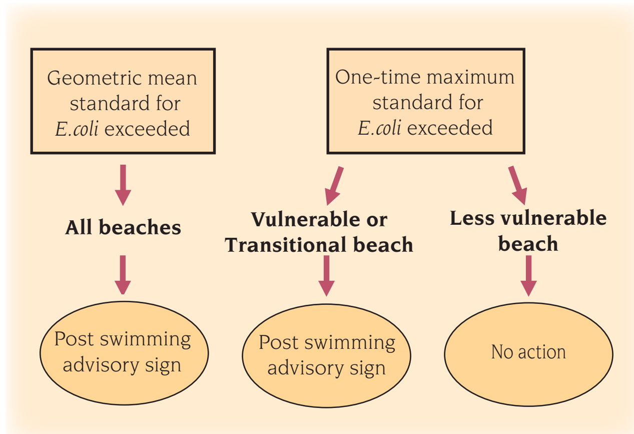
IOWA'S WATER
Ambient Monitoring Program

Iowa's Beach Monitoring Program 2009

For the tenth consecutive year, beaches around the state were monitored for bacteria as part of Iowa's Ambient Water Monitoring Program in order to safeguard the health of those recreating in Iowa's lakes.



Beach Policy

As in previous years, beach policy was based on the two *E. coli* bacteria standards used in Iowa for recreational waters: a one-time sample maximum and a geometric mean. The one-time sample maximum standard was used at beaches that have experienced persistent problems with bacteria in recent years. These beaches are classified as "vulnerable" or "transitional" beaches. Whenever a sample from any of these beaches had an *E. coli* result exceeding 235 organisms per 100 milliliters (ml) of water, a "Water Quality Advisory" sign was posted. The geometric mean standard, which is based on five consecutive samples collected within a 30-day period, was used to determine when beaches were experiencing chronically elevated levels of *E. coli*. Bacteria concentrations in the environment, and therefore results from sampling, often vary by orders of magnitude from week to week; the geometric mean calculation provides an unbiased average across a number of samples (see Figure 1). "Water Quality Advisory" signs were posted at any beach that exceeded Iowa's geometric mean standard of 126 organisms per 100 ml of water.

Above: *Beach policy flow chart.*
Below: *Signs posted at Iowa's state beaches.*

State park beaches were posted with educational signs providing information on ways to reduce the potential health risks associated with swimming at public beaches. These signs also reference resources beachgoers can access to obtain water quality information along with other details about the Beach Monitoring Program.

Indicator Bacteria and Bacteria Standards

Indicator bacteria, although not typically disease-causing themselves, are correlated with the presence of water-borne pathogens. Because it is difficult and costly to analyze water for the many disease-causing organisms that may be present, indicator bacteria, such as *E. coli*, are used to assess the microbiological quality of water as they are easy to collect, relatively safe to handle, and are usually present when pathogens are in the water. An increase in the level of indicator bacteria indicates a potentially elevated health risk of exposure to pathogens. Elevated levels of bacteria can also be associated with cloudy water, unpleasant odors, and increased oxygen demand, all of which impact the overall health of aquatic ecosystems.

So how did we arrive at 235 organisms per 100 ml of water for the one-time sample maximum standard and 126 organisms per 100 ml of water for the geometric mean standard? Epidemiological studies conducted by the U.S. Environmental Protection Agency (1984) demonstrated that the presence of *E. coli* in freshwater is strongly correlated to swimming-related illness and has developed guidelines for *E. coli* based on an acceptable illness rate of 8 per 1,000 people following contact with Class A (primary contact recreation) water bodies.

Sample Collection

The 2009 monitoring season took place between the week before Memorial Day and Labor Day weekend. Samples were collected at least once a week at all state park beaches, but most beaches were sampled twice weekly. Due to renovation projects, samples were not collected at George Wyth (Black Hawk Co.), Green Valley (Union Co.), and Lake Darling (Washington Co.). At each beach, program staff collected water from three transects (left, center, and right) at three water depths (ankle-, knee-, and chest-deep) for a total of nine points within the swimming area. Water gathered from these points was combined and mixed to form a composite sample. This method of sample collection better reflects current water quality conditions compared to collecting and analyzing a single sample from each beach.

