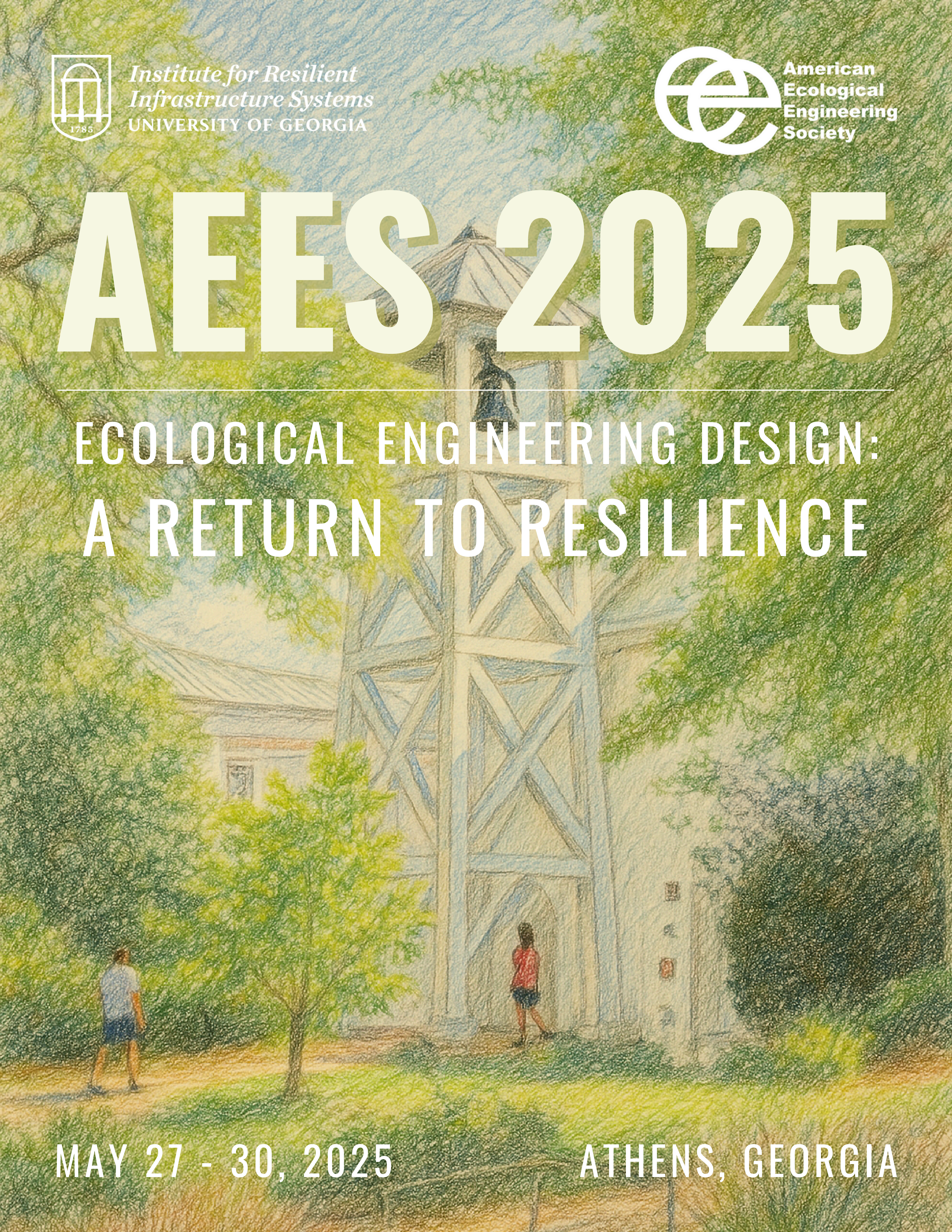

Institute for Resilient Infrastructure Systems
UNIVERSITY OF GEORGIA

American Ecological Engineering Society

AEES 2025

ECOLOGICAL ENGINEERING DESIGN: A RETURN TO RESILIENCE

MAY 27 - 30, 2025

ATHENS, GEORGIA

CONTENTS

ORGANIZERS

Institute for Resilient Infrastructure Systems
UNIVERSITY OF GEORGIA

The University of Georgia's Institute for Resilient Infrastructure Systems works toward a more resilient future through interdisciplinary research, discovering innovative ways to combine natural and conventional infrastructure.

Learn more about this year's hosts at iris.uga.edu.

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SCHEDULE

TUESDAY, MAY 27

2:00 - 5:00	Curriculum Roundtable, *Driftmier Engineering Center Room 1240*
5:00 - 7:00	Pre-Conference Social, *Creature Comforts (271 W Hancock Ave)*

WEDNESDAY, MAY 28

8:20 - 9:00	Registration/Check-In and Breakfast
9:00 - 9:30	Welcome & Opening Remarks
9:30 - 10:15	Keynote Speaker: Sara McMillan
10:15 - 10:30	Break
10:30	Group Photo
10:45 - 12:00	Concurrent Technical Sessions

	Resilience in the Face of Extreme Events *Athena A*	Circular Bioeconomy and Life Cycle Assessment I *Athena B*	Ecological Engineering for Water Quality in Agriculture *Athena C*	Ecological Engineering Education Approaches *Athena D*	Special Topics: H.T. and E.P. Odum's "A Prosperous Way Down" Panel *Athena E*
Moderator	Chris Grose	Stephanie Lansing	Jay Martin & Eric Roy	Trisha Moore	Peter May
10:45	Digant Chavda	Dayton Dorman	Laura O'Brien	Randall Etheridge	
11:00	Alysha Helmrich	Maureen Nabulime	Tiffany Chin	Trisha Moore	
11:15	Greg Jennings	Katherine Porterfield	Jaydan Martin	Joseph Smith	
11:30	Chris Grose	Stephanie Lansing	Nisha Nadkarni	Sara McMillan	

12:00 - 1:00	Lunch
1:10 - 2:20	Concurrent Technical Sessions

	Engineering Ethics Panel *Athena A*	Circular Bioeconomy and Life Cycle Assessment II *Athena B*	Water Quality and Ecological Monitoring *Athena C*	Practice-Based Education and Training for Wetland Engineering Panel *Athena D*
Moderator	Holly Yaryan Hall	Stephanie Lansing	Tiffany Chin	Tamara Jameson
1:10	Jay Martin, Sara McMillan, Richard Morris, Joshua Robinson	Lauren McPhillips	David Kaplan	Ellen Herbert, Brian Nicholson, Rhett Jackson, Will Mattison, Nick Austin, Hattie Greydanus
1:27		Kari Lagan	Renee Price	
1:44		Christine Lepine	Jason Evans	
2:01		Stephanie Lansing		

2:25 - 2:45	Break
2:45 - 5:00	Local Tours and Field Trips
	Buses depart at 5:45 and 6:10 from the Hyatt. Group walk at 6:00.
6:00	Dinner and Awards, *The Chapel (100 Prince Ave)*

FIELD TRIPS *Wednesday, May 28, 3:00 - 5:00*

Whitehall Forest and Dam Removal Site	Meet in front of the Classic Center for bus transportation to your respective field trip. See here for more information on buses.
Lilly Branch Site Tour (required for CED course)	
Athens Land Trust, Williams Farm	
UGA Botanical Gardens	
North Oconee River Greenway	Meet in front of the Classic Center to walk as a group to the Greenway.

THURSDAY, MAY 29

8:00 - 8:30	Registration/Check-In and Breakfast
8:30 - 9:15	Community Conversations
9:15 - 9:45	Workforce & Curriculum Development Session
9:45 - 10:30	Keynote Speaker: Ellen Wohl
10:30 - 10:45	Break
10:45 - 12:00	Concurrent Technical Sessions

	Humans in the Loop *Athena A*	Ecological Engineering in Coastal Settings I *Athena B*	Ecological Engineering in Agriculture *Athena C*	Emerging Contaminants in Ecologically Constructed Systems *Athena D*
Moderator	Anand Jayakaran	Matt Bilskie	David Blersch	Jessica Boyer
10:45	Megan Rippy	Levi McKercher	Erin Ebersbach	Ada Camila Montoya
11:00	Anand Jayakaran	Nolan Williams	Marina Howarth	Natasha Bell
11:15	Larry Davis	Evan Smyjuna	David Blersch	Abigail Neufarth
11:30	Sofia Solis Naranjo	Rod Lammers		Jessica Boyer
11:45	Victoria Rexhausen	Megan Kramer		Mollah Mohammad

12:00 - 1:15	Lunch, Keynote Speaker: Amy Rosemond
1:30 - 2:45	Concurrent Technical Sessions

	Resilient Department of Defense *Athena A*	Ecological Engineering in Coastal Settings II *Athena B*	Ecological Engineering in Urban Settings *Athena C*	Wetland Restoration and Design I *Athena D*
Moderator	Zak Ruehman	Rod Lammers	Christopher Streb	Daniel McLaughlin
1:30	Dan Coleman	Sean King	Christopher Streb	Pieter De Wolf
1:45	Matt Bilskie	Yiyang Kang	Matt Chambers	Latif Kalin
2:00	Will Mattison	Joshua Robinson	Yufan Zhang	Samantha Taylor
2:15	Zak Ruehman	Mariah Livernois	Vinicius Taguchi	Daniel McLaughlin
2:30			Larry Davis	

2:45 - 3:00	Break
3:00 - 4:15	Concurrent Technical Sessions

	Stormwater I *Athena A*	Ecological Engineering in Coastal Settings III *Athena B*	Ecological Engineering: Perspectives from Consulting Panel *Athena C*	Wetland Restoration and Design II *Athena D*	Benefits & Ecosystem Services *Athena E*
Moderator	Joseph Smith	Matt Bilskie	Dan Hitchcock	Michael Burchell	Alec Nelson
3:00	Erin Cartner	Aditya Gupta	Christopher Streb	Alex Horne	Eldon Blancher
3:15	Joseph Smith	Rebecca Stanley	Joshua Robinson	Alexis Jackson	Richard Morris
3:30	Thorsten Knappenberger	Mauricio Arias	*Panel Discussion*	Robert Thomas	Alejandra Gomez
3:45		Megan Kramer			

4:15 - 6:15	Poster Session
6:30	Student Networking Meetup, *Paloma Park (235 W Washington St)*

FRIDAY, MAY 30

8:00 - 8:30	Registration/Check-In and Breakfast				
8:30 - 9:45	Concurrent Technical Sessions				
	Stormwater II *Athena A*	Innovative Algae Management Approaches *Athena B*	Bill Mitsch Impact on Ecological Engineering *Athena C*	Stream & Stream Crossing Design *Athena D*	Participatory Science *Athena E*
Moderator	Barbara Doll	Mauricio Arias	Bill Strosnider	Brian Bledsoe	Andrea Ludwig
8:30	Zhou Guo	Iffat Tasnim	Lauren Griffiths	Daniel Buhr	Michael Burchell
8:45	Barbara Doll	Laura Krueger	Kyle Boutin	Debabrata Sahoo	Andrea Ludwig
9:00	Savannah Roth	Mauricio Arias	Bill Strosnider	Kyle McKay	Stewart Diemont
9:15	Joe Berg	Nicholas Chin		Benjamin Bradley	
9:30		Peter May		Kyle McKay	
9:45 - 10:10	Break				
10:10 - 11:25	Concurrent Technical Sessions				
	Nature-based Solutions for River Resilience *Athena A*	Vegetation in Ecological Engineering *Athena B*	Planning & Decision Making *Athena C*	Innovation in Water Treatment Technologies *Athena D*	
Moderator	Matt Chambers	Nathan Jones	Fouad Jaber	Natasha Bell	
10:10	Rod Lammers	Andrew Balder	Mary Szoka	Liz Riedel	
10:25	Alec Nelson	Molly Robles	Osama Tarabih	Ana Martin-Ryals	
10:40	Elissa Yeates	Kathleen Schoenberger	Fouad Jaber	Sofia Solis Naranjo	
10:55	Kyle McKay	Nathan Jones	David Kaplan	Danielle Delp	
11:10	Matt Chambers			Kelly Harris	
11:45 - 1:30	Business Meeting Lunch, *Athena F*				
2:00 - 5:00	CED/AED Workshop, *Dodd School of Art*				

SATURDAY, MAY 31

8:30 - 12:00	CED/AED Workshop, *Dodd School of Art*
1:00 - 4:00	Paddle Trip led by Dan Hitchcock, *Broad River Outpost*

KEYNOTE SPEAKERS

SARA MCMILLAN

Professor of Ecological Engineering, Iowa State University

Wednesday, May 28, 9:30am

Dr. Sara Winnike McMillan is an ecological engineer and biogeochemist in the Department of Agricultural and Biosystems Engineering at Iowa State University. She is also a Professional Engineer with expertise in restoration, natural infrastructure, and agricultural conservation. Sara's research focuses on how humans impact water quality in rivers, lakes, and wetlands and how climate change will affect access to clean water, sustainable food production, and healthy ecosystems.

ELLEN WOHL

Professor of Geosciences, Colorado State University

Thursday, May 29, 9:45am

Dr. Ellen Wohl is a fluvial geomorphologist and professor of geology with the Warner College of Natural Resources at Colorado State University. Her research has spanned from bedrock canyons in Australia to carbon cycling dynamics in the Rocky Mountains, Costa Rica and Panama.

AMY ROSEMOND

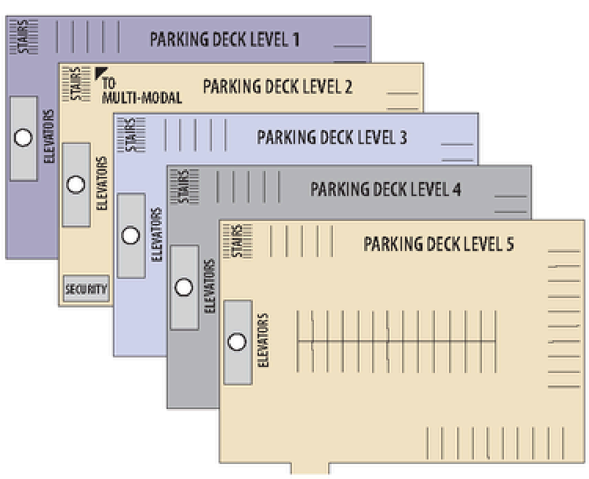
UGA Foundation Professor of Ecology, University of Georgia

Thursday, May 29, 12:00pm

Amy Daum Rosemond is the UGA Foundation Professor in Ecology and Distinguished Research Professor at the University of Georgia. Her research program is motivated by society's need for healthy, resilient freshwater ecosystems, equitable access to their goods and services, and the long-term sustainability of aquatic life. Her current studies focus on how elevated temperature and nutrient pollution affect stream functions.

FACILITY MAP

Site Map Legend



- Information Center
- Restrooms
- Vending
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300 North Thomas Street Building - Upper Level
Theatre Lobby
Ticket Office & Administration
Parking Deck Level 5
Loading Dock 1

300 North Thomas Street Building - Lower Level
Theatre-Orchestra Level
Parking Deck Level 2
Loading Dock 2 & 4
Multi-Modal Transit Center

130 Foundry Building Lower Level
Parking Deck Level 1
Loading Dock 3

Akins Ford Arena

VISITOR INFORMATION

PARKING INFORMATION

Attendees will have access to the Classic Center parking deck. If you are staying at the Hyatt Place Athens Downtown, the Classic Center is right next door.

FOOD & DRINKS

The following meals are included in your conference registration: breakfast and lunch May 28, 29 and 30, as well as the Awards Dinner on the evening of May 28. Snacks and coffee service will be provided at breaks throughout the conference.

For guidance on places to eat outside of these meals, check out the conference website: www.ecoeng.org/2025-annual-meeting/venue-lodging-travel

SOCIAL EVENTS

Pre-Conference Social
Creature Comforts
271 W Hancock Ave
Tuesday, May 27 5:00pm

25th Anniversary Awards Dinner
The Chapel
100 Prince Ave
Wednesday, May 28 6:00pm

Student Networking Event
Paloma Park
235 W Washington St
Thursday, May 29 6:30pm

Business Meeting Lunch
Classic Center, Athena F
Friday, May 30 11:45am

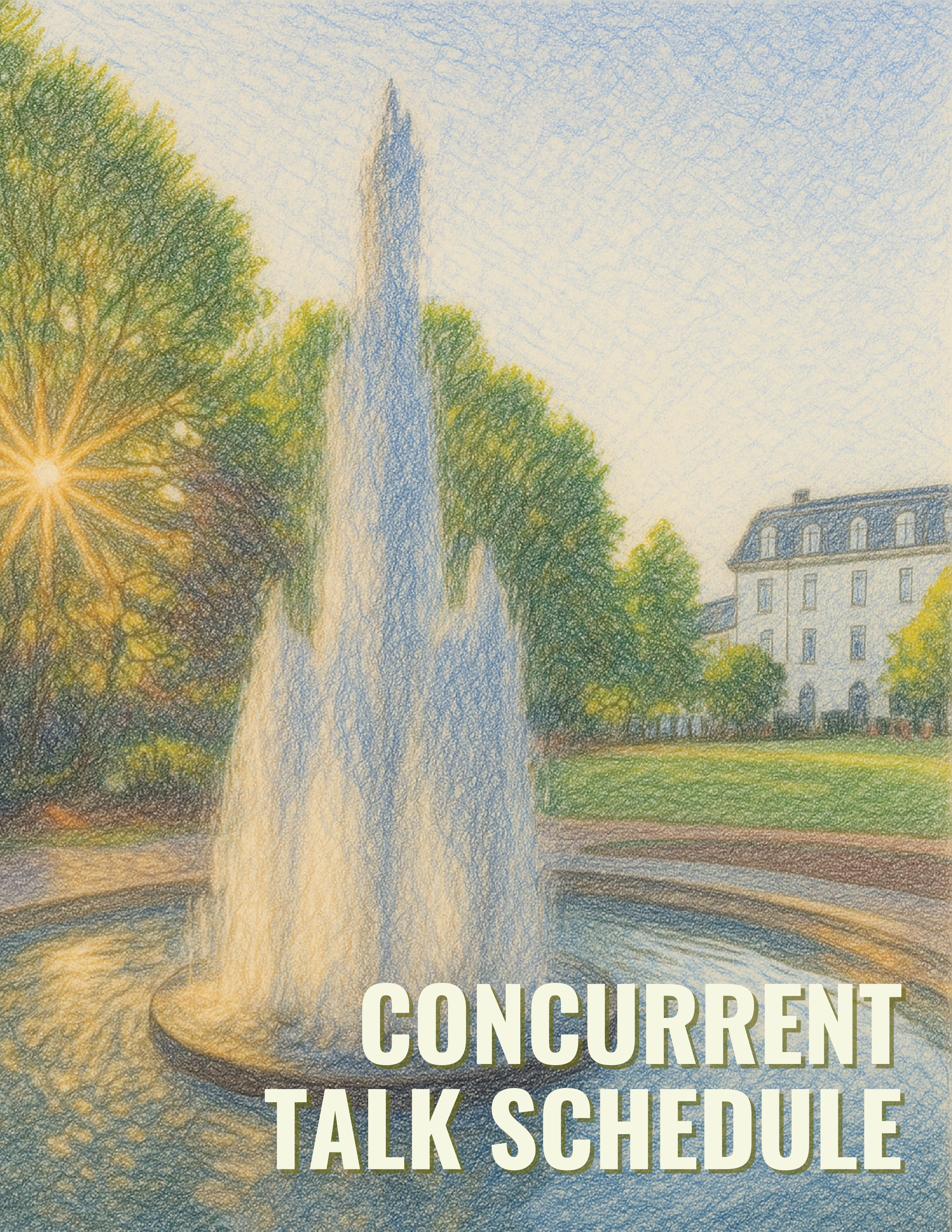
Paddle Trip
Broad River Outpost
Saturday, May 31 1:00pm

BUSES

Bus transportation for some events will be provided, with **limited capacity**.

Field Trips: For those attending the Whitehall Forest, Lilly Branch, and Botanical Gardens field trips please meet in front of the Classic Center at 2:45 pm for a prompt 3:00 pm departure. Buses will return riders to the Classic Center at 5:00 pm.

Anniversary Dinner: Buses will transport riders from the Hyatt Place Athens Downtown (412 North Thomas Street) to The Chapel at 5:45 pm and 6:10 pm. Buses will make the return trip at 8:30 pm and 9:00 pm. We will also walk over as a group at 6:00.


CONCURRENT
TALK SCHEDULE

WEDNESDAY MORNING

Weds. May 28, 10:45am - 12:00pm

Athena A

Resilience in the Face of Extreme Events

Moderator: Chris Grose

Rising Rivers, Rising Risks: A Future Floodscape Analysis of a central Pennsylvanian Watershed, Digant Chavda, *Penn State University*

Co-developing a Regional Watershed Resilience Framework, Alysha Helmrich, *University of Georgia*

Stream and Floodplain Restoration Lessons Learned Following 2024 Helene Flooding in Western North Carolina, Greg Jennings, *Jennings Environmental PLLC*

A Retrospective Look at the Resiliency of Nature-based Solutions Following Hurricane Helene, Chris Grose, *Robinson Design Engineers*

Athena B

Circular Bioeconomy and Life Cycle Assessment I

Moderator: Stephanie Lansing

Beneficial Reuse of Mine Drainage Residuals as Phosphorus Sorbents to Close the Resource Recovery Loop, Dayton Dorman, *University of Oklahoma*

Biogas Production of Food Waste from Different Sources: Characterization within a Biocircular Economy Framework, Maureen Nabulime, *University of Maryland*

Food Waste Dehydration Poses Climate Tradeoffs Between Transportation Savings and Electricity Use, Katherine Porterfield, *University of Vermont*

Food Waste Diversion and Anaerobic Digestion as Pillars in a Resilient Bioeconomy, Stephanie Lansing, *University of Maryland*

Athena C

Ecological engineering for water quality improvement in agricultural landscapes

Moderators: Jay Martin & Eric Roy

Phosphorus retention and soil development in a formerly farmed, Vermont riparian wetland two decades after restoration, Laura O'Brien, *University of Vermont*

Modeling net phosphorus retention on restored riparian wetlands in the Lake Champlain Basin, Vermont, Tiffany Chin, *University of Vermont*

Location, Design, and Results of Conservation Practices to Reduce Phosphorus Runoff from Agricultural Fields in the Lake Erie Basin, Jaydan Martin, *University of Vermont*

Evaluating Stacked Conservation Practice Effects at the Field-Scale in the Lake Champlain Basin of Vermont, Nisha Nadkarni, *University of Vermont*

Athena D

Education Approaches in Ecological Engineering

Moderator: Trisha Moore

Community and student engagement in ecological engineering projects to promote resiliency and sustainability, Randall Etheridge, *East Carolina University*

Continuing the accreditation journey: meeting the need for ecological engineering program evaluators, Trisha Moore, *Kansas State University*

Ohio State University's AEES student branch designs, funds, and constructs a bioswale, Joseph Smith, *The Ohio State University*

From Classroom to Community: Bridging Ecological Engineering and Civic Engagement, Sara McMillan, *Iowa State University*

Athena E

Special Topics Related to H.T. and E.P. Odum's Societal Outlook Publication "A Prosperous Way Down"

Moderator: Peter May

WEDNESDAY AFTERNOON

Weds. May 28, 1:00pm - 2:20pm

Athena A

Engineering Ethics Panel

Moderator: Holly Yaryan Hall

Featuring Jay Martin, Sara McMillan, Richard Morris and Joshua Robinson

Athena B

Circular Bioeconomy and Life Cycle Assessment II

Moderator: Stephanie Lansing

Upcycling duckweed grown on dairy wastewater into an organic fertilizer, Lauren McPhillips, *Penn State University*

Integrating Manure Slurry Acidification and Duckweed Growth Systems for Protein-rich Animal Feed Production and Greenhouse Gas Mitigation, Kari Lagan, *Penn State University*

Waste-to-Value: Nutrient Recycling of Recirculating Aquaculture System Waster Solids Through Commercial In-Vessel Composting, Christine Lepine, *The Conservation Fund Freshwater Institute*

Athena C

Water Quality and Ecological Monitoring

Moderator: Tiffany Chin

Combining remote sensing and in-situ data to improve detection of Florida red tide (*Karenia brevis*), David Kaplan, *University of Florida*

Evaluating the Frequency of Water Level Data Collection in Central Florida Marsh Wetlands: Insights from Two Decades of High-Resolution Data, Renee Price, *AtkinsRéalis* and *University of Florida*

Performance Monitoring at the "Smart Rain Garden," City of Cape Canaveral, Florida, Jason Evans, *Stetson University*

Athena D

Building a Practice-Based Education and Training Pathway for Wetland Management and Engineering Panel

Moderator: Tamara Jameson

Featuring Ellen Herbert, Brian Nicholson, Rhett Jackson, Will Mattison, Nick Austin and Hattie Greydanus

THURSDAY MORNING

Thur. May 29, 10:45am - 12:00pm

Athena A

Humans in the Loop

Moderator: Ananda Jayakaran

Leveraging virtual spaces for human-centered design – an exploration of cultural services provisioning by green stormwater infrastructure, Megan Rippy, *Virginia Tech*

Stormwater management and community involvement in a rapidly developing city in the global south, Anand Jayakaran, *Washington State University*

Advancing Environmental Justice and Nature-Positive Infrastructure through Algal Turf Scrubbers and Oyster Reef Restoration, Larry Davis, *Green Mechanics Benefit LLC*

Sowing water: the drop of the future that we can save, Sofia Solis Naranjo, *University of Costa Rica*

An Environmental and Economic Justice Framework for Socially Integrated GI, Victoria Rexhausen, *University of Tennessee*

Athena B

Ecological Engineering in Coastal Settings I

Moderator: Rod Lammers

Changing with the tides: Estuarine influence on the function of coastal stormwater ponds, Levi McKercher, *University of South Carolina*

Utilizing Stream Power as a Metric for Classifying and Designing Low-Gradient Headwater Streams in the Coastal Plain, Nolan Williams, *Robinson Design Engineers*

Performance and degradation of plastic-free geotextiles along the tidal exposure gradient in a warm-temperate salt marsh estuary, Evan Smyjunas, *University of Dayton*

Floodplain reconnection in coastal areas: How do backwater effects impact floodplain reconnection effectiveness?, Rod Lammers, *Central Michigan University*

The role of coastal wetlands in mitigating hurricane flooding in a shallow subtropical estuary, Megan Kramer, *University of South Florida*

Athena C

Ecological Engineering in Agriculture

Moderator: David Blersch

Variability of Soil Texture Influences P Loss from Agricultural Fields in Lake Erie Watersheds, Erin Ebersbach, *The Ohio State University*

Streamflow influences wildrice restoration in lake fringe wetlands, Marina Howarth, *Bowhead*

Critical focus on Controlled Environment Agriculture as an Ecological Engineered System, David Blersch, *Auburn University*

Athena D

Emerging Contaminants in Ecologically Constructed Systems

Moderators: Jessica Boyer & Md Tariqul Islam Shajib

AeroFTWs: Floating Treatment Wetlands without Plastics are Possible, Ada Camila Montoya, *Clemson University*

PFAS prevalence and mitigation opportunities in coastal Virginia stormwater systems, Natasha Bell, *Virginia Tech*

Innovations in Infiltration Treatment Wetland Design, Abigail Neufarth, *Jacobs Engineering*

Degradation Dynamics of Microplastics Across a Constructed Wetland, Jessica Boyer, *University of South Florida*

GenX Removal in Hybrid Constructed Wetlands: A Nature-Based Approach to PFAS Mitigation, Mohammad Mollah, *North Carolina Agricultural & Technical State University*

THURSDAY AFTERNOON I

Thur. May 29, 1:30pm - 2:45pm

Athena A

Mission-Readiness and Ecological Uplift: Resilient Department of Defense Installations Through Nature-based Solutions

Moderator: Zak Ruehman

Monitoring Effects of Conventional Infrastructure on Natural Infrastructure at Hunter Army Airfield, Dan Coleman, *University of Georgia*

Coastal Resilience at Marine Corps Recruitment Depot, Parris Island, Matt Bilskie, *University of Georgia*

Laundry Creek Stream Restoration at Lawson Army Airfield – Ft. Benning, Will Mattison, *University of Georgia*

Multi-Objective Stream Crossing at Garnsey Range - Ft. Benning, Zak Ruehman, *University of Georgia*

Athena B

Ecological Engineering in Coastal Settings II

Moderator: Rod Lammers

Evaluation of Minimum Flow Requirements for Gulf Sturgeon in the Suwannee River, Sean King, *Suwannee River Water Management District*

Processes and impacts of mangrove poleward expansion across Florida's Gulf of Mexico coast, Yiyang Kang, *University of Florida*

Building Tidal Creeks by Hand: The Ashleyville Marsh Restoration Project, Charleston, SC, Joshua Robinson, *Robinson Design Engineers*

Wood stakes as substrate for oyster enhancement in coastal South Carolina, Mariah Livernois, *University of South Carolina*

Athena C

Ecological Engineering in Urban Settings

Moderator: Christopher Streb

The Dredge Glass Sand and Charred Wood Adventures: Tidal Marsh Restoration in Urban Waters, Christopher Streb, *Biohabitats*

Modeling the service of city-scale distributed green stormwater infrastructure, Matt Chambers, *University of Georgia*

Developing storage-discharge curves for various green stormwater infrastructure: Enhancing H&H Models for Urban Stormwater Management, Yufan Zhang, *Texas A&M AgriLife*

Investigating the Role of Large Storms in Urban Stormwater Management, Vinicius Taguchi, *North Carolina State University*

Developing a Smart Urban Agro-Ecology Resilience Hub: Integrating Salvaged Shipping Containers for Sustainable Infrastructure in Baltimore Maryland, Larry Davis, *Green Mechanics Benefit LLC*

Athena D

Wetland Restoration & Design I

Moderator: Daniel McLaughlin

Ritch Grissom Memorial Wetlands Maintenance After 20 years of Operation: A Case Study, Pieter De Wolf, *Jacobs Engineering*

WetQual: A Process-Based Model for Simulating Hydrology, Nutrients and Carbon Dynamics in Non-Floodplain Wetlands, Latif Kalin, *Auburn University*

Using Hydrology, Water Quality, Soils, and Vegetation to Evaluate Wetland Condition and Effects on Trace Metals in Natural and Treatment Wetlands in the Tar Creek Watershed, Samantha Taylor, *University of Oklahoma*

Integrative Assessments to Inform Hydrologic Restoration of Wetland Functions, Daniel McLaughlin, *Virginia Tech*

THURSDAY AFTERNOON II

Thur. May 29, 3:00pm - 4:15pm

Athena A

Stormwater I

Moderator: Joseph Smith

Optimal Hydraulic Loading Ratio for Bioswale Design, Erin Cartner, *North Carolina State University*

Bioretention soil media evolution in Midwest United States and Central China urban catchments: Understanding pedogenesis of these technosols to enhance monitoring, design, and maintenance, Joseph Smith, *The Ohio State University*

Bioretention for Heavy Metals: Evaluating Removal Efficiency, Speciation, and Toxicity, Thorsten Knappenberger, *Auburn University*

Athena B

Ecological Engineering in Coastal Settings III

Moderator: Matt Bilskie

Quantifying the Protective and Economic Value of Barrier Islands in the North Carolina Outer Banks, Aditya Gupta, *University of Georgia*

Optimal Model Resolution for Accurate Hydrodynamic and Marsh Biomass Predictions under Sea Level Rise, Rebecca Stanley, *University of Georgia*

The role of mangroves in coastal hydrodynamics in the Yucatan Peninsula, Mauricio Arias, *University of South Florida*

Modeling of hybrid natural-engineered infrastructure designs for urban flood protection under extreme storm conditions, Megan Kramer, *University of South Florida*

Athena C

Ecological Engineering in Practice: Perspectives and Lessons from the Design and Consulting World Panel

Moderator: Dan Hitchcock

From Sapelo to Ripple: Tales of an Ecological Engineering Career Path, Dan Hitchcock, *Ripple Environmental LLC*

A Confluence to a Discipline: How Ecological Engineering Found a Home at Biohabitats, Christopher Streb, *Biohabitats*

Engineering Design Standards for Ecological Approaches to Water Management, Joshua Robinson, *Robinson Design Engineers*

Athena D

Wetland Restoration & Design II

Moderator: Michael Burchell

Possible co-metabolism of chlorate and nitrate in a large free-surface wetland, Alex Horne, *University of California, Berkeley*

Patterns and Drivers of Wetland Soil Organic Carbon Storage across the United States, Alexis Jackson, *University of Florida*

Meeting the Challenge of Integrating Habitat and Aesthetics into Functioning Treatment Wetlands for Zinc and Manganese, Robert Thomas, *Jacobs Engineering*

Athena E

Benefits & Ecosystem Services

Moderator: Alec Nelson

Quantification of natural capital benefits for restoration projects using emergy accounting, Eldon Blancher, *Moffatt & Nichol*

Spatially designing nature-based solutions to maximize ecosystem services: a case study from New Zealand using ESMAX, Richard Morris, *Lincoln University*

Designing Data Centers with Nature-based Solutions and Emergy Analysis, David Tilley, *University of Maryland*

Incorporating climate resilience into transportation planning, Alejandra Gomez, *University of Georgia*

FRIDAY MORNING I

Fri. May 30, 8:30am - 9:45am

Athena A

Stormwater II

Moderator: Barbara Doll

A holistic analysis of Chinese sponge city cases by region: Using PLS-SEM models to understand key factors impacting LID performance, Zhou Guo, *Wuhan University*

Identifying Opportunities for Natural Infrastructure for the North Carolina Flood Resiliency Blueprint, Barbara Doll, *North Carolina State University*

Advancing Stormwater Management Through Open-Source Real-Time Control Systems, Savannah Roth, *North Carolina State University*

How the idea of Regenerative Stormwater Conveyance became an Approved BMP and a Widespread Restoration Solution, Joe Berg, *Biohabitats*

Athena B

From watershed models to algal turf scrubbers: innovate approaches to algae management

Moderator: Mauricio Arias

The Contribution of Sediment Recalcitrant Organic Phosphorus to Harmful Algal Blooms, Iffat Tasnim, *Georgia Southern University*

Linking Watershed Management to Cyanobacteria Blooms through a Coupled Watershed-Lake Model in a Eutrophic Kansas Reservoir, Laura Krueger, *Kansas State University*

Algae Bloom Prevention and Management through easy-to-use Forecasting and Seasonal Planning Apps, Mauricio Arias, *University of South Florida*

Identifying the Drivers of Florida red tide Dynamics, Nicholas Chin, *University of Florida*

Algal Turf Scrubbers, Replicated Algal Floway Data Collected on Anacostia River in Prince George's County, Maryland, Peter May, *University of Maryland*

Athena C

Bill Mitsch's Impact on Ecological Engineering

Moderator: Bill Strosnider

Urban Wetland Parks: Lessons from Bill Mitsch for improving habitat and water quality, Lauren Griffiths, *Florida Southern College*

Science for Maximum Impact: Lessons from my time with Dr. Bill Mitsch, Kyle Boutin, *University of South Florida*

Bill Strosnider, *University of South Carolina*

Athena D

Stream & Stream Crossing Design

Moderator: Brian Bledsoe

Design and Pilot-Scale Implementation of Nature-based Solutions for Streambank Stabilization in Coastal South Carolina, Daniel Buhr, *Jacobs Engineering*

Nutrient Dynamics in Response to Short-Term In-Stream Disturbances in Contrasting Stream Environments, Debabrata Sahoo, *Clemson University*

Enhancing Stream Restoration Practices through Integrated Design Approaches and Assessment Tools, Kyle McKay, *University of Georgia*

Road-Stream Crossing Design: A Stream Smart Approach, Benjamin Bradley, *Trout Unlimited*

Predictive Ecological Models for Hyporheic Exchange in Texas, Kyle McKay, *University of Georgia*

Athena E

Participatory Science

Moderator: Andrea Ludwig

Enhancing statewide data collection and outreach though the NC Volunteer Wetland Monitoring Program, Michael Burchell, *North Carolina State University*

Equipping Communities with Science-Driven Tools for Riparian Restoration, Andrea Ludwig, *University of Tennessee*

Urban stormwater management through food production: community-engaged research for culturally relevant and nutritious wild foods in Syracuse, New York, Stewart Diemont, *State University of New York, College of Environmental Science and Forestry*

FRIDAY MORNING II

Fri. May 30, 10:10am - 11:25am

Athena A

Nature-based Solutions for River Resilience

Moderator: Matt Chambers

Enhancing the design of constructed wetlands along the Missouri River to improve nutrient removal, Rod Lammers, *Central Michigan University*

Spatial Prioritization of Freshwater Nature-based Solutions: A Case Study identifying Levee Setback sites in the Lower Missouri River Watershed, Alec Nelson, *University of Georgia*

Harnessing investments in reservoir operations to promote hydrologic reconnection and ease, Elissa Yeates, *University of Georgia*

Design Guidance for Floodplain Benching as a Nature-Based Solution, Kyle McKay, *University of Georgia*

Natural Flood Management for Big Rivers, Matt Chambers, *University of Georgia*

Athena B

Vegetation in Ecological Engineering

Moderator: Nathan Jones

Evaluating woody plant species and their associations with salinity and hydrology in the Mobile-Tensaw Delta, Andrew Balder, *Auburn University*

Duckweed: its Microbiome, Exudates and their Interactions, Molly Robles, *EA Engineering* and *Michigan State University*

Hydrodynamics of submerged aquatic vegetation motion: A case study in Florida Springs, Kathleen Schoenberger, *University of Florida*

Nature based solutions: How does variation in marsh plant communities impact coastal compound flooding?, Nathan Jones, *University of Alabama*

Athena C

Planning & Decision Making

Moderators: Fouad Jaber

Incorporating Operational Decision-Making to Forecast Estuarine Discharges from a Highly Managed Watershed Using a Transformer Neural Network, David Kaplan, *University of Florida*

Rethinking Water Quality Project Planning: Coupling restoration needs of conservation lands with nutrient reduction allocations, Mary Szoka, *University of Oklahoma*

Optimizing Reservoir Operations to Mitigate Nutrient and Phytoplankton Loads in a Eutrophic Subtropical Lake, Osama Tarabih, *University of South Florida*

Watershed Protection Plans as way to increase nature-based solutions adoption, Fouad Jaber, *Texas A&M AgriLife*

Athena D

Innovations in Water Treatment Technologies

Moderator: Natasha Bell

Advancing Rural Wastewater Treatment with Biochar: A Low-Cost, Sustainable Solution for Nutrient Management, Liz Riedel, *North Carolina State University*

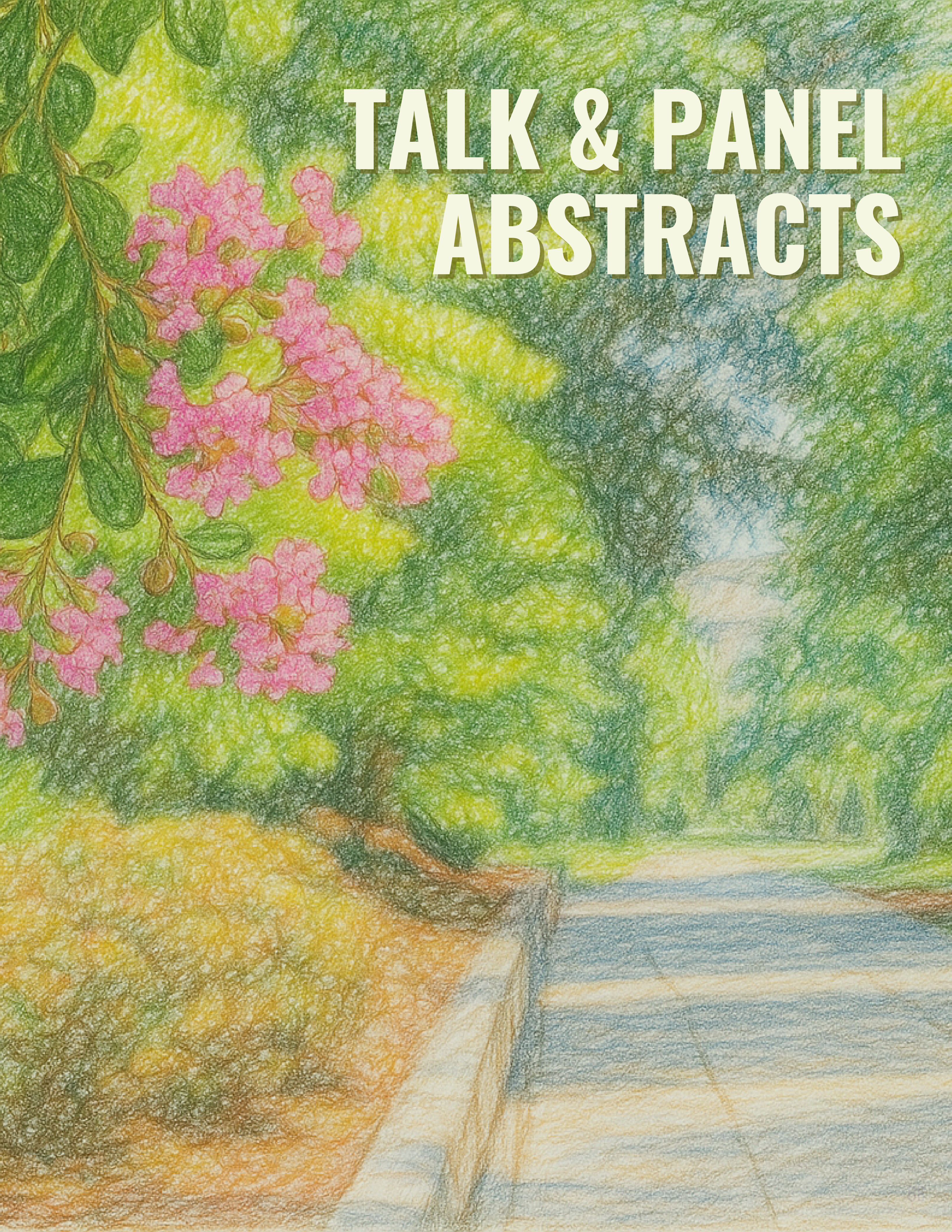
Evaluating Environmental and Economic Impacts of the Algae Wheel for Wastewater Treatment, Ana Martin-Ryals, *University of Florida*

Life cycle assessment of constructed wetlands with horizontal subsurface flow for the treatment of domestic wastewater in the canton of Monteverde, Puntarenas province, Costa Rica, Sofia Solis Naranjo, *University of Costa Rica*

Anaerobic bioremediation of historical chlorinated organic pollutants from Superfund sites in New Jersey and Michigan, Danielle Delp, *Rutgers University*

Bioreactor Gardens: Scalable Nature-Based Solutions for Decentralized Wastewater Treatment, Kelly Harris, *Ridge to Reefs*

TALK & PANEL ABSTRACTS



Resilience in the Face of Extreme Events

Athena A

A Retrospective Look at the Resiliency of Nature-based Solutions Following Hurricane Helene

Chris Grose, *Robinson Design Engineers*

In September of 2024, Hurricane Helene produced the new flood of record in many locations of Western North Carolina and Eastern Tennessee. The magnitude of this storm, when routed through the steep and narrow valleys of the region, resulted in hydraulic forces that significantly altered channel forms, destroyed infrastructure, deposited sediment and debris, and led to loss of life. Immediately post-Helene, we performed a series of triage site visits to assess project states, which were then followed by retrospective site visits some months later. The intent was to review the efficacy of our nature-based solutions (NBS) when exposed to an extreme event and the intentional resiliency incorporated into the designs. Few failures were observed during either time frame, including projects in constrained urban settings. Based on the results of this qualitative assessment, we are encouraged as practitioners to continue to design NBS with fewer robust features and more intentional resiliency. This means designing for self-adjustment and healing. Robust measures inherently trade-off ecological benefits, often through additional land disturbance during construction or the introduction of habitat features that would not form from natural processes. Resilient measures, however, can provide function and stability at varying scales if the initial problem is approached with rigorous design and alternative analyses. Stream channels will continually self-sort their sediment and reorganize into stable bedforms while floodplains will exchange water, sediment, and carbon through increased connectivity. Conclusions drawn from this retrospection can be applied to other locations outside of the Helene impact area and should also be incorporated into cleanup and recovery actions to both protect human infrastructure and promote ecological integrity.

