Weathering the Storm

A Conversation on Stormwater Management & Priorities

Ted Brown 12/04/2024

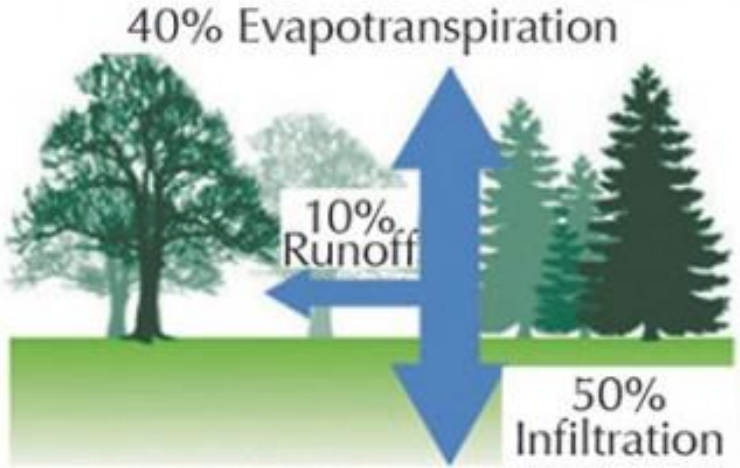
Biohabitats

Overview

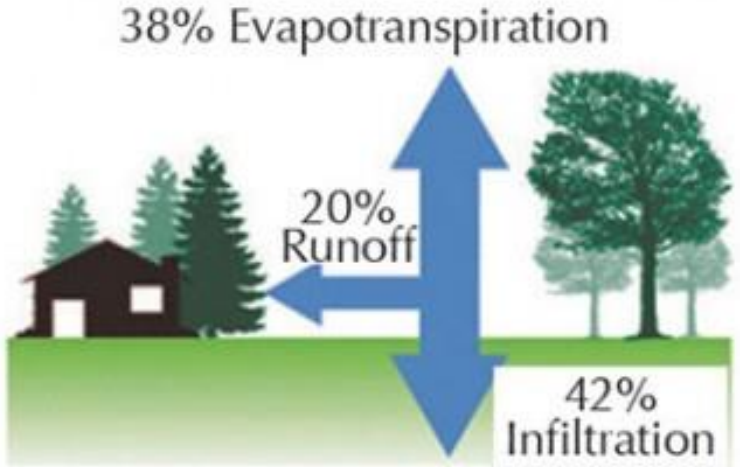
1. History of Stormwater Management and MS4 Programs
2. City of Raleigh Stormwater Program Components
3. Future of Thoughtful Programs
4. Concluding Thoughts

Biohabitats

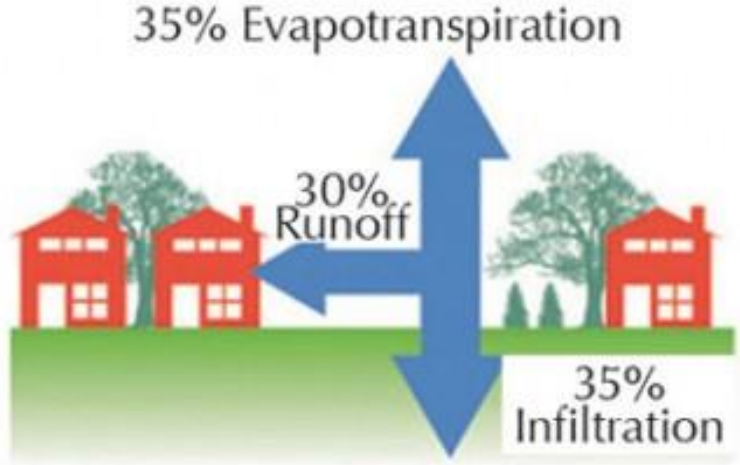
EFFECTS OF IMPERVIOUSNESS ON RUNOFF AND INFILTRATION



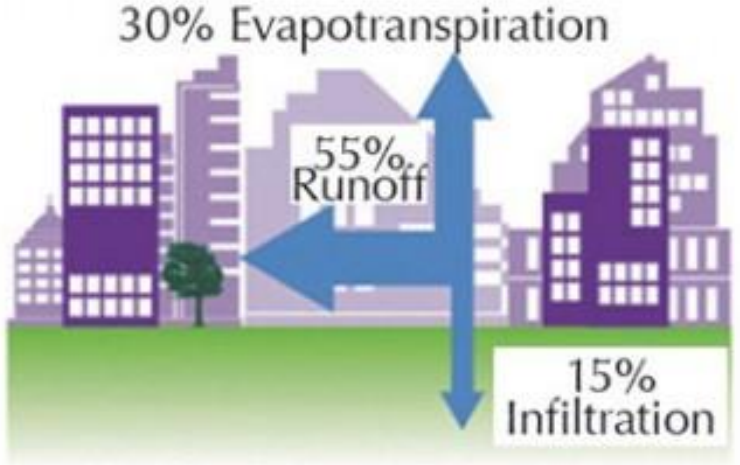
Natural Ground Cover
0% Impervious Surface



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

(SOURCE: CITY OF GRIFFIN, GA)

