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New Hampshire's Cyanobacteria Plan: A Statewide Strategy

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

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New Hampshire's Cyanobacteria Plan: A Statewide Strategy

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Acknowledgments

NHDES thanks the members of the cyanobacteria advisory committee for their valuable input on this plan. The committee included 17 individuals with broad interests in the surface waters of the state and public health. The range of disciplines, backgrounds and experiences represented on the committee added significantly to the content of the plan. The recommendations herein represent a consensus of the committee.

Cyanobacteria Advisory Committee Members

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Executive Summary

In 2022, Governor Chris Sununu signed House Bill 1066 which directed the New Hampshire Department of Environmental Services (NHDES) to develop a plan to prevent the increase of, and eventually control, cyanobacteria blooms in New Hampshire's waterbodies (Chaptered Law 0292, Laws of 2022). In recognition that cyanobacteria blooms cannot be eliminated from the state's surface waters, the plan also included two additional goals: To reduce the risks of cyanobacteria blooms to humans, pets and livestock; and, to better understand the causes of cyanobacteria blooms and develop methods to monitor their occurrence.

NHDES staff experience, input from the cyanobacteria advisory committee, existing literature and a review cyanobacteria related data from New Hampshire surface waters were used to develop a plan focused on achieving the goals. In addition, HB 1066 provided $30,000 in funding to assist NHDES in completing the plan. These funds were used to complete two studies to further inform the plan's content and recommendations: a public outreach survey that evaluated public awareness and concerns about cyanobacteria blooms and another that analyzed cyanotoxin prevalence in bloom samples from 2022.

Since 2004, cyanobacteria blooms have been documented in 113 surface waters in New Hampshire and currently account for 64 water quality impairments. Most blooms have occurred in lakes or ponds, but do occur in rivers. On average, blooms have lasted 25 days in New Hampshire in recent years and interfere with recreation, present risks to human, pet, or livestock health and threaten drinking water supplies. Health risks associated with cyanobacteria are a result of the toxins (cyanotoxins) which they can produce. The toxins are known to cause a range of symptoms including, but not limited to, mild gastrointestinal illness or skin rashes to severe acute neurological system failures. Cyanotoxin results from New Hampshire samples indicate that between 56% and 73% of samples from waterbodies with blooms had detectable levels of microcystin, a common cyanotoxin. In 2022, 20% of samples tested for cyanotoxins exceeded the federal microcystin drinking water health advisory threshold. Additionally, cyanobacteria blooms reduce water clarity and the overall aesthetic value of surface waters. Blooms and cyanotoxins appear to be increasing primarily because of nutrient loads but are also influenced by warming waters and improved reporting by the public.

The public outreach survey found that, of almost 700 respondents, nearly all (96%) expressed concern regarding the potential impacts of cyanobacteria on the state's surface waters. Survey respondents represented business and industry interests and environmental stakeholders, including watershed organizations, lake and river associations and statewide conservation organizations. Health risks associated with cyanotoxins, reduced recreational use of surface waters, reduction in property values and negative impacts to the local economy where the most frequent concerns mentioned by survey participants.

Given the high-level of public concern and frequency of cyanobacteria blooms in New Hampshire's surface waters (average 34 per year, 2019-2022) four important strategies have been identified as necessary to accomplish the plan's goals (see summary of strategies and priorities table below). The strategies and respective priorities were identified as being necessary to reduce or mitigate the impacts of cyanobacteria blooms and protect public health. The strategies and priorities capture multiple actions based on NHDES staff knowledge and recommendations supported by the cyanobacteria advisory committee, and focused on making progress towards the goals of the plan and 2022 legislation directing the plan's development.

First, significant efforts must be made to reduce nutrient inputs into the state's surface waters. Control of nutrient loading to surface waters, in particular phosphorus, is best accomplished through state and local policy implementation, stormwater control and watershed and lake management. On average, based on

phosphorus loading models included in watershed plans, an estimated 60% of phosphorus originates from external watershed sources that drain to lakes and ponds. Efforts should be made to identify and remediate the "external" nutrient sources that are human induced to the extent possible to reduce the likelihood of cyanobacteria blooms.

In some New Hampshire surface waters cyanobacteria blooms have become unavoidable even when external nutrient sources are minimized because internal nutrient loads from the bottom sediments are excessive. In these cases, a variety of in-lake management activities may be useful to avoid or control blooms. Remediation of blooms through in-lake management is expensive and requires significant planning, expertise and permitting oversight. The plan has identified that additional funding and permitting authority specific to cyanobacteria in-lake management projects are critical priorities to address these situations.

Second, respondents to the public outreach survey identified increasing education and training tools as important to making informed decisions about the use of the state's surface waters with respect to cyanobacteria bloom presence. Such efforts are important to increase general awareness of the public and specific segments of the workforce who have direct contact with the state's surface waters for recreation and as a drinking water source. With approximately 1,000 lakes and ponds and nearly 17,000 miles of rivers and streams, it is it is impractical to simultaneously characterize the real-time risk for all waterbodies across the state. Therefore, it is of critical importance to make cyanobacteria recognizable to the broader population, including the casual recreational surface water user to avoid potential health risks. In particular, significant effort should be invested in campaigns that promote the completion of "self-risk assessments" (i.e. "know your risk") and the phrase "when in doubt, stay out."

Third, enhancement of cyanobacteria monitoring is needed to track blooms and clearly communicate current conditions to the public. Cyanobacteria blooms vary widely in their duration, severity and distribution. Currently, the NHDES cyanobacteria monitoring program responds to public bloom reports and relies on a single full-time staff person to identify the severity of the bloom and notice the public of conditions. The system has served the state well over the years, but blooms have become more frequent and intense, often making it challenging to keep up with demand. To improve program capacity, additional trained staff and sample processing efficiency is needed. Improved volunteer monitoring via training and use of advanced monitoring techniques are also recommended to confirm bloom presence and understand the causes of bloom occurrence, respectively. Notifying the public of where blooms are or have occurred and their severity is the last step, and arguably the most important step in cyanobacteria monitoring. A simple and clear bloom notification system that includes a visual, map-based component as well as automated message alerts is needed to improve public safety.

Finally, there are over 560,000 service points in New Hampshire that provide water to the public that originates from surface waters. To date NHDES is aware of nine surface water sources where cyanobacteria blooms have occurred. Most public water systems have, at a minimum, "conventional treatment" that can remove moderate concentrations of cyanobacteria cells but may not be sufficient during a severe bloom event or in removing toxins that can exist extracellularly. While some of New Hampshire's 37 public water systems that use surface waters consider cyanobacteria in their facility's operational and maintenance plans, many do not. To ensure a higher-level protection from cyanobacteria blooms in public water supplies, the development of cyanobacteria action plans by all suppliers should be required. Cyanobacteria monitoring should be a routine activity designed for early detection of blooms. In situations when blooms occur, the plan should address if the treatment processes available are sufficient reduce the potential for toxins being distributed to

customers in finished water, if an alternate source can be used, bloom monitoring and how public health risks will be evaluated.

Cyanobacteria blooms cannot be eliminated from New Hampshire's surface waters. The strategies identified herein are designed to minimize bloom occurrence and associated health risks through nutrient load reduction, increased public awareness, enhanced bloom monitoring and minimization of bloom impacts in public water supplies. The efforts identified in the plan require policy changes, financial investments, partnerships, research and the production of educational materials.

Summary of New Hampshire Statewide Cyanobacteria Plan Strategies and Priorities

Strategy (focal areas of the plan)	Priorities
1. **Develop the policies and practices to reduce, control and prevent the nutrient inputs that cause cyanobacteria blooms.**	• Identify and implement state and local regulations and practices that address the sources of nutrient inputs that cause cyanobacteria blooms. • Identify ways to increase capacity and financial support for watershed and in-lake management efforts that prevent and reduce nutrient inputs and address cyanobacteria blooms. • Develop laws, rules and guidance that clearly define the permitting requirements and processes for lake management activities designed to remediate cyanobacteria.
2. Advance education and outreach efforts that allow individuals who recreate or use surface waters to assess the cyanobacteria risks and respond accordingly.	• Promote self-risk assessment messaging and techniques. • Produce cyanobacteria informational materials to provide learning opportunities that are available to related professional disciplines and consumer groups.
3. Enhance cyanobacteria monitoring to track when and where blooms occur and clearly communicate current conditions to the public.	• Enhance cyanobacteria monitoring, sample submission and processing efficiency. • Develop and implement advanced bloom notification tools.
4. Establish policies and procedures for prevention, early detection and response and treatment of cyanobacteria blooms and cyanotoxins in surface waters that serve as public drinking water supplies to minimize risks to customers.	• Develop cyanobacteria action plans by public water suppliers.

1.0 Purpose and Scope

The following plan is intended to help readers understand the status, impacts and risks of cyanobacteria blooms in New Hampshire waterbodies. The plan focuses on what is needed to 1) prevent, avoid and control blooms, 2) ways to improve education and outreach efforts, 3) cyanobacteria monitoring and 4) prepare for cyanobacteria blooms in surface drinking water supplies. The plan addresses freshwater lakes, ponds, rivers and streams.

The document presents an overview of cyanobacteria including their occurrence, the factors that cause blooms, the potential impacts that can result from blooms and the associated health risks. The document also includes an analysis of cyanobacteria bloom history in New Hampshire, the prevalence of cyanotoxins and a summary of NHDES' Cyanobacteria Harmful Algal Bloom (CyanoHAB) Program. Additionally, the report includes a summary of research activities funded through HB1066 that were used to inform the recommendations included in the plan.

The plan includes four major strategies supported by priorities and tactics to achieve the respective strategy. Each tactic includes a timeframe for implementation and indicates if additional funding or revised policies are required or recommended. This plan includes measurable milestones that address a variety of prioritized needs in an attempt to minimize the risks posed by cyanobacteria blooms, reduce and prevent the likelihood of bloom occurrence and restore those waterbodies where blooms occur on a frequent basis. The suggestions in the plan are not meant to be definitive solutions for the impacts associated with cyanobacteria blooms, but rather a reasonable guide to improve upon current activities and provide direction for new initiatives.

The plan was prepared by NHDES but is grounded by input received from the Cyanobacteria Plan Advisory Committee (Committee). The Committee was comprised of 17 members representing a broad diversity of interest groups (Appendix A). The Committee met with NHDES staff five times between October 2022 and October 2023. The Committee offered input on the causes and impacts of blooms, possible solutions and other needs, budgetary and legislative recommendations and ways to better communicate with the public regarding cyanobacteria blooms. The strategies, priorities and tactics included in the plan are supported by Committee.

Like most plans, the cyanobacteria plan should be revisited regularly to assess progress and make necessary updates. Additionally, there are many areas of active research with respect to managing cyanobacteria blooms. Cyanobacteria bloom frequency, duration and severity in New Hampshire is anticipated to continue to change. This plan is written to identify and address needs over the next ten years. As new information emerges and as the CyanoHAB program evolves, NHDES commits to periodically updating the cyanobacteria plan to incorporate new research, recommendations from stakeholders and changed circumstances. Updates will continue to reflect information and input from multiple stakeholders. NHDES recognizes that successfully preventing and controlling blooms will require a coordinated effort from many stakeholders and partnerships will be a key component for the implementation of many of the actions identified in this plan.

2.0 Introduction

Cyanobacteria, formally known as blue-green algae, naturally occur in most freshwater environments. They are photosynthetic, like algae, and typically occur as free-floating organisms (plankton) within the water column but can also exist as bottom-dwelling organisms. Cyanobacteria are small, usually microscopic, and occur as single cells, long chains of cells and colonies of hundreds or thousands of cells grouped together. Cyanobacteria taxa usually comprise a minority of the plankton community. However, under certain

circumstances, cyanobacteria grow rapidly and reach high densities that result in surface scums, whole water discoloration or dense benthic mats. To date, most cyanobacteria blooms in New Hampshire have been documented on lakes and ponds but also occur in rivers.

Cyanobacteria density and proliferation is generally driven by two primary factors; nutrient availability and heat (water temperature) that is supplied by sunlight. When excessive nutrients become available and as waterbodies warm cyanobacteria density will increase along with the general biomass of the algal community. Under certain circumstances, however, cyanobacteria outcompete algae and become dominant.

In some cases, cyanobacteria can produce toxins (cyanotoxins) which present a risk to humans, pets, livestock and wildlife. However, toxin production is not always associated with a bloom and the factors that trigger toxin production over the course of a bloom are not well understood. The testing and detection of toxins is neither simple nor rapid. Therefore, when cyanobacteria blooms occur, exposure should be limited to minimize potential health risks.

The presence of cyanobacteria and production of cyanotoxins can significantly interfere with recreational opportunities such as swimming, boating, or fishing. When blooms occur, the issuance of advisories limits the use of public beaches or, in some cases, entire waterbodies for all recreational uses. Advisories during bloom events for recreational purposes can have immediate, long term and severe economic impacts. A 2017 valuation of activities in New Hampshire's freshwaters by University of New Hampshire researchers indicated recreational fishing spending totaled $215 million per year, visitations to state parks amounted to $40 million in combined revenue, and that non-NH registered boater visits in New Hampshire contribute $100 million dollars to the economy (Rodgers and Watts, 2019). Advisories placed on waterbodies because of cyanobacteria blooms negatively affect the frequency of these activities and, in turn, the amount of money spent on all types of recreation and related activities associated with the waterbodies where they occur. Additional studies have linked decreased water clarity and harmful algal blooms, including cyanobacteria, to decreased property values and in turn, loss of tax revenue (Dodds et al., 2009; Wolf and Klaiber, 2017; Zhang et al., 2022).

Cyanobacteria blooms that occur in public surface water drinking water supplies require additional maintenance or treatment. If a toxic bloom occurs in a drinking water supply, it may be necessary to temporarily discontinue using the source to protect public health. New Hampshire has 37 public surface water sources that supply water to 560,000 service points. To date, there has not been a situation when a drinking water supply in New Hampshire has been disrupted because of a cyanobacteria bloom. However, there have been instances when cyanobacteria blooms have occurred in a public surface water supply. In these cases, robust monitoring was completed to determine cyanotoxin levels and ensure finished drinking water remained below drinking water health advisory levels. In addition to public surface water supplies, there are an unknown number of households that draw water directly from surface waters for private use, and, in some cases for drinking water. These intakes are unregulated. Most in-home water treatment technologies (e.g., home water filtration systems) will clog quickly if cyanobacteria are drawn into the system and do not remove cyanotoxins, meaning these households are potentially at risk if a bloom occurs near their private intake.

2.1 Cyanotoxins and Health Risks

Freshwater cyanobacteria can produce multiple cyanotoxins (Merel et al., 2013). Cyanotoxins can affect the liver and digestive organs, the nervous system, cause skin irritation, result in gastroenteritis, headache, diarrhea and vomiting (Chorus and Welker, 2021). The pathways by which cyanobacteria can cause health risks

are through direct contact, ingestion and inhalation (Table 1). Based on the Center for Disease Control's One Health Harmful Algal Blooms System (OHHABS), out of 380 human cases reported from 2016-2018, gastrointestinal symptoms were most frequently reported (67% of cases); however, general illness (headache, fever, lethargy; 43%), dermatologic irritation (27%), or ear, nose, throat-related irritation (16%) were also reported as common symptoms (Roberts et al 2020). Evidence also suggests that some cyanotoxins can accumulate in fish tissue, but it is unclear if eating fish exposed to cyanobacteria blooms pose a possible health risk to people (Hardy et al. 2015).

Table 1. *Common cyanotoxins and modes of action (Courtesy Amanda McQuaid, UNH; modified from Handbook of Cyanobacteria and Cyanotoxin Analysis, First Ed, 2017).*

Cyanotoxin	**Mode of action and/ or symptoms**
Anatoxin-a (ATX)	Neurotoxic, inhibits acetylcholine receptors (neurotransmitter), neuromuscular blocking, fast-acting (may cause numbness, seizures and/or death).
Anatoxin-a (S) or Guanitoxin	Neurotoxic, hyperexcitation of nerves.
Beta-methyl-amino L-alanine amino acid (BMAA)	Neurotoxic, motor system disorder (chronic exposure may be linked to neurodegenerative diseases).
Cylindrospermopsin (CYN)**	Hepatotoxic, cytotoxic and genotoxic, affecting neurons and genes and irreversible inhibition of protein and glutathione synthesis, toxic to multiple organs.
Homoanatoxin-a	Neurotoxic, blocking of the neuromuscular transmission.
Jamaicamides/Kalkitoxin/Antillatoxin/Aplysiatoxin	Neurotoxins associated with *Lyngbya, often marine types.*
Lipopolysaccharide (LPS)	Dermatoxic, impairment of immune system, skin irritations and allergic effects.
Lyngbyatoxins	Cytotoxic, dermatoxic, tumor promotion.
Microcystins (MCY)** (> 100 variants)	Hepatotoxic, genotoxic, typically targets the liver and digestive organs, inhibition of protein phosphatases, acute gastroenteritis and chronic tumor promotion.
Nodularins	Hepatotoxic, (similar in structure to microcystins), common in brackish or marine systems (produced by *Nodularia*).
Saxitoxins	Neurotoxic, blocking voltage gate of sodium ion channels and neuronal communication.

Notes: This is not a complete list of cyanotoxins. **USEPA health advisory guidelines are for CYN and MCY only. Exposure can occur through drinking, food, dietary supplements, inhalation and/or by dermal contact, and exposure has occurred by hemodialysis (injection with contaminated water). Dermal toxins (dermatoxins) may cause rashes on skin or allergic reactions. Synergistic effects of multiple cyanotoxins and other contaminants may also occur.

In a summary of the peer-reviewed literature, short-term exposure of humans to cyanobacteria were most common during recreational activities and accounted for approximately one-half of the cases when symptoms were reported, while impacts to drinking water supplies were less frequent but affected more people (Wood 2016). In severe cases of exposure, hospitalization or death are possible depending on the cyanotoxin present, bloom toxicity and the exposure pathway. More commonly though, symptoms are short term and less severe.

Pets and livestock that enter the waters in which toxic blooms occur can also be negatively affected and, typically, the outcome of exposure is more severe (Wood 2016). Impacts to pets, primarily dogs, occur through ingestion of water containing cyanotoxins or after bathing when grooming their fur. A summary of dog related cyanotoxin impacts from 13 states during the period of 2007 through 2011 reported 20 fatalities and another summary from a variety of sources dating from the 1920s to 2012 found 115 cyanobacteria-related events that involved 260 dogs of which 215 died (83%) (Backer et al 2013). For livestock and aquatic organisms, such as fish, hundreds to thousands of individuals have been reported to become sick or die during in single event (Wood 2016). These types of catastrophic events that involve a large die-off of fish may also have been an indirect result of cyanobacteria decomposition which reduced dissolved oxygen levels.

In an effort to reduce the known health risks that cyanotoxins present to humans, in 2015 the Environmental Protection Agency (EPA) established drinking water health advisories (HAs) for two cyanotoxins; microcystin and cylindrospermopsin(Table 1, EPA Drinking Water Health Advisory Factsheet, 2015). HAs identify the cyanotoxin level above which adverse health effects may occur. These thresholds are used to guide consumptive use where blooms occur in surface water supplies. Additionally, in 2019, EPA issued recreational use guidelines (RUGs) for these same cyanotoxins (EPA 2019). The RUGs are designed to be used in the development of water quality criteria and issuance of swimming advisories (Table 1). In developing both HAs and RUGs, EPA considered the latest scientific data and research that were available. There are many other cyanotoxins which do not yet have HAs or RUGs, but are known to present health risks, however, research has focused on the cyanotoxins that most commonly occur and pose the greatest risk.

Table 2. *EPA recommended cyanotoxin thresholds for drinking water (HA) and recreational use (RUG).*

Cyanotoxin	Threshold Type	Bottle-fed infants and pre-school children	School-age children and adults	Source
Cylindrospermopsin	HA	0.7 ug/L	3.0 ug/L	EPA drinking water cyanotoxin health advisory fact sheet
Microcystin	HA	0.3 ug/L	1.6 ug/L	EPA drinking water cyanotoxin health advisory fact sheet
Cylindrospermopsin	RUG	15 ug/L	15 ug/L	EPA recommended recreational cyanotoxin threshold fact sheet
Microcystin	RUG	8 ug/L	8 ug/L	EPA recommended recreational cyanotoxin threshold fact sheet

2.2 Cyanobacteria and Cyanotoxins in New Hampshire

NHDES has tracked reports of cyanobacteria, primarily in the state's lakes and ponds since the early 2000s. The records track the incidence of blooms that have resulted in advisories for recreational purposes and the duration of advisories. From 2004 to 2020, cyanobacteria advisories have been issued for 113 waterbodies and have occurred statewide (Figure 1). In total, there are currently 64 waterbodies impaired by cyanobacteria in New Hampshire (Wood 2022). The incidence of bloom-related advisories has increased from 2003 to 2022 (Figure 2). On average over the last five years (2018 - 2022), there have been 34 advisories per year. NHDES records indicated that the average length that an advisory was in place from 2018 through 2022 was 25 days with some advisories lasting only 2 days and some lasting over 100 days. Several waterbodies have advisories issued annually, while some waterbodies have a sporadic bloom history, or occur for a single year. Each year cyanobacteria blooms are documented on waterbodies for the first time. A majority of NHDES bloom reports

occur in summer and into the fall. From 2018 through 2022, the earliest date an advisory was issued was May 18 and the latest date an advisory ended was December 7 (Figure 3).

