

The Metropolitan

Water Reclamation District

of Greater Chicago

**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 District





CHICAGO
PARK DISTRICT



CHICAGO
PARK
DISTRICT

CHICAGO
PARK
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CHICAGO
PARK
DISTRICT

CHICAGO
PARK
DISTRICT



1934

BIRD'S-EYE VIEW OF THE BUSINESS DISTRICT OF CHICAGO

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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50

WARDS

77

COMMUNITIES

234

SQUARE MILES

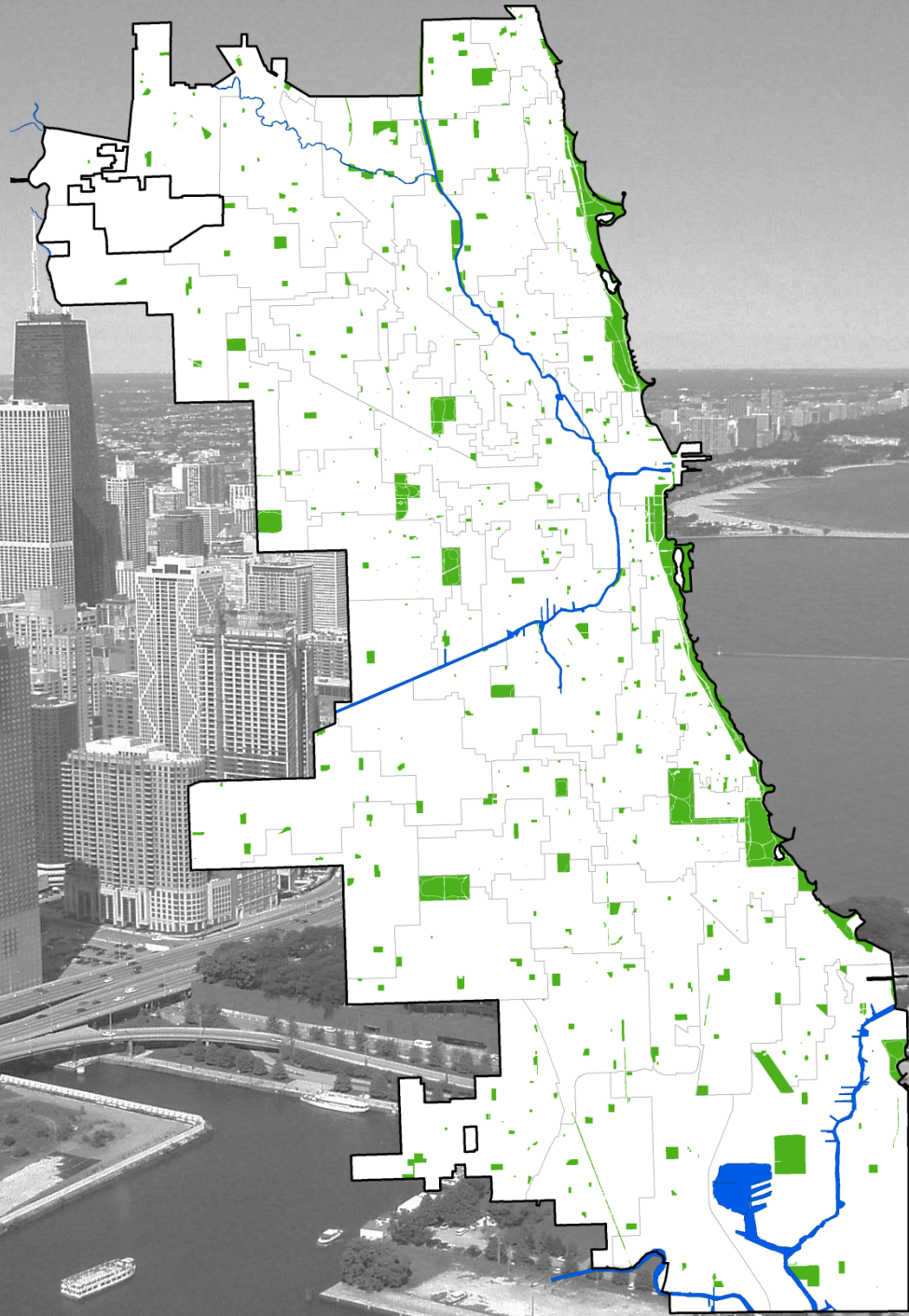








Photo by: Michael Chrzastowski, Illinois State Geological Survey

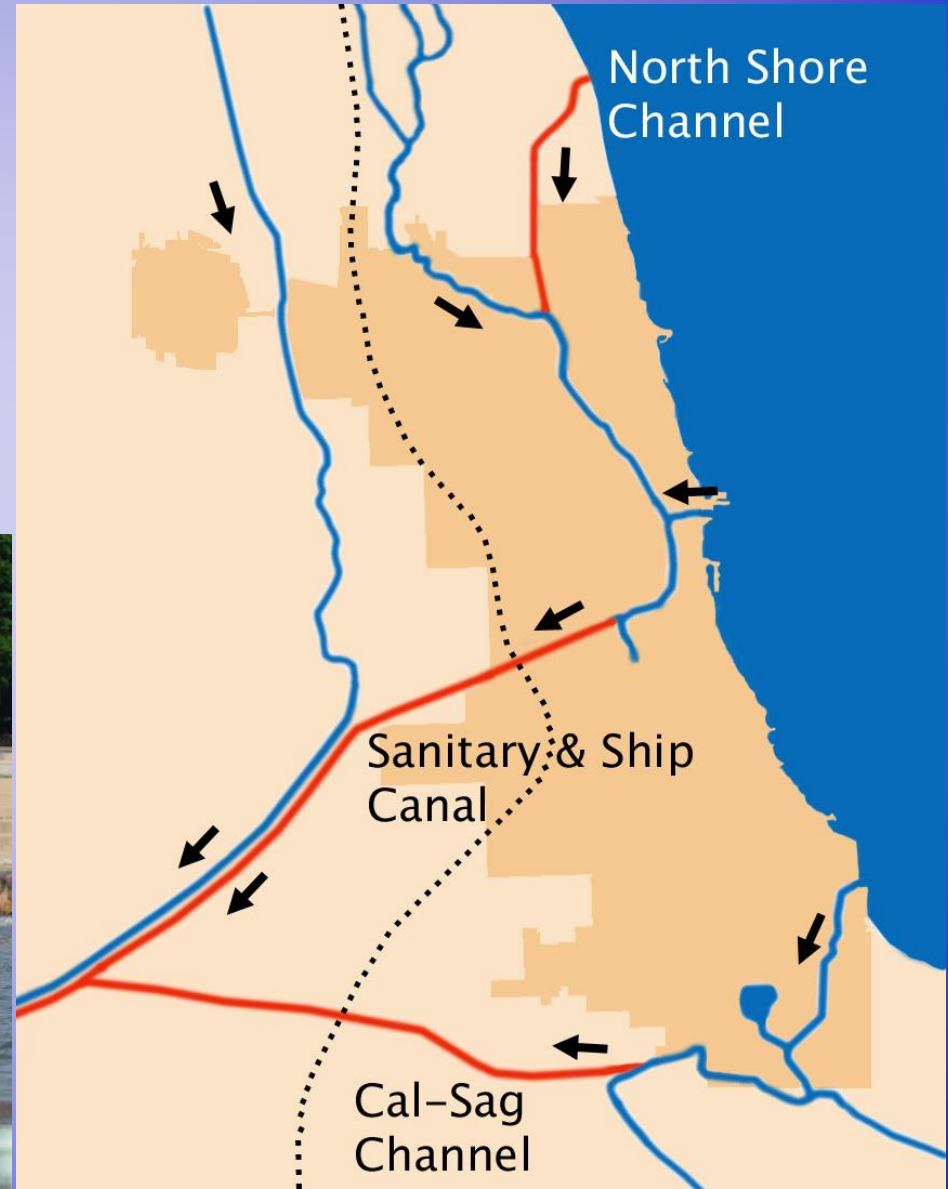
Chicago's Beach Water Quality

- 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





Metropolitan Water Reclamation District *of* Greater Chicago

Press Release

Allison Fore
Public and Intergovernmental Affairs Officer
312.751.6632
allison.fore@mwrdd.org
100 East Erie Street, Chicago, Illinois 60611

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

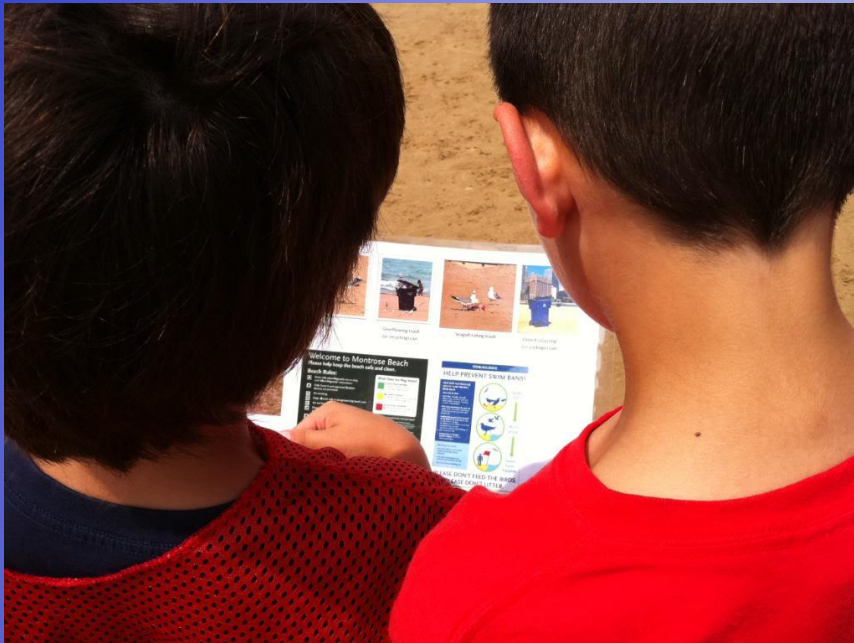


Trash & recycling are
collected in lidded containers
to minimize the attraction to
gulls

Beach Grooming



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





THE MAP ALL BEACHES

- ✓ 12th Street Beach
- ✓ 31st Street Beach
- ✓ 57th Street Beach
- ✓ 63rd Street Beach
- ✓ Calumet Beach
- ✓ Fargo Beach
- ✓ Foster Beach
- ✓ George A. Lane Beach
- ! Hartigan Beach
- ✓ Howard Beach
- ✓ Humboldt Park Beach
- ✓ Jarvis Beach
- ✓ Juneway Beach
- ✓ Kathy Osterman Beach
- ✓ Leone Beach
- ✓ Loyola Beach
- ✓ Montrose Beach
- ✓ North Avenue Beach
- ✓ Oak Street Beach
- ✓ Oakwood Beach
- ✓ Ohio Street Beach
- ✓ Rainbow Beach
- ✗ Rogers Beach
- ✓ South Shore Beach

✓ NO RESTRICTIONS ! SWIM ADVISORY ✗ SWIM BAN

Beach List with Addresses >

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



2013 Chicago Air Show
JUNE 14-15

FEATURED BEACH 57th Street

The 57th Street Beach was originally designed by Olmstead & Vaux, the famed designers of New York's Central Park.

