

Legislative Mandated Report: 2022 Water Code Section 13182(a) Comprehensive Report

Introduction

[Assembly Bill No. 834 \(AB 834\)](#) was approved by the Governor September 27, 2019, requiring the State Board to establish a Freshwater and Estuarine Harmful Algal Bloom (FHAB) Program to protect water quality and public health from harmful algal blooms (HABs). The fiscal year 2020/2021 budget act authorized five new staff positions and \$750,000 in annual contracting funds. The staff positions were filled by June 2021 and are distributed among the State Board (two positions) and three [Regional Boards](#) (one position each at Regional Boards 1, 5, and 6).

Background

Per the requirements of Section 13182(a) of the California Water Code, the State Water Board posted the first legislative report in June 2021 to the FHAB Program webpage under the State Board's Surface Water Ambient Monitoring Program's webpage. In the [2021 Legislative Report](#), the Water Boards proposed a phased approach to complete the report to the legislature in two parts: (1) 2021 Legislative Report and (2) comprehensive report which allowed for one full fiscal year of work supported by the program funds and permanent staff. The 2021 Legislative Report provided details as to how the Water Boards addressed HABs since the onset of the FHAB Program in 2016. It thoroughly outlined the different requirements of AB 834 and identified the Water Boards' actions, infrastructure, and partnerships to meet those requirements.

California Water Code Section 13182(a)

On or before July 1, 2021, post on the state board's internet website a report including the following information:

- The incidence of, and response to, freshwater and estuarine harmful algal blooms in the state during the previous three years.
- Actions taken by the state board including requirements pursuant to paragraphs (1) to (5)¹, inclusive.
- Recommendations, by the state board and other entities participating in the Freshwater and Estuarine Harmful Algal Bloom Program, for additional actions, including preventative actions where possible, that should be taken to protect water quality and public health from harmful algal blooms, including

¹ (1) Coordinate immediate and long-term event incident response, including notification to state and local decisionmakers and the public regarding where harmful algal blooms are occurring, waters at risk of developing harmful algal blooms, and threats posed by harmful algal blooms.(2) Conduct and support field assessment and ambient monitoring to evaluate harmful algal bloom extent, status, and trends at the state, regional, watershed, and site-specific waterbody scales.(3) Determine the regions, watersheds, or waterbodies experiencing or at risk of experiencing harmful algal blooms to prioritize those regions, watersheds, or waterbodies for assessment, monitoring, remediation, and risk management.(4) Conduct applied research and develop tools for decision-support. (5) Provide outreach and education and maintain a centralized internet website for information and data related to harmful algal blooms.

recommendations for statutory or regulatory changes that are needed to achieve that goal.

This 2022 Comprehensive Report provides information regarding:

- the incidence of freshwater and estuarine harmful algal blooms in the state during the previous three years, and
- actions taken since June 2021 in meeting the requirements of Water Code Section 13182(a) 1 & 2, and recommendations for additional actions that should be taken to protect water quality and public health (California Water Code Section 13182(a)3).

The incidence of freshwater and estuarine harmful algal blooms in the state during the previous three years.

Public Reports

The incidence of HABs has increased at an alarming rate over the last four years, with both the number of reports and illnesses investigated by the Water Boards. The public is becoming more actively engaged in the topic of HABs as it is becoming more readily showcased in the media. Table 1 below summarizes the number of FHAB reports submitted by the public and coordinating agencies to the Water Boards between 2018-2021.

Table 1. Number of voluntary reports submitted through the On-line Report Form from 2018-2021

	2018	2019	2020	2021
Total Reports	190	241	370	603

In 2018, the voluntary Interagency HAB-related Illness Workgroup (Illness Workgroup) was developed to investigate and track potential HAB-related illnesses in humans and animals throughout California. Reports of HAB-related illnesses in humans and animals have also increased between 2018-2021. Table 2 summarizes the number of all potential illness reports received.

Table 2. Number of all potential illness reports* received (includes dog, livestock, wildlife, fish, and humans)

	2018	2019	2020	2021
Illness Reports Received	40	49	42	91

*Note: These numbers reflect illness reports initially received. A report may include multiple individuals.

Notably, our data shows that HABs are being observed earlier in the year and in some cases, becoming a year-round issue impacting recreation, affecting wildlife and aquatic

life, and impacting drinking water reservoirs. Numerous reservoirs on the State Water Project are impacted by HABs. The California Department of Water Resources shares their potentially toxigenic cyanobacteria screening and laboratory data with the FHAB Program during the summer months. Many reservoirs, afterbays, and forebays exceed the advisory trigger levels each year, especially in the Central Valley. This causes challenges for water managers including management efforts to avoid using the source waters in the distribution network and increased costs to public water systems by funding new treatment technology to protect public health. In addition, a recent study in Lake County identified impacted private water systems sourcing water directly from a HAB impacted lake that resulted in emergency potable water distribution to impacted households and business for two months. Recently, the FHAB Program has also received requests from tribes and counties for assistance in evaluating potential drinking water contamination of cyanotoxins for small community and private direct water intakes. This is an emerging issue, and the FHAB Program has expanded the scope of the program to provide technical expertise and guidance in designing monitoring plans and training staff for collection of samples, funding analyses, and interpreting results.

Hydromodification projects also affect the occurrence and abundance of HABs. With drought conditions in California becoming more common, projects have been implemented to protect and conserve water for California's agricultural economy. These efforts often include permits issued by the Department of Water Rights. The FHAB Program has been heavily consulted the past year regarding a salinity barrier in the Sacramento Delta and providing guidance on a monitoring program to help determine if these types of projects affect the occurrence of HABs with slowing down water flows, providing longer water residence periods where the water has the opportunity to warm, and potential for spread to other parts of the Delta.

HABs threaten the safety of our drinking water, cultural and tribal practices, fish and mussel consumption, recreational uses, and ecosystem health. The occurrence, intensity, and duration of HABs is increasing, securing this as a continued top concern for Californians.

Actions Taken and Recommendations (June 2021 to Current)

The following section includes actions taken by the California Water Boards to implement the program and each of the AB 834 requirements from June 2021 to current. Recommendations are included where needed for each section.

13182.a.1. Incident Response

Coordinate immediate and long-term event incident response, including notification to state and local decisionmakers and the public regarding where harmful algal blooms are occurring, waters at risk of developing harmful algal blooms, and threats posed by harmful algal blooms.

Organization and Resources

Since July of 2021, the FHAB Program has been initialized with one or more FHAB Coordinators at each Regional Board and two State Board FHAB Program staff housed within the Office of Information Management and Analysis. Immediate incidence response is carried out throughout the state utilizing these coordinators and State Board staff. Three Regional Boards currently have dedicated funded positions for the FHAB program (Regions 1, 5, and 6). These staff manage incident response within their region in addition to program coordination and planning activities. Regions 2, 3, 4, 7, 8, and 9 voluntarily share the responsibilities of incidence response with existing staff assigned and funded through other programs.

The State and Regional Water Boards recognized early on that adequate staffing and funding for equipment, laboratory and research services would be key priority for successful and complete implementation. To begin to assess the needs of the program for full implementation throughout the state, the State Board FHAB Program staff conducted a resource gap assessment. Each of the Regional Boards and key statewide programs were interviewed to determine where further support is needed. The results of this survey can be found in [Appendix A](#). The findings of this survey reiterate the need for the agency to develop strategies to further develop the program. These findings are planned to be used during budget request and approval cycles and strategic coordination within the agency.

Recommendation

California should continue prioritize the program, evaluate resource needs, and implement strategies for resource allocations throughout the state for successful implementation of AB 834.

Program Reporting and Notification System Infrastructure

Prior to legislation, the State Water Board established a voluntary bloom reporting system for public and external agency use as well as establishing the [Harmful Algal Bloom \(HAB\) Portal](#) (CA HABs Portal). The CA HABs Portal serves as the central resource for FHABs in the state of California. The content is developed by the State Board, participating agencies, and the [California Cyanobacteria and HAB \(CCHAB\) Network](#). The CA HABs Portal also houses the FHAB Reporting System, maintained by the State Board. This reporting system provides 1) a public data entry for voluntarily reported blooms in California, 2) an internal FHAB management database for logging information about the bloom and investigative follow up, and 3) the [FHAB Incident Reports Map](#) (Web Map) providing the bloom report, investigation findings, and any advisory signage posted at the water body.

Communication about harmful blooms to the public and coordinated response to those blooms are key goals of the FHAB Program. To further enhance the ability of the program to meet those goals in 2022 and beyond, the FHAB Reporting System underwent a significant design overhaul starting in July of 2021. A new web based

FHAB database has been developed and launched in coordination with the Water Boards Division of Information Technology (DIT).

