Clean Water … Green City

Blending interests of land and water

Howard M. Neukrug, PE
Director, Office of Watersheds

A NEW APPROACH

…to a SUSTAINBLE City!!

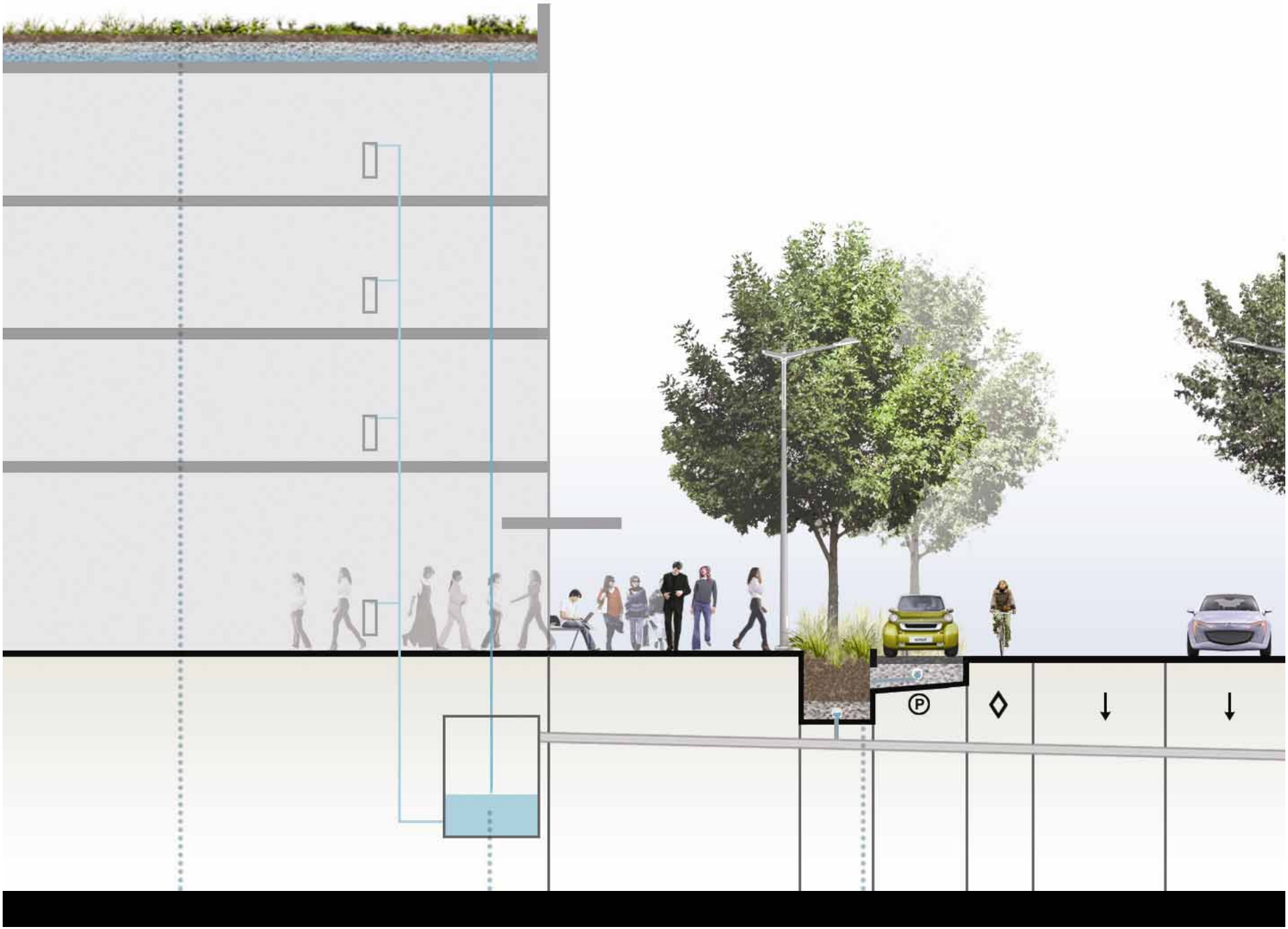
MSU Green Roof Research Program
(courtesy Old House Journal)

Green infrastructure is recognized as:

- Cost effective,
- Environmentally preferable, and
- An acceptable solution to:
  - Clean Water Act Goals
  - Sustainability City Goals
  - Global Warming Goals

Sustainable Site Design

Courtesy of WRT and PennPraxis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Courtesy of WRT and PennPraxis

The “Green Water” Utility

- Re-defining an industry
  - Environmental Stewards
  - Providers of Resource Management & Protection
  - Leaders in Sustainability and Green Design
  - Recognize our regional role and the importance of partnerships
  - Using very different approaches, strategies and priorities

Presentation Outline

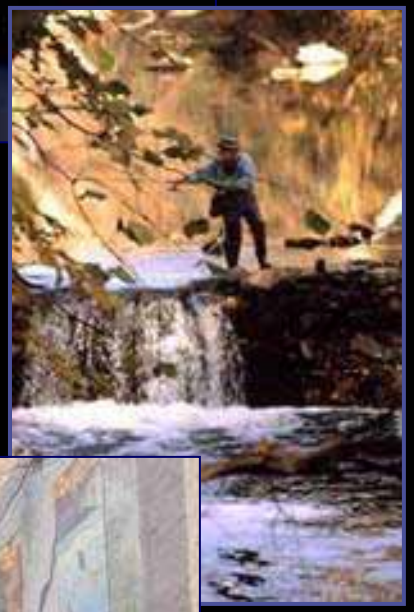
- **Wet Weather Management in Philly today**
- A vision for our future
- Anticipated degree of success
- Constraints and challenges
- Ideal outcomes

Philadelphia Water Department Office of Watersheds

- An integrated utility:
  - Drinking Water
  - Wastewater
  - Stormwater

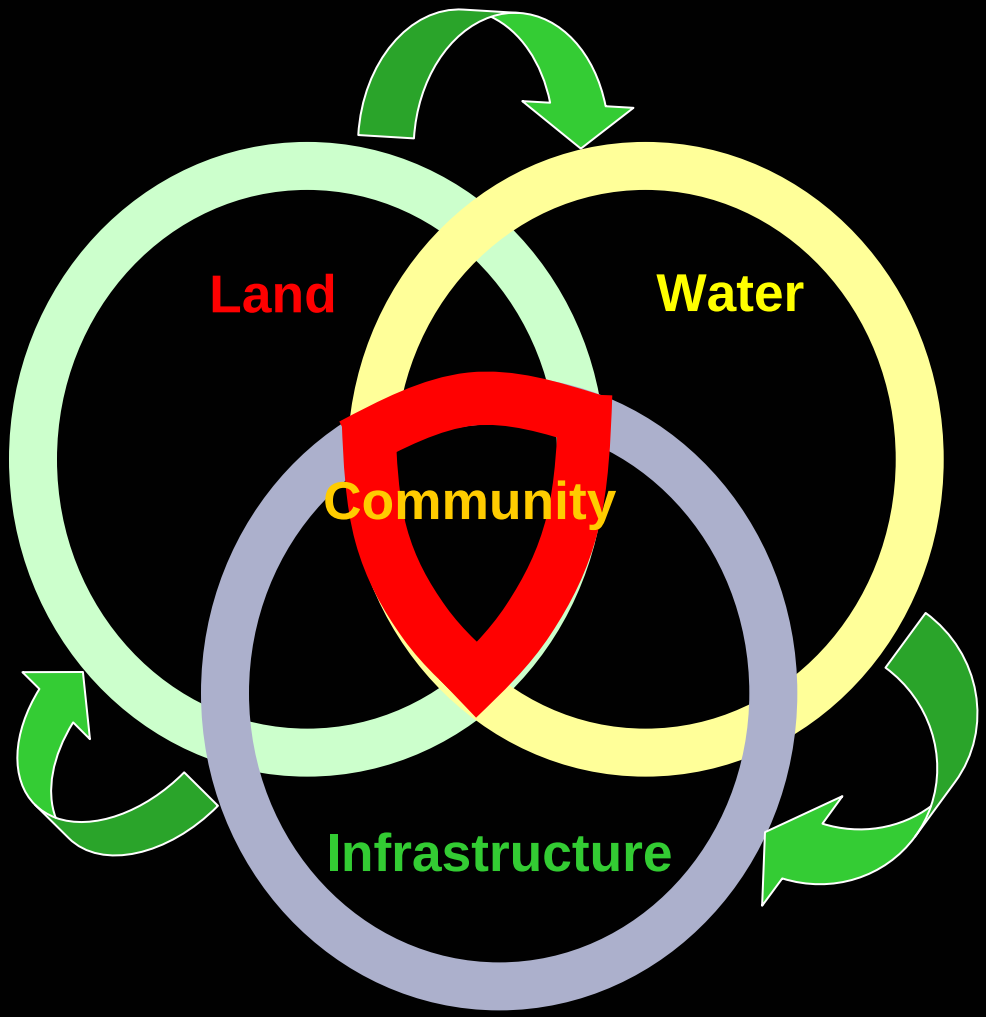
- A new integrated approach:
  - Land
  - Waterways
  - Infrastructure
  - Community

Clean Water … Green City



- Unite the City with its water environment
- Create a green legacy for future generations
- Incorporate a balance between ecology, economics and equity

Linking land and water



How to Manage Stormwater

Old Approach –

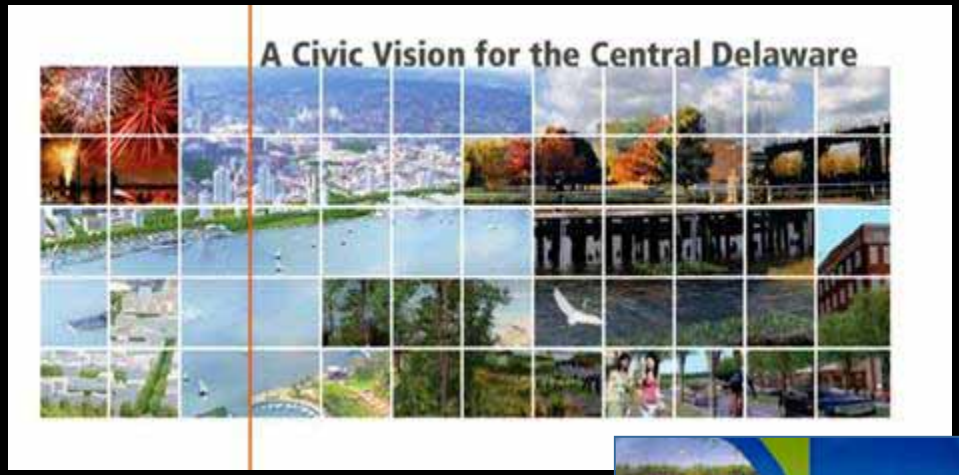
Collect it and pipe it away quickly!

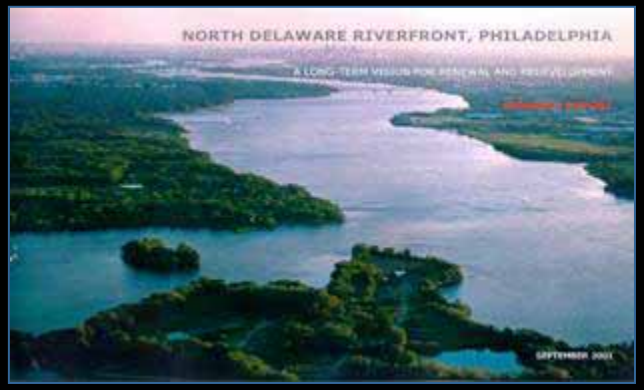
How to Manage Stormwater

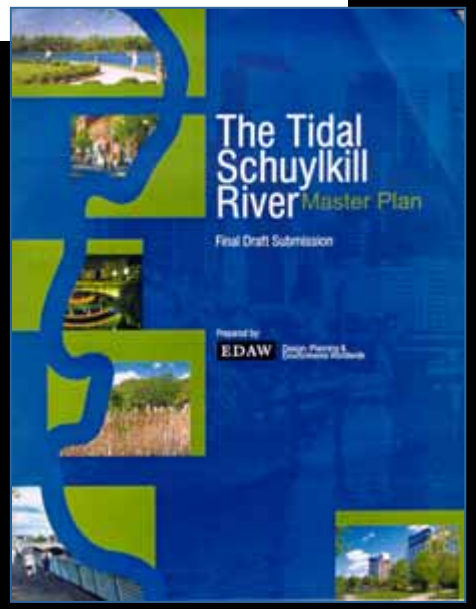
New Approach –

Privatize, decentralize, minimize waste, add value

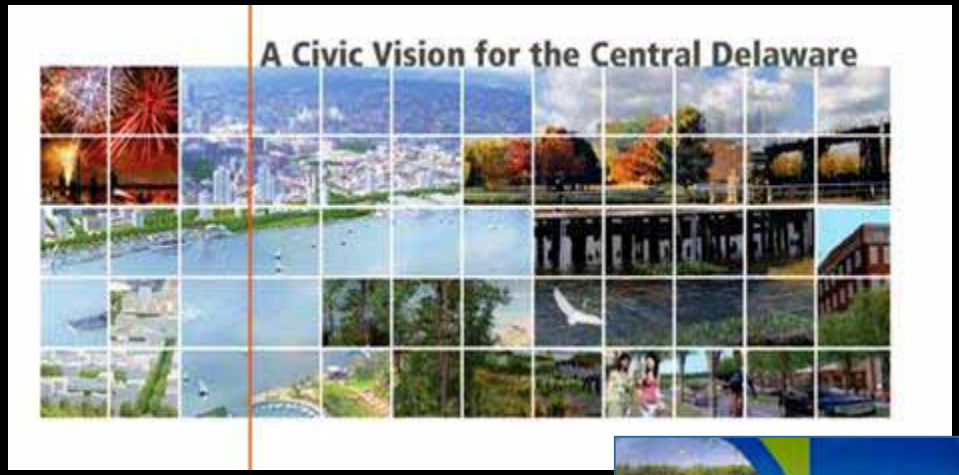
Managing Wet Weather in Philly today

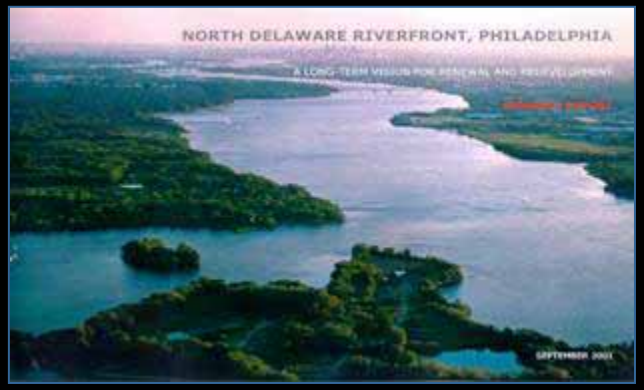






Managing Wet Weather in Philly today





Planning for land can improve our water

WATERWORK

Grand Prize Winner
Urban Voids Competition
The Van Alen Institute

Juliet Geldi
Chariss McAfee
Charles Loomis
Gavin Riggall

Philadelphia + vacant land + water = stormwater management + civic beauty + fun!