LEARN MORE >

The 2013 Beach Season runs May 1 through September 15.



Chicago's Beaches are part of the Great Lakes ecosystem, a national resource of international importance.

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Terms of Use / Privacy Policy

Switch to Desktop View

Contact Us

Report a Problem

Volunteer at the Beach

Beach Partners

Home



(312) 742-PLAY / 7529
TTY (312) 7573-2001
541 N. Fairbanks,
Chicago IL 60611



BEACH HOTLINE

(312) 74-BEACH
(742-3224)
(English and Espanol)

GET WATER QUALITY INFO ON THE GO

Text a beach name to
(312) 715-SWIM (7946).

New Beaches Website



North Avenue Beach

NO RESTRICTIONS

View swim status history for this beach

- What do the flags mean?
- Learn about rip tides

DISTANCE SWIMMING

Beaches 3 & 4 (north of boathouse), parallel to shore

NO CURRENT ADVISORIES

Ecoli level 3/26
Bacteria Level 110

Last Sample taken August 22

View bacteria samples history for this beach

- What does bacteria level mean?
- What can I do to prevent swim advisories?



See Full Map

LOCATION

1600 N. Lake Shore Dr.
intersection of North Avenue at Lake Michigan

(312) 742-5121

Get Directions

BEACH HOURS

When flags are on duty, 9:30 a.m.–7 p.m., unless otherwise posted.

CURRENT WEATHER

75° F / X° C

What a great day for the beach!

WATER TEMP

77 F/XX° C

WIND

10.9 mph from N-NW

More Weather for this Beach

How does weather information get collected?

GET SOCIAL

Share this Page

Stay Connected

FOLLOW US



JUNE 14-15

FEATURED BEACH

57th Street

The 57th Street Beach was originally designed by Olmstead & Vaux, the famed designers of New York's Central Park.

LEARN MORE

Overview

North Avenue Beach is located in Lincoln Park at 1600 N. Lake Shore Drive (North Ave. @ Lake Michigan). As one of Chicago's most popular beaches, North Avenue Beach offers an array of amenities and recreational opportunities for beach goers that include volleyball, biking, kayaking, paddle board and wake board rentals and a very popular food concession - Castaways. There is an ADA accessible beach walk and restrooms available. Distance swimming is available at beaches 3 & 4 (north of boathouse), parallel to shore. Paid parking lot is also available.

The North Avenue Beach House contains 22,000 square feet of space that features something for everyone and is permanently docked along this popular beach. Home to a very popular food and beverage concessionaire, Castaways, this sleek, ocean liner-inspired building, decked out in a crisp blue and white, boasts one of the best views in the city. The beach house has upper decks and portholes for looking at the magnificent horizon or the multitudes of bikers, runners, walkers and rollerbladers streaming down the lakefront trail.

Events

Amenities/Facilities

Getting to North Avenue Beach

ADA Accessibility

Beach Rules

History of North Avenue Beach

The 2013 Beach Season runs
May 1 through September 15.



Chicago's Beaches are part of the Great Lakes ecosystem, a national resource of international importance.

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541 N. Fairbanks,
Chicago, IL 60611



BEACH HOTLINE
(312) 742-BEACH
(742-2224)
(English and Español)

GET WATER QUALITY
INFO ON THE GO
Text a beach name to
(312) 715-SWIM (7946).

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:

 124 *6/30/12*

Predicted water quality today:

 54



chicago park district



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.chicagoparkdistrict.com/facilities/beaches

Gull Management



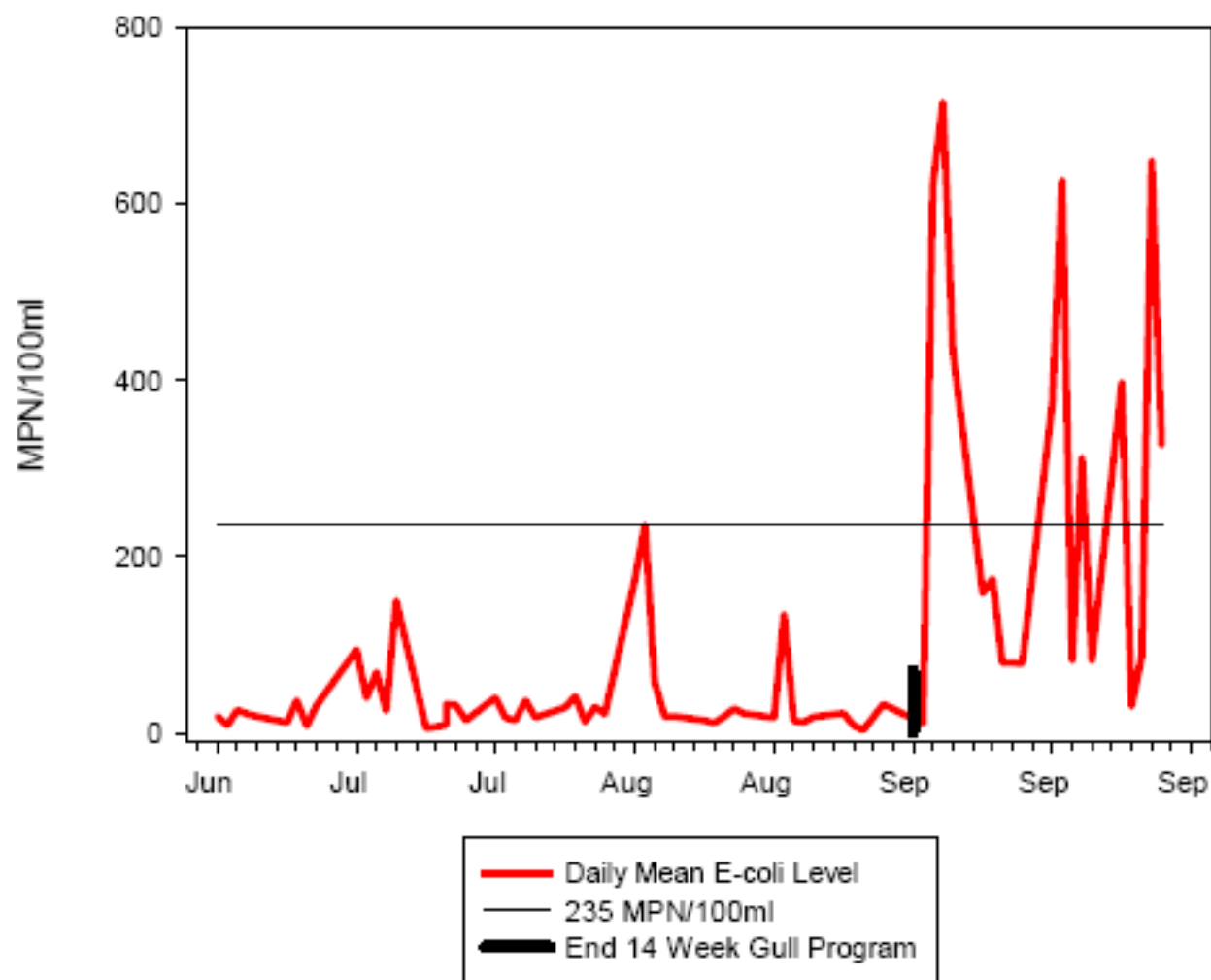
↑ Ring-billed gull nesting colony at Dime Pier
Gulls snacking on trash at 63rd Street Beach →



