



Weathering the Storm

A Conversation on Stormwater Management & Priorities

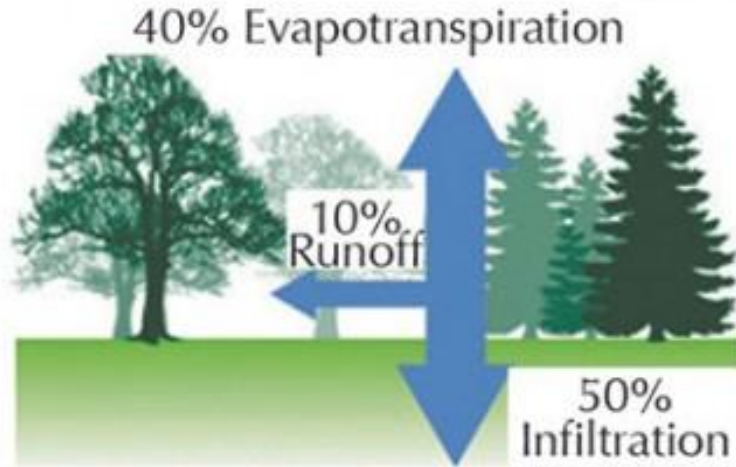
Ted Brown 12/04/2024



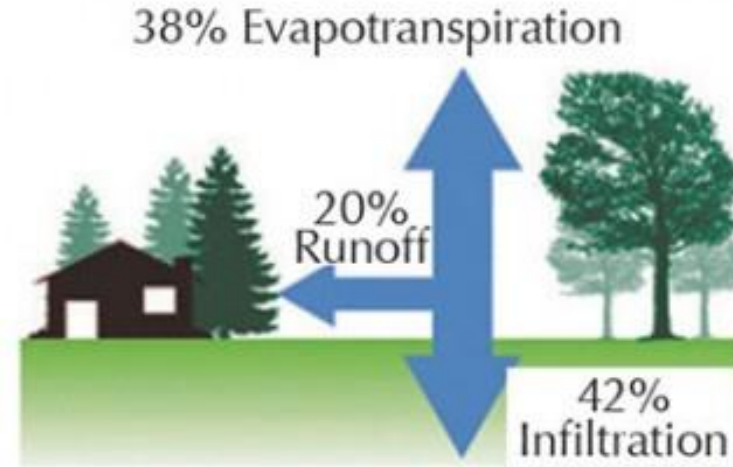
- 1 **History of Stormwater Management and MS4 Programs**
- 2 **City of Raleigh Stormwater Program Components**
- 3 **Future of Thoughtful Programs**
- 4 **Concluding Thoughts**



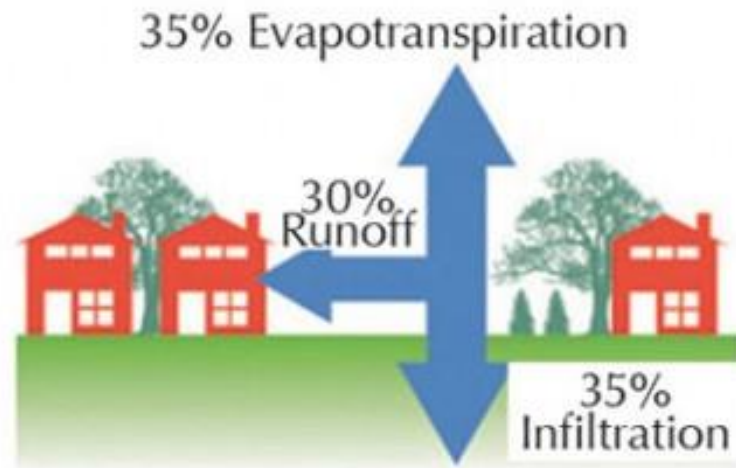
EFFECTS OF IMPERVIOUSNESS ON RUNOFF AND INFILTRATION



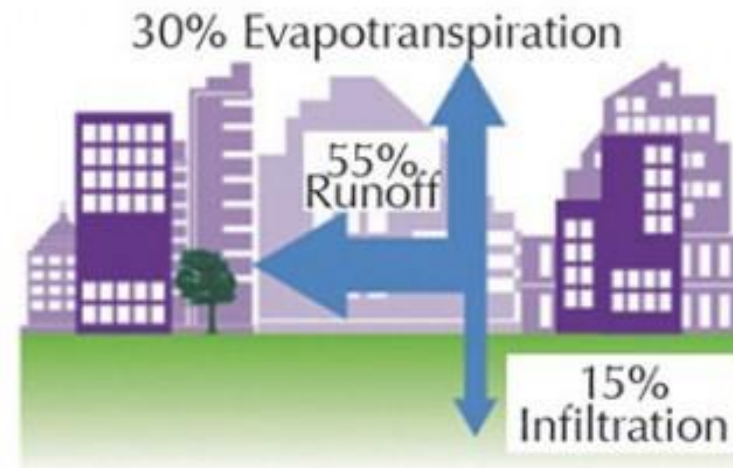
Natural Ground Cover
0% Impervious Surface



Low Density Residential (e.g. rural)
10–20% Impervious Surface



Medium Density Residential
(e.g. subdivision)
30–50% Impervious Surface



High Density
Residential / Industrial / Commercial
75–100% Impervious Surface

EVOLUTION OF STORMWATER MANAGEMENT

- 1950's • Dams, flood control reservoirs, and channelization
- 1970's • Focus on floods and moving the water away fast
- Late 1970's • Dry detention for large storms
- Early 1980's • Wet detention and first flush (water quality)
- 1990's • Phase 1 MS4 permits, LID/BSD (bioretention, filters, etc.)
- 2000's • Phase 2 MS4 permits, Unified Sizing Criteria, stream restoration
- 2010's • Environmental site design and runoff reduction



MS4 PROGRAMS WITH STICKS

- **General Requirements**

- Public Education and Outreach
- Public Involvement and Participation
- Illicit Discharge Detection and Elimination
- Construction Site Stormwater Runoff Control
- Post Construction Stormwater Management
- Pollution Prevention and Good Housekeeping

- **Watershed Restoration**

- Demonstrate progress toward meeting local stormwater wasteload allocations (WLAs) associated with Total Maximum Daily Loads (TMDLs)
- Restore existing developed lands that have little or no stormwater management

CONTINUED EVOLUTION OF THE MS4 PERMIT

- Accelerate watershed restoration
- Achieve reductions for Total Maximum Daily Loads (TMDLs)
- Use Environmental Site Design (ESD) to the maximum extent practicable (MEP)

In addition to...

- Assuring public input and stewardship opportunities
- Interagency coordination
- Annual reporting
- Source identification
- Discharge characterization
- Monitoring
- Stormwater facility inspection and maintenance enforcement
- Illicit discharge detection and elimination

