Water Resources Research Institute of the University of North Carolina Annual Technical Report FY 2014

Introduction

During 2014-2015 (Fiscal Year 2014), the Water Resources Research Institute (WRRI) of The University of North Carolina System was responsible for fostering and developing a research, training, and information dissemination program responsive to the water problems of the State and region. To develop its programs, the Institute maintains an aggressive effort to interact and communicate with federal, state, and local water managers. The close contact with water managers is a basis for determining the ever-changing water research priorities. Initial planning efforts were begun during this review period to develop a WRRI strategic plan. This effort is being undertaken through engagement all of WRRI's stakeholders and users.

Research priorities continue to be identified and refined by the WRRI Advisory Committee, composed of representatives of several federal and state agencies, local governments, industries, and non-governmental environmental organizations (NGOs), as well as by other water resource experts in the state with whom WRRI has close relationships. A technical review committee is also convened on an annual basis to advise WRRI staff on the scientific merit of research proposals submitted for funding. Full-time faculty members from all North Carolina institutions of higher education are eligible to receive grants from WRRI.

The information transfer program continued to focus on disseminating results of sponsored research and providing information on emerging water issues, solutions, and regulations. Results of research are disseminated by publication of technical completion reports, peer reviewed manuscripts, summaries in the WRRI newsletter, the WRRI website, and presentations by investigators at the WRRI Annual Conference and individual group meetings where appropriate. WRRI continues to be a sponsor of continuing education credits by the NC Board of Examiners of Engineers and Surveyors and the NC Board of Landscape Architects. This allows WRRI to offer Professional Development Hours (PDHs) and contact hours for attendance at the WRRI Annual Conference and other workshops and seminars that WRRI sponsors.

WRRI continues to adapt to changes in the landscape of its home institution, NC State University, by consolidating its operations and maximizing staff efficiencies and outputs. The program continues to leverage funds from a variety of sources to expand the reach and impact of research and outreach activities, and grow their involvement in and support of water-related research and outreach across the state. During this review period WRRI was reviewed by NC State University's Board of Trustees. The review highlighted WRRI's successes and as a result of the review WRRI was approved for continuation within the UNC system.

WRRI continues to provide leadership in water resource issues across the state. The WRRI Director was elected co-Chair of the State's Sedimentation Control Commission during this reporting year. Also this year WRRI became a voting advisory board member on the NC Water Resources Association.

Research Program Introduction

During 2014-2015 (Fiscal Year 2014), WRRI continued its regular program of fostering research, training, and information transfer responsive to water issues of the state and region. Results from Institute-supported research efforts are expected to assist local, municipal, state, regional and federal agencies improve their decision-making in the management and stewardship of their water resources.

To help it chart and sponsor a research program responsive to the water resource issues and opportunities in North Carolina, WRRI interacts closely with the N.C. Department of Environment and Natural Resources, other agencies, water and power utilities, and an array of research and outreach programs within the UNC system and at private higher educational institutions across North Carolina. A research advisory committee provides input, guidance, and review of the Institute's research priorities. This committee is composed of representatives of several federal and state agencies, local governments, industries, and non-governmental environmental organizations (NGOs). In early 2015, the committee convened in person in Raleigh for a thorough discussion of the state's most pressing water issues and how WRRI's research priorities and program could address these issues.

The results of this process of honing research priorities are shared with prospective investigators as part of WRRI’s annual call-for-proposals. Proposals that address the annual priorities and meet peer review and other criteria receive preferential consideration for funding. Research priorities, as determined via the above process, are incorporated into our Section 104 Objectives on an annual basis. The proposal solicitation, as in the past, is sent to relevant contacts at colleges and universities across North Carolina to apprise them of the opportunity to submit proposals. The call for proposals is also sent to an email distribution list of approximately 180 university faculty across North Carolina. Full-time faculty members from all North Carolina institutions of higher education are eligible to receive grants from WRRI.

The proposals received are sent to a Technical Committee and to external peer reviewers to determine the relevancy, need for the proposed research and relative strength and weaknesses. The Technical Committee convenes on an annual basis to review all comments made by reviewers, advise WRRI staff on the scientific merit of research proposals, and make recommendations regarding proposal funding.

Efforts were made to maintain a consolidated, refined, and focused list of FY14-15 research priorities based on in-depth discussions of the most significant water research needs and priorities for the state of North Carolina. These priorities were included in the annual call for FY 2014-2015, and the projects resulting from this annual call will be funded from March 1, 2015 to February 28, 2016 and will be reported in the next USGS Annual Report.

The FY 2014-2015 research priorities were: - quantifying the economic value of water quality

- quantifying sources, transport, and fate of nutrients and sediments in surface waters, and water quality changes in NC watersheds in which TMDLs and nutrient management plans have been implemented

- quantifying the potential impacts of coal ash on North Carolina surface and groundwater

- defining and evaluating in-stream flow needs and aquatic ecosystem function

- human impacts on groundwater availability and quality, interaction of surface water and groundwater resources, and fundamental hydrogeological understanding needed to support sustainable use of groundwater resources

- development and evaluation of methods for quantifying pollutant removal from stream restoration practices and projects

- defining and evaluating different stormwater control and nutrient reduction measures, their relative pros and cons, their cost-effectiveness, and appropriate pollutant removal credits for these measures as they relate to sediment, nitrogen, phosphorous, pathogens/bacteria, and other stormwater contaminants in urban stormwater systems

- defining and evaluating realistic management measures (including riparian buffers) that can quantifiably mitigate the effects of impervious cover on water quality and aquatic life, in different urban settings and stormwater systems

- understanding, quantifying, and managing risks and uncertainties in public water supplies, in the face of changing population, land use, climate, and regulations

- setting rates and financing capital improvements for water and/or sewer utilities, in the face of changing population, land use, climate, and regulations

- applying social science and economic valuation methodologies to help utilities better understand customers' level-of-service expectations, their motivations, and willingness to pay for services, as well as understand customer perceptions, attitudes, opinions and beliefs related to water, wastewater, and reclaimed water

- identifying, understanding, and applying innovative processes and technologies for water and wastewater treatment, plant operation, distribution systems, and potable and reclaimed water supply and waste discharge management

- evaluation of alternative water sources (e.g., graywater or harvested rainwater) for differing consumptive uses (e.g., home irrigation), health risks of alternative sources, and potential impacts of alternative water use on overall water supply and demand.

During this reporting cycle, a special joint RFP was released in collaboration with the N.C. Sea Grant College Program. This RFP highlighted three common themes shared by both programs: 1) Impacts of drought on North Carolina waters, communities, ecosystems and economies; 2) Eutrophication issues on North Carolina lakes, streams, rivers and estuaries including: causes, impacts, trends and management strategies; and 3) Citizen science programs that address water-related issues in North Carolina. The RFP generated 21 proposals and resulted in a highly competitive competition. Three projects were selected for funding out of this special call, one in each focus area. These projects are ongoing. This special call benefited WRRI through leveraged funds and by reaching new partners.

Integrated Drought Management and Assessment Portal for the State of North Carolina

Basic Information

Title:	Integrated Drought Management and Assessment Portal for the State of North Carolina
Project Number:	2014NC185B
Start Date:	3/1/2014
End Date:	2/28/2015
Funding Source:	104B
Congressional District:	2
Research Category:	Engineering
Focus Category:	Hydrology, None, None
Descriptors:	None
Principal Investigators:	Sankarasubramanian Arumugam, Ryan Boyles, Tushar Sinha

Publications

There are no publications.

Integrated Drought Management and Assessment Portal for the State of North Carolina

Sankar Arumugam and Ryan Boyles

NC State University, Raleigh 27695-7908

Progress Report for the period March 2014 – February 2015

Project Meetings and Personnel: One PhD student, Mr. Amirhossein Mazoorei and Ms. Rebecca Cumbie from the State Climate Office have been working on the project. Amirhossein has been working on developing retrospective seasonal streamflow and soil moisture forecasts using NASA's Land Information System for the entire state of NC. In addition, Amir has been working on developing probabilistic downscaling methods that uses the entire ensembles from climate models for providing probabilistic streamflow forecasts. Rebecca has been working on developing an integrated drought management portal which will combine existing data with the newly-developed land surface model based products. Four project meetings were held over the past six months between Dr. Arumugam's research group and Dr. Boyles' research group.