Figure 1. *New Hampshire surface waters with cyanobacteria advisories, 2004 – 2022.*

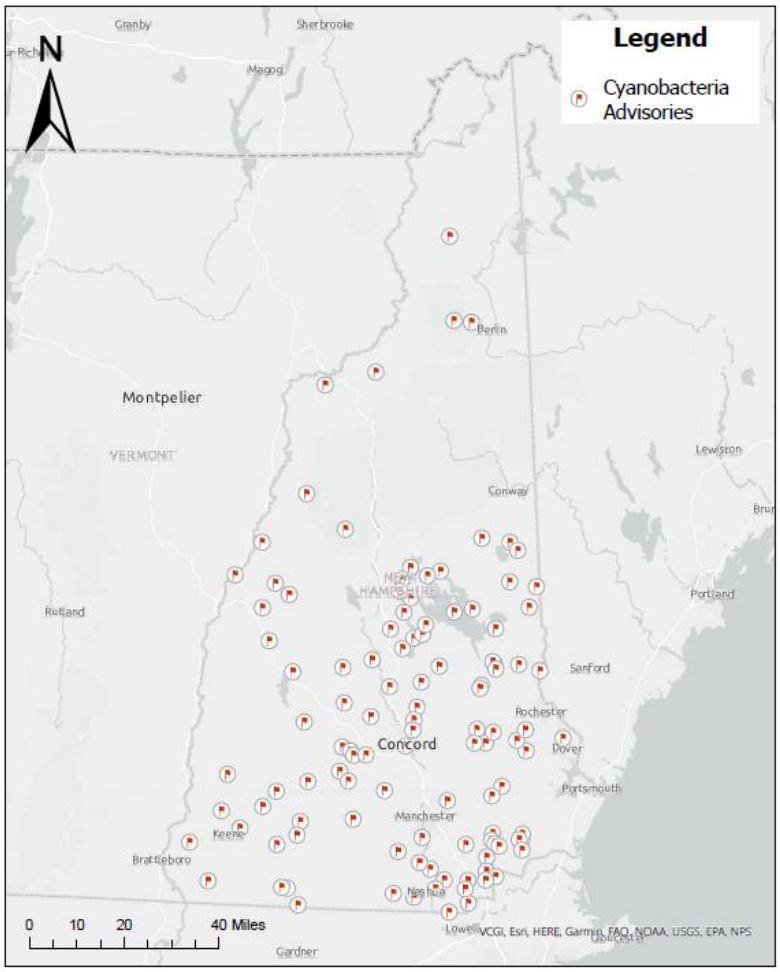


Figure 2. *Number of cyanobacteria advisories and alerts for New Hampshire surface waters, 2003 – 2022.*

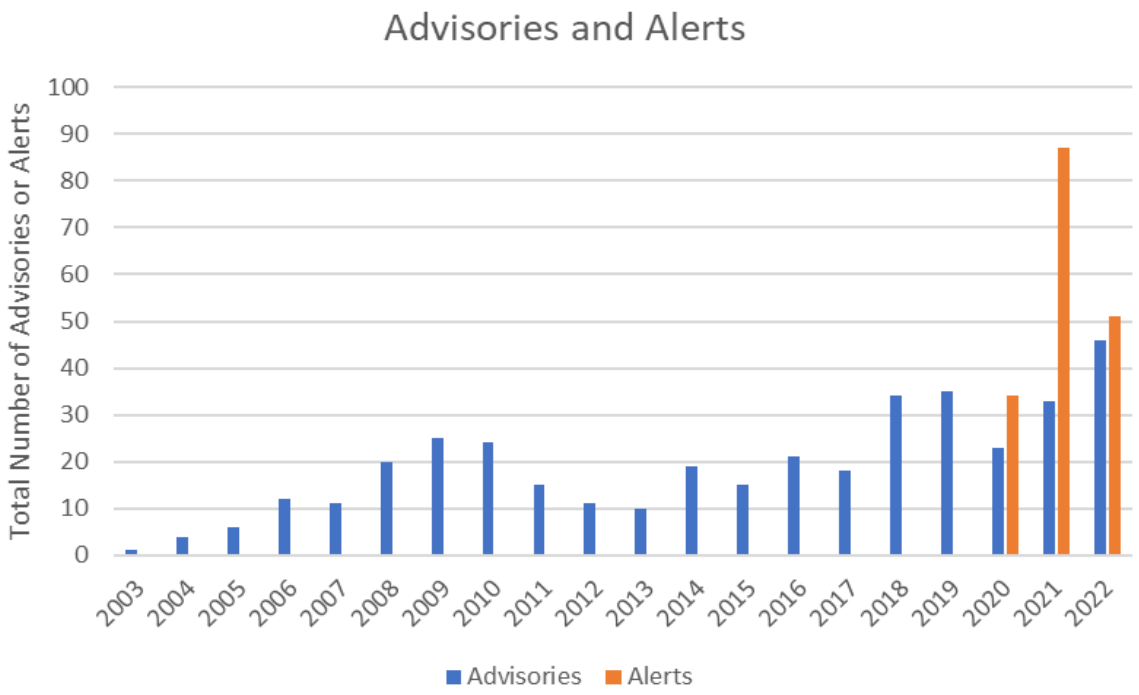
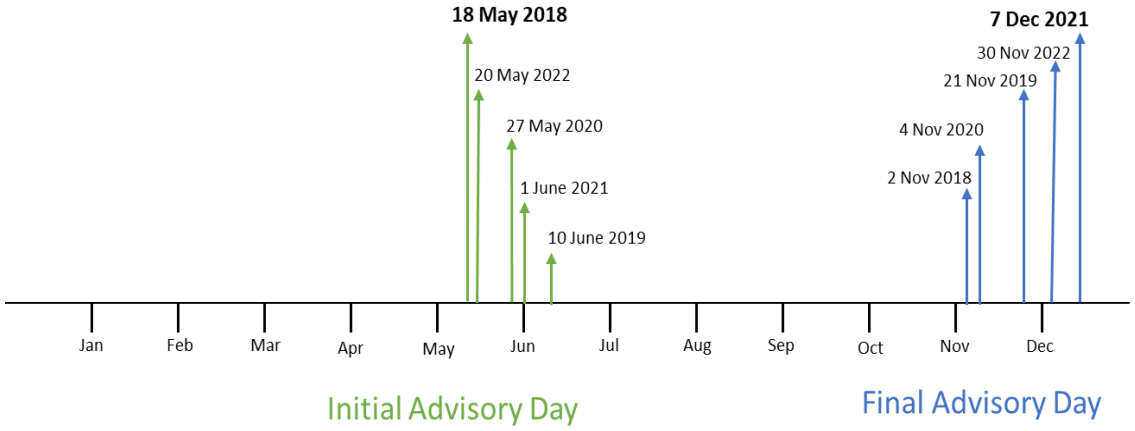


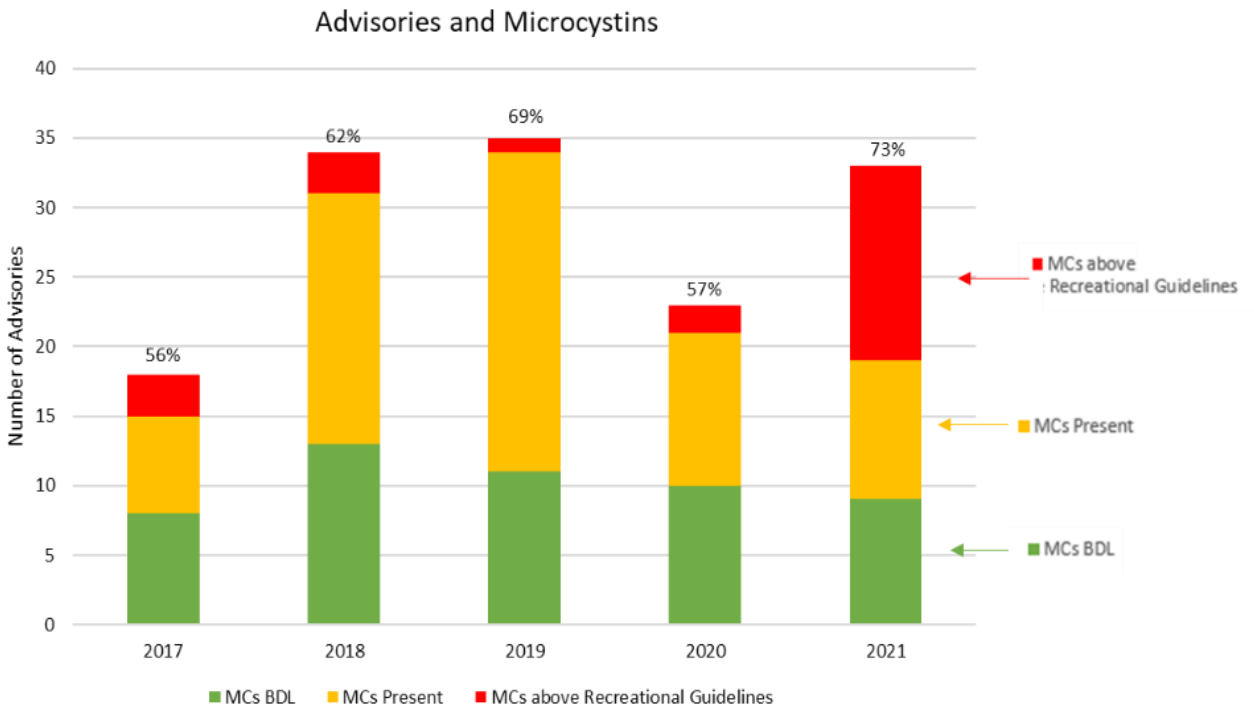
Figure 3. First and last day of the year for cyanobacteria advisories in New Hampshire surface waters, 2018 – 2022.



Cyanotoxin testing at NHDES occurred annually from 2017 through 2021. Microcystin concentrations were the most frequently evaluated cyanotoxin. The percentage of bloom samples with detectable microcystin concentrations ranged from 56 to 73%. The number of advisories that had microcystin levels exceeding the EPA RUG (8 µg/L) ranged from 1 out of 35 advisories (2019) to 14 out of 33 advisories (2021) (Figure 4). In 2020, samples from 23 lakes where advisories were issued were also evaluated for other cyanotoxins (cylindrospermopsin, anatoxin and β-N-methyl L-alanine amino acid, BMAA). The results found that in three lakes none of the cyanotoxins tested were above the detectable level, thirteen lakes had two or more cyanotoxins that were detected, and five lakes had at least one detectable cyanotoxin that was not microcystin (NHDES CyanoHAB program manager, pers. comm). These results indicate that cyanotoxin production is

complex in that it may not occur during bloom conditions at a level that is easily detectable, that blooms could include the production of multiple toxins, or that blooms may not include microcystin.

Figure 4. *Number of cyanobacteria advisories (total bar height), percent with detectable microcystin concentrations (percent on top of bar) and number exceeding the EPA RUG (red bar only).*



2.3 NHDES Cyanobacteria Harmful Algal Bloom (CyanoHAB) Program

The current program for evaluating cyanobacteria blooms and communicating the status to the public is managed by one full-time staff person with periodic assistance from other NHDES staff when time allows. In the summer months, one intern is hired to support the program. The program is based in the Biology Section of the Watershed Management Bureau. The primary components of the current program include receiving and responding to bloom reports, determination of the type and severity of cyanobacteria blooms, notification to the public of bloom locations and determination of bloom toxicity.

The CyanoHAB program is a response-based monitoring program. That is, monitoring only occurs when a bloom is suspected or ongoing. There is no routine or "sentinel" monitoring. Any member of the public, including lake residents, boaters and anglers can report a potential bloom. Once samples are collected, they are transferred to and analyzed at the NHDES Jody Connor Limnology Center (JCLC) in Concord. Staff microscopically identify the cyanobacteria present and estimate the cyanobacteria density (number of cells/mL) in the water. The use of density estimates to determine recreational safety allows NHDES to make a rapid determination of bloom severity as a precautionary method to minimize health risks. The use of cell density is commonly used and considered the industry's best practice for monitoring cyanobacteria (ITRC online publication #1).

NHDES issues two tiers of notifications about cyanobacteria blooms: warnings (advisories) and alerts. Recreational warnings are issued when the density of cyanobacteria exceeds 70,000 cells/mL. The cell count

threshold of 70,000 cells/mL is based on Administrative Rule (Env - Wq 1108.14). Cyanobacteria densities above this level are more likely to result in cyanotoxin levels that could be a health risk (

3.2 Cyanotoxin Prevalence **Research**). When NHDES issues a warning, it is suggested that people avoid contact with the water, keep pets and children out of the water and to not drink the water. Warnings are posted on public access points and made available on the NHDES webpage, and waterbodies are resampled weekly until the cell density declines below 70,000 cells/mL. NHDES issues alerts when cell densities are below but approaching the 70,000 cells/mL threshold, based on an image prior to sample analysis, or when a bloom was present but there is no longer evidence of a bloom by the time a sample is analyzed. Alerts are a suggestion to be on the watch for a potential future bloom. Waterbodies with alerts are only resampled if NHDES receives reports of worsening bloom conditions.

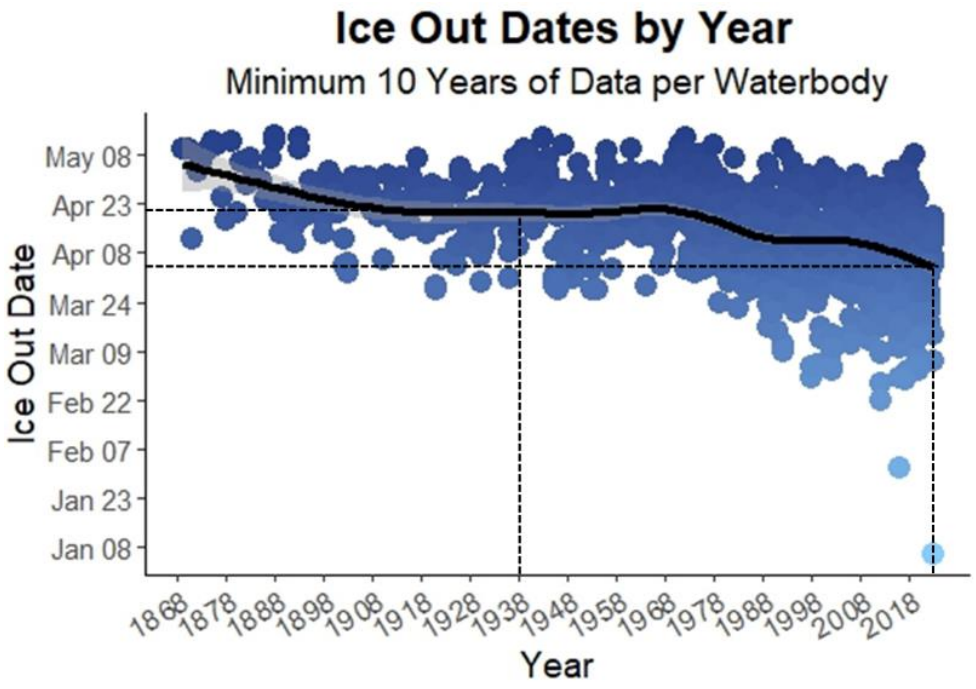
NHDES uses Enyzme-Linked Immunosorbent Assays (ELISA) to determine the concentration of a limited set cyanotoxins for initial advisory bloom samples. Cyanotoxin analysis is focused on the microcystin complex, but samples are tested for other cyanotoxins., such as anatoxin, cylindrospermopsin and BMAA. Cyanotoxin testing is performed in the winter months on samples collected the previous summer. Cyanotoxin data adds to the understanding of bloom toxicity levels among waterbodies, over the course of a bloom, and especially from year-to-year for waterbodies that bloom annually. Cyanotoxin data are also useful to better understand the relationship between cell density and bloom toxicity. At this point, NHDES does not concurrently test bloom samples for cyanotoxins during a bloom event primarily because the analysis is time intensive, and results would not be available rapidly enough to inform public health decisions. The exception to this is with cyanobacteria blooms that occur on drinking water supplies. In these cases, samples are tested for cyanotoxins during a bloom event using an external laboratory to determine bloom toxicity.

2.4 Cyanobacteria and Changing Environmental Conditions

Changing environmental conditions are, in part, responsible for the observed increase in bloom frequency, severity and duration. Water temperature increases, in conjunction with greater nutrient inputs (loads), are the primary factors suspected in driving bloom frequency and severity (Paerl and Paul 2012). A recent NHDES report on the status and trends of lake water quality documented that the period of time that the state's lakes are ice covered has significantly decreased by approximately two weeks (Figure 5, Hugger and Neils 2020). Beginning around 1938, lakes in New Hampshire have exhibited a trend of earlier ice out. In 1938, lakes typically iced-out in late April. In 2020, ice-out was typically occurring in early April or late March. Earlier ice out means the surface waters begin warming sooner. The 2020 Lake Report also documented that the state's surface waters are warmer in the summer months now than 30 years ago and that there was a significantly increasing trend in water temperature for nearly 20% of the waterbodies analyzed (Hugger and Neils 2020). It is expected that the trends towards shorter periods of ice cover and warmer water in the summer months will continue as air temperatures rise, making the control of nutrient sources (loads) even more critical in managing cyanobacteria blooms. In an intercontinental research effort that included lake data from North and South America, Bonilla et al (2023) found that nutrients were stronger predictors of cyanobacteria biomass than the natural climatic gradient. Paerl and Paul (2012) emphasize that while multiple factors act synergistically to favor cyanobacteria growth, stricter nutrient management is the most reasonable approach to long term control of cyanobacteria blooms. Last, it is important to recognize that local efforts that reduce nutrient inputs to our surface waters will have more immediate effect on reducing cyanobacteria bloom

probability than global initiatives to slow a warming and dynamic climate. It is for these reasons that the plan focuses its efforts on nutrient control measures.

Figure 5. *Trend in ice-out dates for New Hampshire lakes with 10 or more years of data.*



3.0 Studies Completed to Inform the Plan

HB1066 provided $30,000 in funds to NHDES to complete this plan. The funds were used to complete a public outreach survey and research the prevalence of four cyanotoxins in samples collected in 2022. Both efforts informed the content of this plan and the future direction of managing cyanobacteria blooms in New Hampshire surface waters.

3.1 Public Outreach Survey

Summary

- 687 responses were received.
- 96% of respondents expressed a concern regarding the potential impacts of cyanobacteria.
- Health risks, reduced recreational use of surface waters and impacts to property values were the most common concerns.
- Cyanobacteria bloom monitoring and notification, education/training tools, land development policies and regulations, and lake management were commonly included in responses as important actions that are needed.

The purpose of the survey was to receive input on the awareness level and concern for cyanobacteria blooms. Stakeholders were also asked to provide input on the effectiveness of cyanobacteria bloom communication, the types and availability of educational of materials, the methods and support needed for bloom monitoring and efforts NHDES or other regulatory entities should take to address the causes or consequences of blooms.

The stakeholders were broken down into three major groups; business/industry and municipal organizations, lake/watershed/river organizations and other conservation groups and the general public. A total of 687 responses were received. The majority of responses were from the general public (Table 2).

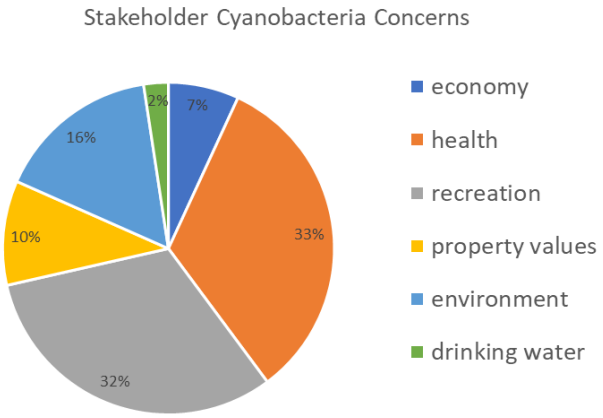
Table 3. *Outreach survey groups and number of responses.*

Invited Stakeholder Groups and Survey Participation

Group	Shared survey with constituents?	# of respondents
BUSINESS & INDUSTRY & MUNICIPAL STAKEHOLDERS		
NH Association of Chamber of Commerce Executives	No	-
New Hampshire Camp Directors Association	Yes	13
New Hampshire Health Officers Association	Yes	1
New Hampshire Lakes Region Tourism Association	Yes	18
New Hampshire Lodging and Restaurant Association	No	-
New Hampshire Marine Trades Association	Yes	41
New Hampshire Municipal Association	Yes	2
New Hampshire REALTORS Association	No	-
New Hampshire Recreation & Park Association	Yes	6
New Hampshire Travel Council	Yes	6
New Hampshire Water Works Association	Yes	1
Subtotal		**88**
LAKE, WATERSHED, RIVER ASSOCIATIONS, & OTHER CONSERVATION STAKEHOLDERS		
New Hampshire Association of Conservation Commissions	Yes	76
New Hampshire Dept. of Environmental Services Volunteer Lake Assessment Program group leaders	Yes	81
NH LAKES Partners (lake, pond, and watershed groups)	Yes	18
New Hampshire Rivers Council river partner groups	Yes	2
UNH Cooperative Extension Lay Lakes Monitoring Program group leaders	Yes	5
Subtotal		**182**
PUBLIC		
NH LAKES Facebook Followers	Yes	90
NH LAKES Supporters	Yes	327
Subtotal		**417**
TOTAL		**687**

The survey consisted of a mix of questions that could be answered as "yes/no", multiple choice, or as free text. Overall, 94% of respondents indicated they were aware of cyanobacteria and 96% expressed a level of concern regarding their occurrence. Only 3% of respondents indicated they did not know much about cyanobacteria. The responses received in the free text section were categorized into six areas of concern: economic, health-related, recreational, property values, environmental and drinking water. Of the respondents that expressed a level of concern, many of the responses included multiple categories. For example, it was common for respondents to indicate that they were concerned both about the health impacts of cyanobacteria and that blooms could restrict recreational use. Based on NHDES' review of the responses, health and recreational concerns were most common, followed by potential impacts to the environment including fish, wildlife and aesthetic enjoyment (Figure 6). Respondents also expressed concerns that cyanobacteria blooms could impact property values and the economy, specifically local businesses, tax revenues and tourism. Public and private drinking and household water sources were noted as concerns as well.

Figure 6. *Percent of public survey responses mentioning major categories of concern with respect to cyanobacteria blooms.*



The survey also included several specific questions. Responses to these questions indicated that public notification of when and where blooms occur is critical and that electronic notification as well as physical signage is preferred at the recreational site. Respondents also indicated that additional education and training is needed to build public awareness, particularly regarding visually recognizing cyanobacteria and how to complete a basic self-risk assessment. For questions related to cyanobacteria monitoring, volunteer monitors or watershed/lake/river organizations indicated they monitored local waterbodies and that monitoring typically involved visual observations for surface scums or overall water clarity. Finally, survey participants were asked what efforts NHDES or other regulatory entities should take to address the cause or consequences of toxic blooms. Common responses to this question included more participation by municipalities, establishment and enforcement of building or development setbacks, increases in fines for those that violate current regulations, additional funding for planning and remediation projects, control of fertilizer use, updated regulations for septic systems and additional support for monitoring to diagnose the cause of blooms.

3.2 Cyanotoxin Prevalence Research

Summary

- Of the 245 samples tested, 68% had detectable levels of microcystins, 33% had detectable levels cylindrospermopsin, 68% had detectable levels anatoxin and 39% had detectable levels BMAA.
- The EPA drinking water health advisory (HA) and EPA recreational use guidelines (RUG) concentrations for microcystin were exceeded in 20% and 11% of samples, respectively.
- There was a 17% risk of exceeding the RUG for microcystin if the cyanobacteria cell density was over 70,000 cells/mL.
- Samples that had a cyanobacteria cell density greater than 70,000 cells/mL were 4 times more likely to exceed the RUG than samples with a cell density less than 70,000 cells/mL.

Cyanobacteria bloom samples collected in 2022 were tested for four cyanotoxins. The purpose of the evaluation was twofold; 1) to determine the frequency of detection of cyanotoxins and their respective

concentration and 2) to examine the relationship between cell density and cyanotoxin frequency and concentration.