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

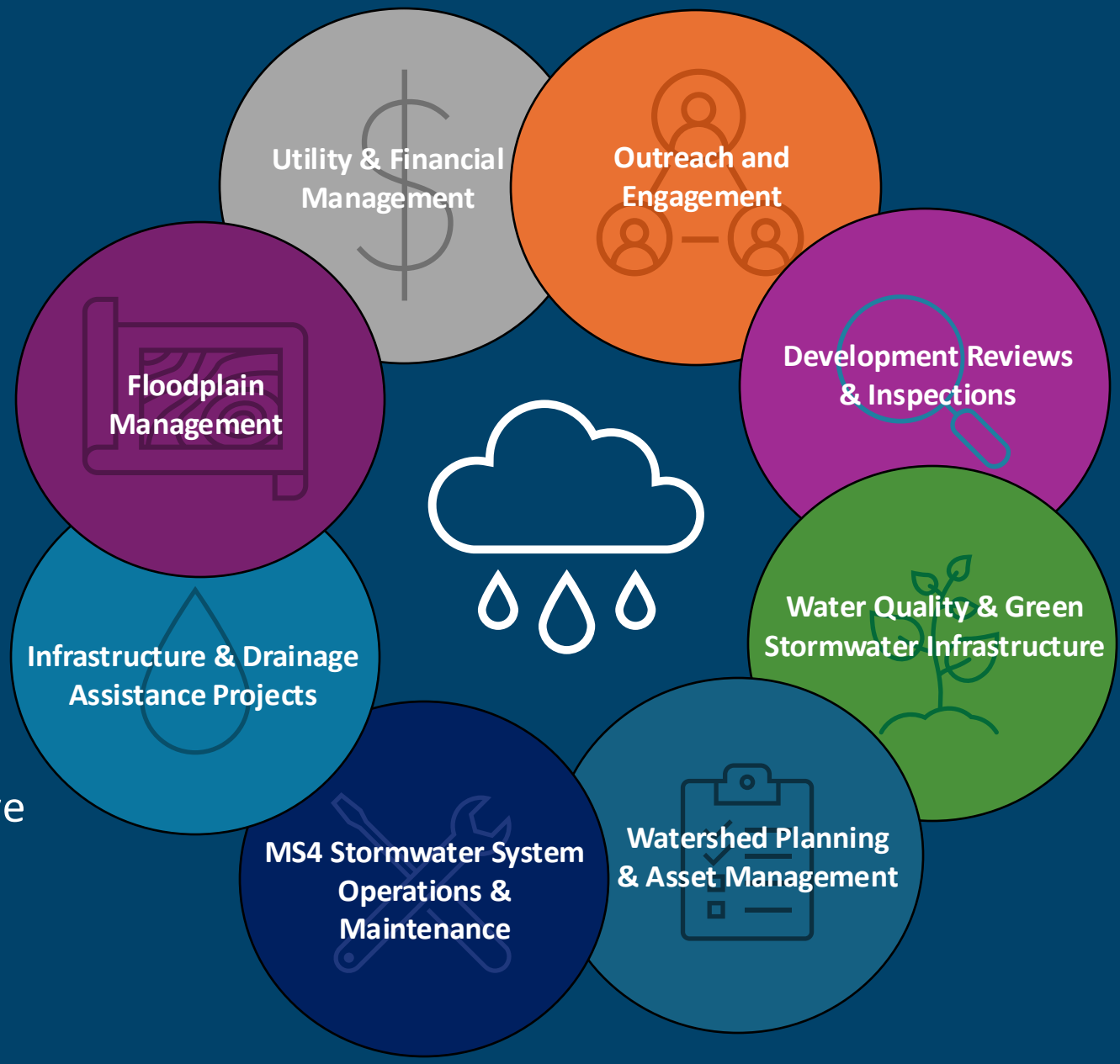
Mission Statement

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.

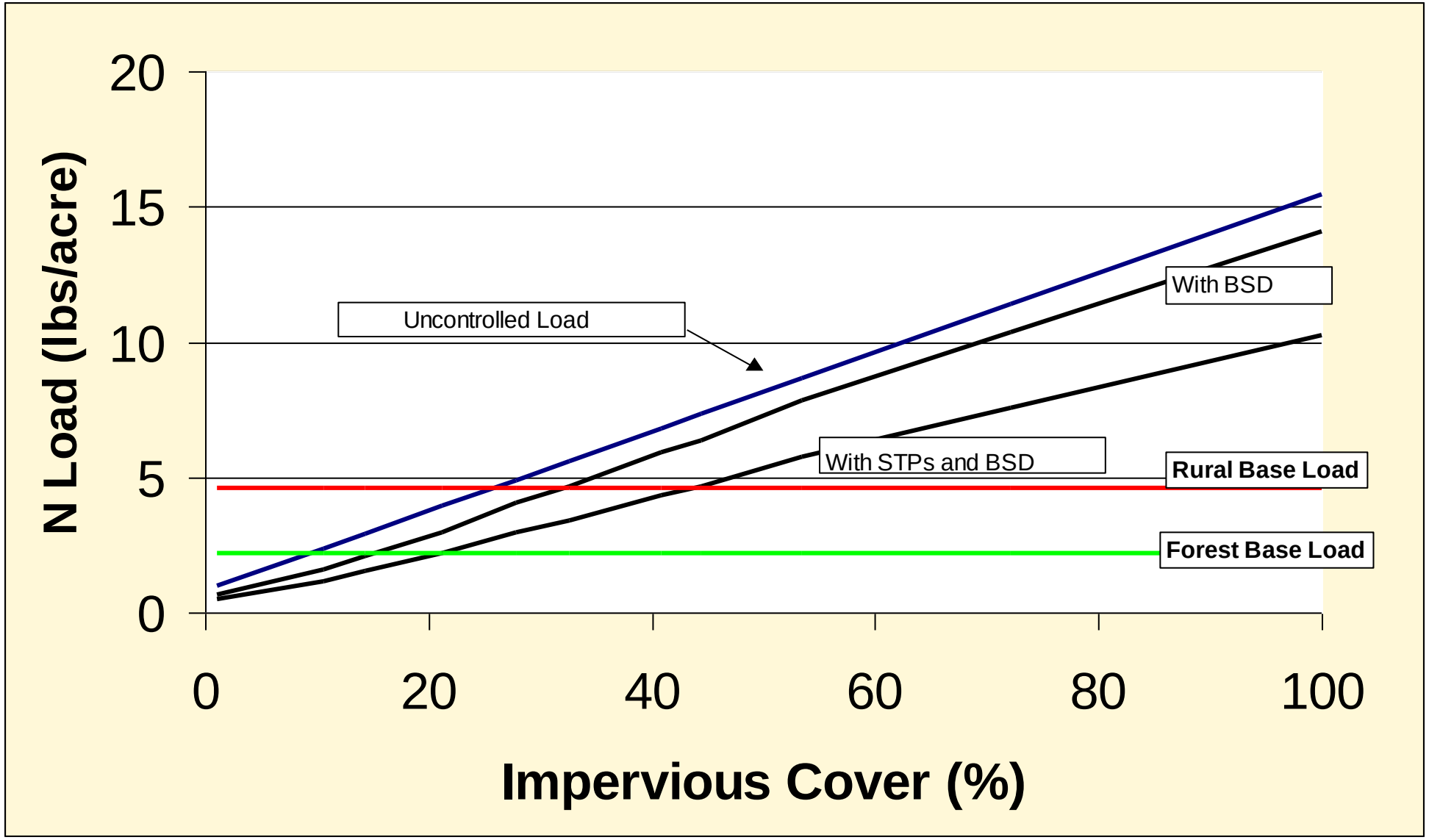
Be Stormwater Smart!



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?



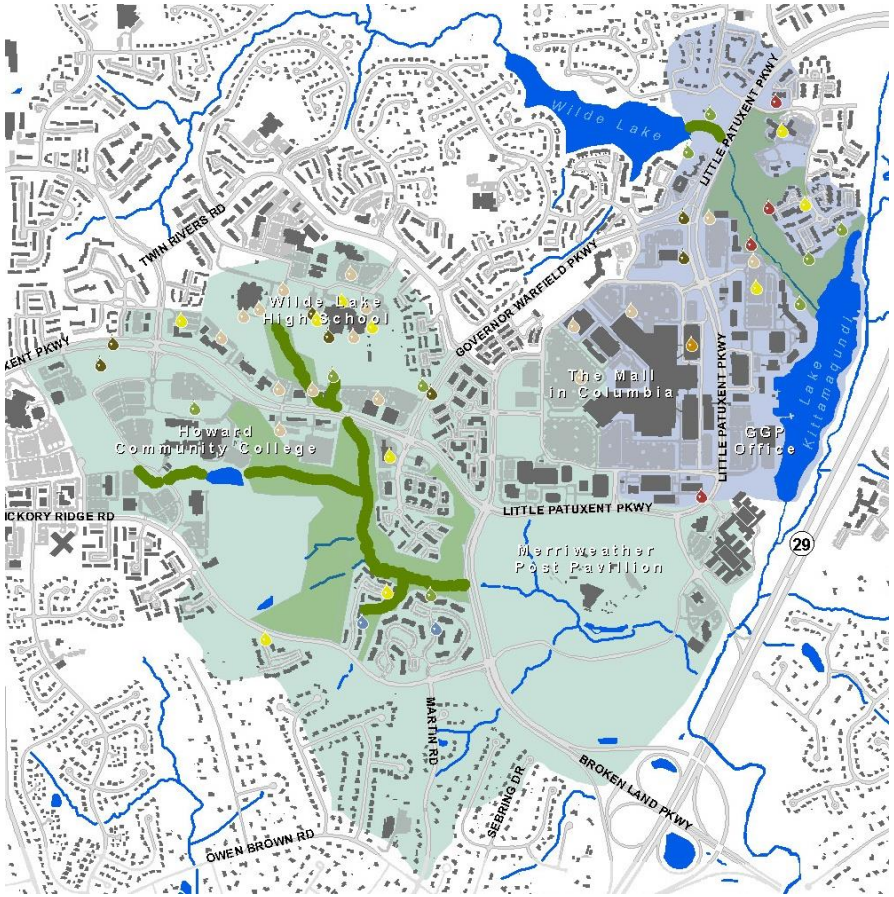
HERE'S HOW MS4S ARE SUCCEEDING

- 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
- Accomodates 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

