



# FRESHWATER HARMFUL ALGAL BLOOM PROGRAM

Ali Dunn & Marisa Van Dyke  
Co-Leads Freshwater HABs Program  
Surface Water Ambient Monitoring Program (SWAMP)  
State Water Resources Control Board

# WHO IS SWAMP? WHY INVOLVED IN HABs?

- SWAMP = Surface Water Ambient Monitoring Program
- Works to provide water quality resources and information to decision makers and the public about the condition of California waterbodies
- Freshwater Harmful Algal Bloom (FHAB) Program is part of a recent statewide initiative to address HAB issues and support the protection of animal, wildlife and human health throughout California.
- Provide outreach and technical support services



*Anabaena* sp. individual spire with air bubbles (South Fork Eel R.).

# OVERVIEW

**Cyanobacteria  
and Harmful  
Algal Blooms  
(HABs)  
Overview**

**CA State  
Water Board  
HAB  
Assessment &  
Support  
Strategy**

**My Water  
Quality –  
California  
Harmful Algal  
Blooms Portal**

**CA CyanoHAB  
Network  
(CCHAB)**



# WHAT ARE HARMFUL ALGAL BLOOMS? (HABS)



Photo Credit: KarukTribe



Photo Credit: Rich Fadness



# CYANOHAB TOXINS

## CYANOTOXINS

- Dermatoxins – skin
- Hepatotoxins - liver
- Cytotoxins – kidneys
- Neurotoxins – nervous system



### ▪ Pet and livestock health effects:

- ✓ Diarrhea
- ✓ Vomiting
- ✓ Convulsions
- ✓ Death



### ▪ Humans health effects:

- ✓ Skin rash
- ✓ Eye irritation
- ✓ Diarrhea
- ✓ Vomiting
- ✓ Seizures
- ✓ Paralysis



### ▪ Wildlife effects:

- ✓ Toxins found in fish organs and tissue
- ✓ Accumulation in shellfish
- ✓ Acute poisoning of wildlife



# COMMON HAB FORMING CYANOBACTERIA

## RIVERS

## LAKES

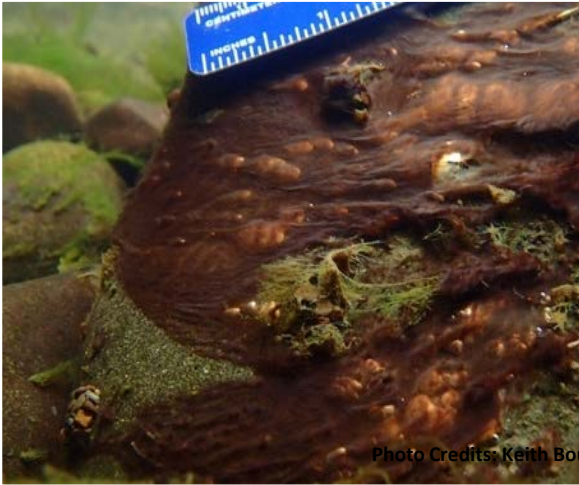


Photo Credits: Keith Bouma-Gregson

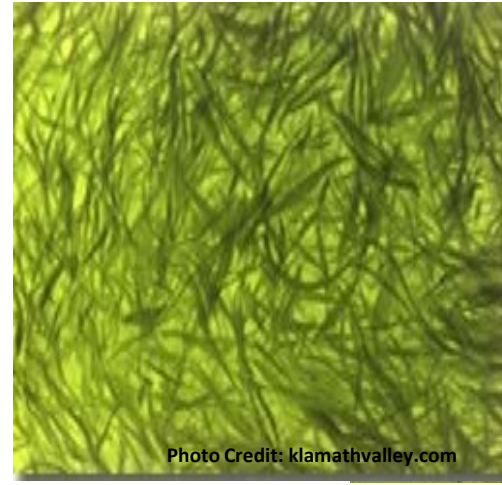
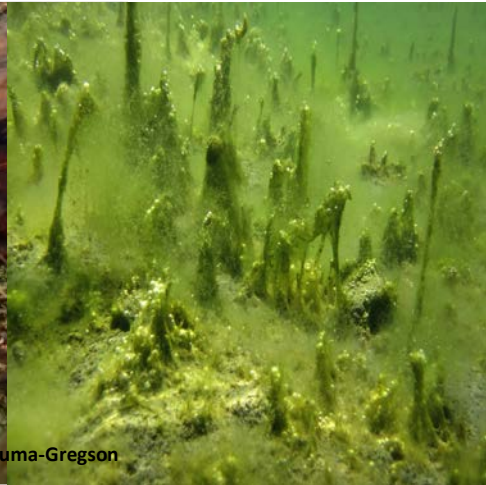


