16TH ANNUAL
Great Lakes
BEACH ASSOCIATION CONFERENCE
Marquette, MI | October 4-7, 2016

Poster Presenters - *Biographies and Abstracts*

BENJAMIN, DAVID P., *Great Lakes Surf Rescue Project*

On December 26, 2010 Dave Benjamin survived a drowning accident while surfing in Lake Michigan. After his accident he dedicated his life to water safety and drowning survival (a short video describing his accident: https://www.youtube.com/watch?v=aeqxKGQ_BJg). Since his accident, Dave Benjamin co-founded the Great Lakes Surf Rescue Project (GLSRP) and has co-organized and promoted over 293 Great Lakes Water Safety Presentations in 7 of the 8 Great Lakes states (Minnesota, Wisconsin, Illinois, Indiana, Michigan, Ohio, and Pennsylvania). As Executive Director of Public Relations for the Great Lakes Surf Rescue Project, it received almost 300 media mentions in the Great Lakes region.

ABOUT THE GLSRP - The Great Lakes Surf Rescue Project, Inc. (www.GLSRP.org) is a nonprofit 501c3 corporation that is about saving lives. The GLSPR: 1. Tracks the Great Lakes drowning statistics (472+ drownings since 2010) 2. Performs "Great Lakes Water Safety" presentations and trainings (Over 293 in 7 of the 8 Great Lakes states since 2011) 3. Works with family and friends of Great Lakes drowning victims to advocate water safety. 4. Hosts Open Water Surf Lifeguard Certification training.

Understanding Drowning for Best Beach Management Practices – The BIG Picture of Drowning "

When establishing Best Beach Management Practices, it's extremely important to understand that drowning is one of the leading causes of accidental death in the United States and the world. It's also extremely important to know that drowning is a silent epidemic that most people do not know about or understand. The old saying, "You don't know what you don't know" applies here. This presentation will educate attendees on simple bullet points about drowning The presentation will explore the Big Picture of Drowning also known as "The Vicious Cycle of the Drowning Epidemic." The vicious Cycle of the Drowning Epidemic: 1. The World Health Organization says that drowning is a neglected public health issue and drowning gets very little attention or funding for educational outreach; 2. Each year millions of dollars are spent to bring more people to water ; 3. Most people who come to the water: A. Do not know that drowning is a leading cause of accidental death (CDC Statistics) B. Do not know what drowning looks like; i.e. the "Signs of Drowning" C. Do not have the basic swimming abilities to save their own lives (Red Cross Survey) D. Do not understand the drowning process and how time sensitive drowning is E. Do not know basic water survival strategies; e.g. "Flip, Float, and Follow" F. Unknowingly support the "Stigma of Drowning;" 4. Then drownings happen and drowning continues to be a neglected public health issue and the cycle repeats. Knowing the bullet points about drowning will assist Best Management Practices for Beaches when deciding what type of staff education, beach signage, rescue equipment, and printed safety materials to use to ensure that patrons have a safe and happy visit. "

BOTT, ALEX, *Northern Michigan University and Superior Watershed Partnership* – **STUDENT POSTER**

Alex Bott is a UP native and student at Northern Michigan University. Alex has a Bachelor's degree in Biology with an emphasis in Ecology and a minor in Chemistry, and is currently getting her teaching certificate.

Climate Conservation Corps Launched to Assist Great Lakes Coastal Communities *(with Chelsey Robinson)*

The Superior Watershed Partnership (SWP) is announcing the expansion of the Great Lakes Conservation Corps (GLCC) with the addition of the Climate Conservation Corps (CCC). The Great Lakes Corps has been steadily growing over the years and now has summer crews working in the Lake Superior, Lake Michigan and Lake Huron

watersheds. GLCC crews work on a wide variety of conservation, restoration and recreation projects while the Climate Conservation Corps is specifically dedicated to projects that help coastal communities adapt to climate change and increase community resiliency to more extreme weather events. CCC projects include but are not limited to coastal dune restoration, coastal wetland restoration, green infrastructure, stormwater management projects, buffer restoration and more. According to Emily Goodman, the SWP Corps Coordinator, "Much of the real work of community climate adaptation involves hand labor. It takes people, not just heavy equipment, to properly restore a riverbank, or dune, or wetland. The CCC takes climate planning to the next level: on-the-ground implementation. CCC members are helping to build more resilient coastal communities." Many Great Lakes communities are already feeling the impact of climate change and more extreme weather events. The combination of coastal storms and high lake levels has caused extensive erosion and infrastructure damage in many coastal communities. The iconic acronym for the Climate Conservation Corps (CCC) is an intentional nod to the legendary Civilian Conservation Corps initiated by Franklin D. Roosevelt during the Great Depression.

CAMPBELL, AARON, *Graduate Student, University of Wisconsin Oshkosh* – **STUDENT POSTER**

An Evaluation of US EPA qPCR Methods at Select Door County, WI Beaches

Traditional culture techniques for enumerating fecal indicator bacteria (FIB) require 18 to 24 hours of incubation and often do not provide results in a timely manner. The US EPA has developed more rapid bacterial indicator methods based on real-time quantitative Polymerase Chain Reaction (qPCR) technology and also have demonstrated a significant relationship between FIB enumerated by qPCR and the risk of gastrointestinal illness in beachgoers. These rapid test methods have the advantage of providing laboratory results within two or three hours of sample receipt, enabling beach managers to take action to protect public health on the same day that water samples are collected. In this study, qPCR Method 1609 (enterococci) along with *E. coli* Method C and culturable methods for enumerating *E. coli* (Colilert®) and enterococci (Enterolert®) were utilized during summer 2015 and 2016 at four beaches in the Door County Wisconsin, twice each week. Beaches were selected for having average FIB concentrations over a wide range throughout the traditional monitoring season. At each beach the qPCR methods were compared to the traditional culture methods for both *E. coli* and enterococci. FIB concentrations were normalized through a log transformation and then a linear regression was performed on the normalized data comparing the culture methods and the associated qPCR methods for each beach. At the completion of summer 2015, FIB concentrations determined by Method 1609 were not positively correlated with concentrations measured by either the culturable method for *E. coli* or enterococci at Bailey's Harbor (r2= 0.0021 and 0.0322, respectively). Fish Creek beach showed a significant correlation between enterococci methods (r2= 0.1749), while the *E. coli* methods did not show any significant correlation (r2=0.0112). Otumba beach showed a significant correlation between qPCR and culture methods for both enterococcus and *E. coli* with r2 values of 0.1309 and 0.196 respectively. Sunset beach had correlation coefficients between qPCR and culture methods of 0.0571 for enterococcus and 0.0867 for *E. coli*. Though much research is still needed to help determine which indicator and method is most appropriate for monitoring recreational water in the Great Lakes Region, this study does suggest adoption of a molecular test for detection of *E. coli*, such as Method C, for use in monitoring beach water quality.

