CENTER FOR WATERSHED PROTECTION

Runoff Rundown

ISSUE 66 • JANUARY 2017

INSIDE THIS ISSUE:

The Role of Urban Trees in Stormwater Management

The Center for Watershed Protection is currently working to develop a stormwater credit for urban tree planting through a grant provided by the National Urban and Community Forestry Advisory Council. One of the first tasks was to review the available literature to quantify the runoff and water quality benefits of urban trees. The results of the Center's extensive review are highlighted here and are available in the final report: *Review of the Available Literature and Data on the Runoff and Pollutant Removal Capabilities of Urban Trees*.

What We Did

The Center reviewed a total of 159 publications to evaluate the research questions defined in the scope of this project:

1. What is the effectiveness of urban tree planting on reducing runoff, nutrient and sediment?
2. How does effectiveness vary by species, over time, with differences in planting sites (e.g., distance from impervious cover or other trees, soil conditions, geographic location) and with different maintenance strategies?

The review included studies on the hydrologic and water quality benefits of urban trees and factors affecting the mortality, growth, condition and survival rates of urban trees, as well as a review of the available models, calculators and existing credit systems for urban trees. The primary focus was on upland tree planting in urban environments; however, because the literature on urban trees was sparse, we also included studies of non-urban systems.

What We Found

While the processes and mechanisms by which trees reduce runoff and pollutants are well known, there is limited research to document and quantify these benefits in the urban environment. Figure 1 illustrates how urban trees influence the hydrologic cycle (shown in blue), positively influence water quality (shown in green), and potentially contribute to runoff pollution (shown in red).

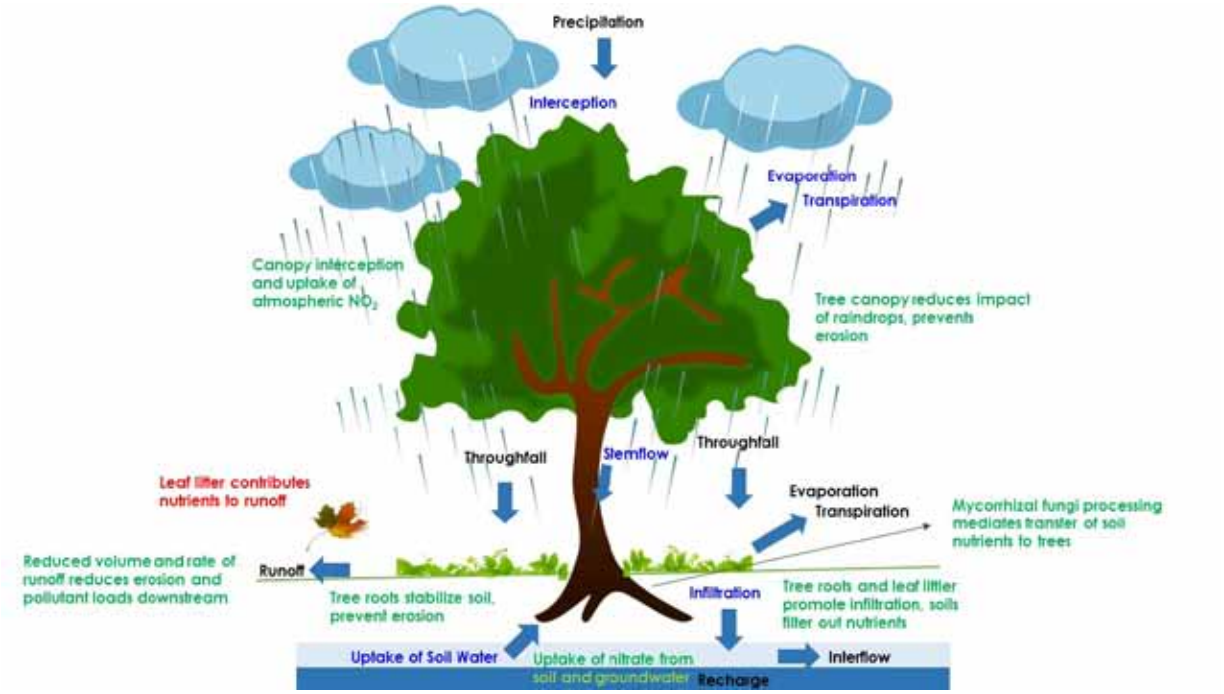

Figure 1. Urban Tree Impacts on Hydrology and Water Quality (Source: Law and Hanson 2016)