Award from the project: Amirhossein Mazoorei supported from this project received the second best student poster presentation for his work in the annual NC WRRI symposium. The poster focused on developing integrated streamflow and soil moisture forecasts over the entire state of NC.

Progress Report:

The proposed research builds upon existing inflow and storage forecasts portal at the SCO into an integrated drought management and assessment portal for NC. The proposed drought information portal involves development of forecasts of soil moisture, streamflow conditions over the state of NC. Two specific objectives are proposed in this study:

1) Develop operational soil moisture and streamflow forecasts for the entire state of NC by enhancing the existing experimental reservoir inflow and storage forecasts portal with the NASA's Land Information System (LIS) and distributed modeling framework.

2) Develop adaptive drought management framework that supports monitoring, prediction and drought management including customized drought indices for the entire state of NC.

We report here the progress on the two objectives.

Objective 1: Develop operational soil moisture and streamflow forecasts for NC using LIS

A new procedure for developing tercile categories of streamflow forecasts is developed using multinomial regression. The procedure uses previous month observed streamflow and the ensembles of precipitation forecasts issued for that month to develop tercile categories of streamflow forecasts. Currently, we are using principal component regression (PCR) that uses ensemble mean to develop streamflow forecasts for the upcoming month. The limitation of PCR is in ignoring the probabilistic information in the precipitation forecasts from the climate models. The proposed procedure will overcome that limitation in utilizing the entire probabilistic information in precipitation forecasts for developing streamflow forecasts. Our analyses show that multinomial regression performs better in developing streamflow forecasts for the summer months as well as in arid basins. We intend to incorporate this streamflow forecasting procedure as part of the drought management portal.

We have also developed seasonal soil moisture and streamflow forecasts for the entire state of NC for the period 1991-2000. These retrospective precipitation and temperature forecasts are issued in January, April, July and October of each year for the period 1991-2000 from ECHAM4.5 General Circulation Model. These monthly precipitation and temperature forecasts are downscaled to 0.5X0.5 and then they are disaggregated to hourly time step for developing the primary forcings for LIS. The secondary meteorological forcings (wind speed, humidity etc.,) are provided based on the hourly climatology of the NLDAS2 (National Land Data Assimilation version 2). Based on these primary and secondary forcings for LIS, we developed gridded streamflow and soil moisture forecasts from two Land Surface Models (Noah and CLM). These will be displayed through the integrated drought management portal for analyzing the performance of past forecasts.

Plan of work for the next six months: a) Add NOAA GFS as an additional GCM.

Objective 2: Develop Integrated Drought Management Portal for the state of NC

The plan here is to develop an integrated drought management portal that shows both current and past data of hydrometeorological attributes and retrospective and future forecasts of soil moisture and streamflow forecasts. We have made progress on three fronts: (a) Integrate past data, current data and future forecasts under one view (Figure 1), (b) Retrieve the time series and perform analysis on the existing time series of those hydrometeorological attributes (past, current and future data) (Figure 2) and (c) integrate existing reservoir inflow and storage forecasts under the new portal (Figure 3).

We have integrated the soil moisture forecasts into the portal (Figure 4) and it is currently being evaluated and summarized in terms of developing the tercile forecasts of soil moisture. Since we don't have observed soil moisture information, we will use simulated soil moisture from the land surface model and then obtain the percentiles of the soil moisture forecasts by mapping the quantiles of the forecasted with the quantiles of simulated soil moisture. We intend to integrate this soil moisture forecasts in the drought management portal.

We have also provided detailed retrospective analyses (Figure 5) for streamflow and storage forecasts for all the reservoir locations under the Wilmington District (Falls Lake, Lake Jordan, Kerr-Scott and Philpott) as part of the drought management portal. The inflow forecasts could be used for developing storage forecasts based on the user specified releases.

Plan of work for the next six months: (a) Route the forecasted flow for specific HCDN stations.

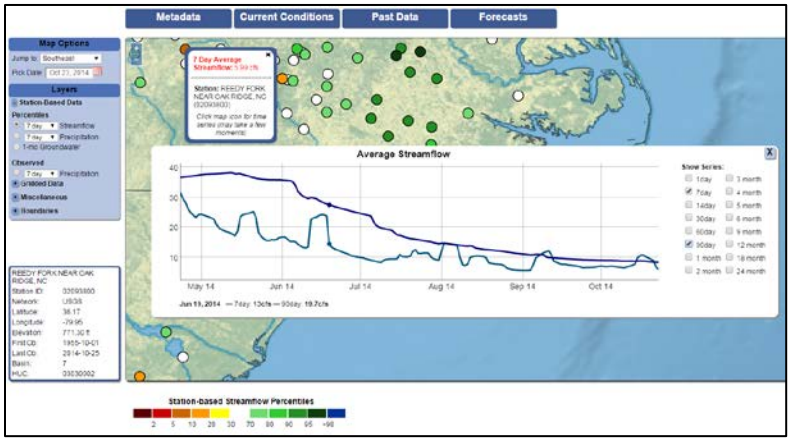

Figure 1: Gauge data from sites across the Southeast can be overlaid with a variety of data (the most recent USDM map shown here) for monitoring current and historical surface, groundwater, and weather conditions.

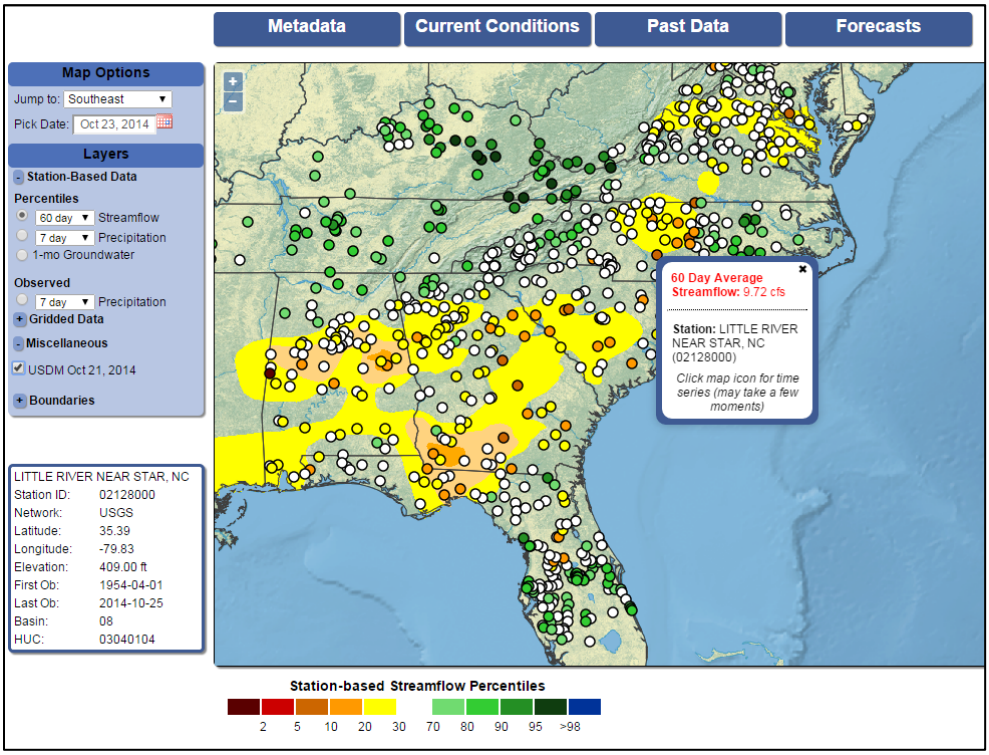

Figure 2: Users can click on station icons to view time series over the most recent year.

