

Wisconsin's Great Lakes Beach Monitoring & Notification Program

Annual Report Beach Season 2010



University of Wisconsin – Oshkosh
Department of Biology & Microbiology

Bureau of Watershed Management
Wisconsin Department of Natural Resources



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Local participants include:

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
City of South Milwaukee Health Department

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University of Wisconsin – State Laboratory of Hygiene

Thank you to everyone who makes Wisconsin's Great Lakes Beach Monitoring & Notification Program a success!

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Summary

The summer of 2010 was the eighth season of the Wisconsin's Great Lakes Beach Monitoring & Notification Program. The Wisconsin Department of Natural Resources (WDNR) was awarded \$227,000 by the United States Environmental Protection Agency (USEPA) to implement the federal Beaches Environmental Assessment and Coastal Health (BEACH) Act of 2000. With this funding, 113 public beaches along the Wisconsin shorelines of Lake Superior and Lake Michigan were sampled for *Escherichia coli* (*E. coli*) bacteria.

In response to WDNR staff reductions, much of the day-to-day administration of the Beach Monitoring Program was performed by the Biology & Microbiology Department of the University of Wisconsin–Oshkosh operating under contract with WDNR. Under this contract, UW-Oshkosh was responsible for routine check-ins with participants, resolving data entry issues, responding to general program inquiries, conducting an end-of-season program evaluation, and preparing an end-of-season report.

Similar to past years, 16 health departments representing 13 Lake Michigan and Lake Superior coastal counties accepted BEACH Act funding and collected samples at selected public beaches one to five times per week.¹ Beach *advisories* and/or *closures* were posted using signs placed on the beach property in addition to information being provided on an Internet Web Site (<http://ww.wibeaches.us>). Decisions to post an advisory versus a closure were generally triggered by the amount of *E. coli* present as compared to thresholds recommended by USEPA. In some cases, advisories and/or closures were prompted by other factors including weather, known or suspected sewage bypasses, or other factors that have been linked to high *E. coli* counts in the past.

Based on the monitoring results of the 2010 beach season, the overall rate of advisories and closures was above the level seen in 2009. Further, the percentage of total samples that exceeded the federal daily maximum *E. coli* water quality criterion of 235 CFU/100 mLs was only 3% lower than the average of the seven previous beach seasons.

¹ Marinette and Oconto counties have chosen not to participate in Wisconsin's BEACH Act program.

Introduction

The BEACH Act of 2000 applies to all public beaches that border the Atlantic and Pacific Oceans as well as the Great Lakes. Recipients of grants provided by the federal BEACH Act are required to develop and implement a beach monitoring and public notification programs in alignment with grant performance criteria specified by USEPA. The State of Wisconsin has participated in the federal BEACH Act program since its inception through a collaborative effort involving the Wisconsin Department of Natural Resources (WDNR), local health departments, academia, and the United States Geological Survey (USGS) to collect and share information related to water quality of Lake Michigan and Lake Superior public beaches since 2003.

The 2010 Beach season was the eighth consecutive summer of Wisconsin's statewide beach-monitoring and notification program on the shorelines of Lake Michigan and Lake Superior. The activities described in this report were conducted during Federal Fiscal Year 2010 (October 1, 2009 through September 30, 2010).

Program Overview

A BEACH Act Workgroup was formed in 2002 to help develop Wisconsin's Great Lakes Beach Monitoring & Notification Program. This workgroup was comprised of state-level environmental and public health officials, local health officials, and other interested parties to design a beach monitoring and notification program. Workgroup members included representatives from:

Keep Our Beaches Open	City of Racine Health Department
Kenosha County Health Department	Wisconsin Department of Health & Family Services
City of Madison Public Health Department	Wisconsin State Laboratory of Hygiene
City of Milwaukee Health Department	United States Geological Survey
Milwaukee Metropolitan Sewerage District	University of Wisconsin – Oshkosh
Ozaukee County Health Department	

In 2002, 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 & 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 pathogen impacts to each beach such as: location of stormwater outfalls, waterfowl usage, proximity of wastewater treatment plant outfalls and farms. This information – along with general estimates of swimmer density – was used to rank and classify beaches as "high," "medium," or "low" priority. These ranks were then used to distribute available program funds as equitably as possible to address the relative risk of pathogen exposure to people who swim or wade in the nearshore waters of public beaches.