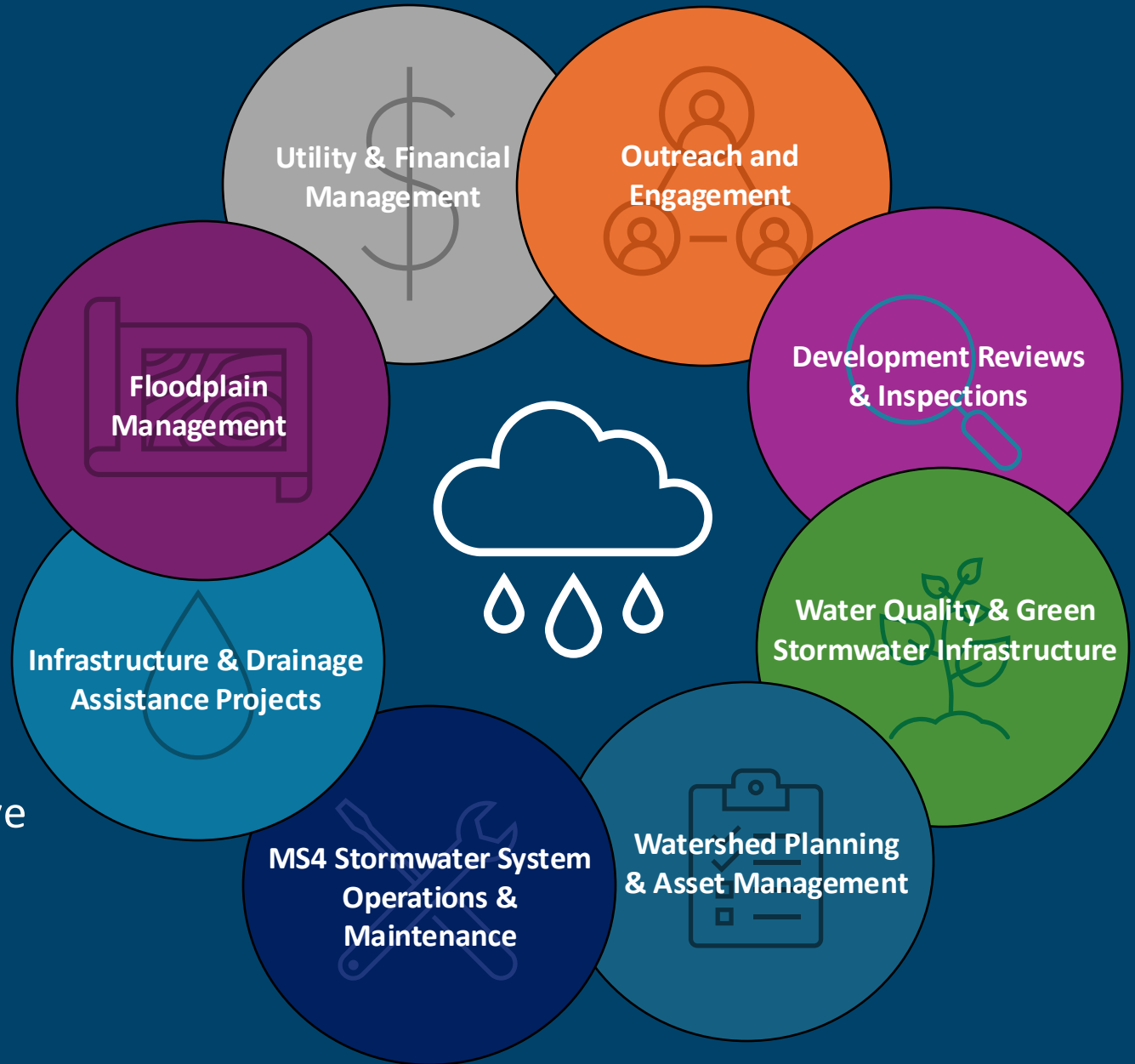
Mission Statement

Manage stormwater to preserve and protect life, support healthy natural resources, and complement sustainable growth for the community.

Vision Statement

Be the “smartest” stormwater program possible to economically and equitably achieve our mission.

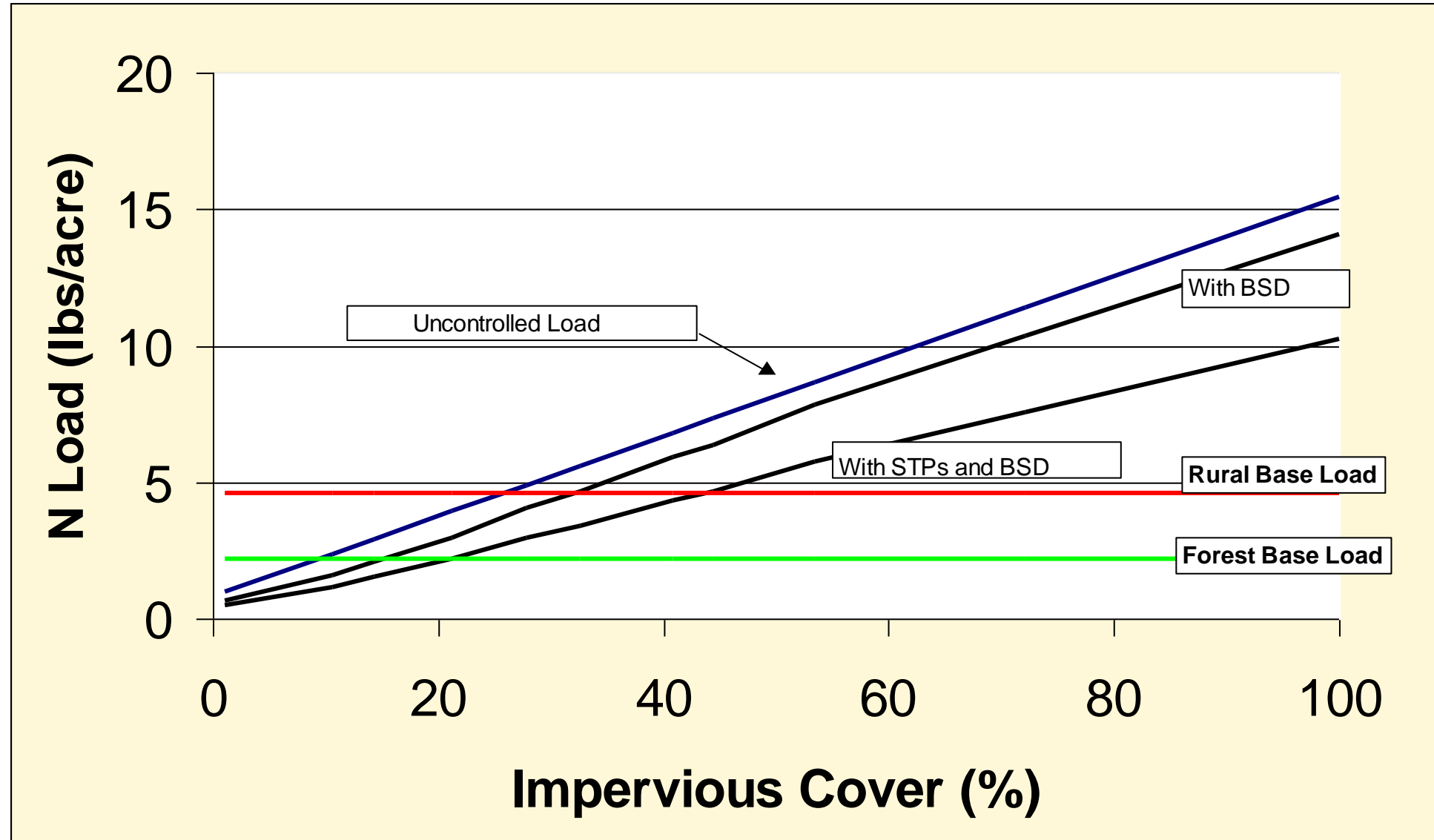
Be Stormwater Smart!



CHALLENGES FROM THE BEGINNING

- Jurisdictional buy-in (locally and statewide)
- Internal program capacity
- External capacity – design and construction
- Permitting agencies capacity
- Procurement process
- Design – permitting – construction timeline
- Untested and “young” technologies
- Stakeholder concerns (private property owners, public scrutiny)
- Future maintenance burden
- Funding (\$\$)

The Best We Can Do?



