

An Update of HAB Impacts to USACE Operations and Operation Control Measures to Address HAB Impacts

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USACE Recreation Stats (FY13)

from Value to the Nation: <http://www.corpsresults.us/watersupply/wsfastfacts.cfm>

- 420 lakes in 43 states
 - hosting 33% of all fresh water fishing
 - 4,628 recreation areas
 - 80% within 50 miles of a large U.S. city
- 7,829,605 acres of land and 5,630,584 acres of water under USACE management (~ 2% of all federal lands)
 - Hosting 20% of visits on federal lands
 - 56,000 miles of shoreline; 90,773 campsites; 2,022 playground sites; 959 designated swimming areas; 9,504 miles of hiking trail; 3,671 boat ramps; 110,735 marina slips
- 335,293,332 total visits (person-trips) in FY 2012
- 9,779,584 acre-feet of water supply
 - 9,359,419 currently under contract (95.7%)
 - 7,907.53 mgd yield currently under contract

Regional and National

USACE HAB IMPACTS

Historic USACE HAB Activities

Table 3. HAB occurrence and impact summary table.

District	HAB Occurrence	HAB Impact
Louisville	Blooms occur at multiple Corps projects every summer, late in the season. Blue-green algae blooms have become a larger issue in the Louisville District in the past three years, most often in Indiana lakes, but also in Ohio and Kentucky bodies of water. Associated factors are thought to include eutrophication, oxygen depletion, high temperatures, and drought conditions.	Multiple projects have reported fish kills. Anecdotal reports of dogs that died after jumping into/drinking water high in algal toxins. Blooms have necessitated an increase in filtration and application of carbon to remove taste and toxins in the water supply. Beaches have been closed down due to blooms, and some people have reported skin rashes.
Norfolk	Large bloom occurred at the Craney Island Dredged Material Management Area in the summer of 2005.	Algal toxin effects are negligible, as the toxins dissipate in the wide mixing area of Norfolk Harbor and recreational activities do not take place in the region.
Buffalo	The Buffalo District manages and maintains many harbors along the south shore of Lake Erie, which currently faces multiple problems and concerns with algal blooms. Blooms have occurred on Lake Erie every summer, with a peak of 2-3 weeks, for at least the past 5 years.	No documented human health impacts have resulted thus far. Beaches have been closed as a precautionary measure.
Portland	Most of the Portland District projects have experienced algal blooms at one time or another. Blooms begin in June and last through the summer. In 2005, large blooms occurred at three of the 17 district projects; typically up to two-thirds of the district's projects experience a large bloom in a given year.	Despite bloom prevalence, health and property impacts were not specified.
Jacksonville	Blooms occurred at several of the district's biggest projects in 2005. Blooms seem to be associated with heavy rainfall periods.	Anecdotal reports of dead manatees. Many human health concerns, especially relating to potable water. Concerns will likely impact the design of a costly project where a downstream water quality treatment installation could increase costs.
Tulsa	Blooms occurred at six of the district's 36 projects in 2005. Marion Reservoir in Kansas blooms annually.	A dog is thought to have gotten sick from Microcystin at Marion Reservoir, Kansas. A golden algae bloom at Lake Texoma in January 2004 killed 25-30,000 fish. Golden algae threaten the striped bass fishery on the lake, which is a \$40 million/year economic asset as reported by Paul Mauk, Oklahoma Department of Wildlife Conservation.

Table 5. HAB monitoring summary table.

District	HAB Monitoring
Louisville	The Louisville District collects data from each of their reservoir projects, from the inflows and from the tail waters. At Harsha Lake the District conducted a modeling study, collecting data on a weekly basis through the summer of 2005. Sampling included five locations within the lake every four weeks at different depths. Measurements included metals, nutrients, phytoplankton, chlorophyll, and physical parameters. However, the budget only contains enough money to monitor other locations once a year (in August or September). The Corps collects water for analysis from different depths at tail waters, dam sites, and major tributaries. Special circumstances may warrant a closer look at other places. Other agencies, such as the Division of Water, Fish & Wildlife, and USGS, also collect data in Kentucky, as well as many Indiana agencies.
Norfolk	The Norfolk District has recently measured chlorophyll A levels at Craney Island. USACE noticed these levels increasing over the summer of 2005. Levels started fairly low (i.e. levels the previous winter were around 1-2 ug/L, but levels in the spring and summer were 15-20 ug/L). USACE does not have past summer background measurements and has not done testing until the last few years.
Buffalo	The Buffalo District does not collect data related to algal blooms.
Portland	For the past ten years, the Portland District has taken comprehensive measurements at three projects: the Willow Creek Reservoir (which often experiences algal blooms), Lost Creek Lake, and Applegate Dam. Sample analysis consists of organism ID, cell counts, cell density, and biovolume, as well as environmental factors (including temperature, pH, turbidity, dissolved oxygen, dissolved solids, etc.). Samples are generally 500 mL to 1 L, taken from the top layer of water. Due to budget constraints, samples are not taken regularly at other projects and often include analysis for fewer factors. The interviewee estimated that monitoring all projects on a weekly basis would take over \$100,000 per year, which is much larger than the District's entire water quality budget.
Jacksonville	Rather than USACE, the Florida DEP and South Florida Water Management District often sample for algal blooms. The Jacksonville District has, however, collected data about cyanobacteria at sites connected with the Aquifer Storage & Recovery Project. These data are taken from four sites (Lake Okeechobee, Kissimmee River, Hillsboro Canal, Caloosahatchee River), quarterly for one year. Sampling is expensive.
Tulsa	In 2005, the Tulsa District took measurements at the Marion and Fort Gibson reservoirs. Microcystin levels ranged from 2.9 to 9.6 ppb at Marion (June 8th to July 13th, samples taken every two weeks, possibly 60 or 70 samples); 2.8 to 3.6 ppb at Fort Gibson (July 6th, possibly 40 samples). Samples were also taken at Tenkiller Reservoir in 2005, and Skiatook Lake samples were taken on a day at peak of cylindrospermopsin bloom near a swim beach. All told, approximately 360 samples were taken during the year. Data include nutrient levels, total phosphorous, nitrate/nitrite, ammonia, organic carbon, chloride, and total calcium in some lakes, as well as vertical profiles of turbidity, oxygen, pH, conductivity, temperature, chlorophyll, and some light data. Most samples are surface samples; others are a half meter below surface or a meter above the bottom, taken in 1-L amber bottles, split between microcystin and cylindrospermopsin analysis. Historically, the District has had chlorophyll data, but now Dr. Bob Lynch at OU is doing phytoplankton analysis for them.