For more information: www.vanalen.org/urbanvoids
Project team contact: Charles Loomis, charlesl@loomismcafee.com

Planning for our water can improve our land

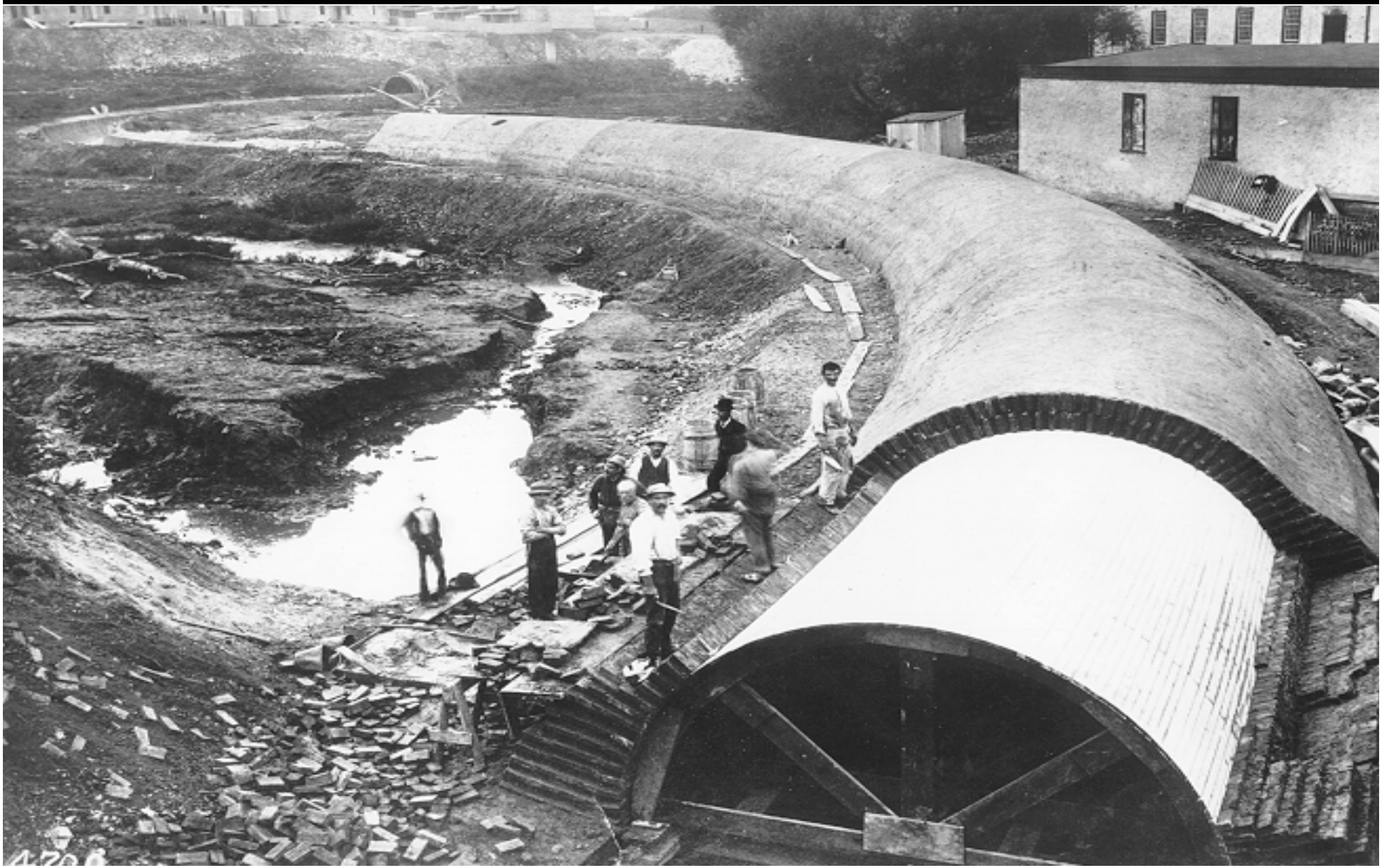
Civic Vision for the Central Delaware

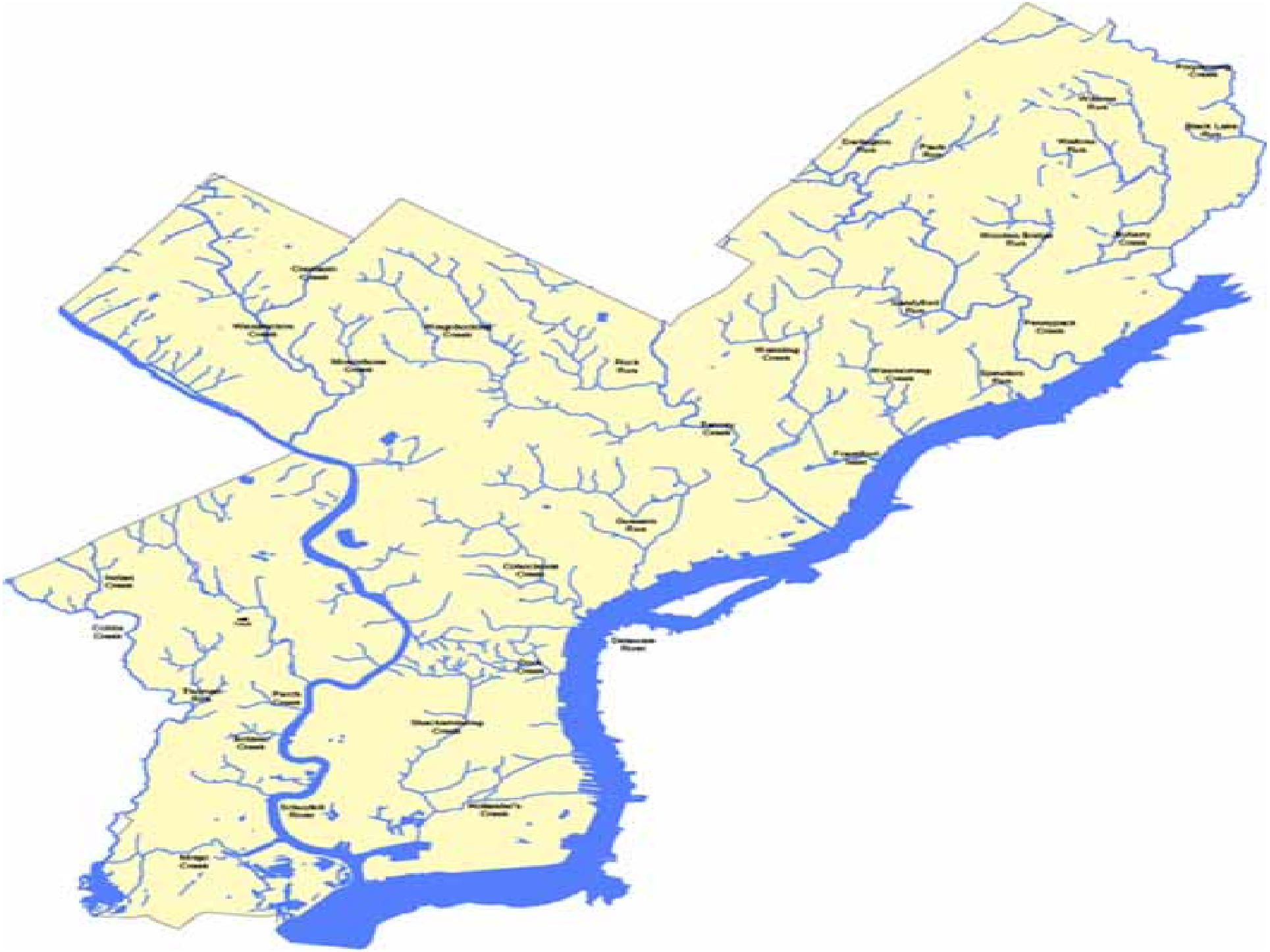
There are significant issues ahead of us for improving the water environment

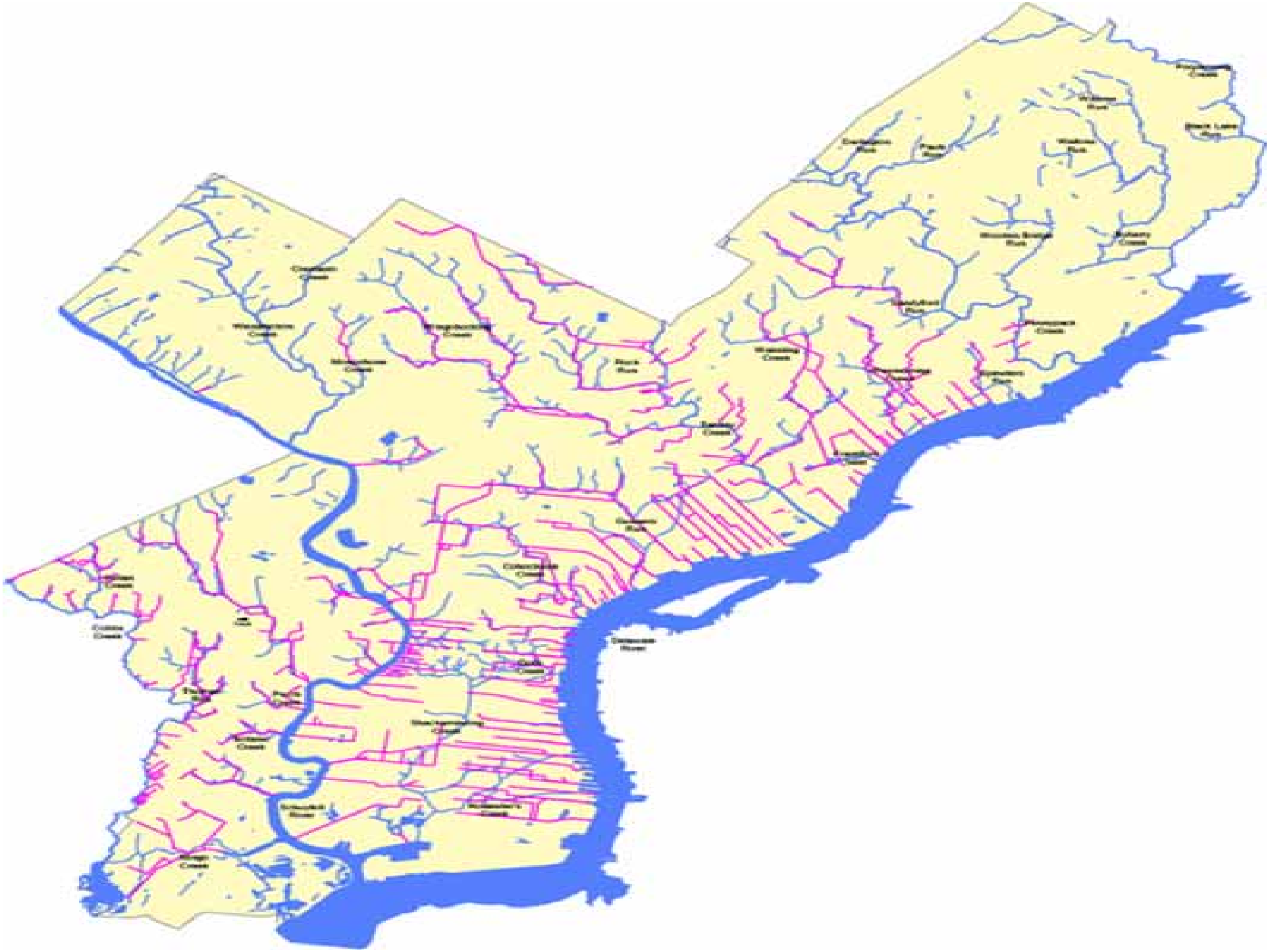
PLUS: LTCPU, 308 letter, state COA, new

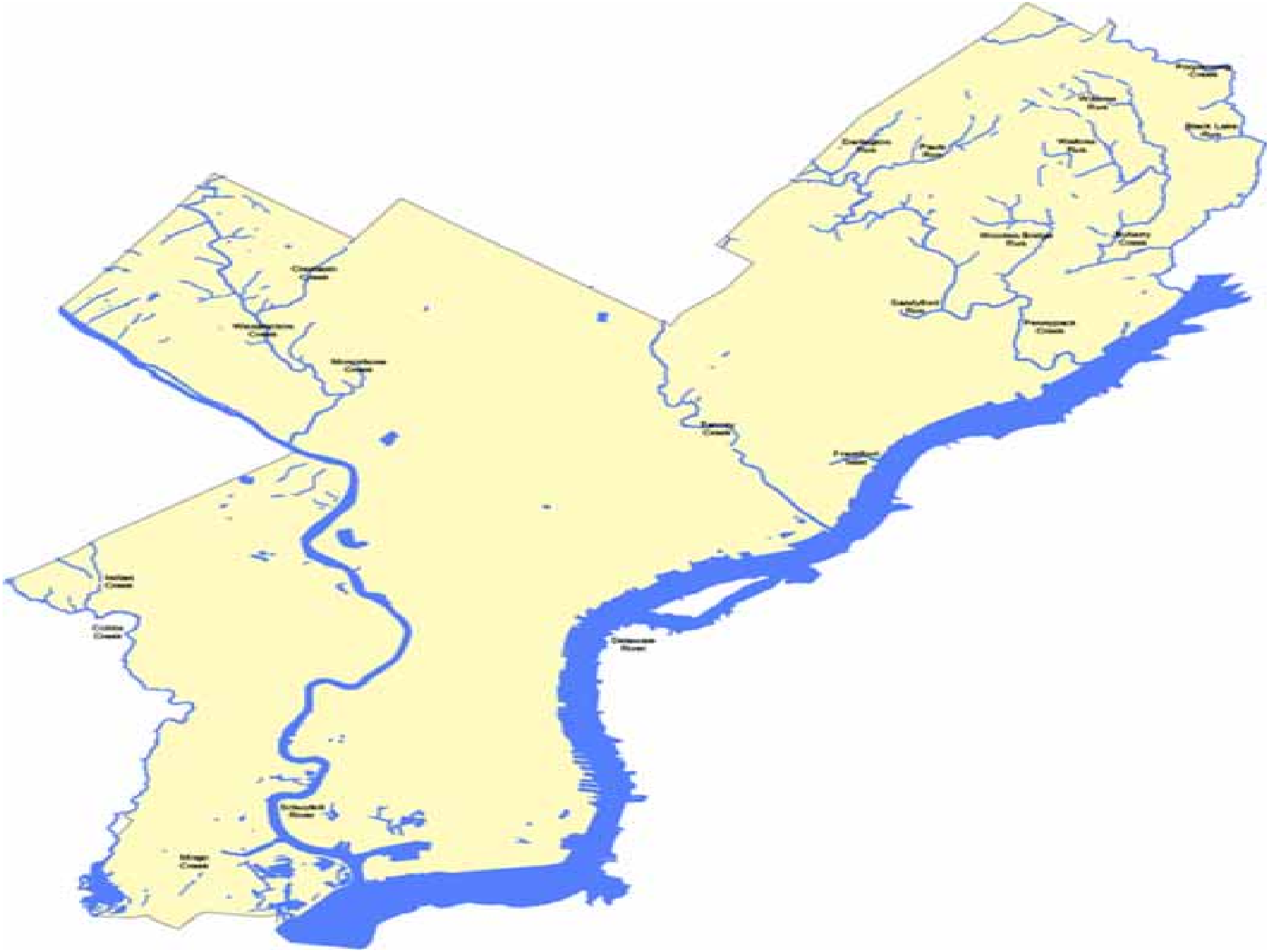

THE VIAGRA IN THE WATER MAKES ME WANT TO SWIM UPSTREAM, BUT THE PROZAC IS MAKING ME TOO TIRED...
Rx
WASTE

How did we get here?