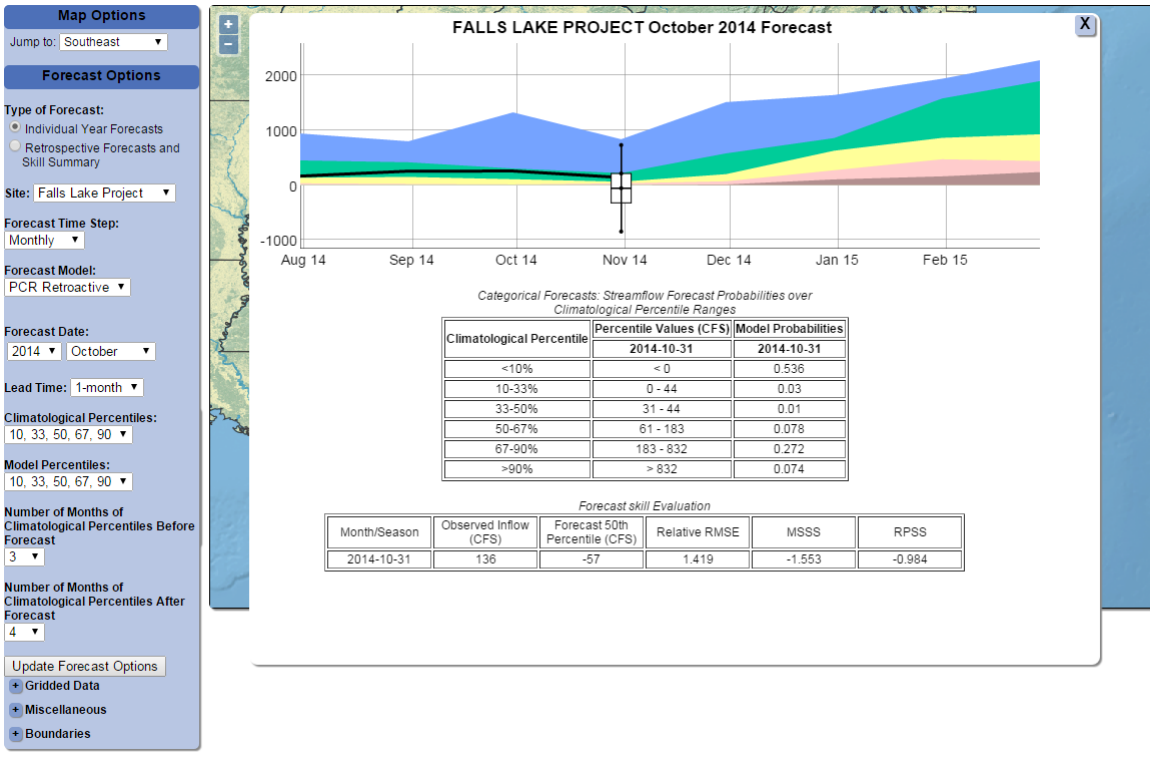

Figure 3: Existing experimental inflow forecasts (http://www.nc-climate.ncsu.edu/inflowforecast) have been added to the new water portal and these will be updated as we develop better ways to integrate observed data with monthly and seasonal forecasts.

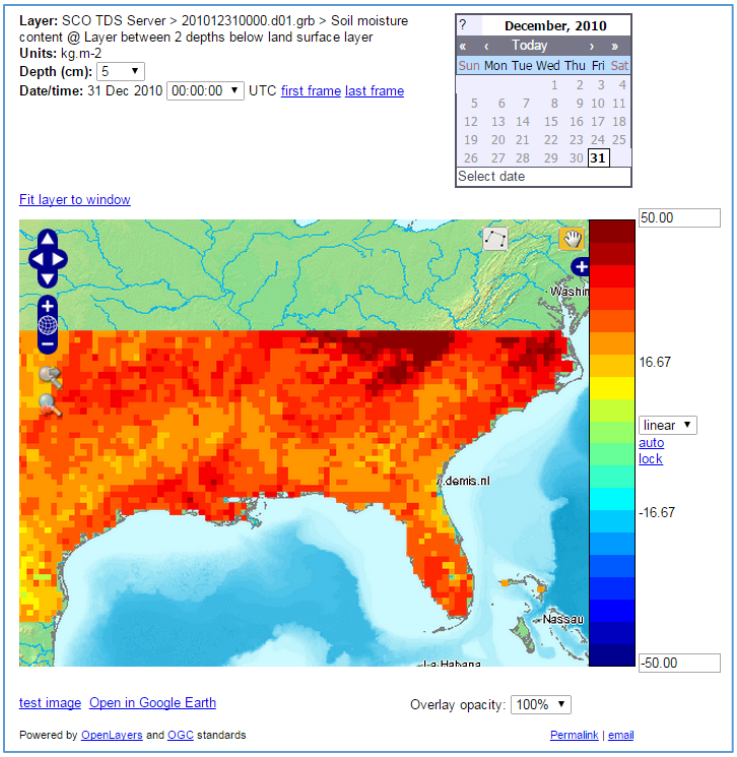

Figure 4: Soil moisture forecasts from NASA's Land Information System integrated into the drought management portal.

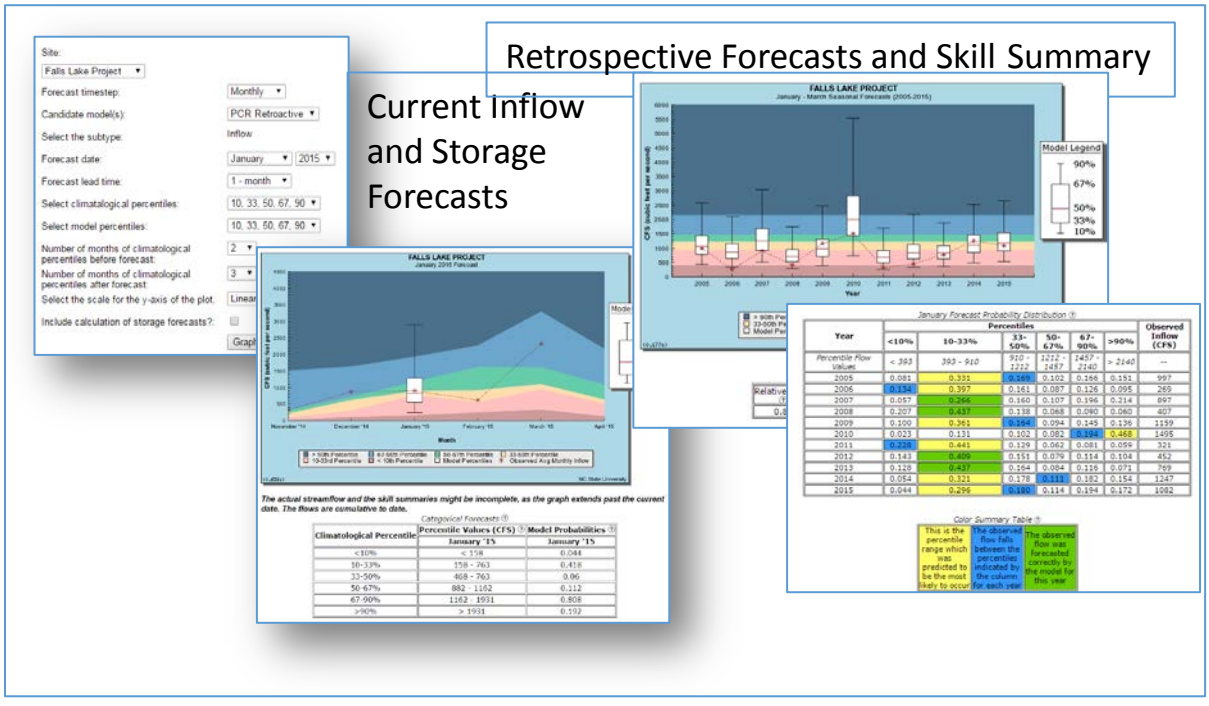

Figure 5: Retrospective forecasts and skill summary for inflow and storage forecasting portal that is encompassed within the drought management portal.

Quantification of Fecal Bacteria Removal by Micro-zooplankton Grazing in Stormwater BMPs

Basic Information

Title:	Quantification of Fecal Bacteria Removal by Micro-zooplankton Grazing in Stormwater BMPs
Project Number:	2014NC186B
Start Date:	5/1/2014
End Date:	2/28/2016
Funding Source:	104B
Congressional District:	NC7
Research Category:	Water Quality
Focus Category:	None, None, None
Descriptors:	None
Principal Investigators:	Michael A. Mallin, Lawrence B. Cahoon

Publications

There are no publications.

