

Transforming the Built Urban Environment:
Providing Leadership and Vision
In an Era of Change and Uncertainty



Summary of My Talk

The world is changing

We must adjust our water policies and land practices

We will need vision and leadership

Summary of My Talk

- Existing conditions are overwhelming our water systems
- Communities need to become more resilient
- There is just not enough money
- Stormwater Management = control over water + land
- Community-based Public-Private Partnerships are essential
- This will support smart investments and leverage funding
- We can turn hazards into community opportunities

Kansas City's Challenge

- Sewer overflows during wet weather
- Aging wastewater infrastructure
- Sewer backups
- Poor water quality in local streams, urban lakes, and rivers
- Past rates did not reflect the true cost of maintaining wastewater infrastructure



City Comparison

Kansas City

- City Department
- Water/wastewater/stormwater
- Retail and wholesale accounts
- Population: 650,000
- Size: 320 sq miles
- Budget: \$307M
- Average Bill: \$82
- MHI*: \$45,376

Philadelphia

- Same
- Same
- Same
- 1,550,000
- 141 sq miles
- \$650 M
- \$71
- \$41,233

*US \$53,482

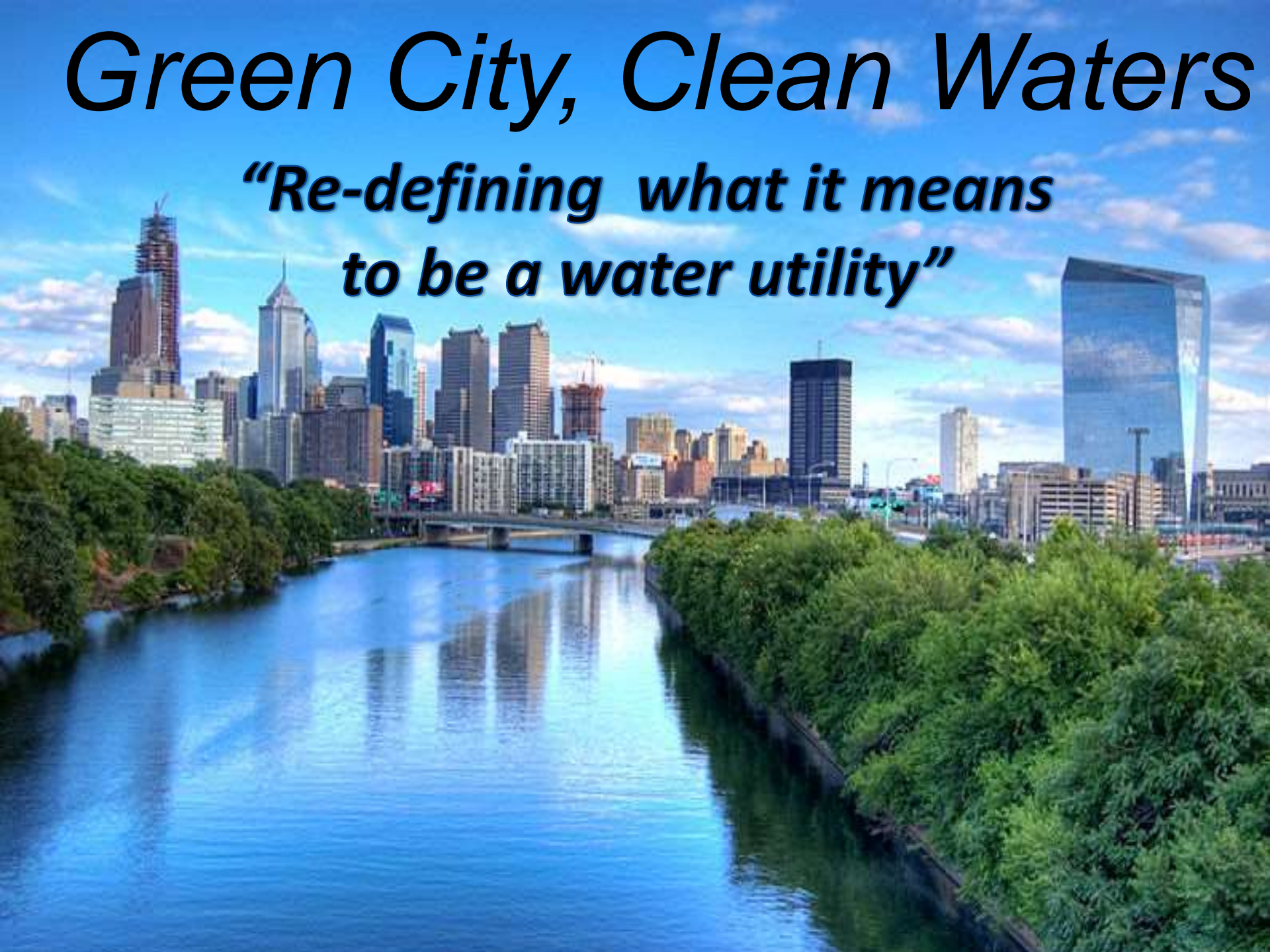
Combined Sewer System

- 7 basins covering 58 sq. miles
- 1,060 miles of pipe
- 90 outfalls
- 2,500 manholes
- 6.4 billion gallons of overflow in a typical year
- **Overflow Control Plan Goals:**
 - Evaluate green infrastructure
 - Capture 88% of wet weather flows
 - Reduce number of overflows by 65%



Green City, Clean Waters

*“Re-defining what it means
to be a water utility”*



1.5 BILLION GALLONS OF ANNUAL CSO OVERFLOWS -- GONE



THANK YOU, GREEN INFRASTRUCTURE !!!

Transitioning Green Infrastructure

From a “*utility-centric*”

water cleaning and saving function

Transitioning Green Infrastructure

From a “***utility-centric***”

water cleaning and saving function,

To a “***universally adopted approach***”

For greening our cities, with a focus on inclusion, diversity, equity and helping our inner cities flourish.

Through our leadership,
we have the opportunity to
shape the culture and direction
of the water industry *and*
the future landscape of our cities

If it looks like water, it is.

Rain

Reuse

Floods

Scarcity

Wetlands

Overflows

Lead Pipes

Rising Tides

Affordability

Water supplies

Aquatic Habitats

Water main breaks

Wastewater treatment



Shoemaker Green



[UPenn Time Series](#)

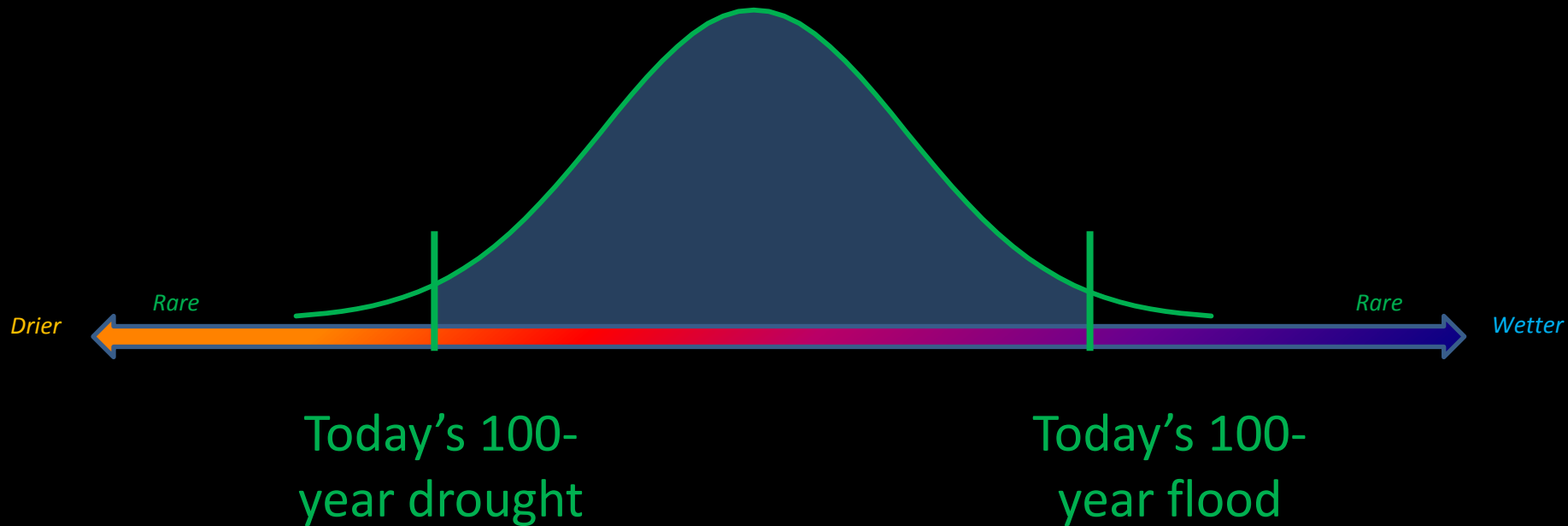
Water is a universal connector for our times and our concerns

RAIN REUSE FLOODS SCARCITY WETLANDS
OVERFLOWS LEAD PIPE REPLACEMENT RISING TIDES
AFFORDABLE WATER CLEAN WATER SUPPLIES
DESALINATION AQUATIC HABITAT WATER MAIN BREAKS
GROUNDWATER CWA MINING IRRIGATION LAND
CONSERVATION STORMWATER ENERGY RESOURCE
RECOVERY ECOSYSTEMS SUSTAINABLE FOOD
PRODUCTION DROUGHT FORESTRY REGIONAL
PLANNING URBAN SUSTAINABILITY SDWA
GREENHOUSE GAS MITIGATION RENEWABLE ENERGY
RECREATIONAL BOATING FISHING RESILIENCE
DEVELOPMENT WATER ALLOCATIONS EFFICIENCY
INDUSTRIAL WASTEWATER UTILITY OF THE FUTURE
DEMAND MANAGEMENT NUTRIENTS SALT INTRUSION
PUBLIC PERCEPTION INCLUSION PHARMACEUTICALS
PCB'S INFRASTRUCTURE JOBS HURRICANES
MONITORING ALGAE SECURITY EXTREME WEATHER

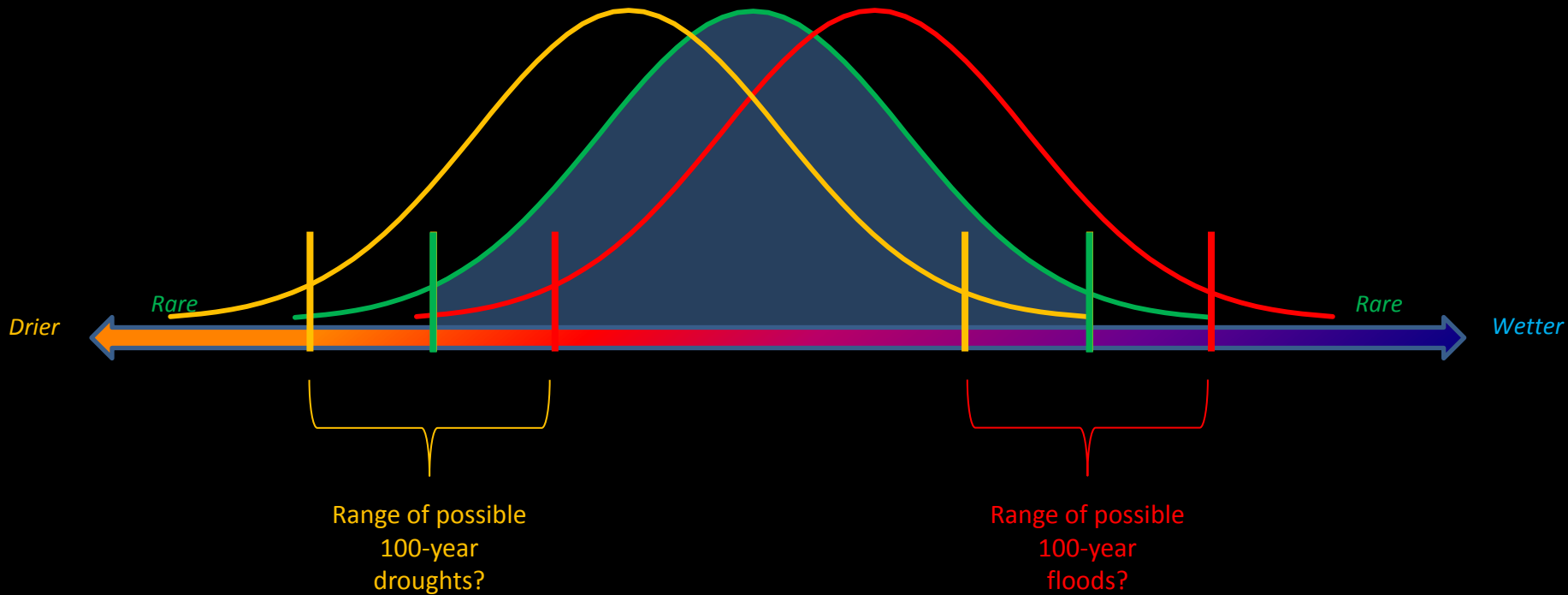
The US Urban Water Sector

- 19th c. infrastructure, 20th c. technology
- Centralized, isolated systems
- The Civil Right to Affordable Water
- Federal funding and political will
- Siloed Priorities
- Extreme weather and terrorism
- Uncertain risk and the loss of “stationarity”

Stationarity = Equilibrium



The old probabilities don't work anymore!



