondack Park Agency	NBRC	Northern Border Regional Commission
APIPP	Adirondack Park Invasive Plant Program	OPRHP	Office of Parks, Recreation, and Historic Preservation
AWI	Adirondack Watershed Institute	other assoc.	assoc in watershed (e.g., Lake Clear Association)
CWICNY	Champlain Watershed Improvement Coalition of New York	SC	Town of Santa Clara
DEC	Department of Environmental Conservation	SWCD	Soil and Water Conservation District
DOH	Department of Health	TNC	The Nature Conservancy
DOS	Department of State	USF	Upper Saranac Foundation
DOT	Department of Transportation	USLA	Upper Saranac Lake Association
FC	Franklin County	WQIP	Water Quality Improvement Project Program (DEC)

†Timeline:

ongoing=	task is underway
short term=	< 1 year
near term=	1 to 3 years
long term-	> 3 years

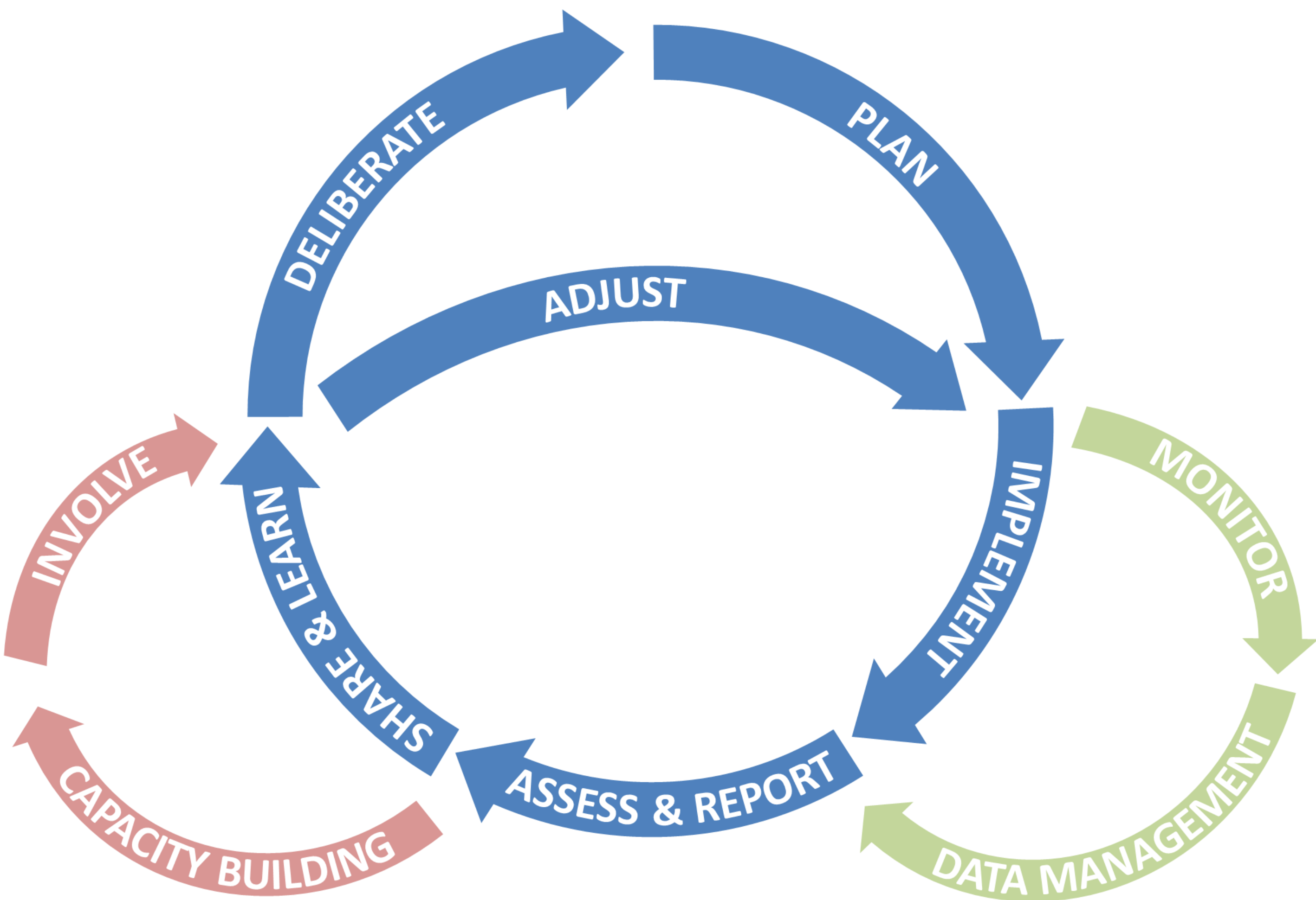
‡Cost Estimates:

A=	$0-$5,000
B=	$5,000-$10,000
C=	$10,000-$25,000
D=	$25,000-$50,000
E=	$50,000-$100,000
F=	$100,000-$250,000
G=	$250,000-$500,000
H=	$500,000-$1,000,000
I=	$1,000,000+

11. Implementation Table/Recommendations Summary

The Upper Saranac Watershed Management Plan was developed by AWI in close collaboration with USF and with input from advisors and stakeholders in the watershed. The goals and tasks herein reflect the concerns and interests of stakeholders combined with water quality protection needs identified as part of the watershed and water quality assessment. The plan has 7 goals which collectively have 59 tasks associated with them. Of these 59 tasks, 33 are identified as on going, 7 are identified as being initiated in less than 1 year, 18 are identified as being initiated in 1 to 3 years, and only 1 is identified as being initiated in greater than 3 years. Successful implementation of these various tasks following their timelines requires an immediate focus on implementing the plan and taking action by seeking resolutions of support (7.1), creating implementation groups (7.2), and seeking funding to support the work. In addition to forming implementation groups, a plan oversight committee should be formed that assigns priorities to tasks, seeks funding needed to support any task, and develops and implements a monitoring and evaluation program that includes metrics and measures of performance as well as timelines and benchmarks to evaluate success. This committee should form immediately after the final plan is adopted and must meet and communicate regularly to ensure the tasks are implemented and there is accountability for the work. Equally important is for this committee to support the Lake Manager, on whose shoulders much of the task- related work resides. The Lake Manager will need a lot of support and guidance and needs to know the priorities and expectations to perform their job effectively. Along this line, successful implementation of this management plan is in the hands of the oversite committee and working groups.

The adaptive management process suggested by Vugteveen and others (2015) for integrated coastal management is a useful tool for conceptualizing the general management process that the oversite committee should use. The graphic emphasizes the importance of monitoring (green) and capacity building (red), as well as the need to adjust management approaches based on performance.



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13. Appendices

13.1. Tables

13. Appendices

Appendix Table 1. New York State Species of Greatest Conservation Need with the potential to occur in the Upper Saranac Lake Watershed. Superscripts indicate species designated High Priority SGCN (*), Endangered (E), Threatened (T), or Special Concern (SC) by New York State; bold indicates species tracked by AWI. Habitats are as: Northern Hardwood and Conifer (NHC), Boreal Upland Forest (BUF), Cliff and Talus (CT), Outcrop and Summit Scrub (OSS), Northern Peatland (NP), Northern Swamp (NS), Emergent Marsh (EM), Agriculture (AG), Developed (DV).

Species	**Class**	**NHC**	**BUF**	**CT**	**OSS**	**NP**	**NS**	**EM**	**AG**	**DV**
American black duck*	Aves					Y	Y	Y		
Blue-winged teal	Aves					Y		Y	Y	
Common goldeneye	Aves	Y	Y							
Northern pintail	Aves				Y	Y		Y	Y	
Common nighthawk[*, SC]	Aves	Y	Y						Y	Y
Eastern whip-poor-will[*, SC]	Aves	Y	Y							
American woodcock	Aves	Y				Y	Y		Y	
Upland sandpiper[*, E]	Aves					Y			Y	
American bittern[SC]	Aves					Y		Y		
Black-crowned night heron	Aves					Y	Y	Y		
Least bittern[T]	Aves					Y		Y		
Black-billed cuckoo	Aves	Y	Y							
Bald eagle[T]	Aves	Y	Y	Y	Y		Y			
Northern goshawk[SC]	Aves	Y	Y							
Northern harrier[T]	Aves				Y	Y		Y	Y	
Red-shouldered hawk	Aves	Y					Y		Y	
American kestrel	Aves	Y	Y	Y	Y				Y	Y

Peregrine falcon[E]	Aves	Y	Y	Y	Y	Y		Y		Y
Ruffed grouse	Aves	Y	Y							
Spruce grouse*, [E]	Aves	Y	Y							
Common loon[SC]	Aves					Y		Y		
Scarlet tanager	Aves	Y								
Canada jay*	Aves	Y	Y			Y	Y			
Vesper sparrow*	Aves								Y	
Bobolink*	Aves					Y		Y	Y	
Eastern meadowlark*	Aves									Y
Rusty blackbird*	Aves	Y	Y			Y	Y		Y	
Brown thrasher*	Aves	Y							Y	Y
Bay-breasted warbler*	Aves	Y	Y			Y				
Black-throated blue warbler	Aves	Y								
Blue-winged warbler	Aves	Y				Y	Y			
Canada warbler*	Aves	Y	Y			Y	Y			
Cape May warbler*	Aves	Y	Y			Y				
Golden-winged warbler*, [SC]	Aves	Y				Y	Y			
Louisiana waterthrush	Aves	Y					Y			
Sedge wren*, [E]	Aves					Y		Y	Y	
Bicknell's thrush*, [SC]	Aves	Y	Y		Y					
Wood thrush	Aves	Y					Y		Y	Y
Olive-sided flycatcher*	Aves	Y	Y			Y	Y			

Three-toed woodpecker*	Aves	Y	Y				Y			
Pied-billed grebe	Aves					Y		Y		
Long-eared owl	Aves	Y	Y			Y		Y		
Short-eared owl*,[E]	Aves				Y	Y		Y	Y	
Barn owl*	Aves			Y	Y	Y		Y	Y	Y
Moose	Mammalia	Y	Y		Y	Y	Y	Y		
Eastern pipistrelle*	Mammalia	Y							Y	Y
Eastern small footed bat[SC]	Mammalia	Y	Y	Y	Y					
Hoary bat	Mammalia	Y	Y							
Indiana bat*,[E]	Mammalia	Y					Y			
Little brown bat*	Mammalia	Y				Y	Y	Y	Y	Y
Northern long-eared myotis*,[T]	Mammalia	Y	Y							Y
Red bat	Mammalia	Y							Y	Y
Silver-haired bat	Mammalia	Y	Y							
Smooth green snake	Reptilia	Y	Y			Y		Y	Y	Y
Common snapping turtle	Reptilia					Y	Y	Y		
Wood turtle*,[SC]	Reptilia	Y				Y	Y	Y		

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Appendix Table 2. Fish species in Upper Saranac Lake Watershed lakes and ponds for which information is available. Species codes are as: alewife (AL), cisco (CI), landlocked salmon (LS), kokanee (KO), round whitefish (RW), brown trout (BNT), brook trout (BKT), lake trout (LT), splake (SP), rainbow smelt (RS), northern pike (NP), fallfish (FA), white sucker (WS), brown bullhead (BB), pumpkinseed sunfish (PS), bluegill (BL), largemouth bass (LB), smallmouth bass (SB), rock bass (RB), black crappie (BC), yellow perch (YP). Round whitefish, brook trout (wild), lake trout (wild), cisco, and alewife are SGCN.

Lake/Pond	AL	CI	LS	KO	RW	RT	BNT	BKT	LK	SP	RS	NP	FA	WS	BB	PS	BL	LB	SB	RB	BC	YP
Bone								Y														
Copperas												Y			Y			Y				Y
Deer							Y		Y					Y	Y	Y			Y			Y
East Pine															Y	Y		Y			Y	Y
Fish Creek			Y									Y			Y	Y		Y	Y			Y
Floodwood	Y											Y	Y		Y	Y	Y	Y	Y	Y	Y	Y
Follensby Clear			Y								Y	Y			Y	Y			Y			Y
Grass								Y														
Green			Y				Y	Y		Y				Y	Y							
Hoel		Y	Y						Y					Y	Y	Y		Y	Y			Y
Horseshoe						Y		Y						Y								
Lake Clear			Y				Y		Y			Y			Y	Y		Y				Y
Ledge					Y			Y														
Little Green				Y	Y	Y		Y							Y	Y						
Little Polliwog							Y							Y								
Little Rainbow															Y	Y						
Little Square			Y									Y		Y	Y	Y		Y	Y			Y

Long				Y				Y	Y					Y	Y	Y			Y			Y
Meadow								Y														
Middle												Y			Y	Y		Y				Y
Mountain								Y							Y							
Pink														Y	Y	Y		Y				Y
Polliwog				Y			Y		Y		Y			Y	Y							Y
Rat							Y															
Rock												Y				Y		Y				Y
Rollins			Y						Y			Y			Y	Y		Y	Y			Y
Slang								Y						Y	Y	Y		Y	Y			Y
Square																Y						Y
St Germain								Y														
Turtle														Y	Y			Y	Y			Y
Upper Saranac			Y			Y			Y		Y	Y		Y	Y	Y		Y	Y	Y		Y
West Pine				Y		Y		Y	Y													
Whey						Y	Y	Y							Y							

13.2. Threats to Wildlife

The New York State Wildlife Action Plan categorizes and describes a wide variety of threats to wildlife and provides recommendations for addressing them (New York State Department of Environmental Conservation 2015). Relevant to the Upper Saranac Lake watershed include the threats of climate change, invasive species, pollution, natural systems modification (e.g., dams and water management; fire and fire suppression), biological resource use (e.g., hunting and fishing), residential and commercial development, human intrusion, and disturbance (e.g., recreational activities), and transportation and service corridors.

Given the number of lakes and waterways present, aquatic invasive species are a particularly important threat to the Upper Saranac Lake Watershed. Motorboats are believed to be the primary mechanism of spread of AIS (Johnson et al. 2001) and motorized use is very high in the Saranac chain of lakes. Motorized aquatic recreation (Cordell 2012) as well as mean summer temperatures (Hayhoe et al. 2008, Lynch et al. 2016) are predicted to continue to increase in the coming decades and increased temperatures may increase the proportion of motorized boat use over other forms of aquatic recreation (Patrolia et al. 2017) and lead to increased survivorship of aquatic invasive species (Zerebecki and Sorte 2011). Continued efforts to prevent the arrival and control the spread of aquatic invasive species in the watershed will be critical.

Additional threats to wildlife in the watershed include residential development and recreation. Recreation is known to negatively impact terrestrial and aquatic wildlife and several authors have described these effects in broad overviews and focused reviews of aquatic and semiaquatic species in particular (Knight and Cole 1995, Waller et al. 1999, Leung and Marion 2000, Steven et al. 2011, Larson et al. 2016, Bateman and Fleming 2017, Venohr et al. 2018). It is instructive to consider the possible implications of aquatic recreation for those species that may be particularly sensitive and, at the same time, important symbols for the Adirondacks and among the attractants of the region for recreationists. Among them are northern forest icons that are also SGCN including brook and lake trout, moose, common loon, and several sought-after boreal songbirds including Canada jay, olive-sided flycatcher, rusty blackbird, and three-toed woodpecker.

Brook and lake trout are two iconic native salmonids in the Northern Forest (Pershyn 2018). Apart from the consumptive effects of sport fishing, recreation is also associated with numerous sublethal effects on the biology and ecology of fish including changes in behavior, communication, habitat structure and use, physiological disturbance, disruption of biological functions, and interactions with other species (Venohr et al. 2018). Common loon is a popular regional icon whose presence is associated with increased property values in the Adirondacks (Tuttle and Heintzelman 2015). Recreational development and activity may affect nest site selection and reduce overall productivity for this species (Robertson and Flood 1980, McCarthy and Destefano 2011). Moose also have strong associations with aquatic habitats and increase use of them with increasing ambient temperature (Street et al. 2015). The species is still rare enough in the Adirondacks that individual animals, with the help of social media, occasionally acquire names and followings and are sought after in known locations, possibly to a degree that becomes detrimental. The temporal coincidence of high temperatures with high levels of recreational use (midday, midsummer) may deter use of some lakes and ponds by moose during times of thermal stress. Inhabiting a North American geographic range very similar to that of the moose and iconic among the birding community are a suite of boreal songbird and woodpecker species which are at or near the southern edge of their breeding range in the Adirondack Park. Their habitats include boggy shorelines which occur at the edges and along inlets and outlets of numerous Adirondack lakes as well as open river corridors. Peatland and fen vegetation is sensitive and vulnerable to direct disturbance in locations where humans have access (Slater and Agnew 1977). Even in the absence of direct physical contact to the shoreline, recreational disturbance via aquatic recreation, via motorboats in particular, is associated with a number of negative impacts on birds including changed nesting behavior, increased alertness and energy expenditure, and decreased nest attendance and breeding success (Venohr et al. 2018). Such disturbances may be particularly harmful for several species of boreal birds exhibiting patterns of decline in the Adirondacks (Glennon et al. 2019a, 2019b).

