

Delta HABs Monitoring

Information Sheet

Jenna Rinde¹, Karen Atkins², Keith Bouma-Gregson³, Ted Flynn⁴, Eva Bush⁵,
Meghan Klasic⁶, Tricia Lee⁵, and Tabitha Birdwell⁵

¹California Department of Fish and Wildlife

²Central Valley Regional Water Quality Control Board

³U.S. Geological Survey – California Water Science Center

⁴California Department of Water Resources

⁵Delta Stewardship Council

⁶University of Minnesota

Background

This document includes information on the monitoring associated with HABs in the Delta. The management context for HABs monitoring, maps of monitoring stations and description of ongoing monitoring programs, as well as relevant tools for monitoring practitioners are all described. **This information provides context for potential monitoring locations and efforts that might be used for monitoring harmful algal blooms (HABs).**

Management Context for HABs Monitoring

Assembly Bill 834

In September 2019, the Governor signed Assembly Bill (AB) 834 ([Freshwater and Estuarine Harmful Algal Bloom Program](#)) to **require the State Water Board to establish a formal program to protect water quality and public health from HABs** in consultation with State and federal agencies, and California Native American Tribes. The major responsibilities under the bill include six components:

- | | |
|--|---------------------------------|
| (1) event response, | (4) research, |
| (2) statewide assessment and monitoring, | (5) outreach and education, and |
| (3) risk assessment, | (6) reporting |

In response to AB 834, five permanent staff positions and annual contracting funds were granted to the State and Regional Water Boards, and one position has been created at the California Department of Fish and Wildlife. These staff work to implement the mandates of AB 834 at the State and regional scales.

The Bay-Delta Plan and Decision 1641

The California Department of Water Resources (DWR) and the U.S. Bureau of Reclamation (USBR) manage reservoirs and water exports in the Delta watershed and are water right holders for the two major water conveyance projects in California: the State Water Project (SWP) and the Central Valley Project (CVP).

Water quality and flow requirements for the Sacramento- San Joaquin Delta (Delta) are established in the State Water Board's Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta (Bay-Delta Plan). The State Water Board's Water Right Decision 1641 (D-1641) implements the Bay-Delta Plan. DWR and USBR are water rights permittees subject to D-1641 and operate the SWP and the CVP consistent with D-1641.

Compliance monitoring stations throughout the Delta and Suisun Marsh measure salinity and water temperature, and data are evaluated to determine if stations meet compliance requirements.

Temporary Urgency Change Petitions

A Temporary Urgency Change Petition (TUCP) is a process that any post-1914 water right permit or license holder may use to petition the State Water Board's approval for a deviation from existing water rights conditions. The State Water Board will **review the TUCP and may choose to grant a Temporary Urgency Change Order (TUCO) to manage circumstances when water quality objectives may not be met** for a temporary time, such as during extreme events.

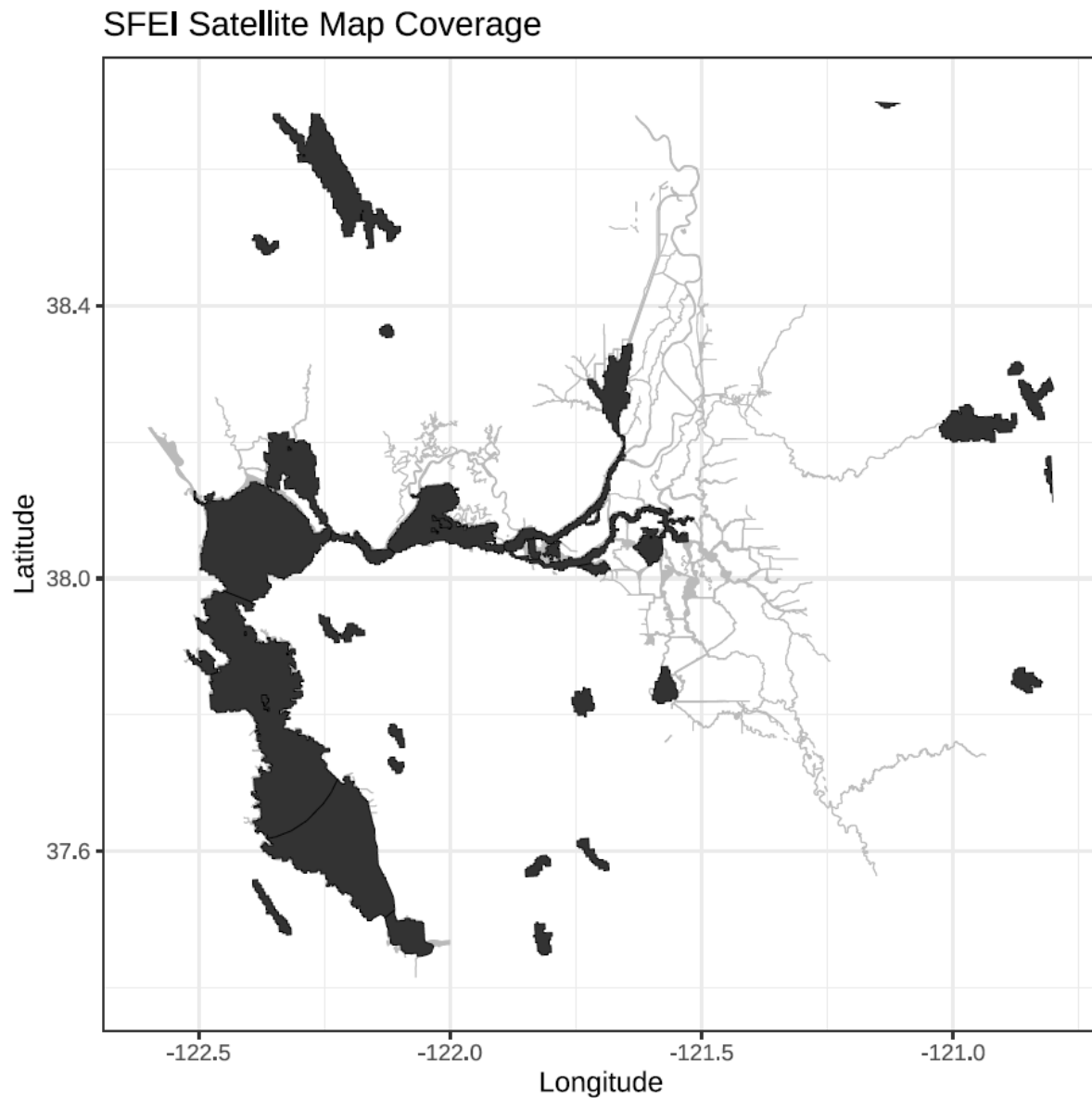


Monitoring Locations

Maps created by Delta HABs Workshop Planning Committee Members Jenna Rinde and Karen Atkins

