NOAA Technical Memorandum GLERL-138

GREAT LAKES BEACH HEALTH RESEARCH NEEDS:

WORKSHOP SUMMARY

Great Lakes Beach Association in cooperation with
NOAA, Great Lakes Environmental Research Laboratory and the
 Michigan Sea Grant Program
U.S. Environmental Protection Agency
U.S. Geological Survey

Great Lakes Environmental Research Laboratory
Ann Arbor, Michigan

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INTRODUCTION

The Great Lakes coastline is the largest in the continental United States, containing hundreds of beaches and providing recreational opportunities for millions of visitors, thus making it a vital part of the Midwest economy. Too often the health of these beaches is compromised by water quality degradation particularly from the introduction of sewage and accompanying pathogens. These events, whether chronic or episodic, not only reduce the quality of recreation but threaten human health. Public officials responsible for protecting natural resources and visitor health seek ways to remediate these problems and to communicate any health threats in a timely manner. Increasingly sophisticated scientific information is required to provide solutions to these problems not only for the Great Lakes but along coastlines worldwide.

Beach managers throughout the Great Lakes basin requested a dialogue with scientists to begin to address these problems and create opportunities for improvement. In response, the U.S. Geological Survey (USGS), the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Environmental Protection Agency (USEPA) co-sponsored a Beach Health Research Workshop in the fall of 2005. The purpose of the workshop was to listen to the needs and concerns of beach managers and other stakeholders and to define research priorities and strategies for addressing recreational water quality issues in the Great Lakes. This report describes the results of the workshop, actions currently being taken to address the needs identified by stakeholders, and strategies to help guide future research.

METHODS

The workshop was held on November 4, 2005 in Green Bay, WI, in conjunction with the State of Lake Michigan and Great Lakes Beach Association Conference. The Overarching Workshop Question was: **How can EPA, NOAA, and USGS research programs help state and local agencies meet their recreational water quality goals, related specifically to beach closures?** Participants had the option of selecting one of the following breakout groups: "Forecasting," "Monitoring and Assessment," and "Managing Public Health Issues." Each group was facilitated and included at least one scientist with relevant expertise. The groups were asked to answer the following six questions within the context of their theme:

1. What are your data, information, and research needs relative to improving your ability to reduce the risks to human health in recreational uses of beaches?
2. If we could develop tools to forecast water quality on beaches:
    a. What are the preferred time scales?
    b. What are the preferred space scales?
3. Is there a need for training?
4. How can we improve our communication with beach managers?
5. Are there emerging issues we should begin addressing?

Break out group discussions lasted approximately two hours. The groups then reconvened and briefly presented their findings to the entire audience. The floor was then opened for group discussion, followed by a ranking exercise to allow participants to prioritize what they deemed to be the three top beach health research needs (see Appendix A for detailed breakout group responses to these questions).

RESULTS

The workshop provided participants with an opportunity to inform federal agencies of their research needs as well as the information, data, and tools they need to more effectively manage recreational water quality and beach health issues. The highest priorities identified among the three breakout groups in response to the workshop questions are listed below, (see Appendix B for a more detailed list of priorities), followed by the actions being taken to respond to the identified research needs. A table of these actions can be found in Appendix C.

Question 1: What are your data, information, and research needs relative to improve your ability to reduce risks to human health in recreational uses of beaches?

Question 2: If we could develop tools:
a. What are the preferred time scales?
b. What are the preferred space scales?

Research Need:
Rapid test methods, predictive models, and real-time data for prediction of beach closures.

Currently, the most cost-effective methods for counting fecal indicator bacteria take 18-24 hours. During this period, indicator concentrations may change dramatically, and beach managers end up using the previous day's results to evaluate current beach conditions. Rapid test methods are needed to more accurately reflect the current indicator levels. In addition, there is a great need for real-time data on wind, precipitation, water temperature, and wave height at multiple spatial scales for the development of models to predict beach closures and to determine the disease potential of swimming waters. Real-time data will enable beach managers to more accurately predict beach conditions and potential beach closures.

Actions being taken to address Research Need:

- Rapid test methods for measuring beach water quality are currently being evaluated through the USEPA/CDC National Epidemiological Environmental Assessment of Recreational (NEEAR) Waters Study.

- USGS is conducting Rapid Test Using QPCR during beach monitoring program to provide nowcasting beach data.

- NOAA and USGS are developing forecasting models that predict beach closures.

