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Landscape Architects



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Environmental and
Energy Study Institute

Green Infrastructure: A Blueprint for Climate Resilient Communities

March 4, 2019

Materials will be available at: www.eesi.org/030419asla

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EESI

Environmental and
Energy Study Institute

- Founded in **1984** by a **bipartisan** Congressional caucus.
- Now an **independent**, bipartisan **nonprofit** with no Congressional funding.
- We provide **fact-based information** on **energy** and **environmental** policy for Congress and other policymakers.
- We focus on **win-win solutions** to make our energy, buildings, and transportation sectors **sustainable** and **resilient**.

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ASLA - Green Since 1899

ASLA Blue Ribbon Panel on Climate Change and Resilience



Diane Jones Allen, ASLA
University of Texas at Arlington



Armando Carbonell, FAICP
Lincoln Institute of Land Policy



Mark Dawson, FASLA
Sasaki Associates Inc.



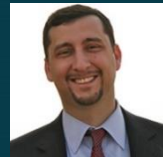
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SWA, Los Angeles Studio



Dr. Dwane Jones
University of the District of Columbia



Adam Ortiz
Prince George's County, Maryland



Dr. Jalonne L. White-Newsome
The Kresge Foundation



Vaughn B. Rinner, FASLA
ASLA 2017 President



Nancy C. Somerville, Hon. ASLA
ASLA Executive Vice President and CEO

Smart Policies for a Changing Climate: Report of the Blue Ribbon Panel on Climate Change and Resilience



Photo: ASLA

- Core principles
- Key design and planning approaches for creating healthy, climate-smart, and resilient communities
- Public policy recommendations to support those approaches

Policies should:

- Use incentives whenever feasible
- Promote holistic planning and provide multiple benefits
- Address environmental justice and racial and social equity
- Reflect meaningful community engagement
- Be regularly evaluated, including for unintended consequences
- Address regional as well as local and site-specific goals/issues



The report addresses:

- Natural Systems
- Community Development
- Vulnerable Communities
- Transportation
- Agriculture



Emphasis on designing with natural systems

Green Infrastructure

- Maximize use of green infrastructure in urban and suburban settings
 - Green roofs and cisterns
 - Street-level stormwater planters, bioswales
 - Green Street technologies
 - Increased tree canopy
 - Community parks and open space



Emphasis on designing with natural systems

Green Infrastructure

- Maintain and enhance existing natural systems
 - Wetlands
 - Critical water sources
 - Wildlands and natural forest
 - Biohabitats
 - Greenways and wildlife corridors



Benefits of Green Infrastructure



- Manages stormwater and reduces flooding
- Reduces water pollution
- Cools and cleans the air
- Provides biohabitat
- Costs less than “gray” stormwater infrastructure

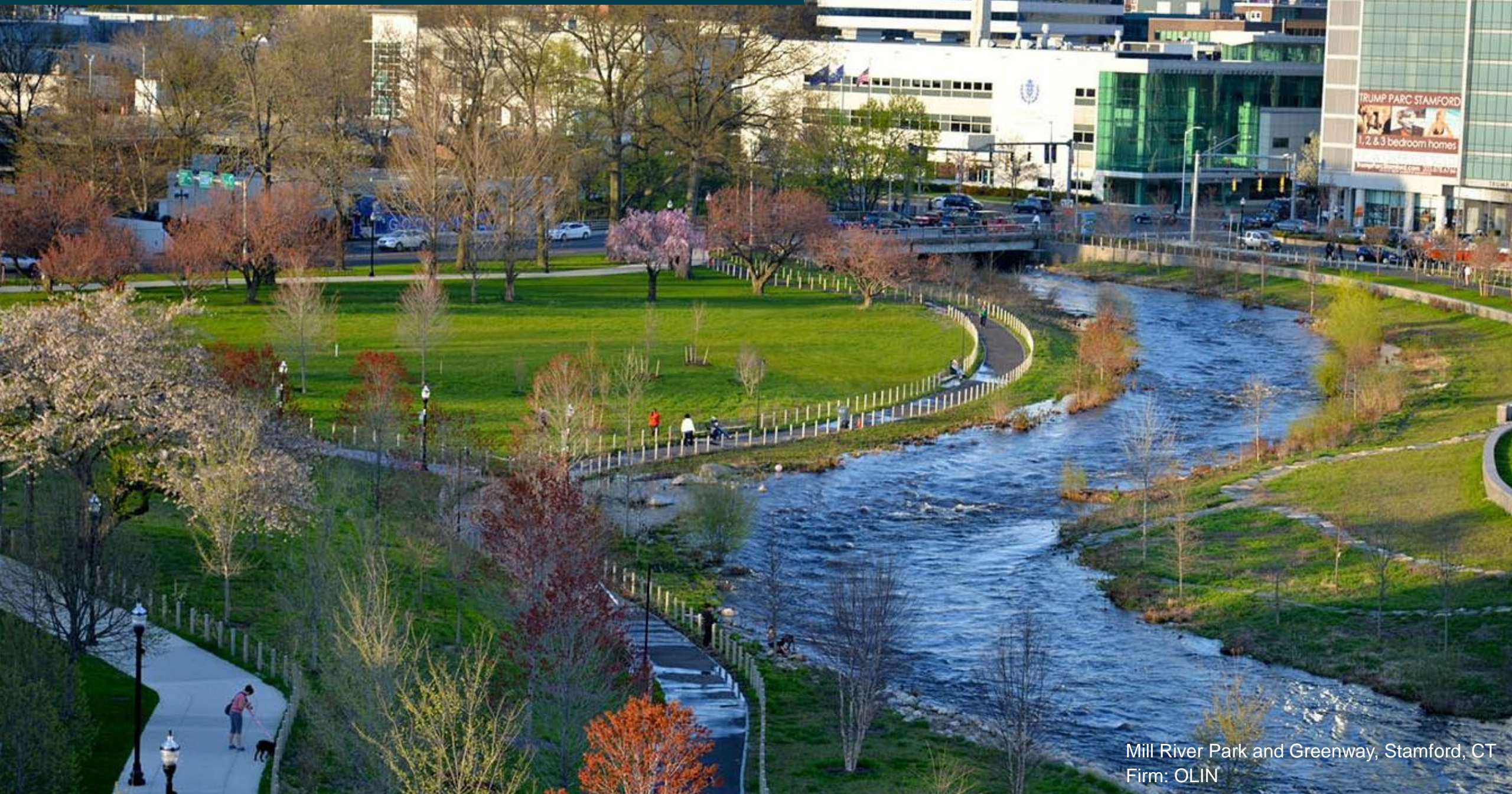


Smart Policies Policy Recommendation to Promote Green Infrastructure

- Provide dedicated funding for Green Infrastructure
- Provide incentives for:
 - Infiltrating precipitation on site
 - Planting regionally appropriate, pollinator-friendly vegetation
 - Protecting existing green space
- Adopt a national urban and suburban tree planting strategy and tree canopy goals



Water Infrastructure Improvement Act



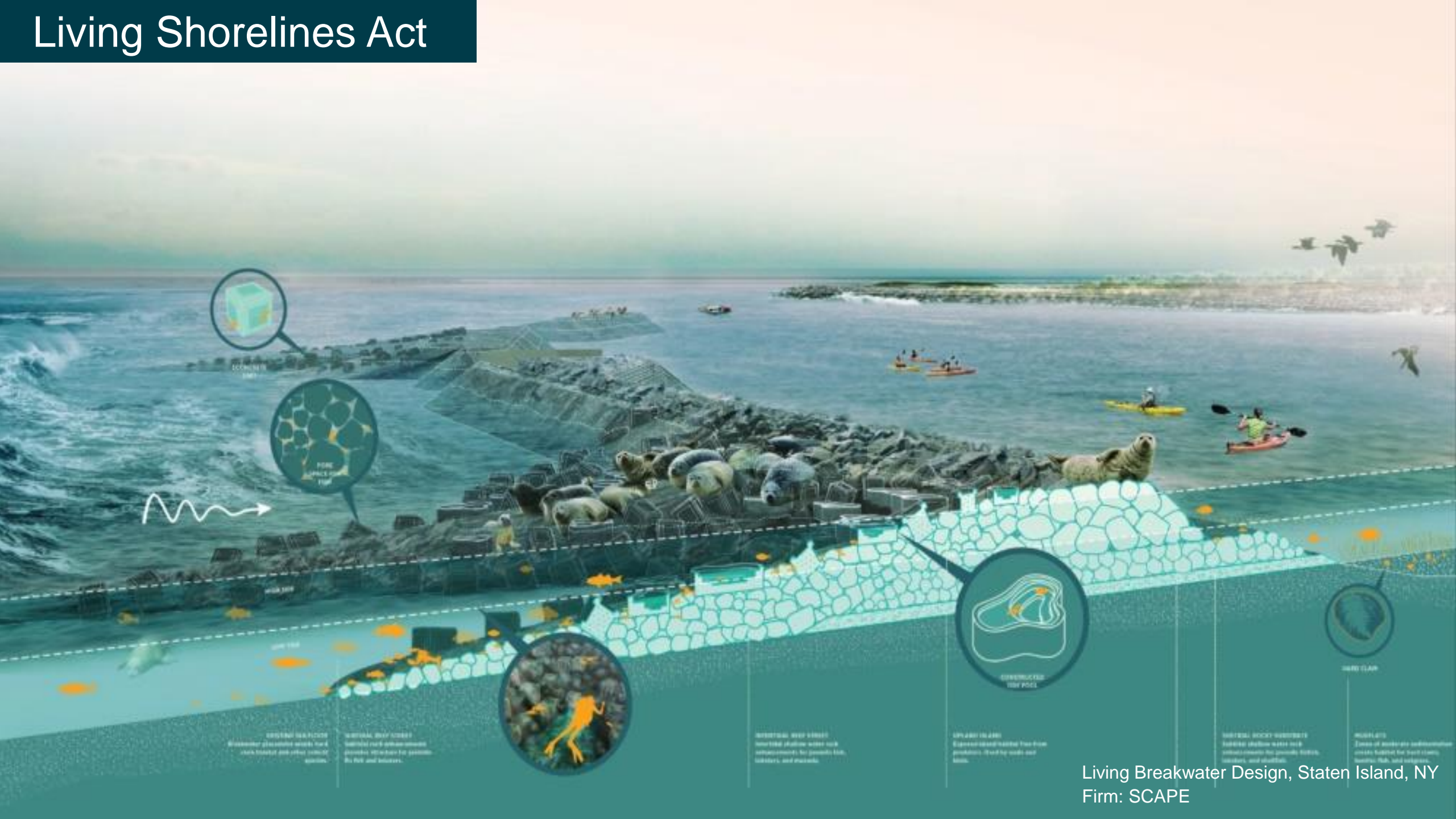
Mill River Park and Greenway, Stamford, CT
Firm: OLIN