Dr. Michael A. Mallin 14-02-W

Please answer questions as they apply to activities between March 1, 2014 and February 28, 2015

Specific Reporting Questions:

1. Please specify the number of each of the following: undergraduates, masters students, PhDs and/or postdocs who worked on this project. (They may have received stipends from other sources, but the idea is to capture the ones whose research was supported with the WRRI/USGS funds).

   one graduate student (marine sciences), Jade Burtchett, finishing her second semester of graduate school (M.S. in Marine Sciences)
   two faculty on this project (Dr. M.A. Mallin and Dr. L.B. Cahoon)

   Please also indicate in parentheses whether their field of study was engineering, physical sciences, biological sciences, natural resources/agricultural sciences, social sciences, or other (define other). Finally, please also indicate the number of faculty working on this project.

   For Graduate students, please give first/last names of the student and whether they have graduated already or are still a student (note, this item is being required of Centers and Institutes of the UNC System).

2. Did you or your students receive any awards or recognition for the research performed under this grant (example: a student received an honorable mention for a presentation delivered at a conference based on research results from this project)? If so, please specify the nature of the award (date, name of award, person receiving award, and organization/conference issuing the award). No awards

3. Please list any presentations, workshops, technology demonstrations, outreach events etc delivered based on research results from this project (include date, title, location of presentation and/or conference, and a brief description of session). If a workshop was held, please include number of attendees.

   Burtchett, J.M., M.A. Mallin, M.R. McIver and L.B. Cahoon. 2014. "Quantification of fecal bacteria removal by micro-zooplankton grazing in stormwater BMPs". Meeting of the Southeastern Estuarine Research Society, Carolina Beach, N.C.

   Burtchett, J.M., M.A. Mallin, M.R. McIver and L.B. Cahoon. 2015. "Seasonal variation in the quantification of fecal bacteria removal by micro-zooplankton grazing in stormwater BMPs". Meeting of the Southeastern Estuarine Research Society, Jacksonville, Fla.

4. If student attendance at a conference was supported with funds from this project, please list the title of the conference and number of students who attended (note, this can be attendance only, and does not have to include giving a presentation, which would be covered under question 4).

5. Were any teaching assistantships given as a result of the award? no

6. Were there any patents or copyrights as a result of this research? If so, please give the title of intellectual property, and a brief description of the property. no

7. Please list citations for any publications of research results from this project (can include outreach publications such as brochures or manuals, or research publications such as journal articles). Please also indicate if the publication was peer reviewed. None yet

8. Technology transfer or impact – please provide a brief description of any technology transfer and a summary of the impact on technology adoption or deployment. none

9. Were there any press releases or otherwise noteworthy events of interest to the general public that arose from your research project? no

10. Please list any service or involvement in an organization or on an external advisory group that was a direct result of funding for this project (include group name, description of interactions and role/appointments and work performed). none

11. Have any students that graduated and were supported from funding from this project received professional placement? If so, please specify the economic sector in which they became employed. Not yet

Microbial Quality and Risk Assessment of Type 2 NC Reclaimed Water for Non-potable and Potable Reuse

Basic Information

Title:	Microbial Quality and Risk Assessment of Type 2 NC Reclaimed Water for Non-potable and Potable Reuse
Project Number:	2014NC187B
Start Date:	3/1/2014
End Date:	8/31/2015
Funding Source:	104B
Congressional District:	NC4
Research Category:	Water Quality
Focus Category:	None, None, None
Descriptors:	None
Principal Investigators:	Mark D Sobsey

Publications

There are no publications.

Please answer questions as they apply to activities between March 1, 2014 and February 28, 2015

Submitted by Mark D. Sobsey, PhD
Department of Environmental Sciences and Engineering
University of North Carolina, Chapel Hil, NC 27599-7431

Specific Reporting Questions:

1. Please specify the number of each of the following: undergraduates, masters students, PhDs and/or postdocs who worked on this project. (They may have received stipends from other sources, but the idea is to capture the ones whose research was supported with the WRRI/USGS funds).

   Please also indicate in parentheses whether their field of study was engineering, physical sciences, biological sciences, natural resources/agricultural sciences, social sciences, or other (define other). Finally, please also indicate the number of faculty working on this project.

   For Graduate students, please give first/last names of the student and whether they have graduated already or are still a student (note, this item is being required of Centers and Institutes of the UNC System).

   Undergraduates (5)
   Katherine Mulligan (Biology)
   Brooke Stemple (Environmental Science)
   Allison Kline (Environmental Science)
   Hemali Oza (Environmental Science)
   Daisy Wang (Global Studies)

   Master's Students (2)
   AJ Karon (Environmental Science and Engineering), continuing student
   Matthew Price (Environmental Science and Engineering), graduated

   PhD Students (1)
   Emily Bailey (Environmental Science and Engineering), continuing student

   Faculty (1)
   Dr. Mark D. Sobsey, Kenan Distinguished Professor, Environmental Science and Engineering, The Gillings School of Global Public Health

2. Did you or your students receive any awards or recognition for the research performed under this grant (example: a student received an honorable mention for a presentation delivered at a conference based on research results from this project)? If so, please specify the nature of the award (date, name of award, person receiving award, and organization/conference issuing the award).
   No awards were received for the work done by the project team.

3. Please list any presentations, workshops, technology demonstrations, outreach events etc delivered based on research results from this project (include date, title, location of presentation and/or conference, and a brief description of session). If a workshop was held, please include number of attendees.

10/10/2014, "Pathogens and Reclaimed Water: Detection Methods, Risk Assessment, and Alternative Sources. A review of recent and proposed future research and regulatory implications"
Description: An invited 45-minute presentation by Mark D. Sobsey at the Urban Water Consortium Meeting (a consortium of NC water and wastewater utilities that support scientific and technical research and demonstration projects relevant to their interests). Eastside WWTP, 5898 Riverdale Dr., Jamestown, NC 27282

5/19/15, "Microbial Quality of Reclaimed Water to Meet NC Type 2 Performance for *Escherichia coli*, Coliphage Viruses, *Salmonella* spp., and *Clostridium perfringens"*, The University of North Carolina at Chapel Hill Water Microbiology Conference, May 18-21, 2015, Chapel Hill, NC
Description: An abstract was submitted in early 2015 for consideration for presentation at this conference. The submission was accepted for verbal presentation. This will be a 15-minute PowerPoint presentation by Emily Bailey followed by a 5 minute question and answer period. The goal of this presentation is to describe the process for producing NC Type 2 Reclaimed water and then to present the $\log_{10}$ reductions obtained by these treatment processes at 5 wastewater utilities in the Research Triangle Area of Raleigh, NC.

5/20/15, "Evaluation of a Candidate Bacteria Host for Simultaneous Detection and Quantification of Somatic and Male-specific/F+ Coliphages in Reclaimed Water", The University of North Carolina at Chapel Hill Water Microbiology Conference, May 18-21, 2015, Chapel Hill, NC
Description: An abstract was submitted in early 2015 for consideration for presentation at this conference. The submission was accepted for verbal presentation. This will be a 15-minute PowerPoint presentation by Matthew Price followed by a 5-minute question and answer period. The goal of this presentation is to detail the evaluation of a combined somatic and male specific coliphage host for the detection of coliphage viruses in reclaimed water.

5/21/15, Best methods for detecting *C. perfringens* in untreated and treated wastewater, The University of North Carolina at Chapel Hill Water Microbiology Conference, May 18-21, 2015, Chapel Hill, NC
Description: An abstract was submitted in early 2015 for consideration for presentation at this conference. The submission was accepted for verbal presentation This will be a 15-minute PowerPoint presentation by AJ Karon followed by a 5-minute question and answer period. The focus of this presentation is to present analysis on the simultaneous detection of *C. perfringens* on 3 candidate agar media in NC T2RW and raw sewage.

4. If student attendance at a conference was supported with funds from this project, please list the title of the conference and number of students who attended (note, this can be attendance only, and does not have to include giving a presentation, which would be covered under question 4).

Although students will attend The University of North Carolina at Chapel Hill Water Microbiology Conference, May 18-21, 2015, Chapel Hill, NC, they will not have to pay registration because they will be volunteering to assist with conference organization and management. They will not have to pay travel because the conference is at UNC-Chapel Hill.

5. Were any teaching assistantships given as a result of the award?

There were no teaching assistantships but Research Assistantships were supported partially as a result of this award.