All three portions of the reporting system have been or are slated to be enhanced. The public data entry system underwent design enhancements to improve user experience and added features for photo and document uploads by reporting parties. These improvements were complete in the spring 2022. The Web Map is slated for similar user experience enhancements in the winter of 2022.

The most significant design updates have been to the interagency incidence response database. The new system houses laboratory data, photos and files, public advisories and updates, and communication logs. It also allows for tracking report follow-up, response to field investigations, and voluntary compliance with monitoring and whether advisory signs were posted at the waterbody. This new FHAB data system allows for tracking of public reports over time and better collaboration among partners for more effective incident response. It also serves as a data repository for easier data evaluation to better address AB 834 requirements including trends, identifying waterbodies for prioritization, and providing the data to feed into decision support tools. The new FHAB data system is designed to have three main modules: (1) reports case; (2) illness tracking; and (3) partner monitoring. The first module was completed in June 2022. The illness tracking and partner monitoring modules are under development and are expected to be completed by the end of the calendar year.

Recommendation

California would benefit from dedicated resources to maintain and update the infrastructure to record and report out to the public. This allows for further adaptive management to ingest all available data and information regarding HABs across the state, better cross-coordination internally among the Water Boards and with partners, and enhanced communication with the public.

Incident Investigation and Follow up Collaboration

The Water Boards FHAB Program currently implements a standardized approach for incident response through [voluntary statewide guidance](#) developed and published in coordination with the California Water Quality Monitoring Council, CCHAB Network. Response tasks are currently primarily focused on investigating blooms and posting physical advisory signage. The FHAB Program has committed to working in collaboration with local water agencies to investigate and respond to blooms. However, both collaboration and the response guidance are voluntary at this time.

There are inherent limitations and gaps in implementation consistency using a voluntary approach, which can put the public at risk of exposure to HABs. For example, some local water agencies and recreation managers have not utilized or only partially utilized the guidance. As a result, not all HAB-confirmed waterbodies have public safety notices posted, nor has there been consistent investigation into confirmation of toxin presence and concentration across the state. As the number of blooms occurring and reported to

the state increases at a dramatic rate, there is an exponentially growing need for increased collaboration and shared resources.

There is also a direct nexus with [AB 1066](#), which focuses on water recreation hazards at priority in-land water-contact recreation sites, although there is no funding to ensure the public's risk to HABs is integrated into this bill's requirements. Resources are needed to develop a more coordinated approach with the state and local health department to keep the public informed of health risks due to water contact recreation.

The FHAB Program also focuses incident response to freshwater and estuarine HABs. In 2022, a red tide (marine bloom) overtook much of the San Francisco Bay, including parts of the estuary and caused a major fisheries die-off. With no existing response plan in place for protection of human health (swimming/fishing) for marine blooms, the FHAB Program offered expertise and assistance in coordinating follow-up monitoring, paying for water sample analyses, showcasing the bloom on the Web Map, and providing recommendations for advisory postings. There are no incident response procedures for addressing marine blooms for when they extend into estuaries, nor identified responsible agencies to lead the response to inform recreational and fishing advisories.

Recommendations

The Water Boards recommends that additional legislation be developed to mandate the design and implementation of mandatory interagency response procedures, including marine blooms. This will allow agency resources to be used efficiently, generate, and share comparable data, and the public is informed via centralized website and public map. Additionally, it is recommended that an agency like the Water Boards be granted statutory authority for posting physical advisory signage on affected Waters of the State.

13182.a.2. Monitoring and Assessment

Conduct and support field assessment and ambient monitoring to evaluate harmful algal bloom extent, status, and trends at the state, regional, watershed, and site-specific waterbody scales.

Water Quality Objectives for the Protection of Public Health and Beneficial Uses

California currently lacks comprehensive water quality objectives for HABs as required by the Water Boards [Water Quality Control Policy for Developing California's Clean Water Act Section 303\(d\) List](#). In California, HABs primarily float (planktonic) or grow on the bottom (benthic) of the waterbody, and are documented in lakes, reservoirs, rivers, and streams. Due to the dynamic nature of HABs, no one threshold would be protective of the different beneficial uses (ex. recreation; fishing; cultural; wildlife, etc.) assigned to different waterbodies. The California Office of Environmental Health, Hazard, and Assessment (OEHHA) developed recommended benthic thresholds for acute and chronic exposure of dogs and cattle, but they were published in 2012 and are antiquated. New guidance or regulatory thresholds are needed for evaluation of

cyanotoxin impairments as part of the [Integrated Report](#) so these impairments are recognized and added to the 303(d) List of Impaired Waters.

The Water Boards Division of Water Quality is in the process for developing policy to address biostimulatory conditions to be incorporated into Water Quality Control Plans and permits. They recently added on the development of numeric thresholds to protect several beneficial uses from cyanotoxins. However, the policy to address biostimulatory conditions has been in development for many years and may not be finalized for upwards of 8-10 years. It is also uncertain what cyanotoxin thresholds might be included in the policy, if any. Increase of HAB occurrences and duration, particularly exacerbated by drought conditions and climate change, are anticipated to worsen in the coming years, so dedicated resources for HAB specific policy development is essential to work towards near term policy and regulatory measures. The lack of regulatory measures has impaired the effectiveness of immediate and long-term event response to HAB events, statewide monitoring, and data to inform management decisions to begin addressing the causes of HABs, ongoing impacts, and mitigation efforts.

Recommendations

California should develop comprehensive water quality objectives focused on protecting the public during water recreation and to determine if other beneficial water uses are impaired due to cyanotoxins.

Framework and Strategy for Freshwater Harmful Algal Bloom Monitoring

In early 2021, SWAMP funded and closely collaborated with the Southern California Coastal Water Research Project (SCCWRP) to release the report, [California Water Boards' Framework and Strategy for Freshwater Harmful Algal Bloom Monitoring](#)² (hereafter, FHAB Monitoring Strategy). This document lays the foundation for how to develop an ambient monitoring program for freshwater and estuarine HABs in California, a priority that was identified in SWAMP's 2016 FHABs Assessment and Support Strategy. An [executive synthesis](#) is available that provides a high-level overview of the strategic plan and presents prioritized research needs. When work on the FHAB Monitoring Strategy began, AB 834 had not been approved and the available resources for FHABs monitoring were not yet established. Therefore, the FHAB Monitoring Strategy was written as a conceptual document to comprehensively consider all the monitoring options for the Water Boards. The FHAB Monitoring Strategy proposes many programmatic and special study recommendations for the Water Boards

² Smith, J., Sutula, M., Bouma-Gregson, K., & Van Dyke, M. (2021). *California Water Boards' Framework and Strategy for Freshwater Harmful Algal Bloom Monitoring: Full Report with Appendices* (SCCWRP Technical Report 1141.B). Southern California Coastal Water Research Project.

including efforts to support implementation of monitoring, research, and risk assessment objectives under AB 834.

The monitoring framework lays out a tiered approach to focus on assessing status and trends of HAB impacts on swimmable, fishable, and raw water (for drinking water) beneficial uses of California lakes, streams, rivers, and coastal confluences, then later as resources are available integrate in assessment of cultural uses and aquatic life. Further the tiered approach also lays out conceptual monitoring programs of medium and high-cost tiers with corresponding assessment questions the data can answer. This data can then be used to develop and integrate cyanotoxin water quality objectives into relevant regulatory programs and permits.

A key strength of the FHAB Monitoring Strategy is its reliance on multiple approaches to collecting ambient FHAB monitoring data to inform management decisions that ultimately lead to better protections for public health and the environment. Specifically, the strategy integrates: a) a partner program that provides infrastructure to encourage FHAB monitoring by other federal, state and local agencies, tribal governments, citizen science groups, etc., b) field surveys developed and managed by SWAMP or its partners, and c) remote sensing approaches that build upon the current partnership that California has formed with federal agencies. Additionally, incident response will continue and will be strengthened via synergies with ambient monitoring approaches. Meanwhile, the FHAB Monitoring Strategy relies on data management, visualization, and decision support systems as a core part of the monitoring infrastructure necessary for managers to effectively use FHAB data for management decisions and timely communication to the public. These assessments would inform management decisions, regulatory measures (amend existing permits), forecasting tools, and mitigation actions.

With the initial financial and personnel resources allocated through AB 834 and the BCP, the Water Boards has begun to expand resources for partner monitoring including a webpage that guides partners as to types of monitoring and resources, including videos, checklists, and reference documents to ensure data is consistent and of quality. The SCCWRP contract was recently amended and FHAB contract funding will support SCCWRP to continue to build out our partner monitoring program. It also includes FHAB contract funding to provide recommendations for methods for analyzing remote sensed data for algae and cyanobacteria, explore DNA metabarcoding analyses, and provide recommended methods for measuring cyanotoxins in algal and cyanobacteria mats to further quality data collection and evaluation.