CITRIGLIA MARK, *Northeast Ohio Regional Sewer District*

Mark Citriglia is currently the Manager of Analytical Services for the Northeast Ohio Regional Sewer District. Mark has a Bachelor's of Science from Cleveland State University with a Major in Biology and a Minor in Chemistry. He has worked for the Northeast Ohio Regional Sewer District (NEORSD) for 26 years. He started at NEORSD in the Analytical Services laboratory) as a Wastewater Analyst, and has successfully gained the skills and knowledge to become the Manager of Analytical Service. Mark is a member of the Water Environment Federation, The NELAC Institute, and the Lab Safety Institute. Mark was the recipient of the 2007-2008 Northeast Section Ohio Water Environment Association "Lab Analyst Award", 2009 Ohio Water Environment Association "Lab Analyst Award", and the 2010 Water Environment Federation Laboratory Excellence Award, 2016 Crystal Crucible Award. Mark is a certified State of Ohio Wastewater Class III Operator and a Class IV Certified Wastewater Analyst.

Make It "Tough": qPCR Master Mix Comparison

Within the 2012 Recreational Water Quality Criteria guidelines the EPA provides information for states who want to adopt Water Quality Standards based on rapid methods that EPA has developed and validated using quantitative polymerase chain reaction (qPCR). Currently the EPA has validated Method 1609 and 1611 for the quantification of enterococcus in environmental waters using qPCR. The NEORSD laboratory has collected samples from two Northeast Ohio Beaches and analyzed them by EPA method 1609 and a qPCR assay for *E. coli*. The objectives of this study was to identify a master mix that (1) could be used for both assays (2) reduce inhibition (3) is similar to the Environmental Master Mix (EMM) recommended by the EPA (4) utilizes an Internal Amplification Control (IAC) allowing for analysis on the same platform and (5) contains a purified DNA polymerase that is validated free of extraneous *E. coli* DNA. A total of 241 samples were analyzed for both organisms using two different chemistries, EMM as stated in method 1609 and Tough Mix. The data for each organism and master mix combination was compared for inhibition, method QC, level of quantification and difference between assay absolute and relative quantitation. The accuracy, sensitivity and specificity were calculated as compared to the conventional method. In conclusion, we have determined that the Tough Mix yielded comparable data to the EPA recommended mix with respect to the accuracy and reproducibility but the level of inhibition and instance of positive QC data decreased with the Tough Mix.

Beach Water Quality Modeling using Enterococci by qPCR

The U.S Environmental Protection Agency (USEPA) developed a Beach Action Plan for recreational waters as the public health faced risk of illness associated with swimming in beach waters contaminated with disease-causing microorganisms. Previous studies performed have identified a direct relationship between high concentrations of *E. coli* (E.coli) and enterococci and an increase in waterborne disease, specifically gastroenteritis, among swimmers. For the state of Ohio, the single-sample maximum (SSM) was established to not exceed 235 CFU/100 ml of E.coli. The analytical methods used to quantify the amount of E.coli present in a sample requires an 18 to 24 hour incubation period before results can be obtained. Therefore, by the time data is available, recreational water quality conditions may have changed since sample collection leading to erroneous assessments of public health risks. Consequently, reliable indicator tests or real-time methods are needed to evaluate water quality conditions and to predict events in which there may be a potential health risk to swimmers. As a result, the Northeast Ohio Regional Sewer District (NEORSD) has turned to the development of Predictive Models and qPCR as an approach for real-time forecasting, resolving the delay in notification of fecal contamination in recreational waters. Samples collected during the 2014 and 2015 recreational beach season were analyzed by NEORSD for concentrations of fecal-indicator enterococci using EPA method 1611: Enterococci in water by TaqMan Quantitative Polymerase Chain Reaction (qPCR) assay. These concentrations along with other environmental parameters, such as wave height, turbidity, rainfall, and number of birds were implemented into a multiple-linear regression (MLR) model. The use of this statistical approach for real-time forecasting of E.coli resolves the delayed notification of contamination in recreational waters. Using the output of qPCR and additional parameters, probabilities of exceedences or non-exceedences of the SSM can be predicted on a daily a basis to issue an advisory to the public. Implementing the output of qPCR for enterococci into the MLR model showed a very strong relationship with an accuracy of 85% in predicting E. coli concentrations. Using environmental factors alone to predict E.coli concentration at Villa Angela Beach, a Lake Erie Beach located in Cleveland, Ohio, was not nearly as accurate without the addition of the variable enterococci into the model producing around an average of 70% accuracy each year. NEORD continues develop more accurate models eliminating delayed notification of water quality.

DeMARIA, ANNETTE, *Environmental Consulting & Technology, Inc.*

Annette DeMaria is a Senior Engineer at ECT with 19 years of experience in stormwater management and municipal stormwater permit compliance. She has served as project manager and/or client contact for many of ECT's green infrastructure projects. She has overseen projects that employ pervious pavement, native landscaping, rain gardens, bioswales, and passive and active bird deterrents. Her areas of technical specialization include watershed planning, stormwater management, beach management, illicit discharge elimination, stormwater permit compliance, and total maximum daily load assessments. She has secured over $10 million in federal and state grants for our clients and assists them in managing the grants during implementation.