$$\text{Geometric Mean} = \sqrt[5]{x_1 * x_2 * x_3 * x_4 * x_5}$$

where x is a single bacteria result

Example: Lake of Three Fires

$$\text{Geometric Mean} = \sqrt[5]{5 * 10 * 120 * 20 * 2700} = 50$$

$$\text{Average} = \frac{5 + 10 + 120 + 20 + 2700}{5} = 571$$

Figure 1. *Geometric mean formula and example.*

Results

Twenty-eight state park beaches exceeded the one-time standard for *E. coli* (235 organisms per 100 ml of water) on at least one occasion during the 2009 monitoring season while 12 beaches exceeded the geometric mean standard for *E. coli* (126 organisms per 100 ml of water). Figures 2 and 3 illustrate bacteria monitoring results at state-owned beaches throughout Iowa.

The Iowa Department of Natural Resources (DNR) has also made arrangements that allow locally managed beaches within the state to participate in the Beach Monitoring Program. Unlike state-owned beaches which are subject to Iowa DNR beach

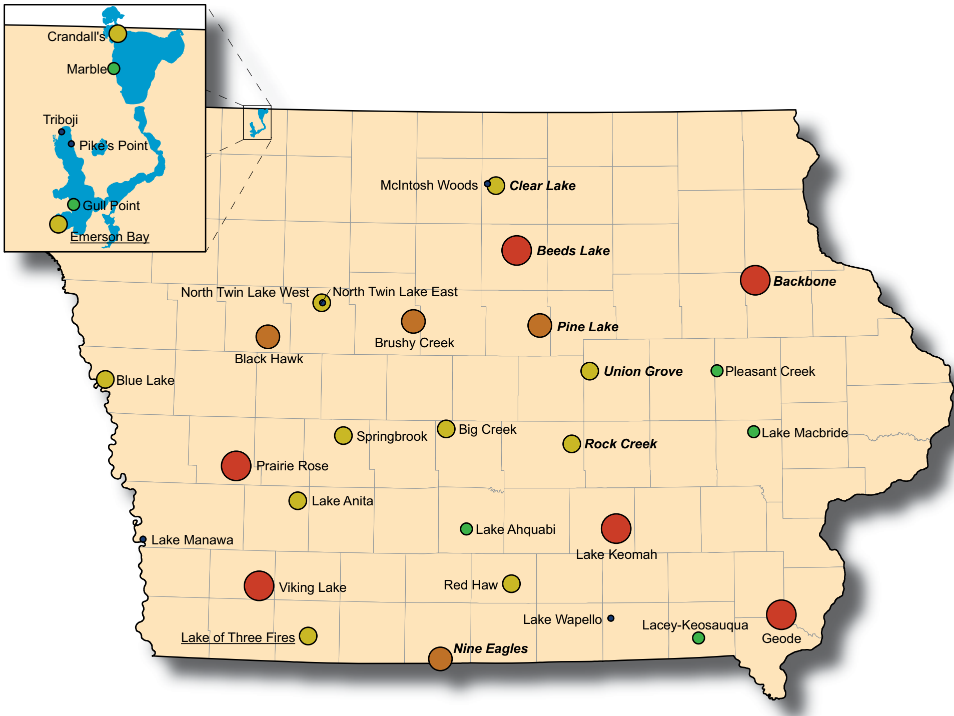


Figure 2. *Percentage of weeks in which samples exceeded the state one-time standard for* E. coli *at state park beaches during the 2009 monitoring season. Beach classes are noted in the lake name: standard text = "less vulnerable," underline = "transitional," and bold/italics = "vulnerable."*

