

USACE

Great Lakes & Ohio River Division

Harmful Algae Blooms (HAB) Response Plan

Erich Emery

USACE

Great Lakes & Ohio River Division

Jade Young

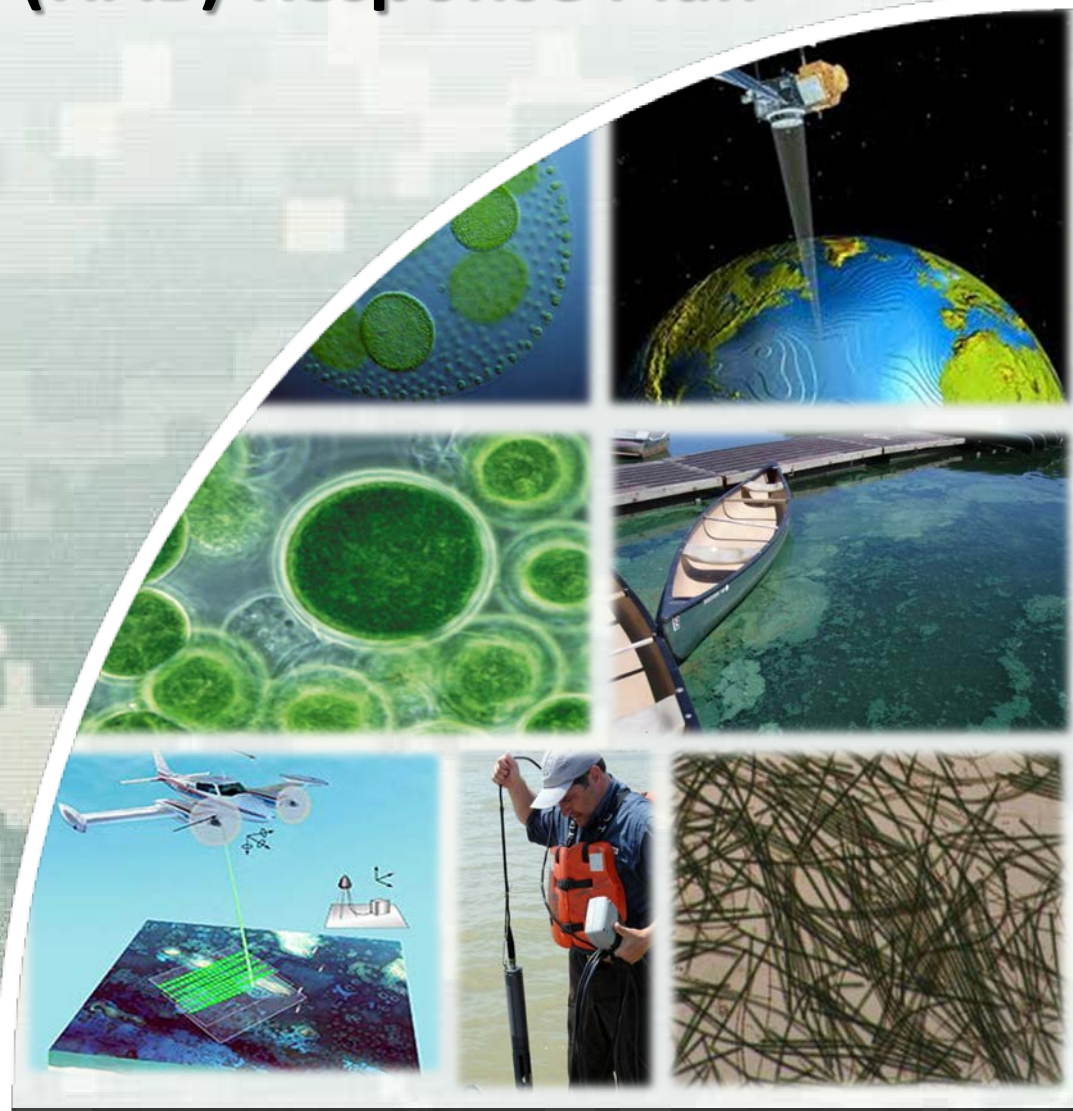
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Louisville District

28-29 MAY 2014



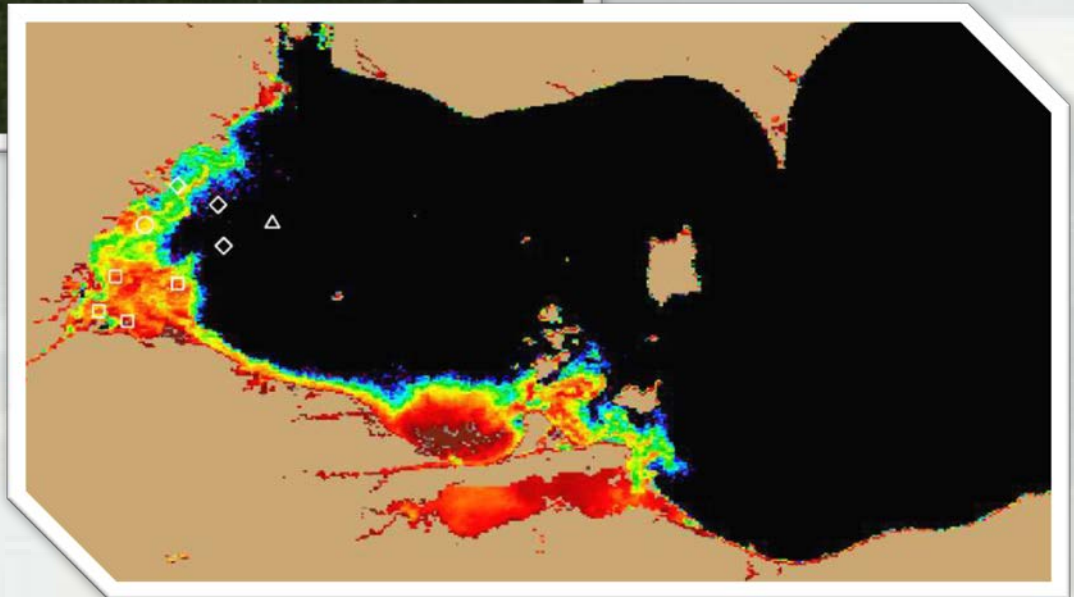
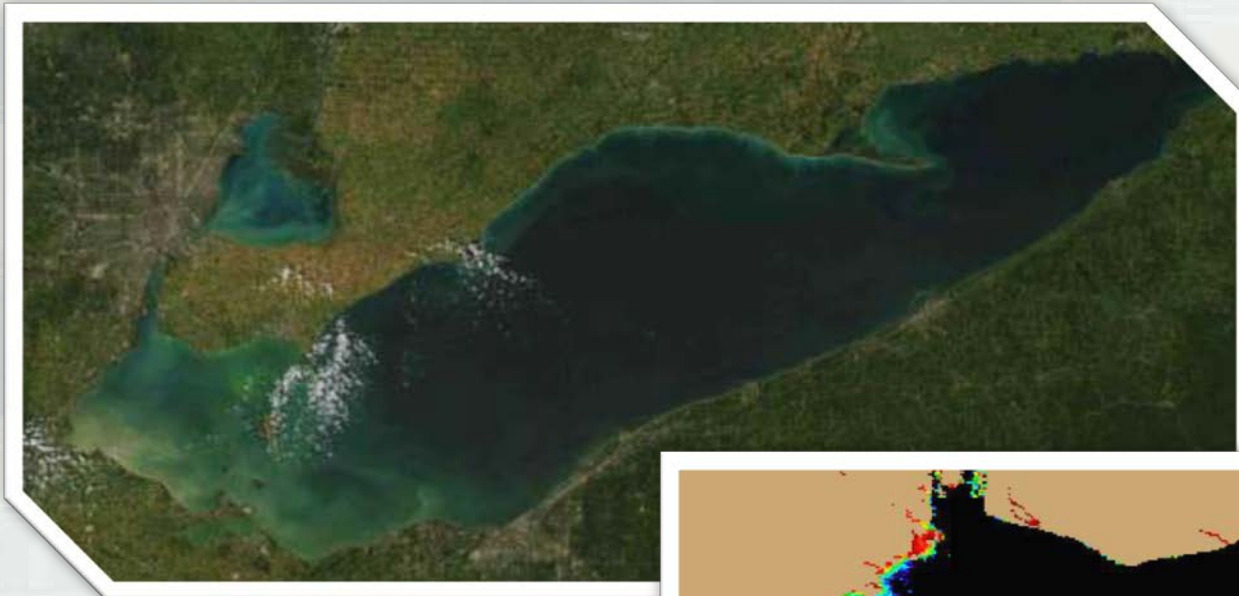
US Army Corps of Engineers
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Great Lakes & Ohio River Division

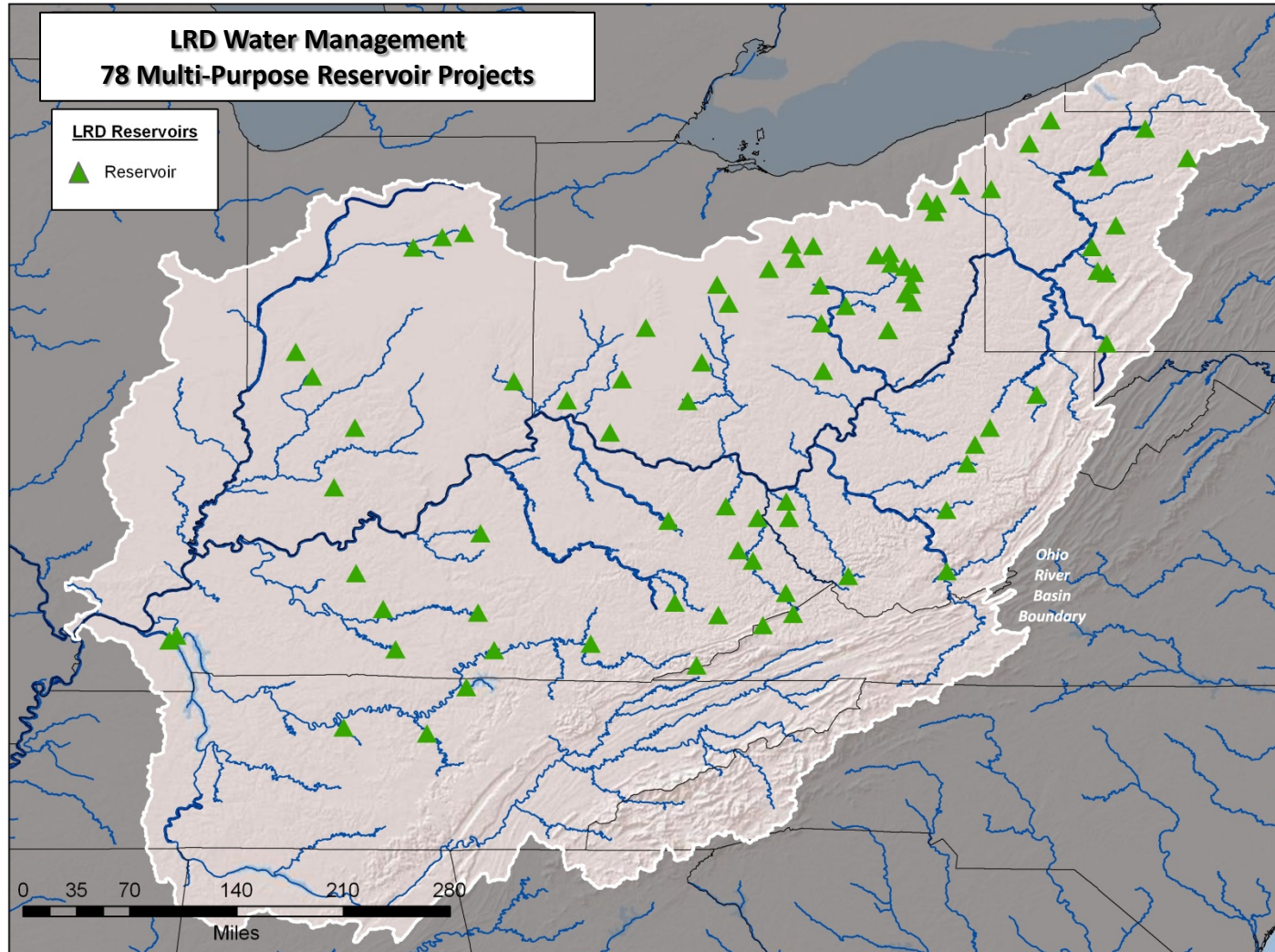


Lake Erie



NOAA processed satellite imagery showing concentrations of cyanobacteria in Western Basin Lake Erie 7/27/2010

Focus: Ohio River Basin



What is being done elsewhere?

- State Agencies
 - Some are developing HAB programs
 - Ohio EPA
 - IDEM
 - KY
- National Interagency HAB Team
 - Multiple federal agencies
 - Plans to begin including state agencies
 - Improving communication and coordination
 - No EPA 'criteria' at this time.
 - EPA web site does reference WHO guidelines.

How to move out?

- Understanding our responsibilities
- Consistency among districts
- Coordinating with state agencies
- Complicating Factors
 - Real-Estate
 - Legal
 - Logistical



2012

HAB EVOLUTION

Harsha Lake

- 3-May: Bloom Observed
- 25-May: Dead fish reported
- 28-May: Field test kits show toxins present
- 7-June: Bloom 'Explodes'
- 13-June: more dead fish reported
- 14-June: cell counts exceed 100,000 cells/mL
- 19-June: cell counts surpass 1 Million lakewide (53million Max!)
- 21-June: 2 toxins detected (Microcystin and Saxitoxin) > state thresholds
- 27-June: 500 kid open water swim event, toxins present < thresholds
- 29-June: BG Burcham issues memorandum
- 10 July: counts > 100,000 -- Microcystin and Saxitoxin detected
- 24-July: counts > 100,000 -- Microcystin and Saxitoxin detected
- 30-July: districts submit HAB Response Plans
- 14-Aug: counts > 100,000 -- Microcystin present
- 21-Aug: counts > 100,000
- 28-Aug: counts > 100,000

MAY

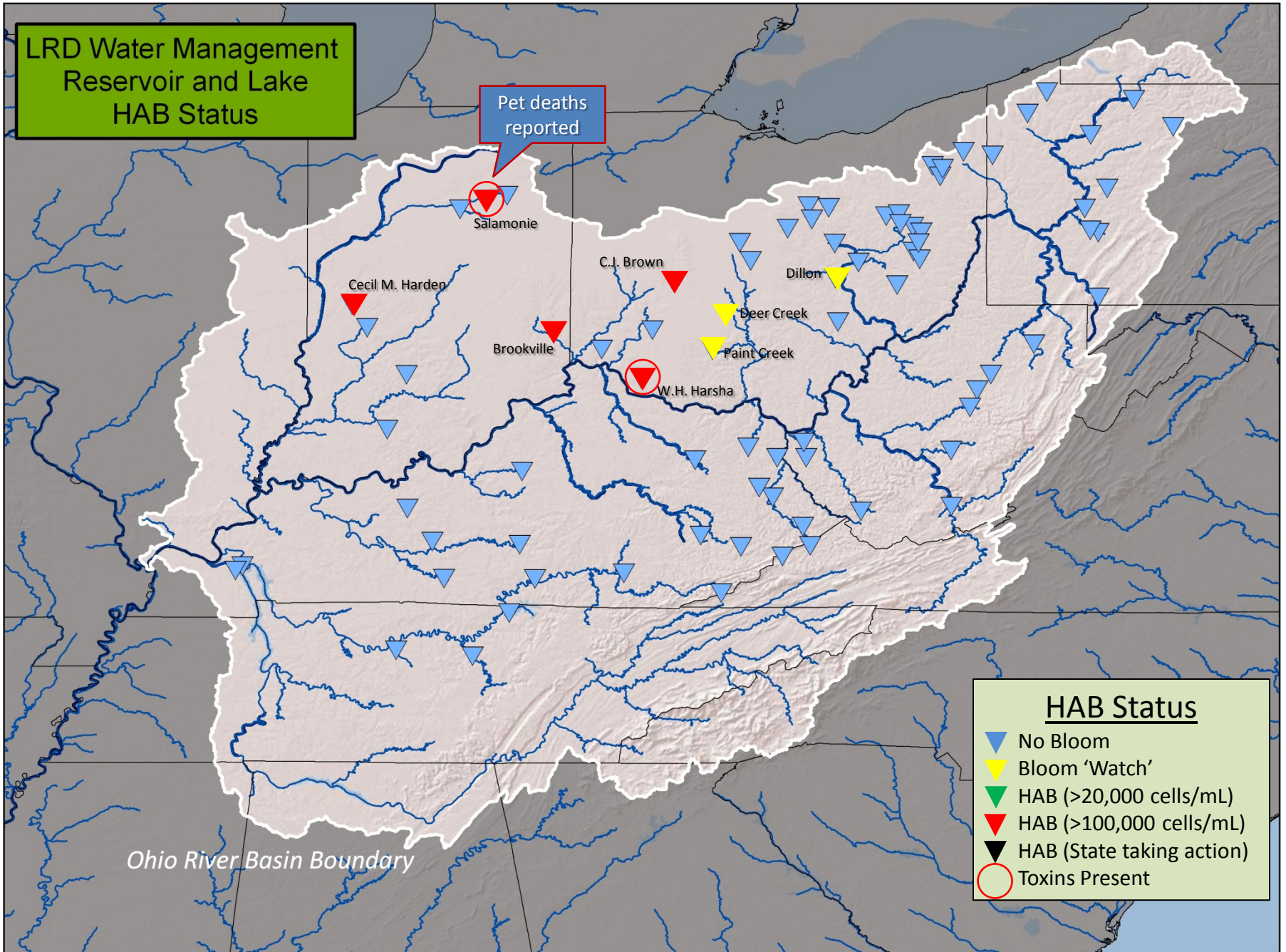
JUN

JUL

AUG

LRD Water Management Reservoir and Lake HAB Status

Pet deaths reported



HAB Status

- Blue Triangle: No Bloom
- Yellow Triangle: Bloom 'Watch'
- Green Triangle: HAB (>20,000 cells/mL)
- Red Triangle: HAB (>100,000 cells/mL)
- Black Triangle: HAB (State taking action)
- Red Circle: Toxins Present

Ohio River Basin Boundary

Salamonie

San Francisco Chronicle
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Ind. warns of toxic algae risk after dogs' deaths

Published 01:11 p.m., Saturday, July 21, 2012

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ANDREWS, Ind. (AP) — Indiana residents are being urged to protect themselves and their pets from water in some of the state's lakes after the deaths of two dogs that swam in a reservoir tainted by toxic algae.