- Soil and runoff input of fecal bacteria are being characterized in coastal streams and waterways by USGS.

- Increased accessibility to water temperature data is being provided by NOAA. The BeachCast website provides Great Lakes beach goers with access to information on beach conditions, including health advisories, water temperature, wave heights, and monitoring data.

- USEPA has developed GIS maps of Great Lakes tributaries, has the most up-to-date hydrological GIS data from USGS, and has generated maps for many of the Great Lakes tributaries for a variety of purposes within USEPA. This mapping can be done to support the GLBA upon request.

- USEPA has all of the storm water outfall locations that the States have entered into the Permit Compliance System (PCS) national database. A subset of these data, CSO, has been previously mapped for the Great Lakes watershed. However, because the PCS database is regularly updated by the states, it would be prudent to conduct a new mapping effort using the most updated outfall locations should the need arise.

Research Need:
Source tracking and nonpoint source contamination.

Beach managers need reliable methods to determine the origins of nonpoint-source contaminants in order to reduce those sources and maintain a healthy beach. Sources of fecal contamination in recreational waters are often unknown and/or of nonpoint origins. Identifying and reducing the sources of fecal contamination to a particular beach is often hindered by the presence of multiple and diffuse sources, natural variability in bacterial indicator concentrations over space and time, and the dynamic currents, weather patterns, and natural processes that affect these concentrations.

Action being taken to address Research Need:

- Source and fate studies are being conducted by USGS, EPA, and NOAA via the Center of Excellence for Great Lakes and Human Health research team at Michigan State University to identify non-fecal, non-point indicator bacteria sources. Background levels of indicator bacteria and non-fecal sources are being identified.

Research Need:
Epidemiology and pathogens.

Recreational waters are seldom monitored for pathogens. Fecal indicator bacteria, however, do not have the same transport and survival properties as all pathogens, especially protozoan and viral pathogens. Beach managers desire data on the types of pathogens present, their relation to indicator concentrations, and options for other indicators that may be better correlated with pathogens and potential bather illness at their beaches. In particular, links between pathogens and indicators and their contribution to disease need to be identified. Development of methods that discriminate between human and animal nonpoint-source fecal contamination are also needed to help identify risks associated with contaminated recreational waters.

Action being taken to address Research Need:

- Studies of new pathogen indicators are being conducted through the NEEAR Waters Study as required by the BEACH Act. Based on the results of the NEEAR Waters Study, EPA will develop new ambient water quality criteria for coastal and Great Lakes waters. These criteria will take advantage of the new rapid indicator methodology and advanced state of the science of health implications from recreational waters.

Question 3: Is there a need for training?

Research Need:
Training and standardized survey design and test methods.

Training is high on the list of needs for workshop participants. Beach managers want standardized survey designs and sampling methods, as well as training on how to develop and run predictive models, operate databases, calibrate and maintain instruments, and collect and manage data. Local training sessions, on-line training or videos would reach a larger number of beach managers.

Action being taken to address Research Need:

- A BEACH 101 class will be held annually at the GLBA workshops. The class will provide information about resources and the various beach management tools that are available.

- USEPA is taking the lead on development of a standardized sanitary survey for use by all Great Lakes beach managers for identification of contamination sources impacting beaches. While this action will ideally lead to the implementation of remediation measures to reduce beach closures, the key is to provide the information to the public so beachgoers can make educated decisions about when and where to swim. This action also addresses the Great Lakes Regional Collaboration Coastal Health Strategy Team recommendation for a standardized sanitary survey.

- USGS and USEPA are developing a training video on the use of predictive models of high bacteria levels to better inform the public of the status of beach water quality. The video will cover several different types of predictive models and will train beach management personnel on how to collect predictive modeling data.

- A video is being developed by the Wisconsin Department of Natural Resources to train individuals on how to conduct water quality sampling at beaches. The video will be posted on the University of Wisconsin's website.

Question 4: How can we improve our communication with beach managers?

Research Need:
Better communication, data management, coordination, and sharing among agencies.

Communication among local, state, and federal agencies is critical, especially among local beach managers and federal scientists/researchers. Development of a beach health website to help meet these communication needs would be very useful. Data should be updated more frequently and should be standardized among agencies. Much of the important data on water temperature and weather conditions is available at the federal level and needs to be more easily accessible at state and local levels and updated frequently. Information is also needed on storm water outfalls that pose risks to humans as well as readily accessible information on combined sewer overflow events. The development of a multi-agency regional data network was discussed as a potential solution to these problems. Informing the public and the media on beach health issues was also identified as a need. It is important that beach goers understand why a beach is closed, what the advisories mean, how their health might be affected, and what they can do to help protect beach water quality.

