Lake Saint Catherine Association

# Evidence-Based Decision-Making: 1978-2018

**Understanding the science of:**

- **Measuring Water Quality**
- **Protecting the Watershed**
- **Mitigating/Abatement of Invasive Species**
- **Cultivating a Healthy Ecology for Fish and Wildlife**
- **Promoting Recreational Safety**

**By: Philip Hicks, with contributions from LSCA Trustees**

# I. Introduction

**Purpose of the Report**

The intention of this report is to highlight the tireless work that the Lake St. Catherine Association (LSCA) has done in the last forty years through the analysis of historical data and examination of its methods of quality control as they relate to the best management practices of the Vermont Department of Environmental Conservation and the Federation of Vermont Lakes and Ponds. We will examine the current status of the environment and ecology of Lake St. Catherine, as well as the strategies LSCA is utilizing to ensure the quality, safety and health of the Lake community during the 2018 season. Keeping the past techniques and current status of the Lake in mind, we will explore how LSCA aims to move forward to continue protecting Lake St. Catherine in the future.

**This report is divided into five chapters:**

I. Introduction
II. Water Quality and the LSC Watershed
III. Invasive Species Mitigation and Abatement
IV. Fish and Wildlife Protection
V. Recreational Use and Safety
VI. Watershed Protection

We will examine each focus area through the past, present and future work of the Lake St. Catherine Association to create a comprehensive, data-driven resource that LSCA can use to substantiate their efforts, demonstrate how science and therefore the strategies of LSCA have evolved, and share with other Lake associations and state officials. The three sub-sections are entitled: Past Interventions, Current Snapshot and Future Considerations.

**Process Undertaken and Data Sources (Quantitative and Qualitative)**

This report was written using a variety of evidence-based and science-driven resources, and serves to act as a compendium of internal and external reports. This report contains substantial data and information from the Vermont Department of Environmental Conservation, including but not limited to the Lay Monitoring Program data, the Spring Phosphorus Program data, the Checklist of Lake Protection Acts, and the Shoreland Best Management Practices. This report also utilizes minutes from past meetings of the board of trustees of the Lake St. Catherine Association, LSCA newsletters, and other historical documentation of the association that contains important information concerning the past actions and interventions that the group has performed. Data relating to the management of Eurasian Watermilfoil on Lake St. Catherine comes from the contractors hired to perform these management actions, including the annual reports from the association's herbicide treatment contractor, SOLitude Lake Management (previously Aquatic Control Technology). Finally, this report was constructed with the aid of one-on-one interviews and testimonials from a governance focus group consisting of individuals from the Board of Directors of the Lake St. Catherine Association (see Appendices 18, 19 & 20). It is essential that this report be based in scientific evidence, historical analysis, confirmation of data, and first hand observation.

**Expected output:**

- A central compendium of quantitative and qualitative information
- Potential message points for use with external constituencies
- Comprehensive information for use in LSCA communication vehicles
- A briefing book for new LSCA Board Members

**History of the Lake St. Catherine Association**

First, it is important to chronicle the history of the Lake St. Catherine Association to establish the roles and responsibilities of the organization on the Lake, and how they have changed to meet the needs of the community. A Lake association on Lake St. Catherine had initially been started in 1918, but quickly lost steam as interest faded in the 1920's. There was a resurgence in interest after residents of Lake St. Catherine heard about the Lake Dunmore Association and learned more about its work in the 1950's. On August 21, 1953, individuals from Lake St. Catherine moved to sign Articles of Association for a Lake St. Catherine Association in Poultney, Vermont. The original purpose of the organization was defined as "...encouraging and promoting the development and beautifying of the grounds, cottages, beaches and roads of privately owned homes and cottages on or near Lake St. Catherine." (Historical Scrapbook)

Since its inception, the purpose and goals of the Lake St. Catherine Association have evolved. As approved by the LSCA in July of 1997, the purpose was redefined as "...a public charity to receive donations, grants or contributions and to utilize its income and assets for the preservation, protection and maintenance of Lake St. Catherine." Its purpose was also to include "...education on environmental issues affecting Lake St. Catherine and its watershed areas, testing of water and soil for pollution, and mitigation and/or removal of harmful materials, substances or plants in or upon Lake St. Catherine so that the burdens of government in these areas are lessened." (Lake St. Catherine website, Bylaws)

In 2010, LSCA changed its by-laws to include the charitable, educational, environmental and scientific activities that are the principal components of its mission in the 21st century. In 2011, the state of Vermont recognized the corporate changes and helped initiate the process of applying to the Internal Revenue Service for a change of tax status from 501(c)(4) to 501(c)(3). Effective August 21, 2012, LSCA was re-classified as a public charity and became exempt from Federal Income Tax under 501(c)(3) of the Internal Revenue Code.

LSCA began as a homeowners association, focused on the maintenance of Lake properties for Lake residents and the development of the Lake grounds. However, the evolution of its purpose as well as its new designation as a public charity redefined its role on the Lake. LSCA had to expand its funding base in order to keep the Lake community safe and healthy for everyone who enjoys the Lake, not just the homeowners. LSCA transitioned from a homeowners association to having a greater environmental purpose, which is demonstrated through its environmental consciousness and exhaustive efforts to maintain the quality, safety, and recreational value of the Lake, as well as education of the public, which we will explore throughout this report.

It is important to note that everyone associated with the Lake St. Catherine Association is a volunteer. There are 15 trustees. Membership and the dues and contributions we receive allows LSCA to accomplish its work, as maintaining the Lake costs approximately $100,000 annually. Annual grants from Poultney, Wells, and the State, membership dues and contributions make up the majority of funding.

**Functions of the LSCA**

LSCA oversees the preservation, protection and maintenance of Lake St. Catherine in its entirety. Examples of its functions include:

- Maintaining and purchasing navigation and shoreline protection buoys on the Lake.
- Testing the water for E coli, and water clarity, including weekly lay monitoring collecting samples for phosphorus and Chlorophyll tested by the State of Vermont.
- Managing the free Boating Safety courses that are state mandated for all persons born after January 1, 1974.

- Inspecting boats wishing to enter the Lake for milfoil, zebra mussels and water chestnuts (and other invasives as they become a threat).
- Controlling milfoil (and other invasive species) while maintaining native weeds at tolerable levels.
- Working with the state to solve the problems of silting and impacts of phosphorus and other sources of pollution.
- Maintaining “welcome” signs and gardens.
- Liaising with other Lakes in order to exchange information.
- Sponsoring the annual fun-filled July 4th Boat Parade.
- Sharing information with our membership and the community via newsletters, LSCA website, social media, and local publications (see Appendices 21 & 22).
- Organizing funding through membership fees, donations and grants from the State of Vermont, Towns of Poultney and Wells.
- Representing the Lake at state and local entities
- Protecting the value of property by maintaining the beauty, access, & safety of the Lake.
- Working in partnership with DEC and the Towns obtaining permits to do the work

# II. Water Quality and the LSC Watershed

**Background**

**How does DEC measure the performance of Lakes in Vermont?**

The Vermont Department of Environmental Conservation has created a system for individuals to better understand the current status of a Lake, see its trends, and compare it to other water bodies in the state of Vermont. The Vermont Inland Lake Score Card is "a user-friendly interface developed by the Vermont Lakes and Ponds Management and Protection Program (VLPP) to share available data on overall Lake health with Lake users." The Score Card takes into account four key aspects of Lake health: nutrients; aquatic invasive species; shoreland and Lake habitat; and mercury pollution. Throughout this report, we will use these four Lake characteristics to guide our discussion of the quality, safety and health of Lake St. Catherine. It is important to recognize, however, that this score card does not tell the entire story of the Lake and we should not depend on the score card as our sole resource in our analysis of the Lake. We must also consider trends of improvement, comparisons with other similar Lakes, and the specific context in Wells and Poultney. Moreover, the approval by DEC of a Lake's Grant-in-Aid permit process is an indication of trust and support of a Lake's strategic direction.

In our first focus area of water quality and watershed protection, we will touch upon three of the four indicators included in the score card: nutrients, shoreland and Lake habitat, and mercury pollution. These three measurements have large impacts on water quality, and the protection of the Lake's watershed can improve and maintain healthy levels of these three indicators. First, we will discuss how exactly the nutrient levels, state of the shoreland and Lake habitat, and the extent of mercury pollution can affect water quality. Score cards for Lily Pond, Little Lake and Lake St. Catherine are found in Appendix 1A, 1B, 1C

## Past Interventions

A water column's nutrient levels, or its total productivity, can be monitored through participation in the Vermont DEC's Citizen Lay Monitoring Program. The Lake St. Catherine Association has been a part of the Citizen Lay Monitoring Program (LMP) since its inception in 1979. The principal goals of this program are to "establish baseline water quality conditions, track long-term nutrient enrichment, and teach Lakeshore homeowners and Lake users about Lake ecology and stewardship." The nutrients that indicate productivity are measured over time through the Lay Monitoring Program to establish trends and better understand the water quality of a Lake. The program trains and equips the volunteers, or lay monitors, to conduct periodic Lake water quality sampling from their boats using quality assured methods. A minimum of eight samples must be collected in order to calculate a summer mean. According to the most recent Lay Monitoring Program Manual, many measures of quality assurance are taken by the DEC to ensure that all samples are collected and tested properly. The DEC provides the same equipment for all monitors, all lay monitors are trained by DEC personnel, and there are on-Lake quality control checks of all monitors by program assistants each summer.

**What exactly does the Lay Monitoring Program measure, and how do the measurements indicate water quality?**

**Phosphorus:** Phosphorus is the most limited nutrient present in Vermont Lakes that algae require to grow, and is therefore often a determinant of the extent of algal growth. Phosphorus enters a Lake from a variety of sources, such as rainfall, incoming streams, overland runoff, groundwater, and direct discharges. Too much phosphorus will reduce clarity. To sample for total phosphorus concentration, lay monitors collect a water sample in a specially cleaned test tube and transported to the DEC laboratory for analysis. 2017 Summer Average in Vermont and Lake Champlain Regions - Appendix 5.

