Green Infrastructure Webcast Series

The Many Benefits of Green Infrastructure
Philadelphia Municipal Case Study

Guide to Our Webcasts

For Technical Support click the "*Help*" button

- *To Ask a Question* - Type your question in the text box located in the lower left-hand corner of your screen and click on the "Submit Question" button
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- *To See Closed Captioning* – Turn your pop-up blocker off and click on the "closed captioning" button
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- *To Obtain a Certificate* – Watch 1 hour and 30 minutes of the webcast and then click "Download Certificate." If you are in a room with multiple attendees please wait until the last slide to obtain the URL to customize your own certificates

Green Infrastructure Webcast Series

Tuesday, March 24, 2009
- **Revising Local Plans, Codes & Ordinances.**
- **Water Harvesting**

Tuesday, April 28, 2009
- **Models & Calculators**
- **Municipal Case Study: Louisville**

Tuesday, May 12, 2009
- **Site Planning & Design Considerations**
- **Costs and WERF Cost Tool**

Tuesday, June 23, 2009
- **Funding & Incentives**
- **Brownfield Redevelopment**

Tuesday, July 28, 2009
- **Retrofits: Green Streets**
- **Operation & Maintenance**

Green Infrastructure Website
www.epa.gov/greeninfrastructure

- General Information
- Key Resources
- Case Studies
- Performance Data
- Partnership Contacts
- Statement of Support

Planning as if Water Truly Matters

Benefiting from Green Infrastructure in a Changing World

Steve Wise
Natural Resources Program Manager
Center for Neighborhood Technology

EPA Wet Weather Webcast

March 3, 2009

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The Center for Neighborhood Technology

- 30 year old Chicago-based non-profit
- Sustainable energy, transportation, natural resource, climate strategies:
  - Research
  - Advocacy
  - Demonstration projects
  - Scaling up, replication
- Green Infrastructure agenda
  - Planning/Analysis Toolbox
  - Policy
  - Education
  - Practice

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The Challenge: (Re)Capture Natural Capacity

- Adapt, (re)naturalize built landscape to absorb, clean and hold water
- Create peak and baseload capacity via conservation
- Get it right in new and retrofit development, public and private

Portland, Oregon "Green Streets"

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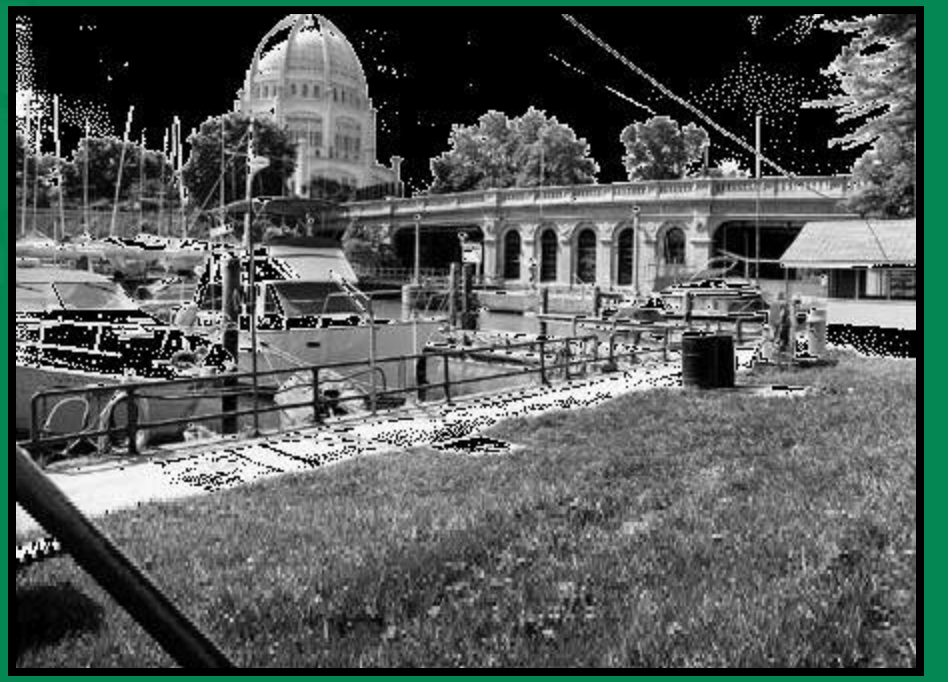
Chicago, August 2007

- 100 year storm, following days of rain
- **~ 225 million gallons Combined Sewer Overflow (CSO)** into Lake Michigan
- Minimized by deep tunnel



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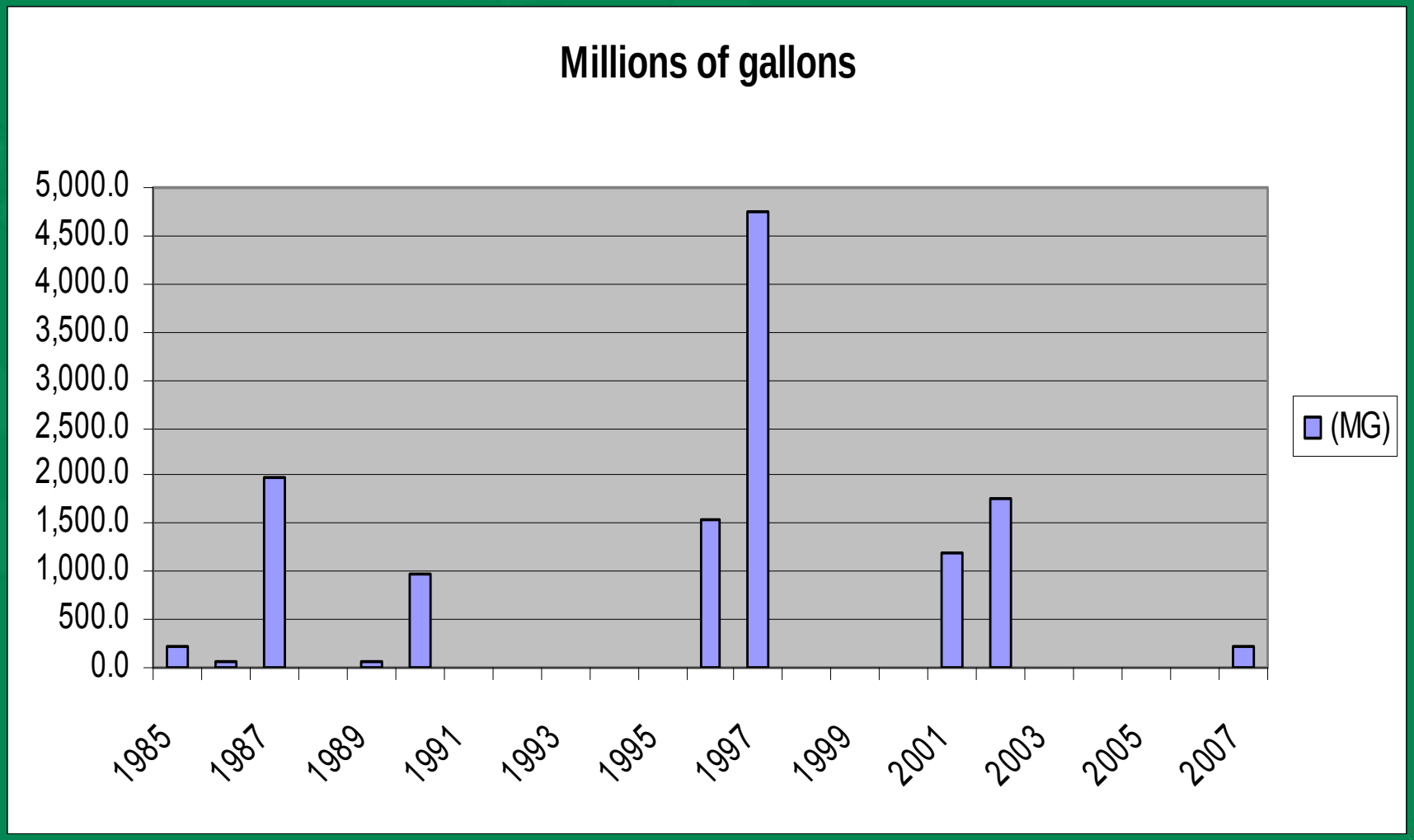
Chicago Lake Overflows



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Climate and Water

“ The frequency of heavy precipitation events (or proportion of total rainfall from heavy falls) will *very likely* increase over most areas during the 21st century, with consequences to the risk of rain-generated floods.”

Intergovernmental Panel on Climate Change Technical Paper on Climate Change and Water, April ‘08

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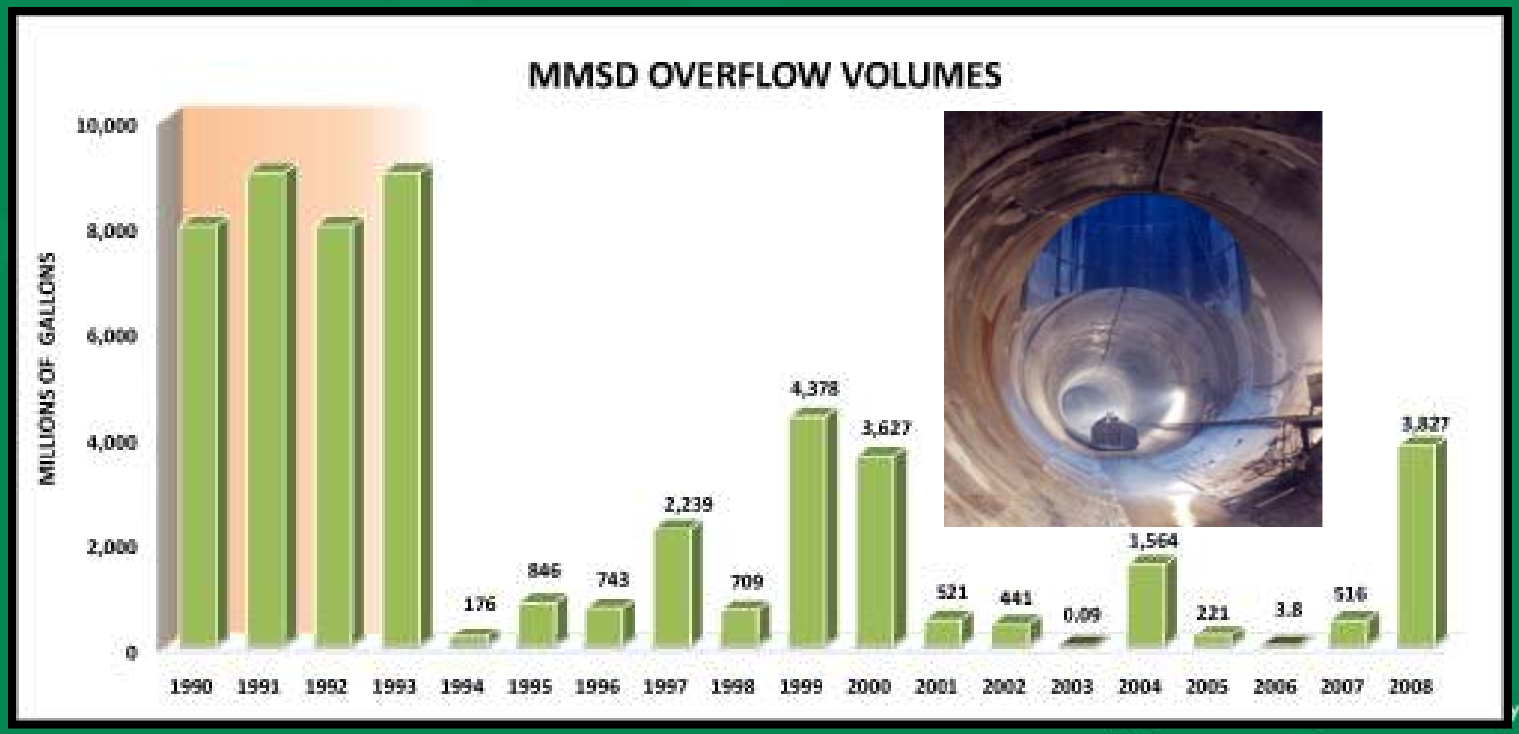
Milwaukee, June 2008

- **100 year storm**
- **Deep tunnel filled in 56 minutes**
- **~ 3 billion gallons CSO**
  into Lake Michigan



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Chicago, September 13, 2008

- 500 year storm (6-9 inches in 24 hours), following days of rain
- ~ **11 Billion gallons CSO** into Lake Michigan

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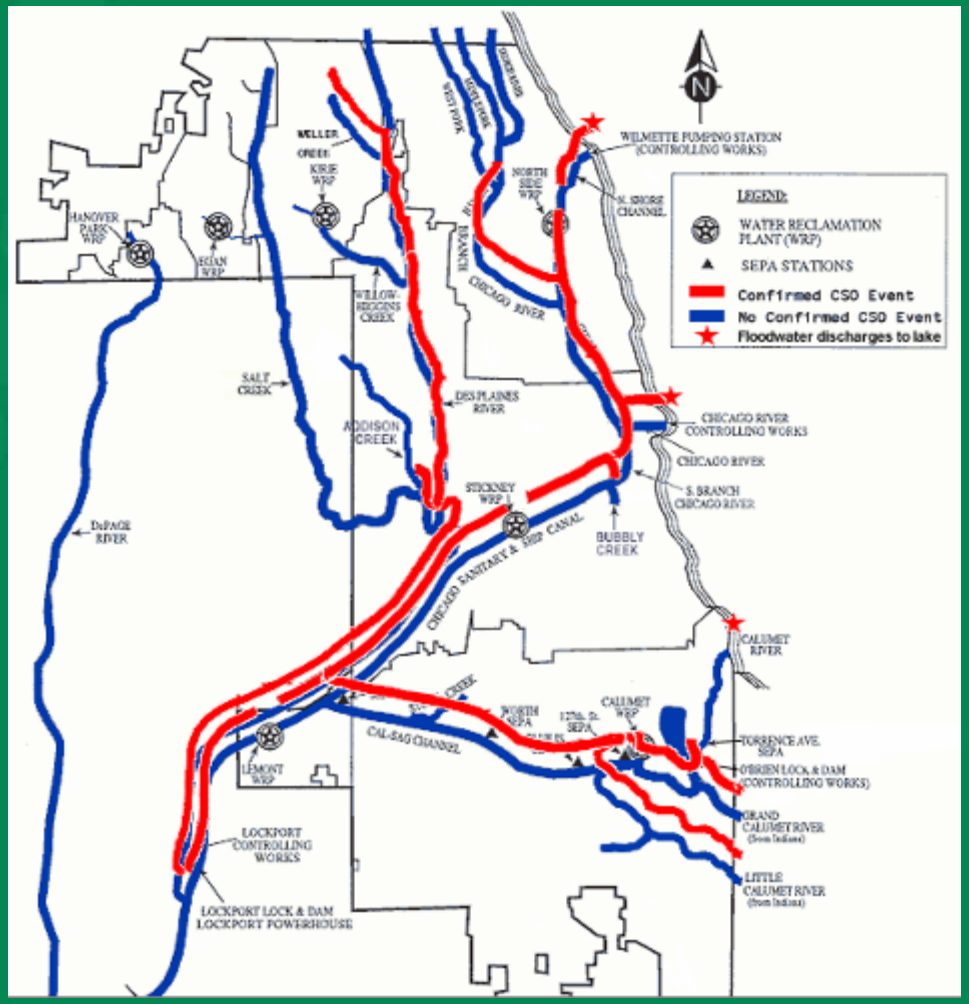
Chicago, September 13, 2008

- 500 year storm (6-9 inches in 24 hours), following days of rain
- ~ **11 Billion gallons CSO** into Lake Michigan
- **+ 50 Billion** overflow to Mississippi



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Increasing Storm Intensity

- 36% increase in design rainfall intensity (5 year return storm) from 1st to 2nd half of 1900s
- "to maintain the same design and service standards, **the diameter of every sewer pipe in the Chicago region would have been increased by up to 17%** if rainfall IDF relationships were updated properly in time." (Guo, 2006)
- "Using 6.4 cm (2.5 in) of daily precipitation as the threshold for initiating combined sewer overflow into Lake Michigan, **the frequency of these events is expected to rise by 50% to 120% by the end of this century**." (Patz 2008)

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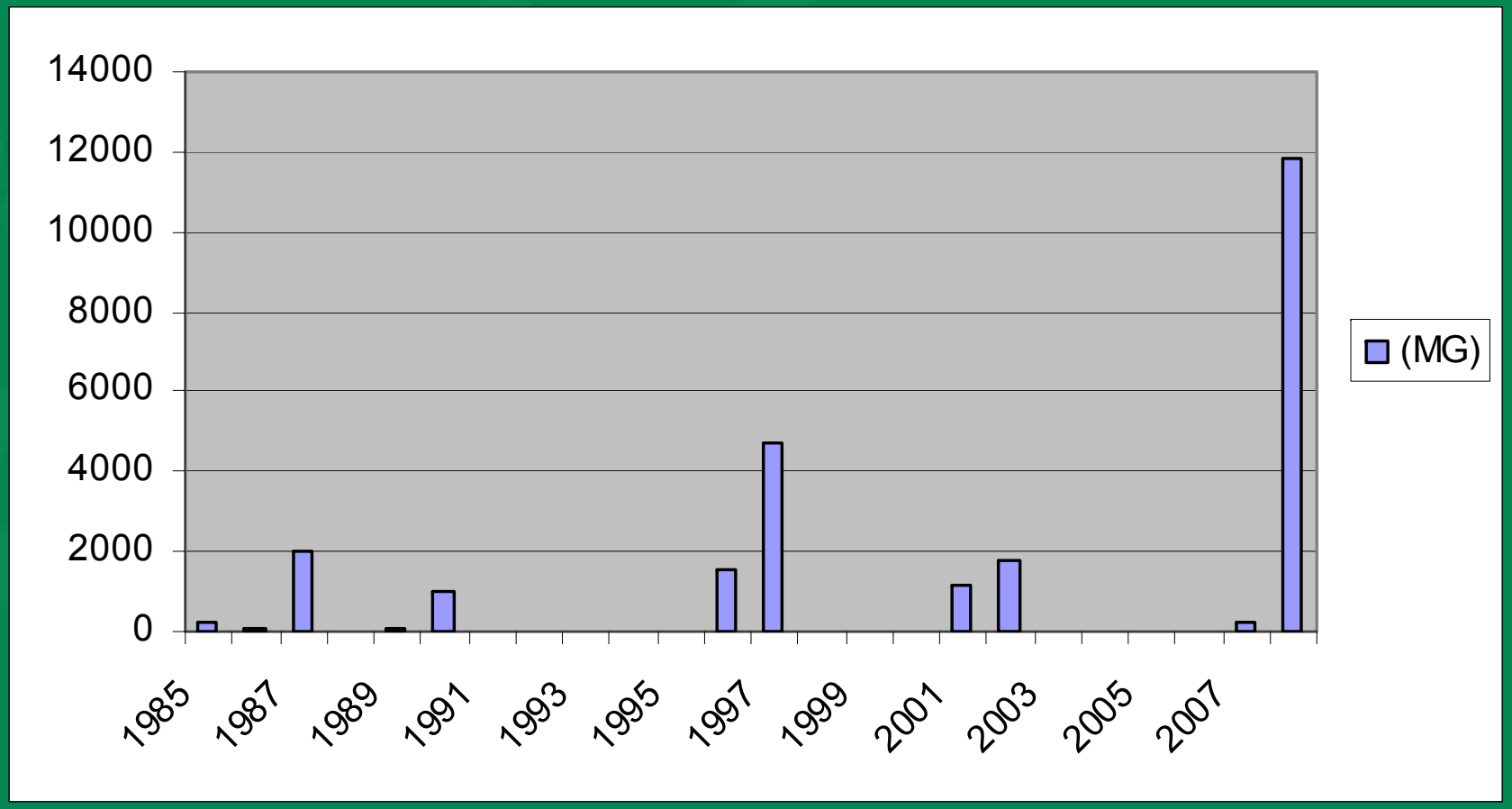
Chicago Lake Overflows