Action being taken to address Research Need:

- Beach management workshops are held annually by the GLBA at various locations around the Great Lakes. The 6th annual GLBA workshop will be held in Niagara Falls, New York, October 10-13, 2006, in conjunction with the National Beach Conference. USEPA holds a national beach conference every 2 – 3 years.

- Several Great Lakes states hold beach management workshops and promote conferences and newsletters via GLBA list-serve and USEPA's BEACH Watch web site.

- The BEACHNET, currently maintained by the Great Lakes commission, includes an email discussion list that seeks to facilitate communication among individuals interested in the improvement of recreational beach water quality in the Great Lakes basin.

- USEPA's quarterly *Beach Currents Newsletter* is posted on USEPA's BEACH Watch website. List serves can lead to improved communication with beach management.

- NOAA's Center of Excellence for Great Lakes and Human Health as well as several states have developed beach health outreach products with advice for beach goers on how to help keep beach water clean to reduce the risk of contracting illness at the beach.

Question 5: Are there emerging issues we should begin addressing?

Discussion of emerging issues included studying diseases in animals and how they intersect with water to create new pathways of exposure to humans, looking at emerging nuisances such as avian influenza and pandemic flu, and identifying emerging drivers of public health issues. It was also suggested that we think about how to best gather health data so people can register their information if they think they've been affected by water borne disease. Preparing for the potential transition from *E. coli* to enterococci as indicator bacteria was also discussed.

Our intention is to begin addressing and prioritizing emerging issues during future steering committee meetings.

NEXT STEPS

1. Provide an update of accomplishments and strategy for moving forward at the joint National Beach Conference/Great Lakes Beach Association Conference that will be held in Niagara Falls, New York, October 11-13, 2006.

2. Form a steering committee that includes federal, state, and local agencies and public health officials to develop a framework for implementation of research strategies at both a Great Lakes (regional) and national scale. A consensus-based approach will be used to design a research strategy and implement scientific studies to address the high-priority beach research issues that were identified at the workshop.

3. Schedule a short meeting with the steering committee during the National Beach Conference to discuss direction and next steps.

Breakout Group Results

Section A: FORECASTING

(1) Data, Information and Research Needs for Improving Ability to Reduce Risks to Human Health in Recreational Uses of Beaches.

Equipment
- Need for equipment at local/county level to measure wave height, turbidity, temperature and wind.

Data
- Need real time local data on wave height.
- Need real time local rainfall data taken closer to beach areas.
- Rapid method indicator as a part of the model available.
- Increase resolution of spectrometry data; what we have now is not detailed enough.
- Need detailed uniform, consistent wind data. Better data management coordination between agencies.
- Increase accessibility to water temperature data; it is very difficult to locate this data on current website.
- Update data more frequently; this is especially true for precipitation data.
- Develop regional data network. Need a regional understanding of the scale/resolution of data needed - discussion among states for equipment needs.

Maps
- Develop GIS maps for all the tributaries to build better research models.
- Longitude/ Latitude information for tributaries is important.
- Need upstream information.
- Information must be available on a website.

Storm Water
- Storm water upstream data needed.
- Need information regarding outfalls.
- Identify which storm water outfalls pose risks to humans.
- Provide access to sewer maps and storm water maps. Need more coordination between agencies in the distribution of this information.
- Post information regarding combined sewer overflow (CSO) events online so that it is more accessible.
- Need more information about tiled fields. Currently there is a shortage of data on what can be carried from tiled field to the lake.

Pathogens
- Develop land use pathogen leaks - agriculture, CSOs, leaky sewers.
- *E-coli* modeling - need to be able to differentiate between harmful pathogens and benign ones.

- Need better indicators for fecal contaminants - which pathogens are doing what?
- Higher resolution for pathogen data.
- Need a study/model that leads forecasting to illness - models to predict pathogens and illness.
- Capture information regarding illnesses in the community.
- Need tools and funding to better identify sources of high indicator levels.
- Need scientific models to track the sources.
- Develop better set of tools for tracers in the natural environment - we have tracers in smaller venues and in the lab, but now moving those tracers to the field to link the whole issue of transport.
- Currently, need is related to managing sources – not focused on identifying best management practices applied to reducing harmful pathogens - i.e. suspended solids - need more monitoring of this sort.