Officials with the state Board of Animal Health told WANE-TV that blue-green algae is likely what caused two dogs belonging to Larry and Marge Young to die last week about 24 hours after the Wabash couple let them play in northern Indiana's Salamonie Reservoir.

They told The Journal Gazette that their two other dogs were sickened by the lake's water and are currently taking medication to combat liver problems caused by the toxin. The Youngs are hopeful their surviving dogs will pull through.

"This is new to us. It's a hard lesson to learn," Marge Young said of the toxic algae.

The Indiana Department of Environmental Management has found high levels of the algae in seven Indiana lakes, including Salamonie, where record levels were discovered. The other lakes are Raccoon Lake, Hardy Lake, Brookville Lake, Whitewater Lake, Sand Lake and Worster Lake.

"We have not seen levels this high," said Cyndi Wagner of IDEM's Office of Water Quality.

The algae feed on phosphorus, a common ingredient in fertilizer and animal waste. Hot and dry weather, overfertilization of lawns and runoff from livestock farms all contribute to the algae's growth, said IDEM spokesman Rob Elstro.

"The blue-green algae problem we have in a lot of our lakes and reservoirs is strictly due to

Photo Galleries 1-3 of 40 41 39

St Vincent \$29.6M Big Island estate \$29M Oahu property near Obama family vacation spot

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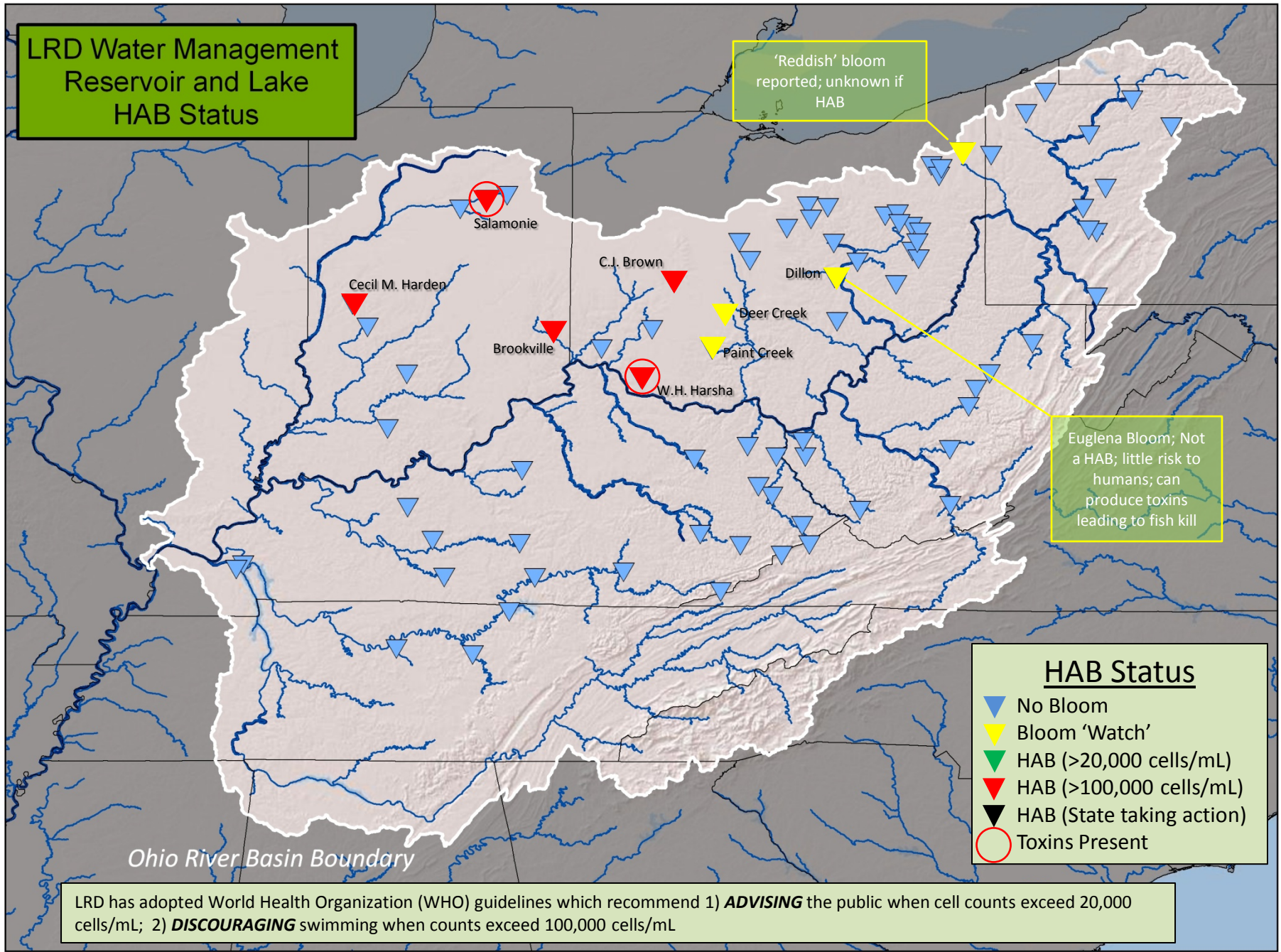
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Today's Deal

LRD Water Management Reservoir and Lake HAB Status



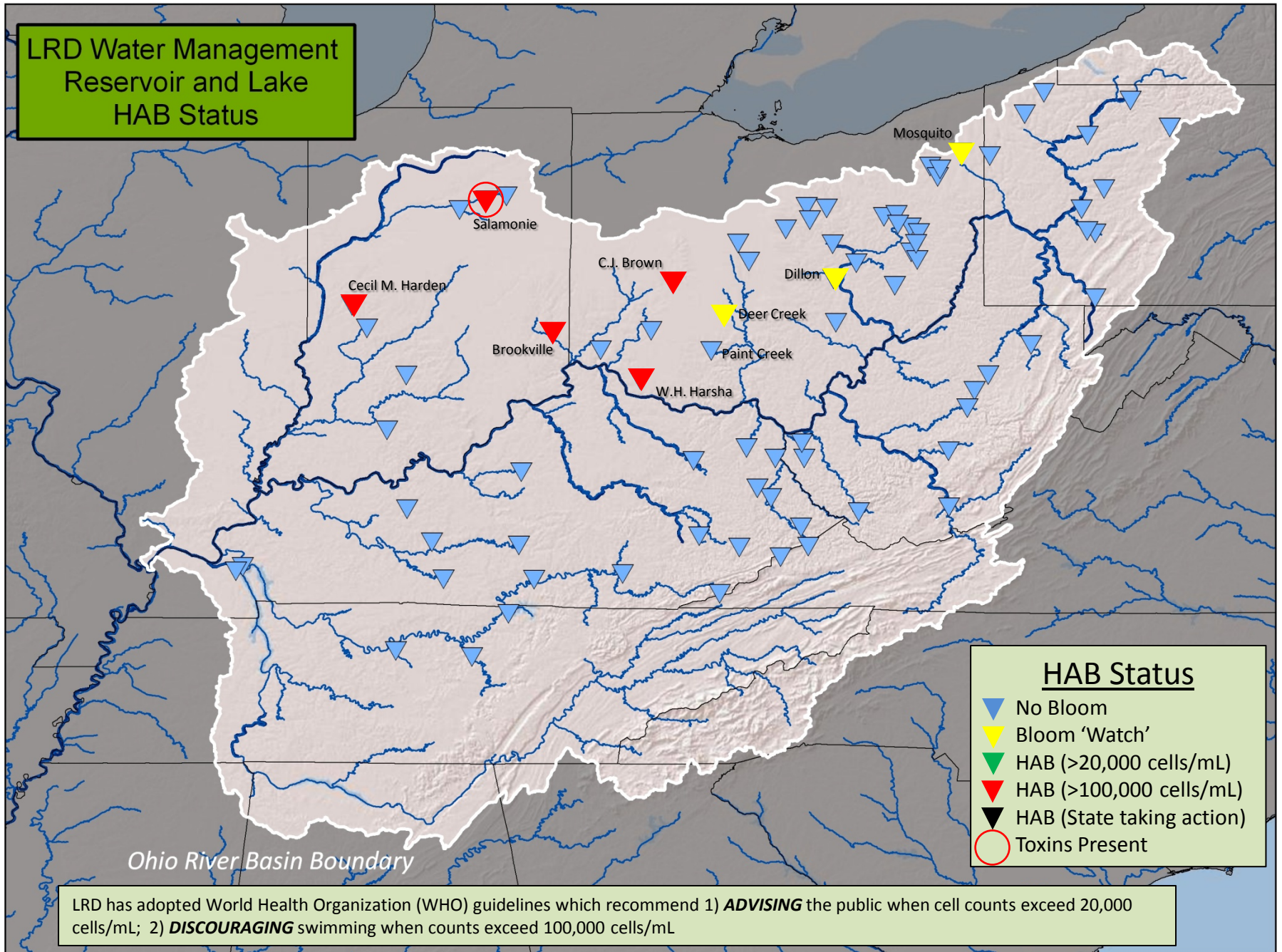
LRD has adopted World Health Organization (WHO) guidelines which recommend 1) **ADVISING** the public when cell counts exceed 20,000 cells/mL; 2) **DISCOURAGING** swimming when counts exceed 100,000 cells/mL

HAB Status

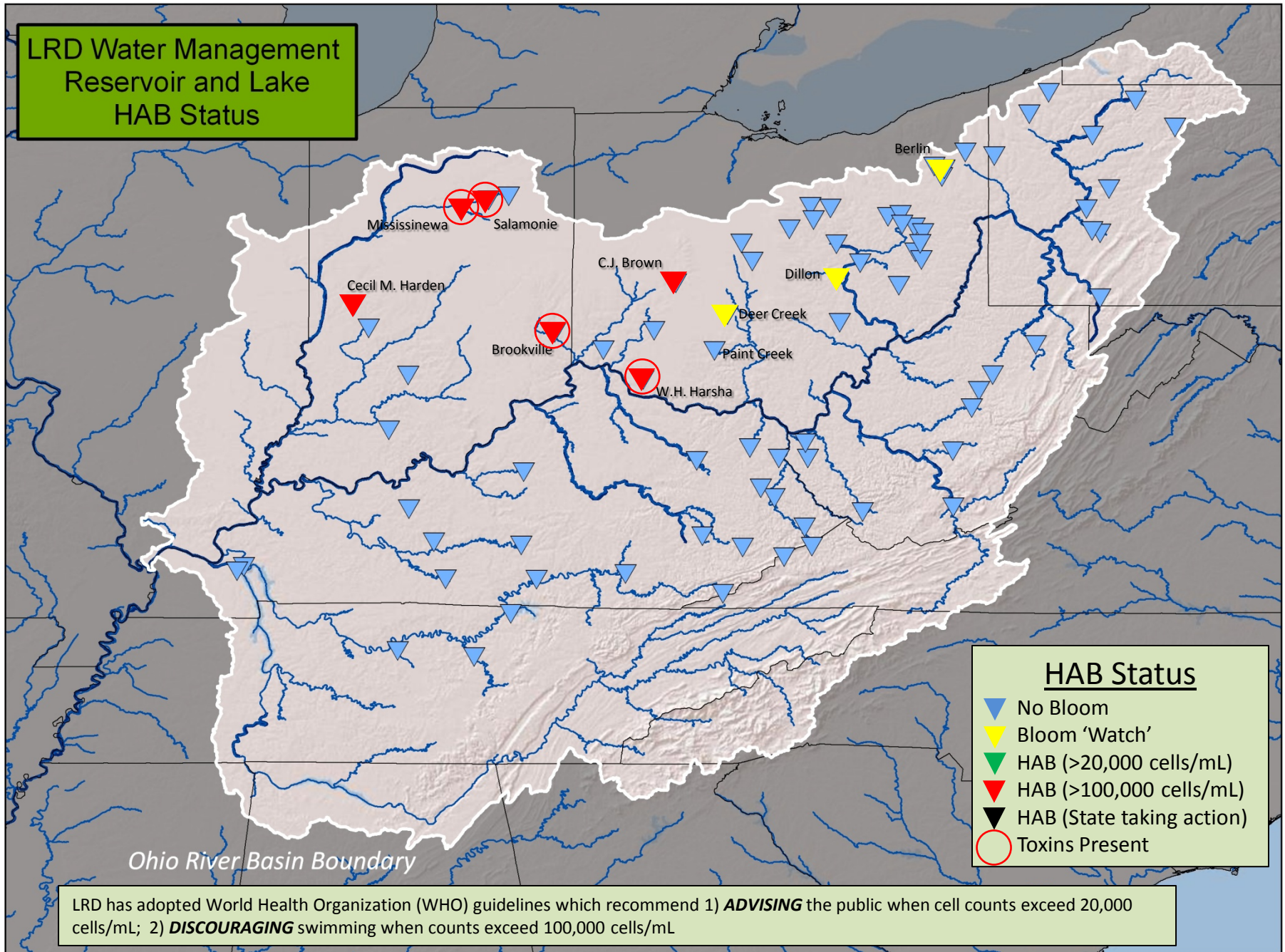
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- ▲ Bloom 'Watch'
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- ▲ HAB (State taking action)
- Toxins Present