Rising Rivers, Rising Risks: A Future Floodscape Analysis of a central Pennsylvanian Watershed

Digant Chavda, *Penn State University*

This study seeks to understand the impact of climate change on a flood-prone region in central Pennsylvania—the Swatara Creek watershed—by integrating projections from the IPCC AR6 global climate models (GCMs), hydrologic and hydraulic modeling, and risk assessment to evaluate costs and damages associated with future flood events under different Shared Socioeconomic Pathways (SSP) scenarios. It also examines the application of nature-based solutions (NbS) for flood mitigation.

The framework combines weather forecasts from an ensemble of GCMs under various SSP scenarios and geospatial information within a hydrological model to simulate streamflow in the Swatara Creek through the year 2100. A 2D hydraulic model is employed to simulate 5-day flood events in the watershed for each daily streamflow value exceeding historical flood levels recorded at the USGS gauge located in the study area. Further, geospatial analysis is conducted to identify building infrastructure within flood inundation extents, and potential damages are estimated following FEMA guidelines.

The study addresses three key questions:

1. How will climate change reshape streamflow dynamics in the Swatara Creek watershed over the 21st century?

2. What are the economic consequences of varying flood extents for urban infrastructure in the region?

3. Can nature-based solutions effectively buffer the Swatara Creek watershed against intensifying flood risks under future climate scenarios?

The outcomes of this study provide a quantitative assessment of future flood risks and evaluate sustainable strategies to enhance flood resilience in the Swatara Creek watershed. The findings contribute to regional adaptation planning and highlight the role of NbS in mitigating flood impacts under changing climatic conditions.

Co-developing a Regional Watershed Resilience Framework

Alysha Helmrich, *University of Georgia*

Critical infrastructure systems must be managed to withstand extreme disturbances and adapt to increasingly complex environments (e.g., climate change, urbanization, emerging technologies, etc.). Systematic planning for regional critical infrastructure resilience requires a robust process, numerous data inputs, and significant participation from relevant stakeholders. This study uses capabilities-based planning to inform decision-making for future investments in social processes and physical infrastructure across five critical infrastructures: water and wastewater systems, energy, transportation systems, information technology, and communications. The proposed Regional Watershed Resilience Framework aids the U.S. Army Corps of Engineers (USACE) and local planners and operators in preparing for known and unknown risks (pertaining to flood risk management) in a complex environment and identifies the existing and missing capacities to address resilience for interconnected infrastructures across spatial scales (component to watershed) and with consideration of people, planet, and profit. The framework was co-developed with USACE through an iterative process of document analysis, collaborative discussions, and validation with subject matter experts. The framework was then piloted with the USACE Nashville District in Spring 2025. While the tool was co-developed with USACE, it was created to be accessible to diverse users (e.g., public utilities, non-profits, state agencies, etc.). Eighteen personas were identified to expand the usefulness of the tool. The proposed framework demonstrates a process to navigate complexity while providing measurable target capabilities to assess the system's resilience from diverse perspectives.

Stream and Floodplain Restoration Lessons Learned Following 2024 Helene Flooding in Western North Carolina

Greg Jennings, *Jennings Environmental PLLC*

Extreme flooding occurred in September 2024 throughout Western North Carolina when Hurricane Helene produced unprecedented rainfall. Impacts to streams and rivers included erosion, deposition, loss of forest buffers, channel morphology changes, and pollution. This presentation describes post-flood observations of 40 ecosystem restoration projects implemented over the past decade in a variety of watershed settings. All projects included natural restoration techniques designed to enhance flood resilience through floodplain connectivity, native riparian vegetation, and in-stream wood and rock structures. Channel sizes range from 1 to 30 m in width and 0.2 to 3 m in depth. Flood inundation depths estimated based on visual indicators and nearby gages ranged from 1 to 6 m above top of bank. Floodplain widths ranged from 2 to 22 times the bankfull channel width of the restored stream channel. Post-flood site conditions were rated as successful, partially successful, or failing to meet flood resilience objectives in terms of maintaining natural channel forms and riparian vegetation. Of the 40 restoration projects assessed, 31 were successful, 7 were partially successful, and 2 were failing to maintain resilience. In general, successful projects were older and had wider floodplains with dense riparian forest buffers. Damaged projects were in more urbanized areas with local infrastructure such as bridges and had less available floodplain width for energy dissipation. Lessons learned from assessing restoration projects exposed to extreme flooding e should be integrated into plans for future projects to optimize flood resilience and ecosystem functions.

A Retrospective Look at the Resiliency of Nature-based Solutions Following Hurricane Helene

Chris Grose, *Robinson Design Engineers*

In September of 2024, Hurricane Helene produced the new flood of record in many locations of Western North Carolina and Eastern Tennessee. The magnitude of this storm, when routed through the steep and narrow valleys of the region, resulted in hydraulic forces that significantly altered channel forms, destroyed infrastructure, deposited sediment and debris, and led to loss of life. Immediately post-Helene, we performed a series of triage site visits to assess project states, which were then followed by retrospective site visits some months later. The intent was to review the efficacy of our nature-based solutions (NBS) when exposed to an extreme event and the intentional resiliency incorporated into the designs. Few failures were observed during either time frame, including projects in constrained urban settings. Based on the results of this qualitative assessment, we are encouraged as practitioners to continue to design NBS with fewer robust features and more intentional resiliency. This means designing for self-adjustment and healing. Robust measures inherently trade-off ecological benefits, often through additional land disturbance during construction or the introduction of habitat features that would not form from natural processes. Resilient measures, however, can provide function and stability at varying scales if the initial problem is approached with rigorous design and alternative analyses. Stream channels will continually self-sort their sediment and reorganize into stable bedforms while floodplains will exchange water, sediment, and carbon through increased connectivity. Conclusions drawn from this retrospection can be applied to other locations outside of the Helene impact area and should also be incorporated into cleanup and recovery actions to both protect human infrastructure and promote ecological integrity.

Circular Bioeconomy and Life Cycle Assessment I

Athena B

Beneficial Reuse of Mine Drainage Residuals as Phosphorus Sorbents to Close the Resource Recovery Loop

Dayton Dorman, *University of Oklahoma*

Mine drainage (MD) passive treatment systems (PTS) have been demonstrated to be resilient applications of ecological engineering that improve water quality. However, their long-term viability and sustainability depend on the sustainable management of accumulated mine drainage residuals (MDRs). Historically, these MDRs have been treated as waste; however, recently, there has been an initiative to beneficially reuse these MDRs in support of a circular economy. This study evaluated the reuse of MDRs from three distinct MD sources in Oklahoma, USA, including an untreated net-acidic coal MD discharge (Gowen), a net-alkaline coal MD PTS (Rock Island #7 Passive Treatment System, RI7PTS), and a net-alkaline hard-rock MD PTS (Mayer Ranch Passive Treatment System, MRPTS) as phosphorus (P) sorbents. Laboratory sorption experiments found that at an initial concentration of 4,000 mg/L P, the MRPTS MDRs sorbed 244±86 mg/g P while the MDRs from Gowen and RI7PTS sorbed 61±48 and 88±45 mg/g P, respectively. Similarly, laboratory sorption studies found that all MDRs removed over 88% of P within 24 hours with an initial concentration of 50 mg/L P and a dose of 10 g MDR/L. A concern and limiting factor with reusing MDRs is the potential release of trace metals. All MDRs evaluated released measurable concentrations of metals. However, the release of metals at ecotoxic concentrations typically occurred at unnatural concentrations of P (>1,000 mg/L P) or an MDR dose greater than 5 g/L. Similarly, the P solutions used in this study were slightly acidic compared to natural settings, overestimating the metal leachability of the MDRs. These results indicate that MDRs can be reused as P sorbents despite their different physicochemical properties. The MDRs can be reused to produce a product that addresses eutrophication concerns due to elevated anthropogenic P, bringing the resource recovery loop closer to circularity.

Biogas Production of Food Waste from Different Sources: Characterization within a Biocircular Economy Framework

Maureen N. Nabulime, *University of Maryland*

Our municipal solid waste (MSW) characterization study has shown that food waste (FW) accounts for over 24% of MSW generated in the United States, mainly going to landfills and contributing to greenhouse gas emissions. Anaerobic digestion (AD) presents a sustainable waste management approach by converting organic waste into biogas, a renewable energy source, and digestate, a nutrient-rich byproduct. However, variations in food waste composition across different sources can significantly influence biogas yield and process stability. In this study, MSW restaurants, schools, and landfills were categorized into 27 categories, including then film plastics, cardboard, yard waste, and FW, with the FW from further categorized into 13 categories. Laboratory-scale biochemical methane potential (BMP) tests were conducted under controlled batch conditions at mesophilic temperatures (37°C) to understand the bioenergy potential of each FW type and yard waste. The results indicated that FW was primarily fruit and vegetable waste, accounting for 52% of FW in landfills, 50% in restaurants, and 12% in schools. Schools generated a higher proportion of mixed food waste, liquids, bread, and French fries. The 30-day BMP test revealed that dairy and meat waste produced the highest methane yields (650–750 mL CH_4/g VS) when normalized by organic input, known as volatile solids (VS), due to the high fat and protein content. In contrast, fruit and vegetable waste, grains, and mixed food waste had yields ranging 550 to 650 mL CH_4/g VS. Yard waste had the lowest methane yields (250 mL CH_4/g VS) due to its high lignin content in grass, which impedes microbial degradation during anaerobic digestion. These findings highlight the variability in biogas production based on substrate composition and nutrient balance, showing the importance of understanding FW streams by source and composition for bioenergy production. Results can be used to estimate bioenergy from waste from specific schools and restaurants or from a collection of FW producing entities by zip code or municipality.

Food Waste Dehydration Poses Climate Tradeoffs Between Transportation Savings and Electricity Use

Katherine Porterfield, *University of Vermont*

Organics recycling strategies can be hindered by the high water content of certain organic wastes—such as food scraps—making long-distance transportation costly and greenhouse gas intensive. One potential solution is drying these materials prior to transport, but this introduces a new trade-off, as the energy used for drying is also associated with greenhouse gas emissions. We conducted a life cycle assessment (LCA) to explore this trade-off in the context of countertop food waste dehydration technologies. Scenarios analyzed included home composting, centralized composting, landfilling, and countertop dehydration followed by either home or centralized composting. Sensitivity analysis evaluated how transportation distance and grid carbon intensity influence the climate impact of each strategy. All dehydration scenarios resulted in a lower climate impact than landfilling. The comparison between centralized composting scenarios, with and without prior dehydration, depends on transport distance and the carbon intensity of the electric grid. Countertop food waste dehydration is most effective when paired with a clean electric grid and longer transport distances to centralized composting facilities. This analysis highlights the importance of considering energy sources in circular economy strategies and suggests potential mitigation approaches, such as adopting renewable energy or improving energy efficiency in dehydration technologies. Finally, we contextualize this study within broader organics recycling challenges, drawing insights from previous work on resource recovery from other organic wastes, such as dairy manure and biosolids.

Food Waste Diversion and Anaerobic Digestion as Pillars in a Resilient Bioeconomy

Stephanie Lansing, *University of Maryland*

In the US, 47 million people face food insecurity, yet 1/3 of the food produced is wasted. A resilient, circular bioeconomy context will be used to present research on decreasing food waste and using anaerobic digestion or bioplastic formation for inedible food and waste. Our NourishNet project (nourishnet.co) developed an app, FoodLoops, that expand the real-time access to healthy food allows for people experiencing food insecurity. Donors using the FoodLops app can add data from our patented QuantumNose sensor that detects the level of food freshness. Embedded greenhouse gas (GHG) emission modeling an empower government agencies and institutions to strategically invest in climate-smart infrastructure. We showed that the diversion of 73,000 kg of surplus food annually reduced 49 tons CO2eq per year, which is equivalent annual CO2 reductions achieved by 1,000 solar panels (400 W each).

Innovations in anaerobic digestion of food waste included assessing how the waste collection location (restaurants, food pantries, schools, or residential) impacted biogas potential. The percent of food waste collected from sorted municipal solid waste (MSW) was highest at food pantries (90%) and restaurants (50%) compared to schools (20%) and residential trash (15%), but the portion of fruits and vegetables was lower at schools (12%) compared to restaurants (50%). This is important as the energy production from anaerobic digestion of food waste was shown to be 14% greater with fruits and vegetables compared to mixed food waste. Understanding the amount and type of food waste collected at MSW sites throughout the country have enabled us to predict bioenergy potential based on location and scale.

Finally, bioplastics in the form of polyhydroxyalkanoates (PHA) were created from dark fermentation of food waste. The results showed that during dark fermentation using our robust bacterial consortium was able to shunt traditional anaerobic digestion products (biogas) and create an effluent with volatile fatty acid (VFAs) concentrations exceeding 20 g/L over long-term operation (>2 years). The VFAs were used by a halophilic bacteria, Haloferax mediterranei, to create thin-filmed bioplastics to increase sustainability and reduce PFAS in food systems.

Combined these studies show ways to increase our resiliency through use of a circular bioeconomy and a focus on reducing food waste. The importance of understanding life cycle GHG emission reductions and economic costs from each diversion strategy was central to our analyses. These results show the value of reducing wasted food through targeted recycling efforts that result in the highest social, economic, and environmental value. Taking a wasted product and recycling it back into the bioeconomy can be seen as a model to increase our resiliency and reduce GHG emissions and environmental impact of waste production.

Ecological engineering for water quality improvement in agricultural landscapes

Athena C

Phosphorus retention and soil development in a formerly farmed, Vermont riparian wetland two decades after restoration

Laura O'Brien, *University of Vermont*

A total maximum daily load mandates phosphorus (P) load reduction in Vermont's Lake Champlain Basin to minimize water quality impacts. Wetland restoration is one strategy towards this goal, but there are concerns about potential release of legacy phosphorus from former agricultural land. This study focused on a restored riparian wetland in central Vermont which last saw active farming two decades ago. Soil samples from three plots were characterized for bulk density, loss-on-ignition, inorganic P, organic P, total P, and oxalate extractable P, aluminum, and iron. To simulate soluble reactive P (SRP) release during flooding events, fifteen-day incubations were performed on intact soil cores under aerobic and anaerobic treatments. A process-based model (wetlandP) was previously developed to estimate net P balance for restored wetlands. One parameter, equilibrium dissolved inorganic P (DIP), can be derived from the average SRP concentration measured in the last five days of an aerobic intact core incubation. This study's intact core results informed a model sensitivity analysis using a range of equilibrium DIP scenarios reasonable for flood conditions onsite, as well as scenarios indicative of more recently farmed, hypothetical sites. Model outputs estimate net P retention for plausible scenarios at the site studied, and by extension, other wetlands on the latter end of their restoration timeline. Five years ago, similar soil analyses and an intact core experiment were performed for the same site. Comparison of these results offers insight into how wetland soils and corresponding P retention capacity develop within restored systems as they mature.

Modeling net phosphorus retention on restored riparian wetlands in the Lake Champlain Basin, Vermont

Tiffany Chin, *University of Vermont*

Excess phosphorus (P) in the Lake Champlain watershed has led to declining water quality and frequent cyanobacteria blooms. A reduction in P runoff to the lake is mandated by a Total Maximum Daily Load (TMDL), and one of the methods used to retain P in the watershed is wetland restoration. Many riparian wetlands in Vermont were historically converted to farmland, and some of the land suitable for wetland restoration has elevated soil P from fertilizer/manure applications. As such, there is a risk of initial P losses from wetland restoration projects in this region. To assist with restoration site selection and watershed P retention estimates, our team has developed a process-based model to estimate net P retention in restored riparian wetlands. We used two years of monitoring data (water quality, continuous water level, soil data, and intact core incubation results) from five restored wetlands in central Vermont to model P flux and estimate net P retention at each wetland site. We compare net P retention at sites with different time since farming and across two subwatersheds with different influent river water quality characteristics. Preliminary results show net TP retention ranging from 0.6 – 2.7 g-P/m2/yr. Our results can be used to inform future wetland restoration projects and watershed management planning in the region.

Location, Design, and Results of Conservation Practices to Reduce Phosphorus Runoff from Agricultural Fields in the Lake Erie Basin

Jaydan Martin, *The Ohio State University*

Legacy phosphorus fields, which have greater amounts soil phosphorus than needed agronomically, are known to be larger contributors of phosphorus runoff and drivers of Lake Erie's harmful algal blooms. Despite this, these locations are difficult to identify and manage, which has prohibited the documentation of the potential large gains in water quality by managing these sites. This presentation will document the formation of a public-private partnership between farmers, crop consultants, academia, and NGOs that was used to identify and locate wetlands, phosphorus filters and drainage water management at these sites. From 2018-2025, these sites and practices were designed and monitored to determine 1. if legacy phosphorus sites do indeed have greater amounts of phosphorus runoff, and 2. the potential of management practices to reduce phosphorus runoff from these sites. Results from phosphorus filters that included reductions ranging from 30-80% of dissolved reactive phosphorus highlight the potential gains of identifying and locating management at these sites with greater nutrient runoff. Overall, these results demonstrate potential benefits for upfront outreach and evaluation that can result in larger gains in water quality for Lake Erie watersheds by finding and managing legacy phosphorus fields.

Evaluating Stacked Conservation Practice Effects at the Field-Scale in the Lake Champlain Basin of Vermont

Nisha Nadkarni, *University of Vermont*

Excess phosphorus (P) contributes to the eutrophication of freshwater bodies and subsequent Harmful Algal Blooms (HAB). This is an increasingly urgent problem in freshwater systems globally, including the Lake Champlain Basin (LCB). Agriculture, including dairy farming, is a prominent part of the landscape within the LCB and contributes a significant portion of the P load entering Lake Champlain. There are promising edge-of-field practices that may reduce dissolved and total P loads from agricultural surface and subsurface runoff. A Conservation Effects Assessment Project (CEAP) Stacked Practices and Innovative Phosphorus Removal project was initiated as a field-scale study in 2021. The field study takes place in Bridport, Vermont. The study evaluates the 'stacking' of multiple conservation practices at the field-scale including manure injection, no-till, cover cropping, and edge-of-field phosphorus removal technologies (subsurface tile drain filters) to determine their effects on the water quality of agricultural runoff. The tile drain filters contain iron oxide material mixed with pea gravel with the goal of reducing dissolved and total P loads from subsurface runoff. Results of surface and subsurface flow monitoring and water quality sampling from study fields will be presented, as well as performance data for the phosphorus removal structures.

Education Approaches in Ecological Engineering

Athena D

Community and student engagement in ecological engineering projects to promote resiliency and sustainability

Randall Etheridge, *East Carolina University*

Lake Mattamuskeet is the largest natural lake in North Carolina. The lake is located in the coastal plain and much of its watershed is approximately 1 meter above sea level. Between 2010 and 2015 the lake experienced a shift from an ecosystem dominated by submerged aquatic vegetation to one plagued by cyanobacteria blooms. In addition, much of the watershed received substantial flooding during Hurricane Matthew in 2016. These challenges spurred the development of a watershed restoration plan beginning in early 2017. The community where the lake is located has less than 5,000 residents and the annual budget is less than the cost to implement the large-scale projects needed to address the issues facing the lake. The effort to restore the lake has involved extensive collaboration among multiple partners. Ecological engineering researchers and students at East Carolina University have assisted with community engagement and developing concept designs to address the challenges facing this economically and socially valuable ecosystem.

As a part of the effort, three capstone teams were assigned different focus areas around which they had to develop a preliminary design in 2021. The three areas were: (1) improving the four existing outflow canals; (2) directing water onto an adjacent 17,200 ha (42,500-acre) drainage association that has pump infrastructure and land available for water treatment; and (3) redirecting water from private property that currently drains to the lake to another body of water following treatment. Since the concept designs were completed, partners on the restoration effort have received substantial funding to pursue implementation of two of the designs plus additional ecological engineering solutions. This presentation will include a summary of the community engagement efforts, an overview of the concept designs, and how the restoration process continues to move forward because of the joint effort by the project partners.

Continuing the accreditation journey: meeting the need for ecological engineering program evaluators

Trisha Moore, *Kansas State University*

AEES passed a major milestone in its mission to advance ecological engineering education with the recent approval of ecological engineering curricular criteria by ABET. These criteria provide baseline curricular standards for accredited ecological engineering education programs and a recognized "home" under which these programs can seek accreditation or re-accreditation. The AEES membership now has the opportunity to bring its ecological engineering expertise to bear by serving as reviewers to ecological engineering programs seeking new or continued accreditation. These reviewers, known as program evaluators (PEVs), can come from industry, government and non-governmental agencies, and academic backgrounds to provide this important service to our discipline. The purpose of this presentation is to communicate the roles and responsibilities of PEVs, the steps to become one, and the training and support that is provided along the way. If you are looking for ways to serve the society and/or have interest in the accreditation process we encourage you to attend.

Ohio State University's AEES student branch designs, funds, and constructs a bioswale

Joseph Smith, *The Ohio State University*

Urban stormwater runoff poses challenges to surface water quality, impacting ecosystems and communities alike. How can small-scale, student-led initiatives address this global issue?

In 2009, the Ohio State University (OSU) American Ecological Engineering Society (AEES) student branch designed and constructed the "Ecological Engineering Society Rain Garden" to intercept and treat runoff from a sidewalk before it drained to the Olentangy River downstream. The project was completed in partnership with, and within, Chadwick Arboretum, which is adjacent to the Agricultural Engineering building on campus. However, the rain garden received runoff volumes that exceeded its design capacity due to an undersized storm sewer inlet in the upstream parking lot, which frequently became clogged with leaves, debris, and sediment from agricultural machinery washing. This problem went unaddressed, and the student branch ultimately dissolved.

In 2022, the OSU AEES student branch reformed and began investigating and documenting the problem. On April 2, 2024, a severe storm event once again overwhelmed the clogged inlet, causing runoff to bypass the storm sewer, overflow the curb, and exceed the capacity of the rain garden. This created a safety hazard by flooding the sidewalk the garden was intended to drain. Despite regenerative maintenance efforts, the rain garden's efficacy was limited by the underlying problem of the undersized, frequently clogged storm sewer inlet.

After nearly two years of detailed photo documentation, land surveying, infiltration tests, and soil analyses, the student branch secured $3,000 in grant funding to address the underlying problem. This presentation describes the OSU AEES student branch's process of designing, funding, and constructing a curb cut and bioswale to alleviate some of the stormwater volume burden on the storm sewer inlet and existing rain garden. It aims to demonstrate the meaningful role that initiatives led by a student branch of our Society can play in addressing real-world environmental challenges while fostering community engagement and transdisciplinary collaboration in ecological engineering.

From Classroom to Community: Bridging Ecological Engineering and Civic Engagement

Sara McMillian, *Iowa State University*

Special Topics Related to H.T. and E.P. Odum's Societal Outlook Publication "A Prosperous Way Down" Approaches in Ecological Engineering Panel

Athena E

Explorations of H.T. and E.P. Odum's proposal for "A Prosperous Way Down" through an intentional and controlled descent of global human society

Peter May, *University of Maryland*

Through a decade of teaching University of Maryland's Environmental Science and Technology Department upper-level classes in Ecosystem Ecology and Ecological Design, undergraduate students were exposed to and discussed HT and EP Odum's now classic book and paper "A Prosperous Way Down." An intentional multiple year extra credit question was given at the end of each final exam which asked the student what kind of world and society they believed would exist in 50, 100 and 1,000 years. Not all students answered the question although through 13 semesters of final exams quite a few responses have been generated. Data is presented on the responses with groupings of sometimes unique points of view and a surprising/unsurprising majority result. The Odum's 2001 book and 2006 paper are explored in the context of 2025 and the implications for the "Future" of society as told by students.

WEDNESDAY 1:00pm - 2:20pm

Engineering Ethics Panel

Athena A

Holly Yaryan Hall, *Robinson Design Engineers*

This special session addresses topics related to ethics for professional engineers. For example, this might include awareness of ethical concerns and conflicts, familiarity with codes of conduct, understanding of standards of practice or care, or project management and risk-assessment management. These and other topics are aimed at maintaining, improving, or expanding skill sets and knowledge relevant to conducting the practice of the ecological engineering profession so as to protect the health, safety, and welfare of the public. It is also intended to support those needing 1 professional development hour (PDH) in ethics.

Circular Bioeconomy and Life Cycle Assessment II

Athena B

Upcycling duckweed grown on dairy wastewater into an organic fertilizer

Lauren McPhillips, *Penn State University*

Duckweed is a tiny aquatic plant with great potential as an ecological engineering solution that can be used to remediate nutrient-laden water such as dairy wastewater. One application of duckweed used in nutrient remediation is to recycle the duckweed into an organic soil amendment. In prior research, loose duckweed amended to soils has shown promising results in reducing nutrient leaching compared to traditional fertilizers, while still sustaining crop yield. However, other potential pathways of nutrient losses, such as greenhouse gas (GHG) emissions, have yet to be studied. Additionally, there has not been prior evaluation of alternate forms of duckweed, such as pelletizing prior to fertilization. Thus, a greenhouse soil column experiment to grow a representative crop (triticale) was conducted to compare application of pelletized and loose duckweed with a traditional synthetic fertilizer (urea) and a conventional organic fertilizer (liquid dairy manure). In a series of simulated rainfall events, we evaluated surface soil emissions of GHGs (nitrous oxide, carbon dioxide and methane), nutrient leaching, soil and plant accumulation of nutrients, and investigated the fate of nitrogen using nitrogen isotope tracing techniques. When evaluating GHG emissions, systems fertilized with manure and urea both had higher overall GHG emissions than those with duckweed, and isotope tracing showed direct contributions of urea to nitrous oxide emissions. Though there was some initial nitrogen leaching from duckweed-fertilized systems, total nitrogen losses in leachate were lowest for duckweed-fertilized systems. Crop size was similar between treatments, though final plant height was slightly higher with manure. This study demonstrates that duckweed can support comparable crop yields as traditional fertilizers, while reducing nitrogen losses, supporting its use as an organic fertilizer as part of a circular bioeconomy.

Integrating Manure Slurry Acidification and Duckweed Growth Systems for Protein-rich Animal Feed Production and Greenhouse Gas Mitigation

Kari Lagan, *Penn State University*

Rising global populations and incomes are increasing the demand for animal-derived proteins and dairy products, intensifying the challenges associated with livestock feed production and manure management. Dairy farming requires substantial protein inputs to feed livestock and generates significant volumes of wastewater, posing nutrient management concerns. Slurry acidification technique (SAT) is employed in manure management in Europe to reduce greenhouse gas (GHG) emissions and odors from manure storage, but integration of this technique with nutrient recovery systems remains to be explored. Duckweed, a small free-floating aquatic plant, has been grown on various waste streams to upcycle nutrients into protein-rich biomass, which can be used in livestock feeds. This study investigates the potential of combining SAT with duckweed-based systems to simultaneously mitigate GHG emissions and enhance protein-rich biomass production on farms. Experimental mesocosms were designed to simulate four scenarios: open slurry storage pits, acidified open slurry storage pits, unacidified duckweed ponds, and acidified duckweed ponds. Methane, nitrous oxide, and carbon dioxide emissions were measured using gas sampling chambers, while duckweed biomass was harvested weekly, and water quality was analyzed. Duckweed reactors reduced net GHG emissions compared to slurry storage systems, as photosynthesis-driven carbon dioxide uptake exceeded emissions from the mesocosms. Acidified digestate initially promoted higher duckweed growth; however, prolonged use led to toxic declines in pH due to proton exchange. Future research will explore flow-through system designs to stabilize pH and optimize the sustainability of acidified duckweed systems.

Waste-to-Value: Nutrient Recycling of Recirculating Aquaculture System Waster Solids Through Commercial In-Vessel Composting.

Christine Lepine, *The Conservation Fund Freshwater Institute*

Recirculating aquaculture systems (RAS) are an intensive fish farming method that produces more fish per unit volume through highly efficient water reuse. In RAS, waste solids, such as fecal matter and uneaten feed, can be rapidly captured and removed from the systems to prevent water quality degradation, which could affect fish health. Due to intensification, vast quantities of solid wastes are dewatered and condensed to reduce treatment volumes. Waste solids collected from RAS, characterized by their high organic matter and nutrient content and low levels of chemical and pharmaceutical residues, present a promising opportunity for resource recovery processes. However, these wastes are often discarded or treated at a significant cost to farmers by municipal wastewater treatment plants, where they are devalued through mixing with contaminated waste streams.

An alternative waste treatment method to increase sustainability by supporting a circular bioeconomy could include nutrient recycling of aquaculture waste solids through in-vessel composting. Through the intentional aerobic decomposition of organic matter, composting produces a highly stable and valuable product that may be used as nutrient-rich soil amendment. Utilizing an automated and tightly controlled system, in-vessel composting remains biosecure while allowing operators to balance the C/N ratio, moisture content, and aeration, creating favorable temperatures and conditions for optimal microbial decomposition.

Two studies at The Freshwater Institute assessed the feasibility of composting fish waste solids from Atlantic salmon (Salmo salar) and rainbow trout (Oncorhynchus mykiss) production in a commercial-scale rotary drum composter. Each study was conducted over five weeks, with new material loaded every 3-4 days. Study 1 evaluated composting waste solids with mushroom soil and wood flake, while Study 2 replaced the mushroom soil with fish mortalities. Each study examined feedstock characteristics, equipment operating parameters, and compost quality. The finished product was evaluated using standard testing assurance for certified compost. Results will be presented.

Leveraging Multidisciplinary Data to Guide Animal Waste Management and Policy in Maryland

Stephanie Lansing, *University of Maryland*

Waste technologies, such as composting, anaerobic digestion, thermochemical processing, and manure injection, can process carbon and nutrients from animal waste to create economically viable products. These technologies can also enable farmers to meet nutrient management requirements while reducing greenhouse gas emissions and public health risks. Maryland-based manure nutrients, transportation, economic opportunities, relevant policies, and economic barriers and opportunities were assessed. Additionally, best practices for siting these technologies from an environmental justice and community input perspective was developed. The assessment integrated a broad spectrum of data sources, including federal and state agency documents, such as US Dept of Agriculture and Maryland Department of Agriculture watershed implementation plans, aerial photography, remote sensing, and laboratory test results, which were supplemented by interviews, surveys, and focus groups. This interdisciplinary approach merged Extension outreach with advanced GIS/mapping and data/information management to create a detailed nutrient landscape of Maryland.

Livestock populations, manure production, and nutrient outputs were quantified by county, revealing that three species (broilers, cattle, and equine) account for over 90% of the state's nutrient loads. Notably, while broilers contribute the overwhelming majority of animal units (88.3%), the volume of manure results in the majority of nitrogen in manure coming from cattle and dairy populations, while the majority of P in manures comes from the poultry population in the state. Composting dairy manure solids produced in Maryland could lead to a 66.7% reduction from the baseline (open lagoon storage). Anaerobic digestion of this dairy manure slurry (liquids and solids) would have a 106% reduction from the baseline, resulting in sequestering of carbon.

Findings indicate that overall animal and nutrient production in Maryland is not projected to decrease over time. Yet, stakeholders concur that there is no single "silver bullet" technology solution, and legislative attention is limited; only 2% of the 2023 Maryland legislative session focused on animal waste technologies, with current legislation emphasizes food waste diversion and electrification. By synthesizing diverse disciplinary insights with precise spatial and economic analyses, we offer actionable insights to advance sustainable animal waste management, foster a circular economy, and balance agricultural productivity with environmental stewardship and public health imperatives.

Water Quality and Ecological Monitoring

Athena C

Combining remote sensing and in-situ data to improve detection of Florida red tide (Karenia brevis)

David Kaplan, *University of Florida*

We present a novel method for detecting red tide (Karenia brevis) blooms off the west coast of Florida, driven by a neural network classifier that combines remote sensing data with spatiotemporally distributed in situ sample data. The network detects blooms over a 1-km grid, using seven ocean color features from the MODIS-Aqua satellite platform (2002–2021) and in situ sample data collected by the Florida Fish and Wildlife Conservation Commission and its partners. Model performance was demonstrably enhanced by two key innovations: depth normalization of satellite features and encoding of an in-situ feature. The satellite features were normalized to adjust for depth-dependent bottom reflection effects in shallow coastal waters. The in-situ data were used to engineer a feature that contextualizes recent nearby ground truth of K. brevis concentrations through a K-nearest neighbor spatiotemporal proximity weighting scheme. A rigorous experimental comparison revealed that our model outperforms existing remote detection methods presented in the literature and applied in practice. This classifier has strong potential to be operationalized to support more efficient monitoring and mitigation of future blooms, more accurate communication about their spatial extent and distribution, and a deeper scientific understanding of bloom dynamics, transport, drivers, and impacts in the region. This approach also has the potential to be adapted for the detection of other algal blooms in coastal waters.

Evaluating the Frequency of Water Level Data Collection in Central Florida Marsh Wetlands: Insights from Two Decades of High-Resolution Data

Renee Price, *AtkinsRéalis* and *University of Florida*

Wetland structure, function, and integrity are dependent on unique combinations of hydrology, vegetation, and soils. Practitioners monitor these wetland characteristics to establish reference conditions and ensure impacts are not occurring, however monitoring methods and frequency vary widely. Evaluations of wetland hydrology and vegetation trends are often truncated, with few studies lasting over 5 years. Additionally, studies on monitoring frequency may encompass as few as one to two years of data. The objective of this research is to provide monitoring duration and frequency guidance using long term (~16 years) of hourly monitoring well data coupled with annual vegetation sampling in three comparable marsh reference wetlands in central Florida.

First, ecohydrologic metrics computed from water level data were calculated for each wetland and compared using the Kruskal-Wallis test. Similarity, annualized species richness, species overlap, and similarity indices were compared for vegetation. Second, the number of years of data required to characterize of annualized ecoydrologic metrics and species richness data within a 5 to 10% of the long-term mean was calculated to determine the appropriate monitoring duration. Third, data were aggregated into seven unique frequencies to identify sufficient monitoring frequency. Each frequency was compared to the baseline hourly data using the Kruskal-Wallis test to determine if significant differences occurred.

Preliminary results found the three reference marsh wetlands to be hydrologically similar but with variation in plant species. Length of record analysis revealed 2.5 to 7 years of hydrologic data needed to capture measures of magnitude and 2.5 to 11 years of data for species richness. When comparing monitoring frequency for magnitude statistically, mean and median water levels were similar while minimum and maximum were different. This research intends to inform practitioners and researchers on both effective and efficient means to monitor wetland systems that also account for natural variation, allowing for cost maximization while capturing representative conditions.

Performance Monitoring at the "Smart Rain Garden," City of Cape Canaveral, Florida

Jason Evans, *Stetson University*

Many coastal communities in Florida – the third most populous state – are facing increasing impacts from both coastal flooding and deteriorating water quality, including harmful algal blooms (HABs) in coastal waters. Antiquated infrastructure in the built environment and accelerating climate change are amplifying these threats, impacting public safety, ecosystem health, and private property. While green stormwater infrastructure (GSI) is widely promoted by academic researchers and outreach professionals, relatively few municipal governments in the coastal zone – or elsewhere – in Florida have widely adopted GSI as a primary flood resilience strategy. The City of Cape Canaveral, located on a heavily developed barrier island in east central Florida, is a notable exception. In 2022, Cape Canaveral adopted a 25-year master plan for implementing GSI within its historic Presidential Streets neighborhood, a noted hotspot for stormwater flooding events. One of the first major projects implemented through this master plan is a pilot-scale "Smart Rain Garden" at the City-owned Veterans Memorial Park. The Smart Rain Garden was constructed by the City in partnership with researchers at several universities and the East Central Florida Regional Planning Council, largely through funding support provided by the National Science Foundation's CIVIC Innovation Challenge. A multi-disciplinary performance monitoring program that includes assessment of infiltration rates, nutrient treatment, vegetation condition, pollinator utilization, and resident perceptions was established soon after construction was completed in April 2024. This presentation will provide an overview and assessment of the performance data collected to date at the Cape Canaveral Smart Rain Garden, with a primary focus on hydro-ecological findings. Some major "lessons learned" through project implementation and initial performance monitoring phases will also be discussed. Overall, the promising results from the project to date seem poised to provide opportunities for more research-based GSI interventions in the City of Cape Canaveral and other municipalities within Florida's greater Indian River Lagoon watershed.

