FINAL REPORT

Volunteer Coordination and Training for the 2022 Lake Champlain Cyanobacteria Monitoring Program

Project Code: LS-2022-003
NEIWPCC Job Code: 0357-002-001
Contractor: Lake Champlain Committee
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Project Period: 1/24/22 - 4/23/23
Date Submitted: 4/28/23
Date Approved: May 10th, 2023

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This is a Lake Champlain Basin Program funded project. This project has been funded wholly or in part by the United States Environmental Protection Agency under assistance agreement (LC 00A00707- 0) to NEIWPCC in partnership with the Lake Champlain Basin Program (LCBP). NEIWPCC manages LCBP's personnel, contract, grant, and budget tasks and provides input on the program's activities through a partnership with the LCBP. The contents of this document do not necessarily reflect the views and policies of NEIWPCC, the LCBP, or the EPA, nor does NEIWPCC, the LCBP or the EPA endorse trade names or recommend the use of commercial products mentioned in this document.

Week 7 Blooms from 8/6/22

The photos above show close-ups (top row) and broad views (bottom row) of blooms from Derway Cove Inlet on the Winooski River (left column), St. Albans Bay Park beach on Lake Champlain (middle column), and the Lake Carmi VT State Park beach (right column) on Saturday 8/6/22. Blooms impact use any day of the week but have an outsized impact on a hot summer weekend.

EXECUTIVE SUMMARY

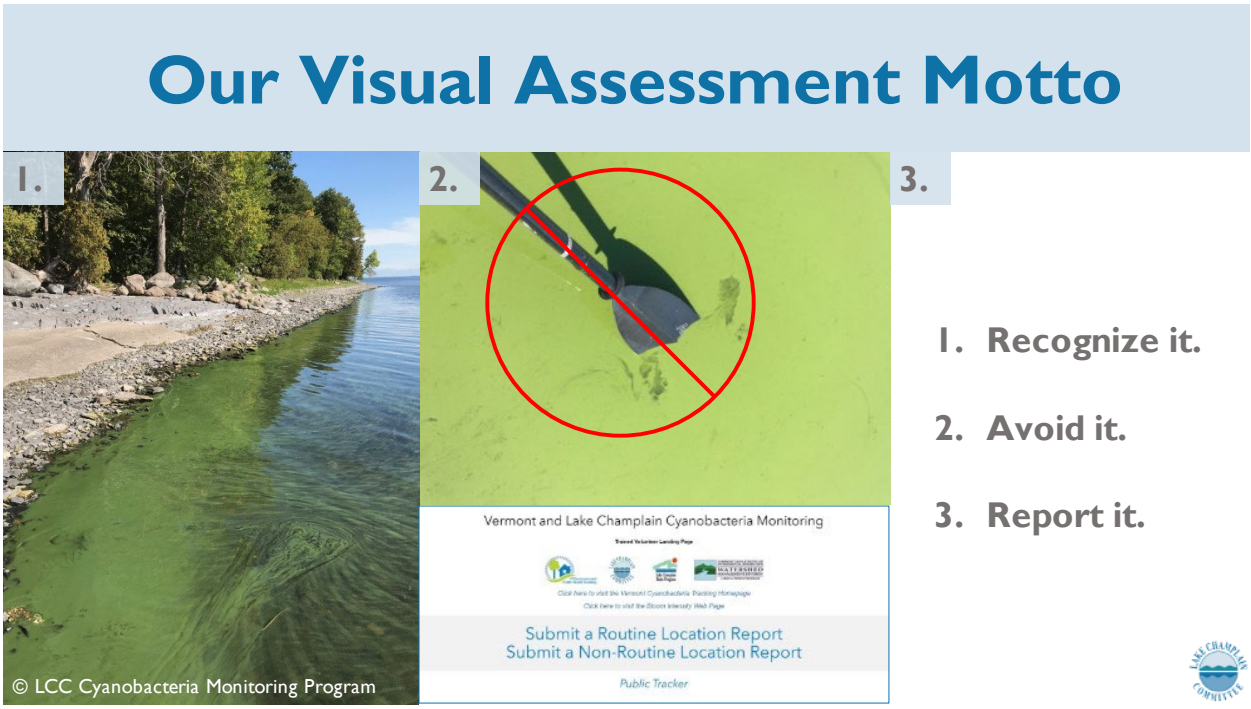
A Lake Champlain cyanobacteria monitoring program has been in place since 2002. The Lake Champlain Committee (LCC) initiated a community-based near-shore monitoring program in 2003 and has expanded the network of trained volunteers and monitoring sites since that time. The monitoring program is a collaboration with the Vermont Department of Environmental Conservation (VT DEC), Vermont Department of Health (VDH), the Lake Champlain Basin Program (LCBP) and participating New York agencies. The program includes New York, Vermont and Quebec monitoring sites on Lake Champlain and monitoring sites on inland Vermont lakes. All of the monitoring data collected is housed in the Cyanobacteria Tracker database hosted by VDH. Funding for LCC's portion of the monitoring program is provided by the Lake Champlain Basin Program and private donations.

This report covers LCC's portion of the Lake Champlain cyanobacteria monitoring program development and implementation for the period between January 24, 2023 and April 23, 2023 and focuses on monitoring season preparation, recruitment and training of volunteers, monitor season reporting, and program deliverables. Since 2012, VT DEC has had primary responsibility for Quality Assurance/Quality Control and the Quality Assurance Project Plan (QAPP) program oversight. Reporting analysis is provided in a separate joint report by the Vermont Department of Environmental Conservation (VT DEC), Vermont Department of Health (VDH), and the Lake Champlain Committee (LCC).

During the 2022 season, LCC recruited volunteers year-round, trained over 300 individuals at 24 separate virtual training sessions and two in-the field sessions, and supported a network of community science volunteers and state and municipal staff who monitored for cyanobacteria at 139 Lake Champlain locations and 59 inland Vermont lake sites. LCC also assisted with training needs for state park staff in select regions, inland lake monitors throughout Vermont, and other personnel. LCC's data collection complemented those of VT DEC and VDH and was integrated into a program that included qualitative observations and quantitative analysis. Community science volunteers, partner organization staff, and the general public submitted 2,534 approved site-specific reports during the 2022 monitoring season, 1,869 from Lake Champlain and 665 from inland Vermont lakes. In addition, two LCC monitors augmented weekly reporting by assessing conditions on a daily basis at three Vermont locations – Graveyard Point East (134 observations) and Graveyard Point West (142 observations) in North Hero, and Shipyard in Highgate (131 observations) for a total of 407 daily reports.

LCC, with some assistance from partner agencies, vetted all of the monitor observations before they were approved for public viewing on the Cyanobacteria Tracker housed on the VDH website. The vast majority of the report review and approval was done by LCC staff (89% by LCC, 8% by VDH, 1.5% by LCC and another partner jointly, 1.5% by VT DEC). All partners prioritized vetting reports of blooms over generally safe conditions, but only LCC vetted reports on weekends. LCC endeavored to review reports within an hour of receipt to ensure timely posting on the public data tracker. On days we were in the field, the review time was slower.

LCC communicated reporting results via our website, separate weekly emails to monitors and a list-serve of interested community members and the media, and through media interviews, community outreach, and social media avenues. LCC's public outreach focused on how and why to recognize, avoid, and report cyanobacteria blooms.



Training sessions for monitors and interested community members taught people how to recognize, avoid, and report cyanobacteria. The above slide is from a 2022 Cyanobacteria Training Session.

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1. PROJECT SYNOPSIS

Program Background and Purpose

Lake Champlain is one of the largest lakes in the United States and an important water resource for the states of Vermont and New York, and the province of Quebec. The lake is a drinking water source for nearly 200,000 people, a prime recreational resource for residents and visitors, and the economic driver for the region. The regional tourism economy is heavily dependent on the lake health and water quality. Cyanobacteria blooms have been documented in the lake since the 1970s, with some areas experiencing extensive annual blooms. In 1999, several dog deaths were attributed to cyanobacteria toxins, raising health and safety concerns regarding drinking water supplies and recreational activities such as swimming, boating and fishing. Public concern about cyanobacteria blooms remains high and exposure to cyanobacteria blooms represents a public health threat. The community science cyanobacteria monitoring program enlists and engages volunteers, partner organizations and agencies, environmental and recreational personnel, municipal staff, and community members in a collaborative program to assess water access areas and keep the public informed about conditions. It also provides important data to help us further understand when and why blooms occur, engages community members in helping to gather and share information about an environmental/public health issue of concern, and fosters actions to reduce future frequency of blooms.

Week 8 Bloom Sampler

A montage of blooms from the week from Lake Champlain's St. Albans Bay (left two), Burton Island State Park (middle), Knight Point State Park (second from right), and Missisquoi Bay (right).

History of Cyanobacteria Monitoring on Lake Champlain

A Lake Champlain cyanobacteria monitoring program has been in place since 2002. The Lake Champlain Committee (LCC) initiated a community science-based near-shore monitoring program in 2003 and expanded the network of trained volunteers and monitoring sites since that time. The monitoring program is an effective collaboration with the Vermont Department of Environmental Conservation (VT DEC), Vermont Department of Health (VDH) and participating New York agencies including the New York Department of Environmental Conservation (NYS DEC), New York Department of Health, (NY DOH), and New York Office of Parks, Recreation and Historic Preservation (NYOPRHP). From 2002 to 2011, the Lake Champlain Basin Program provided the majority of funding for the annual cyanobacteria monitoring program which utilized cell density and toxin data to evaluate recreational conditions around the lake. Results were communicated to stakeholders around the region through weekly updates. The University of Vermont (UVM) developed and implemented the program, in cooperation with LCC, VT DEC and VDH. The monitoring program was well received locally and served as a model at the regional and national level.

