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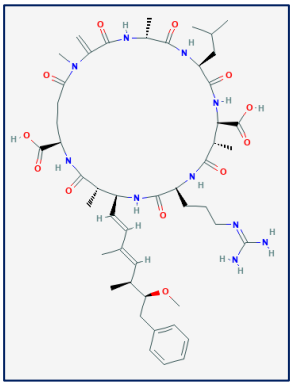
EPA Needs an Agencywide Strategic Action Plan to Address Harmful Algal Blooms

Report No. 21-E-0264 **September 29, 2021**



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Abbreviations:

CWA	Clean Water Act
EPA	U.S. Environmental Protection Agency
GAO	U.S. Government Accountability Office
HAB	Harmful Algal Bloom
HABHRCA	Harmful Algal Bloom and Hypoxia Research and Control Act of 1998
OIG	Office of Inspector General
ORD	Office of Research and Development
OW	Office of Water
SDWA	Safe Drinking Water Act

Cover Image:

Excess nutrients flowing into bodies of water, such as from soil and fertilizer runoff from a farm during a rainstorm (top left), can fuel the formation of algal blooms (top right). Blooms can produce harmful toxins (bottom left) that can impact the safety of drinking water and lead to the closure of recreational waters (bottom right). (Top row, left to right: U.S. Department of Agriculture and EPA OIG photos. Bottom row: National Institutes of Health image and EPA photo).

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Office of Inspector General
U.S. Environmental Protection Agency
At a Glance

21-E-0264
September 29, 2021

Why We Did This Evaluation

The U.S. Environmental Protection Agency's Office of Inspector General conducted this evaluation to determine how the EPA is exercising its authority under the Clean Water and Safe Drinking Water Acts to address harmful algal blooms and protect human health and the environment.

Harmful algal blooms impact our nation's recreational and drinking waters. They occur when, among other conditions, high levels of nutrients—nitrogen and phosphorus—pollute rivers, lakes, and reservoirs. These nutrients reach bodies of water from sources such as livestock operations; fertilizer runoff from farm fields, lawns, and gardens; urban stormwater; and industrial and municipal discharges.

This evaluation supports EPA mission-related efforts:

- *Partnering with states and other stakeholders.*
- *Operating efficiently and effectively.*

This evaluation addresses these top EPA management challenges:

- *Overseeing states implementing EPA programs.*
- *Communicating risks.*
- *Complying with key internal control requirements (data quality).*

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List of OIG reports.

EPA Needs an Agencywide Strategic Action Plan to Address Harmful Algal Blooms

What We Found

Scientists predict that harmful algal bloom occurrences in recreational waters and drinking water sources will increase as excess nutrients continue to flow into water bodies, temperatures warm, and extreme weather events occur due to climate change.

The EPA does not have an agencywide strategy for addressing harmful algal blooms, despite Congress appointing the EPA administrator as the leader for federal actions focused on reducing, mitigating, and controlling freshwater HABs. Federal guidance instructs agencies to establish systems, such as developing strategic plans, that will promote effective government programs. By developing an agencywide HAB strategy, the EPA can improve in four strategic planning areas: (1) purpose, scope, and methodology; (2) problem definition and risk assessment; (3) organizational roles, responsibilities, and coordination; and (4) integration and implementation. By creating an agencywide HAB strategy that addresses these planning areas, the EPA can reduce HABs and their impacts on human health and the environment using the authorities and tools provided by the Clean Water and Safe Drinking Water Acts. We also found that the EPA has not fulfilled its 2015 commitment to Congress to develop additional drinking water health advisories for cyanotoxins associated with some blooms as information became available. In addition, the EPA needs to take further action to develop revised nitrogen and phosphorus numeric water quality criteria recommendations for states to adopt to better control levels of these nutrients in water bodies.

Recommendations and Planned Agency Corrective Actions

We recommend that the assistant administrator for Water develop an agencywide strategic action plan to describe the EPA's efforts to maintain and enhance a national program to forecast, monitor, and respond to freshwater HABs. This plan should incorporate strategies for (1) closing identified knowledge gaps; (2) monitoring and tracking HABs; (3) enhancing the EPA's leadership role in addressing freshwater HABs; (4) coordinating EPA activities internally and with states; and (5) establishing additional criteria, standards, and advisories, as the scientific information allows. We also recommend that the EPA establish new nutrient numeric water quality criteria recommendations under the Clean Water Act in lakes, reservoirs, rivers, and streams and determine whether additional actions under the Safe Drinking Water Act are warranted.

The EPA completed actions to meet one recommendation and provided acceptable corrective actions and estimated completion dates for two other recommendations. The recommendation regarding numeric water quality criteria in rivers and streams remains unresolved.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

THE INSPECTOR GENERAL

September 29, 2021

MEMORANDUM

SUBJECT: EPA Needs an Agencywide Strategic Action Plan to Address Harmful Algal Blooms
Report No. 21-E-0264

FROM: Sean W. O'Donnell

TO: Radhika Fox, Assistant Administrator
Office of Water

This is our report on the subject evaluation conducted by the Office of Inspector General of the U.S. Environmental Protection Agency. The project number for this evaluation was OA&E-FY20-0280. This report contains findings that describe the problems the OIG has identified and corrective actions the OIG recommends. Final determinations on matters in this report will be made by EPA managers in accordance with established audit resolution procedures.

The Office of Water is responsible for the subjects discussed in this report.

In accordance with EPA Manual 2750, your office completed corrective actions for Recommendation 2. Your office also provided acceptable planned corrective actions and estimated milestone dates in response to Recommendations 1 and 4. These recommendations are resolved or completed.

Action Required

Recommendation 3 is unresolved. The resolution process, as described in the EPA's Audit Management Procedures, begins immediately with the issuance of this report. Furthermore, we request a written response to the final report within 60 days of this memorandum. Your response will be posted on the OIG's website, along with our memorandum commenting on your response. Your response should be provided as an Adobe PDF file that complies with the accessibility requirements of Section 508 of the Rehabilitation Act of 1973, as amended. The final response should not contain data that you do not want to be released to the public; if your response contains such data, you should identify the data for redaction or removal along with corresponding justification.

We will post this report to our website at www.epa.gov/oig.

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Chapter 1
Introduction

Purpose

The U.S. Environmental Protection Agency's Office of Inspector General initiated this evaluation to determine how the EPA is exercising its authority under the Clean Water and Safe Drinking Water Acts to address harmful algal blooms, known as HABs, and protect human health and the environment.

Top Management Challenges Addressed

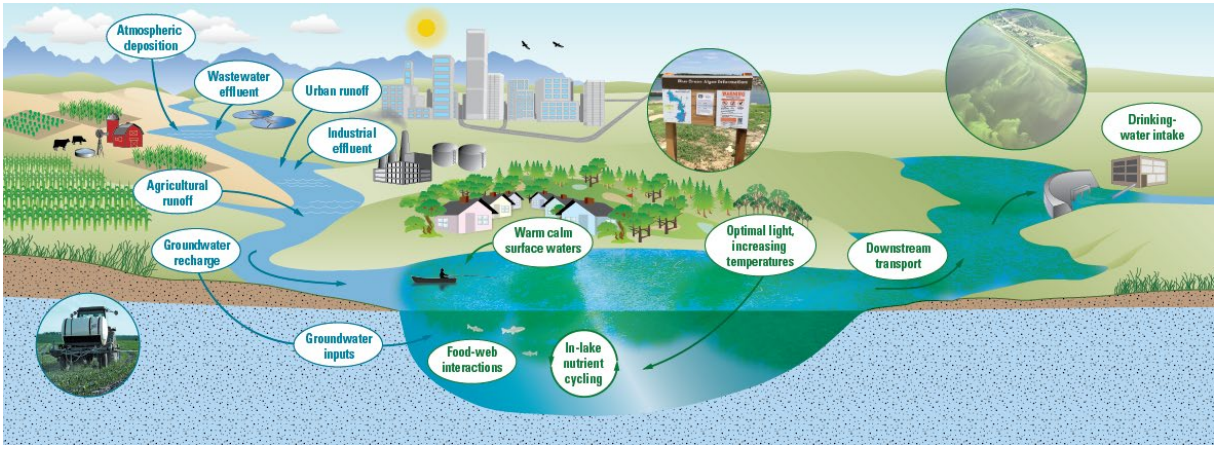
This evaluation addresses the following top management challenges for the Agency, as identified in OIG Report No. 20-N-0231, *EPA's FYs 2020–2021 Top Management Challenges*, issued July 21, 2020:

- Overseeing states implementing EPA programs.
- Communicating risks.
- Complying with key internal control requirements (data quality).

Background

HABs impact our nation's recreational and drinking waters. The EPA's website identifies HABs as a major environmental problem throughout the United States. HABs occur, among other circumstances, when high levels of nutrients pollute rivers, streams, lakes, and reservoirs. These nutrients—nitrogen and phosphorus—reach bodies of water from sources such as livestock operations; fertilizer runoff from farm fields, lawns, and gardens; urban stormwater; and industrial and municipal discharges (Figure 1). Other factors contributing to the formation of HABs include how the water flows, the temperature of the water, and the amount of sunlight.

Figure 1: Formation of HABs and cyanotoxins in rivers, lakes, reservoirs, and drinking water sources



Source: U.S. Geological Survey. (U.S. Geological Survey image)

Nutrient pollution allows cyanobacteria, common in freshwater ecosystems, to grow excessively under certain conditions and form blooms in water bodies. Some cyanobacterial algal blooms generate cyanotoxins, which are harmful to the health of the environment, animals, and humans. HAB occurrence in sources of drinking water can change the odor and taste of water, and associated cyanotoxins can be harmful to human health if they are not removed during treatment. HABs can sicken people and kill animals; create oxygen-poor zones in rivers and lakes, making them unsuited for aquatic life; raise treatment costs for drinking water; cause economic hardship for industries that depend on clean water; and negatively impact recreational activities. Human exposure to cyanotoxins can result in dermatitis, respiratory illness, gastrointestinal effects, liver and kidney damage, neurotoxicity, paralysis, and death in rare circumstances.