Regional studies are being conducted to assess priority waterbodies and inform local management decisions and actions. Some current studies include evaluating Big Bear for public advisories, evaluating the year-round bloom at Lake Elsinore to identify cyanobacteria compositions throughout the year, and bettering the understanding benthic blooms in the Russian River using passive samplers. These studies have been designed by the Regional Boards (with support from the State Board) to inform various management objectives and questions including, but not limited to, bloom status and

trends, magnitude of toxicity and relationships between regional and watershed biostimulatory conditions and FHABs.

The State Board is collaborating with existing Water Board programs including the Surface Water Ambient Monitoring Program bioassessment and bioaccumulation monitoring programs to leverage existing monitoring throughout the state. Field staff are collecting water and algal mat samples in the summer for analysis of cyanotoxins. Previously, monitoring has been focused on HAB incident response and so this additional data will help to better understand the extent and magnitude of HABs across California.

Recommendations

California should further support regional studies to ensure they can be completed in their entirety to best inform Total Maximum Daily Load development, regulation/policy, enforcement, and/or mitigation measures. California should also prioritize implementing the comprehensive FHAB Monitoring Strategy that identifies a roadmap on how to leverage resources and better understand and characterize the extent of HABs across the state. This includes a nexus with existing monitoring programs to include HABs to better understand the extent of HABs across the state and to better inform the public of waters safe to recreate.

Pre-Holiday Assessments

To protect Californians when water recreation is at the highest during the warm season and when HABs peak, the Water Boards and partner organizations perform pre-holiday assessments to monitor some of the more popular California lakes and rivers. The first year of three consecutive pre-holiday assessments started in May 2021 to proactively monitor popular recreational waterbodies prior to the Memorial, Independence, and Labor Day holiday weekends. Water quality conditions and relevant recreational advisories are shared through the Web Map. For 2022, a similar program has been initiated. Over 140 sites were sampled for Memorial Day and 135 sites sampled for the Independence Day pre-holiday assessment. Water Boards staff either sample or enlist and train partners to monitor. Laboratory analysis for these assessments is 90% funded by the FHAB Program with approximately \$50,000 - \$75,000 allocated for each holiday. The pre-holiday assessments were recommended in the FHAB Monitoring Strategy to leverage partner monitor programs.

Recommendations

California should support a comprehensive summer ambient monitoring program to both inform the public of when popular recreational beaches are safe and to inform future management actions to support the beneficial uses of these waters.

Monitoring Limitations

Currently, there is little information about HABs for surface waters in California. The initial limited resources have been focused on incident response; therefore, there is

limited information to assess status and trends which would inform permit development, forecasting tools, and mitigation actions.

There are Water Board monitoring programs that collect data to answer questions about bioaccumulation, pesticide toxicity, and biological health of streams. These monitoring programs visit approximately 30-80 sites per year and cost \$2-4 million annually to sustain. HAB monitoring and assessment are more complex than these existing models since HAB organisms and their toxins are not persistent like heavy metals (i.e., mercury) and change in toxicity in as little as 24 hours, as well as vary spatially and temporarily. The dynamic characteristics of HABs require much more frequent site visits to collect data (not annually) and need sample collection at different depths of the water column and locations (depending on flowing or ponded system). In addition, the number of waterbodies known to have re-occurring HABs increases the number of sites needed to be visited on regular basis. The FHAB Strategy was developed to provide the road map for a comprehensive monitoring program. The FHAB Monitoring Strategy does not only recommend a new standalone monitoring program to inform the questions in this objective but also recommends leveraging existing monitoring programs at the Water Boards and other agencies to fill in some data gaps.

As stated in this report, the current resources of the FHAB Program are focused on the most urgent need to respond to public reports of HAB events statewide and publish site investigation results and advisory recommendations to the Web Map. HAB incident response often only produces data that is collected one time per year at the shoreline to inform the immediate risk to public health from recreational exposure (bathing, swimming, fishing). Additional equipment, watercraft, and lab analysis funds would be needed to collect samples for other indicators to better understand the environmental drivers to mitigate for HABs. It will also be important to expand the water quality monitoring to evaluate nutrients and other corresponding analytes that influence HAB growth. A portion of the FHAB Program resources have been allocated to short-term monitoring studies at a single waterbody to inform status and trends assessments; but with the numerous watersheds impacted or at risk of being impacted by HABs, these studies are insufficient and do not replace a statewide monitoring program.

A HAB monitoring program would not only benefit many other Water Boards' programs, but also other state and local agencies with mandates for protecting water quality and public health. Without the HAB data that would be generated through a comprehensive monitoring program, water quality and public health cannot be protected, and waterbodies cannot be restored. The HAB monitoring data also will be highly relevant and valuable to local, state, and federal governments, and various community, stakeholder, and tribal groups with an interest in protecting the many beneficial uses that are being impacted by HABs. Finally, it is important to note that while implementing a statewide FHAB Monitoring Strategy will not on its own prevent, control, or mitigate HABs, the monitoring program will generate the data necessary to inform management actions, as well as track changes in water quality following management actions. An

overview of the recommendations from the FHAB Monitoring Strategy is provided below.

Recommendations

1. Implement comprehensive statewide monitoring program

California would benefit from a comprehensive monitoring program following the recommendations within the FHAB Strategy. Coordination should occur across Water Boards divisions and among partnering entities.

The program should include field surveys to assess HAB status focused on human health, assessment of long-term data for trends, focused assessment of drivers of HABs to inform prevention and mitigation, and synergy with the existing incident response program.

2. Implement Partner Monitoring Program

California would benefit from promoting and supporting local level HAB monitoring efforts by establishing a shared monitoring framework and leveraging resources. This FHAB program is envisioned to involve the Water Boards as the primary coordinating agency with multiple partner entities including tribes, local environmental health departments, parks departments, drinking water agencies, private waterbody managers, scientific non-governmental organizations (NGOs) and community science groups. To implement a successful partner monitoring program, the FHAB Program would need resources to a) coordinate and train partner entities and to ensure data meets minimum quality metrics and is shared rapidly with the Program, b) supplies and equipment to support equitable participation of groups in disadvantaged communities, and c) expansion of the HAB data system to ingest, store, analyze, and publish partner monitoring data.

3. Strengthen Remote Sensing

The Water Boards recommend making strategic investments to strengthen California's partnership on remote sensing to capitalize on cost-effective and complementary information that it provides to field-based assessments of FHAB status, trends, and drivers. Remote sensing is a cost-effective and complementary approach to field-based assessments of FHAB status, trends, and drivers.

The Water Boards have already made strategic investments to capitalize on federally curated HAB remote sensing products (specifically satellite imagery) for large lakes and reservoirs; these data are provided through a web based FHAB satellite tool. . . The existing web based FHAB satellite tool provides pre-processed satellite imagery data provided by federal agencies that only includes a subset of the available data. Specifically, investments were made when pre-processed data from a single satellite was available and the FHAB Program has not had the resources to integrate satellite imagery made available in the last couple of years that would significantly increase

spatial coverage of CA from approximately 250 lakes to 1000s of lakes and, for the first time, include rivers.

Satellite imagery could be implemented more comprehensively in the FHAB monitoring program with strategic investments, including standardized protocols and quality assurance and control; data communication, accessibility, visualizations, and reporting that can increase the utility of the program for the Water Boards and their partners; and technological improvements that can greatly expand the number and completeness of waterbodies characterized. Further utility of the remote sensing in combination with monitoring to track long-term changes in waterbodies would enhance the California's ability to better prioritize and identify those waterbodies at risk.

13182.a.3. Risk Assessment

Determine the regions, watersheds, or waterbodies experiencing or at risk of experiencing harmful algal blooms to prioritize those regions, watersheds, or waterbodies for assessment, monitoring, remediation, and risk management.

Identifying and Prioritizing At-Risk Areas

As it is early in program implementation, risk assessment activities have been limited to where resources are available, and opportunities exist to leverage existing monitoring efforts. Some small-scale assessments, usually focusing on one or two waterbodies, have been completed a few regions. Most have been exploratory studies identifying the risk of HABs in a water body, using passive sampler technology to better understand benthic HABs, or leveraging collaborations with research institutions. A conceptual model for risk development is included in FHAB Monitoring Strategy. The model lays out the foundation of a risk assessment tool to support identification of at-risk areas statewide.

It is important to leverage the FHAB Monitoring Strategy to adequately determine waterbodies and watersheds at risk and to provide data into forecasting models and tools. As such, a comprehensive evaluation of satellite imagery and tools should be completed to determine waterbodies that are impacted by HABs. The Water Boards should explore the ability to use other satellite tools to evaluate smaller waterbodies and the cost effectiveness of employing these tools as recommended by the FHAB Monitoring Strategy.

