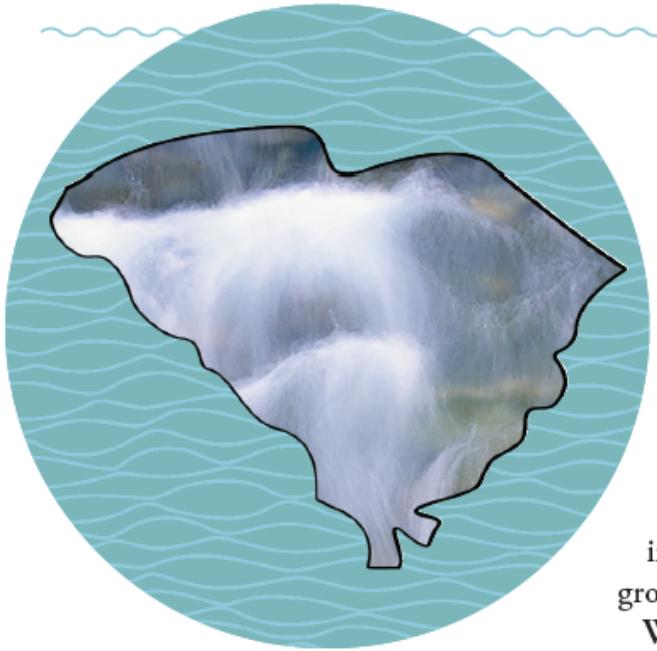
Izaak Walton League of America



SOUTH CAROLINA

C-

THE PROBLEM

Residents of South Carolina have the right to know whether the water flowing in their neighborhood streams is safe for fishing, swimming, and playing. Under the Clean Water Act, the state is tasked with monitoring all of its waterways, presenting that information to the public, and restoring polluted waters. Residents have much to be concerned about when it comes to water pollution. Pollutants found in South Carolina's waterways include toxic metals, mercury, bacteria, and acids; nutrients that spur algae growth; and sediment that chokes fish and other aquatic life.

When the Izaak Walton League did our own investigation, we found that South Carolina's dirty water problems go even deeper.

Transparency	Site-Specific Information	Age of Data	Frequency of Sampling	Water Quality Standards	Volunteer Engagement*
B	F	B	C+	C	D

*50% of final grade

Volunteer Engagement: D

- With rigorous monitoring procedures and training, volunteers can collect scientifically valid, accurate water quality data.
- Because it is so important that states work with volunteer monitors, this counts for 50% of a state's final grade in this report.
- In SC, independent groups educate, train, and equip volunteers to monitor SC's streams and rivers.
- However, the state does not use these data in its mandatory biennial water quality reports to USEPA and has little to no communication with volunteers about how their data is, or is not, being used.
- **Recommendation:** SC should expand engagement with volunteer stream monitors and more effectively use the data they collect to ensure the public has accurate, timely, and site-specific information about water quality in streams and rivers statewide.

Volunteer Monitoring for fecal indicator bacteria

Susan Libes

Volunteer Water Quality Monitoring Luncheon 2016

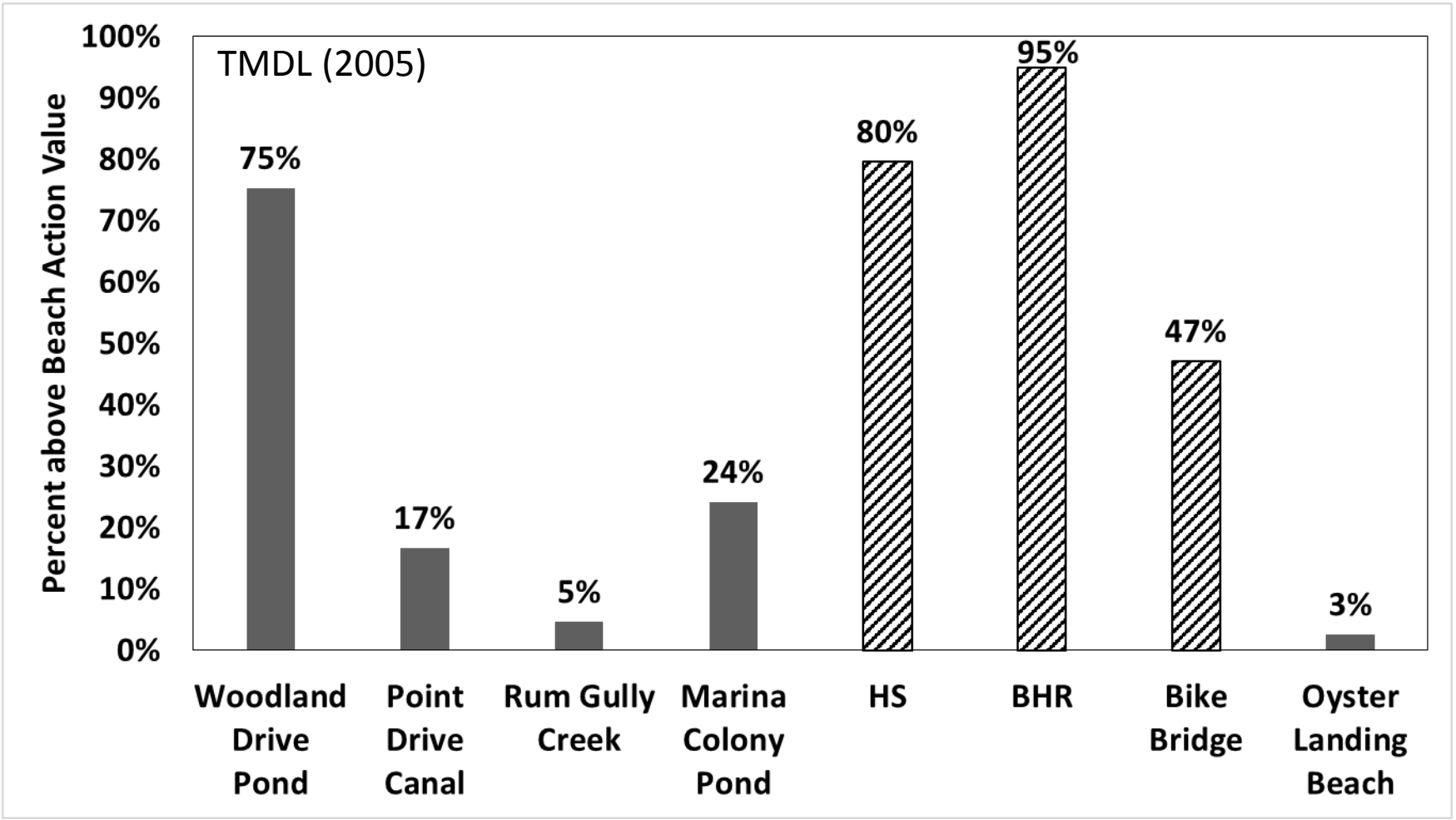
Topics

- Highlight the differences between the programs
- How we report out the results to the stormwater managers
- What they do with the data
- How our data compare to certified lab results
- Complications in the use of bacteria for assessing health risks