Building a Practice-Based Education and Training Pathway for Wetland Management and Engineering Panel

Athena D

Tamara Jameson, *Ducks Unlimited, Inc.*

Ducks Unlimited (DU), North America's largest wetland conservation organization, relies on a highly interdisciplinary team of scientists, engineers, and naturalists that work together to develop and refine restoration and management techniques for wetlands and associated habitats to benefit waterfowl, wildlife, and people. DU's expertise spans from site identification through design, permitting, securing funding, construction, and post-project monitoring. With the vision of conserving wetlands into the future, DU has stewarded the next generation of conservationists through youth programming and scholarships. Recognizing a need for preparation of the next generation of engineers and designers, DU and University of Georgia's Institute for Resilient Infrastructure Systems (UGA IRIS) have partnered to offer a Natural Infrastructure Graduate Fellowship. The fellowship gives students the opportunity to work with DU's project teams and advance research in planning, prioritization, design, implementation, and monitoring of natural infrastructure projects. The research being advanced is paramount to inform future practice and expand the use of natural infrastructure by engineers both at DU and globally. This special session will include an organizational overview of DU and project highlights, UGA IRIS natural infrastructure fellowship overview and examples of research projects and practical experience supported by the program, and concluding remarks followed by a panel discussion.

Humans in the Loop

Athena A

Leveraging virtual spaces for human-centered design – an exploration of cultural services provisioning by green stormwater infrastructure

Megan Rippy, *Virginia Tech*

This study explores the potential of virtual reality (VR) to capture community perceptions of cultural services provisioning (e.g., aesthetics and sense of place) by green stormwater infrastructure. Surveys were administered to > 500 people at the University of Maryland, each of whom viewed a bioretention system (UMD West or UMD Creek) or its corresponding virtual model. Two models were prepared for each real site (bioretention-only and situated within the surrounding landscape) to explore the importance of incorporating situational context into VR simulations. Our results suggest that virtual bioretention models reproduce many of the patterns in cultural services provisioning observed in real bioretention systems; they co-provide aesthetic and sense of place services and were perceived to provide more services relative to parking lots and wild greenspace than manicured greenspace. However, perceptual accuracy was inconsistent, both across bioretention sites and model simulations, with the situated model of UMD Creek exhibiting significantly elevated cultural service scores. The bias associated with this particular model appears to reflect the absence of contextual factors (e.g., signs of neglect, messy complexity, and anthropogenic noise) that were present in the real environment. The direction of the bias has implications for participatory design – namely, care should be taken with situational context to avoid overpromising services to viewers. These results have important implications for landscape professionals who are interested in leveraging new technologies for community-centered design as well as the communities they serve who have the potential to benefit from participatory design approaches and more culturally sensitive stormwater infrastructure.

Stormwater management and community involvement in a rapidly developing city in the global south

Anand Jayakaran, *Washington State University*

As the planet experienced its warmest summer on record in 2024, it is critical to understand urban communities' rapidly changing needs and co-create research and education products that fit a specific community's needs. This talk explores how stormwater is managed in Bengaluru and the available knowledge of traditional water management in the surrounding landscapes. The objectives of this sabbatical project were to A) to identify current strategies of stormwater management in the city and its developing suburbs, B) to learn how the community is engaged in the decision-making process, C) to identify relevant traditional knowledge that can be used to manage flooding in the city today. An outline of management structures, challenges, and successes will be shared to give insight into how ecological engineers could position themselves to contribute meaningfully to urban ecosystems in the developing world that face the dual threats of rampant urbanization and a changing climate.

Advancing Environmental Justice and Nature-Positive Infrastructure through Algal Turf Scrubbers and Oyster Reef Restoration at the Sparrows Point Container Terminal in Baltimore, Maryland

Larry Davis, *Green Mechanics Benefit LLC*

The Sparrows Point Container Terminal (SPCT) project, in collaboration with the Tradepoint Atlantic (TPA) logistics hub built on the former Bethlehem Steel brownfield site in Baltimore County, Maryland, presents a pioneering opportunity to integrate ecological engineering solutions into urban infrastructure, water-energy-food nexus, and resilient community-building. Green Mechanics, through the deployment of Algal Turf Scrubbers (ATS) and oyster reef restoration, is championing an innovative approach that aligns with environmental justice principles for nearby working class communities while supporting Maryland's Clean Water Act goals. The ATS technology, proven effective through a multi-year dataset from the nearby Dundalk Marine Terminal, provides a scalable, cost-effective means to generate stormwater nutrient abatement credits, targeting hundreds of acres of impervious surface runoff mitigation. Concurrently, the establishment of oyster reef seeding systems and biohuts will enhance aquatic habitat resilience and contribute to the living shoreline initiative, mitigating erosion and reinforcing coastal stability while mitigating shallow water habitat impacts. These interventions also support Green Marine terminal certification, meeting key sustainability benchmarks in water quality, waste management, and biodiversity enhancement goals of the project. A dynamic community dashboard is being developed to ensure transparency, stakeholder engagement, and AI-integrated reporting, fostering data-driven decision-making. By integrating these regenerative technologies, SPCT is poised to set a global precedent for nature-positive infrastructure, balancing industrial expansion with ecological stewardship and community well-being.

Sowing water: the drop of the future that we can save

Sofia Solis Naranjo, *University of Costa Rica*

The outreach project "Sowing water: the drop of the future that we can save" is led by the Department of Biosystems Engineering of the University of Costa Rica. It aims to involve local communities in sustainable water management, working with ASADAS, pipeline and sewerage associations, as well as primary schools in Monteverde (upper watershed), Sardinal (middle watershed) and Chomes (lower watershed). In this region, climate change has extended periods of drought. Although the total amount of rainfall has not decreased, it is concentrated in shorter and more intense periods. As a result, soil impermeabilization and the strength of rainfall generate runoff instead of infiltration, which reduces the recharge of subway aquifers. During the summer, this situation makes it difficult for ASADAS to supply drinking water. To improve water infiltration, the project proposes the implementation of water seeding systems. In 2023, workshops were held with the ASADAS and primary schools, addressing three key topics: 1) the hydrological cycle, 2) the causes of low infiltration and 3) water sowing systems. These workshops were successful, as they allowed the community to understand that, given the current climate and landscape conditions, these strategies represent a viable solution for water resource management. In 2024, a sowing water and harvesting system was built and implemented, accompanied by new workshops for the ASADAS and the Sardinal school. These activities emphasized the importance of water care and promoted the expansion of these practices to other localities. In addition, educational videos and manuals were produced to reinforce the knowledge acquired and facilitate its application in the future.

An Environmental and Economic Justice Framework for Socially Integrated GI

Victoria Rexhausen, *University of Tennessee*

In August 2022, the National Oceanic and Atmospheric Administration's (NOAA) UHI (Urban Heat Island) Mapping Campaigns found exposure to higher temperatures disproportionately affected low-income, predominantly black communities and historically redlined neighborhoods in East Knoxville due to less infrastructure investment, abundant heat-retaining surfaces, and a lack of canopied vegetation (https://heatequity.utk.edu/knoxville-heat-map/). To address this multifaceted social and environmental justice issue, a collaboration between The University of Tennessee Knoxville (UTK) and the local nonprofit Socially Equal Energy Efficient Development (SEEED) organization will install cutting-edge "Gravel Tree Stormwater Systems" (GTSS). The GTSSs have significant implications for climate resilience, providing shading, evaporative cooling, and extreme precipitation mitigation. UTK/SEEED is working to leverage the benefits of these installations within underserved communities in East Knoxville. The project aims to provide ecosystem services and bolster the community's resilience to climate change, emphasizing community engagement to guide implementation efforts. The project also aims to provide pathways out of poverty for young adults through K-12 environmental education and workforce development programs, including internships and certification programs. To ensure the project design integrates with the needs and desires of the East Knoxville community, the project began by establishing an

Environment and Economic Justice Framework (EEJF). The EEJF guides the project to ensure that equity is embedded in the entire project so that this environmentally and economically neglected community will accrue the benefits of green infrastructure development. This presentation will provide an overview of the EEJ Framework implemented in this project to guide the development of similar environmental justice programs. It will also discuss the project's progress, emphasizing design choices for maximizing the social benefits of BMPs to the community in need and the qualitative outcomes of the initial community engagement efforts.

Ecological Engineering in Coastal Settings I

Athena B

Changing with the tides: Estuarine influence on the function of coastal stormwater ponds

Levi McKercher, *University of South Carolina*

Stormwater ponds are commonly built within coastal developments in the southeastern US. A subset of these ponds experience connectivity with downstream open waterways which may influence water quality and potential habitat value within both systems. To examine the influence of tidal connectivity, we quantified water quality dynamics over 2 years within three tidally influenced stormwater ponds located within a highly developed urban estuary (Charleston Harbor, South Carolina, USA). Tidal connectivity varied across ponds, ranging from 17 – 82% of tidal cycles considered. Pond salinity oscillated from oligohaline (< 0.5 mS cm-1) while receiving stormwater runoff to euhaline (> 53.0 mS cm-1) during strong tidal backflows. Periodically, water temperatures surpassed maximum and minimum thresholds known to stress aquatic organisms, and surface and benthic dissolved oxygen concentrations were suboxic. Total dissolved nutrient concentrations were often oligotrophic, although spikes were observed following rain events, especially in ponds draining more developed urban watersheds. Total algal biomass (i.e., Chl a concentration) within ponds was variable; however, fresher ponds with less tidal exchange were more often eutrophic, and at times, hypereutrophic. Considering the elevated internal nutrient concentrations and large volumes exchanged between ponds and open creeks during tidal backflow events, we estimate that significant nutrient and algal biomass loading to Charleston Harbor occurred. Our findings suggest that tidally influenced stormwater ponds represent inconstant habitats within which water quality may be compromised. Pond designs which intentionally incorporate features characteristic of tidal wetlands (e.g., diverse native vegetation) are likely to be more functional.

Utilizing Stream Power as a Metric for Classifying and Designing Low-Gradient Headwater Streams in the Coastal Plain

Nolan Williams, *Robinson Design Engineers*

The use of field-measured or easily estimated hydrologic and geomorphic parameters for the purposes of classifying and designing stream channels is a commonly accepted practice in the field of environmental restoration. Various systems and methodologies based on this philosophy have been developed and implemented across a broad spectrum of locations, landscapes, and hydrologic and geologic settings. However, many commonly utilized systems and methodologies for typifying or parametrizing stream channels are based on data collected from relatively high gradient streams or from higher order stream systems with relatively large contributing watersheds. For low-gradient, headwater streams located in the Coastal Plain, many of these existing practices are not well-suited for the purposes of assessing existing stream channels or designing restored stream channels.

We surveyed and collected data from six sites on low-order headwater streams located in and around the Francis Marion National Forest near Charleston, SC to develop a 'reference reach' dataset to inform the design and engineering of stream restoration measures. Along with data collected by others in the Coastal Plains of North Carolina and Georgia, we were able to perform hydrologic and geomorphic analyses based on a handful of field measurements related to the dimension of the surveyed stream channels. This presentation will discuss the use of stream power (Bagnold, 1966) as a means to evaluate and design headwater Coastal Plain streams and will also discuss how this application may be used for long-term monitoring and adaptive management of restored headwater streams that have been constructed at a large-scale ecological restoration site near Charleston, SC.

Performance and degradation of plastic-free geotextiles along the tidal exposure gradient in a warm-temperate salt marsh estuary

Evan Smyjunas, *University of Dayton*

Synthetic (plastic) geotextiles are commonly used in coastal environments for erosion control, shoreline stabilization, and water quality protection. While these materials are generally effective at securing sediment, slowing erosion, and arresting oyster shell movement for reef restoration, their degradation produces microplastics that are harmful to ecosystems and human health. To reduce the amount of plastic being used in these coastal applications, natural-fiber geotextiles have increased in popularity as biodegradable alternatives to traditional synthetic meshes and to plastic mesh bags for oyster reef restoration. However, quantitative testing of how these materials degrade in coastal habitats, and therefore how practitioners can most effectively apply them, is lacking. To address this research opportunity, a degradation study was performed to quantify the impact of coastal exposure on the mechanical properties of plastic-free geotextiles. Experimental panels containing samples of the products were deployed at three narrow-channel low-flow-rate tidal creeks in the Winyah Bay North Inlet Estuary, at sub-tidal, inter-tidal, and high tidal regions of the creeks. Six extractions were performed after 2, 5, 7, 9, 12 and 16 weeks with 18 samples of each material being pulled per extraction (two samples per tidal level and site). Once extracted, mechanical testing was performed according to ASTM D6818 to determine the percent elongation at break, ultimate tensile strength, toughness, and elastic modulus for each sample. Testing of degraded samples is ongoing. It is anticipated that the results of this study will be used to assess the suitability of natural-fiber alternatives for erosion control, shoreline stabilization, and water quality protection; provide a robust material property database to inform regulatory policies; and encourage the inclusion of sustainable alternatives on qualified products listings published by government agencies.

Floodplain reconnection in coastal areas: How do backwater effects impact floodplain reconnection effectiveness?

Roderick Lammers, *Central Michigan University*

Floodplain reconnection is an increasingly common approach for mitigating flood risk, by either removing barriers (e.g. levees) or using water control structures to passively or actively allow previously disconnected floodplains to flood. This can provide valuable floodwater storage on constrained rivers, reducing peak flood depths up and downstream. Despite increasing implementation and research on floodplain reconnection, it is unclear how floodplain reconnection effectiveness may be influenced by backwater effects from downstream water bodies, especially in coastal areas. To address this, we modeled floodplain reconnection scenarios at the Shiawassee National Wildlife Refuge (NWR) near Saginaw, MI. This NWR was historically leveed and farmed, but has since been restored by adding water control structures to allow managed flooding of wetland units. Rivers in the refuge flow into Saginaw Bay, Lake Huron, and river hydraulics are highly influenced by short- and long-term changes in lake levels. We use a combined 1D-2D HEC-RAS model to simulate both historic (leveed) and current (reconnected) scenarios under a variety of lake levels to quantify these interactions. Floodplain reconnection has resulted in relatively minor reductions in peak flood depths, mostly because levees are overtopped during moderate to large flood events (effectively resulting in a connected floodplain even under historic, disconnected conditions). However, variable lake levels significantly impact flood hydraulics, with large differences in peak depths and inundated areas during high versus low lake levels. These variable lake levels have only a minor effect on the magnitude of floodplain reconnection benefits, but do control the distance downstream that these benefits extend. These results suggest that while flooding overall is highly influenced by backwater effects in this coastal area, these do not have a major impact on the effectiveness of floodplain reconnection. This supports the continued use of this flood management approach, even in coastal areas with significant backwater effects.

Evaluating the Effects of Green to Grey Shorelines on Coastal Hydrodynamics

Megan Kramer, *University of South Florida*

Coastal wetlands are important ecosystems that provide numerous benefits, including serving as critical wildlife habitat and natural protection from storm surges. Among the tropics and subtropics, large mangrove forests are recognized for their ability to attenuate waves, though their integration with traditional urban storm protection methods such as seawalls and bulkheads for flood mitigation requires further demonstration of performance. In this study, we explore the potential to combine mangroves with hard infrastructure by comparing wave and velocity dissipation across three shoreline types: mangrove in front of a seawall, seawall only, and natural mangrove. We conducted multiple field campaigns in Tampa Bay, Florida, where we measured hydrostatic pressure and velocity using pressure transducers and acoustic doppler current profilers along cross-shore transects at each shoreline type for a period of 2.5 weeks. We then calculated and compared the wave energy and velocity reduction that occurred from offshore to onshore locations among the different shoreline types. The results of this study show the impact of small mangrove forests on coastal hydrodynamics, which improves understanding of their function for ecological engineering design and the ability of hybrid infrastructure to meet the needs of coastal communities and the environment.

Circular Ecological Engineering in Agriculture and Life Cycle Assessment II

Athena C

Variability of Soil Texture Influences P Loss from Agricultural Fields in Lake Erie Watersheds

Erin Ebersbach, *The Ohio State University*

Phosphorus (P) stored in agricultural soils runs off into downstream aquatic systems causing negative ecological and economic consequences. Targeting management to the critical source areas losing the greatest P is projected to yield larger reductions in P loading, however this approach is limited by challenges to identify areas of greater P transport. While soil test phosphorus (STP) is a commonly measured agricultural variable, it's often a poor predictor of P loss, and fields with greater STPs do not always discharge P at greater rates. Studies predict that targeting critical source areas requires improved understanding of the geospatial variability of soils in influencing P loss beyond STP alone. This research describes the role of soil texture as a factor influencing P discharge from agricultural soils with a focus on the differing influences region specific hydrology and biochemistry. Through the analysis of 23 agricultural fields across Lake Erie's western watersheds, the concentration and areal loading rates of P discharged from field sites were found to have contrasting behavior relative to STP and the regional formation of soils. As the regionality of models was narrowed, soil texture increased in significance as a predictor of P loss distinct from STP. Through this, it was found that the highest losses were routinely from fields with silty soils formed in the impounded glacial lake-plain between course-textured moraines and the former Great Black Swamp. Results demonstrate the significance of soil texture and regional geomorphological conditions as a predictor of P loss. Results will be used to better target critical sources areas for P loss and guide the location of management practices to better protect freshwater ecosystems.

Streamflow influences wildrice restoration in lake fringe wetlands

Marina Howarth, *Bowhead*

Wildrice (Zizania palustris L.) is a traditional foodway, with significant cultural and economic value to Native American tribes in the Great Lake region. Recent widespread declines in the distribution and productivity of wildrice, which grows in riparian and fringe wetlands, have led to an ongoing partnership with the U.S. Army Corps of Engineers. The collaborative effort is investigating 13 lakes across the Upper Peninsula of Michigan, assessing vegetation community dynamics, soil properties, hydrology, and water quality to identify drivers of wildrice decline and inform restoration initiatives. This presentation evaluates the impact of reduced flow velocities into wetlands exhibiting declining wildrice. Beaver activity rapidly increased in the focus lake watershed over the last 50 years, converting a semi-incised stream into a large wetland complex, slowing water movement into the wildrice habitat. We hypothesize the flow velocity reductions induce or exacerbate factors limiting wildrice establishment and growth including: the presence of low bulk density flocky sediments, floating organic sediment mats, water lilies and other competing aquatic plants, and the potential for decreased oxygen availability. In response, we combine 1) outputs from a 1D streamflow model, 2) traditional ecological knowledge, and 3) monitoring data about water quality, soil characteristics, and plant community dynamics, to assess the impact of reduced flow on wildrice productivity. We find that altered flow conditions in the area of interest lead to sparse wildrice distributions and flocky sediments, associated with lower wildrice productivity, compared to lake wetlands with fewer flow alterations and consistently abundant wildrice populations. These results are essential to better understand how environmental change drives wildrice population dynamics, to inform adequate management actions including restoration strategies.

Critical focus on Controlled Environment Agriculture as an Ecological Engineered System

David Blersch, *Auburn University*

Controlled environment agriculture (CEA) has potential to revolutionize food production through increased productivity and quality of products. The high technology and high level of control in CEA establishes an approach for high levels of production of many desirable and valuable agricultural products. Particular implementations, such as many aquaponics and paired aquaculture-horticulture production systems, employ controlled nutrient chemical environments along with controlled physical environments that promise high productivity of cultivated crops. Systems of this sort are designed around closed nutrient cycles, employ diverse microbial ecosystems, to support higher order species for valuable crops, and in that way approach a constructed and designed ecosystem. State of the field, however, employs little ecological design know-how, and often diverges far from most ecotechnologies because of the high proportion of technology necessary for containment and control. In this talk, the state of CEA and aquaponics approaches will be critically reviewed, and components of ecological engineering applied to these systems will be discussed for assessment of CEA as a future sustainable food production strategy.

Emerging Contaminants in Ecologically Constructed Systems

Athena D

AeroFTWs: Floating Treatment Wetlands without Plastics are Possible

Ada Camila Montoya, *Clemson University*

Floating treatment wetlands (FTWs) are a green infrastructure practice to improve water quality, often applied in stormwater ponds. However, conventional FTW scaffolds are typically constructed with various plastic polymers, including high-density polyethylene or polyurethane, to facilitate flotation and durability at low cost. However, over time these plastic-polymers may degrade and contribute to the release of microplastics. Microplastics (particles < 5 mm in size) are an emerging environmental contaminant contributing to degraded ecosystems and risking human health. Although conventional FTWs are considered an eco-friendly technology for improving water quality, their design can be modified to reduce plastic use. The goal of this study was to construct innovative FTWs using non-plastic materials and evaluate whether this new design can be a reliable and more eco-friendly alternative to traditional plastic-based FTWs. A series of FTWs were constructed using aero-glass aggregates as the primary material to provide buoyancy. Additional materials, including natural jute burlap fabric, wire mesh, bamboo, and jute twine, were used to provide structural support. Key parameters such as floating stability, material degradation, and plant growth performance were assessed over time. A secondary objective of this study involved analyzing root system development in relation to aero glass aggregates using a CT scanner to quantify root growth patterns such as direction and distribution. AeroFTWs are a promising advance in FTW design, providing an alternative to conventional plastic designs.

PFAS prevalence and mitigation opportunities in coastal Virginia stormwater systems

Natasha Bell, *Virginia Tech*

Per- and polyfluoroalkyl substances (PFAS) are a class of persistent synthetic chemicals widely used in industrial and consumer products due to their water- and grease-resistant properties. Their widespread use and resistance to degradation have led to their accumulation in the environment, raising concerns about potential human and ecological health impacts. Stormwater systems can serve as a major transport pathway for PFAS, particularly in urban and coastal settings where contamination sources are diverse and hydrological connectivity is high. Understanding PFAS prevalence in stormwater is crucial for assessing risks and identifying effective mitigation strategies. During this presentation, I will present on our past and ongoing investigations to characterize the transport and fate of PFAS in coastal urban stormwater systems via a key potential pathway: leaking sewer infrastructure. We are currently monitoring four urban stormwater systems with parallel sewer and stormwater lines in two coastal VA communities. A total of 40 PFAS compounds (including the six that are regulated by the EPA) are being quantified in the stormwater sediment and water samples collected before and immediately following storm events. Preliminary results indicate that PFAS has been present in every water and sediment sample collected ranging from 22 to 692 ppt and 455 to 5,100 ppt (dry weight basis), respectively. PFAS levels were ~100 times higher in these coastal urban stormwater systems as compared to monitored surface water systems and a WWTP outfall. PFAS levels in urban stormwater sediment were found to be about 1/10 of that commonly detected in biosolids. These preliminary results indicate that urban stormwater systems appear to be significant and widely distributed intermediate sources of PFAS in the environment and that urban stormwater sediment serves as a reservoir for PFAS. Ongoing and future work include retrofitting an existing stormwater pond with a floating treatment wetland and adsorptive filter to evaluate the performance of a new type of stormwater best management practice (BMP). We will also engage with K-12 students and regional high school teachers using a community-science-based approach on the environmental occurrence and impacts of PFAS in coastal communities by hosting a field day during the stormwater BMP retrofit, as well as a workshop where high school teachers may earn continuing education credits.

Innovations in Infiltration Treatment Wetland Design

Abigail Neufarth, *Jacobs Engineering*

Historically, many successful infiltration treatment wetland systems were designed with an inlet deep zone, a downstream deep zone, and sometimes intermediate deep zones to ensure proper plug-flow type hydraulics across the treatment marsh as water infiltrates to the underlying groundwater. This concept achieves exceptional hydraulics under steady flow conditions, including typical regional seasonality, to maximize treatment performance on the surface portions of the wetland system. However, during a shortage of flows due to limited water, there may not be enough water to sheet flow across the treatment marsh which can lead to channelization, impaired treatment performance, and declining plant health.

When challenged with two recent projects with extreme flow variability, the Jacobs team developed an innovative approach to infiltration treatment wetland hydraulics that maintains a healthy emergent marsh community, accommodates a large range of flows, and ensures treatment performance for state permitting compliance.

Instead of the traditional layout of deep zones, this approach positions the inflow at the center of each cell in a central deep zone that intersects groundwater. The bottoms of the cells are gently sloped to allow the water to accumulate starting in the deep zone and widening as the water level increases until it meets the berm. As flows decrease, the water will slowly recede from the berm toward the central deep zone, mimicking natural depressional wetlands. Planting zones are concentric with the traditional deep zone species (ex: Schoenoplectus californicus) in the center of the cell, followed by the emergent marsh species (ex: Pontederia cordata), and finally, upland species (ex: Canna flaccida) closest to the berm. While this approach does not provide the typical treatment wetland surface hydraulics, measured water quality performance of infiltration wetlands has shown that surface treatment in these is minimal. Most biological processes that improve water quality occur in the wetland subsoils as water infiltrates, so treatment performance is not sacrificed.

This presentation will discuss case studies of the innovative preliminary designs of the infiltration treatment wetland systems for Rod and Gun at the Preserve and Edgewater Wetland Park which experience extreme flow variability and require unique planning considerations.

Degradation Dynamics of Microplastics Across a Constructed Wetland

Jessica Boyer, *University of South Florida*

In constructed wetland ecosystems, physical, chemical, and biological processes work together to degrade microplastics over time. In this study, the aging and degradation of five microplastic polymer types (LDPE, HDPE, PP, PS, PET) was contextualized in four habitats within a wastewater constructed (treatment) wetland over 18 months. This is the first study to analyze the physical, chemical, and biological changes of different types of microplastics as they age in unique zones within a constructed wetland cell. A multi-step analysis approach was employed to assess degradation drivers. Microorganisms quickly and abundantly colonized all polymer types, with the highest biomass and cell counts being found on particles at the wetland cell outlet. Biological and physical metrics were found to be time-dependent, while chemical metrics were found to be polymer-dependent. Overall, the wetland cell outlet was deemed to have the highest degradation potential, and PET and PS were found to have highest degradability within this system. No complete disintegration was found in this study, underscoring the durability of microplastics in aquatic systems. As microplastics abundantly flow through wastewater treatment streams, and receiving constructed wetlands have demonstrated strong retention potentials, it is important that environmental managers better contextualize the degradation abilities of these systems.

GenX Removal in Hybrid Constructed Wetlands: A Nature-Based Approach to PFAS Mitigation

Mohammad Mollah, *North Carolina Agricultural & Technical State University*

Following the phase-out of perfluorooctanoic acid (PFOA) in the United States by 2015, GenX chemicals were introduced as an alternative replacement. However, research has since revealed that GenX persists in the environment and poses significant health risks, including adverse effects on the liver, kidneys, blood, immune system, and potential links to cancer. Conventional water treatment techniques, including coagulation, flocculation, sedimentation, and biologically active carbon filtration, have been found to be ineffective in removing GenX contaminants, necessitating sustainable alternatives such as constructed wetlands (CWs). This study aims to evaluate hybrid CWs as a viable approach for GenX remediation, leveraging plant uptake, substrate adsorption, and microbial degradation. We have set up three constructed wetlands (CWs) consisting of a horizontal surface flow wetland (SFW; containing 2.54 cm of sand) connected to a horizontal subsurface flow wetland (SSFW; containing 8.89 cm of coarse gravel, 13.97 cm of fine gravel, and 5.08 cm of sand for stratified filtration) via PVC pipes. Duckweeds (Lemna spp.) are introduced in the SFW, while Cattails (Typha spp.) and Bulrush (Schoenoplectus spp.) are cultivated in the SSFW. Water samples will be collected at three points- before treatment, after the SFW, and after the SSFW-and will be analyzed using liquid chromatography-mass spectrometry (LC-MS). We hypothesize that stratified filtration in the SSFW will enhance retention via adsorption, while plant-microbe interactions in the SFW will contribute to partial biodegradation. The findings of this study will evaluate the efficacy of hybrid constructed wetlands as a viable nature-based solution for GenX mitigation, advancing sustainable PFAS remediation strategies and providing critical insights for optimizing future wetland designs.

Mission-Readiness and Ecological Uplift: Resilient Department of Defense Installations Through Nature-based Solutions

Athena A

Monitoring Effects of Conventional Infrastructure on Natural Infrastructure at Hunter Army Airfield

Dan Coleman, *University of Georgia*

Both conventional infrastructure and natural ecosystems have been shown to offer protection to coastal communities. The combination of the two can potentially further mitigate the risk of coastal hazards. However, in circumstances where conventional infrastructure degrades natural ecosystems, it can be unclear what the net effect of using both approaches may be. At Hunter Army Airfield (HAAF) in Savannah, GA a tide gate located within a wetland complex is used to protect critical infrastructure. The presence of the tide gate—and the history of failure and repair—has significantly altered the upstream hydrology. Here we determine how the impact of conventional infrastructure has augmented or diminished the ability of the system as a whole to provide protection from waves and storm surge. We couple long term monitoring of several ecosystem parameters with numerical modeling. While we observed pronounced ecosystem changes in the area upstream of the tide gate, ultimately it was the presence or absence of the tide gate that made the most significant difference in coastal protection. Still, efforts to improve the health of the upstream ecosystem would likely further enhance the protection potential of the system as a whole. Additionally, restoration of the upstream ecosystem would likely improve or re-establish an array of other ecosystem services that have been adversely affected by the presence of the tide gate. This work therefore underscores the importance of a holistic approach to assessing infrastructure, both with regards to the interaction of different components and secondary services.

Coastal Resilience at Marine Corps Recruitment Depot, Parris Island

Matt Bilskie, *University of Georgia*

Marine Corps Recruit Depot Parris Island (MCRD-PI) is situated in Port Royal Sound, South Carolina, which is at the confluence of the Broad and Beaufort Rivers. Due to its coastal-facing location, MCRD-PI faces many coastal hazards, which are being exacerbated in magnitude and frequency due to a changing climate. These hazards include flooding, shoreline erosion, and sea level change, affecting the mission and readiness of MCRD-PI. These coastal hazards are causing shoreline erosion at critical locations. Landscape-scale interventions and projects that optimize ecosystem function are necessary to protect military readiness, training, and testing at MCRD-PI from ongoing and future coastal hazards. To protect military readiness and inform of hazard mitigation, this project will establish a baseline hazard assessment, which does not exist currently. This work will then support and demonstrate NBS to build coastal resilience, specifically for shoreline protection, flood mitigation, and habitat/restoration/improvement through field-based monitoring and data development, computational modeling, design development, and construction. The outputs of this effort will directly improve the resilience of MCRD-PI to coastal risks, support better-informed management strategies for MCRD-PI, and provide a framework for other installations to enhance resilience through the use of NBS.

Laundry Creek Stream Restoration at Lawson Army Airfield – Ft. Benning

Will Mattison, *University of Georgia*

Military installations across the United States must maintain their ability to operate effectively and stay resilient in the face of changing conditions. Future precipitation scenarios and land use change can potentially jeopardize military operations and the readiness of the Nation's fighting force. Amplified rainfall intensity, coupled with altered landscapes, can negatively impact water resources and compromise existing infrastructure systems of installations through increased runoff, erosion of hillsides, streambank instability, and debris flow. Laundry Creek Stream Restoration is a proposed Engineering with Nature (EWN) project that highlights the opportunities that exist to enhance the military mission by integrating conventional infrastructure with natural systems to produce sustainable and efficient engineering solutions. The EWN solution for Laundry Creek seeks to restore the historical Laundry Creek flow path outside of the Lawson AAF and reconnect it farther south into Sewelson Creek. Natural processes, stream restoration techniques, non-stationary hydrology, and multi-objective design principles will be used to restore Laundry Creek and reconnect it to the surrounding floodplain to provide flood risk reduction, water quality, and ecological benefits. The restored stream alignment will have much higher ecological function compared to the proposed existing ditch and culvert alternative and will restore vital ecosystem services. The stream restoration alternative provides stream mitigation, a high level of net environmental benefits, and improved drainage at a fraction of the cost of a traditional, concrete box-culvert alternative.

Multi-Objective Stream Crossing at Garnsey Range - Ft. Benning

Zak Ruehman, *University of Georgia*

Stream crossings, such as bridges and culverts, are vital elements of the transportation systems as they carry the roads, trails, and railways that connect our built world over waterways like streams and rivers. Traditional design and implementation of these crossing structures often present barriers to aquatic organisms and drive terrestrial wildlife onto the roadway, increasing risks of vehicular collisions. In addition to the ecological hindrances associated with stream crossings, current design standards often result in structures that are not prepared to withstand the nonstationary conditions associated with land use changes and projected increase in precipitation. The practical effects of these engineering shortcomings increase the risk of overtopping or complete roadway failures at these stream crossings. These risks, in a military context, threaten mission-readiness and ultimately national security. Robust designs of these crossing structures provide unique opportunities for “multi-win” results that supports both mission-readiness and ecological uplift. The Shell Creek crossing at the Ft. Benning Garnsey Tank Range in Georgia provides a case study of how incorporating infrastructure resilience through nonstationary analyses also facilitates aquatic organism/terrestrial wildlife passage, floodplain connectivity, and habitat creation.

Ecological Engineering in Coastal Settings II

Athena B

Evaluation of Minimum Flow Requirements for Gulf Sturgeon in the Suwannee River

Sean King, *Suwannee River Water Management District*

The Suwannee River Water Management District (District) is tasked with conducting environmental flow assessments to develop minimum flows and levels (MFLs) for priority waterbodies. These MFLs set the limit at which further surface and groundwater withdrawals would be significantly harmful to the water resources or ecology of the area. A focal area of the MFL evaluation for the Suwannee River has been to determine the flow requirements for a federally listed fish species: Gulf sturgeon (Acipenser oxyrinchus desotoi). Gulf sturgeon are large anadromous fish that migrate from the Gulf of Mexico to spawning areas found in upstream river reaches. As the longest unregulated river in the southeastern United States, the Suwannee River currently exhibits the largest spawning migrations of Gulf sturgeon. The Suwannee River MFL assessment examined several aspects of how river flows affect Gulf sturgeon spawning success, including the water depths and water quality at spawning areas and the water depths over shoals that can limit passage to the spawning areas. Maintaining sufficient flows for Gulf sturgeon to pass over restrictive shoals was determined to be the limiting factor for minimum flows in the Suwannee River, which spurred further investigation into their specific flow requirements. The District collaborated with United States Geological Survey researchers to analyze existing acoustic tagging data that tracked the movements of Gulf sturgeon along the river. This dataset was used to refine the critical flows needed for passage over restrictive shoals and to estimate passage event timing, duration and frequency criteria. Additional research is planned to further refine the flow requirements for Gulf sturgeon passage and allow for robust MFL implementation for the Suwannee River.

Processes and impacts of mangrove poleward expansion across Florida's Gulf of Mexico coast

Yiyang Kang, *University of Florida*

Decreases in the intensity and duration of freeze stress under a warming climate are driving mangrove poleward expansion into temperate saltmarshes, reshaping coastal wetland ecosystems in North Florida. To advance understanding of the ecological consequences of mangrove range expansion, we examined the spatiotemporal dynamics of mangrove variations and responses to winter temperatures and the impact of mangrove expansion on soil organic carbon (SOC), using 18 sites that span a temperature gradient across Florida's Gulf of Mexico coast. Across the gradient, mangrove coverage and canopy height showed a threshold response with minimum air temperature, while temperature relationships for population abundance and individual structure were species-specific. A post-freeze assessment quantified mangrove freeze resistance and resilience vary by species and strata. The low-temperature thresholds for leaf damage to Avicennia germinans, Rhizophora mangle, and Laguncularia racemosa were near −6, −4 and − 4°C, respectively. Projections based on these field-derived temperature relationships and future climate projections indicate that future warming is expected to accelerate mangrove expansion and development in northern Florida. Soil samples from the study sites, representing a chronosequence of mangrove range expansion, shows a regional increasing SOC with mangrove expansion stages. However, vertical changes show that no contrasting effect in SOC was found in saltmarsh-mangrove transition site compared to mature mangrove sites, suggesting no significant effect of mangrove expansion in SOC. Collectively, our findings advance our understanding of mangrove range expansion and provide information about the future of coastal wetland structure and function in a changing climate.

Building Tidal Creeks by Hand: The Ashleyville Marsh Restoration Project, Charleston, SC

Joshua Robinson, *Robinson Design Engineers*

The Maryville-Ashleyville community of Charleston, SC was the first self-governing Black community in South Carolina. Built along the western bluff of the Ashley River and Old Town Creek, the community is situated around a seven-acre cove of salt marsh. A decade ago, community members noticed severe dieback of the marsh vegetation and feared contamination as the culprit. Community leaders engaged the South Carolina Aquarium, and through a coalition of volunteers, researchers, and resource managers, NOAA NFWF granted funds to investigate the causes of dieback.

Severe drought, followed by severe tidal and rainfall flooding, were found to be the most likely culprits of the dieback. Once the marsh vegetation died, the salt marsh converted to mudflat, a process that may or may not lead the ecosystem toward marsh regrowth. Extensive community collaboration led to a volunteer-based approach to replant the impacted areas by hand. Early efforts were complicated by the lack of tidal flushing in the mudflat, since the first-order distributary channels had been smothered by eroded marsh sediments. The presenter and RDE were hired to work with researchers and resource managers to design, permit, and impelement tidal creek restoration.

This presentation will cover the field-based analyses, the GIS-based analytical approach to conceptualizing the design of new tidal channels, and the construction approach to excavating the channels by hand. The three-phase, three-year process will be presented, including photos and measurements before, during, and two years following construction of tidal channels. Many lessons learned will be shared, and a draft version of the tidal channel design and construction guidelines will be shared.

Wood stakes as substrate for oyster enhancement in coastal South Carolina

Mariah Livernois, *University of South Carolina*

Anthropogenic pressures on coastal ecosystems, including resource exploitation and pollution, have resulted in severe degradation of keystone biogenic habitats like oyster reefs. Along the US Atlantic and Gulf coasts, reefs built by the Eastern oyster (Crassostrea virginica) provide important ecosystem services such as shoreline protection, water quality improvement, and habitat provisioning, but their abundance has reduced dramatically. In South Carolina, wild harvest of oysters is managed carefully and significant efforts to restore oyster reefs are aiding their recovery. In addition, commercial oyster harvest requires replanting of settlement substrate, typically recycled oyster shell. However, shell is often costly to obtain and can be ineffective in moderate to high energy environments, so wood stakes are permitted as an alternative substrate and are used frequently. This study documented the density and size distribution of oysters grown on wood stakes in a commercial harvest site after two years of deployment (planted August 2022, sampled July - September 2024), and assessed the associated nekton communities. Compared to adjacent intertidal reefs, average oyster density on wood stakes was nearly three times greater (per 0.0625 m2) while the size distribution of oysters in each location was similar. Analyses are ongoing, and include comparisons of nekton community structure, abundance, and diversity between wood stakes and adjacent oyster reefs. The results from this study are informing continued experimentation to directly guide management of shellfish resources in South Carolina.