The status and trends assessments of HAB impacts to beneficial uses such as swimmable, fishable, raw water, tribal and cultural uses, and aquatic life to characterize HAB risk requires repeat sampling and dedicated resources. The prioritization of monitoring resources to identify waterbodies at risk is a common challenge among state, regional, and local agencies and organizations. Another integral component that has not been actively explored is identifying tribal, subsistence, environmental justice/disadvantaged communities for prioritization and including this metric for determining at risk waterbodies.

There is a need for a decision support tool that could support prioritization of monitoring of waterbodies experiencing or at risk of HABs. It could consist of a desktop tool that pools available monitoring and incident response data (site visits and remotely sensed) and shows predicted HAB risks where data are lacking.

Additional watershed or waterbody contextual information could be included to drive decision support. Standard and user defined thresholds or triggers could be used to evaluate the monitoring data, predicted HAB model responses, and other contextual information. The outcomes could be visualized as a map or as a ranked list of waterbodies or riverine segments for each of the factors of interest. Determining what factors should be considered needs to be defined by the Water Boards and partner entities, rather than some standardized index, because of significant differences in what is valued as ranking factors is different among local entities.

Recommendations

California would benefit from the dedication of additional resources to implement the FHAB Monitoring Strategy and to support monitoring studies to help define metrics for determining waterbodies at risk. Without this baseline data, the FHAB Program will not be able to plan programmatically to proactively collaborate with other programs and partners for protecting those waterbodies, especially for communities most reliant on those beneficial uses.

Management actions for prioritized areas

Currently, the FHAB Program prioritizes incident response and therefore lacks a nexus with other Water Board regulatory programs (TMDLs, biostimulatory conditions objectives, water rights, permitting, enforcement, Integrated Report) and divisions. The Water Boards needs standard language for permit provision to address monitoring and management for HABs and expertise for review of monitoring plans and reports. Additional resources are also needed to address drought and climate change that trigger HAB response. Dedicated staff resources are needed for data sharing, updates to new FHAB data system to intake data, and a funding platform to support a laboratory contract for HAB analysis which can be upwards of nine hundred dollars a sample.

Addressing HAB-impacted waters currently does not have dedicated funding and it is rare for mitigation projects to be implemented. With drought conditions and increasing impacts from climate change, HABs will not resolve naturally and are predicted to get worse.

Recommendations

California would benefit from dedicated resources for mitigation and remediation opportunities for HAB-impacted waterbodies, employing new technologies, as well as developing case studies to represent unique ecoregions and biology of California. One proposed concept could include a Water Boards grant reimbursement program. This program could assist counties and researchers in employing new mitigation technologies and the associated monitoring costs. Facilitating mitigating projects would

ensure the Water Board's is purview to new technologies, effectiveness, and support improved water quality.

13182.a.4 Research and Tools

Conduct Applied Research and Develop Tools for Decision-Support

The FHAB Program leverages satellite imagery data available from federal agencies. With this data, Water Boards and a contractor developed a [web-based FHAB satellite tool](#) that displays remotely sensed bloom data, which is used as a screening level analysis tool by the Water Boards and coordinating agencies. The satellite tool presents processed satellite imagery for approximately 250 waterbodies in California large enough to be detected by the satellite. The remotely sensed data can be used to support applied research and tool development such as informing risk models and status and trends assessments. The FHAB Program also allocates resources to streamline and standardize data evaluation and sampling procedures to ensure quality and comparable data.

Research studies were designed in the FHAB Monitoring Strategy to answer or inform specific technical questions that contribute to the design of the monitoring program, advance the development of a component of the monitoring program implementation (e.g., standardized operating procedures), or projects to improve the interpretation of core monitoring results. Special studies were prioritized based on three timescales ranging from immediate, near-term, and long-term and includes 33 studies that each cost several thousands to hundreds of thousands to implement once implementation of statewide monitoring is funded.

Recommendations

California would benefit from increased participation in state, national, and global research and agency groups to keep apprised of the growing science. This includes close coordination among Water Board Regional Boards, Divisions, researchers, and other state and federal agencies. Subject matter expertise is integral in developing tools, which includes conducting research and testing new tools.

California would also benefit from advancements in research and tools as prescribed by the FHAB Monitoring Strategy. To effectively digest and implement new research from the HAB research community and institutions, diverse technical expertise is needed, as well as an adaptive data system that expands California's ability to analyze and visualize data. Research studies are needed to better understand the drivers of blooms, sources, and causes. The data collected from these studies will be used to inform options for source control, restoration, or other actions to reduce frequency and extent of blooms. These studies would also benefit the management of drinking water reservoirs within the State Water Project (consists of 34 reservoirs and lakes and 701 miles of aqueducts) and water treatment facilities to enhance toxin-class based treatment options.

13182.a.5 Outreach and Education

Provide outreach and education and maintain a centralized internet website for information and data related to harmful algal blooms

The Water Boards continues to use the CA HABs Portal as an informational resource for the public and to support coordination with statewide partner entities to address FHABs. It contains the Web Map that is maintained by State Board staff, as well as several fact sheets to answer frequently asked questions by various audiences. The funded FHAB Coordinators have performed multiple targeted trainings this spring and developed a partner monitoring website as a central training hub. Funded FHAB Coordinators and State Board FHAB Program staff have presented at conferences and workshops, currently assisting in Delta HAB workshop development, participate in HAB-related meetings, and train internal staff. In addition, Water Boards staff have developed outreach pamphlets, flyers, videos, and presentation recordings to share with the public.

Recommendations

California would benefit from a continued focus on outreach strategies and education for the public. The public has only begun learning and understanding the threat of HABs, and it is important to have a consistent message while also promoting safe water recreation.

Additional multi-lingual outreach materials are needed, as well a distribution strategy that includes diverse media platforms. Beyond publicly available resources, outreach should be directed to ranchers; tribal liaisons; drinking water purveyors; national, state, and city parks; and disadvantaged communities; to name a few. In addition to developing materials, continuing outreach via conferences, workshops, and meetings are necessary to keep agency, the public, and other entities informed as to the FHAB Program, resources available, and enlist new partners. Additional visual storytelling about HABs should be developed to clearly convey information about HABs, where they are located, and how to stay safe. And lastly, there needs to be more focused media and press releases for the public and outreach through media outlets to ensure multiple avenues of public outreach.

Key Legislative Component: 13182.a Consultation

Consult with the CWQMC, OEHHA, CDPH, DWR, CA DFW, Dept. of Parks and Recreation, other appropriate state agencies, and CA Native American tribes

The State Board FHAB Program staff collaborate with other state and federal agencies. But it should be noted that many of these agencies do not have dedicated HAB staff or staff with expertise directly related to HABs, and so there is often a disconnect in communications and in implementation of efforts. This is imperative to ensure consistent and coordinated approaches to address HABs. In cases where there is in-house expertise, there is often just one staff member, which creates challenges to implement the many tasks that are necessary for this ever-growing program. There has been opportunistic outreach and or collaboration with many of the above listed entities

but limited in targeted outreach. In addition, opportunistic collaboration is temporary and requires formal agreements, such as memorandum of understandings, to work towards shared goals. With a lack of a formal mechanism to encourage communications and collaborations, monitoring data and reports of HAB events are not readily shared amongst agencies and transparent to the public. In addition, without effective collaborations, there is no consistent use of a singular methodology for sample collection and analysis; comparable data is essential for data analysis to inform several objectives in AB 834. The FHAB Program has developed and published standard operating procedures (SOPs) for sample collection and analysis. With additional support, more routine, statewide trainings could be performed with certifications for those trained on FHAB Program SOPs.

Consultation with key federal water managers is challenging due to lack of staff and resources to address HABs. For example, US EPA published in 2019 [Recreational Water Quality Criteria or Swimming advisories for Two Cyanotoxins](#). However, federal water managers in California lack the resources to implement monitoring of the two cyanotoxins to determine if the water quality criteria are met during the recreational season or even year-round in some areas. In addition, several reservoirs do not have routine monitoring for these cyanotoxins or have recreational HAB alert signs that deviate from the standardized framework under the [Eight Step Voluntary Response Plan](#) (Voluntary Response Plan), which results in inconsistent public health notification and messaging.

Private water systems are also at risk as they are not regulated by the CA Water Boards Division of Drinking Water (DDW) and local agencies do not have dedicated staff and resources to respond to potential impacts of HABs. These cases involve a water system that has less than 20 connections; therefore, local agencies regulate these systems. To support actions by local agencies, dedicated funding is necessary for monitoring of private water systems and, when necessary, to provide alternative potable water supply in emergencies. In 2021, Lake County issued a do not drink order for households and businesses on private water systems that source water directly from Clear Lake. The Water Boards were diverted to quickly coordinate with local agencies to fund the distribution of emergency potable water supply in the form of bottled water for approximately two months. The order was informed by an opportunistic study conducted in partnership with the FHAB Program during the peak HAB season to detect potential impacts to normally unmonitored water systems. This study only has temporary funds to extend through 2022. This case in Lake County highlights the under monitoring of potential health risks of private potable water systems nearby HAB impacted lakes in the state and need for resources and staff to rapidly provide emergency potable water supplies during an advisory.

