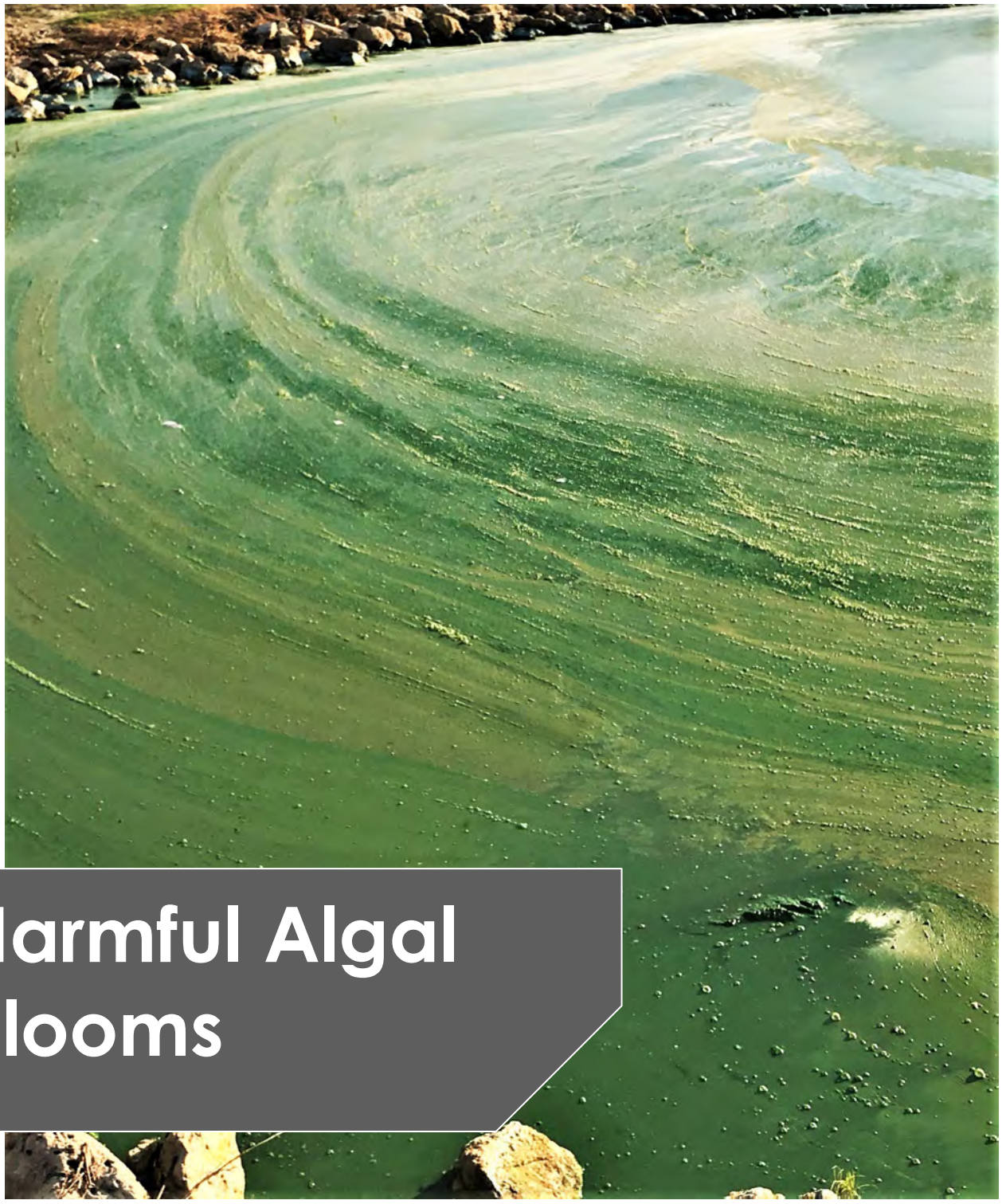

Harmful Algal Blooms

KDHE Agency Response Plan – 2022

Kansas
Department of Health and Environment

Harmful Algal Blooms

KDHE Agency Response Plan

Revision Dates

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Colwich City Lake, Sedgwick County, KS, September 2021

Courtesy of Amanda Smyth

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SECTION 1. PURPOSE

This plan is to provide guidance for Kansas Department of Health and Environment's (KDHE) response to reduce the risk of exposure to humans, pets, and livestock from cyanobacterial toxins.

Cyanobacterial toxins (also known as blue-green algal toxins) in freshwaters have been implicated in human and animal illness in at least 43 states in the United States (Graham et. al. 2016). In Kansas, cyanobacteria are naturally present in most surface waters. When certain conditions develop, such as high nutrients and abundant light levels, these organisms can reproduce rapidly. This dense growth of algae is called a bloom and can sometimes lead to a cyanobacterial harmful algal bloom (HAB). These conditions tend to occur in the warmer summer months after spring rainfalls wash accumulated high nutrient loads from animal waste, agricultural fertilizers, sewage effluent, and urban stormwater runoff into surface waters. Subsequent summer conditions improve water clarity, allowing light to penetrate deeper into waters, fueling primary productivity where nutrients are plentiful. Dry summer conditions can increase the impact of wastewater effluent on lakes and streams, when lower water levels concentrate nutrients. Blooms can also occur in winter months, although winter-dominant algal species have been found to be different from those of spring and summer. Organisms most frequently responsible for HAB outbreaks in both fresh and marine waters include cyanobacteria and dinoflagellates. In Kansas, HABs are most commonly associated with cyanobacteria species in the genera *Microcystis*, *Dolichospermum* (formerly *Anabaena*), *Planktothrix*, *Aphanizomenon*, and *Raphidiopsis* (formerly *Cylindrospermopsis*).

Freshwater cyanobacteria under bloom conditions can produce potent toxins that may cause damage to the liver, skin, and nervous system (Kuiper-Goodman et. al., 1999). HABs vary in toxicity and may pose a direct threat to human and animal health. Exposure to cyanobacterial toxins can result in adverse human health effects such as: hay fever-like symptoms, respiratory distress, skin rashes, vomiting, and diarrhea among other symptoms (Falconer et. al., 1999). These toxins have also been identified as the cause of multiple animal deaths in the US (Backer et. al., 2013), including in Kansas (Trevino-Garrison, et. al., 2015). Exposure to these toxins most commonly occurs when persons or animals have direct contact with, ingest, or inhale contaminated water (Falconer et. al., 1999). There are no known antidotes to algal toxins, so preventing exposure is imperative. Details on common toxins and the symptoms they cause can be found in **Appendix F**, Public Water Supply.

SECTION 2. OVERVIEW

This plan outlines the interaction, responsibilities, and activities of KDHE, including coordination with other stakeholders, to ensure that HAB investigations are conducted in a rapid and effective manner and founded on the principles outlined below (Queensland HAB Steering Committee, 2002). KDHE reserves the right to use best professional judgement in making decisions beyond or on occasion contrary to this plan and its protocols, when unusual or extenuating circumstances occur.

A. Potential HAB events will be treated as harmful until proven otherwise.

B. Response to HABs will be limited to "Public Waters of the State" only. If a waterbody is not accessible to the public and does not serve as a public drinking water source, its owners/managers who request assistance with HABs will be referred to one of two resources: the Kansas State Veterinary Diagnostic Laboratory (KSVDL) or the Kansas Small Business Environmental Assistance Program (SBEAP) in Manhattan, Kansas. The KSVDL can ascertain presence of cyanobacteria in a water sample, while SBEAP provides resources to private organizations, such as HOAs, who manage small non-agricultural waterbodies.

1. In Kansas, for the KDHE Harmful Algal Bloom response plan, "Public waters" and "Private water bodies" are defined as:

    a. **Public waters**: Those waters that are referred to as reservoirs, community lakes, or state fishing lakes and/or are waters managed or owned by federal, state, county, or municipal authorities, as well as all privately-owned lakes that serve as public drinking water supplies (PWS) or that are open to the public for primary or secondary contact recreation. *Note: Primary contact recreation includes those activities where the body is immersed to the extent that some inadvertent ingestion of water is probable. This use shall include activities such as: boating, mussel harvesting, swimming, skin diving, waterskiing and windsurfing. Secondary contact recreation includes any activity in which the ingestion of surface waters is not probable. These uses shall include activities*

such as wading, fishing, trapping and hunting. K.A.R. 28-16-28b and 28-16-28d through 28-16-28h, Kansas Surface Water Quality Standards.

b. Private water bodies: Any freshwater reservoir or pond that is both located on and completely bordered by land under common private ownership or is not freely accessible to the public (*i.e.*, access by the public is controlled or restricted in some manner).

c. Rivers and streams. Only classified rivers and streams that are listed in the Kansas Surface Water Register (KSWR) will be investigated, and these will be subject to the same criteria for eligibility as described above for lakes and ponds. Downstream impacts may also be considered.

C. Response should be as rapid as practical considering the resources available;

D. Response to HAB events and all advice provided will be consistent across all bureaus and responding agencies;

E. KDHE will be the primary responder unless multi-agency response is requested;

F. The response may include: photo documentation, toxin analysis, and, where warranted and possible, the identification and enumeration of cyanobacteria. All available information will be used to determine the public health advisories;

G. When requested, KDHE will provide training for all responding agencies to ensure the effective coordination and consistency of response amongst agencies;

H. The KDHE Harmful Algal Bloom Response Plan is a dynamic document that is reviewed annually and revised as needed by KDHE.

SECTION 3. KDHE RESPONSIBILITY

Bureau of Water, Monitoring, Assessment, and Science Section (BOW-MASS) – responsibilities shall include:

A. Host and attend the annual Harmful Algal Bloom stakeholder meetings.

B. Collect and validate incoming requests for the investigation of cyanobacteria (blue-green algae or BGA) blooms to initiate sampling activities; complaints may arrive via the HAB website, HAB telephone hotline, or other forms of communication;

C. Provide Bureau of Environmental Field Services (BEFS) District Offices with HAB sampling supplies and support, as well as Emergency Sampling Kits for reports of HAB related illnesses;

D. Coordinate rapid response for collection and analysis of environmental samples to support epidemiology investigations; as needed, promptly relay incoming reports of illness related to cyanobacteria from the public and forward the information to Bureau of Epidemiology and Public Health Informatics (BEPHI) Epidemiology Hotline (EpiHotline) or online reporting tool;

E. Identify sample type, location(s), and number of samples to be collected for recreational waters;

F. For PWS lakes that are not participating in the voluntary monitoring program, obtain samples at surface sites as required, as proxies for raw water intake samples;

G. Analyze recreational water samples to determine the type of algae present and the level of microcystin toxins as needed. Optional analysis includes detailed identification and cell counts of cyanobacteria and other algae;

H. Coordinate other analytical needs with Kansas Health and Environmental Laboratories (KHEL), as needed, while keeping in mind that KHEL toxin analysis takes significantly longer due to the more intensive laboratory processes they use for toxin analysis.

I. Review the results of cyanobacterial analysis of water samples, determining the appropriate health advisory as outlined by agency policy;

J. Enter the results into the in-house Oracle Algae database;

K. Host weekly (typically Thursday afternoon) meeting and telephone conference with relevant lake managers and stakeholders to review the current week's data results and to advise recommended lake status;

L. Notify lake managers and stakeholders, when appropriate, and keep BEFS District Environmental Admins (DEAs) apprised of advisory changes in their region. The appropriate office for notifying stakeholders shall be determined during the initial response, depending on the waterbody and the agencies involved, and shall continue until the conclusion of the response. The agencies with which KDHE will communicate may include:

a. *Kansas Department of Wildlife and Parks (KDWP, www.ksoutdoors.com),* which is responsible for management of many recreational areas around Federal reservoirs, state fishing lakes, and other waterbodies, as well as tracking of imperiled, invasive, and game species and regulation of hunting and fishing in the state (620-672-5911);

b. *U.S. Army Corps of Engineers* (USACE, www.usace.army.mil), with district offices in Tulsa, OK (918-669-7366) and Kansas City, MO (816-389-2000), which is responsible for management of many major reservoirs;

c. *Kansas State Veterinary Diagnostic Laboratory (KSVDL,* http://www.ksvdl.org/). KSVDL serves two very different functions: (1) They can assist private citizens with low cost fee-for-service analysis of water samples, to evaluate for the presence of cyanobacteria and/or cyanotoxins; (2) The pathologists and toxicologists perform animal necropsies and serve a support function for the state in cases of difficult animal health investigations. The phone number for KSVDL is 785-532-5650; email is clientcare@vet.k-state.edu;

d. *Small Business Environmental Assistance Program at K-State (SBEAP, https://www.sbeap.org/water-quality/harmful-algal-blooms)*, located in Manhattan, KS (800-578-8898) aids managers of small urban and suburban private water features which are experiencing HABs, especially HOAs.

e. *U.S. Department of Interior, Bureau of Reclamation (USBR, https://www.usbr.gov/);* with area offices in McCook, NE (308-345-4400) and Austin, TX (512-899-4150), which is responsible for management of seven reservoirs in Kansas;

f. *Kansas Department of Agriculture-Division of Animal Health (KDAH, https://agriculture.ks.gov/divisions-programs/division-of-animal-health)* – KDAH is the office of the state Animal Health Commissioner and may be a point of contact for the public and veterinarians regarding health effects of cyanobacteria on pets and other animals. KDAH communicates with a network of Kansas veterinarians through Flash Reports as well as through publication of a newsletter. Although HAB related animal health reporting is not mandatory in Kansas, KDAH may also report relevant animal health data back to the State Public Health Veterinarian at KDHE-BEPHI. The KDAH number is 785-564-6601;

M. Communicate, via consistent messaging and public health advisory information, with lake managers, stakeholders, and users of state managed waters through various means including but not limited to:

a. weekly stakeholder meetings,

b. prepared signage,

c. website updates, and

d. KDHE HAB Hotline;

N. Coordinate with the KDHE Public Information Officer (PIO) for the preparation and release of official KDHE Public Health Advisories/News Releases, as warranted;

O. Provide technical assistance for water quality questions and interpretation of laboratory analytical results relative to initial and follow-up water samples, as needed;

P. Assist the KDHE PIO in responding to public requests for information that require technical or scientific responses;

Q. Train KDHE and non-KDHE staff concerning sampling methods, sample submission, and chain-of-custody requirements;

R. Prior to April 1 of each year, work with the Kansas Health and Environmental Laboratories (KHEL) to ship sample containers to District offices for epidemiology investigations and other emergency toxin sampling;

S. In collaboration with KDHE-Office of Information and Technology, annually review the Cyanobacterial Apex HAB Tracker for data management;

T. Maintain and update content for the HAB website that is associated with and available through the KDHE public website. On this website, all information provided by the BEFS, BEPHI (except for Protected Health Information), and the BOW shall be made available to the public. Such information shall include, but is not limited to: lists and maps of affected waterbodies, general blue-green algae information, photos of HABs, analytical results, public health notices, and warning signs for the public;

U. Retain a database of photographic records and scientific data relative to water sampling, and share such data when requested;

V. Maintain a database of HAB data over time for each affected body of water for future trend tracking and geospatial analysis;

W. Provide technical expertise related to water quality and watershed management and technical assistance for water quality questions;

X. Assist lake owners in identifying possible WRAPS projects, when requested; and

Y. Oversee and manage contractors and work with collaborators to plan effective HAB monitoring, control, and mitigation pilot projects, where resources allow.

Bureau of Water, Public Water Supply Section (BOW-PWSS) – responsibilities shall include:

A. Attend annual stakeholder meetings;

B. Coordinate with BOW-MASS, where needed, to identify ambient sample sites to serve as proxies for raw water intakes;

C. Schedule with the KHEL to ship sample bottles, prior to May 1 of each year, to PWS facilities that are participating in the voluntary Public Water Supply Harmful Algal Bloom Monitoring Program.

D. Provide technical assistance to public water supply systems when HAB affected lakes are their main source for drinking water;

E. In the event that finished drinking water testing indicates cyanobacterial toxins in excess of the 2015, EPA developed Health Advisories (HA), work with the PWS and KDHE-Public Information Officer (PIO) to issue an immediate Tier 1 public Advisory (24-hour notification) informing all affected customers of the situation. A public notice template will be provided by KDHE containing the appropriate health effects language and use restrictions;

F. Encourage public water systems to work with KDHE, their local emergency management agency, and local health departments to develop a coordinated response to cyanotoxin detections in finished water above EPA designated health advisory Levels.

Bureau of Environmental Field Services (BEFS) and its district offices – responsibilities shall include:

A. Attend HAB Stakeholder meetings;

B. Provide or coordinate field staff for water sample collection and photographic field documentation;

C. Collect water samples or recruit qualified non-KDHE staff to do so;

D. Transport samples in good condition to BOW-MASS (or KHEL if needed), or coordinate transportation by qualified individuals, as needed;

E. Maintain chain of custody from waterbody sampling to delivery of samples for analysis;

F. Assist the PIO in responding to requests for information that require technical or scientific responses from agency stakeholders;

Bureau of Epidemiology and Public Health Informatics (BEPHI) – responsibilities shall include:

A. Attend annual stakeholder meetings;

B. Maintain, as part of the KDHE Harmful Algal Bloom public website, the Human Illness Report Form and Animal Illness Report Form, which serve to collect information on HAB-related illness or death from health care providers, veterinarians, and the public;

C. Answer all health-related questions through the EpiHotline;

D. Complete the "Algae Bloom Reporting Form" when human or animal health related incidents possibly due to a BGA exposure are reported (this form notifies BOW-MASS that a response needs to be initiated) and communicate site locality information to the HAB response team as soon as it is available;

E. Provide epidemiological investigation of human and animal illness related to harmful algal blooms;

F. Provide technical advice on the public health aspects of HABs and coordinate the KDHE public health response;

G. Analyze data and provide reports of epidemiological investigations of human and animal illness/deaths,

H. Communicate, as needed, with both Federal and county/local health agencies:

a. In addition to compiling data at the state level, BEPHI contributes both animal health and human health HAB reports to the "One Health Harmful Algal Bloom System" (OHHABS) surveillance database, operated by US Centers for Disease Control and Prevention (CDC).

b. BEPHI communicates regularly with the network of County Health Departments and similar local entities and health care providers across the state; this network may be used to provide educational materials, solicit data, or issue alerts.

c. BEPHI reserves the option to use the Kansas Health Alert Network (KS-HAN, https://member.everbridge.net/892807736724418/login) in case of a statewide HAB-related emergency. This state emergency alert network includes county/local health departments as well as hospitals, emergency response personnel, any interested health care providers, and many more.

KDHE Public Information Officer (PIO) – responsibilities shall include:

A. Prepare and release the official KDHE Public Health Advisories/News Releases (See **Appendix G**).

B. Advise BOW and BEFS when media requests for information are received that require technical or scientific responses from agency stakeholders; and

C. Coordinate any public forum events that may be required from time to time, (*i.e*. press conferences, public meetings), during which KDHE representatives may be required to address issues related to HABs.

SECTION 4. ADVISORIES

4.1 Criteria for Public Health Protection Levels

KDHE has established three levels of public health protection recommendations, “Harmful Algal Bloom (HAB) Watch,” “Harmful Algal Bloom (HAB) Warning,” and “Harmful Algal Bloom (HAB) Hazard.” These advisory notification levels are determined by the concentration of harmful toxin level(s) and/or the concentration of cyanobacteria cell counts; see **Table 1**. In extenuating circumstances, Emergency Operations are followed as laid out in **APPENDIX M**. When appropriate, KDHE will recommend the following actions for:

A. Harmful Algal Bloom (HAB) **Watch** – serves as an advisory to notify the public that hazardous conditions are possible or present. A Watch may be issued based on visual confirmation of a bloom, microcystin toxin concentrations, and/or cyanobacterial cell counts. Visual confirmation is determined by qualified KDHE staff working with lake managers and/or managing agencies using jar tests, photographs or site visits. A Watch is issued if it has been analytically determined that the *microcystin toxin concentration* in the water is **greater than 4 µg/L but less than or equal to 8 µg/L** and/or *cyanobacterial cell counts* are **greater than 80,000 cells/mL but less than or equal to 250,000 cells/mL** (U.S. Environmental Protection Agency, 2019; World Health Organization, 2003). Persons should use caution when in contact with lake water and avoid areas of algae accumulation.

1. The appropriate HAB Watch signage (see
2. Appendix B) should be posted at all primary public access locations such as beaches, marinas, boat ramps, and other main points of entry to the body of the water;
3. If the provided signage is not used, then sign information must include:
    - **a.** persons should use caution when contacting lake water and wash with clean water afterward;
    - **b.** cyanobacteria are present, and the body of water **may** be unsafe for people and animals;
    - **c.** contact information for the posting authority;

d. the date of the posting;

e. the symptoms of cyanobacterial exposure;

f. what to do in case of contact with the water; and

g. whom to call in case of illness potentially associated with exposure.

The signage should also:

a. discourage people from having contact with the water near visible blooms (*e.g.,* no swimming, waterskiing);

b. discourage allowing pets to drink or swim in the water. If pets do come in contact with the water, then they should be rinsed off with clean water immediately. They should not be allowed to lick the algae off of their fur or consume dried algae on shorelines, as algal toxins will remain toxic even in dry form;

c. permit boating and fishing, although boaters should be aware of the possible inhalation of harmful spray; and

d. indicate that if fish are caught, the fish should be properly cleaned and rinsed with clean potable water, and all internal organs removed, with only the fillets retained for human consumption;

B. Harmful Algal Bloom (HAB) **Warning** serves as an advisory to notify the public that conditions **are** expected to be unsafe for human exposure. A warning will be issued if it has been analytically determined that the *microcystin toxin concentrations* are **greater than 8 µg/L but less than or equal to 2,000 µg/L** and/or *cyanobacterial cell counts* are **greater than 250,000 cells/mL to less than or equal to 10,000,000 cells/mL**. If there is verification of significant cyanobacterial surface scum present (U.S. Environmental Protection Agency, 2019) a “Warning” may be issued based on visual confirmation of significant cyanobacterial scum. It is recommended that action be taken over and above those listed in the “HAB Watch,” restricting or prohibiting public exposure.

1. The appropriate HAB Warning signage (see
2. **Appendix** B) should be posted at all primary public access locations such as beaches, marinas, boat ramps, and other main points of entry to the body of water.

3. If the provided signage is not used, then sign information must include:

    a. that cyanobacteria are present and that the body of water is unsafe for people and animals;

    b. contact information for the posting authority;

    c. the symptoms of cyanobacterial exposure;

    d. what to do in case of contact with the water; and

    e. whom to call in case of illness potentially associated with exposure.

    The signage should also:

    a. restrict swimming, water skiing, boating or other activities that would involve direct contact with the affected water;

    b. warn that all contact with water should be avoided;

    c. warn owners not to allow pets to drink or swim in the water. If pets do come in contact with the water, then they should be rinsed off with clean water immediately. They should not be allowed to lick the algae off of their fur or consume dried algae on shorelines, as algal toxins will remain toxic even in dry form;

    d. warn that if fish are caught, the fish should be properly cleaned and rinsed with clean potable water, all internal organs removed, with only the fillets retained for human consumption;

C. Harmful Algal Bloom (HAB) Hazard notifies the public that extreme conditions exist. At this level, it has been analytically determined that the *microcystin toxin concentration* is **greater than 2,000 µg/L** and/or *cyanobacterial cell count* is **greater than 10,000,000 cells/mL**. It is recommended that either a portion of the lake, entire lake, or zone be closed and in some cases the adjacent land (*e.g.,* approximately 100 ft. from the shoreline) be closed to the public. Actual setback distances will be determined on a site-specific basis, if necessary. When partial closures (*i.e.,* beach or cove) are issued, the remaining lake or zone area should carry a warning status.

D. Zoned Lakes: Zoned lakes are impoundments considered large enough in size and with shorelines structured in such a manner that they could shelter localized algae blooms, resulting in a combination of conditions that can limit specific portions of the lake to public use. Zoned lakes are differentiated by both size and shape and are

limited to those waterbodies with a surface area over 10,000 acres and with a shoreline sinuosity index greater than 4. Only three lakes in Kansas meet these criteria: Milford, Perry, and Tuttle Creek Lakes. Exact zone lines were drawn based on visible landmarks for lake users. Each zone's public health protection level is based on the highest sample result collected within a zone. Zoning a lake allows for mixed health protection levels and public contact on a lake. The public should be aware that a combination of conditions can exist in the affected lake, and visitors should observe the posted notices for each specific zone. On these lakes, if a lake manager/owner issues a more stringent advisory in a zone (*i.e.,* beach closure), then KDHE will list the more severe advisory level.

E. Other General Health Information

1. If water from an affected lake is used for irrigation, then people should avoid contact with the spray, due to potential inhalation and illness. Avoid fruits and vegetables that have come in contact with contaminated water until they have been thoroughly washed with clean, potable water. Do not allow livestock to drink affected irrigation water. If water is used to irrigate pastures, livestock owners should be aware that continued application of heavily affected waters can lead to significant toxin accumulation on foliage (Miller and Russel, 2017). Although rare, this residue can affect livestock.
2. Areas of an affected waterbody may contain significantly higher HAB concentrations due to wind effects, increasing the health threats in localized areas.

Further information pertaining to HABs and their effects on health can be found on KDHE's HAB website at https://www.kdhe.ks.gov/777/Harmful-Algal-Bloom

Table 1. Waterbody Status Determination

Waterbody Status Determination Blue-Green Cell Count and Toxin Exposure Levels		
Condition of Waterbody	Advisory Level	Recommendations
Microcystin toxicity at ≤4 µg/L AND Cell count of ≤80,000 cells/ml	None – Waterbody clear	None
Microcystin toxicity at >4 µg/L to ≤8 µg/L OR Cell count of >80,000 cells/ml to ≤250,000 cells/ml OR Visual confirmation of bloom	**Waterbody will be placed on a Public Health WATCH**	» Post signage » Post on website » Notify public water suppliers » Notify health dept., doctors, vets, health providers » Issue media release
Microcystin toxicity at >8 µg/L to ≤2,000 µg/L OR Cell count of >250,000 cells/ml to ≤10,000,000 cells/ml OR Presence of significant Cyanobacterial surface scum	**Waterbody will be placed on a Public Health WARNING**	» Post signage » Restrict direct contact with water » Post on website » Issue media release » Notify public water suppliers » Notify health dept., doctors, vets, health providers, etc.
Microcystin toxicity at >2,000 µg/L OR Cell count of >10,000,000 cells/ml	**Waterbody will be placed on a Public Health HAZARD**	» Recommend that portions of the lake, the entire lake, or the zone, be closed. If necessary – close adjacent land up to 100 ft from shoreline. » Post signage » Post on website » Issue media release » Notify public water suppliers » Notify health dept., doctors, vets, health providers, etc.

4.2 Criteria of Status Change of Advisories

A. A body of water with a HAB Watch will be sampled based on the resampling frequency discussed in **Section: 5.2 Response Prioritization**. The most recent toxin and cell count values will always determine the HAB status of a lake, except if it is under Hazard or Warning status due to toxin levels in a given week. In these cases, at least two consecutive sampling events with toxin levels at or below 8 ug/L must occur over at least a two-week period before a Hazard or Warning can be lifted.

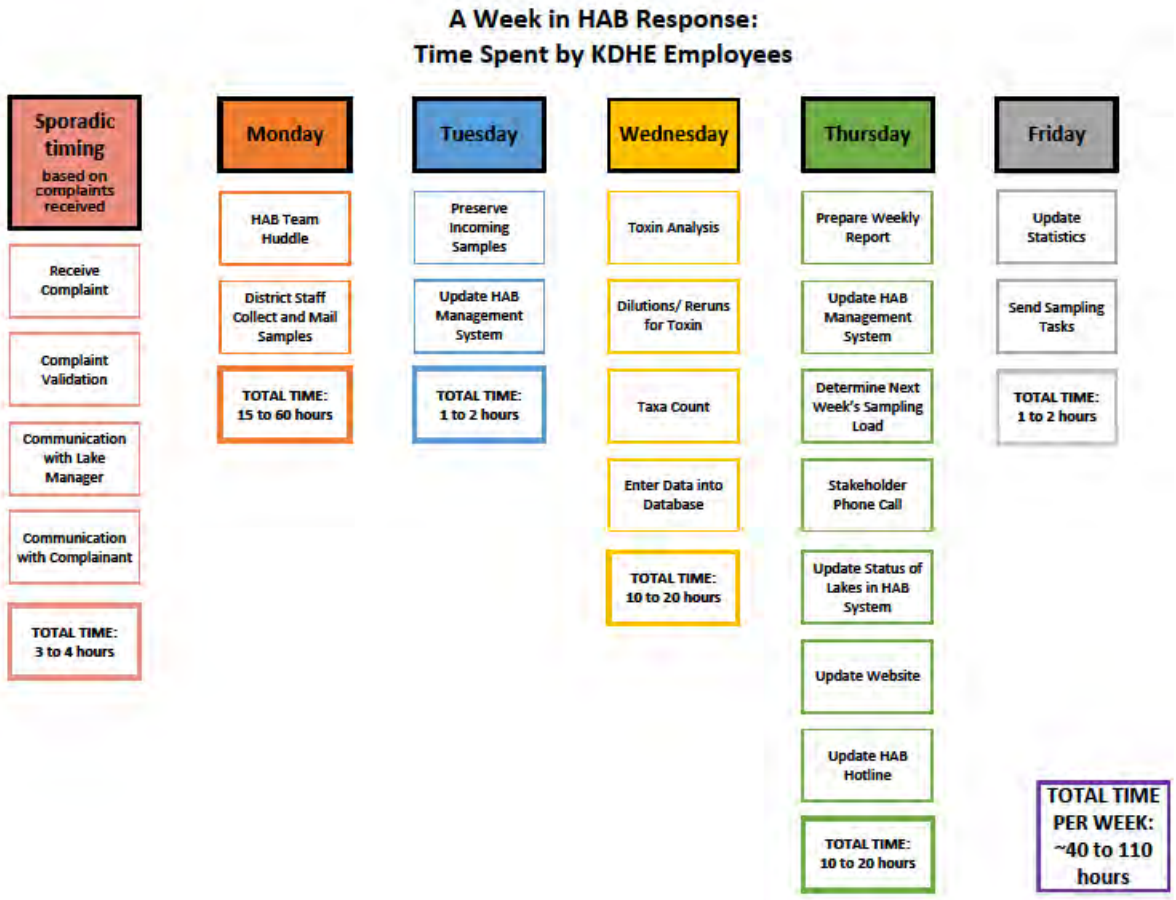
1. Exceptions: Mixed status lakes. Lakes that have more than one “zone” will be required to follow the above described procedure for each individual zone.
2. Exceptions: If cyanobacterial cell counts are not analyzed, the decisions to lift or cancel an advisory will be based on microcystin toxin concentrations.

SECTION 5. RESPONSE

5.1 Harmful Algal Bloom Response Procedures

(See **Appendix** D and **Appendix M)**

Figure 1. Typical HAB Response Timeline



A. A complaint is received concerning a potential harmful algal bloom in public waters, and an investigation is requested. Prior to any investigation, the complaint must be documented on the "Algae Bloom Reporting Form" located on the KDHE "Harmful Algal Bloom" website. BEFS/BOW will validate the existence of the bloom and location information. If a BEFS district office receives a complaint, it will collect the location information and complete the reporting form. If BEPHI receives a health-related complaint associated with a HAB, BEPHI will communicate with the HAB response team immediately and provide as much locality detail as possible. This can be done via phone/email or via the "Algae Bloom Reporting Form" (https://survey123.arcgis.com/share/5b5aeea4205c411d97cbeb173a5d6d96).

B. If a complaint is not submitted by trained Federal or state staff, or if issuance of a provisional (pre-test) advisory is requested, then a jar test and photographic documentation are required as part of the verification process (see **Appendix H** for additional information on jar testing and **Appendix M** for more on Visual advisories):

1. This test must be conducted by the lake management authority/manager at a KDHE designated site(s). (If no sampling sites have been previously designated, then contact BOW-MASS for site locations.)
2. Photos of the jar test(s) must be submitted/emailed to HAB Response Team for verification, along with any other photo documentation. Site photos or Jar Tests *must* be taken between mid-morning and mid afternoon in order to accurately display the extent of the bloom.

C. HAB Response Team will enter the investigation request information into the KDHE Apex system for tracking.

D. HAB Response Team will prioritize responses and issue sampling requests.

E. Under normal circumstances BEFS District offices will collect samples and ship or transport to KDHE Central Office in Topeka, BOW-MASS.

F. HAB Response Team, will analyze the recreational samples collected and enter the analytical results into the BOW ORACLE Algae database, which will then migrate into the Apex system.

G. HAB Response Team will review the analytical results and, if warranted, a public health recommendation will be issued consistent with KDHE's Harmful Algal Bloom Policy (see **Appendix A**).

H. All complaint locations will be checked to determine whether the waterbody is a drinking water supply. If so, BOW-PWSS will notify the affected PWS immediately to discuss the status of the source and provide technical assistance when needed (see BOW-PWSS **Appendix F**). If the PWS is not part of the voluntary monitoring program, raw water samples or proxy samples from the waterbody may be ordered.

I. BOW-MASS and BEFS District Offices will contact agencies, municipalities, lake owner/managers, other external stakeholders and, if applicable, the complainant, to provide them with the analysis results and the KDHE public health recommendations.

J. Lake Managers will be asked to post the waterbody with the appropriate signage (see

K. **Appendix** B).

L. HAB Response Team will coordinate any meetings between Bureaus and between KDHE and other state and federal agencies.

M. HAB Response Team will coordinate memos of recommendation for KDWP through the Secretary's office, if needed.

N. BOW will notify the Secretary's Office/PIO of the status for all affected waterbodies. The Office of Communications will prepare formal agency press releases and coordinate as needed with other stakeholders' Office of Communications (see **Appendix G**)

O. BEPHI will communicate with public health departments and animal health agencies as needed, to deliver public health advisory information.

P. HAB Response Team will update the HAB Management System.

Q. Based upon the HAB status, BOW-MASS will prioritize and coordinate proper follow-up testing consistent with the KDHE plan on blue-green algae response (see Error! Reference source not found.).

R. BOW will prepare information for updating of the HAB website and send it to the KDHE webmaster.

S. BEPHI will conduct investigations of human and animal illness or deaths related to harmful algal blooms.

T. HAB Response Team will update the Apex contact list as needed, along with any other relevant contact datasets.

U. BEPHI will analyze data and provide reports of epidemiological investigations and human and animal illness and death.

5.2 Response Prioritization

The investigation timeframe and the prioritization of waterbodies shall be determined according to the following parameters, described in detail below and in **Table 2:**

A. When there has been a human or animal health report.

B. When the complaint concerns a waterbody that is an active public water supply source that is not already actively sampled through the voluntary monitoring program.

C. Whether the number of complaints exceeds KDHE's capacity resources, taking into account both sample collection and laboratory analysis.

D. When resampling is required.

E. When the situation does not reflect the above situations.

Table 2. Priority Response Timeframe

Lake Category	Priority	Response
Lakes that Support: Public Beach Public Water Supply Full Body Contact Activities Lakes where Human or Animal Illness is Suspected or Confirmed	**Priority 1**	Samples will be collected within the immediate week if the HAB complaint form was received and verified prior to Wednesday of the sampling week. Sampling will be conducted on the following Monday otherwise. PWSS that are part of the voluntary monitoring program may have prioritization lowered as long as PWS sampling data is up to date. PWSS that test above the HA at the plant intake will be sampled as promptly as possible.
Public lakes that are publicly accessible but have no swimming beach and do not allow full body contact activities.	**Priority 2**	If resources are available and sampling capacity allows, samples will be collected within the immediate week if the HAB form was received and the complaint verified prior to Tuesday of the sampling week. Otherwise, sampling will be conducted on the following Monday.
Other public lakes that are largely inaccessible to the general public.	**Priority 3**	Will respond if capacity resources are available. Otherwise, the response will be handled through technical advice utilizing site photography and jar testing. KDHE may issue advisories based on visual evidence. The complainant may be advised to contact their local extension office or the Kansas State Veterinary Diagnostic Laboratory at: KSVDL Client Care 1800 Denison Ave. Manhattan, KS 66502 785-532-5650 Clientcare@vet.k-state.edu

*** K.A.R. 28-16-28b -** Kansas Water Quality Standards **…***Public water bodies* - any surface water or surface water segment that supports or, in the absence of artificial sources of pollution, would support one or more of the designated uses of surface water defined in K.A.R. 28-16-28d (b) or K.S.A. 82a-2001(c), and amendments thereto, and that meets the criteria for classification given in K.A.R. 28-16-28d (a).

****K.S.A. 65-171d - (d) …** If a freshwater reservoir or farm pond is privately owned and where complete ownership of land bordering the reservoir or pond is under common private ownership, such freshwater reservoir or farm pond shall be exempt from water quality standards except as it relates to water discharge or seepage from the reservoir or pond to waters of the state, either surface or groundwater, or as it relates to the public health of persons using the reservoir or pond or waters there from.

A. Health Related Reports

1. *Initial Sampling*. When there has been a human or animal illness reported, response will be given a high priority. If district staff are unable to provide a timely response, then staff from the Topeka office will respond to the complaint. If staff at the Topeka office cannot respond, then KDHE may request assistance from the KDWP or USACE or another partner agency for sample collection. These health complaints will have an expanded toxin test through KHEL and the Emergency Kits, allowing for a fuller analysis of the toxins present.

B. Public Drinking Water Source

1. *Initial Sampling*. When the waterbody is a public drinking water source and is not monitored through the PWSS voluntary monitoring program, then sampling will be initiated as promptly as possible. If capacity is limited at the Topeka office, toxins can be analyzed by KHEL when possible.

C. Does Not Exceed KDHE Capacity

1. *Initial Sampling*. When the number of complaints does not exceed the agency capacity, then the response will be initiated as promptly as possible. (See Error! Reference source not found. or **Appendix C** for a more complete timeline). To minimize the potential of exceeding staff capacity, KDHE may request assistance from the KDWP or USACE for sample collection.

D. Exceeds KDHE Capacity

1. *Initial Sampling*. When the number of complaints exceeds the agency capacity (to include sample collection and laboratory analysis), then response priorities will be determined by pre-set categories. (See **Table 2**).

