Managing Cyanobacteria in the East Bay Regional Park District

Hal MacLean, Water Management Supervisor, East Bay Regional Park District
Quick Overview

• Blooms in the District
• District Bloom Response
• District Strategies to Manage Blooms
EBRPD Bloom History

- Annual Blooms
- 2008 - 1\textsuperscript{st} bloom testing at Anza
- 2010 - 2\textsuperscript{nd} bloom testing at Anza = Test Kits
- 2014 – 1\textsuperscript{st} toxin at Temescal
HABs in District Waters Since 2014

Lake Temescal - July 2014
Lake Chabot - Sept 2014
14-15 - 4 dog deaths
Morgan Territory
Dog death April 2015
Quarry Lakes - May 2015
Lake Temescal - June 2015
Lake Anza - Sept 2015
Big Break - October 2015
Sunol - Nov 2015 dog illness
Del Valle - Dec 2015
Quarry Lakes - Feb 2016
Lake Temescal - May 2016
Big Break - July 2016
Lake Anza - Aug 2016
Jones - Aug 2016
Lake Temescal - Oct 2016
Quarry Lakes - Oct 2016
Del Valle - Dec 2016
Concerns & Fallout

- Health Concerns = No bodily contact
- Swimmers & Programs = No Fun
- Fish & Wildlife = Exposure
- Stigma
## Table 1. CyanoHAB Trigger Levels for Human Health

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<td>Blooms, scums, mats, ect.</td>
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Caution – No Dogs
Warning – No Swimming
Danger – Do Not Eat Fish
Recreational Fishery

- Transient/Put & Take
- Testing Fish Tissue
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*Based on California Guidance

ug/L micrograms per liter is equivalent to parts per billion
Figure 1. Decision Tree for Posting and De-posting Health Advisories for CyanoHABs
Proposed changes to consider for Voluntary CHAB Guidance

Start
(1a) Bloom Event: Visible or Suspected?
(2b) No issue-Monitor for changes
(2a) Are cyanobacteria or cyanotoxins detected?
(3) Sampling for Lab Analysis see Narrative
(4c) Action Trigger Toxins or Cell Density > Triggers in Table 1?
(6d) Does waterbody meet de-posting criteria?
(6a) Toxin producers and/or bloom decreased?
(5) Is the waterbody posted?
(7b) Remove posting.
(7a) Does waterbody meet de-posting criteria?
(8) Return to Box 3 Continue sampling at the appropriate frequency

Start
(1b) CHAB-Related human or animal illness?
CAUTION sign

If Yes
SUSPECTED
CONFIRMED

Draft 3232016
2017 HAB Monitoring Program

(1a) Bloom Event: Visible or Suspected?
- Yes: (2a) Are cyanobacteria or cyanotoxins detected?
  - Yes: (3) Sampling for Lab Analysis
    - Yes: (4a) Closure: Toxins = Closure Triggers in Table 1?
      - Yes: (5) Return to Box 2
        - Continue sampling at the appropriate frequency
      - No: (6) Closure: Toxins ≠ Closure Triggers in Table 1?
        - Yes: (7) Remove posting
        - No: (8) Return to Box 2

(1b) HAB-Related human or animal illness?
- Yes: Post CAUTION Sign
- No: Continue monitoring

(2b) No reason to Monitor for changes
- No: (3a) Bloom Event: Visible or Suspected?
- Yes: (4b) Action Trigger: Toxins ≠ Triggers in Table 1?
  - Yes: (5) Return to Box 2
  - No: (6)Toxin producers and/or bloom decreased?
    - Yes: (7a) Does waterbody meet de posing criteria?
      - Yes: (8) Return to Box 2
      - No: (9) Permanent posting
    - No: (10) Return to Box 2
HAB Monitoring Program

Weekly Visual During Recreation Sampling (DV, SC, QL, Tem, Anza- major swim areas)

Park Staff Monitoring

Interns Monitor Trouble Spots and Strategic Areas

Abraxis Toxin Kit - Initial Evaluation

Certified Lab or CAAS - Confirmation

Staff and Health Dept. Coordination & Notifications

Public Notification, Education and Outreach

Remediation Actions

Strategic Planning
Typical EBRPD Monitoring

Visual ID

Cyanobacteria?
Typical EBRPD Monitoring

Visual ID Cyanobacteria?
Got Toxins?
You need to test to know
Typical EBRPD Monitoring