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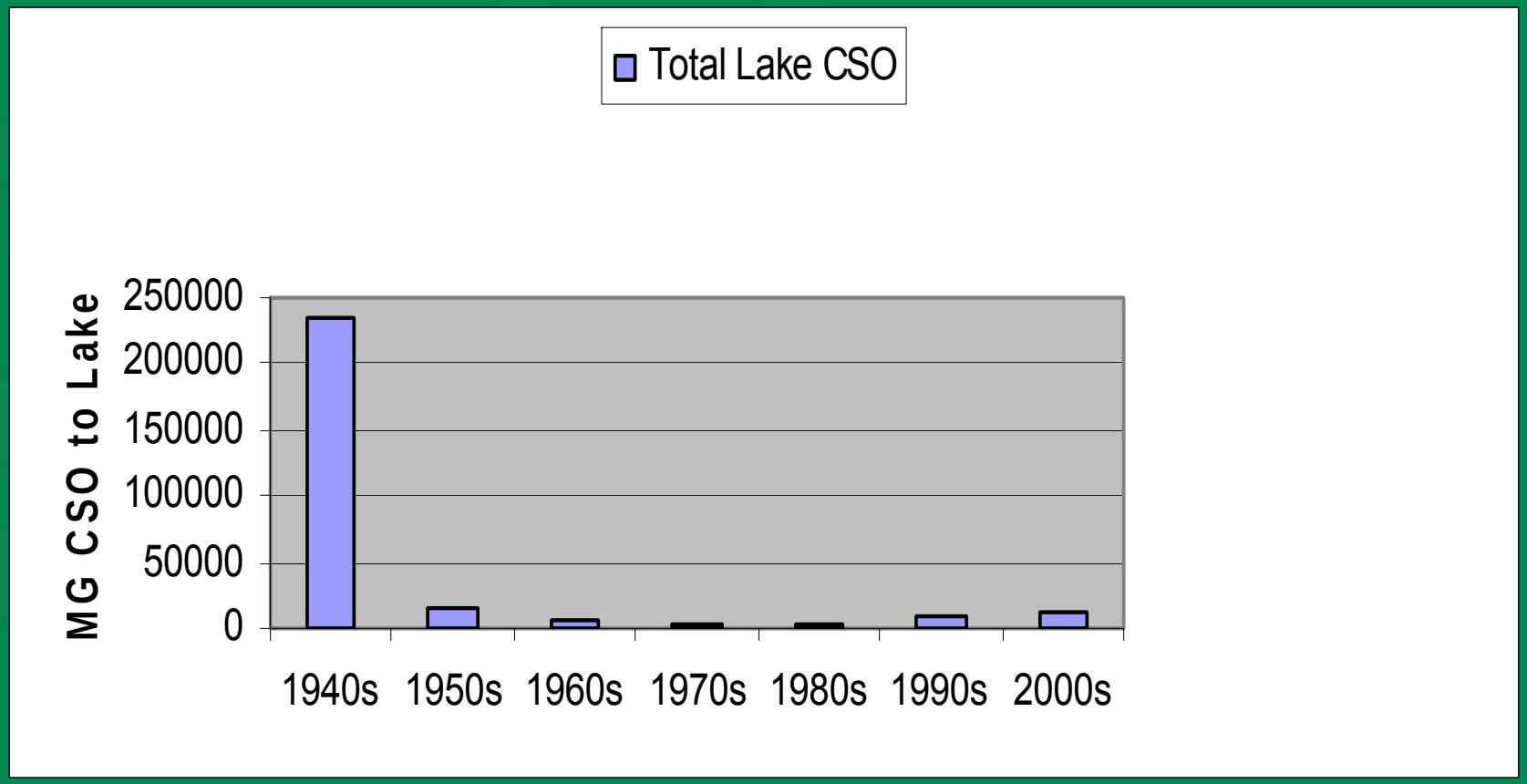

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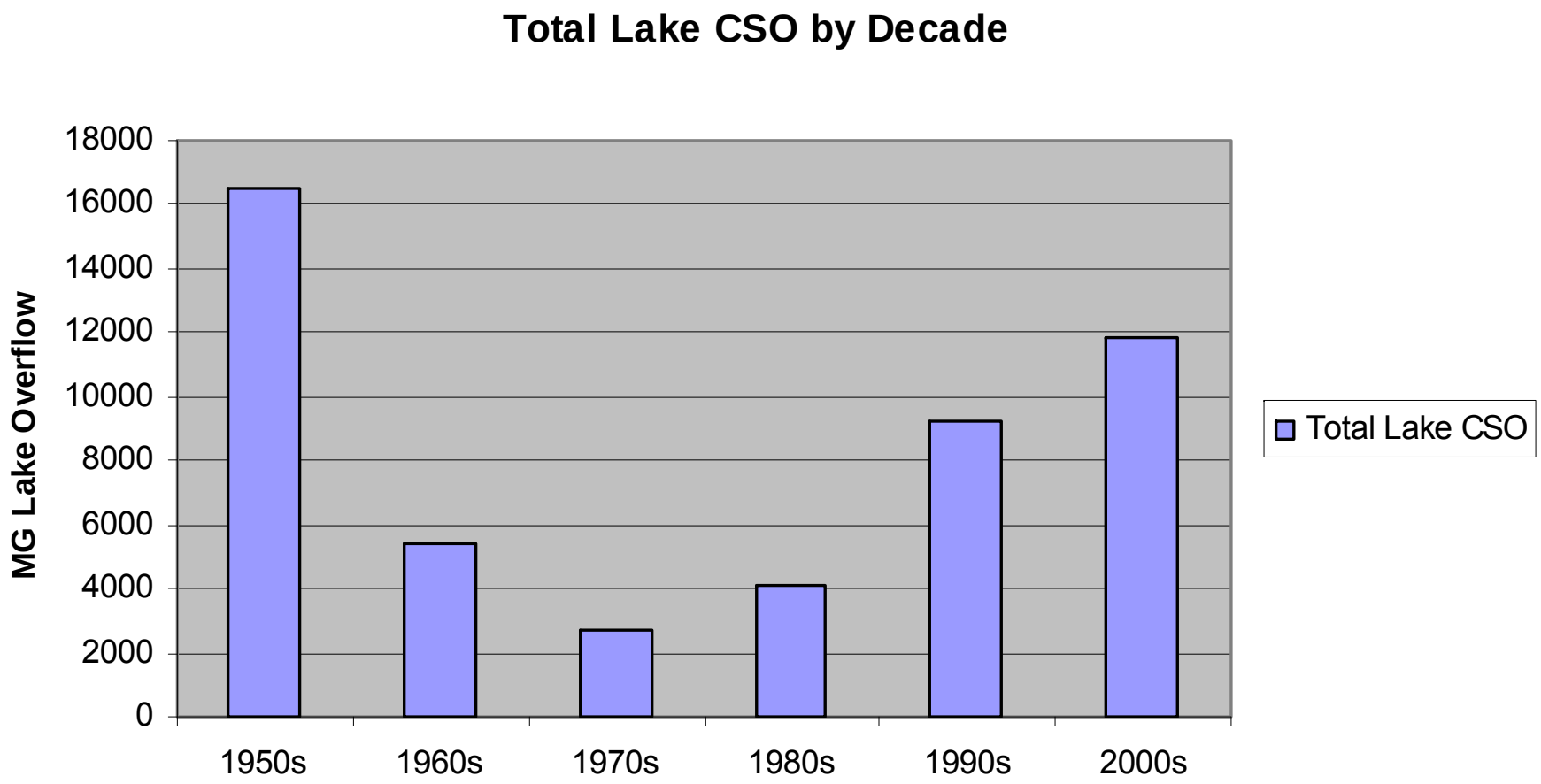

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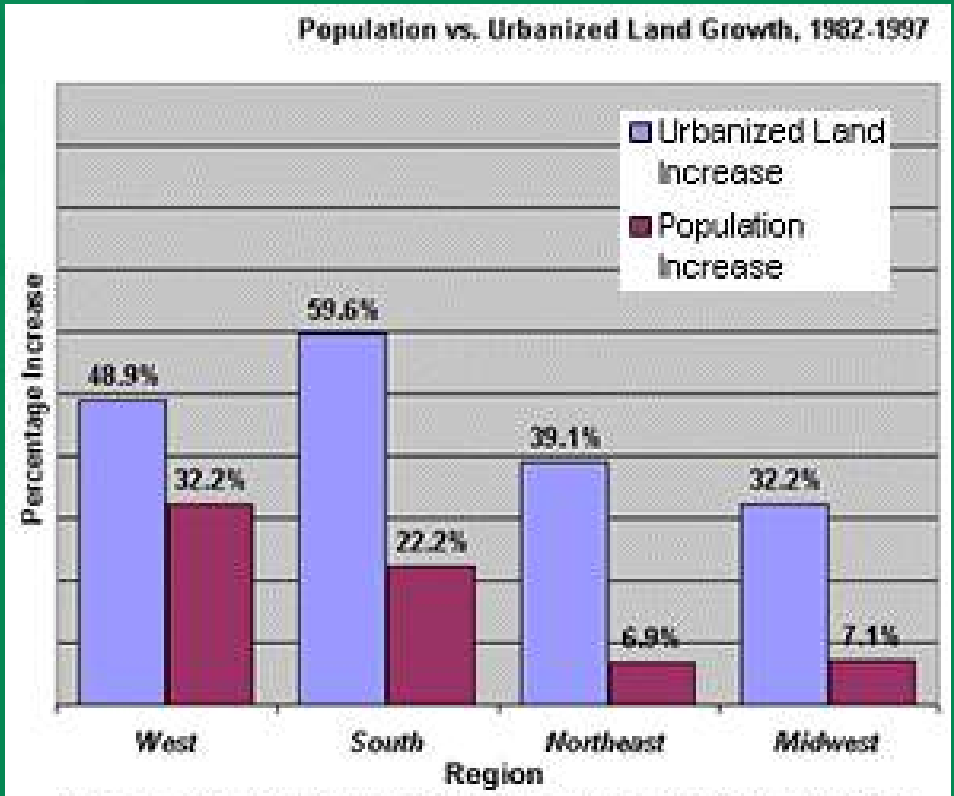
Increasing Development Intensity

- **Between 1982 and 1997 Chicago Population increased 12 %**
- **Developed Land increased 25%**
- **10-24 Billion Gallon loss in infiltration**

-- Paving our Way to Water Shortages (2002)



Adapted with permission from Fulton, William, et al., "Who Sprawls Most? How Growth Patterns Differ Across the U.S.", Center for Urban And Metropolitan Policy, The Brookings Institution, July 2001.

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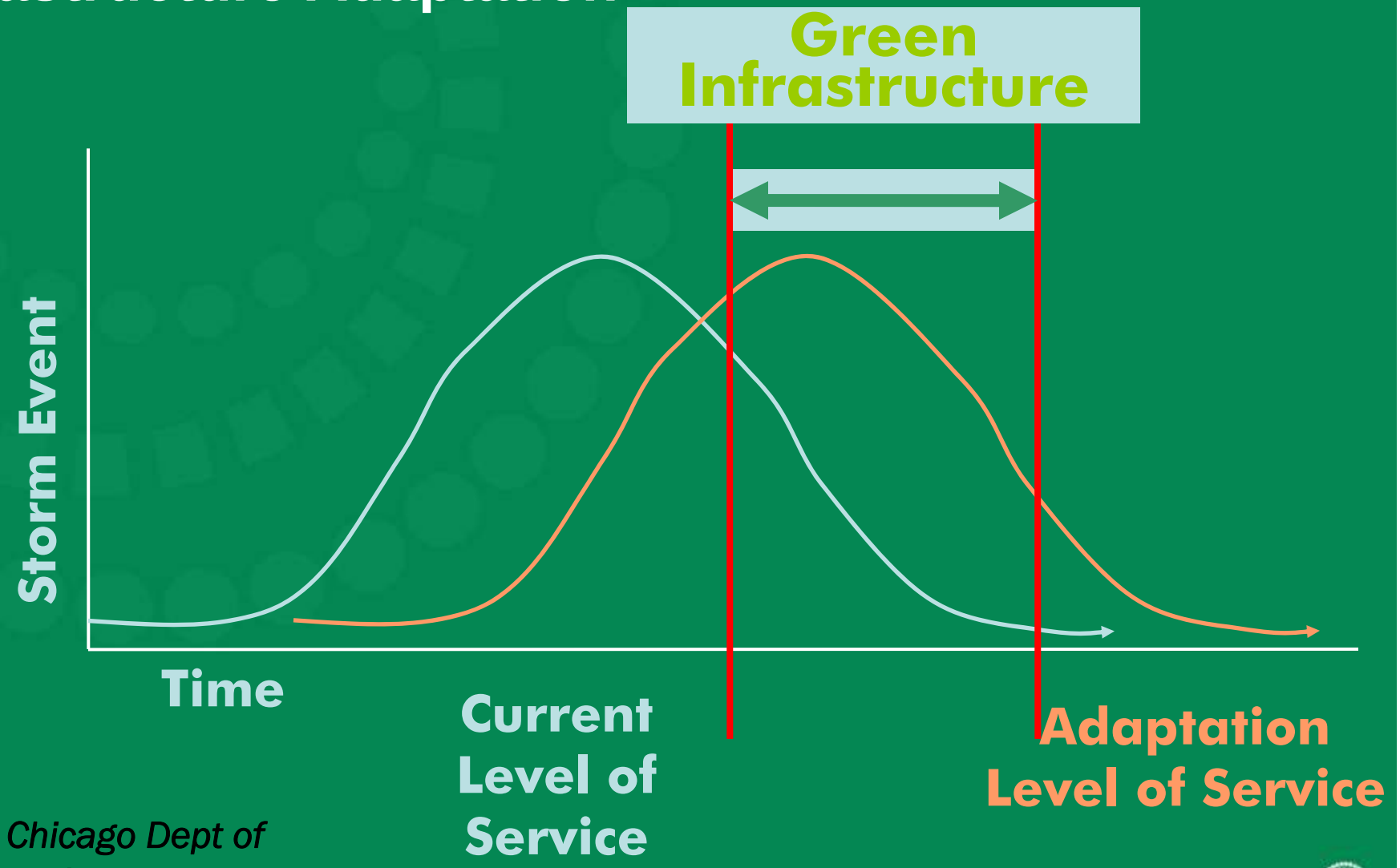
Climate Change and Infrastructure Adaptation



Source: Chicago Dept of Transportation

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Thinking Outside the Pipe

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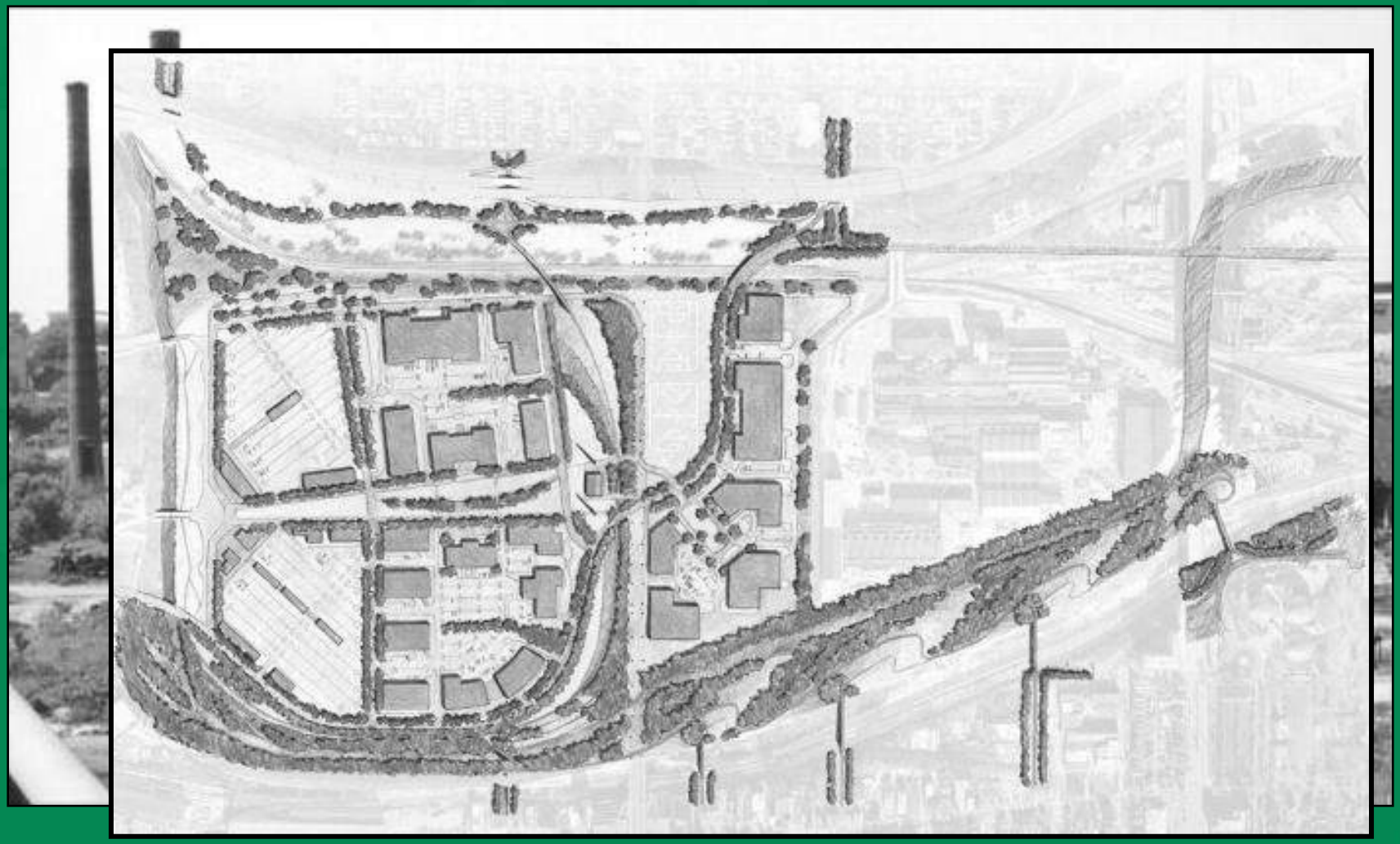
Thinking Outside the Pipe



