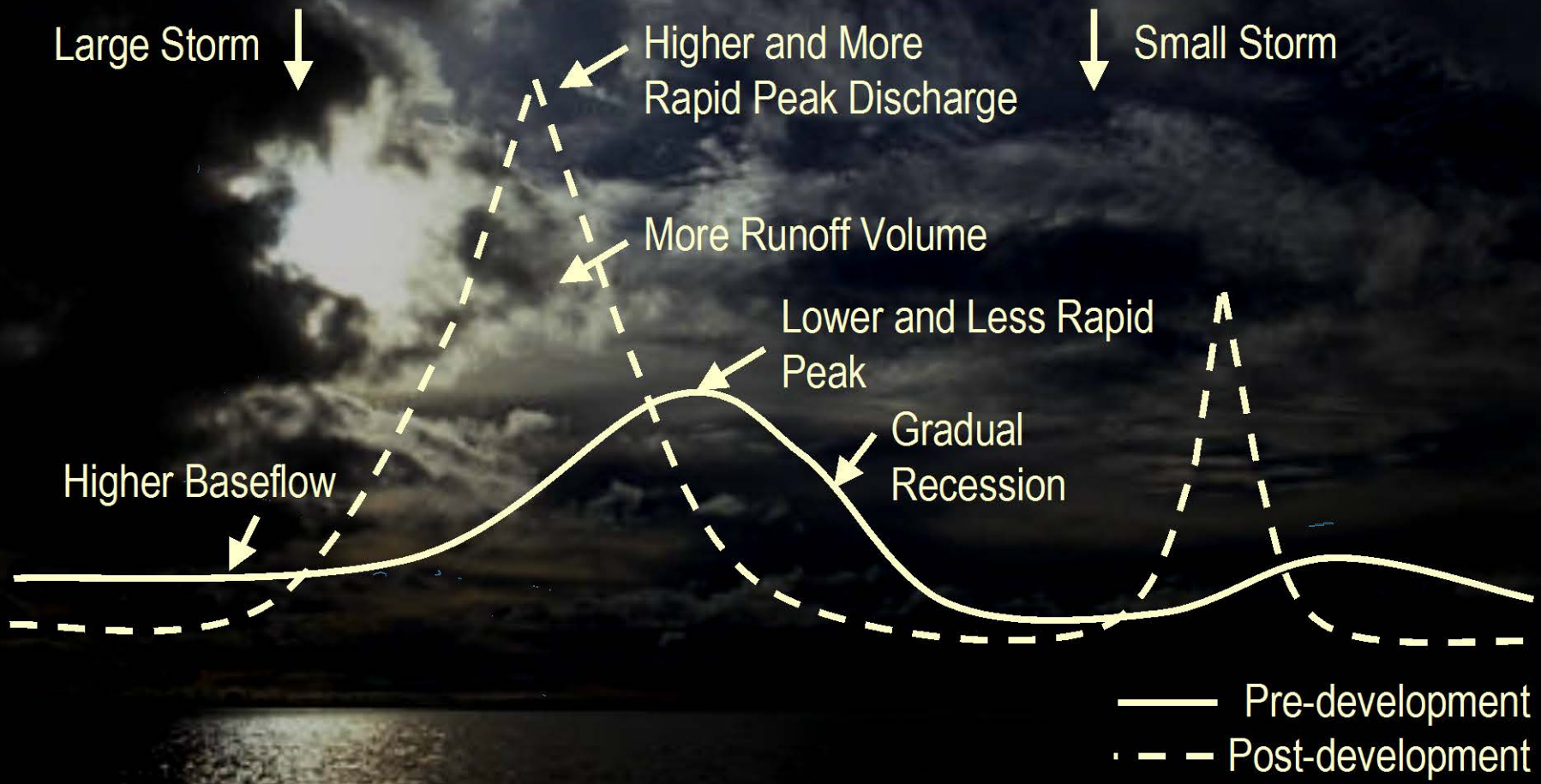




Green Infrastructure and Low Impact Development with 319 Funds

Nancy Arazan, EPA Office of Water

Consequences of Development to Urban Streams