MARISA
a NOAA Mid-Atlantic CAP team

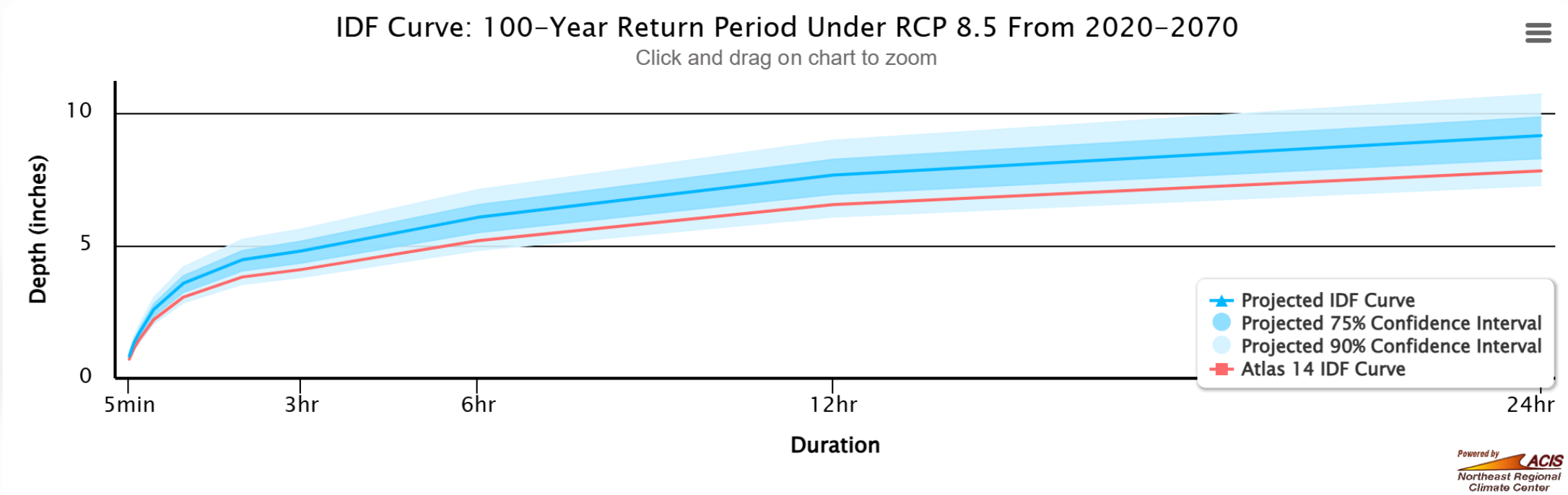
@MidAtlanticRISA

About · Climate Summaries · Data Tools · Publications and News

CHART TABLE COMPARISON

Toggle Confidence Intervals

DANVILLE 2 SE



MANAGEMENT PRACTICES

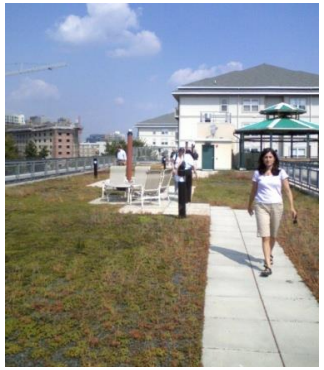
Center for Watershed Protection, late 1990s

