Program History and Overview

The goal of the Clean Lakes Alliance's (CLA) citizen monitoring program is to use citizen science to investigate the near-shore environment, use this information to improve lake user satisfaction and safety, and also generate interest and engagement with the lakes. Though several agencies conduct regular water sampling on the Madison-area lakes, most monitoring occurs far from shore, away from the beaches and access points where citizens interact with the lakes.

A 2014 Lake User Survey conducted by CLA found that as a consequence of this monitoring gap, lake users were often discouraged by murky water or floating algal scums, unaware that other nearby beaches might have dramatically better conditions. A lack of information about near-shore conditions led lake users to assume that the condition of beaches and access points were universally the same. CLA also recognized that near-shore monitoring information could be useful in combating two major health risks associated with beach use: blue-green algal (BGA) blooms and bacterial contamination. Both of these public health threats are recognized as important challenges in the Yahara Capitol Lakes Environmental Assessment and Needs (Yahara CLEAN) Memorandum of Understanding.

The 2015 Near-Shore Water Quality Monitoring initiative was informed by three years of planning and pilot programs. Clean Lakes Alliance (CLA) began designing a near-shore water quality monitoring pilot program in 2012 with the assistance of former State Laboratory of Hygiene research scientist Jon Standridge. In 2013, the pilot explored the role that citizen monitoring could play in evaluating 10 near-shore sites and communicating that information to the public. It also involved CLA staff sampling James Madison Park beach for *E. coli* bacteria five days per week throughout the summer.

Citizen monitors took quantitative measurements of water temperature, turbidity, and total phosphorus, and qualitatively assessed other conditions such as presence of plant debris or algae, waterfowl, and bathers. 2014 saw the expansion of the program to 46 sites, and the introduction of Lakeforecast.org, which allowed volunteers to enter their data via desktop or mobile phone.

This year, CLA launched the full-scale monitoring program. The major components of the program were:

- Citizen monitoring at 58 near-shore sites across all five Madison-area lakes
    - Quantitative measurements of air temperature, water temperature, and turbidity
    - Qualitative observations of water clarity, plant debris, algal blooms (including type), wave intensity, bather load, and waterfowl
    - Coordinated sampling on Thursday mornings
- Weekly staff sampling of *E. coli* at six targeted beaches (83 samples total)
    - Goodland County Park, Esther Beach, James Madison Park Beach, Olbrich Beach, Vilas Beach, and Warner Park Beach
- Two post-storm *E. coli* bacteria assessments at 24 public beaches (47 samples total)

    - This effort was not included as an expense for this grant
- Full integration of Lakeforecast.org
    - Public launch of the site before the summer beach season
    - Remote entry of citizen monitoring data
    - Near real-time updating of near-shore conditions, along with beach closure data, weather, and off-shore water quality data from the Lake Mendota buoy

Partnerships

Clean Lakes Alliance reached out to several entities in an effort to create a more comprehensive monitoring program consistent with the goals of our organization. Software company MIOsoft played a key role in designing Lakeforecast.org, which became the primary data repository for the 2014 and 2015 monitoring season. The City of Madison worked with CLA to involve city lifeguards at four beaches in water quality monitoring and reporting. Public Health – Madison and Dane County (PHMDC) analyzed 83 *E. coli* samples and coordinated with CLA to determine a sampling plan that would best complement PHMDC's weekly sampling schedule at City and County beaches. Staff from the Wisconsin State Lab of Hygiene also met with CLA staff and offered advice on the structure of the 2015 monitoring season. Finally, Badger Volunteers from the UW Morgridge Center for Public Service performed weekly sampling of three beaches along the UW Lakeshore Nature Preserve.

Project Goals and Objectives

The following goals and objectives are outlined in the grant application.

1. *Establish near-shore water quality monitoring stations around each of the five Yahara Lakes.*

In 2015, CLA continued to expand its near-shore monitoring program to a total of 58 sites across all five Madison-area lakes. This includes four new stations made possible by our partnership with City of Madison lifeguards. For each monitoring event, volunteers, staff, and lifeguards measured air temperature, water temperature, and water turbidity using a turbidity tube. Monitors also made qualitative observations on water clarity, plant debris, algal blooms (including type), wave intensity, bather load, and waterfowl presence. Each visual observation is recorded on a scale from one to three. Monitoring results were logged on Lakeforecast.org using a mobile phone or desktop computer. A blank data form as it appears on Lakeforecast.org is included as Appendix A.