Excerpted from ERDC/TN ANSRP09-1, The Impact of Harmful Algae Blooms on USACE Operations:

<http://el.ercd.usace.army.mil/elpubs/pdf/ansrp09-1.pdf>

Provisional Date Do Not Cite

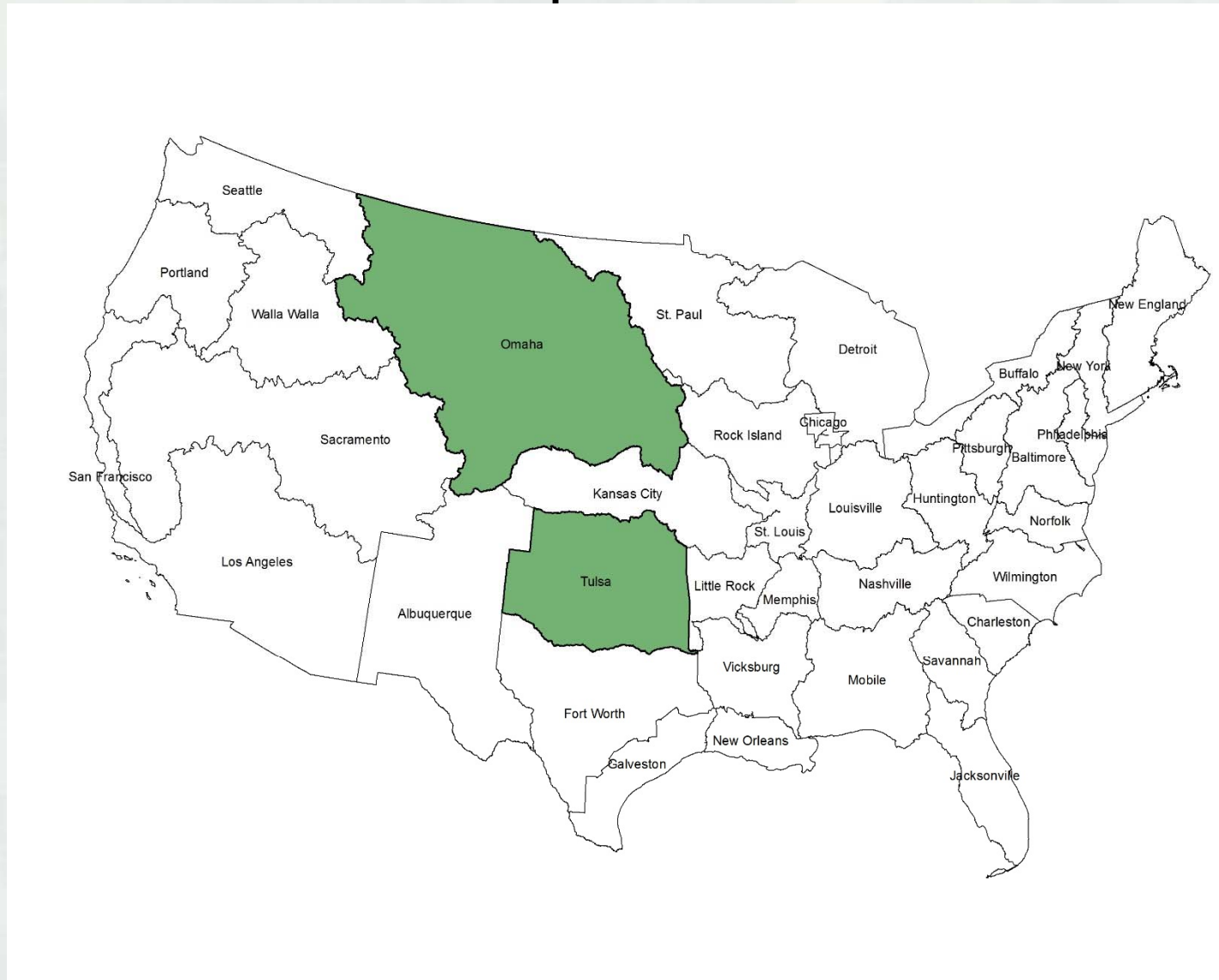
Summary of National Impacts (FY15)

District	Do you have a District HAB response plan/protocol?	HAB Algal Group	Percent of Project experiencing HABs	Area of Impact
Kansas City	No ¹	Cyanobacteria Dinoflagelates	10	Entire lake, coves open water
Rock Island	Yes	Cyanobacteria		Coves, open water
Huntington	Yes ¹	Cyanobacteria	5	Coves, open water
Pittsburg	Yes ¹	Cyanobacteria Prymnesiophyta	15	Limited to coves only Entire lake, open water
Louisville	Yes ¹	Cyanobacteria	60	Entire lake
Omaha	No ¹	Cyanobacteria	5	Entire lake
Jacksonville	Yes ¹	Cyanobacteria	< 10	No Response
Vicksburg	No ¹	Cyanobacteria		No Response
Seattle	No ¹	Cyanobacteria	1	Coves, open water
Portland	Yes ¹	Cyanobacteria	25	Entire lake, coves, open water
St. Louis	No	Cyanobacteria	< 5	Coves, open water
Tulsa	Yes ¹	Cyanobacteria Prymnesiophyta	40	Limited to coves only Entire lake, open water