Gull Management

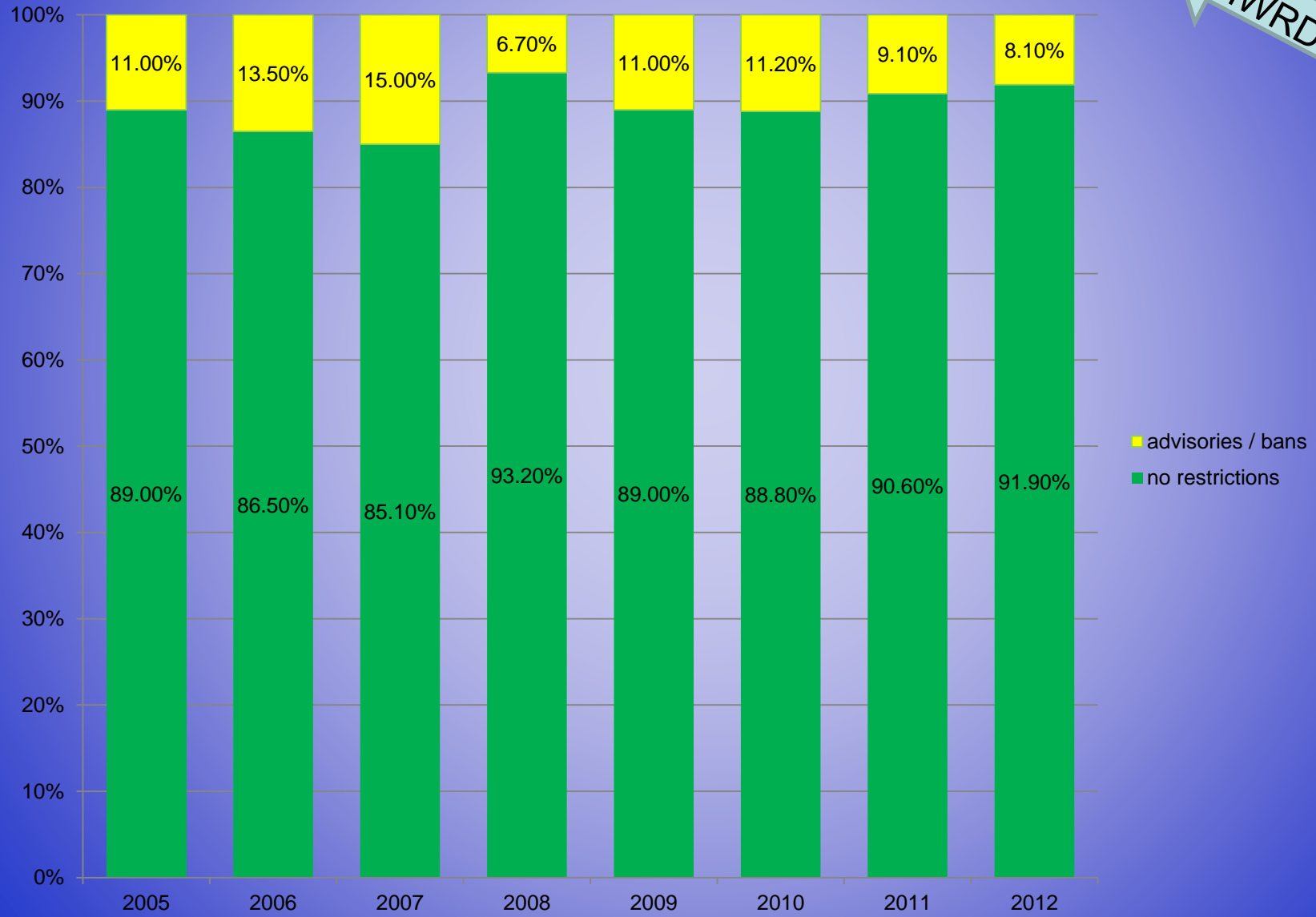


Chicago Park District
63rd Street Beach
Escherichia coli Daily Means



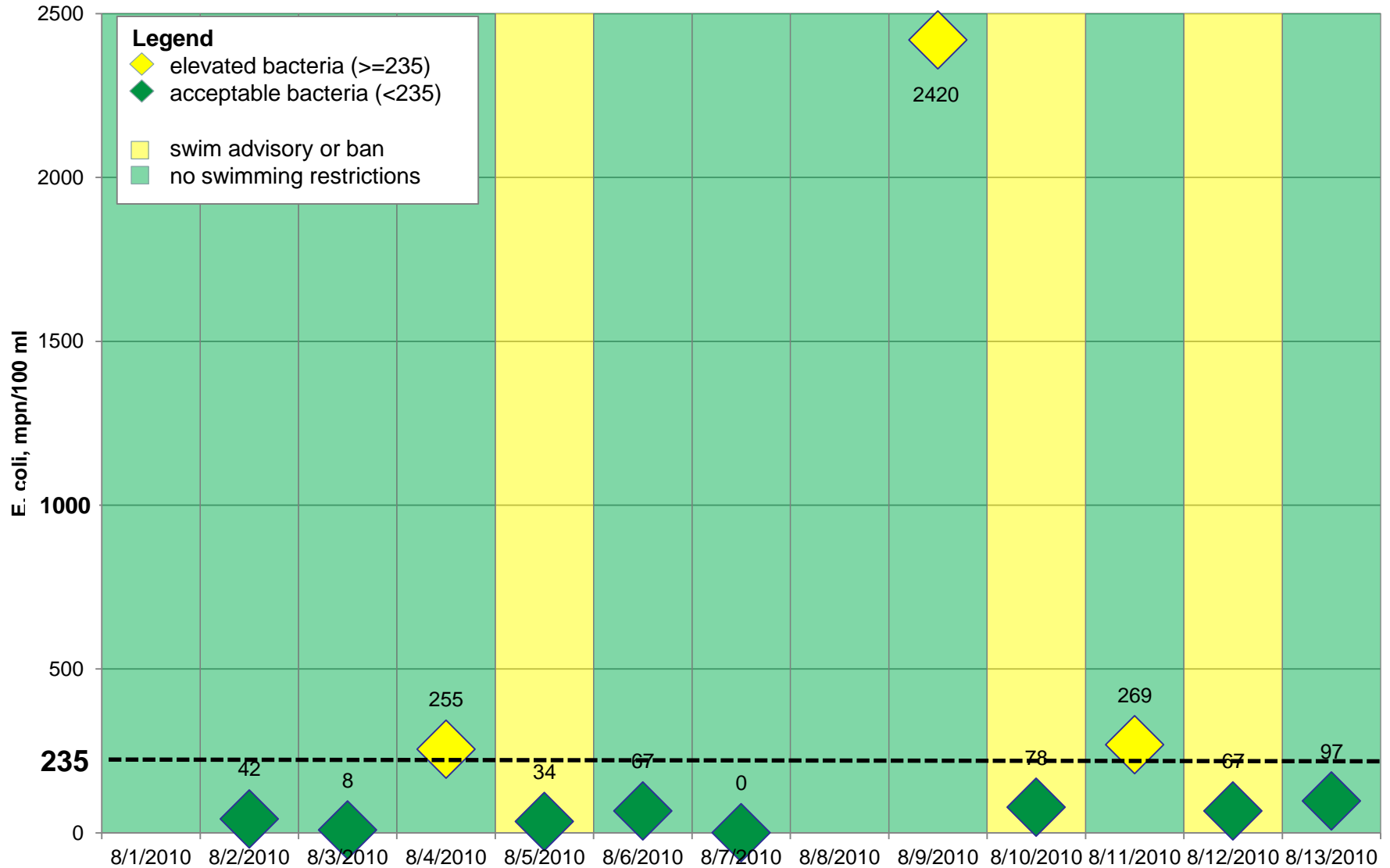
Advisories due to water quality exceedances at all beaches, 2005 – 2012

(*figure also includes precautionary bans due to river reversals)



Why predictive modeling?

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



Great Lakes RESTORATION



2010 GLRI grant: development of predictive models for water quality

- \$250,000 for equipment and contractual work (technical support and statistical work)
- Local funds: \$75,00 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

http://v4.wqdata.com/webdblink/chicagopark.php

File Edit View Favorites Tools Help

Web Interface for Real-Time Data | NexSens...



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 that 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 —after 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, Montrose, 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, rainfall, and temperature. Hourly readings are automatically communicated by cell phone to this website, where USGS scientists can download the data for developing a predictive model for bacteria concentrations. The first year of data



Calumet Buoy

at 07/15/11 2:00PM

Battery Life	11.8 V
Water Temp	77.00 F
Turbidity	2.45 NTU
Transducer Depth	4.071 ft
Wave Height	0.210 ft
Wave Period	2 sec

ALL DATA Powered by NexSens Technology

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

WQData Web Applet - Windows Internet Explorer

http://v4.wqdata.com/webdbtextapplet/c

File Edit View Favorites Tools Help

WQData Web Applet

63rd Street Weather Station

at 07/15/11 2:00PM

Battery Life	13.7 V
SolarRad	651 W/m2
Wind Direction	87 Deg
Wind Speed	12.6 mph
Max Windspeed	13.4 mph
Air Temp	73.50 F
Relative Humid.	75 %
Barometric Pre.	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 Dep.	3.906 ft
Wave Height	0.340 ft
Wave Period	3 sec

Oak Street Weather Station

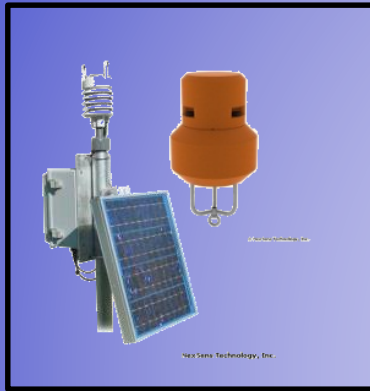
at 07/15/11 1:00PM

Battery Life	13.7 V
Wind Direction	124 Deg
Wind Speed	7.6 mph
Max Windspeed	7.8 mph
Air Temp	71.70 F
Relative Humid.	79 %
Barometric Pre.	29.3 inHg
DailyRain	0.00 in

Oak Street Buoy

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

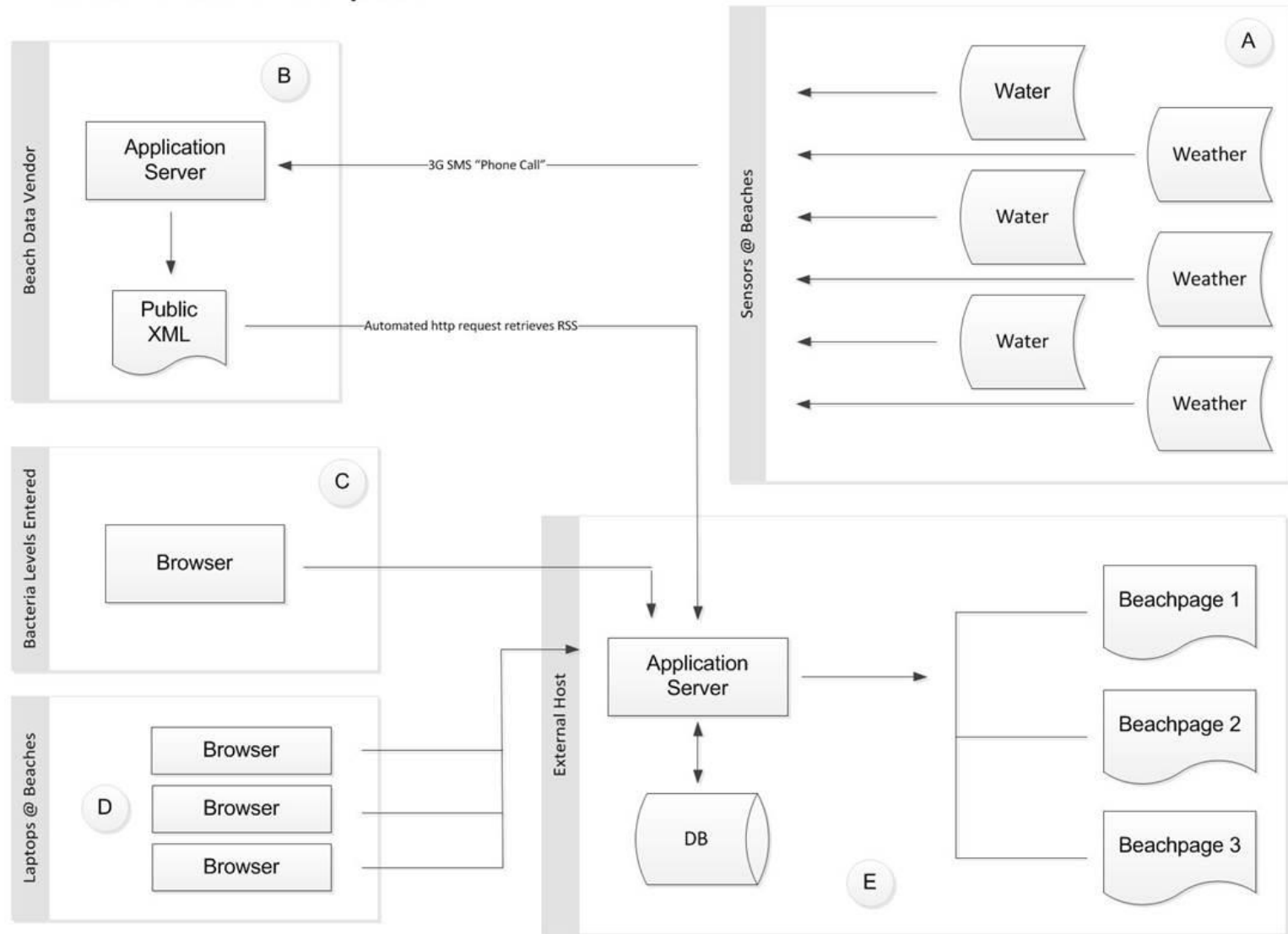
Predicted log *E. coli* = $2.038 + (-0.006 * \text{solar radiation (4 hr)}) + (0.484 * \text{Log rainfall (24 hr)}) + (-0.005 * \text{Day of year}) + (3.664 * \text{Log wave height (4 hr)})$