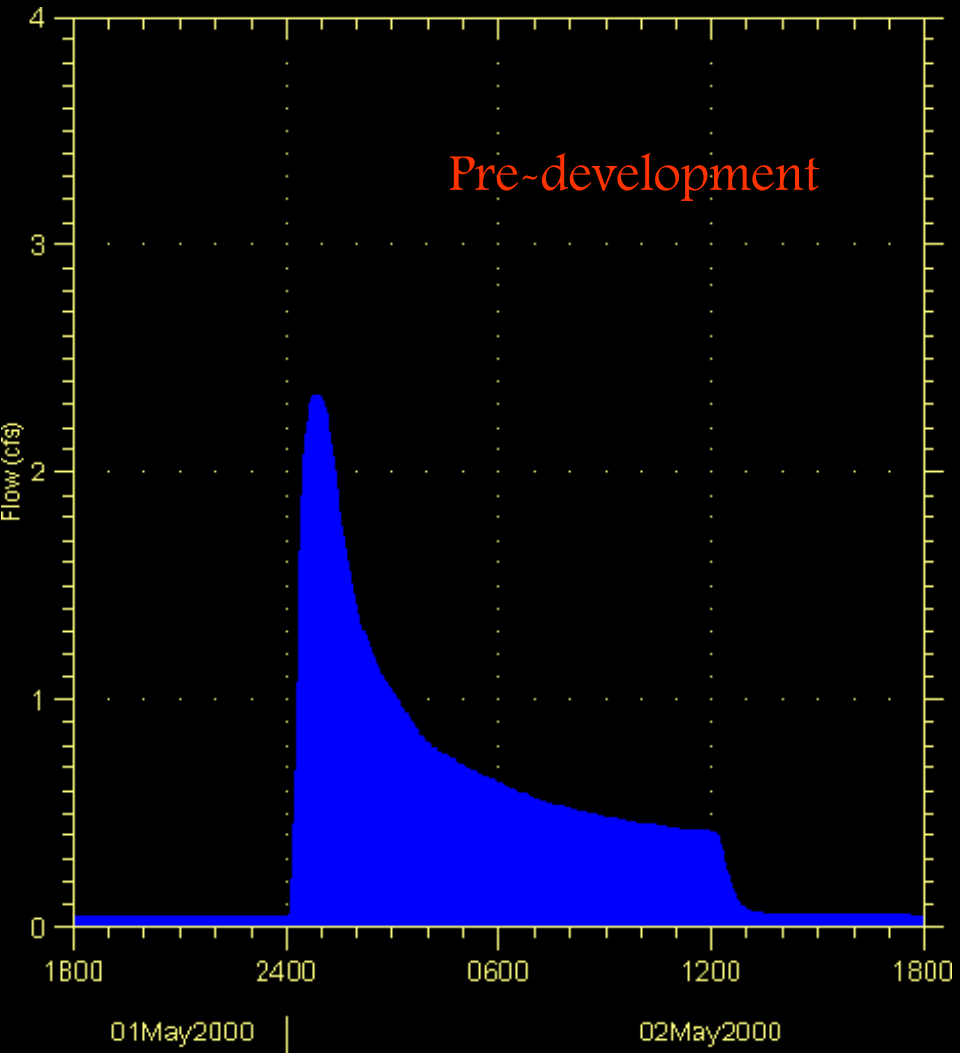


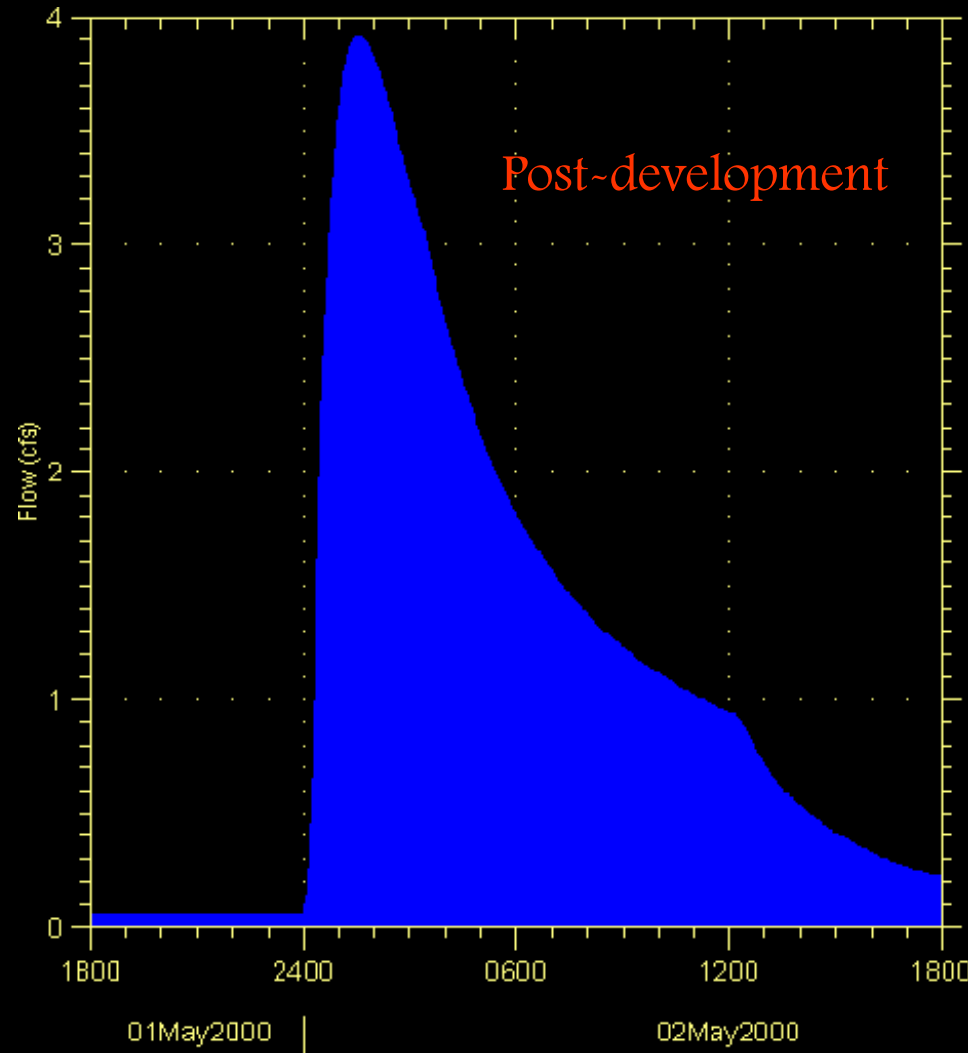
Blakeslee Creek, Michigan

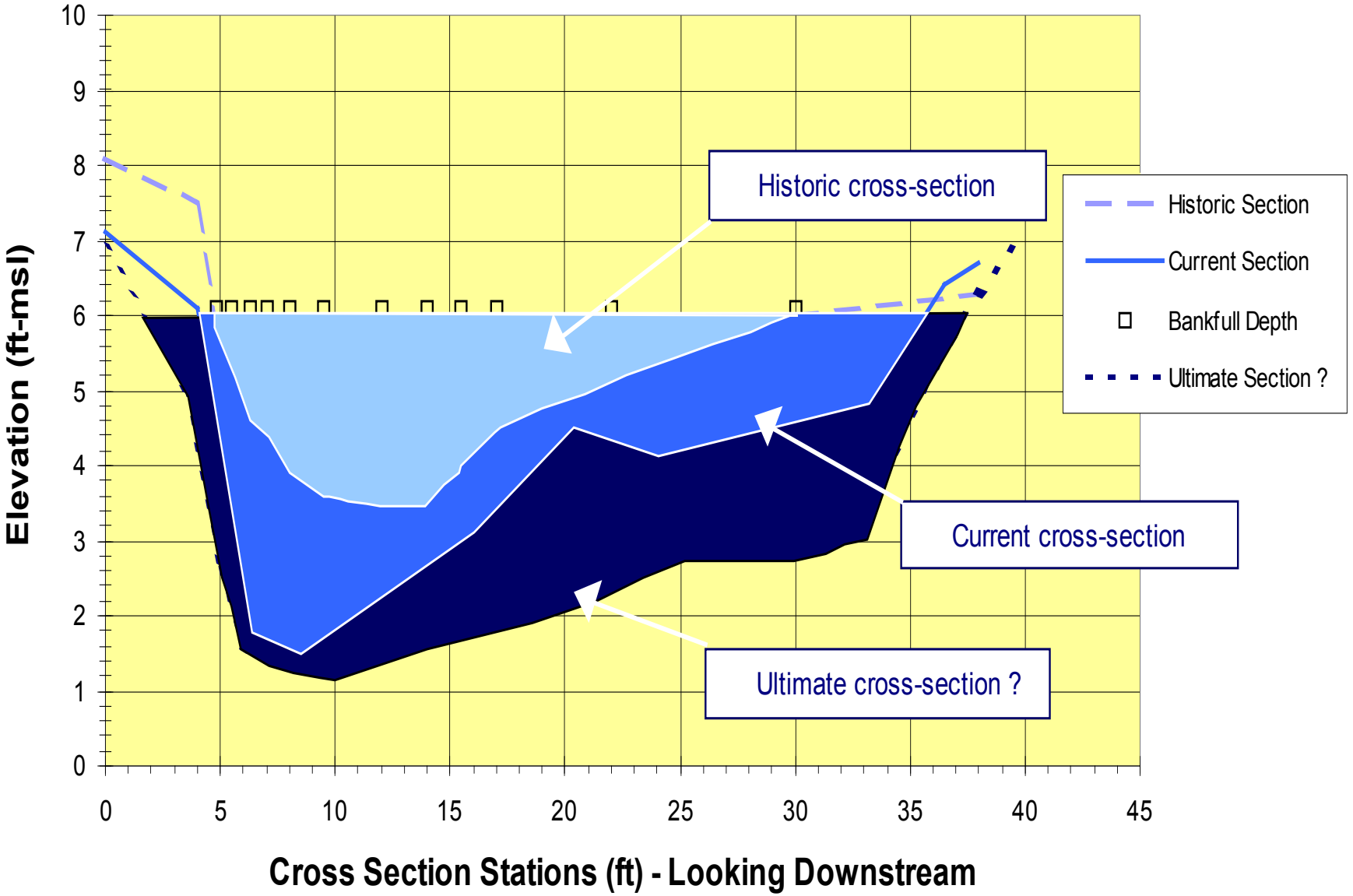
70% increase in peak flow.

170% increase in runoff volume.