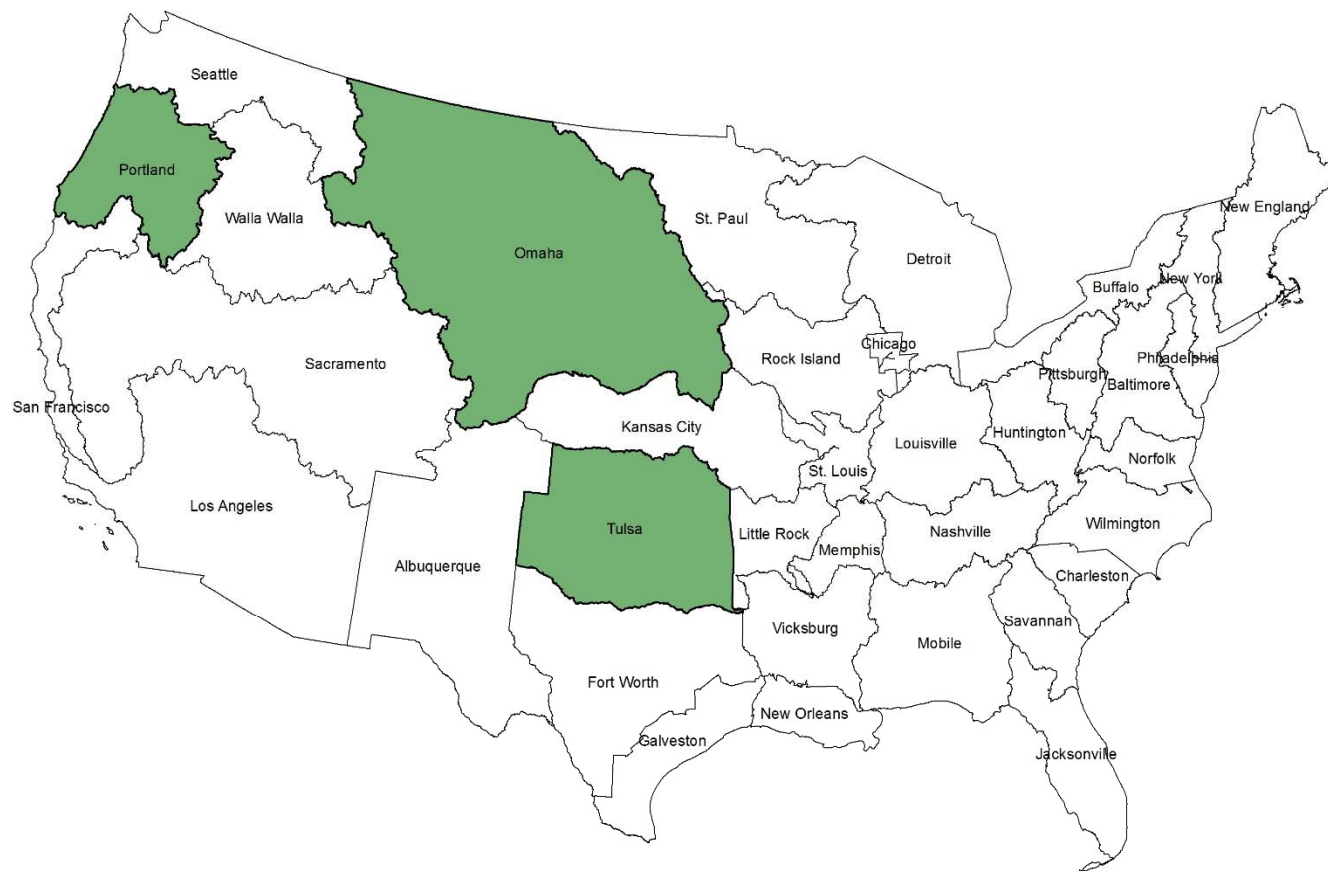
USACE Districts Regularly Reporting HAB Events and Impacts - 2004



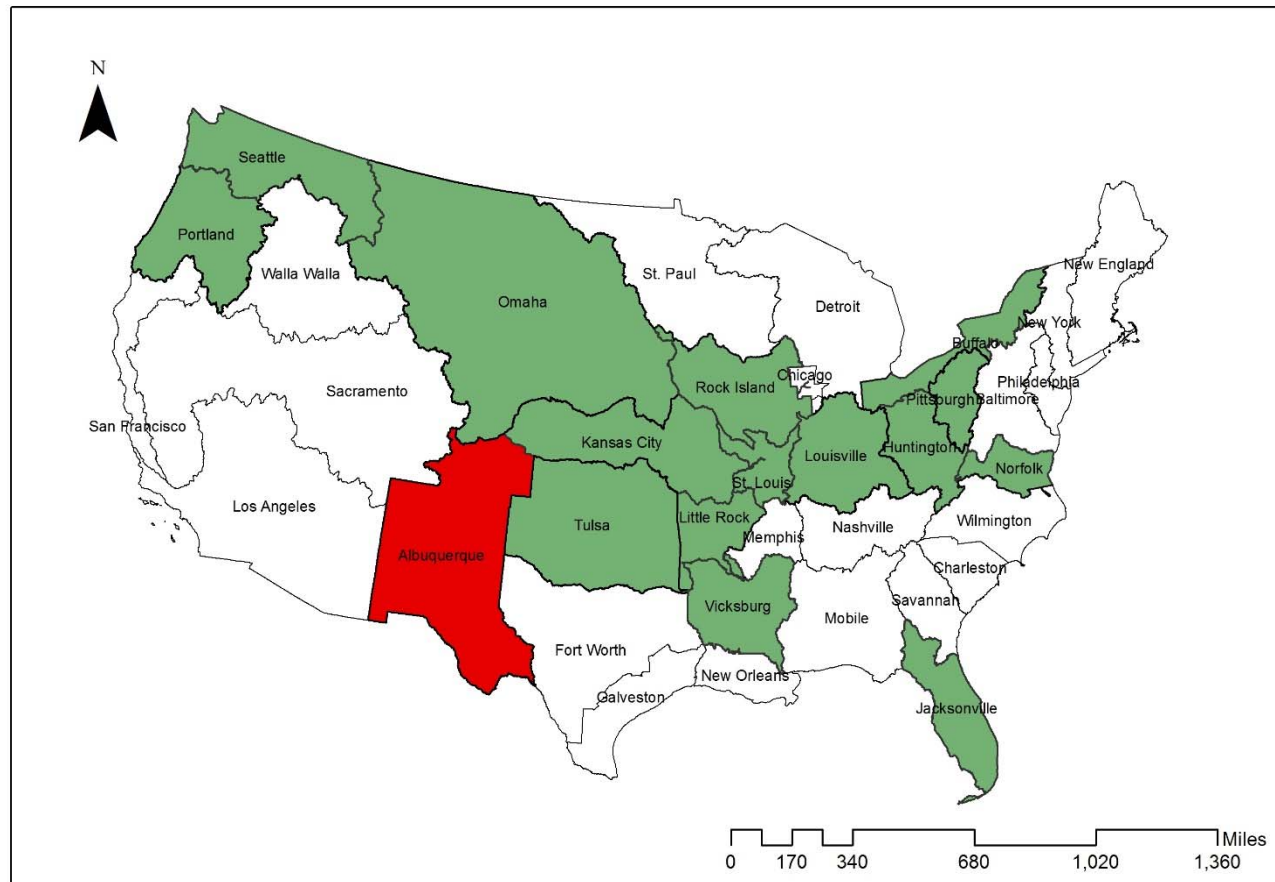
USACE Districts Regularly Reporting HAB Events and Impacts - 2007