Cyanobacteria and Cyanotoxins

Cyanobacteria, also called blue-green algae, are microscopic organisms found in fresh water. In warm, nutrient-rich environments, cyanobacteria can multiply quickly, creating blooms that spread.

Cyanobacteria can produce toxins, called *cyanotoxins*, which pose health risks to humans and animals and are found in drinking water and recreational water.

The EPA collects data about nutrient pollution. For example, in 2012 the EPA found in its National Lakes Assessment that about one in three lakes (about 33 percent) had excess nitrogen and two out of five lakes (40 percent) had excess phosphorus when assessed against regionally specific benchmarks determined by the EPA. In addition, the EPA estimated that about 15,000 water bodies were impaired by nutrients. We concluded that there are likely more water bodies with nutrient-related impairments, as not all waters have been assessed.

As temperatures rise and extreme weather events increase with a changing climate, scientists predict that HABs will occur with greater frequency and intensity and across a greater geographic range. According to the EPA's 2012 National Lakes Assessment, 8.3 percent more lakes were in what the EPA defines as the "most disturbed condition," based on the density of cyanobacteria, than in the 2007 survey. The detection of microcystin, a cyanotoxin, also increased by 9.5 percent. Given these trends, the negative impacts of HABs and the risks of exposure to dangerous cyanotoxins will rise unless actions are taken to mitigate, respond to, and prevent freshwater HABs.

HABs can impose significant economic costs. For example, following the occurrence of a large bloom in Lake Erie in 2014 that resulted in more than 400,000 residents losing access to clean drinking water, the City of Toledo, Ohio, invested over $400 million to upgrade its water utilities.

HABs do not occur only in lakes. For example, a bloom extended 650 miles along the Ohio River through six states—Illinois, Indiana, Kentucky, Ohio, Pennsylvania, and West Virginia—in 2015 and threatened the source of drinking water for over five million people. The cyanotoxins formed by some HABs can be transported downstream from the bloom. The EPA's National Rivers and Streams Assessment conducted in 2013 and 2014 detected the cyanotoxin microcystin in 37 percent of the 1.2 million miles of rivers and streams assessed.

HABs have also been found in relatively pristine waters. For example, in July 2020, Utah public health officials warned Zion National Park visitors to stay out of the Virgin River after a dog died from being exposed to a cyanotoxin while swimming in the river. Scientists are working to understand what drives the development of blooms and toxins under these varied conditions.

Appendix A describes how the communities around Grand Lake St. Marys, Ohio, are taking action to reduce nutrients, address microcystin concentrations that greatly exceed the recreational swimming and drinking water health advisory levels, and limit HAB impacts to recreational waters and sources of drinking water.

Warning sign posted by Utah and the National Park Service in Zion National Park. (National Park Service image)

CWA and SDWA Regulatory Authorities and Tools Available to Address HABs

The CWA and SDWA provide authorities and tools that the EPA, states, territories, and tribes can use to prevent and mitigate excess nutrients, HABs, and cyanotoxins.[1] Appendix B presents a flowchart showing the formation of HABs and cyanotoxins, how they impact recreational waters and drinking water sources, and the authorities and tools from the CWA and SDWA that can be used to address them.

The Acts also include provisions that allow the EPA to research topics, such as the toxicity of cyanotoxins and the factors driving the formation of HABs, to support regulatory action, as well as to provide guidance, technical assistance, and outreach activities.

CWA Authorities and Tools

The CWA provides authorities and tools that can be used to reduce nutrient pollution and thus can be used to prevent the formation of HABs. The CWA makes it unlawful to discharge any pollutant, including nutrients, from a point source into navigable waters of the United States without a permit. This permitting process limits the amount of nutrients that can be discharged into navigable waters via point sources. The CWA defines a *point source* as:

> [A]ny discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural stormwater discharges and return flows from irrigated agriculture.

[1] Throughout this report, we use "states" to refer to states, territories, and tribes authorized to implement a particular program.

Water Quality Standards

State water quality standards, which include the designated uses and water quality criteria, must provide for the attainment and maintenance of the water quality standards of downstream waters.

Designated uses include public water supply; propagation of fish and wildlife; and recreational, agricultural, industrial, and navigational uses.

Water quality criteria establish limits on chemicals or conditions in a water body. The criteria protect designated uses; are based on scientific rationale; and can be expressed as acceptable levels, or numeric criteria, or as narrative statements that describe the desired conditions of a water body, also known as narrative criteria.

The CWA does not define *nonpoint sources*; by default, they are sources that are not included in the definition of a point source. Nonpoint sources of nutrient pollution flow from agricultural lands, urban stormwater, or other dispersed sources. In many parts of the country, nutrient pollution comes mostly from nonpoint sources. For example, in a 2020 study, the Ohio Environmental Protection Agency estimated that 88 to 96 percent of the nutrients that flowed from seven watersheds into western Lake Erie came from nonpoint sources. Congress chose not to address nonpoint sources through a regulatory approach, but the CWA required states to develop nonpoint source-management plans and established an EPA grant program to address nonpoint source pollution.

Federal regulations under the CWA require authorized states or the EPA to designate specific uses for waters of the United States and to align water quality standards, permits, and other activities to protect these designated uses and reduce pollution within bodies of water.

In 2019, the EPA recommended CWA recreational water quality criteria and swimming advisory values for two cyanotoxins—microcystins and cylindrospermopsin—"to better protect Americans' health when they swim or play near water." These recommendations establish concentrations of the two cyanotoxins in water at or below which the EPA determined public health is protected. States may, but are not required, to adopt these criteria and advisory values. The EPA also issued guidance on monitoring cyanobacteria and cyanotoxins in recreational waters and presented risk communication information on its website to help water managers inform people accessing recreational waters about the health risks associated with recreational exposure to cyanotoxins.

Cyanotoxins

Microcystins are the most widespread cyanotoxins and can bioaccumulate in fish, mussels, and zooplankton. Microcystins primarily affect a person's liver.

Cylindrospermopsin is a cyanotoxin produced by a variety of freshwater cyanobacteria. It can damage a person's liver and kidneys.

Saxitoxin effects the nervous system. Exposure occurs through ingestion of untreated drinking water or fish containing saxitoxin in its flesh.

Anatoxin-a is a potent neurotoxin that is dangerous to humans and can cause convulsions, respiratory failure, and death in animals.

SDWA Authorities and Tools

SDWA provides the EPA the authority to establish safe levels of contaminants in drinking water, or *maximum contaminant levels*. HAB events can occur in rivers, lakes, and reservoirs that serve as raw water sources for drinking water. While there is no federal mandate requiring comprehensive protection for these drinking water sources, drinking water utilities, the EPA, and states can engage in other efforts to protect them. For example, states can fund source water protection in part by using funds Congress appropriates annually to the drinking water state revolving fund, a program established in the 1996 amendments to SDWA that provides financial support to water systems and state safe water programs.

Under SDWA, maximum contaminant levels establish enforceable standards for public drinking water systems. The EPA can also publish health advisories for contaminants for which it has not established maximum contaminant levels. According to the EPA, health advisories "describe non-regulatory

concentrations of drinking water contaminants at or below which adverse health effects are not anticipated to occur over specific exposure durations." The health advisories do not represent enforceable standards; instead, they serve as informal technical guidance to assist federal, state, and local officials, as well as managers of drinking water systems, in protecting public health when these contaminants are found in drinking water. In June 2015, the EPA issued health advisories for two cyanotoxins: microcystins and cylindrospermopsin.

The EPA uses the Unregulated Contaminant Monitoring Rule, developed under the 1996 amendments to the SDWA, to obtain information on contaminants that are suspected to be present in drinking water and do not have health-based standards set under SDWA. Under this rule, the EPA required large public water systems and some smaller systems across the United States to collect information on the occurrence of ten cyanotoxins in treated drinking water, including total microcystins, cylindrospermopsin, and anatoxin-a, from March 2018 through November 2020. Levels of total microcystins that exceeded the health advisory for bottle-fed infants and young children were found in seven of the 3,464 public water systems sampled, according to the EPA's July 2021 preliminary results. The occurrence of the other cyanotoxin for which the EPA has issued a health advisory, cylindrospermopsin, was lower. Quantitative data on the levels of cyanotoxin in source water were not collected; however, qualitative information, such as visual observations of blooms, was collected to help inform the EPA's future decision-making.

In August 2015, the Drinking Water Protection Act amended SDWA to require that the EPA develop a strategic plan for assessing and managing the risks of cyanotoxins in drinking water, including identifying the steps and timelines to make determinations whether to publish health advisories for cyanotoxins in drinking water provided by public water systems. The EPA submitted the required strategic plan, titled *Algal Toxin Risk Assessment and Management Strategic Plan for Drinking Water*, to Congress in November 2015 and committed to develop additional health advisories for cyanotoxins if the EPA found that it had information sufficient for such development, among other actions.[2] The EPA did not establish a milestone for making this determination and has not yet developed additional advisories.

In its *Safe and Sustainable Water Research Strategic Research Action Plan 2019–2022,* the EPA's Office of Research and Development, or the ORD, committed to developing information that may be used to formulate additional cyanotoxin health advisories for drinking water and water quality criteria for cyanotoxins in surface water, among other research objectives.

