HARMFUL ALGAL BLOOMS TOOLKIT

A planning guide for public health and emergency response professionals

WISCONSIN HARMFUL ALGAL BLOOMS PROGRAM
Bureau of Environmental and Occupational Health

dhs.wisconsin.gov/water/bg-algae/index.htm
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INTRODUCTION

Purpose

The purpose of this harmful algal blooms toolkit is to provide information to local governments, health departments, and citizens in Wisconsin about preparing for and responding to harmful algal blooms. The toolkit provides background information, practical guidance, strategies, media releases, talking points, definitions, and useful reference materials on this topic.

The guides in this toolkit may be copied onto local agency letterhead for distribution to residents affected by harmful algal blooms. Additional resources can be found in Appendix B.

Background

More than 15,000 lakes and rivers in Wisconsin are home to a multitude of organisms, including algae. Blue-green algae, also known as cyanobacteria, are photosynthetic bacteria that are often responsible for harmful algal blooms (HABs) in Wisconsin lakes and rivers. Harmful algal blooms are rapidly reproducing populations of cyanobacteria caused by a favorable set of conditions, including an overabundance of nutrients such as nitrogen and phosphorus, warm temperatures, light availability, and calm weather.

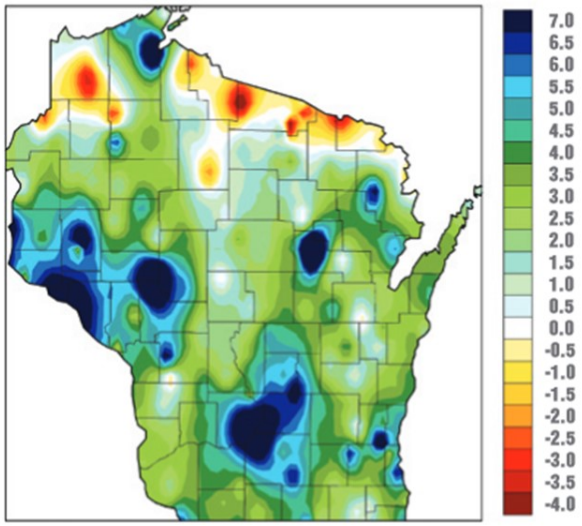
> Wisconsin has more than 15,000 lakes and rivers, which are home to many organisms, including algae.

Not all cyanobacteria produce toxins, and those that produce toxins do not produce them at all times.[1] The toxins produced by cyanobacteria are called cyanotoxins. Some common cyanotoxins found in Wisconsin waters include microcystin and anatoxin. Microcystin is a liver toxin, while anatoxin is a neurotoxin. Both can produce illness in humans and animals. Harmful algal blooms can deplete oxygen levels and block sunlight for other organisms, causing a disruption in the aquatic ecosystem.[2]

Climate Trends

Long-term trend analysis of Wisconsin's climate indicates that the state is becoming warmer, wetter, and experiencing a longer growing season (Figures 1 and 2).[1] After analyzing historical climate data for 1950-2006 and developing downscaled local climate models, University of Wisconsin climate scientists created potential climate projections based on historical trends and scientifically validated models. These projections indicate that Wisconsin may experience an increase in average annual precipitation, a longer growing season, and warmer annual average temperatures.

Fig 1. Changes in Annual Average Precipitation (Inches) from 1950 to 2006[1]