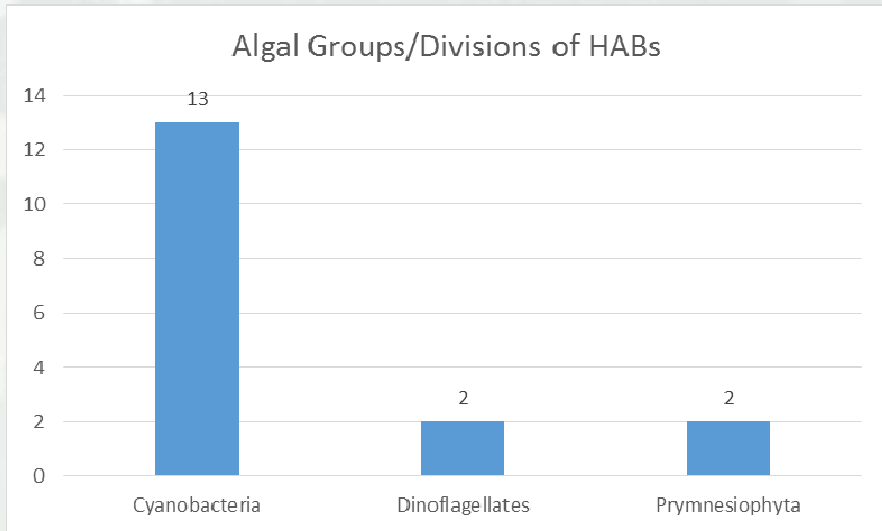
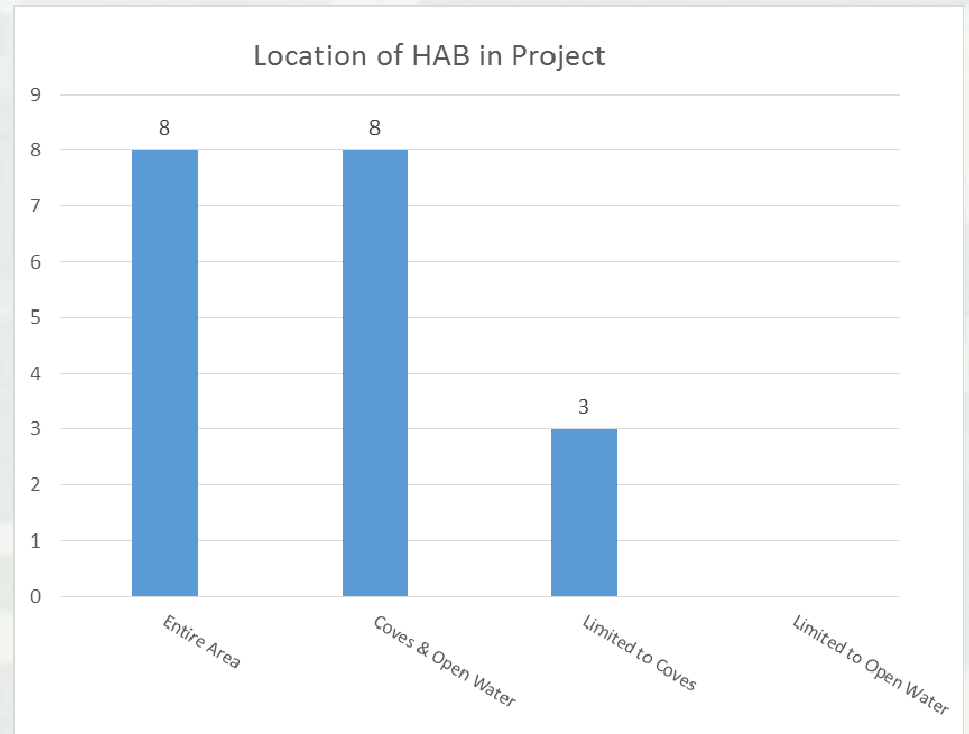
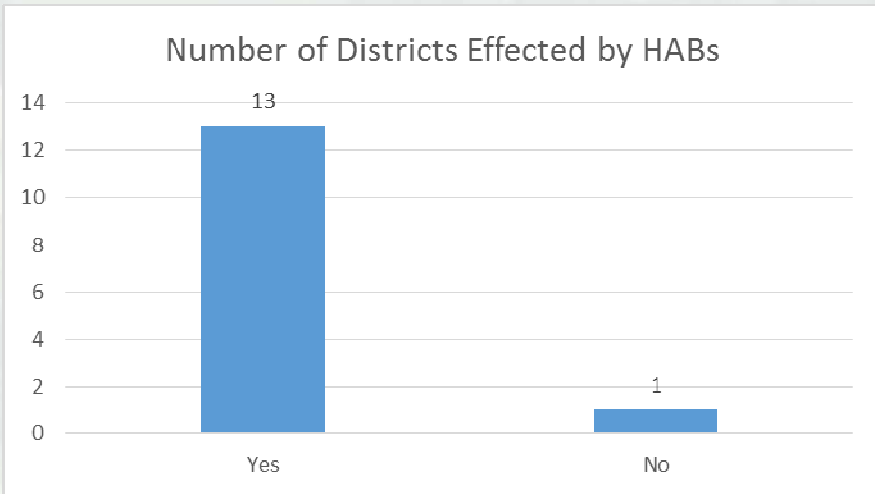