In total, 245 cyanotoxin samples were tested for micocystin (MC), cylindrospermopsin (CYN), anatoxin (ATX), BMAA using ELISA methods. Of these samples, approximately 40% (96 samples) came from seven waterbodies that experienced relatively severe and long-lasting blooms in 2022. Samples that were analyzed came from initial bloom advisory or alert samples, as well as follow up sampling from waterbodies with continued high cyanobacteria densities. It is important to note that while the cyanotoxins tested in this evaluation have been associated with a variety of health risks and symptoms, only microcystin and cylindrospermopsin have HA and RUG concentrations recommended by the EPA. Additionally, because this analysis is based on a single year of data, it is not a complete evaluation of cyanotoxin prevalence in New Hampshire's surface waters, nor is it an evaluation of all possible cyanotoxins potentially produced by cyanobacteria that occur in New Hampshire waterbodies.

The summary of cyanotoxins tested in 2022 samples indicated that microcystin and anatoxin were the most commonly detected toxins, while BMAA and cylindrospermopsin were detected less frequently (Table 3). Microcystin exceeded the HA concentration in 49 samples (20%) and the RUG concentration in 27 samples (11%). Cylindrospermopsin concentrations did not exceed HA or RUG concentrations in any of the samples. Provisional guideline threshold values for anatoxin from the World Health Organization (WHO) are 30 µg/L for drinking water (acute exposure) and 60 µg/L for recreation (Chorus and Welker, 2021). The maximum anatoxin concentration for 2022 samples was 4 µg/L. For BMAA, there are currently no recommended thresholds that can be applied to the data. BMAA is a highly complex cyanotoxin with little consensus among researchers regarding its toxicity and testing methods (Faassen, 2014). Several studies have suggested a linkage between BMAA and neurodegenerative diseases such as amyotrophic lateral sclerosis (ALS) (Caller et al, 2009, Pablo et al, 2009). However, without toxicity guidelines, data are only interpreted for presence or absence. Of the samples tested, less than 50% of the samples had detectable levels of BMAA.

Table 4. *Results of 2022 cyanobacteria bloom samples tested for four cyanotoxins. * MC sample required further dilution; maximum concentration is greater than 48.0 µg/L.*

Cyanotoxin	Frequency of detection	Average of detectable concentrations (µg/L)	Minimum Concentration (µg/L)	Maximum Concentration (µg/L)	EPA recommended HA/RUG (µg/L) – school-age children and adults
Microcytin (MC)	68%	3.85	0.16	> 48.0*	1.6/8.0
Cylindrospermopsin (CYN)	33%	0.15	0.05	1.70	3.0/15.0
Anatoxin (ATX)	68%	0.43	0.15	4.00	None
BMAA	39%	15.2	7.00	81.4	None

The 2022 data also included 182 samples with both cyanotoxin data and estimates of cell density (number cells/mL). Using these data, the instances when cyanobacteria exceeded a cell density threshold and had a corresponding exceedance of the respective RUG were determined for microcystin and cylindrospermopsin. The microcystin RUG was exceeded in 27 samples. Of these, 26 samples exceeded both the microcystin RUG and were above the cell density threshold used by NHDES to issue cyanobacteria advisories (70,000 cells/mL) (Table 4). Conversely, there were 131 instances when the RUG was not exceeded, but the cell density did

exceed 70,000 cells/mL. These data indicate there is a 17% (26/131) "risk" that the RUG for microcystin was exceeded when the cell density was over 70,000 cell/mL. In contrast, of the 25 samples that were analyzed for microcystin that had a cell density less the 70,000 cells/mL only one exceeded the RUG (4%). When comparing these two frequencies, these data indicate that the "risk" of exceeding the RUG was four times more likely to be exceeded when cell densities were above 70,000 cells/mL (17%/4%). A similar evaluation for cylindrospermopsin was not possible because there were no samples that exceeded the RUG.

Table 5. *Frequency of cyanotoxins (CYN=cylindrospermopsin; MC=microcystins) above and below EPA recreational use guidelines (RUGs) in 2022 cyanobacteria bloom samples.*

Condition	**CYN** (RUG=15 µg/L)	**MC** (RUG=8 µg/L)
Count of samples over toxin threshold and over 70,000 cells/mL	0	26
Count of samples over toxin threshold and under 70,000 cells/mL	0	1
Count of samples under toxin threshold and over 70,000 cells/mL	157	131
Count of samples under toxin threshold and under 70,000 cells/mL	25	24
TOTAL	182	182

The toxin data paired with cell density from 2022 samples was useful in beginning to understand the frequency of which various cyanotoxins are detected in samples from New Hampshire surface waters. Based on these data, microcystin is the most useful cyanotoxin to test because it was regularly detected, has EPA recommended thresholds for drinking and recreational use and occasionally exceeded the HA and RUG thresholds recommended by EPA. However, there are many more cyanotoxins than those tested in the 2022 samples, making the reliance on any single cyanotoxin as an indicator risk unreliable. Further, several lakes were tested for cyanotoxins several times in 2022 and it was evident that cyanotoxin concentrations varied widely over short periods of time or locations on the waterbody. For example, at Silver Lake in Hollis microcystin concentrations ranged from 0.20 µg/L to over 48 µg/L from June to October and on two occasions within approximately 10 days the toxin concentration went from over 48 µg/L to less than 5 µg/L. In contrast, the 2022 data demonstrate that using cell density estimates as a surrogate "risk" estimator of encountering high cyanotoxins is a reasonable conservative measure that is protective of public health. Furthermore, estimating cell density using a microscope is relatively quick and inexpensive allowing NHDES to make rapid decisions on waterbodies where blooms are occurring relative to their use for recreational purposes or as a water supply. Cyanotoxin evaluation is, however, useful in understanding the cyclical nature and types of toxin production in individual waterbodies, the association with various cyanobacteria that are present, and in completing statewide analyses to determine the overall frequency of toxin production and magnitude of concentration.

4.0 Statewide strategies to manage cyanobacteria impacts

Cyanobacteria blooms are significantly impacting New Hampshire's surface waters. An increase in documented bloom occurrence and severity requires action to reduce and control impacts related to public health,

recreational and commercial water uses and the economy supported by the state's surface waters. NHDES worked in partnership with the cyanobacteria advisory committee to identify the actions needed to reduce these impacts. A full account of the ideas and suggestions provided by the cyanobacteria advisory committee is provided in Appendix B. The actions identified for inclusion into the plan were considered to be the most important based on the best and most current science available, first-hand experience and knowledge about cyanobacteria and input from the public outreach survey.

In total, four strategies were identified that address the concerns relative to cyanobacteria blooms and the toxins they can produce. For each strategy, the priorities and specific tactics necessary to accomplish the strategy are included. The strategies include a focus on preventing and reducing bloom occurrence, raising awareness about cyanobacteria, monitoring and tracking bloom occurrences and minimizing the threats to public water supplies (Table 6, See Appendix C and D for summary).

Table 6. *NHDES cyanobacteria plan strategies and priorities.*

Strategy (focal areas of the plan)	Priorities
1. Develop the policies and practices to reduce, control and prevent the nutrient inputs that cause cyanobacteria blooms.	• Identify and implement state and local regulations and practices that address the sources of nutrient inputs that cause cyanobacteria blooms. • Identify ways to increase capacity and financial support for watershed and in-lake management efforts that prevent and reduce nutrient inputs and address cyanobacteria blooms. • Develop laws, rules and guidance that clearly define the permitting requirements and processes for lake management activities designed to remediate cyanobacteria.
2. Advance education and outreach efforts that allow individuals who recreate or use surface waters to assess the cyanobacteria risks and respond accordingly.	• Promote self-risk assessment messaging and techniques. • Produce cyanobacteria informational materials to provide learning opportunities that are available to related professional disciplines and consumer groups.
3. Enhance cyanobacteria monitoring to track when and where blooms occur and clearly communicate current conditions to the public.	• Enhance cyanobacteria monitoring, sample submission and processing efficiency. • Develop and implement advanced bloom notification tools.
4. Establish policies and procedures for prevention, early detection and response and treatment of cyanobacteria blooms and cyanotoxins in surface waters that serve as public drinking water supplies to minimize risks to customers.	• Develop cyanobacteria action plans by public water suppliers.

Strategy 1. Develop the policies and practices to reduce, control and prevent the nutrient inputs that cause cyanobacteria blooms.

Important Premise: Nutrients are a significant factor that contribute to bloom occurrence. A reduction in the quantity of nutrients that enter our surface waters either through policy or engineered solutions is an important step to controlling cyanobacteria blooms.

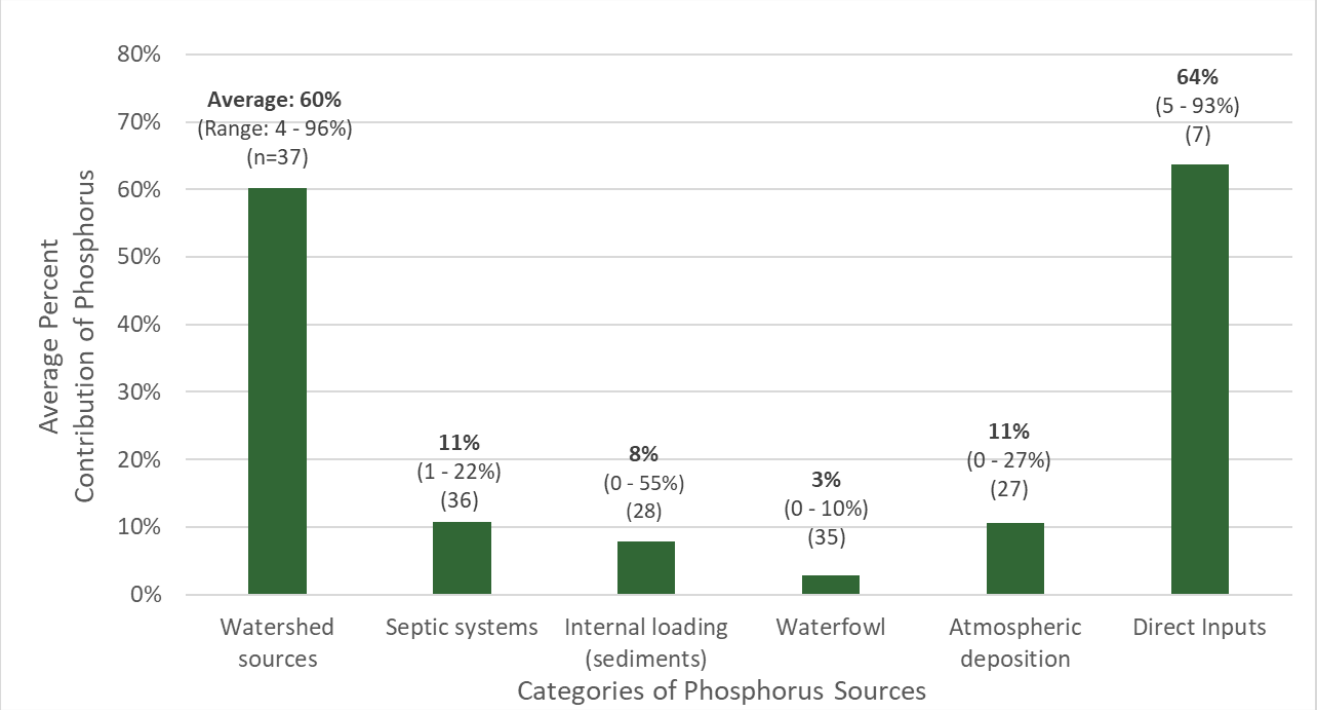
4.1.1 Background

Human activities have increased phosphorus availability in waterbodies, which contributes to the likelihood of cyanobacteria bloom formation (Paerl 2014). Urban and suburban development, roads and impervious surfaces (pavement, hardscapes, roofs) are associated with higher nutrient loads because these land use types generate significant stormwater runoff (McGrane 2016). Stormwater runoff contributes 50% of the water quality impairments in New Hampshire (Wood, 2022). Nutrient pollution from stormwater is one source of nutrients to surface waters. Other sources include wastewater, agricultural runoff, septic systems, atmospheric deposition, waterfowl and internal loading from bottom sediments. Natural nutrient sources to surface waters come from the breakdown of organic material, like leaves and soils, and through "weathering" of rocks. In New Hampshire, municipal wastewater discharges are well regulated by permit and agricultural inputs are typically small unless there is a significant amount of unmanaged agricultural land use practices within a watershed.

Watershed plans are vital to understanding waterbody dynamics and the contribution of various pollution sources, specifically nutrients. Nutrient source identification provides a roadmap of where efforts should be focused to protect or restore waterbodies to a desirable condition. Since 2010, NHDES has funded or worked on 37 watershed plans that included pollution "load" estimates specific to nutrients. These budgets typically focus on phosphorus because it is the limiting nutrient in the growth of aquatic plants, algae and cyanobacteria in New Hampshire's freshwaters. In addition, watershed planning serves to bring interested parties together to define a common target for a waterbody, identify specific projects or activities to achieve the target, track the progress towards the target and reformulate the plan or target when necessary.

A summary of the nutrient load estimates indicates that "watershed sources", on average, contribute 60% of the phosphorus load to a waterbody (Figure 7). The watershed source load estimate is determined based on the land use types within the watershed. Forested watersheds have a much lower loading rate than watersheds with a large amount of developed land. In general, developed lands contribute phosphorus loads at a rate eight times higher than forested lands during runoff events and at rate two times higher under ambient conditions (i.e., non-storm event) (Lake Loading Response Model export coefficients, unpublished). The high rate of nutrient load contribution by developed lands, especially during storm (runoff) events, highlights the critical importance of managing stormwater by policy and regulation or though engineered solutions. Furthermore, these plans demonstrate that, in many cases, the overall phosphorus load can be dominated by local sources that emanate from poor, failed, or neglected stormwater management such as roadside erosion, improperly sized culverts, excessive impervious cover, lack of stormwater management structures and compromised shoreland. In some cases, "direct inputs" contribute a significant portion of the load as a result from of upstream lakes or ponds that drain into the waterbody of interest and are a combined result of all nutrient sources (i.e. watershed sources, septic systems, internal loading, waterfowl and atmospheric deposition).

Figure 7. *Average of modeled phosphorus load sources for 37 New Hampshire surface waters included in watershed plans completed from 2010-2022. *Note that the "Direct Input" category only includes estimates from seven waterbodies. "Direct Inputs" refer to the phosphorus load contributed by upstream lakes/ponds. Sum of sources adds to more than 100% because each source is the independent average across multiple watershed plans.*



The watershed plan nutrient load summary also indicates that septic systems contribute about 11% of the overall phosphorus load (Figure 7). Comparatively, septic systems contribute a relatively small percentage of the total phosphorus load to surface waters in New Hampshire based on loading estimates included in watershed plans. A properly functioning septic system is important and can remove in excess of 90% of the phosphorus from household wastewater (Lusk et. al. 2018). However, septic systems that are improperly installed, maintained, or old septic systems (including holding tanks and other ad hoc systems) may not function effectively, thereby allowing a higher nutrient load to reach surface waters. Therefore, septic system inventories, maintenance and replacement can be useful tools for managing nutrient loads. The cyanobacteria advisory committee made several specific recommendations for legislative actions to improve septic system management and tracking that are included in the supplemental actions for strategy one.

Internal nutrient loading of phosphorus can be particularly problematic in some lakes and ponds. Internal loading typically occurs when phosphorus is released from the bottom sediments when the deep water has little to no dissolved oxygen. Under these conditions, phosphorus enters the water column and becomes available to fuel cyanobacteria growth. Bottom sediment accrual of phosphorus occurs slowly over time and reflects current and legacy land use practices and nutrient inputs. The average internal load based on previous watershed plan estimates was 8% of the total phosphorus load (Figure 7). In lakes where internal loads were greater than 20%, and even up to 55% of the total phosphorus load, cyanobacteria blooms occurred annually and over prolonged periods.

When internal phosphorus loads are identified to be significant (>20% of the total load) and a reduction is needed to minimize the occurrence of cyanobacteria blooms, so-called "in-lake" management activities can be

useful. These activities include the use of chemicals, aeration, oxygenation, or physical mixing. The selection, planning for, and use of in-lake management activities is complex and an expensive endeavor. Additionally, the success of these activities is usually dependent of the elimination or significant reduction in the major nutrient inputs from watershed sources, also known as "external" sources because they originate outside of the waterbody. When selected and planned for properly, in-lake management activities can be highly effective in achieving the desired condition, including the elimination or reduction in cyanobacteria bloom occurrence.

4.1.2 NHDES current activities

NHDES currently has a variety of programs that contribute to nutrient pollution control, estimation, and tracking. Regulatory-based programs that are designed to prevent or reduce nutrient inputs to surface waters include the state wetlands regulations (RSA 482-A), the shoreland water quality protection act (RSA 483-B) and alteration of terrain permits (RSA 485-A:17). Additionally, NHDES maintains permitting authority over septic systems (RSA 485-A various). At the federal level, NHDES works in consultation with the EPA to review and authorize surface water discharges and activities that could affect water quality through the issuance of the Clean Water Act (CWA) section 401 water quality certificates (RSA 485-A:12). Federal stormwater permits are issued directly by EPA to communities and facilities under the CWA as construction general permits (CGP), multi-sector general permits (MSGP), or small municipal separate storm sewer system general permits (MS4GP).

Additional work by NHDES that is not regulatory includes watershed-based plan development and implementation, completion of total maximum daily loads (TMDLs), implementation of homeowner assisted stormwater management projects and collaboration with a variety of partners in the production of the New Hampshire Stormwater Manual.

The Watershed Assistance Section at NHDES supports lake associations, municipalities and other organizations interested in developing and implementing watershed management plans. Funds from EPA to NHDES under sections 604b and 319 of the Clean Water Act (CWA) are used to support watershed-based plan development and implementation, respectively. Additionally, low-interest, Clean Water State Revolving Fund (SRF) Stormwater Planning loans are available from NHDES to support watershed-based planning. In all cases, grants and loans are awarded through a competitive application process. Funding availability is usually the limiting factor in watershed-based plan preparation and implementation, and demand far outpaces available funds.

TMDLs are required to be completed on "impaired waters" as identified by NHDES in its water quality report to EPA. Impaired waters are reported to EPA every two years as required under section 303(d) of the CWA. Surface waters afflicted with cyanobacteria blooms are listed as "impaired" depending on the frequency of occurrence and bloom severity. NHDES currently has 64 waterbodies listed as impaired for cyanobacteria (Wood, 2022). As of March 2022, NHDES has approved TMDLs on 22 waterbodies that are impaired for cyanobacteria (K. Edwardson, pers. comm.). It is likely that several others will be included on this list in the future as cyanobacteria blooms are becoming more common. TMDLs include water quality targets and recommended pollution reduction actions necessary to achieve those targets. Successful implementation of a TMDL requires that the water quality targets are met to remove the waterbody from the impaired waterbody list.

Watershed-based plan and TMDL development require pollutant modeling to predict water quality conditions. Specifically, nutrient modeling relies on multiple years of water quality data to calibrate and ensure the accuracy of the models. In New Hampshire, much of the lake water quality data are collected by volunteers participating in NHDES's Volunteer Lake Assessment Program (VLAP) or UNH's Lay Lakes Monitoring Program

(LLMP). In many cases, significant additional or specialized data collection is required beyond what is collected by volunteers to complete an accurate nutrient model. Where resources allow, the NHDES Biology Section intensifies data collection on waterbodies with repetitive cyanobacteria blooms. In other cases, consultants must fill this role to satisfy intensified or specialized data collection needs.

Voluntary, home-based nutrient prevention and reduction efforts are supported by the NHDES "Soak up the Rain" program. The program engages home and small business owners by providing assistance for stormwater management on their property. In some cases, this includes designing and implementing stormwater prevention best management practices (BMPs) such as rain gardens, infiltration trenches and gravel lined swales. Since this program began in 2010, 34 projects with NHDES oversight have been completed to reduce phosphorus loads to surface waters. Other organizations in New Hampshire have similar programs, such as the NH LAKES LakeSmart program, which assists shoreland property owners in identifying actions they can take on their property to reduce nutrient pollution and protect water quality.

In 2008, NHDES published a three-volume stormwater manual which is meant to serve as a planning and design tool for communities, developers, engineering professionals and agencies involved in stormwater management in New Hampshire. The manual provides an overview of the various state and federal regulatory requirements for stormwater management, a detailed description of the structural best management practices (BMPs) applicable for use to control stormwater on developed landscapes and stormwater management practices for use during construction. NHDES and its partners are currently working on an update to this manual.

Priority: Identify and implement state and local regulations and practices that address the sources of nutrient inputs that cause cyanobacteria blooms.

Tactic	Description	Timeframe	Additional Funding Required (Y/N)	New or Revised State or Local Policy Required	Measurable milestones
1	Stormwater utilities	Immediate and ongoing	None	Yes – local	Number of communities that have adopted stormwater utilities
2	Municipal Overlay districts	Immediate and ongoing	None	Yes – local	Number of overlay districts adopted specifically to manage nutrient inputs
3	NH stormwater manual	Available summer 2024	None	Potentially – state or local level	Availability and use of manual
4	Review of state regulations	2025	**$50,000 one-time investment to hire independent contractor**	None	Review complete

5	Voluntary statewide stormwater management programs	2026 and ongoing	**$150,000 annually for support of voluntary stormwater management programs**	None	Estimated nutrient reduction annually

Statewide management of stormwater to reduce nutrient inputs to surface waters requires regulatory and non-regulatory actions. Land use regulations and policies are one of the best ways to control stormwater. State laws and administrative rules related to land use provide broad coverage of permittable activities and requirements to protect water quality. However, the state defers to local communities to develop and implement proactive regulations for stormwater management that have reasonable limitations on development. Local communities can adopt regulations that are stricter that state laws and rules.

The plan also recognizes the value of non-regulatory efforts to reduce nutrient inputs that will prevent or curtail cyanobacteria blooms. Proper design, implementation and management of stormwater control measures are critical to achieving expected performance measures and meet nutrient input targets. Similarly, homeowners and small businesses can positively affect their stormwater input contributions by participating in programs that promote awareness and assist in the design and implementation stormwater control measures.

Tactic 1. Promote the development and implementation of stormwater utilities that control stormwater runoff and fund stormwater management projects.

Stormwater utilities are recommended for adoption in communities where sensible under the provisions provided in RSA 149-I. Adoption of stormwater utilities occurs at the local level. In densely populated communities that contain surface waters that have had or could have cyanobacteria blooms, the adoption of a stormwater utility has the potential to reduce and control nutrient inputs that originate from stormwater. Stormwater utilities generate funding through user fees that are typically based on the impervious surfaces (e.g., roofs, roads, driveways, parking lots) of each property within the stormwater utility district. Revenues generated from the user fees are placed in a dedicated fund to implement a stormwater management program.