(2) Time and Space Scales for Better Research and Monitoring

Space Scales
- Look beyond geo-political boundaries. Need a system that maps beaches based on their physical and biological boundaries.
- Consider multiple space scales – watershed, shoreline, beach
- Incorporate individual beach factors into spatial models as beaches differ greatly not only in their physical properties, but also by the manner in which they are groomed.
- Include sewer systems in spatial models.
- Need consistent wind, wave and precipitation data from all federal agencies.
- Use graphics for spatial models to help city planners understand beach closure events relative to sewer systems.

Time Scales
- Need finer time resolution for hourly models coupled with an extensive public education campaign to explain significance of fluctuating beach closures.
- Train beach managers to help communicate hourly sampling procedures and significance to public so as not to lose their confidence.
- Develop a forecasting system that assesses a probability as to whether or not a beach closure will occur the next day. Probability attached to future events.
- Need hourly data for open lake systems.
- Investigate the dynamics of morning/afternoon sampling.
- Develop sampling criteria that differ based on 48 hour forecast information. Higher probability of beach closure would require more thorough sampling; and vice versa for lower probabilities.

(3) Training

Government
- Train city employees using continuing education credits as a means to encourage them.
- Decision making organizations need to understand implications of their actions on the ground. Training for higher up people in the government, like regional directors, about issues of beach closures.

- Educate public and government about the issues using local town meetings as a forum to bring them up.

Public Training
- Educate the public by developing strong outreach products.
- Create awareness on how to be responsible beach goers.
- Use Sea Grant Extension agents to aid public in understanding beach closure issues.

Communication Networks
- Establish two way communication network between local beach managers and federal scientists/researchers.
- Establish network for beach managers to continue discussion on emerging technologies, new training devices, etc.
- Develop better web tools to maintain open communication lines in the region.

(4) Improving Communication with Beach Management

- Develop stronger federal outreach partnerships and presence in the New York region (Erie and Ontario).

(5) Emerging Issues

- Adaptive system to predict impact of catastrophic release.
- Harmful algal bloom predictions.
- Impacts of exotics on human health.
- Identify emerging drivers of public health issues. Think about how to deal with gathering health data so people can register their information if they think they've been affected by water borne disease.
- Increase research in genetics and in information regarding mutations.
  Genetic change in *E. coli*.

Section B: MONITORING AND ASSESSMENT

(1) Data, Information and Research Needs for Improving Ability to Reduce Risks to Human Health in Recreational Uses of Beaches.

Data
- Develop rapid test methods and obtain real time data for determining disease potential of swimming waters.
- Develop a multi-agency database so critical data is accessible at state and local level.
- Need to relate wastewater discharge limits to ambient water criteria.
- Need scientific data to address requests for dilutions by dischargers.

Pathogens and Indicators Information
- Identify links between pathogens and indicators and determine their contribution to disease.

- Need short tests that will provide timely results
- Assess recreational waters to determine what we need to look at beyond indicators.
- Identify sources of disease, indicators, or other contaminants (e.g. beach sand, chemicals, etc.).
  - Sanitary surveys.
  - Simple systems for monitoring environmental data (e.g. rain events).
  - Determine contribution of source to disease and health risk
  - Differentiate between human and non-human sources.
  - Emphasis on how to control pollution source.
- Develop new forecasting model by linking current EPA epidemiological study to environmental variables (e.g. wind, turbidity, wave height, rainfall, etc.); link forecasting models with human health disease risk.

Research and Training
- Expand Great Lakes research to include inland lakes and non-coastal (river) beaches.
  - Broaden EPA directives to include non-coastal beaches (not just Great Lakes).

- Extend spatial coverage of research.
  - Determine how to relate studies on one lake to other lakes or other parts of the same lake or beach.
- Develop and standardize training tools at local levels.
  - Develop a sanitary survey training tool box.

(2) Time and Space Scales for Better Research and Monitoring

Time Scales
- Need real time data, especially peak swimming time.
- Develop a dynamic system that can be updated throughout the day as conditions change.
- Inform the public via radio, TV, and internet; survey indicated that the public wants to know the day before if beaches will be closed.
- We have now-casting but need to be able to forecast closures.
  - What are the forcing factors and can we predict what the indicators and pathogens would be?
  - Need better instrumentation to measure forcing factors (e.g. buoy systems, turbidity measurements) and standard protocols.