CPD website retrieves raw weather data and modeling results through RSS feed



A screenshot of a web browser showing the CPD website for Montrose Beach. The browser address bar shows "www.cpdbeaches.com/beaches/montrose-beach/". The page features a large photo of people playing volleyball on a beach. Below the photo, the title "Montrose Beach" is displayed. Underneath, there are two main sections: "SWIM STATUS" which shows a green checkmark and "NO RESTRICTIONS", and "WATER QUALITY INFORMATION" which shows a forecast for today of 4.7, a most recent test result of 80, and a sample collected on Aug 30, 2013. To the right of the main content is a Google Maps satellite view of the beach area. At the bottom right, there are tabs for "LOCATION" and "BEACH HOURS", with the "LOCATION" tab selected, showing the address "4400 N Lake Shore Dr" and phone number "(312) 742-5121".

Beach Data Transport



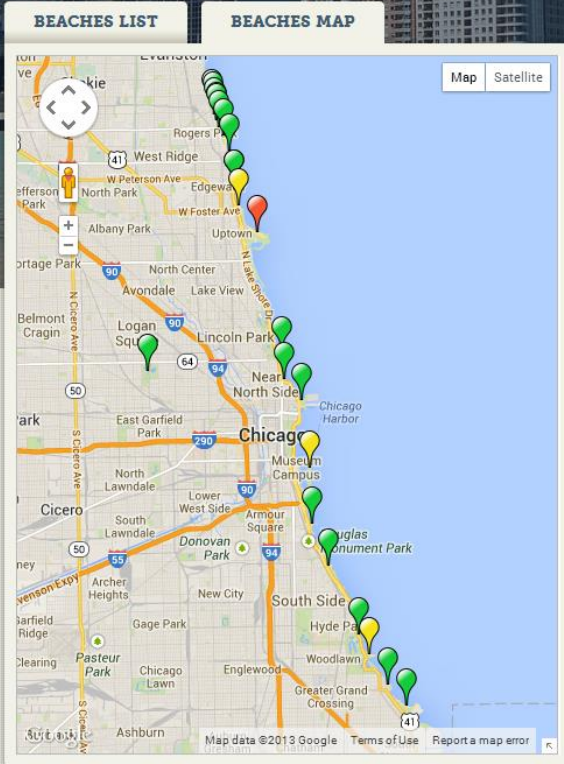


MAPBEACHPAGE

beach page devices fields data mapped 2 beachpage

id	beachpage	buoy	weatherStation	model	samplingPoint
1	12th Street Beach	Ohio Street Beach	Oak Street Weather Station	Calumet Level	12th
2	31st Street Beach	63rd Street Beach	63rd Street Weather Station	Calumet Level	31st
3	57th Street Beach	63rd Street Beach	63rd Street Weather Station	63rd Street Level	57th
4	63rd Street Beach	63rd Street Beach	63rd Street Weather Station	63rd Street Level	Jackson-63rd
5	Calumet Beach	Calumet Beach	63rd Street Weather Station	Calumet Level	Calumet
6	Fargo Beach	Leone Beach	Oak Street Weather Station	Leone Level	Jarvis-Fargo
7	Foster Beach	Leone Beach	Oak Street Weather Station	Foster Level	Foster
8	Hartigan Beach	Leone Beach	Oak Street Weather Station	Leone Level	Hartigan
9	Howard Beach	Leone Beach	Oak Street Weather Station	Leone Level	Howard
10	Humboldt Beach	Not Mapped	Oak Street Weather Station	Not Mapped	Humboldt

again on May 23, 2014.



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!

Park Points
Sign Up For Park Points

FEATURED BEACH

Oak Street Beach

The mural entitled "You Know What You Should Do" by artist Jeff Zimmerman can be found along a wall 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.

Parking

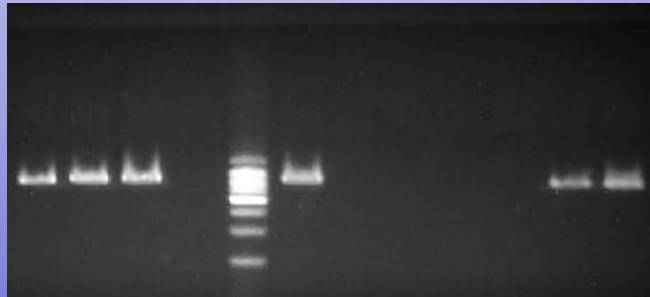
DISTANCE SWIMMING
tower 4 (north of boathouse), parallel to shore

CURRENT BEACH WEATHER

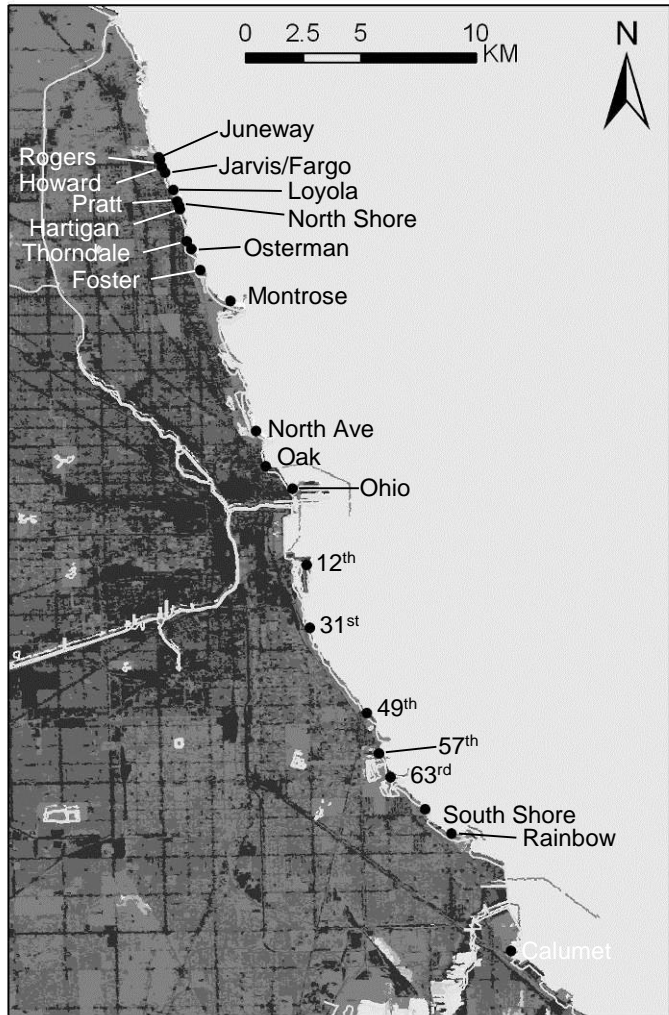
62.6° F / 17° C

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

Beach	Exceedances (%)		
	2011	2012	2013
Leone	6	7	6
Osterman	10	9	9
Foster	4	11	11
Montrose	21	25	32
Oak	4	0	5
Ohio	9	7	7
63rd	12	24	18
Rainbow	23	30	20
Calumet	13	16	17