In an effort to standardize as much of the statewide program as possible, the Workgroup agreed to collect samples using consistent field protocols and to use common advisory signs for beach posting. The signs were designed based on feedback collected during a beach user survey in 2002 and public meetings held around the state (Appendix D). With the assistance of BEACH Act funding, staff from the USGS designed and manage the Wisconsin Beach Health Website

(<http://www.wibeaches.us>) in partnership with the local health department staff. The USGS also serves as the primary data manager and oversees all data integration needs with USEPA to support the national information exchange goals of the BEACH Act.

Beach Season - 2010

For the 2010 beach season, one change was the provision of analytical support to the Lake Superior beaches for a thirteen week sampling season (Ashland, Bayfield, Douglas, and Iron counties), while all Lake Michigan beaches received analytical support for a fourteen week sampling season. Once again, the primary purpose was to maintain a consistent statewide Great Lakes beach water monitoring program to improve public notification and to reduce beach visitors' risk of exposure to disease-causing microorganisms in water. Very few changes were made to the beaches that were monitored in previous years. Federal restrictions on how grant funds could be used prevented local partners from collecting samples for the explicit purpose of identification and control of pollution sources leading to elevated bacteria levels. Any efforts to do so were done independent of the BEACH Act funding.

Time Schedule

The activities described in this report took place during Federal Fiscal Year (FFY) 2010 (October 1, 2009 through September 30, 2010). FFY 2010 encompassed the entire 2010 beach season, which is defined for Wisconsin coastal beaches as Memorial Day Weekend through Labor Day Weekend (as of 2010, 14 weeks for Lake Michigan beaches and 14 weeks for Lake Superior beaches).

Budget

In May of 2010, USEPA awarded Wisconsin a grant in the amount of \$227,000. Due to funding limitations and additional reporting requirements to increase financial accountability, a few changes were made to the contracts provided to local health departments in 2010. The most significant change was a requirement to provide more detailed reporting of travel and expenses to help better understand program costs.

WDNR believes these data will help enable future allocations to be more equitable and reflective of actual costs incurred.

In preparation for the 2010 Beach Season, WDNR used available data from 2009 to prepare allocations representing the relative level of effort anticipated for each partner in recognition of the sampling associated with beaches within their jurisdiction. Thus, there were some local public health department partners who saw an increase from their 2009 allocation and others health departments that saw a decrease in their 2010 funding. All told, >83% of the base grant was used to fund the local health department efforts to sample the beaches (Table 1).

Table 1: Allocation of WDNR Beach Program funding by county.

County	Allocation
Ashland, Bayfield, Douglas, Iron & Kewaunee Counties (Group Contract)	\$ 41,886
Brown County	\$ 2,908
Door County	\$ 57,989
Kenosha County	\$ 7,541
Manitowoc County	\$ 10,185
Milwaukee, City of	\$ 12,304
Northshore, Village of	\$ 3,650
Ozaukee County	\$ 21,085
Racine, City of	\$ 10,276
Sheboygan County	\$ 9,990
Shorewood, Village of	\$ 4,559
South Milwaukee, City of	\$ 6,200
Total	\$ 188,574

NOTE: BEACH Act funds provided by USEPA are not eligible for distribution and use to cover monitoring or public notification costs for non-coastal beaches. However, several progressive Wisconsin counties and local health

departments are collecting data on inland waters and are including those data into the same data base managed by USGS. The funding for any USGS efforts to accommodate those data is separate from the BEACH Act grants awarded to Wisconsin.

Monitoring Summary Results

The 2010 beach season was the eighth year of implementing the Wisconsin Great Lakes Beach Monitoring & Notification Program. A total of 113 coastal beaches were sampled regularly and results were used to provide the public with information on risk of waterborne pathogens in accordance with program requirements. As noted earlier, the sampling and public notification efforts were the combined effort of 16 individual health departments and their contractors in 13 coastal counties along both Lake Michigan and Lake Superior. In addition to the sampling efforts, additional work conducted in 2010 in support of beach health included:

Great Lakes Research Initiative – UW Oshkosh

qPCR Pilot Implementation Study – Racine, Dr. Julie Kinzelman

From July 23 – September 7, 2010, with the foreknowledge of WDNR and USEPA's Office of Water, the Racine Health Department began informing their daily management decisions using qPCR. This pilot implementation study was designed to parallel a similar effort occurring at approximately the same time at nine public bathing beaches in Orange County, CA. On each day that sampling occurred, split samples were analyzed by qPCR (same day) and Colilert-18. Beach management decisions were made on the same day results using the qPCR and confirmed the following morning by Colilert-18. In the event that non-consensus or inhibition of the qPCR reaction occurred the Health Department agreed to default to the previous day's *E. coli* results as determined by the culture-based method. As per contractual agreement, all results logged into the USGS database were determined by the culture-based assay.

