

**New York State Water Resources Institute  
Department of Earth and Atmospheric Sciences**

**Annual Technical Report  
2018**

## General Information

### Products

Project: 2018NY242B

Title: The Pathogen Panel for rapid quantification of 17 waterborne viral, bacterial and protozoal pathogens and fecal indicators at New York State Beaches

PI: Ruth Richardson

Institution: Cornell University

Publications:

Final technical report; <https://wri.cals.cornell.edu/grants-funding/104b/2018/>

Richardson, R.E, Bae, J., Delatorre, O., Fernandez-Baca, C., Szegletes, Z., Barrott, N., and Sausele, D. (2019) Rapid In-field Workflow for qPCR-based Detection of Elevated Fecal Enterococci in Swimming Beach Waters. Abstracts of the American Society for Microbiology General Meeting, San Francisco, CA.

Project: 2018NY243B

Title: Invasive round goby as a water quality assessment tool: bioindicators of contaminants in Northeastern U.S. inland waters

PI: Suresh Sethi

Institution: Cornell University

Publications:

Final technical report; <https://wri.cals.cornell.edu/grants-funding/104b/2018/>

Project:2018NY244B

Title: Balancing cyanotoxin removal and N-nitrosamine formation control during ozonation of harmful algal bloom-impacted source waters

PI: Teng Zeng

Institution: Syracuse University

Publications:

Final technical report; <https://wri.cals.cornell.edu/grants-funding/104b/2018/>

Pu, C.; Zeng, T., Formation of N-nitrosamines upon chloramination and chlorination of cyanobacterial strains. Poster presentation, Gordon Research Conference Drinking Water Disinfection By-Products, South Hadley, MA, 2019.

Project: 2018NY245B

Title: Turning Vacant Lots into Green Infrastructure: Application of A Multi-objective Optimization Tool in the City of Buffalo

PI: Zhenduo Zhu

Institution: SUNY Buffalo

Publications:

Final technical report; <https://wri.cals.cornell.edu/grants-funding/104b/2018/>

A. M Saharia, Z. Zhu, N. Aich, et al., Modeling the transport of titanium dioxide nanomaterials from combined sewer overflows in an urban river, Science of the Total Environment (2019), <https://doi.org/10.1016/j.scitotenv.2019.133904>

M.S. Behrouz, Z. Zhu, L.S. Matott, A.J. Ribideau, A New Tool for Automatic Calibration of the Storm Water Management Model (SWMM), submitted for review to Journal of Hydrology

Z. Zhu, K. Macro, M. Shahed Behrouz, S. Matott and A. Rabideau. "An Optimization Tool for Green Infrastructure Planning with SWMM". American Geophysical Union Fall Meeting, Washington. D.C., USA, December 10-14, 2018.

Project: 2018NY247B

Title: Strengthening regional extension on flood resiliency

PI: Todd Walter

Institution: Cornell University

Publications:

Erin Fenton, Robin Blakely-Armitage, and David L. Kay, Perceptions of Risk and Behavior: Climate Change & Weather-Related Relocation - <https://cardi.cals.cornell.edu/sites/cardi.cals.cornell.edu/files/shared/RPB-Nov2018FINAL.pdf>

Other Publications including NYSWRI staff:

Jeffrey Jacquet, Anne Junod, Dylan Bugden, Grace Wildermuth, Joshua Fergen, Kirk Jalbert, Brian Rahm, Paige Hagley, Kathryn Brasier, Kai Schafft, Leland L. Glenna, Timothy W. Kelsey, Joshua Fershee, Richard Stedman, David Kay, James Ladlee "A decade of Marcellus Shale: impacts to people, policy, and culture from 2008 to 2018 in the Greater Mid-Atlantic region of the United States" The Extractive Industries and Society, Volume 5 (4), 2018. <https://doi.org/10.1016/j.exis.2018.06.006>

Fernandez-Baca, C.P.; Truhlar, A.M.; Omar A-E.H.; Rahm, B.G.; Walter, M.T.; Richardson, R.E. "Methane and nitrous oxide cycling microbes in soils above septic leach fields: abundances with depth and correlations with net surface emissions" Science of the Total Environment, Volume 640-641, <https://doi.org/10.1016/j.scitotenv.2018.05.303>

## Information Transfer Program

Project: 2018NY247B

Title: Strengthening regional extension on flood resiliency

PI: Todd Walter

Institution: Cornell University

Information Transfer:

WRI reached out to municipalities by contacting county cooperative extension offices within regions with known flooding concerns. For those that expressed interest WRI staff discussed creation of an "inland flooding" toolkit and crosswalk document. We created customized toolkits for the Town of Conklin and Kirkwood in Broome County, and the Village of Wellsville in Allegany County. The content of these toolkits was modeled after work performed in the Hudson Valley, which can be viewed here: <https://wri.cals.cornell.edu/hudson-river-estuary/climate-change-hudson-river-estuary/resources-resilience/>

In terms of meeting additional proposal objections, we also:

- Continued to convene the Cornell Flood Resilience Working Group, and began to develop a website (<https://wri.cals.cornell.edu/research-topics/flood-resiliency-working-group/>)
- Co-hosted, with the Cornell Community and Regional Development Institute, an event focused on Flood Risk and Community Resilience (<https://cardi.cals.cornell.edu/training/cdi/2018-institute/>)
- Held the proposed workshop on culvert modeling, attended by Tompkins County, Cornell Cooperative Extension, and Soil and Water Conservation District staff

Talks given:

"Dealing with Storm Water" Talk presented at the Penn York Ag-stravaganza, hosted by CCE Allegany County, Wellsville, NY, December 1st, 2018 (~7 registered attendees)

"Flood Risk & Resiliency – Cornell University Resources from New York State" Talk presented with David Kay

(CaRDI) at the NY Upstate Chapter of the American Planning Association Annual Conference, Ithaca, NY, October 5th, 2018 (~45 talk attendees)

## **Student Support**

Student Support:  
undergraduate - 5  
graduate - 4  
post-docs - 0

## **Notable Achievements and Awards**

Ruth Richardson's work on detection of pathogens at swimming beaches garnered media attention from a variety of local and regional outlets, including:

- NPR and WAER press coverage, "Cornell Researchers Hope New Water Contamination Test Can Keep Beaches Open During the Summer" <http://waer.org/post/cornell-researchers-hope-new-water-contamination-test-can-keep-beaches-open-during-summer>
- Cornell Chronicle, "Engineers test device for monitoring NY state park water quality" <http://news.cornell.edu/stories/2018/07/engineers-test-device-monitoring-ny-state-park-water-quality>
- Spectrum News <http://spectrumlocalnews.com/nys/buffalo/news/2018/07/17/cornell-researchers-using-buffalo-beaches-to-research-rapid-water-testing-device-biomeme>

## Projects

### **Balancing cyanotoxin removal and N-nitrosamine formation control during ozonation of harmful algal bloom-impacted source waters**

**Project Type:** Annual Base Grant **Project ID:** 2018NY244B

**Project Impact:** Project Impact: Blooms of blue-green algae (cyanobacteria) cause many water quality management issues. Water utilities oftentimes need to treat source waters laden with various cyanobacterial populations, which may contribute to the formation of harmful disinfection byproducts (DBPs), such as N-nitrosamines, in downstream drinking water treatment. This preliminary study investigated the formation of total and specific N-nitrosamines upon chloramination and chlorination of laboratory cultures of cyanobacteria. Preliminary characterization of cyanobacterial samples using fluorescence spectroscopy and high resolution mass spectrometry revealed differences in optical and molecular properties of cyanobacterial organic matter derived at exponential and stationary growth phases. Three Summary Points of Interest • The toxin producing *Microcystis aeruginosa* strain produced more N-nitrosamine precursors per dry cell weight than the non-toxin producing strain; • N-nitrosamine precursors originated from both particulate and dissolved and/or colloidal fractions of cyanobacterial organic matter; • In situ formation of organic chloramines likely played a role in N-nitrosamine formation upon chlorination of cyanobacterial cultures.

### **Invasive round goby as a water quality assessment tool: bioindicators of contaminants in Northeastern U.S. inland waters**

**Project Type:** Annual Base Grant **Project ID:** 2018NY243B

**Project Impact:** Project Impact: After first being recorded in Lake Erie and Lake Ontario in the early 1990s, the invasive fish Round goby (*Neogobius melanostomus*) is rapidly expanding across New York inland waterbodies and is advancing towards the Hudson River system and Atlantic Ocean. Where introduced, round goby quickly reach high biomass. As predators, round goby foraging behavior potentially exposes them to high contaminant loads, consuming benthic invertebrates and filter feeding invasive mussels. Because round goby are widely spread throughout habitats in invaded systems, and they are easy to catch, they may provide an indicator reflective of contaminant levels in inland waterbodies, providing spatially extensive bioindicators of water quality. Here, we assessed total mercury concentration in 52 round gobies sampled among 5 lakes in NY. Goby contaminant levels were consistent within waterbody, but varied significantly among waterbodies with mean concentrations ranging from 16.5 – 77.9 THg ng/g wet weight. These results suggest round goby may reflect waterbody contaminant loads and serve as potential bioindicators of contaminants in invaded waterbodies. Three Summary Points of Interest • Round goby are spreading rapidly from the Great Lakes to inland waters through connected waterways. • We assayed 52 round goby among 5 NY lakes for total mercury concentration and found contaminant concentrations varied widely among populations, ranging from 10 – 140 THg ng/g (wet weight) among individuals. • As a benthic feeding fish, round goby concentration levels were associated with patterns in lake-wide mercury contamination, indicating this species may provide an indicator of total mercury loads in waterbodies.

