

San Francisco Bay Harmful Algal Bloom Coordination Group

Incident Response Procedure



Heterosigma akashiwo bloom in the Oakland Estuary. Photo credit: Vanessa Zubkousky, California Department of Public Health.

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1 Purpose

This document outlines the San Francisco Bay Harmful Algal Bloom Coordination Group's (Coordination Group) procedures for responding to harmful algal blooms (HABs) in the San Francisco Bay (Bay). The Coordination Group is a collaborative team consisting of state and federal agencies, non-profits, and community scientists. This is a living document and may be updated after the algae bloom season.

2 San Francisco Bay Harmful Algal Bloom Coordination Group

The San Francisco Bay HAB Coordination Group (Coordination Group) was formed in 2022 in response to the historic red tide and fish kill in San Francisco Bay. Together, the Coordination Group works to track bloom progression; understand impacts to water quality and fish and wildlife; and share information with interested parties. In addition to active bloom response, the Coordination Group will meet before and after the HAB season on an annual basis to update response procedures. The roles and resources of each member of the Coordination Group are summarized in the following sections.

2.1 San Francisco Bay Water Board

The San Francisco Bay Regional Water Quality Control Board (SF Water Board) HAB Coordinator (SF HAB Coordinator), with support from Water Board management, is the communication lead for HAB response in the Bay. The SF Water Board's Bay HAB response procedures are consistent with the State Water Board's [Statewide HAB program](#), but require additional coordination and communication. The SF Water Board's resources and responsibilities for responding to Bay HABs include:

- Maintain the Coordination Group email list and organize coordination meetings, as needed.
- Communicate bloom updates and advisory recommendations to local entities (public health agencies, waterbody managers, cities, etc.).
- Maintain bloom [FAQs](#) on the Water Board's website.
- Ensure bloom observations shared by the Coordination Group in the tracking sheet are uploaded to the Water Board's HAB database and publicly accessible [HAB Reports Map](#).
- Perform shore-based fieldwork, as needed.
- Communicate with the Water Board Office of Public Affairs (Executive Officer).
- Has lab contract funds to pay for HAB ID and toxin analysis (*Heterosigma akashiwo* degrades too rapidly to be identified by contract lab so local labs are needed).

2.2 State Water Board

The State Water Board Freshwater and Estuarine Harmful Algal Bloom (FHAB) Program was established to protect water quality and public health from HABs in consultation with state and federal agencies, and California Native American tribes. The major responsibilities of the program include event response, statewide assessment and monitoring, risk assessment, research, outreach and education, and reporting. The State Water Board's resources and responsibilities for responding to Bay HABs include:

- Support Regional Water Board staff and fill in if the SF HAB Coordinator is unavailable.

- Manage the Water Boards' lab contract for algal ID and toxin analysis (freshwater and marine species).
- Manage the SFEI satellite imagery tool that displays Sentinel 3 chlorophyll data.
- Maintain the HAB database and HAB Reports Map.
- Provide communication and outreach support (subscription email lists, fact sheets, pre-printed advisory signs, etc.).
- Participate in the interagency HAB-related illness workgroup.

2.3 California Department of Fish and Wildlife (CDFW)

The California Department of Fish and Wildlife (CDFW) HAB Coordinator supports interagency coordination to respond to HABs. They also lead the monitoring and analysis of HAB-related fish and wildlife impacts in the SF Bay Area. CDFW Fisheries Branch, Marine Region, Bay Delta Region, and others will provide support, as resources allow. CDFW's resources and responsibilities for responding to Bay HABs include:

- Project management for fish kill tracking through [iNaturalist](#).
- Collect and compile fish kill data from all sources (iNaturalist, emails, hotline reports, etc.).
- Project management for fish kill tracking through boat and shore-based field surveys including organizing supplies, writing, maintaining, and distributing standard operating procedures, and coordinating field teams and transects.
- Can conduct field surveys to determine the scale of die off and coordinate fish collection and necropsy.
- Participate in the interagency HAB-related illness workgroup
- Provide communication/PR resources (issue statements, retweet advisories, etc.).
- Has lab contract funds to pay for HAB ID in water and toxin analysis in water and tissue (*Heterosigma akashiwo* degrades too rapidly to be identified by contract lab so local labs are needed).

