



Harmful Algal Bloom in West Guth Park Corpus Christi, Texas (May 2020)

GUIDE FOR PUBLIC HEALTH RESPONSE TO CYANOBACTERIAL HARMFUL ALGAE IN RECREATIONAL FRESHWATER IN TEXAS

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HARMFUL ALGAL WORKGROUP**

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Guide for Public Health Response to Cyanobacterial Harmful Blooms in Recreational Fresh Water of Texas

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Purpose

In Texas, responses to cyanobacterial harmful algal blooms (HABs) fall on local governments and health departments. Because there are no state regulations on cyanobacterial HABs, appropriate responses to protect public health are often not clear. The purpose of the *Guide for Public Health Response to Cyanobacterial Harmful Blooms in Recreational Fresh Water of Texas* is to provide unified statewide guidance for responding organizations, including local governments, local health departments, waterbody managers and others, for use if a lake, river, stream, pond, or other type of fresh water body may be impacted by cyanobacterial HABs.

The guidance describes ways to protect humans and animals from HABs in recreational fresh water and identifies advisory thresholds, appropriate responses to protect public health and safety, tracking mechanisms for HABs and cases of human and animal illnesses, HAB alert levels and recommended advisory language and other related communications. This is not statewide policy, but rather serves as guidance. This guidance draws on information from other states and federal agencies that have established HAB guidelines.

Introduction

Harmful algal blooms (HABs) occur when algae reproduce rapidly in bodies of fresh and marine water. One kind of HAB is caused by blue-green algae (also known as cyanobacteria). Cyanobacterial blooms occur naturally in fresh water when they multiply to high densities, which may be visible as scums, mats and discolorations, found mostly on the surface of fresh water. Both harmful algal blooms and cyanobacterial blooms are collectively referred to as HABs. Numerous cyanobacterial genera can form blooms at specific light intensities and depths. Certain conditions, such as warm and still water, high nutrient levels, and abundant sunlight can make these organisms reproduce rapidly (Gilbert et al. 2018). Benthic cyanobacteria can proliferate in clear waters with low nutrient levels and high transparency, conditions that allow penetrating light to reach bottom substrates (WHO 2021, Wood et al. 2020).

Cyanobacteria can produce toxins, called cyanotoxins, that can harm human and animal health. Cyanobacteria release toxins into the water, and this occurs more when their cells die and break apart. However, cyanobacteria do not always produce cyanotoxins, and the environmental conditions that cause cyanotoxin production are not fully understood. Therefore, identification of a bloom does not necessarily correlate with toxicity. In addition to toxic effects, the high biomass of blooms can kill fish and plant populations by causing low oxygen levels in the water column or by being dense enough to prevent sunlight from reaching the lower depths of the water.

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While no human deaths are known to have been caused by cyanobacteria in the United States, cyanobacteria have been implicated in human illness and animal illness and death in at least 43 states across the country, including Texas (USGS 2017). Because of the differing characteristics and potential health risks of cyanotoxins, it is recommended that local governments and health departments monitor and investigate algal blooms as described in Figure 4 and take appropriate measures to protect public health and the environment.

Cyanobacterial Toxins

Table 1 summarizes the chemical structure, main cyanotoxin groups, cyanobacteria that produce them, and primary target organ of cyanobacterial toxins. Each cyanobacterial toxin can be produced by more than one cyanobacterial genus, and the same genus can produce more than one toxin. Some cyanotoxins are toxic to the liver while others are neurotoxins, which attack the nervous system. Cyanotoxins fall into three groups of chemical structure which include cyclic peptides, alkaloids, and lipopolysaccharides (Table 1) (WHO 1999).

Table 1. List of various cyanobacteria, their toxins, and primary target organs.

Chemical structure	Toxin group	Primary target organ in animals	Cyanobacterial genera
Cyclic peptides	Microcystins	Liver, kidney, heart and gills	<i>Microcystis</i> , <i>Anabaena</i> (<i>Dolichospermum</i>), <i>Planktothrix</i> (<i>Oscillatoria</i>), <i>Nostoc</i> , <i>Hapalosiphon</i> , <i>Anabaenopsis</i>
	Nodularin	Liver, kidney, heart and gills	<i>Nodularia</i>
Alkaloids	Anatoxin-a	Nervous synapse	<i>Anabaena</i> (<i>Dolichospermum</i>), <i>Planktothrix</i> (<i>Oscillatoria</i>), <i>Aphanizomenon</i>
	Anatoxin-a(s)	Nervous synapse	<i>Anabaena</i>
	Aplysiatoxins	Skin	<i>Lyngbya</i> , <i>Schizothrix</i> , <i>Planktothrix</i> (<i>Oscillatoria</i>)
	Cylindrospermopsins	Liver and kidney	<i>Cylindrospermopsis</i> , <i>Aphanizomenon</i> , <i>Umezakia</i>
	Lyngbyatoxin-a	Skin and gastrointestinal tract	<i>Lyngbya</i>
	Saxitoxins	Nervous axons	<i>Anabaena</i> (<i>Dolichospermum</i>), <i>Aphanizomenon</i> , <i>Lyngbya</i> , <i>Cylindrospermopsis</i>
Lipopolysaccharides (LGS)	N/A	Potential irritant; affects any exposed tissue	All

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Common freshwater cyanotoxins in the U.S. include microcystins, cylindrospermopsins, anatoxins, and saxitoxins. In Texas, cyanobacterial blooms do not appear to be as common as other states, and there are few records of their occurrence. However, not all cyanobacterial blooms may have been reported. In recent years, increases in cyanobacterial blooms appear to be occurring. For instance, the United States Geological Survey (USGS) monitored Lake Houston from 2006 to 2008 and identified microcystins in 16% of samples at concentrations at or less than 0.2 micrograms per liter (µg/L) (USEPA 2019b). In February through April of 2012, the Grayson County Health Department took water samples from Lake Texoma and found concentrations of cylindrospermopsin ranging from 0.1 to 0.6 µg/L. They also detected other toxins, such as anatoxin-a, microcystins and saxitoxins (Lillis et al. 2012). From 2016 to 2018, the USGS detected cyanotoxins in more than 42% of samples collected from reservoirs across the state (Trevino and Petersen 2020). While microcystins were detected in more than 31% of the samples. In August 2020, a cyanobacterial bloom in Lady Bird Lake in Austin, Texas sickened and killed several dogs (COA 2020). This event triggered the development of the present guidance. The USGS Texas Water Science Center currently works in cooperation with river authorities, municipalities, groundwater districts and state and federal agencies to evaluate and track algal blooms and to provide scientific information to resource planners and managers.

Routes of Exposure and Symptoms

Humans

The public may be exposed to cyanotoxins in recreational fresh water by incidental ingestion, dermal contact or inhalation of tiny airborne droplets or mist during activities such as swimming and wading (Chorus et al. 2010).

Main Exposure Routes to Cyanotoxins in People

- **Inhalation:** breathing in aerosols or tiny airborne droplets or mist containing toxins
- **Skin contact:** direct contact with contaminated water when swimming, wading, or other water activities
- **Ingestion:** swallowing contaminated water or eating seafood contaminated with toxins

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Another route of exposure is the consumption of fish caught from cyanotoxin contaminated water (Buratti et al. 2017). Although there have been no reports of people becoming sick from eating freshwater fish caught during a HAB, fish organs should be discarded before consumption and fillets rinsed with tap or bottled water to avoid cyanotoxin exposure. Studies have shown that microcystins bioaccumulate up to 20 times in fish liver and other internal organs compared to fish muscle (Buratti et al. 2017).

If you think you have been exposed to a harmful algal bloom

- Watch for symptoms
- Call the Texas Poison Center Network at 1-800-222-1222
- Consult with your primary physician

Cyanotoxins can cause many different types of adverse health effects that vary from mild to severe. The type and severity of the adverse health effects depend on factors such as the amount and type of toxin, and the route and length of exposure to the toxin. The specific short-term and long-term health effects are difficult to predict because there is limited information on human health effects following cyanobacterial exposure (Koreiviene et al. 2014). Generally, people exposed to cyanotoxins through inhalation or direct skin contact could experience skin, eye, nose, throat and general respiratory irritation. People who ingest high levels of cyanotoxins could experience vomiting, diarrhea, headaches, abdominal pain, and neurological symptoms, such as loss of coordination and muscular twitching. Long-term exposure can lead to liver and kidney damage (Table 2) (CDC 2017).

Individuals who believe they may have been exposed to HABs and are concerned about their health should immediately contact their healthcare provider, or the Texas Poison Center Network at 1-800-222-1222.

Animals

Pets (e.g. dogs, cats), livestock (e.g. sheep, cattle) and wildlife (including birds and mammals) can be exposed to cyanotoxins through direct contact, drinking contaminated water, or ingesting algal mats. Dogs are at greater risk than people because they are more likely to drink contaminated water, swim in it, and ingest algae or scum from their fur after swimming. Animals exposed to cyanotoxins could experience symptoms such as vomiting, fatigue, excessive salivation, difficulty breathing, and neurological symptoms, such as convulsions and staggered walking (Table 2). Liver failure and death can occur hours to days following exposure to high levels of cyanobacterial toxins (CDC 2017).