Currently, there are no stormwater utilities in place in New Hampshire; however, several communities have studied or are contemplating their adoption. Across New England stormwater utilities have been adopted in approximately 30 communities in Connecticut, Maine, Massachusetts and Vermont.

Tactic 2. Promote the development and implementation of municipal overlay districts in areas adjacent to surface waters and in areas that are known to contribute significant quantities of nutrients to surface waters.

Across New Hampshire, municipalities use overlay districts to enact more stringent measures than statewide standards to protect valuable resources. The authority to implement overlay districts by municipalities is provided in RSA 674 (see section 21, Innovative Landuse Controls). Overlay districts can be used to manage stormwater or regulate septic systems within smaller geographic areas than the whole municipality (e.g., within 250' of a waterbody). Overlay districts are particularly useful tool when

used to address nutrient issues identified during the watershed-based planning process for specific waterbodies.

In New Hampshire, many communities have enacted overlay districts for a specific waterbody's watershed or shoreland area. As an example, the Town of Windham adopted a watershed protection overlay district that applies to specific areas within the Cobbetts Pond and Canobie Lake watersheds (see Town of Windham zoning and land use regulations, section 616). Additionally, in spring 2023, the Town of Sunapee adopted new rules specific to septic system maintenance within an established shoreland overlay district (see Town of Sunapee shoreland septic system rule).

Tactic 3. Promote the use of the New Hampshire stormwater manual to plan, design and implement stormwater control measures that slow down, infiltrate and reduce nonpoint source nutrient pollution.

The New Hampshire Stormwater Manual was last published in 2008 in three volumes (2008 Volume 1, Volume 2, Volume 3). An updated manual is scheduled for release in summer 2024. NHDES recommends that this manual become the standard for planning and designing stormwater management efforts and stormwater control measures (SCMs). The manual can be used for large developments and small individual properties during and after construction. Eventually, the use of the stormwater manual could become a requirement for developing stormwater management plans or design structures included in state permits, including alteration of terrain, shoreland and wetlands.

Tactic 4. Complete a review of state laws and administrative rules that are designed to reduce nutrient inputs with the goal of identifying regulatory priorities.

The cyanobacteria advisory committee had several specific suggestions regarding changes to state laws or administrative rules that were targeted at reducing nutrient inputs to surface waters. Several of those suggestions are included as supplementary actions and tactics below. In reviewing these suggestions, NHDES staff concluded that broader overview of current laws and associated rules might provide a comprehensive understanding of their effectiveness. Therefore, it is recommended that a one-time allotment of funds be provided to hire an outside, third-party contractor to complete a review of NHDES' efforts to manage nutrient inputs, primarily through its regulatory oversight. The review is recommended to be restricted to the laws and rules that apply to a generalized list of environmental programs designed to protect and restore water quality, in particular nutrients. The purpose of the review would be to provide objective feedback to NHDES on the effectiveness of its current regulations and programs and where improvements are needed. The scope of work would also include considerations of how other states have addressed statewide nutrient control and reduction concerns.

Tactic 5. Promote and provide financial assistance to statewide voluntary stormwater management programs.

The NHDES "Soak up the Rain" program (NHDES Soak up the Rain) has been in place for approximately 10 years and has participated in 34 projects that involved installing stormwater control measures. The program also functions to provide outreach materials to property owners. The program is currently managed by a single part-time employee. NHDES feels confident that with additional resources and equipment this program could increase the number of projects completed and waterfront property owners reached. Non-NHDES voluntary waterfront property management programs, such as the NH LAKES LakeSmart (NH LAKES LakeSmart) offer additional pathways to reach waterfront property owners

and reduce nutrient loading by protecting and improving shorelands, reducing stormwater inputs and reducing use of chemicals, such as fertilizers.

It is recommended that a dedicated, recurring source of funds be provided to the NHDES "Soak up the Rain" program for direct use to fund projects and outreach materials and to outside organizations as contractors. The funds would be used exclusively to support volunteer stormwater management efforts on residential and small business properties.

Priority: Identify ways to increase capacity and financial support for watershed and in-lake management efforts that prevent and reduce nutrient inputs and address cyanobacteria blooms.

Tactic	Description	Timeframe	Additional Funding Required (Y/N)	New or Revised State or Local Policy Required	Measurable milestones
1	Identify sources for watershed management plan support	Within 1-2 years	**Y – Continuous state source**	**Y – Modification of RSA 487**	Additional funding made available to support watershed management projects
2	Improve in-lake management program	Within 2 years	**Y – Continuous state source**	**Y – Modification of RSA 487**	Additional funds made available to support in-lake management projects and investigations

Watershed management is recognized as a critical step in preventing and controlling cyanobacteria blooms through the abatement of nutrient loading. Many of New Hampshire's surface waters are located in rural communities, have relatively small watersheds and are influenced most significantly by the activities on the landscape. Thus, watershed management is the best targeted approach to address water quality protection and restoration efforts on individual waterbodies and the land that drains to the waterbody of interest (see Infographic 1).

NHDES currently has a moderate level of staffing and financial resources to support watershed management; however, there is a need for expanded programming as symptoms of excessive nutrient loading such as cyanobacteria blooms become more common. Demand already exceeds available planning and implementation funding need by approximately 3:1. Nutrient-focused watershed-based plans identify a variety of types of SCMs to address nutrient inputs to a lake. Example SCMs include regrading roads to divert runoff, upgrading inadequately sized culverts, replacing dysfunctional septic systems, repairing boat launches and installing catchment basins or other green infrastructure.

Additionally, for some waterbodies that regularly experience cyanobacteria blooms, "in-lake management" projects are the most effective way to reduce their occurrence. Many projects that would measurably improve water quality go unimplemented because of lack of funding or lack of required non-federal matching funds. A dedicated source of funding towards watershed management would allow many lake, pond and watershed groups to move forward with the actions necessary to prevent and control cyanobacteria blooms. Increased

funding for watershed management was one of the needs emphasized by the Cyanobacteria Plan Advisory Committee.

In the 2023 legislative session, $1 million in funding was provided to NHDES to as part of a cyanobacteria mitigation fund (Chaptered Law 0079, 2023). The purpose of these funds is to reduce the number of chronic and extended cyanobacteria blooms considered to be a threat to the long-term health of waterbodies. Continued or expanded funding of this manner is needed to fund watershed and in-lake management projects.

Tactic 1. Increase resources that support the development and implementation of watershed management plans on waterbodies that are specifically targeted to address cyanobacteria blooms.

Currently the Watershed Assistance Section at NHDES oversees watershed plan development and implementation. Dedicated planning grant funds amount to $75,000 annually and are provided solely from federal sources through the EPA. Additional state funds for planning are available through the state revolving loan fund (SRF). Funds for implementing watershed plans are provided to NHDES by EPA in the amount of $500,000 annually. NHDES awards these grants to organizations that have completed watershed management plans that meet certain EPA criteria, and who are able to provide a 40% matching contribution in finances or in-kind services. In 2022, there were approximately $800,000 in unfunded grant requests. The administration of these funds and associated projects requires significant staff resources. In most cases, NHDES staff in these positions manage 10 - 20 projects concurrently.

To successfully meet the demand for watershed management plan development and implementation, additional funding for projects and staffing is recommended by the advisory committee. NHDES suggests that the financial support for the increased resources be raised on a continuous basis through the creation of a statutory program under RSA 487, specifically section 17 (New Hampshire Clean Lakes Program). As currently written, the statute specifies the program's intent as "the preservation and protection of New Hampshire's lakes and ponds." It is recommended that the statute be modified to include watershed-wide planning and implementation efforts and explore funding sources that do not interfere with current invasive plant management funds. Such a program could be specific to waterbodies afflicted by cyanobacteria blooms or where efforts are focused to prevent their occurrence.

Tactic 2. Implement a lake management program with sufficient funding dedicated to diagnosing the cause of cyanobacteria blooms and implementing the recommended actions for remediation.

Over the past five years, there have been 30 – 40 cyanobacteria warnings annually on surface waters in New Hampshire. For several of these waterbodies, cyanobacteria blooms are annual events that restrict recreational activities for extended periods of time. In these situations, lake restoration projects are

necessary to minimize the occurrences of blooms. For other lakes, diagnosing the cause of cyanobacteria blooms requires specialized, intensive water quality studies. NHDES currently does not have sufficient funding or staff to meet the demand for lake management projects or diagnostic studies to control cyanobacteria blooms.

It is recommended that a program be developed in concert with Tactic 2 (Watershed planning and implementation) using RSA 487, section 17 as the basis for the purpose of funding in-lake management restoration projects and diagnostic studies. Collectively, by combining these two tactics, a singular lake management program would be established that targets waterbody-specific actions directed at understanding the factors that cause blooms and preventing or minimizing their occurrence.

Infographic 1. Nippo Lake Watershed Management Plan and Cyanobacteria Remediation Project

In 2010, Nippo Lake in Barrington began to experience annual, persistent cyanobacteria blooms (**A**). An analysis of lake water quality data showed an increasing trend in total phosphorus and the bottom depths lacked oxygen promoting the release of phosphorus from benthic sediments (internal loading).

A watershed-based plan developed for Nippo Lake in 2019 included setting an annual epilimnetic nutrient concentration target of 7.2 ug/L and restoration strategies necessary to achieve these targets. The first priority was to reduce the phosphorus sources, such as stormwater, originating from the surrounding landscape (external load). However, to achieve the nutrient concentration target, a reduction in the internal load of phosphorus from bottom sediments was necessary.

A. Aluminum compounds being added to Nippo Lake

B. Cyanobacteria bloom. Nippo Lake, Barrington. Photo credit: University of New Hampshire, Lay Lakes Monitoring Program

An aluminum compound treatment plan was developed and permitted by NHDES in spring 2021 to address the internal load. In summer 2021, 65% of Nippo Lake's surface area was treated with aluminum compounds (B). In 2022, the internal phosphorus load had decreased by 90%, the epilimnetic phosphorus concentration was 6 ug/L, and the average Secchi disc transparency (water clarity) had increased to 6m as compared to 4 – 5m prior to treatment.

Overall, the control of cyanobacteria blooms in Nippo Lake hinged on the watershed planning process and the availability of sufficient funding to execute the projects necessary to reduce the nutrient loads that were causing the blooms.

Priority: Develop laws, rules and guidance that clearly define the permitting requirements and processes for lake management activities designed to remediate cyanobacteria.

Tactic	Description	Timeframe	Additional Funding Required (Y/N)	New or Revised State or Local Policy Required	Measurable milestones
1	Update laws relative to lake management practices	Within 1-2 years	N	**Y – Modification of RSA 487**	RSA 487 revised to cover in-lake management and the formal creation of a cyanobacteria tracking and management program

2	Develop administrative rules specific to lake management practices	Within 2-3 years	N	**Y – Expand Env -Wq 1300**	Env – Wq 1300 expanded to cover proposed lake management and associated permitting processes
3	Guidance materials for lake management practices	Within 3 years	N	N	Guidance documents available for project development

As the need to remediate cyanobacteria blooms increases, a permitting process and associated guidance is needed to consider proposed lake management activities and ensure they are conducted responsibly, according to state laws, and in the best interest of the public at-large. Currently, there isn't a universal law or set of administrative rules to consider and potentially permit the range of project types that are possible. Certain lake management activities, like aeration or mixing, rely on the physical manipulation of waters to reduce the likelihood of cyanobacteria booms. Chemical additions can be used to block nutrient release from sediments, used as algaecides, or manipulate oxygen concentrations. In other cases, the addition of organic or non-toxic materials or solutions are proposed as remedies to cyanobacteria blooms. NHDES currently receives multiple inquiries and requests annually to "treat" waterbodies yet doesn't have a consistent system for reviewing and approving the proposed projects. To address this gap, enabling legislation specific to the requirements for safe and effective lake management activities is necessary.

There are already several lakes and ponds that NHDES knows are likely candidates for these types of activities. Chemical treatments, specifically, are the most common requests, but several other types of lake management activities are expected to be proposed. Going forward, NHDES recommends that an improved permitting process be developed through law and administrative rule to allow for a consistent and protective process to consider and approve a variety of in-lake projects designed to reduce and control cyanobacteria blooms.

Tactic 1. Update current applicable law(s) to address lake management practices that are designed to reduce nutrient inputs that contribute to cyanobacteria blooms.

NHDES has identified an immediate need to modify the law (RSA 487) to address lake management actions proposed for the long term (10+ years) control of cyanobacteria. Specifically, NHDES anticipates several requests in the next 1-2 years for the use of chemicals to reduce the amount of phosphorus released from lake bottom sediments. The current staff at NHDES have one prior experience with a project at Nippo Lake in Barrington (2021) where aluminum compound solutions were used to effectively control cyanobacteria. Throughout the permitting process for Nippo Lake it was determined that a more consolidated and consistent permitting process was required for lake management practices that are designed to add chemicals, organic matter or solutions, or physically manipulate water stratification patterns.

By default, the current laws that pertain to these activities include RSA 485-A (Water Pollution and Waste Disposal), RSA 482-A (Fill and Dredge in Wetlands). In specific cases, certain chemicals suggested for use are classified as herbicides, such as copper sulfate, and the New Hampshire Department of Agriculture is the permitting authority. Going forward, NHDES recommends that RSA 487 (New Hampshire Clean Lakes

Program) serve as the permitting authority for use when lake management activities are proposed. NHDES is not suggesting modifications to the laws that pertain to herbicides.

Tactic 2. Develop administrative rules that establish a process for obtaining the necessary permits or permissions to utilize in-lake management practices that are designed to minimize the impacts and remediate of cyanobacteria blooms.

There are three primary sets of administrative rules that currently provide a haphazard process and oversight for the consideration of lake management activities designed to prevent and control cyanobacteria blooms. These are Env Wq 301 (Surface Water Discharge Permits) and Env Wq 100-500 (Wetlands Programs), and Env-Wq 1700 (Surface Water Quality Regulations).

To improve consistency for proposed lake management activities, NHDES recommends that dedicated administrative rules be developed under Env-Wq 1300 that specifically defines lake management activities and provides a clear process for applying for project approval. This set of administrative rules is currently used exclusively for the management of aquatic invasive plants but could be modified to serve as a more comprehensive rule set for lake management.

Tactic 3. Complete guidance materials that describe effective and allowable lake management practices for the prevention or treatment of cyanobacteria.

To make the process for developing, proposing and applying for lake management activities through NHDES clearer and more consistent, it is recommended that a guidance document and several fact sheets be developed. These informational materials would describe the various lake management activities that would be covered under the permitting process, the necessary watershed management actions that would be needed prior to project consideration, the process for justifying a selected lake management activity and the information required to consider a proposed project.

4.1.3 Supplemental Actions

Below are additional recommendations for strategy 1 specific to reducing nutrient inputs to New Hampshire's surface waters.

As noted above, a key recommendation by NHDES is to conduct a regulatory review relative to the control of nutrients. In the meantime, the Advisory Committee recommended a number of programmatic funding initiatives, legislative changes and administrative rules updates that are listed below.

Change to law or administrative rules that would reduce nutrient inputs.

Action 1. Consider updating Administrative Rule Env-Wq 1500 (Alteration of Terrain) to address the land slope threshold associated with the definition of a significant alteration. (see Env-Wq 1502.58, specifically). **Advisory Committee Recommendation. **Requires Rulemaking.***

Action 2. Consider updating RSA 485-A:39 and Administrative Rule Env-Wq 1025 relative to waterfront property site assessment studies to require a formal septic system inspection and to include that the results be reported to NHDES and the local municipality. **Advisory Committee Recommendation. ** Requires legislation.***

Action 3. Identify ways to create a stronger enforcement and penalty structure for violation of the Shoreland Water Quality Protection Act. The root concern is the inability of NHDES to issue stop work orders which fall to local enforcement. **Advisory Committee Recommendation.**

Continued implementation of roadway maintenance practices to reduce erosion.

Action 4. Consider requirement for culvert maintainer certification through UNH stormwater center (Certified Culver Maintainer Website).

Action 5. Use routine roadway maintenance guide from New Hampshire Department of Transportation (NHDOT BMPs for Routine Roadway Maintenance).

Action 6. Use/development of guidance/requirements for gravel road maintenance [see UNH gravel road resource library (UNH Gravel Road Maintenance Website)].

Create and provide continued appropriations to an assistance fund for septic system upgrades or replacements.

Action 7. Consider updating RSA 485-A:39 to require replacement of septic systems determined to be in failure at the time of sale of property. **Advisory Committee Recommendation. ** Requires legislation.***

Action 8. Explore establishing a funding source that would assist property owners, through a cost-sharing program, to complete the required upgrade or replacement depending on a demonstration of financial need. **Advisory Committee Recommendation. ** Requires legislation. * Requires Funding.***

Action 9. Consider legislation that requires unpermitted septic systems that serve properties within the protected shoreland to be upgraded. **Advisory Committee Recommendation. ** Requires legislation.***

Utilize Total Maximum Daily Load (TMDL) studies to address cyanobacteria blooms.

Action 10. Enter into discussions with EPA to explore and utilize novel TMDL approaches by NHDES staff where recurring cyanobacteria blooms have resulted in water quality impairment.

Action 11. Research, explore and consider the appropriateness of completing a statewide nutrient TMDL. **Advisory Committee Recommendation.**

Action 12. Increase the implementation of nutrient reduction strategies included in TMDLs after they are completed specifically for waterbodies with recurrent cyanobacteria blooms.

Implement workgroups to gather information that inform nutrient reduction efforts.

Action 13. Convene a group of stakeholders to provide input on the content of the 2024-2029 Nonpoint Source Management Program Plan.

Strategy 2. Advance education and outreach efforts that allow individuals who recreate or use surface waters to assess the cyanobacteria risks and respond accordingly.

Important Premise: Given the number of surface waters in New Hampshire and the rapid nature of which cyanobacteria blooms can change, it is impossible to characterize the risk of cyanobacteria blooms on all

waterbodies across the state at all times. Thus, the availability of information that educates the public about the presence of cyanobacteria blooms and their associated risks is critical in allowing the public to make informed decisions about the use of New Hampshire surface waters.

4.2.1 Background

There are approximately 1,000 lakes and ponds and nearly 17,000 miles of rivers and streams in New Hampshire. Therefore, in practice NHDES will never be able to monitor and have a real-time response for every waterbody in the state. There are times when NHDES staff are unavailable, and by nature of the analysis needed there is time lag between when a sample is collected and when a decision can be made about bloom severity. Given that different people have different tolerances for risk, it is important that members of the public have an adequate awareness about cyanobacteria blooms. The general public needs to be able to self-assess in real-time the risks associated with using the water, to adjust their behavior accordingly.

Respondents to the public outreach survey identified increasing education and training tools as an important priority to make informed decisions. The development of additional educational materials is needed to raise the awareness of the general public and specific segments of the workforce that have direct contact with those using the state's surface waters for recreation and as a drinking water source. Several organizations have suggested the need for additional information to help people identify blooms by sight and inform them of the risk blooms can pose. Signs, pamphlets, fact sheets, a comprehensive website, social media content and videos were all suggested as media forms that would be beneficial.

4.2.2 NHDES current activities

During the bloom season, the NHDES CyanoHAB Program has daily contact with affected stakeholders. Throughout the year, staff give presentations and provide technical assistance to lake associations and other stakeholders upon request regarding bloom identification, reporting, cyanobacteria ecology and cyanotoxin basics. In the summer, demand for presentations exceeds staff capacity. Presentation requests are usually for evenings and weekends.

NHDES also maintains a variety of factsheets about cyanobacteria, lake ecology and watershed management. Lake associations often use these in their communications with residents about cyanobacteria and other issues. The NHDES website has a page dedicated to the CyanoHAB Program that includes contact information for program staff, how to report an illness, information for drinking water suppliers and links to the Healthy Swimming Mapper. While the existing webpage has many resources, stakeholders regularly express confusion over where to find information and find it easier to call NHDES for answers than to navigate to existing resources.

NHDES also maintains the Lake Information Mapper, which has historical water quality information, including the history of cyanobacteria advisories for any given lake. The mapper is updated annually during the winter. NHDES also publishes the Lake Trend Report summarizing long-term changes in water quality in New Hampshire. For information about water quality impairments on lakes and rivers, NHDES publishes required reports pursuant to sections 305(b) and 303(d) of the CWA. Outcomes of this assessment are published in report form and viewable on the Surface Water Quality Assessment Mapper.

Priority: Promote self-risk assessment messaging and techniques.

Tactic	Description	Timeframe	Additional Funding Required (Y/N)	New or Revised State or Local Policy Required	Measurable milestones
1	Add permanent signage at public access points	Within 3 years	N	N	Number of public access points with permanent cyanobacteria signage
2	Strengthen organizational partnerships	Within 2 years	N	N	Review of partnerships annually and documentation of efforts
3	Production of outreach materials	Within 2 years	N	N	Catalog of cyanobacteria outreach materials

Based on NHDES' experience over the past decade, an informational campaign that focuses on "self-risk assessment" and "when in doubt, stay out" is critical as a first line defense to avoid the potential risks of cyanobacteria blooms. Such an effort would provide the necessary materials to enable surface water users to recognize blooms independently onsite when they are occurring and avoid the risks of cyanobacteria. The efforts would span several user groups to include surface water recreational enthusiasts, resident living near a waterbody, those that use surface waters as a drinking water supply, pet owners, agricultural professionals that keep livestock or grow crops and those that vacation in rental properties with water access.

Tactic 1. Install informational signage at waterbody (lakes and rivers) public access points.

Common informational signs posted at public access points around the state was one of the most frequent suggestions in the public outreach survey and recommended by the cyanobacteria advisory committee. NHDES concurs and recommends that a standard sign be developed and posted with assistance from other state agencies or municipalities where possible. Signage should include how to do a personal risk assessment and QR codes to the Healthy Swimming Mapper.

Tactic 2. Partner with various organizations to promote common messaging and training.

There are several statewide and regional environmental organizations that are actively involved in providing information to their constituents about cyanobacteria. NHDES will need to work with these organizations to obtain support in advancing the importance of "self-risk assessments." It will be the responsibility of NHDES to provide outreach materials to these organizations that contain factual and timely information, and that carries an effective message.

Tactic 3. Creation of dedicated self-risk assessment instructional videos, written materials and public service announcements.

To directly promote the use of self-risk assessments, a variety of videos, written materials and public service announcements should be developed. The materials would be available year-round but should

be emphasized annually during the common cyanobacteria bloom months when recreational use of waterbodies is high.

Priority: Produce cyanobacteria informational materials to provide learning opportunities and that are available to related professional disciplines and consumer groups.

