

Wisconsin's Great Lakes Beach Monitoring and Notification Program Annual Report Beach Season 2006



Wisconsin Department of Natural Resources

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Summary

In 2006, 123 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 2006 Wisconsin Beach Monitoring and Notification Program.

The Wisconsin Beach Monitoring and Notification Program's primary goal is to reduce beach visitors' risk of 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. All warm-blooded animals have *E. coli* in their feces, so if high levels of *E. coli* are found in beach water there is a high chance of fecal matter being in the water. Potential sources of *E. coli* contamination at Wisconsin beaches include agricultural runoff, urban storm water 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.

Fifteen health departments along Lake Michigan and Lake Superior sample the water at beaches one to five times per week. An advisory sign is posted warning swimmers that there is an increased risk of illness whenever the water quality criterion of 235 colony forming units (CFU)/100 mL for *E. coli* is exceeded. A red stop sign that closes the beach is posted when *E. coli* levels exceed 1,000 CFU/100mL, indicating a more serious risk of illness. Advisories and closures may also follow rainfall events or storm water and sewage overflows. Other factors that may influence *E. coli* concentrations include: the nuisance algae *Cladophora*, wind direction, wave height, water temperature, and even beach grooming.

Statewide, the summer of 2006 had more closures and advisories than 2005, but less than 2004. In Wisconsin, 17.5% of the samples taken in 2006 exceeded the *E. coli* standard of 235 CFU/100mL (676 samples out of 3861 total samples). Approximately 5% of the total samples exceeded 1000 CFU/100mL and resulted in beach closures.

The following table summarizes the percent of samples that exceeded the advisory limit of 235 CFU/100mL for each county:

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

2006 marked the fourth successful season of the Wisconsin Beach Monitoring and Notification Program. It is hard to predict what the next beach season will bring as every beach and year is

unique. Water quality awareness has increased in Lake Superior and Lake Michigan Counties as more data becomes available. Some counties and concerned citizens have taken initiative and are working toward finding sources of *E.coli* contamination and solutions to address them.

Introduction

The BEACH Act was passed in October of 2000, requiring 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 2006, the WDNR, working closely with local health departments and university researchers, conducted the fourth 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 2006 (October 1, 2005 - September 30, 2006).

Program Overview

The beginning of this project brought together 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 public beach miles and 192 total coastal beaches were identified along Lake Michigan and Lake Superior (Appendices A & B). The definition of “beach” for the purpose of Wisconsin BEACH Act 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.”

The coastal beaches were geo-located using GPS technologies and maps were created for each county identifying all beaches (Figure 1). Additional GPS data layers were added to include the location of all wastewater treatment outfalls along with their proximity to the beaches. Additional information was collected for each beach for evaluation: the potential for impacts from storm water runoff, bather and waterfowl loads, and the location of outfalls and farms. This information was used to rank and classify beaches as “high,” “medium,” or “low” priority.

A standard sampling protocol was developed and standard advisory signs were designed based on feedback from a beach user survey in 2002 and public meetings held around the state (Appendix C). The Beach Health Website formerly designed and used by the City of Milwaukee Health Department as part of an EPA EMPACT project for Milwaukee, Racine and Kenosha beaches was expanded to include all public beaches monitored under the BEACH Act program. The WDNR contracts with the United



Figure 1. WDNR Staff Geo-locating beaches in 2002.

States Geological Survey (USGS) to oversee data management and the WI Beach Health Website: www.wibeaches.us.

Goals & Objectives

The purpose of this project in 2006 was to maintain a consistent statewide beach water-monitoring program to reduce beach visitor's risk of exposure to disease-causing microorganisms in water. Selected beaches along the Great Lakes were monitored in accordance with BEACH Act requirements with prompt notification to the public whenever bacterial levels exceed EPA's established standards (Appendix D).

Time Schedule

The activities described in this report took place during Federal Fiscal Year 2006 (October 1, 2005 - September 30, 2006). This period encompasses the 2006 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 colder water temperatures. Where weather and swimming history indicate this to be the case, initial sampling associated with this program was reduced or delayed to occur when swimming occurs. Counties, if north of Manitowoc County, had an opportunity to sample less in the month of June to save funds until the beach was used on a more frequent basis. This report describes activities before, during, and after the 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
University of Wisconsin - Milwaukee WATER Institute	
Wisconsin Department of Natural Resources	

Beach 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 Dept. of Biology and Microbiology	

Budget

- In September 2001 the WDNR was awarded a developmental grant for \$58,694. The 2002 grant was also targeted for program development in the amount of \$228,396. 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 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 May of 2006, 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 (Figure 2). As federal funds decrease, the program adjusts to maintain a consistent monitoring program to protect public health. Health departments often have to pay for costs of the Beach Monitoring Program that exceed their county allocation because funding for the program is insufficient. Other projects that occur simultaneously that complement the BEACH program are funded by outside sources.

In 2006, seventy-seven percent (\$173,770) of the \$225,270 was contracted out to local health departments to carry out the BEACH Act in WI in 2006 (Table 1). A total of 92% of the grant is used to contract out with other agencies (Figure 2).