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Thinking Outside the Pipe

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Stimulus Funds Now Available

- American Reinvestment and Recovery Act dedicates **20% of water infrastructure $ to green infrastructure** ($772 million nationally in Clean Water SRF)
- **120 day window** until funds become available to conventional infrastructure projects
- States and EPA developing guidance under State Revolving Loan (SRF) programs
- Contact your state SRF or Stimulus managers for details

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Rethinking Performance

- Performance measured, valued in 'Anti-Gallons' left in natural drainage
- Drainage, flood control, pollution prevention move upstream from treatment plant to distributed sites at water's origins
- Account for full range of economic, ecological benefits

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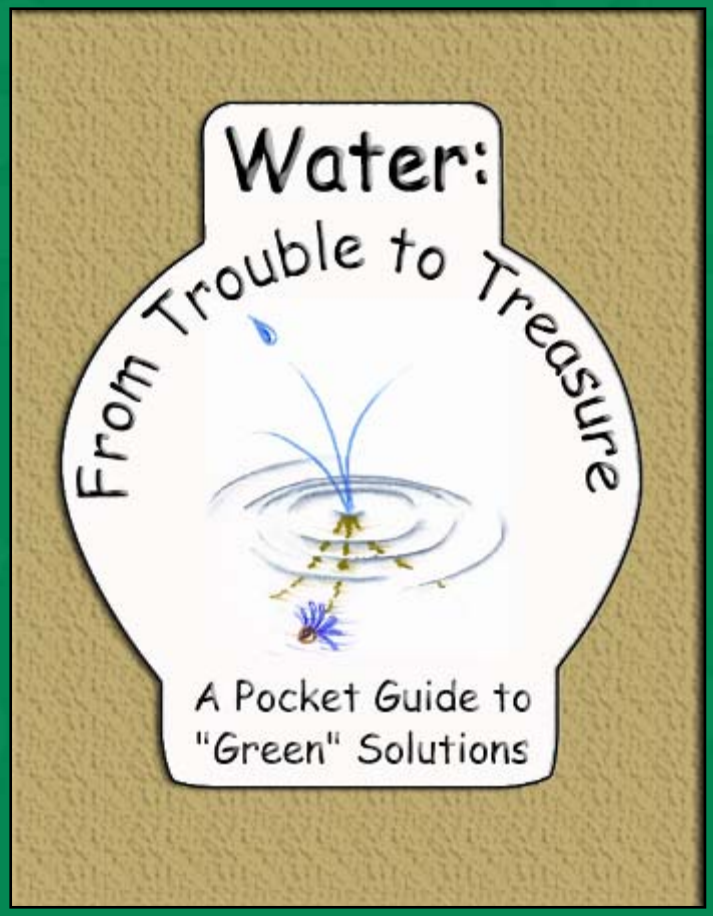
CNT Green Infrastructure Tools



Outreach

Policy Development

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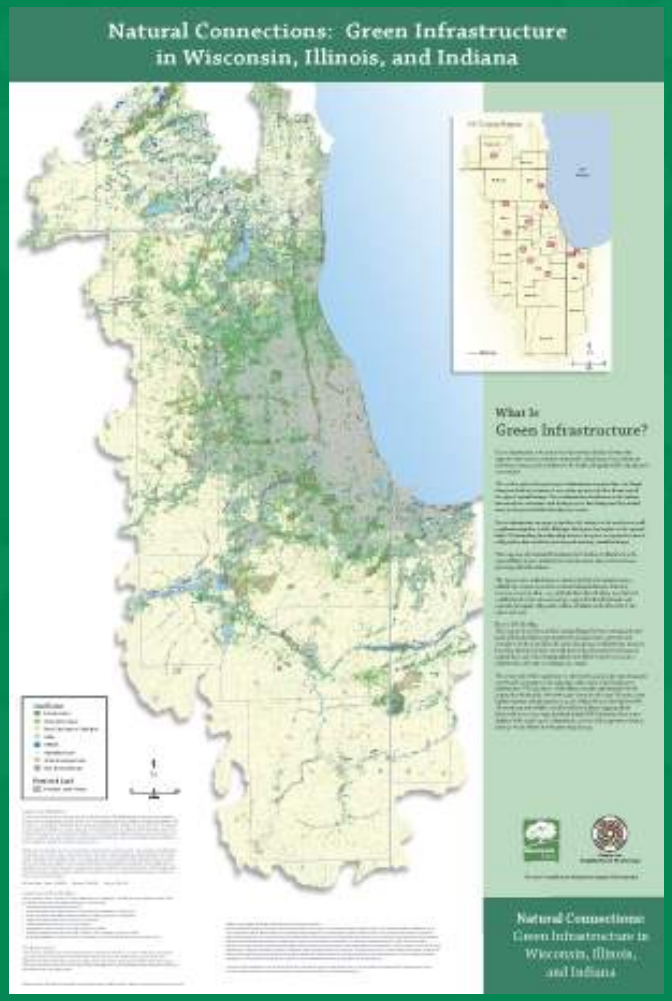
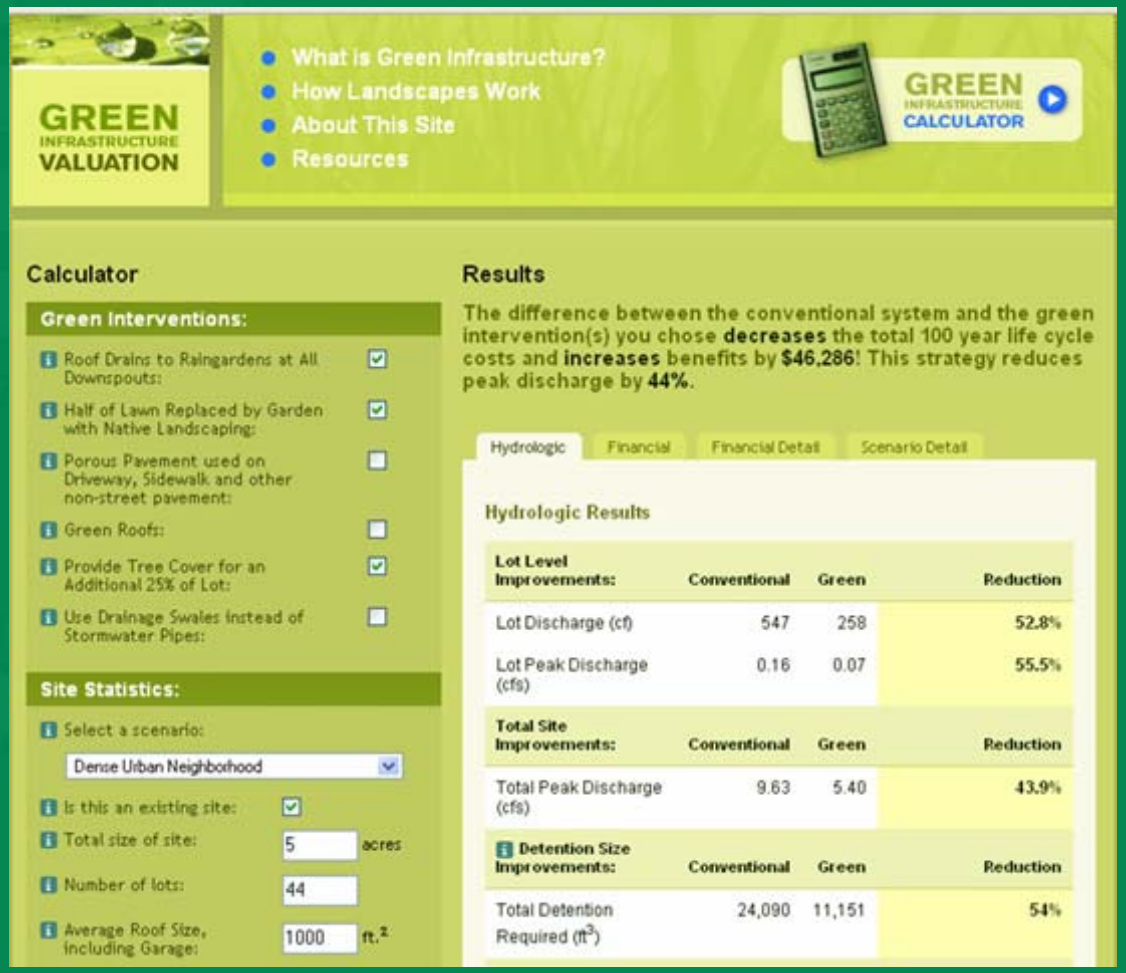
CNT Green Infrastructure Tools





greenmapping.org

greenvalues.cnt.org

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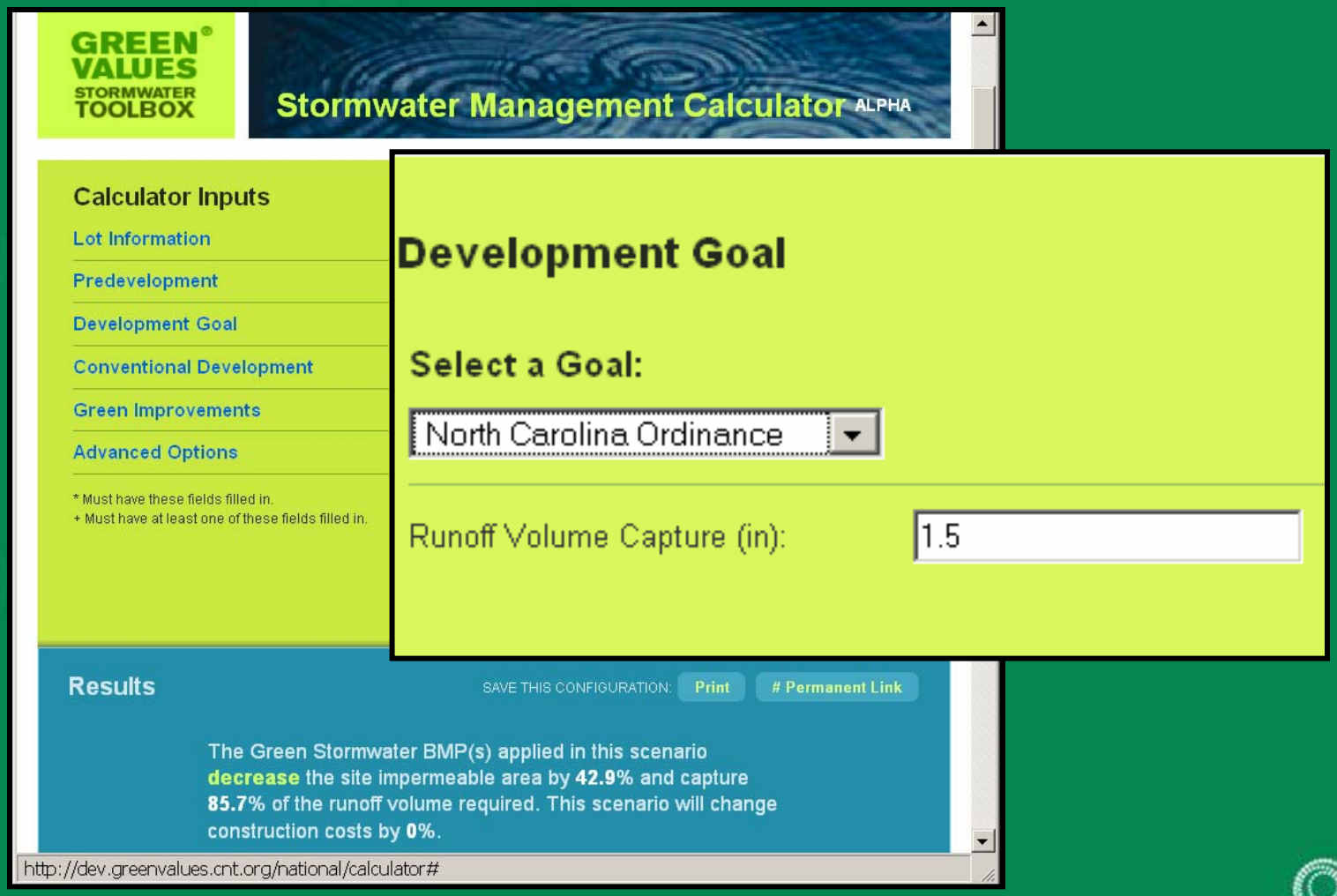
Coming soon:
National Green Values Calculator



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Why Green Infrastructure?

- **Restores, recycles, extends** natural and built regional infrastructure

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Monitored Demonstrations

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St Margaret Mary 9/13/08

"For the first time ever in a major storm, much less a record…we had no problem"

-- Jack Kent, Margaret Mary Church

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Why Green Infrastructure?

- **Restores, recycles, extends** natural and built regional infrastructure
- **Highly effective for stormwater runoff reduction and pollutant removal**

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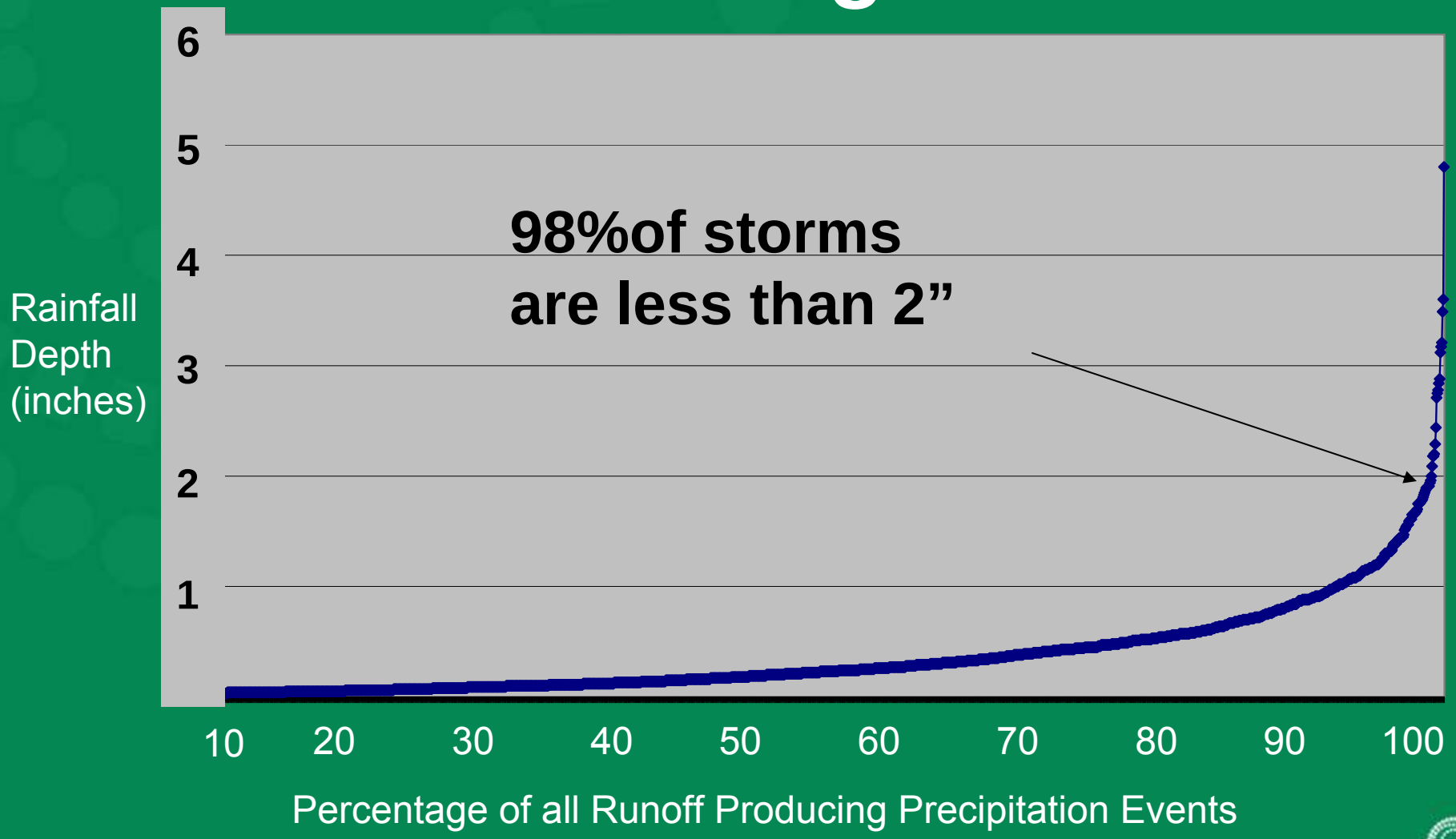
Effectiveness and Performance: Chicago



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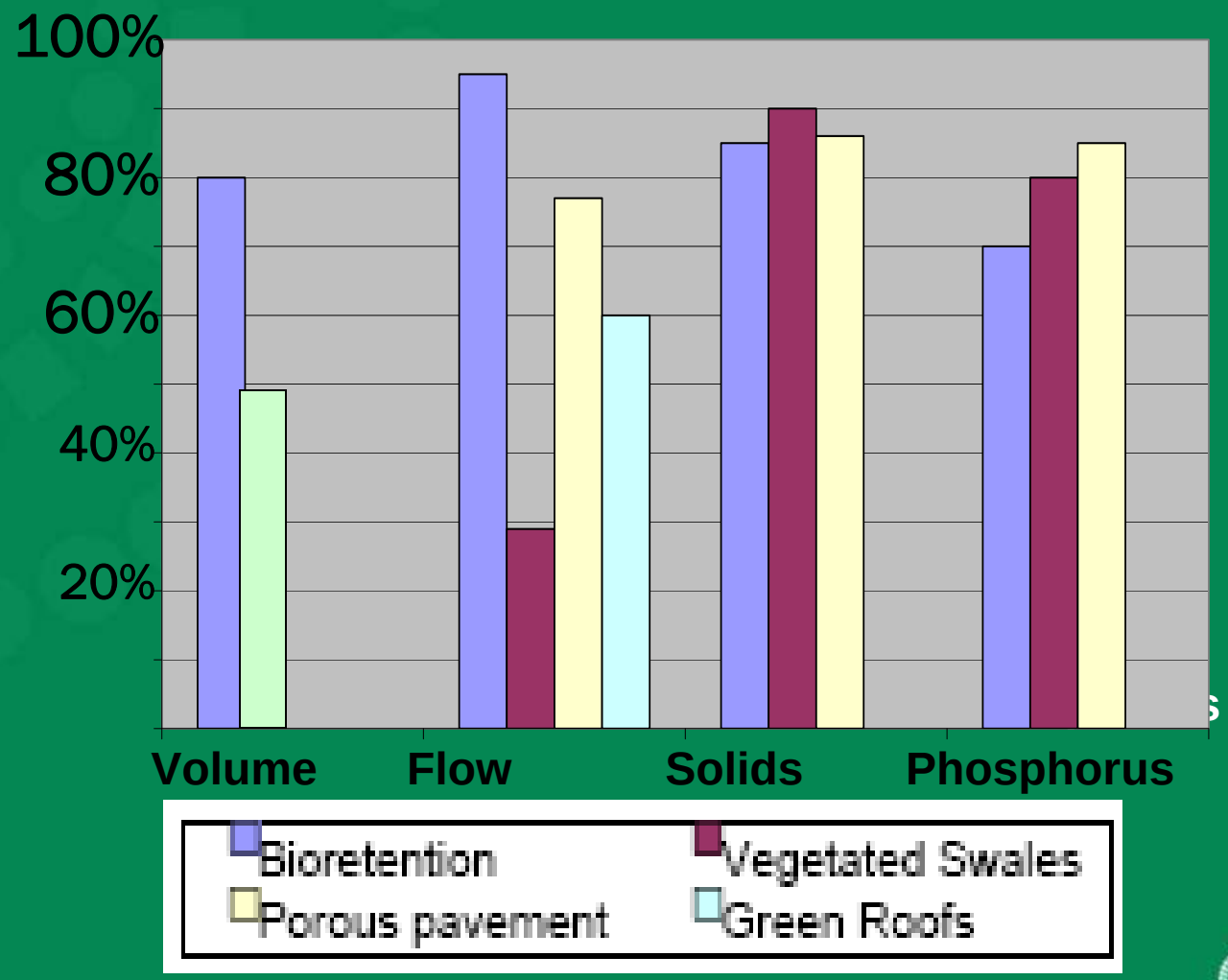
High Performance Standard