Land and Water Conservation Fund



Buffalo Bayou, Houston, TX
Firm: SWA Group

Living Shorelines Act



ECCENTRIC PILES



PORE SPACES



VERTICAL ROCK SCREEN
Vertical rock screen allows
passive structure for passage
by fish and invertebrates.



CONSTRUCTED TIDY POOL

VERTICAL ROCK SCREEN
Vertical rock screen allows
passive structure for passage
by fish and invertebrates.

CONSTRUCTED TIDY POOL
Elevated rock structure from
breakwater, used by birds and
fish.



MUDFLATS

VERTICAL ROCK SUBSTRATE
Elevated rock structure from
breakwater, used by birds, fish,
invertebrates, and shellfish.

MUDFLATS
Zones of shallow water
suitable for beach crabs,
mudflats, fish, and invertebrates.

Environmental Justice



West Shore Park, Baltimore, MD
Firm: Hord Coplan Macht and
Thomas Balsey and Associates

Smart Policies for a Changing Climate

The Report and Recommendations of the ASLA Blue Ribbon Panel on Climate Change and Resilience



ASLA Blue Ribbon Panel Report
www.asla.org/climatepolicies

Continue the conversation at:
<https://climate.asla.org>



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**We create places
that prove
human potential.**



National Harbor, Oxon Hill, MD
Firm: Sasaki Associates Inc.

Mark Dawson, Managing Principal, Sasaki Associates Inc.





Climate risks
are not new for
Boston, but they
will continue to
increase as the
global climate
changes.

Sea level Rise – Boston, MA





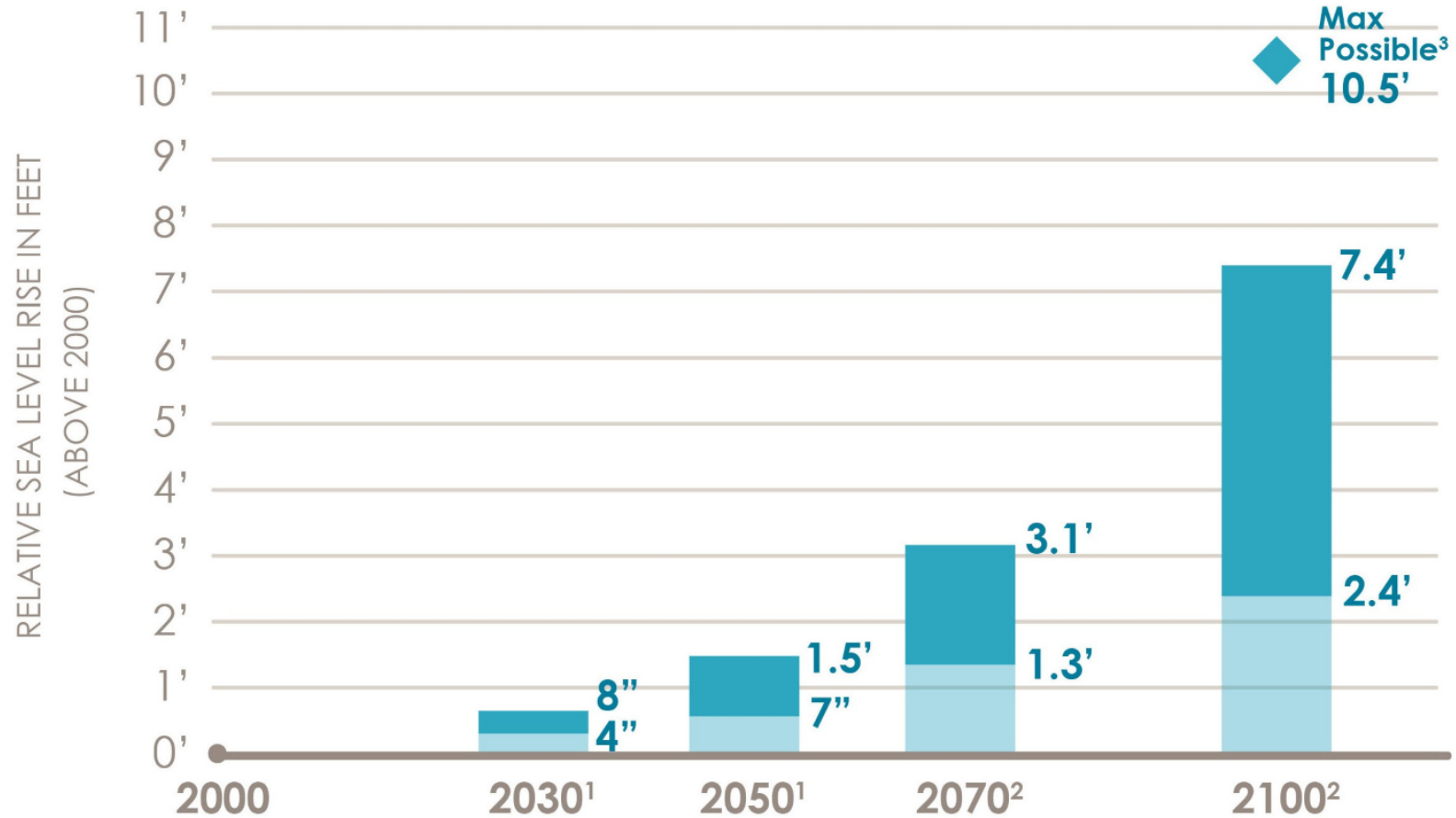
October 2016 - King Tide Flooding



Jan- March 2018 - Nor'easter with "100 Year" Flooding



Sea levels in Boston will continue to rise



1 - Likely under all emission scenarios

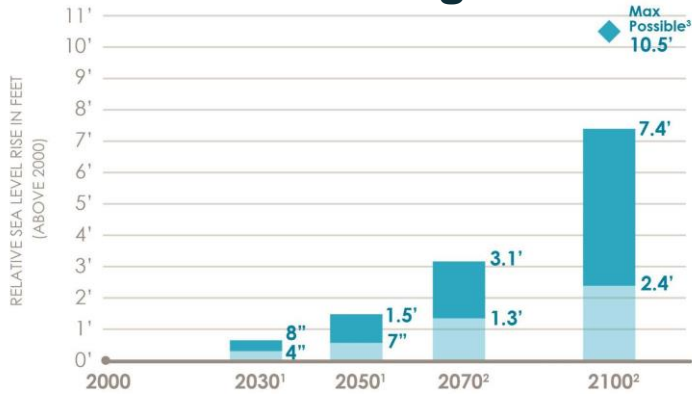
2 - Likely under moderate to high emission scenarios