Ecological Engineering in Urban Settings

Athena C

The Dredge Glass Sand and Charred Wood Adventures: Tidal Marsh Restoration in Urban Waters

Christopher Streb, *Biohabitats*

In a world where industry left nature behind…The Middle Branch of the Patapsco River—once a thriving tidal marsh, now a relic of Baltimore's industrial past. For a century, its waters have been cut off, its ecosystems left to struggle. But now, a bold new movement is rising. Glass sand. Charred wood. Waste reborn. With over 70 acres of tidal marsh restoration underway, a community-driven initiative is rewriting the future—turning discarded materials into the foundation of a living, breathing waterfront. Can research, policy, and innovation work together in time to undo the damage? Or will the landfill claim another victory? This isn't just restoration. It's redemption. The Dredge, Glass Sand, and Charred Wood Adventures. Coming soon—to a shoreline near you.

Modeling the service of city-scale distributed green stormwater infrastructure

Matt Chambers, *University of Georgia*

The science and practice of green stormwater infrastructure (GSWI) is rapidly advancing and numerous GSWI approaches have been demonstrated in urban communities around the world. Such approaches are often hydrologically localized without integration into city-scale stormwater management systems or are tailored for a specific community and lack generality. As investment in GSWI increases, city managers need generalized approaches for quantifying the potential stormwater benefits of city-scale spatially distributed systems of GSWI. The purpose of this work is to provide such a method using numerical modeling and the curve number method as they are common tools of professional engineering practice in the USA. Our approach is demonstrated for an urban community of coastal Georgia, USA. We first numerically model the watershed's hydrology with a fully distributed rainfall runoff model that includes tidal influx and the service of the community's existing grey stormwater infrastructure. We then numerically model the hydrologic benefits of incremental land use conversions to GSWI in the buffers of public road rights-of-ways and residentials areas that are spatially distributed within the community. Our results suggest that hydrologic benefits increase non-linearly with incremental land use conversion. Benefits are first reported as city-wide net reductions in excess runoff generation (up to 36%). Then as reductions on the service demand of existing grey stormwater infrastructure (up to 50% reduction in average peak discharge through outfalls) and ultimately as reductions in the severity of nuisance flooding (up 28% reductions in average ponding depths on structures, roads, and storm drain inlets). This work supports future resilience planning by providing a generalized method that city managers may use to calculate how much city-scale investment in GSWI is required to achieve desired improvements in stormwater management.

Developing storage-discharge curves for various green stormwater infrastructure: Enhancing H&H Models for Urban Stormwater Management

Yufan Zhang, *Texas A&M AgriLife*

Many existing hydrologic and hydraulics (H&H) models often lack specific modules for green stormwater infrastructure (GSI), limiting their effectiveness in predicting and optimizing stormwater management in urban environments. One significant barrier to incorporating GSI into these models is the complexity of storage-discharge relationships, which differ from the simpler, well-established curves for detention ponds. This research aims to develop and refine storage-discharge curves for various types of GSI, including rain gardens, bioswales, green roofs, permeable pavement, rainwater harvesting, and constructed wetlands. This study employs a series of mathematical derivations and calculations based on the hydrologic and hydraulic processes (e.g., infiltration, pipe flow) to develop these curves, offering a nuanced representation of GSI performance. By conducting a comprehensive literature review and gathering relevant observed data, empirical storage-discharge curves will also be developed, which will be compared with process-based representation to validate the simulation concept. This study will establish robust, accurate curves that can be integrated into H&H models, enabling more realistic simulations of GSI performance in managing stormwater runoff. The results will enhance the functionality of existing modeling tools, facilitating the optimization of GSI in urban stormwater management strategies, and supporting the design and implementation of more sustainable, resilient urban water systems.

Investigating the Role of Large Storms in Urban Stormwater Management

Vinicius Taguchi, *North Carolina State University*

Stormwater Control Measures (SCMs) are typically designed to capture runoff volumes from the water quality event. This event depth is based upon the literature of first flush studies and is assigned precipitation depths of 1 and 1.5 inches in NC. It has been assumed that capturing and treating these small, frequent rain events would account for 80 to 90% of total annual rainfall. This study examines whether pollutant loads from infrequent, larger storms (>2.0-inch depths) disproportionately account for overall pollutant loads. Researchers at NC State's Stormwater Engineering Group (NCSU SEG) have been active in field monitoring of urban catchments since 1999 and have collected data from various catchment types across North Carolina. During this period, several studies were able to (nearly) fully capture nutrient and TSS pollutant loads from larger, less-frequent storm events, in addition to the targeted small to medium-sized events. We have observed that, for example, approximately two-thirds of the cumulative pollutant load collected at one site was associated with a single large storm (5.24 in). Thus, the other 11 events recorded at that site, all of which were less than 2.0 inches, tallied only one-third of the pollutant load delivered. A goal of this work is to develop alternative SCM designs that focus on flow rate rather than runoff volume capture and compare whether certain pollutant types are better suited to these flow-based designs.

Developing a Smart Urban Agro-Ecology Resilience Hub: Integrating Salvaged Shipping Containers for Sustainable Infrastructure in Baltimore Maryland

Larry Davis, *Green Mechanics Benefit LLC*

Urban communities face increasing environmental and socio-economic challenges, necessitating innovative infrastructure solutions that enhance resilience, reduce waste, and promote food sovereignty. This study presents the development of a smart urban agro-ecology Resilience Hub at the Mount Clare Project in South Baltimore, Maryland, utilizing salvaged shipping containers from the Maryland Port Authority as modular structures for urban agriculture, food processing, and climate-adaptive infrastructure. The project repurposes containers into an office space, food processing facility, mushroom production hub, and equipment storage, integrating high-performance insulation and sustainable design strategies. To mitigate thermal bridging and enhance energy efficiency, the design incorporates recycled foam glass gravel as a lightweight, stormwater-permeable foundation material, coupled with exterior hempcrete insulation (R24-R27), optimizing thermal regulation and reducing operational energy demands.

Additionally, the project employs green roof systems for passive cooling, rainwater capture, and reduced labor time in irrigation, supporting flow-hive honey production and pollinator health. The integration of smart sensing technology enables real-time monitoring of environmental conditions, optimizing resource management and providing a data-driven approach with potential AI applications to enhance urban agro-ecological performance. This research contributes to nature-positive infrastructure, demonstrating the feasibility of container-based regenerative design in urban settings. By aligning ecological engineering, sustainable food systems, and technological innovation, this model provides a replicable framework for climate-resilient, community-driven urban agriculture and stormwater management.

Ecological Engineering in Urban Settings

Athena D

Ritch Grissom Memorial Wetlands Maintenance After 20 years of Operation: A Case Study

Pieter De Wolf, *Jacobs Engineering*

Constructed treatment wetlands are considered low maintenance solutions to polish wastewater effluent. However, they still require some maintenance to preserve proper hydraulics and hydrology, ensuring healthy and diverse communities and treatment performance.

In 2004, Brevard County, FL constructed the Ritch Grissom Memorial (RGM) Wetlands, a large-scale surface flow wetland designed to polish wastewater facility effluent. The RGM Wetlands are approximately 200 acres, divided into four cells across two parallel treatment trains. The wetland system discharges into a canal that feeds into the St. Johns River. In 2021, the facility was cited for exceeding nutrient thresholds at the outfall of the wetlands. Consequently, the County conducted some rehabilitation that included partial demucking, regarding, and replanting. Unfortunately, these efforts were unsuccessful and led to further hydraulic and treatment performance challenges.

Following a post-rehabilitation inspection to evaluate treatment efficiency and optimize operation of the wetlands utilizing drone vegetation surveys and field visits, the cause for nutrient exceedances were identified. Recommendations for short-term and long-term maintenance, as well as flow path optimization, were presented and will be implemented to restore the wetland's treatment efficiency and better integrate it into the County's effluent management strategy. This presentation will showcase the lessons learned from evaluating a wetland that has received little to no maintenance over the past 20 years, as well as the solutions proposed for restoring performance.

WetQual: A Process-Based Model for Simulating Hydrology, Nutrients and Carbon Dynamics in Non-Floodplain Wetlands

Latif Kalin, *Auburn University*

This paper presents the development, evolution, and applications of the WetQual model, a process-based tool designed to simulate hydrology, sediment transport, and nutrient and carbon cycles in non-floodplain wetlands. Wetlands, which are periodically or permanently flooded ecosystems, provide critical environmental services such as flood regulation and pollutant removal. However, their complex biogeochemical processes are challenging to measure directly, necessitating robust modeling approaches. Originally developed to simulate nitrogen and phosphorus cycling in flooded wetlands, WetQual employs coupled ordinary differential equations to represent interactions between physical, biological, and chemical processes. It models oxygen dynamics in aerobic and anaerobic zones, simulating nitrogen transformation, phosphorus precipitation, and release. A plant growth module distinguishes between rooted and floating vegetation. Subsequent updates incorporated a carbon cycle to simulate greenhouse gas emissions, carbon export, and retention. Additionally, a compartmental version was developed to simulate wetting and drying cycles by dividing wetlands into ponded and unponded sections. WetQual has been successfully applied to wetlands in Maryland, Coastal Alabama, and California, with model simulations demonstrating strong agreement with field data on nitrogen, phosphorus, total suspended solids (TSS), and carbon. The model was recently coupled with the Soil Water Assessment Tool (SWAT) to assess watershed-scale impacts on nutrient and carbon removal. The latest enhancement introduces a novel cell-averaged subsurface flow numerical model to improve hydrological and pollutant removal simulations in constructed wetlands, which have been widely used in wastewater treatment over the past 50 years. This new numerical model was validated against analytical solutions for simplified scenarios and field data from a constructed wetland in Ohio, further advancing WetQual's applicability.

Using Hydrology, Water Quality, Soils, and Vegetation to Evaluate Wetland Condition and Effects on Trace Metals in Natural and Treatment Wetlands in the Tar Creek Watershed

Samantha Taylor, *University of Oklahoma*

Natural and treatment wetlands have been shown to improve water quality on mining impacted lands using biogeochemical and microbiological processes as well as providing ancillary ecosystem services including wildlife habitat and stormwater control. Wetlands are defined and evaluated through indicators such as hydrology, water quality, hydrophytic vegetation, and hydric soils. In the Tar Creek Superfund Site, part of the historic Tri-State Lead-Zinc Mining District in Oklahoma, Kansas, and Missouri, treatment wetlands have been successfully incorporated into holistic multi-cell passive treatment systems to remove trace metals from net-alkaline, artesian flowing mine drainage. Incidental wetlands have also developed adjacent to the creek and near untreated mine drainage seeps throughout this watershed. This study compares the effectiveness of treatment wetlands and incidental wetlands in removing trace metals from surface water and determines which indicators of wetland condition correlate with effective removal of trace metals in mining-impacted wetlands. This study also determines which indicators of wetland condition correlate with a greater wetland vegetative structure in mining-impacted wetlands in order to develop site-specific recommendations for water quality improvement. Ten wetland sites in the Tar Creek watershed were included in this study, which represent various hydrologic regimes, water quality, vegetative communities, and substrate composition. Water quality analyses were conducted at the inlet and outlet of the sites, including three treatment wetlands and seven incidental wetlands, to determine the change in trace metal concentrations. Vegetative surveys were conducted to identify species richness, Simpson's index, and Pielou's index. Soils analyses were conducted to determine organic matter content, particle size distribution, total recoverable metal concentrations, and bioavailable nutrient supply rates using Plant-Root Simulator Probes. These results are then compared to evaluate the relationship between wetland indicators and the water quality improvement function of these wetlands as they relate to the influent water quality and the structure of the wetlands.

Integrative Assessments to Inform Hydrologic Restoration of Wetland Functions

Daniel McLaughlin, *Virginia Tech*

Informed wetland restoration requires understanding the hydrologic controls on linked biogeochemical and habitat functions. From the Great Dismal Swamp to Delmarva Bays and Florida Flatwoods, restoration and conservation efforts are active and motivated to achieve a variety of outcomes. Here, we present highlights from multiple projects in such landscapes that assess the role wetland hydrology and topography play in habitat conditions and carbon processing. Projects vary in their focal restoration goal (e.g., peat fire mitigation, vegetation composition, biota support, carbon storage and export) but are fundamentally linked in that they all seek to understand how water level regimes and flows regulate wetland functions. In presenting these collective projects, our goal is to emphasize how multiple approaches (from in situ observations to remote sensing and modeling) can better inform active restoration efforts that largely employ the hydrologic lever to reach restoration goals.

Stormwater I

Athena A

Optimal Hydraulic Loading Ratio for Bioswale Design

Erin Cartner, *North Carolina State University*

Bioswales are a possible solution for managing urban impacts to water quality and quantity. Bioswales are a relatively new stormwater control measure (SCM) which are being studied for mitigating water quality issues associated with urbanization. Bioswales are a modified version of the traditionally-used grassy swale. Swales are commonly applied along roadsides to convey stormwater. Bioswales include underdrains, infiltration media and check dams, making them different from traditional swales. Bioswales may provide even better water quality treatment than swales, while simultaneously conveying stormwater flows, in a relatively small – and linear – footprint.

The majority of the current design standards for bioswales are based on research of traditional grassy swales and bioretention cells due to a lack of applied research on bioswales. This project looks to bridge the knowledge gap with a special emphasis on the optimal hydraulic loading ratio for bioswales and further inform design guidance.

Three residential bioswales in Hillsborough, North Carolina, were studied for 12 months to assess their volume reduction and pollutant treatment. The three swales were 18, 12, and 30 meters long with 0.45 meters of media depth. The watershed to swale area ratios of each swale were 16:1, 462:1, and 15:1 respectively. The inlet, overland flow, and underdrain flow were measured and water samples collected using ISCO 6712 automated samplers. Total Suspended Solids (TSS), Total Nitrogen (TN), and Total Phosphorus (TP) were reduced on average by 41%, 23%, and 29%, respectively. The loading ratio significantly affected the pollutant removal efficiency of the bioswales with the highest loading ratio performing at a lower removal rate than the other bioswales. The performance of each swale and that of others monitored in NC will be used to produce a design model for the hydraulic loading of bioswales. These results are also part of a larger synthesis to provide further guidance for bioswale design.

Bioretention soil media evolution in Midwest United States and Central China urban catchments: Understanding pedogenesis of these technosols to enhance monitoring, design, and maintenance

Joseph Smith, *The Ohio State University*

Bioretention cells (BRCs) are widely employed infiltration-based stormwater control measures to manage urban runoff. Bioretention soil media (BSM), a key component of these systems, evolves over time due to ongoing soil-forming processes, or pedogenesis. However, BSM pedogenesis and longevity remains poorly understood. While BSM is designed to promote infiltration and pollutant removal, its long-term effectiveness could be shaped by age, parent material, organic matter (OM) content, and the accumulation of fine particles. This field study of 50 BRCs across the Midwest United States and Central China explores the pedogenesis of BSM, focusing on the relationship between BSM properties and BRC performance. We employ a chronosequence approach of BRCs of varying ages (ranging from 1-16 years post-construction) and catchment characteristics paired with machine learning to assess key predictors of infiltration rate, fines accumulation, and OM dynamics over time. Mean infiltration rates for the BRCs ranged from 9 to 362 cm/hr. Nearly all (i.e., 98%) BRCs had mean infiltration rates within or above regional specifications. Most BRCs exhibited significant fines and OM accumulation at the surface over time. Results demonstrate that BSM evolves from an infertile technosol toward a more naturally occurring soil due a combination of O horizon development and fines and OM deposition, among other factors. The most important factors influencing BRC pedogenesis were related to BSM composition and plant and mulch characteristics, location within the BRC, contributing catchment characteristics, and BRC design and age. Notably, BRC age and linear regression were not reliable predictors of infiltration capacity, emphasizing the need for comprehensive monitoring and adaptive maintenance strategies. OM increased naturally from the contributing catchment, challenging the necessity of compost amendments. These findings contribute to the scientific knowledge of the evolution of older BRCs, which can better inform monitoring, design, and maintenance to promote effective stormwater management over time.

Bioretention for Heavy Metals: Evaluating Removal Efficiency, Speciation, and Toxicity

Thorsten Knappenberger, *Auburn University*

We investigated the performance of four bioretention soil media (BSM) mixes for reducing heavy metal concentrations in urban stormwater, with particular attention to copper, lead, and zinc. Using Bayesian statistics, we evaluated how effectively each BSM removed total and dissolved metals across eleven storms. Our results showed high probabilities of achieving at least 60% reduction for total copper, lead, and zinc, suggesting that bioretention can be a strong tool for mitigating heavy metal loads in urban runoff. Moreover, we observed that as the bioretention media aged, it generally became more effective at retaining heavy metals in outflow.

To complement our removal analysis, we examined heavy metal speciation and potential toxicity to aquatic organisms in both influent and effluent stormwater. By applying Visual MINTEQ 3.1 and the Biotic Ligand Model (BLM), we found no significant shifts in speciation for cadmium, copper, lead, or zinc within the bioretention cell outflow. In addition, a multiple-factor analysis suggested that differences among the four BSMs did not substantially alter the predicted toxic limits for aquatic organisms as determined by the BLM. However, our findings indicate that bioretention systems are most effective at reducing toxicity when influent metal concentrations are relatively high. Under low-inflow metal conditions, export of copper from compost-rich mixes can occasionally raise effluent toxicity levels.

Overall, our work underscores the importance of bioretention as a green infrastructure practice for mitigating heavy metal pollution in stormwater and protecting aquatic life. By integrating removal efficiency, speciation shifts, and predicted toxicity thresholds, we provide a more comprehensive picture of how bioretention systems influence urban stormwater quality and aquatic ecosystem health.

Ecological Engineering in Coastal Settings III

Athena B

Quantifying the Protective and Economic Value of Barrier Islands in the North Carolina Outer Banks

Aditya Gupta, *University of Georgia*

Tropical cyclone-induced flooding is among the most destructive natural hazards, with impacts intensifying due to climate change and increasing coastal development. In the United States, these events are the costliest disasters, affecting densely populated and economically critical coastal regions. Traditional hard infrastructure, such as seawalls and levees, has effectively mitigated flooding but poses challenges, including high costs, limited adaptability, and environmental impacts. Nature-based solutions (NbS), such as barrier islands, offer a sustainable alternative by leveraging natural processes to reduce storm surge and wave energy. This study quantifies the protective and economic benefits of barrier islands using the North Carolina Outer Banks as a case study. Numerical modeling was conducted using coupled ADCIRC-SWAN to evaluate variations in wave energy and water levels across different barrier island configurations under tropical cyclone scenarios. Additionally, the economic implications of barrier island protection were assessed using FEMA's HAZUS tool to estimate flood damage costs under various scenarios. Results demonstrate that barrier islands significantly mitigate hydrodynamic forces and reduce economic losses, emphasizing their critical role in coastal resilience. This work provides actionable insights for policymakers and resource managers, highlighting the importance of preserving and restoring barrier islands as sustainable and effective coastal defense mechanisms.

Optimal Model Resolution for Accurate Hydrodynamic and Marsh Biomass Predictions under Sea Level Rise

Rebecca Stanley, *University of Georgia*

Salt marshes are critical coastal ecosystems that provide abundant ecological services, including carbon sequestration, habitat provision, and coastal protection. However, they are increasingly threatened by rising sea levels induced by climate change. Previous studies have used hydrodynamic and ecological models to predict how salt marshes will respond to sea level rise (SLR) through mechanisms such as tidal regime changes, organic and inorganic matter production, sediment deposition, and erosion. However, these studies have focused on regional scales, allowing for high model resolution (~10 m horizontal resolution). This study extends the application of Hydro-MEM, a coupled ADCIRC hydrodynamic model, and ecological model MEM (Marsh Equilibrium Model) for the South Atlantic Bight (SAB). The expanse of the SAB's marsh and tidal creek network does not permit mesh resolution as previous Hydro-MEM applications have used. Therefore, this requires careful development of an unstructured finite-element mesh that balances accuracy and computational efficiency. An optimal mesh development strategy is identified by comparing ADCIRC simulated water level and tidal regime outputs to observed data across a suite of different meshes focusing on smaller test regions, each varying in resolution, tidal creek representation through stream order delineation, and the ability to resolve wind-driven flows and advective processes. The impact of mesh resolution on accurately capturing water levels, tidal regimes, wetting and drying of the marsh platform, hydroperiod, mean high water, and mean low water is evaluated using a dense network of RBR Solo pressure sensors deployed in 2023. Comparisons between observed water levels and ADCIRC simulations across this suite of meshes inform an optimal mesh-development strategy that ensures both computational feasibility and sufficient resolution to capture local wind-driven dynamics and advective transport. The final optimized mesh will enable a large-scale Hydro-MEM simulation of the SAB, providing a comprehensive understanding of salt marsh vulnerability to sea level rise, informing conservation and management strategies to mitigate the impacts of climate change on these vital coastal ecosystems.

The role of mangroves in coastal hydrodynamics in the Yucatan Peninsula

Mauricio Arias, *University of South Florida*

Given the extensive mangrove coverage and high exposure to cold fronts and tropical storms, the Yucatán Peninsula is an ideal natural laboratory to study how these ecosystems buffer wave energy and help reduce flooding. This study aims to quantify changes in coastal hydrodynamic conditions across four transects during the "nortes" season. Each transect was equipped with ADCPs and pressure sensors. Additionally, topographic surveys, soil condition analyses, and vegetation inventories were conducted. During the two field campaigns on the northern coast, winds exceeding 20 km/h were recorded for 33 days, generating significant wave heights of up to 0.8 m. Water velocities in front of the mangroves reached 0.5–1 m/s, with high variability in velocity reduction before and within the mangrove areas. Significant changes in water levels within the mangroves were also observed, suggesting an important role of these ecosystems. The collected data will be used to develop numerical models of wave dissipation under extreme storm conditions.

Modeling of hybrid natural-engineered infrastructure designs for urban flood protection under extreme storm conditions

Megan Kramer, *University of South Florida*

Coastal communities worldwide are Facing unprecedented stressors due to a changing climate. Many urban subtropical regions must develop innovative strategies to combat tropical cyclones of increasing frequency and intensity, which are leading to devastating storm surge and flooding. In Tampa Bay, Florida, the value of the bordering coastal wetlands in mitigating storm surge while simultaneously supporting biodiversity and productive habitats is widely recognized. In this study we utilized a coupled 2-dimensional hydrodynamic-wave model of McKay Bay adjacent to the historic Palmetto Beach (Tampa) community which has experienced multiple significant flood events in recent years and is exploring shoreline improvement options For its crumbling seawall. The model, developed in Delft3D Flexible Mesh, features a high-resolution flexible mesh with grid lengths ranging From approximately 3 to 60 meters. It was evaluated to assess the influence of coastal wetlands and engineered infrastructure on storm surge flooding during a major storm event. We systematically varied mangrove wetland width and seawall height under storms of varying intensity to determine the ideal dimensions for potential hybrid designs, considering inundation depth, extent, and velocity. Vegetation was represented as a depth dependent bed roughness coefficient. As climate conditions continue to evolve, urban coastal regions like Tampa Bay will face increasing risks that threaten vulnerable communities, infrastructure, and water resources. Our model results demonstrate the flood protection benefits of hybrid shoreline at the neighborhood scale and highlight the importance of integrating nature-based solutions into future coastal urban water resource management strategies.

Ecological Engineering in Practice: Perspectives and Lessons from the Design and Consulting World Panel

Athena C

From Sapelo to Ripple: Tales of an Ecological Engineering Career Path

Dan Hitchcock, *Ripple Environmental LLC*

This interactive session will engage the audience with presentations by mid-career ecological engineers who will share their experiences and stories of their individual professional development, as well as business ventures and growth, followed by an extended panel discussion. The session objective is to provide guidance, learned lessons, and likely some humorous anecdotes for those either interested in or fully grounded in our profession. Whether you are only now embarking on your career journey - or you are a seasoned veteran - we hope that this session will enlighten attendees as we join in discussion and learn from one another about “how we all got here”.

My career path began long before Ecological Engineering was an offered degree program, a potential professional certification, and a budding career opportunity. My educational foundation came in three seemingly separate yet certainly overlapping waves: (1) understanding ecosystem structure, function, and interactions, (2) learning how perturbations can positively or adversely affect ecosystems, and (3) how ecological design and engineering can be utilized to enhance or mitigate these effects. And a central theme throughout has always been a focus on “systems”.

A pinnacle of my academic journey was attending the first “official” AEES meeting in Athens in 2001 – I knew I had found a “home” – a network of enthusiastic experts and students that shared my similar interests and passions - and thus it all began…

From my undergraduate experience (UT-Knoxville, Ecology) to my first job as a research technician at the UGA Marine Institute, Sapelo Island, GA; from graduate work (UGA, Bio & Ag Engineering) in constructed treatment wetlands to a post-doc (U.S. Forest Service) in phytoremediation systems at the Savannah River Site; from returning to academia as a professor (Clemson) to starting my own company (Ripple Environmental) - whether or not I was fully aware, ecological engineering principles and systems analyses - and my many mentors along the way - have fundamentally shaped my career journey to this day. And for that and for them, I am forever grateful!

A Confluence to a Discipline: How Ecological Engineering Found a Home at Biohabitats

Christopher Streb, *Biohabitats*

Back in 1982, a fresh-out-of-college landscape architect named Keith Bowers started Biohabitats, not because he loved his profession, but because he was deeply unimpressed by it. Frustrated by a design culture that prioritized aesthetics over ecological integrity, and skeptical of an engineering discipline largely divorced from living systems, Bowers sought a different path. Biohabitats began not with engineers, but with ecologists, wetland scientists, and earth science professionals committed to restoring and regenerating natural systems.

For over 15 years, Biohabitats grew as an interdisciplinary team rooted in ecological science, intentionally operating outside the conventional boundaries of both landscape architecture and engineering. It wasn't until the late 1990s that the company reluctantly willingly hired its first engineers: individuals steeped in systems thinking and ecological principles.

Forty plus years in, Biohabitats has expanded its engineering capacity while staying true to its ecological foundation. The firm's journey reflects a broader transformation in the professions: a convergence of design, science, and engineering around the urgent need to align human development with the operating principles of nature. This discussion will explore how Biohabitats evolved into a home for ecological engineers, the role of values in shaping professional identity, and what this trajectory reveals about emerging career paths in ecological engineering.

Hurricanes and Hydraulics: The Ecology of a Small Engineering Firm Design Standards for Ecological Approaches to Water Management

Joshua Robinson, *Robinson Design Engineers*

Robinson Design Engineers was established in 2008, in the first months of what would be later termed "The Great Recession." But the germ of RDE was the Category 4 Hurricane Hugo, which made landfall directly over my childhood home in Charleston, SC in September 1989. As a third-grader, I witnessed widespread flooding and devastation that none of my elders had seen. And I also felt the warmth of community and family and connection in the storm's aftermath. These experiences were an early education in what we now call "resilience." And nearly 36 years later, the landscape has recovered, and infrastructure has been rebuilt, and many of the new or young residents of the region have either no memory of Hugo or no imagination of the destructive power of a similar event.

Presently, RDE is an award-winning team of hydrologists and engineers engaged in thoughtful, creative, nature-based problem solving and design. From our offices in Charleston, SC and Hendersonville, NC, we work with institutions, municipalities, design professionals, and non-profits across the Southeast and Mid-Atlantic. We have reclaimed the service oriented, professional practice model of engineering consulting, and we follow an intentional, responsive, rigorous consulting process.

Several other hurricanes have been guideposts along the way, including Katrina, Sandy, Joaquin, Harvey, and most recently, Helene. Each of these storms has impacted our philosophy and approach—both to the design of our projects and the design of our firm. Through RDE, we gauge our work from the three perspectives of Relationships, Discovery, and Economy. And we hope to consider these perspectives at the three concentric levels of Personal, Project, and Practice. We believe in the intrinsic value of natural resources and the fundamental importance of built infrastructure, and we work to promote the harmony and sustainability of ecological and human communities.

Wetland Restoration & Design II

Athena D

Possible co-metabolism of chlorate and nitrate in a large free-surface wetland

Alex Horne, *University of California, Berkeley*

Wetlands can substantially reduce nitrate (NO_3) pollution but a similar compound, chlorate (ClO_3), is less well studied though small downflow, porous media wetlands can remove it. Nowadays, chlorate is mostly derived from chlorinated disinfection of water and wastewater. Chlorate has increased in surface waters partially due to increased use of chlorine-based disinfection following the Covid-19 pandemic. The two possible mechanisms for chlorate removal in wetlands are direct reduction via (per)chlorate reductase or co-metabolism where the denitrification enzymes mistake ClO_3 for NO_3 since the molecules are of a similar size and shape. (Per)chlorate and nitrate reductases use a similar molybdenum-sulfur active center. The importance for constructed treatment wetlands is that if nitrate reductase, already induced to removal the more common nitrate pollution, also removes chlorate by co-metabolism, then two contaminants are removed for the price of one. In a large (118 ha, 292 acres) Prado Wetland, a free-surface treatment wetland in Southern California, I found a good correlation (R2 = 0.7) between the efficiency of removal of nitrate and chlorate over 14 years. Free-surface wetlands, which are relatively cheap and can be large can be designed to remove both chlorate and presumable perchlorate by initiating co-metabolism with nitrate.

Patterns and Drivers of Wetland Soil Organic Carbon Storage across the United States

Alexis Jackson, *University of Florida*

Wetlands are an important global carbon storage reservoir, which makes them critically important for regulating climate and biogeochemical cycles. While previous research has explored the drivers of wetland carbon storage and loss, few studies have integrated field surveys, remote sensing, and advanced modeling techniques to provide a comprehensive understanding of soil organic carbon (SOC) patterns at a national scale. In this study, we analyzed data from the Environmental Protection Agency's National Wetland Condition Assessment (NWCA), a nationwide survey that aims to quantify wetland condition and identify key stressors across the US, alongside remotely sensed and plant trait data. We used wetland vegetation and soil data collected in 2011 (n=928) and 2016 (n=941), including 121 wetlands sampled in both years. Using these data, we asked the following questions: 1) What is the spatial patterning of SOC across wetlands in the US?; 2) What are the primary predictors of wetland SOC among hydrologic indicators, vegetation, and soil properties?; and 3) How are plant composition and their functional traits associated with SOC? Preliminary results indicate that wetland carbon is concentrated in the top 0-30 cm of soil. Among wetland types, estuarine herbaceous wetlands store the greatest quantity of carbon, while regionally, wetland carbon storage was highest in the Eastern Mountains and Upper Midwest. Vegetation variables explained the largest proportion of variance in wetland SOC, followed by hydrologic variables, and then soil properties. Overall, this study enhances our understanding of how the linkages between carbon storage, hydrology, and vegetation in wetlands across diverse geographic and disturbance gradients. Ultimately, we aim to provide guidance on how to model and conserve carbon storage in these globally important ecosystems.

Meeting the Challenge of Integrating Habitat and Aesthetics into Functioning Treatment Wetlands for Zinc and Manganese

Robert Thomas, *Jacobs Engineering*

One of the challenges of mine closure is creating sustainable remedial systems that will continue to provide low-cost, low-maintenance treatment post-closure. Passive treatment systems offer one option for sustainable, low-maintenance water treatment; however, in the post-closure environment there is a secondary desire for these treatment systems to blend into the natural surroundings and provide a benefit to the future landowner beyond simple water treatment and a benefit to native flora and fauna. This presentation describes two constructed wetlands designed to meet these expectations at a mine closure site in the south-central United States. The first system reduces zinc concentration/loading and increases hardness of the effluent of a pit lake. The second system includes three separate wetlands that reduce iron, manganese, and zinc concentrations/loadings from groundwater seeps. Both wetland complexes include open water and subsurface flow components designed for long-term hardness addition and metal retention. The surface flow marshes were planted with native vegetation and designed with diverse habitat features that create a natural aesthetic that blends into the surrounding environment. Both systems meet treatment goals: zinc is reduced below detection limits in the first system and manganese is reduced by more than 90% in the second system.

Benefits & Ecosystem Services

Athena E

Quantification of natural capital benefits for restoration projects using emergy accounting

Eldon Blancher, *Moffatt & Nichol*

We have demonstrated ecological uplift increases for several nature-based environmental restoration projects in Alabama and Florida using natural capital accounting techniques. This accounting considers the value of the ecosystem assets (primary, secondary and tertiary producers) of aquatic and emergent habitats as well as an estimate of the annual services the habitats generate (ecosystem services or flows). This can be used to estimate the ecological uplift provided by created and restored habitats and determine the natural capital benefit:cost ratio for local restoration projects, expressed in multiple metrics (biomass, dollars or emergy) to maximize utility in different applications. Documentation of these metrics is important for decision processes (often used for prioritization) to document the stocks and flows of nature based features for comparison to economic flows. We have found that, while each metric provides information useful for various applications, calculation of the increase in emergy indicators represents the cross habitat estimate of ecological benefits provided by the restoration activities. For example, the comparison of productivity increases across different aquatic and upland habitats is only directly comparable using emergy metrics. We illustrate this across several living shoreline and marsh creation projects in Alabama and Florida and compare the benefits provided by each. Application of these metrics are also useful for ecological engineering of restoration projects by targeting nature based project components which maximize ecosystem benefits.

Spatially designing nature-based solutions to maximize ecosystem services: a case study from New Zealand using ESMAX

Richard Morris, *Lincoln University*

Nature-based Solutions (NbS) are increasingly recognised as cost-effective strategies for addressing extreme climatic events, biodiversity loss, and landscape degradation while simultaneously enhancing resilience and delivering multiple ecosystem service (ES) benefits. As national economies grow more dependent on ES, the role of high-performing NbS in sustaining societal, economic, and community prosperity becomes critical. However, despite it being well-established that there is an interaction between ES supply and NbS design, tools to explicitly model the spatial effects of NbS on regulating ES performance remain absent.

The development of ESMAX, a conceptual model initiated during PhD research, addresses this gap by offering a framework to analyse and design NbS for maximising the delivery of specific regulating ES. ESMAX emphasises the need for science-based spatial tools to evaluate both standalone and multi-component NbS frameworks. By focusing on the quantitative measurement and spatial optimisation of ES, the model aims to maximise cost-effectiveness and flexibility while addressing diverse and hierarchical ES demands.

Initial validation of ESMAX in rural and periurban contexts highlighted its potential to design resilient landscapes that can also facilitate agricultural productivity and urban growth. Current efforts include scaling and productising the model, with proof-of-concept applications including a papakāinga (an indigenous community housing project) on a floodplain in the Bay of Plenty, New Zealand. This example demonstrates the model's flexibility and its capacity to support adaptive settlement designs that incorporate Nature-based Solutions (NbS) to address challenges such as sea level rise and river inundation. While ESMAX remains in its early stages, it offers a valuable tool for visualising and quantifying multiple regulating ES in both real and hypothetical NbS scenarios. By bridging the gap between analysis and design, the model supports the creation of adaptive solutions that integrate ecological resilience with socio-economic objectives, establishing a basis for sustainable living in vulnerable environments.

Incorporating climate resilience into transportation planning

Alejandra Gomez, *University of Georgia*

This study presents an innovative approach to integrating climate resilience into transportation infrastructure planning, demonstrating how current frameworks can accommodate multi-objective projects aligned with nature-based solutions. A decade ago, the focus on climate adaptation in transportation revolved around recognizing the increased intensity of precipitation across much of the continental U.S., which was expected to strain culverts, stormwater drainage systems, and natural basins while placing greater hydraulic demands on bridges, levees, and dikes. Despite this understanding, traditional design standards for hydraulic structures continue to prioritize transportation safety, low maintenance, and cost-effectiveness, often emphasizing the smallest culvert size capable of handling design flows within allowable headwater depths.

However, the current state of aging infrastructure and its increasing failure highlights a critical opportunity to rethink stream crossing design. By incorporating climate resilience, we can create solutions that not only ensure road safety but also mitigate climate risks and enhance ecosystem connectivity. This presentation showcases a case study applying a multi-criteria decision analysis methodology to guide infrastructure investments. By evaluating diverse metrics, this approach helps prioritize actions where they are most effective while integrating a nature-positive perspective. This methodology offers a comprehensive response to challenges in flood risk management, transportation safety, and landscape ecological health, promoting long-term sustainability and resilience.

FRIDAY 8:30am - 9:50pm

Stormwater II

Athena A

A holistic analysis of Chinese sponge city cases by region: Using PLS-SEM models to understand key factors impacting LID performance

Zhou Guo, *Wuhan University*

Sponge city is a national sustainable stormwater management program proposed by the Chinese government to deal with urban water issues (e.g., flooding, poor water quality) brought on by climate change and urbanization. Various strategies for sponge city construction are required since environmental constraints differ regionally across the country. To identify regional variations, reveal the inner links between externalities and design elements in sponge city construction, and offer practical suggestions, efforts in two directions are made based on the data of 68 sponge city cases around China, 1) discussing design parameters of four Low Impact Development (LID) facilities, including bioretention cell, permeable pavement, grass swale, and sunken green space, under four regionalization maps of hydrologic, climatic, landform and soil texture factors, and 2) building a holistic Partial Least Squares-Structural Equation Modelling (PLS-SEM) model illustrating the relationship between local characteristics, LID system design, and LID system performance in sponge city construction. The results show that: 1) rainfall and landform factor have great impact on the LID facilities design, as their design depths and sand portion tend to be higher in water rich areas and the coastal areas; 2) as bioretention cell soil ages, the pedogenesis process becomes more apparent with finer particles concentrating on the surface; 3) LID types and areas are positively influenced (+0.745) by the total area and permeable portion of a project, while the LID system performance (water quantity and quality control) is negatively impacted (-0.407) by the rainfall amount and clay fraction; 4) comprehensive LIDs choice and design instead of single LID facility shows more significant effect on improving LID system performance. It is recommended to establish different design standards and assessment indexing systems tailored to local environment when constructing sponge city projects.

Identifying Opportunities for Natural Infrastructure for the North Carolina Flood Resiliency Blueprint

Barbara Doll, *North Carolina State University*

In 2022, the NC Legislature of North Carolinas allocated $20 Million in funding to the NC Department of Environmental Quality to develop a Flood Resiliency Blueprint. The Blueprint is a statewide initiative to develop an online-decision support tool and associated planning to address flooding for communities in North Carolina's River basins. Traditional approaches to flooding have focused on impounding and blockading large volumes of water. However, these approaches are costly, take a long time to permit and construct and can result in catastrophic damage and losses if they fail. As a result, there has been a shift in focus toward exploring natural Infrastructure (NI) or nature-based solutions for flood mitigation. Example NI practices include expanding wetlands and forested areas designed to store water and slow down runoff from storms. NC Sea Grant and the NCSU Biological & Agricultural Engineering Department partnered with Wildlands Engineering and AECOM to develop strategies for identifying the natural infrastructure options for the Neuse River basin, which was selected as the first prototype Blueprint basin. This presentation will outline the design strategies and geospatial mapping and modeling routines that were developed for determining the most suitable locations for afforestation, water farming, flood storage wetlands and floodplain expansion projects featuring results for several subcatchments of the Neuse River. In addition, in 2023, we successfully secured funding from the NC Land & Water Fund to develop a water farming/irrigation system at the NCDA Caswell Research Farm and a water farming system on active silviculture land at the NC State-owned Hofmann Forest. Design of both sites has been completed, and construction is currently underway for the Caswell project. A brief overview of both demonstration and research sites will also be presented.

Advancing Stormwater Management Through Open-Source Real-Time Control Systems

Savannah Roth, *North Carolina State University*

As rainfall events intensify due to climate change, adaptive stormwater management systems are essential to reduce flood risks and alleviate peak flows. This project introduces a forecast-driven, real-time control (RTC) system designed to optimize stormwater pond performance. Using IoT-enabled nodes, the system monitors water depths and automates pond outlet operations to enhance storage capacity and responsiveness.

The system integrates rainfall forecasts with real-time hydrological data to preemptively drain stormwater ponds before storms arrive, reducing the likelihood of flooding and high peak flows. Each node operates within a modular network, connected to a centralized dashboard that processes data and executes control decisions. This dashboard provides real-time insights, enabling dynamic, multi-pond management.

