

Wisconsin's Great Lakes Beach Monitoring and Notification Program Annual Report Beach Season 2007



Wisconsin Department of Natural Resources

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Cover Photo: North Beach, Racine County, Wisconsin; Courtesy: Julie Kinzelman



Summary

In 2007, 122 monitoring sites at public beaches in Wisconsin were sampled for *Escherichia coli* (*E.coli*) bacteria for implementation of the Beaches Environmental Assessment and Coastal Health (BEACH) Act of 2000. The Wisconsin Department of Natural Resources (WDNR) received \$225,270 from the United States Environmental Protection Agency (US EPA) to implement the 2007 Wisconsin Great Lakes Beach Monitoring and Notification Program.

The Wisconsin Great Lakes Beach Monitoring and Notification Program's primary goal is to increase visitors' awareness of potential exposure to disease-causing microorganisms in water. *E.coli* bacteria serve as an indicator of the possible presence of other pathogens in the water, such as bacteria and viruses. *E. coli* can be found in the feces of all warm-blooded animals; therefore, if high levels of *E. coli* are found in the water at a beach there is a high probability of fecal matter existing in that water. Potential sources of *E.coli* contamination at Wisconsin beaches include agricultural runoff, urban stormwater runoff, and sewage overflows. In addition, localized sources from wildlife and waterfowl feces contribute to high levels of *E.coli* in both beach sand and water.

Sixteen health departments along Lake Michigan and Lake Superior are funded to sample the water at selected beaches one to five times per week. In conjunction with the sampling efforts, beach users are notified of risk through the use of signs when results indicate an exceedance of US EPA recommended *E.coli* levels (Appendix A). Advisories and closures may also follow rainfall events or stormwater and sewage overflows which may increase the *E.coli* concentration in water. Other factors that may influence *E.coli* concentrations include the presence of *Cladophora* (a green alga that accumulates on the shoreline in large mats), wind direction, wave height, water temperature, and beach grooming.

In Wisconsin, 17.1% of the samples collected and analyzed in 2007 exceeded the *E.coli* daily

maximum standard of 235 cfu¹/100mL (748 samples out of 4,373 total samples). In 5.8% of the total samples, a threshold of 1,000 cfu/100mL was exceeded and resulting in beach closures. Table 1 summarizes the annual percent of samples that exceeded the advisory limit of 235 cfu/100mL for each county from 2003 through 2007:

2007 marked the fifth season of the Wisconsin Great Lakes Beach

Table 1. Annual sample % exceeding advisory level of 235 cfu/mL

County	2003	2004	2005	2006	2007
Ashland	3.2%	10.2%	4.6%	3.5%	3.8%
Bayfield	1.9%	2.2%	4.3%	7.1%	7.1%
Brown	0.0%	2.0%	1.8%	0.0%	4.5%
Door	4.1%	8.2%	6.9%	7.3%	4.8%
Douglas	9.5%	11.8%	23.7%	12.9%	11.3%
Iron	1.1%	1.5%	2.7%	3.5%	0.0%
Kewaunee	26.0%	33.9%	26.9%	33.9%	49.7%
Kenosha	21.0%	36.3%	31.9%	29.9%	32.2%
Manitowoc	49.6%	40.1%	20.4%	54.4%	31.7%
Milwaukee	24.3%	38.7%	30.3%	20.0%	23.7%
Ozaukee	15.9%	28.9%	12.9%	17.1%	27.6%
Racine	16.5%	17.6%	7.4%	6.9%	6.7%
Sheboygan	23.8%	30.2%	24.8%	43.9%	28.5%
State-wide	14.6%	22.2%	15.7%	17.5%	17.1%

¹ cfu = Colony Forming Units: A unit of measurement used in microbiology that indicates the number of viable microorganisms present in a water sample.

Monitoring and Notification Program. Water quality awareness continues to increase in Lake Michigan and Lake Superior counties as more data become available. This is evident by the fact that some counties and concerned citizens have taken initiative and are working toward finding sources of *E.coli* contamination and solutions to address them. Under a separate federal grant, sanitary surveys to identify potential *E.coli* sources were conducted in Ashland, Bayfield, Door, Douglas, Kenosha, Manitowoc, Racine, Sheboygan, and Milwaukee counties. These initial surveys will provide valuable information on how to conduct future sanitary surveys and on where potential pollution sources exist. Independently, Door County stakeholders have taken action to implement remediation activities at priority beaches. Ashland, Bayfield, Iron, Milwaukee, and Racine county stakeholders have teamed with researchers to characterize *E. coli* at Lake Michigan and Lake Superior beaches.

Introduction

The BEACH Act of October 2000, requires states that border coastal or Great Lakes waters to develop beach monitoring and public notification programs. Under the BEACH Act, the US EPA provides grants to states to develop and implement these programs. In 2007, the WDNR, working closely with local health departments and university researchers, conducted the fifth summer of the statewide beach-monitoring and notification program on the shorelines of Lake Michigan and Lake Superior. These activities were conducted during Federal Fiscal Year 2007 (October 1, 2006 through September 30, 2007).

