

# Grand Lake and the Harmful Algal Bloom of 2011

(Unique Isolated Event or Looming Annual Threat)



# Grand Lake Watershed





# Watershed Inputs & Challenges...



Chat Pile



Tar Creek



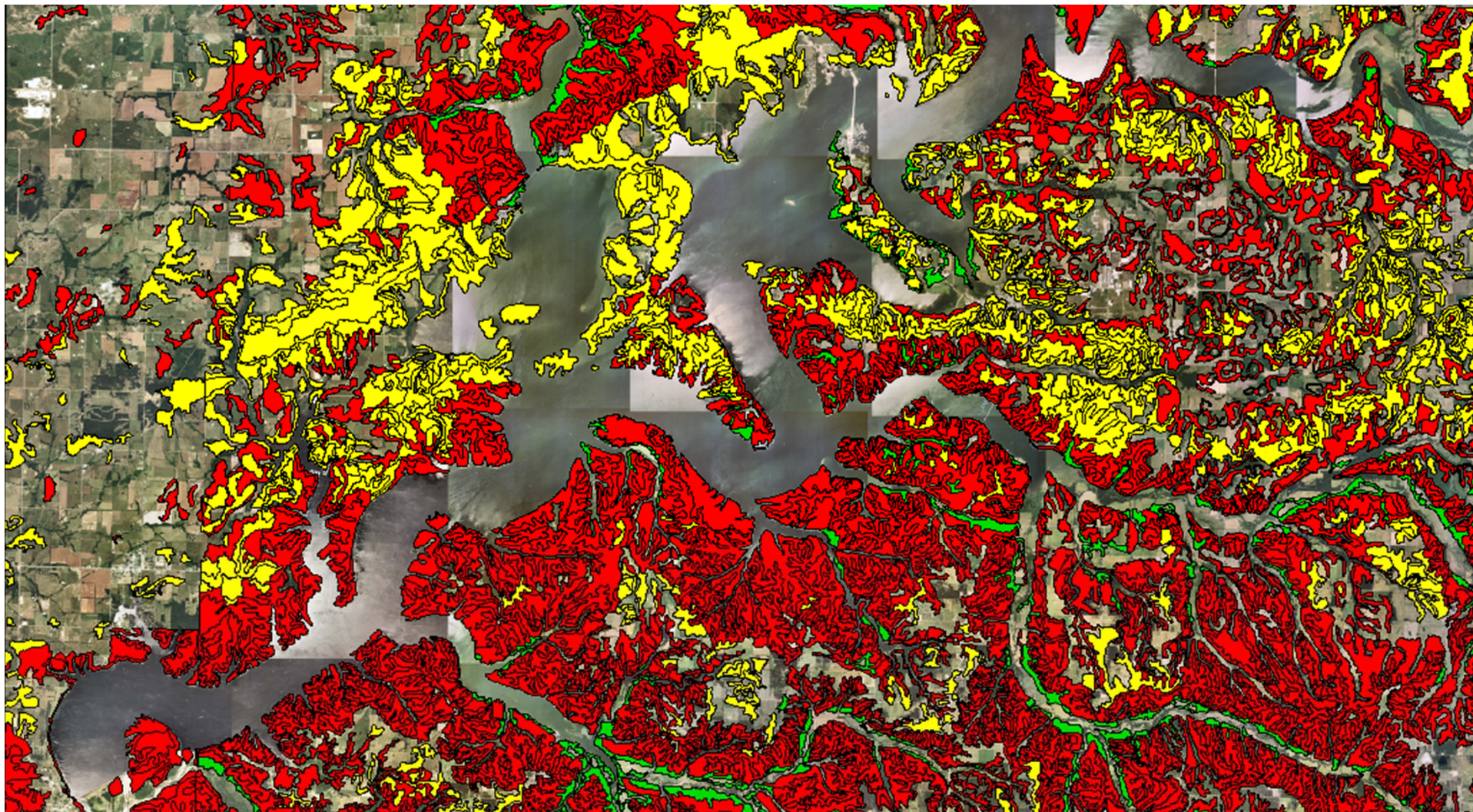
● Superfund  
Site/Tri-State  
Mining District