Beginning in 2012, the volunteer monitoring portions of the program coordinated by LCC transitioned from an analytically intensive sampling-based system to a visually-based observation approach. This change enabled us to expand the monitoring network to underserved areas of the lake, provide rapid assessments of visible water quality characteristics, while continuing to provide the information necessary to inform recreational and public health response in a fiscally sustainable program. The volunteer monitoring complemented on-going analytical sampling and analysis conducted by VDH and VT DEC. This visual assessment protocol was officially adopted by the program in 2012, and data quality was evaluated by comparing visual assessment reports with laboratory-based results for cyanobacteria and cyanotoxins. Both approaches were used simultaneously for several summers to ensure usefulness. As the value of the visual assessment protocol became evident, the collection of water samples at every station was replaced by annual quality control samples collected at a subset of locations.

Timetable

The Cyanobacteria Monitoring Program is a year-round program. Key program partners (see below) meet or are in contact throughout the year to coordinate on the different program phases. LCC recruits monitors throughout the year. Program review and development of training and educational materials takes place in the winter and spring before the upcoming monitoring season. Training of new and returning monitors is focused in the spring prior to the official monitoring start date but continues throughout the monitoring season with additional training sessions offered in the summer and fall. Monitoring spans three seasons, beginning in

late spring, covering the entire summer, and ending in early fall. The 2022 monitoring season ran for 20 weeks in order to capture late season blooms. Report clean-up, program assessment, and data analysis is conducted during the fall and winter. The final project report is completed in the spring once project partners have completed their joint review and analysis of reporting results.

Partnership Approach

The Lake Champlain Cyanobacteria Monitoring Program is a unique partnership that leverages existing monitoring programs around the lake and works with stakeholders from across the watershed. This partnership includes the Lake Champlain Basin Program (LCBP), an organization that coordinates management of Lake Champlain; Departments of Environmental Conservation (DEC) and Departments of Health (DOH) in New York and Vermont; and the Lake Champlain Committee, a watershed-based nonprofit. In addition to these coordinating partners, several other stakeholders actively participate, including: state and municipal park staff throughout the watershed; State University of New York at Plattsburgh; University of Vermont; and hundreds of community scientists trained by LCC that volunteer their time to monitor cyanobacteria in Lake Champlain and inland Vermont waterways.

Further monitoring, technical, and outreach support is provided by Vermont and New York DEC, Vermont and New York DOH, the New York Office of Parks, Recreation, and Historic Preservation, and Vermont State Parks. The Cyanobacteria Tracker and cyanotoxin analyses are currently supported by the Vermont DOH through funding received from the U.S. Centers for Disease Control and

Roles of Primary Partners

Lake Champlain Basin Program (LCBP) – LCBP provides financial support for the Lake Champlain Committee's cyanobacteria monitoring program work, supports the project coordinator housed in the Vermont Department of Environmental Conservation's (VT DEC) Watershed Management Division through the Lake Champlain Long-term Water Quality and Biological Monitoring Project (CLTM), and provides funding for cyanotoxin testing at Vermont drinking water facilities on Lake Champlain. They also help coordinate the regional meetings throughout the year amongst the lead New York, Vermont, and Quebec organizations and agencies involved in the program.

Vermont Department of Environmental Conservation (VT DEC) - Since 2012, VT DEC has had primary responsibility for Quality Assurance/Quality Control and the Quality Assurance Project

Plan (QAPP) program oversight. They coordinate with LCC on monitor training for inland waterways, conduct water sampling and analysis at Lake Champlain and VT inland waterway long-term monitoring sites, assist with outreach and communication about cyanobacteria, support the Drinking and Groundwater Protection Division's (DWGWPD) oversight of the cyanotoxin testing at Vermont drinking water facilities on Lake Champlain, and oversee the analysis of reporting results at the end of the monitoring season. The results of that analysis are provided in a separate joint report by the Vermont Department of Environmental Conservation (VT DEC), Vermont Department of Health (VDH), and the Lake Champlain Committee (LCC).

Vermont Department of Health (VDH) – VDH provides ongoing communication and analysis of health risks associated with cyanobacteria, houses and oversees the Cyanobacteria Tracker database and public map, coordinates with LCC and DWGWPD on water sampling and oversees the analysis, contacts municipal health officers and coordinates with municipalities when blooms are reported at local public access sites, and assists with monitor training and report vetting.

Week 12 - Jars of Blooms

Monitors captured water samples of blooms from Lake Carmi and Lake Memphremagog on 9/6/22 (top left and center) and Lake Champlain sites at Valcour Island on 9/7/22 (top right and bottom left), and Arnold Bay and St. Albans Bay on 9/9/22. LCC provides monitors with in-depth guidance on how to assess conditions and categorize blooms and tool to assist them including sample jars and photo cards to document conditions.

2. TASKS COMPLETED AND METHODOLOGY

TASK 1 – Plan 2022 Season

Planning

LCC assessed all aspects of the 2021 monitoring season in order to identify programmatic needs for the 2022 season and then began making changes and updating materials in the winter and spring of 2022. We drafted an outline of actions needed, identified lead implementors, reached out to monitors for feedback, developed and updated shared folders and files in Googledocs for LCC Team members, and held regular Team meetings to maintain program momentum.

TASK 2 – Implement 2022 Monitoring Program

Recruitment

LCC recruited monitors broadly through a variety of mediums and the training sessions were publicized through media outreach, public events, presentations, emailings and social media. Sign-in sheets for LCC programs and donation forms included a check-off box to indicate interest in serving as a monitor or receiving weekly updates during the monitoring season. These options were also conveyed through mailings and emailings to LCC's list-serve and community members throughout the year. LCC thank you letters and emails to donors, along with organizational information forms and fliers, and donation forms included an option to sign-up to monitor or receive our weekly cyanobacteria monitoring reports. LCC's website further reinforced the program with web pages dedicated to information on cyanobacteria and the monitoring program, a volunteer response form and online forms to indicate interest in monitoring or sign up for or read weekly reports on water conditions.

Given the ongoing pandemic and monitor preference, we continued to promote online and virtual training sessions. Our monitor commitment form required that all prospective community science volunteers agreed in writing to follow COVID-19 safety measures required by the municipality or state they were monitoring in or the Centers for Disease Control (CDC) requirements, whichever was stricter.

Community scientist volunteer monitors were required to:

- Attend an online training session *(approximately two and a half hours for returning monitors, three hours for new monitors)*
- Have weekly access to a public or private lakeshore location
- Wear gloves and avoid dermal exposure when taking water samples
- Read and follow guidance in the LCC weekly emails to monitors

- Follow all applicable local, state, and federal COVID safety guidelines while monitoring and traveling across state and provincial borders for monitoring
- Agree not to sample or assess conditions at any public locations if they were feeling sick, had COVID-19 symptoms, or had close contact with anyone with COVID-19 in the last five days
- Follow any posted COVID-19 guidelines at any public sites where they monitor and agree not to monitor if the site wasn't open for public use
- Wear a face mask and practice physical distancing at public sites including state parks, beaches and boat launches if it was required
- File weekly reports via an online form after meeting the above protocols

Monitor Tools of the Trade

Monitors are provided with hats, gloves, T-shirts, photo cards and a hard copy toolkit if requested and urged to bring water and soap with them to wash off right away in the case of cyanobacteria exposure.

Public Access Sites are Prioritized for Monitoring

LCC's top priority for monitor recruitment is to have public access sites, such as beaches, boat launches, and parks, routinely monitored. From both a public health and equity perspective, they are the locations most accessible to the public and most likely to experience the highest levels of recreational traffic and public exposure during cyanobacteria blooms. Additionally, they provide greater options for maintaining data continuity whereas private site coverage may end when a monitor retires or property changes hands. In 2021 and 2022 we expanded our

monitoring form and outreach to more specifically identify both geographic and public access site gaps in coverage and promote these to prospective monitors. The online monitor sign-up form included a drop-down list of site needs and included links to a list by state and province as well as lake section. We also asked monitors to identify whether their site type is:

- public (i.e. a municipal, state or provincial beach)
- quasi-public (marina)
- multi-party private (private beach or launch area with access restricted to multiple private landowners)
- private (private property with single-family access to shoreline or private dock)