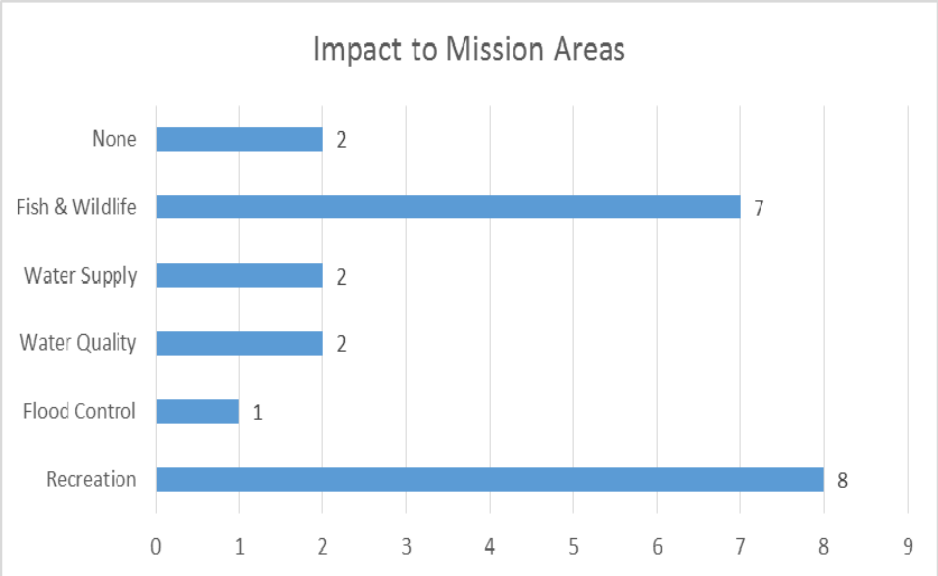
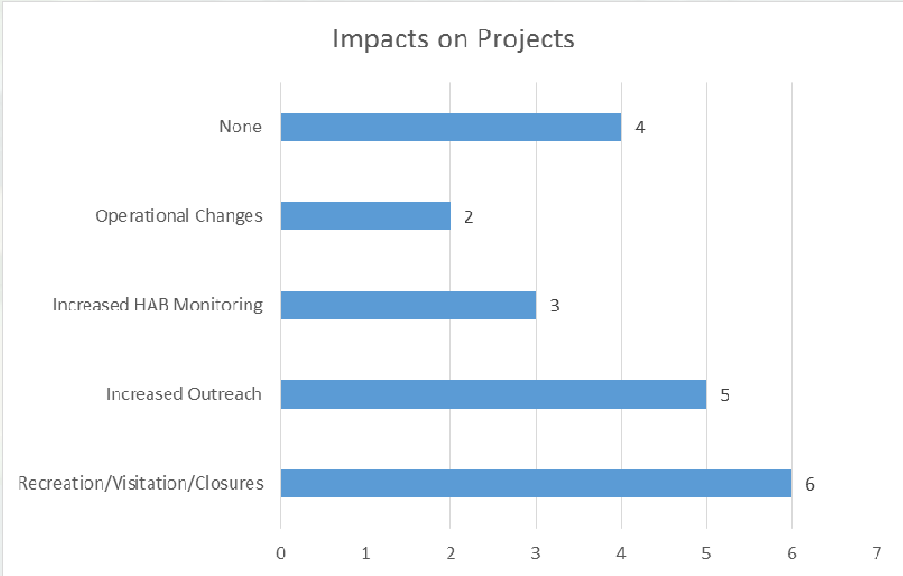
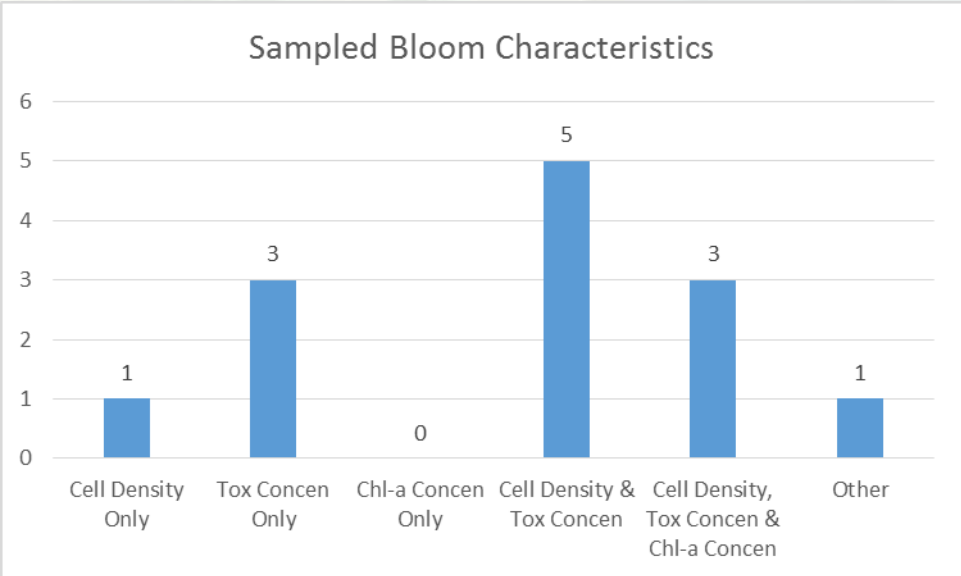
USACE Districts Regularly Reporting HAB Events and Impacts - 2009



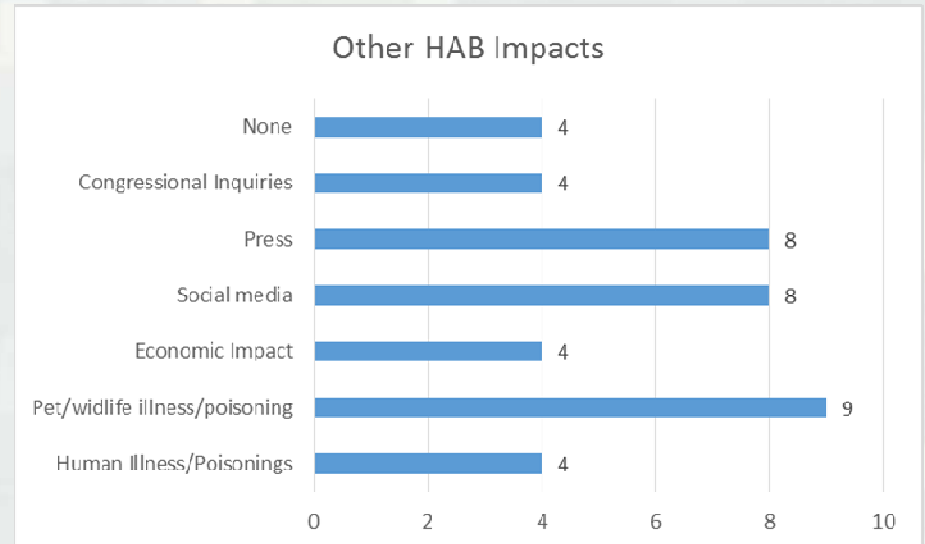
USACE Districts Regularly Reporting HAB Events and Impacts - 2012







	Office	Total Costs 2010-2014	Costs/Year
Northwestern Division			
Kansas City	NWK		
Omaha	NWO	\$64,000.00	\$16,000.00
Seattle	NWS	\$0.00	\$0.00
Portland	NWP	\$130,000.00	\$32,500.00
Mississippi Valley Division			
Rock Island	MVR	\$13,600.00	\$3,400.00
Vicksburg	MVK		
St. Louis	MVS		
South Pacific Division			
Albuquerque	SPA		
Great Lakes and Ohio R Division			
Pittsburgh	LRP	\$46,000.00	\$30,000.00
Louisville	LRL	\$370,000.00	\$104,133.33
Huntington	LRH	\$19,600.00	\$4,900.00
South Atlantic Division			
Jacksonville	SAJ	\$30,000.00	\$7,500.00
Southwestern Division			
Tulsa	SWT	\$96,000.00	\$24,000.00
Little Rock	SWL	\$4,088.00	\$1,022.00
TOTAL		\$773,288.00	\$223,455.33
Average		\$77,328.80	\$22,345.53



Impacts from HABs Experienced by USACE

- Lake closures
 - Impacts to economy
 - Frustrated public/business owners
 - Impacts to water supply customers
- Increased workload and cost to monitor HABs
 - Challenges in scaling lake monitoring to ensure public safety
 - Has resulted in limiting resources for other public outreach (Corps' life jacket campaign, campground maintenance, etc)
- Public education challenges/effectiveness
 - Mitigated somewhat by state HAB programs, varies state to state
 - monitoring and public notification practices differ from state to state – this is confusing!
 - Need for national perspective and national guidance

Financial Impacts: Grand Lake

TULSA WORLD

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Sales tax numbers show algae had little effect on Grand Lake revenue

by: RHETT MORGAN World Staff Writer
 Monday, August 29, 2011
 8/29/2011 7:34:46 AM

KETCHUM - Municipal sales tax numbers that coincide with Grand Lake difference in lake town revenues compared to the same period a year ago.