Ohio River Basin Boundary

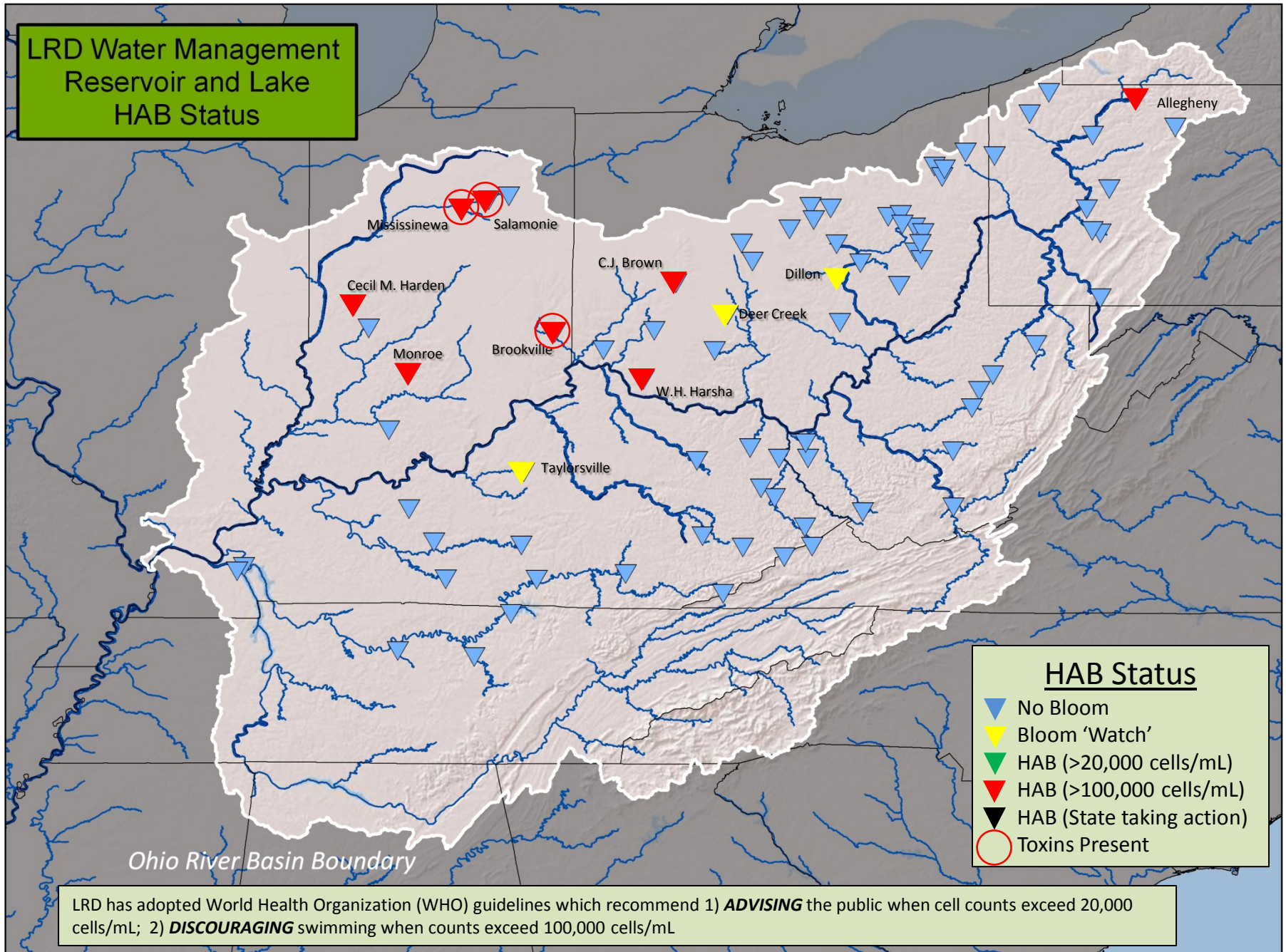
LRD Water Management Reservoir and Lake HAB Status



LRD Water Management Reservoir and Lake HAB Status



LRD Water Management Reservoir and Lake HAB Status



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Dillon

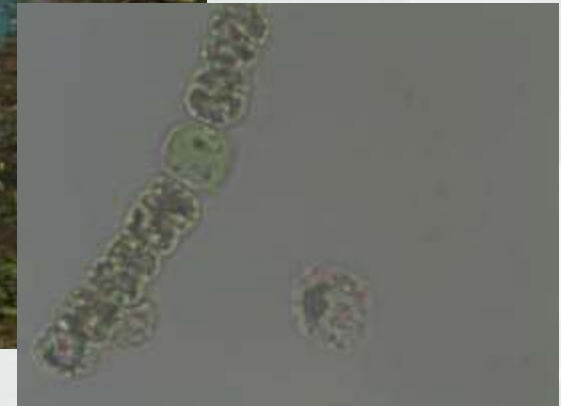
- Euglena bloom (not a HAB species)
- Not associated with human toxins
- Can produce fish toxins and cause fish kills
- Hold the presses.... a new algal toxin related to Euglena blooms has been discovered....related to mortality in livestock and has shown toxicity to mammals!



Burr Oak Lake



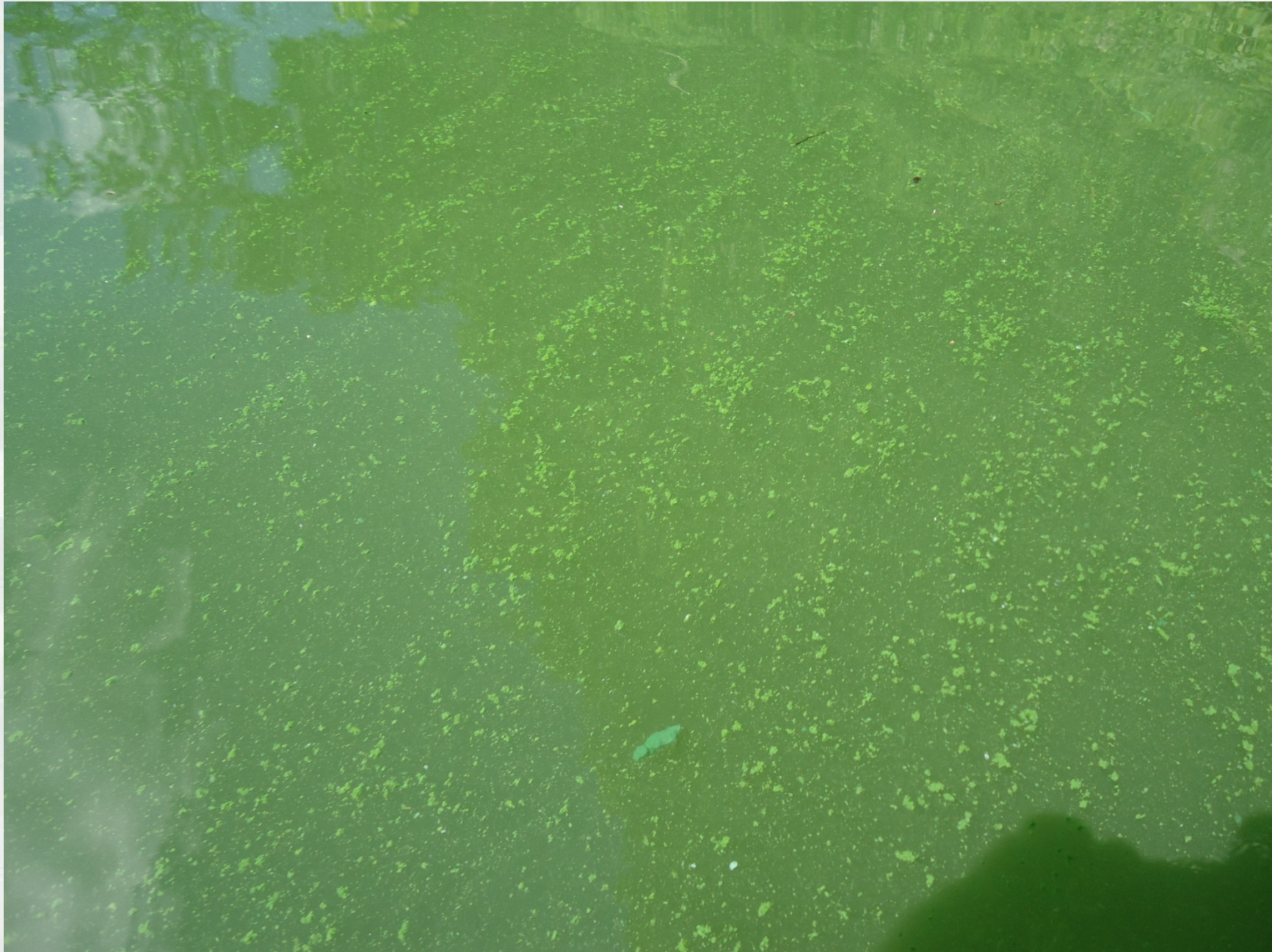
Photo By Linda Merchant- Masonbrink - - *Anabaena-Burr Oak*, 2010



Harsha Lake

















Taking the Lead

POLICY EVOLUTION

LRD HAB Response Plan

- CG Memo dated 29-June-2012
 - District HAB Plans
 - World Health Organization (WHO) Guidelines
 - Promote internal and external communication
 - Consistency across districts sharing jurisdiction in a state
 - Each District has developed an HAB plan
 - Coordinated through Water Quality POC

LRD HAB Plan Overview

- WHO Guidelines
 - @ 20,000 cells/mL
 - *ADVISE* the public of increased risk
 - Post ADVISORY signs at appropriate locations – TDB by district HAB plan.
 - Begin sampling on a weekly basis.
 - 2 consecutive weeks of sampling results below the threshold level needed to remove signs.



LRD HAB Plan Overview

- WHO Guidelines
 - @ 100,000 cells/mL
 - *DISCOURAGE* contact
 - Post CAUTION signs at appropriate locations – TDB by district HAB plan.
 - Continue sampling on a weekly basis.
 - 2 consecutive weeks of sampling results below the threshold level needed to remove signs.

Blue-green Algae Awareness Level

CAUTION

Elevated Risk of Adverse Health Effects


BLUE-GREEN ALGAE BLOOMS ARE PRESENT

For Your Safety, The U.S. Army Corps of Engineers, _____ District
Recommends the Following:

- DO NOT drink untreated lake water.
- Children and pets are more likely to get sick because of blue-green algae.
- Contact with the water is *discouraged* (e.g., swimming, wading, water skiing).
- Keep pets/livestock off of the beach and out of the water.
- Avoid areas with visible algae accumulation.

Symptoms from exposure may include nausea, vomiting, diarrhea, skin rash, eye irritation, respiratory problems or other unexplained illness.

For more information go to:



Report algae blooms to:	For additional information contact your local health department:
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LRD HAB Plan Overview

- District plans vary only slightly from one another.
- Some districts distributing sampling instructions, sampling kits and shipping envelopes etc to project offices.
 - District WQ POCs may also be developing and distributing training materials which will aide in the identification of blooms.

Communication is Key

- USACE Internal
 - Vertical – Lateral
- Interagency
- Public
 - Posters
 - Pamphlets
 - Facebook

What can you do?

- Follow instructions found on posted signs and avoid contact with any questionable scums or floating scum that may have an odd green or sometimes blue or brown color.

ADVISORY - Advisory signs will be posted when cyanobacteria concentrations reach levels that may potentially cause irritative or allergic effects.

CAUTION - Caution signs will be posted when higher concentrations are found. At these higher levels, cyanobacteria are more likely to be present and increase the risk of more pronounced health effects.

Please help reduce the risk of HABs

Measures you can take:

- Limit boating use near streams and ditch lines.
- Minimize septic tanks.
- Do not treat possible HABs with algicides.
- Remove overplant growth along streams and ditches that may act as a "buffer zone" and reduce potential runoff.

Additional HAB Resources

Ohio EPA: <http://www.epa.state.oh.us/div/HAB.aspx>

National Oceanic and Atmospheric Administration: <http://www.noaa.gov/education/outreach/HAB/>

Centers for Disease Control and Prevention: <http://www.cdc.gov/nczod/dzdx/HAB/HAB.html>

U.S. Geological Survey: http://water.usgs.gov/habitats/HAB_homes.html

Do not let livestock or pets drink from any waters posted with an advisory.

- Immediately rinse off after swimming in natural waters.
- If anyone becomes ill after swimming, seek medical attention immediately. Seek veterinary assistance if a pet appears ill.
- Never report possible HAB sighting or fish kills to the appropriate USACE office.

To report a HAB please call the local project office at () - () - () - ()

For more general information concerning HABs contact the District Water Quality Office at () - () - () - ()

Good or bad?

Not all "scums" or floating mats are harmful! Healthy lakes produce many species of aquatic vegetation and algae that are beneficial to the environment and pose no threat to human or animal health. When individuals, even the size of caution and avoid contact.

Avoid floating scums!

What are HABs?

Harmful Algal Blooms are microscopic cyanobacteria or "blue green algae" colonies that resemble green algae. HABs can have a bluish appearance and can often times be seen as scums, foams or mats anywhere on the surface of a lake or stream. The area affected by a "bloom" can range from the size of a basketball to half the lake.

Why are they harmful?

HABs can generate toxins that can potentially impact humans, pet livestock, and fish health. The toxins can cause:

- Allergic type reactions
- Skin irritation
- In severe cases liver or nervous system damage could occur
- Unexplained pet livestock sickness

For protection always avoid other water contact with medical attention!

Avoid green or unusually colored water!

Harmful Algal Blooms (HABs)

What are HABs?

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U.S. Army Corps of Engineers Great Lakes & Ohio River Division

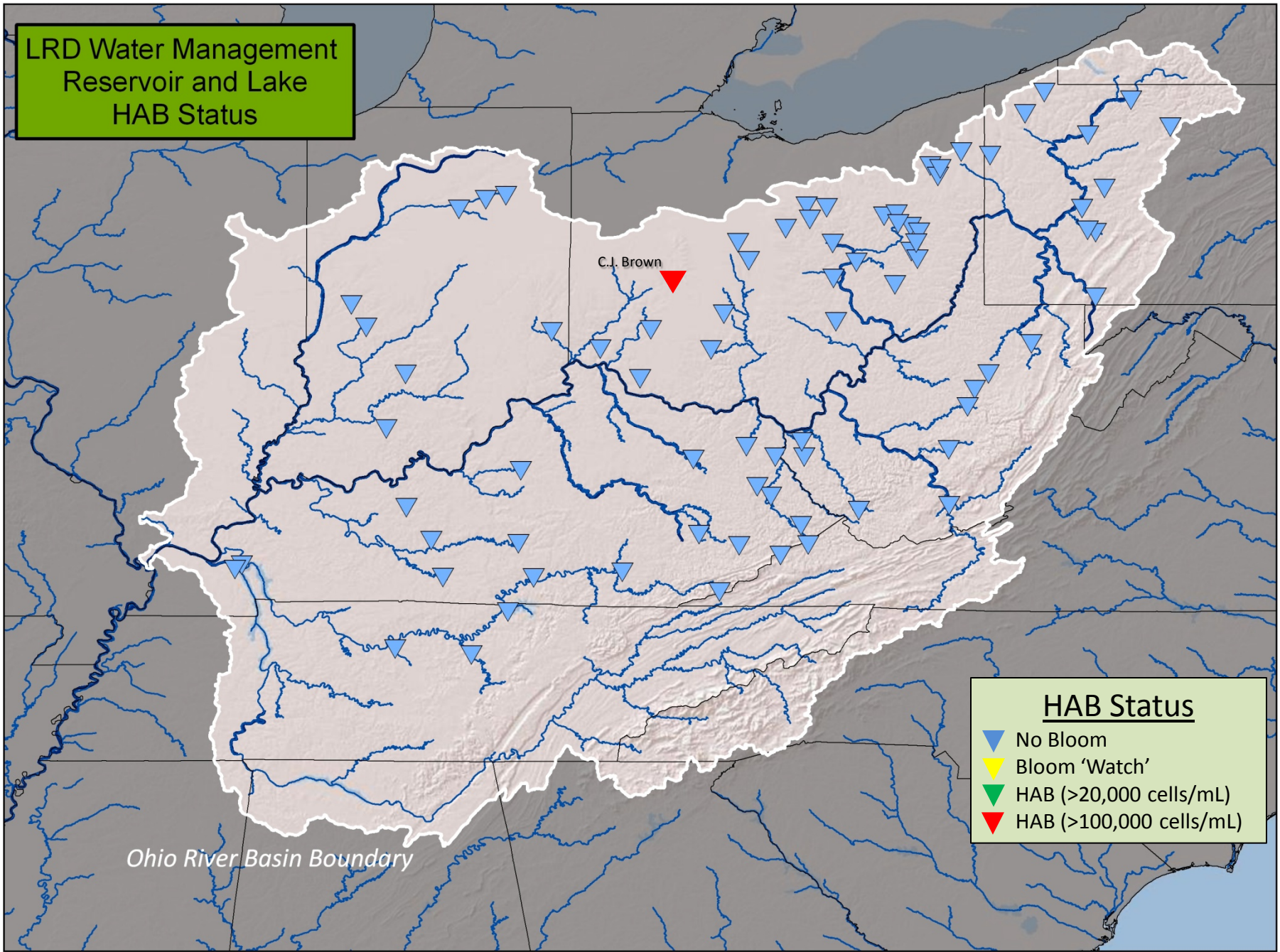
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Status