The same management decisions would have been made for the duration of the pilot study, regardless of analytical method, based on an *E. coli* standard. A summary of the entire 2010 season is show below:

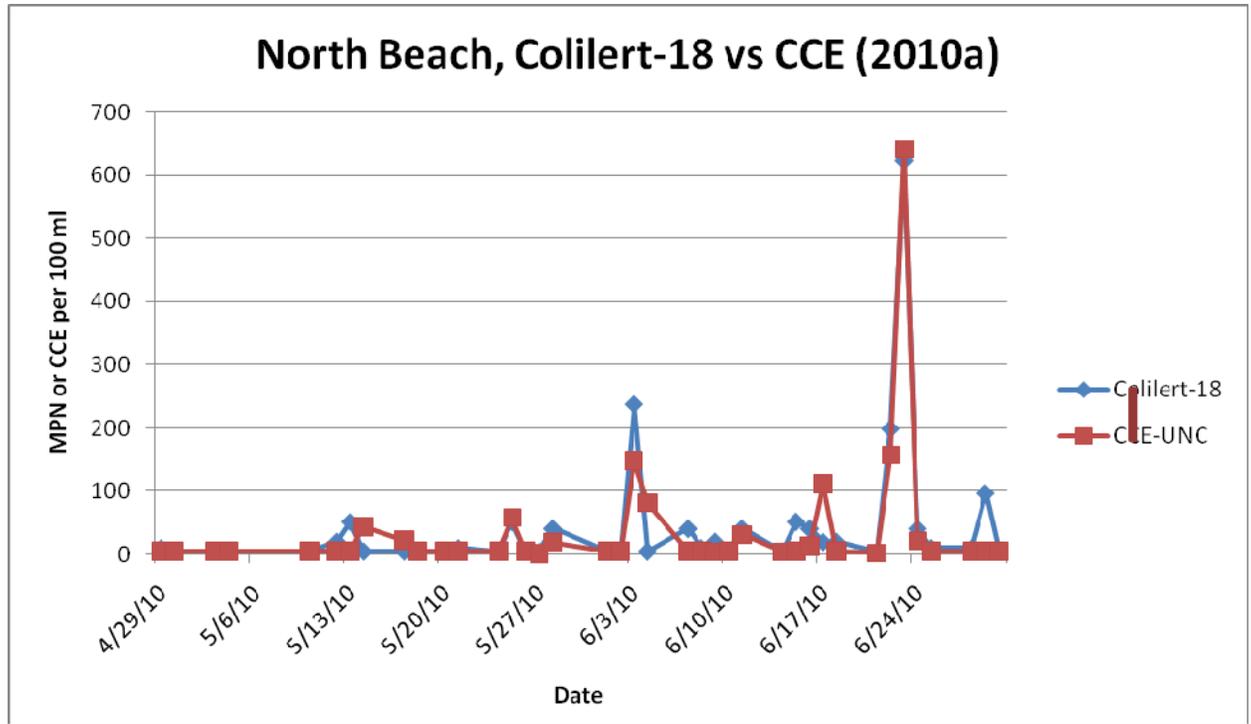
Results for *E. coli* – 2010

- North Beach
 - 87 sampling days
 - Numerical match, Colilert-18 vs. QPCR = 66%
 - Regulatory Agreement = 98%*
 - 1 Type I and 1 Type II error
- Zoo Beach
 - 88 sampling days
 - Numerical match, Colilert-18 vs. QPCR = 73%
 - Regulatory Agreement = 86%*
 - 12 Type I errors
 - 8/12 mismatches occurred consecutively and may be attributed to lab error