**Chlorophyll-*a*:** Chlorophyll-*a* is a photosynthetic pigment found in planktonic algae and serves as a good approximation for algal abundance in a Lake. Generally, water clarity decreases as Chlorophyll-*a* increases. To measure chlorophyll-*a*, a water sample is taken from the Lake at a specified location, and a certain volume of that water is then filtered. All of the algae and other suspended particles in the water collect on the filter paper, which is then analyzed in the laboratory for chlorophyll-*a* concentration. 2017 Summer Average in Vermont and Lake Champlain Regions - Appendix 6.

**Secchi depth:** Secchi disk measurements are routinely used to quantify the clarity of the water, which can be influenced by turbidity and the presence of planktonic algae. The Secchi disk is a 20 centimeter diameter metal disk with black and white quadrants. Attached to the center is a line measured and marked in meters. The weighted disk is lowered slowly straight down into the water and the exact depth just before the disk disappears from view is observed and measured on the marked line. This depth is known as the "Secchi disk transparency". Nutrient rich Lakes with high algal populations and suspended silt will have shallow Secchi disk readings. 2017 Summer Average in Vermont and Lake Champlain Regions - Appendix 7.

Through the Spring Phosphorus Program, scientists of the Vermont Lakes and Ponds Management and Protection Program (VLPP) collect phosphorus samples at spring turnover in Vermont Lakes. The resulting spring total phosphorus annual means represent the potential available phosphorus that will feed primary producers like aquatic plants and planktonic algae during the following summer. To reiterate, water quality in a Lake can be understood by the trends in its productivity, which are measured through indicators like phosphorus, chlorophyll-a and secchi depth. These prepared samples are analyzed in the DEC laboratory and catalogued to examine trends and produce the Vermont Inland Lake Score Card.

The Lake St. Catherine Association demonstrates a dedication to the maintenance of water quality through the participation in the Lay Monitoring Program and the Spring Phosphorus Program taken by (DEC / Watershed program), two essential actions on the DEC's Checklist of Lake Protection Acts. This Checklist provides guidance on actions that help protect Vermont Lakes and improve a Lake's Score Card. in Appendix 2 you will find the DEC's Checklist of Lake Protection Acts. Attached in Appendix 3A, 3B, 3C you will find all of the available Lay Monitoring Data for Little Lake and Lake St. Catherine, which goes through the end of the 2017 season. While there are some gaps in the measurements, the general consistency of data collection fares well for the health of Lake St. Catherine.

The lay monitor for Lake St. Catherine, Mary Jo Teetor, also conducts tests for e.coli in conjunction with the town manager of Poultney, going above and beyond what is required of the Lay Monitoring Program. It is worth noting that Lake St. Catherine has never had a positive reading for e.coli, and the association has been diligent about listening to the concerns and requests of Lake residents that the Lake be consistently tested for e.coli. Additionally, this collaboration with a local town official is another action that the Vermont DEC Lakes and Ponds Program suggests to protect the Lake.

**A Case Example of Successful Approach to addressing Cyanobacteria**

Cyanobacteria is a good example of how high phosphorus and chlorophyll-*a* concentrations can negatively impact water quality. Phosphorus feeds cyanobacteria, or blue-green algae, and chlorophyll-*a* is the pigment present in this type of algae. Natural and cultural sources can contribute to a cyanobacteria bloom, but in June 2018, the natural conditions in a man made channel connecting to Lake St. Catherine were perfect for an occurrence of cyanobacteria. There was a lack of rain, high temperatures, and a lack of water movement in the channel of the Lake leading from Halls Bay. While this cyanobacteria bloom did not bode well for the water quality of Lake St. Catherine for the summer 2018 season, the LSCA took the necessary steps to eradicate the bloom as efficiently as possible. Attached in Appendix 4 is the DEC Fact Sheet on Cyanobacteria. The LSCA reported to an emergency toxic spill task force who dispatched a crew to contain the bloom with containment booms, floating barriers to

bacteria blooms. Signs were posted to make property owners aware that children and pets should avoid contact with the blue-green algae blooms in order to ensure the safety of the recreational users of the Lake. By June 30, the LSCA was given the all-clear to remove the warning signs as the bloom had dissipated and the channel became safe for individuals to enter. A naturally occurring bloom was contained and eradicated in a matter of weeks, due to the association's diligence in monitoring the water body and maintenance of communication with the DEC. This demonstrates not only the knowledge of the members of the Lake Association, but its resolve to ensure the safety and quality of the Lake.

**Water Quality: The Intersection with Watershed Protection**

The main way for Lake Associations to control the nutrient trends and thus maintain water quality is through the protection of the watershed, shoreland and other Lake habitats. We can begin to understand these efforts through the Shoreland and Lake Habitat measurements collected in conjunction with the Spring Phosphorus Program conducted by VLPP scientists. The scientists select one site along the shoreline using GPS and use that location to place nine additional sites equidistant from each other around the Lake. At each site, various types of human disturbance are noted within a 15 meter by 15 meter plot on the shore immediately adjacent to the water. Types of disturbances include buildings, lawns, commercial activities, roads and railroads, powerlines, docks, dams or seawalls, trash or landfills, and agricultural activities. Runoff into the Lake from lawns, fertilizers, road culverts and construction sites all serve to encourage weed growth and silt accumulation.

The Vermont Inland Lake Score Card also provides a Watershed Disturbance score beyond the four main aspects of Lake health, which is derived from a landscape development intensity index (LDI). This is a measure of human-induced alterations to the biological, chemical and physical processes of a watershed's lands that impact the receiving water.

Although Lakeshore residents and owners ultimately have the responsibility for the majority of shoreland protection and runoff diversion, LCSA has taken steps to educate the residents of Lake St. Catherine and encourage the best management practices promoted by the Lake Wise Program.

First, LSCA collaborates with the Poultney Mettowee Natural Resources Conservation District (PMNRCD) and their Lake Education and Action Program (LEAP) to create mutual learning experiences and take action on Lake St. Catherine. College interns, with the assistance from PMNRCD, lead LEAP and set the curriculum. High school students provide the "work force" and are trained about potential Lake issues. Most importantly, the students then create a dialogue with landowners on the Lake about potential issues and solutions on Lake St. Catherine. Those same students also plant shoreline buffers and rain gardens, present solutions to property owners, conduct door-to-door outreach, and maintain older installations like rain gardens.

In July of 2017, LSCA members were invited to participate in a septic social, where local residents came to learn about septic systems on Lake-front property, how they work, their impact on the Lake, and more about alternative systems that can be used on small Lakeshore lots. This type of gathering is another action promoted by the Lakes and Ponds Program as a way to improve nutrient trends and shoreland conditions. In another effort to educate residents of Lake St. Catherine, LSCA collaborated with the Lake Champlain Sea Grant and the Vermont DEC to hold a Shoreline Erosion Control Workshop called "Protecting Property and Lake -- Be Storm Ready with Lake Friendly Practices". The workshop provided an opportunity for landowners to learn about natural approaches to protect and stabilize their shoreline, the Lake Wise program, and basic information about the Shoreland Protection Act.

The LSCA also has a blog on their website, an essential tool for educating the Lake community about ways to protect the Lake. On July 5, 2018, LSCA posted a blog entitled "Sharing the Edge: A Guide for Lakeshore Property Owners in Vermont" in which LSCA shared this new guide published by the Vermont DEC.

LSCA has really prioritized educating Lake residents about the importance of buffer plantings on their properties, creating informational handouts, including advice in the LSCA newsletters, and presenting the same information at Lake wide meetings. In fact, LSCA has collaborated with local organizations to offer free plantings to residents on the Lake. Again, it remains in the hands of individual property owners to protect the shoreline, but LSCA has done a lot in the past to educate and inform.

**Water Quality and the Result of Successful Milfoil Abatement**

It has been and continues to be the highest of priorities of the LSCA to be vigilant and diligent in promoting water quality at Lake St. Catherine. It is useful to reference an underlying irony involving the inverse relationship between successful strategies in milfoil abatement and water quality.

Specifically, the clarity of the water received some improvement in an era of prolific milfoil cover, inasmuch as the milfoil tended to suck up all of the nutrients. Being highly successful at mitigating invasive species can have a short term modest compromise of water clarity, as seen in the LSC scorecard yet resolves itself in the long run.

## Current Snapshot

So far, we have discussed how Vermont Lakes measure water quality, and what the LSCA has done in the past to ensure that water quality through monitoring and efforts at protecting the watershed. Now we will assess the current status of water quality and watershed protection with the Vermont Inland Lake Score Card for Lake St. Catherine given all of the most recent data. Attached in the Appendix 1C you will see the score card for Lake St. Catherine. You will notice that the main score card features four quadrants to represent a Secchi disk, one of the key tools used for quality assessment. As previously mentioned, the nutrient trend section of the score comes from the Lay Monitoring Program and Spring Phosphorus Program data. You will see that Lake St. Catherine's current nutrient trend is rated as "fair". "Fair" or "yellow" Lakes offer opportunity for watershed residents to reduce nutrient inputs and improve conditions on the Lake.

Score cards for the Lily Pond and Little Lake are found in Appendices 1A and 1B.

This final nutrient trend score represents an overall trend for each Lake, but the DEC emphasizes the importance of examining the graphs provided by the score card interface to better understand the context of Lake St. Catherine's "fair" rating. If you look at the plotted data from 1979 to 2017 for Lake St. Catherine, in Appendices 3A and 3B, you will see that phosphorus and chl-*a* concentrations have remained completely stable.

It is also important to mention that the score card indicates that the water of Lake St. Catherine meets the Vermont Water Quality Standards, meaning that its quality score is not at all stressed or impaired by things such as water level fluctuations, low alkalinity, high chloride concentrations, or E. coli presence.

However, the Secchi depth for Lake St. Catherine has been rated as "highly significantly decreasing". While nutrients and chlorophyll-*a* have remained stable, the secchi disk transparency readings have demonstrated a decreasing clarity. This definitely contributes to the "fair" nutrient trend rating for Lake St. Catherine, and is an area to improve upon for the future through reduction of nutrient inputs as a result of watershed and shoreline protection efforts. See Appendix 3C.

**Current Data**

The latest data we have for Lake St. Catherine, as of September 10, 2017.

Our average Secchi Depth was 3.3 meters, our chlorophyll-*a* concentration was 5.71 ug/l, and our phosphorus concentration was 13.60 ug/l.