● Poultry

● Feed Lots

● Waste-Water  
Treatment





## Soil Limitations for Septic Tank Absorption Fields (Grand Lake Oklahoma)



Severe  
Malfunction risk



Moderate  
Malfunction risk



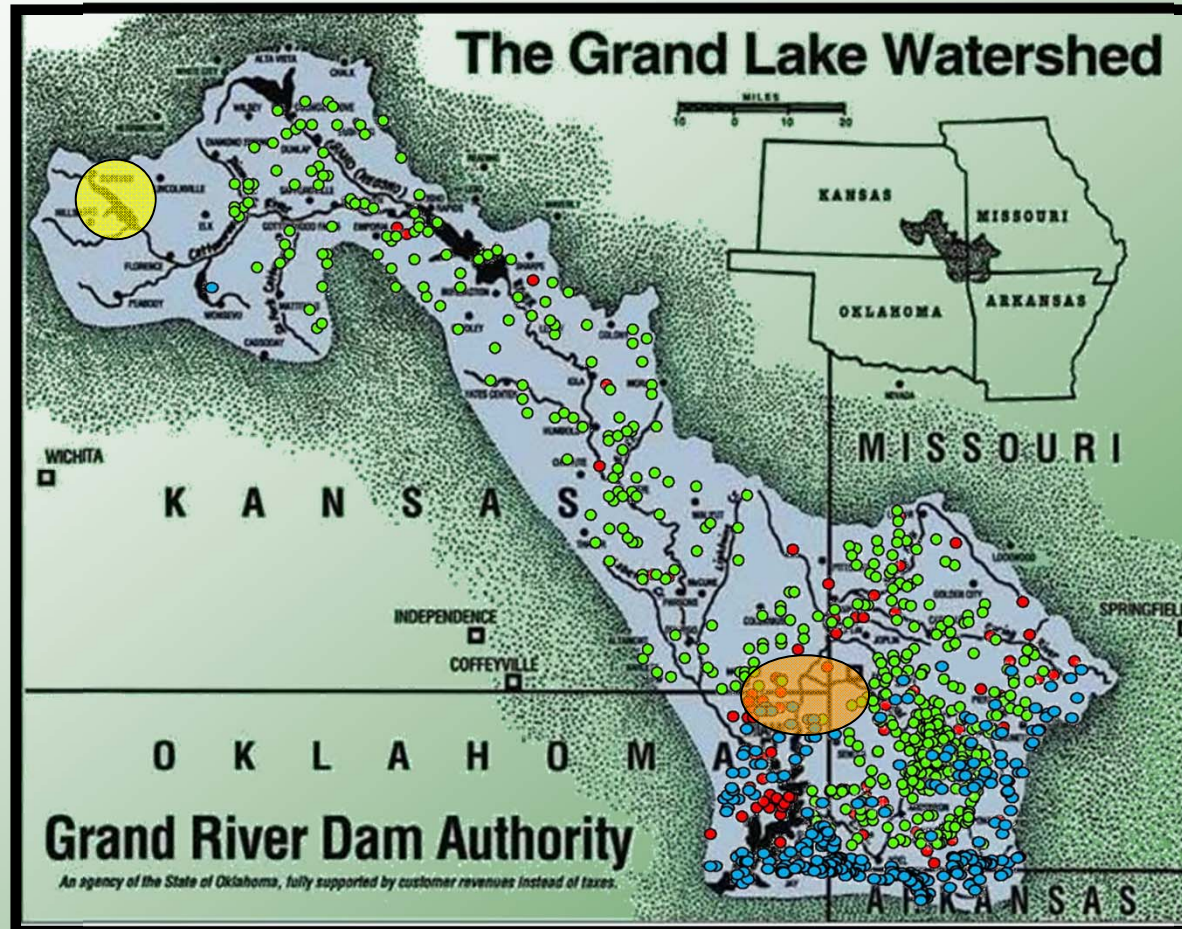
Slight  
Malfunction risk



# Watershed Inputs & Challenges...



ZM/HAB  
Lake Marion  
KS



Superfund  
Site

Poultry

Feed Lots

Waste-Water  
Treatment



# ZM: W.R. Holway Reservoir





# Lake Marion, Kansas





# 2011 News Headlines

## Public warned of algae at Bernice

### Staff Reports

An Oklahoma Department of Environmental Quality (DEQ) recommendation to temporarily avoid body contact with water at Bernice State Park is prompting the Grand River Dam Authority to remind lake enthusiasts to take extra precaution on Grand Lake this summer. The state park is putting up signage to notify the public.

DEQ made the recommendation after the GRDA Ecosystems Management's water lab confirmed blue green algae (BGA) was in the waters near the park, and in portions of Horse Creek and the back of Duck Creek.

BGA are microscopic organisms that are naturally

present in lakes and streams, usually in low numbers. However, the algae can become abundant in shallow, warm water that receives heavy sunlight. While most BGA are not toxic, toxins can be produced in some algae blooms. Results of the tests of BGA water samples taken by the GRDA Ecosystems Management Department will not be available until early next week. However, as a precaution DEQ made its recommendation to avoid body contact.

GRDA joins with the DEQ in urging lake users to practice caution and use common sense when



Courtesy Photo

This blue green algae has appeared near Bernice State Park.

See, *ALGAE*, page 9

**Grove Sun: June 28, 2011**

## DEQ issues Grand Lake algae warning

• Tests are being run to determine the toxin level of the blue-green algae.

BY RANDY KREHBIEL  
World Staff Writer