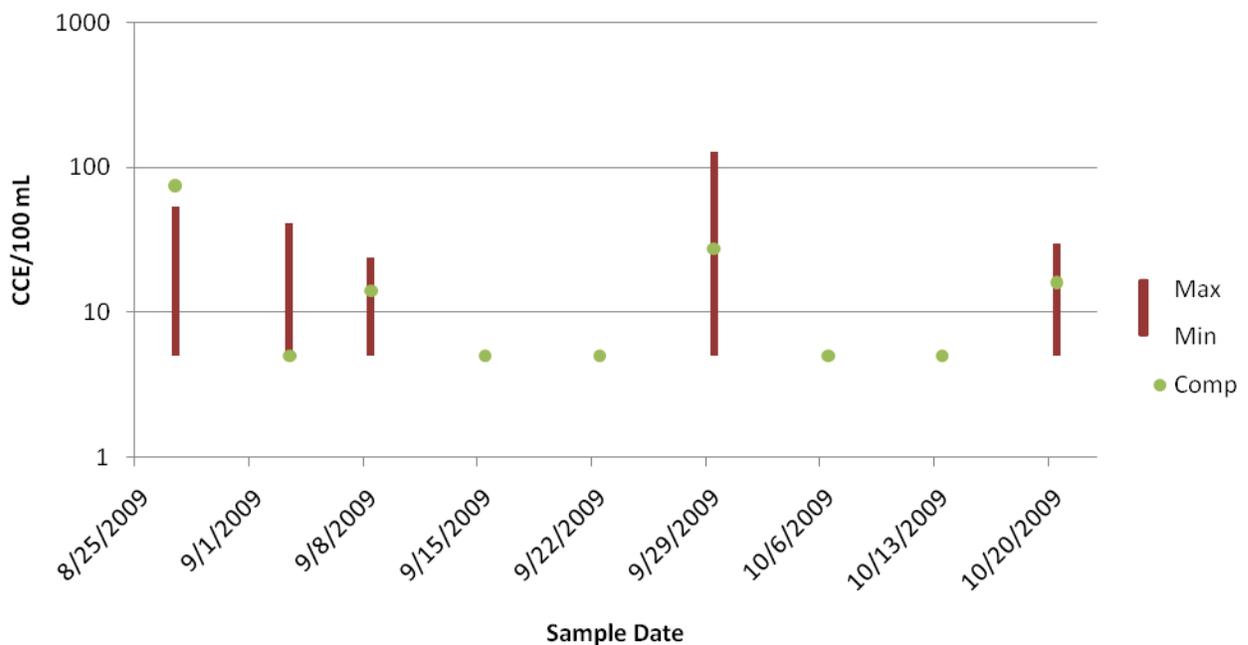
*Based on the single sample advisory limit of 235 *E. coli*/100 ml.

Composite sampling using qPCR was also investigated between August 2009 and June 2010. This effort was undertaken to determine if the results of composite sampling would fall within the range of 3 – 4 individual samples when using qPCR as the analytical method. Based upon 40 sampling results across two beaches (North Beach and Zoo Beach in Racine County), the following conclusions were drawn:

- No mean difference in *E. coli* concentration across beach transects (i.e. still valid to composite samples).
- Composite samples fell within the range of the individual samples 92% of the time.
- The use of composite sampling would have made no difference with respect to regulatory action.
- Compositing samples would represent a significant cost savings if using qPCR.



North Beach *E. coli* Composite vs. Individual Site Analysis by QPCR



Monitoring Summary Results

In 2010, monitoring occurred at a total of 113 sites generating 4,361 sample results that were reported on the Beach Health Website. In the simplest of terms, roughly 12.4% of the discrete samples collected during the beach season exceeded the water quality advisory threshold of 235 CFU/100mL (Table 2). In addition, roughly 3.1% of all samples collected exceeded 1,000 CFU/100mL resulting in mandatory beach closures.

Table 2: 2010 annual sample percentage exceeding the advisory level of 235 CFU/100mL².

County	2003	2004	2005	2006	2007	2008	2009	7-Year Average	2010
Ashland	3.2%	10.2%	4.6%	3.5%	3.8%	3.3%	4.0%	4.7%	5.8%
Bayfield	1.9%	2.2%	4.3%	7.1%	7.1%	3.1%	0.8%	3.8%	5.8%
Brown	0.0%	2.0%	1.8%	0.0%	4.5%	0.0%	5.2%	1.9%	5.9%
Door	4.1%	8.2%	6.9%	7.3%	4.8%	6.3%	8.1%	6.5%	4.7%
Douglas	9.5%	11.8%	23.7%	12.9%	11.3%	18.8%	1.5%	12.8%	18.4%
Iron	1.1%	1.5%	2.7%	3.5%	0.0%	0.0%	0.0%	1.3%	7.1%
Kenosha	21.0%	36.3%	31.9%	29.9%	32.2%	31.7%	23.5%	29.5%	24.0%
Kewaunee	26.0%	33.9%	26.9%	33.9%	49.7%	11.1%	9.1%	27.2%	10.9%
Manitowoc	49.6%	40.1%	20.4%	54.4%	31.7%	31.3%	5.3%	33.3%	16.3%
Milwaukee	24.3%	38.7%	30.3%	20.0%	23.7%	22.4%	12.7%	24.6%	26.1%
Ozaukee	15.9%	28.9%	12.9%	17.1%	27.6%	24.0%	4.8%	18.7%	22.9%
Racine	16.5%	17.6%	7.4%	6.9%	6.7%	6.7%	6.4%	9.7%	0.7%
Sheboygan	23.8%	30.2%	24.8%	43.9%	28.5%	18.1%	13.6%	26.1%	22.7%
Statewide	15.1%	20.1%	15.3%	18.5%	17.8%	13.6%	7.3%	15.4%	12.4%