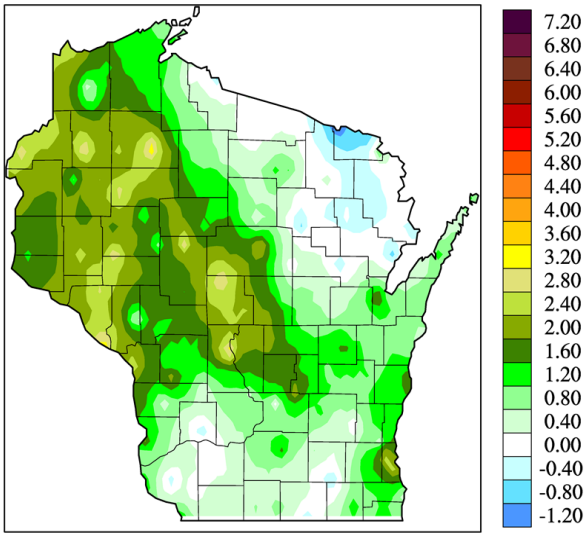


The combination of these factors can lead to environmental impacts such as harmful algal blooms.[2] Increasing precipitation and flooding can contaminate waterways with large amounts of silt, fecal material, and nitrogen/phosphorus-based fertilizers. Warmer air and water temperatures suggest that algal blooms will occur earlier in the year, and may be more prolific.

Health Impacts

Expected climate and weather impacts suggest that Wisconsin will need to prepare for more public health implications due to harmful algal blooms. As the risk for exposure increases, it is important to be able to recognize the symptoms associated with harmful algal blooms. Different species of cyanobacteria produce different toxins, including neurotoxins, liver toxins, cell toxins, and skin irritants.[3] Skin exposure to contaminated water and ingestion of contaminated water can cause skin rash, muscle cramps, nausea, and vomiting.[3] People and animals that ingest water containing algal toxins can show symptoms of lethargy, seizures, diarrhea, and vomiting. Recreational bodies of water are at risk for developing blooms of toxin-producing blue-green algae, and may pose a health risk to swimmers, boaters, lakeshore residents, livestock, and pets.

Fig 2. Change in Annual Average Temperature (°F) from 1950-2006[1]



Health planning efforts must consider the number of people exposed to harmful algal blooms during recreation, provide tools to identify cyanobacteria, and ensure that residents and recreational users can recognize the symptoms of algal bloom exposure.

Harmful Algal Blooms Response and Recovery Guidance

The Wisconsin Harmful Algal Bloom Surveillance program was established

through a cooperative agreement with the Centers for Disease Control and Prevention. This program continues beyond its original funding by leveraging strong partnerships with the Wisconsin Department of Natural Resources and the Wisconsin State Laboratory of Hygiene.

Staffing is supported by the Great Lakes Restoration Initiative (GRLI) program through the placement of a Council of State and Territorial Epidemiologists (CSTE) Waterborne Disease fellow at the Wisconsin Division of Public Health.

The program continues to collect information about human and animal illnesses related to cyanobacteria in Wisconsin. In response to reports of illness, this program coordinates follow-up water sampling through the Wisconsin Department of Natural Resources and water analysis at the Wisconsin State Laboratory of Hygiene.

The information collected during the first five years of this program has enhanced outreach capacity and increased awareness of health issues related to cyanobacteria. Shoreline residents and recreational water users may also contact their local public health agency with questions related to locations of known harmful algal blooms (HABs), monitoring of HABs, and symptoms associated with ingestion of cyanotoxins.

DEFINITIONS

Blue-Green Algae

Photosynthetic bacteria that can cause illness and death in humans and animals. They are a natural part of lake ecosystems and have been for many centuries. Also known as cyanobacteria. ("Photosynthetic" means they grow in the presence of sunlight.)

Algal Bloom

A bloom is a sudden increase in the concentration of algae cells in a certain area of water. In Wisconsin, blooms typically occur during the warm-weather months between mid-June and mid-September.

Toxin

A poisonous substance that is a product of a living organism's metabolic process.

Neurotoxin

A toxin that affects the nervous system and can result in muscle spasms, lethargy, memory impairment, seizures, and confusion.

Hepatotoxin

A toxin that affects the liver and other internal organs, and can cause gastrointestinal illness, tissue damage, muscle weakness, paralysis, respiratory failure, tumors, and possibly liver cancer (with long-term, chronic exposure).

Dermatotoxin

A toxin that affects the skin, and can cause rashes, eye/nose/throat irritation, and asthma, as well as headaches, fever, and gastrointestinal illness.

Eutrophication

The enrichment of bodies of water by inorganic nutrients, such as nitrate and phosphate. This process occurs naturally, but can be accelerated by human activity.

