SAVING URBANIZED STREAMS: WHAT IS THE ANSWER?

A RESEARCH PROJECT TO DETERMINE WHETHER OUR WATERSHED MANAGEMENT EFFORTS IMPROVE STREAM QUALITY

Photo: Mouth of the Poquessing Creek in Philadelphia.
Nearly 15 miles of this stream are impaired, caused by residential stormwater runoff, excessive algal growth, water flow variability and habitat alterations, according to the 1999 Watershed Restoration Action Strategy.

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Ninety-six percent of the water-quality-impaired watersheds in Pennsylvania are polluted because of nonpoint sources of pollution, such as abandoned mine drainage, urban and agricultural runoff, atmospheric deposition, on-lot sewage systems, groundwater base flow, earthmoving, stream hydro modification, and timber harvesting.

-- PA DEP Watershed & Flood Protection Grant Application Package

Introduction

Although a variety of watershed restoration efforts are underway throughout the country, practitioners still find themselves in very new territory when addressing its impacts on water quality. Given the aquatic biota measure for water quality, we know that achieving success is a complex relationship between base flow, storm events, discharges, vegetative buffers and the geo-morphology of the stream. Issues such as land use and community quality of life also play a role in the long-term success of healthy watersheds.

Urbanized streams have been radically altered by past human activities and to a lesser extent by their own impairments (legacy sediments). Now, human activities attempt to re-create the “natural state” and undo the damage we have done. Adding to the complexity, we do not necessarily have a clear vision of the watershed’s natural state or what impairments are already in the stream.

Our purpose is to articulate an integrated course of actions that would be necessary to achieve successful “remediation” of impaired/impacted streams in suburban/urban areas that would achieve the Clean Water Act’s fishable and swimmable goals.

Impaired stream

Background

What is Pennsylvania spending on watershed management?

$61 million (from 1990-2005) in federal Section 319 grants to treat non-point source pollution problems, develop educational programs and begin comprehensive watershed initiatives.

$172 million in Growing Greener watershed grants (1999-2005)

$337.5 million from local partners from their own resources

--PA DEP 2006 Integrated Water Quality and Assessment Report

$729.5 million paid to Pennsylvania communities since 1978 through the National Flood Insurance Program.

-- National Flood Insurance Program Loss Statistics

"With regards to Growing Greener money spent, are we moving the needle in the stream channels? We may show the effects of BMPs but are they improving the streams and will they be de-listed?"

-- Shandor Szalay, Senior Project Manager, AKRF Consulting

Pennsylvania has roughly 12,000 miles of impaired streams (PA DEP Water Quality Assessment 2006). Polluted runoff from urban development, roadways and small residences impairs more than 3,400 stream miles, and reduces our drinking water quality, degrades wildlife habitat and hinders our ability to use our waterways for recreational activities such as swimming and fishing. Streams are regularly tested for water quality and those that do not meet standards for drinking, fishing and swimming are listed on Pennsylvania's 303d list of impaired streams.

Prompted by new stormwater regulations, and increased incidences of damaging and fatal flooding in Southeast Pennsylvania, communities are beginning to focus attention and to devote resources to repair streams.

Pennsylvania has identified best management practices (BMPs), streambank restoration, and riparian buffers as important components to restoring healthy streams. The Commonwealth has embarked on a well intended stormwater management "experiment" by funding millions of dollars of projects through Growing Greener I and II, and developing and promoting the new BMP manual.

However, many stream restoration projects are still considered unconventional and need to be refined for standard use in our communities. Furthermore, attempts to mainstream these projects are plagued by a lack of understanding of their costs, results, and benefits.

While we consider raising and investing vast sums of additional resources through municipalities and possibly stormwater authorities, and as counties try to clean up streams and rivers, we don't know how to predict the impacts of our investment. We do not know how storm events, especially in heavily developed watersheds, might undo our efforts – as can other actions beyond our control.

This is a critical investment issue that speaks to the viability and continuity of future funding for watershed enhancement and restoration. In order to avoid taxpayer fatigue and frustration amongst elected officials and the public, practitioners need to be able to predict outcomes and provide a predictable pathway to success.

If success doesn't occur or problems worsen, a predictable response will be that money and time and effort were wasted and that "good money" shouldn't be thrown after "bad."