6. Were there any patents or copyrights as a result of this research? If so, please give the title of intellectual property, and a brief description of the property.

No

7. Please list citations for any publications of research results from this project (can include outreach publications such as brochures or manuals, or research publications such as journal articles). Please also indicate if the publication was peer reviewed.

This project is still in progress; however, manuscripts are being prepared for publication.

8. Technology transfer or impact – please provide a brief description of any technology transfer and a summary of the impact on technology adoption or deployment.

No technology transfer has occurred yet from this award. However, this may be possible in the future.

9. Were there any press releases or otherwise noteworthy events of interest to the general public that arose from your research project?

There have been no press releases or other noteworthy events to the general public yet from this research.

10. Please list any service or involvement in an organization or on an external advisory group that was a direct result of funding for this project (include group name, description of interactions and role/appointments and work performed).

Prof. Mark Sobsey, the project PI, is an advisor to the World Health Organization's Water, Sanitation and Hygiene Programme. In this capacity he advises WHO on water reclamation and reuse. He has participated in technical meetings in which potable reuse has been discussed for the development of WHO Guidelines. Such a meeting was held in February, 2014 in Bonn, Germany.

Prof. Mark Sobsey has been a technical advisor to the City of Raleigh, NC on potable water reuse issues for several years. He has done water quality microbiology studies in support of City of Raleigh's efforts to explore potable water reuse for their utility.

11. Have any students that graduated and were supported from funding from this project received professional placement? If so, please specify the economic sector in which they became employed.

No students working on this project have graduated yet.

Linkages of Mercury and Methane Cycles in Piedmont Streams and Rivers in North Carolina, and Implications for Mercury Bioaccumulation in Food Webs

Basic Information

Title:	Linkages of Mercury and Methane Cycles in Piedmont Streams and Rivers in North Carolina, and Implications for Mercury Bioaccumulation in Food Webs
Project Number:	2014NC188B
Start Date:	5/1/2014
End Date:	4/30/2015
Funding Source:	104B
Congressional District:	NC12
Research Category:	Water Quality
Focus Category:	None, None, None
Descriptors:	None
Principal Investigators:	Martin Tsz-Ki Tsui, Craig J. Allan, Anne Hershey, Stephen C. Whalen

Publications

There are no publications.

WRRI GRANT PROGRESS REPORT

Subagreement no.: 2007-0199-19 and 2011-1481-06

Date of report: 11-5-2014

Title: **Linkages of mercury and methane cycles in Piedmont streams and rivers in North Carolina, and implications for mercury bioaccumulation in food webs**

Investigators:

PI: **Martin Tsz-Ki Tsui** (UNC-Greensboro) E-mail: tmtsui@uncg.edu Tel.: 336-256-0087

Co-PIs: **Anne E. Hershey** (UNC-Greensboro) and **Stephen C. Whalen** (UNC-Chapel Hill)

Project activities

Personnel involved: The project has so far involved a number of people, mainly from UNC-Greensboro (UNC-G). Drs. Tsui and Hershey from UNC-G designed and coordinated all work. Dr. Whalen (UNC-CH) provided analytical facilities for methane analysis. The work described in the project are included as part of the theses for two graduate students at UNC-G Biology Dept. (Josh Brigham, Ph.D. student, and Peter Blum, M.S. student), and two undergraduate research assistants at UNC-G Biology Dept. (Kimber Corson and Joel Alva).

Field sampling: Stream sampling of 12 piedmont streams of diverse land covers have been carried out during 2014 summer in or near the city of Greensboro. In the field, we collected surface water, sediment cores, and dominant groups of aquatic invertebrates. Sample analysis is ongoing and the following table summarizes the parameters:

	Parameters to be analyzed		
	Methane (at Whalen lab)	**Mercury** (at Tsui lab)	**Others** (at outside labs or Tsui lab)
Surface water	Dissolved CH_4	Particulate and dissolved total-Hg & MeHg	C/N isotope in seston C isotope in DOC TSS levels
Surface sediment (sieved < 1 mm)		Total-Hg & MeHg	Organic matter content
Sediment porewater	Dissolved CH_4	Dissolved total-Hg & MeHg	
Invertebrates (caddisflies or clams)		Total-Hg & MeHg	C/N isotope in tissues

Lab microcosm: A series of pilot experiments have been carried out to examine the optimal conditions for the experiment on microbial inhibition and mercury methylation. Once this phase is finished, we will plan to use enriched Hg isotopes (as ^{200}Hg) to measure Hg methylation rates in sediments from 4 different Piedmont streams. Sediment samples with ^{200}Hg will be analyzed at Dr. Chad Hammerschmidt's lab at Wright State University to determine the methylation potential of each treatment. Below is a summary of microcosm treatments:

	Methane	**Mercury (as ^{200}Hg)**
Control		
BESA (methaogen inhibitor)	0-48 hr	48 hr
Na_2MoO_4 (sulfate reducer inhibitor)		
Chloramphenicol (general bacterial inhibitor)		

Preliminary findings: From the field experiment, we have found heterogeneity in methane concentrations in sediment porewater from a variety of stream sites. Dissolved methane concentrations can vary 2-3 orders of magnitude within site. Overall, we found relatively low levels in total-Hg and MeHg in surface water, porewater and sediment in all 12 piedmont streams. Interestingly, we found urban streams (e.g., North Buffalo Creek in Greensboro) have higher MeHg levels than streams with wetland influence, which is different from the literature (Brigham et al., 2009). We are still in the process to finish all sample analyses for total-Hg and MeHg.

Reference list:

Brigham ME, Wentz DA, Aiken GR, Krabbenhoft DP (2009) Mercury cycling in stream ecosystems. 1. Water column chemistry and transport. *Environmental Science and Technology* 43(8): 2720-2725.

Land Application of Aquaculture Effluents to Prevent Surface Water Eutrophication and Promote Groundwater Re-Infiltration in Coastal North Carolina

Basic Information

Title:	Land Application of Aquaculture Effluents to Prevent Surface Water Eutrophication and Promote Groundwater Re-Infiltration in Coastal North Carolina
Project Number:	2014NC190B
Start Date:	7/1/2014
End Date:	6/30/2015
Funding Source:	104B
Congressional District:	NC-04
Research Category:	Water Quality
Focus Category:	Water Quality, Groundwater, Nutrients
Descriptors:	None
Principal Investigators:	Harry Daniels, Dennis William Hazel

Publications

There are no publications.

Please answer questions as they apply to activities between March 1, 2014 and February 28, 2015

Specific Reporting Questions:

1. Please specify the number of each of the following: undergraduates, masters students, PhDs and/or postdocs who worked on this project. (They may have received stipends from other sources, but the idea is to capture the ones whose research was supported with the WRRI/USGS funds).
   - One M.Sc. student (Allison Culbreth, natural resources, current student) and one PhD student (Shawn Shifflet, forestry, current student).
   - Four faculty involved with this project: Harry Daniels, PI (Applied Ecology), Elizabeth Nichols (Forestry and Environmental Resources), Dennis Hazel (Forestry and Environmental Resouces), and Garry Grabow (Biological and Agricultural Engineering).

   Please also indicate in parentheses whether their field of study was engineering, physical sciences, biological sciences, natural resources/agricultural sciences, social sciences, or other (define other). Finally, please also indicate the number of faculty working on this project.

   For Graduate students, please give first/last names of the student and whether they have graduated already or are still a student (note, this item is being required of Centers and Institutes of the UNC System).

2. Did you or your students receive any awards or recognition for the research performed under this grant (example: a student received an honorable mention for a presentation delivered at a conference based on research results from this project)? If so, please specify the nature of the award (date, name of award, person receiving award, and organization/conference issuing the award). NA

3. Please list any presentations, workshops, technology demonstrations, outreach events etc delivered based on research results from this project (include date, title, location of presentation and/or conference, and a brief description of session). If a workshop was held, please include number of attendees.