Photo Credit: klamathvalley.com



Photo Credit: KarukTribe 2009 9 20

**Phormidium**

**Anabaena**

**Aphanizomenon**

**Microcystis**

**TOXINS**

- ✓ Microcystins
- ✓ Anatoxin-a
- ✓ Saxitoxin

- ✓ Microcystins
- ✓ Anatoxin-a
- ✓ Saxitoxin
- ✓ Cylindrospermopsin

- ✓ Microcystins
- ✓ Anatoxin-a
- ✓ Saxitoxin
- ✓ Cylindrospermopsin

- ✓ Microcystins

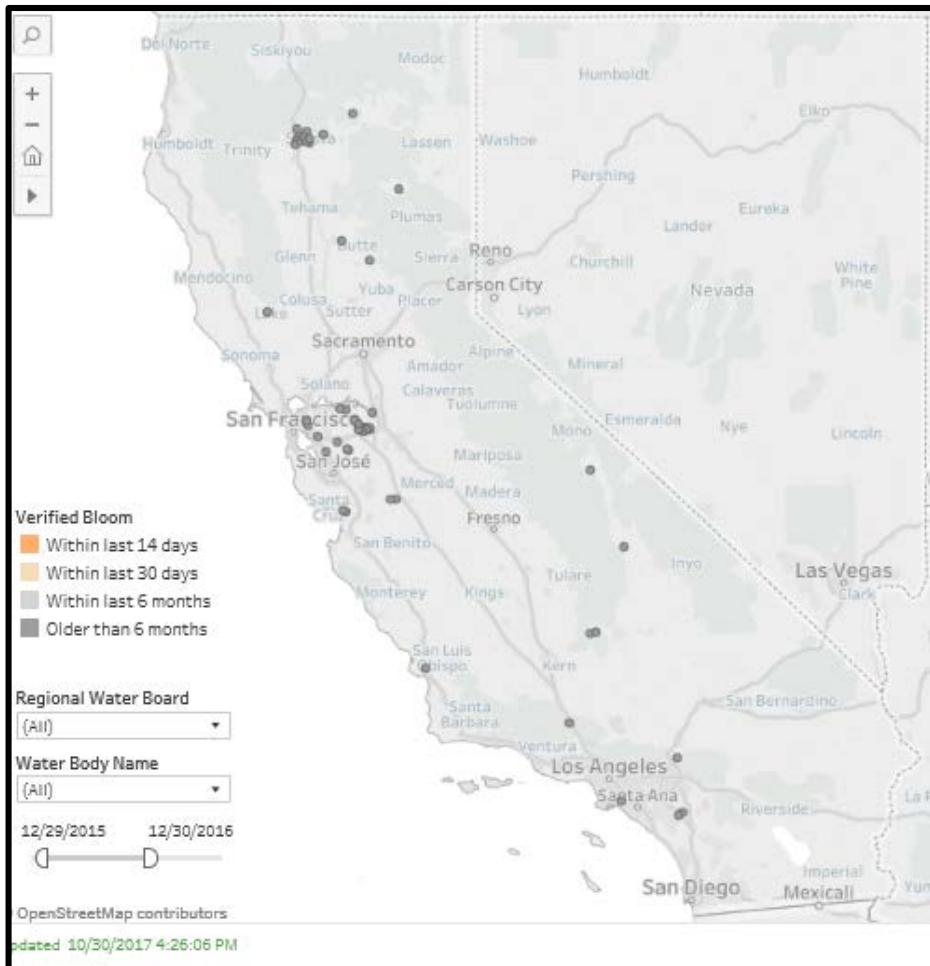


# HARMFUL ALGAL BLOOM WATER QUALITY RISK FACTORS

<b>Risk Factors</b> (Modified from Paerl and Otten, 2013)	<b>Co-Factors</b> (Biostimulatory Conditions)
Climate Change / changing precipitation patterns	Reduced Riparian Canopy
Warm temperatures	Channel Morphology
Long residence time/low flow	Impoundments
Persistent stratification	Reduced Flows
Nutrient over-enrichment	Pollutant Loading
High light/solar radiation	Watershed Conditions
High dissolved organic matter	

# 2016

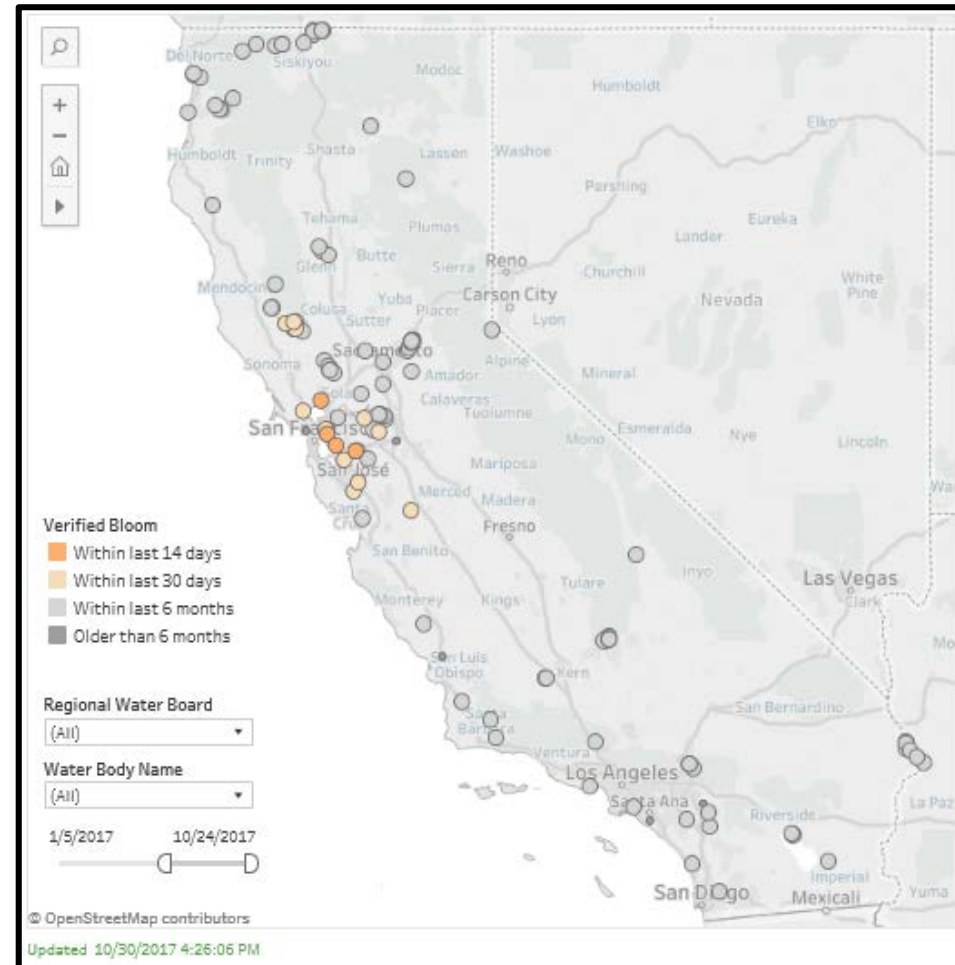
- Total No. Reports = **91**
- Approx. Advisory Signs = **80**



# 2017

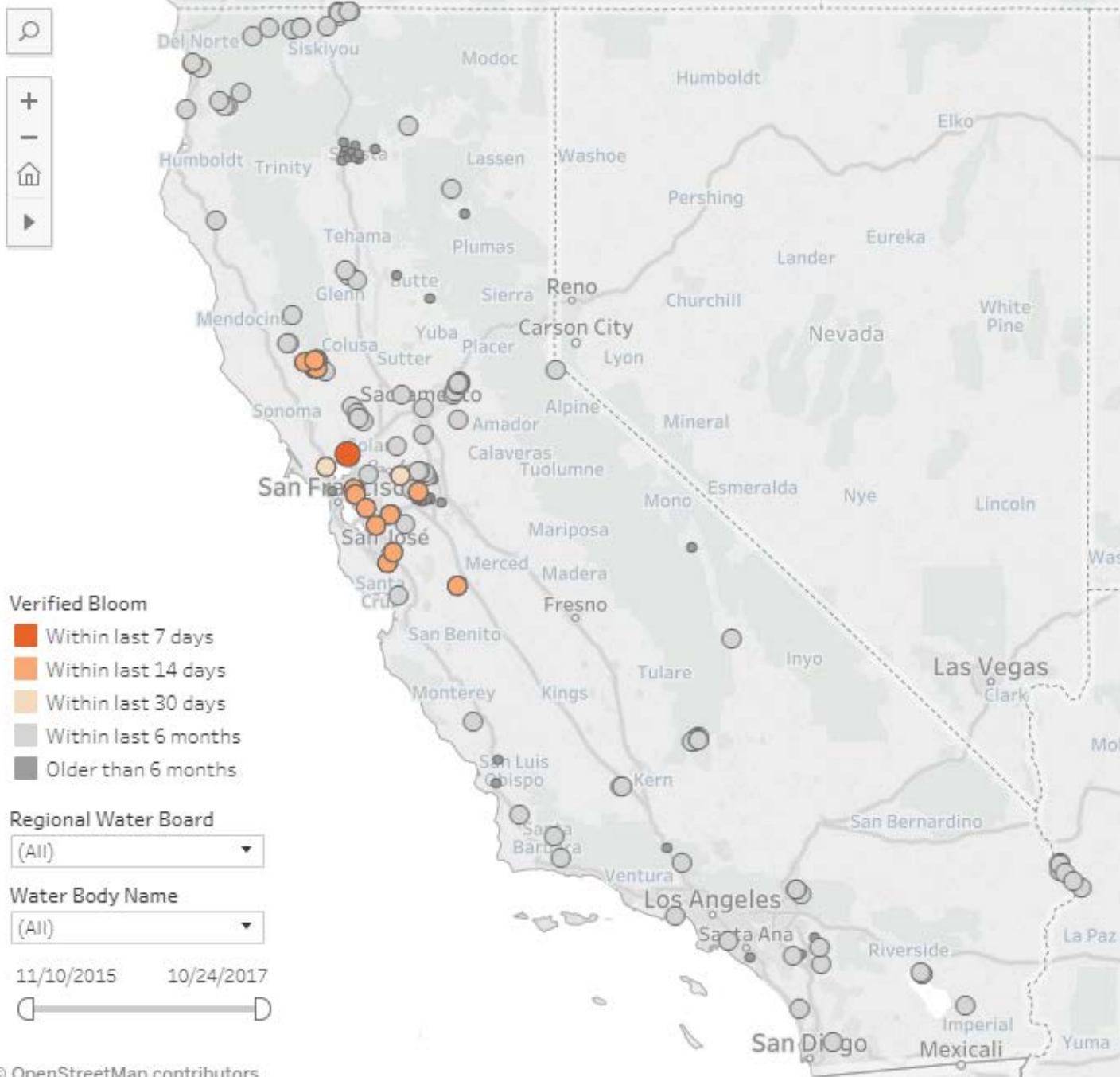
- Total No. Reports = **181**
- Approx. Advisory Signs = **141**