Literature Review

"A lot of the practices that improve water quality have some elements of landscaping or bioretention. We're absolutely not going to be putting in a concrete ditch. We're going to be putting in trees and landscaped areas. The goal, particularly in such an urban area [Watershed 263], is to make it an asset for the community."

-- Sally Hoyt, an engineer on the design team for the CWP

Pennsylvania communities value watershed restoration strategies such as stormwater BMPs as a means to treat polluted runoff. Watershed managers use them on a small scale to improve the health of creeks and streams that feed into our national water treasures such as the Delaware Estuary and Chesapeake Bay.

The support of BMPs is not unfounded. Existing studies report the effectiveness of BMPs to reduce pollutants such as nitrogen, phosphorus and total suspended solids. Reports often outline costs associated for each BMP. This type of data may be helpful for engineers and stormwater managers to choose which BMP is right for a specific site. However, it is unclear whether BMPs improve the water quality of the receiving water body.

There are several challenges to conclude positively that BMPs improve stream quality. Long-term monitoring often lies outside a project's funded scope, or the project has not been monitored long enough to identify trends. Variability in the strength and frequency of rain events can also inhibit accurate assessments. Additionally, BMPs are useless in reducing such things as legacy sediments that cause natural in-stream impairments.

The Council sought models from other cities that could provide a clear plan for removing streams from the U.S. Environmental Protection Agency's 303(d) list of impaired streams. While we discovered admirable efforts in several watersheds, no examples demonstrated a clear cause-effect relationship between watershed restoration efforts and stream de-listing.

The following three examples represent approaches taken by other urban communities to improve watershed health.

Baltimore, Maryland

Baltimore youth help plant native trees

Watershed 263, a 930-acre storm drain area, discharges into Baltimore Harbor. The area encompasses 11 urban Baltimore neighborhoods and is largely impervious (more than 75%).

In 2002 the Water Quality Management Section of Baltimore City's Department of Public Works, tasked with meeting National Pollutant Discharge Elimination System (NPDES) requirements, selected Watershed 263 as a pilot project. In this ultra-urban area, it was important to implement a strategy that incorporated both water quality improvements and quality of life improvements.

Baltimore implemented numerous greening and urban forestry projects in watershed 263 including tree planting, vacant lot

cleaning, street cleaning and creating community gardens. The project has successfully engaged the community and sustained a stewardship program.

For more information visit:
http://www.watershed263.org/

Waterford, Connecticut

The Jordan Cove watershed is located in Waterford Connecticut, a highly urban community along the coast of Long Island Sound. The project attempts to determine the benefits of using BMPs in an 18-acre residential subdivision.

"Not only will the residents of this subdivision benefit from this national project, the ideas and practices utilized at Jordan Cove can be applied across Connecticut and the country to improve water quality, becoming the standard for the design and construction of residential neighborhoods nationwide."

-- Connecticut DEP Commissioner Gina McCarthy

The subdivision was split into two distinct neighborhoods. One neighborhood is traditionally zoned, with a wide asphalt road, and curb and gutter stormwater collection. The other neighborhood has cluster housing and a variety of BMPs including shared, porous pavement driveways, low-mow areas and narrower road access.

The data collected during construction and three years post-construction show that reducing the amount of impervious surfaces significantly reduces the amount of polluted stormwater entering local streams and other waterways. According to the Connecticut DEP, monitoring of rain events after installing the BMPs indicate that the amount of stormwater runoff generated by the cluster neighborhood is similar to that generated by an undeveloped, forested parcel of land.

For more information visit
http://www.canr.uconn.edu/jordancove/

Waukegan, Illinois

The Waukegan is a 12 mile river with a highly urbanized watershed about 35 miles outside Chicago. Erosion and sediment were identified as major issues for the River's water quality.

"No single project is more important to Waukegan's economy than the environmental restoration of Waukegan Harbor."

-- U.S. Representative Mark Kirk (R-IL)

Two parks served as locations to implement streambank restoration projects. Structural stabilization projects included installing lunkers, a-jacks, and pool and riffle construction. Vegetative stabilization practices included wetland plants, willows and grasses.