Ashland, Bayfield, Iron Counties	\$30,000
Brown County	\$2,000
City of Milwaukee	\$19,345
City of South Milwaukee	\$4,550
Door County	\$50,000
Douglas County	\$8,400
Kenosha County	\$8,600
Kewaunee County	\$5,000
Manitowoc County	\$7,200
Ozaukee County	\$16,000
Racine County	\$5,875
Sheboygan County	\$12,000
Village of Northshore	\$2,000
Village of Shorewood	\$4,550

Table 1. Participant Contracts for 2006

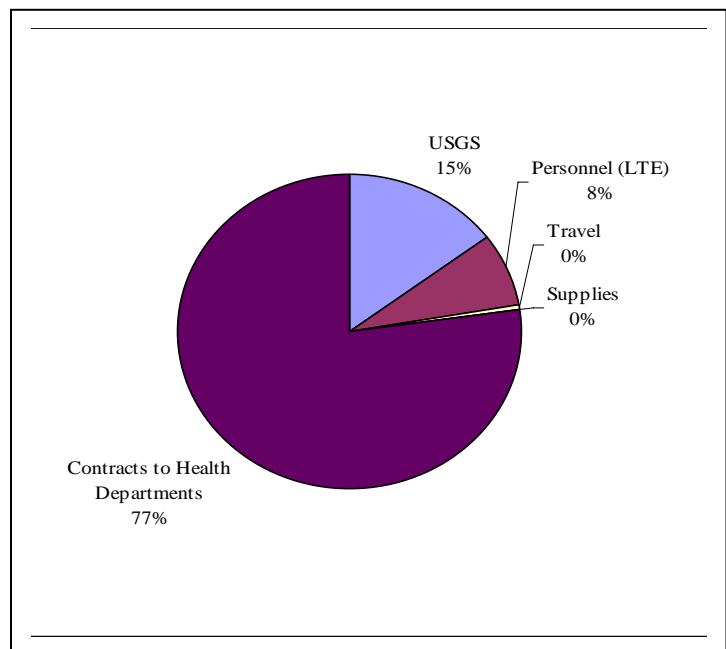


Figure 2. Grant Expenditures 2006

Work Completed in 2006

The 2006 beach season was the fourth year Wisconsin implemented the coastal beach-monitoring program. Work completed in 2006 includes:

- The WDNR hosted a conference call in March of 2006 to discuss the upcoming beach season with all local health departments and workgroup members that were interested in participating in the program for 2006.
- Allocations were evaluated and redistributed 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.
- The State contracted with 16 individual health departments in 13 counties to conduct the routine monitoring of 123 beaches along Lake Superior and Lake Michigan.
- In response to reductions in grant allocations to counties and cities, local health officials chose to sample less often than their 'priority' ranking within the first month of the beach season, under the condition that they had previous data to support that less people visited the beach early in the season (i.e. less swimmers due to cooler water temperatures in Lake Superior). This resulted in more funds reserved for later in the beach season, when increased sampling was needed.
- Unfortunately the statewide toll-free BEACH Hotline telephone service was disconnected when grant funding ended with the cooperating agency, UW-Extension. However, local health department phone numbers replaced the hotline number on all beach signs and were listed on our website, so individuals could call health officials to ask questions relating to beach health.
- Over 10,000 brochures were updated, printed, and sent out to local health departments and parks to inform visitors about beach water quality.



Figure 3. Kid Corps Volunteers in Milwaukee clean up beaches for National Clean Beaches Day July 5th, 2006. Picture courtesy of Keep Greater Milwaukee Beautiful.

Project Highlights and Deliverables

- Changes were made to the website (www.wibeaches.us). On-line input forms were created for updating once-a-year information about beaches, monitoring stations, and personnel. Data entry continues to be updated and designed to be more efficient for the local health departments. A .csv format was added for all reports for ease in downloading data from the website. An automatic e-mail service continued in 2006 for the public to subscribe to and get daily updates on beach conditions at beaches of their choosing.
- The WDNR in collaboration with the State Lab of Hygiene released a short “how-to” sample *E.coli* movie to the public. The video can be previewed at: <http://slhstream.slh.wisc.edu/mediasite/viewer/>

- The WDNR encouraged local communities and non-profit organizations to participate in National Clean Beaches Week 2006, sponsored by the Clean Beaches Council. Two events were held in Wisconsin: a boating event by recreational group, MIMXrecreation, in Sheboygan, and a beach clean-up in Milwaukee County on July 5th, sponsored by Keep Greater Milwaukee Beautiful. The WDNR developed a supportive website highlighting favorite swimming spots in Wisconsin, what-to-do to reduce your risks at the beach, and posted public events being held on Wisconsin beaches.
- The WDNR, Department of Health and Family Services, and the State Laboratory of Hygiene continued their statewide program of inland beach monitoring. Popular swimming beaches at 10 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 was modeled after the Great Lakes program.