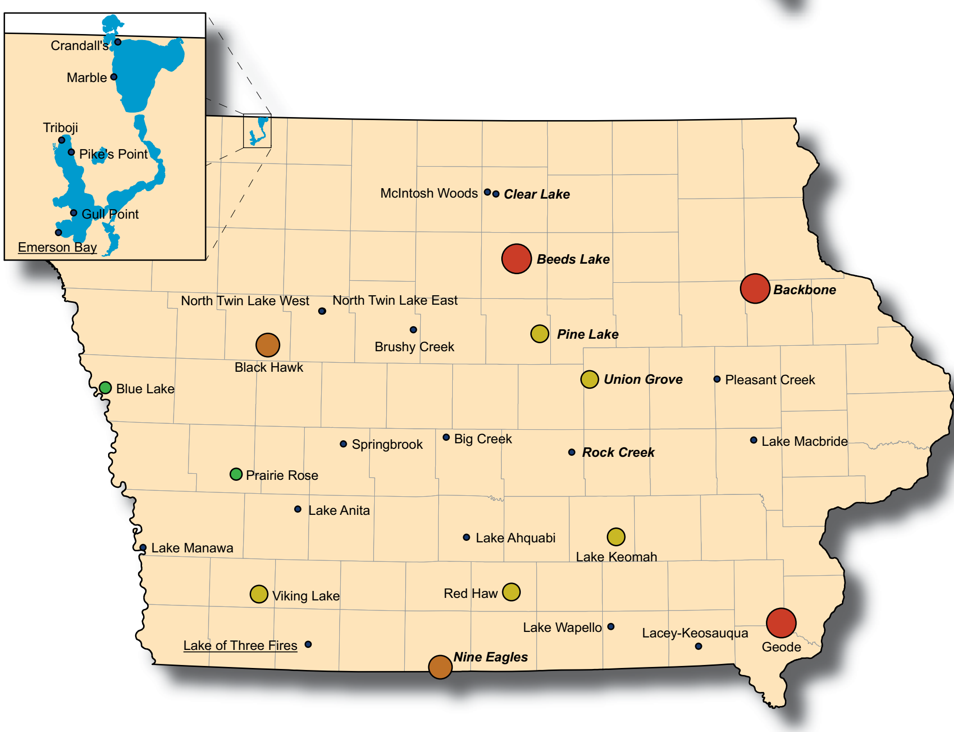


Figure 3. *Number of weeks in which samples exceeded the state geometric standard for* E. coli *during the 2009 beach monitoring season.*

policy, sample collection at these beaches was conducted on a completely voluntary basis and management decisions based on sample results were at the discretion of local agencies.

In 2009, twelve of the 23 beaches participating in the program submitted no samples which exceeded state bacteria standards, while another six had only one such violation. Overall, results from samples collected at these beaches were below the one-time standard of 235 organisms per 100 ml of water 90.7% of the time. Compiled bacteria monitoring results from locally managed beaches are illustrated in Figure 4. (Note: locally managed beaches that did not submit at least two-thirds of their weekly samples are not represented in this summary.)

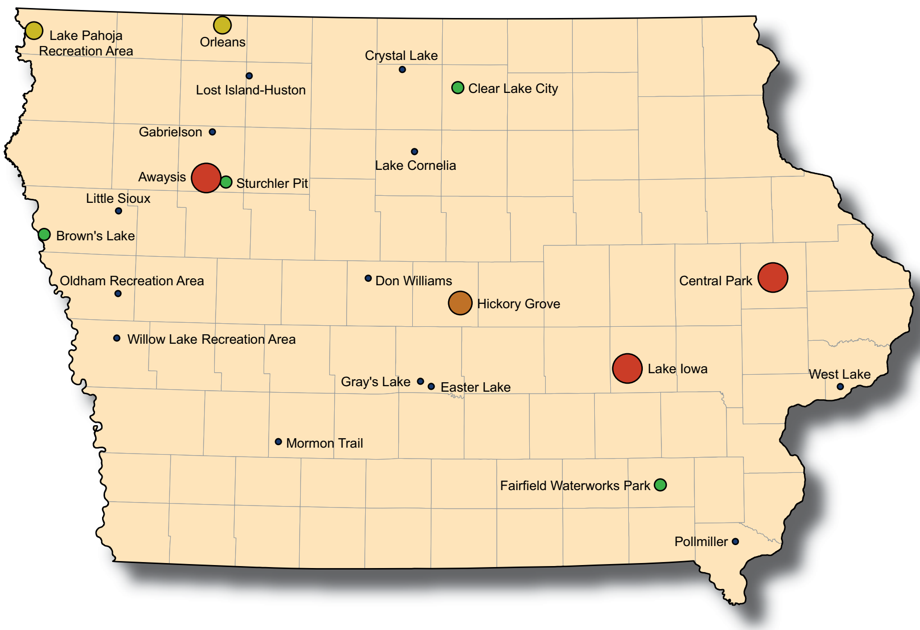


***Figure* 4.** *Percentage of locally managed beach samples that exceeded Iowa's one-time standard for* E. coli *during the* 2009 *beach monitoring season.*

Looking Ahead

The downturn in the U.S. economy has had a sharp impact on the operating budgets of many state programs in Iowa, including the Beach Monitoring Program. Budgets may dictate the length of future sampling seasons and the frequency of sample collection. Despite these limitations, monitoring efforts will continue to provide information on water quality conditions at swimming areas throughout the state.