E. coli Results

- **Waccamaw River (since 2009)**
  - Consistently low levels
  - E. coli strains produce small and weakly blue-colored colonies
- **Murrells Inlet (since 2009)**
  - Half the sites exhibit consistently high levels
  - Microbial source tracking has eliminated human sources
    - Some done by the volunteers
    - Some done by CCU's EQL
  - Nuisance wildlife is the likely suspect
  - A watershed plan has been developed to remediate these problem areas

Percent Exceedance of *E. coli* above the EPA (2012) Beach Action Value of 235 CFU/100 mL July 2009 to March 2016

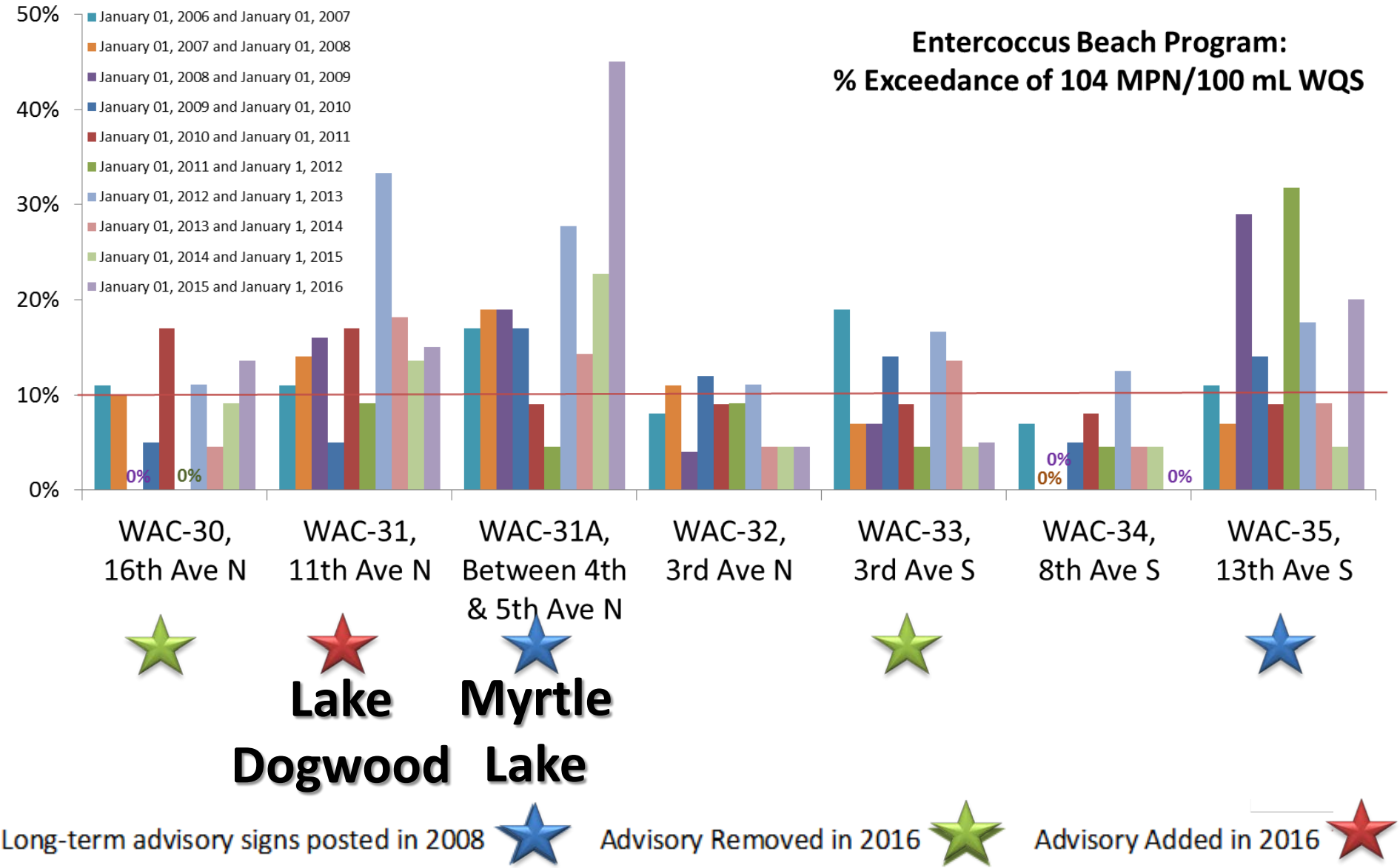


Total sample count per site ranges from 151 to 158. Cross hatched bars indicate sites in Georgetown County where microbial source tracking was performed in 2015.