Program Overview

This project began in 2002 when WDNR formed a workgroup of state-level environmental and public health officials, local health officials, and other interested parties to design a beach monitoring and notification program. Approximately 55 miles of public beach miles at 192 coastal beaches were identified along Lake Michigan and Lake Superior (Appendices B & C). The definition of “beach” for the purpose of the Wisconsin Great Lakes Beach Monitoring and Notification Program implementation is:

“A publicly owned shoreline or land area, not contained in a man-made structure, located on the shore of Lake Michigan or Lake Superior, that is used for swimming, recreational bathing or other water contact recreational activity.”

Coastal beaches were geo-located using geographic positioning software (GPS) and geographic information system (GIS) technologies and maps were created for each county identifying the locations of beaches. Information was collected on the potential for impacts from stormwater runoff, human and waterfowl usage, and the proximity of wastewater treatment plant outfalls and farms for each beach considered for evaluation. This information was used to rank and classify beaches as “high,” “medium,” or “low” priority in order to distribute funds equitably while recognizing relative levels of pathogen exposure.

A standard sampling protocol was developed and standard advisory signs were designed based on feedback collected during a beach user survey in 2002 and public meetings held around the state (Appendix D). Currently, the WDNR contracts with the United States Geological Survey (USGS) to oversee data management as well as the Wisconsin Beach Health Website (<http://www.wibeaches.us>) which provides the public with current beach health conditions. The Wisconsin Beach Health Website was expanded from the former Beach Health Website designed and used by the City of Milwaukee Health Department. The development of the Beach Health Website was funded by US EPA as part of an Environmental Monitoring for Public Access and Communication Tracking (EMPACT) project for Milwaukee, Racine, and Kenosha county beaches.

Goals & Objectives

The purpose of this project in 2007 was to maintain a consistent statewide beach water monitoring program to improve public notification and to reduce beach visitors’ risk of exposure to disease-causing microorganisms in water. Selected beaches along Lake Michigan and Lake Superior were monitored in accordance with BEACH Act requirements with prompt notification to the public whenever bacterial levels exceeded the US EPA's established standards (Appendix A). However, source identification and control was restricted by funding.

Time Schedule

The activities described in this report took place during Federal Fiscal Year (FFY) 2007 (October 1, 2006 through September 30, 2007). FFY 2007 encompassed the entire 2007 beach season, which is defined for Wisconsin coastal beaches as Memorial Day Weekend through Labor Day Weekend, approximately 14 weeks. At some coastal beaches in Wisconsin, swimming may not begin until mid-June due to cold water temperatures. Where weather and swimming history indicate this to be the case, initial sampling associated with this program was reduced or delayed to coincide with the local swimming season in order to save funds until the beach was used more frequently. This report describes activities conducted before, during, and after the 2007 beach season (i.e. preparation, implementation and evaluation of the beach season).

Cooperators Involved

BEACH Act Workgroup:

Keep Our Beaches Open	City of Racine Health Department
Kenosha County Health Department	City of Madison Public Health Department
Ozaukee County Health Department	City of Milwaukee Health Department
Wisconsin State Lab of Hygiene	Milwaukee Metropolitan Sewerage District
State Bureau of Parks	State Department of Health & Family Services
Wisconsin Department of Natural Resources	University of Wisconsin - Milwaukee WATER
Institute	

Wisconsin Great Lakes Beach Monitoring and Notification Program Participants:

Ashland County Health Department	Bayfield County Health Department
Brown County Health Department	City of Milwaukee Health Department
Door County Health Department	Douglas County Health Department
Iron County Health Department	Kenosha County Division of Health
Kewaunee County Health Department	Manitowoc County Health Department
North Shore Health Department	Ozaukee County Health Department
City of Racine Health Department	Sheboygan County Human Services
Shorewood/Whitefish Bay Health Department	South Milwaukee Health Department
University of Wisconsin - Oshkosh Department of Biology and Microbiology	

Budget

- In September 2001, the WDNR was awarded a developmental grant for \$58,694. A 2002 grant for \$228,396 was also targeted for program development. This resulted in a total of \$287, 090 for program development.
- In June of 2003, the WDNR was awarded the first implementation grant in the amount of \$225,670. Funds totaling \$55,000, remaining from the development grant, were added to the new implementation grant, resulting in the availability of \$280,670 for implementation of the beach program in summer 2003.
- In June of 2004, the WDNR was awarded a grant in the amount of \$226,570. The amount of the grant was insufficient to fully implement the program. DNR funds were used along with a small amount of carryover from 2003 to help the program meet its budget.
- In May of 2005, the WDNR was awarded a grant in the amount of \$226,260. Once again, the amount of the grant was insufficient to fully implement the program.

