Collection of Abstracts

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"Ecological Engineering: Addressing Uncertainty in a Dynamic World"

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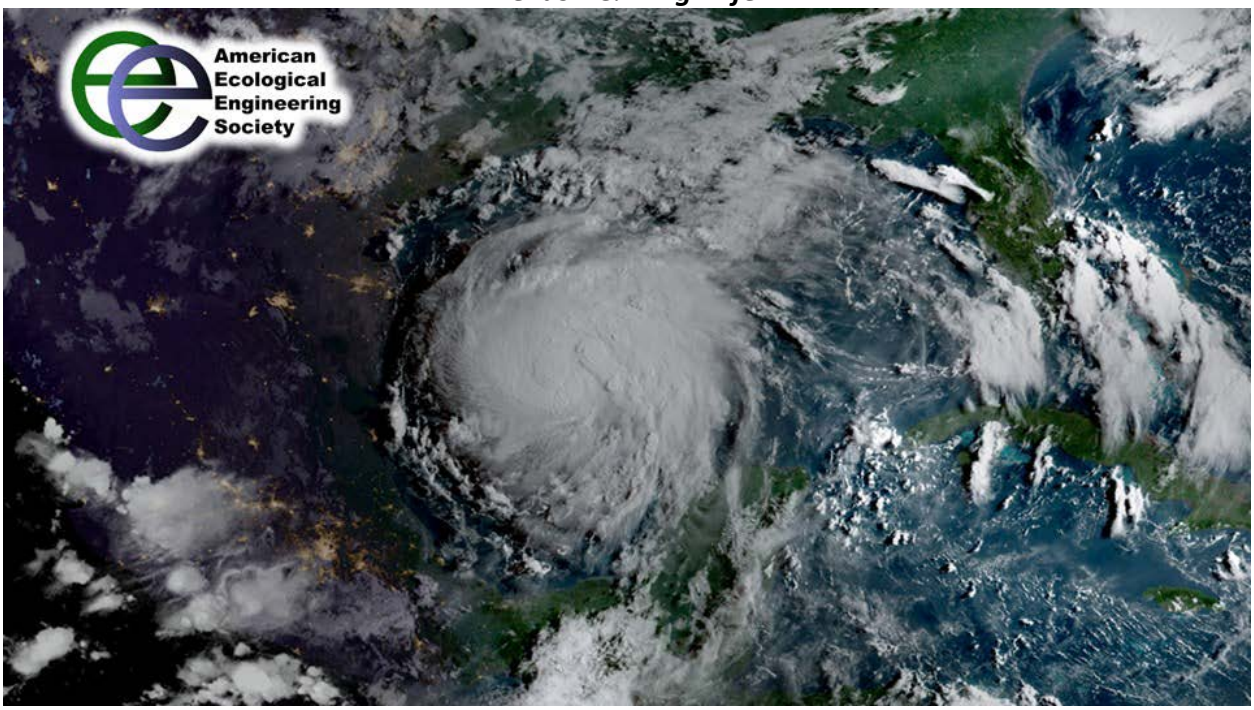
Texas A&M AgriLife



Otak

Texas Water Resources Institute
make every drop count

eureka water probes

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(Abstracts are arranged by date, time, and session title.)

STORMWATER MANAGEMENT 1 –
TUESDAY, JUNE 12, 2018, 1:30 – 2:50 PM TECHNICAL SESSION

Presenter: Tsegay, Awet
Co-Author: Arias, Mauricio

LINKING URBAN HYDROLOGY AND BAFFLE BOX PERFORMANCE TO SUPPORT SUSTAINABLE STORMWATER MANAGEMENT IN THE CITY OF TAMPA

With the world's ongoing urbanization, development practices need to incorporate the maintenance of ecosystem functions and minimize alterations to natural systems. Conventional urban infrastructure drastically modifies the hydrologic cycle by reducing infiltration and evapotranspiration and increasing runoff. Traditional engineering practices remove stormwater from the sites and therefore contribute to the disruption of natural water flows. In contrast, low impact developments and sustainable urban drainage systems allow to mimic natural ecological processes. Baffle boxes are in-situ stormwater treatment units in highly urbanized areas that use the hydrology of their drainage areas to collect sediments. The City of Tampa (Florida) retrofitted their stormwater pipe network with 47 baffle boxes to create onsite water treatment that prevents sediment and trash from entering the Hillsborough River, and Tampa Bay. However, the effectiveness of these units was questioned due to consistent backflows from receiving waters, low sediment capture and clogging from trash. Primarily their functionality depends on rainfall-catchment relationships. Hence to optimize their functionality in the future it is necessary to evaluate their current performance under existing runoff conditions that correlate to natural and anthropogenic factors such as precipitation, catchment and demographic parameters. The present research correlates these spatial characteristics firstly by comparing rainfall data with sediment cleanout reports from the city and secondly by spatially comparing soil cover, tree canopy and impervious data with sediment loads modelled using EPA's SWMM model. This analysis links natural drainage flow patterns and urban ecology to the performance of baffle boxes to improve placement and functionality.

Presenter: Mast, Jacob
Co-Author: Francis, Samantha; Arnold, Annabelle; Goo, Emily; Tasker, Miriam

Algal "Terp" Scrubber

The UMD chapter of the AEES is designing and installing an algal turf scrubber garden at the site of a bioretention pond on campus, in order to offset the storm water runoff from the Terrapin Trail parking garage. In collaboration with renowned faculty, campus facilities, and College Park Scholars, the AEES submitted a proposal to the EPA Rainworks competition in 2017. Members of the AEES also created a one credit class for advancing the understanding of ATS for general body members, and a two credit class for project management. Undergraduate sudents have filled all roles of this project, from conceptualization alongside professors, to setting up meetings, to creating 3D renderings, and have been the driving force of this operation. It is the goal of the AEES that the ATS will be constructed in 2018, that it's construction and maintenance will be ongoing efforts of the AEES for at least the next five years, and that graduate research opportunities will be created in further developing ATS technology with this installation as a test bed. The one credit class will be producing a poster board and demonstrative cutaway model for recyclable use at presentations of the AEES, such as Maryland Day, the Do Good Challenge, and the National AEES conference, as well as creating an elevated 1mx1m ATS for UMD AGNR research use. It is the intention of this team to create detailed plans for the construction and maintenance of the Algal "Terp" Scrubber, and grow as a professional society through interacting with University faculty, and break ground on the project the Monday after Earth Day, 2018.

Presenter: Taylor, Alex
Co-Author: Wetzel, Jill; Mudrock, Emma; King, Kennith; Davis, Jay; McIntyre, Jen

Assessment of the impact of plants and fungi on bioretention performance for stormwater management

Bioretention - infiltration into soil - is among the most commonly utilized green stormwater infrastructure techniques. Previous replicated mesocosm studies at Washington State University (WSU) have suggested that while bioretention soil can dramatically reduce the toxicity of urban stormwater, the role of plants appears limited to aesthetics and hydrologic performance. Recent studies have also indicated that wood-decomposing fungi can be incorporated into the wood mulch used in bioretention and may provide unique environmental services such as enhanced removal of microbial pathogens and degradation of polycyclic aromatic hydrocarbons (PAHs).

A multi-year factorial experiment is underway to evaluate the effects of the deciduous shrub Pacific Ninebark (Physocarpus capitatus) and the mycelium of the white rot saprobic Wine Cap mushroom (Stropharia rugoso-annulata) on the toxicity and water quality of bioretention-treated effluent under field conditions. Four treatment mesocosms (no plants / no fungi; plants / no fungi; no plants / fungi; plants / fungi) have been installed in triplicate in Seattle, WA and continuously receive runoff from an high-density urban watershed. Quarterly sampling of influent stormwater and treated effluent over two years is in process to determine the potential for toxicant break-through under field-relevant loading conditions. Known stormwater toxicants including PAHs, Cu, Zn, and Pb, among others, are being monitored and toxic effects in zebrafish (Danio rerio) embryos are being assessed. A multivariate analysis of the first year of water quality and toxicity data as functions of various soil, plant, microbial, and environmental factors is presented.

Presenter: Mahmoud, Ahmed
Co-Author: Sanchez, Augusto; Guerrero, Javier ; Jones, Kim D.

Evaluation of Field-Scale Stormwater Bioretention Structure Flow and Pollutant Load Reductions in a Semi-arid Coastal Climate

Bioretention has become an effective option for treatment of stormwater in urbanized watersheds, through substantial runoff volume reduction and improvement of runoff water quality. This field-scale study evaluated a bioretention system designed to reduce runoff volume and pollutant loading, including total suspended solids (TSS), biological oxygen demand (BOD), total Kjeldahl nitrogen (TKN), total phosphorus (TP) and E.coli count, by comparing its performance over a 13 month period with a traditional asphalt pavement located in the same parking area at South Texas College (STC), McAllen, Texas. The bioretention system effectively reduced not only runoff volume but also provided a substantial improvement in the water quality of the effluent by reducing the event mean concentration (EMC) as well as total pollutant loadings. Runoff volume from the bioretention cell was lower than the traditional asphalt pavement section by 82±20%. Water quality samples from bioretention effluents showed a significant reduction ($p<0.05$) for various pollutants including indicator bacteria. For this bioretention structure, removal efficiency for TSS, BOD, TKN, and TP were reduced over TAP by 96±1.8%, 51±23%, 65±44% and 83±16%, respectively. For indicator bacteria, overall performance for the bioretention showed E.coli removal by 49%. Antecedent dry periods were found to influence the treatment performance of runoff reduction and water quality improvement.

RESILIENT COASTAL COMMUNITIES –
TUESDAY, JUNE 12, 2018, 1:30 – 2:50 PM TECHNICAL SESSION

Presenter: Kuhl, Hannah
Co-Author: Callahan, Timothy J.; Robinson, J.

Stormwater and tidal hydraulics in an urban watershed: land use change impacts

This presentation will provide an introduction to tidal creek hydrology in the central South Carolina coast, and will cover recent data collection from James Island Creek. The objective of this study is to create a water balance model of tidal flows and stormwater runoff in the basin of a suburban tidal creek watershed located in Charleston, and to characterize the brackish to freshwater ecotone in this altered suburban landscape. It is becoming increasingly important to understand the hydrology of this low-lying area that is experiencing land use change for development. An acoustic Doppler current profiler is being used to measure the discharge, velocity and cross-section geometry of James Island Creek under a variety of tidal conditions. These data will be compared to four previously studied tidal creeks in the region. Stormwater modeling will provide estimates of the volume of runoff that may enter the creek system during individual storm events of different sizes, and will be used to compare the impacts of identical storm events on similarly sized watersheds with varying development levels. An assessment of vegetation zones and ecotones using indicator species will assist in interpreting whether vegetation communities reflect a transition from brackish to freshwater in the upland portions of first-order tributaries of James Island Creek, and if so, where these transitions typically occur. Identifying hot spots of floodwater pressures will enable the community of James Island and the greater Charleston area to focus on mitigation and adaptations in these tidal creek systems.

Presenter: Ajedegba, Johnson
Co-Author: Choi, Jong-Won; Jones, Kim D

Analytical modeling of coastal dune erosion at South Padre Island; A consideration of the effects of vegetation roots and shear strength

Dune erosion exposes coastal communities to greater risks of sea level rise, severe storm surge impact, flooding and property damage. This new study evaluated the contribution of vegetation roots to dune erosion volume reduction using an analytical wave impact model. A new proposed resistance coefficient is introduced to an analytical model through direct field measurements of dune shear strength and root density carried out at South Padre Island, Texas, U.S.A. The range of new coefficient 0.2 - 0.8 was estimated from the ratio of in-situ shear strength of bare dunes and dunes vegetated with sea oats. The results of the analytical model showed that reduction of dune erosion volume is linearly related to in-situ shear strength and root density within the collision regime. Resistance of dunes to erosion depends on the type of dune vegetation; direct field measurements showed that the average in-situ shear strength of dunes vegetated with monocot species (sea oats) was twice as those vegetated with dicot species (railroad vines and gulf croton). Hence, sea oats and other related monocot native dune vegetation are more suitable for ecological roots reinforcement of dunes than dicot vegetation types. The result from this study further validates the importance of suitable dune vegetation for an overall resilient coastal dune system against erosion.

Presenter: Hitchcock, Daniel
Co-Author: Jayakaran, Anand; Wijesinghe, Dhanuska

Evaluating Ecohydrological Function and Water Quality Benefits to Support Green Infrastructure Decision-Making in Coastal South Carolina

Coastal South Carolina is experiencing increased residential and commercial development as well as impacts from climate variability. Our research focuses on the definition of ecohydrological criteria at varying scales to sustain water resources. Studies have been conducted in watersheds comprised of coastal upland and wetland ecosystems where stormwater management is complicated not only by shallow groundwater and low gradient topography but also downstream tidal and salinity influences. Climate variability has been demonstrated in terms of local and regional extremes with both flooding and drought conditions, which in turn affect design criteria and stormwater management decision-making. Our results have implications for watershed planning and, more specifically, the siting for and selection of green infrastructure based low impact development (LID) practices. Vegetative stormwater control measures - engineered wetlands, bioretention systems, and retention ponds enhanced with green infrastructure - have been investigated to determine hydraulic and water quality performance. At a larger scale, discharges from small coastal watersheds (<1 mi^2) comprised of land cover varying from forested to wetland to developed areas have been monitored for flow and runoff coefficient determination, as well as discharge water quality parameters, including suspended solids, dissolved organic carbon, inorganic and organic nitrogen, and coliform bacteria as E. coli. An assessment of existing resources (green infrastructure) and their processes as ecohydrological services at various scales can provide guidance toward resource protection with the goal of creating resilient communities - whether by conservation or restoration efforts, or by better site design as land use change progresses.