Noting the algae outbreak, the Grand River Dam Authority on July 4th chilling those who typically flock there over the Fourth of July week.

With the main part of the lake testing negative for the toxins, the Grand Lake towns are seeing a slight increase in revenue.

The city of Grove's sales tax deposit letter for August, which reflected a \$554,364, roughly a 6 percent increase over the same period in 2010.

Other lake cities showed negligible change as well. The town of Langley, Bernice and Disney, however, rose slightly.

Tulsa World: August 29, 2011

Sales tax revenues at selected Grand Lake towns

Key: 2010 2011

Grand Lake Towns	July*		August**	
Grove	\$515,075	\$516,462	\$523,754	\$554,364
Disney	\$6,702	\$6,297	\$5,806	\$5,932
Langley	\$81,026	\$79,842	\$79,581	\$77,439
Ketchum	\$11,291	\$17,005	\$20,510	\$19,928
Bernice	\$17,077	\$17,605	\$16,734	\$17,731

* Reflects collections from May 16 to June 15

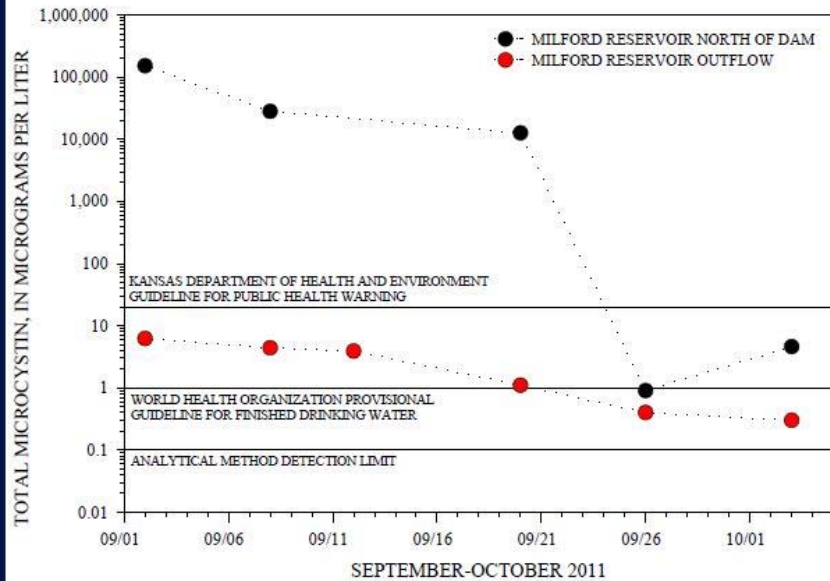
** Reflects collections from June 16 to July 15

Note:

1. Not adjusted for changes in sales tax rate.
2. Representative of July/August only.
3. Indicates the need to better understand the economic impact of HABs on a site specific, local, and regional scale.

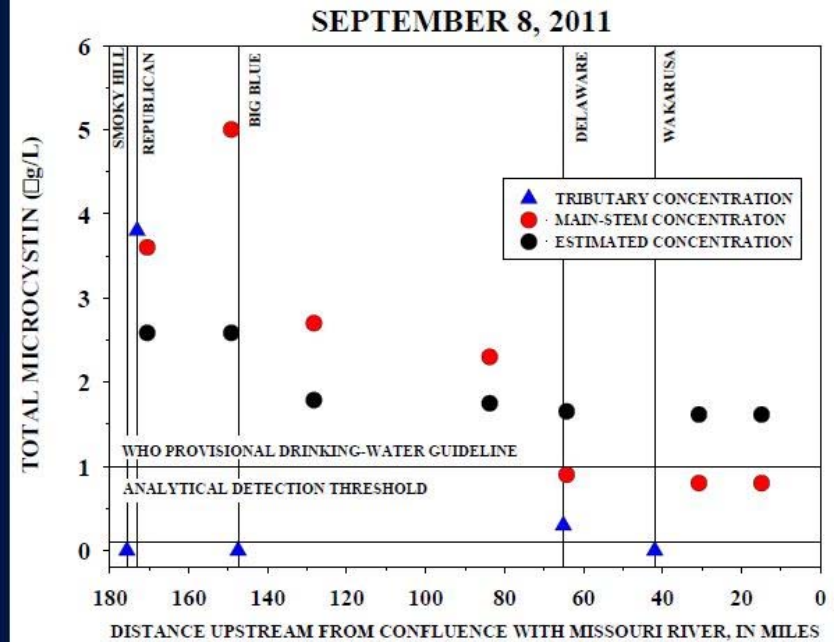
Occurrence

Cyanobacterial Toxins and Taste-and-Odor Compounds May Be Transported for Relatively Long Distances Downstream from Lakes and Reservoirs