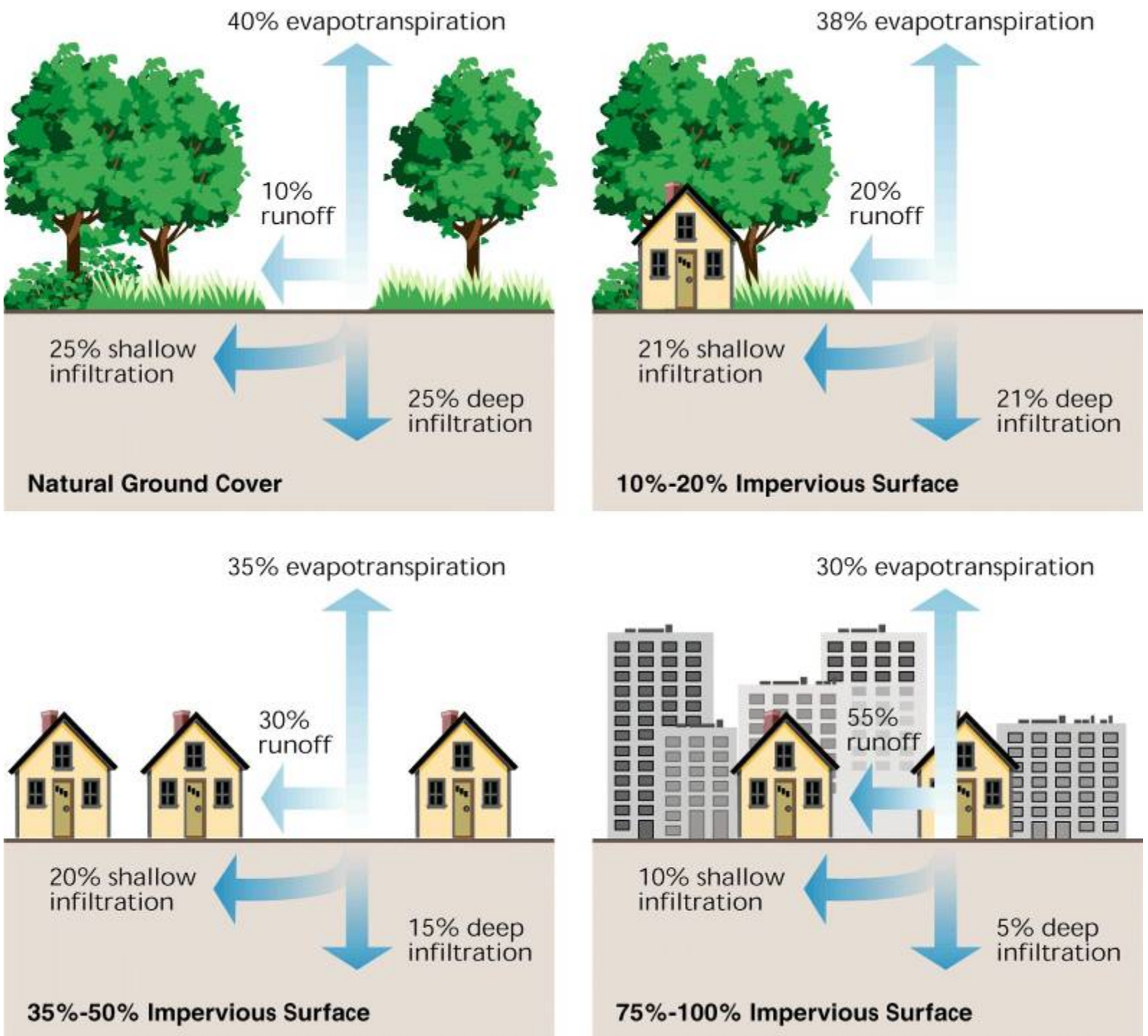
Former instantaneous peak flow now lasts ~4 hours.







Increased rates and volumes of storm water discharges lead to stream widening and down-cutting, or incision.