Monitoring Results

A total of 123 monitoring sites were sampled in 2006. Approximately 3861 monitoring samples were collected and reported on the beach website in 2006. Out of these samples, 676 of them exceeded the water quality advisory limit of 235 CFU/100mL for *E.coli*. Figure 4 below shows the percentage of samples that exceeded the advisory limit per county. Two-hundred samples (5.2% of total) exceeded 1000 CFU/100mL resulting in beach closures.

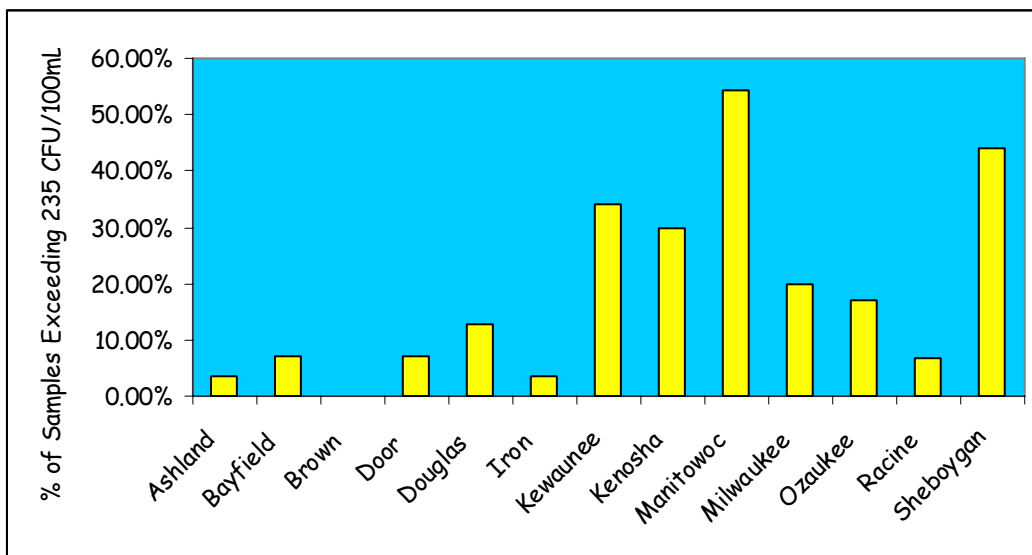


Figure 4. Percent of Samples per County that Exceeded 235 CFU/100 mL for *E.coli* in 2006
(This does not include pre-emptive advisories or advisories based on a geometric mean).

In comparison to the other years, 2006 overall was comparable to 2005, although variability exists between counties (some better in 2006, some worse than 2005). Some trends are beginning to develop among some beaches (chronic beach advisories and beach closures) in counties such as Kewaunee, Manitowoc, Sheboygan, and Kenosha due to high *E.coli* samples (Figure 5). All historical data (2003-2006) can be downloaded from the www.wibeaches.us website.