It is important to note as well that when comparing the phosphorus, chlorophyll-*a* and secchi depth measurements to the other Vermont Lakes that partake in the Lay Monitoring Program, Lake St. Catherine consistently falls toward the middle of that distribution.

Lake St. Catherine also falls in the mesotrophic category for all three measurements, which is the intermediate trophic state. These types of Lakes are characterized by moderate nutrient enrichment, moderate algae growth, moderate aquatic plant growth, some sediment accumulation over most of the Lake bottom, and they usually support warmwater fish species. Many other Vermont Lakes fall in this mesotrophic, intermediate category, with many others already reaching a eutrophic state of high nutrient enrichment, high productivity, extensive aquatic plant beds and lots of sediment accumulation on all of the Lake bottom.

What this mesotrophic state implies is that the body of water is rich with nutrients, and sediment is starting to build up on the bottom. However, it does not seem that the eutrophication process is being accelerated too significantly by nutrients or other cultural sources on Lake St. Catherine, as indicated by the phosphorus and chl-*a* stability. While eutrophication of Lakes is a natural process by which a Lake eventually becomes a wetland, it is important to protect the watershed and shoreline to maintain a Lake in its recreational and functional state for visitors and the wildlife for as long as possible.

We have discovered that the status of the shoreline and watershed dictate the amount of nutrients introduced to a Lake, and thus impact water quality. We will discuss how the Inland Lake Score Card assesses these issues and what that looks like at Lake St. Catherine. The Score Card also includes a Watershed Score, a Shoreland and Lake Habitat Score, and a Mercury pollution score to create a more comprehensive look at a Lake's status.

**Watershed Score**

Lake St. Catherine's watershed score was rated as moderately disturbed, but what does that mean exactly. The Watershed Disturbance Score is derived from a landscape development index (LDI) developed by Brown and Vivas. The LDI is a measure of human-induced alterations to the biological, chemical and physical processes of a watershed's lands that impact the Lake. The DEC scoring guide emphasizes that the watershed disturbance score is extremely dependent on the accuracy and age of the underlying dataset. The Nature Conservancy's watershed delineations were mathematically derived using the U.S. Geological Survey's National Hydrography Dataset stream flow network tools, which do not include a mapped visualization of the watersheds. Users are cautioned to keep these types of limitations in mind when viewing the colored watershed outlines. Not to say that this indicator is unimportant or irrelevant, because Lake St. Catherine and the LSCA should always be taking steps to further protect the watershed. However, this score may not be exact or indicative of the true watershed. (see Appendices 16A, 16B & 16C)

**Shoreland and Lake Habitat**

To produce the Shoreland and Lake Habitat score, scientists from VLPP randomly select one site along the shoreline of each Lake using GPS. Using this location, an additional nine sites are placed equidistant from each other around the Lake, for a total of ten sites. Each site is visited by a field crew as part of the Spring Phosphorus Program and assessed for various types of human "disturbances" within a 15 meter by 15 meter plot on the shore immediately adjacent to the water. Types of disturbances include buildings, lawns, commercial activities, roads and railroads, powerlines, docks, dams or seawalls, trash or landfills, and agricultural activities.

Lake St. Catherine has an extensive perimeter that abuts Vermont Rt 30, for both roads and powerlines, which factors into its "disturbance" score. The Lake received a poor Shoreland and Lake Habitat score, which is indicative of poor shoreline protection and the resulting consequences. The Vermont DEC Inland Lake Score Card scoring guide remarks that Lakeshore residents and owners can reduce the impacts from existing development by revegetating their shorelines and instituting the best management practices promoted by the Lake Wise Program.

**Vermont Roadways Best Management Practices**

Vermont roadways are responsible for about 10% of sediment and phosphorus sources to surface waters, and municipal roads make up 70% of 118,777 total miles of roads in Vermont.

To help reduce road runoff and protect surfaces waters, Act 64 (Vermont's Clean Water Act) mandates all hydrologically connected roads (class one through four) be maintained according to new road drainage standards. In addition road crews should not be cutting down trees, shrubs and mixed vegetation within 250 ft. of a Lakeshore, which does not include mowing grass or clearing noxious weeds. This vegetation is protected under the Vermont Shoreland Protection Act, and serves as best management to stabilize the bank and protect the integrity of the road.

The DEC recognizes that the shoreline and Lake habitat score cannot necessarily be improved by the actions of Lake associations, as Lakeshore residents, business owners and municipalities together bear the responsibility of watershed protection.

What LSCA can do is provide information and resources for property owners on Lake St. Catherine, which they have consistently done in the past. Moving forward however, it is important for the LSCA to emphasize and fortify these efforts.

**Mercury Pollution:**

The mercury pollution score, or the level of mercury fish tissue contamination, reflects the most recent data that VLPP has regarding the presence of mercury (Hg) in the food web of Vermont Lakes. The DEC emphasizes that mercury pollution is a serious environmental problem, contaminating many forests, soils, rivers and Lakes in the state. While Lake St. Catherine's mercury pollution score is fair, this score means that studies indicate that Hg accumulation in fish tissue is likely. Not only does this score reflect some level of uncertainty, results from an intensive study of Lakes in Vermont and New Hampshire indicated that 40% of Lakes in Vermont were likely to have fish exceeding EPA limits for allowable fish tissue Hg concentrations, constituting a poor score. It is extremely important to monitor and recognize the impact that mercury pollution can have on aquatic ecosystems, but Lake St. Catherine seems to be doing well, relative to the rest of the field.

While the Inland Lake Score Card is a great resource to understand the status of a Lake, it is not the only way we should be adjudicating our Lake. Seeing the scorecard with only yellow and red quadrants has been very disconcerting for members of the Lake St. Catherine association and community. However, It is important to complicate our understanding and look beyond these indicators. We have seen through our analysis that a fair or poor score does not necessarily mean that the Lake is in peril, especially when comparing these scores to those of other Lakes in the state. Additionally we have seen all of the precautions, many of which identified by the DEC as important Lake protection acts, that the LSCA has taken to secure water quality. Lake St. Catherine undoubtedly has room for improvement when it comes to water quality and watershed protection, and now we will explore how the LSCA plans to move forward and continuing fighting for a clean, healthy and accessible Lake.

## Future Considerations

**Key actions relative to improving performance on on the Inland Lake Score Card**

We have already touched on many of the actions on the Checklist of Lake Protection Actions that the LSCA has already accomplished, including: having a Lake Association, participation in the Spring Phosphorus Program, participation in the lay monitoring program, working together with local town officials, and the holding of a septic social. Thus, for the future, the LSCA will continue all of these programs and actions to maintain the work they have already done. Of course, continuing the LSCA's participation in the Lay Monitoring Program is essential to maintaining consistent data in order to identify problems and implement the necessary interventions. The current lay monitor for Lake St. Catherine, Mary Jo Teetor, says that "the current status [of water quality] is pretty good and she echoes the voices of many other members of the focus group, that "the only way that it's going to get better is for us to stop erosion and runoff." Many of the individuals interviewed as part of the governance focus group agreed that watershed and shoreline protection should be a focus area for the next five-year permit application. A key action that the LSCA wants to implement is increased participation in the Lake Wise program, encouraging shoreland owners to adopt Lake friendly practices. The LSCA will also be dedicated to disseminating information about the Vermont DEC's Shoreline Best Management Practices for those living along a Lake. Rain gardens and shoreline buffers are already being implemented on the Lake, but the LSCA hopes to expand on these efforts to include as many of the Shoreline Best Management Practices as possible and to earn Lake Wise awards for Lake St. Catherine. Generally speaking, when it comes to watershed and shoreline protection, the LSCA wants to increase its outreach and its effectiveness, giving Lake property owners understanding and education to improve their shoreline by planting buffer plantings. This type of outreach has already been conducted by the LSCA in the last few years, but many interviewees of the focus group indicated that voluntary compliance with the information and techniques is variable. Getting more individuals on the Lake invested in how their properties impact the Lake ecology is essential for the LSCA moving forward and to further understand and appreciate that a healthy Lake and Watershed has a direct impact on property values and quality of life.

To summarize, water quality and watershed protection on a body of water are difficult to effectively measure and conceptualize. An easy, accessible way for individuals to understand what water quality and watershed protection look like on their Lake is the Vermont Inland Lake Score Card and the DEC Best Management Practices program as well as the Lake Wise Program developed by the Vermont Lakes and Ponds Management and Protection Program. It has become clear that score cards do not tell the entire story though, and it is essential to add nuance and context to every score provided through this program.

# III. Invasive Species Mitigation and Abatement

## Past Interventions

**Eurasian Watermilfoil:**

When interviewing the governance group, most individuals agreed that the Eurasian Watermilfoil mitigation program is the largest, most important and influential intervention the LSCA has conducted since the inception of the Association up to the present day. Invasive species presence in Lake St. Catherine is not limited to Eurasian Watermilfoil, but it is the nuisance plant that has most impaired the water quality and recreational viability of the Lake. First, we will discuss the problematic nature of Eurasian watermilfoil (EWM) as it relates to freshwater Lakes. Next, we will chronicle the efforts of the LSCA to mitigate the EWM problem from 1979 to the present day. Finally, we will analyze the abatement techniques used by the LSCA using the most recent data and research on invasive species mitigation.

Eurasian Watermilfoil (*Myriophyllum spicatum*) is an aquatic nuisance plant that is not native to North America, but has become present in most US states and much of Canada. As it was introduced to this continent, there are no natural controls to keep its growth in check. Eurasian watermilfoil, or EWM, is known for its rapid growth if not in check. EWM creates dense beds that can seriously impair the recreational use of a Lake, reduce the availability of fish spawning grounds, outcompete beneficial native plants, and otherwise alter a Lake's natural environment. When milfoil dies at the end of the season, it creates substantial biomass, which creates a mucky bottom to the Lake, making it difficult to maintain a good habitat for fish. Eurasian Watermilfoil is the aquatic invasive species found most in Vermont Lakes and ponds, so it is not surprising that it found its way to Lake St. Catherine.