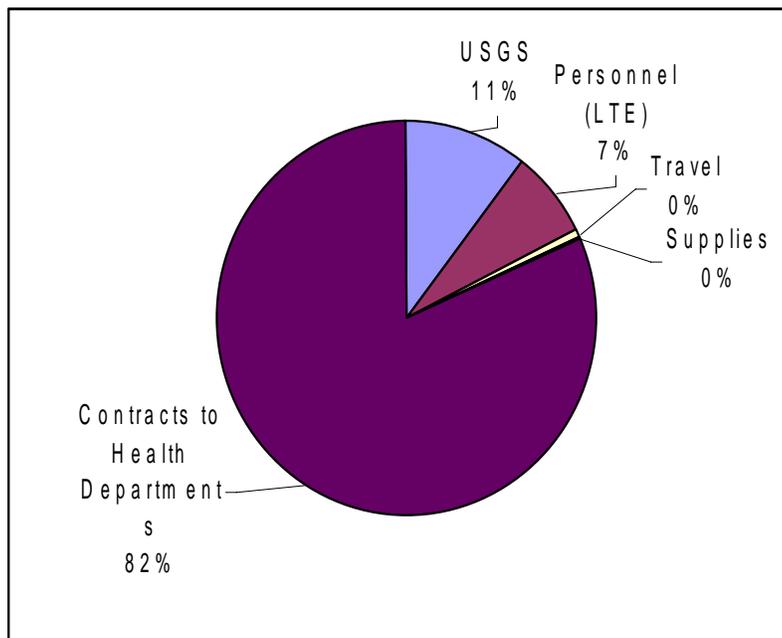
- In both May of 2006 and 2007, the WDNR was awarded a grant in the amount of \$225,270. BEACH Act funds assist monitoring and notification programs with local health departments, website maintenance and database management (USGS), and assists in personnel costs for a part-time employee to manage the beach program. Health departments often have to pay for costs of the Wisconsin Great Lakes Beach Monitoring and Notification Program that exceed their county allocation because funding for the program is insufficient. Other projects that occur simultaneously that complement the Wisconsin Great Lakes Beach Monitoring and Notification Program are funded by outside sources.
- Following the 2007 Beach Season, Wisconsin was awarded an additional \$44,000 by the US EPA. This additional funding was used to supplement administration of the program as well as enhance public notification through the publication of materials such as magnets, brochures, and signs which inform the public how to access the Wisconsin Beach Health Website. Also this funding will be utilized to conduct a summit meeting for the Wisconsin Great Lakes Beach Monitoring and Notification Program. At that meeting stakeholders will be able to help make the program stronger through participation in presentations and workshops.

In 2007, eighty-two percent (\$183,270) of the \$225,270 was contracted out to local health departments to carry out the Wisconsin Great Lakes Beach Monitoring and Notification Program (Table 1). A total of 93% of the grant is used to contract out with other agencies (Figure 2).

Table 2. Participant Contract Allocations in 2007

County	Allocation
Ashland, Bayfield, Iron Counties ²	\$30,725
Brown County	\$2,000
City of Milwaukee	\$20,070
City of South Milwaukee	\$5,275
Door County	\$50,725
Douglas County	\$9,125
Kenosha County	\$9,325
Kewaunee County	\$5,725
Manitowoc County	\$8,190
Ozaukee County	\$16,725
City of Racine	\$6,600
Sheboygan County	\$12,725
Village of Northshore	\$2,725
Village of Shorewood	\$3,525

Figure 1. Grant Expenditures in 2007



² Ashland, Bayfield, and Iron Counties operate collaboratively under a single contract.

Work Completed in 2007

The 2007 beach season was the fifth year of implementing the Wisconsin Great Lakes Beach Monitoring and Notification Program. Work completed in 2007 included:

- Evaluating and redistributing allocations to each of the contracting entities based on the number of high, medium, or low priority beaches, a minimum sample per beach (plus 15% for re-sampling after advisories or closures), and an adjustment was made for travel reimbursement, since gas prices continue to rise directly affecting sampling costs.
- Contracted with 16 individual health departments in 13 counties to conduct the routine monitoring of 122 beaches along Lake Superior and Lake Michigan.

Project Highlights and Deliverables

Project highlights and deliverables for the Wisconsin's 2007 beach season included:

- The development of secure on-line input forms to update information about beaches, monitoring stations, and personnel utilizing the Wisconsin Beach Health Website (<http://www.wibeaches.us>). Data entry protocols continue to be redesigned to be more efficient for the local health departments. A comma-separated value (*.csv) is used for all reports downloaded from the website. An automatic e-mail messaging service and a really simple syndication service (RSS Feed) provided daily updates on beach conditions to the public.
- Encouraged local communities and non-profit organizations to participate in National Clean Beaches Week 2007, sponsored by the Clean Beaches Council.
- The WDNR, Wisconsin Department of Health and Family Services (WI DHFS), and the State Laboratory of Hygiene continued their statewide program of inland beach monitoring³. Popular swimming beaches at state parks and forests were monitored. The beaches were tested at least 4 times each week with results posted on the beach. The inland program is modeled after the Wisconsin Great Lakes Beach Monitoring and Notification Program on the Great Lakes.

Monitoring Results

A total of 122 monitoring sites were sampled in 2007. Approximately 4,373 monitoring samples were collected and reported on the Beach Health Website in 2007. Out of these samples, 748 (17.1%) exceeded the water quality advisory limit of 235 cfu/100mL and 252 samples (5.8%) exceeded 1,000 cfu/100mL for *E.coli* resulting in mandatory beach closures.

In comparison, the 2007 beach season was similar to the 2005 and 2006 beach seasons. Some trends (chronic beach advisories and beach closures) may be observed among some beaches in counties such as Kewaunee, Manitowoc, Sheboygan, and Kenosha (Table 1). Historical data (2003-2007) may be downloaded from the Wisconsin Beach Health Website (<http://www.wibeaches.us>). Table 1 (located on page 1 of this report) summarizes the annual percent of samples that exceeded the advisory limit of 235 cfu/100mL for each county from 2003 through 2007.

