Pennsylvania Water Resources Research Center

About the Center...

The **Pennsylvania Water Resources Research Center (PaWRRC)**, founded in 1964, is one of 54 federally funded state and territorial water research centers and institutes nationwide designated to conduct research and technology transfer programs. The Center operates under the authority of the Water Resources Research Act of 1984 and in cooperation with the U.S. Geological Survey, U.S. Department of the Interior. The Center has three objectives:

- To plan, facilitate, and conduct research to help resolve local, state and national water resources problems.
- To train water scientists and engineers through participation in water resources research and outreach.
- To promote technology transfer and the dissemination and application of research results.

With a focus on water problems pertinent to Pennsylvania and the mid-Atlantic region, research areas include water quality and quantity management, hydrologic model development and assessment and fate and impact of pollutants. The center maintains a fully equipped and staffed inorganic water quality laboratory. Addionally, the water resources extension specialists with the College of Agricultural Sciences, serve as a liaison between the scientific and technological community and the public. More information is available on the Center's website: www.pawatercenter.psu.edu.

Location...

The PaWRRC is located in the Land and Water Research Building on the University Park campus of the Pennsylvania State University. It is affiliated with the Penn State Institutes of the Environment (PSIE). PSIE is an amalgam of several institutes and centers at Penn State with a focus on environmental problems, including water-related issues.

Recent Research Activities...

Using its FY2004 allotment of $92,524, the PaWRRC provides administration and funding for a program of small grants in support of exploratory water resources research, public education, and training. Funds are provided on a 2:1 non-federal: federal matching basis. Recently funded projects for FY2004 are summarized below.

"Nitrogen Dynamics in the Spring Creek Watershed: Evaluating Stream Retention of Point and Non-Point Loadings"

Cultural eutrophication is a problem of epidemic proportion in the United States, and this issue is particularly pronounced in water bodies that are in close proximity to the demands of a growing human population. Elevated material loading from changing land-use (urban and agricultural practices) has had a measurable effect on aquatic ecosystems throughout the state of Pennsylvania, where more than 2,500 miles of native streams receive some degree of impact.

Identification of the source of nitrate in streams can be facilitated by using ^{15}N and ^{18}O stable isotope signatures along with inorganic water chemistry. Characterization of stable isotopes signatures can be used to estimate nitrate loads from point sources such as fish hatcheries and sewage treatment plants and non-point sources such as septage, urban runoff, agricultural lands, and atmospheric deposition.

This project supports a new faculty member and several students in the Fisheries Program at the Penn State-University Park campus proposing to look at how nitrogen with varying isotope composition within a large mixed landuse watershed affects the trophic transfer of nitrogen in the stream biological community.

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"Split-Flow Stormwater Demonstration and Feasibility Study"

The management of stormwater runoff from impermeable surfaces in highly developed urban areas is a major environmental challenge. Impervious surfaces such as roads, roofs, and parking lots convey considerable volumes of runoff to sewer systems, bypassing the normal detention and infiltration processes. Federal regulations require municipal governments to develop, adopt, and implement stormwater management strategies to reduce non-point source pollution directly related to new development. Despite these regulations, current stormwater management strategies have shown only limited success in protecting aquatic environments. To address this issue, a new stormwater management strategy is proposed that regards runoff as a valuable resource, emulates the natural hydrology system, fulfills our environmental goals, and satisfies local flood control regulations.

The Split-Flow Stormwater Management Strategy is a newly developed method for managing stormwater on-site by replicating the natural processes of evapo-transpiration, soil infiltration and stream flow. The design feasibility and construction costs of the split-flow system have been compared to other stormwater management methods with promising results. However, development of the strategy is at a standstill due to a lack of in-ground testing.

The study will be the first in-ground test to assess the system's ability to replicate natural discharge flow rates, volumes, frequency and duration. This will be done by comparing runoff discharges from parking lots equipped with Split-Flow systems to runoff discharges from undeveloped adjacent analogous land. The knowledge gained from in-ground testing will offer practical evidence of the strategy's usefulness and reveal areas in need of further refinement. Additionally, the site will serve as a sustainable stormwater management demonstration and education facility.

This project supports research by a new faculty member in Landscape Architecture at the Penn State-University Park campus.

"Controls on Nutrient Levels for Spruce Creek and a Major Tributary"

Spruce Creek, one of the premier trout fisheries in the state, economically bolsters an otherwise agricultural regional economy. Although both the tourism and agricultural industries are essential to the Spruce Creek watershed region's economy; agricultural land use, if not properly managed, does present potential environmental risks to the stream.

In previous work, baseline water quality parameters were measured for Spruce Creek and these data are beginning to elucidate a better understanding of variable nutrient level patterns, localized areas of nutrient loading, and the interactions between stream flow dynamics and nutrient levels. This study will expand the data collection efforts and employ high frequency sampling and analysis (HFSA) techniques to develop more accurate predictive models for use in understanding the physical and chemical aspects of the stream to highlight conditions that lead to stream impairment.

The objectives of the study are threefold:

(1) Illustrate the influence of agricultural inputs to the stream: The dataset may quantify the effect of agricultural practices in the Spruce Creek watershed. The data will allow us to complete the development of a predictive model that will help avoid impairment of the stream's health. Additionally, the data will allow us to help engineer solutions to minimize agricultural influence upon the stream.

(2) Provide research experience for undergraduates: The students involved in the experience will gain invaluable practical training in water quality assessment and collection of information.

(3) Involve and spark interest in the local community: The dataset will be accessible to the community and presented at local meetings. The study will provide valuable information to a community that relies so heavily on the health of the stream.

This project assists with training and education of several students and supports two junior faculty and one senior faculty at Juniata College, a small private school in south-central Pennsylvania.


Photo: Greg Grieco

"Nutrient Removal of a Sequencing Batch Reactor (SBR) Treating Wastewater with Potential for Water Reclamation"

This research supports a new faculty member at the Penn State-Capital Campus who along with a graduate student will be studying optimization of nutrient removal from both agricultural and municipal wastewaters using sequencing batch reactor (SBR) technology.

The SBR wastewater treatment system is a sequential suspended growth (activated sludge) process in which all major wastewater treatment steps occur in the same tank in sequential order. The unit processes of the SBR operate in time rather than in space – all operations are performed in a single tank using a timed control sequence, which reduces the space requirements of the treatment facility. In addition, the SBR has real time control, which allows for optimization of the treatment process.

The objective of this research is to determine the optimal operating conditions of the SBR to obtain the highest nitrogen removal efficiency. Phase 1 will evaluate the SBR nitrogen removal efficiency when treating low concentration wastewater (municipal wastewater) and high concentration wastewater (agricultural wastewater). The optimal operating conditions will be tested by adjusting aeration intensity, aeration duration, and anoxic duration. Phase 2 will examine the nitrogen removal in the SBR system under influent shock. The study will provide information for the adjustment of SBR operation cycles, and test the feasibility of SBR handling nitrogen removal under influent shock.

The overall vision for this research is to optimize a cost- and space-effective wastewater treatment system to remove nitrogen from wastewater, and if possible, to provide high effluent quality for water reclamation.