WELCOME TO THE JULY EDITION OF THE 2014 M&R SEMINAR SERIES
BEFORE WE BEGIN

• PLEASE SILENCE CELL PHONES & SMART PHONES

• QUESTION AND ANSWER SESSION WILL FOLLOW PRESENTATION

• PLEASE FILL EVALUATION FORM

• SEMINAR SLIDES WILL BE POSTED ON MWRD WEBSITE (www.MWRD.org: Home Page ⇒ Reports ⇒ M&R Data and Reports ⇒ M&R Seminar Series ⇒ 2014 Seminar Series)

• STREAMING VIDEO WILL BE AVAILABLE ON MWRD WEBSITE (www.MWRD.org: Home Page ⇒ MWRDGC RSS Feeds)
**Brendan Daley**

**Current:** Director of Strategy and Sustainability, the Chicago Park District.
  Manage the strategic plan

**Experience:** Director of Green Initiatives for the Chicago Park District.
  Overseeing environmental remediation management, brownfields work, river issues relating to the District, overall stormwater and water conservation efforts, utility management and energy efficiency initiatives, and the District’s beach monitoring and notification program.

**Deputy Commissioner, Chicago Department of Environment,**
  Overseeing Energy & Air Quality Division,
**Legislative Liaison,**
**Project Coordinator,** Permitting & Enforcement & Natural Resources Divisions

**Education:** BA in Political Science, Roosevelt University
  LLB in Law from Queen’s University Belfast, Northern Ireland

**Professional:** LEED accredited professional with the US Green Building Council
  Certified Park and Recreation Professional through the National Recreation and Parks Association.
Meredith B. Nevers

**Current:** Research ecologist with the U.S. Geological Survey, Great Lakes Science Center in Porter, Indiana.

**Experience:** Worked with the USGS for the past 17 years.
- Research interests in microbiological contamination of beaches, water and public health microbiology, impact assessments on biological communities, and aquatic ecology.
- Extensive publication on beach science and improving monitoring accuracy through predictive modeling as well as in the ecology and natural occurrence of indicator bacteria.
- Leader of the Environmental Health theme research at the science center

**Education:** B.A. in biology/English from Wittenberg University
M.S. in marine biology from the University of North Carolina at Wilmington

**Professional:** President-elect for the Great Lakes Beach Association
Active member of the American Society for Microbiology
Active member of the International Water Association (IWA)
Predictive Modeling in Chicago

Meredith Nevers
US Geological Survey

Brendan Daley
Chicago Park Park District
Gia Biagi
Chief of Staff
Chicago Park District
@civicdesign_lab
gia.biagi@chicagoparkdistrict.com

CHICAGO PARK DISTRICT
530 playgrounds
585 parks
8,341 acres
231 fieldhouses
26 miles of lakefront
77 pools
12 museums
Chicago’s Beach Water Quality

- CPD monitors each beach for E. coli bacteria a minimum of 5 days per week.

- We use the federal single sample maximum standard of 235 mpn/100 ml, and the 18-hour Colilert method for analyzing samples.

- The standard is based on a statistical association with the rate of gastrointestinal illness: 235 = 0.8 percent risk (yellow flag – swim advisory)
Chicago’s Beach Water Quality

- Causes of advisories in Chicago:
  - Gull / wildlife / pet waste
  - Bather load (people in the water shedding bacteria)
  - Stormwater
  - Regional & unknown
  - Very rarely human sewage
- Advisories also issued based on weather
Press Release

For immediate release
July 1, 2014

Severe storms impact Cook County

The Metropolitan Water Reclamation District of Greater Chicago (MWRD) has been working around the clock to provide flood protection for Cook County. All systems are running at full capacity as an average of 1.83” fell across Cook County: 3.08” in the north, 1.45” central and 1.63” in the south. Today’s rain event began at 7 p.m. on June 30 and ended at 1:35 a.m. this morning.