E. Resampling Frequency for KSWR Waterbodies

1. During confirmed cyanobacterial blooms, the resampling frequency for affected surface waters is directly associated with the initial sampling analytical results, the waterbody's "Lake Visitation Potential," and three other potential factors. All public water impoundments that are either currently on the Kansas Surface Water Register or have had a HAB in the past have been ranked within either the upper 25th percentile for "visitation potential" or in the lower 75th percentile for "visitation potential" (see Appendix K). Visitation potential is determined using the following formula (see **Figure 2**). With the help of this "score," BOW

MASS staff determine the resampling frequency for continued HAB monitoring. BOW-MASS reserves the right to best professional judgement when considering extraneous variables.

a. Determining resampling frequency for top 25% for visitation potential, see **Figure 3**.

b. Determining resampling frequency for lower 75% for visitation potential, See **Figure 4.**

Figure 2. Visitation Potential Formula

Lake Visitation Potential =
Population within 30 Miles × Lake Size Factor × Lake Density Factor
× Public Access Factor × Contact Recreation Factor (**Appendix K**)

Figure 3. Determining Resampling Frequency for KSWR Lakes with top 25% for Visitation Potential

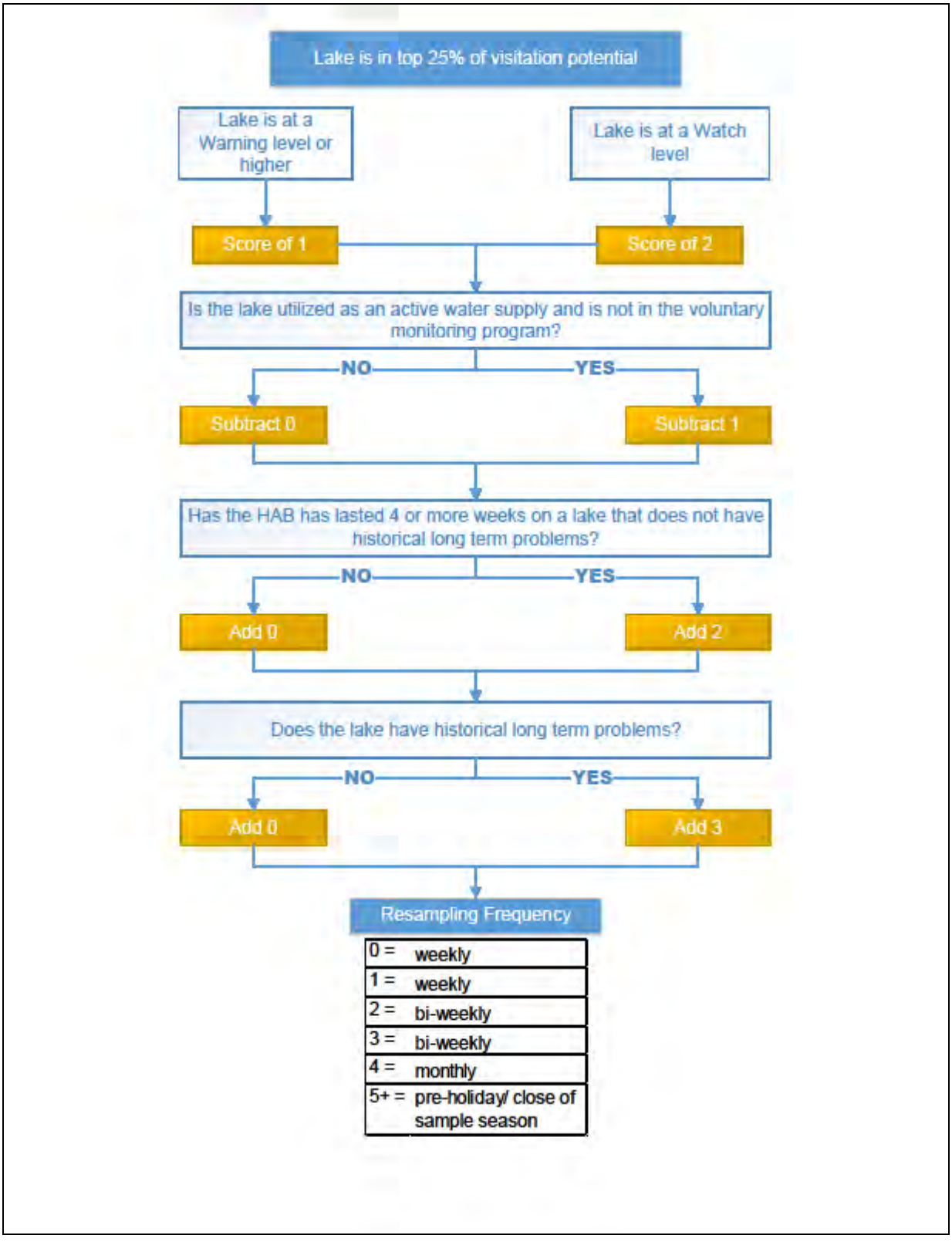
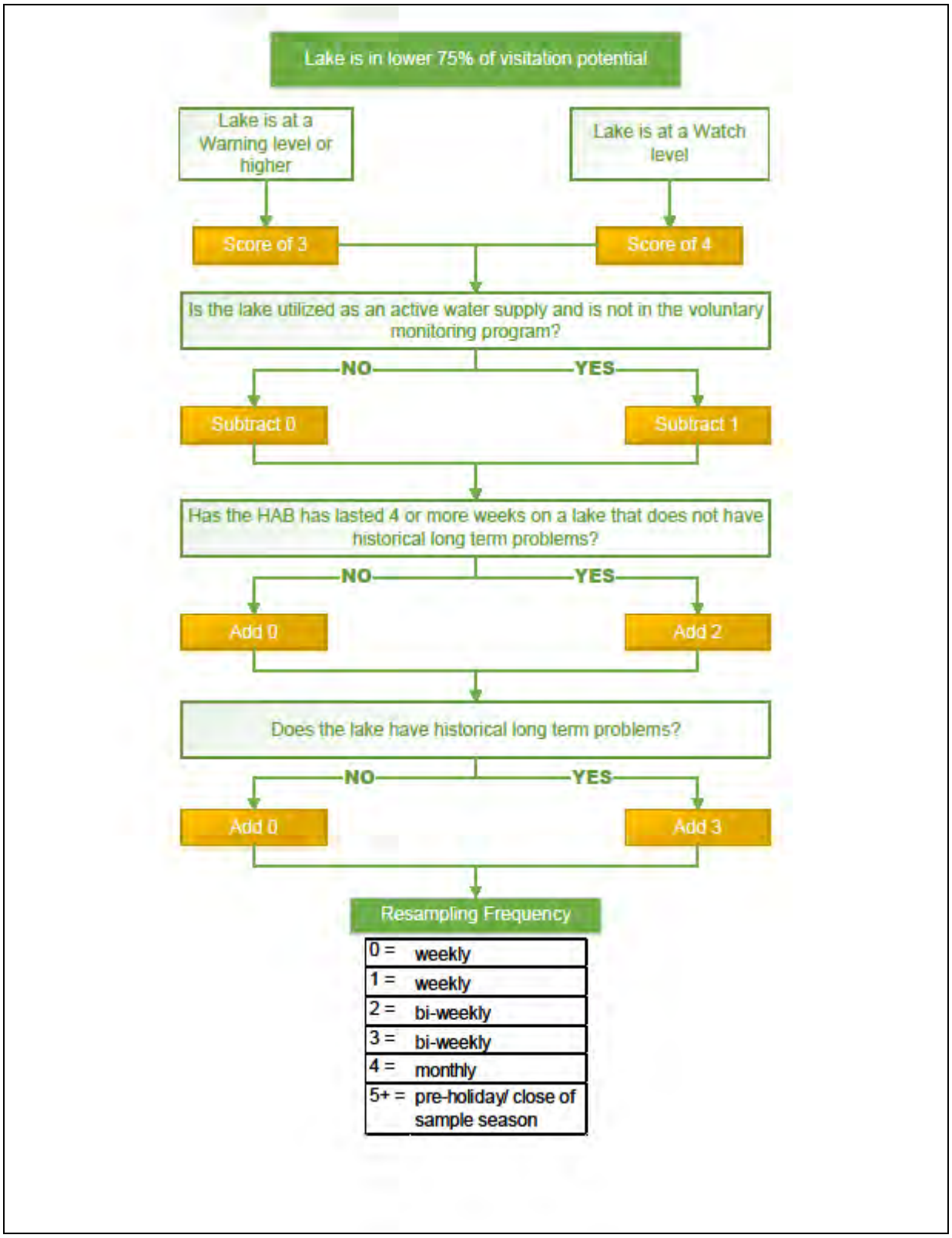


Figure 4. Determining Resampling Frequency for KSWR Lakes with Lower 75% for Visitation Potential



F. Lakes that do not have a “visitation potential” ranking will be re-sampled monthly or at a frequency determined by the initial response priority and KDHE staff. Priority 1 Response Lakes will be given a higher priority than priority 2 or 3 responses for resampling. Priority 1 responses may be resampled more frequently as determined by KDHE. Priority 2 and 3 responses may be sampled less frequently as determined by KDHE. KDHE reserves the right to make any final sampling priority decisions based on the myriad factors that affect this priority.

G. Sampling Deferment: KDHE may defer weekly sampling for a specific waterbody during prolonged and stable HAB events. Sampling may be deferred until visual conditions are indicative of water quality improvement. Likewise, if visual evidence suggests significant bloom dissipation well in advance of scheduled resampling AND analytical capacity allows, this waterbody may be sampled ahead of schedule.

H. Any situations that occur at surface waters not defined above will be considered on a case-by-case basis.

I. When the complaint is received for privately owned lakes (single owner shorelines or lakes with restricted access to the general public), the complainant will be advised on how they can screen their waterbody using the “Jar Test” and to contact their local extension office, the Kansas State Veterinary Diagnostic Laboratory, or the Kansas Small Business Environmental Assistance Program:

KSVDL Client Care
1800 Denison Ave.
Manhattan, KS 66502
785-532-5650
https://www.ksvdl.org/clientcare@vet.k-state.edu

SBEAP
2323 Anderson Ave.
Manhattan, KS 66506
800-578-8898
https://www.sbeap.org/
sbeap@ksu.edu

5.3 Sampling Season

A. The HAB Response Program will adopt a sampling season concurrent with the Kansas Surface Water Quality Standards Primary Contact Recreation season, from April 1 to October 31. New and continued investigations will not be conducted after the 31st of October, except in special circumstances. If capacity allows, a final sample will be collected at all surface waters that are still under a HAB advisory in the last week of October to document the final analytical results and public health advisory level for the season.

B. Occasionally, winter blooms of the blue-green species *Planktothrix rubescens* have been reported in Kansas (appearing as surface scums of purple to red material or observed under thin ice covers). In the event a *Planktothrix rubescens* bloom is suspected, then it will be handled on a case by case basis.

C. End of Season. If lakes are still under an HAB Advisory by October 31st, then it is the responsibility of the lake's management authority to conduct observational monitoring and jar testing to assess the condition of the waterbody. The HAB Response Team will contact appropriate lake managers to assist with the lake assessment. Until KDHE receives evidence of a negative jar test or other compelling observational data that the bloom has expired, the waterbody will remain over the winter at the status that was in effect on October 31. If the jar test and other observational data confirm that the bloom has dissipated below the level at which a visual Watch would be issued, then KDHE will lift the end of the season notification.

D. Emergency Operations. If field capacity or analytical capacity is severely curtailed, the program may revert to Emergency Operations, as described in (**APPENDIX M**, Emergency Operations).

For further questions regarding sampling of lakes and cyanobacteria, contact KDHE's Bureau of Water/Bureau of Environmental Field Services at the Harmful Algal Bloom Hotline, **785-296-1664**.

For further questions regarding health effects of cyanobacteria on humans, contact KDHE's Bureau of Epidemiology and Public Health Informatics at **877-427-7317**.

For further questions regarding health effects of cyanobacteria on pets and animals, contact the Kansas Department of Agriculture Division of Animal Health at 785-564-6601 **during normal business hours**. If assistance is needed for an urgent issue after business hours, call the KDHE Epidemiology Hotline at 877-427-7317.

SECTION 6. SAMPLING

6.1 Sampling Safety

Field staff must exercise caution to protect themselves during HAB sampling events as cyanobacteria can produce toxins that can cause skin irritation, respiratory and/or gastric problems. When sampling from an area that has been reported to have a bloom, the following safety precautions must be followed.

A. Depending on each sampling location and situation, samplers should wear at a minimum:

1. Gloves, latex or nitrile;
2. Boots or closed shoes;
3. Long pants;
4. Eye protection such as safety glasses or goggles, depending on the presence of splashing or spray.

B. If any of the following conditions apply, then additional Personal Protective Equipment (PPE) may be necessary.

1. Conditions include:
   - **a.** If significant visual bloom or scum is present, and breezy conditions create wave action that may generate spray or aerosolize the water;
   - **b.** If there is a noticeable odor;
   - **c.** If prior week's samples indicate toxins are present and at levels greater than or equal to 2,000 µg/L.
2. Additional Personal Protective Equipment includes:
   - **a.** Elbow length gloves, Nitrile rubber;
   - **b.** Goggles or splash guard;
   - **c.** Waterproof tall boots or hip waders;
   - **d.** For staff who are certified to wear one, half-face respirator fitted with Organic Vapor/HEPA filters. **If sampler is not certified**, then the

DEAs/Supervisors may need to send staff who are qualified to wear respirators or provide photographic evidence of extreme conditions. When conditions are warranted (*i.e.,* evidence of significant cyanobacterial matting), BOW-MASS staff may notify District Offices that personnel who are qualified to wear respirators are required to perform the sampling.

C. General Sampling precautions:

1. Do not allow the water to come in contact with exposed skin;
2. Do not touch hands to mouth, eyes, or other exposed areas of the body before washing;
3. Avoid contamination of vehicle and common use items (e.g., steering wheel, clipboards, pens);
4. Sampling equipment may be sequestered in a lawn-size garbage bag to prevent contamination of vehicle cargo area.
5. Hands should be washed thoroughly with soap and clean, fresh/potable water after sampling and before eating, drinking, or smoking;
6. Remove any rings, watches or other jewelry that might have been exposed to algae contaminated water and wash skin surface area and items;
7. All equipment, gloves, and waders should be rinsed with clean water (not lake water) after sampling and before storage;
8. Used disposable gloves should be removed using proper technique to avoid contamination;
9. All wet and/or damp clothing should be removed and replaced with clean, dry clothing;
10. Wet clothing should be washed separately before next wearing;
11. Do not inhale spray from boats, wind, other water surface disturbances or irrigation water from areas with harmful algal blooms;
12. Do not ingest affected water;

13. Samplers should complete the HAB Illness form if they suspect that they are experiencing side affects associated with a HAB. If this occurred as part of sampling activities the supervisor is to receive notice as well.

D. Different species of algae can produce different toxins such as neurotoxins, liver toxins, and skin irritants. It is important that field staff can recognize exposure indicators associated with algal blooms and report to their supervisors and to BEHPI if they begin to experience potential symptoms and seek medical care if needed. Symptoms can occur immediately or within days of exposure. Those symptoms can include:

1. Skin irritation – visible rash, hives, or blisters, especially under clothing, swimsuits, or wetsuit.
2. Respiratory problems – runny eyes and nose, sore throat, headache, and asthma-like symptoms.
3. Kidney toxicity – acute, severe gastroenteritis (including diarrhea and vomiting).
4. Liver toxicity – abdominal pain, diarrhea, and vomiting, may take hours or days for symptoms to appear in humans.
5. Neurotoxicity – numb lips, tingling fingers and toes, or dizziness, often appear within 15 to 20 minutes of exposure.

E. Field personnel should be aware that hazardous conditions potentially exist at every waterbody. If unfavorable conditions are present at the time of sampling, including the need to wear additional PPE, or if hazardous weather conditions arise, such as lightning or high winds, then personnel should cease sampling, move to a safe place, and contact their DEA/Supervisor. Sampling can be rescheduled for a time when weather conditions have improved or the appropriate staff with PPE are available.

6.2 Sample Collection/Sample Locations

Samples will be collected in accordance with BOW-MASS Standard Operating Procedures, SOP HAB-001 (see Appendix J).

A. Sampling stations for toxin or phytoplankton analysis will be selected based on common public access points, which for this particular sampling task are primarily defined as: swimming beaches, boat docks/ramps, marinas, shoreline adjacent to maintained trails and marked fishing areas, and other frequently used areas designated for public access. All sample stations will initially be determined by KDHE's Central Office in cooperation with District staff and Lake Managers when possible. Once these stations have been identified, they will then be plotted on maps that will be provided to those conducting the sampling. If it is determined that nutrient samples are needed they will be collected at a HAB sampling station or near BOW-MASS's ambient Lake Program sampling station.

1. If a bloom is observed at other common public access points of the lake that are not designated sampling stations, then all designated stations shall still be sampled, and at the sampler's discretion, an additional sample may be collected at the point where the bloom can be readily observed and the public can readily access the water's edge.

a. If there is not an easy and readily available point of public access to collect this optional sample, then no additional sample is required. Under these circumstances a determination of the status may be based on the observation of an obvious bloom and from the results of the samples collected at the designated stations. The status may be set at least at a Watch level, and the waterbody will likely be resampled the following week.

2. If, upon arrival, it appears that the sample collection at the designated stations is unattainable, (due, *e.g.,* to flood waters, drought conditions/no water, impassable roads) then an alternate sample location may be determined by the sampler within proximity of the original station.

3. If public waters are water sources for Public Water Supply Systems (PWS), and especially if the PWS is not participating in the voluntary monitoring program, then:

a. When a complaint is validated, the BOW-PWSS will be notified.

b. When directed by the Public Water Supply Section, BEFS will collect initial samples at PWS proxy stations as well as “recreation” stations. If there is no established KDHE PWS sample site, then see below.

c. As needed, BOW-MASS will establish PWS sampling stations relative to raw water intake locations:

1. Samples will be collected as close to the intake as possible, or
2. Discharge samples will be collected if a PWS intake is downstream from the impacted lake/reservoir and the outflow from that lake/reservoir comprises a significant proportion of stream flow arriving at the intake of that PWS.
3. KDHE has the discretion to initiate river monitoring at locations above the PWS intakes to confirm the absence/presence/concentration of microcystin toxins, if warranted.
4. If levels are detectable, then KDHE-PWSS will coordinate with the affected system(s) to determine recommended resampling (See **Appendix F**).

d. For PWS not participating in the voluntary monitoring program, it will be recommended to continue to resample at PWS intake as long as the lake has elevated levels impairing recreational status (See **Appendix F**).

4. Other types of sampling may be required to determine background levels or potential contaminant sources, or to determine whether public waters used for livestock watering are impacted.

5. Lakes that have multiple zones may require new sampling locations if persistent (≥ 3 days) winds drive existing blooms into unmonitored areas. During initial response activities, the zone that was subject to the response will be sampled at all established sampling stations. At a minimum, one

sample from all other zones will be sampled during the initial response for microcystin toxins. During subsequent sampling activities, KDHE will determine which zones warrant testing.

6. For any newly established sampling locations, a GPS point should be recorded (Datum NAD83), or the location must be marked on a map.

B. Miscellaneous Waterbody Sampling

1. Streams/Rivers

a. Only classified rivers/streams listed in the Kansas Surface Water Register will be investigated.

b. Initial sampling will typically be conducted by BEFS District Office staff or by BOW-MASS Central Office staff, depending upon location and resources available.

1. If analysis for toxins are above detection, then BOW-PWSS will notify all Public Water Supply (PWS) systems downstream, and it will be the responsibility of the systems to continue resampling. (See PWS **Appendix F**), or

2. If analysis indicates that toxin and/or cell count levels are above recreation levels, then resampling and notification will be at the discretion of the agency for livestock watering, irrigation, and recreation uses.

2. Sampling and resampling of other miscellaneous public use waterbodies will be conducted at the discretion of KDHE.

6.3 Sample Types/Sample Analysis

Three types of samples may be collected for HAB events: toxin samples, phytoplankton samples, and nutrient samples. Samples will be collected in accordance with BOW-MASS HAB-001 and HAB-002 (see Appendix J), and analysis will be in accordance with BOW-MASS HAB-003 (see Appendix J).

A. Toxin samples:

1. Toxin samples will always be analyzed for levels of microcystin toxins, using the Coated Tube ELISA Kit (Abraxis, Warminster, PA)
2. When cyanobacteria that produce cylindrospermopsin toxin have been identified, then the level of toxin may be determined using Abraxis (Abraxis, Inc, Warminster, PA) test strips (optional).

B. Phytoplankton samples: Depending on the resources available, phytoplankton samples may be analyzed for:

1. Taxon identification, with cyanobacteria typically to genus;
2. Cell counts and cyanobacteria cell percentage;
   - **a.** One sample from each waterbody is analyzed, unless under special circumstances. For lakes with more than one sampling point, typically the sample with the worst (most green) visual appearance will take priority. If there is no discernible difference between the worst sample(s), then KDHE will select the sample that is most likely to have a negative impact on health, based on current knowledge. Factors informing this decision could include the importance of the sampling stations for human health, wind conditions during sampling, reporting from the field, photographic evidence, jar test results, or previous analysis results (**Appendix I**).
   - **b.** Those samples not analyzed during the response week may be retained for the duration of the HAB season, at which time KDHE may determine to perform additional analyses or dispose of the sample(s).
3. Cell biovolume (at the discretion of analyst).

C. Nutrient samples **may** be analyzed for:

1. Nitrate;
2. Nitrite;
3. Kjeldahl nitrogen;
4. Ammonia;
5. Total phosphorus; and
6. Ortho-phosphate;

D. Additional field and laboratory measurements and analytes may include:

1. Water Temperature (field);
2. Air Temperature (field);
3. pH (field or lab);
4. Dissolved oxygen (field or lab);
5. Chlorophyll-a; and
6. Liquid Chromatography Mass Spectrometry (LCMS) analyses for microcystin variants and other algal toxins.

Sample analysis will be conducted in accordance with BOW-MASS SOP HAB-003 (see Appendix J). Additional analyses may be required and will be based on individual investigation circumstances.

SECTION 7: ANNUAL PROGRAM MANAGEMENT

The HAB program is busiest during the April to October contact recreation season but has multiple tasks during the rest of the year. The following is a general annual timeline of events, beginning with the first day of the active season.

- **April**
    - All involved staff are informed of any new changes to the KDHE Agency HAB Response Plan as well as any changes to the computer interface side of the HAB program.
    - If no changes have taken place, the staff is still informed/refreshed with current protocols.
    - Stakeholders are sent standing invitations to the weekly HAB Meeting and Conference Call.
    - Once the first complaint comes in, the weekly work cycle is followed, as documented in **Appendix C**. This continues throughout the season.
- **September**
    - The process of compiling subjects and inviting speakers and exhibitors for the annual meeting begins, along with identification of possible venues and dates.
- **October**
    - All lakes left with advisories will be sampled to determine their season closure status.
    - In this final month of HAB season, during the conference call and in the stakeholder weekly email, KDHE solicits suggestions for changes to the HAB Response Plan.
- **November**
    - The BOW-MASS response team works with KDHE Office of Information and Technology staff for any modifications to the software or databases that support the HAB response program.
    - At the end of November, the team begins contacting lake managers with the object of closing out as many outstanding advisories as possible.

  - The speakers and agenda for the annual meeting are set, and the date and location are finalized.
  - Identify and begin completion of all other tasks and arrangements required for the annual meeting. This includes the initiation of any necessary contracts, mechanisms for participant registration, and the like.

- **December**
  - At the end of the month, contact lake managers and close out as many outstanding advisories as possible, then close out in the HAB system any existing lakes on advisories.

- **January**
  - Re-submit any lakes that were not lifted in the previous year into HAB Management System. The closeout and re-submission is done so that the system can generate annual statistics and to track extended HAB problems.
  - Complete all final arrangements and tasks for the annual meeting, including: agendas; name tags; acquisition of equipment, printing of materials, etc.
  - The annual meeting is held.

- **February**
  - A hot wash of the annual meeting takes place to document improvement for the next annual meeting.
  - A conference room is reserved for Thursday afternoons from April 1 through the Thursday after the last Monday in October, along with the BOW conference call phone line.
  - All revisions proposed for the response plan are discussed, and those deemed necessary are added to the plan.

- **March** – Ideally, the Response Plan is published for the season ahead.

SECTION 8. DATA MANAGEMENT

Waterbody data, analysis data, advisory status, and tasks are managed through the HAB Data Management System, which includes three components:

A. The Survey Web Application takes complaints from the public and/or lake managers for possible harmful algal blooms and Human and/or Animal Illness complaints (**Appendix L**, DM-001). This front end is built in ESRI Survey123.

B. The HAB Tracker (Apex), which is built in Apex software environment, manages complaints, field assignments, evaluates the final analytical results, and calculates the health protection level recommendations. In addition, this program has a web presence which shows locations, recommendations and the ability to produce data reports (**Appendix L**, DM-003.)

C. ORACLE and GIS databases. The Apex HAB Tracker system pulls data from two sources: 1) the “Site ID” geospatial database; and 2) the ORACLE ENVI Algae Database (**Appendix L**, DM-002.)

1. *Site ID* geospatial database contains waterbody map coverages as well as a map of existing sampling stations. New sampling stations can also be added through this application. This system is linked to the Apex HAB Tracker and provides all geospatial data for it.
2. *Algae Database* contains taxonomy, cell counts, and results of toxin analyses performed at the KDHE central office. This system is linked to the Apex HAB Tracker and is required to be completed to provide System with the data needed to evaluate and generate a health protection level recommendation.

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APPENDIX A

KDHE Policy: Guidelines for Addressing Harmful Algal Blooms in Kansas Recreational Waters

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Lee A. Norman, M.D., Secretary

Laura Kelly, Governor

April 1, 2020

KDHE INTERNAL DIRECTIVE 2020 - HAB
Subject: Policy: Guidelines for Addressing Harmful Algal Blooms in Kansas Recreational Waters

1. PURPOSE.

The KDHE mission is to protect and improve the health and environment of all Kansans. This policy considers the health and environmental risks of Harmful Algal Blooms (HABs) in recreational waterbodies, as well as the economic impact on resources within our agency. As HABs are both pervasive and relatively unpredictable, this issue presents unique challenges in health risk assessment. The basis for this policy is the epidemiologic and scientific study of HAB data collected by KDHE in Kansas as well as the analysis of established scientific and medical research, including studies conducted by the US Environmental Protection Agency (USEPA) and the World Health Organization (WHO).

2. BACKGROUND.

Cyanobacteria, also known as blue-green algae, can produce toxins in recreational waters and have been implicated in human and animal illness in Kansas. The threat to health is related to the prevalence of cyanotoxins and cyanobacterial cell concentrations in recreational water and corresponding contact with or ingestion of the cyanobacterial cells or cyanotoxins. Exposure may occur via contact, ingestion, or inhalation and may be from affected water, spray, aerosols, or dried algae. There are no known antidotes for cyanotoxins.

During a HAB, children are at a greater risk than adults, due to their lower body weight. In addition, behavior of children when exploring recreational water may create more opportunities for exposure than adults; they typically swallow a higher volume of water, exposing them to a higher volume of toxin. Individuals with compromised immune systems, liver disease, kidney damage, and women who are pregnant or nursing may also be more vulnerable to HABs than the general population. The most common complaints after recreational exposure to cyanobacteria and associated toxins include vomiting, diarrhea, skin rashes, eye irritation, and respiratory symptoms. As the concentration of cyanobacterial cells increases, the probability of adverse health effects also increases.

Science on cyanobacteria and their associated toxins is rapidly advancing, and the USEPA has recently (2019) set recommended ambient water quality criteria for cyanotoxins in recreational water, for microcystin at no greater than 8 µg/L and cylindrospermopsin at no greater than 15 µg/L. Microcystin is the cyanotoxin most commonly found in Kansas waterbodies. Microcystin toxin is the foundation of this policy but KDHE retains the right to develop supplemental policy should other cyanotoxins become prevalent and problematic at Kansas waterbodies.

3. PROCEDURES.

Once a credible HAB compliant has been submitted for a public waterbody, KDHE samples the waterbody for cyanobacteria. Samples are taken at established public access points, such as swim beaches, fishing piers, and boat ramps. KDHE has the capability to test for microcystin toxin and to identify and quantify the type of cyanobacteria present. The issuing of a public health advisory is based on the concentration of microcystin toxin, cyanobacterial cell density, or verified visual evidence.

When a HAB has been confirmed in a Kansas public lake, KDHE will issue a Public Health Watch, Warning, or Hazard advisory, depending on the level of risk associated with the HAB, as determined through water sampling or visual confirmation. Under emergency conditions, when staff and analytical resources are severely limited, visual confirmation of possible HABs can be the primary means of determining that a Public Health Warning is to be issued for a given lake. While conservative, this contingency approach alerts the public to possible issues at a recreation lake without delay.

4. ACTION.

The primary distinctions among a Public Health Watch, a Public Health Warning, and a Public Health Hazard are:

a. the level of risk that needs to be communicated to the public; and
b. the actions recommended to the governing authority of the affected waterbody, to discourage exposure.

Implementation of appropriate measures to restrict exposure will be the responsibility of the governing authority of the affected waterbody. If the governing authority chooses to post or close the waterbody, KDHE can provide examples of Watch, Warning, and Hazard signs, as well as informational signs.

A Public Health Watch serves as an advisory to notify the public that hazardous conditions are possible or present. A Watch will be issued when the microcystin toxin concentration is detectable at a concentration above 4 µg/L and/or when cyanobacterial cell counts are above 80,000 cells/mL.

The following guidance is provided for a Public Health Watch:

- KDHE will post Public Health Watch advisories on its website and issue a press release.
- KDHE will notify any public water suppliers with intakes in the affected waterbody or downstream of the waterbody will be notified.
- Signs should be posted at beaches, marinas, boat ramps, and other points of public access to the waterbody.
- Local Health departments, physicians, veterinarians, and hospitals are advised to report adverse health events associated with HAB exposure or cyanobacterial toxin poisoning to the KDHE Bureau of Epidemiology and Public Health Informatics.
- Members of the public should be advised of the symptoms of cyanobacterial poisoning, what to do in case of exposure to a cyanobacteria bloom, and whom to call in case of illness potentially associated with exposure.
- Members of the public should be advised of the following:
    - Harmful algae may be present, and the waterbody may be unsafe for people and animals.
    - Swimming, wading, and jet skiing are discouraged near visible blooms.
    - Boating and fishing are acceptable, provided that contact with the water is minimized, and any exposure to contaminated water is followed by washing with clean water.

- Pets and livestock should not be allowed to drink the water, swim in it, or touch or eat dried algae on the shoreline.
- Fish caught during a Public Health Watch should first be cleaned and the entrails discarded, and only the fillet portion should be eaten.
- Irrigation water affected by a HAB could pose a risk; avoid the spray and thoroughly wash fruits or vegetables in clean water.

A Public Health Warning supersedes a Watch and serves as an advisory to notify the public that conditions are expected to be unsafe for human and animal exposure. A Warning will be issued when microcystin toxin concentrations are greater than 8 µg/L and/or when cyanobacterial counts are greater than 250,000 cells/mL. A Warning may also be issued if there is verified documentation of a visible, pervasive cyanobacterial scum present, particularly when emergency conditions limit the availability of staff and resources to conduct a quantitative analysis.

The following recommendations are provided for a Public Health Warning:

- KDHE will post Public Health Warning advisories on its website and issue a press release.
- KDHE will notify any public water suppliers with intakes in the affected waterbody or downstream of the waterbody.
- Signs should be posted at beaches, marinas, boat ramps, and other points of public access to the waterbody.
- Local Health departments, physicians, veterinarians, and hospitals are advised to report adverse health events associated with HAB exposure or cyanobacterial toxin poisoning to the KDHE Bureau of Epidemiology and Public Health Informatics.
- Members of the public should be advised of the symptoms of cyanobacterial poisoning, what to do in case of exposure to a cyanobacteria bloom, and whom to call in case of illness potentially associated with exposure.
- Members of the public should be advised of the following:
  - Harmful algae are present at a level considered unsafe for people and animals.
  - Any contact with water is considered a high risk and should be restricted, including swimming, wading, boating, water skiing, or jet skiing.
  - Pets and livestock should not be allowed to drink the water, swim in it, or touch dried algae on the shoreline.
  - Fish caught during a Public Health Warning should first be cleaned and the entrails discarded, and only the fillet portion should be eaten.
  - Irrigation water affected by a HAB could pose a risk; avoid the spray and thoroughly wash fruits or vegetables in clean water.

A Public Health Hazard supersedes a Warning and serves as an advisory to notify the public that extreme conditions exist. A Hazard will be issued when microcystin toxin concentrations exceed 2,000 µg/L and/or cyanobacteria cell counts are greater than 10,000,000 cells/mL.

The following recommendations are provided for a Public Health Hazard:

- KDHE will post Public Health Hazard advisories on its website and issue a press release.
- KDHE will notify any public water suppliers with intakes in the affected waterbody or downstream of the waterbody.

- Local Health departments, physicians, veterinarians, and hospitals are advised to report adverse health events associated with cyanobacteria toxin poisoning to the KDHE Bureau of Epidemiology and Public Health Informatics.
- It is recommended that all in-lake recreation cease.
- In many cases, it is also recommended that picnic, camping and other public land activities directly adjacent to affected waters be closed.

5. FOLLOW UP SAMPLING.

A waterbody with any type of active HAB advisory, whether Watch, Warning, or Hazard, will be tested by KDHE on a regular basis and in a consistent manner, provided adequate staffing and analytical resources are available.

A Public Health Watch will remain in effect until the cyanobacterial concentrations are 80,000 cells/mL or lower at all sample sites and microcystin toxin concentrations are 4 µg/L or lower at all sample sites, at which point the Watch will be lifted.

A Public Health Warning based on cell counts will remain in effect until the cyanobacterial concentrations are 250,000 cells/mL or lower at all sample sites for at least one week. A Public Health Warning based on microcystin toxin concentrations will remain in effect until microcystin toxin concentrations are 8 µg/L or lower at all sample sites for a given week and for the next consecutive sample, taken the following week or later. Waterbodies meeting these criteria may have the Warning lifted or may be reduced to a Watch level, depending on results. Any Warning advisory that was issued based on visual evidence alone will remain in effect until the bloom dissipates and either: (a) toxin analysis confirms the absence of health risk or, (b) the recreation season ends.

A Public Health Hazard will remain in effect until the cyanobacterial concentrations are 10,000,000 cells/mL or lower and concentrations of microcystin toxin concentrations are 2000 ug/l or lower at all sample sites for at least one week. Waterbodies meeting these criteria may have the Hazard lifted or may be reduced to a Warning or Watch level, depending on results.

Leo Henning

Leo Henning
Deputy Secretary and Director of Environment
Kansas Department of Health and Environment

3-31-2020
Date

APPENDIX B

Notification Signs

WATCH

Harmful Algae Possible and May be Present

Blue-Green Algae May be Harmful to Humans & Animals

Swimming, wading, and jet skiing are discouraged near visible blooms.

Keep pets & livestock away from water.

- **Use caution when contacting lake water and wash with clean 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 a doctor or veterinarian if people or animals have nausea, vomiting, diarrhea, rash, irritated eyes, seizures, breathing problems or other unexplained illness.

Report harmful algal blooms to Kansas Department of Health and Environment at:
kdhe.ks.gov/HAB/
Or call: 855-422-5253

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

For more information:
Scan this code or visit
kdhe.ks.gov/HAB

Posted by:

Posted on:

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

Example of “Watch” signage for lakes with contact recreation

WATCH

Harmful Algae Possible and May be Present

Blue-Green Algae May be Harmful to Humans & Animals

Keep pets & livestock away from water.

- **Use caution when contacting lake water and wash with clean 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 a doctor or veterinarian if people or animals have nausea, vomiting, diarrhea, rash, irritated eyes, seizures, breathing problems or other unexplained illness.

Report harmful algal blooms to Kansas Department of Health and Environment at: kdhe.ks.gov/HAB
Or call: 855-422-5253

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

For more information: Scan this code or visit kdhe.ks.gov/HAB

Posted by:

Posted on:

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

Example of “Watch” signage for lakes without contact recreation

ADVERTENCIA

Presencia de algas nocivas

Las algas azul-verdosas pueden ser dañinas para los seres humanos y los animales

No se recomienda nadar, vadear, esquí acuático o el jet ski acuáticas cerca de la floración visible.

Mantenga las mascotas y ganado lejos del agua

- **Tenga cuidado al ponerse en contacto con el agua del lago y lávese con agua limpia después**
- **Evite las zonas de acumulación de algas**
- **No permita que otras personas o animales coman algas secas o beban agua no tratada del lago**
- **Limpie bien el pescado y deseche las entrañas**

En caso de contacto con algas nocivas: consulte un médico o veterinario si personas o animales tienen náuseas, vómitos, diarrea, erupción cutánea, irritación de ojos, convulsiones, problemas respiratorios u otras enfermedades inexplicadas

Reporte foraciones de algas al Departamento de Salud y Medio Ambiente de Kansas: kdhe.ks.gov/HAB
O llame al: 855-422-5253

Reporte posibles enfermedades causadas por la floración de algas al Departamento de Salud y Medio Ambiente de Kansas: kdhe.ks.gov/HAB
O llame al: 877-427-7317

P ara obtener más información: Escanee este código o visite kdhe.ks.gov/HAB

Publicado por:

Publicado en:

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

Example of “Watch” signage in Spanish

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 kdhe.ks.gov/HAB

Report harmful algal blooms to Kansas Department of Health and Environment at: kdhe.ks.gov/HAB
Or call: 855-422-5253

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

Posted by:

Posted on:

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

Example of “Warning” signage

ADVERTENCIA

Presencia de algas nocivas

Se pueden enfermar personas y animales

Evite el contacto con el agua, como al nadar y vadear

Evite el esquí acuático o el jet ski

Mantenga las mascotas y ganado lejos del agua

- **Si la gente o las mascotas se mojan con el agua del lago - lave con agua limpia tan pronto como sea posible**
- **Evite las zonas de acumulación de algas**
- **No permita que otras personas o animales coman algas secas beban agua no tratada del lago**
- **Limpie bien el pescado y deseche las entrañas**

En caso de contacto con algas nocivas: consulte un médico o veterinario si personas o animales tienen náuseas, vómitos, diarrea, erupción cutánea, irritación de ojos, convulsiones, problemas respiratorios u otras enfermedades inexplicadas

Reporte floraciones de algas al Departamento de Salud y Medio Ambiente de Kansas: kdhe.ks.gov/HAB
O llame al: 855-422-5253

Reporte posibles enfermedades causadas por la floración de algas al Departamento de Salud y Medio Ambiente de Kansas: kdhe.ks.gov/HAB
O llame al: 877-427-7317

P ara obtener más información: Escanee este código o visite kdhe.ks.gov/HAB

Publicado por: _____

Publicado en: _____

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

Example of “Warning” signage in Spanish

Example of “Beach Closed” signage

Example of “Beach Closed” signage in Spanish

Example of “Lake Closed” signage

Example of “Lake Closed” signage in Spanish

APPENDIX C

A Week in a HAB Response

A WEEK IN HAB RESPONSE

Accounting of KDHE staff time spent on HAB response
based on a moderate to busy week during the HAB season (7 – 15 lakes)

SPORADIC

Occurs when complaints are received.

Complaints reviewed and validated or not by review of jar test and photos → **1.5**

- Complaint validation is entered into the KDHE Harmful Algae Bloom Management System (DM-003). Validation process is enacted each time a complaint is received.
- District staff is notified of the lakes that are being reported within their district office boundaries.

Personnel from district offices communicate with managers of small lakes, while central office personnel communicate with federal agency partners and lake managers. → **1 – 2 hours**

Communicate with complainant to notify them of response procedures activated. → **0.5 hour**

Total Time: 3 to 4 hours

MONDAY

Topeka staff has HAB Huddle meeting to confer on the events for that week. → **0.5 hour**

District staff dispatched to collect sample(s). Samples are ideally overnighted or hand carried to Topeka Central Office. → **15 – 60 hours**

- Staff leaves district office as soon as possible to travel to designated lake.
- Samples collected per HAB-001.
- Staff prepare samples for shipment per protocol HAB-001.
- Samples shipped to Topeka Central Office by 1500 hours to be received on Tuesday morning in Central Office by 0900 or 0930.

Total Time: 15 - 60

TUESDAY

Most samples received from district offices by Fed-Ex or mail. → **0.5 - 1 hour**

- Samples are received between 0900 and 1130.
- HAB staff receives samples and preserves sample as soon as possible to prevent degradation.
- Complete the Chain-of-Custody paperwork.
- Staff preserves samples per HAB-002 protocol.
- Part of sample must be frozen overnight for lysing of cells in order to complete ELISA testing on Wednesday.

Update HAB Management System per DM-003 protocol. → **0.5 - 1 hour**

Total Time: 1 - 2 hours

WEDNESDAY

Receive and process last samples as needed. Samples for ELISA tests are run for toxins. Any high concentrations are diluted and run again. → **1.5 - 3 hours**

- Samples are pulled from freezer and allowed to thaw at room temperature.
- ELISA kits are also pulled out of refrigerator to warm to room temperature.
- Per HAB-003 protocol- ELISA toxicity tests run and diluted as needed.

Preserved sample in Lugol's is prepared for scope work and the algal taxa are identified and enumerated. → **7 – 15 hours**

- Preserved samples are prepared for scope work on a covered slide and allowed to settle for approximately 30 minutes.
- Enumeration and identification is completed by randomly selecting 50 positions along a grid viewed in the ocular of the scope.

Data from cell enumeration and toxin analyses are entered into ORACLE database (DM-002 protocol) → **0.5 - 1 hour**

Total Time: 10 to 20

THURSDAY

When there are many samples for cell enumeration, taxa analysis may continue into Thursday.

Prepare for stakeholder meeting → **1.5 - 3 hours**

- Pull analysis data from ORACLE into HAB Management App (per DM-003).
- Make report of week's sampling results.
- Determine following week's sampling load.

3:00 pm Stakeholder meeting; all partners in → **0.5 – 1 hour** x 15 staff = **7 - 15 hours**

- Analysis results are emailed to HAB Stakeholders and other people interested in the waterbody after 12:30 p.m. for the phone conference held at 3:00 p.m.
- Suggestions on lake status for lake managers are discussed during the meeting.