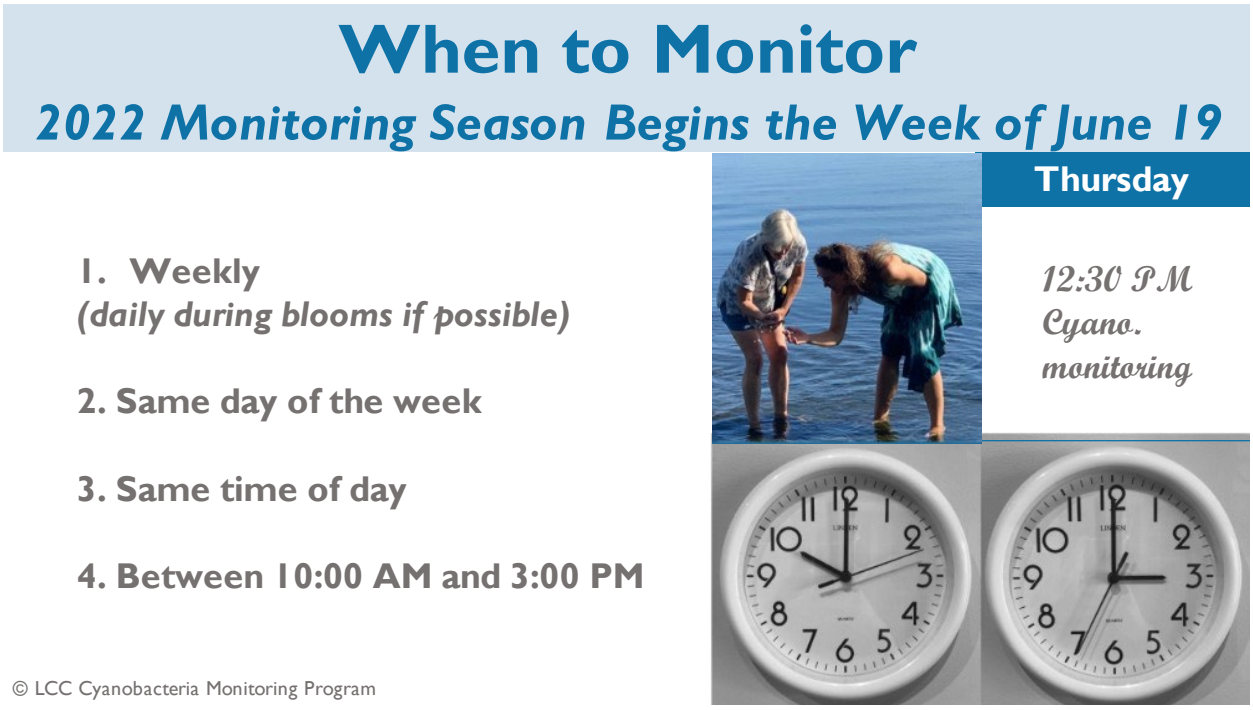
While we prioritized monitoring at public sites and multi-party private from a data continuity and public health perspective, we did not turn any potential monitors away and also responded to local knowledge about what private sites were commonly used by community members. Back or front yard monitoring also provides valuable information, particularly in areas like the South Lake that have fewer public access sites and very importantly they provide landowners with a stewardship opportunity and active engagement in water quality issues.

The volunteer monitor program has an impact beyond the recruitment of volunteers and collection of data. There is widespread public concern about cyanobacteria. While not all trained volunteers go on to report, all become familiar with cyanobacteria, potential health risks associated with them, the water quality conditions that increase the likelihood of blooms, and individual actions they can take to improve water quality.

Training Sessions

Due to the ongoing Covid-19 pandemic, and because virtual training sessions were generally more convenient for both staff and monitors, LCC continued to host training sessions online and trained over 300 potential monitors during 24 formal training sessions held via Zoom or other virtual platforms and two in-the-field trainings. Volunteers received extensive outreach from LCC to support attendance at the training sessions including outreach emails and reminders in advance of Zoom sessions. The emails provided information about the training sessions and guidance for accessing them online and how to navigate Zoom. Additional online and over the phone training sessions were also offered to people unable to attend pre-monitoring trainings. LCC provided training for municipal and state recreational staff and interested community members. Training sessions were separated into new (approximately three hours in length) and returning monitor sessions (approximately two and a half hours in length). LCC Executive Director Lori Fisher conducted all the trainings. “Open mic” sessions were held at the end of each training to allow for additional questions, discussion about water quality, and enable monitors to socialize with each other. Throughout the year we also held

informal information sessions about cyanobacteria as part of larger presentations on water quality.



Monitor Training

A slide from the returning monitor training session. Monitors are asked to check conditions weekly and on the same day of the week and roughly the same time of day whenever possible. Assessments should be done between 10 a.m. and 3 p.m. as that's when cyanobacteria are most visible in the water column. If monitors see blooms outside of those times they are asked to report them right away, but absence of blooms before 10 a.m. or after 3 p.m. is not necessarily an accurate reflection of conditions. Weekly monitoring tips are provided in the Weekly emails to monitors.

LCC's cyanobacteria monitor training sessions covered:

- background on cyanobacteria;
- causes and conditions that favor blooms;
- health concerns;
- management efforts and actions to reduce blooms;
- appearance and how to distinguish cyanobacteria from other lake phenomena;
- categorization of water conditions and blooms;
- photographic and water sampling requirements;
- reporting protocols; and
- instructions for filling out both the VDH and LCC online reporting forms.

Participants received detailed guidance on how to assess conditions. As needed or desired, monitors were also provided with sample jars, T-shirts, hats, gloves, masks (if desired), photo cards for documenting blooms, written information on how to take and mail water samples, the monitor toolkit, and LCC contact information.

All guidance materials were made available on the Lake Champlain Committee website (lakechamplaincommittee.org) and links to the online resources were provided in the weekly monitor emails throughout the season so that monitors had ready access to guidance on how to recognize and report on water quality conditions. Community members who attended training sessions or received our reports were encouraged to distribute the information to friends and neighbors to help broaden awareness about cyanobacteria.

LCC also provided online resources to educate anyone visiting our website about cyanobacteria. Information covered included:

- cyanobacteria in Lake Champlain;
- the cyanobacteria monitoring program;
- how to stay informed;
- what to do if you see a bloom;
- actions to take to reduce blooms.

Training materials for the monitors were based on monitoring results from previous years, the Vermont Department of Health's *Cyanobacteria (blue-green algae) – Guidance for Vermont Communities* along with field knowledge of experienced staff, and input from monitors. Key training tools or changes in approach were shared with VT DEC and VDH in advance of the 2022 season.

Monitoring Protocols

Monitors were asked to commit to monitoring at least one location for the duration of the monitoring period (late June through early fall). All volunteers attended a mandatory virtual training session or had personal contact with the LCC staff to learn how to recognize cyanobacteria, become familiar with the assessment protocol, and to submit their weekly reports. Monitors were trained to make their weekly observations between 10 a.m. and 3 p.m. on roughly the same day of the week. If they observed bloom conditions outside of their regular reporting period, they were asked to file supplemental reports as soon as possible. Any time blooms were observed monitors were encouraged to submit daily reports until after the bloom dissipated. LCC staff met with or interacted with each volunteer in the weeks following

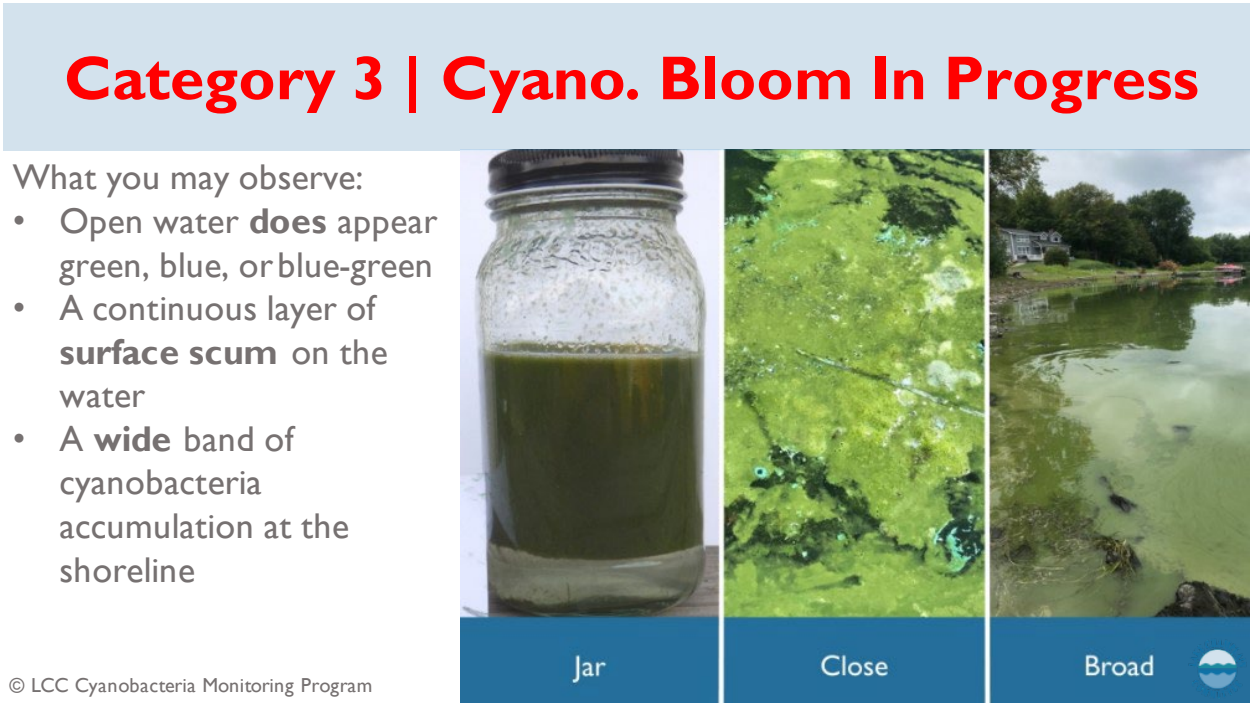
the training to ensure reporting consistency among volunteers and provide ongoing support. Not all volunteers were able to use the internet-based reporting system and instead submitted their reports by telephone or email. In some cases, LCC staff called monitors on a weekly basis to take reports over the phone.