EWM reproduces almost exclusively through the breaking of plant fragments that can drift away, sink, develop roots and grow into new plants. Typically, human recreational activities account for the spread of non-native aquatic plants like EWM between Lakes, as these fragments can cling to boat motors or trailers and start new populations. Animals and bird migration also contribute to the presence and growth of the plants. There is no way to completely eradicate EWM from a Lake once it has been introduced; control efforts must focus on controlling newly introduced infestations, preventing further spread of the plant, or reducing the nuisance level of the problemAs will be made apparent, the Lake St. Catherine Association has engaged in all of these types of control.

**Chronology: Mitigation Strategies, by Year**

The Lake St. Catherine Association has employed a variety of strategies to deal with the EWM problem since it began causing problems for the Lake ecosystem and the recreational users of the Lake since the 1970's. While the Vermont Department of Environmental Conservation first confirmed the presence of EWM in Lake St. Catherine in 1983, according to residents of the Lake, it was evident that EWM had become a problem on the Lake as early as 1970. Here we will present a brief summary and chronology of the different methods of EWM mitigation the association has elected to employ from 1979-2017, followed by a data-driven evaluation and analysis of each strategy and the actions taken by the LSCA.

While there are gaps in the chronology, as a general and simplified schema, the LSCA used mechanical harvesting from 1979 to 2003, bottom barriers, hydro-raking, Sonar herbicide treatment in 2004, hand-pulling in 2005 and 2006, and a combination of suction harvesting and Renovate herbicide from 2007 to the present day. Attached you will also find a year by year summary of herbicide treatments from 2004 to 2018 which includes information about acreage and dosage.

- 1979-2003: Mechanical Harvesting and Hand-pulling were the main strategies used to deal with milfoil

- 1979: The Lake St. Catherine Association purchased their first mechanical harvester nick-named Hungry Harvey while continuing to investigate alternative solutions to the EWM problem
- 1983: The Lake St. Catherine Association purchased a conveyor and a truck to aid in the harvesting process
- 1987: A second weed harvester named Hungry Harvey Junior was purchased after the retirement of the first harvester
- 1988: Hungry Harvey Junior harvested 3,767 cubic yards of EWM from Lake St. Catherine
- 1990: 3,500 cubic yards of EWM was removed from Lake St. Catherine
- 1991: The Lake St Catherine Association harvested a record breaking 5,000 cubic yards of milfoil from Lake St. Catherine
- 1992: A third harvester named Millie Foil was purchased by the Lake St. Catherine Association from the town of St. Albans, Vermont. Forty-three (43) camp owners on Lake St. Catherine applied for the hydro-raking program sponsored by the Lake St. Catherine Association as a way for individual homeowners to control EWM populations around their properties.
- 1993: The Lake St. Catherine Association reports that twice as much EWM was removed from the Lake than in the previous year.
- 1994: 4,250 cubic yards of EWM were removed from Lake St. Catherine. It was reported that harvesting crews were working twelve hour shifts during this summer.
- 1997: The Lake St. Catherine Association purchased a fourth harvester named Uncle Sam. This was an important purchased for the association as this was the first harvester that could fit under the bridge between the big and little Lakes, eliminating the tedious process of unloading and reloading to get around the bridge
- 1996-2000: Hydro-raking was conducted in a limited number of small, approved sites. Hydro-raking was a technique used on the Lake throughout the 1990's and 2000's. It used to be that LSCA would help individual homeowners submit hydro-raking permits for small areas around their docks when milfoil was at its worse, in order to clear paths for getting in and out. A diver from the state would then travel to inspect the sites and approve the hydro-raking projects. These individuals were responsible for the costs of the hydro-raking, but the LSCA organized this program to benefit the Lake and supplement the mechanical harvesting program.
- 2004: The Lake St. Catherine Association contracted Aquatic Control Technology to conduct a full Lake herbicide treatment with Sonar AS (Fluridone). This was the largest full Lake herbicide treatment known to have occurred in New England. Four additional booster applications were performed on the Lake between June and the end of August.
- 2004: The Vermont Public Access Greeter program was brought to Lake St. Catherine by the Lake St. Catherine Association as a way to prevent the spread of aquatic invasive species.
- 2005: Diver Hand-Pulling was the primary method for EWM mitigation as milfoil cover and frequency of occurrence were reduced significantly after the first Sonar herbicide treatment.
- 2006: Diver Hand-pulling was again the primary method used in the main basin of Lake St. Catherine, but as milfoil frequency of occurrence began to again increase, the LSCA began to explore other methods to mitigate the EWM.
- 2006: Vermont DEC issued a permit for a suction harvesting program on Lake St. Catherine
- 2007: Management activities performed in 2007 included spot-treatment of two areas totaling 15 acres with Renovate OTF herbicide, diver hand-pulling, diver assisted suction harvesting and aquatic vegetation monitoring
- 2008: Management activities performed in 2008 included spot-treatment of eight areas totaling approximately 79 acres with Renovate OTF herbicide, diver hand-pulling, diver assisted suction harvesting and aquatic vegetation monitoring. Suction harvesting was conducted in 8 locations.
- 2009: Management actions in 2009 included spot-treatment of seven areas totaling approximately 140 acres with Renovate OTF and Renovate 3 herbicide as well as diver

hand-pulling and diver assisted suction harvesting. Shoreline Weed Control also conducted a small hydro-raking project in the channel in the back of Cone's Point.

- 2010: Management actions included spot-treatment of seven areas totaling approximately 59 acres with Renovate OTF herbicide as well as hand-pulling and diver assisted suction harvesting. The Lake St. Catherine Association also coordinated a program to provide individual property owners with a hydro-raking service through Shoreline Weed Control, a Massachusetts based contractor. 60 individuals signed up for this program.
- 2011: Management actions included spot-treatment of seven areas totaling approximately 45.8 acres with Renovate OTF herbicide as well as diver hand-pulling and diver assisted suction harvesting. Over 60 properties on the Lake signed up for LSCA's hydro-raking program through Lycott.
- 2012: Management actions in 2012 included spot-treatment of five areas totaling approximately 63 acres with Renovate OTF herbicide, as well as diver hand-pulling and diver assisted suction harvesting
- 2013: Management actions included spot-treatment of six areas totaling approximately 42 acres with Renovate OTF herbicide as well as diver hand-pulling and diver assisted suction harvesting
- 2014: Management actions included spot-treatment of five areas totaling approximately 54 acres with Renovate OTF herbicide as well as diver hand-pulling and diver assisted suction harvesting. Residents interested in having their areas hydro-raked could contact the vendor Lycott for individual hydro-raking services. In June 10, 2014 the Vermont DEC issued a permit to the Lake St. Catherine Association for the use of a pesticide, a powered mechanical device (DASH) and bottom barriers to control aquatic nuisance plants in accordance with the application, monitoring, reporting and other requirements.
- 2015: Management actions included spot-treatment of eight areas, totaling approximately 51.4 acres with Renovate OTF herbicide as well as diver hand-pulling and diver assisted suction harvesting. Suction harvesting was permitted at nine locations.
- 2016: Management actions included spot-treatment of six areas totaling approximately 66.8 acres with Renovate OTF and Renovate 3 herbicides as well as diver hand-pulling and diver-assisted suction harvesting. In the third year of LSCA's new contractor, the Association received approval to suction harvest in 10 locations spread throughout the main Lake totaling 18.3 acres.
- 2017: Management actions included spot-treatment of six areas totaling approximately 42 acres with Renovate OTF and Renovate 3 herbicide as well as diver hand-pulling and diver assisted suction harvesting.

**Explanation and Analysis of Strategies**

A fundamental tenet of the comprehensive multi-component strategy employed by the LSCA is one of "balance". There are advantages and disadvantages to each available tactic and technique. ***The underlying values require that priorities must be science-driven and evidence-based.***

**How Gap Analysis informs the Process:**

**Other strategies researched but rejected due to research gap analysis**

As previously mentioned, the Lake St. Catherine Association has always been at the forefront of the investigation and research of different and innovative strategies to mitigate the problem of EWM on the Lake. In collaboration with the Poultney-Mettowee Natural Resources Conservation District, the Lake St. Catherine Association completed the Lake St. Catherine Research Compilation Project and Gap Analysis to determine the most sound, safe and viable approach to mitigating the EWM present in the Lake. This project objectively evaluated past

strategies and explored alternatives used by other Lake associations, which demonstrates the association's dedication to using the best management practices the state of Vermont will allow. Now we will explore all of the techniques researched in this project, including those that the LSCA has utilized, to analyze their viability, safety and cost-effectiveness and efficacy.

There have been many interventions considered by the LSCA, and the organization has truly explored every viable option in order to provide the safest, healthiest, most effective treatment.

**Herbicide Treatment**

There are alternative treatments that the LSCA has researched before arriving at first the use of Sonar and later the use of Renovate. Navigate was deemed too expensive and has the potential to treat non-target species. Komeen Aquatic Herbicide does not require use restrictions after application, but is not selective for EWM and many plants can build a resistance to this herbicide. REWARD, another fast acting contact herbicide, is not selective and does not kill the root of the plant. While there is risk and apprehension associated with the use of any herbicide on a body of water, Sonar and Renovate have been the most appropriate and effective for use on Lake St. Catherine (given the selectiveness of the product, water restrictions, etc).

**Biological Methods**

The LSCA also considered using biological methods to deal with the EWM problem. The introduction of the Watermilfoil Weevil was explored, as it is native to North America and only feeds on EWM, minimizing its impact on native flora (Solarz and Newman 2000). It damages its host in every stage of its life cycle; the adult female weevil lays her eggs on the tips of the EWM plant, and when the larvae hatch, the climb down the stem and burrow a hole in it, destroying the plant. In 1994, Lake Bomoseen introduced 20,000 weevils to the ecosystem, which caused considerable damage to the EWM, but was still growing and topped off at the surface of the Lake. There have been inconsistent results in studies using the weevils, and has not yet been proven to be effective in open-water field settings where the insects have been intentionally introduced (2009 permit). Lake Bomoseen has also used the Watermilfoil moth, another tactic considered by the LSCA. While it was relatively effective on Bomoseen, it has also been shown to hinder native species belonging to the pondweed family. Milfoil Midges were considered but it has proven difficult to properly identify this specie of midge. The introduction of grass carp was also researched, but the release of grass carp is currently illegal in Vermont, as studies showed a problem with algae and a concern about escape, so this treatment option is not presently relevant. At this point in time, there is not enough data or research to employ these biological methods with any amount of certainty of effectiveness.