HAB 2013

LRD Water Management
Reservoir and Lake
HAB Status



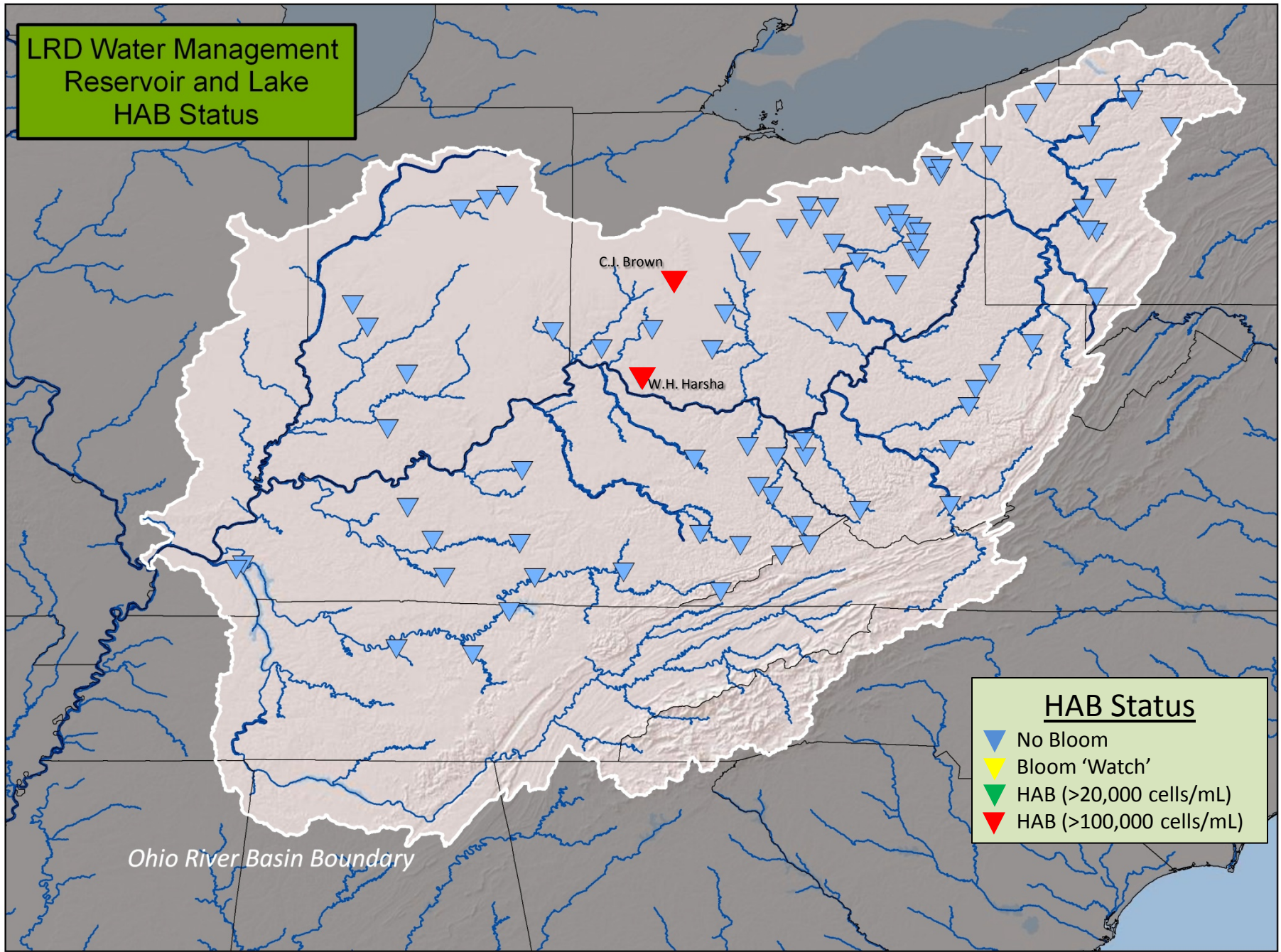
C.J. Brown

HAB Status

- Blue triangle: No Bloom
- Yellow triangle: Bloom 'Watch'
- Green triangle: HAB (>20,000 cells/mL)
- Red triangle: HAB (>100,000 cells/mL)

Ohio River Basin Boundary

LRD Water Management
Reservoir and Lake
HAB Status



HAB Status

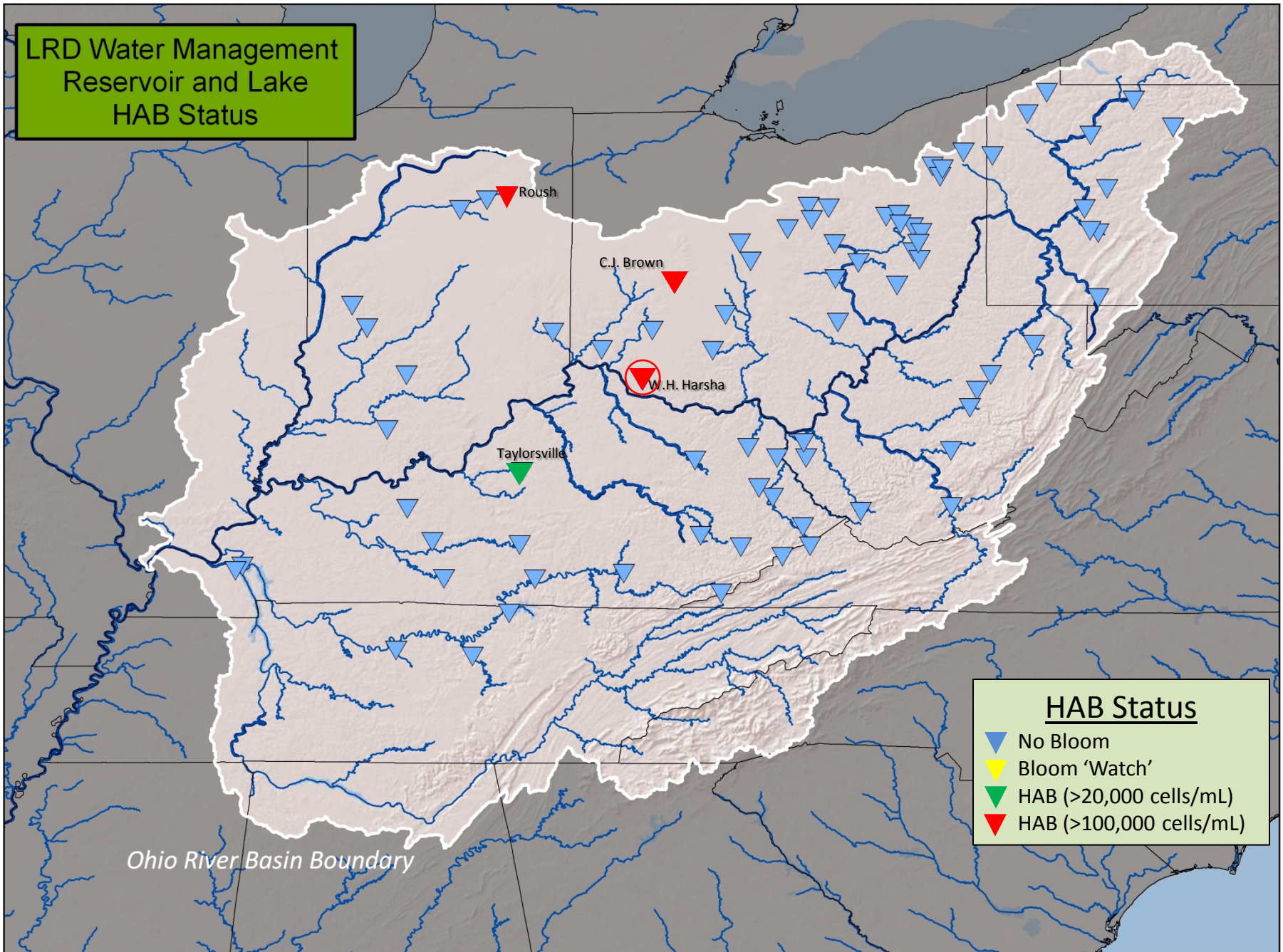
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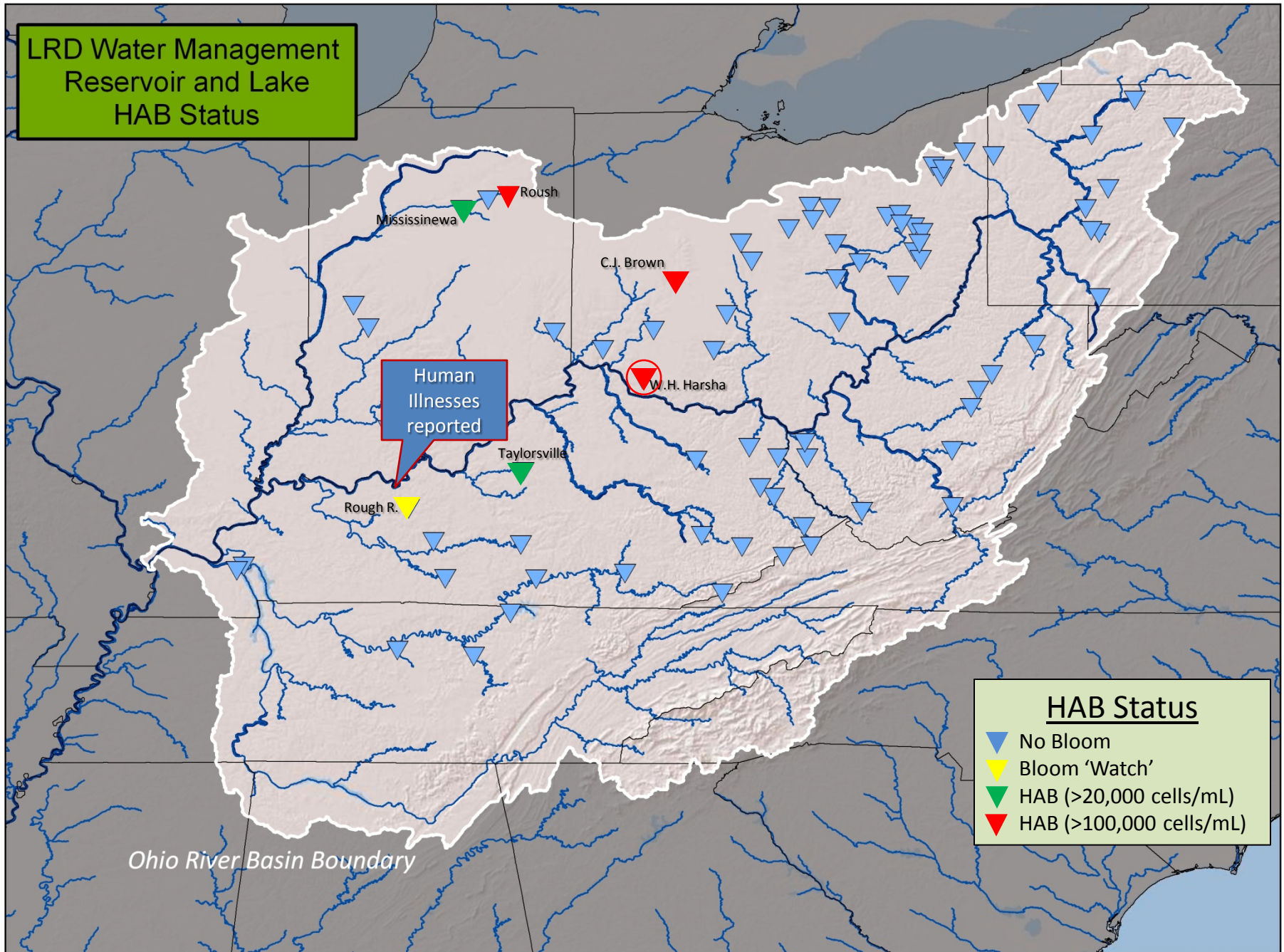
C.J. Brown

