IOWA'S WATER

Ambient Monitoring Program

Iowa's Beach Monitoring 2003

For the fourth consecutive year, Iowa's State Park beaches have been tested weekly for bacteria as part of Iowa's Ambient Water Monitoring Program (Figure 1). Summarized below are the results from 2003.

Program Revisions for 2003

Beach Policy. Due to a change in the Iowa State Water Quality Standard for swimmable waterbodies, several revisions were made to the beach monitoring program in 2003. The new state standard uses *E. coli*, instead of fecal coliform, and also adds a one-time sample limit in addition to the geometric mean limit. The 2003 Beach Policy has two components: a geometric mean standard and a one-time sample maximum standard.

The geometric mean standard is based on five samples over a 30-day period (Figure 2). Swimming advisory signs, which state that swimming is not recommended at this time, were posted at any beach that exceeded the geometric mean standard for *E. coli* (126 organisms per 100 mL of water).

The one-time sample maximum standard (235 organisms per 100 mL) was used to either post a swimming advisory sign at a beach or to take a re-sample, depending on the beach classification. Based on data from 2000 through 2002, the state-owned beaches were classified as either "vulnerable" or "not vulnerable" to experiencing consistent, high levels of bacteria (Figure 1).

Those beaches on the "vulnerable" list had high geometric means for bacteria in previous years. When these "vulnerable" beaches have a high sample they are more

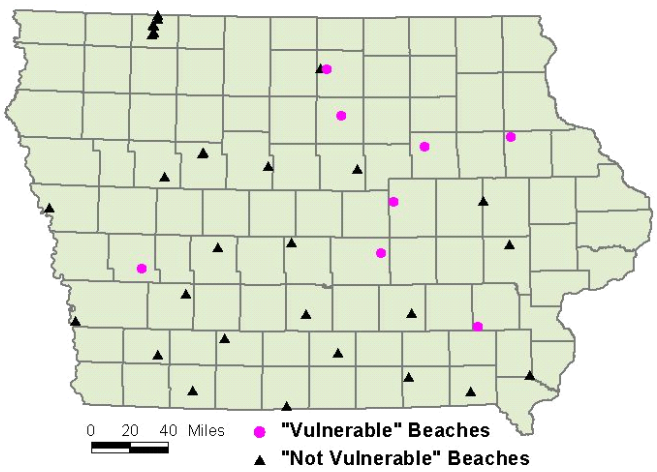

Figure 1. *Beaches monitored weekly are classified as "vulnerable" or "not vulnerable" to chronic, high levels of bacteria.*