**No. of Reports Doubled in 2017**





2017 → 141 advisories



**CAUTION**

Harmful algae may be present in this water.  
For your family's safety:

- You can swim in this water, but stay away from algae and scum in the water.
- Do not let pets and other animals go into or drink the water, or eat scum on the shore.
- Keep children away from algae in the water or on the shore.
- Do not drink this water or use it for cooking.
- For fish caught here, throw away guts and clean fillets with tap water or bottled water before cooking.
- Do not eat shellfish from this water.

Call your doctor or veterinarian if you or your pet get sick after going in the water.  
For information on harmful algae, go to [mywaterquality.ca.gov/monitoring\\_council/cyanobab\\_network](http://mywaterquality.ca.gov/monitoring_council/cyanobab_network)  
For local information, contact:

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**WARNING**

Toxins from algae in this water can harm people and kill animals

- No swimming.
- Do not let pets or other animals go into or drink the water, or go near the scum.
- Stay away from scum, and cloudy or discolored water.
- Do not eat shellfish from this water.
- Do not use this water for drinking or cooking. Boiling or filtering will not make the water safe.
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- Skin rashes, eye irritation  
- Dizziness, vomiting

For animals, the toxins can cause:  
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# Human and animal illnesses (2017)

## Human – 8 incidents

- Lake Elsinore
- Malibu Creek (~5 swimmers)
- Pyramid Lake
- Blue Lakes (Upper/Lower)
- Clear Lake

## Animal Deaths (dog & livestock)

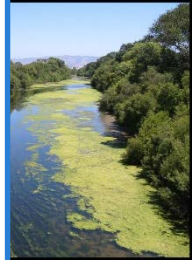
- 25 animals

## Fish and wildlife

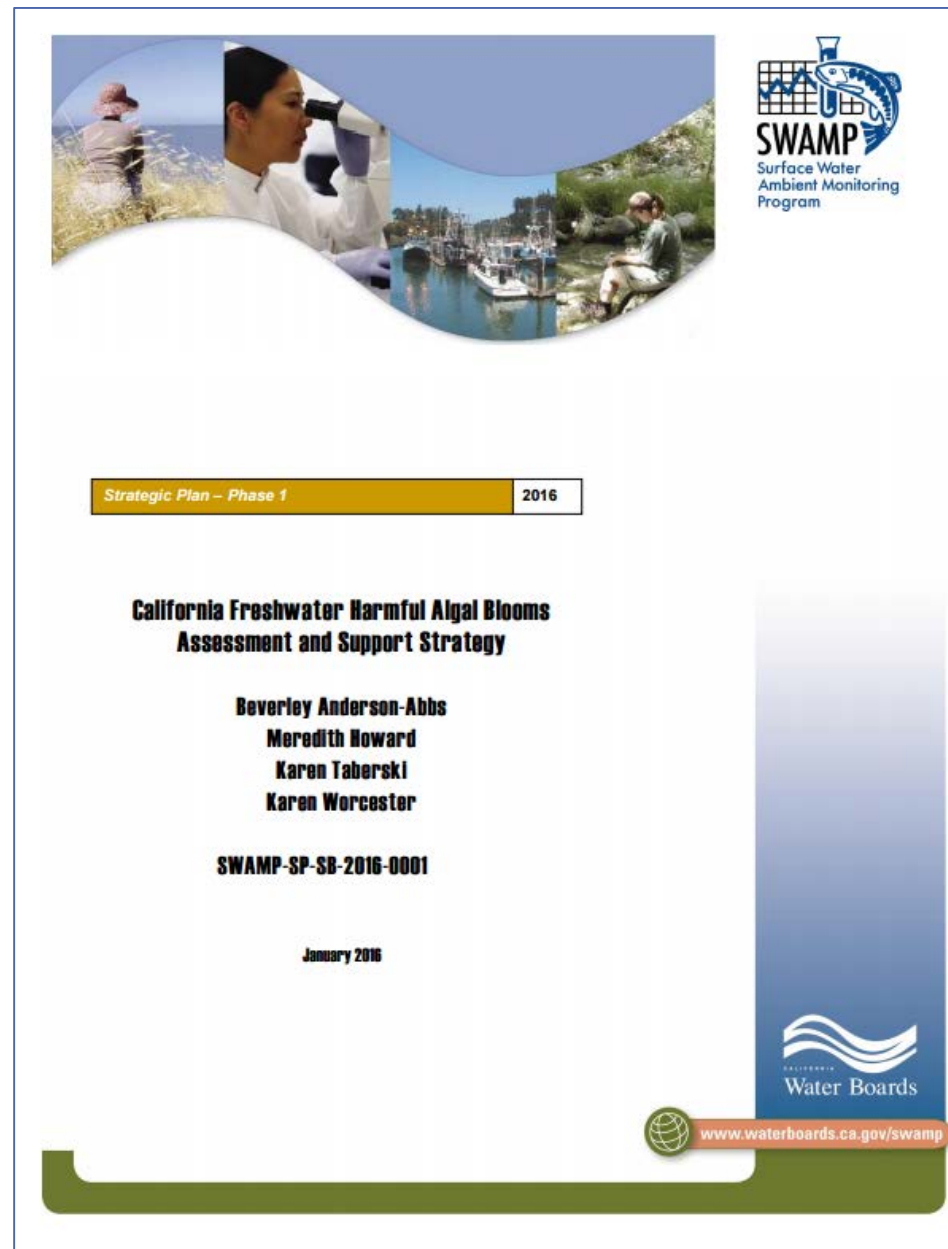
- Numerous incidents statewide

# NEED FOR A FRESHWATER HAB STRATEGY

- HABs increasing worldwide and in California
  - Increasing water temperatures
  - High nutrient concentration inputs
  - Drought – less water, low flows
- HABs create significant water quality issues
- Multi-agency and stakeholder involvement