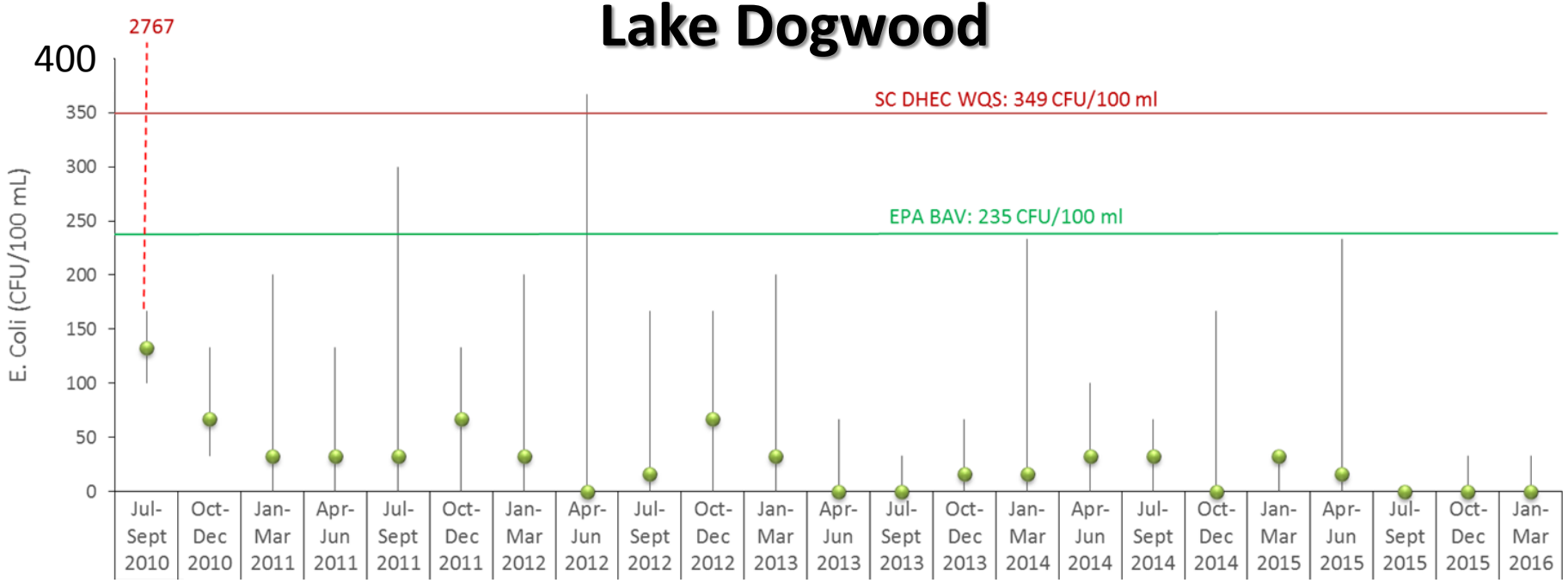
E. coli Results

- **Waccamaw River (since 2009)**
  - Consistently low levels
  - E. coli strains produce small and weakly blue-colored colonies
- **Murrells Inlet (since 2009)**
  - Half the sites exhibit consistently high levels
  - Microbial source tracking has eliminated human sources
    - Some done by the volunteers
    - Some done by CCU's EQL
  - Nuisance wildlife is the likely suspect
  - A watershed plan has been developed to remediate these problem areas
- **Surfside (2010)**
  - One of the two sites exhibits elevated levels that are generally just above the water quality standard
  - Microbial source tracking has eliminated human sources
  - Birds are the likely suspect