Figure 2. *Geometric mean formula and example.*

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

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

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

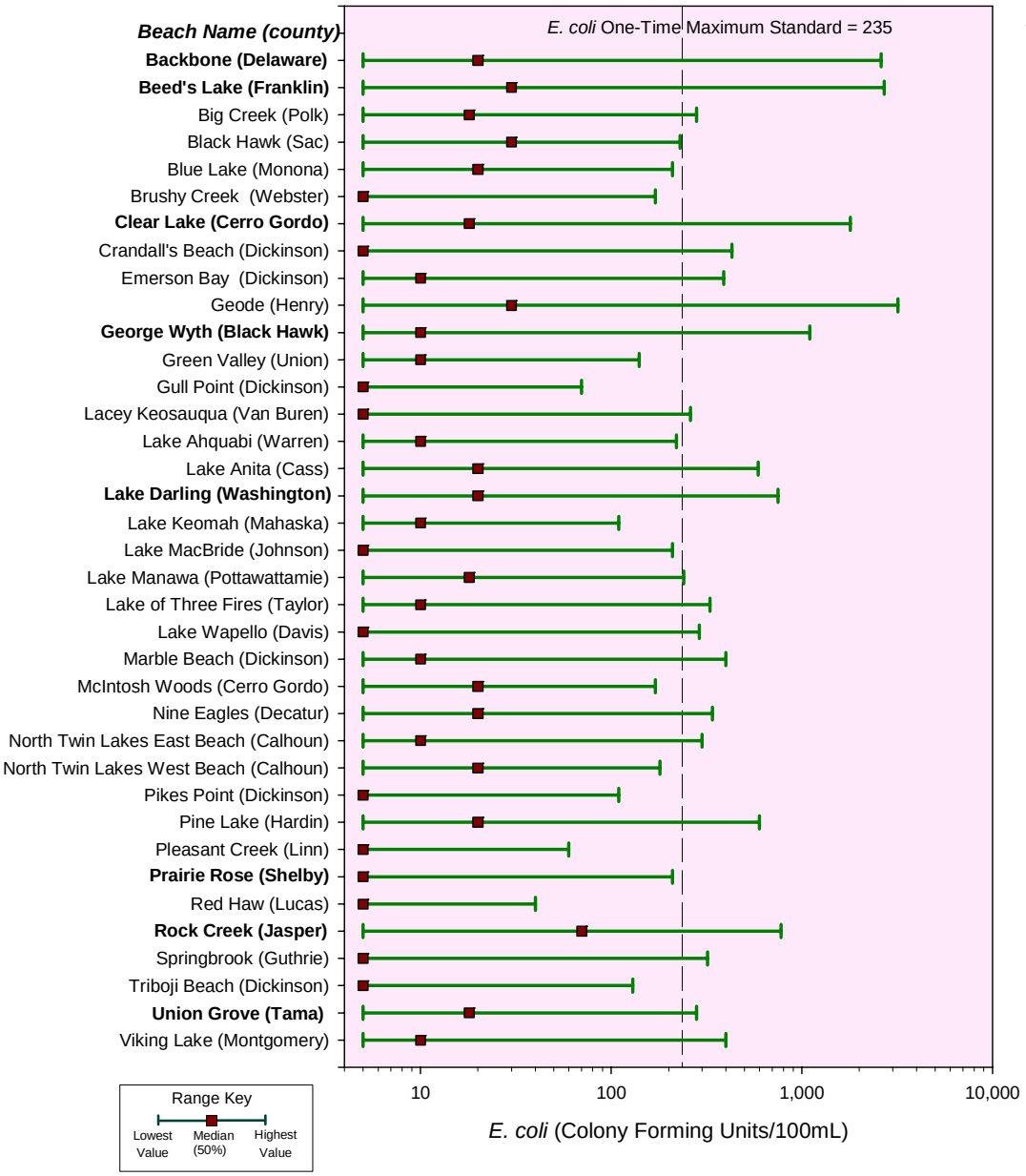

Figure 3. *Median and range of weekly* E. coli *bacteria results in 2003. Median is the value where 50 percent of the results fall above and 50 percent below this value. Beaches classified as "vulnerable" are shown in bold.*

Table 1. *Beaches that exceeded the geometric mean and one-time maximum standards for* E. coli *bacteria in 2003.*

Beach Name	*E. coli* One-Time Maximum (# of weeks exceeded)	*E. coli* Geometric Mean (# of weeks exceeded)
Backbone Beach	7	6
Beed's Lake Beach	3	3
Big Creek Beach	1	0
Clear Lake Beach	2	0
Crandall's Beach	1	0
Emerson Bay Beach	1	0
Geode Beach	9	5
George Wyth Beach	1	4
Lacey-Keosauqua Beach	1	0
Lake Anita Beach	1	0
Lake Darling Beach	4	1
Lake Manawa	1	0
Lake of Three Fires Beach	1	1
Lake Wapello Beach	2	0
Marble Beach	2	0
Nine Eagles Beach	3	0
North Twin Lake East Beach	2	0
Pine Lake Beach	2	0
Rock Creek Beach	6	3
Springbrook Beach	1	0
Union Grove Beach	1	0
Viking Lake Beach	1	0

likely to have subsequent high bacteria samples. For this reason, a swimming advisory sign is posted at "vulnerable" beaches after a single one-time high bacteria sample.

Those beaches classified as "not vulnerable" are beaches which have not had high geometric means in the past and include all state-owned beaches not listed as "vulnerable." They have variable bacteria levels, where the bacteria will be high one week and low the next. For this reason, the "not vulnerable" beaches are re-sampled after a single one-time high sample to determine if the bacteria levels are still elevated. If the re-sample is also above the one-time standard, then a swimming advisory sign is posted at the beach.