3 - Low probability under high emission scenario



Sea level rise isn't the only concern

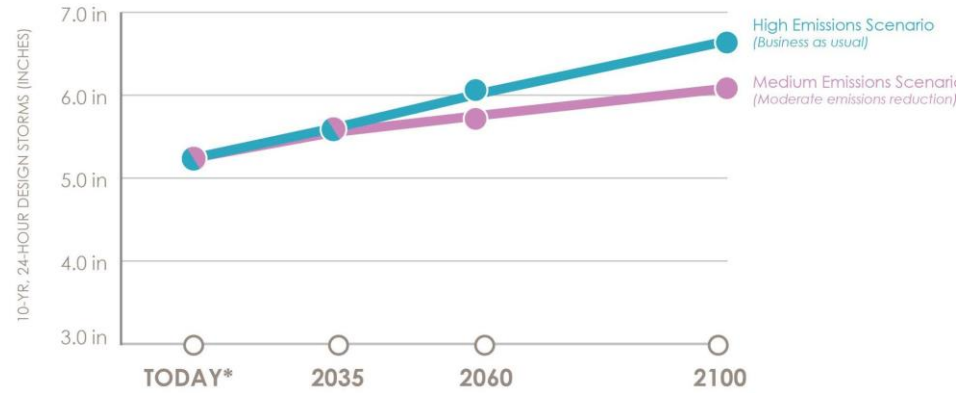
Coastal and Riverine Flooding



1 - Likely under all emission scenarios
 2 - Likely under moderate to high emission scenarios
 3 - Low probability under high emission scenario

Flooding risks will increase

Stormwater Flooding

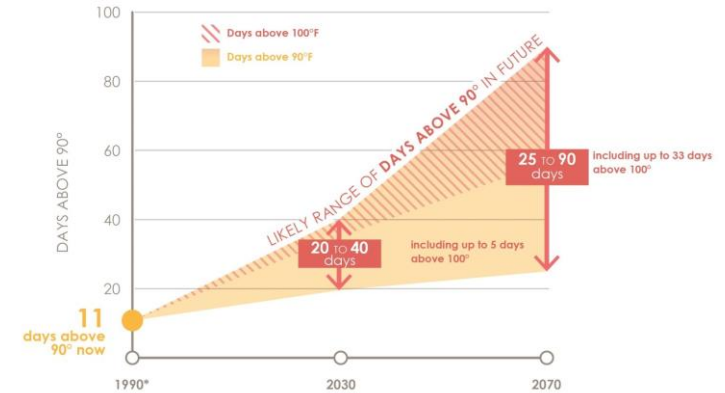


* "Today" baseline represents historical average from 1948-2012. Confidence intervals are not available for these projections but are likely large, so these numbers should be considered as the middle of a large range.

Data Source: Boston Water & Sewer Commission

Rainfall from storms will increase

Extreme Temperatures



* Baseline represents historical average from 1971-2000. Upper values from high emissions scenario. Lower values from low emissions scenario.

Data source: Rossi et al. 2015

Number of very hot days will increase



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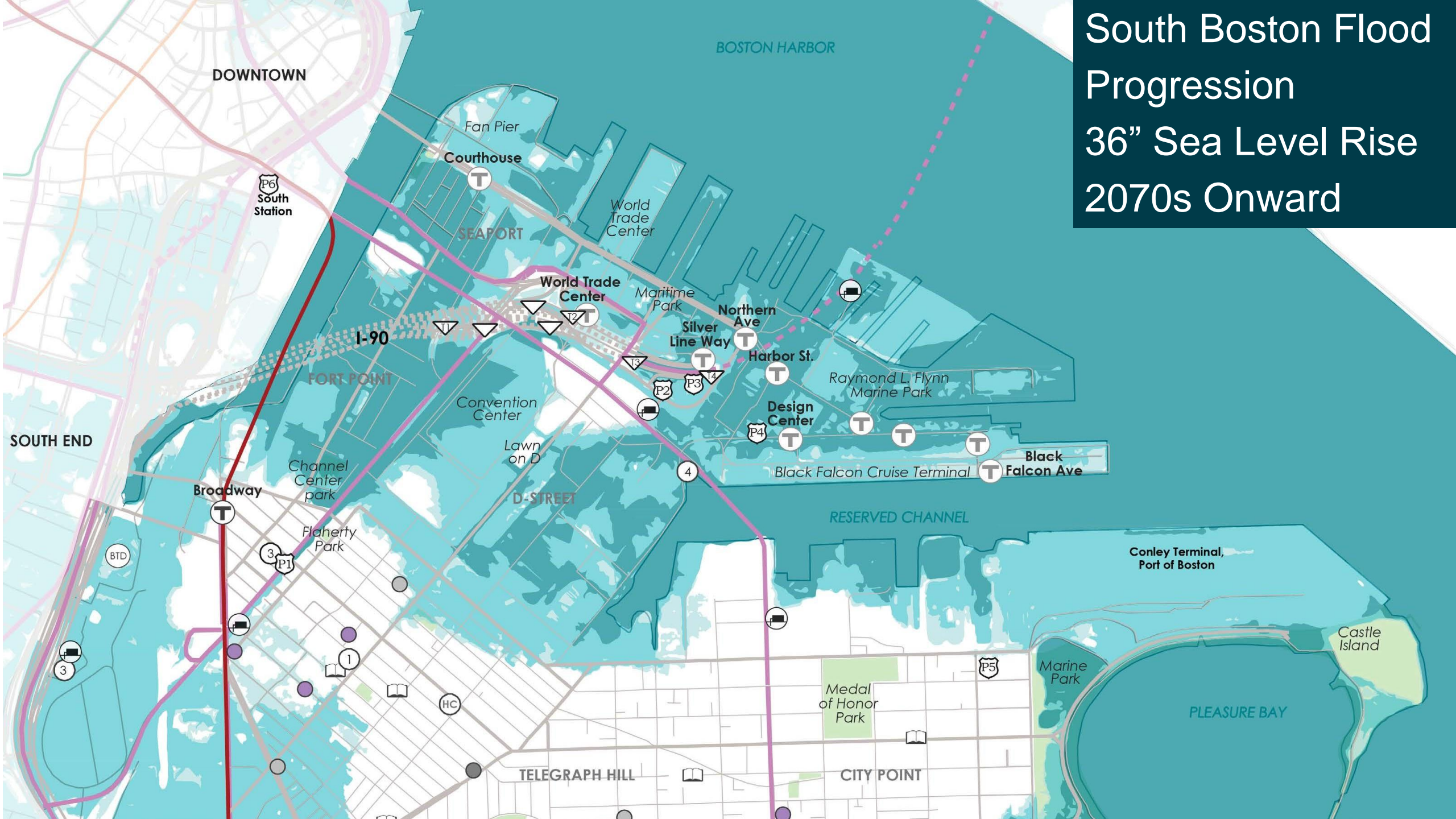
South Boston Flood Progression 9" Sea Level Rise 2030s-2050s



South Boston Flood Progression 21" Sea Level Rise 2050s-2100s



South Boston Flood Progression 36" Sea Level Rise 2070s Onward





**SEA
CHANGE
BOSTON**

ON
EXHIBIT
AT
DISTRICT
HALL

Gat

IF NOTHING IS DONE, THIS IS WHERE HIGH TIDE COULD BE IN 2100

IF NOTHING IS DONE, THIS IS WHERE HIGH TIDE COULD BE IN 2100

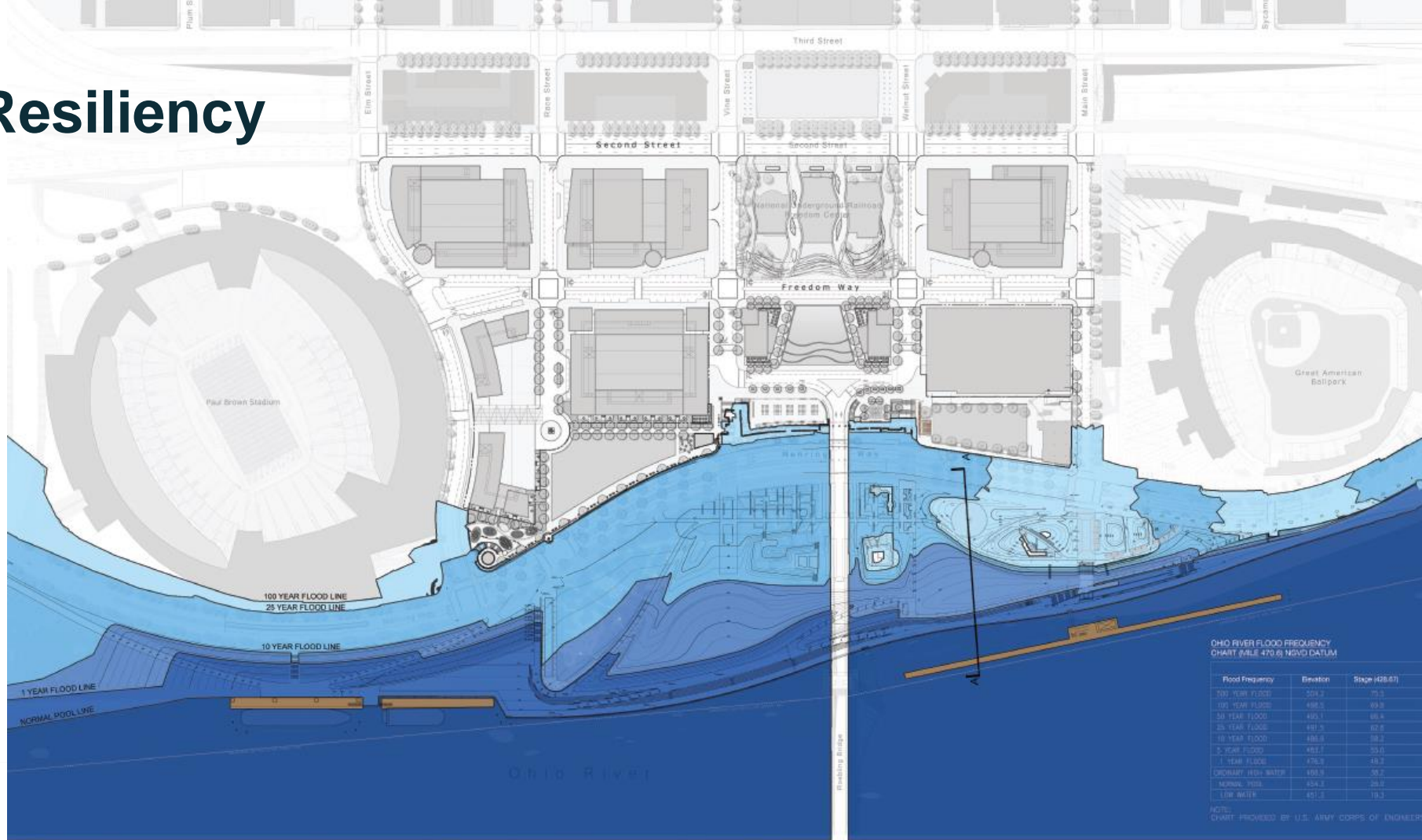
Sea Change Boston, Boston, MA
Sasaki Associates Inc.