EPA Responsibilities Under the Harmful Algal Bloom and Hypoxia Research and Control Act

The Harmful Algal Bloom and Hypoxia Research and Control Act of 1998, also known as HABHRCA, established a task force that included representatives from 11 federal agencies, including the EPA, to assess the ecological and economic consequences of HABs; alternatives for reducing, mitigating, and controlling HABs; and the social and economic costs and benefits of such alternatives. A 2014 amendment expanded HABHRCA beyond coastal, estuarine, and Great Lake waters to include "freshwater harmful algal blooms in lakes, rivers, estuaries (including their tributaries), and reservoirs" and assigned leadership of the freshwater aspects of the program to the EPA administrator. A further amendment in 2019 required the task force to complete and submit to Congress a scientific assessment

[2] Throughout this report, we use the term "cyanotoxin" for "algal toxin."

of HABs in the United States, including in freshwater lakes and rivers, at least every five years with the first report due in 2024.

Under the amendment to HABHRCA enacted in 2019,[3] the EPA is required to determine whether a freshwater HAB event is an event of "national significance" for purposes of mobilizing federal resources to assess and mitigate its detrimental effects, using the following considerations:

- The toxicity of the HAB.
- The potential for the HAB to spread.
- The size of the HAB occurrence.
- The economic impact of the HAB.
- The geographic scope, including the potential to affect several municipalities, to affect more than one state, or to cross an international boundary.

In September 2019, the EPA requested public comment to inform its development of a policy for determining if a HAB event in fresh water is an event of national significance. As of September 2021, the EPA had not finalized that policy.

Federal Guidance for Strategic Planning

Federal guidance instructs agencies to establish systems, such as developing strategic plans, that will promote effective government programs. The U.S. Government Accountability Office advises that a strategic plan can be useful for resource and policy decisions and to better ensure accountability.[4] The GAO identified a set of characteristics that promote developing and implementing national strategies. According to the GAO, key characteristics of a national strategy include (1) purpose, scope, and methodology; (2) problem definition and risk assessment; (3) organizational roles, responsibilities, and coordination; and (4) integration and implementation. The GAO determined that these and other characteristics enhance the usefulness of national strategies in resource and policy decisions and improve accountability.

[3] Unless otherwise noted, all subsequent references to HABHRCA in this report are to the 2019 amended version, codified at 33 U.S.C. § 4001 et seq.

[4] GAO, *Combating Terrorism: Evaluation of Selected Characteristics in National Strategies Related to Terrorism,* GAO-04-408T, February 2004.

Responsible Offices

The Office of Water manages several EPA efforts to address HABs:

Bloom on the Potomac River. (EPA photo)

- Its Office of Science and Technology develops national water quality criteria recommendations and drinking water health advisories
- Its Office of Wetlands, Oceans, and Watersheds coordinates national assessments that document HABs and nutrient pollution, oversees state development of restoration strategies, and supports state work to reduce nonpoint sources of nutrients that contribute to HABs.
- Its Office of Groundwater and Drinking Water works toward minimizing human exposure to cyanotoxins in drinking water
- Its Office of Wastewater Management reduces nutrients through point source permitting.

Additionally, the ORD conducts research to better understand, detect, mitigate, and respond to HABs and cyanobacteria toxins. The EPA regions work directly with states and local stakeholders to reduce and mitigate HABs.

Scope and Methodology

We conducted this evaluation from August 2020 through July 2021 in accordance with the *Quality Standards for Inspection and Evaluation* published in January 2012 by the Council of the Inspectors General on Integrity and Efficiency. These standards require that we perform the evaluation to obtain sufficient, competent, and relevant evidence to provide a reasonable basis for our findings, conclusions, and recommendations based on our objective. We believe that the evidence obtained provides a reasonable basis for our findings, conclusions, and recommendations.

To conduct our evaluation, we used the GAO's selected characteristics in national strategies to understand the EPA's HAB-related work in the context of good practices in the federal government.[5] We limited the scope of our assessment to four of the GAO's characteristics: (1) purpose, scope, and methodology; (2) problem definition and risk assessment; (3) organizational roles, responsibilities, and coordination; and (4) integration and implementation.

We met with EPA managers and staff from the OW, the ORD, and the Office of Enforcement and Compliance Assurance. We collected written responses to questions posed to all ten EPA regions regarding their HABs work, the challenges the states incur, and what steps the EPA could take to reduce nutrients from entering waterways. We interviewed relevant managers and staff in Regions 5 and 7. We reviewed OW, ORD, and other documents pertaining to HAB reduction plans. We analyzed CWA, SDWA, HABHRCA, and relevant regulations.

[5] Ibid.

To gather information about HAB work outside of the EPA and to understand how the EPA works with external partners, we spoke with (1) the U.S. Geological Survey coordinator for HABs research; (2) academic experts; (3) staff at seven nongovernmental organizations; (4) managers and staff in the Ohio Environmental Protection Agency, Ohio Department of Natural Resources, and Ohio Department of Agriculture; (5) a drinking water system operator, (6) a county agricultural agent; and (7) a local environmental advocacy group associated with Great Lake St. Marys, Ohio.

This evaluation addresses the EPA's work related to HAB occurrences in fresh water, as Congress designated the EPA administrator as the federal leader for freshwater HABs. We did not include HABs in marine waters in our scope, as Congress designated the National Oceanic and Atmospheric Administration administrator as the lead for marine waters. We coordinated our evaluation with the GAO, which is evaluating several agencies' work on HABs in fresh and marine waters.

Prior Reports

OIG Report No. 09-P-0223, *EPA Needs to Accelerate Adoption of Numeric Nutrient Water Quality Standards*, issued August 26 2009, found that the EPA's 1998 strategy and plan to promote state adoption of numeric nutrient water quality criteria had been ineffective. We recommended that the EPA:

- Select significant waters of national value which need numeric nutrient water quality criteria to meet CWA requirements.
- Set numeric nutrient water quality criteria for the waters identified in the first recommendation to meet CWA requirements.
- Establish EPA and state accountability for adopting numeric nutrient criteria for the rest of the nation's waters.
- Establish metrics to gauge the actual progress made by the states.

The EPA certified on November 25, 2013, that it had completed the corrective actions.

OIG Report No. 14-P-0348, *Nutrient Pollution: EPA Needs to Work With States to Develop Strategies for Monitoring the Impact of State Activities on the Gulf of Mexico Hypoxic Zone*, issued September 3, 2014, found that the EPA lacks the necessary data to determine the impact of state nutrient-reduction strategies on the Gulf of Mexico hypoxic zone. We recommended that the EPA work with state and federal task force members in the Mississippi River Watershed to develop and enhance monitoring and assessment systems that will track the environmental results of state nutrient-reduction activities, including their contribution to reducing the size of the Gulf of Mexico hypoxic zone. The EPA certified on November 24, 2015, that it had completed the corrective actions.

OIG Report No. 21-P-0130, *EPA Helps States Reduce Trash, Including Plastic, in U.S. Waterways but Needs to Identify Obstacles and Develop Strategies for Further Progress,* issued May 11, 2021, found that the EPA and states can reduce the volume of trash, including plastics, in U.S. waterways by developing strategies to overcome obstacles to implementing the CWA. One obstacle presented is addressing nonpoint source pollution using the CWA authorities. The EPA is working to complete the corrective actions.

Chapter 2
EPA Needs an Agencywide HABs Strategic Action Plan

The EPA does not have an agencywide strategy for addressing HABs, despite Congress appointing the EPA administrator as the leader for federal actions focused on reducing, mitigating, and controlling freshwater HABs. Federal guidance instructs agencies to establish systems, such as developing strategic plans, that will promote effective government programs. By developing an agencywide HAB strategic plan, the EPA can improve in four strategic planning areas defined by the GAO: (1) purpose, scope, and methodology; (2) problem definition and risk assessment; (3) organizational roles, responsibilities, and coordination; and (4) integration and implementation.

We also found that the EPA has not fulfilled its 2015 commitment to develop additional drinking water advisories for cyanotoxins associated with some blooms as information became available. In addition, the EPA has not succeeded in getting most states to adopt numeric water quality criteria for nitrogen and phosphorus, two nutrients that, in excess, contribute to the formation of HABs. The EPA needs to take further action to develop new numeric water quality criteria recommendations for states to adopt to better control excessive levels of nutrients. By creating an agencywide HAB strategy that addresses these planning areas and issues, the EPA can improve its nationwide ability to reduce HABs and their impacts on human health and the environment using the authorities and tools provided by CWA and SDWA and meet its HABHRCA responsibilities.

EPA Lacks Agencywide HAB Strategy

We determined that the EPA has not established a comprehensive, agencywide strategic action plan to guide its work addressing HABs and their impacts on human health and the environment. The EPA is proactively working on HABs on different fronts, including researching, monitoring, and forecasting; developing guidance, criteria, recommendations, and technical support documents; and providing technical assistance. Appendix C lists selected EPA actions to reduce nutrients and mitigate and reduce HAB impacts. The EPA needs to coordinate these efforts across the Agency, among the national and regional levels, and with state partners to avoid duplication of efforts, facilitate information exchange, and further advance Agency efforts to address HABs. An agencywide strategy would result in a sustained effort, promote consistent coordination, and allow the EPA to better meet its obligations under the CWA, SDWA, and HABHRCA.

Purpose, Scope, and Methodology: Identifying Knowledge Gaps

The CWA, SDWA, and HABHRCA establish the EPA's authority to take action to reduce HABs and their impact and provide a clear scope for the EPA's work in freshwater environments. The EPA regions and other stakeholders we spoke with identified knowledge gaps that limit the EPA's ability to take coordinated and targeted action (Table 1). The EPA should employ a coordinated effort to assess HAB-related knowledge gaps as part of its role as the federal lead for freshwater HABs.