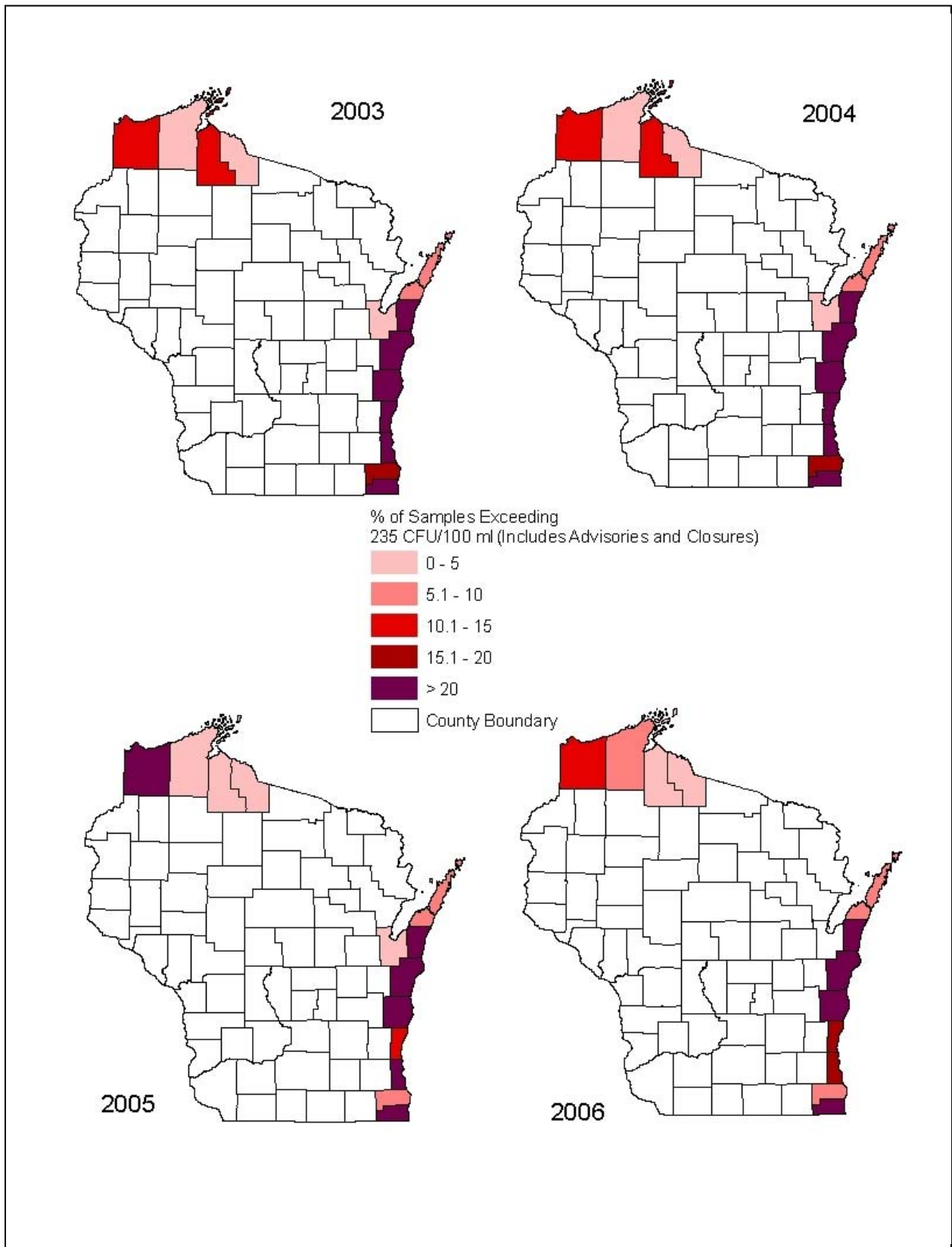


Figure 5. Comparison over the past 4 years of beach advisories: percent of beach samples over the advisory limit of 235 CFU/100ml for each county participating. The darkest colors are the counties with the greatest number of advisories.

Success Stories and Concurrent Research Projects

The Wisconsin Beach Monitoring and Notification Program has been successful in creating public awareness about the fecal contamination problems that face the Great Lakes. After four years of consistent monitoring data for nearly 123 monitoring sites, some beaches are showing trends of advisories and closures. The program has raised public awareness and many communities have begun to look at source tracking, identification and mitigation. Highlighted below are major research efforts that occurred in the 2006 on Wisconsin's coastal beaches.

Door County

Door County is one of the most popular summer tourist destinations in Wisconsin. Recreational water is an important resource to the economy of this county. In the summer of 2006, 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.

Several groups have been brought together to answer the question "where is the contamination coming from and is it safe to swim at *this* beach?" The Door County Soil and Water Conservation Department (interested in source tracking issues and remediation of contamination sources) joined forces with UW-Oshkosh to tackle this question. The following objectives for source tracking of microbial contamination in the county were established:

- Monitor *E. coli* concentrations at selected beaches after significant (0.2 inches or greater) rainfall; 1,2,3,4,8,12, and 24 hours after the rainfall. These data would help determine if storm water runoff contributed significantly to microbial contamination of beaches. In 2006, samples were diluted in order to detect actual (elevated) *E.coli* concentrations, rather than stating that the concentration was the maximum detectable by the assay.
- Monitor pathogen concentration (*Campylobacter*) at five selected beaches and serotype the organism in order to determine the sources of the isolates. In addition, isolate *Campylobacter* from human waste and from avian waste to use as a comparison to that isolated from water samples. *Campylobacter* was detected at most of the beaches investigated. The source of *Campylobacter* was similar to *Campylobacter* from waterfowl. In addition, the beach with closest proximity to the wastewater treatment plant (50% of influent samples from this plant contained *Campylobacter*) had the most *Campylobacter* isolates and greatest *Campylobacter* concentrations in water.
- Beach sand from several selected beaches was washed and *E.coli* was enumerated. This study showed *E.coli* can be found in greatest concentrations in the swash zone sand, but was substantial in sand higher on the beach as well.
- Isolate *E. coli* from beach water, sand and avian, bovine and human waste in Door County and conduct DNA fingerprinting of these isolates. These data would be used to further characterize the indicator organism used to monitor beach water quality and help to identify the source of contamination.
- Isolate *Bacteroides* from avian waste from Door County beaches to try to identify unique sequences in the bacterial DNA that are specific to waterfowl and will allow another mechanism of source tracking microbial contamination in water. Unique DNA sequences previously have been identified in *Bacteroides* from bovine and human feces.
- Monitor three inland lakes in Door County for microbial contamination in order to more fully protect public health.

Next, the Door County Soil and Water Conservation Department acquired funding to pay samplers and analysts to meet the objectives listed above. This brought Door County funding, as well as individual town funding to the project to help fund the research.

A triathlon was held in July 2006 at Murphy Park Beach in Door County. The organizers of the event paid UW-Oshkosh to collect additional samples for *E.coli* in beach water to best protect the health of individuals participating in the event.