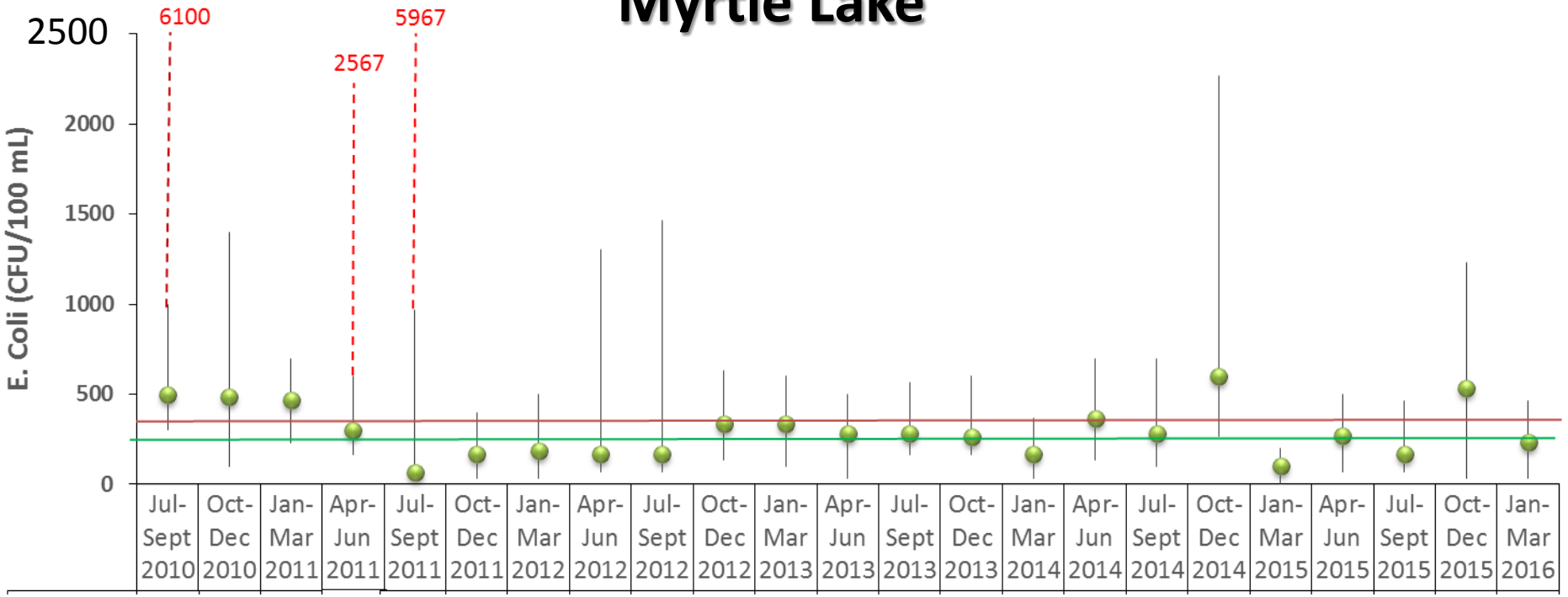
SC DHEC Beach Monitoring Data



Lake Dogwood



Myrtle Lake



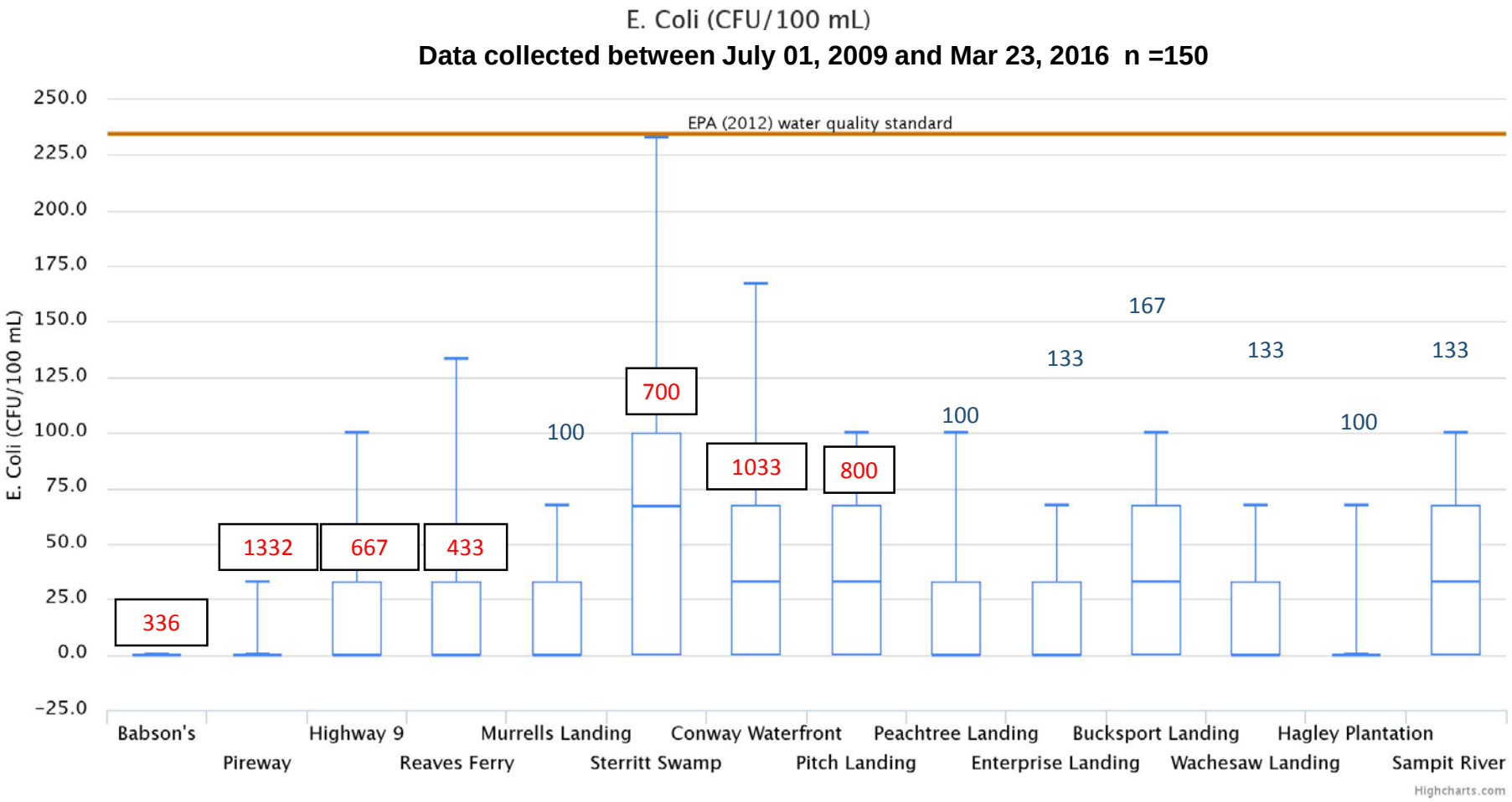
Illicit Discharge Detection

- You check your percentiles
- Report unusually high results via phone/email
- We report to field leaders and stormwater managers
- Case Study: Waccamaw River on 11/4/15.

Values are highly unusual if they are outside of this range

SITE:	***4th Ave N***		
Parameter	***Range***		
Cond (uS/cm)	1977	to	23200
TDS (mg/L)	990	to	13470
pH	7	to	8
Turbidity (NTU)	4	to	9
Nitrate (mg N/L)	0	to	0
Nitrite (mg N/L)	0	to	0
Ammonia (mg N/L)	0	to	0
E. Coli (CFU/100 mL)	67	to	1000
Total Coliform (CFU/ 100 mL)	533	to	7233
DO (mg/L) > 20 C	5.11	to	9.3
DO (mg/L) < 20 C	7.17	to	11.52
%DO > 20 C	64.1	to	112
%DO < 20 C	72	to	101.5
Temp > 20 C	20.8	to	30.2
Temp < 20 C	8.7	to	18.1

E. coli (CFU/100 mL)



Waccamaw River Volunteer Monitoring: 11/4/2015

Sampling Sites	Conductivity (µS/cm)	TDS (ppm)	pH	DO (mg/L) < 20 C	% DO < 20 C	Temp < 20 C	Turbidity (NTU)	Nitrate (ppm N)	Nitrite (ppm N)	Ammonia (ppm N)	E. coli (CFU/100 mL)	Total coliform (CFU/100 mL)
LAWA Dam	<10th	<10th	Site Normal	<25th	Site Normal	> 90th	Site Normal	Site Normal	Site Normal	Site Normal	Site Normal	>75th
Canal Cove	<25th	<25th	Site Normal	>75th	>75th	> 90th	> 90th	Site Normal	Site Normal	Site Normal	Site Normal	> 90th
Maple Street	Site Normal	Site Normal	Site Normal	<10th	<25th	> 90th	>75th	Site Normal	Site Normal	Site Normal	Site Normal	> 90th
Big Creek	<25th	<25th	Site Normal	<25th	<25th	> 90th	Site Normal	Site Normal	Site Normal	Site Normal	Site Normal	>75th
Babson's Landing	<10th	<25th	Site Normal	<25th	<25th	> 90th	Site Normal	Site Normal	Site Normal	Site Normal	> 90th	> 90th
Pireway Landing	<10th	<10th	Site Normal	<25th	<25th	> 90th	> 90th	Site Normal	Site Normal	>75th	> 90th	> 90th
Highway #9	<10th	<10th	Site Normal	<25th	Site Normal	> 90th	> 90th	Site Normal	Site Normal	Site Normal	> 90th	> 90th
Reaves Ferry	<10th	<10th	Site Normal	<25th	Site Normal	> 90th	> 90th	Site Normal	Site Normal	Site Normal	> 90th	> 90th
Murrells Landing	<10th	<10th	<25th	<10th	<10th	> 90th	Site Normal	Site Normal	Site Normal	Site Normal	> 90th	> 90th
Sterritt Swamp	<10th	<10th	Site Normal	Site Normal	>75th	> 90th	> 90th	Site Normal	Site Normal	Site Normal	> 90th	> 90th
Conway Waterfront	<10th	<10th	Site Normal	Site Normal	>75th	> 90th	> 90th	Site Normal	Site Normal	Site Normal	> 90th	> 90th
Pitch Landing	<10th	<10th	Site Normal	<25th	<25th	> 90th	> 90th	Site Normal	Site Normal	Site Normal	> 90th	> 90th
Bucksport Landing	<25th	<25th	<25th	<10th	<10th	> 90th	<10th	Site Normal	Site Normal	Site Normal	>75th	>75th
Peachtree Landing	<10th	<10th	Site Normal	<10th	<25th	> 90th	Site Normal	Site Normal	Site Normal	>75th	> 90th	Site Normal
Enterprise Landing	<25th	<25th	Site Normal	<10th	<10th	> 90th	Site Normal	Site Normal	Site Normal	Site Normal	> 90th	Site Normal
Wachesaw Landing	Site Normal	Site Normal	Site Normal	<25th	<25th	> 90th	<25th	Site Normal	Site Normal	Site Normal	> 90th	Site Normal
Hagley Landing	Site Normal	Site Normal	Site Normal	<25th	Site Normal	> 90th	<25th	Site Normal	Site Normal	> 90th	>75th	Site Normal
Sampit River	<25th	<25th	Site Normal	<10th	<25th	> 90th	Site Normal	Site Normal	Site Normal	Site Normal	>75th	> 90th

ALERT: value is somewhat to highly unusual and contravenes WQS

Warning: Value contravenes WQS, but is not unusually bad

Caution: Value is highly unusual, but does not contravene WQS

Value is somewhat unusual and should be watched

For threat levels: For the highest threat, first consider the cells that are red font on red shading. Then consider red shaded cells with black font as these suggest some new and significant event has occurred. The second level of threat are the green shaded cells. Those in black font are of lowest concern but bear watching.