Additional Sources of Fecal Indicator Bacteria



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

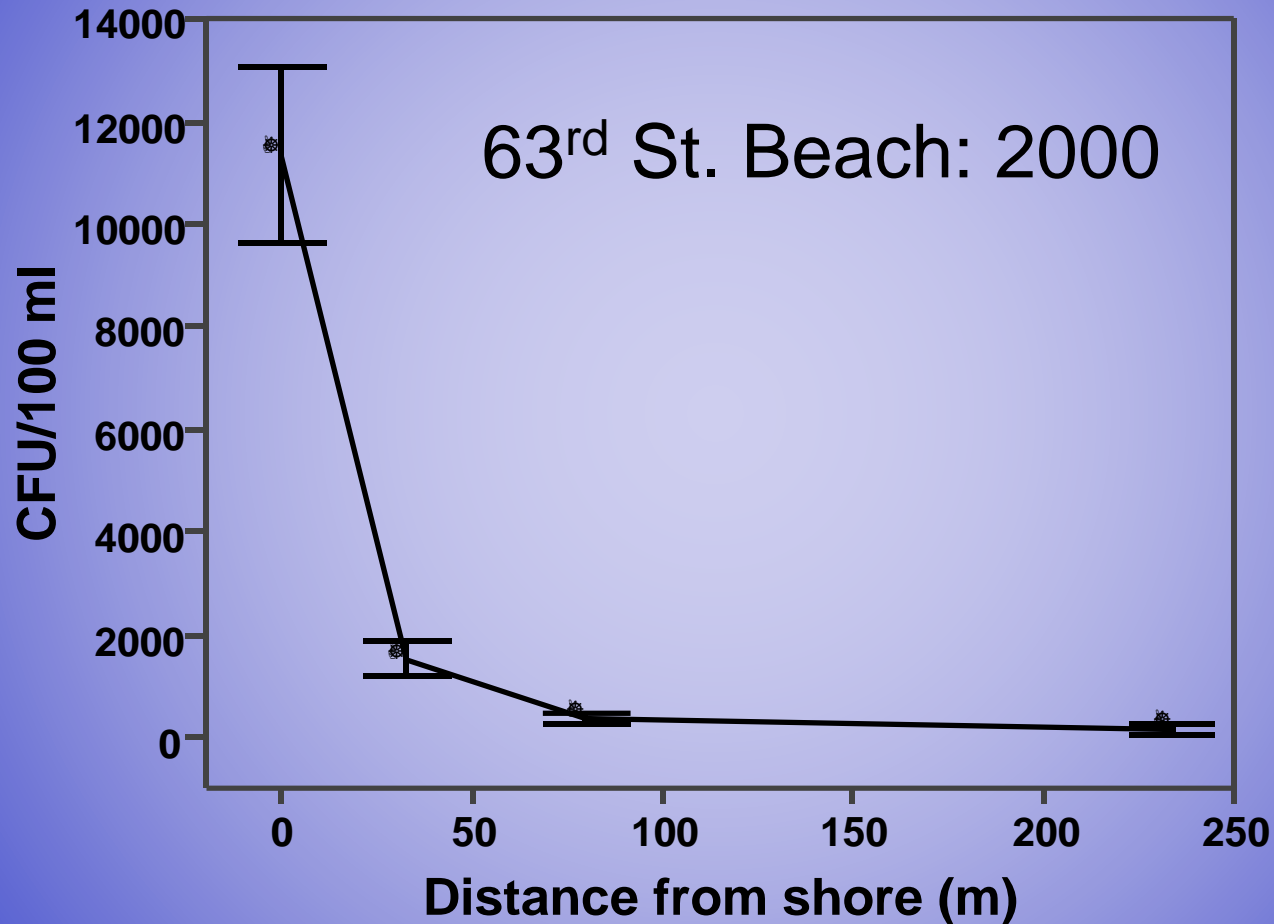


Sand along with associated fecal indicator bacteria is re-suspended into beach water through wave action

Gulls may increase *E. coli* concentrations in sand and beach water

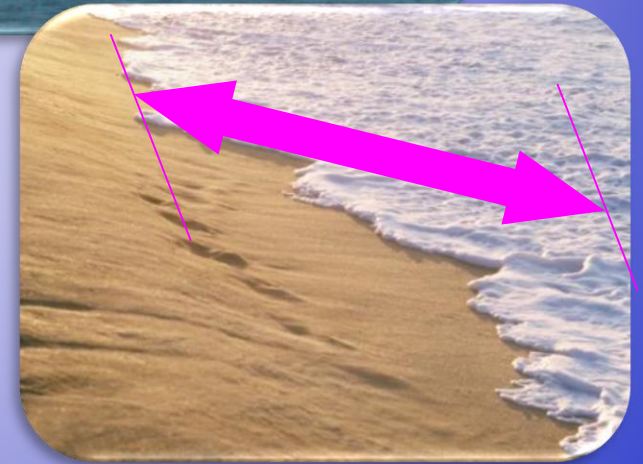
	# gulls lagged 1 day, P values
Foreshore sand	0.000
45 cm water AM	0.004
90 cm water AM	0.001

E. coli Concentrations are Highest in Sand and Diminish in Water With Distance From Shore



Whitman, R. L. and M. B. Nevers. 2003. Foreshore sand as a source of *Escherichia coli* in nearshore water of a Lake Michigan beach. *Applied and Environmental Microbiology* **69**:5555-5562.

Connecting Bacteria in Foreshore Sands and in the Swash Zone

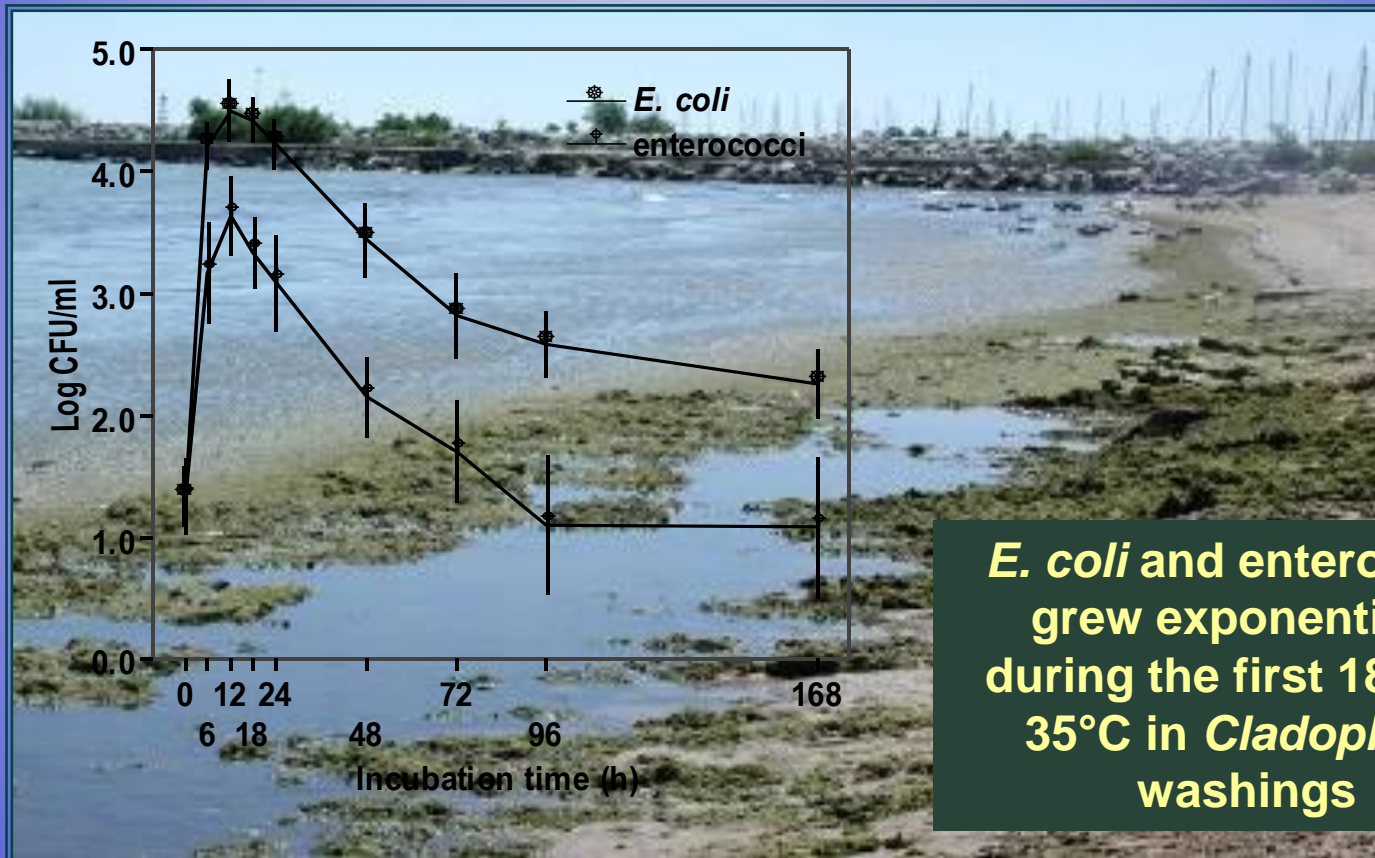


E. coli and Enterococci are Commonly Found in *Cladophora* in Lake Michigan



Whitman, R. L., D. A. Shively, H. Pawlik, M. B. Nevers, and M. N. Byappanahalli. 2003. Occurrence of *Escherichia coli* and enterococci in *Cladophora* (Chlorophyta) in nearshore water and beach sand of Lake Michigan. *Applied and Environmental Microbiology* **69**:4714-4719.

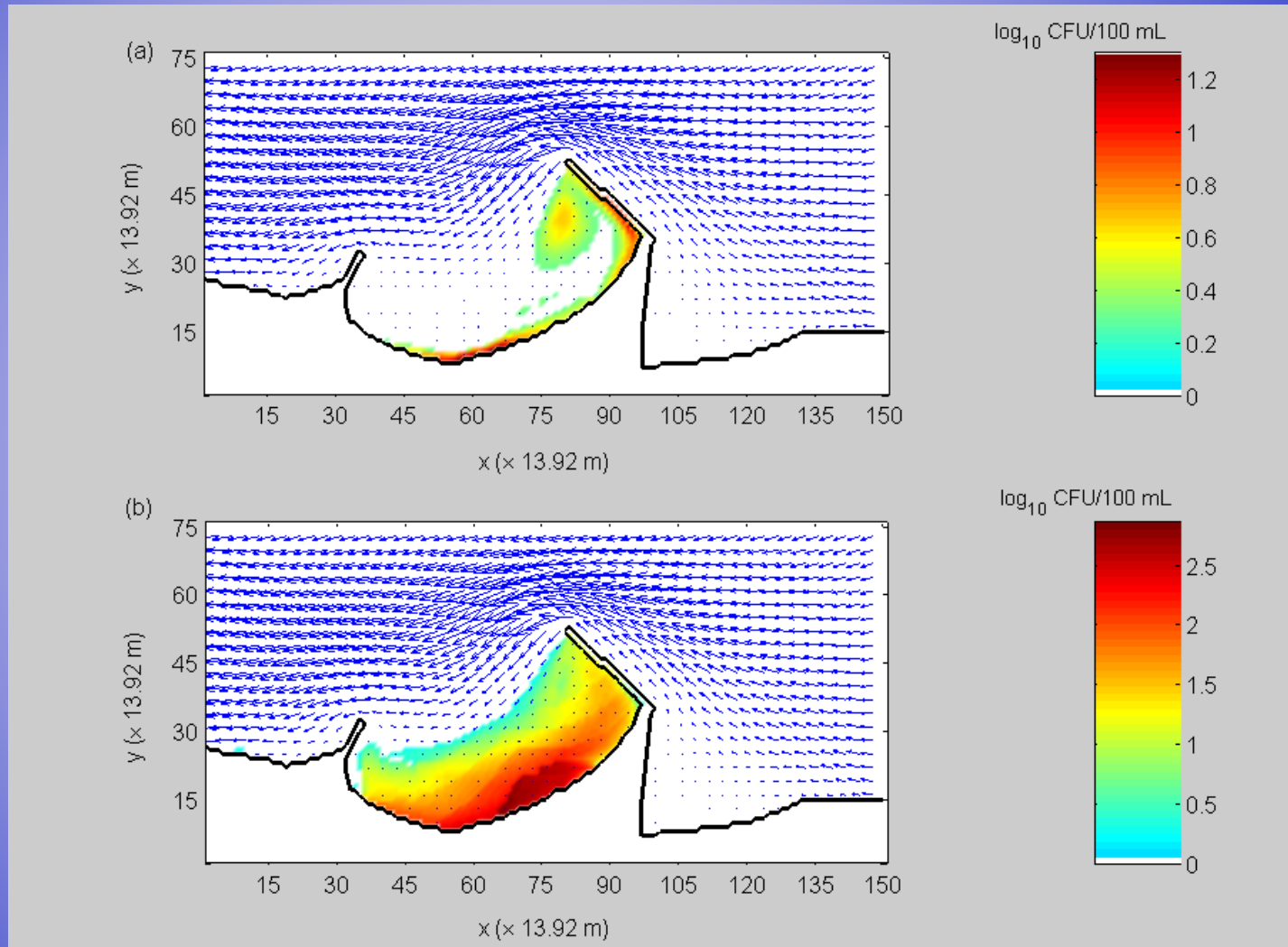
Nutrients in Algal Washings Promoted *In vitro* Growth of *E. coli* and Enterococci



