Nature-based solutions and stormwater management in Los Angeles County

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The Nature Conservancy

AGENDA

TNC goals and team

Green v. gray and nature-based solutions

TNC's portfolio of work in the Los Angeles region

Q & A

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Our work in stormwater

Washington State: Developing scientific basis for stormwater retrofit intervention.

Chicago and Cook County: Supporting creation of stormwater credit market including pilot trades.

Detroit: Launching first Watershed Improvement District.

Philadelphia: Delivering projects through Greened Acre Retrofit Program.

Maryland: Generating water quality credits under Maryland Nutrient Credit Trading Program.

Washington DC: Implementing GSI projects to bring credits to market.

L.A. County: Developing recommendations for stormwater incentive programs and launching pilot projects.

Gulf Coast States: Developing stormwater investment blueprints to leverage Deepwater Horizon spill funds.

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TNC goals in LA

Treat stormwater using natural infrastructure

Deliver additional benefits to urban residents

Enhance biodiversity in urban LA

Strategy:

- Create the enabling conditions through appropriate policy, governance, and education campaign.
- Develop the science for nature-based solutions.
- Develop market-mechanisms to leverage private investment in natural infrastructure.
- Create a proof of concept demonstration project.

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TNC Urban Conservation Team

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Green vs Gray Infrastructure

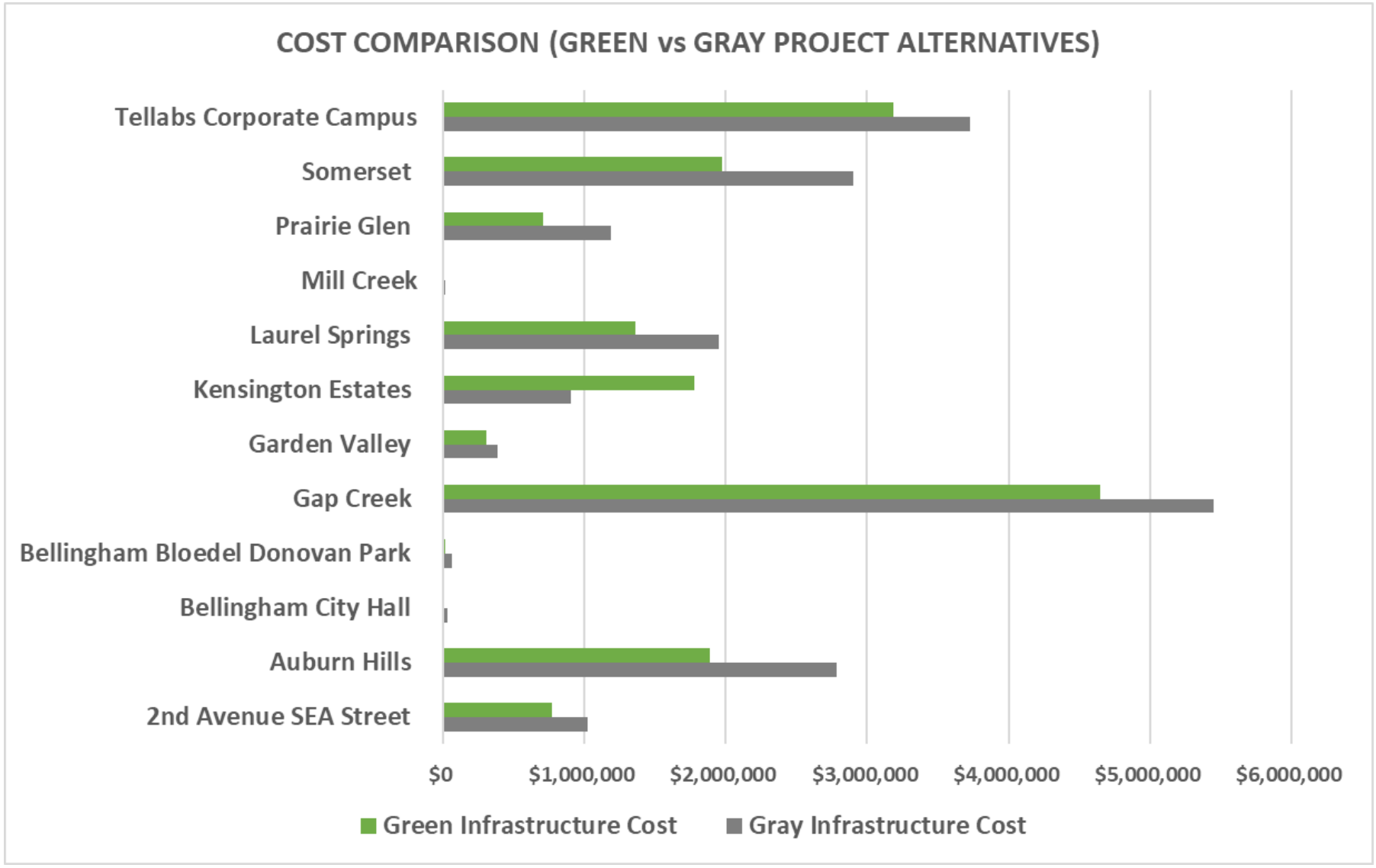
Santa Monica Urban Runoff Recycling Facility (SMURF)

Dominguez Gap Wetlands

South LA Wetlands Park

Subsurface Infiltration Vault (Ex. StormPrism System)

Green vs. Gray: Private Development



Source: EPA, 2007. Reducing Stormwater Costs through LID Strategies and Practices

GREEN vs. GRAY

The City of **Philadelphia** evaluated two infrastructure options designed to meet the same stormwater needs, with different overall benefit.