SWAMP works collaboratively with CCHAB to implement the overall strategy to address HABs in California

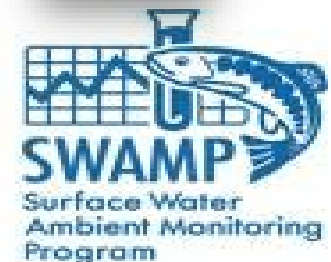


# CCHAB

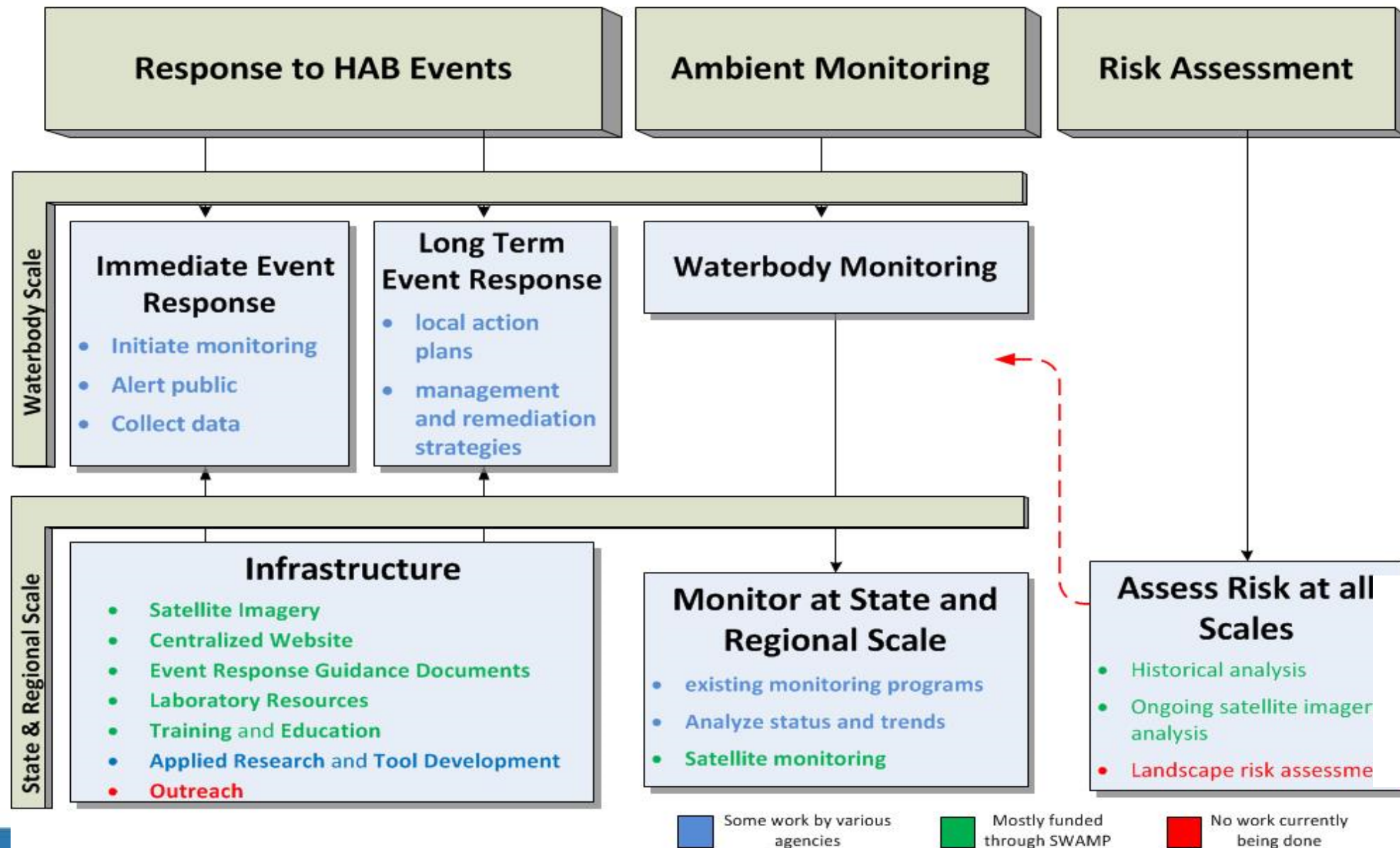
- To work towards a comprehensive, coordinated program to ID and address the causes and impacts of cyanobacteria and HABs in California (Strategy implementation)
- Partnership: state, federal, and local agencies; tribes, academia, and NGOs



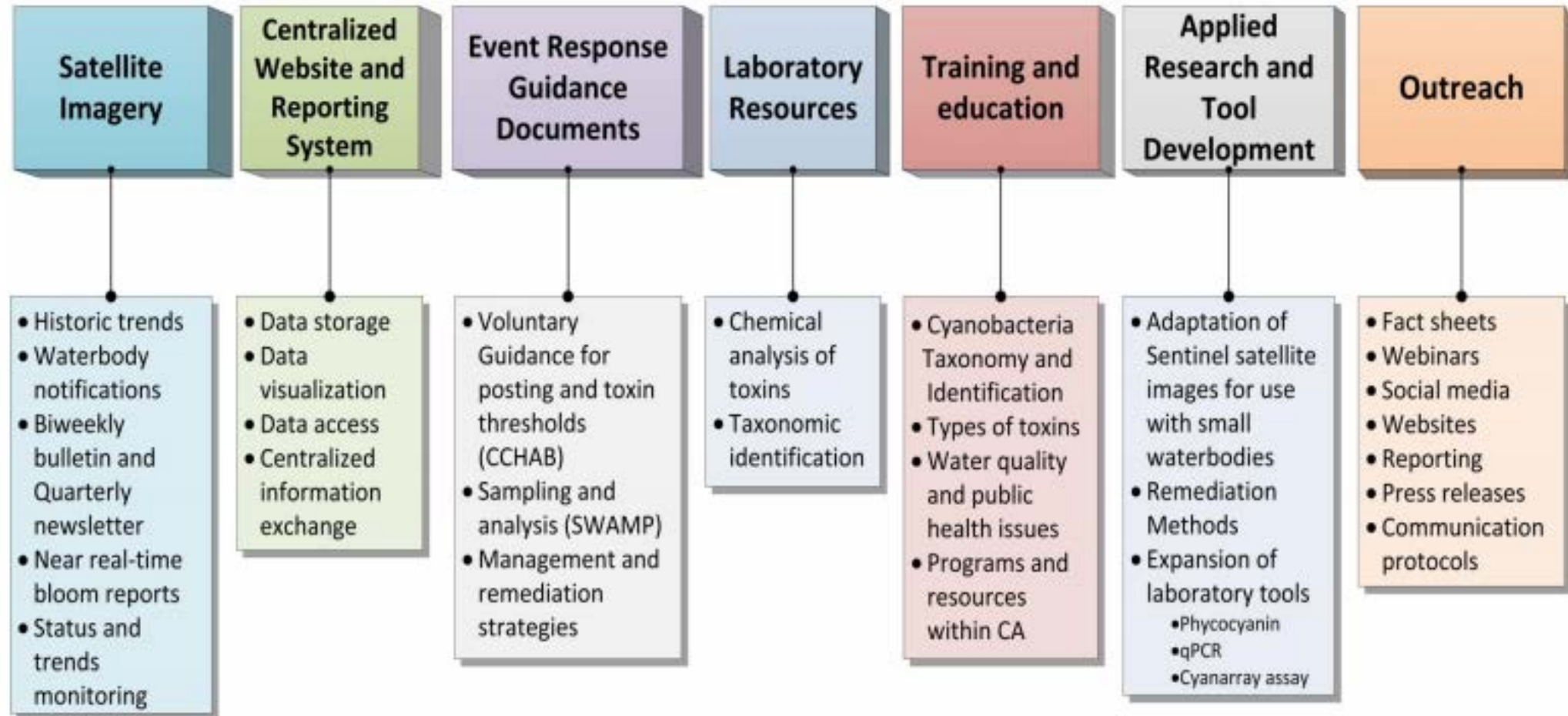
- Under the overarching guidance of the CA Water Quality Monitoring Council