The natural system assumptions upon which we base all water standards, permits, and water use and delivery systems may no longer be valid.



- USEPA Climate Ready Water Utilities Working Group

Flooding of Coast Has Already Begun...Scientists' warnings of Climate Change are no longer theoretical



New York Times, Sept. 3, 2016

In the past, the engineered solutions seemed simpler, more independent



Do we have capacity for your new development? Yes!!





New York City “Combined Sewer Interceptor”

The *Incline* of our Cities



North 34th Street

JESSICA GRIFFIN / Staff Photographer, Billy Penn



Southeast Philadelphia (10th & Moyamensing),
photo by Andrew Dobshinsky







Des Moines River, Iowa

Why did we Bury our Streams?

1. City grid, flat, no bridges
2. Gravity and Right-of-way
3. No one cared



Philadelphia in 1702

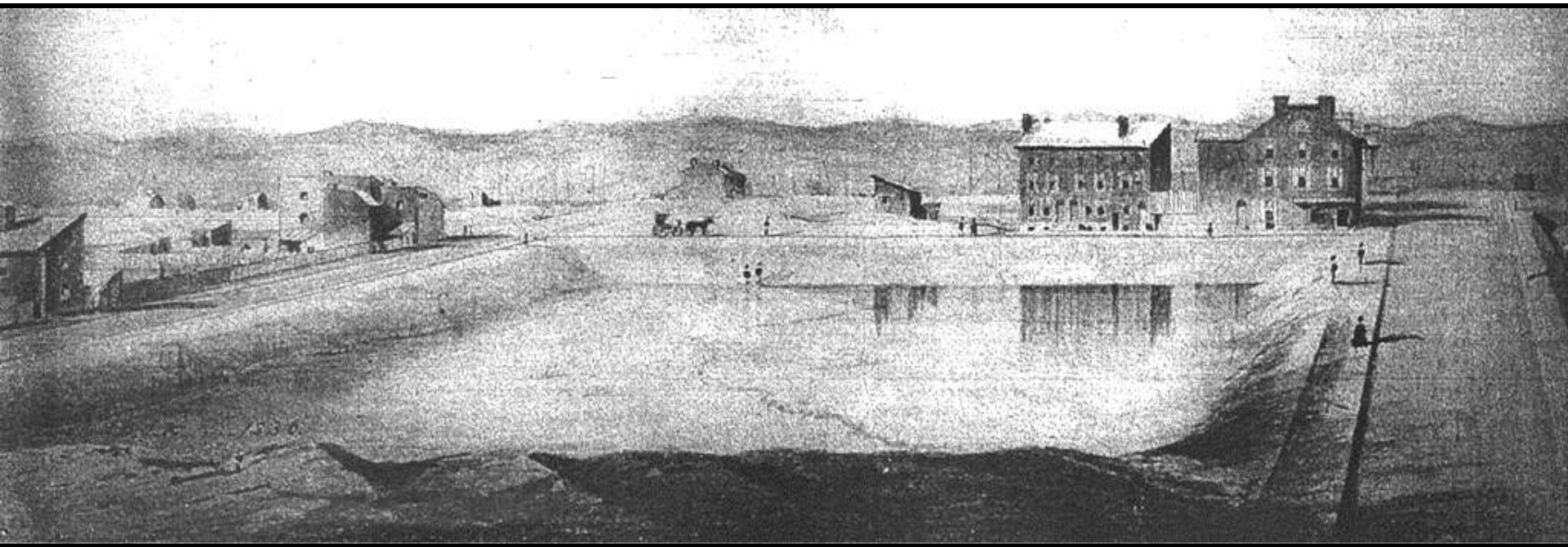
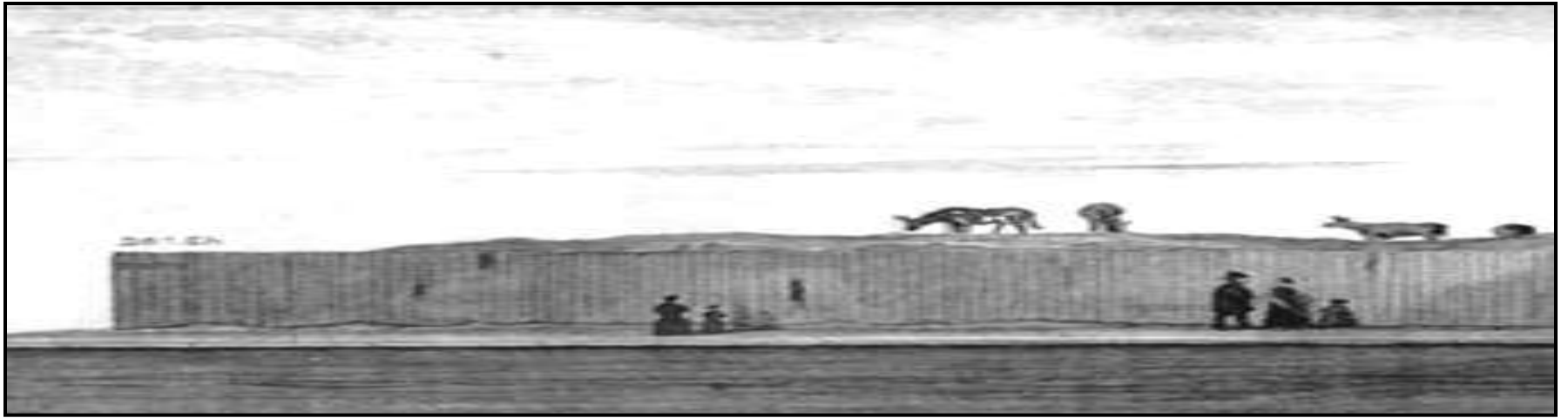


USGS, 1898

STREAMS OF PHILADELPHIA

Current





Coal Ash Disposal



TROLLEY ASH CAR



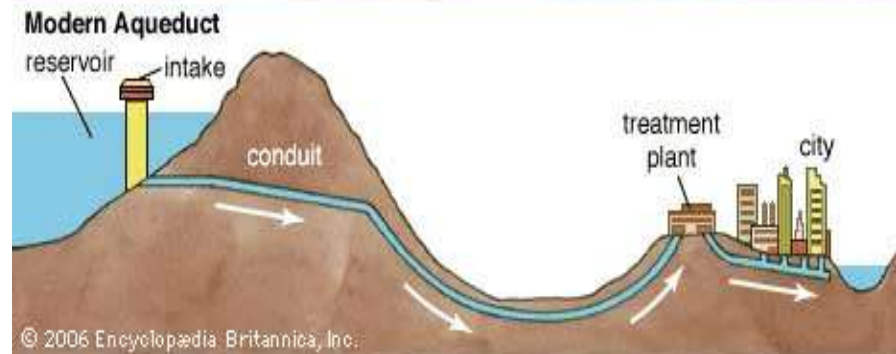
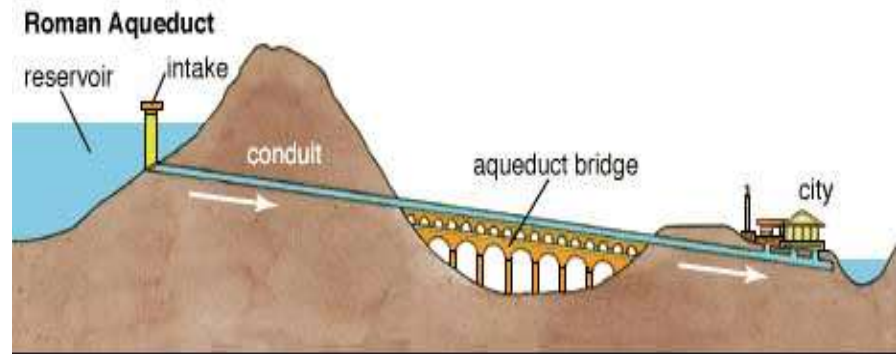
STANDARD ASH WAGON

“Ashes from household fires are removed once each week from all buildings...
All ashes are hauled to authorized dumps, mostly low-lands and streets requiring filling.”

The Great Water Cities in History



Roman Aqueducts (1st century BC)



The Dijkgraaf of Delft



1404, 1421, 1530,
1570, 1717, 1916



North Sea Flood of 1953



The Dijkgraaf of Delft

“We raise the dikes another meter....

...And the coming catastrophe will be that much bigger”



Room for the River

“After 800 years of building dikes, we’ve been making them higher and higher. But if something goes wrong, the damage will be greater. We need to remain flexible in adapting to climate change, so now we try to remove the bottlenecks.”

- Gert-Jan Meulepas, Project Manager for Royal Haskoning in the Netherlands

The Waal River Diversion at Nijmegen



“The river will run through the city,
instead of along the city.”

- Meulepas

What Makes a Great Water City Today?



What Makes a Great Water City Today?

- Fishable, Swimmable Waters (CWA)
- Drinkable Waters (SDWA)
- Safe, attractive waterways
- Accessible waterfronts
- Adaptable, abundant, resilient, redundant and sustainable water systems
- A thriving, sustainable city



Honolulu Harbor and Canal Systems



Kapalama Canal



Ali Wai Canal



Honolulu Harbor




Honolulu Harbor



12/2/96

SCHUYLKILL RIVER PARK BULKHEAD
PROJECT# 320 - 0065-041
DATE: 12/2/96 PHOTOM 01
VIEW: STATION 1A + 82 (R)
THE SEDWELL CO.
RANFORD PHOTOGRAPHIC CO., CO. 0.88



6/24/97

SCHUYLKILL RIVER PARK BULKHEAD
PROJECT# 329 - 2085-041
DATE: 6/24/97 PHOTO# 04
110W RACE STREET (H)
THE BREWELL CO.
RAINBOW PHOTOGRAPHIC CO. CO. C 37



Explore the impact of local infrastructure policy decisions on desired outcomes



Cramp Elementary School, Philadelphia

Water as the heart of the design Enghaveparken, Copenhagen



OWI, TREDJE NATUR and Platant

“New Orleans is Done Fighting Water”

-CITYLAB, The Atlantic



The 25-acre Mirabeau Water Garden to filter stormwater while providing beautified space for recreation and education. (New Orleans Redevelopment Authority)

JUSTICE
for FLINT

GREENPEACE

Missing: One Water Vision, Leadership, Progress



Urban Stream Concerns

- Water Quantity and Quality
- Contaminants
- Bank Erosion
- Channel hardening
- Aquatic Habitat and Biodiversity
- Invasive plants and species
- Public Access
- Dumping, Litter and Trash
- Vandalism and crime
- Social and Environmental Justice
- Groundwater recharge
- Urban Land management
- Runoff /Overflows



*Can Urban Water Policy be
adapted to protect public
health and the environment*

WHILE

*encouraging innovation,
growth and sustainability in
our Great Water Cities?*

Green City, Clean Waters



How to stop flooding and overflowing pipes?