INVESTMENT

GREEN/GRAY	GRAY
$2.4 billion	$3.8 billion

ADDED VALUE

$2.85 billion	$0.122 billion

Summary of Triple Bottom Line Analysis - Philadelphia

City-wide present value benefits (2009 million USD)

Benefit categories	GREEN/GRAY	GRAY
Increased recreational opportunities	$524.5	
Property value increase	$574.7	
Reduction in heat stress mortality	**$1,057.6**	
Water quality/aquatic habitat enhancement	$336.4	$189.0
Wetland services	$1.6	
Local green jobs	$124.9	
Air quality improvements from trees	$131.0	
Energy savings/usage	$33.7	$(2.5)
Reduced (increased) damage from SO_2 and NO_x emissions	$46.3	$(45.2)
Reduced (increased) damage from CO_2 emissions	$21.2	$(5.9)
Disruption costs from construction and maintenance	**$(5.6)**	**$(13.4)**
Total	**$2,846.4**	**$122.0**

Source:

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Operation and Maintenance– Green versus Gray

TNC and our partners have demonstrated O&M costs of between **1% and 3% of construction costs annually** in Philadelphia, Washington DC and L.A.

Less or equivalent to gray infrastructure

Enhanced Watershed Management Plans which include blended green and gray have O&M range between 1% and 14%.

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Green vs. Gray: Municipal Programs

Peoria, Illinois

100% green infrastructure solution to CSOs **30-percent more cost-effective than** gray infrastructure. $250M investment in GSI

EPA, 2014. The Economic Benefits of Green Infrastructure, A Case Study of Lancaster, PA. EPA 800-R-14-007. February, 2014

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Green vs. Gray: Municipal Programs

Lancaster, Pennsylvania

Avoided capital cost of $120 million due to blending gray infrastructure with a $94.5 million investment in green infrastructure. (EPA, 2014)

EPA, 2014. The Economic Benefits of Green Infrastructure, A Case Study of Lancaster, PA. EPA 800-R-14-007. February, 2014

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What is a nature-based solution? – As defined by Measure W

"**Nature-Based Solution**" means a Project that utilizes **natural processes that slow, detain, infiltrate or filter** Stormwater or Urban Runoff. These methods may include relying predominantly on **soils and vegetation; increasing the permeability** of Impermeable Areas; protecting undeveloped mountains and floodplains; creating and restoring riparian habitat and wetlands; creating rain gardens, bioswales, and parkway basins; and enhancing soil through composting, mulching, and planting **trees and vegetation**, with preference for native species. Nature-Based Solutions may also be designed to provide additional benefits such as sequestering carbon, supporting biodiversity, providing shade, and improving quality of life for surrounding communities.

Nature-Based Solutions include Projects that mimic natural processes, such as green streets, spreading grounds and planted areas with water storage capacity.

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What is a nature-based solution? - Types of practices

Nature Based Practices – Practices that use natural processes to treat and manage runoff. Processes include **soil filtration and infiltration or physical and biological treatment with vegetation**. Nature based practices can be vegetated or non-vegetated.

Vegetated Practices – A subset of nature-based practices, vegetated practices are strictly those that **include vegetation** as a component of the system. Vegetation may be a critical component of the treatment process, installed primarily for habitat improvement.

Retention Based Practices – Practices that **capture runoff without releasing it** back to the stormwater collection system via either surface outlets or subsurface drains. Retention is achieved through a combination of infiltration to shallow or deep groundwater systems, evapotranspiration or on-site reuse.

Detention Based Practices – Practices that **capture and release runoff back to the stormwater collection system** by either surface or subsurface drains. Orifices or other engineered outlet structures are typically used to meter release rates from detention-based practices.

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What is a nature-based solution? - Types of practices

NATURE BASED and VEGETATED PRACTICES

Bioretention/ Bioinfiltration/Raingarden

Biodetention with Underdrains

Green Roofs

Constructed Stormwater Wetlands

Outfall Retrofits

Wet and Dry Detention Basins

Subsurface Infiltration (Nature Based / Not Vegetated) and Detention (Non-Nature-Based)

Permeable Pavement (Nature-Based and Not Vegetated)

Cisterns (Non-Nature-Based)

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Nature-based solutions and co-benefits?

	Recreation	Urban heat	Air Quality	Energy Savings	Habitat	Property Value	Groundwater recharge/ water supply
Bioretention							
Biodetention with Underdrains							
Green Roofs							
Constructed Stormwater Wetlands							
Outfall Retrofits							
Wet and Dry Detention Basins							
Subsurface Infiltration							
Subsurface Detention							
Permeable Pavement							
Permeable Pavement with underdrain							
Cisterns							

Most co-benefits are associated with vegetation

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Green Infrastructure: Benefits by the Numbers

Air Quality

- **6.9 g** average ozone reduction per square meter of tree canopy (Nowak, 2006)
- **10% reduction in ozone** by converting 15% of manmade surfaces in LA Basin to vegetative cover (City of L.A., 2006)

Crime & Safety

- **12% decrease in crime** rate associated with 10% increase in tree cover (Troy et. al. 2012)