Update public outlets of information → **1.5 hours**

- Update status of lakes in HAB Management System; data is viewable online (per DM-003).
- Update website
- Update message on HAB hotline
- Press release distributed

Total Time: 10 to 20

FRIDAY

Update season's statistics. → **0.5 - 1 hour**

Send sampling tasks to district offices using HAB Management System (DM-003). → **0.5 - 1 hour**

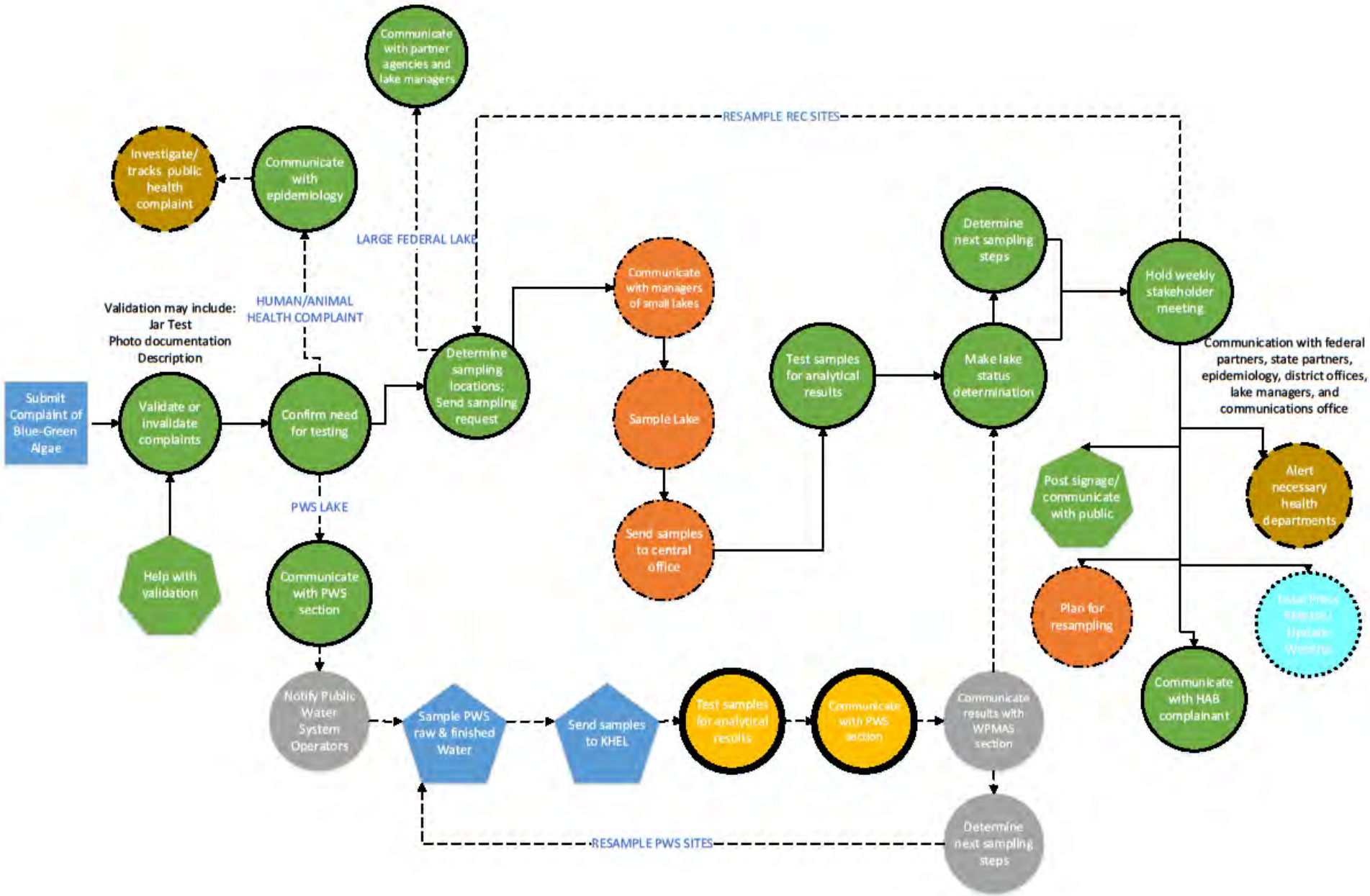
Total Time: 1 to 2 hours

TOTAL WEEKLY STAFF TIME ~40 TO 110 HOURS

APPENDIX D

KDHE's Harmful Algal Bloom Response Procedures Flow Chart


KEY
KDHE
BOW: WPMAS
BEFS: District Offices
BOW: PWS
BEPHI: Epidemiology
KHEL
HAB Complainant
PWS System Operator
Lake Manager


Communicate with partner agencies and lake managers
RESAMPLE REC SITES
Investigate/ tracks public health complaint
Communicate with epidemiology
LARGE FEDERAL LAKE
Determine next sampling steps
Hold weekly stakeholder meeting
Validation may include:
Jar Test
Photo documentation
Description
HUMAN/ANIMAL HEALTH COMPLAINT
Communicate with managers of small lakes
Test samples for analytical results
Make lake status determination
Communication with federal partners, state partners, epidemiology, district offices, lake managers, and communications office
Submit Complaint of Blue-Green Algae
Validate or invalidate complaints
Confirm need for testing
Determine sampling locations; Send sampling request
Sample Lake
Post signage/ communicate with public
Alert necessary health departments
PWS LAKE
Send samples to central office
Help with validation
Communicate with PWS section
Plan for resampling
Initial Press Release/ Update Website
Communicate with HAB complainant
Notify Public Water System Operators
Sample PWS raw & finished Water
Send samples to KHEL
Test samples for analytical results
Communicate with PWS section
Communicate results with WPMAS section
Determine next sampling steps
RESAMPLE PWS SITES

APPENDIX E

Algae Submission Form/ Chain of Custody

ALGAE SAMPLE SUBMISSION FORM (Reproduce as needed for each sample)

Send this form with samples to:

Kansas Department of Health and Environment, Bureau of Water
Watershed Planning, Monitoring, and Assessment / Attn: Algae
1000 SW Jackson St., Ste. 420 (Curtis State Office Building)
Topeka, KS 66612

IMPORTANT: Use cubetainers with no preservatives, and leave some airspace.
Submit one cubetainer and form per site sampled.
Ship ASAP in cooler using blue ice or a small amount of ice and mark REFRIGERATE ON ARRIVAL
Samples should arrive cold but never freeze; freezing can destroy some specimens.
If submitting aquatic plants, use a ziplock bag with only a tiny amount of water in the bag.

Type of water body:
❒ Public Lake/Pond
❒ Private Lake/Pond
❒ Stream/River
❒ PWS – raw water
❒ PWS – finished water
❒ Other: _____

Type/s of problem under investigation:
❒ HAB Report
❒ Taste/Odor Incident
❒ Livestock/Pet health incident
❒ Human health incident
❒ Fish kill
❒ Other: _____

_____
Waterbody Name, Waterbody Number, and Site ID if applicable (Example: Central Park Lake, LM0609-AA)
If this is a sampler-determined location rather than an established site, please label sites as XA, XB, XC, and so on.

_____ / _____ _____
Sample coordinates (Lat/Lon) Additional Site Info (*e.g.* dock, beach, shoreline)

_____ _____
Collector Name Date and Time

Sampling method: ❒ Pole sampler (standard method) *or* ❒ Other: _____

Additional algal samples collected at this water body today? ❒ NO *or* ❒ YES

Photos taken at this site? ❒ NO *or* ❒ YES

In-situ measurements taken at this site? ❒ NO *or* ❒ YES (*please include units with measurements)*

Temp: _____ pH: _____ DO: _____

Cond: _____ Secchi: _____ Other: _____

Complete cyanotoxin panel (MC, CYL, ANA, SAX) collected and sent to KHEL? ❒ NO *or* ❒ YES

Other samples collected and sent to KHEL? ❒ NO *or* ❒ YES -- Analytes: _____

**If toxin or chemistry samples are sent to KHEL, please notify Tony Stahl and Elizabeth Smith as well as KHEL.*

CONTINUED ON BACK

Example of Algae Submission/Chain of Custody form - front

If this is raw or finished water collected in response to a Taste/Odor Incident for a PWS, please check appropriate boxes:

Odor (raw or finished):

❒ Earthy/musty ❒ Marshy/septic
❒ Chlorinous ❒ Fishy/aquarium
❒ Grassy/Woody ❒ Fragrant/flowery
❒ Medicinal ❒ Hydrocarbon/chemical

Taste (finished):

❒ Sour/acidic ❒ Bitter
❒ Salty ❒ Sweet
❒ Other: _____
❒ Mouthfeel: _____

"Mouthfeel" covers a number or characteristics of sensation such as powdery, metallic, burning, etc.

Also supply information about the water treatment plant:

If this is **not** a taste/odor incident (i.e., is a bloom report, fish kill, health investigation, etc.) please record any other potentially relevant information related to the incident here. This can include field conditions, site appearance, water level, recent and current weather, other agencies present, etc.

Site sketch:

Chain of custody:

Date/time: _____ Relinquished by: _____ Received by: _____

Date/time: _____ Relinquished by: _____ Received by: _____

Date/time: _____ Relinquished by: _____ Received by: _____

Ice packs still at least partially frozen? ❒ NO *or* ❒ YES

Also send results to: _____

Form updated: May 2021

Example of Algae Submission/Chain of Custody form - back

Chain of Custody

564267

Kansas Department of Health and Environment

Workorder ID: Junction City Walmart Pond HC
Submitter: Joshua Cullum
Phone:
Lab Site: MAIN

Client: BOW Watershed Planning
Contact: Tony Stahl
Phone: 785-296-5578
Reason:

Kansas Health & Environmental
6810 SE Dwight Street
Topeka, KS 66620
Phone (785) 296-1620
Fax (785) 559-6205

Pos	Sample ID, Collection Site	Matrix	Collector	Collected Date	Collected Time	40MLAG (10X DIL)	40MLBRO (NONE)	CUBE (NONE)	Containers	Notes
1	HAB Response JC Walmart Pond	W	Joshua Cullum	08/13/2021	08:10	1	1	1	HSN: 1915712 COC: 564267	11°C

Transfers	Released By	Date/Time	Received By	Date/Time
1	Joshua Cullum	8/13/21 9:45		8/13/21 9:45
2				
3				
4				
5				

HORIZON

Example of Laboratory Algae Submission/Chain of Custody form – completed

APPENDIX F

Public Water Supply

2022 Kansas Public Water Supply
Harmful Algal Bloom
Seasonal Monitoring Program Guide

The Kansas Public Water System (PWS) Harmful Algal Bloom (HAB) Seasonal Monitoring Program is a voluntary participation program for Water Supply Systems, which provides consistent proactive monitoring for potential toxins through the HAB bloom season. It is intended to provide water systems with important information, so that treatment processes can be modified, or other measures taken to assure safe drinking water is provided to their customers. Early detection will also allow for timely notification to customers should an event occur.

This Guide provides guidelines on Harmful Algal bloom (HAB) monitoring and sampling periods and protocols, identifies acceptable analytical methods, and identifies cyanotoxin levels that will be used to make advisory decisions and consistent monitoring protocol for public water systems.

Human Health Effects of Cyanotoxins

Adverse health outcomes from exposure to cyanotoxins may range from a mild skin rash to serious illness or death. Acute illnesses caused by exposure to cyanotoxins have been reported, and after short-term exposures, microcystin and cylindrospermopsin could cause liver and kidney damage. The table below summarizes the health effects caused by the most common toxin producing cyanobacteria. The below table is taken from the EPA Health and Ecological Effects website at: https://www.epa.gov/cyanohabs/health-effects-cyanotoxins

Cyanotoxins	**Acute Health Effects in Humans**	**Most common cyanobacteria producing toxin**
Microcystin-LR	Abdominal pain, Headache, Sore throat, Vomiting and nausea, Dry	*Microcystis*, *Anabaena***, *Nodularia*, *Planktothrix*, *Fischerella*, *Nostoc, Oscillatoria*, and *Gloeotrichia*

Cyanotoxins	Acute Health Effects in Humans	Most common cyanobacteria producing toxin
	cough, Diarrhea, Blistering around the mouth, and Pneumonia	
Cylindrospermopsin	Fever, Headache, Vomiting, Bloody diarrhea	*Raphidiopsis (formerly Cylindrospermopsis) raciborskii, Aphanizomenon flos-aquae, Aphanizomenon gracile, Aphanizomenon ovalisporum, Umezakia natans, Anabaena bergii***, Anabaena lapponica, Anabaena planctonica***, *Lyngbya wollei, Rhaphidiopsis curvata,* and *Rhaphidiopsis mediterranea*
Anatoxin-a group	Tingling, burning, numbness, drowsiness, incoherent speech, salivation, respiratory paralysis leading to death*	*Chrysosporum (Aphanizomenon) ovalisporum, Cuspidothrix, Raphidiopsis (formerly Cylindrospermopsis), Cylindrospermum, Dolichospermum, Microcystis, Oscillatoria, Planktothrix, Phormidium, Anabaena flos-aquae***, *A. lemmermannii,*** *Raphidiopsis mediterranea* (strain of *Cylindrospermopsis raciborskii),* *Tychonema* and *Woronichinia*

Cyanotoxins	Acute Health Effects in Humans	Most common cyanobacteria producing toxin
Saxitoxin	In severe poisoning, illness typically progresses rapidly and may include gastrointestinal (nausea, vomiting) and neurological (cranial nerve dysfunction, a floating sensation, headache, muscle weakness, parasthesias and vertigo) signs and symptoms. Respiratory failure and death can occur from paralysis	*Marine dinoflagellates, cyanobacteria in the genera Anabaena**, Aphanizomenon, Planktothrix, Cylindrospermopsis, Lyngbya and Scytonema (Smith et al., 2012; Wiese et al., 2012).*

* Symptoms observed in animals.

**Note: most planktonic *Anabaena* have now been placed into the genus *Dolichospermum*

Numerical Cyanotoxin Thresholds for Drinking Water Health Advisories

In 2015, EPA developed Health Advisories (HA) for the two cyanobacterial toxins. These thresholds will be used to determine when a public health advisory will be issued for a detection of cyanotoxins in finished drinking water. These HAs are not regulations and should not be construed as legally enforceable federal standards. HAs may change as new information becomes available.

Cyanotoxin	Drinking Water Health Advisory (10-day)	Drinking Water Health Advisory (10-day)
	Bottle-fed infants and pre-school children	School-age children and adults

Microcystins	0.3 µg/L	1.6 µg/L
Cylindrospermopsin	0.7 µg/L	3 µg/L
Anatoxin-A	*	*
Saxitoxin	*	*

**A few States have determined their own guidance/action levels for Anatoxin-A and Saxitoxin. However, Kansas will continue to follow EPA's Guidance. From:*

https://www.epa.gov/cyanohabs/epa-drinking-water-health-advisories-cyanotoxins

Kansas PWS Proposed Monitoring Plan – (Surface Water Sources Only)

1. Monitoring Season will run from May 1 through October 31 of each year.
2. PWS will conduct initial microcystins monitoring for both raw and finished water during May of each year.
3. If no microcystins are detected, the PWS would begin weekly monitoring of raw water at water intake only (i.e. the same location as LT2 Samples are collected or water intake structure)
4. If microcystins are detected in the raw water, Contact KDHE PWS-Section immediately (contact information listed below). PWS will then collect a paired raw and finished water microcystins samples within 24 hours of receiving the positive results and complete analysis within five days.
5. Depending on the microcystins levels detected, KDHE may instruct PWS to continue weekly monitoring or request increased testing of raw and/or finished water. Modifications to water treatment process may be recommended to remove toxins.
6. PWS will continue with weekly paired raw and finished water microcystins monitoring until results are below the HA for at least two consecutive weeks or as recommended by KDHE.
7. PWS will subsidize the cost for monitoring. The current estimated cost for laboratory analysis is approximately $100.00 per sample. The cost to your PWS system will be no more than $25.00 per sample. This cost may be lower depending upon the number of participating PWS systems.
8. PWS systems that choose not to participate in the voluntary routine monitoring program will still be eligible to use Kansas Health and Environmental Laboratories (KHEL) for special samples if a HAB occurs in their source water, however there may delays in sample collection due to sample bottle scheduling and shipping and the cost is estimated at $75.00 per sample.

KDHE PWS HAB Contact Information

Questions regarding KDHE monitoring for public water supplies or to report possible Hazardous Algal Bloom or positive test results contact:

During Normal Business Hours (8:00 to 5:00pm, M-F):

Robert Gavin, Ph. 785-296-0643, rob.gavin@ks.gov

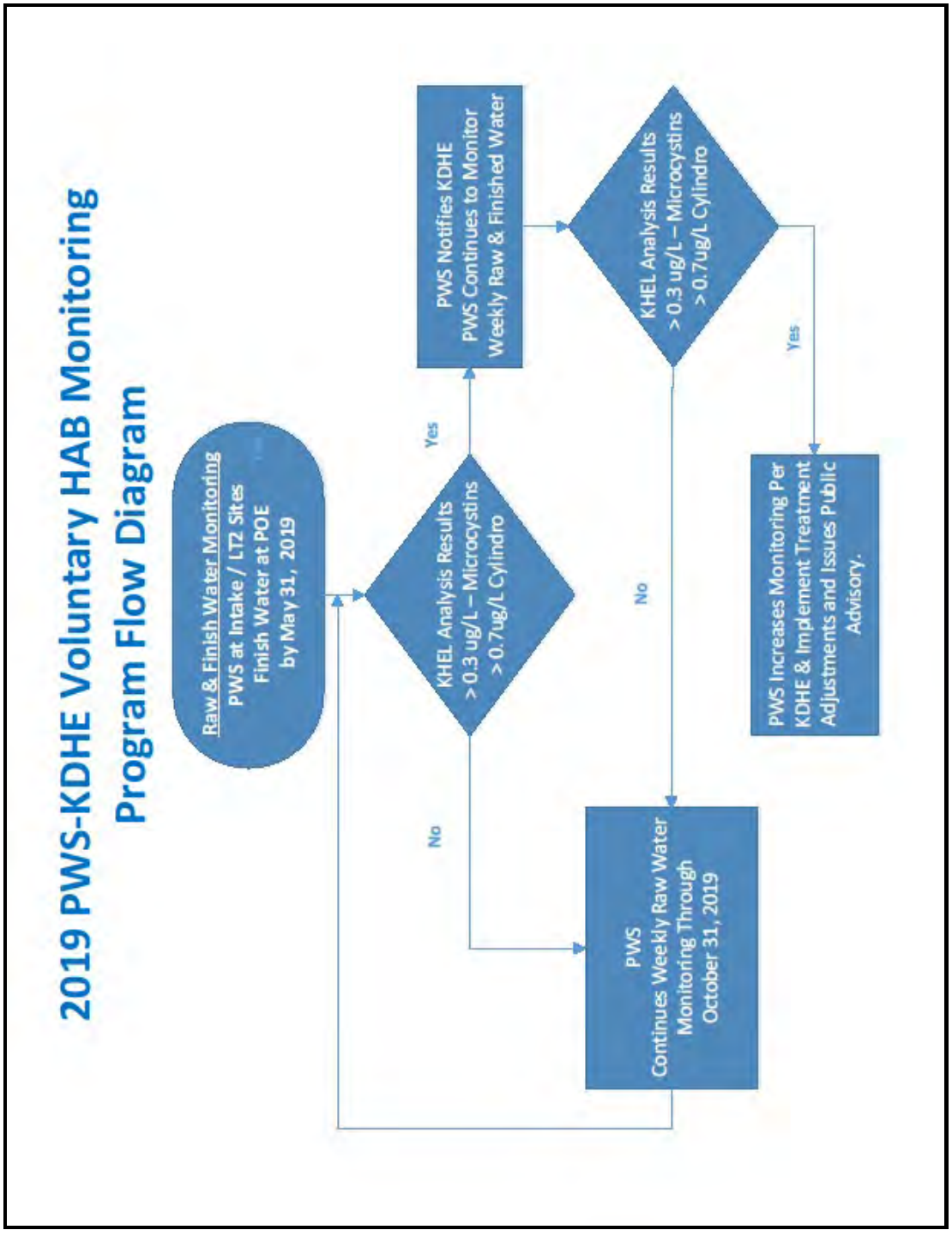
Amelia Springer, Ph. 785-296-5523, amelia.springer@ks.gov

Cathy Tucker-Vogel, Ph. 785-368-7130, cathy.tucker-vogel@ks.gov

After Hours or Weekends/Holidays contact (24/7):

KDHE Spill Hotline, 785-296-1679

For additional information related to cyanotoxins management for public water supply systems please refer to the following Environmental Protection Agency Website: https://www.epa.gov/cyanohabs



Public Notification Procedure

Public notification for total microcystins will be conducted in accordance with the provisions contained in this section. Should an exceedance of the 2015 EPA Health Advisory occur in the finished water or distribution system samples, Contact KDHE PWS-Section immediately. KDHE will assist the PWS to issue an immediate Tier 1 public Advisory (24-hour notification) informing all customers of the situation. If requested, a public notice template may be provided by KDHE containing the appropriate health effects language and use restrictions.

The geographic area under public notification may be limited based on distribution sample results and provisions described in the system's written contingency plan. Distribution sampling results may also be a consideration when modifying use restrictions or lifting the advisory.

Contingency Planning

KDHE encourages public water systems to work with KDHE, their local emergency management agency, and local health departments to develop a coordinated response to cyanotoxin detections in finished water above EPA designated health advisory Levels. A detailed response protocol should be included in the contingency plans of those PWSs using surface water sources susceptible to a harmful algal bloom.

Items the water system should address in their contingency plan include a communication strategy, including 24-hour emergency contacts, identification of critical users/possible susceptible populations, and considerations for water restrictions or connections to a backup water system. KDHE can provide additional guidance if requested.

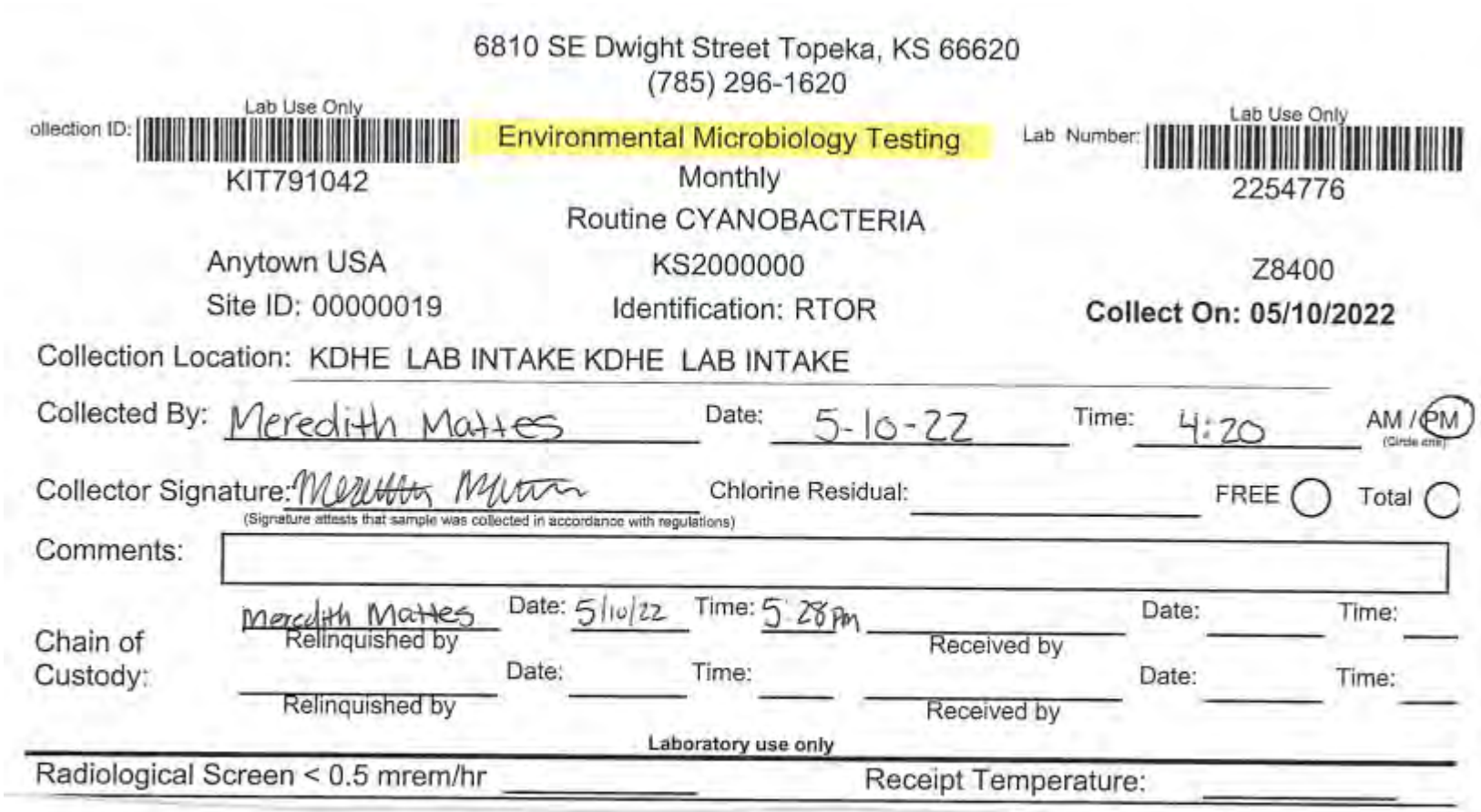
Helpful Links for PWS

Managing Cyanotoxins in Public Drinking Water Systems
https://www.epa.gov/ground-water-and-drinking-water/managing-cyanotoxins-public-drinking-water-systems

Drinking Water Cyanotoxin Risk Communication Toolbox
https://www.epa.gov/ground-water-and-drinking-water/drinking-water-cyanotoxin-risk-communication-toolbox

Cyanotoxin tools -Management Plan Template
https://www.epa.gov/ground-water-and-drinking-water/what-cyanotoxin-tools-are-available-public-water-systems

KDHE HAB Website
https://www.kdhe.ks.gov/777/Harmful-Algal-Bloom



6810 SE Dwight Street Topeka, KS 66620
(785) 296-1620

ollection ID: Lab Use Only KIT791042

Environmental Microbiology Testing
Monthly
Routine CYANOBACTERIA

Lab Number: Lab Use Only 2254776

Anytown USA
Site ID: 00000019

KS2000000
Identification: RTOR

Z8400
Collect On: 05/10/2022

Collection Location: KDHE LAB INTAKE KDHE LAB INTAKE

Collected By: Meredith Mattes Date: 5-10-22 Time: 4:20 AM / PM (Circle one)

Collector Signature: Meredith Mattes (Signature attests that sample was collected in accordance with regulations)

Chlorine Residual: FREE ◯ Total ◯

Comments:

Chain of Custody:

	Date	Time		Date	Time
Meredith Mattes (Relinquished by)	5/10/22	5:28 PM	(Received by)		
(Relinquished by)			(Received by)		

Laboratory use only

Radiological Screen < 0.5 mrem/hr

Receipt Temperature:

Example of Laboratory Algae Submission/Chain of Custody form – completed

APPENDIX G

Public Health Release Example

Kansas
Department of Health and Environment

For Immediate Release
Oct. 7, 2021

Public Health Advisories for Kansas Lakes Due to Blue-Green Algae

TOPEKA – The Kansas Department of Health and Environment (KDHE) and the Kansas Department of Wildlife and Parks (KDWP) have issued several public health advisories for Kansas lakes due to blue-green algae.

KDHE and KDWP urge Kansans to be aware of active advisories before participating in any water recreation including kayaking, waterfowl hunting and anglers. Blue-green algae blooms are unpredictable, and conditions can change quickly. Harmful algae blooms (HAB) typically begin in May and can occur through October or later. They generally coincide with longer days and warm water temperatures and often flourish in nutrient-laden waters. However, dead algae can wash up on shorelines and in marshy areas and persist for long periods. Children and dogs are most susceptible to toxin exposure.

A HAB may look like foam, scum or paint floating on the water and be colored blue, bright green, brown or red. Blooms can develop rapidly; if the water appears suspicious or there is decaying algae on the shore, avoid contact and keep dogs away. These toxins can be absorbed by ingestion, inhalation of aerosols and even skin contact. Symptoms vary depending upon the type of exposure (e.g. direct contact, ingestion, inhalation) but can include rash, vomiting, diarrhea, fever, sore throat, and headache. If you, or your dog, come into contact with algae rinse the area with clean, fresh water.

Active Advisories

Warning
Ford County Lake, Ford County
Gathering Pond at Milford, Geary County
Jerry Ivey Pond, Saline County
Lake Afton, Sedgwick County
Lake Jeanette, Leavenworth County
Melvern Outlet Pond, Osage County
Melvern Outlet Swim Pond, Osage County
Milford Lake Zone C, Geary/Dickinson/Clay Counties
Neosho Co SFL, Neosho County
River Pond below Tuttle Reservoir, Riley County (new)
Riverwalk Landing Pond, Geary County
South Lake, Johnson County

Watch
Big Eleven Lake, Wyandotte County
Cheney Lake, Reno County
Colwich City Lake, Sedgwick County (lowered Oct. 7)
Harvey County East Lake, Harvey County
Milford Lake Zone A, Geary County
Milford Lake Zone B
Peyton Creek Dam #104, Chase County (new)
Roses Lake, Johnson County
Webster Reservoir, Rooks County

Lifted on Oct. 7
Hodgeman Co SFL, Hodgeman County
Marion Reservoir, Marion County
Pony Creek Lake, Brown County

A **Warning status** indicates that conditions are unsafe for human and pet exposure. Contact with the waterbody should be avoided.

When a warning is issued, KDHE recommends the following precautions be taken:

- Lake water is not safe to drink for pets or livestock.
- Lake water, regardless of blue-green algae status, should never be consumed by humans.
- Water contact should be avoided.
- Fish may be eaten if they are rinsed with clean water and only the fillet portion is consumed, while all other parts are discarded.
- Do not allow pets to eat dried algae.
- If lake water contacts skin, wash with clean water as soon as possible.
- Avoid areas of visible algae accumulation.

A **Watch status** means that blue-green algae have been detected and a harmful algal bloom is present or likely to develop. People are encouraged to avoid areas of algae accumulation and keep pets and livestock away from the water.

During the watch status, KDHE recommends the following precautions be taken:

- Signage will be posted at all public access locations.
- Water may be unsafe for humans/animals.
- Avoid areas of algae accumulation and do not let people/pets eat dried algae or drink contaminated water.
- Swimming, wading, skiing and jet skiing are discouraged near visible blooms.
- Boating and fishing are safe. However, inhalation of the spray may affect some individuals. Avoid direct contact with water, and wash with clean water after any contact.
- Clean fish well with potable water and eat fillet portion only.

KDHE investigates publicly-accessible bodies of water for blue-green algae when the agency receives reports of potential algae blooms in Kansas lakes. Based on credible field observation and sampling results, KDHE reports on potentially harmful conditions.

If you observe a scum or paint-like surface on the water, small floating blue-green clumps or filaments in the water, or if the water is an opaque green, avoid contact and keep pets away. These are indications that a harmful bloom may be present. Pet owners should be aware that animals that swim in or drink water affected by a harmful algal bloom or eat dried algae along the shore may become seriously ill or die.

For information on blue-green algae and reporting potential harmful algal blooms, please visit www.kdheks.gov/algae-illness/index.htm.

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Protect and Improve the Health and Environment of all Kansans

APPENDIX H

Jar and Stick Tests

The Jar and Stick Tests

Option for testing your pond:

There are a couple of simple tests that a pond owner or manager can do, at no cost, to determine if a green pond has a blue-green algae community, or if any algal material visible at the water surface is a blue-green surface scum.

NOTE: No test is 100% perfect, and that includes the jar test for blue-greens (cyanobacteria). The test relies on the buoyancy adaptation of most free-floating (planktonic) blue-green algae. In Kansas, bloom complaints are overwhelmingly the result of the forms that are buoyant. However, there is a small possibility (<2%) that the algae in your particular test happen to be non-buoyant species of blue-greens, resulting in a false negative test. Likewise, some swimming forms of non-cyanobacterial algae (like Euglenoids) may form a surface layer during a jar test, resulting in a false positive. Fortunately, most *Euglena* blooms will be reddish in color rather than green, allowing for their identification. Although the jar test does provide a quick and inexpensive way to confirm whether you have a blue-green community in your lake, it does not tell you what species are present, nor does it tell you whether they are actually producing toxins. Be aware, too, that just having blue-green algae present does not mean your pond is automatically hazardous. Many lakes and ponds in Kansas typically have blue-green algae in them. Hazardous conditions occur when the concentration of blue-green algae is high, and composed of species capable of generating toxins. For that information, a microscopic examination of the water, combined with a chemical test for toxins, would be required for a more complete picture.

The Kansas Department of Health and Environment only tests samples from public waterbodies. Kansas State Veterinary Diagnostic Lab, for a small fee, can assist in issues regarding private waterbodies. If you are conducting one or both of these tests on your private farm pond or lake and you determine that you do have a blue-green bloom occurring in your pond, you may obtain further assistance by going to this website:

https://www.kdhe.ks.gov/807/Info-for-Private-Waterbody-Owners

THE JAR TEST PROCEDURE

Purpose

Look out over the pond and see if the water looks very green. To decide whether the "green" is blue-green algae in the pond, or just an overabundance of some of the more beneficial types of planktonic algae, a simple test can be conducted called the "**jar test**."

Follow this step by step process to make an initial assessment of the pond in question.

Materials

- Clear jar (pint to quart size) – A Mason (canning) jar or a store-bought pickle jar with the label removed works well.
- Rubber or latex gloves.
- Plastic bag or other containment device

Procedure

1. Find an appropriate clear glass jar with a screw top lid.
2. For safety reasons, use rubber or latex gloves to collect a sample of water from the pond in question to prevent skin exposure.
3. Collect the water just below the surface of the water.
   a. DO NOT collect sample directly from the surface but collect just under the surface to avoid collecting just the scum on the top layer of the water.
4. Fill the jar about ¾ of the way full with the pond water. (See Photo 1.)
   - (DO NOT fill the jar completely to the top. Algae will give off gases and may cause of buildup of pressure inside the jar causing it to break.)

Photo 1 – Initial Samples

5. Wipe off any scum that may be on the outside of the jar.
6. Screw the lid onto the jar.
7. Be aware that the jar may be contaminated with any toxins present in the water. To avoid contamination of other surfaces, place the jar in a plastic bag or other containment device.
8. Place the jar in a cold refrigerator and leave it completely undisturbed overnight.
9. The next day, **carefully** remove the jar from the refrigerator and look to see where the algae have accumulated.
   a. **IT IS VERY IMPORTANT** that you do not shake or agitate the jar in any way. If you do, this will mix the algae into the water again and you will not get usable test results.

9. If the algae are all settled out near the bottom of the jar, then that is a likely indication that the lake does not have a lot of blue-green algae growing in it. (See arrow on Photo 2.)

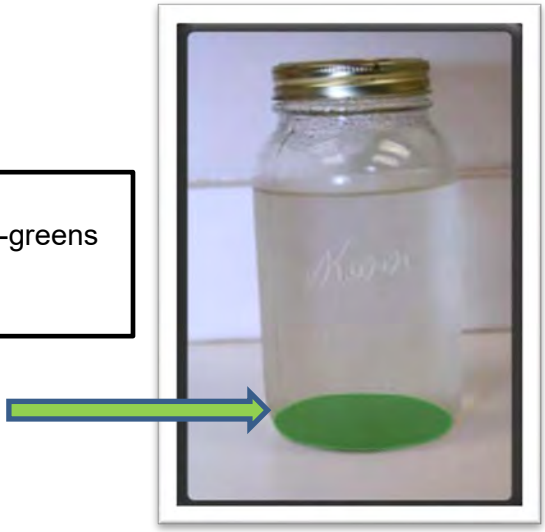


Photo 2 – NO - Blue-greens (Negative)

If the algae have formed a green ring around the top of the water in the jar, or just seem to be collected at the air/water divide, there is a strong possibility that the pond does have a blue-green algae community present. (See arrow on Photo 3.)

Photo 3 – YES - Blue-Greens (Positive)

THE STICK TEST PROCEDURE

Purpose

Look out over the pond and see if a mat of green material is floating on the surface. Is it blue-green algae forming a surface scum, or is it a mat of floating filamentous green algae (often called “fisherman’s moss” or “string algae”)? A simple test to determine what the material might be is called the “stick test.”

Materials

- Sturdy stick – Make sure it is long enough to reach into the water without getting algae on your hands.
- Rubber or latex gloves

Procedure

1. Find a sturdy stick.
2. Put rubber or latex gloves on before attempting to retrieve a sample of the green material from the pond to prevent skin exposure.
3. Thrust the stick into the surface mat and slowly lift out of the water.
   a. Make sure you do not fall into the water while attempting to retrieve material.
4. Look at the end of the stick to see what came out of the water.
   a. If the stick comes out looking like it has been thrust into a can of paint, the mat on the pond is likely to be a blue-green algae scum.
   b. If the stick pulls out strands that look like green hair or threads, the mat on the pond is likely filamentous green algae, NOT cyanobacteria. (Although filamentous green algae can be a nuisance when over-abundant, they do not pose a danger to your health.) (See Photo 1.)

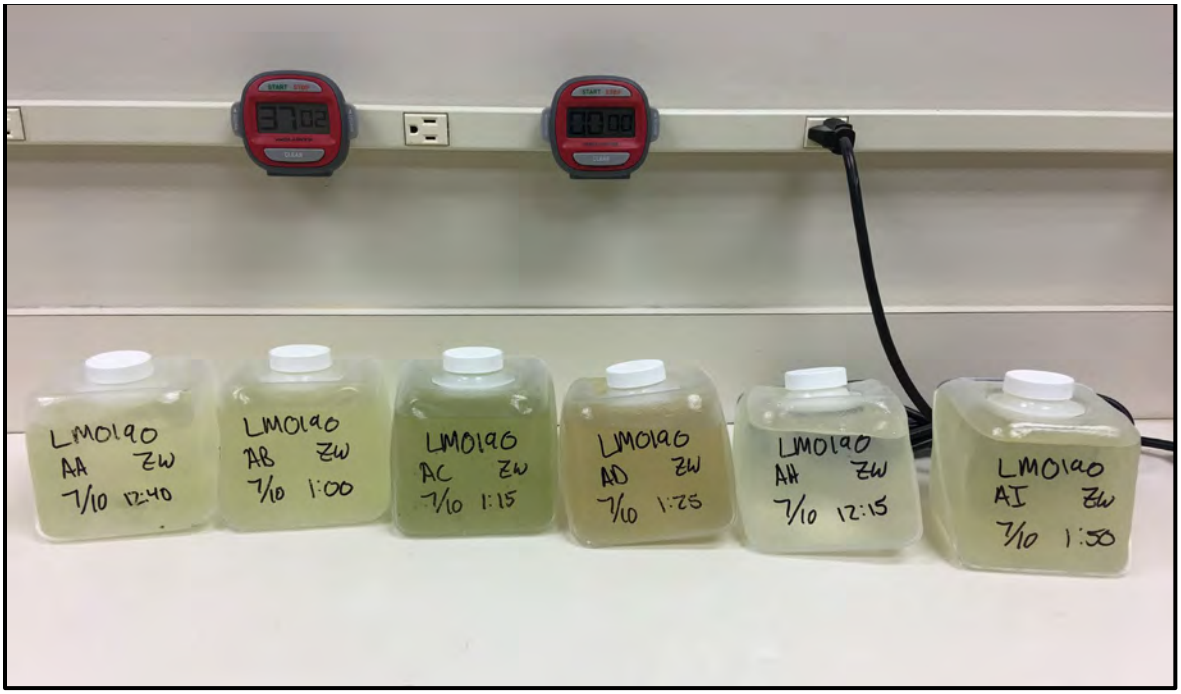
Photo 1 - Filamentous algae

Note: The stick test can fail when a particular type of blue-green alga is present. This type of algae is called *Lyngbya wollei*. This species of blue-green algae can form tough filamentous mats that float to the surface, similar to the mats formed by harmless filamentous green algae. However, *Lyngbya wollei* typically will have a very putrid sewage-like odor, which filamentous green algae do not. *Lyngbya wollei* mats also will often release a purple pigment in the water around them, which is something filamentous algae do not do. (See Photo 2.)

Photo 2 - *Lyngbya wollei*

APPENDIX I

Taxonomic Analysis Priority



In each picture shown above, the samples were from different sampling locations in one lake. In this instance, KDHE will test all samples for their levels of microcystin. In cases of limited resources, KDHE may choose the sample with the appearance of the highest level of blue-green algae for taxonomic (cell count) analysis. If it is difficult to tell visually which sample has the most blue-green algae, KDHE will use best professional judgement to determine which sample is likely to have the most negative impact on human health. Data informing this decision could be the importance of the location for human health, wind conditions during sampling, reporting from the field, photographic evidence, jar test results, or previous analysis results. In the event that resources are limited, an initial toxin analysis can preclude

taxonomic analysis (i.e. in the event that two consecutive toxin tests are necessary to downgrade an advisory from a “Warning” to a “Watch,” a toxin test alone can be performed.)

APPENDIX J

Standard Operating Procedures for Algal Samples

Procedure	Last Revised
Protocol for Algal Sample Collection (HAB-001)	05/10/22
Initial Processing of Algal Samples (HAB-002)	05/10/22
Microcystin Testing Using ELISA Coated Tube Kit (HAB-003)	05/10/22

PROTOCOL FOR ALGAL SAMPLE COLLECTION (HAB-001)

I. INTRODUCTION

A. Purpose

The following paragraphs describe the procedures for the collection, preservation, and transport of algal samples from water bodies with a validated HAB complaint. Exact collection bottles can vary, and the specifics of any instance will be communicated to the sampler.

B. Minimum Staff Qualifications

Personnel implementing this SOP should be an employee of KDHE or a partner agency who has had training/experience in ambient water sampling and field measurement. They must also receive training from KDHE personnel for HAB sample collection protocols.

C. Equipment/Accessories

1. Cubitainers – 1 per sample location
2. Amber Glass Preserved, Chilled Anatoxin-Saxitoxin Sampling Bottle – 1 per proxy sample station (“proxy” stations are those associated with raw water intakes for Public Water Supplies)
3. Small, plastic, Microcystin-Cylindrospermopsin Sampling Bottle – 1 per proxy sample station
4. Nutrient Bottle - 1 per HAB event (when nutrient samples are requested)
5. Waterproof permanent marker
6. Pole sampler with attached plastic beaker
7. GPS unit or smartphone with GPS capability
8. Camera or smartphone with camera
9. Paper Towels
10. Cooler
11. Cold packs or ice
12. Zip lock plastic bags for containment of concentrated samples
13. Tap or distilled water
14. Large trash bags

15. Map of area

II. PROCEDURES

A. Collection of Algal Samples - (one cubitainer per site)

NOTE: No samples should be taken early morning, if possible, as blooms often sink below the surface overnight and will not surface until late morning.

1. Take site photos, some close-up of the water and some facing out onto the open water;
2. Fill out Chain of Custody Form with necessary information;
3. Using a pole sampler with an attached beaker, either a “grab” or “composite” sample can be collected.

    a. *“Grab” Samples:*

    1) Verify that the designated sampling location(s) where a sample is to be collected is representative of a major public access area where the public will have full access to the water.

    2) Mark the cubitainer (clear, plastic, 1-liter cube shaped bottle, non-preserved) with the following information:

    a. Sample Station I.D. number

    b. Sample Collection Time

    c. Sample Collection Date

    d. Sample Collector’s Name or Initials

    3) Inflate the cubitainer. This can be done by removing the cap and gently exhaling into the opening until it completely inflates. (Do not contaminate the cube by expelling saliva into the container.)

    4) Submerge the pole sampler’s beaker open end down through the water until completely submerged. Slowly turn the sample pole until the beaker is sideways and approximately 1-2” under the water’s surface. Once the beaker is filled, pull the sample pole and attached beaker out of the water.

    5) Pour collected sample into the inflated cubitainer. It generally takes two of these processes to fill one cubitainer.

    6) Leave a headspace in the container of at least ½” for gas expansion.

    7) Secure the lid and wipe the cubitainer until it is clean and dry. Place in a plastic zip lock bag and then in a cooler.

    8) Move to your next sampling location.

    9) If sample collection is required in the future at that same public access area, then collect as close as possible to that exact point. (Do not “chase the

scum" that might appear a few feet away from your original sampling point.) This will maintain consistency of the sampling activities.

b. *"Composite" Samples:*

1) Verify that the designated sampling location(s) where a sample is to be collected is representative of a major public access area where the public will have full access to the water.