Recently the Iowa Department of Public Health has assumed a more active role in the Beach Monitoring Program, which will likely lead to an increased presence in decision-making processes. Rapid methods for the detection of *E. coli* are now being developed that will increase the speed at which samples can be analyzed for fecal contamination, and the potential exists for near real-time results which would enhance the effectiveness of swimming advisories. These improvements will aid in the DNR's ongoing mission to protect the health of those recreating at Iowa's beaches.

Reference

United States Environmental Protection Agency, 1984. *Health Effects Criteria for Fresh Recreational Waters*. EPA-600/1-81-004, 33 p.

Acknowledgements

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Iowa Watershed Monitoring and Assessment Program Web Site – www.igsb.uiowa.edu/wqm/

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Ten Years of Iowa's Beach Monitoring Program

2009 marked the 10th anniversary of the inception of the Iowa Department of Natural Resources (DNR) Beach Monitoring Program. Although the program has experienced many modifications over the years, its ultimate goal remains unchanged in safeguarding public health while striving to improve public understanding of watershed processes and the ways in which bacteria impact recreational waters.

Program Background

In order to ensure public health at beaches around the nation, the Beaches Environmental Assessment and Coastal Health (BEACH) Act was signed into law on October 10, 2000. The overall goal of the BEACH Act was to standardize beach water quality monitoring programs throughout the United States while making beach status information readily available to the public. It set national beach water quality standards and required states to generate a list of all beaches within their borders.

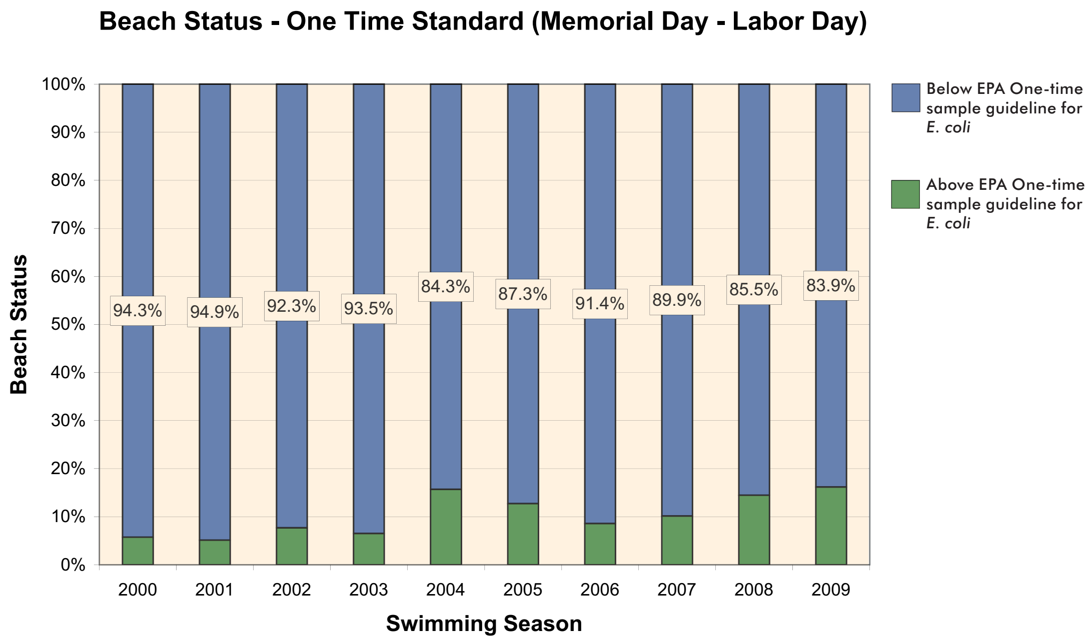
The BEACH Act requires states with coastal or Great Lakes beaches to monitor these waters according to Environmental Protection Agency (EPA) guidelines. Although Iowa is one of twenty states not required through the BEACH Act to monitor its swimming areas, the Iowa DNR understands the need for a comprehensive program to monitor water quality at beaches throughout the state.