When the Chicago area waterway levels are higher than Lake Michigan and certain elevations are reached, the MWRD opens control structures to move as much water as possible out of the system. This provides overbank flooding protection as well as more capacity for stormwater. The gates at Wilmette were opened at 11:23 p.m. and closed at 5:50 a.m. The gates on the Chicago River Controlling Works downtown were opened at 12:58 a.m. and closed at 7:10 a.m. The amount of
Daily Maintenance

All beaches are Groomed seven days per week.

Rakes with deep tines were specially designed for Chicago.

Trash & recycling are collected in lidded containers to minimize the attraction to gulls.
Beach Ambassadors

• Direct outreach to the public to provide info on beach health and encouraging people not to feed the birds and clean up after themselves

• Activity for CPD summer camps at beaches
New Beaches Website
Site features

- Interactive & comprehensive map
- Responsive design for mobile and tablet use
- Map, beach list and beach pages will reflect swim status at the beach (swim advisories and bans)
- Dynamic weather data will update hourly
- Pilot project with Google = additional visibility
Swim Status: **No restrictions**

**Reason (if Advisory or Ban):**

**Water Temperature:** 70 degrees

What does the water quality test result mean?

The Chicago Park District tests the water for *E. coli* bacteria. *E. coli* is not harmful itself and is naturally occurring in the environment. However, this bacteria is an indicator of the presence of other germs that could make you sick. US Environmental Protection Agency (EPA) beach policy recommends notifying the public when *E. coli* bacteria levels are above the federal water quality standard, which is 235*. This standard is used at beaches throughout the Great Lakes region.

According to the EPA, the number 235 corresponds to a risk level of 0.8% of swimmers becoming sick to their stomachs — or 8 out of 1000 people. For comparison, a bacteria level of 1000 corresponds to a 1.4% risk, and a bacteria level of 2000 corresponds to a 1.8% risk.

The Chicago Park District, in partnership with the US Geological Survey, has also developed statistical models that use weather data to predict the bacteria levels in real-time. These models provide information about water quality in real-time, compared to 18-24 hours to get results from a lab for traditional water quality testing. The models were developed with grant funding from the EPA’s Great Lakes Restoration initiative.

*The unit of measurement for water quality testing is CFU/100 ml, which stands for colony forming units of *E. coli* per 100 milliliters of water.

**Most recent water quality test result:**

<table>
<thead>
<tr>
<th>Test result</th>
<th>Date of test</th>
</tr>
</thead>
<tbody>
<tr>
<td>124</td>
<td>6/30/12</td>
</tr>
</tbody>
</table>

**Predicted water quality today:**

<table>
<thead>
<tr>
<th>Date of test</th>
<th>Water quality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>54</td>
</tr>
</tbody>
</table>

Please do your part to keep this beach clean. Properly dispose of garbage and recycling, don’t feed the birds, pick up pet waste, and use waterproof swim pants for babies and toddlers.

For more information, please visit [www.chicagoparksdistrict.com/facilities/beaches](http://www.chicagoparksdistrict.com/facilities/beaches)
Gull Management

↑ Ring-billed gull nesting colony at Dime Pier
Gulls snacking on trash at 63rd Street Beach ➔
Gull Management
Chicago Park District
63rd Street Beach
*Escherichia coli* Daily Means

Graph showing daily mean *E. coli* levels in MPN/100ml from June to September. The graph includes a horizontal line indicating the 235 MPN/100ml threshold. The graph also indicates the end of a 14-week gull program.
Advisories due to water quality exceedances at all beaches, 2005 – 2012 (*figure also includes precautionary bans due to river reversals)
Why predictive modeling?