Tactic	Description	Timeframe	Additional Funding Required (Y/N)	New or Revised State or Local Policy Required	Measurable milestones
1	Production of training and information media	Within 2 years	N	N	Videos available for use to increase familiarity about cyanobacteria.
2	Create new and updated written materials	Within 3 years	N	N	Written materials available to the public and organizations to increase cyanobacteria awareness.
3	Production of outreach materials for veterinarians and medical professionals	Within 2 years	N	N	Availability of materials to veterinarians and medical professionals.

Based on feedback from the public outreach survey, NHDES has identified the need for a variety of communication materials to improve public understanding about cyanobacteria and limit human, pet and livestock exposure. These include factsheets and videos covering topics such as:

- Describing risk level by activity (e.g., swimming, boating, fishing, drinking water and various domestic uses of surface waters).
- Visual identification guides.
- How to take a sample and get it to NHDES for analysis.

Tactic 1. Create publicly accessible training and information videos about cyanobacteria risks, identification and the bloom warning system.

To increase familiarity with cyanobacteria identification, health risks and NHDES' bloom warning system, written training materials and instructional videos will be created and made available to the public and partner organizations. These materials will be targeted toward those wishing to monitor cyanobacteria and to assist in understanding the bloom notification system used by NHDES.

Tactic 2. New and updated written materials that can be shared directly and used by statewide organizations and local watershed/lake/river associations.

As specific information gaps are identified, NHDES will develop new or updated materials for use. Benthic cyanobacteria are one specific example where information has been requested regarding the risk, avoidance and potential removal/disposal. Increasing awareness that cyanobacteria do occur in

rivers is another area where new material is needed. Further, a factsheet about what cyanotoxins have been tested for and detected in the state's surface waters would be useful. NHDES will use the feedback it receives from its constituents to decide what subjects will be addressed.

Tactic 3. Development of targeted materials for use by veterinarians and medical professionals.

NHDES will work with the New Hampshire Veterinary Medical Association to develop and distribute online information and handouts for vets and pet owners. Similarly, NHDES will work with the New Hampshire Department of Health and Human Services to determine what types and how to deliver information to medical professionals. Examples of the types of materials that could be developed are handouts for veterinarians and pet owners, educational materials for medical professionals and seasonal notices to veterinarians and medical professionals.

4.2.3 Supplemental Actions

Below are additional recommendations for strategy 2 specific to advancing cyanobacteria education and outreach efforts. Where applicable, recommendations suggested by the cyanobacteria advisory committee are noted as well as those items requiring funding, legislation, or rulemaking. Supplemental actions and associated tactics were characterized as such because either they are very specific or require additional development.

Action 1. Create a new NHDES cyanobacteria website. **Advisory Committee Recommendation.**

Action 2. Integrate information about cyanobacteria into other state agency informational materials and distribution points.

Action 3. Establish a contract with a public relations firm to assist NHDES in developing messaging that is effective in communicating the risk of cyanobacteria and materials for public consumption. **Advisory Committee Recommendation. *Requires Funding.**

Action 4. Complete an NHDES annual cyanobacteria status report. **Advisory Committee Recommendation.**

Action 5. Identify the best methods for informing individuals renting properties with water access about the potential occurrence and risks of cyanobacteria. NHDES will identify stakeholders and establish a workgroup to explore the range of acceptable options. **Advisory Committee Recommendation. *Requires legislation.**

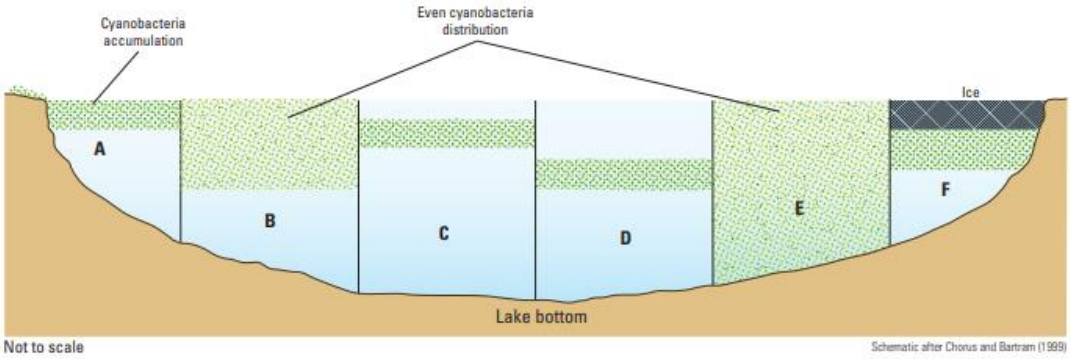
Strategy 3. Enhance cyanobacteria monitoring to track when and where blooms occur and clearly communicate current conditions to the public.

Important Premise: Response-based cyanobacteria monitoring is the best method to definitively confirm the presence of a bloom and track bloom duration. To protect public health, methods to confirm and report blooms must be rapid and easily communicated. Research is useful in developing new and advanced monitoring techniques and understanding why blooms occur.

4.3.1 Background

Cyanobacteria blooms are dynamic in their duration, severity and distribution. Cyanobacteria monitoring can take a variety of forms but must be designed to meet program goals and response activities (Interstate Technology Regulatory Council, HCB-1). In New Hampshire, the primary goal of cyanobacteria monitoring is to confirm the presence of a bloom and track its severity and duration for the purpose of minimizing health risks to the public. Blooms can occur for short periods of time (hours or days) or persist for weeks or longer. Cyanobacteria blooms are also very patchy in their distribution within a waterbody. In lakes, ponds and rivers, bloom accumulations are driven by wind, wave, boat action and lake morphology. Blooms can also be distributed vertically within the water column which adds to the monitoring complexity (Figure 8)

Figure 8. *Various scenarios of cyanobacteria distribution in the water column, Graham et al 2008.*



EXPLANATION

Potential water column distributions of cyanobacteria

- **A** Shoreline, near-shore, and open water accumulations and scums
- **B** Even distribution throughout the photic zone or epilimnion
- **C** Specific depth in the photic zone
- **D** Metalimnetic bloom (special case of **C**)
- **E** Even distribution throughout the water column
- **F** Under ice bloom

Infographic 2. Self-Risk Assessments and When in Doubt, Stay Out

A. Cyanobacteria bloom visual appearances in several NH waterbodies.

B. Glass jars demonstrating bloom severity and diversity. Photo credit Lake Champlain Committee

NHDES recommends "Self-Risk Assessments" before entering or using the water and "When in doubt, stay out" to avoid the health risks associated with cyanobacteria.

Cyanobacteria blooms are diverse in their appearance (**A**). In some cases, thick bright green "mats" form on the surface of the water. Other times green specks or globs are observed or the whole water column may appear dingy. Blooms also range in severity (**B**) with more severe blooms posing a greater risk of cyanotoxin exposure. Blooms are dynamic and can move around a waterbody based on the prevailing wind, boat action and lake morphology. Sunlight, air temperature, or rain also affect bloom presentation.

The variability in cyanobacteria blooms make them difficult to track. NHDES supports a wide variety of bloom reporting and notification tools; however, it will never be possible to simultaneously characterize bloom status in all the state's waterbodies. Therefore, it is important for the public to be able to recognize blooms and know to avoid the water if a bloom is occurring.

In some cases, monitoring may be fairly simple and include visual observations and photographs; however, there is usually an interest in understanding the type(s) of cyanobacteria that may be present and quantifying the bloom density. In these cases, viewing water samples under a microscope is necessary to identify and enumerate the cyanobacteria. Microscopic identification and enumeration are commonly used because it is relatively quick and inexpensive to process a sample, there are minimal equipment requirements and the outcome provides an indication of bloom severity. However, because cyanobacteria can produce cyanotoxins, it may also be important to test directly for toxin presence and type using laboratory techniques.

In the last 10 to 15 years there has been an abundance of research in the field of cyanobacteria monitoring (Interstate Technology Regulatory Council, HCB-1, Graham et al 2008). Some of these efforts have focused on the development of tools to detect and predict cyanobacteria blooms. For example, the EPA and external partners have developed the cyanobacteria monitoring collaborative (CMC) that provides a tiered approach to

bloom monitoring for citizen scientists (Cyanobacteria Monitoring Collaborative). Advances have also been made in toxin testing techniques using laboratory techniques and the development of rapid detection tests. There are also remote sensing tools, such as the EPA Cyanobacteria Assessment Network (CyAN), that uses satellite data as an early warning indicator to detect cyanobacteria blooms (EPA CyAN). Several research efforts have also focused on the development of models for predicting cyanobacteria blooms (Rousso et al. 2020). The models use environmental data to forecast when blooms are most likely. The development of accurate predictive models typically requires significant amounts of advanced monitoring data collected over extended periods of time.

4.3.2 NHDES current activities

The NHDES CyanoHAB program is a response-based program with one full-time staff person who processes samples, issues advisories and communicates with members of the public about blooms. The position requires a distinct and highly technical skill set. Due to limited staff capacity, NHDES does not do any systematic, repetitive monitoring for cyanobacteria ("sentinel monitoring") that is not in response to an ongoing bloom. NHDES' current data on bloom occurrence and duration is based on notifications from the public when a suspected bloom is observed and subsequent inspections of water samples. The data indicate that bloom frequency, severity and length appear to be increasing. However, these observations are, in part, confounded by increased public awareness which likely increases the number of blooms that are reported.

Anyone can report a suspected bloom on any waterbody (lake, pond, river or stream) using a standardized bloom report form. If necessary, samples are collected by the individual reporting a bloom or NHDES staff. Samples are brought to the NHDES Jody Connor Limnology Center (JCLC) in Concord, New Hampshire, where staff use a microscope to confirm the presence of cyanobacteria, identify the taxa present and enumerate the density of cyanobacteria cells. As indicated in the analysis of 2022 bloom samples, cell density is a useful surrogate indicator of cyanotoxins with the assumption that as cyanobacteria density increases so does the likelihood of cyanotoxin production and concentration (See section 3.2).

NHDES uses a density of 70,000 cells/mL of water as the threshold to recommend against recreational uses. If cyanobacteria density exceeds this recreational threshold, NHDES issues a warning (advisory) to inform people that high levels of potentially toxic cyanobacteria have been identified in the water. When a warning is issued, NHDES states that the water is currently unsuitable for wading or swimming, recommends against coming in contact with bloom material and suggests keeping children and pets out of the water. Lakes with warnings are resampled weekly until the advisory is removed. When fewer than 70,000 cells/mL are present but a more severe bloom is likely, NHDES may issue an "alert", which is a local warning to be on the lookout for cyanobacteria. NHDES may also issue alerts before a sample can be analyzed, based on photos, or if the bloom has passed by the time the sample is analyzed.

Warnings are widely publicized through beach signage, an online map (Healthy Swimming Map), multiple social media channels and email lists. The results of the public outreach survey indicated that the preferred methods for notification of bloom status updates were email, social media, a website and signage. Members of the public interested in receiving notification of advisories can use an online form to sign up for waterbody-specific notifications. Weekly statewide cyanobacteria summaries are also widely shared to provide a simple briefing on bloom activity around the state including waterbodies with new blooms and those where blooms are ongoing or have subsided.

NHDES conducts limited toxin testing on bloom samples to determine toxin concentration. Bloom samples are processed at the beginning of the following year during in January or February. NHDES primarily tests for microcystin, but has tested for cylindrospermopsin, anatoxin-a and BMAA on limited subset of samples (see section 3.2). There are dozens of known cyanotoxins, some with hundreds of variants, and each toxin must be tested for separately.

4.3.3 Cell density vs. toxin testing

States vary whether they use cell density or cyanotoxin analysis as an immediate indicator of the cyanobacteria blooms risks (Interstate Technology Regulatory Council, HCB-1). NHDES uses cell density (cells/mL) instead of toxin analysis for many reasons:

1) The toxicity of individual toxins can change over the duration of the bloom.
2) There are many types of cyanotoxins, and quantitative tests are cyanotoxin-specific.
3) Cell counts help standardize our response to cyanobacteria, capturing the potential risk of a range of toxins.
4) Cell counts are rapid and can usually be completed the same day as sample submission.
5) Reliable quantitative measures of cyanotoxins are time consuming, resulting in a delayed response to active blooms.
6) Cyanotoxin testing is expensive compared to microscopic evaluation.

Cyanotoxin production is highly variable between blooms and over time such that within the course of hours, a bloom's toxicity can change dramatically. The variability in cyanotoxin production poses health risks and communication challenges because a low concentration of cyanotoxins at one point in time isn't confirmation the bloom will remain non-toxic. Frequent sampling and analysis would be required to effectively understand bloom toxicity.

In addition to the variable nature of cyanotoxin concentrations, there are many cyanotoxins to consider. Cyanotoxin-based programs tend to rely on the analysis of microcystin. The analysis of 2022 samples from New Hampshire indicated that this was the most commonly detected cyanotoxin in bloom samples (see Section 3.2). However, the cyanotoxin data for New Hampshire surface waters to date indicates that other toxins are occasionally present. Current cyanotoxin testing via ELISA technology requires that cyanotoxin tests are performed in batches, which typically introduces delays in obtaining results. During a bloom, it is important to quickly provide results to the public in order to protect public health. Currently, NHDES does not have a sufficient volume of samples to justify daily cyanotoxin analyses nor the necessary staff or laboratory equipment.

In contrast, cell density estimates provide a standardized, less variable response to bloom events and capture a presumed risk of cyanotoxin exposure as a conservative assumption that is protective of public health. Warnings issued based on cell density avoid the need to perform multiple separate cyanotoxin tests to assess risk. Instead, the types and amounts of cyanobacteria present in samples can be rapidly evaluated to determine the likely risk associated with using the water.

Priority: Enhance of cyanobacteria monitoring, sample submission and processing efficiency.

Tactic	Description	Timeframe	Additional Funding Required (Y/N)	New or Revised State or Local Policy Required	Measurable milestones
1	Increase NHDES bloom monitoring capacity	Within 3 years	**Y – Funding for additional capacity**	N	Train one additional current NHDES staff and add one new staff person
2	Increase sample transfer efficiency	Within 1 year	N	N	Develop sample mailing system and establish common sample exchange points
3	Increased training and tools for volunteer monitoring	Within 2 years	N	N	Number of waterbodies with routine monitoring by volunteers
4	Invest in research of advanced monitoring and modeling	Within 3 years	**Y – Continuous source of funds in support of novel projects**	N	Number of NH-based cyanobacteria research projects funded or completed

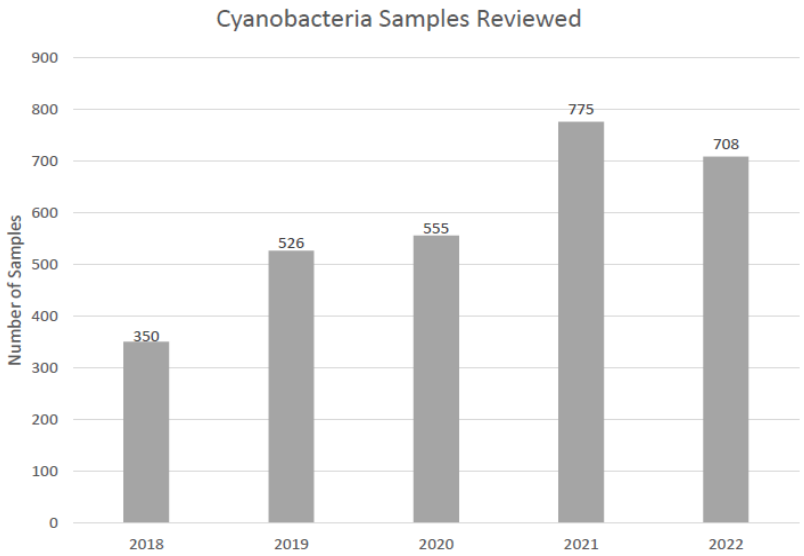
Currently, cyanobacteria monitoring at NHDES includes three major components: 1) bloom reporting and sample collection, 2) sample processing for bloom confirmation and status and 3) communication of bloom status to the public. NHDES relies on assistance from the public for bloom reporting and sample collection. NHDES staff also participate in sample collection but are focused on sample processing and communication of bloom conditions to the public.

The skills necessary for cyanobacteria monitoring range from simple to complex. Sample collection, delivery and tracking are relatively easy and do not require an advanced skill set. Cyanobacteria identification and enumeration require advanced training and significant experience as does testing for cyanotoxins. The development and maintenance of bloom status communication tools requires a moderate skill set and level of experience.

Over the course of summer and fall seasons when most blooms occur, over 700 samples are collected and submitted to the JCLC for investigation (Figure 9). The number of samples collected and processed has more than doubled since 2018. Receipt of suspected bloom reports, sample collection and sample processing is estimated to account for more than one-half of the time needed to implement the program during the summer months when blooms are most active. Updates to online communication tools, issuance of warnings and direct communication with interested parties consumes the rest of the time current staff have available. In

months when blooms are not active, staff focus on toxin testing, development of education materials and general program improvements.

Figure 9. *Number of cyanobacteria samples evaluated by NHDES staff, 2018 – 2022.*



The ebb and flow of the program is predictable, but the program cannot meet the demands in the period of time when blooms are most active. Further, with only one dedicated staff person with the skill set necessary to process samples and with a specific background in cyanobacteria studies, the program lacks the redundancy in skills necessary to meet expected increases in demand and to as serve as backup support.

Staff support and resources for the program currently do not allow for advanced monitoring and research. Additional efforts are necessary to develop and test monitoring techniques that could be useful for predicting cyanobacteria blooms, use of alternative rapid testing options and understanding the factors that cause blooms.

Tactic 1. Increase NHDES cyanobacteria monitoring and bloom tracking capacity by adding new staff and training current staff.

The CyanoHAB program manager is the only staff person with the skill set necessary to identify and enumerate cyanobacteria using a microscope. This person is also responsible for receiving bloom reports, coordinating sample collection and updating the online information systems that communicate the status of blooms.

To allow NHDES to accommodate the increased demand for bloom monitoring, a new entry-level full-time staff person is required. Additionally, NHDES is committed to training one additional current full-time staff person to add redundancy in the skill required to process cyanobacteria samples. Additional staffing will also allow communications of bloom occurrences to be more responsive.

Tactic 2. Increase sample processing efficiency by establishing new options for sample transfer to NHDES.

Currently, volunteers drive to Concord to deliver samples or a NHDES staff member picks them up at locations specific to the waterbody where the bloom is occurring. To reduce this burden and to facilitate

getting samples collected by the public to NHDES more efficiently, sample submission kits are proposed so that organizations can ship and submit samples to NHDES for analysis. To minimize the time between sample collection and processing, samples would need to be shipped overnight to NHDES.

NHDES also recommends the establishment of regional sample transfer locations that would reduce the distance citizens collecting samples would have to drive and would provide common points of sample delivery easing the burden on NHDES staff who regularly drive to individual waterbodies to gather samples.

Tactic 3. Development of cyanobacteria monitoring training opportunities and tools for volunteer monitoring organizations and citizen scientists.

There are already several volunteer groups collecting water quality information in New Hampshire. These include VLAP, VRAP, LLMP, Weed Watchers, lake and watershed associations and several of independent river organizations. NHDES will provide existing volunteer monitors with cyanobacteria identification guides, safety information and sampling materials. Public outreach survey results support the conclusion that current volunteers monitoring water quality already monitor for cyanobacteria or are interested in regularly doing so. By empowering existing volunteer groups with information and materials to spot and report cyanobacteria blooms, the reach of the state's current ability to document blooms will be increased.

Tactic 4. Research the utility of various advanced monitoring techniques for tracking cyanobacteria bloom indicators and development of cyanobacteria bloom predictive tools.

The use of advanced monitoring techniques, such as the collection of continuous water quality data and sensors to measure photosynthetic pigments, would establish robust datasets necessary to develop predictive cyanobacteria models. Additionally, there are remote sensing tools, novel cyanobacteria collection methods and alternative toxin testing techniques that should be researched to determine their efficacy in meeting the state's cyanobacteria monitoring needs. Together, these efforts would allow the state to advance its monitoring techniques and ability to anticipate when blooms are likely to occur.

It is recommended that funds be made available that can be used to support the purchase and use of advanced monitoring equipment, the development of cyanobacteria predictive models and the application of novel monitoring and cyanotoxin testing tools for cyanobacteria.

Priority: Develop and implement advanced bloom notification tools.

Tactic	Description	Timeframe	Additional Funding Required (Y/N)	New or Revised State or Local Policy Required	Measurable milestones
1	New bloom severity system	N/A (implemented in 2023)	N	N	Continued improvement as needed.
2	Advanced mapping tool	N/A (implemented in 2023)	N	N	Continued improvement as needed.

3	Automated bloom notification message system	N/A (implemented in 2023)	N	N	Continued improvement as needed.

Communication of the status of cyanobacteria blooms is the final step in NHDES' cyanobacteria monitoring process. Communication of blooms includes the waterbody of occurrence, level of bloom severity, general location of bloom on the waterbody and a waterbody's bloom history. Feedback from stakeholders and the cyanobacteria advisory committee suggests that there is confusion about the difference between alerts (issued when there are <70,000 cells/mL, or prior to sample analysis) and warnings (advisories) (issued when there are >70,000 cells/mL). Interest also exists in knowing whether a waterbody is regularly monitored either by observation or techniques such as microscopic cell density estimates. The availability of monitoring outcomes to the public in simple, current and readily available formats is the best way to reduce the health risks associated with cyanobacteria.

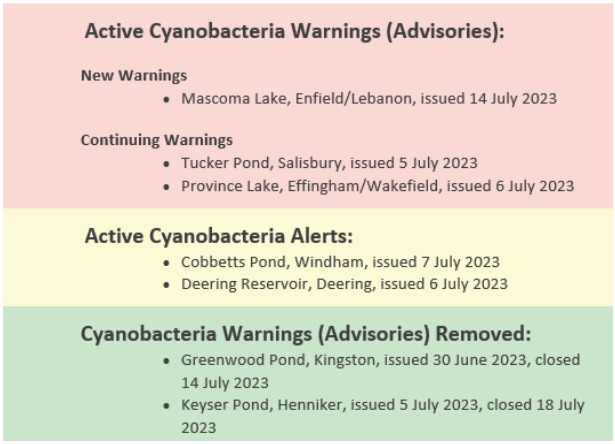
Over a period of approximately 7 years leading up to 2023, NHDES used an online map system to denote the status of cyanobacteria blooms severity in waterbodies where cell densities had been determined to exceed the 70,000 cells/mL threshold. The online "mapper" simply listed a waterbody as having a current "advisory" if the cell density exceeded the threshold. Further, there was no consistent way to report a bloom, receive automated updates on bloom status, or research a waterbody's bloom history.

The result was that staff spent an exceedingly large amount of time tracking bloom reports, making the outcome of monitoring results publicly available, indicating bloom severity and monitoring efforts. The effect of these inefficiencies meant fewer samples could be processed to determine if a bloom was a potential health risk.