Stormwater runoff, pollutant reductions



Portland, Oregon Sustainable Stormwater Program

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Raingarden Performance

- Infiltration reduces peak discharge rate
- Vegetative uptake of stormwater pollutants
- Pretreatment for suspended solids
- plus
- Groundwater recharge
- Aesthetic Improvement

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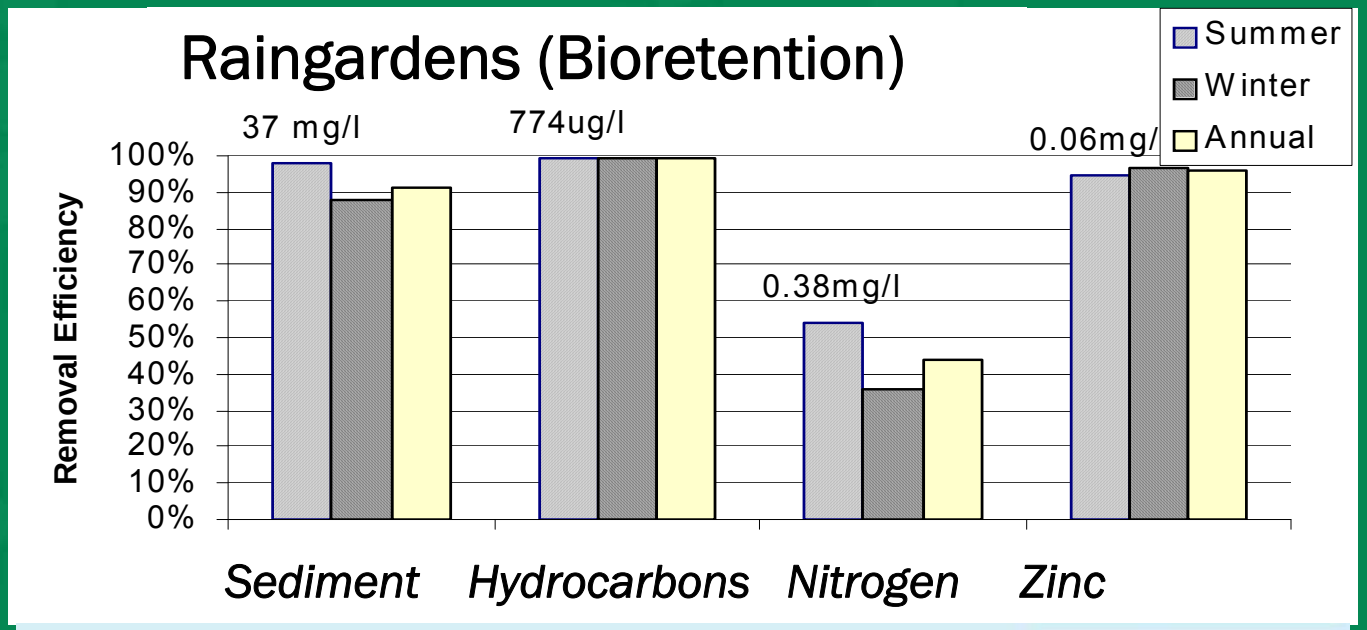
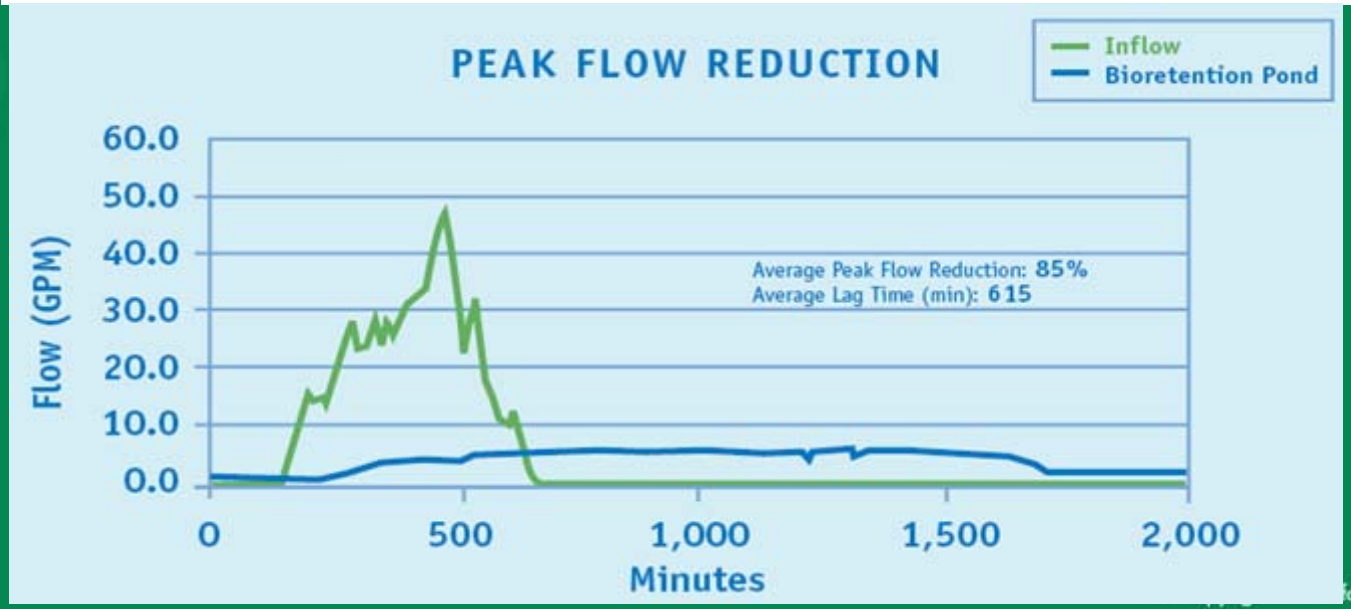
Performance Efficiencies –Filtration/Infiltration

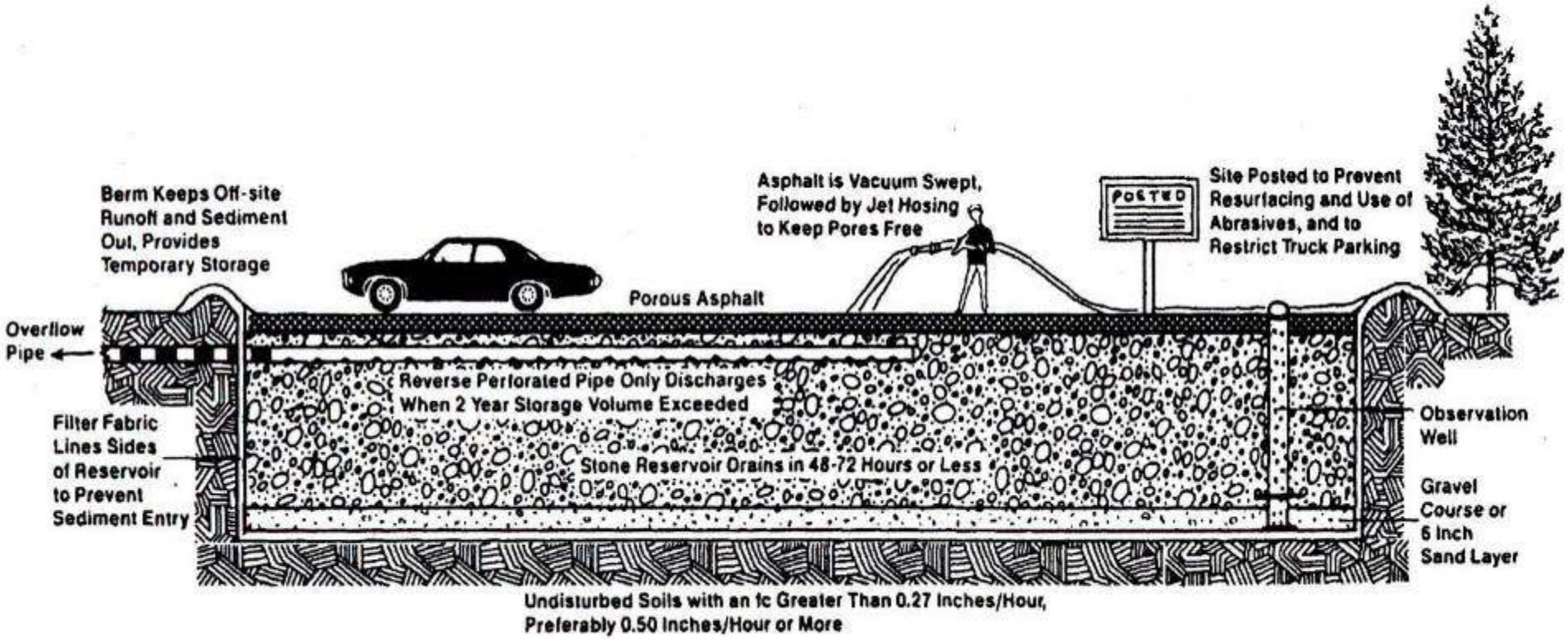




University of New Hampshire Stormwater Center

for Neighborhood Technology CNT

Permeable Pavement



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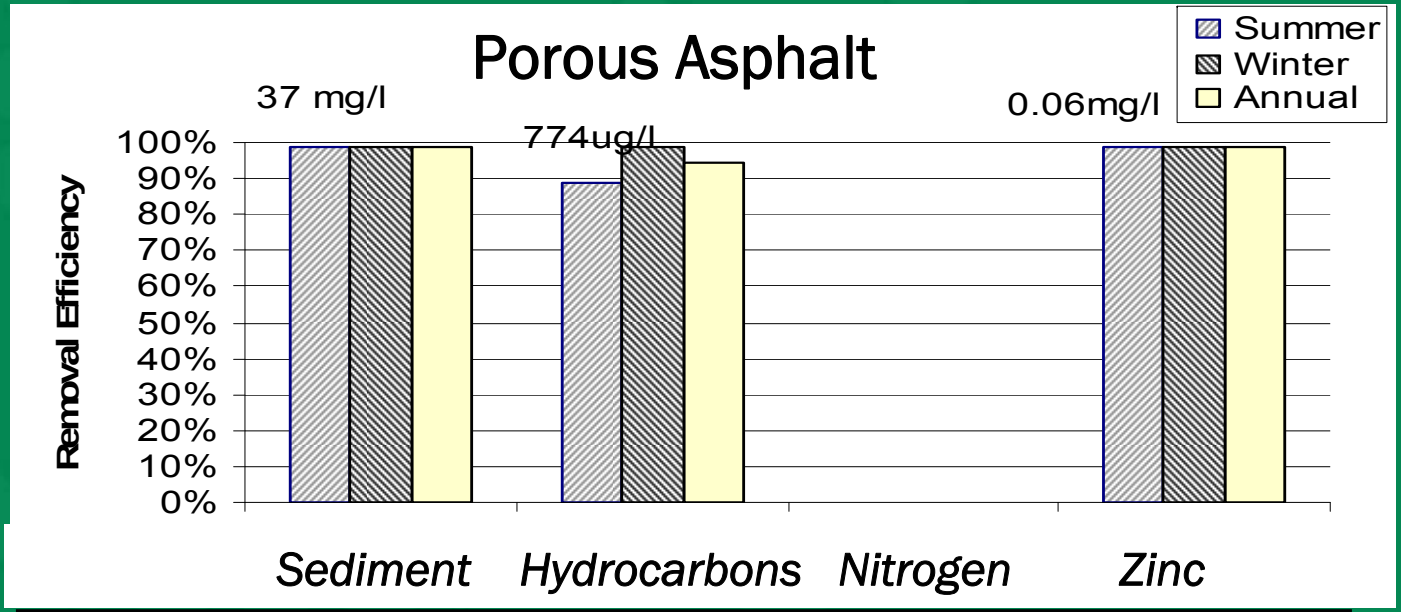
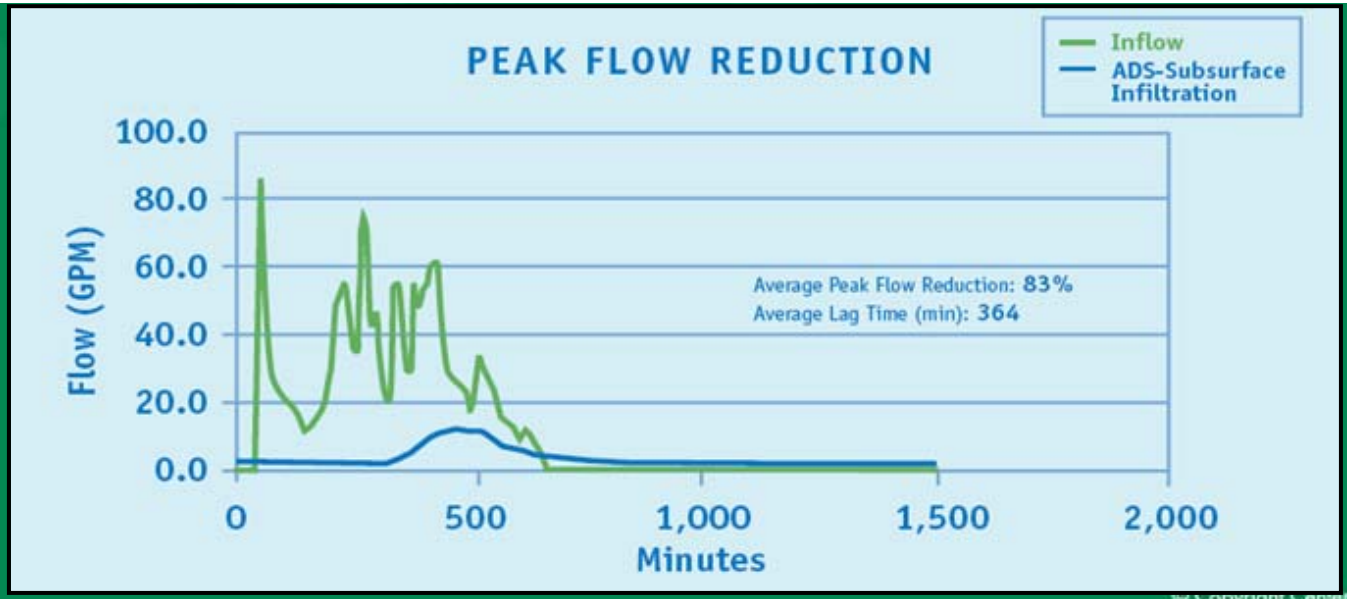
Performance Efficiencies –Filtration/Infiltration





University of New Hampshire Stormwater Center

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Porous Pavement Performance

- 16 year old porous pavement in Philadelphia reported zero discharge during Hurricane Floyd in 1999 (10” rain/24 hours)
- Functions in cold weather
- 75% reduction in salt use (Toronto & NH) from reduced surface freezing

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Why Green Infrastructure?