- Make it stop raining so much
- Increase sewer capacity (grey)
- Stop putting rainwater in my sewer (green)



MSU Green Roof Research Program
(courtesy Old House Journal)

The “New” Water Sector

Water Utility Services

Water Supply & Scarcity

Thriving Cities and Waterfronts

Integrated Watersheds

Forestry & Land Conservation

Food Production

Waterways and Ecosystems

Energy & Mining

Industry & Business

City and Regional Planning

(Re) Development

Recreation

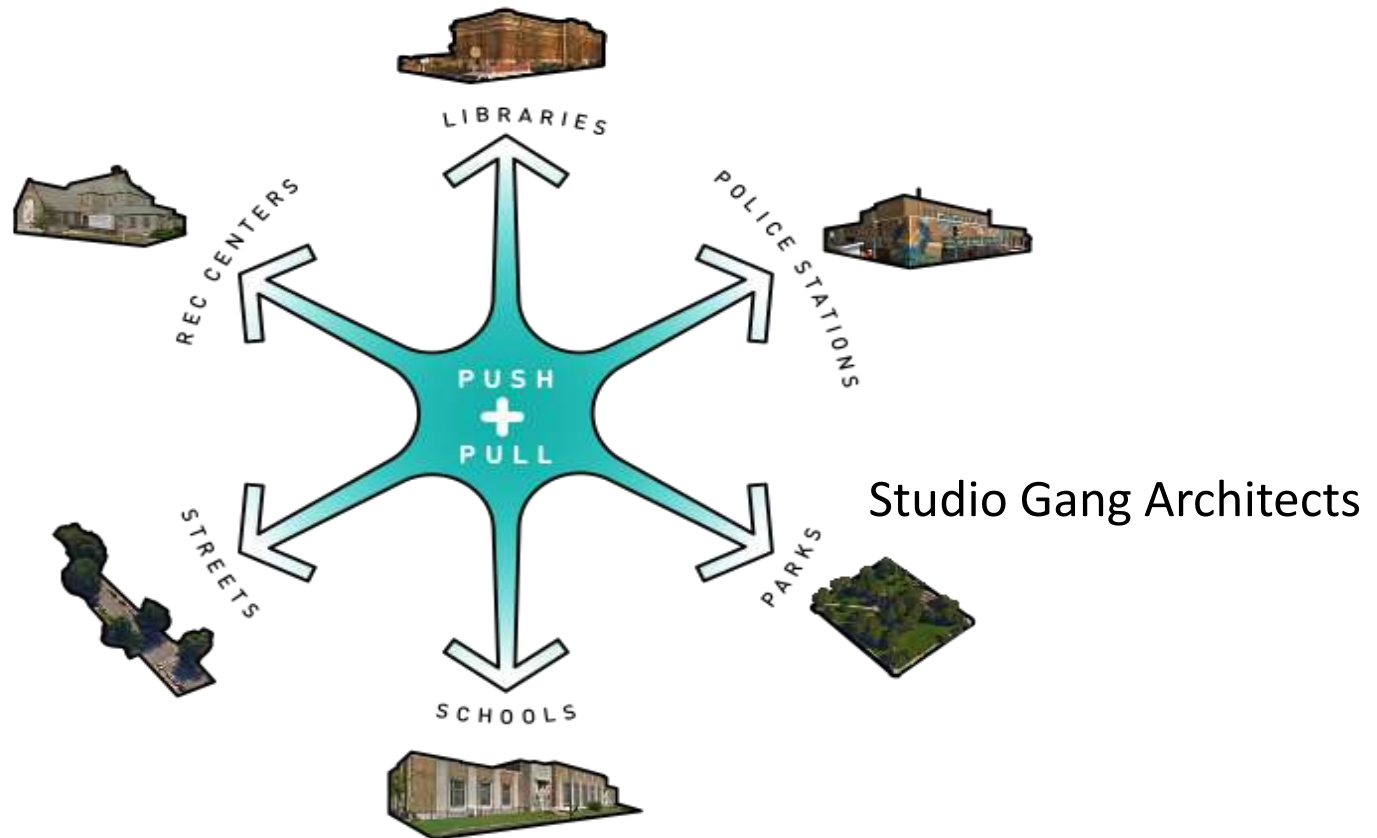
Flooding

Climate Change and Resiliency

Social Equity

Environmental Justice

Green Infrastructure was the foundation for One Water Practice



The Civic Commons
“see, hear, combine”

How we speak to each other

- MS4s
- CSOs
- NPDES
- TMDLs
- PCBs / Mercury
- Road Salt
- Pathogens
- Emerging contaminants
- Nitrogen / phosphorous
- Green Stormwater Infrastructure

How we need to speak

What's Possible?

People are the city. People make the city. And every city has a stake in the health and safety of its populace, the quality of its education system, the state of its economy, the impact of climate change, the need for infrastructure, and the engagement of its citizens as active participants in their future. These shared concerns serve as a starting point for envisioning cities that are responsive to their people and ever-changing conditions. They provide a foundation for engaging with existing assets, places, and relationships to imagine what is possible. They also act as touchstones that cities can return to as they evaluate and continue to shape their civic commons over time.

Health

Integrated Wellness

Holistic community health that addresses the physical, mental, and social needs and aspirations of society

Security

Public Safety

Relationships and environments that support productive encounters between people and institutions

Education

Open Opportunity

Multiple, accessible places and platforms for skill sharing, knowledge transfer, and talent discovery

Economy

Inclusive Growth

Economic development that makes socio-economic mobility possible for everyone

Environment

Sustainable Practices

Conscientious actions and behaviors that mutually support people, water, land, and wildlife

Infrastructure

Engaged Ownership

Partnerships formed to reclaim, invest in, manage, and repurpose shared systems to benefit everyone

Society

Social Solidarity

A sense of belonging and a commitment to cooperating for collective well-being

What's in Your City?

Every city has a combination of public buildings, institutions, land, water, and infrastructure that affect everyone's quality of life. These assets are collectively owned and operated for community benefit. In many American cities, they were created and constructed by different people at different points in time, and continue to be thought of as performing separate and specialized roles in society.

Reconsidering these assets today as part of a single, interconnected civic commons involves focusing on the relationships between them—building a kind of ecological understanding of how they operate together within the context of a particular city.

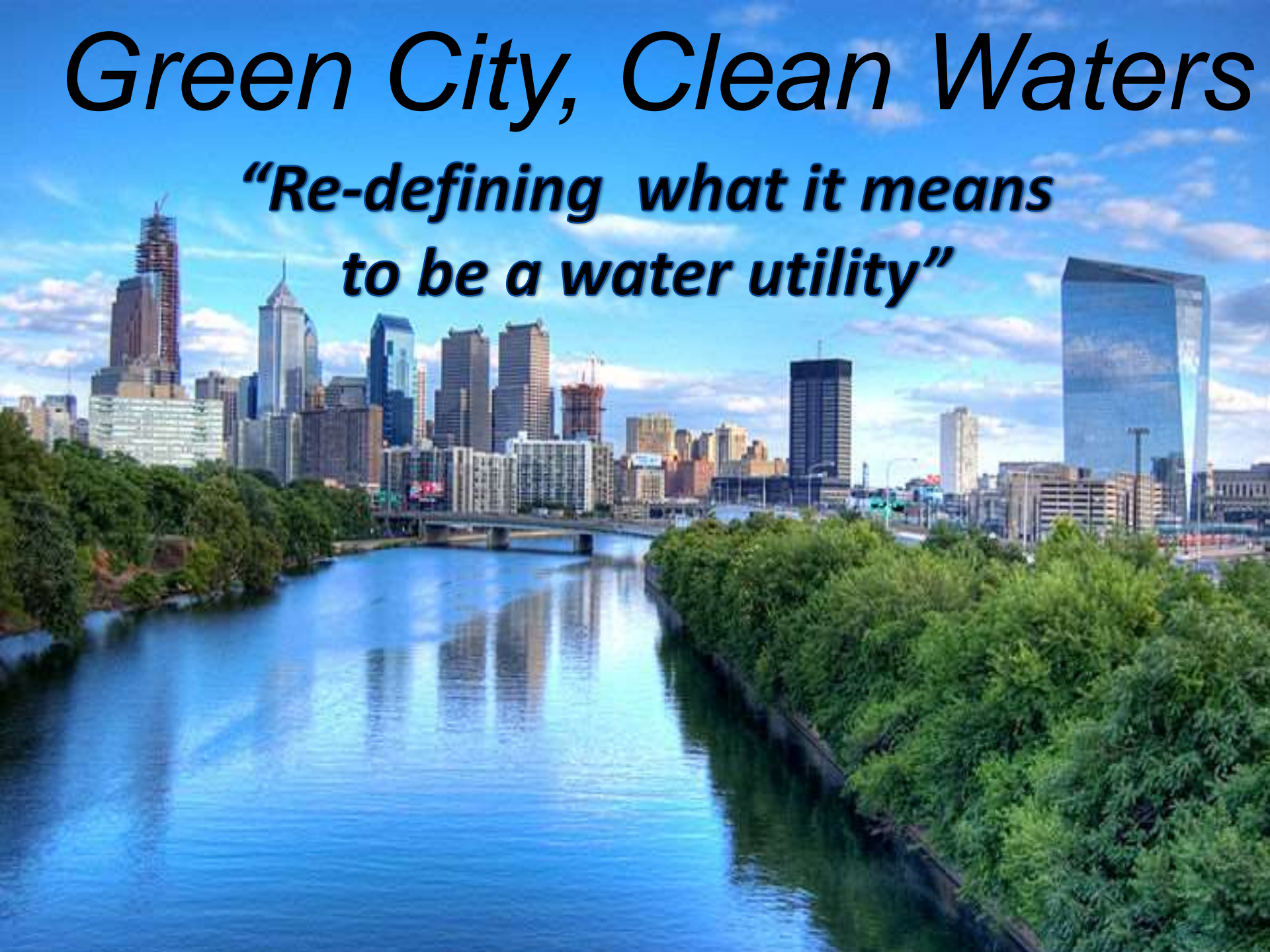
Examining how selected assets relate to one another spatially, functionally, and experientially makes it possible for you to identify how they do or do not currently work together to affect city life. This understanding makes it possible for you to speculate about how they might work together differently, both in the near future and longer term. With these ideas in mind, you can start to strategize about how current local initiatives can connect with existing assets to expand on their core capacities, combining in new ways that generate exciting spaces, uses, and experiences which benefit people and communities.



These civic assets represent only a selection of the wide variety available in American cities. Other types include cultural centers, plazas, fire stations, churches, post offices, homeless shelters, and water bodies.

Green City, Clean Waters

*“Re-defining what it means
to be a water utility”*



One Water, One City, Many Places

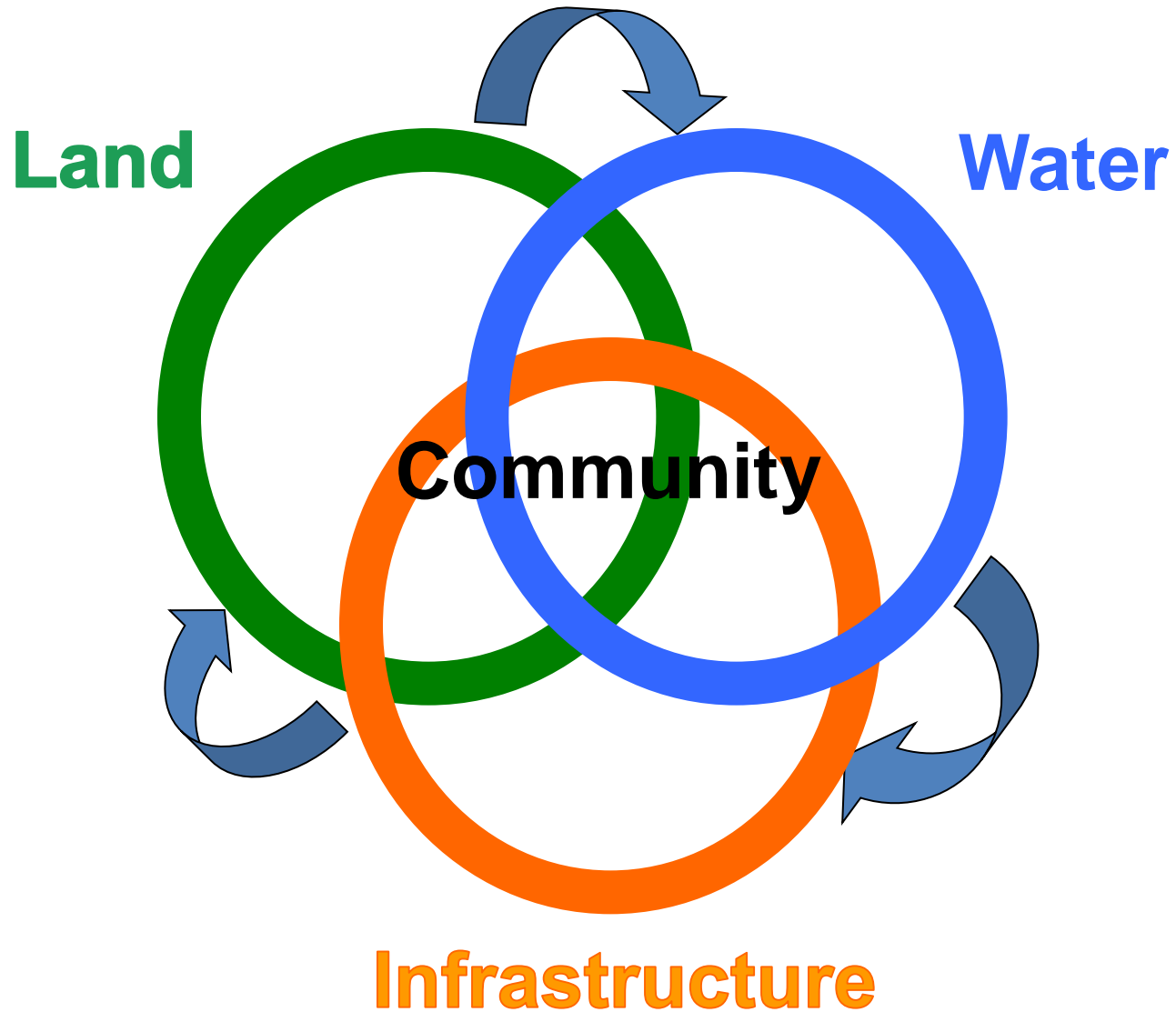
- Communities
- Transit
- Rivers & Streams
- Parks
- Schools
- Streets
- Businesses
- Parking lots
- Universities



Connecting Water to Urban Sustainability and Resilience and Social Justice



An Integrated Approach to Water



Out of the Gutter (2002)

Action steps are integrated into our strategic planning:

1. Review code and ordinances for obstacles/opportunities
2. Lead by example – use LID on City properties
3. Educate development review agencies on LID techniques
4. Prepare state of the art technical guidance document
5. Promote high visibility LID projects
6. Develop a large-scale “sewer shed” LID application
7. Create commercial incentives for LID designs
8. Foster coordination among City agencies
9. Create an incentive program to encourage LID
10. Protect existing open space
11. Focus on redevelopment not greenfield development
12. Restore the urban forest and street tree canopy
13. Develop tree protection and steep slope overlays
14. Implement day lighting and tributary restoration projects
15. Construct fish passages
16. Expand wetlands restoration and mitigation efforts
17. Use pocket parks, squares, traffic circles, triangles, islands

Mill Creek Playground



25-years = 10,000 GAs



5-years = 750 GAs



Metric	Year 0	Year 5	Year 10	Year 15	Year 20	Year 25
Total Greened Acres	0	750	2,100	3,800	6,500	10,000

Green Stormwater Goals

25-Year Implementation of *Green City, Clean Waters*



7.9 B gallon overflow reduction

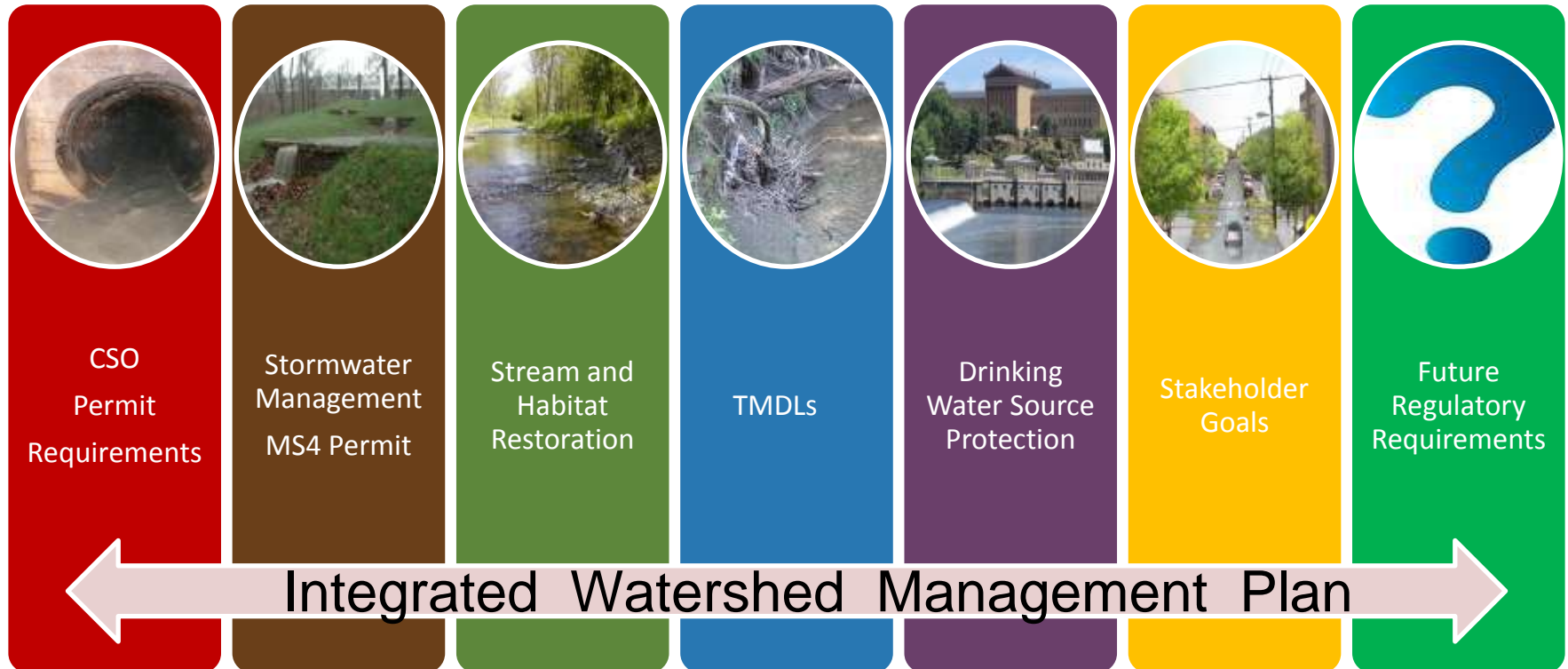


10,000+ Greened Acres or 1/3 of existing impervious cover



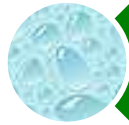
85% mass capture

The Office of Watersheds - 1999

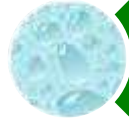


Fishable, Swimmable, Drinkable, Safe, Attractive, Accessible

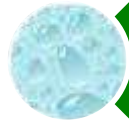
10,000 Green Acres Plan



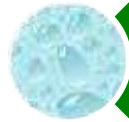
Vision and Leadership



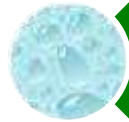
Public Outreach and Education



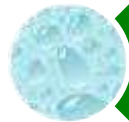
Innovate and Demonstrate



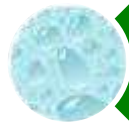
Adaptive Management



Leverage and Coordinate Investments



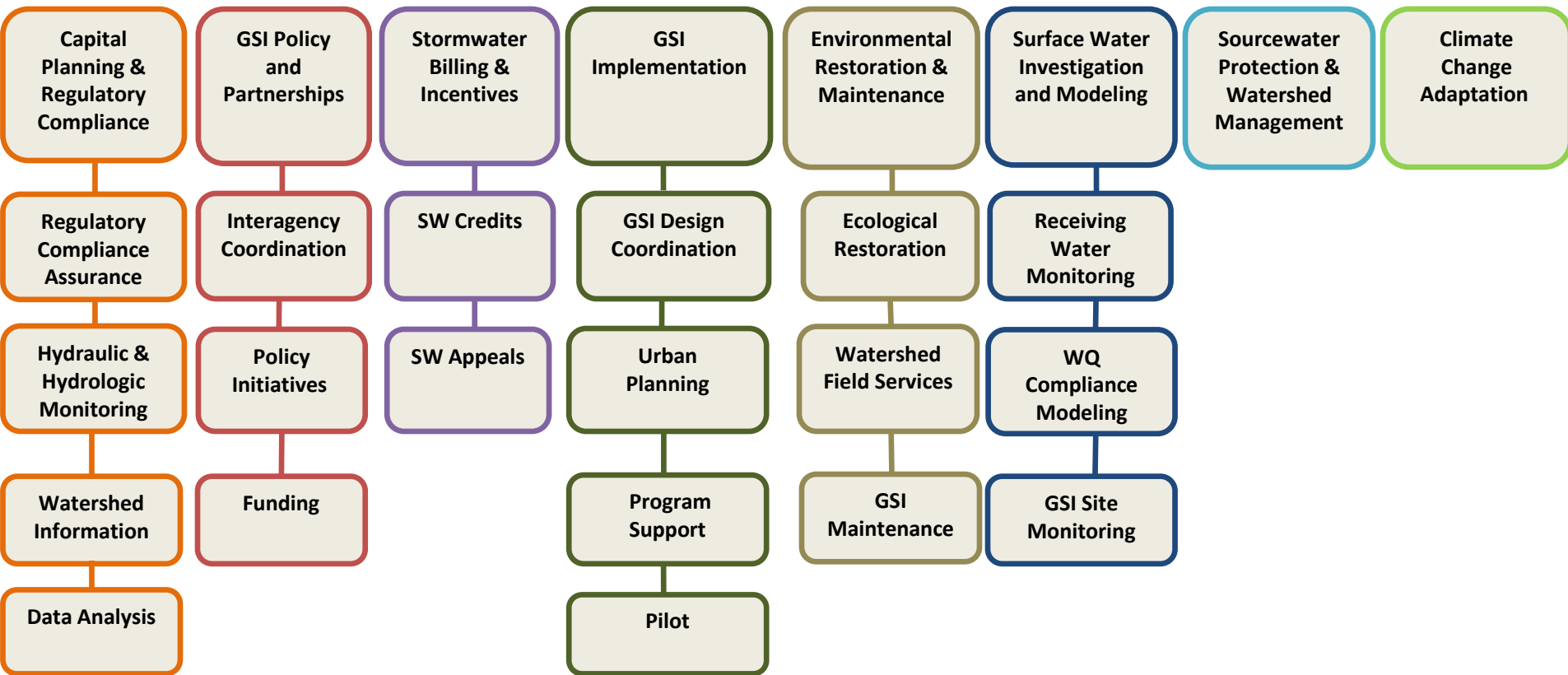
Set Policies, Incentives and Fees



Monitor and Maintain

A Transdisciplinary Approach

Philadelphia Office of Watersheds Core Functions



LAND + WATER

PHILADELPHIA PARKS + WATER INITIATIVES

GERMANTOWN GREEN BOWLS

Stormwater management parks

Sections of Germantown experience frequent localized flooding including roadways and traffic intersections. Through targeted land acquisition and integrated green stormwater management, some of these known flood locations may be redesigned to reduce flood impacts and improve safety, and transform these areas into an open space infrastructure network that can protect and sustain future development and investment.

EXTENDING THE LEGACY OF FAIRMOUNT PARK

Community greening throughout East Park + Strawberry Mansion

Fairmount Park was conserved in the late 1800s as open space to preserve and protect the Schuylkill River as a water supply. Community greening and park enhancements will extend this legacy, by integrating green stormwater infrastructure projects throughout the Strawberry Mansion neighborhood and East Park, as envisioned by PPR's New Fairmount Park plan. Coupling green stormwater infrastructure with streetscape improvements and gateways can connect adjacent communities to the park and the river. In addition, PWD, PPR, Audobon and Outward bound partnership and investment in East Park Reservoir will create a hub for conservation and leadership for Philadelphia communities.

GATEWAYS TO NATURE + RECREATION

Natural land + watershed park: Cobbs Creek

Cobbs Creek has the potential to be one of the major connective fibers of our region, providing miles of needed trail links, connecting neighborhoods and amenities, and conveying and clearing our waters before they reach the Delaware River. PWD has made a long-term commitment toward stream restoration of the in-City portions of Cobbs Creek. Restoring Cobbs Creek reaches 6 through 8, from Market Street to Railroad Bridge, as well as creating gateways and managing stormwater using green infrastructure lays the groundwork for accomplishing this vision and commitment.

PROMOTING SUSTAINABLE DEVELOPMENT

Creating an environmental recreation base

Focus on south of Gray's Ferry Bridge communities by enhancing parks and open space, as well as street connections to the Schuylkill River through green stormwater infrastructure projects, as well as extending recreation opportunities along the Schuylkill River. The goal would be to create an environmental recreation base that would leverage these investments to support future redevelopment.

CITY TRANSFORMATION

Partnership Expansion

PWD, PPR, and other partners have been collaborating to leverage green stormwater infrastructure investments with amenity improvements to enhance park, recreation, open space, and school projects, as well as street greenways. PWD and PPR collaboration has been through various partnership efforts, including Neighborhood Parks, Green 2015, and alignment with council funding improvements. An expansion of this existing partnership would be advanced by additional funding, leading to a citywide transformation.

DESTINATION WATERSHED

Natural land and watershed park: Tacony Creek

The vision for the Tookany/Tacony Frankford watershed conceptualizes the watershed as a destination for stormwater innovation, distinctive recreation and healthy creeks that supports further investment in the area's vibrant neighborhoods. PWD has made a long-term commitment toward stream restoration of the in-City portions of the Tookany/Tacony Frankford creeks. Restoring Tacony Creek reaches 4 through 6, from Whittaker Avenue to Wyoming Avenue, as well as creating gateways and managing stormwater using green infrastructure lays the groundwork for accomplishing this vision and commitment.

FRANKFORD CREEK TO THE DELAWARE RIVER

Placeholder text - awaiting PPR input

The Frankford Creek Greenway Feasibility Study proposed a combination on and off road trail along the Frankford Creek to Delaware Avenue and the East Coast Greenway. This trail was identified as one of the city's highest priority trails in the Philadelphia Trail Master Plan (2013). PWD advised PCPC, as part of their Frankford Brownfield Area Wide Planning study, on the potential to integrate green stormwater infrastructure upon redevelopment of the Philly Coke/Dow site and the Rohm & Haas site, to manage stormwater from the right of way.