The impacts of residential development on wildlife have also been studied extensively in the Adirondack Park (Glennon and Kretser 2021, Glennon and Kretser 2016, Seewagen et al. 2015, Glennon et al. 2014, Spilman et al. 2014, Glennon and Kretser 2013, Glennon and Porter 2007, Glennon and Porter 2005). In particular, the impacts of large lot, back country or exurban development have been investigated in multiple contexts in the Adirondacks and this highly fragmenting development pattern has been associated with impacts to wildlife in the park that (1) occur rapidly (Glennon and Kretser 2012a), (2) extend beyond the physical footprint of the development (Glennon and Kretser 2012b, Glennon and Kretser

2013), (3) occur as a result of both structural habitat changes and human activities (Glennon and Kretser 2021), (4) simplify ecological communities (Glennon et al. 2013, Glennon and Kretser 2016), and (5) transcend regional biogeographies (Glennon et al. 2014, Glennon and Kretser 2021). Land use planning tools that are aimed at careful siting and assessment of potential development can help prevent negative impacts associated with residential development (Glennon 2012).

Climate change is a pervasive threat to wildlife across the globe, but in our region is particularly relevant to species associated with northern habitats, those at high elevation or high latitude which are adapted to northern temperatures and disturbance processes (Jenkins 2010). A suite of boreal birds have been monitored in low elevation boreal wetlands in the Adirondack Park for nearly 2 decades, including at Black Pond Swamp on the eastern shore of Upper Saranac Lake. The majority of these birds are exhibiting declines in our region, potentially the result of a range retraction associated with warming temperatures (Glennon et al. 2019 a,b). Careful land use and recreational planning can also help prevent non climate-related negative impacts to these species.

13.3. Summary of Stakeholder Survey

Survey Background

Survey questions were developed by the Paul Smith's College Adirondack Watershed Institute (PSCAWI) with input from the Upper Saranac Foundation and a group of project advisors. Final questions were uploaded in the Survey Monkey app which was used to distribute and manage the survey. The survey was circulated from June to October 2020, via print in the Upper Saranac Lake Association (USLA) newsletter, via email to listservs of USLA, Upper Saranac Foundation (USF), and PSCAWI, regular email to specific groups, and lastly using USF and AWI social media. The following groups were sampled in the survey: USLA and USF members, DEC and APA staff, Franklin County SWCD staff, and the Adirondack Park Invasive Plant Program. We estimate that nearly 3,000 individuals received the survey. We received completed surveys from 169 individuals for an approximate response rate of 5.6%.

Demographics of Respondents

Choose as many options that describe your relationship with the Upper Saranac Lake watershed:

Option	Percent of Respondents
Seasonal resident	81.3%
Waterfront property owner within Upper Saranac Lake watershed	76.0%
Live within watershed	41.3%
Recreating public	27.3%
Active with an environmental advocacy group	17.3%
Year-round resident	14.7%
Live outside the watershed	14.7%
Visitor to the region	14.0%
Work for a nonprofit or university	7.3%
Local business owner	2.7%
Elected or appointed local government official	1.3%
Student	0.7%
Manager of natural resources in the watershed	0.7%
Waterfront property renter within Upper Saranac Lake watershed	0.7%
Former waterfront property owner within Upper Saranac Lake watershed	0.7%

How long have you lived in/visited the Upper Saranac Lake watershed?

Option	Percent of Respondents
More than 20 years	72.8%
10 to 20 years	16.6%
5 to 10 years	5.9%
Less than 5 years	4.1%

How old are you?

Age Group	Percent of Respondents
90 and greater	0.7%
85 to 89	2.7%
80 to 84	4.7%
75 to 79	7.3%
70 to 74	17.3%
65 to 69	23.3%
60 to 64	16.0%
55 to 59	8.7%
50 to 54	8.0%
45 to 49	4.0%
40 to 44	0.7%
35 to 39	2.7%
30 to 34	2.0%
29 and lower	2.0%

Uses of watershed

Which areas or waterbodies do you use or visit in the Upper Saranac Lake watershed?

Option	Percent of Respondents
Upper Saranac Lake	100.0%
Follensby Clear Pond	37.0%
Fish Creek Campground	32.1%
Hoel Pond	18.8%
St. Regis Canoe Area	18.8%
Lake Clear	16.4%
Rollins Pond campground	16.4%
Polliwog Pond	7.3%
Green Pond	6.7%
Little Green Pond	6.1%
Floodwood Pond	1.2%
Horseshoe Pond	1.2%
Spider Creek	0.6%

How do you utilize the Upper Saranac Lake watershed?

Option	Percent of Respondents
Motorized boating	88.8%
Cross country skiing	88.2%
Swimming	87.0%
Non-motorized boating	86.4%
Relaxing/aesthetic	84.0%
Nature/wildlife watching	76.3%
Fishing	55.6%
Other recreation	22.5%
Drinking water	20.1%
Back-country camping	14.8%
Campground visitor	10.7%
Golf (comment)	0.6%

Summary of further comments or recommendations for the future management of the Upper Saranac Lake watershed

Twenty-six survey respondents submitted comments, most of which were like the comments already summarized. These included interest in prohibiting jet skis or restricting their use, not allowing wakeboarding/surfing within 1000 feet of shoreline, greater enforcement of boating regulations, and a local tax to cover costs of dam and invasive species. Several respondents emphasized the importance of the watershed when considering the lake, some applauded this focus too. One respondent commented that we should strive for 100% voluntary participation in protection/improvement efforts, not making any mandatory. Some respondents were opposed to any efforts to manage the shoreline or to limit wake boards.

Perceptions of impacts

Reflecting on your experiences in the Upper Saranac Lake watershed, rate the level of impact you have observed over the time period you've lived in/visited the watershed.

Question	Negative	No	Positive
Amount and patterns of land use and development have resulted in _________ impacts in the watershed?	29.5%	36.5%	34.0%
Amount of and type of recreational use have resulted in _________ impacts in the watershed?	37.4%	49.7%	12.9%
Past management activities have resulted in _________ impacts in the watershed?	3.9%	14.3%	81.8%

Summary of comments on land use and development: 17 respondents submitted comments. There were several negative comments related to development, these included too much land clearing close to shore for "mega mansions", too much new construction/over development, development patterns starting to mimic the suburbs (from people coming to "get away"), and development not in character with the surroundings (including too much shoreline tree cutting). It was mentioned that property taxes are driving fragmentation of lots and more development at higher density. There was concern that increasing trends in short term rentals were bringing in larger groups and over usage of properties. One respondent commented that there is not enough enforcement of building/development regulations.

Summary of comments on recreational use: 22 respondents submitted comments. There were several comments on increased use of larger, faster, and louder motorboats being operated by day users. Increased use of jet skis and wake boats were also mentioned. Several respondents commented that these boats have become a nuisance and there are too many, overuse was mentioned. Comments were made on the size of wakes produced by the larger boats and wake boats and how these waves were impacting the shoreline as well as docks. Boaters were observed speeding and not following boating rules and basic etiquette. It was suggested that there should be more monitoring, education, and enforcement regarding motorboats and jet skis. One respondent mentioned there is increased occurrence of people camping in non-camping areas.

Summary of comments on management activities: 10 respondents submitted comments. Comments on past management activities largely on invasive species and milfoil control and how management has helped. There was mention of algae blooms. There was also mention that literature is very good but now regulations need to be enforced.

Perceptions of water quality

How would you describe the overall water quality in the Upper Saranac Lake watershed?	Fair	Good	Excellent
	3.0%	50.9%	46.1%

In your opinion, is the water quality getting:	Worse	Staying the same	Better
	11.0%	42.7%	46.3%

Summary of comments on perceptions of water quality: 9 respondents submitted comments. One respondent commented that the water was much cleaner in 2020 and speculated that this was due to COVID and fewer larger boats from summer camps. Several respondents commented that ongoing milfoil control and AIS prevention efforts have improved water quality. One respondent commented that there are too many big, oversized boats with too many people and was concerned about overuse.

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Perceptions of threats

Rank the top FIVE threats to the future of Upper Saranac Lake (Rank 1 to 5, 1 being most threatening):

Threat	Weighted Rank	#1 Threat	#2 Threat	#3 Threat	#4 Threat	#5 Threat
Aquatic invasive species	82.6%	55.9%	22.4%	9.3%	6.8%	2.5%
Climate change	62.3%	27.3%	28.0%	10.6%	9.1%	12.9%
Recreational overuse or inappropriate use	47.6%	9.2%	19.3%	22.7%	16.8%	12.6%
Wastewater control / private septic	46.9%	6.5%	18.7%	23.7%	18.7%	18.7%
Road salt	39.5%	9.4%	10.2%	19.5%	16.4%	18.8%
Land use and development	34.3%	6.3%	10.7%	13.4%	20.5%	16.1%
Storm water runoff / erosion / poor land use practices	28.7%	1.7%	5.8%	15.0%	22.5%	21.7%
Pesticides / herbicides / lawn fertilizers	25.8%	0.9%	9.9%	11.7%	15.3%	18.9%
Lack of or consistent local ordinances and zoning	10.5%	0.0%	2.3%	7.0%	5.8%	10.5%

Summary of comments: 23 respondents submitted comments, most of which were to provide more details on threats listed on the survey. Increased shoreline erosion from wakeboarding was mentioned a few times and drinking while boating and increased trash were also mentioned. Impervious surface and shoreline erosion were mentioned, including an observation of seeing sediment plumes after a big rainstorm. Several respondents commented on codes and regulations, mentioning enforcement of ordinances (too much and not enough), APA regulations, and the EPA. One respondent commented that the "State/DEC should allow more directed runoff to minimize shore erosion", suggesting that some shore owners may not understand the importance of minimizing direct runoff. Several respondents commented that they either did not feel qualified to comment on the threats or to rank them.

Rank the top FIVE resources you believe are most at risk in the Upper Saranac Lake watershed (Rank 1 to 5, where 1 is most at risk):

Resource	Weighted Rank	#1 Resource	#2 Resource	#3 Resource	#4 Resource	#5 Resource
Native plants and animals	72.8%	33.1%	24.8%	21.4%	15.2%	4.8%
Aesthetic enjoyment	60.9%	20.5%	19.7%	24.4%	20.5%	9.4%
Clean drinking water	55.1%	23.7%	18.6%	12.7%	13.6%	16.9%
Natural shoreline	54.8%	24.4%	17.6%	10.7%	19.1%	11.5%
Character of the lake community	46.1%	11.9%	16.9%	19.5%	16.1%	12.7%
Quality of fishing	37.9%	7.7%	11.5%	16.3%	14.4%	26.9%
Recreational access and opportunities	29.5%	6.5%	11.8%	7.5%	11.8%	21.5%
Public health and safety	28.8%	2.2%	10.8%	17.2%	9.7%	19.4%

Summary of comments: 16 respondents submitted comments. There were several comments about boat traffic and safety, as well a mention of overcrowding of the shoreline in Square Bay on summer days. There was concern that increased boat traffic will impact the natural beauty of the shoreline and general aesthetics (e.g., increased noise day & night) of the lake. Several respondents commented that they either did not feel qualified to comment on the risks or to rank them.

Support of management activities

Please indicate how strongly you support or do not support each of the following management activities:

Category	Management Activity	Strongly do not support	Do not support	Neither support nor not support	Support	Strongly support
General Water Quality	Ongoing lake monitoring	0.0%	0.6%	1.3%	15.3%	82.8%
	Repair and maintain the Upper Saranac Lake, Bartlett Carry Dam	0.0%	0.0%	5.0%	18.9%	76.1%
	Limitations on fertilizer application	0.0%	0.6%	10.7%	25.8%	62.9%
Aquatic Invasive Species	Harvesting of aquatic invasive species	0.6%	0.0%	1.3%	11.4%	86.7%
	Information about aquatic invasive species spread prevention	0.0%	0.0%	0.6%	17.6%	81.8%
	Boat inspectors at launches	0.0%	1.9%	3.2%	18.6%	76.3%
	Special tax district to pay for invasive species spread prevention and management	4.4%	6.3%	25.3%	25.3%	38.6%
Land Use and Development	Consistent local land use ordinances across jurisdictions on issues such as shoreline use and buffers, wastewater management,	2.5%	3.1%	5.0%	32.7%	56.6%
	Regulation of short term rentals to include, but not limited to; public safety, occupancy limits and septic maintenance	3.8%	7.0%	13.9%	24.1%	51.3%
	Adoption and enforcement of model storm water/wastewater ordinances	0.6%	3.2%	10.3%	45.8%	40.0%
	Special tax district to pay for Upper Saranac Lake, Bartlett Carry Dam maintenance and repair	5.7%	9.5%	19.0%	36.1%	29.7%
Recreation	Targeted education about aquatic invasive species to guests, visitors, and recreational users of the Upper Saranac Lake waterways	0.6%	0.0%	3.2%	34.2%	62.0%
	Education about boater safety and recreational use of waterways	0.6%	0.6%	6.3%	44.7%	47.8%
	Targeted education to anglers about aquatic invasive species impacts on fisheries	0.0%	1.3%	11.4%	42.4%	44.9%
	Information about access to public lands/campsites/fishing areas in the watershed	1.9%	3.8%	18.2%	42.8%	33.3%
	Increased law enforcement of recreational activities, e.g. navigational, camping	3.1%	10.7%	20.8%	33.3%	32.1%
Communication from Upper Saranac Foundation to shore owners about	Aquatic invasive species spread prevention	0.0%	0.0%	2.5%	15.7%	81.8%
	Septic maintenance	0.0%	0.6%	3.1%	27.7%	68.6%
	Fertilizer application	0.0%	2.5%	6.4%	33.1%	58.0%
	Shoreline buffers	0.6%	3.2%	8.9%	34.8%	52.5%
	Managing stormwater	0.0%	0.6%	8.3%	41.7%	49.4%
	Water conservation	0.0%	3.2%	15.4%	37.2%	44.2%

13.4. Summary of Past Research

Overview

Upper Saranac Lake (USL) is one of the most studied lakes in the Adirondacks, with a diverse history of both scientific research and water quality monitoring (**Table 1**). USL has been the field site for an impressive amount of scientific work. Peer-reviewed scientific papers have been published on the degradation of water quality (Stager et al. 1997; Chen 1988; Laxson et al. 2018b.), management of Eurasian water-milfoil (Wilson and Ricciardi 2009; Kelting and Laxson 2010), use of bioindicators (Benson et al. 2008), spawning of lake trout (Royce 1951), and accumulation of DDT in fish (Burdick et al 1964). USL also serves as a showcase for the value of long-term water quality monitoring. The lake has been continuously monitored since 1989. During this 30-year period, six different organizations have made over 30,000 observations across dozens of different water quality indicators and produced numerous technical reports. What began with basic observations on trophic indicators has grown to include the collection of comprehensive lake chemistry data, analysis of the hydrologic budget and nutrient export, and the assessment of invasive plant management strategies.

History of Limnology and Water Monitoring

Human intrusion into the Upper Saranac Lake watershed in the form of residential development, logging, road construction, and nutrient discharge has been occurring for over 130 years. The cumulative result of our impacts was first noticed by observant residents in the 1970's, but exploded into visibility in 1989-1990 when dense surface blooms of cyanobacteria persisted on the lake for nine months (reviewed by Laxson et al. 2018b). The Upper Saranac Lake community rallied around the goal of improving water quality and initiated a comprehensive lake monitoring program with the PSCAWI (Paul Smith's College Adirondack Watershed Institute). This program resulted in volumes of data and is still in action today.

By the mid 1990's the eutrophication issues in the lake were under control, but another more costly problem was on the horizon. In 1996 the first large beds of Eurasian water-milfoil were documented in the head of Saginaw Bay. Limited control efforts in the form of hand harvesting and supplemental benthic matting began in 1999 and continued through 2003. The initial removal effort was successful at reducing milfoil cover within the managed areas, but the lakes 76 km of shoreline made lake wide control unattainable. Recognizing the partial success of the limited control effort and the documented expansion of Eurasian water milfoil in other parts of the lake, the Upper Saranac Foundation (USF) in partnership with the PSCAWI implemented a new management approach in 2004 (Kelting and Laxson 2010). The intensified approach to milfoil management called for the selective removal of the plant through hand harvesting of the entire littoral zone of the lake at least twice each summer for three years, supplemented by limited benthic matting of dense beds. The intensive management effort employed 32 divers during the period of 2004-2006. The effort was reduced by approximately 50% in 2007, and again in 2008 as the lake entered into the 'maintenance period' that it continues to operate in to this day. In an effort to monitor the success of the management strategy, the PSCAWI established 15 underwater monitoring sites across the lake in 2004, and one location in Fish Creek Pond in 2006.

In the summer of 2007, the USF and the PSCAWI established a watershed-monitoring network with the goal of understanding long-term watershed hydrology and chemical loading to the lake from its main tributaries. With support of the Upper Saranac Foundation, the PSCAWI instrumented the five main tributaries of the lake, equating to 77% of the total watershed area. High-resolution data on stream discharge, nutrient inputs, and road salt run off have been collected at intervals as short as 30 minutes for the period of 2007-2018.