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If you think your pet has gotten into a harmful algal bloom

- Rinse it off immediately with fresh water
- Don't let the animal lick its fur
- Watch for symptoms
- Call a veterinarian

Animal owners should contact their veterinarians with concerns. They may also call the ASPCA Animal Poison Control Center at 1-888-426-4435 or the Pet Poison Helpline at 1-855-764-7661 if they have questions about their animal (there is a fee for these calls).

Table 2. Possible symptoms in humans and animals after cyanotoxin exposure (CDC 2017).

Human symptoms	Animal symptoms
Skin, eye, nose, and throat irritation	Vomiting
Vomiting and diarrhea	Fatigue
Headaches	Excessive salivation
Abdominal pain	Difficulty breathing
Neurological symptoms	Convulsions
Liver and kidney damage	Staggered walking
	Liver failure
	Death

How to Identify and Report a Cyanobacterial HAB

Cyanobacterial blooms can look like thick pea soup or spilled paint on the water's surface (Figure 1). It can create a thick mat of white or gray foam along the shoreline. Cyanobacteria are generally green or turquoise (cyan) in color but can also appear red or gold. A bloom may be made up of small specks floating on or just beneath the surface. Cyanobacterial benthic mats, also known as benthic cyanobacterial proliferations, may also occur under the surface or floating on top of the water, appearing as scum or blobs (Figure 2) (Wood et al. 2020). The color of the benthic mat may not appear as green and may be brown or dark brown. Cyanobacterial harmful blooms can often be confused with non-toxic algae and plants. Figure 1 provides guidance on the key visual differences between

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cyanobacterial HABs and non-toxic algae and plants (CWB 2020). However, laboratory tests are the only way to tell if a cyanobacterial HAB is producing toxins.

The public can report potential cyanobacterial HABs to the local health authority (LHA) or waterbody authority (such as the river authority or the U.S. Army Corps of Engineers; see appendices F and G). Local health authorities may also be contacted using the 311-phone service.

When reporting a cyanobacterial HAB, it is helpful to provide information such as the waterbody name or location, the location of the bloom, and other general observations, as well as photos. These details can be used to track the HAB and its impact. For more information on taking photos of HABs, see Appendix A of this document. Table A2 in Appendix I provides examples of information that are useful in a HAB report.

Local health authorities or other agencies responding to HABs have the option to assist DSHS with reporting HABs to the CDC One Health Harmful Algal Bloom System (OHHABS). OHHABS collects reports on HAB events and associated human and animal illnesses as part of a national database in the interest of developing the science of understanding and responding to HABs. See Appendix I for more information on OHHABS and what details are needed for reporting.

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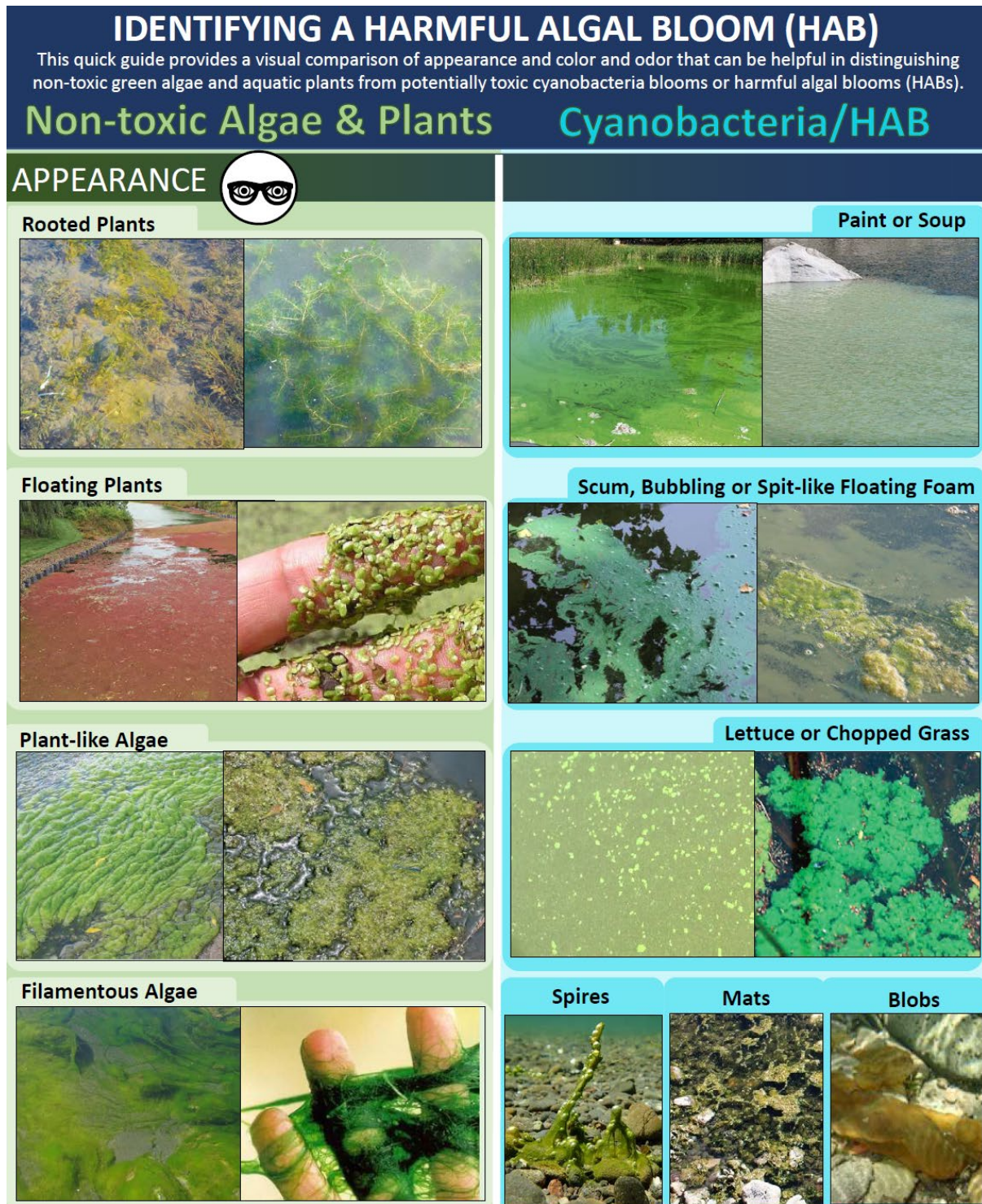


Figure 1. Identification of a cyanobacterial harmful algal bloom (CWB 2020).

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Figure 2. Benthic algal mats, also known as benthic proliferations, and scum from Lake Travis, TX, March 2021. Photos courtesy of Lower Colorado River Authority.

Sampling and Analysis

Cyanobacterial HABs cannot be identified based on visual observation alone; they need to be monitored and evaluated using samples analyzed by a laboratory to confirm the presence and concentration of cyanotoxins. The cyanobacterial species should be identified, and the number of cells should be counted (WHO 1999). Worldwide, about 75% of algal bloom samples tested contained toxins. It is likely that this is an underestimation because algal blooms have a highly variable distribution, horizontally, vertically and within time. Wind, for instance, can drive them to other locations (Buratti et al. 2017). It is also important to note that many species produce cyanotoxins, mainly microcystins, that are contained in the cells and are released into the water after cell destruction (lysis). Other species release toxins during both their growth period and cell death (Chorus et al. 2010). Therefore, it is important to sample bodies of water that are used for recreational purposes, when there is evidence of a HAB. Detailed sampling methods are described in Appendix B.

Analysis of samples

There are several screening tests and laboratory methods to detect and identify cyanobacterial cells and cyanotoxins in water. A list of laboratories that can conduct analytical tests is provided in Appendix C. This non-exhaustive list is not intended to provide specific approval or recommendations of laboratories.

Quick laboratory methods for monitoring large numbers of water bodies or sampling sites have been developed. One standardized method for cell density involves counting a 0.5 milliliter sample of water for 2 minutes and determining the number of cyanobacterial units present. This gives the number of cells per milliliter of water. Microscopic direct enumeration of cyanobacteria assesses the presence of organisms that could potentially produce toxins (WHO 1999).

These are some methods recommended by EPA to analytically determine concentrations of cyanotoxins in water:

For microcystins and nodularins (combined intracellular and extracellular):

- Liquid chromatography/tandem mass spectrometry (LC/MS/MS) in ambient freshwater (USEPA 2017b).
- Enzyme-linked immunosorbent assay (ELISA) in drinking water and ambient water (USEPA 2016).

For cylindrospermopsin and anatoxin-a (combined intracellular and extracellular):

Liquid chromatography/tandem mass spectrometry (LC/MS/MS) in ambient freshwater (USEPA 2017a).