2) Mark the cubitainer (clear, plastic, 1-liter cube shaped bottle, non-preserved) with the following information:

a. Sample Station I.D. number

b. Sample Collection Time

c. Sample Collection Date

d. Sample Collector's name or initials

3) Inflate the cubitainer. Inflating the cubitainer can be done by removing the cap, gently exhaling into the opening until it completely inflates. (Do not contaminate the cube by expelling salvia into the container.)

4) Submerge the pole sampler's beaker open end down through the water until completely covered. Slowly turn the sample pole until the beaker is sideways and approximately 1-2" under the water's surface. Once the beaker is filled pull the sample pole and attached beaker out of the water.

5) Pour collected sample into a clean bucket. Continue this process collecting samples from various locations around the dock, (*e.g.,* one from each side of the dock).

6) Once all samples have been collected and poured into the bucket, swirl the bucket to mix.

7) Pour the mixed sample into the inflated cubitainer.

8) Leave a headspace in the container of at least ½" for gas expansion. Secure lid, wipe cubitainer clean, and place it inside a plastic bag.

9) If sample collection is required in the future at that same public access area, then collect as close as possible to that exact initial point. (Do not "chase the scum" that might appear a few feet away from your original sampling point.) This will maintain consistency of the sampling activities.

B. How to Collect Water Samples for Drinking Water Analysis – (Anatoxin-Saxitoxin and Microcystin-Cylindrospermopsin for KHEL):

1. Using a pole sampler with an attached beaker or bucket with rope and swivel, a proxy sample can be collected.

2. Verify that the designated sampling location(s) is representative of where a public water supply system would be pulling their raw water samples.

3. Mark the sample bottles (amber glass preserved, chilled Anatoxin-Saxitoxin sampling bottle and a plastic, Microcystin-Cylindrospermopsin sampling bottle) with the following information:

   a. Sample location I.D. number

   b. Sample Collection Time

   c. Sample Collection Date

   d. Sample Collector's Name or Initials

4. Remove the cap.

5. Submerge the pole sampler's beaker open end down through the water until completely covered. Slowly turn the sample pole until the beaker is sideways and approximately 1-2" under the water's surface. Once the beaker is filled pull the sample pole and attached beaker out of the water. Do the same process for a bucket and rope.

6. Pour collected sample into the bottles, but be sure not to overfill as this will spill the preservatives.

7. Leave a headspace in the container of no less than ½" for gas expansion.

8. Secure the lid and wipe the bottle until it is clean and dry. Place in a cooler.

9. Move to your next sampling location.

10. If sample collection is required in the future at that same public access area, then collect as close as possible to that exact initial point. (Don't chase scum that might appear a few feet away from your original sampling point.) This will maintain consistency of the sampling activities.

C. How To Collect Nutrient Samples - (one Cubitainer and one Nutrient bottle per site):

1. Using a clean pole sampler with an attached beaker, collect a "grab" sample.

   a. Nutrient samples will be collected only from designated locations believed representative of the lake's normal ambient sampling station. Verify that the location where the sample is to be collected is at the normal ambient sampling station or as close as possible to that station location.

4. Mark both the nutrient container, (brown, opaque, plastic 250 milliliter bottle, Sulfuric Acid preserved) and a cubitainer with the following information:

   a. Sample Location I.D. number

   b. Sample Collection Time

   c. Sample Collection Date

   d. Sample Collector's name or initials

5. Submerge the beaker's open end down through the water until completely covered. Slowly turn the sample pole until the beaker is sideways and approximately 1-2" under the water's surface. Once the beaker is filled pull the sample pole and attached beaker out of the water.
6. Carefully open the Nutrient bottle. (The bottle contains a Sulfuric Acid preservative and will burn the skin or clothing.)
7. Slowly pour collected sample into the bottle making sure not to overfill, as a loss of preservative will affect the integrity of the sample.
8. Secure the lid tightly and wipe clean and dry. Place the sample container in a zip lock bag and secure bag. (Placing the container in its own individual bag will minimize the potential of cross contamination).
9. Follow the "How to Collect Phytoplankton Samples" directions to fill the cubitainer for additional nutrient parameters.
10. Place containers in a cooler.

*****REMINDER: All nutrient samples collected should be taken 1 to 2 inches under the water surface. Samples do not need to be taken at deeper depths when sampling for blue-green algae. Do not "skim" from the surface (the air/water interface).**

D. Cleaning Equipment Between Samples:

1. Between Sampling Locations at the Same Waterbody
   - **a.** After the sample has been collected, discard any remaining water from sampling equipment.
   - **b.** Wipe all equipment dry with paper towel
   - **c.** Once at the next sampling location, rinse sampling equipment with ambient water from a location that is different from but near the location where the sample is to be collected.
   - **d.** Discard rinse water, then move to sampling location to collect sample.
2. Between Different Water Bodies
   - **a.** Clean all sampling equipment with tap water. Be especially diligent to wash thoroughly if the equipment was used in a water body known or suspected to have zebra muscles.
   - **b.** Once at sampling location, rinse sampling equipment several times with ambient water at a location that is different from but near the location where the sample is to be collected.
   - **c.** Discard rinse water, then move to sampling location to collect sample.
   - **d.** Follow the above directions if additional samples are to be collected at the same waterbody.

E. Preparing Samples for Shipment:

1. Wipe dry the exterior of all containers and ensure that lid is secured tightly. Place container inside zip lock plastic bag if the sample is being shipped via commercial courier, or if the sample is sufficiently concentrated that could contaminate the cooler or harm the recipient if it leaks

2. Place all containers in a cooler along with a cold pack(s). If ice is used, double bag it first before placing in the cooler. This will minimize the potential of cross-contamination or making a mess when the ice melts. Plastic pop bottles filled with water and then frozen can also be used in place of cold packs. Place enough cold packs or ice in the cooler to keep the samples cool. **DO NOT FREEZE THE SAMPLES.**

3. Fill out the algae and/or the KHEL PWS submission/chain-of-custody form (see **Appendix E**). When filling out the algae sampling form, include environmental conditions at time of sampling, *e.g.,* water and air temperature, wind speed/direction, cloud cover, any unusual conditions.

4. If the samples are to be delivered by a carrier company, then place the submission form(s) inside a plastic bag and tape to the inside the lid of the cooler.

5. If samples are to be transported to the lab(s) by the collector or handed off to another partner, then place the submission form(s) inside a plastic bag and tape to the OUTSIDE the cooler so it is readily accessible for additional chain of custody signatures.

6. Secure the cooler.

D. Shipment of Samples:

1. Samples must be shipped no later than overnight.

2. At any time that the samples exchange to a different handler, then the chain-of-custody must be signed. Exception is if shipment is sent by commercial carrier, then note which company the samples were “relinquished to …”

3. All algae samples are to be delivered or sent to:

Kansas Dept of Health and Environment
BOW-MASS HAB Response Program
1000 SW Jackson
Suite 420
Topeka, Kansas 66612-1367

4. All nutrient samples are to be sent to:

KHEL Laboratories
Forbes Field, Building 740
Topeka, Ks. 66620-0001

5. If necessary, Public Drinking Water samples will be taken to the Kansas Health and Environmental Lab by BOW/PWS staff, for those not analyzed by BOW-MASS.

If samples are shipped by commercial carrier, minimize shipping costs by sending all samples to BOW/BEFS, including nutrient samples, and program staff will carry the nutrient samples to the lab. Send emails at shipping time to confirm this arrangement.

Further questions? Contact:

HAB response team:
Josh Cullum – (785) 296-0079
Katlynn Decker (785) 296-5580
Elizabeth Smith – (785) 296-4332
Taxonomy and toxin analysis:
Britini Jacobs – (785) 296-5576
Tony Stahl – (785) 296-5578
Policy:
Tom Stiles 785-296-5500

INITIAL PROCESSING OF ALGAL SAMPLES (HAB – 002)

I. INTRODUCTION

A. Purpose

The following paragraphs describe the procedure for the collection, preservation, and transport of algal samples from water bodies with a validated HAB complaint.

B. Minimum Staff Qualifications

Personnel implementing this SOP should meet requirements for State of Kansas Environmental Associate job class and be experienced in the measurement of the physicochemical and microbiological properties of surface water and the performance of environmental field investigations.

C. Equipment/Accessories

1. Lugol's solution

2. Sample bottles with lids

3. Yellow round labels

4. Chain of Custody sheet

II. PROCEDURES

A. Receiving samples

1. Coolers containing samples will be directed to BOW-MASS HAB Response Team or Analytical Support staff. This is usually around 10:00 to 10:30 a.m. on Tuesday or Wednesday, depending upon the carrier bringing in the samples.

2. Upon receiving the coolers, remove the samples and paperwork.

3. Place samples in refrigerator in the Algal ID lab until ready to process. Make sure the refrigerator door closes completely.

4. On the back of the Algae Sample Submission Form (see **Appendix E**) and under the Chain of Custody section, date and sign by the Received By line. Also note whether the sample was cold when received.

5. The Algae Sample Submission Forms are to be kept with the samples and are placed by the algal taxonomist's scope. Once sample analysis is completed, then the Sample Submission Form is to be filed by year with the lake reports.

B. Algal Preservation

1. When ready to process samples, remove them from the refrigerator and arrange on the lab bench in the order in which they will be processed. Take a photo of the samples from each waterbody.

2. In the drawer directly to the left of the sink, remove the round stickers and a pencil to mark each bottle used to preserve samples.

3. In the chlorophyll lab room (small room) and directly to the left of the door on a cart, remove one bottle for each sample to be preserved (or two bottles, if live samples are also to be retained). Lids to the bottles are in the far-right bottom cabinet and on the bottom shelf.

4. Line the bottles and lids up on the counter by the refrigerator in the Algal ID lab. Write on the stickers the lake number and sampling point (for example – Milford would be 190 as the lake number and AA is one of the sample points). Place the stickers on top of the lids prior to preserving sample.

5. In the same room and under the sink is the brown Lugol's container. It has a small needleless syringe attached to it. Place 5 drops of Lugol's in each bottle. Be careful with this as Lugol's does stain just about everything it comes in contact with, including the counter, hands, and clothes. Place bottle back under the sink.

6. Take the first sample and shake cubitainer vigorously to thoroughly mix the water and contents. Over the sink, carefully pour sample water into one of the small bottles containing the Lugol's until it is about to the line where the neck begins (about ¼ inch from the top). Double check that the lid you put on the bottle matches the sample you poured into it. Screw that lid onto the bottle securely.

7. Optional step: along with each preserved sample, aliquot another sample into a second vial, label it the same, and place into the refrigerator so that live sample can be compared to preserved.

8. A portion of the remaining sample will need to be frozen to conduct the ELISA toxicity test, so pour a good portion of the sample down the drain but retain at least a ½ inch in the bottom of the cubitainer.

9. Continue this process with all the remaining samples.

10. Place the preserved samples on the table with the algal taxonomist's microscope.

11. Place the cubitainers with the saved water into the ultracold freezer..

12. Scan the chain of custody forms (in IT office or upstairs, or through OneDrive scan to PDF function on an agency mobile hone) for electronic records retention, and return hard copy form to the algal taxonomists' bench.

MICROCYSTIN TEST USING ABRAXIS ELISA COATED TUBE TESTS OR EQUIVALENT (HAB – 003)

I. INTRODUCTION

A. Purpose

The following paragraphs describe the procedures to test water samples for the presence and quantification of microcystins.

B. Minimum Staff Qualifications

Personnel implementing this SOP should be experienced in the measurement of the physicochemical and microbiological properties of surface water.

C. Equipment/Accessories

1. ABRAXIS ELISA Coated Tube Test
2. Test tube rack to place tubes in for analysis
3. Timer
4. Use of water in sink area
5. Thawed water samples from freezer of lakes that are under investigation
6. Paper and Pencil
7. ABRAXIS Model 6+ Colorimeter
8. Kimwipes
9. Adjustable pipette (0.1 – 1.0 mL) and disposable tips

II. PROCEDURES

A. Preliminary procedures:

1. Remove frozen samples from freezer to begin thawing, ensuring that all samples have returned to room temperature before starting the process.
2. Read all the instructions before running the kit.
3. Allow all reagents to reach room temperature before beginning (at least 30 minutes with un-boxed tubes and reagents at room temperature – do not remove tubes from bag with desiccant until they have warmed up).
4. Organize all samples and reagents so that steps can be performed with as few delays as possible.
5. Do not run more than 12 tubes at a time.

B. Dilutions

1. To complete the assay in a timely manner, it may be helpful to dilute samples that are potentially high in toxin before testing them (*i.e.* based on previous week's analysis results, or based on visual appearance of sample). A dilution of 1:5 is often a good starting place; samples that do not fall within the absorbance range of the calibrators will need to be diluted at a different level.
2. A list of common dilutions is printed in the ELISA book, and include:

Ratio	Sample (mL)	DI Water (mL)	Dilution multiplier
1:1	0.5	0.5	x 2
1:2	0.5	1	x 3
1:3	0.5	1.5	x 4
1:4	0.5	2	x 5
1:5	0.5	2.5	x 6
1:6	0.5	3	x 7
1:7	0.5	3.5	x 8

3. Multiply the resultant concentration by the dilution multiplier to find the actual concentration of the sample.

C. Completing the assay.

1. Remove the required number of coated test tubes from the re-sealable aluminum pouch. Place the tubes in a rack capable of holding 12 mm test tubes securely and label appropriately.
2. Label appropriately so as not to mix up samples.
3. Make sure to run a set of standards for calibration curve.
4. Add 500 uL of enzyme conjugate solution to the coated tubes successively using a stepping pipette.
5. Add 500 uL of the standard solutions, controls, or samples into the appropriate coated tubes.
6. Add 500 uL of antibody solution to the coated tubes successively using a stepping pipette. Carefully vortex the tubes at a low speed for 1 to 2 seconds or swirl the tubes rapidly allowing the contents to mix and being careful not to spill or splash contents.
7. Incubate the tubes for 20 minutes at room temperature.
8. Decant the contents of the tubes by vigorously shaking into a sink. Blot the inverted tubes on absorbent paper towels. Flood the tubes with 5 mL of diluted (1x) washing

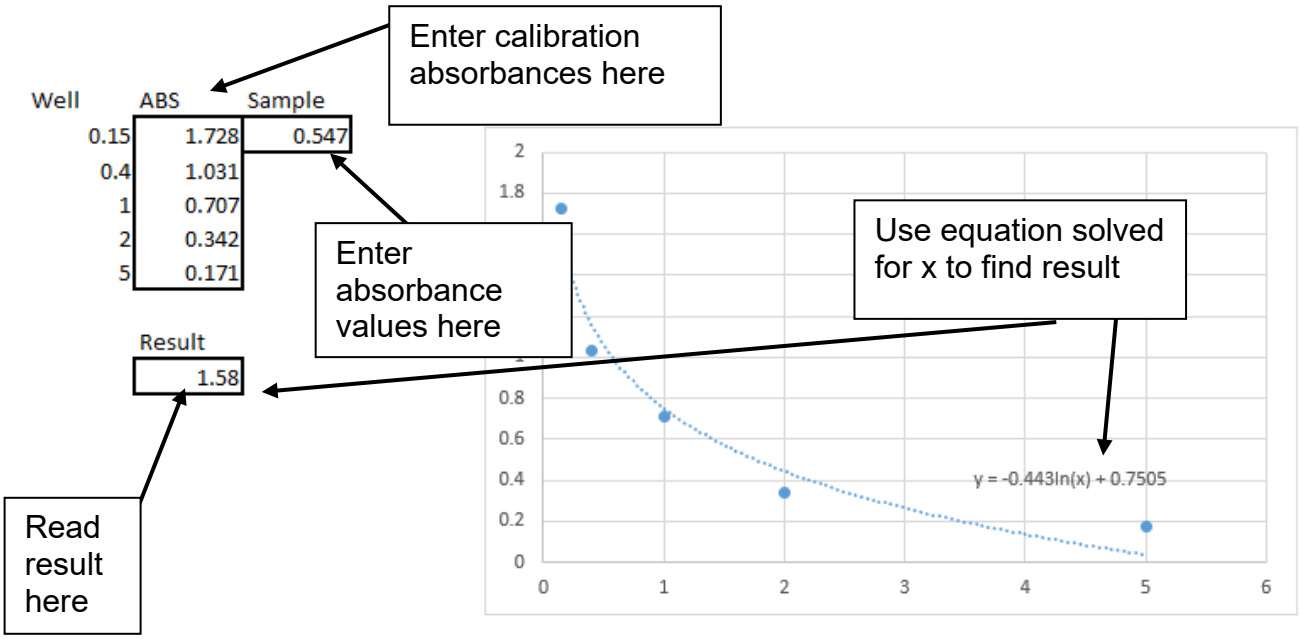
solution, decant by shaking vigorously into a sink, and blot the inverted tubes on absorbent paper towels. Repeat four times for a total of five washes.

9. Add 500 uL of substrate (Color) solution to the tubes. Carefully vortex the tubes at a low speed for 1 to 2 seconds or swirl the tubes rapidly, being careful not to spill or splash the contents.
10. Incubate the tubes for 20 minutes at room temperature. Protect the tubes from direct or indirect sunlight.
11. Add 500 uL of stop solution to the tubes in the same sequence as for the substrate solution.
12. Read the absorbance at 450 nm using a test tube photometer within 15 minutes after the addition of stopping solution.

D. Interpreting the results using a colorimeter.

1. Fill a blank tube half way with DI water.
2. Plug in the Colorimeter and wait for it to turn on and warm up (5 minutes).
3. Remove the meter cap. Wipe excess liquid and finger prints off tube using a Kimwipe. Place the tube in the reader.

4. Press the SEL/ESC button and ensure [1]BLANK is selected.
5. Check the blank by pressing the READ/ENTER button. The instrument will show "- - - -" followed by the results.
6. Remove the blank and place the samples/calibration tubes into the reader.
7. Press the SEL/ESC button and navigate to [4]SAMPLE. Agree to wipe previous data if asked.
8. Press the READ/ENTER button. The instrument will show "- - - -" followed by the results. Record the absorbance values in the Laboratory ELISA Assay Work Sheet.
9. Repeat steps 6-7 for the calibrator tubes prepared and all the samples. Record the absorbance values in the Laboratory ELISA Assay Work Sheet. Make sure to have all tubes and measurements properly labeled to their correct site.
10. To find the results, enter the absorbance values of the calibration tubes and the sample tubes into the Envirologix Interpolation excel spreadsheet. Calibration values do not change, but simply change out the "Sample" cell to see all values.
11. NOTE: the results cell must be updated every week using a reversed equation from the calibration curve. Once calibration ABS values are entered, the best fit curve on the graph will have a formula. Solve for x,and put this equation into the "Results" cell, with Y being the sample cell. This will allow you to input ABS and receive an answer back in ug/L of Microcystin.



	Lw Acc	Up Acc
Control = 0.75+/- 0.188	0.562	0.938
Std. 5 = 5.0 +/- 1.25	3.75	6.25

NOTE: For all diluted samples, the test results must be multiplied by the appropriate dilution factor to yield the final concentration of the original sample.

APPENDIX K

Lake Visitation Potential

LAKE VISITATION POTENTIAL MULTIPLICAND EXPLANATION

In determining a lake's visitation potential, the following equation was used:

Population 30 × Lake Size Factor × Lake Density Factor × Public Access Factor × Contact Recreation Factor = Lake Visitation Potential

The following table is an explanation of the multiplicands in the above equation:

Population 30	Population within 30-mile radius		
Lake Size Factor	Based on lake size in acres, divided into classes and then assigned size factors:		
	Size Class	**Size Factor**	
	<1 acre =	**.001**	
	1 – 5 acres =	**.01**	
	5 – 50 acres =	**0.1**	
	50 – 500 acres =	**0.5**	
	500 – 1000 acres =	**1.0**	
	> 1000 acres =	**2.0**	
Lake Density Factor	Based on number of lakes within 30 mile diameter and then assigned density factors:		
	Number of Lakes	**Density Factor**	
	1 to 3 lakes =	**1.0**	
	4 to 6 lakes =	**0.8**	
	7 to 16 lakes =	**0.6**	
	> 16 lakes =	**0.4**	
Public Access Factor			
	Private Lake	**Open to Public**	
	0.1	**1.0**	
Contact Recreation Factor	Similar but not necessarily identical to factor on the KSWR.		
	Definition	**Primary Contact Attainability**	**Recreation Factor**
	Swimming beach/boating/skiing facilities provided.	Attainable	CR A = **1.0**
	Swimming/boating facilities not provided but water depth greater than 18 inches.	Attainable	CR B = **0.5**
	Waterbody less than 18 inches in depth. Full immersion not likely.	Not Attainable	CR a = **0.1**

HAB KANSAS LAKE RANKING FOR VISITATION POTENTIAL

Top 25% in visitation potential are in the shaded rows;

Lower 75% are in the unshaded region

Lake Name	LM #	County(s)	Centroid Latitude	Centroid Longitude	Pop_30	Acres	Size Factor	Lake_30	Lake Factor	Private	CR_KSWR	CR_PROV	Contact Factor	PWS	Federal Reservoir	Final Score
Hillsdale Lake	LM0350	Miami	38.6800	-94.9230	938,776	4,342.1	2	48	0.4	1	A		1	x	x	751,021
Clinton Lake	LM0300	Douglas	38.9181	-95.3837	609,538	7,341.1	2	59	0.4	1	A		1	x	x	487,630
Cheney Lake	LM0170	Reno, Kingman, Sedgwick	37.7597	-97.8350	534,577	9,765.4	2	25	0.4	1	A		1	x	x	427,662
Perry Lake	LM0290	Jefferson	39.1768	-95.4516	481,198	10,704.1	2	54	0.4	1	A		1		x	384,958
El Dorado Lake	LM0330	Butler	37.8762	-96.7896	311,353	7,419.6	2	13	0.6	1	A		1	x	x	373,624
Pomona Lake	LM0280	Osage	38.6689	-95.5992	343,359	3,781.2	2	45	0.4	1	A		1	x	x	274,687
New Olathe Lake	LM0613	Johnson	38.8763	-94.8715	1,015,606	143.4	0.5	48	0.4	1	A		1			203,121
Shawnee Mission Lake	LM0418	Johnson	38.9839	-94.8033	1,008,193	116.8	0.5	47	0.4	1	A		1			201,639
Gardner City Lake	LM0404	Johnson	38.8474	-94.9275	1,008,128	106.7	0.5	48	0.4	1	A		1			201,626
Wyandotte Co. Lake	LM0424	Wyandotte	39.1635	-94.7819	958,241	339.5	0.5	40	0.4	1	A		1			191,648
Baker Wetlands	LM0144	Douglas	38.9203	-95.2331	922,927	564.5	1	55	0.4	1	B		1			184,585
Milford Lake	LM0190	Clay, Dickinson, Geary	39.1536	-96.9443	153,072	14,607.4	2	14	0.6	1	A		1		x	183,686
Miola Lake	LM0510	Miami	38.5902	-94.8439	650,814	184.7	0.5	43	0.4	1	A		1			130,163
Tuttle Creek Lake	LM0210	Riley, Pottawatomie	39.3449	-96.6652	160,552	11,985.3	2	17	0.4	1	A		1		x	128,442
Wellington Lake	LM0422	Sumner	37.2183	-97.5227	207,783	525.0	1	14	0.6	1	A		1	x		124,670

Lake Name	LM #	County(s)	Centroid Latitude	Centroid Longitude	Pop_30	Acres	Size Factor	Lake_30	Lake Factor	Private	CR_KSWR	CR_PROV	Contact Factor	PWS	Federal Reservoir	Final Score
Augusta Santa Fe Lake	LM0416	Butler	37.7094	-97.0568	618,840	255.8	0.5	28	0.4	1	A		1	x		123,768
Kanopolis Lake	LM0160	Ellsworth	38.6327	-97.9980	99,756	3,459.6	2	10	0.6	1	A		1	x	x	119,707
Augusta City Lake	LM0400	Butler	37.7037	-96.9782	590,088	183.6	0.5	25	0.4	1	A		1	x		118,018
Lake Afton	LM0492	Sedgwick	37.6121	-97.6271	585,157	180.7	0.5	25	0.4	1	A		1			117,031
Harvey Co. East Lake	LM0520	Harvey	38.0512	-97.2034	519,946	185.4	0.5	26	0.4	1	A		1			103,989
Leavenworth Co. SFL	LM0123	Leavenworth	39.1273	-95.1501	1,005,870	151.9	0.5	52	0.4	1	B		1			100,587
Cedar Lake	LM0616	Johnson	38.8448	-94.8419	995,513	61.1	0.5	48	0.4	1	B		1			99,551
Winfield City Lake	LM0508	Cowley	37.3542	-96.8740	242,052	979.1	1	17	0.4	1	A		1	x		96,821
Lone Star Lake	LM0114	Douglas	38.8336	-95.3816	478,139	177.5	0.5	53	0.4	1	A		1			95,628
Marion Lake	LM0200	Marion	38.4002	-97.1218	78,282	6,263.1	2	13	0.6	1	A		1	x	x	93,938
Douglas Co. SFL	LM0113	Douglas	38.8006	-95.1592	840,297	178.2	0.5	57	0.4	1	B		1			84,030
Melvern Lake	LM0270	Osage	38.4988	-95.7908	99,002	6,289.5	2	37	0.4	1	A		1	x	x	79,202
Council Grove Lake	LM0220	Morris	38.6998	-96.5196	96,075	2,899.2	2	20	0.4	1	A		1		x	76,860
Lake Shawnee	LM0122	Shawnee	39.0038	-95.6278	355,021	382.3	0.5	40	0.4	1	A		1			71,004
Big Hill Lake	LM0310	Labette	37.2921	-95.4586	76,871	1,105.3	2	47	0.4	1	A		1	x	x	61,497
Cedar Bluff Lake	LM0130	Trego	38.7864	-99.7784	36,331	5,940.7	2	6	0.8	1	A		1		x	58,130
John Redmond Lake	LM0260	Coffey	38.2515	-95.8029	70,011	8,246.5	2	31	0.4	1	A		1		x	56,009
Carey Park Lake	LM0630	Reno	38.0470	-97.8391	184,333	78.4	0.5	15	0.6	1	A		1			55,300
Quivira Little Salt Marsh	LM0502	Stafford, Reno	38.1142	-98.4891	85,386	8,402.2	2	8	0.6	1	B		1			51,232
Elk City Lake	LM0250	Montgomery	37.2574	-95.8024	62,731	3,418.0	2	23	0.4	1	a	A	1		x	50,185
Hargis Lake	LM0399	Sumner	37.2828	-97.3869	454,988	60.6	0.5	19	0.4	1	B		1			45,499
La Cygne Lake	LM0440	Miami, Linn	38.3625	-94.6548	112,004	2,396.9	2	21	0.4	1	B		1		x	44,802
Gathering Pond	LM0764	Geary	39.0795	-96.8840	147,808	99.3	0.5	14	0.6	1		A	1			44,342

Lake Name	LM #	County(s)	Centroid Latitude	Centroid Longitude	Pop_30	Acres	Size Factor	Lake_30	Lake Factor	Private	CR_KSWR	CR_PROV	Contact Factor	PWS	Federal Reservoir	Final Score
River Park Pond	LM0199	Pottawatomie, Riley	39.2508	-96.5808	146,316	167.8	0.5	14	0.6	1		A	1			43,895
Wellington New City Lake	LM0423	Sumner	37.2071	-97.5270	142,482	206.4	0.5	11	0.6	1	A		1	x		42,745
Kill Creek Park Lake	LM0419	Johnson	38.9120	-94.9729	1,037,216	23.9	0.1	51	0.4	1		A	1			41,489
Quivira Big Salt Marsh	LM0506	Stafford, Rice	38.1903	-98.5114	68,219	13,592.4	2	7	0.6	1	B		1			40,931
Louisburg SFL	LM0438	Miami	38.5065	-94.6762	403,243	271.9	0.5	29	0.4	1	B		1			40,324
Neosho W.A.	LM0534	Neosho	37.4971	-95.1408	96,935	2,845.4	2	69	0.4	1	B		1			38,774
Wabaunsee Co. Lake	LM0420	Wabaunsee	38.8618	-96.1917	189,650	209.5	0.5	27	0.4	1	A		1	x		37,930
Heritage Park Lake	LM0624	Johnson	38.8349	-94.7490	944,242	39.2	0.1	45	0.4	1	A		1			37,770
Wilson Lake	LM0140	Russell, Lincoln	38.9401	-98.5568	23,177	7,846.2	2	4	0.8	1	A		1		x	37,083
Toronto Lake	LM0240	Greenwood, Woodson	37.7672	-95.9392	45,743	2,502.0	2	27	0.4	1	A		1		x	36,594
New Alma City Lake	LM0499	Wabaunsee	38.9735	-96.2978	181,079	50.6	0.5	19	0.4	1	A		1	x		36,216
Strowbridge Reservoir	LM0512	Osage	38.8118	-95.6423	348,889	243.8	0.5	43	0.4	1	B		1	x		34,889
Banner Creek Lake	LM0320	Jackson	39.4514	-95.7783	171,895	487.8	0.5	22	0.4	1	A		1	x		34,379
Osage Co. SFL	LM0124	Osage	38.7675	-95.6707	340,033	132.5	0.5	42	0.4	1	B		1			34,003
Cheyenne Bottoms	LM0504	Barton	38.4752	-98.6753	55,706	26,374.4	2	10	0.6	1	B		1			33,424
Parsons Lake	LM0414	Neosho	37.4105	-95.3426	80,858	820.7	1	53	0.4	1	A		1			32,343
Coffey Co. Lake (Wolf Creek Lake)	LM0396	Coffey	38.2272	-95.6926	73,620	5,037.6	2	32	0.4	1	B		1			29,448
Waconda Lake	LM0180	Osborne, Mitchell	39.4886	-98.3836	17,917	10,745.5	2	4	0.8	1	A		1	x	x	28,667
Lovewell Lake	LM0150	Jewell	39.8978	-98.0640	17,803	2,860.6	2	5	0.8	1	A		1		x	28,485
Marais Des Cygnes W.A.	LM0532	Linn	38.2551	-94.7097	66,169	7,831.3	2	29	0.4	1	B		1			26,468

Lake Name	LM #	County(s)	Centroid Latitude	Centroid Longitude	Pop_30	Acres	Size Factor	Lake_30	Lake Factor	Private	CR_KSWR	CR_PROV	Contact Factor	PWS	Federal Reservoir	Final Score
Louisburg Old Lake	LM0657	Miami	38.6086	-94.6725	652,153	21.5	0.1	39	0.4	1	A		1			26,086
Emery Park Lake	LM0632	Sedgwick	37.6160	-97.3099	630,186	6.6	0.1	30	0.4	1	A		1			25,207
Shawnee Co. SFL	LM0125	Shawnee	39.2053	-95.8046	238,786	122.8	0.5	30	0.4	1	B		1			23,879
Kirwin Lake	LM0110	Phillips	39.6598	-99.1446	14,369	1,039.0	2	6	0.8	1	A		1			22,990
McPherson Wetlands	LM0147	McPherson	38.3401	-97.7528	180,785	1,732.5	2	15	0.6	1	a		0			21,694
Pottawatomie Co. SFL #2	LM0132	Pottawatomie	39.2305	-96.5261	142,940	71.0	0.5	14	0.6	1	B		1			21,441
Herington City Lake	LM0697	Dickinson	38.6635	-96.9943	70,153	170.5	0.5	15	0.6	1	A		1			21,046
Prairie Lake	LM0619	Jackson	39.4899	-95.6885	104,979	61.0	0.5	22	0.4	1	A		1			20,996
Inman Lake	LM0503	McPherson	38.2472	-97.7191	138,394	131.7	0.5	14	0.6	1	B		1			20,759
Herington Reservoir	LM0472	Dickinson	38.6527	-97.0133	69,007	411.5	0.5	15	0.6	1	A		1	x		20,702
Mize Lake	LM0766	Johnson	38.9542	-94.8760	1,015,818	5.7	0.1	50	0.4	1		B	1			20,316
Lenexa City Lake	LM0226	Johnson	38.9651	-94.8396	1,011,255	27.9	0.1	48	0.4	1	B		1			20,225
Lake Quivira	LM0227	Wyandotte, Johnson	39.0395	-94.7719	996,708	161.3	0.5	45	0.4	0	A		1			19,934
Olathe Waterworks Lakes	LM0622	Johnson	38.8752	-94.8045	992,055	9.9	0.1	47	0.4	1	B		1			19,841
Frisco Lake	LM0685	Crawford	37.6206	-94.8304	990,966	12.3	0.1	46	0.4	1	B		1			19,819
Butler Co. SFL	LM0494	Butler	37.5492	-96.6884	131,589	101.5	0.5	16	0.6	1	B		1			19,738
Spring Hill City Lake	LM0735	Johnson	38.7615	-94.8410	978,825	35.4	0.1	47	0.4	1	B		1			19,577
Mary's Lake	LM0614	Douglas	38.9293	-95.2162	941,104	5.2	0.1	64	0.4	1	B		1			18,822
Edgerton City Lake	LM0650	Johnson	38.7635	-95.0045	932,905	7.1	0.1	48	0.4	1	B		1			18,658
Pierson Park Lake	LM0618	Wyandotte	39.0668	-94.7117	920,782	11.6	0.1	40	0.4	1	B		1			18,416
South Lake Park	LM0675	Johnson	38.9580	-94.6688	905,097	5.7	0.1	42	0.4	1	B		1			18,102
Miami Co. SFL	LM0436	Miami	38.4210	-94.7916	180,624	111.3	0.5	26	0.4	1	B		1			18,062
Osage City Reservoir	LM0661	Osage	38.6152	-95.8345	178,212	50.0	0.5	35	0.4	1	B		1			17,821

Lake Name	LM #	County(s)	Centroid Latitude	Centroid Longitude	Pop_30	Acres	Size Factor	Lake_30	Lake Factor	Private	CR_KSWR	CR_PROV	Contact Factor	PWS	Federal Reservoir	Final Score
Jamestown W.A.	LM0528	Republic, Cloud	39.6638	-97.9049	21,871	1,033.7	2	6	0.8	1	B		1			17,497
Tomahawk Park Lakes	LM0417	Johnson	38.9226	-94.6258	865,457	6.0	0.1	37	0.4	1		B	1			17,309
Fall River Lake	LM0230	Greenwood	37.6626	-96.0834	21,411	2,213.7	2	18	0.4	1	A		1		x	17,129
Marion Co. Lake	LM0121	Marion	38.3207	-96.9853	54,058	138.7	0.5	14	0.6	1	A		1			16,217
Ottawa Co. SFL	LM0141	Ottawa	39.1095	-97.5697	80,163	95.6	0.5	5	0.8	1	B		1			16,033
Harvey Co. West Park Lake	LM0490	Harvey	38.0762	-97.5841	381,496	12.6	0.1	26	0.4	1	A		1			15,260
Council Grove City Lake	LM0430	Morris	38.6736	-96.5613	74,881	384.6	0.5	18	0.4	1	A		1	x		14,976
Lake Dabinawa	LM0540	Jefferson	39.1361	-95.2391	740,628	78.6	0.5	54	0.4	0	A		1			14,813
Spring Creek Park Lake	LM0668	Douglas	38.7550	-95.1619	731,640	9.9	0.1	49	0.4	1	B		1			14,633
Linn Valley Lake	LM0443	Linn	38.3799	-94.7183	72,804	114.9	0.5	21	0.4	1	A		1	x		14,561
Lake Meade State Park	LM0106	Meade	37.1666	-100.4342	28,700	66.9	0.5	2	1	1	A		1			14,350
Paola City Lake	LM0732	Miami	38.6147	-94.8934	692,859	24.2	0.1	41	0.4	1	B		1			13,857
Atchison Co. SFL	LM0126	Atchison	39.6345	-95.1755	91,395	61.7	0.5	15	0.6	1	B		1			13,709
Elm Creek Lake	LM0448	Bourbon	37.7568	-94.8543	66,389	91.0	0.5	31	0.4	1	A		1			13,278
Cedar Creek Valley Lake	LM0407	Anderson	38.2439	-95.3196	65,167	311.9	0.5	23	0.4	1	A		1			13,033
Colwich City Lake	LM0175	Sedgwick	37.7819	-97.5297	646,996	8.6	0.1	29	0.4	1	B		1			12,940
Watson Park Lake	LM0644	Sedgwick	37.6446	-97.3411	636,896	22.0	0.1	30	0.4	1	B		1			12,738
Lake Crawford State Park #2	LM0111	Crawford	37.6365	-94.8128	63,595	146.2	0.5	57	0.4	1	A		1			12,719
Emerald Bay Estates	LM0653	Sedgwick	37.7303	-97.3939	630,610	66.9	0.5	29	0.4	0		A	1			12,612
Windmill Lake	LM0645	Sedgwick	37.7132	-97.4183	625,213	17.5	0.1	30	0.4	1	B		1			12,504
Fort Scott City Lake	LM0450	Bourbon	37.7769	-94.7551	62,440	336.9	0.5	31	0.4	1	A		1			12,488

Lake Name	LM #	County(s)	Centroid Latitude	Centroid Longitude	Pop_30	Acres	Size Factor	Lake_30	Lake Factor	Private	CR_KSWR	CR_PROV	Contact Factor	PWS	Federal Reservoir	Final Score
Kid's Lake	LM0636	Sedgwick	37.7217	-97.4139	624,264	9.2	0.1	30	0.4	1	B		1			12,485
Moss Lake	LM0641	Sedgwick	37.7174	-97.4160	624,123	13.8	0.1	30	0.4	1	B		1			12,482
Horseshoe Lake	LM0635	Sedgwick	37.7251	-97.4144	624,121	11.1	0.1	29	0.4	1	B		1			12,482
Vic's Lake	LM0643	Sedgwick	37.7212	-97.4183	624,016	11.5	0.1	30	0.4	1	B		1			12,480
Buffalo Park Lake	LM0222	Sedgwick	37.7041	-97.4752	623,123	12.3	0.1	30	0.4	1	B		1			12,462
Cadillac Lake (Pracht Wetland)	LM0541	Sedgwick	37.7348	-97.4589	621,218	6.4	0.1	30	0.4	1	B		1			12,424
Bone Creek Lake	LM0439	Crawford	37.6212	-94.7481	62,055	515.5	1	54	0.4	1	B		1	x		12,411
Lebo City Lake	LM0412	Coffey	38.4231	-95.8879	61,253	60.9	0.5	25	0.4	1	A		1			12,251
Horsethief Canyon Lake	LM0550	Hodgeman	38.0581	-100.0560	40,315	229.3	0.5	10	0.6	1	A		1			12,095
North Point Lake	LM0758	Cowley	37.3962	-97.1149	576,638	7.9	0.1	27	0.4	1		B	1			11,533
Newton City Park Lake	LM0642	Harvey	38.0508	-97.3520	565,965	34.6	0.1	32	0.4	1	B		1			11,319
Hole In The Rock	LM0228	Douglas	38.7772	-95.2815	565,343	7.8	0.1	54	0.4	1	B		1			11,307
Merrit Lake	LM0208	Leavenworth	39.3479	-94.9213	548,031	6.0	0.1	25	0.4	1	B		1			10,961
Mission Lake	LM0136	Brown	39.6787	-95.5173	53,795	125.8	0.5	17	0.4	1	A		1			10,759
Webster Lake	LM0120	Rooks	39.4002	-99.4346	13,018	948.3	1	6	0.8	1	A		1		x	10,414
Centralia Lake	LM0737	Nemaha	39.7018	-96.1500	34,143	382.6	0.5	11	0.6	1	A		1			10,243
Pleasanton Reservoir	LM0442	Linn	38.1937	-94.6900	50,603	98.2	0.5	22	0.4	1	A		1	x		10,121
Nemaha Co. SFL/W.A.	LM0108	Nemaha	39.7646	-96.0271	32,907	708.3	1	13	0.6	1	B		1			9,872
Murray Gill Lake	LM0487	Chautauqua	37.2373	-96.1928	31,979	405.3	0.5	12	0.6	1	A		1	x		9,594
Madison City Lake	LM0518	Greenwood	38.1055	-96.1520	47,885	100.1	0.5	23	0.4	1	A		1	x		9,577
Olpe City Lake	LM0410	Lyon	38.2483	-96.1849	46,641	76.1	0.5	19	0.4	1	A		1			9,328
Neosho Co. SFL	LM0446	Neosho	37.4242	-95.2000	93,127	72.7	0.5	62	0.4	1	B		1			9,313
Chase Co. SFL	LM0102	Chase	38.3668	-96.5873	46,004	105.9	0.5	17	0.4	1	A		1			9,201