- Restores, recycles, extends natural and built regional infrastructure
- Highly effective for stormwater runoff reduction and pollutant removal
- **Saves money compared to conventional infrastructure**

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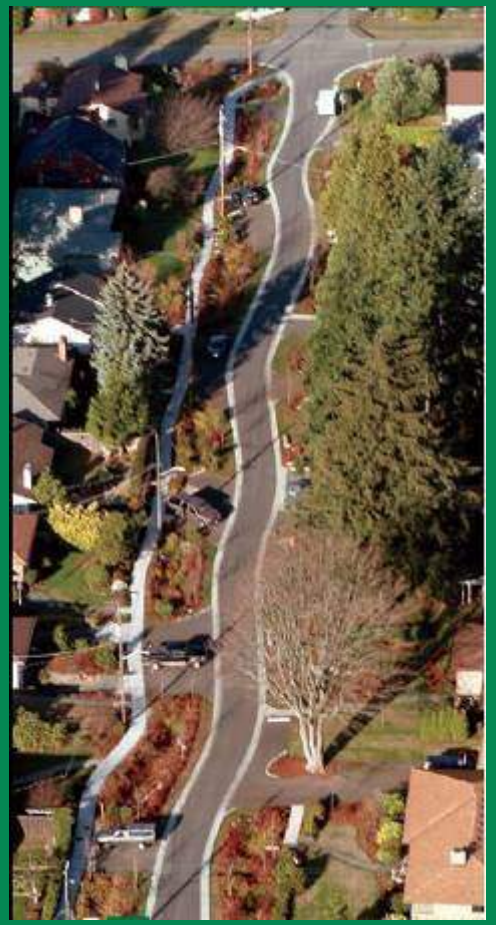
Cost-Effectiveness: Seattle SEA Streets

- vegetated strips, no curbs = 11% reduction in impermeable surface
- 90+% runoff reduction
- 25% cost savings compared to conventional design



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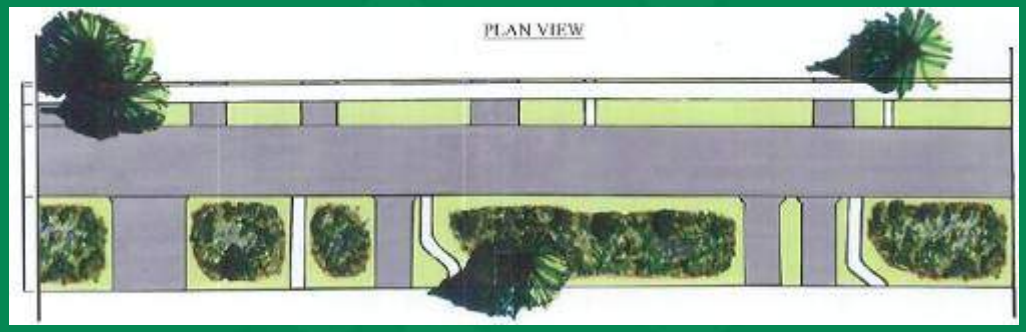
Cost-Effectiveness: Seattle Green Grid



- 86% annual volume
- Serves 5 blocks (49 acres)
- "double the stormwater benefit for the same cost" as SEA Street 1

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Streets or Sewers? Autumn Trails

Item	Permeable	Concrete	Asphalt
Paving/sf	$2.25	$8.00	$3.00
Excavating/sf	$1.00	$1.00	$1.00
Stone/sf	$2.00	$1.50	$1.50
Installation/sf	$4.00	(in paving cost)	$1.50
Curbs	$1.50	$1.50	$1.50
Maintenance	$0.20	0	Not known
Replacement	None	None	Every 12 years
Detention/Retention required	None	Yes	Yes
Storm Sewer System/sf paving	None	$3.00	$3.00
Total/sf	**$10.95**	**$14.00**	**$11.50**
Total/linear foot muni street	**$171**	**$218**	**$179**
Total/linear ft 30' wide street	**$230**	**$280**	**$230**

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EPA GI Cost-effectiveness Study

Table 2. Summary of Cost Comparisons Between Conventional and LID Approaches[a]

Project	Conventional Development Cost	LID Cost	Cost Difference[b]	Percent Difference[b]
2nd Avenue SEA Street	$868,803	$651,548	$217,255	25%
Auburn Hills	$2,360,385	$1,598,989	$761,396	32%
Bellingham City Hall	$27,600	$5,600	$22,000	80%
Bellingham Bloedel Donovan Park	$52,800	$12,800	$40,000	76%
Gap Creek	$4,620,600	$3,942,100	$678,500	15%
Garden Valley	$324,400	$260,700	$63,700	20%
Kensington Estates	$765,700	$1,502,900	–$737,200	-96%
Laurel Springs	$1,654,021	$1,149,552	$504,469	30%
Mill Creek[c]	$12,510	$9,099	$3,411	27%
Prairie Glen	$1,004,848	$599,536	$405,312	40%
Somerset	$2,456,843	$1,671,461	$785,382	32%
Tellabs Corporate Campus	$3,162,160	$2,700,650	$461,510	15%

EPA 'Reducing Stormwater Costs through LID Strategies and Practices

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Long Term Control Plan Savings

go green louisvi!!e

- Proposed LTCP includes $86 million for green roofs, streets, biofiltration
- Saves estimated $40 million from original LTCP of $324 million
- Conservative assumptions → average cost $.09/gallon removed
- "green infrastructure can be a very cost competitive solution, with successful partnerships and cost sharing, when compared to more traditional gray controls "

  -- *Louisville Metropolitan Sewer District*
  Integrated Overflow Abatement Program
  Draft summary 9/20/08

(Photo: budsmith.com)

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Why Green Infrastructure?

- Restores, recycles, extends natural and built regional infrastructure
- Highly effective for stormwater runoff reduction and pollutant removal
- Saves money compared to conventional infrastructure
- **Delivers multiple community benefits along with stormwater management**

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How many problems can your community solve for $3 billion?

- **CSO Tunnel/Grey Infrastructure:**
  - **Reduce sewerage overflows to our rivers**

- **Land-Based Storm Water Strategies:**
  - **Reduce sewerage overflows to our rivers**
  - **Create green space, urban land restoration, mitigate global climate change, reduce heat island, improve quality of life, water conservation, energy use, education, recreation, riparian buffers, flood control, access, unimpaired streams…**

(Philadelphia Watersheds Office)

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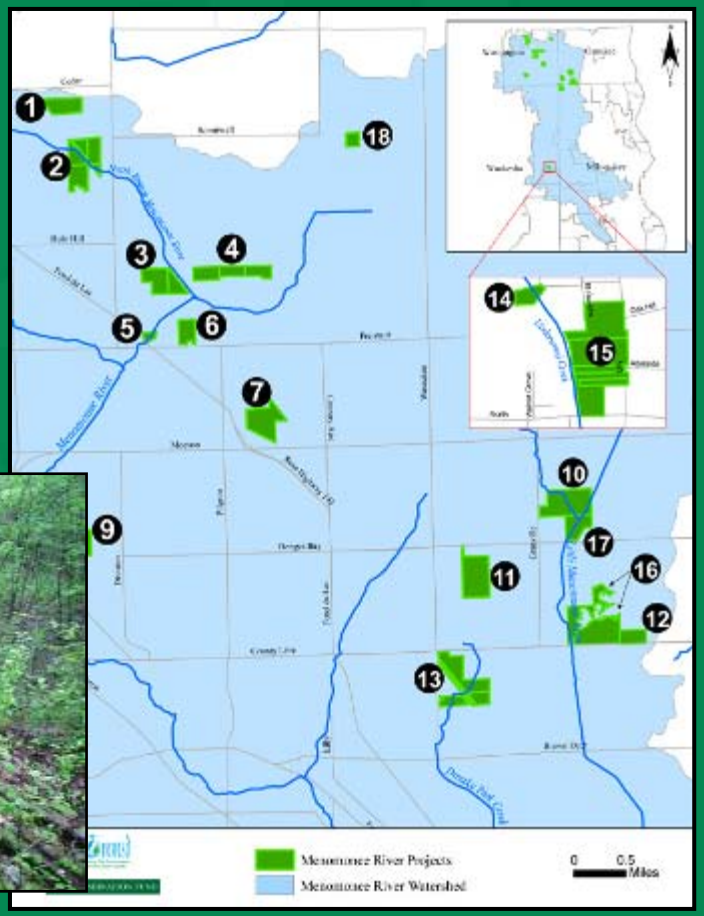
Source Protection - Milwaukee



- **Purchases undeveloped land for permanent open space in growth areas**
- **Upstream flood control, infiltration, recreation, habitat**
- **$15 million capital committed over 8 years**
- **2007: 460 acres, $3.9 million**

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Real Estate Value: *A Philadelphia Story*

- **Vacant land improvements increased surrounding housing values by as much as 30%**
- **New tree plantings increased surrounding housing values by approximately 10%**

(University of PA data)

(Philadelpia Watersheds Office photos))

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“Tree Increment Financing”

Tree Plantings:

- **$4 million property value gain**
- **20 years taxed at 2.64% = $2,112,000**

Lot Improvements:

- **$12 million gain through**
- **20 years taxed at 2.64% = $6,336,000**

U of PA study only 2 of 50 zip codes

Now citywide: 423 parcels (13 acres) since 2000

PA Horticultural Society photos

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Urban Cooling

- Trees:
  10% canopy increase →
  5-10% energy savings from shading, windblocking
- Toronto study: permeable pavements reduce heat island

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Green Roof Energy Potential

- **Chicago citywide projection: $100 million energy savings and 720 megawatts (= 3 coal fired power plants)** *-- Weston Design Consultants*

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Air Quality

- One square meter green roof can remove .2 kg particulates per year
- 5 square meters = capture from 10,000 vehicle miles traveled

Sydney Conservatorium of Music (image courtesy www.wsud.org)

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Chicago Roofs Less Graveled

2 million square feet built, 4 million planned

~ annual particulate capture from 74,322 cars

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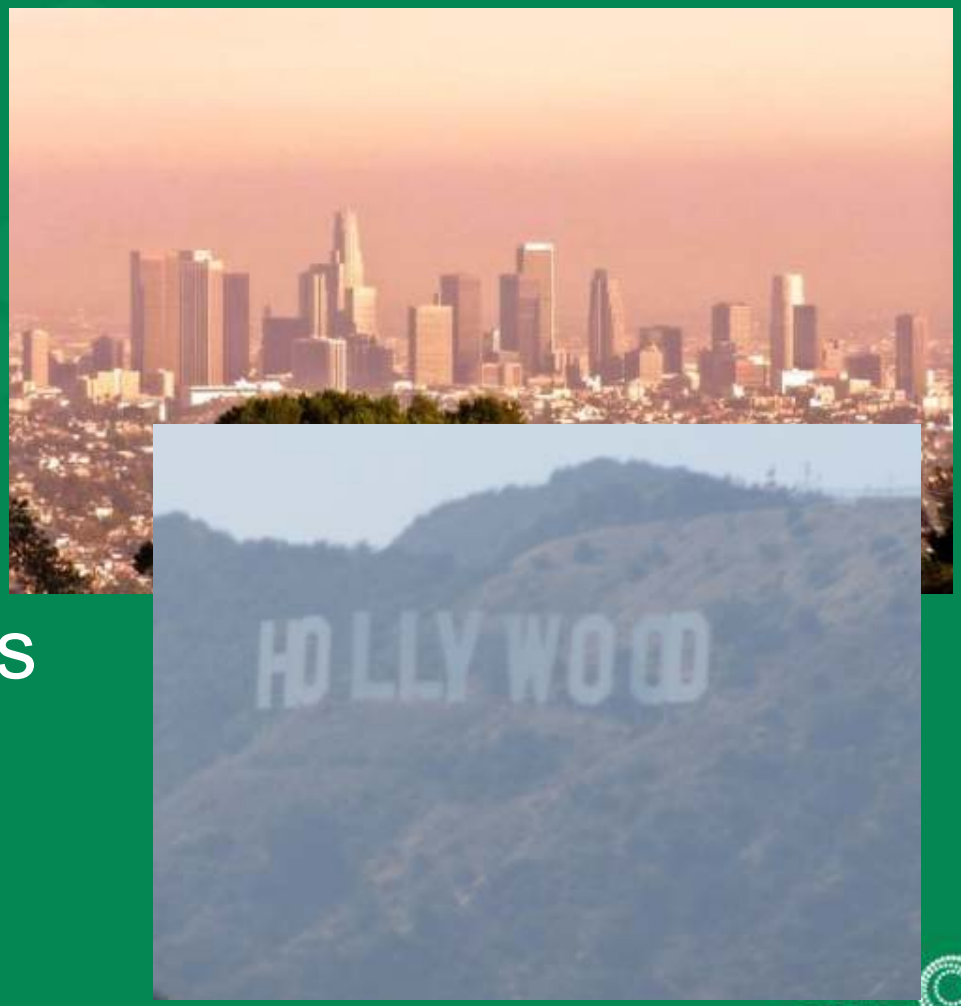
Los Angeles Green Roof Potential

- 15% Green Roof Coverage
- 5-9 degree heat island reduction
- .5 - 1 **Gigawatt** peak power savings



Lawrence Berkeley Labs Heat Island Group, 2000

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Los Angeles Green Roof Potential

- 15% Green Roof Coverage
- 5-9 degree heat island reduction
- .5 - 1 **Gigawatt** peak power savings
- Proposition O: $500M

Lawrence Berkeley Labs Heat Island Group, 2000

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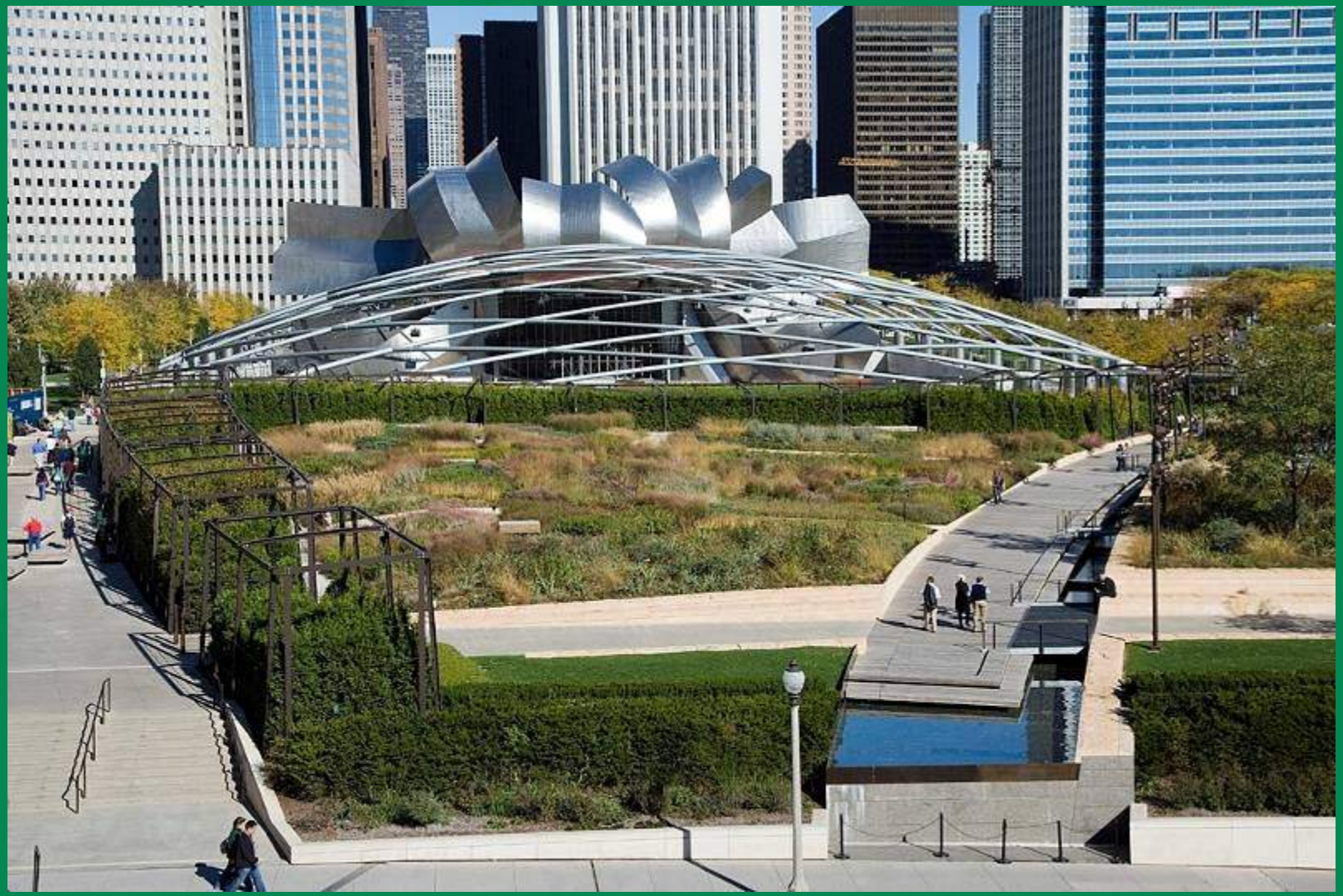
Put the ‘Park’ Back in ‘Parking’



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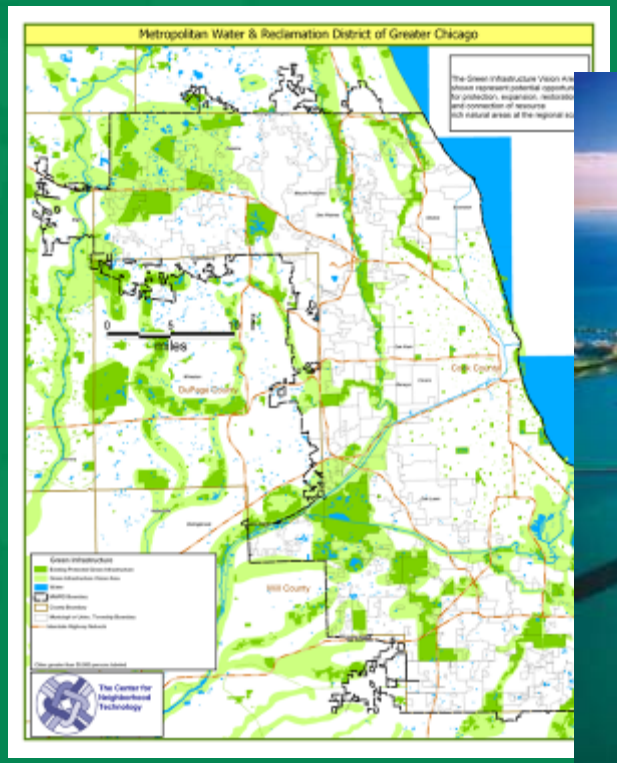
Getting to Scale – Water Supply

- Cook County Estimate:
  Apply Various Green Infrastructure →

- 40% runoff reduction

- Aquifer & lake recharge equivalent to additional supply for >1 million people



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Crime Prevention Approach

Compared with areas that had little or no vegetation, buildings with high levels of greenery had 52% fewer crimes

Landscape and Human Health Laboratory
University of Illinois at Urbana-Champaign

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Community Health

"exposure to green surroundings reduces mental fatigue and the feelings of irritability that come with it. The ability to concentrate is refreshed by green views, along with the ability and willingness to deal with problems thoughtfully and less aggressively. And, in this study, ***even small amounts of greenery—a few trees and a patch of grass—helped inner city residents have safer, less violent domestic environments****."*

Landscape and Human Health Laboratory
University of Illinois at Urbana-Champaign

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Community Connection

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Green Jobs Strategy

- **Entry level landscaping: Job skills with inspiring purpose**
- **“For the first time, I can go home and tell my mother I’m proud of what I’m doing”**

Chicago GreenCorps at Our Lady Gate of Heaven project site

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Green Jobs Ladder

- **Certified installers:**
  - Permeable pavement
  - EPA Watersense

- **High skilled engineering, landscape architecture, monitoring**

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Habitat

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Habitat

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Beauty

Opal Creek, Oregon

opalcreek.org

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‘Holier’ than Thou

“We are ahead of the Pope.”

-- Fr. Jim Barrett

“…the greenest ward in the greenest city in America.”