Burke Park: A Green Infrastructure Solution to Beach Water Quality Concerns in Macomb County "Green infrastructure has once again demonstrated that beach restoration efforts can be a beautiful, successful, and cost effective solution to water quality issues on the Great Lakes. ECT assisted the Macomb County Public Works commissioner's office with developing a scope of work to secure grant funding from the Great Lakes Restoration Initiative (GLRI) to install green infrastructure at Burke Park Beach in New Baltimore, MI. Located on Lake St. Clair, the beach suffered from repeated closures each season due to elevated bacteria levels. ECT designed, permitted, and provided construction services for the project, which aimed to reduce stormwater runoff draining to the beach and minimize the number of seagulls and Canada geese loafing (and defecating) at the beach. Topographic and geotechnical data informed design efforts, the focus of which was centered around improving drainage in the park, improving water quality locally with regional Great Lakes impacts, minimizing beach closures both on-site and regionally, and providing native plant habitat with a particular focus on pollinators.

The design included:

- Pervious pavers with a culturally-relevant decorative design; existing memorial pavers incorporated into pervious paver layout
- Acoustic seagull deterrents permanently mounted in strategic locations to provide coverage to the entire property
- Rain gardens to infiltrate stormwater, filter runoff, and address drainage issues
- Native goose-resistant plantings to deter geese from the site
- Relocation of an existing memorial garden
- Educational signage focused on the benefits of green infrastructure

During the design phase, the project aimed to have best management practices (BMPs) installed at a second site; however, the landowner did not approve of the various conceptual designs that were proposed. This is a perfect example of the importance of public support and education in the design of restoration projects. The cultural aesthetic and land use expectations held by a community will hold priority over ecological integrity in most cases. The second site was dropped from the scope of work even though the funding was available and restoration efforts would have responded to their water quality concerns and beach closures. This presentation will discuss design considerations, speed bumps that were encountered, and lessons learned which will be applicable to others undertaking beach restoration projects. We will also discuss how preparing a beach restoration plan has so much more involved than the science of restoration, including cultural expectations, politics, the existing use of the park, aesthetics, and off-site factors such as views and local economies.

FAUST, SHERI J., *St. Clair County Health Department*

Sheri has held the Environmental Health Educator position for the St. Clair County Health Department's Storm Water Program since 2004. She is responsible for programming that supports the county's watershed planning efforts and represents the Health Department on the St. Clair River Area of Concern Binational Public Advisory Council. Sheri is the current President of Friends of the St. Clair River and was instrumental in launching this non-profit in 2007. Sheri received her B.S. from Michigan State University in Natural Resources Management and recently achieved Michigan Citizen Planner Planning and Zoning certification.

Successful Beach Restoration in an Area of Concern

Significant environmental recovery has been achieved in the St. Clair River, as demonstrated by the recent milestone of the U.S. EPA removing the Beach Closing Beneficial Use Impairment. Located along St. Clair County in southeast Michigan, the St. Clair River is significant throughout the Great Lakes as being only one of five binational Areas of Concern (AOC). The St. Clair River was designated an AOC in 1987 and, like all AOC's, suffered decades of environmental contamination from industrial and municipal pollution. Frequent discharges from combined sewer overflows (CSOs) were a primary reason for the St. Clair River Beach Closing impairment. In 1991, 49 CSOs existed on the U. S. side of the St. Clair River. Substantial infrastructure improvements were implemented at the two

largest cities along the U.S. side of the St. Clair River and today only one CSO remains. As well, additional illicit discharge and green infrastructure projects, such as goose deterrent landscaping and parking lot bioswales, have further reduced pathogen sources. Thanks to the many local, state and federal partners who were instrumental in achieving this improvement, St. Clair River beaches are healthier providing fewer beach closings. The St. Clair River is a shining example of how community investment and partnerships can create and sustain environmentally, socially and economically viable places.

HERNANDEZ, ROLAND, *University of Wisconsin Oshkosh* – **STUDENT POSTER**
Roland Hernandez is currently a first year graduate student at the University of Wisconsin - Oshkosh studying for his master's degree in biology. He recently graduated from the University of Wisconsin - La Crosse with a major in microbiology. He is originally from Madison, WI where he worked at the biotechnology lab called Silliker Inc. before starting college.

Detection of E. coli in northern Lake Michigan waters using qPCR Method C
The defined substrate assay, ColilertÒ (IDEXX, Westbrook, ME), is currently approved by the U.S. Environmental Protection Agency (U.S. EPA) in order to detect *E. coli* and total coliforms in water. One use for the test is to prevent waterborne illness in beach users after contact with recreational water, but results are not available for 18 to 24 hours. Conducting quantitative, real-time polymerase chain reaction (qPCR) Method C (US EPA, 2015) reduces the analysis time to less than six hours when identifying *E. coli* calibrator cell equivalents (CCE). However, much of the research and application of qPCR enumeration to beach water has been conducted at locations with relatively elevated levels of *E. coli*. Comparison of both techniques (Method C and ColilertÒ) was conducted at six Wisconsin beaches throughout the 2016 beach season. These beaches represent locations with relatively elevated indicator levels and ones with historically low concentrations of indicators. The locations chosen had historically varying concentrations of *E. coli* and represent a variety of beach types along the Door County peninsula. The overall goal of this project was to determine how Method C relates to traditional culture-based enumeration methods at northern Lake Michigan beaches. The results from each location and method will be compared in terms of quantitative numbers as well as method selection on beach management implications.

HUDSON, SARA, *City of Ashland Parks and Recreation*
Sara Hudson has worked in the Parks and Recreation Department for over 10 years for the City of Ashland, WI. Sara holds a BS from UW-Stevens Point in Natural Resources Management and Conservation Biology and post-baccalaureate Degree in Secondary Education with a Biology emphasis. Her love of the outdoors, passion for the environment, plus her desire to practice servant leadership, keeps and her family close to Lake Superior.