# Freshwater HABs Assessment and Support Strategy Framework



# Infrastructure



# CENTRALIZED WEBSITE & REPORTING & INFO DISSEMINATION



Portals

About Us

Work Groups

HABs Links

## California Harmful Algal Blooms (HABs)

HAB events represented below are voluntarily reported to the State Water Board's Surface Water Ambient Monitoring Program. Data provided are for general information purposes only and may contain errors. The exact location, extent and toxicity of the reported bloom may not be accurate and may not be affecting the entire waterbody. The data are subject to change as new information is received. Please check back for updates.

- [More detailed information on freshwater HAB events](#)



### Toolbox

- [Report a Bloom](#)
- [Signs and Guidance for Posting](#)
- [Field Guide and Forms](#)
- [Resources for Labs](#)

### News and Announcements

- [Current Advisories](#)
- [Bulletins & Newsletters](#)
- [California CyanoHAB Network](#)

### Questions Answered

- [What are harmful algal blooms?](#)
  - What are harmful algae?
  - Why are they important?
  - Where do they come from?
  - Why should I be concerned?
  - What are the impacts?
    - Swimming & recreation
    - Drinking water
    - Fish & shellfish harvesting
    - Domestic animals
    - Wildlife
- [Where are harmful algal blooms occurring?](#)
  - HABs event maps
    - Freshwaters



# Report a Bloom

Report a bloom - either suspected or confirmed

- Online [Freshwater Bloom Incident Form](#)
- Call toll free: 1 (844) 729-6466
- Email: [CyanoHAB.Reports@waterboards.ca.gov](mailto:CyanoHAB.Reports@waterboards.ca.gov)

All reports are directed to the state reporting hub and managed by the Water Boards

- Incident response coordinated with multi-agency task force



# EVENT RESPONSE GUIDANCE DOCUMENTS

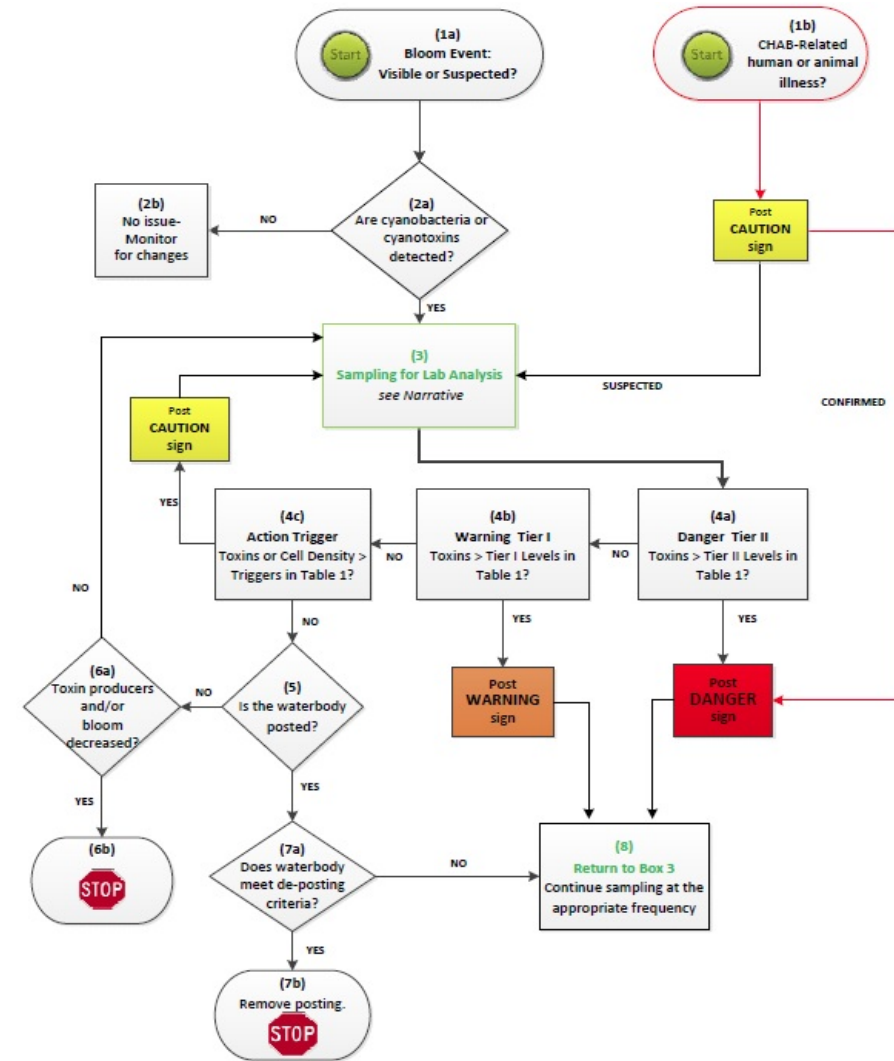
Table 1. CyanoHAB Trigger Levels for Human Health

	Caution Action Trigger	Warning TIER I	Danger TIER II
<b>Primary Triggers<sup>a</sup></b>			
Total Microcystins <sup>b</sup>	0.8 µg/L	6 µg/L	20 µg/L
Anatoxin-a	Detection <sup>c</sup>	20 µg/L	90 µg/L
Cylindrospermopsin	1 µg/L	4 µg/L	17 µg/L
<b>Secondary Triggers</b>			
Cell Density ( <i>Toxin Producers</i> )	4,000 cells/mL	--	--
Site Specific Indicators of Cyanobacteria	Blooms, scums, mats, ect.	--	--

<sup>a</sup> The primary triggers are met when ANY toxin exceeds criteria.