Water Conservation

- **200,000 gallons (0.6 acre-ft.),** potentially collected annually from a 1-acre impervious parcel in L.A. (estimate)
- **$720/acre-ft.** Benefit of groundwater recharge based on difference of cost of imported water from MWD and local groundwater extraction and treatment. (DRI, 2015)

Habitat/ Ecosystem

- **1 acre of habitat** created for every 25 acres of impervious surface area managed (estimate)

Heat Island Effect

- **6°F** cooler by converting 15% of manmade surfaces in LA Basin to vegetated cover (LBNL, 2006)

Public Health

- **$21M and $51M in annual economic loss** due to **1.5M swimmers** contracting gastrointestinal illnesses at 28 L.A. County beaches. (Given et. al. 2006)

* Water conservation and public health benefit can also be achieved by grey-infrastructure projects

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Why Green Infrastructure: Economic Benefits

Green Jobs

- **About 9 FTE construction job-years created** per $1 million capital spent on green infrastructure project (estimate)
- About **8 FTE operations and maintenance** job-years created for same (estimate)

Property Values / Property Tax Revenue

- **3 to 15% increase in residential property values** associated with street trees. (Wolf, 2007)
- **7% higher rental rates** for commercial offices having high quality landscapes including green infrastructure (Laverne and Winson-Geideman 2003)
- Increasing **city property tax revenue** due to higher sale prices.

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Our Stormwater-focused work in Los Angeles

- Los Angeles County Natural Infrastructure Project and Site Review
- Market-based strategies to incentivize stormwater management best practices on private property
- Stormwater capture and habitat enhancement demonstration project adjacent to the Los Angeles River at the Bowtie Parcel, Taylor Yard

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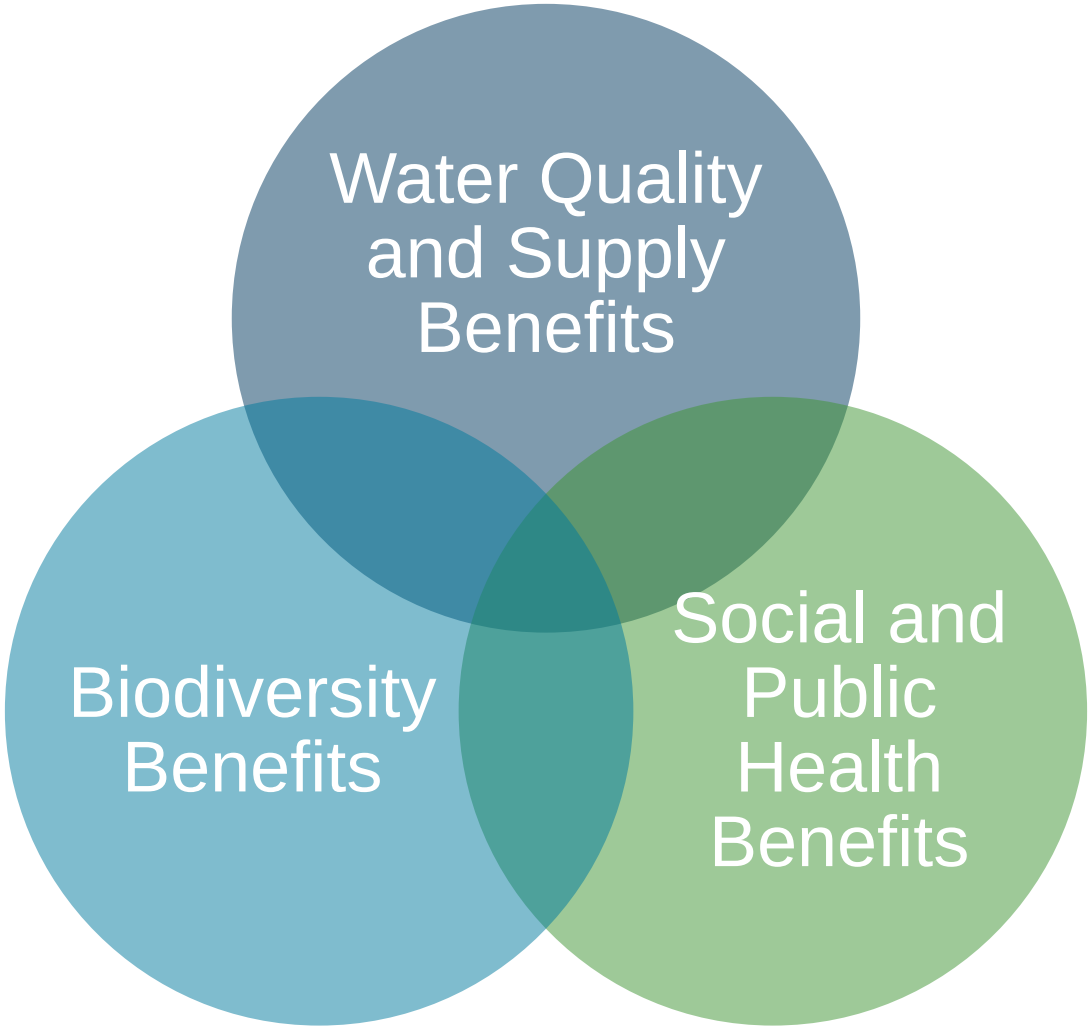
Los Angeles County Natural Infrastructure Project and Site Review