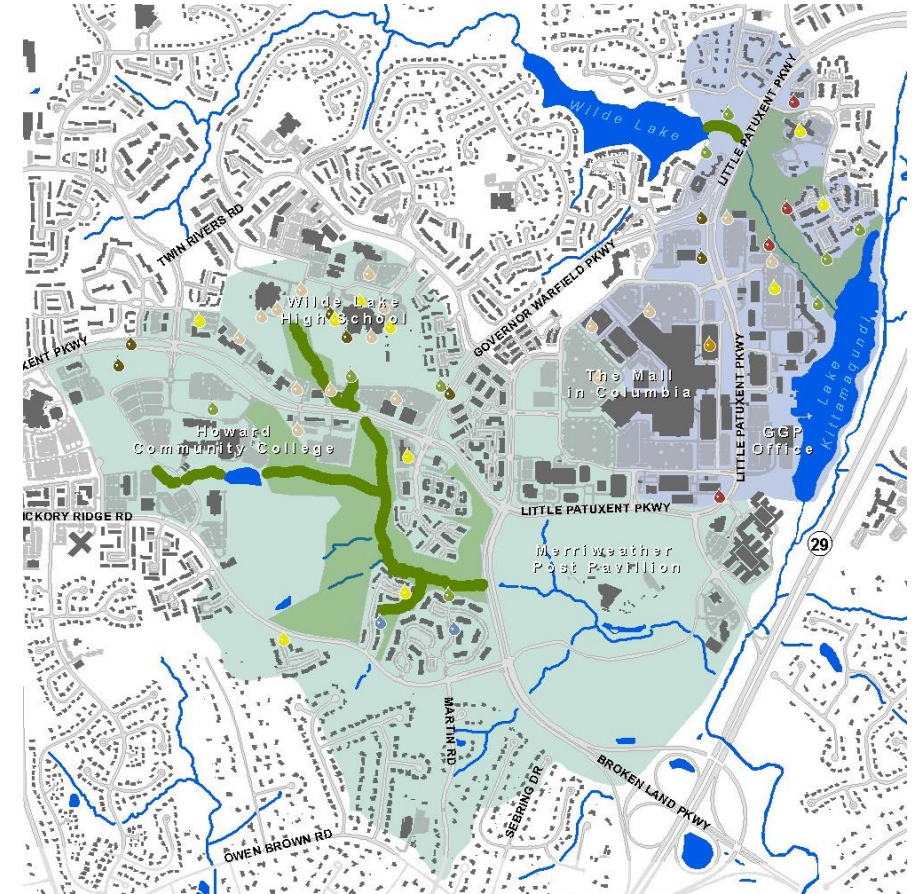
HERE'S HOW MS4S ARE SUCCEEDING

- Taking a **watershed approach**
- Planning and accounting for **Climate Change**
- Applying a **wide range of management practices**
- Exploring **alternative delivery mechanisms**
- Nurturing **external partnerships**
- Developing robust **monitoring and assessment programs**
- Not forgetting about **maintenance** and **dedicated funding**
- Engaging and Listening to the **community members**

WATERSHED PLANNING

What is a Watershed Plan?

- Customized road map - allows for holistic strategies that avoid piece-meal solutions
- Projects can be grouped together within high-priority drainage areas
- Lays out a prioritized approach - avoids proposed solutions exacerbating conditions further downstream within drainage systems
- Accommodates a combination of tools
- Achieves specific, local watershed goals



CHESAPEAKE BAY TMDL

- Established by U.S. EPA in 2010
- Encompasses 64,000 sq. mile watershed
- Set annual Bay watershed limits:
 - 185.9 million pounds of nitrogen
 - 12.5 million pounds of phosphorus
 - 6.45 billion pounds of sediment per year
- Limits further divided by jurisdiction & sector
- Accountability framework includes WIPs and two-year milestones
- Designed to ensure measures needed to fully restore the Bay are in place by 2025



ACCOUNTING FOR CLIMATE CHANGE



@MidAtlanticRISA

About - Climate Summaries - Data Tools - Publications and News



CHART

TABLE

COMPARISON

Toggle Confidence Intervals

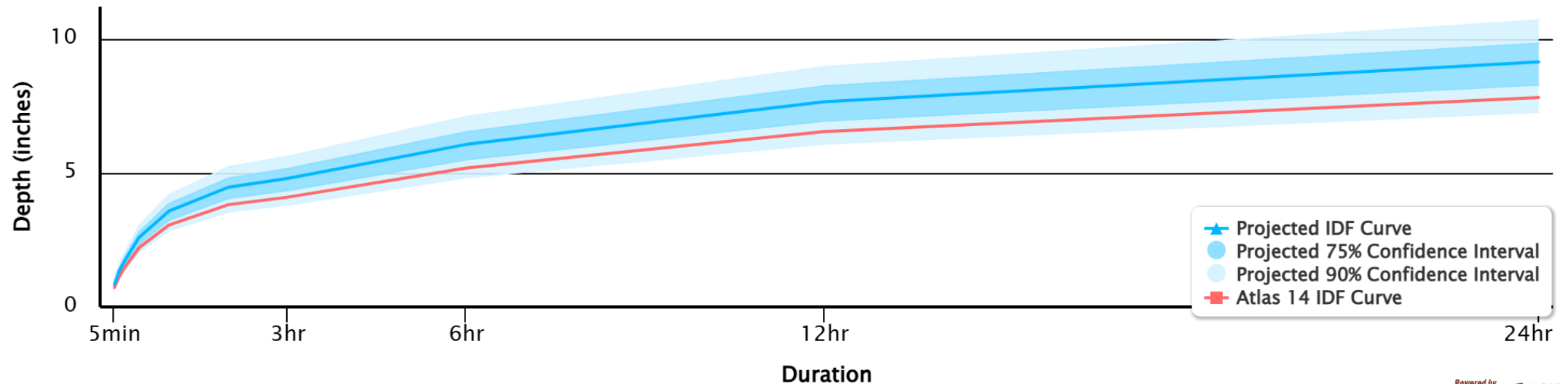


DANVILLE 2 SE



IDF Curve: 100-Year Return Period Under RCP 8.5 From 2020-2070

Click and drag on chart to zoom



MANAGEMENT PRACTICES



8. Watershed Stewardship



1. Land Use Planning



2. Land Conservation



7. Non-Stormwater Discharges



3. Aquatic Buffers



6. Stormwater Management



5. Erosion & Sediment Control



4. Better Site Design

MANAGEMENT PRACTICES

ENVIRONMENTAL SITE DESIGN (ESD) TO THE MEP

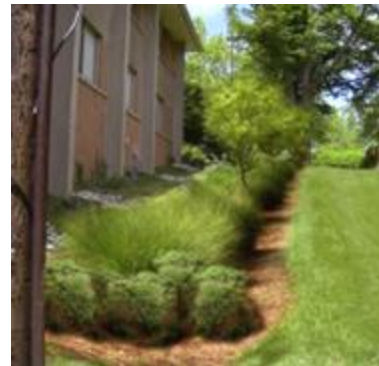
- Preserve natural features
- Better site planning and design
- Minimize development footprint
- Mimic natural hydrology
- Slow down and break up runoff
- Infiltrate and evapotranspire
- Small scale practices distributed across sites
- Emphasis on Green Infrastructure



Typical Centralized Detention Pond



Small Scale, Integrated ESD Practices



MANAGEMENT PRACTICES

- Rainwater harvesting
- Rainwater interception
- Functional landscapes and conveyance
- Green parks and public spaces
- Riparian corridor restoration