Table 1: Examples of HAB-related knowledge gaps

Knowledge area	Identified gap
Nutrient management	• Information on environmental drivers. • Efficacy of HAB prevention strategies, including those targeting nutrient runoff. • Standardized methodologies for cell counting and reporting. • Methods to mitigate and resolve legacy phosphorus issues. • Information on ecosystem effects. • How extreme weather events, like increased intensity of rain events, will impact HABs, and how weather changes affect the ability to achieve nutrient-reduction targets and influence bloom growth and toxicity.
Human health	• Toxicity and other health-related data for some of the cyanotoxins for developing health assessments, drinking water health advisories, and recreational criteria and advisories, particularly for anatoxin-a and saxitoxin. • Impacts of consuming fish and animals contaminated with cyanotoxins. • Impacts on crops irrigated with water contaminated with cyanotoxins. • Cyanotoxin effects on tribal subsistence and resources. • Human health impacts from low-level, long-term toxin exposure.
Treatment techniques	Unintended consequences for aquatic life and human health of common chemical or physical treatments used in lake HAB management.

Source: OIG analysis based on information gathered in written responses to OIG questions posed to EPA regions and OIG interviews of stakeholders. (EPA OIG table)

We determined that the EPA needs to fully identify and address knowledge gaps to provide needed agencywide input into the development of the ORD's next *Safe and Sustainable Water Resources Strategic Research Action Plan*, tie together and advance all of its HAB-related programmatic and research work, and meet its federal leadership role.

Problem Definition and Risk Assessment: Establishing Monitoring and Tracking System

The EPA needs to establish a national HAB event-monitoring and -tracking system to better define the magnitude of the problem and assess the risks HABs pose to human health and the environment. Establishing an effective national strategy requires that the EPA understand HAB occurrence locations, frequency, and severity, where possible, through a national HABs tracking system. Such a system is needed to timely deliver products, tools, and information to use in locating, monitoring, quantifying, classifying, responding to, and mitigating HABs in lakes, reservoirs, rivers, and streams across the United States, as well as to establish a baseline and mechanisms for measuring progress.

Cyanotoxins impacting drinking water. (EPA photo)

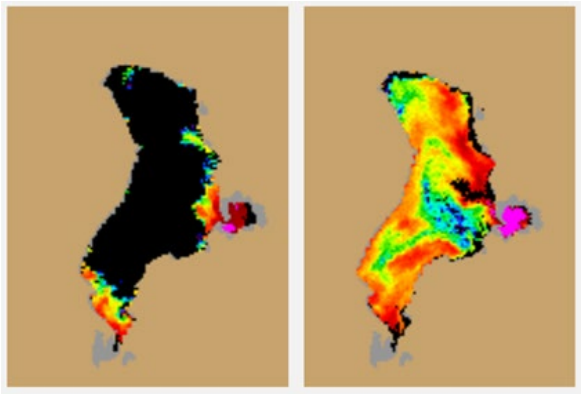
HABHRCA designated the EPA administrator as the federal leader for understanding, detecting, predicting, controlling, mitigating, and responding to freshwater HABs. Yet, the EPA has limited baseline information to facilitate addressing HABs at a national level. The EPA assesses the quality of the nation's lakes, reservoirs, rivers, streams, and other water bodies every five years through its national aquatic resource surveys. The frequency and the statistical nature of the surveys limit their usefulness in understanding progress in addressing HABs and serving as a management tool. A national HABs tracking system would help to fulfill the congressional mandate made through the HABHRCA that the EPA administrator forecast, monitor, and respond to freshwater HABs in lakes, rivers, estuaries, and reservoirs. A tracking system would also provide information needed for the freshwater portion of the scientific assessment that the HABHRCA task force is to deliver to Congress every five years starting in 2024.

The EPA does not have a national tracking system for HABs, but it does undertake several efforts in which HAB-related information is collected and, in some cases, distributed. For example:

- Under the CWA, federal, state, and tribal agencies monitor lakes and rivers to determine water quality condition. These partners submit their water monitoring data to the EPA electronically and the public retrieves the data through a database portal. The data include the levels of cyanotoxins if measured.
- The EPA partners with states to periodically conduct the national aquatic resource surveys to assess the quality of the nation's waters. These surveys include indicators related to nutrients and some cyanotoxins.
- The EPA gathers information on the possible existence of HABs through its sanitary survey for recreational waters. These surveys involve collecting information at the waterbody's shoreline, as well as in the surrounding watershed. Information collected can include the amount of algae. The sanitary survey mobile application submits the data to the EPA, but the data are not available to the public. The EPA reports state and local authority advisories related to HAB occurrences in its monthly HABs newsletter. The EPA does not assemble these listings into a database.
- A suite of tools developed by Region 1 and the ORD, in collaboration with external partners and adopted by some states and EPA regions, includes an application for the public to report when and where potential blooms occur and a tool for use by professionals and trained citizen scientists to monitor blooms. The tools have not been expanded to a national HAB tracking system, mostly due to the EPA not fully investing in the expansion.

- In 2019, EPA scientists released a mobile application to help local and state water quality managers make faster and better-informed management decisions related to cyanobacterial blooms based on satellite data (Figure 2). The EPA further enhanced this capability with its July 2021 release of a web-based version of the application. The EPA believes that making the satellite data available across more platforms will improve its ability to respond to HABs.
- In August 2021, the EPA released a story map that compiled state-issued, HAB-related recreational and drinking water health advisories; however, advisories were not available for all states.

Figure 2: Satellite imagery of algal bloom development



Source: Cyanobacteria Assessment Network.

Note: EPA scientists and their collaborators, while developing the mobile application, showed how the application can be used to monitor the development of a bloom in Utah Lake, a 148-square-mile freshwater lake near Provo, Utah. The images show satellite-derived estimates of cyanobacteria concentrations on June 18, 2017 (left), and 16 days later on July 3, 2017 (right).

Organizational Roles, Responsibilities, and Coordination: EPA's Leadership Role, Coordinating EPA Activities, and Coordinating with States

According to the GAO, effective strategic planning "addresses who will be implementing the strategy, what their roles will be compared to others, and mechanisms for them to coordinate their efforts." We found that, while the CWA and SDWA establish authorities for the EPA to use in taking action to mitigate HABs and HABHRCA establishes the EPA administrator as the leader for mitigating freshwater HABs, the EPA has not fully embraced its national leadership role or defined roles and responsibilities. Absent clear national leadership for addressing freshwater HABs and an agencywide HAB strategy, we determined that the various EPA HAB-related efforts lack effective communication and coordination.

Establishing EPA's Federal Leadership Role in Addressing Freshwater HABs

Through HABHRCA, Congress appointed the EPA administrator as the federal leader in mitigating freshwater HABs. While the EPA is serving as colead of the interagency working group on HABs, the EPA has not fully embraced its national leadership role in mitigating freshwater HABs. HABHRCA specifically states that the EPA's participation:

> [S]hall include (A) research on the ecology and impacts of freshwater [HABs]; and (B) forecasting and monitoring of and event response to freshwater [HABs] in lakes, rivers, estuaries (including their tributaries), and reservoirs.

Agency leadership could demonstrate its commitment to mitigating, responding to, and preventing freshwater HABs and their related cyanotoxins by defining how the EPA intends to fulfill its federal leadership role.

Improving EPA Coordination, Including Assessing Workforce and Resource Needs for Implementing a HAB Strategy

The EPA's HAB-related work occurs in three program offices within the OW: the Office of Wetlands, Oceans, and Watersheds; the Office of Groundwater and Drinking Water; and the Office of Science and Technology. Scientists conduct HAB-related research under the ORD's Safe and Sustainable Water Research program. All ten EPA regions also conduct work to understand and reduce HABs. Coordination among those working on HABs occurs mostly at a person-to-person level, rather than in an organized, programmatic manner. Greater coordination within the Agency would improve the effectiveness of this work. An agencywide strategic action plan identifying all EPA efforts and establishing EPA coordination strategies can ensure that EPA efforts are well-informed, efficient, and well-coordinated.

A key component of coordination is regular, transparent communication. To promote communication across the Agency and with external stakeholders, an EPA scientist in the OW had maintained a list of people working on HABs and distributed a monthly HAB-related newsletter from January 2017 through November 2019, missing only one month, which was then combined with the following month's newsletter. According to the EPA scientist, around 1,200 people received the newsletter, of which 12 percent were EPA staff. At the end of 2019, the OW stopped this distribution in favor of formal, coordinated communication from the OW. We found that formal communication from the OW in 2019 and 2020 was limited to two HAB-related press releases. In November 2020, the OW restarted its newsletter distribution. A commitment to consistent communication and the resources to meet that commitment are still needed.

The Agency has limited information about staff time devoted to HAB-related work. Staff often work on several matters, making it difficult for the EPA to estimate the number of people working on HABs. One OW scientist recollected that the number of staff working on HABs has increased from a few to more than 50 since 2009. But all regions except for Region 5 reported having fewer than two full-time equivalent staff working on HABs. Region 5 is home to the Great Lakes National Program Office, which coordinates with Canada to restore and maintain the chemical, physical, and biological integrity of the Great Lakes—which may be why almost 11 staff members in the region work on HABs.

Through developing an agencywide strategic action plan, the EPA could assess its workforce and resource needs for carrying out its HAB-related work. Through this assessment, the EPA can improve its ability to meet the requirement to provide federal leadership in addressing freshwater HABs.

Coordinating with and Assisting States on Nutrient Reduction

Most states serve as the frontline implementers for many of the requirements under the CWA and SDWA. As such, an EPA strategic action plan should address how the EPA will coordinate its work with states on addressing HABs on various fronts, such as by reducing nutrient pollution. Additional EPA support to states, emphasizing the importance of establishing numeric nutrient criteria, may strengthen

nonpoint source program efforts to reduce nutrients.[6] Numeric nutrient criteria establish important leverage for states to control nonpoint source nutrient pollution.