Guidelines and Advisories

Recreational Water

Three-tiered approach to protect public health during a HAB event in a recreational water body

This guideline proposes a three-tiered approach to respond to and manage cyanobacterial HABs in freshwater. The type of advisory issued should be based on the recommendations in Tables 1 and 2 and the decision flow chart (Figure 3). Advisories will rely on visual observations and determinations of cyanobacterial cell density and cyanotoxin concentration.

Outreach and educational efforts will encourage the public to notify their LHA or waterbody authority when a potential bloom is observed. Observers should look for surface accumulations and developing blooms. Scum formations and blooms are transitory in nature; therefore, a notification should be made as soon as possible. Upon notification, the LHA should coordinate with state and local partners to determine if sampling and testing is needed. After results are received, the LHA should decide which advisory tier, if any, is warranted.

Tier I – Caution Advisory

A caution advisory should be issued based on visual reports of a bloom, reports of animal or human illness, or water samples with density or concentrations of cyanotoxins below “warning advisory” levels (Table 3). People should use caution when in contact with the body of water and avoid areas of algae accumulation (Appendix D). Caution signs should be posted at all primary public access locations and include the following information:

- Cyanotoxins may be present, and the water may be unsafe for people and animals.
- Discourage people from having contact with the water with visible algal blooms.
- Keep pets away from either drinking or swimming in affected water. Pets should not lick the algae off their fur or eat dried algae. Pets should be rinsed off with clean water.
- If fish are caught where HABs may be present, all internal organs should be removed prior to consumption and fillets rinsed with clean water.
- Contact information for the posting authority.
- Date of the posting.
- What to do in case of contact with the water.
- Who to call in case of both human and animal illness related to potential exposure.

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Tier II – Warning Advisory

A warning advisory should be issued if one or more of the following conditions are true (Table 3):

- Cyanobacteria cell density is greater than or equal to 20,000 cells/mL.
- Microcystin concentrations are greater than or equal to 8 µg/L.
- Cylindrospermopsin concentrations are greater than or equal to 15 µg/L.
- Anatoxin-a is detected.

It is recommended that actions be taken over and above those listed for the Tier I – Caution Advisory. Signs should include the following information:

- Cyanotoxins are present, and the water is unsafe for people and animals.
- Restrict swimming, water skiing, boating and other activities that would involve direct, incidental, or accidental contact with the affected water.
- Warn owners not to allow pets to drink or swim in the water. Pets should not lick the algae off their fur or eat dried algae. Pets should be rinsed off with clean water.
- If fish are caught where HABs may be present, all internal organs should be removed prior to consumption and fillets rinsed with clean water.
- Contact information for the posting authority.
- Date of the posting.
- What to do in case of contact with the water.
- Who to call in case of both human and animal illness related to potential exposure.

Tier III – Danger Advisory

A danger advisory should be issued when there is confirmation of the presence of HABs through laboratory testing and if one or more of the following conditions are true (Table 3):

- Cyanobacterial cell density is greater than or equal to 100,000 cells/ml.
- Microcystin concentrations are greater than or equal to 20 µg/L.
- Cylindrospermopsin concentrations are greater than or equal to 17 µg/L.
- Anatoxin-a concentrations are greater than or equal to 60 µg/L.

It is recommended that actions be taken over and above those listed for the Tier I – Caution Advisory and Tier II – Warning Advisory. Signs should include the following information:

- Cyanotoxins are present, and the water is unsafe for people and animals.
- Any recreational activity should not be allowed (such as swimming, water skiing, boating, and fishing).
- Water body should be closed.

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- Contact information for the posting authority.
- Date of the posting.
- What to do in case of contact with the water.
- Who to call in case of both human and animal illness related to potential exposure.

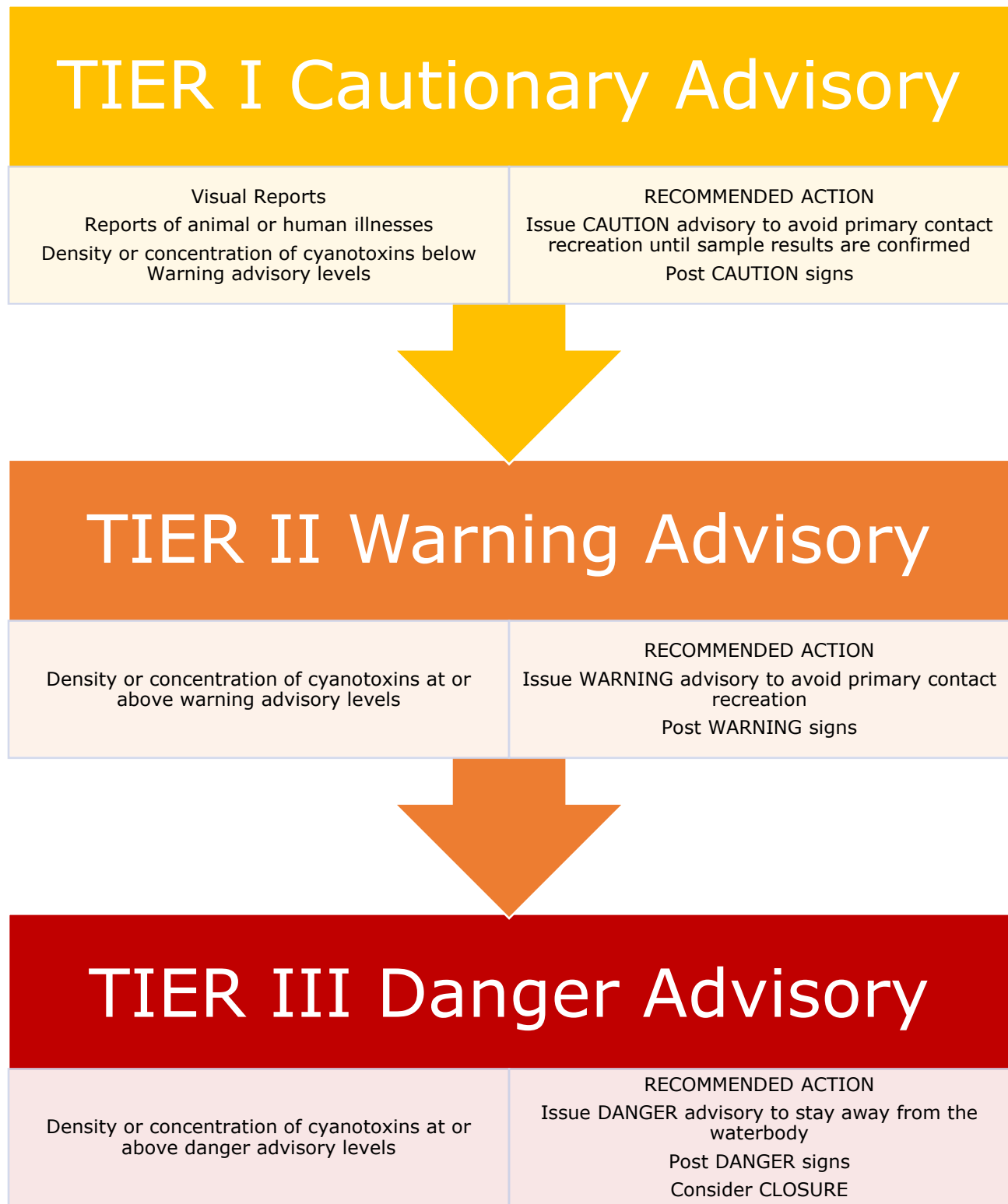


Figure 3. Three-tiered approach to protect public health during a HAB event in a recreational water body (See Table 3 for advisory levels).

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Table 3. Three-tiered approach values for cyanobacterial harmful algal bloom response. See Appendix J for details on threshold selection.

	Tier I Caution Advisory	Tier II Warning Advisory	Tier III Danger Advisory
Cyanobacterial cell density (cells/mL)	^a	20,000 ^b	100,000 ^b
Total Microcystins (µg/L)	^a	8 ^c	20 ^b
Cylindrospermopsin (µg/L)	^a	15 ^c	17 ^d
Anatoxin-a (µg/L)	^a	Detected ^e	60 ^f
Recommended action	Issue CAUTION advisory to avoid primary contact recreation until sample results are confirmed Post CAUTION signs	Issue WARNING advisory to avoid primary contact recreation Post WARNING signs	Issue DANGER advisory to stay away from the waterbody Post DANGER signs Consider CLOSURE

^a Tier I is triggered with visual reports, reports of animals or human illness, density or concentrations of cyanotoxins below "Warning advisory" levels.

^b [WHO] World Health Organization. 2003. Guidelines for safe recreational water environments. Volume 1 Coastal and Fresh Waters.

^c [USEPA] United States Environmental Protection Agency. 2019b. Recommended Human Health Recreational Ambient Water Quality Criteria or Swimming Advisories for Microcystins and Cylindrospermopsin.