MANAGEMENT PRACTICES



Stream Restoration

MANAGEMENT PRACTICES



MANAGEMENT PRACTICES



BEFORE



AFTER

Outfall Restoration

MANAGEMENT PRACTICES



Floating Wetlands

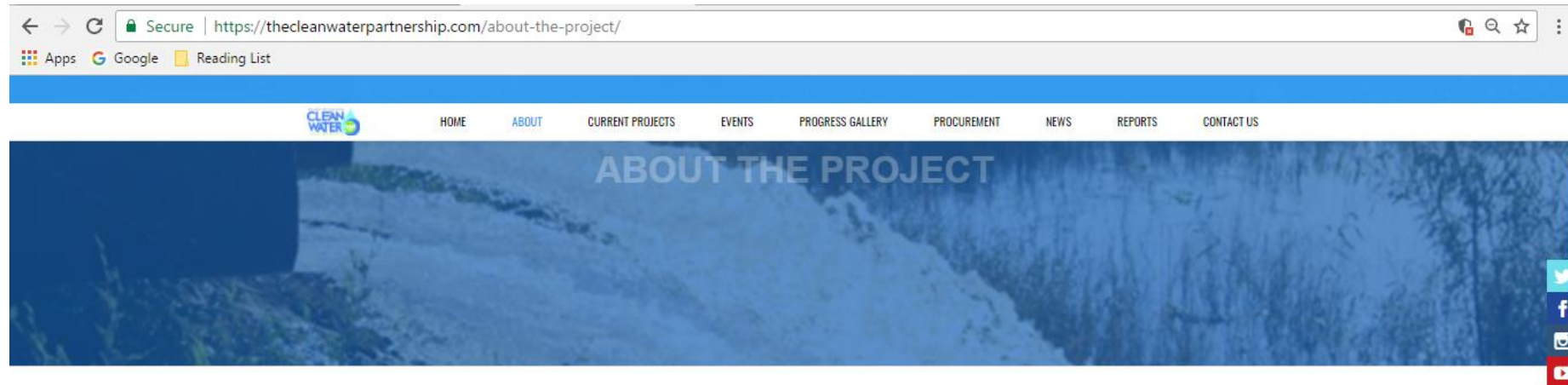
MANAGEMENT PRACTICES



Mr. Trash Wheel

ALTERNATIVE DELIVERY

- Prince George's County: Public-Private Partnership



In 2014, Prince Georges County was faced with an enormous regulatory challenge in the management of its National Pollutant Discharge Elimination System and its Municipal Separate Storm Sewer System (MS4) Permit that needed an innovative solution.

Traditional project delivery methodologies and procurement could have been utilized; however, given the magnitude of the challenge of retrofitting 2,000 impervious acres with Green Infrastructure, with the flexibility to potentially grow to 15,000 acres of untreated impervious area by 2025, and an estimated cost of \$100 million, an alternative solution was sought. The County's elected political leaders including the County Executive; Legislative Branch; and sponsoring agencies—Department of the Environment and Department of Central Services collaborated for the development of an alternative solution. That alternative solution was a Community Based Public Private Partnership or CBP3. As a result of the courage and leadership of the County's elected officials Prince Georges County is the first municipality to utilize the CBP3 model as a solution to the challenges that are facing many jurisdictions across the US in meeting federal regulatory stormwater compliance requirements.

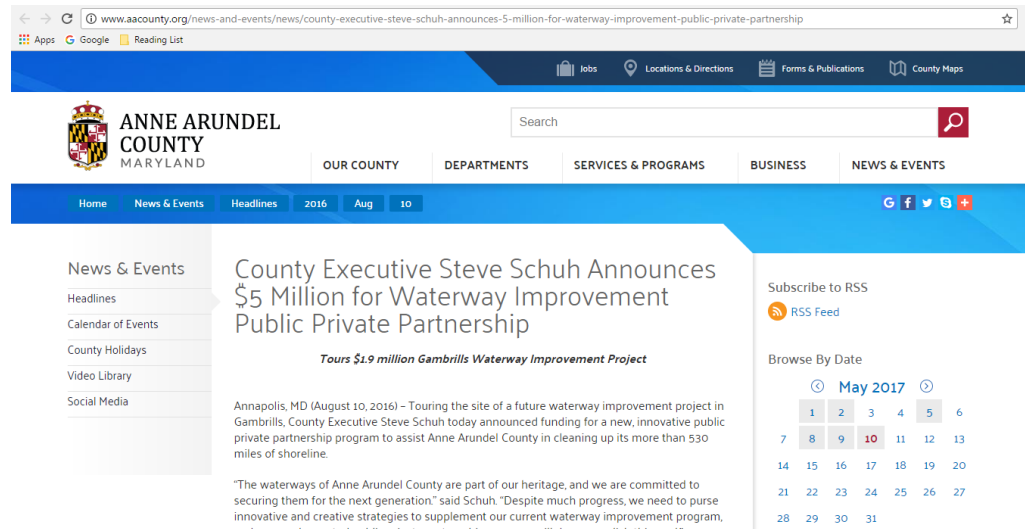
How was Corvias Solutions Selected?

Prince George's County utilized a Request for Qualification (RFQ) process in order to avoid the expensive upfront Request for Proposal (RFP) process that are typically overly prescriptive on the technical design and construction that favors firms experience in government contracting versus their ability to innovate and think outside of the box. The Request for Qualifications process focused on a company's financial stability, management capabilities, experience with complex problem solving, and proven commitment and success with local small business utilization and creation. Instead of a traditional client-contractor relationship, the RFQ process allowed for the development of a business partner that shares in the risk and invests in the County's goals.

RFQ Process Evaluation Criteria

ALTERNATIVE DELIVERY

- Anne Arundel County: Pay for Performance



The screenshot shows the Anne Arundel County website with the following details:

- URL: www.aacounty.org/news-and-events/news/county-executive-steve-schuh-announces-5-million-for-waterway-improvement-public-private-partnership
- Navigation: Home, News & Events, Headlines, 2016, Aug, 10
- Section: News & Events
- Headline: County Executive Steve Schuh Announces \$5 Million for Waterway Improvement Public Private Partnership
- Sub-headline: *Tours \$1.9 million Gambrills Waterway Improvement Project*
- Text: Annapolis, MD (August 10, 2016) – Touring the site of a future waterway improvement project in Gambrills, County Executive Steve Schuh today announced funding for a new, innovative public private partnership program to assist Anne Arundel County in cleaning up its more than 530 miles of shoreline.
- Quote: "The waterways of Anne Arundel County are part of our heritage, and we are committed to securing them for the next generation," said Schuh. "Despite much progress, we need to pursue innovative and creative strategies to supplement our current waterway improvement program,..."
- Additional features: Search bar, RSS Feed, Browse By Date (May 2017 calendar)

Capital Gazette

News / Government

First water quality partnership signed under new Schuh initiative



County Executive Steve Schuh surveys, a watershed improvement project in Gambrills. (Amanda Yeager / Capital Gazette)



By Amanda Yeager · Contact Reporter

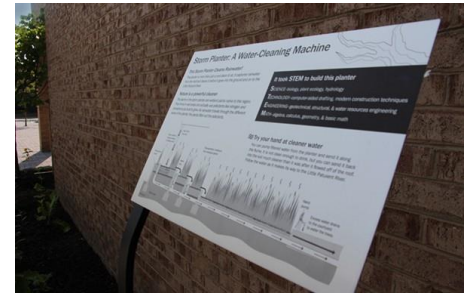
MAY 5, 2017, 12:42 PM

Anne Arundel County is contracting with the private sector to strengthen water quality protections for the Severn Run, Patapsco and Patuxent waterways, County Executive Steve Schuh announced Friday.

Schuh said the county has signed a \$3.8 million agreement with Resource Environmental Solutions, a national firm with a regional office in Odenton, that will pay for restoration of 2,500 linear feet of stream

ALTERNATIVE DELIVERY

- Howard County: Design-Build



EXTERNAL PARTNERSHIPS

- Howard County + READY Program



The screenshot shows the website path-iaf.org/ready/. The navigation bar includes links for Home, About PATH, Current Campaigns, Victories, News and Events, and a Donate button, along with social media icons for Facebook and Twitter. The main banner features a group of young adults in yellow shirts working on a rain garden. Below the banner, the word "READY" is displayed in large orange letters. A section titled "Restoring the Environment and Developing Youth" includes a "Milestones" timeline with entries for 2010 (Chesapeake Bay "Pollution Diet") and 2012 (READY Begins Work, employing 31 young adults).

READY

Restoring the Environment and Developing Youth
READY

• **Milestones** •

2010 Chesapeake Bay "Pollution Diet"

2012 **READY Begins Work**
In its first year, READY employs 31 young adults to build rain gardens and

READY employs Howard County residents ages 16-26 to build rain gardens and conservation landscapes that filter stormwater runoff and alleviate flooding from pavement and other impervious surfaces.