GUIDE 1

GUIDE 1: HOW HARMFUL ALGAL BLOOMS FORM

In Wisconsin, blooms typically occur during the warm-weather months between mid-June and mid-September. Lakes and rivers in Wisconsin can become cloudy with rapidly reproducing algae. Blue-green algae will follow sunlight and nutrients by floating to the surface, where they can form thick scum layers or mats and may look bubbly or frothy. Algal scums can be pushed to different locations by wind or wave action.

Factors Contribution to Algal Bloom Growth

- Warm weather
- Sunlight
- Large rain events
- Nutrient run-off

Harmful algal blooms can seem to appear overnight. This is because many species of blue-green algae have developed the ability to control their buoyancy as the availability of light and nutrients changes with various weather conditions.

At night, when there is no light, the cyanobacteria cells are not able to adjust their buoyancy and will float to the surface, forming a scum on top of the water that is visible in the morning, seemingly appearing overnight.

What Do Harmful Algal Blooms Look and Smell Like?

When harmful algal blooms are present, the algal scum can be a variety of colors such as fluorescent blue, green, white, red, or brown. Blooms can have more than one color present and may look like thick paint floating on the water. Algal blooms can give off a foul odor, which is particularly offensive in the warm summer months.[5,6]

Harmful algal blooms can often be mistaken for pollen, duckweed, and filamentous green algae in waterways. These organisms are part of the ecosystem and can serve as primary producers in their food web.

GUIDE 1

Not Harmful

POLLEN

FILAMENTOUS GREEN ALGAE

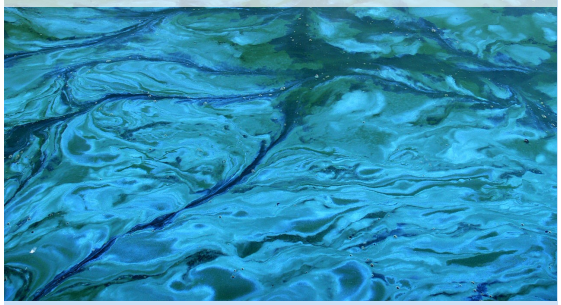
DUCKWEED

DUCKWEED

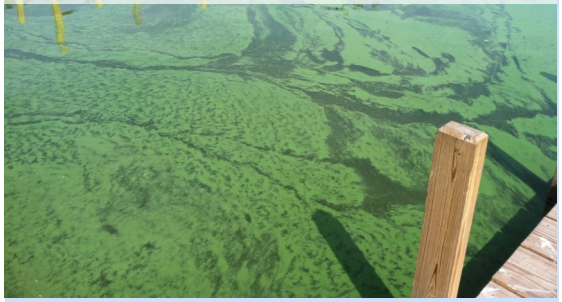
Harmful

CYANOBACTERIA ON ROCK

CYANOBACTERIA



BLUE-GREEN ALGAE



BLUE-GREEN ALGAE

GUIDE 2

GUIDE 2: HUMAN EXPOSURE AND SYMPTOMS

Symptoms

Humans can be exposed to harmful algal blooms in a variety of ways, including:

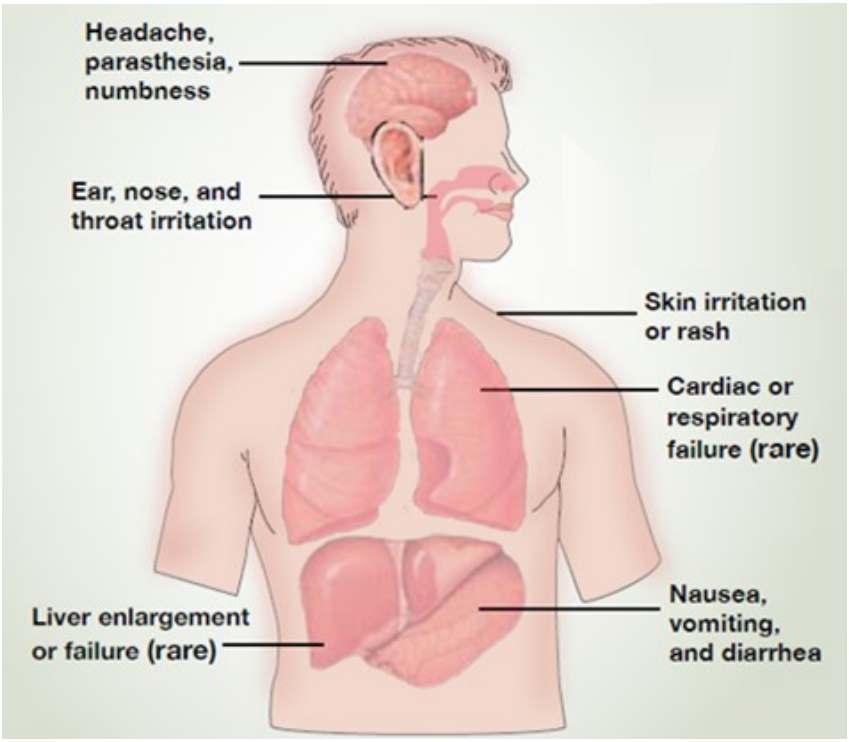
- Accidentally drinking water that comes from a lake or reservoir with a harmful algal bloom present
- Drinking untreated water
- Being in the water with a harmful algal bloom
- Inhaling aerosols (spray) from water-related activities such as jet skiing or boating
- Inhaling aerosols when watering lawns or irrigating golf courses with pond water

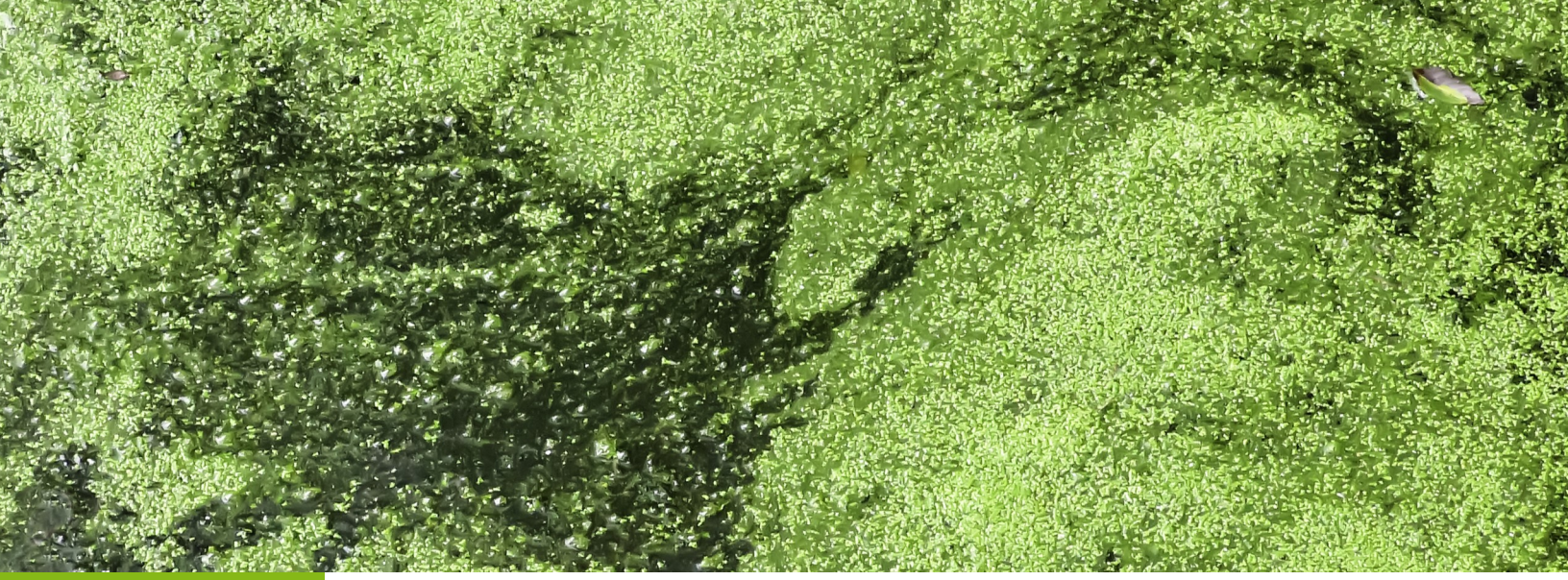
If you wade into water up to your knees, and cannot see your feet, the amount of algae could be unsafe.