Three-tiered Visual Assessment Approach

Volunteer monitors were taught to assess cyanobacteria conditions using a three-tiered visual system outlined at the training sessions and in the training materials. They identified conditions and assigned them to one of three categories:

- Category 1 – no or very few cyanobacteria observed. (Category 1 contained subcategories of ratings from 1a through 1 d).
    - 1a – clear water
    - 1b – brown and turbid conditions
    - 1c – other material present
    - 1d – little cyanobacteria, tiny specks present but no striations or clumps (photos requested)
- Category 2 - cyanobacteria present at less than bloom levels.
- Category 3 - cyanobacteria bloom in progress.

This language emulates the lake-user surveys conducted between 1987 and 1991 that formed the basis for the Lake Champlain water quality standards.

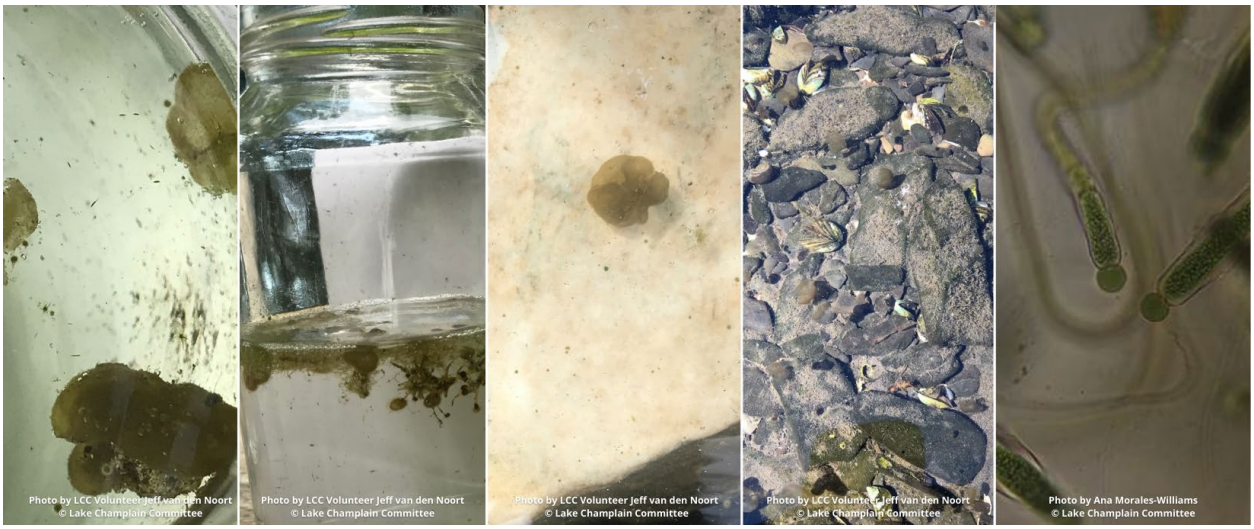


In the event that monitors observed category 1d, category 2 or category 3 where cyanobacteria was visible, they were asked to submit photographic documentation. We requested three photographs: a close-up of the water, a broader view to evaluate the extent of the bloom, and a water sample in a clear jar to help distinguish color and give cyanobacteria a chance to float toward the water surface. Photographs allowed us to check the monitor's assessment. If we disagreed with a monitor's categorization, we followed up to provide further guidance. When possible, monitors observing category 2 or 3 conditions reported daily through the duration of the bloom. Any time monitors reported blooms, LCC contacted them to encourage daily reporting.

Community scientist volunteers were trained to recognize cyanobacteria using visual cues and knowledge that project partners have gained over the 19-year lifespan of the volunteer monitoring program. We focused on the typical appearance of cyanobacteria blooms and other aquatic phenomena but also provided training on the exceptions we have seen in the field.

Assessing Less Common Cyanobacteria

In recent years monitors have witnessed cyanobacteria that are challenging to evaluate solely by visual observation. For example, the benthic cyanobacterium *Scytonema* sp. has become common in parts of Lake Champlain and Lake Carmi where it can form extensive surface accumulations that present more like filamentous green algae than cyanobacteria. The colonial cyanobacterium *Gloeotrichia* sp. Has showed up annually in several Lake Champlain locations since the 2017 season but sometimes looked more like pollen than cyanobacteria and could be confused with Daphnia. *Nostoc* sp., a bottom-dwelling genus of cyanobacteria was observed twice during 2019 in Lake Winona. During the 2022 season there were several reports of what turned out to be benthic cyanobacteria colonies on Lake Champlain and Lake Morey. In late August and off and on during September, two LCC monitors witnessed relatively large populations of benthic colonial cyanobacteria of the genus Calothrix *sp.* The sightings in North Hero, Vermont were confirmed by lab analysis but the samples from Alburgh were temporarily lost at the lab and by the time they were found they had deteriorated too much to be analyzed. Based solely on field samples and photographs one cannot distinguish Calothrix *sp.* from Rivularia. In Lake Morey, VT, a large bloom of *Microseira wollei* rose to the surface in the fall, and persisted for more than a month. *Microseira wollei* is a primarily benthic taxa that can form thick mats. Under the right circumstances, these mats can create serious surface blooms.



Calothrix sp. Cyanobacteria Found in Lake Champlain's Inland Sea

Astute LCC monitors noticed strange globules in the water at North Hero and Alburgh monitoring sites in late August and September 2022. Lab analysis from one of the samples confirmed it was Calothrix sp. a benthic filamentous cyanobacteria that can produce cyanotoxins. It has been found in most US states but is more commonly associated with rivers and streams than lakes and ponds. It can thrive in both flowing and standing freshwater as well as saltwater and is found in temperate, tropical, and sub-tropical regions. It is often attached to submerged rocks and wood but can also grow on the surface and in the tissues of aquatic plants and spread laterally across substrate.

To assist with identifications monitors are encouraged to share unusual observations with us and send a water sample to the University lab if they see something strange. This approach is reiterated in the weekly emails they receive throughout the monitoring season. However, given that benthic blooms have been increasing around the country and in our region as well, LCC has urged Vermont Department of Environmental Conservation and Vermont Department of Health project staff to help develop clear protocols to guide monitors in how to assess benthic cyanobacteria accumulations and what should trigger water sampling and lab analysis.

Paired Visual Assessment & Water Sampling

Since 2012/13 when the monitoring program moved to the visual assessment approach, four Vermont shoreline monitoring locations--Shipyard in Highgate, St. Albans Bay Park, North Beach in Burlington, and Red Rocks Park in South Burlington--have been designated locations for a paired visual assessment and water sampling approach. This is conducted for roughly 12 weeks of the monitoring season usually beginning in July and running through the end of September. The sites were chosen for additional analysis as an ongoing check on the visual assessment monitoring and because the locations were deemed of high risk/high concern due to the presence of drinking water facilities, high recreational usage, and/or a history of blooms. In 2022, Kingsland Bay State Park was added to the water sampling sites, due in part to the

relatively high incidence of cyanobacteria blooms in the southern Main Lake during the 2021 monitoring season.

LCC staff oversee recruit, train, and support the four community science volunteers at the four original sites, and Vermont state agency partners coordinate oversight for the new Kingsland Bay location. The volunteer monitors and State park staff for these five sites received additional training in water assessment and testing. They made visual observations at their designated sites on a weekly basis and also collected water samples from the shore during the 12-week water sampling period. For each weekly report a visual assessment was done and a single whole water sample was collected by placing a 0.5-L bottle carefully at the surface and tipping to fill, avoiding dilution of the surface scum as much as possible. The sample was mixed thoroughly and decanted into sample bottles for subsequent cyanobacteria enumeration or toxin analysis. All samples were kept on ice in coolers or refrigerated while in transit or at a drop-off location prior to reaching the designated lab for analysis. At the lab samples were

Water Sample Training

LCC Cyanobacteria monitors are trained to follow visual assessment protocols to provide rapid evaluations of water conditions. Monitor reports are vetted by trained staff at the Lake Champlain Committee (LCC) and our partners at the VT Department of Health and VT Department of Environmental Conservation. Some LCC monitors, like Red Rocks Park monitor Joe Brayden pictured above, provide both visual assessments and collect water samples which are analyzed to provide quality control of the visual monitoring.

analyzed for microcystin, anatoxin and cyanobacteria density and for quantification of cyanobacteria taxa to validate visual assessments. These samples were used to evaluate the effectiveness of the visual assessment protocol when evaluating recreational risk. VT DEC and VDH staff are responsible for reporting back results to LCC, especially if there is any situation where the visual assessments have under-reported conditions for cyanobacteria recreational standards. Based on lab analysis results to date, the visual assessments have never under-reported conditions that would trigger a health alert.