Lastly, the Fish Creek Watershed Group and the Bayshore Property Owners (two groups of private citizens) collected water samples at private beaches and from outfalls located around these beaches. The monitoring efforts were funded by bringing in grant money or by utilizing Property Association dues. This helped to fund additional monitoring information and source identification efforts. The private citizen groups were able to bring samples to the Door County laboratory (no shipping involved) and obtain results in a timely fashion and for a reasonable fee.

Door County Outcomes from 2006 results:

- Otumba Park Beach (Sturgeon Bay) has a storm water outlet pipe that drains storm water directly onto the beach. The spatial water sampling conducted in 2005 revealed *E.coli* concentrations at the beach. Originally (2005), the City of Sturgeon Bay created a lined channel that diverted the pooled water off the beach into the water. They filled in a portion of the storm water pond/channel with jagged rocks to make the channel less inviting to beach goers. For the 2006 beach season, the outfall pipe was extended further out into the Sturgeon Bay Canal. It appears that poor water quality advisories and closures were less frequent in 2006 (than the last few years) due to this remediation effort.
- Sampling after significant rainfall events in 2004 resulted in detection of elevated *E.coli* concentrations in beach water at Otumba Park Beach and at Sunset Park Beach (both in Sturgeon Bay) for up to 8 hours following rain. Door County Health Department worked with the City of Sturgeon Bay and Door County Soil and Water Conservation to initiate pre-emptive beach closures (for 12 hours) at these 2 beaches after a significant rainfall event. In 2005, additional beaches were sampled after significant rainfall events (> 0.2 inches). A correlation between rainfall and elevated *E.coli* in beach water for up to 12 hours after the rain was noted for some of these beaches. In 2006, "Wet Weather" Advisories were given to the beaches tested in 2005, regardless of the data. We had many pre-emptive beach closures in 2006, but most could not be correlated with elevated *E.coli* concentrations in beach water.

The combined efforts between beach monitoring and microbial source tracking in Door County have resulted in another summer's worth of excellent data to be analyzed. In 2006, approximately 1000 *E.coli* isolates were collected from water and waste and the majority have been DNA fingerprinted. This information has been added to the database from previous years and researchers are beginning to see patterns in isolates. In addition, a large amount of spatial and rain data has been collected for the studied beaches in 2005 and 2006. In all cases *E.coli* concentrations were greater in storm water runoff and appear to have a negative impact on beach water quality for at least 8 hours after a significant rainfall event. Approximately ten scientific presentations and several published papers have resulted from these data. A full report of the findings will be presented to the Door County Board in January 2007.

Lake Superior Counties: Ashland, Bayfield, and Iron

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. The BEACH Act funding has been inadequate for a comprehensive monitoring program, so other funding sources have been sought. 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. The following objectives completed by this collaboration include:

- Investigation of high levels of *E.coli* with additional spatial sampling to assist in identifying the source of contamination. This included investigation of tributaries, outfalls, and other inputs to Lake Superior in proximity to the beaches. This included vertical and horizontal sampling at several beach locations.
- Recovery of *E.coli* isolates from a variety of sources so that a database could be constructed to help determine the source of *E.coli* recovered from beach water samples. Over 2,000 *E.coli* isolates have been recovered from sources such as dogs, cattle, sheep, deer, gulls, geese, human sources, and from the beaches (beach water) under study.
- Investigated the implications of sampling at different water depths; 12, 24, 36, and 48 inches.
- Utilized genetic fingerprinting techniques (rep PCR), antibiotic resistance patterns, and spatial sampling to determine the source of beach water *E.coli* isolates.
- Conducted watershed investigations at select locations to determine impacts on beach water quality.
- Working with local health officials to mitigate any source of *E.coli* and beach contamination so beaches can remain open and public health is protected.

In addition to the aforementioned objectives being met for 2006, many other successes have resulted from the BEACH program in Northern WI:

- A State of WI Certified Lab has been set up in an area that had no previous capability for beach testing. This lab also allows other local health departments and citizens to have samples collected and analyzed when they believe there is a problem with either a beach or another location in the area.
- Testing Lake Superior's public beaches have spurred counties to test their local inland beaches as well. Vilas and Oneida Counties in northern WI modeled their inland beach program after the Wisconsin Coastal Beach Program and sampled 16 beaches in the summer of 2005.
- Twenty-seven Lake Superior beaches now have baseline *E.coli* data and beach management decisions can be based on good scientific data.
- The use of genetic testing, antibiotic resistance patterns, and spatial sampling has identified several likely sources of *E.coli*.
- Having identified potential sources of contamination we can now start the process of source mitigation.
- There have been several public meetings at several locations in the Lake Superior region to bring all interested parties together to discuss water quality and beach 'health' issues.

The BEACH Act has brought a foundation to an economically disadvantaged area so that it can acquire high quality scientific data, protect public health at local beaches, help local officials acquire data to respond to questions from citizens regarding the beach water quality, and help mitigate any issues that may pose a risk to human health. While there have been some growing

pains as the program was initiated, overall, the program has been a tremendous success and is a great asset to Northern Wisconsin.