^d [CWQMC] California Water Quality Monitoring Council. 2016. California Voluntary Guidance for Response to HABs in Recreational Inland Waters.

^e Tier II is triggered by any detectable concentration for anatoxin-a due to possible presence of algal mats with highly concentrated anatoxins.

^f [WHO] World Health Organization. 2020. Cyanobacterial toxins: anatoxin-a and analogues, Background document for development of WHO Guidelines for drinking-water quality and Guidelines for safe recreational water environments.

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Drinking Water

Harmful algal blooms can create taste and odor problems in drinking water when the impacted body of water supplies a public water system. Drinking water with cyanotoxins can also pose health risks to humans and animals. The U.S. Environmental Protection Agency (EPA) has published national drinking water Health Advisories for microcystins and cylindrospermopsin^a. The EPA Health Advisory levels are 0.3 µg/L for microcystins and 0.7 µg/L for cylindrospermopsin for children under six years old, and 1.6 µg/L and 3.0 µg/L, respectively, for children six and older and adults. Advisories are non-enforceable and non-regulatory limits. No maximum contaminant level or maximum contaminant level goal has been established under the Safe Drinking Water Act (SDWA) for cyanotoxins. The World Health Organization has a draft anatoxin-a short-term drinking-water health-based reference value of 30 µg/L (WHO 2020). There is currently insufficient information in the scientific literature to derive a long-term health-based reference value for anatoxin-a. In addition, there is currently no regular monitoring for cyanotoxins in drinking water in Texas.

Animal exposure and protective values

Ingestion of cyanotoxins by domestic animals and wildlife has resulted in several lethal poisonings in the United States and the world, especially by drinking contaminated water (Buratti et al. 2017). Federal animal standards for drinking water have not been established. In addition, cyanotoxins are not usually tested as part of regular water quality sampling and testing. If there is an algal bloom or mat, it should be considered a risk for acute adverse health effects and all domesticated animals (including livestock) should be denied access to the area. A Tier I caution advisory should be issued regardless of its location, color or time of occurrence (Carlson 2018). Appendix E can be used as educational material.

^a <https://www.epa.gov/cyanohabs/epa-drinking-water-health-advisories-cyanotoxins>

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HAB Response

In Texas, currently there is not a specific state statute related to HABs or a state agency tasked with regulating HABs. Often the response falls on local governments and health departments. Therefore, the Toxic Substances Coordinating Committee (TSCC) HAB Workgroup drafted this document to help direct local response. As such, during a HAB, the workgroup recommends the LHA exercise the appropriate actions to protect public health, including posting health advisories, closing water bodies to the public and informing the public to minimize unintentional exposure to harmful algal blooms. State and federal governmental agencies, such as DSHS and TPWD, can provide technical guidance to local partners, as needed. A list of the agencies on the TSCC HAB workgroup, including their contact information, is listed later in this section. Table 4 defines lead roles and assisting roles for agencies in monitoring and responding to HABs. The following are recommended guidance for local and state agencies.

Local Health Authority (LHA)

- Established under the 79th Texas Legislature, Texas Health and Safety Code, the LHA is a physician appointed under the provisions of Chapter 121, to administer state and local laws relating to public health within an appointing body's jurisdiction.^a
- See Appendix F for a list of local health departments/LHA.
- In cases where an LHA has limited resources, the LHA should reach out to the Regional Health Authority / DSHS and to local waterbody authorities to request assistance in HAB response.
- Accurately and precisely characterize waters within their jurisdiction through observation and monitoring when a suspected HAB is reported.
- Relay scientific information to the appropriate partners when a bloom is in progress.
- Inform local drinking water providers if a HAB is found to be present in their source supply.
- Determine if a public health advisory is necessary to protect water users in coordination with partners, based on lab analysis of water samples.
- Educate the public on the health effects of cyanobacteria and ways to prevent exposure through various outreach efforts.
- Stay current with federal guidelines and the science of cyanobacteria and HABs.
- Update local health department's website with relevant HAB information.

^a <https://www.dshs.texas.gov/rls/lha/Department-of-State-Health-Services-Appointed-Health-Authority.aspx>

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- Voluntarily report suspect or confirmed HAB events, suspect, probable or confirmed HAB-associated human or animal cases, and outbreaks to DSHS at **EPITOX@dshs.texas.gov** or call hotline 1-888-681-0927.
- Optional: Assist DSHS with reporting HAB events to CDC One Health Harmful Algal Bloom System (OHHABS, Appendix I).

Texas Parks and Wildlife Department (TPWD)

- Participate in the TSCC HAB workgroup.
- Investigates fish kills and pollution events that may impact fish and wildlife resources.
- Identify the source and cause of the event.
- Provide guidance to minimize impacts to fish and wildlife resources.
- Notify LHA and TCEQ of possible bloom.

Contact: The link below provides information for regional points of contact
https://tpwd.texas.gov/landwater/water/envirnonconcerns/kills_and_spills/
Email: **le.communications@tpwd.texas.gov**
Phone number: (512) 389-4848

Texas Commission on Environmental Quality (TCEQ)

- Participate in the TSCC HAB workgroup.
- Maintain situational awareness of reported HABs.

Contact: Monitoring and Assessment Section
Email: swqm@tceq.texas.gov
Phone number: (512) 239-6682

Texas Department of State Health Services (DSHS)

- Participate in the TSCC HAB workgroup.
- Provide HAB educational materials to LHA and partners.
- Maintain situational awareness of reported HABs.
- Provide consultation on health advisories as needed.
- Inform and share information on HAB events with the Texas Poison Center Network.
- Collect and maintain surveillance on reported animal and human HAB related illnesses.
- Report HAB events on CDC One Health Harmful Algal Bloom System (OHHABS). LHA and other state agencies can assist in reporting to OHHABS (Appendix I).

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Contact: Environmental Surveillance and Toxicology Branch (ESTB)

Email: epitox@dshs.texas.gov

Phone number: 1-888-681-0927

Texas Poison Center Network (TPCN)

- Provide medical toxicology support.
- Answer calls from the public to their hotline regarding health concerns or symptoms (1-800-222-1222).
- Share the location of reported HABs to their social media.

Texas Animal Health Commission (TAHC)

- Notify livestock owners when a water body contains a suspected HAB and may be a source of animal drinking water.
- Coordinate, if needed, pet and livestock sampling done by the local accredited veterinarian.

Contact: Olivia Hemby, Emergency Planner

Email: [**Olivia.Hemby@tahc.texas.gov**](mailto:Olivia.Hemby@tahc.texas.gov)

Phone number: (512) 719-0778

Contact: Jeff Turner, Director of Emergency Management

Email: [**jeff.turner@tahc.texas.gov**](mailto:jeff.turner@tahc.texas.gov)

Phone number: (512) 636-0795

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Table 4. Roles and responsibilities for monitoring and responding to harmful algal blooms.

Activity	Lead Role	Assist
Monitor	Local partners monitor water bodies through on-site observations for evidence of HABs	USGS provide guidance on how to monitor for public health purposes and in identifying cyanobacteria
Collect water samples	LHA use scientifically acceptable methods to obtain water samples	Contract Lab, TPWD (when investigating fish kills), and USGS provide guidance on sampling techniques
Analyze samples	LHA contract with laboratories that are qualified to perform the required analyses	TPWD provides a list of laboratories with appropriate analytic capabilities
Investigate fish or wildlife mortalities	TPWD	River Authorities (Appendix G), local municipalities
Investigate human and domestic animal morbidity and mortality	LHA	DSHS
Issue or lift advisories	LHA evaluates data and compares test results to established criteria to determine if an advisory should be issued or lifted	Partners respond to questions about waterbody status
Communicate advisory information	LHA informs the public through advisory news releases, broadcast and print media, a toll-free hotline, website and educational materials	Partners inform constituents of health advisory status through news releases and signage

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Communication Plan

In the case of a suspected HAB event, consider issuing a Tier I recreational public health advisory. While waiting for laboratory analysis to determine if a Tier II or Tier III recreational use public health advisory should be issued, it is recommended that educational materials such as social media alerts, press releases, and/or caution signs be posted by an LHA as a precautionary measure, to alert the public of potential health risks associated with recreating in a water body during a suspected HAB.

Public Notification Guidance

The LHA should use several concurrent notification methods in the issuing and lifting of public health advisories. In addition, the LHA should ensure that the HAB has been reported to DSHS. Templates for notifications are available from EPA^a and examples are provided in Appendices D, E and H. The recommended methods are as follows:

News Releases: The LHA may issue local press releases which then could be reported by local news and print media outlets in the community. These press releases should contain information about the nature and location of the advisory, possible health effects, recommended protective actions and where people can obtain more information. Examples might include Public Notices, Posters, Billboards, Local Newspapers, Radio/TV advertisements, Social Media (see Appendix H).

Website: The LHA should consider posting on their website updated information on the issuing and lifting of HAB advisories in its jurisdiction. The public and others can also access resources for water sampling, response strategy, prevention tips, frequently asked questions, and general information about cyanobacterial HABs.