³ This program is supplemental to the Wisconsin Great Lakes Beach Monitoring and Notification program. No BEACH Act funds are used to directly fund collection of samples from inland beaches.

Success Stories and Concurrent Research Projects

The Wisconsin Great Lakes Beach Monitoring and Notification Program is successful in creating public awareness about the fecal contamination problems that face the Great Lakes. The program has raised public awareness and many communities have begun to look at source tracking, identification, and mitigation.

Ashland, Bayfield, and Iron Counties

Ashland, Bayfield and Iron Counties have 200 miles of Lake Superior shoreline that are high-valued tourist destinations. Among these counties, 27 beaches are monitored. Even though the funding provided by the BEACH Act is a great asset for these northern counties, the BEACH Act funding has been inadequate for a comprehensive monitoring program and other funding sources have been necessary. The local health departments, Northland College, University of WI-Oshkosh, and the Lake Superior Alliance have been brought together to create a comprehensive monitoring and source-tracking program. Since the Wisconsin Great Lakes Beach Monitoring and Notification Program has been implemented, the following successes have been seen in the Lake Superior counties:

- Genetic fingerprinting techniques (rep PCR), antibiotic resistance patterns, and spatial sampling have been used to determine the source of beach water *E.coli* isolates.
- Watershed investigations were conducted to determine impacts on beach water quality.
- Local health officials have begun to mitigate sources of *E.coli* and beach contamination to reduce the number of beach closures.
- Twenty-seven Lake Superior beaches now have baseline *E.coli* data and beach management decisions can be based on good scientific data.

Door County

Door County is one of the most popular summer tourist destinations in Wisconsin where coastal recreational water is an important resource to the economy. In the summer of 2007, the BEACH Act grant was used to monitor 28 beaches along Lake Michigan in Door County. Monitoring funds, however, were not plentiful enough to allow for source identification of detected microbial contamination.

In recent years, several groups have collaborated to answer the question “where is the contamination coming from and is it safe to swim at *this* beach?” The Door County Public Health Department, the Door County Soil and Water Conservation Department (DCSWCD), and the University of Wisconsin - Oshkosh joined forces to tackle this question. Genetic fingerprinting and antibiotic resistance testing on *E. coli* isolates, rain event and storm water system water *E. coli* samples, bird surveys, and spatial distribution surveys of *E. coli* at the beaches were used to identify possible contamination sources.

The combined efforts between beach monitoring and microbial source tracking in Door County have resulted in a set of reports summarizing data collected from 2004 through 2006. These reports were released to the public in 2006 when the DCSWCD began the process of contracting with engineers to create stormwater alternatives. Currently 11 beaches in 9 municipalities have stormwater discharging directly onto the beaches. The new stormwater alternatives will enhance beach maintenance and reduce the amount of *E.coli* in stormwater discharge to beaches. These efforts include, but are not limited to: changing impervious surfaces around beaches to

porous pavement, constructing rain gardens, naturalized dunes, and biofilters to remove microbes from storm water. Monitoring efforts will continue at these beaches to assess the effects of these changes

Milwaukee County

In addition to the projects mentioned above, Dr. Sandra McLellan, with the Great Lakes Water Institute (GLWI), continues to be involved in source and transport mechanisms of *E.coli* at Lake Michigan beaches. One project, funded by Wisconsin Sea Grant, focuses on two main items: 1) determining the source of elevated *E.coli* concentrations in surface water where obvious contamination sources (stormwater or sewage overflows) are absent and 2) characterizing the *E.coli* patterns in the near shore waters of Door and Milwaukee counties. Another project the GLWI is working on is installing rain gardens and green roofs in urban areas to look at the benefits of using on-site storm retention systems to reduce the frequency of flooding events and its conveyance of pollutants to nearby surface waters.

City of Racine

In addition to the BEACH Act Funds for monitoring their beaches, the City of Racine works closely with partners to seek additional funding through grants to do source identification research. In the past researchers have conducted hydrogeological assessments as well as researched the presence of *Campylobacter* species in gull feces. During the 2006 and 2007 beach seasons, researchers evaluated real-time, quantitative PCR as a method to determine pollutant loading utilizing a Wisconsin Coastal Management Program (WCMP) grant.

The data collected will allow Racine to compare the DNA present in treated wastewater effluent, bypasses, storm water, and surface run-off and to assess pollutant loading in real-time. Analyses were conducted with agar-based and chemical detection techniques for method comparison. The ability to monitor both point source and non-point source contamination in real-time will allow local governments to undertake effective coastal management measures. This method is also the same as the method currently being validated by the US EPA for monitoring recreational waters throughout the United States.

Beach Buddy Awards

In 2007, two Wisconsin Great Lakes Beaches were named to the Natural Resources Defense Council (NRDC) Beach Buddy List. Sister Bay Beach in Door County and North Beach in Racine County along with eleven other beaches in the US were chosen because the beaches exceeded advisory limits less than 10% of the time and the counties took steps to reduce pollution. August 2007 was the wettest month on record since 1896 for most of Wisconsin. North Beach saw its highest 24-hour rainfall event; however, it was only necessary to issue two advisories and no closures. The 2007 season also marks the third season where there were five or fewer water quality advisories at North Beach.