- Collect & ID Samples
<table>
<thead>
<tr>
<th>Cyanobacteria Genera</th>
<th>Hepatotoxins</th>
<th>Neurotoxins</th>
<th>Dermatoxins</th>
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<td>CYN MC NOD ATX BMAA NEO SAX LYN LPS</td>
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<tr>
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</tbody>
</table>
Typical EBRPD Monitoring

Test samples

Test Strips
Typical EBRPD Monitoring

Confirm samples
## Certified Lab Confirmation

### United States Environmental Protection Agency
Region 9 Laboratory

1337 S. 4th Street, Building 201, Richmond, CA 94804
Phone (510) 412-2300 Fax (510) 412-2302

Project Manager: Susan Kaydel
Project Number: R14WI2
Project Title: FY2016 Cyanobacteria for California Lagoon

<table>
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<tr>
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<th>Raw Material</th>
<th>Method</th>
<th>Target Analysis</th>
<th>Result</th>
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<td>Microcystis sp.</td>
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Typical EBRPD Response

Notification/Posting

DANGER

Toxins from algae in this water can harm:

- Water

CyanoHAB Trigger Levels for Human Health in EBRPD

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Based on California Guidance

ug/L micrograms per liter is equivalent to parts per billion

For more information, contact East Bay Regional Park District
(510) 544-2328 or visit the California Department of Public Health online
www.cdph.ca.gov/healthinfo/environment/water/pages/bluegreenalgae.aspx
For more information on harmful algae, go to
wwwmonitoring_council/cyanohab_network
**Typical EBRPD Response**

**Weekly Emails**

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**April 14th CyanoHAB (Cyanobacteria Harmful Algal Blooms)/Cyanobacteria/Blue-Green Algae (BGA) Update**

<table>
<thead>
<tr>
<th>Quarry Lakes (Caution)</th>
<th>Lake Del Valle (Caution)</th>
<th>Lake Chabot (Caution)</th>
<th>Shadow Cliffs (No Visible BGA)</th>
<th>Lake Anza (No Visible BGA)</th>
<th>Lake Temescal (No Visible BGA)</th>
<th>Big Break (No Visible BGA)</th>
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**Quarry Lakes** is still experiencing a bloom by the boat launch. On Thursday the bloom was getting thicker and beginning to turn turquoise from the decaying cyanobacteria. We did not run any tests, but did have Microcystin toxins last week. The lake remains closed to body contact. We plan to monitor again next week.

Del Valle will re-open tomorrow, April 15th. We are still seeing small specs of cyanobacteria around the boat launch and the marina. On Monday we sent four samples (DW intakes, raw water, clarifier, and distribution system) to Bend Genetics. All of the samples came back absent for all four types of toxins (Microcystin, Anatoxin-A, Cylindrospermopsin, and Saxitoxin). We also ran a sample from the boat launch using our in house ABRAxis test strip kit, and no Microcystin toxins were detected. Today there was still some suspended bits of Anfahizomenon, but less than on Monday. We will monitor again next week.

Our Fisheries Department conducted a bass survey in Honker Bay at Lake Chabot on Tuesday. There were small clumps of cyanobacteria dispersed throughout the area, but no scums visible.

There was no visible cyanobacteria at Shadow Cliffs, Lake Anza, Lake Temescal, or Big Break. Lake Anza and Lake Temescal are scheduled to open on April 29th, but may open on April 22nd depending on the weather.

Fishing remains open at all facilities.

Please report any suspicious algae, and let me know if anyone needs to be added to this distribution list.

For Reference:

State recommendations are to close lakes to swimming with the detection of: 6 ppb of Microcystin toxins; 20 ppb of Anatoxin-A toxins or 4 ppb of Cylindrospermopsin.

Have a great weekend,

Hal
Toxic Algae Update

Due to the drought and unusually warm weather conditions, toxic blooms of blue-green algae and other water-quality issues are occurring more frequently in the East Bay Regional Park District and elsewhere. We monitor our lakes and shorelines regularly, and post warnings and closures when appropriate. Here's a current update of which lakes and shorelines are affected:

> Temescal beach at Lake Temescal is **CLOSED** to swimming and water contact due to toxins related to the blue green algae. Fishing is not currently affected and fishing access will remain open. Please keep your dogs out of the water for their safety.