The investment Howard County makes in READY yields returns in four ways:

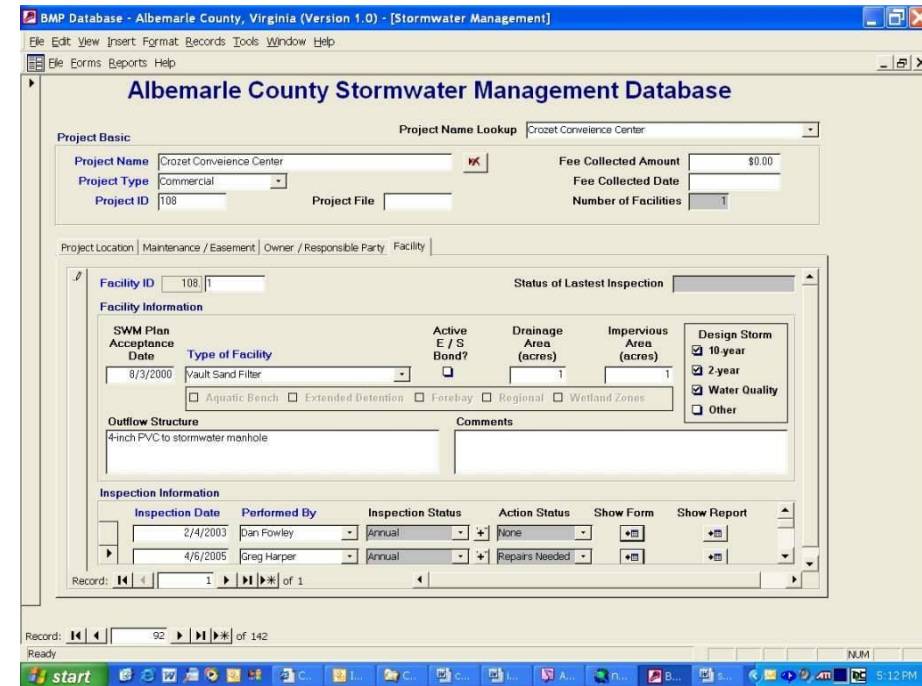
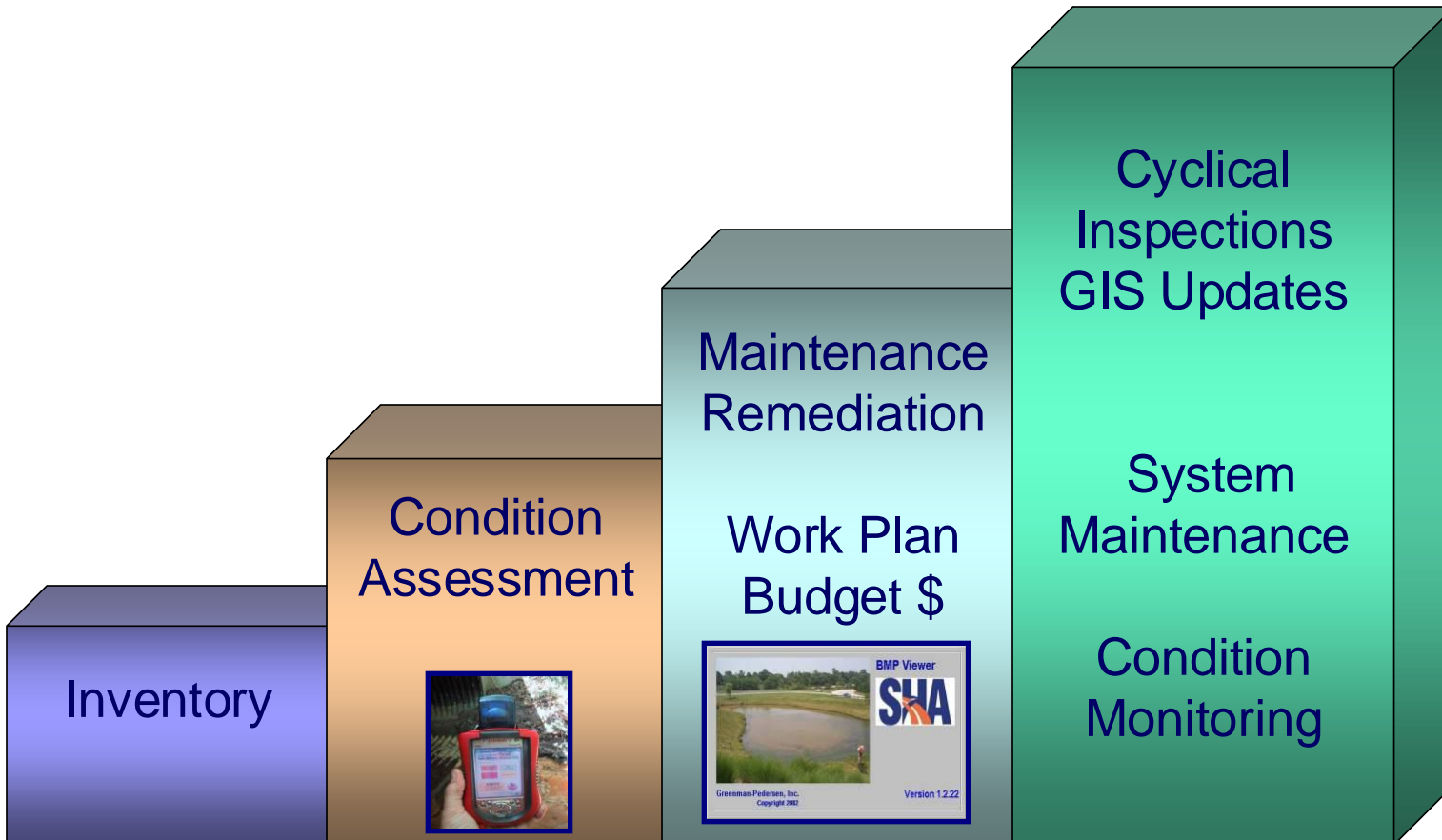
MONITORING AND ASSESSMENT

- **Aquatic**
 - Hydrologic Response
 - Water Quality
 - Biological Integrity
 - Geomorphic Structure
- **Riparian**
 - Buffer Zone Hydrology
 - Buffer Zone Water Quality
 - Vegetative Structure & Species Composition