The EPA has issued several guidance documents to states to assist them with their efforts to reduce nutrient pollution:

- In 1998, the EPA published the *National Strategy for the Development of Regional Nutrient Criteria* and the *Water Quality Criteria and Standards Plan – Priorities for the Future (Interim Final)* to help states adopt numeric nutrient water quality criteria.
- In 2000 and 2001, the EPA published numeric nutrient criteria guidance for states to consider and recommended criteria by ecoregion. According to the EPA, ecoregions are areas within the continental United States where the ecosystems and the type, quality, and quantity of environmental resources are generally similar.
- In 2005, the EPA initiated its Nutrient Scientific Technical Exchange Partnership and Support program to provide technical assistance to states regarding numeric nutrient criteria.
- In 2010, the EPA published a technical document on the stressor-response approach to developing numeric nutrient criteria.
- In 2011, the EPA issued a framework entitled, *Working in Partnership with States to Address Phosphorus and Nitrogen Pollution through Use of a Framework for State Nutrient Reductions*, to assist states in addressing nutrient pollution.
- In 2016, the EPA issued the memorandum titled, *Renewed Call to Action to Reduce Nutrient Pollution and Support for Incremental Actions to Protect Water Quality and Public Health*, encouraging states to "continue to develop numeric nutrient criteria that clearly identify nutrient levels that are consistent with a state, tribe or territory's uses of its waters under the [CWA] and serve as clear guides for protecting and restoring those uses for its citizens."

Most states have not established the numeric nutrient water quality criteria that would allow them to make progress in addressing nutrient pollution. As of September 2021, only three states and four territories have developed numeric phosphorus criteria for their rivers, streams, lakes, and reservoirs. Three additional states established statewide numeric phosphorus criteria for lakes and reservoirs. Other states established numeric criteria that cover only some of their waters. Twenty-seven states continue to rely solely on narrative nutrient water quality criteria, which are subjective, difficult to incorporate in regulatory and voluntary pollution control decisions, and not easily measurable. Three EPA regions told us that states need additional technical assistance from the OW to develop numeric nutrient criteria.

The EPA developed draft water quality criteria recommendations for lakes and reservoirs in 2020 that relied on a stressor-response modeling approach that differed from the approach used in 2000 and 2001. The Agency finalized these recommendations in August 2021. States will be able to incorporate local data into the national models, helping states to develop numeric nutrient criteria from national

[6] According to the EPA, "[n]umeric nutrient water quality criteria are a critical tool for protecting and restoring a waterbody's designated uses related to nitrogen and phosphorus pollution." These criteria enable effective monitoring of a water body, formulation of discharge permits, creation of water quality trading programs, and development of total maximum daily loads for restoring a water body.

data and unique local conditions. An OW manager told us in March 2021 that, based on interest expressed by states, more states would likely adopt these new criteria for lakes and reservoirs. The EPA has not developed similar criteria based on a stressor-response modeling approach for rivers and streams. OW managers told us that developing criteria for flowing waters is more difficult than for lakes and reservoirs and that they have substantial river ecology research left to complete before criteria for rivers and streams could be developed. They also lack staff with the needed expertise.

Adoption of numeric nutrient criteria would promote state activities that would reduce HABs. For example:

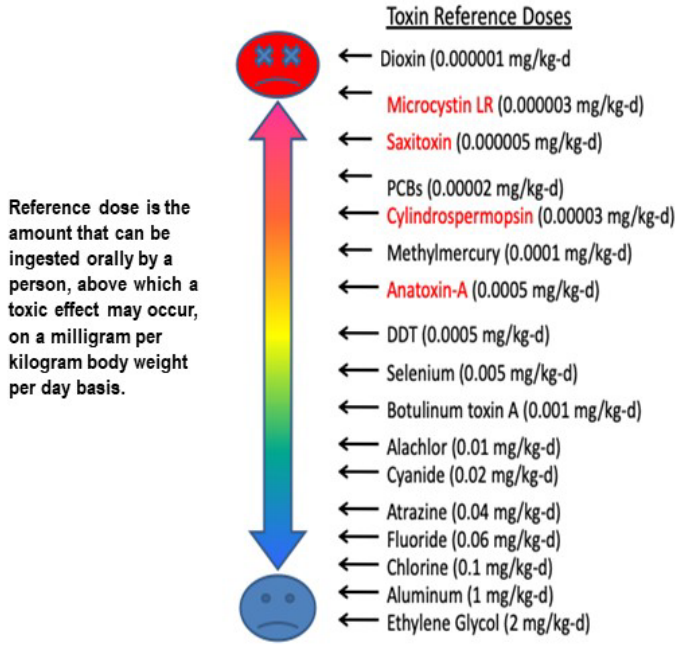
- Numeric criteria allow state permitting programs to develop protective National Pollutant Discharge Elimination System permit limits for point sources of nutrients. These permits allow states to better track and monitor nutrient inputs from these sources through permittee reporting and state or EPA inspections. Numeric criteria also facilitate effective enforcement.
- Numeric nutrient criteria would facilitate the development of watershed-based projects focused on nonpoint source nutrient reduction. Watershed-based projects allow states to focus on a variety of nutrient sources feeding into a water body.

When states can improve their point source and nonpoint source strategies for reducing nutrients, the EPA can focus its HAB-related work on the most promising strategies, assist the programs, and disseminate best practices to other states. Without additional leadership and technical expertise from the EPA, it will be difficult for states to develop the nutrient criteria needed to reduce nutrient pollution and the occurrence and severity of HABs, as well as prevent the formation of dangerous cyanotoxins.

Integration and Implementation: Establishing Criteria, Advisories, and Standards

During interviews, EPA personnel, state personnel, and other stakeholders emphasized that protection of human health and the environment from the cyanotoxins associated with some HABs will not improve without additional recreational water quality criteria, more drinking water health advisories, and enforceable standards from the EPA. To accomplish this, the EPA would need to address knowledge gaps and coordinate its research efforts with its programmatic efforts.

Figure 3: Cyanotoxins (in red) compared to other toxic compounds found in water, based on toxin reference doses



Source: OIG image adapted from the Ohio Environmental Protection Agency. (EPA OIG image)

Issuing Additional Recreational Water Quality Criteria to Protect Humans from Cyanotoxins

Developing an agencywide strategic action plan could provide the steps needed for the EPA to issue recreational water quality criteria for additional cyanotoxins. In 2019, the EPA issued criteria for two cyanotoxins—microcystins and cylindrospermopsin. Four EPA regions and other stakeholders we interviewed noted that the EPA needed to develop additional recreational water quality criteria for cyanotoxins. Along with microcystins and cylindrospermopsin, anatoxin-a and saxitoxin are also dangerous for humans, based on their reference doses (Figure 3). Additional EPA criteria would provide states with actionable information for revising their water quality standards and developing swimming advisories for public notification purposes at recreational waters.

Developing Additional Standards and Health Advisories to Provide Greater Protection from Cyanotoxins in Drinking Water

The EPA needs to provide leadership and technical expertise to develop enforceable standards and additional health advisories to protect the public from exposure to cyanotoxins in drinking water. In 2015, the EPA issued national drinking water health advisories for microcystins and cylindrospermopsin. However, these drinking water health advisories are not enforceable under SDWA and drinking water utilities are not obligated to test their water for these cyanotoxins unless required by the state.

The water quality sampling for unregulated contaminants conducted at public drinking water systems from 2018 through 2020 collected information on the levels of nine cyanotoxins and one cyanotoxin group. This periodic national sampling effort is one of the primary sources of information on occurrence and levels of exposure that the Agency uses to inform regulatory decisions for contaminants in the public drinking water supply. Limitations of the data collection effort include:

- Only treated water was sampled; samples were not collected of the untreated water that entered the public water system.
- Samples were not analyzed for the cyanotoxin saxitoxin even though the EPA included saxitoxin on the candidate contaminant list it finalized in 2016.

In the EPA's drinking water strategic plan submitted to Congress in 2015, the Agency committed to developing, as information allows, health advisories for additional cyanotoxins. However, the EPA has

not issued advisories for cyanotoxins, such as anatoxin-a and saxitoxin, that may be found in drinking water. In addition, stakeholders said that the 2015 health advisories for microcystins and cylindrospermopsin may be insufficient for protecting human health because they are not enforceable. Given the occurrence of these cyanotoxins in rivers, lakes, and reservoirs that serve as sources of drinking water, enforceable maximum contaminant levels may be needed. The development of additional health advisories and possibly enforceable maximum contaminant levels in drinking water would assist states in monitoring and tracking potential HAB-related issues in drinking water.

Conclusions

Scientists predict that the prevalence, severity, and frequency of HAB occurrences in recreational waters and cyanotoxins in drinking water sources will increase as excess nutrients flow into these waters, temperatures rise, and extreme weather events increase with a changing climate. Through HABHRCA, Congress appointed the EPA administrator as the leader for federal actions focused on reducing, mitigating, and controlling freshwater HABs. The EPA needs an agencywide strategic action plan for protecting human health and the environment from this continuing threat. A clear strategy to address HABs, the nutrients that fuel blooms, and the cyanotoxins that some HABs produce will serve as a critical resource for regions, states, and stakeholders that are requesting technical assistance. Such a strategy will enable improved collaboration among the EPA's offices and regions, as well as with federal, state, and other external partners leading to improved outcomes for our nation's waters and protection of drinking water.

Recommendations

We recommend that the assistant administrator for Water:

1. Develop an agencywide strategic action plan, including milestones, to direct the EPA's efforts to maintain and enhance a national program to forecast, monitor, and respond to freshwater harmful algal blooms. This plan should incorporate strategies for:

    a. Identifying knowledge gaps.

    b. Closing identified knowledge gaps, particularly related to health risks from exposure to cyanotoxins in drinking water and during recreational activities.

    c. Monitoring and tracking harmful algal blooms.

    d. Enhancing the EPA's national leadership role in addressing freshwater algal blooms.

    e. Coordinating EPA activities internally and with states.

    f. Assessing the health risks from exposure to cyanotoxins in drinking water and during recreational activities and establishing additional criteria, standards, and advisories, as the scientific information allows.