RIVER MEETS RIVER

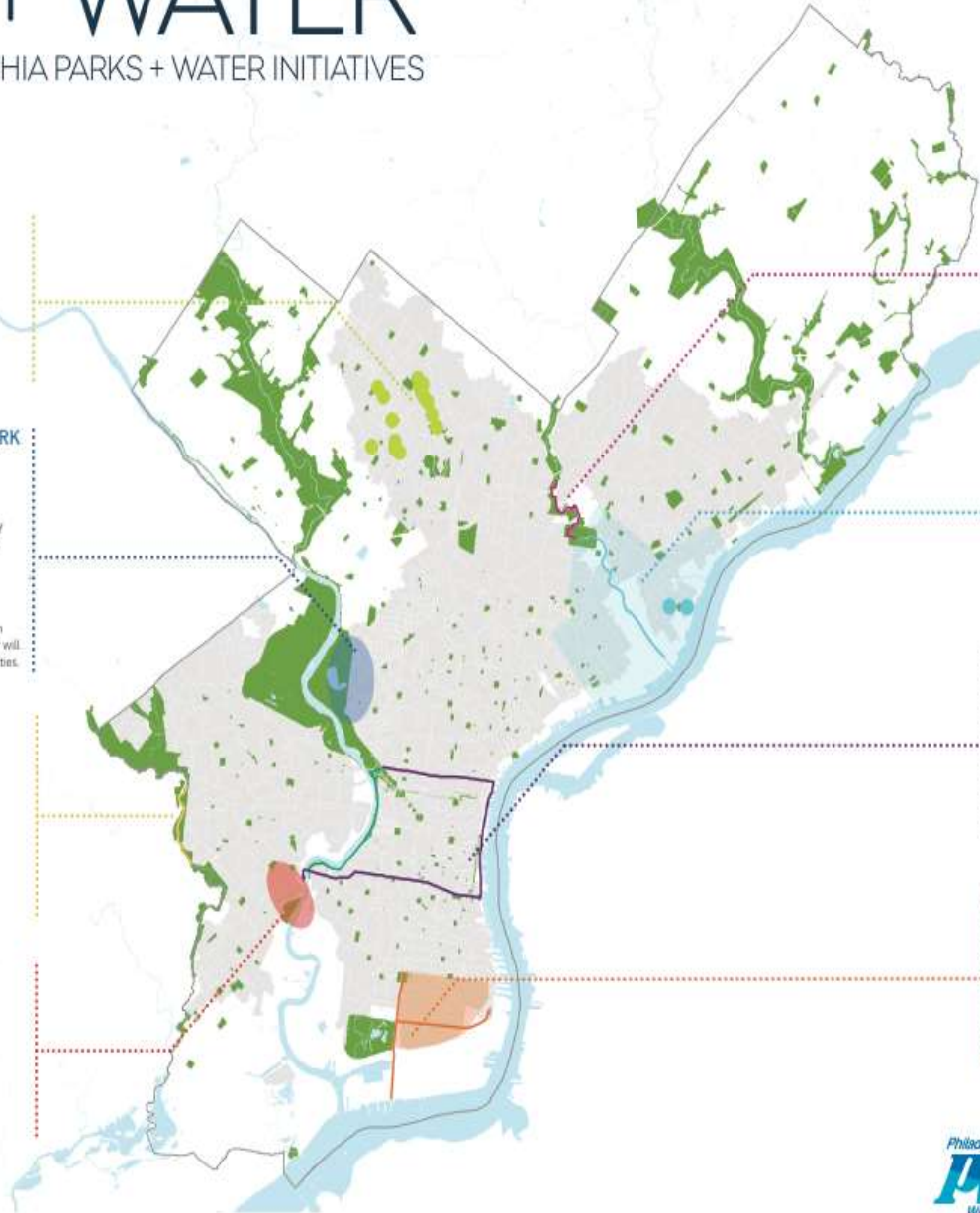
Delaware River to Schuylkill River trail connection

The planned Spring Garden and Washington Avenue Greenways, coupled with the planned Delaware Riverfront trail can complete a 12 mile river to river loop within Philadelphia and connect to the East Coast Greenway and Schuylkill River trails (in green), by creating complete streets, including green stormwater infrastructure, bike lanes, and street greening. This would provide local communities with access and recreation on both rivers and access to amenities along each route. Alignment with a stormwater flood relief sewer project on Washington Avenue, would leverage PWD's investment.

MEETING THE NEED

FDR Park to the Delaware River

Enhance FDR Park, Broad Street and Patissot Street through green stormwater infrastructure and complete street features. Creating this gateway and connection between Marconi Plaza and the Stadium District to the Delaware River would provide recreational and water related amenities to many significantly under-served communities. The Stadium District also provides a significant opportunity to transform the sports complex into a more pervious and green place that will beautify the area and educate the public about stormwater and the environment.

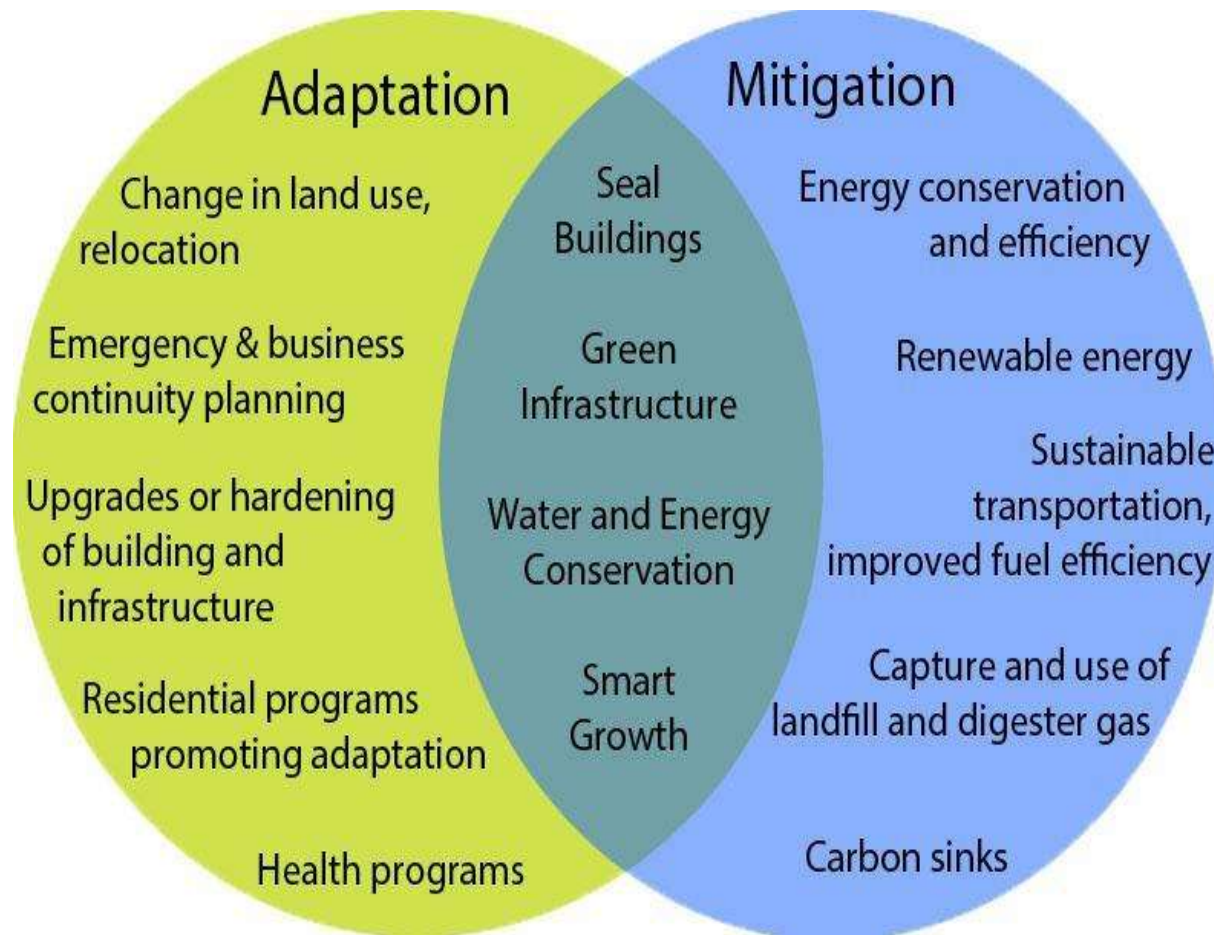


PHILADELPHIA
PARKS &
RECREATION

LEED and Water

- Bring the stakeholders together early
- Integrate the process
- Sustainability and resiliency goals
- Metrics and certification
- Public / Private Innovations
- Market forces

Green City, Clean Waters is Integral to Philadelphia's Climate Action Plans





10.3% PROPERTY VALUE INCREASE

Estimated property value gain from proximity to GSI investment.

Sustainable Business Network estimates an aggregate \$1.3B increase in citywide property value, producing an annual increase of \$18M in property taxes.





430 NEW JOBS 14% GROWTH

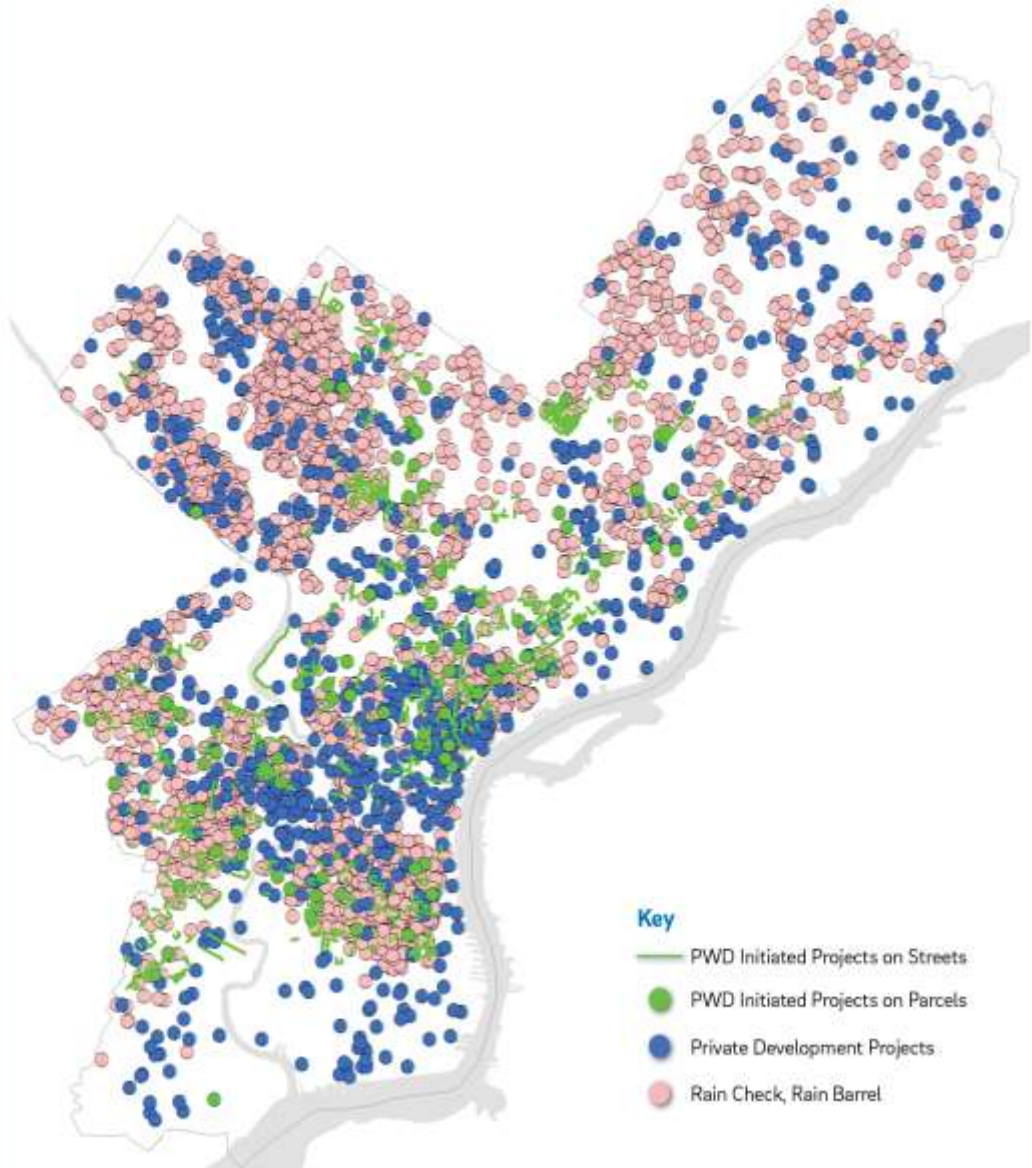
In Greater Philadelphia Green Stormwater Infrastructure industry, including members of the PowerCorpsPHL program for at-risk youth + local GSI design and maintenance firms.