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Melvern Outlet Pond	LM0271	Osage	38.5178	-95.7027	91,938	84.6	0.5	31	0.4	1		B	1			9,194
Ogden City Lake	LM0117	Riley	39.1006	-96.7092	149,866	14.2	0.1	16	0.6	1	A		1			8,992
Yates Center Reservoir	LM0692	Woodson	37.8663	-95.7515	44,845	114.0	0.5	24	0.4	1	A		1			8,969
Slate Creek W.A.	LM0142	Sumner	37.1833	-97.2048	146,470	843.3	1	10	0.6	1	a		0			8,788
Sherman Co. SFL/W.A.	LM0702	Sherman	39.1848	-101.7834	8,290	1,542.0	2	2	1	1	B		1			8,290
Mined Land Lake 44	LM0484	Cherokee	37.2668	-94.9324	81,969	75.9	0.5	58	0.4	1	B		1			8,197
Mined Land Lake 31	LM0377	Cherokee	37.2166	-94.9892	81,604	59.3	0.5	58	0.4	1	B		1			8,160
Cowley Co. SFL	LM0134	Cowley	37.0986	-96.8008	38,705	73.9	0.5	6	0.8	1	B		1			7,741
Clark Co. SFL	LM0101	Clark	37.3934	-99.7835	38,505	282.0	0.5	6	0.8	1	B		1			7,701
Osawatomie City Lake	LM0662	Miami	38.5283	-94.9927	379,827	26.8	0.1	40	0.4	1	B		1			7,597
Sedan City South Lake	LM0720	Chautauqua	37.1533	-96.2104	24,716	64.8	0.5	10	0.6	1	A		1			7,415
St. Jacobs Well (Big Basin W.A.)	LM0600	Clark	37.2356	-99.9812	7,344	1,826.6	2	3	1	1	B		1			7,344
Lake Jivaro	LM0750	Shawnee	39.0043	-95.5509	359,649	74.0	0.5	39	0.4	0	A		1			7,193
Myer's Lake	LM0752	Shawnee	39.0094	-95.5983	357,506	13.2	0.1	40	0.4	1	B		1			7,150
Overbrook Lake	LM0205	Osage	38.7803	-95.5491	353,206	6.1	0.1	40	0.4	1	B		1			7,064
Carbondale West Lake	LM0608	Osage	38.8178	-95.7143	339,941	7.2	0.1	41	0.4	1	B		1			6,799
Caney City Lake	LM0726	Chautauqua	37.1277	-96.0198	43,545	65.3	0.5	12	0.6	1	B		1			6,532
Lake Sherwood	LM0202	Shawnee	39.0010	-95.7834	322,847	242.6	0.5	37	0.4	0	A		1			6,457
Lyon Co. SFL	LM0105	Lyon	38.5438	-96.0632	64,504	131.6	0.5	28	0.4	1	B		1			6,450
Kingman Co. SFL	LM0104	Kingman	37.6552	-98.2604	32,232	148.3	0.5	6	0.8	1	B		1			6,446
Anthony City Lake	LM0488	Harper	37.1800	-98.0514	15,953	79.8	0.5	4	0.8	1	A		1			6,381

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Atchison Co. Park Lake	LM0606	Atchison	39.6377	-95.4569	60,662	64.3	0.5	17	0.4	1	B		1			6,066
Montgomery Co. SFL	LM0107	Montgomery	37.1635	-95.6927	60,375	78.2	0.5	17	0.4	1	B		1			6,038
Chanute Santa Fe Lake	LM0444	Neosho	37.6544	-95.4579	60,014	71.6	0.5	22	0.4	1	B		1			6,001
Rock Creek Lake	LM0452	Bourbon	37.8102	-94.7539	59,926	74.3	0.5	30	0.4	1	B		1			5,993
Critzer Lake	LM0513	Linn	38.1496	-94.9355	59,813	184.5	0.5	29	0.4	1	B		1	x		5,981
Hodgeman Co. SFL/W.A.	LM0742	Hodgeman	38.0470	-99.8287	39,739	253.8	0.5	9	0.6	1		B	1			5,961
Brown Co. SFL	LM0103	Brown	39.8486	-95.3746	39,511	65.8	0.5	13	0.6	1	B		1			5,927
Eureka Lake	LM0402	Greenwood	37.8990	-96.2977	19,642	253.9	0.5	15	0.6	1	A		1			5,893
Cedar Creek Reservoir	LM0441	Bourbon	37.8238	-94.8007	58,776	218.1	0.5	30	0.4	1	B		1			5,878
Bourbon Co. SFL	LM0133	Bourbon	37.7925	-95.0674	58,474	92.8	0.5	24	0.4	1	B		1			5,847
Plainville Township Lake	LM0700	Rooks	39.2272	-99.3219	36,955	90.2	0.5	7	0.6	1	B		1			5,543
Finney Co. SFL/W.A.	LM0707	Finney	38.1824	-100.3349	18,336	855.7	1	7	0.6	1	B		1			5,501
Empire Lake	LM0741	Cherokee	37.0602	-94.6944	54,443	420.5	0.5	48	0.4	1	B		1			5,444
Norton Lake (Sebelius Lake)	LM0100	Norton	39.7971	-99.9537	10,770	492.6	0.5	3	1	1	A		1	x	x	5,385
Beymer Lake	LM0710	Kearny	37.8962	-101.2568	51,899	7.9	0.1	3	1	1	A		1			5,190
Moline Reservoir	LM0719	Elk	37.3898	-96.3169	16,983	178.3	0.5	13	0.6	1	A		1			5,095
Lake Scott State Park	LM0112	Scott	38.6846	-100.9204	9,812	110.3	0.5	2	1	1	A		1			4,906
Mound City Lake	LM0514	Linn	38.1222	-94.8916	48,431	124.2	0.5	26	0.4	1	B		1			4,843
Otis Creek Lake (Eureka)	LM0539	Greenwood	37.9399	-96.4648	31,989	252.1	0.5	12	0.6	1	B		1	x		4,798
Lake Warnock (Atchison City Lake)	LM0398	Atchison	39.5380	-95.1501	119,605	33.4	0.1	20	0.4	1	A		1			4,784

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Xenia Lake	LM0744	Bourbon	37.9676	-94.9836	46,483	60.7	0.5	26	0.4	1	B		1	x		4,648
New Yates Center Lake	LM0538	Woodson	37.8396	-95.8009	46,419	182.3	0.5	24	0.4	1	B		1	x		4,642
Wilson Co. SFL	LM0151	Wilson	37.6979	-95.6728	45,879	111.1	0.5	22	0.4	1	B		1			4,588
Woodson Co. SFL	LM0118	Woodson	37.7956	-95.8444	44,746	120.7	0.5	23	0.4	1	B		1			4,475
Black Kettle State Fishing Lake	LM0521	McPherson	38.2292	-97.5102	146,248	7.0	0.1	16	0.6	1		B	1			4,387
Rocky Ford W.A.	LM0206	Riley, Pottawatomie	39.2384	-96.5869	144,691	7.8	0.1	15	0.6	1	B		1			4,341
Winfield Park Lagoon	LM0723	Cowley	37.2494	-96.9975	140,221	8.5	0.1	10	0.6	1	B		1			4,207
Geary Co. SFL	LM0432	Geary	38.9021	-96.8633	139,640	46.5	0.1	15	0.6	1	B		1			4,189
Lake of the Forest	LM0425	Wyandotte	39.0684	-94.8409	997,250	31.2	0.1	45	0.4	0		A	1			3,989
Alma City Lake	LM0500	Wabaunsee	38.9801	-96.2607	193,982	24.7	0.1	24	0.4	1	B		1	x		3,880
KWP Hatchery and Ponds	LM0505	Pratt	37.6326	-98.7003	19,044	79.4	0.5	5	0.8	1	B		1			3,809
Sabetha City Lake	LM0115	Nemaha	39.9075	-95.8995	24,664	107.0	0.5	11	0.6	1	B		1			3,700
Pony Creek Lake	LM0730	Brown	39.9434	-95.7804	24,445	148.8	0.5	10	0.6	1	B		1	x		3,667
Melvern Outlet Swim Pond	LM0272	Osage	38.5127	-95.6996	91,136	27.1	0.1	31	0.4	1		A	1			3,645
Antioch Park Lake	LM0677	Johndon	39.0096	-94.6838	909,036	2.8	0.01	41	0.4	1	A		1			3,636
Nebo SFL	LM0615	Jackson	39.4474	-95.5987	170,992	30.4	0.1	24	0.4	1	B		1			3,420
McPherson Co. SFL	LM0135	McPherson	38.4793	-97.4696	113,101	29.8	0.1	16	0.6	1	B		1			3,393
Washington Co. SFL	LM0109	Washington	39.9267	-97.1195	16,798	69.1	0.5	4	0.8	1	B		1			3,360
Saline Co. SFL	LM0137	Saline	38.9023	-97.6552	81,336	22.1	0.1	6	0.8	1	B		1			3,253
Pottawatomie Co. SFL #1	LM0129	Pottawatomie	39.4700	-96.4092	104,454	17.5	0.1	12	0.6	1	B		1			3,134
Garnett North Lake	LM0406	Anderson	38.3018	-95.2423	77,664	38.1	0.1	29	0.4	1	A		1			3,107
Lake Coldwater	LM0426	Comanche	37.2490	-99.3485	6,164	233.4	0.5	3	1	1	A		1			3,082

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Riverwalk Landing Pond	LM0773	Geary	39.0212	-96.8233	152,560	16.7	0.1	17	0.4	1		B	1			3,051
Polk Daniels Lake (Elk Co. SFL)	LM0127	Elk	37.4646	-96.2241	20,012	64.9	0.5	15	0.6	1	B		1	x		3,002
Pillsbury Crossing W.A.	LM0203	Riley	39.1289	-96.4409	145,210	7.8	0.1	17	0.4	1	B		1			2,904
Thayer Old City Lake	LM0722	Neosho	37.4821	-95.4858	66,740	23.7	0.1	24	0.4	1	A		1			2,670
Lakewood Park Lake	LM0698	Lakewood Park Lake	38.8467	-97.5881	81,028	11.0	0.1	7	0.6	1	B		1			2,431
Jetmore Lake	LM0739	Hodgeman	38.0528	-99.9551	39,850	31.3	0.1	9	0.6	1	A		1			2,391
Harvey Co. Camp Hawk Lake	LM0634	Harvey	37.9950	-97.3628	597,219	1.5	0.01	34	0.4	1	A		1			2,389
Kansas Jaycees Cerebral Palsy Lake	LM0401	Butler	37.7464	-96.9567	586,893	11.4	0.1	27	0.4	0		A	1			2,348
Sterling City Lake	LM0648	Rice	38.2036	-98.2026	78,220	8.4	0.1	8	0.6	1	B		1			2,347
Camp Hyde Lake	LM0493	Sedgwick	37.5568	-97.6387	578,498	1.4	0.01	24	0.4	1		A	1			2,314
Concannon SFL	LM0536	Finney	38.0666	-100.5650	44,242	13.6	0.1	3	1	1	B		1			2,212
Gridley City Lake	LM0456	Coffey	38.1127	-95.8790	53,950	34.1	0.1	27	0.4	1	A		1			2,158
Edna City Lake	LM0717	Labette	37.0371	-95.3933	53,602	13.8	0.1	35	0.4	1	A		1			2,144
Saint Francis W.A.	LM0714	Cheyenne	39.7388	-101.8670	8,429	484.4	0.5	1	1	1	B		1			2,107
Sunflower Park Lake	LM0736	Johnson	38.9412	-95.0154	1,038,829	1.4	0.01	53	0.4	1	B		1			2,078
Prairie Center Park Pond	LM0772	Johnson	38.8928	-94.8483	1,012,928	1.7	0.01	48	0.4	1		B	1			2,026
North Park Lake	LM0627	Wyandotte	39.0763	-94.8924	999,560	2.3	0.01	47	0.4	1	B		1			1,999
Rose's Lake	LM0625	Johnson	38.9695	-94.7582	998,591	2.3	0.01	45	0.4	1	B		1			1,997
Mahaffie Farmstead Lake	LM0204	Johnson	38.8931	-94.8036	997,787	1.3	0.01	47	0.4	1	B		1			1,996
Stohl Park Lake	LM0628	Johnson	38.9169	-94.7291	965,100	1.6	0.01	43	0.4	1	B		1			1,930

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Sheridan W.A.	LM0145	Sheridan, Gove	39.1393	-100.1935	9,611	455.2	0.5	4	0.8	1	B		1			1,922
Lansing City Lake	LM0672	Leavenworth	39.2437	-94.8829	940,247	2.7	0.01	40	0.4	1	B		1			1,880
Meadowbrook Park Lake	LM0767	Johnson	38.9591	-94.6438	887,818	3.0	0.01	38	0.4	1		B	1			1,776
Lake Jayhawk	LM0397	Jefferson	39.1988	-95.4001	443,777	19.9	0.1	45	0.4	0	A		1			1,775
Big Eleven Lake	LM0671	Wyandotte	39.1176	-94.6373	871,345	3.2	0.01	34	0.4	1	B		1			1,743
Potter's Lake	LM0734	Douglas	38.9603	-95.2487	866,696	1.4	0.01	62	0.4	1	B		1			1,733
Mined Land Lake 06	LM0476	Crawford	37.4215	-94.7536	85,754	7.1	0.1	58	0.4	1	B		1			1,715
Mined Land Lake 36	LM0382	Cherokee	37.2392	-95.0375	85,578	20.9	0.1	62	0.4	1	B		1			1,712
Mined Land Lake 33	LM0379	Cherokee	37.2256	-95.0368	85,311	43.3	0.1	59	0.4	1	B		1			1,706
Wilderness Lake	LM0765	Johnson	38.8376	-94.6410	851,680	3.1	0.01	39	0.4	1		B	1			1,703
Mined Land Lake 34	LM0380	Cherokee	37.2255	-95.0258	84,640	33.0	0.1	59	0.4	1	B		1			1,693
Mined Land Lake 30	LM0376	Cherokee	37.2196	-95.0244	84,287	30.2	0.1	58	0.4	1	B		1			1,686
Lake Jeanette	LM0768	Leavenworth	39.2760	-94.8927	838,083	4.3	0.01	39	0.4	1		B	1			1,676
Mined Land Lake 35	LM0381	Cherokee	37.2244	-95.0037	83,718	28.1	0.1	59	0.4	1	B		1			1,674
Mined Land Lake 24	LM0370	Cherokee	37.2129	-95.0093	83,244	33.8	0.1	58	0.4	1	B		1			1,665
Mined Land Lake 27	LM0373	Cherokee	37.2008	-95.0451	83,184	33.0	0.1	56	0.4	1	B		1			1,664
Fossil Lake	LM0526	Russel	38.8613	-98.8509	41,551	42.7	0.1	6	0.8	1	B		1			1,662
Mined Land Lake 25	LM0371	Cherokee	37.1988	-95.0556	82,783	9.3	0.1	56	0.4	1	B		1			1,656
Mined Land Lake 20	LM0366	Cherokee	37.2409	-94.9888	82,637	17.1	0.1	58	0.4	1	B		1			1,653

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Mined Land Lake 39	LM0385	Cherokee	37.2554	-94.9819	82,326	14.5	0.1	58	0.4	1	B		1			1,647
Mined Land Lake 45	LM0390	Cherokee	37.2897	-94.9115	82,229	30.8	0.1	58	0.4	1	B		1			1,645
Mined Land Lake 29	LM0375	Cherokee	37.2067	-95.0021	82,214	12.3	0.1	56	0.4	1	B		1			1,644
Mined Land Lake 21	LM0367	Cherokee	37.2482	-94.9726	82,140	15.2	0.1	58	0.4	1	B		1			1,643
Mined Land Lake 22	LM0368	Cherokee	37.2294	-94.9926	82,126	22.8	0.1	58	0.4	1	B		1			1,643
Mined Land Lake 23	LM0369	Cherokee	37.2315	-94.9763	82,060	31.9	0.1	58	0.4	1	B		1			1,641
Mined Land Lake 40	LM0386	Cherokee	37.2545	-94.9663	82,052	17.1	0.1	58	0.4	1	B		1			1,641
Mined Land Lake 41	LM0387	Cherokee	37.2643	-94.9512	82,035	42.3	0.1	58	0.4	1	B		1			1,641
Mined Land Lake 07	LM0478	Crawford	37.3930	-94.7828	81,980	13.4	0.1	59	0.4	1	B		1			1,640
Mined Land Lake 18	LM0364	Cherokee	37.2731	-94.9222	81,955	13.8	0.1	57	0.4	1	B		1			1,639
Mined Land Lake 17	LM0482	Cherokee	37.2931	-94.9018	81,751	17.5	0.1	58	0.4	1	B		1			1,635
La Claire Lake	LM0729	Montgomery	37.0529	-95.6409	54,412	6.1	0.1	13	0.6	1	B		1			1,632
Mined Land Lake 42	LM0388	Cherokee	37.2619	-94.9244	81,564	9.9	0.1	58	0.4	1	B		1			1,631
Mined Land Lake 43	LM0389	Cherokee	37.2647	-94.9194	81,524	10.0	0.1	57	0.4	1	B		1			1,630
Mined Land Lake 38	LM0384	Cherokee	37.2482	-94.9292	81,484	6.2	0.1	58	0.4	1	B		1			1,630
Mined Land Lake 19	LM0365	Cherokee	37.2793	-94.8954	81,445	19.2	0.1	57	0.4	1	B		1			1,629
Mined Land Lake 32	LM0378	Cherokee	37.2197	-94.9726	81,393	14.3	0.1	58	0.4	1	B		1			1,628
Richmond City Lake	LM0468	Franklin	38.3941	-95.2247	81,359	12.9	0.1	27	0.4	1	B		1	x		1,627

Lake Name	LM #	County(s)	Centroid Latitude	Centroid Longitude	Pop_30	Acres	Size Factor	Lake_30	Lake Factor	Private	CR_KSWR	CR_PROV	Contact Factor	PWS	Federal Reservoir	Final Score
West Campus Lake KU	LM0762	Douglas	38.9495	-95.2635	806,441	2.0	0.01	58	0.4	1		B	1			1,613
Stone Lake	LM0525	Rush	38.5417	-99.2765	53,737	14.5	0.1	8	0.6	1		B	1			1,612
Mined Land Lake 08	LM0355	Crawford	37.3890	-94.7734	80,552	11.9	0.1	56	0.4	1	B		1			1,611
Mined Land Lake 26	LM0372	Cherokee	37.3319	-94.8033	79,423	9.2	0.1	58	0.4	1	B		1			1,588
Lake Jewell	LM0629	Jewell	39.6725	-98.1621	19,850	5.6	0.1	4	0.8	1	A		1			1,588
Parker City Lake	LM0663	Linn	38.3190	-94.9995	78,162	7.6	0.1	24	0.4	1	B		1			1,563
Mined Land Lake 11	LM0358	Cherokee	37.2654	-94.8397	77,966	5.9	0.1	56	0.4	1	B		1			1,559
Stone Lake	LM0740	Barton	38.3523	-98.7716	38,871	38.7	0.1	6	0.8	1	B		1			1,555
Mined Land Lake 12	LM0359	Cherokee	37.2563	-94.8179	77,401	13.2	0.1	56	0.4	1	B		1			1,548
Mined Land Lake 14	LM0361	Cherokee	37.2485	-94.8203	77,362	8.3	0.1	56	0.4	1	B		1			1,547
Mined Land Lake 15	LM0362	Cherokee	37.2486	-94.8066	77,191	17.4	0.1	55	0.4	1	B		1			1,544
Mined Land Lake 09	LM0356	Cherokee	37.2868	-94.7744	77,063	9.5	0.1	54	0.4	1	B		1			1,541
Lyndon City Lake	LM0659	Osage	38.5862	-95.6814	153,776	74.2	0.5	33	0.4	0	B		1			1,538
Texas Lake W.A.	LM0530	Pratt	37.6559	-98.9778	18,960	919.8	1	6	0.8	1	a		0			1,517
Lake Tanko (Cherryvale City Lake)	LM0716	Montgomery	37.2591	-95.5522	74,908	16.8	0.1	25	0.4	1	B		1			1,498
Veterans Lake Ark City	LM0138	Cowley	37.0471	-97.0507	49,418	15.6	0.1	8	0.6	1		B	1			1,483
Crystal Lake	LM0649	Anderson	38.2683	-95.2461	73,302	14.3	0.1	26	0.4	1	B		1			1,466
Ellis City Lake	LM0696	Ellis	38.9407	-99.5578	36,232	8.7	0.1	5	0.8	1	B		1			1,449
Mined Land Lake 04	LM0354	Crawford	37.4383	-94.6226	69,415	14.9	0.1	56	0.4	1	B		1			1,388
Hiawatha City Lake	LM0116	Brown	39.8259	-95.5284	46,003	7.2	0.1	16	0.6	1	B		1			1,380

Lake Name	LM #	County(s)	Centroid Latitude	Centroid Longitude	Pop_30	Acres	Size Factor	Lake_30	Lake Factor	Private	CR_KSWR	CR_PROV	Contact Factor	PWS	Federal Reservoir	Final Score
Lake Kahola	LM0434	Morris, Chase	38.5217	-96.4243	45,675	365.1	0.5	15	0.6	0	A		1			1,370
Thayer New City Lake	LM0496	Neosho	37.4756	-95.5017	66,281	19.5	0.1	24	0.4	1	B		1			1,326
Altamont City Main Lake (#1)	LM0680	Labette	37.1409	-95.2890	64,599	21.5	0.1	50	0.4	1	B		1			1,292
Altamont City West Lake (#3)	LM0682	Labette	37.1404	-95.2930	64,513	11.1	0.1	49	0.4	1	B		1			1,290
Frisco Lake	LM0652	Johnson	38.8707	-94.8051	64,056	11.0	0.1	57	0.4	1	B		1			1,281
Ford Co. Lake	LM0708	Ford	37.8241	-99.9182	42,625	8.5	0.1	8	0.6	1	B		1			1,279
McLaughin Lake	LM0757	Sedgwick	37.8418	-97.3673	637,329	1.6	0.01	31	0.4	1		B	1			1,275
Hain SFL	LM0709	Ford	37.8509	-99.8569	42,479	16.3	0.1	7	0.6	1	B		1			1,274
Eagle Lake (Belaire Lake)	LM0221	Sedgwick	37.7565	-97.2766	635,682	3.3	0.01	30	0.4	1	B		1			1,271
Chisholm Creek Park Lake	LM0646	Sedgwick	37.7409	-97.2683	633,990	2.1	0.01	30	0.4	1	B		1			1,268
Bartlett City Lake	LM0454	Labette	37.0585	-95.2156	62,110	16.1	0.1	48	0.4	1	B		1			1,242
Harrison Park Lake	LM0223	Sedgwick	37.6720	-97.5523	608,045	1.2	0.01	28	0.4	1	B		1			1,216
Riggs Park Lake	LM0224	Sedgwick	37.5728	-97.3674	600,931	1.2	0.01	30	0.4	1	B		1			1,202
Memorial Park Lake	LM0715	Barton	38.3706	-98.7955	38,988	12.8	0.1	7	0.6	1	B		1			1,170
Elks Lake	LM0743	Neosho	37.7220	-95.4403	56,723	28.9	0.1	22	0.4	1		B	1			1,134
Smith Lake	LM0207	Leavenworth	39.3463	-94.9181	553,425	3.9	0.01	26	0.4	1	B		1			1,107
Little Lake	LM0626	Brown	39.6691	-95.5189	54,162	9.1	0.1	17	0.4	1	B		1			1,083
Blue Mound City Lake	LM0464	Linn	38.1046	-95.0265	53,898	18.1	0.1	30	0.4	1	B		1			1,078
Gunn Park West Lake	LM0655	Bourbon	37.8273	-94.7249	52,843	6.7	0.1	28	0.4	1	B		1			1,057
Fraizer Lake	LM0602	Grant	37.5643	-101.3346	21,079	14.9	0.1	2	1	1		B	1			1,054
Oskaloosa Lake	LM0617	Jefferson	39.2051	-95.3183	496,565	12.6	0.1	44	0.4	0		B	1			993

Lake Name	LM #	County(s)	Centroid Latitude	Centroid Longitude	Pop_30	Acres	Size Factor	Lake_30	Lake Factor	Private	CR_KSWR	CR_PROV	Contact Factor	PWS	Federal Reservoir	Final Score
Pleasanton City Lake #1	LM0664	Linn	38.1741	-94.7289	49,439	24.0	0.1	25	0.4	1	B		1			989
Pleasanton City Lake #2	LM0665	Linn	38.1732	-94.7244	49,056	15.2	0.1	25	0.4	1	B		1			981
Lake Idlewild	LM0612	Marshall	39.7091	-96.7446	24,157	6.2	0.1	6	0.8	1	B		1			966
Iola City Lake	LM0212	Allen	37.9066	-95.4075	46,891	17.4	0.1	28	0.4	1		B	1			938
Circle Lake	LM0211	Woodson	38.0231	-95.5531	44,202	21.9	0.1	23	0.4	1	B		1			884
Leonard's Lake	LM0213	Woodson	37.9937	-95.5415	43,694	7.5	0.1	25	0.4	1	B		1			874
Belleville City Lake	LM0607	Republic	39.8306	-97.6197	16,035	22.3	0.1	3	1	1	B		1			802
Moline City #1 (Santa Fe Lake)	LM0718	Elk	37.3655	-96.3301	13,177	12.8	0.1	13	0.6	1	A		1			791
Pratt Co. Lake	LM0640	Pratt	37.6292	-98.6808	19,632	42.9	0.1	5	0.8	1	B		1			785
Sedan City North Lake	LM0486	Chautauqua	37.1729	-96.2172	24,291	30.9	0.1	10	0.6	1	B		1			729
Central Park Lake	LM0609	Shawnee	39.0393	-95.6905	337,401	1.3	0.01	40	0.4	1	B		1			675
Scraton City Lake	LM0229	Osage	38.7654	-95.7020	337,043	11.2	0.1	41	0.4	0		B	1			674
Gage Park Lake	LM0611	Shawnee	39.0577	-95.7309	333,326	2.9	0.01	39	0.4	1	B		1			667
Cedar Crest Lake	LM0201	Shawnee	39.0609	-95.7446	330,519	2.2	0.01	39	0.4	1	B		1			661
Washburn Rural Environmental Lab Lake	LM0437	Shawnee	38.9626	-95.7520	329,653	3.8	0.01	40	0.4	1	B		1			659
Clarion Woods Park Lake	LM0759	Shawnee	38.9979	-95.7473	329,539	2.4	0.01	39	0.4	1		B	1			659
Lakeview Estates Lake	LM0753	Shawnee	38.9460	-95.7678	326,685	17.1	0.1	41	0.4	0	B		1			653
Topeka Public Golf Course Lake	LM0501	Shawnee	39.0203	-95.7846	315,609	3.3	0.01	36	0.4	1	B		1			631
Barber Co. SFL	LM0131	Barber	37.2977	-98.5812	15,669	29.4	0.1	6	0.8	1	B		1			627
Jewell Co. SFL	LM0128	Jewell	39.6996	-98.2785	15,580	39.6	0.1	4	0.8	1	B		1			623
Logan City Lake	LM0693	Phillips	39.6271	-99.5804	15,190	23.4	0.1	6	0.8	1	B		1			608

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Isabel W.A.	LM0143	Pratt	37.4934	-98.5442	19,925	441.4	0.5	8	0.6	1	a		0			598
Atwood Township Lake	LM0712	Rawlins	39.8160	-101.0428	11,923	40.1	0.1	2	1	1	B		1			596
Marysville City/Golf Course Lake	LM0756	Marshall	39.8432	-96.6289	19,610	7.7	0.1	7	0.6	1		B	1			588
Prescott City Lake	LM0666	Linn	38.0605	-94.6794	28,556	16.4	0.1	22	0.4	1	B		1			571
Kiowa Co. SFL	LM0428	Kiowa	37.6119	-99.3012	11,156	20.2	0.1	3	1	1	B		1			558
Rooks Co. SFL	LM0119	Rooks	39.4008	-99.3185	13,226	28.8	0.1	6	0.8	1	B		1			529
Sheridan Co. SFL	LM0694	Sheridan	39.3603	-100.2290	10,580	34.6	0.1	2	1	1	B		1			529
Harveyville Lake	LM0408	Wabaunsee	38.7917	-95.9797	237,163	17.3	0.1	40	0.4	0		B	1			474
Rimrock Park Lake	LM0705	Geary	39.0214	-96.8501	147,719	3.0	0.01	16	0.6	1	B		1			443
Jerry Dishman Lake	LM0216	Riley	39.1844	-96.6303	144,399	4.6	0.01	14	0.6	1		B	1			433
Mingenback Lake	LM0647	McPherson	38.3731	-97.6512	143,248	3.2	0.01	14	0.6	1	B		1			430
Smoky Hill Garden Lake	LM0701	Sherman	39.1881	-101.7591	8,259	12.8	0.1	2	1	1	B		1			413
Dillon Park Lakes	LM0631	Reno	38.0877	-97.8776	134,097	3.4	0.01	12	0.6	1	B		1			402
Sam's Pond Syracuse	LM0162	Hamilton	37.9625	-101.7590	7,524	6.9	0.1	3	1	1		B	1			376
Moline City Lake #2	LM0480	Elk	37.3508	-96.3424	12,176	25.3	0.1	14	0.6	1	B		1			365
Severy City Lake	LM0721	Greenwood	37.6214	-96.1733	17,640	11.0	0.1	17	0.4	1	B		1	x		353
Muscotah Marsh	LM0146	Atchison	39.5278	-95.5168	79,801	7.8	0.1	18	0.4	1	a		0			319
Logan Co. SFL	LM0704	Logan	38.9354	-101.2383	5,431	44.8	0.1	2	1	1	B		1			272
Elkhorn Lake	LM0610	Jackson	39.4718	-95.7422	126,299	4.4	0.01	20	0.4	1	B		1			253
Boy Scout Lake	LM0706	Hodgeman	38.0674	-99.9996	40,023	4.2	0.01	9	0.6	1	A		1			240
Barton Lake	LM0727	Barton	38.4528	-98.7780	38,809	13.7	0.1	8	0.6	1	a		0			233
Herington City Park Lake	LM0728	Dickinson	38.6766	-96.9444	75,939	2.1	0.01	16	0.6	1	B		1			228

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Deanna Rose Farmstead Fishing Pond	LM0231	Johnson	38.8766	-94.7030	909,813	0.9	0	42	0.4	1		B	1			182
Goodman SFL	LM0524	Ness	38.3871	-99.8541	5,790	18.8	0.1	7	0.6	1	B		1			174
Mined Land Lake 05	LM0474	Crawford	37.4241	-94.7611	86,244	4.9	0.01	58	0.4	1	B		1			172
Hamilton Co. SFL	LM0161	Hamilton	38.0297	-101.8199	3,345	44.3	0.1	2	1	1	B		1			167
Mined Land Lake 37	LM0383	Cherokee	37.2511	-94.9416	81,656	3.9	0.01	58	0.4	1	B		1			163
Mined Land Lake 10	LM0357	Cherokee	37.2690	-94.8086	77,385	1.0	0.01	55	0.4	1	B		1			155
Mined Land Lake 13	LM0360	Cherokee	37.2630	-94.8106	77,323	4.7	0.01	55	0.4	1	B		1			155
Jerry's Lake	LM0678	Leavenworth	39.3000	-94.9219	749,489	1.0	0	34	0.4	1	B		1			150
Playter's Lake	LM0690	Crawfod	37.4031	-94.7135	72,376	3.6	0.01	57	0.4	1	B		1			145
Peyton Creek Dam #104	LM0774	Chase	38.4128	-96.5053	46,015	4.2	0.01	13	0.6	1		B	1			138
Mined Land Lake 01	LM0351	Crawford	37.4783	-94.7026	68,287	3.2	0.01	58	0.4	1	B		1			137
Pittsburg College Lake	LM0733	Crawford	37.3903	-94.6983	67,780	2.6	0.01	55	0.4	1	B		1			136
Timber Lake	LM0691	Neosho	37.6583	-95.2099	65,980	21.3	0.1	31	0.4	0	B		1			132
New Strawn Park Lake	LM0731	Coffey	38.2610	-95.7434	65,674	3.0	0.01	30	0.4	1	B		1			131
Altamont City North Lake	LM0681	Labette	37.1433	-95.2895	64,506	3.9	0.01	50	0.4	1		B	1			129
Lake Charles	LM0711	Ford	37.7754	-100.0391	42,922	1.4	0.01	8	0.6	1	B		1			129
Wolf Pond	LM0746	Barton	38.3541	-98.5874	41,344	1.3	0.01	7	0.6	1		B	1			124
Big Creek Oxbow	LM0703	Ellis	38.8697	-99.3419	41,047	3.3	0.01	7	0.6	1	B		1			123
Lebo City Park Lake	LM0656	Coffey	38.4148	-95.8718	61,378	2.3	0.01	24	0.4	1	B		1			123
Cedar Brook Pond	LM0177	Sedgwick	37.4860	-97.2270	613,068	0.4	0	30	0.4	1		B	1			123

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Bronson City Lake	LM0462	Bourbon	37.8870	-95.0340	59,847	13.3	0.1	29	0.4	0	B		1			120
Troy Fair Lake	LM0738	Doniphan	39.7882	-95.1002	34,985	3.8	0.01	8	0.6	1	B		1			105
Gunn Park East Lake	LM0654	Bourbon	37.8287	-94.7211	52,006	2.4	0.01	28	0.4	1	B		1			104
Jones Park Lake	LM0687	Lyon	38.4259	-96.2019	51,665	1.2	0.01	23	0.4	1	B		1			103
Peter Pan Lake	LM0689	Lyon	38.3944	-96.1883	50,590	2.8	0.01	22	0.4	1	B		1			101
Yates Center Kids' Fishing Pond	LM0770	Woodson	37.8361	-95.7938	46,162	2.9	0.01	24	0.4	1		B	1			92
Neosho Falls City Lake	LM0214	Woodson	38.0039	-95.5538	43,383	1.7	0.01	23	0.4	1	B		1			87
Agra Lake	LM0771	Phillips	39.7596	-99.1267	10,777	2.4	0.01	5	0.8	1		A	1			86
Quarry Lake	LM0225	Wilson	37.7099	-95.7225	42,677	18.0	0.1	22	0.4	0	B		1			85
Lemon Park Lake	LM0639	Pratt	37.6350	-98.7299	18,917	1.9	0.01	5	0.8	1	B		1			76
Overbrook City Kids Pond	LM0763	Osage	38.7781	-95.5490	353,091	0.2	0	40	0.4	1		B	1			71
Dornwood Park Lake	LM0623	Shawnee	39.0240	-95.6362	350,113	0.0	0	38	0.4	1	B		1			70
Feldhausen, Johnson, & Mitchell Pond	LM0755	Marshall	39.7800	-96.4001	22767	28.1	0.1	8	0.6	0		B	1			68
Colby City Lake	LM0713	Thomas	39.3816	-101.0521	13,603	1.8	0.01	2	1	1	B		1			68
Carousel Lake	LM0769	Shawnee	39.0560	-95.7320	333,538	0.6	0	39	0.4	1		B	1			67
Rock Garden Pond	LM0761	Shawnee	39.0545	-95.7322	333,522	0.4	0	39	0.4	1		B	1			67
Warren Park Lake	LM0620	Shawnee	39.0203	-95.7181	331,316	0.2	0	39	0.4	1	B		1			66
Antelope Lake	LM0695	Graham	39.3731	-100.1044	10,194	1.6	0.01	3	1	1	B		1			51
Buhler City Lake	LM0507	Reno	38.1409	-97.7685	144,586	0.6	0	14	0.6	1	B		1			43
Cimarron Lake (Moss Lake Middle)	LM0604	Morton	37.1360	-101.8218	7,970	1.1	0.01	3	1	1	B		1			40
Wamego City Lake	LM0621	Pottawatomie	39.2024	-96.3013	130,677	0.8	0	11	0.6	1	B		1			39

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Eisenhower Park Pond Marquette	LM0775	McPherson	38.5582	-97.8398	98,773	0.9	0	10	0.6	1		B	1			30
Jerry Ivey Pond	LM0760	Saline	38.7961	-97.5956	94,971	0.7	0	8	0.6	1		B	1			28
Mined Land Lake 02	LM0352	Crawford	37.4411	-94.6390	70,093	2.5	0.01	56	0.4	1	a		0			28
McKinley Lake	LM0754	Barton	38.3695	-98.7910	38,518	4.7	0.01	7	0.6	0		A	1			23
Hillsboro City Lake	LM0209	Marion	38.3473	-97.2068	75,757	0.7	0	14	0.6	1	B		1			23
Westphalia Lake	LM0669	Anderson	38.1761	-95.4952	41,811	23.8	0.1	25	0.4	0		a	0			17
Point of Rocks Lake (Moss Lake West)	LM0605	Morton	37.1162	-101.9112	3,269	1.0	0.01	3	1	1	B		1			16
Mined Land Lake 03	LM0353	Crawford	37.4409	-94.6267	69,015	0.6	0	56	0.4	1	B		1			14
Tallwood Drive Lake	LM0176	Sedgwick	37.7145	-97.1909	625,978	0.3	0	30	0.4	0		B	1			13
Vineyard Park Pond	LM0745	Ellis	38.8952	-99.3061	40,893	0.3	0	7	0.6	1		B	1			12
Olpe Jones Park Lake	LM0411	Lyon	38.2641	-96.1676	44,311	0.6	0	20	0.4	1		B	1			9
Mallard Lake (Moss Lake East)	LM0603	Morton	37.1454	-101.7934	9,069	0.5	0	3	1	1	B		1			5
Mined Land Lake 28	LM0374	Cherokee	37.2017	-95.0152	82,611	0.5	0	56	0.4	1	a		0			3
Sabetha Watershed Lake (Niehues)	LM0751	Nemaha	39.8843	-95.7918	29,926	0.3	0	13	0.6	0	B		1			1

APPENDIX L

Standard Operating Procedures for HAB Data Management System

Procedure	Last Revised
The Survey Web Application (DM-001)	05/10/22
Oracle Harmful Algal Bloom Database System (DM-002)	05/10/22
KDHE Harmful Algae Bloom Management System (DM-003)	05/10/22

THE SURVEY WEB APPLICATION
(DM-001)

The Survey Web Application is the public facing web interface to the KDHE's complaint tracking system. It has three distinct entry forms:

1) Algal Bloom complaint
https://survey123.arcgis.com/share/5b5aeea4205c411d97cbeb173a5d6d96

2) Human Health complaint
https://kdheks.co1.qualtrics.com/jfe/form/SV_6G7KaEywuwGtsBD

and

3) Animal Health complaint

https://kdheks.co1.qualtrics.com/jfe/form/SV_3m9Zfcls27nckMB

The algal complaint form is routed simultaneously to environmental staff in BOW and BEFS and queued into the HAB Tracking System. The human and animal health complaints are simultaneously routed to staff in BEPHI. Complaints are responded to by the respective staff.

1. Algal bloom complaints are received into the HAB Tracking System, where they will be reviewed by BOW-MASS staff to determine whether the complaint is valid and whether the waterbody is a "public" lake and/or a Public Drinking water supply source.

2. Human and Animal health complaints are reviewed by the BEPHI staff to determine if the illness is associated with HAB exposure. The BEPHI staff is required to enter the environmentally relevant portion of the complaint information (no Protected Health information) into the algal bloom component to initiate the investigation.

Technical Note: The Survey Web Applications are built within KDHE ArcGIS Online Organizational account. They were built by Office of Information Technology GIS Staff using Desktop ESRI Survey123 Connect Application. The data from the Survey is written into the KDHE Oracle GIS Schema, which is then consumed by the Harmful Algal Bloom Tracking System (Oracle APEX application). Verification of the Survey is the first step in the HAB Management System.