2. Publish final numeric water quality criteria recommendations for nitrogen and phosphorus under the Clean Water Act for lakes and reservoirs and publish implementation materials to help states in adopting these criteria recommendations.

3. Mindful that the EPA has substantial work to complete before publishing final numeric water quality criteria recommendations for nitrogen and phosphorus under the Clean Water Act for rivers and streams, establish a plan, including milestones and identification of resource needs, for developing and publishing those criteria recommendations.

4. Assess and evaluate the available information on human health risks from exposure to cyanotoxins in drinking water and recreational waters to determine whether actions under the Safe Drinking Water Act are warranted.

Agency Response and OIG Assessment

The Agency provided a response to the draft report on August 16, 2021 (Appendix D). The OW completed actions to meet Recommendation 2 in August 2021 by finalizing the final numeric water quality criteria recommendations for lakes and reservoirs. The OW also provided acceptable corrective actions and planned completion dates for Recommendations 1 and 4.

OW's proposed corrective action does not meet the intent of Recommendation 3. We met with OW staff and managers on September 7, 2021, to discuss Recommendation 3. On September 20, 2021, the deputy assistant administrator for Water provided by email a corrective action for Recommendation 3, stating that the "EPA will develop a strategic plan to explore the potential for new or revised numeric nutrient criteria," with an estimated completion date of December 30, 2022. The OIG does not accept this corrective action as it does not commit the Agency to establishing a plan, including milestones and identification of resource needs, for developing and publishing final numeric water quality criteria recommendations for nitrogen and phosphorus for rivers and streams.

The Agency also provided technical comments, and we updated the report where appropriate.

Status of Recommendations

RECOMMENDATIONS

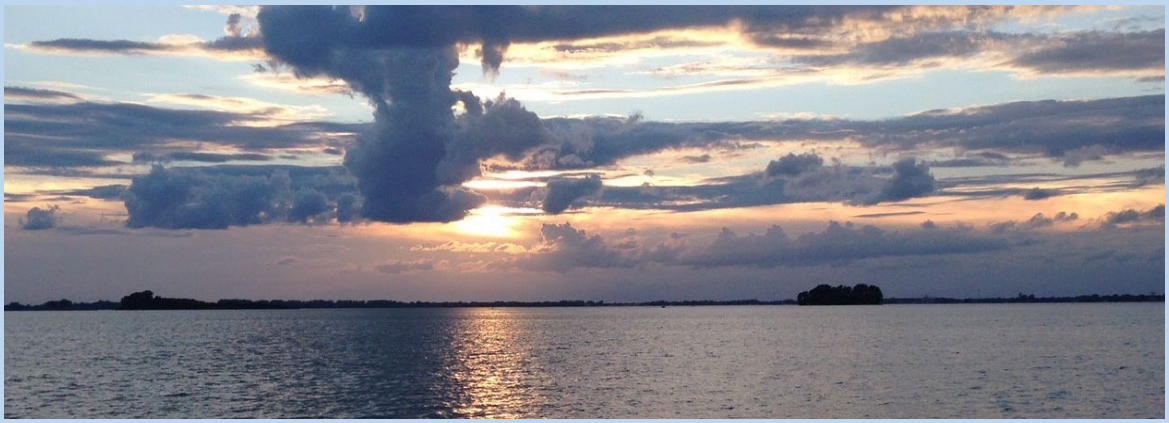
Rec. No.	Page No.	Subject	Status[1]	Action Official	Planned Completion Date
1	17	Develop an agencywide strategic action plan, including milestones, to direct the EPA's efforts to maintain and enhance a national program to forecast, monitor, and respond to freshwater harmful algal blooms. This plan should incorporate strategies for: a. Identifying knowledge gaps. b. Closing identified knowledge gaps, particularly related to health risks from exposure to cyanotoxins in drinking water and during recreational activities. c. Monitoring and tracking harmful algal blooms. d. Enhancing the EPA's national leadership role in addressing freshwater algal blooms. e. Coordinating EPA activities internally and with states. f. Assessing the health risks from exposure to cyanotoxins in drinking water and during recreational activities and establishing additional criteria, standards, and advisories, as the scientific information allows.	R	Assistant Administrator for Water	1/31/23
2	17	Publish final numeric water quality criteria recommendations for nitrogen and phosphorus under the Clean Water Act for lakes and reservoirs and publish implementation materials to help states in adopting these criteria recommendations.	C	Assistant Administrator for Water	8/13/21
3	18	Mindful that the EPA has substantial work to complete before publishing final numeric water quality criteria recommendations for nitrogen and phosphorus under the Clean Water Act for rivers and streams, establish a plan, including milestones and identification of resource needs, for developing and publishing those criteria recommendations.	U	Assistant Administrator for Water	
4	18	Assess and evaluate the available information on human health risks from exposure to cyanotoxins in drinking water and recreational waters to determine whether actions under the Safe Drinking Water Act are warranted.	R	Assistant Administrator for Water	12/31/22

[1] C = Corrective action completed.
R = Recommendation resolved with corrective action pending.
U = Recommendation unresolved with resolution efforts in progress.

Environment Case Study: Grand Lake St. Marys, Ohio

Grand Lake St. Marys is an example of the challenges faced by the EPA, states, and local officials in addressing HABs.

Grand Lake St. Marys in Ohio started construction in 1837 and was a feeder reservoir for the Miami and Erie Canal. At nearly 13,000 acres, it is Ohio's largest inland water body. Now a state park, it is one of the busiest tourist areas in Ohio with approximately 700,000 visitors annually. Recreation activities on the lake include swimming, boating, and fishing. The lake has suffered a toxic bloom every year since 2010.



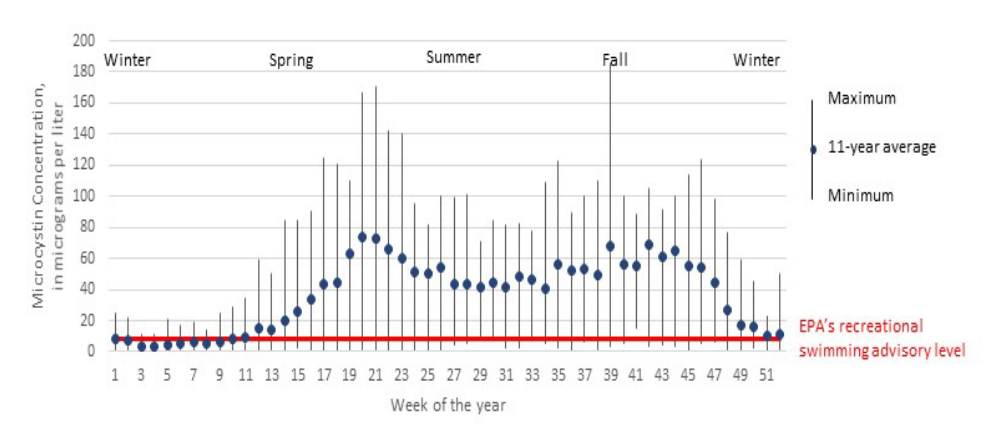
Grand Lake St. Marys. (Lake Improvement Association photo, used with permission)

Streams that feed into the lake are impaired primarily by high levels of nutrients from livestock producers and row crop agriculture. Residential use of lawn and garden fertilizers, failing septic systems, and other sources also contribute to the nutrient pollution. Excessive amounts of phosphorus in the lake fuel algal growth.

The concentration of phosphorus within the lake regularly exceeds twice the level used to define a lake as *hypereutrophic*, meaning the nutrient concentrations in the lake provide the conditions for substantial algal growth. In addition, the lake's bottom sediments store phosphorus.

The City of Celina, Ohio, uses the lake as a source for producing its drinking water. Microcystin, a cyanotoxin produced by some algal blooms, reaches dangerous levels in the lake for much of the year. Figure A-1 displays the 11-year average and range of microcystin concentration measured by Celina every week of the year. The Ohio Environmental Protection Agency measured even higher levels of microcystin in the lake. For example, in 2010, the agency measured the level at over 6,000 times above the health advisory that the EPA established for drinking water for infant and preschool children and 250 times over the EPA's recreational swimming advisory level.