A significant advancement in our lake monitoring capabilities occurred in 2017 with the launch of the Upper Saranac Lake Environmental Monitoring Platform (EMP). The EMP is an autonomous in-lake monitoring station supported by funds from the National Fish and Wildlife Foundation and the Upper Saranac Foundation. The EMP collects information such as temperature, dissolved oxygen, pH, conductivity, turbidity, chlorophyll-a, and cyanobacterial pigment. Surface water data is collected every hour and a full profile from the surface to the bottom is collected every four hours. In addition to lake information, the EMP also contains a full meteorological station that gathers instantaneous data on air temperature, humidity, pressure, precipitation, wind speed, wind direction, and incoming solar radiation (Figure 1). Weather and lake data collected by the EMP are transmitted in near real time to Paul Smith's.

Recommendations and Data Gaps

USL is fortunate to have a robust and continuous dataset. The establishment of a central water quality database by PSCAWI has allowed for detailed analysis of historical water quality trends (Kelting 2013). One of the more intriguing observations to come from this analysis is that water transparency continues to decline despite significant reduction in phosphorus and chlorophyll-a concentrations. The cause of this decline remains in question, and is an ideal candidate for future study. We hypothesize that the observed decrease in transparency is caused by an increase in the concentration of terrestrially derived dissolved organic carbon (DOC). It is possible that DOC has increased in the lake due to the regional reduction in acid deposition, increased temperature, changes to hydrologic input to the lake, or a combination of these stressors. The increase in DOC may also be having an effect on other in-lake processes, such as stratification stability, mixing depth, and hypolimnetic oxygen depletion.

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Table 1. A synthesis of the major reports and publications focused on the limnology and water quality of Upper Saranac Lake.

Source	Lake water quality	Watershed inputs	Aquatic biota	Aquatic vegetation
NYSCD (1930)	Limited data for summer months of 1929.			
Royce (1951)			Fish from Upper Saranac Lake were used to understand sexual dimorphism, spawning habitats, and egg development in lake trout.	
Burdick et al., (1964)			Fish from Upper Saranac Lake and other water bodies were used to understand the accumulation of DDT in Lake trout and the effect on reproduction	
Fuhs (1972)	Comprehensive data for May-Sep, 1971.		Phytoplankton speciation and counts.	
Mikol (1984)	Comprehensive data from four stations, April – Nov 1981.	Nutrient export from six tributaries, summer 1981.		
Chen (1988)		Fate of wastewater effluent discharge from nearshore septic tanks was evaluated across eight lakes in NYS.		

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DeAngelo and Ziolkowski (1990)	Comprehensive data from the north and south basin, May-Nov 1989.			
DeAngelo and Smith (1991)	Comprehensive data from the north and south basin, May-Nov 1990.	Nutrient export from 11 stations, April – Nov 1990. Shoreline occupancy survey		
Rafferty et al., (1992)	Comprehensive data from the north and south basin, April-Nov 1991.	Nutrient export from three tributary stations April-Nov 1991. Summary of permitted discharges into the lake.		
Martin (1993)	Comprehensive data from the north and south basin, May-Oct 1992.	Nutrient export from three tributary stations March-Nov 1992.		
Stager et al., (1997)	Paleolimnological reconstruction of past water quality.			
Martin et al., (1998)	Comprehensive data from the north and south basin, at monthly and biweekly intervals, 1995-1996.	In-depth analysis of hydrologic and nutrient inputs to the lake from seven major tributaries, including basin wide phosphorus budget.	Detailed analysis of zooplankton and phytoplankton community composition and biomass, 1995-1996. Includes summary of available fisheries data.	Thorough analysis of the species composition and relative abundance of aquatic vegetation across the lake, 1996 .
Martin (1999)	Comprehensive data from the north and south basin, at monthly and biweekly intervals, 1997-1998.			Locations of Eurasian water-milfoil 1996-1998.

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Martin (2000)	Comprehensive data from the north and south basin, at monthly and biweekly intervals, 1999.			Refers to milfoil location map for 1999 (map is missing). Limited data on 1999 hand harvesting activities.
Benson (2008)		Results suggest ecologically relevant N derived from septic waste is entering the lake.		Analyzed stable isotopes in *Vallisneria americana* to examine if septic waste played a significant role in nutrient loading.
Wilson and Ricciardi (2009)				Aquatic plants from Upper Saranac Lake and other waterbodies where studied to understand the impact invasive macrophytes have on epiphytic invertebrate communities.
CSLAP (2012)	Surface and bottom water chemistry data, May-October. 2006 – 2012.			
Kelting and Laxson (2010)				Analysis of Eurasian water-milfoil frequency of occurrence, stem density and harvesting effort from 2004-2008.
Kelting (2013)	A complete curation of all available water quality data from 1929-2013. All data moved to a single database.			

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Kelting and Laxson (2014)	Comprehensive water quality data for the summer of 2013 plus trend analysis on available historical data since 1989.	Instantaneous analysis of watershed hydrology 2007-2013, Estimates of annual phosphorus export from six tributaries based on biweekly sampling, April-November 2007-2013.		
Laxson et al., (2018a)	Annual update to long-term water quality study. Includes comprehensive data from 2014-2017 and trend analysis on historical data. Examines trend in Oxygen depletion rates 1990-2016. Analysis sodium and chloride concentration as a surrogate of road salt impact.	Instantaneous analysis of watershed hydrology 2014-2017, Estimates of daily export of nutrients and chloride from six tributaries April-November 2014-2017. Curation of phosphorus export from Adirondack Fish Hatchery, 1992-2017.		Assessment of the efficacy of milfoil management by analyzing current and historical milfoil abundance across the lake, as well as select locations in Fish Creek Ponds, 2004-2017. Complies percent frequency of occurrence of native and non-native aquatic vegetation across 16 underwater monitoring sites.
Laxson et al. (2018b)	Evaluation the limnological recovery of Upper Saranac Lake since BMP were enacted at the Adirondack Fish Hatchery.			

13.5 Maps

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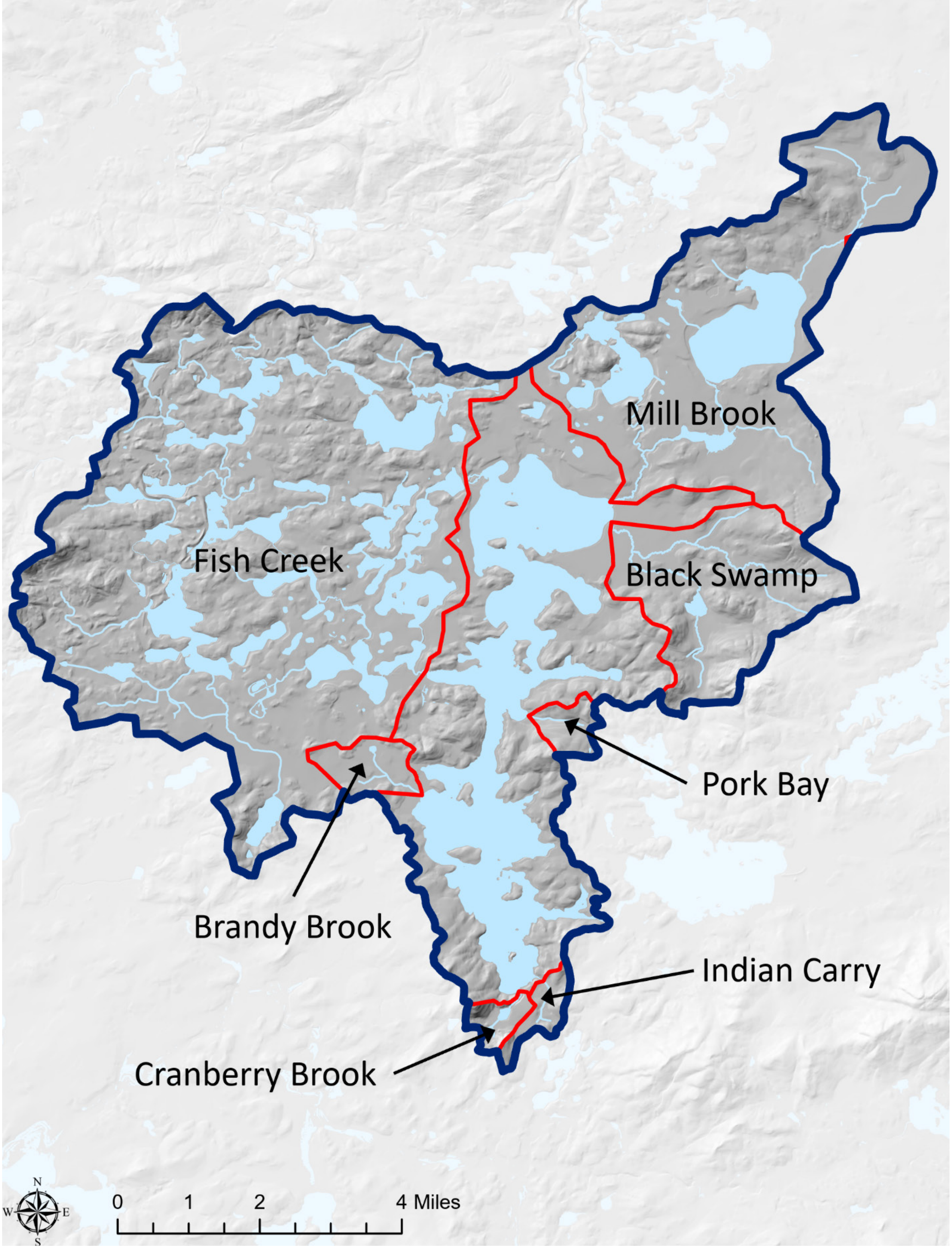
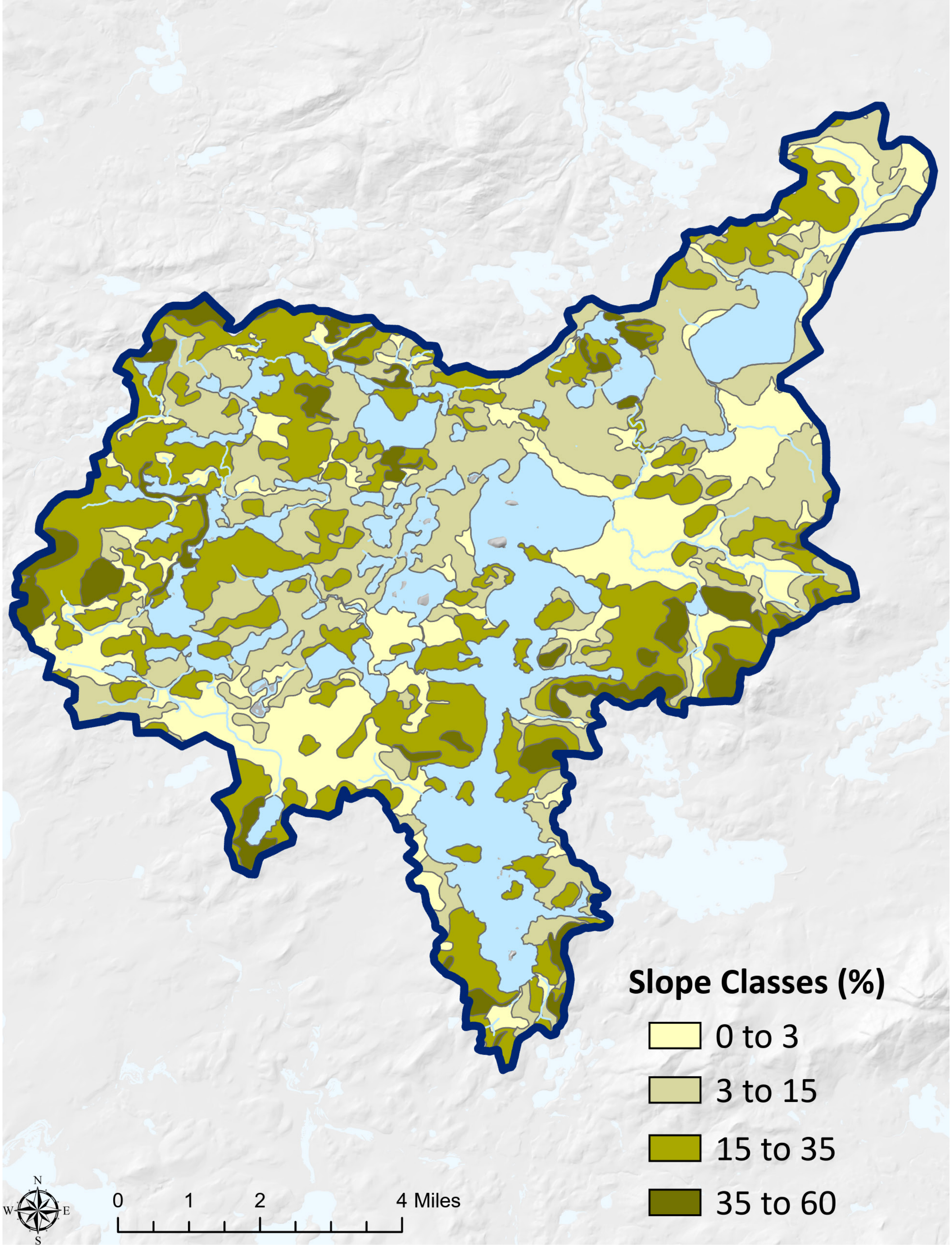
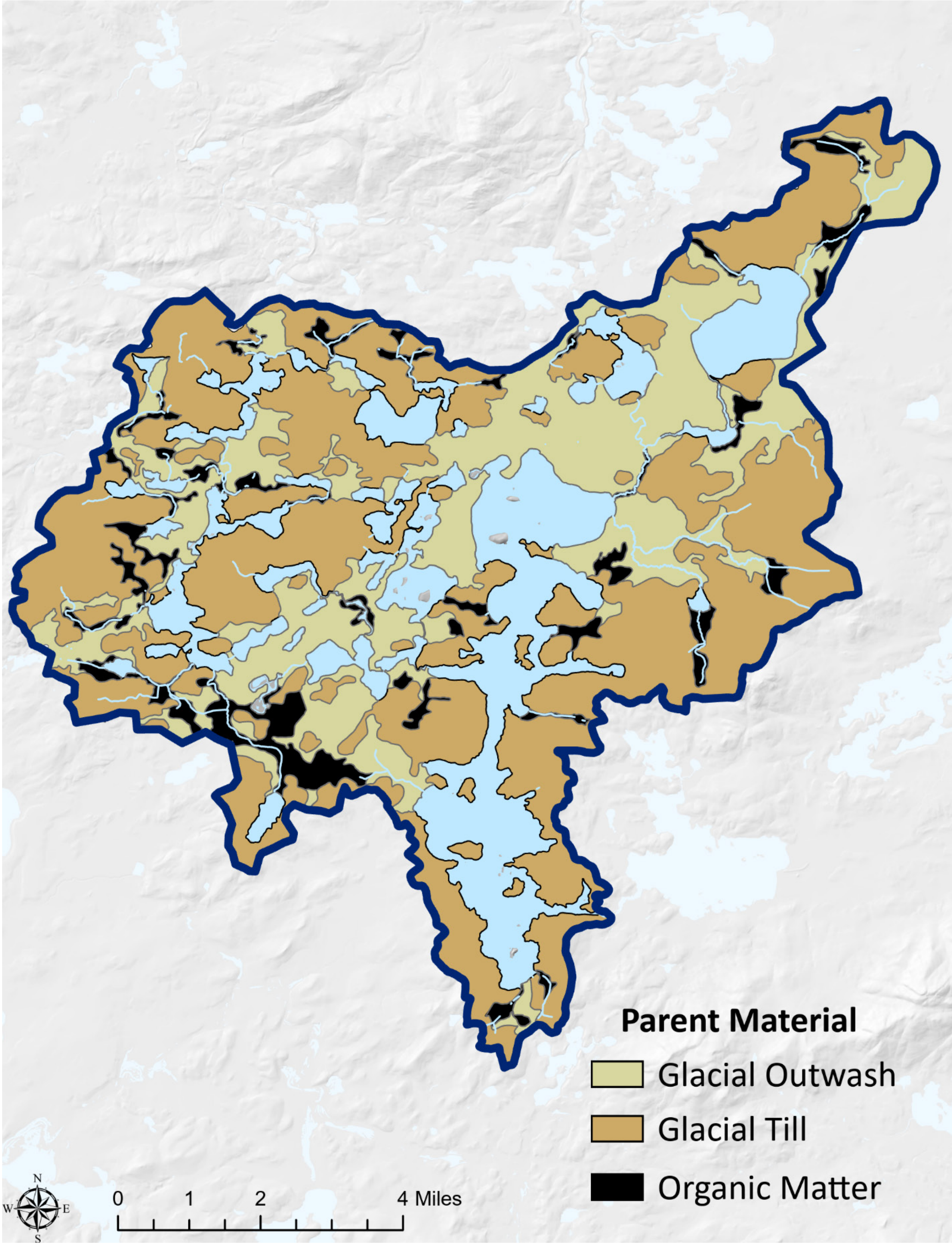
Map 1. Watershed boundaries and hydrography.