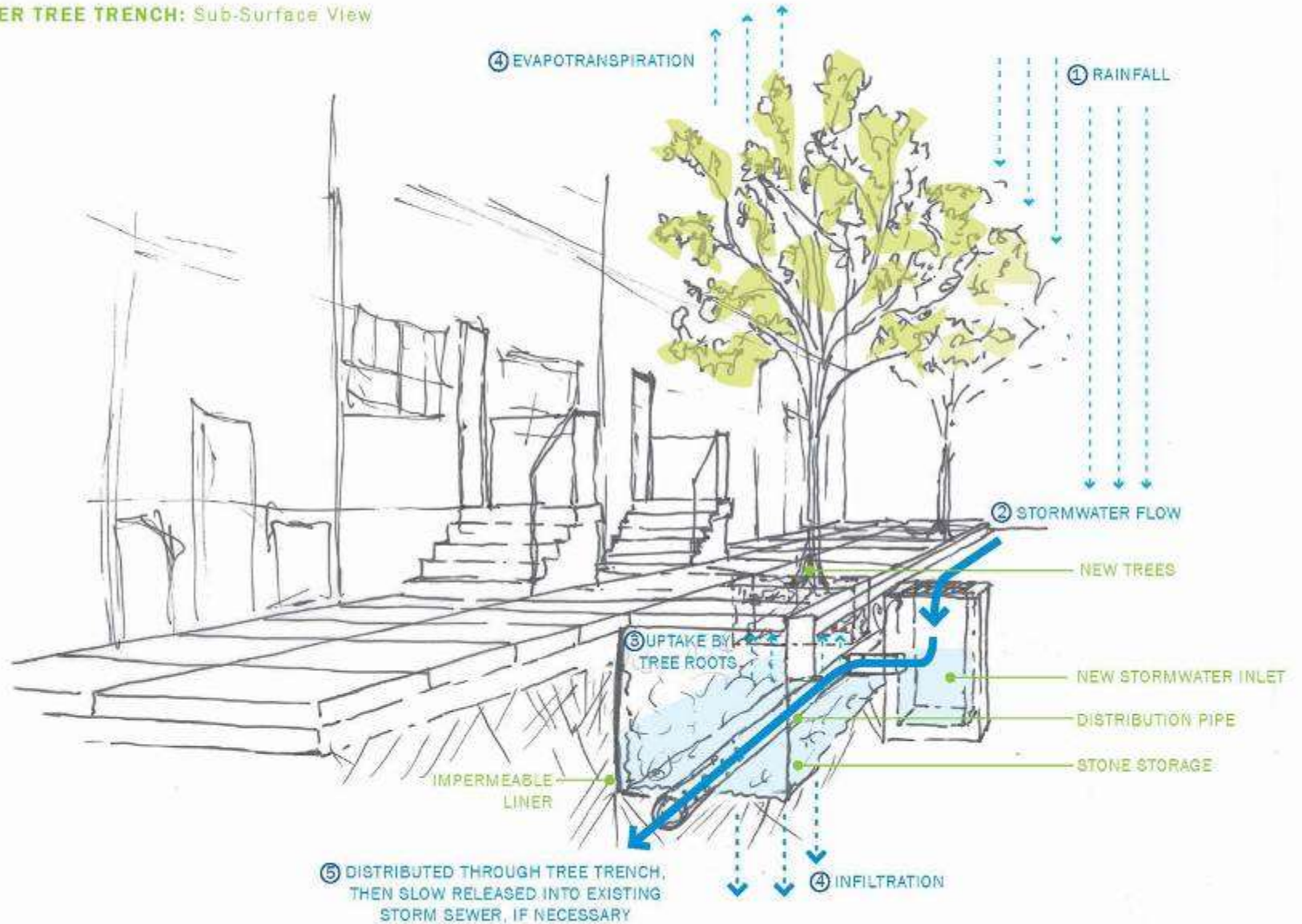


440+ GSI SITES

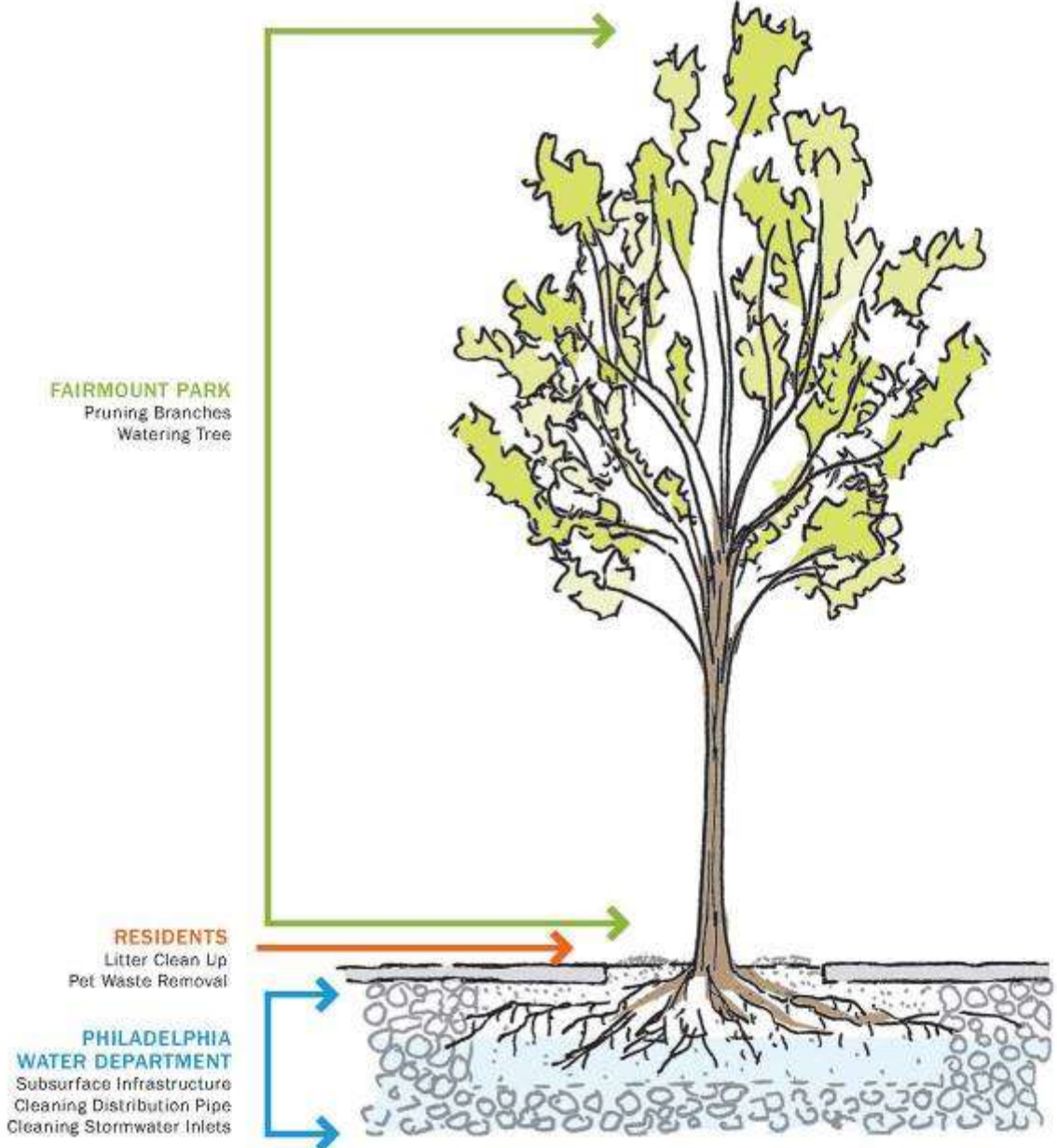
The *Green City, Clean Waters* program was established in 2011. Today, hundreds of green stormwater sites across the city help to manage millions of gallons of runoff every time it rains in Philadelphia. This widely distributed green infrastructure network currently reduces pollution from sewer overflows by 1.5 billion gallons per year, and is set to grow tenfold by 2036.