Comparison with Regulatory Method

Site	E.coli (RG: MPN/100 mL) (VM: CFU/100 mL) River Gaging 11/5/15	Vol. Mon. (11/4/15)	%RPD (VM-RG)
Babson's Lndg, NC		366	
Pireway, NC		1332	
Buck Creek	687		
Highway 9	517	667	25%
Reaves Ferry	345	433	23%
Murrells Lndg		100	
Sterritt Swamp		700	
Crabtree	980		
Conway	326	1033	104%
Pitch Landing		800	
Bucksport	118	100	-16%
Peachtree Lndg		133	
Enterprise Lndg		167	
Wachesaw Lndg		133	
Hagley	186	100	-60%
Gallivants Ferry	365		
Sampit		133	

> SC DHEC WQS

From: Fuss, Dave [mailto:fussj@HorryCounty.org]
Sent: Tuesday, November 10, 2015 4:22 PM
Subject: RE: High E. coli in the Waccamaw River

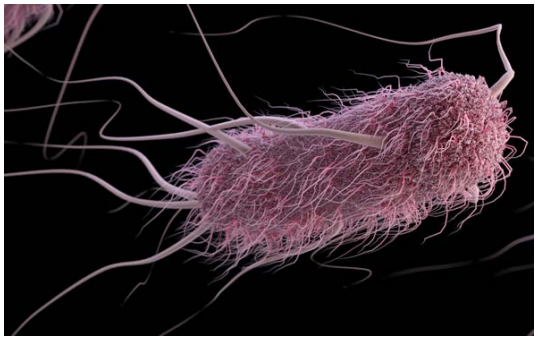
In the Crabtree Swamp basin, I am aware of **sewer overflows** near the Oak St restoration site and Sherwood Ave associated with the big storm in early October and then again near Oak St restoration site early last week. I consulted with Grand Strand Water and Sewer Authority and they have not had any overflows in the Hwy 9/Buck Creek area - sewer is limited in that area anyway. During the big storm in early October (4-5), the Central wastewater plant on Jackson Bluff Rd failed and overflowed. I'm not sure that this would still be affecting Pitch Landing, though.

The magnitude of these numbers could be attributed to washoff of wildlife or domestic animal waste or compromised septic systems, but it is difficult to pinpoint specific sources of these contributors. Sewer overflows typically result in bacteria numbers several orders of magnitude or higher.

I will continue to monitor these areas as I can to check for possible sources.

Dave Fuss | Watershed Planner
Horry County Government
Stormwater Management
4401 Privetts Road, Conway, South Carolina 29526
Tel 843-915-6952 | Fax 843-365-2208 | fussj@horrycounty.org

What are we measuring and why?



- Fecal indicator bacteria
  - *E. coli* for freshwater
  - *Enterococcus* for saltwater
  - Fecal coliform for shellfish
- Want an assessment of human health risk
  - Recreational contact
  - Shellfish consumption
- Use numeric water quality criteria
  - Single sample
  - Geometric mean from samples collected over a 30-day period
- Health endpoint used to set water quality criteria
  - Gastroenteritis
  - Relates exposure to a GI illness rate with a specified level of confidence
  - For example, 90% confidence that less than 8 out of 1000 swimmers will get ill if *E. coli* levels are below the water quality criteria.

NOTE: We are not measuring their true concentrations, but the number that will grow on media at a certain temperature over a specific time period

Why are we using Micrology's Easygel Plus media?

THE Volunteer Monitor
THE NATIONAL NEWSLETTER OF VOLUNTEER WATERSHED MONITORING Volume 18, Number 1 • Winter 2006

volunteers conduct
Bacteria Methods Comparison study

by Eric O'Brien

An interesting fact came to light at a 2002 strategic planning meeting for the Great Lakes region: out of the six states attending (Iowa, Indiana, Michigan, Minnesota, Ohio, and Wisconsin), only two had volunteer monitoring programs that included testing for bacteria. These were Iowa's IOWATER program, run by Iowa Department of Natural Resources (DNR), and Indiana's Hoosier Riverwatch, sponsored by Indiana DNR.

This discovery was the beginning of what would become the Citizens Monitoring Bacteria Project, a multiyear, multistate undertaking.

Soon after the meeting, representatives from Iowa DNR, Indiana DNR, Purdue University, Michigan State University, the University of Minnesota, the Ohio State University, and the University of Wisconsin formed a workgroup to encourage more bacteria monitoring by volunteer programs in the region. We decided that our first step should be to conduct a study to compare several different bacteria testing methods. Recognizing the potential value of our efforts, not only in our region but around the country, we applied for and received a grant from USDA Cooperative State Research, Education, and Extension Service (CSREES).

Iowa and Indiana took the lead in designing and carrying out the first year of the study while researchers in Wisconsin worked on creating survey questionnaires to determine the volunteers' opinions of the different methods. Michigan, Minnesota, and Ohio were charged with developing training and outreach materials.

We began the comparison study in 2004, expecting that at the end of a year we would have a clearcut "winner"—but it didn't quite work out that way, as we shall see.

"Real world" conditions

It's important to emphasize that our project was not a pure method-comparison study in which other variables besides the methods themselves are strictly controlled. To the contrary, we intentionally kept the "messiness" in. Our goal was to compare the performance of the different methods in the hands of actual volunteer monitors, sampling at their own monitoring sites and performing the analyses in their own homes. The volunteers' opinions and perceptions were also taken into account in evaluating the different methods.

Choosing methods for the study

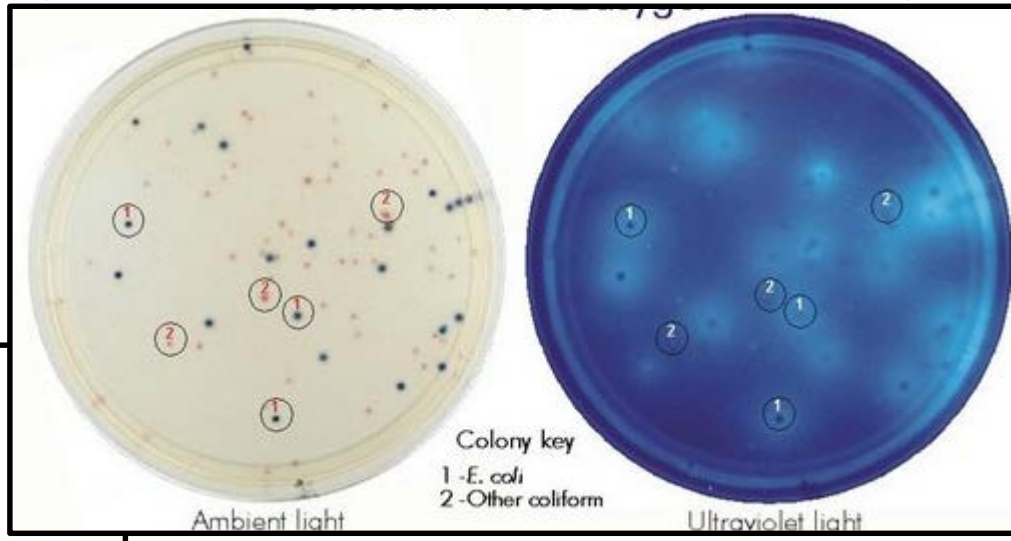
All the methods we studied were for enumerating the indicator *E. coli*, which is, or soon will be, the indicator of choice for all the states in our region for ambient freshwater monitoring. In selecting the methods, we kept in mind the different needs and resources of different volunteer monitoring programs. Pro-