Hotline: The LHA should consider establishing a toll-free telephone service that provides updated advisory information to the public, which is particularly helpful for individuals who are traveling, or those without Internet access. In addition, Texas Poison Center Network (1-800-222-1222) can provide answers on symptoms related to potential exposures.

^a <https://www.epa.gov/cyanohabs/communicating-about-cyanobacterial-blooms-and-toxins-recreational-waters>

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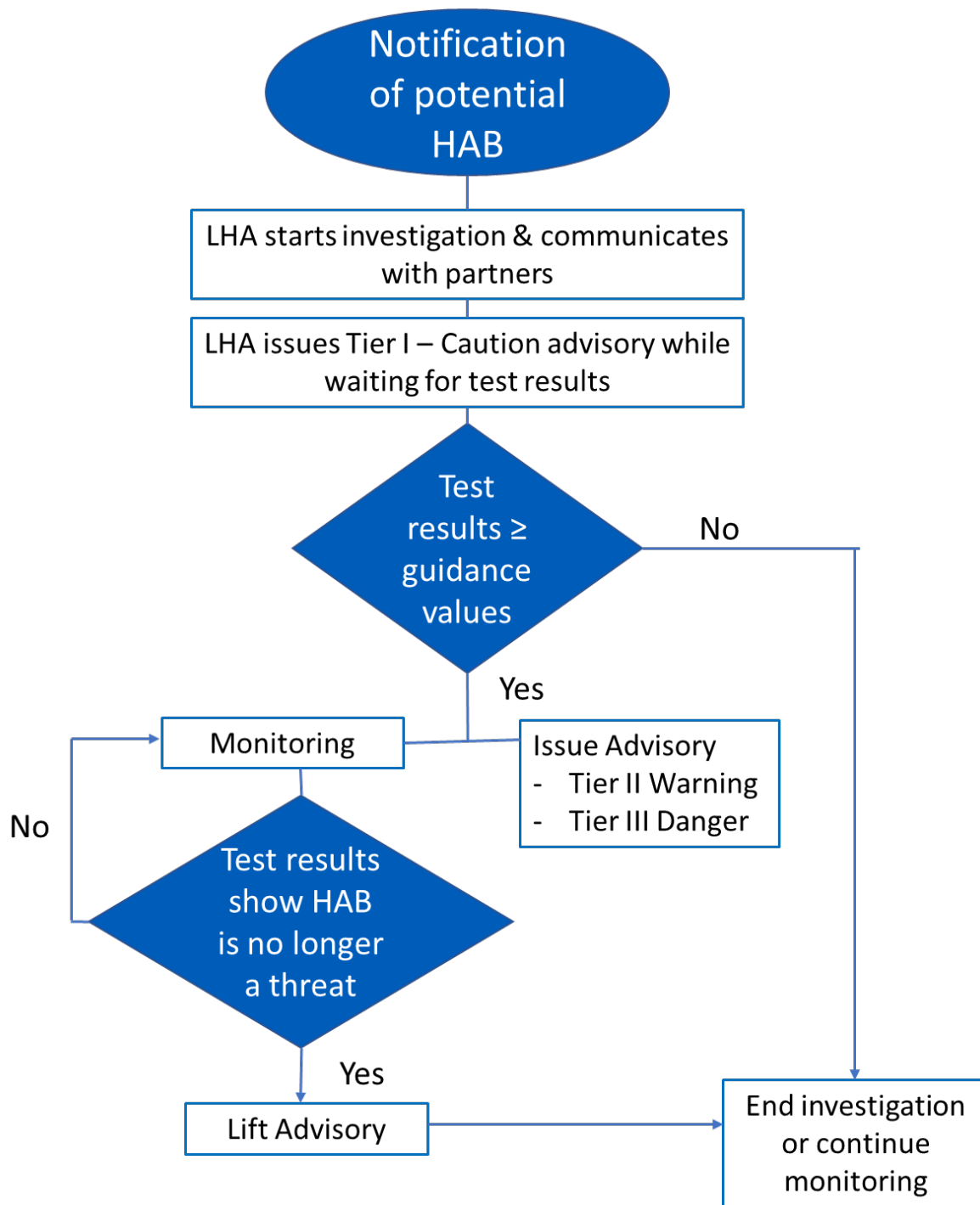


Figure 4. Harmful algal bloom response flowchart.

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Appendix A

Instructions for Photographing Cyanobacterial HABs

- Suspected cyanobacterial HAB can be reported to state and local health departments with photographs.
- It is important to take photos that clearly tell a story and convey all the information necessary for the event. The guidance below helps to ensure that accurate and helpful photos are taken:
 - Rule of 3 – The image is divided into nine equal parts by two equally-spaced horizontal and vertical lines. Important compositional elements should be placed along these lines or their intersections.
 - Put every photo in perspective – Every close-up should be followed by one or more wider-angle shots that will show the close-up in the context of the rest of the environment. The closer the initial shot the more perspective shots may be needed. For example:
- Habitats and spatial patterns of bloom.
- Context shots (Maybe not every time but always when the broader picture has changed or when it's important to make specific close-ups more valuable.)
 - To document location, take photos of landmarks: road intersections, coastal promontories, stream outlets, shore access locations, lighthouses, etc.
 - Consistent, repetitive photo process – Taking photos in the same order will help to ensure that important photos are not missed and will help keep things organized so it's easier to review photos later. This can be done by:
- Starting each new location with panorama shots, where appropriate.
- Always capture your subjects the most zoomed out to the most close-up.
 - Provide scale in the photos
- 15-cm scales are standard (6 inches). Be sure the scale is labeled.
- If a scale is not available, provide another object (pen, etc.) that can provide perspective in the photo.
- Scales (and quadrat frames) should have intermediate reflectance, not bright white. A bright scale object can cause the camera to underexpose the rest of the photo.
 - Avoid harsh shadows and over exposure – When conditions allow, try to change the perspective of the photo to avoid shadows or over exposure.
 - Review critical photos to ensure that photos are capturing needed information.

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- Adjust camera if needed – It is often necessary to adjust camera settings in the field if photos are not coming out well.

Appendix B

Water-Sample Collection

The following procedures are general recommendations developed from the federal guidance documents cited throughout this section. For specific sampling strategies and techniques, consult with the applicable local monitoring entities and laboratories.

Sampling Strategy

Sampling conducted in reaction to bloom events provides information about conditions occurring during the sampling period only, and may not capture conditions that represent bloom development or occurrence. Proactive monitoring and sampling before, during and following bloom events may increase understanding of the environmental conditions associated with bloom events (ITRC 2021).

Monitoring and sampling objectives should be determined prior to sampling, because they will affect the sampling strategy. In general, three forms of sampling are common—surface, discrete depth, and depth-integrated samples—and vary based on monitoring objectives. In areas where water recreation (such as swimming, water skiing, diving, fishing, and boating) occurs, surface sampling is most commonly used. Surface sampling generally involves collecting a sample from 0.5-1.0 meters below the surface of the water (USGS 2018). If a surface scum is present, sampling should take place directly at the surface, or within the scum layer, to account for maximum potential risk. Additionally, sampling should occur near shorelines, where swimming and recreation are most likely to occur.

Discrete-depth samples are often used when the bloom is known to be at a specific depth, depth profiles are desired, or if monitoring near a drinking water intake (USGS 2018).

Depth-integrated sampling generally takes place when the bloom is evenly mixed throughout the water column (i.e. due to wind mixing), or if the depth of the cyanobacteria community is unknown. Whole-profile samples or integrated photic-zone profiles may be collected (USGS 2018). For integrated photic zone samples, the vertical water column is composited from the surface to the bottom of the photic zone. The bottom of the photic zone is the depth at which 99% of the surface light has been attenuated. This can be determined by using a photosynthetically reactive radiation (PAR) sensor or by estimating the depth of the photic zone by using a Secchi disk (Secchi depth X 2.5).

Regardless of the sampling form chosen, samples may be collected as single grab samples or composite samples. A grab sample is an individual volume of water

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taken over a period of time not to exceed 15 minutes. Composite samples are collected by sampling multiple locations and/or depths and combining the samples into one homogenized sample (USGS 2018). Sampling strategy will depend on the monitoring objectives.

For more information on sampling strategy/design, refer to the USGS National Field Manual for the Collection of Water-Quality Data - Lakes and Reservoirs: Guidelines for Study Design and Sampling (USGS 2018).

Sample Collection

Cyanotoxins can adsorb onto plastic containers and degrade in sunlight (USEPA 2014). Therefore, it is best to collect samples in amber glass containers (USEPA 2019a). Samples should be placed on ice and shipped the same day as collection, with analysis taking place within five days of collection (USEPA 2019a). Some samples could require preservatives or several freeze/thaw cycles before analysis. Prior to sampling, consult with the laboratory for sampling/handling instructions that comply with their Quality Assurance Plans (QAPs).