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

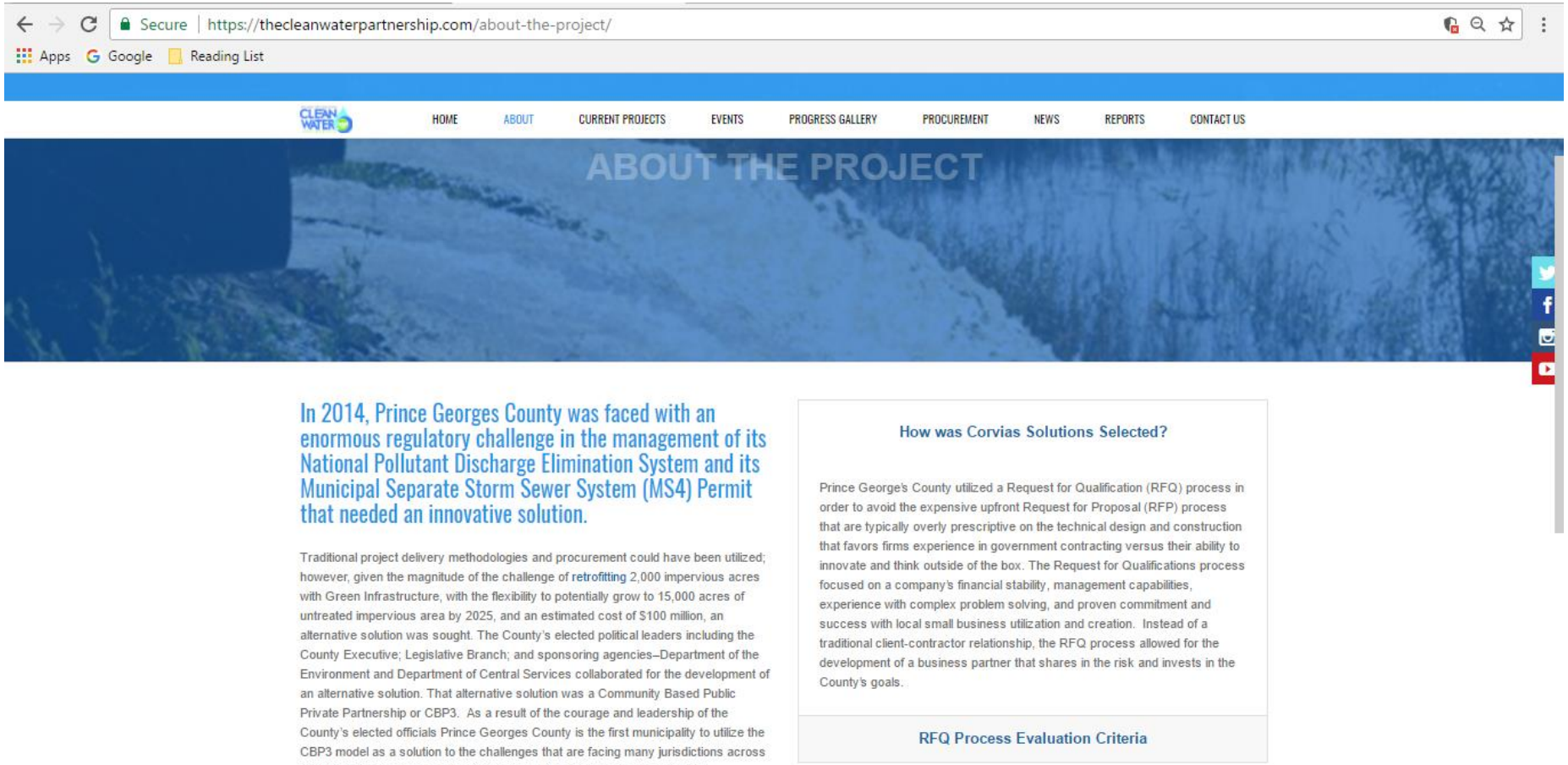
Floating Wetlands

MANAGEMENT PRACTICES

Mr. Trash Wheel

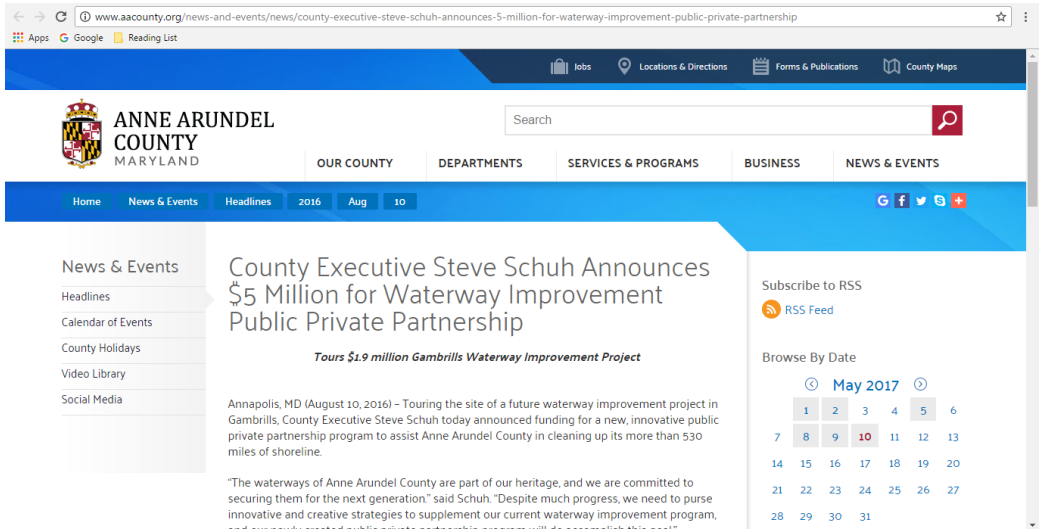
ALTERNATIVE DELIVERY

- Prince George's County: Public-Private Partnership



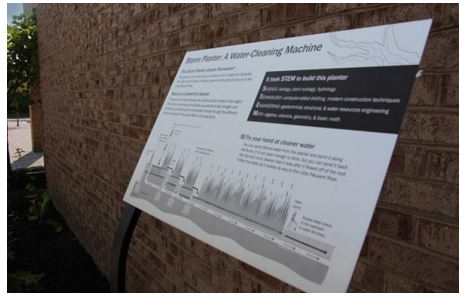
ALTERNATIVE DELIVERY

- Anne Arundel County: Pay for Performance



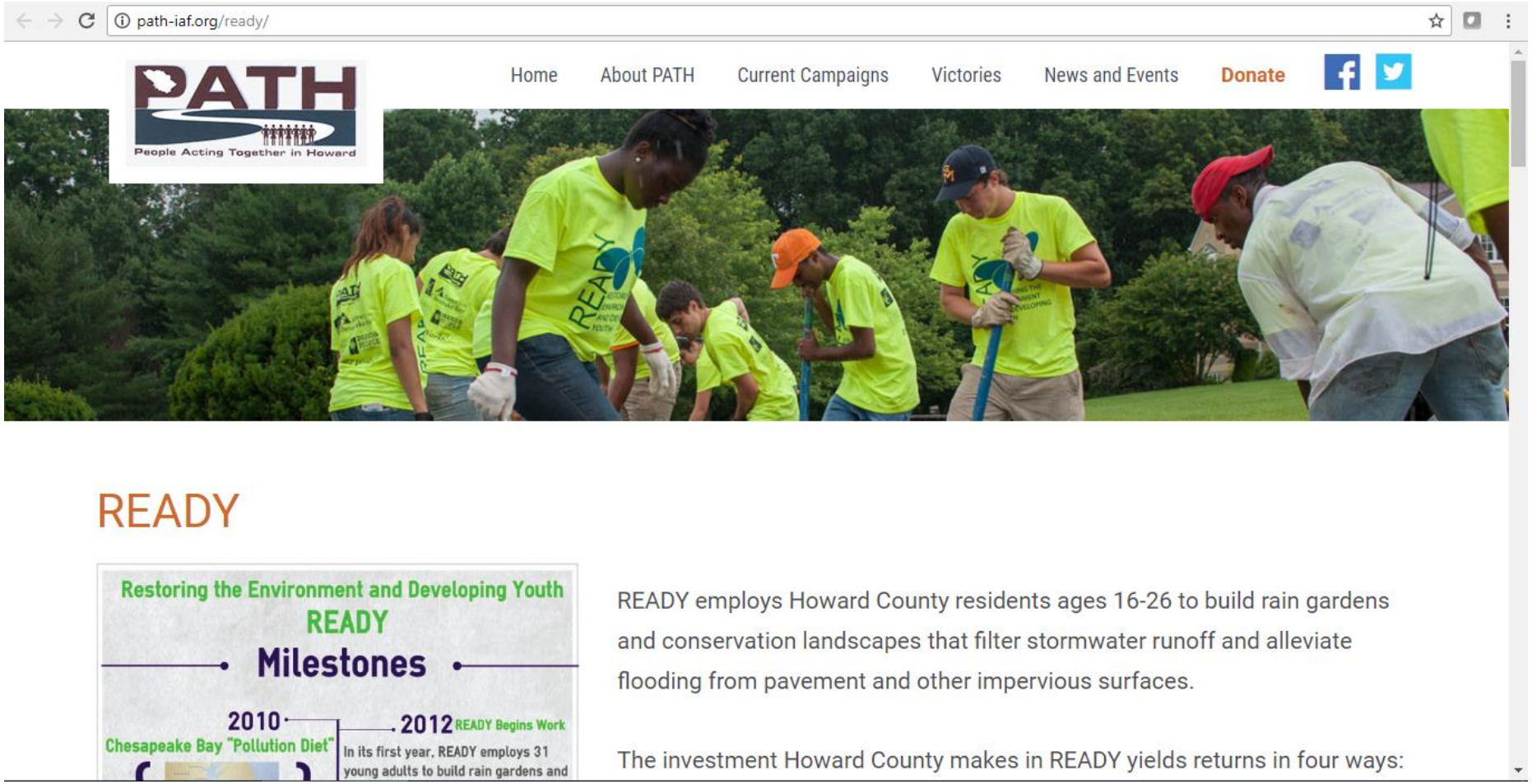
ALTERNATIVE DELIVERY

- Howard County: Design-Build



EXTERNAL PARTNERSHIPS

- Howard County + READY Program



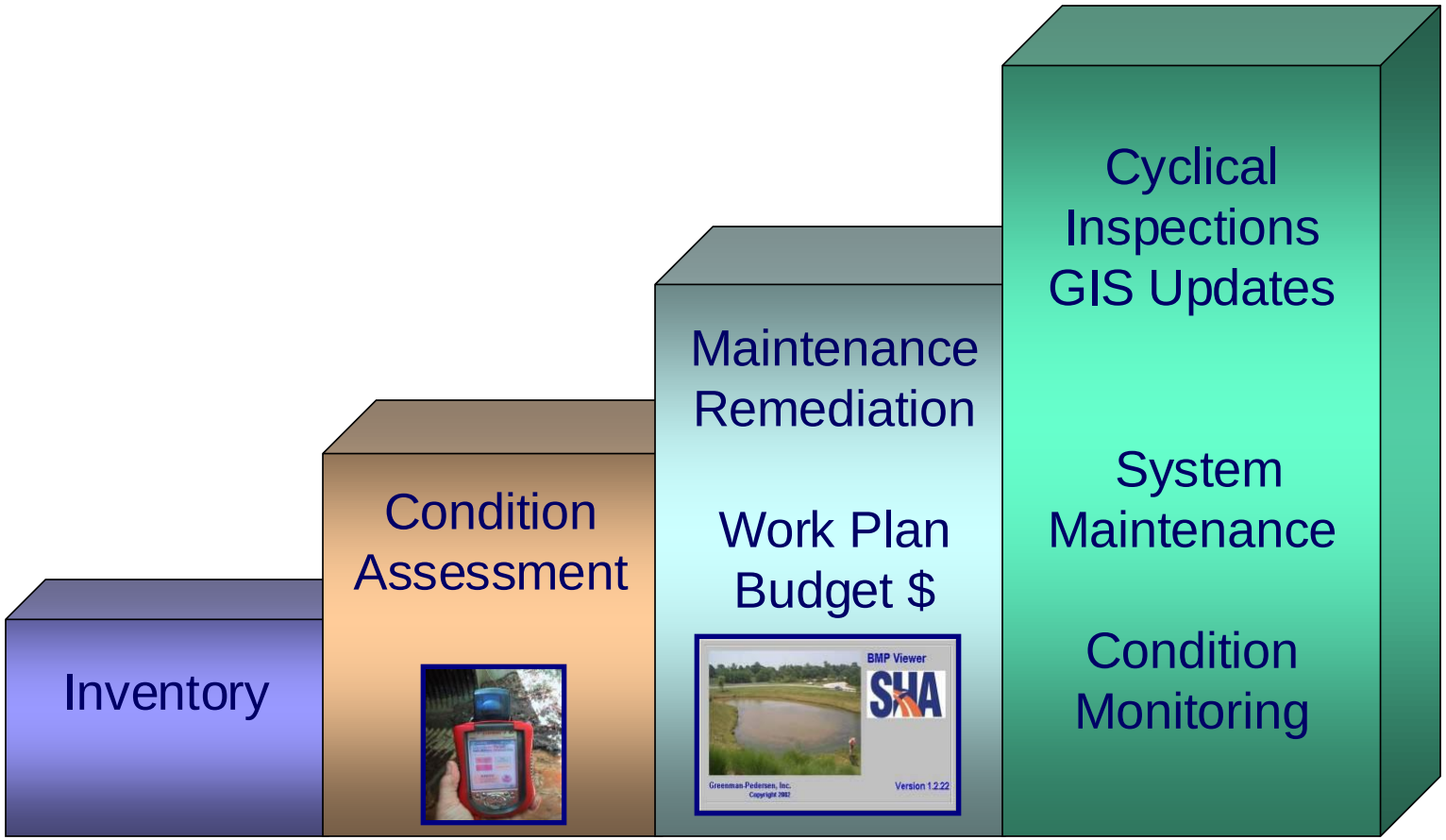
MONITORING AND ASSESSMENT

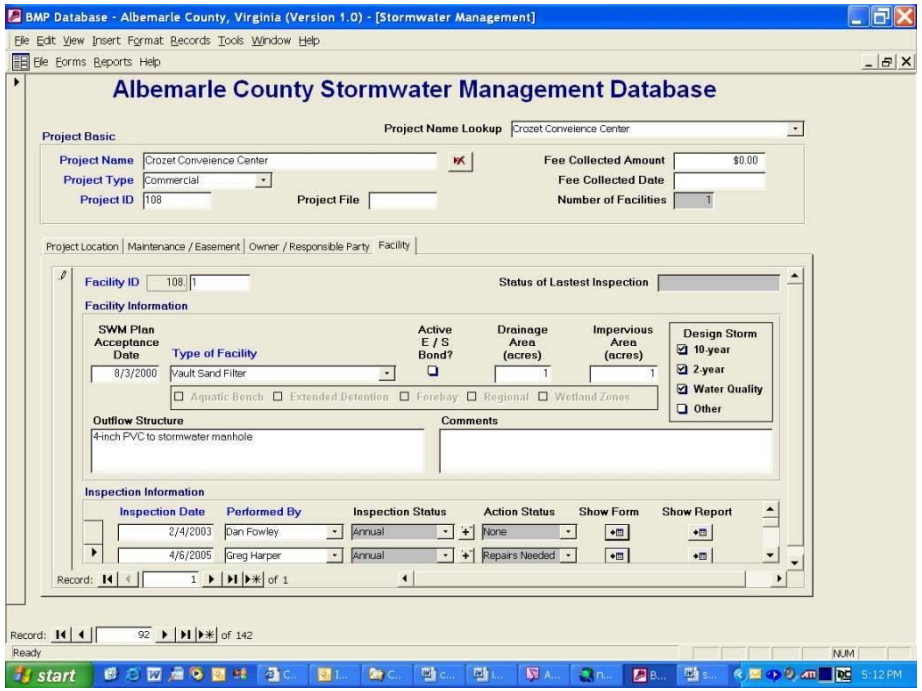
- **Aquatic**
  - Hydrologic Response
  - Water Quality
  - Biological Integrity
  - Geomorphic Structure
- **Riparian**
  - Buffer Zone Hydrology
  - Buffer Zone Water Quality
  - Vegetative Structure & Species Composition

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.
			Comparison Metric: Groundwater Levels
			Performance Goal: Groundwater levels at or above baseline levels during low flow periods of the year.
	Water Quality	Pre-development Conditions or Better	Comparison Metric: Groundwater Water Baseline Physical and Chemical
			Performance Goal: Water physical and chemical properties meet or improve from baseline/reference multi-seasonal data
			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
	Biological Integrity	Pre-development Conditions or Better	Comparison Metric: Baseline Macroinvertebrates
			Performance Goal: Macroinvertebrates IBIs meets or improved from baseline data or reference condition
			Comparison Metric: Baseline Fish
			Performance Goal: Fish IBIs meets or improved from baseline data or reference condition
	Geomorphic Stability	Maintains or Improves to Stable Channel 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