Sanitary Surveys

In the 2007 Beach Season, sanitary surveys were conducted on 18 beaches along Lake Michigan and Lake Superior. Health Departments in Ashland, Bayfield, Door, Douglas, Manitowoc, Sheboygan, Racine, and Milwaukee counties, researchers at the University of Wisconsin – Oshkosh, and the WDNR collaborated to conduct these initial sanitary surveys. A WDNR report summarizing the conclusions of the project will be released before the 2008 beach season. The results of the sanitary surveys will be used to refine the methods for sanitary survey and also

identify potential areas of concern. Sanitary surveys may provide valuable information about potential pollution sources and help stakeholders remediate the sources to provide cleaner and safer beaches.

Program Deficiencies

As the Wisconsin Great Lakes Beach Monitoring and Notification Program continues to grow, there are a few changes in the future that could improve make the program more successful:

- *Source Identification and Remediation.* After the fifth year of full implementation of the Wisconsin Great Lakes Beach Monitoring and Notification Program, the biggest public concern is still source identification and reduction. Although more communities are becoming more interested in the source of *E.coli* to their beaches, they are not all implementing actions to control the source of contamination.
- *Insufficient Funding for full implementation.* For the third year in a row, the participating counties were asked to reduce monitoring at high priority beaches from 5 times per week to 4 times per week. The amount of funding made available is not enough for full implementation. Wisconsin received \$225,270 and the amount estimated for full implementation is approximately \$300,000.

To Be Completed for the 2008 Beach Season

- Utilizing the \$44,000 recently awarded by the US EPA, the WDNR will conduct a summit meeting in the spring of 2007 to receive input from local health departments and other concerned citizens and organizations regarding the Wisconsin Great Lakes Beach Monitoring and Notification Program. The summit meeting will re-evaluate the program, looking for ways to make the program even more successful for years to come.
- University of Wisconsin - Oshkosh researchers plan to investigate better predictive models.
- Source identification methods such as sanitary surveys will be considered for implementation in the 2008 beach season if funding is available. Sanitary surveys may be conducted in 2008 based on the results of the 2007 beach season sanitary surveys and the funding received for the implementation of the Wisconsin Great Lakes Beach Monitoring and Notification Program.
Door County Soil and Water Conservation Department (DCSWCD) obtained a Coastal Zone Management Grant and county and municipal funding to hire an environmental consulting firm to design further storm water remediation efforts for eleven beaches in the county (in nine communities). The firm will implement a number of changes to reduce storm water contamination of beach water, depending on beach location.

Conclusion

The Wisconsin Great Lakes Beach Monitoring and Notification Program continues to grow and provide useful monitoring information for health departments and the public. As the program evolves, public awareness will increase and the data set will grow allowing more informed decision making regarding beach health. The data and experiences from the monitoring and notification efforts will continue to aid the public and decision makers in the management of beach health throughout Wisconsin.

APPENDIX A Public Notification and Risk Communication Measures

The BEACH Act Workgroup developed a comprehensive communication plan for the 2003 beach season which continues to be implemented. This plan implements the US EPA exceedance standards and beach health advisories.

Exceedance Standards

The US EPA recommends the following exceedance criteria for *E. coli*:

- 235 cfu/100mL as a maximum per sample
- 126 cfu/100mL as a geometric mean for at least 5 samples collected over a 30-day period.

Beach Advisory Posting

High Priority Beaches

Advisory signs (Figure D1) will be posted at high priority beaches under the following conditions:

- whenever the sample results for *E. coli*, exceeds 235 cfu/100mL as a single sample maximum
- and/or whenever the sample results for *E. coli*, exceeds 126 cfu/100mL as a geometric mean of at least 5 samples collected over a 30-day period.

Medium Priority Beaches

Advisory signs (Figure D1) will be posted at medium priority beaches whenever the level of *E. coli* in the beach water sample exceeds 235 cfu/100mL.

Low Priority Beaches

Monitoring at low priority beaches and the posting of signs will be determined on a case-by-case basis. Advisory signs (Figure D1) will be posted at low priority beaches which require weekly monitoring whenever the level of *E. coli* in the beach water sample exceeds 235 cfu/100mL.

Removing Advisory Signs

Beach advisory signs may be removed after the next daily sample is below 235 cfu/100mL *E. coli*.



Figure D1. Yellow “Caution Advisory” Sign

Beach Closures

Closure signs (Figure D2) will be posted whenever the level of *E. coli* in the beach water sample exceeds 1,000 cfu/100mL.

All beaches will be closed under the following conditions:

- Whenever a human health hazard exists as determined by the local health department (i.e. reported illnesses).
- After a major pollution event where potential exists that indicator levels may be expected to exceed standard (i.e. sewage leak, spill)
- After a significant rainfall event that is determined to impact a beach area through runoff.



Figure D2. Red “Stop Closed” Sign

Re-opening Beaches

Beach closure signs may be removed after the sample results of two consecutive sampling days are below 1,000 cfu/100mL *E. coli*.

Open Beach Signs

Signs (Figures D3 and D4) indicating that beach water quality is below the exceedance standard of 235 cfu/100mL *E. coli*, will remain posted at beaches as long as none of the conditions for posting advisory or closure signs exist.