Designed as an open-source platform, the system prioritizes accessibility and scalability. By providing comprehensive documentation, it enables adoption by professionals and communities alike, fostering collaboration and innovation across stormwater management practices. This open-source approach reduces barriers to entry and promotes customization for diverse applications. However, it also introduces tradeoffs compared to commercial off-the-shelf solutions, including considerations of reliability, ease of implementation, and long-term support.

This presentation will explore the design and deployment of the system, emphasizing how its integration of forecast data and real-time control offers a forward-thinking, cost-effective solution for stormwater pond management. The benefits and challenges of open-source technology will also be examined, providing insights into its potential as a transformative tool for ecological engineering.

How the idea of Regenerative Stormwater Conveyance became an Approved BMP and a Widespread Restoration Solution

Joe Berg, *Biohabitats*

Regenerative Stormwater Conveyance (RSC) is a nature based solution to restore ephemeral flowpaths eroded by stormwater runoff. This practice consists of filling the eroded flowpath with a porous mineral media (e.g., sand or gravel) amended volumetrically with 20% wood chips to introduce a long-lived carbon source. This establishes a hyporheic bed that improves runoff quality and is sustainable once established with native plant material. Bioturbation associated with soil invertebrate feeding in the hyporheic bed maintains porosity, while native plant roots continue to provide carbon to support biological, physical and chemical activity in the hyporheic bed. On top of this hyporheic layer, a series of riffles and pools is created to non-erosively convey large runoff events. This 'stream layer' is designed to be a losing stream, with the small, high frequency precipitation events (i.e., 1-inch rains) being infiltrated into the hyporheic bed as a shallow groundwater seepage flow where biological, physical and chemical transformation of stormwater delivered nutrients and contaminants are processed. Larger events, up to the design flow (typically 100-yr precipitation event), are routed through the repeating series of riffles and pools which contribute to a reduction in peak discharge, reduced velocity/shear stresses, and increased time of concentration. This technique was collaboratively developed by Underwood & Associates, Biohabitats, and Anne Arundel County DPW. Anne Arundel County contracted Biohabitats and Underwood & Associates to develop and implement a training session for approximately 500 local engineers, designers and reviewers. Biohabitats and Underwood & Associates, in collaboration with the past President of the Association of Maryland Floodplain Managers, presented a free two hour workshop (prior to video webinars) to every County and larger City in Maryland over a two year period. This method of restoring eroded ephemeral flowpaths has been adopted by EPA Region 3 as a non-structural BMP for the seven state Chesapeake Bay region and has proven to be one of the most cost-effective methods for municipalities and other regulated entities to meet their MS4 and TMDL water quality permit requirements.

From watershed models to algal turf scrubbers: innovate approaches to algae management

Athena B

The Contribution of Sediment Recalcitrant Organic Phosphorus to Harmful Algal Blooms

Iffat Tasnim, *Georgia Southern University*

In recent decades, ample efforts and resources have been made to minimize external phosphorus (P) inputs into freshwater systems. However, lowering P-loadings has not invariably resulted in eliminating harmful algal blooms (HABs). The role of organic-P as a feasible source of orthophosphate (OP) has been marginalized due to limited technology for precisely quantifying OP production from organic-P. This study aimed to quantify OP generation from IP, a surrogate form of recalcitrant organic-P, to elucidate the contribution of organic P forms to the total pool of OP that stimulates HABs in freshwaters. Experimental results showed that OP concentrations gradually increased from 0.01 to 0.1 mg-P/L in aerobic conditions. These results suggest organic-P mineralization as the principal factor contributing towards OP release rather than redox reactions. In anoxic environments, OP concentrations rose over 0.1 mg-P/L as reduced conditions were established. As ORP continued to decrease, OP initially dropped to approximately 0.05 mg-P/L, then abruptly rose to levels exceeding 0.1 mg-P/L. Initial variations in OP levels in anaerobic environments were attributable to redox processes, followed by organic-P mineralization in reduced conditions after an initial decline in OP concentrations. Sediment-P fractionation revealed that sediments had relatively high levels of recalcitrant organic-P, signaling a substantial potential for organic-P mineralization. A fluorescent probe acting as a substrate analog for phytic acid was used to accurately measure enzymatic activity for IP mineralization to determine OP synthesis from IP. Microcosm tests conducted under various conditions (e.g., aerobic vs. anaerobic) showed the potential for IP mineralization in the absence of OP. IP mineralization rates were greater in anaerobic and reduced circumstances than in aerobic conditions.

Though IP abundance and mineralization rates were relatively low, the results denoted the importance of recalcitrant organic-P as a viable source of soluble reactive phosphorus for initiating HABs in freshwaters.

Linking Watershed Management to Cyanobacteria Blooms through a Coupled Watershed-Lake Model in a Eutrophic Kansas Reservoir

Laura Krueger, *Kansas State University*

Freshwater harmful algal blooms (HABs) occur worldwide, and in many cases are dominated by cyanobacteria. Climatic extremes and alterations to a variety of ecological conditions have accelerated cultural eutrophication and are believed to intensify cyanobacterial HABs in freshwater systems. In addition, toxin production by some HABs pose health risks to humans and animals, and subsequent closures of public waters negatively impact local economies. This research aims to advance understanding of HAB dynamics and mitigation opportunities in a eutrophic reservoir system through a combination of in-situ water quality monitoring and integrated watershed (SWAT+) and lake (GLM) model development. Discrete, spatially distributed water quality sampling and continuous, in-lake monitoring with a multiparameter sensor have been conducted in Marion Reservoir in central Kansas since 2022. Exploratory statistical methods were used to describe relationships among environmental variables and bloom responses to better understand the dynamics of cyanobacterial HABs. Field-collected data were then used to create and calibrate an integrated watershed (SWAT+) and lake (GLM) model. The Soil Water and Assessment Tool Plus, or SWAT+, is a hydrologic modeling tool that utilizes various input datasets such as land use, soils, and elevation to simulate hydrologic and water quality responses of a delineated watershed. The General Lake Model, or GLM, is a one-dimensional lake hydrodynamic model capable of simulating lake water and energy budgets and vertical mixing and can be coupled with biogeochemical and biological (phytoplankton) submodels. This integrated watershed and lake modeling approach is utilized to strengthen the modeling capabilities of each model and to gain insights to potential ecological outcomes in the reservoir. Watershed management scenarios will be tested in this integrated modeling framework to examine how the magnitude and timing of nutrients delivered from the watershed combine with internal lake processes to influence the occurrence of cyanobacterial HABs. This integrated monitoring and modeling approach will identify sets of environmental and ecological conditions that may trigger cyanobacterial HABs and improve current understanding of the drivers that impact and link watershed hydrology, nutrient transport and reservoir states. These advances will provide additional insights for improving management responses to cyanobacterial HABs.

Algae Bloom Prevention and Management through easy-to-use Forecasting and Seasonal Planning Apps

Mauricio Arias, *University of South Florida*

Traditional approaches to dealing with algae blooms in lakes and rivers are often expensive, labor-intensive, and/or ineffective. An alternative to these approaches involves modifying water infrastructure operations, an economical, low-risk method that could prevent algal blooms by deterring excessive amounts of nutrients and phytoplankton from reaching sensitive waters. The goal of our project is to develop a digital toolbox that water resource managers can use to prevent algae blooms in the short term (2 weeks) and long term (1 year). The toolbox engine is the Lake Operations Optimization of Nutrient Exports (LOONE) model, a documented open-source software that couples water, nutrient, and phytoplankton processes with an optimization algorithm to help optimize operation rules based on desired environmental and societal goals. LOONE has been adapted to serve two specific lake management goals: For short-term management (up to 14 days), the model has been coupled with a global river discharge system (GeoGloWS), allowing the end-user to visualize predicted water levels and concentrations at lake monitoring stations, as well as predicted discharges and loads. For long-term planning (up to a year), an easy-to-operate guided user interface was developed, which allows the user to explore expected nutrient and phytoplankton loads as a function of desirable or regulatory monthly discharge rates. This project is part of an interdisciplinary partnership, including the US Army Corps of Engineers and the South Florida Water Management District, entities in charge of managing Lake Okeechobee (Florida) and its receiving rivers, the main case study of this project. This presentation will provide an overview of the end-user engagement process, a demonstration of the toolbox, and a short discussion on ongoing project efforts.

Identifying the Drivers of Florida red tide Dynamics

Nicholas Chin, *University of Florida*

Blooms of the marine dinoflagellate Karenia brevis ("red tide") occur almost annually along Florida's Gulf Coast, leading to fish kills, marine mammal mortality, shellfish contamination, and human respiratory irritation. These blooms are influenced by climatological, oceanographic, and watershed processes; however, the drivers of intra- and interannual bloom severity, extent, and duration remain poorly understood. Evidence suggests that K. brevis blooms initiate offshore in the Gulf of Mexico and are transported inland by wind and currents, where terrestrial nutrient loading likely contributes to bloom intensification. This study employs machine learning techniques to investigate the environmental conditions associated with different bloom stages. A neural network was used to generate daily gridded probabilistic maps of K. brevis presence, trained on in-situ observations and remote sensing data. Subsequently, the self-organizing map (SOM) algorithm was applied to cluster daily environmental variables alongside the spatial distribution of bloom severity. This approach simultaneously reduces the dimensionality of environmental features and bloom responses, enabling the identification of characteristic conditions corresponding to distinct bloom dynamics, such as initiation, rapid growth, and termination.

By pinpointing the drivers of these key bloom stages, this work provides critical insights that can inform management strategies to mitigate the impact of future blooms.

Algal Turf Scrubbers, Replicated Algal Floway Data Collected on Anacostia River in Prince George's County, Maryland with Implications for Acre Scale-Up Planning to Meet EPA Total Maximum Daily Load Reduction Goals for Chesapeake Bay

Peter May, *University of Maryland*

Small scale pilots of the Algal Turf Scrubber ecotechnology operated on Anacostia River in 2018 demonstrated high potential nutrient and sediment load reduction potential for the ecotechnology. In 2023 a grant from Prince George's County Parks funded a 2024 construction and start-up of three replicated 1m x 15m floways at the Bladensburg Waterfront Park and Marina at the headwaters of the tidal Anacostia River. Operation of the three floways from Summer through Fall of 2024 produced algal biomass, nutrient and sediment load reduction data. Estimates of scaled up production to meet EPA's required load reduction requirements for the County are made. Impervious surface mitigation calculations are provided, along with estimates of energy production, soil/fertilizer creation and concrete sequestration potentials for the algal biomass end uses are explored.

Bill Mitsch's Impact on Ecological Engineering

Athena C

Urban Wetland Parks: Lessons from Bill Mitsch for improving habitat and water quality

Lauren Griffiths, *Florida Southern College*

After several decades of operation, the Olentangy River Wetland Research Park (Columbus, Ohio, USA) and Freedom Park Wetlands (Naples, Florida, USA) provide compelling examples of the valuable ecological services that constructed riparian wetlands provide. These projects demonstrate the relative simplicity of construction and operation of urban wetland parks in addition to defining 30 years of research by Dr. Bill Mitsch. His research highlights the importance of adaptive management, interdisciplinary collaboration, and the application of ecological principles to urban environments. Key lessons learned from Dr. Mitsch's guidance include the necessity of integrating hydrological and ecological processes, the benefits of long-term monitoring, and the role of wetlands in urban sustainability. These insights underscore the successes and challenges of urban wetland restoration, providing a roadmap for future projects aimed at enhancing ecosystem services in urban landscapes.

Science for Maximum Impact: Lessons from my time with Dr. Bill Mitsch

Kyle Boutin, *University of South Florida*

Dr. Bill Mitsch was a key figure in the development of ecological engineering, the advancement of wetland science, and an advisor to nearly 90 graduate students. His massive footprint wasn't limited to academic research, but extended to advising federal policymakers and serving as Chair of Ramsar USA. Dr. Mitsch's productive, impactful, and inspirational career would not have been possible without some key personality traits he possessed, the combination and strength of which made him unique among academics. I outline four of these traits – global-mindedness, flexibility, doggedness, and a commitment to public service – with generous examples of each from my time as his advisee. Not only do these traits continue to inspire my own approach and those of his students, but I believe they can provide a template for ecological engineers eager to maximize the impact of their work.

Bill Strosnider, *University of South Carolina*

Stream & Stream Crossing Design

Athena D

Design and Pilot-Scale Implementation of Nature-based Solutions for Streambank Stabilization in Coastal South Carolina

Daniel Buhr, *Jacobs Engineering*

Coastal streams are subjected to a variety of erosive forces – ebb and flood tidal flows, storm surge and wave action, slope stability, and channel migration. The dynamic nature of these erosive forces generates complex conditions that can be addressed through hybrid or nature-based solutions. Two reaches of a coastal stream in the South Carolina low country were selected for restoration due to severe erosion that has endangered important recreational infrastructure and land. Desktop and field data collection identified existing characteristics such as soil stratigraphy, site topography and bathymetry, hydraulic conditions (water stage and velocity), major geomorphic drivers, and ecological communities. Pilot-scale projects were designed to stabilize approximately 100 linear feet of streambank within each eroded reach, focusing on the implementation of nature-based solutions above Mean High Water elevation to minimize permit requirements. Examples of nature-based solutions that were considered for the pilot-scale design included bank reshaping with coir mats, encapsulated soil lifts, or compost-filled biodegradable mesh bags, and toe stabilization with coir logs or oyster shell bags. Native shrubs, grasses, and marsh grasses (e.g., Spartina alterniflora) were recommended to be planted in various zones up the slope to provide additional stabilization against erosive forces. One pilot project will be constructed in Spring 2025, while the pilot project for the second site will be implemented later this summer. Lessons learned from the implementation and performance of these pilot projects will inform a full-scale design of each reach. Full-scale restoration of the two reaches will address the entire eroded length of the reach and include restoration measures below Mean High Water to better protect the streambank toe. These designs will utilize hybrid or nature-based solutions to protect existing infrastructure and land, while achieving social and ecological co-benefits.

Nutrient Dynamics in Response to Short-Term In-Stream Disturbances in Contrasting Stream Environments

Debabrata Sahoo, *Clemson University*

Streams are inherently dynamic ecosystems due to the constantly changing nature of flowing water. They play a crucial role in the downstream transport and fate of solutes such as nitrogen (N) and phosphorus (P), linking upstream reaches with downstream water bodies. These elements are important because they directly affect ecological processes like primary productivity and various biotic activities. While streams connect and process nutrients, they also experience both short-term and long-term disturbances, such as those caused by stream restoration and construction projects, which can potentially impact nutrient dynamics and, in turn, affect downstream ecological processes. The current study investigates how nutrient dynamics are impacted during short-term disturbances under base flow conditions. The study was conducted in two contrasting first-order streams in upstate region of South Carolina, each approximately 100 meters in length: one urbanized and one agricultural. Short-term nutrient injection studies were used to examine nutrient dynamics in these streams. Nutrient injections involved adding N and P salts along with a conservative tracer, chloride, which was captured using NaCl. Conductivity was measured at the most downstream site of the stream reach. Once conductivity reached a plateau, final samples were collected to measure nutrient uptake length under undisturbed conditions. Subsequently, the streambed was manually disturbed at different sections for at least 20 minutes, while the nutrient injection continued to simulate short-term disturbances. Additional samples were collected over the next several minutes to estimate uptake lengths in the disturbed system. Both pre- and post-disturbance uptake lengths were compared and analyzed. The results of this experiment will be presented, helping engineers, scientists, and policymakers understand the impact of short-term disturbances on nutrient cycling and downstream water quality.

Enhancing Stream Restoration Practices through Integrated Design Approaches and Assessment Tools

Kyle McKay, *University of Georgia*

Stream restoration efforts are critical for compensatory mitigation and improving aquatic ecosystems, yet current practices face major challenges in integrating design approaches with assessment tools. First, guidance is lacking on selecting restoration design philosophies tailored to specific landscape or context-based applications. Methods like natural channel design, Stage 0 design, and threshold channel design have varying constraints and impacts, necessitating a clearer understanding of their appropriate use across diverse settings. Second, gaps in debit/credit tools (i.e., ecological assessments) can misalign design decisions with broader ecological goals. Designs are often tailored to specific metrics that maximize benefits (e.g., large wood debris or planting frequency), rather than metrics that support a full range of pertinent stream functions (e.g., flow regime, floodplain connectivity, carbon processing). Refining these tools is essential to support a full range of stream functions and align design with desired ecological outcomes. Third, interdisciplinary miscommunication often complicates restoration projects. While regulatory assessments emphasize ecological outcomes for compensatory mitigation, design professionals focus on performance metrics like cost effectiveness, persistence or stability of the design features, capacity to cope with site constraints (e.g., utility crossings), and other factors. Bridging this gap requires a shared framework for aligning restoration goals, metrics, and design philosophies. This research, centered on some of the diverse landscapes in the Great Lakes and Ohio River region, develops a comprehensive framework to address these challenges. By integrating context-specific design guidance with refined assessment tools, this work aims to improve consistency, adaptability, and ecological effectiveness in stream restoration practices.

Road-Stream Crossing Design: A Stream Smart Approach

Benjamin Bradley, *Trout Unlimited*

Traditional road-stream crossings, often designed solely for hydraulic capacity, frequently disrupt natural stream processes, fragment aquatic habitats, and diminish infrastructure resilience. This presentation will explore the critical shift towards a "Stream Smart" approach to road-stream crossing design, emphasizing the restoration of stream function and the creation of resilient infrastructure. Case studies will illustrate how implementing Stream Smart crossings can enhance ecological connectivity, mitigate flood risks, and improve the long-term performance of road infrastructure. This presentation will advocate for a paradigm shift in road-stream crossing design, promoting a holistic approach that balances engineering requirements with the imperative to restore and protect our valuable stream ecosystems.

Design Predictive Ecological Models for Hyporheic Exchange in Texas for Floodplain Benching as a Nature-Based Solution

Kyle McKay, *University of Georgia*

Hyporheic exchange between surface water and shallow groundwater can be an important driver of stream functions, influencing temperature regulation, nutrient cycling, pollutant attenuation, and habitat creation. Traditionally, site-specific detailed modeling and monitoring are used to assess these benefits, however, these approaches can be time-consuming and difficult to scale. Consequently, there is growing interest in developing widely applicable predictive ecological models that identify when and where hyporheic processes significantly benefit stream ecosystems.

Here, we present predictive models for hyporheic exchange by linking flow characteristics to ecological outcomes in a range of Texas streams. We focus on riffle-pool sequences and use a two-step modeling framework: HEC-RAS for two-dimensional surface water simulations and MODFLOW for three-dimensional groundwater flow. Surface water elevations from HEC-RAS serve as boundary conditions in MODFLOW, allowing us to model hyporheic flow paths, rates, and residence times. Key metrics, including hydraulic conductivity, flow path geometry, and residence time are then compared with invertebrate and water quality data to identify patterns and develop predictive tools.

By synthesizing hydrologic and ecological data, we aim to provide efficient, broadly applicable models for evaluating the ecological functions of hyporheic zones. These models can be used as screening tools for assessing hyporheic zone functions, informing restoration actions, and better understanding how to scale up hyporheic zone benefits to large scales.

Participatory Science

Athena E

Enhancing statewide data collection and outreach through the NC Volunteer Wetland Monitoring Program

Michael Burchell, *North Carolina State University*

Wetlands are important aquatic ecosystems that provide a myriad of ecosystem services. They are complex, so to understand their condition and functions, data collection on water quality, soil chemistry, hydrology, plants, and animals is required. Monitoring wetlands over time is important to detect potential impacts from stressors (e.g. climate change, urbanization, and fragmentation) and helps inform restoration criteria. Most states like North Carolina do not have a government-supported long-term ambient wetland monitoring program like they do for lakes and streams. Our goal was to create a sustainable network of wetland monitoring sites across the state, supported by volunteers. In phase one of this pilot program, we have developed and are testing different protocols and training methods to enable volunteer citizen scientists to conduct wetland monitoring. The study areas are in the eastern Piedmont, located on properties protected from future development so they can best provide a long-term baseline of wetland condition. The data collected (hydrology, vegetation, soils, amphibians, water quality) is based on previous larger-scale NC wetland monitoring studies to allow for comparisons. We are also evaluating using digital applications and electronic data forms for collecting data and have developed an online data portal to view results and further engage with our volunteer citizen scientists. We are also conducting periodic surveys of the volunteers to assess and inform the future of the program. After three full years, the program appears successful and sustainable and is poised for expansion to additional sites across the Carolinas in 2025, and hopefully can act as a model for future programs in other states.

Equipping Communities with Science-Driven Tools for Riparian Restoration

Andrea Ludwig, *University of Tennessee*

Tennessee contains more than 60,000 miles of rivers, streams, and headwaters. With such a density and richness of surface water resources, land use changes can pose a significant challenge to the health of these systems. It is estimated that nearly 10 acres of farmland is converted to other uses (mostly more impervious surfaces) every hour in Tennessee. These conditions require that restoration and protection efforts be strategically implemented to ensure the biggest impact per investment. The University of Tennessee Extension has endeavored to create more science-driven tools for communities aiming to protect and restore aquatic and riparian ecosystems. This presentation will overview the activities of the Tennessee Community Riparian Restoration Program to equip communities with accurate riparian lands spatial data as well as share experiences from practical, hands-on workshops in streambank stabilization approaches.

Urban stormwater management through food production: community-engaged research for culturally relevant and nutritious wild foods in Syracuse, New York

Stewart Diemont, *State University of New York, College of Environmental Science and Forestry*

Food and water are places where we meet. We all have a meal that brings us warmth inside. We all value clean streams, rivers, and lakes. Syracuse, New York is a city that is working toward rectifying impacts of combined sewer overflow through green infrastructure. It is a city that struggles with enormous food inequity. Syracuse is the traditional homeland of the Onondaga Haudenosaunee. It is also the home of numerous New Americans who escaped persecution and civil unrest in their former homelands. The Syracuse Urban Food Forest Project brings together these vital interests. We are restoring a 9-mile edible plant corridor with culturally-relevant wild foods. Over 3000 food-bearing trees, shrubs, and perennials have been planted. Community members have been engaged through design, planting events, research, and educational programs. An estimated 3 million gallons of stormwater will be intercepted over the next 20 years. We evaluated the planting needs of ramps, Allium tricoccum, a species of cultural importance for the Haudenosaunee and a part of our planting program. We found that the active chemical, allicin, increased due to planting stress, indicating that planting ramps on slopes could improve culinary value. We are currently working with New Americans in Syracuse to evaluate presence and harvestability of plants native to New York, but with culinary similarities to culturally-significant plants from their homelands. We are harvesting from these species [e.g., black cherry (Prunus serotina), black raspberry (Rubus occidentalis)] to determine wild food harvestability. This research complements our findings that species such as serviceberry (Amelanchier spp.) are productive for foraged wild harvest, while also providing other ecosystem services (e.g., water regulation, pollination). Our work indicates that engaged scholarship can improve the value to communities of urban restoration, while also meeting urban planning needs.

FRIDAY 10:10am - 11:30am

Nature-based Solutions for River Resilience

Athena A

Enhancing the design of constructed wetlands along the Missouri River to improve nutrient removal

Roderick Lammers, *Central Michigan University*

The U.S. Army Corps of Engineers (USACE) and local partners build and maintain a vast network of levees on U.S. rivers, including the lower Missouri. When levees are repaired, maintained, or realigned, significant amounts of fill material are collected locally from “borrow pits”. In some cases, these borrow pits have been converted to wetlands to provide habitat for wetland plants and animals. At one site, an agricultural drainage ditch was re-routed through a created wetland to improve water quality (primarily through nutrient removal) before the ditch discharges into the Missouri River. Currently, however, these wetlands are not being designed specifically for nutrient retention, and their water quality benefits have not been quantified. The goal of this research is to determine the potential water quality benefits of routing agricultural drainage through constructed wetlands in the lower Missouri River basin and help improve the design of these nature-based solutions. We monitored one year of water levels and water quality in the constructed wetland receiving agricultural runoff to quantify nutrient removal. We are using these data to develop watershed and wetland models to quantify long term performance, test different design alternatives, and provide recommendations for optimizing nutrient removal in these wetlands. Preliminary results show that the wetland is effectively retaining nitrogen and phosphorus, but wetland hydrology and nutrient removal are highly affected by Missouri River water level. The results of this work will help USACE prioritize locations for constructed wetlands and inform their design to enhance water quality benefits.

Spatial Prioritization of Freshwater Nature-based Solutions: A Case Study identifying Levee Setback sites in the Lower Missouri River Watershed

Alec Nelson, *University of Georgia*

Nature-based solutions (NbS) are increasingly important management approaches that integrate multifunctional landscape features, benefiting both people and ecosystems. As NbS projects gain global traction across various sectors, there is a growing need to align governance and decision-making with systematic planning methodologies. Historically, these solutions have been implemented opportunistically; however, they can be deployed more efficiently through spatially explicit decision-support tools. This study demonstrates a spatial prioritization approach for identifying future levee setback sites in the Omaha District of the US Army Corps of Engineers along the Lower Missouri River. Levee setbacks are a natural infrastructure strategy that reduces flood risk and restores floodplain connectivity by relocating levee edges away from the main river channel. With increasingly frequent extreme weather events, floodplain management has become a critical priority. Levee setbacks offer multiple regional benefits, including improved water quality, ecological restoration, and recreational opportunities, while promoting equitable environmental outcomes and community resilience.

The spatial prioritization tool evaluates levee areas by ranking them according to normalized co-benefit metrics across four categories: flood risk reduction, water quality and quantity, socio-cultural values, and biodiversity. It incorporates spatially explicit relationships of natural features, such as soil characteristics, sedimentation patterns, topography, and peak flow dynamics. This study also utilizes existing levee setback areas to compare their outcomes across assessments of multiple co-benefits, highlighting their relative successes and trade-offs. By quantifying social, environmental, and economic co-benefits, this approach enables stakeholders to identify optimal levee setback locations that maximize sustainable and resilient outcomes. A web-mapping interface permits diverse stakeholders- local governments, engineers, and community leaders- to explore prioritization scenarios based on expert input, interactive criteria weighting, and engineering guidance. This method offers practical support for policymakers and engineers in selecting key levee areas for strategic project design, facilitating targeted investments in sustainable infrastructure that yield quantifiable socio-economic and ecological returns.

Harnessing investments in reservoir operations to promote hydrologic reconnection and ease

Elissa Yeates, *University of Georgia*

Water managers are navigating complex, interrelated challenges in the 21st century: intensifying drought and flood risk, increasing demands for water supply, diminishing groundwater availability, degrading snowpack storage, habitat and species loss, and aging infrastructure designed for events of the past. Ongoing efforts within the U.S. Army Corps of Engineers (USACE) are attempting to modernize infrastructure operations to satisfice across multiple competing objectives. The Forecast-Informed Reservoir Operations (FIRO) research program seeks to improve multi-objective dam operations by using advanced precipitation forecasts to inform release decisions, and encoding the flexibility this enables in water control manual updates. Assessment of FIRO at pilot sites in California demonstrates improved supply reliability and opportunity for increased groundwater recharge. A screening process is being applied across the USACE portfolio of ~700 reservoirs to identify FIRO-suitable sites. The Sustainable Rivers Program (SRP), a partnership between USACE and The Nature Conservancy to improve riparian health by changing dam operations, has projects at over 40 river systems and is expanding. SRP projects promote environmental flows at participating dams, modifying releases to include high-flow pulses, more variable base flows, and seasonal low flows.

This work investigates alignment between FIRO and SRP expansion efforts, using the rich site-specific data gathered for the FIRO national screening effort and the environmental opportunities identified at SRP Regional Meetings to identify and prioritize sites suitable for FIRO where greater environmental benefits can be realized through operational flexibility. Additionally, restoration activities upstream of reservoirs are considered as a strategy to enable FIRO at more sites by promoting water storage on the landscape, effectively increasing inflow forecast lead times. Adapting water resource management this century could follow the path of hardening, oversizing, and expanding gray infrastructure, further degrading ecosystems. Alternatively, we explore opportunities to operate existing infrastructure more effectively, enabling upstream and downstream hydrologic reconnection and ease.

Design Guidance for Floodplain Benching as a Nature-Based Solution

Kyle McKay, *University of Georgia*

The U.S. Army Corps of Engineers (USACE) Engineering With Nature® Program promotes the intentional alignment of natural and engineering processes to efficiently and sustainably deliver economic, social, and environmental benefits associated with infrastructure. To advance these goals, the USACE is developing engineering guidance on how to identify, conceptualize, and design nature-based solutions for riverine and coastal systems. Floodplain benches are a natural geomorphic feature within a riverine system that form at an elevation between the riverbed and a higher floodplain or terrace. Benches provide many of the same ecosystem and social benefits as larger floodplains, including reduced flood risk, improved aquatic ecosystems, enhanced diversity of plants and wildlife, expanded recreational opportunities, and uses for cultural and tribal values. Thus, floodplain benches are a nature-based solution for incised channels in areas where out-of-bank flooding generates unacceptable flood risk. This presentation describes ongoing development of engineering guidance to inform the design of floodplain benches. Long-term channel evolution or land use encroachment may have restricted access to these floodplains, and design of a high-inundation floodplain bench provides a means of addressing diverse flood risk, ecological, and social objectives. This guidance describes site investigation, design, and other considerations for the use of floodplain benches.

Natural Flood Management for Big Rivers

Matt Chambers, *University of Georgia*

Natural flood management (NFM) is an innovative approach for mitigating riverine flood risks through watershed-scale interventions with natural and hybrid infrastructure features that change the timing, sources, and pathways of water. Applications of this approach often attempt to exaggerate natural attenuation processes on hillslopes (e.g. cross-slope vegetation features) and in channels (e.g. in-line storage ponds) or attempt to desynchronize tributary additions with mainstem flood waves (e.g. leaky barriers). NFM has been modeled and demonstrated in small watersheds, though its basic principles of attenuation and tributary desynchronization could be effective in large watersheds as well. Applications in large watersheds are limited by the existing common tools of NFM practice (e.g. leaky barriers, headwater woody bundles, cross-hillslope vegetative features) which would be impractical to implement at large spatial scales and are poorly suited to large rivers. Alternative tools, such as various forms of floodplain reconnection, afforestation, engineered log jams, and dam retrofitting could enable NFM applications in much larger watersheds. This talk further develops the theory of NFM by adapting it for larger watersheds and big river applications. Examples are provided with nature-based solutions (e.g. levee setbacks) and with restoration practices (e.g. dam removal) as both can be used to either attenuate or desynchronize tributary additions.

Vegetation in Ecological Engineering

Athena B

Evaluating woody plant species and their associations with salinity and hydrology in the Mobile-Tensaw Delta

Andrew Balder, *Auburn University*

Tidal freshwater forested wetlands (TFFWs) are understood to be ecologically diverse and important areas that are vulnerable to anthropogenic disturbances, including channelization, dredging, and climate-induced sea level rise. Despite their ecological significance, important knowledge gaps persist related to the role of salinity regime on TFFW communities. To address this gap, we surveyed 47 forest plots across the tidal gradient of the Mobile-Tensaw River Delta (MTRD) along the northern Gulf of Mexico using 400-m² circular plots to document canopy and midstory species composition and canopy tree diameters. We integrated species composition data with predicted salinity and digital elevation analysis to assess environmental influences on vegetation distribution. To develop the salinity model, we deployed nine sensor dataloggers across the tidal gradient to record hourly salinity, water level, and temperature from November 2022 to July 2024. Using these and other publicly available data, we developed a hybrid deep neural network model with a residual network technique to predict salinity dynamics at each forest plot over the previous 15-year period (2008-2023). Species composition varied significantly across the tidal gradient in response to two key environmental parameters: salinity and elevation. Distinct zonation patterns were observed in both the midstory and canopy layers, with more salinity-tolerant species such as Morella cerifera and Nyssa biflora persisting in areas of higher salinity, while less tolerant species like Ilex verticillata and Nyssa aquatica were more prevalent in fresher environments. Other species, such as Taxodium distichum and Ilex verticillata, were more prevalent in low-elevation forests prone to more prolonged flooding. Threshold analysis identified distinct changepoints in species composition along the salinity gradient, with the percent exceedance of 2 psu emerging as the most ecologically informative threshold, marking key shifts in community structure. Additionally, long-term average salinity thresholds corresponded with a transition from large tree-dominated forests at approximately 0.4 psu to shrub/scrub tidal zones near 0.8 psu, highlighting a critical shift in vegetation communities. Our findings highlight species-specific salinity thresholds that may be used to better predict the impacts of increasing salinity intrusion caused by sea level rise and anthropogenic modifications.

Duckweed: its Microbiome, Exudates and their Interactions

Molly Robles, *EA Engineering* and *Michigan State University*

Plants interact with their surroundings and manipulate their microbiome through exudates, low molecular weight plant metabolites. Recent research has identified relationships between exudates and external factors such as contaminant exposure through the use of duckweeds as model plants. While these studies examined the relationship between exudates and external factors, they did not consider the effects of duckweed source or species on the duckweed exudates. Several experiments were conducted to examine the relationship between exudates and characteristics of different duckweed treatments.

Exudates were collected from sterilized duckweed treatments consisting of four species and five sources. The exudate profiles associated with each duckweed treatment were differentiated from each other using multivariate statistical analysis. Sources of duckweed appeared to have a larger effect on metabolite profile than species. The subfamily Wolffioideae has distinct metabolite profiles compared to the Lemnoideae subfamily treatments. Exudates were also collected from sterilized treatments of duckweed and their wild counterparts and compared. The presence of a microbiome affects the metabolites generated by the duckweed. Sterile Lemna Minor from a duckweed collective was immersed in wild water collected from several different environments in an effort to inoculate that duckweed with that microbiome and compare the metabolites generated. Two of the inoculated treatments had similar microbial profiles and generated similar metabolites. The wild treatments were more similar to each other than the treatments inoculated with the matching wild water. Overall, the microbiome, duckweed source, and duckweed species all distinctly impacted the exudate profile. Work is on-going to identify key exudates in the interaction between duckweed and its microbiome.

Hydrodynamics of submerged aquatic vegetation motion: A case study in Florida Springs

Kathleen Schoenberger, *University of Florida*

Submerged aquatic vegetation (SAV) plays a critical role in aquatic systems. In lotic ecosystems, SAV provides habitat and resources to species by forming the energic base of the trophic pyramid, promoting sediment stability, and modifying hydrodynamics within the stream channel. However, the relationships between structural properties of SAV canopies (flexibility, height, blade morphologies) and their impacts on flow across different scales are not well understood. Given the foundational nature of SAV to aquatic communities, a better understanding of these relationships is necessary for improved natural resource management. Florida springs and spring-fed rivers support robust SAV canopies, making them ideal locations to study the dynamics of SAV and flow interactions. However, Florida springs have also seen a reduction of rooted SAV in recent years while algae have proliferated. We hypothesize that SAV canopy structural properties have a significant impact on hydrodynamics above and within SAV canopies and control algal establishment and abundance through canopy motion and blade-to-blade interactions. We tested our hypothesis by conducting multiple field campaigns and collected hydrodynamic data using in situ flow velocimeters and captured vegetation canopy movement using underwater video cameras. These field observations will be used to qualitatively validate a high-fidelity computational fluid dynamics model of SAV-fluid interactions. Preliminary results show that periodic waving motion in vegetation, known as monami, combined with certain plant structures, significantly influences the overall hydrodynamic conditions. This approach creates a novel framework for modeling flow over SAV and advances our understanding of SAV behavior under different flow conditions with different blade properties. Based on observations, we hope to better understand the effects of SAV on hydrodynamics and apply this to key ecosystem processes, such as sediment transport and algae growth dynamics.

Nature based solutions: How does variation in marsh plant communities impact coastal compound flooding?

C. Nathan Jones, *University of Alabama*

Increasingly, coastal communities are threatened by multiple, interacting, and compounding hazards such as increased urbanization, sea-level rise, and storm surges. In the case of compound flooding, these components can interact in a non-linear fashion resulting in expanded flood extents, increased uncertainty in flood predictions, and ultimately greater risk to coastal communities. Nature based solutions (NBS) such as marsh restoration have been proposed to help address these compounding risks; however, natural resource managers often lack tools necessary to evaluate and optimize NBS design and implementation. To begin to develop actionable tools for NBS site selection, our transdisciplinary team partnered with coastal decision-makers and other vested parties from across the greater Mobile Bay, AL region to evaluate how NBS could impact coastal resilience to compound flooding. Our project consisted of three interacting and interconnected components: targeted end-user meetings, ecological sampling, and coupled hydrologic and hydrodynamic modeling. In this presentation, we will focus on sampling marsh communities and their impact on compound flooding. We sampled marsh plant communities across Mobile that vary in both salinity and the resulting dominant vegetation type. Vegetation communities were dominated by Juncus roemerianus, Spartina alterniflora, Phragmites australis, and Typha latifolia along a salinity gradient. When calculating roughness coefficients, we estimated values ranging from 0.04 to 0.07 in areas dominated by Spartina alterniflora and Phragmites australis, respectively. While these differences in vegetation communities result in ecologically meaningful variation, our team is evaluating if the differences in roughness impact inundation during compound flooding events within the modeling domain. Our results will provide insights into how hydrodynamic modeling tools can be used to evaluate NBS. More broadly, our approach provides an example of how community-engaged research can inform ecological engineering activities such as nature based solutions and wetland restoration.

Planning & Decision Making

Incorporating Operational Decision-Making to Forecast Estuarine Discharges from a Highly Managed Watershed Using a Transformer Neural Network

David Kaplan, *University of Florida*

Forecasting in highly managed water systems presents significant challenges due to anthropogenic operational intervention. Traditional hydrological models struggle to capture the complex interactions between regulatory actions, natural drivers, and system responses. This study introduces an operational medium-range forecasting framework using a Transformer Neural Networks (TNN) to predict discharges from Lake Okeechobee, a highly regulated water system in Florida, to the Caloosahatchee and St. Lucie estuarine ecosystems. The model integrates spatiotemporal precipitation forecasts from NOAA's Global Forecasting System, and local hydrological observations to forecast discharges at key estuarine environments – Caloosahatchee and St. Lucie. This operational framework integrates the Lake Okeechobee System Operating Manual (LOSOM) to perform daily 10-day forecasts to support socio-economic and environmental management.

The results highlight the model's effectiveness in producing accurate multi-step 10-day forecasts within operationally relevant timeframes. Predictions at S80 closely track observed flows due to its direct connectivity to the lake discharges to the St. Lucie canal, while predictions at S79 exhibit greater uncertainty due to short-term management actions in the canal, and the unmonitored runoff within the Caloosahatchee watershed. Despite these challenges, the model successfully captures key hydrological patterns, including runoff peaks and baseflow variations due to gate operations, offering substantial improvements over existing decision-support tools. By integrating AI-driven modeling with operational hydrological forecasting, this framework enhances water management strategies for Lake Okeechobee and provides a scalable approach for other regulated systems. Future work will focus on linking this model with coastal numerical models to support real-time decision-making by regulatory agencies.

Rethinking Water Quality Project Planning: Coupling restoration needs of conservation lands with nutrient reduction allocations

Mary Szoka, *Alachua County, Florida*

Alachua County is a stakeholder in 3 different Basin Management Action Plans (BMAPs), which have allocated tens of thousands of pounds of annual nutrient reduction. So far, implemented quality projects provide hyper localized benefits while not being very cost effective. This presentation will quickly review a few of these projects and discuss a revised strategy to identify projects that meet restoration needs on County-owned lands while providing water quality benefits to meet nutrient reduction allocations.