   - Land Application of Aquaculture Effluents. Culbreth, A, H. Daniels, E. Nichols and D. Hazel. Poster presented at meeting of Water Resources Research Institute, March 18-19, 2015, McKimmon Center, North Carolina State Unversity, Raleigh, NC.
   - Land Application of Aquaculture Effluents to Meet Dual Objectives: Grow Woody Biomass and Prevent Surface Water Eutrophication. Shifflett, S., A. Culbreth, H. Daniels, E. Nichols and D. Hazel. Poster presented at annual meeting of the US Aquaculture Society, February 19-24, 2015. New Orleans, LA, USA.
   - Land Application of Effluents. H. Daniels. Oral presentation at annual meeting of the NC Aquaculture Development Conference, February 19-21, 2015, New Bern, NC.

4. If student attendance at a conference was supported with funds from this project, please list the title of the conference and number of students who attended (note, this can be attendance only, and does not have to include giving a presentation, which would be covered under

question 4). Allison Culbreth (see above) poster presentation at annual US Aquaculture Society meeting. Aquaculture America 2015.

5. Were any teaching assistantships given as a result of the award? No

6. Were there any patents or copyrights as a result of this research? If so, please give the title of intellectual property, and a brief description of the property. No

7. Please list citations for any publications of research results from this project (can include outreach publications such as brochures or manuals, or research publications such as journal articles). Please also indicate if the publication was peer reviewed. NA

8. Technology transfer or impact – please provide a brief description of any technology transfer and a summary of the impact on technology adoption or deployment. Final results still not compiled. Project is still ongoing.

9. Were there any press releases or otherwise noteworthy events of interest to the general public that arose from your research project? NA

10. Please list any service or involvement in an organization or on an external advisory group that was a direct result of funding for this project (include group name, description of interactions and role/appointments and work performed). NA

11. Have any students that graduated and were supported from funding from this project received professional placement? If so, please specify the economic sector in which they became employed. NA

Information Transfer Program Introduction

The Water Resources Research Institute (WRRI) is designed to provide water resources information to a range of stakeholders including, industry, academic, non-profit groups, and governmental entities. WRRI maintains a strong information transfer program by cooperating with various state agencies, municipalities, and professional organizations to sponsor workshops and other events and by seeking grants for relevant activities.

The professionals targeted by this program include private entrepreneurs, federal, state and local government staff and officials, and representatives of industry, agriculture, consulting, and environmental groups. The main forms of information transfer are through an Institute internet site, quarterly newsletter, conferences, seminars, forums, workshops, luncheons, and research publications.

The workshops conducted through WRRI's partnership with the Department of Environment and Natural Resources Division of Energy, Mineral and Land Resources constitute the primary means by which the Division meets its educational obligations for sediment control under the state's Sedimentation Pollution Control Act.

WRRI continues to be a sponsor of continuing education credits by the NC Board of Examiners of Engineers and Surveyors as an Approved Sponsor of Continuing Professional Competency activity for Professional Engineers and Surveyors licensed by the State of North Carolina. In addition, WRRI also submits information for approval to the N.C. Board of Landscape Architects to offer contact hours to landscape architects. This allows WRRI to offer Professional Development Hours (PDHs) to engineers and surveyors, and Continuing Education Units (CEUs) to landscape architects for attendance at the WRRI Annual Conference and other workshops, seminars and forums that WRRI sponsors.

During this reporting year, WRRI provided 55.5 PDHs and 50 CEUs to 910 people at 9 workshops, seminars, and other events described in the following pages.

During this reporting period, WRRI expanded its leadership role on N.C. water resource related activities by becoming a voting member of the Advisory Board of the N.C. Water Resources Association (NCWRA). WRRI participation on the Board includes leading this groups strategic planning efforts and helping plan the annual NCWRA conference.

WRRI Information Transfer Program

Basic Information

Title:	WRRI Information Transfer Program
Project Number:	2014NC189B
Start Date:	3/1/2014
End Date:	2/28/2015
Funding Source:	104B
Congressional District:	NC-04
Research Category:	Not Applicable
Focus Category:	None, None, None
Descriptors:	None
Principal Investigators:	Nicole Wilkinson

Publications

1. Messer, T. L.*, Burchell, M.R. and Birgand F. 2014 Determining the Nitrogen Loads for Rerouted Agricultural Drainage Water into Restored Wetlands – An Experimental and Modeling Approach ASABE AIM. ASABE Paper No. 1895614
2. Messer, T. L.* and Burchell, M.R. 2014. Tracing the Fate of Nitrate through Restored Wetlands: A mesocosm 15N Tracer Study. ASABE AIM. ASABE Paper No. 1892505
3. Land Application of Aquaculture Effluents. Culbreth, A, H. Daniels, E. Nichols and D. Hazel. Poster presented at meeting of Water Resources Research Institute, March 18-19, 2015, McKimmon Center, North Carolina State Unversity, Raleigh, NC.
4. Land Application of Aquaculture Effluents to Meet Dual Objectives: Grow Woody Biomass and Prevent Surface Water Eutrophication. Shifflett, S., A. Culbreth, H. Daniels, E. Nichols and D. Hazel. Poster presented at annual meeting of the US Aquaculture Society, February 19-24, 2015. New Orleans, LA, USA.
5. Land Application of Effluents. H. Daniels. Oral presentation at annual meeting of the NC Aquaculture Development Conference, February 19-21, 2015, New Bern, NC.
6. McMillan, S.K. and Noe G.B. In preparation. Nutrient retention and floodplain connectivity in restored urban streams. Target journal: Biogeochemistry.
7. Noe, G.B., C. Hupp, E. Schenk, K. Krauss, S. Ensign, S. McMillan, K. Wolf, and C. Ahn. In preparation. Nutrient inputs and cycling in floodplain wetlands: a quantitative synthesis. Target journal: BioScience.
8. PI: Song, WRRI project: 11-06-W; Title: FACTORS CONTROLLING MICROBIAL NITROGEN REMOVAL EFFICACY IN CONSTRUCTED STORMWATER WETLANDS; Report No: 443
9. PI: McLaughlin; WRRI project: 12-06-W; Title: OPTIMIZING SOIL-POLYACRYLAMIDE INTERACTIONS FOR EROSION CONTROL AT CONSTRUCTION SITES; Report No: 441.
10. PI: Qi; WRRI project: 13-07-SE; Title: CITY OF DURHAM WATER QUALITY WEB PORTAL; Report No: 446
11. PI: Bergund (Zechman); WRRI project: 12-01-W; Title: An Integrated Framework for Assessing the Dynamics of Population Growth, Land Use and Climate Change for Urban Water Resources Management; Report No: not assigned
12. PI: Guyer; WRRI project: 12-08-U; Title: TAILORING FATS, OIL, AND GREASE COMMUNICATION PLATFORMS TO FIT THE NEEDS OF NC UTILITIES, WHILE ENHANCING THE MESSAGE THROUGH STATEWIDE SYNERGY; Report No: 442

13. PI: Aziz; WRRI project: 13-01-W; Title: Sustainable Anaerobic Co-Digestion of Grease Interceptor Waste; Report No: not assigned
14. PI: Sobsey; WRRI project: 13-06-W; Methods to detect fecal indicator viruses and protozoan surrogates in NC reclaimed water: optimization, performance evaluation, protocol development, validation, collaborative testing, and outreach; Report No: not assigned.

FY 2014 Information Transfer Progress & Achievements

WRRI-SPONSORED WORKSHOPS, FORUMS AND SEMINARS

Below is a list of the educational and training events WRRI sponsored during the project year, along with a description of each and the number of attendees. In total, WRRI provided 55.5 PDHs and 50 CEUs to 910 people at 9 workshops.

MULTIPLE DATES - Erosion and Sedimentation Control Planning and Design Workshop

Description: These workshops are structured to educate and familiarize design professionals with the NC Sedimentation Pollution Control Act (SPCA), the rules implementing the Act, design standards for erosion and sedimentation control BMPs, and elements that are necessary to submit an erosion control plan. This comes directly from the source—the NC Division of Energy, Mineral and Land Resources Land Quality Section – and its partners to provide professionals with the information they need to submit an erosion control plan and prevent pollution by sedimentation.

Attendance:

March 3, 2014 – 76

April 3, 2014 – 57

November 19, 2014 – 99

December 2, 2014 – 87

March 19-20, 2014 WRRI Annual Conference and NCWRA Symposium

Description: The 16th Annual WRRI Conference focused on North Carolina's Water Resource Issues, Solutions, and Opportunities. The North Carolina Water Resources Association (NCWRA) was again a key partner, with the NCWRA Annual Symposium being an integral element of the conference program. "Local Governments as Keystone Water Resource Managers" explored the unique and critical role that local governments play in managing water and in shaping the future of our water resources in North Carolina. Water projects were showcased that exemplify leadership and innovation at the local level. The conference offered approximately 100 presentations over a 2-day period.