The primary way that trees and forests affect water quality is by reducing stormwater runoff. Trees reduce runoff through rainfall interception by the tree canopy, by releasing water into the atmosphere through evapotranspiration, and by promoting infiltration of water through the soil and storage of water in the soil and forest litter. In the absence of tree canopy, rain falling on urban surfaces such as parking lots, streets and lawns picks up various pollutants as it runs off the landscape. The cumulative effect of tree canopy is to temporarily detain rainfall and gradually release it, regulating the flow of stormwater runoff downstream and thereby preventing some of the pollutants in rainfall and on urban surfaces from being transported to local waterways. Trees provide additional water quality benefits through uptake of pollutants from the atmosphere, soil and groundwater, and may contribute nutrients to surface waters through leaf litter, but these components are more challenging to quantify given the available data and its variability.

The specific amount by which an individual tree, group of trees or forest patch reduces runoff is highly variable and difficult to measure. For example, annual rainfall interception by urban trees and forests can range from 6% to 66%, while urban trees can transpire from 0.2 to 46.7 gallons per tree per day. This is because each process shown in Figure 1 is affected by numerous factors, such as tree characteristics (species, age, size canopy architecture, leaf area, leaf angle distribution), meteorological factors (wind speed, vapor pressure deficits, temperature), storm event characteristics (intensity, duration and frequency of rainfall), and soil and underlying land cover conditions (understory versus turf versus pavement, fertilizer application). Runoff reduction is also difficult to measure because trees are unlike most other stormwater BMPs, which are engineered to capture and treat runoff from a defined drainage area. In addition, tree functions are likely to vary with the geographic scale (i.e., plot or watershed-scale) and time period of interest (i.e., newly planted, tree at maturity). All of these factors present a challenge for integrating trees and forests into stormwater management programs which requires the ability to assign a single numeric value that represents the "average" hydrologic benefit.

What's Next

The Center is currently working on adapting a tree planting credit recently developed for the Chesapeake Bay program so that is can be used nationally. We are working with partner Justin Hynicka of American Forests, to develop a water balance model for major U.S. climate regions, the U.S. Forest

Service to model tree growth for these same regions using i-tree Forecast, and will be soliciting review of the draft credit from experts around the country. For more information, contact Karen Cappiella at kc@cwp.org or 410-461-8323 ext. 3203.

New Credit Approved for Redirecting Runoff from Impervious Areas onto Amended Soils or Treatment in the Stormwater Conveyance System

The Chesapeake Bay Program recently approved recommendations to define nutrient and sediment load reductions associated with the disconnection of existing impervious area runoff from stormwater drainage systems. Until now, disconnection of impervious area runoff was not defined by the Chesapeake Bay Program as a best management practice (BMP) available for credit towards the Chesapeake Bay total maximum daily load (TMDL). The crediting recommendations were developed by an Expert Panel, which was chaired by the Center's Bill Stack, and included representatives from the Bay jurisdictions, scientists and stormwater practitioners. The Panel Coordinator was Jeremy Hanson from Virginia Tech. The charge of the Expert Panel was to review and evaluate the scientific literature and other data sources, review the Chesapeake Bay Watershed Model assumptions to simulate the impact of impervious area disconnection and make recommendations to quantify and qualify this BMP, as well as review information to verify its performance after implementation.

The Expert Panel reviewed existing credits for stormwater retrofit projects and stormwater performance standards, research publications and the State and District of Columbia stormwater design guidance for simple disconnection and soil amendments. A total of 75 publications were reviewed to form the basis of the Expert Panel recommendations on the nutrient and sediment load reduction from impervious area disconnection to amended soils. In addition, the Expert Panel reviewed whether the existing drainage network of a site could be retrofitted via the creation of storage facilities within the drainage network or adjacent treatment areas with the option of diverting runoff from disconnected impervious cover into these facilities to achieve full or partial disconnection.

The Expert Panel recommendations are summarized in Table 1. The pollutant load reductions are available if the qualifying conditions are met and verified post-construction.