Optimizing Reservoir Operations to Mitigate Nutrient and Phytoplankton Loads in a Eutrophic Subtropical Lake

Osama Tarabih, *University of South Florida*

Harmful algal blooms have major negative impacts on aquatic ecosystem and human health. Nutrient enrichment, in combination with warm water temperatures, high light availability, and low water turbulence, have been proven to be major factors driving algal blooms. In this study, lake eutrophication processes, including phytoplankton production and nutrient cycling, were simulated and coupled with a reservoir operations model to optimize multi-criteria lake operation goals. The main objective of this study was thus to design reservoir operations that minimized phosphorus (P), nitrate/nitrite-nitrogen (NOx), and phytoplankton loads to downstream water bodies while also meeting water resource demands in eutrophic Lake Okeechobee, the largest subtropical lake in the USA. We used an open-source, multi-objective evolutionary algorithm framework with four optimization objectives (minimizing P, NOx, and phytoplankton loads and water demand deficits), assessing each constituent separately and in combination. In addition, different optimization scenarios associated with each objective were investigated. We identified multiple opportunities to reduce downstream loads while minimizing impacts on water demand deficits. Notably, considering combined P, NOx, and phytoplankton load objectives yielded substantial reductions in summertime P, NOx, and phytoplankton exports by up to 73%, 82%, and 73%, respectively, with minimal increases in water demand deficits. The coupled model offers the flexibility to explore alternative operational strategies in the future and can be adapted to other similar settings, providing a useful tool for balancing downstream water quality and societal water resource needs.

Watershed Protection Plans as way to increase nature-based solutions adoption

Fouad Jaber, *Texas A&M AgriLife*

Watershed planning has been considered as a solution to water pollution in the USA as far back as 1878. For a long time, most of these plans were "top-down" projects until the NRCS "small watersheds program" in 1954 that provided a blueprint for bottom-up planning that involves stakeholders from the beginning of the planning process. The adoption of the Clean Water Act (CWA) in 1972 (including Section 319 provided a funding mechanism and a methodology for large adoption of watershed planning as part of the non-point source pollution program. "The Watershed Approach" includes a nine elements methodology that has been adopted in certain states in-lieu of TMDLs. In this presentation the development of a watershed plan in the highly urbanized Rowlett Creek watershed in Texas will be used as a case study to detail the methodology of watershed planning but also to provide insight on how these plans can be used to increase funding to nature-based green stormwater infrastructure in the US.

Innovations in Water Treatment Technologies

Athena E

Advancing Rural Wastewater Treatment with Biochar: A Low-Cost, Sustainable Solution for Nutrient Management

Liz Riedel, *North Carolina State University*

As eutrophication of surface waters continues to be a concern, it is crucial to explore novel approaches for reducing point source nutrient loads from rural wastewater treatment facilities. In North Carolina, most rural wastewater treatment plants are not subject to stringent nutrient discharge standards and their aging infrastructure and reliance on outdated technologies limit their treatment efficiency. As a result, they discharge higher nutrient concentrations, increasing the risk of eutrophication in receiving watersheds. This study evaluates the efficacy of biochar made from pyrolyzed pine bark to enhance nitrogen and phosphorus removal in rural wastewater systems. The initial phase of this study involved batch tests to optimize the formulation of magnesium-doped biochar and oxygen-doped biochar. Optimal batches were tested in plastic columns to assess N and P removal rates under varying influent NH4-N and o-PO4 concentrations, influent flow rates, and biochar mass. Both physical (e.g., adsorption) and biological processes (e.g., nitrification) were analyzed by comparing water quality samples from the inlet and outlet of the columns for NH4-N, NO3-N, and o-PO4 and establishing the removal efficiencies or production of N and P species. The results will identify the best configuration to maximize nutrient removal. Based on these findings, a pilot test at a wastewater treatment plant will apply the highest-performing biochar formulations in several flow-through constructed wetland mesocosms with and without aeration. This field study aims to determine whether biochar proves a viable option to enhance wastewater treatment at rural wastewater sites and improve watershed health.

Evaluating Environmental and Economic Impacts of the Algae Wheel for Wastewater Treatment

Ana Martin-Ryals, *University of Florida*

Algal-based processes can provide multiple benefits to reduce the ecological impact of municipal wastewater treatment. The Algae Wheel is a wastewater treatment technology that leverages heterotrophic bacteria and phototropic algae to remove wastewater organics and nutrients, while sequestering CO2 and producing biomass that can utilized for downstream biofuel/biomaterials production. The Algae Wheel is different than other algal based wastewater treatment systems as it incorporates a series of wheels rotated by coarse bubble aeration to provide more surface area for attached film algal growth. This design can enhance nutrient removal and biomass yield, while reducing the land footprint and energy demand compared to traditional algal raceways and conventional activated sludge (CAS) treatment, respectively. This presentation will present results from full-scale work investigating application of the Algae Wheel for nutrient removal and biomass production from municipal wastewater in Illinois and Florida. The Algae Wheel system demonstrated biomass productivity rates from 20 g/m2/day under normal operating conditions, up to 80 g/m2/day through various treatment interventions, while meeting effluent nutrient discharge standards. Techno-economic analysis indicates the Algae Wheel can provide a lower cost for wastewater treatment compared to CAS and traditional algal raceway pond systems. Finally, life cycle assessment results indicate that the Algae Wheel has a lower impact in several environmental impact categories including global warming potential compared to alternative wastewater treatment scenarios.

Life cycle assessment of constructed wetlands with horizontal subsurface flow for the treatment of domestic wastewater in the canton of Monteverde, Puntarenas province, Costa Rica

Sofia Solis Naranjo, *University of Costa Rica*

This work, entitled "Life cycle assessment of constructed wetlands with horizontal subsurface flow for the treatment of domestic wastewater in the canton of Monteverde, Puntarenas province, Costa Rica", is part of the undergraduate research project for the Agricultural and Biosystems Engineering program at the University of Costa Rica. Since approximately 70% of wastewater in Costa Rica is not treated and is discharged directly into the environment, this generates an environmental problem that endangers public health. One technique implemented in rural areas to treat graywater is constructed wetlands. Monteverde is an example of the application of this technology, and this work aims to validate it through a Life Cycle Assessment (LCA). The methodology used to establish the control volume and the inventory necessary to perform the LCA in two study sites: Hotel Los Pinos and Creativa School will be presented. In addition, the conformation of these treatment systems will be analyzed. Finally, it is expected to determine which construction elements of the control volume generate greater emissions to the environment, according to impact categories such as eutrophication, acidification and climate change. Likewise, the quality of the treated water in the artificial wetland will be compared with that of the untreated water that is generally released into the environment.

Anaerobic bioremediation of historical chlorinated organic pollutants from Superfund sites in New Jersey and Michigan

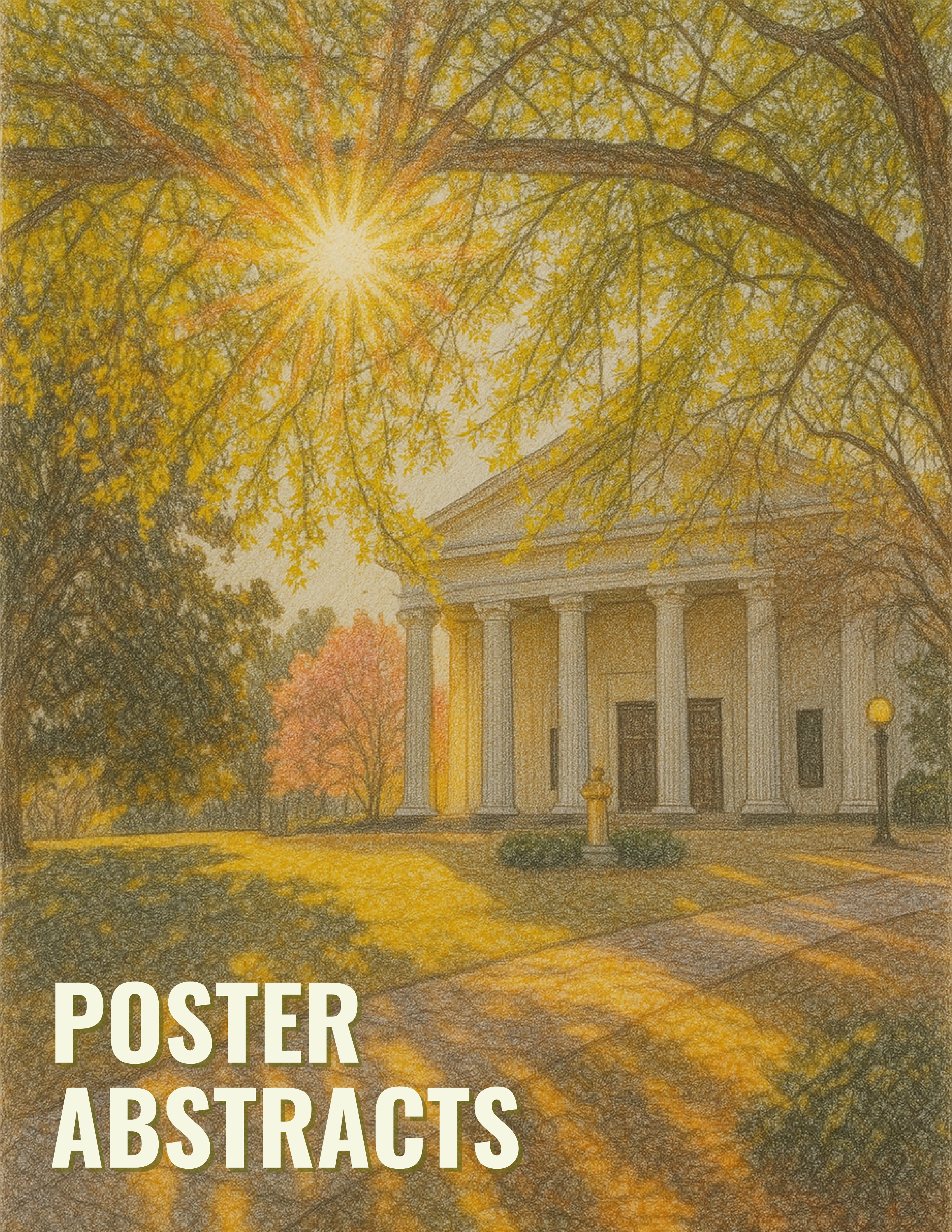
Danielle Delp, *Rutgers University*

Decades of chemical manufacturing adjacent to the Passaic River in New Jersey and Tittabawassee River in Michigan has left miles of both rivers heavily contaminated. Among the contaminants of greatest concern are the polychlorinated dibenzo-p-dioxins and furans (PCDD/Fs). Organohalide respiring bacteria are able to de-chlorinate these chemicals to less toxic forms, however this process is extremely slow in the in situ environment. This research is a long-term study to analyze methods to stimulate bacterial dechlorination of these contaminants. Small-scale (100 mL) microcosms were established with anaerobic sediments collected from the Tittabawassee and Passaic Rivers and dosed with 0.8 μmol/L of 2,3,7,8-tetrachlorodibenzofuran (TCDF) delivered on floated silica gel. Amendments tested to improve dechlorination rate included co-amendment with 1,2-dichlrorobenzene as an alternate halogenated electron acceptor, and cobalamin (vitamin B12). Bacteria were fed using a 6 μmol/L volatile fatty acid mixture (acetic, butyric, propionic, and lactic acids) or a slow-release electron donor. Preliminary results indicate that microcosms with unamended sediments from the Tittabawassee River did not dechlorinate TCDF within 6-months of incubation, however dechlorination of dichlorobenzene to chlorobenzene was observed during this time. Additional results from the Passaic River are anticipated. The results of this study will demonstrate how the natural ecology of the river microbiome can be stimulated to optimize degradation of these dangerous contaminants and more quickly restore the health of both impacted sites.

Bioreactor Gardens: Scalable Nature-Based Solutions for Decentralized Wastewater Treatment

Kelly Harris, *Ridge to Reefs*

The Bioreactor Garden is a green infrastructure, nature-based wastewater treatment system that purifies effluent discharged from traditional septic systems. Currently approved for use in the state of Virginia, Ridge to Reefs is introducing this nature-based technology throughout the Southeast at a variety of scales, from residential to municipal. Bioreactor Garden systems use passive, naturally-driven processes which mimic the actions of wetland filtration in an optimized subsurface footprint. Multi-redundant treatment arises from bioremediation and phytoremediation, filtration through layers of activated biochar, beneficial bacteria, treatment media, and wood chips made from invasive species. Nitrification is performed through aerobic treatment media (which can utilize recycled crushed glass), and denitrification is performed by bacteria which grow on the wood chips and biochar. Bioreactor Gardens treat water to a high standard; this treatment results in nearly total removal of key nutrients and contaminants of concern. By efficiently removing nutrients and contaminants that pollute water resources, Bioreactor Gardens protect ecosystems and community health. This presentation will review the utilization of these systems in diverse locations internationally and nationally as well as anticipated in the Southeast. Data related to system performance for key parameters such as nutrient removal and removal of pharmaceuticals will be reviewed. In addition, the use of local materials and development of local circular economies will be highlighted as a strategy to lower costs and the carbon footprint associated with traditional onsite wastewater treatment. Furthermore, strategies for reduction of effluent volume and the reuse of treated effluent will be covered in this presentation.



POSTER ABSTRACTS

POSTER SESSION

Thur. May 29, 4:15pm - 6:15pm

1. Fungal Mycoremediation within Treatment Wetlands: A Novel Approach for Antibiotic-Resistant Bacteria Removal in Aquatic Systems, Buddhika Aberathne, *Virginia Tech*

2. Evaluating the Robustness and Accuracy of Low-cost Sensors for Stormwater Monitoring, Ashfaq Ahmad, *University of Kentucky*

3. A Comparative Lifecycle Assessment of High-Density Polyethylene Floating Wetlands and Eco-friendly Floating Wetlands *Bamboo and Aero glass, John Mark Asare, *Clemson University*

4. Integrating Infiltration-Based NBI in Coastal Areas for Sustainable Stormwater Management: Case Study of St. Mary's, Chukwuemeka Atuma, *University of Georgia*

5. Evaluating the Environmental Benefits of Composting and Anaerobic Digestion Systems for Manure Management, Rafian Aziz, *University of Maryland*

6. Impact of Hydrological Changes on Methane Emissions and Archaeal Diversity in Appalachian Urban River Sediment, Bhuparaj Bhattarai, *West Virginia State University*

7. Ecological Drivers of the Cultural Service Sense of Place, Megan Blumenauer, *Virginia Tech*

8. Estimation of irrigation return flow to groundwater in the Santa Fe River Basin, Florida, Cristel Cedeno-Martinez, *University of Florida*

9. Modeling Habitat Transitions for the American Black Duck in South Carolina's Coastal Wetlands, Noah Cleveland, *University of Georgia*

10. Evaluating the Impact of Aquatic Nutrient Reduction Barriers on Water Quality, Rachael Cooper, *University of South Florida*

11. Optimizing Green Infrastructure Using Multi-Scale Geospatial Analysis and Machine Learning Techniques, Yan Duan, *University of Georgia*

12. Anaerobic Co-digestion of Poultry Litter and Switchgrass: Climate Smart Commodities on Delmarva Peninsula, Fahmi Dwilaksono, *University of Maryland*

13. Phosphorus Recovery from Freshwater Sediments: Evaluating Feasibility for Sustainable Nutrient Pollution Management, Tasnuva Farnaz, *Georgia Southern University*

14. A Process-Based Approach to Model Pesticide Dynamics in Non-Floodplain Wetlands: Model development and Application, Cristiano Feitosa, *Auburn University*

15. Efficacy of Biochar, Bacteria, and Crops in Remediating PFAS and Enhancing Plant Productivity, Sisam Gautam, *North Carolina Agricultural & Technical State University*

16. Assessing Riparian Functioning Condition for Improved Ecosystem Services: A Case Study of the Back Creek watershed (Virginia, USA), Santosh Ghimire, *Environmental Protection Agency*

17. Temporal variation in dissolved oxygen and phosphorus concentrations in Vermont restored riparian wetlands, Xia Gillespie, *University of Vermont*

18. Evaluating the Novel Dominant Bacteria in Thermophilic Anaerobic Digestion Using MAGs (Metagenome-Assembled Genomes), Maria del Carmen Gonzalez Rangel, *West Virginia State University*

19. Coal mining effects on the spatial differentiation of the microorganisms in a subwatershed in the Appalachia region, Flor de Maria Guerrero Toledo, *West Virginia State University*

20. Integrating Land Use and Climate Change Scenarios for Sustainable Water Quality Management in Agricultural-Urban Landscapes, Alvee Bin Hannan, *University of Georgia*

21. Weathering the Storm: Climate Entities Across U.S. Public Universities, Myranda Hentges, *University of Kentucky*

22. Nature-based Design Standards: Past, Present, and Future, Tamara Jameson, *Ducks Unlimited, Inc.*

23. Improving Saturated Riparian Buffer Design Methods with Empirical Nitrate Load Removal Data, Gabriel Johnson, *Iowa State University*

24. Proposed Design of a wastewater treatment pilot plant for poultry processing wastewater using the Tidal flow constructed wetlands model, Natacha Kakama, *Auburn University*

25. An Example of High Algal Turf Scrubber Productivity, Patrick Kangas, *University of Maryland*

26. Evaluating the Water Quality Performance of a Subsurface Gravel Wetland Treating Stormwater Runoff, Molly Landon, *North Carolina State University*

27. Evaluating Alternative Development Scenarios to Protect Vital Sportfish Habitat in SW Florida, Kallan Latham, *University of Florida*

28. Unsteady flood dynamics across the channelized, agricultural floodplain of the East Fork White River, Indiana, Sarah Leach, *Virginia Tech*

29. Lilly Branch Restoration Concepts: An Exploration of Stream Rehabilitation Scenarios, Bryce LeCates, *University of Georgia*

30. Assessing the Impacts of Land Use and Climate Changes on Water Quality in the Santa Fe River Basin Using Integrated Hydrologic Models, Dogil Lee, *University of Florida*

31. Bringing Ecological Engineering Home: Tennessee Smart Yards, Andrea Ludwig, *University of Tennessee*

32. Emergy Analysis for the University of Maryland's 2007 Solar Decathlon entry, LEAFhouse, Joshua Marlowe, *University of Maryland*

33. Identifying Optimal Media for Duckweed Exudate Analysis, Katherine McCullen, *Michigan State University*

34. Capstone Project: Designing a Floating Treatment Wetland System for Nutrient Removal Practices with Advanced Drainage Systems (ADS), Matthew Mendak, *The Ohio State University*

35. Synergizing Green Infrastructure: Exploring the Combined Use of Permeable Pavement and Geothermal Energy Systems, Lydia Miller, *North Carolina State University*

36. A Case for Increased Consideration of Downstream Riverine Health Analysis in Stormwater Management Regulation, John Montoya, *University of Georgia*

37. Filamentous Algae as a Natural Biofilter: Enhancing Nutrient Recovery in Controlled Environment Agriculture, Shokouh Mousavi, *Auburn University*

38. Optimization and Deployment of Biofilters with Ultra-High Surface Media for Highly Efficient Stormwater Remediation, Surjith Krishna Muthukumar, *Georgia Southern University*

39. Analyzing nitrogen and phosphorus in restored riparian wetlands, Lauren Nelson, *University of Vermont*

40. Howard Marsh Wetland Restoration, Brian Nicholson, *Ducks Unlimited, Inc.*

41. A Spatial Conservation Prioritization of Coastal Freshwater Impoundments Based on Predicted Climate Impacts and Waterfowl Habitat Value, Alexa Ouellette, *University of Georgia*

42. Influence of Material and Density on Intertidal Oyster Enhancement Success Using Wood and Bamboo Stakes in a Subtropical Estuary, Briar Ownby-Connolly, *University of South Carolina*

43. Evaluating Riverine Microbiomes Under Multiple Environmental Stressors In A Heavily Affected Central Appalachian River, West Virginia, Sailesh Phuyal, *West Virginia State University*

44. Comparative System Modeling and Energy Performance of the UMD Solar Decathlon Entries reACT and LEAFhouse, Donald Plugge, *University of Maryland*

45. Sustainable Wastewater Treatment through Algal Systems, Gabriel Proano-Pena, *Auburn University*

46. Investigating the Impacts of Coastal Flooding on Sandy Island's Ecological and Cultural Resilience, Tyler Pyatt, *University of South Carolina*

47. Does reservoir sediment flushing change water quality downstream? A study in the Big Blue and Kansas Rivers downstream of Tuttle Creek Reservoir, Josiah Quinlan, *Kansas State University*

48. Removal of Antibiotics from Agricultural Wastewater Using Ecological Engineering Techniques, Sushmita Roy, *North Carolina Agricultural & Technical State University*

49. Leveraging Ecological Engineering to Improve Aging Rural Wastewater Treatment Systems and Effluent Quality, Nathan Salas, *North Carolina State University*

50. Evaluation of the potential benefits and practical barriers for co-digestion of food waste and manure on Vermont dairy farms, Hailey Sanphy, *University of Vermont*

51. Investigating the Role of Channel Morphology and Sediment Lithology in Shaping Downstream Sediment Transport in Several Rivers of Washington State, Fatemeh Shacheri, *Virginia Tech*

52. Chemical Contaminants Can Affect Methane Production in the Sediment of an Industrialized Appalachian River, Manju Sharma, *West Virginia State University*

53. Describing the Septic Tank System Microbiome and Resistome in Rural Southwest Virginia, Emilie Sidelinger, *Virginia Tech*

54. Analysis of Bioretention Design Performance on Georgia's Coast Using DRAINMOD-Urban, Maria Laura Siqueira Batista, *University of Georgia*

55. Unraveling the role of hydrodynamics in nutrient and algae transport in Lake Okeechobee, Sajad Soleymani Hasani, *University of South Florida*

56. Investigating Soil Moisture Memory: Evaluating the Impact of Atmospheric Disturbances Across Ecosystems, Evren Soylu, *Environmental Protection Agency*

57. Efficacy of a Restored Ohio Wetland in Mitigating Nitrogen and Phosphorus from Legacy-Phosphorus Field Runoff, Autumn Sylvestri, *The Ohio State University*

58. Stormwater Wetlands: A Nature-Based Solution to Stormwater and Carbon Management on Military Bases, Maliha Tabassum, *University of Georgia*

59. Optimizing Agricultural Sites for Best Management Practices in the Western Lake Erie Basin Using Multicriteria Decision-Making, Mahesh Tapas, *The Ohio State University*

60. Upcycling Nutrient Pollution with Typha Bioproducts, Elissa Touma, *University of South Florida*

61. A systematic literature review on water quantity and water quality modeling tools, Ngoc Trieu, *University of South Florida*

62. Mass Accumulation in Aging Stormwater Wetlands and Maintenance Implications, Amanda Van Pelt, *North Carolina State University*

63. What Model should I use? A Tool for Selecting the Appropriate Surface Water Modeling Platform, Qiong Zhang, *University of South Florida*

64. Evaluating Hybrid Constructed Wetlands for Nutrient Removal in Sidestream Wastewater, Kimiya Yousefi, *Virginia Tech*

1. Fungal Mycoremediation within Treatment Wetlands: A Novel Approach for Antibiotic-Resistant Bacteria Removal in Aquatic Systems

Buddhika Aberathne, *Virginia Tech*

Antibiotic-resistant bacteria (ARB) and antibiotic-resistant genes (ARGs) pose an escalating global crisis, threatening ecosystem and human health due to their presence in the environment and entry through food chains. Excessive usage of antibiotics in agricultural and anthropogenic interventions has led to ARB-related health issues that severely affect immuno-compromised living beings. Conventional remediation technologies such as chemical disinfections and physical filtration systems often fall short in effectively addressing ARB contamination. These methods can produce harmful byproducts and unintentionally impact non-target microbial and aquatic species, compromising ecosystem balance. This study pioneers an innovative mycoremediation strategy that aims to apply edible fungal mycelia as a biofilter within treatment wetlands (TWs) to remove ARB from contaminated water sources. This study investigates the remediation potential of Oyster mushroom, Shiitake mushroom, and Reishi mushroom based on their biosorption capacity and secretion of antimicrobial compounds. This research is structured into three phases: Design and development of a TW inlet myco-filtration system; optimization of ARB removal efficiency under different water pH and salinity conditions; and assessment of water quality and toxicity post-remediation. A preliminary study revealed that Oyster mushroom achieved 100% Escherichia coli K12 reduction, from 10^7 CFU/ml to zero, within 12 hours under laboratory experimental batch conditions. Through integration of mycoremediation systems within TWs as a pre-treatment system, ARB removal efficiency has the potential to be optimized. This synergetic system offers a sustainable water treatment solution that serves as a feasible and non-toxic alternative to conventional remediation methods. By studying the underexplored potential of fungi in environmental remediation, this research aims to bridge scientific innovation with real-world applications for safeguarding global health and water security.

2. Evaluating the Robustness and Accuracy of Low-cost Sensors for Stormwater Monitoring

Ashfaq Ahmad, *University of Kentucky*

Climate change has been shown to increase the amounts and frequencies of precipitation events. This is increasing the risk of flooding and erosion as well as related risks to water quality. Higher intensity, duration, and volume of precipitation events, coupled with increased impervious surfaces in developed areas also creates challenges to aging and sometimes under-designed stormwater infrastructure. There is a need to increase the spatial and temporal stormwater monitoring footprint to monitor both the suitability of water quality for its designated uses and, also to assess the adequacy and effectiveness of the stormwater retention and drainage systems. There are various commercial monitoring systems available in the market, but the costs associated with installing them make them cost prohibitive for widespread adoption. On the other hand, there are some low-cost general-purpose sensors available that can be paired with generic microcontrollers to build low-cost monitoring systems. The lower associated costs make them suitable for widespread adoption, however, the common perception that these sensors might not be as accurate or robust as the industrial ones, is preventing them from being incorporated widely. To assess the current state of water monitoring, a review was conducted for the accuracy and robustness of sensors from among these two classes for monitoring parameters such as temperature, pH, conductivity, as well as various types of water level monitoring sensors. Additionally, the review explores other key aspects of implementing a monitoring framework using those low-cost variants, such as initial configuration, micro-controller programming, and calibration. As extreme weather patterns continue to push the limits of water resources, monitoring becomes an important tool to understand both current and future performance for water quality and quantity challenges. This review helps to inform the barriers and opportunities that exist for low-cost monitoring approaches.

3. A Comparative Lifecycle Assessment of High-Density Polyethylene Floating Wetlands and Eco-friendly Floating Wetlands *Bamboo and Aero glass

John Mark Asare, *Clemson University*

Floating treatment wetlands (FTW) for water treatment are gaining traction as new innovative approaches are being developed by ecological scientists and engineers every day. Life cycle assessment is a method used to assess and quantify the environmental impacts of a product or a service. Previous research has been carried out using LCA to determine the impact of floating wetlands. However, most of these research areas usually focus on the lifecycle costing of construction of floating wetlands failing to capture and compare the environmental impacts of using high-density polymers as floating wetlands and the impacts of moving to ecofriendly materials on the environment. Our research focuses on a comparative LCA of High-Density Polymer(HDPE) FTW with alternatives made from non-plastic materials including jute, bamboo, metal wire mesh, and foamed glass aggregates made from recycled glass. The work followed the ISO 14040 standard to ensure methodological consistency, transparency, and reliability. Midpoint impacts being considered are Acidification potential, Global warming, Fresh Water Ecotoxicity, Human-Carcinogens. Initial results show that among the three Floating Treatment wetlands, HDPE FTW has the highest score followed by Bamboo FTW and Chicken- Net FTW being the lowest in Acidification Potential Category. For Global Warming category, HDPE FTW shows the highest impact followed by Bamboo FTW and Chicken-Net FTW. In the Ecotoxicity category, HDPE FTW scores the highest points, then Chicken-Net FTW and Bamboo FTW being the least. The last of the results, which is Human Carcinogen, showed HDPE FTW with the highest score, followed by Chicken-Net FTW whiles Bamboo FTW gave the lowest score. These initial results demonstrate that moving from High Density Polymer (HDPE) Floating Wetlands to Eco friendly Wetlands reduces Global warming impact. However, the tradeoff for doing this should be considered across impact categories since they can be equally devastating.

4. Integrating Infiltration-Based NBI in Coastal Areas for Sustainable Stormwater Management: Case Study of St. Mary's

Chukwuemeka Atuma, *University of Georgia*

Coastal floodplain systems are experiencing heightened flood risks attributable to climate change, urbanization, and deficiencies in conventional infrastructure (CI). Current coastal infrastructure frequently lacks the flexibility and environmental advantages to manage elevated water tables, storm surges, and severe precipitation events. This study examines the efficacy of infiltration-based nature-based infrastructure (NBI) strategies, specifically Green Infrastructure (GI) and Hybrid Infrastructure (HI), in improving flood resistance. The emphasis is on St. Mary's, Georgia, a low-lying coastal city susceptible to tidal flooding and storm surges, where sandy soils and shallow groundwater intensify flood threats.

This study utilizes StormWise™ hydrological modeling to evaluate baseline, green infrastructure-enhanced, hybrid, and conventional infrastructure-only scenarios under different storm intensities and tidal effects. The methodologies encompass evaluating essential performance measures like peak flow reduction, infiltration rates, flood extent, and groundwater recharge. Sensitivity analyses will examine the impact of key parameters such as soil permeability, rainfall intensity, and vegetation coverage on system performance.

Anticipated outcomes indicate that green infrastructure and hybrid systems can enhance water infiltration, postpone peak runoff, and augment ecological co-benefits relative to conventional infrastructure alone. Hybrid systems are expected to reconcile green infrastructure's environmental benefits with traditional infrastructure's dependability, offering a scalable and adaptable option for flood management.

This work addresses a significant knowledge deficiency by measuring the hydrological and ecological advantages of Nature-Based Interventions (NBI) in coastal environments and emphasizing the trade-offs linked to adopting hybrid strategies. These findings will inform sustainable flood management measures and influence long-term urban design for flood-prone coastal areas.

5. Evaluating the Environmental Benefits of Composting and Anaerobic Digestion Systems for Manure Management

Rafian Aziz, *University of Maryland*

Anaerobic digestion (AD) and composting systems are essential for sustainable manure management and greenhouse gas (GHG) mitigation from solids in agriculture. These processes enhance nutrient recycling, reduces pathogen loads, and minimizes environmental impacts. The integration of these processes optimizes organic waste management by stabilizing solids and improving soil health through compost application. Understanding the combined effects of digestion and composting can help refine best practices for nutrient management and emissions reduction in agricultural systems.

This study evaluates the environmental performance of anaerobic digestion and composting of dairy manure solids and compares greenhouse gas reductions through a mass balance approach of dairy manure only digestion compared to co-digesting with food processing residuals. Additionally, the effect of heating the digester will be determined through methane potential testing at ambient temperatures experienced year-round in Maryland compared to a continuously heated digester to determine differences in energy production. The results will include collecting liquid, solid, and biogas samples to analyze solids concentration, chemical oxygen demand, ammonia, biogas composition, and other parameters. A comparative cradle-to-grave Life Cycle Assessment (LCA) will be performed to analyze nutrient flows, energy consumption, GHG emissions, and eutrophication potential from composting compared to anaerobic digestion. This research will quantify the environmental benefits of advanced manure management systems and provide critical insights for Maryland producers and policymakers on meeting state climate goals through sustainable agricultural practices. The forthcoming results aim to guide the adoption of effective technologies for manure management and environmental stewardship.

6. Impact of Hydrological Changes on Methane Emissions and Archaeal Diversity in Appalachian Urban River Sediment

Bhuparaj Bhattarai, *West Virginia State University*

Urban rivers are natural sources of methane, a potent greenhouse gas. However, quantifying CH_4 emissions from highly dynamic riverine environments is very challenging because many factors influence the production and emission of CH_4 in these environments. Changes in hydrology are among the least studied factors related to methane biogeochemistry. Therefore, we investigated the impacts of hydrological changes such as low water discharge (LD) and high water discharge (HD) on CH_4 emissions and archaeal diversity from Kanawha River sediment in WV. Water flow for the LD level was <40,000 cubic ft/sec over the previous four months while the HD level was >60,000 cubic ft/sec during two heavy precipitation events that occurred within one month of sampling. The HD level visibly displaced sediment although we did not measure this variable. Sediment cores were collected from three locations along 11.2 km of the river and Biochemical Methane Potential (BMP) assays were conducted with anoxic sediment microcosms. Methane production was measured using gas chromatography. Sediment chemical analysis was performed using Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES) and Dionex Ion Chromatography. 16S rRNA marker gene sequencing with Illumina Miseq PE300 was used for microbial diversity analysis. The Modified Gompertz Model was used to estimate maximum CH_4 production kinetics. BMP was found to vary by location and sediment depth. HD sediment produced 4.5 times more methane than LD sediment. Redundancy Analysis showed sediment samples were less differentiated in terms of chemistry and microbial diversity during high water discharge. HD increased organic matter, silt/clay, and archaeal diversity compared to LD. The most abundant methanogens were Methanoregula, Methanosaeta, Methanosarcina, Methanobacterium, and Candidatus-Methanomethylicus. In conclusion, Kanawha River sediment exhibits higher methane emissions associated with high discharge volume. Funding provided by USDA NIFA grant 2021-38821-34706 to DHH.

7. Ecological Drivers of the Cultural Service Sense of Place

Megan Blumenauer, *Virginia Tech*

Green infrastructure such as bioretention cells (BRCs) provide nature-based experiences to urban residents who may otherwise lack access to nature. These experiences can have positive effects on physical and mental health, making them important for human well-being. However, current BRC designs often prioritize hydrologic and water quality services over the cultural services that foster a deeper connection to nature. New design tools like virtual reality (VR) and fuzzy cognitive mapping (FCMs) could help surmount this design barrier, a premise we test in this study. Our work focuses specifically on the cultural service sense of place and uses a coupled VR-FCM workflow to 1) evaluate the capacity of BRCs to contribute to sense of place and 2) identify key design features that influence its provisioning. Given that vegetation is the most visually obvious feature of BRCs and is easily manipulated during the design phase, our analysis focuses on plant traits, the spatial arrangement of plants within landscapes, and plant biodiversity as putative design features. We engaged 50 participants in virtual walkthroughs of ten BRC models with different vegetative elements and asked them to consider the degree to which those models stimulated place attachment, a key dimension of sense of place. They then constructed FCMs to illustrate how various plant traits, landscape elements and other design features influenced their attachment to place. Here we describe the results of this exercise, focusing not only on how BRCs were perceived but on the specific design decisions that influenced place attachment the most. We draw specific attention to 1) vegetative elements that were variously perceived and the implications of that variability for future BRC design as well as 2) vegetative elements that were broadly influential and how those elements might be leveraged to improve provisioning of sense of place for a range of community demographics.

8. Estimation of irrigation return flow to groundwater in the Santa Fe River Basin, Florida

Cristel Cedeno-Martinez, *University of Florida*

Irrigation return flow (IRF) is the excess water extracted for irrigation purposes that is not completely consumed by evapotranspiration and returns to a water body. Previous studies have examined IRF to assess its impact on water balance and sustainability, agricultural management, and environmental health in agricultural regions. The contribution of IRF to surface water and groundwater can be substantial, however it is often neglected when considering water resource planning. This study aims to quantify the spatial and temporal variability of IRF and net recharge in the Santa Fe River Basin (SFRB), where water use for irrigated agricultural and municipal/domestic supply have motivated concerns about declining spring and river flows. For this purpose, a previously calibrated SWAT-MODFLOW model was used to assess how IRF affects aquifer recharge, groundwater levels, and river flows. To do so, two instances of the model were run, one with agricultural irrigation and one without, and the difference in percolation between the two was taken as an initial estimate of IRF. The model also allowed comparison of different cropping and management systems in the region. Preliminary results over 39 years of simulation showed that an overall average of 62% of applied agricultural irrigation returns to the aquifer; seasonally this ratio ranged 45 and 91%. Return flows were approximately 110% higher for calendar-based irrigation vs. soil moisture sensor-based irrigation, and 8.7% higher for corn-carrot-peanut vs. corn-peanut rotations. Given the relatively small footprint of agricultural land uses in the watershed (~4%), the effects of IRF on streamflow were relatively minor and most apparent for low flows. Future work will compare irrigation application, net recharge, and IRF estimated by the SWAT-MODFLOW model with an HSPF-MODFLOW model used by water regulators in the region to determine how best to incorporate IRF into water use decision-making.

9. Modeling Habitat Transitions for the American Black Duck in South Carolina's Coastal Wetlands

Noah Cleveland, *University of Georgia*

South Carolina's coastal wetlands are ecologically and economically vital, yet they face increasing threats from urban expansion and climate change. Rising sea levels and development pressures are reducing available habitats for key wildlife species, particularly waterbirds that rely on salt marshes and managed impoundments. Without proactive conservation efforts, these ecosystems and the services they provide—such as flood mitigation, water filtration, and biodiversity support—will continue to decline. This research project focuses on modeling habitat transitions for the American Black Duck within the Winyah Bay watershed to inform conservation planning. By analyzing future habitat distributions under different environmental scenarios, the study aims to identify strategies that promote habitat connectivity and resilience. The research methodology involves locating preferred sites through habitat suitability mapping using marsh migration and projected land use change datasets. Habitat suitability is analyzed by comparing habitat transitions between time steps, determining habitat resilience and vulnerability to change, and by creating composite maps to identify priority habitats. Potential focal areas are further prioritized using the American Black Duck decision support tool. Results indicate rapid habitat transitions within the first six inches of sea level rise, followed by slower transitions under twelve and eighteen inches. Habitat cores become disconnected as they travel up separate river corridors, creating connectivity challenges. Landscape managers need to understand future salt marsh movements to adaptively manage the landscape and increase resilience. This study provides data-driven insights to support adaptive land management, ensuring critical wetland habitats persist despite ongoing environmental changes.

10. Evaluating the Impact of Aquatic Nutrient Reduction Barriers on Water Quality

Rachael Cooper, *University of South Florida*

Non-point source nutrient pollution is a problem that persists as a global environmental challenge. Legacy phosphorus (P) refers to non-point nutrient sources from historical anthropogenic inputs to sediments and soils. Aquatic Nutrient Reduction Barriers (ANRBs) are a new technology for addressing legacy P sites, such as our study site at a former phosphate mine in Lakeland, Florida. In these systems, surface water flows through a permeable barrier to filter and settle particulate P. The novelty of this project is the amendment of aquatic barriers with a sorbent medium. Sorbent-amended ANRBs can potentially remove total P by combining filtration, sedimentation, and sorption mechanisms. A pilot-scale ANRB was deployed and monitored for one year at the study site, which experiences intermittent algal blooms from legacy P. Results from pilot-scale ANRB monitoring and recommendations for future ANRB applications in Florida will be presented. Monitoring of the ANRB included quantitative effects on water quality parameters, such as temperature, pH, dissolved oxygen, nitrogen, and P. Qualitative impacts on ecological indicators will also be presented, including erosion, sedimentation, vegetation dynamics, algal growth, and the presence of fish and predator species. Throughout the monitoring period, P concentrations were lower than anticipated based on prior monitoring data, with the median of legacy-dissolved P remaining below 0.20 mg/L PO43--P and the median of total P remaining below 3 mg/L PO43--P. Despite these lower-than-expected nutrient levels, the presence of the ANRB did sustain the growth of aquatic plant species and provided a habitat for wildlife species previously not encountered at the site.

11. Optimizing Green Infrastructure Using Multi-Scale Geospatial Analysis and Machine Learning Techniques

Yan Duan, *University of Georgia*

Rapid urbanization in the Piedmont region has intensified water quality issues associated with stormwater. While guidance from the Georgia Stormwater Management Manual (GSMM) and tools like the Community-enabled Lifecycle Analysis of Stormwater Infrastructure Costs (CLASIC) support municipal planning and watershed management, potential gaps exist when linking large-scale land suitability assessments with site-specific green infrastructure (GI) implementation. This study addresses this gap by integrating a machine learning-based Random Forest algorithm for pervious and impervious land classification and a deep learning computer vision model to detect and quantify tree count along with hydrological assessments, to optimize green infrastructure (GI) placement.