Water level drawdowns, or a temporary lowering of a Lake's water column for the purpose of exposing the Lake bottom and controlling weeds by drying them out, was explored as an alternative mechanical option. However, this method is not an option for the LSCA because there is not an existing outlet structure at the Little Lake that would enable a significant lowering of the Lakes. Additionally, this method is not selective for EWM. Bottom barriers have also been considered, and the LSCA has received permits for the use of bottom barriers in the past. This technique involves placing a screen of some sort on the Lake floor to prevent sunlight from reaching any plants taking hold in a targeted area. Although the LSCA purchased several panels of Aquascreen benthic barrier material, no concentrated patches of dense EWM growth have been found to-date that would benefit from benthic barrier installation. It reduced wildlife habitat by covering sediment, they must be regularly inspected and maintained and removed at the end of the season, they are easily damaged, and is also not selective for EWM. This is an important aspect of the treatment plan of the LSCA -- the methods must be selective for EWM as to not disturb other native species or the nature of the ecosystem.

The LSCA also looked into aeration systems, which oxygenate the water column, and claim to eliminate potential turbidity. However, there is a constant need for electricity and the need for the presence of this system is indefinite. It is also an expensive system that could have high future costs associated with it. Moreover, it does not directly affect milfoil negatively and its long-term efficacy is yet to be demonstrated.

As you can see, the LSCA did their homework in order to make an informed decision about what tactics would be most effective for Lake St. Catherine and its EWM problem. Now we will talk about the methods the association did choose to employ, their effectiveness, and the reasons why the methods have changed and evolved over time.

**Mechanical Harvesting**

As previously mentioned, mechanical harvesting was used to treat milfoil from 1979 to 2003 on Lake St. Catherine as it was the most widely used and accessible method at the time. Since the beginning the LSCA was searching for any and every alternative method.

- A harvesting machine has vertical and horizontal sickle-bar cutters, and it shears off the plants just above the Lake bottom. The cut plants are then collected and conveyed onboard the harvester to be deposited onshore and dewatered. The major advantage is that mechanical cutters and harvesters can remove a large amount of biomass in a short period of time.
- During all of the LSCA's mechanical harvesting efforts, the milfoil was delivered to various gardens and agriculturists in the Wells-Poultney area for compost purposes. In 1996, about 95% of the weeds were delivered to the Dennis Brown farm. Mr. Brown told the LSCA that he allows the weeds to dry-out for about a year for his purposes.
- There were many reasons that the LSCA eventually discontinued the mechanical harvesting program. As early as 1996, the Vermont DEC expressed concern about the impact that mechanical harvesting may have on the habitat of any non-targeted species. (1996 fall newsletter) In the 1990's, the LSCA had many problems with the harvesting equipment, including the capsizing of Hungry Harvey and the tipping over of the transporter in 1994.
- It became clear that mechanical surface harvesting only cuts off the top four feet of the milfoil, and quite literally does not get to the root of the problem. Many of the interviewees of the governance focus group likened mechanical harvesting to simply mowing the lawn. Fragmentation, or the dispersal of milfoil fragments from harvesting efforts, causes the spread of milfoil.
- Additionally, the maintenance of the equipment became relatively costly, the LSCA had to harvest quite frequently, and of course the harvester is not selective for EWM. When we are talking about managing an invasive species, it is important that the methods utilized are selective for the invasive species, as we do not want to disturb the native species and habitats of the Lake.
- Statement from the Vermont Agency of Natural Resources: "Some mechanical harvesting was used for EWM control on Lake St. Catherine from 1985-2003, this method did not provide a satisfactory level of control and may have contributed to its spread via fragmentation. Experience with mechanical harvesting on Rutland County Lakes in the 1980's and 1990's showed that harvesting resulted in dense beds of EWM since the aggressive plant is quickest to regrow after cutting."
- According to the Vermont DEC's 2018 Guide for Managing Aquatic Invasive Species, mechanical harvesting "can be detrimental in spreading aquatic plant material, which can spread invasive plants to new areas" They also mention the high cost of maintaining the equipment, the fact it often requires full-time personnel, and is really only appropriate for large Lakes. The Minnesota Aquatic Invasive Species Research Center echoes these sentiments, stating that mechanical harvesting does not result in long term control, several removals may be needed each year, and regrowth may be fast.

- Mechanical surface harvesting was a mechanism that worked in its time, but as the EWM became more dominant, the Association needed to find a better way to control it.
- In the late 1990's and the early 2000's, the EWM on Lake St. Catherine began to get out of control. In 2003, the last year of harvesting before the Sonar herbicide treatment in 2004, the frequency of occurrence of EWM was close to 100% and the EWM percent cover was above 80%.
- Many of the interviewees described Lake St. Catherine in 2003 as a "disaster", a completely unnavigable Lake with very restricted recreational value. It was obvious that the LSCA needed to make a change.

**Hand-pulling**

Hand-pulling EWM has remained the most consistent mitigation strategy utilized by the LSCA as a complement to other methods. As the most informal technique, there is not data for us to evaluate the efficacy and efficiency of this strategy. However, it remains a consistent method to accompany other management techniques. Hand-pulling was conducted following the 2004 Sonar AS treatment and has been continued in each subsequent year of the five year long range management plan.

- After the 2004 treatment, scattered EWM was found in the Lily Pond, so hand-pulling was used as a complementary strategy. The diver hand-pulling conducted in 2005 and 2006 as the primary EWM control method was helpful, but expanded distribution and density of EWM was observed in several areas during the late season inspections.
- If you look at the graph, you will see that EWM rebounded quite a bit following the absence of herbicide treatments in 2005 and 2006.
- Hand-pulling can be highly effective if the roots are pulled successfully, and is most effective for widely scattered EWM populations. If conducted by a property owner, it is much less expensive than suction harvesting and requires no machinery. However, it is very labor intensive, thus less feasible for large areas. Additionally, the person doing the hand-pulling must be sure to remove the entire plant, otherwise they run the risk of spreading the EWM instead of eradicating it.
- In short, hand-pulling has been a EWM mitigation strategy that the LSCA has utilized for over a decade, but alone certainly cannot manage the EWM problem in Lake St. Catherine.

**Hydro-raking**

Hydro-raking has been a method used on and off by the LSCA since the 1990's. Hydro-raking involves dragging a rake's long tines through the bottom sediment of the Lake, and in the process raking up rooted weeds, benthic algae and non-rooted weed masses. As it removes the root of the plant, it is most effective than other mechanical harvesting methods. Typically, individual homeowners on the Lake were permitted to hire private contractors to hydro-rake their property in limited areas around docks with the assistance of the LSCA.

- A permit for hydro-raking in the Lily Pond as a part of the Lily Pond Channel project was approved in 2017. The goal of this project was to "...remove sediment and organic debris from the center of the channel between the Lily Pond and the North Bay of Lake St. Catherine to restore the connectivity, i.e. navigation, increase water movement, improve water quality, enhance open water habitat, and control invasive or nuisance vegetation."
- LSCA board member and lay monitor Mary Jo Teetor worked with SOLitude Lake Management, the same contractor that the LSCA uses for its herbicide treatments, to submit the permit using bathymetric surveys and plant assessments. This project was a success for the LSCA and the Lily Pond, opening up the channel for recreational use. Kayaks and fishermen can now enjoy ease of access to the Lily pond and the project was beneficial for the wildlife on the Lily Pond and on Lake St. Catherine.

- There are also limitations to hydro-raking as a comprehensive EWM mitigation method. It can be very expensive; in 2010 individual property owners had to pay $1,000 each@$160 per hour just to have the areas in front of their properties raked. It is difficult to imagine the cost for an entire Lake treatment using hydro-raking. Additionally, the organization of this program on the part of the LSCA was a lot of work to coordinate, and after a number of years, individual property owners were less interested and the permits became more restricted, as the modality not selective but removed muck that stuck to weeds.
- Many members of the focus group interviewed mentioned that the state of Vermont does not seem to be a fan of hydro-raking. In 2015, the state denied the Lake St. Catherine Conservation Fund's request for hydro-raking permits on the Little Lake.
- According to the 2018 guide for Managing Aquatic Invasive Plants by the Vermont DEC, hydro-raking is not an appropriate tactic for whole-Lake vegetation management as the many negative effects outweigh the benefits.
- Turbidity resulting from the disturbance of the sediments will release nutrients locked up in the sediment, creating short term problems for fish and benthic organisms. (Tiedemann et al. 2009)
- This method can negatively impact aquatic and terrestrial non-target organisms, and does not provide for long term control.

**Herbicides**

Attached in Appendices 8, 9, 10, 11, 12 and 13, you will find a summary of herbicide treatments, dosages, and acreage treated, along with a summary of milfoil cover as it changed over time and reacted to the milfoil treatment since the first one in 2004.

- The use of herbicides on Lake St. Catherine was not a decision taken lightly by the Lake St. Catherine association, and was the result of years of research and testing by the Environmental Protection Agency, the Vermont Department of Environmental Conservation and the Vermont Department of Health.

**Sonar**

Sonar Aqueous Solution, or Fluridone, is a slow acting aquatic herbicide that can be selective for EWM when used at the labeled rate. It is a broad spectrum, systemic herbicide. Systemic herbicides are absorbed and move within the plant to the site of action, and tend to act more slowly than contact herbicides.

- The LSCA and SOLitude Lake Management submitted a permit application for the use of Sonar AS in a whole Lake treatment to manage EWM in 2001.
- Not until 2004 did the state award the permit, which (was attached to a 5 year plan that included restrictions on any mechanical means of weed removal).
- The Penn State Extension College of Agricultural Sciences, contact herbicides kill only the plant parts contacted by the chemical, whereas systemic herbicides are absorbed by the roots or foliage and translocated (moved) throughout the plant. Additionally, herbicides can work selectively or non-selectively. Selective herbicides kill weeds without significant damage or desirable or native plants, but non-selective herbicides kill or injure all plants present if applied at an adequate rate.
- Since 2004, SOLitude Lake Management has been very diligent and comprehensive when it comes to testing and monitoring the Lake.
- The survey methods have been very consistent; all three major Lake basins were systematically toured by boat. A differential GPS system enabled the same locations to be examined during the

pre and post treatment surveys. The plant community was assessed through visual inspection, use of a long-handled rake and throw-rake, and with an Aqua-Vu underwater camera system.