40% evapotranspiration
10% runoff
25% shallow infiltration
25% deep infiltration
Natural Ground Cover
38% evapotranspiration
20% runoff
21% shallow infiltration
21% deep infiltration
10%-20% Impervious Surface
35% evapotranspiration
30% runoff
20% shallow infiltration
15% deep infiltration
35%-50% Impervious Surface
30% evapotranspiration
55% runoff
10% shallow infiltration
5% deep infiltration
75%-100% Impervious Surface


What needs to change?

Paradigm Shift:
Rain is a Resource, Not a Waste

- Drinking water
- Ground water recharge
- Stream baseflow
- Trees & other plants
- Aesthetic qualities

Paradigm Shift:
Get away from the curb and gutter, big basin approach

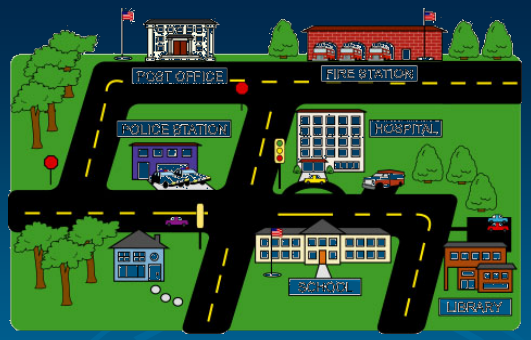
- Shift from the concept of moving stormwater as far away as quickly as possible in large, buried collection and conveyance systems.

- Shift towards the concept of managing stormwater the way mother nature would do it: where it falls; plants & soils.

Paradigm Shift:
Trifocal Approach to Stormwater Management

Region or Watershed

Neighborhood



Site

Approaches to Flow Management

- Good Site Design
- Good Neighborhood and Community Design
- Water Conservation & Reuse

Infiltration ~ Evapotranspiration ~ Capture & Use

Green Infrastructure and Low Impact Development (LID)

- Green infrastructure and LID uses vegetation and soils in urban and suburban areas to manage and treat precipitation naturally rather than collecting it in pipes.
- It preserves natural systems and uses engineered systems such as green roofs, rain gardens, and vegetated swales to mimic natural functions.
- Green infrastructure and LID includes approaches that capture and re-use stormwater.

Green Infrastructure Practices

- Amended soils
- Impervious cover removal
- Bioretention
- Permeable pavements
- Green roofs
- Cisterns & rain barrels
- Trees & expanded tree boxes
- Reforestation & restoration
- Redevelopment
- Infill development
- Alternative parking & street designs
- Water Conservation

Green Infrastructure and LID Benefits

- Cleaner water
- Stable hydrology/baseflow maintenance
- Reduced flooding
- Climate change mitigation and adaptation
- Cleaner air
- Reduced urban temperatures
- Jobs creation
- Water supply
- Energy savings
- Cost savings
- Habitat protection
- Community benefits (recreation, public health, crime prevention)

Low Impact Development Works Everywhere

- LID can be applied to new development, redevelopment, or as retrofits to existing development.
- LID has been adapted to a range of land uses from high density ultra-urban settings to low density development.

Bioinfiltration

Open Swales

Parking Lot Island Infiltration Areas

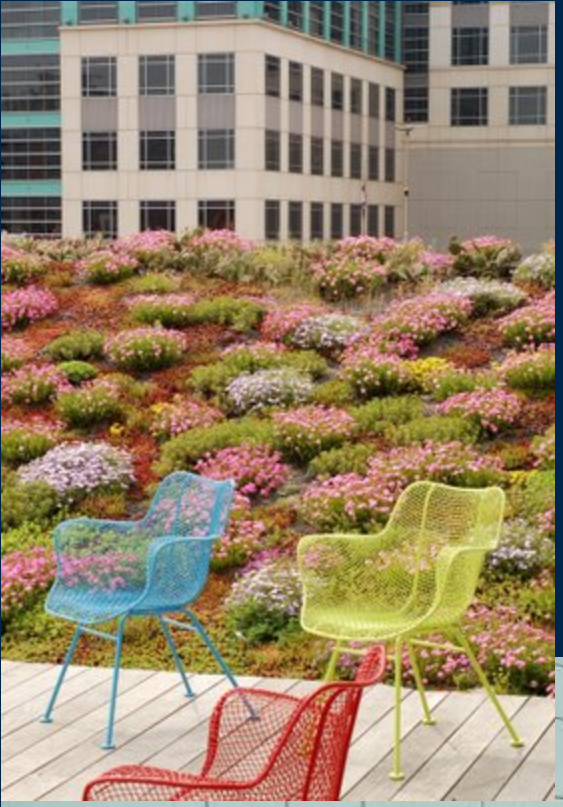
Rain Gardens

Planters

Permeable Pavements


Porous
Asphalt
Standard
Asphalt

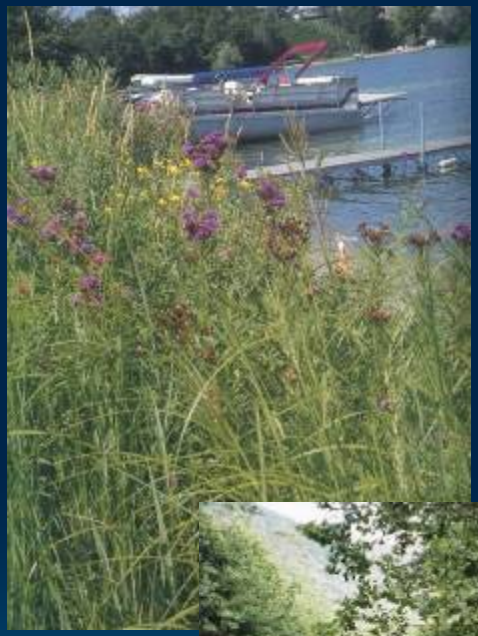
Green Roofs



Green Walls

Pocket Wetlands

Vegetated Buffers & Native Landscaping



Rainwater Harvesting & Use

Tree & Canopy Programs

- Trees intercept, and evapotranspire significant amounts of water
- Trees filter pollutants
- Canopies shade and cool paved surfaces

Water Conservation

- High efficiency fixtures and appliances (low-flow toilets, urinals, showerheads, faucets)
- Water recycling and reuse of wastewater from sinks, kitchens, tubs, washing machines, and dishwaters for landscaping, flushing toilets, etc.
- Waterless technologies (composting toilets, waterless urinals)
- Rain harvesting (rain barrels, cisterns)

National Research Council 2008 Stormwater Study Findings

- Even though "pollutant" is defined broadly in the Act to include virtually every imaginable substance added to surface waters, including heat, it has not traditionally been read to include water volume.
- A more straightforward way to regulate stormwater contributions to waterbody impairment would be to use flow or a surrogate, like impervious cover, as a measure of stormwater loading …. Flow from individual stormwater sources is easier to monitor, model, and even approximate as compared to calculating the loadings of individual contaminants in stormwater effluent. Efforts to reduce stormwater flow will automatically achieve reductions in pollutant loading. Moreover, flow is itself responsible for additional erosion and sedimentation that adversely impacts surface water quality.