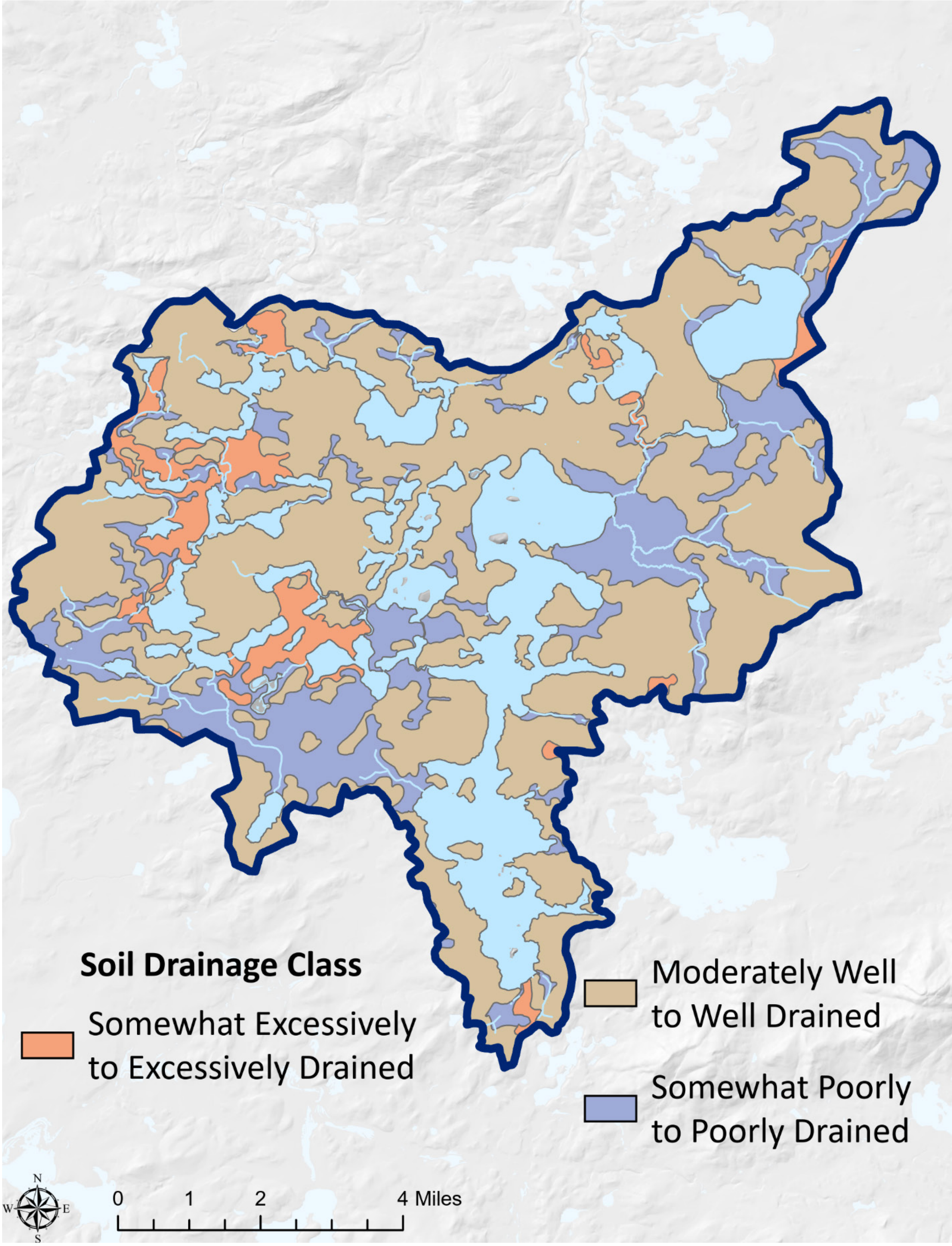
Map 2. Topography represented by slope classes.



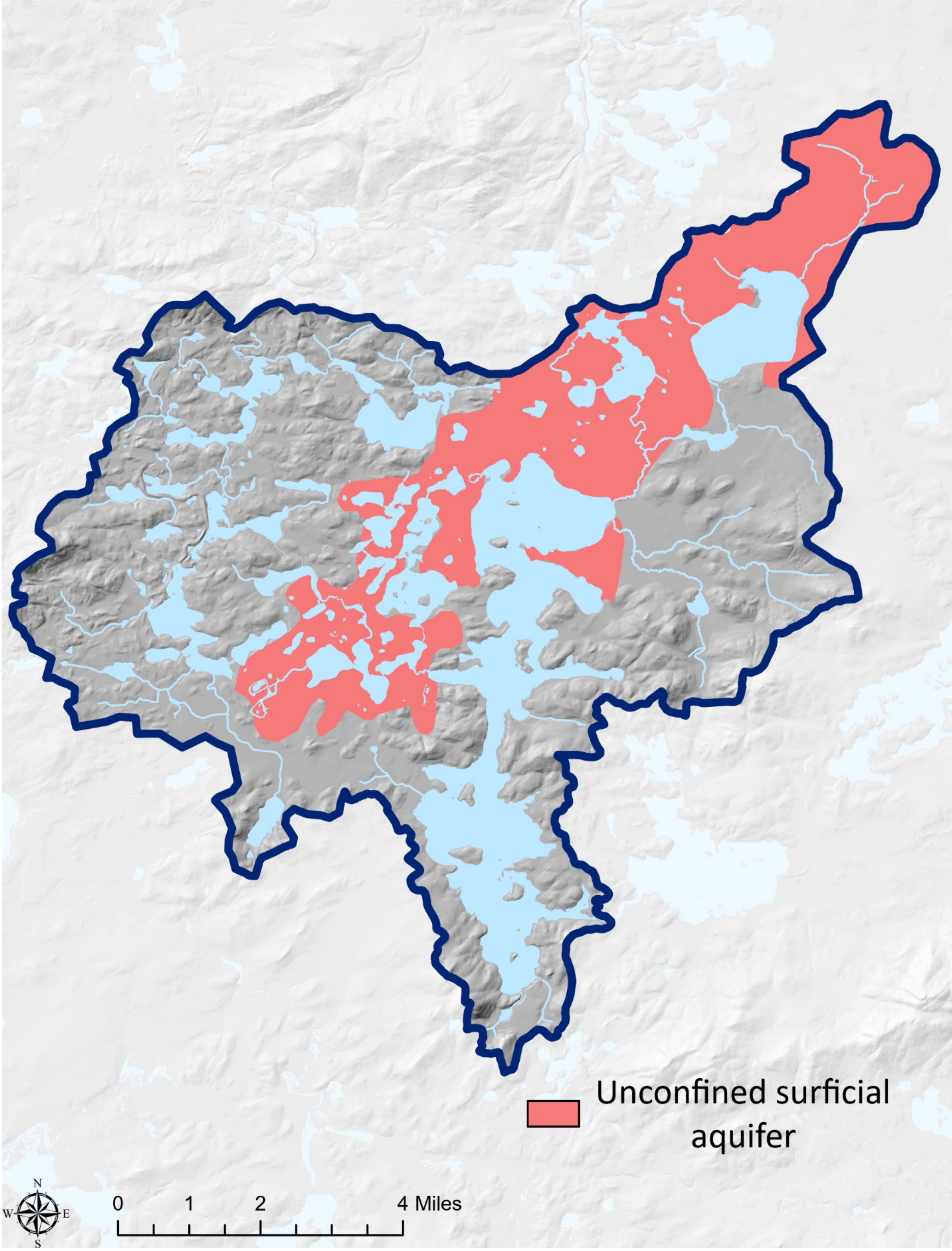
Map 3. Soil parent materials.



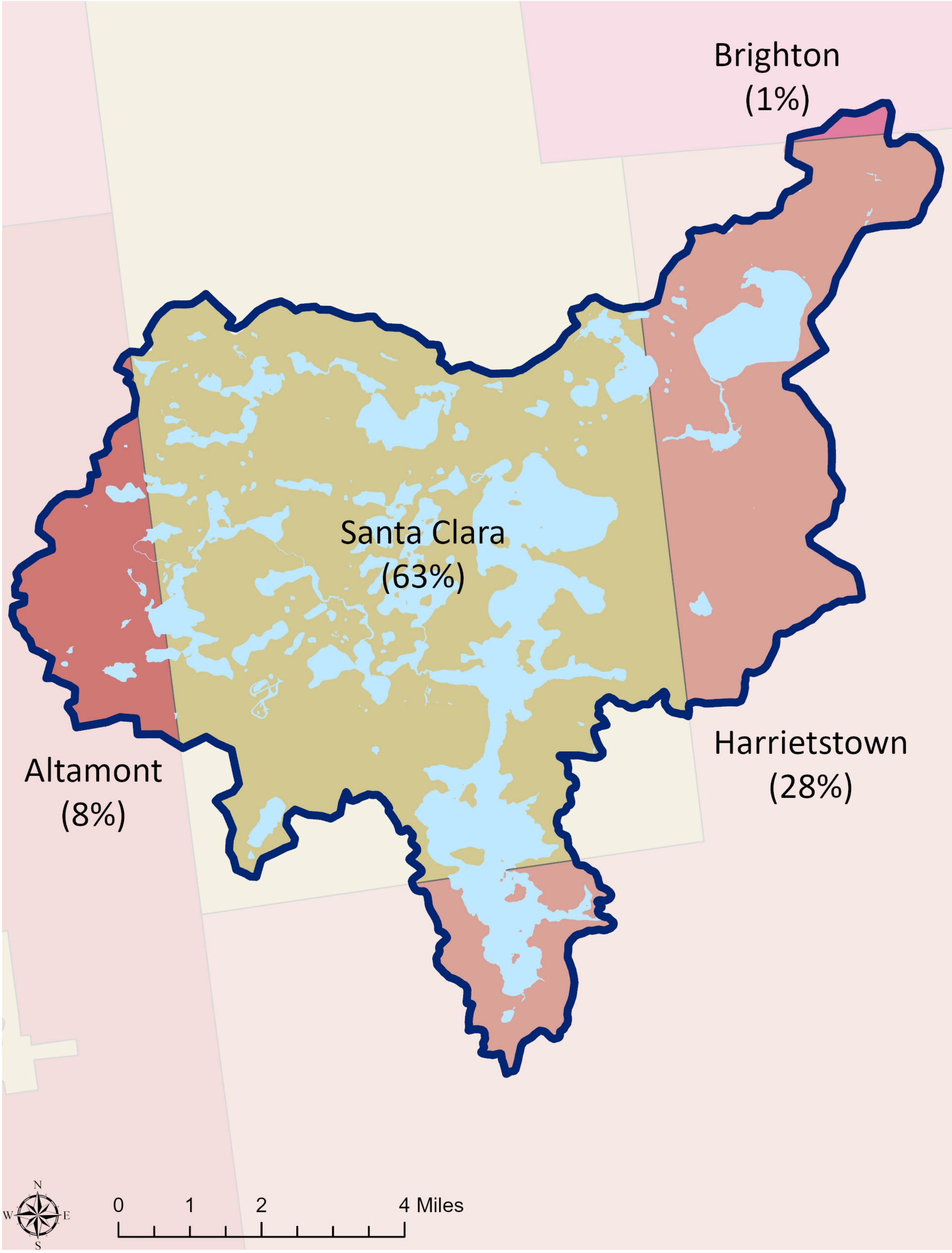
Map 4. Soil drainage classes.



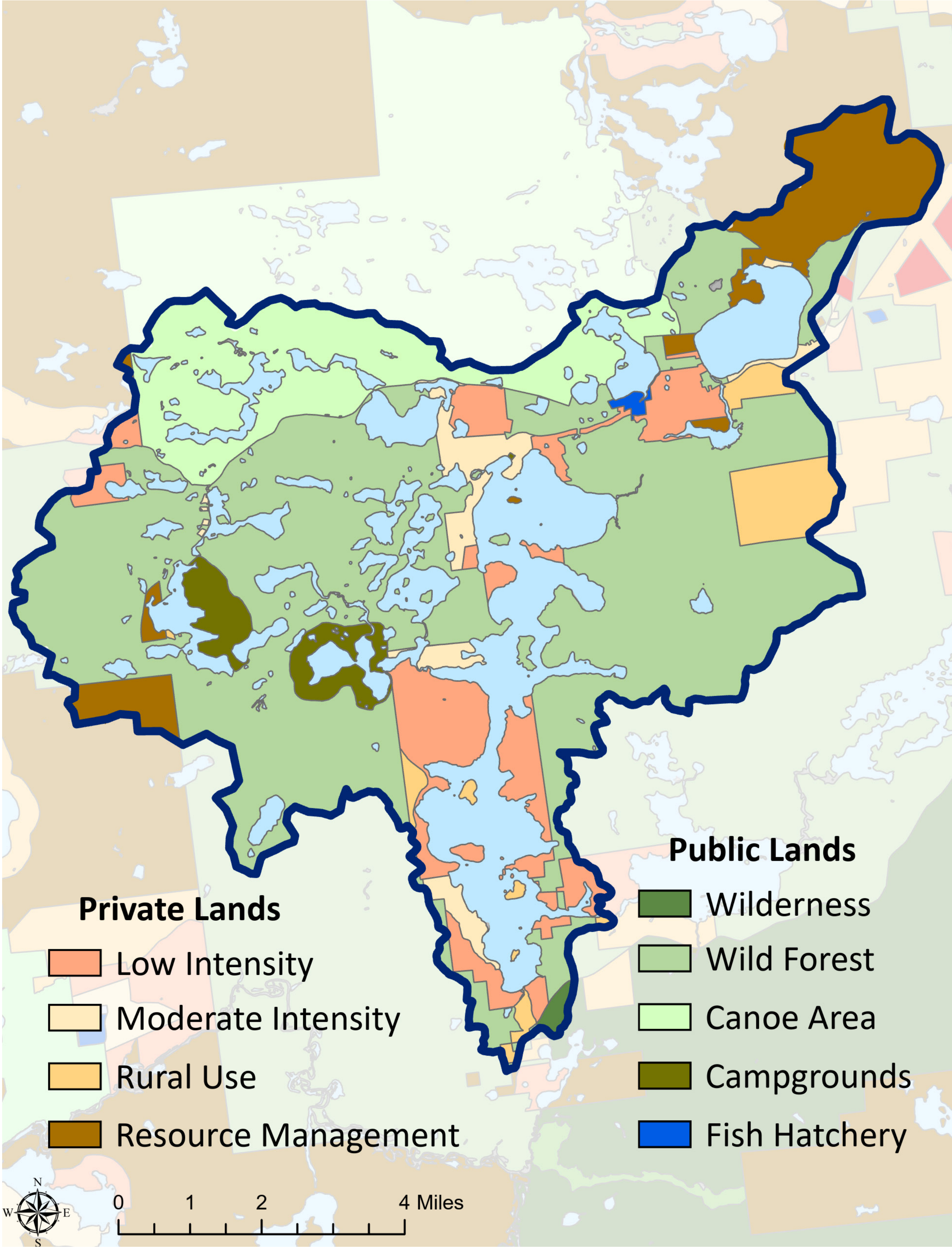
Map 5. Unconfined surficial aquifer.



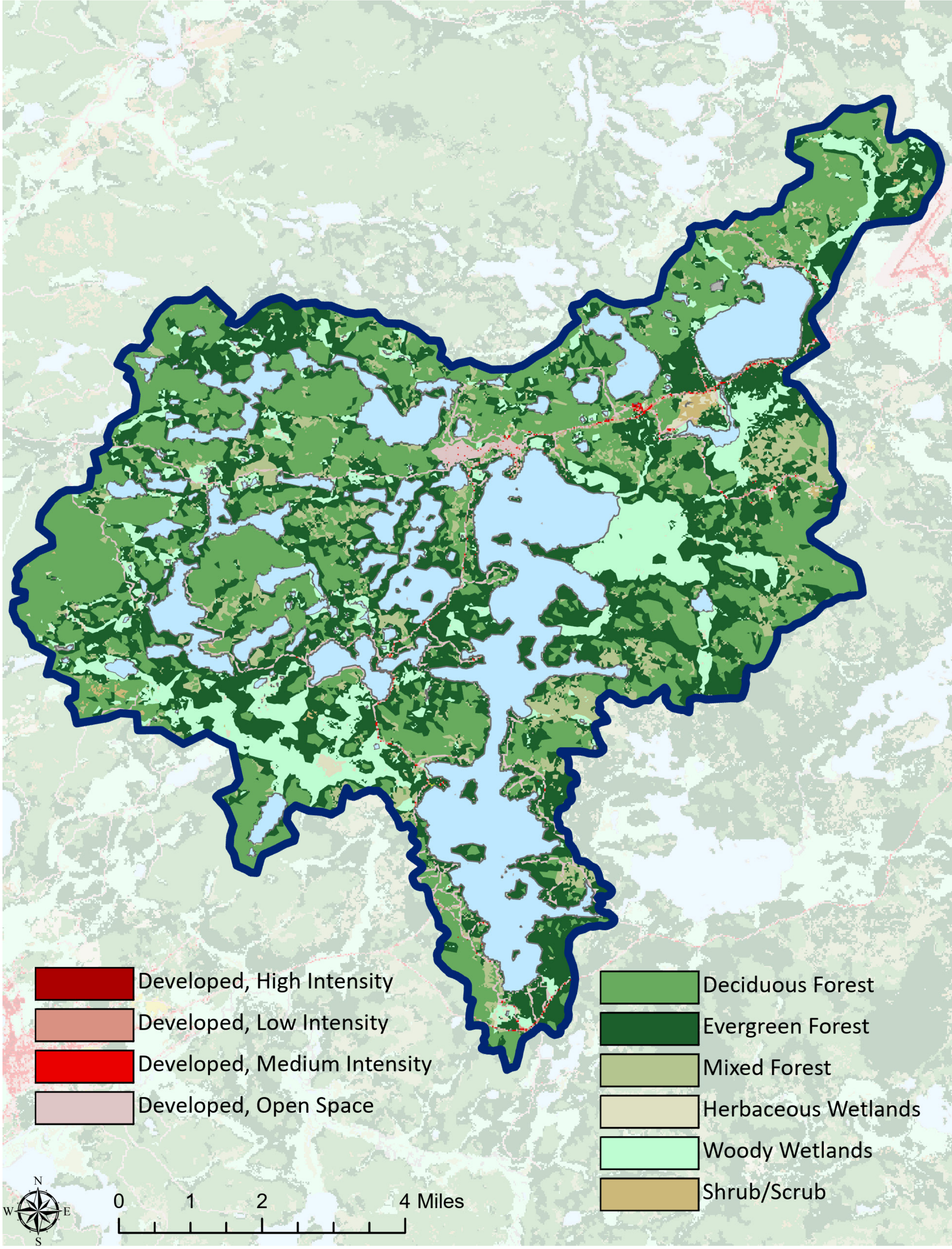
Map 6. Municipal boundaries.



