Alabama Water Resources Research Institute
Auburn University

Annual Technical Report
2019

Products

O'Donnell 2019AL013B:

- Master's thesis in Civil and Environmental Engineering presenting the results of the project. It will be posted online at https://etd.auburn.edu/handle/10415/7287 after a standard embargo period to allow manuscript publication:

  Ellis, J.R., (2020). Developing a Practical Tool for Integrating Green Infrastructure into Cost-Effective Stormwater Management Plans. M.S. Thesis. Auburn University, Auburn, AL.

- Civil and Environmental Engineering thesis topic is the porous pavements portion of the tool development. His thesis will also be posted online after a standard embargo period to allow manuscript publication.

- The preliminary results of the project were submitted for presentation to the World Environmental and Water Resources Conference. The conference was canceled due to the COVID-19 pandemic, but the following conference proceedings paper was published:

  Ellis, J.R., O'Donnell, F.C. and Vasconcelos, J.G., (2020). A Cost-Optimization Tool for Stormwater Management Plans Using Green Infrastructure Practices. World Environmental and Water Resources Congress, May 17–21, 2020, Henderson, Nevada (Conference Cancelled). https://ascelibrary.org/doi/10.1061/9780784482988.006

- The following manuscript has been submitted presenting the final results of the project:

  Ellis, J.R., Biessan, D.G., O'Donnell, F.C., Vasconcelos, J.G., and Bowers, B.F., (*submitted*). Developing a practical tool for integrating green infrastructure into cost-effective stormwater management plans. *ASCE Journal of Hydrologic Engineering*.

Waters 2019AL011B:

- Orndorff, T. 2021. The paleolimnology of Lay Lake and Weiss Lake: Sediment Transport, Heavy Metals and Eutrophication through Time. MS. Thesis (Spring of 2021)
- Orndorff, T. and MN Waters. 2020. Heavy metal deposition through time: the paleolimnology of Lay Lake and Weiss Lake, Coosa River, AL. Auburn University College of Agriculture Graduate Student Poster Showcase.
- Orndorff, T. and MN Waters. 2019. Sediment transport, nutrient deposition, and water quality through time: the paleolimnology of Weiss Lake and Lay Lake. Auburn University College of Agriculture Graduate Student Poster Showcase.

Howeth 2019AL012B:

- Sickler, Stephanie M. 2020. Community and Ecosystem Response to Beaver Dam Removal Disturbance. PhD Dissertation Research Proposal. University of Alabama, Tuscaloosa.
- A planned research presentation at the 2020 Alabama Water Resources Conference was not possible due to COVID cancellation of the conference. As a consequence, a research presentation is planned for this conference in 2021.

Information Transfer Program

O'Donnell 2019AL013B:

The main result of this project is a spreadsheet-based decision-support tool to help designers to develop cost-effective stormwater management plans that integrate GIPs with other stormwater BMPs. A primary objective in the development of the tool was to make it user-friendly and have it meet the needs of municipal stormwater managers and private contractors. To achieve this objective, we solicited guidance and feedback from potential users throughout the design process. We held regular meetings of the project team and stormwater managers from the City of Auburn engineering division and solicited feedback from engineers working with a local contractor who wishes to remain anonymous to protect information provided to the project team for case study analysis. With the support of project funds, graduate student Ross Ellis presented the preliminary results of the project at the 2019 Alabama Water Resources Conference to connect with a broader audience. The plan for dissemination of the tool, which is best achieved through in-person sessions, was disrupted by the COVID-19 pandemic. We plan to work with the Alabama Stormwater Association to organize a demonstration and hands-on trial of the tool once it is safe to host an in-person meeting. This in-person demonstration will encourage implementation of the tool and will create an opportunity for potential users to interact with the tool developers.

Waters 2019AL011B:

Given that most of the information is currently being written up as a Master's Thesis, most of the information is still being consolidated into final versions of figures and tables. However, our lab has been in touch with most of the entities who are interested in the lakes studied by this project. For example, we have contacted the Alabama Department of Environmental Management to discuss our findings of heavy metals possibly originating from coal ash ponds. We have contacted the managers of the lakes, Alabama Power, as to our findings both for harmful metals as well as eutrophication histories for each system so that management can be improved. We have contacted the Georgia Environmental Protection Department to discuss materials stored in Lake Weiss given that these materials originate in Georgia. Finally, all findings will be shared with the Coosa River Keeper group to better manage the river as a whole.

Howeth 2019AL012B:

DNA cytochrome oxidase I sequences for crayfish species will be deposited at the National Center for Biotechnology Information Genbank, and thus publicly available to serve as reference DNA sequences for future species identification and barcoding. DNA barcoding is in progress.

Student Support

TOTAL

5 Graduate Students (3 MS; 2 PhD)
7 Undergraduate Students (1 financial support; 6 research/training support)

Notable Achievements and Awards

O'Donnell 2019AL013B:

- In recognition of his work on the GI decision support tool, Ross Ellis was awarded a scholarship by the Alabama-Mississippi Section of the American Water Works Association (AWWA).