- The initial application occurred on June 1, 2004. Because fluridone concentration needs to be maintained at a certain level in order to be effective, three additional booster applications were performed on the whole system between June and the end of August. In-Lake fluridone concentration monitoring was performed weekly and 24-hours after each Sonar AS application between June 2nd and September 28th. LSCA members were very active in this process, collecting samples from 14 different locations as a part of the monitoring process. as well as being present for the surveys and inspections alongside SOLitude.
- By the time the comprehensive post-treatment vegetation survey was performed on September 20 and 21, 2004, the vast majority of milfoil plants had fallen out of the water column, and the remaining plants were highly chlorotic, having almost completely stripped stems. On Lake St Catherine, the average viable milfoil cover went from 64.80% to 0.00% between 2001 and 2004.
- Sonar AS has also been used on Lake Hortonia, Sunrise Lake, Burr Pond, and Star Lake for EWM treatments in the past.
- 2013: "[New 5-year plan] will not include use of Sonar as we find it overly expensive"
- There are a few issues with the Sonar herbicide that caused the LSCA to transition to a new herbicide, Renovate. Primarily, most of the individuals from the focus group interviewed remarked that it is really prohibitively expensive to continue with this specific herbicide. Additionally, it is necessary to maintain a certain concentration of the herbicide in the Lake for an effective treatment, so booster applications are often needed creating an additional expense.
- Furthermore, the state of Vermont has become much more wary about herbicide treatments except on a spot treatment basis, and Sonar is only viable as an entire Lake treatment. The LSCA also recognized that spot treatments would be sufficient following the initial entire Lake treatment, which limits the amount of herbicides introduced to the Lake and reduces the amount of time that recreational users have to avoid contact.
- Although native plant populations rebounded completely after the initial Sonar treatment, there were noticeable changes to the plant community after the treatment, as many native species were found in lower densities and frequencies of occurrence.

**Renovate**

Renovate 3 (Triclopyr) has been used in Lake St. Catherine and the Little Lake since 2006. The Research Compilation Project, co-authored by the Poultney-Mettowee Natural Resources Conservation District, describes Renovate 3 as inexpensive, fast acting, systemic and selective. While systemic herbicides are slower acting, they generally only require one treatment per season and are less volatile to the ecosystem, especially when compared to contact herbicides. Triclopyr is a selective broadleaf herbicide that can be used to control a variety of nuisance and invasive aquatic plant species. It rapidly enters through a plant's leaves and stems, then translocates down into the roots, disrupting the plant's metabolism. It is highly selective for EWM, so impacts to non-target species are anticipated to be minimal (all from the 2009 permit).

- Renovate 3 is an aqueous solution, and a US EPA-registered aquatic herbicide. The label indicates that Renovate 3 can be applied as either a surface or subsurface application to control Eurasian watermilfoil. The LSCA has also used Renovate On Target FLakes (OTF), which is a fLake formation instead of an aqueous solution. This formulation has proven to be effective for steeply sloped areas, smaller EWM beds and in areas where there is potential for excessive dilution from untreated water. The liquid formulation, on the other hand, is used in larger treatment blocks and cove areas that were not subject to as much dilution.
- The transition from Sonar to Renovate was an important move for the LSCA in their treatment goals. Because another whole-Lake treatment was cost prohibitive, because the state of Vermont

became hesitant about permitting whole-Lake treatments of Sonar, and because the LSCA found spot-treatments to be most appropriate following the whole-Lake treatment, Renovate seemed like the obvious choice. A spot-treatment program was the right choice for the LSCA because it allows the LSCA to treat the EWM on a rotating basis, and the localized spot treatments are very effective, targeting the exact areas that the herbicide is applied to. Additionally, it is faster acting, only requires a single treatment per season, and only prohibits Lake use for 24 hours following the treatment; it is important that herbicide treatments do not interfere too much with the usability of the Lake for property owners and visitors alike. There is sufficient research supporting the use of Renovate in spot-treatments. The Vermont DEC and DOH have voiced their support for the use of Renovate as an extremely safe and effective treatment for EWM in their responses to questions on the most recent permit for the LSCA.

- "The Lakes and Ponds Program acknowledges opposition to the proposed use of the herbicide triclopyr. However, as required by state law, the use of herbicide is an integral part of a long-term management plan to control EWM in Lake St. Catherine, which incorporates many other techniques to minimize its use."
- "The requisite annual plant surveys indicate significant reduction and control of EWM, especially in the Main Lake. Renovate is highly specific to EWM. With a reduction in EWM presence, an increase in native aquatic plant growth is anticipated."
- "At the request of the Lakes and Ponds Program, the Vermont Department of Health has conducted a thorough review of the proposed use of herbicide and determined that it poses negligible risk to public health if conducted in accordance with its recommendations. To date, the Lakes and Ponds Program confirms that no health problems or elevated health risk have been directly attributed to the use of triclopyr."
- The EPA classifies Renovate as "practically non-toxic" to mammals, fish, amphibians and birds
- It is important to note that the herbicide contractor, SOLitude Lake Management, provides extremely comprehensive plant surveys and concentration testing before, during and after the treatment.
- The pre and post treatment plant surveys conducted by SOLitude demonstrate consistency in species richness since the beginning of the Renovate treatments, indicating that Renovate is highly selective for EWM and its use has not had a perceptible impact on other non-target plant species.

**Suction Harvesting**

A permit authorizing the use of suction harvesting on Lake St. Catherine was issued on October 3, 2006 for the following summer season. It was permitted as an additional control technique in areas where the re-growth of EWM had outpaced the other non-chemical control methods in use. (From permit) It has been consistently used from 2007 up to the present 2018 season.

- There are many advantages to using suction harvesting in addition to herbicide treatments. Suction harvesting eliminates the entire plant, including the root. It is also very effective at breaking up the canopy created by the EWM. It can be used for larger areas than hand-pulling. The suction action removes biomass from the water, thus reducing the threat of milfoil spreading (Research Project/Gap Analysis). SOLitude Lake Management, as a result of their pre-treatment survey, recommends to the LSCA the locations that will be most receptive to suction harvesting efforts in addition to the herbicide treatment. LSCA Board members go out at the end of each season to conduct a visual inspection of the areas that were designated by SOLitude as the best places to suction harvest.
- There are also many reasons why suction harvesting is used in addition to herbicide treatments, and not instead of. It is extremely labor intensive, thus making it more expensive for the LSCA.

Suction harvesting also requires individuals trained to dive, suction harvest, and properly identify EWM among other plants, meaning that there is a limited pool of possible harvesters. Additionally, suction harvesting is primarily designed for small infestations because of the speed and labor intensiveness. Use of multiple suction harvesters can also pose a risk to non-target organisms because of turbidity. While it is an important part of the long-range management plan for the LSCA, it is not a reasonable approach to take to achieve effective EWM control Lakewide.

- Attached you will find summaries of suction harvesting efforts for the past 5 years

**How has the EWM Reacted to the Different Treatments?**

Attached is a graph that shows the frequency of occurrence and percent milfoil cover since the beginning of herbicide treatments on Lake St. Catherine. You will notice that both measurements took a large plunge after the initial Sonar treatment in 2004, and increased in 2007 after two years without any herbicide treatment. Since then, though it has fluctuated, it has remained relatively stable and far below the frequency of occurrence and percent cover present prior to the first herbicide treatment in 2004.

**Other invasives**

EWM is not the only invasive species that the LSCA has had to deal with over the years. According to the Vermont DEC, Lake St. Catherine has also dealt with Curly-leaf Pondweed, Water Chestnut, and Alewives. While EWM was substantially limiting the Lake's recreational value and taking over the Lake ecosystem, it is important to be aware of other invasive aquatic species that might negatively impact the Lake in other, less noticeable ways. The LSCA has not had specific programs targeting these other invasives, rather they have taken precautions against the introduction of any invasive species into the Lake through the Greeter Program.

**Lake St. Catherine Public Access Greeter Program: Inspection and Education**

The Greeter Program at Lake St. Catherine began in 2004, the same year as the first herbicide treatment on the Lake. The Vermont Public Access Greeter program is supported by the Vermont DEC and is operating on 27 Lakes and ponds statewide. In 2017, 23,547 watercrafts were inspected in the state of Vermont as a part of this program. On Lake St. Catherine, the program operates Memorial through Labor Day on Saturdays, Sundays and holidays. The Association reimburses salaries of the Public Access as part of the aquatic nuisance grant from DEC, whose job it is to educate Lake visitors on invasive species, provide courtesy watercraft inspects, and stop introductions of invasive species. "The most effective way to prevent the spread of aquatic invasive species is through education, equipment inspection and watercraft decontaminations performed to clean and remove potential invasive species "hitching a ride" on equipment and watercrafts." (Vermont DEC Public Access Greeter Program Manual) It makes much more economic sense to prevent introduction of invasives than to eradicate them after introduction. Invasive species that are targeted in the Greeter Program include alwives, asian clams, brittle naiad, curly-leaf pondweed, European frogbit, Eurasian watermilfoil, Starry stonewort, spiny water flea, variable-leaved watermilfoil, water chestnut, and zebra mussels.

The Public Access Greeters perform a variety of inspections and decontaminations to prevent the spread of aquatic invasive species. They perform a visual and tactile inspection, remove organic material, ask the boater to remove the bilge plug until drained, and provide educational materials regarding invasive species and how to reduce their spread as boaters travel between Lakes. In the most recent year, over 800 watercraft have been inspected by the Greeter Program on Lake St. Catherine.

The Greeter Program is not only aimed at preventing the introduction of invasives to Lake St. Catherine, but also at education and community building. It is really an opportunity to interact with boaters, gain their trust, and provide them with information on how to safely enjoy the Lake. The Federation of Vermont Lakes and Ponds

(FOVLAP) stands by the goals of the Public Access Greeter Program, calling upon Vermonters in their April 2018 news release to obey the law and clean their boats and trailers of all plant fragments and tiny animals before transporting them to other bodies. They also highlight that Act 67 authorizes the Vermont Department of Fish and Wildlife to crack down on violators by issuing fines. The Lake St. Catherine Association has documentation of well over 800 boats checked in a single season through the Greeter Program. The LSCA has taken the initiative preventing the spread of new invasives to their Lake by choosing to bring the Greeter Program to Lake St. Catherine and taking on all of the additional work necessary to maintain the program.