Table 1. Recommended nutrient and sediment removal for the disconnection of existing impervious area runoff from stormwater drainage systems

Protocol	Units[1]	Pollutant Removal
Impervious area disconnection to amended HSG A or B soils[2]	Pounds per year	TN, TP, and TSS removal calculated as simple impervious area disconnection following recommendations of the Expert Panel to Define Removal Rates for Urban Filter Strips (UFS EP, 2014).
Impervious area disconnection to amended HSG C or D soils	Pounds per year	TN, TP, and TSS removal calculated based on the runoff reduction from a 1.0 inch rain event, which is used as the water quality volume treated and the Runoff Reduction pollutant removal curves in SRP EP (2012).
Treatment in the stormwater conveyance system	Pounds per year	TN, TP, and TSS removal calculated based on the water quality volume treated and the Runoff Reduction and Stormwater Treatment pollutant removal curves in SRP EP (2012).

[1]Note that relative reductions from the SRP EP (2012) curves must be multiplied by location specific TN, TP, and TSS yields (i.e. 50% reduction of 10 pounds per acre per year for one acre gives 5 pounds per year reduction).
[2]Amendments or de-compaction activities are typically not suggested for A or B soils, as infiltration rates tend to be high for these soil groups. However, the computational method protocols in the Expert Panel report (Section 5.1.2) can be used if measured Ksat is found to be extremely low from compacted urban areas.

In addition to the specific recommendations to define impervious area disconnection as a BMP for the Chesapeake Bay Program, the Expert Panel provides a set of future research and management needs to advance our understanding of this BMP. The final Expert Panel report, *Recommendations of the Expert Panel to Define Removal Rates for Redirecting Runoff from Impervious Areas onto Amended Soils or Treatment in the Stormwater Conveyance System,* will be available by the end of the month at: http://www.chesapeakebay.net/groups/group/bmp_expert_panels. For more information, contact Bill Stack at bps@cwp.org or 410-461-8323 ext. 222.

Papers Cited

SRP EP (Urban Stormwater Retrofit Projects Expert Panel). (2012). *Recommendations of the Expert Panel to Define Removal Rates for Urban Stormwater Retrofit Projects*.

UFS EP (Urban Filter Strip Expert Panel). (2014). *Recommendations of the Expert Panel to Define Removal rates for Urban Filter Strips and Stream Buffer Upgrade Practices*.

Training Services Available from the Center on Illicit Discharge Detection & Elimination (IDDE)

In the past couple of years, we have been busy delivering Illicit Discharge Detection & Elimination trainings for local government staff in communities across the East Coast. The demand has been huge!

Not only do regulated MS4 communities have to develop and implement an IDDE program as part of their stormwater permit requirement, but illicit discharges can significantly degrade local water quality in receiving waters and threaten aquatic, wildlife and human health. Improving municipal staff understanding of illicit discharges is essential to finding, fixing and preventing further damage to watersheds.

As a result of the Center's IDDE trainings, participants are able to identify weaknesses and improve their municipality's IDDE programs, recognize visual indicators of various types of illicit discharges, understand which water quality parameters can help detect illicit discharges, and discover field and lab technologies available for finding illicit discharges and tracking down their sources.

Here is an example agenda from one of the Center's recent IDDE trainings held in Hampton Roads, VA:

Time	Topic	Description
9:00 – 9:30	IDDE 101	Brief introduction to the concepts, terms, and regulatory context for IDDE as part of a local MS4 program. What are common types of discharges?
9:30 – 9:50	IDDE & Water Quality	Research on the role of illicit discharges in the overall water quality picture: a few case studies
9:50 – 10:10	Desktop Analysis & Prioritizing Areas for IDDE Investigations	Examples of conducting a desktop/GIS analysis to refine and prioritize IDDE work
10:10 – 10:25	BREAK	
10:25 – 10:40	Indicator Methods	Quick overview of candidate screening methods, including single indicator and flowchart
10:40 – 11:30	*Facilitated Discussion:* Coastal Issues	• What is an outfall, station, good "dry weather" screening location in coastal areas, considering groundwater, tidal influences? • What are pros and cons of various chemical indicators as part of a screening program?
11:30 – 11:50	Fixing discharges, source tracking	• Local case study • Overview of methods for tracking & locating • Enforcement procedures
11:50 – 12:00	Q&A, Discussion	
Lunch Break		
1:00 – 1:40	Field Investigations & Safety Procedures	Overview of field testing, equipment & supplies, tracking & documentation, field & lab safety. Holding/sampling times for various tests.
1:40 – 3:10	Hands-on use of selected field kits	Rotate between stations to test for ammonia, fluoride, potassium, preparing samples for optical brighteners & bacteria
3:10 – 3:30	Q&A, Discussion	
3:30	Adjourn	

If your MS4 program could benefit from a thorough, hands-on IDDE training session for your public works, stormwater management, and/or utility personnel, get in touch! Contact Laurel Williamson at lw@cwp.org and she can put together a cost estimate for you.