How DYNAMITE streamlines streams

Straightening of Pequest River in New Jersey by CCC workers stopped its yearly floods. Section of new channel is seen at right. Note temporary dam at left to provide volume of water for scouring blasted channel.

Explosion of dynamite charge by propagation excavates new channel.

Immediately after explosion, water is entering new channel, whose banks will be smoothed and "stream-lined" by the speedier flow of water.

CROOKED STREAMS are a menace to life and crops in the areas bordering on their banks. The twisting and turning of the channel retards the flow and reduces the capacity of the stream to handle large volumes of water. Floods result. Crops are ruined. Lives are lost. Banks are undermined, causing cave-ins that steal valuable acreage.

In many instances straightening out a stream has doubled its capacity for disposing of run-off water.

DYNAMITE may be used most efficiently and economically in taking the kinks out of a crooked stream. The dynamite is loaded along the length of "cut-off" channel. When fired, the dirt and other debris is heaved high in the air and is scattered over the adjoining territory—leaving practically no spoil-banks. In addition to the material actually thrown out, much dirt is loosened and is later scoured out by the water which rushes swiftly through the straightened channel.

Du Pont Dynamite has straightened many thousands of miles of crooked streams. Du Pont engineers have worked for years to develop the best blasting methods for the cleaning out and straightening of streams. All their data is in a 48-page book, "Ditching with Dynamite." It is for your use. Write for it.

Dynamite can help you do other jobs, too. It can help you build highways, dams; fight soil erosion; work quarries. Du Pont has an explosive for every purpose.

DU PONT

E. I. du Pont de Nemours & Co. Inc.
Explosives Department
6107 du Pont Building
Wilmington, Del.

Crooked Streams are a menace to life and crops...

In addition, much of the dirt is loosened and later scoured out by the water ...which rushes swiftly through the straightened channel

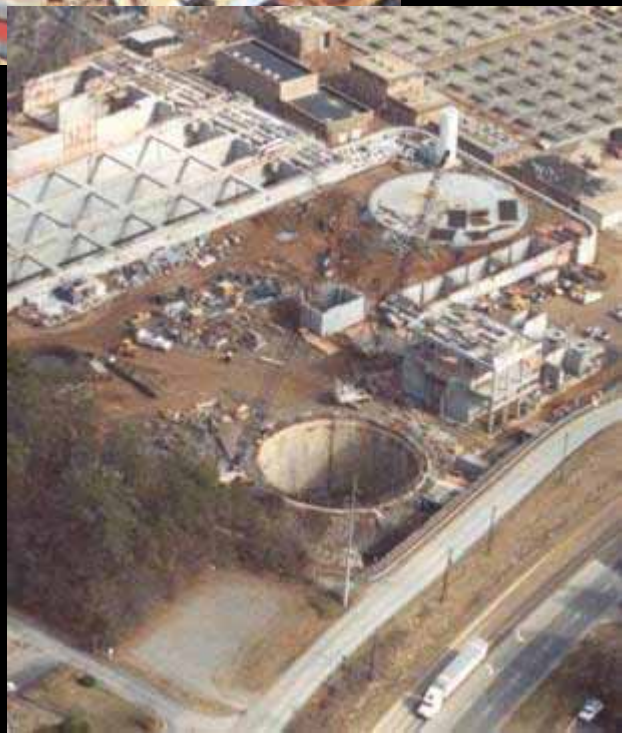
1200 Porter St.

2’-3” x 1’-6” Brick Sewer
Installed in 1894
Inspected on 10/21/06

Sewer in good condition. Low lateral connections seen.

Outfalls in South Philadelphia

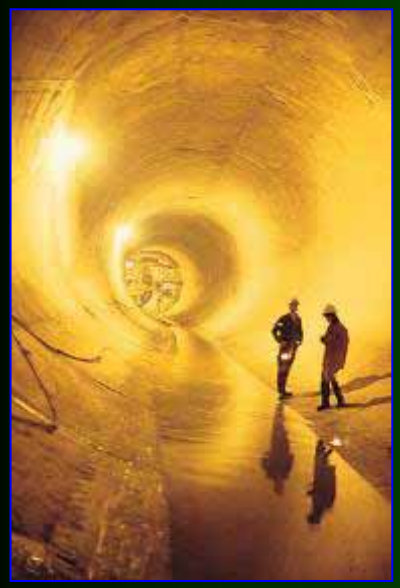
Today, Cities are expanding the GREY Infrastructure



Overflow Compliance Costs

	Washington	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	16
Compliance Costs	$ 2.65 Billion	$2 - $3 Billion	$ BILLIONS

Grey Infrastructure Solutions Green



Presentation Outline

- Wet Weather Management in Philly today
- **A vision for our future**

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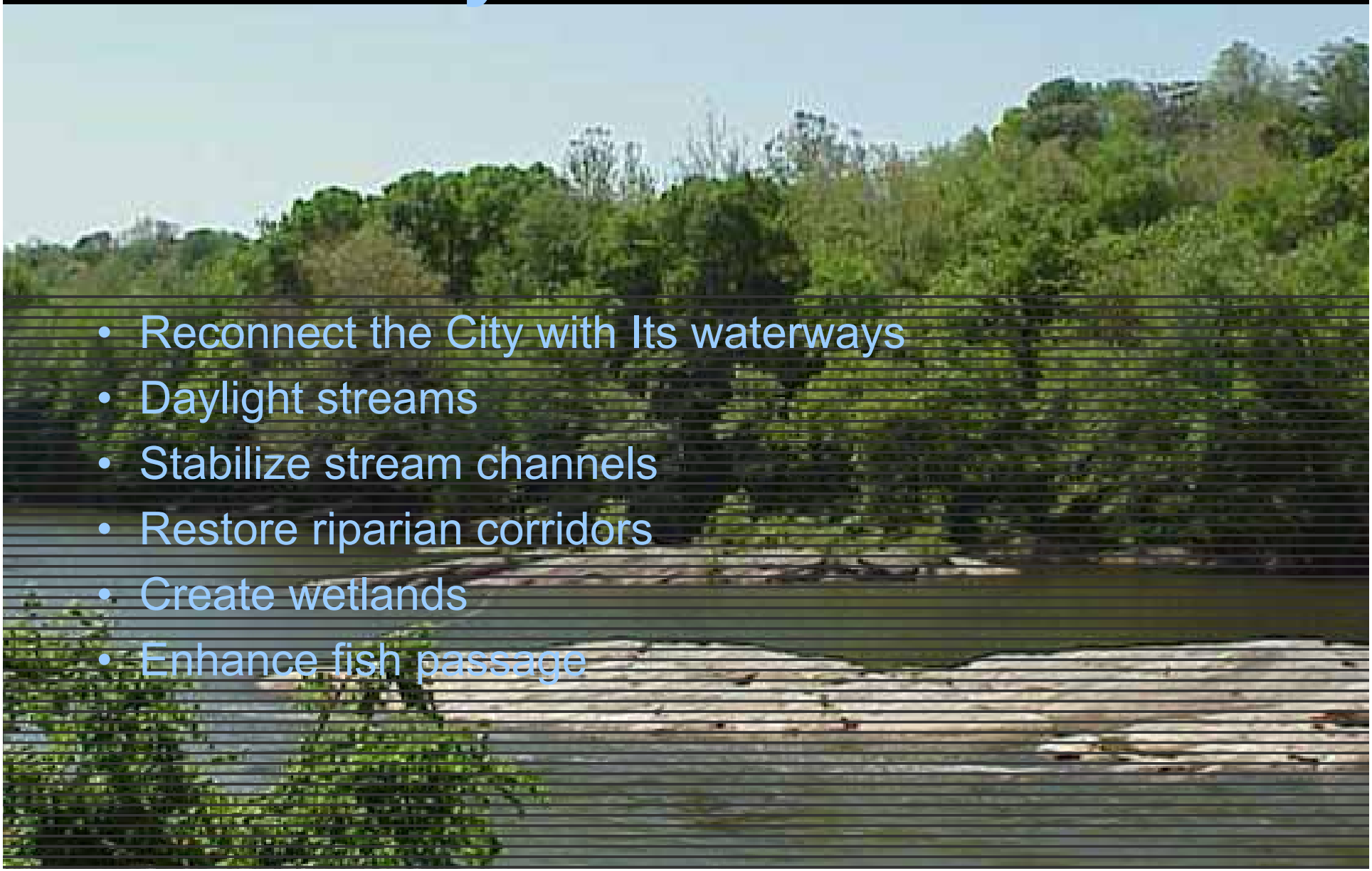
Waterways



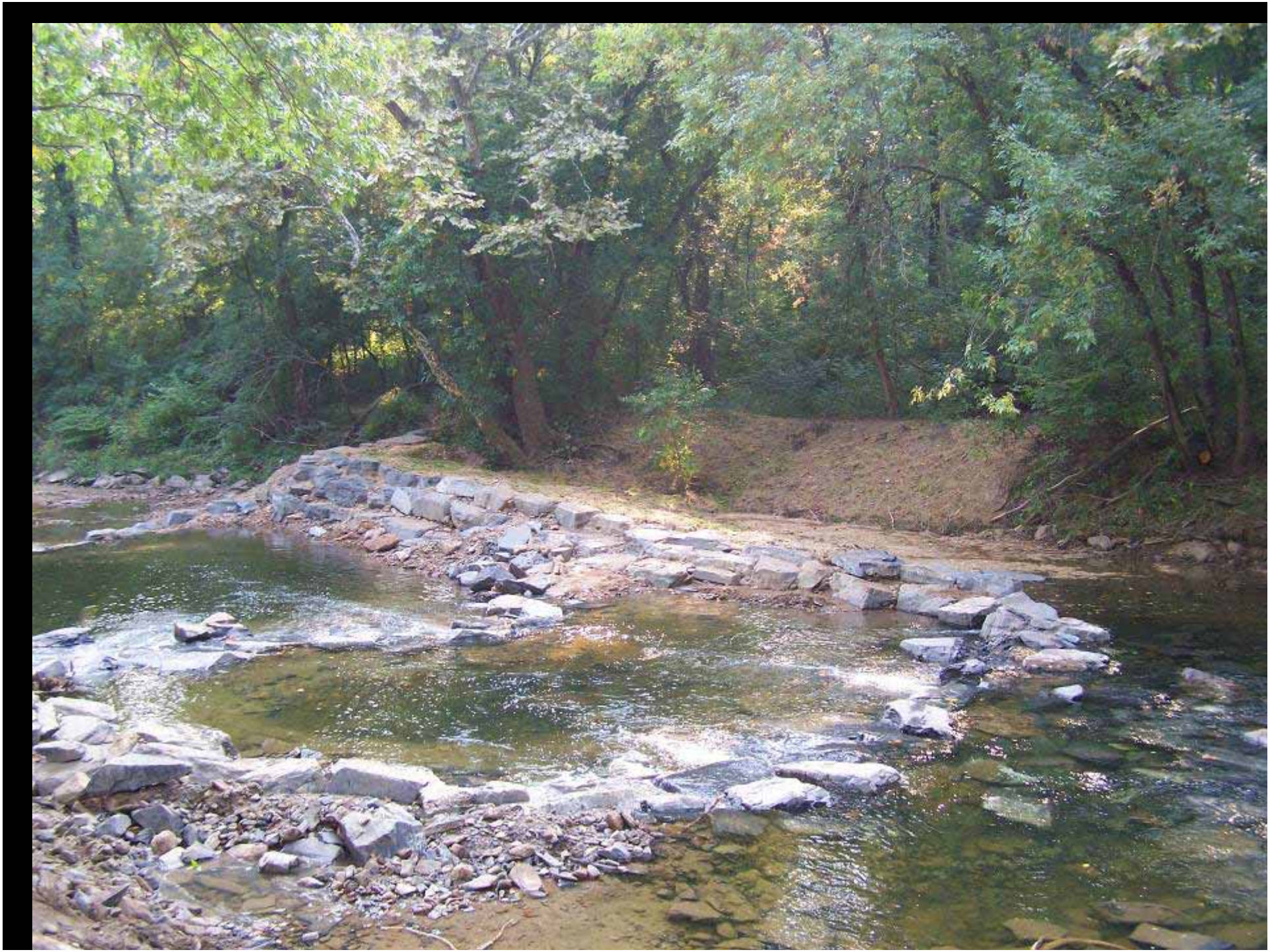
- Reconnect the City with Its waterways
- Daylight streams
- Stabilize stream channels
- Restore riparian corridors
- Create wetlands
- Enhance fish passage