City of Racine and Kenosha County

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. Research conducted over the 2006 beach season in addition to BEACH Act funds included:

- Characterization of *E.coli* in beach sands relative to sediment size and hydrologic factors (Wisconsin Coastal Management Program (WCMP) Grant, partner with Dr. John Skalbeck, UW-Parkside).

This grant allowed Racine to do hydrogeological assessments of North Beach in Racine and at Eichelman and Pennoyer beaches in Kenosha County, to determine the relationship between *E.coli* density in beach sands as a function of grain size and uniformity. Results indicated that well-sorted, fine sand has the highest concentration of *E. coli* and this is most pronounced at the berm crest, an area prone of continual wetting. In conclusion fine sandy beaches, like those in Racine, may benefit most from beach sand manipulation tactics. Racine's changes to the beach slope, an increased berm crest, and removing swales at North Beach have resulted in improvements in recreational water quality as seen by the BEACH monitoring and notification program.

- Sampling of gull feces for the isolation of *Campylobacter* spp. (UW-Milwaukee WATER Institute, source of funding and partner, Dr. Sandra McLellan)

A previous grant from the National Institute of Health (NIH) was used to screen gull fecal samples using culture based methods in tandem with PCR methods to (1) determine the incidence of human pathogens in the gull populations and (2) validate pathogen detection by PCR, which will in turn allow for the gull populations in the Racine and Milwaukee area carry *Campylobacter* spp., a significant cause of human gastrointestinal illness worldwide. In 2006, over 100 gull fecal samples were screened for the presence of enteric pathogens. This research will ultimately help determine if *E.coli* from gulls carries the same health risk to humans as from other sources. This may allow Racine to discount the number of advisories in areas where sources have been adequately characterized.

- Evaluation of real-time, Quantitative PCR as a method to determine pollutant loading (WCMP Grant)

This project began in 2006 and will continue through June of 2007. The project will allow Racine to compare the DNA concentration present in treated wastewater effluent (as followed through the treatment train), bypasses, storm water, and surface run-off and to assess pollutant loading in real-time. Analyses will be conducted in conjunction with currently approved 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 one currently being validated for monitoring recreational waters.

In addition to Racine's continuing research, for the first time, Racine's North Beach had 5 or less advisories. This met the 2002 Great Lakes Strategy goal of being open 95% (or more) of the swimming

season. North Beach continues to be the only “Blue Wave” Certified beach by the Clean Beaches Council in Wisconsin!

Milwaukee County

In addition to the projects mentioned above, 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 the 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.

In 2006, the City of Milwaukee Health Department continued using predictive models for beach advisories and posting of advisories for a few of the beaches in the City of Milwaukee. The predictive model used for South Shore was consistent with monitoring information and cut back on costs for the city health department. In addition, the county continued a *Cladophora* cleanup along the shores of the City of Milwaukee beaches. *Cladophora*, a nuisance alga, has been linked to higher *E.coli* concentrations in the water. This clean-up helps reduce the smell and the overall aesthetics of the beaches.

Program Deficiencies

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

- After the fourth year of full implementation of the Beach Monitoring and Notification Program in WI, 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 implementing actions to control the source of contamination.
- *Complications regarding grant management.* The Wisconsin beach season begins a week prior to Memorial Day and continues through Labor Day in September. Although the season begins in May, the grant is not made available until June. In many cases monitoring and the purchase of supplies had to be delayed until the grant money was made available.
- *Insufficient Funding for Full Implementation.* For the second 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 \$226,260 and the amount needed for full implementation is approximately \$300,000.

To Be Completed for the 2007 Beach Season

- Conduct public meetings as needed in spring of 2007, to receive input from local citizens regarding the Wisconsin Beach Program. These meetings re-evaluate the program, looking for ways to make the program even more successful for years to come.
- Draft state standards for use of *E. coli* as pathogen indicator or other indicator as requested by EPA guidance.
- UW-researchers plan to investigate better predictive models (from NOAA) for Door County in 2007.
- Door County Soil and Water Conservation Department 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 9 communities) for the 2007 beach season. The firm will implement a number of changes to reduce storm water contamination of beach

water, depending on beach location. 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. This “naturalized storm water management plan” will be implemented beginning in spring 2007 and should prepare beaches for the 2007 swimming season. Monitoring efforts will continue at these beaches to assess the effects of these changes.

Appendix A
Public Beaches in Wisconsin and Subsequent Monitoring Priority
(High, medium, low priority and “-“ symbol means public beach not monitored)

Ashland County

Bayview Park	Medium
Kreher Park*	Medium
Maslowski* ³	Medium
Big Bay State Park*	Low
Big Bay Town Park*	Low
Casper Road	Low
LaPoint Memorial	Low

Bayfield County

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

Brown County

Bayshore	Low
Communiversity Park	Low
Longtail-North	Low
Longtail-South	Low
Bay Beach	-
Joliet Beach	-
Riverside Drive	-
Town of Scott Park	-
Van Lanen	-
Volks Landing Boat Launch	-