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Market-based strategies to incentivize stormwater management best practices on private property

1. Funding

- Strategies that create a new revenue or funding for jurisdictions to deliver stormwater management services

2. Contracting

- Ways for jurisdictions to procure stormwater management services

3. Regulation and Policy

- Strategies that have the effect of law or which create rules that require or allow for certain stormwater management activities

4. Monetary Incentives

- Strategies that create pathways for municipalities to purchase stormwater management capacity

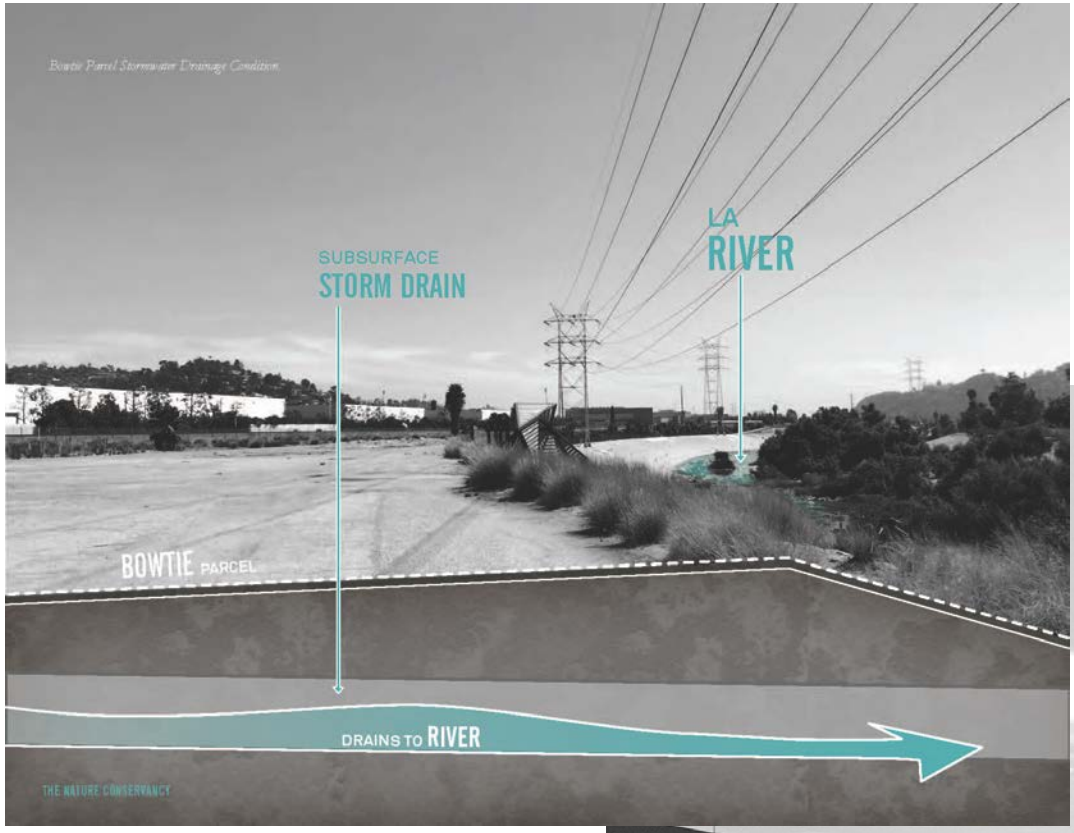
5. Non-Monetary Incentives

- Strategies that convey non-monetary benefits or incentives to entities who implement stormwater management practices

6. Financing

- Strategies that help jurisdictions, landowners, GSI developers or other entities to finance stormwater management projects

Stormwater capture and habitat enhancement demonstration project at the Bowtie Parcel



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06 BOWTIE PARCEL

DESCRIPTION

Approximate Size (acres): 18

Existing open space, minimal degree of existing use/maintenance/programming

Overall ratio is low, but can strategically pick off ~100 acres of catchment with WQ priority of 5 using the two northernmost outfalls. That would only need ~5 of the 10 acres that are available to treat.

3 large (~6, 8, 12') outfalls from storm drains, 1 small (~4') outfall from local or adjacent runoff

~2 on average for catchment, but localized smaller (industrial) area (~100 acres) with 3 and 5 that feed into 2 of the 3 drains and does not have u/s watershed that dilutes

KEY SPECIES OBSERVED

Black-necked Stilt *(Himantopus mexicanus)*
Black Phoebe *(Sayornis nigricans)*
Swallow *(Petrochelidon sp.)*
Cormorant *(Phalacrocoracidae sp.)*
Common Yellowthroat *(Geothlypis trichas)*
Killdeer *(Charadrius vociferus)*
Red Winged Blackbird *(Agelaius phoeniceus)*

HYDROLOGY

Estimated BMP Size (acres):	10
Impervious Catchment Area (acres):	1600
Ratio (%):	0.2