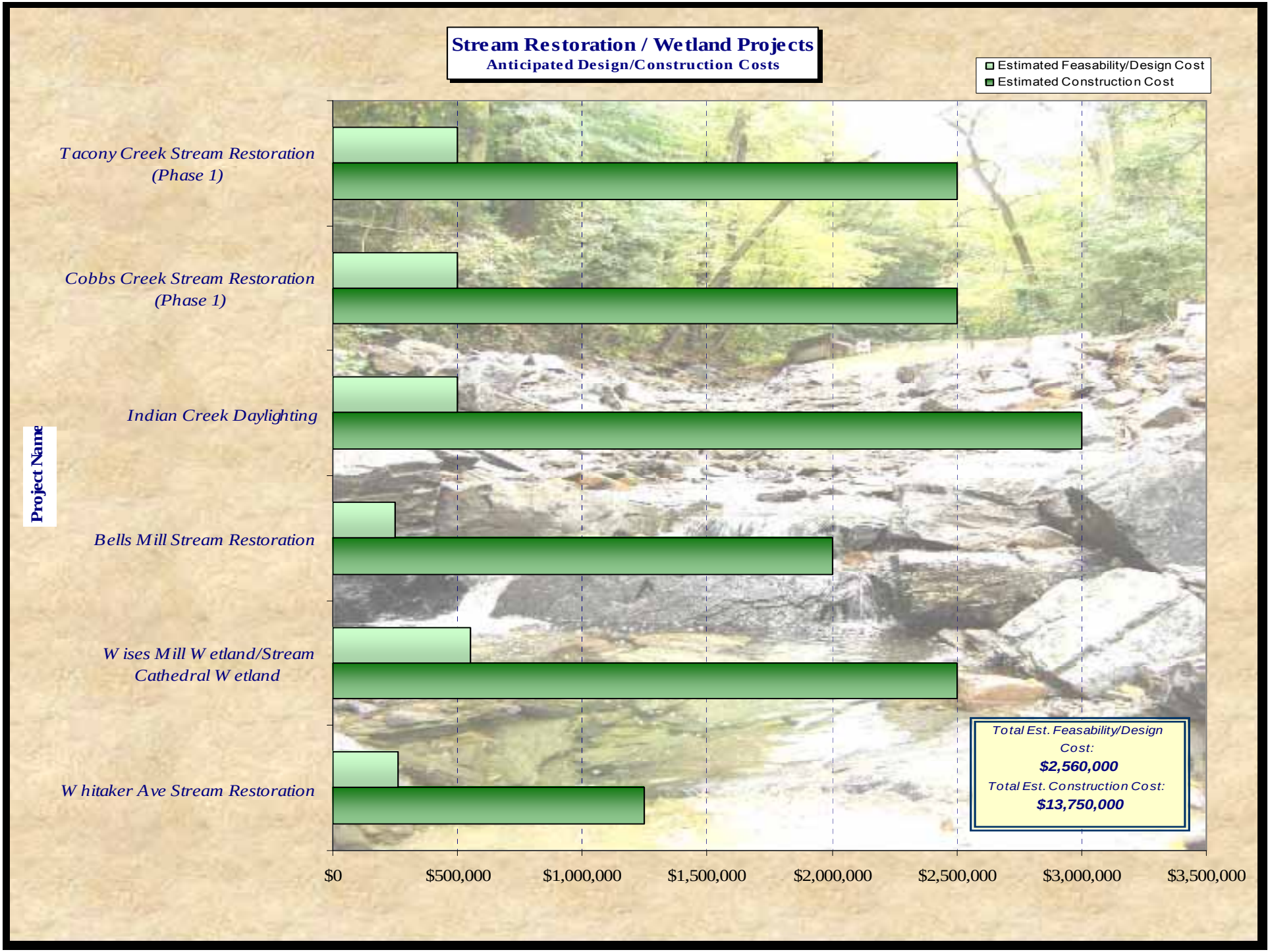

8/19/99
Marshall Road – Cobbs Creek

10-25-04

Saylors Grove Stormwater Wetland


3/30/2005
Lower Reach of Wises Mill




Stream Restoration / Wetland Projects
Anticipated Design/Construction Costs
Estimated Feasability/Design Cost
Estimated Construction Cost
Project Name
Tacony Creek Stream Restoration (Phase 1)
Cobbs Creek Stream Restoration (Phase 1)
Indian Creek Daylighting
Bells Mill Stream Restoration
Wises Mill Wetland/Stream Cathedral Wetland
Whitaker Ave Stream Restoration
$0
$500,000
$1,000,000
$1,500,000
$2,000,000
$2,500,000
$3,000,000
$3,500,000
Total Est. Feasability/Design Cost:
$2,560,000
Total Est. Construction Cost:
$13,750,000


McDonald's

A vision of our future utility

- Develop a new “core” value with a Green Focus to our Business Plan
- Encourage community-based environmental leadership and green jobs
- Create regional partnerships for growth and strength
- Make the best use of very limited environmental dollars
- Support Philly’s Sustainable Green City Movement
- Create links between our laws, regulations and codes
- Encourage employee diversity through belief in actions and environmental ethics

Presentation Outline

- Wet Weather Management in Philly today
- A vision for our future
- **Anticipated degree of success**

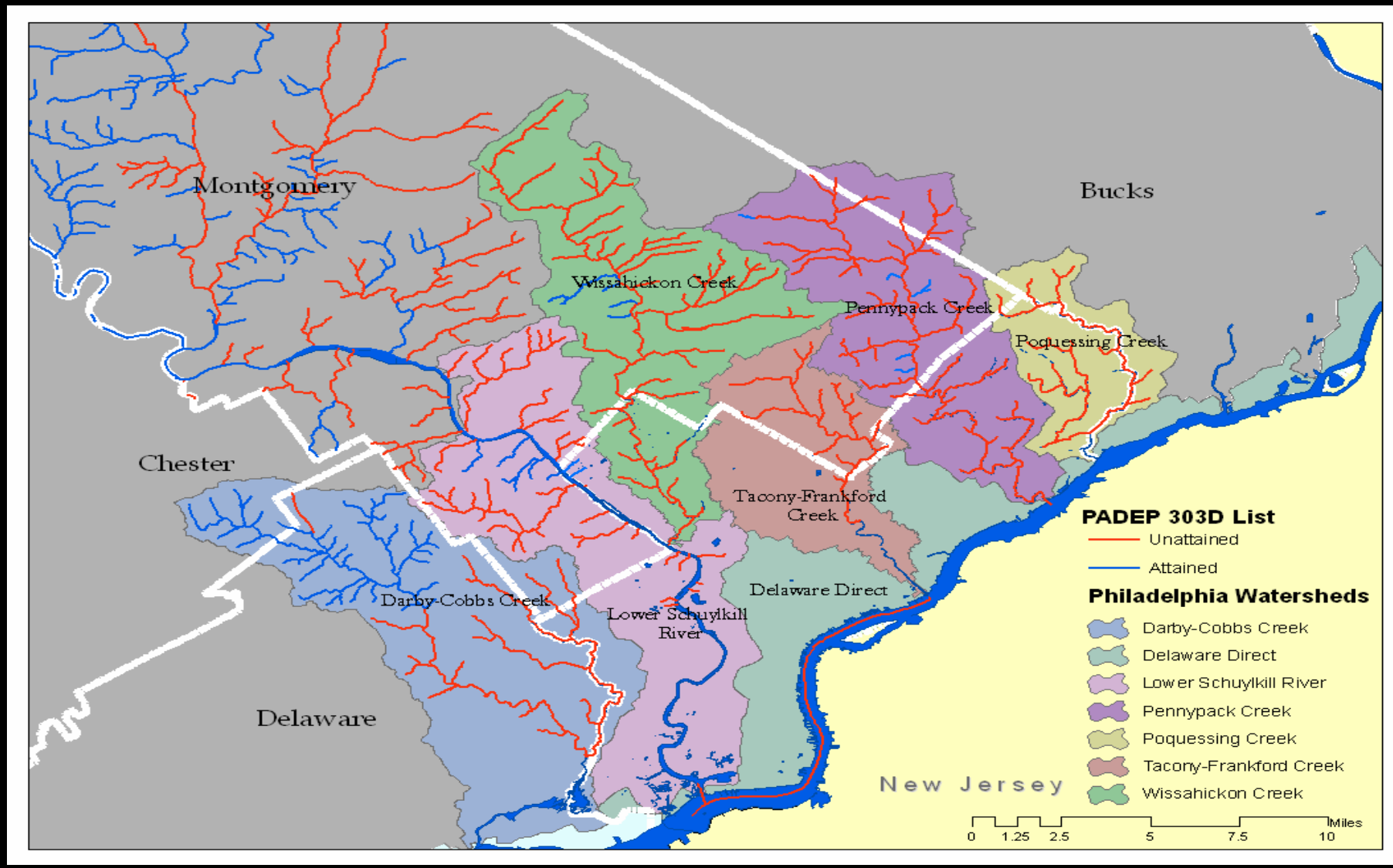
Presentation Outline

- Wet Weather Management in Philly today
- A vision for our future
- **Anticipated degree of success**
  - 100 % … Can we settle for anything less?

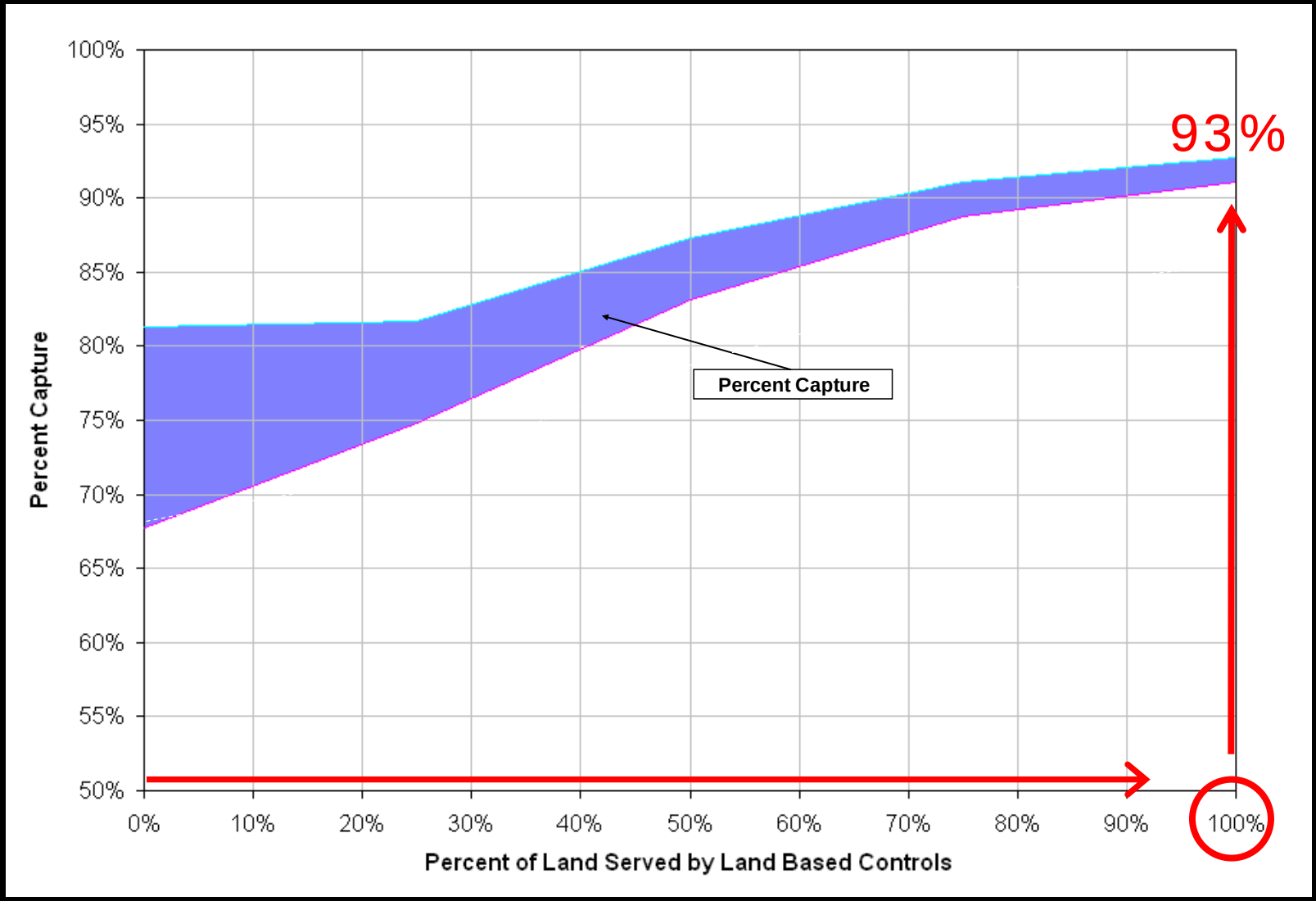
Presentation Outline

- Wet Weather Management in Philly today
- Our vision for the future
- Anticipated degree of success
- **Constraints and challenges**

Impaired Streams in Philadelphia



Our Challenge: Capturing the 1st inch of rain



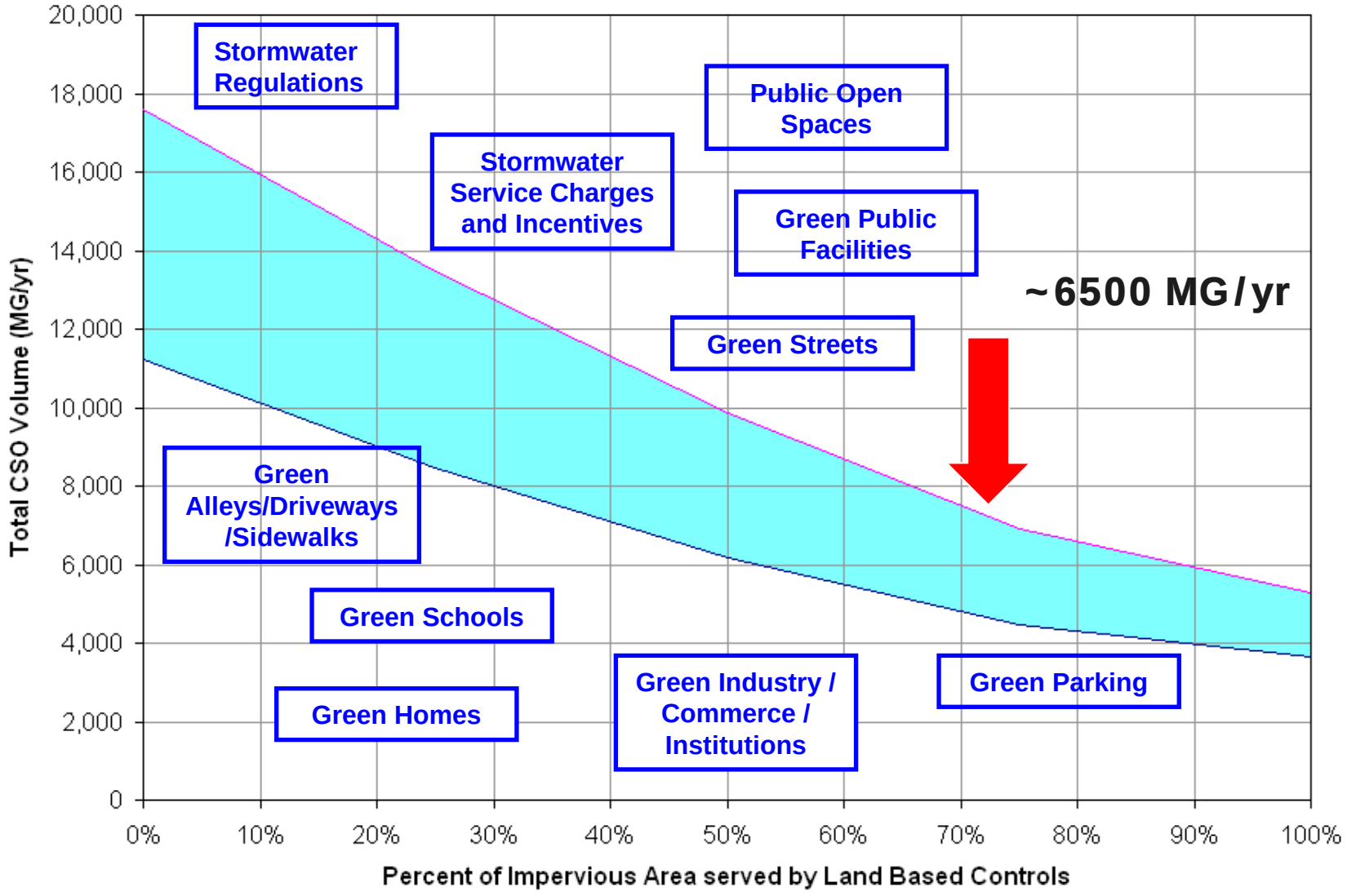
How can we solve a problem in 15 years that took 150 years to create….