Figure D3. Sign Interpretations in Spanish and Hmong

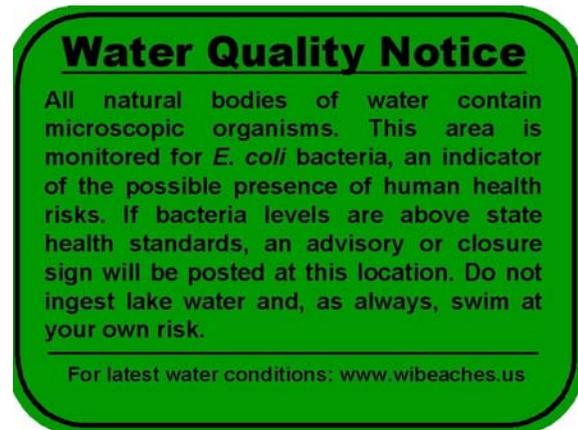


Figure D4. Water Quality Notice Sign

Brochures

An informational brochure was developed by the BEACH Act Workgroup and published by the UW-Extension. This brochure was developed for both Great Lakes and inland beaches. The brochure informs the public of why the waters are being tested and what citizens can do to help keep beaches clean.

Websites

The Beach Health Website (<http://www.wibeaches.us>) is the primary website for WI Great Lakes beaches and is administered by the US Geological Survey. The WDNR website (<http://dnr.wi.gov/org/water/wm/wqs/beaches/>) features information about beach water quality, public health, the BEACH Act, and maps depicting the locations of public beaches along the WI Great Lakes coastlines.

Appendix B
Monitoring Priority of Wisconsin Great Lakes Public Beaches

Ashland County	
Bayview Park Beach	Medium
Big Bay State Park Beach	Low
Big Bay Town Park Beach	Low
Casper Road Beach	Low
Kreher Park Beach	Medium
LaPoint Memorial Beach	Low
Maslowski Beach*	Medium

Bayfield County	
Bark Bay Beach	Low
Bono Creek Beach	Low
Broad Street Beach	Low
Herbster Beach	Low
Highway 13 Wayside Beach	NS
Little Sand Bay Beach	NS
Memorial Beach (Bayfield)	Low
Memorial Park Beach (Washburn)	Low
Port Wing Beach East	Low
Port Wing Beach West	Low
River Loop Road Beach	NS
Sioux River North	Low
Sioux River South	Low
Siskiwit Bay Beach	Low
Thompson West End Park Beach	Low
Wash Walking Trail/BAB	Low
Washburn Marina	Low
Washington Avenue Beach	Low
Wikdal Memorial Boat Launch	Low

Brown County	
Bay Beach	NS
Bayshore Park Beach	Low
Communiversity Park Beach	Low
Joliet Beach	NS
Lon Tail Point Beach South	Low
Long Tail Point Beach North	Low
Riverside Drive Beach	NS
Town of Scott Park Beach	NS
Van Lanen Beach	NS
Volks Landing Boat Launch	NS

Door County	
Anclam Park Beach	Medium
Arrowhead Lane Beach	NS
Bailys Harbor Beach	High
Bittersweet Lane Beach	NS
Braunsdorf Beach	NS
Chippewa Drive Beach	NS
Clay Banks Beach #1	NS
Clay Banks Beach #2	NS
Cliff View Drive Beach	NS
County Road TT Beach	NS
Deer Path Lane Beach	NS
Egg Harbor Beach	High
Ellison Bay Town Park Beach	High
Ephraim Beach	High
Europe Bay Beach #1	Medium
Europe Bay Beach #2	Medium
Europe Bay Beach #3	Medium
Fish Creek Beach	High
Garrett Bay Boat Launch	NS
Gislason Beach	Low
Goldenrod Lane Beach	NS
Haines Park Beach	Low
Hemlock Lane Beach	NS
Isle View Beach	NS
Jackson Harbor Ridges Beach	Medium
Kickapoo Drive Beach	NS
Lakeside Drive Beach	NS
Lakeside Park Beach	Medium
Lily Bay Boat Launch	NS
Murphy Park Beach	High
Newport Bay Beach	High
Nicolet Bay Beach	High
Otumba Park Beach	High
Pebble Beach Road Beach	NS
Percy Johnson Beach	Medium
Portage Park Beach	Medium
Potawatomi State Park #1	NS
Potawatomi State Park #2	NS
Rock Island State Park	Low
Sand Bay Beach #1	NS
Sand Bay Beach #2	NS
Sand Cove Beach	NS
Sand Dune Beach	Medium

Door County (continued)	
Sandy Bay Beach	Medium
School House Beach	Medium
Sister Bay Beach	High
Sturgeon Bay Canal Rec Area	Medium
Sunset Park Beach (Fish Creek)	NS
Sunset Park Beach (Sturgeon Bay)*	High
White Pine Lane Beach	NS
Whitefish Bay Boat Launch	Low
Whitefish Dunes-Inter Center	High
Winnebago Drive Beach	NS

Douglas County	
Allouez Bay Beach #1	NS
Allouez Bay Beach #2	NS
Allouez Bay Beach #3	Low
Amnicon River Beach	Low
Barker Island Inner Beach*	Medium
Barker Island Outer Beach	NS
Brule River State Forest Beach #1	Low
Brule River State Forest Beach #2	Low
Brule River State Forest Beach #3	Low
Connor's Point Beach	NS
Middle River Beach	Low
Wisconsin Point Beach #1	Medium
Wisconsin Point Beach #2	Low
Wisconsin Point Beach #3	Low
Wisconsin Point Beach #4	Low
Wisconsin Point Beach #5	Low