The advisory exceedance rate in 2010 was much higher than 2009 (increase of 5.1%); however, only 3% less than the 7-year average (2003-2009). Compared to 2009, only two counties in 2010 saw a decrease in the rate of exceeding the advisory threshold. Although it is impossible to determine without comprehensive source investigations, unusually heavy rainfall and wet conditions at many coastal beaches in Wisconsin in 2010 may have contributed to elevated *E. coli* levels resulting in more advisories and closures than in previous years. This is consistent with the fact that several dynamic environmental factors are known to affect the quality of beaches from day-to-day and year-to-year, including, but not limited to: rainfall, stormwater and sewage discharges, accumulation of *Cladophora*, wind direction, wave height, and water temperature.

Regardless, data collected and summarized for 2010 suggest that some communities and/or counties (namely Door County and the City of Racine) may be having success in increasing awareness of beach health issues and prompting efforts to address beach issues. Historical data (2003-2009) may be downloaded from the Wisconsin Beach Health Website.

Local Program Status, Research Initiatives, & Successes

The many partners involved in Wisconsin's Great Lakes Beach Monitoring & Notification Program continue to collaborate to increase public awareness about the problems associated with waterborne pathogens along nearshore waters – especially public beaches. In addition to the funding provided by the federal BEACH Act, other local, state, and federal resources have

² This figure was calculated by dividing the number of discrete samples that exceeded the 235 CFU/100 mL threshold by the total number of samples collected for the individual county.

been used to help address some of these problems and increase the use of our public beaches. Some of the notable actions and observations by local partners include:

Ashland, Bayfield, Douglas & Iron Counties

With over 200 miles of Lake Superior shoreline that attract many tourists, Ashland, Bayfield, Douglas, and Iron Counties are keenly aware of the importance of clean water and clean beaches. Within these counties, 39 public beaches are monitored at least once per week during the normal Lake Superior beach season (mid-June through mid-September). While BEACH Act funding is helpful, additional resources are needed to supplement local efforts. In particular, partnerships have been built between the counties and Northland College, UW-Oshkosh, and the Lake Superior Alliance to create a comprehensive monitoring and source-tracking program that will help address problems as they are identified.

Brown County

The Brown County Health Department monitors three beaches: Bayshore Park Beach, Communiversity Park Beach, and Longtail Beach. In 2010, county staff reported that fishing activities increased around Bayshore Park Beach.

Door County

Door County is one of the most popular summer tourist destinations in Wisconsin. Clean water for recreation is critical to the economy of this area – especially since the beach season coincides with the heaviest tourist activity. In total, 34 public beaches are tested regularly throughout the summer. Door County has done a fantastic job of supplementing BEACH Act funding with additional resources, including those provided in partnership with the Door County Public Health Department, the Door County Soil & Water Conservation Department (DCSWCD), and UW-Oshkosh. Genetic fingerprinting and antibiotic resistance testing on *E. coli* isolates, rain event and storm water system samples, bird surveys, and spatial distribution surveys of *E. coli* at the beaches have been used to identify possible contamination sources leading to a better understanding of pathogen mitigation opportunities.

Kenosha County

Elevated rain levels slightly affected beaches as seen by an increase in the number of advisories (up to 21 advisories in 2010). However, there was a decrease in the number of closures (8) during the summer of 2010 compared to the number of closures (13) during the summer of 2009.

Manitowoc County

It is believed that the increase in the number of advisories and beach closures in 2010 was due to the increased rain levels seen throughout the summer.

Ozaukee County

Ozaukee County has begun using predictive modeling (NowCast) for their beaches. County staff report that this tool was helpful during the 2010 season.