Map 7. APA Land Classifications.

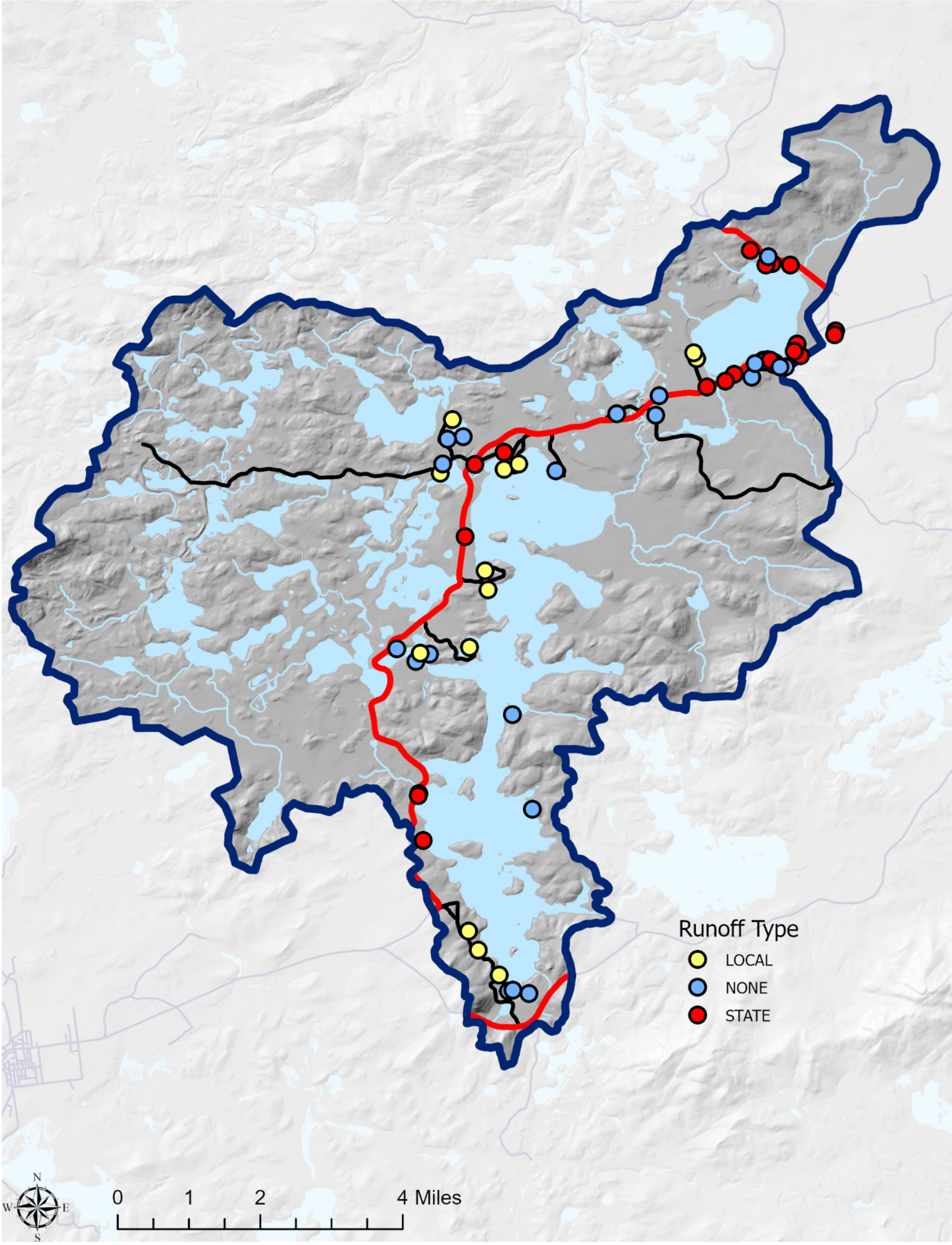


Map 8. Land cover types.

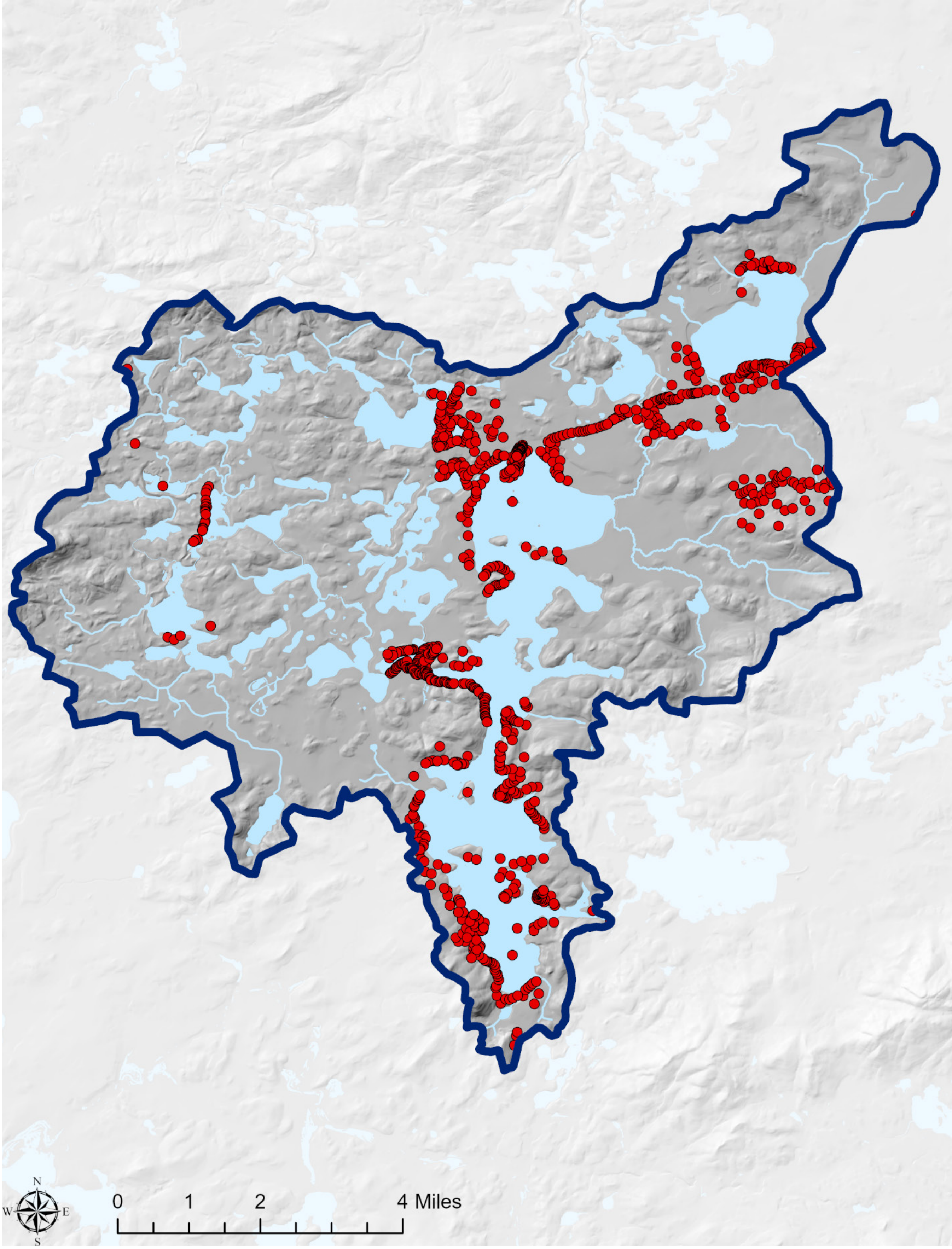


Map 9. Recreational features.

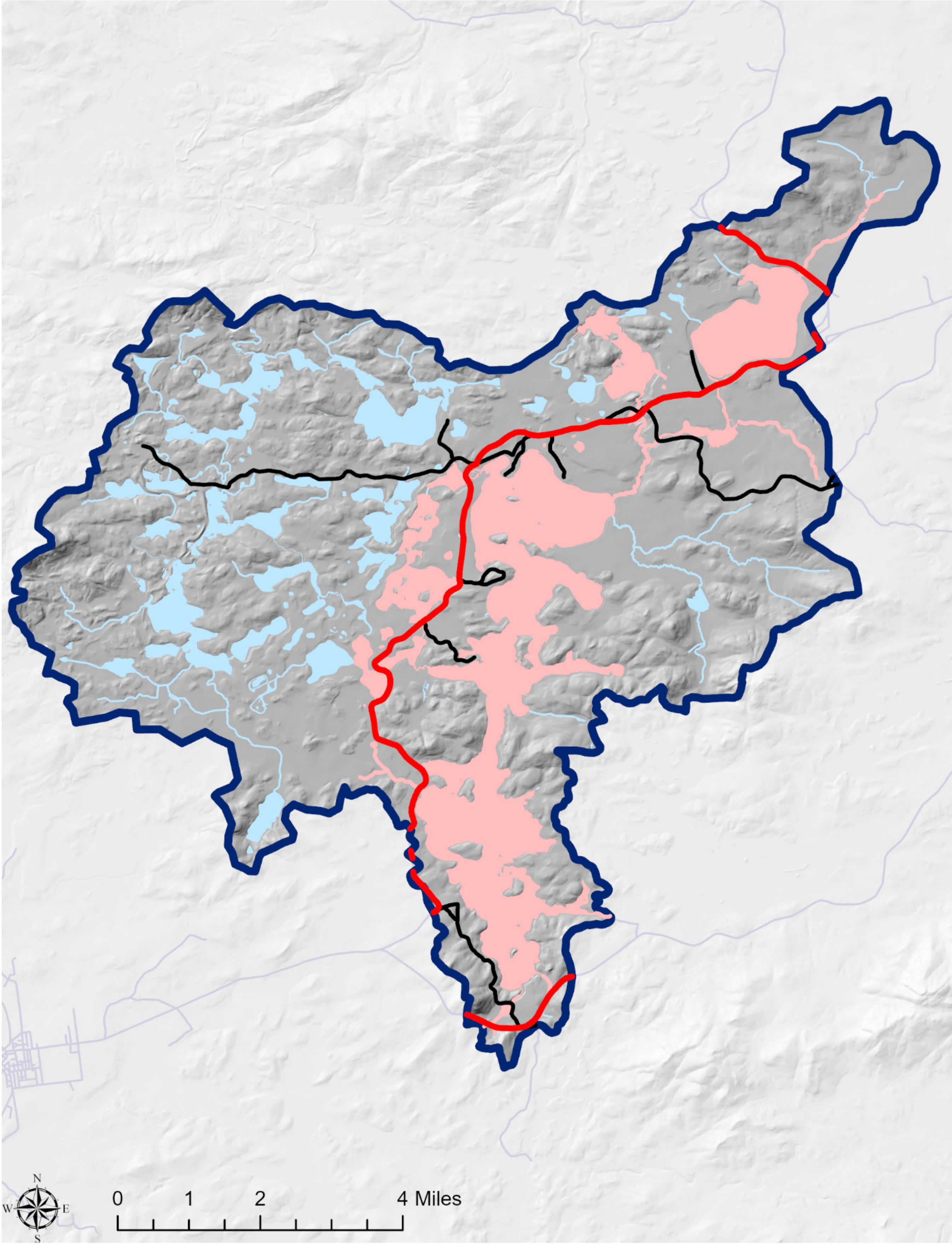
Map 10. Private wells tested in the watershed.



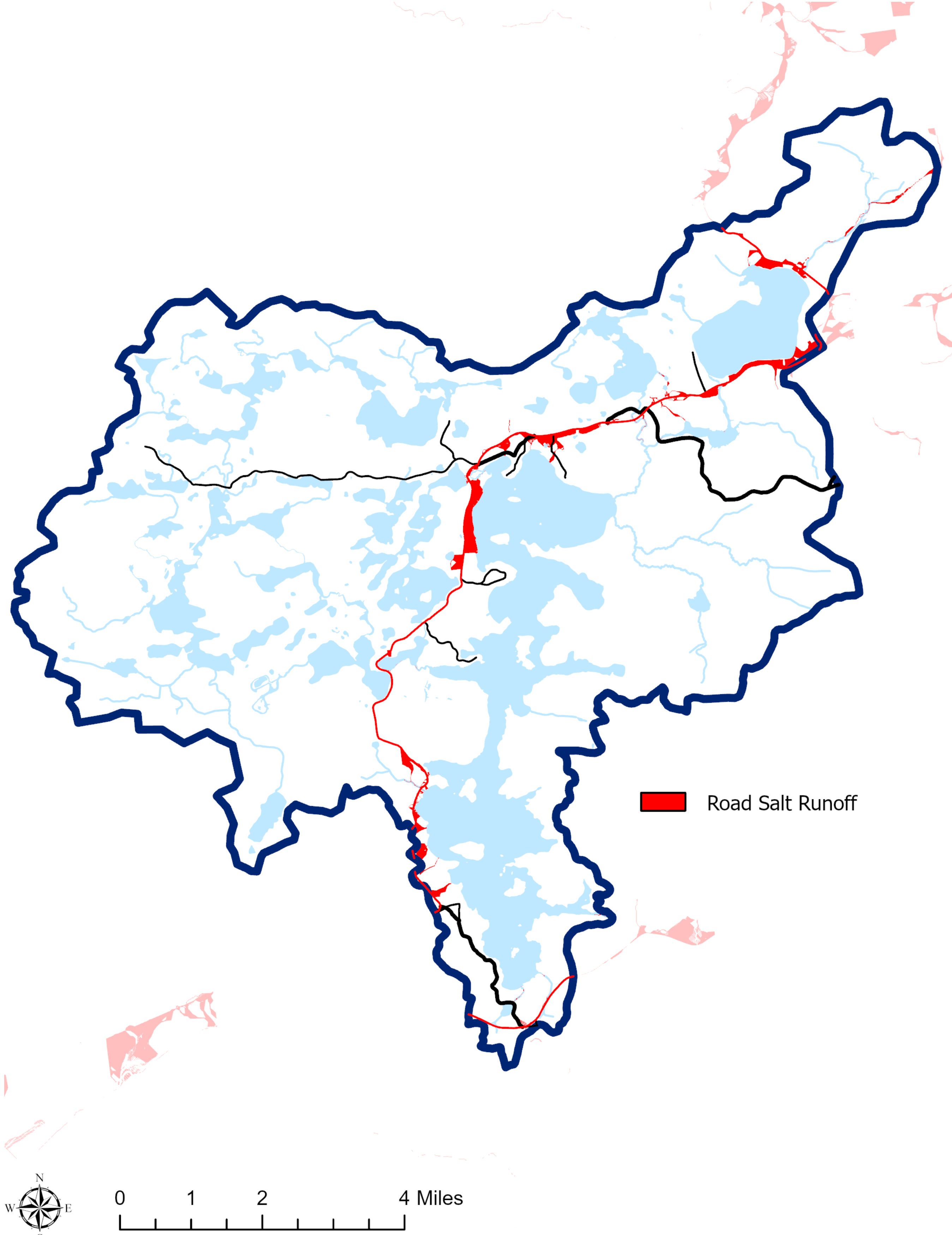
Map 11. Locations of septic systems.



Map 12. Surface waters receiving chloride from state roads.



Map 13. Private lands receiving road salt runoff.