Inspired by the "Sponge City" concept, rooted in low-impact development (LID) , sustainable urban drainage systems (SuDS) , and green infrastructure, this research envisions stormwater management as a decentralized micro scale GI network. Stormwater Control Measures (SCMs) like bioretention, stormwater wetlands, permeable pavements, and restoration of urban soils and forests can complement conventional drainage systems, providing cumulative hydrological and ecological benefits.

To refine GI implementation, this study applies the Patchwork Theory Landscape framework, McHarg's "Design with Nature" and Forman's Landscape Ecology Principles. A land suitability model, developed using Geographically Weighted Regression (GWR) in ArcGIS pro, incorporates flood risk, slope, land cover, and recreational access. High-resolution aerial imagery classification and deep learning techniques further enhance spatial decision-making by detecting tree cover and impervious surfaces, integrating these datasets with land use and soil characteristics to site potential SCMs

By leveraging machine learning and geospatial analytics, this research advances data-driven, adaptive stormwater management strategies. Estimates suggest that GI can reduce construction costs by 5%–30% and long-term maintenance costs by approximately 25% compared to conventional infrastructure. This pilot study contributes to evidence-based GI planning, supporting climate-resilient urban development.

12. Anaerobic Co-digestion of Poultry Litter and Switchgrass: Climate Smart Commodities on Delmarva Peninsula

Fahmi Dwilaksono, *University of Maryland*

The Delmarva region (Delaware, Maryland, and Virginia) is a poultry production hub, generating 850,000 tons of poultry litter annually. Poultry litter, composed of spent bedding and manure, is rich in nitrogen (N), phosphorus (P), and potassium (K) and can contribute to nutrient runoff into the Chesapeake Bay if not properly managed. To address this concern, initiatives such as the Maryland Manure Transport Program and the Delmarva Chicken Association's Litter App were created to facilitate transporting poultry litter from the Peninsula to farmland with lower residual soil phosphorus concentrations. Currently, litter production on the Delmarva Peninsula exceeds fertilizer demand. Anaerobic digestion (AD) can be used to process poultry litter and facilitate transformation of the poultry litter into fertilizer products, such as potting soil, which can be used locally on the Peninsula while harnessing the energy potential of the litter resource.

Meanwhile, switchgrass is increasingly used on the Delmarva Peninsula in areas of saltwater intrusion to keep soil covered and allow for crop growth without the large fertilizer inputs needed for traditional row crops. Switchgrass sequesters carbon through its deep root system, while harvested material from this perennial crop can be used as a bioenergy feedstock. Combining the carbon-rich switchgrass with nitrogen-rich poultry litter through co-digested can create a more balance C:N ratio for the microorganisms responsible for methane production during AD.

This study examined the environmental benefits of incorporating switchgrass as a co-digestion feedstock with poultry litter. Methane potential testing examined switchgrass harvest period, silage methods, and varying ratios of switchgrass to poultry litter during co-digestion. Key parameters analyzed included biogas quantity and quality, volatile solids, pH, and nutrients. Statistical analysis compared methane production and nutrient transformation across treatments. The AD results will be used in a life cycle assessment to determine carbon reductions with poultry litter and switchgrass co-digestion during growth, storage, and processing using AD.

13. Phosphorus Recovery from Freshwater Sediments: Evaluating Feasibility for Sustainable Nutrient Pollution Management

Tasnuva Farnaz, *Georgia Southern University*

Global phosphorus reserves are rapidly declining due to increasing agricultural demand and inefficient management practices, with phosphate mines expected to be depleted within the next 50 years. At the same time, many aquatic ecosystems are experiencing eutrophication caused by excessive nutrient inputs, particularly nitrogen and phosphorus. These surplus nutrients promote the overgrowth of harmful aquatic organisms and algae, leading to severe pollution in freshwater and marine environments. Research has demonstrated that water bodies have been receiving and retaining phosphorus loads for extended periods, primarily from wastewater, and agricultural and industrial activities. Orthophosphate from these sources gets utilized and mineralized to organic phosphorus, which along with many organic phosphorus forms that are also discharged into environment, is captured and stored in sediments from receiving water bodies. However, this stored phosphorus can be remobilized, further exacerbating nutrient pollution and eutrophication. Given that phosphorus is a finite and non-renewable resource, its traditional linear management model has led to inefficiencies and long-term environmental consequences. To address this challenge, our research aims to develop a sustainable approach for phosphorus recovery from freshwater sediments, contributing to a circular economy model. Nonetheless, before any new technology is applied for sediment phosphorus recovery, it is crucial to assess its practicality. This study will assess the feasibility of extracting phosphorus from sediment deposits that have accumulated over decades. Specifically, we will quantify recoverable phosphorus in sediments, evaluate the efficiency of various recovery techniques, and its potential for reuse in agricultural and industrial applications. Additionally, the study will examine the environmental implications of phosphorus extraction, particularly its role in mitigating eutrophication and enhancing sustainable nutrient management. This study proposes a novel approach to quantify recoverable phosphorus in freshwater sediment using life-cycle analysis techniques, providing critical insights into the viability of sediment-based phosphorus reclamation as a long-term nutrient management strategy.

14. A Process-Based Approach to Model Pesticide Dynamics in Non-Floodplain Wetlands: Model development and Application

Cristiano Feitosa, *Auburn University*

This study presents a physically based model for pesticide cycling and degradation in wetlands, incorporating key biogeochemical interactions that influence pesticide retention, degradation, and export. While pesticides enhance agricultural productivity, they also pose environmental risks when entering waterbodies, threatening ecological health and water safety. Constructed wetlands have emerged as cost-effective solutions to mitigate pesticide pollution, but their efficiency depends on understanding the dominant processes governing pesticide fate. Building upon the WetQual model, which simulates hydrology, sediments, nutrients, and carbon in wetlands, we incorporated key pesticide fate processes, including photolysis, hydrolysis, biotransformation, volatilization, and plant uptake. The enhanced model was evaluated in two distinct wetlands: (1) a constructed wetland in Illinois designed to control atrazine pollution from agricultural runoff, and (2) a wetland in Hajek, Czech Republic, treating drainage water contaminated with hexachlorocyclohexane (HCH). The model performed well in predicting both atrazine concentration and pollutant load at the first study site, with a predicted final removal rate of 52% and a Pbias of -6.5% when compared to the observed concentration. Sensitivity analysis suggests that the dominant degradation pathways are transformation processes, while volatilization also plays a significant role. Settling is nearly negligible, indicating that most of the pesticide remains in a dissolved state. This aligns with the expected behavior of moderately mobile pesticides like atrazine under low Suspended sediment concentrations. At the second study site, the model predicts removal rates between 40% and 50%, depending on the HCH isomer. It achieves relatively good results for the isomers with more chemical data available, with Pbias values between 8% and 18% for α-HCH, β-HCH, and γ-HCH. However, it underestimates the removal of ε-HCH by 31%. ε-HCH, a byproduct of lindane production, is typically found in trace amounts and is not as prominent in environmental and toxicological research. At this study site, dense vegetation contributes to plant uptake, which becomes a major removal pathway. The results provide insights into pesticide dynamics in wetlands and contribute to improved design and management strategies for pesticide removal.

15. Efficacy of Biochar, Bacteria, and Crops in Remediating PFAS and Enhancing Plant Productivity

Sisam Gautam, *North Carolina Agricultural & Technical State University*

Climate Change poses several challenges on environmental health and crop productivity through shifts in global temperature, and increased pollutant levels. To address these challenges, soil amendments, bacteria and plants can be used as a climate smart solution. Manufacturing facilities in North Carolina have been utilizing Per and Poly fluoroalkyl substances (PFAS) which led to their widespread presence in the soil, water and environment. The presence of PFAS in water at the concentration level of 634 ppt, which far exceeds the maximum contaminant levels underscores the need for effective remediation strategies. This study will investigate the efficacy of biochar, bacteria (Pseudomonas spp.), plants (tomato, carrot and spinach), and their synergistic relationships on plant growth, yield, and PFAS remediation. A greenhouse pot experiment will be conducted with twelve treatments replicated four times across 48 experimental plots. Long chain and short chain PFAS will be introduced into the soil after baseline analysis and key parameters such as PFAS uptake by plants, plant growth, and productivity will be assessed. Analytical tools that will be used for PFAS quantification include Orbitrap Exploris 120 Liquid

Chromatography-Mass Spectrometer (LC-MS) and automated Solid Phase Extraction (SPE). Results will not only reveal the effects of biochar and bacteria addition into soil on the PFAS remediation and plant productivity, but also the uptake of PFAS by food crops and potential risk to human health. The results from the study are important to develop strategies that combine environmental remediation with sustainable crop production for food security and climate impact mitigation.

16. Assessing Riparian Functioning Condition for Improved Ecosystem Services: A Case Study of the Back Creek watershed (Virginia, USA)

Santosh Ghimire, *Environmental Protection Agency*

Riparian functioning condition refers to a rating and description of the current ecological status of a reach of a riparian ecosystem in consideration of its potential hydrology, vegetation, and geomorphology. We assessed functioning condition of flowing riverbank areas of the Back Creek located in Virginia (USA) using the riparian Proper Functioning Condition (PFC) protocol developed by the U.S. Department of the Interior and the Department of Agriculture and remotely sensed data retrieved from National Hydrography Dataset Plus (NHDPlus Version 2). The PFC protocol involved qualitative answering of 17 assessment items that addressed three categories of attributes (hydrology, vegetation, and geomorphology) with the reach rating options of PFC, Functional-At-Risk, Non-Functional, and apparent or monitored trends. We delineated the NHDFlowlines as reaches each with corresponding catchments based on the NHDPlus framework in ArcGIS® Pro. We characterized 26 Back Creek reaches of 41.1 km length and analyzed the patterns of 1981–2018 daily dataset of the precipitation, surface runoff, air temperature, and composition of vegetation types and soils for the Back Creek watershed. Then, we conducted the PFC assessments using field reconnaissance of 10 reaches of 19.3 km. The field assessments concluded that 52% of the assessed length was in PFC, attributed to diverse vegetation and maintained channel characteristics. This study provides an exemplar of nonpoint source methodology for identifying key riparian functioning issues that drive stream water quality and assessing effectiveness of the best management practice programs. This study was published in the Journal of Environmental Management (Ghimire et al., February 2025 Vol. 375).

17. Temporal variation in dissolved oxygen and phosphorus concentrations in Vermont restored riparian wetlands

Xia Gillespie, *University of Vermont*

As part of efforts to improve the water quality of Lake Champlain, the state of Vermont is working to reduce phosphorus (P) loading. One method of P load reduction is restoring riparian wetlands, which trap sediment-bound P but could release dissolved P during flooding. Understanding the magnitude and impact of this P release is crucial to evaluate if restored wetlands are acting as a net sink for P. This project explores how dissolved oxygen (DO) concentrations, water level, and concentrations of total suspended solids (TSS), total phosphorus (TP), and soluble reactive phosphorus (SRP) compare across annual flood cycles, during different temperature regimes, and across different watersheds. We monitored five sites on restored, riparian wetlands along the Otter Creek and Lemon Fair Rivers in central Vermont from 2022 through the summer of 2024. Each site included plots for wetland water quality monitoring, one adjacent river access point for river water quality monitoring, at least one high frequency water level logger and one dissolved oxygen sensor. Surface water grab samples for this analysis were collected from wetlands and rivers during the filling and draining limbs of flood events. Across both watersheds, there was a lack of change in wetland DO between the rising and falling flood stages, despite generally more aerobic river water. The magnitude of yearly flooding had the greatest effect on wetland oxygen regime. The findings suggest that while aerobic conditions are relatively stable across flood events, both oxygen regime and P retention can be influenced by annual flood magnitude and watershed.

18. Evaluating the Novel Dominant Bacteria in Thermophilic Anaerobic Digestion Using MAGs (Metagenome-Assembled Genomes)

Maria del Carmen Gonzalez Rangel*, West Virginia State University*

Anaerobic digestion (AD) is used for both large- and small-scale treatment of organic wastes, particularly animal manures, which become converted into bioenergy (methane). The AD process requires diverse communities of bacteria and archaea that create a food web with the general steps of hydrolysis, acidogenesis, acetogenesis and methanogenesis. AD processes are usually operated at mesophilic temperatures but thermophilic digestion is also used. The microbiomes of thermophilic AD are less understood than mesophilic and harbor more unique taxa. Thermophilic AD also has the reputation for being less stable. WVSU has a research and education facility for studying and improving the stability and versatility of thermophilic AD applied to livestock wastes. We operated a large pilot-scale (40 cubic m) thermophilic (56C) CSTR digester for more than a decade using poultry liter as the primary feedstock. Previous research showed that this digester was dominated by hydrogenotrophic methanogenesis. We have also conducted many experiments with 10-liter replicate digesters derived from the parent reactor to evaluate codigestion and system resilience to perturbations. In this study, we used metagenomics to explore the functional diversity of the dominant bacteria which are primarily novel species. Two 10-liter thermophilic (56C) digesters were operated with poultry litter feedstock for >5 years. AD performance variables (biogas, methane, COD, volatile acids, pH, ammonia) were measured using standard HACH tests and gas chromatography. DNA was collected from one time point in each digester. Illumina sequencing was performed. 43 bacterial and archaeal MAGs (metagenome-assembled genomes) were retrieved through KBase analysis. Four methanogen families were recovered including the recently described Methanomassiliicoccaceae. 39 bacterial MAGs were distributed in 8 named phyla and 1 unnamed phylum. Most of the MAGs were not classifiable below the family level; 8 were not classified below class; 5 were not classified below phylum. Two classes, Limnochordia and SHA-98, have been previously associated with acetate oxidation. This digester was found to harbor novel dominant bacteria at the levels of class and even phylum. Our analysis of MAG functions is ongoing. This research was funded by several USDA NIFA grants and Evans Allen funds to DHH.

19. Coal mining effects on the spatial differentiation of the microorganisms in a subwatershed in the Appalachia region

Flor de Maria Guerrero Toledo, *West Virginia State University*

Although the use of renewable energy has increased in recent years, coal is an essential resource that ensures energy security and sustainable development. Being considered the cheapest source of energy, coal produces 17% of the electricity in the US. However, the environmental impacts associated with conventional methods of coal mining and consumption can affect all trophic levels of the environment. Mining also influences water resources by changing hydrogeological conditions. The chemical and/or microbial weathering of metal sulfide-rich rocks produces sulfuric acid, which leads to the formation of acid mine drainage (AMD). AMD-impacted streams may even have a neutral pH and still be severely damaged by weathering of exposed minerals. West Virginia lies within the Appalachian Coalfield Region with extensive mountaintop mining. Our objectives were to compare sediment chemistry and microbial diversity in different geographic points in a circumneutral headwater stream damaged by surface mining. The upperk sediment samples (1 -10 cm) were collected from six locations near an AMD seep and surface mining. Chemical analysis (ICP-OES and Dionex) was done on replicate samples, and microbial DNA was extracted from sediment. Illumina sequencing and Earth Microbiome Project Protocols were used for 16S rRNA gene diversity. About 1 million 16S rRNA sequences were analyzed using QIIME-2. Statistical analysis (PCA, CCA, Discriminant Analysis, Pearson correlation, and hierarchical clustering) were done using R (v. 4.1.2). Both Discriminant Analysis and PCA showed clear spatial differentiation into two groups based on proximity to the AMD seep. Iron and sulfate decreased in the downstream locations. Comamonadaceae, Vicinamibacteraceae, Nitrosomonadaceae, Rhodobacteraceae, and Gallionellaceae were the most abundant families and are related to the biogeochemical cycles of iron, sulfur and nitrogen. In conclusion, the spatial differentiation of microorganisms was affected by the geochemistry of the sediment. Funding provided by USDA-NIFA-2021-38821-34706 grant to DHH.

20. Integrating Land Use and Climate Change Scenarios for Sustainable Water Quality Management in Agricultural-Urban Landscapes

Alvee Bin Hannan, *University of Georgia*

The Chesapeake Bay, the largest estuary in the United States, faces significant water quality challenges due to non-point source pollution from urban and agricultural areas. Nutrient runoff, sediment, and other pollutants have degraded the bay's ecosystem, prompting the U.S. Environmental Protection Agency (EPA) to establish the most extensive Total Maximum Daily Load (TMDL) in its history, targeting reductions in nitrogen, phosphorus, and sediment. As population growth and climate change intensify these pressures, innovative solutions are needed to manage competing land-use priorities sustainably.

This study leverages the Soil and Water Assessment Tool (SWAT) to simulate the impacts of land use and climate change scenarios on water quality in the Susquehanna River Basin, the largest tributary to the Chesapeake Bay watershed. Three scenarios—projected land use, projected climate, and their combined impacts—are modeled to evaluate the effectiveness of Best Management Practices (BMPs) in reducing runoff, sediment, nitrogen, and phosphorus loads. Agricultural BMPs include cover crops and buffer strips, while the urban BMPs include Low Impact Development (LID) strategies such as rain gardens and bioretention cells at a watershed scale.

Preliminary findings suggest that urban expansion will significantly increase phosphorus and sediment loads, while agricultural lands will continue to dominate nitrogen contributions. Climate change, with more frequent and intense storm events, poses additional challenges by reducing BMP effectiveness, particularly in urban areas. Despite these limitations, urban LID strategies show promise in mitigating pollution in highly developed areas, while agricultural BMPs remain critical for addressing watershed-scale nutrient loads.

This research provides actionable insights into BMP performance under future scenarios, highlighting the importance of integrating agricultural and urban management practices to achieve sustainable water quality improvements. Additionally, the study's focus on the SRB serves as a model for understanding and managing water quality in integrated landscapes that balance the needs of agriculture, urban development, and ecosystem health.

21. Weathering the Storm: Climate Entities Across U.S. Public Universities

Myranda Hentges, University of Kentucky

Resilience, adaptation, and mitigation in the face of climate change are prominent areas of focus for research and action across both public and private sectors. Addressing such a multifaceted challenge involves numerous stakeholders and interconnected components, including government agencies, non-profits, private companies, and academic institutions. Universities, with their established infrastructure, skilled personnel, and commitment to community impact at various levels- local, national, and global – are uniquely positioned to contribute play a leading role in these efforts. Over recent decades, universities have responded to climate-related challenges by creating various types of climate centers: laboratories, consortia, hubs, institutes, networks, and collaborative groups. These entities often work with external agencies to secure funding or foster partnerships that promote awareness and understanding of climate change impacts. However, the complexity of this active and crowded space often leads to lack of awareness or understanding regarding the diverse missions, roles, organizational structures, and connections among these entities. To address this, a comprehensive inventory of university-based climate organizations in the United States is being developed. This resource enables a detailed comparative analysis of their missions, organizational frameworks, and funding approaches. This will enhance public awareness of existing resources and clarify the trajectories of research and implementation efforts. Additionally, this will provide valuable insights for universities looking to establish their own climate-focused entities, offering guidance on efficient start-up strategies, effective collaborations, and sustainable funding mechanisms. Ultimately, this initiative aspires to elevate the impact of research and outreach in climate mitigation and adaptation, fostering a society better equipped to confront the challenges of climate change.

22. Nature-based Design Standards: Past, Present, and Future

Tamara Jameson, *Ducks Unlimited, Inc.*

With rising costs and threats from extreme weather events and climate hazards, nature-based solutions (NbS) hold great promise as climate adaptation alternatives. While these solutions show potential for providing multi-functional benefits, a lack of design criteria, guidance, and standards has been frequently identified as a barrier limiting application at scale. This poster examines past projects in the US that utilized nature in designs, present engineering resources that can be applied to NbS designs, and future upscaling of NbS implementation based on available data and practitioner needs. A proposed framework for development and long-term archival of engineering guidance is offered. Ultimately, this poster summarizes an engineering perspective on the past, present, and future of guidance development to facilitate design, funding, permitting, construction, and post-project monitoring of nature-based infrastructure. The solution relies upon strengthening evidence-based decision-making abilities for project teams and creating nimble best practice guidance focused on specific types of nature-based solutions.

23. Improving Saturated Riparian Buffer Design Methods with Empirical Nitrate Load Removal Data

Gabriel Johnson, *Iowa State University*

Saturated riparian buffers (SRB) are key ecological engineering practices for reducing nitrate loading from agricultural drainage in the U.S. Midwest, with an average annual nitrate removal of 46% or 9.4 kg/ha. A SRB uses a water control structure and perforated distribution pipe to reroute a fraction of the drainage discharge as shallow lateral groundwater flow in a riparian buffer, promoting denitrification and plant uptake. The current design standard (NRCS CPS 604) uses a drainage system capacity percentage criterion to determine design parameters, but this criterion is not directly related to nitrate load removal. As practice implementation increases, site selection and design methods should seek to optimize nitrate load removal to provide the highest water quality impact and cost efficiency ($/kg N). This study compared the measured nitrate load removal performance with the design parameters of 10 SRB monitored between 2011 and 2024 to guide improvements to the design process. Flow and load performance metrics (measured flowrates, percent flow treated, percent nitrate removal, load removal) were compared with design parameters from the NRCS design spreadsheet (design capacity, distribution pipe flow rate, percentage of drainage system capacity handled by saturated buffer design) to evaluate the efficacy of the design methods. Empirical flow performance exceeded predictions from the NRCS design spreadsheet. Mass load removal across sites was driven by contributing drainage area and saturated buffer length, while load removal percentage was driven by percentage of drainage system flow treated. Alternative design methods incorporating these results can improve the SRB design process to optimize nitrate load removal and water quality benefits.

24. Proposed Design of a wastewater treatment pilot plant for poultry processing wastewater using the Tidal flow constructed wetlands model

Natacha Kakama*, Auburn University*

Poultry processing uses large quantities of wastewater in the processing of meat and in maintaining operational hygiene, with the amounts estimated to be 26 liters per bird. The treatment of this effluent before release into nature is of paramount importance. Organic matter, nitrogen, phosphorous, and pathogens have been reported as possible contaminants in high concentration with potentially serious health and environmental concerns. This work proposes that using Tidal Flow Constructed Wetlands provides an effective and sustainable approach for poultry wastewater treatment using natural processes that include wetland vegetation, soil, and microbes. A tidal flow constructed wetland system has been designed to explore its performance relating to its ability to remove pollutants, specifically organic matter and nitrogen, from poultry processing plant wastewater. Experiments with the wetland system will feature four replicates on the Tidal Flow constructed wetland mesocosms. The soil will be varied in different sets; namely, limestone with peatmoss, coarse gravel mixed with pea gravel, proprietary substrate with biochar, proprietary substrate with Typha plantation, and proprietary substrate with biochar & Typha plantation were included in this study. The Tidal flow operates with alternating filling and draining cycles over 24 hours, treating 7.5 gallons of real poultry wastewater over the course of 7 to 14 days. Model projections predict that the system is expected to remove 95, 85 and 64% of Chemical oxygen demand, ammonium nitrogen and nitrate nitrogen, respectively. The processes will be monitored by measuring chemical oxygen demand (COD) and nitrogen to determine the first order removal rate constants for the wastewater constituents to refine a model for treatment of poultry industry wastewater.

25. An Example of High Algal Turf Scrubber Productivity

Patrick Kangas, *University of Maryland*

Algal turf scrubbers (ATS) are an ecologically-engineered technology for improving water quality. The technology is based on net production of periphyton algae which take up pollutants in their biomass during growth. The pollutants are removed from the system when the algal biomass is periodically harvested. The ATS is designed for maximum productivity in order to achieve the highest performance of water quality improvement. In this presentation the productivity rate of an experimental ATS that was operated on Baltimore Harbor, Maryland is reported. Some of the highest gross primary productivity rates ever recorded for an ecosystem were estimated in the system, at more than 300 grams of dissolved oxygen/m2/day in daylight hours during the summer. These high gross primary production rates supported the elevated net primary production that is the basis of the water treatment capacity of the ATS. Values of the metabolism of the Baltimore Harbor ATS are compared with published data from other ecosystems in order to assess the magnitude of productivity that the ATS technology is capable of supporting.

26. Evaluating the Water Quality Performance of a Subsurface Gravel Wetland Treating Stormwater Runoff

Molly Landon, *North Carolina State University*

Subsurface gravel wetlands are engineered treatment practices designed to treat stormwater runoff by forcing water horizontally through a layer of gravel, removing pollutants via physical filtration, adsorption, biological uptake, and microbial transformation. While gravel wetlands have been used for decades in wastewater treatment, their use in stormwater management is relatively new, and research on their effectiveness remains limited. This study evaluates the water quality performance of a subsurface gravel wetland treating roadway runoff from a 0.94-acre drainage area. Monitoring began in March 2024 and will continue through summer 2025, with samples collected from the wetland's inlet and outlet during storm events. Water quality samples are being analyzed for nutrients and sediments to assess the system's pollutant removal efficiency. Preliminary data from six storm events suggest that the wetland is effectively removing ammonia nitrogen, particulate bound phosphorus, and total suspended solids, with median removal efficiencies of 63%, 38%, and 87%, respectively. However, the system exhibits export of nitrate-nitrite nitrogen, total nitrogen, and orthophosphate at median rates of 320%, 42%, and 61%, respectively. Potential causes for pollutant export include incomplete denitrification due to insufficient anoxic conditions and leaching of dissolved pollutants from the soil media. Once data collection is complete, additional statistical analyses will be performed to identify the factors driving the nutrient export and inform design recommendations. These findings highlight the complexity of pollutant dynamics in stormwater treatment systems and the importance of optimizing gravel wetland design for effective water quality treatment.

27. Evaluating Alternative Development Scenarios to Protect Vital Sportfish Habitat in SW Florida

Kallan Latham, *University of Florida*

High densities of human populations gather on coastlines and bring about rapid urbanization, impacting fragile ecosystems such as estuaries, salt marshes, and mangrove forests. Some of these impacts include increased freshwater runoff, sediments, and nutrients, as well as disconnecting habitat continuity. In Charlotte County, FL a mosaic of coastal ponds and creeks serves as a critical sport fishing nursery habitat for Tarpon and Common Snook. Sport fishing in the region is a major economic driver, attracting visitors from around the world. These sensitive habitat areas are situated within an area that was platted for future development in the 1980s but has remained relatively undeveloped until recently. If fully developed, the increased runoff could degrade these areas and ultimately impact the regional economy. Modifying the development plan by clustering developed lots further away from the habitat may reduce the impacts on these habitat areas. To evaluate this, a hydrologic and hydraulic (H+H) model will be developed for the study area to evaluate the effects of future scenarios, including various land development iterations and sea level rise, on the coastal ponds. Outcomes from this model will inform policy and regulations to protect these sportfish nursery habitats. Data collection has already occurred along with a literature review of common H+H models such as StormWise (ICPR4), EPA SWMM, and MIKE11. A model of existing conditions will be calibrated and validated by comparison of results to observed outcomes of select rainfall and hurricane events. Potential future conditions will then be simulated and impacts evaluated to inform Charlotte County's future land use plans and regulations.

28. Unsteady flood dynamics across the channelized, agricultural floodplain of the East Fork White River, Indiana

Sarah Leach, *Virginia Tech*

Floodplains attenuate flood peaks, trap sediment, process nutrients, and provide refuge for biota. Their efficacy in providing these ecosystem services depends on the extent and duration of inundation. Many investigations into the dynamics of floodplain inundation rely on steady-state models or assumptions that relate a single flood stage to a corresponding single pattern of inundation. Through unsteady flow modeling and field measurements, we show that different flood hydrographs, with the same peak stage and discharge, result in different patterns of inundation. This is due to a combination of factors including the rate of hydrograph rise and fall, duration of the peak, seasonal variation in vegetation, and antecedent moisture conditions. These factors affect the temporal progression of water into and out of the floodplain. We show this behavior in the floodplain of the East Fork White River, Indiana using 2D HEC-RAS modeling with field validation from stage and flow data from USGS gages, stage data from pressure transducers at 18 locations, and stage and velocity data from acoustic Doppler velocity profilers at two locations.

29. Lilly Branch Restoration Concepts: An Exploration of Stream Rehabilitation Scenarios

Bryce LeCates, *University of Georgia*

This project explores form and processed-based stream design alternatives to ameliorate issues within a daylit section of Lilly Branch, a tributary to the North Oconee River. These issues included head cut drainage channels, channelization with limited access to the floodplain, and dense invasive growth in the riparian area. Methods used for the form-based channel design were typical riffle surveying of both Lilly Branch and restored reaches in the area to determine the ideal design channel type based on Rosgen's stream classification. The process-based design was informed by the Low-Tech Process Based Design Manual. Ultimately, we decided a mixture of both form-based and process-based design would satisfy a range of ecological, financial, and educational goals. By comparing stream restoration paradigms, this project demonstrates that there are a range of options for improving water quality and creating healthier riparian habitat in our urban stream systems.

30. Assessing the Impacts of Land Use and Climate Changes on Water Quality in the Santa Fe River Basin Using Integrated Hydrologic Models

Dogil Lee, *University of Florida*

31. Bringing Ecological Engineering Home: Tennessee Smart Yards

Andrea Ludwig, University of Tennessee

The rate of land conversion in Tennessee from agriculture to other uses, mainly residential, is about 10 acres per hour. While agriculture may pose risks to the environment, generally, agricultural lands maintain more ecosystems services as compared to urban development. Increased impervious surfaces impact local waterways and natural resources by way of increased runoff generation, decreased vegetation abundance, and reduced support for wildlife, among other impacts. Green infrastructure can mitigate impacts of urbanization, but Tennessee does not currently require green infrastructure in stormwater management plans for new development projects (although it is incentivized). With weak and varied regulations for development, the importance of voluntary stewardship practices becomes increasingly important. The Tennessee Smart Yards program is a university-led education and yard certification program that teaches participants about ecologically sound landscaping approaches. The University of Tennessee Extension partners with municipal stormwater programs and others to deliver the program at the county level. Modeled after other successful yard certification programs (e.g. Florida Friendly Landscapes), as land stewards adopt practices in their landscapes, they collect inches towards a certified yard. Participants learn about stewardship practices, such as rain gardens, soil health management, and riparian buffers, through online videos. Since certifications have been recorded using a digital response form (circa October 2020), there have been over 750 yards certified across the state with over 13,500 stewardship actions logged. With those certifications, there have been 211 new residential rain gardens built, 1,300 acres of land improved with native plants, 249 riparian buffers maintained, and dozens of HUC12 watersheds protected with certified Tennessee Smart Yards. This presentation will showcase how Extension programs can be adapted from one location to another to meet unique needs of audiences and incorporate technology to foster a sense of community that leads to greater engagement and meaningful change in mindsets that ultimately result in greater ecological function in residential landscapes.

32. Emergy Analysis for the University of Maryland's 2007 Solar Decathlon entry, LEAFhouse

Joshua Marlowe, *University of Maryland*

The LEAFhouse, a solar-powered and net-zero energy designed home built by students in the 2007 US Department of Energy Solar Decathlon, is the poster child for sustainable living. Approximately 18 years after the creation of LEAFhouse, an emergy analysis of the sustainable home will be conducted to analyze the environmental impacts of its net-zero design. This assessment will test LEAFhouse's environmental sustainability regarding its construction, operation, and maintenance over the last 18 years. Emergy methodology, created by H.T. Odum, uses aspects such as renewable (R), nonrenewable (N), and purchased (F) into a common solar energy unit. This allows the evaluation of resource efficiency. The 800 square foot house currently resides at 3907 Metzerott Road, College Park, MD. Key aspects of the house include solar energy (7.2 kW of power generation), energy-efficient double-glazed windows and doors, cupiuba wood paneling, bamboo plywood, tigerwood flooring, and recycled materials. By using unit emergy values from literature, annual emergy flows can be estimated. Emergy Yield Ratio ($EYR = (R+N+F)/F$) can be calculated to determine if there is a high return on investment due to relying on solar energy. The Environmental Loading Ratio ($ELR = (N+F)/R$) determines the burden that construction may have had on the environment. The final equation to determine the emergy analysis is the Emergy Sustainability Index ($ESI = EYR/ELR$) which determines the long-term viability of LEAFhouse ($ESI > 1$). These tests, along with further understanding of the materials and construction of the house, will determine the emergy analysis of LEAFhouse 18 years after its construction for the 2007 Solar Decathlon.

33. Identifying Optimal Media for Duckweed Exudate Analysis

Katherine McCullen, *Michigan State University*

Phytoremediation is a complex system of interactions between plants, microbes, and their abiotic matrix. The size and complexity of these natural systems makes it difficult to study in situ, as well as to replicate in vitro. Our goal is to better understand phytoremediation by Lemna minor, otherwise known as duckweeds. The metabolic capabilities and therefore, remediation potential of duckweeds is directly linked to their physiological state and response to growth conditions. Typical health metrics for plants are growth rate and chlorophyll content, but these provide limited insight into metabolic state. Plant exudates are an emerging field of study, and are known to change based on environmental stressors, pathogens, and/or their associated microbial communities. Exudates can therefore provide more detailed insight into plant metabolism and physiology. In order to optimize conditions for future in vitro studies, we wished to first examine the effect of laboratory growth medias and their impact on duckweed health and exudate profiles. Our study compared five commonly used duckweed growth medias: Duckweed Nutrient Solution, Hoagland, Schenk & Hildebrandt, Steinberg, and Swedish Standard (SIS). Axenic cultures of L. minor were grown in bulk on sucrose-modified Schenk Hildebrandt plates, then transferred to modified Schenk Hildebrandt plates without sucrose before beginning the study. Moisture content and chlorophyll content were quantified for the plated biomass before moving into the experiment. Samples were acclimated in bulk to their respective liquid medias for 1 week, then triplicate 1g fresh weight samples were transferred to fresh media for a 1 week growth phase. At the beginning and end of the growth phase, fresh weight, moisture content, and chlorophyll content were measured. At the end of the growth phase, the liquid media of each sample was de-salted and concentrated with solid phase extraction before analyzing with LC-MS. Relative growth rate of each sample and the chlorophyll content were compared across all five medias to examine overall health. MS features were identified as exudates by subtracting MS features found in media only controls. Exudate profile separation was examined via OPLS-DA. With further investigation, we hope to identify key exudates from the profiles and link them to overall health.

34. Capstone Project: Designing a Floating Treatment Wetland System for Nutrient Removal Practices with Advanced Drainage Systems (ADS)

Matthew Mendak, *The Ohio State University*

Natural water bodies are prone to water degradation caused by stormwater runoff in rapidly urbanized and agricultural areas. These conditions cause excessive nutrients in water systems, including nitrogen and phosphorus. Advanced Drainage Systems and Ohio State University partnered on a capstone project to design a floating treatment wetland (FTW) to improve water quality in stormwater detention ponds. Floating treatment wetlands are planted floating platforms within bodies of water that provide additive treatment of stormwater runoff from urban and agricultural areas where normal treatment conditions are insufficient. FTWs have been an increasingly valuable option for urban planning strategies and water management due to the cost-effective and eco-friendly components within the design, including plants and recycled materials. FTWs that have been properly designed help significantly reduce excessive dissolved nutrient levels. The capstone design team is working to design an FTW system to be implemented in stormwater detention ponds, that contains less plastics compared to industry competitors.

35. Synergizing Green Infrastructure: Exploring the Combined Use of Permeable Pavement and Geothermal Energy Systems

Lydia Miller, *North Carolina State University*

As urban areas expand, water runoff and energy demands increase. Combined with the escalating impacts of climate change, such as heightened risks of flooding and pollution, these challenges highlight the growing importance of green infrastructure innovations. Two such systems, permeable pavement and geothermal energy, have been independently researched and implemented for decades. Permeable pavement systems (PPS) for stormwater control were first introduced in the United States in the 1970s, while the first geothermal heat pump system (GHPS) was installed in Portland, Oregon, in 1946. The integration of these two systems is a relatively new concept, with one of the earliest laboratory experiments conducted in 2008. Although initial studies have demonstrated promising potential, further research is required to assess feasibility, cost-effectiveness, and optimal design parameters. Building on previous laboratory and real-world studies, we designed a field experiment in Wilson, NC, to test a combined system with optimized design parameters. The site is scheduled for construction in spring 2025, with data collection planned to span one year following construction. The main objectives of the project are to evaluate the water quality exiting the permeable pavement system, assess the energy efficiency of the geothermal coils, and provide a practical demonstration of a combined PPS and GHPS system. To assess the heat pump's efficiency, the Coefficient of Performance (COP) will be calculated using data collected on temperature, air flow, and energy usage. COP serves as a standard efficiency measurement, with a minimum value of 3.1 required to meet ENERGY STAR standards for geothermal closed-loop systems. In addition to energy efficiency, the permeable pavement performance will be evaluated by monitoring flow rates and analyzing the water quality during storm events. Water quality samples will be collected from the underdrain using automatic portable samplers and analyzed for nutrients and sediments. The results from this study will provide critical insights into the performance of this integrated system, helping to address both stormwater management and energy demand challenges. The integration of these two green infrastructure systems has the potential to incentivize contractors to adopt PPS over traditional pavements by demonstrating enhanced financial benefits, such as reduced energy costs, that justify higher initial investments.

36. A Case for Increased Consideration of Downstream Riverine Health Analysis in Stormwater Management Regulation

John Montoya, *University of Georgia*

Flood prevention and maintaining water quality standards are incredibly important tasks. Without stormwater management, watersheds would experience massive increases in peak flows and sediment transport that would quickly alter river morphology and in turn the surrounding area. Current standards and regulatory requirements ensure that development will not have an adverse impact on the site itself by returning peak flows to pre-development conditions. However, the same cannot be said about stream conditions downstream of the site. This study focuses on the intersection of stormwater management and downstream riverine health analysis. A StormWise model was developed to represent an area of new development at the Savannah River Site (SRS) and develop an understanding of the runoff quantity and timing of the site. We expect the StormWise model to show how the conventional stormwater infrastructure, while maintaining peak flows to pre-development conditions, is creating harmful conditions for the downstream reaches. Several detention ponds at the same site can cause an unintended new peak in flows when all the water that has been detained by each pond is released at similar time periods. Furthermore, detention ponds reduce the sediment transport of the watershed, which compounds with unexpectedly high flows to create erosive conditions. Left unattended, this could lead to head cuts traveling upstream and affecting the SRS development and large amounts of sediment being transported downstream and damaging even more of the river system and the surrounding ecosystems. A River Evolution Model (REM) was also developed to understand how stormwater flows predicted by StormWise due to the site development would affect stream erosion downstream. The REM model is expected to show that the current conditions upstream are causing massive incision and channel degradation. Through the research conducted at the SRS, we hope to better define the relationship between stormwater management and downstream riverine health in order to support updating stormwater management regulations.

37. Filamentous Algae as a Natural Biofilter: Enhancing Nutrient Recovery in Controlled Environment Agriculture

Shokouh Mousavi, *Auburn University*

Benthic filamentous algae cultivation has been widely utilized for wastewater remediation and nutrient recovery across various industries. However, its potential for material recovery from wastewater within emerging controlled environment agriculture (CEA) systems remains underexplored, despite the growing need for sustainable resource management in these closed-loop systems. A key characteristic of these algae—their natural tendency to attach to surfaces or form turfs and mats—simplifies the otherwise challenging process of algae harvesting in microscale cultivation. Unlike conventional microalgae, benthic filamentous strains offer a promising biomass processing approach that eliminates the need for energy-intensive harvesting methods. This study investigates the critical role of filamentous algae in CEA for wastewater treatment, evaluating their tolerance to both low-nutrient and high-nutrient conditions to assess their suitability for greenhouse wastewater management.