City of Racine

Racine has been conducting method validation studies related to, and comparative analyses of, currently approved culture-based methods and real-time qPCR for the enumeration of *E. coli* and enterococci in ambient waters since 2005. These studies have generated a large amount of data from two high priority Great Lakes coastal beaches with respect to regulatory concordance. Preliminary data suggest that qPCR provided similar beach management decisions to Colilert-18 based on USEPA 1986 guidelines for monitoring recreational water. Furthermore, *E. coli* and enterococci were correlated.

Shorewood/Whitefish Bay Health Department (Milwaukee County)

The Shorewood/Whitefish Bay Health Department only tests for *E. coli*. During 2010, there was only one advisory and one closure at Shorewood/Whitefish Bay Health Department monitored beaches.

Program Deficiencies

Similar to past years, there are a several changes that would be helpful to Wisconsin's efforts to implement a more comprehensive and effective Great Lake Beach Monitoring Program. Two key areas that could use additional support include:

- **Source Identification & Remediation.** After the eighth year of full implementation of the program, the biggest outstanding concern among partners and the public is what is being done to **eliminate** beach advisories and closures. In order to be effective at pollution elimination, *source identification* must be a priority. Although an increasing number of communities would benefit by identifying the sources of *E. coli* to their beaches, the federal BEACH Act does not allow for this. It is unlikely that state funding will be provided for this purpose at the level needed due to constraints on the state budget. Ideally, changes in the federal BEACH Act which have been proposed and debated in the US Congress would be made and funding associated with source identification and remediation would be authorized. Absent those changes, it will be left to local governments and volunteers to engage in effective source identification and remediation to the degree possible using all available tools (i.e., Beach Sanitary Surveys, Great Lakes Restoration Initiative funding, etc.).
- **Insufficient Funding for Full Program Implementation.** The 2010 Beach Season required additional cuts in program implementation to account for increased program costs. Reductions in the frequency of beach testing were part of the cost savings measures used in 2010. As has been estimated in the past, Wisconsin would achieve full implementation of the required monitoring outlined in the BEACH Act Grant Performance Criteria with an annual budget estimated at nearly \$350,000. If not state funding is available and federal funding remains static at approximately \$225,000 annually, Wisconsin will continue to implement a program that requires cost-saving measures that may not allow achievement of all of the federal program goals for addressing the problems associated with waterborne pathogens in Great Lakes coastal waters.

Ideas for the 2011 Beach Season

Regardless of program deficiencies, there are ongoing efforts to increase program awareness and advance key program needs for the 2011 Beach Season. It is hoped that some of these may benefit the program as a whole, including, but not limited to:

- Efforts continue by multiple researchers in academia and state, federal, and local government to develop, validate, and utilize **predictive models**.
- Health department officials throughout the state (including non-Great Lakes Coastal agencies) are engaged in a growing dialogue about how to seek program expansion to address pathogen testing and public notification for **inland beaches** using a program model similar to that used for the Great Lakes beaches.

Conclusion

In spite of a limited budget and an uncertain future for the federal BEACH Act, Wisconsin's Great Lakes Beach Monitoring & Notification Program continues to evolve and provide useful monitoring information for health departments and the public. It is hoped that continued support of this program will heighten awareness of beach health and will provide the resources

necessary to increase the knowledge of health professionals allowing for more informed decision making by state and local leaders and less risk to the beach-going public. After seven years of program implementation, the contributing partners believe that the data and experience gained will continue to aid both the public and local and state decision makers in efforts to manage water quality and seek effective solutions to restore and maintain excellence in the quality of all public beaches throughout Wisconsin.

Appendix A

Public Notification & 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 USEPA exceedance standards and beach health advisories.

Exceedance Standards

The USEPA 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*.

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



Figure 1. Yellow "Caution Advisory" Sign



Figure 2. Red "Stop Closed" Sign

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.

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 3. Sign Interpretations in Spanish and Hmong

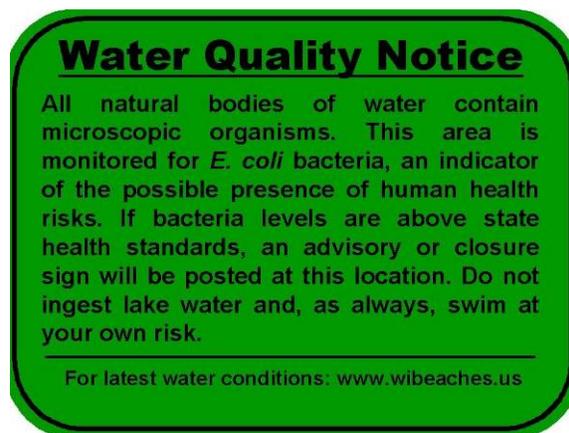


Figure 4. Water Quality Notice Sign

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. The Great Lake brochure can be found at:

<http://www.dnr.state.wi.us/org/water/wm/wqs/beaches/GreatLakesBeachBrochure2007.pdf>.