Presenter: Bean, Eban
Co-Author: Robbins, Jeremy; O'Driscoll, Michael

Urbanization Effects on Low Order Coastal Plain Stream Quality

Low order, headwater streams vital areas of exchange between upland and aquatic systems. Urban stream syndrome is commonly attributed to increasing watershed total impervious area (TIA). However, this over simplifies the compounding fundamental effects of urbanization resulting from increased runoff volumes, rates, and deviations in water quality characteristics. The cycling of carbon in watersheds supports valuable ecosystem services to downstream reaches. Focusing on low-order watersheds in and around Greenville, NC, we investigated the relationship between TIA and drainage network evolution, riparian zone quality, and in-stream water and sediment characteristics within the context of ecosystem change. Seven watersheds (1.0 - 3.0 km^2 in area) represented a range of urbanization, with TIA ranging from 6.9 to 66%. Drainage flow paths were digitized and categorized as natural, ditched, and stormwater pipe. For each watershed, nested sampling was performed at 0.5 km^2, 0.75 km^2, and 1.0 km^2 sub-watershed areas. Buffer integrity and stream assessment were assessed using previous methodologies by Reinhart et al. and the NC Division of Water Quality, respectively. At each site, stream sediment and water samples were collected and analyzed using loss on ignition, total organic carbon, and total nitrogen techniques. Drainage networks transitioned from natural, to ditched, to piped, as TIA increased, with 30% impervious being the transition between the latter. Riparian quality and in stream Carbon:Nitrogen ratios both exhibited clear declining trends as TIA increased. Results from a few high TIA locations deviated from the general trends, revealing opportunities within urban drainage to potentially preserve stream quality.

WASTEWATER TREATMENT AND REUSE –
TUESDAY, JUNE 12, 2018, 1:30 – 2:50 PM TECHNICAL SESSION

Presenter: Kant, Shashi
Co-Author: Jaber, Fouad

Drivers and Barriers for Alternative Water Resources

This presentation describes the drivers and barriers to the adoption of different alternative water supply resources. A thorough comparative analysis is discussed for various types of alternative resources, including desalination, rainwater harvesting, domestic wastewater, greywater, and A/C (Air-Conditioner) condensate. These alternative resources can play a vital role in mitigating water stress but there are limitations in their quality/quantity assessment, and gaps between scientific, social, and political boundaries. With an integrated water management perspectives, the 21st century requires a more focused study on improving the potentials of alternative resources by their qualitative and as quantitative assessment.

Presenter: Benjamin, Joshua
Co-Author: Arias, Mauricio; Zhang, Qiong

Alternative Usage Cases for Pressure Retarded Osmosis Power Generation

Pressure-retarded osmosis is a form of osmotic power, which is an emerging renewable energy source that relies on harnessing the salinity gradient between high concentration (e.g. saltwater) and low concentration (e.g. freshwater) solutions. Currently, one of the primary detriments to this technology is membrane fouling, which can drive up overall energy generation costs to the point of making the process economically unfeasible. Reduced fouling will make membranes more cost-effective by extending their operational lifetime and lowering their energy requirements. Foulant reduction can occur through pretreatment using methods such as ultrafiltration and low-pressure reverse osmosis (RO). However, pretreatment has an inherent energy cost, and so needs to be carefully evaluated to ensure the overall process is economically feasible.

The purpose of this study is to optimize the pretreatment process for various salinity gradients using a process-based dynamic model. The three configurations that are compared are treated wastewater and seawater, treated wastewater and RO brine, and RO brine and seawater. The overall goals of this study are to determine which of the scenarios can generate overall energy densities higher than 5 W/m^2 of membrane material (the energy density necessary to make a PRO process economically viable), and which process is the best in terms of cost, sustainability, and energy generation potential. While still in a preliminary phase, it is expected that the information from this study can be used as a reference for coastal water systems that are looking to providing clean renewable energy generation through water reuse.

Presenter: Nairn, Robert
Co-Author: Knox, Robert; Shepherd, Nicholas

Hydrologic Budgets and Conservative Ions: Neglected Tools in Ecologically Engineered Treatment System Performance Evaluation

The design of passive treatment systems for metals-contaminated waters has advanced considerably in recent decades. Performance evaluations often depend on water quality concentration changes alone, assuming no changes in water throughput rates, ignoring portions of the hydrologic budget, and disregarding any mechanisms affecting water chemical composition other than those designed to directly address constituents of concern. In this study, hydrologic budgets were estimated for two Oklahoma passive treatment systems in the Tri-State Lead-Zinc Mining District. Reliable inflow and outflow volumetric discharge rates were obtained monthly, pressure transducers were installed in each process unit to monitor water level fluctuations continuously, monthly rates of evapotranspiration were calculated, and daily county-level precipitation data were obtained. Based on soils data, seepage rates were considered negligible. Concentrations of conservative ions (e.g., Mg, Na, K), assumed to change only due to dilution or evaporation, were used to estimate the effects of precipitation, drought, and temperature extremes. Annual evapotranspiration exceeded or was equal to total water volumes of the passive treatment systems. Mean monthly rates of evapotranspiration and precipitation were approximately 8% of volumetric inflow rates. Given the dynamic climate of the Great Plains, precipitation varied considerably both intra- and inter-annually. Monthly precipitation volumes accounted for as much as 20% of volumetric inflow rates. Changes in concentrations of conservative ions indicated that evaporative concentration could underestimate contaminant removal rates by up to 20% in summer months, depending on duration of drought. These techniques may provide insight into improved treatment performance evaluation.

Presenter: Burmistrova, Julia
Co-Author: Beutel, Marc; Shackelton, Stephen; Bailey, Jodi

Feasibility of Co-digestion to Manage Organic Solid Waste and Wastewater Solids from Yosemite National Park, USA

Yosemite National Park is a UNESCO World Heritage site and a world leader in park stewardship and management. Yosemite National Park has a Zero Landfill Initiative goal to completely divert their solid waste away from landfills. The Park receives 4 to 5 million visitors each year that produce an estimated 665 annual tons of solid municipal waste. Solid waste includes organic waste, predominantly in the form of food waste, the easiest waste stream to divert from landfills. This presentation will present preliminary data regarding an analysis of the amount of organic food waste produced relative to the wastewater produced, with the potential for co-digestion of organic solid waste with wastewater solids. Co-digestion is a process in which organic waste, such as food waste, and wastewater solids are combined and treated via anaerobic digestion and biogas (methane) is collected and used to make energy. This project is significant because it will inform managers in the design of a new $80 million wastewater treatment plant currently being planned for the Park. Since Yosemite National Park is a flagship park for the US and world, successful implementation of an organic waste management plan could set a precedent for the other 58 national parks in the US and has the potential to positively model a progressive engineering solution for solid waste management in national park systems worldwide.

STORMWATER MANAGEMENT II –
TUESDAY, JUNE 12, 2018, 3:00 – 4:50 PM TECHNICAL SESSION

Presenter: Jayakaran, Ani
Co-Author: Knappenberger, Thorsten

Performance of Permeable Pavements to Improve Stormwater Quality

Recent advances in several broadly allied scientific disciplines have shown that green stormwater infrastructure (GSI) can to some extent restore the natural pathways that stormwater takes from landscape to stream. Permeable pavements are one of several GSI techniques that are commonly used across the country to mitigate the effects of stormwater on downstream receiving waters. In the State of Washington, the use of GSI is mandated for any new or retrofit construction project that meets certain criteria. The talk will focus on performance studies of a 9-cell replicated asphalt pavement test facility that is installed at the Washington State University Puyallup Research and Extension Center Campus, Puyallup, WA. The asphalt test facility has 9 lined cells - 3 cells are constructed with conventional asphalt and 6 with porous asphalt. Runoff from the impervious cells acted as a control and were compared to runoff from the pervious cells. All water applied to the surface and that which infiltrated through the sub-base aggregate was monitored and collected at the outflow. Artificial and natural storm events were used to test both hydrologic and biogeochemical properties of the two systems. Pollutants evaluated were suspended sediments, metals, nutrients, and hydrocarbons. Results from this work show that porous asphalt pavements are able to infiltrate as much as 99.5% of incident rainfall. Additionally, preliminary results suggest that porous asphalt pavement systems are capable of considerable treatment of several key stormwater pollutants. This work will be presented in full at the conference.

Presenter: Lisenbee, Whitney
Co-Author: Hathaway, Jon; Winston, Ryan

Promoting Successful Urban Watershed Restoration through Enhanced Bioretention Cell Modeling

According to the most recent National Water Quality Inventory, 44% of assessed streams throughout the United States are listed as impaired. Urban runoff and stormwater is one of the top ten leading causes of water quality impairment in lakes, estuaries and streams in the United States (USEPA 2004). Over the last decade, bioretention systems have become a leading stormwater control measure that contributes to the restoration of urban streams and watersheds. Bioretention cells increase infiltration of stormwater thereby reducing urban runoff volumes and peak flows which alter the hydrology of local waterways. Although these systems have proven to perform well in many site-scale field studies, less is known about how well these systems work when implemented en masse. Modeling of bioretention allows designers to better optimize the function of bioretention cells, provide guidance for design standards, and scale local impacts to the larger watershed. However, current hydrologic models with bioretention capabilities consist of lumped parameters and simplifications that do not fully account for fundamental hydrologic processes. DRAINMOD is an agricultural drainage model that has shown promise when applied to bioretention systems. It has the capability of using the soil-water characteristic curve to obtain detailed water balances over a continuous time period (both advances over other models for bioretention). However, because DRAINMOD was designed for agricultural purposes, it cannot currently accommodate the rapid response time of an urban runoff hydrograph, instead aggregating data to a daily timeframe. For this study, DRAINMOD has been recoded to allow high temporal resolution inputs and outputs, more closely matching the travel times of urban systems. DRAINMOD simulations were conducted both with and without the time scale modifications (original vs. bioretention-specific model) to determine if improvements in site-scale modeling were realized. Future work will compare these results to those of simplistic, lumped-parameter bioretention modeling.

Presenter: Martin, Jay
Co-Author: Winston, Ryan; Witusynski, David; Lee, Jiyoung; Lee, Seungjun

Blueprint Columbus: Watershed Scale Impacts of Over 400 Bioinfiltration Cells on Stormwater Flow and Quality, and Public Health.

The Blueprint Columbus project is an innovative effort by the City of Columbus, OH to reduce stormwater runoff and improve stormwater quality through the installation of 400+ bioinfiltration cells across 550 acres of residential watersheds. Following modeling and conceptual studies that have predicted substantial watershed scale impacts of green infrastructure, this is a unique study focused on field monitoring of impacts at a watershed scale. This presentation will describe holistic monitoring to quantify baseline, existing conditions prior to the installation of green infrastructure. Four sewersheds were instrumented to measure rainfall and flow at single outfalls and obtain flow-proportional, composite water quality samples during 70 storm events. Stormwater samples were analyzed for several water quality variables, then utilized with measured runoff volume to determine pollutant loading. Runoff coefficients ranged from 0.2 to 0.3, modestly lower than similar catchments. Nutrient, metals, and TSS concentrations and loads from 30 storms were within the range of residential runoff from past studies. Average E. coli concentrations from the four outfalls ranged from 29,000 to 626,000 CFU/100 mL, 2-3 factors of ten above the USEPA geometric mean threshold. Microbial source tracking showed that ruminant, human, dog, and avian sources of bacteria were present in the stormwater samples. Virulence genes were observed in samples from all outfalls, with those from Staphylococcus aureas representing more than 70% of total virulence genes. In the future, these results will be compared against data after the implementation of green infrastructure to quantify the impacts of Blueprint Columbus.

Presenter: Mazer, Katy
Co-Author: Hunt III, William F.; Waickowski, Sarah

Converting Dry Detention Basins to Constructed Stormwater Wetlands for Enhanced Pollutant Removal

Dry detention basins (DDBs) are a type of stormwater control measure typically implemented to mitigate peak flow. However, research has shown that DDBs lack water quality benefits due to short detention times and minimal pollutant removal mechanisms. Poor maintenance and standing water can also lead to the establishment of wetland characteristics in DDBs. These wetland features may be beneficial, as constructed wetlands have been found to effectively remove sediment-bound pollutants and soluble nutrients. The objective of this research project is to examine pollutant removal changes associated with a retrofit that converts DDBs to behave like constructed stormwater wetlands. Two existing DDBs in North Carolina were monitored for pollutant removal from February to August of 2017 using a paired watershed methodology. During this period, cumulative load reductions for DDB-1 were -42% for TSS, -11% for TP, and -26% for TN and in DDB-2 36% for TSS, -39% for TP, and -24% for TN. DDB-1 was retrofitted in September 2017, and DDB-2 remained unchanged as a control. The retrofit included (1) raising and reducing the size of the outlet orifice to create a shallow permanent pool and (2) planting wetland plants within the lower portion of the basin. Monitoring resumed in both DDBs post-retrofit in November 2017 to quantify the effect of the retrofit on water quality. Preliminary data shows improvement in pollutant removal in DDB-1. If effective, this simple and low-cost retrofit can be adapted to increase pollutant removal in many DDBs throughout the region.