Maslowski Beach Water Quality Education Project
This unique project was a collaborative effort between Northland College's Mary Burke Center for Fresh Water Innovation, the Applied Research and Environmental Lab, Center for Rural Communities and the City of Ashland to perform a more in depth water quality sampling effort at Maslowski beach to identify and quantify the sources of *E. coli*, why people swim at Maslowski Beach and how to more effectively educate beach patrons on beach health and water quality issues.

KOCH, JEFF, *Superior Watershed Partnership*
Jeff is responsible for coordinating watershed restoration efforts, grant opportunities, workshops, and newsletters for the Partnering for Watershed Restoration (PWR) group. He is also involved in many other projects at SWP, including the Great Lakes Conservation Corps (GLCC), Community Environmental Monitoring Program (CEMP), the Great Lakes Shore Viewer web application, and GIS analysis. Jeff brings a diverse skillset to SWP obtained through 15 years of professional natural resource experience, including 10 years with the Ottawa National Forest in wildfire suppression, fire ecology, and GIS analysis, and five years as an environmental scientist with a consulting company performing groundwater sampling, surface water sampling and wetland delineations. He holds a B.S. degree in Natural Resource Management from the University of Wisconsin-Stevens Point.

Web Applications for Environmental Monitoring - Great Lakes Shoreviewer Update and Expansion
The Great Lakes Shoreviewer (Shoreviewer) is a publicly accessible online tool that currently comprises color, digital, oblique-angle, Global Positioning System (GPS) referenced photographs paired with downloadable Geographic Information System (GIS) maps, which can assist coastal management, restoration, planning, and outdoor recreation. In 2014, the Superior Watershed Partnership (SWP) acquired technical services from partners Applied Ecological Service (AES) and 906 Technologies to expand the application of Shoreviewer through acquisition of multi-spectral, high resolution aerial imagery combined with spatial analysis that will produced a dataset descriptive of coastal erosion risk. The Shoreviewer expansion project addresses the need for the collection and development of geographic information system (GIS) datasets that improve knowledge and foster increased resilience for Michigan's Great Lakes coastal areas with respect to erosion and improved resiliency to a changing climate. The datasets and assessment developed for enhancing the Shoreviewer are available to coastal stakeholders including local, state and federal officials, coastal property owners and the public. The output of this project provides land managers with online access to both a systematic automated classification as well as tools for manual interpretation to inform and prioritize critical land management decisions. Lake Superior Environmental Buoys: The long stretch of beaches and coastal rock formations along the southeastern shore of Lake Superior make it a popular destination for swimming, kayaking, surfing, recreational boating, and fishing. Despite being a hub of recreational activity in the well-populated eastern half of Michigan's Upper Peninsula (UP), this section of Lake Superior has had virtually no scientific observation equipment (wave height, wind speed, temperature, etc.) or related data available to the general public, boaters or researchers. The lack of observations in the nearshore region of southeastern Lake Superior presents a major obstacle for local communities and emergency management agencies in providing accurate coastal hazard and warning information. To address the needs noted above, in 2015 the Superior Watershed Partnership (SWP) partnered with Northern Michigan University (NMU), the National Oceanic and Atmospheric Administration (NOAA), Great Lakes Observing System (GLOS), and LimnoTech (a water sciences and environmental engineering consulting firm) to purchase and deploy three high-tech storm buoys in Lake Superior adjacent to Marquette, Munising, and Grand Marais. These nearshore buoys provided public real-time and historic data (available via greatlakesbuoys.org and from the "Superior Buoys" smartphone app) to better inform the public and coastal municipalities on current lake and meteorological conditions. Erosion Hazard Reporting Form SWP has partnered with 906 technologies to create a web based form to report coastal erosion problems, as well as other environmental impacts within the Upper Peninsula of Michigan. The form has a clickable map that drops a pin, and then the user fills out contact information, describes the environmental/erosion impact and then has the option to upload a photograph. This tool will be used to monitor impacts along the Great Lakes coasts, as well as inland locations within the UP.

MILLER, ROGER G., PE, *Miller Engineers & Scientists*
Roger G. Miller, PE, has provided principal direction in corporate technical and client service development for Miller Engineers & Scientists since 1991. His 35+ years of technical experience includes a wide range of site, land, natural resource, and facility evaluation and planning services; subsurface exploration; utility and infrastructure design; harbor and shoreland restoration; soil and ground water contamination remediation; and design of heavy machine foundations. Other experience includes land and hydrographic surveying, hydrology and storm water management, and structural design and failure analysis.

Adverse Effects of Revetments on Natural Littoral Processes
A primary intent of Great Lakes shoreland regulations that were promulgated several decades ago was to provide sufficient setback of structures to allow room for natural, long term shore recession rates throughout the structure's service life. Along most reaches of the Great Lakes, that recession rate ranges somewhere between 50 to 200 feet per century. While regulations allow revetments to be installed below the Ordinary High Water Mark (OHM), that opportunity should be limited to protecting pre-existing substantial structures that are not practical to move. By contrast, the installation of revetments below the OHM to protect new construction, which is often positioned right to the minimum setback requirements, is becoming increasingly common. This proliferation of revetments is artificially altering the natural dynamics of littoral sand that otherwise plays an important role in limiting long term shore recession. At some locations, the effects on "down drift" properties is already disastrous.

From that perspective, this presentation will review the basic concepts of shore dynamics that are required to make sound decisions regarding artificial structures on the Great Lakes and will summarize how policy and regulations can be updated to reinforce the intent of existing shoreland ordinances to affirm sound long term policy. In addition to revetments, we will look at harbor break walls and how a policy of sand bypassing would help to alleviate the interruption of sand movement around these structures, which would work to lessen down drift shore recession rates.

PARENT-DOLINER, GABRIELLE, *Lake Ontario Waterkeeper/ Swim Guide*
Gabrielle Parent-Doliner has been the Program Manager for Swim Guide since 2014. She supports nearly 70 public and nonprofit organizations that contribute water quality information to the Swim Guide app and website. Gabrielle also manages information for over 7,000 beaches in Canada, the US, Mexico and New Zealand to ensure that Swim Guide users have access to the most current water quality data. She earned her undergraduate degree from Trent University in First Nations Studies and her Masters in Canadian History from Lakehead University.