Map 1

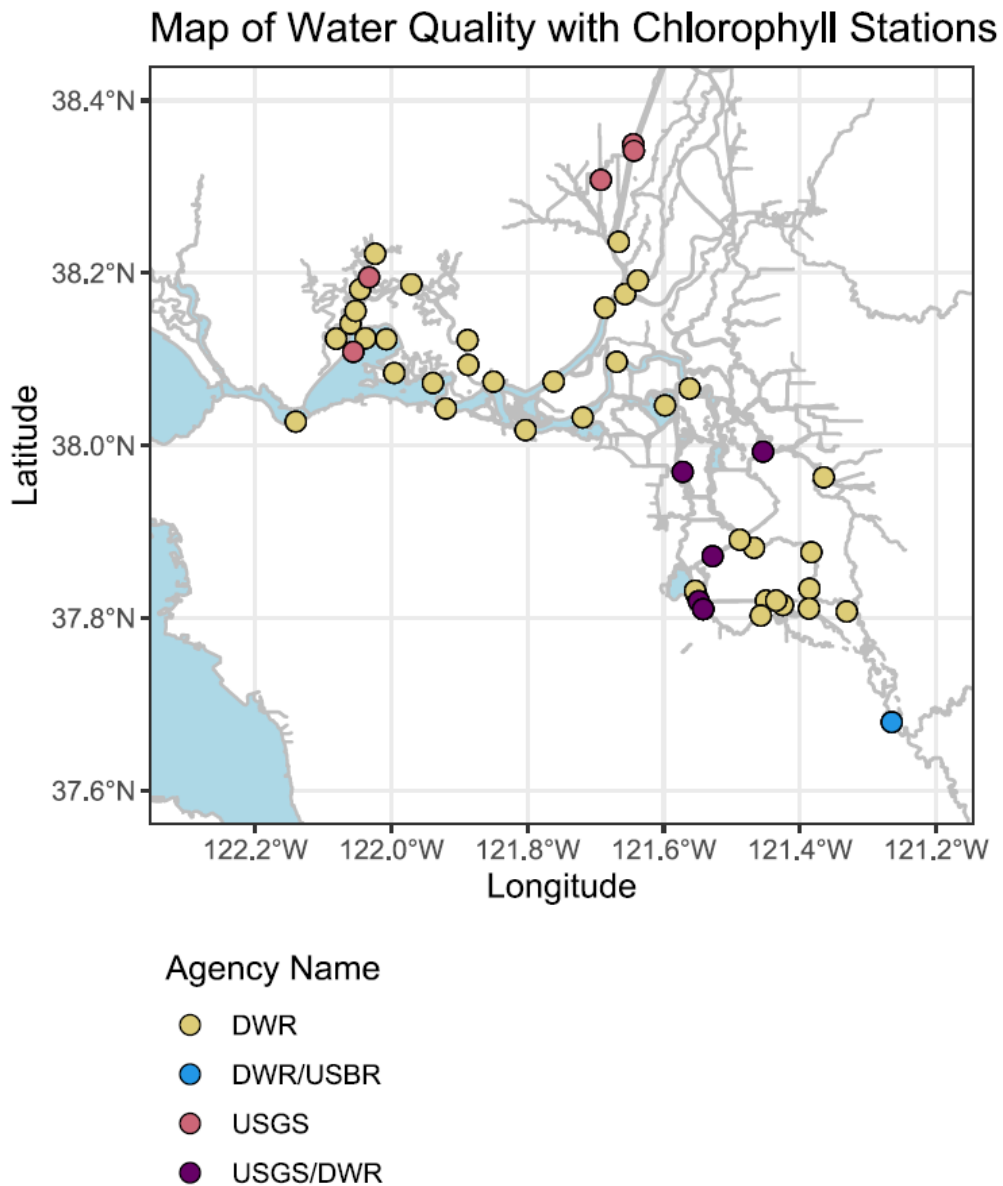
Map 1 shows the extent of the [HAB Satellite Analysis Tool](http://fhab.sfei.org/) (fhab.sfei.org/) created by The San Francisco Estuary Institute in partnership with the State Water Resources Control Board and the National Oceanic and Atmospheric Administration.



Map 1: Map of sites that are covered by the HAB Satellite Analysis Tool. The geographic area covered by the tool is highlighted in black.

Map 2

Maps 2 and 3, from the [California Data Exchange Center \(CDEC\)](https://cdec.water.ca.gov/) (cdec.water.ca.gov/), show locations of sensors collecting continuous water quality and flow data. Agencies managing the continuous monitoring stations include the CA Department of Water Resources (DWR), the U.S. Bureau of Reclamation (USBR), and the U.S. Geological Survey (USGS). Given that there is no long-term continually funded monitoring program that collects cyanobacteria and cyanotoxin data in this area, there is no cyanotoxin map.