Bacteria levels vs. swim status at 63rd Street Beach, July 2010

Legend
- elevated bacteria (>=235)
- acceptable bacteria (<235)
- swim advisory or ban
- no swimming restrictions

E. coli, mpn/100 ml

- 8/1/2010: 42
- 8/2/2010: 8
- 8/3/2010: 255
- 8/4/2010: 34
- 8/5/2010: 67
- 8/6/2010: 0
- 8/7/2010: 78
- 8/8/2010: 269
- 8/9/2010: 67
- 8/10/2010: 97
- 8/11/2010: 67
- 8/12/2010: 97
- 8/13/2010: 67
2010 GLRI grant: development of predictive models for water quality

- $250,000 for equipment and contractual work (technical support and statistical work)
- Local funds: $75,000 in capital funds, plus significant operating support
- Partnership with USGS Lake Michigan Ecological Research Center

Year One (2011): Data collection during beach season
Model development during winter

Year Two (2012): Initial deployment of 5 models at 15 beaches
Model refinement and expansion during winter

Year Three (2013): Deployment of 9 models at all lakefront beaches

Ongoing: Further refinement of models & decision making protocols;
2014 continue predictive model at all lakefront beaches
Weather Station Installation
Buoy Installation & Maintenance
Buoy Maintenance
Real-time data available online

Web Interface for Real-Time Data | NexSens WQData v4.01.20 - Windows Internet Explorer

Overview | Map | Data | Graph | Stats | Panel | Go Live | Forum

Project Description
The Chicago Park District is using the latest technology to protect the health of the millions of swimmers who visit their 24 beaches each summer. In collaboration with USGS scientists, water quality instruments and weather stations have been installed at five Chicago beaches to develop a system of predicting bacteria concentrations in real-time. Currently, the Park District tests the swimming water five days a week for bacteria concentrations, but sample results are not available until 18 hours later if water conditions may have changed. With these instruments, water and weather measurements such as temperature, sunlight, water clarity, and wave height, will be used to predict when bacteria concentrations will be higher than advisable for safe swimming. At Foster, Monroe, Oak Street, 63rd Street, and Calumet Beaches, water quality instruments have been installed that collect continuous measurements of wave height, turbidity (water clarity), water temperature, and lake level. Additionally, weather stations have been installed at Foster, Oak Street and Calumet Beaches to record wind conditions, sunlight, rain, and temperature. Hourly readings are automatically communicated by cell phone to the website where USGS scientists can download the data for developing a predictive model for bacteria concentrations. The first year of data

Limitation & Data Disclaimer
Uncertainty and potential for error can be associated with environmental monitoring data. Data users are cautioned to consider carefully the provisional nature of the information before using it for decisions that concern personal or public safety or the conduct of business that involves substantial monetary or operational consequences.

No warranty, express or implied, is given as to the accuracy, reliability, utility or completeness of the data hosted on this datacenter, and this organization shall not

63rd Street Weather Station
at 07/15/11 12:00PM
Battery Life 13.7 V
SolarRad 651 W/m2
Wind Direction 124 Deg
Wind Speed 7.8 mph
Max Windspeed 7.8 mph
Air Temp 71.70 F
Relative Hum. 79 %
Barometric Pres. 29.3 inHg
DailyRain 0.00 in

63rd Street Buoy
at 07/15/11 2:00PM
Battery Life 11.7 V
Water Temp 75.38 F
Turbidity 4.02 NTU
Transducer Depth 3.906 ft
Wave Height 0.340 ft
Wave Period 3 sec

Oak Street Weather Station
at 07/15/11 1:00PM
Battery Life 13.7 V
Wind Direction 124 Deg
Wind Speed 7.6 mph
Max Windspeed 7.6 mph
Air Temp 71.70 F
Relative Hum. 79 %
Barometric Pres. 29.3 inHg
DailyRain 0.00 in

Oak Street Buoy
at 07/15/11 2:00PM
Battery Life 11.7 V
Water Temp 75.38 F
Turbidity 4.02 NTU
Transducer Depth 3.906 ft
Wave Height 0.340 ft
Wave Period 3 sec
How does it work?