Canadian beach water quality monitoring and reporting: A review of national practices
Who monitors beach water quality in Canada? What standards do they use? How is information communicated to the public? These are all questions that the Canada Beach Report, published by Swim Guide, answers. Scheduled for publication in Fall 2016, members of the Great Lakes Beach Association will receive a sneak peak at the first "Canada Beach Report". The report identifies water quality monitoring agencies and organizations, summarizes water quality standards that apply in each jurisdiction, describes monitoring frequencies, and explains how beach water quality information is reported to the general public. As the first report of its kind, the Canadian Beach Report is written for three audiences: (i) individuals who want to know how water quality, monitoring, and reporting practices at their favourite beach stack up against other jurisdictions; (ii) federal government policy and tourism officials who have stated a need for this information to advance water quality improvement and tourism agendas; and, (iii) the provincial and municipal agencies who design and execute most beach water quality programs in Canada. Presenter Gabrielle Parent-Doliner will walk attendees through the report's key findings and highlight insights that are relevant to the Great Lakes region. Parent-Doliner manages Swim Guide, the beach information app and website that aggregates current beach water quality information and promotes healthy living. Over the last five years, Swim Guide has grown to describe beach information, water quality history, and water quality monitoring practices in every province in Canada. The Beach Report draws on Swim Guide's extensive database, as well as reflects the concerns and perspective of beach users. This presentation would pair well with presentations on beach water quality monitoring practices, citizen science, health protection and promotion, communication with the general public, policy trends, open data/ data sharing, or cross-border collaboration.

RAKHIMBEKOVA, SABINA, *Western University, London, Ontario* – **STUDENT POSTER**
Sabina graduated from University of Miami in May, 2014 with a Bachelor's degree in Environmental Engineering and minors in Business Administration and Marine Science. While at University of Miami, Sabina has been actively involved in National Science Foundation Autonomous Net-Zero Water project focused on converting wastewater into potable water using low energy treatment mechanisms. In September 2014, Sabina was very excited to join RESTORE research group at Western university to pursue her master's and now PhD degree. At Western, she is conducting research focused on the effect of groundwater surface water interactions in inland coastal environment such as the Great Lakes on the behavior of pollutants (nutrients and arsenic).

Transport of Septic-Derived Nutrients to the Great Lakes through a Permeable Beach Aquifer
Nutrient loading to the Great Lakes from septic systems is poorly quantified although they are often cited as an important contributor of nutrient flux to the Great Lakes. In particular, there is limited understanding of whether nutrients leaching from septic tile beds into the groundwater are actually delivered to the lake or if they are attenuated in the subsurface before discharge. Nutrients may undergo important reactions as they are transported from the tile beds to the lake, particularly in a geochemical reaction zone in groundwater immediately before discharge to the lake. The objective of this study was to evaluate the transport and

transformation of septic-derived nutrients through a sandy homogenous beach aquifer and to estimate the associated loading of nutrients to the lake. Field investigations were conducted in 2014 and 2015 downgradient of a large public septic system located 140 m from the shores of Lake Huron. The sampling was designed to understand the seasonal variability in nutrient loading to the lake as well as the physical and geochemical factors controlling the nutrient loading. Groundwater chemistry data was collected using multi-level samplers installed in a transect between the septic tile beds and the lake. Vertical arrays of pressure transducers and groundwater wells were installed to determine groundwater flows at the study site. Sediment samples were also collected and analyzed to identify the zone of PO43- accumulation downgradient of the septic tile beds and the distribution of artificial sweeteners in the groundwater was analyzed to confirm the origin of the nutrients in the groundwater. Elevated nitrate (NO3-) and phosphate (PO43-) concentrations of 110 mg/L and 450 µg/L, respectively, were observed at depths of 1-3 m at distances 10-40 m landward of the shoreline. Nutrient concentrations generally decreased towards the shoreline. Understanding the extent of the transformations of septic-derived nutrients is essential to quantify nutrient loading to the lake and to develop effective strategies and regulations for the installation and maintenance of septic systems along Great Lakes shorelines.

ROBINSON, CHELSEY, *Northern Michigan University and Superior Watershed Partnership* – **STUDENT POSTER**
A UP native and student at Northern Michigan University, Chelsea is in her Senior year, getting a degree in Environmental Studies and Sustainability, with a minor in Biology.

Climate Conservation Corps Launched to Assist Great Lakes Coastal Communities *(with Alex Bott)*
The Superior Watershed Partnership (SWP) is announcing the expansion of the Great Lakes Conservation Corps (GLCC) with the addition of the Climate Conservation Corps (CCC). The Great Lakes Corps has been steadily growing over the years and now has summer crews working in the Lake Superior, Lake Michigan and Lake Huron watersheds. GLCC crews work on a wide variety of conservation, restoration and recreation projects while the Climate Conservation Corps is specifically dedicated to projects that help coastal communities adapt to climate change and increase community resiliency to more extreme weather events. CCC projects include but are not limited to coastal dune restoration, coastal wetland restoration, green infrastructure, stormwater management projects, buffer restoration and more. According to Emily Goodman, the SWP Corps Coordinator, "Much of the real work of community climate adaptation involves hand labor. It takes people, not just heavy equipment, to properly restore a riverbank, or dune, or wetland. The CCC takes climate planning to the next level: on-the-ground implementation. CCC members are helping to build more resilient coastal communities." Many Great Lakes communities are already feeling the impact of climate change and more extreme weather events. The combination of coastal storms and high lake levels has caused extensive erosion and infrastructure damage in many coastal communities. The iconic acronym for the Climate Conservation Corps (CCC) is an intentional nod to the legendary Civilian Conservation Corps initiated by Franklin D. Roosevelt during the Great Depression.