-- Alderman Joe Moore

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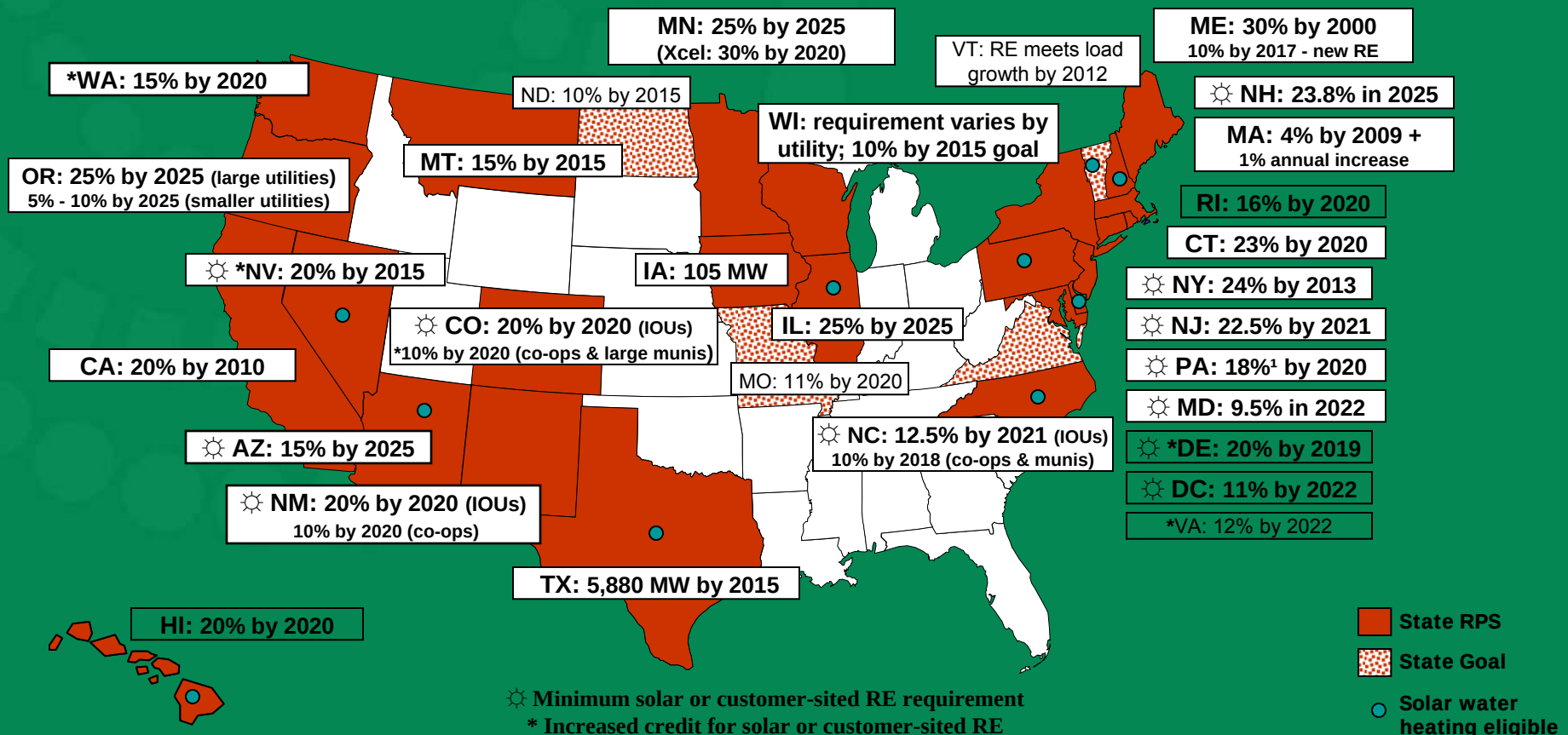
Competing for Clean Energy

Renewables Portfolio Standards – January '08



Minimum solar or customer-sited RE requirement
* Increased credit for solar or customer-sited RE
¹PA: 8% Tier I / 10% Tier II (includes non-renewables)

Source: DSIRE: www.dsireusa.org

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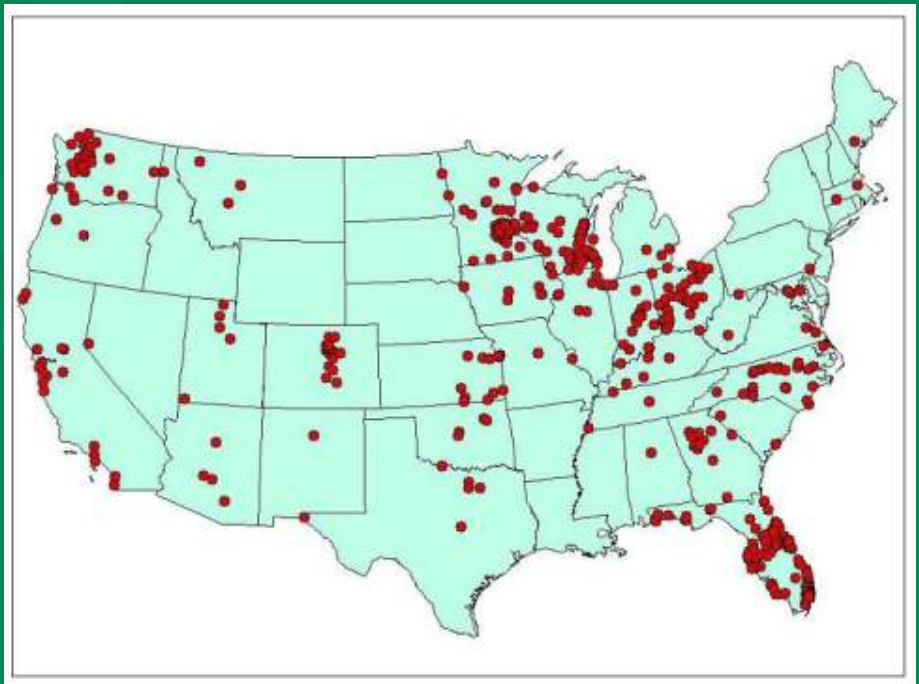
Raising the Water Bar

- Stormwater utilities
- Pre-development Hydrology standards
- Parking, street width maximums
- Regional public-private collaboration on solutions, performance
- State sustainable stormwater portfolio standards



Stormwater Utility Survey. Western Kentucky University, 2008

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Toward “New Water Conservatism”

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“Drain’ge We Can Believe In”

- ***Trickle Down Economics*** **– cost effective reduction of capital intensive infrastructure**

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“Drain’ge We Can Believe In”

- ***Trickle Down Economics*** **– cost effective reduction of capital intensive infrastructure**

- ***1000 Points of Infiltration*** **– emphasizing distributed approach to manage clean water asset in place**

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CNT

"Drain'ge We Can Believe In"

- ***Trickle Down Economics*** – cost effective reduction of capital intensive infrastructure

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- ***Supply Side Theory*** – preventing stormwater treatment also boosts groundwater supply, extends capacity of existing treatment systems

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"Drain'ge We Can Believe In"

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- ***'Are you more permeable today than you were 4 years ago?'***

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Answering the Global Challenge

"It is this kind of project that needs to be replicated a billion times around the world."

-- Nobel Peace Laureate Wangari Maathai

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Thank You

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Questions

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A Green Vision for CSO Long-Term Control Planning in Philadelphia: How Green Can One City Get??

Marc Cammarata, PE
Philadelphia Water Department – Office of Watersheds

Overflow Compliance Costs

	Washington, DC	Pittsburgh	Philly
Population (million)	2	0.850	2
Service Area (mi^2)	725	200	286
CSO Area (mi^2)	19.5	60	64
Number of CSOs	53	> 300	166
Overflow Volume (BG/Yr)	2.5	14	14
Compliance Costs	$ 2.65 Billion	$2 - $3 Billion	??? BILLIONS

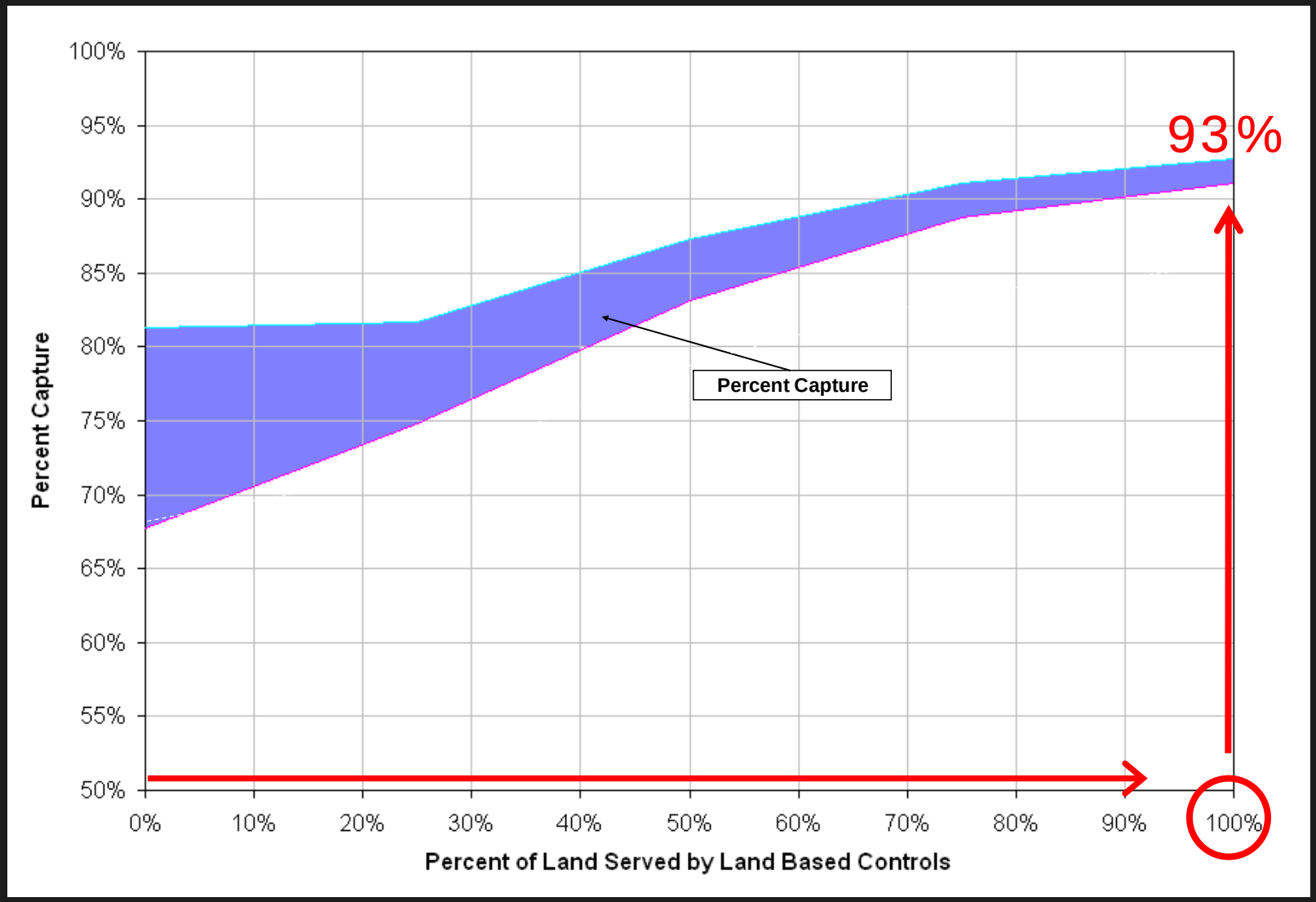
A new approach: on the verge of BIG CHANGE…

MSU Green Roof Research Program

(courtesy Old House Journal)

Wall on Jean Nouvel's Musée du quai Branly

The Challenge: Capturing the 1st inch



How far can we take this approach & how long do we have?

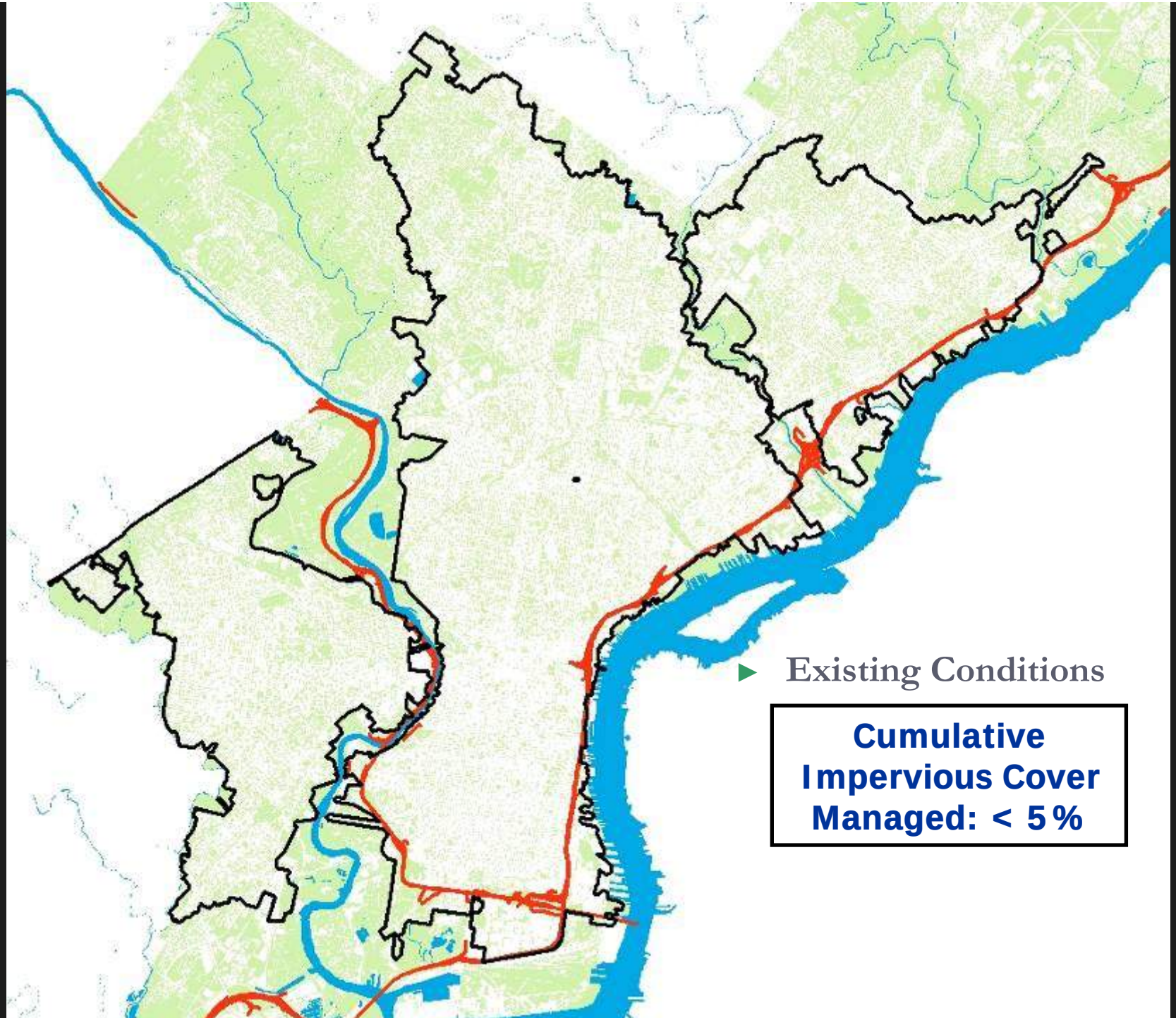
Philadelphia's Green Approach

- Sustainable
- Support numerous EPA initiatives
  - Green Policy
  - Protecting America's Waters
  - Reducing Green House Gas Emissions
  - Improving Air Quality
- Adaptable (Climate Change)
  - Adaptive Management
- Benefits accrue from 'Day One'
- Affordable
  - Triple Bottom Line Analysis
    - Almost a 1:1 Cost/Benefit Ratio
- Positive Risk?

Include an Aggressive Green Vision…

- Dry Weather Water Quality & Aesthetic Improvements
  - Sewer Relining
  - Trail Development
  - Trash Removal
- Healthy Living Resources
  - Stream Restoration
  - Wetland Creation
- A major urban setting turn Green
  - 25% 'Green City' in 20 yrs
  - 50% in 40 yrs?
  - 75% in 60yrs?
  - 10 Aggressive and Innovative Green Elements – Streets, Homes, Open Spaces, Schools, etc.