2.4 California Department of Public Health (CDPH)

The California Department of Public Health (CDPH) Shellfish Program monitors paralytic shellfish poisoning and domoic acid biotoxins in bivalve shellfish. It also coordinates volunteer-based monitoring for toxic phytoplankton along the California coastline. CDPH staff have the expertise to provide microscope ID for species of concern. The CDPH Center for Healthy Communities is the lead for responding to HAB-related human illnesses. CDPH's resources and responsibilities for responding to Bay HABs include:

- Provide microscope identification of algal species in samples (including *Heterosigma akashiwo*)
- Can collect shore-based samples (East Bay locations only).
- Participate in the interagency HAB-related illness workgroup.
- Triage human illness reports.

2.5 Office of Environmental Health Hazard Assessment (OEHHA)

The Office of Environmental Health Hazard Assessment (OEHHA) is the lead agency for tracking marine HAB-related illnesses in domestic and wild animals. OEHHA's resources and responsibilities for responding to Bay HABs include:

- Participate in the interagency HAB-related illness workgroup.
- Compile and assess evidence to determine if illnesses are HAB-related.
- Submit reports of HAB-related illnesses to the CDC's One Health Harmful Algal Bloom System (OHHABS) database
- Contribute the California Cyanobacteria Harmful Algal Bloom (CCHAB) Network guidance subcommittee with relation to cyanotoxin thresholds, advisory signage, and health messaging on the HAB Portal.
- Host/maintain the [Marine HAB-related illness tracking](#) webpage.

2.6 San Francisco Estuary Institute (SFEI)

The San Francisco Estuary Institute (SFEI) is an environmental research institute and a 501(c)3 nonprofit organization. SFEI manages the Nutrient Management Strategy (NMS), a collaboration of researchers, dischargers, and other agencies. The NMS studies potential impacts of nutrients on the Bay and evaluates potential management actions to control nutrient inputs to avoid or respond to adverse impacts. SFEI's resources and responsibilities for responding to Bay HABs include:

- Coordinate with USGS to do high frequency mapping cruises and collect discrete samples. Routine mapping surveys are scheduled for July and August in 2024.
- Fund USGS long-term monitoring (two times per month in the Bay channel)
- Maintain a moored sensor program (EXO2s)
 - Adding new stations and adding telemetry in 2024
 - Includes continuous dissolved oxygen, temperature, and nitrate monitoring
 - Data synthesis and analysis
- Revamping the mussel sampling work for the toxin monitoring program (existing dataset from 2014-2022).
- Manage a Bay-specific satellite tool for chlorophyll data.
- Has provisional authorization from the NMS Steering Committee to do two additional surveys if people/boats are available

2.7 United States Geological Survey California Water Science Center

The United States Geological Survey (USGS) California Water Science Center (CWCS) collects pre-scheduled sampling for algae composition, nutrients, and dissolved oxygen via the NMS. Can conduct enhanced contracted field sampling, if needed. USGS's resources and responsibilities for responding to Bay HABs include:

- Coordinate with SFEI to do surveys
- Collect phytoplankton samples
- Continuous chlorophyll monitoring
- Help SFEI with telemetry
- On call during blooms to do high resolution monitoring surveys (in the past)

2.8 San Francisco Baykeeper (Baykeeper)

Baykeeper is a 501(c)3 nonprofit with a mission to defend San Francisco Bay and its watersheds from the biggest threats. Potential HABs are often reported through Baykeeper's pollution hotline. Baykeeper has a network of staff and volunteers that can investigate and respond to potential blooms. Baykeeper's resources and responsibilities for responding to Bay HABs include:

- Provide microscope identification of algal species in samples (including *Heterosigma akashiwo*), if needed, using the NOAA Phytoplankton Monitoring Network protocol.
- Maintain a pollution hotline where potential HABs are often reported.
- Can conduct field investigation and sampling at shoreline and at open water sites via boat.
- Can conduct aerial observations via drone or plane (partnership with Light Hawk).