Study Findings

- SCMs that harvest, infiltrate, and evapotranspirate stormwater are critical to reducing the volume and pollutant loading of small storms.
- "It should be noted that there are important, although indirect, water quality benefits of all runoff-volume-reduction SCMs—

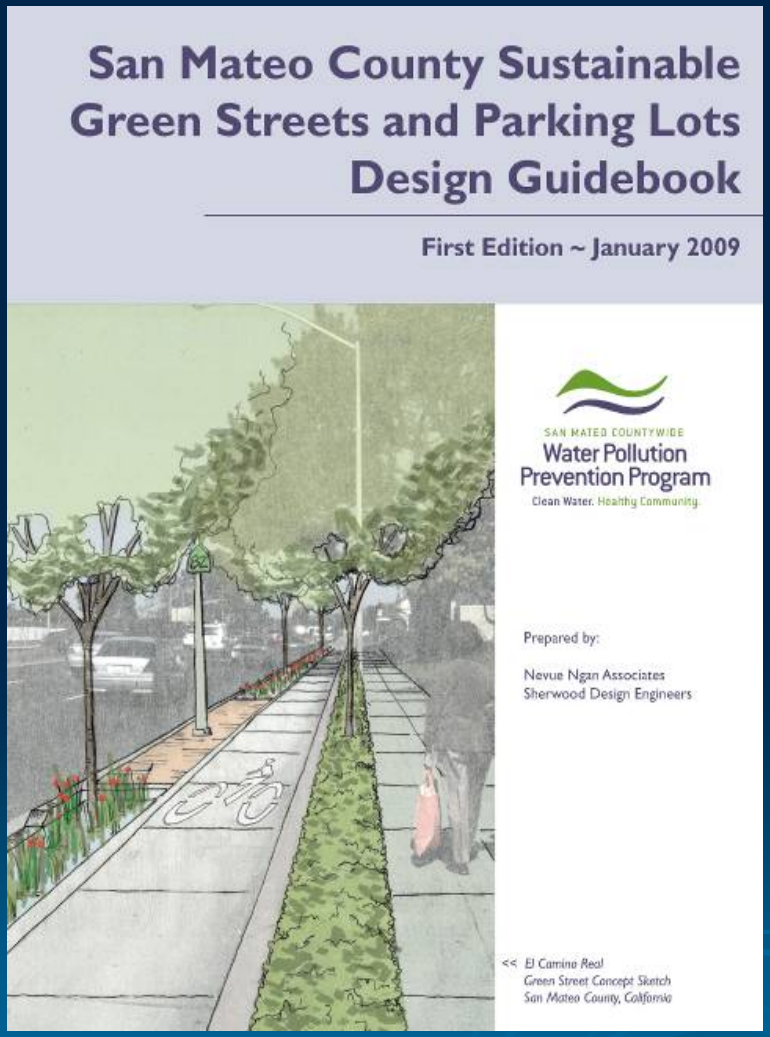
  (1) the reduction in runoff will reduce streambank erosion downstream and the concomitant increases in sediment load, and

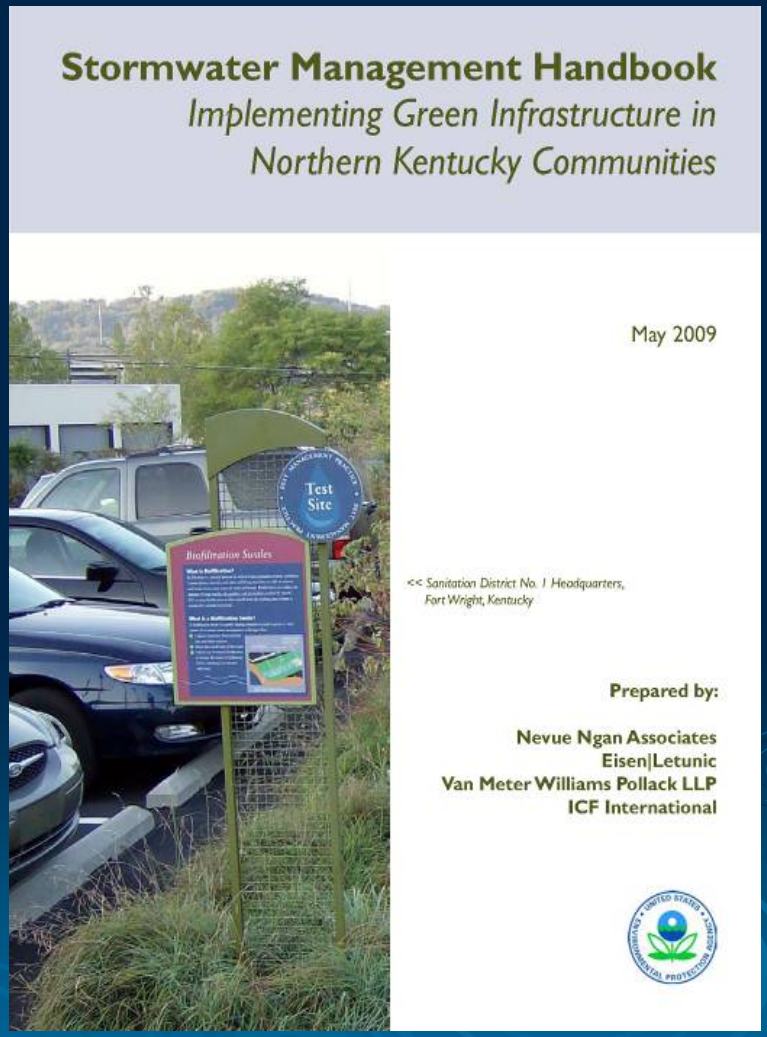
  (2) volume reductions lead to pollutant load reductions, even if pollutant concentrations in stormwater are not decreased.