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13.6 Figures

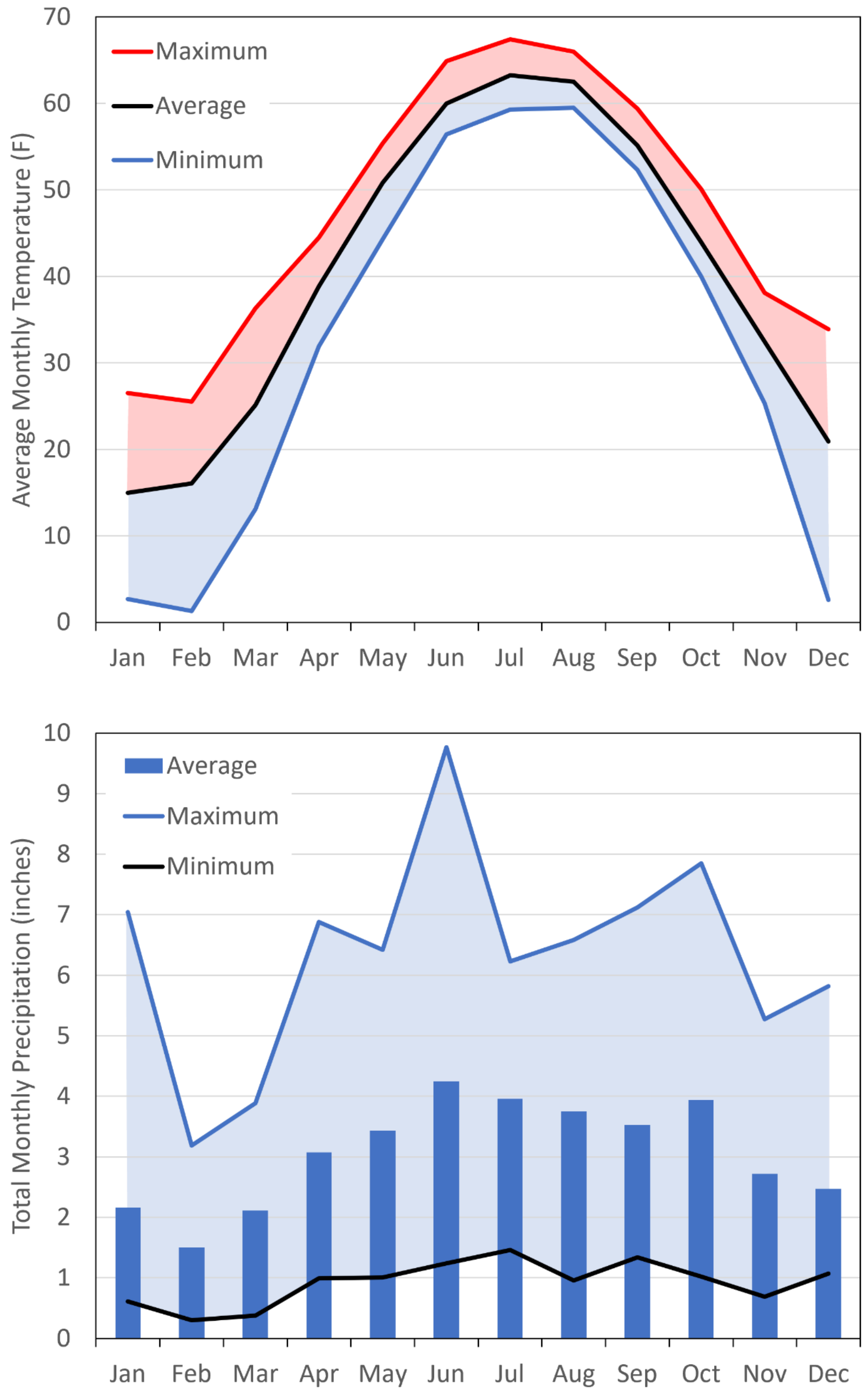
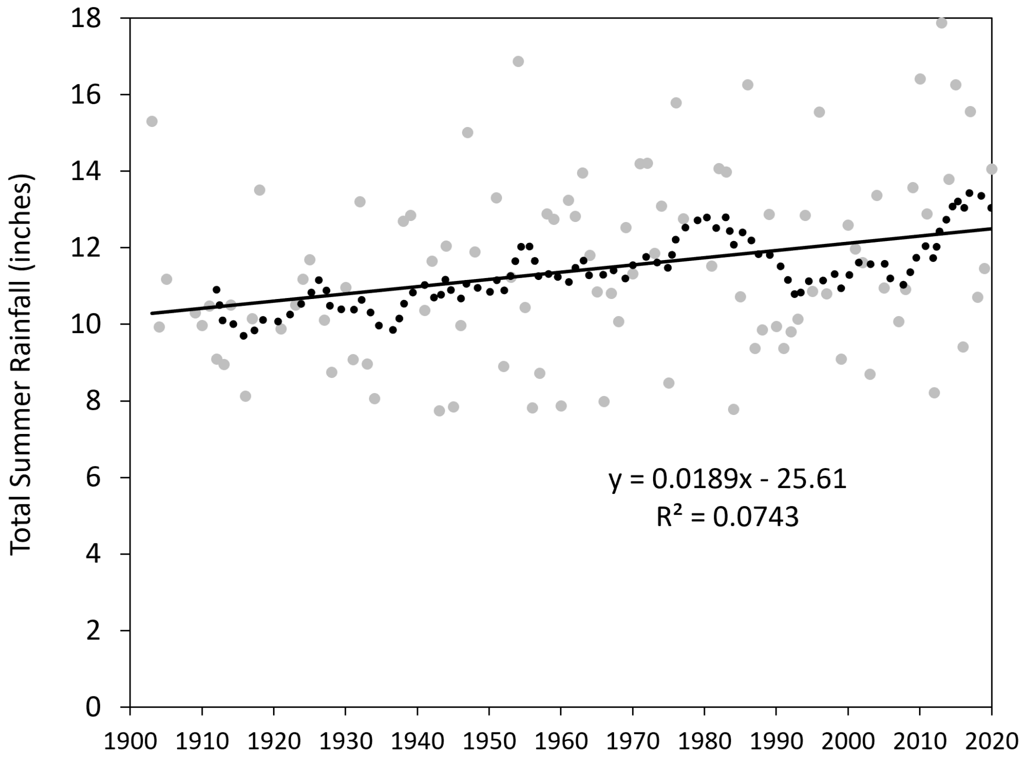


Fig 1. Average, minimum, and maximum monthly temperature and total precipitation.



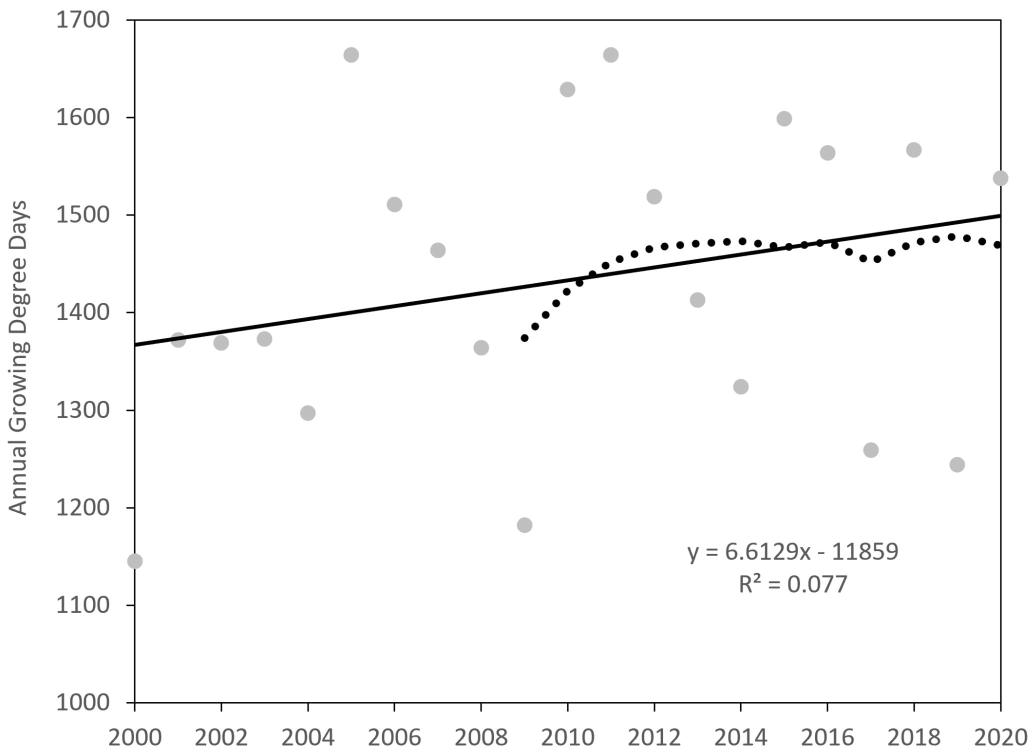


Fig 2. Long-term total summer rainfall and annual growing degree days. Solid lines are trends and dotted lines are 10-year rolling averages.

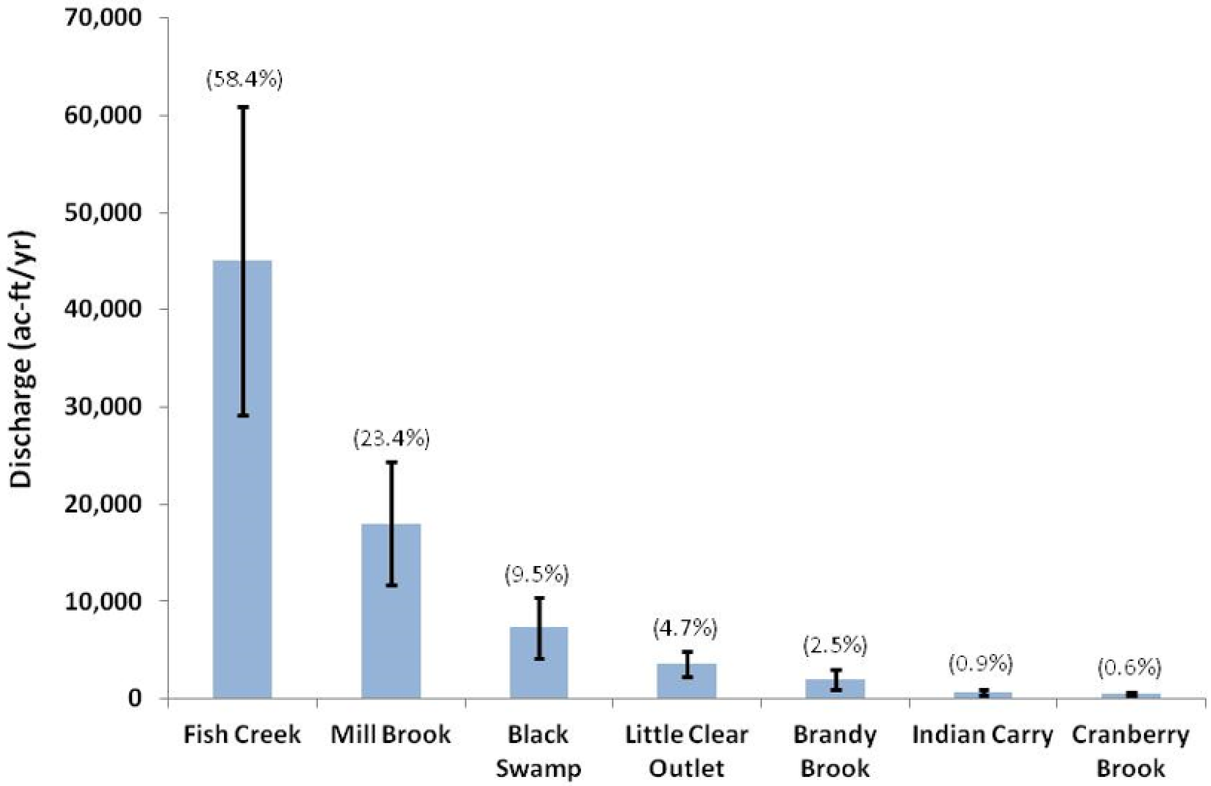


Fig 3. Average annual discharge of water from each measured tributary in acre-ft per year, determined from 2007 to 2013 hydrographs. Vertical bars are one standard deviation of the mean. Numbers in parentheses above each bar are the percent of total stream discharge attributed to the stream (from Kelting and Laxson 2014).

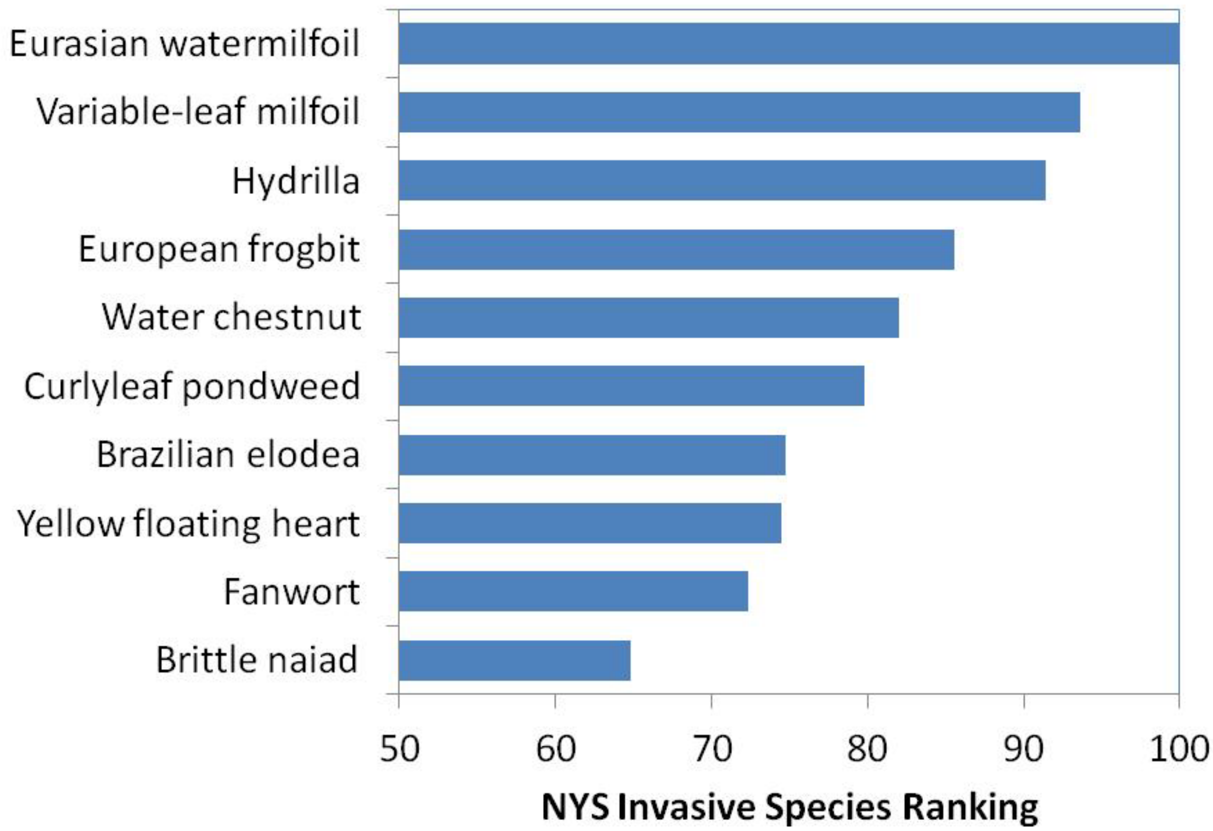


Fig 4. New York State Invasive Species Rankings for invasive aquatic plant species of concern.

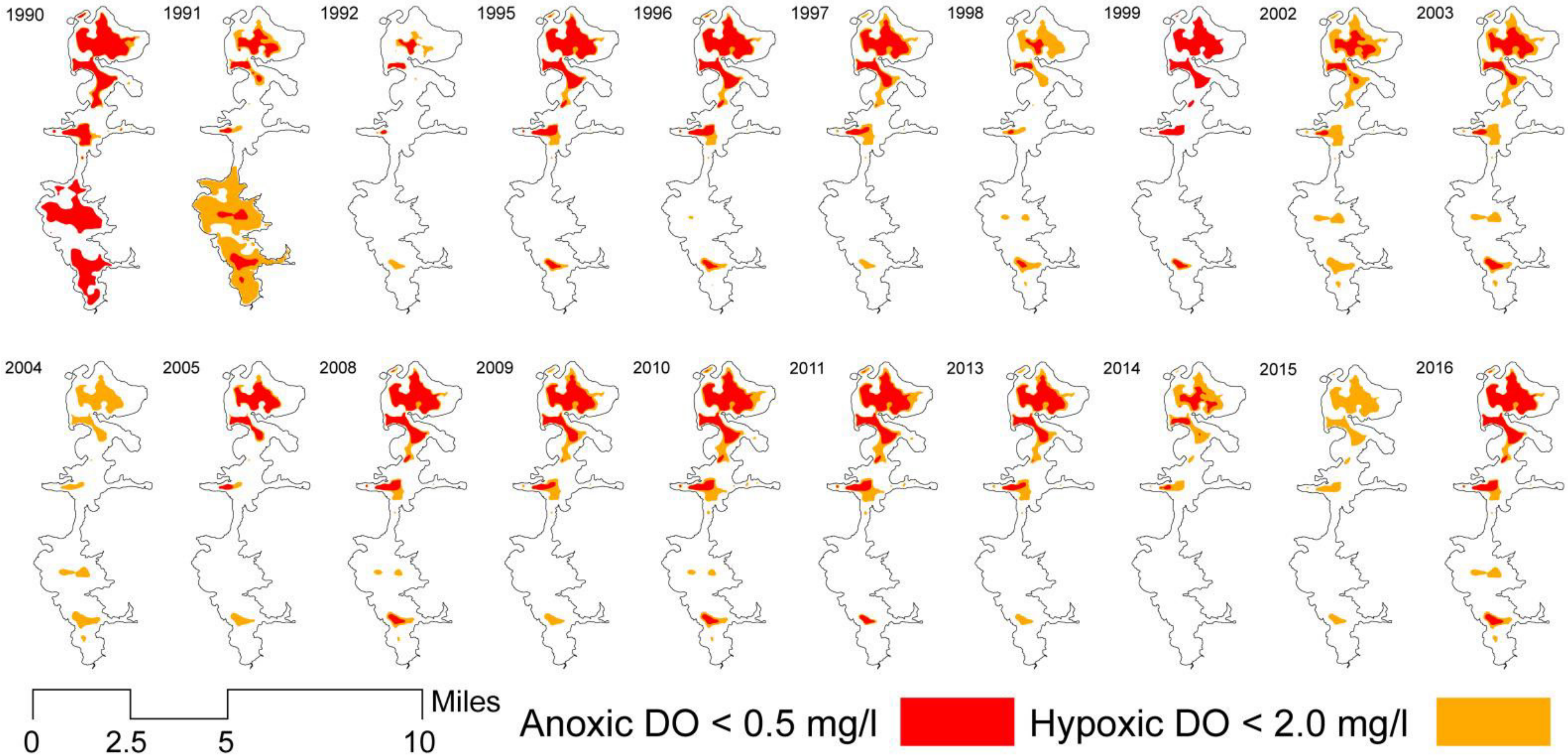


Fig 5. Aerial extent of anoxic and hypoxic zones estimated annually from dissolved oxygen profiles from 1990 to 2016 (from Laxson et al. 2018).