Tactic 1. Implementation of a clearer cyanobacteria bloom severity notification system with multiple levels that are more easily interpreted.

In 2023, NHDES modified its cyanobacteria bloom notification system to include three levels of bloom severity (warning, alert, removed) (Figure 10). The system includes color coding to allow viewers to recognize the outcome of cell density estimates more easily. In the future a fourth notification level will be added if a waterbody is regularly monitored rather than strictly in response to an ongoing bloom.

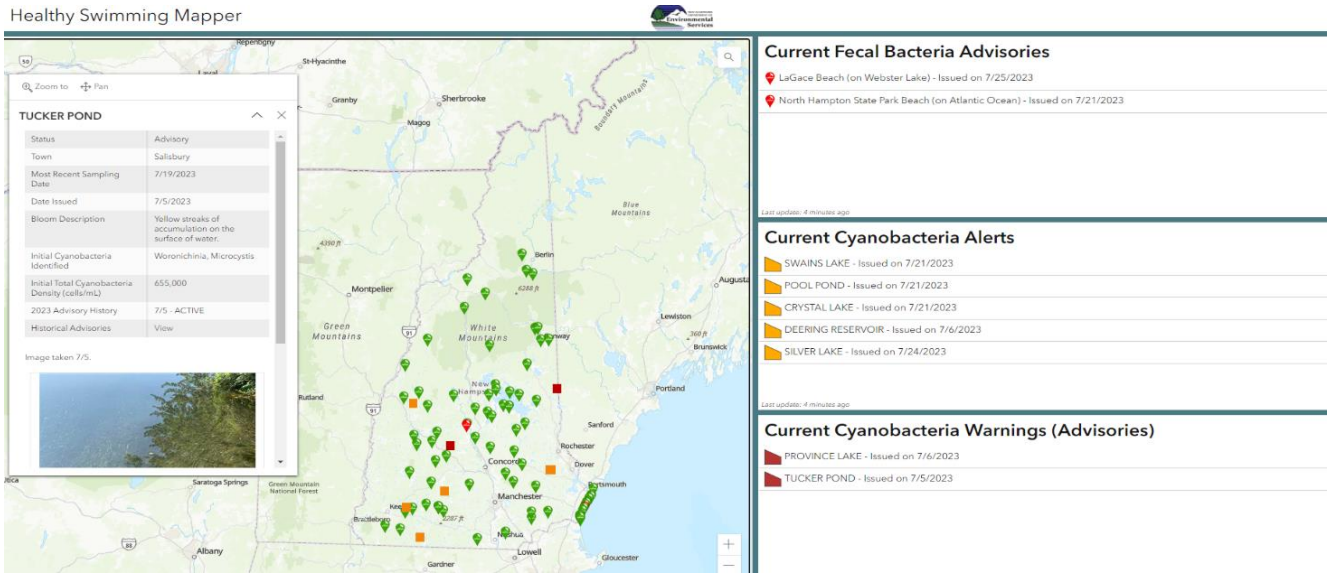
Figure 10. *NHDES multi-level cyanobacteria bloom severity notification system.*



Tactic 2. Creation and use of an advanced, map-based online cyanobacteria bloom status tool.

A new online map was developed and implemented in 2023 (Healthy Swimming Map) (Figure 11). The map now includes a simple icon that signifies the confirmation of a bloom. Additionally, the map includes information about when the last sample was collected, the cell density of the initial sample, the type(s) of cyanobacteria present in the sample, a photograph of the bloom and the history of blooms from the waterbody. Alerts are now included on the map as well, including if the alert was issued based on a sample review or a photo of a bloom prior to sampling.

Figure 11. *NHDES healthy swimming map.*

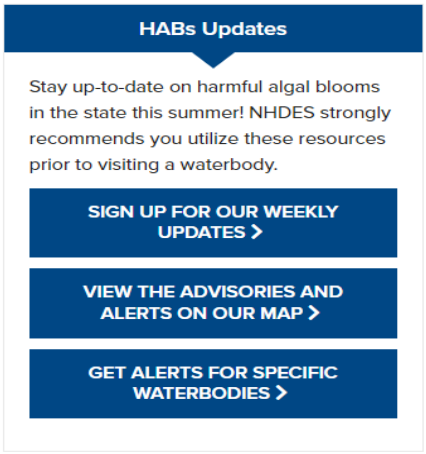


Tactic 3. Development and use of electronic options that allow for waterbody-specific reporting of suspected blooms and notices of current blooms.

To increase the consistency of bloom reports, in 2023 NHDES developed a bloom reporting form that anyone suspecting a bloom can complete (Cyanobacteria bloom report form). The form is delivered to NHDES electronically and includes information about the suspected bloom's location, date of

observation, size and the individual's contact information. It also allows a photo to be uploaded. Additionally, NHDES now issues a weekly bloom status report to those that have subscribed to receive it. Last, there is also an option to subscribe to electronic waterbody-specific bloom status reports if a user has a particular interest in specific waterbodies. These are all found on the NHDES Harmful Algal Bloom homepage (Figure 12).

Figure 12. *Excerpt from NHDES harmful algal bloom homepage.*



4.3.4 Supplemental Actions

Below are additional recommendations for strategy 3 specific to enhancing cyanobacteria monitoring and bloom notification efforts. Where applicable, recommendations suggested by the cyanobacteria advisory committee are noted as well as those items requiring funding, legislation, or rulemaking. Supplemental actions and associated tactics were characterized as such because either they are very specific or require additional development.

Action 1. - Implement sentinel monitoring locations in several lakes and rivers in order to better understand the conditions that promote cyanobacteria blooms.

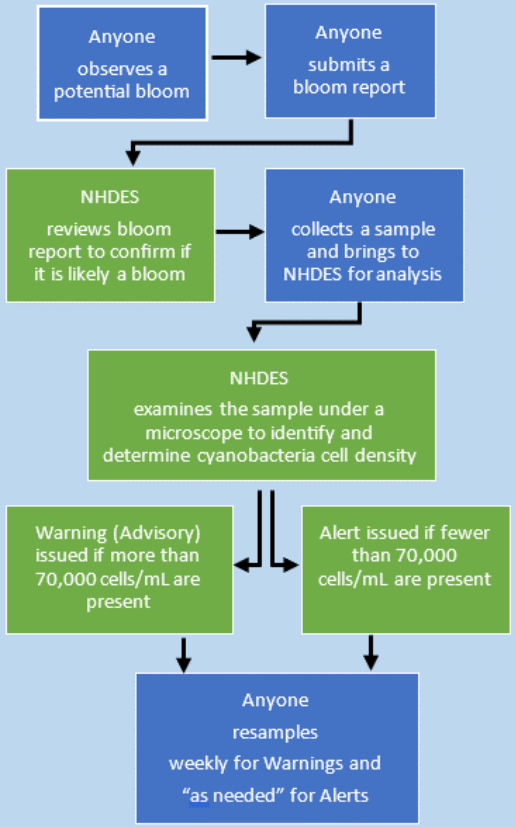
Action 2. - Improve existing suspected bloom-related illness reporting opportunities for humans, pets and livestock to better monitor the incidence, severity and types of illnesses that occur. **Advisory Committee Recommendation.**

Action 3. - Periodically evaluate the validity and practicality of using cyanobacteria cell density as the primary indicator as opposed to cyanotoxin testing for determining the risks associated with cyanobacteria blooms. **Advisory Committee Recommendation.**

Action 4. - Update administrative rule Env-Wq 1100 (Public Bathing Places) to reflect the most current and effective cyanobacteria risk indicator(s) for use by NHDES. ***Requires rulemaking.**

Infographic 3. NHDES Cyanobacteria Monitoring

NHDES standard cyanobacteria monitoring process



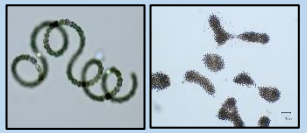
The CyanoHAB program completes "response-based" monitoring that follows a standard process (Left). When an individual observes a suspected bloom, it can be reported using an online form. Photos of potential blooms are reviewed and, if warranted, follow up sampling is completed. If a sample is submitted to or collected by NHDES, it is evaluated using a microscope to determine what types of cyanobacteria are present and the density of cyanobacteria cells (Right).

If the density is over 70,000 cells/mL a cyanobacteria warning (advisory) is issued. In some cases, samples have densities near, but not over the 70,000 cell/mL threshold. In these cases, an alert is issued. Alerts may also be issued based on photographic evidence alone or if a bloom was observed but has dissipated. Warnings and alerts are issued to protect public health, pets and livestock from cyanotoxins which can be produced by cyanobacteria.

NHDES processes over 700 cyanobacteria samples annually using microscopy. On average over the last five years, 34 warnings have been issued annually and warnings persist on average for 25 days. When all the "warning days" are combined across all waterbodies, there can be over 1,000 days when NHDES recommends against recreational use annually.

Bloom Observation

Sample Evaluation



Warning or Alert
(if needed)

Strategy 4. Establish policies and procedures for prevention, early detection and response and treatment of cyanobacteria blooms and cyanotoxins in surface waters that serve as public drinking water supplies to minimize risks to consumers.

Important Premise: A significant portion of New Hampshire's population and businesses rely on surface waters for domestic and commercial uses. Protection, monitoring and treatment of these sources is critical to ensuring their integrity and minimizing public health risks.

4.4.1 Background

Over 560,000 service points in New Hampshire provide water to the public that originates from a reservoir, lake, or river. There are 37 public water supplies (PWS) in New Hampshire that use surface water as their drinking water source, including many of the state's larger population centers (e.g., Manchester, Salem, Rochester, Keene and Portsmouth). Most do not yet have a formal cyanobacteria prevention, monitoring and response strategy.

Facilities vary in their capacity to remove cyanotoxins if present based on the treatment techniques they have available for use. Most have "conventional treatment" that includes filtration and flocculation/coagulation that typically removes moderate concentrations of cyanobacteria cells but may not be sufficient during a severe bloom event. The potential exists that cyanotoxins, if present, could persist in finished drinking water depending on bloom severity and the treatment system(s) being used. To date, NHDES is aware of nine surface water sources where cyanobacteria blooms have occurred. Of the blooms in waterbodies where testing has been completed, none have had cyanotoxins detected in their finished water.

4.4.2 NHDES current activities

The Drinking Water and Groundwater Bureau (DWGB) at NHDES has the primary responsibility for regulation and oversight of PWSs. Their responsibilities include communication and technical assistance on topics pertaining to cyanobacteria, including the development of cyanobacteria monitoring plans for surface drinking water supplies. The DWGB uses nationally available information including guidance from EPA and the American Water Works Association when advising PWSs. Currently, all DWGB's cyanobacteria monitoring efforts are federally funded through the Safe Drinking Water Act.

The DWGB has a response protocol when blooms occur in surface waterbodies used as sources of drinking water. The DWGB coordinates closely with the CyanoHAB Program to respond to blooms in drinking water sources. Both programs provide PWSs with technical assistance when requested.

In 2023, the DWGB issued a Request for Proposals (RFP) to expand cyanobacteria monitoring in surface waterbodies used to supply drinking water for PWSs. That work will employ contractors to monitor source waters and develop site-specific recommendations for future monitoring to anticipate and detect cyanobacteria blooms. Also in 2023, the DWGB, in consultation with the CyanoHAB program, piloted a cyanobacteria monitoring program at several PWSs to learn more about bloom characteristics and resultant risk of cyanotoxins in raw water.

The DWGB provides PWSs with factsheets, the response protocol, information about funding opportunities and relevant guidance about cyanobacteria. NHDES also provides sample bottles and information on accredited labs

for doing cyanotoxin analysis. DWGB has $30,000/year dedicated to cyanotoxin monitoring equipment and training grants. This funding source is often unutilized because of lack of staff capacity at PWSs to undertake monitoring.

Priority: Develop of cyanobacteria action plans by public water suppliers.

Tactic	Description	Timeframe	Additional Funding Required (Y/N)	New or Revised State or Local Policy Required	Measurable milestones
1	Funds to support development of cyanobacteria action plans	Within 5 years	**Y – investigate continuous source of state funds to leverage existing federal funds**	N	Availability of state funds to support development of plans.
2	Policies and guidance for cyanobacteria action plans	Within 2 years	N	**Y – requires additional analysis of current authorities provided in law**	Modification of current policies to require plan development and production of guidance to direct plan content.
3	Provide sufficient staffing for cyanobacteria action plans	Within 2 years	**Y – investigate if additional staffing is needed**	N	Determination by NHDES if additional staffing is required to support plan development.

NHDES recommends that cyanobacteria action plans be required of all PWSs that use surface waters as a source for all or part of the year by 2030. Each plan would address three elements: 1) bloom prevention, including source protection and support for watershed planning, 2) risk monitoring to anticipate and track bloom occurrence and 3) bloom response, including in-line treatment of the source water prior to distribution or switching to an alternate source.

Bloom prevention should be the highest priority for all surface water supplies. Watershed planning and subsequent project implementation is the most critical step in protecting or minimizing the risk from cyanobacteria to surface water supplies. A reduction in nutrient inputs by controlling stormwater or other nutrient sources such as septic systems will limit cyanobacteria blooms. Protection of lands from development is also a key to minimizing nutrient inputs.

Cyanobacteria monitoring should become a regular part of every surface water source supplier's routine. Early detection of blooms is critical to controlling blooms and preparing for treatment activities. For surface waters

that serve as drinking water supplies, it is important to understand what types of cyanobacteria are present, their typical abundance at various times of the year, and the conditions that promote bloom conditions. It is also important to have a monitoring plan if a bloom occurs.

In the case that a bloom occurs, surface water suppliers will need to be prepared to manage potential impacts to their customers. To this end, the cyanobacteria action plan should evaluate the preferred options to avoid or treat blooms if they occur. In some cases, additional water supply sources may be available to use if a bloom occurs. However, this may not be possible if the surface water is the sole supply or is critical to meet demand. In these cases, suppliers should complete a review of their treatment methods to understand their ability to filter out cyanobacteria or remove toxins. The review should also include the additional supplies, labor and costs associated with treating finished water that originates in a waterbody with an ongoing bloom when necessary. For surface waters where blooms haven't been detected or have a low likelihood of occurrence, bloom mitigation plans are still important to consider to be prepared.

Tactic 1. Provide sufficient funding that supports the development of cyanobacteria action plans by public water suppliers that utilize surface waters.

The development of cyanobacteria action plans requires financial support to a PWS. Through its DWGB grants, NHDES will make federal funds available to surface water suppliers annually to accomplish this task. It is also recommended that the state of New Hampshire contribute funding annually to support cyanobacteria action plan development to leverage federal funds.

Tactic 2. Develop the policies and guidance that define what is to be included in a cyanobacteria action plan.

New Hampshire has 37 surface water supplies that range in size and complexity. Some are small and located in relatively undeveloped watersheds. Others serve thousands of customers and are in large watersheds that are much more developed or could become highly developed. The diversity of these systems requires flexibility in the content of cyanobacteria action plans. For smaller, less developed systems, a cyanobacteria action plan may be relatively simple and include a basic land use analysis, observational monitoring and a review of the existing treatment system. For more complex systems, the development and implementation of a formal watershed plan, a regular water quality monitoring program and plans for upgraded treatment options maybe be more appropriate.

Policies and guidance will be required from NHDES to PWSs to define what should be included in the cyanobacteria action plan for those surface waters that serve as water supplies. The complexity of the plan could be based on population served, waterbody size and bloom potential based on existing water quality data.

Tactic 3. Sufficient NHDES staff to support the development of and progress towards implementation of cyanobacteria action plans.

The development and implementation of 37 cyanobacteria action plans will require significant time and effort. NHDES will need to assess its current DWGB staff numbers and responsibilities to determine if additional staff support is needed to support this effort. An evaluation of staffing needs will be made if cyanobacteria action plans are required so that support is available to PWSs.

4.4.4 Supplemental Actions

Below are additional recommendations for strategy 4 specific to addressing and minimization of risks that cyanobacteria pose to drinking water supplies. Where applicable, recommendations suggested by the cyanobacteria advisory committee are noted as well as those items requiring funding, legislation, or rulemaking. Supplemental actions and associated tactics were characterized as such because either they are very specific or require additional development.

Action 1. Support the development and use of advanced monitoring techniques to track bloom development and the water quality conditions that support blooms. High frequency data on parameters such as temperature and dissolved oxygen in conjunction with cyanobacteria indicators or density would be useful in building predictive models that can forecast bloom probability.

Action 2. Require a PWS to report known blooms that occur in close proximity to the water intake to NHDES. Bloom reporting requires that monitoring, of some type, occurs on a regular basis. Currently there is no such policy in place. **** Requires legislation.***

Action 3. Identification or development of state or regional laboratory services for cyanotoxin testing. NHDES Biology section staff complete cyanotoxin testing using ELISA techniques in the winter months on samples collected the previous summer, but there are no local or regional laboratories that complete cyanotoxin testing on a continuous basis to satisfy rapid tests of drinking water supplies during a bloom event.

Action 4. Consider an evaluation of authority needed to require PWSs to incorporate cyanobacteria into their emergency response plans (ERPs). ERPs are federally required and cover a variety of threats to drinking water sources.

Action 5. NHDES will work with PWSs to develop a communications plan that describes how the public will be informed in the event a cyanobacteria bloom or cyanotoxins impact their water supply and what emergency measures are in place to protect public health.

Infographic 4. Cyanobacteria bloom in a New Hampshire water supply

A. Arlington Mill Pond, Salem, NH

Arlington Mill Pond, Salem, NH

Arlington Mill Pond, Salem, NH Arlington Mill Pond (**A**) is a 320-acre surface water in southern NH with a maximum depth of 40 feet. From November through May it serves as the water supply for approximately 20,000 residents in the Town of Salem, NH. Its watershed is highly developed with 21% of the land area that drains to the lake serving as roadways or residential or commercial land.

In May 2022, the waterbody began experiencing a significant cyanobacteria bloom. A sample of the surface scum documented a peak cyanobacteria density that exceeded 300,000 cells/mL. The bloom subsided within 15 days (**see timeline below**).

During the bloom event, the Town of Salem immediately switched to an alternate surface water source and samples were collected from the finished water holding tank to test for cyanotoxins. All cyanotoxin test results were below the EPA health advisory limit for microcystin.

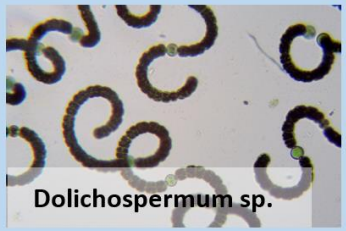
The experience highlighted the importance of having a process in place to detect and avoid cyanobacteria blooms in public water supplies to minimize risks to the customers served. Given the highly developed land in this waterbody's watershed, it is highly susceptible to excessive nutrient loads from stormwater runoff, making cyanobacteria blooms more likely.

2022 Arlington Mill Pond Cyanobacteria Bloom Timeline

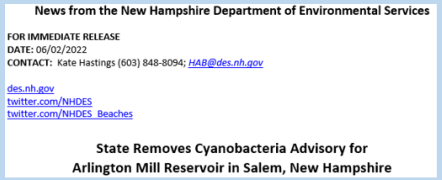
May

Widespread bloom observed around lake, including near intake

Town immediately switches to alternate surface water source



Cyanobacteria enumeration completed and samples sent to private lab for cyanotoxin testing



News from the New Hampshire Department of Environmental Services

FOR IMMEDIATE RELEASE
DATE: 06/02/2022
CONTACT: Kate Hastings (603) 848-8094; HAB@des.nh.gov

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State Removes Cyanobacteria Advisory for
Arlington Mill Reservoir in Salem, New Hampshire

June

Bloom subsides and state removes warning. Town continues using alternate source

5.0 Summary and Conclusions

Cyanobacteria blooms in New Hampshire have been documented in 113 surface waters. Over the last five years on average, blooms have been severe enough to warrant recreational use restriction recommendations on 34 waterbodies per year to protect public health. Bloom duration is highly variable, but based on NHDES records for 2018 - 2022, the average length of a recreational use restriction has been 25 days. Annually, cyanotoxins have been detected in anywhere from 33% to 73% of bloom samples dating back to 2017. The most commonly tested and detected cyanotoxin is microcystin (above detection limit in 68% of bloom samples in 2022). Drinking water and recreational use guideline thresholds issued by EPA were exceeded in 20% and 11% of bloom samples from 2022, respectively, however those guidelines only cover two of the potentially many toxins. When cyanobacteria densities exceeded NHDES recommended recreational use thresholds, EPA cyanotoxin thresholds for recreational use were four times more likely to be exceeded.

Input from the public outreach survey indicated that 96% of respondents were concerned about the occurrence of cyanobacteria blooms in the state's surface waters. Public health, recreation, economic interests and property values were the most common concerns. Respondents stressed the need for additional educational materials to recognize and avoid blooms. Additionally, those that participated in the survey indicated the need for additional cyanobacteria monitoring as well as regulatory actions that address development or activities near surface waters to reduce the nutrient inputs that contribute to cyanobacteria blooms.

To achieve the goals of the plan, four primary strategies were identified. To reduce and control cyanobacteria blooms, the primary focus should be on the reduction of nutrient loads, in particular phosphorus, to the state's surface waters. The control of phosphorus loads will limit the nutrient that drives cyanobacteria production in that state's lakes, ponds, rivers and streams. The development and implementation of innovative land use development policies, such as stormwater utilities and overlay districts, are needed to reduce the delivery of nutrients in stormwater and other sources that drain to the state's surface waters. Additional support through funding and staffing is needed for watershed management plan development and implementation to identify and minimize nutrient sources for individual waterbodies. An improved statewide lake management program with sufficient funding that supports lake management projects is recommended to diagnose the cause and control of cyanobacteria blooms. Revised laws and administrative rules are needed to provide a clear and consistent process to consider and permit lake management projects designed to minimize and control cyanobacteria blooms.

Given the number of surface waters in New Hampshire and unpredictability of when and where cyanobacteria blooms can occur, an emphasis needs to be placed on raising the awareness of those that use surface waters to recognize and avoid cyanobacteria. Based on NHDES' experience over the past decade, an informational campaign that focuses on "self-risk assessment" and "when in doubt, stay out" is critical as a first line of defense to avoid the potential risks of cyanobacteria blooms. Educational materials and messaging through a variety of media sources are needed to advance this effort and raise the overall awareness about cyanobacteria for the general public and specific professions, such as animal health and the medical community.

Tracking and anticipating cyanobacteria blooms requires a robust monitoring program. NHDES currently operates a response-based monitoring program that uses cell density estimates to determine what type of cyanobacteria may be present and how severe the bloom is. Overall, NHDES current monitoring program has

no capacity to meet additional monitoring needs. Improvements need to be made in sample transfer options and staffing redundancy to increase monitoring efficiency. Additional effort is required to support volunteer monitoring through the development of training programs and tools for those wanting to track conditions on individual waterbodies of interest. Last, investments are needed in support of cyanobacteria research projects especially those that evaluate advanced monitoring alternatives and in development of predictive models.