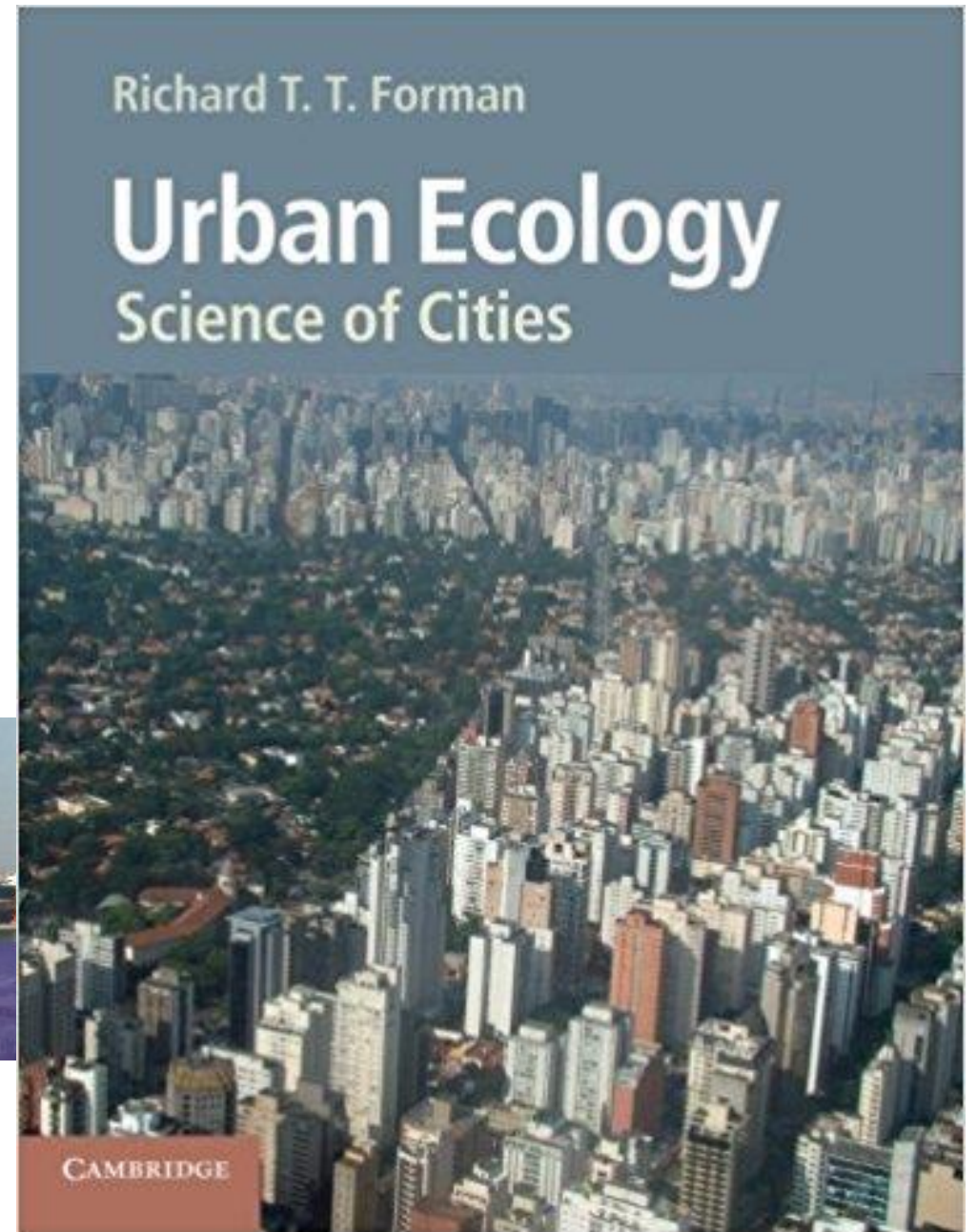
Target	Category	Protection Outcome	Comparison Metrics & Performance Goals
AQUATIC	Hydrologic Response	Pre-development Conditions or Better	Comparison Metric: Surface Flow Hydrographs
			Performance Goal: Onsite and downstream peak flow (magnitude and lag time – small and medium sized storms ¹) at or below pre-development condition.
			Comparison Metric: Surface Water Baseflow
			Performance Goal: Baseflow conditions at or above baseline conditions during low flow periods of the year.
	Water Quality	Pre-development Conditions or Better	Comparison Metric: Groundwater Levels
			Performance Goal: Groundwater levels at or above baseline levels during low flow periods of the year.
			Comparison Metric: Groundwater Water Baseline Physical and Chemical
			Performance Goal: Water physical and chemical properties meet or improve from baseline/reference multi-seasonal data
	Biological Integrity	Pre-development Conditions or Better	Comparison Metric: Surface water baseline physical and chemical or reference condition or use standards
			Performance Goal: Water physical and chemistry meets or improve from baseline multi-seasonal data or reference condition or use standards
			Comparison Metric: Baseline Macroinvertebrates
			Performance Goal: Macroinvertebrates IBIs meets or improved from baseline data or reference condition
	Geomorphic Stability	Maintains or Improves to Stable Channel Condition	Comparison Metric: Baseline Fish
			Performance Goal: Fish IBIs meets or improved from baseline data or reference condition
			Comparison Metric: Baseline Profiles
			Performance Goal: Maintains or Improves Stream Bed Elevation and Plan Form
			Comparison Metric: Baseline Cross Sections
			Performance Goal: Maintains or Improves Stream Bank Profile

1. Selection of small or medium sized storms for monitoring will depend on site characteristics and should relate to sizing criteria set forth in the Maryland Stormwater Design Manual.

MAINTENANCE AND FINANCING



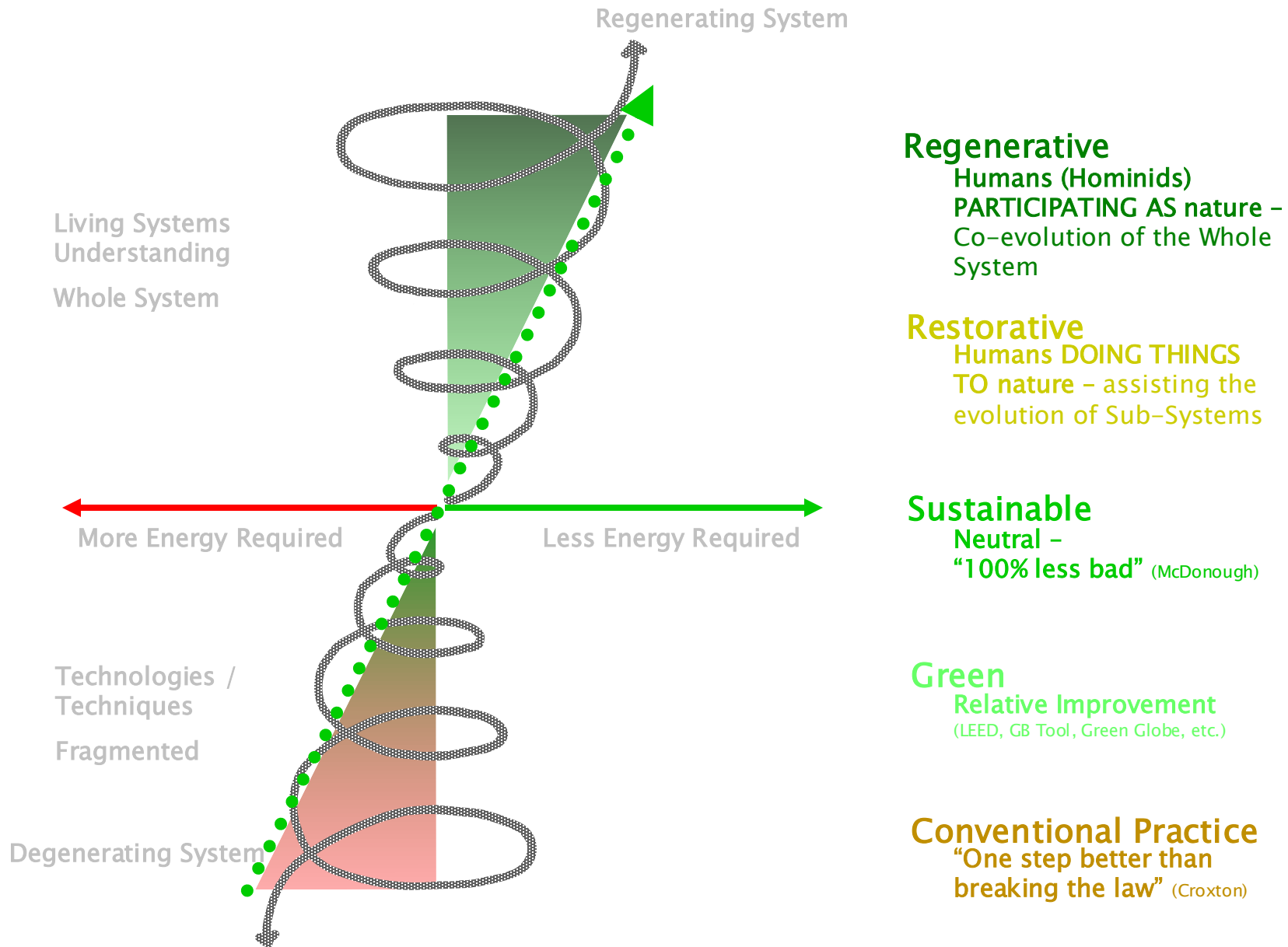
Urban ecology



We often think of cities as steel and concrete, roads and parking lots, and skyscrapers and apartments. But underlying all of that grey infrastructure is a landscape that was first sculpted by rivers and streams, covered by forests and grasslands, and teeming with insects, birds and mammals.