Figure A-1: Microcystin concentration in Grand Lake St. Marys, 2010–2020



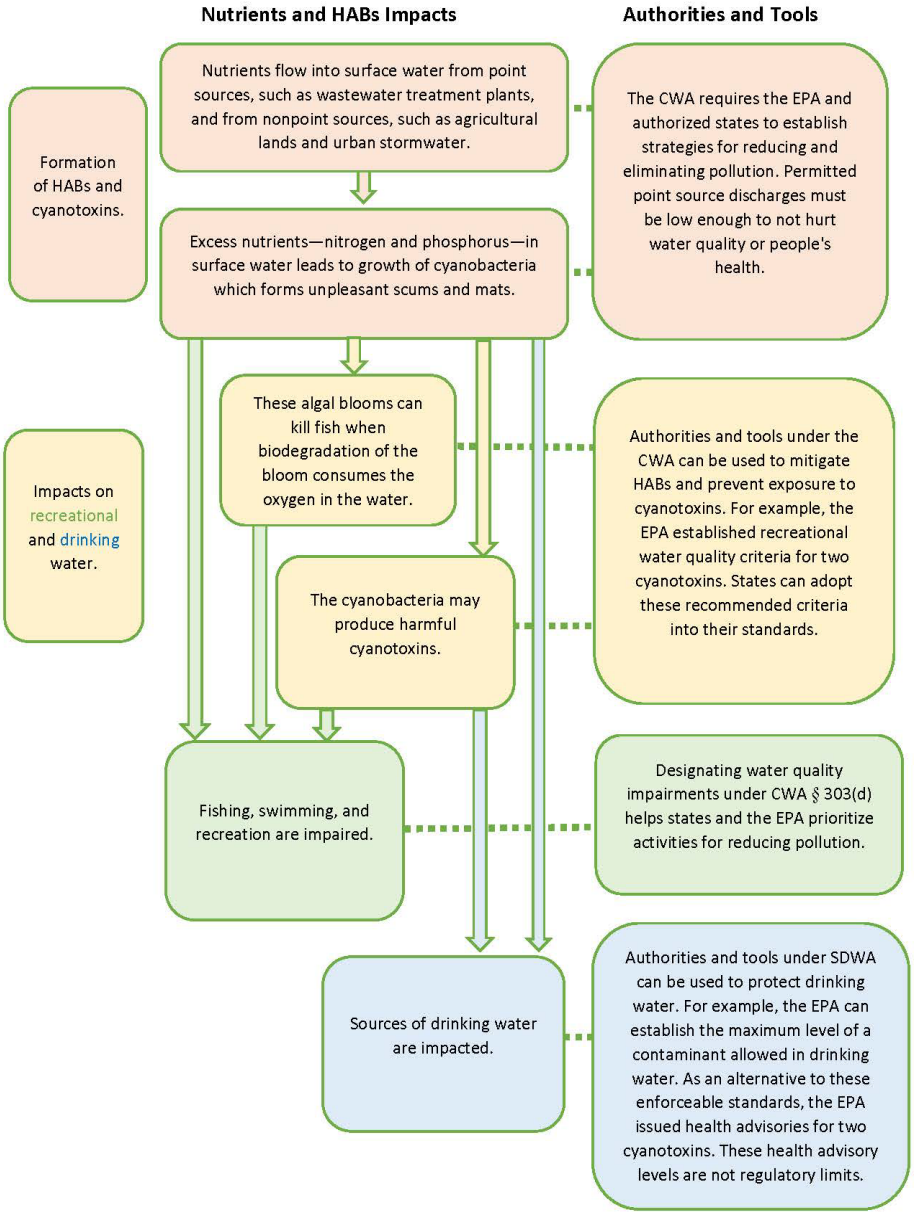
Source: OIG analysis of Celina's water treatment plant data. (EPA OIG image)

Tourism and recreation within the lake area accounted for as much as $150 million in annual economic activity prior to 2009. Economic effects after three years of algal blooms shrunk water-based recreation to a small percentage of what it once was. Several marinas and boat dealers closed, businesses suffered revenue reductions, and state park revenues fell by approximately $250,000. As of October 2010, Celina spent approximately $12.4 million upgrading its public drinking water treatment system.

Recreating on Grand Lake St. Marys. (Lake Improvement Association photo, used with permission)

On January 18, 2011, Ohio designated the Grand Lake St. Marys watershed as distressed. Since that declaration, a variety of watershed-specific rules have been implemented, including a ban on spreading manure on agricultural lands during the winter without prior approval and a requirement that over 130 agricultural producers develop nutrient-management plans. The rules under this distressed designation were phased in to allow time for producers to develop nutrient-management plans and make the management changes needed to comply with the rules, such as constructing manure storage capabilities. In addition, the state and county have completed restoration efforts, including constructing upland and in-lake wetlands and restoring a degraded stream. To date, these nutrient management and restoration efforts appear to be reducing the flow of nutrients to the lake and microcystin levels are moderately declining but are continuing to risk the environment and public health. More time and resources are needed to ensure improved water quality.

Tools and Authorities for Addressing Excess Nutrients and HABs



Source: OIG analysis of EPA information, the CWA, and SDWA. (EPA OIG image)

Appendix C

Selected EPA Actions to Reduce Nutrients and Mitigate and Reduce HAB Impacts

Year	EPA Action
Control of Excess Nutrients	
2007–2017	Periodically conducted statistical surveys of the condition of our nation's lakes, ponds, reservoirs, rivers, and streams. These surveys were designed to provide information on the extent that these waters supported healthy biological condition and recreation, estimate how widespread major stressors were that impact quality, and provide insight into whether these waters nationwide are getting cleaner.
2021	Finalized water quality criteria recommendations for lakes and reservoirs for nitrogen and phosphorus. These criteria rely on a stressor-response modeling approach.
Response to HABs in Recreational Waters	
2017	Created a recreational water communication toolbox.
2019	Recommended recreational water quality criteria and swimming advisories for microcystins and cylindrospermopsin.
2019	Developed infographic to help educate the public about potential dangers of exposure to HABs while recreating.
2019	Issued recommendations for monitoring recreational waters for cyanobacteria and cyanotoxins.
2021	Updated the sanitary survey application to allow managers of recreational waters to record HAB-related observations.
2021	Released a preparedness and response toolkit which will help states prepare for potential HABs in freshwater bodies and respond to protect public health.
Response to HABs in Drinking Water	
2015	Published two health advisories regarding microcystin and cylindrospermopsin in drinking water. Included available drinking water treatment technologies.
2015	Issued recommendations for public water systems to manage cyanotoxins in drinking water.
2015	Issued the cyanotoxin strategic plan for drinking water, mandated by the 2015 amendments to SDWA, after holding a listening session for stakeholders to present their views on key issues.
2015	Issued health effects support document for the cyanotoxin anatoxin-a.
2015	Developed analytical methods for cyanotoxins in drinking and surface waters.
2016	Issued guidance for drinking water systems faced with HABs in their source water on optimizing treatment considerations.
2016	Developed a toolbox, which supports public water systems, states, and local governments in developing drinking water cyanotoxin risk communication materials.
2016	Issued a template for states and public water systems to use to develop system-specific cyanotoxin management plans.
2016	Issued fact sheet templates that provide HAB-related information on health impacts, managing risks, and drinking water advisories.
2017	Issued a checklist for drinking water systems to use to prepare for, respond to, and recover from HAB incidents.
2018	Created informational video on tools for addressing the risks of cyanotoxins in drinking water.
Date Unknown	Developed a frequently asked questions website on laboratory analysis for microcystins in drinking water.
Research Efforts	
2016	Contributed to the federal government HABHRCA research plan and action strategy.
2019	Released a mobile application that allows easy access to information based on satellite data that can help local and state water managers to make faster and better-informed management decisions related to cyanobacterial blooms.
2020	Established HAB research priorities in strategic research action plan.

Source: OIG analysis of EPA information. (EPA OIG table)

Agency Response to Draft Report

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF WATER

MEMORANDUM

SUBJECT: Response to the Office of Inspector General Draft Report: *EPA Needs an Agencywide Strategic Action Plan to Address Harmful Algal Blooms* (Project No. OA&E-FY20-0280)

FROM: Radhika Fox
Assistant Administrator
RADHIKA FOX
Digitally signed by RADHIKA FOX
Date: 2021.08.16 09:58:19 -04'00'

TO: Kathlene Butler, Director
Water Directorate, Office of Evaluation

Thank you for the opportunity to respond to the issues and recommendations in the Office of Inspector General (OIG) subject draft evaluation report, *EPA Needs an Agencywide Strategic Action Plan to Address Harmful Algal Blooms*. Following is a summary of the U.S. Environmental Protection Agency's (EPA) overall position, along with its proposed corrective actions on each of the report's recommendations and estimated completion dates.

AGENCY'S RESPONSE TO DRAFT AUDIT RECOMMENDATIONS

1. **Develop an agencywide strategic action plan, including milestones, to direct EPA's efforts to maintain and enhance a national program to forecast, monitor, and respond to freshwater harmful algal blooms. This plan should incorporate strategies for:**

    a. **Identifying knowledge gaps.**
    b. **Closing identified knowledge gaps, particularly related to health risks from exposure to cyanotoxins in drinking water and during recreational activities.**
    c. **Monitoring and tracking harmful algal blooms.**
    d. **Enhancing the EPA's national leadership role in addressing freshwater algal blooms.**
    e. **Coordinating EPA activities internally and with states.**
    f. **Assessing the health risks from exposure to cyanotoxins in drinking water and during**

recreational activities, and establishing additional criteria, standards, and advisories, as the scientific information allows.

EPA Response: EPA, as the leader in responding to freshwater HABs nationwide, understands that developing an agencywide strategic action plan may further demonstrate the existence of a national EPA HABs program. Therefore, EPA intends to develop a consolidated agencywide strategic plan building upon two existing EPA strategic plans (Algal Toxin Risk Assessment and Management Strategic Plan for Drinking Water and U.S. Environmental Protection Agency's FY 2018-2022 U.S. EPA Strategic Plan), and cross-agency plans/implementation reports from the Interagency Working Group for the Harmful Algal Blooms and Hypoxia Research And Control Act (IWG HABHRCA) (HAB and Hypoxia Comprehensive Research Plan and Action Strategy and Great Lakes Research Plan and Action Strategies). EPA's protection of human health and the environment against HAB risks requires a multi-faceted, intra- and inter-agency effort, and these strategic plans bridge across programs and partners to address a broad range of issues including ecosystem health, safe drinking water, and safe recreational waters. Together these plans have provided EPA with the necessary guidance and vision to make significant progress in understanding, tracking, and managing HABs across various disciplines and programs.

2. **Publish final numeric water quality criteria recommendations for nitrogen and phosphorus under the Clean Water Act for lakes and reservoirs and publish implementation materials to help states in adopting these criteria recommendations.**

EPA Response: EPA published these criteria recommendations on August 13, 2021.