What to Do if You Experience Symptoms

- If you think you are experiencing symptoms from exposure to harmful algal blooms, contact your doctor or the **Poison Information Hotline (800-222-1222)** right away.
- For more information about harmful algal blooms, contact your local health department.
- To report a case of potential health effects caused by harmful algal blooms, visit the DHS algae website at dhs.wisconsin.gov/water/bg-algae/index.htm or contact the Bureau of Environmental and Occupational Health at 608-266-1120.

Possible Harmful Algal Bloom Related Symptoms





GUIDE 3

GUIDE 3: ALGAL TOXIN GUIDANCE LEVELS

Each algal toxin can affect your health differently. Symptoms also depend on how much of the toxin you are exposed to, and how you are exposed. The World Health Organization (WHO) provides guidelines for algal toxin exposure. In Wisconsin, there is an advisory level of >100,000 cells/mL or if a scum layer is visible.[8] There is an increased risk of adverse health effects relating to harmful algal blooms as the masses of algae increase in size. It is important to stay away from these larger blooms.

Probability of Adverse Health Effect	Cell Density (cells/mL)*	Microcystin-LR (µg/L)**
Low	Less than 20,000	Less than 10
Moderate	20,000-100,000	10-20
High	100,000-10,000,000	20-2,000
Very High	More than 10,000,000	More than 2,000

***Cell Density**: The number of cells per unit volume. Often cell density is denoted as viable cell density, which is the number of living cells per unit volume.[9]

** **Microcystin-LR**: Toxin produced by a species of cyanobacteria that can be measured to determine potential health effect.

GUIDE 4

GUIDE 4: DRINKING WATER AND RECREATIONAL SAFETY INFORMATION

Drinking Water

Exposure to harmful algal blooms in your drinking water is unlikely. The World Health Organization guidance value for microcystin-LR in drinking water is 1µg/L.8

No one should ingest raw lake or pond water at any time.

In Wisconsin, our drinking water comes from surface waters and wells, and is not at great risk for exposure to cyanobacteria. While most municipal drinking water treatment plants with surface water supplies do not regularly monitor for algal toxins, they do use treatment techniques that remove these toxins, if present.

Boiling water from lakes, ponds, or rivers to try to make it safe does not remove blue-green algal toxins. Because it is impossible to detect the presence of toxins in water by taste, odor, or appearance, assume they are present.

Recreational Safety

Recreational water users should avoid water with visible scum or algae present. All natural surface waters contain bacteria, algae, viruses, and other pathogens, which if consumed may pose health risks to humans, pets, and other domestic animals. The chance for health effects is greater if you or your children participate in water-related activities such as swimming, wading, water or jet-skiing, or wind surfing.

If you are unsure about the water quality, do not jump in.

If blue-green algae cannot be avoided while swimming or diving, you should try to minimize the ingestion of water during activities. Shower or rinse off thoroughly after getting out of the water, and clean all gear after use.

Some cyanobacteria toxins can accumulate in fish tissues. The World Health Organization advises that people who choose to eat fish taken from water with a harmful algal bloom should eat these fish in moderation, and avoid eating the guts of the fish.

Also, take care to not cut into organs when filleting the fish. Rinse the fillets with clean water to remove any liquids from the guts or organs before freezing or cooking.

GUIDE 5

GUIDE 5: PET SAFETY INFORMATION

Animals, particularly dogs, are especially susceptible to harmful algal blooms because they are not easily deterred from water, and continually groom by licking.

Livestock and wildlife may be exposed to algal blooms by wading in or drinking from affected waters.

Illness onset can occur within minutes to hours of exposure. Animals and humans that come in contact with algae-affected waters should be rinsed immediately, monitored for signs of illness, and advised to seek medical treatment if symptoms occur.