Attendance: 201

September 8, 2014 NCWRA Seminar, "National Flood Insurance Program BW-12 and Homeowners Flood Insurance Affordability Act of 2014"

Description: Mr. Gerber discussed the National Flood Insurance Program and the impacts resulting from the Biggert-Waters Flood Insurance Reform Act of 2012 and the recent Homeowners Flood Insurance Affordability Act of 2014. He also gave an update of the flood mapping schedule and process.

Attendance: 77

September 9, 2013 NCWRA Seminar "The New Division of Water Resources"

Description: The 2013 NC Legislature consolidated the state's water quantity and water quality programs into one division within the Department of Environment and Natural Resources as of August 1, 2013. This presentation reviewed the rationale behind the consolidation, implications for program realignment and impacts to the Division's customers. The event also included a webinar session that allowed participation statewide.

Attendance: 177

December 8, 2014 NCWRA Seminar, "Big Environmental Regulatory Changes Coming to North Carolina"
Description: North Carolina is entering an unprecedented period in environmental regulation. From the review and revision of all North Carolina environmental regulations to mandated studies covering everything from the beneficial reuse of coal ash to expansion of the use of risk-based corrective action, major changes are coming. The North Carolina Environmental Management Commission will be a key player in these efforts. Benne Hutson, the chair of the EMC, covered all of these developments and the effect they will have on event participants, their companies and their clients.
Attendance: 133

February 9, 2015 NCWRA Seminar and Webinar "Changes in Water Infrastructure Funding"
Description: Session Law 2013-360 (2013-14 Budget) consolidated most water infrastructure (drinking water, wastewater, reclaimed water, and stormwater) funding programs into the newly created Division of Water Infrastructure. In addition, SL 2013-360 created the State Water Infrastructure Authority (SWIA) to make funding decisions and to look at many other water infrastructure issues. This presentation reviewed those changes and looked ahead as the work of the Division and SWIA continues.
Attendance: 75

February 11-12, 2015 Local Programs Erosion and Sediment Control Workshop
Description: This annual Local Programs Workshop provided training for local governments that have ordinance delegation and enforce the North Carolina Sedimentation Pollution Control Act. The training provides local programs an opportunity to be updated on the most current erosion and sedimentation control research and to get together with other local programs and exchange sedimentation and erosion control ideas and practices utilized at the local level. This training is also helpful for landscape architects that may work for a local government that has an erosion and sedimentation control program.
Attendance: 105

CENTER OF EXCELLENCE FOR WATERSHED MANAGEMENT
***NC Watershed Stewardship* Network**
In FY14, WRRI committed to the NC Watershed Stewardship Network, which was formed through a collaboration in which WRRI was highly active and engaged, by providing funding for a new staff person to serve part-time as co-coordinator of the network. Providing a paid staff member helps support the predominantly volunteer-based steering committee that guides the network and sustains the momentum of the steering committee's activities and efforts. With the new hire, Christy Perrin, in a leadership role, WRRI now has two of its program coordinators engaged in the WSN.

The two WRRI program coordinators, along with other WSN steering committee members, put together a networking and educational session at the September 2014 Water Education Summit in Asheville, "Successfully recruiting public and private partners in watershed improvement projects: A roundtable symposium." Thirty participants from North Carolina, Alabama, South Carolina, Vermont, the District of Columbia, Georgia and Texas shared success stories about sparking connections between people and their resources, engaging landowners in projects and

engaging underserved communities. The results will be summarized and published as a guidance document to serve as a resource for North Carolina watershed stewards.

As the NCWSN moves into its second year, it will introduce a suite of online interactive tools, engage non-traditional watershed audiences such as businesses, finalize a strategic plan and coordinate regional workshops with partner organizations.

For more information, visit *ncwatershednetwork.org*.

Community watershed restoration efforts
The Sustainable Waters and Communities Coordinator managed two community watershed restoration efforts funded by grants that were acquired (EPA 319). These include the Black Creek Watershed Association in the Neuse River Basin, and the Burnt Mill Creek Watershed Initiative in the Cape Fear River Basin. Both projects involve engaging local municipal and citizen partners in education, installing stormwater control measures to reduce urban runoff, and monitoring impacts. Two Community meetings (6/2014, 1/2015), a stream clean up (10/2014), and a volunteer wetland planting event (10/2014) were held in Black Creek. A stormwater control measure, a volunteer bioretention planting event held (9/2014), and educational signage was installed at New Hanover High School.
Total attendance: 50

NEWSLETTER
WRRI News was published three times during the reporting period (January-March 2014 Issue #385, April-June 2014 Issue #386, Fall 2014 Issue #387). The WRRI News is an 8-12 page newsletter that covers a wide range of water-related topics from current federal and state legislation and regulatory activities to new research findings, water-related workshops and conferences, and reviews of water-related publications. The WRRI News is now sent electronically to 1012 federal and state agencies, university personnel, multi-county planning regions, city and local officials, environmental groups, consultants, businesses and individuals. It is also posted on the WRRI website
http://ncsu.edu/wrri/code/publications/currentpublications.htm

INTERNET SERVICES
WRRI continues to maintain a website, www.ncsu.edu/wrri. Overall, the goals of our website are:

- to provide access to information on upcoming events (seminars, workshops, etc) that are hosted by WRRI and other events in the state related to water resources, as well as access to materials and resources from past events;
- to provide information to the research community about funding opportunities and state research priorities;
- to increase dissemination of information by providing access to research reports, the WRRI newsletter, and other relevant publications;
- to provide information on key organizations with which WRRI has strong partnerships and which play a key role in water resource research and management in the state;
- to provide background information about WRRI at the state and federal levels, our roles, and what we can offer to different audiences throughout the state.

A related component of the website involves working with NC State University's DH Hill Library to increase and enhance WRRI's use of their technical reports repository for all WRRI publications. Through this collaboration, we are now able to direct people to this well organized, easily searchable site where they can access research reports from all WRRI-funded projects as far back as the 1960s.

During this review period, the initial planning was conducted to completely redesign the WRRI website. The goals of the redesign is to enhance the functionality, ease the access to research products, and overall make the site more customer friendly.

WRRI ELECTRONIC LISTS

WRRI maintains the following electronic mail lists (listservs) for information transfer purposes:

- **Water-Research list** - 199 subscribers – inform water researchers from NC universities about calls for papers, grants, upcoming conferences, student internships, etc.;
- **WRRI-News list** - 1063 subscribers - informs researchers, local governments, municipalities, interest groups etc. about calls for papers, grants, upcoming conferences and events, etc.;
- **NCWRA-info list** - 380 subscribers - provides information of the North Carolina Water Resources Association sponsored events;
- **Sediments list –** 463 subscribers- used to disseminate erosion and sedimentation control information in North Carolina;
- **Watershed Stewardship Network (WSN) list –** 134 subscribers **–** provides watershed professionals, volunteers and stakeholders throughout the state with a mechanism to contact, network, and learn from each other as well as to learn about the WSN and its offerings;
- **Urban Water Consortium (UWC) list** for Urban Water Consortium member communicationsl;
- and **UWC-Stormwater Group list** for the UWC Stormwater Group member communications.

NC URBAN WATER CONSORTIUM

WRRI administers the NC Urban Water Consortium (UWC) and meets with the members quarterly. The consortium was established in 1985 by the Institute, in cooperation with several of North Carolina's larger cities to provide a program of research and development, and technology transfer on water problems that urban areas share. Through this partnership, WRRI and the State of North Carolina help individual facilities and regions solve problems related to local environmental or regulatory circumstances. Participants support the program through annual dues and enhancement funds and guide the program through representation on an advisory board, selection of research topics, participation in design of requests for proposals, and review of proposals. There are 12 member cities/special districts in North Carolina, and members hosted four quarterly meetings throughout the state in FY14.