Cincinnati John G. and Phyllis W. Smale Riverfront Park

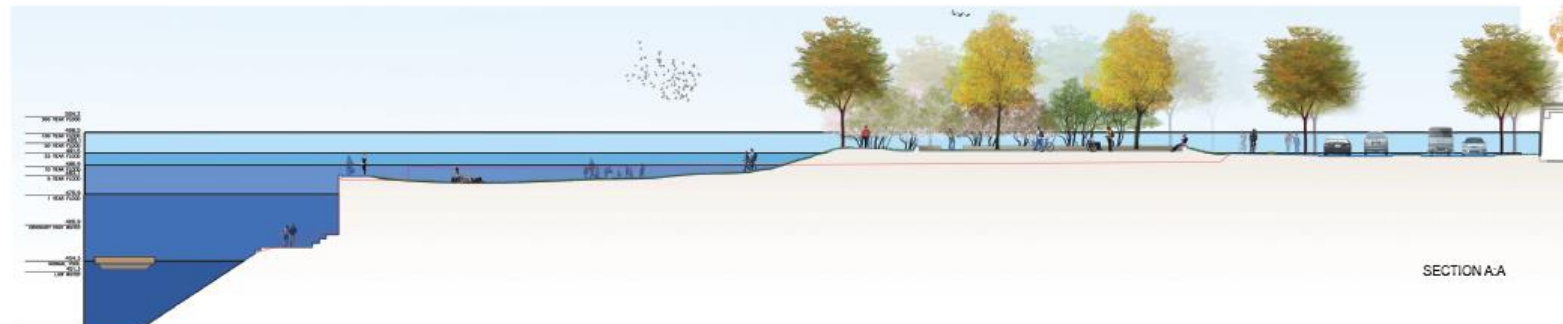
Cincinnati Park Board | Cincinnati, OH



Flood Resiliency



- 100+ YEAR FLOOD
- 25-100 YEAR FLOOD
- 10-25 YEAR FLOOD
- 1 - 10 YEAR FLOOD
- NORMAL POOL + 1 YEAR FLOOD
- NORMAL POOL





2018

Designed to Flood



Normal Water Pool

Record Flood- February 2018
Cleaned and re-opened within
1 week



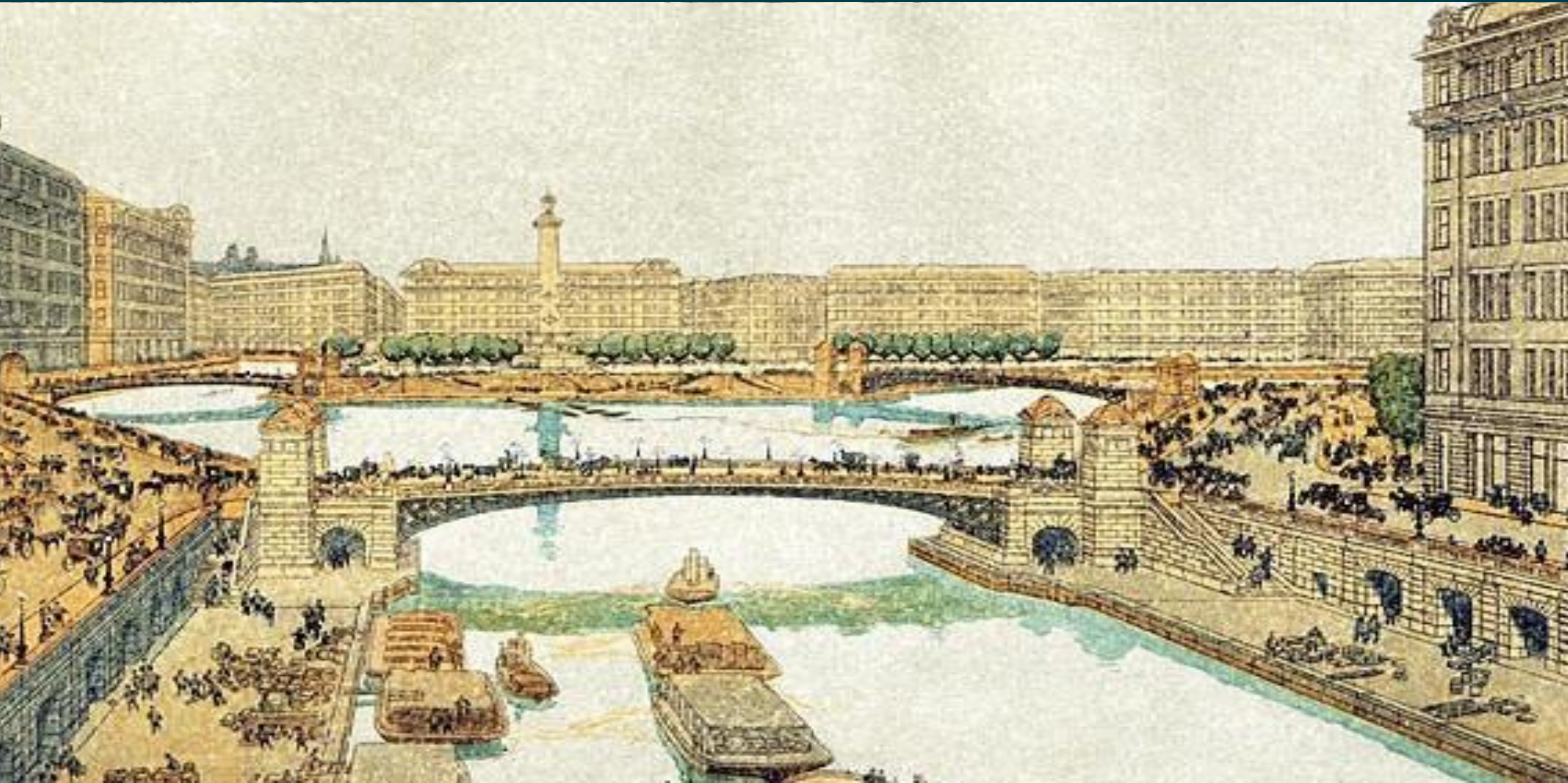
Deployable Details Minimize Damage and Ease Recovery

The park was cleaned and re-opened within 1 week of the February 2018 flood.