Space Scales
- Determine whether models can be applied to all beaches.
- Different issues on different lakes.
- Can models be applied at large spatial scales? Local conditions can be very different.

Other
- Important to understand the data we have and to link these data back to epidemiology if possible and then build the tools.

Training Beach Management
- Provide managers with a good working knowledge of available data, options, and implications.
- Researchers should train managers and public health officials to:
  - Run models and operate databases.
  - Calibrate and maintain instruments.
  - Collect and manage data.
- A website may be useful for this training.

Public Training
- Public outreach and education should also be addressed.

(4) Improving Communication with Beach Management

Communication Strategies
- Provide information in a form that is understandable to managers, administrators and decision makers.
- Use list serves and blogs.

Conferences and Workshops
- Hold one regional conference/listening session per year after beach season.
- Include wastewater operators and associations in next conference and consider them in our decisions; this should happen at higher management level.
- Request the Wastewater Industry to help fund a joint workshop; wastewater organization has a chapter in each of 8 Great Lakes states.
- Write a proposal to fund a workshop that would include beach managers, public health officials, and the Wastewater Industry.
- Hold conferences at the local level as often as necessary (generally more than once per year).

(5) Emerging Issues

Legacy Act Data (States)
- Gather, assemble, and analyze data (some of the data goes back many years, e.g. Milwaukee, some less).

Address Changing Standards for Indicators.
- When should they begin looking at the transition from Enterococci as the indicator instead of *E. coli*?
- What are we doing now to move in this direction?
- The change to Enterococci as the indicator is imminent.

(1) Data, Information and Research Needs for Improving Ability to Reduce Risks to Human Health in Recreational Uses of Beaches.

Sanitary Surveys
- Need to obtain good sanitary survey data to find out what the contamination sources are at beaches and use that knowledge to reduce beach closures/advisories.
- Need a standardized survey tool that's flexible and takes a holistic watershed approach.
- Need sanitary survey guidelines/forms for consistent assessment which would enable us to conduct trend analyses.

Heath Information
- Determine health significance from the contamination sources.
- Conduct disease surveillance in communities to recognize illness occurrence.

(2) Time and Space Scales for Effective Communication

Public Outreach
- Develop a plan to communicate risks to the public.
- Explain *why* beaches are closed.
- Determine how to communicate the problem (due to wastewater, gulls, etc.).
- Need cooperation at the local level.

Time-relevant data
- Provide the public with beach water quality information quickly (e.g., via t.v. or radio weather forecaster).
- Provide information in a format the public can understand.
    - Conduct a communication survey to assess what would be the best vehicle to use to provide information to the public in a timely manner.
- Identify appropriate partners to put this mechanism together.
- Find out where people get their information.
- Provide beach closure information for the preceding swimming season at the end of the season so beach managers can look at the data prior to the upcoming swimming season.

Collaborations and Consistency
- Develop a press package to ensure delivery of consistent messages.
    - Present information to the press in a simple way so that it can be understood by the public.
- Collaborate with local bureaus of tourism to make information specific to beach users.
- Work with all parties involved (wastewater treatment plant operators, public health officials, researchers, etc.) to deliver consistent messages.
- Encourage collaboration among different groups that are involved in beach management and public health.
- Ensure that we consider the uniqueness of communities (different cultures) and build in standardized flexibility.

(3) Training

Training Beach Management
- Identify what a beach manager needs to know about what's impacting the water in order to make decisions on properly managing a beach.
- Develop a list of beach management information sources.
- Create a box of tools that includes the standard elements one needs to develop a standardized beach management program. Include sampling protocol and other important beach management information, including an Information Technology atlas.
- Develop a plan for maintaining corporate memory for beach program and monitoring information in case of personnel turnover.
- Create a flip chart with bullet points listing critical information, references, and where to find additional information (consider that beach managers come from varied backgrounds, and that some deal with water quality issues while others may deal with the physical aspects of beach maintenance).
- Offer a continuing education credits program for beach managers.
- Conduct more training on emerging technologies and on best management practices.
- Develop a video that everyone can use on sampling techniques and on collection of predictive modeling data.
- Develop a list of Best Management Practices.

(4) Improving Communication with Beach Management

Public Outreach
- Ensure that everyone responsible for beaches hears the message (there are other groups of people we are not reaching out to that we may need to include).