## Current Snapshot

On the most recent Inland Lake Score Card for Lake St. Catherine, the only portion we have yet to discuss is the aquatic invasive species section. The score for Lake St. Catherine is poor, another red area on the score card that was disappointing for the Lake St. Catherine Association to see. However, the score is based on the presence of one or more invasive animal or plant species. “Poor” indicates that there is at least one invasive species present, regardless of its abundance or nuisance level or trends in observation and inspection. In fact, the only possible scores are good for a Lake without any trace of aquatic invasive species, or poor for the presence of one or more. A poor score does not mean that a Lake is overrun with invasive species, but simply that they are present. According to the Vermont DEC, 101 water bodies in the state of Vermont have EWM present, the majority of water bodies in the state Vermont. Addressing the most problematic aquatic invasive species must be an organized, concerted effort among all Lakes and ponds in Vermont.

**What has the LSCA Done this Season to Deal with Aquatic Invasive Species?**

EWM has, as the most problematic nuisance species in Lake St. Catherine, remained the focus of the invasive species mitigation programs of the LSCA. The LSCA decided to continue with the combination of Renovate herbicide spot treatments and diver assisted suction harvesting efforts in other spots. 13 areas totaling 38 acres were selected for suction harvesting, 39.1 acres were treated with Renovate 3 Aqueous solution, and 8.2 acres were treated with Renovate OTF. This is representative of the roughly 50/50 strategy that the LSCA is attempting to maintain between suction harvesting and herbicide treatments. The Lake was treated on Monday June 18th, 2018. Signage, printed warnings and online notification were all provided to the Lake community to advise them about Lake water use restrictions following the treatment to ensure safety.

Of course, the Public Access Greeter Program has continued through the 2018 season in order to prevent the spread of any new invasive species. The Public Access Greeters at Lake St. Catherine have yet to have an issue regarding the introduction of aquatic invasive species at the entry points through watercrafts.

## Future Considerations

Looking toward the future, especially as it pertains to management of invasive species, there are many possibilities. As science progresses and becomes more precise, the LSCA will be on the forefront of the research and discovering which treatment options will provide the most effective, safe and healthy treatment program for Lake St. Catherine. There is a new herbicide on the market that the LSCA has expressed interest in, as there is a lot of interest surrounding its emergence. ProcellaCOR is a new aquatic herbicide that can be used in spot treatments to control EWM, Hydrilla, Crested Floating Heart, and other aquatic weeds. LSCA’s herbicide contractor, SOLitude Lake Management, is currently waiting for approval from the EPA to apply for use of ProcellaCOR (which will in turn be scrutinized by the Vermont Dept of Health before considered by DEC). Apparently, ProcellaCOR has the potential to become the new gold standard when it comes to aquatic herbicides. It has been tested on ponds; it is selective for EWM, it does not appear to have any side effects, the treatment solution lasts longer than its competitors, and it completely obliterates the plant as well as having no water restrictions. Once SOLitude Lake Management receives EPA approval, they will have to receive approval from the

Vermont Department of Health, which could potentially take a couple of years. Even staff at the Vermont DEC are excited and optimistic about this new prospect.

All of the Board Members interviewed as part of the focus group agreed that the LSCA would ideally like to move toward using more suction harvesting and less herbicide. Although Renovate is completely safe, most would agree that replacing herbicide treatments with more suction harvesting would be more accepted in the Lake community and a more organic method of weed management. The LSCA has maintained this 50/50 relationship between the two methods, but many would like to see that scale tipped toward more suction harvesting.

As far as future invasive species management goes, many members of the LSCA would like to see the Association combine forces with the Lake St. Catherine Conservation Fund, an organization concentrating its involvement with the Little Lake in Wells. The Little Lake is a part of Lake St. Catherine as a connected water body, but the residents of that Lake decided to separate, create their own Lake association, and employ their own strategies. For the future, it would be most effective to have a cohesive treatment plan that includes both water bodies and benefits the entire Lake community. Hopefully there will be more discussion between the two organizations, a convergence of treatment and perhaps some compromise to do what is best for all of Lake St. Catherine and those who enjoy its waters.

# IV. Fish and Wildlife Protection

Unlike the sections of this report involving water quality, invasive species abatement and watershed protection which are data-driven, the discussion regarding fish and wildlife is a qualitative one. Specifically, have the interventions had positive consequences for the ecology of the Lake or have there been unintended consequences on fish and wildlife.

The beliefs in this area are governed by qualitative inspection, by observing trends and new developments.

## Past Interventions

Fish and game organizations had previously expressed reservations with respect to bass fishing in the Lake through their belief that the milfoil gave cover for the bass habitat. Although preference was given to weed harvesting, it became increasingly clear that the unbridled growth of milfoil negatively affected the overall ecology and recreational use of the Lake.

## Current Snapshot

Lake St. Catherine offers both warm water and cold water fishing. It is common to find big and small mouth bass as well as the usual pan fish (including some large crappies) and yellow perch. The Lake has been known to yield 13 pound pike.

Since the main Lake is almost 70 feet deep, you'll find Lake trout, rainbows, brown trout (stocked and consume alewife) and an occasional brook trout. The State claims there are landlocked salmon here also. The state regularly stocks predator fish such as trout to control a herring-like fish--the alewife—that was introduced to the Lake, probably by a fisherman dumping a bait bucket. The alewife is a great bait fish. However, it eats zooplankton which eat algae and it known to have impacted water clarity.

It is commonly held that there is ample example of the maintenance of species richness since the beginning of the herbicide program. This is especially true given the use of a selective herbicide has meant that native wildlife are not being negatively impacted by herbicide use.

The structured interview of LSCA Board members also contributed to this discussion and yielded the following observations:

- Fish and wildlife in this Lake has made a massive turnaround in the last 10 years
- When the weeds were at their worst, the wildlife, fish, and enjoyment of the Lake was on the decline
- Many board members report that wildlife is flourishing.
- Fishing seems to be abundant, the Lake is a stocked Lake
- Reappearance of bald eagles at Lake St. Catherine
- The loons are now present
- Presence of large herons
- The Lake hosts several major fishing tournaments here every year.
- In the past two year Benson Derby Ice Fishing Tournaments, Lake St Catherine competed favorably with size and number of fish, compared to Lake Bomoseen and Lake Champlain
- Non-aquatic life present on the Lake: Beavers, woodchucks, frogs, muskrats and otters are abundant

- Now we have eagles, loons, cormorant and osprey, a sign that the Lake is healthier as a wildlife habitat

## Future Considerations

Trends seem to continue to favor both the presence and return of species richness. Although it is difficult to track specific data on each type of fish and wildlife, LSCA can lend its voice to the development of measurement tools through its involvement in the Federation of Vermont Lakes and Ponds. It would be useful, for example, to develop a peer group of Vermont Lakes of similar size and characteristics and compare experience over time. Similarly, it will be useful to continue an ongoing dialogue with fish and wildlife organizations to learn from each other's perspective and experience.

Moreover, as a part of LSCA's diligence in this regard, there may be opportunities to develop objective criteria to measure progress in the future. In this way, LSCA will be increasingly able to evaluate strategies for water quality, watershed improvement, invasive species abatement, and recreational safety for their projected impact on fish and wildlife.

# V. Recreational Use and Safety

Recreational use and safety has been enhanced through a multi-part strategy that includes:

- Maintaining and purchasing navigation and shoreline protection buoys throughout the Lake.
- Managing the free Boating Safety courses that are state mandated for all persons born after January 1, 1974.
- Providing signage and beautification through community-sponsored gardens.
- Providing recreational activities to encourage involvement and camaraderie with events such as the annual boat parade.
- Cooperation with the Vermont State Troopers in patrolling the Lake

## Past Interventions

- Summer 2018: 43 people passed the boating safety course
- Summer 2017: 13 people passed the boating safety course
- Summer 2016: 19 people passed the boating safety course in Wells, 18 in Poultney
- Summer 2015: Only four people took the course in Wells and all passed
- Summer 2014: 12 attended and 10 passed the course in Wells. Poultney class cancelled due to lack of sign ups.
- Summer 2013: 19 attended and 14 passed the course.
- Summer 2012: 42 attended and 37 passed
- Summer 2011: 20 attended and 17 passed
- Putting out the buoys
- Education, information and notification of herbicide treatment and impacts
- Presence of the Lake Association at Wells variety day, East Poultney Day: a table with a banner and informational pamphlets
- Connecting with the communities that surround the Lakes
- Change of the organization to a 501(c)(3) for the Association to have a greater environmental purpose on the Lake
- Cooperating with State Trooper patrols on the Lake on a periodic basis and as circumstances warrant

## Current Snapshot

- The Boater safety course enjoyed a record-breaking boating safety program this season with 28 people at each of two sessions, for a total of 56 participants. After passing the test, students receive a license to operate motorized vessels, which is good in all 50 states.
- The program continues to coordinate the “buoy buddies” by placing and maintaining “No Wake” and safety markers around the Lake each summer.
- Outreach on Lake Safety continues with East Poultney Day and Wells Variety Day
- Education about herbicide treatment and safety concerns via website and newsletter
- Social media involvement via Facebook Page, Blogs and increased online presence
- In cooperation with the Greeter program, the collaboration provided an opportunity to interact with boaters and provide them with information (pamphlets) on how to safely enjoy the Lake.

## Future Considerations

- Although the LSCA does not have any legal authority over the people who use the Lake, its job is to set up the Lake to be a safe environment and educate people on how to safely engage with the Lake.
- There are great opportunities to have an influence both through communication and education.
- Given the constraints on the State Police's ability to control every Lake in Vermont, the historic cooperation with LSCA can be maximized by touching base with the State Police about what we can do to better ensure recreational safety as a volunteer organization

# VI. Watershed Protection

## Past Interventions

2016 Milfoil Management Report: “Runoff into the Lake from lawns, fertilizers, road culverts and construction sites all serve to encourage weed growth and silt accumulation. Planting appropriate barriers along shorelines is critical to reversing this problem”.