Chicago Riverwalk

Chicago Department of Transportation | Chicago, IL



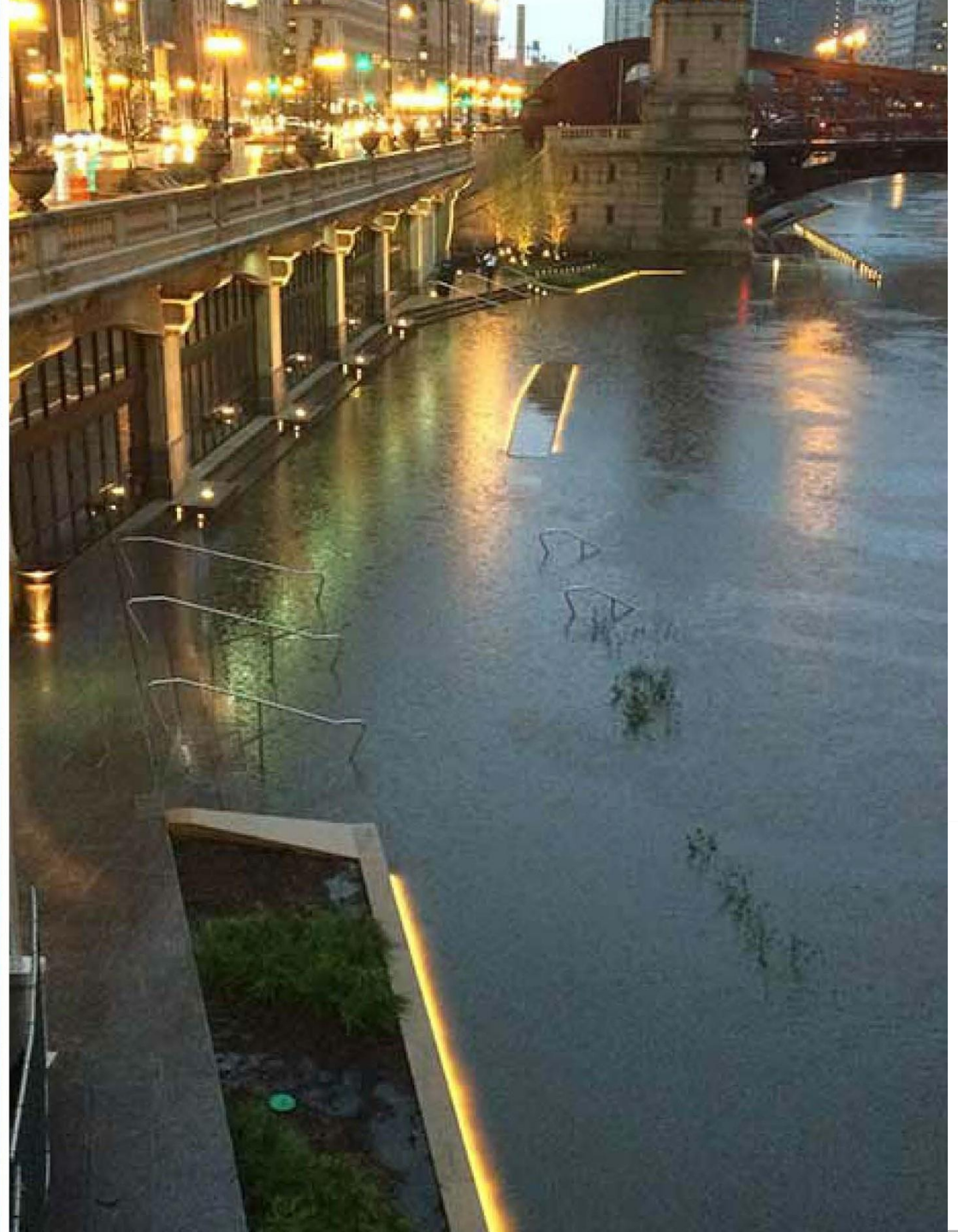
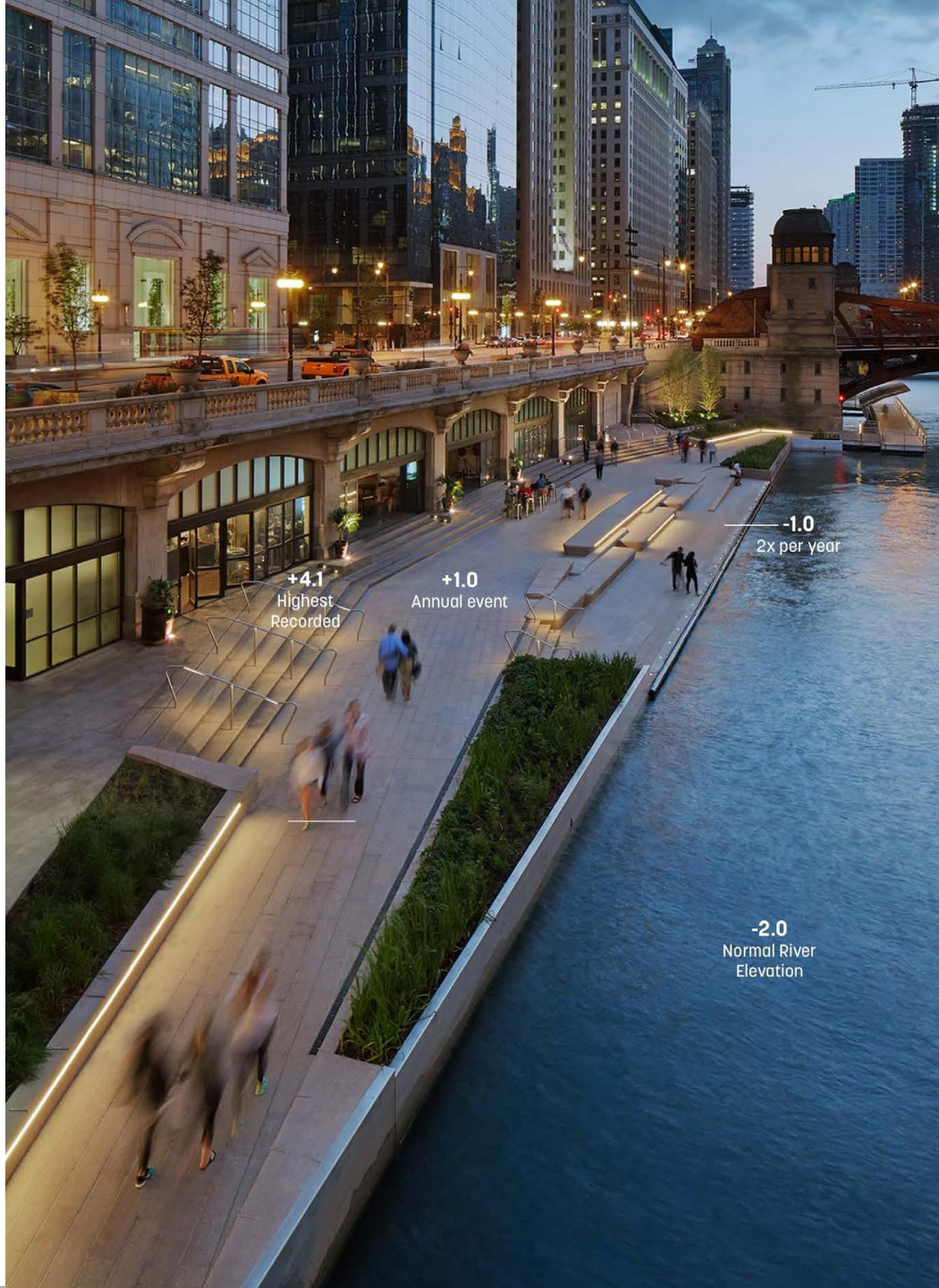