2.9 Community Scientists

Other entities or citizen scientists may make observations of the bloom, collect samples, or bring other information to the Coordination Group. Damon Tighe was instrumental in organizing and contributing to fish kill reporting efforts via iNaturalist in the 2022 and 2023 red tide events. The Rotary Nature Center Friends collect monthly HAB samples at Lake Merritt. Community scientists can collect and identify species, if additional support is needed.

3 Bloom Communication and Response

The following sections outline the different scenarios and best practices for responding to HAB reports in the Bay.

3.1 Initial Report

The Water Boards' HAB Program uses the [Freshwater and Estuarine Bloom Incident Form](#) as the public reporting system for HABs. However, there are several ways potential HAB events are reported to the Coordination Group. For example, reports have been submitted to Baykeeper's pollution hotline, the Water Board spill line, the San Francisco Estuary Institute (SFEI), or have been observed from the remote sensing imagery. When a potential HAB report is submitted to a member of the Coordination Group, they should email the Coordination Group and enter it in the Bloom Observations Tracking spreadsheet as soon as possible. Alternatively, individuals can notify the SF HAB Coordinator and request they begin the email chain and log the information. The SF HAB Coordinator will review the report and upload it to the HAB Reports map as soon as possible, and within two business days. If needed, they will also follow up with the reporting party to request additional information (e.g., bloom description, photos of the bloom, etc.) and communicate with impacted local entities (health departments, water body manager, land manager, etc.) in accordance with the Water Boards' FHAB incident response procedure. The Coordination Group will communicate mainly through email updates, but will schedule virtual meetings when necessary (e.g., at the beginning of a bloom event, after a major fish kill, etc.). Communication will continue until the bloom dissipates.

3.2 Sharing Observations

Entities within the Coordination Group are requested to provide immediate email updates regarding important information such as field observations (expansion of bloom), local actions (posting or de-posting advisories), and laboratory results. The Coordination Group will catalog bloom reports,

data files, and other relevant information using the SF Bay Collaboration Folder. The SF HAB Coordinator will ensure that all HAB incidents (suspected or confirmed) in the shared Bloom Observation Tracking spreadsheet are uploaded to the Water Board's HAB database and published on the [HAB Reports Map](#). They will also provide information to local entities and update and maintain FAQs on the Water Board's website during active HAB events. The SF HAB Coordinator will request local entities post advisory signage near impacted areas based on the Illness Workgroup's recommendation and CCHAB guidance.

3.3 Field Investigation to Confirm Bloom

When a potential HAB is reported, the Coordination Group will communicate existing sampling plans and their ability to conduct additional monitoring in response to HAB reports. A HAB report will also trigger the NMS to evaluate satellite data. Protocols detailed by the NOAA Phytoplankton Monitoring Network and/or [SWAMP's California Freshwater Harmful Algal Bloom Field Guide](#) will be used to collect samples. The appropriate field response and personnel will depend on the bloom location and extent. Taxonomic identification will typically be requested through the CDPH Preharvest Shellfish Program because they can quickly identify marine species including *Heterosigma akashiwo*. Baykeeper and community scientists can also provide taxonomic identification, if needed. The Water Boards and CDFW can arrange freshwater or marine algal species identification and toxin testing through Bend Genetics.

3.3.1 In-Bay Field Response

If a boat is required for sampling, SFEI will coordinate sample collection with Baykeeper, USGS, or others. SFEI will prep bottles and preservatives so equipment is on hand, if needed. Initial sampling may include collection of water samples for microscopy (various labs) or molecular analysis (Bend Genetics).