BERNICE — The presence of a potentially dangerous algae caused the Oklahoma Department of Environmental Quality to

**'In the interest of public safety, we are just asking lake users to be careful and vigilant.'**

Justin Alberty  
corporate communications  
director for the GRDA

Results of tests to determine the toxin level of the

the public's help in that regard. If you see areas of the lake where you believe blue-green algae is present, please contact GRDA."

Blue-green algae might look like thick pea soup, green paint, or bluish, brownish or reddish-green paint. When it washes up on shore, it may appear to look like a thick green mat that falls apart when handled.

The more common green algae are stringy and made

**Tulsa World: June 25, 2011**



**Microcystin Data Report**  
Project: Grand River Dam Authority

<u>Sample Identification</u>	<u>Sample Collection Date</u>
Horse Creek (Tow)	110627
Horse Creek (Grab)	110628
Duck Creek (Tow)	110628
Duck Creek (Grab)	110628

**Toxin** – Microcystin (MC)

**Sample Prep** – The samples were ultra-sonicated to lyse cells and release toxins. Sample dilutions (10x & 100x) were necessary to accommodate the calibrated range for ELISA analysis.


**Analytical Methodology** – A microcystins enzyme-linked immunosorbent assay (ELISA) was utilized for the quantitative and sensitive congener-independent detection of MCs. The current assay is sensitive to down to a LOD/LOQ of 0.15 µg/L for total MCs. The average recovery of the lab fortified blank (LFB) spiked with 1 µg/L MCLR was 85%.

Liquid chromatography/mass spectrometry (LC/MS) was utilized for the determination of four of the most common microcystin variants and their relative abundance. The [M+H]<sup>+</sup> ions for LR (m/z 995.5), RR (m/z 519.5), YR (m/z 1045.6) and LA (m/z 910.5) provided both specificity and sensitivity. Microcystin-LR was found to be the dominant variant present in the Horse Creek (tow) sample with a small level of MCRR present as well.