Equipment on lakefront measures weather/surf parameters

Data sent to web hosting service by cellular modem once per hour

Executable program calculates modeling results each morning at 8:30 AM

Example: Montrose Beach

Predicted log $E. coli = 2.038 + (-0.006 \times \text{solar radiation (}4\text{ hr}) + (0.484 \times \text{Log rainfall (}24\text{ hr}) + (-0.005 \times \text{Day of year}) + (3.664 \times \text{Log wave height (}4\text{ hr})$)

CPD website retrieves raw weather data and modeling results through RSS feed
<table>
<thead>
<tr>
<th>id</th>
<th>beachpage</th>
<th>buoy</th>
<th>weatherStation</th>
<th>model</th>
<th>samplingPoint</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12th Street Beach</td>
<td>Ohio Street Beach</td>
<td>Oak Street Weather Station</td>
<td>Calumet Level</td>
<td>12th</td>
</tr>
<tr>
<td>2</td>
<td>31st Street Beach</td>
<td>63rd Street Beach</td>
<td>63rd Street Weather Station</td>
<td>Calumet Level</td>
<td>31st</td>
</tr>
<tr>
<td>3</td>
<td>57th Street Beach</td>
<td>63rd Street Beach</td>
<td>63rd Street Weather Station</td>
<td>63rd Street Level</td>
<td>57th</td>
</tr>
<tr>
<td>4</td>
<td>63rd Street Beach</td>
<td>63rd Street Beach</td>
<td>63rd Street Weather Station</td>
<td>63rd Street Level</td>
<td>Jackson-63rd</td>
</tr>
<tr>
<td>5</td>
<td>Calumet Beach</td>
<td>Calumet Beach</td>
<td>63rd Street Weather Station</td>
<td>Calumet Level</td>
<td>Calumet</td>
</tr>
<tr>
<td>6</td>
<td>Fargo Beach</td>
<td>Leone Beach</td>
<td>Oak Street Weather Station</td>
<td>Leone Level</td>
<td>Jarvis-Fargo</td>
</tr>
<tr>
<td>7</td>
<td>Foster Beach</td>
<td>Leone Beach</td>
<td>Oak Street Weather Station</td>
<td>Foster Level</td>
<td>Foster</td>
</tr>
<tr>
<td>8</td>
<td>Hartigan Beach</td>
<td>Leone Beach</td>
<td>Oak Street Weather Station</td>
<td>Leone Level</td>
<td>Hartigan</td>
</tr>
<tr>
<td>9</td>
<td>Howard Beach</td>
<td>Leone Beach</td>
<td>Oak Street Weather Station</td>
<td>Leone Level</td>
<td>Howard</td>
</tr>
<tr>
<td>10</td>
<td>Humboldt Beach</td>
<td>Not Mapped</td>
<td>Oak Street Weather Station</td>
<td>Not Mapped</td>
<td>Humboldt</td>
</tr>
</tbody>
</table>
Chicago's Beaches

Chicago's 26 miles of public beaches offer the perfect settings for playing, relaxing and soaking it all in. From charming neighborhood beaches to Oak Street's skyline view, we've got a beach just for you.

Come Out and Play!

Featured Beach
Oak Street Beach

The mural entitled "You Know What You Should Do" by artist Jeff Zimmerman can be found along a well running parallel to the Lakefront Trail at Oak Street Beach.

LEARN MORE
Montrose Beach

SWIM ADVISORY
Swim advisory due to water quality

Learn about riptides

WATER QUALITY INFORMATION
Forecast for today 315
Most recent test result 80
Sample collected on Aug 30, 2013

About Montrose Beach
New in July 2013, Montrose Beach offers free wifi for beach visitors.
This popular Uptown neighborhood beach located in Lincoln Park offers patrons many amenities. South of the recreational beach, a natural area attracts many migratory birds during the fall and spring seasons. A serene dune area hosts a rare “panne” habitat—a flat, wet and open sandy area—for birds. Endangered plant life thrives at this location.