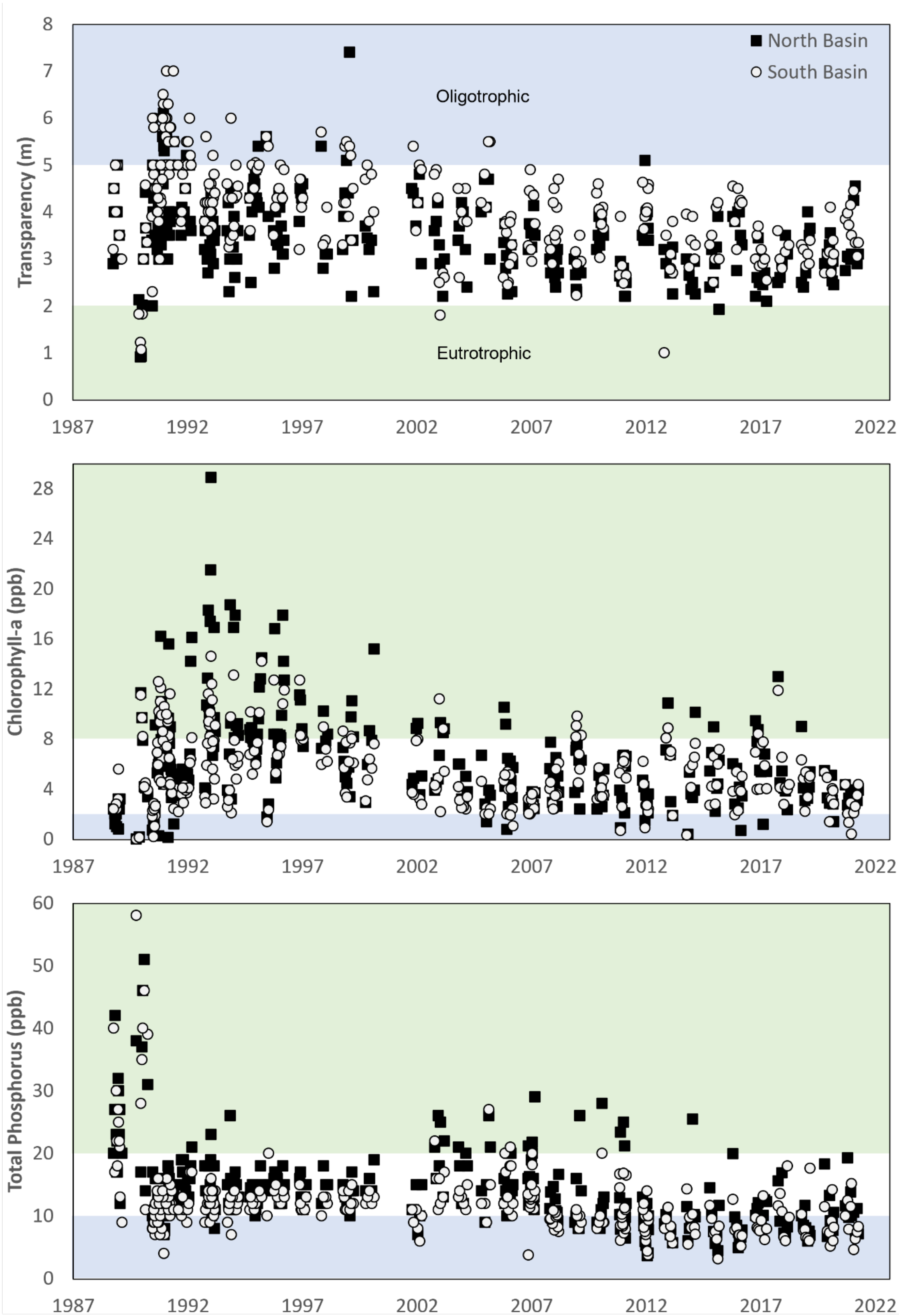


Fig 6. Long-term trends in secchi transparency, chlorophyll-a, and total phosphorus in the north and south basins of Upper Saranac Lake.

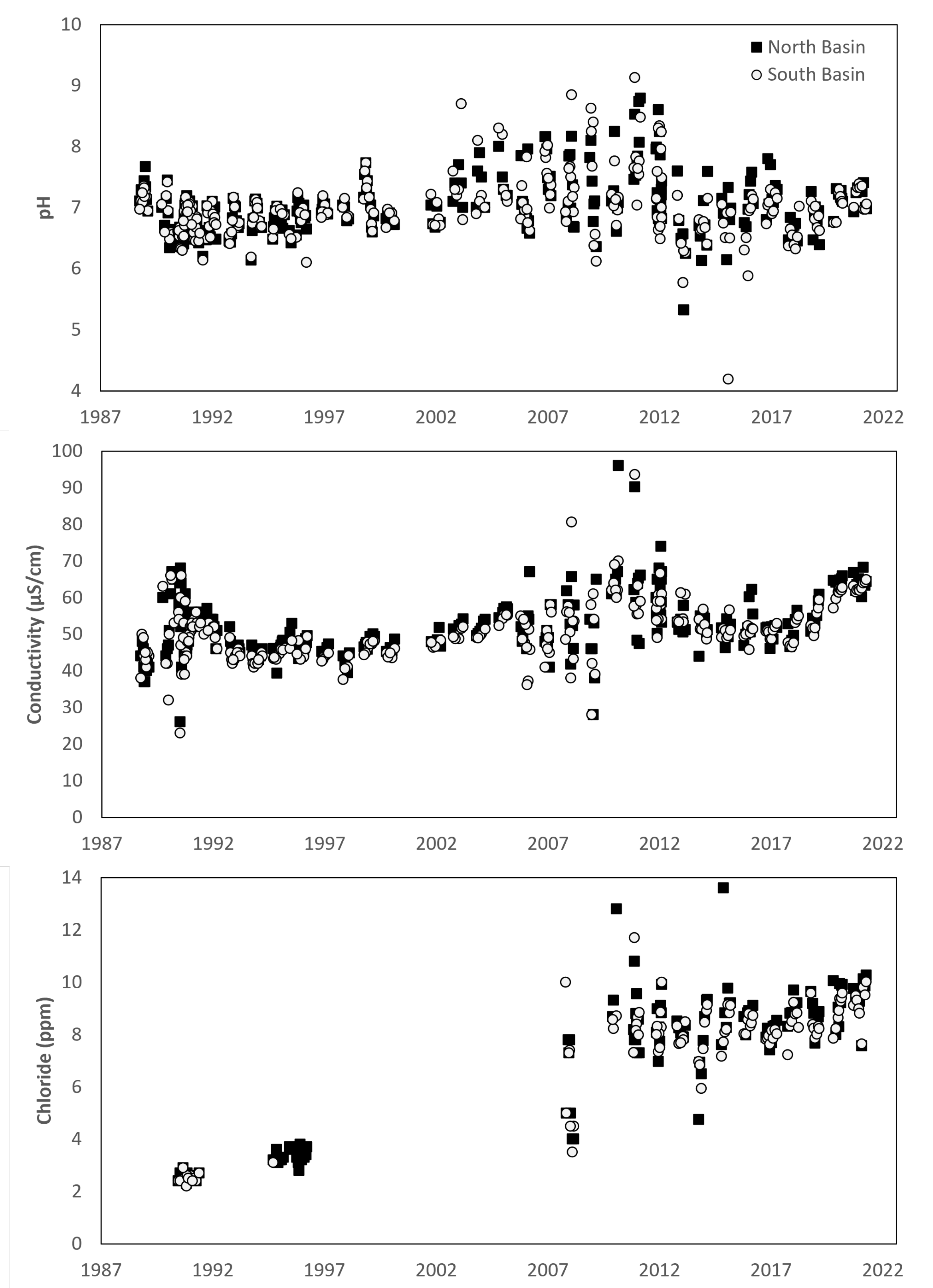


Fig 7. Long-term trends in pH, conductivity, and chloride in the north and south basins of Upper Saranac Lake.

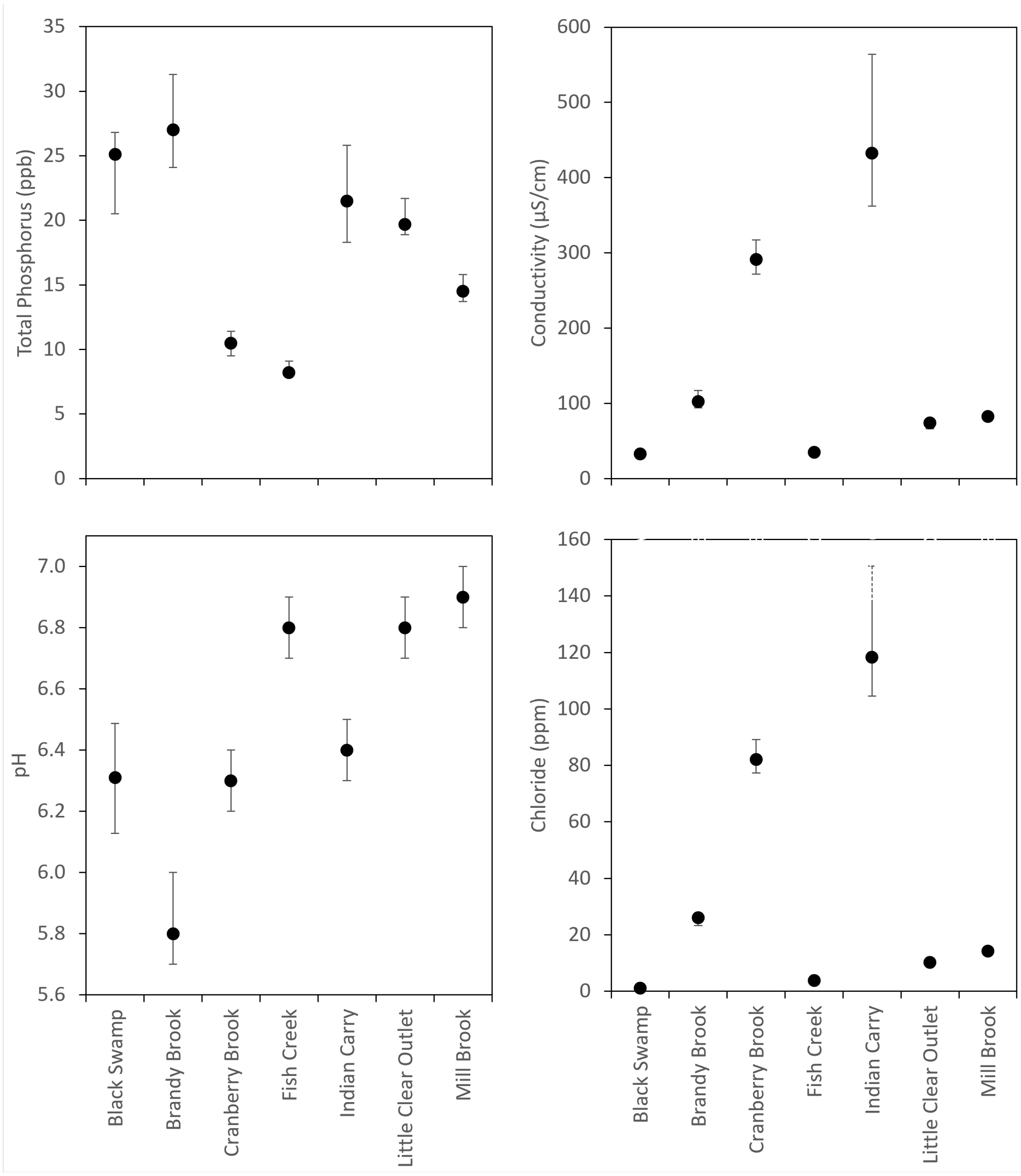


Fig 8. Median total phosphorus, conductivity, pH, and chloride concentrations in the tributaries to Upper Saranac Lake. Vertical bars represent +/- 95% confidence intervals on the median.

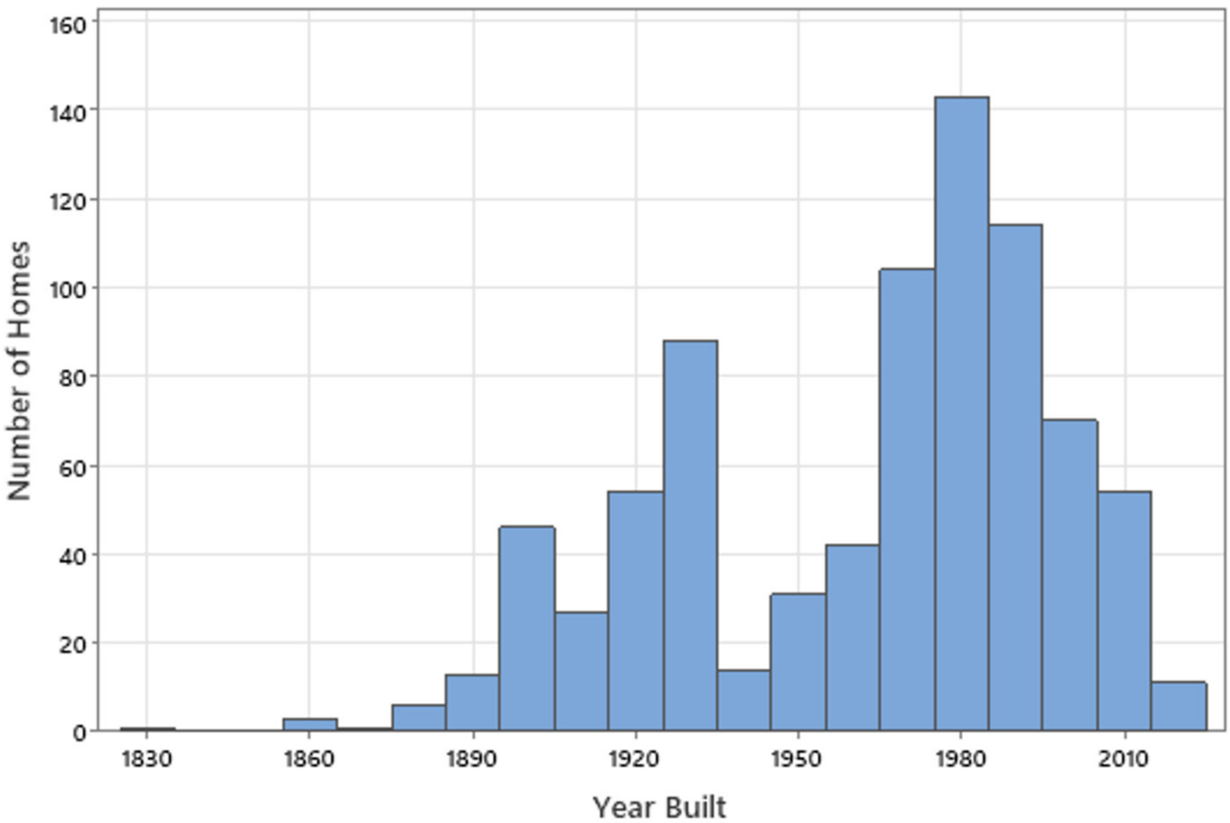


Fig 9. Frequency distribution of the number of homes built by year in the Upper Saranac Watershed (data source, Office of Real Properties).

