

# IOWA'S WATER

## Ambient Monitoring Program

## Frequently Asked Questions About Beach Monitoring for Environmental Professionals

### Why does the Iowa DNR monitor beaches?

Swimming in lakes or any other natural body of water involves risks. By far, the greatest risk is drowning caused by cloudy water, fast currents, submerged objects, or the lack of lifeguards or direct supervision. There is also the risk of contracting a waterborne illness from swimming in contaminated waters. The main objective of beach monitoring is to evaluate the level of fecal contamination by monitoring the water. Based on this monitoring, the DNR informs the public of the risk of waterborne illness by posting advisory signs at beaches where bacteria levels are elevated.



*Beeds Lake beach, Franklin County.*

### How can swimming in contaminated waters make a person sick?

Most of the diseases associated with swimming cause diarrhea and are contracted by swallowing contaminated water that contains disease-causing organisms. These organisms are called **enteric** (fecal) **pathogenic** (disease-causing) **microorganisms** (small organisms not visible to the eye) and include some types of bacteria, viruses and parasites. Nausea, abdominal cramps, diarrhea, headache and fever are some of the symptoms that might be experienced. Other minor health effects can include ear, eye, nose and throat infections. More serious diseases, although much less likely, could include dysentery, hepatitis and cholera. Small children, the elderly, and persons with weakened immune systems are the most at risk to develop illnesses or infections after swimming in contaminated water, which could develop into life-threatening conditions for these people.



*Swimming at George Wyth State Park, Black Hawk County.*

## How do disease-causing organisms get in the water?

Many microorganisms exist on the skin and can be washed into the water during swimming. Other microorganisms live in the digestive tract of humans and animals and are carried into the water with fecal material. Some of these microorganisms can be pathogenic, especially those in the excrement of infected people and animals. If the

fecal material gets into water the organisms can live for a period of time. Most pathogenic bacteria will die off within hours or days once in water, but some viruses and parasites survive for longer periods of time.

Sources of fecal contamination include anything that adds fecal material to the water, such as improperly constructed and operated septic systems and sewage treatment plants, manure spills, storm water runoff from lands with wildlife and pet droppings, storm water runoff from fields after manure application, direct contamination from animals, dirty diapers, and boating or swimming fecal “accidents.”

## How does the Iowa DNR determine if the water is contaminated?

Testing for potential pathogens in water is difficult, time consuming, and expensive. Therefore, the U.S. Environmental Protection Agency (EPA) recommends testing for **fecal indicator bacteria**. Fecal indicator bacteria are easy to collect and analyze, are relatively safe to handle, and are usually present when enteric (fecal) pathogens are present. Fecal indicator bacteria are bacteria that also live and multiply in the digestive tract of humans and animals, but they normally do not cause disease. If these indicator bacteria are present, some amount of fecal material in the water is likely. A higher level of indicator bacteria signifies a greater level of contamination from fecal matter and a greater chance that pathogenic microbes may be present. Therefore, indicator bacteria *suggest* the presence of pathogens and can be used as a measure of the health risk to swimmers from waterborne illness. The DNR tests for three types of indicator bacteria: fecal coliform, *E. coli* and enterococci. Figure 1 illustrates that *E. coli* is a subset of fecal coliform bacteria.

## How are samples collected and analyzed?

Beginning in 2002, an expanded sampling schedule was implemented. From April 15 through October 31, water samples were collected weekly at all 35 state-owned beaches by trained personnel from the University of Iowa Hygienic Laboratory. Samples were taken at three locations along each beach and at three water depths (ankle-, knee- and chest-deep). These nine individual samples were mixed together and one sample was taken from the composite. This composite sample was taken to a laboratory where it was analyzed for fecal indicator bacteria. The analysis typically takes two days to perform because the bacteria must be allowed to grow before being counted. The levels of bacteria in the water were measured in colony forming units (CFUs) per 100 milliliters (mL) of water. A level of 100 CFU/100 mL would mean there are about 100 of these bacteria in every half cup of water.