Oracle Harmful Algal Bloom DATABASE System

(DM-002)

I. A critical component of the HAB Management System, which is required by the HAB Tracking System, are two other Oracle databases. The two other Oracle databases are updated through separate applications:

A. The Surface Water Site ID System. The locations of all sites sampled for any water quality parameter are entered into this database. This geospatial database gives the geographic location of the sites, names, and other fields explained below. A site not existing in the system needs to be entered prior to associating/entering any data. (Oracle Table: GIS.HYDRO_BOW_MON_POINT)

B. The Algae Database. This contains cell counts for several individual cyanobacteria taxa as well as for diatoms, dinoflagellates, crytophytes, euglenophytes, and other algae. It also contains calculated metrics (percent cell counts) and percent biomass counts for these. In addition, it contains results from toxin analysis. Data must be hand entered into this database before the HAB Tracking System can evaluate recommended advisory status for a given waterbody. (Oracle Table: BEFS_ADMIN.ALGAE)

Both databases are used by the monitoring networks outside of the HAB system. The procedures to enter both databases are as follows:

A. Surface Water Site ID System

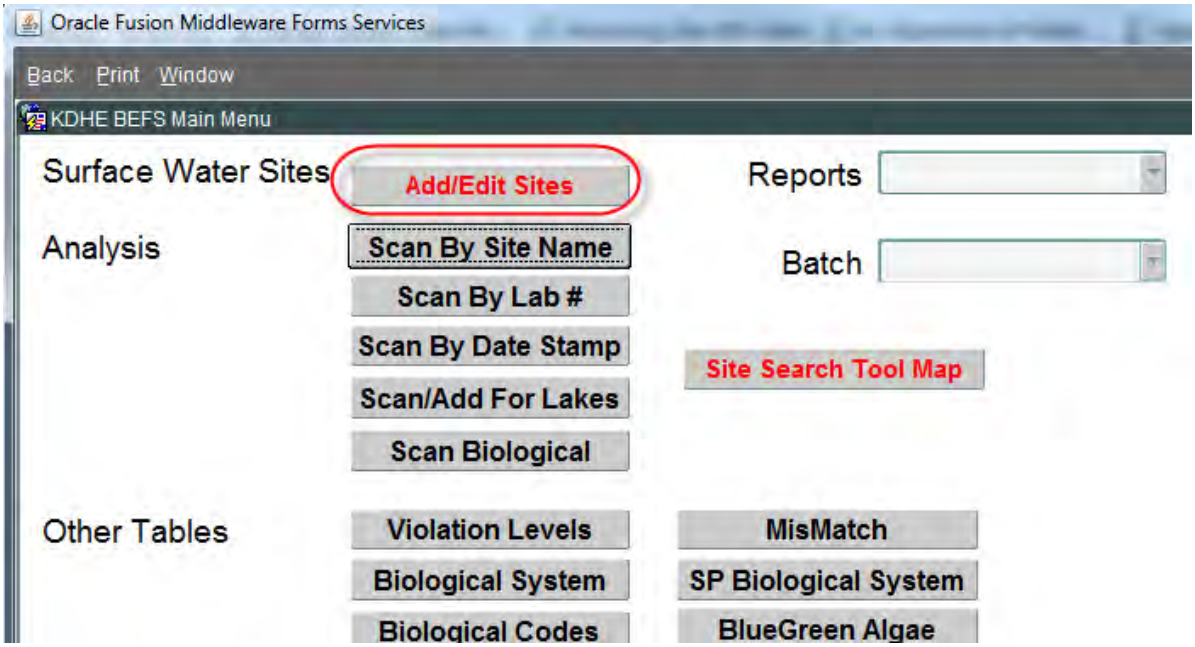
In order to enter HAB data into KDHE's Oracle database, first a Surface Water Site has to be created in Oracle Forms for the HAB site. If a header already exists for the site then proceed to **B.**

1. Logon to Oracle must be authorized by IT:

http://kdhenet/KDHEoracle_apps_gallery.htm

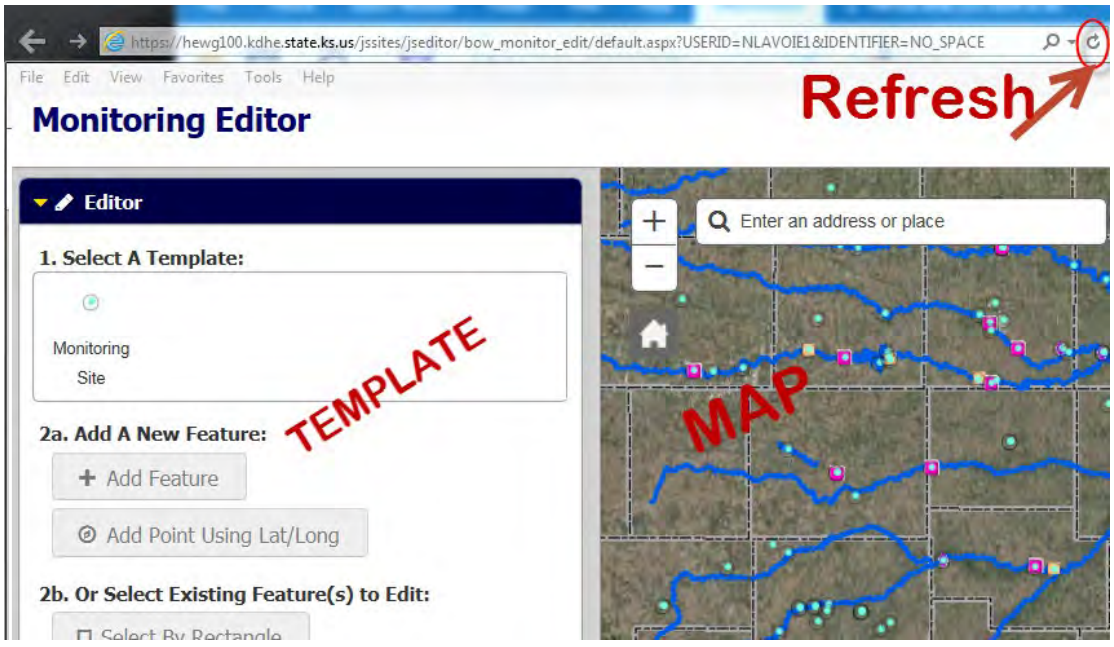
Surface Water Quality Analysis … (oraforms\SC\SCMAINMENU.fmx)

2. Log onto Oracle, and click on ‘Add/Edit Sites’ to add HAB site header:

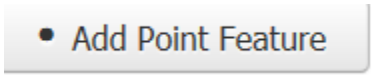


3. This will open a Web Map Editor in which to add the new Site Header.
**NOTE: If you receive a 404 web page not found error, please request your name be added to the approved Web Map Editing. This is a separate security layer for editing in the map.

** Click Refresh on the browser if the map or template doesn’t draw first time.



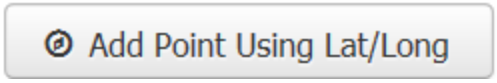
4. Add the Point Using one of the following methods:
   1. Click on the “Select A Template” Monitoring Site to make it active
   2. **A.** - Zoom in on the map to location …

      - Click 

…

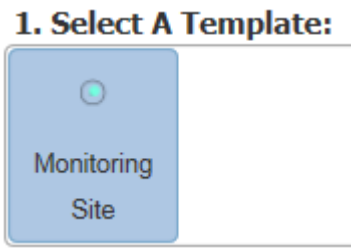
      - Click on the map to add the point or

      B. If you already have Lat/Long from GPS or other source …

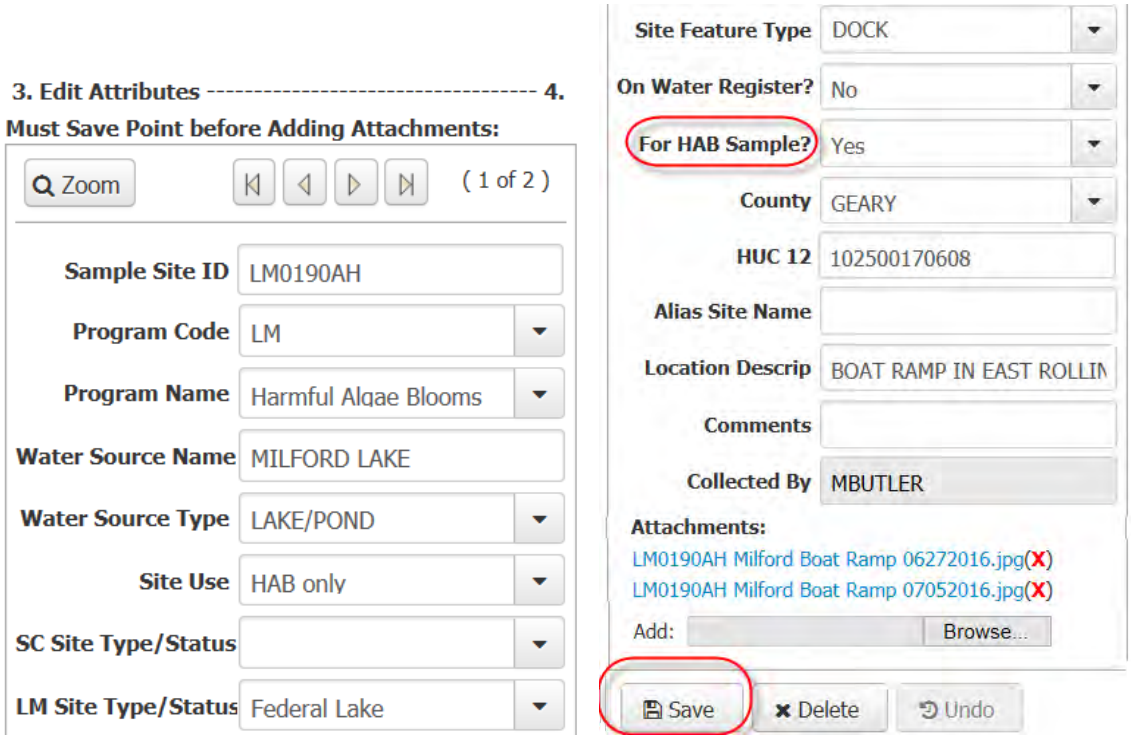
      Click the 

and enter the coordinate.

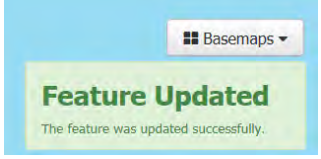
   3. Enter required minimum information (the site name will be decided by HAB group) on screen:



** MUST HAVE HAB SAMPLE? “YES” for it to draw in the HAB web maps.
** Attachements can be added only <u>after</u> a NEW point is saved and the map Refreshed.
** HUC 12 and County Labels should be drawing in the map (or turn the layer on)



4. A Green box will appear in the upper right hand when the Point is added or updated. Click the Refresh button if you need to add attachements.



Algae Database

Generating Data: After performing taxonomic identifications and absolute cell counts, the algal taxonomist uses a stand alone MSExcel software spreadsheet with built in macros (described in the KDHE Lake and Wetland Monitoring Program's Quality Assurance Management Plan; see "Form LW-5") to calculate derived metrics such as percent bluegreens, percent greens, and biovolumes. Toxin analysis results and chlorophyll-a analysis results may also be entered into this same spreadsheet.

Entering Data: Once there is a header for the Sample Site, the actual data can be entered into Oracle's Algae database; again, logon needs to be authorized by IT.

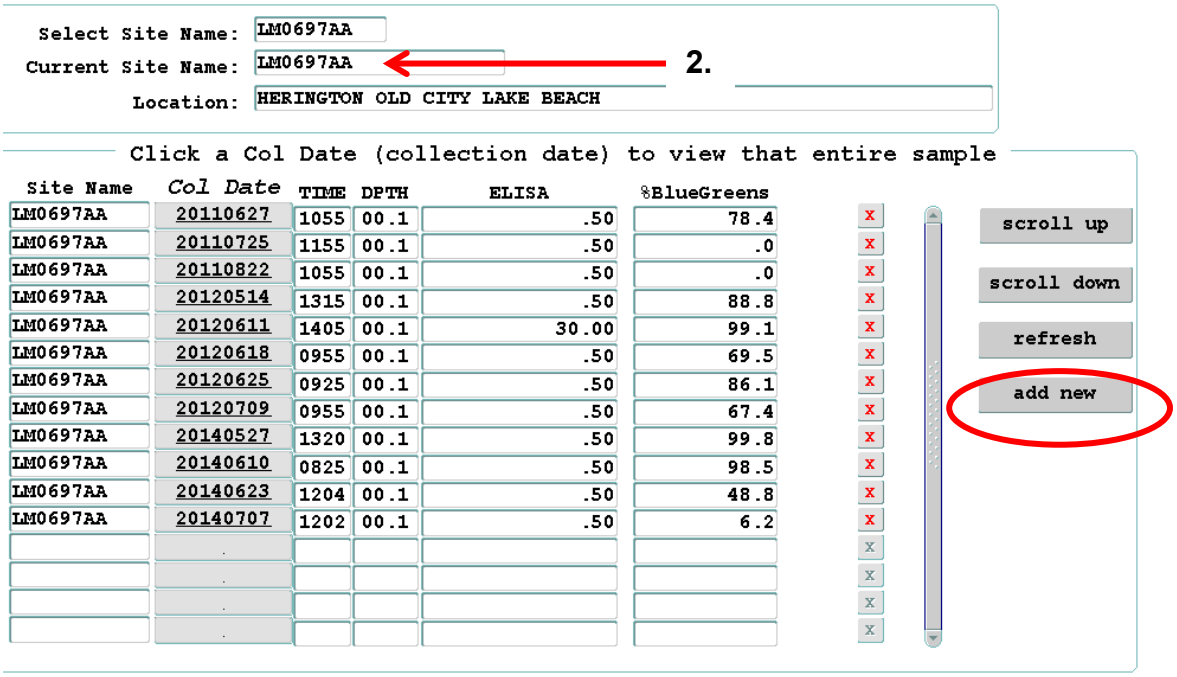
1. Logon to Oracle has to be authorized by IT:

   http://kdhenet/KDHEoracle_apps_gallery.htm

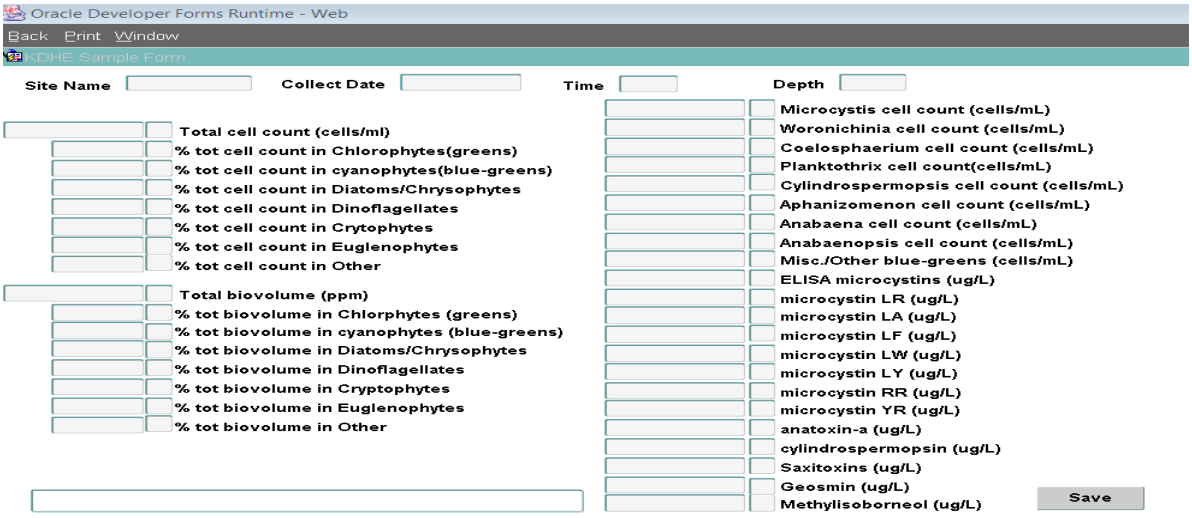
   

   Surface Water Quality Analysis … (oraforms\SC\SCMAINMENU.fmx)

2. Type in 'Site Name' and hit 'Enter'
3. Click on 'Add New'



4. This will bring up a blank page to which the new information for the site can be added.



From the lab sheets, obtain the following information to be entered:

a. Site Name (Required)

b. Collection Date (Required)

c. Time sample was collected (Required)

d. Depth of sample (Depth is 00.1 m for all algal data, required field)

e. Total cell count

f. % Greens, Blue-greens, etc.

g. Total biovolume

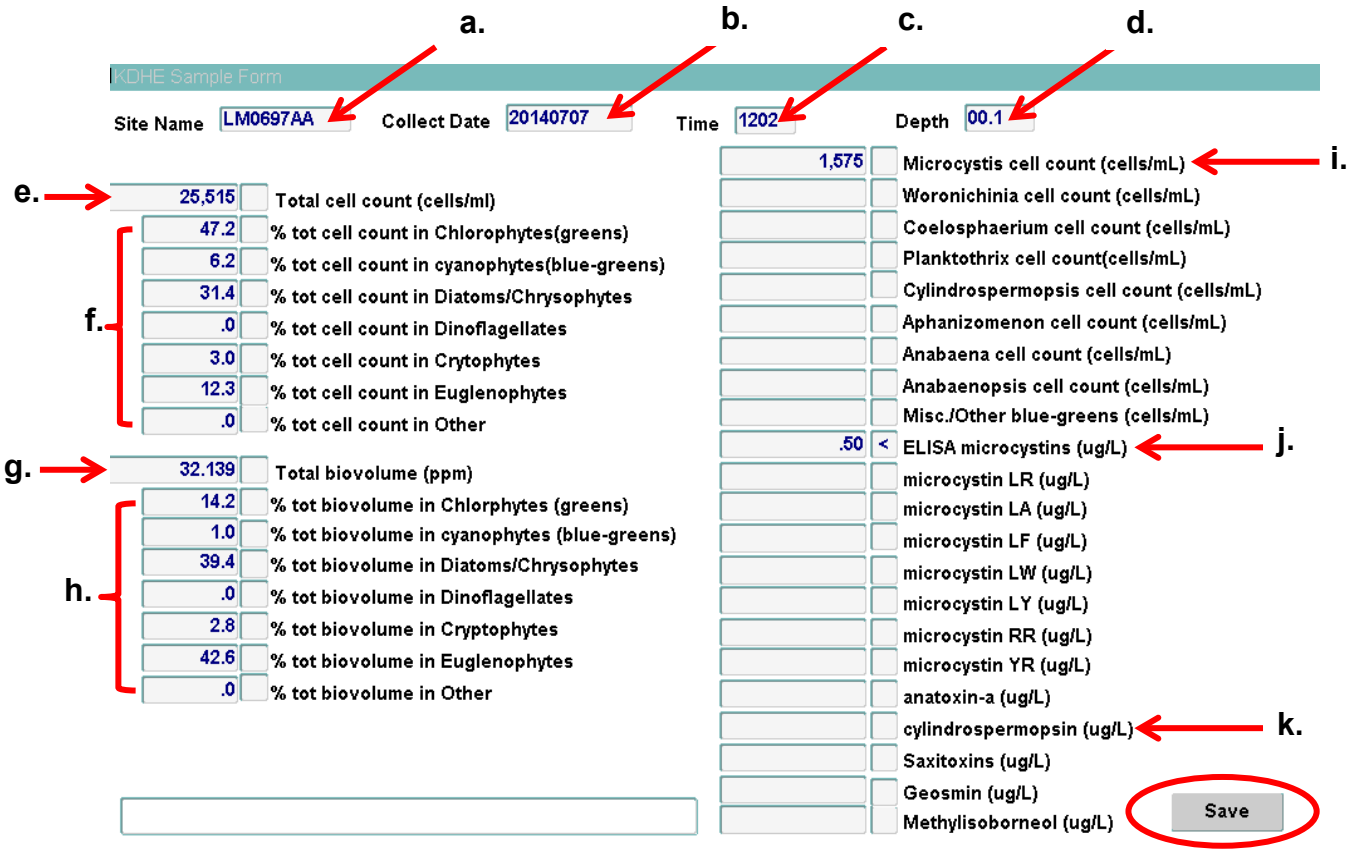
h. % total biovolume in greens, blue-greens, etc.

i. Microcystis cell count

j. ELISA Microcystins

k. Cylindrospermopsin (if required)

l. Click on 'Save' when finished



The data can be retrieved from the Algae database located in Oracle/Environment. The algal data on Oracle is automatically linked to the KDHE Harmful Algae Bloom Management System application, where it can be viewed/downloaded.

REFERENCE: KDHE 2017. Division of Environment, Quality Management Plan Part III: Lake and Wetland Monitoring Program (Revision 5), 103 pp.

KDHE HARMFUL ALGAE BLOOM MANAGEMENT SYSTEM PROCEDURE (DM-003)

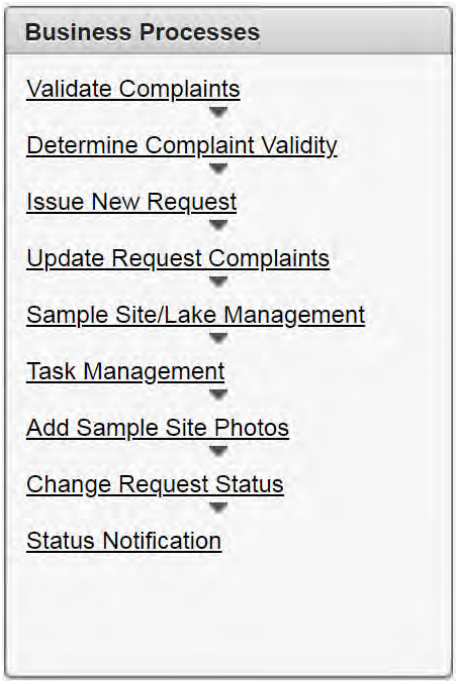
Summary

The HAB Tracking System receives complaints from the public-facing, online reporting form system. If a HAB complaint arrives via email or phone call, BOW-MASS staff initiate the process by submitting a complaint form on behalf of the individual who called or emailed.

Next, we determine whether the HAB complaint is valid. For example, if a member of the public enters a complaint for a private pond, we will mark the complaint as “invalid” and may contact the individual to redirect them elsewhere for assistance. Or, the complaint may not contain convincing evidence that a full scale analysis is warranted (*e.g.,* no photograph provided or the photo is unclear). In the latter case, BOW-MASS staff may request additional evidence (in the form of a jar test) from the complainant or the lake manager.

If the complaint is considered valid, the HAB sampling procedure will be initiated. The event nomenclature for the HAB Tracking Application is for an individual waterbody to receive a “Request,” which is then followed by a “Task” for each sampling event. As long as a lake is in an active bloom, only one “Request” is required. Once a sampling task has been initiated, it must go through the whole process (from issuing the sampling task to changing the status of the “Request” based on the sampled data) before another sampling task can be issued. The “Request” will disappear only when the advisory status for that waterbody is updated to “Below Watch.” In general, the user must keep in mind that the HAB Tracking Application has minimal error trapping and is not equipped to deal with typos or discrepancies between records. For example, if sample stations are labeled incorrectly in the Algal Database, or if times/dates do not match, then the record won’t be imported into the HAB Tracking Application. Make sure that dates and times are entered in the correct format, etc.

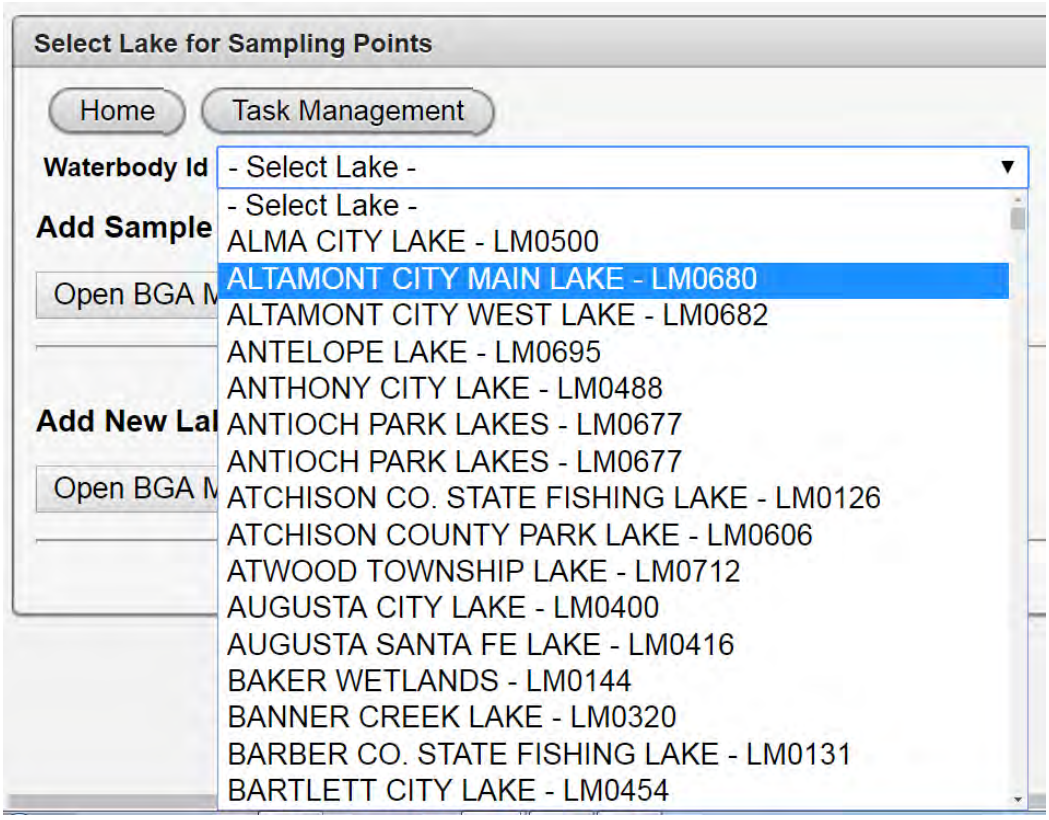
Most operations will occur in the “Business Processes” Menu, in the upper right-hand corner of the main screen.



After a HAB complaint is received:

Step 1: Check to see if the lake has an assigned number

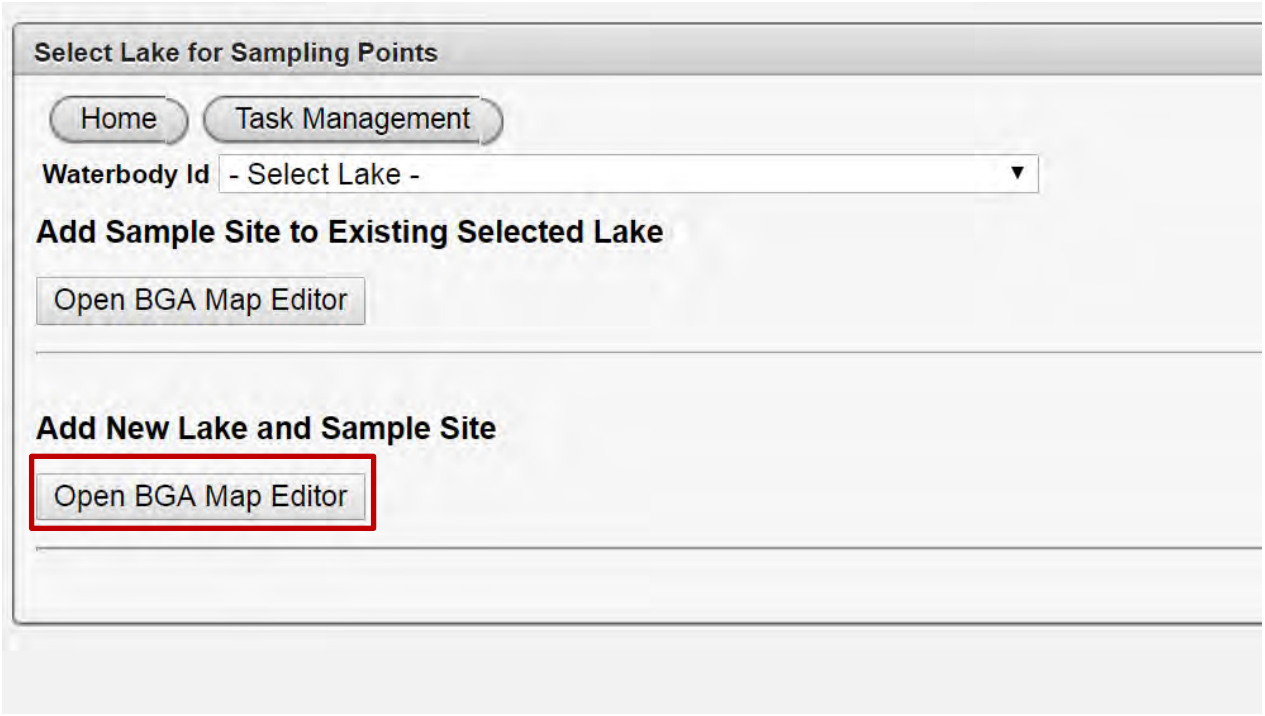
Before starting the process, it is helpful to make sure that the lake in question has a lake number and HAB sample locations- this can be verified directly in Oracle ENVI, or through the ***Sample Site/Lake Management*** screen. (*NOTE- if the “Sample Site / Lake Management screen is blank, computer support staff will need to give permissions for access). All lakes with a number assigned in Oracle will appear in the dropdown menu, even if they’ve never been sampled for HABs. All zoned lakes will have the nomenclature “LM(zone letter)(lake number without leading 0).” For example, Perry Lake Zone A is: LMA290. If the given lake does not appear in the dropdown list, proceed to the next step to add a lake to the HAB tracking system.



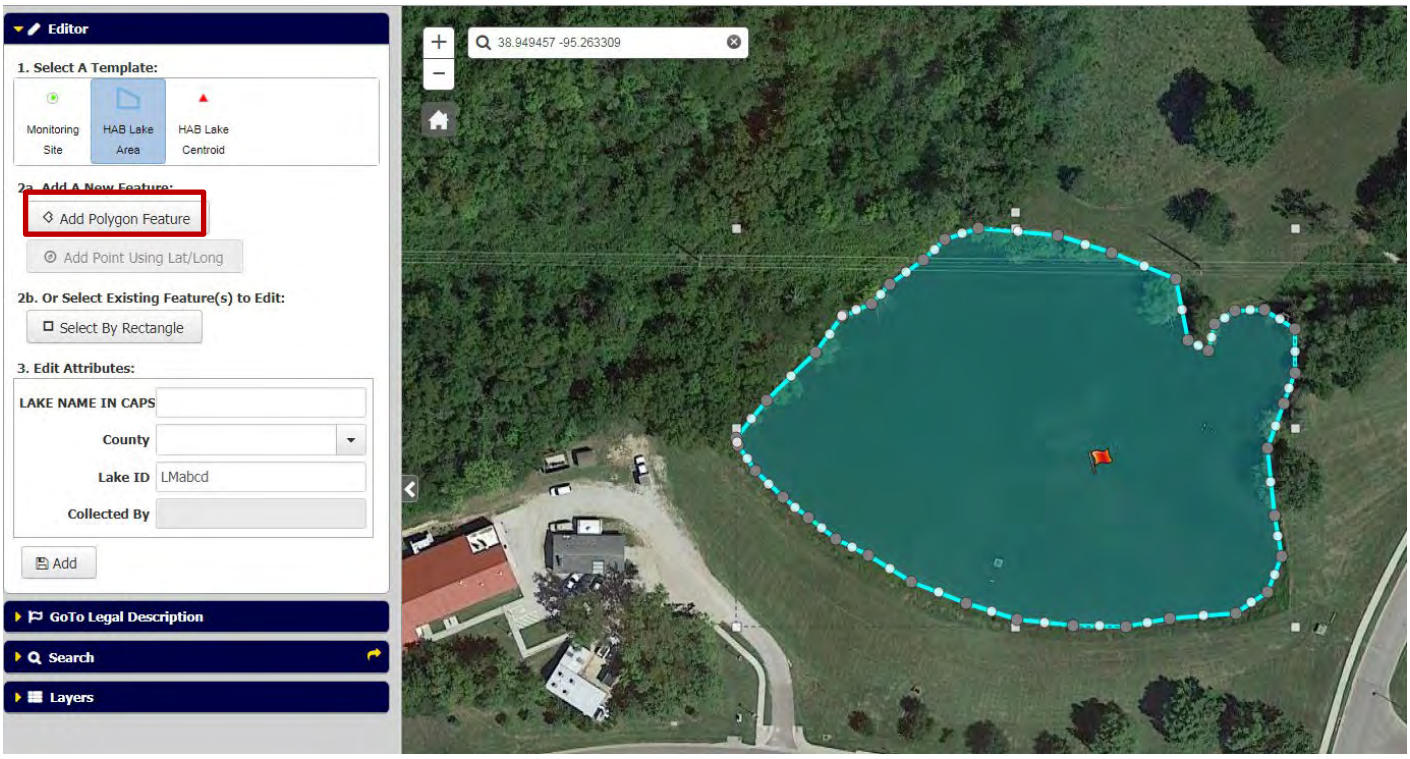
Step 1.1 Adding a lake to the system

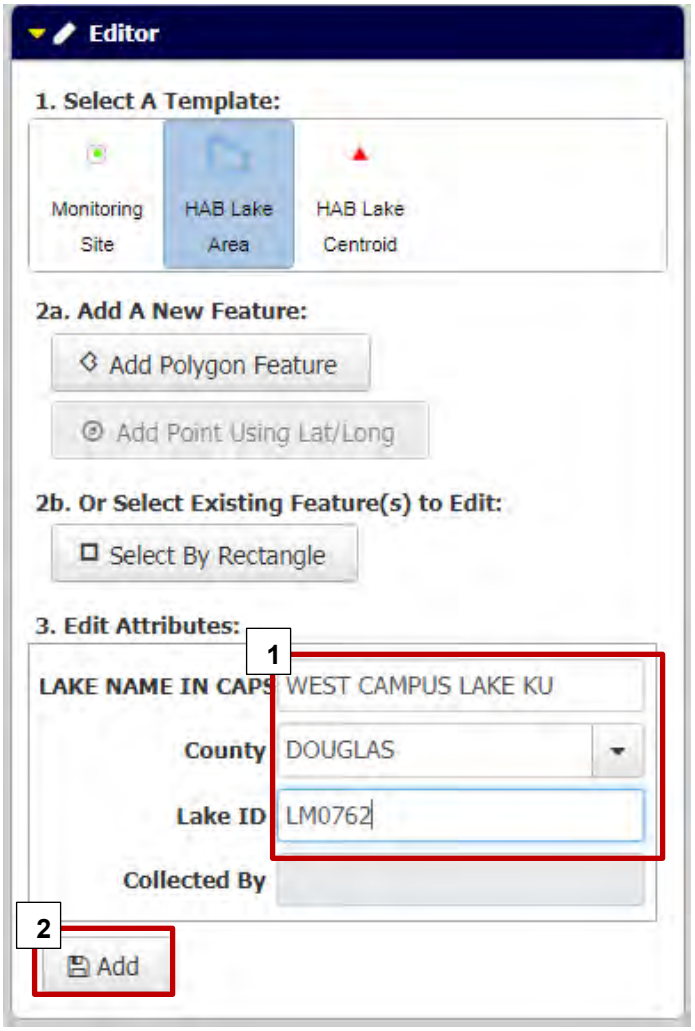
Before assigning a number to a lake, it is important to check with the Lake and Wetland Monitoring Program Staff, who are responsible for assigning them. This ensures that numbers are neither skipped nor duplicated.

Once a new lake number is established, open the ***Sample Site/Lake Management*** screen. Underneath “Add New Lake and Sample Site,” click on the “Open BGA Map Editor” button.



Navigate to the lake location with the search bar and select “Add Polygon Feature.” Outline the lake’s shape, then fill in the fields below “Edit Attributes.”

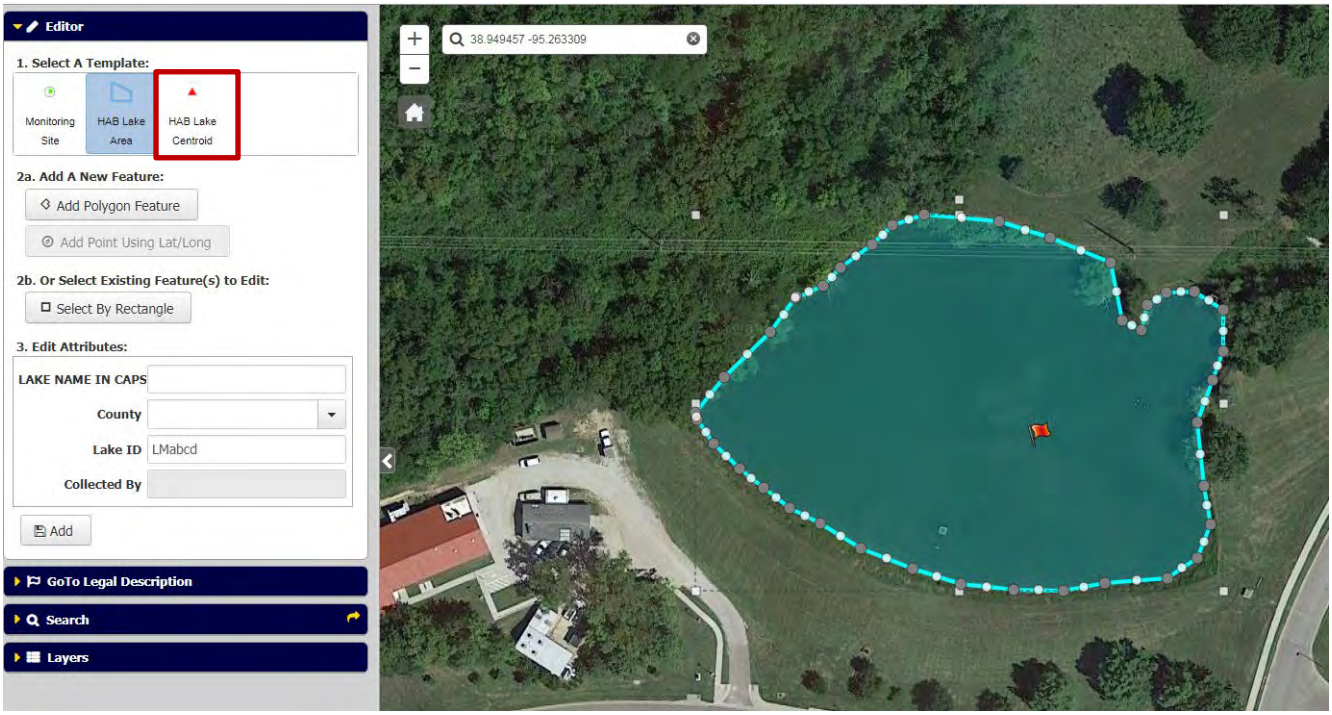




Select the “Add” button. The words “Feature added!” will appear on the map if everything worked correctly.

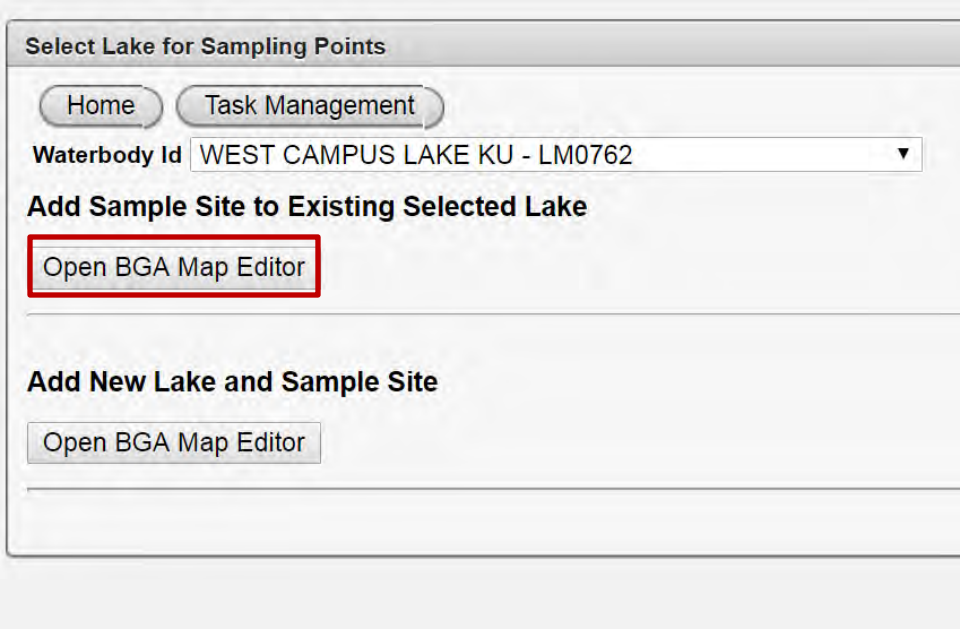
Step 1.2 Adding a centroid to the lake

After creating the lake outline, add a “centroid” to the lake. Select “HAB Lake Centroid” in the same “Add Polygon Feature” screen. The centroid needs to be placed somewhere in the middle of the lake polygon, but it does not have to be the exact center. The coordinates are used for lake location mapping.



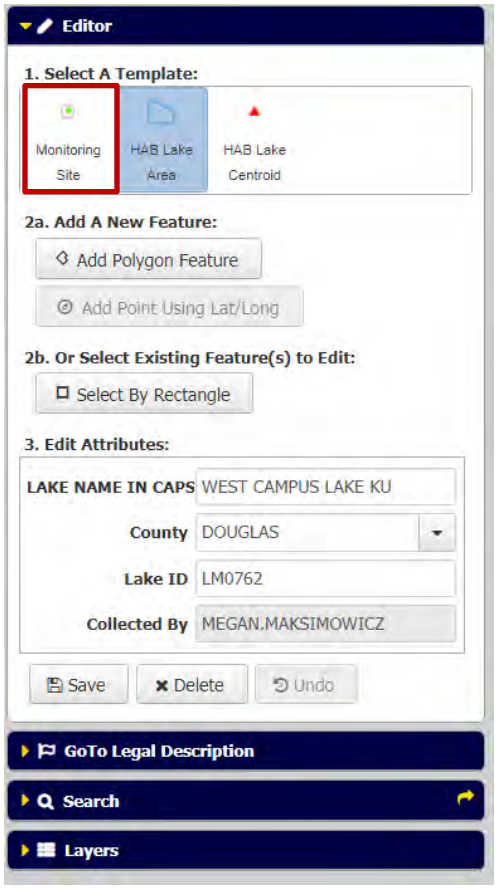
Step 2: Check to see if there are HAB sample sites

If a new lake number was required, it has not been sampled for HABs before. However, if the lake was already in the system, check to see whether it has been sampled for HABs before. As soon as the lake has a number in Oracle, it will be visible in the ***Sample Site/Lake Management*** (under the "Business Processes" menu). Select the lake, click on "Open BGA Map Editor," and wait for the map to appear; it may take a few seconds. The map will have all sample locations marked. All HAB recreation sample sites are designated by the convention "AA," "AB," "AC," and so on. All HAB PWS sample sites are designated by the convention "BA," "BB," and so on. If the lake has a site designated, go on to Step 3: Validate visual description of complaint.