SUSTAINABLE FOOD SYSTEMS –
TUESDAY, JUNE 12, 2018, 3:00 – 4:50 PM TECHNICAL SESSION

Presenter: Matlock, Marty
Co-Author: Thoma, Alison; Thoma, Greg

World without Cows: An exploration of costs/benefits of global dairy

The goal of this project, called World without Cows, was to assess the role that the dairy industry currently plays and could play in supporting a sustainable global food system, and the subsequent gap in food supply if diary production was not supporting the food system. The scope of this assessment included global impacts of dairy production systems, including milk and meat, across six regions. This was a scan level assessment, intended to provide preliminary data inventory and scope for a more comprehensive analysis of the World without Cows. The preliminary Functional Unit for this analysis was protein provided by dairy production of milk and meat per region per year across six regions covering the globe: Africa, Asia, Europe, North America, South America, and Oceania. The production year was 2015. Results showed a wide range of production capacities, efficiencies, and yields across the six regions. Global annual milk protein production was 2.15 kg per person. Europe produced 6.2 million metric tons (MMT), while Oceania only produced 0.13 MMT. Africa was generally the lowest yielding region with respect to population and land area. Europe had the highest grazing lands as a proportion of available lands at more than 27 percent while Oceania had only 3 percent of available marginal lands supporting dairy grazing. North America had the highest annual land use efficiency for milk and dairy beef production (0.06 km^2/MT), and Africa had the lowest (1.37 km^2/MT). Global average annual yield was 2.96 MT milk and beef protein produced per km^2 land used for feed and grazing. Projected demand for milk protein in 2050 was 31.71 MMT/year, with 15.75 MMT demand coming from Asia alone. This is twice the total production in 2015 (15.8 MMT). Global per capita deficits will be 0.63 kg milk protein per year, with a total annual milk protein net deficit of 6.11 MMT. The additional area of land necessary to meet 2050 milk and dairy beef protein will be more than 9 million km^2.

Presenter: Matlock, Marty
Co-Author: Luoni, Steve; Boles, Eric

Desiging a 21st Century Food System in Hawaii

Hawai'i food imports in 2010 were estimated at over 1.14 million tons, totaling over 4.52 billion dollars (Loke et al., 2013). The state planning office reported 85-90% of Hawai'i's food is imported from either the mainland U.S. or foreign countries (Hawaii Office of Planning Department of Business Economic Development & Tourism, 2012). Currently, the majority of foreign food imports are sourced from China, Vietnam, and Thailand. Low price and a high volume of imports may create a market with prices too low for local farmers to remain competitive. The food that the island of O'ahu yields is only enough to feed itself for less than four weeks, which leads to low food security (Office of Planning DBEDP et al., 2010). The remainder of the food supply is met through imports. Approximately 85% of the food imported to Hawai'i is consumed locally. The remaining 15% is re-exported to either the continental U.S. or to foreign markets (Loke et al., 2013).

The goal of this project was to analyze food hub models and create a Master Plan for the Whitmore Agriculture Project. The objectives included:
1. Inventory and analyze existing assets for the Master Plan.
2. Evaluate existing zoning and regulatory requirements to determine if variances are necessary for Master Plan implementation.
3. Create a systems model for the process flows and operational activities for management and implementation of the Whitmore Food Hub (WFH).
4. Engage local food and agricultural supply chain stakeholders to ensure local knowledge and values are incorporated into the Master Plan.
5. Create an economic model for sustaining the Whitmore Agricultural Project over time.
6. Develop the Master Plan, including the conceptual design of the site and each associated building/facilities.
7. Draft, revise and finalize Master Plan and deliver the project to ADC stakeholders.
8. Create a universal model for Food Hub Master Plans.
The results of the master planning process will be presented.

Presenter: O'Brien, Brendan
Co-Author: Roy, Eric

Physicochemical properties of combined dairy manure and food waste digestates & their use for cultivation of Pleurotus ostreatus

Universal recycling and composting laws recently enacted in VT, MA, CT, and RI, indicate a regional trend toward increased organics recycling, including wasted food. Manure anaerobic digesters on dairy farms represent an attractive approach to food waste processing because existing infrastructure is already in place. In addition to generating biogas for energy production, anaerobic digestion results in effluents that can be separated into solid and liquid fractions. Liquid fractions high in soluble nutrients are typically spread as fertilizer for feed crops or pasture fields, and may pose a similar eutrophication risk as raw manure. Residual solids consist of lignocellulosic biomass resistant to microbial degradation and enriched in nutrients. How digestate materials will change with increased food waste inputs remains poorly understood. In addition, developing export markets for digester solids is of economic and environmental concern for farmer-operators, environmental managers, and public stakeholders, who seek to address nutrient imbalances that contribute to eutrophication. This research: (1) quantifies the carbon and nutrient (N, P) variability for separated liquid and solid effluents from six full-scale manure digesters receiving variable proportions of food waste, and (2) evaluates the effectiveness of solid digestates as ingredients in substrate recipes used to cultivate gourmet oyster mushrooms (Pleurotus ostreatus). Our results show substantial variability in digestate materials, with important implications for nutrient management. Furthermore, oyster mushroom yields for substrate recipes including a mix of solid digestates, sawdust, and soy hulls were high, indicating strong potential for simultaneous nutrient extraction and production of safe, nutritious, protein-rich food.

Presenter: Roy, Eric
Co-Author: Mo, Weiwei

Envisioning a sustainable circular nutrient economy in New England

Nutrient recovery and reuse has become a key research topic within the sustainability, food systems, wastewater engineering, and nutrient management communities. Technologies exist that can effectively capture nutrients from feedstocks including wasted food, farm animal manure, and human wastewater, and innovation in this area continues to be an important pursuit. However, practical nutrient recycling solutions require more than capable nutrient capture technologies. We also need to understand the role that nutrient recovery and reuse can play within broader nutrient management schemes at the landscape level, including important interactions at the nexus of food, energy, and water. This presentation will focus on spatial nutrient balance results for the New England region, which account for both food system and wastewater nutrient flows. These results illustrate that both centralized and decentralized nutrient recovery schemes have potential to transform nutrient flows in many New England watersheds, diverting N and P away from landfills or aquatic ecosystems and toward local or regional agricultural soils where they could offset a substantial percentage of imported fertilizer. Key economic, spatial, and agronomic challenges that need to be overcome to increase effective nutrient recycling in the region will also be discussed.

URBAN ECOSYSTEMS AND INNOVATIONS –
WEDNESDAY, JUNE 13, 2018, 8:30 – 10:20 AM TECHNICAL SESSION

Presenter: Matlock, Marty
Co-Author: Luoni, Steve; McCarthy, James

Urban Watershed Design: A Framework in Conway, AR

The Framework Plan focuses on the overlaps of city and water to create a reconciliation landscape that overcomes their traditional mutual exclusivity. The plan imagines a cityscape that cultivates a highly livable green urban environment made through “low-tech/high concept” enhancements to ordinary infrastructure investments already scheduled to service the city’s growth. Since urban watersheds are in direct competition with cities over the very ways in which the surface area should be shaped, the Framework Plan proposes a portfolio of value-added infrastructural retrofits - green streets, water treatment art parks, urban eco-farms, conservation neighborhoods, parking gardens, riparian corridor improvements, lake aerators, vegetative harvesters and floating bio-mats, and a city greenway - complementing mainstream infrastructural investments. The approach builds a representative cityscape expressive of the city’s desire for a place-based green stormwater utility that creates a public open space system.

Presenter: Wituszynski, David
Co-Author: Hayford, Donald; Nelson, Angelika; Martin, Jay

The effect of large-scale bioretention installation on an urban avian community: Year 1

Green infrastructure practices such as bioretention are often believed to serve as suitable habitat in urban areas. This intuition has been used to promote their installation, with the suggestion that habitat creation will both confer benefits to people from increased contact with nature while also promoting biodiversity conservation in urban areas. However, the quality of habitat actually provided by bioretention basins has not been well-examined in the scientific literature. As a first step toward evaluating the ecological benefits of bioretention installation, we surveyed birds near several new bioretention basins in a residential neighborhood of Columbus, OH. By comparing the results of these surveys with surveys conducted before installation, and with nearby areas lacking bioretention basins, we determine the extent to which bioretention basin installation affects avian communities in the immediate area of the basins. Our work focuses both on the overall community structure, and on changes in presence and absence of individual species.

Presenter: Bare, Ryan

Optimizing water efficiency, sustainable site design, and stormwater management: A case study on the first LEED Platinum Green Building in Montgomery County, Texas

Low impact development planning strategies, including green stormwater infrastructure features along with water and energy optimizing technologies, contributed to the first Leaders in Energy and Environmental Design Platinum new building construction project in Montgomery County, Texas. From the building's interior to the campus' exterior, protection of water resources and preservation of water supplies has been a pivotal driver of planning and design choices. The building design team worked to protect 70% of the site's mixed pine and hardwood forested property from development through ecological exclusion zones (prioritized by highest biodiversity). Where site clearing was deemed necessary, post construction restorative landscaping imbued the site with native trees, shrubs, and grasses. This presentation will discuss water efficiency features and the energy-water nexus connection that allows the Houston Advanced Research Center's (HARC) 18,000 square foot building to operate using less water than an average three person household and how ecological sustainable stormwater management is an integral part of the site's resilience strategy. Water usage characteristics including low flow technologies and water utility cost, sustainable stormwater management design features such as bioswales that incorporate native vegetation and rip rap weirs, a curbless parking lot with center island prairie, water savings derived from energy reducing technology, and an automated real-time metering dashboard technology will be highlighted in the discussion. The opportunity to educate is a priority for HARC as we advocate for a sustainable future.

STREAMS: ECOLOGICAL RESTORATION –
WEDNESDAY, JUNE 13, 2018, 8:30 – 10:20 AM TECHNICAL SESSION

Presenter: Lariosa, Kelly-Rose
Co-Author: Tsang, Yin-Phan

Stream Restoration: Removal of Hibiscus Tiliaceus in Kahana Valley, O'ahu

Streams provide valuable ecosystem services and maintaining stream health should be a priority. However, threats such as invasive species have led to the degradation of stream systems worldwide. Stream restoration efforts can be implemented to restore favorable hydrological conditions for ecosystem processes. The intent of this study was to assess stream restoration efforts regarding the removal of hau (Hibiscus tiliaceus), an invasive shrub that has detrimentally impacted Kahana Stream on O'ahu, Hawaii. This study assessed pre and post restoration hydrological and biological data in Kahana Stream, ranging from 1969 to 2018. The goal of the restoration endeavor was to restore the natural flow regime for endemic fauna, decrease the concentration of fine sediment within Kahana Estuary, and re-establish a diverse community of native vegetation along the stream banks. One of the objectives was to evaluate the impacts of hau removal on flow regime by performing surveys in the proposed restoration area (point-velocity method). The secondary objective was to assess the impact of hau removal on aquatic community composition by conducting surveys in the upper reaches of Kahana Stream (point-quadrat method) and within the estuary (seine method) to replicate historic surveys. Results from this study showed that the mean velocity of the stream increased by 0.02 m/s in the restoration area after hau removal. Species composition was significantly different from historical findings, but the benefits of restoration may take more time to respond to improved conditions. Findings from this study suggests that the removal of invasive species may improve stream functions.

Presenter: Lammers, Roderick W.

Urban river restoration: A case study from the South Platte River, Denver, Colorado

Urban rivers have been straightened, polluted, and neglected. Recently, however, cities have been trying to reconnect to their waterways, hoping to gain some environment, social, and economic benefits. I will present a case study of one such example: the South Platte River through Denver, Colorado. I will focus primarily on the impacts of a large riverside redevelopment project. At this site, a partial floodplain will be restored and a section of the river that is often dried out because of irrigation diversions will be re-wetted. First, I show that reconnecting this floodplain can reduce flood risk for nearby neighborhoods. Next, I show that re-wetting the river can increase fish habitat and potentially reduce water temperatures, especially during the critical summer months. Finally, I examine the water quality benefits of re-wetting the river with reclaimed wastewater. This treated effluent is cleaner than in-stream water and - through dilution - can make a slight but significant improvement in water quality. This is important for the South Platte which nearly always exceeds recreational contact standards for E. coli and is consistently above forthcoming state standards for nitrogen and phosphorus. This analysis shows that restoring even a relatively small portion of the riverfront (~ 1/3 of a mile out of a 20 mile stretch through the city) can have measurable benefits on the river ecosystem. What's more, creating a showcase for river restoration and reconnecting residents to their urban river can hopefully spur additional investment in this overlooked resource.

Presenter: Wagner, Staryn

Designing Trickly Channels With An Ecological Perspective. Oak Springs Case Study.

The conveyance of stormwater is at the root of most problems needing solved by a majority of modern urban engineers. Our urban environments have become too large and too liable to overlook or pass off this biproduct of development. With savvy you can solve for conveyance, slope, Manning's equation, velocities, open channel flow and shear stress but if you have just taken what could be the most productive zone and reduced its ecological function to zero then how successful was the project in relation to its potential.