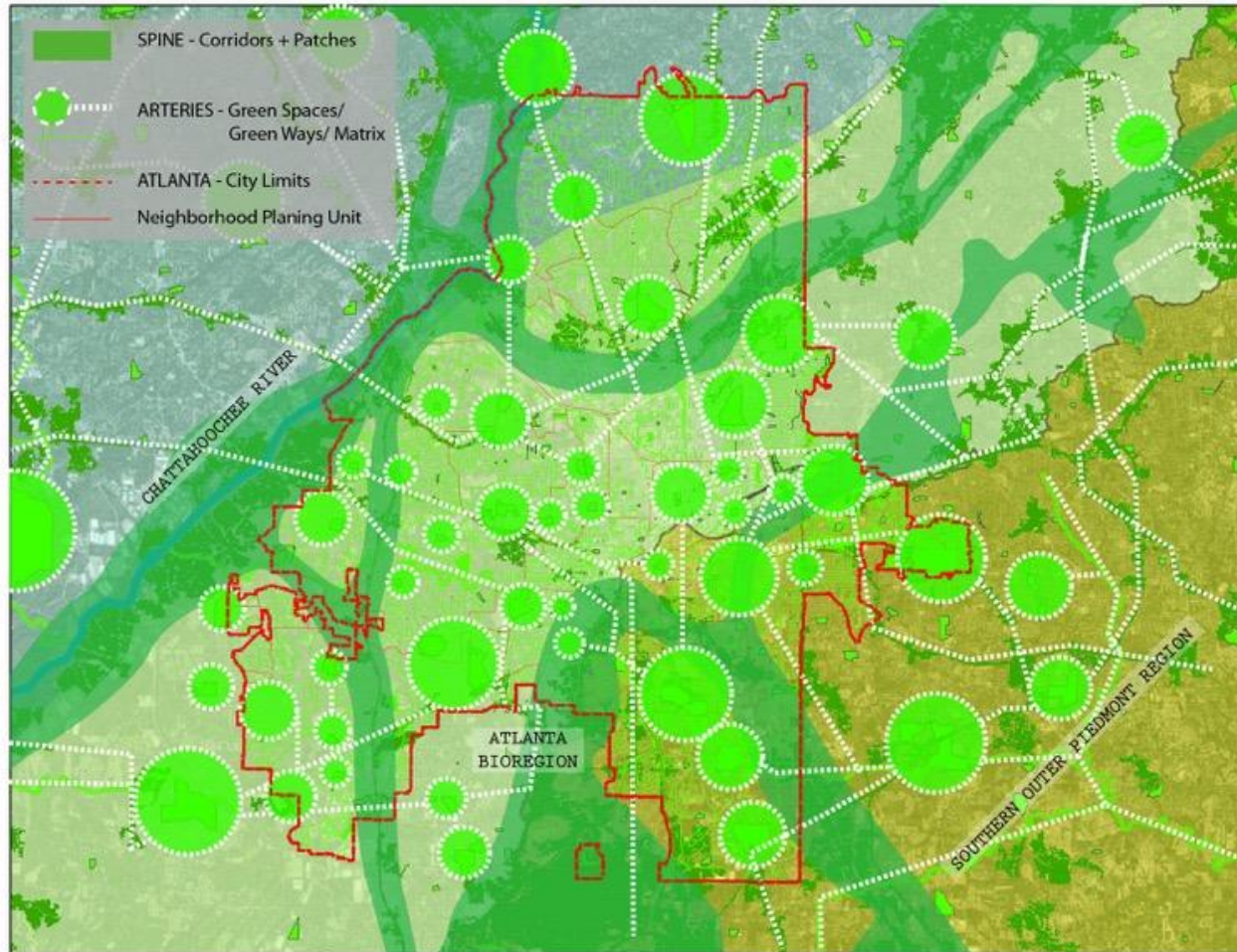


Mannahatta: A Natural History of New York City



Trajectory of Environmentally Responsible Design

Green Living Infrastructure

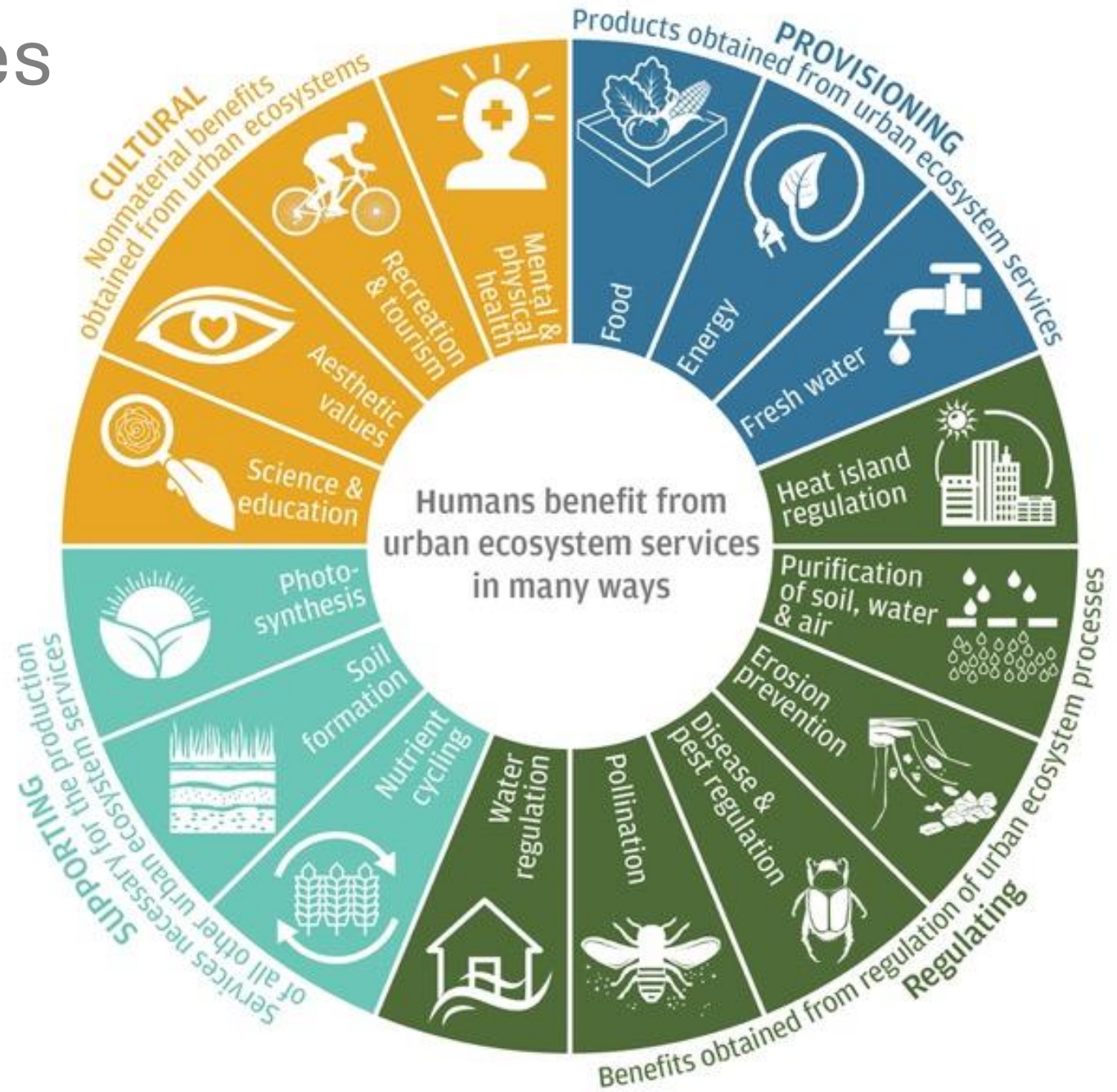


Strategically planned and managed networks of natural lands, working landscapes and other green spaces – at many scales – that conserve ecosystem functions, restore ecosystem processes and regenerate healthy, robust and resilient communities.