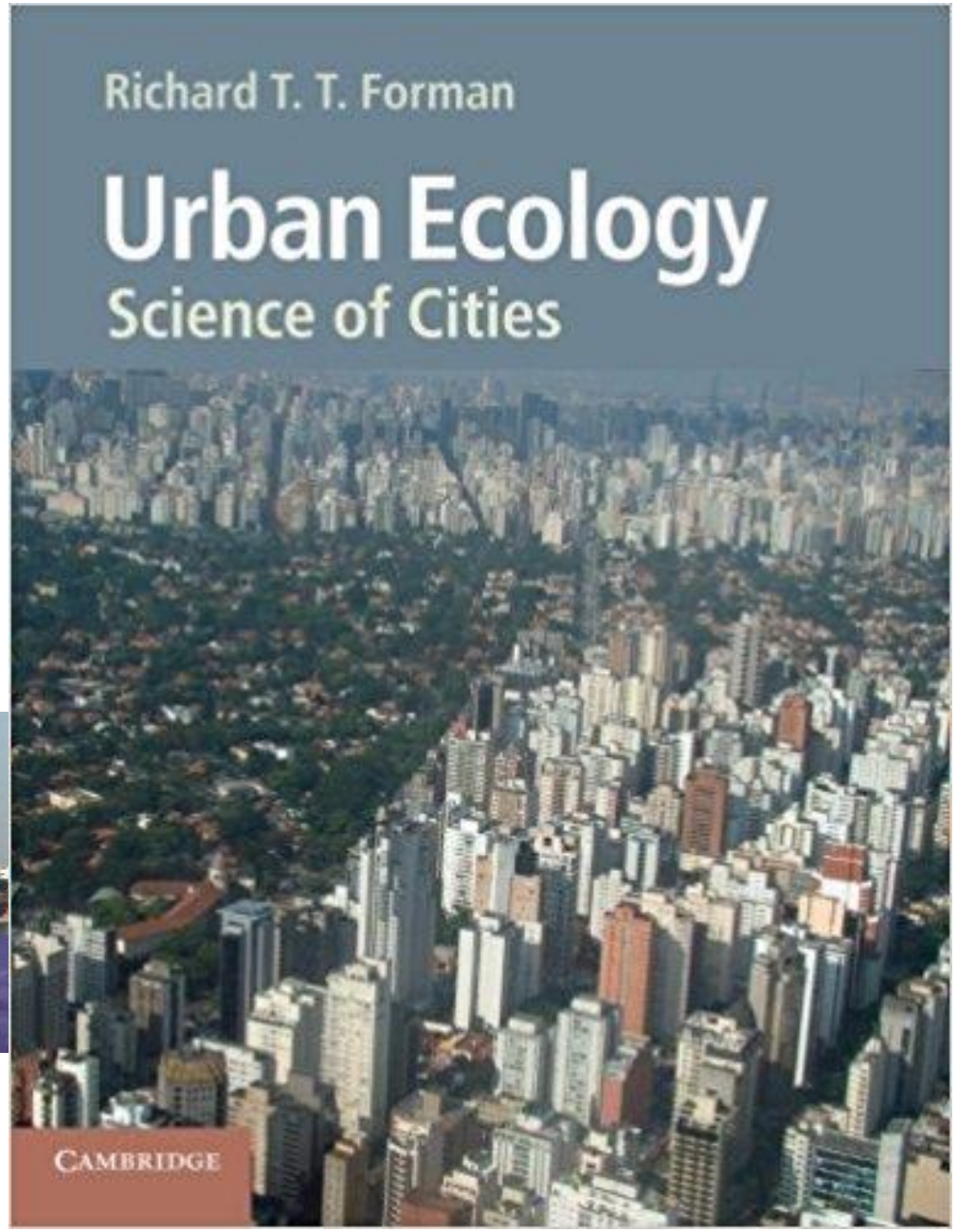
1. Selection of small or medium sized storms for monitoring will depend on site characteristics and should relate to sizing criteria set forth in the Maryland Stormwater Design Manual.

MAINTENCANCE AND FINANCING



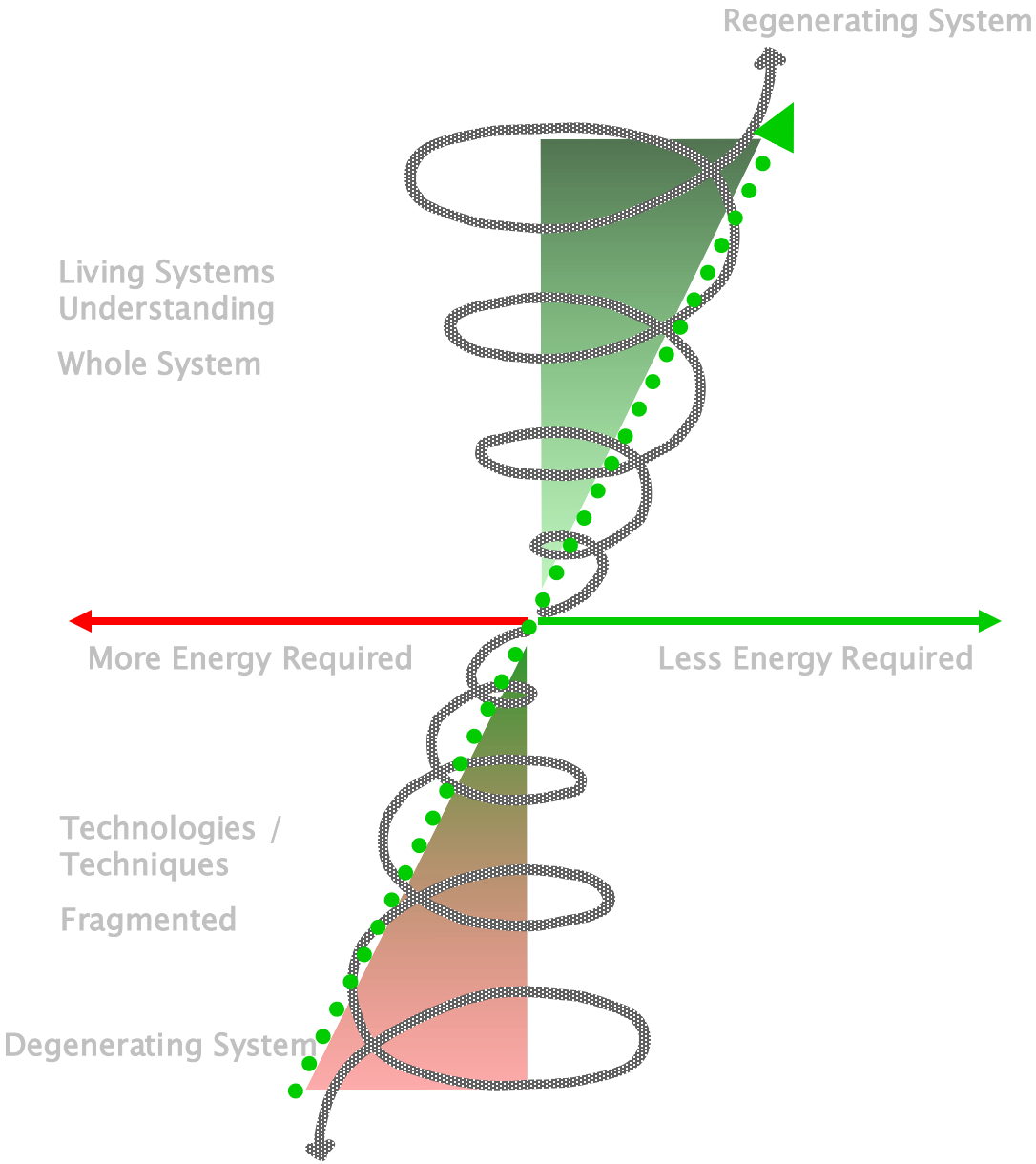


Urban ecology



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



Regenerative
Humans (Hominids)
PARTICIPATING AS nature –
Co-evolution of the Whole System