Health and Safety Tips for Pets and Livestock

- Do not let your pets or livestock graze near, drink, or swim in water that contains foam, scum, or mats of algae on the water.
- If your animal gets in water with a bloom, wash the animal immediately with clean water. Do not let the animal lick algae off its fur.
- Call a veterinarian if your animal shows any of these symptoms of blue-green algae poisoning: lethargy, vomiting, diarrhea, convulsions, difficulty breathing, or general weakness.
- When in doubt, it's best to keep out.

Follow These Steps to Protect Yours Pets and Livestock

- Visit dhs.wisconsin.gov/water/bg-algae/index.htm to learn more about blue-green algae.
- Know what a bloom looks like and avoid contact.
- Keep pets and livestock away from the water if you see signs of blue-green algae.
- Call your veterinarian if your animals are sick.
- Call your state or local health department to report pets or livestock made sick by blue-green algae.

GUIDE 6

GUIDE 6: VETERINARY REFERENCE CARD: ANIMAL EXPOSURE AND CLINICAL INFORMATION

Potential Exposure Route	Likely Symptoms and Signs	Time to Symptom Onset	Differential Diagnosis	Possible Laboratory or Other Findings
Swallowing water that is contaminated with blue-green algae (cyanobacteria) or toxins, or licking it off fur or hair	**Hepatoxins** • Excess drooling, vomiting, diarrhea • Foaming at mouth • Jaundice, hepatomegaly • Blood in urine or dark urine • Malaise • Stumbling • Loss of appetite • Photosensitivity in recovering animals • Abdominal tenderness	Minutes to hours	Acetaminophen or NSAID overdose, rodenticide ingestion, aflatoxicosis and other hepatotoxic poisonings	• Elevated bile acids, ALP, AST, GGT • Hyperkalemia • Hypoglycemia • Prolonged clotting time • Proteinuria • Presence of toxin in clinical specimens from stomach contents taken from animals that became ill
	Neurotoxins • Progression of muscle twitches • For saxitoxin, high doses may lead to respiratory paralysis and death if artificial ventilation is not provided	Minutes to hours	Pesticide poisoning, myasthenia gravis, other toxin poisonings	Presence of toxin in clinical specimens from stomach contents taken from animals that became ill
Skin contact with water contaminated with blue-green algae or toxins	**Dermal Toxins** Rash, hives, allergic reaction	Minutes to hours	Other dermal allergens	Blue-green staining of fur or hair

GUIDE 7

GUIDE 7: THE DOs AND DON'Ts OF HARMFUL ALGAL BLOOMS

DO

DO rinse yourself and your pet immediately if there is contact with algae affected waters.

DO look for beach posting and water quality notices before swimming.

DO get medical treatment right away if you think you, your pet, or your livestock might have been poisoned by algal toxins.

DON'T

DON'T swim, water ski, or boat in areas where the water is discolored or where you see foam, scum, or mats of algae on the water.

DON'T let pets or livestock swim in or drink from areas where the water is discolored or where you see foam, scum, or mats of algae on the water.

DON'T let pets lick algae off.

GUIDE 8

GUIDE 8: TALKING POINTS

If you are approached by the media about harmful algal blooms in your jurisdiction, the following talking points may be helpful.

1. Don't swim where water contains foam, scum, or algal mats.
2. Shower and wash hands after swimming in lakes, rivers, and ponds.
3. Clean fish thoroughly with fresh, clean water and discard the viscera (guts).
4. Keep pets out of soupy, green water or where you see foam, scum, or mats of algae.
5. Rinse dogs off immediately—do not let them lick algae off their fur.
6. Respect water-body closures and health advisories.

Some additional talking points to include, if applicable:

7. If you think you are experiencing symptoms from exposure to harmful algal blooms, contact your doctor or the Poison Control Center (800-222-1222) right away.
8. For more information about harmful algal blooms, contact your local health department or visit the Wisconsin Department of Health Services web page on Harmful Algal Blooms (dhs.wisconsin.gov/water/bg-algae/index.htm).