The NMS has provisional authorization from the steering committee to collect two additional surveys in the 2024 bloom season, pending boat and personnel availability. An additional NMS field investigation will occur if:

- The spatial extent of the bloom includes large parts of the Bay, many areas within the Bay, or seems likely to expand across the Bay.
- The chlorophyll concentrations in the bloom area, measured directly or estimated from satellite imagery, are considered very high and likely to affect dissolved oxygen.
- There is interest from the media.
- The dominant bloom species identified is *Heterosigma akashiwo* or a toxin producing species.

If thresholds for field investigation are not met, SFEI will continue monitoring remote sensing data until the HAB is resolved or monitoring is triggered.

3.3.2 Bay Shoreline Field Response

The Communication Group will discuss availability to collect and analyze samples. The Water Board and Baykeeper will primarily be responsible for shoreline-based sampling. CDPH and USGS may be available to collect shoreline samples from East Bay locations.

3.3.3 Lake Merritt Field Response

Lake Merritt is tidally influenced and can be impacted by in-Bay HABs, as was the case during the 2022 red tide. The Water Board and Rotary Nature Center Friends began a collaborative Lake Merritt HAB monitoring program in 2023. The Rotary Nature Center Friends collect monthly samples from two locations during the bloom season (May – October) that are analyzed for taxonomic ID and freshwater toxins by Bend Genetics using the Water Board’s HAB contract. The Water Board also began collecting continuous dissolved oxygen data and monthly nutrient samples in 2024. If a Bay HAB expands to Lake Merritt, the Water Board and their community partners will be the primary response team. The Rotary Nature Center Friends and Water Board will be available to collect additional shoreline samples in the event of a bloom. Lake Merritt Institute has a boat and can assist with mid-lake sampling, if necessary. The City of Oakland’s contractor (Lake Tech) may also be available to provide boat transportation for sampling.

3.4 Illness Tracking and Response

During a Bay HAB event, the CDFW HAB Coordinator will create a new iNaturalist project to document fish kills and other wildlife impacts. If resources are available, they will work with the Bay-Delta region to document the scale of die off via field surveys and the Fish Health Lab to perform necropsy. They will also collect and compile fish kill data from all sources. If signage is not already in place, the SF HAB Coordinator will request local entities post advisory signs in the impacted areas.

In the event of a HAB related illness or death, the Interagency HAB Illness Workgroup will communicate with the applicable contacts (physician, veterinarian, ill person’s representative, and animal owner) to collect information and create an illness record for the CDC’s OHHABS database.

3.5 Post-HAB Wrap-up

At the end of a significant HAB event and/or the HAB season, the Coordination Group will discuss what worked, what didn’t work, and significant findings from response procedures. The discussion may take place over email or in a virtual meeting. The SF HAB Coordinator will document changes and update the response procedures, as needed.

4 Appendix 1 – San Francisco Bay HAB Coordination Group

- Rebecca Nordenholt, Water Board HAB Coordinator (SF HAB Coordinator – Bay HAB lead)
- Kristina Yoshida, Water Board HAB Coordinator
- Kevin Lunde, Water Board HAB Supervisor
- Eileen White, Water Board Executive Officer
- Carly Nilson and Marisa Van Dyke, State Board HAB Coordinators
- Dave Senn, NMS Program Director
- Ari Chelsky, NMS Monitoring Manager
- Dan Killam, SFEI
- Karen Odkins, CDFW HAB Coordinator
- Shannon Murphy, OEHHA Toxicologist
- Beckye Stanton, OEHHA alternate
- Matt Scanlon, CDPH Preharvest Shellfish Program
- Sam Rankin, CDPH

- Vanessa Zubkousky, CDPH Preharvest Shellfish Program Supervisor
- Thomas Hayashi, CDPH Center for Healthy Communities
- Aundi Mevoli, Field Investigator
- Ian Wren, Baykeeper Staff Scientist
- Cheryl Patel, Baykeeper Field Investigator and Community Science Coordinator
- Jon Rosenfield, Baykeeper
- Keith Bouma-Gregson, USGS
- Dulcinea Avouris, USGS
- Tamara Kraus, USGS
- Brian Bergamaschi, USGS
- Emily Richardson, USGS
- Schuyler Nardelli, USGS
- Damon Tighe, Community Naturalist
- Levi Lewis, UC Davis
- Katie Noonan, Rotary Nature Center Friends