Interns from the Poultney-Mettowee Conservation District visited Lakeside homeowners in 2013 to conduct survey of septic systems. They built on a survey to get a grant to help people who have wells, and those using Lake water to locate inputs and outputs. There is a history of collaboration with the Conservation District, especially connecting homeowners on the Lake with experts on the planting of buffer plants to reduce runoff. The Poultney Mettowee Natural Resources Conservation District presented information at the LSCA 2018 Annual Meeting about the LEAP program which works to add native plantings around the Lake on homeowners’ properties and also discussed the LSC Stormwater Master Plan which looks to fix areas where storm runoff makes its way into the Lake.

## Current Snapshot

### LEAP program; summer internships on the Lake

The Lake Education and Action Program, initiated and run by the Poultney Mettowee Natural Resources Conservation District (PMNRCD or the District), just finished a great summer of work on Lake St. Catherine and Lake Bomoseen. The program was run by a Green Mountain College student, and provided month-long internships to four students from Mill River and Poultney High Schools. The students learned about Lake-related water quality issues and visited past project areas as part of their on-the-ground training. Through the program, the students interacted directly with Lakeshore homeowners, passing out packets of information on timely topics, such as the importance of shoreline vegetation, the shoreline protection act, invasive Water Milfoil, and septic maintenance. They also installed four buffer plantings each on Lake Bomoseen and Lake St. Catherine. In addition to installing new plantings that will help to improve soil health and filter nutrients and water draining from impervious surfaces to the Lake, the LEAP interns maintained several older installations, keeping them functioning properly into the future.

### The important work at Lake St. Catherine State Park

The State of Vermont DEC has been evaluating State Parks within the context of the Lake Wise Program, which is an initiative that awards lake-friendly shoreland properties. The goal of Lake Wise is to establish a new culture of lakeshore landscaping that is proven to help protect the lake. A property that earns the Lake Wise Award will represent a "model" shoreland property. The Lake Wise Award certifies a property is well managed, using shoreland Best Management Practices, and is maintained to care for the lake.

In 2014, Lake St. Catherine State Park was one of 10 State Parks that was evaluated through the Lake Wise Program. The Lake wise evaluation provided recommendations for improvement to bring the Park up to the Lake Wise standards. Three of the 10 Lake Wise evaluated State Parks received funding in 2017 to implement the Lake Wise recommendations (Lake St. Catherine, Silver Lake State Park in Barton, and Island Pond State Park in Brighton.) In the spring of 2017, crews worked to install two sets of infiltration steps in steep, eroding access path areas, widen the vegetated buffer to 15 feet, and to add plantings on the banks. In the fall of 2017, crews returned to complete some upper bank stabilization at the top of the slope and to remove a campsite at the top of a steep slope, renaturalizing the area to reduce compaction at the top of the slope, which will reduce erosion.

**Stormwater Assessment and Lake Wise Certifications**

The Poultney Mettowee Natural Resources Conservation District is working with Fitzgerald Environmental Associates (FEA), Lake Associations, Towns of Wells and Poultney, and local homeowners to assess pollution contributions made to Lake St. Catherine and the Wells River during storm events. With increasing rainfall during thunderstorms and additional winter thaw cycles, it is more important than ever to infiltrate and filter the water draining to our Lakes and rivers. The partners on this project have identified a number of opportunities and will continue to work with landowners and town boards to identify solutions to stormwater runoff issues. This project provides the exciting opportunity for local homeowners to receive free Lake Wise Assessments. The assessments are designed by Vermont's Lakes and Ponds Section of the Department of Environmental Conservation (DEC) to identify aspects of homes, paths, and parking areas that meets or exceeds the recommended practices to keep pollution from reaching the Lake. Anyone on Lake St. Catherine may sign up and properties that meet the suggested practices will receive a sign for their yard. Most importantly, homeowners will receive site-specific information about their property's runoff and erosion and a corresponding list of solutions to improve drainage and infiltration of stormwater around their home.

Hilary Solomon of the Poultney Mettowee Natural Resources Conservation District applied for Ecosystem Restoration Program (ERP) funding and was awarded the funds to go forward with the assessment. Hilary will be working with partners to do a lake-focused assessment of the Lake St Catherine and the Wells Brook watershed, which includes roughly half of the Wells Brook-Mettowee River. Included are Endless Brook, the largest tributary to Lake St Catherine, which carries high sediment loads during storms, and Wells Brook, which flooded badly on July 1, 2017, and shows erratic and often high bacteria and nutrient concentrations during summer water quality monitoring. The project will involve completing an extensive field assessment to identify sources of pollution and stormwater to the streams in the Wells Brook Watershed and to Lake St Catherine.

Projects to fix the problem areas will be identified and will be prioritized, based on quantitative criteria agreed upon by Vermont DEC staff. The 20 most effective projects will receive a one-page write up to assist with public outreach and help facilitate implementation. The six highest-priority, more complex projects (to be determined with DEC input) will receive conceptual designs.

LSCA will be working in partnership with the Poultney Mettowee Natural Resources Conservation District with the release of the overall Watershed Protection report in December 2018 and will collaborate on implementing the findings in 2019.

**Act 64 and Town Roads**

Vermont roadways are responsible for about 10% of sediment and phosphorus sources to surface waters, and municipal roads make up 70% of 118,777 total miles of roads in Vermont. To help reduce road runoff and protect surfaces waters, Act 64 mandates all hydrologically connected roads (class one through four) be maintained according to new road drainage standards. (see Appendix 15)

**Best Management Practices (BMPs) include:**

Enabling water to flow like a "sheet" off the road, avoiding concentrated erosive flow by building up the crown—the high point in the middle of the road—to distribute flow to both sides of the road.

- Increasing the size of road culverts where erosion occurs (generally, to 18-inches in diameter) to reduce clogging.
- Stabilizing ditches either with stone (≥8% slope) or vegetation to prevent soils from eroding.

- Removal of roadside berms that prevents water from leaving the road, also by lowering the built-up shoulders, ditching may be avoided with improved sheet flow
- Trees and shrubs along roads within 250 feet of a Lake should not be cut and roads should not be widened toward the Lake side. This existing vegetation is essential for protecting the integrity of the road while stabilizing the shoreland bank.

* For discussions with the Towns of Poultney and Wells:

If Town Road within 250 ft. of a Vermont Lake, the Town is not required to do any cutting, as the vegetation holds bank stability and reduces runoff.

## Future Considerations

These include, but are not limited to: the priorities in the next five-year DEC permit application; the DEC Best Practices Checklist; LEAP and Stormwater Master Planning; Act 64 Municipal Roadways Permit; Lake Wise criteria; State of the Art of Herbicide Development; lessons learned from the Lily Pond Case Example; and the evolution of new technologies.

Throughout this paper it has been clear that LSCA has tried to take a balanced and integrated approach to problem-solving on behalf of all Lake residents and the surrounding communities. It needs to be noted that the approach discussed for Lake St. Catherine throughout this paper is at variance with the priorities of the Little Lake's Conservation Fund. The 3 point plan from the Conservation Fund includes: Aeration; Dredging and Mechanical Harvesting.

Other opportunities to highlight potential improvements in the watershed, going forward, include:

- Leahy Summit and Clean Water Week, specifically consideration of LSCA organizing a team to attend the Leahy Summit in April, 2019, with the overall goal to bring many different interest groups together and working on the LSCA watershed together.
- Partnering with the Lake Champlain Basin Program for grants involving: Pollution Prevention, Watershed Protection, Invasive Species Prevention, Organizational and Community Outreach and Development of Organizational Capacity
- Communication with Lake St. Catherine State Park on common protocols for public access boat launches
- Partnering with Poultney Mettowee Natural Resources Conservation District on the implementation of Lake Wise projects in the Lake St. Catherine watershed.
- Annual review of DEC Lake Protection Best Management Practices (see Appendix 14)

**Research on the Economic Benefit of Lakes to the surrounding community**

Repeated research projects conducted in nearby Maine (Boyle, Bouchard et al) have been instructive in discussing the importance of maintaining the quality of Vermont Lakes. The following summarizes applicable themes:

- Vermont's 162 scenic Lakes and ponds are as woven into Vermont's quality of life as they are into the landscape. Clean Lakes maintain Lakeshore property values, contribute to the economic status of entire communities, and offer intrinsic, aesthetic value for recreation. Defining the value of Lakes allows us to put the risk of degrading water quality and the cost of protecting our Lakes in perspective.
- Thirty-five of the 53 Vermont State Parks are located on Vermont Lakes, including all the most popular parks. In Maine, New Hampshire, and Vermont, studies on the impact of water quality on

Lakefront property values demonstrate a significant loss in property value as water quality degrades. Lower property values represent a loss in town tax revenue. The Parks represent an important central locale for summer vacations and community gatherings.

- The seasonal nature of most of the residents does not place a lot of demand on the community resources, such as schools, yet does contribute meaningfully to the tax base for municipal services and education.
- The influx of residents and the trend to more year-round retirement homes on the Lake has a significant positive benefit on shoring up local businesses as well as construction trades.
- The ample opportunities for recreation in and around the Lake has a positive impact on the health of the local population.
- Employment opportunities at the Lake for students and adults include the Greeter program at the boat launch as well as jobs in businesses serving Lake residents.
- Lake residents are active consumers supporting the economies of Poultney, Wells, Granville, NY and surrounding communities.
- Local construction contractors and subcontractors will be encouraged to build expertise in preserving and protecting the Lake watershed by attending Vermont DEC seminars and highlighted on the LSCA website for recognition accordingly.
- The community of LSCA members is a conduit for both communication and education and a vehicle for the development of civic pride.

Accordingly, there is a fundamental alignment of interest between LSCA, the local municipalities of Poultney and Wells, local elected officials and the state legislature and Governor's office.

**For all the above reasons, supporting the past, present and future contributions of LSCA is in the best interest of the broader community from both an ecological, social and economic standpoint.**

**LSCA stands ready to continue its interventions that are science-driven and evidence-based now and into the future.**

## List of Appendices