Table 1: Sites where routine shoreline quality assurance samples were collected

Site Number	Site Name (Location)	Waterbody (Region of Lake Champlain)	Sampler Affiliation	Number of Routine Shoreline Samples Collected
22	North Beach (Burlington, VT)	Lake Champlain (Main Lake Central)	LCC Volunteer	12
27	Red Rocks Beach (South Burlington, VT)	Lake Champlain (Main Lake Central)	LCC Volunteer	12
30	Shipyard, Highgate Springs (Highgate, VT)	Lake Champlain (Missisquoi Bay)	LCC Volunteer	10
31	St. Albans Bay Park (St. Albans Town, VT)	Lake Champlain (St. Albans Bay)	LCC Volunteer	11
180	Kingsland Bay State Park (Ferrisburgh, VT	Lake Champlain (Main Lake South)	VT DEC Staff	11

Report Vetting

LCC did the majority of report vetting with some assistance from the Vermont Department of Health Staff and limited involvement of Vermont Department of Environmental Conservation. All monitor reports were vetted before they were approved for public viewing on the Cyanobacteria Tracker housed on the VDH website. The results are accessible to anyone with internet access. In addition to presenting information on bloom conditions, the tracker also showed photographs (a feature initiated in 2020) of category 1d, 2, and 3 conditions whenever they were included with monitor reports. Monitors' observations were directly entered into the VDH tracker by monitors or received via an online form available on the Lake Champlain Committee website, by phone, or email. For reports that were entered into the VDH tracker, partners received automated notification of alert level reports posted to the tracking database. This facilitated communication and enabled quick review, approval and public posting of cyanobacteria blooms.

The vast majority of the report review and approval was done by LCC staff (89% LCC, 8% VDH, 1.5% by LCC and partners jointly, 1.5% VT DEC). All partners prioritized vetting reports of blooms over generally safe conditions. To ensure timely posting on the public tracker, LCC endeavored to review reports within an hour of receipt and immediately in cases of alert conditions. When possible we let project partners know in advance when we would be in-the field or out of a service area and unable to access reports. Since recreational activity increases

during the weekend, LCC also reviewed reports on Saturday and Sunday to ensure timely public notification and follow up with monitors. This high standard of vetting frequency resulted in LCC reviewing the majority of monitor reports that were posted and doing most of the monitor follow-up.

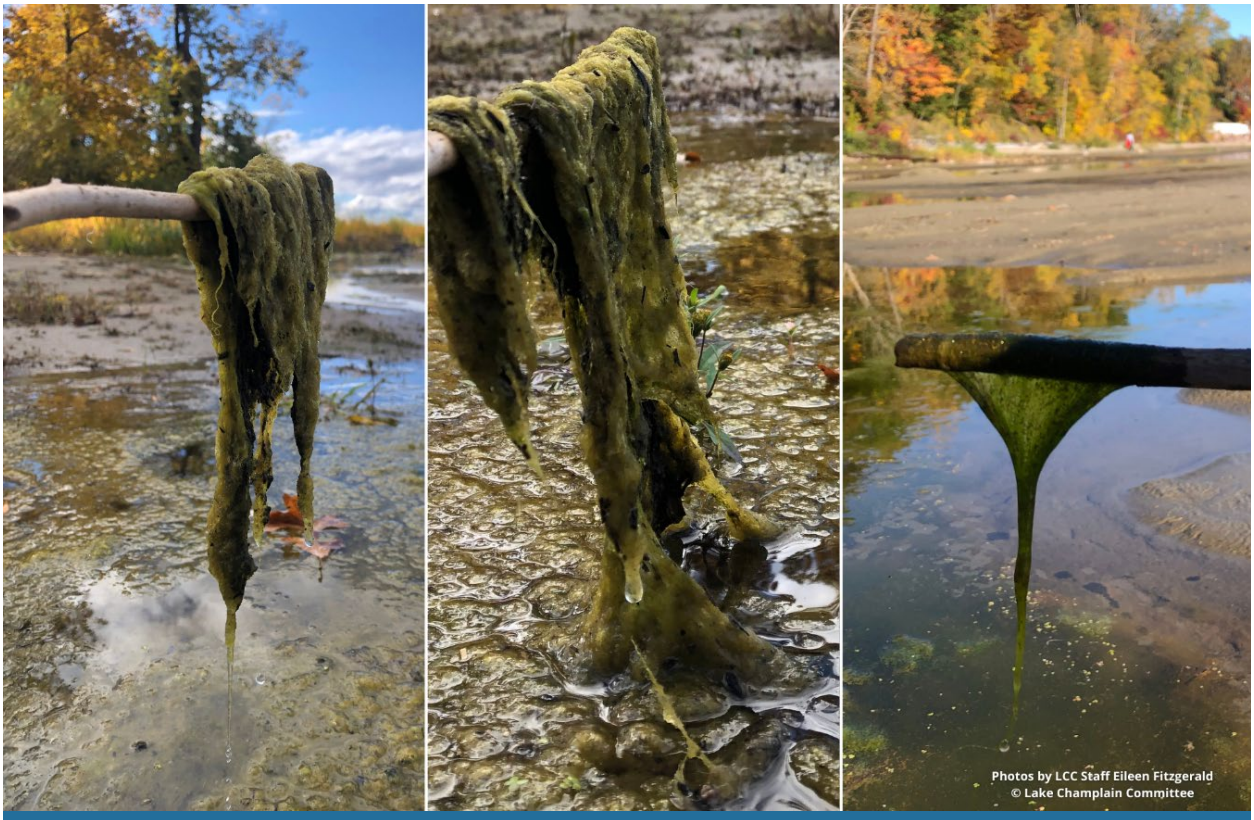
Each monitor was provided with a user name and password for the VDH tracker and trained how to submit online reports. The LCC online reporting form provided a back-up option for monitors who had trouble using the VDH site and form or during times when the VDH site had technical issues. Additionally, LCC took verbal and email reports on conditions when monitors were not able to access online reporting forms and for municipal and state personnel who experienced recreational staffing shortages during the season. These reports then had to be manually entered onto the VDH tracker. New York State Department of Environmental Conservation (NYS DEC) and New York County and State Health Department designated personnel were informed of any blooms at state beach sites. The state then took over monitoring until water sample tests came back with results warranting beach opening according to New York protocols.

Monitoring Season

The official monitoring season began the week of June 19, 2022. However, we did accept and vet early reports from anyone available to assess conditions earlier in the season. Monitors at many state and municipal parks generally ended monitoring by September 30 or earlier that month but some monitors continued through mid-November for a 20-week season due to late season blooms.

Communicating Monitoring Results

Monitors and partners received a weekly email summarizing water conditions on the lake generally on the following Monday (Appendix B and C). The weekly updates included photographs of conditions observed that week, monitor's individual user names and passwords, links to resource materials including the online materials, relevant information and reporting tips, and actions to take to reduce bloom frequency. This way monitors always had easy access to information to file accurate reports. We generally included a “Weekly Monitor Tip” to reinforce training protocols, provide further guidance on reporting issues monitors were having, or offer additional guidance to increase reporting frequency and accuracy. (*See Monitor Tip below from the Week 17 email that reinforces using the stick test to distinguish filamentous green algae from cyanobacteria.)*



Monitor Tip – Use the Stick Test

Not sure if you're seeing cyanobacteria or algae? Use the stick test to help you distinguish one from the other. All the photos above show algae draping off a stick. It's usually very easy to pick up algae with a stick. In contrast, most types of cyanobacteria cannot be picked up with a stick. There are some exceptions, but the stick test is a helpful tool to confirm algae.

The weekly emails had a table of contents that was hyperlinked to the sections of the report so recipients could readily move to the information they needed or were most interested in. The weekly emails also served to continue educating recipients about cyanobacteria. A separate weekly update report was provided to interested community members and area media (Appendix C). Weekly updates and notices of cyanobacteria blooms were also posted on LCC's website and Facebook pages, relayed to some Front Porch Forum outlets, and promoted through additional emails and e-newsletters as relevant.

Best Practices

The following practices are a key component of LCC's training and approach for the community scientist-based monitoring program.

1. **Communicate regularly and personally to provide ongoing training and support**

Weekly communications during the monitoring season and at several times throughout the year helped keep trained community scientists engaged and informed, and contributed toward maintaining the target frequency and quality of reports. Weekly emails included reminders on protocols, links to report instructions, a compilation of weekly reporting results, photographs and descriptions of cyanobacteria, and contact information (Appendix B). These emails also profiled exemplary community scientists, featured different lake phenomena each week, and reinforced participants' valuable contributions to the program. All emails to community science volunteers are personalized for the recipient with their name(s), monitoring sites, user name and password and other relevant details for their monitoring needs. Additionally, LCC followed up with monitors throughout the season to ensure that every monitor received personal communication beyond the weekly emails through phone calls, in-person visits, Zoom connection, handwritten thank you notes, or some other way to help them feel valued.

2. Budget time and resources for frequent volunteer support

LCC staff follow up with monitors frequently, whether it is to answer questions about water conditions they observe, clarify an element of their online report form submittal, or troubleshoot technical issues. Community scientists have a wide range of experience with technology and some need additional assistance to submit reports. We provided volunteers step-by-step guidance on how to fill out online report forms, label photos on a smartphone, and fulfill other program reporting requirements. We also created a range of education and outreach materials that target different learning styles, including visual, auditory, and verbal.