The Oak Springs Channel restoration project removed a concrete trickle channel that conveyed stormwater and spring flow through a stormwater detention pond and replaced it with a meandering rock channel with natural grade control structures, connectivity to the soils of the riparian border, and guided the vegetation to match the soil moisture conditions of the reach. Three years after completion there is a vigorous wetland community thriving with native vegetation. This stretch of creek that was once a barren scene of mowed grass, dry soil, and concrete is now thriving. Woody establishment of the planted seedlings and natural recruitment is well on its way. The understory vegetation is thick with a diverse array of wetland through upland plants and the wildlife is returning. A diverse riparian forest is the bright future for this urban creek.

ANTIBIOTICS, PESTICIDES, AND NUTRIENTS IN AGRICULTURE –
WEDNESDAY, JUNE 13, 2018, 8:30 – 10:20 AM TECHNICAL SESSION

Presenter: Hansen, Samuel
Co-Author: Messer, Tiffany; Mittelstet, Aaron

Mitigating the risk of atrazine in surface waters across Nebraska

Atrazine is one of the most used herbicides in the world, and threatens both terrestrial and aquatic biota. Several studies have shown associations between exposure to atrazine in drinking water and increase in birth defects, and non-hodgkin's lymphoma. These associations showed a higher level of significance when a dual exposure of atrazine and nitrate occurred. Nitrate is used as an agricultural fertilizer and is often detected in surface waters in agricultural states across the Midwest. The objective of this study is to identify the surface waters across Nebraska that are the "hot spots" at risk for containing atrazine and nitrate simultaneously, and to identify the specific times in the year where this risk is the greatest. The study will utilize a risk factor to determine which HUC8 watershed in Nebraska is at risk for high surface water concentration of atrazine. This risk factor is determined by a ratio of the 95% exceedance of the measured concentration for each watershed over the maximum contaminant level (MCL) of atrazine. These factors will then be analyzed using GIS software to identify the high risk locations in an attempt to mitigate the detrimental health effects of both of these contaminants. The risk factors will also be analyzed over each year that data is available to see how the trend changes over time. These trends will then be analyzed to assess which watersheds are increasing in risk factor over time.

Presenter: Kast, Jeffrey
Co-Author: Martin, Jay; Kalcic, Margaret; Long, Colleen; Muenich, Rebecca; Gignac, Ashley; Harden, E'Lise; Apostel, Anna; Kujawa, Haley

Manure Management in the Maumee River Watershed: How do Intentions Align with Actions?

Recent regulation focusing on livestock agriculture in Ohio, and in particular, the Maumee River watershed, have been implemented with the aim to improve Lake Erie's water quality. These regulations emphasize manure applications by permitted livestock operations. To investigate how manure from these permitted operations is planned to be managed and actually applied, we analyzed permits and inspection reports from the Ohio Department of Agriculture Department of Livestock and Environmental Permitting. Results show that utilized liquid manure management is similar to that of the planned management. Permits indicated 81% of liquid manure would be applied between April and October; in 2014, 86% of liquid manure and in 2015, 81% of liquid manure was applied in this period. Further results indicate that the fields under control of a permitted facility which received manure in 2014 and 2015 generally followed Ohio regulations. 57% of acres receiving manure in 2014 were below the agronomic need of 40 ppm of phosphorous while in 2015 this value rose to 67%. Although our results indicate permitted operations are generally following their stated intentions, knowledge gaps exist for manure generated from these permitted operations and transferred to fields not under control of the operation through Distribution and Utilization processes. 32% (330,761 lbs), 63% (1,752,895 lbs), and 100% (4,175,228 lbs) of P2O5 generated from swine, cattle, and poultry permitted operations, respectively, was planned to be transferred through this process.

Presenter: Huynh, Khang
Co-Author: Reinhold, Dawn

Fate of antibiotics and their phytometabolites in plant-soil ecosystems

Application of animal manure as organic fertilizers has been linked to occurrence of antibiotic residues in agricultural soils and subsequent accumulation in crop plants. Our studies revealed that antibiotic residues, following plant uptake, are prone to extensive transformation and conjugation in plant tissues, with less than 10% of the residues present as unaltered parent forms. For example, direct glycosylation at the N4-nitrogen atom has been found to be the main metabolic pathway of sulfonamide antibiotics (e.g. sulfamethazine and sulfamethoxazole) in model plant Arabidopsis thaliana. More importantly, excretion of the phytometabolites observed in our recent hydroponic studies has raised concerns regarding the total loadings of antibiotics and fate of the released phytometabolites in the environment. While idealized, sterile hydroponic experiments are essential to elucidating phytometabolic pathways, they likely overestimate the importance of phytometabolism in the real-world environment where competing biological and physicochemical processes will be present. Our on-going trials are performed to characterize the contribution of phytometabolism to fate of antibiotics in plant-soil ecosystems, using controlled studies with radiolabeled antibiotics to facilitate comprehensive mass balance evaluation. Given our preliminary results indicating that more than 90% of sulfonamide antibiotics uptaken by A. thaliana is phytometabolized, quantifying the contribution of phytometabolites to the fate of antibiotics is essential to assess the environmental impacts of the continued consumer and agroindustrial use of antibiotics.

ECOLOGICAL ENGINEERING THEORY AND PRACTICE –
WEDNESDAY, JUNE 13, 2018, 10:30 – 11:50 AM TECHNICAL SESSION

Presenter: Goo, Emily
Co-Author: Lee, Victoria; Kangas, Dr. Patrick

Ecological Engineering in Arizona Through the Decades

Over the course of nine days, University of Maryland students from the Department of Environmental Science and Technology visited Arizona to study different examples of Ecological Engineering. Students observed and studied the archeological sites of the Hohokam and Sinagua people, Arcosanti, and Biosphere 2.

Although the civilization existed almost seven hundred years ago, the Hohokam and Sinagua were sophisticated in their architectural design and agricultural practices. Furthermore, their social structure showed complexity and organization very much similar to today's social construct.

Currently, people are increasingly being isolated from the environment as urban sprawl becomes more common in today's society. People spend more time in their automobiles as they commute to work than connecting with their community and environment. Arcosanti is a complex living ecosystem that represents the antithesis of urban sprawl where minimal space and resources are tested. Arcosanti represents a platform of a growing community that incorporated the people with the environment. The miniature city shows that it is possible to create mixed use spaces in a small footprint while providing the same experiences as a larger city.

Lastly, Biosphere 2 is an extreme representation of Ecological Engineering where the creators and designers wanted to make a habitable environment in Mars. Inside Biosphere 2 contains representative biomes: rainforest, ocean, mangrove, savannah, desert, and human habitat. Again, this example was a resource dense environment meant for a much harsher environment. Through the years, self-organization in each biome can truly be observed.

Presenter: Austin, David

De facto ecological engineering design: A project-driven perspective

Because it is engineering, ecological engineering must be about design held to quantifiable performance goals. Otherwise it is not engineering. In a de facto sense, it is engineering design that explicitly employs ecological science, or ecological design that explicitly employs engineering methods. It is practiced by engineers or ecologists, but not by those who are neither.

Although a new field, ecological engineering is already diverse enough to have escaped its founding definitions. The definition given above intentionally has no theoretic power. It is descriptive. There is a proliferation of practices that meet this definition, yet do not self-recognize as ecological engineering. Practitioners need intellectual frameworks more than unifying theory to define membership in a discipline.

This presentation surveys de facto ecological engineering projects from a design perspective. None were designed using classic ecological engineering theory. Rather, disciplines germane to solving problems defined by projects dominated design methods. Together, these example projects demonstrate transdisciplinary practice: phytoremediation, wastewater engineering, limnology, irrigation methods, soil science, aqueous biogeochemistry, geomorphology, wildlife ecology, etc.

The intent of this survey is to consider conceptual frameworks for ecological engineering. By close analogy, civil engineering has no unifying theory. Hydraulic engineers, traffic engineers, and structural engineers, for example, recognize each other as civil engineers, but have essentially disjoint professional tool sets. They share, however, foundations of academic preparation and conceptual intellectual frameworks developed over generations. As ecological engineering matures, similar disciplinary divergence is inevitable and needs inclusive intellectual frameworks.

Presenter: Francis, Samantha
Co-Author: Kangas, Patrick; May, Peter; Tickle, Evelyn

GREEN CONCRETE: A COMPARISON OF CONCRETE SUBTRATES FOR MACROINVERTEBRATE COLONIZATION

Algal Turf Scrubbers are gaining popularity as a method of removing nutrients from eutrophied waterways, but how should we sequester the nutrients within the algae? This experiment attempts to find a way to sequester nutrients held within algae and improve the bioreceptivity of concrete used for artificial reefs and coastline development. Bioreceptivity is contrasted between four substrate treatments: Ordinary Portland Cement (OPC) (the control), OPC combined with dried algae, CaCO3 concrete (mimicking the chemistry of oyster shells), and CaCO3 concrete combined with dried algae. The substrate samples are 6.4 cm tall, 10 cm diameter disks. Each substrate treatment is tied to a rope at three different depths, and the ropes are hung from a bulkhead next to the National Aquarium in Baltimore. Samples are collected every three months for a year and analyzed for colonization by macroinvertabrates. It is hypothesized that adding algae to concrete will improve the bioreceptivity of the concrete by improving the biogenic signature, attracting more bivalves and barnacles. Also, CaCO3 concrete will have higher rates of settlement because its chemical composition is similar to that of an oyster shell, which tends to attract colonizers. Data from the first six months have indicated the largest quantity of colonizers on CaCO3 concrete and the lowest on concrete containing algae. Also, concrete containing algae is more likely to breakdown when subjected to freeze-thaw cycles. Though this indicates an algae-concrete mixture at this ratio does not improve bioreceptivity, incorporating algae into concrete shows promise as a method of sequestering pollutants.

Presenter: Panda, Sudhanshu
Co-Author: Turk, Jeff

Ultra-high Resolution Geospatial Data Based Model Development for Okeefenokee Swamp Wildfire Potential Analysis

Okefenokee swamp, though one of the largest wetlands in United States, is experiencing extensive wildfire since 2007. It is unbelievable that a swamp would burn but it is happening due to changing topography of the region. An initial geospatial model was developed to determine the elevation changes from 1980s to 2010. 30m DEM created in 1980s were temporally analyzed with the LiDAR based DEM (30 cm) developed in 2010. It was observed from analysis that a majority of the swamp has an increment in elevation, thus changing the wetland forest and herbaceous land cover to upland forest cover. It was attributed to eroded soil from northern and central Georgia being deposited in the swamp. An automated geospatial model was developed to determine the wildfire spatial vulnerability in the wetland. Several contributing ecological factors like land cover, slope, aspect, road and stream density, fuel abundance and connectivity, soil and vegetation moisture, weather and climate pattern, lightning density, and others were used to develop the model in the ArcGIS ModelBuilder platform. All these spatial factors were developed using ultra-high resolution data, such as 1 m resolution NAIP imagery, 30 cm DEM, PRISM annual average temperature and precipitation raster, SMAP satellite data (for soil moisture), etc. Advance image processing approaches were used to develop the geospatial data and a Delphi weight scale process was used to combine the contributing factors to develop the wildfire vulnerability map of the wetland. The result would help managing the wildfire to sustain the biodiversity of the wetland.

STREAMS: GEOMORPHOLOGY –
WEDNESDAY, JUNE 13, 2018, 10:30 – 11:50 AM TECHNICAL SESSION

Presenter: Robinson, Joshua

Resurrecting an Urban Stream: The Smith Branch Daylighting Project in Columbia, SC

Urban streams provide tremendous potential for communities wishing to improve flood control and water quality, introduce new opportunities for parks and recreation, and create green spaces and natural corridors. The Bull Street Redevelopment Project in urban Columbia, SC provided the ideal opportunity to naturalize Smith Branch, one of the City's major urban waterways. More than 2,000 linear feet of natural stream channel is being reconstructed in two phases. In the first phase, a reach of approximately 1,000 linear feet is being rehabilitated using a combination of floodplain grading, constructed stone riffles and expansion pools, and bio-engineered bank stabilization measures. In the second phase, a new stream channel of approximately 1,000 linear feet is being excavated to create a bypass to the existing double 84" culverts that have conveyed all stream flows for more than fifty years. The new, "daylighted" stream channel will carry base flows and small storms, while large flood flows will be re-diverted to the existing culverts to increase overall flood conveyance. The stream and associated floodplain wetlands have been designed to improve stormwater quality and rehabilitate and expand the existing aquatic ecosystem. This functional landscape will be the centerpiece of a new City park. This presentation will introduce the typical opportunities and constraints of urban streams, using the Smith Branch project to provide examples of flood control, recreation, water quality, and habitat solutions.