How can we solve a problem in 15 years that took 150 years to create…. while not dealing with the real problem???

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

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 / Regulations / Specs**
  - 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
  - Fairmount Park Specifications
    - Tree plantings
  - Zoning Code
    - Buffers, setbacks, tree canopy, parking requirements, and/or planted spaces
  - Streets Department Specifications
    - Porous asphalt and pavements
  - PWD Regulations
    - Require management of runoff from all new public streets and sidewalks

New Stormwater Regulations

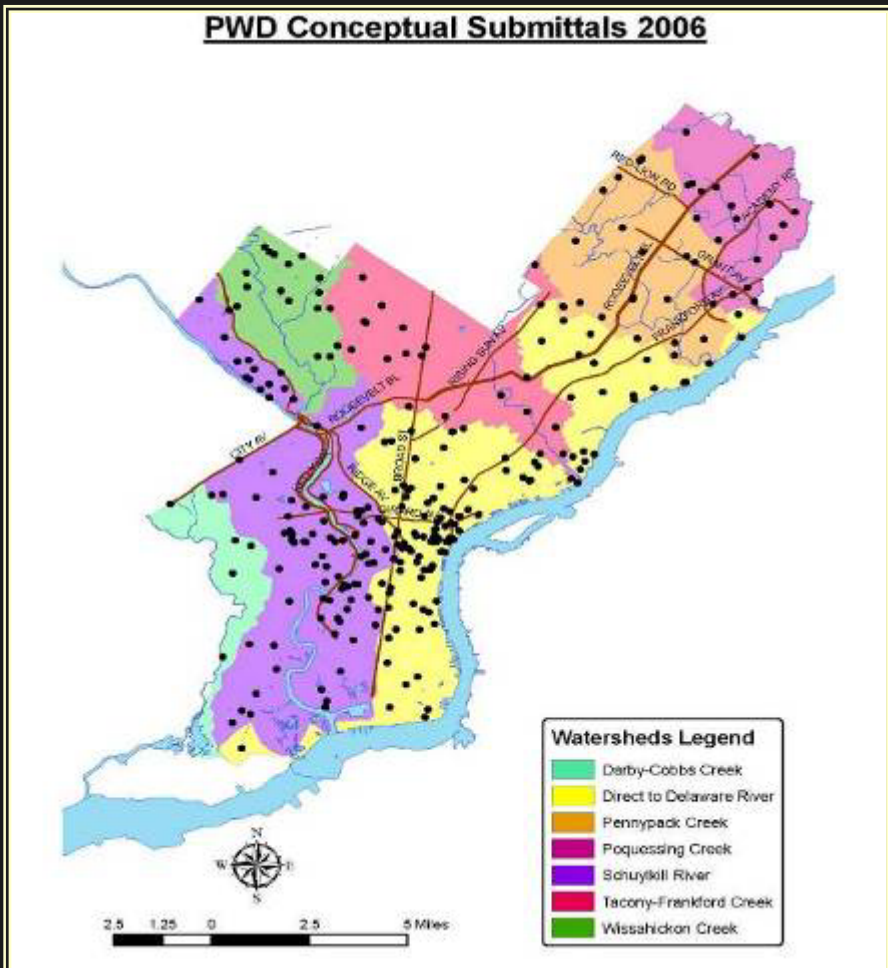
Maintain Groundwater Recharge	Maintain W-Q	Prevent Streambank Erosion
Infiltrate 1.0 inch	Remaining Volume from 1”	1-yr, 24hr Detained, 24hrs

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**



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

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

Administrative Tools

- **Stormwater Billing Credits**
- Green Permits
- Encourage LEED
- **Watershed Mitigation Registry**
- Demonstration Programs
- **Cost-Sharing**
- **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
- Police
- Fire
- Library
- Sports Facilities & Convention Center
- Homeowner Associations
- **Developers** (nonprofit and for-profit)
- 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
- **DRBC**

- Many, many more……

Private Lands – Industry / Commercial / Institutional

Private Lands – Industry / Commercial / Institutional

Private Lands – Industry / Commercial / Institutional

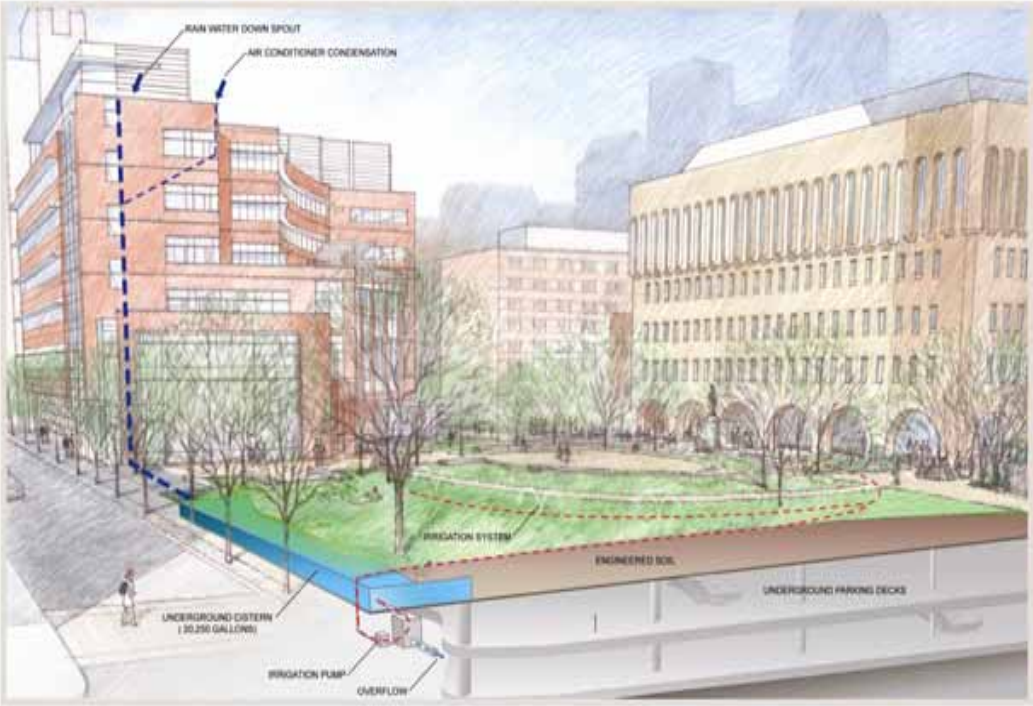
Private Lands – Industry/Commercial/Institutional

→ Green Industry / Commercial / Institutional

- Concept
  - Represents **10%** (5 Ind, 4 Comm, 1 Instit) of all impervious cover in combined system
  - Require compliance with **Stormwater Re**
  - Retrofit at least 25 large properties per yea
  - 1.0% redevelopment projection per year
- Results by 2044?
  - **95%** of Industry/Comm/Institutions
- Major Tools
  - **Parcel-Based Stormwater Billing**
  - **Enhanced LEED Certification**
  - **Grants and Tax Abatement**
- Major Partners

Wellness Center
Sugarloaf, PA

simple, sustainable, urban : a project for the 21st century



PROJECT CONTRIBUTIONS:

The plaza & green will add 1.3 acres of open space to the city fabric while promoting water conservation

Greening Philadelphia: A 1.8 acre project site, formerly 7% pervious, becomes 40% pervious

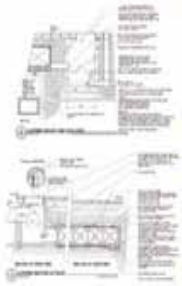
Landscape integrated stormwater management system reduces stormwater volume & delays peak flow discharge through storage & re-use for irrigation

Enhances Water Quality: "First Flush" is captured and filtered by plants and soils

Contributes to the elimination of combined sewer overflow discharge to the Delaware River.

PROJECT WATERSHED:

This urban watershed produces 95 million gallons of stormwater per year with an average of 29 overflow events



PROJECT TECHNICAL FEATURES:

Capacity to store & re-use over 20,000 gallons of storm water and air conditioner condensate for irrigation

Gravity-fed cistern, easy to drain and maintain

Engineered soils to hold up to 11,500 gallons of water per each % organic matter at 12" depth

Evapotranspiration further reduces stormwater volume with over 55 canopy trees & nearly 1 acre of lawn