3. **Mindful that the EPA has substantial work to complete before publishing final numeric water quality criteria recommendations for nitrogen and phosphorus under the Clean Water Act for rivers and streams, establish a plan, including milestones and identification of resource needs, for developing and publishing those criteria recommendations.**

EPA Response: EPA is poised to publish final revised CWA Section 304(a) ambient water quality criteria recommendations for nitrogen and phosphorus for lakes/reservoirs and will thereafter publish implementation materials to help states, territories, and authorized tribes in adopting these criteria recommendations. The criteria recommendations for lakes/reservoirs represent over 10 years of work and will continue to consume resources as EPA provides significant technical support to states to encourage adoption. Even though EPA has had national criteria recommendations for lakes/reservoirs available for over 20 years, currently, only one state has adopted numeric criteria for nitrogen and phosphorus for their lakes and reservoirs statewide, while five additional states have adopted numeric criteria for phosphorus for their lakes and reservoirs statewide. An additional 15 states have adopted site specific numeric criteria for their lakes and reservoirs; however, currently 28 states have no numeric nutrient criteria and rely on their narrative criteria statements to address nutrient pollution in lakes and reservoirs. EPA's National Nutrient Criteria Program believes it is the best use of available resources to provide direct technical assistance to states, territories and authorized tribes who are interested in adopting numeric nutrient criteria to protect the designated uses of their lakes/reservoirs using the newly published criteria recommendations.

EPA is currently evaluating the latest science available to determine whether EPA can update the previously published national criteria recommendations for rivers/streams or establish first time national criteria recommendations for estuarine/coastal marine waters. EPA is also evaluating the available science to determine whether the concentrations of nitrogen and phosphorus in rivers/streams that would be protective of downstream waters (either lakes/reservoirs or estuarine/coastal marine waters) would be less than the concentrations to protect the rivers/streams themselves. If this is the case, and given the widespread problem of HABs and hypoxia in estuarine and coastal marine waters, then EPA would plan to develop national recommendations for estuarine/coastal marine waters, rather than for rivers/streams. However, we know that the development of national criteria recommendations for either of these types of flowing waters will be far more difficult than it was for lakes/reservoirs and will take time to evaluate the latest scientific information to determine what can be recommended at a national level. In the meantime, EPA believes that the best use of available resources is to continue to provide direct technical assistance to states, territories, and authorized tribes who are interested in adopting numeric nutrient criteria to protect the designated uses of their rivers/streams and estuarine/coastal waters using state-specific data through the agency's N-STEPS Program. It is through these state-specific case studies that we hope to gain a better understanding of the science that may help us publish new national recommendations for these flowing waters.

It is important to note that while it is important to have numeric nutrient criteria that represent the latest science, the availability of EPA criteria recommendations does not fully solve the problem of HABs. States, territories, and authorized tribes would need to choose to adopt these numeric nutrient criteria recommendations into their water quality standards to protect their designated uses. Many states have opted not to adopt numeric nutrient criteria for a number of reasons unrelated to the science of the criteria themselves. Currently, Florida is the only state in the country with comprehensive numeric nutrient criteria for nitrogen and phosphorus for all lakes/reservoirs, rivers/streams, and estuarine/coastal marine waters, and yet there continues to be massive harmful algal blooms in the state. This may be an indication that the mere adoption of criteria does not necessarily solve the problem.

4. **Assess and evaluate the available information on human health risks from exposure to cyanotoxins in drinking water and recreational waters to determine whether actions under the Safe Drinking Water Act are warranted.**

EPA Response: EPA develops Health Effects Support Documents (HESDs) to comprehensively evaluate the occurrence, toxicology, and epidemiology data for unregulated drinking water contaminants and estimate the risks from ingestion of the contaminant in drinking water. EPA uses the HESDs as the basis for developing Health Advisories (HA), which are not federally enforceable standards. In 2015, EPA published health advisories for total microcystins and cylindrospermopsin and an HESD for anatoxin-a. In 2019, EPA published *Recommended Human Health Recreational Ambient Water Quality Criteria or Swimming Advisories* for microcystins and cylindrospermopsin. EPA did not publish a health advisory for anatoxin-a because the available toxicity database was insufficient to derive a health-based value. EPA has been evaluating the health data for saxitoxins since then and expects to release a HA or HESD soon. The ability to develop health advisories is dependent on the availability and adequacy of the health effects database.

Additionally, the Safe Drinking Water Act (SDWA) directs EPA to regularly publish a list of unregulated drinking water contaminants (referred to as the Contaminant Candidate List or CCL) to

assist with identifying priority contaminants for regulatory decision making and information collection. Starting with the third CCL (finalized in 2009), EPA listed cyanotoxins as an aggregate group. The group of cyanotoxins on the fourth CCL (2016) specifies that the group includes toxins produced by cyanobacteria including but not limited to microcystins, cylindrospermopsin, anatoxin-a, and saxitoxin. Cyanotoxins are reproposed for inclusion on the fifth CCL expected to be finalized in 2022.

In 2013, EPA started evaluating the risks to human health from exposure to three cyanotoxins (microcystins, cylindrospermopsin, and anatoxin-a) listed on the CCL 3. In 2017, EPA started evaluating the human health risks of saxitoxins, the fourth cyanotoxin highlighted in the cyanotoxins group on the CCL 4 (2016). Adequate and complete toxicity data for anatoxin-a and other emerging cyanotoxins and their metabolites (e.g., dermatoxins, lipopolysaccharides, and β-methylamino-alanine [BMMA]) are not currently available. Given this information gap, EPA is conducting a broad range of research to support the understanding of human health effects, including an assessment of toxicity after inhalation of aerosols containing cyanotoxins, effects of cyanobacteria and their metabolites after dermal exposure, and national passive surveillance for health effects associated with harmful algal blooms. To aid in providing robust science to support Office of Water's efforts, the Office of Research and Development (ORD) is conducting toxicological exposure studies of anatoxin-a for a variety of health endpoints, including gastrointestinal health outcomes. Through an agreement with the National Institute of Health's National Toxicology Program, analytical monitoring of dosing solutions, stability of stored anatoxin-a, and assessment of levels in tissue samples will be performed. This work is being augmented by a project conducted by ORD and the Office of Water to perform a systematic review of the peer-reviewed scientific literature for freshwater saxitoxin, nodularin, and anatoxin-a health effects after exposure to harmful algal blooms and/or the toxins produced. Results from this health effects research, national monitoring data collected under the fourth Unregulated Contaminant Monitoring Rule, and other information will be used to inform next regulatory and nonregulatory steps under the SDWA.

AGENCY'S CORRECTIVE ACTIONS TO DRAFT AUDIT RECOMMENDATIONS

Agreements No.	Recommendation	High-Level Corrective Action(s)	Est. Completion Date
1	Develop an agencywide strategic action plan, including milestones, to direct EPA's efforts to maintain and enhance a national program to forecast, monitor, and respond to freshwater harmful algal blooms. This plan should incorporate strategies for: • Identifying knowledge gaps. • Closing identified knowledge gaps,	To address this recommendation EPA will develop an agencywide strategic plan that builds upon the two existing, relevant EPA strategic plans: 2015 Algal Toxin Risk Assessment and Management Strategic Plan for Drinking Water, and ORD's FY 2018-2022 U.S. EPA Strategic Plan. EPA will also review and consider cross-agency plans/implementation reports that were developed by the	January 2023

	particularly related to health risksfrom exposure to cyanotoxins in drinking water and during recreational activities. • Monitoring and tracking harmful algal blooms. • Enhancing the EPA's national leadership role in addressing freshwateralgal blooms. • Coordinating EPA activities internally and with states. • Assessing the health risks from exposure to cyanotoxins in drinking water and during recreational activities, and establishing additional criteria, standards, and advisories, as the scientific information allows.	IWG-HABHRCA, including the HAB and Hypoxia Comprehensive Research Plan and Action Strategy, and the Great Lakes Research Plan and Action Strategies. This agencywide strategic plan will encompasses EPA's work on the six components recommended by OIG.	-
2	Publish final numeric water quality criteria recommendations for nitrogen andphosphorus under the Clean Water Act for lakes and reservoirs and publish implementation materials to help states in adopting these criteria recommendations.	EPA expects to publish these criteria recommendations in the near term.	August 2021
3	Mindful that the EPA has substantial work to complete before publishing final numeric water quality criteria recommendations for nitrogen and phosphorus under the Clean Water Act for rivers and streams, establish a plan, including milestones and identification	EPA is evaluating the relative priority of developing new water quality criteria recommendations for estuarine and coastal marine waters, and for rivers and streams. Once EPA has a better understanding of state/tribal water quality programs' technical needs and the scientific strategic plan that can best meet	December 2021

	of resource needs, for developing and publishing those criteria recommendations.	those needs, EPA will be better positioned to act under its CWA Section 304(a) authorities for these waters. EPA will continue to work in partnership with states that are interested in developing and adopting numeric nutrient criteria for rivers/streams and estuarine/coastal marine waters.	
4	Assess and evaluate the available information on human health risks from exposure to cyanotoxins in drinking water and recreational waters to determine whether actions under the Safe Drinking Water Act are warranted.	EPA will continue evaluating the risks to human health from exposure to cyanotoxins and will develop Health Effects Support Documents (HESDs) for new toxins (e.g., saxitoxins and nodularin). EPA intends to develop health advisories and recreational criteria for these toxins when sufficient health data are available. EPA will re-evaluate the human health risks to previously evaluated toxins (e.g., anatoxin-a) as new ORD's toxicological exposure studies and systematic reviews of peer-reviewed scientific literature are completed. EPA will determine whether additional regulatory or non-regulatory actions are appropriate under the SDWA, using the above health effects information, UCMR 4 and other cyanotoxins occurrence data, and additional information.	December 2022

Appendix E

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