- Biologically complex
- Self Organizing
- Self Maintaining
- Life Giving

Ecosystem services

If we maximize biodiversity
all the other ecosystem
services will follow



WHY WE FOCUS ON URBAN TREES

Trees bring benefits to communities, wildlife and the environment. In cities, they can...

Conserve Energy

Carefully positioned trees can cut heating and cooling requirements in buildings, providing shade in the summer and blocking wind in the winter.

Add Character & Charm

Trees add beauty to their surroundings. They bring colour, soften harsh lines of buildings, screen unsightly views and enhance the character of an area.

Support Environmental Education

Tree-planting projects, school gardens and Edible Playgrounds can help children develop their environmental awareness, conservation skills and knowledge of sustainable food.

Enrich Habitats & Biodiversity

An increase in tree diversity benefits a host of insects, birds and mammals that rely on trees for food and protection. For example, they are an important source of nectar for bees.

Improve Air Quality

Trees improve air quality and counteract the greenhouse effect by absorbing pollutants and intercepting harmful particulates.

Enable Urban Foraging

Trees provide fruits and nuts for wildlife and humans. Community orchards offer health, social and environmental benefits.

Reduce Flood Risk

Trees absorb water, lowering stress on storm water drains and mitigating flood risk. They also improve soil quality and prevent erosion, so more water is held in the ground.

Strengthen Communities

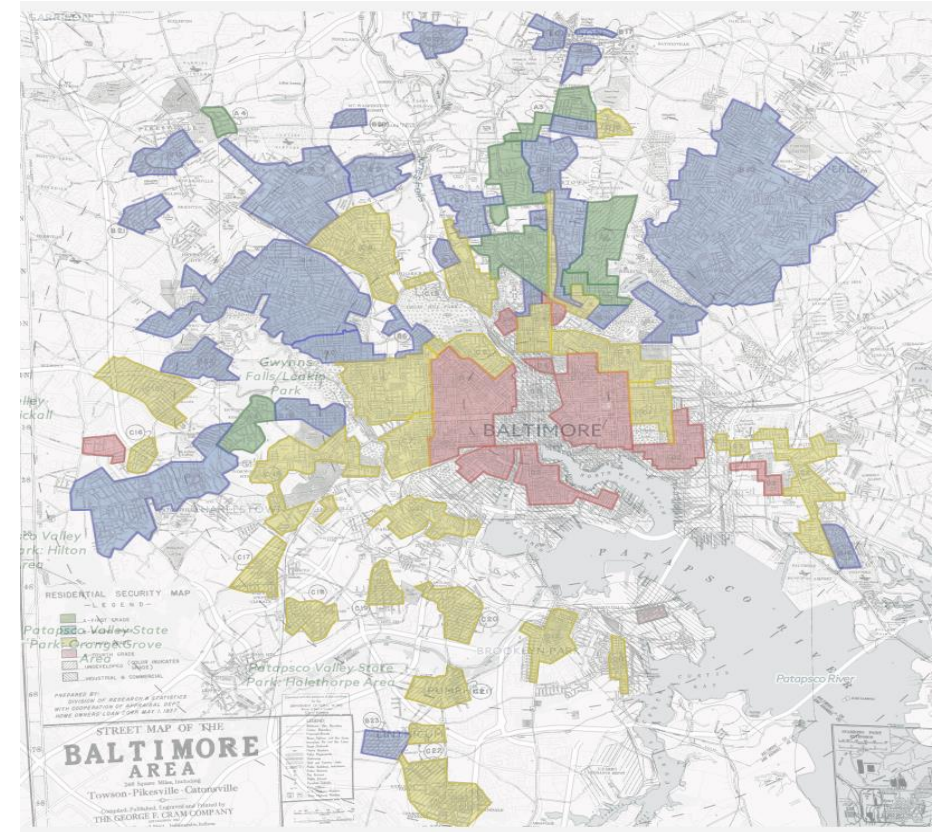
Creating and caring for green spaces helps people reconnect with their neighbours and their surroundings.

Enhanced Health & Well-being

Trees and green spaces can improve recovery times from illness, reduce stress and boost mental health.



Environmental/Climate Justice



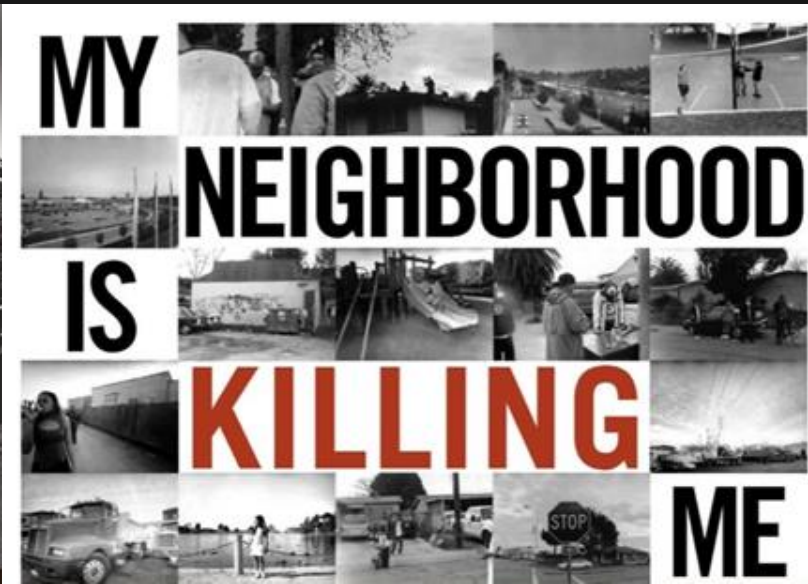
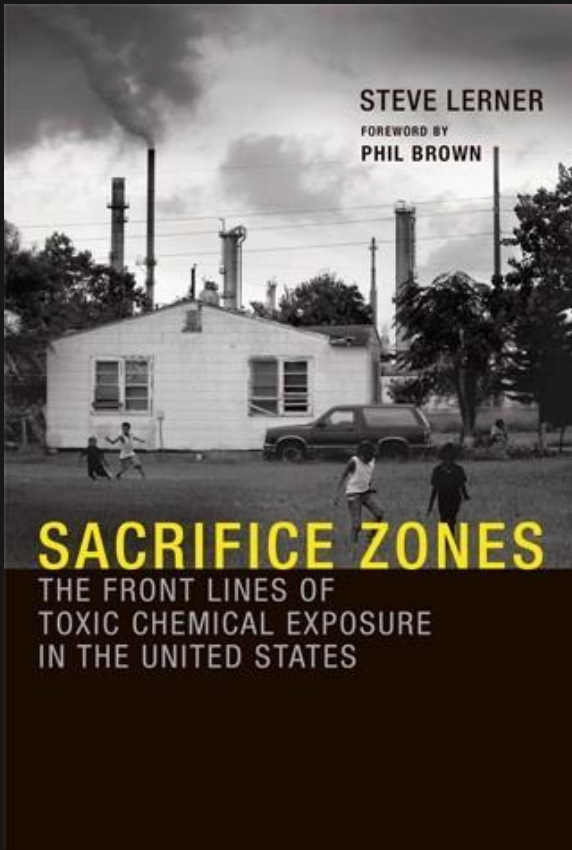


Image Source: Sojourners Magazine



Access to nature/Quality of green space





Not changing is not an option.

The most strategic scenario for
growth includes everyone.



We're going to design for people.

We're going to design for nature.

We're going to design for people in
nature.



“The Earth is an organism that needs expansive wilderness to regulate climate and support biodiversity. Cities are systems dependent on subsidized resource inputs. We are living organisms that respond to living systems for our mental health and well being (biophilia). As the world grows more populated, we must make cities function like ecosystems, to produce more life support systems within the cities’ limits, eliminate concept of waste, enrich human spirit and health with life, so that we can let the wild be wild.”