Drinking water concerns extend beyond Clear Lake. The FHAB Program received requests for assistance by two counties and a tribe in the Central Valley with concerns of private water systems with direct water intakes being impacted by HABs in the last

year. They requested our expertise in sample collection (both raw and finished water), analyses, and interpreting results to best inform residents of potable water safety.

Within the CA Water Boards that spans nine regions, there are also challenges to collaborate to meet the legislative objectives. There often lacks cross-coordination with other agency field offices, where regional expertise and knowledge would be an asset in addressing HABs. Tasks include attending local waterbody/watershed meetings, reviewing documents regarding HAB monitoring requirements, and/or providing expertise in the development of such requirements.

The State Board has recently adopted new beneficial water uses specific to CA native tribal, cultural, and subsistence uses. To identify relevant waterbodies across the state to adopt these uses, targeted engagement is needed to ensure those uses are protected from HABs. This also includes coordination with tribes to gain better insight as to waterbodies of cultural significance to prioritize HAB monitoring and collection of data to inform a cultural use exposure assessment to develop appropriate protective thresholds.

Recommendation

Addressing HABs extends beyond the FHAB program and collaboration, and coordination is paramount to successfully implement all the requirements of AB 834. California should support a more extensive FHAB Program across the state.

Programmatic Recommendations

Centralized website and data management

Dedicated data science staff are recommended in the FHAB Program for data base design, development, management, and analysis to populate the Web Map. In terms of data infrastructure, the new modern FHAB data system will need to be expanded to include the additional modules to facilitate programmatic expansion, as well as maintenance and updates.

An additional component to meet the needs of the AB 834 is to standardize and validate laboratory methods to meet the data management requirements of regulatory programs. For example, many regulatory programs prioritize use of data from methods accredited by the Ca Environmental Lab Accreditation Program. With this, additional contract funding will be necessary to support new laboratory method technologies for HABs.

FHAB Program Infrastructure

With the expansion of the FHAB Program to implement AB 834, additional infrastructure and work planning is recommended to house, evaluate, and track success of the FHAB Program. This includes developing performance measures and coordination with other divisions and programs to ensure common goals and reporting metrics are developed to adaptively manage the FHAB Program. To support a successful FHAB Program, there is a need to train new staff, develop training materials for internal staff, manage staff and workloads, develop workplans, and develop legislative and programmatic reports.

Although the FHAB Program has been funded for one-year, additional administrative support services are recommended to support the program. The FHAB Program receives seven hundred and fifty thousand dollars per year. Most of those funds are encumbered into contracts which require support services that includes contract development, management of deliverables, invoice payment, and detailed tracking of funds. The FHAB Program also orders multiple supplies, including field equipment, sampling kits to share with partners, and other programmatic materials adding additional logistics and administrative workload. These orders must go through procurement and then must be tracked for supply distribution.

In Closing

In one year, the five dedicated FHAB Program staff and Regional Board FHAB Coordinators have successfully undertaken response to over six hundred incident reports and continued to build out partnerships to strengthen the program. At the current resource level, the program is envisioned to grow slowly over the next five years, with effort continuing to be primarily focused on metered incident response to protect public health and voluntary support from regional boards without dedicated FHAB program funding.

With the rising reports of HABs across California, and unknown consequences of long-term climate change, California's need for an expanded FHAB program is at a critical juncture. To fully realize the objectives of AB 834 as well as further enhance California's ability to protect its people, action must be taken to allow for enhancement and expansion of the program, including formalized partnerships with other agencies and integration into other Water Boards programs for determining FHAB impairments and informing regulatory measures to prevent and address FHAB impairments.

Appendix A: Freshwater and Estuarine Harmful Algal Bloom (FHAB) Program Gap Assessment for Regional Board and State Board Divisions

Introduction

Until 2016, there were no organized efforts by the State Water Resources Control Board (State Board) to address FHABs through a new or existing programs inherently due to lack of any dedicated funding. To begin addressing the issue of the increasing occurrence and prevalence of FHABs in surface waters, the Surface Water Ambient Monitoring Program (SWAMP) at the State Board developed the FHAB Strategy. They also began coordinating efforts and temporarily diverted resources in 2016 from existing SWAMP programmatic areas to address FHABs. This SWAMP effort that began in 2016 accomplished several key infrastructural and coordination milestones that have enabled the State Board to begin to protect public health by informing citizens of risks associated with HABs and identify water quality conditions degraded by HABs. Although a step in the right direction, this SWAMP effort was not formally staffed or funded and lacked support to fully address the complexity and growing prevalence of FHAB incidents across the state.

[Assembly Bill No. 834 \(AB 834\)](#) was approved by the Governor September 27, 2019, requiring the State Board to establish a Freshwater and Estuarine Harmful Algal Bloom Program to protect water quality and public health from HABs. The fiscal year 2020/2021 budget act authorized five new staff positions and \$750,000 in annual contracting funds. The staff positions were filled by June 2021 and are distributed among the State Board (2 positions) and three Regional Boards (1 position each at Regional Board: 1 [North Coast], 5 [Central Valley], and 6 [Lahontan]). These positions provide the initial resources for effective regional incident response, data collection, coordination with relevant agencies, advisory posting, and communication of public and environmental health data. It is important to note that the other six regional boards that did not receive a funded position voluntarily respond to HAB incidents when they are able, although it often impacts other priority Water Board programs and projects.

Gap Assessment Process

Although dedicated resources are now allocated to the FHAB Program, there are still resource gaps to meet all the AB 834 requirements. To clearly identify and characterize what the gaps are, State Board FHAB Program staff reached out to the nine Regional Boards and to State Board Divisions including Department of Water Quality, Division of Water Rights, Division of Drinking Water, Division of Financial Assistance, and Division of Information Technology in a series of meetings in the spring of 2022. In these meetings, State Board FHAB Program staff introduced the new FHAB Program, shared the AB 834 requirements and nexus to Water Board and Regional Board Programs, and requested input on needs from these groups on what additional resources would be necessary to conform to the AB 834 requirements.

The input from the Regional Boards and State Board Divisions was collated into categories based on the AB 834 requirements. It was further reviewed by the State Board Divisions and Regional Boards to ensure that all data was accurately captured. The information received from the Regional Boards is shown in [Table 1](#) and [2](#). Table 1 provides qualitative information as to resources needed and Table 2 provides the associated numeric staff and contract resources. [Tables 3](#) and [4](#) provide similar information based on Water Board Division input.

Table 1. Regional Board input received during the gap assessment process as organized by AB 834 requirement. For Reference: RB 1: North Coast; RB 2: San Francisco Bay; RB 3: Central Coast; RB 4: Los Angeles; RB 5: Central Valley; RB 6: Lahontan; RB 7: Colorado; RB 8: Santa Ana; RB 9: San Diego

Water Code	Description	
13182.a	Consult with the CWQMC, OEHHA, CDPH, DWR, CA DFW, Dept. of Parks and Recreation, other appropriate state agencies, and CA Native American tribes	
Regional Board	PY/\$	Resources Necessary
RB 1	PY	Expand consultation and coordination with agency and tribal partners, review state-wide documents, and attend state-wide meetings. Work with heads of agencies (CDFW, NOAA, OEHHA) and Tribes to further program development and monitoring.
RB 3	PY	Improve coordination with CWQMC, OEHHA, CDPH, DWR, CA DFW, Dept. of Parks and Rec, other appropriate state and federal agencies, and CA Native American tribes. Including follow up with agencies regarding results and risks.
	PY	Initiate tribal consultation/coordination efforts – this will likely be a heavy lift since our region has had very little engagement with tribes
	PY	Develop Permit requirements: e.g., wastewater treatment discharges (NPDES), ILP (Ag Order), 401s, NPS, WDRs, etc.
	PY	Attend meetings and review documents
RB 8	PY	To ensure successful coordination with local, state and federal agencies, as well as other interested parties, RB8 shall maintain dedicated staff that manages the FHAB program. The employees shall be familiar with the reporting requirements of the FHAB program, have experience investigating and responding to HABs, and will continue to consult and coordinate with outside agencies, when appropriate.
RB 9	PY	Consult and coordinate with local partners, review documents, and attend meetings
	PY	Coordination with relevant entities for San Diego Basin Plan updates for tribal and subsistence uses