W.H. Harsha

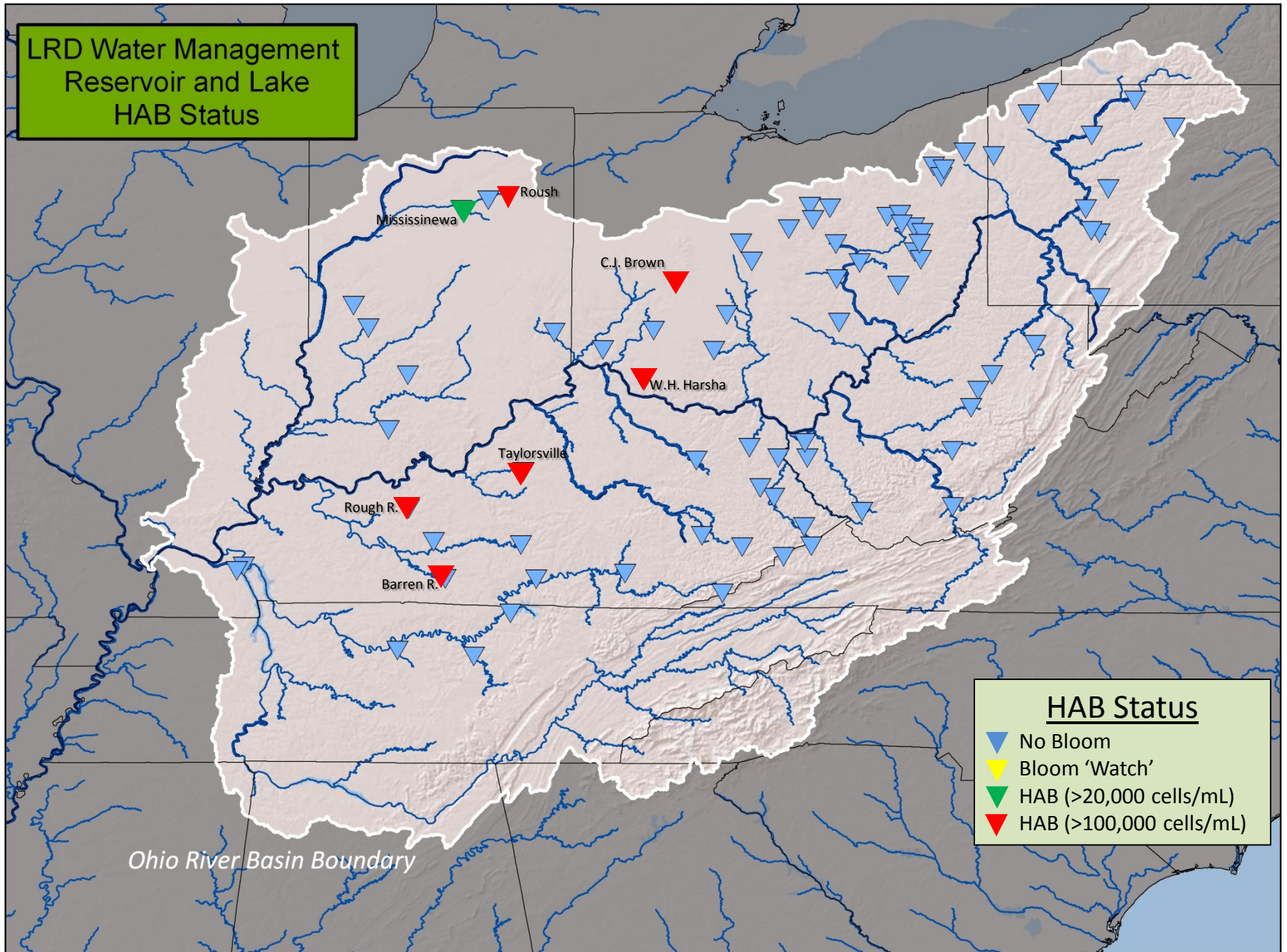
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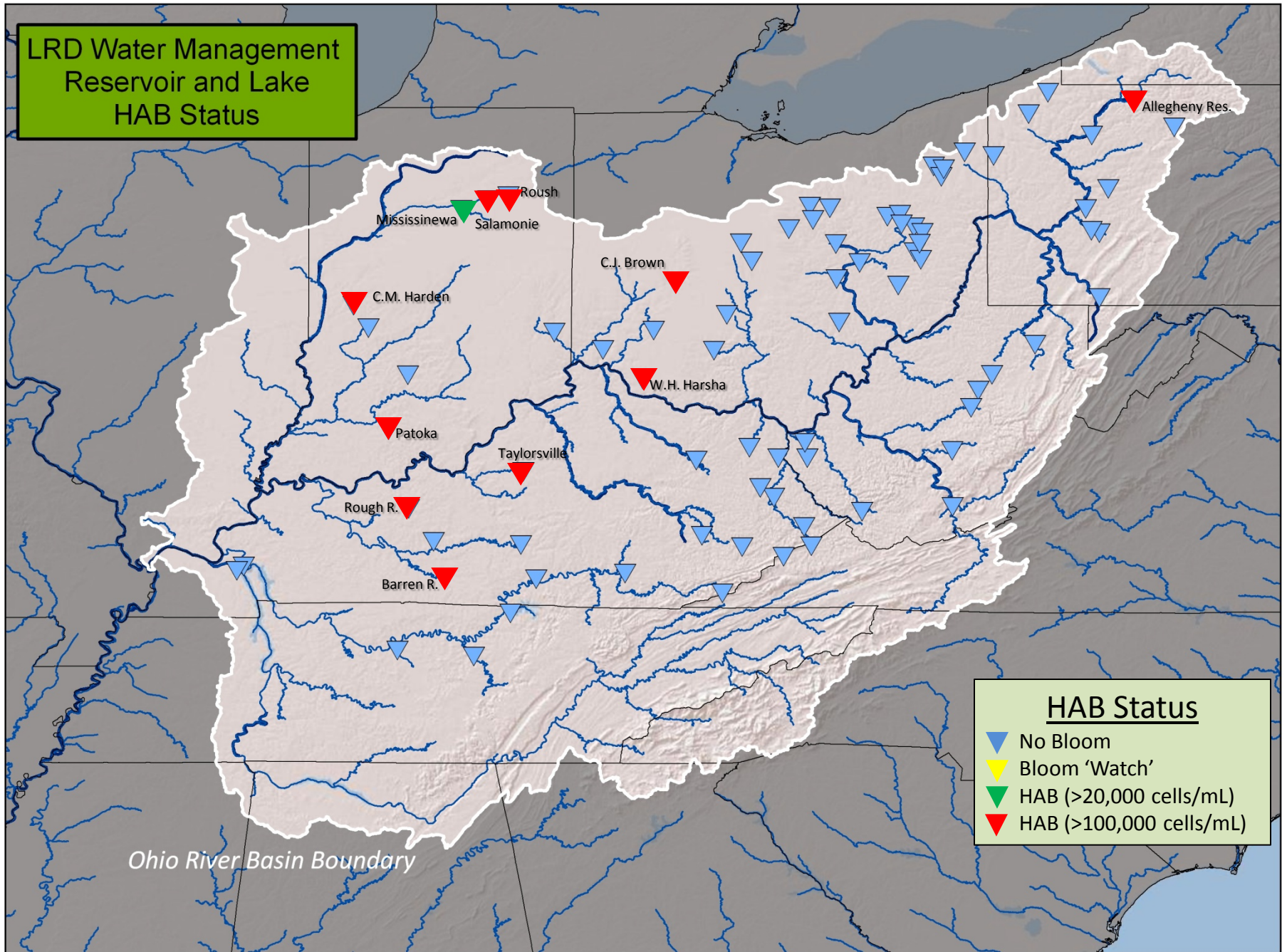
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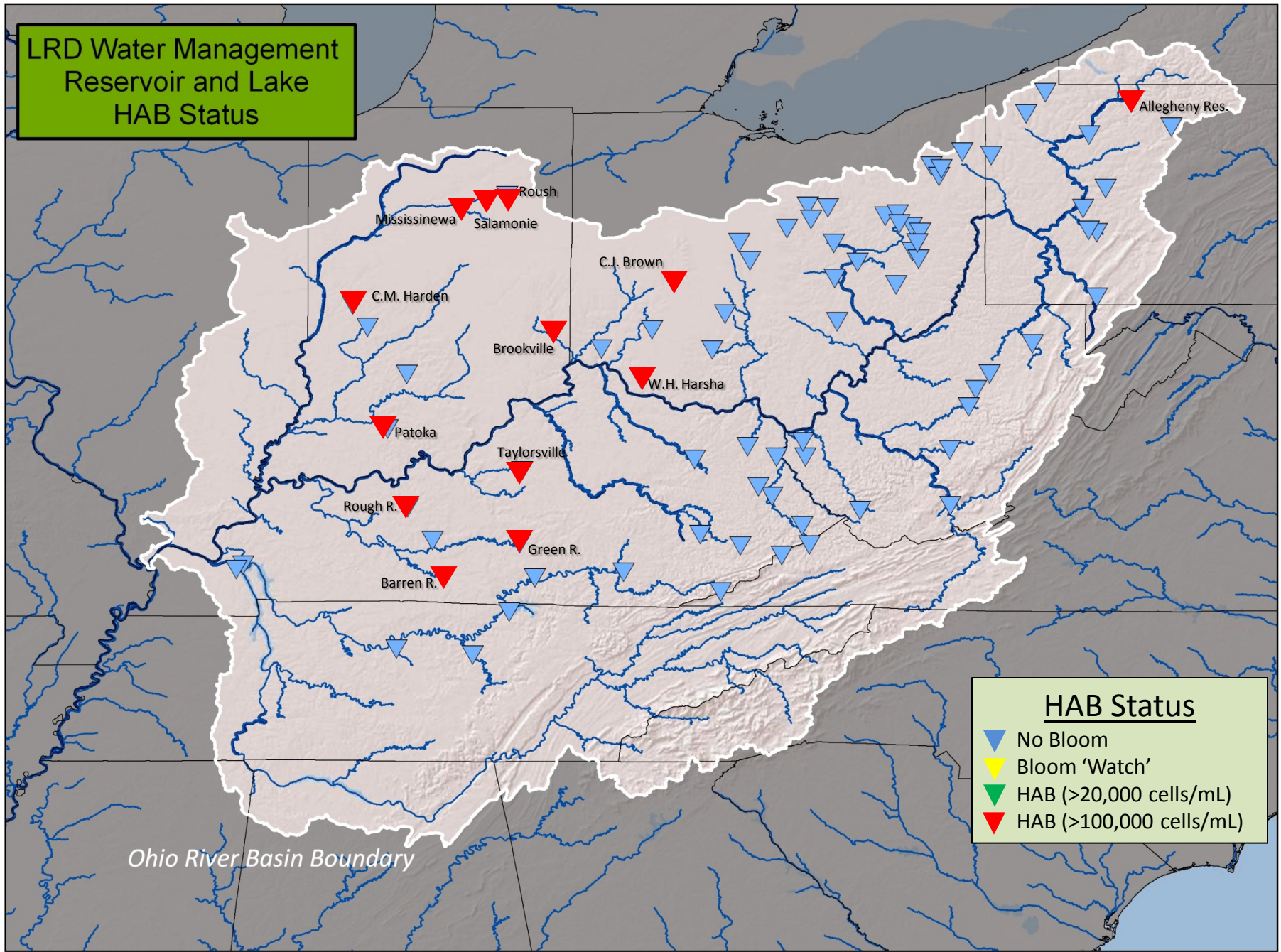
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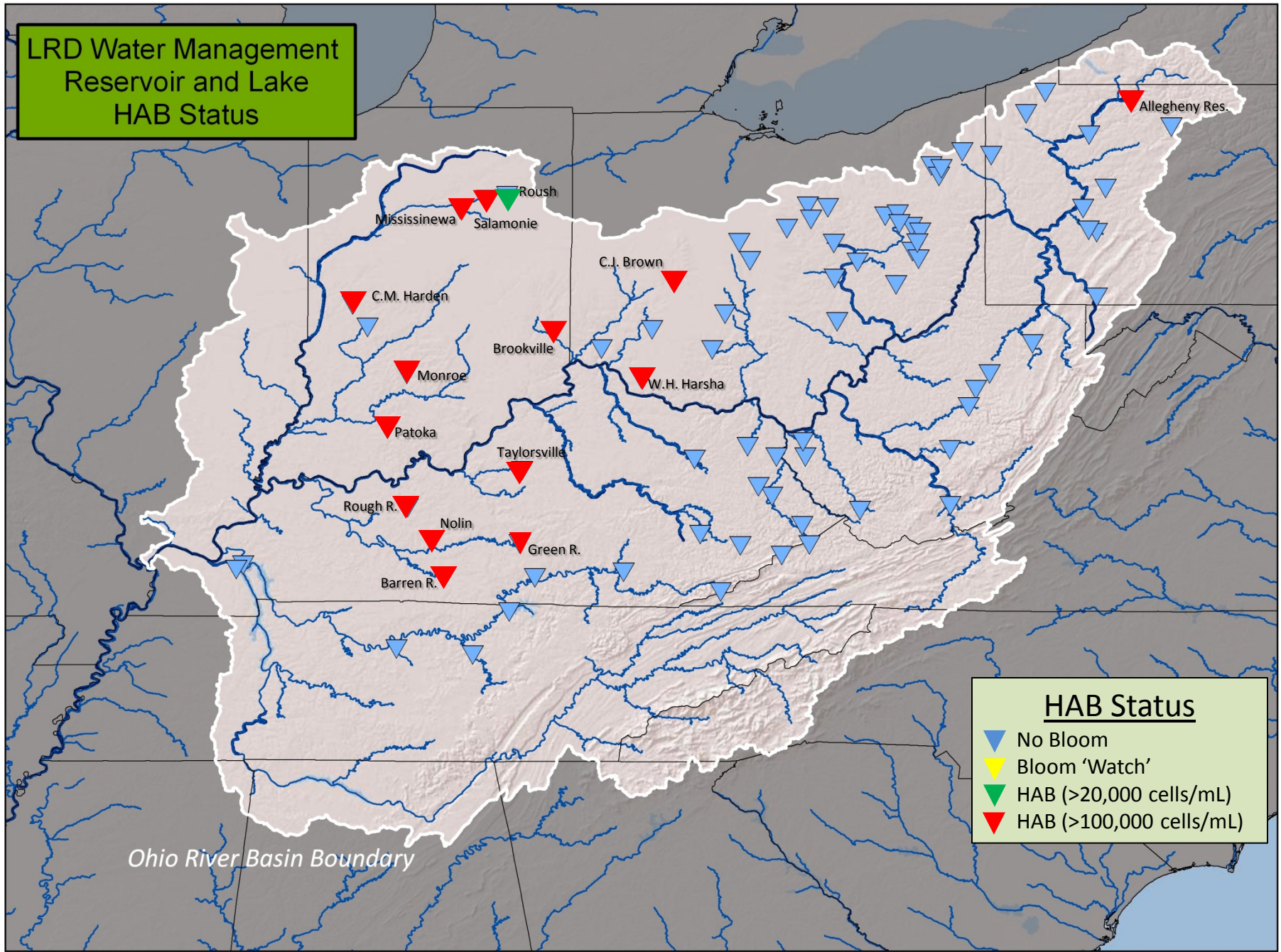


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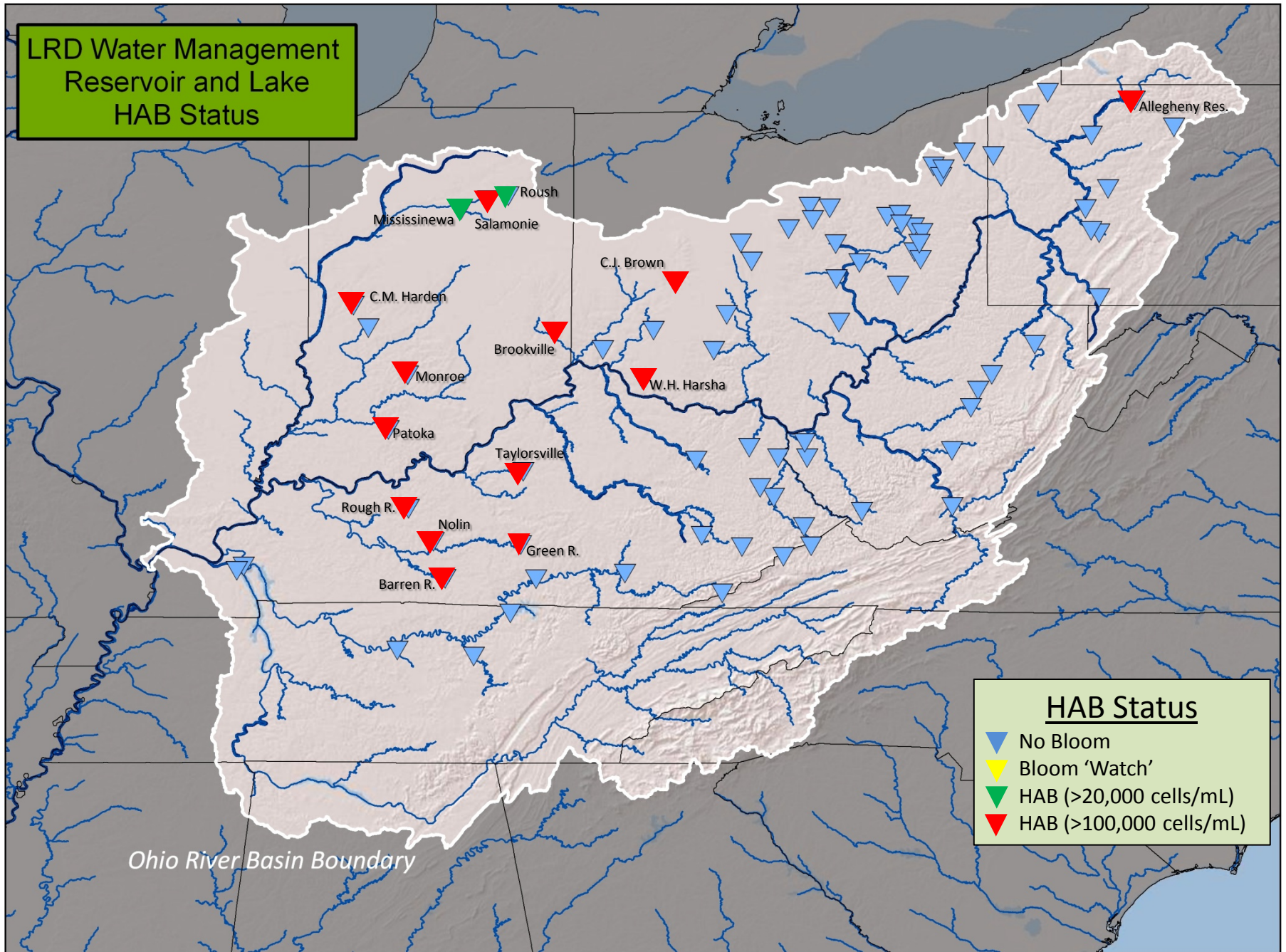