Iron County	
Oronto Bay Beach #1	Low
Oronto Bay Beach #2	Low
Oronto Bay Beach #3	Low
Saxon Harbor Beach East	Low
Saxon Harbor Beach West	Low

Kenosha County	
Alford Park Beach	Low
Eichelman Beach*	Medium
Lakeshore Drive Beach	NS
Marina/Melissa Beach	NS
Pennoyer Park Beach*	Low
Simmons Island Beach*	Medium
Southport Park Beach	Low

Kewaunee County	
9 th Avenue Wayside Beach	NS
City of Kewaunee Beach *	Low
Crescent Beach*	Medium
Lighthouse Vista Beach	NS
Red River Park Beach	NS

Manitowoc County	
Fischer Park Beach*	Low
Hika Park Beach*	Low
Lincoln High School Beach	NS
Maritime Drive Boat Launch	NS
Memorial Drive Wayside (North)*	Medium
Memorial Drive Wayside (Middle)	NS
Memorial Drive Wayside (South)*	Medium
Neshota Beach*	Medium
Point Beach (Concessions)*	Medium
Point Beach (Lakeshore)*	Medium
Point Beach (Lighthouse)*	Medium
Red Arrow Park Beach*	Medium
Silver Creek Beach	NS
Two Creek Boat Launch	NS
University Beach	NS
Warm Water Beach	NS
YMCA Beach*	Medium

Marinette County	
Michaelis Park Beach	NS
Peshtigo Harbor Boat Launch	NS
Red Arrow Beach #1	NS
Red Arrow Beach #2	NS
Red Arrow Beach #3	NS
Seagull Bar Wildlife Area	NS

Milwaukee County	
Atwater Park*	Medium
Bayview Park Beach	Low
Bender Park Beach*	Medium
Big Bay Park Beach	NS
Bradford Beach North*	High
Bradford Beach South*	High
Grant Park Beach*	Medium
Klode Park Beach	Medium
McKinley Beach	Medium
Sheridan Park Beach	NS
South Shore Rocky Beach	Medium

Milwaukee County (continued)	
South Shore Beach*	High
Tietjen/Doctor's Beach*	Medium
Watercraft Beach	Medium

Oconto County	
Oconto City Park Beach	NS

Ozaukee County	
Cedar Road Beach	High
County Road D Boat Launch*	High
Harrington State Park North Beach*	High
Harrington State Park South Beach*	High
Jay Road Beach	NS
Lion's Den Gorge North Beach	Low
Lion's Den Gorge North Beach	Low
Upper Lake Park North Beach*	NS
Upper Lake Park South Beach*	NS

Racine County	
Michigan Blvd. Beach	NS
Myers Park Beach	NS
North Beach #1	High
North Beach #2	High
North Beach #3	High
North Beach #4	High
Parkway Beach	NS
Shoop Park Beach	NS
Wind Point Lighthouse Beach	NS
Zoo Beach #1	High
Zoo Beach #2	High
Zoo Beach #3	High

Sheboygan County	
3 rd Street Beach	NS
Amsterdam Beach	Low
Blue Harbor Beach*	High
Deland Park Beach*	Medium
Forest Road Beach	NS
General King Beach*	Medium
KK Road Beach	Low
Kohler Andrae Nature Center*	High
Kohler Andrae North Beach*	High
Kohler Andrae North Picnic Area*	High
Kohler Andrae South Picnic Area*	High
Lakeview Park Beach	NS
Vollrath Park Beach	NS
Whitcomb Avenue Beach	NS
Wilson Lima/White Sands Beach	NS

NS = Not Sampled

* Indicates a beach that is on Wisconsin's 303(d) Impaired Waters List based on percentage of exceedances of 235 cfu/100mL.

APPENDIX C
Total Beach Length Per County

County	Total # of Beaches	Total Beach Distance (Miles)	Total Beach Distance (Feet)	Total Beach Distance (Meters)
Ashland	7	3.02	15,969	4,869
Bayfield	19	5.12	27,021	8,238
Brown	9	3.80	20,069	6,120
Door	53	6.41	33,820	10,311
Douglas	16	5.77	30,454	9,283
Iron	5	1.44	7,624	2,325
Kenosha	7	2.81	14,863	4,532
Kewaunee	5	1.33	7,025	2,143
Manitowoc	17	7.65	40,385	12,308
Marinette	6	1.76	9,268	2,825
Milwaukee	13	4.81	25,393	7,742
Oconto	1	0.04	217	66
Ozaukee	11	3.44	18,171	5,537
Racine	7	2.03	10,739	3,274
Sheboygan	16	4.89	25,823	7,873
Total	192	54.32	272,409	83,024

APPENDIX D

Tiered Monitoring, Sampling and Analysis Plans

Tiered Monitoring Plan

The tiered monitoring plan describes the monitoring requirements for *High*, *Medium* and *Low* priority beaches. It also addresses when basic sampling should be conducted, when additional samples should be collected and where and how to collect samples.