Tribute to Dave Hirschman

At the end of 2016, the Center said farewell to Dave Hirschman, who spent the last 11 years developing the Center's training and stormwater services programs. We would like to acknowledge Dave and his many important contributions to the Center's technical work as well as our staff culture. A few highlights of Dave's tenure here include:

- Opened our first "remote" office in Charlottesville, VA
- Started "Runoff Ramblings" before blogging was even a thing
- Trainer and host extraordinaire: launched the CWP webcast series and served as host for many years, trained countless watershed and stormwater professionals through CWP institutes, workshops, conferences and videos
- Creator of the "BMP Smackdown" and many songs about stormwater
- Instrumental in updating Virginia's stormwater management regulations and BMP specifications, including development of the Runoff Reduction Method
- Authored an inordinate number of state stormwater design manuals
- Authored national guidance on developing stormwater programs
- Implemented numerous demonstration stormwater BMP retrofits, including one on Guam
- Assisted many, many local government agencies and environmental organizations in Virginia with their watershed and stormwater needs

Dave is now focusing on his business Hirschman Water & Environment and can be reached at dave@hirschmanwater.com. We are sad to see Dave go but look forward to working with him on future projects in Virginia. Below, read Dave's final "Runoff Ramblings" piece.

A Note From Dave

There were fewer acronyms to keep track of when I began my career in water resources in 1984. There was NPDES and a few others, but MS4, TMDL, and certainly LID and GI were not rolling off of peoples' tongues as part of our professional lexicon. One of most important acronyms I became aware of as my career evolved was CWP. As a local government water resources manager in the 1990s, CWP represented the wellhead of knowledge for those of us trying to understand the principles and intricacies of watershed and stormwater management. The arrival in the mail (in an actual mailbox that was not on a computer!) of my copy of CWP's Watershed Protection Techniques was a highlight of each month, and I guarded the time to sink into the articles on emerging stormwater practices and the latest research. I had no notion at the time that I would eventually come to work for CWP and contribute to that fine legacy.

Through my tenure at CWP, the staff continued to make significant contributions to the evolving field. I learned a great deal from my colleagues about the role of forests and wetlands, IDDE (another wonderful acronym for the list), the perils of impervious cover, coral reef watersheds, how to design the latest stormwater gizmo, and multiple other topics. The world was demanding stormwater design manuals and webinars, compliance spreadsheets, and more recently, guidance on how to actually maintain all the things that were being designed and installed across our watersheds. The profession was growing– both in terms of technical complexity and also the number of practitioners active in government agencies, watershed organizations, consulting firms, and academic institutions. This signals a quantum leap in our collective capacity to protect and restore watersheds, and I am duly impressed with the quality and integrity of people working in the profession.

I will always appreciate the great collaborative spirit that characterizes CWP and its staff. We also participated in many episodes of tomfoolery and even some mayhem – it's important to have fun if you are doing serious work! To continue on the theme of acronyms, I offer a hearty TY to my CWP colleagues, if not a SWAK.

You can still find me through Hirschman Water & Environment, based in Charlottesville, VA. Please do stay in touch: dave@hirschmanwater.com.

Announcements

2017 Watershed and Stormwater Conference
The agenda for the national webcast portion of the 2017 Watershed and Stormwater Conference is now available! Click here to download the agenda. To celebrate the Center for Watershed Protection's 25th anniversary, we are offering a $25 early bird discount on conference registration until February 4th 2017. Just be sure to enter the coupon code on the website to take advantage of this opportunity.

The conference also includes local hubs with additional content. We have two hubs confirmed in Baltimore, MD and Omaha, NE and will be announcing other hub locations shortly. Check out our conference website for more information on how to register, agendas for the local hubs, and more!

2017 Watershed and Stormwater Webcast Series
The schedule and topics for the 2017 webcasts are now available! Go to our webcast page to view the webcast descriptions and to register.