<sup>b</sup> Microcystins refers to the sum of all measured microcystin variants. (See Box 3)

<sup>c</sup> Must use an analytical method that detects ≤ 1µg/L Anatoxin-a.



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WARNING

Toxins from algae in this water can harm people and kill animals.

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# STANDARD OPERATING PROCEDURES FOR MONITORING & SAMPLING

**CA .GOV** **My Water Quality** **Are harmful algal blooms affecting our waters?**

**PORTALS** **ABOUT US** **WORK GROUPS** **HABs Links**

## SWAMP's California Freshwater Harmful Algal Bloom Field Guide

Welcome to the California Freshwater Harmful Algal Bloom Field Guide, prepared by the Surface Water Ambient Monitoring Program (SWAMP). The goal of this manual is to provide easy-to-use, individually downloadable guidance documents, forms, and standard operating procedures (SOPs) for responding to possible harmful algal blooms (HABs). The topics covered in this field guide are listed on the side of this page for easy navigation.

- **Not sure which resources you need?**  
Download our visual guide to assist you in selecting field forms and methods. **\*Coming Soon\***

### Before Heading Out . . .

#### Health and Safety Guide

Protecting the health and safety of field personnel is of the utmost importance in any type of environmental sampling. Collecting samples in and around water bodies experiencing HABs has additional risks because some HABs can produce toxins, which can poison livestock and wildlife, as well as humans. Caution and safety procedures should be used to prevent direct contact with a bloom.

Field personnel should read and familiarize themselves with the information contained in this Health and Safety Guide before visiting a monitoring site.

- [Download Health and Safety Guide](#)

#### Site Reconnaissance SOP

Project staff should gather information about a monitoring site before and during an initial site visit. It is important to understand where the site is located, who owns and manages the land where you want to sample, and if there are any access limitations or safety issues that field personnel will encounter.

This Site Reconnaissance SOP provides procedures and helpful tips for compiling information about the site before and during a site visit.

- [Download Site Reconnaissance SOP](#)

### Table of Contents

- **Before Heading Out . . .**
  - Health and Safety Guide
  - Site Reconnaissance SOP
- **Making Observations and Measurements in the Field**
  - Field Sheet and Chain-of-Custody Forms
  - Visual Guide to Observing Blooms
  - Field Microscopes SOP
  - Field Fluorometry SOP
  - Field Toxin Detection Test Kits SOP
- **Collecting Samples for Laboratory Analysis**
  - Toxin Sample Collection SOP
  - Microscopy Sample Collection SOP
  - Fluorometry Sample Collection SOP
  - Laboratories for Analysis Guide
- **Interpreting the Data & Posting Advisories**
  - Cyanobacteria and Known Toxins Chart
  - Guide to Interpreting the Lab Report
  - HAB Incident Response and Posting Advisories Guide
  - Submitting Data to SWAMP
- **Incidents of Toxin Exposure**
- **Glossary**
- **Contacts**

# STANDARD OPERATING PROCEDURES FOR MONITORING & SAMPLING

## FIELD SAMPLING KITS



## CyanoHABs Laboratory List

The purpose of this laboratory list is to readily provide information about laboratories capable of analyzing water samples for cyanobacteria and the toxins cyanobacteria can produce. This list is not intended to describe any regulatory requirements or make any laboratory endorsements. The laboratories are listed in alphabetic order. Please note – laboratories should be contacted prior to submitting any samples. Many laboratories discussed flexibility in prices and the need to coordinate any sampling and analysis. (This list was last updated September 2016)



Cyanotoxin Analysis								
Laboratory	Matrix	Cyanotoxin	Method	MDL (µg/L)	RL (µg/L)	Response Time	Sample Storage/ Shipping Condition	Shipping Preference
Beagle Bioproducts Inc. Contact: (614) 682-6588 <a href="mailto:info@beaglebioproducts.com">info@beaglebioproducts.com</a> Location: Columbus, OH	DW, AW	microcystins, total	ELISA	contact lab	contact lab	2 day response time. 24 hours response time upon request and additional fees.	<a href="http://Beaglebioproduct.com">Go to Beaglebioproduct.com</a> for sampling kits & shipping containers for purchase.	Fedex overnight. Samples collected over weekend should be frozen and shipped Monday.
	DW, AW	microcystins	LC-MS	contact lab	contact lab			
	DW, AW	microcystins	LC-MSMS	contact lab	contact lab			
	DW, AW	anatoxin-a	ELISA	contact lab	contact lab			
	DW, AW	cylindrospermopsin	ELISA	contact lab	contact lab		<a href="http://beaglebioproducts.com">Go to beaglebioproducts.com</a> for sampling guide and more details.	
	DW, AW	saxitoxins	ELISA	contact lab	contact lab			
	DW, AW	anatoxin-a	LC-MS	contact lab	contact lab			
	DW, AW	cylindrospermopsin	LC-MS	contact lab	contact lab			
<a href="http://BENDGENETICS.LLC">BEND GENETICS, LLC</a> LABORATORY Contact: (541) 600-GENE or <a href="mailto:customer_service@bendgenetics.com">customer_service@bendgenetics.com</a> Location: Sacramento, CA	DW, AW	microcystins, total	ELISA	0.10	contact lab	Response time next day from sample receipt (Mon. – Thurs. delivery), and rush services (same day) can be arranged.	Frozen or on wet ice	No preference
	DW, AW	anatoxin-a	ELISA	0.10	contact lab			
	DW, AW	cylindrospermopsin	ELISA	0.04	contact lab			
	DW, AW	saxitoxins	ELISA	0.015	contact lab			
	DW, AW	domoic acid	ELISA	6	contact lab			
	Tissue (shellfish)	microcystins	ELISA	contact lab	contact lab			
	Tissue (shellfish)	saxitoxins	ELISA	0.015	contact lab			
	Tissue (shellfish)	domoic acid	ELISA	30	contact lab			
Tissue (shellfish)	okadaic acid	ELISA	100	contact lab				
CA Animal Health and Food Safety Lab (CAHFS), UC Davis Contact: (530) 752-7578 Location: Davis, CA	Note: Lab analyzes samples related to <i>animal health</i> . The lab can analyze animal samples (tissues and stomach contents) related to possible animal exposures to cyanotoxins from harmful algal blooms.			contact lab	contact lab	contact lab	contact lab	No preference