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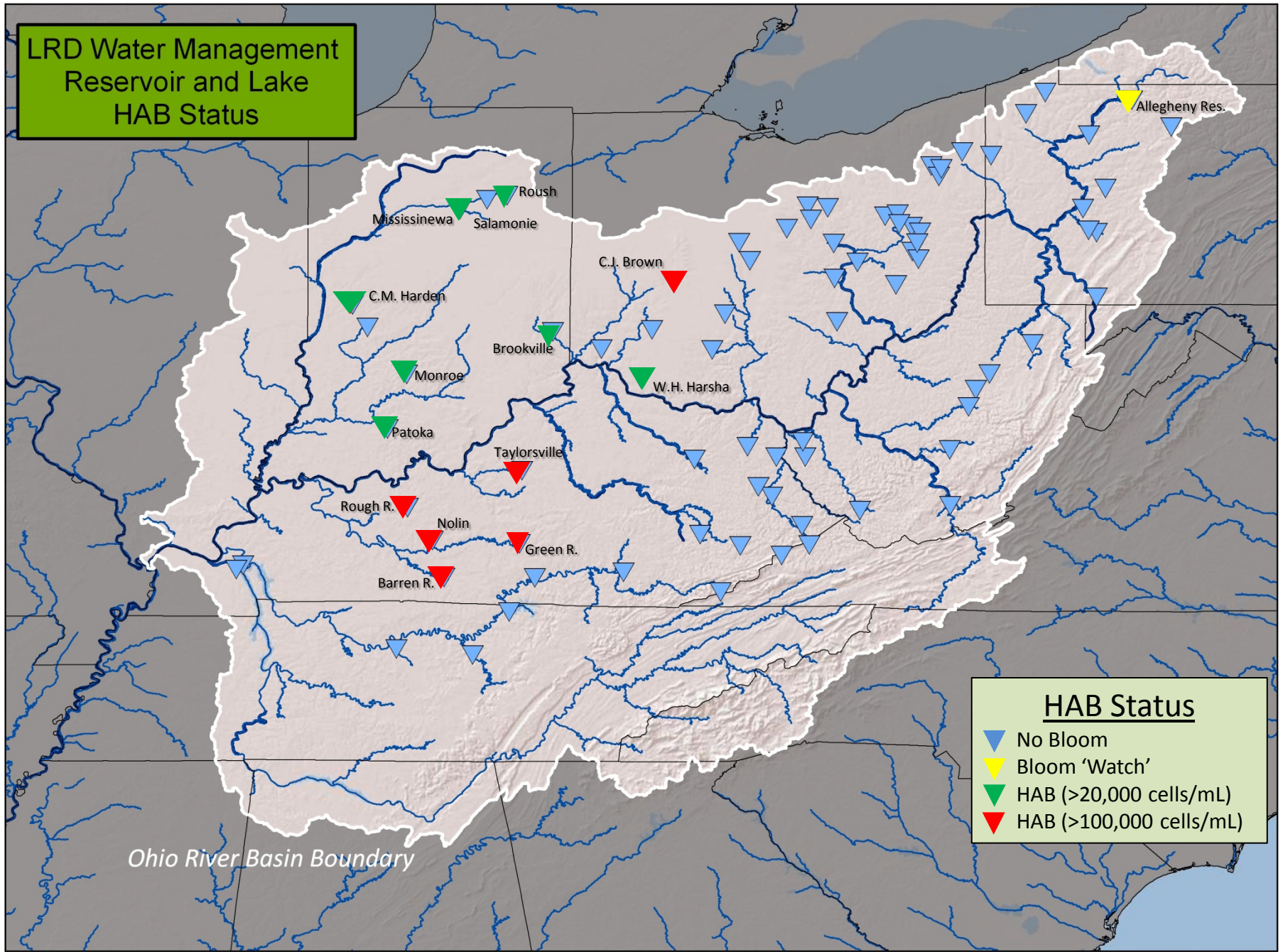


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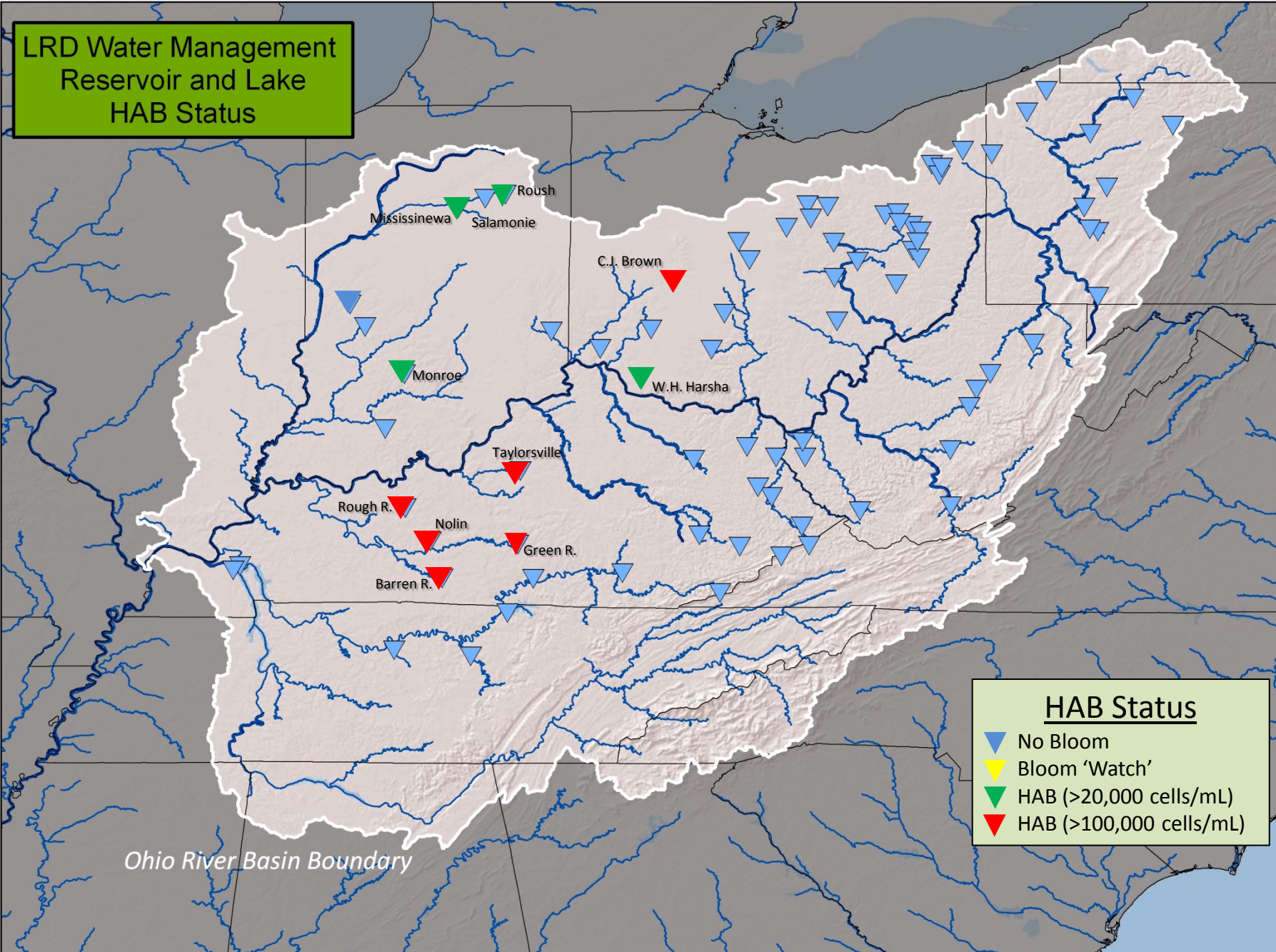
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Ohio River Basin Boundary

LRD Water Management Reservoir and Lake HAB Status



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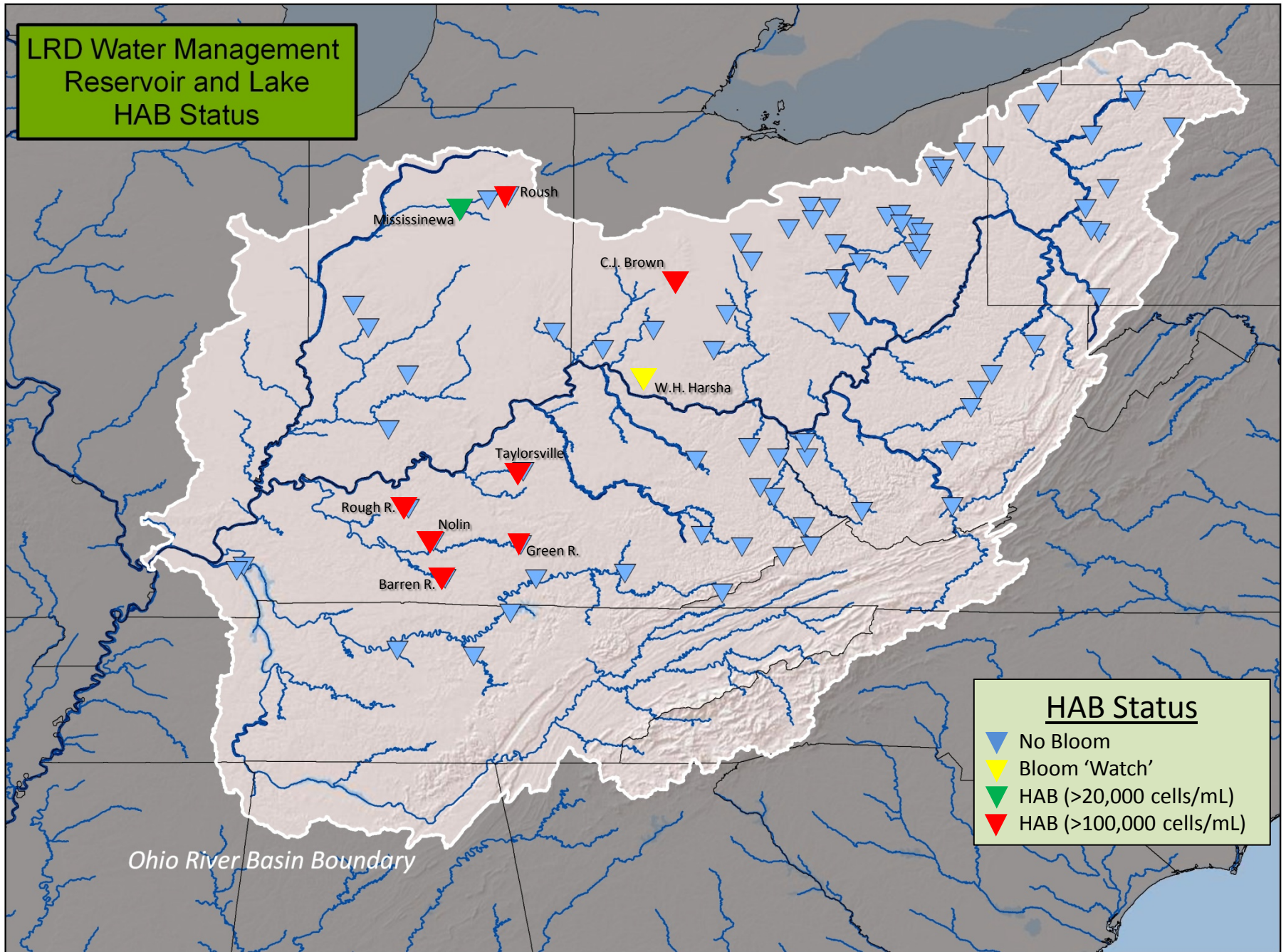


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Ohio River Basin Boundary

LRD Water Management
Reservoir and Lake
HAB Status



A *SHIFT* in responsibility, liability and a way to lighten the load....

STATE AGENCY COLLABORATION

Indiana

- Pushed by 2012 dog deaths to finalize
- Already sharing data!
- Concerned with conflicting thresholds (messages to public)
- Approached by IDEM & IDNR to get around the table

IN “Beach Sign”

- Posted at beaches and some park entrances
- Diamond color indicative of “alert levels”
- Provides general information



Does the Beach Have Blue-green Algae?

Blue-green algae can be found in many of Indiana's lakes and reservoirs. Swimmers, boaters and pet owners can enjoy water based recreation, but should be on the lookout for evidence of harmful algal blooms (HABs).

Blue-Green Algae
Algae of many species occur naturally in Indiana's lakes and reservoirs. Blue-green algae is common and not a problem unless levels are high. When levels are high, toxins may be produced as algae cells grow and die.

What Does Blue-Green Algae Look Like?
When conditions are right, HABs may occur. An HAB occurs when algae reproduce quickly creating mats of algae or discoloration of the water because of the large quantity of algae cells present. High nutrient levels from lawn and agricultural fertilizers, sunlight and warm, shallow water all contribute to HABs.

How Can Exposure to High Levels of Blue-Green Algae Affect People, Pets and Fish?

Swimmers and boaters	Pet Owners	Fishing
Precautions: Avoid contact with algae. Avoid swallowing water while swimming. Take a bath or shower with warm, soapy water after coming in contact with lake water. Do not use lake water for cooking or bathing.	Precautions: Do not allow your pets to swim in or drink water where algae is present. Rinse pets with soap and water if they swim in murky water. Do not let your pet lick algae off their fur.	Precautions: Do not eat fish caught when fishing your fish. Rinse the fillet with clean water before freezing or cooking. Avoid consuming the guts, where toxin accumulation is greatest. Eat in moderation.

Colors may vary from green, blue-green, brown, black, white, purple, red or black.
Algae may look like a film, crust, puff balls, green clippings, dots, spilled paint, pea soup, foam, wool, straws or cottage cheese curds.
Watch for signs that might indicate a blue-green algae bloom in this lake or reservoir and report your sighting to the property office.



Blue-green algae and toxin levels are tested in this body of water. Alert levels vary with testing results:

	LOW RISK Don't drink the water Shower after you swim
	ADVISORY <i>Swimming and boating permitted.</i> Avoid contact with algae. Avoid swallowing water while swimming. Take a bath or shower with warm soapy water after coming in contact with lake water. Do not use lake water for cooking or bathing. Do not allow your pets to swim in or drink water where algae are present.
	CAUTION <i>All Recreation Advisory precautions, plus . . .</i> Children and those with compromised immune systems should not swim.
	BEACH CLOSED Algae and toxin levels make this beach currently unsafe for swimming.

Today's Alert Level

ADVISORY
Don't drink the water. Shower after you swim. Keep pets out of the water.

Indiana's lakes and reservoirs provide great recreational opportunities. Learn to recognize blue-green algae, be alert, take precautions and have fun on the water!

Water Quality Notice

Watch for Blue-Green Algae!

Water conditions, combined with weather and high nutrient levels may result in harmful algal blooms (HABs).

- Check for alerts at property offices, entrances or beaches indicating possible HABs.
- **DO NOT** drink untreated lake water.
- Learn to recognize blue-green algae and avoid areas with visible algae accumulation.
- Do not allow children or pets to swim where algae is present.
- After swimming, wading or skiing, shower with warm soapy water and wash hands thoroughly.

Take appropriate precautions for people and pets, and have fun on the water!

More information available:

- Property offices
- www.algae.IN.gov
- www.lrl.usace.army.mil



IN “Boat Ramp Sign”

- Posted at boat ramps and common access areas
- Offers precautions
- Direction on how to investigate further

Harmful Algal Blooms

Blue green algae and outdoor recreation in Indiana's waters

Indiana's lakes and reservoirs provide great recreational opportunities. To be safe while having fun on the water, you should learn to recognize blue-green algae. Be alert and take appropriate precautions for people and pets.

What is a Harmful Algal Bloom?

Algae occurs naturally in most lakes, and most algae does not present a health risk. A harmful algal bloom (HAB) is a large growth of certain types of algae that can produce toxins. These toxins may affect the liver, nervous system and/or skin.

How dangerous are HABs?

If you touch HABs, swallow water with HAB toxins or breathe in HAB water droplets, you could get a rash, have an allergic reaction, get a stomachache, or feel dizzy or light-headed. HABs also are toxic to pets.

How will I know if there is an HAB?

HABs have different colors and looks. Some colors are green, blue-green, brown, black, white, purple, red and black. They can look like film, crust or puff balls at the surface. They also may look like grass clippings or dots in the water. Some HABs look like spilled paint, pea soup, foam, wool, streaks or green cottage cheese curd.

The Indiana Department of Environmental Management (IDEM) samples the water at many state beaches in the summer. Watch for advisory postings at entrance gates and beaches, but know that high algae or toxin levels also may be present in untested areas such as coves, shallow bays and along shorelines.

Always look for HABs before going in the water.

Check for HAB advisories at www.algae.IN.gov or www.dnr.IN.gov. Ask the property manager if there has been a recent HAB. If so, colorless toxins can still be in water.



What should I do if I see an HAB?

- Stay out of water that may have an HAB.
- Do not let your children or pets play in HAB debris on the shore.
- After swimming, wading or skiing, even where no HABs are visible, shower with warm soapy water as soon as possible.
- Never swallow any lake or river water, whether you see HABs or not.
- Do not let pets lick HAB material from their fur or eat HAB material.
- Do not drink or cook with lake or river water.
- See a doctor if you or your children might be ill from HAB toxins. If your pet appears ill, contact your veterinarian.

What about fishing and other activities?

If you plan to eat the fish you catch, remove the guts and liver, and rinse fillets in tap water before cooking and eating.

Other activities near the water such as camping, picnicking, biking and hiking are safe. If you are picnicking, wash your hands before eating if you have had contact with lake water or shore debris.

For general HAB information and current advisories visit www.algae.IN.gov



For more information about state parks, reservoirs and forests visit www.dnr.IN.gov



For U.S. Army Corps of Engineers HAB info visit www.frl.usace.army.mil



Pictured: Clean water (top), Blue-green algae (bottom)



Harmful Algal Blooms (HABs)

What are HABs?

Harmful **A**lgal **B**looms are microscopic cyanobacteria or “blue green algae” colonies that resemble green algae.

HABs can have a bluish appearance and can often times be seen as scums, foams or mats anywhere on the surface of a lake or stream. The area effected by a “bloom” can range from the size of a basketball to half the lake.

Why are they harmful?