DISTANCE SWIMMING
tower 4 (north of boathouse), parallel to shore

CURRENT BEACH WEATHER
62.6° F / 17° C
Multi-tiered Approach to Understanding Recreational Beach Water Quality

- Source of contamination
- Microbial source tracking
- Mechanistic modeling
- Empirical predictive modeling
Chicago Shoreline

26 miles of lakefront
23 beaches
20 million visitors/year

23 Chicago beaches considered for model development

- No nearby river inputs
- Variable closure rates (13-37%)
- Urban development
Percent exceedances per year

<table>
<thead>
<tr>
<th>Beach</th>
<th>Exceedances (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2011</td>
</tr>
<tr>
<td>Leone</td>
<td>6</td>
</tr>
<tr>
<td>Osterman</td>
<td>10</td>
</tr>
<tr>
<td>Foster</td>
<td>4</td>
</tr>
<tr>
<td>Montrose</td>
<td>21</td>
</tr>
<tr>
<td>Oak</td>
<td>4</td>
</tr>
<tr>
<td>Ohio</td>
<td>9</td>
</tr>
<tr>
<td>63rd</td>
<td>12</td>
</tr>
<tr>
<td>Rainbow</td>
<td>23</td>
</tr>
<tr>
<td>Calumet</td>
<td>13</td>
</tr>
</tbody>
</table>
Additional Sources of Fecal Indicator Bacteria

- stormwater outfall
- sand resuspension by waves
- birds
- parking lot drainage
- Cladophora algae
- beachgoers
*E. coli* and enterococci are present in recreational beach sand.

*E. coli* and enterococci persisted in sub-surface sand year-long at two Indiana beaches.

Sand along with associated fecal indicator bacteria is re-suspended into beach water through wave action.
Gulls may increase *E. coli* concentrations in sand and beach water

<table>
<thead>
<tr>
<th></th>
<th># gulls lagged 1 day, P values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreshore sand</td>
<td>0.000</td>
</tr>
<tr>
<td>45 cm water AM</td>
<td>0.004</td>
</tr>
<tr>
<td>90 cm water AM</td>
<td>0.001</td>
</tr>
</tbody>
</table>
E. coli Concentrations are Highest in Sand and Diminish in Water With Distance From Shore

Connecting Bacteria in Foreshore Sands and in the Swash Zone
*E. coli* and Enterococci are Commonly Found in *Cladophora* in Lake Michigan

Nutrients in Algal Washings Promoted *In vitro* Growth of *E. coli* and Enterococci

*E. coli* and enterococci grew exponentially during the first 18 hr at 35°C in *Cladophora* washings.

Mechanistic Models

EC distribution in the water and in the sediment at hour 20 after a sediment resuspension event near the shoreline at hour 0

(a): suspended EC in the water; (b) settled EC in the sediment. Blue arrows: current field, note the gyre that concentrates E. coli in (a). This plot shows that under a typical current pattern EC cannot be released efficiently from inside to outside the embayment. Settling occurs faster (see (b)) than transport because of the shallow water nearshore.
Calumet River and Grand Calumet River Plume Hydrodynamic Model

Day 0.3

Wind speed 11.5 (mph)
Historically there is a relationship between *E. coli* measured at Chicago beaches (2000-2005) and the distance between beaches.