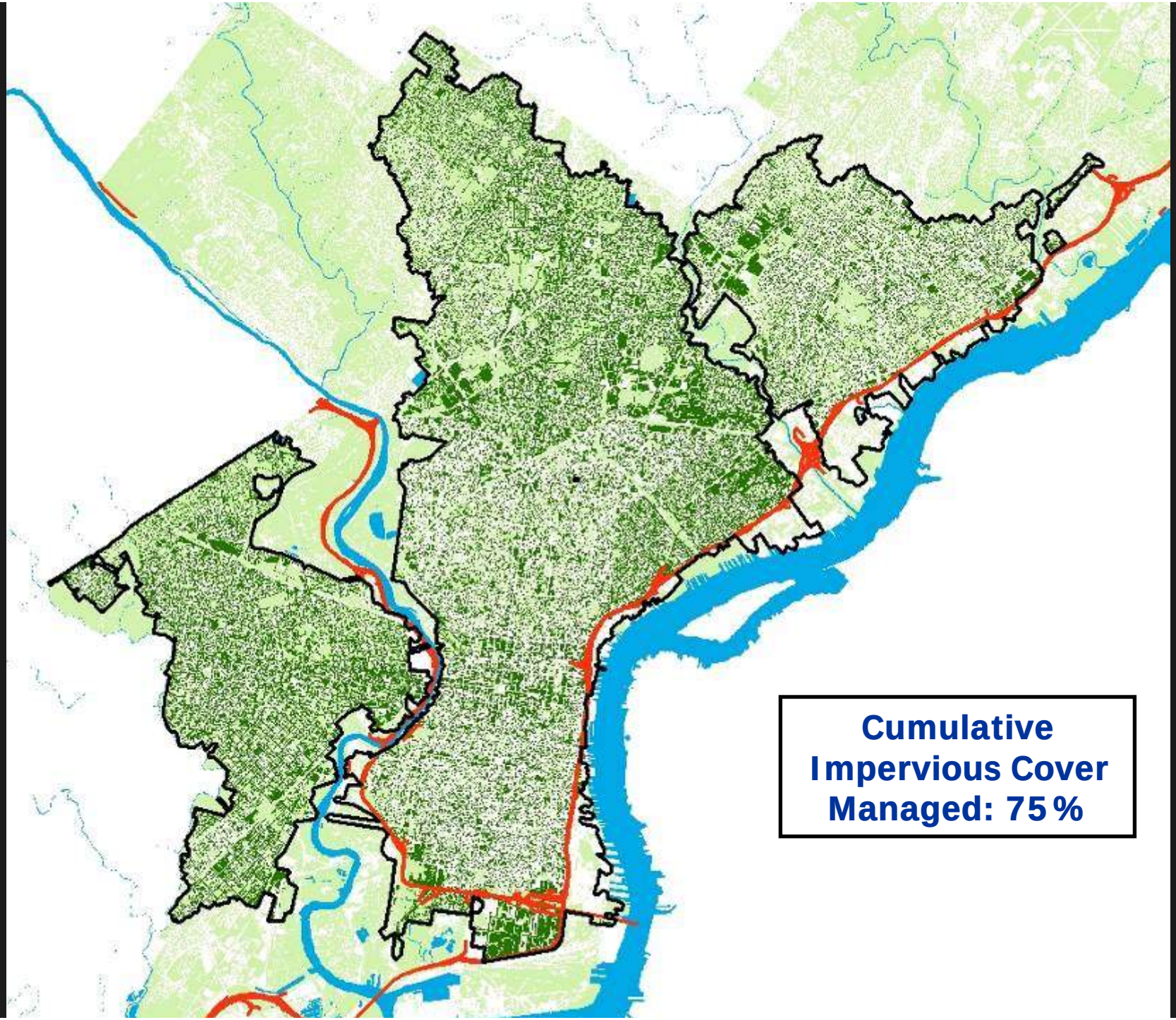
Green Infrastructure Program



- Existing Conditions

Cumulative Impervious Cover Managed: < 5%

Green Infrastructure Program

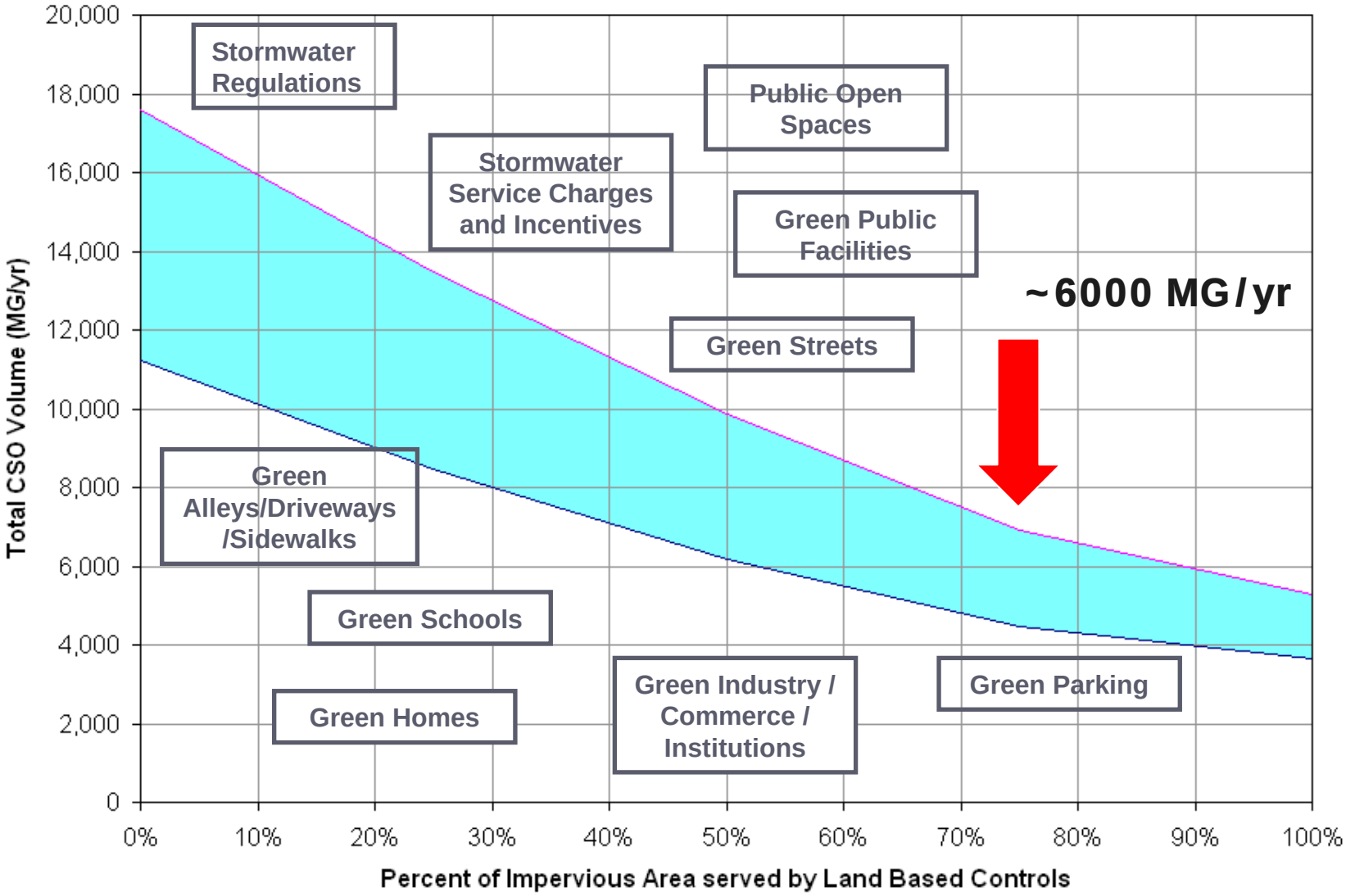


Cumulative Impervious Cover Managed: 75%

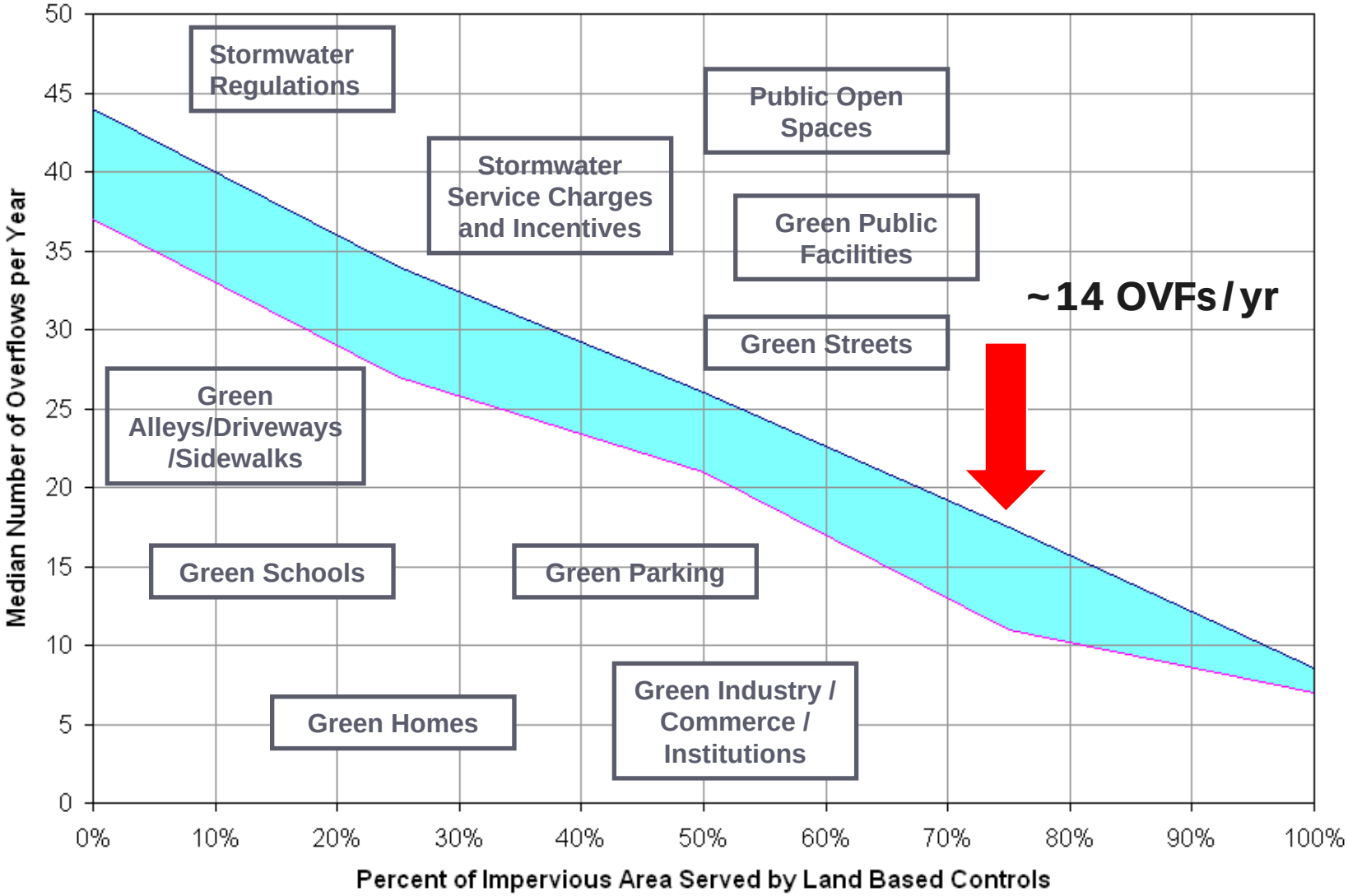
Green Infrastructure Elements Considered as LTCPU Alternatives

- Private Lands Program
  - Industrial
  - Commercial
  - Institutional
  - Homes
  - Parking
  - Alleys, Driveways and Walkways
- Public Lands Program
  - Streets
  - Schools
  - Public Facilities
  - Open Spaces

Green Infrastructure Program



Green Infrastructure Program



Regulatory Tools

- **PWD Stormwater Regulations** (for new construction and redevelopment)
  - Trigger the regulations at 5000 sq ft or 2000 sq ft ?
- **Parcel-Based Stormwater Billing**
- **Amended Code**
  - Plumbing Code
    - Allow disconnection of rain leaders to new stormwater control infrastructure
    - Allow use of Rain Barrels
  - Building Code
    - Investigate building code regarding roof live- and dead-load requirements and the relationship to green roofs
  - Zoning Code
    - Buffers, setbacks, tree canopy, parking requirements, and/or planted spaces
- **Amended Regulations**
  - PWD Regulations
    - Require management of runoff from all new public streets and sidewalks
- **Spec Development**
  - Fairmount Park Specifications
    - Tree plantings
  - Streets Department Specifications
    - Porous asphalt and pavements

New Stormwater Regulations

Maintain Groundwater Recharge → Infiltrate 1.0 inch

Maintain W-Q → Remaining Volume from 1”

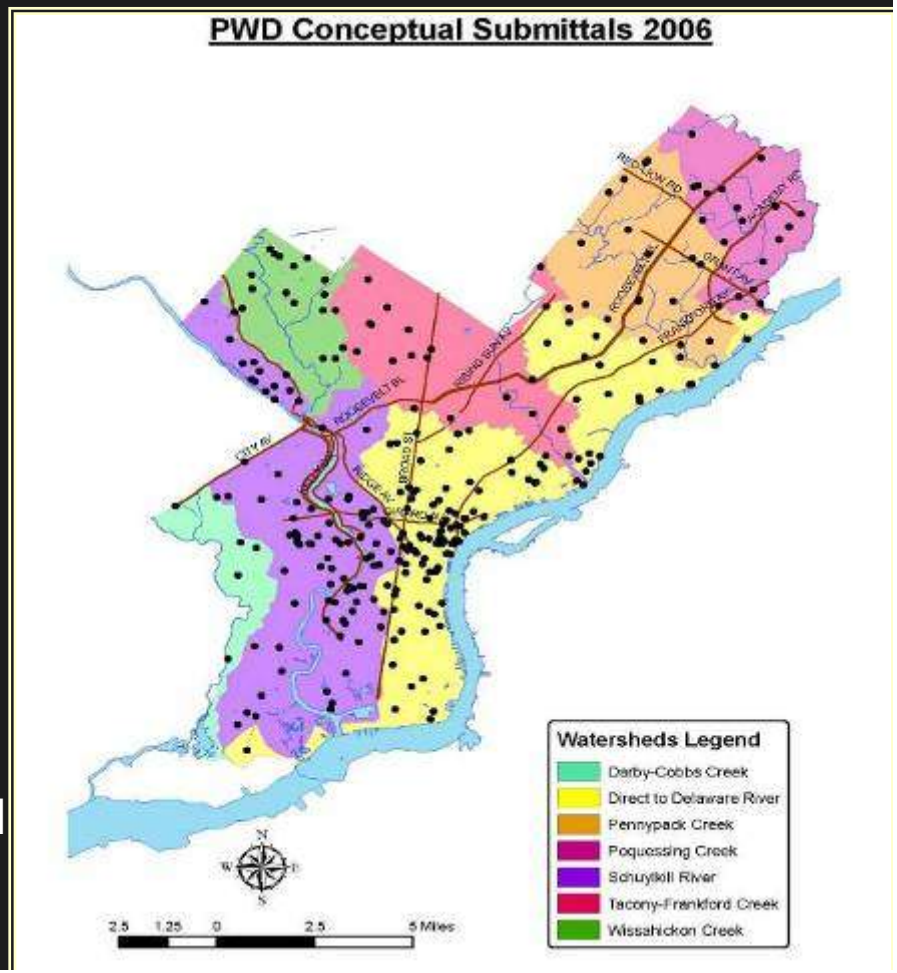
Prevent Streambank Erosion → 1-yr, 24hr Detained, 24hrs

1” Total from IMP Area

Earth Disturbances > 15,000 sq ft

***1000+ acres of land managed to date**

***20+ Green Roofs – Passed Conceptual Phase of Plan Review**



Stormwater Plan Review Reduced The City's Runoff by 908 Million Gallons Per Year

- That's a volume equal to the block of City Hall 370 feet Deep. (drawn to scale)
- A 3% reduction in citywide runoff
- Up to <u>$425 Million</u> in infrastructure capital costs saved
- Up to <u>$80 Million</u> in additional future operation and maintenance costs saved

Parcel Based Billing

Top 500 Parcels in the Combined Sewered Area make up 12.3% of total impervious area

Gross Area = 599,744
Imperv Area = 491,035

Existing Charge = $ 377.23
New Charge = $ 2,496.42

Typical property with increased stormwater fee – large site, small meter

Administrative Tools

- Stormwater Billing Credits
- Green Permit Expediting
- Encourage LEED certification
- Emphasize the stormwater aspects of LEED
- Apply Stormwater Regulations as sites redevelop or renovate
- Watershed Mitigation Registry
- Demonstration Projects & Programs
- Cost-Sharing (PWD pays difference)
- Full-Cost (for integral locations)
- Rate incentives
- Tax incentives
- Grant programs
- Low income assistance
- Education & Workshops

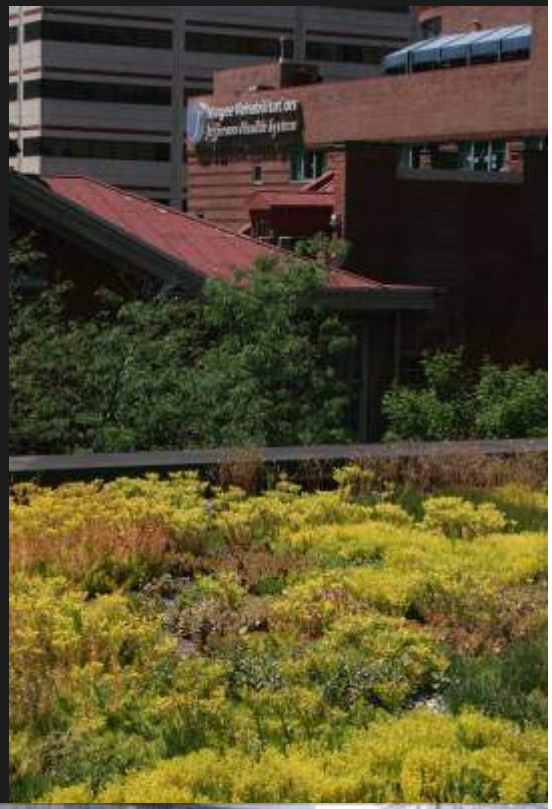
Potential Partners

- **Philadelphia Streets Department**
- Fairmount Park Commission
- Philadelphia Department of Recreation
- Philadelphia Airport
- Philadelphia Office of Housing & Community Development
- Philadelphia Housing Authority
- **Philadelphia Parking Authority**
- Philadelphia Department of Public Property
- Philadelphia Parking Association
- Pennsylvania Department of Transportation
- Special Services Districts
- Philadelphia Department of Commerce
- Philadelphia Public Schools
- Capital Programs Office
- Sports Facilities & Convention Center
- Police
- Fire
- Library
- Homeowner Associations
- **Developers** Private Schools
- Community College of Philadelphia
- Universities and Colleges
  - Drexel
  - LaSalle University
  - St. Joseph's University
  - Temple University
  - University of Pennsylvania
  - University of the Sciences in Philadelphia
- Neighborhood Groups and Associations
- Community Development Corporations
- Watershed Partnerships

- Many, many more……

Private Lands – Industry/Commercial/Institutional

→ Green Industry/Commercial/Institutional



- Concept
  - Represents **10%** (5 Ind, 4 Comm, 1 Instit) of all impervious cover in combined system
  - Require compliance with **Stormwater Regulations**
  - Retrofit at least 25 large properties per year
  - 1.0% redevelopment projection per year
- Results by 2069?
  - **95%** of Industry/Comm/Institutions
- Major Tools
  - **Parcel-Based Stormwater Billing**
  - **Enhanced LEED Certification**
  - **Grants and Tax Abatement**
- Major Partners
  - Commerce Department
  - NGOs, Hospitals, Churches, Stadiums, Univ., etc.