Biological sampling from 1994-2004 indicated an increase in the number of fish species and abundance. Additionally, the Index of Biotic Integrity rose from degraded to moderately

degraded.

For more information visit:
http://www.bae.ncsu.edu/programs/extension/wqg/05rept319/indexframe.html

"It is vital for communities to put in place sound stormwater management practices that will protect our natural resources and set standards for development."

Governor
Edward G. Rendell

The Council Convenes Stormwater Practitioner Meeting

By posing the watershed challenge to a group of professionals involved in watershed organizations, engineering projects, planning, academia, and research, the Council uncovered that the experts themselves have more questions than answers. The Council also found overwhelming enthusiasm among these professionals to pursue the answers and to engage in discussion about holistic watershed restoration. Additionally, the Council realized that many of the players involved in stormwater management do not regularly speak with each other or coordinate efforts.

The Council's natural role as convener and collaborator emerged as the ideal organization to bring these individuals together as an advisory group and to begin the dialogue.

Understanding that solving watershed problems is a matter of financing, engineering, natural systems and community by-in, the Council convened a group of professionals from a variety of fields from engineers, geomorphologists, geologists, ecologists and social organizations (see Appendix B).

Meeting attendees spoke about their professional and personal involvement in watershed management. They identified **challenges** faced from prioritizing, planning, implementing and monitoring phases of watershed management. They also identified potential **opportunities** to collaborate and ways to address funding and educational outreach.

Villanova University stormwater bio-infiltration traffic island BMP

Challenges to fixing the stormwater problem

Need to identify a reference or outcome. Communities need a vision for what waterways should be.

Meeting participants indicated that most non-profits and communities dealing with stormwater know what the problem is, but they need to know what they are reaching for as an end result rather than continuing to implement small projects. That end result might be achieving a stable situation, or it might be reducing sediment. Regardless, participants felt that one approach would not meet the unique needs of each stream.

Lack of ability to monitor BMP effectiveness and overall water quality.

Participants noted examples of monitoring gaps, such as Villanova's ability to monitor only four of its eight BMPs. Participants also expressed concern that data collected from monitoring was not adequate to reflect changes or improvements in the stream. For example, Baltimore's watershed monitoring design for Watershed 263 has not indicated that their efforts have improved water quality. Additionally, participants felt it was important to establish short term benchmarks, noting that monitoring the Chesapeake Bay directly will not show the progress that has been made further upstream.

"We have a watershed monitoring design for the Watershed 263 project and hope to be able to use data to document improvements. To date we haven't seen any improvements through our monitoring."

-- Bill Stack, Program Administrator, Water Quality Management Section Bureau of Water and Waste Water Baltimore City Department of Public Works

None or unclear established guidelines for long-term operations and maintenance of BMPs.

Participants expressed concern regarding the long-term operations and maintence, noting that the detention basins observed in the Pennypack watershed were un-maintained for the most part. Participants also noted the additional problems that can arise from unmaintained BMPs, such as dry detention basins providing breeding grounds for west-nile virus mosquito larvae, invasive species and deer browsing.

Limited or no dedicated funding mechanisms.

Meeting participants agreed that communities must play a role in financing stormwater and cannot rely on grants and other periodic and unpredictable sources of funding.

Currently, stormwater BMPs are implemented where there is an opportunity (land and funding synergy), not necessarily where the need is most evident.

"We are beginning to see that water quality parameters maybe showing some improvement [in the White Clay, Red Clay and Brandywine]. But how long do you have to monitor to see that it's a trend?"

-- Jan Bowers, Chester County Water Authority

Participants acknowledged the current random nature by which stream restoration projects are implemented. For example, Project Headwaters implemented projects in the Pennypack based on the opportunities present, not necessarily where it was most strategic to implement BMPs. However, it was also advised that downstream improvements should not be discounted.

Opportunities for working together to fix the stormwater problem

Better planning and design

Participants agreed that appropriately scaled watershed models were important and suggested a ¼ mi^2 drainage area rather than the Federal Emergency Management Agency's ½ mi^2 drainage area. They suggested that projects needed to be designed for long term performance, and recommended programmatic solutions as well, such as the level of services needed and ordinances adopted that would help achieve the goal. They also suggested starting with institutions with large impervious cover such as schools and hospitals.