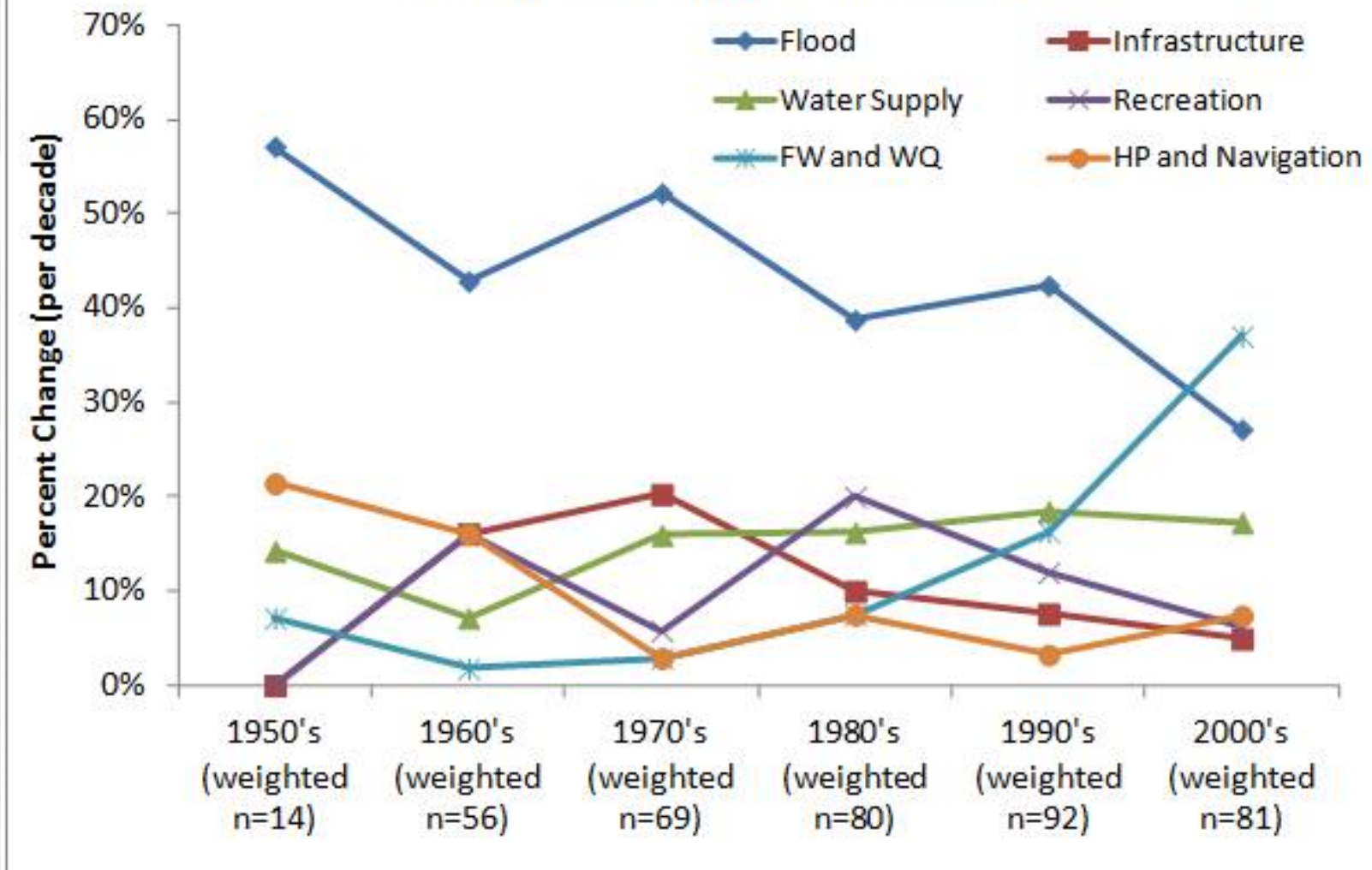


Milford Lake release sends algae to Kansas River

MARIA SUDEKUM FISHER, Associated Press
Published 09:10 p.m., Wednesday, September 21, 2011



Operational changes in WCM



Source: John Hickey, HEC

Review and Evaluation of Reservoir Management Strategies for Harmful Algal Blooms

Authors: Brook D. Herman, M.S., Jed O. Eberly, Ph.D.,
Carina M. Jung, Ph.D., and Victor F. Medina, Ph.D., P.E



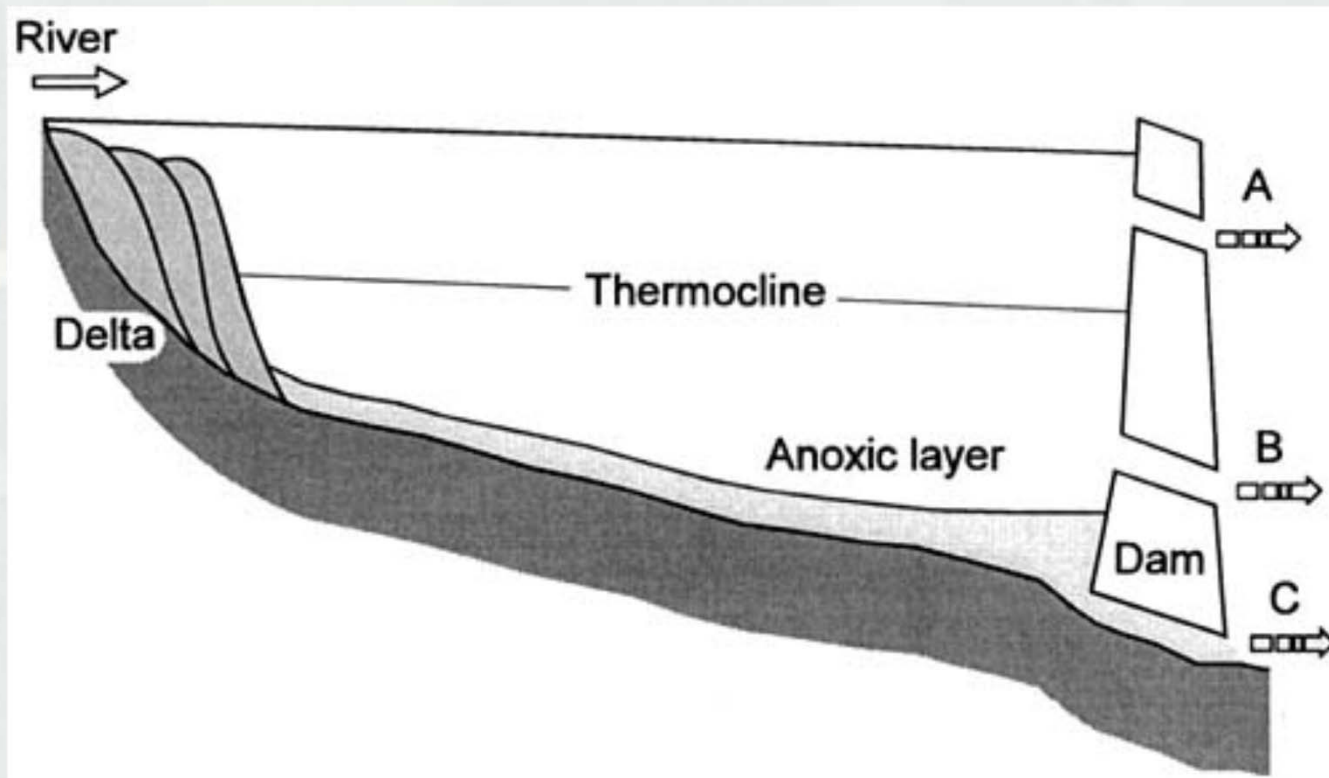
Overview of Problem

- No published guidelines or protocols for management of HABs with reservoir operations
- Uncertainties associated with HAB formation
- Managers are challenged by having to consider algal growth patterns, environmental conditions (e.g., nutrient inputs), species of algae and toxicological properties
- Need management strategies tailored to situation
- Must be flexible with new information

Management Strategies

Water Control:

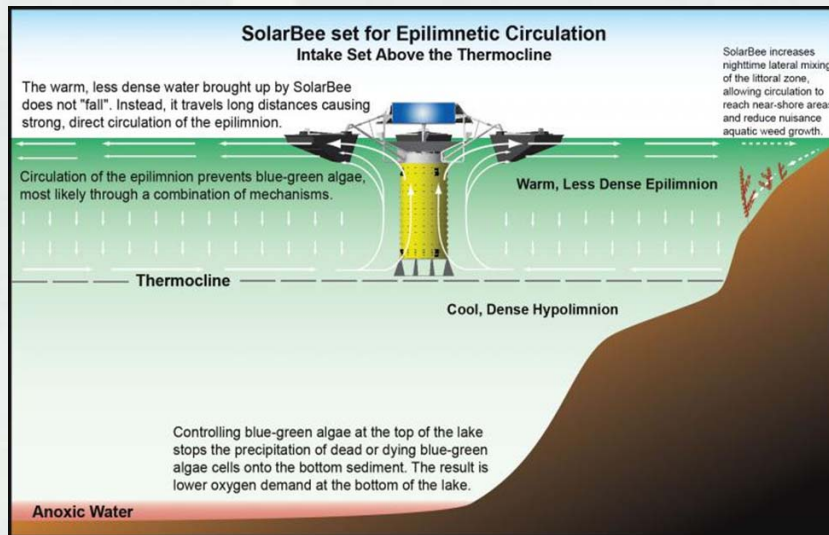
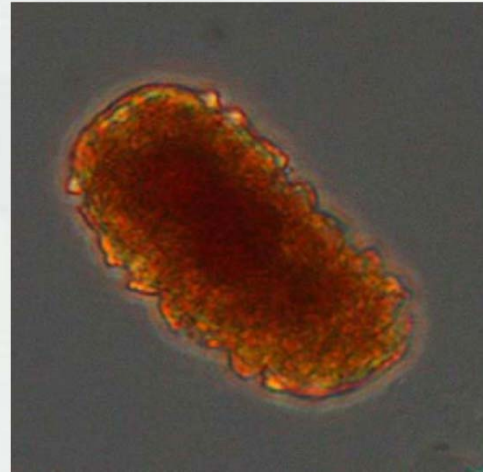
- Hypolimnetic Withdrawals
- Horizontal Flushing



Management Strategies

In Situ Treatment:

- Mechanical Mixing
- Hydraulic/Pneumatic Pumping
- Floating Covers
- Biological Control



Management Strategies

In Situ Treatment:

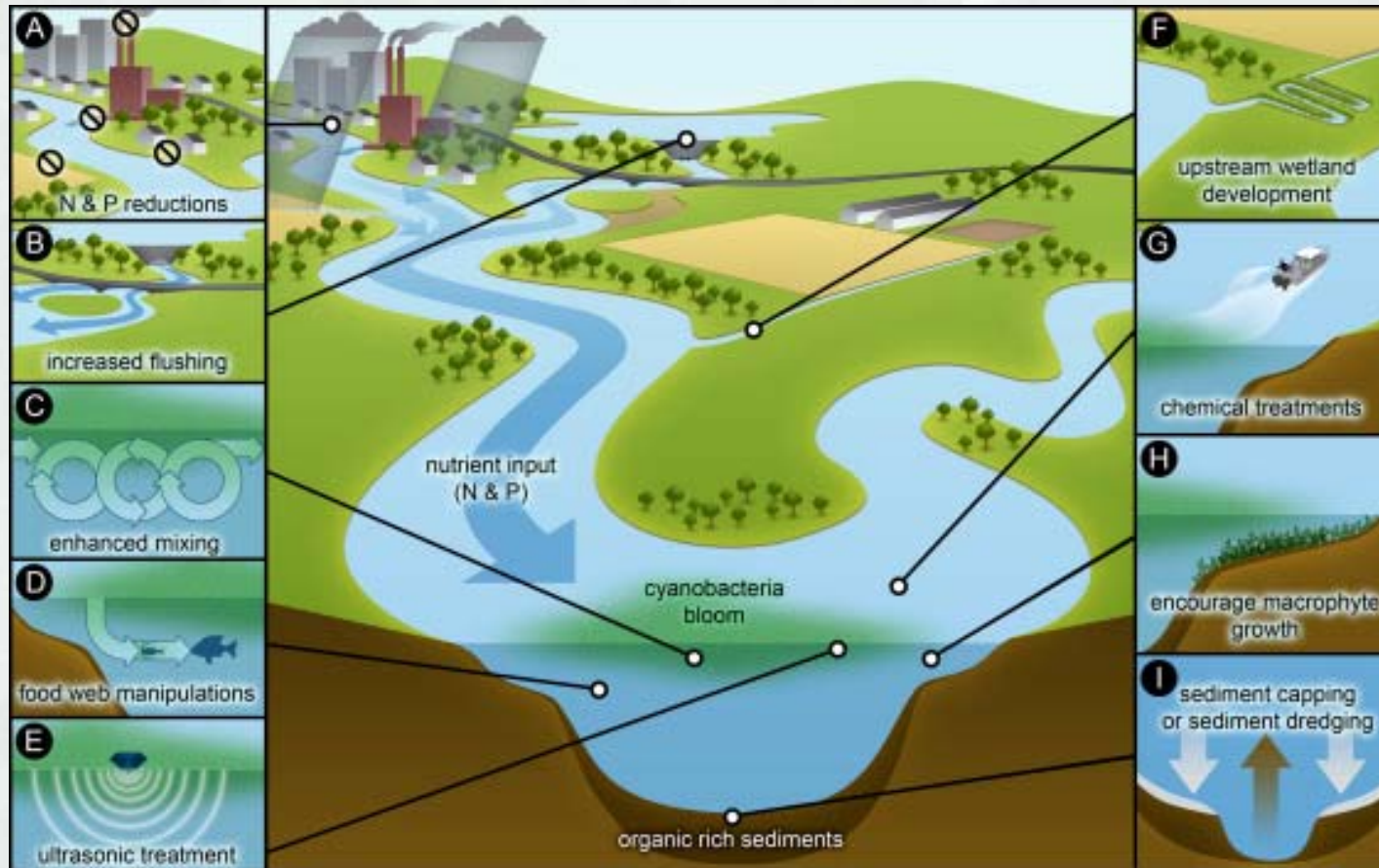
- Chemical Control
- Isolation
- Nutrient Removal/Control



Watershed Management

Nutrient/Resource Removal:

- Limit surface water nutrients entering system
- Implement nutrient controls – agricultural activities
- USACE has limited authority to enact watershed management



Conclusions

- There are a range of methods that can be applied to address HABs in reservoirs.
- The efficacy of these methods decreases in larger reservoirs.
- None of the methods individually solves all problems or is applicable in all cases.
- In larger reservoirs, a combination of methods will likely be needed.
- There is a great need for dedicated and focused research in the area of reservoir water control and management of HABs.



Questions?

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