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Sustainable Watershed Resources Management - the Shepherd Creek Pilot Project

Sustainable watershed resources management is an approach to ecosystem restoration and management that incorporates social equity, economic stabilization, and environmental quality, and seeks to preserve what is valued most about our national water resources by finding solutions that are more natural and easier to implement and to sustain. Through this form of resources management, citizens, regulators, and service providers work together to address particular environmental problems.

For example, urbanized conditions in mixed-use urban and rural watersheds increase the risk of downstream flooding, stream channel degradation, and damage to both aquatic and terrestrial ecosystems. There is a dearth of experience and data on retrofitting watersheds to minimize these environmental impacts. To fill this gap in knowledge and sustainably meet resource management needs in a small urban watershed, in 2004 the Shepherd Creek Pilot Project was started as a field research program.

Project Site

The project site is located in the Shepherd Creek watershed, a mixed land-use watershed located near Cincinnati, Ohio. Here, suburban development converts precipitation into large volumes of runoff that affects stream ecosystem health, and contributes stormwater to waste-water systems, leading to combined and septic sewer overflows.

Urban storm flow (shown at right) and a rain garden (far right) installed as a part of the Shepherd Creek Pilot Project.

Project Overview

The goals of the project were to determine the effectiveness and feasibility of using economic incentives to encourage more sustainable watershed or regional land and resource use. To meet those goals, EPA scientists have researched the problem of excess stormwater runoff from the perspectives of the environment, economics, and the law. To address the environmental perspective, hydrologic, biogeochemical and ecological impacts were monitored.

The core of the project is its assessment of economic incentives to promote retrofitting of stormwater management practices (SWMPs) in a suburban watershed and to decrease excess storm water runoff. Although storm water is typically conveyed to centralized detention, retention, or treatment structures, there is great potential for residents to reduce stormwater runoff through source control, water detention or water infiltration.

Landowners are keenly aware that while parcel-level SWMPs might generate significant social benefits, the costs may be privately borne. These costs can be adequately offset by providing an economic incentive. Yet, offering landowners too little an incentive is ineffective while offering too much is inefficient.

Voluntary programs that use reverse auctions as incentives were implemented to spur citizen participation in effective and sustainable stormwater management. Two reverse auctions were held (spring 2007, 2008), which led to 83 rain gardens and 170 rain barrels being installed.

EPA researchers probed these basic research questions in the project:

• Can a market-based mechanism provide appropriate incentives to install on-lot SWMPs throughout a small Midwestern watershed?

• Will the incentives induce the placement of an adequate number of SWMPs, and will implementation result in quantifiable hydrologic, ecological, and water quality improvements in this watershed?

Monitoring

An important part of the project is

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the gathering of baseline ecological, hydrologic, and water quality data. Monitoring allows inferences to be made about what contributes to the effectiveness of economic incentives and to the resulting distribution of SWMPs in meeting environmental management objectives.

Baseline ecological, hydrologic, and water quality data collection took place from 2004 through the spring of 2007. Monitoring continued through May 2011after the installation of stormwater management practices.

Ecological data were gathered from October to May of each year from 2004 to 2007 to quantify the presence, absence, and composition of periphyton and macroinvertebrate assemblages. Methods were bolstered by the Qualitative Habitat Evaluation Index protocol.

EPA researchers installed a hydrologic monitoring infrastructure to measure discharge (across several spatial scales) from rain gardens and rain barrels, neighborhood stormwater outfalls, subwatersheds, and the outlet of the watershed. An updated soils assessment, baseline stream geomorphic surveys, and an assessment of impervious surface connectivity at the parcel level were completed between 2004 and 2006.

Results and Conclusions

Given a 22% participation rate (which is impressive for these types of programs) and the fact that an average of 66% of participants bid $0 for one garden and up to four barrels, we concluded that the incentives were a success; they were well-tuned to citizen expectations and perceptions of what they could do to help mitigate the stormwater problem. The rain gardens and rain barrels have added a considerable amount of detention capacity to the watershed.

The initial hydrologic analysis showed that there was an overall significant decrease in runoff, though this decrease was quite small. This suggests that the effect of the treatment has reached a threshold point and that if additional stormwater management practices (e.g., swales in the right-of-way to moderate road runoff, more citizens to participate, etc.) were implemented, the benefits would accrue more quickly.

EPA continues to study the effectiveness of these measures in ongoing research projects.

Project Team

Co-Leads: WD Shuster, H Thurston
Law and Policy: A Garmestani
Water Quality: O Shanks, L Boczek
Biology and ecological assessments: J Beaulieu

Collaborators

Hamilton County Soil and Water Conservation District; Hamilton County Engineers Office; Cincinnati Health Department; Cincinnati Metropolitan Sewer District; Cincinnati Parks: EPA Region 5; EPA Region 5 Central Regional Laboratory; U.S. Geological Survey; U.S. Department of Agriculture's Natural Resource Conservation Service

Publications (reprints available upon request)

Parikh, P., M. Taylor, T. Hoagland, et al. (2005). "At the Intersection of Hydrology, Economics, and Law: Application of Market Mechanisms and Incentives to Reduce Storm Water Runoff." Environmental Science and Policy, 8, 2: 133–144.

Shuster, W., H. Thurston, E. Warnemuende, et al. (2005). "Impacts of Impervious Surface on Watershed Hydrology: A Review." Urban Water Journal, 2, 4.

Thurston, H. (2006). "Opportunity Costs of Residential Best Management Practices for Storm Water Runoff Control." Journal of Water Resource Planning and Management, 132, 2: 89–96.

Shuster, W., R. Gehring, and J. Gerken. (2007). "Prospects for Enhanced Ground Water Recharge via Infiltration of Urban Storm Water Runoff – A Case Study." J. Soil Water Conservation, 62: 129–137.

See also:
Mt. Airy Rain Catchers
www.mtairyraincatchers.org/

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