During the summer of 2015, a total of 1,263 monitoring events took place. A table of the results and map of sampling sites is attached as "Near-shore monitoring data.csv", and "Sites Map.jpg", respectively. Lat-long coordinates of the sites may be found in the file "Site Locations.csv".

CLA's near-shore water quality monitoring network complements the existing monitoring done by WI DNR, PHMDC, and other natural resources organizations. While our program does not include monitoring of offshore conditions, no other organization maintains such a high density of monitoring stations throughout the Yahara chain of lakes.

2. *Double the number of weekly E. coli bacteria sampling at a minimum of 6 and up to 16 currently-tested public beaches.*

CLA staff selected six beaches to undergo weekly bacteria sampling, meaning that each of these six beaches would be sampled once a week by CLA and once by PHMDC. The six beaches were selected on the basis of public use and previous closures due to bacteria, and with the goal of representing most of the five lakes in the set of tested beaches. In the end, Esther, Goodland County Park, James Madison Park, Olbrich, and Vilas beaches were selected, representing lakes Mendota, Monona, Wingra, and Waubesa.

A total of 77 *E. coli* samples were collected as part of the weekly monitoring program and analyzed by Public Health – Madison and Dane County. Nine of the samples were over the 1000 MPN/100 ml threshold set by the EPA. The full results of the near-shore monitoring of *E. coli* can be found in the attached document "Weekly E. coli sampling results.csv."

CLA also performed post-storm event bacteria sampling at 23 public beaches on July 13th and 18 beaches on July 29th. The purpose of this event-based sampling was to determine the vulnerability of our Yahara public beaches to *E. coli* contamination immediately following periods of elevated runoff.

3. *Compile and communicate monitoring results using a mobile-ready website.*

On May 5th, 2015, CLA officially introduced Lakeforecast.org to the general public. The launch was timed to coincide with the annual *Save Our Lakes* Community Breakfast, and was promoted through local media press releases and television segments. During the 2015 summer beach season, volunteers, staff, and lifeguards remotely submitted monitoring results, which instantly became viewable to all site visitors. The monitoring data is combined with RSS feeds from PHMDC, the University of Wisconsin Center for Limnology and Space Science and Engineering Center, to generate an intuitive map to guide users in their choice of beach. With a few clicks, lake users can check if their favorite beach is open or closed, and view the most recent measurements from that site or other nearby locations. Beaches and lake access points are also searchable by water clarity, closure status, and amenities. By the end of the summer beach season, Lakeforecast.org had amassed almost 50,000 page views over 9,300 sessions.

Greater detail on CLA's development of Lakeforecast.org may be found on the report for SPL-345-15 "Yahara Lakes and Beaches Mobile-Ready Website Development".

4. *Share results with the public and relevant jurisdictions to advocate for improved monitoring and information sharing.*

CLA has shared these results with interested partners and met with City of Madison Engineering, City of Madison Parks, and PHMDC to discuss the results. A community presentation of the 2015 monitoring data was given on November 12, 2015 and was attended by 75 volunteer monitors and interested citizens. This presentation is attached as "2015 Yahara Lakes 101 Presentation.pdf".

Each volunteer received an end-of-season summary specific to their monitoring site, as well as a survey about their experiences in the monitoring program.

Results

With 1,263 volunteer monitoring events and 118 *E. coli* samples, the 2015 Near-shore Water Quality Monitoring program provided a wealth of data about a relatively under-monitored environment. For the first time, volunteers were asked to synchronize samplings on Thursday mornings, and indeed 40% of monitoring events took place during that window. Volunteers observed some kind of algal bloom during 25% of observations, and observed floating plant debris during 40% of observations. About 60% of turbidity measurements were greater than 80 centimeters – what most lake users would consider "clear water".