3. Strike a balance between public and private monitoring sites

Although data from high-traffic public areas (e.g., beaches, boat launches, and parks) are most useful for the general public, backyard monitoring is also valuable information and provides the opportunity for more volunteers to engage in water quality issues. We publicized and prioritized public locations but enabled anyone who committed to the monitoring protocols to participate in the program.

4. Budget time and resources for frequent volunteer support

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6. Provide training to improve the quality photographic documentation

Submitted photos are valuable and effective at confirming reported water conditions and complementing education and outreach efforts. In addition, posting report photos on an online map (e.g. as with the Lake Champlain CyanoTracker) provides a learning opportunity for anyone who checks on water quality conditions. Photos of water quality conditions can be challenging to capture, especially of low density cyanobacteria blooms (e.g. category 1d). Factors that influence the quality of photos include sun glare, low light, camera focus, and image resolution. LCC emphasized the need for photos as well as clear narrative descriptions of conditions, such as approximate bloom extent along the shore and into the water in all our training materials.

Monitor Toolkit

LCC Cyanobacteria monitors receive a toolkit of information to guide their reporting either in hard copy or virtually that includes photo cards, informational fliers, background information on lake issues, and guidance on actions they can take to protect water quality. Toolkits are distributed with personalized, handwritten thank you notes as part of ongoing efforts to let monitors know how much their volunteerism is valued.

7. Let community scientist volunteers know they are valued

The community scientist volunteers are key to the success of the monitoring program. We thanked volunteers early and often. Their importance to the program was emphasized in the trainings and in all communications. This personalized approach helps increase volunteer retention and improve participation.

8. Encourage communication on all water-related phenomena and unusual conditions

Monitors were urged to share unusual observations with program staff and submit a water sample if they saw something unfamiliar. This approach assisted community scientists with cyanobacteria identification and fostered environmental literacy, especially since the findings are usually provided to all program participants.

3. QUALITY ASSURANCE TASKS COMPLETED

There were no Quality Control requirements on the visual observations beyond generally requiring that non-bloom reports not be accepted before 10:00 a.m. since cyanobacteria are far less likely to be visible in the water then. Trained LCC staff or partners reviewed all reports for consistency and checked for errors before entering the data into the VDH Cyanobacteria Database Tracker. Nearly 90% of the report review was done by LCC because staff check the tracker more frequently than partners and are the only project partner vetting reports on the weekend. In cases where we changed categorizations or required additional information, we always contacted monitors or the oversight agency to explain our decisions and provide them with the background and support they needed to correctly assess conditions. We also contacted monitors from high priority sites if they were delinquent in their reporting and followed up with anyone who appeared to have trouble filing complete reports. Phytoplankton samples from five priority Lake Champlain Vermont locations were dropped at designated sites for courier pick-up and delivered to the appropriate laboratory for analysis and QA. LCC coordinated, trained, and supported the four community science volunteers who did visual assessments as well as sampled at Red Rocks Park (South Burlington), North Beach (Burlington), St. Albans Bay Park (St. Albans), and Shipyard (Highgate) and Vermont state partners coordinated the sampling at Kingsland Bay State Park. The latter site was added in 2022 in and partners follow protocols for monitoring as outlined in the five-year Quality Assurance Project Plan (QAPP) developed for this program and overseen by VT DEC.

4. DELIVERABLES COMPLETED

Training and Educational Materials

The following materials were produced to assist with training.

LCC Cyanobacteria Monitor Toolkit (Appendix D) - This comprehensive document includes background information, monitoring guidelines, how-to directions, visuals of cyanobacteria, and more. You can easily navigate to each section of the toolkit via the linked table of contents. We will continue to add information and update this resource throughout the monitoring season.

Water Condition Categorization – We expanded our online guide for visual assessments to include additional pictures to help both monitors and community members recognize cyanobacteria.

How to Submit a Routine Location Report Via the VDH Online Report Form

Photo Card Template

LCC Recognize | Avoid | Report Flyer *NY PDF*

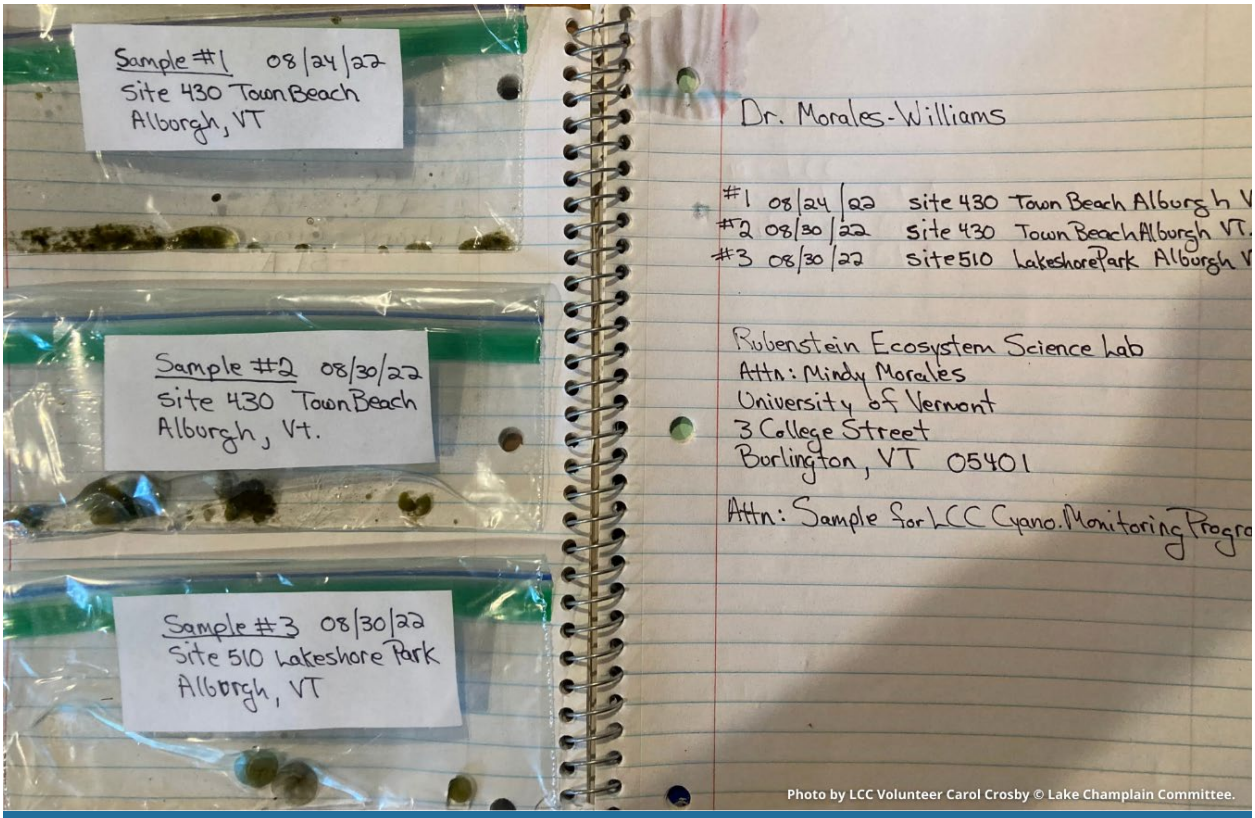
LCC Recognize | Avoid | Report Flyer *VT PDF*

LCC Flyer on How to Distinguish Cyanobacteria from other Phenomena

Training Sessions

Over 300 community members and park personnel were trained at 26 formal monitoring sessions held during the season. Twenty-two were conducted virtually and two in the field. Trainings were concentrated in the spring prior to the first week of monitoring but also held during the summer on the following dates and times:

1. JOINT MONITOR TRAINING – Tuesday, 5/17/22 – 9:00 a.m. to Noon via Zoom
2. RETURNING MONITOR TRAINING - Wednesday, 5/18/22 – 9:00 a.m. to 11:00 a.m. via Zoom
3. RETURNING MONITOR TRAINING - Wednesday, 5/18/22 – 6:00 p.m. to 8:00 p.m. via Zoom
4. NEW MONITOR TRAINING - Thursday, 5/19/22 – 9:00 a.m. to noon via Zoom
5. NEW MONITOR TRAINING - Thursday, 5/19/22 - 5:30 p.m. to 8:30 p.m. via Zoom
6. JOINT MONITOR TRAINING – Tuesday, 5/24/22 – 5:30 p.m. to 8:30 p.m. via Zoom
7. NEW MONITOR TRAINING - Wednesday, 5/25/22 – 9:00 a.m. to noon via Zoom
8. RETURNING MONITOR TRAINING – Wednesday, 5/25/22 – noon to 2:15 p.m. via Zoom
9. NEW MONITOR TRAINING - Wednesday, 5/25/22 - 5:30 p.m. to 8:30 p.m. via Zoom
10. RETURNING MONITOR TRAINING - Thursday, 5/26/22 – 9:00 a.m. to 11:00 a.m. via Zoom
11. RETURNING MONITOR TRAINING - Thursday, 5/26/22 – 6:00 p.m. to 8:00 p.m. via Zoom
12. JOINT MONITOR PRESENTATION/TRAINING – Wednesday, 6/1/22 – 1:15 p.m. to 3:15 p.m. via Zoom
13. RETURNING MONITOR TRAINING - Tuesday, 6/7/22 – 9:00 a.m. to 11:30 a.m. via Zoom
14. RETURNING MONITOR TRAINING - Tuesday, 6/7/22 – 6:00 p.m. to 8:30 p.m. via Zoom
15. RETURNING MONITOR TRAINING - Wednesday, 6/8/22 – 9:00 a.m. to 11:30 a.m. via Zoom
16. NEW MONITOR TRAINING - Wednesday, 6/8/22 - 5:30 p.m. to 8:30 p.m. via Zoom
17. RETURNING MONITOR TRAINING – Friday, 6/10/23 – on-site in person
18. VT FPR SW Parks Staff Training – Tuesday, 6/14/22 – 9:00 a.m. to 11:30 a.m. via Zoom
19. JOINT MONITOR TRAINING – Wednesday, 6/15/22 – 2:00 p.m. to 4:30 p.m. in person
20. NEW MONITOR TRAINING – Wednesday, 6/15/22 – 5:30 p.m. to 8:30 p.m. via Zoom
21. RETURNING MONITOR TRAINING – Thursday, 6/16/22 – 9:00 a.m. to 11:30 a.m. via Zoom
22. BOAT STEWARD TRAINING = Monday, 6/20/22 – 8:30 a.m. to 10:00 a.m. via Zoom
23. RETURNING MONITOR TRAINING – Monday, 6/20/22 – 10:00 a.m. to 12:30 p.m. via Zoom
24. WATER SUPPLY OPERATOR TRAINING – Wednesday, 6/22/22 – 10:00 a.m. to 11:00 a.m. virtually
25. NEW MONITOR TRAINING – Wednesday, 7/6/22 – 9:00 a.m. to Noon via Zoom
26. JOINT MONITOR TRAINING – Monday, 5:30 p.m. to 8:30 p.m. via Zoom



Monitor Tip – What to do If You See Something Strange

Take water samples and email LCC staff at lcc@lakechamplaincommittee.org with photos and narrative details if you witness something strange in the water. We will let you know if we'd like you to send water samples to the University of Vermont lab for further analysis. LCC monitor Carol Crosby did a great job of labeling and packing up her samples as shown in the photos above. We're still waiting on lab analysis but will share results in a future email.

Weekly Emails Include Lots of Visuals

The Monitor Tip shown above from the Week 11 report both reinforces what monitors should do if they observe phenomena they can't readily identify and gives a shout out to a monitor for doing a great job.

Weekly Monitoring Reports & Emails

Monitor Emails – Throughout the season monitors received a weekly personalized email with photos and pictures from the week's monitoring reports, a compilation of monitoring results, their user name, password and reporting links for easy reporting. The weekly emails included teachable moments from conditions observed, weekly monitoring tips, guidance to address reporting issues, and reiterated key messages from training sessions. We mapped out key

program messages we were going to reinforce in advance but also responded to situations that arose during the week. For example, during the spring we shared additional photos and guidance on how to differentiate pollen from cyanobacteria. When iron bacteria began showing up on beaches we provided visual and narrative guidance to help monitors recognize it. The weekly emails are rich with content and cover a lot of territory. To help recipients navigate them efficiently they have a detailed table of contents that is hyperlinked to sections of the report so recipients can click on the subject and get directly to the information they seek rather than scrolling through a long email. This way monitors always had ready access to their site numbers, names, lake region, and any passwords or user names in order to file timely reports. And if they wanted to see some pictures of conditions monitors encountered that week, learn more about types of cyanobacteria, find out results of drinking water testing, it was easy to do. Additionally, the weekly emails included contact information if they needed support and provided other useful information to both aid their reporting and help them educate others about cyanobacteria. We spend time crafting the emails to make them useful for the recipients. They are provided to all monitors LCC trains as well as monitors trained by state agencies if we are provided with email addresses.

Community Member Emails – Personalized weekly emails were sent to approximately 1,700 community members over a 20-week period. Select cyanobacteria emails were sent to a list-serve of nearly 4,000. We advertised the subscription for weekly emails through mailings, emailings and social media posts. We also promoted it through the media, outlets like Front Porch Forum and through a wide variety of public outreach programs including presentations and tabling events. Recipients received a personalized email each week which provided:

- an overview of conditions,
- details of the weekly reports by lake section or inland lake,
- information about and links to the data tracker map and resources housed on the VT Dept. of Health website,
- links to resources to learn more about cyanobacteria and report on conditions,
- guidance on what to do if they observe a bloom,
- information on how the data is utilized,
- photographs of cyanobacteria and other phenomena to help people differentiate

The weekly emails also share relevant public information about water quality to encourage ongoing stewardship beyond the monitoring program.

Monitoring Report Results

Monitoring results for generally safe conditions and blooms are provided separately in the joint report *Cyanobacteria Monitoring on Lake Champlain, 2022* produced by VT DEC, VDH, and LCC.

Public Forums & Outreach

LCC, VT DEC, and VDH collaborated to host a virtual public information session but it was later cancelled due to lack of time to publicize it to engage a broader community beyond monitors. In the absence of a new session, we continued to promote the Youtube Video from our 2021 virtual session.

In addition to the weekly emails, outlined earlier, weekly updates on conditions were also provided via Facebook posts, website updates and Front Porch Forum. We also distributed information to the press, conducted media interviews and fielded inquiries about cyanobacteria throughout the year.

Community Mailings

LCC distributed approximately 3,000 cyanobacteria flyers throughout the year through mailings and emailings to community members in the Lake Champlain watershed. Links to the flyers were also provided in the weekly emails.

- LCC Recognize | Avoid | Report Flyer *NY PDF*
- LCC Recognize | Avoid | Report Flyer *VT PDF*
- LCC Flyer on How to Distinguish Cyanobacteria from other Phenomena

Challenges

Cyanobacteria Tracker Issues - There were several challenges that emerged during the season. The Cyanobacteria Tracker was updated with new colors for accessibility and color-sensitivities but LCC staff weren't made aware of it in advance of the monitoring program launch so our training materials and monitor guidance had not been updated accordingly. The green dot coloring on the tracker for "Generally Safe" conditions was replaced with purple but since in the past, purple had indicated that there were technical issues with the tracker LCC staff and monitors initially thought there were reporting errors. This triggered a lot of confusion especially since key state agency staff were not available during the first week of monitoring. Monitors ended up filing reports through LCC's reporting form which then LCC had to hand enter and also had to respond to a lot of individual emails, texts, and phone calls to address the

issue in addition to updating relevant communication and training materials with the new colors.

Additionally, the cyanobacteria tracker had technical issues off and on especially during the beginning of the season that required a lot of monitor follow up by LCC. While LCC's monitoring form is used as a back-up in these situations it requires that all the data collected has to be re-entered manually onto the cyanobacteria tracker house at VDH. This was a time-consuming process solely shouldered by LCC staff.

To help minimize similar problems in the future, the VT Department of Health has agreed to make the Cyanobacteria Tracker live several weeks prior to the start of monitoring season so LCC staff and select monitors can beta test it and provide feedback.

Report Vetting – Partner agencies were not able to devote much time to report vetting. VDH only had one person available generally for report vetting throughout the season whereas they had two people during the 2021 season. VT DEC had anticipated playing a larger role in report vetting, but that did not come to pass. State agency partners do not vet reports on the weekends but that is when there is heightened public interest in water conditions so LCC reviews reports during the weekend to ensure timely public outreach, especially with regard to blooms. During the 2022 season, 89% of the reports were reviewed and approved by LCC staff, 8% by VDH, 1.5% by LCC and partners jointly, and 1.5% by VT DEC. To accommodate the need to do the majority of report vetting to ensure the Cyanotracker was updated accurately and in a timely manner, we shifted the schedule for distributing our weekly emails from Friday or Saturday to Monday.

The shift enabled us to prioritize report vetting and include all the weekly monitor reports in our emails to monitors and community members. We did not receive complaints for the schedule shift so plan to continue this approach during the 2023 season.

Lack of Quebec Involvement – The Province of Quebec no longer has much involvement in the monitoring program which results in less reporting and coverage.

LCC will increase outreach in Quebec to try to find more community monitors but these efforts need to be reinforced by government environmental and health officials reinforcing the importance of monitoring and being proactive about public health safety. We urge LCBP to help facilitate greater involvement of Quebec partners for the 2023 season and beyond.

Calothrix sp. – Cyanobacteria

The above left photos show Calothrix sp. in the water (look for the globules within the yellow circles) and in a jar sample. In the field, Calothrix sp. looks a lot like Rivularia sp. – another benthic cyanobacteria that's been documented in our region. While it's very difficult to tell them apart in the field, you can differentiate them under the microscope (right photos). Calothrix sp. has a resting cell (akinete) at the end of each filament – these are circled in yellow on the right-most photos.

Calothrix sp. attach to rocks and wood below the water's surface but also grow on aquatic plants which can wash up on shorelines especially later in the summer. Monitors were urged to keep an eye out for gelatinous colonies. Calothrix sp. tend to be rubbery in feel (volunteers are advised to wear gloves when monitoring). Green algae will often become jelly-like when squished, Calothrix is firmer and will generally split or flatten when squeezed.