***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

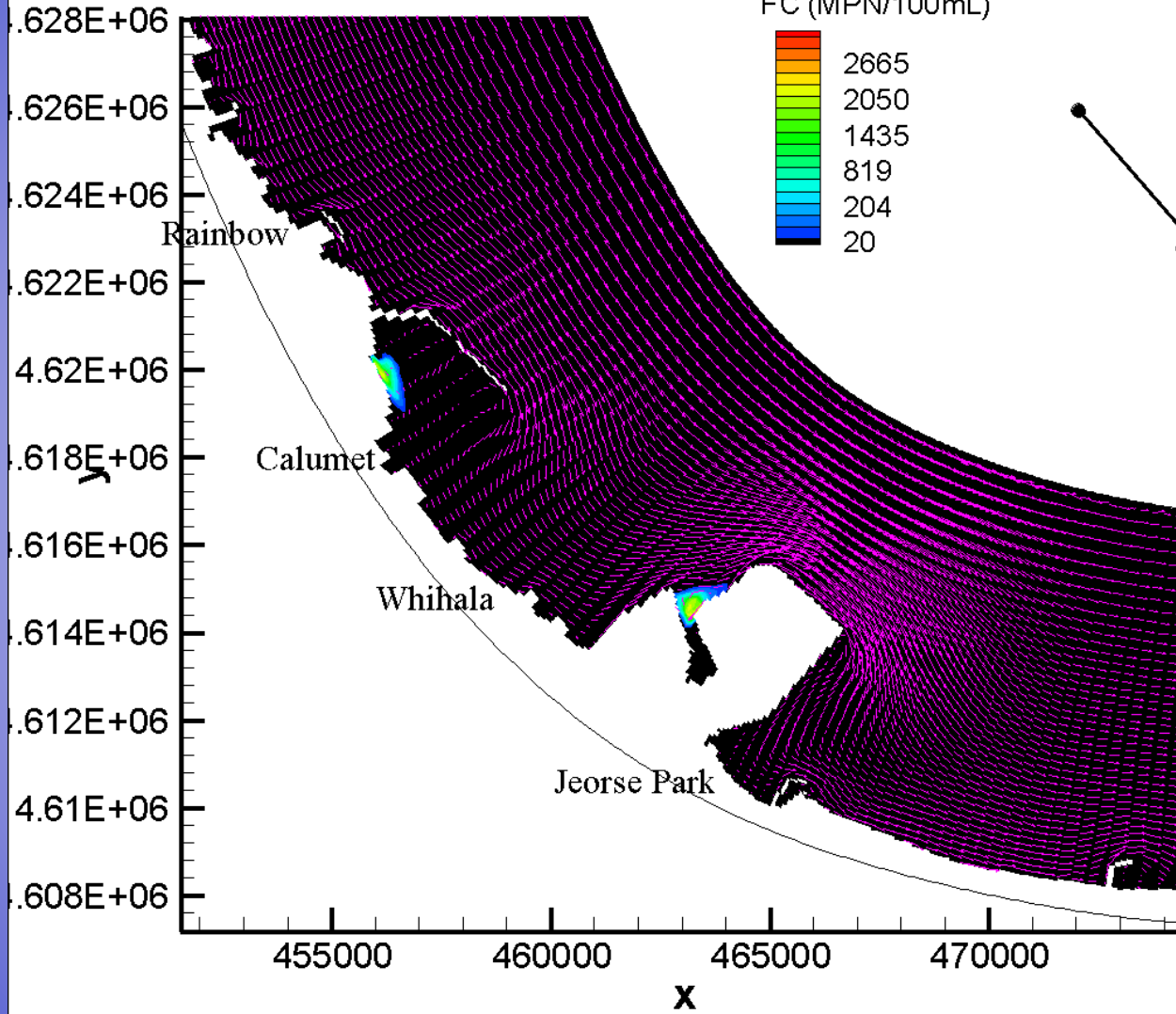
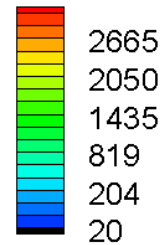


(a): suspended EC in the water; (b) settled EC in the sediment. Blue arrows: current field, note the gyre that concentrates *E. coli* in (a). This plot shows that under a typical current pattern EC cannot be released efficiently from inside to outside the embayment. Settling occurs faster (see (b)) than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

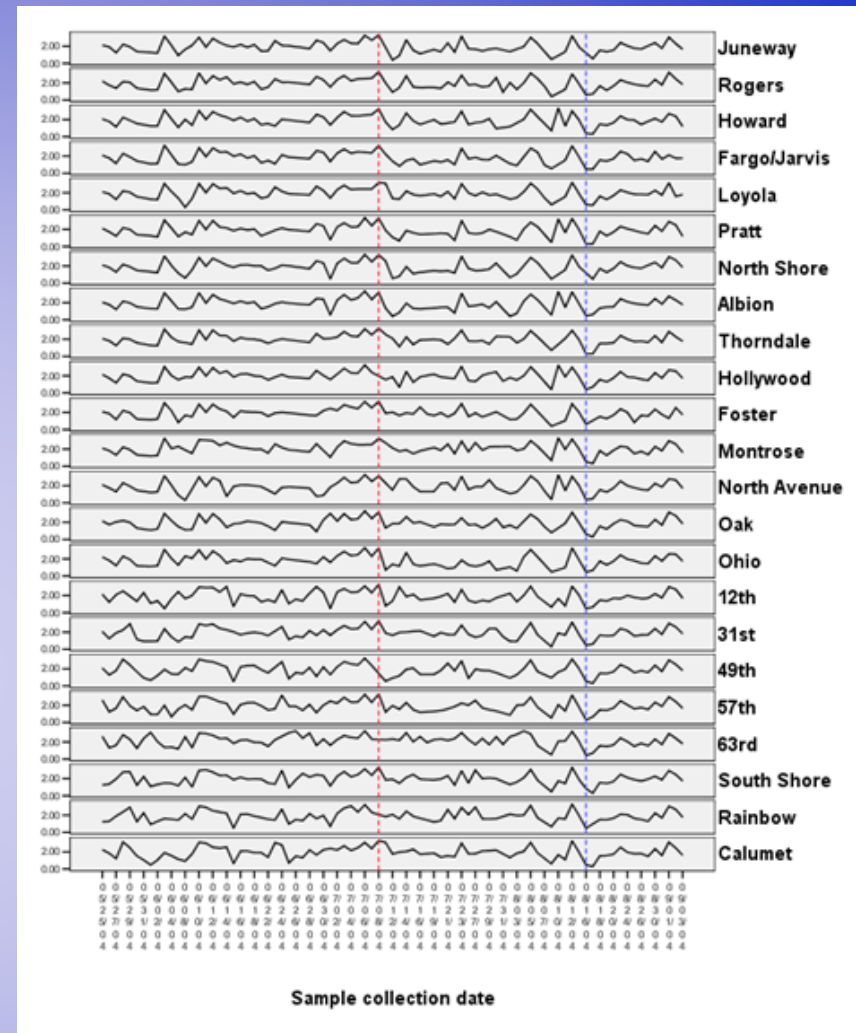
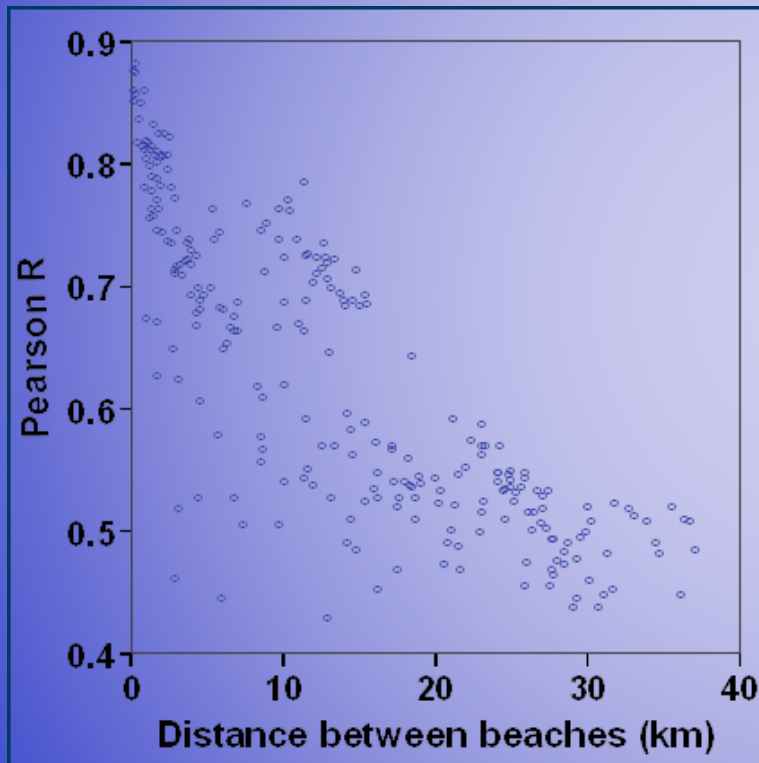
Day .3

Wind speed 11.5 (mph)

FC (MPN/100mL)



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

Whitman, R. L. and M. B. Nevers. 2008. Summer *E. coli* patterns and responses along 23 Chicago beaches. Environmental Science & Technology 42:9217-9224

Microbial Source Tracking

– summer 2010

	No. of Samples	HF183 human marker	Gull-2 Marker
Foster	55	4 (7%)	0
Montrose	55	4 (7%)	0
Calumet	55	1 (2%)	0
63rd	55	0	0
Jeorse Park	54	8 (15%)	20 (37%)