## What levels of indicator bacteria are considered safe?

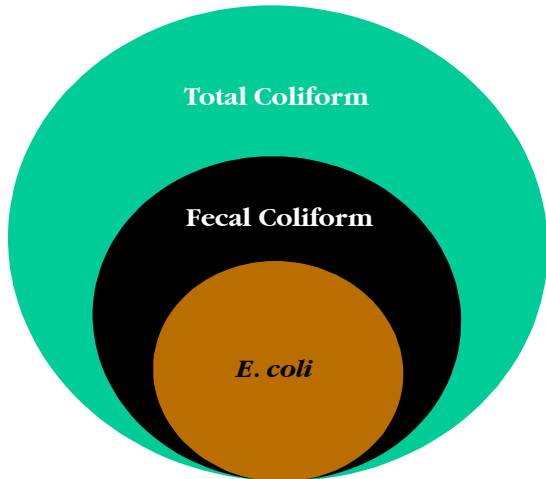
The EPA has published guidelines for beaches and other waters used for swimming, water skiing or similar activities based on epidemiological studies that investigated the number of swimming-related illnesses compared to the level of indicator bacteria at beaches. EPA suggests that if the **geometric mean** of the indicator bacteria exceeds the guidelines, the water presents an unreasonable level of risk of waterborne illness for swimming and other similar activities. They recommend calculating the geometric mean of at least five samples equally spaced over a 30-day period (Figure 2). The geometric mean minimizes the influence of a one-time high result and therefore helps to identify chronically high levels of bacteria (example, Figure 2).

The EPA recommended guidelines (Figure 3) do not indicate a level of zero risk and, in fact, a beach having the



*Boating on Lake Darling, Washington County.*





**Figure 1.** Coliform bacteria group. Size does not represent the actual percentage of each subset.

above values may be expected to result in some type of swimming-related health effects for eight out of every 1,000 swimmers over the long term.

Iowa's current water quality standards use the fecal coliform standard. However, it is anticipated this will be changed to the *E. coli* standard, as recommended by the most recent EPA guidelines. Currently the DNR posts a swimming advisory sign when the fecal coliform geometric mean is exceeded. Over the last three years of monitoring, Iowa's beaches have been determined to be safe for swimming about 97 percent of the time (Figure 4).

## Why not set the limits based on one sample?

Fecal indicator bacteria levels in natural waters can vary drastically from day to day. For instance, the fecal coliform count could be 1,000 CFU/100 mL one day and drop to 50 CFU/100 mL on the next day. A two to three day delay exists between when samples are collected and the results are obtained, which also makes it difficult to predict risk based on single samples. By the time the sample is analyzed and the results made available, the level of indicator bacteria may have dropped by a factor of 100 or 1,000 due to natural die-off in water or other factors. Conversely, the levels may have increased by that much following rains. In addition, pathogenic viruses and parasites may survive longer in water than the indicator bacteria, so the geometric mean gives a better overall indication of risk for waterborne illness.

## How does the public know if it is safe to swim at a beach?

One of the main goals of Iowa's beach monitoring is to inform the public about the risk of contracting waterborne illness. In 2002, fecal coliform results were posted on the DNR Parks Web site and swimming advisory signs were posted at beaches that exceeded the

**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.** EPA geometric mean guidelines for recreational water quality.

Indicator Bacteria	Geometric Mean Value
Fecal coliform	≤ 200 CFU / 100 mL
<i>E. coli</i>	≤ 126 CFU / 100 mL
Enterococci	≤ 33 CFU / 100 mL

geometric mean for fecal coliform. The DNR is reviewing the monitoring data for the last several years to develop beach “profiles” that describe the relative risk. Developing beach profiles may be a better way to inform the public about risks in the future.

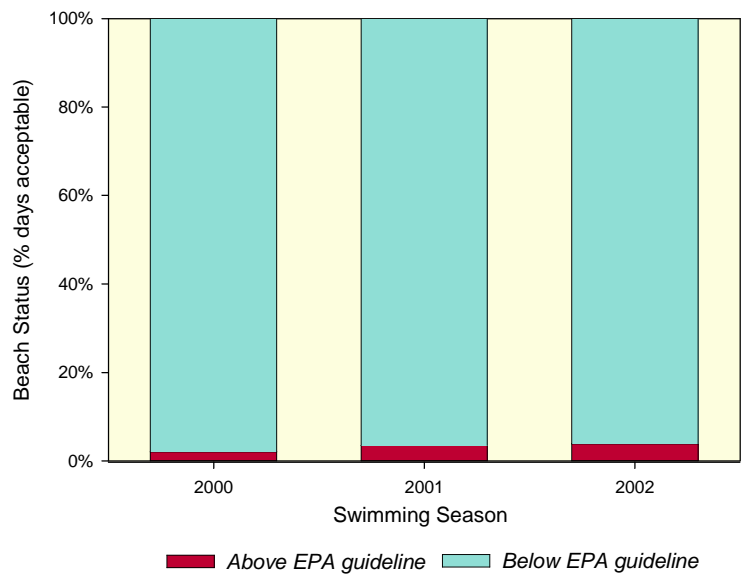
### Will the DNR close beaches if the levels are high?