Private Lands – Homes

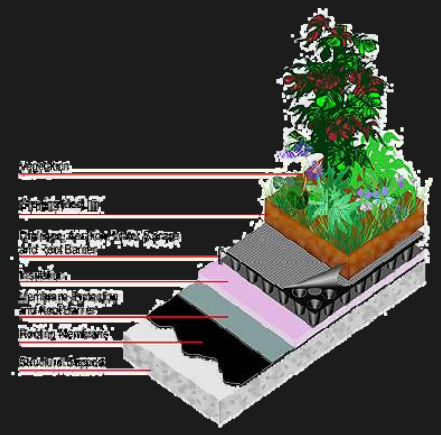
→ Green Homes

- Concept
  - **25%** of the City's impervious cover in the combines system is associated with residential rooftops
    - Low Cost - Rain barrels & Rain gardens
    - Higher Cost - Porous sidewalks, driveways and walkways / Green roof

- Major Tools
  - **Structural Engineering Analysis**
  - Amended Plumbing Code
  - Amended Building Code
  - The Alleys!!!
- Results by 2069?
  - **50%** of all homes
- Major Partners
  - Neighborhood Groups and Associations
  - Community Development Corporations
  - Watershed Partnerships
  - Pennsylvania Horticultural Society

Private Lands – Homes

Credit: Maurer, City of Linz



Private Lands – Homes

From 4 Private Developments (McDonald Developments)

Private Lands – Parking

→ Green Parking

- Concept
  - Parking lots represent almost **19%** of the City's impervious cover in the combined system
  - Numerous Retrofit Opportunities
  - Reduced summer temperatures
  - No Parking loss during and after storms due to standing water
  - Appearance improvements in commercial and business districts
- Major Tools
  - **Amended Zoning Code**
    - Require buffer, setback, and/or planted space be utilized to manage runoff
    - Require a set tree canopy cover
- Results by 2069?
  - **80%** of all Parking
- Major Partners
  - Philadelphia Parking Authority
  - Philadelphia Department of Public Property
  - Philadelphia Parking Association

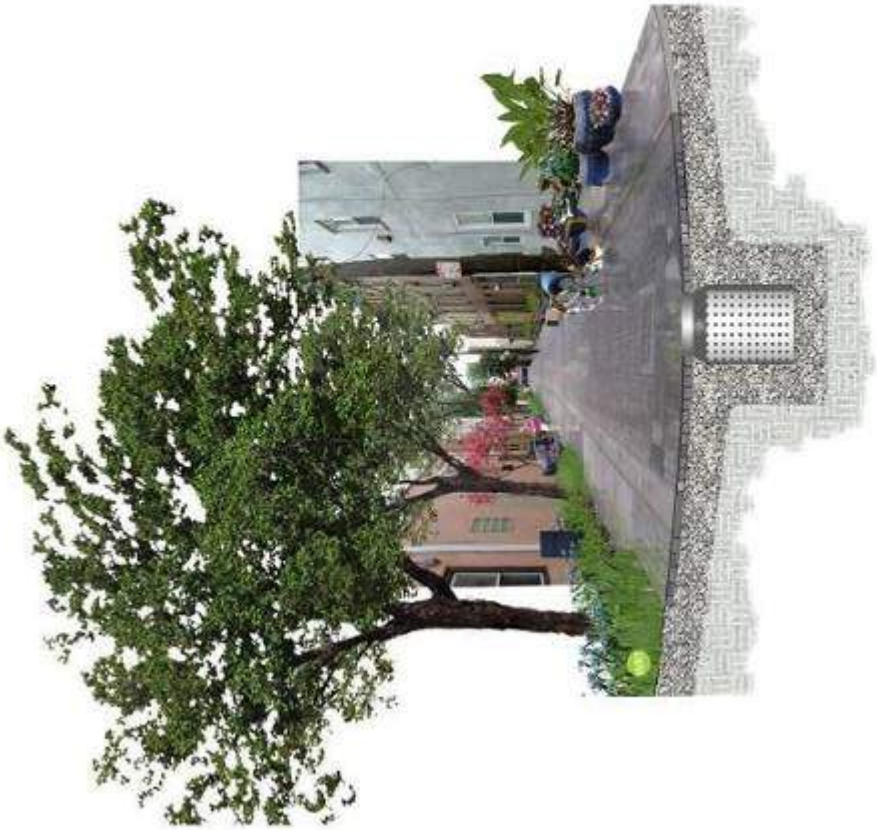
Private Lands – Parking

Morris Arboretum - Philadelphia, PA

Conventional Asphalt

Porous Asphalt

Tropical Storm Floyd, September 1999



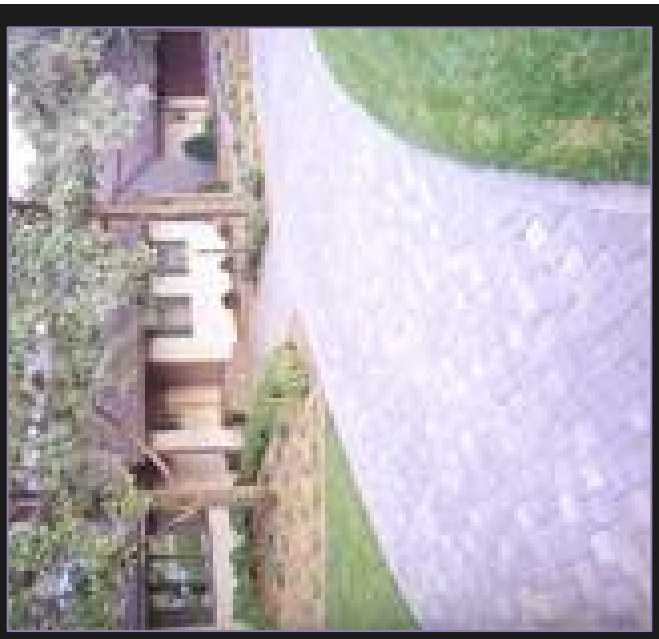
Private Lands – Alleys/Driveways/Sidewalks

Private Lands – Alleys/Driveways/Walkways

→ Green Alleys, Driveways & Walkways

- Concept
  - Alleys and Driveways represent **2%** of City's Impervious Cover
  - Manage stormwater while improving aesthetics
  - Potential flow pathways for harvested rainwater
  - Infiltration or conveyance of stormwater to the end of the alleys or walkways
- Major Tools
  - **Amended Streets Department Specifications**
    - Allow or require porous asphalt or other porous pavement for alleyways and driveways
- Results by 2069?
  - **50%** of all Alleys/Driveways
- Major Partners
  - Philadelphia Streets Department
  - Philadelphia Housing Authority
  - Homeowner Associations
  - Developers (nonprofit and for-profit)

Chicago's Green Alley Program



Sulzberger Outdoor Classroom - Philadelphia

Private Lands – Alleys/Driveways/Walkways

Green Infrastructure Elements Considered as LTCPU Alternatives

- Private Lands
  - Industrial
  - Commercial
  - Institutional
  - Homes
  - Parking
  - Alleys, Driveways and Walkways
- **Public Lands**
  - **Streets**
  - **Schools**
  - **Public Facilities**
  - **Open Spaces**

Public Lands – Streets

→ Green Streets

- Concept
  - Streets represent **37%** of the impervious cover within the combined system
  - Variety of approaches for all types of streets - Increasing tree cover, use of pervious pavements, stormwater planters, and underground infiltration/evapotranspiration/retention facilities
    - During:
      - Storm Flood Relief construction
      - Water & Sewer repair/replacement
      - Utility construction (cable, gas, electric)
      - City Street retrofit during Repaving
      - Sidewalk Retrofits – Replacement Grant Program
- Major Tools
  - **Amended Stormwater Regulations**
    - Require management of runoff from all new public streets and sidewalks
  - Amended Streets Department Specifications
  - Amended Fairmount Park Specifications
- Results by 2069?
  - **80%** of all Streets
- Major Partners
  - Philadelphia Streets Department / PaDOT
  - Philadelphia Department of Commerce

SEA Streets - After Construction
2nd Ave NW - NW 117th St to NW 120th St

Public Lands – Streets

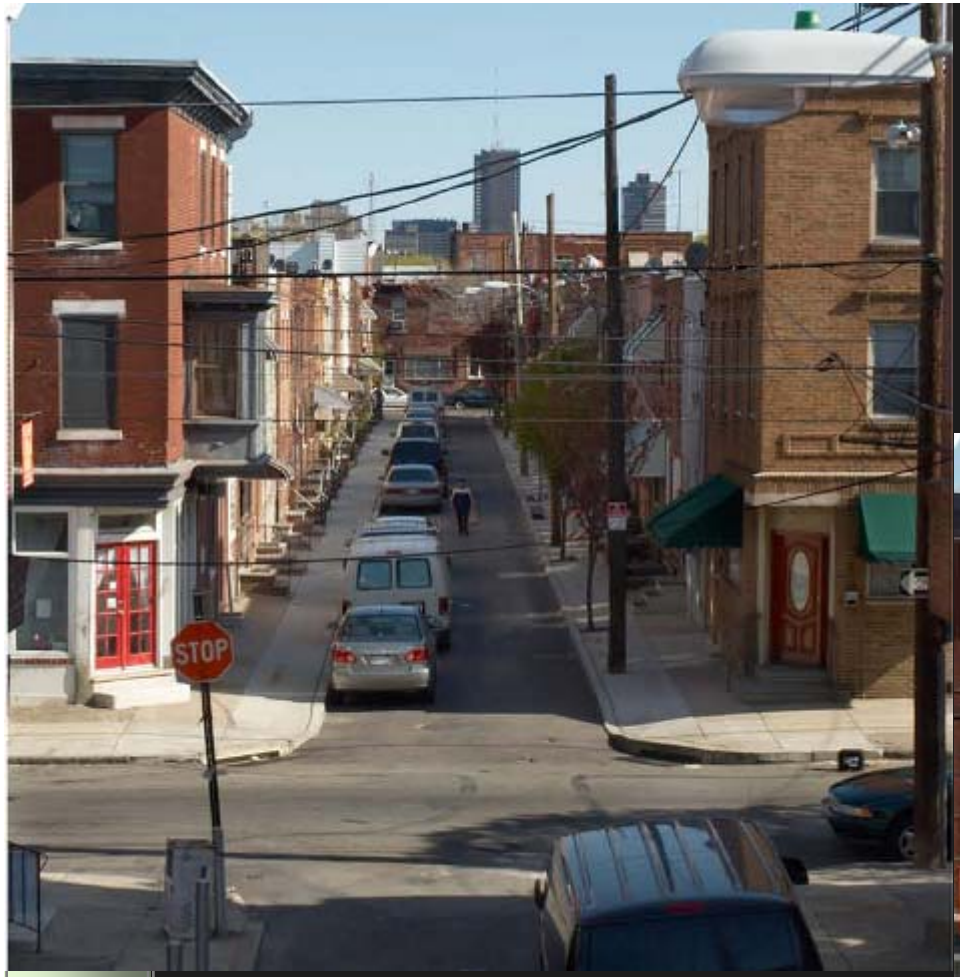
GREEN STREETS

Near Term Goals

Category	*Estimated Number of Projects*	*Estimated Impervious Area Managed (ac)*	*Estimated Cost (million)*
PWD Facilities	6	17.5	$4.5
Other City Facilities	6	4.6	$1.2
Parks & Recreation	15	57.4	$15.0
Philadelphia School District	10	11.7	$3.1
Universities	5	10.1	$2.6
Other	5	5.0	$1.3
TOTAL	47	106.3	$27.7

$260 k / acre

Public Lands – Streets


STOP

→ Green Schools

▸ Concept

- Represents **2%** of City's impervious cover in the combined system
- Highly visible locations associated with education
- Transforms heat trapping asphalt surfaces into cooler, green islands
- Capture local universities ambitious sustainability initiatives

▸ Major Tools

- **Design Standards & Design Assistance**
- Cost-Sharing & Full Cost
- Stormwater Bill Credits

▸ Results by 2069?

- **100%** of all Schools

▸ Major Partners

- Philadelphia Public Schools
- Private Schools
- Community College of Philadelphia

Public Lands - Schools

GREEN SCHOOLYARDS

Near Term Goals

Category	*Estimated Number of Projects*	*Estimated Impervious Area Managed (ac)*	*Estimated Cost (million)*
Philadelphia Schools	35	94.1	$20.5
Universities	7	19.5	$5.1
TOTAL	**42**	**113.6**	**$25.6**

$225 k / acre

Public Lands – Public Facilities

→ Green Public Facilities

- Concept
  - Represents **1%** of impervious cover in the combined system.
  - Retrofit all facilities to meet the new stormwater regulations.
  - Develop cooperative greening initiatives with Rec / Fire / Police / Library / Airport / etc.
- Major Tools
  - **Parcel-Based Stormwater Billing**
  - Full Cost
- Results by 2069?
  - **100%** of all Public Facilities
- Major Partners
  - Police / Fire / Free Library
  - Department of Recreation
  - Streets Department
  - Fairmount Park Commission
  - Airports
  - Sports Facilities
  - Convention Center

Venice Island Storage Tank

Public Lands – Public Facilities

Public Lands – Public Open Spaces

→ Green Public Open Spaces

▸ Concept

- Represents **4%** of City's impervious cover in the combined system
- The routing and managing stormwater from the surrounding areas where this can be done without adversely impacting the function of the public land itself.
- Vacant and Abandoned lands
  - Converted to pervious areas or that the SW regulations are implemented
- Bikeways/Trails designed for zero stormwater discharge
- Wetland creation/restoration and stream restoration near Park land
- Golf Courses and Plazas designed to manage stormwater

▸ Major Tools

- **Revision of Stormwater Ordinance**
  - Apply regulations to disturbance of 5000 square feet or more
- **Watershed Mitigation Registry**

▸ Results by 2069?

- **50%** of all Open Public spaces

▸ Major Partners

- Fairmount Park Commission
- Philadelphia Department of Recreation
- Philadelphia Airport
- Philadelphia Horticultural Society

Public Lands – Public Open Spaces

PARKS, RECREATION AND OPEN SPACES

Near Term Goals

Category	*Estimated Number of Projects*	*Estimated Impervious Area Managed (ac)*	*Estimated Cost (million)*
Street Runoff Diversion	3	8.9	$2.0
Community Gardens/ Urban Farming	10	3.0	$1.0
Stormwater Parks	3	8.1	$3.0
TOTAL	**16**	**20.0**	**$6.0**

$300 k / acre

Triple Bottom Line

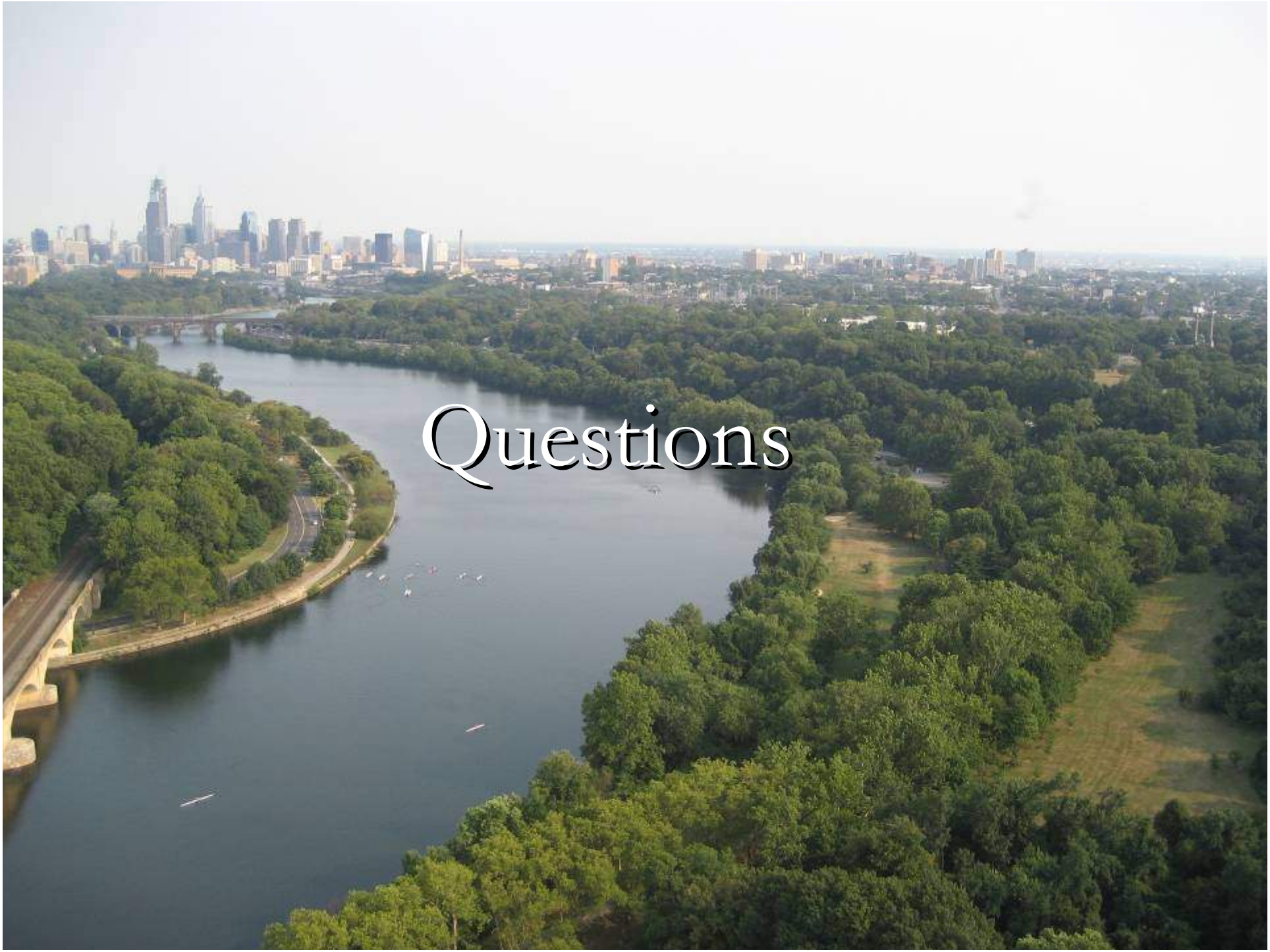
Two Alternatives in the Tookany/Tacony Watershed – 50% Green vs. 30' Diam. Tunnel

Natural Unit Benefits for TTF: Cumulative through 2049		
Benefit Categories	**Green 50%**	**Grey 30'**
Additional Creekside Recreational User Days	10.2 million	
Additional Non-creekside Recreational User Days	35.9 million	
Reduction in Number of Heat-Related Fatalities	18	
Electricity Savings Due to Cooling Effect of Trees	119.7 million kWh	
Natural Gas Savings Due to Cooling Effect of Trees	230.7 million kBtu	
Fuel Used (Vehicles for Construction and O&M)	(2.3 million gallons)	(530,000 gallons)
SO_2 emissions (metric tons)	(500 MT)	400 MT
NOx emissions (metric tons)	60 MT	1.0 million MT
CO_2 emissions (metric tons)	(220,000 MT)	74,000 MT
Green Collar Jobs	3,400 work-years	
Disruption Delay from Construction and Maintenance	(75,000 hours)	(113,000 hours)
Aquatic and Terrestrial Ecosystems	+	-
Water Quality Enhancement	+	+

Triple Bottom Line – In Dollars

Two Alternatives in the Tookany/Tacony Watershed – 50% Green ($400M) vs. 30' Diam. Tunnel ($1000M)

Present Value Benefit Estimates for Tookany-Tacony-Frankford Watershed		
Benefit Categories	**Green 50% (Alt 1a-2)**	**Grey 30 ft (Alt 2-4)**
Increased Recreational Opportunities	$ 41.8 million	
Reduction in Heat Stress Mortality	$ 93.5 million	
Energy Savings/Usage	$9.8 million	($1.3 million)
Air Quality Improvements from Trees	$ 51.2 million	
Reduced (Increased) Costs of SO_2 and NO_x Emissions	$14.5 million	($12.3 million)
Reduced (Increased) Costs of CO_2 emissions	$4.4 million	($1.3 million)
Social Costs Avoided by Green Collar Jobs	$27.8 million	
Improved Aesthetics/Property Value (50%)	$41.5 million	
Disruption Costs from Construction and Maintenance	($1.2 million)	($1.9 million)
Aquatic and Terrestrial Ecosystems	+	(-)
Water Quality Enhancement	+	+
Total	**$283+ million**	**($17+ million)**


Questions

Green Infrastructure Webcast Series

Tuesday, March 24, 2009
- Revising Local Plans, Codes & Ordinances.
- Water Harvesting

Tuesday, April 28, 2009
- Models & Calculators
- Municipal Case Study: Louisville

Tuesday, May 12, 2009
- Site Planning & Design Considerations
- Costs and WERF Cost Tool

Tuesday, June 23, 2009
- Funding & Incentives
- Brownfield Redevelopment

Tuesday, July 28, 2009
- Retrofits: Green Streets
- Operation & Maintenance

Participation Certificate

- If you would like to obtain participation certificates for multiple attendees, click the link below
- You can type each of the attendees names in and print the certificates

www.epa.gov/npdes/webcasts/certificate/gi_benefits.pdf