Restorative
Humans DOING THINGS TO nature – assisting the evolution of Sub-Systems

Sustainable
Neutral –
"100% less bad" (McDonough)

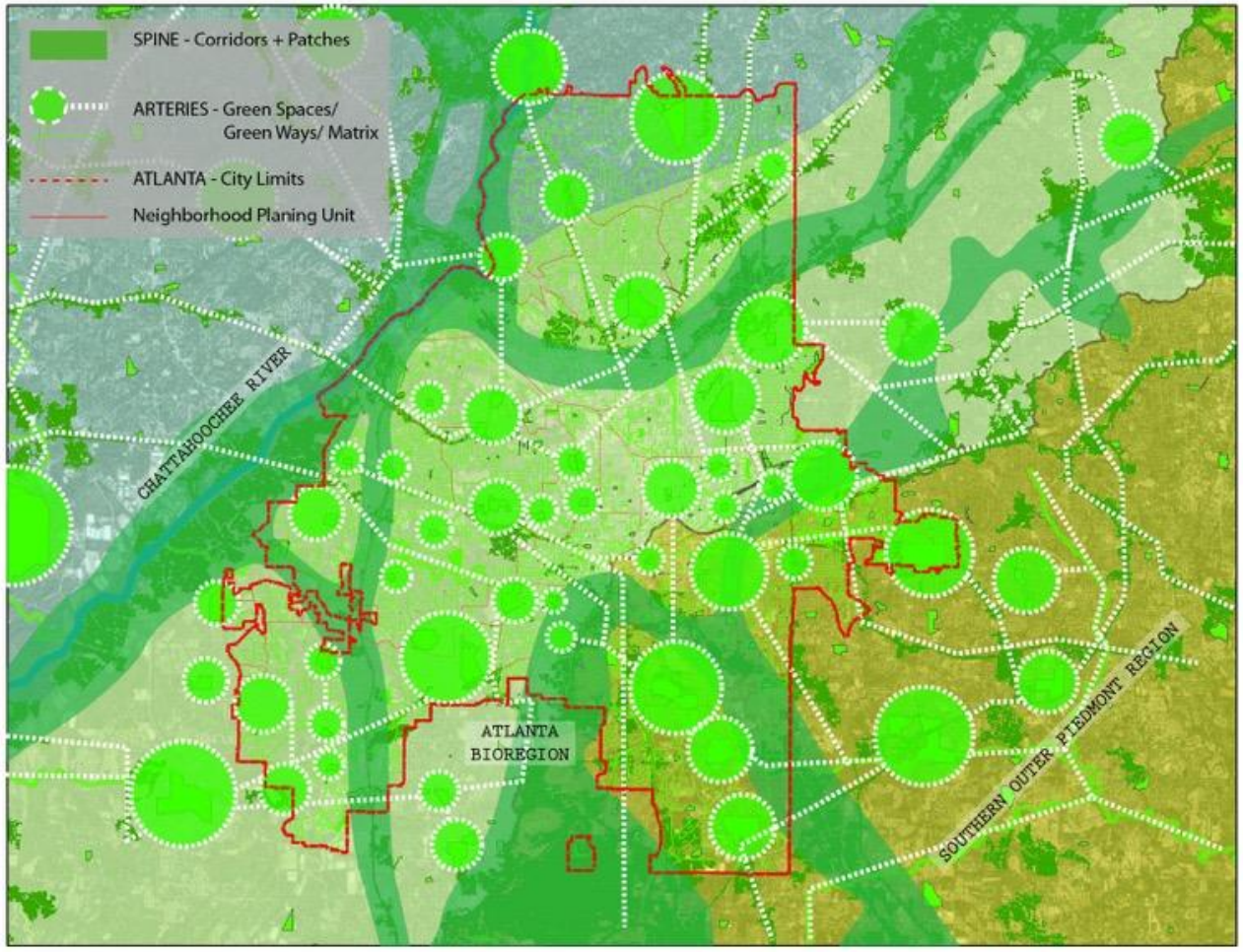
Green
Relative Improvement
(LEED, GB Tool, Green Globe, etc.)

Conventional Practice
"One step better than breaking the law" (Croxton)

Trajectory of Environmentally Responsible Design

Integrative Design Collaborative and Regenesis 2006 – Bill Reed, reed@integrativedesign.net

~~Green~~ Living Infrastructure

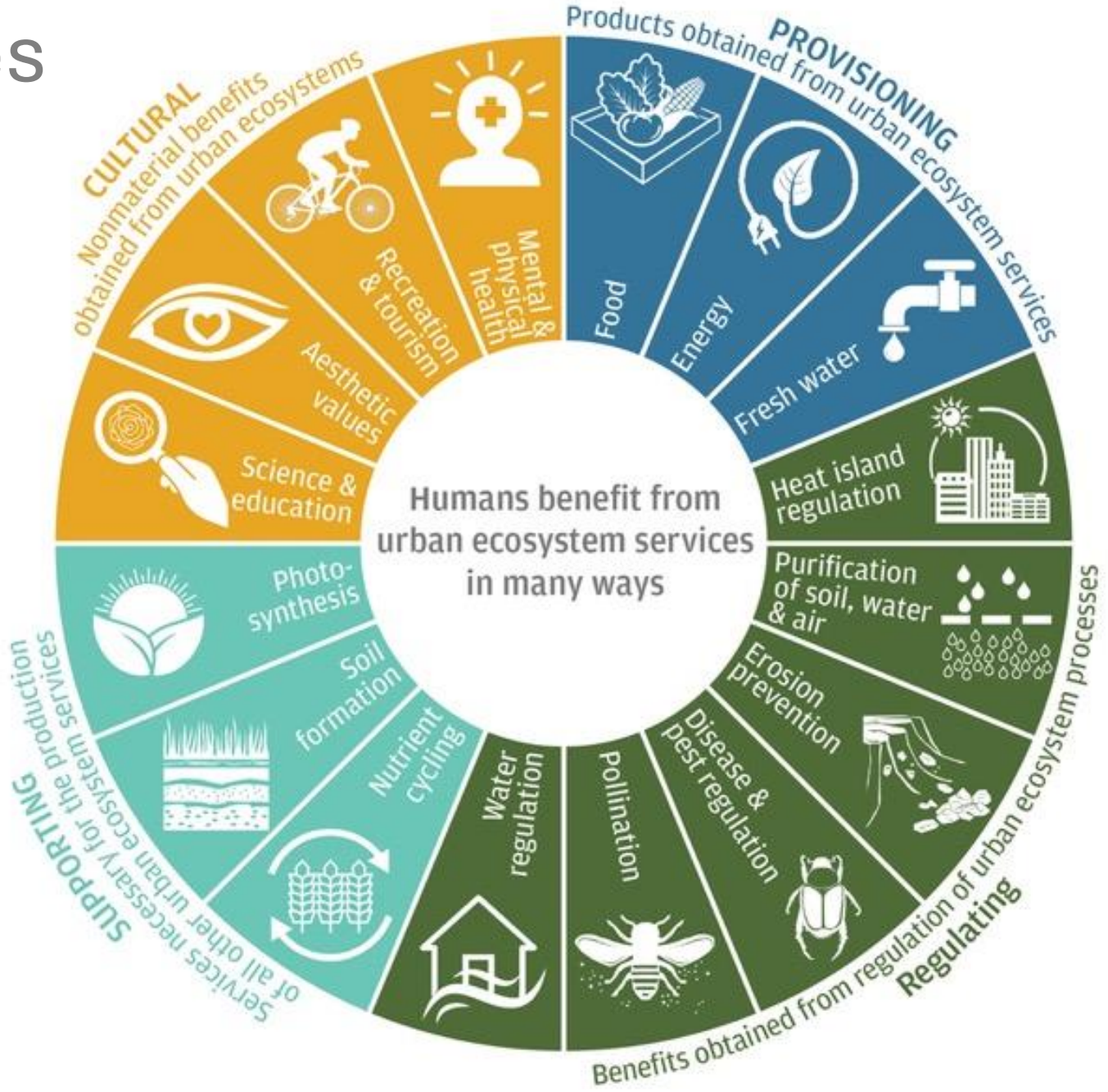


Strategically planned and managed networks of natural lands, working landscapes and other green spaces – at many scales – that conserve ecosystem functions, restore ecosystem processes and regenerate healthy, robust and resilient communities.