Jefferson

DORRANCE H. HAMILTON BUILDING AND PLAZA

BURT, HILL

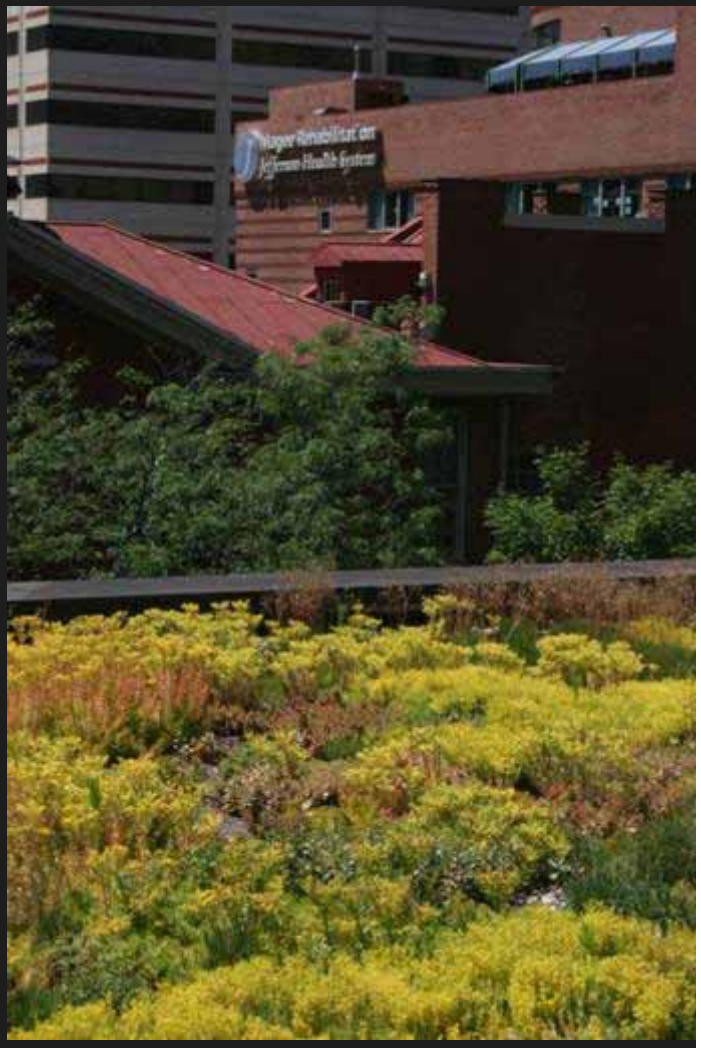
andropogon

Private Lands – Industry / Commercial / Institutional

Schuylkill Center for Environmental Education
Philadelphia, PA

Private Lands – Industry / Commercial / Institutional

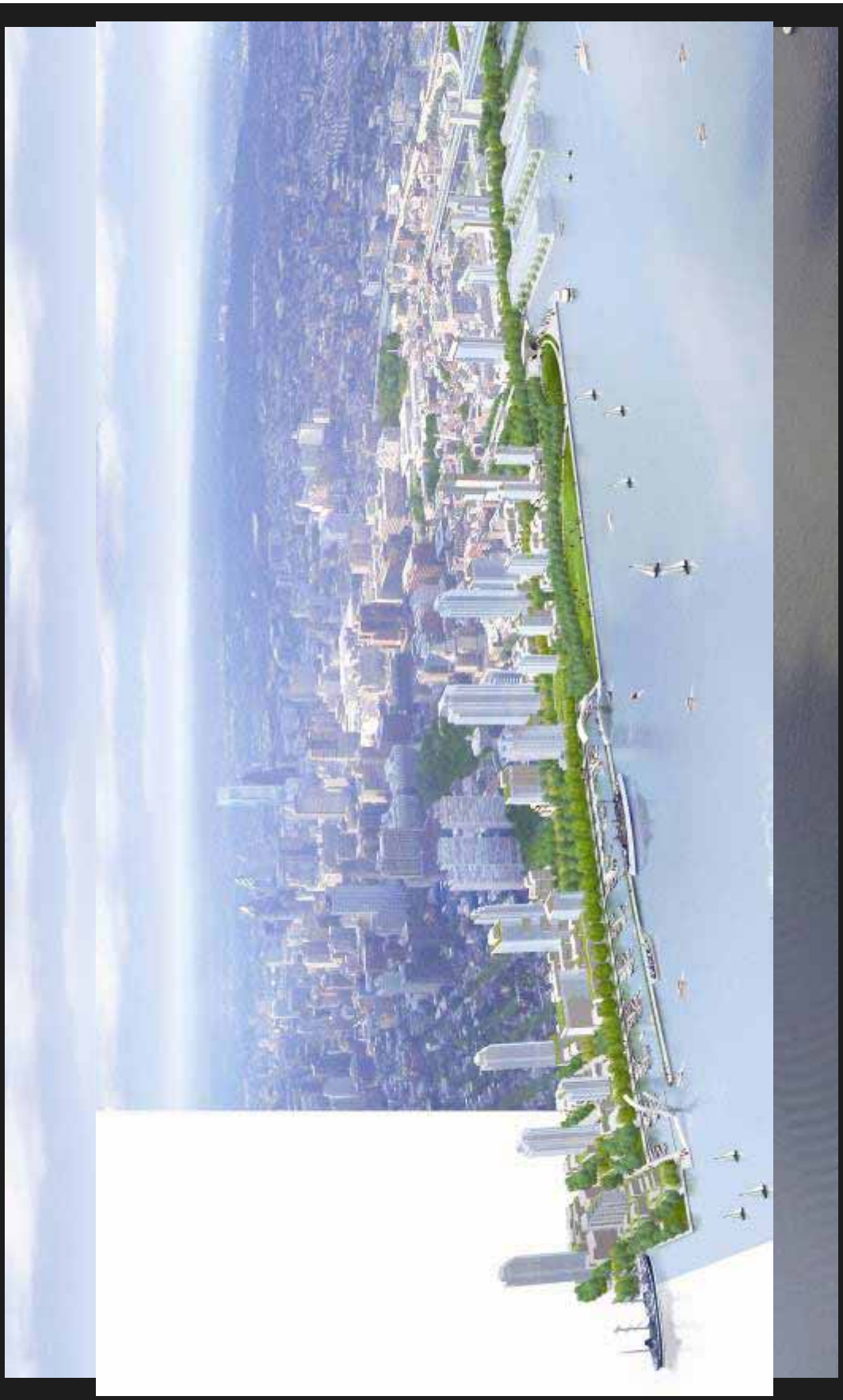
Friends Center
Philadelphia, PA



Private Lands – Industry / Commercial / Institutional

Comcast Center
Philadelphia, PA

Private Lands – Homes (Row)



Private Lands – Homes (High Rise)

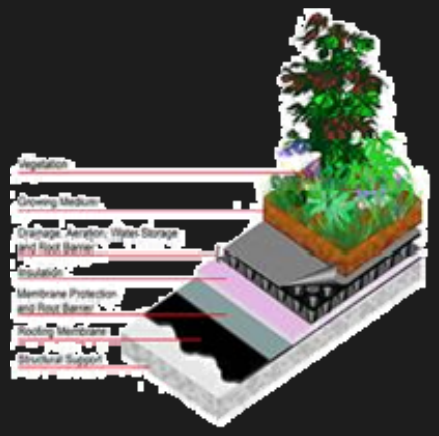
Private Lands – Homes

→ 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 2044?
  - **47%** 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

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 2044?
  - **80%** of all Parking
- Major Partners
  - Philadelphia Parking Authority
  - Philadelphia Department of Public Property
  - Philadelphia Parking Association

Portland BMP Manual

Private Lands – Parking

Morris Arboretum - Philadelphia, PA

Conventional Asphalt

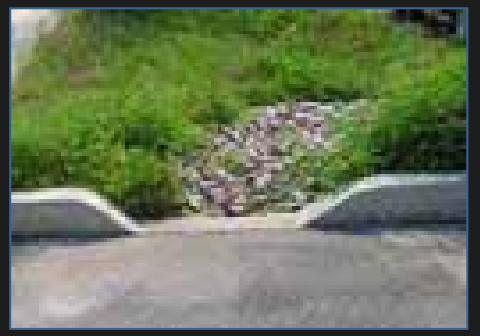
Tropical Storm Floyd, September 1999

Porous Asphalt

Private Lands – Parking

Police Forensics Science Center

Philadelphia, PA



Private Lands – Parking

East Falls Community Parking Lot Philadelphia, PA

Philadelphia Airport Employee Parking Lot Expansion

Private Lands – Alleys / Driveways / Sidewalks

→ 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 2044?

- **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 2044?
  - **80%** of all Streets
- Major Partners
  - Philadelphia Streets Department / PennDOT
  - Philadelphia Department of Commerce

Portland, OR

Public Lands – Streets

Portland, OR

SEA Street total retrofit - Seattle

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

Monitoring results for four years: 99% reduction in total runoff volume

After

Public Lands – Streets

West Mill Creek Stormwater Tree Trench
Philadelphia, PA
PWD, Dept. of Recreation

Pervious Pavers, Subsurface Infiltration,
Disconnected Inlets

Public Lands – Streets

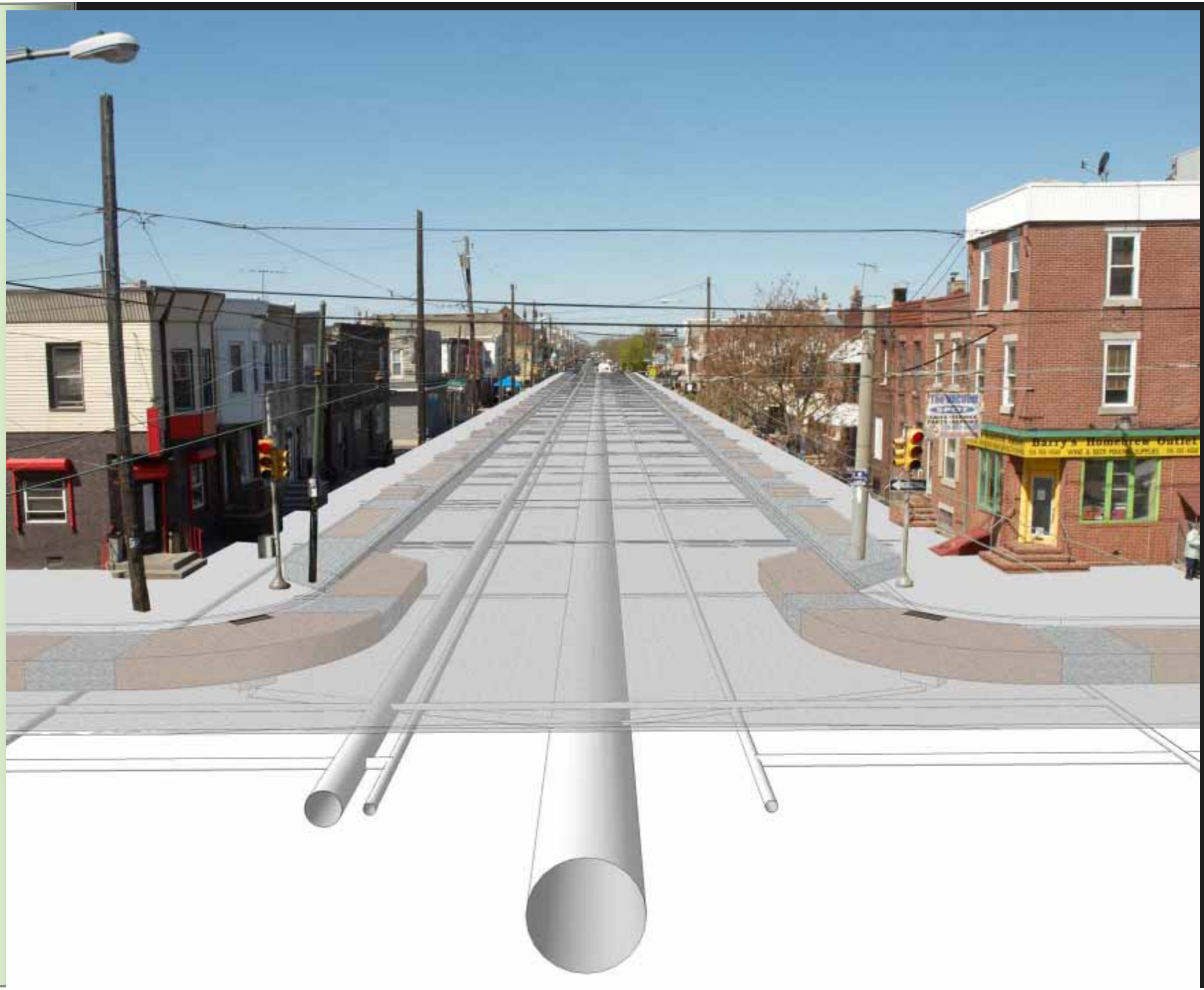
Traffic Triangle Rain Garden
Philadelphia, PA
PWD, UC Green