STORMWATER TREE TRENCH: Sub-Surface View



STORMWATER TREE TRENCH: Maintenance Responsibilities



FAIRMOUNT PARK
Pruning Branches
Watering Tree

RESIDENTS
Litter Clean Up
Pet Waste Removal

**PHILADELPHIA
WATER DEPARTMENT**
Subsurface Infrastructure
Cleaning Distribution Pipe
Cleaning Stormwater Inlets

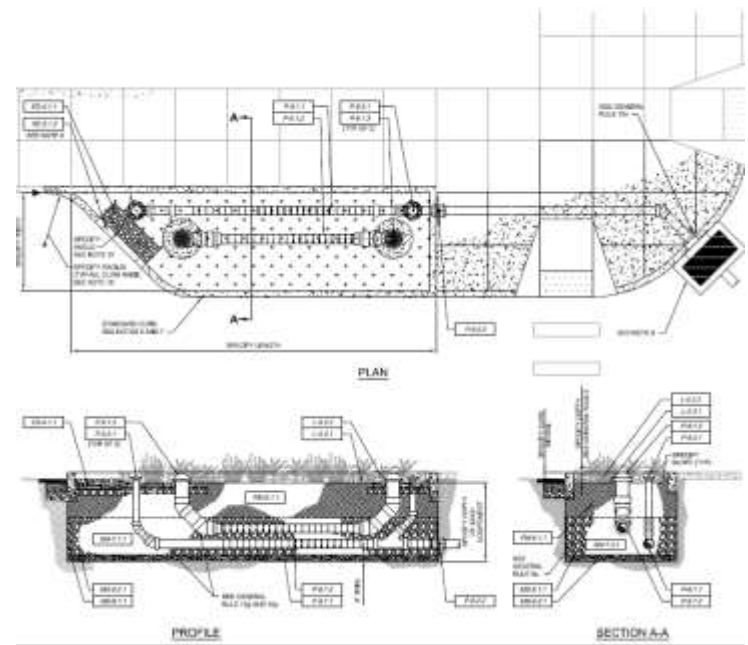
Green and Complete Streets



Mid-block Stormwater Bump-out

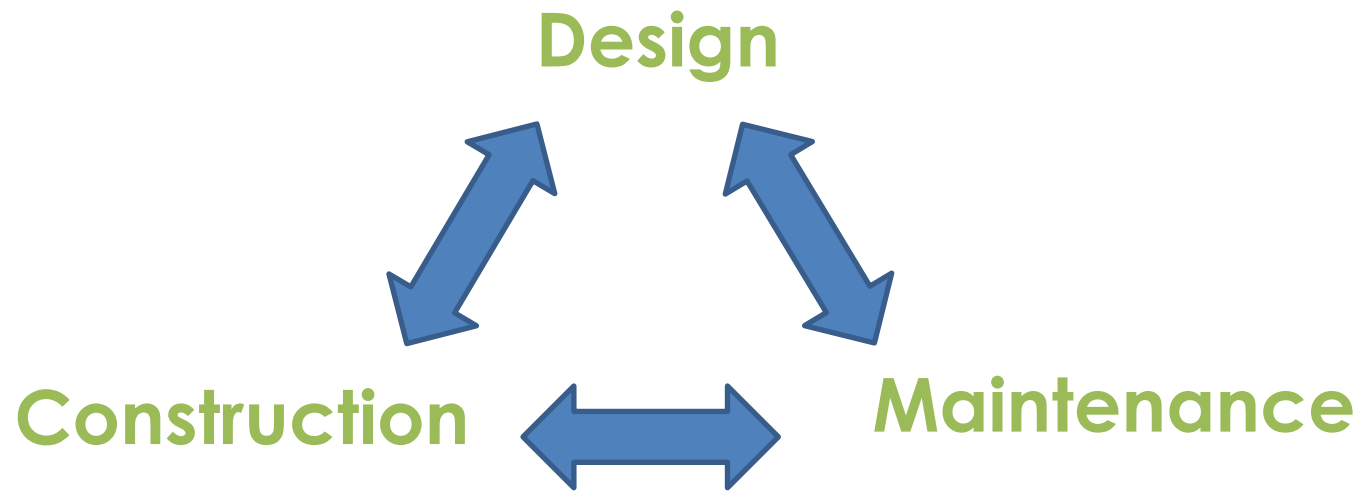


Corner Stormwater Bump-out





Feedback Loop



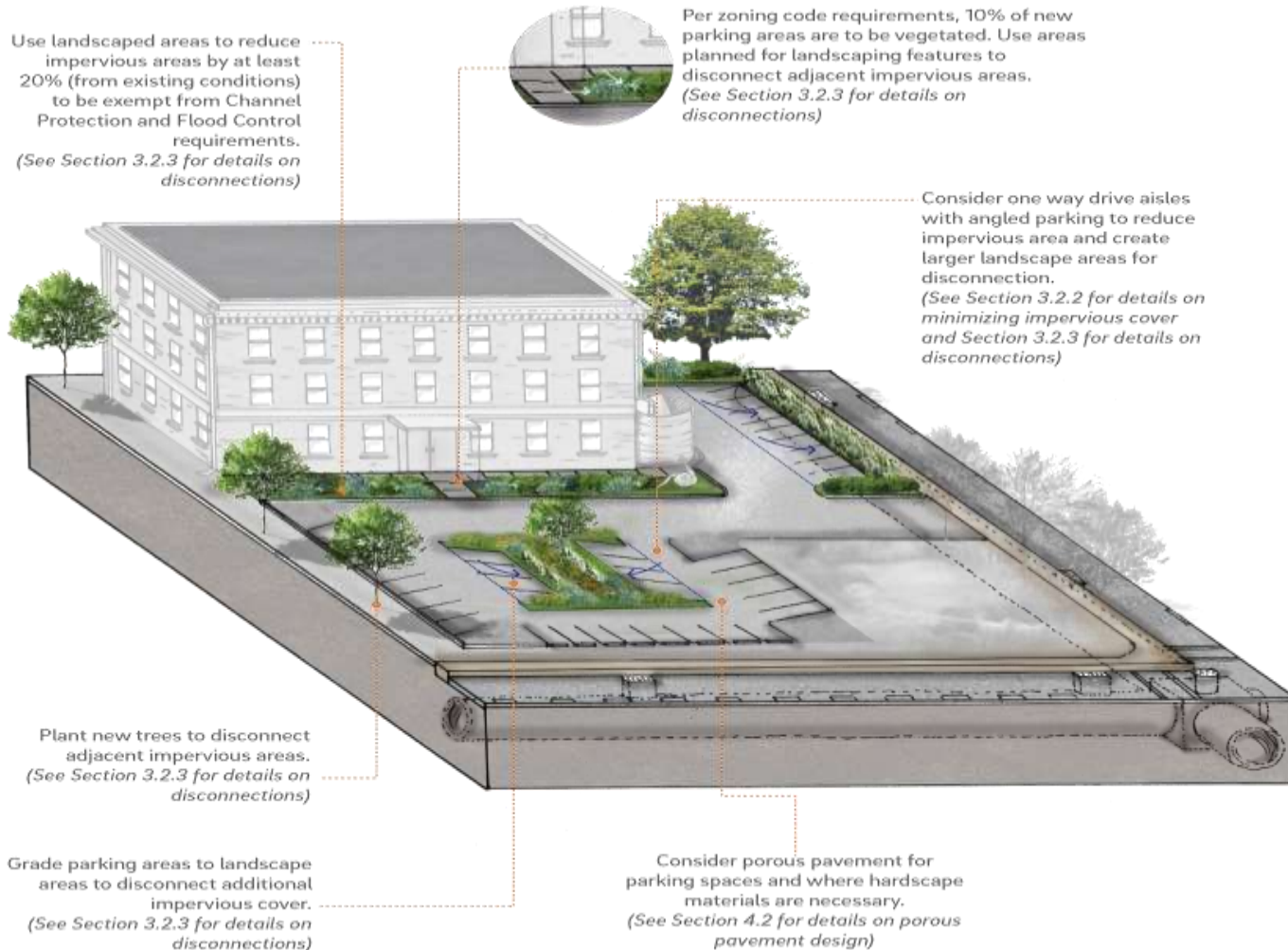








Philadelphia Stormwater Development Regulations





PECO, Philadelphia, PA

Philadelphia
FWD
Water & Power
Photo by Paul Rider



CIRA Center Roof, Philadelphia

Parcel Based Stormwater fees

Have a stormwater
HEADACHE?

Try
this!



Compliments of
unified business owners
of Philadelphia

Stormwater Fees and Credits

- Gross area charge ~\$0.50 / 1000 sq ft / mo
- Impervious area charge ~\$9.50 / 1000 sq ft / mo

- 1 acre parking lot unmanaged ~\$ 5200 / year
- 1 acre parking lot managed ~\$ 260 / year

- Residential Stormwater Fee ~ \$170 / year

Grants to Private Property Retrofits 2012 to 2014

Total Award Amount	\$25 million
Projects Awarded	49
Greened Acres	298
Cost Per Acre	\$83,000

Cardone Industries:

Completed in 2013

Gross Area: 2,935,236 sf (67.38 acres)

Total project cost \$3,361,441 (100% PWD contribution)

Impervious Area managed: 2,253,868 sf (51.74 acres)



Fishable, Swimmable, Drinkable
Safe. Attractive. Accessible.





6,000 TONS TRASH & DEBRIS

Removed from Philadelphia's
waterways as a result of our
pledge to make rivers & streams
fishable, swimmable, accessible
and beautiful.







Yellow Perch



Pike



Catfish



White Perch



American Shad



Walleye

Indian Creek Daylighting







CASE STUDY: Stanley's Hardware

STORMWATER
PIONEERS
PHILADELPHIA WATER DEPARTMENT





Salvation Army Kroc Center of Philadelphia



Philadelphia Kidzoo



Stroud Water Research Center



Cira Center Blue Green Roof



Venice Island Park and CSO Storage Tank



Porous Surface Test Site







De-Paving Party





Heston Gardens





**PHILADELPHIA
GREEN ROOFS**



Stormwater Tours



Wrapped Rain Barrels



Green Homes





rain
check



Womrath Park

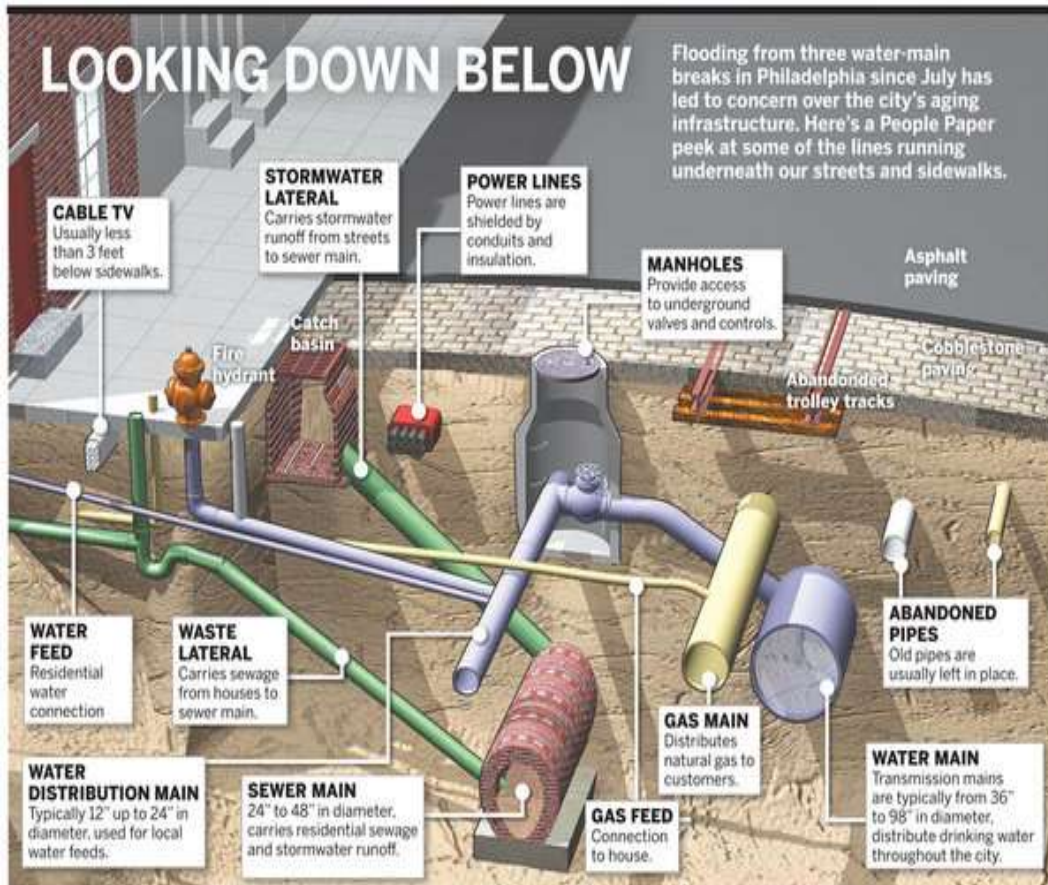


Kemble Park



The Water Sector Cannot Do This
on its Own !!!!

Deep Systems Change



Deep Systems Change



There is nothing more difficult to plan, nor more doubtful of success, nor more dangerous to manage than the creation of a new order of things.

(Machiavelli , The Prince - 1513)

People love change*



*as long nothing appears different

Change Impacts People



Change Impacts People



Reinforce Change

Feedback, Training, Rewards

Change needs time to evolve



Contrary to everything I just said:

Implement NOW

Ask Forgiveness Later....

Implementation *IS* Policy

Institutionalizing Change



Summary of My Talk

- Existing conditions are overwhelming our water systems
- Communities need to become more resilient
- There is just not enough money
- Stormwater Management = control over water + land
- Community-based Public-Private Partnerships are essential
- This will support smart investments and leverage funding
- We can turn hazards into community opportunities



image by WR



image by WR

Thank you!



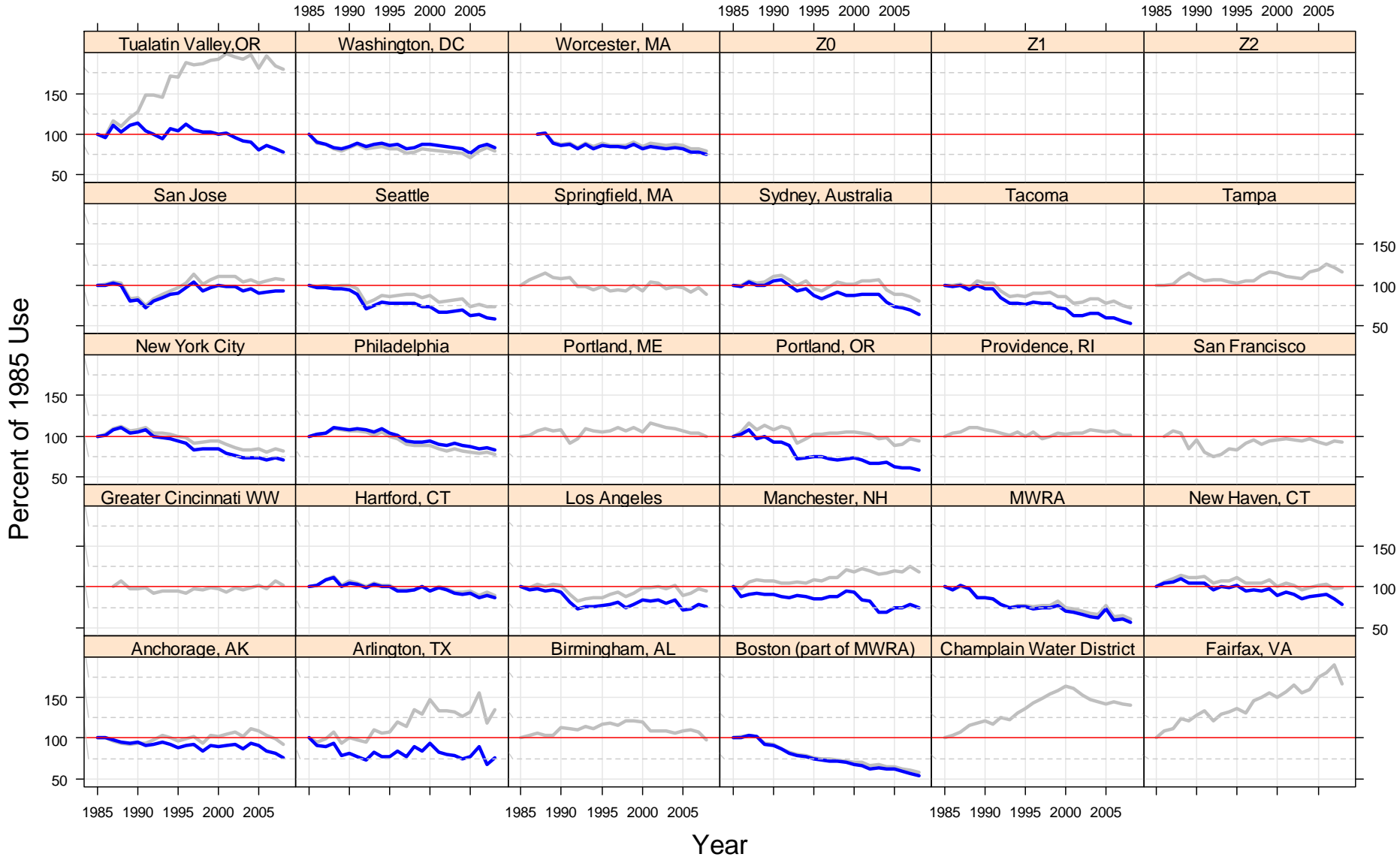
Howard Neukrug, PE

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All cities normalized to 1985

— Volume

— Gross Per Capita



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

Build a CSO Tunnel:

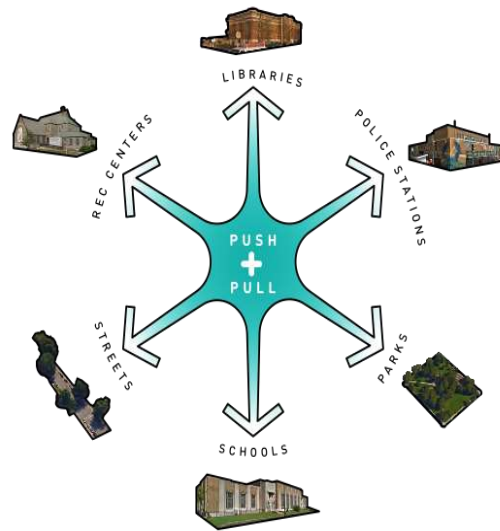
- Reduce sewage overflows to rivers and lakes