HABs can generate toxins that can potentially impact human, pet, livestock, and fish health. The toxins can cause:

- Allergic type reactions
- Skin irritation
- In severe cases liver or nervous system damage could occur
- Unexplained pet/livestock sickness

If an unknown illness occurs after water contact seek medical attention!

Good or bad?

Not all “scums” or floating mats are harmful! Healthy lakes produce many species of aquatic vegetation and algae that are beneficial to the environment and pose no threat to human or animal health. When in doubt, err on the side of caution and avoid contact.

What can you do?

Follow instructions found on posted signs and avoid contact with any questionable waters or floating scum that may have an odd green or sometimes blue or brown color. Do not let livestock or pets drink from any waters posted with an advisory. Always shower after swimming, boating or skiing. Please report possible HAB sighting or fish kills to the property office.

Please help reduce the risk of HABs

Measures you can take:

- Limit fertilizer use near streams or ditch lines
- Maintain septic tanks
- Do not treat possible HAB blooms with algaecides
- Promote native plant growth along streams and shorelines that may act as a “buffer zone” and reduce potential runoff.

To report a HAB please contact the local property office.

For more information about HABs visit:

www.algae.IN.gov or www.lrl.usace.army.mil

Anabaena

Planktothrix

Microcystis



U.S. Army Corps of Engineers



IDEM Samples Lake

Post HAB info sign at beach for summer season. Post Water Quality Notice signs at ramps and access points. Make rack cards available at gates and in brochure racks.

DNR staff monitor for HABS; IDEM staff sample beaches monthly June-August.

USACE responds to potential HABS in Corps lakes with sampling.

Cell Count < 100,000 cells/ml
Toxin Level < 6 ppb

YES

NO

Change diamond on BGA info sign at beach to ADVISORY alert. Post ADVISORY on web. Maintain Water Quality Notice signs at ramps and other access points.

IDEM Samples Biweekly

Cell Count \geq 100,000 cells/ml
Toxin Level \geq 6 ppb but < 20 ppb

YES

Change diamond on BGA info sign at beach to CAUTION alert. Post CAUTION on web. Maintain Water Quality Notice signs at ramps and other access points.

IDEM Samples Weekly

Cell Count \geq 100,000 cells/ml
Toxin Level \geq 20 ppb

YES

Change diamond on HAB info sign at beach to BEACH CLOSED alert. Post BEACH CLOSED on web, at gates and issue a media release. Maintain Water Quality Notice signs at ramps and other access points.

IDEM Samples Weekly

Toxin Thresholds

Type of Posting	Microcystin (ppb)	Cylindrospermopsin (ppb)
Recreation Caution	\geq 6 but < 20	\geq 5 but < 20
Beach Closed	\geq 20	\geq 20

IDEM/IDNR HAB SOP Thresholds

Table 1: Cell count and toxin thresholds with corresponding warning color and associated precautions. If either the cell count or toxin threshold is met, the associated alert level will be activated. (Both thresholds DO NOT have to be met before activation of a particular alert level.)

Alert Level	Cell count/mL	Toxin Level	Color	Precautions
LOW RISK	< 100,000	< 6 ppb	Blue	Don't drink water; shower after swimming
ADVISORY	≥ 100,000	< 6 ppb	Yellow	Swimming/boating permitted; Avoid contact with algae. Keep pets out of water or bathe after swimming and prevent licking fur.
CAUTION	≥ 100,000	6 – 20 ppb	Orange	Children and immune compromised individuals should avoid water.
CLOSED	≥ 100,000	≥ 20 ppb	Red	Unsafe to swim for humans or pets.

Water Quality Notice

Watch for Blue-Green Algae!

Water conditions, combined with weather and high nutrient levels may result in harmful algal blooms (HABs).

- Check for alerts at property offices, entrances or beaches indicating possible HABs.
- **DO NOT** drink untreated lake water.
- Learn to recognize blue-green algae and avoid areas with visible algae accumulation.
- Do not allow children or pets to swim where algae is present.
- After swimming, wading or skiing, shower with warm soapy water and wash hands thoroughly.

Take appropriate precautions for people and pets, and have fun on the water!

More information available:

- Property offices
- www.algae.IN.gov
- www.lrl.usace.army.mil



Public Courtesy of IDNR and IDEM

Does the Beach Have Blue-green Algae?

Blue-green algae can be found in many of Indiana's lakes and reservoirs. Swimmers, boaters and pet owners can enjoy water based recreation, but should be on the lookout for evidence of harmful algal blooms (HABs).

Blue-Green Algae

Algae of many species occur naturally in Indiana's lakes and reservoirs. Blue-green algae is common and not a problem unless levels are high. When levels are high, toxins may be produced as algae cells grow and die.

What Does Blue-Green Algae Look Like?

When conditions are right, HABs may occur. An HAB occurs when algae reproduce quickly, creating mats of algae or discoloration of the water because of the large quantity of algae cells present. High nutrient levels from lawn and agricultural fertilizers, straight and manure, blue-green water, all contribute to HABs.

Colors may vary from green, blue-green, brown, black, white, purple, red or black. Algae may look like a film, crust, puff balls, grass clippings, dots, splilled paint, pea soup, foam, wool, straws or cottage cheese curds.

Watch for signs that might indicate a blue-green algae bloom in this lake or reservoir and report your sighting to the property office.

How Can Exposure to High Levels of Blue-Green Algae Affect People, Pets and Fish?



Swimmers and boaters

Precautions:
Avoid contact with algae.

Avoid swallowing water while swimming.

Take a bath or shower with warm, soapy water after coming in contact with lake water.

Do not use lake water for cooking or bathing.



Pet Owners

Pets can be poisoned by the toxins produced by some algae.

Precautions:
Do not allow your pets to swim in or drink water where algae is present.

Rinse pets with soap and water if they swim in murky water.

Do not let your pet lick algae off their fur.



Fishing

Some toxins may accumulate in the tissues of fish.

Precautions:
Do not eat fish organs when filleting your fish.

Rinse the fillets with clean water before freezing or cooking.

Avoid consuming the fish, where toxin accumulation is greatest.

Eat in moderation.

Blue-green algae and toxin levels are tested in this body of water. Alert levels vary with testing results:



LOW RISK

Don't drink the water
Shower after you swim



ADVISORY

Swimming and boating permitted.

Avoid contact with algae.

Avoid swallowing water while swimming.

Take a bath or shower with warm soapy water after coming in contact with lake water.

Do not use lake water for cooking or bathing.

Do not allow your pets to swim in or drink water where algae are present.



CAUTION

All Recreation Advisory

precautions, plus . . .
Children and those with compromised immune systems should not swim.



BEACH CLOSED

Algae and toxin levels make this beach currently unsafe for swimming.



Photos courtesy of the Indiana Department of Environmental Management.

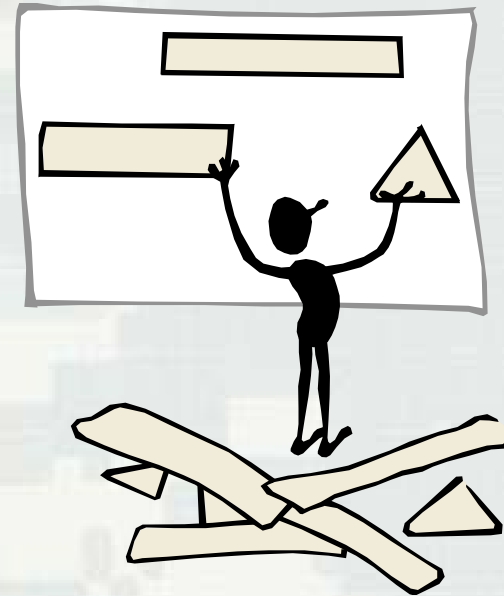
Today's Alert Level



Indiana's lakes and reservoirs provide great recreational opportunities. Learn to recognize blue-green algae, be alert, take precautions and have fun on the water!

Indiana Next Steps

- Pursuing HAB response “season”
- Collecting input from lake managers
- Revising sampling plans



Ohio (previous plan)

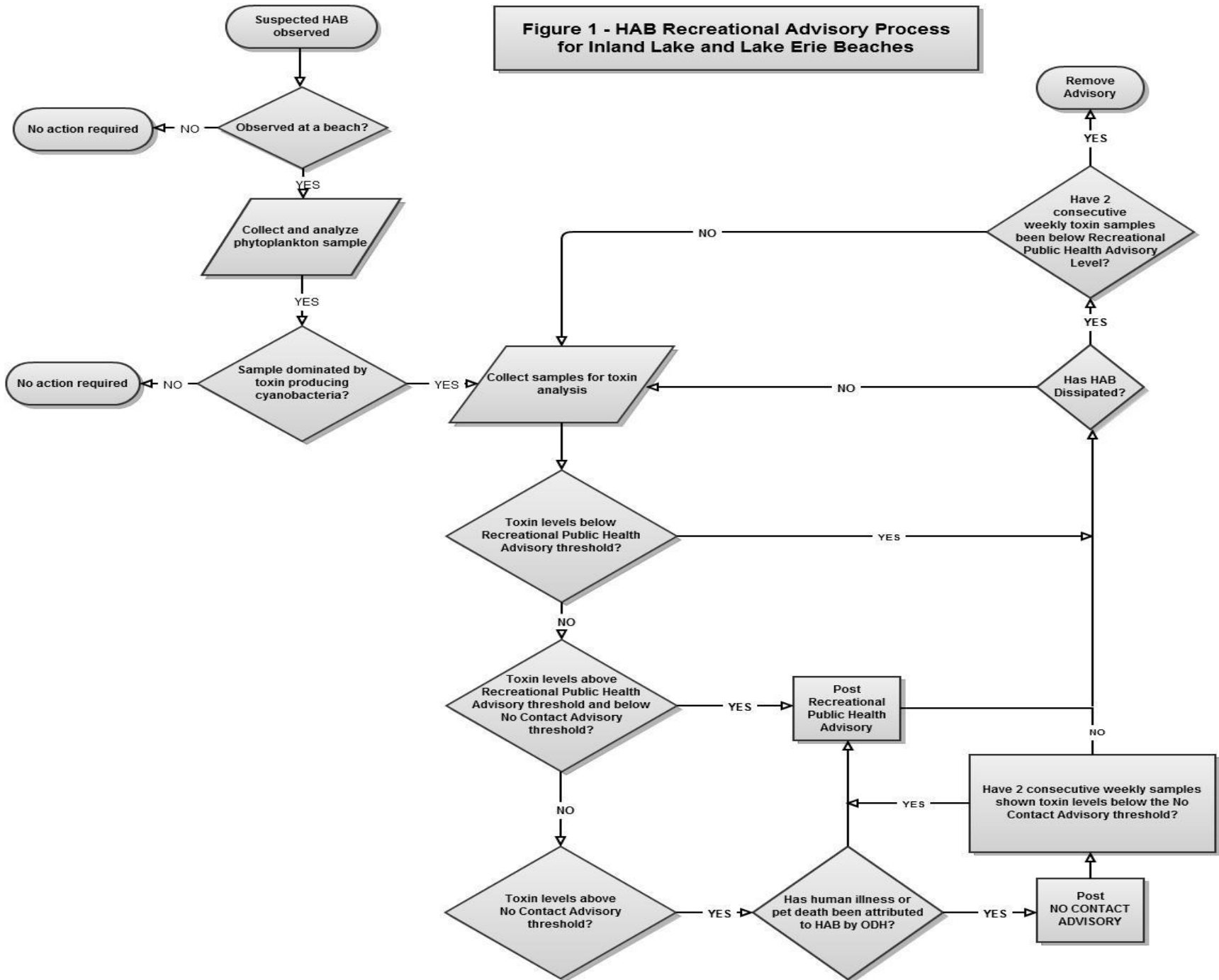
- OH focused on beaches for public advisories
 - Basing advisories on toxin data
- Corps sampling from body of lake
 - Corps contracting cell count analysis
- Results in conflicting messages to the public

Ohio/ Corps Cooperative Agreement



- State continues to sample beaches
- Corps continues to sample rest of lake
- All samples analyzed for toxins at state lab with state funding

Figure 1 - HAB Recreational Advisory Process for Inland Lake and Lake Erie Beaches



Ohio Thresholds

Threshold (ppb)	Microcystin*	Anatoxin-a	Cylindrospermopsin	Saxitoxin*
Recreational Health Advisory	6	80	5	0.8
Recreational No Contact Advisory	20**	300**	20**	3**

*Microcystin and saxitoxin thresholds are intended to be applied to total concentrations of all reported congeners of those toxins.

**In combination with a confirmed human illness or pet death.

- All advisory thresholds set by the state
 - Corps recognizes state as water quality authority
 - Corps works as a cooperating partner in collecting data

Advisory Diamonds

- Recreational Health Advisory
 - **ORANGE**
 - “WARNING”
 - “High levels of algal toxins have been detected. Swimming and wading are not recommended for the very old, the very young or those with compromised immune systems.”
- Recreational No Contact Advisory
 - **RED**
 - “DANGER”
 - “Algal toxins at UNSAFE levels have been detected. Avoid all contact with the water.”



OH “General Awareness”

Have fun on the water, but know that blue-green algae are in many Ohio lakes. Their toxins may be, too.

Be Alert! Avoid water that:

- looks like spilled paint
- has surface scums, mats or films
- is discolored or has colored streaks
- has green globs floating below the surface



Avoid swallowing lake water.

***For more information, visit
ohioalgaeinfo.com
or call 1-866-644-6224.***



- Description of HABs
 - Verbal description
 - Photographs
- Don't drink the water
- Direction for more information
- Revision in the works

Ohio/ Corps Cooperative Agreement

- Each lake has unique sign posting and communication plan
 - Establishes WHO is responsible for posting WHAT message, WHERE on the property
- Builds on locally established Corps/State park relationships

Ohio/ Corps Cooperative Agreement

- State HAB Advisory Board concerns
 - Advisory sign posting around entire lake
 - “Prolonged full body exposure” (swimming beaches)
- Awaiting guidance



Photo courtesy of Erich Emery – Harsha Lake 2012 “explosion”

Kentucky 2013

- No formalized plan
- Public affairs
- Communication issue



Blue-green Algae Awareness Level

CAUTION

Elevated Risk of Adverse Health Effects

BLUE-GREEN ALGAE BLOOMS ARE PRESENT

For Your Safety, The U.S. Army Corps of Engineers, Louisville District, in coordination with Kentucky Division of Water, Kentucky Department for Fish and Wildlife Resources, Kentucky Department for Public Health, and the Kentucky Department of Parks, Recommend the Following:

- **DO NOT** drink, or allow pets/horses to drink, untreated lake water.
- Children and pets are more likely to get sick because of blue-green algae.
- Keep pets/horses out of the water.
- Avoid areas with visible algae accumulation.
- Remove fish skin and organs before cooking, do not consume or allow pets/animals to consume the organs or skin.

Symptoms from exposure may include nausea, vomiting, diarrhea, skin rash, eye irritation, respiratory problems or other unexplained illness.