National Example 95th Percentile Storms

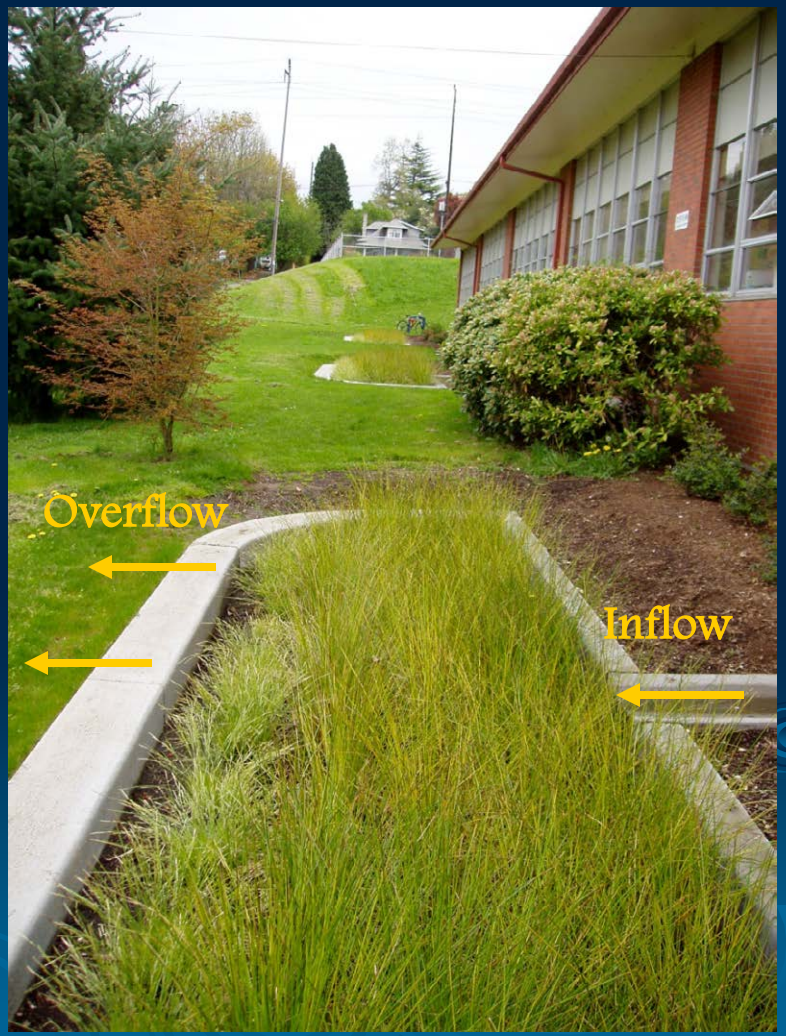
City	95th Percentile Event Rainfall Total (in)	City	95th Percentile Event Rainfall Total (in)
Atlanta, GA	1.8	Kansas City, MO	1.7
Baltimore, MD	1.6	Knoxville, TN	1.5
Boston, MA	1.5	Louisville, KY	1.5
Buffalo, NY	1.1	Minneapolis, MN	1.4
Burlington, VT	1.1	New York, NY	1.7
Charleston, WV	1.2	Salt Lake City, UT	0.8
Coeur D'Alene, ID	0.7	Phoenix, AZ	1.0
Cincinnati, OH	1.5	Portland, OR	1.0
Columbus, OH	1.3	Seattle, WA	1.6
Concord, NH	1.3	Washington, DC	1.5
Denver, CO	1.1		

Design Guidebooks



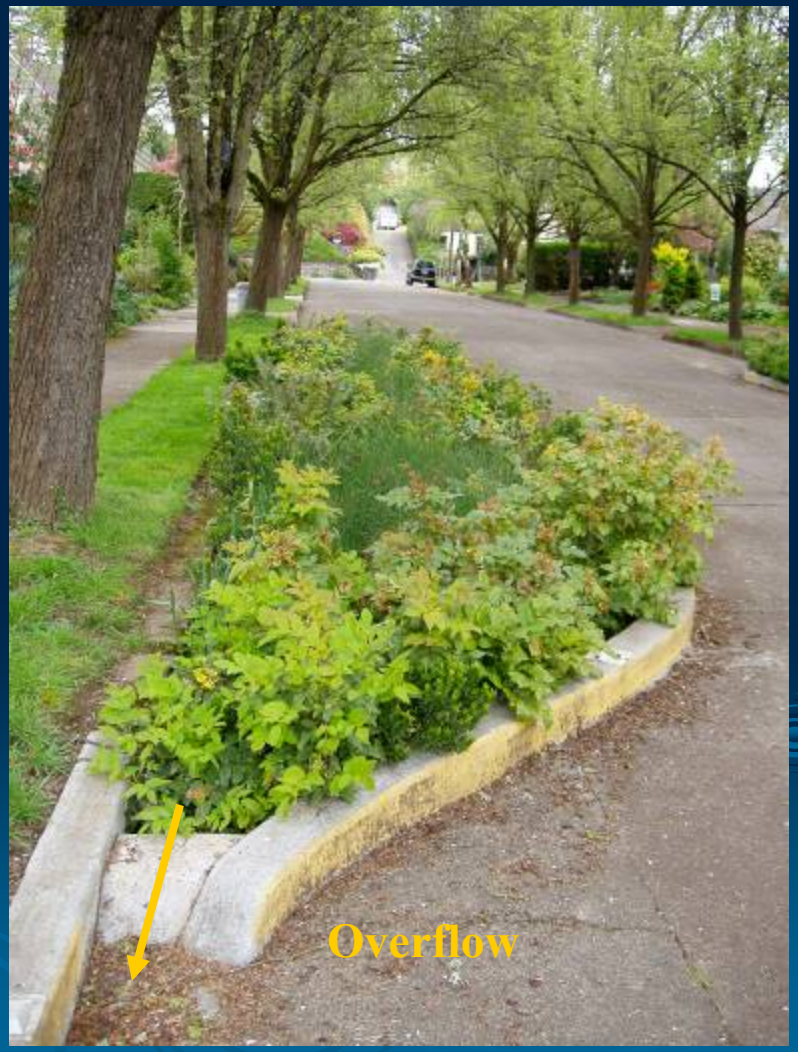


Designs to Maximize Retention



Designs to Maximize Retention

Designs to Maximize Retention



Designs to Maximize Retention

Green Streets Guide

- Describes green approaches for:
  - Residential Streets
  - Commercial Streets
  - Arterial Streets
  - Alleys
- Includes concept designs
- Discusses functions and applications