**Summary of MC Results**

<u>Sample</u>	<u>MC levels</u> (µg/L)
Horse Creek (Tow)	≈ 125
Horse Creek (Grab)	≈ 49
Duck Creek (Tow)	≈ 358
Duck Creek (Grab)	≈ 10

LOD/LOQ = 0.15 µg/L

Submitted by:   
Mark T. Aubel, Ph.D.  
Date: 6/30/11

# Test Results

## Summary of MC Results

<u>Sample</u>	<u>MC levels</u> (µg/L)
Horse Creek (Tow)	≈ 125
Horse Creek (Grab)	≈ 49
Duck Creek (Tow)	≈ 358
Duck Creek (Grab)	≈ 10

LOD/LOQ = 0.15 µg/L

World Health Organization 2003:  
Warns of High Probability of Adverse  
Health Effects When Microcystin ≥ 20ug/L



# News Headlines

## Governor quick to respond to warning about Grand Lake

TULSA (AP) — Oklahoma officials said Friday they are discouraging swimming in Grand Lake because of potentially dangerous blue-green algae — a statement that drew a quick response from the governor, who was concerned about the effect on tourism over the holiday weekend.

Gov. Mary Fallin said she was extremely concerned about the economic damage that could result if people canceled trips to the north-eastern Oklahoma lake at the last minute.

"There are still a lot of great things to do at the lake, even though there are concerns about the quality of the water," Fallin told The Associated Press.

Public pools are available for swimming, and there's golf courses, fireworks, an

air show, free concerts, a carnival and numerous tourist attractions in the towns near the lake, including Grove, Pryor, Salina, Langley and Miami.

"I've had calls from businesses at the lake expressing concern about the effect on business and revenue," Fallin said. "Grand Lake is a wonderful tourism spot for Oklahoma. There's a lot of economic activity at the lake. We need to do all we can to support the lake."

Fallin's family had already planned a trip to Grand Lake over the Independence Day weekend and "we're still going," she said.

The GRDA is "strongly discouraging" swimming or other activities that would bring people into contact with the water, agency spokesman Justin Alberty



THE TULSA WORLD, TOM GILBERT

This aerial photograph shows Oklahoma officials said Friday Grand Lake because of potential statement that drew a quick concerned about the effect

said. The agency issued advisory because of rapidly changing levels of green algae in the lake said.

The agency's board of directors scheduled an emergency meeting in Tulsa Friday afternoon to discuss the situation.

Blue-green algae are microscopic organisms that are naturally present in lakes and streams, usually in low numbers. However, the algae can become a dominant in shallow, warm w

## DEQ Issues Algae Alert

By CAREY HEAD  
News Lifestyles Editor

OKLAHOMA CITY — An Oklahoma Department of Environmental Quality recommendation to temporarily avoid body contact with water at Bernice State Park and a few other areas of Grand Lake is prompting the Grand River Dam Authority to remind lake enthusiasts to take extra precaution on Grand Lake this summer. The state park is putting up signage to notify the public.

Blue green algae, or BGA has been found in the waters near Bernice State Park, in portions of Horse Creek and the back of Duck Creek — all popular destinations for tourists enjoying the waters of Grand Lake. The DEQ made the recommenda-

tion to avoid body contact with water in these areas after BGA was found there.

Toxins produced by BGA, or cyanobacteria, may cause allergic reactions, damage to the liver and other internal organs, as well as damage to the central nervous system and the brain.

According to Justin Alberty, corporate communications director with GRDA, the area on Duck Creek where the BGA was found was at the back of

the creek beyond the popular Thunder Bay restaurant.

Alberty explained the biggest area of concern is Bernice State Park and Horse Creek. Tests conducted June 17 found the largest amounts were in Horse Creek, "but over the weekend, the strong southerly winds helped it dissipate."

Over a busy holiday weekend, such as the Fourth of July, the population of Grand Lake proper swells to the third largest in Oklahoma,

according to Grand Lake area Chambers of Commerce.

