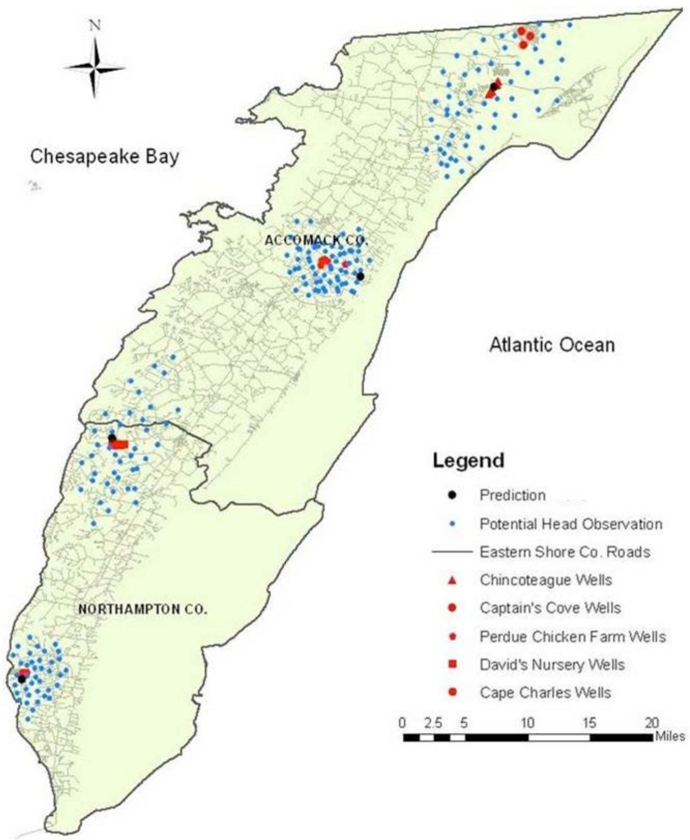


We prepare engineers for careers in the interdisciplinary field of environmental and water resources engineering. Our research focuses on the development and use of computational modeling for effective water resources management. The challenges that we are addressing include nutrient management for complex watershed-stream-aquifer systems, ecologically sensitive stormwater designs, and integration of public health and livelihood maintenance into reservoir operations. We are active in UVa's Program on Interdisciplinary Research in Contaminant Hydrogeology (PIRCH). PIRCH is an interdisciplinary graduate research and education program to train scientists and engineers in the fields of hydrogeology, geochemistry, microbial ecology, civil engineering, and chemical engineering.

# Environmental & Water Resources Group

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"Modeling for effective and sustainable water resources management."

UNIVERSITY of VIRGINIA ENGINEERING

## Computation Modeling of Integrated Groundwater Systems

The coastal aquifers are critical resources that are threatened from inputs of agricultural chemicals, over-development, and climate change. Computational models are important tools to facilitate sustainable management of these coastal aquifer systems. While nutrient transformations occur at the surface, in vegetation and soils, in groundwater and in the hyporheic layer under streams, management models do not integrate these systems and the biogeochemical reactions within them. We are investigating what the impacts that simplifications in the complexity of nutrient transport and transformation have on the accuracy of regional nutrient management models and the extent to which these simplifications affect the efficacy of model-derived nutrient management schemes meant to protect coastal systems, like the Chesapeake Bay. We are also developing techniques to identify critical data inputs to improve the accuracy of regional management models.

## Sustainable Stormwater Management

Increased imperviousness from urbanization alters the natural hydrology, resulting in increased volume and rate of surface runoff, decreased groundwater recharge and stream flow, increased frequency and severity of local flooding often leads to decreased water quality in receiving streams, which detrimentally affects the receiving aquatic systems. Current regulations, promulgated at the local and state levels, have focused on impacts of development, limiting landscape alterations. Best management practices (BMPs) have been developed without explicitly addressing ecological protection. We are researching methods in which ecological functions could be more intimately integrated into BMPs. Specifically, we are working on ecological-flow-based designs to mitigate the negative ecological impacts of current stormwater management.

## Operation of Multi-purpose Reservoirs

Globally we are in a period of rapid construction of reservoirs. In addition to the intended purposes of water supply, flood control and power generation, reservoirs can also have substantial negative ecological and social impacts. For instance, ponded water within a reservoir may enhance the habitat for malaria vectors, and the reservoir footprint often disrupts agricultural livelihoods. We are seeking to directly address and mitigate these side effects by working with local stakeholders to identify feasible livelihood alternatives and by developing and testing of alternative reservoir release protocols.

## RECENT RESEARCH DEVELOPMENTS

- Developed a methodology to quantify the impact of new data on the accuracy of a regional groundwater model and used the approach to identify new monitoring locations within critical regions of the Eastern Shore of Virginia.
- Devised a malaria-management reservoir release rule and demonstrated that reservoir-enhanced malaria could be controlled without detriment to hydropower production in subtropical Ethiopia.

## RECENT GRANTS

- Virginia Water Resources Research Center – Integrating Ecological Flows into BMP Designs
- National Science Foundation – Planning for Reservoir Operation and Land Use with Stakeholders in the Mekong Basin

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