Presenter: Robinson, Joshua

In-Stream Stone Structures: Hydraulic Design and Long-term Function

Stone structures are often constructed to stabilize or enhance waterways that are tightly constrained, or whose watersheds have been hydromodified. Several design methodologies and construction practices have been used successfully, and stone structures have been implemented to armor eroding channel banks, manipulate channel and floodplain flows, establish grade control, enhance in-stream habitat, and/or induce sedimentation. However, to be successful a stone structure should be appropriate for the specific setting. This presentation will provide an overview and comparison of the various types of structures, along with their proper application and design process across a range of geomorphic settings and hydraulic conditions. Specific examples of project successes, failures, and lessons learned will be presented. A multi-year, mile-long restoration effort along the North Fork of the Pacolet River, in which various types of structures have been implemented with varying degrees of success, will used as a specific case study.

Presenter: Stroth, Travis

Integrated Design for Integrated Systems - combining geomorphic and engineering design to maximize channel, floodplain, and wetland functions

Stream corridors are complex, integrated systems. In healthy systems, channels, floodplains, and wetlands are intricately related, working together for maximum function and health. While this may sound like common and widely accepted knowledge, it isn't when you realize stream restoration has focused on single-thread channels and two-dimensional floodplain connection, overlooking opportunities for more profound improvements. This talk looks at common results of hydraulically-based engineering design and compares a new approach that combines geomorphic and engineering tools for more robust understanding of complex riverine systems. This approach allows greater health and function improvement, provides designers with tools to navigate the technical and societal challenges of recommending more natural treatments, and increases our motivation to keep finding more and better ways to work with natural processes.
Examples include design of single-thread channels with limited floodplain connectivity and restrained use of large wood. Hydraulic analyses can demonstrate that traditional designs meet allowable thresholds for velocities and shear stresses in critical locations, thereby meeting design goals and seemingly delivering significant increases in stream function and health. However, single-thread channels are not appropriate in every system, and engineering stability does not always align with geomorphic stability and function in dynamic natural systems. Further, opportunities can be missed when floodplain connection is delivered only via bank overtopping and when wood is limited in the system. Adding geomorphic assessment guides designers to consider the integrated system and adds powerful tools to the engineering toolbox to navigate challenges and maximize interrelated channel, floodplain, and wetland functions.

Presenter: Moore, Trisha
Co-Author: Kari Bigham, Tim Keane

Woody Revetments Woody Revetment Monitoring in the Smoky Hill River, Kansas

Streambank erosion is a major source of sediment in many watersheds and, as such, contributes to accelerated sedimentation rates in downstream reservoirs and associated water security issues. In Kansas and other locations throughout the Great Plains, woody revetments are gaining acceptance as a more "natural" and cost-effective structure to facilitate increased channel stability. A lack of monitoring data, however, precludes assessment of the effectiveness of weedy revetment structures for slowing channel erosion. The objective of this study is to assess changes in channel physical stability and habitat provision, as assessed through aquatic macroinvertebrate community diversity, in two reaches of a sand-bed stream in which woody revetments were installed. The study in currently in year two of four, but results to date and lessons learned will be shared in this presentation.

DECISION MAKING TOOLS –
WEDNESDAY, JUNE 13, 2018, 10:30 – 11:50 AM TECHNICAL SESSION

Presenter: Panda Sudhanshu
Co-Author: Turk, Jeff

Lake Lanier Watershed Management Decision Support System Development with Geospatial Technology Supported Hydrologic Modeling Approach

Lake Sidney Lanier, the drinking water supply source for over 5 million Atlanta residents, is severely under environmental stress recently due to exponential urban growth in the watershed along with changing agricultural practices (poultry and cattle concentrated animal feedlot operations) that is environmentally regressive. The Lanier Bridge and Browns Bridge segments of the lake were included in the 2014 303(d) list for exceedances of the chlorophyll-a criteria. This study performs a comprehensive landuse change analyses between 1974, 1985, 1992, 2001, 2005, 2008, 2011, 2015, and 2018. Water quality data is being collected from nine river confluence points. Soil and Water Assessment Tool hydrologic modeling was completed from 1992 - 2020. The model results were calibrated with the actual water quality data obtained. Thus, a comprehensive spatial map of the watershed with HRUs showing potential impairment scale was developed. A geospatial model was developed to determine the stream segment health using several spatial environmental characteristics like landuse along and upstream of the segment, point sources, wetlands presence, roads in the vicinity, slope, and others. Another geospatial model was developed to determine spatially environmentally vulnerable locations in the watershed using 12 different parameters including impaired streams, agricultural land percentage, land cover percentage, population density, human health impact, etc. All these model results were combined together to develop the environmentally degrading spatial distribution map of the watershed. Subsequently, we developed comprehensive best management practices as a decision support system to improve the degraded subwatersheds for enhancing the water quality of the reservoir.

Presenter: Alam, Taufiqul
Co-Author: Jones, Kim ; Guerrero, Javier

Development of Decision Making Tool (DMT) for Stormwater Detention Requirements in LRGV, Texas

To address U.S. - Mexico border water quality issues associated with non-point source pollution within the Arroyo Colorado watershed, stormwater runoff generated from new commercial developments within the Lower Rio Grande Valley (LRGV), TX is required to be detained on-site for a 50-year frequency storm event and released into the receiving system for a 10-year frequency storm event. Because of safety and maintenance issues, the traditional design of a large detention pond footprint can be reduced by allowing the storage volume of LID BMPs to be incorporated into innovative design detention calculations. This project has developed a Decision-Making Tool (DMT) as a simple macro-enabled excel spreadsheet, which was formulated to assist in discharge calculations and BMPs planning to meet the 10 years discharge goal from the 50-year rainfall event. WinSLAMM is the foundation of the DMT database and analysis, which was developed based on the discharge resulting from calibrated BMP models for permeable pavements, bioretention cells, and bioswales. In its algorithm, this tool uses the rational method (predevelopment conditions) and WinSLAMM translated BMP equations (controlled conditions) to calculate the peak discharge from the proposed commercial developments for the Arroyo watershed. This tool can be valuable for LRGV planners, stakeholders, and stormwater task force partners for planning, design, and implementation of innovative BMPs and incorporating the outcomes into land development opportunities for regional developers. The tool and its methodology for development can be applied to other impaired watersheds and rapidly growing urban areas.

Presenter: Stephens, Tim
Co-Author: Bledsoe, Brian

Mapping flood hazards under uncertainty: A template for integrated floodplain management

Changing precipitation, rapid urbanization, and the dynamic behavior of river channels interact to create unprecedented challenges for flood mitigation and management. Additionally, recent studies have shown an increase in housing density within and adjacent to regulatory floodplains. Standard methods for quantifying flood hazards and evaluating risk are hindered by approaches that do not sufficiently account for the compounding effects of changing precipitation, land-use, and river channels on flood hazards. Thus, there is a need for an improved method to portray flood hazards that incorporates uncertainty and enables integrated water management. This presentation outlines novel techniques for portraying flood hazards through probabilistic flood inundation maps that reflect uncertainty quantified through Monte-Carlo analyses of model inputs and parameters. The likelihood of inundation and range of variability in flood extents resulting from Monte-Carlo simulations are then compared with deterministic evaluations of flood hazards from current regulatory flood hazard maps. Further, we describe how the confidence bounds in inundation extents can be used to identify areas of elevated or hidden risk and areas ripe for features that reduce the consequence of inundation, increase biodiversity, and provide valuable amenities that enhance quality of life. The novel techniques described in this presentation can aid flood management by acknowledging the inherent uncertainty in model estimates and serving as a template for mitigation.

Presenter: Porras, Abel

A Modeled Based Design of a Stream Monitoring Program for Austin, Texas

The City of Austin is conducting a review of their stream monitoring program, the Environmental Integrity Index (EII). The EII currently consists of collecting various water quality and biological samples and physical measurements of its streams at approximately 120 sites. The City is now attempting to expand its network of sampling to a greater resolution with the goal of accurately identifying degrading sites while minimizing level of effort. To do this, the City is utilizing Geographic Information System (GIS) data throughout the City along with floodplain models to predict water quality and hydrological impacts at approximately 2000 foot increments throughout all of Austin's creeks. As a consequence, thousands of sampling sites will be included into the EII of which only a small percentage will be randomly sampled. Furthermore, staff generated mental models of the interaction between GIS, floodplain model data, water quality samples, physical measurements, and biological metrics in the creeks. The compilation of this mental model facilitated in the development of causal relations, which will assist design practitioners in choosing appropriate solutions to degrading sites on a more local scale. Future sampling and GIS information will provide further feedback on the uncertainty of the model and the effectiveness of various solutions to creek health. This combination of GIS data, floodplain models, and causal relations will result in an overall model that can identify locations where there is a degrading creek or insufficient information of the creek, which can then inform potential sampling locations and potential solutions.

ENGAGING EDUCATION –
THURSDAY, JUNE 14, 2018, 8:30 – 9:50 AM TECHNICAL SESSION

Presenter: Ludwig, Andrea
Co-Author: Gangaware, Timothy

Catching the Rain and Some Attention with Campus Demonstrations of Green Infrastructure

Rain gardens and created wetlands are sprouting up across campus facilities at the University of Tennessee (UT) to demonstrate residential and farmland applications to create ecological lift in areas otherwise underutilized. Since 2012, UT has held a general permit to operate a small municipal separate storm sewer system within the City of Knoxville. As such, the Facility Services at UT under the support and guidance from faculty and staff of the Watershed Faculty Consortium have created campus rain gardens to meet their self-imposed targets of creating two demonstration sites per year. To date, this effort has created 12 rain gardens on UT property (both in Knoxville and across the state) and approximately five acres of created or enhanced wetlands with the purpose of reducing impacts from farming operations. This activity has created an opportunity for integrated teaching, Extension, and applied research in the area of stormwater management. This presentation will be an overview of the projects comprised in this effort, including a summary of utilized campus resources, measured and expected outcomes, and a discussion on future applied research projects now made possible in these field-scale laboratories.

Presenter: Michelle Wood-Ramirez

Integrating ecosystems and society: Utilizing the Stream Trailer to reach TRWD Audiences

The TRWD Stream Trailers are an award winning part of our educational toolbox that foster outdoor learning and emphasize hands-on learning styles. The stream trailer is an activity that demonstrates how rivers change and form over time, and how landscape level processes interact with each other. It allows everyone to identify with and place themselves within the system so that they can see how they affect watershed health and water quality. We will cover programming and curriculum, and how we tie abstract geomorphologic concepts learned in school to real world places and scenarios that any audience can relate to. Key discussion points for lessons learned, and future goals for our Watershed Program. How we utilize partnerships for our education and outreach as some of the main tools the Tarrant Regional Water District uses to teach and promote watershed health.

Presenter: Jantrania, Anish
Co-Author: Munster, Clyde; Gentry, Terry

REEU Program at TAMU: Getting Undergraduate Students Excited about Onsite Wastewater Treatment & Reuse

At Texas A&M, we received a USDA-NIFA grant to support a summer fellowship program for undergraduate students that will focus on "Integrated High Impact Extension, Research, and Education Program for Undergraduate Students in Water Quality projects" using onsite wastewater treatment systems. At first, our team was worried about not receiving adequate number of applicants for our program, however, during the last week of application deadline we received 45 applications for 10 open seats. With high level of interests in our program, we requested USDA to increase the number of open seats from 10 to 15 and they agreed.

In summer of 2017, the first batch of 15 undergraduate students participated in the hands-on research and extension experience for (a) working with onsite wastewater treatment and reuse technologies, and (b) understanding the role of soil for treating wastewater. This presentation will give details on our funding program and share our experience in attracting young scientists and engineers to the onsite wastewater industry. We will also present a progress report on the activities happening at our training center related to starting of onsite water reuse projects and the plans for the summer of 2018 REEU program. Finally, a group of students from Year-2 will make a poster presentation about last year program and what they are what they are working on this year.

Presenter: Franti, Thomas G.
Co-Author: Clark, O. Grant

Teaching Ecological Engineering Using a Project-Based, International Collaboration

In 2014 the authors collaborated to create a new course in Ecological Engineering that met the need for an undergraduate class at the University of Nebraska-Lincoln (UNL) and a combined undergraduate/graduate class at McGill University. Course outcomes were designed to enable students to: 1) work in a diverse team, 2) collaborate using online tools, and 3) create an ecological engineering design. The content followed the textbook Ecological Engineering Design (Matlock and Morgan, 2011) with an alternative ecosystem ecology section. The classes met simultaneously on their respective campuses to enable shared, online lectures. Diverse teams comprising students from both universities were assigned an internet-based project: to develop a self-selected ecological engineering design, thus providing a focus for the shared curriculum. The design was developed and delivered via an online "whiteboard-style" platform in lieu of a written report. Peers and the instructors reviewed a preliminary version of the assignment, and the instructors graded the final version. Successful aspects of the course were: 1) assigned team membership; 2) self-selected projects; 3) international student interaction; and 4) shared guest lectures with diverse expertise. Problematic aspects were: 1) a tedious online platform; 2) difficulty scheduling team meetings; 3) mismatched student motivation and experience; and 4) unfamiliarity with "ecological engineering solutions". The cumulative course content, experience, and increased delivery expertise continue to strengthen the course. There are plans to involve a third, French-speaking ecology/environmental science class from another Montreal university to increase the diversity of the project teams and the interdisciplinarity of the project.