Visitors are advised to avoid areas where the water is shallow, still and warm. "We've not had this on Grand Lake before," Alberty said. "We don't want to panic anybody but still advise everyone to swim in the main lake."

Three magnets attracting boaters are Woodward Hollow, Big Hollow and Dripping Springs.

(See ALGAE, Page 3)



IN THIS PHOTO provided by State of Washington Department of Ecology, a blue green algae bloom washed up along the shoreline in Long Lake, Thurston County, Washington. The bluish color means that some of the algae are starting to decompose leaving the blue pigment. Some forms of blue green algae, or BGA, are toxic to humans, pets and livestock. The Oklahoma Department of Environmental Quality and the Grand River Dam Authority have issued a warning to visitors to Grand Lake that BGA has been found in the waters of Bernice State Park, Horse Creek and Duck Creek on Grand Lake.

**Lawton Constitution: July 2, 2011**

**Ponca City News: June 28, 2011**



# Blue-Green Algae Bloom

Grand Lake, 2011





# News Headlines

*Ada Evening News: July 21, 2011*

## Heat wave fosters toxic algae in touristy lakes

OKLAHOMA CITY (AP) — A prolonged heat wave in the central U.S. has fostered the growth of a dangerous form of algae in lakes and ponds, threatening swimmers and livestock and scaring away tourists during the busy summer season.

Blue-green algae are actually bacteria that produce toxins

harmful to humans and livestock. It flourishes in warm, stagnant, sunlit water, and this year's heat wave combined with Oklahoma's worst drought since the Dust Bowl have created what one water official called a "perfect storm" for its growth.

Officials have issued a series of warnings, telling boaters and

swimmers at lakes in northeast Oklahoma, southern Kansas and Nebraska to avoid contact with the toxic gunk. The issue attracted national attention earlier this month when Oklahoma Sen. James Inhofe blamed a respiratory illness on a swim in **Grand Lake** in Ketchum Hollow.

The bad publicity has had dire

consequences for some businesses in Oklahoma where tourism is the third largest industry with an estimated annual impact of \$6.2 billion. Oklahoma's numerous lakes are a "huge economic engine" driving that industry, said Leslie Blair, a spokeswoman for the Department of Tourism and Recreation.

Problems on **Grand Lake** have subsided, the **Grand River Dam Authority** said. Advisories remained in effect Wednesday for portions of Keystone, Fort Gibson and Eufaula lakes in Oklahoma, Marion and Big Hill lakes in Kansas, and Willow Creek Lake in northeast Nebraska.

## Dangerous algae plague Oklahoma's lakes, ponds

By Sean Murphy  
Associated Press

OKLAHOMA CITY — A prolonged heat wave in the central U.S. has fostered the growth of a dangerous form of algae in lakes and ponds, threatening swimmers and livestock and scaring away tourists during the busy summer season.

Blue-green algae are actually bacteria that produce toxins

**"My friends at the marinas say their shops are full to the ceiling with beer that they haven't sold ... all because a senator went into a bad area in a cove and got a rash."**

— Sam Williams

quences for some businesses in Oklahoma, where tourism is the third largest industry with an estimated annual impact of \$6.2 billion. Oklahoma's numerous lakes are a "huge economic engine" driving that industry, said Leslie Blair, a spokeswoman for the Department of Tourism and Recreation.

"We took a beating from hell," said Sam Williams, who sells everything from water

*Durant Daily Democrat: July 3, 2011*

## Inhofe says swimming in **Grand Lake** made him ill

TULSA (AP) — Sen. James Inhofe says he believes a swim earlier this week in algae-laden **Grand Lake** made him ill.

Inhofe told the Tulsa World that he took a routine dive into the lake Monday morning and

that night he was "deathly sick."

Oklahoma authorities warned people Friday against swimming in the lake, saying potentially

toxic blue-green algae had been detected. They've also advised

against water skiing and other activities that would bring people or pets in contact with the water.