How do other urban communities pay for stormwater?

Baltimore, MD receives an appropriation from Maryland 's Green Fund to help fund stormwater management. The fund is generated by assessing fees on new impervious surfaces including buildings, parking lots, sidewalks and roadways.

Austin, TX uses a drainage fee cost of service plan which funds capital improvements as well as parks and watershed management. The residential fee is $6.30 per month and the commercial fee is $120.41 per acre per month.

Cincinnati, OH formed a stormwater utility in 1985. In 2003 the city became part of the Hamilton County Stormwater District. A typical single family residence pays $2.16 to $4.86 per year, and businesses pay a comparable rate based on square feet of the property.

Tampa, FL allocates money from its General Fund to pay for stormwater management. It also asses a Utility Tax on its residents.

Potential funding sources.

Participants identified potential funding sources such as watershed impact fees assessed to developers, stormwater authorities and dedicated stormwater fees. They also suggested tapping into related sources of funding such as transportation, housing and recreation, and including additional stormwater funding among water and sewer bills. Participants recommended that stormwater management be paid for in the design process rather than a retrofit.

Link stormwater management activities to other community priorities such as neighborhood aesthetics, public health and safety. Seek out multiple benefits to tie with other capital funds.

Baltimore combined their street repaving activities with reworking median strips to recess them so that they infiltrate water. The city integrated environmental quality and restoration with quality of life solutions and urban renewal priorities.

Educate the public on the importance of stormwater management.

Participants discussed ways to gain public support for stormwater management. They suggested demonstrating to people that they already pay for it when it comes to road repairs and flooding, and that it would cost less than some of their current household bills. Participants noted the importance of demonstrating the economic benefits of riparian buffers and other management practices, and indicated the challenge that residents often want their upstream neighbors to improve the stream but don't realize the impact they have on their downstream neighbors.

Next steps: Scope of research

Valley Creek Park

Preliminary Research

- Comprehensive search of stormwater models to determine the best approach for a Southeastern PA watershed
- Shape the model so that it can be used to demonstrate the interventions, cost and accomplishments

How we might scope this research project

Identify potential locations to conduct stream work

- Start in headwaters of impaired stream
- Start in a small sub-watershed where data could be extrapolated for use on a larger scale
- Select stream with existing gauges
- Have an understanding of the stream's historic/pre-development characteristics
- Choose location with large tracts of land rather than small tracts with multiple land owners and managers.

Planning/Design/Implementation

- Identify specific problem and end result (e.g. reduce sediment and nutrients, stabilize streambanks, control erosion)
- Establish appropriate scale
- Consider water quantity, flow rate and water quality
- Design for long-term use
- Determine what tools are needed to address problem
    - Agricultural preservation
    - Low impact development
    - Best management practices
    - Zoning
    - Greenway development
    - Floodplain policy
- Choose cost-effective approach

Chester County

Monitoring

- Determine what to monitor – chemical, biological, hydrological and physical parameters
- Determine how to measure – loads, concentrations, removals
- Determine who will monitor progress
- Understand other watershed characteristics that might impact BMP performance such as percent of impervious cover, land use breakdown and soil types
- Ensure funding for long-term monitoring

Essential Considerations for Fixing the Stormwater Problem:

- Public/homeowner education
- Community involvement
- Decision-maker buy-in
- Prioritize stormwater among other regional priorities such as flood control, open space preservation and land use
- Integrate funding among municipal expenses such as transportation, recreation and housing

Appendix A. Literature Review and References

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Page 4 "Baltimore Youth Planting Trees." Parks and People. http://www.parksandpeople.org/programs_watershed_263.html

Page 6 "Villanova Traffic Island BMP." PA DEP Growing Greener Final Project Report 2002 http://www.stormwaterauthority.org/assets/Villanova%20Stormwater%20Bioinfiltration%20traffic%20island.pdf

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Appendix B. Meeting Participants

Jan Bowers, Chester County Water Authority
Richard Nalbadian, Temple University/Ambler
Gary Snyder, Chester Ridley Crum Watershed Association
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Appendix C. Other interviews/conversations
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David Velinsky, Senior Scientist, Academy of Natural Sciences
Denis Newbold, Stroud Water Research Center