- 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.

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

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.

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

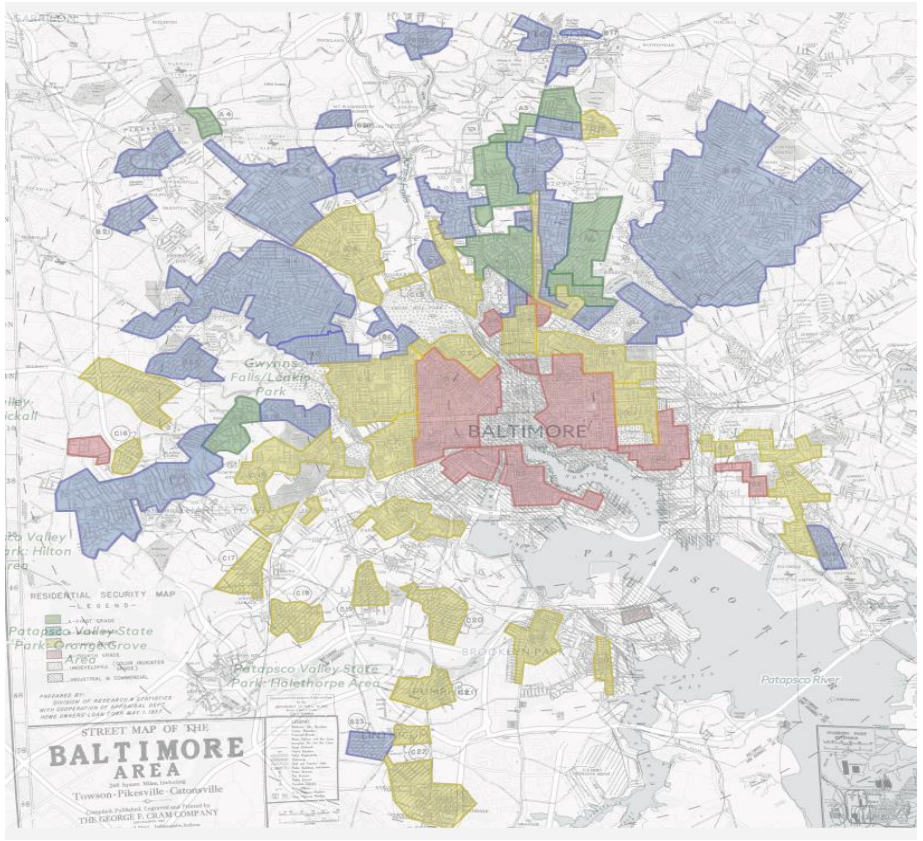
Enrich Habitats & Biodiversity
An increase in tree diversity benefits a host of insects, birds and mammals that rely on trees for food and protection. For example, they are an important source of nectar for bees.

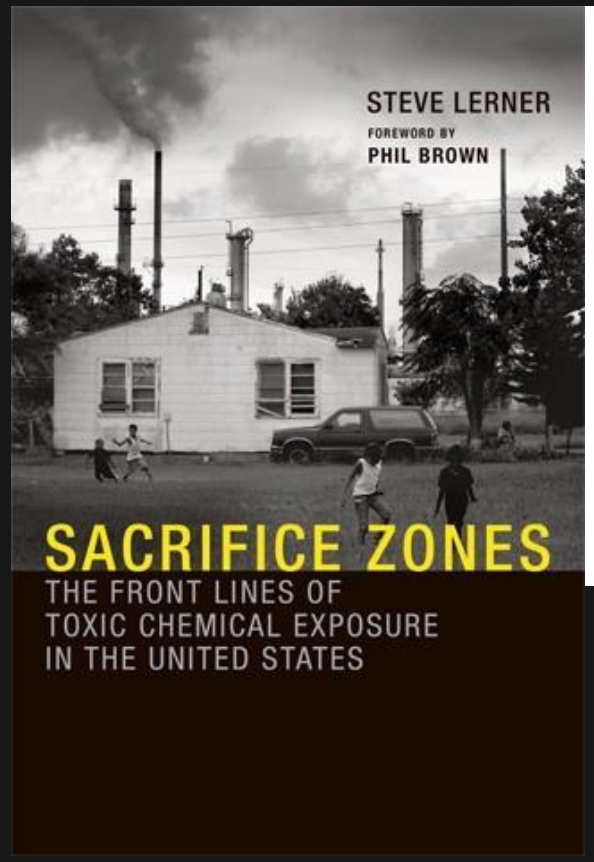
Reduce Flood Risk
Trees absorb water, lowering stress on storm water drains and mitigating flood risk. They also improve soil quality and prevent erosion, so more water is held in the ground.

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





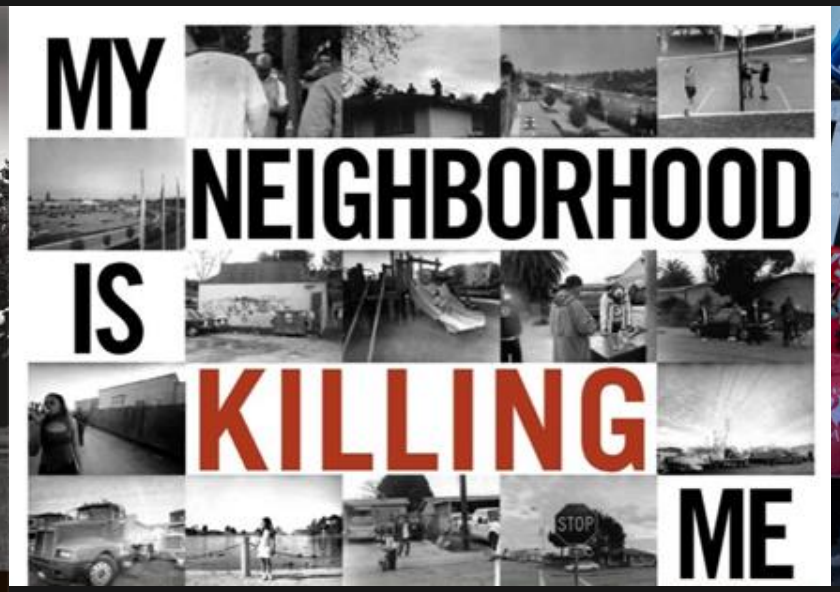


Image Source: Sojourners Magazine

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.”