Sample Collection. The monitoring season was from April 15 through October 31, with weekly samples taken at 37 state-owned beaches. Two beaches were added to the monitoring program in July 2003 – North Twin Lake East and North Twin Lake West in Calhoun County. The University of Iowa Hygienic Laboratory staff took water from nine locations at each beach – at three locations along the beach (center and two ends of the beach) and at three water depths (ankle-, knee-, and chest-deep). The water taken from these locations was mixed to form one composite sample for each beach. All of the beach samples were analyzed for fecal coliform, *E. coli*, and enterococci bacteria.

Results

In 2003, the indicator bacteria used to measure the state water-quality standard changed to *E. coli*. During the 2003 monitoring season, 7 beaches exceeded the geometric mean for *E. coli* (126 organisms per 100 mL) and 22 beaches exceeded the one-time standard for *E. coli* (235 organisms per 100 mL) (Table 1). Figure 3 displays the median and range

Figure 4. *Iowa beaches met or were below the geometric mean standard for* E. coli *about 96 % of the time and met or were below the one-time standard for* E. coli *about 94 % of the time.*

of the weekly *E. coli* bacteria values for all of the beaches in 2003. Intensive watershed investigations were undertaken at those beaches with chronically high bacteria levels to try to determine the source(s) of this bacteria (see insert).

Over the last four years of sampling, Iowa's state-owned beaches have shown weekly fluctuations in bacteria levels. Overall, beaches met or were below the geometric mean standard for *E. coli* 96 percent of the time and met or were below the one-time standard for *E. coli* 94 percent of the time (Figure 4).

As the ambient program continues to grow, more changes will likely be made to the monitoring framework. Ultimately, the goal of the beach monitoring program is to use comprehensive monitoring and research to enhance the public's understanding of the environment, protect swimmer health, and increase enjoyment of the state's beaches.

Acknowledgements

The Iowa DNR would like to acknowledge the contributions of contractors involved with the water-monitoring program including the University of Iowa Hygienic Laboratory, Iowa Department of Public Health, Iowa State University, and United States Geological Survey. Staff from Iowa DNR Conservation and Recreation Division and Environmental Services Division – Water Quality Bureau have graciously provided many hours in the development and implementation of this program. The dedication, hard work and vision of the current Water Monitoring Section staff is also greatly appreciated.

Funding

Water monitoring activities of the Iowa Department of Natural Resources are funded by Iowa Infrastructure – Environment First Fund appropriations, as well as grants provided by the U.S. Environmental Protection Agency from Sections 106 and 319 of the Clean Water Act.

Water Monitoring Program Web Site – wqm.igsb.uiowa.edu

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Intensive Watershed Investigations

Iowa's Ambient Water Monitoring Program conducts intensive watershed investigations to determine the source of bacteria at beaches with chronically high levels of bacteria (Figure 1-insert). Several factors may influence bacteria levels in a watershed, such as the amount of rainfall, number of swimmers, water clarity, and the number and location of potential sources. If bacteria levels increase after rainfall events, this can signify a nonpoint source for the bacteria, meaning the bacteria are transported from many areas on the land surface. In contrast, bacteria levels from a point source, such as a leaking sewage lagoon, will typically decrease after rainfall due to dilution.

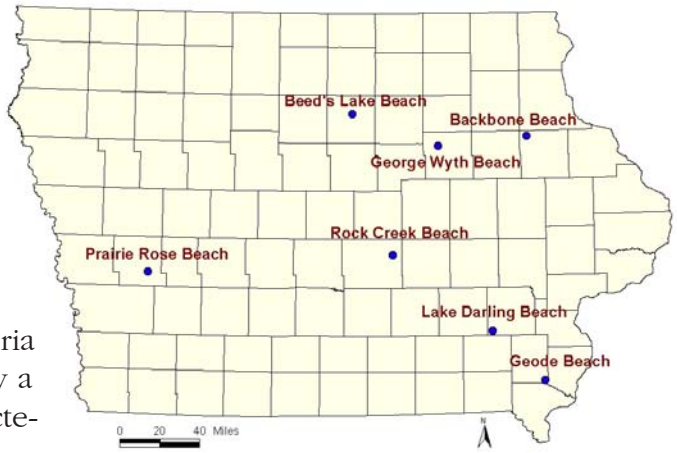

Figure 1-insert. *Seven of Iowa's State Park beaches have been monitored intensively due to high levels of bacteria.*