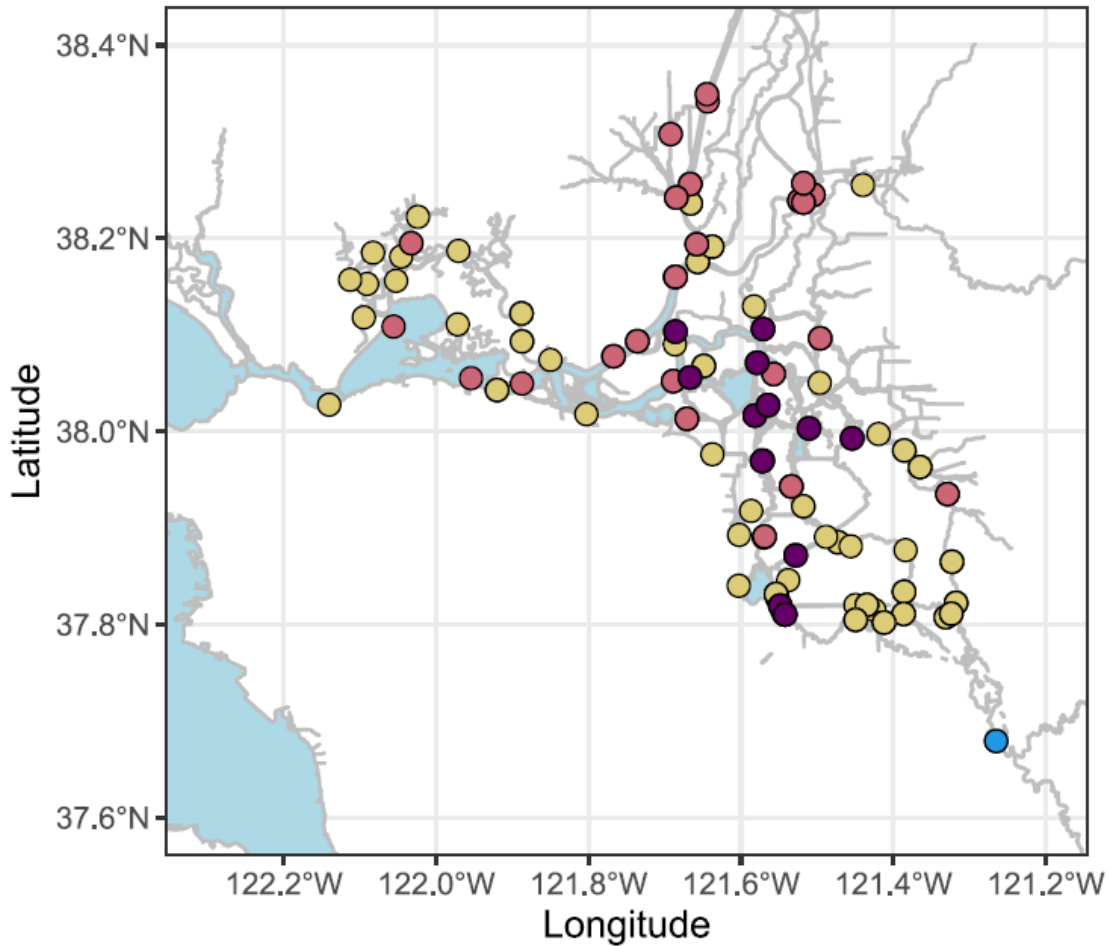


Map 1: Map of continuous water quality sites that measure chlorophyll. In addition to chlorophyll, the stations measure pH, dissolved oxygen, electrical conductivity, and temperature..

The remaining maps, depicting relevant discrete water quality (wq) stations from the Delta and Suisun Marsh, were compiled from the [discrete wq EDI package](https://portal.edirepository.org/) (portal.edirepository.org/) and from contacting principal investigators from various programs. The discrete water quality data is available for any interested parties.