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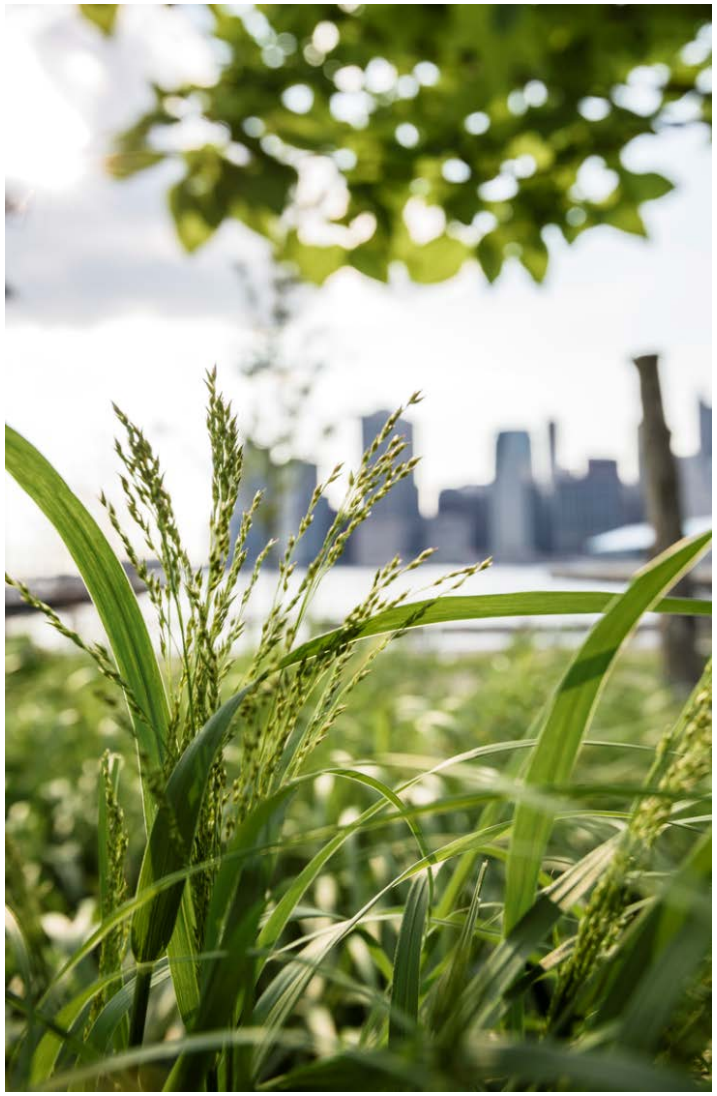
Q&A / Discussion

BACKUP SLIDES

Partnerships: A Proven Track Record (Stormwater)



Philadelphia, PA

- Existing **stormwater fee reduction incentive and grant program** for GSI on private parcels
- TNC partnering with non-profit landowners to deliver GSI projects
- Demonstrating **cost effectiveness of nature based, vegetated practices** to shift market away from non-vegetated practices
- Delivering GSI on private property at roughly **50% of cost** of public realm projects ($150k/GA versus $300k/GA)

Partnerships: A Proven Track Record (Stormwater)

Chesapeake Bay

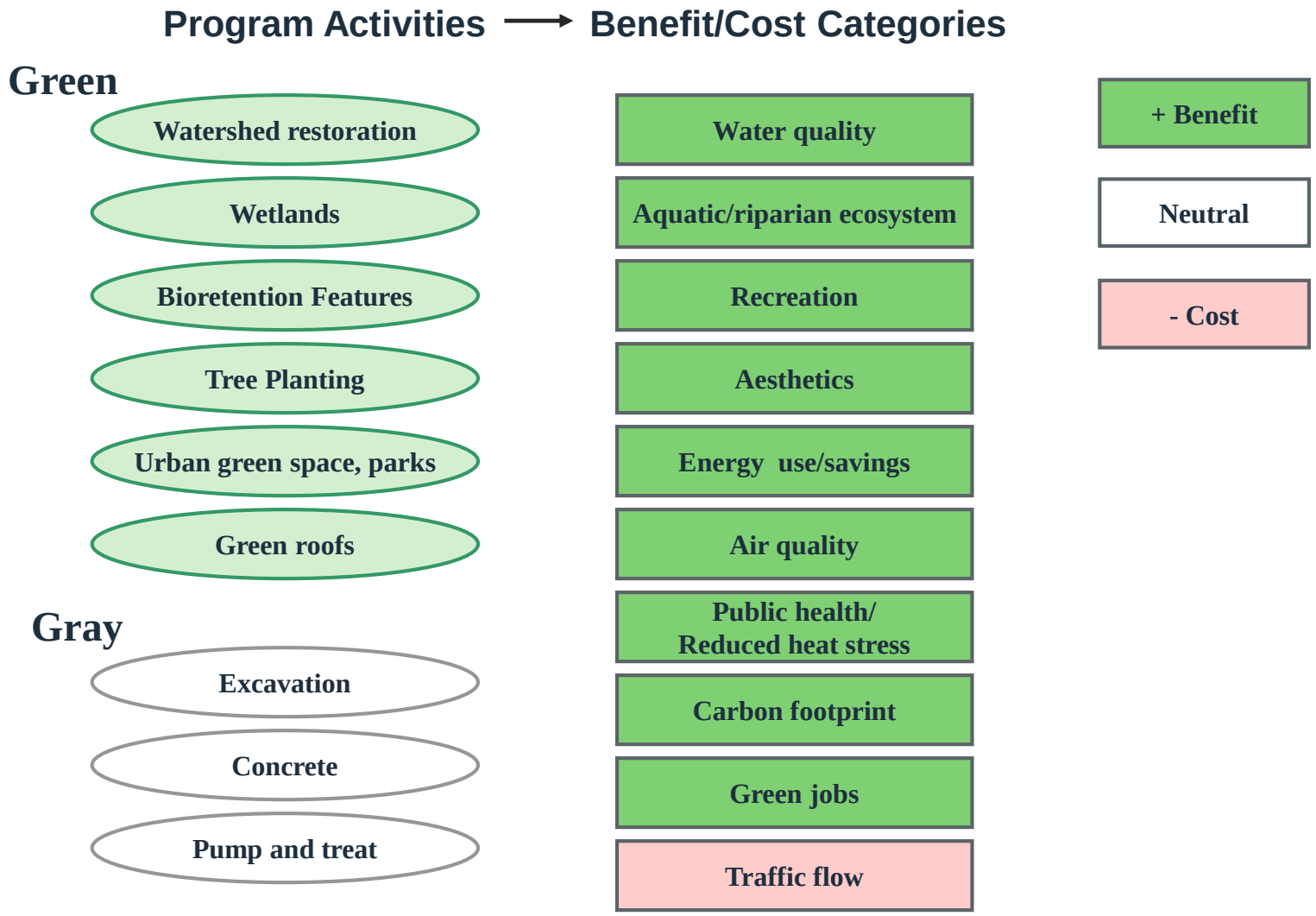
- Existing **sediment and nutrient market** to comply with TMDLs
- Partnership between TNC, tech, big box retail (suppliers) and Maryland Department of Transportation (buyers)
- **Detention basin retrofits** to remove sediment and nutrients
- Delivering sediment and nutrient treatment capacity on private property at **20% of typical cost** to MDOT