**Simultaneous fluctuations of *E. coli* at Chicago beaches**

# Microbial Source Tracking – summer 2010

<table>
<thead>
<tr>
<th>Location</th>
<th>No. of Samples</th>
<th>HF183 human marker</th>
<th>Gull-2 Marker</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foster</td>
<td>55</td>
<td>4 (7%)</td>
<td>0</td>
</tr>
<tr>
<td>Montrose</td>
<td>55</td>
<td>4 (7%)</td>
<td>0</td>
</tr>
<tr>
<td>Calumet</td>
<td>55</td>
<td>1 (2%)</td>
<td>0</td>
</tr>
<tr>
<td>63rd</td>
<td>55</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Jeorse Park</td>
<td>54</td>
<td>8 (15%)</td>
<td>20 (37%)</td>
</tr>
</tbody>
</table>

Fecal markers correlated with sanitary survey observations:

<table>
<thead>
<tr>
<th>Category</th>
<th>Fecal marker</th>
<th>Human marker</th>
<th>Gull marker</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swimmers</td>
<td></td>
<td>0.200**</td>
<td>-0.006</td>
</tr>
<tr>
<td>Birds</td>
<td></td>
<td>0.048</td>
<td>0.306**</td>
</tr>
<tr>
<td>Algae</td>
<td></td>
<td>0.047</td>
<td>-0.096</td>
</tr>
<tr>
<td>Debris</td>
<td></td>
<td>-0.015</td>
<td>-0.051</td>
</tr>
<tr>
<td>Fecal Material</td>
<td></td>
<td>0.178**</td>
<td>0.328**</td>
</tr>
</tbody>
</table>
Potential Solutions

- Modeling
- Rapid Testing
- Refined Source Identification
Independent variables incorporated into models used during 2013 season

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar Radiation</td>
<td>9/9</td>
</tr>
<tr>
<td>Rainfall</td>
<td>7/9</td>
</tr>
<tr>
<td>Wind Direction x Wind Speed</td>
<td>5/9</td>
</tr>
<tr>
<td>DOY</td>
<td>4/9</td>
</tr>
<tr>
<td>Water Depth</td>
<td>3/9</td>
</tr>
<tr>
<td>Wind Direction</td>
<td>3/9</td>
</tr>
<tr>
<td>Air Temperature</td>
<td>2/9</td>
</tr>
<tr>
<td>Barometric Pressure</td>
<td>1/9</td>
</tr>
<tr>
<td>Wave Height</td>
<td>1/9</td>
</tr>
<tr>
<td>Turbidity</td>
<td>1/9</td>
</tr>
<tr>
<td>DOW</td>
<td>1/9</td>
</tr>
</tbody>
</table>
## Predictive Model Performance

### Adjusted $R^2$ by year

<table>
<thead>
<tr>
<th>Location</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leone</td>
<td>0.381</td>
<td>0.341</td>
<td></td>
</tr>
<tr>
<td>Osterman</td>
<td>0.364</td>
<td>0.397</td>
<td></td>
</tr>
<tr>
<td>Foster</td>
<td>0.306</td>
<td>0.329</td>
<td>0.353</td>
</tr>
<tr>
<td>Montrose</td>
<td>0.334</td>
<td>0.238</td>
<td>0.191</td>
</tr>
<tr>
<td>Oak</td>
<td>0.220</td>
<td>0.167</td>
<td>0.267</td>
</tr>
<tr>
<td>Ohio</td>
<td>0.367</td>
<td>0.286</td>
<td>0.144</td>
</tr>
<tr>
<td>63rd</td>
<td>0.103</td>
<td>0.117</td>
<td></td>
</tr>
<tr>
<td>Rainbow</td>
<td>0.390</td>
<td>0.378</td>
<td>0.169</td>
</tr>
<tr>
<td>Calumet</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Calumet

<table>
<thead>
<tr>
<th>Beach</th>
<th>Coefficients</th>
<th>Model Adj R²</th>
<th>Pers Adj R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calumet</td>
<td>Wave height</td>
<td>0.378</td>
<td>-0.005</td>
</tr>
<tr>
<td></td>
<td>Solar radiation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Downshore wind</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Depth</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Turbidity</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