Following training by beach monitoring program staff, Iowa DNR parks personnel monitored state beaches from 2000-2001. In 2002, the University of Iowa Hygienic Laboratory was contracted to complete sample collection and analysis and remained in this role through the 2006 monitoring season. Upon completion of the newly expanded and renovated Iowa DNR Water Lab in 2007, sampling was conducted by Watershed Monitoring and Assessment Section staff, including a team of summer field technicians. Bringing sample collection and analysis in-house expedited sample turnaround, thereby allowing beaches to be re-sampled in the event of high bacteria results early in the week with re-sample results available before the weekend. The advantages of in-house sample collection and analysis eventually permitted increased monitoring frequency at most beaches, which provided better, more timely information to make public health and management decisions.

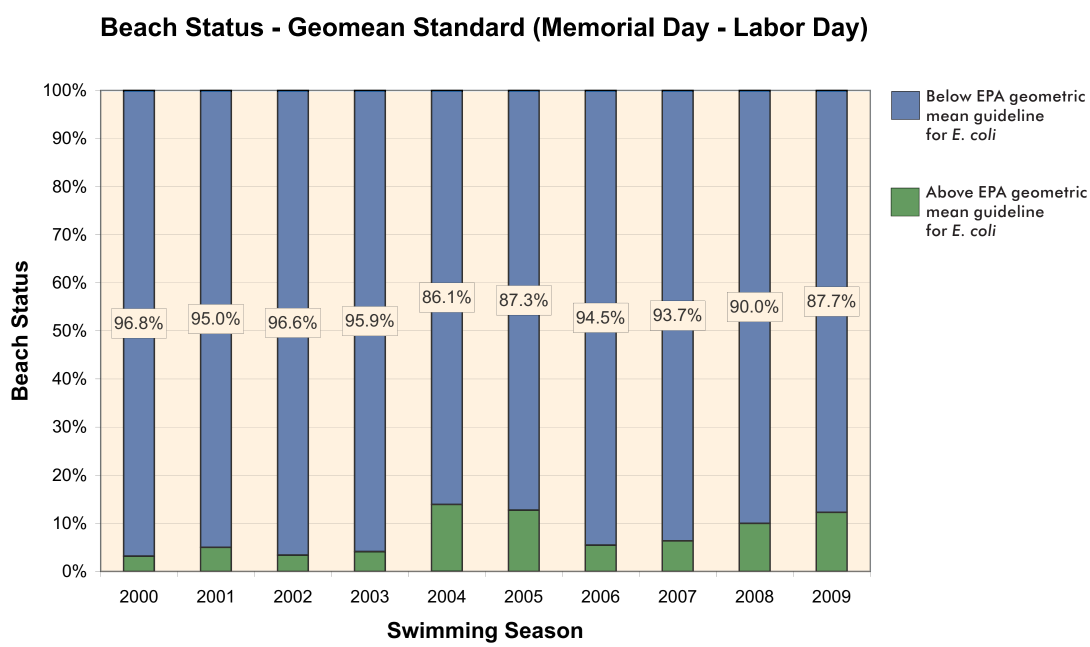
Bacteria Results – 2000-2009

Iowa's state-owned beaches have experienced weekly fluctuations in *E. coli* concentrations throughout the ten years that samples have been collected, but overall bacterial water quality has been generally good. When all samples collected from Memorial Day to Labor Day between the years 2000 and 2009 are taken into account, beaches met or were below the one-time standard (235 organisms per 100 ml) for *E. coli* 89.7% of the time while beaches met or were below the geometric mean standard (126 organisms per 100 ml) for *E. coli* 92.0% of the time. (See graphs on reverse side.)

With improvements to monitoring and analysis techniques in the coming years, in conjunction with continued research and community outreach, the Iowa DNR Beach Monitoring Program will continue its mission to safeguard public health at beaches throughout the state into the next decade.



Percentage of weeks where samples exceeded the state one-time standard (235 *organisms per* 100 *ml*) *vs. weeks where samples were below the state one-time standard by year* (2000-2009).



Percentage of weeks where samples exceeded the state geometric mean standard (126 *organisms per* 100 *ml*) *vs. weeks where samples were below the state geometric mean standard by year* (2000-2009).

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