Map 3

Map of Flow Stations

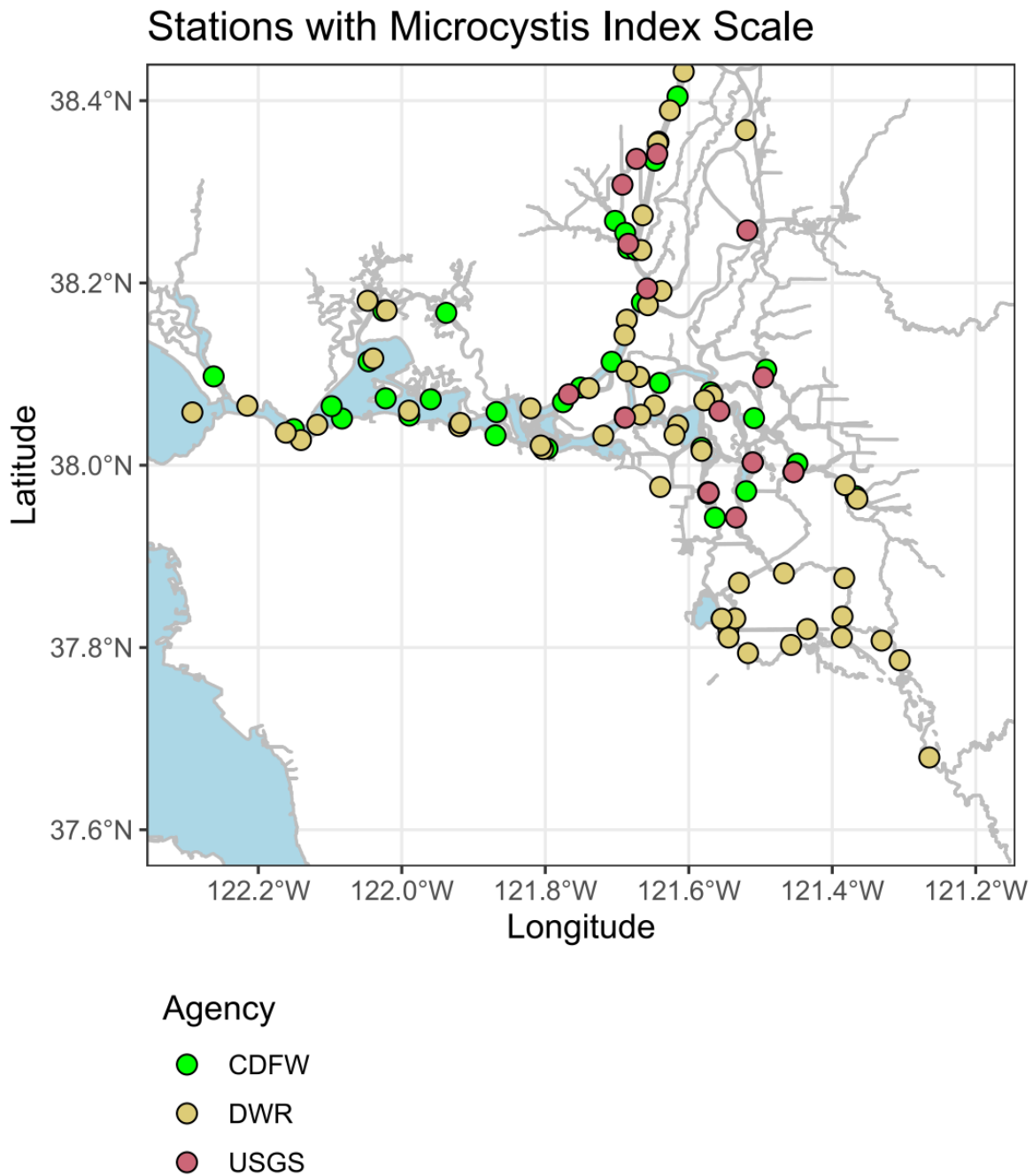


Agency Name

- DWR
- DWR/USBR
- USGS
- USGS/DWR

Map 2: Map of continuous water flow sites that measure flow, velocity, and/or river stage.

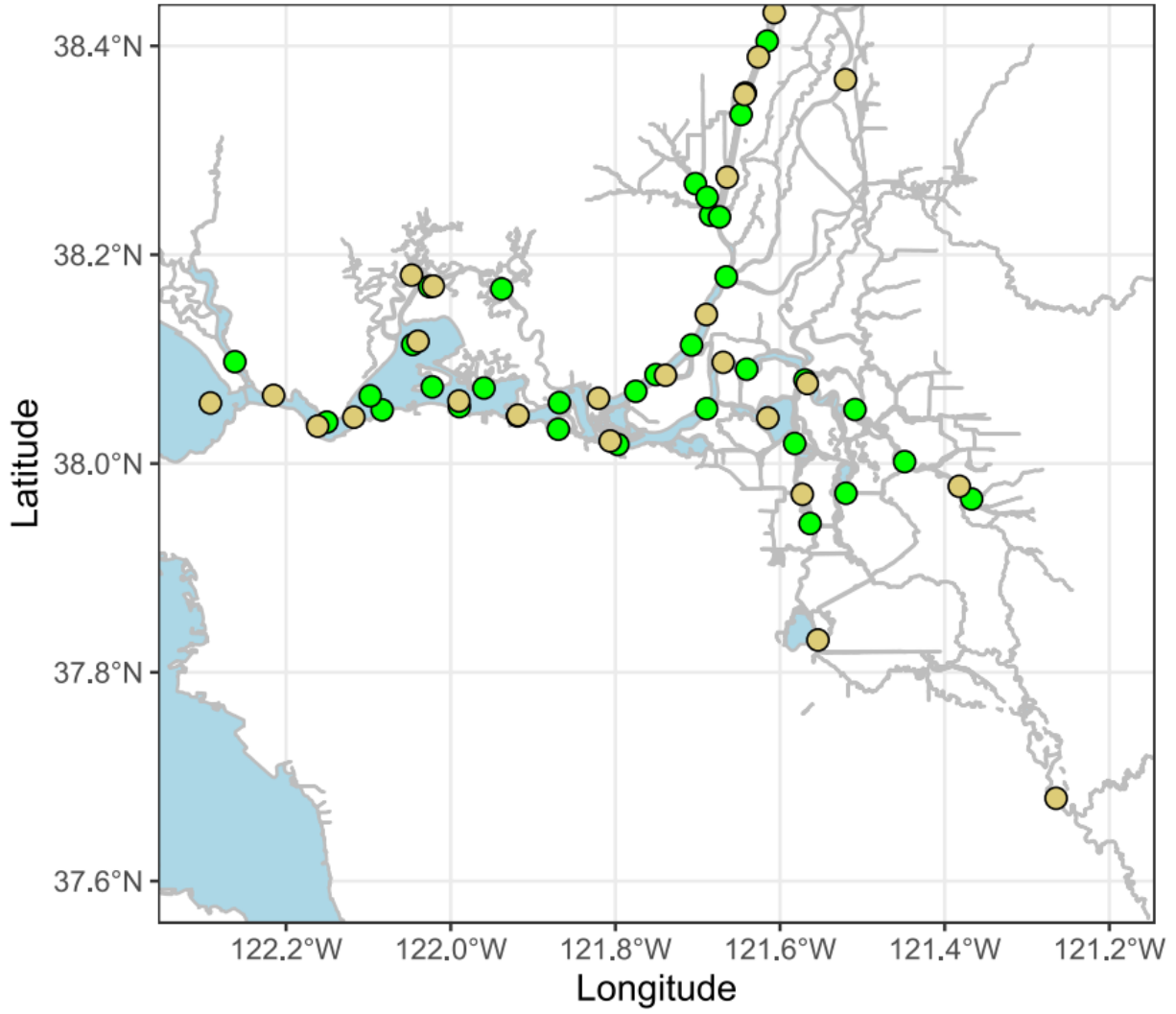
Map 4



Map 3: Map of stations that utilize the [Microcystis Index scale, a qualitative visual assessment for estimating Microcystis abundance \(figshare.com/\)](#).