High Priority Beaches

<i>Basic Sampling</i>	<i>Additional Sampling</i>	<i>Where to Sample</i>	<i>Depth to Sample</i>
<ul style="list-style-type: none"> • Begin sampling at least one week prior to the swimming season • Sample at least 4 times per week during the swimming season 	<ul style="list-style-type: none"> • After heavy rainfall (generally ¼ to ½ inch- depending on local conditions) • After a major pollution event where potential exists that indicator levels may be expected to exceed standard (sewage leak, spill) • Immediately following the exceedance of the water quality standards 	<p><i>Depends on characteristics of the beach</i></p> <ul style="list-style-type: none"> • Middle of typical bathing area • For longer beaches, one sample for every 500m of beach 	<ul style="list-style-type: none"> • Knee depth • Where 24-30 inch depth is first encountered, take sample 6-12 inches below surface of water • Other as you feel is necessary for your beach (<i>e.g., surface of water, waist depth, sediment</i>)

Medium Priority Beaches

<i>Basic Sampling</i>	<i>Additional Sampling</i>	<i>Where to Sample</i>	<i>Depth to Sample</i>
<ul style="list-style-type: none"> • Begin sampling at least one week prior to the swimming season • Sample at least 2 times per week during the swimming season 	<ul style="list-style-type: none"> • After heavy rainfall (generally ¼ to ½ inch- depending on local conditions) • After a major pollution event where potential exists that indicator levels may be expected to exceed standard (sewage leak, spill) • Immediately following the exceedance of the water quality standards 	<p><i>Depends on characteristics of your beach</i></p> <ul style="list-style-type: none"> • Middle of typical bathing area • For longer beaches, one sample for every 500m of beach 	<ul style="list-style-type: none"> • Knee depth • Where 24-30 inch depth is first encountered, take sample 6-12 inches below surface of water

Low Priority Beaches

<i>Basic Sampling</i>	<i>Additional Sampling</i>	<i>Where to Sample</i>	<i>Depth to Sample</i>
<ul style="list-style-type: none"> • Begin sampling at least one week prior to the swimming season • Sampling frequency at low priority beaches should be determined by state and local authorities, taking into account resource constraints and evaluation of risk factors at individual beaches. 	<ul style="list-style-type: none"> • After a major pollution event where potential exists that indicator levels may be expected to exceed standard (sewage leak, spill) • Immediately following the exceedance of the water quality standards 	<p><i>Depends on characteristics of your beach</i></p> <ul style="list-style-type: none"> • Middle of typical bathing area 	<ul style="list-style-type: none"> • Knee depth • Where 24-30 inch depth is first encountered, take sample 6-12 inches below surface of water.

Sampling Protocol

The following sampling protocol can also be viewed in a short movie at:
<http://slhstream.slh.wisc.edu/mediasite/viewer/>

To assure consistency in collecting samples for analysis, the following procedures will be used:

- 1) Specific sites will be designated for collecting samples during the bathing season. Samples will be collected exclusively at these sites for the duration of the sampling period.
- 2) Sample bottles will be prepared and provided by the laboratories charged with conducting bacteria analyses.

General Rules of Sampling



- Take extreme care to avoid contaminating the sample and sample container.
 - Do not remove bottle covering and closure until just prior to obtaining each sample.
 - Do not touch the inside of the sample container.
 - Do not rinse the sample container.
 - Do not put caps on the ground while sampling.
 - Do not transport the samples with other environmental samples.
 - Adhering to sample preservation and holding time limits is critical to the production of valid data.
 - Samples should be labeled, iced or refrigerated at 1 - 4 degrees C immediately after collection and during transit to the lab.
- Care should be taken to ensure that sample bottles are not totally immersed in water during transit or storage.
 - Samples should arrive in the lab no later than 24 hours after collection. Whenever possible samples should arrive at the lab on the day of collection, preferably before 2 p.m.
 - The sampler will complete the laboratory data form noting time, date, and location of sample collection, current weather conditions (including wind direction and velocity), water temperature, clarity, wave height and any abnormal water conditions.

Sampling Method

- (1) Carefully move to the first sampling location. Water should be approximately knee deep. While wading slowly in the water, try to avoid kicking up bottom sediment at the sampling site.
- (2) Open a sampling bottle and grasp it at the base with one hand and plunge the bottle mouth downward into the water to avoid introducing surface scum.
- (3) The sampling depth should approximately 6 to 12 inches below the surface of the water.
- (4) Position the mouth of the bottle into the current away from your hand. If the water body is static, an artificial current can be created by moving the bottle horizontally with the direction of the bottle pointed away from you.
- (5) Tip the bottle slightly upward to allow air to exit and the bottle to fill.
- (6) Make sure the bottle is completely filled before removing it from the water.
- (7) Remove the bottle from the water body and pour out a small portion to allow an air space of 2 cm for proper mixing of the sample before analyses.
- (8) Tightly close the cap and label the bottle.
- (9) Store sample in a cooler filled with ice or suitable cold packs immediately.

Analytical Methods

All sample analyses shall be conducted by State certified labs using one of the following US EPA approved methods:

Most probable number (MPN) tests for E. coli:

- LTB EC-MUG (Standard Methods 9221B.1/9221F)
- ONPG-MUG (Standard Methods 9223B, AOAC 991.15, Colilert, Colilert-18, and Autoanalysis Colilert)

Membrane filter tests for E. coli:

- MEndo, LES-Endo, or mFC followed by transfer to NA-MUG media (Standard Methods 9222B/9222G or 9222D/9222G)
- MI Agar, M-ColiBlue24 Broth