Partnerships: A Proven Track Record (Stormwater)

DC Stormwater Credit Market

- Existing **stormwater ordinance, stormwater market** for alternative compliance**, and stormwater fee reduction incentive**
- Partnership between TNC and Archdiocese of DC to deliver credits - **largest provider of stormwater retention credits**
- Helped utility formulate **purchase guarantee** program to reduce risk to investors
- Delivering GSI on private property for **45% of cost** of public realm projects

TBL Benefits and Costs of CSO Control Options: Philadelphia



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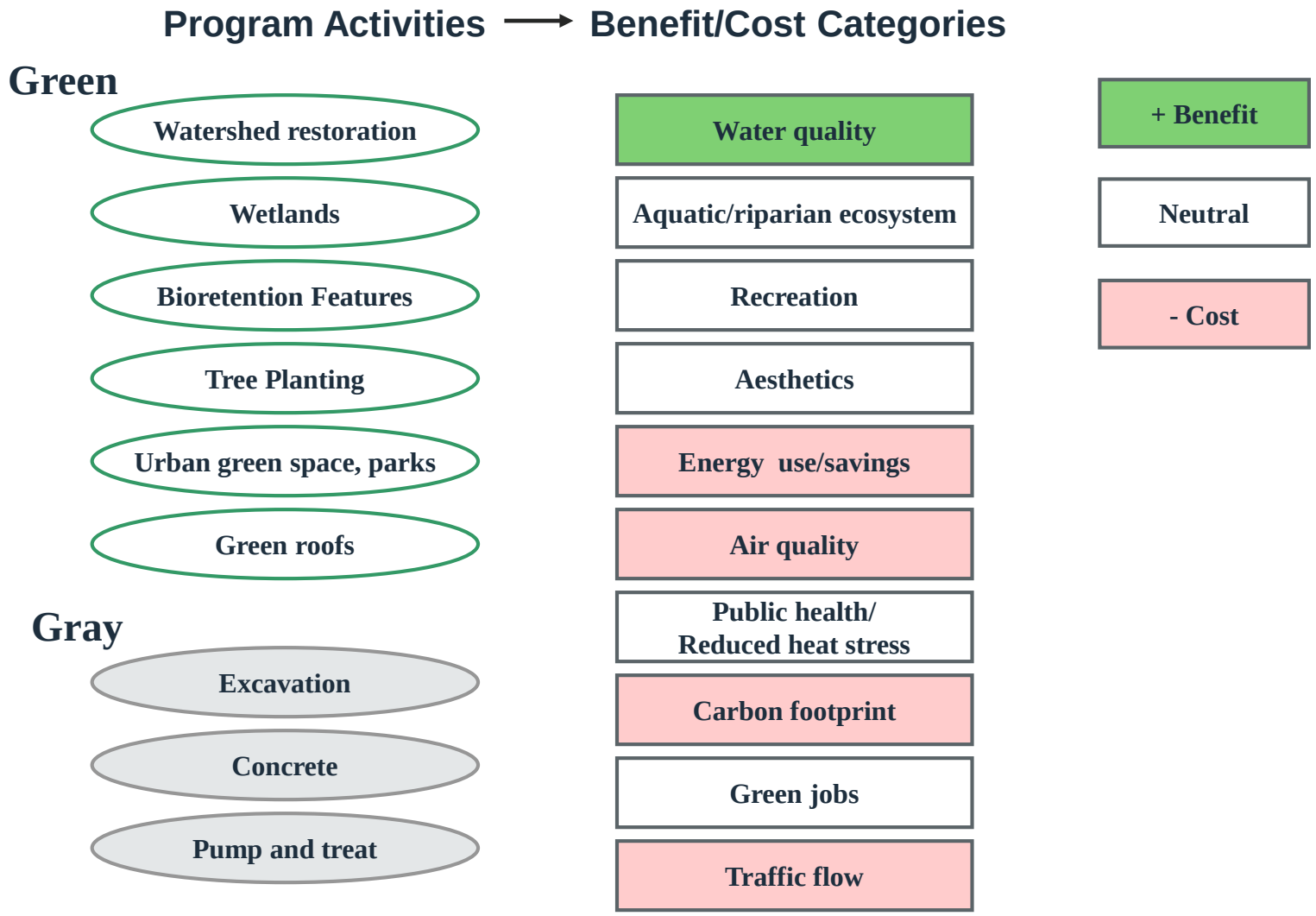
TBL Benefits and Costs of CSO Control Options: Philadelphia