GUIDE 9

GUIDE 9: MESSAGE MAPS ABOUT HARMFUL ALGAL BLOOM SAFETY

Message mapping is one of the most important risk communication tools that public health agencies can employ. The goal of a message map is to convey important information in a concise and easy to understand fashion.

General Guidelines for Completing a Message Map

- Stick to three key messages or one key message with three parts for each underlying concern or specific question.
- Keep key messages brief. The reader should ideally spend less than 10 seconds per line.
- Develop messages that are easily understood by the target audience. (For communications with the general public, use a 6th to 8th grade readability level.)
- Place messages within a message set. The most important messages should occupy the first and last positions.
- Develop key messages that cite credible third parties.
- Use graphics and other visual aids to enhance key messages.
- Keep a positive tone. Messages should be solution oriented and constructive. Try to balance negative messages with positive ones.
- Avoid unnecessary use of "absolute" words, such as no, not, never, nothing, and none.[5]

GUIDE 9

The following is a message map that could be used when addressing the general public regarding harmful algal blooms.

Key Messages *Three key messages*	Supporting Information *Three pieces of supporting information for each key message*
Message 1 Blue-green algae, also known as cyanobacteria, can cause adverse health effects.	**Supporting Info 1** Cyanobacteria, otherwise known as blue-green algae, are photosynthetic (light-using) organisms that are responsible for harmful algal blooms. **Supporting Info 2** Not all cyanobacteria can produce harmful toxins, but those that do can cause rashes, diarrheal disease, and respiratory problems. **Supporting Info 3** In Wisconsin, harmful algal blooms are most common during the warm-weather months between mid-June and mid-September, but they can occur all year.
Message 2 When in doubt, stay out!	**Supporting Info 1** Humans can be exposed to harmful algal blooms through accidental ingestion while swimming, by inhaling aerosols (spray) during water recreation, or just by being in the water where a bloom is occurring. **Supporting Info 2** If you are unsure about the water, don't go in! Be sure to check for beach postings and water quality notices before swimming. **Supporting Info 3** Rinse yourself off immediately after being in contact with algal-affected waters, and get medical treatment right away if you think you have been poisoned by harmful algal blooms.
Message 3 Animals and livestock can become very ill after exposure to harmful algal blooms.	**Supporting Info 1** Do not let your pets or livestock drink, graze, or play near water where there could be harmful algal blooms. **Supporting Info 2** If your animal gets into water with a bloom, immediately wash him with clean water, and do not let him lick algae off its fur. **Supporting Info 3** If your pet displays symptoms such as seizures, vomiting, or diarrhea after contact with surface water, contact your veterinarian right away.

APPENDIX A: REFERENCES

1. Climate projections noted in this toolkit come from: Wisconsin's Changing Climate: Impacts and Adaptation. 2011. Wisconsin Initiative on Climate Change Impacts. Nelson Institute for Environmental Studies. UW-Madison and Wisconsin Department of Natural Resources, Madison, WI. Available at: http://www.wicci.wisc.edu/report/2011_WICCI-Report.pdf
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12. Wisconsin Department of Health Services. "Harmful Algal Blooms in Wisconsin's Lakes," accessed August 1, 2016, at https://www.dhs.wisconsin.gov/publications/p4/p45069.pdf
13. Icons from The Noun Project

APPENDIX B: ADDITIONAL RESOURCES

Wisconsin Department of Health Services (DHS)
608-266-1120

Harmful Algal Blooms Page
dhs.wisconsin.gov/water/bg-algae/index.htm

List of Wisconsin Tribal Health Directors
dhs.wisconsin.gov/lh-depts/contacts/tribal-health-directors.pdf

List of Wisconsin Local Health Departments
dhs.wisconsin.gov/lh-depts/counties.htm

Centers for Disease Control and Prevention
cdc.gov/nceh/hsb/hab/

Wisconsin Department of Natural Resources
dnr.wi.gov/lakes/bluegreenalgae/

Environmental Protection Agency
epa.gov/nutrientpollution/harmful-algal-blooms

National Oceanic and Atmospheric Administration
glerl.noaa.gov/res/waterQuality/?targetTab=habs