CONSTRUCTED WETLANDS –
THURSDAY, JUNE 14, 2018, 8:30 – 9:50 AM TECHNICAL SESSION

Presenter: Austin, David

Intensification of free water surface wetlands for nutrient removal

Free water surface (FWS) wetlands are passive biogeochemical reactors. Oxidative processes are limited by atmospheric transfer of oxygen to water. Permanent sequestration of phosphorus (P) into minerals depends on site-specific geochemistry. These processes have low rates. Unit process modifications to FWS wetlands, however, can boost treatment rates. A 2.3 ha FWS wetland in Michigan (USA) treats 800 m^3/d of ammonium contaminated groundwater by recirculating water supersaturated with pure oxygen. Mean inflow NH3-N was 8.0 mg/L, mean outflow 0.6 mg/L. The observed mean area rate coefficient was 206 m/y compared to a median literature value of 14 m/y. A 108 ha FWS wetland in Georgia has an inflow of 57,000 m^3/d with a mean TP of 0.5 mg/L. Aluminum chlorohydrate (ACH) was injected into inflow at non-flocculating concentrations well below the Al chronic toxicity concentration (440 µg/L). Prior to ACH injection, the TP areal rate coefficient was 3 m/y, with ACH 20 m/y. A similar pilot project in Oregon at 12,000 m^3/d in a 0.8 ha FWS wetland achieved a rate coefficient of 135 m/y, but exceeded the Al chronic toxicity concentration. The impact of higher rates is smaller treatment areas. Super oxygenation reduces area required for nitrification by over 90%. Geochemical augmentation with Al or Fe to sequester TP reduces required area by about 90%. The intensification of these unit process substantially increases the potential to use FWS wetlands because of reduced demands on treatment area.

Presenter: Keilhauer, Mary
Co-Author: Messer, Tiffany

Nutrient Treatment Potential of Floating Treatment Wetlands

Floating treatment wetlands (FTWs) are an innovative wetland design to passively improve water quality and remove pollutants from lakes with little infrastructure modifications or construction as compared to traditional treatment wetlands. The goal of this project was to quantify the removal potential of nitrogen and phosphorus and create FTW placement recommendations based on seasonal lake flow patterns. To examine the impacts of the natural environment on FTW nutrient removal, a custom multisensor probe measured depth, conductivity, temperature, and other water parameters simultaneously with location and velocity measurements at various depths of a urban lake in Lincoln, NE. Findings were then integrated into a mesocosm study in a greenhouse on the University of Nebraska-Lincoln's campus focused on nitrate-N and phosphate-P removal in FTW systems. The study quantified nitrate-N and phosphate-P removal for FTW systems over a range of nitrate-N and phosphate-P concentrations. Three treatments were evaluated in replicates of six: 1. Only water (Control), 2. FTW with monoculture rush macrophytes (J. effusus and J. torreyi), and 3. FTW with diverse macrophytes (Carex comosa, Carex vulpinoidea, Asclepias incarnata, Juncus effusus, Juncus torreyi, and Iris). Three mesocosms for each treatment had recirculation pumps installed to examine water recirculation impacts on lake systems, while recirculation was absent in the additional three mesocosm replicates. Throughout the experiments, regular water samples were taken to determine nutrient removal rates. The mesocosm results in conjunction with field experiments provide a basis for recommendations on the placement and sizing of FTWs to maximize removal potential.

Presenter: Alex Horne

Denitrification trenches; are they the beginning of the end for treatment wetlands or the end of the beginning?

Last year I discussed expansion of constructed wetlands to treat large volumes of water diverted from rivers and then returned clean. This circumvents finding suitable land close to the pollution source but is not always ideal. Denitrification trenches, the early successes of which were reported at AEES, can have no surface manifestations so can be placed almost anywhere. In addition, with some tweaking, they can treat much more than nitrate. Will they replace conventional treatment wetlands or augment them? Results to date, mostly in mid-western agricultural regions, show almost magical results with good nitrate removal using almost any design. This seems too good to be true, so some parameters must be better defined. These include HRT, longevity, type of substrate (any kind of wood chips or sand-wood mix seems to work), temperature dependence, and location of inlets and outlets. Recent experience in the Mt. Lake watershed, Presidio, San Francisco, indicates some problems. The concern is nutrient flow to this small natural urban lake from a working golf course on sandy soil and from a heavily-used dog-walking area. Ideas for solutions and expansion of the method will be discussed but not necessarily solved.

RESERVOIR QUALITY –
THURSDAY, JUNE 14, 2018, 8:30 – 9:50 AM TECHNICAL SESSION

Presenter: Arias, Mauricio E.
Co-Author: Kaura, Mohit; Oeurng, Chantha; Cochrane, Tom A.

The role of forest conservation and restoration in securing hydropower needs of Cambodia

Hydropower relies on protection of watersheds to regulate water and sediment yields. Deforestation accelerates the rate of soil erosion, thereby increasing the amount of river sediments heading to the dam's reservoir, decreasing the longevity of the dam. In Cambodia in particular, recent deforestation rates are among the largest on the planet, and forests are expected to disappear within the lifespan of proposed dams. The cost of protecting and restoring forested watersheds can be considered as an annual investment towards sustainable reservoir management and hydropower generation. A modeling framework is developed to estimate the sediment accumulation in reservoirs from deforestation-driven soil erosion. Associated power generation loss is then calculated, and by relating it to current electricity tariffs, the annualized and present monetary value associated with the benefits of forest conservation to hydropower are estimated. This framework is applied to four large hydropower proposed dams in Cambodia. With an ongoing average deforestation rate of 1.35-1.65% in the past 5 years, reservoir watersheds could lose all forest cover in the coming 40-55 years. This could increase the current sediment yield up by 15-20%, resulting in acceleration of reservoir filling with sediments. These phenomena would incur additional sediment removal costs to the hydropower industry, which could be reduced through investments in forest conservation and restoration, potentially financed via a payments for ecosystem services scheme. The modeling tool is general and transferable to other rivers globally where hydropower development is accelerating.

Presenter: Fuhrmann, Byran
Co-Author: Beutel, Marc

Mercury Cycling in California Reservoirs: Takeaways and Management Strategies to Repress Bioaccumulation

Inorganic Hg, predominantly from widespread atmospheric deposition, but also from point sources including mine and industrial sites, is transformed to methylmercury (MeHg) by anaerobic bacteria in oxygen-poor water and sediment. The profundal zone of productive lakes commonly exhibits summertime anoxia and associated accumulation of MeHg in bottom waters. MeHg in bottom water bioaccumulates in pelagic biota when it diffuses upwards across the thermocline or when MeHg-rich bottom water mixes into the upper water column. With the shortcomings of conventional Hg control strategies, such as dredging, capping, watershed controls and source control, managers are increasingly interested in developing in situ strategies to repress Hg bioaccumulation in managed aquatic ecosystems. One potential strategy is to enhance the redox potential at the sediment-water interface to repress MeHg efflux to overlying water. The impact of enhanced redox potential can then be correlated with changes in MeHg and inorganic Hg species, concentration, and distribution in the reservoir. This study utilizes a variety of analytical methodologies in order to determine theses changes in speciation, concentration, and distribution of MeHg/Hg. Afterwards, a conceptual model of MeHg cycling at the profundal sediment-water interface is presented and redox-mediated mechanisms that enhance MeHg efflux are summarized. Highlights of experimental sediment-water chamber incubations from a number of California reservoirs are also presented and summarized. With a more comprehensive understanding of MeHg cycling at the profundal sediment-water interface, managers will be better able to develop effective management strategies aimed at repressing MeHg bioaccumulations in lakes and reservoirs.

Presenter: Tang Zepei
Co-Author: Nairn, Robert W.

The Role of Algal Biomass Growth on Nutrient and Metal Interactions at the Sediment-Water Interface

In this research, the goal was to understand the nutrient and metal cycling processes at the sediment layer-water column interface in a large terminal reservoir, the Grand Lake o' the Cherokees, Oklahoma. The study site has both elevated metals concentrations in the sediments from the upstream Tri-State Lead-Zinc Mining District and elevated nutrient concentrations in the water from agricultural and urban run-off, resulting in eutrophication and substantial algae blooms. A greenhouse microcosm study was designed with three different biomass addition treatments: control, low biomass and high biomass using lake sediment, groundwater and laboratory-incubated Microcystis aeruginosa, which is one of the dominant blue-green algae in this lake. Over 30 days, these three treatments had overall decreasing trends in chlorophyll-a concentrations, despite some changes in the dominant algae species. Dissolved reactive phosphorus (ortho P) and nitrate-nitrogen (NO3-N) in the water column showed decreasing trends over time, indicating nutrient uptake by the biomass growth. At the end of study, Fe concentrations in the sediment showed a deceasing trend with greater biomass growth and all treatments had lesser concentration then the initial sediment, and also the final sediment extracted ortho P concentrations were lesser than the initial concentrations. The hypothesis was that biomass growth would change the P distribution between the water column and sediment layer. It is expected that the results will show that monitoring biomass growth can benefit P control release in the water column and therefore address eutrophication in lakes.

POSTER SESSION –
WEDNESDAY, JUNE 13, 2018, 5:00 – 6:30 PM

Presenter: Lin, James
Co-Author: Tasker, Miriam

Analysis of Vermicompost as a Supplemental Nutrient Solution for Aquaponic Prawn Systems to Grow Basil

Aquaponic systems combine the nutrients waste produce from aquaculture and the ability to grow plants without soil from hydroponics into a re-circulating closed-looped system to produce both plants and fish. The project is designed to assess the difference in plant yields based on different nutrients used. Basil is grown with an aquaponics system that utilizes freshwater prawn waste. However, prawns do not produce enough nutrients to maintain the plants growth. Thus, our hypothesis is that additional vermicompost supplements will address the nutrient deficiencies from prawn aquaculture. Vermicomposting is the combination of earthworms and microbial communities that break down organic wastes to produce a compost that is rich in macro and micronutrients. Two different treatments are analyzed using 6 prawn aquaponics systems, three with vermicompost solution and three without. After one month of growth, the biomass of the basil will be harvested, dried, and analyzed through ANOVA standard tests. Throughout the experiment the water chemistry of all the systems are recorded, specifically the dissolved oxygen, pH, temperature, salinity, ammonia, nitrites, and nitrates. Our research on vermicompost as a supplemental nutrient source for aquaponics systems utilizing prawns and systems with nutrient deficiencies indicates that plants with vermicompost supplements have a higher biomass.

Presenter: Garner, Joe
Co-Author: Levy, Nicole; Miele, Brandon; Moore, Casey; Sioson, Michael; Yen, Ashley; Kangas, Patrick

Assessing the Use of Harvested Algae as Fertilizer

Several kinds of algal-based ecotechnologies are being studied for removing nutrients and sediments from polluted waters. Algae take up the pollutants through multiple mechanisms and water quality is improved when the algal biomass is harvested. One of the benefits of this approach is that the harvested biomass is a byproduct of the water quality function that can be used in an economic process. In this study data are reported on potential use of harvested algae to make a fertilizer. Building on earlier studies algae of known nutrient content, that had been harvested from an algal turf scrubber in the Chesapeake Bay watershed, were added to potting soil in a plant growth experiment. The mass of algae added to the soil was scaled so that the amount of nitrogen added would be equivalent to the recommended commercial fertilizer application rate. Cucumber seeds were planted in the potting soil and their germination and growth were compared between pots with algae fertilizer versus pots with a commercial fertilizer. Rates of plant growth were similar between the two treatments demonstrating the byproduct value of the algae as a fertilizer. Since the algae harvested from the algal turf scrubber contain some of the fertilizer nutrients that had runoff from farm fields, their return use to farms as a fertilizer can help to close the agricultural nutrient cycle in the Chesapeake Bay watershed. Preliminary plans for a business based on the sales of algae fertilizer in place of commercial fertilizer are presented.

Presenter: Tasker, Miriam
Co-Author: Lin, James

Analysis of Vermicompost as a Supplemental Nutrient Solution for Aquaponic Prawn Systems to Grow Basil

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Presenter: Cianfrani, Christina
Co-Author: Hews, Sarah; Tor, Jason; Shillington, Claire

Modeling Nitrogen Transformations in Greywater Treatment Constructed Wetlands in a Living Building on the Hampshire College Campus

Student generated data in class and independent research projects have been used to assess the functioning and effectiveness of a greywater treatment constructed wetland system at the Kern Center, a newly opened “Living Building,” on the Hampshire College campus. The building uses aerobic indoor vertical flow and anaerobic outdoor horizontal flow constructed wetlands to treat greywater generated within the building. Ultimate discharge of the treated greywater is to a leach field on-site. The current average building demand for water is 300 liters for use in water fountains, bathroom sinks, janitorial sinks, and a coffee bar. In Phase I of the project, students created 6 liter mesocosms in the lab to develop a conceptual understanding of nitrogen cycling within the system. Aerobic and anaerobic conditions were simulated. Nitrate/nitrite, ammonia (NH3/NH4), and pH were measured using test strips. The presence of nitrifying and denitrifying bacteria were measured using a most-probable-number procedure. Stella dynamic systems software was used to model transformation of nitrogen within the system using measured data. In Phase II, students applied their understanding of the treatment processes to create a model of the in-situ wetlands using water quality data collected in the field. Preliminary analysis shows that nitrogen is being added to the system rather than removed as predicted.The students have shared their data with the building manager and design engineer to to aid in the monitoring and management of the constructed wetland systems.