Map 5

Stations with Secchi Depth



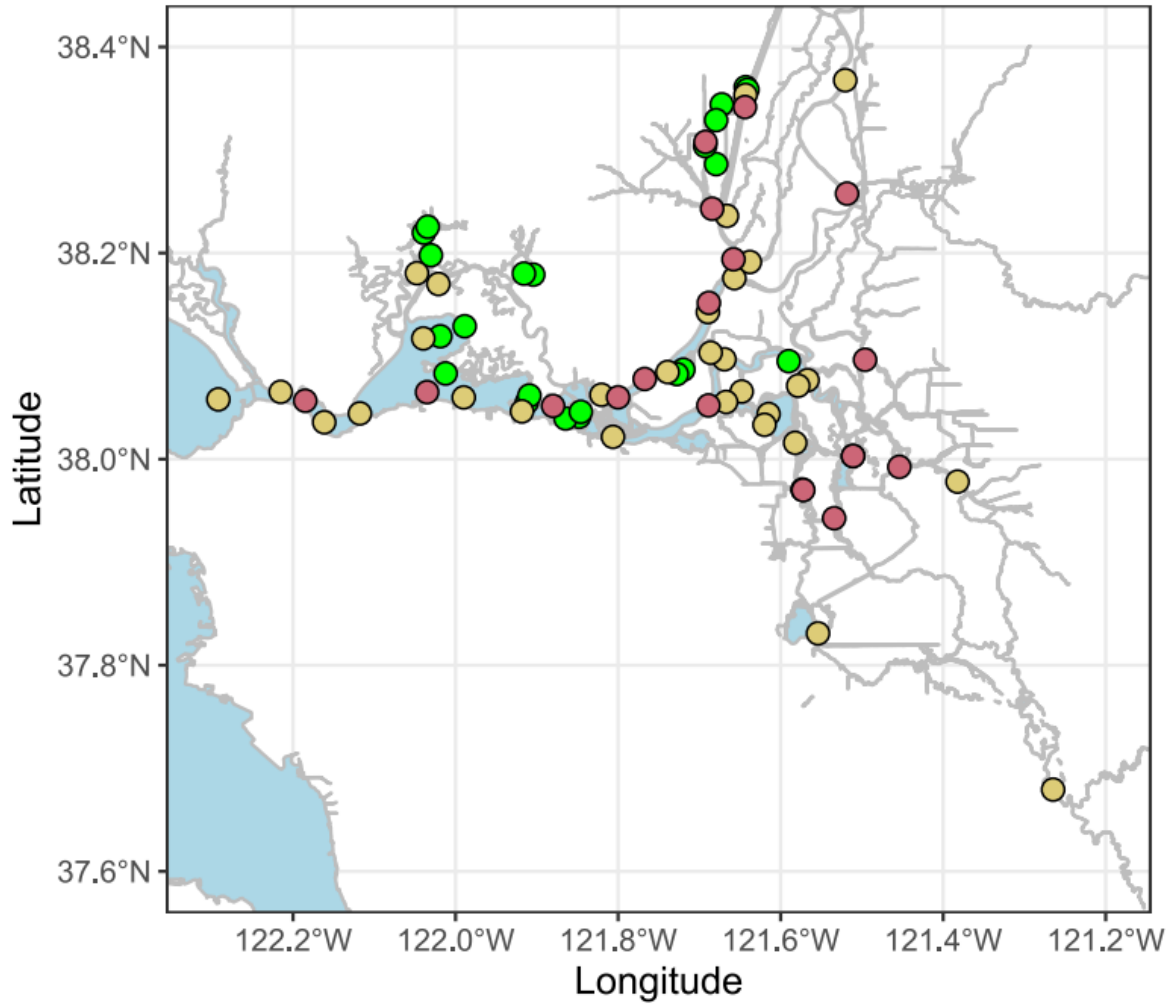
Agency

- CDFW
- DWR

Map 4: Map of stations that collect Secchi depth, an indicator of light in the water column.