Websites

The Wisconsin 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 Wisconsin Beach Health Website features current and historical monitoring data for both great lakes and inland beaches. In 2010, website managers tracked the number of page views to the home page (<http://www.wibeaches.us>). There were a total of 1.3 million hits to the home page, which is an average of 7,000 page views per day. The busiest time of the year occurred in July with a total of 485,000 views to the home page. In addition, there were a total of 15,000 visitors (average of 78 per day) to the home page in 2010.

There are also tools for the public to receive instant updates, contact information, and program information. The Advisory Email Alert System allows users to sign up to receive advisory information for favorite beaches. Many users have signed up for this service and are very happy to receive information about beaches directly to their email inbox. "Really Simple Syndication" or RSS is a XML format for distributing and syndicating content. The Beach Health website uses RSS feeds to show the most recently entered status for any monitored beaches along the Great Lakes. In 2010:

- A total of 255 users have registered email addresses to receive beach advisories.
- Approximately 580 people receive beach advisories (the number changes as people ask to be removed near the end of the season).
- Users received email advisory alerts for 111 beaches.

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

Wisconsin's Public Great Lakes Beaches and Associated Use Priority

Ashland Co.	Use Priority	Door Co.	Use Priority
Bayview Park Beach	Medium	Anclam Park Beach	Medium
Big Bay State Park Beach	Low	Baileys Harbor Ridges Park Beach	High
Big Bay Town Park Beach	Low	Egg Harbor Beach	High
Casper Road Beach	Low	Ellison Bay Town Park Beach	High
Kreher Park Beach	Medium	Ephraim Beach	High
La Pointe Memorial Beach	Low	Europe Bay Beach 1	Medium
Maslowski Beaches	Medium	Europe Bay Beach 2	Medium
		Europe Bay Beach 3	Medium
Bayfield Co.	Priority	Fish Creek Beach	High
Bark Bay Beaches	Low	Gislasen Beach	Low
Bono Creek Boat Launch Beach	Low	Haines Park Beach	Medium
		Jackson Harbor Ridges (Washington Island)	Low
Broad Street Beach	Low	Lakeside Park Beach	Medium
Herbster Beach	Low	Murphy Park Beach	High
Memorial Beach Bayfield	Low	Newport Bay State Park Beach	High
Memorial Park Beach Washburn	Low	Nicolet Bay Beach (Peninsula State Park)	High
		Otumba Park Beach	High
Port Wing Beach East	Low	Percy Johnson Memorial Park Beach (Washington Island)	Low
Port Wing Beach West	Low	Portage Park Beach	Medium
		Rock Island State Park Beach	Low
Sioux River Beach North	Low	Sand Dune Beach (Washington Island)	Low
Sioux River Beach South	Low	Sandy Bay Town Park Beach	Medium
Siskiwit Bay Beach	Low	School House Beach (Washington Island)	Low
		Sister Bay Beach	High
Thompson West End Park Beach	Low	Sturgeon Bay Canal Recreation Area Beach	Medium
Washburn Marina Beach	Low	Sunset Park Beach Sturgeon Bay	High
Washburn Walking Trail Beach / BAB Beach	Low	Whitefish Dunes Beach	High
Washington Avenue Beach	Low		
Wikdal Memorial Boat Launch Beach	Low		
Brown Co.	Priority		
Bayshore Park Beach	Low		
Communiversity Park Beach	Low		
Longtail Beach	Low		

Wisconsin's Public Great Lakes Beaches and Associated Use Priority (Continued)