In developing a watershed investigation, the placement of monitoring sites is crucial. To be able to draw conclusions about the watershed, consistent monitoring coverage is needed over the water body and its surrounding tributaries. In addition, bacteria levels in nature are variable and several sampling events are needed to identify areas with chronically high levels of bacteria.

Backbone Lake Beach (Delaware County) has tested high for bacteria several times in the last few years. Beach monitoring at Backbone shows that elevated bacteria in this lake is related to rainfall events in the watershed. The watershed investigation includes 16 sampling sites along the North and South forks of the Maquoketa River and their tributaries. Five sampling events occurred in 2002 and ten sampling events occurred in 2003. Intensive collection in the Backbone watershed during 2003 focused on determining the impact that sewage lagoon discharges from the City of Strawberry Point may have on the beach. After extensive testing, it was determined that the sewage lagoon discharges appear to have no significant impact on bacteria levels at the beach.

Beed's Lake Beach (Franklin County) has had high levels of bacteria during the last several years. Although elevated bacteria levels appear to be related to rainfall, the relationship has not been well defined. Six sampling sites were located at tributaries throughout the watershed, seven sites on the lake, and nine sites at the beach. Samples were taken during four sampling events in 2002 and three sampling events in 2003.

Geode Lake Beach (Henry County) had high bacteria levels beginning in May 2003. Water sampling sites were located at nine points along the beach and at seven sites in the surrounding watershed. Water samples were taken over four events in 2003.

George Wyth Lake Beach (Black Hawk County) has experienced high bacteria levels during the last several years. Water sampling sites were located at nine points along the beach and at four wells drilled near the beach. Sampling from the nine beach sites occurred during ten events in 2002 and over two events in 2003. The wells were sampled during eight events in 2002 and then were sampled weekly during the monitoring season in 2003. The beach was closed during part of 2002 due to suspected human contamination. The possible human sources have been investigated and are no longer considered a likely source of the bacteria, but they will continue to be monitored through water sampling at four monitoring wells. Another possible source of bacteria at the beach is geese. In 2003, measures were implemented at the park to control the goose impact on the beach. Motion activated sprinklers were used on the beach, approximately 80 geese were transported to another park, and goose fecal matter was removed from the beach daily.

Lake Darling Beach (Washington County) has had high bacteria levels since beach monitoring began in 2000. After review of the monitoring data, high bacteria levels seemed to correspond with heavy rainfall. Six sampling sites were located around the lake, three sites at the beach, and nine sites at tributaries in the watershed. Results from these samples, taken over four sampling events in 2002 and four sampling events in 2003, identified several areas in the watershed as needing improvement. In 2003, a bacteria source tracking project was started for the Lake Darling watershed. This project incorporates several source tracking methods such as DNA "fingerprint" analysis, antibiotic resistance analysis, pathogens testing, biological markers, and caffeine and cotinine analysis. Six sets of samples were taken in 2003 at ten sites on the lake, at the beach, and in the surrounding watershed. Four additional sampling events are planned for spring 2004 following significant amounts of rainfall. The project will be completed by fall 2004.

Prairie Rose Lake Beach (Shelby County) had high bacteria levels in 2002, but had low levels throughout 2003. Six sampling sites were located around the lake, nine at the beach, and seven in the surrounding watershed. Samples were taken over five events in 2002 and over nine events in 2003.

Rock Creek Lake Beach (Jasper County) has had high levels of bacteria since 2002. Seven sampling sites were located around the lake, nine sites in the watershed, and nine sites at the beach. Samples were taken during five sampling events in 2002 and during three events in 2003. In addition, two sets of three sediment samples were taken at the beach and one set of sediment samples were taken throughout the watershed and were analyzed for bacteria.

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