5 Appendix 2 – 2024 Resources for Response

Entity	Role/Resources
San Francisco Water Board	<ul style="list-style-type: none"> • Organize coordination group meetings, as needed • Communicate updates and advisory recommendations to local entities (public health agencies, waterbody managers, cities, etc.) • Maintain bloom FAQs on webpage • Add reports to database/HAB Reports Map • Communicate with the governor's office, the press, etc. (Eileen) • Can collect shore-based samples • Has lab contract funding for ID and toxin analysis
State Water Board	<ul style="list-style-type: none"> • Support regional board HAB staff (if regional lead unavailable) • Manage lab contract (freshwater and marine) • Manage SFEI satellite imagery tool (SF Bay and California) • Advisory signs printed to share with partners • HAB online webmap • Support for outreach tools (subscription email lists, fact sheets)
CDFW	<ul style="list-style-type: none"> • Interagency coordination • iNaturalist project management • Collect and compile fish kill data from all sources • PR resources (issue statements, retweet advisories) • Lab contract (Bend Genetics) • Boat and shore-based field surveys and management- scale of die off, data analysis • Limited staff in region, limited field capacity this year

	<ul style="list-style-type: none"> • Fisheries Branch, Marine region, Bay Delta region, and others may be involved this year
CDPH	<ul style="list-style-type: none"> • Biotoxins in shellfish, advisories for recreational shellfish • Centrally located in Richmond, can ID samples with short notice • Participate in inter-agency workgroup, triage human illnesses
OEHHA	<ul style="list-style-type: none"> • Participate in inter-agency HAB-related illness workgroup • Compile and assess evidence as HAB related incidents - submit to CDC OHHABS database • Contribute to CCHAB Network guidance subcommittee with relation to cyanotoxin thresholds, advisory signage, health messaging on HABs Portal • host/maintain Marine HAB-related illness tracking webpage
USGS	<ul style="list-style-type: none"> • Coordinate with SFEI to do surveys • Collect phytoplankton samples • Continuous chl monitoring • Help SFEI with telemetry • On call during blooms to do high resolution monitoring surveys (in the past)
SFEI	<ul style="list-style-type: none"> • NMS - monitoring, remote sensing, data synthesis/analysis • Coordinate with USGS to do high frequency mapping cruises and collect discrete samples • Moored sensor program (EXO2s) - adding new stations and adding telemetry • Mussel sampling work - toxin monitoring program (2014-2022) revamping this year • Continuous nitrate monitoring at moored stations • Fund USGS long term monitoring - 2x per month Bay channel • Routine mapping surveys scheduled for July and August • Provisional authorization from steering co to do two additional surveys if people/boats are available • SF Bay specific satellite tool
Baykeeper	<ul style="list-style-type: none"> • Contact through pollution hotline • Field investigation/sampling • Four people trained to collect and ID target species • Has a boat - shoreline and open water sampling • Has a drone and partner with light hawk (plane) • Citizen science program - 6 volunteers testing 6 sites weekly (heavily impacted in 2022 bloom)
Damon Tighe	<ul style="list-style-type: none"> • iNaturalist platform 2022 and 2023

6 Appendix 3 – Helpful Links

- [California HABs Portal](#)
- [Freshwater and Estuarine Harmful Algal Bloom Report Form](#)
- [San Francisco Bay bloom FAQs](#)
- [California Cyanobacteria Harmful Algal Bloom \(CCHAB\) Network webpage](#)
- [CDPH Shellfish Program webpage](#)
- [Marine Harmful Algal Bloom \(HAB\)-Related Illness Tracking | OEHHA \(ca.gov\)](#)
- [CDPH Red Tides Q&A](#)
- [iNaturalist](#)
- [Harmful Algal Blooms Analysis Tool \(sfei.org\)](#)