Communication Strategies
- Continue to hold workshops and meetings to disseminate information.
  - Keep track of and promote conferences and newsletters.
- Provide information to beach managers and public health officials on the "plate" that they normally receive or look to for information. For example, a beach manager may pay attention to emails they receive from a particular entity or organization, but may not pay attention to information sent by EPA.

(5) Emerging Issues

- Need to conduct more research on:
  - Non-human, non-point sources of contamination (e.g., birds vs. human – what is more dangerous?)
  - Pathogen criteria
  - Cyanobacteria
  - Effects of climate change
  - Watershed factors that make beaches different
  - Interactions of groundwater and surface water
- Consider emerging nuisances such as avian influenza and pandemic flu

- Look at diseases in animals and how they intersect with water to create new pathways of exposure to humans
- Consider pop dynamics and demographic changes
- Focus on children's health issues
- Determine how much research is enough (new pathogen indicators will replace the current ones, faster testing methods are being evaluated, etc.)

Priorities

Information Sharing

1. Communication between local, state, and federal agencies.
   a) Networking at workshops.
   b) Collaborative strategies.
   c) Developing communication pathways; both bottom up and top-down.
   d) Sharing information with marine beaches and with inland lake institutions.
   e) Shared research agendas communicated.
   f) Stronger federal outreach presence in New York.

2. Multi-disciplinary/ Multi Agency Communication.
   a) Collaborative strategies.
   b) Connecting epidemiology studies and environmental data between agencies/groups.

3. Local level communication.
   a) Communicate with waste water professional groups; especially for storm water events.
   b) Educate city waste waster issues to parents and grand parent s(multi-level education).
   c) Collaboration between public health and environmental community.

Training

1. Hands-On
   a) Training packets, videos.
   b) Health surveillance (swimmer illness outcome based matrix model for program).
   c) Training for beach mgrs on how to use models.
   d) How to guides for sampling and managing beaches.
   e) Sampling training.
   f) Info on emerging technology.
   g) Conferences, workshops for beach managers (multi-disciplinary).
   h) Training for new beach managers (welcome packets).
   i) Sanitary Survey.
   j) Train managers how to use databases.
   k) Best Management Practice training.
   l) Including beach health information in the continuing education curriculum that city employees have access to.

2. Policy/Regulation Training
   a) Teach local and state government officials about issues effecting beach closures.
   b) Conduct beach health assessments.
   c) Bring up beach health issues at local town meetings.

3. Public Outreach
    a) Info & training on health/swim issues (for local government & beach mgrs.).
    b) Media training about advisories.
    c) General public education on storm water & why to support non-point source management legislation.
    d) General public outreach material to teach people how to be responsible beach goers.
    e) Use sea grant extension agents to communicate with public.
    f) "What Can You Do?" guide for public on preventing water pollution.
    g) Public education campaign to understand significance of closings; need to create public confidence.

Tools

1. Monitoring
    a) Improvement in rapid test methodologies.
    b) Pre-emptive research.
    c) Surveillance for disease in community.
    d) Programs that are focused on elimination of beach contamination sources.
    e) Improving source tracking methods- especially those sources that effect human health.
    f) Improve indicator monitoring.
    g) Link pathogen and indicators.
    h) Identify which storm water outfalls pose risk to human health.
    i) Monitor at a multi scale.
    j) Hourly data collection.

2. Input
    a) Higher resolution data.
    b) Easier data accessibility; perhaps a regularly updated website.
    c) Standardized data between agencies; especially for precipitation, wind and wave height information.
    d) Data that is time relevant for local, state and federal needs; more real-time data.
    e) Wind and precipitation data needs to be collected closer to beaches.
    f) pre-emptive research/sampling.
    g) Collection of data related to illness in the community.
    h) Multi-beach data collection; not limited by geo-political boundaries. Beach boundaries established using biological and physical differences; not political.
    i) Need data related to tiled fields.
    j) Need access to sewer maps and storm water maps.
    k) CSO events need to be posted online.

3. Output
    a) Improvement in predictive modeling.
    b) Improvement in probabilistic modeling.
    c) Time relevant data management.
    d) Development of web portal to access data.
    e) Pathogen and illness modeling links.

f) Multi-scale, multi parameter modeling.
g) Visual modeling; using graphics instead of just formulas especially to show city planners/engineering's how their decisions effect beach health.
h) GIS maps of all tributaries; upstream information needed.