Presenter: Haberstroh, Charlotte
Co-Author: Arias, Mauricio

Modelling Plastic Debris in Freshwater Systems

Plastic pollution in freshwater is as an emerging environmental issue. Widespread presence of plastic in aquatic and terrestrial ecosystems harms wildlife, facilitates the transport of other chemical pollutants and toxic contaminants, pathogens, and non-native species, and compromises ecosystem services. Land-based release of plastics –mostly via rivers– contributes an estimated 80% to the debris in the oceans; yet, data particularly for loads in rivers and other freshwater systems are fragmentary to absent. The potential of Ecological Engineering technologies to address plastic debris in the environment has not been identified. A better understanding of transport and fate, degradation pathways, and removal mechanisms can forward the discussion if or how Ecological Engineering approaches can contribute to solve the issues associated with plastic debris.
The work to be presented is part of a broader research project developing a large-scale model to describe and analyze the input and transport of plastic debris in freshwater systems on different temporal and spatial scales. This involves a continuous and long-term data collection to characterize plastic loads in the Hillsborough River (HR) in Florida. Overall goal is to identify strategies for better waste management and source reduction. Currently, a numerical model has been set up displaying the transport processes governing the movement and fate of plastics of a river reach, using a section of the HR as basis for flow characteristics. Several scenarios for source inputs will be applied to the system to model the fate of different plastic classes.

Presenter: Morales,Castulo
Co-Author: Lopez,Cesar; Gonzales,Katherine; Al-Qudah, Omar

Production of Ethanol from Citrus Waste via Limonene Extraction and Fermentation

All over the world, enormous quantities of citrus waste are generated by citrus processing companies, which frequently only utilize the pulp of the citrus. The citrus waste is regularly just discarded or sold as cow feed for a very low profit. Citrus waste contains fermentable sugars such as fructose, glucose and sucrose, which can be fermented into bioethanol. Antibacterial compound limonene must be removed prior to the fermentation process, as it inhibits the fermentation process. In the experiment, a simple distillation unit was used to remove the limonene present in the homogeneous citrus waste mixture. The limonene-free slurry was then fermented for 48 hours in an incubator with enzyme saccharomyces cerevisiae, allowing the fermentation process to take place. Distillation was then performed to remove the ethanol from the slurry mixture. Gas Chromatography Mass Spectrum (GCMS) was used to analyze the products of limonene and ethanol obtained. The percentages of both ethanol and limonene experimentally obtained were similar to those provided in literature. The results showed a 1.91% of ethanol in a water-ethanol mixture with only 0.02% of methanol. After the extraction of ethanol from the ethanol-water mixture, it is expected to yield close to 8% by weight of the citrus waste used. As shown by research, the higher the amount of limonene extracted, the higher the yield of ethanol via fermentation. If the highest yield of ethanol is desired, an attempt to extract close to 100% limonene should be attempted.

Presenter: Myers, Harrison
Co-Author: Tharp, Rebecca; Roy, Eric

Phosphorus Cycling at the Sediment-Water Interface of Vermont Stormwater Ponds

Phosphorus (P) in urban and agricultural runoff is known to cause eutrophication in freshwater ecosystems, which degrades their economic, environmental, and social value. We examined the biogeochemical cycling of P within stormwater ponds in Vermont, specifically at the sediment-water interface. Stormwater ponds are the most widely used stormwater management practice in Vermont, so understanding P dynamics within them is critical to mitigate eutrophication in Lake Champlain. Nutrient gradients can occur at the sediment-water interface due to relatively low nutrient concentrations in the pond inflow, and relatively high concentrations within the sediments of stormwater ponds caused by nutrient accumulation over time. This gradient can drive internal loading of P across the sediment-water interface. The vertical gradient of soluble reactive P (SRP) at the sediment-water interface was measured using peepers deployed in three stormwater ponds. A clear SRP gradient was observed in two out of the three ponds, indicating internal leakage of SRP from sediments. Positive correlations were observed between the vertical sediment-water interface SRP gradient and organic matter content, % sand, and porosity. Respiration of organic matter can drive down dissolved oxygen (DO) at the sediment-water interface, and organic matter has been shown to increase porosity in flooded sediments, creating a less restrictive path for the flux of SRP. Implications for pond design and stormwater management will be discussed.

Presenter: Martinez, Jaycee
Co-Author: Beutel, Marc; Fuhrmann, Byran; Brower, Sarah; Pasek, Jeffrey

Mercury bioaccumulation in the aquatic food web of a eutrophic reservoir, Hodges Reservoir, California

Hodges Reservoir is a eutrophic reservoir in San Diego, California, deemed mercury impaired by state regulators. Methylmercury (MeHg) is a serious contaminant threatening our nation's aquatic systems because it bioaccumulates in aquatic food webs. It is a potent neurotoxicant that poses a threat to different trophic levels in aquatic communities such as fish and water fowl. The major route of human exposure is through the consumption of MeHg-contaminated fish which have been exposed to MeHg through ingestion of contaminated lower organisms. This poster will present preliminary data on the amount of MeHg and ionic Hg biomagnified from water to seston to zooplankton to fish in Hodges Reservoir. We expect to see the greatest jump in MeHg levels from the water to seston and from seston to zoopkankton. We also expect to see an increasing ratio of MeHg to total Hg in tissue with higher trophic level. This study is essential not only to raise awareness on MeHg toxicity, but to inform the development of in-lake methods, such as lake oxygenation, to prevent Hg methylation from occurring in mercury impaired lakes such as Hodges Reservoir. By preventing the production of MeHg in the state's lakes and reservoirs, we can help ensure the safety of California's residents when eating lake-caught fish.

Presenter: Rome, McNamara

Beyond Nutrient Reduction: The Role of Biological Factors in Reversing Eutrophication in Shallow Lakes

For many decades the fields of limnology and freshwater ecology have deepened our understanding of eutrophication by emphasizing the importance of biological factors in determining the expression of nutrient pollution. As early as the 1980s, specialist studying hyper-eutrophication have urged a shift in emphasis from nutrient studies to studies involving trophic level interaction. Since that time many studies have documented the effect that factors such as the fish population structure and presence of submerged vegetation can have on the grazing capacity of zooplankton and in turn the abundance of phytoplankton and overall lake turbidity. These observations, though robust and consistent over many studies, have had relatively little impact on the work of environmental engineers and many regulators who, when considering surface water quality, still tend to view freshwater ecology as a black box with a largely uniform response to nutrient pollution. For moderately-eutrophied waterbodies, how much emphasis should be placed on further nutrient reduction and how much emphasis should be placed on shifting biological factors through ecological restoration? Answering this question is of critical importance to how we approach the restoration of degraded waters. Based on existing research, relationships between eutrophication and biological factors are classified and ordered in terms of relative importance. This allows for a robust multi-parameter definition of eutrophication that is applicable across lake types. We categorize mitigation efforts used to ameliorate the effects of eutrophication and to prevent harmful algal blooms to identify trends in treatment strategies.

Presenter: Nesbit, Taylor
Co-Author: Mitsch, William J.

Seasonal and Hurricane Irma effects on the hydrology and nutrient pulsing of a subtropical urban stormwater treatment wetland in southwest Florida

The hydrology of a created wetland is a critical component in understanding the overall functioning of its design. Freedom Park, a 4.6-ha subtropical stormwater treatment wetland in Naples, Florida, was designed to improve the water quality and reduce peak flows for the downstream estuaries connected to the Gulf of Mexico. The wetland lies within a 1,766 ha urbanized watershed. A monthly hydrologic budget was developed from August 2016 to January 2018. During this study period, average pumped surface inflow was 50.1 cm week-1, surface outflow was 38.8 cm week-1, precipitation was 3.76 cm week-1, and potential evapotranspiration (PET) was 5.34 cm week-1. Because this wetland was designed to store and treat stormwater, it was imperative to understand how this system operates during storm events. A stormwater pulsing study during Hurricane Irma (September 9-16, 2017) showed that after an initial inflow flush due primarily to rainfall (34 cm), total phosphorus and total nitrogen concentrations were higher at the outflow than at the inflow for several days before returning to normal conditions. The mass of nutrients leaving the system was 130% and 37% higher for TN and TP, respectively, than the mass entering the system during this period. The design of the inflow with pumps, rather than natural land overflow, meant that the hurricane-caused inflow was much less than it could have been during such a dramatic pulse. This stormwater pulsing study was performed for four other storm events from July to October 2017 and analyzed for their effects on water quality.

Presenter: Baillargeon, Natalie
Co-Author: Hibbs, Flynn; Madison, Rose; Noble, Rick; Sadri, Joshua; Washington, Memphis; Cianfrani, Christina; Hews, Sarah; Sistla, Seeta; Tor, Jason

Undergraduate Research in a Collaborative Community: Inquiries Inspired by Hampshire College's Sustainable Operations Initiatives

The Integrated Sciences First-Year Program at Hampshire College creates a collaborative community for undergraduate students to design independent research projects that investigate the experimental systems implemented on campus. These research projects foster innovative thinking and encourage students to question and inform the ways Hampshire implements its Sustainable Operations Initiatives (SOIs) and other research. The SOIs include the recent construction of the R.W. Kern Center, certified under the Living Building Challenge, the installation of 19-acres of photovoltaic (PV) arrays, and the transformation of lawns into meadows; these initiatives are a source of inspiration for our research. We explored the microbial communities present in the outdoor construction wetland at the R.W. Kern Center. We examined the ecological impacts of the PV arrays on invertebrate populations and soil decomposition. We recently welcomed Physarum polycephalum, slime mold, as a visiting scholar and investigated its behavior under varied environmental conditions. We explored the influence of grass type, biodiversity, and manufactured Effective Microorganisms on soil health in an attempt to improve our on-campus land management strategies. Our research projects offer insights to improve the established SOIs or suggest new ones, create further understanding for sustainable practices, and serve as a model for independent undergraduate research.

Presenter: Lammers, Roderick
Co-Author: Bledsoe, Brian

Modeling watershed phosphorus and sediment loading from river erosion while accounting for uncertainty

Phosphorus and fine sediment pollution are primary causes of water quality degradation. The significance of stream channel erosion as a source of these pollutants is increasingly being recognized, but it remains difficult to quantify the magnitude of this loading. We use a new, easily applied, watershed scale model to simulate the potential for future phosphorus and sediment loading from channel erosion in two watersheds: Big Dry Creek, Colorado and Lick Creek, North Carolina. The projected magnitude of loading for both pollutants is about an order of magnitude higher in Big Dry Creek compared to Lick Creek; however, in both watersheds model results suggest that channel erosion will not be a significant source of phosphorus (~4% of historic watershed total) but will of sediment (nearing 100% of historic watershed total). Uncertainty in these results is high --- similar to what has been reported for other estimates of bank erosion --- and is larger than typical uncertainty bounds for other non-point pollution sources. Importantly, modeling also suggests that loading will decrease over time in Big Dry Creek as the channel adjusts to a new stable state. Lick Creek shows no decrease into the future but estimates are sensitive to upstream sediment supply, reinforcing the importance of considering alterations to both the hydrologic and sediment regimes when analyzing potential channel changes. This new model is a valuable tool for estimating pollutant loading from channel erosion and may also be useful for testing the effects of stream restoration techniques on watershed scale channel response.

Presenter: Collins, Georganna

Natural and Nature-based Features for Coastal Protection

Working with Nature is an integrated process which involves means and methods to develop win-win solutions with respect to nature and projects that provide economic development and coastal protection. Working with nature has become a program launched in 2013 called Engineering With Nature (EWN) at the U.S. Army Corps of Engineers' Engineering Research Development Center that enables more sustainable delivery of economic, social, and environmental benefits associated with water resources infrastructure projects, such as navigation channel maintenance and inland stormwater management. As part of this EWN Program, in response to Hurricane Sandy recovery efforts, in 2015 a report on the Use of Natural and Nature-based Features (NNBF) for Coastal Resilience was prepared classifying NNBF, characterizing vulnerabilities, developing performance metrics, and addressing key policy challenges. To date, international guidelines are being developed to inform the conceptualization, planning, design, engineering, construction, and maintenance of NNBF used to support resilience and flood risk reduction for coasts, bays, and estuaries. This presentation highlights NNBF Guidance Document content addressing beaches, dunes, barrier islands, marshes, seagrass beds, and reefs.

Presenter: Kangas, Patrick
Co-Author: Doherty, Morgan; Frys, Benjamin; Huntzinger, John, Kinnaman, Jay; Lagomarsino, Matthew; Nichols, Joshua; Settles, Risharda; May, Peter

Sediment Removal Performance of a Green Bulkhead System

A green bulkhead is a special type of living shoreline best management practice for water quality improvement and beautification in urban harbors. We are developing a green bulkhead system for harbors in the District of Columbia and in Baltimore, Maryland as part of a long-term project in ecological engineering. The system is essentially a vertical wetland with plants grown in netting that is hung along the bulkhead. Water is pumped from the harbor to the top of the bulkhead where it is dripped across the netting that supports the plants. A bicycle-powered pump is employed to operate the system that involves volunteer participation by people visiting the harbor for recreation. Signage about the system is used to engage the people and to provide educational information about water quality issues in the harbor and the green bulkhead system. Nutrients and suspended sediments are removed from the water passing through the green bulkhead by plant uptake and physical filtration. In this presentation data on suspended sediment removal by an experimental green bulkhead are reported. Two kinds of media (coconut coir and rock wool) for growing plants in the system were tested and were found to remove 62 - 93% of the suspended sediments in the water flowing through the system. The potential of the overall system to provide water quality improvement, recreation and educational outreach about harbor restoration is discussed.