EPA GREEN RESERVE

The American Recovery and Reinvestment Act (ARRA), Green Reserve of 2009, through the State Revolving Fund, provides funding for a wide variety of qualifying projects in the categories of: *green infrastructure, energy efficiency, water efficiency, and other innovative projects.* For more information on ARRA, to find out if your current or future planned project meets the necessary criteria, and how to apply, visit www.Recovery.gov.

A CONCEPTUAL GUIDE TO EFFECTIVE GREEN STREETS DESIGN SOLUTIONS

Green Streets

Residential Streets
Commercial Streets
Arterial Streets
Alleys

Green Street designs provide better environmental performance while creating attractive, safer environments.

A Green Street is a street that uses natural processes to manage stormwater runoff at its source.

Streets comprise a significant percentage of publicly owned land in most communities, and thus offer a unique opportunity to manage for environmental outcomes. A Green Street uses a natural systems approach to reduce stormwater flow, improve water quality, reduce urban heating, enhance pedestrian safety, reduce carbon footprints, and beautify neighborhoods.

Through various combinations of plants and soils, these objectives—and several others—can be met on different types of streets in many settings. Green Street features include vegetated curb extensions, sidewalk planters, landscaped medians, vegetated swales, permeable paving, and street trees. This guide provides an overview of different strategies that can be employed in transportation rights-of-way at the local or neighborhood scale.

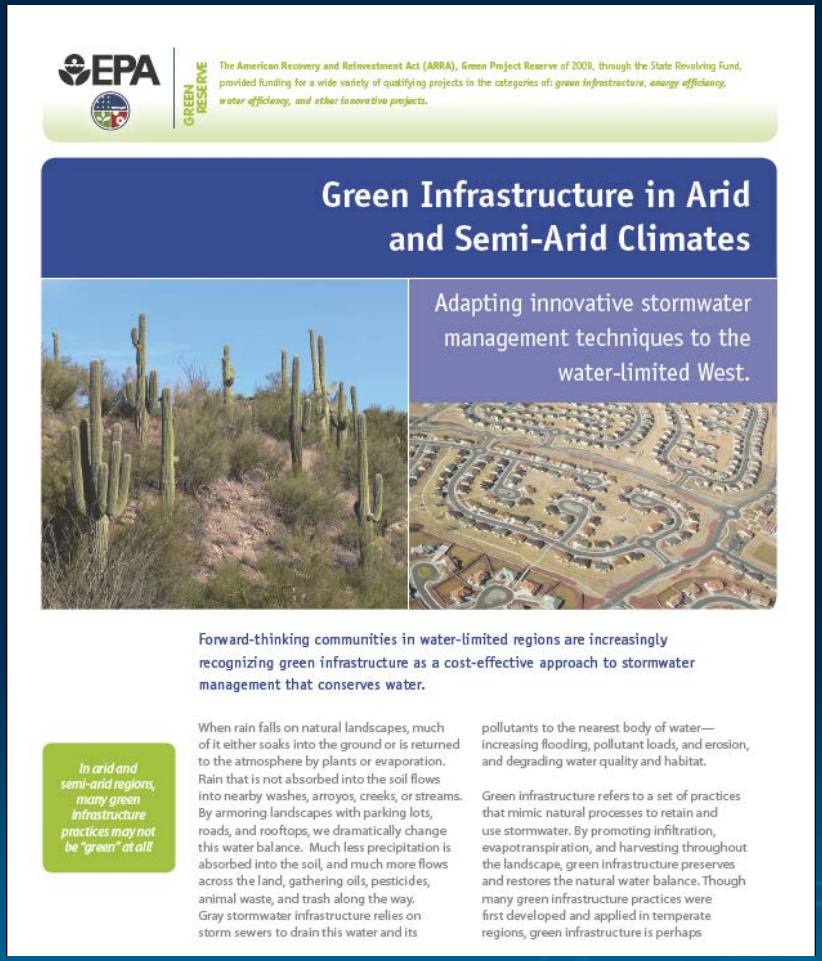
Green Streets | 1

Water Quality Scorecard

- Communities can evaluate local policies
- Can set goals or objectives for making modifications to local plans, codes or ordinances
- Provides information and suggestions on how plans, codes or ordinances may be improved

October 2009

Green Infrastructure in Arid and Semi Arid Climates



EPA

GREEN RESERVE

The American Recovery and Reinvestment Act (ARRA), Green Project Reserve of 2009, through the State Revolving Fund, provided funding for a wide variety of qualifying projects in the categories of: *green infrastructure, energy efficiency, water efficiency, and other innovative projects.*

Green Infrastructure in Arid and Semi-Arid Climates

Adapting innovative stormwater management techniques to the water-limited West.

Forward-thinking communities in water-limited regions are increasingly recognizing green infrastructure as a cost-effective approach to stormwater management that conserves water.

In arid and semi-arid regions, many green infrastructure practices may not be "green" at all!

When rain falls on natural landscapes, much of it either soaks into the ground or is returned to the atmosphere by plants or evaporation. Rain that is not absorbed into the soil flows into nearby washes, arroyos, creeks, or streams. By armoring landscapes with parking lots, roads, and rooftops, we dramatically change this water balance. Much less precipitation is absorbed into the soil, and much more flows across the land, gathering oils, pesticides, animal waste, and trash along the way. Gray stormwater infrastructure relies on storm sewers to drain this water and its pollutants to the nearest body of water—increasing flooding, pollutant loads, and erosion, and degrading water quality and habitat.