Epidemiology Study
a) Determine relationship between beach closures and health problems.
b) Non-human health risks to swimmers.
c) Identify harmful pathogens and differentiate between benign ones.
d) Link pathogen and disease prevalence; which pathogens cause what disease.
e) Linking pathogens to modeling and other monitoring tools.
f) Identify impacts to public health.

APPENDIX C.

Actions Addressing Research Needs

Need Identified at Workshop	Actions Being Taken to Address Research Needs	Lead Agency/ Org
Conduct basic training for beach managers.	A BEACH 101 class will be held annually at the GLBA workshops. The class will provide information about resources and the various beach management tools that are available.	GLBA
Develop a video that everyone can use on sampling techniques.	A video is being developed by the Wisconsin Department of Natural Resources (WDNR) to train individuals on how to conduct water quality sampling at beaches. The video will be posted on the University of Wisconsin's website.	WDNR
Develop a standardized sanitary survey tool to identify contamination sources at beaches.	In connection with the Great Lakes Regional Collaboration's Coastal Health Strategy, a standardized sanitary survey is currently being developed for use by all Great Lakes beach managers for identification of contamination sources impacting beaches. While this action will ideally ultimately lead to the implementation of remediation measures to reduce beach closures, the key is to provide the information to the public so beachgoers may make educated decisions about when and where to swim.	USEPA
Hold annual beach conferences.	Beach management workshops are held annually by the GLBA at various locations around the Great Lakes. The 6th annual GLBA workshop will be held in Niagara Falls, New York, October 2-4, 2006, in conjunction with the National Beach Conference. USEPA holds a national beach conference every 2 – 3 years.	GLBA/ States/ USEPA
Hold conferences at the local level.	Several Great Lakes states hold beach management workshops.	States
Develop a video that everyone can use on collection of predictive modeling data.	A video is being developed on the use of models to predict high bacteria levels to better inform the public of the status of beach water quality. The video will cover several different types of predictive models and will train beach management personnel how to collect predictive modeling data.	States/ USEPA/ USGS
Promote conferences and newsletters.	USEPA's BEACH Watch web site and the GLBA list-serve actively promote beach conferences and workshops. USEPA's quarterly Beach Currents Newsletter is posted on USEPA's BEACH Watch website.	GLBA/ USEPA/NOAA

Develop GIS maps of Great Lakes tributaries.	USEPA Region 5 has the most up-to-date hydrological GIS data from USGS, and has generated maps for many of the Great Lakes tributaries for a variety of purposes within USEPA. This mapping can be done to support the GLBA upon request.	USEPA
· Use list serves to improve communication with beach management. · Establish network for beach managers to continue discussion on emerging technologies, new training devices, etc.	BEACHNET is an email discussion list that seeks to facilitate communication among individuals interested in the improvement of recreational beach water quality in the Great Lakes basin. Expand BEACHNET nationally	GLBA/ GLIN/ USGS/NOAA
Identify location of storm water outfalls.	USEPA Region 5 has all of the storm water outfall locations that the States have entered into the Permit Compliance System (PCS) national database. A subset of these data, CSO, has been previously mapped for the Great Lakes watershed. However, because the PCS database is regularly updated by the states, it would be prudent to conduct a new mapping effort using the most updated outfall locations should the need arise.	USEPA
CSO events need to be posted online.	IDEM is developing a plan for CSO events to be reported to IDEM's NW IN office and then automatically reported to Earth 911 for immediate posting online.	IDEM
Develop rapid test methods.	Rapid test methods for measuring beach water quality are currently being evaluated through the USEPA/CDC National Epidemiological Environmental Assessment of Recreational (NEEAR) Waters Study.	USEPA CDC
Need better indicators for fecal contaminants.	Studies of new pathogen indicators are being conducted through the NEEAR Waters Study as required by the BEACH Act. Based on the results of the NEEAR Waters Study, EPA will develop new ambient water quality criteria for coastal and Great Lakes waters. These criteria will take advantage of the new rapid indicator methodology and advanced state of the science of health implications from recreational waters.	USEPA
Create awareness on how to be responsible beachgoers.	Several states have developed beach health outreach products with advice for beach goers on how to help keep beach water clean to reduce the risk of contracting illness at the beach.	States/NOAA
Validate Rapid Test	Conduct Rapid Test Using QPCR during beach monitoring program	USGS

Develop Predictive Models	Develop models that predict beach closures within the southern Lake Michigan area and Lake St. Clair	USGS/ NOAA
Identify non-fecal, non-point indicator bacteria sources	Background levels of indicator bacteria and non-fecal sources or identified. Source and fate studies are conducted.	USGS/EPA and NOAA/ MSU
Characterize fluvial inputs	Soil and runoff input of fecal bacteria are characterized in coastal streams and waterways	USGS
Increase accessibility to water temperature data	The BeachCast website provides Great Lakes beach goers with access to information on beach conditions, including health advisories, water temperature, wave heights, monitoring data, etc.	Great Lakes Commission/ GLIN

APPENDIX D.