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What is a nature-based solution? - Types of practices

Bioretention/Bioinfiltration/Raingarden (Nature-Based and Vegetated)
Landscaped areas that use surface ponding, plants, engineered soil profiles, and subsurface storage media to manage and treat and retain stormwater runoff from nearby impervious areas such as driveways, roofs, parking lots, and playgrounds.

They are typically planted with native flora providing increased visual appeal as well as habitat for native fauna. The shape and size of these practices can vary widely. Linear systems are often called bio-swales though the term “swale” can be misleading in that it implies conveyance, which may or may not be a functional aspect of the system.

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What is a nature-based solution? - Types of practices

Biodetention with Underdrains (Nature-Based and Vegetated)

Biodetention systems with underdrains are landscaped areas that use surface ponding (detention), plants, engineered soil profiles, and subsurface storage media to manage and treat stormwater runoff from nearby impervious areas such as driveways, roofs, parking lots, and playgrounds. Biodetention systems include underdrains connected to the stormwater systems to release the water at a specified rate.

They are typically planted with native flora providing increased visual appeal as well as habitat for native fauna. Biodetention is typically used when sub-surface infiltration rates are insufficient to drain down the stored volume or when infiltration may not be permitted due to subsurface contamination, proximity to buildings or other site constraints. Biodetention systems can be lined or unlined depending on the site conditions and may allow for some infiltration to occur. Hybrid bioretention/detention systems for example may be unlined and include underdrains.

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What is a nature-based solution? - Types of practices

Green Roofs (Nature-Based and Vegetated)

A planted roof designed to collect, store, retain and/or detain stormwater runoff generated by the roof and connected areas. The rooftop vegetation captures rainwater allowing evaporation and root uptake to reduce the amount and peak flow rate of runoff entering stormwater systems.

When the amount of rainfall exceeds the capacity of the soil and plants, excess water is conveyed to a roof drain.