![Scatter plot showing data distribution](image)
### 2013 Validation Results

<table>
<thead>
<tr>
<th>Location</th>
<th>Accuracy (%)</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leone</td>
<td>94</td>
<td>87</td>
<td>0</td>
</tr>
<tr>
<td>Osterman</td>
<td>92</td>
<td>84</td>
<td>0</td>
</tr>
<tr>
<td>Foster</td>
<td>90</td>
<td>82</td>
<td>14</td>
</tr>
<tr>
<td>Montrose</td>
<td>71</td>
<td>57</td>
<td>14</td>
</tr>
<tr>
<td>Oak</td>
<td>97</td>
<td>91</td>
<td>0</td>
</tr>
<tr>
<td>Ohio</td>
<td>92</td>
<td>89</td>
<td>25</td>
</tr>
<tr>
<td>63rd</td>
<td>78</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>Rainbow</td>
<td>84</td>
<td>66</td>
<td>8</td>
</tr>
<tr>
<td>Calumet</td>
<td>67</td>
<td>72</td>
<td>36</td>
</tr>
</tbody>
</table>
E. coli sampling results (log10) MPN / 100 ml

31st Street Beach 2013 Modeling

Water Quality Criteria
235 MPN/100 ml

E. coli modeling data (log10) MPN/100 ML

Correct Open

Type I Error (False Advisory)

Correct Advisory

Type II Error (False Open)
E. coli sampling results of next day (log10) MPN / 100 ml

Water Quality Criteria
235 MPN/100 ml

E. coli sampling results of next day (log10) MPN / 100 ML

Type I Error
(False Advisory)

Correct Open

Type II Error
(False Open)

Correct Advisory

31st Beach – Persistence Model
Predictive modeling: 2014

9 new models were developed using three years of data

Models will be applied at all beaches

Example: Montrose
Predicted log $E. coli = 2.038 + (-0.006 \cdot \text{solar radiation (4 hr)}) + (0.484 \cdot \text{Log rainfall (24 hr)}) + (-0.005 \cdot \text{Day of year}) + (3.664 \cdot \text{Log wave height (4 hr)})$
Potential Improvements

- Maximize monitoring effectiveness at Chicago’s beaches by using a variety of field-based and laboratory-based methods
- Rapid Testing using qPCR
Rapid Analytical Methods decrease the time between sample collection and results availability: QPCR assay vs. traditional membrane filtration.
Table 2. Comparison of the Percent of Samples Exceeding a Beach Action Value (BAV) for Three Analytical Methods Tested, Using the Same Water Sample

<table>
<thead>
<tr>
<th>Location</th>
<th>EC % exceeding</th>
<th>ENT % exceeding</th>
<th>QENT % exceeding</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calumet 2010</td>
<td>25</td>
<td>27</td>
<td>3</td>
<td>33</td>
</tr>
<tr>
<td>Foster</td>
<td>13</td>
<td>12</td>
<td>3</td>
<td>33</td>
</tr>
<tr>
<td>Montrose 2009</td>
<td>18</td>
<td>42</td>
<td>12</td>
<td>33</td>
</tr>
<tr>
<td>Montrose 2010</td>
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<td>55</td>
<td>6</td>
<td>33</td>
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<tr>
<td>63rd 2009</td>
<td>76</td>
<td>97</td>
<td>64</td>
<td>33</td>
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<tr>
<td>63rd 2010</td>
<td>24</td>
<td>21</td>
<td>0</td>
<td>33</td>
</tr>
<tr>
<td>Jeorse 2010</td>
<td>78</td>
<td>44</td>
<td>26</td>
<td>32</td>
</tr>
</tbody>
</table>
Conclusions

- Models can be used for source identification, transport, and predicting contamination events.
- Chicago beaches are exposed to similar nonpoint sources of contamination.
- Wind characteristics describe much of the *E. coli* variation, indicating significant resuspension of sediment-borne bacteria.
- Predictive modeling is an effective method for real-time monitoring at Chicago’s beaches.
Thank You!

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