Door County

Baileys Harbor	High
Egg Harbor	High
Ellison Bay Town Park	High
Ephraim	High
Fish Creek	High
Murphy Park	High
Newport Bay	High
Nicolet Bay	High
Otumba Park	High
Sister Bay	High
Sunset-Sturgeon Bay ³	High
Whitefish Dunes-Inter Center	High
Anclam Park	Medium
Europe Bay Beach #1	Medium
Europe Bay Beach #2	Medium
Europe Bay Beach #3	Medium
Jackson Harbor Ridges	Medium
Lakeside Park	Medium
Percy Johnson	Medium
Portage Park	Medium
Sand Dune	Medium
Sandy Bay	Medium
School House	Medium
Sturgeon Bay Canal	Medium
Gislason Beach	Low
Haines Park	Low
Rock Island State Park	Low
Whitefish Bay Boat Launch	Low
Arrowhead Lane	-
Bittersweet Lane	-
Braunsdorf	-
Chippewa Drive	-
Clay Banks #1	-
Clay Banks #2	-
Cliff View Drive	-
County Road TT	-
Deer Path Lane	-
Garrett Bay Boat Launch	-
Goldenrod Lane	-
Hemlock Lane	-

Door County (continued)

Isle View Road	-
Kickapoo Drive	-
Lakeside Drive	-
Lily Bay Boat Launch	-
Pebble Road Beach	-
Potawatomi State Park #1	-
Potawatomi State Park #2	-
Sand Bay Beach #1	-
Sand Bay Beach #2	-
Sand Cove Beach	-
Sunset Beach Fish Creek	-
White Pine Lane	-
Whitefish Dunes Hwy WD*	-
Winnebago Drive	-

Douglas County

Barker's Island Inner ³	Medium
Wisconsin Point #1	Medium
Allouez Bay #3	Low
Amnicon River	Low
Brule River #1	Low
Brule River #2 ³	Low
Brule River #3 ³	Low
Middle River	Low
Wisconsin Point #2	Low
Wisconsin Point #3	Low
Wisconsin Point #4	Low
Wisconsin Point #5	Low
Allouez Bay #1	-
Allouez Bay #2	-
Barker's Island Outer	-
Connor's Point	-

Iron County

Oronto Bay #1	Low
Oronto Bay #2	Low
Oronto Bay #3	Low
Saxon Harbor East	Low
Saxon Harbor West	Low

Kenosha County

Eichelman ³	Medium
Simmons Island ³	Medium
Pennoyer ³	Low
Southport Park	Low

Alford	Low
Lakeshore	-
Marina (aka Melissa)	-
<u>Kewaunee County</u>	
Crescent ³	Medium
City of Kewaunee ³	Low
9 th Avenue Wayside	-
Lighthouse Vista	-
Red River Park	-

Manitowoc County

Memorial Drive North ³	Medium
Memorial Drive South ³	Medium
Neshota ³	Medium
Point Beach-Concessions ³	Medium
Point Beach-Lakeshore ³	Medium
Point Beach-Lighthouse ³	Medium
Red Arrow Park ³	Medium
YMCA ³	Medium
Fischer Park ³	Low
Hika Park* ³	Low
Lincoln High School	-
Maritime Drive Boat Launch	-
Memorial Middle	-
Silver Creek	-
Two Creek Boat Launch	-
University Beach	-
Warm Water Beach	-

Marinette County

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

Milwaukee County

Bradford-North ³	High
Bradford-South ³	High
South Shore ³	High
Atwater ³	Medium
Bender ³	Medium
Grant Beach ³	Medium
Klode Park	Medium
McKinley*	Medium
South Shore Rocky*	Medium
Tietjen/Doctor's Park ³	Medium
Watercraft Beach*	Medium
Bayview Park*	Low

Big Bay Park -

Sheridan Park -

Whitcomb Ave -

Wilson Lima (aka whites) -

Oconto County

Oconto City Park -

*Priority has changed in 2006 due to historical beach data or construction at that beach.

Ozaukee County

Cedar Beach³ High

County Road D B.Launch³ High

Harrington State Park-North³ High

Harrington State Park-South³ High

Upper Lake Park-North³ High

Upper Lake Park-South³ High

Lion's Den Gorge-North Low

Lion's Den Gorge-South Low

³Indicates Beach is listed on Wisconsin's 303(d) Impaired Waters List based on percentage of exceedances of 235 CFU/100 mL.

Sheboygan County (continued)