13. Appendices

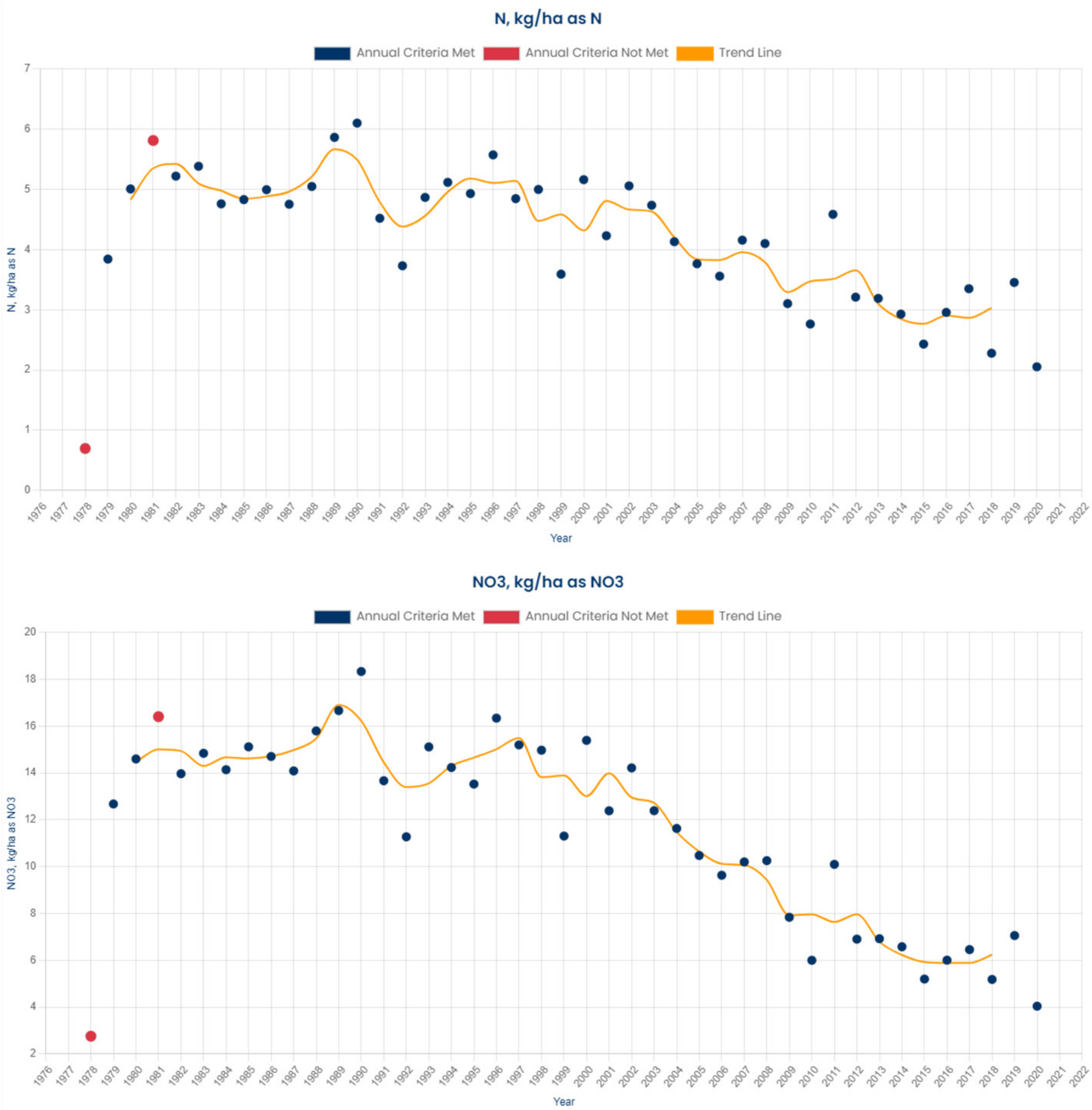


Fig 10. Long-term atmospheric deposition trends for total nitrogen and nitrate for the monitoring station located in Newcomb, New York (data source, National Atmospheric Deposition Program).

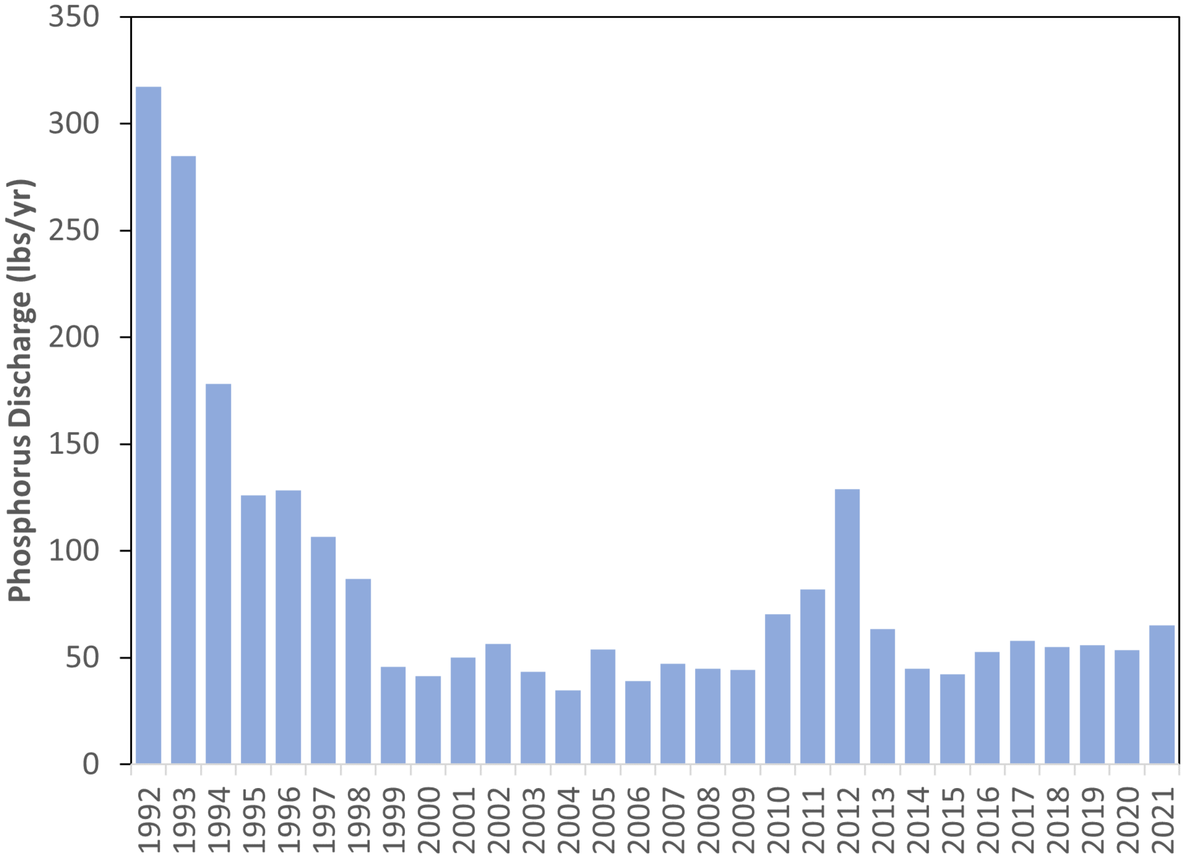


Fig 11. Annual phosphorus discharge reported from the Adirondack Fish Culture Station located at the outlet of Little Clear Pond.

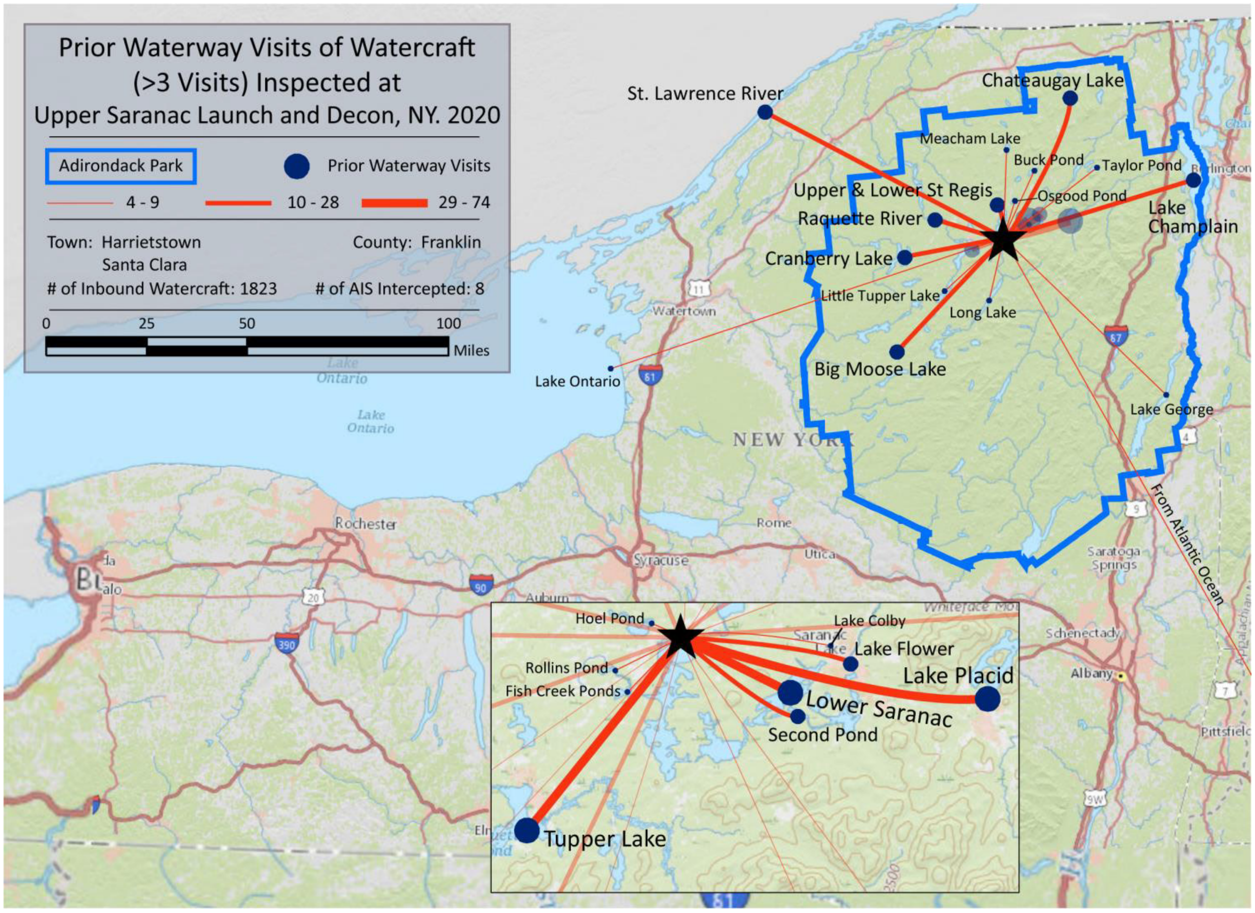


Fig 12. Vectors showing prior waterbodies visited by boaters launching at Back Bay in 2020.

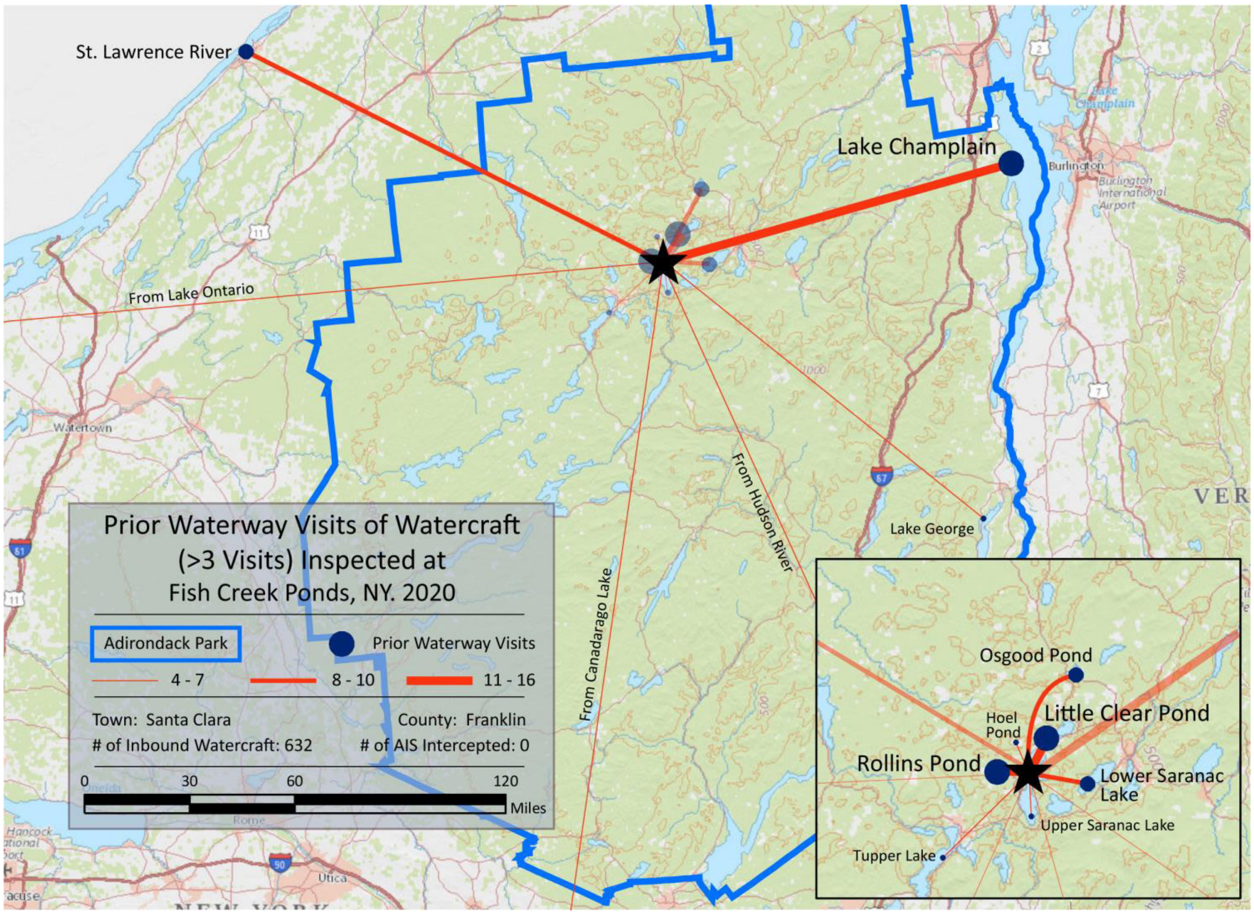


Fig 13. Vectors showing prior waterbodies visited by boaters launching at Fish Creek Pond Campground in 2020.

13.7. Summary of Public Comments

In addition to the comments provided during the public meetings, project leaders received 23 public comments via email.

On-site wastewater treatment: There were a significant number of comments and questions related to the impacts of onsite wastewater treatment (septic) on the water quality of the lakes. Many comments referred to replicating local ordinances and voluntary homeowner programs that are being implemented elsewhere (e.g. Warren County). Some people were in full support of such programs; others questioned the feasibility and raised concerns about the cost of upgrades. There was a recommendation to keep records of repairs to wastewater treatment systems and to reach out to septic companies to provide group pump-out programs.

There are several recommendations related to on-site wastewater treatment systems identified in this plan, including (1) Inventory on-site wastewater treatment systems in the watershed, identify locations of greatest concern and reach out to homeowners to further understand potential issues (2) Evaluate model ordinances and established voluntary programs that support upgrades and replacement of on-site wastewater treatment and consider adopting them in the watershed (3) Create a mailing to send to homeowners with information about maintaining and upgrading on-site septic wastewater treatment systems (4) Work collaboratively with NYS DEC to ensure that all SPDES permitted facilities are in compliance with the terms and conditions of their permit

Upper Saranac Lake Environmental Monitoring Platform: There were a couple of questions about the Monitoring Platform. An overview of the platform and access to real-time data can be found at usfoundation.net/programs/water-quality/usl-environmental-monitoring-platform/. The Upper Saranac Foundation website provides access to annual water quality reports usfoundation.net/programs/water-quality/ and the 2018 State of the Lake Report and Water Quality Database: usfoundation.net/programs/lake-science.

Ongoing threats and issues:

Members of the public submitted comments expressing their concerns about the future of issues, including:

- Maintaining the dam at Bartlett Carry
- Reducing road salt and mitigating ground and surface water contamination
- Upgrades to Fish Creek campground
- Upper Saranac Lake Marina expansion
- Preventing shoreline erosion
- Increased watercraft activity on the lake

Upper Saranac Foundation continues to work on most of these issues, some in more depth than others. For example, USF works with some of the youth camps to discuss the impacts of watercraft activity and explore solutions such as varying locations of their watercraft activity and avoiding activity too close to shore and docks. The Foundation has hired a professional Engineer to oversee ongoing dam related projects and assist in preserving our Dam. USF developed and implemented an Inspection and Maintenance Plan for the dam and conducted routine safety inspections. USF is also currently pursuing funding to conduct the needed maintenance on the dam. USF works with partner organizations and agencies to stay abreast of the ongoing threats to the watershed and looks for opportunities to find solutions. A link to the Foundation's ongoing programs is found at usfoundation.net/programs/.

These issues are identified in the plan and can be found in the Implementation Table and Recommendation Summary.

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