List of Participants

State

Name	Affiliation	Break Out Group
Alex DaSilva	Indiana Department of Environmental Management	Forecasting
Eric Weigert	NY Department of Health	Monitoring/Assessment
Geeta Rijal	Metropolitan Water Reclamation District of Greater Chicago	Monitoring/Assessment
Irena Draksic	Massachusetts Department of Public Health	Forecasting
Joe Keithley	Indiana Department of Environmental Management	Managing Public Health
Kate Bushren	NY State Parks	Forecasting
Kelly O'Connor	WI Department of Natural Resources	Managing Public Health
Kristen Strasser	NY State Parks	Monitoring/Assessment
Kristi Sorsa	Madison Department of Public Health	Monitoring/Assessment
Nicole Richmond	WI Department of Natural Resources	Monitoring/Assessment
Ronda Volz	WI Department of Natural Resources	Forecasting
Sara Summer	New Hampshire Department of Environmental Services	Managing Public Health
Shannon Briggs	Michigan Department of Environmental Quality	Managing Public Health
Toni Glymph	WI Department of Natural Resources	Monitoring/Assessment
Tracynda Davis	WI Division of Public Health	Managing Public Health
Doug Sackett	New York Department of Health	Managing Public Health
Alicia Carlson	New Hampshire Department of Environmental Services	Managing Public Health
Chris Huskey	Massachusetts Department of Public Health	

Federal

Name	Affiliation	Break Out Group
Charles Peters	USGS	Monitoring/Assessment
Christine Manninen	Great Lakes Commission	Monitoring/Assessment
David Rockwell	EPA	Managing Public Health
Dawn Shively	USGS	Monitoring/Assessment
Donna Francy	USGS	Forecasting
Holiday Wirick	USEPA	Managing Public Health
Judy Beck	EPA	Managing Public Health
Kanika Suri	NOAA	Forecasting
Katarzyna Przybyla-Kelly	USGS	Forecasting
Meredith Nevers	USGS	Forecasting
Milo Anderson	EPA	Forecasting
Murulee Byappanahalli	USGS	Managing Public Health
Norman Grannemann	USGS	Managing Public Health
Richard Whitman	USGS	Monitoring/Assessment
Sandra Morrison	USGS	Monitoring/Assessment
Sonia Joseph	NOAA	Monitoring/Assessment
Stephen Brandt	NOAA	Forecasting
Steve Corsi	USGS	Monitoring/Assessment
Sheridan Haack	USGS	Managing Public Health
Tammy Mitchell	EPA	Managing Public Health
Alfred Dufour	EPA	Managing Public Health
Charles Kovatch	EPA	Managing Public Health

Rochelle Sturtevant	NOAA/Sea Grant	Forecasting
Leon Carl	USGS	Monitoring/Assessment

University

Name	Affiliation	Break Out Group
Erica Jensen	UWM- Water Institute	Forecasting
Joan Rose	MSU	Forecasting
Lubo Liu	MSU	Forecasting
Michael Gardner	Northland College	Managing Public Health
Sandra McClellan	UWM- Water Institute	Monitoring/Assessment
Stephanie Molloy	MSU	Managing Public Health
Vera Volva	MSU	Managing Public Health
Teresa Roth		

Local/County

Name	Affiliation	Break Out Group
Jill Lis	Cuyahoga County Board of Health	Managing Public Health
Julie Kinzelmann	City of Racine	Managing Public Health
Mark Borkhurt	Marshfield Clinic	Monitoring/Assessment
Mary Ellen Bruesch	Milwaukee Health Department	Managing Public Health
Michael Mclenose	Hatfield Lakefront Association	Managing Public Health
Paul Biedrzycki	Milwaukee Health Department	Managing Public Health
Christine Daley	Chippewa County Health Department	Managing Public Health
William Shultzer	Door County Soil and Water Conservation	Forecasting
Bob Slow	Blue Water Shoreline Residents Association, Wisc.	Forecasting