# EDUCATION AND OUTREACH

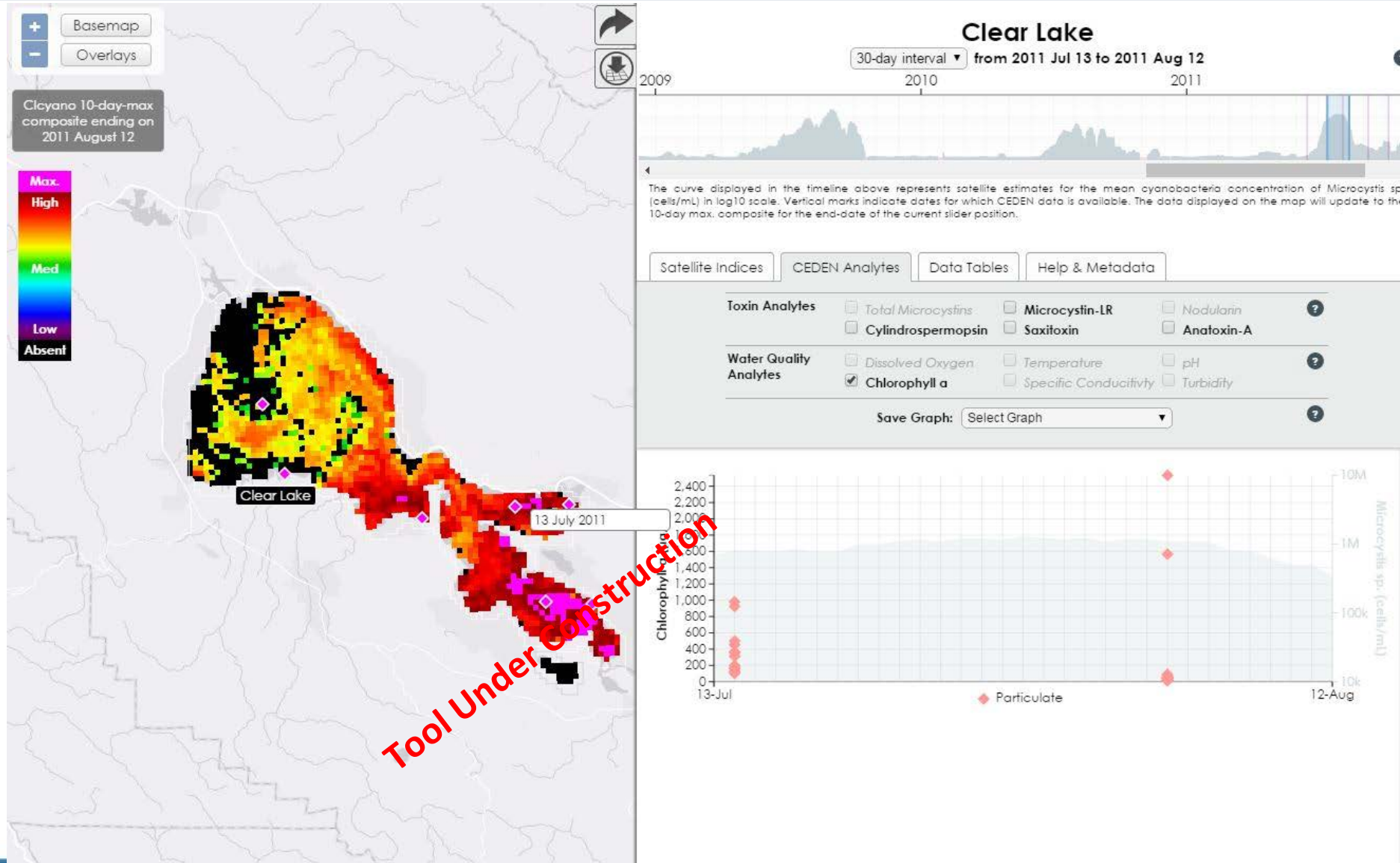


## Informational Presentations

- 2016 One Day Workshop on **Identifying and Responding to Cyanobacteria Harmful Algae Waterblooms in California** - Recorded June 14, 2016 at the University of California, Davis  
These lectures, organized by the State Water Resources Control Board's Training Academy and OIMA's Surface Water Ambient Monitoring Program (SWAMP) in cooperation with UC Davis Extension, were recorded and can be viewed on YouTube.
  - [HABs Workshop Video Playlist](#)
  - [Introduction: Goals of Workshop](#) 9:35
  - [Lecture 1: History and Biology of Harmful Algae Blooms \(HABs\) National and International Approaches to Detection, Management and Mitigation](#) 56:18
  - [Lecture 2: Sampling, Handling, Storage and Shipment of CyanoHABs](#) 46:09  
Includes guidance on their classification as hazardous substances.
  - [Lecture 3: Cyanobacteria taxonomy, identification, enumeration and biovolume determination](#) 1:07:16
  - [Lecture 4: SWAMP Freshwater HABS Program and Resources & CCHAB Voluntary Guidance Updates](#) 52:47
  - [Lecture 5: Management and mitigation options, a ground level approach](#) 46:20
  - [Lecture 6: Lab – Identification of CyanoHABs-discussion of taxonomy keys plus some discussion/demonstration of sampling, handling and enumeration](#) 23:15
  - [2015 Lecture: An Introduction to Using Dichotomous Keys to Identify Organisms Causing Harmful Algal Blooms \(HABs\)](#) 5:08
- California Water Quality Monitoring Collaboration Network's **Cyanobacteria (Blue-green algae)**, January 2016
  - [Widespread Prevalence of Cyanobacteria & Cyanotoxins from a Variety of California Waterbodies](#) 1:09:28
  - [The California CyanoHAB Network \(CCHAB\)](#) 42:21
  - [Genetic Testing of Cyanobacteria Blooms](#) 49:27
  - [Biotoxin Gene qPCR Assay for the Aquatic Motoring and Management of Biotoxin Risk](#) 49:58



# APPLIED RESEARCH AND MONITORING TOOL DEVELOPMENT



# ADDITIONAL RESOURCES

THE OFFICE OF ENVIRONMENTAL HEALTH HAZARD ASSESSMENT AND  
THE UNIVERSITY OF CALIFORNIA DAVIS PRESENT  
Domoic Acid Workshop: Evaluating the State of the

The screenshot shows the website for the California Water Quality Monitoring Council, titled "My Water Quality". The page features a navigation bar with "Portals", "About Us", and "Work Groups". The main content area is titled "California Water Quality Monitoring Collaboration Network" and includes a description: "A statewide forum for members of the monitoring community to share ideas, successes and common concerns." Below this are links for "Participants", "Monthly Webinars", and "More Information".

Below the website content is a video player showing a presentation. The video title is "Introduction-Goals of Workshop" and it has 34 views. The video content includes several slides and a speaker. The slides are:

- Slide 2: "Lecture 2 Sampling, Handling, Storage and Shipment of CyanoHABs" (46:10, 58 views)
- Slide 3: "Lecture 3 Cyanobacteria taxonomy, identification, enumeration and biovolume determination" (h2o monitoring)
- Slide 4: "Lecture 4 SWAMP Freshwater HABs Program and Resources CCHAB Voluntary Guidance Updates" (h2o monitoring)
- Slide 5: "Lecture 5 Management and mitigation options: A ground level approach" (h2o monitoring)
- Slide 6: "Assessments Satellite Monitoring for Cyanobacteria in Large Waterbodies across California" (h2o monitoring)

Additional text on the right side of the video player area includes "blooms along the California coast, the contamination of shellfish can be widespread. Consuming contaminated" and "Buehler Alumni Center UC Davis (AGR Room)".