Green infrastructure refers to a set of practices that mimic natural processes to retain and use stormwater. By promoting infiltration, evapotranspiration, and harvesting throughout the landscape, green infrastructure preserves and restores the natural water balance. Though many green infrastructure practices were first developed and applied in temperate regions, green infrastructure is perhaps

This guide discusses the drivers, applications, and design of green infrastructure in arid and semi-arid regions.

Look for local resources on Green Infrastructure and LID

- Watershed Management Group based in Tucson, AZ
- Has numerous trainings offered in Tucson and Phoenix
- Watershedmg.org

AridLID 2012 Conference

- Green Infrastructure and Low Impact Development in Arid Environments
- March 27-29, 2012 Tucson, Arizona
- AridLID.org

Municipal Handbook

The Municipal Handbook is a series of guidance documents to help local officials implement green infrastructure in their communities. Modules include:

- Rainwater Harvesting Policies
- Green Streets
- Funding Options
- Retrofit Policies
- Municipal Incentives

Case Studies

Shakopee Mdewakanton Sioux Community Projects

- CWA Section 319 Competitive Grant Award has supported:
  - 15,000 square feet of pervious asphalt at tribal community center parking lot (reconstruction)
  - 3,900 square feet of bioretention areas located upstream of receiving wetlands
- Demonstrate to casino management that project is aesthetically pleasing and provides water quality benefits

Big Eagle's Water Quality Improvement Project

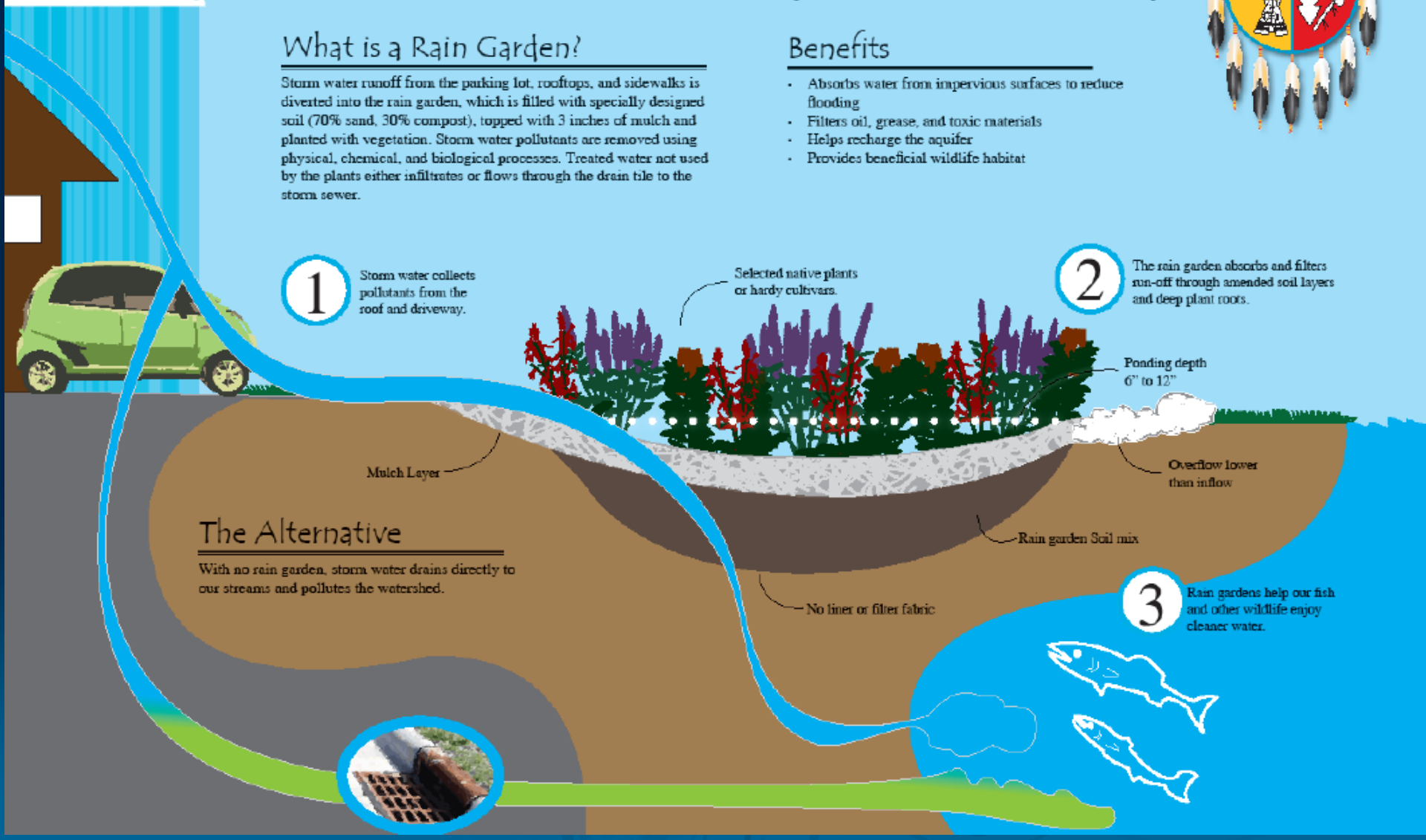
Shakopee Mdewakanton Sioux Community

What is a Rain Garden?

Storm water runoff from the parking lot, rooftops, and sidewalks is diverted into the rain garden, which is filled with specially designed soil (70% sand, 30% compost), topped with 3 inches of mulch and planted with vegetation. Storm water pollutants are removed using physical, chemical, and biological processes. Treated water not used by the plants either infiltrates or flows through the drain tile to the storm sewer.

Benefits

- Absorbs water from impervious surfaces to reduce flooding
- Filters oil, grease, and toxic materials
- Helps recharge the aquifer
- Provides beneficial wildlife habitat



The Alternative

With no rain garden, storm water drains directly to our streams and pollutes the watershed.

- Bioretention areas in high visibility locations

- Goal: to improve runoff water quality

- Other projects include:
  - Vegetated roof on ice arena
  - Vegetated roof on wastewater treatment facility
  - Recycled pavers and bioretention areas at sport and fitness arena
  - Bioretention areas at community center parking lot
- Site tours and other outreach engages the tribal community and visitors
- More information at http://www.smscland.org/lowimpact.html





www.epa.gov/greeninfrastructure

www.epa.gov/nps/lid