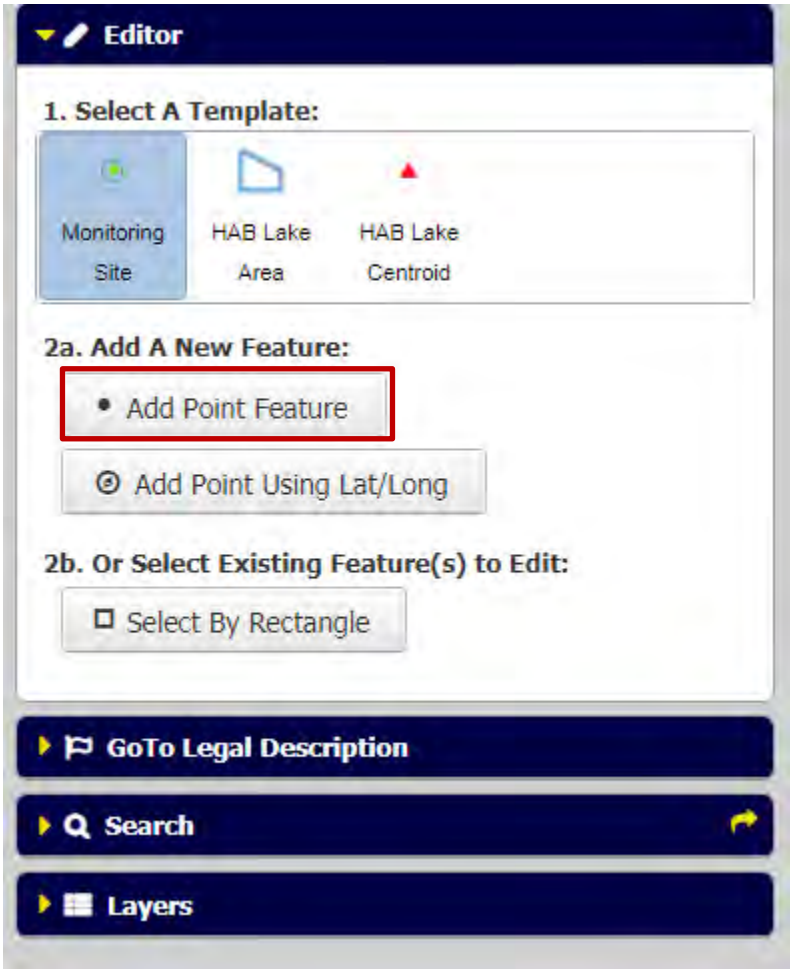


Step 2.1: Adding a HAB sample site

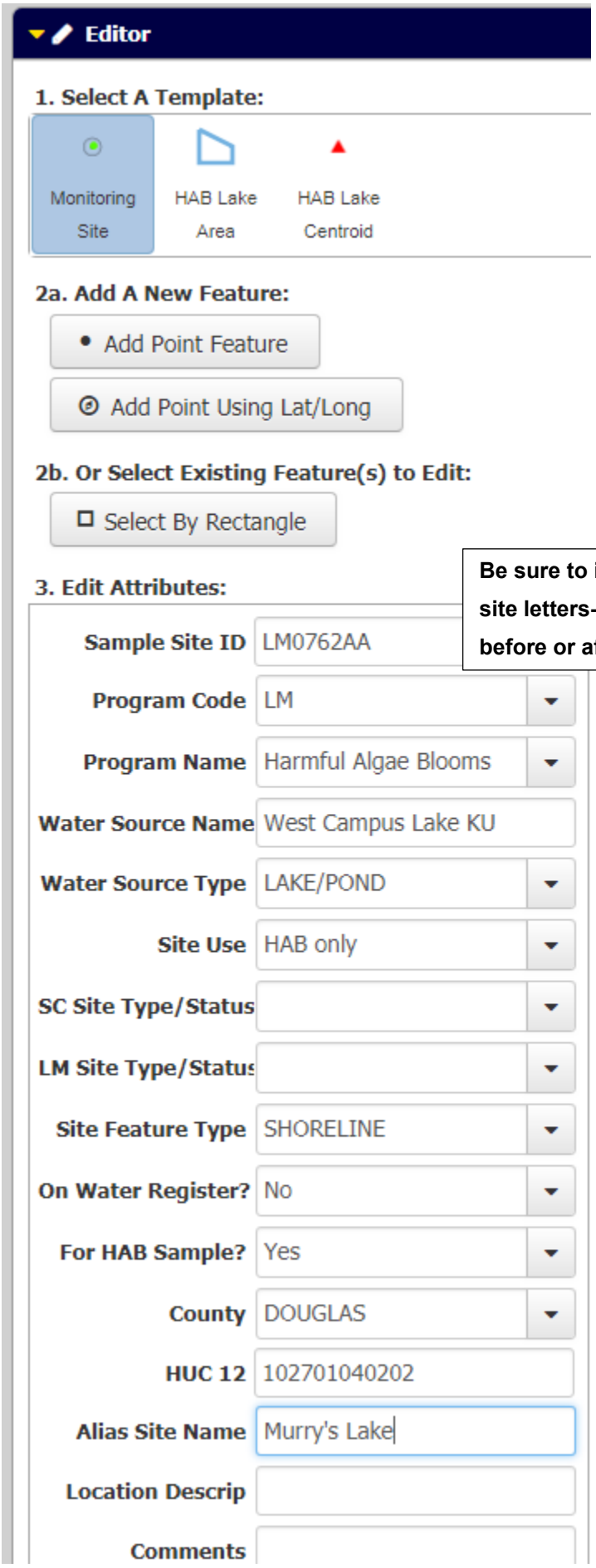
Open a map of the lake in the ***Sample Site/Lake Management*** screen. Click on “Monitoring Site” under “1. Select a Template” on the left-hand side.



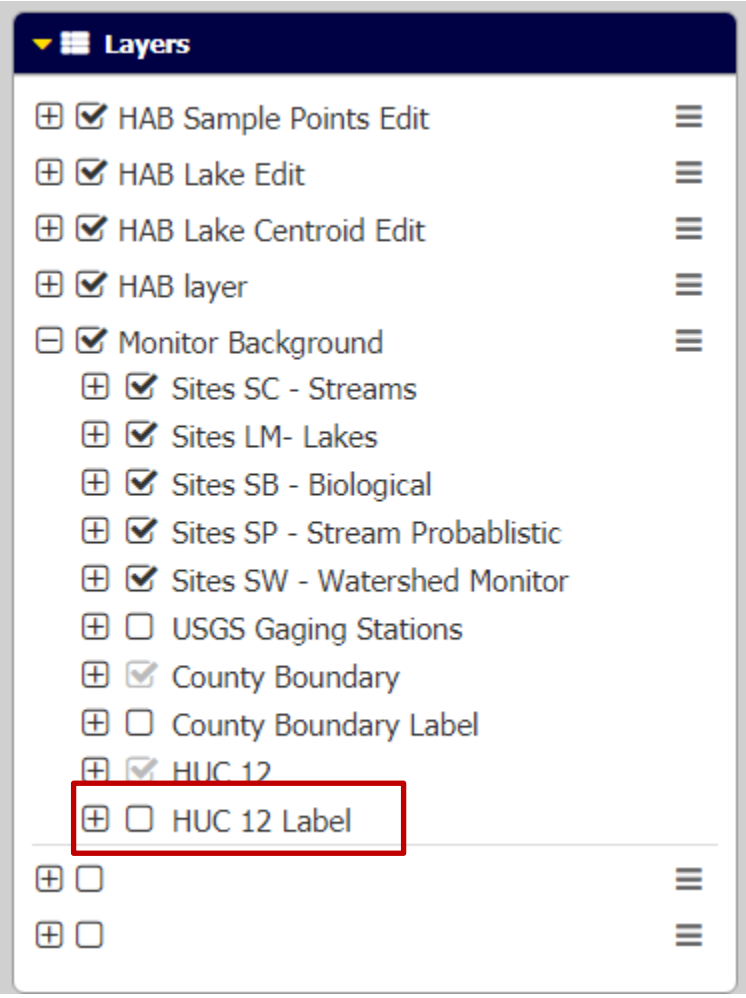
The menu will change. Select “Add Point Feature,” unless measured coordinates (latitude and longitude) are available.



Select the sample site location on the map (based on primary contact locations, *e.g.,* a swim beach – discuss with HAB group first).


Editor
1. Select A Template:
Monitoring Site
HAB Lake Area
HAB Lake Centroid
2a. Add A New Feature:
Add Point Feature
Add Point Using Lat/Long
2b. Or Select Existing Feature(s) to Edit:
Select By Rectangle
3. Edit Attributes:
Be sure to include the site letters- No spaces before or after!
Sample Site ID LM0762AA
Program Code LM
Program Name Harmful Algae Blooms
Water Source Name West Campus Lake KU
Water Source Type LAKE/POND
Site Use HAB only
SC Site Type/Status
LM Site Type/Status
Site Feature Type SHORELINE
On Water Register? No
For HAB Sample? Yes
County DOUGLAS
HUC 12 102701040202
Alias Site Name Murry's Lake
Location Descrip
Comments

Fill out the attributes for that specific location. The HUC 12 label can be found on the “Monitor Background” dropdown, under the “Layers” dropdown, located at the very bottom of the editor toolbar.



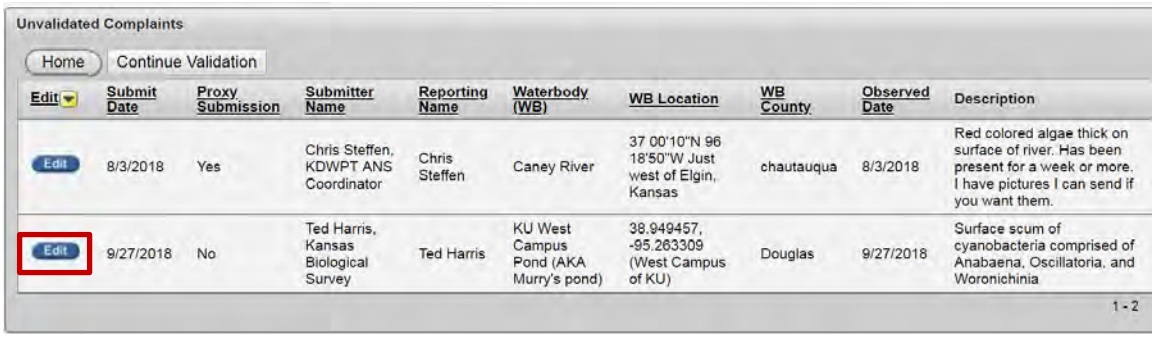
When all the attributes are entered, click on the “Add” button at the bottom of the attributes box. When a sample site is successfully added, it will appear on the map with the words “Feature Added!”

Step 3.1: Validate visual description of complaint.

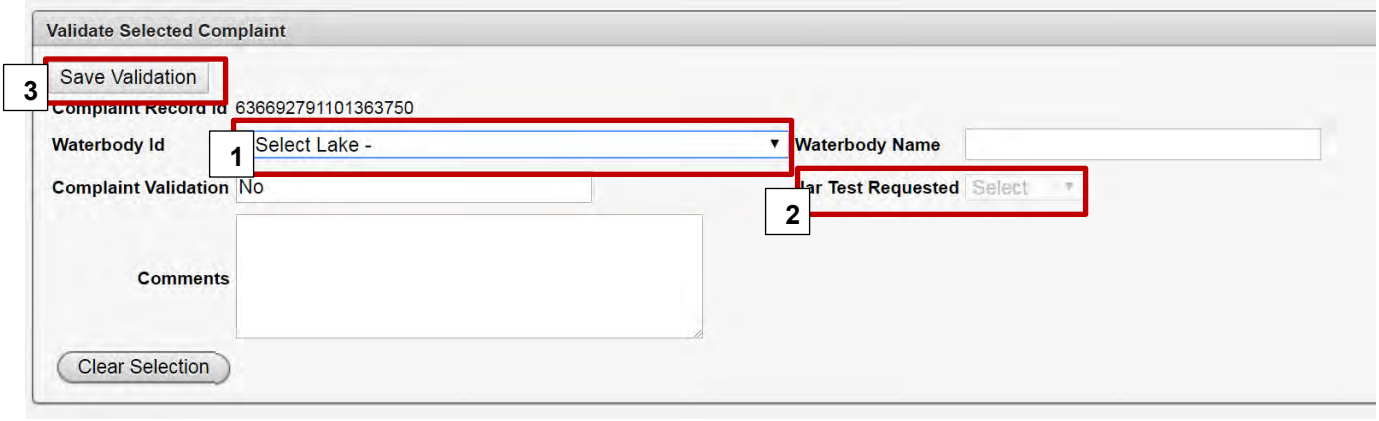
There are two components to validation of a complaint. The first component is based on narrative description or a visual, and the second component is if further validation is required using the jar test method. If a complaint is received by a lake manager or other professional who have a good working knowledge of HAB, it is often advanced in the system without a request for further data. The jar test validation is most often used in cases where the

reliability of the complainant is unknown or it is difficult to tell, from field photographs, if a cynanobactieral bloom is present. Both components must be completed in the HAB Tracking Application to fully validate a complaint.

For the first validation, select ***Validate Complaints*** under the Business Processes Menu. Select "Edit" for the complaint in question.



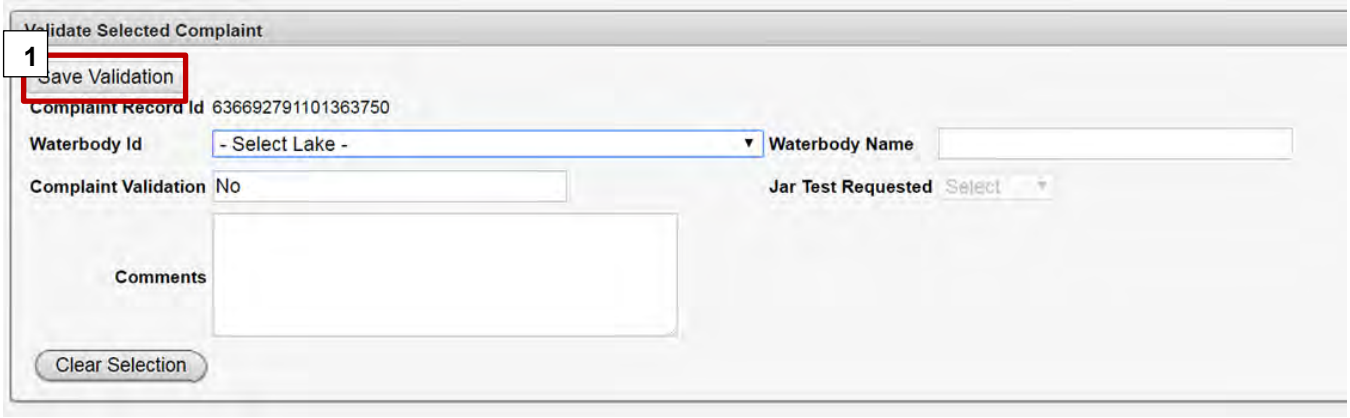
This will bring up the following menu:



First, select "Waterbody Id" from the dropdown menu. This will change the "Complaint Validation" section to say "Yes," and the "Jar Test Requested" dropdown will then be active. Select "Yes" or "No" for the Jar Test Requested, depending on whether one is required. This will send out an email to the HAB Team listserv that there has or has not been a jar test requested, so it is helpful to add comments here - (Example: If a jar test has already come in, the user can say "Yes" for the request, but add a comment to specify that the test has actually been completed already, and results were already submitted.)

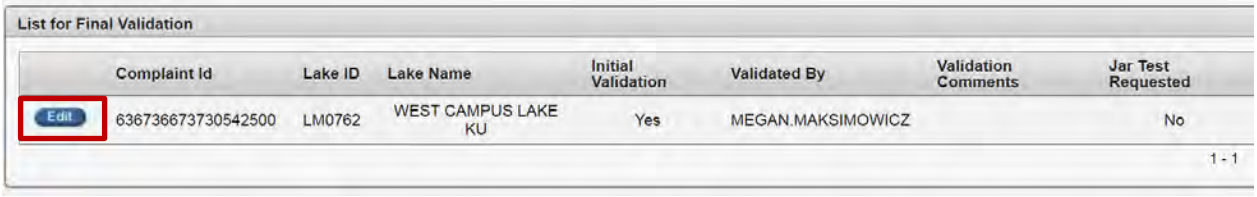
Step 3.2: Invalidate Complaint

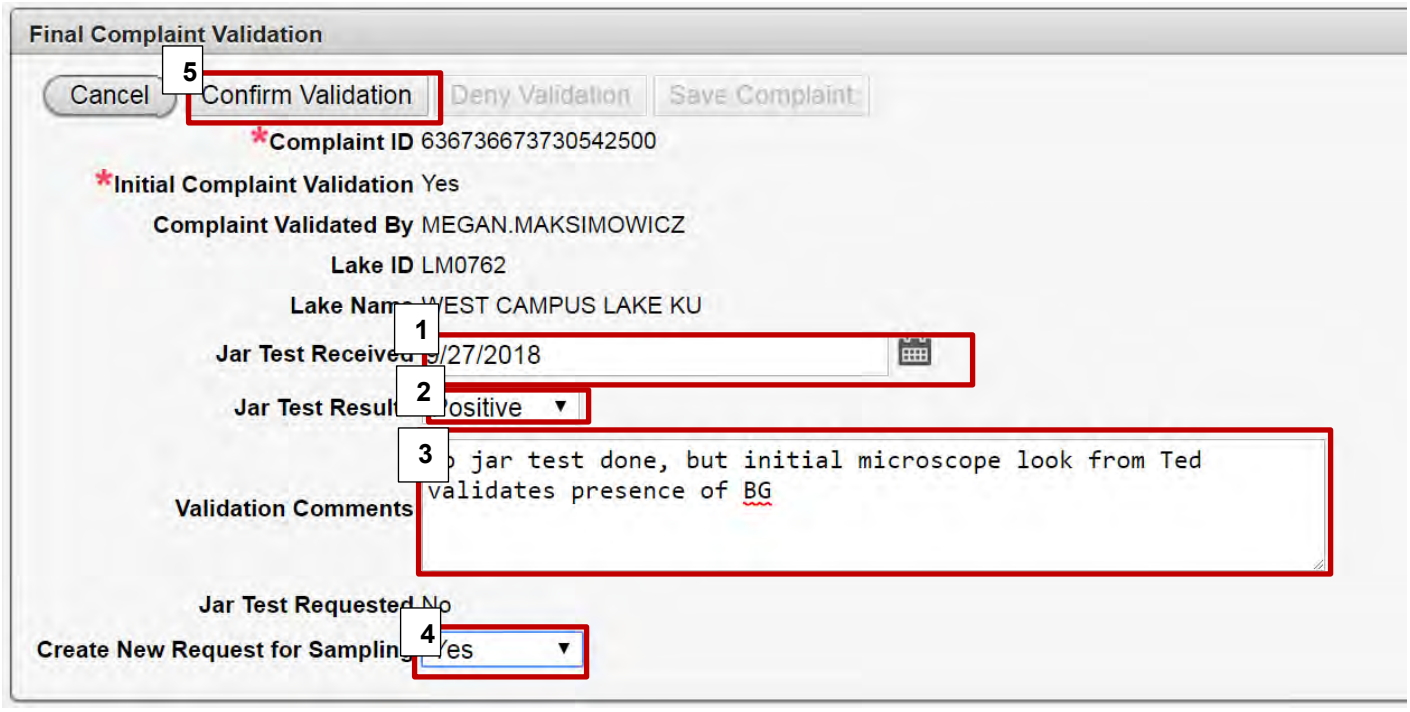
Alternatively, if the complaint is not valid, select “Save Validation” and do not fill out any other information. This will mark the complaint as invalid, and it will not appear again.



Step 4: Validate Jar Test

After the initial visual validation is saved, the complaint will now appear under ***Determine Complaint Validity***, on the Business Processes menu. Again, select “Edit” for the complaint in question.





First, select the date using the calendar icon to the right of “Jar Test Received.” Select a date, even if no actual jar test was done (for example, if the complaint was submitted by an experienced professional, and/or convincing photographic documentation was provided).

IMPORTANT: In order for the “Confirm validation” button to become active, the jar test results *must* be marked as “Positive.” If no jar test was conducted, just enter an explanation under “Validation Comments.”

Change the “Y” to “Yes” under “Create New Request for Sampling.” Then select “Confirm Validation.”

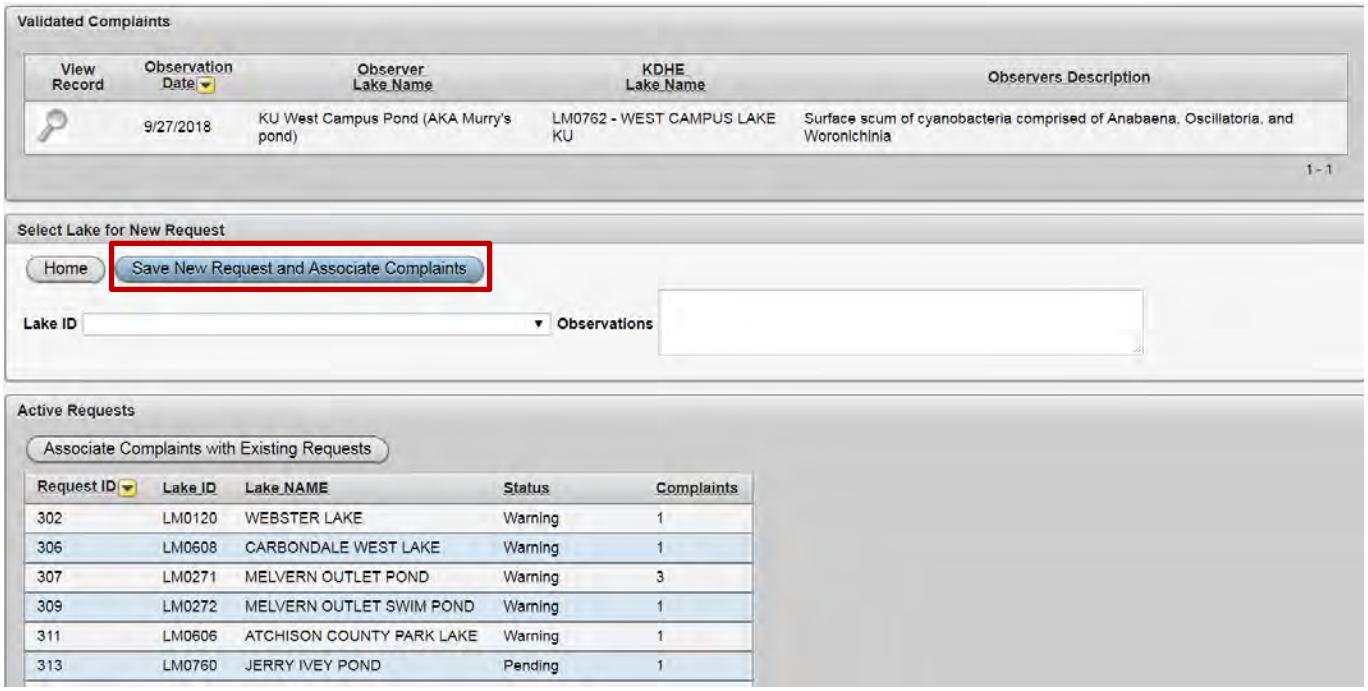
Step 5: Use validated complaint to create a new request, or attach validated complaint to existing request

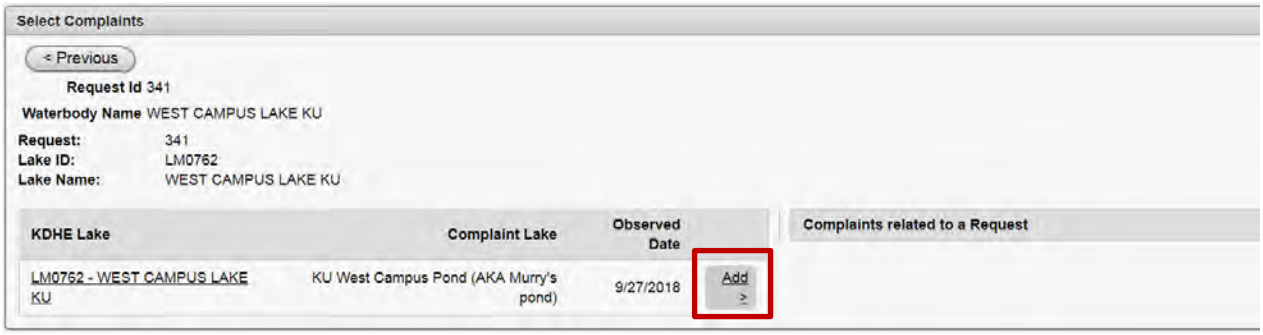
Once it has been determined that at least one sample will be needed from a given lake, the first task is to set up the “Request.” This can be thought of as the way the application tracks the status of the whole lake. Once a Request has been opened, then “Tasks” can be assigned to sample. The waterbody-specific “Request” only needs to be initiated once for each active bloom, and that Request will then be updated with the waterbody’s advisory status (*i.e.,* Watch, Warning, Below Watch) each time a sample is submitted.

To initiate the request, click on Issue ***New Request*** under the “Business Processes” menu. After the complaint has been validated for the jar test, it will appear under the “Validated Complaints” screen.

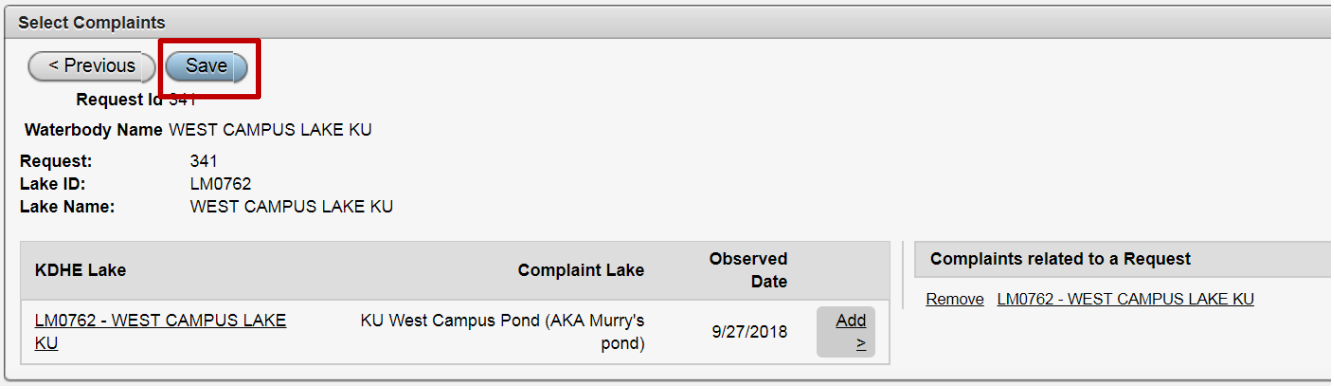
Step 5.1 (for a new request)

If this is the first Request for a lake, select the lake from the “Lake ID” dropdown menu (otherwise, please refer to Step 5.B for an existing request). After the lake is selected, click on the “Save New Request and Associate Complaints” button. All validated complaints will appear on the menu.





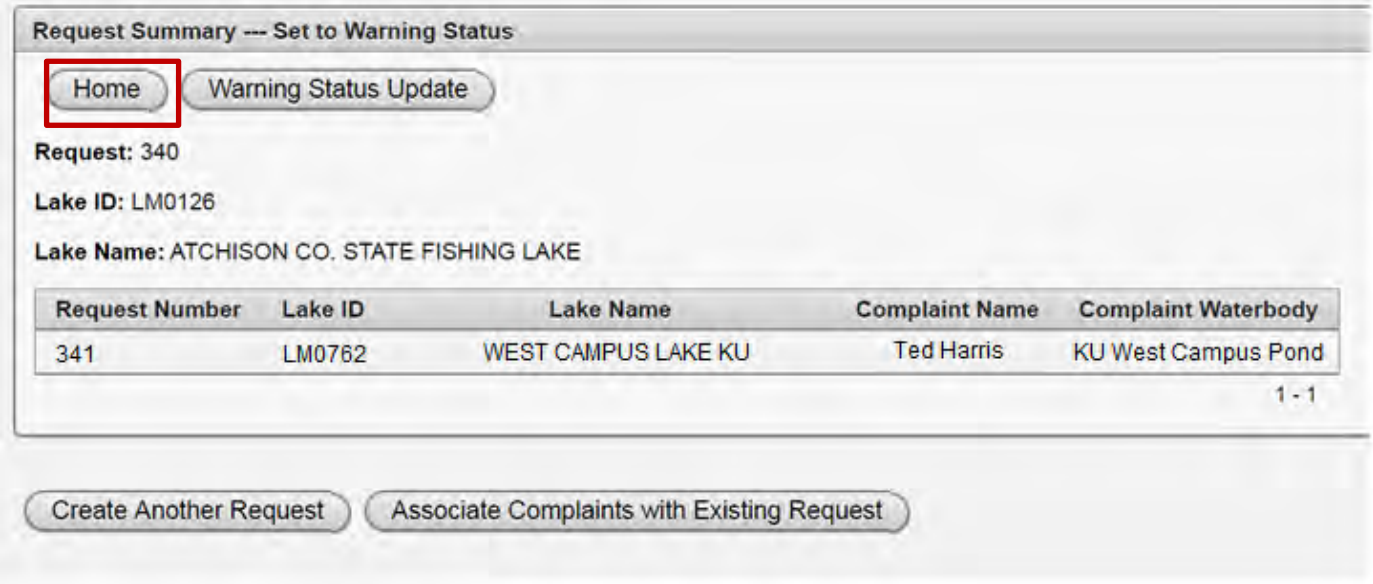
Select the “Add” button on the complaint that matches the given lake. This will populate the “Complaints related to a Request” column, and a “Save” button will appear.



Click “Save.” This will send an email to the HAB Team listserv that a new sampling request has been issued.

Then a new screen will appear, with a button for “Home” and a button for “Warning Status Update.” The “Warning Status Update” is for instances in which the HAB Team knows, based on professional reports or convincing photographic evidence, that the lake in question is already in the midst of an extreme bloom, and they wish to change the status without first sampling. This screen may also be used to “Create Another Request” for complaints for other lakes, or to “Associate Complaints with Existing Request” if there are multiple complaints for the same lake.

In most instances, just select the “Home” button, and move on to issuing a sampling task.



Step 5.2 (for an existing request)

If there is already an active request for a lake, it will not appear on the dropdown menu. Instead, select the “Associate Complaints with Existing Requests” button. This screen can also be accessed using the “Update Request Complaints” link on the Business Processes menu. Select the “Edit” button next to the lake with the complaint. This screen should have all of the available validated complaints to add to the request, but this may not be updated immediately. (Ask a coworker to login to double check this task under his/her login, if known complaints do not appear on this screen as expected.)

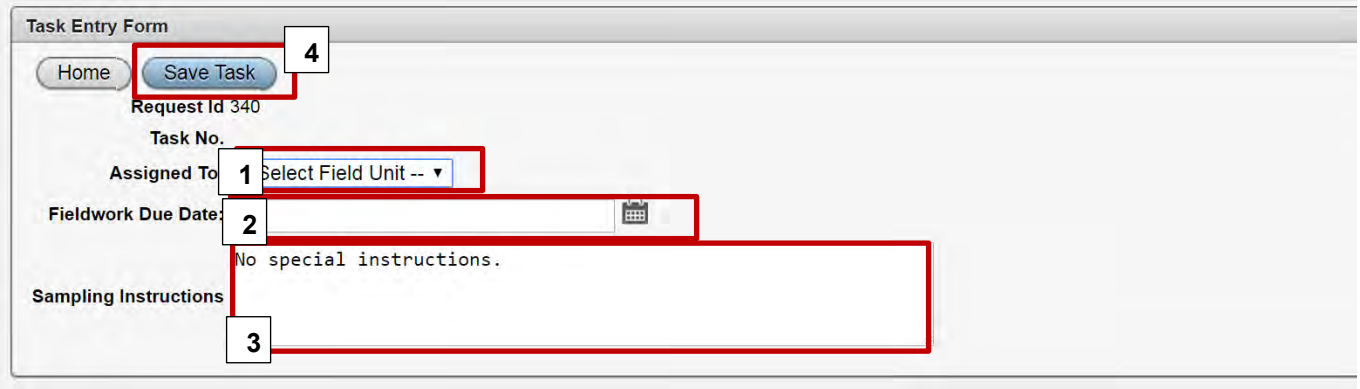
Step 6: Issue a sampling task

For all of the steps dealing with an individual sampling task, the user will keep returning to the ***Task Management*** link on the "Business Processes" screen. The menu will be separated into two sections – "Request with no task" and "Request with assigned tasks."

The new request will fall under the first section, "Request with no task." Note that if there are more than 15 records, the user may have to select the Next arrow at the bottom of the section to see more requests. They are not necessarily in alphabetical order.

Select the "Edit" button next to the lake where sampling is needed. Before completing this step, **make sure that all of expected sampling locations exist in the "Sampling Site/Lake Management" map and are correctly labeled.**

Selecting "Edit" will pull up the following screen.



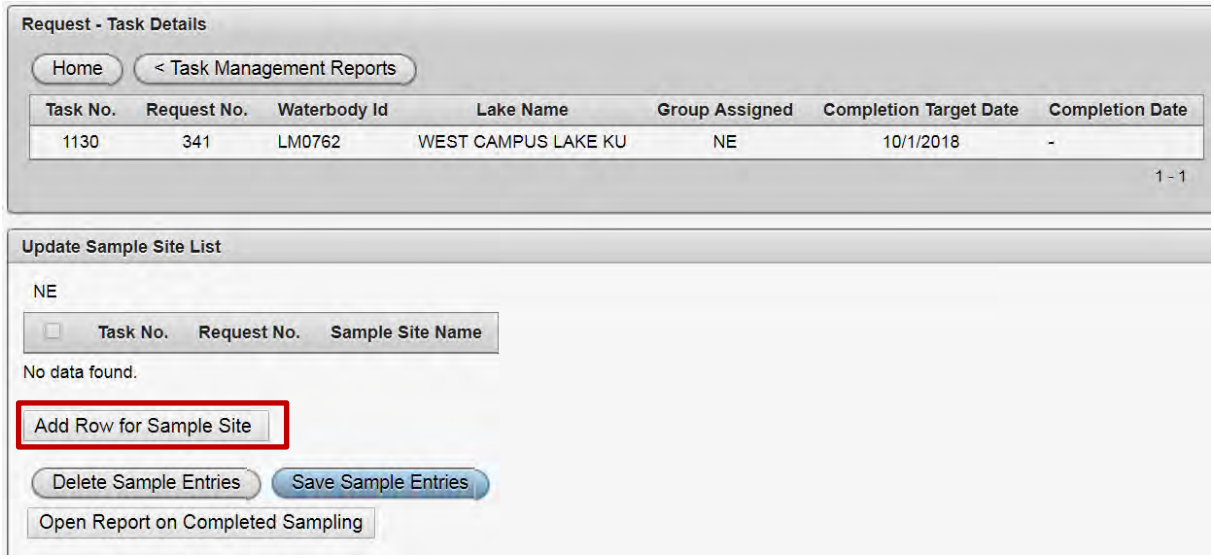
First, select from the dropdown menu which Field Unit will collect the sample. Field Unit can be determined using the District map located at: http://www.kdheks.gov/befs/dist_office.html. Most lakes fall within one district's jurisdiction; however, some lakes require special treatment; consult the HAB Team manager if there is any question. Other monitoring crews

may sample when it falls into their regular sampling schedule, but for the most part, it will go to the District Office.

Next, select the calendar next to the “Fieldwork Due Date,” and select the date (usually the Monday of the new sampling week).

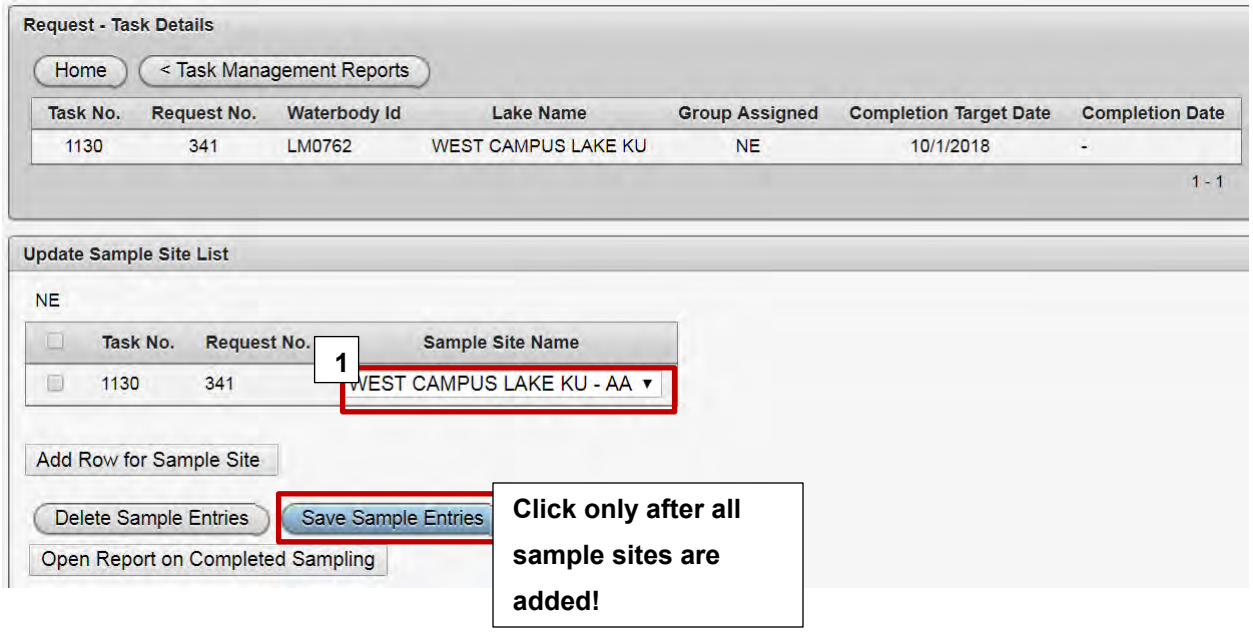
In the “Sampling Instructions” box, it is helpful to fill out any info for PWS sampling information, or to let District Offices know of any special information.

After this screen is complete, select the “Save Task” button.



This will pull up a new screen, which is only accessible after the “Save Task” button has been hit. This is why it’s important to have the sampling site locations correct before this point. If they are incorrectly labeled or nonexistent, they will not be selectable at this time, and the sampling task will be irretrievable by the user; it cannot be advanced, deleted, or overwritten. If this happens, the user must contact computer support staff to delete the record, fix the sampling site error, and then resubmit the sampling task.

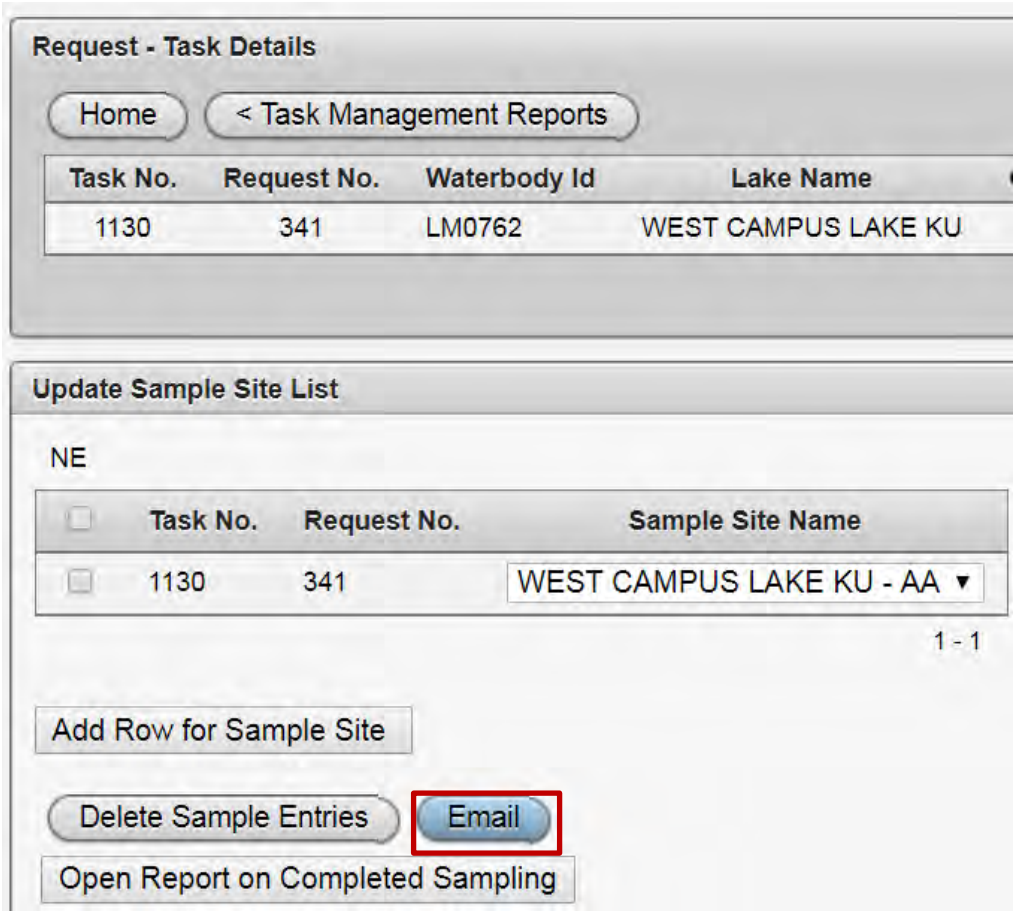
To add sampling sites, select the button for “Add Row for Sample Site.”