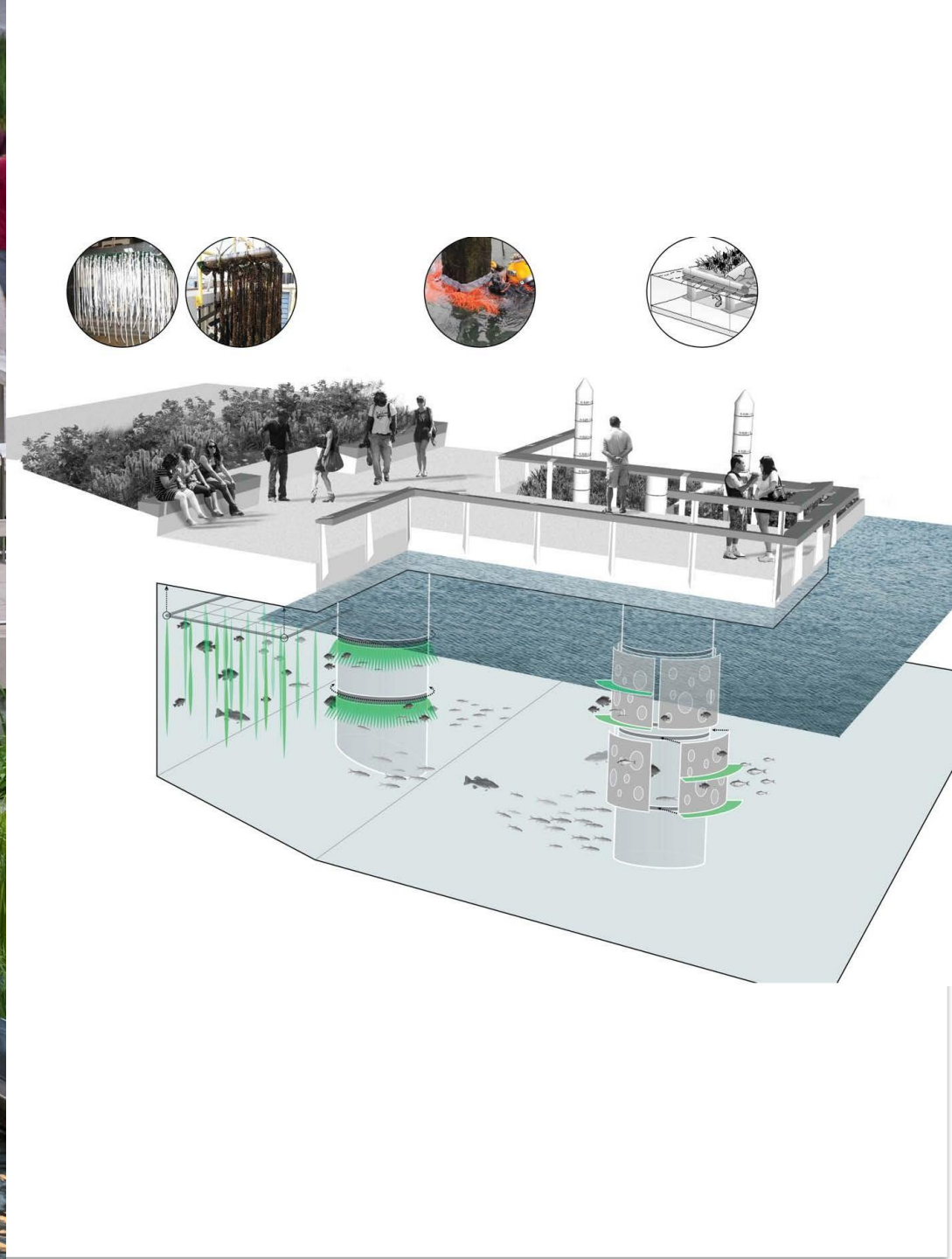
BEFORE

Chicago Riverwalk



AFTER

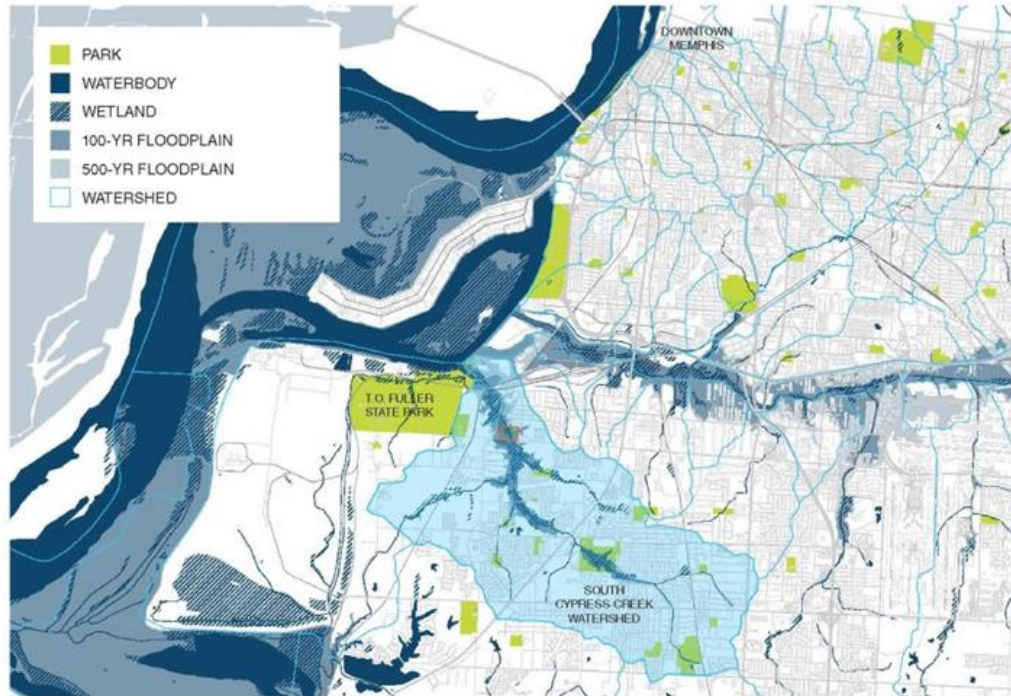




Memphis – Shelby County, TN

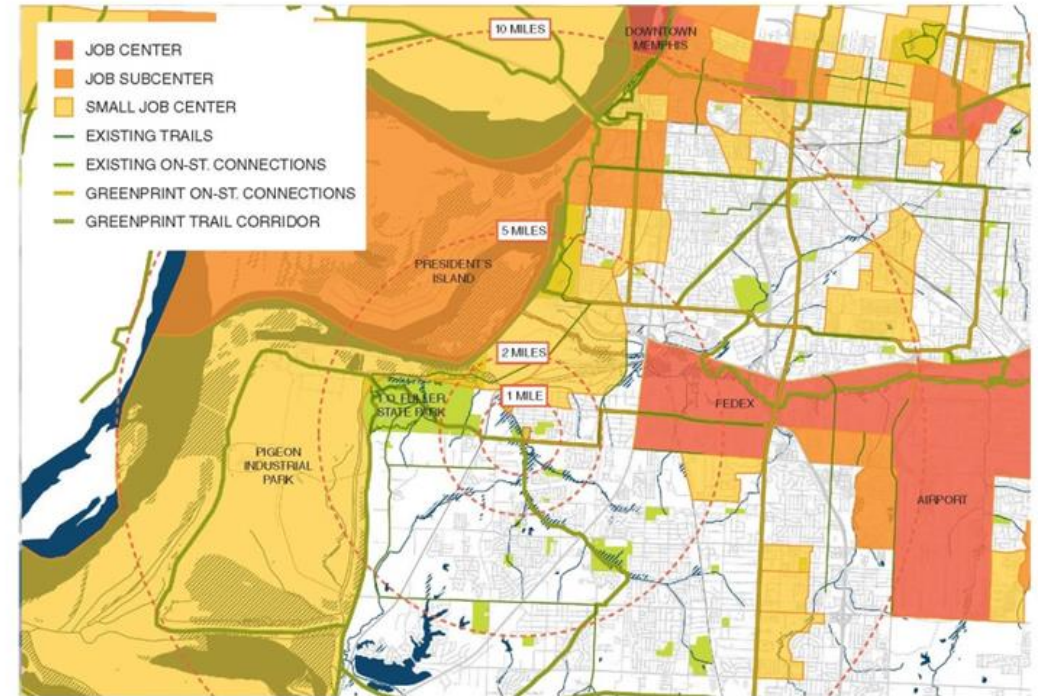


REGIONAL ANALYSIS: SOUTH CYPRESS CREEK WATERSHED AND JOB PROXIMITY



SOUTH CYPRESS CREEK WATERSHED HAS “HIGH SENSITIVITY”

8,400 ACRES
 18.5% IMPERVIOUS SURFACE
 EROSION FROM 2011 FLOODS



SOUTH CYPRESS CREEK RESIDENTS LIVE IN CLOSE PROXIMITY TO JOB CENTERS

42% RESIDENTS WITHIN 1 MILE OF WEAVER PARK COMMUTE EAST TO WORK

PROXIMITY TO JOB CENTERS COULD SUPPORT ALTERNATE MODES OF TRANSIT

34% COMMUTING EAST TRAVEL LESS THAN 10 MILES

GREENPRINT FOR RESILIENCE

Shelby County, Tennessee

Figure 3.3



WEST JUNCTION
NEIGHBORHOOD
ACTION PLAN

VACANT LOT RE-USE TYPOLOGIES



SOUTH CYPRESS CREEK WATERSHED AND NEIGHBORHOOD REDEVELOPMENT PROPOSAL

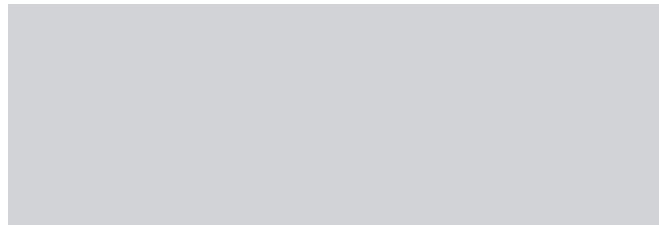
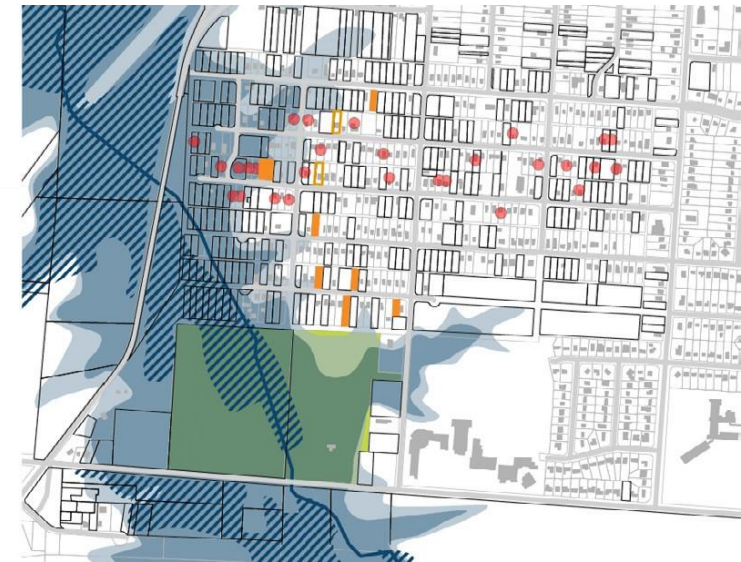


GREENPRINT FOR RESILIENCE

Shelby County, Tennessee

Figure 3.12

- Buyout of existing homes and replace with greenspace, wetlands, and other flood storage to accommodate water flow
- Better protection for nearby LMI homes
- Create affordable infill or rehabilitation nearby for displaced residents
- Creation of multi-purpose trails
- Local food production
- Development of vacant lot program



West Junction

Building Condition

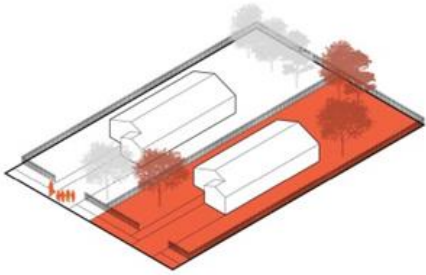
Many buildings in fair condition, interspersed with many vacant lots, and some buildings in good, excellent, or poor condition.