Water Code	Description	
13182.a.1	Coordinate immediate and long-term event incident response, including notification to state and local decisionmakers and the public regarding where harmful algal blooms are occurring, waters at risk of developing harmful algal blooms, and threats posed by harmful algal blooms.	
Regional Board	PY/\$	Resources Necessary
RB 1	PY	Continue to provide rapid incident response for all reported blooms, including reviewing and validating reports, coordinating with interagency task force, coordinating field investigations, and recommending postings
	PY	Expand the facilitation and coordination of waterbody specific partnerships for immediate response actions. Develop long-term response plans and programs with partners and secure funding for monitoring and lab analysis. Partnerships include County Health Departments, Division of Drinking Water, Non-Governmental Organizations, and Tribal Governments.
	\$	Sampling supplies and laboratory analysis
RB 2	PY	Triage and respond to short-term incidents via outreach and coordination with landowners (~20) and field sampling (~10) each year and regularly update statewide incident database
	PY	Continue to sample long-term incident sites until HABs subside (~5 sites per year) and regularly update statewide incident database
	\$	Laboratory analysis
	PY	Public notifications: assistant land managers to enter routine monitoring data into updated statewide FHAB data system; coordinate with local landowners and/or county to post public notification signage based on CCHAB Network human health trigger levels; and coordinate with State Board FHAB staff and OPR on press notifications of HAB incidents
RB 3	PY	Increase coordination and outreach to partners (counties, agencies, waterbody managers, landowners, water districts, general public/reporting parties, etc.) to increase regional awareness and facilitate more immediate and ongoing response and timely notification of risks.
	PY	Increase sampling frequency and expand ambient monitoring scope to determine waters at risk and provide consistent and long-term incident response throughout advisory periods
	PY	Develop and provide training opportunities for staff, agencies, partners, public, etc.

	PY	Take more of a lead role for coordinating incident response and data management tasks including reviewing and verifying reports and updating information on web map (SB has been supporting/leading much of these efforts in recent years)
	\$	Need to secure dedicated and sustainable lab funding for analysis (e.g., not SWAMP Regional Allocations or Discretionary funds)
RB 5	PY/\$	Support the streamlining and partial automation of HAB incident response coordination
	PY/\$	Create a set of resources for small or private waterbody owners covering the basics of HAB ecology and formation, the risks of HABs, and an overview of mitigation option (also addresses 13182.a.5)
	\$	Increase monitoring and outreach partnerships in the northern and southern portion of region 5 where there is currently a deficit of information and many rural and disadvantaged communities
	\$	Laboratory analysis
RB 6	PY	Water quality monitoring at priority recreation sites associated with AB 1066
	\$	Laboratory funding for sample analysis
RB 8	PY/\$	Resources to investigate reports of potential HABs through sampling and onsite reconnaissance; funding for lab analysis and monitoring equipment supplies
	PY	Coordinate with land and or water managers, notify local, state and/or federal agencies; update FHAB data system that populates HAB Incident Reports web map; and consult with local agencies for physical advisory sign postings
RB 9	PY	Resources to respond to incidents/complaints, including coordination with local decision makers/responsible parties
	\$	Laboratory analysis for samples collected for incident response

Water Code	Description	
13182.a.2	Conduct and support field assessment and ambient monitoring to evaluate harmful algal bloom extent, status, and trends at the state, regional, watershed, and site-specific waterbody scales	
Regional Board	PY/\$	Resources Necessary
RB 1	PY/\$	Expand working with partners to develop Monitoring and Response Plans for rivers that experience annual HABs. The goal is for these plans to eventually be implemented by local partners using their funds, however, at present time most

		of our local partners do not have sufficient staff or resources to support monitoring and response so they responsibility falls on regional staff.
	PY	Implement ambient monitoring through the FHAB Program as outlined in the Strategy for Freshwater Harmful Algal Bloom Monitoring (2021). This monitoring would complement bloom response and partner monitoring to generate more complete data sets for assessment.
	PY	Data analysis, interpretation, and reporting of findings to better characterize the timing, extent, and risk of benthic cyanobacteria within the region
	PY	Review decision support tools for remotely sensed satellite data, support field verification efforts of remotely sensed algorithms, review metrics for satellite data, and explore high resolution satellite imagery
	\$	Monitoring and assessment of HABs
	\$	Monitoring supplies and laboratory analysis
	\$	Perform special studies and/or support new research methods
RB 2	PY	Conduct holiday sampling at 5-10 freshwater sites 3 times per year
	PY	Conduct rotating annual ambient monitoring projects, for example: <ul style="list-style-type: none"> • assess high recreation freshwater sites that are not monitored by other agencies (~10 stream and reservoir sites per sampling year) • assess FHAB and nutrient levels at reference stream sites (~20 sites) • collect samples and work with community members in high recreation areas in environmental justice communities (~5 sites bi-monthly during high incident period) assess if FHABs are moving downstream of reservoirs into streams (~5 sites bimonthly grab samples during high incident period or SPATT bag deployment)
	PY	Conduct monthly mussel toxin & nutrient monitoring at 10-15 sites around the Bay margin
	PY	Leverage new sampling opportunities with externally funded monthly nutrient, phytoplankton, HAB taxonomy, and HAB toxin data collection
	\$	Laboratory analysis for cyanotoxins, nutrients, and mussel toxins
RB 3	PY	Need dedicated staff/personnel to conduct field assessments, design appropriate special studies, look for opportunities to coordinate and leverage and/or augment other monitoring efforts in region, lead data management efforts (e.g., compile, evaluate, analyze, and interpret data), develop reports/presentations, etc.
	PY	Develop a robust partner monitoring program and increase coordination with partner agencies to implement ambient monitoring at a much broader spatial scale across the region.
	PY	Provide more support and facilitate better coordination with partners for sample collection, sampling materials, trainings, data sharing, etc. (R3 staff conducts bulk of monitoring in our region).
	PY	Offer and lead field and health and safety trainings - staff, agencies, public, etc. (both online modules and in person/field-based training options).
	PY/\$	Increase monitoring frequency and expand scope to include additional riverine/stream and estuarine/marine HAB assessments.
	PY/\$	Incorporate HABs monitoring into other Statewide monitoring programs (e.g., BOG, Tox, PSA/RCMP, etc.).

	\$	Additional funding required for lab analysis to focus on ambient/trend monitoring AND to address special studies.
	\$	Additional funding to support partners and cover monitoring expenses (materials, lab analyses, etc.).
RB 4	\$	Contract for ambient assessment of freshwater HAB species and toxins in marine ecosystems
	PY	Manage contract for ambient assessment
RB 5	PY/\$	Create a fully fleshed out partner monitoring program including recruiting, training, and supporting partners and purchasing, creating, and updating materials
	PY	Increase monitoring and outreach partnerships in the northern and southern portion of region 5 where there is currently a deficit of information and many rural and disadvantaged communities
	PY/\$	Create a formal program and funding mechanism for providing support to a wide variety of monitoring organizations including entities that serve disadvantaged communities, rather than selecting organizations in an ad-hoc manner (also addresses 13182.a)
	PY	Coordinate with other Central Valley Water Board programs so relevant HAB and HAB driver information may be incorporated into their work
	PY	Implement ambient monitoring through the FHAB Program as outlined in the Strategy for Freshwater Harmful Algal Bloom Monitoring (2021). This monitoring would complement bloom response and partner monitoring to generate more complete data sets for assessment
	PY	HAB monitoring requirements into relevant permits
RB6	PY/\$	Data analysis, interpretation, and reporting of findings specifically for regularly monitored waterbodies and special studies
	PY/\$	Create a fully flesh out a partner monitoring program including recruiting, training, and supporting partners and purchasing, creating, and updating materials
	PY/\$	Support for SB staff time to find and distribute HAB monitoring programs, funding opportunities, and mitigation control measures across the State. Widely distribute funding opportunities through lyrics list or create a page on the website
RB 8	PY/\$	Use remote sensing platforms to develop monitoring response plans
	PY/\$	Conduct field assessments and ambient monitoring of waterbodies where potential HABs can negatively impact beneficial uses, including, but not limited to, recreation and drinking water supplies; resource needs include laboratory analysis, maintenance of monitoring equipment, and SPATT bad deployment
	PY/\$	Conduct pre-holiday assessments three times per year
RB 9	PY	HAB monitoring requirements into relevant permits (e.g. agricultural WDRs)
	PY	Resources for conducting ambient monitoring at priority water bodies in the region
	\$	Perform special studies and/or support new research methods
	\$	Conduct monitoring of various water body types throughout the region; focus on priority waterbodies (streams, wetlands, etc.) and perform trend and condition monitoring