In 2002, the DNR beach policy stated that beaches would not be closed unless the level of fecal contamination was believed to constitute a high risk of sickness. When beaches did not meet the geometric mean standard for fecal coliform, warnings were posted at beaches to inform swimmers that swimming was not recommended at that time. The beach users then decided for themselves whether to swim or to reduce their risk, perhaps by wading in the water or avoiding the water altogether.

### Can the source of bacteria be determined?

At beaches with chronic high levels of bacteria, the DNR tries to determine the source of the bacteria. During this intensive investigation, the DNR takes frequent water samples from the lake and the surrounding watershed. Results from these intensive watershed investigations help determine the source of the bacteria and assist local officials in efforts to improve water quality in the area. Public meetings are held in the affected watersheds to discuss the results of monitoring with the public and inform them of what can be done to improve water quality in their watershed.

**Fecal Coliform at State Beaches**



**Figure 4.** Iowa State Park beaches met or were below EPA guidelines about 97 percent of the time for fecal coliform bacteria.

Researchers throughout the country have been working on source identification strategies which have ranged from chemical monitoring to various microbial molecular methods. Recently, the DNR has obtained a grant to utilize one of these methods (DNA fingerprinting) in the Upper Iowa Watershed, which covers areas of Allamakee, Howard and Winneshiek counties. This method requires the establishment of a fingerprint database of known animal *E. coli* isolates. Once a substantial number of *E. coli* isolates are fingerprinted, unknown samples from streams or lakes can be compared to the database to assess the potential source of contamination. The DNR is currently taking samples to build the fingerprint database for the Upper Iowa Watershed and several other watersheds in Iowa.



*Rock Creek State Park, Jasper County.*

### **How many fresh water swimming-related illnesses are reported in Iowa each year?**

To date, the DNR has received no confirmed reports of illnesses caused by swimming or water skiing in Iowa waters. The lack of documented cases could be because waterborne illnesses are under-reported and because many people with symptoms do not seek medical attention. Persons who believe they have contracted a waterborne illness should contact their health department.

### **How much water would have to be swallowed to get sick? What about the risk of infection through open wounds?**

Swallowing a small amount of contaminated water (less than a teaspoon) can cause illness. However, the body has natural defenses that may kill some pathogens as the water passes through the body.

When compared with full contact swimming, wading into the water is usually less risky due to the protection of a person's skin. Although, if an open wound or sore exists on the skin, the risk of skin infection from swimming in contaminated water increases.

## **Can fish be eaten from waters with high levels of fecal contamination?**

Yes. High levels of indicator bacteria or pathogenic microbes have no influence on the quality of fish for human consumption. While alive, the fish is protected from waterborne contaminants by the skin, scales, and mucus covering its body. Proper fish cleaning, rinsing, refrigeration and cooking should always be used, regardless of where the fish is caught.

## **How can families minimize the risk of illness when recreating in lakes or rivers?**

- **Do not swallow the water.**
- **Wash hands after using the restroom and after changing diapers.**
- **Swimming in lakes is not recommended for persons who are very young, very old, or have immune system problems.**
- **Do not swim if you have or have recently had diarrhea. Please wait to swim for at least a week after the episode of diarrhea before swimming.**
- **Keep children in clean diapers and please change diapers in the restroom.**



*Fishing at Beeds Lake, Franklin County.*



*Union Grove State Park, Tama County.*



*Pine Lake State Park, Hardin County.*

Visit [www.state.ia.us/dnr](http://www.state.ia.us/dnr) to view the weekly levels of fecal coliform bacteria at Iowa's 35 state-owned beaches. For more information on the beach monitoring program, call (319) 335-1575 or visit the Web site at <http://www.igsb.uiowa.edu/water>.

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Water Monitoring Program Web Site – [www.igsb.uiowa.edu/water](http://www.igsb.uiowa.edu/water)



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