BUILDING CONDITION

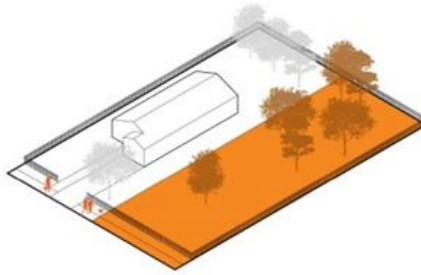
- EXCELLENT
- GOOD
- FAIR
- POOR
- NO DATA



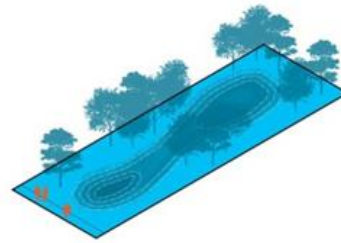
VACANT LOT RE-USE TYPOLOGIES



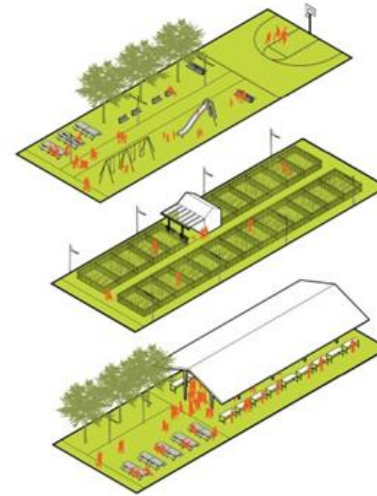
HOME LOT



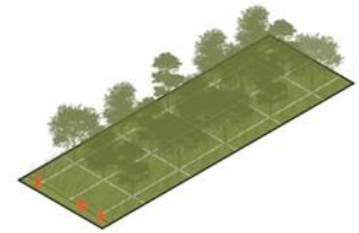
EXPANDED LOT



FLOOD LOT

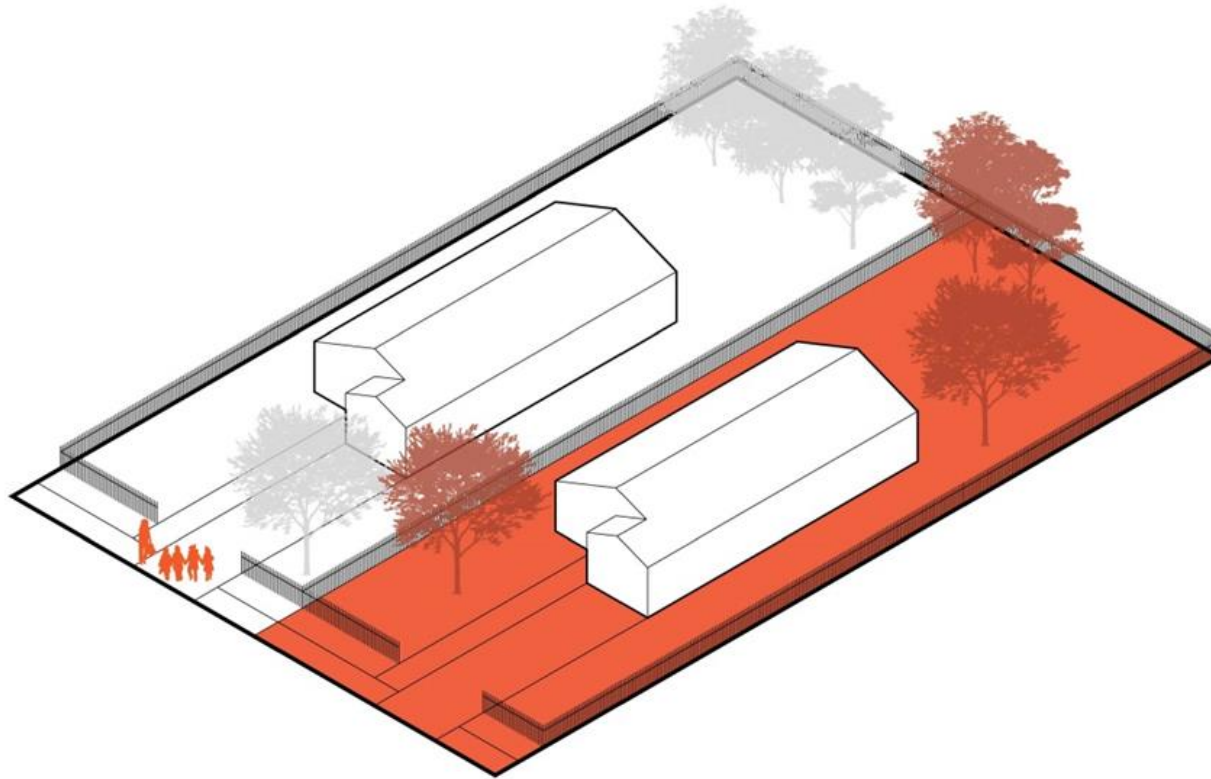


COMMUNITY LOTS



NATURE LOT

HOME LOT



Ownership transferred to residents in floodplain with unmet need from 2011 floods (11 properties)