ROBINSON, CLARE, PhD, *Western University*
Dr. Robinson is an Associate Professor in Civil and Environmental Engineering at Western University, Canada. Dr. Robinson received her B.Eng and Ph.D. in Environmental Engineering from the University of Queensland and completed a post-doctoral fellowship at Ecole Polytechnique du Lausanne, Switzerland. Dr. Robinson received an Early Research Award from the Ontario Government in 2012 and is a member of the International Joint Commission Great Lakes Science Advisory Board. Dr. Robinson has significant expertise in groundwater-surface water interactions in coastal and lake environments as well as the fate of pollutants in natural and engineered systems. Her work generally combines laboratory and field investigations with groundwater, geochemical and/or reactive transport numerical modeling to identify underlying processes. Dr. Robinson's current research projects include investigating the contribution of groundwater to surface water quality in the Great Lakes Basin, understanding the accumulation and release of fecal contaminants in beach sand, and evaluating the behaviour of contaminants in nearshore aquifers.

Use of 222-radon for evaluation of groundwater discharge to inland waters

Groundwater discharge may be an important pathway for delivering pollutants including nutrients, metals and chloride into inland waters. This pathway however is generally not well understood and quantified. This is in part because there are limited field methods available for evaluating groundwater discharge to inland waters particularly at the regional-scale (i.e. 1-100 km). The objective of this study was to evaluate the suitability of the natural tracer radon (222Rn) for evaluating groundwater discharge to inland lakes. 222Rn is a suitable tracer as its concentration is typically 3-4 orders of magnitude higher in groundwater than in surface water. Regional scale 222Rn surveys were conducted along 75 km of shoreline in Kempenfelt Bay and Cook's Bay in Lake Simcoe, Ontario from June – September 2015 to identify potential groundwater discharge hotspot zones. Measurements were conducted using portable radon instrumentation (RAD 7 and RAD AQUA, Durridge Inc.). Following identification of discharge hotspot zones, high spatial resolution 222Rn surveys were carried out in these zones and a steady-state mass balance model which considers the various sources and sinks of 222Rn (e.g., air evasion, offshore mixing) was applied to estimate groundwater discharge rates. The challenge of applying a 222Rn mass balance is minimizing uncertainties associated with 222Rn loss through air evasion, as well as adequately characterizing 222Rn concentrations in the groundwater end-member. Intensive sampling and analysis was conducted to minimize these uncertainties. Results indicate high groundwater discharge occurs in the nearshore with discharge decreasing offshore. Hydraulic gradient profiles were also collected at discrete shoreline locations within the survey areas to validate the 222Rn survey results. The assessment of field methods such as 222Rn for quantifying groundwater discharge to inland waters including Lake Simcoe is critical for developing more effective and targeted management plans to mitigate the contribution of groundwater pollutants to degrading lake water quality.

SHANKS, STEPHANEY, PhD, *Research Program Manager, UES, Inc.*

Stephaney is the Research Program Manager for the Biological and Nanoscale Technologies Division of UES, Inc., a small woman-owned business in Dayton, OH. Stephaney is a water quality microbiologist and was involved with assay development and test and evaluation of biosensor technology for the Army at the Center for Biological Defense before joining UES in 2013. She has authored several peer-reviewed manuscripts and a book chapter on the topic of rapid detection as well as presented her work at numerous national and international conferences. Stephaney joined UES as it began to expand its sensor development effort that began with technologies for microbial detection for the Air Force and Army.

Rapid Detection of E. coli in Inland Ohio Recreational Waters

Monitoring of recreation al waters for microbial fecal indicators, including *E. coli*, are crucial for meeting the goals of the Clean Water and BEACH Acts. Standardized methodologies (i.e., membrane filtration or defined substrate technology such as Colilert) for detection of indicator organisms require at least 24 hours for a confirmatory result, which increases the opportunity for public exposure to fecally transmitted pathogenic microorganisms. Development of rapid detection assays for *E. coli* is imperative for enhanced protection of public health in recreational coastal waters such as the Great Lakes. UES, a woman-owned, small business in Ohio, has developed a biosensor capable of meeting this need utilizing our extensive experience in ligand identification for capture of specific targets. The sensor platform was developed under stringent Department of Defense (DoD) cost, size, weight and power (C-SWaP) constraints to allow human portability (e.g., in a backpack). The current study describes the direct comparison of a rapid methodology for detection of *E. coli* in Ohio recreational waters with EPA Method 1603 and Colilert. During the summer of 2016, 2 L of freshwater from streams in southern Ohio were collected, stored on ice and transported to the laboratory for analysis within 6 hours. The time required for detection was approximately 1 h for the biosensor assay versus the 24-h minimum required for EPA Method 1603 and Colilert. Public health could be enhanced by the ability to post advisories and warnings earlier as well as providing an economic benefit to coastal businesses adversely impacted by extended closures. These data demonstrate the potential of the SilverHAWQ in regulatory monitoring of recreational coastal waters. The technology has shown promise in detecting a variety of microbial targets and toxins and can be expanded to detect enterococci, harmful algal blooms and associated toxins.

SHIVELY, DAWN, *Michigan State University/U.S. Geological Survey*

Dawn Shively is a research assistant with United States Geological Survey, Lake Michigan Ecological Research Station (LMERS) contracted through Michigan State University. She obtained a Bachelor of Science degree in Biology at Indiana University northwest campus in 2001, with a concentration in ecology and microbiology. She has over 18 years of microbiology experience, and has worked with the USGS for the past 16 years. She was involved in the conception of the microbiological program at LMERS and is currently the microbiology laboratory manager. Her research interests include microbial ecology, molecular microbiology, and recreational water quality and public health. She has co-authored/authored numerous articles published in refereed scientific journals and investigative reports related to recreational water quality in the Great Lakes basin. Other interests are statistical analysis and empirical predictive modeling for bacteria concentrations at recreational beaches.