A significant portion of New Hampshire's population and businesses rely on surface waters for domestic and commercial use. Protection, monitoring and treatment of these sources is critical to ensuring their integrity and minimizing public health risks. The potential for cyanobacteria blooms to occur exists in all surface waters; therefore, suppliers should make every effort to understand if their sources are vulnerable to blooms and how to react if one should occur. The development of cyanobacteria action plans for all water suppliers that use a surface water source is recommended to address this risk. Funding is needed to provide financial assistance to water suppliers in completing plan development. NHDES will need to develop policies and guidance to direct the plan's requirements and provide consistency in their content. Plan complexity will vary depending on population served, waterbody size and bloom potential. Plans will require periodic updates with the continued goal of protecting, detecting and managing cyanobacteria blooms in public water supplies.

Cyanobacteria blooms cannot be eliminated from the state's surface waters. New policies and funding, use of existing expertise, additional education and partnerships among stakeholders are key to reducing and controlling blooms as well as minimizing their impacts. Statewide and local efforts to control nutrient inputs are critical to curb the potential for blooms to occur. Additionally, significant work is required on individual waterbodies through watershed management and monitoring to better understand the specific causes of, and remedies for, cyanobacteria blooms. These efforts coupled with education and outreach represent the best opportunity to reduce the risks and impacts associated with cyanobacteria blooms.

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Appendix A. Cyanobacteria Advisory Committee Members and Meetings

Name	Representing
Kristin Conte	Drinking Water Suppliers
Douglas Darling*	Lake Associations
Charles DeCurtis	The Nature Conservancy
Laura Diemer	Environmental Engineers
Sara Holland	Lakes Management Advisory Committee
Don Kretchmer	Environmental Engineers
Andrea LaMoreaux	NH LAKES
John Magee	New Hampshire Fish and Game Department
Abigail "Abby" Mathewson	New Hampshire Department of Health and Human Services
Amanda McQuaid	University of New Hampshire
David Neils	New Hampshire Department of Environmental Services
Representative Andrew Renzullo	New Hampshire House of Representatives
Thomas Shevenell	Volunteer Lake Monitors
Inga Sidor	Veterinarians
Pat Tarpey	Lake Associations
Michele L. Tremblay	New Hampshire Rivers Council
Senator Ruth Ward	New Hampshire Senate

* Committee chair

Meetings:

October 13, 2022 – Agenda, Meeting Minutes

December 1, 2022 - Agenda, Meeting Minutes

January 26, 2023 - Agenda, Meeting Minutes

March 10, 2023 - Agenda, Meeting Minutes

September 28, 2023 - Agenda, Meeting Minutes

Appendix B. Cyanobacteria Advisory Committee ideas and suggestions.

Cyanobacteria Committee Suggestion/Recommendation	Strategy	Related Action	Comment
Develop a model local ordinance for local septic codes more protective than state standards.	1. Control of Nutrient Inputs	Priority 1 - Promote, implement, fund regulations/practices	
Work with RPCs to analyze existing status of overlay districts	1. Control of Nutrient Inputs	Priority 1 - Promote, implement, fund regulations/practices	
Provide technical assistance to lake associations and municipalities on the adoption of shoreland overlay districts	1. Control of Nutrient Inputs	Priority 1 - Promote, implement, fund regulations/practices	
Encourage use of shoreland overlay districts to influence the extent and type of development.	1. Control of Nutrient Inputs	Priority 1 - Promote, implement, fund regulations/practices	
Give municipalities the ability to establish local septic codes that are more protective than state standards.	1. Control of Nutrient Inputs	Priority 1 - Promote, implement, fund regulations/practices	
Establish areas of special concern with stricter septic requirements than the statewide requirements.	1. Control of Nutrient Inputs	Priority 1 - Promote, implement, fund regulations/practices	
Adoption or development of BMPs that cost-effectively prevent nutrients, especially particulate and dissolved forms of phosphorus, from flowing into water bodies that can easily be maintained and use of policies to evaluate the conintuing effectiveness of BMPs over time	1. Control of Nutrient Inputs	Priority 1 - Promote, implement, fund regulations/practices	
Local/state bonds to fund stormwater improvement projects, green infrastructure and septic upgrades	1. Control of Nutrient Inputs	Priority 1 - Promote, implement, fund regulations/practices	
Small grant cost-share program for land owners making DIY improvements to reduce stormwater runoff or nutrient pollution	1. Control of Nutrient Inputs	Priority 1 - Promote, implement, fund regulations/practices	
Provide funding for nonprofit groups to increase education efforts about stormwater management and nutrient pollution.	1. Control of Nutrient Inputs	Priority 2 - Watershed / lake management program support	
Some sort of program like Moose Plates used to support clean water projects	1. Control of Nutrient Inputs	Priority 2 - Watershed / lake management program support	
Devote a chunk of SRF funds to work on waterbodies with cynobacteria issues	1. Control of Nutrient Inputs	Priority 2 - Watershed / lake management program support	

Appendix B. Cyanobacteria Advisory Committee ideas and suggestions.

Cyanobacteria Committee Suggestion/Recommendation	Strategy	Related Action	Comment
Build capacity for assessing the need for lake treatment in New Hampshire waterbodies	1. Control of Nutrient Inputs	Priority 2 - Watershed / lake management program support	
Need diagnostic feasibility studies for lakes considering how to address blooms.	1. Control of Nutrient Inputs	Priority 2 - Watershed / lake management program support	
Develop in-lake program	1. Control of Nutrient Inputs	Priority 2 - Watershed / lake management program support	
Establish water quality monitoring program or expand existing monitoring capacity to feed into watershed plans about cyano.	1. Control of Nutrient Inputs	Priority 2 - Watershed / lake management program support	
Create a statewide programmatic plan for waterbodies impaired by cyanobacteria with a process that describes the unique features of individual waterbodies.	1. Control of Nutrient Inputs	Priority 2 - Watershed / lake management program support	
Develop real-time flushing rates tied to lake water and nutrient budgets	1. Control of Nutrient Inputs	Priority 2 - Watershed / lake management program support	
Provide funding on a watershed basis, rather than a project-by-project basis.	1. Control of Nutrient Inputs	Priority 2 - Watershed / lake management program support	
Create a state environmental protection fund from the real estate transfer tax. Designate watershed plans and implementation and cyano treatment as allowable uses for it	1. Control of Nutrient Inputs	Priority 2 - Watershed / lake management program support	
Establish a private-public partnership to create funding for stormwater improvement projects, green infrastructure and septic upgrades	1. Control of Nutrient Inputs	Priority 2 - Watershed / lake management program support	
Create a funding stream for developing watershed plans (incl. non a-i)	1. Control of Nutrient Inputs	Priority 2 - Watershed / lake management program support	
Create dedicated state match funds for cyano-related watershed-based plans and their implementation	1. Control of Nutrient Inputs	Priority 2 - Watershed / lake management program support	
Issue state/local bonds to fund stormwater improvement, septic improvement, other nutrient remediation.	1. Control of Nutrient Inputs	Priority 2 - Watershed / lake management program support	
Clarify what must be done before being considered for treatment	1. Control of Nutrient Inputs	Priority 3 - Laws, rules, guidance for lake management practices/projects	

Appendix B. Cyanobacteria Advisory Committee ideas and suggestions.

Cyanobacteria Committee Suggestion/Recommendation	Strategy	Related Action	Comment
Develop guidance about what residents can legally do relative to lake treatment (e.g. purchasing remediation products online). How deal with unregulated citizen action, esp. on DW sources?	1. Control of Nutrient Inputs	Priority 3 - Laws, rules, guidance for lake management practices/projects	
Need a comprehensive program, including legislative authority, funding source, staffing and methods for tracking, evaluation and permitting	1. Control of Nutrient Inputs	Priority 3 - Laws, rules, guidance for lake management practices/projects	
Require that a watershed plan be developed and implemented and external nutrient loading addressed before permit In-Lake management.	1. Control of Nutrient Inputs	Priority 3 - Laws, rules, guidance for lake management practices/projects	
Guidance needed on when treatment is appropriate	1. Control of Nutrient Inputs	Priority 3 - Laws, rules, guidance for lake management practices/projects	
Develop guidance on what monitoring is required before, during and after treatment for different treatment types.	1. Control of Nutrient Inputs	Priority 3 - Laws, rules, guidance for lake management practices/projects	
Create guidance on how to decide treatment type and dosage.	1. Control of Nutrient Inputs	Priority 3 - Laws, rules, guidance for lake management practices/projects	
Develop guidance about In-Lake treatment options on lakes that are also DW sources	1. Control of Nutrient Inputs	Priority 3 - Laws, rules, guidance for lake management practices/projects	
Develop guidance about when treatment is appropriate, how to select a treatment type and treatment doseage and the monitoring that is required before, during and after treatment. Include consideration of any factors unique to waterbodies that have DW intakes.	1. Control of Nutrient Inputs	Priority 3 - Laws, rules, guidance for lake management practices/projects	
In lake treatment should not be done without a permit	1. Control of Nutrient Inputs	Priority 3 - Laws, rules, guidance for lake management practices/projects	
Charge DES with rulemaking to establish a process to permit In-Lake treatment. Should accommodate different types of treatments.	1. Control of Nutrient Inputs	Priority 3 - Laws, rules, guidance for lake management practices/projects	
Develop a low-interest state revolving loan fund, tax credits and/or other financial incentives to support septic system inspections, pumping, upgrades and retrofits, operation and maintenance and advanced treatment systems, especially for low and moderate-income homeowners in highly sensitive or impaired areas or waterfront areas.	1. Control of Nutrient Inputs	Supplemental action	

Appendix B. Cyanobacteria Advisory Committee ideas and suggestions.

Cyanobacteria Committee Suggestion/Recommendation	Strategy	Related Action	Comment
Create a septic sytem remediation/upgrade fund for systems near waterbodies.	1. Control of Nutrient Inputs	Supplemental action	
Amend AoT rules to have them apply to runoff over land with a slope gradiant of 15% or more, rather than 25% or more, for small projects.	1. Control of Nutrient Inputs	Supplemental action	
Stronger enforecement and penalty structure for violations of the Shoreland Act.	1. Control of Nutrient Inputs	Supplemental action	
Make information available about advanced septic systems and their implications for nutrient movement	1. Control of Nutrient Inputs	Supplemental action	
Site assessment results should be required to be shared with the town and state, regardless of if in failure or not.	1. Control of Nutrient Inputs	Supplemental action	
Sellers or buyers should be required to fix the septic system if it is found faulty during inspection.	1. Control of Nutrient Inputs	Supplemental action	
Require an inspection of the septic system at the time of sale. Require it to be fixed if found faulty. Require information to be shared with the town and state.	1. Control of Nutrient Inputs	Supplemental action	
Create a mandatory septic system maintenance/inspection cycle	1. Control of Nutrient Inputs	Supplemental action	
Watershed plans: Prioritize waterbodies with an established TMDL	1. Control of Nutrient Inputs	Supplemental action	
Implement TMDLs for cyanotoxins.	1. Control of Nutrient Inputs	Supplemental action	
Post how to do stick and jar tests and what they mean	2. Education and Outreach	Priority 4 - Production of self risk assessment materials/techniques	
Build capacity and responsibility for public bloom awareness ("When in doubt, stay out")	2. Education and Outreach	Priority 4 - Production of self risk assessment materials/techniques	
Signage at public access points on lakes and rivers – reminders to do visual assessments	2. Education and Outreach	Priority 4 - Production of self risk assessment materials/techniques	
Create a public forum for information sharing among stakeholder groups.	2. Education and Outreach	Priority 5 - Informational material available	

Appendix B. Cyanobacteria Advisory Committee ideas and suggestions.

Cyanobacteria Committee Suggestion/Recommendation	Strategy	Related Action	Comment
"Bloom basics" training for public health officials, nurses, enviro health staff	2. Education and Outreach	Priority 5 - Informational material available	
Epidemiologists (DPH) develop outreach materials to medical care providers and local health departments using their website, Epidemiology Bulletein, social media, meetings, conference calls for interested stakeholders	2. Education and Outreach	Priority 5 - Informational material available	
DHHS provide a seasonal notice to vets reminding them of risk and where to find info	2. Education and Outreach	Priority 5 - Informational material available	
Coordinate with statewide user groups to distribute educational information to members about cyano.	2. Education and Outreach	Priority 5 - Informational material available	
Develop materials describing risk level by activity (swimming, boating, fishing, drinking water, household use)	2. Education and Outreach	Priority 5 - Informational material available	
Communication material on how to limit risk and dispose/clean up benthic material	2. Education and Outreach	Priority 5 - Informational material available	
Develop visual ID guides, including benthic cyano	2. Education and Outreach	Priority 5 - Informational material available	
Publish a sampling protocol.	2. Education and Outreach	Priority 5 - Informational material available	
Have prerecorded presentations.	2. Education and Outreach	Priority 5 - Informational material available	
Targetted information to increase awareness of veterinarians and medical professionals to recognize the symptoms and risks of cyanotoxins	2. Education and Outreach	Priority 5 - Informational material available	
67% want a pamphlet or other material to give to clients	2. Education and Outreach	Priority 5 - Informational material available	
Disseminate posters for dog owners for posting at vet offices	2. Education and Outreach	Priority 5 - Informational material available	
Create a roles and responsibilities document for DES and DHHS, and other groups if needed	2. Education and Outreach	Supplemental action	

Appendix B. Cyanobacteria Advisory Committee ideas and suggestions.

Cyanobacteria Committee Suggestion/Recommendation	Strategy	Related Action	Comment
Integrate education about cyanobacteria into existing "touch" points (e.g. fishing licenses)	2. Education and Outreach	supplemental action	
Contract with a PR firm to help develop messaging effective at changing behavior. Based on the results, develop and distribute materials for specific audiences.	2. Education and Outreach	supplemental action	
Annual statewide cyanobacteria status report.	2. Education and Outreach	supplemental action	
Develop handout for short-term renters	2. Education and Outreach	supplemental action	
Educate river users that blooms can occur on rivers	2. Education and Outreach	supplemental action	
Have a dedicated website for cyanobacteria information and resources	2. Education and Outreach	supplemental action	
Website overhaul: make things easier to find.	2. Education and Outreach	supplemental action	
Reconsider the impairment listing (303d list) for cyanobacteria and if toxin testing is an important criterion to include.	3. Monitoring	Priority 6 - Enhance monitoring	
Figure out a process to pilot and evaluate new treatment technologies in New Hampshire. Possibly a third party evaluation, regulated by NHDES?	3. Monitoring	Priority 6 - Enhance monitoring	
Coordinate with academia to develop and deploy enhanced monitoring and detection techniques, including for predictive monitoring.	3. Monitoring	Priority 6 - Enhance monitoring	
Regular volunteer visual monitoring at least weekly to achieve green light status	3. Monitoring	Priority 6 - Enhance monitoring	
Establish sample "drop off sites" around state	3. Monitoring	Priority 6 - Enhance monitoring	
Deploy sample submission kits that can be shipped if paid for by recipient.	3. Monitoring	Priority 6 - Enhance monitoring	
Have at least one secondary point of contact to analyze samples and issue advisories to build capacity of the program and provide coverage.	3. Monitoring	Priority 6 - Enhance monitoring	

Appendix B. Cyanobacteria Advisory Committee ideas and suggestions.

Cyanobacteria Committee Suggestion/Recommendation	Strategy	Related Action	Comment
Expansion of NHDES staff positions to accommodate increasing monitoring need.	3. Monitoring	Priority 6 - Enhance monitoring	
Check-out system or opportunities for partners to purchase rapid test systems (e.g. lightdeck, Hach, Abraxis…)	3. Monitoring	Priority 6 - Enhance monitoring	
Provide cyanobacteria ID guides to existing monitors (VLAP, VRAP, weedwatchers, lake/watershed associations, river groups, etc.)	3. Monitoring	Priority 6 - Enhance monitoring	
Develop a volunteer monitoring program to report cyanobacteria blooms	3. Monitoring	Priority 6 - Enhance monitoring	
Provide tools and direction to organizations interested in volunteer monitoring.	3. Monitoring	Priority 6 - Enhance monitoring	
Provide an annual training for people who want to routinely monitor for cyano.	3. Monitoring	Priority 6 - Enhance monitoring	
Visual assessment by lake residents	3. Monitoring	Priority 6 - Enhance monitoring	
How prevalent are winter blooms in NH? What types of lakes do they occur on?	3. Monitoring	Priority 6 - Enhance monitoring	Research
Does fish stocking affect the likelihood of cyanobacteria blooms?	3. Monitoring	Priority 6 - Enhance monitoring	Research
Picoplankton dynamics and toxin production	3. Monitoring	Priority 6 - Enhance monitoring	Research
Evaluate the effectiveness of treatments to prevent or eliminate blooms.	3. Monitoring	Priority 6 - Enhance monitoring	Research
Develop a list of priority waterbodies for regular data collection to try to determine trends in bloom frequency/duration/severity.	3. Monitoring	Priority 6 - Enhance monitoring	Research
Collect and review water quality data, bathymetry, weather/climate information, land use and other information to predict and/or prevent blooms	3. Monitoring	Priority 6 - Enhance monitoring	Research
How can satellite data be used to inform monitoring efforts?	3. Monitoring	Priority 6 - Enhance monitoring	Research
How does shallow water recreation affect the likelihood of blooms or bloom dynamics?	3. Monitoring	Priority 6 - Enhance monitoring	Research

Appendix B. Cyanobacteria Advisory Committee ideas and suggestions.

Cyanobacteria Committee Suggestion/Recommendation	Strategy	Related Action	Comment
Use risk mapping/modelling to indicate lakes and rivers likely to bloom regularly	3. Monitoring	Priority 6 - Enhance monitoring	Research
Monitoring sediment anoxia as a form of bloom prediction for high-risk waterbodies	3. Monitoring	Priority 6 - Enhance monitoring	Research
How can satellite and remote sensing data be used to monitor or predict blooms on smaller lakes of the size relevant in NH?	3. Monitoring	Priority 6 - Enhance monitoring	Research
Ability to predict timing, species composition and toxicity of cyanobacteria (including enviro triggers for toxicity)	3. Monitoring	Priority 6 - Enhance monitoring	Research
Understand how nutrients move through New Hampshire soils	3. Monitoring	Priority 6 - Enhance monitoring	Research
Assess the nutrient removal efficiency of advanced septic systems compared to conventional ones	3. Monitoring	Priority 6 - Enhance monitoring	Research
Is phosphorus available to other organisms once a bloom (e.g. gleotrichia bloom) forms on the sediment and then rises in the water column?	3. Monitoring	Priority 6 - Enhance monitoring	Research
Understand nutrient drainage through undeveloped/remote watersheds	3. Monitoring	Priority 6 - Enhance monitoring	Research
Understand cyanotoxin effects on fish and resultant consumption exposure.	3. Monitoring	Priority 6 - Enhance monitoring	Research
Under what conditions are private wells at any risk when a nearby surface water is blooming?	3. Monitoring	Priority 6 - Enhance monitoring	Research
What are the environmental justice implications of blooms for public access?	3. Monitoring	Priority 6 - Enhance monitoring	Research
Provide data to develop a national cost-benefit analyses for mitigation/control/prevention	3. Monitoring	Priority 6 - Enhance monitoring	Research
How does nitrogen affect the production of microcystin or other toxins in NH?	3. Monitoring	Priority 6 - Enhance monitoring	Research

Appendix B. Cyanobacteria Advisory Committee ideas and suggestions.

Cyanobacteria Committee Suggestion/Recommendation	Strategy	Related Action	Comment
Need to understand the toxins that do not currently have an established health advisory level.	3. Monitoring	Priority 6 - Enhance monitoring	Research
How frequently should a bloom be retested for toxicity in order to document changes meaningful to public health?	3. Monitoring	Priority 6 - Enhance monitoring	Research
Bioaccumulation to loons and other higher trophic species	3. Monitoring	Priority 6 - Enhance monitoring	Research
Explore different methods of testing for toxin presence, concentration, or potential to create toxins	3. Monitoring	Priority 6 - Enhance monitoring	Research
better understand the relationship between biovolume and toxicity	3. Monitoring	Priority 6 - Enhance monitoring	Research
more e-DNA and genomic information on cyanobacteria blooming in NH lakes	3. Monitoring	Priority 6 - Enhance monitoring	Research
72% (51/70) wanted a link to a webpage for information, specifically a link where can check current list of affected waterbodies	3. Monitoring	Priority 7 - Bloom notification tools	
Ask statewide groups to distribute link to sign up for advisory notifications/local waterbody lists	3. Monitoring	Priority 7 - Bloom notification tools	
Sign up for text alerts by waterbody	3. Monitoring	Priority 7 - Bloom notification tools	
Weekly bloom summary notification to vets, medical professionals (e.g. there are blooms on these 8 waterbodies, in these towns), in lieu of daily statewide notice as advisories	3. Monitoring	Priority 7 - Bloom notification tools	
An opt-in system for receiving notification of blooms	3. Monitoring	Priority 7 - Bloom notification tools	
Develop a mechanism for maintaining updated contact information for stakeholders receiving advisory notifications	3. Monitoring	Priority 7 - Bloom notification tools	
Focus more on providing notifications through waterbody-specific email lists for detailed and targetted communication, and less on constant contact, NHDES website, press releases	3. Monitoring	Priority 7 - Bloom notification tools	

Appendix B. Cyanobacteria Advisory Committee ideas and suggestions.

Cyanobacteria Committee Suggestion/Recommendation	Strategy	Related Action	Comment
Weekly bloom summary notification to the press (e.g. there are blooms on these 8 waterbodies, in these towns)	3. Monitoring	Priority 7 - Bloom notification tools	
Change the words for advisory and alert to be clearer	3. Monitoring	Priority 7 - Bloom notification tools	
Update Beach Map: traffic light system, pictures of blooms, rapid toxin results(?), more basic info about cyanobacteria	3. Monitoring	Priority 7 - Bloom notification tools	
Develop a clearer advisory system (i.e. traffic light)	3. Monitoring	Priority 7 - Bloom notification tools	
Include alerts (yellow light) on advisory map	3. Monitoring	Priority 7 - Bloom notification tools	
Figure out where long-term information (data) about history of cyano blooms on rivers can be stored.	3. Monitoring	Priority 7 - Bloom notification tools	
Develop a standardized bloom reporting system	3. Monitoring	Priority 7 - Bloom notification tools	
Integrate bloom reporting with an app.	3. Monitoring	Priority 7 - Bloom notification tools	
Develop a list of waterbodies likely to bloom regularly and use it to inform routine sampling	3. Monitoring	Supplemental action	
Routine monitoring at representative lakes to determine trends	3. Monitoring	Supplemental action	
Have a communication strategy for alerting downstream DW intakes when a bloom occurs in an upstream water body	4. Drinking Water	Priority 8 - Cyanobacteria action plans	
Distribute factsheets for PWS explaining NH-specific resources, guidance, points of contact, funding opportunities, etc.	4. Drinking Water	Priority 8 - Cyanobacteria action plans	
Assist drinking water suppliers to develop and implement formal cyanobacteria monitoring and response plans for surface water drinking supplies	4. Drinking Water	Priority 8 - Cyanobacteria action plans	
Develop NH specific guidance for DW suppliers about how to monitor and respond to blooms.	4. Drinking Water	Priority 8 - Cyanobacteria action plans	

Appendix B. Cyanobacteria Advisory Committee ideas and suggestions.