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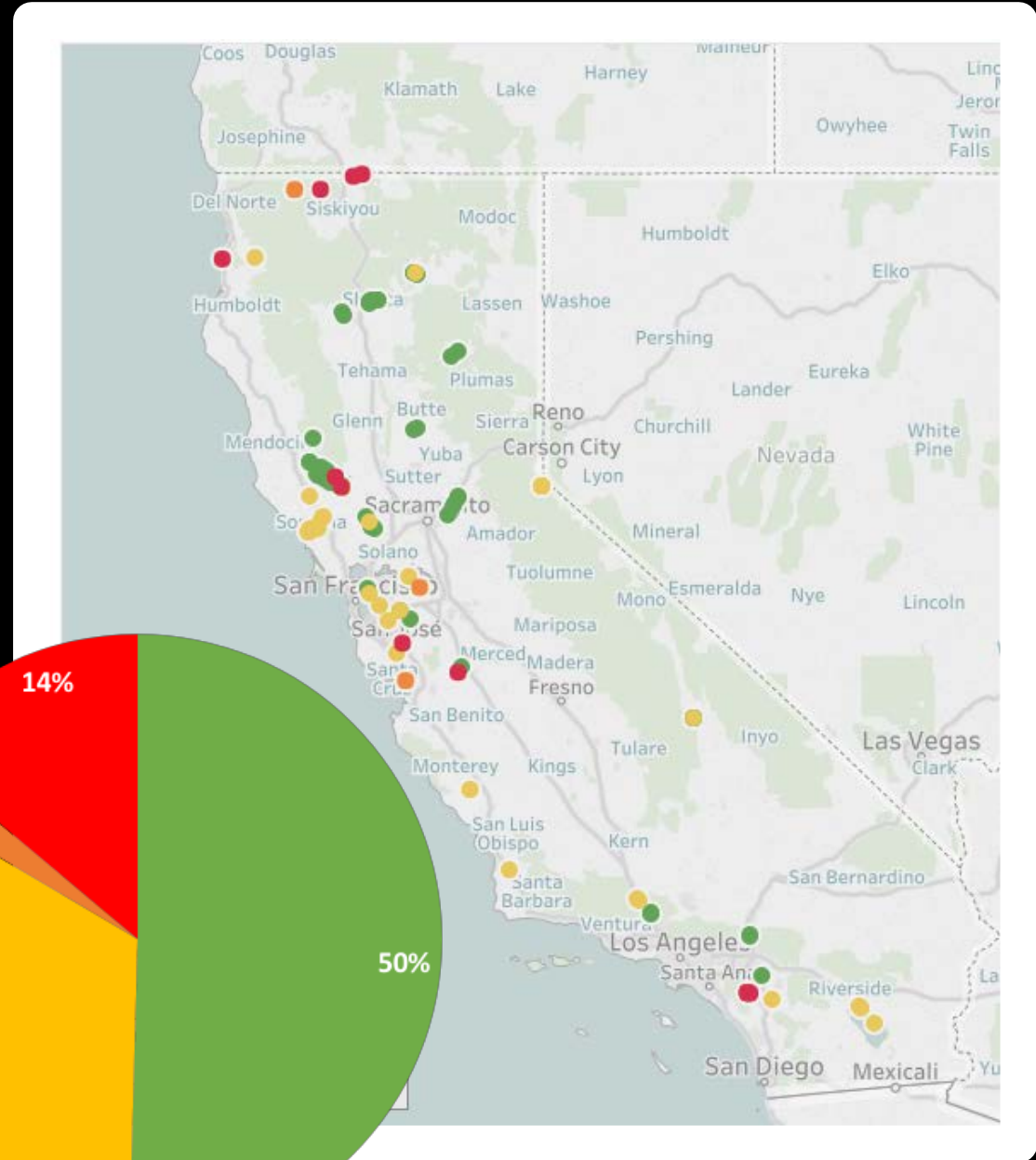
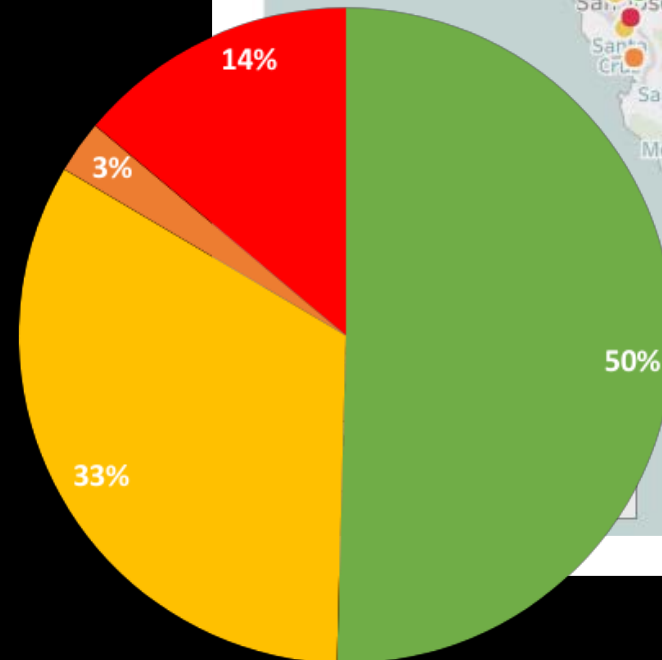
Surface Water Ambient Monitoring Program



# Pre-Holiday Assessment - Interactive Map

- 43 waterbodies/sites
- Over 100 sampling locations
- High # of visitors & history of HABs
- Dots = sampling locations, color coded by advisory level

■ No Advisory ■ Caution ■ Warning ■ Danger



# STATEWIDE GENERAL and INDIVIDUAL NPDES PERMIT

[http://www.waterboards.ca.gov/water\\_issues/programs/npdes/pesticides/weed\\_control.shtml](http://www.waterboards.ca.gov/water_issues/programs/npdes/pesticides/weed_control.shtml)

- Statewide
  - Applicable when using FIFRA and CA Department of Pesticide Regulation approved pesticide active ingredients
  - Issued by State Water Board
  - **Water Quality Order No. 2013-0002-DWQ**
- Individual
  - Applicable when using pesticide active ingredients not listed in statewide, general permit and adding non-pesticide chemical control
  - Issued by Regional Water Boards

- Algae control approaches within the NPDES framework
  - Algaecides and herbicides approved for aquatic use
  - Dyes approved for aquatic use
  - Anionic polyacrylamide & oxidizers
  - Flocculants and coagulants: alum, ferric salts, clay, polyaluminum chloride, PhosLok™
  - Barley straw
  - Biological manipulation with bacteria and viruses
- Algae control approaches outside of the NPDES framework
  - Mixing/Aeration
  - Ultra Sound
  - Floating artificial wetlands
  - Mechanical harvesting

# THANK YOU!

**Marisa Van Dyke and Ali Dunn**

Co-Leads Freshwater HABs Program

State Water Resources Control Board

Email: [marisa.vandyke@waterboards.ca.gov](mailto:marisa.vandyke@waterboards.ca.gov)

[ali.dunn@waterboards.ca.gov](mailto:ali.dunn@waterboards.ca.gov)