Safety

Take necessary precautions to prevent potential exposure to cyanotoxins while sampling. Wear appropriate personal protective equipment (such as gloves and waders or boots), avoid ingestion of water, and thoroughly wash any areas of exposed skin that contact the water. Thoroughly rinse sampling equipment between water bodies (if sampling more than one) or when sampling is completed (USEPA 2019a).

Appendix C

Table A 1. Laboratories available for sample analysis. Cyanobacterial taxa are identified and quantified using microscopy. Toxin concentrations are quantified using liquid chromatography tandem mass spectrometry (LC-MS/MS) and enzyme-linked immunosorbent assay (ELISA) methods.

Laboratory	Taxonomic Identification	Enumeration	Toxin Analysis: Water	Toxin Analysis: Tissue
Texas A&M University Corpus Christi Center for Coastal Studies, Plankton Lab	Yes	Yes	LC-MS/MS, ELISA	LC-MS/MS, ELISA
University of Texas Marine Science Institute, Liu Lab			LC-MS/MS	
Baylor University Center for Reservoir and Aquatic System Research	Yes	Yes	LC-MS/MS	LC-MS/MS
University of Texas at Austin Center for Systems and Synthetic Biology	Yes	Yes	LC-MS/MS	LC-MS/MS
BSA Environmental Services, Inc	Yes	Yes	ELISA	ELISA
Green Water Laboratories	Yes	Yes	LC-MS/MS, ELISA	LC-MS/MS, ELISA

Contact Information for Cyanobacterial Analysis

University of Texas-Marine Science Institute, Liu Lab

- **Address:** 750 Channel View Drive, Port Aransas, Texas, 78373.
- **Point of Contact:** Dr. Zhanfei Liu, zhanfei.liu@utexas.edu, 361-749-6711.
- **Analytical Method:** Solid phase extraction, Tandem mass spectrometry (LC-MS/MS)

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Texas A&M University-Corpus Christi, Center for Coastal Studies-Plankton Lab

- **Address:** 6300 Ocean Drive, Unit 5866, Corpus Christi, TX 78412
- **Point of Contact:** Dr. Paul Zimba, paul.zimba@tamucc.edu, 361-825-2768
- **Enumeration Method:** Pigments, light microscope, fluorescence, inverted and upright scopes
- **Analytical Method:** Elisa and HPLC-MS/MS

Baylor University, Center for Reservoir and Aquatic Systems Research

- **Address:** One Bear Place #97178, Waco, TX 76798
 - **Point of Contact:** Dr. Thad Scott, Thad_Scott@baylor.edu, 254-710-2147
 - **Enumeration Method:** Compound microscopy
 - **Analytical Method:** Liquid Chromatography Mass Spectrometry by Isotope Dilution
-
- **Address:** One Bear Place #97178, Waco, TX 76798
 - **Point of Contact:** Dr. Bryan Brooks, bryan_brooks@baylor.edu
 - **Analytical Method:** Agilent LC-MSMS for targeted HAB analysis; Thermo Fisher Q-Exactive Focus Orbitrap LC-MSMS for nontargeted HAB analysis

The University of Texas at Austin, Center for Systems and Synthetic Biology

- **Address:** 204 W. 25th BIO 316, Austin, TX 78712
- **Point of Contact:** Dr. Schonna Manning, schonna.manning@utexas.edu, 512-922-1190 (cell)
- **Analytical Method:** High-resolution HPLC-MS for biomass and water analyses.

BSA Environmental Services, Inc.

- **Address:** 23400 Mercantile Rd., Suite 8, Beachwood, OH 44122
- **Point of Contact:** Dr. John Beaver, j.beaver@bsaenv.com, 216-765-0582
- **Enumeration Method:** BSA offers speciation, enumeration, and biovolume estimation of phytoplankton, including toxin producing algal species, utilizing standard Utermöhl microscopic method. \$150 up depending upon the SOW/counting standards.

Green Water Laboratories

- **Address:** 205 Zeagler Drive Suite 302, Palatka, FL 32177
- **Point of Contact:** Dr. Mark Aubel or Amanda Foss, info@greenwaterlab.com, 886-328-0882
- **Enumeration Method:** Potentially toxigenic cyanobacteria screening, algal identification, enumeration, and biovolume calculation.
- **Analytical Method:** Molecular / genetic analysis (rt qPCR), Toxin analysis for targeted groups including anatoxins (ELISA and LC-MS/MS).

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Appendix D

Example of Signs

Signs should have Poison Control and Local Health Authority contact number. Posters, reference cards and fact sheets are also available from the CDC (<https://www.cdc.gov/habs/materials/index.html>), Utah (<https://deq.utah.gov/water-quality/signage-harmful-algal-blooms>), and Texas [website]. Below are examples of Caution, Warning, and Danger signs.



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WARNING

Harmful Algae Expected or Present
People & Animals May Get Sick



No water contact, swimming, or wading



No skiing or jet skis



No pets or livestock

- If people or pets contact lake water: wash with clean, potable water afterward
- Avoid areas of algae accumulation
- Do not let people or pets eat dried algae or drink untreated water
- Clean fish well and discard guts

In case of contact with harmful algae: Call doctor or veterinarian if people or animals have nausea, vomiting, diarrhea, rash, irritated eyes, seizures, breathing problems or other unexplained illness.



For more information: Scan this code or visit kdheks.gov/algae-illness

Report harmful algal blooms to Kansas Department of Health and Environment at:
www.kdheks.gov/algae-illness/
Or call: 785-296-5606

Report possible algal bloom related illness to Kansas Department of Health and Environment at:
www.kdheks.gov/algae-illness
Or call: 877-427-7317

Kansas Department of Health and Environment, 1000 SW Jackson, Topeka, Kansas 66612, 785-296-1500 www.kdheks.gov

WARNING

TOXIC ALGAE PRESENT
Lake unsafe for people and pets

Until further notice:

- **Do not swim or water ski**
No nade o practique el esquí acuático.
- **Do not drink the lake water.**
No tome el agua del lago.
- **Keep pets and livestock away.**
Mantenga alejados las mascotas y el ganado.
- **Clean fish well and discard guts.**
Limpie bien el pescado y deseché las tripas.
- **Avoid areas of scum when boating.**
Evite las áreas con espuma o verdin cuando ande en lancha.




Date Posted: _____

Call your doctor or veterinarian if you or your animals have sudden or unexplained sickness or signs of poisoning.
Learn more: habs.utah.gov

Utah Poison Control Center
(800) 222-1222

Report new algae blooms to the Department of Environmental Quality: (801) 536-4123





Call your local health department.

WARNING

TOXIC ALGAE PRESENT
Water is unsafe for people and animals

Until further notice:

- Do not swim, wade or jet ski
- Do not drink the water
- Keep pets and livestock away
- Clean fish well and discard guts
- Avoid areas of scum




In case of contact with harmful algae: Call your doctor or veterinarian if you or your animals have sudden or unexplained sickness or signs of poisoning.

Local Health Department/Authority
Contact Information

Texas Poison Control Center
1-800-222-1222

Date Posted: _____

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Local Health
Department/Authority
Contact Information

Date Posted:

Texas Poison Control Center
1-800-222-1222

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Appendix E

Example of Animal Safety Alert

Cyanobacterial Blooms and Animals

Cyanobacterial blooms can be deadly for pets and livestock.

When in doubt, keep animals out!



Cyanobacteria (also called blue-green algae) are microscopic organisms that can be found naturally in all types of water (fresh; marine; or a combination, which is also called brackish). Sometimes cyanobacteria rapidly grow out of control, or bloom. Cyanobacterial blooms are most commonly found in fresh water, such as lakes, rivers, and streams. Cyanobacteria can produce toxins (poisons), which can cause serious illness in animals.

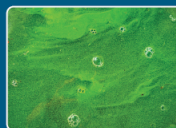
Signs of a cyanobacterial bloom



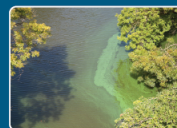
Foam, scum, mats, or paint-like streaks on the water's surface.



Different colors like green, blue, red, or brown.



As the bloom dies off, it may smell like rotting plants.



Cyanobacteria bloom more often in summer and fall, but can bloom anytime.

You cannot tell if a cyanobacterial bloom is toxic or not just by looking at it.

Protect your pets and livestock

- Keep pets and livestock away from the water if you see signs of cyanobacteria.
- Do not let your animals drink, swim in, or eat near discolored or scummy water.
- Keep animals from licking their fur, eating dead fish or other animals found near the bloom, or eating mats of cyanobacteria.

If your pets or livestock are exposed to a bloom

- **Immediately wash them** with clean water so they don't lick cyanobacteria off their fur.
- **Call a veterinarian** if your animal shows any of these signs
 - » Loss of energy
 - » Stumbling and falling
 - » Convulsions
 - » Any unexplained sickness that occurs within a day or so after being in contact with water
 - » Loss of appetite
 - » Foaming at the mouth
 - » Excessive drooling
 - » Vomiting
 - » Diarrhea
 - » Tremors and seizures

Pets and livestock can get very sick and die within hours to days after swallowing toxins made by cyanobacterial blooms.