Waters 2019AL011B:

- No awards were obtained as part of this project, but the graduation of Tristan Orndorff will be a notable achievement. Other notable achievements would be the use of preliminary data and field samplings to forward other projects on the Coosa River that have been funded. Dr. Matt Waters received an Internal Grant from Auburn University to add the analysis of microplastics to the analysis of the surface samples of Lake Weiss. The data from this project aided in securing those funds. Likewise, Drs. Ann
- Ojeda and Stephanie Rodgers, two junior faculty at Auburn, along with Dr. Waters secured another Internal Grant from Auburn to focus on heavy metal inputs of the Chocolocco Creek which is a tributary of the Coosa River.

Howeth 2019AL012B:

None

Sediment Transport, Nutrient Deposition, And Water Quality Through Time For The Coosa River: The Paleolimnology Of Weiss Lake And Lay Lake

Project Type: Annual Base Grant
Project ID: 2019AL011B

Project Impact:

Sediment cores and surface sediment samples were obtained from two reservoirs on the Coosa River, Alabama. Lake Weiss was studied to provided an analysis of the materials entering Alabama from neighboring Georgia while Lay Lake was studied to focus on the ecological changes and material delivery experienced by a system that is over 100 years old. Findings for Lake Weiss include a better understanding of the complex hydrology of the system with only certain areas storing materials within the multiple basins and arms of the reservoir. These areas can serve as future hotspots of management. Also, heavy metal storage originating from upstream industrial areas only showed problematic concentrations in the lower sediments suggesting that historic changes in management and regulation proved successful in protecting the inputs into the system. For Lay Lake, a similar trend was found for heavy metals. However, the eutrophication of the system appeared to develop early in the reservoir's construction and has not changed dramatically over 100 years. The period of greatest change was caused by a change in flow regimes around 1964 when most of the upstream reservoirs were constructed. Most nutrients and materials increased following the decrease in flows thus causing decreases in eutrophication to be more difficult. This project sets a precedence on using reservoir sediment records to provide reservoir histories throughout Alabama and the SE USA.

Beaver Impoundments As Flow Experiments: Effects Of Dam Removal On Instream Flow, Water Quality, And Species Diversity

Project Type: Annual Base Grant
Project ID: 2019AL012B

Project Impact:

Identifying effects of instream flow on the biotic integrity and ecosystem function of freshwater systems is critical to sustain Alabama's natural resources in the presence of rapid human population growth and environmental change. In this study, we experimentally alter stream flow by removing beaver-formed dams to identify the concurrent response of crayfish and fish populations, and water quality, to the altered hydrologic regime. Preliminary data prior to dam removal indicates that fish community composition significantly differs between pond and upstream reference sample sites, while downstream sites represent a combination of species found at both upstream and pond sites. Crayfish DNA barcoding is still in progress, but it is expected to show different community composition between ponds and upstream reference sites. While beaver dams will be removed after the 2021 growing season due to COVID delays, removal is predicted to result in higher stream flow, reduced water depth, and an increase in lotic habitat availability relative to impounded conditions. Fish and crayfish community composition is predicted to track these changes in the local environment after dam removal and more closely match the communities located in upstream reference sites. As a consequence of the need for data on instream flows to inform new policy on water quantity management in Alabama, the results this work will be of particular interest to state agencies and entities, including the Alabama Office of Water Resources, the Alabama Department of Conservation and Natural Resources, the Alabama Department of Environmental Management, and the Geological Survey of Alabama.

Cost Optimization Of Green Infrastructure For Stormwater Management

Project Type: Annual Base Grant
Project ID: 2019AL013B

Project Impact:

Green infrastructure practices (GIPs) have emerged as an effective means for improving the sustainability of stormwater management. Optimized combinations of GIPs with other best management practices (BMPs) can maximize performance and cost effectiveness, and simple methods for identifying these combinations will promote more widespread use of GIPs. We created a spreadsheet-based decision-support tool to help designers to develop cost-effective stormwater management plans that integrate GIPs with other stormwater BMPs. The hydrologic impact on detention storage of using GIPs is modeled with rainfall-runoff simulations. Infiltration trenches, porous pavements and bioretention are available as options in the tool. Additionally, the porous pavements element of the tool combined three different design methods, one for each porous pavement type, into a single module to identify the design requirements and associated costs given scenario. An optimization model for a storage-based BMP was developed to be used in conjunction with the spreadsheet tool. We applied the tool to a representative case study site for which the actual design and cost estimates of on-site BMPs were known. It provided realistic results for the case study analysis and revealed that successive applications of the tool could easily provide the user with a site design that maximized cost-effectiveness. A sensitivity analysis illustrated the critical trade-off relationship between GIP costs and detention basin BMP costs.