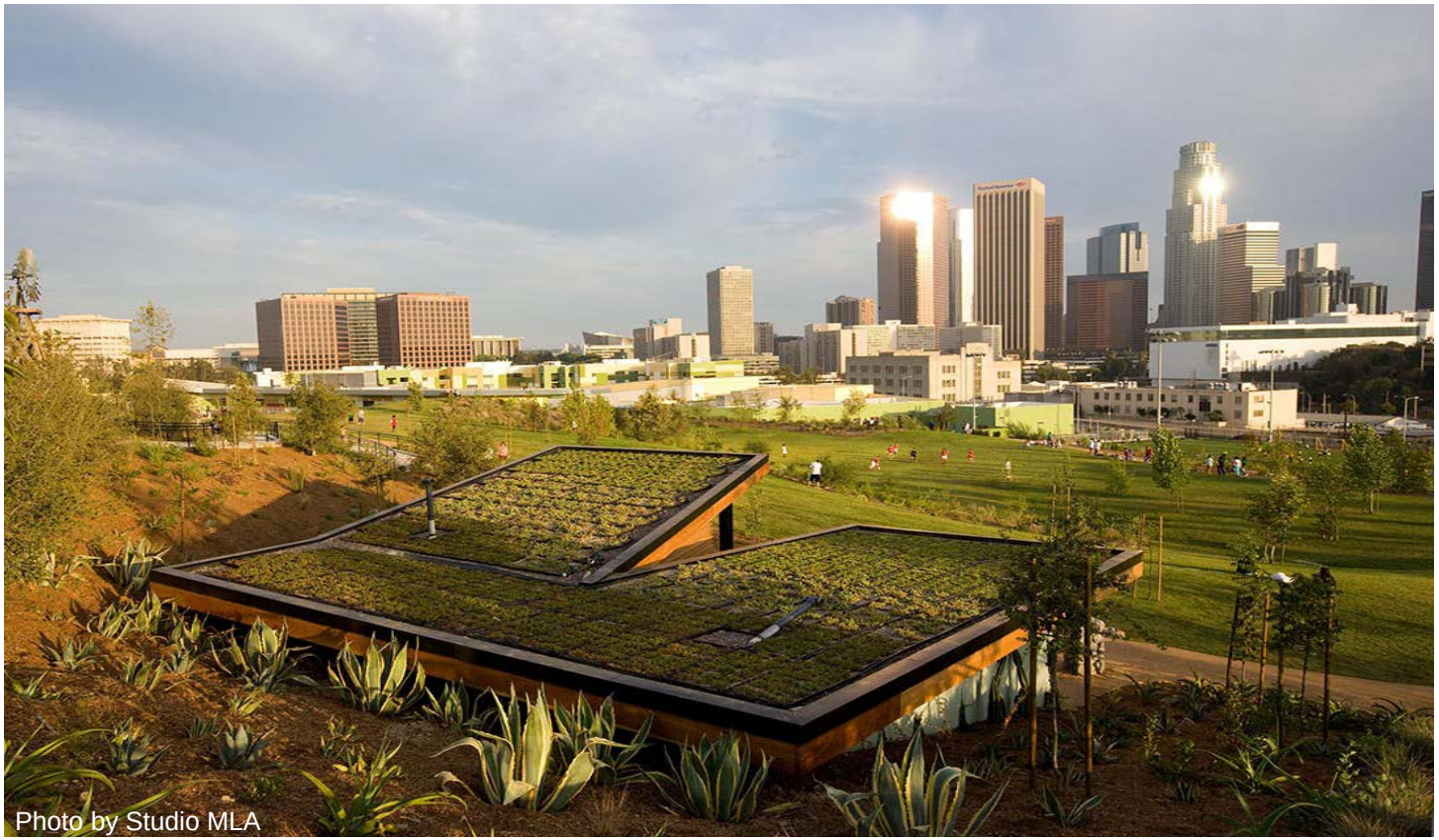

Photo by Studio MLA

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What is a nature-based solution? - Types of practices

Permeable Pavement (Nature-Based and Not Vegetated)

An alternative to conventional pavement types like asphalt and concrete. It provides the structural support of conventional pavement used for parking, sidewalks, and patios, while reducing runoff from impervious areas. Permeable pavement is designed to allow stormwater to infiltrate through the pavement surface typically into a gravel storage layer and into the surrounding soils. Permeable paving may be designed with or without underdrains depending on subsurface soil conditions.

Synthetic turf in athletic fields with permeable surfaces can also be used to collect, store, retain and/or detain stormwater runoff generated by the turf area and potentially adjacent impervious areas.

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What is a nature-based solution? - Types of practices

Constructed Stormwater Wetlands (Nature-Based and Vegetated)
Systems designed to remove pollutants from stormwater runoff through settling and both uptake and filtering by vegetation. Constructed stormwater wetlands temporarily store runoff in relatively shallow pools that support conditions suitable for the growth of wetland plants.

They use natural processes involving wetland vegetation, soils, and their associated microbial assemblages to improve water quality and provide native wildlife habitat and aesthetic features. Constructed stormwater wetlands can be implemented as new facilities or retrofits of existing dry stormwater management ponds.


Dominguez Gap Wetlands

What is a nature-based solution? - Types of practices

Subsurface Infiltration (Nature Based and Not Vegetated) and Detention (Non-Nature-Based)

Underground facilities that use pipes, stone, tanks and/or chambers to take runoff from large impervious areas and store, retain (infiltrate) and/or detain it before it enters the sewers.

Water is usually carried to the system by inlets that drain nearby impervious areas. Occasionally, these systems treat overflow from other GI practices. Subsurface systems can be built under parking lots, playgrounds, sport courts, etc.

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What is a nature-based solution? - Types of practices

Outfall Retrofits (Nature-Based and Vegetated)

Systems used to convert concentrated stormwater runoff to sheet flow. They are typically constructed at the outfall of an existing storm sewer to divert runoff from smaller storms, dissipate energy, filter, and treat stormwater through energy dissipators that can include a sand layer, and level spreaders.

Outfall retrofits allow storm flows to be discharged into a buffer at a slower rate and spread the flow over a larger area. The buffer can be designated as conserved open space or as a vegetated filter strip, if space is available. In some instances, runoff can be discharged to bioretention or constructed wetlands.

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What is a nature-based solution? - Types of practices

Cisterns (Non-Nature-Based)
Underground or above ground tanks that allow for stormwater runoff storage and reuse. Cisterns can receive runoff form roofs, parking lots, and any other site areas. Real time controls can be used to maximize efficiency and time reuse releases.

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What is a nature-based solution? - Types of practices

Wet and Dry Detention Basins (Nature-Based and Vegetated)
Stormwater management facilities that store runoff and remove pollutants through storage and settling. Wet detention basins include a permanent pool of water.

The use of forebays, micro pools, and vegetated benches can enhance pollutant removal. Extended detention through control of runoff release or real-time-controls can also enhance performance of detention basins.

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By the numbers

50	69	3,700
STATES	COUNTRIES	STAFF

1M+	$713M
MEMBERS	ANNUAL GRANTS RAISED

120M	100	5,000
ACRES PROTECTED	ACTIVE MARINE PROJECTS	MILES OF RIVERS PROTECTED

TNC California

OUR APPROACH

We test real-world solutions, prove what works, and adapt it to drive change here and around the world. Technology interventions, unconventional markets, science that drives action, and unexpected alliances can create solutions that benefit nature and the human experience.

OUR SUCCESSES

Across the state we are protecting nature and communities:

- 1.5 million acres of rivers, forests, and lands directly protected by the Conservancy
- 6,000 square miles of California ocean protected
- In southern California we pioneered a new model for conservation-friendly development.
- On a 100 mile stretch of the Sacramento River, we undertook the most ambitious river restoration project in the nation.
- Participating in the creation of numerous landmarks and preserves including Carrizo Plain National Monument, Coachella Valley Preserve, the Irvine Ranch National Natural Landmark and the Santa Rosa Plateau Ecological Reserve.