Shorebird Deterrence Improves Water Quality at a Highly Contaminated Beach

Jeorse Park Beach (JP) is located on southern Lake Michigan in a highly industrialized area of East Chicago, IN. JP has experienced frequent closures as a result of high *E. coli* levels, with bacterial levels steadily increasing between 2005 and 2010, with similar patterns in US EPA exceedances for safe water quality: 26-76% (for years 2005-2015). Efforts to determine contaminant sources have been on going, and in 2010 the USGS performed a microbial source tracking (MST) study in which Human (HF183)-and gull-fecal-specific (Gull-2) genetic markers were tested along with sanitary surveys. Results suggested that shorebirds were likely to be one of the dominant sources of *E. coli* to the beach, as the Gull-2 marker was detected in 37 % of samples tested and the results concurred with observations of gull roosting and bird droppings in and around the swash zone. Recent remediation strategies have been suggested for deterring birds with different beach management practices, including (a) establishing natural vegetation in backshore areas, (b) altering breakwalls to improve circulation and reestablish reef habitats, and (c) using trained dogs to deter birds.

In a pilot study in 2015, triplicate water samples were collected 3 days/week from 6/11/2015 to 9/4/2015 at JP and analyzed for *E. coli* and Gull-2 marker; shorebirds counts also were recorded. Mean log *E. coli* densities ranged from 1.56 to 1.78 and exceedances ranged from 26 to 42%. Overall, birds were observed on 29 of 38 occasions totaling 2251 birds, with gulls (2069) and geese (131) accounting for the majority of birds. The Gull-2 genetic marker was detected in 44% of samples, with 55 % of positives within the range of quantification (ROQ), indicating that the Gull-2 assay was a reasonable method for confirming gull fecal contamination. Mean log Gull-2 copy numbers (CN) ranged from 2.81 to 3.05. Over the course of this study, a bird deterrent pilot testing (Wild Goose Chase, Chicago Ridge, IL) was undertaken for four weeks in July and August, in which trained dogs chased shorebirds from the beach throughout daylight hours. During this period, birds were observed on only 3 occasions: 7 gulls (n=2) and 30 geese (n=1). *E. coli* and CN levels in nearshore water declined significantly and the Gull-2 marker was detected in only 14 % of the samples during this time. The gull deterrent activity is being extended for the entire 2016 recreational season; thus far, *E. coli* densities and exceedances are substantially reduced, relative to previous years. This study shows that shorebird deterrence can be an effective short-term management strategy for improving recreational water quality and similar approaches can be adapted at beaches impacted by shoreline birds.

SIVY, TAMI, PhD, *Saginaw Valley State University*

Tami Sivy has worked with qPCR methods for 5 summers in rapid bacterial testing. Beginning as a collaboration with Bay County for measuring potential contamination at 2 beaches, her group now tests nearly 20 beaches throughout the Saginaw Bay Watershed. She is an Associate Professor of Chemistry at Saginaw Valley State University. She holds a Ph.D. in Chemistry and Biochemistry from University of Colorado-Boulder and a B.S. in Biochemistry from Calvin College.

Validation of rapid bacterial testing in the Saginaw Bay Watershed

During the summer of 2016, thirteen sites in the Saginaw Bay Watershed were tested for fecal contamination using both Colilert and EPA Method C: *E. coli* in Water by TaqMan Quantitative Polymerase Chain Reaction (qPCR) Assay. This study was a collaboration between the U.S. EPA, the Michigan Department of Environmental Quality, area health departments and Saginaw Valley State University, with samples from Bay, Iosco, and Huron Counties

being processed at SVSU. The water samples were evaluated as either composites or triplicates in order to obtain at least 30 data sets for each site. Comparisons of analysis type as well as comments on exceedance criteria for Method C are presented. Anomalies in method correlation at certain sites are considered, and widespread application of Method C is discussed.

SUK, HAILIE, *University at Buffalo (SUNY)* – **STUDENT POSTER**

Hailie Suk is an undergraduate environmental engineering student at the University at Buffalo (SUNY). She worked on this research as part of an NSF-REU program at the University at Buffalo with Dr. Lauren Sassoubre. Hailie is passionate about improving water quality and the environment. Hailie has participated on the Executive Board on the University at Buffalo's Engineers for a Sustainable World chapter as secretary and president. She also works as a teaching assistant in an entry level engineering class. Hailie is especially passionate about the Great Lakes' water quality as a lifelong resident of Buffalo NY.

Investigating Microbial Pollution in Lake Erie to Improve Current Monitoring Methods

In Western New York (WNY), Lake Erie beaches suffer from closures due to high fecal indicator bacteria (FIB) concentrations. This study aimed to identify hotspots of microbial pollution and the potential sources contributing to frequent beach closures at Woodlawn Beach. Potential sources of pollution include nearby creeks, groundwater, combined sewer overflows, sand, and bird feces. During the summer 2016, samples were collected weekly at Woodlawn Beach from Lake Erie, Blasdell Creek, Rush Creek, beach sand, and groundwater wells. Culture based methods were used to enumerate *E. coli* (*E. coli*) and Enterococcus spp. Two molecular methods, quantitative polymerase chain reaction (qPCR) and droplet digital PCR (ddPCR), were used to quantify the presence of human fecal bacteria markers (using HF183 and Lachno2 assays).These two methods are being compared to validate the results of the experiment, as ddPCR is a new technology offering several advantages over qPCR. Culture and molecular based results were compared to beach closure days based on culture-based and modeling results from Erie County Department of Public Health. Examining the current beach monitoring methods alongside the source specific molecular marker results from this study allows for a deeper understanding of the sources of microbial pollution impacting Woodlawn beach. This comparison also allows for the model to be improved by adding variables. Overall, the results from this study provide valuable insight into the source of microbial pollution at Woodlawn beach and better protection of public health with improved water quality monitoring.

VOGEL, LAURA, *University of Western University*

Laura completed her Undergraduate and Master's degrees in Environmental Engineering and Civil Engineering, respectively at the University of Miami. She is currently a PhD candidate at the University of Western Ontario in the Civil and Environmental Engineering department where she is focusing on microbial water quality at recreational beaches.