Douglas Co.	Use Priority	Manitowoc Co.	Use Priority
Allouez Bay Beach 3	Low	Fischer Park Beaches	Low
Amnicon River Beach	Low	Hika Park Bay	Low
Barker's Island Inner Beach	Medium	Memorial Drive Wayside Beach North	Medium
Brule River State Forest Beach 1	Low	Memorial Drive Wayside Beach South	Medium
Brule River State Forest Beach 2	Low	Neshotah Beach	Medium
Brule River State Forest Beach 3	Low	Point Beach State Forest - Concession Stand Beach	Medium
Middle River Beach	Low	Point Beach State Forest - Lakeshore Picnic Area Beach	Medium
Wisconsin Point Beach 1	Medium	Point Beach State Forest - Lighthouse Picnic Area Beach	Medium
Wisconsin Point Beach 2	Low	Red Arrow Park Beach Manitowoc	Medium
Wisconsin Point Beach 3	Low	YMCA Beach	Medium
Wisconsin Point Beach 4	Low		
Wisconsin Point Beach 5	Low		
		Milwaukee, City of	Use Priority
		Bradford Beach	High
Iron Co.	Use Priority	McKinley Beach	Low
Oronto Bay Beach 1	Low	Rock Area	Low
Oronto Bay Beach 2	Low	South Shore Beach	High
Oronto Bay Beach 3	Low	Watercraft Beach	Low
Saxon Harbor Beach East	Low		
Saxon Harbor Beach West	Low		
Kenosha Co.	Use Priority	North Shore	Use Priority
Alford Park Beach	Low	Tietjen Beach / Doctor's Park	Medium
Eichelman Beach	Medium		
Pennoyer Park Beach	Low		
Simmons Island Beach	Medium	Ozaukee Co.	Use Priority
Southport Park Beach	Low	Cedar Beach Rd Beach	High
		Concordia University	Medium
		County Road D Boat Launch Beach	High
Kewaunee Co.	Use Priority	Harrington State Park Beach North	High
City Of Kewaunee Beach	Low	Harrington State Park Beach South	High
Crescent Beach (Algoma)	Medium	Lion's Den Gorge Nature Preserve (North & South)	Low
		Upper Lake Park Beach (North & South)	High

Wisconsin's Public Great Lakes Beaches and Associated Use Priority (Continued)

Racine, City of	Use Priority		Shorewood	Use Priority
North Beach (4 Sites)	High		Atwater Park Beach	Medium
Zoo Beach (3 Sites)	High		Klode Park Beach	Medium
Sam Myers Park Beach	Low			
Sheboygan Co.	Use Priority		South Milwaukee, City of	Use Priority
Amsterdam Beach	Low		Bay View Park Beach	Low
Blue Harbor Beach	High		Bender Beach	Medium
Deland Park Beach	High		Grant Park Beach	Medium
General King Park Beach	Medium			
KK Road Beach	Low			
Kohler Andrae State Park Nature Center Beach	High			
Kohler Andrae State Park North Beach	High			
Kohler Andrae State Park Picnic Beach (North)	High			
Kohler Andrae State Park Picnic Beach (South)	High			
Van Ess Road Beach	Low			

Appendix C

Length of Public Beaches by County

County	Number of Beaches	Number of Sampled Beaches	Total Beach Distance		
			Miles	Feet	Meters
Ashland	7	6	2	11,832	3,606
Bayfield	19	16	5	27,022	8,236
Brown	9	3	1	7,712	2,351
Door	53	34	7	34,404	10,486
Douglas	16	12	6	30,454	9,282
Iron	5	5	1	7,624	2,324
Kenosha	7	5	3	14,061	4,286
Kewaunee	5	2	1	7,025	2,141
Manitowoc	17	7	8	40,385	12,309
Marinette	6	0	2	9,268	2,825
Milwaukee	13	11	5	27,889	8,501
Oconto	1	0	0	217	66
Ozaukee	12	6	4	18,521	5,645
Racine	7	2	2	10,739	3,273
Sheboygan	16	9	5	25,823	7,871
Total	193	118	52	272,976	74,709

Appendix D

Tiered Monitoring, Sampling & Analysis Plans

MONITORING

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

Basic Sampling	Additional Sampling	Where to Sample	Depth to Sample
<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

Basic Sampling	Additional Sampling	Where to Sample	Depth to Sample
<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 physical characteristics of 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

Basic Sampling	Additional Sampling	Where to Sample	Depth to Sample
<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.

In-water Sample Collection

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.

1. 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.
2. The sampling depth should approximately 6 to 12 inches below the surface of the water.
3. 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.
4. Tip the bottle slightly upward to allow air to exit and the bottle to fill.
5. Make sure the bottle is completely filled before removing it from the water.
6. 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.
7. Tightly close the cap and label the bottle.
8. Store sample in a cooler filled with ice or suitable cold packs immediately.

LABORATORY ANALYSIS

All sample analyses shall be conducted by State certified labs using one of the following USEPA 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