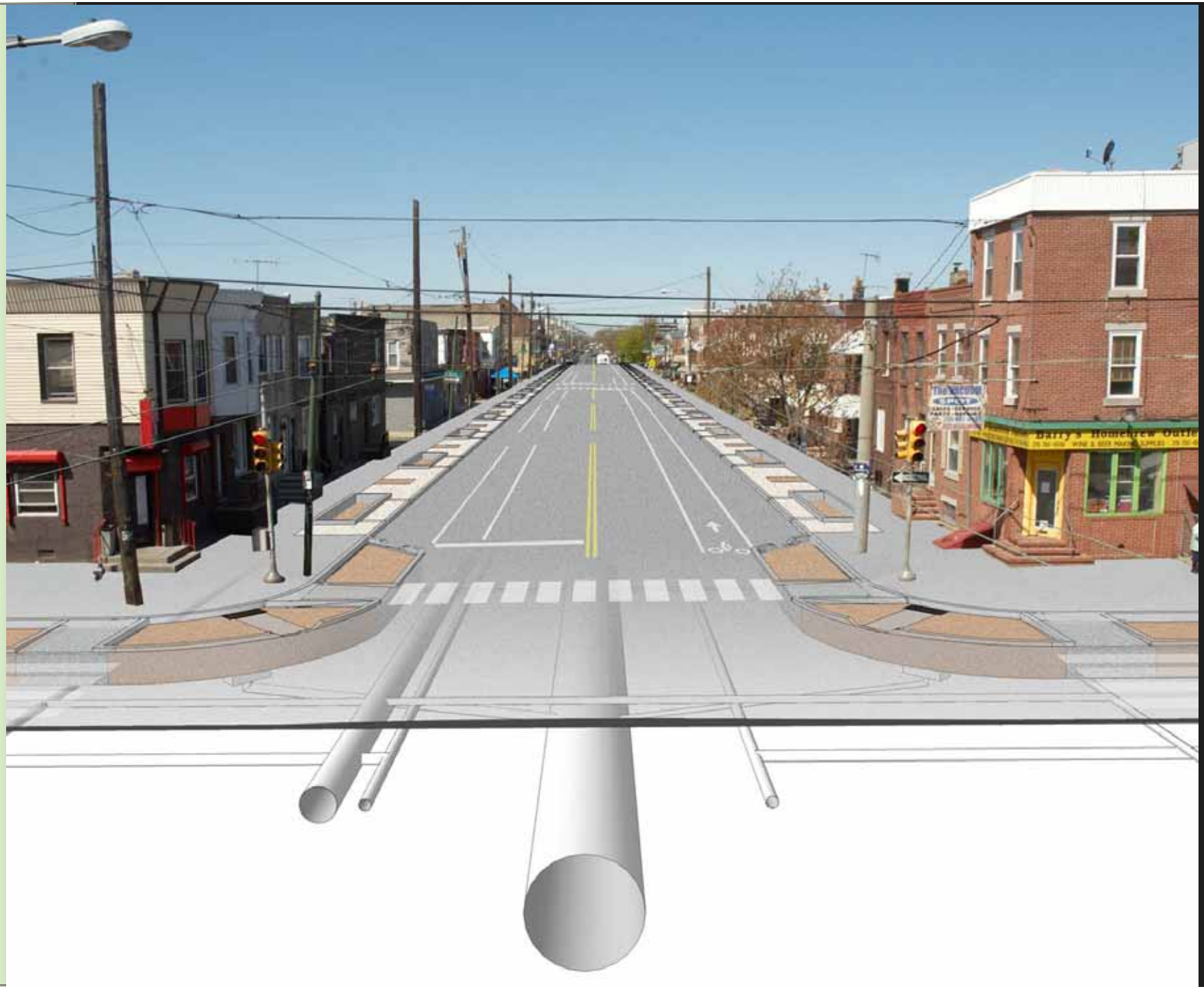
Bioretention/ Infiltration Zones

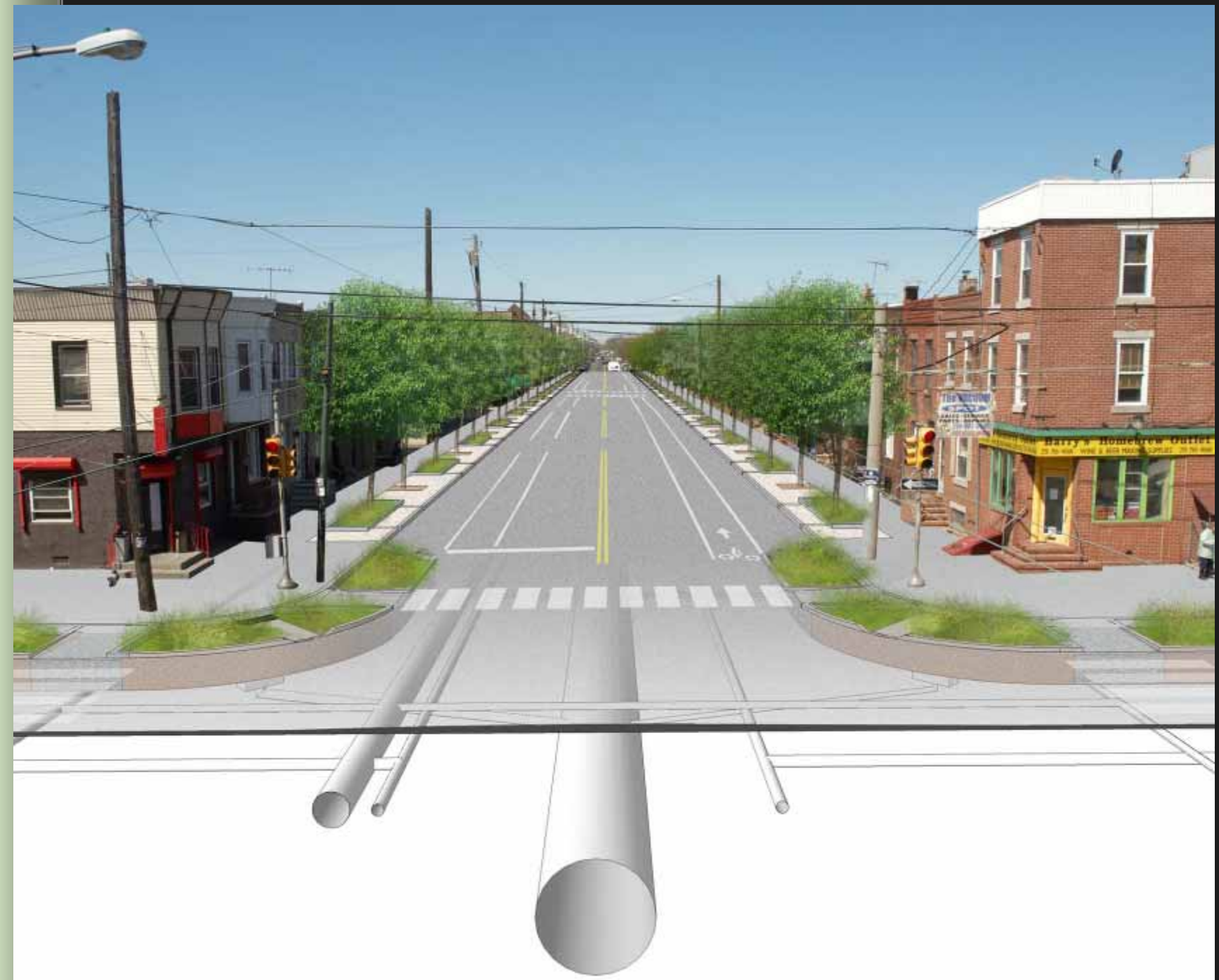
Island Avenue

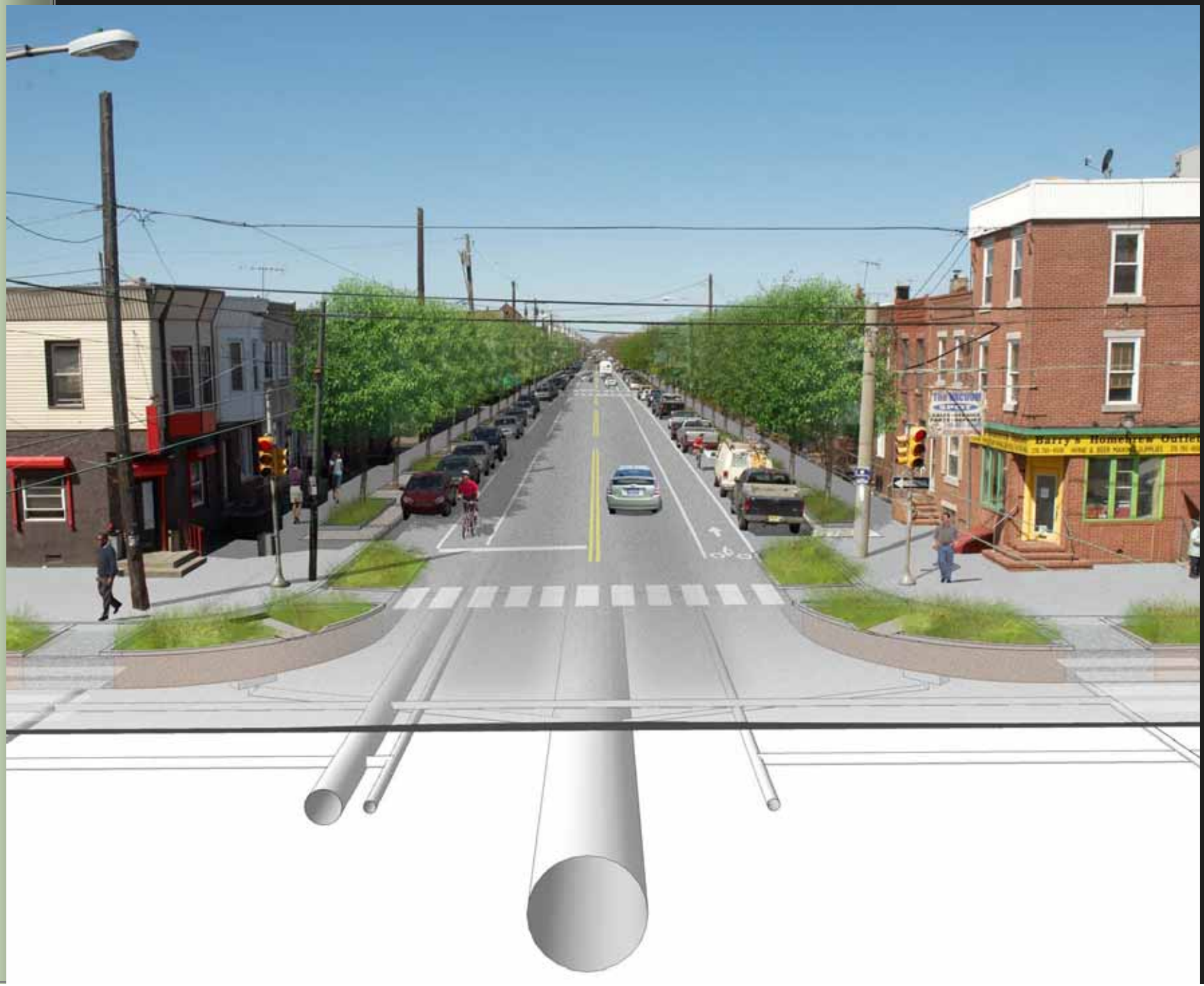
Vegetated Street Medians - PWD

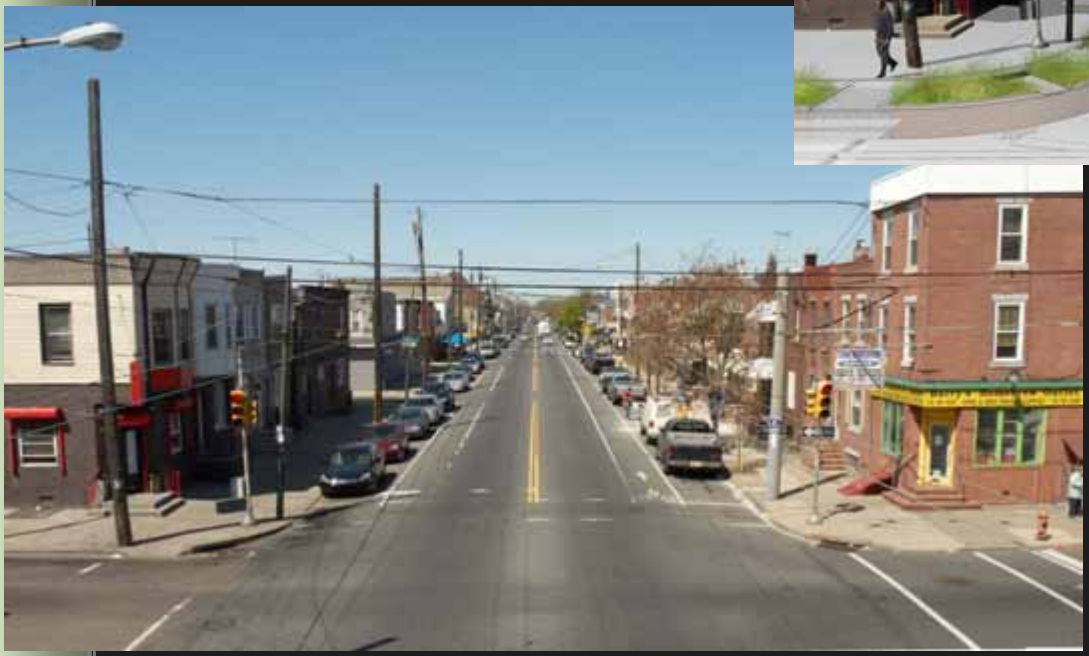

Barry's Homebrew Outlet

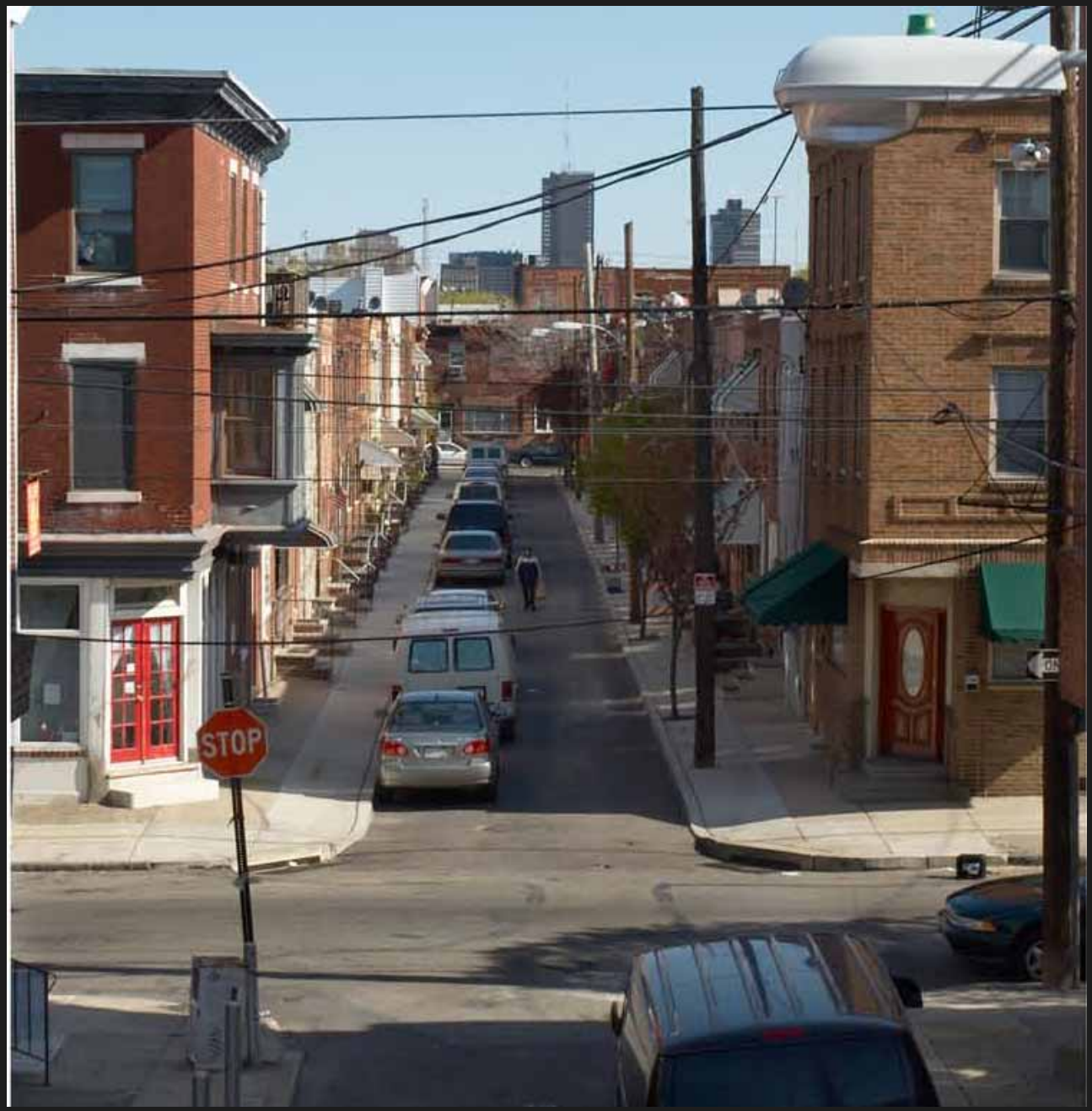

Barry's Homebrew Outlet





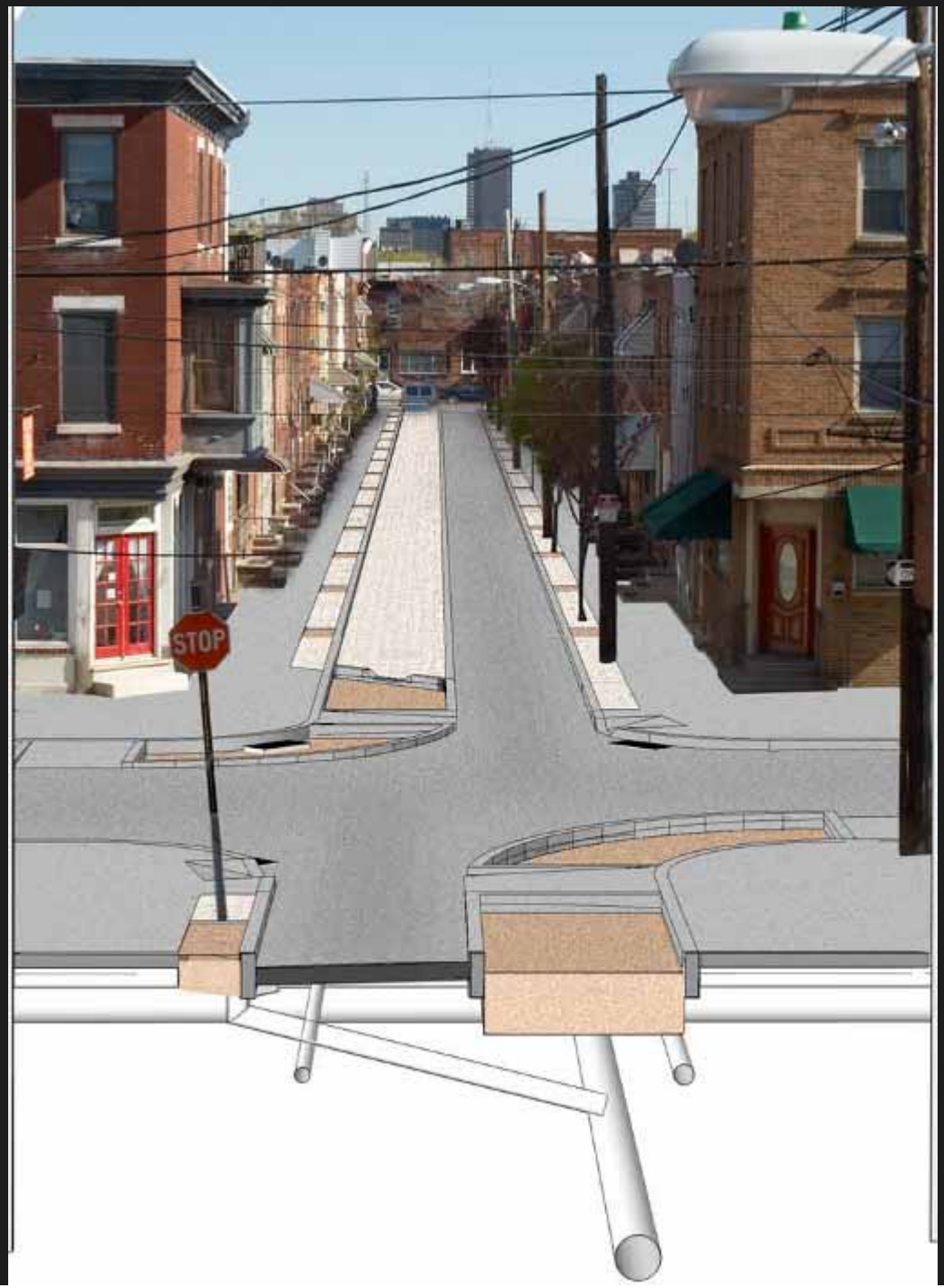

Barry's Homebrew Outfitters




STOP


STOP


STOP


STOP


STOP

Public Lands – Schools

Image credit: PENN Praxis

→ 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 2044?