Accumulation of E. coli in the foreshore sand and pore water at freshwater beaches

E. coli concentrations in the foreshore sand and pore water at beaches are often elevated compared to adjacent surface waters. There is limited understanding of the factors controlling the delivery and accumulation of *E. coli* in this reservoir. Understanding the buildup of *E. coli*, and related microbes, in the foreshore sand and pore water is important as it can act as a non-point source to surface waters and poses a potential health risk to beach goers. Possible sources that contribute to high levels of *E. coli* in the foreshore sand and pore water include infiltration of lake water through wave run up, direct deposition of fecal sources (e.g. bird droppings, trash), and storm water drains or runoff. Once in this reservoir, *E. coli* may under certain conditions replicate resulting in even higher concentrations. The accumulation of *E. coli* in the foreshore reservoir is complex due to the dynamic interactions between the foreshore sand and pore water, and shallow waters. The objective of this study was to quantify the temporal variability of *E. coli* concentrations in the foreshore sand and pore water at freshwater beaches and to identify the environmental factors (e.g. temperature, rainfall, wind and wave conditions) controlling this variability. The temporal variability in *E. coli* concentrations in the foreshore reservoir was characterized by collecting samples (surface water, pore water, saturated and unsaturated foreshore sand) approximately once a

week at three beaches along on the Great Lakes from May-October 2014 and 2015. These beaches had different sand types ranging from fine to coarse and had varying sources of *E. coli* inputs (creeks, bird impacted, etc.). More frequent sampling was also conducted in July-August 2015 with samples collected daily over a 40 day period at one beach. The data was analyzed to determine the relationships between the *E. coli* concentrations and environmental variables as well as changes in sand level profiles and groundwater level fluctuations. Unaltered sand was collected from each beach, stored in an environmental chamber, and subsampled for up to 40 days to determine if replication was possible in the unsaturated foreshore sand at each of the beaches. Insight into how and why *E. coli* accumulates in the foreshore reservoir is essential to develop effective strategies to reduce *E. coli* levels at beaches and to enable better prediction of beach water quality.

WEISKERGER, CHELSEA, *Michigan State University* – **STUDENT POSTER**

Chelsea Weiskerger is a first year Ph.D. student with Michigan State University's department of Civil and Environmental Engineering. She has collaborated extensively with the United States Geological Survey, through the Lake Michigan Ecological Research Station, to assist with field data collection and analysis. Her ongoing research involves assessing patterns in climate, meteorology, and hydrogeology to determine how they affect *E. coli* concentrations at Lake Michigan beaches. As part of this research, Weiskerger has worked closely with her collaborators and coauthors to compile, edit, and analyze long-term beach data, developing metrics and performing statistical analyses on over 60,000 records for beaches surrounding Lake Michigan and Lake Erie. In the future, she hopes to extend her expertise to hydrodynamic modeling, in order to more fully characterize and validate the empirical trends observed.

Tides of Change: Effects of a Changing Climate on Southern Lake Michigan

Anthropogenic climate change has led to countless ecological transformations across the globe, from increases in temperatures and sea level, to intense weather events. The American Great Lakes basin is not immune to these effects. We assessed meteorological variables in Chicago and Lake Michigan between 2000 and 2014, in order to gain insight into how climate has changed in the lake recently and what may be expected in the future. Average air temperatures, as recorded by land-based (on-shore) weather stations, and nearshore and offshore buoys indicate that offshore air temperature values tend to increase at a marginally higher rate than nearshore or on-shore air temperature values over the course of the summer. This was seen in both 2000-2003 and 2011-2014, with a larger difference observed in 2011-2014 data compared to 2000-2003 data. In 2011-2014, the quadratic increases in temperature for the two buoys and the on-shore weather station were less pronounced than for 2000-2003 (average change in R2=-0.115).

An interesting trend emerges from these data, showing a sort of gradient in temperature as well as rate of change, between offshore, nearshore, and on-shore air temperatures. Temperature values tend to increase moving onshore, while the initial rate of change tends to increase moving offshore. Degree day data showed similar trends. In assessing the difference between on-shore, nearshore, and offshore degree day data, it was found that the overall trends are similar between the two study periods, showing a logistic increase in degree day values over time, as expected. However, there is significant variation in the differences in degree day between offshore and onshore, compared to the differences between offshore and nearshore degree day values over the course of the season. These degree day data seem to support the idea that there is a temperature gradient between on-shore, nearshore, and offshore degree day values. For both study periods, the differences between on-shore and offshore degree day values are larger than the differences between on-shore and nearshore degree days, indicating that nearshore degree day values fall somewhere between on-shore and offshore values. Wind patterns have also changed between 2000 and 2014. Prevailing winds between 2011 and 2014 are more southerly than those from 2000-2003. Additionally, prevailing winds seem to have shifted over time, from frequent south-southwesterly winds in 2000-2003, to frequent south-southeasterly winds in 2011-2014. Finally, 2000-2003 saw stronger northerly winds than 2011-2014. These findings support the idea that Lake Michigan and its beaches are impacted by climate changes. Previous research has indicated that air and water temperature, wind speed, and wind direction all influence *E. coli* concentrations on recreational beaches, and with the changes seen in these variables, we would expect that *E. coli* trends on the beaches would also have changed over the study period.

However, it is possible that climate change impacts are only beginning to manifest at Lake Michigan beaches. With additional data and longer-term analyses, understanding these climate change impacts may lead to management adjustments at affected Great Lakes beaches.

WU, HUIYUN, *Michigan State University* **– STUDENT POSTER**

Huiyun Wu holds a B.S. Environmental Science, M.S. Environmental Engineering; Analitical chemistry in Environmental Engineering field ; Ph.D. Environmental Engineering; Microbial genomics in Environmental Engineering field

First-Flush of Microbiological Pollutants in Red Cedar River

Michigan climate is characterized by hot-humid summers, cold winters with snowfall, and wet springs. The state receives an average of 30-40 inches of precipitation annually. This climate creates a long period of pollutant build-up deposited on land during dry weather (November-March) that are washed away in spring when the snow starts to melt into rivers and lakes. The initial storms of the spring season usually have high pollutant concentrations, which create a first-flush phenomenon. These microbial pollutants may originate from different sources such as animal waste, runoff from agricultural fields with manure and biosolid applications, leaking septic system, combined sewer outflows etc.

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