	PY	Support having reservoir owner/operators being responsible for reservoir monitoring and Water board staff reviewing data
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Water Code	Description	
13182.a.3	Determine the regions, watersheds, or waterbodies experiencing or at risk of experiencing harmful algal blooms to prioritize those regions, watersheds, or waterbodies for assessment, monitoring, remediation, and risk management.	
Regional Board	PY/\$	Resources Necessary
RB 1	PY	Determine at-risk watersheds and/or waterbodies that experience HABs and prioritize their monitoring, and support development of tools to determine at-risk waterbodies
	PY/\$	Expand pre-holiday assessments for Memorial, Independence, and Labor Days
	PY	Fieldwork assistance to collect nutrient samples and ancillary/appropriate environmental data
	PY	Develop TMDLs, to help develop permitting conditions, as well as work on planning and the impacts of climate change
	PY	Participate in the review of biostimulatory conditions objective and advise on objective development
	PY	Determine how water rights and flow conditions contribute to water quality issues such as HABs
	\$	Risk Assessment: nutrient, flow, shade, and hydrology data collection to better understand the role of biostimulatory conditions on benthic cyanobacterial growth and assess risk for various waterbodies
	\$	Sampling supplies and laboratory analysis
RB 2	PY	Use spatial tools to identify small lakes in our region, determine landowners, and create a database for future outreach, sampling, or incident response (overlap with §13182.a.4)
	PY	Complete a thorough assessment of high recreation water bodies in our region for holiday and ambient monitoring
	PY	Compile and review past reports from the SFEI satellite analysis tool to identify hot spots, create reports, and notify landowners
	PY	Work with OIMA and contractors to develop high resolution satellite imagery data for smaller waterbodies not assessed with the SFEI satellite analysis tool
	PY	Conduct monthly mussel toxin & nutrient monitoring at 10-15 sites around the Bay margin
	PY	Leverage new sampling opportunities with externally funded monthly nutrient, phytoplankton, HAB taxonomy, and HAB toxin data collection
	\$	Contract funding to UCSC and SFEI to maximize and further develop tools
RB 3	PY	Identify and prioritize regional watersheds, or waterbodies experiencing or at risk of experiencing HABs for assessment, monitoring, remediation, and risk management
	PY	Develop tools to better represent and evaluate smaller/shallower waterbodies more accurately

	PY	Develop tools to conduct spatial and land use analysis (modeling?) to identify additional environmental factors that contribute to or increase risk of HABs in various watersheds
	PY	Strategies for determining waterbodies that might be at risk for HABs that are located on tribal lands or in EJ/DAC areas in our region
	PY	Dedicate resources for exploring mitigation and remediation opportunities for high-risk waterbodies
	PY	Develop a consistent way to address private waterbodies or various "water features" that exist on private properties where we do not have jurisdiction
	PY/\$	Increase response to HAB incident reports and conduct follow up monitoring
	PY/\$	Expand holiday assessments and ambient/trend monitoring opportunities
	PY	Integrate HABs monitoring into programmatic workplans and regulation (IR, TMDL, NPS, Basin Planning, AG/ILP, Permits, 401, WDR, etc.)
	\$	Provide dedicated funding to incentivize more frequent monitoring by waterbody managers/partners to alleviate some of the cost burden
	\$	Provide funding to address site specific issues and support remediation efforts
RB 5	PY/\$	Assess which CA waterbodies are naturally eutrophic as opposed to those influenced by cultural eutrophication to guide management prioritization (also addresses 13182.a.4)
	PY	Identify tribal and disadvantaged community areas that may be at increased risk from HAB effects
	PY/\$	Funding and time for Solid Phase Adsorption Toxin Tracking (SPATT) materials and SPATT lab analysis to further our understanding of benthic cyanobacteria in Foothill rivers and help prioritize monitoring in this area of our region
	PY	Resources to integrate HABs into Regional Board Programs (e.g. 401 certs, NPS, TMDLs, Basin Planning, IR, permitting, enforcement)
RB 6	PY	Evaluate and develop Basin Plan amendments to include mitigation measures for HABs
	PY	Evaluate existing statewide permits and develop region-wide permits and/or updates to 401 water quality certifications for mitigation measures for HABs
	PY	TMDL development for water bodies/watersheds with HABs
	PY	Incorporate objectives for cyanotoxins and other biostimulatory chemicals into Basin Plan
	PY	Process HAB related data for the Integrated Report that informs 303 (d) List of Impaired Water
	PY	Manage and support HAB related contracts
	PY	Enforce permit requirements related to monitoring and preventing HABs
	PY	HAB data entry into SWAMP database
	PY	Review CEQA documents for projects proposed in at-risk water bodies for HABs
	\$	Data analysis and reports on special studies
RB 7	PY/\$	Evaluate up to 30 candidate sites for a comprehensive assessment and follow-up monitoring to further determine risk and/or impairment

RB 8	PY/\$	Develop monitoring plans and perform field assessments for waterbodies that have been identified to have reoccurring HABs to evaluate environmental conditions and trends
	PY	Work with permitting staff to update requirements to include mitigation for HABs or prevent conditions that contribute to HABs
	PY	Collaborate with interested agencies and the public to ensure recreators are informed when blooms occur and are educated on the risk of HABs.
	PY	Work with Replenish Big Bear staff to conduct monitoring to determine if recycled water discharges are contributing to HAB abundance and severity
RB 9	PY	Resources to incorporate this type of monitoring into regular monitoring assessment programs
	PY	Need to identify tribal, subsistence, environmental justice/disadvantage communities and areas that are at risk
	PY	Resources to integrate HABs into Regional Board Programs (e.g. 401 certs, NPS, TMDLs, Basin Planning, IR, permitting, enforcement)

Water Code	Description	
13182.a.4	Conduct applied research and develop tools for decision-support	
Regional Board	PY/\$	Resources Necessary
RB 1	PY	Expand participation in FHAB, USEPA Benthic Work Groups, and CCHAB and its subcommittees to further develop benthic cyanobacteria program and research
	PY	Expand development of benthic signage, sampling SOPs, visual guides, and various research projects such as using SPATTs and eDNA
	PY	Expand coordination with State Board on press releases, training and outreach, webmap updates, and disseminating signs and sampling supplies
	PY	Explore utility of high spectral resolution satellite imagery for detecting benthic mats in rivers and identifying toxigenic cyanobacteria genera in all waterbody types
	PY	Support development of tools for case management, data analysis, and visualization
	PY/\$	Support research for determining toxins of concern and associated threshold for protection of different beneficial uses
	\$	Funding for additional Solid Phase Adsorption Toxin Tracking (SPATT) and SPATT lab analysis to further and strengthen our knowledge regarding the applicability of SPATTs as a proactive trigger tool for initiating additional monitoring tools and techniques
RB 2	PY	Support and engage with statewide FHAB efforts to develop new decision tool
	PY	Work with the Integrated Report roundtable, Basin Planning roundtable, OEHHA, and CCHAB team to develop evaluation thresholds
	PY	Work with NOAA and CA HABs map https://calhabmap.org/ steering committee and membership to develop coastal HAB modeling and warning tools
RB 3	PY/\$	Design and implement special studies that augment and leverage other types of monitoring conducted in region

	PY	Increase data collection and integration from various sources (internal and external partners, other agencies, etc.) and compile into comprehensive/centralized or compatible system (e.g., SWAMP/CEDEN, FHAB data system, etc.)
	PY	Work with subject matter experts/specialists to conduct research and perform scientific literature review
	PY	Work with internal groups/departments and partner agencies to develop/identify specific thresholds/evaluation criteria for assessments (support Integrated Report, TMDLs, Permits, etc.)
	PY	Ensure data/information is shared with all applicable programs, roundtables, workgroups, etc. (e.g., Integrated Report, TMDL, Permits, etc.)
	PY	Develop and refine data analysis and visualization tools, conduct more “ground truthing” studies
	\$	Dedicated funds to conduct research and create opportunities to work with contractors to develop said tools
RB 5	PY/\$	Coordinate with relevant teams to understand and address HABS’ impacts on tribal beneficial uses
	PY/\$	Support and/or conduct research into HAB controls and mitigation
	PY/\$	Funding for additional Solid Phase Adsorption Toxin Tracking (SPATT) and SPATT lab analysis to further and strengthen our knowledge regarding the applicability of SPATTs as a proactive trigger tool for initiating additional monitoring tools and techniques
	\$	Convene a scientific panel to obtain guidance on performing relevant statistical analyses and modeling of HABS and HAB driver data
RB 6	PY/\$	Contract funding and personnel time to support new areas of investigations and application of new control technologies
	PY/\$	Help improve the use of satellite tool within small waterbodies, and high elevation lakes
RB 8	PY	Review results from special study conducted from 2021 to 2022 and summarize conclusions and next steps. Collaborate with other interested parties and share results of study.
	PY/\$	Develop and implement a HABS special study for the Big Bear watershed that evaluates sources of nutrients or other biostimulator constituents that can impact HABS in Big Bear Lake. Conclusions from the study will be used to inform revisions to the nutrient TMDLs for Big Bear Lake.
	PY/\$	Develop special study to determine the impact on HABS of the addition of recycled water to Big Bear Lake. Collaborate with other interested parties to use models to predict the impacts to the Lake.
	PY/\$	Develop special study to assess the impact of in-lake best management practices in use at Lake Elsinore on HAB abundance. Collaborate with TMDL Task Force to combine sampling efforts and utilize group expertise
RB 9	PY/\$	Conduct research and test new tools
	PY/\$	Support research for determining toxins of concerns and associated thresholds for protection of different beneficial uses
	PY	Conduct research on internal lab analysis screening capabilities