continued on page 3

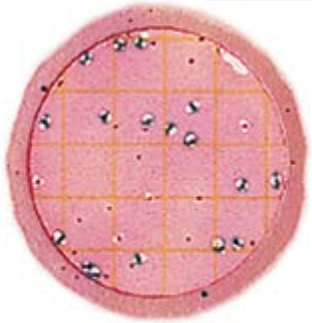
Bacteria Monitoring

IN THIS ISSUE

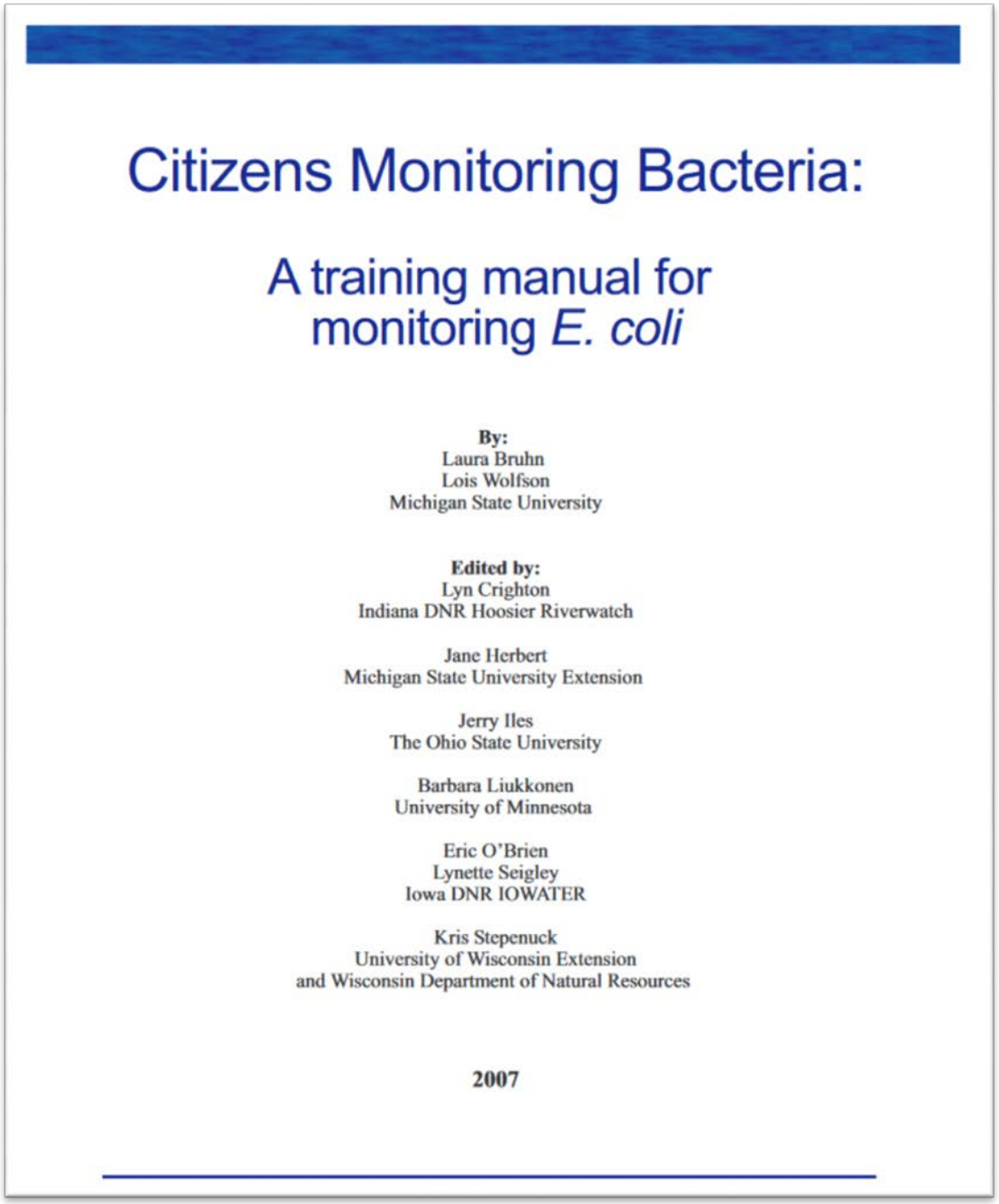
Micrology's Coliscan Plus Easygel



3M's Petrifilm



Idexx's Colilert



Citizens Monitoring Bacteria:

A training manual for monitoring *E. coli*

By:
Laura Bruhn
Lois Wolfson
Michigan State University

Edited by:
Lyn Crighton
Indiana DNR Hoosier Riverwatch

Jane Herbert
Michigan State University Extension

Jerry Iles
The Ohio State University

Barbara Liukkonen
University of Minnesota

Eric O'Brien
Lynette Seigley
Iowa DNR IOWATER

Kris Stepenuck
University of Wisconsin Extension
and Wisconsin Department of Natural Resources

2007

http://www.usawaterquality.org/volunteer/EColi/June2008Manual/Final_ecoli_06c1.pdf

QUALITY ASSURANCE PLAN FOR BACTERIOLOGICAL MONITORING

(Addendum to the Quality Assurance Plan approved on March, 1995)

for

Alabama Water Watch

A Program dedicated to developing Citizen Volunteer Monitoring of Alabama's Lakes, Streams and Wetlands

Funded in part by a grant from the U.S. EPA, Region 4
Clean Water Act, Section 319
and the Alabama Department of Environmental Management

prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 4, Section 319

November 10, 1999

APPROVALS:

Allison L. Busby, M.S., AWW QA/QC Officer — Date 11/16/99

William G. Deutsch, Ph.D., AWW Program Manager — Date 11/16/99

Norman Blakey, ADEM Project Director — Date 12/3/99

Gary Bennett, U.S. EPA Region 4, Quality Assurance Officer — Date 12-20-99

Comparability is done through the side-by-side studies of the Coliscan Easygel method with Standard Methods for bacteriological testing. These comparison studies have indicated that the Coliscan Easygel method is a reliable and valid tool for the detection of fecal contamination

http://www.alabamawaterwatch.org/wp-content/uploads/sites/40/2015/02/QAQC-Bact-Plan_1999.pdf

Complications in using fecal indicator bacteria for estimating recreational health risk

- Fecal indicator bacteria are not specific for humans
- True pathogen is likely norovirus
  - Pathogens are not likely to be present in the same abundance and persistence as the FIB

- FIB can survive and replicate outside the host.
  - They can potentially lose their relationship to pathogenic organisms.
- Beach sands and wetlands can serve as a reservoir.
- Water quality criteria are based on limited EPI studies, some of which trace back to WWTP sources and not stormwater sources.

Myrtle Lake in Surfside

- Colilert results are usually higher than Easygel
  - Sometimes straddle the water quality criteria
- False positives on Colilert?
- False negatives on Easygel?