Call **Poison Control** at **1-800-222-1222** if you have questions about cyanobacterial toxin poisoning.

Call the **ASPCA Animal Poison Control Center** at **1-888-426-4435** or the **Pet Poison Helpline** at **1-855-764-7661** if you have questions about your pet or livestock. (Note: There is a fee for these calls.)

Report cyanobacterial blooms or illnesses to your health department online or by phone.



U.S. Department of
Health and Human Services
Centers for Disease
Control and Prevention

Learn more about cyanobacterial blooms: www.cdc.gov/habs

PubNo.300861

CS 319419-A

https://www.cdc.gov/habs/pdf/algal_bloom_poster.pdf





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Appendix F





Local Public Health Organizations

For a list of Local Public Health Organizations see <https://dshs.texas.gov/regions/lhds.shtm>.

Public Health Regions

<p>PUBLIC HEALTH REGION 1 - Lubbock Kelly Northcott, Deputy Regional Director Regional Headquarters: 6302 Iola Ave, Lubbock, Texas 79424, Mail Code 1899 Phone: (806) 744-3577 FAX: (806) 783-6435 Map to Region 1 office Web site</p>	
<p>PUBLIC HEALTH REGION 2/3 - Arlington Joel Massey, MD, MPH, Regional Medical Director Becky Earlie-Royer, PhD, MPH, CHES, Deputy Regional Director Regional Headquarters: 1301 South Bowen Road, Suite 200, Arlington, Texas 76013, Mail Code 1905 Phone: (817) 264-4500 FAX: (817) 264-4506 TDD: (817) 264-4505 Map to Region 2/3 office Web site</p>	
<p>PUBLIC HEALTH REGION 4/5 - Tyler Sharon Huff, MD, MS, Regional Medical Director David Leary, MSW, Deputy Regional Director Regional Headquarters: 2521 West Front Street, Tyler, Texas 75702, Mail Code 1901 Phone: (903) 595-3585 FAX: (903) 593-4187 Map to Region 4/5 North office Web site</p>	
<p>PUBLIC HEALTH REGION 6/5 - Houston Carlos Plasencia, MD, MSPH, Regional Medical Director Greta Etnyre, MS, RD, REHS/RS, Deputy Regional Director Regional Headquarters: 5425 Polk, Suite J, Houston, Texas 77023, Mail Code 1906 Phone: (713) 767-3000 FAX: (713) 767-3049 Map to Region 6/5 South office Web site</p>	

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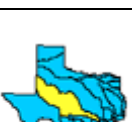
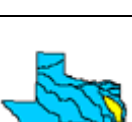
<p>PUBLIC HEALTH REGION 7 - Temple Sharon Melville, MD, MPH, Regional Medical Director Carol Davis, MSPH, CPH, Deputy Regional Director Regional Headquarters: 2408 South 37th Street, Temple, Texas 76504, Mail Code 1902 Phone: (254) 778-6744 FAX: (254) 778-4066 Map to Region 7 office Web site</p>	
<p>PUBLIC HEALTH REGION 8 - San Antonio Lillian Ringsdorf, MD, MPH, Regional Medical Director Gale Morrow, MPH, MCHES. Deputy Regional Director Regional Headquarters: 7430 Louis Pasteur Drive, San Antonio, Texas 78229, Mail Code 5716 Phone: (210) 949-2000 FAX: (210) 949-2015 Map to Region 8 office Web site</p>	
<p>PUBLIC HEALTH REGION 9/10 - El Paso Rachel Sonne, MD, MPH, Regional Medical Director Art Alvarado, RS, MPH., Deputy Regional Director Regional Headquarters: 401 East Franklin, Suite 210, El Paso, Texas 79901, Mail Code 1903 Phone: (915) 834-7675 FAX: (915) 834-7799 Map to Region 9/10 office Web site</p>	
<p>PUBLIC HEALTH REGION 11 - Harlingen Emilie Prot, DO, MPH, Regional Medical Director Sylvia Hobbs, Deputy Regional Director Regional Headquarters: 601 West Sesame Drive, Harlingen, Texas 78550, Mail Code 1907 Phone: (956) 423-0130 FAX: (956) 444-3298 Map to Region 11 office Web site</p>	

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Appendix G

Texas River Authorities

<https://tpwd.texas.gov/landwater/water/habitats/rivers/authorities.phtml>

Location	River Authority	Website
	Angelina-Neches River Authority	https://www.anra.org/
	Bandera County River Authority	http://www.bcragd.org/
	Brazos River Authority	https://www.brazos.org/
	Guadalupe-Blanco River Authority	https://www.gbra.org/
	Lavaca-Navidad River Authority	http://www.lnra.org/
	Lower Colorado River Authority	http://www.lcra.org/
	Lower Neches River Authority	https://lnva.dst.tx.us/

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	Nueces River Authority	http://www.nueces-ra.org/
	Red River Authority	http://www.rra.texas.gov/
	Sabine River Authority	https://www.sratx.org/
	San Antonio River Authority	https://www.sariverauthority.org/
	San Jacinto River Authority	https://www.sjra.net/
	Trinity River Authority	http://www.trinityra.org/
	Upper Colorado River Authority	https://www.ucratx.org/
	Upper Guadalupe River Authority	http://www.ugra.org/

Appendix H

Examples of Communication Materials

Press Release



CITY OF AUSTIN

FOR IMMEDIATE RELEASE

Release Date: Aug. 05, 2019

Contact: Communications and Public Information Office [512-974-2220](tel:512-974-2220) [Email](#)

Owners strongly advised to keep pets out of Lady Bird Lake.

The City of Austin is advising pet owners to not allow pets to swim in or drink water from Lady Bird Lake after being notified that two dogs have died after swimming in the lake. The City cannot confirm the cause of either death.

On Sunday, City of Austin scientists investigating the water quality noted the presence of clumps of algae in Lady Bird Lake. Preliminary results indicate the algae is a type of blue green algae of the genus *Oscillatoria*. This type of algae can release a neurotoxin. The neurotoxin in this type of algae can be harmful to pets and people if a sufficient quantity of water or algae is ingested.

The algae is especially prevalent near Red Bud Isle, covering up to 40% of the water surface in that area. It also tends to be more abundant near shorelines and in areas with low water flow. The situation is evolving. We have not seen any impacts to aquatic species at this time.

There have been blue-green algae blooms in Austin in previous years, but we have not been aware of any effects from neurotoxins. Algae tends to be more prevalent in late summer and early fall and when flows are low.

Austin Water regularly looks at algae levels on Lake Austin and Lake Travis and has

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not seen levels of concern for drinking water. Austin Water does not use Lady Bird Lake as a source for drinking water.

The current algae bloom appears to be confined to algae growing on the bottom of the lake and then floating in clumps to the surface. Scientists have taken samples of both the algae and the water near the algae in Lady Bird Lake. Results from the analysis for the actual presence of the toxin should be available early next week.

Dogs who ingest water contaminated with this toxin could have a number of symptoms. On the severe end, it could result in respiratory paralysis and death. Look for these signs in your pet within minutes to hours of exposure:

- Excessive drooling, vomiting, diarrhea
- Foaming at the mouth
- Jaundice, hepatomegaly
- Blood in urine or dark urine
- Stumbling
- Loss of appetite
- Photosensitization in recovering animals
- Abdominal tenderness
- Progression of muscle twitches
- Respiratory paralysis