Cyanobacteria Committee Suggestion/Recommendation	Strategy	Related Action	Comment
Require EITHER rapid-turnaround toxin testing OR having an alternative source ready to go online and plan detailing when it would do so in response to a bloom.	4. Drinking Water	Priority 8 - Cyanobacteria action plans	
Incorporate cyanobacteria into PWS emergency response plans	4. Drinking Water	Priority 8 - Cyanobacteria action plans	
If a supply has had a known bloom, require that the PWS monitor for cyanobacteria and have a response plan in place.	4. Drinking Water	Priority 8 - Cyanobacteria action plans	
Have grant money available for bloom monitoring equipment deployed on PWS.	4. Drinking Water	Priority 8 - Cyanobacteria action plans	
Get more labs able to test for toxins following best protocols and able to do <24 hour turnaround.	4. Drinking Water	Supplemental action	
Develop a list of labs that do the standardized testing protocol NH recommends.	4. Drinking Water	Supplemental action	
Develop a template a communication plan in place for what do say in event of a bloom on a PWS or toxins in finished water. Work with suppliers to get them to adopt system-specific ones.	4. Drinking Water	Supplemental action	
Make no-cost toxin testing available to any PWS at request	4. Drinking Water	Supplemental action	
Potential expansion of toxin testing to include additional toxins and to provide a more immediate indication of bloom toxicity	4. Drinking Water	Supplemental action	
Require PWSs to share bloom data with the state	4. Drinking Water	Supplemental action	
Figure out how to develop additional lab testing capacity for cyanotoxins, including both water and animal samples.	4. Drinking Water	Supplemental action	
Get more labs able to test for PWS toxins following best protocols and able to do <24 hour turnaround.	4. Drinking Water	Supplemental action	
Deploy continuous data monitors at DW sources	4. Drinking Water	Supplemental action	

Appendix B. Cyanobacteria Advisory Committee ideas and suggestions.

Cyanobacteria Committee Suggestion/Recommendation	Strategy	Related Action	Comment
Produce a research needs document for use by academics in seeking grants		Plan did not specifically address	
Work with CMC to receive bloom reports submitted through that mechanism		Plan did not specifically address	
Provide private campgrounds on lakes with free passes to nearest state park or state beach when lake has an advisory.		Plan did not specifically address	
Have trainings for PWS about cyanobacteria and the need for monitoring etc.		Plan did not specifically address	
Develop an annotated bibliography describing available treatment technologies for cyanotoxins, for planning use by PWSs		Plan did not specifically address	
Mechanism for having 1 contract with lake treatment company that could be used by any of the state's PWS		Plan did not specifically address	
Provide toxin test strips for PWS.		Plan did not specifically address	
Figure out how to integrate DW response plan with existing regulatory framework for approving new treatments.		Plan did not specifically address	
Create a business card with information about how to report, and the link to current advisories. Hand it out to all field staff across DES that work in rivers and lakes (e.g. Dam Bureau). Put a cyano card in every field vehicle as well.		Plan did not specifically address	
DHHS present at vendor session at annual meeting, focused on how to report		Plan did not specifically address	
Have the links on the DHHS webpage and DES webpage go to the same central cyanohab website		Plan did not specifically address	
Vet present at vendor session at annual meeting, focused on how to report		Plan did not specifically address	

Appendix B. Cyanobacteria Advisory Committee ideas and suggestions.

Cyanobacteria Committee Suggestion/Recommendation	Strategy	Related Action	Comment
Have boilerplate social media posts created ahead of time that agencies can use at peak periods thru the bloom season, and that can be shared with partners		Plan did not specifically address	
Have a regular (annual?) forum for stakeholders to share information		Plan did not specifically address	
"speaking tour" to annual meetings of constituent organizations. Continue presentations to spread awareness.		Plan did not specifically address	
Train others to deliver cyanobacteria presentations		Plan did not specifically address	
Talk with Fish and Game about communication needs at WMAs		Plan did not specifically address	
Develop additional communication materials		Plan did not specifically address	
Develop a "what you can do" factsheet for homeowners		Plan did not specifically address	
Guidance for people that use surface water for household use		Plan did not specifically address	
Consider what terminology to use: HAB has word "harmful" but "algal bloom" is scientifically inaccurate.		Plan did not specifically address	
Communication materials to post at marinas		Plan did not specifically address	
Have a list of all available funding sources to support watershed planning and implementation – and related work to improve water quality		Plan did not specifically address	
Develop message: what if an advisory is in place but the water is clear?		Plan did not specifically address	
Education campaign to encourage people to boat in deeper waters		Plan did not specifically address	
61% want an online training module		Plan did not specifically address	
Website tailored to the vet community: reporting form, clinical testing options, link to info about clinical signs and treatment (e.g. Cornell), link to active advisories and historical lake-specific info, info page to refer clients to		Plan did not specifically address	
Reporting form for vets that would trigger water testing at a particular site where there was suspected exposure		Plan did not specifically address	

Appendix B. Cyanobacteria Advisory Committee ideas and suggestions.

Cyanobacteria Committee Suggestion/Recommendation	Strategy	Related Action	Comment
Improve online communication materials		Plan did not specifically address	
Get metrics from DOIT on visitation to different parts of the HAB website and use it to inform adjustments in communications		Plan did not specifically address	
Add link to CDC webpage for physicians to the "do people get sick" page.		Plan did not specifically address	
Develop clearer website structure about watershed based plans.		Plan did not specifically address	
Develop a FAQ or factsheet about why the program is based on cell counts and not toxins.		Plan did not specifically address	
Inflation Reduction Act money for emerging contaminants		Plan did not specifically address	
Allow private donations to a clean lakes fund administered by DES		Plan did not specifically address	
Partner with private foundations to establish a cyanobacteria grant fund with lake and watershed associations as the primary intended applicants		Plan did not specifically address	
More communities use lakes and rivers than just the people in the town where the lakes and rivers is. Design funding source accordingly.		Plan did not specifically address	
Create an option for making SRF loans into grants for work on waterbodies with cyanobacteria issues		Plan did not specifically address	
Multiple funding sources are needed for lake management, reflecting differences in local capacity, public access, local support, severity of the problem and other variables.		Plan did not specifically address	
Funding to support testing of domestic animals and surveillance testing of game and non-game wildlife		Plan did not specifically address	
Fund to subsidize toxin tests for veterinary diagnoses.		Plan did not specifically address	
Need more certified lake managers in New Hampshire		Plan did not specifically address	
State compiled list of lake management firms		Plan did not specifically address	
Need a standardized sediment sampling protocol or sediment sampling guidance for assessing internal loading		Plan did not specifically address	

Appendix B. Cyanobacteria Advisory Committee ideas and suggestions.

Cyanobacteria Committee Suggestion/Recommendation	Strategy	Related Action	Comment
Guidance for preparing a cyanobacteria management plan, with template outline. Required to apply for treatment funding.		Plan did not specifically address	
Develop waterbody prioritization process for In-Lake treatments.		Plan did not specifically address	
Get more DES staff trained as certified lake managers		Plan did not specifically address	
In lake treatment: Prioritize waterbodies that are vulnerable, supply drinking water, or are tourist hot spots		Plan did not specifically address	
In lake treatment: Prioritize waterbodies with an established TMDL		Plan did not specifically address	
In lake treatment: Prioritize by risk? By recovery potential? By how bad things are?		Plan did not specifically address	
Establish a process for how to prioritize which waterbodies receive funding and support for cyanobacteria-related watershed planning and in-lake treatments.		Plan did not specifically address	
How should cyanobacteria blooms be incorporated into water releases for instream flow?		Plan did not specifically address	
Need new or stronger legislation to address polluted stormwater runoff from development and re-development.		Plan did not specifically address	
Regulate net phosphorus loads associated with new development, following the Class A/B/C waters		Plan did not specifically address	
Need a process to pilot and evaluate new septic and stormwater treatment technologies in New Hampshire. Possibly a third party evaluation, regulated by NHDES?		Plan did not specifically address	
Compile information on how local ordinances are applied for and pursued. Post on the agency's website BMPs, model ordinances and how to apply overlay districts to the shoreline		Plan did not specifically address	
Develop a factsheet about the different types of inspections, evaluations, etc., what they mean and who does them		Plan did not specifically address	

Appendix B. Cyanobacteria Advisory Committee ideas and suggestions.

Cyanobacteria Committee Suggestion/Recommendation	Strategy	Related Action	Comment
Within 250' of lakes and rivers with nutrient-related impairment, NHDES recommend advanced treatment systems or connection to public wastewater infrastructure for all new development or renovations that increase sewage loading		Plan did not specifically address	
Permit requirement that owners of advanced septic systems have an active maintenance contract		Plan did not specifically address	
Give sampling info to spill response, Dam Bureau, State Parks, Fish and Game, etc.		Plan did not specifically address	
Provide sample bottles to health officers.		Plan did not specifically address	
Refine online form available for reporting health impacts to reach doctors and vets		Plan did not specifically address	
Better coordinate DES and DHHS in order to track illness reports in humans, pets, livestock through OHHABS		Plan did not specifically address	
Give sampling info to Fish and Game		Plan did not specifically address	
Figure out how to develop lower-cost, readily available animal sample testing for use by vets to determine cause of illness		Plan did not specifically address	
Streamline process of advisory notifications to make more efficient and effective		Plan did not specifically address	
Define the time of year within which advisories will be issued.		Plan did not specifically address	
Revisit using cell counts as the basis for advisory issuance, in light of how rapidly technology and understanding of bloom dynamics are evolving.		Plan did not specifically address	
Create a tiny url for the beach mapper that could be posted on risk signage		Plan did not specifically address	
Periodically evaluate whether cell counts are the right basis for issuing advisories.		Plan did not specifically address	

Appendix B. Cyanobacteria Advisory Committee ideas and suggestions.

Cyanobacteria Committee Suggestion/Recommendation	Strategy	Related Action	Comment
What automatic reply is on the HAB email or standardized bloom report?		Plan did not specifically address	
Expand locations for sample analysis.		Plan did not specifically address	
Plan - put a separate section in monitoring chapter that describes current approach to toxins, problems with a toxin-based program and that we are not electing to change to a toxin-based program as part of this plan.		Plan did not specifically address	
Create an incentive system for communities to install sewer systems instead of individual septic systems within some distance from affected waterbodies		Plan did not specifically address	
Include level of a community's participation in the LakeSmart or Watershed Steward program in the scoring criteria for grant funding for water quality work		Plan did not specifically address	
Watershed plan: Prioritize waterbodies that are vulnerable, supply drinking water, or are tourist hot spots		Plan did not specifically address	
Understand the conditions under which blooms rise to the surface.		Plan did not specifically address	Research
How is climate change affecting the frequency/severity/duration/toxicity of blooms in NH?		Plan did not specifically address	Research
Under what conditions do blooms occur in New Hampshire rivers and what can be done to address them?		Plan did not specifically address	Research
How do winter dynamics contribute to summer blooms?		Plan did not specifically address	Research
What's up with lakes that bloom but don't have internal loading?		Plan did not specifically address	Research
Does in-Lake treatment of aquatic invasive species affect the likelihood of cyanobacteria blooms?		Plan did not specifically address	Research

Appendix B. Cyanobacteria Advisory Committee ideas and suggestions.

Cyanobacteria Committee Suggestion/Recommendation	Strategy	Related Action	Comment
Have a process for DES updating the cyano plan, to incorporate new information/recommendations from stakeholders provided at the annual coordination meeting, new research, methods, changed circumstances on the ground, etc.			Term of plan is 10 years; revisit and revise in year 11

Appendix C. Summary of Strategies, Priorities and Tactics. = indicates law or administrative rule change required. **$** = Indicates additional funding required.

Strategy	Priority	Tactics
1. Develop policies and practices to reduce, control and prevent the nutrient inputs that cause cyanobacteria blooms.	• Identify and implement state and local regulations and practices that address the sources of nutrient inputs that cause cyanobacteira blooms.	1. Promote the development and implementation of stormwater utilities that control stormwater runoff and fund stormwater management projects. (local) 2. Promote the development and implementation of municipal overlay districts in areas adjacent to surface waters and in areas that are known to contribute significant quantities of nutrients to surface waters. (local) 3. Promote the use of the New Hampshire stormwater manual to plan, design and implement stormwater control measures that slow down, infiltrate and reduce nonpoint source nutrient pollution. 4. Complete a review of state laws and administrative rules that are designed to reduce nutrient inputs with the goal of identifying regulatory priorities. **$** 5. Promote and provide financial assistance to statewide voluntary stormwater management programs. **$**
1. Develop policies and practices to reduce, control and prevent the nutrient inputs that cause cyanobacteria blooms.	• Identify ways to increase capacity and financial support for watershed and in-lake management efforts that prevent and reduce nutrient inputs and address cyanobacteria blooms.	1. Increase resources that support the development and implementation of watershed management plans on waterbodies that are specifically targeted to address cyanobacteria blooms. , **$** 2. Implement a lake management program with sufficient funding dedicated to diagnosing the cause of cyanobacteria blooms and implementing the recommended actions for remediation. , **$**
1. Develop policies and practices to reduce, control and prevent the nutrient inputs that cause cyanobacteria blooms.	• Develop laws, rules and guidance that clearly define the permitting requirements and processes for lake management activities designed to remediate cyanobacteria.	1. Update current applicable law(s) to address lake management practices that are designed to reduce nutrient inputs that contribute to cyanobacteria blooms.

Strategy	Priority	Tactics
		2. Develop administrative rules that establish a process for obtaining the necessary permits or permissions to utilize in-lake management practices that are designed to minimize the impacts and remediate of cyanobacteria blooms. 🏛 3. Complete guidance materials that describe effective and allowable lake management practices for the prevention or treatment of cyanobacteria.
2. Advance education and outreach efforts that allow individuals who recreate or use surface waters to assess the cyanobacteria risks and respond accordingly.	• Promote self-risk assessment messaging and techniques.	1. Install informational signage at waterbody (lakes and rivers) public access points. 2. Partner with various organizations to promote common messaging and training. 3. Creation of dedicated self-risk assessment instructional videos, written materials and public service announcements.
2. Advance education and outreach efforts that allow individuals who recreate or use surface waters to assess the cyanobacteria risks and respond accordingly.	• Produce cyanobacteria informational materials to provide learning opportunities that are available to related professional disciplines, consumer groups and tourists.	1. Create publicly accessible training and information videos about cyanobacteria risks, identification and the bloom warning system. 2. New and updated written materials that can be shared directly and used by statewide organizations and local watershed/lake/river associations. 3. Development of targeted materials for use by veterinarians and medical professionals.
3. Enhance cyanobacteria monitoring to track when and where blooms occur and clearly communicate current conditions to the public.	• Enhance cyanobacteria monitoring, sample submission and processing efficiency.	1. Increase NHDES cyanobacteria monitoring and bloom tracking capacity by adding new staff and training current staff. **$** 2. Increase sample processing efficiency by establishing new options for sample transfer to NHDES. 3. Development of cyanobacteria monitoring training opportunities and tools for volunteer monitoring organizations and citizen scientists. 4. Research the utility of various advanced monitoring techniques for tracking cyanobacteria bloom

Strategy	Priority	Tactics
		indicators and development of cyanobacteria bloom predictive tools. **$**
3. Enhance cyanobacteria monitoring to track when and where blooms occur and clearly communicate current conditions to the public.	• Develop and implement advanced bloom notification tools.	1. Implementation of a clearer cyanobacteria bloom severity system with multiple levels that are more easily interpreted. 2. Creation and use of an advanced, map-based online cyanobacteria bloom status tool. 3. Development and use of electronic options that allow for waterbody-specific reporting of suspected blooms and notices of current blooms.
4. Establish policies and procedures for prevention, early detection and response and treatment of cyanobacteria blooms and cyanotoxins in surface waters that serve as public drinking water supplies to minimize risks to customers.	• Develop cyanobacteria action plans by public water suppliers.	1. Provide sufficient funding that supports the development of cyanobacteria action plans by public water suppliers that utilize surface waters. **$** 2. Develop the policies and guidance that define what is to be included in a cyanobacteria action plan. 🏛 (potentially) 3. Sufficient NHDES staff to support the development of and progress towards implementation of cyanobacteria action plans. **$** (potentially)

Appendix D. Summary of Supplemental Actions. 🏛 = indicates law or administrative rule change required. **$** = Indicates additional funding required. "Advisory Committee Recommendation" are specific items brought forward by member of the cyanobacteria advisory committee.

Strategy	Supplemental Actions
1. Develop policies and practices to reduce, control and prevent the nutrient inputs that cause cyanobacteria blooms.	1. Consider updating Administrative Rule Env-Wq 1500 (Alteration of Terrain) to address the land slope threshold associated with the definition of a significant alteration. (see Env-Wq 1502.58, specifically). **Advisory Committee Recommendation.** 🏛 2. Consider updating RSA 485-A:39 and Administrative Rule Env-Wq 1025 relative to waterfront property site assessment studies to require a formal septic system inspection and to include that the results be reported to NHDES and the local municipality. **Advisory Committee Recommendation.** 🏛 3. Identify ways to create a stronger enforcement and penalty structure for violation of the Shoreland Water Quality Protection Act. The root concern is the inability of NHDES to issue stop work orders which fall to local enforcement. **Advisory Committee Recommendation.** 4. Consider requirement for culvert maintainer certification through UNH stormwater center (Certified Culver Maintainer Website). 5. Use routine roadway maintenance guide from New Hampshire Department of Transportation (NHDOT BMPs for Routine Roadway Maintenance). 6. Use/development of guidance/requirements for gravel road maintenance [see UNH gravel road resource library (UNH Gravel Road Maintenance Website). 7. Consider updating RSA 485-A:39 to require replacement of septic systems determined to be in failure at the time of sale of property. **Advisory Committee Recommendation.** 🏛 8. Explore establishing a funding source that would assist property owners, through a cost-sharing program, to complete the required upgrade or replacement depending on a demonstration of financial need. **Advisory Committee Recommendation.** 🏛, **$** 9. Consider legislation that requires unpermitted septic systems that serve properties within the protected shoreland to be upgraded. **Advisory Committee Recommendation.** 10. Enter into discussions with EPA to explore and utilize novel TMDL approaches by NHDES staff where recurring cyanobacteria blooms have resulted in water quality impairment. 11. Research, explore and consider the appropriateness of completing a statewide nutrient TMDL. **Advisory Committee Recommendation.** 12. Increase the implementation of nutrient reduction strategies included in TMDLs after they are completed specifically for waterbodies with recurrent cyanobacteria blooms. 13. Convene a group of stakeholders to provide input on the content of the 2024-2029 Nonpoint Source Management Program Plan.
2. Advance education and outreach efforts that allow	1. Create a new NHDES cyanobacteria website. **Advisory Committee Recommendation.**

Strategy	Supplemental Actions
individuals who recreate or use surface waters to assess the cyanobacteria risks and respond accordingly.	2. Integrate information about cyanobacteria into other state agency informational materials and distribution points. 3. Establish a contract with a public relations firm to assist NHDES in developing messaging that is effective in communicating the risk of cyanobacteria and materials for public consumption. **Advisory Committee Recommendation. $** 4. Complete an NHDES annual cyanobacteria status report. **Advisory Committee Recommendation.** 5. Identify the best methods for informing individuals renting properties with water access about the potential occurrence and risks of cyanobacteria. NHDES will identify stakeholders and establish a workgroup to explore the range of acceptable options. **Advisory Committee Recommendation.**
3. Enhance cyanobacteria monitoring to track when and where blooms occur and clearly communicate current conditions to the public.	1. Implement sentinel monitoring locations in several lakes and rivers in order to better understand the conditions that promote cyanobacteria blooms. 2. Improve existing suspected bloom-related illness reporting opportunities for humans, pets and livestock to better monitor the incidence, severity and types of illnesses that occur. **Advisory Committee Recommendation.** 3. Periodically evaluate the validity and practicality of using cyanobacteria cell density as the primary indicator as opposed to cyanotoxin testing for determining the risks associated with cyanobacteria blooms. **Advisory Committee Recommendation.** 4. Update administrative rule Env-Wq 1100 (Public Bathing Places) to reflect the most current and effective cyanobacteria risk indicator(s) for use by NHDES.
4. Establish policies and procedures for prevention, early detection and response and treatment of cyanobacteria blooms and cyanotoxins in surface waters that serve as public drinking water supplies to minimize risks to customers.	1. Support the development and use of advanced monitoring techniques to track bloom development and the water quality conditions that support blooms. High frequency data on parameters such as temperature and dissolved oxygen in conjunction with cyanobacteria indicators or density would be useful in building predictive models that can forecast bloom probability. 2. Require a PWS to report known blooms that occur in close proximity to the water intake to NHDES. Bloom reporting requires that monitoring, of some type, occurs on a regular basis. Currently there is no such policy in place. 3. Identification or development of state or regional laboratory services for cyanotoxin testing. NHDES Biology section staff complete cyanotoxin testing using ELISA techniques in the winter months on samples collected the previous summer, but there are no local or regional laboratories that complete cyanotoxin testing on a continuous basis to satisfy rapid tests of drinking water supplies during a bloom event. 4. Consider an evaluation of authority needed to require PWSs to incorporate cyanobacteria into their emergency response plans (ERPs). ERPs are federally required and cover a variety of threats to drinking water sources.

Strategy	Supplemental Actions
	5. NHDES will work with PWSs to develop a communications plan that describes how the public will be informed in the event a cyanobacteria bloom or cyanotoxins impact their water supply and what emergency measures are in place to protect public health.

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Strategy	Supplemental Actions
	4. Consider an evaluation of authority needed to require PWSs to incorporate cyanobacteria into their emergency response plans (ERPs). ERPs are federally required and cover a variety of threats to drinking water sources. 5. NHDES will work with PWSs to develop a communications plan that describes how the public will be informed in the event a cyanobacteria bloom or cyanotoxins impact their water supply and what emergency measures are in place to protect public health.