Complications with the Water Quality Criteria

- **Recreational Usage** (Clean Water Act)
  - Total coliform (1948) → Fecal coliform (1968) → *E. coli (1986)*
  - Saltwater: *Enterococcus* (1986)
  - VM program started using *E. coli* in 2008
  - SC DHEC adopted *E. coli* criteria in 2012
  - *Under court order USEPA updated their *E. coli* criteria in 2012
- **Shellfish Consumption** (National Shellfish Sanitation Program)
  - Fecal coliforms
- **Drinking Water** (Safe Drinking Water Act)
  - Total coliforms
- **How else are the criteria used?**
  - Biannual 305(b) reports
  - Biannual 303(d) list
  - Total Maximum Daily Loads (TMDLs)

The current last word .....

International Journal of
Environmental Research and Public Health
ISSN 1660-4601
www.mdpi.com/journal/ijerph

Conference Report

U.S. Recreational Water Quality Criteria: A Vision for the Future

Roger S. Fujioka [1,*], Helena M. Solo-Gabriele [2], Muruleedhara N. Byappanahalli [3] and Marek Kirs [4]

The RWQC of 2012 did not meet expectations among the research community because key recommended studies were not completed, new data to assess risks to bathers exposed to non-point sources of fecal indicator bacteria (FIB) were not developed, and the 2012 RWQC did not show marked improvements in strategies for assessing health risks for bathers using all types of recreational waters.

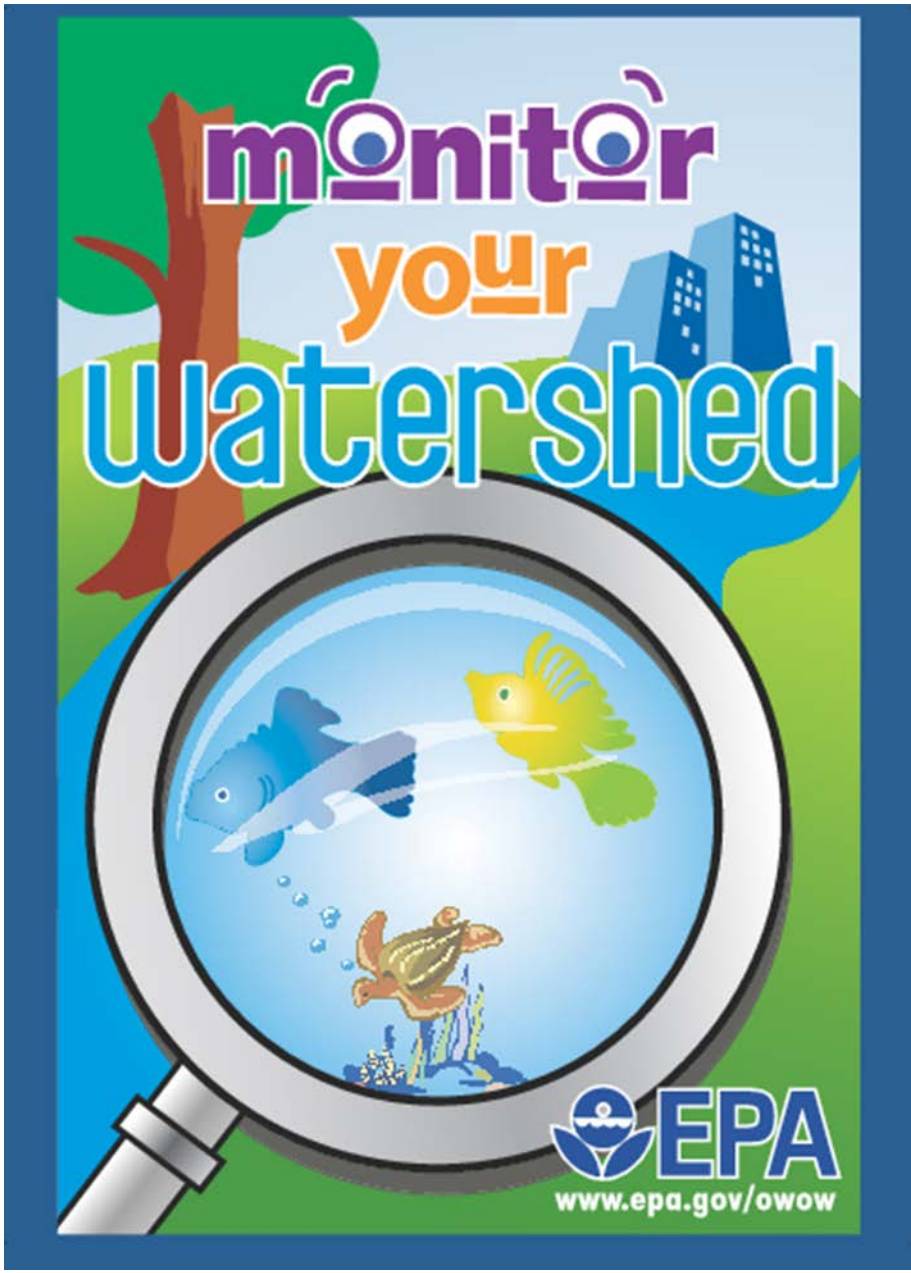
The 2012 RWQC introduced a program for states and tribes to develop site-specific water quality criteria, and in theory this approach can be used to address the limitations associated with the measurements of the traditional FIB.

What's coming

- Quantitative Microbial Risk Assessment (QMRA)
  - Not all sources present the same level of health risk
  - Human-sourced pathogens are the biggest health risk to humans
- Measurement of the true pathogens
  - Norovirus
  - Coliphage project (Joe Cannon)
- Standards for beach sand
- For beach advisories, new technologies for faster production of results

In conclusion …..

- We measure more sites & more frequently than SCDHEC.
- Our data are provided quickly enough to support illicit discharge follow ups by the stormwater managers.
- Our data are available online in easy-to-use formats (statistics, graphs, and with rain data).
- Are results compare well with certified lab on the Waccamaw River.
- Research effort to be conducted to investigate sites that might be special.