### **Owasco Lake impairment and the link to land use and tributary health**

**Project Type:** Annual Base Grant **Project ID:** 2018NY246B

**Project Impact:** Project Impact: Study focus: Dairy manure is commonly applied to NY, USA agricultural fields as both a crop nutrient source as well as a means of waste disposal. Managing excess manure places an economic burden on small farm operations due the prohibitive cost of existing practices and regional dominance of saturation-excess hydrology. Through a SWAT modeling exercise we evaluate the efficacy of dairy manure application following the topographic wetness index (TI) as a means of reducing non-point source agricultural nutrient runoff. Next, we examine the efficacy of amending dairy manure with chemical N as a means of reducing the rate of soil TDP accumulation. New hydrological insights: We observed that application of manure to drier pastures results in less TDP and NOX surface losses, but an undesirable increase soil TDP accumulation. Further, pastures receiving dairy manure are typically N limited during summer months, limiting plant P uptake. Manure N amendment reduced TDP accumulation and increases crop yield, but slightly increased NOX surface losses. Spreading dairy manure based on

the TI concept represents a feasible path towards reduction of agricultural non-point nutrient runoff, although management strategies need to consider ways to also reduce the long-term accumulation of soil P, which could have consequences in the future that are difficult to mitigate.

## **Strengthening regional extension on flood resiliency**

**Project Type:** Annual Base Grant **Project ID:** 2018NY247B

**Project Impact:** Please see the general description of this Information Transfer project for details of its impact. We were successful in creating publications and outreach documents for three municipalities, such as: - Erin Fenton, Robin Blakely-Armitage, and David L. Kay, Perceptions of Risk and Behavior: Climate Change & Weather-Related Relocation - <https://cardi.cals.cornell.edu/sites/cardi.cals.cornell.edu/files/shared/RPB-Nov2018FINAL.pdf> - Crosswalk Document: <https://cornell.box.com/s/wknpj76lls3o7nabyh3ie2ma3qedtro> - Flood Preparedness Guide (Credits: CCE Ulster): <https://cornell.box.com/s/jmnmj8wh1a9kqwtlp62ijkb00jyugyvoe> - Streambusters Factsheet (Credits: CCE Ulster): <https://cornell.box.com/s/vqjt9hidnq7242x0cjz27puawx8w2zne> - Annotated Bibliography (Customized for Town of Conklin) <https://cornell.box.com/s/vqjt9hidnq7242x0cjz27puawx8w2zne> We also: - Continued to convene the Cornell Flood Resilience Working Group, and began to develop a website (<https://wri.cals.cornell.edu/research-topics/flood-resiliency-working-group/>) - Co-hosted, with the Cornell Community and Regional Development Institute, an event focused on Flood Risk and Community Resilience (<https://cardi.cals.cornell.edu/training/cdi/2018-institute/>) - Held the proposed workshop on culvert modeling, attended by Tompkins County, Cornell Cooperative Extension, and Soil and Water Conservation District staff

## **The Pathogen Panel for rapid quantification of 17 waterborne viral, bacterial and protozoal pathogens and fecal indicators at New York State Beaches**

**Project Type:** Annual Base Grant **Project ID:** 2018NY242B

**Project Impact:** Beach managers must balance the significant risks of human disease with social and economic costs of closing public beaches. Effective and accurate quantitative microbial risk assessment (QMRA) requires direct measurements of pathogens. Direct measurement of waterborne pathogens has been historically difficult due to cost, labor-intensive methodologies, low concentrations in the environment and problems identifying the correct pathogen(s) to monitor at a given locale. There is need for an affordable and rapid technique to simultaneously determine presence and concentration of myriad waterborne pathogens. Such a tool will be useful to benchmarking which pathogens are posing the greatest risk in recreational waters. We recently designed and partially validated a Pathogen Panel using the high-throughput real-time PCR platform, OpenArray (Life Technologies). Three Summary Points of Interest • Overall, NY State Park Beaches (n=12) had only sporadic detection of human diarrheal pathogens, suggesting that overall water quality is good. • Our PathogenPanel, for simultaneous detection and quantification of 12 pathogens and 5 fecal indicator bacteria (both general FIB and human-, poultry-, and cow-specific), was validated and showed excellent reproducibility across and within OpenArray plates. With this PathogenPanel we have highlighted some State Beaches with possible human fecal contamination threats. • Given the sparsity of data in the beach water samples we analyzed with respect to detections of pathogens, we did not find statistically significant differences between risk levels associated with pathogen exposure on days that met versus exceeded the Beach Action Value (BAV) for culturable Fecal Indicator Bacteria (FIB).

## **Turning Vacant Lots into Green Infrastructure: Application of A Multi-objective Optimization Tool in the City of Buffalo**

**Project Type:** Annual Base Grant **Project ID:** 2018NY245B

**Project Impact:** Project Impact • A multi-objective optimization tool for optimal siting of GI/LID, OSTRICH-SWMM, has been developed. This tool is open source and free to access through <https://github.com/ubccr/ostrich-swmm>. • The tool was demonstrated for automatic calibration of a SWMM model in Buffalo, and optimizing the implementation of rain barrels in a subcatchment in Buffalo. • Applying the SWMM model and a three-dimensional river model, for the first time, we model the possible transport of titanium dioxide nanomaterials from combined sewer overflows (CSOs) in Buffalo River, and highlight the spatial and temporal variations of the concentrations of nanomaterials.