Inhofe has had a home on the lake in Ketchum Hollow for decades.

He says he's never

seen that kind of algae in the water before.

The 76-year-old Republican says he believes he's turned the corner on the respiratory illness and plans to return to Washington next week.

*Enid News: July 21, 2011*



# Blue-Green Algae Bloom

Grand Lake, 2011 (Horse Creek)





# Blue-Green Algae Bloom

Grand Lake, 2011 (Horse Creek, Unfinished Bridge)





# Blue-Green Algae Bloom

Grand Lake, 2011 (Duck Creek)





# Blue-Green Algae Bloom

Grand Lake, 2011





# Health Department Reports

22Aug11

**Acute Disease Service (ADS)**

**Harmful Algal Bloom – Related Illness**

The ADS has received 62 reports of illness possibly related to harmful algal blooms in Oklahoma. The ADS has conducted interviews on 49 of 54 reports for which contact information was available.

## ***Grand Lake Report: August 22, 2011***

- Lake & Area of lake exposed (if available; not mutually exclusive)
  - Grand Lake (20)
    - Woodard Hollow (2)
    - Drowning Creek (3)
    - Honey Creek (4)
    - Dripping Springs (1)
    - Horse Creek (2)
    - Duck Creek (3)
    - Party Cove (1)
    - Hinds point cove (2)
    - Grand Terra (North Cove) (2)



# Financial Impacts

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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 \$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 saw a slight increase, while the city of Ketchum dipped slightly, and 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

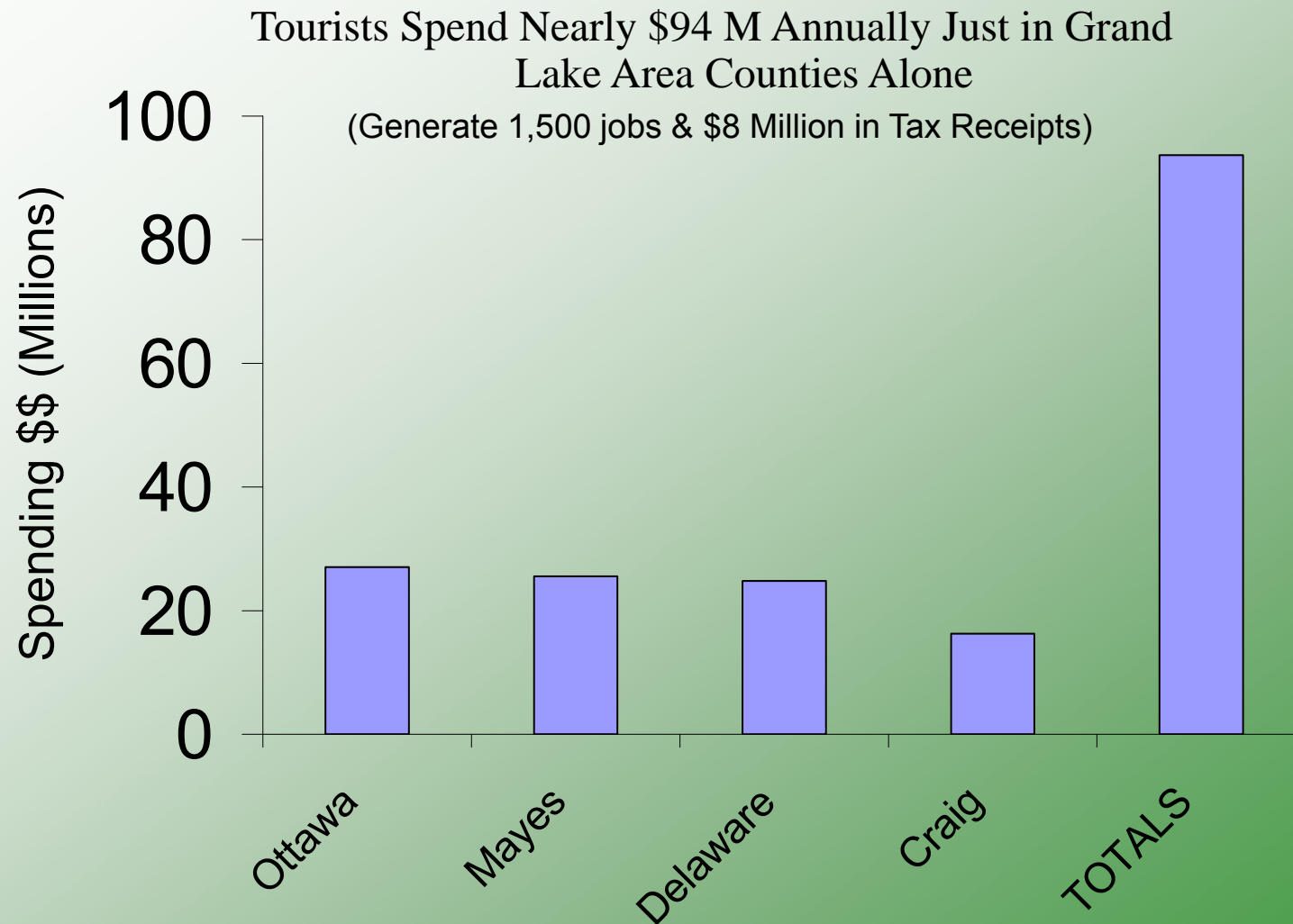
\* Reflects collections from May 16 to June 15