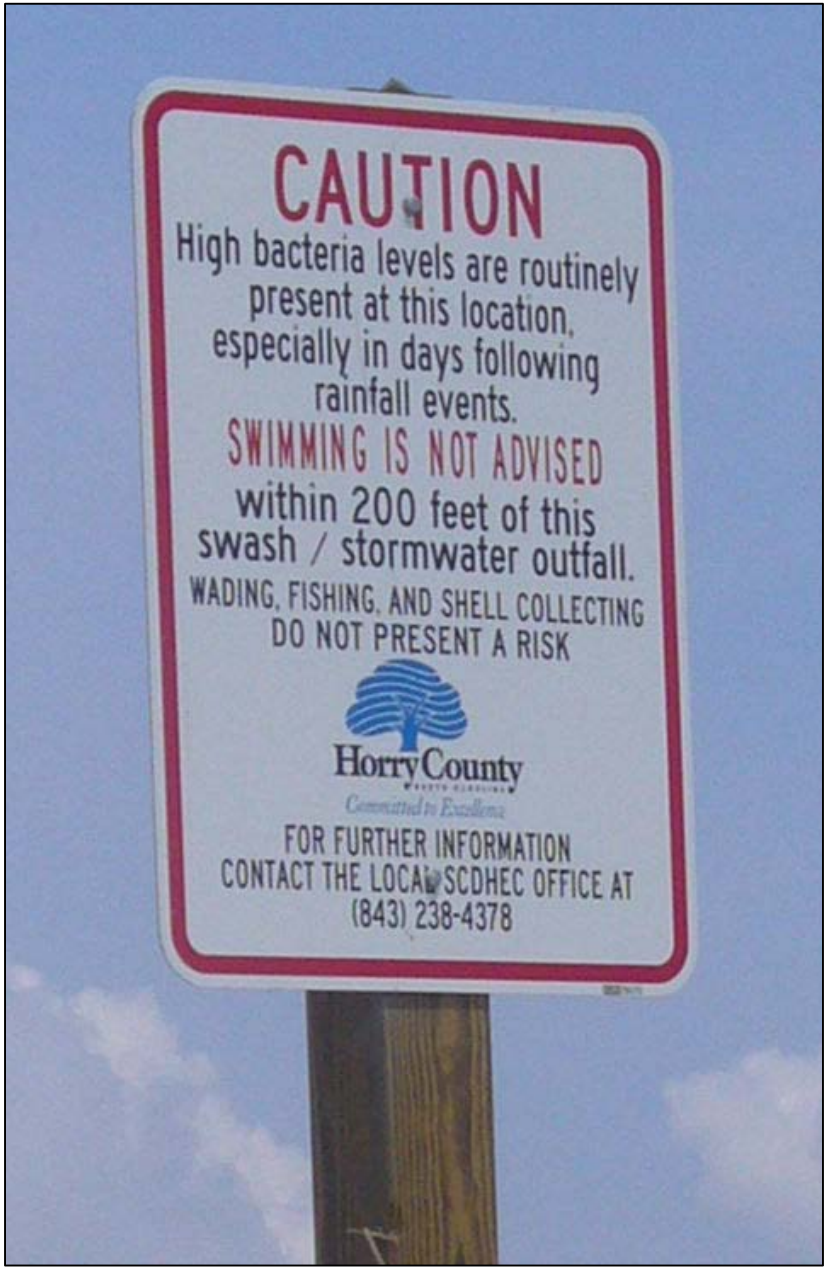
Beach monitoring slides

Stormwater Pipes on the Beach Face

Swashes - aka Tidal Creeks

Fishing In Swash


CAUTION
High bacteria levels may be present at this location, especially in days following rain due to storm water runoff.
SWIMMING IS NOT ADVISED
within 200 feet in each direction of this swash/stormwater outfall.
Wading, fishing, and shell collecting do not present a risk.
For more information contact the local DHEC office at (843) 238-4378.
D H E C
PROMOTE PROTECT PROSPER
South Carolina Department of Health and Environmental Control
CITY OF MYRTLE BEACH
SOUTH CAROLINA


CAUTION
High bacteria levels are routinely present at this location, especially in days following rainfall events.
SWIMMING IS NOT ADVISED
within 200 feet of this swash / stormwater outfall.
WADING, FISHING, AND SHELL COLLECTING DO NOT PRESENT A RISK
Horry County
Committed to Excellence
FOR FURTHER INFORMATION CONTACT THE LOCAL SCDHEC OFFICE AT (843) 238-4378

S.C. Beach Guide Online Help

Welcome to the S.C. Beach Guide!

A product of the South Carolina Department of Health and Environmental Control

This application is designed to provide residents and visitors information and directions to public beach access locations and the amenities associated with those locations, and also important beach water quality information for monitoring stations proximate to access locations. With a few simple selections, you'll be able to explore over 600 public access points along South Carolina's 187 miles of Atlantic shoreline. This application is web-based and mobile device-enabled, so you can plan your trip in advance and navigate among public access sites while on your trip!

Please learn more about using this application by reading below. We hope you enjoy your next visit to the beach!

***NOTE:** Beach water quality monitoring for swimming advisories is ONLY performed May 1 through October 1.*

Symbology

No Active Swimming Advisory

Beach monitoring for swimming advisories is performed May 1 through October 1. Monitoring shows no swimming advisory is needed.

Long-Term Swimming Advisory

Long-term swimming advisory signs are posted at this location. Swimming is not advised within 200 feet on either side of the sign because high bacteria levels may be present, especially following rain due to storm water runoff. Wading, fishing, and shell collecting do not present a risk. Health problems typically come from swallowing the water. See the Long-Term Swim Advisory graphic below for further explanation.

Temporary Swimming Advisory

Recent sample results indicated the area 200 feet on either side of this sign is NOT safe for swimming at this time. Sampling will continue daily until the advisory can be lifted. Wading, fishing, and shell collecting are not a risk unless you have open sores or lesions. Bacteria can get into open sores and cause infection. Health problems typically come from swallowing the water.

Emergency Closure

Beach closure due to a significant event or occurrence.

Beach Advisory Extent

If there is an active advisory, an advisory extent will appear on the map. The advisory extent color corresponds to the advisory symbol color. For example, the extent color will be yellow if the advisory is a Long-Term advisory (yellow symbol with green swimmer). Advisory extents represent the area, 200 feet on either side of monitoring station parallel with the shoreline, where the advisory applies.

http://gis.dhec.sc.gov/beachaccess/help.htm

Swimming is not advised within 200 feet on either side of the sign because high bacteria levels may be present, especially following rain due to storm water runoff. Wading, fishing, and shell collecting do not present a risk. Health problems typically come from swallowing the water.

Public Notification

In the event of an advisory, signs are posted at conspicuous areas on the affected beach. If feasible, signs are posted at points of entry to the affected beaches. Beach advisory signs state the following:

CAUTION

A SWIMMING ADVISORY HAS BEEN ISSUED FOR THIS SECTION OF THE BEACH BY THE SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL. HIGH BACTERIA LEVELS HAVE BEEN DETECTED IN THIS BEACH AREA AND

SWIMMING IS NOT ADVISED

UNTIL BACTERIA LEVELS RETURN TO NORMAL. WADING, FISHING, AND SHELL COLLECTING DO NOT PRESENT A RISK.

FOR INFORMATION ABOUT THIS ADVISORY CONTACT YOUR LOCAL REGION 8 DHEC EQC OFFICE AT (843) 846-1030 OR CALL (803) 898-3541.

CAUTION

A SWIMMING ADVISORY HAS BEEN ISSUED FOR THIS SECTION OF THE BEACH BY THE SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL. HIGH BACTERIA LEVELS HAVE BEEN DETECTED IN THIS BEACH AREA AND

SWIMMING IS NOT ADVISED

UNTIL BACTERIA LEVELS RETURN TO NORMAL. WADING, FISHING, AND SHELL COLLECTING DO NOT PRESENT A RISK.

FOR INFORMATION ABOUT THIS ADVISORY CONTACT YOUR LOCAL REGION 8 DHEC EQC OFFICE AT (843) 846-1030 OR CALL (803) 898-3541.

(The sign above was developed in the spring of 2009. The reverse of the sign is in Spanish.)