For more information go to:



www.lrl.usace.army.mil

Report algae blooms to: USACE lake project office or the Louisville District Water Quality (502) 315-7439	For additional information contact your local health department or the Kentucky Department for Public Health.
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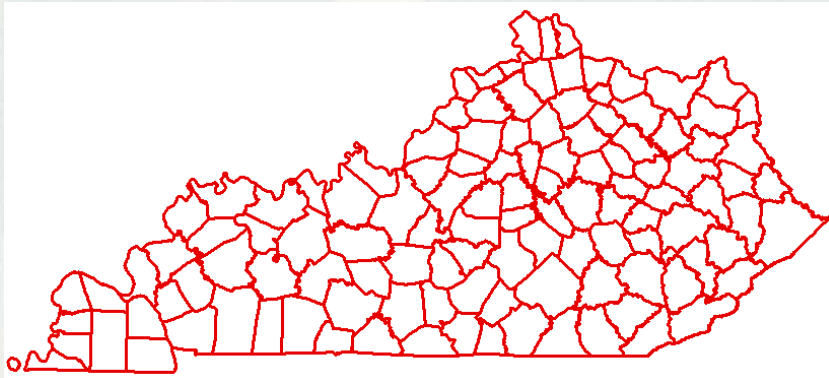
Kentucky 2014

- Limitations

- Staff
 - Over 600 lakes and one assigned staff
- High costs
- HAB identification

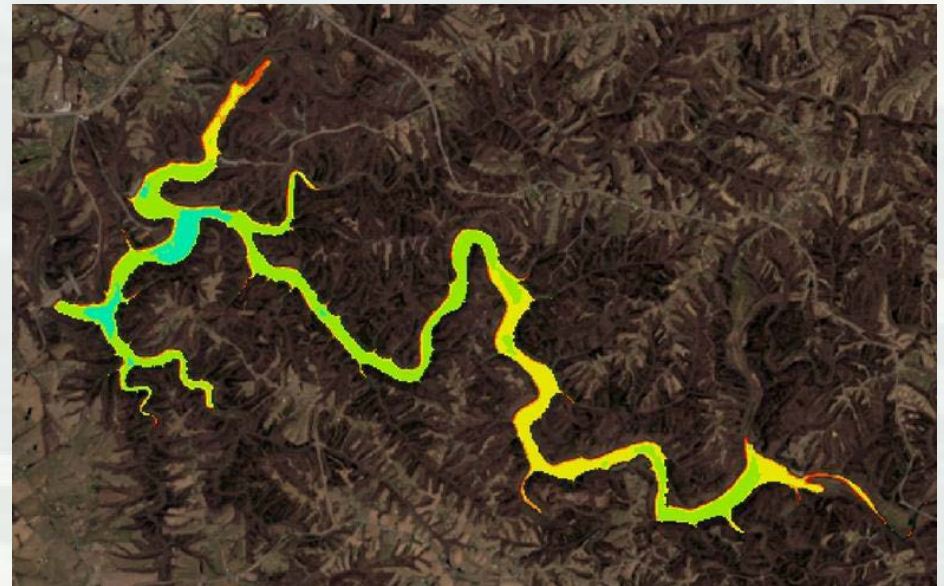
- Objectives

- Identify locations with highest HAB probability
- Produce graphics to communicate water quality conditions to the public
- Use remote sensing and Landsat 8 data to model these conditions



Kentucky / Corps 2014

- More ground truthing
 - Monthly
- Collecting data on flyover dates
 - Secchi disk
 - Chlorophyll a
 - Phycocyanin
- Corps data collection
 - cell count
 - Secchi disk
- Cooperative remote sensing study

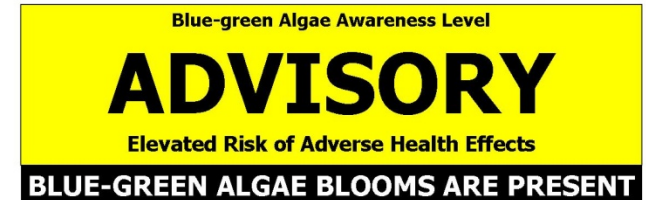


Courtesy of Mark Martin/Garrett Stillings presentation

Kentucky / Corps 2014

(for the time being...)

- Working together to develop model
- Advisories based on Corps cell count data at Corps lakes
- Corps lakes posted with previously agreed upon signage



ers, Louisville District, in co-
Kentucky Department for Fish
t for Public Health, and the
mend the Following:

drink, untreated lake

ing and

get sick with exposure

ation.

oking, do not consume or
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ide nausea, vomiting,
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illness.

mil

nal information contact your local
artment.

WV – PA - NY

- ???
- Continue to apply the LRD HAB Strategy

State Strategies

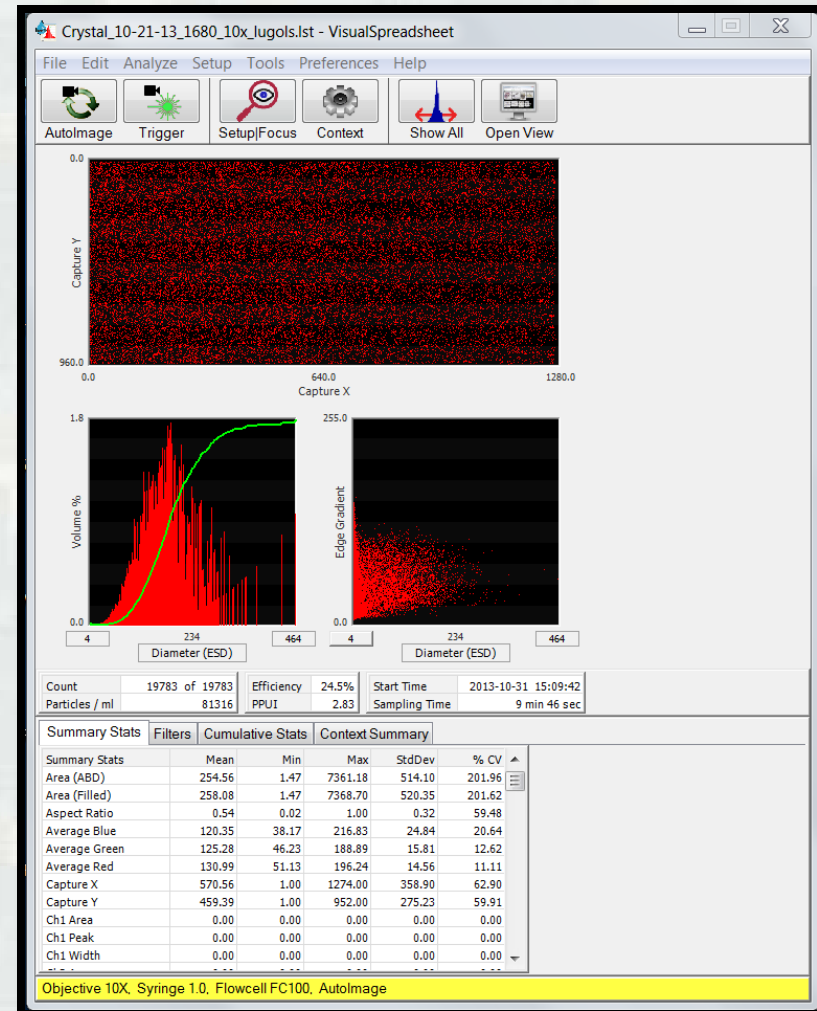
- The Corps doesn't do Water Quality (just kidding)
- The state agencies have the primary responsibility for setting water quality standards/criteria.
- This may lead us back to doing things differently in each state, but that's **OK**.
- The state agencies become the voice to the public, the Corps works in support.

New *TOYS* and...

NEW TECHNOLOGIES

FlowCam

- **Flow Cytometer And Microscope** manufactured by Fluid Imaging Technologies, Inc.
- A proprietary software that analyzes the images taken by the camera to provide particle counts and other information
- Can set up statistical filters to sort particles based on size/shape



Limitations of the FlowCAM[®]

- It images EVERY particle that passes by the camera lens and includes it in the final particle count
- Measures and sorts particles based on shape, so it can only differentiate between rod-shaped algae and colonies
- Can't focus on one particular particle so some images are blurry, some are in focus
- Only imaging a small portion of flow cell, unless you buy Field-Of-View cell

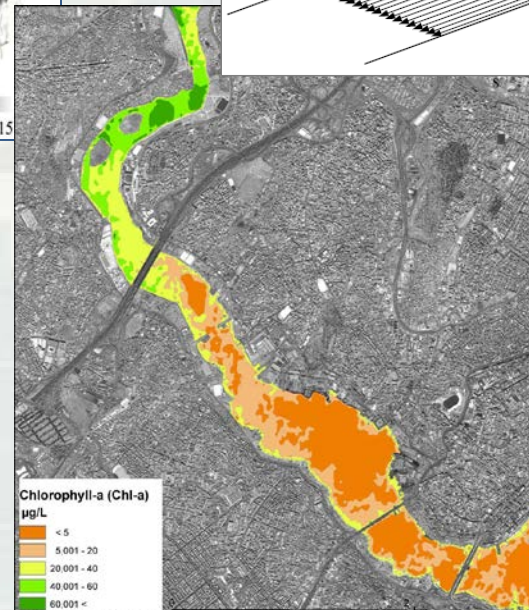
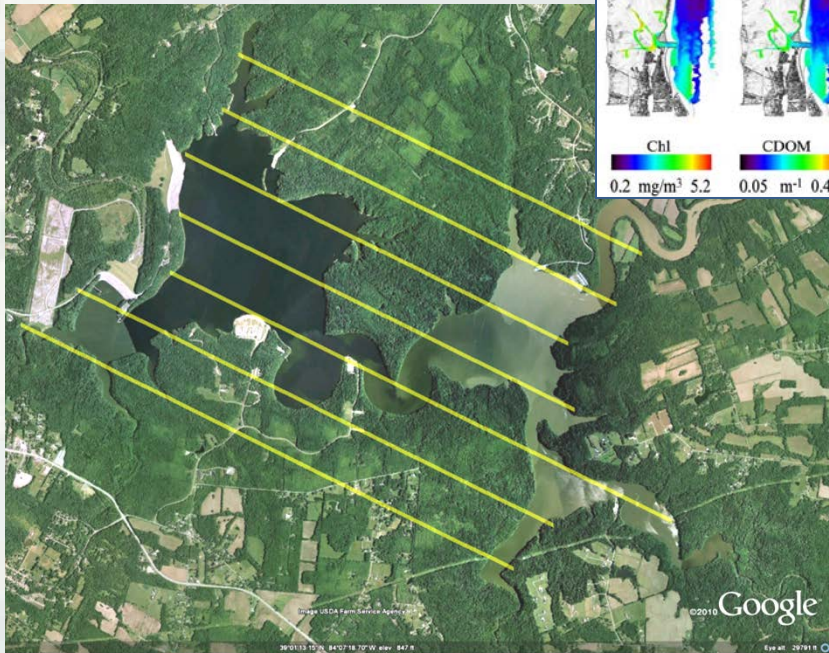
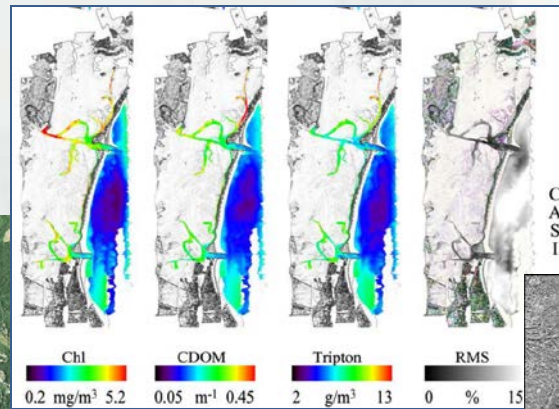
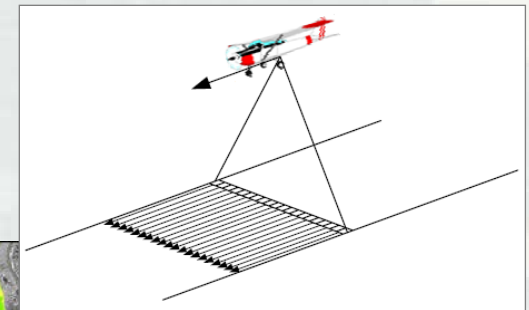
Conclusions / Recommendations

- The FlowCAM is not going to replace traditional identifications
- Particle counts not effective
- May be able to fine tune biovolumes
 - Reduced hold time
 - Use of laser
- Group by dominant taxa and determine correlations with specific filters (i.e. rods and spheres)
- Fluid Imaging developing biovolume capability
- Run samples at different times to determine cell degradation
- Shorten sample run time so that we can perform multiple runs with each sample
- Possibly dilute samples to get more accurate particle data (lower PPUI)
- Build better filters to sort out small debris
- Purchase a Field-of-View flow cell to increase efficiency

Remote Sensing

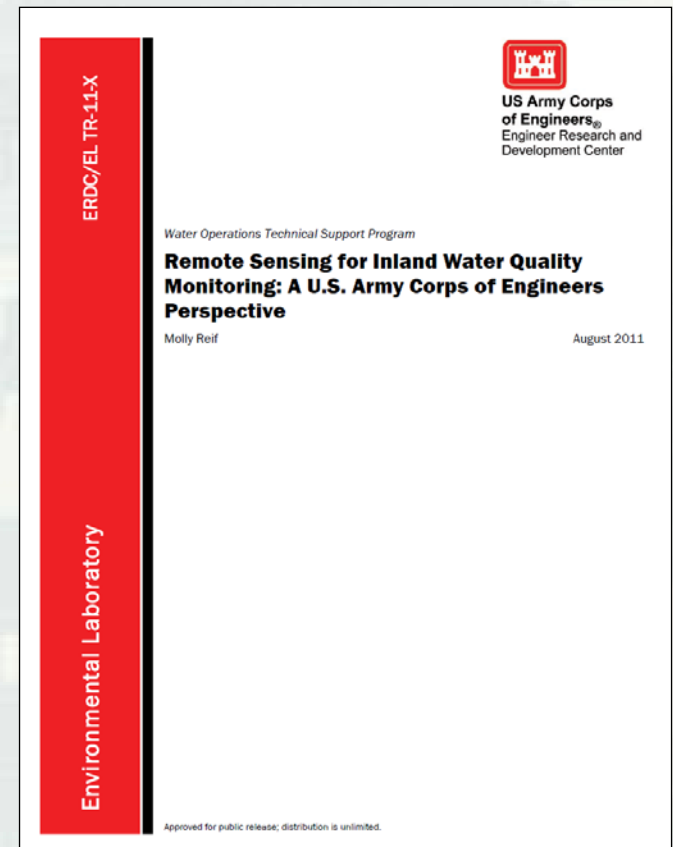
- 2014 Collaborative Pilot Project

Itres CASI-1500 Hyperspectral Imager



Technical Report: *Remote Sensing for Inland Water Quality Monitoring: A U.S. Army Corps of Engineers Perspective*

- Water Operations Technical Support Program (WOTS): supports technology transfer efforts for environmental and water quality operation studies
- Provides rapid direct technical assistance to the USACE field offices in implementing technology to solve water quality environmental problems
- TR is the result of a WOTS request for a review of current remote sensing capabilities and limitations to assess water quality in inland lakes and reservoirs

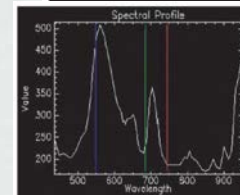
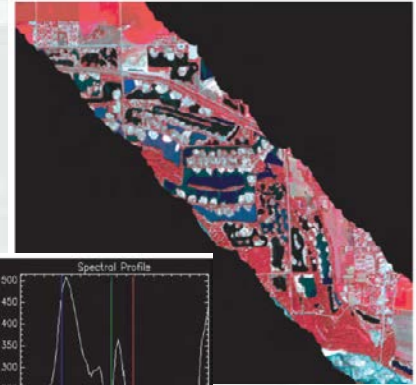


2014 Pilot Project

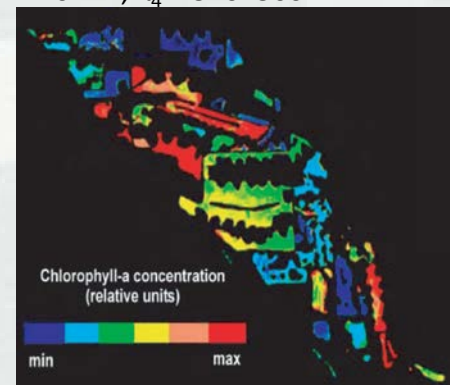
- Collaborators
 - USACE LRD, LRL and LRH
 - USEPA ORD, RTP
 - NOAA
 - University of Cincinnati
 - Kentucky Division of Water
 - USGS
- Flight window
 - June 15-30 2014



AISA hyperspectral image
(false-color) over Fremont, NE

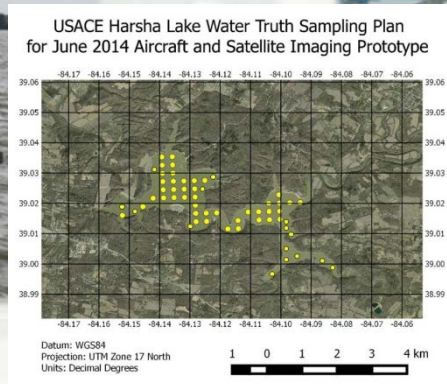


Chl concentration: $\alpha [R^{-1}(\lambda_1) - R^{-1}(\lambda_2)] \times R(\lambda_3)$
where $\lambda_1 = 665-675$ nm, $\lambda_2 = 700-710$ nm, $\lambda_3 = 730-740$ nm, $\lambda_4 = 540-560$ nm



2014 Pilot Project

- Comparing
 - Satellite derived multi- and hyperspectral data (Landsat-8, MODIS, HICO, WorldView and Sentinel-2)
 - Airborne derived hyperspectral data
 - Field measured reflectance
 - Field WQ parameters
 - Grab samples





Questions?