Map 6

Stations with Nutrients



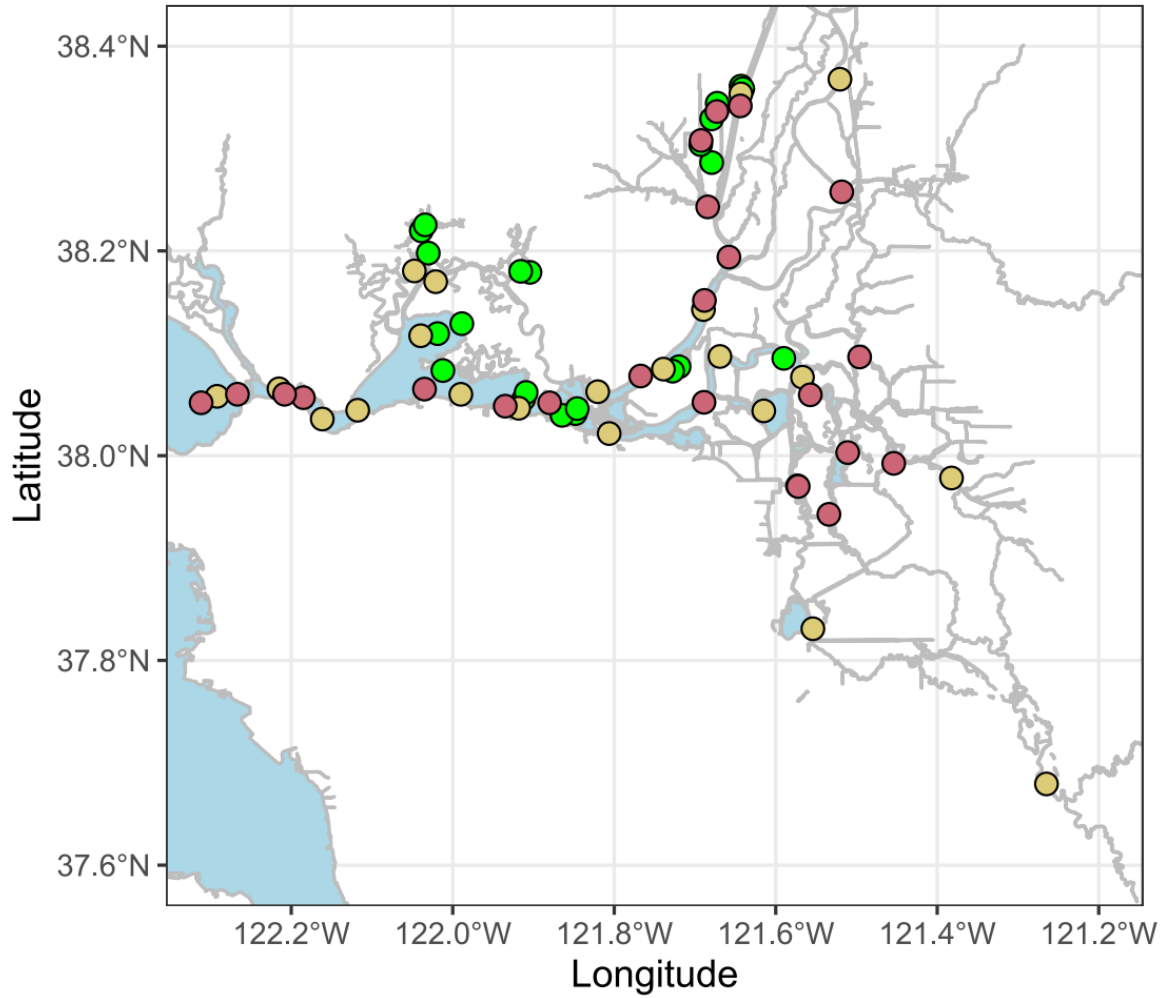
Agency

- CDFW
- DWR
- USGS

Map 5: Map of stations that collect nutrients (nitrogen/phosphorous).

Map 7

Stations with Phytoplankton

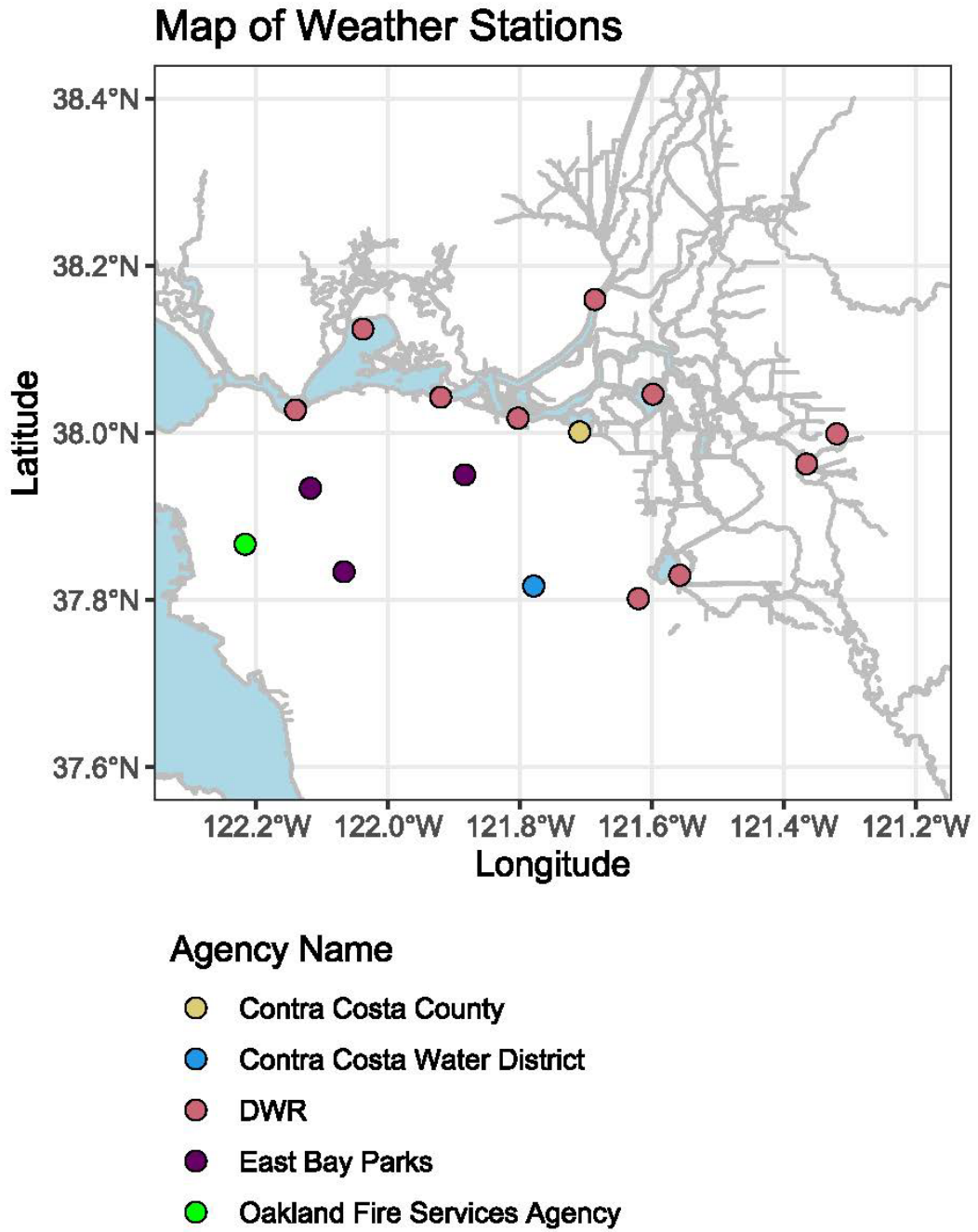


Agency

- CDFW
- DWR
- USGS

Map 6: Map of stations that collect phytoplankton samples.

Map 8



Map 7: Map of weather stations from the California Data Exchange Center.

Drivers and Indicators of HAB Development

The stations identified in the above maps provide the locations where relevant data might be collected and used to indicate the development or presence of a HAB. The following table lists the variables that are relevant for tracking the development of HABs from each map. Information on the drivers is explained in more detail in the “HABs in the Delta” informational sheet for this workshop.