> Quarry Lakes is **CLOSED** to swimming and water contact due to toxins related to the blue green algae. Fishing is not currently affected and fishing access will remain open. Please keep your dogs out of the water for their safety.

> Lake Anza contains toxic blue-green algae and is **CLOSED** to swimming. Avoid any contact with the water and keep dogs away from the water.

> Big Break Regional Shoreline contains toxic blue-green algae. Avoid contact with the water and keep dogs away from the water.

> Swimming is allowed, but keep dogs away from the water.

> Lake Del Valle contains blue-green algae but toxin levels are very low. Swimming is allowed, but keep dogs away from the water.

> Lake Chabot contains toxic blue-green algae and swimming is never permitted. Avoid any contact with the water and keep dogs away from the lake.

> Shinn Pond contains toxic blue-green algae. Avoid contact with the water and keep dogs away from the water.

The Park District encourages visitors who wish to enjoy water activities to visit those other lakes and shorelines which are currently open.
Typical EBRPD Response

Web Parks Closures and Notices page

> East Bay Regional Park District | Embrace Life! > Park Closures and Notices

Park Closures and Notices

Fire Warnings and Weather Related Information

> Fire Warning Information and Weather Related Information

Park & Trail Closure Information - Listed by Facility

> Antioch/Oakley Regional Shoreline
> Alameda Creek Regional Trail
> Alamo Canal Trail
> Anthony Chabot Regional Park
> Big Break Regional Shoreline
> Briones to Mt. Diablo Regional Trail
> Briones Regional Park
> Black Diamond Mines Regional Park
> Carquinez Strait Regional Shoreline
> Castle Rock Regional Recreation Area
> Contra Costa Canal Trail
> Claremont Canyon Regional Preserve
> Contra Loma Regional Park
> Coyote Hills Regional Park
> Las Trampas Regional Wilderness
> Marsh Creek Regional Trail
> Martin Luther King Jr.Regional Shoreline Park
> Martinez Regional Shoreline
> Miller/Knox Regional Shoreline
> Mission Peak Regional Preserve
> Morgan Territory Regional Preserve
> Old Moraga Ranch Trail
> Oyster Bay Regional Shoreline
> Pleasanton Ridge Regional Park
> Point Isabel Regional Shoreline
> Point Pinole Regional Shoreline
> Quarry Lakes Regional Recreation Area
> Redwood Regional Park
Quarry Lakes Regional Recreation Area

Watercraft Owners - Please Help Keep Invasive Mussels Out of Our Water.
> Read more about mandatory watercraft inspections and the Invasive Mussel...

Notice

Quarry Lakes is now closed to swimming and water contact due to toxins related to the blue green algae. Fishing is not currently effected and fishing access will remain open. Please keep your dogs out of the water for their safety.

ACWD work along the Alameda Creek Flood Control Channel will have temporary impacts on recreation along the Alameda Creek Trail and at Quarry Lakes Regional Recreation Area. For more information, please call (888) 327-2757, extension 4552.
Typical EBRPD Response

- Swim Beach Water Quality pages

**DANGER**

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

Stay out of the water until further notice.
Do not touch scum in the water or on shore.

DO NOT let pets go into or drink the water or go near the scum.

DO NOT drink this water or use it for cooking. Boiling or filtering will not make the water safe.

For fish caught here, throw away guts and clean fillets with tap water or bottled water before cooking.

**CAUTION**

Harmful algae may be present in this water.

For your safety:
- Stay away from algae and scum while swimming.
- Do not let pets go into or drink the water.
- Do not drink the water.
Specific Site Monitoring

[Map showing specific site monitoring locations]
Lake Temescal Monitoring
DECONTAMINATION!

- Between Bodies of Water
Lake Anza Monitoring
DECONTAMINATION!

- Between Bodies of Water
DECONTAMINATION!

- Between Bodies of Water
Quarry Lakes Monitoring Challenge

Flow of Water

[Map of Quarry Lakes with indicated flow of water]
Quarry Lakes Monitoring Challenge

Flow of Water Monitoring Sites
Aerial Monitoring!
DECONTAMINATION!