The UWC also provided whole or partial financial support to three research projects, which increased WRRI's ability to fund other high quality research with 104(b) funds. The three projects funded by the UWC in FY 14 were:

- "Microbial Quality and Risk Assessment of Type 2 NC Reclaimed Water for Non-potable and Potable Reuse" by PI Mark Sobsey of UNC-Chapel Hill
- "Integrated Drought Management and Assessment Portal for the State of North Carolina" by PI Sankar Arumugam of NC State University
- "1,4 Dioxane in North Carolina Drinking Water Sources: Occurrence and Treatment Options" by PI Detlef Knappe of NC State University

NC URBAN WATER CONSORTIUM - STORMWATER GROUP

In 1998, several members of the NC UWC partnership formed a special group to sponsor research and technology transfer on issues related to urban stormwater and management. The Urban Water Consortium (UWC) Stormwater Group is administered by WRRI. Participants support the program through annual dues and enhancement funds. They guide the program through selective representation on the WRRI advisory board, determining stormwater-related research priorities, participation in the design of requests for proposals and review of proposals submitted to WRRI directly or to the SWG. Four meetings were hosted by rotating SWG members throughout the state during the reporting year.

The SWG also provided financial support to one other research project that was chosen out of the special RFP that NC WRRI helped the group create and evaluate. That project was:

- "A review of biological condition ratings in urban settings in North Carolina" by PI Michael Paul of Tetra Tech

WRRI Sponsorship

During the reporting year, WRRI sponsored the N.C. Department of Environment and Natural Resources to assist them with their Nutrient Criteria Development Plan, for select water supply reservoirs; and sponsored the 70th Soil and Water Conservation Society (SWCS) international annual conference. Both these sponsorships helped raise awareness of WRRI and positioned WRRI as partners to these key stakeholders.

USGS Summer Intern Program

None.

Student Support					
Category	**Section 104 Base Grant**	**Section 104 NCGP Award**	**NIWR-USGS Internship**	**Supplemental Awards**	**Total**
Undergraduate	5	0	0	0	5
Masters	5	0	0	0	5
Ph.D.	3	0	0	0	3
Post-Doc.	0	0	0	0	0
Total	13	0	0	0	13

Notable Awards and Achievements

1. NC WRRI Participates in National Committee to Enhance USGS/NIWR Partnerships

To enhance the integration of the Water Resource Research Institutes at the federal level with the USGS, a partnership committee was formed. The committee includes WRRI representation from across the nation and USGS headquarters personnel. The main goal of the committee is to better align the research efforts of the Institutes with the USGS's missions and priorities. During FY14, NC WRRI took the lead as committee chair and re-engaged the committee to make progress on items discussed at the February 2014 NIWR annual meeting. The committee met many times by conference call and has created a committee goal and purpose statement and developed a plan for the coming fiscal year to continue to document the synergistic relationships between the Institutes and USGS.

2. Graduate Student Wins Awards with WRRI-Funded Research Project Presentations

Elizabeth Gillispie, a M.S. student in NC State University's Department of Soil Science, won two awards as she presented research that was funded by NC WRRI. WRRI awarded Dr. Matthew Polizzotto of NCSU beginning in FY 13 for his project "Surface and Subsurface Properties Regulating Manganese Contamination of Groundwater in the North Carolina Piedmont." Ms. Gillispie was the graduate student on that project and graduated in July 2014. The two awards are: - Soil Science Society of America, Soil Chemistry 2014 Student Presentation Award - Third Place; - American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America 2014 Graduate Student Leadership Conference awardee.

3. NC WRRI Supports Watershed Stewardship Network

There are more than 1,700 watersheds in North Carolina, and hundreds of organizations, agencies and individuals dedicated to protecting these watersheds. But until recently, there was no avenue for professionals and volunteers from these different groups to effectively communicate, collaborate or cross-train.

In 2012, WRRI, in partnership with UNC-Chapel Hill's Institute for the Environment, the NC Department of Environment and Natural Resources, NC State University's Watershed Education for Community Officials program, and the Triangle J Council Of Governments joined forces to gain a better understanding of the state's diverse watershed programs.

Through several years of intense effort, the North Carolina Watershed Stewardship Network came to fruition. The WSN is now active and engages a wide variety of stakeholders, is creating online and face-to-face opportunities for networking and training, and fostering public education about water quality impacts and watershed protection.

To further the mission of the WSN "to identify, include, link and serve watershed stakeholders in North Carolina," WRRI, as a Center of Excellence for Watershed Management, hired a new staff member to serve in-part as co-coordinator for the WSN. Providing a paid staff member helps support the predominantly volunteer-based steering committee that guides the network and sustains the momentum of the steering committee's activities and efforts. The co-coordinator works closely with a staff member of UNC-Chapel Hill's Institute for the Environment who is also receiving funding to help coordinate the network.

4. WRRI Hires Sustainable Waters and Communities Coordinator

Christy Perrin is now sustainable waters and communities coordinator for the NC WRRI.

“Christy brings a wealth of experience in working with communities to manage and protect water resources,” notes Susan White, executive director for WRRI. “We are pleased to have her join our team.”

Perrin’s responsibilities include coordinating the new and expanding N.C. Watershed Stewardship Network in partnership with University of North Carolina at Chapel Hill’s Institute for the Environment, N.C. Division of Water Resources, Triangle J Council of Governments and multiple other organizations (see above); conducting community watershed planning; leading grant supported watershed stormwater reduction projects; and assisting WRRI with special projects.

Trained in community mediation, group facilitation, and public participation, Perrin also continues to lead long-term collaborative urban water restoration projects in Cary and Wilmington. In north Cary she leads an effort to engage business and institutional landowners in improving the Black Creek watershed, home to the popular Black Creek Greenway. In Wilmington, Perrin works with environmental educators, youth and teaching artists to design and implement urban stormwater retrofits and accompanying educational curricula at an afterschool arts facility for underserved youth.

“I'm excited to join an esteemed water resources organization with 50 years of history in sponsoring and sharing science-based information in North Carolina,” Perrin says. “WRRI continues to serve on the forefront of watershed protection and improvement. And Susan and John [WRRI’s executive and deputy directors] recognize the value of fostering partnerships, a key strategy for successful organizations in today’s world.”

Prior to joining WRRI, Perrin led the Watershed Education for Communities and Officials, or WECO, program for North Carolina State University Extension from 2001 to 2014. The program served communities working to identify and collaboratively address natural resource management issues. From 1998 to 2001 Perrin worked with the NC Natural Resources Leadership Institute, where she engaged citizens in discussing high conflict policy issues such as endangered piping plover management at the beach, stormwater rule-making, and wood chip mills.

Perrin holds a master’s degree in public administration with an environmental policy focus from North Carolina State University. She has a Bachelor of Science in animal science with a wildlife-biology minor from University of Vermont. Perrin also holds certificates in Appreciative Inquiry facilitation and corporate sustainability.

In 2011, Perrin won the Outstanding Statewide Extension Program award from Southern Region Water Program, USDA-NIFA. In 2010, she received the Marvin Collins Outstanding Planning Award for Sustainability from the North Carolina Chapter of the American Planning Association.

5. WRRI Celebrates 50th Anniversary

WRRI celebrated its 50th anniversary during the reporting year. A special WRRI news article (http://repository.lib.ncsu.edu/dr/bitstream/1840.4/8626/1/WRRINews388.pdf) detailed the activities that occurred as part of this celebration including a retrospective examination of projects funded by WRRI. In the 1960s, WRRI provided research funding for pressing issues such as mosquito control, industrial waste and the effects of urbanization. During the 1970s, WRRI funded research into the effects of channelization of streams for agricultural and residential purposes. In the 1980s WRRI focused on urban stormwater, nutrient pollution and hydrilla — an invasive aquatic plant that was spreading at an alarming rate. In the 1990s WRRI focused on drinking water, funding studies that looked into disinfection by-products. Most recently, WRRI projects have investigated nutrient management, stormwater management, potable water supply, toxic chemicals and wastewater treatment.

Publications from Prior Years

1. 2012NC167B ("An Integrated Framework for Assessing the Dynamics of Population Growth, Land Use and Climate Change for Urban Water Resources Management") - Water Resources Research Institute Reports - PI: Bergund (Zechman); WRRI project: 12-01-W; Title: An Integrated Framework for Assessing the Dynamics of Population Growth, Land Use and Climate Change for Urban Water Resources Management; Report No: not assigned