Presenter: Kangas, Patrick
Co-Author: Lane, Franklin; Morgan, Katherine; May, Peter; Mulbry, Walter

The Performance of Experimental Algal Turf Scrubbers Inside of Biosphere 2

Three replicate one square meter algal turf scrubbers (ATS) were set up in Biosphere 2, located in southern Arizona, during March 2017. They were operated for one year with weekly or bi-weekly harvests, treating water from the mangrove forest inside of Biosphere 2. The production of the ATS system has averaged 7.6 grams of dry algal biomass/square meter/day over the study period with much week-to-week variation. Based on an average nitrogen content of 1.8%, the ATS units have removed on average 0.15 grams of nitrogen/square meter/day. During March 2018 the combined primary production of the three ATS was measured at 43 grams of dissolved oxygen per day. Since the waters in the mangrove forest are below saturation, all of the dissolved oxygen produced by the ATS contributes to aerobic ecosystem processes within the aquatic system of the mangroves. These results are discussed within the context of water quality management in Biosphere 2 from the early 1990s when ATS were part of the original system to the present.

Presenter: Kangas, Patrick
Co-Author: Deleeuw, Jason

Structure of a Constructed Savannah Woodland Inside of Biosphere 2

In the late 1980s a small tropical savannah was planned and constructed as part of the wild biomes of the 1.3 hectare Biosphere 2 facility in southern Arizona. The savannah was positioned between a rain forest and a desert inside the mesocosm and it was planted with species that were collected mostly from South America, the Middle East and Africa. The savannah operated as a component in the Biosphere 2 experiment during its operation as an atmospherically closed system in the early 1990s. After that time the administration of the overall facility changed and the savannah was altered by new management objectives. In this presentation the savannah tree vegetation remaining in Biosphere 2 after more than 25 years is described, initiated with data gathered during a visit by a university travel-study course in March 2018. The area of the original savannah has been reduced by the construction of a walkway and other clearings. The vegetation has changed from a grass-dominated community to a woodland through natural succession and human management. A total of 34 individual trees from 19 species were identified and measured. The structure of the savannah woodland is described and related to literature on natural analogs of the system.

Presenter: Ingram, Tajuddin
Co-Author: Alexandros Georgiadis, Josh Smalley, Ellie Park, Ivy Yen, Jackson Hamil, Ariel Kotch

Ecological Rebuilding: Incorporating ecological technologies a design/build projects

As ecological design begins leaving the cradle of labs and entering the economy, it must find a niche that provides a economical and functional use in society. One such place is within the general construction and building renovation industry. Incorporating ecological and systems ecology in the renovation process can provide a path towards a strong sustainable design within the construction industry. However, this approach still requires more development in order to become widely adopted in the economy. In order to make a functional use of an ecological design, a team designed, proposed, and are currently building a functional living wall system as a part of a larger student-led design/build team. The location of the renovation is a dilapidated and poorly ventilated prayer space in College Park, Maryland. The process of designing a functional living wall system to reduce the dependence and cost of a mechanical ventilation system is described. The methods of designing, proposing, and lobbying the project to administration and facilities officials is also discussed.

Presenter: Choudhury, Abhinav
Co-Author: Mulbry, Walter; Lansing, Stephanie

Renewable biochar for hydrogen sulfide and nutrient reduction in anaerobic digesters

Hydrogen sulfide (H2S) is a toxic and corrosive by-product of anaerobic digestion and needs to be removed from biogas before it is used for energy generation. The objective of the project was to evaluate the effect of biochar addition into an anaerobic digester on methane (CH4), hydrogen sulfide, ammonium nitrogen concentrations (NH4-N) and dissolved phosphorus (P). Three particle sizes (0.841 mm, 0.177 mm and 0.074 mm) of corn stover biochar (CS) and maple biochar (MS) were tested and compared to an activated carbon (AC) treatment (0.074 mm) and a control treatment with no biochar addition. The control treatment produced 0.91 ± 0.03 L H2S/kg volatile solids (VS), while biochar treated reactors produced H2S ranging from 0.52 to 0.68 mL H2S/kg VS, showing a treatment efficiency of 26% - 43%. Both biochar types followed a trend where the smallest (0.074 mm) and largest particle sizes (0.841 mm) had the maximum H2S reduction potential. CH4 in the biochar and control treatments ranged from 393 – 410 L CH4/kg VS and it did not vary significantly from each other. Even though the H2S production in the AC treatment was not significantly different from the control, it significantly increased methane production by 10% (435 ± 3 L CH4/kg VS). Tests for NH4-N and dissolved P are being conducted and will be presented at the conference. The results show that biochar addition in anerobic digesters was able to significantly reduce H2S production, without affecting CH4 production.

Presenter: Gentry, Terry
Co-Author: Jantrania, Anish; Gerlich, Ryan; Fares, Ali; Awal, Ripendra; Moore, Janie; Munster, Clyde; 2018 REEU Students

Experiential Onsite Wastewater Treatment & Reuse REEU Program at Texas A&M University

In June 2017, Texas A&M University hosted 15 undergraduate students as the first cohort of the USDA-NIFA-sponsored project "Integrated High Impact Extension, Research, and Education Program for Undergraduate Students in Water Quality" which focused on onsite wastewater treatment systems. Students examined the efficacy of multiple onsite wastewater systems under normal and non-optimal operating conditions. The students also gained an understanding of the role of soil for treating onsite wastewater by sampling and analyzing soil water from a septic drainfield. The students measured field parameters including, dissolved oxygen, pH, conductivity, chloride, and nitrate, along with a variety of laboratory parameters including total coliforms, E. coli, and turbidity. The students analyzed their data and presented the results at the end of the REEU program. A second cohort of 15 students will participate in the course in June 2018 and study treatment performance of two proprietary on-site aerobic wastewater treatment technologies and two proprietary on-site water treatment technologies to determine possibilities for on-site direct potable reuse.

Presenter: Schueler, Jenna
Co-Author: Lansing, Stephanie; Felton, Gary; Hurst, Jerod; Naas, Kayla; Aga, Diana; Crossette, Emily

Fate and Transport of Antibiotics and Nutrients in Anaerobic Digestion Systems

Approximately 80% of antibiotics in the US are used in animal husbandry, and up to 90% of antibiotics administered to livestock can be excreted by the animal unchanged, which presents environmental/human health concerns. Anaerobic digestion (AD) for manure management provides benefits, such as odor management and renewable energy production, but the effect of AD on antibiotics and nutrient transformations is not well understood. This experiment explored the potential of AD to degrade antibiotics and stabilize nutrients in manure fertilizers before land application. A lab-scale digestion study was conducted with seven treatments of tetracycline (TC) and/or sulfadimethoxine (SDM) tested in triplicate, consisting of 1 mg/L and 10 mg/L TC and SDM additions, as well as manure and inoculum controls. Samples were collected before and after the 45-day experiment and analyzed for total solids (TS), volatile solids (VS), volatile fatty acids (VFAs), total kjeldahl nitrogen (TKN) and phosphorous (TKP), total ammonia nitrogen (TAN), and antibiotic concentrations. The antibiotic treatments did not have significant effect on cumulative biogas production compared to the controls. The treatments spiked with SDM showed > 85% degradation of SDM during digestion, while TC degradation was less consistent. TKN and TAN were not significantly different before and after digestion. Post-digestion solids (TS, VS) were not significantly different between antibiotic treatments and the controls, indicating that antibiotic additions did not affect solid degradation. The results showed that anaerobic digestion can be an effective treatment for antibiotics, without limiting biogas or affecting the expected solids and nutrient transformations without antibiotic addition.

Presenter: Helmstadter, Raini
Co-Author: Cianfrani, Christina; Hews, Sarah

Effects of Rainfall Intensity on Occurrence and Magnitude of Pollutant Loads in Harvested Rainwater

Rainwater harvesting (RWH) offers a decentralized method of water supply that can supplement current centralized methods. Rainwater has been shown to be a viable water source that is of consistently high quality; however, water quality is still an important concern in RWH. This research investigated the relationship between rainfall intensity and the occurrence and magnitude of pollutant loads in harvested rainwater. Understanding this relationship will allow designers of RWH systems to improve the pre-treatment quality of their harvested rainwater by selectively harvesting higher quality rainwater. To investigate this relationship, the study pioneered a low-budget testing platform – a miniature roof with irrigation hoses suspended above – which allows researchers to control all aspects of the RWH process; in addition, the platform presents an opportunity for further RWH research. Test methods comprised of six simulated storms, each with a unique arrangement of low, medium, and high intensity rainfall periods. Simulated rainwater was collected and sampled for pH, nitrates (mg/L), turbidity (FNU), specific conductance (µS/cm), and total dissolved solids (TDS) (mg/L). Testing yielded mixed results. Certain parameters, such as TDS, support current first-flush practices, while other parameters, such as turbidity, indicate that intensity is a factor in pollutant load occurrence. These results are promising; there is an important relationship to be further characterized in rainfall intensity and pollutant loads. Additionally, this research presents a novel method of conducting research on RWH; with continued refinement in rainfall distribution and sampling methods, the testing platform can be used to further investigate RWH at a minimal cost.

Presenter: Ludwig, Andrea
Co-Author: Ayers, Paul; Essington, Erin; Essington, Michael; Hawkins, Shawn; Walker, Forbes

Low Head Dam Sediment Characterization in Southeast Tennessee Second Order Stream

Small low-head dams scattered within stream networks across Tennessee and much of the southeast are remnants of historic mill operations. These structures have been identified as significant barriers for fish passage as well as challenges for meeting ecological integrity metric goals. As such, dam removal has become part of many watershed restoration projects; however, removal of an impoundment creates the need to understand the nature of the deposited sediment in the dam shadow expected to be released into downstream ecosystems. A case study project is underway on a small dam on Oostanaula Creek in Southeast Tennessee to develop a protocol for sediment characterization of dam shadow sediments with respect to release into aquatic systems or recycling onsite in upland applications. Sediment cores were collected from fifteen locations throughout the dam shadow footprint, stratified into subsamples relative to depth below sediment-water interface, and analyzed for standard chemical composition as well as constituents of concern based on historic watershed land use activities. Results of the sediment characterization will be presented as well as a summary of employed field methods.

Presenter: Buhr, Daniel
Co-Author: Bledsoe, Brian; Saintil,T.; Calabria, John

Stream Daylighting for Educational Benefit: A Case Study in a Complex Urban Environment

Urban stream daylighting offers a variety of ecological and social benefits to the surrounding community, including educational opportunities. A local elementary school in Athens, Georgia, has a creek on its property that has long been neglected, with channel instability and malfunctioning stormwater controls upstream of where the creek is buried beneath the playground. Motivated by a desire to improve scientific literacy of local youth by increasing their contact with nature, a daylighting project for the buried stream was assessed for feasibility. Complex interactions among the stream, school, and nearby urban influences such as a shopping center and apartments were considered for hydrology and water quality analysis. The Soil and Water Assessment Tool (SWAT) was used to approximate watershed hydrologic characteristics, which facilitated design of the restored stream ecosystem. Two main designs, in conjunction with headwater stormwater management implementation, were developed: daylighting the stream at its existing elevation and grading a floodplain down to it, or elevating the stream to match current topography. A disconnect between the initial engineering design and the school's expectations for riparian vegetation, planform, and in-stream features complicates design formation and selection. A broad range of topics spanning the social and ecological aspects of the project, including stormwater detention regulations, invasive species control, plus safety of the schoolchildren and their visibility to school employees, factored into the multicriterion decision analysis. Designing stream daylighting in a cross-disciplinary setting for primarily educational benefit showcased the breadth of challenges of ecological engineering in an urban stream system.

Presenter: Lagomarsino, Matthew
Co-Author: O'keefe, Elizabeth

The Living Systems of reACT

Many of the ecological issues our planet faces today could be thwarted by applying the knowledge of environmental processes into the designs of built structures and engineered systems. That is one reason the United States' Department of Energy began the Solar Decathlon competition; to blend the many disciplines of design and construction into one cohesive unit. The Solar Decathlon competition hosted Team Maryland at their competition in October 2017 to showcase their solar powered house, reACT (resilient Adaptive Climate Technology), which was awarded second place overall in the global competition. The success of team Maryland was made possible by the wide range of students and mentors who worked on various sub-teams that comprised the overall team. Among these sub-teams were the Living Systems and Waste Sub-Team, which handled the full design and integration of several new and existing green technologies into reACT. Among the new innovations were an automated irrigation system, and an indoor self-contained hydroponic vegetable garden. Existing green technologies, such as a commercially available green wall and composting toilet, were also fully integrated into the designs and construction of the house. These systems were chosen and implemented by the living systems sub-team in close congruence with the architecture, engineering, water, and automation sub-teams. The living systems were inspired and based off of core Native American principles and ecological design elements. The main goals of living systems were to honor the interconnectedness of all things and reflect this in design, to foster ecological sustainability inside and outside of reACT.