Water Code	Description	
13182.a.5	Provide outreach and education and maintain a centralized internet website for information and data related to harmful algal blooms	
Regional Board	PY/\$	Resources Necessary
RB 1	PY	Conduct outreach and develop new partnerships
	PY	Expand HAB trainings for regional partners, statewide agencies, and the public
	PY	Support production of physical and digital outreach content for distribution
RB 2	PY	Conduct outreach and develop relationships with land managers (e.g., cities, water districts, park districts) to provide trainings (e.g., FHAB identification, sample collection, database input)
	PY	Conduct outreach and develop relationships with environmental and watershed community groups to provide resources (e.g., lab sampling) and trainings (e.g., FHAB identification, sample collection)
	PY	Work with the Water Board tribal liaisons to provide resources to local tribes and to sample culturally significant sites
	PY	Work with local RCDs and the Water Board grazing and CAF permit programs to provide resources for ranchers about FHAB risks in stock ponds
	PY	Coordinate a region-wide conference to discuss HAB science, monitoring, and mitigation
	PY	Provide HAB identification and management resources to marina managers and harbor masters
	PY	Summarize HABs information for public consumption on the Water Board portal, NMS stakeholder group, and Regional Water Board website.
	PY	Present on HABs at conferences (e.g., Delta RMP, Bay RMP, Bay-Delta IEP)
	PY	Work with CDPH and shellfish harvesters to communicate monitoring information and risks to the public
	PY	Work with NMS Steering Committee and stakeholders to integrate monitoring under this position with existing efforts
	PY	Develop a technical advisory committee to improve study design and develop robust data analysis techniques
	PY	Share HAB decision tools, management via CA HABsmap (https://calhabmap.org), NOAA partners, other coastal regional Water Boards
	\$	Develop Technical Advisory Committee with a focus on estuarine HABs
RB 3	PY	More consistent messaging for press & social media notifications, and coordinate state press release with local (Region specific) media
	PY	Ensure all internal applicable programs (Integrated Report, TMDL, Basin Planning, AG, Permits, etc.) know how to find and acquire data and information
	PY	Targeted outreach with partners, tribes, DACs, various lyrics lists, etc.
	PY	Host local workshops for partner agencies and the public and offer training/guidance materials upon request
	PY	Provide physical and digital outreach content for distribution
	PY	Develop maps/dashboards/etc. identifying risk information for local recreation areas/waterbodies (lakes, lagoons, beaches, etc.)
	PY	Link to HABs portal through relevant R3 website pages
	PY	Better coordination with drinking water purveyors

RB 5	PY/\$	Create a multi-lingual public outreach program at public recreation areas including national, state and city parks that experience HABs
	PY	Conduct outreach and develop relationships with land managers (e.g., cities, water districts, park districts) to provide trainings (e.g., FHAB identification, sample collection, database input)
	PY	Conduct outreach and develop relationships with environmental and watershed community groups to provide resources (e.g. lab sampling) and trainings (e.g. FHAB identification, sample collection)
	PY	Work with the Water Board tribal liaisons to provide resources to local tribes and to sample culturally significant sites
	PY	Coordinate a region-wide conference to discuss HAB science, monitoring, and mitigation
	PY	Provide HAB identification and management resources to marina managers and harbor masters
	PY	Present on HABs at conferences (e.g. Delta RMP, Bay-Delta IEP, CALMS)
RB 6	PY	Individual to attend and actively participate in TAC's that are in development to meet goals and tasks outlined in the Implementation Plan
RB 8	PY	Continue to conduct outreach and develop relationships with land managers to provide trainings. Provide assistance with interpretation of sampling results
	PY	Work with US Forest Service staff to discuss best management practice implementation to reduce nutrient/sediment load to Big Bear Lake to prevent biostimulatory substances that contribute to HABs occurrence and severity

Table 2. Associated resources needed for Regional Boards to implement tasks identified in Table 1.

Regional Board	Resources Necessary	
	Permanent Full-Time Staff (PY)	Annual Contract Funding
RB 1	2 (1 ES/ 1 Senior ES Specialist)	\$75,000
RB 2	2 (1 ES / 1 Senior ES Specialist)	\$460,000
RB 3	3 (2 ES/1 Senior ES Specialist)	\$35,000
RB 4	0.1	\$50,000
RB 5	2 (1 ES / 1 Senior ES Specialist)	\$250,000
RB 6	1	\$70,000
RB 7	0.2	\$20,000
RB 8	2 (1 ES / 1 Senior ES Specialist)	\$175,000
RB 9	0.5	\$30,000
TOTAL	12.8 PY	\$1,165,000

Table 3. State Board Divisions input received during the gap assessment process as organized by AB 834 requirement. For Reference: Division of Information Technology: DIT; Division of Water Rights: DWR; Division of Water Quality: DWQ; Division of Drinking Water: DDW; Division of Financial Assistance: DFA; Water Board (general): WB

Water Code	Description	
13182.a.1	Coordinate immediate and long-term event incident response, including notification to state and local decisionmakers and the public regarding where harmful algal blooms are occurring, waters at risk of developing harmful algal blooms, and threats posed by harmful algal blooms.	
Water Board	PY/\$	Resources Necessary
DDW	PY	Dedicated personnel for coordination in HAB incident response
DFA	PY/\$	Bottled water for private water systems (not regulated by DDW including tribes) affected by HABs

Water Code	Description	
13182.a.2	Conduct and support field assessment and ambient monitoring to evaluate harmful algal bloom extent, status, and trends at the state, regional, watershed, and site-specific waterbody scales	
Water Board	PY/\$	Resources Necessary
DIT	PY	Update and maintain data infrastructure to house and maintain partner monitoring program
DWQ	PY	Coordination to integrate cyanotoxin water quality objectives into Basin Plans and permits
	PY/\$	Coordination for understanding trends, trainings, statewide implementation, and assisting in trend and effectiveness monitoring to facilitate adaptive management

Water Code	Description	
13182.a.3	Determine the regions, watersheds, or waterbodies experiencing or at risk of experiencing harmful algal blooms to prioritize those regions, watersheds, or waterbodies for assessment, monitoring, remediation, and risk management.	
Water Board	PY/\$	Resources Necessary
DWQ	PY	Assessing cyanotoxin data for the Integrated Report: evolving methods for determining evaluations based on new science and support through Advisory Committees
	PY/\$	Additional resources and support to establish cyanotoxin water quality objectives and a program of implementation

DWR	PY	Standard language for permit provisions to address monitoring and management for HABs and review monitoring plans and reports
	PY/\$	Resources to address drought and climate change that trigger HAB response
	PY	Liaison with other Water Board divisions for data sharing, participating on advisory committees, and coordination
DDW	PY	Staff to insert HAB data into a data system
DFA	PY/\$	Repayment of loans for mitigation
	PY/\$	Grant reimbursement for HAB monitoring

Water Code	Description	
13182.a.4	Conduct applied research and develop tools for decision-support	
Water Board	PY/\$	Resources Necessary
DIT	PY	Develop, update, and maintain data infrastructure to easily ingest data from external partners
	PY	Develop and refine data analysis and visualization tools
DWQ	PY/\$	Studies to better understand drivers of blooms, sources, and causes to inform options for source control, restoration, or other actions to reduce frequency and extent of blooms
DWR	PY/\$	Advisement on new impoundments; reservoir management based on FERCs
	PY	Coordination for understanding drivers/mitigation for reservoirs
DDW	PY/\$	Resources for water treatment facilities to research treatment based on type of toxin class
	PY	Need expertise in HABs (only one staff has it in duty statement) to coordinate with management and other Water board Programs/Divisions
	PY/\$	Development of MCLs for cyanotoxins
WB	PY/\$	New research to consider new analysis methods that are more cost-effective

Water Code	Description	
13182.a.5	Provide outreach and education and maintain a centralized internet website for information and data related to harmful algal blooms	
Water Board	PY/\$	Resources Necessary
DIT	PY	Graphics for use in physical and digital outreach content for distribution. Examples include but not limited to: pamphlets, fact sheets, tri-folds

Table 4. Associated resources needed for State Board Divisions to implement tasks identified in Table 3.

Water Board	Resources Necessary	
	Permanent Full-Time Staff (PY)	Annual Contract Funding
DWQ	2 PY	\$200,000
DWR	1 Senior ES Specialist	\$150,000
DDW	3 PY (northern/southern/HQ)	\$200,000
DFA	0.5	\$100,000
TOTAL	5.75	\$650,000