Fecal markers correlated with sanitary survey observations

	Human marker	Gull marker
Swimmers	0.200**	-0.006
Birds	0.048	0.306**
Algae	0.047	-0.096
Debris	-0.015	-0.051
Fecal Material	0.178**	0.328**



Potential Solutions

- Modeling
- Rapid Testing
- Refined Source Identification



Independent variables incorporated into models used during 2013 season

Solar Radiation	9/9
Rainfall	7/9
Wind Direction x Wind Speed	5/9
DOY	4/9
Water Depth	3/9
Wind Direction	3/9
Air Temperature	2/9

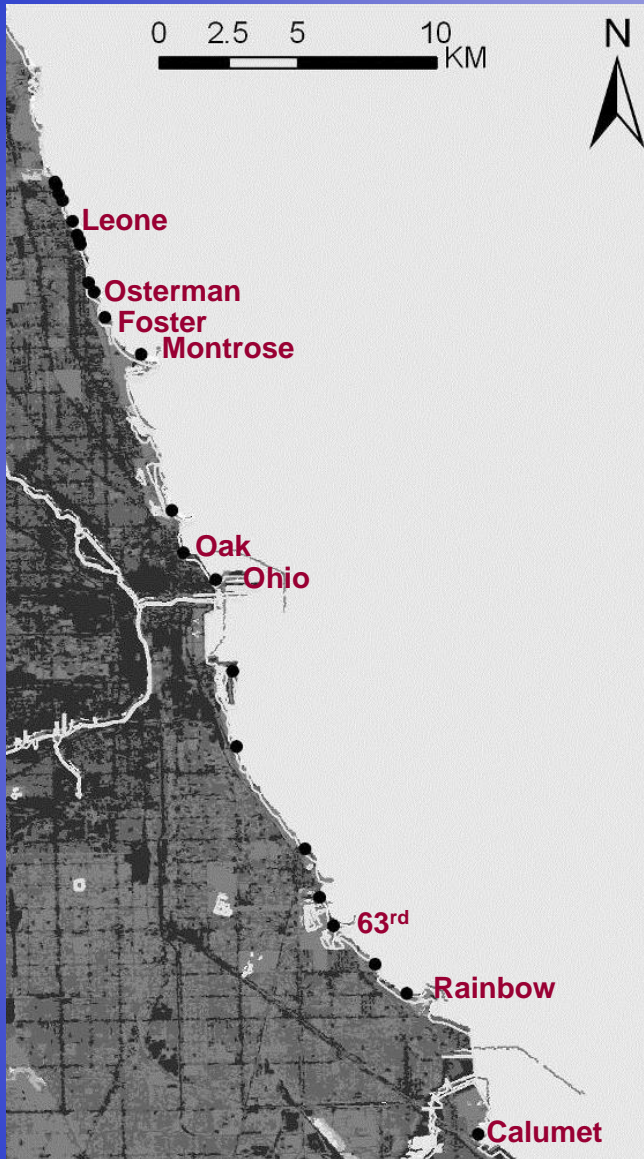
Barometric Pressure	1/9
Wave Height	1/9
Turbidity	1/9
DOW	1/9



Predictive Model Performance

Adjusted R²

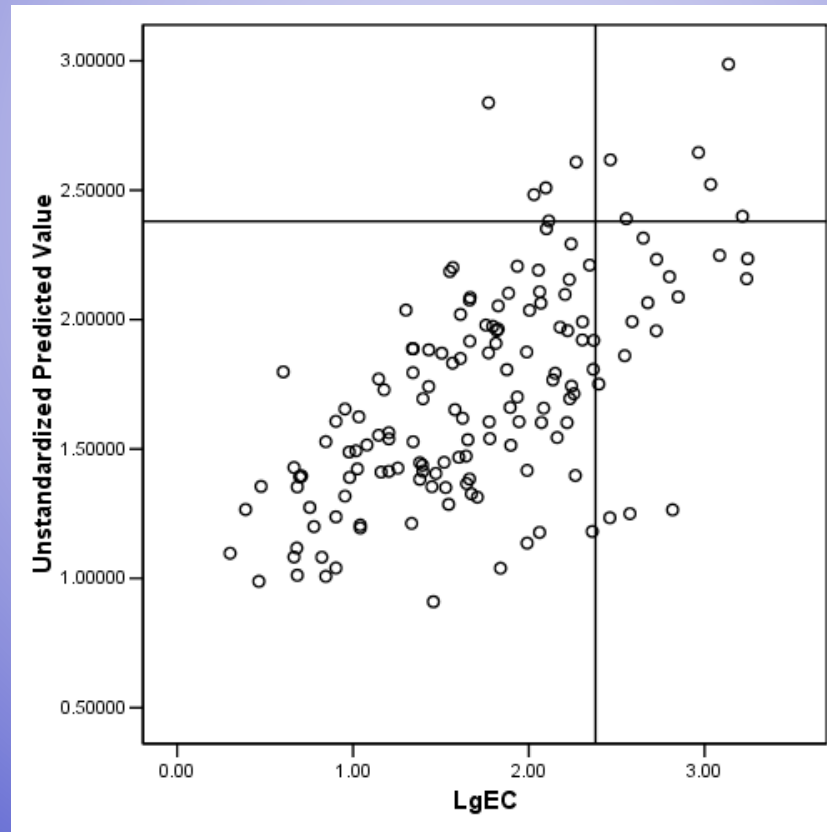
by year



	2012	2013	2014
Leone		0.381	0.341
Osterman		0.364	0.397
Foster	0.306	0.329	0.353
Montrose	0.334	0.238	0.191
Oak	0.220	0.167	0.267
Ohio		0.272	0.310
63 rd	0.367	0.286	0.144
Rainbow		0.103	0.117
Calumet	0.390	0.378	0.169

Calumet

Beach	Coefficients	Model Adj R2	Pers Adj R2
Calumet	Wave height	0.378	-0.005
	Solar radiation		
	Downshore wind		
	Depth		
	Turbidity		