38. Optimization and Deployment of Biofilters with Ultra-High Surface Media for Highly Efficient Stormwater Remediation

Surjith Krishna Muthukumar, *Georgia Southern University*

Runoff from urban and agricultural watersheds containing excess nutrients is known to exacerbate eutrophication in receiving water bodies. However, managing nutrients from nonpoint source pollution may be challenging because of the limited sustainable options available. This study provides insight into using a sustainable approach for nutrient reduction (nitrogen and phosphorus) from runoff by optimizing biofilters with a 3D printed crafted medium. These media can be printed to achieve a high surface area to volume ratio that provides an adequate environment for algal-bacterial consortium to thrive. Three reactors with a hydraulic retention time of 4 days and a volume of 0.25 m 3 were tested for nutrient removal in a controlled environment. The reactors were built with a media having a surface area of 1195 m3/m2 , which was 20 percent higher than conventional media used for nutrient removal. Inflow (Cin) and outflow (Cout) concentrations for ammonia, nitrate, and orthophosphate (OP) were measured to assess the reactors performance. Results showed that Cout/Cin ratios for ammonia, OP, and nitrate in a reactor with 3D printed media were 0.69, 0.86, and 0.42 respectively. In a reactor having media plus high illumination, to improve algal growth, ammonia, OP, and nitrate Cout/Cin values were 0.68, 0.75, and 0.22, respectively. Nutrient removal in a reactor without media was negligible. Results further suggested that the nutrient reduction in the reactors with media was the result of the increased synergy between algae and biofilm, which was facilitated by the media's ultra-high surface area. Results also suggested that excessive biofilm growth resulted in lower water quality as TOC levels were high in the reactor will artificial lighting. Overall, the study demonstrated that the novel 3D printed media may be a sustainable option for nutrient reduction in runoff water.

39. Analyzing nitrogen and phosphorus in restored riparian wetlands

Lauren Nelson, *University of Vermont*

Water quality in Lake Champlain is negatively impacted by phosphorous and nitrate runoff from the agriculturally dominated watershed into the lake. Management efforts to protect the lake include the restoration of riparian wetlands which can retain or remove excess nutrients during flooding. We monitored five riparian wetlands in central Vermont that were previously under agricultural land use. Water grab samples were collected during flood events and analyzed for total suspended solids (TSS), soluble reactive phosphorus (SRP), total phosphorus (TP), and nitrate (NO3-). In this poster presentation, we will focus on potential interactions between nitrate availability in the water column and phosphorus dynamics, showing data from recent historic flood pulses. We hypothesize that nitrate availability can inhibit release of phosphorus associated with iron in wetland soils to the water column as SRP, as has been observed in other some other ecosystems. This could potentially help explain why field data have sometimes indicated less SRP release from soil than would be expected based on laboratory intact soil core incubations.

40. Howard Marsh Wetland Restoration

Brian Nicholson, *Ducks Unlimited, Inc.*

The Howard Marsh projects in northwest Ohio encompass almost 1000 acres of diked and drained historic wetlands. The infrastructure used to drain the area allowed for agriculture and residential development, despite the land being lower than average water elevations of the adjacent Lake Erie. Ducks Unlimited and partners worked to provide flood protection, water quality treatment, habitat restoration, and public park usage of the area through innovative use of engineered wetlands. This poster will present on that project.

41. A Spatial Conservation Prioritization of Coastal Freshwater Impoundments Based on Predicted Climate Impacts and Waterfowl Habitat Value

Alexa Ouellette, *University of Georgia*

Along the US south Atlantic coast, freshwater impoundments have increasingly faced damages from dike overtopping and salinization by outside tidal and river water sources, often due to tropical weather systems. Under current sea-level rise projections, impoundments will become increasingly vulnerable to these events, leading to more frequent costly repairs. Coastal impoundments were created in the mid-20th century to enhance freshwater wetland habitat for migrating and wintering waterfowl, and without the conservation of these tidal freshwater systems, freshwater habitat for waterfowl and shorebirds in coastal areas could decline. With limited financial resources, it is critical to prioritize tradeoffs between habitat value and the cost of maintenance and repairs. Thus, our goal was to create a conservation prioritization tool to better guide future management decisions that balances the tradeoffs of vulnerability to damage/loss from sea-level rise and storm surge, with waterfowl habitat value for twenty-four state and federally managed impoundment properties along the Georgia, South Carolina, and North Carolina coasts. To assess storm surge vulnerability, we summarized the probability of flood inundation under both current conditions and one meter of sea-level rise for each impoundment, from the US Army Corps of Engineers' South Atlantic Coastal Study. To assess relative value for waterfowl, we used eBird data and National Wetland Inventory data for the study area to build predictive models of relative abundance for eight species of ecological and recreational significance. Our findings show how predicted values from both exercises can then be normalized and (with expert input on the cost) be used to prioritize areas for continued management, ensuring the sustainability of waterfowl habitats in the face of rising sea levels.

42. Influence of Material and Density on Intertidal Oyster Enhancement Success Using Wood and Bamboo Stakes in a Subtropical Estuary

Briar Ownby-Connolly, *University of South Carolina*

Over 85% of natural oyster reefs have been lost globally, prompting widespread restoration efforts to recover the critical ecosystem services they provide, such as water filtration, shoreline stabilization, and habitat provisioning. Traditional restoration methods often use plastic mesh bags filled with loose oyster shells as substrate for larval oyster settlement. However, growing concerns over plastic pollution in coastal and marine environments have driven interest in biodegradable alternatives. Few studies, however, have explicitly tested the effects of material type and spatial design on restoration success. Our study will evaluate the effectiveness of wood and bamboo stakes deployed at three spacing densities (6, 9, and 12 inches apart) for oyster enhancement and reef restoration. Across 30 experimental plots, oyster recruitment (density) and growth (shell height) will be quantified for two years to assess material and density effects. Additionally, aspects of ecological function will be measured through monitoring associated nekton communities over time across 15 experimental plots of the wood stakes. All monitored metrics will also be collected at adjacent natural oyster reefs to assess comparability of wood stakes to natural habitat. Findings from this study aim to provide actionable insights for restoration practitioners, identifying optimal materials and spatial designs to maximize oyster recruitment, growth, and ecosystem service enhancement. This presentation will detail the experimental design and provide preliminary results from initial monitoring efforts.

43. Evaluating Riverine Microbiomes Under Multiple Environmental Stressors In A Heavily Affected Central Appalachian River, West Virginia

Sailesh Phuyal, *West Virginia State University*

Riverine sediment microbiomes are crucial for driving biogeochemical cycles that support freshwater ecosystem services. Urban rivers are especially intriguing due to their exposure to natural and human influences. The Kanawha-New River Basin, spanning 31,000 km2 in the Appalachian region, faces aquatic ecosystem threats from persistent xenobiotics like coal dust, Polycyclic Aromatic Hydrocarbons, and agrochemicals that are linked to diverse land uses and industries. Our research focused on how human-induced contaminants impact microbial diversity and methane production in river sediments, a key step in the anaerobic carbon cycle. Sediment cores were collected along a 9 km stretch of Kanawha River in Charleston, West Virginia, and divided into two layers (0 - 5, 5 - 10 cm). 16S rRNA gene amplicon sequencing was performed on the Illumina MISeq-300 platform, and the subsequent analysis was done with QIIME 2. Chemical profiles were created using ICP-OES for metals and ion chromatography. Statistical analysis was done using JMP and R. PCA showed differentiation of samples based on locations and sediment layers, with the chemical variables NO3-, Cl-, and SO42- strongly influencing differences among locations. Analysis using the SILVA 138 database identified 89 phyla and 2,434 species, with Proteobacteria being the most abundant phylum, followed by Bacteroidota. Among the top 60 most abundant hypothetical

species, none were named. The only identifiable methanogen taxon, Methanosarcinales, was at the ordinal level. A sediment microcosm experiment was used to test the effects of coal, fertilizer, glyphosate, wastewater effluent, naphthalene, and phenanthrene on methane production in sediment cores. Unamended, control microcosms did produce methane. Low concentrations of naphthalene and fertilizer increased methane production, while other contaminants had minimal effects. In conclusion, the sediment microbiome contained many novel taxa at all levels, ranging from species to phylum. In addition, methane production by the sediment microbiome could be altered by some contaminants. This research was funded by USDA NIFA grant 2024-38821-42029 to DHH.

44. Comparative System Modeling and Energy Performance of the UMD Solar Decathlon Entries reACT and LEAFhouse

Donald Plugge, *University of Maryland*

As global resource consumption rises and waste accumulates, it is crucial to examine how sustainably designed buildings evolve in energy efficiency—both in construction and operation—over time. The U.S. Department of Energy Solar Decathlon challenges teams to design and build sustainable, energy-efficient homes, with the design and build sections each spanning a year. The University of Maryland has participated in multiple competitions, notably designing LEAFHouse (Leading Everyone to an Abundant Future) in 2007 and reACT (Resilient Adaptive Climate Technology) in 2017, both of which secured second place internationally and first place nationally. This study examines the evolution of energy-efficient home design by comparing these two projects, assessing how technological advancements influence sustainability over time.

LEAFHouse was designed with features such as solar panels, a liquid desiccant waterfall for humidity control, a green wall, and greywater recycling. Its adaptable living space, created through movable panels, maximized functionality within a smaller footprint.

A decade later, reACT expanded on these principles, integrating smart home technologies, a hydroponics system, courtyard which collects heat from the sun, and a dryer and oven which utilize the courtyard's heat to function.

By analyzing the differences in design strategies, materials, and energy systems between these homes, this research aims to highlight how advancements in technology and sustainability practices have influenced energy-efficient housing. The differences will be analyzed using emergy, and the corresponding data will be incorporated into the analysis. Understanding these trends can inform future developments in sustainable architecture, guiding the creation of buildings that minimize environmental impact while maximizing efficiency and resilience.

45. Sustainable Wastewater Treatment through Algal Systems

Gabriel Proano-Pena, *Auburn University*

Wastewater treatment is an essential post-process that municipalities must manage as part of their routine operations. This is an aspect that needs continuous improvement given the reinforcement of regulations. To meet these regulatory demands, algae cultivation systems have provided sustainable solutions for applications requiring high nutrient removal throughout the process. This work aims to review the state-of-the-art application of algae systems in municipal wastewater treatment, emphasizing their capabilities for effective water purification.

The implementation of algae systems can be maximized when deployed as Algal Turf Scrubbers (ATS). This technology, based on periphytic filamentous algae, can remove nutrients from water bodies. They can do it by themselves or even coexisting with well-established biofiltration methods. Although ATS has demonstrated effectiveness in nutrient removal, broader municipal applications have been limited, likely due to operational constraints and misunderstandings about their utility and application. This review will summarize past applications of attached filamentous algae systems in municipal wastewater treatments and preliminary data from an outdoor system that focuses on new opportunities for cultivation and sustainability approaches that will serve as a reference for specialists in this field.

46. Investigating the Impacts of Coastal Flooding on Sandy Island's Ecological and Cultural Resilience

Tyler Pyatt, *University of South Carolina*

Sandy Island Preserve, the nation's largest protected freshwater island on the East Coast, is a unique ecological and cultural landmark. Spanning over 9,000 acres of prehistoric sand dune, the island has a rich ecosystem and the historic Gullah Geechee community—descendants of enslaved Africans who once worked its rice plantations. However, increased coastal flooding threatens the island's environmental integrity and the cultural resilience of its inhabitants. This study aims to assess the physical, cultural, and environmental impacts of rising flood events on Sandy Island and other marginalized coastal communities. By examining adaptation strategies already in place, we will identify their effectiveness, limitations, and barriers to implementation. Additionally, we seek to develop culturally sensitive approaches to preserve the heritage and well-being of at-risk communities while advocating for sustainable, resilience-building practices. Our two-pronged research approach will investigate both anthropogenic and environmental effects of increased flooding. We will collect oral histories and conduct focus groups with Sandy Island residents to document their lived experiences, concerns, and adaptive responses. Simultaneously, we will analyze surface waters from key locations to assess flood-related changes in water quality. The outcomes of this project will provide valuable insights into the adaptive capacity of the Gullah Geechee community, the socio-environmental challenges faced by coastal populations, and the role of cultural identity in resilience-building. Additionally, the study will contribute to understanding how coastal flooding alters water quality and threatens public health. By integrating scientific analysis with community engagement, this research seeks to inform adaptation strategies that safeguard environmental sustainability and cultural heritage in the face of climate-driven coastal change.

47. Does reservoir sediment flushing change water quality downstream? A study in the Big Blue and Kansas Rivers downstream of Tuttle Creek Reservoir

Josiah Quinlan, *Kansas State University*

Reservoir sedimentation and subsequent loss of flood protection and water supply is a mounting challenge to water security in Kansas and globally. Water injection dredging (WID) has been proposed as a novel and potentially economic approach to flush sediment from reservoirs and pass it downstream. However, as this technology has not been tested in freshwater inland reservoirs there are many questions about geomorphic and ecological effects downstream, particularly as flushed waters are expected to contain fine sediments and bottom waters that are rich in dissolved nutrients. In this poster, I will present baseline data regarding water quality in reaches of the Kansas River, directly upstream and downstream from Tuttle Creek Reservoir in which WID is anticipated to occur in summer 2025. These baseline data will be used to characterize water quality (TSS, pH, nitrogen and phosphorus forms, chloride) of both surface waters and the hyporheic zone. A set of piezometers were installed along monumented cross sections in the Kansas River upstream and downstream of its confluence with outflow from Tuttle Creek Reservoir from which hyporheic water will be collected on an approximately monthly basis. Surface water samples will be collected at the same time. Sampling will continue immediately following WID operations this summer and will be used to determine if there are changes in water quality due to sediment flushing from the upstream reservoir. We anticipate that TSS and nutrient concentrations will increase, and that the response time may be lagged and prolonged in the hyporheic zone.

48. Removal of Antibiotics from Agricultural Wastewater Using Ecological Engineering Techniques

Sushmita Roy, *North Carolina Agricultural & Technical State University*

Antibiotics are widely used in animal agriculture to treat diseases, boost growth, and improve feed efficiency. Approximately 70% of antibiotics worldwide are used in intensive animal farming, where 20-90% of the administered antibiotics are excreted by animals in unchanged or active forms. When manure is applied as fertilizer, antibiotics are introduced into agricultural soil, which may leach into groundwater, and reach surface water through runoff after irrigation or rainfall. The contamination impacts soil and water quality and crops grown in the area, leading to antibiotic residues in food and contributing to antibiotic resistance. Amoxicillin (AMX), a widely used antibiotic in human and veterinary medicine, is poorly absorbed in animals with 80-90% excreted in active form. As a result, AMX has been detected at a concentration of 127.49 ng/L in the water posing serious risks to the ecosystem and human health. Ecological engineering solutions, like constructed wetlands (CWs), offer cost-effective and sustainable approaches for mitigating antibiotic contamination involving plants, microorganisms, and soil media. This study focused on the removal of AMX from agricultural runoff using hybrid CWs, having surface flow wetlands planted with duckweed and subsurface flow wetlands containing layered gravel, fine gravel, and sand, and planted with cattail and bulrush. AMX spiked wastewater was introduced to simulate agricultural runoff. Influent and treated effluent samples were prepared using SPE and analyzed using LC-MS/MS. Results showed removal efficiencies were 99%, 86%, and 69% across three pulse events. Overall, this study highlights CWs as a promising post-treatment solution for amoxicillin contamination.

49. Leveraging Ecological Engineering to Improve Aging Rural Wastewater Treatment Systems and Effluent Quality

Nathan Salas, *North Carolina State University*

Many rural wastewater treatment plants (WWTPs) are overlooked sources of nutrient pollution in surface waters across the U.S. Due to less stringent discharge and monitoring requirements, these systems often contribute to localized eutrophication. North Carolina has approximately 425 minor WWTPs (<1 MGD), many with aging infrastructure that reduces treatment efficiency. Collectively, these facilities could play a major role in excessive nutrient loadings to surface waters. This project aims to quantify pollutant loadings (nitrogen, phosphorus, organics, suspended solids, and bacteria) from six WWTPs in North Carolina. This data will provide valuable insights into treatment efficiencies and inform decisions regarding upgrades for these facilities. Five of the systems rely on traditional grey infrastructure, while one utilizes a lagoon and constructed wetland system. Initial sampling over 20 months indicates that traditional WWTPs effectively remove ammonium (NH_4^+-N), organics, and total suspended solids (TSS) but exhibit variable total nitrogen (TN), nitrate (NO_3^--N) and total phosphorus (TP) removals, with effluent concentrations reaching upwards of 25 mg/L NO_3^--N and 6 mg/L TP at some sites. Additionally, disinfection systems frequently fail to meet discharge limits for fecal coliforms. In contrast, the constructed wetland system produced the lowest effluent TN and TP concentrations. Pilot scale surface flow and subsurface flow constructed wetlands are under design to demonstrate the efficacy of their use as a tertiary treatment process at rural WWTP to further improve nutrient removal. The results of this research will be used to quantify the decline in treatment performance of aging rural WWTPs and the opportunities constructed wetlands may provide to improve effluent quality across North Carolina.

50. Evaluation of the potential benefits and practical barriers for co-digestion of food waste and manure on Vermont dairy farms

Hailey Sanphy, *University of Vermont*

Diverting food waste from landfills reduces greenhouse gas emissions, helping to mitigate climate change. Vermont Act 148, enacted in July 2019, bans the disposal of food waste in landfills at all levels, including households. Instead food and beverage waste must be diverted to use as animal feed, anaerobic digestion, or composting. This study explores the potential to increase food and beverage waste management through anaerobic co-digestion with manure on Vermont dairy farms. Digestate, pre-consumer beverage waste, and post-consumer food waste were collected locally and utilized to conduct benchtop laboratory experiments to assess biomethane potential (BMP) over 30 days. Feedstocks and digestate were analyzed for nutrient composition before and after experiments to understand the potential impact of food waste co-digestion on farm nutrient management, as well as for microplastics contamination prior to BMP testing. Preliminary results confirm expected increases in methane production with the addition of both de-packaged soda waste and household food waste to manure substrates. Additionally preliminary results indicate that food waste addition at levels resulting in desired methane production does not substantially alter the phosphorus content and availability in digestates. These findings demonstrate the potential benefits for farmers who incorporate post-consumer food waste into their AD systems, offering an economic incentive while supporting statewide sustainability efforts. Microplastics and farmer survey results will also be presented to examine what factors might limit food waste intake by dairy farms.

51. Investigating the Role of Channel Morphology and Sediment Lithology in Shaping Downstream Sediment Transport in Several Rivers of Washington State

Fatemeh Shacheri, *Virginia Tech*

As climate change drives more frequent and intense alpine mass-wasting events, mountainous landscapes and downstream ecosystems face growing risks. At the same time, rapidly expanding urban communities in the lowland regions of the Pacific Northwest are becoming increasingly vulnerable to shifting sediment and water dynamics, heightening environmental and infrastructure challenges. The timing and attenuation of sediment pulse transport can initiate cascading downstream effects, including increased flood hazards for communities and substantial modifications to riverine habitats. This study examines how variations in channel morphology and sediment lithology influence downstream sediment transport and its associated impacts across rivers with distinct geomorphic characteristics, focusing on the White River, Suiattle River, and White Salmon River in Washington State, USA. This study employs the Network Sediment Transporter (NST), a Lagrangian 1-D morphodynamic model within Landlab, to simulate bed sediment transport and interactions, providing key insights into fluvial sediment dynamics. The Network Sediment Transporter (NST) models channel reaches as interconnected links within a network grid. Sediments are represented as discrete parcels, each characterized by uniform properties such as grain size, volume, abrasion rate, and particle density, allowing for detailed tracking of their transport and interaction dynamics throughout the river network. We employ the Network Sediment Transporter (NST) to investigate whether sediment pulse lithology exert a greater influence on downstream channel responses than factors such as channel geometry or sediment grain size. The distinct geomorphic characteristics of the study rivers offer an ideal setting to evaluate how variations in upstream sediment lithology shape downstream transport and deposition. By refining our understanding of these dynamics, this research supports the development of more effective sediment management strategies and mitigation approaches for downstream impacts.

52. Chemical Contaminants Can Affect Methane Production in the Sediment of an Industrialized Appalachian River

Manju Sharma, *West Virginia State University*

Recent research has shown that production of methane, a potent greenhouse gas, from rivers can be substantial. The methane cycle begins with organic matter decomposed by bacteria, resulting in H2, CO2 and acetate as byproducts. Methanogenic archaea use these substrates to produce methane. However, rivers are extremely dynamic ecosystems that can collect and accumulate foreign chemicals as well. The effects of chemical contaminants on the methanogenic food web are poorly known and could affect predictions of global CH4 emissions. Any particular pollutant could potentially increase, decrease, or have no effect on methane production. In this study, we measured whether various common chemical contaminants can alter methane production in river sediment. Kanawha River (WV) is a large industrialized river that passes through Charleston and joins Ohio River at Point Pleasant. This river has been a critical resource for the metropolitan area for more than a century. However, the river has been heavily damaged by urban and industrial inputs, and regional natural resource extraction processes. The metropolitan region has even been given the epithet “Chemical Valley” due to the chemical industries located along the river. The most severe pollution occurred prior to the 1980s, but water quality has been improving since then. Multiple sediment cores were collected and pooled from one location about two km downstream of a riverside industrial complex. Sediment was placed in serum bottles to create anoxic microcosms. Individual contaminants were added to the microcosms which were incubated for >60 days. Time-course measurements of methane production from the headspace gas were made with gas chromatography. The chemical pollutants evaluated were NaCl, polycyclic aromatic hydrocarbons (pyrene, fluoranthene, acenaphthene), insecticide pyrethrin, and crude oil. Three concentrations of each contaminant were tested. The effects on methane production varied widely and ranged from methane inhibition to stimulation. These results demonstrate that estimates of regional methane production in urban rivers should be wary of the effects of local contaminants. Funding provided by USDA NIFA grant 2024-38821-42029 to DHH.

53. Describing the Septic Tank System Microbiome and Resistome in Rural Southwest Virginia

Emilie Sidelinger, *Virginia Tech*

Rural areas disproportionately lack access to centralized public water facilities; about a quarter of households within the United States are therefore reliant on on-site wastewater treatment, largely represented by septic systems. These private systems have limited oversight, with requirements for continuous inspection or monitoring uncommon. The potential for incompletely treated septage to contaminate groundwater, which source rural private water supplies, is a perennial concern given aging infrastructure, flooding, and improper initial design and/or maintenance. Further, wastewater is known to be a critical source of antimicrobial resistant (AMR) bacteria, which has a burden of disease projected to exceed the cancer death rate by the year 2050. Despite the emerging concern, very little previous work has examined the microbiome of private residential septic systems, and information is needed regarding the makeup, pathogenicity, and antimicrobial resistance of septage.

This study seeks to characterize the microbiome and resistome of septage. We hypothesize that septage, like municipal wastewater, contains high levels of AMR and pathogenic strains of bacteria, but that the relative quantities and patterns of the resistome are distinctly different, given their differing environments. To test these hypotheses, paired samples of municipal sewage and septage pumpouts were collected from a wastewater treatment plant in southwest Virginia. This plant serves approximately 65,000 customers and receives septage pump-outs from seven adjacent counties. One municipal aggregate sample and three septage pumpout samples were collected per month every three months. Septage grab samples were collected from different transport trucks and municipal aggregate samples were collected as a daily composite of equal mass every 15 minutes. DNA was extracted from each sample, and sequences were read using next-generation sequencing for shotgun metagenomic sequencing, resulting in a range of 38-67 million raw reads per sample. Bioinformatic analysis is currently underway to build the taxonomic classifications for each sample's microbiome and proportions of antibiotic resistance relative to a common genetic marker through de novo metagenomic assemblies, with results anticipated by late Spring 2025. This study will illuminate potential microbiological risks of septic system failures and provide data to support ongoing efforts in improving public safety within rural communities and innovative on-site wastewater treatment technologies.

54. Analysis of Bioretention Design Performance on Georgia's Coast Using DRAINMOD-Urban

Maria Laura Siqueira Batista, *University of Georgia*

Climate change and urbanization present significant challenges for stormwater management in coastal regions. To address these issues, green infrastructure has been increasingly adopted, with bioretention systems playing a key role in managing runoff and improving water quality. This study evaluates how design modifications, such as varying media depth, underdrain configurations, and groundwater levels, impact the performance of these systems using DRAINMOD-Urban.

Changes in these design parameters are critical for addressing challenges specific to coastal environments, where high water tables can limit retention capacity. For instance, increasing media depth can enhance water storage and pollutant removal, while strategic underdrain configurations can improve drainage efficiency under fluctuating groundwater conditions. Evaluating the depth to groundwater is essential in these regions, as it directly influences the bioretention system's ability to manage runoff and maintain sufficient retention capacity.

To improve modeling efficiency, pedotransfer functions (PTFs) were utilized to estimate critical soil hydraulic properties, such as saturated hydraulic conductivity (Ksat) and soil-water retention characteristics. This method helps overcome the challenges of obtaining detailed soil measurements, simplifying the input process for

DRAINMOD-Urban simulations. The model will be calibrated based on water level measurements and validated using field data, including rainfall and soil characteristics.

Performance assessment in this study will extend beyond runoff reduction alone. Additional metrics, such as peak flow attenuation, and system resilience under varying precipitation intensities, will be evaluated using DRAINMOD-Urban. These comprehensive performance indicators provide a holistic understanding of bioretention efficacy and resilience in coastal environments .

The study provides valuable insights into optimizing bioretention designs for Georgia's coastal regions, emphasizing the need for tailored stormwater management strategies to mitigate climate change impacts. The findings offer practical guidance for enhancing the resilience and effectiveness of green infrastructure solutions.

55. Unraveling the role of hydrodynamics in nutrient and algae transport in Lake Okeechobee

Sajad Soleymani Hasani, *University of South Florida*

Eutrophication in freshwater lakes is often exacerbated by nutrient resuspension and redistribution driven by hydrodynamic forces. Our previous machine learning-based study on Lake Okeechobee identified turbidity as the primary predictor of nitrogen and phosphorus concentrations across the lake. In deeper, mud-dominated areas, turbidity was influenced by wind speed and air temperature, whereas in shallower, near-inlet regions, inflows and water levels played a more dominant role. These findings underscore the importance of both wind-driven hydrodynamics and inflows/outflows in nutrient cycling and algal bloom dynamics. Building on these insights, we are developing a coupled Delft3D model integrating Wave, Flow (hydrodynamic), and Water Quality modules to evaluate how wind-generated waves and currents influence nutrient resuspension and transport and, ultimately, algal bloom formation. Short-period wind waves, interacting with longer-period currents, are the primary force driving bottom shear stress, mobilizing phosphorus-rich fine sediments and increasing nutrient concentrations in the water column. Wind-induced currents then facilitate the horizontal transport of these suspended nutrients, distributing them across the lake and creating conditions that promote algal growth. Meanwhile, near lake inlets, nutrient-rich waters from upstream sources can create localized nutrient hotspots, which, combined with enhanced light penetration due to shallower depths, can provide optimal conditions for bloom initiation. By integrating wind-induced hydrodynamics—wave and current-driven nutrient resuspension and transport—and water circulation patterns, the Delft3D model will provide a comprehensive understanding of how physical forces regulate nutrient availability and, in turn, algal bloom formation and transport in the lake. This approach offers essential insights for management strategies aimed at mitigating eutrophication and algal blooms, highlighting the importance of addressing both large-scale wind-driven mixing and localized inflow/outflow conditions to effectively safeguard lake water quality.

56. Investigating Soil Moisture Memory: Evaluating the Impact of Atmospheric Disturbances Across Ecosystems

Evren Soylu, *Environmental Protection Agency*

Soil moisture constitutes about 3% of circulating renewable freshwater resources; however, its role is vital for terrestrial ecosystems. It serves as an essential mediator of water between the atmosphere, plants, and subsurface. Soil often acts as a temporary reservoir, accumulating atmospheric anomalies, and tends to retain these deviations. For instance, a heavy rainfall event over hours to days leads to a positive anomaly in soil moisture, and the dissipation of this high moisture state through evapotranspiration and drainage can take weeks to months. Conversely, dry anomalies also persist in the soil, which retains these anomalies long after the dry or wet events have faded from the atmosphere's memory. Soil moisture memory is an important source of information in the Earth's climate and ecosystems, yet our current understanding of the complex dynamics of soil moisture memory across different environmental conditions remains limited. In this study, we investigate the quantification of soil moisture memory from various atmospheric disturbances and assess the role of various vegetation types, soil textures, and climatic conditions in shaping the seasonal dynamics of soil moisture memory. To explore these questions, we analyze how long soils take to forget disturbances of seasonal extremes in different climates within agricultural and natural ecosystems. First, we calculate the conditional probability distributions of soil moisture under conditions of high and low initial soil saturation levels. Then, we compare these conditional distributions with the marginal soil moisture distributions obtained from long-term millennial, temporal-scale ecohydrological model simulations across various lead times. The approach presented here offers a unique opportunity to evaluate the uncertainties and accuracies of soil moisture predictions.

57. Efficacy of a Restored Ohio Wetland in Mitigating Nitrogen and Phosphorus from Legacy-Phosphorus Field Runoff

Autumn Sylvestri, *The Ohio State University*

Nutrient pollution from agricultural runoff can cause devastating ecological impacts such as eutrophication caused by excess nitrogen (N) and phosphorus (P). Nutrient-rich runoff from the Great Lakes watershed has resulted in chronic harmful algal blooms in Lake Eerie, threatening both ecosystem and human health. Management interventions aim to reduce N and P loading, particularly P, as it is often the limiting nutrient for algae and cyanobacteria growth in freshwater ecosystems. Substantial P loading originates from legacy P fields, agricultural fields that have historically received high P loading rates and exhibit soil test P at concentrations two-fold higher than agronomic needs (STP >100 ppm). Wetland creation or restoration has been demonstrated as an effective nature-based solution to intercept and sequester excess nutrients in agricultural runoff. Within the Lake Eerie watershed, a 0.5-acre wetland was restored adjacent to a legacy P field through a public-private partnership and edge-of-field water quality monitoring conducted from December 2020 to April 2025. Wetland N and P removal efficacy was assessed by determining net nutrient flux from concentrations of nitrate, dissolved reactive P, total N, and total P at the wetland inflow and outflow. Statistical analysis was performed to relate N and P net flux with flow rate, precipitation, and temperature. A model was created to predict future wetland removal performance under multiple future climate scenarios.

58. Stormwater Wetlands: A Nature-Based Solution to Stormwater and Carbon Management on Military Bases

Maliha Tabassum, *University of Georgia*

As climate change accelerates, military bases face increased pressure to enhance resiliency while achieving carbon neutrality. Stormwater wetlands have the ability to manage stormwater while supporting ecosystem productivity and sequestering carbon. This research explores the potential of stormwater wetlands to serve as multi-benefit devices, particularly for military bases to achieve net-zero greenhouse gas (GHG) emissions under Department of Defense (DoD) climate strategies. Seasonally inundated wetlands, such as wet meadows are hypothesized to maximize carbon sequestration while minimizing the methane emissions which is a major concern of permanent wetlands. A literature review and modeling framework will serve as the foundation for identifying the optimal design of the proposed wetland. Subsequently, a model of the wetland will be developed. To evaluate wetland performance, the model will be simulated and measured key metrics, including nutrient removal efficiency (e.g., percentage reduction of Total Nitrogen and Total Phosphorus), sediment removal efficiency (e.g., percentage reduction of Total Suspended Solids), organic carbon storage capacity (e.g., carbon sequestration rate in soils and vegetation), and biodiversity indices (e.g., species richness and diversity). Based on the modeling result, a pilot wetland will be constructed to validate the model performance and assess field performance. This study will guide the design criteria of stormwater wetlands into military base infrastructure to enhance ecosystem services, reduce carbon footprints, and increase resilience against climate change.

59. Optimizing Agricultural Sites for Best Management Practices in the Western Lake Erie Basin Using Multicriteria Decision-Making

Mahesh Tapas, *The Ohio State University*

The Western Lake Erie Basin (WLEB) faces nutrient contamination from agricultural runoff, primarily phosphorus and nitrogen, which impacts its ecosystem. This study employs a Multi-Criteria Decision-Making (MCDM) approach to identify optimal locations for conservation practices like Drainage Water Management (DWM), phosphorus filters, and wetlands. By evaluating factors such as soil phosphorus content, slope, drainage, texture, and hydric status, the study targets specific farm-field scale Hydrologic Response Units (HRUs) for Best Management Practice (BMP) implementation. We analyzed 20,358 agricultural HRUs to determine where structural interventions could effectively reduce nutrient loads, combat eutrophication, and enhance soil health. Results show that phosphorus filters cover the largest suitable area, while a combination of DWM, phosphorus filters, and wetlands is the least prevalent. The study offers a cost-effective strategy for BMP deployment, promising significant improvements in soil and water quality and sustaining the ecological health of the WLEB.

60. Upcycling Nutrient Pollution with Typha Bioproducts

Elissa Touma, *University of South Florida*

Harmful algal blooms resulting from anthropogenic nutrients are degrading water resources around the world. Wetlands have been shown to effectively reduce nutrient concentrations in the water passing through them, but this effectiveness can decline over time as a wetland becomes nutrient-saturated. Furthermore, eutrophic wetlands tend to grow monocultures of highly-productive plants such as Typha spp., the dead material of which can hinder vegetation recruitment, alter wetland hydrology, and re-release nutrients upon decay. Periodic harvest offers the potential to sustain wetland performance through the removal of such plants and their constituent nutrients. Here, we describe a recently-initiated project within a central Florida wastewater treatment wetland with the dual aims of assessing the environmental impact of Typha harvest and developing a Typha-based horticultural growing medium. Over the course of 18 months, 2,500 m2 of Typha domingensis will be periodically harvested, then processed into a horticultural growing medium. We will quantify the TN, TP, and TC removed via harvest, and investigate impacts on soil orthophosphate concentrations. From this harvested material, we will produce composts and biochar which will then be blended to produce a horticultural growing medium. This medium will then be evaluated for suitability via physicochemical testing and plant growth trials. This Typha-based growing medium could offer an environmentally beneficial, cost-positive solution to the management of excess aquatic nutrients and nuisance vegetation at the epicenter of the USA's ornamental production.

61. A systematic literature review on water quantity and water quality modeling tools

Ngoc Trieu, *University of South Florida*

Models are critical tools in water resources management, as they simulate physical processes and generate time-series data for key water parameters. Additionally, they enable analysis of climate and land-use impacts on quantity and quality of water, particularly for regions with limited observational datasets. While the variety of models provides flexibility to address diverse objectives, it also presents challenges in selecting the most suitable tool for specific case studies. Thus, this study aimed to synthesize recent research on watershed modeling and develop a tool to assist researchers and managers in selecting the most appropriate model for their specific objectives. Literature published between 2020 and 2024 were identified from Scopus. Manual screening methods and Random Forest machine learning techniques were employed to remove irrelevant studies from the initial dataset. From the remaining 438 papers, relevant data were extracted manually or with the Elicit AI tool, depending on the complexity and nature of the data required. Next, a Python-based meta-analysis highlighted the dominance of the Soil and Water Assessment Tool and its application in addressing water quality challenges. Flow, total phosphorus, and total nitrogen were identified as the most evaluated parameters for water quality studies, with insights into the typical ranges of model performance. These findings provide a reference for modelers to assess simulation reliability. Future work will explore integrated modeling approaches, optimization algorithms, and strategies to address data availability challenges. This study offers a framework to guide modelers in selecting appropriate tools for their study context and purpose.

62. Mass Accumulation in Aging Stormwater Wetlands and Maintenance Implications

Amanda Van Pelt, *North Carolina State University*

In North Carolina, many constructed stormwater wetlands (CSWs) were built in the late 90's and 2000's, and are now between 10 - 25 years old. Maintenance recommendations for these systems have been broadly defined, but research on the success of maintenance practices is scarce in the literature. A key part of current CSW maintenance is clearing the forebay of build-up every five years or so, to preserve the flow pattern of the wetland. There is question as to whether this is sufficient maintenance, or whether the rate of accumulation may require more frequent removal of build-up. Decaying organic matter (both allochthonous and autochthonous) at least somewhat contributes to accumulation but has not been targeted in maintenance recommendations. This study revisited twelve CSWs in North Carolina, each at least eight years old, and quantified accumulated mass. Composition of accumulated mass, recommended frequency of removal, and factors that may increase or influence accumulation rates were also determined. Mass removal was confirmed to be an important maintenance practice for CSWs, with mass removal from the forebay recommended every five to ten years. Accumulated masses were a mix of sediment and detritus, suggesting a need to trim vegetation annually.

63. What Model should I use? A Tool for Selecting the Appropriate Surface Water Modeling Platform

Qiong Zhang, *University of South Florida*

Watershed and lake modeling play a crucial role in evaluating the effects of nutrient management and ecosystem restoration at the watershed scale. Several computer model packages are available for simulating water quantity and quality in watersheds, incorporating the impacts of nutrient management strategies, while various models also exist for simulating water balance and quality in lakes, accounting for the influence of tributary inflows. Selecting a suitable modeling platform for a specific study is an important decision, but it can be a challenging one. This study aims to develop a decision-support tool to assist users in identifying the most appropriate modeling package based on their study area, simulation objectives, and computational requirements. Developed using Python, the tool features a user-friendly graphical interface that allows users to specify key parameters such as study area type (watershed or water body), watershed size and type (urban or agricultural), water body characteristics (e.g., rivers, oceans, reservoirs), spatial dimensions (1D, 2D, or 3D), simulation type (event-based or continuous), parameters of interest (e.g., water flow, phosphorus, nitrogen, chlorophyll-a), time step (e.g., monthly, daily, annual), model complexity (simple, medium, complex), simulation objectives (e.g., holistic simulation, watershed management, flood risk assessment), data requirements (e.g., wind speed, precipitation, nutrient concentrations), model availability (open-source or licensed software), and model limitations. A decision tree analysis module, developed using brute-force techniques and validated with literature data, is then employed to identify the optimal modeling framework from a systematically compiled list of models. The user interphase can be accessed via https://close-habs.aquaveo.com/apps/bmp-model-selector/. Overall, this study presents a decision-support tool designed to help users efficiently select the best modeling package tailored to their specific research context and needs.

64. Evaluating Hybrid Constructed Wetlands for Nutrient Removal in Sidestream Wastewater

Kimiya Yousefi, *Virginia Tech*

Excess nutrient discharge to waterways can result in accelerated eutrophication, harmful algal blooms (HABs), and threaten the safety of drinking water and aquatic food supplies. Effective municipal wastewater management is one approach to reduce nutrient contributions to waterways. This study explored the potential of hybrid constructed wetlands (HCWs) to mitigate high concentrations of ammonium and phosphate from sidestream wastewater produced by aerobic digesters at a municipal wastewater treatment plant (WWTP), which can significantly impair the overall efficiency of wastewater treatment. This comprehensive study evaluates the nutrient reduction efficiencies of four pilot-scale HCW systems installed at a WWTP in eastern North Carolina. The pilot-scale HCW systems operated from June 2022 to May 2023, each incorporating distinct configurations designed to enhance nutrient removal through a combination of natural and engineered processes. The experimental systems varied in substrate composition and flow design to optimize performance: HCW #1 and HCW #2 featured gravel vertical flow cells followed by either oyster shells (#1) or crushed concrete (#2), followed by woodchip bioreactors to support microbial processes. HCW #3 consisted of alum sludge topped with gravel followed by zeolite and then a floating treatment wetland (FTW). HCW #4 consisted of biochar topped with gravel, then zeolite, and then an FTW. The systems operated with cell volumes ranging from 50 to 300 gallons and calculated hydraulic retention times (HRTs) ranged from 13 to 59 hours per cell, with HCW #1 and HCW #2 at 40 hours each, HCW #3 at 117 hours, and HCW #4 at 171 hours. This variability allowed for the evaluation of different retention times and materials on nutrient removal performance.

Preliminary findings highlight zeolite's superior performance in ammonium removal, achieving an average reduction of 85% in HCWs #3 and #4 from an average starting concentration of 48.84 mg N/L. Crushed concrete demonstrated the highest phosphate removal efficiency, with an average reduction of 44% observed in HCW #2 from an average starting concentration of 41.85 mg P/L. These results underscore the critical role of substrate selection and system design in achieving optimal nutrient removal in HCWs.