\*\* Reflects collections from June 16 to July 15



# *Tourism ...*

*Providing vital revenue for state, county and local communities...*



Data Provided by:  
Travel Industry Association of America; Washington, D.C, 2005.



# Financial Impacts

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With the main part of the lake testing negative for the toxins, the Grand River Dam Authority is allowing boating to resume.

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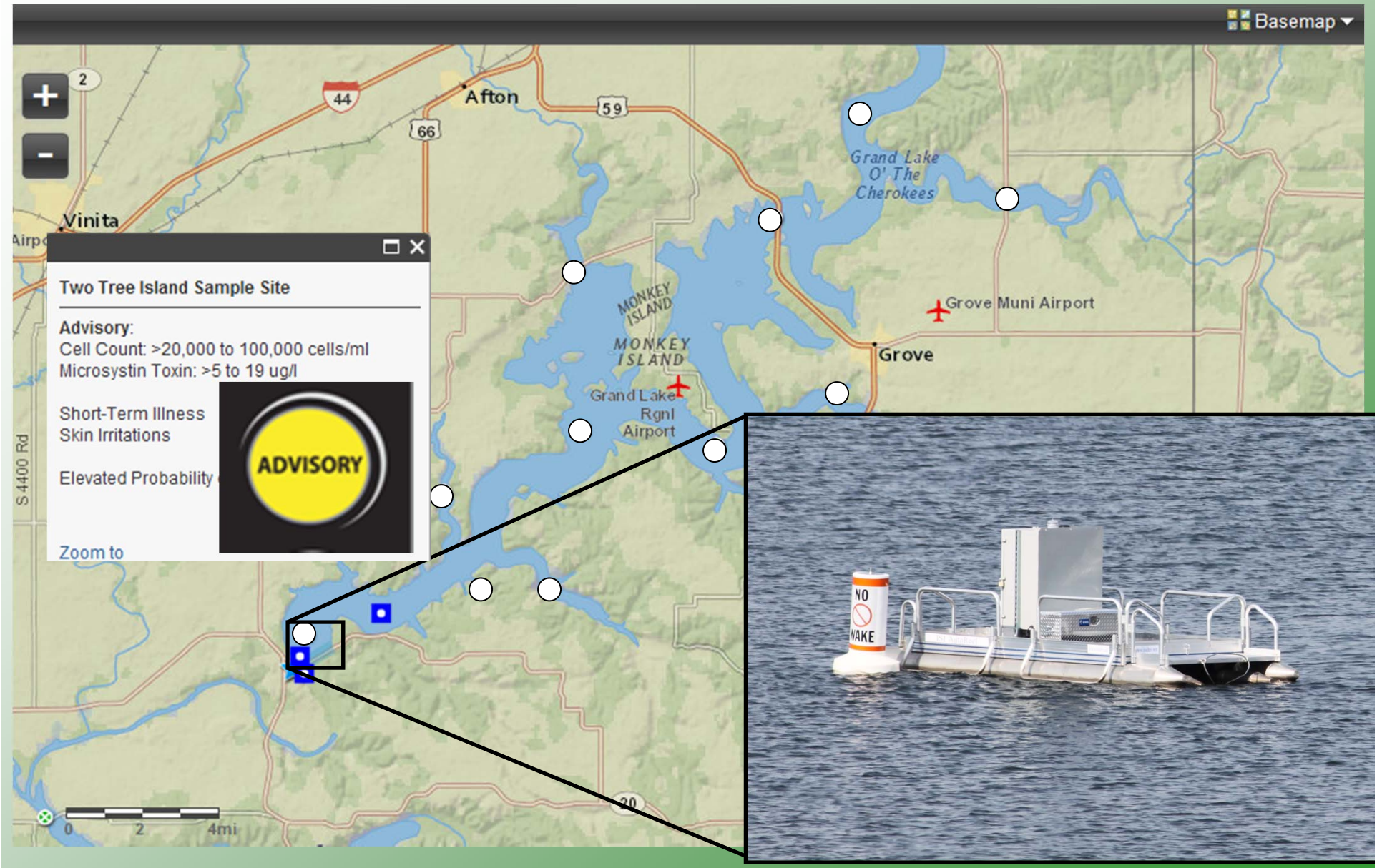
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# GRDA's 2012 Response Plan

## Web-based Advisory System



# Guidance Level

	LAKE ADVISORY GUIDANCE LEVEL	HEALTH RISK
	<b>WARNING</b> Cell Count: $\geq 100,000$ cells/ml Microcystin Toxin: $\geq 20\text{ug/l}$	<b>High Possibility</b> of Adverse Health Effects
	<b>ADVISORY</b> Cell Count: $> 20,000$ to $100,000$ cells/ml Microcystin Toxin: $>5$ to $19\text{ ug/l}$	<b>Moderate Possibility</b> of Adverse Health Effects
	<b>NO ADVISORY</b>	



# Advisory Signs

## ADVISORY

**Routine Monitoring Has Shown That Conditions May Be Suitable To Spawn A Blue-Green Algae Bloom**

For Your Safety, The Grand River Dam Authority (GRDA) Recommends the Following:

- Use caution when swimming, water skiing and coming into contact with water
- Do Not drink untreated lake water
- 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.



LAKE ADVISORY GUIDANCE LEVEL	HEALTH RISK
<b>WARNING</b> Cell Count: $\geq 100,000$ cells/ml Microcystin Toxin: $\geq 20\mu\text{g/l}$	High probability of Adverse Health Effects
<b>ADVISORY</b> Cell Count: $> 20,000$ to $100,000$ cells/ml Microcystin Toxin: $> 5$ to $19\mu\text{g/l}$	Elevated Probability of Adverse Health Effects
<b>NO ADVISORY</b>	

For More  
Information,  
Visit [grda.com](http://grda.com)



## WARNING

**High Levels of Potentially Harmful Blue-Green Algae Are Present In Certain Areas**

For Your Safety, The Grand River Dam Authority (GRDA) Recommends the Following:

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- Do Not drink untreated lake water
- Keep pets/livestock off of the beach and out of the water
- Avoid areas with visible algae accumulation

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