Drivers	Related Variables	Map Reference
Water Temperature Salinity	Water Temperature Specific Conductance/Salinity pH Turbidity Dissolved Oxygen Chlorophyll <i>a</i>	Map 2, Stations with water quality and chlorophyll
Stratification Residence Time	Flow Velocity River Stage	Map 3, Flow stations
Light	Turbidity Secchi Disk	Map 2, Stations include turbidity Map 5, Stations with secchi depth
Nutrients	Dissolved Ammonia Nitrate+Nitrite Orthophosphate	Map 6, Stations with nutrients
Light Stratification	Irradiance Wind Speed	Map 8, Weather stations

program hosts statewide HAB incident event information on a publicly available [web map](https://mywaterquality.ca.gov) portal (mywaterquality.ca.gov) The program is expanding to introduce more robust statewide monitoring practices to better understand the extent, status, and trends of HABs in the state and which areas are most at risk. The FHAB Program also supports applied research and tools for decision support. In 2021 FHAB program staff co-developed the [CA Water Boards' Framework and Strategy for FHAB Monitoring](https://ftp.sccwrp.org/) (ftp.sccwrp.org/) in partnership with the Southern California Coastal Water Research Project and national experts to provide a roadmap for a comprehensive FHAB Monitoring Program in California. While the program itself does not conduct routine monitoring, it will collaborate with partner monitoring entities in 2023 to develop a new web map portal to better display monitoring data alongside incident response data.

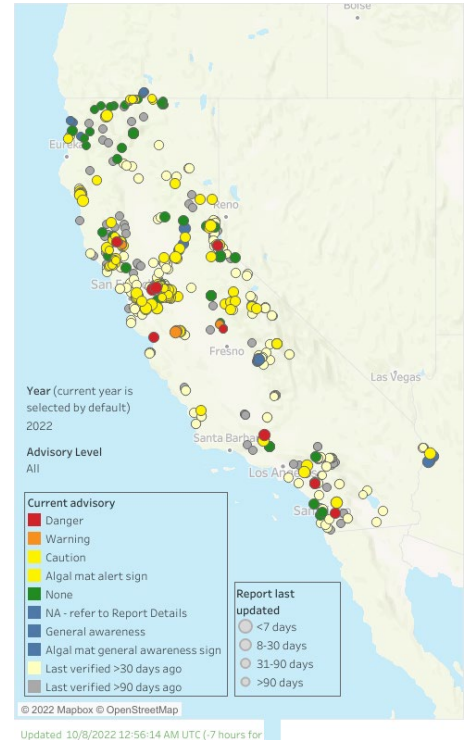
California Department of Fish and Wildlife (CDFW)

As a partner with SWRCB in the Freshwater and Estuarine Harmful Algal Bloom Program, CDFW leads coordination related to HAB impacts to fish and wildlife. CDFW additionally conducts long-term monitoring within the Delta, as listed on the [Interagency Environmental Program's](https://iep.ca.gov/) web page (iep.ca.gov/). Summer Towntnet, Fall Midwater Trawl, and the Fish Restoration Program (FRP) are a few examples, all of which include visual *Microcystis* assessments. Furthermore, CDFW's Ecosystem Restoration Program is designed to maintain, improve, and increase aquatic and terrestrial habitats and improve ecological functions in the San Francisco Bay and Sacramento-San Joaquin Delta and has funded special studies of HABs in support of this objective.

Restore the Delta

[Restore the Delta](https://restorethedelta.org/) (restorethedelta.org/) is a non-profit community organization that leads a community science HABs monitoring program. The program has a full-time Delta Science Coordinator who also leads their Climate Advocate interns to collect weekly toxin samples for *Microcystis*, water temperature, electrical conductivity, salinity, and weather data at seven sites near Stockton. In this first year (2022), cyanotoxins were primarily analyzed with Abraxis Test Strips, and roughly a quarter of the samples were sent to a laboratory for confirmation of strip performance and to enumerate high toxin values. The program uses rapid tests to determine the toxicity of their samples, providing an opportunity to quickly communicate information about site toxin levels to the public.

The Central Valley Regional Water Quality Control Board (CVRWQCB) has collaborated on this project as part of their Freshwater and Estuarine HAB partner monitoring program, but



Restore the Delta is looking to expand its collaborative efforts to include UC Merced to involve more students from the community in their monitoring work. However, the community monitoring program is currently grant-funded and lacks long-term funding for its monitoring efforts.

San Francisco Estuary Institute (SFEI)

[SFEI](https://sfei.org/) (sfei.org/) developed a [freshwater HAB satellite](https://fhab.sfei.org/) analysis tool (fhab.sfei.org/), in collaboration with the National Oceanic and Atmospheric Association and funded by the SWRCB. Some areas of the Delta can be visually monitored for cyanobacterial abundance with this tool; however, the satellite resolution cannot pick up the narrow channels that dominate much of the Delta, so it has limited application. SFEI also coordinates the Bay Regional Monitoring Program and the Bay Nutrient Management Strategy. The latter program collects parameters relevant to HABs in Suisun Bay and the lower Sacramento River to Rio Vista.

HAB Drivers Monitoring

Delta Regional Monitoring Program (RMP)

The [Delta RMP](https://deltarmp.org/) (deltarmp.org/) is a collaborative monitoring group with members from regulatory agencies, resource agencies, permittees, and scientists. The collaboration allows the participants to pool money and expertise to more effectively gather data to inform water quality management and policy decisions facing the Delta. Nutrients and HABs are one of the focus areas of Delta RMP efforts; however, the program does not have consistent funds for ongoing monitoring in its focus areas. Rather, the Delta RMP has funded discrete projects and reports that support understanding status, trends, impacts, and potential future conditions. For example, from 2020-2022 the Delta RMP contributed to USGS's cyanobacteria toxin monitoring project and supported a special *Microcystis* study in 2020-2021.

Central Valley Regional Water Quality Control Board - Delta Nutrient Research Plan

In response to the Delta Plan, in 2013, the CVRWQCB prepared a [Delta Nutrient Research Plan](https://waterboards.ca.gov/) (waterboards.ca.gov/) to identify research and modeling needs for determining whether water quality objectives for nutrients should be established to address HABs and other eutrophic conditions in the Delta. CVRWQCB staff is currently working to gather information to fill gaps identified in the nutrient research plan. Although the CVRWQCB does not have the capability to contract with outside entities to perform monitoring, it has provided staff time and boat resources, which enabled several monitoring collaborations in 2020-2022. These collaborations included a two-year monitoring effort of cyanotoxins in water and clams, funded through a Proposition 1 project administered by CDFW.