- **100%** of all Schools

Major Partners

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

Public Lands - Schools

Wissahickon Charter School

Philadelphia, PA

Public Lands - Schools

Penn Alexander School

Philadelphia, PA

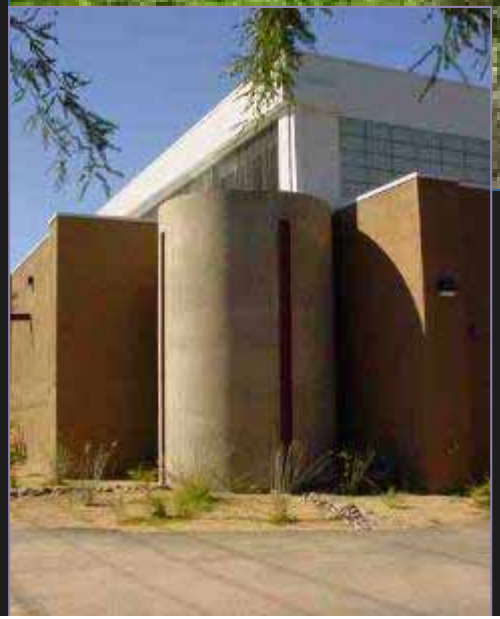
Porous pavement playground & Rain Garden

Public Lands - Schools

Penn Alexander School – Infiltration Field

Soccer Field

Public Lands - Schools



School of the Future – "Microsoft" High School
30,000 gallon cistern will collect
rainwater from roof and use to flush toilets

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 2044?
  - **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

Mill Creek Playground
Philadelphia, PA
PWD, Dept. of Recreation

Porous Pavement; Subsurface Storage with Infiltration

Mill Creek Playground

PWD, Dept. of Recreation

Public Lands – Public Facilities

Waterview Rec Center
Philadelphia, PA
PWD, Dept. of Recreation

Porous Pavement; Subsurface Storage with Infiltration

Public Lands – Public Facilities

- Prelim Designs for:
  - Belmont Water Treatment Plant
    - Vegetated Swale (Ford Rd.)
    - Bump Outs (Belmont Rd)
  - Queen Lane Water Treatment Plant
    - Bump Outs
  - Bureau of Laboratory Services
    - Sidewalk Planters
  - Sewer Maintenance Yard
    - LEED Certified

Public Lands – Public Open Spaces

Public Lands – Public Open Spaces

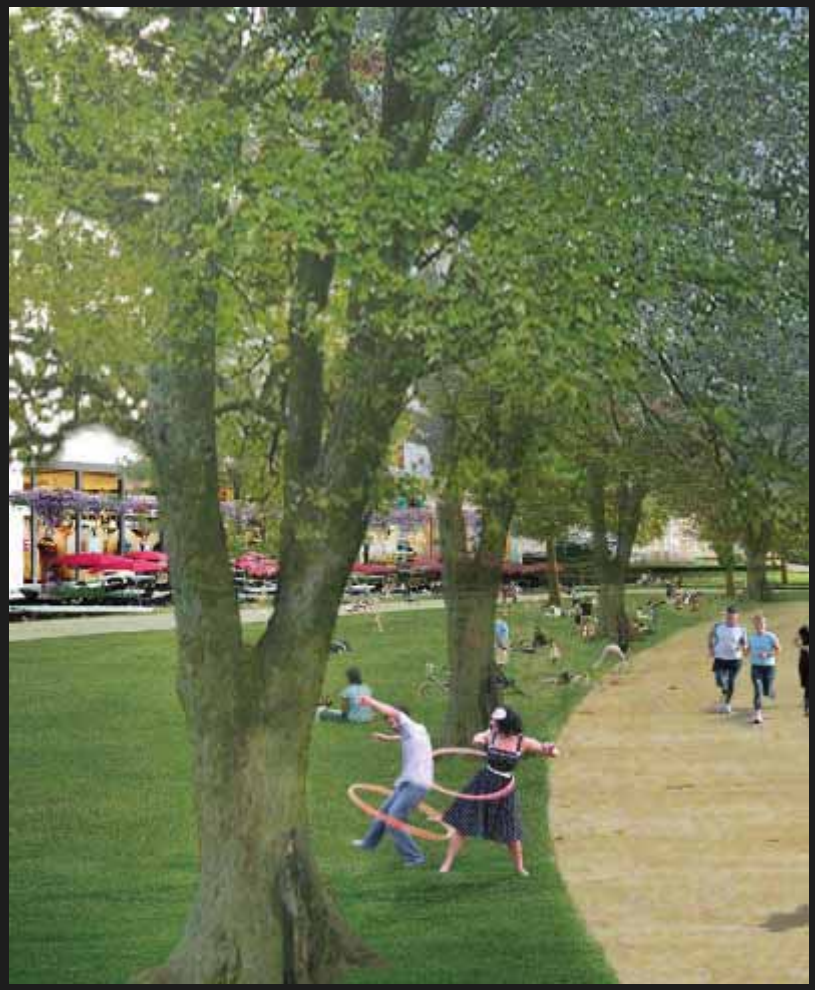


Image credit: PENN Praxis

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 2044?

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

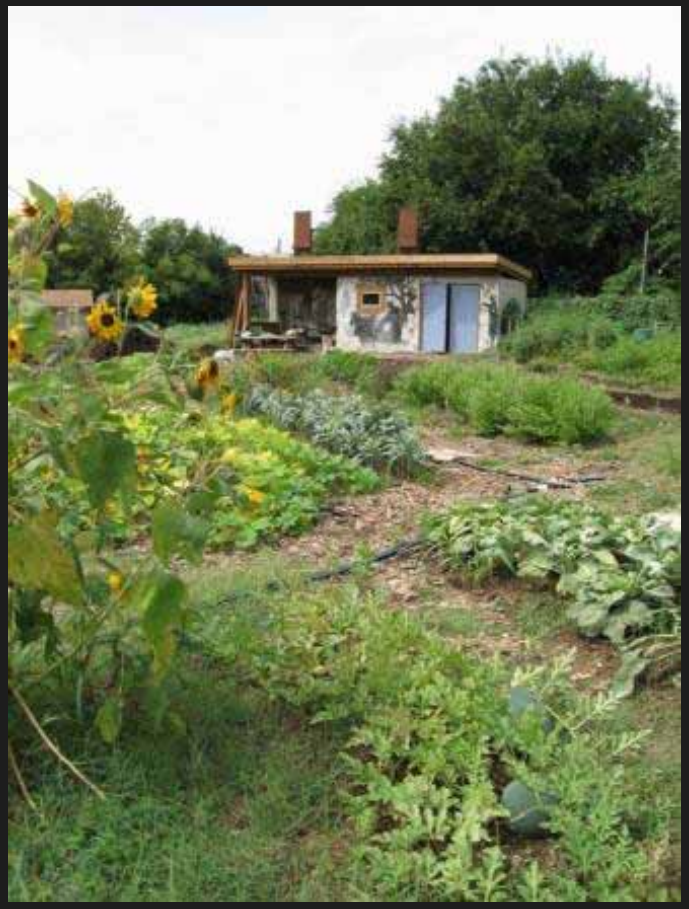
Major Partners

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

Public Lands – Public Open Spaces

Mill Creek Farm

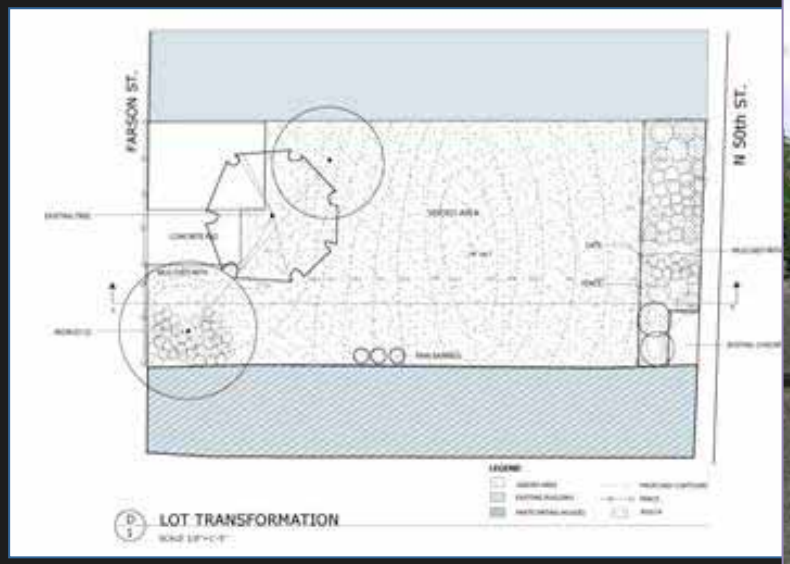
PWD, PA Horticultural Society



Inlet Disconnection; Vegetated Swales; Green Roof

Public Lands – Public Open Spaces

Vacant Land Stabilization in West Philadelphia



Retentive Grading, Plantings

Pennsylvania Horticultural Society

Public Lands – Open Spaces

Clark Park Stormwater Project

Philadelphia, PA

PWD, Dept. of Recreation

Disconnected Inlets, Subsurface Infiltration

Public Lands – Public Open Spaces

Cliveden Park Stormwater Project

Philadelphia, PA

PWD, Dept. of Recreation

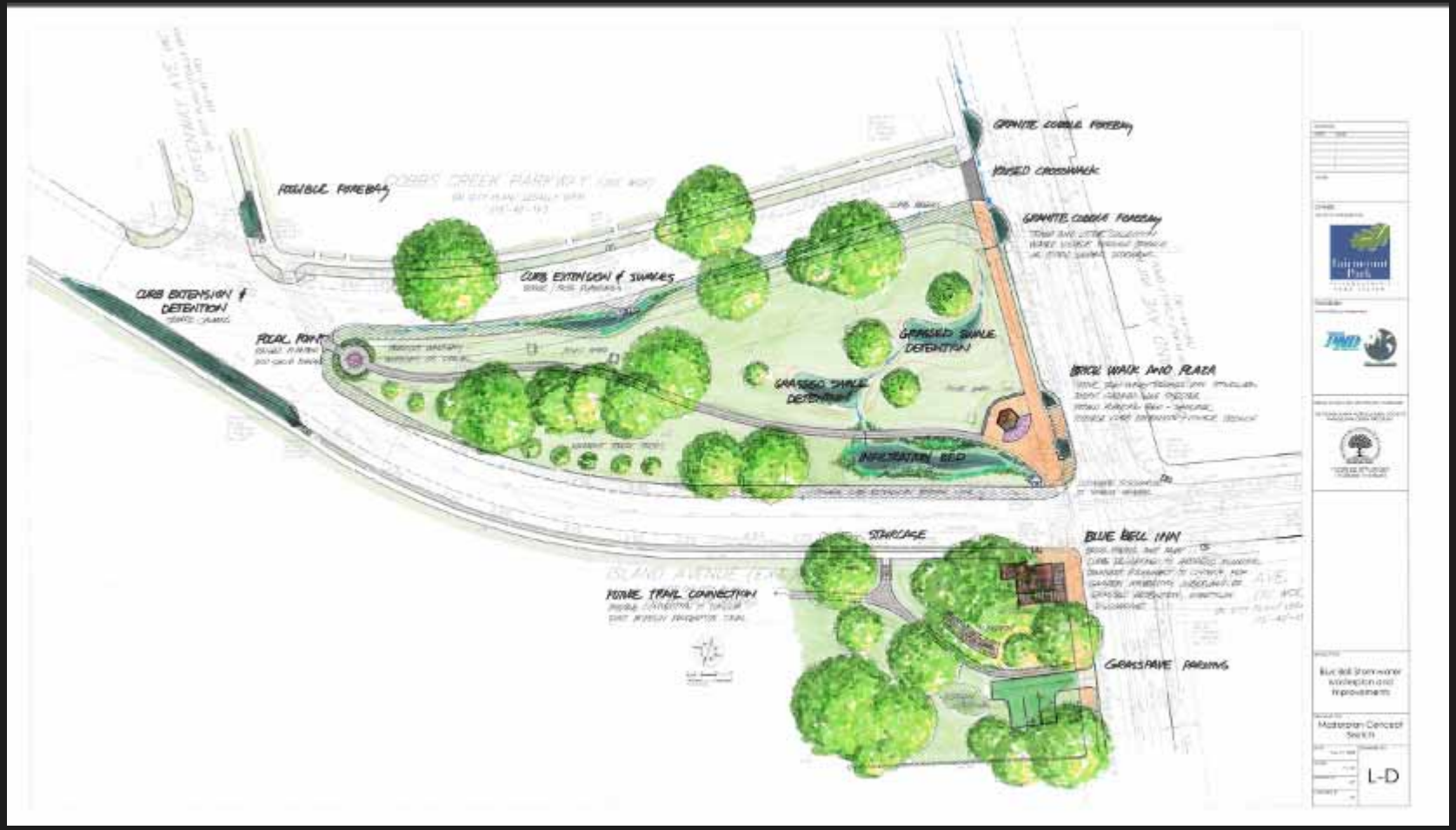
Bioretention Gardens, Disconnected Inlets

Public Lands – Public Open Spaces

Blue Bell Stormwater Project

Philadelphia, Pa

PWD, Fairmount Park



Presentation Outline

- Wet Weather Management in Philly today
- A vision for our future
- Anticipated degree of success
- Constraints and challenges
- **Ideal outcomes**


Please Do Not Feed
the geese

Clean Water … Green City

Credit: Maurer, City of Linz

Questions???