Jay Road Beach -

Pebble Beach Road -

Sandy Beach Road -

Silver Road -

Virmond County Park -

Vollrath Park -

Racine County

North Beach #1 High

North Beach #2 High

North Beach #3 High

North Beach #4 High

Zoo Beach #1 High

Zoo Beach #2 High

Zoo Beach #3 High

Michigan Blvd -

Myers Park -

Parkway -

Shoop Park -

Wind Point Lighthouse -

Sheboygan County

Blue Harbor Beach High

Kohler Andrae Nature Cntr³ High

Kohler Andrae North Beach³ High

Kohler Andrae North Picnic³ High

Kohler Andrae South Picnic³ High

Deland Park³ Medium

General King Park³ Medium

Amsterdam Beach Low

KK Road Beach Low

Van Ess Road Beach Low

3rd Street Beach -

Forest Road -

Lakeview Park -

APPENDIX B. Beach Miles

County Code	County	# of Beaches	Total Beach Dist Miles	Total Beach Dist Ft	Total Beach Dist Mt
2	Ashland	7	3.02	15969	4869
4	Bayfield	19	5.12	27021	8238
5	Brown	9	3.80	20069	6120
15	Door	53	6.41	33820	10311
16	Douglas	16	5.77	30454	9283
26	Iron	5	1.44	7624	2325
30	Kenosha	7	2.81	14863	4532
31	Kewaunee	5	1.33	7025	2143
36	Manitowoc	17	7.65	40385	12308
38	Marinette	6	1.76	9268	2825
41	Milwaukee	13	4.81	25393	7742
43	Oconto	1	0.04	217	66
46	Ozaukee	11	3.44	18171	5537
52	Racine	7	2.03	10739	3274
60	Sheboygan	16	4.89	25823	7873
State Total Beach Miles			54.32 Miles	272409 Feet	83024 Meters

APPENDIX C. 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

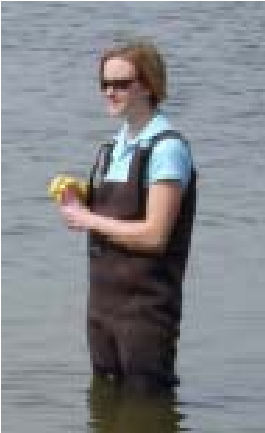
The following sampling protocol can also be viewed in a short movie at:

<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 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

APPENDIX D. Public Notification and Risk Communication Measures

A comprehensive communication plan was developed for the 2003 beach season by the aforementioned workgroup in 2002. The following methods have been implemented.

Beach Signs

EPA recommends the following criteria for *E. coli*:

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

Posting Beach Advisories

High Priority Beaches

High priority beaches shall to post advisory signs (See Figure D1) 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

Medium Priority beaches shall post beach advisory signs whenever the level of *E. coli* in the beach water sample exceeds 235 cfu/100 mL.

Figure D1. Yellow “Caution” Advisory Sign



Figure D1. Yellow “Caution Advisory” Sign

Low Priority Beaches

Monitoring at low priority beaches and the posting of signs will be determined on a case-by-case basis. Low priority beaches that are required to monitor weekly are shall post advisory signs whenever the level of *E. coli* in the beach water sample exceeds 235 cfu/100 mL.

Removing Advisory Signs

Beach advisory signs may be removed when the next daily sample is below 235 CFU/100mL.

Beach Closures

All beaches shall post closure signs (Figure D2) whenever the level of *E. coli* in the beach water sample exceeds 1000 cfu/100mL.

All beaches shall be closed under the following conditions:

- Whenever a human health hazard exists as determined by the local health department (i.e. reported illnesses).



Figure D2. Red “Stop Closed” Sign

- After a major pollution event where potential exists that indicator levels may be expected to exceed standard (sewage leak, spill)
- After a significant rainfall event that is determined to impact a beach area.

Re-opening Beaches

Beach closure signs may be removed when the sample results of two consecutive days of sampling are below the established standard.

Beach Open Signs

Signs indicating that beach water quality is good will remain posted at beaches as long as none of the conditions for posting advisory or closure signs exist (Figures D3).

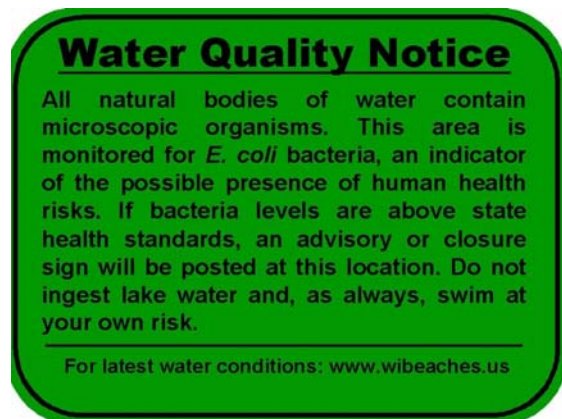


Figure D3. Water Quality Notice Sign



Figure D4. Sign Interpretations in Spanish and Hmong

Brochures

An informational brochure was developed by the 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 they can do as citizens to help keep the beaches clean.

Websites

The primary website (www.wibeaches.us) for Wisconsin Great Lakes beaches is administered by the US Geological Survey. The WDNR website (<http://dnr.wi.gov/org/water/wm/wqs/beaches/>) features a page about beach water quality, public health and the BEACH Act. Included in this website are up-to-date maps of where the public beaches are located in Wisconsin.

Phone Hotline

The DNR and the UW-Extension Beach Health Hotline through the InfoSource Hotline was discontinued in 2006. The funding source for the program was eliminated and could not be covered under the BEACH Act grant. However, concerned citizens are encouraged to speak with local health department officials. Local health department phone numbers were posted on all the signs at the beaches and available on the website.