OR

Invest in Green Infrastructure:

- Reduce sewage overflows to rivers and lakes
- **Create green space, urban land restoration and real estate value, mitigate global climate change, reduce heat deaths, improve quality of life, water and energy conservation, education, recreation, riparian buffers, flood control, access, unimpaired streams...**

Green Infrastructure is the Foundation for One Water Theory



Studio Gang Architects

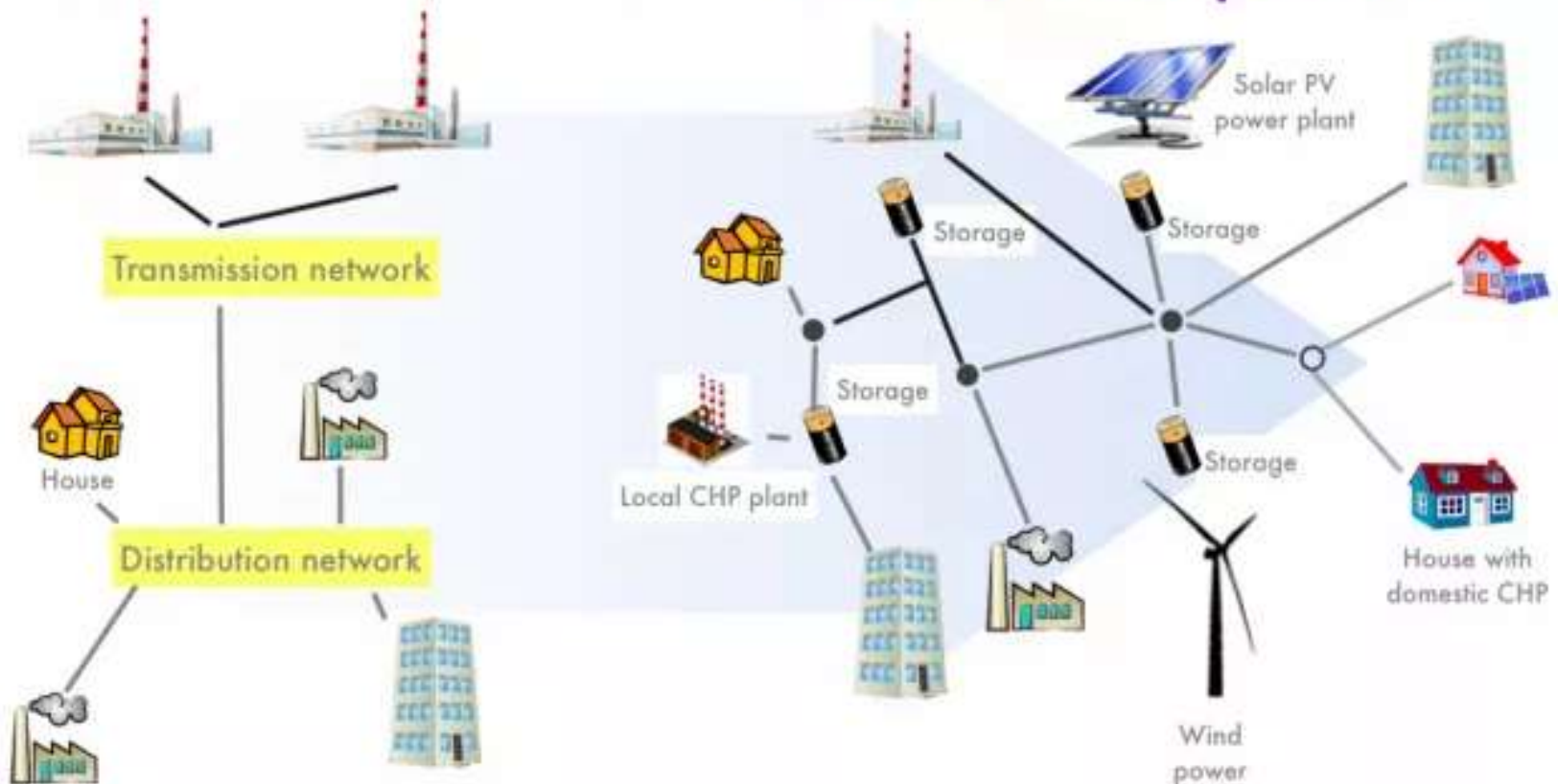
Inclusion, diversity, equity and helping our inner cities flourish



Water Energy Nexus

Centralized Power

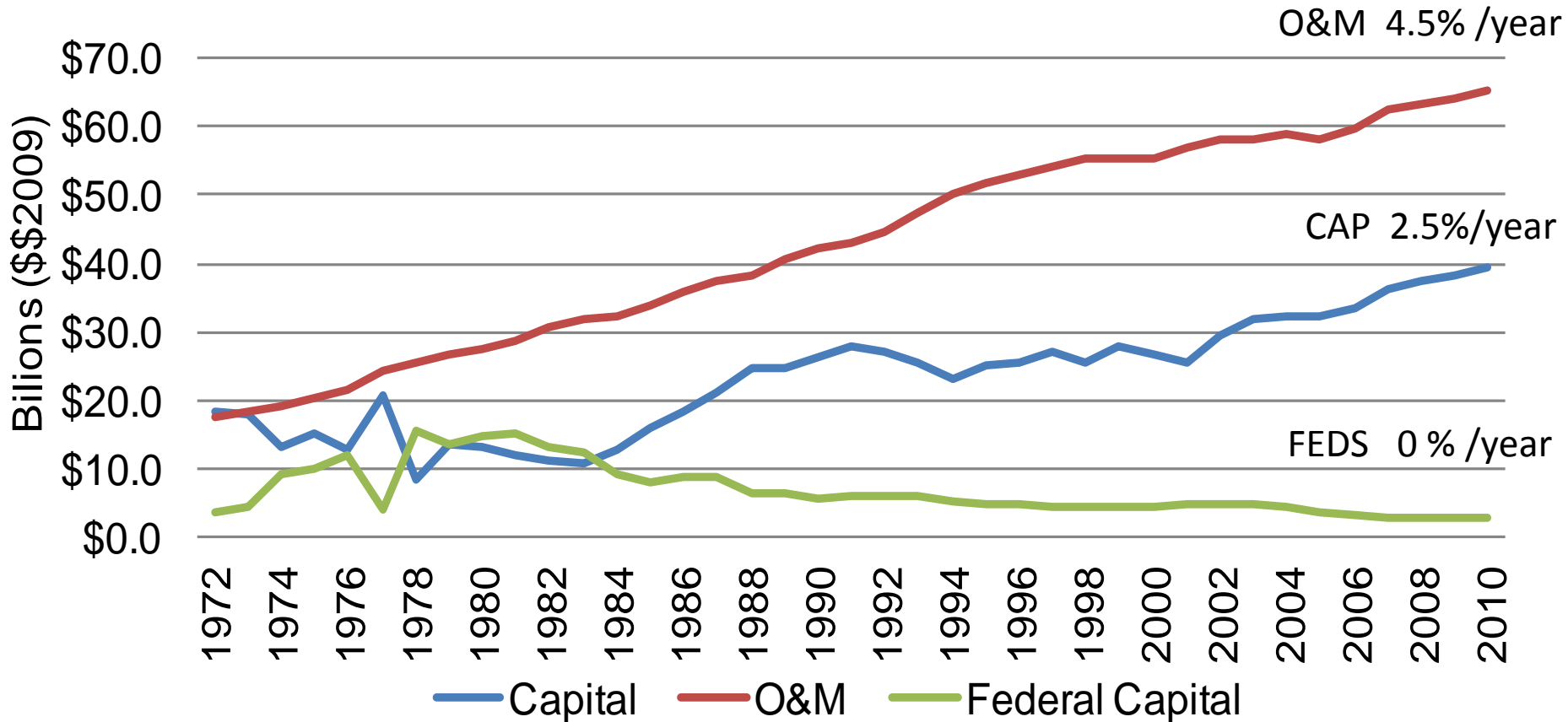
Clean, local power



Deferred Maintenance?

Government Spending on Water and Wastewater

(2009 dollars)

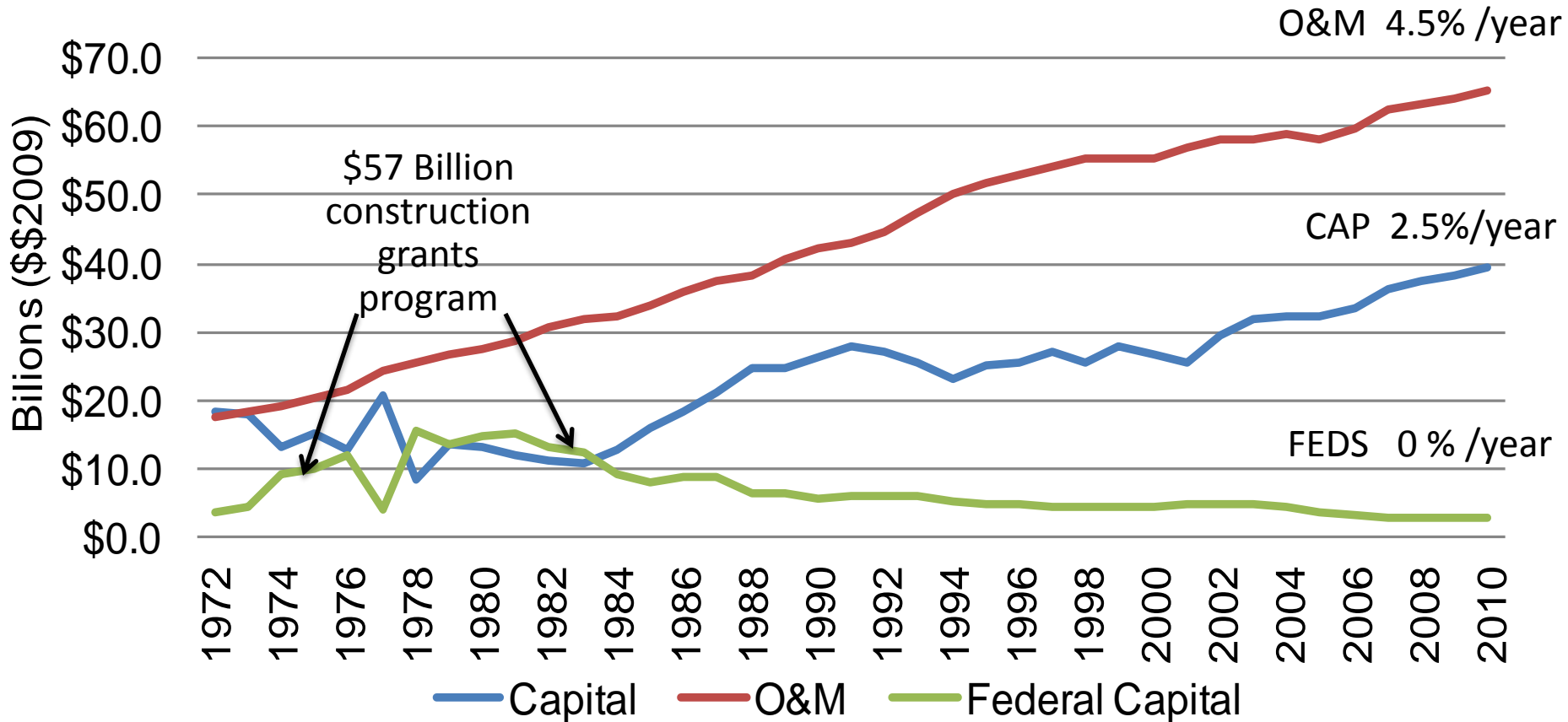


Source: US Census Bureau, Government Expenditure Series and Ken Rubin

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LOOKING DOWN BELOW

Flooding from three water-main breaks in Philadelphia since July has led to concern over the city's aging infrastructure. Here's a People Paper peek at some of the lines running underneath our streets and sidewalks.

CABLE TV
Usually less than 3 feet below sidewalks.

STORMWATER LATERAL
Carries stormwater runoff from streets to sewer main.

POWER LINES
Power lines are shielded by conduits and insulation.

MANHOLES
Provide access to underground valves and controls.

Asphalt paving

Fire hydrant

Catch basin

Cobblestone paving

Abandoned trolley tracks

WATER FEED
Residential water connection

WASTE LATERAL
Carries sewage from houses to sewer main.

ABANDONED PIPES
Old pipes are usually left in place.

WATER DISTRIBUTION MAIN
Typically 12" up to 24" in diameter, used for local water feeds.

SEWER MAIN
24" to 48" in diameter, carries residential sewage and stormwater runoff.

GAS MAIN
Distributes natural gas to customers.

WATER MAIN
Transmission mains are typically from 36" to 98" in diameter, distribute drinking water throughout the city.

GAS FEED
Connection to house.

- As we transition our water management systems to more resilient, sustainable, affordable approaches, we need to work with and get the cooperation of those responsible and in control of the land.
- Connecting our actions on the land to the future of our water systems has never been so important to the future of our civilization.