Our weekly sampling for *E. coli* caught nine instances of high (>1000 MPN/100 ml) bacteria that would otherwise have gone undetected. This corresponds to 12% of the total weekly samples (9 of 77). Four of these instances were at Esther beach, reinforcing the idea that certain beaches may benefit from targeted sampling efforts. During our two post-storm bacteria sampling events on July 13th and July 29th, 54% (13 of 24) and 61% (11 of 18) of public beaches had high bacteria levels. Clearly, rainfall-generated runoff elevates the risk of contamination at public beaches. Genetic testing may reveal the sources of this contamination and help inform future mitigation efforts.

Near-shore Water Quality Monitoring 2016

CLA intends to continue this successful monitoring program in 2016. Lakeforecast.org will continue to act as a publically-accessible data hub and repository for monitoring data. We will expand the functionality of the site to improve the interpretability and accessibility of near-shore monitoring data. Our goal is to make Lakeforecast.org a valuable source of information for the community and a gateway to greater involvement in lake health issues.

The results of our volunteer survey show that we can continue to anticipate high volunteer retention. The vast majority of volunteers wish to continue sampling this year, and most are interested in expanded training to help them better identify blue-green algal blooms. Volunteers were also very concerned with making accurate measurements, and generally interested in the

reasoning behind the chosen parameters and data-collection protocols. CLA will hold a meeting this spring to solicit input from volunteers on the 2016 monitoring season.

We hope to continue building a long-term data set with our volunteers and staff. Some of the volunteer-monitored stations are now entering the third or fourth consecutive year of observations. More lifeguard-monitored stations will be added in 2016, with the goal of at least daily monitoring at each City of Madison beach. Lifeguards are keen observers of near-shore conditions, and showed enthusiasm during the lifeguard monitoring training that took place this year.

In addition to citizen monitoring, CLA has partnered with City of Madison and Public Health – Madison and Dane County to investigate the sources of *E. coli* bacterial contamination at Vilas, Esther, Tenney, and Olbrich park beaches. This effort was spurred by our finding that the majority of beaches are unsafe (>1000 MPN/100 ml) after a rain storm. Samples from these beaches (taken after a rain storm) will undergo genetic sequencing to determine the source of the contamination and help inform mitigation strategies. This effort will aid our efforts to improve the safety and satisfaction of lake users through near-shore citizen monitoring.

List of Associated Files

"2015 Yahara Lakes 101 Presentation.pdf" – community presentation given Nov. 12, 2015
"Blain's and Menard's receipts.pdf" – receipts for purchase of monitoring supplies
"EZ Office Products invoice.pdf" – invoice for purchase of more monitoring supplies
"Near-shore monitoring data.csv" – all citizen monitoring data
"Site Locations.csv" – coordinates of monitoring sites and numbers corresponding to "Sites Map.jpg"
"Sites Map.jpg" – numbered map of monitoring sites
"Thermo Fisher Order.pdf" – invoice for thermometers
"Weekly E. coli sampling results.csv" – results of 83 E. coli samples at 6 beaches

Appendix A: Near-shore Water Quality Monitoring Data Submission Form

The following is the form used on Lakeforecast.org to log the monitoring results of staff, volunteers, and lifeguards.

New Entry

Sample Date	2/16/2016
Sample Time	10:08 AM
Select Site	MononaPier14

Visual Observations

Wave Intensity (click one)

1	2	3
		
Calm to small ripples	Small to moderate chop	Rough water

Waterfowl (click one)

1	2	3
		
None	Some (1-10)	A lot (greater than 10)

Bather Load (click one)

1	2	3
		
None	Some (1-10)	A lot/crowded (greater than 10)

Water Clarity (click one)

1	2	3
		
Good	Fair	Murky

Surface Algal Bloom (click one)

1	2	3
		
None	Some clear evidence	Strong extensive evidence

Floating Plant Debris (click one)

1	2	3
		
None	Some clear evidence	Strong extensive evidence

Quantitative Measurements	
Air Temp (°F)	e.g. 68.0
Water Temp (°F)	e.g. 68.0
Turbidity (cm)	e.g. 33.0
Phosphorus sample?	☐

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