- Between Bodies of Water
Del Valle Monitoring
New Drinking Water Sampling with HAB

Pre-Chlorination

New Raw Sample

Coagulation
Floculation
Sedimentation

Filtration

Post-Chlorination

Finished Samples

Drinking Water Distribution System

Contact Pipe

Test when making water and Weekly random distribution testing
DECONTAMINATION!

• Between Bodies of Water
Lake Chabot Monitoring
DECONTAMINATION!

- Between Bodies of Water
Big Break Monitoring
Big Break Monitoring

September 15, 2016 Visual Observations of Microcystis in San Joaquin River

Key:
- Cyanobacteria colonies low
- Cyanobacteria colonies medium
- Cyanobacteria colonies high

Map of the San Joaquin River (Stockton Deep Water Ship Channel) showing visual densities of cyanobacteria (Microcystis) colonies.
DECONTAMINATION!

- Between Bodies of Water
Alameda Creek Monitoring

Calaveras Reservoir
August 29, 2016

Summary: The ICOS is on with the rate increased to 50 cfs per line on August 17, 2016. Dissolved oxygen concentrations are above saturation in the relatively warm epilimnion and have slightly increased at the thermocline, but remain less than 2 mg/L near the bottom. The total plankton concentration has increased by 191% (from 6,791,000 to 16,877,000 MPN/mL) since the previous August 16, 2016 survey, exceeding both Level I (weekly monitoring) and Level II (treatment) action triggers. The phytoplankton community is dominated by the blue green algae Lyngbya (40% of the total) with high numbers of the elodea freonae and the blue-green algae Anabaena (30% and 12% of the total, respectively). pH is elevated in the upper 15 feet of the water column. Turbidity is elevated in the surface and likely due to floating algae. The next survey will be conducted during the week of September 5th.

Gauge Height (ft): 701.8
Secchi (ft): 3.8

Conditions: clear and calm

Biologist(s): A. Iron (assisted by K. Reich)

Staflims Folding:

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<tr>
<th>Depth (ft)</th>
<th>Elevation (ft)</th>
<th>Temp (°C)</th>
<th>pH</th>
<th>Conductivity (μS)</th>
<th>DO (mg/L)</th>
<th>ORP (mV)</th>
<th>Chl-a (μg/L)</th>
<th>Phyco. (μg/L)</th>
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Phytoplankton:
- Lyngbya: 8,400,000
- Fragilaria: 5,000,000
- Anabaena: 2,000,000
- Aphanizomenon: 650,000
- Ceratium: 350,000
- Staurotheca: 200,000
- Microcystis: 130,000
- Phytoplankton Total: 16,790,000
- Zooplankton Total: 87,000
- Plankton Grand Total: 16,877,000

Water Quality Profile

50-Day Plankton Composition Trending

Blue-Green Algae and Total Plankton 13-Month Trending
DECONTAMINATION!

- Between Bodies of Water
Remediation

• Dredging is the best long term option
• Wetlands
• Aeration
• Short Term Solutions
  – Sedimentation Ponds
  – Alum/Phoslock
  – Pak 27
Progress

Continued Dredging Sedimentation Ponds at Temescal
Progress

Pak 27 Treatments

- Temescal (2014-16)
- Lake Chabot Marina (2015-16)
Progress

Removal
- Temescal Inlet
- Lake Chabot Marina
Progress

Consultants
- Wayne Carmichael

Contractors
- Terry McNabb
- Stephen McCord
- Alex Horne

Networking
- CCHAB
- CALMS
Progress

Phoslock Application
Progress

CSUEB and Nutrient Source Study

Lake Temescal Watershed
Progress

Swim Beach Maintenance & Spot Treatments
Future Tools

Satellite Imagery

What do satellite images tell us about harmful algal blooms?