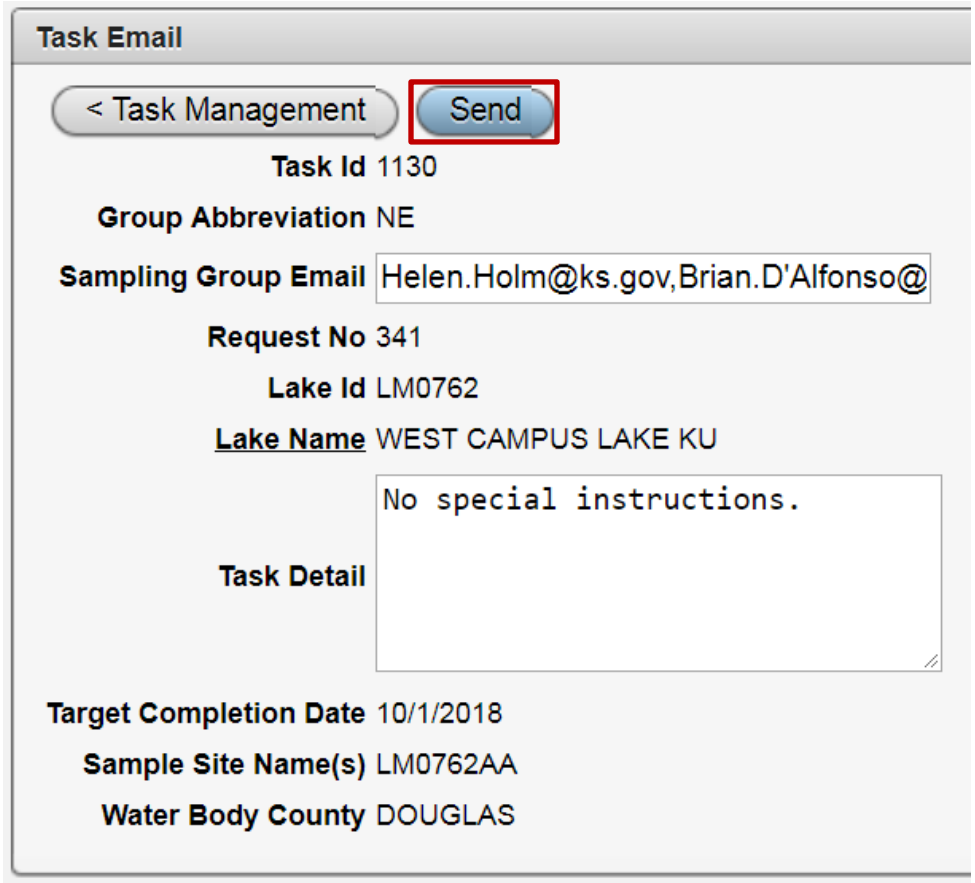


This will bring up a drop down menu, where one sampling site can be selected. Select sites from the dropdown menu. In smaller lakes, often only one sample is required, typically the "AA" site. If samples are needed from more than one location, add a row for each site using the "Add Row for Sample Site" button, and populate each row with a different site location.

When all of the sample site locations are selected, click on the "Save Sample Entries" button. The "Save Sample Entries" button will then be replaced with an "Email" button. Click on the Email button, which will automatically populate with the email addresses of the selected Field Unit*, as well as any special instructions you've already filled out.

*The email addresses can be updated/edited through the "Manage Sampling Crews" button under the "Application Administration" menu on the lower right of the main screen.


Request - Task Details
Home
< Task Management Reports
Task No. Request No. Waterbody Id Lake Name
1130 341 LM0762 WEST CAMPUS LAKE KU
Update Sample Site List
NE
Task No. Request No. Sample Site Name
1130 341 WEST CAMPUS LAKE KU - AA
1 - 1
Add Row for Sample Site
Delete Sample Entries
Email
Open Report on Completed Sampling

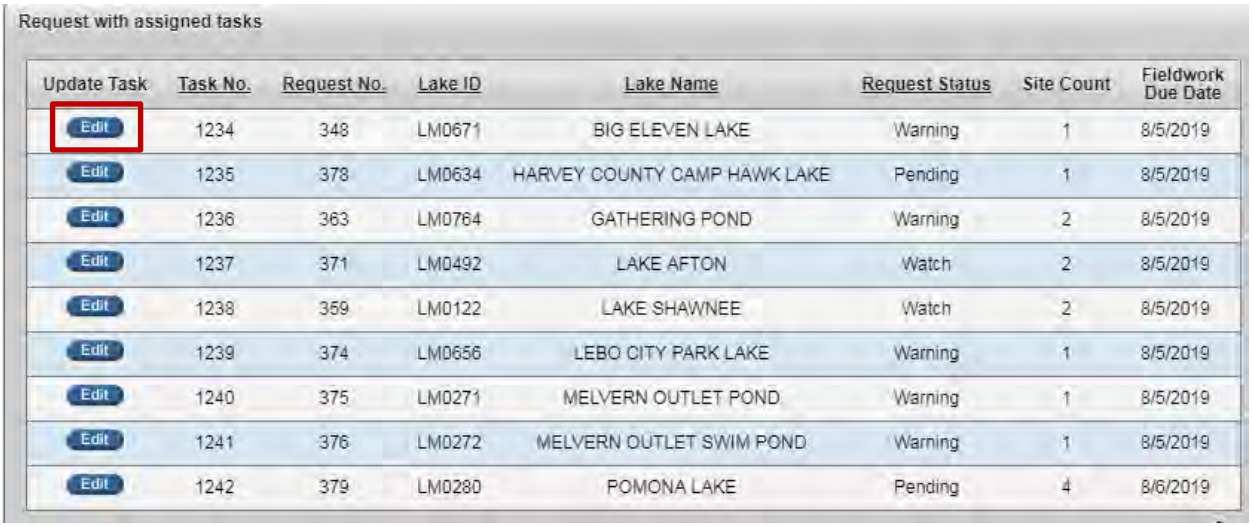

Task Email
< Task Management
Send
Task Id 1130
Group Abbreviation NE
Sampling Group Email Helen.Holm@ks.gov,Brian.D'Alfonso@
Request No 341
Lake Id LM0762
Lake Name WEST CAMPUS LAKE KU
Task Detail No special instructions.
Target Completion Date 10/1/2018
Sample Site Name(s) LM0762AA
Water Body County DOUGLAS

Click “Send.” Now, wait until samples are received from the District Office or other sampling crew.

Step 6.1 Update Request Status without Data

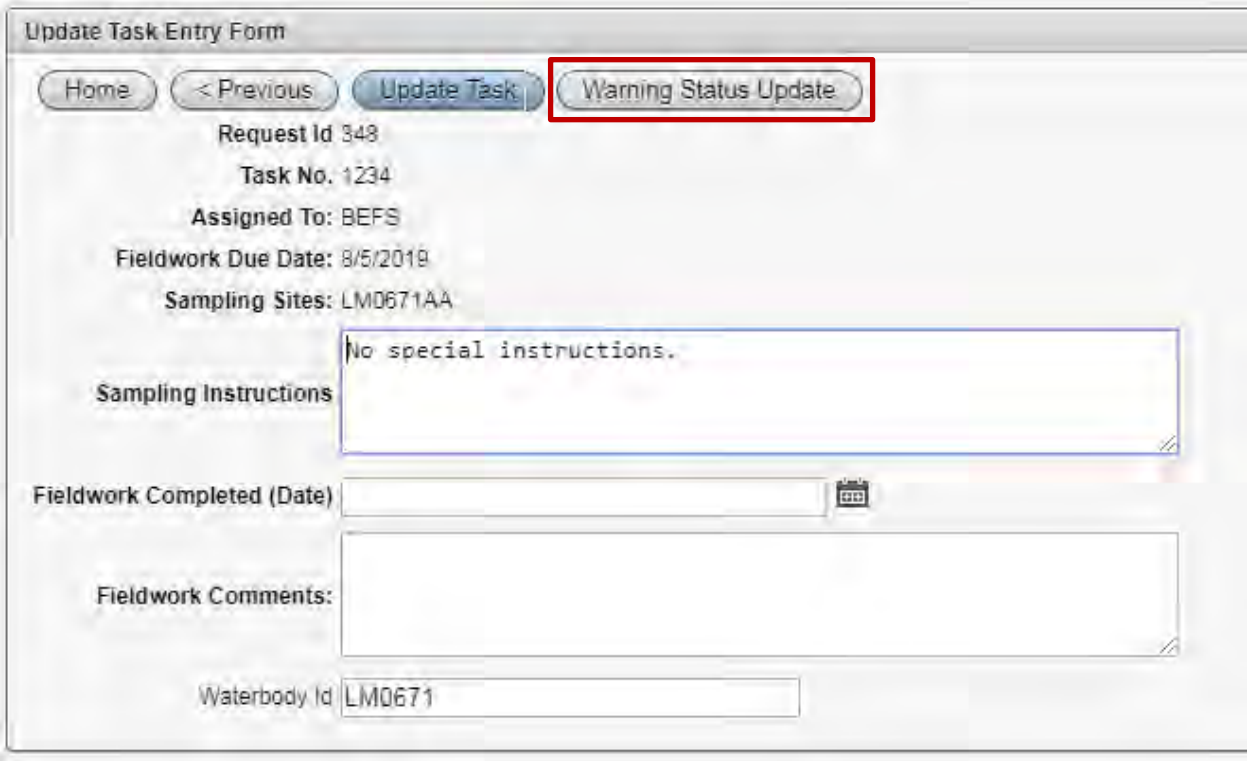
Occasionally after a sampling task has been submitted, we will need to update the status to a “Warning” level based on visual. Updating the status of the lake on the HAB tracking application will update the map of advisories to match our posted advisories listed on the website.

To update a request with a Warning after tasks have been assigned, select ***Task Management*** on the Business Processes menu.


Request with assigned tasks

Update Task	Task No.	Request No.	Lake ID	Lake Name	Request Status	Site Count	Fieldwork Due Date
Edit	1234	348	LM0671	BIG ELEVEN LAKE	Warning	1	8/5/2019
Edit	1235	378	LM0634	HARVEY COUNTY CAMP HAWK LAKE	Pending	1	8/5/2019
Edit	1236	363	LM0764	GATHERING POND	Warning	2	8/5/2019
Edit	1237	371	LM0492	LAKE AFTON	Watch	2	8/5/2019
Edit	1238	369	LM0122	LAKE SHAWNEE	Watch	2	8/5/2019
Edit	1239	374	LM0656	LEBO CITY PARK LAKE	Warning	1	8/5/2019
Edit	1240	375	LM0271	MELVERN OUTLET POND	Warning	1	8/5/2019
Edit	1241	376	LM0272	MELVERN OUTLET SWIM POND	Warning	1	8/5/2019
Edit	1242	379	LM0280	POMONA LAKE	Pending	4	8/6/2019

Select “Edit” by the lake needing updated.

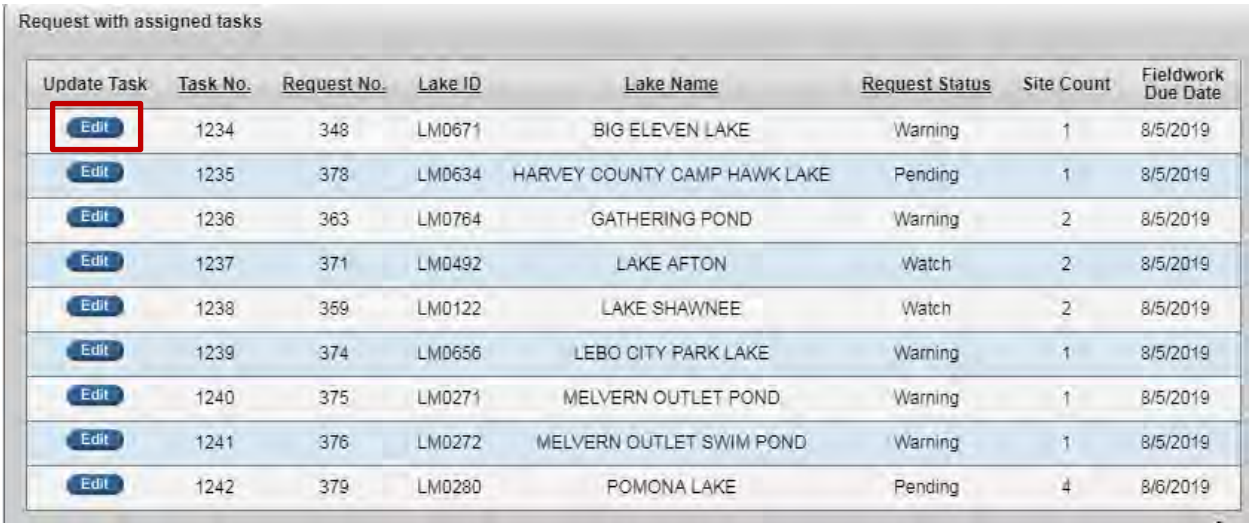


A new screen will appear with the “Warning Status Update” button available.

Step 6.2 Correcting Sampling Sites After a Task Has Been Issued

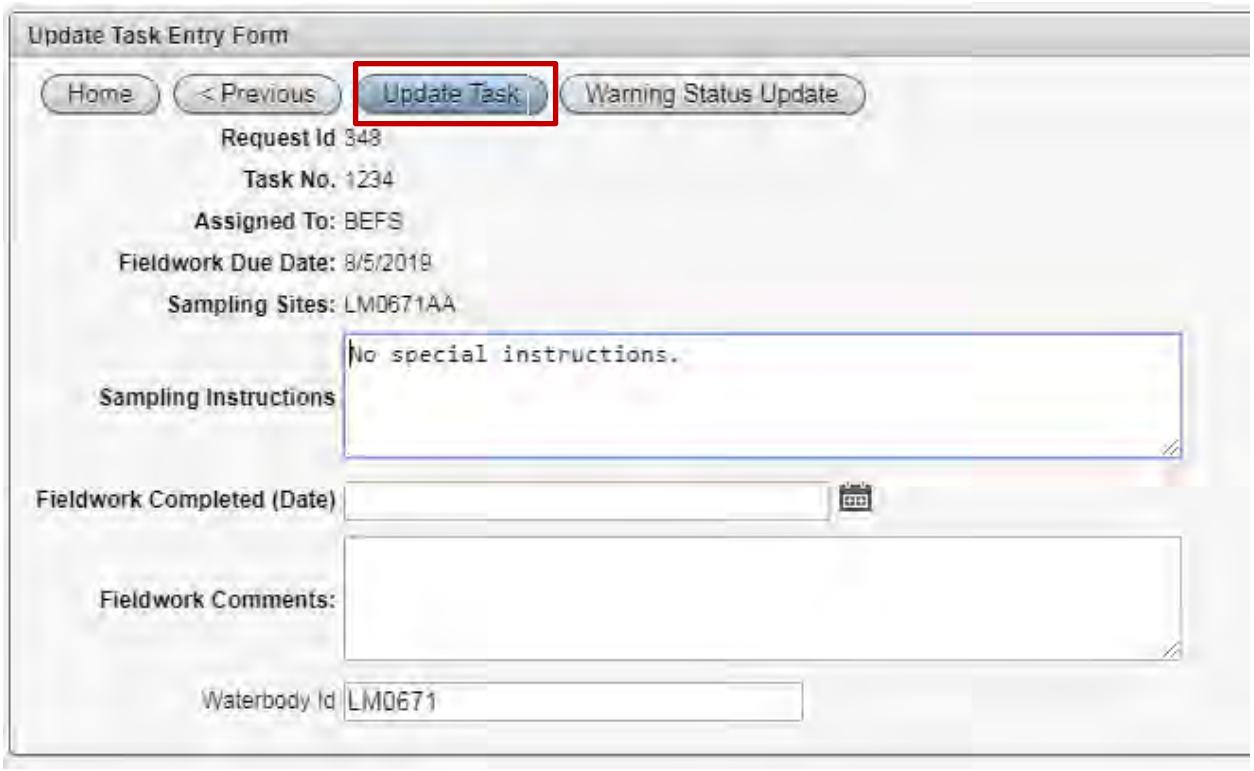
If a correction to sampling sites needs to be made (i.e. site AA was flooded, so samples were retrieved at site AB instead), corrections can be made as follows:

First, select ***Task Management*** on the Business Processes menu.



Update Task	Task No.	Request No.	Lake ID	Lake Name	Request Status	Site Count	Fieldwork Due Date
Edit	1234	348	LM0671	BIG ELEVEN LAKE	Warning	1	8/5/2019
Edit	1235	378	LM0634	HARVEY COUNTY CAMP HAWK LAKE	Pending	1	8/5/2019
Edit	1236	363	LM0764	GATHERING POND	Warning	2	8/5/2019
Edit	1237	371	LM0492	LAKE AFTON	Watch	2	8/5/2019
Edit	1238	369	LM0122	LAKE SHAWNEE	Watch	2	8/5/2019
Edit	1239	374	LM0656	LEBO CITY PARK LAKE	Warning	1	8/5/2019
Edit	1240	375	LM0271	MELVERN OUTLET POND	Warning	1	8/5/2019
Edit	1241	376	LM0272	MELVERN OUTLET SWIM POND	Warning	1	8/5/2019
Edit	1242	379	LM0280	POMONA LAKE	Pending	4	8/6/2019

Select “Edit” by the lake needing updated.



Select “Update Task” without entering any other information.

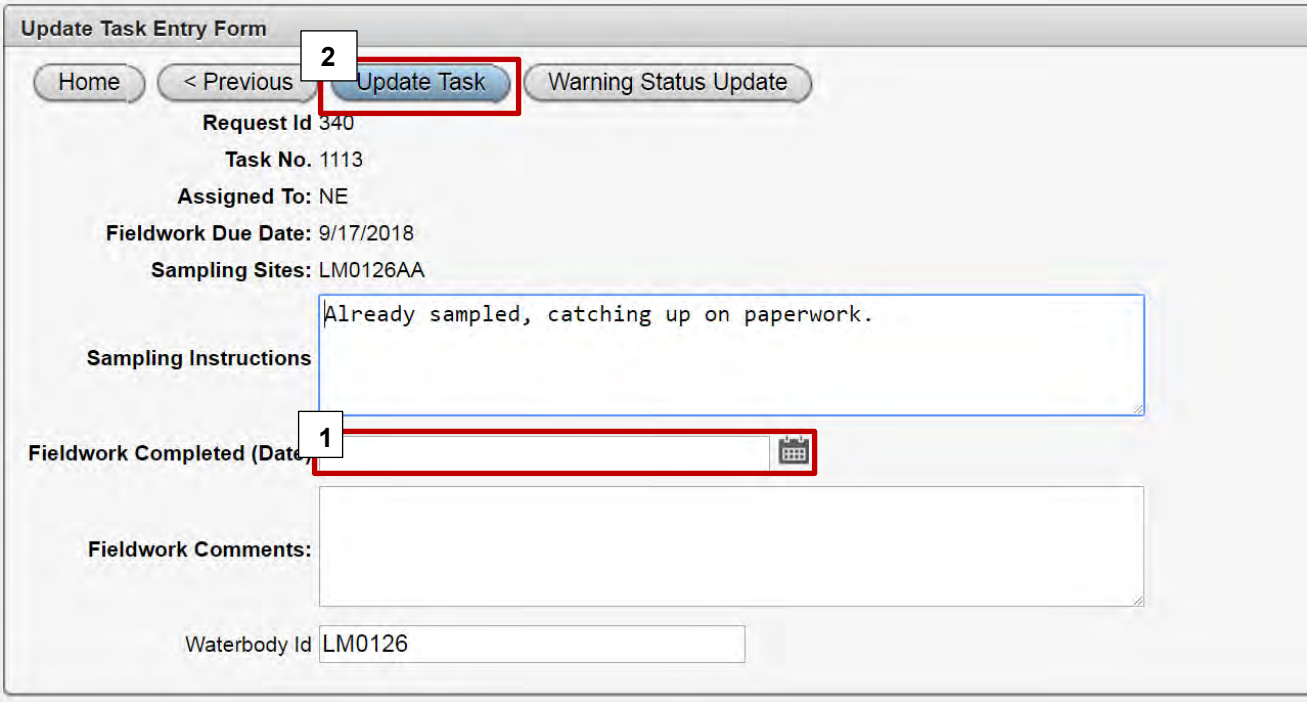
Here, sites can be selected for deletion, while others can be added. Make any changes, then select “Save Sample Entries.” You may need to exit the application or refresh the sampling task to see changes.

Step 7: Update task with completion of fieldwork

Once the sample/s are received, click on ***Task Management*** under the Businesses Processes menu. The lake will appear on the lower menu entitled “Request with assigned tasks.”

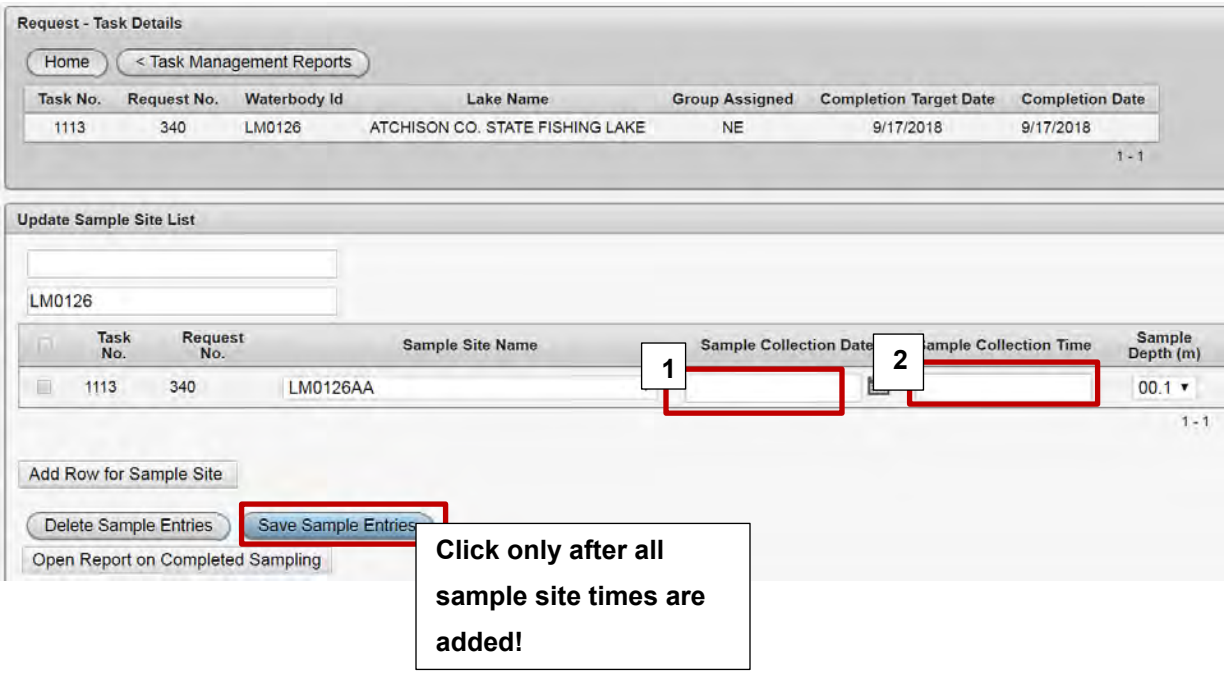
Once the sample results have been entered into the Algae Database by the analytical staff, select “Edit” next to the lake in question. It is possible to do this step before the sample results have been entered, but it is better to wait and double check the data entry with the entries in the Oracle Algae database. The data will be pulled in to the HAB Tracking Application as soon as a sample with the same sample name and time is entered into the Oracle database.

This will bring up the following screen:



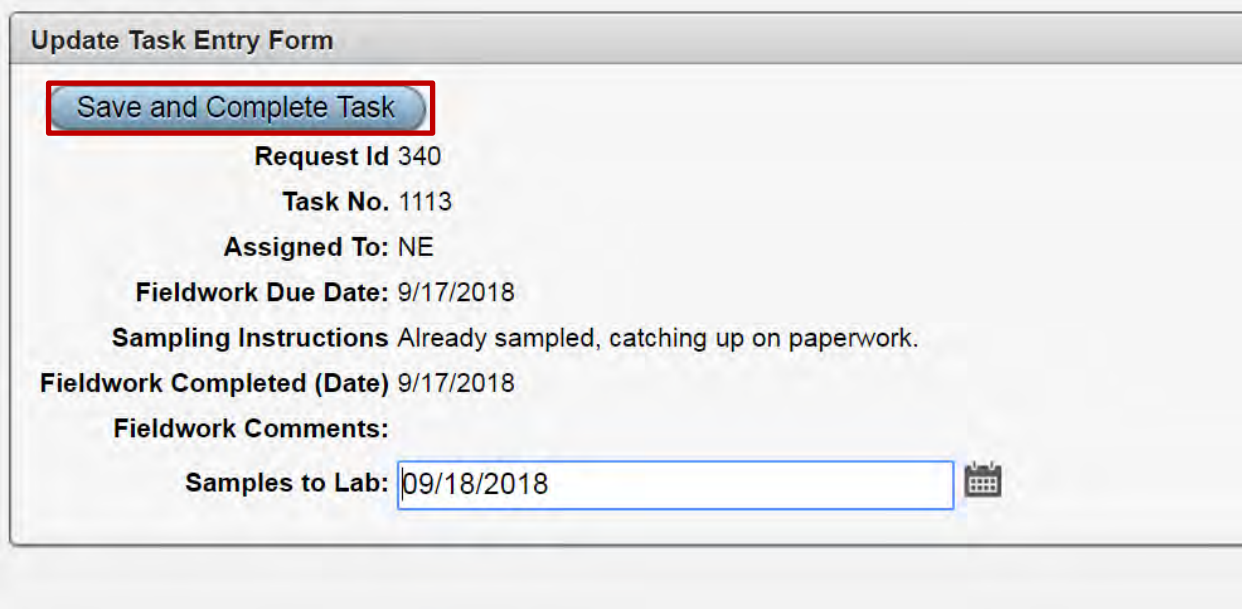
Select the calendar next to “Fieldwork Completed (Date),” and select the date that fieldwork was completed. Then select “Update Task.” (This is another location where the user can skip data, and simply select “Warning Status Update.” This is rare, but useful to know in cases where the HAB Team staff are certain that the lake is in very bad condition, but haven’t been able to test it yet.)

After “Update Task” is selected, the following screen will appear:



It is very important to get the sample date and time correct for each sample site. As soon as a sample with the same header information is entered into Oracle, the data will be imported into the HAB Tracking Application**. Enter all times in military time, and with 4 digits (*e.g.,* 0940 for 9:40 AM and 1340 for 1:40 PM)**. (Dates and times can easily be corrected in the Oracle Algae database, but they cannot be corrected in the HAB Tracking Application. If the user makes a data entry mistake here, computer support staff will have to delete the record so that date/time can be re-entered.

When this step is complete, click on the button for “Save Sample Entries.”

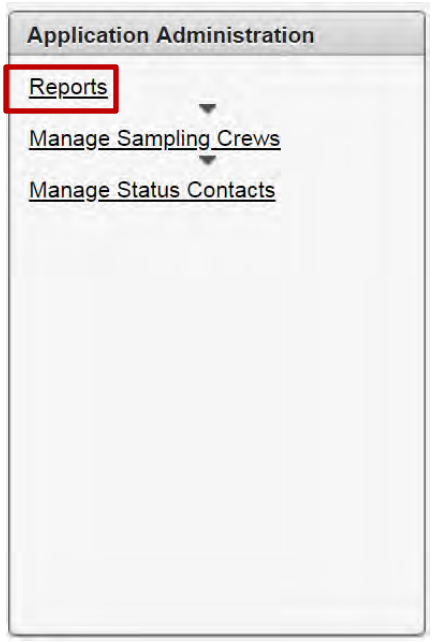


A new screen appears, which automatically populates the “Samples to Lab” with the day after field work is complete. This date is not as consequential - it’s not connected to data or other key components of the HAB Tracking Application. Click on the “Save and Complete Task” button. The request will no longer appear on the Task Management menus (either “Request with no task” or “Request with assigned tasks”).

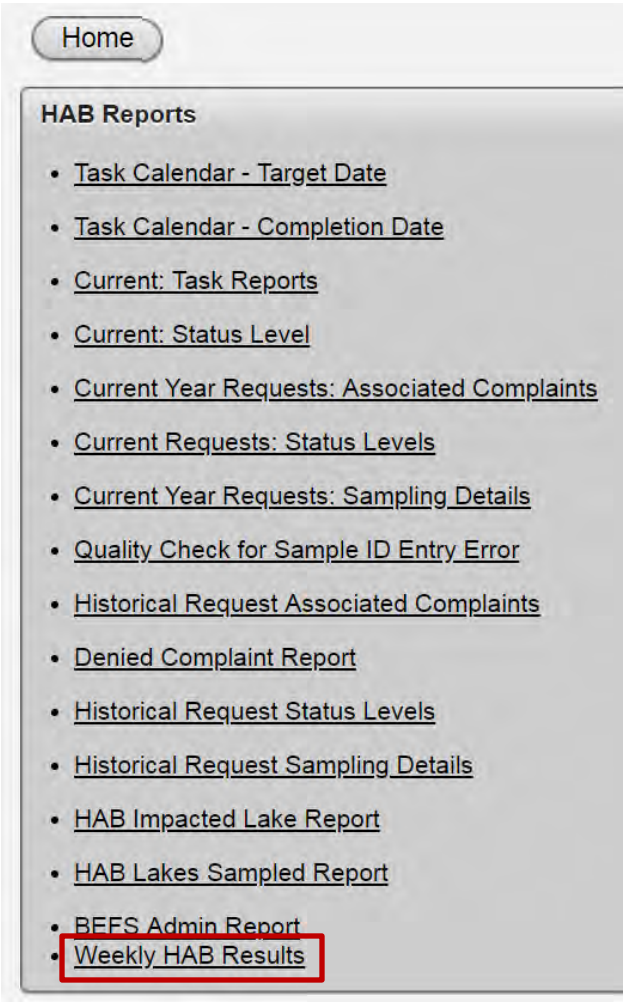
If the date, time, and sample site name match between Oracle and the HAB Tracking Application, then as soon as the data is entered in Oracle, it should be visible in the reports generated within the HAB Tracking Application.

Step 8: View data

This is one instance where we the desired screen is NOT accessed through the “Business Processes” menu. Instead, click on “Reports” under the ***Application Administration*** menu on the lower right of the main menu.



There are a variety of reports that are generated, but the one used to view the most recent data is the “Weekly HAB Results” at the very bottom of the HAB Reports screen.



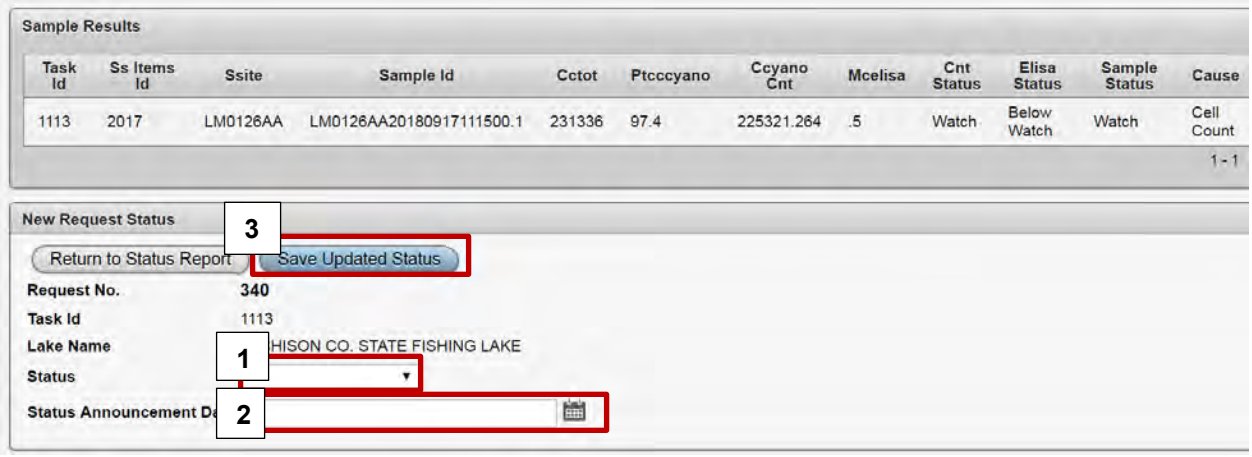
There are many ways to see the desired data. The user can filter through the “Actions” dropdown menu, or select “Date Collected” and click on the “Sort Descending” arrow. If the HAB Tracking Application correctly pulled information from Oracle, all dashes will be replaced by data.

Step 9: Update Request Status

After viewing the data and conferring with the people in the weekly stakeholder meeting, update the request status. This can be done through the link to ***Change Request Status*** on the Business Processes menu. **This will update the HAB map online, so make sure that this occurs immediately after the weekly stakeholder meeting.**

All requests that have data will be available on this menu, along with the recommended status. Select the “Edit” button next to the lake in question. This will bring up the following screen:

Select the “Update Status” button. The following screen will appear:



The user can bypass the recommended status and select the agreed upon status under the "Status" dropdown menu. In most cases, the automatically recommended status is used. One example may be a case in which a credible report from a lake manager or District Staff member indicates that a bloom increased in severity greatly after the sampling date, so instead of the "Warning" that the data shows, the HAB Team may opt to use a visual confirmation to elevate to a "Closed" status. At any rate, all exceptions are to be discussed with stakeholders and supervisors first.

Use the calendar next to the "Status Announcement Date" field to select the date (usually the Thursday of the sampling week).

Then select the "Save Updated Status" button.

Step 10: Close a request or resample active HAB lakes

Step 10.1: Closing the request when a bloom has dissipated

If a request is changed to "Below Watch," it will no longer be an active request.* This request is no longer considered "Active" and will not appear on the "Task Management" menus. If a bloom appears on the same waterbody later in the season, a new complaint will need to be validated, and a new request issued.

*Note on zoned lakes: The HAB Team instituted the "Zone Below Watch" status to make sure that the requests for all of the zones stay active during a bloom. When the bloom is gone, all of the zones have a "Zone Below Watch" status. This does not trigger the HAB Tracking

Application to switch the Requests to inactive. The software does not currently have a mechanism to prevent this. When advisories have been lifted on all zones of a zoned lake, ask computer support staff to change the last status of all of the zones from “Zone Below Watch” to “Below Watch.” This will switch the Request to inactive.

Step 10.2: Send out a task to resample HAB lakes

As soon as a Request is updated with a new advisory status, it will appear on the “Task Management > Request with no task” menu. When it is time to sample the lake again, start from “Step 6: Issue a sampling task” again, and create a sampling task. This process will repeat until the request is updated to “Below Watch” and is no longer considered active.

Step 11: End of Season Protocol

Requests that are active after the HAB season has ended should be closed out before the beginning of the following calendar year. The HAB tracking application resets at the beginning of the calendar year, so Requests must be updated manually in order to maintain proper record keeping.

To close a Request at the end of the HAB season:

1. Request a Sample to be done on 12-31
2. Enter in “0” for sample data on 12-31 in the Surface Water Quality Oracle Application
3. Enter in the sample data in the HAB Oracle App with the “0” sample data
4. This allows you set the Request status as “Below Watch” on 12-31.
5. If there is still an active bloom on the waterbody as of 12-31, issue a new complaint and Request for the waterbody.

APPENDIX M

Emergency Operations

Background

For normal operations, the HAB Response Program relies on complex teamwork and a time sensitive chain of operations performed by skilled staff. Whenever a link in this chain is broken or missing, the agency needs to have a backup plan on hand. During the COVID-19 pandemic lockdown of 2020, agency operations were severely altered. This included greatly curtailed capacity for fieldwork, toxin analysis, algal taxonomy, and even sample receiving. Therefore, in April 2020, an Emergency Operations Plan was approved and enacted.

Good communication and partnership are at the foundation of all teamwork but especially Emergency Operations, since on-site Lake Managers are asked to assume the responsibility of collecting and submitting information. The goal was and is to allow for the HAB team to make well documented decisions that are consistent across the state, consistent throughout the season, and protective of public health, without unnecessary restriction of lake recreation activities.

If any situation arises in the future that compromises a link in the normal chain of activities, a version of this Emergency Operations plan can be enacted again, either statewide or for a certain region. Note that this plan can be modified based on best professional judgement of program staff and agency leadership, and/or augmented with resources that are available, but Partners will be notified immediately of any changes to normal operations and included in decision making as much as possible.

Partners:

KDHE Partners:

1. KDHE BOW-Monitoring and Assessment Section: HAB Response Team
2. KDHE BEFS: District Staff
3. KDHE Kansas Health and Environment Laboratories (KHEL)
4. KDHE BOW - Public Water Supply Section
5. KDHE Bureau of Epidemiology and Public Health Informatics (BEHPI)
6. KDHE Communications Office

External Partners, critical to operations:

7. KDWP: Communications office, Leadership team, and on-site Lake Managers
8. USACE: District leadership, on-site Lake Managers
9. Counties and Municipalities: on-site Lake Managers

HAB Response Program Emergency Operations Plan – Outline

1. Preparations:
    a. HAB Response Team will notify all partners when Emergency Operations begin (and end), discuss details of altered work flow, and confirm responsibilities.
    b. Post a notification for the public on HABs website.
    c. Recommend that all Lake Managers post basic informational signage at all lake access points, on how to recognize HABs.
    d. HAB Response Team arrange for KHEL to ship at least half a dozen cyanotoxin sample containers to District offices, and work with KHEL to assure that adequate test kits are stocked. Response Team will provide KHEL staff with Lugol's preservative, vials, and instruction on how to preserve aliquots for taxonomy (prior to first freezing of sample for toxin analysis).
2. Most Advisories on recreational water bodies will be based on VISUAL data, as follows:
    a. Upon receiving credible complaints, HABs response team will contact on-site Lake Mangers to request jar test, site photos, and other supporting information.
    b. A structured data form will be provided for data collection, including map with KDHE sample points marked. Jar test instructions and photo instructions will also be provided. The form is structured to allow lake managers to accurately depict and describe the nature, intensity, and extent of bloom.
    c. Watch vs. Warning status is based on intensity of bloom at designated sample points, extent of bloom, and other information. Hazard status will require a site visit by KDHE staff.
    d. Additional data provided by Lake Managers, such as private laboratory data, will be taken into consideration but will not be used for quantitative threshold comparisons.

e. For the ~30 large lakes where it is possible, the HAB Response Team will review and consider CyAN satellite data as a supplement to data from Lake Managers.
f. An Advisory that is issued on any day other than Thursday will be formalized the following Thursday and cannot be lifted before then, *i.e.* no lake will be on Advisory for less than one full week.
g. Once a lake is on Advisory, KDHE will check in weekly with Lake Manager (typically on Tuesday) to review status.
h. Advisory can be lifted when bloom has dissipated and does not reappear within a week.
    1. Visual data (report, photos, and photo of jar test) are required again for lift of Advisory.
    2. If a lake has had high toxins in blooms from previous or current years, or if it is a PWS, Response Team may request toxin test before Advisory is lifted (see below).

3. If a PWS lake goes on Advisory (Watch or Warning) and its water plant is NOT part of voluntary program, KHDE PWSS will contact the water plant and ask them to submit a sample ASAP.
    a. Sample bottles will normally be shipped from KHEL directly to the water system at the request of PWSS.
    b. If water system lacks ability to overnight the samples and/or faster turnaround is required, KDHE PWSS and/or HAB Response Team will coordinate with KDHE District offices to provide the water plant with sample bottles and/or assist with shipping. District offices will maintain a stockpile of raw & finished water sample bottles and coolers for these instances.
4. SITE VISITS and WATER SAMPLES by KDHE (Districts or Central office staff) are rare but would be warranted in the following instances:
    a. BEHPI receives notice of a human or animal health incident, and a sample is needed to support BEPHI investigation.
    a. PWS lake, if raw water samples cannot be provided by the water plant in a timely manner. (In such cases, “raw water proxy” sites should be sampled.)
    b. "Hazard" level bloom: extreme conditions that could result in lake closure.
    c. Lake Manager unavailable to provide report, or conflicting views over whether an Advisory should be issued or lifted.

   d. If capacity allows, special arrangements may be made for one-time cyanotoxin testing prior to important event, *e.g.* an open water triathlon event with a lake swim component.
   e. Note: Any samples collected will be overnighted direct to KHEL (Forbes Field) on wet ice, preferably on Monday for arrival Tuesday. Response Program staff may pick up taxonomy/ID aliquot from KHEL.
5. KHEL has agreed to do toxin testing when needed: Microcystins by default, others as resources allow.
   a. KDHE Response Program staff will contact KHEL with as much lead time as possible to alert them to incoming samples.
   b. Maximum capacity is about 4-5 lakes/week (half of typical in-house analytical capacity).
   c. KHEL can preserve taxonomy samples for possible later examination, but IDs/cell counts are not routine. Samples are set aside for optional post-season analysis.
   d. MASS Analytical will provide backup microcystin analysis capacity and could call in taxonomists or other staff if critical.
6. If KDHE sampling and/or analytical capacities are compromised, either by staff shortage, by supply chain issues, or for some other reason, the Response Program may use contract laboratories or alternative methods as needed. Partners will be notified if this occurs.
7. KDHE will host weekly stakeholder calls and issue advisories on Thursday afternoons, as usual, but this will be supplemented with email messaging and phone calls throughout the week. If analysis turnaround time becomes problematic, meetings may be moved to Friday mornings, but the preference is to maintain Thursday schedule so that Lake Managers have time to post signage and all agencies have time to update websites.

APPENDIX N

Acronyms

Acronyms

BEFS	Bureau of Environmental Field Services at KDHE
BEPHI	Bureau of Epidemiology and Public Health Informatics at KDHE
BGA	Blue Green Algae, a.k.a. cyanobacteria
BOW	Bureau of Water at KDHE
CDC	Centers for Disease Control and Prevention
DEA	District Environmental Administrator (head of District office, BEFS)
ELISA	Enzyme-Linked Immunosorbent Assay
EPA	Environmental Protection Agency
GIS	Geographic Information Systems
HA	Health Advisories
KDAH	Kansas Department of Agriculture, Division of Animal Health
KDHE	Kansas Department of Health and Environment
KDWP	Kansas Department of Wildlife, and Parks
KHEL	Kansas Health and Environmental Laboratories
KSVDL	Kansas State Veterinary Diagnostic Laboratory
LCMS	Liquid Chromatography Mass Spectrometry
MASS	Monitoring, Assessment, and Science Section in BOW at KDHE
OC	KDHE, Secretary's Office
OHHABS	One Health Harmful Algal Bloom System
OIT	Office of Information Technology at KDHE
PIO	Public Information Officer
PPE	Personal Protective Equipment
PWS	Public Water Supply or Public Water System (a local water producer)
PWSS	Public Water Supply Section in BOW at KDHE
USACE	U.S. Army Corps of Engineers
USBR	U.S. Department of Interior, Bureau of Reclamation
USGS	United States Geological Survey