Environmental Monitoring Program (EMP)

The [EMP](http://iep.ca.gov/) (iep.ca.gov/), established by the DWR in 1971, is one of the longest-running environmental monitoring programs in the nation, with over 40 years of water and biological data. The EMP conducts monthly collections of water quality, chlorophyll-a, phytoplankton, benthic, and zooplankton samples at fixed locations in the Delta, Suisun Bay, and San Pablo Bay.

Fish Restoration Program (FRP)

Signed on October 18, 2010, the [FRP](http://frp.iep.ca.gov/) (iep.ca.gov/) is an [agreement](http://nrm.dfg.ca.gov/) (nrm.dfg.ca.gov/) between CDFW and the DWR that addresses specific habitat restoration requirements of the U.S. Fish and Wildlife Service and NOAA's National Marine Fisheries Service Biological Opinions for the State Water Project and Central Valley Project operations, and the habitat restoration requirements of the CDFW Longfin Smelt Incidental Take Permit for State Water Project Delta Operations. The FRP agreement collects water quality, chlorophyll a, and phytoplankton at each of their stations.

Existing HAB Monitoring Tools

The FHAB Program has developed multiple resources specifically to support monitoring of freshwater and cyanobacterial HABs (cyanoHABs) statewide. Many of these resources are useful to monitoring practitioners and are listed here.

Statewide Resources

California Cyanobacteria and Harmful Algal Bloom Network

The California Cyanobacteria HAB Network is a working group that has developed [guidance to respond to cyanoHABs](http://mywaterquality.ca.gov/) (mywaterquality.ca.gov/) since 2006.

Statewide Strategy

SWRCB has developed a comprehensive [Framework and Strategy for Freshwater HAB \(FHAB\) Monitoring](http://ftp.sccwrp.org/) (ftp.sccwrp.org/) to bolster the development of ambient monitoring for California waterways. The document provides recommendations for freshwater HAB monitoring and assessment to support management decisions and includes HAB monitoring options that span various cost and effort commitments. More information about the [FHAB Program](http://waterboards.ca.gov/) (waterboards.ca.gov/) is available on the Water Board website.

Field Guide and Standard Operating Procedures

SWRCB's Surface Water Ambient Monitoring Program (SWAMP) prepared a [FHAB field guide](http://mywaterquality.ca.gov/) (mywaterquality.ca.gov/) as well as standard operating procedures for the collection of FHAB samples.

Web Portal

SWRCB maintains a [HABs reports map](https://mywaterquality.ca.gov/) (mywaterquality.ca.gov/) that displays locations where HABs are reported. This information is submitted from water monitoring efforts and voluntary reports.

Regional Resources

Northern California River Benthic Monitoring

From 2016 to 2019, the North Coast Regional Water Quality Control Board monitored riverine benthic cyanoHABs in their region and published a [report detailing their study details](https://waterboards.ca.gov/) (waterboards.ca.gov/), including methods, field sampling, laboratory analysis, data processing and interpretation, and data quality. The North Coast Regional Water Board also provided [partner training on their process](https://www.waterboards.ca.gov/) (www.waterboards.ca.gov/).

Klamath Basin Monitoring Program

The Klamath Basin Monitoring Program is a collaborative group that implements a coordinated regional monitoring plan that monitors water quality for the Klamath River watershed. They have their own [blue-green algae tracker](https://kbmp.net/) (kbmp.net/) and share [details regarding their monitoring plan](https://kbmp.net/) (kbmp.net/).

Other

Water Reporter

Another potential tool for collecting reports of HABs is the [Water Reporter app](https://waterreporter.org/) (waterreporter.org/). Water Reporter is a social network that allows individuals to upload information about their local waterways that monitoring practitioners can use to identify potential areas for sampling.

Interstate Technology and Regulatory Council

The Interstate Technology and Regulatory Council is a state-led coalition that shares information across states. They host information on their website about cyanoHABs and guidance documents for monitoring for both [planktonic](https://hcb-1.itrcweb.org/) (hcb-1.itrcweb.org/) and [benthic](https://hcb-2.itrcweb.org/) (hcb-2.itrcweb.org/) cyanoHABs.



References & Further Reading

- State Water Resources Control Board. Revised Water Right Decision 1641. In the Matter of: Implementation of Water Quality Objectives for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary; A Petition to Change Points of Diversion of the Central Valley Project and the State Water Project in the Southern Delta; and A Petition to Change Places of Use and Purposes of Use of the Central Valley Project. December 29, 1999, revised March 15, 2000.
https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/decisions/d1600_d1649/wrd1641_1999dec29.pdf
- State Water Resources Control Board. Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary.
https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/
- [Additional organizations working in the Watershed and Estuary](http://mywaterquality.ca.gov/) (mywaterquality.ca.gov/)
- [Statewide Strategy for Monitoring HABs with relevant application to watershed approaches titled CA Water Boards' Framework and Strategy for FHAB Monitoring](ftp://ftp.sccwrp.org/) (ftp.sccwrp.org/)
- [California Voluntary Guidance for Response to HABs in Recreational Inland Waters, California Water Quality Monitoring Council](http://mywaterquality.ca.gov/) (mywaterquality.ca.gov/)
- Howard, M. D. A., Smith, J., Caron, D. A., Kudela, R. M., Loftin, K., Hayashi, K., Fadness, R., Fricke, S., Kann, J., Roethler, M., Tatters, A., Theroux, S. 2022. Integrative monitoring strategy for marine and freshwater harmful algal blooms and toxins across the freshwater-to-marine continuum. Integrated Environmental Assessment & Management, doi: [10.1002/ieam.4651](https://doi.org/10.1002/ieam.4651).