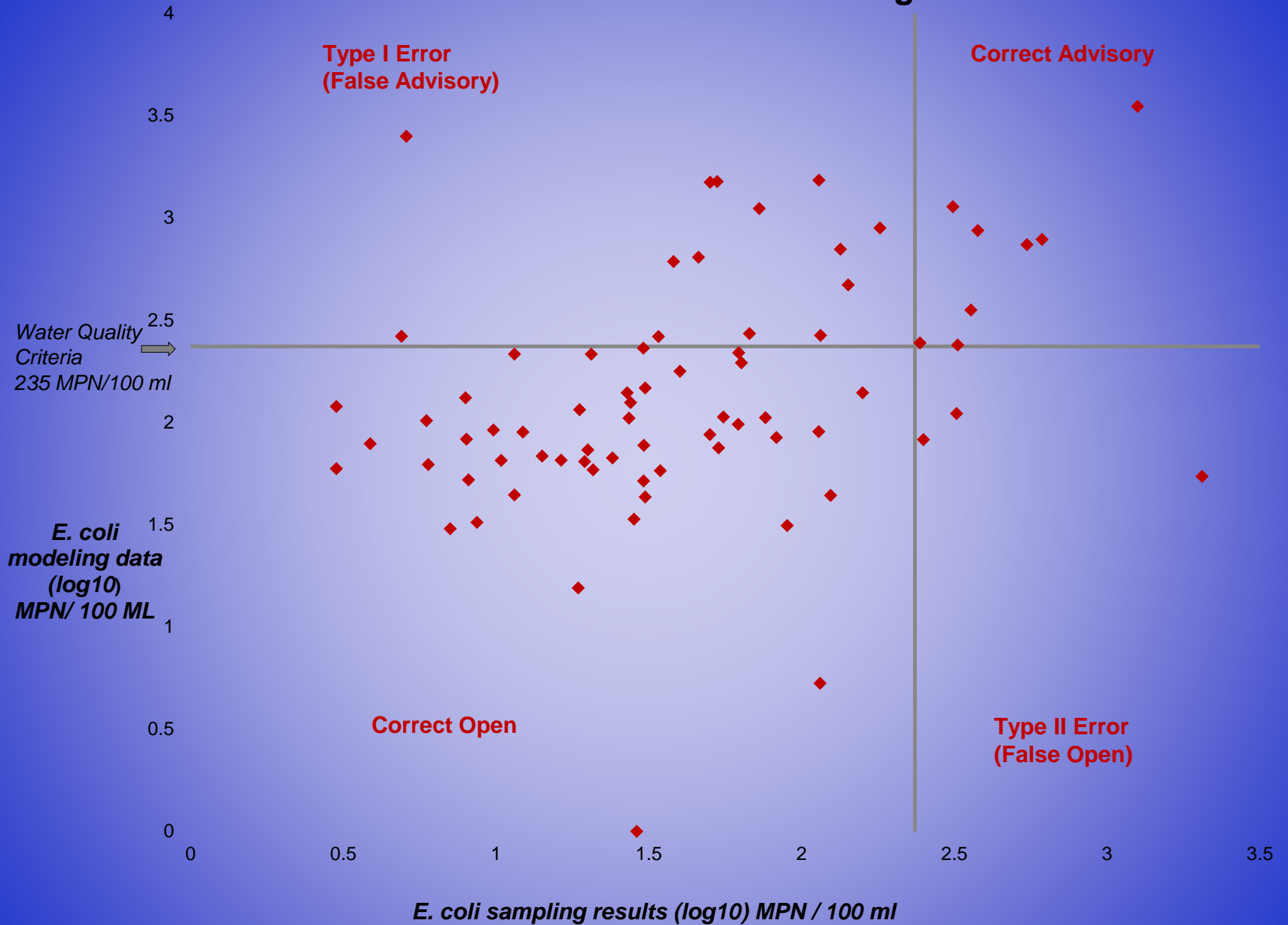


2013 Validation Results

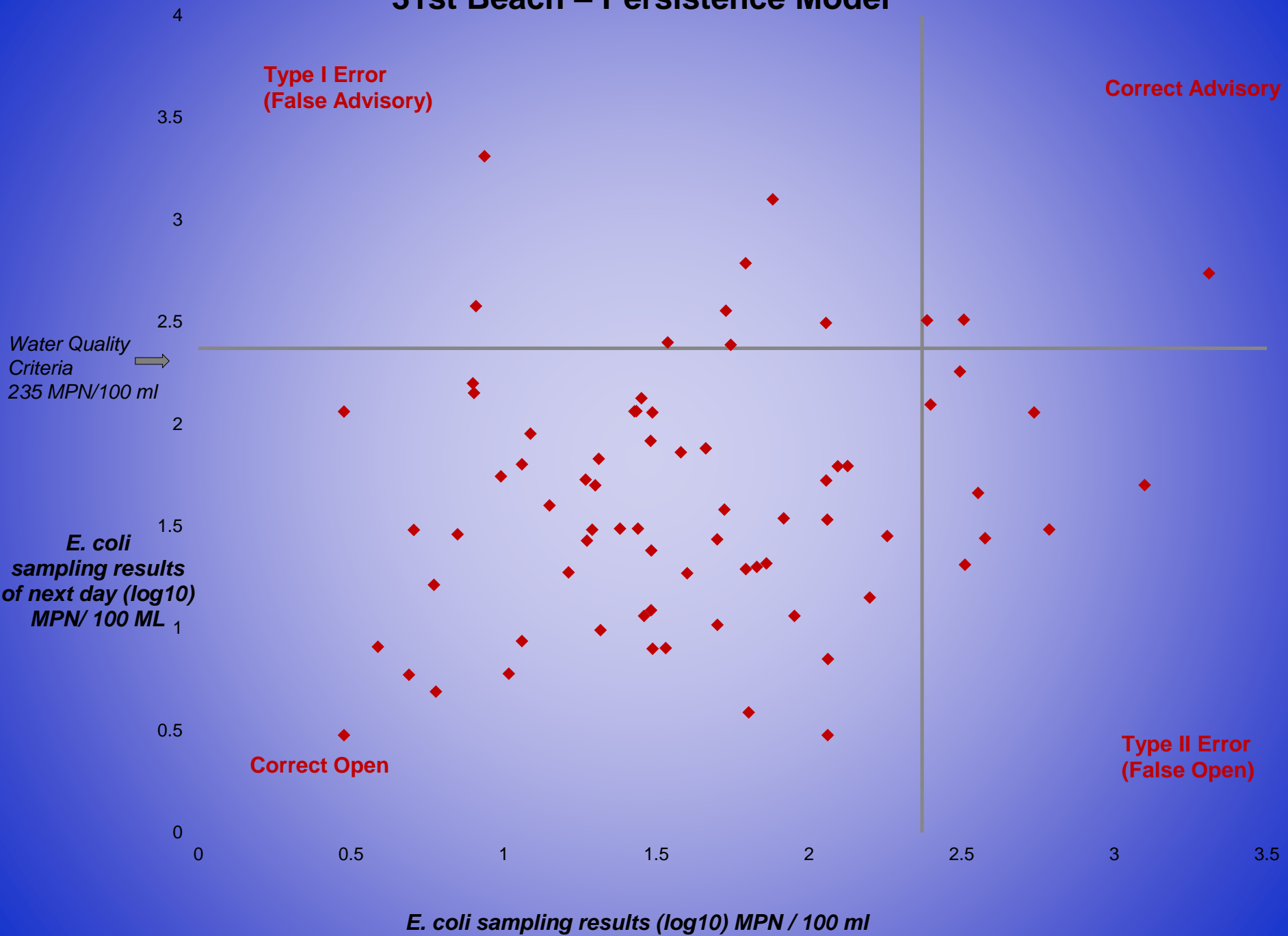


	Accuracy (%)		Sensitivity (%)		Specificity (%)	
	Empirical Model	Persistence Model	Empirical Model	Persistence Model	Empirical Model	Persistence Model
Leone	94	87	0	0	100	92
Osterman	92	84	0	20	100	90
Foster	90	82	14	33	100	88
Montrose	71	57	14	38	94	66
Oak	97	91	0	0	100	96
Ohio	92	89	25	75	100	91
63rd	78	75	25	45	89	82
Rainbow	84	66	8	25	100	77
Calumet	67	72	36	17	72	83

31st Street Beach 2013 Modeling



31st Beach – Persistence Model



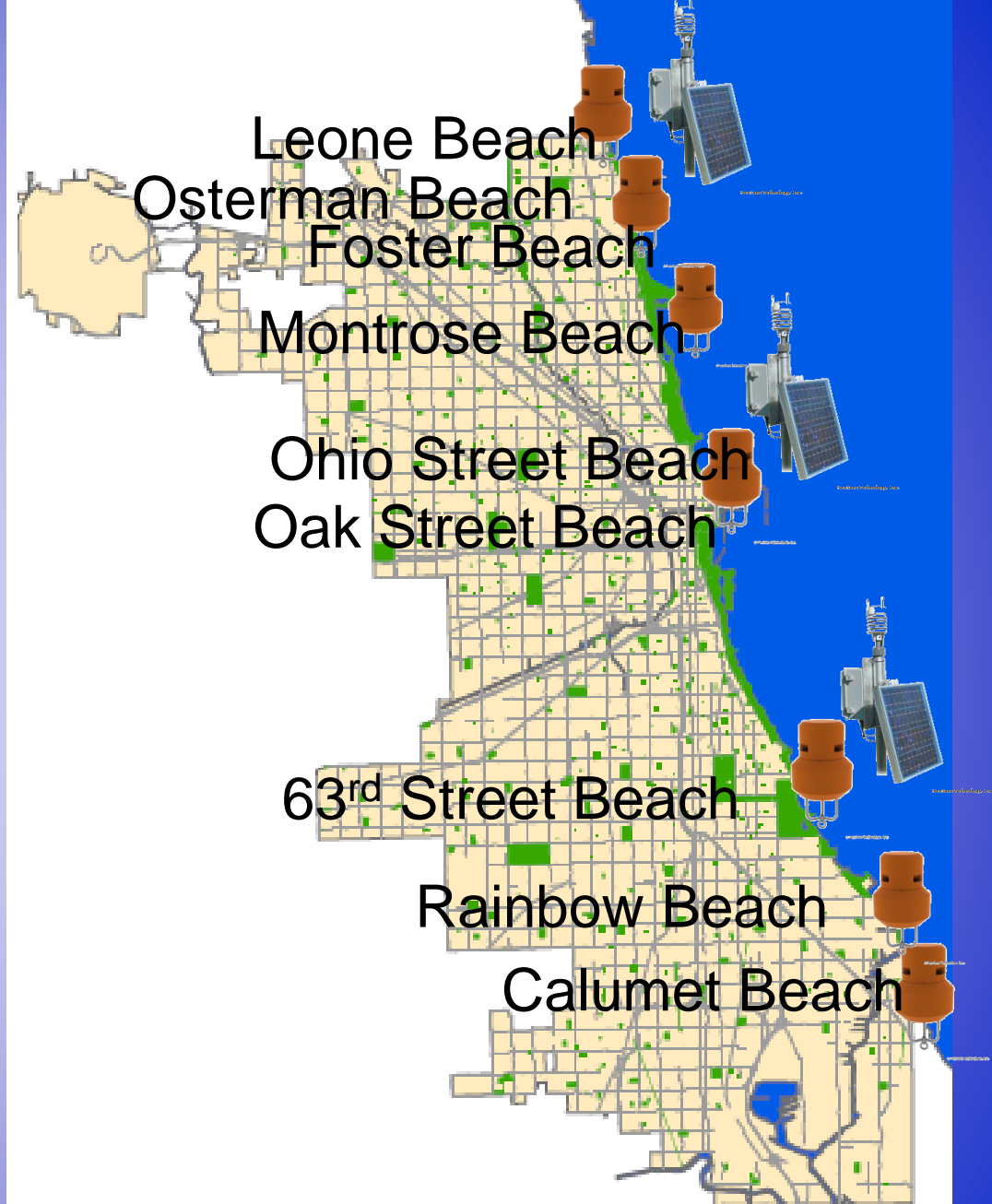
Predictive modeling: 2014

9 new models were developed using three years of data

Models will be applied at all beaches

Example: Montrose

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

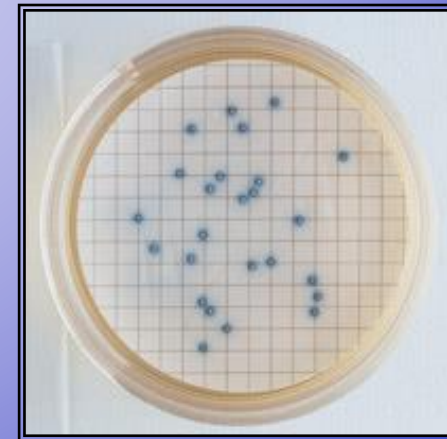
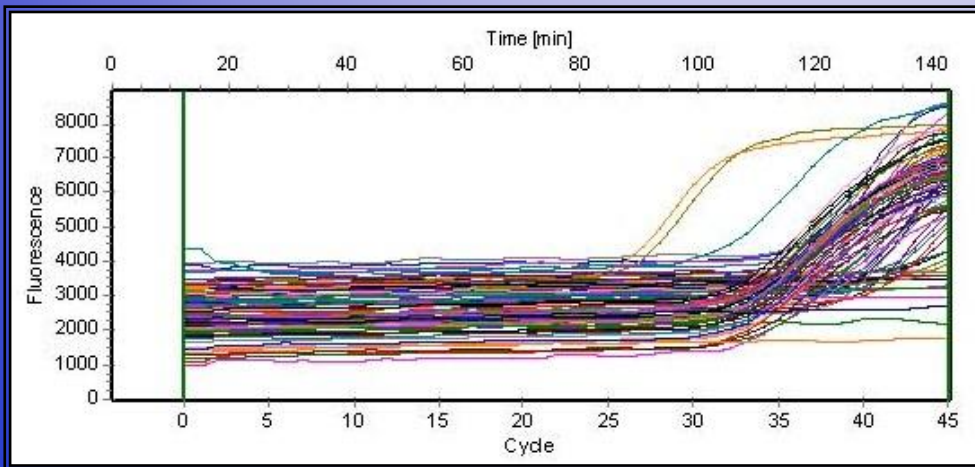


Potential Improvements



- 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



Rapid Testing using qPCR: Pilot Study 2014

Table 2. Comparison of the Percent of Samples Exceeding a Beach Action Value (BAV) for Three Analytical Methods Tested, Using the Same Water Sample^a

	EC %exceeding	ENT %exceeding	QENT %exceeding	N
Calumet 2010	25	27	3	33
Foster	13	12	3	33
Montrose 2009	18	42	12	33
Montrose 2010	27	55	6	33
63rd 2009	76	97	64	33
63rd 2010	24	21	0	33
Jeorse 2010	78	44	26	32

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!

**Meredith Nevers
US Geological Survey**

**Brendan Daley
Chicago Park District**