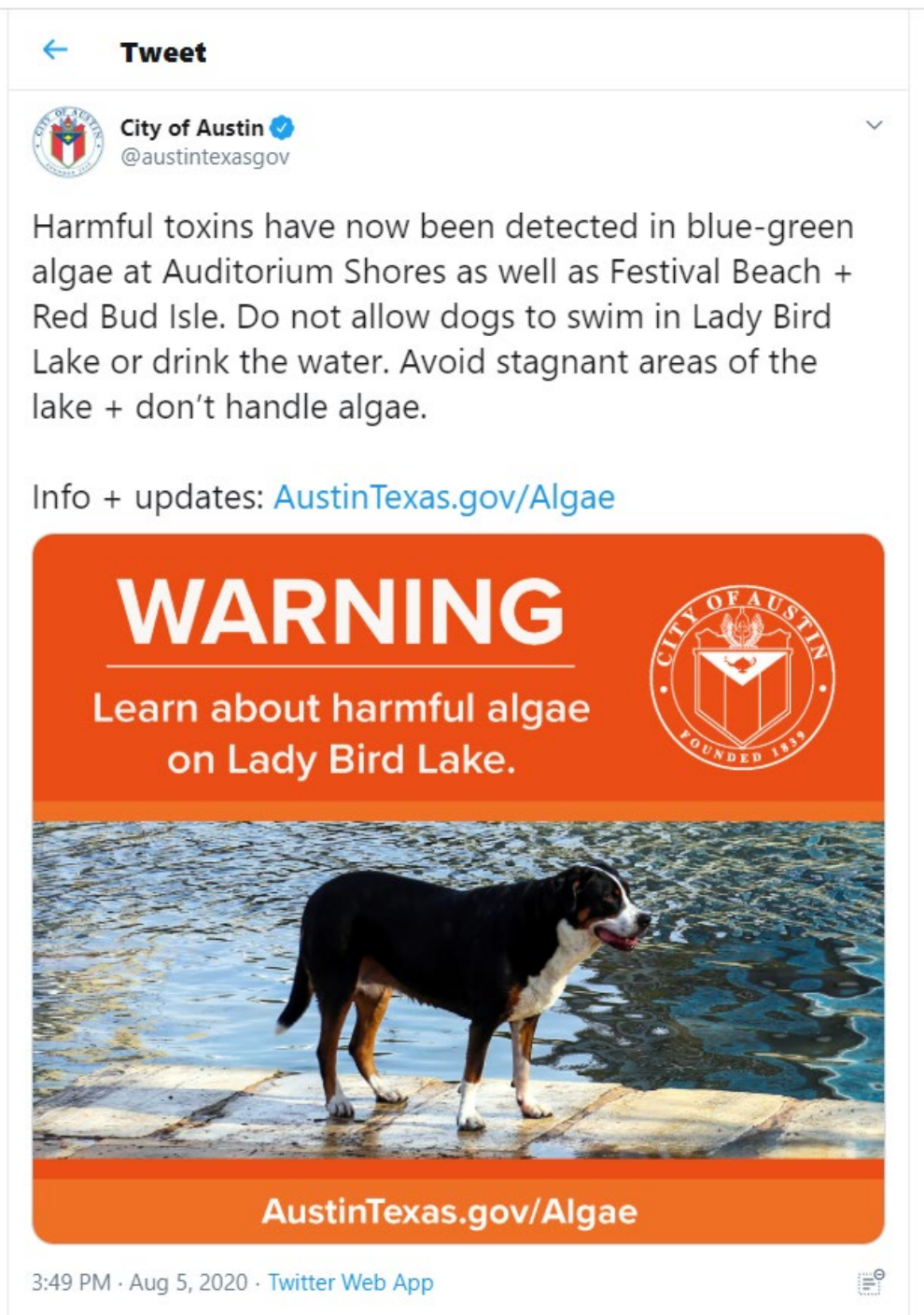
Until we have more information, we strongly advise that pets stay out of the water. At this time, we have no reason to believe that boating is unsafe. However, people should not be swimming in Lady Bird Lake. It is illegal. When out on the lake, people should take care to avoid ingesting water or coming into direct contact with the algae. The degree of risk to human exposure, such as through accidental swallowing of lake water, cannot be known until the tests results are available and analyzed.

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<https://www.austintexas.gov/news/officials-advise-keeping-pets-out-lady-bird-lake>

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Social Media



<https://twitter.com/austintexasgov/status/1291114139302211585?lang=en>

Appendix I

The One Health Harmful Algal Bloom System (OHHABS)

The One Health Harmful Algal Bloom System (OHHABS) is a voluntary HAB reporting and tracking tool launched by the CDC in 2016. OHHABS collects information on HAB events and any associated human and animal illnesses within the U.S. Creating a national database tracking HABs and their impacts is important for developing the science of understanding HABs and addressing them with mitigation and prevention strategies.

U.S. state and territory health departments report information on HABs and human and animal illnesses to OHHABS through an online portal. State health departments can recruit other state agencies and partners to assist with reporting. PDF forms are available for agencies and partners to fill out and send to the reporting health department.

OHHABS Reporting in Texas

Texas DSHS is responsible for submitting reports to OHHABS for Texas. Other agencies and partners are encouraged to assist this process by filling out PDF reporting forms on any HAB events and associated human and animal illnesses they are responding to and sending them to **EPITOX@dshs.texas.gov**.

There are three types of forms for OHHABS reports:

1. Environmental – **Form, Guidance**
2. Human illness – **Form, Guidance**
3. Animal illness – **Form, Guidance**

The minimum information for reporting is the date of the HAB event and the waterbody location. When human or animal forms are submitted an environmental report is automatically generated. Table A2 summarizes the information that OHHABS collects in reports.

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Table A 2. Types of data collected for OHHABS reports for environmental, human, and animal forms. Table from CDC: <https://www.cdc.gov/habs/pdf/overview-slides-nors-ohhabs.pptx>.

Form Type	Types of Data Collected
Environmental Form	<ul style="list-style-type: none">• Location of the HAB event• Observed water body characteristics• Advisories and health warnings• Laboratory testing – event sample testing• Pathogens or toxins detected• Other data systems that contain associated information• Seafood catch or harvest location for HAB-associated foodborne illnesses
Human Form	<ul style="list-style-type: none">• General case information (e.g., sex, age in years)• Exposures (e.g., activities, duration)• Signs and symptoms of illness• Medical and health history• Clinical testing• Pathogens or toxins detected in clinical samples
Animal Form	<ul style="list-style-type: none">• General case information (e.g., type of animal, single/group of animals)• Exposures (e.g. activities, duration)• Signs of illness• Health information (e.g., veterinary treatment)• Clinical testing• Pathogen or toxins detected in clinical samples

HAB Event and Case definitions

OHHABS uses standardized definitions to characterize HAB Events as Suspect or Confirmed and characterize human and animal cases as Suspect, Probable, or Confirmed. These characterizations depend on the level of evidence and data available. See **HAB Case and Event Definitions Table** on the OHHABS website.

OHHABS Resources

- **OHHABS website**
- **PDF forms and reporting guidance**
- **Publication on OHHABS data from 2016-2018**

Appendix J

Threshold Value Selection

Cyanobacterial Cell Density

The basis for cyanobacterial cell density thresholds is WHO (2003), where 20,000 – 100,000 cells/ml of cyanobacteria was associated with moderate probability of acute health effects and >100,000 cells/ml was associated with a high probability of acute health effects. WHO (2003) used epidemiological studies from Chorus and Bartram (1999) to distinguish mild skin irritation effects (<20,000 cells/ml) from microcystin caused liver damage (>20,000 cells/ml). At 100,000 cells/ml the formation of scums or mats is more likely, which carry the danger of exposure to very high concentrations of cyanobacterial cells and associated toxins.

However, there are many uncertainties and high variability in linking cell density to health effects due to differing cyanobacterial species, how much if any toxin is produced, differing potencies of toxins, differing health effects, and potential co-occurrences with pathogens, etc. Because of these uncertainties it is also recommended to analyze toxin concentrations.

Total Microcystins

The basis for the Tier II Warning threshold value for microcystins is USEPA (2019b), where 8 µg/L microcystins is the recommended magnitude for application as either a 10-day recreational water quality criterion or a swimming advisory threshold. This value was calculated based on liver damage to rats in a 28-day study (Heinze 1999).

The basis for the Tier III Danger threshold for microcystins is WHO (2003) where 20 µg/L microcystins represents the level above which severe health effects are possible, such as liver damage. According to WHO (2003), mild health effects such as skin and eye irritation are possible at concentrations between 4 to 20 µg/L.

Cylindrospermopsin

The basis for the Tier II Warning threshold value for cylindrospermopsin is USEPA (2019b) where 15 µg/L cylindrospermopsin is the recommended magnitude for application as either a 10-day recreational water quality criterion or a swimming advisory threshold. This value was calculated based on kidney damage to mice in an 11-week study (Humpage and Falconer 2002, 2003).

The basis for the Tier III Danger threshold is the California Water Quality Monitoring Council (CWQMC 2016) where 17 µg/L is used as the danger threshold in California. CWQMC (2016) used the same study as USEPA (2019b, Humpage and Falconer

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2003) to calculate thresholds but applied different uncertainty factors to calculate a warning threshold (4 ug/L) and a danger threshold (17 ug/L).

Anatoxin-a

The Tier II Warning threshold for anatoxin-a is triggered if anatoxin-a is detected. This is a protective approach based on the nature of benthic cyanobacterial mats associated with anatoxin-a in Texas. There have been high concentrations of anatoxin-a, and other anatoxins, such the more toxic dihydroanatoxin-a, in cyanobacterial benthic mats but low concentrations in the surrounding water (Puddick et al. 2020). The toxins are concentrated in pieces of benthic mat that separate from the underwater mass and float to the surface or accumulate at shores. Therefore, if any anatoxin-a is present in the water a Tier II Warning advisory is appropriate due to the difficulty in visually identifying benthic mats under the water surface and due to the possible presence of dangerous accumulations of toxins.

The basis for the Tier III Danger threshold for anatoxin-a is WHO (2020), where 60 µg/L is the provisional recreational water health-based reference value for anatoxin-a. This value was calculated based on acute lethal toxicity to mice (Fawell et al. 1999). Due to the lack of available studies in the scientific literature and uncertainties within the few available studies, the value from WHO (2020) is considered a temporary and protective value.

Toxic Substances Coordinating Committee
Harmful Algal Workgroup