Benthic Cyanobacteria - Benthic blooms have been increasing around the country and in our region as well, but we lack clear protocols to guide monitors in how to assess benthic cyanobacteria accumulations and what should trigger water sampling and lab analysis. ***LCC has identified the need for clear protocols to project partners. Partners will collaborate during the 2023 season to develop and refine guidance.***

5. CONCLUSIONS

Through a unique partnership of a regional watershed-based nonprofit organization, community scientist volunteers, public beach managers, and state and federal agencies, a comprehensive network of trained cyanobacteria monitors generates timely data on water quality conditions. The majority of these reports are provided by trained community scientist volunteers, strengthening the geographic coverage of the program and the environmental literacy of lake users. This program now trains hundreds of community scientists, documents thousands of water quality condition reports annually, and communicates cyanobacteria conditions to the public via an online Cyanobacteria Tracker map accessible to anyone with an internet connection. The program reinforces the leadership, collaboration, education, service, and science values of NEIWPCC's Strategic Plan.

The success of this program demonstrates that visual assessments conducted by trained community scientist volunteers are a viable way to document and disseminate critical public health information. Our initial laboratory-based approach was a valuable first step in understanding cyanobacteria blooms in Lake Champlain, and the development of the visual assessment protocol has allowed the program to greatly expand geographic coverage and rapidly deliver the most important information to stakeholders. This simple method creates opportunities to share water quality conditions in a way that resonates with the public and generates actionable information to immediately protect public health. The combination of our visual tool with quality assurance sampling for cyanobacteria densities and cyanotoxin concentrations has allowed our collaborative team to monitor a very large geographic area with credibility and public engagement.

Partners are currently developing methods to compare cyanobacteria seasons to historic data and incorporate satellite-based measurements and model outputs (Schaeffer et al. 2018). However, because monitoring locations and times are dependent on volunteer locations and schedules, they can vary from year to year, which makes statistical analyses on a lake-wide or even site-by-site basis challenging. This is one limitation of the community science-based program, compared to a traditional research program that may have limited geographic coverage but a more consistent sampling regime.

Lake Champlain cyanobacteria monitoring partners continue to seek out opportunities that will enhance and improve the monitoring program. For example, the visual assessment protocol guidance for the Lake Champlain program is heavily focused on the planktonic (floating) cyanobacteria. We are working to improve guidance materials to better incorporate information on benthic (bottom dwelling) cyanobacteria as well. In addition, under the leadership of VDH, collaborations are underway to evaluate the combination of visual assessments with dipstick cyanotoxin testing as a way to quickly reopen a beach with confidence that cyanotoxin concentrations are below the public safety threshold values for recreation.

The visual assessment protocol is now used to evaluate smaller lakes throughout Vermont and in lakes throughout New York.

The Lake Champlain Cyanobacteria Monitoring Program has built a common understanding of cyanobacteria blooms around Lake Champlain and inland Vermont waterways that can be understood by all lake users and used by all jurisdictions following their respective response plans.

Our community scientist-based monitoring program has had a positive impact well beyond expanding the number of people who are collecting water quality data. Each person who attends a training becomes familiar with cyanobacteria, associated potential health risks, the water quality conditions that increase the likelihood of blooms, and individual actions they can take to improve water quality. Community scientist volunteer training gives each participant a way to be actively involved with their watershed or lake. By assessing water conditions at a local site on a routine basis week after week, community scientist volunteers deepen their connection to nature, and actively participate in stewardship of their natural resources.

Monitor Innovations

LCC monitor Paul Smith, an engineer and tinkerer came up with a novel approach for monitoring locations in knee-deep water without getting wet. Paul and his wife Elisa Nelson assess conditions in Lake Champlain's South Lake. To avoid exposure to cyanobacteria and extend their reach into the water, Paul duct-taped a jar to a house washing brush with a long handle and attached a thermometer as well. Love that ingenuity and creativity!

Looking Ahead to 2023 Monitoring Season

Identification of Beaches - LCC and LCBP are collaborating on identifying public beaches on Lake Champlain as there is no comprehensive list. We'll use the information to identify and hopefully fill gaps in monitoring coverage.

Improved Signage – State agencies sought public feedback on cyanobacteria signage and created new signs in response. The signs are available to municipalities that request them.

Improved Quebec Coverage and Communication – Site coverage and provincial leadership on cyanobacteria monitoring has waned. LCC has identified this as a need and asked LCBP to help foster better coordination and communication.

Beach Signage

The Vermont Department of Health created new signage for low and high alert conditions. The signs are free to municipalities.

6. ACKNOWLEDGEMENTS

Sincere thanks to partners at the Lake Champlain Basin Program (LCBP), New York Department of Environmental Conservation (NYS DEC), New York Department of Health (NYSDH), Vermont Department of Environmental Conservation (VT DEC), Vermont Department of Forests Parks and Recreation (VT FPR), Vermont Department of Health (VDH), the University of Vermont (UVM), and the Vermont Rural Water Association (VRWA) for their involvement and partnership in the monitoring program. Thanks also to the dedicated work of Lindsey Carlson, Jared Carpenter, Emily DeAlto, Eileen Fitzgerald, Alexa Hachigian, and Rei Jia of LCC; Mae Kate Campbell, Colleen Hickey, Eric Howe, Kathy Jarvis, Lauren Jenness, Meg Modley, and Matt Vaughan of LCBP; Heather Campbell, Kelsey Colbert, Peter Isles, Sille Larsen, Oliver Pierson, and Pete Stangel of VT DEC; Reuben Allen, Nicky Albertson, Bud Fetterolf, and Emily White of VT FPR; David Grass, Dan Jarvis, Kirk Kimball, Jan Leja, Bridget O'Brien, Ben Truman, and Sarah Vose of VDH; Ana Morales-Williams, and Lindsay VanFossen of UVM; and Liz Royer of VRWA for their collective efforts and partnership. We deeply appreciate the ongoing support of former VT DEC Environmental Scientist Angela Shambaugh who retired in 2020 but continues to provide support to LCC in the community monitoring program and to Dr. Mary Watzin, formerly of UVM, who has been a resource for information throughout the monitor program's 19 years of evolution. We gratefully acknowledge the more than 150 community scientist volunteers who continue to be the backbone of the monitoring program.

7. REFERENCES

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8. APPENDICES

Appendix A – LCC Reporting & Visual Assessment Protocols & Guidance

A.1 – Introduction to Cyanobacteria Information

https://www.lakechamplaincommittee.org/lcc-at-work/cyanobacteria-in-lake#c1837

A.2 – LCC Online Reporting Form
https://www.lakechamplaincommittee.org/get-involved/volunteers/cyanobacteriamonitors/new-cyanobacteria-monitor-reporting-form

A.3 – LCC Online Instructions for Categorizing Bloom Intensity
https://www.lakechamplaincommittee.org/get-involved/volunteers/cyanobacteriamonitors/categorization-of-water-conditions

A.4 – LCC Instructions for Photographs & Taking Water Samples
https://www.lakechamplaincommittee.org/get-involved/volunteers/cyanobacteriamonitors/instructions-for-photographing-cyanobacteria-blooms-taking-water-samples

A.5 – LCC Photo Card for Recording Picture Data
https://www.lakechamplaincommittee.org/fileadmin/files/Publications/PhotoCardTemplate_ForJarTest.pdf

A.6 – LCC Cyanobacteria Monitor Training Presentation
Different versions of the training presentation were developed for different audiences. The link provides access to one example.

A.7 – LCC Cyanobacteria Monitor Toolkit
https://www.lakechamplaincommittee.org/fileadmin/files/Publications/2022_CyanobacteriaMonitorToolkit.pdf

A.8 – Updated Visuals for Categorizing Water Conditions
https://www.lakechamplaincommittee.org/get-involved/volunteers/cyanobacteriamonitors/categorization-of-water-conditions

A.9 – Updated Photo Card Template
https://www.lakechamplaincommittee.org/fileadmin/files/Publications/PhotoCardTemplate_ForJarTest.pdf

A.10 – LCC Recognize | Avoid | Report Flyer *NY PDF*
https://www.lakechamplaincommittee.org/fileadmin/files/Publications/NYCyanobacteriaFlyer_Final.pdf

A.11 – LCC Recognize | Avoid | Report Flyer *VT PDF*
https://www.lakechamplaincommittee.org/fileadmin/files/Publications/VTCyanobacteriaFlyer_Final.pdf

A.12 – LCC Flyer on How to Distinguish Cyanobacteria From Other Phenomena
https://www.lakechamplaincommittee.org/fileadmin/files/Photo%20Archive/Learn/2019-07-__LCC_-_Flier_on_Distinguishing_Cyanobacteria_from_other_Lake_Phenomena.pdf

Appendix B – Link to 20 Weekly Emails to Monitors
Click on each weekly report header to access the full report and photos.
https://www.lakechamplaincommittee.org/lcc-at-work/2022-cyano-monitor-reports-monitors

Appendix C – Link to 20 Weekly Emails to Community Members
Click on each weekly report header to access the full report and photos.
https://www.lakechamplaincommittee.org/lcc-at-work/cyanobacteria-in-lake/2022-cyano-monitor-reports-community

Appendix D – Monitor Toolkit (attached)