**Clear Lake, Lake County, CA**

Current Advisory: State and county agencies are urging boaters and recreational users to avoid contact with blue-green algae from blooming in Clear Lake located in Lake County, CA. The lake has been posted with advisories warning of any contact with the water because of possible toxins associated with the algae. (Click for more)

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Trends | Water Quality | Data

Display Last 10 Days

Cyanobacteria Estimated Biomass & Toxicity

Tool Under Construction
Future Plans

Document our Plans

Contents
I. Background
II. State Guidance
III. Monitoring Strategy
IV. Posting
V. De-Posting

Appendices
A. Collecting Samples
B. Identifying Cyanobacteria
C. Processing Samples
D. Test Strip Kits
E. Running the CAAS
F. Certified Lab Contacts & COCs
G. Signage
H. Contacts
I. ATOCA Species and associated Toxins

East Bay Regional Park District

Blue Green Algae Response Plan

Park Operation

2017
Future Plans

Continued Commitment with CSUEB and Build upon Nutrient Source Study
Future Plans

Continued Networking, Communication, Coordination and Outreach & HAB Brochure
Future Plans

Alum Treatment and Floating Island for Temescal
Future Plans

Aeration System for System Lake Anza
Future Plans

- Continue to strategize solutions for larger lakes
Future Plans

Dredging smaller lakes?
The Tribulation Continues...

Blue Green Algae Concerns in East Bay Regional Parks

What are blue green algae? Blue green algae (or cyanobacteria) are a common native algal species often found in water or wet areas.

What is a blue green algae bloom? When conditions are right, algae can rapidly build up or "bloom" on the surface of reservoirs, rivers, creeks, lagoons, lakes, and ponds. The bloom can be green, blue green, white or brown, and may look like a floating layer of scum or paint and may have an unpleasant odor.

What causes blooms? Warm, slow-moving waters that are rich in nutrients can cause algae growth. Blooms can occur at any time, but are most common in late summer or early fall.

How do I know if a bloom is toxic? Only a few types of blue green algae are known to produce poisons. The presence of blue-green algae in a water body does not necessarily mean toxins are always present. However, identifying the presence of toxins is an expensive and difficult process and one that may involve many days to weeks before results are available. Therefore, it is prudent for recreational users to adhere to the following precautions with regard to blue-green algae blooms East Bay Regional Park District water bodies.

Always look for the signs of an algae bloom before you enter the water, or before you let your children or pets enter the water.

How dangerous is toxic algae? If toxic algae touches your skin, or you accidentally inhale or swallow water containing the toxin during recreation, you could get a rash or an allergic reaction, or develop gastrointestinal problems. The long-term effects of these exposures are not well known, but children and pets are at greatest risk. Dogs can be exposed to particularly high levels of toxins by licking blue green algae off their fur after a swim.

What should I do if I see a bloom?

- Stay out of areas where the water has foam, scum, or mats of algae. Keep children and pets out of such areas at all times. If you or your pets swim or wade in water with algae, rinse off with fresh water as soon as possible.
- If no algae scums or mats are visible, you should still carefully watch young children and warn them not to swallow the water.
- Do not drink or cook with this water. Even if you boil or filter it, the toxins can persist.
- Do not let dogs swim in or drink from areas where you see foam, scum, or mats.
- Get medical treatment right away if you think that you or your pet might have been poisoned by blue green algae toxins.
- If you accidentally swallow water from the following locations, contact your doctor immediately:

Blue Green Algae

- Blue green algae blooms are a concern in East Bay Regional Parks.
- Blooms can occur at any time, but are most common in late summer or early fall.
- Only a few types of blue green algae are known to produce poisons.
- Identifying the presence of toxins is expensive and difficult.
- Always look for signs of a bloom before entering the water.
- Avoid contact with foam, scum, or mats of algae.
- Do not drink or cook with contaminated water.
- Get medical treatment immediately if you think you or your pet may have been poisoned.

Weather
- Timing
- Location
- Communication
- Outreach
- Coordination
- Networking
Thanks to

EBRPD STAFF: Sunshine Townsend, Matthew Graul, Casey Brierley, Pamela Beitz, Faithe Lovelace, Becky Tuden, Christina Lopez, Olivia Roberts, Andrew Richie, Alex Hutcherson, Joe Sullivan, Lauren Porter, Kristen Van Dam, Josh Porter, Carolyn Jones, Lakes Unit Staff and many, many more

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AERIAL MONITORING: Key Dismukes and NASA

CDFW: Daniel Orr and Stella McMillin

CONTRACT LABS: Bend Labs, GreenWater Labs, and UCD CAHFS Labs

CAAS, TEST KITS & ADVICE: Abraxis
Questions?

Thank You