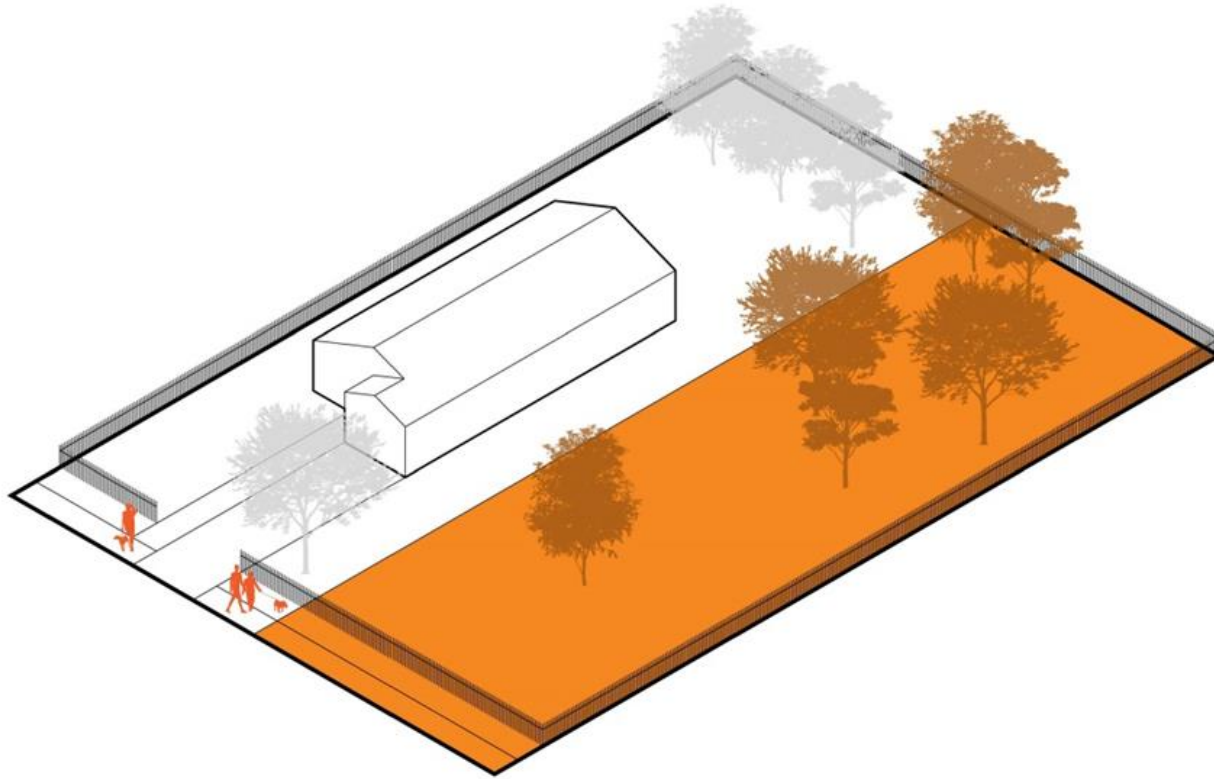
PRECEDENTS

Shelby County Landbank, Memphis, TN
Genesee County Landbank, Flint, MI

POTENTIAL LOCAL PARTNERS

Shelby County Landbank
HUD
Habitat for Humanity

EXPANDED LOT



Ownership transferred to willing adjacent owner

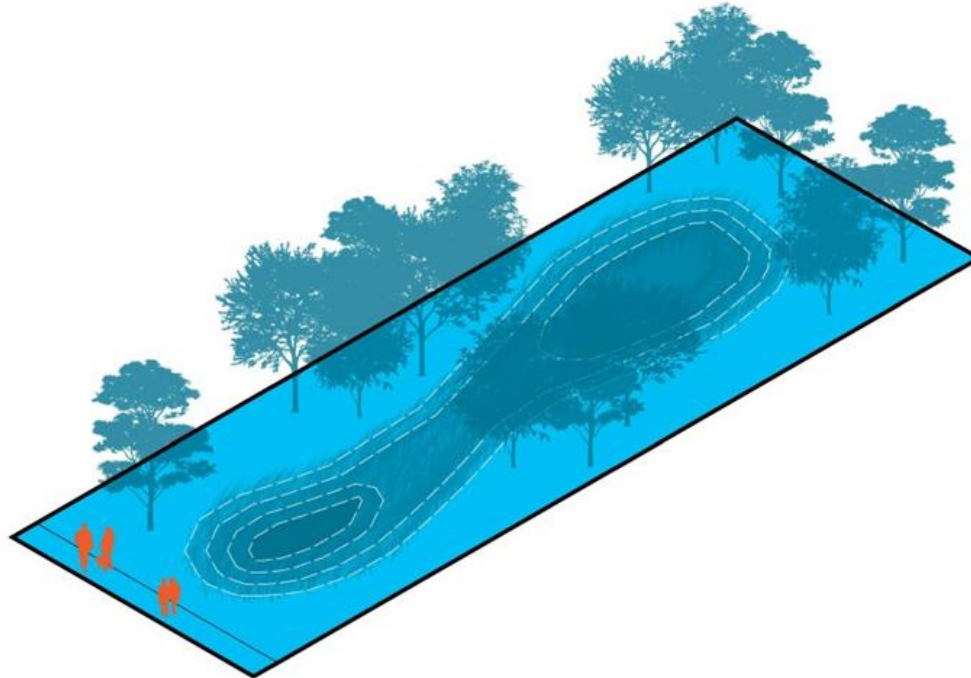
PRECEDENTS

Shelby County Landbank, Memphis, TN
Detroit BLOTS program, Detroit, MI
Genesee County Landbank, Flint, MI

POTENTIAL LOCAL PARTNERS

Shelby County Landbank

FLOOD LOT



Designed to treat stormwater, absorb floodwater

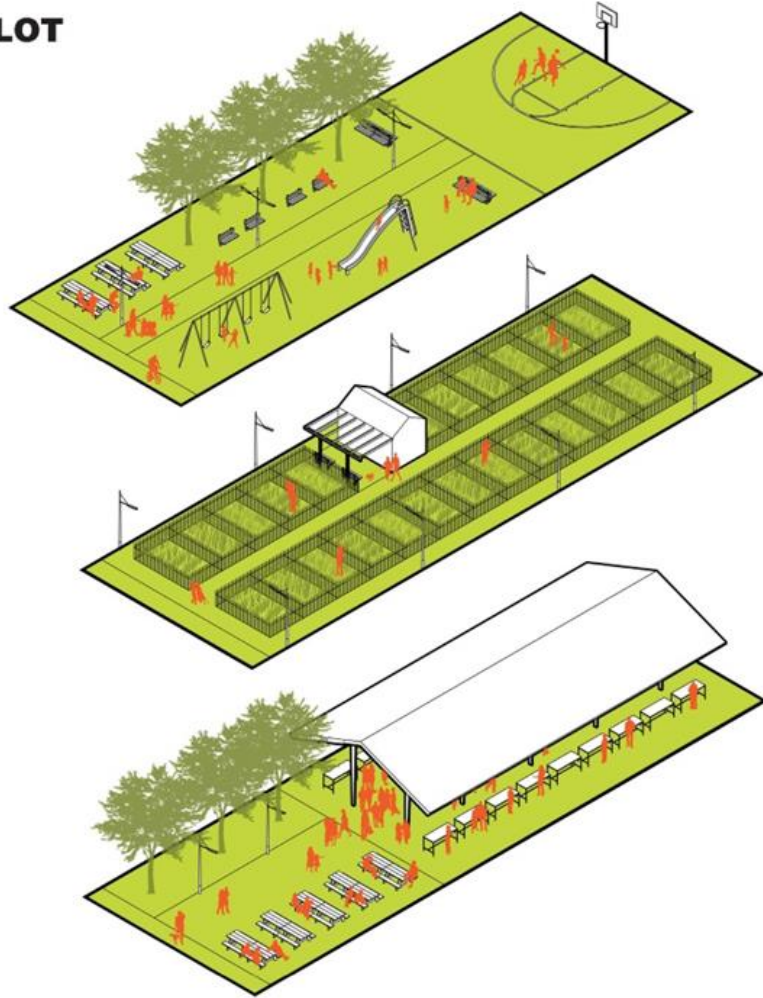
PRECEDENTS

Detroit Future City, Detroit, MI
Future Ground, New Orleans, LA

POTENTIAL LOCAL PARTNERS

City of Memphis Division of Engineering
City of Memphis Stormwater Master Plan
Army Corps of Engineering
Cypress Creek Watershed Alliance

COMMUNITY LOT



Designed for recreation, event plazas, markets, or urban agriculture

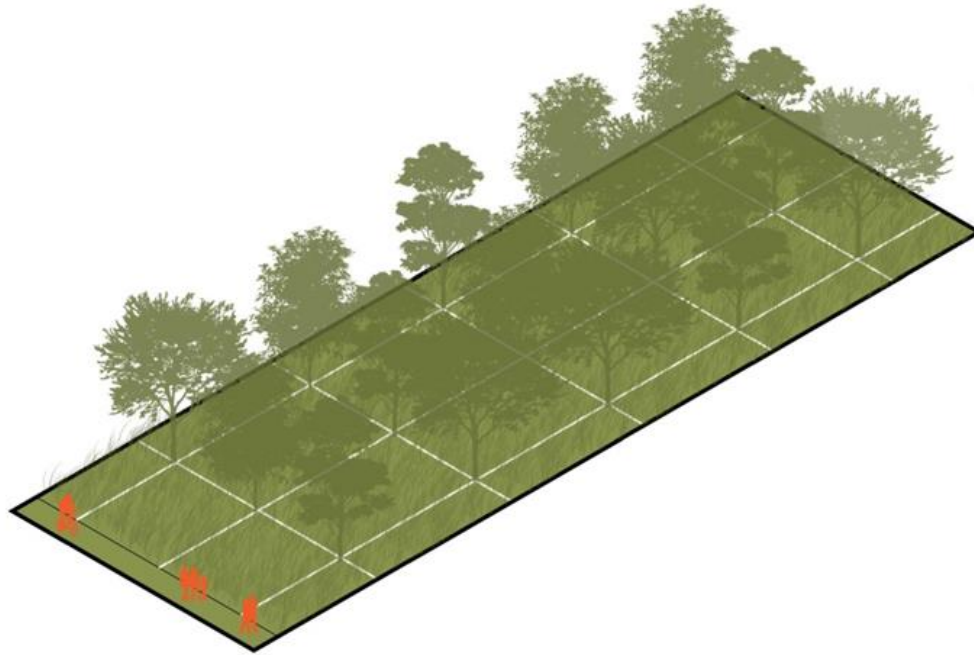
PRECEDENTS

Detroit Future City, Detroit, MI
LandCare Program, Philadelphia, PA

POTENTIAL LOCAL PARTNERS

Michell High School - Mitchell Community Center
City of Memphis Parks & Neighborhoods Department
UT Agriculture Extension - 4H Clubs
Root Memphis - Boys & Girls Clubs

NATURE LOT



Designed as urban forest or urban meadow

PRECEDENTS

Detroit Future City, Detroit, MI
LandCare Program, Philadelphia, PA
Nashville Tree Foundation, Nashville, TN
Hantz Woodlands, Detroit, MI

POTENTIAL LOCAL PARTNERS

TN Department of Environment and Conservation



SASAKI

**We create places
that prove
human potential.**

401 Congress Street, Boston, MA
Firm: Sasaki Associates Inc.



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Green Infrastructure: Maryland's Green Streets

- Prince George's County
 - Decatur Avenue in Edmonston, MD
- Montgomery County
 - Dennis Avenue
 - Forest Estates



Forest Estates Green Street
Montgomery County, MD

**Adam Ortiz, Director of the Department of Environmental Protection of
Montgomery County**



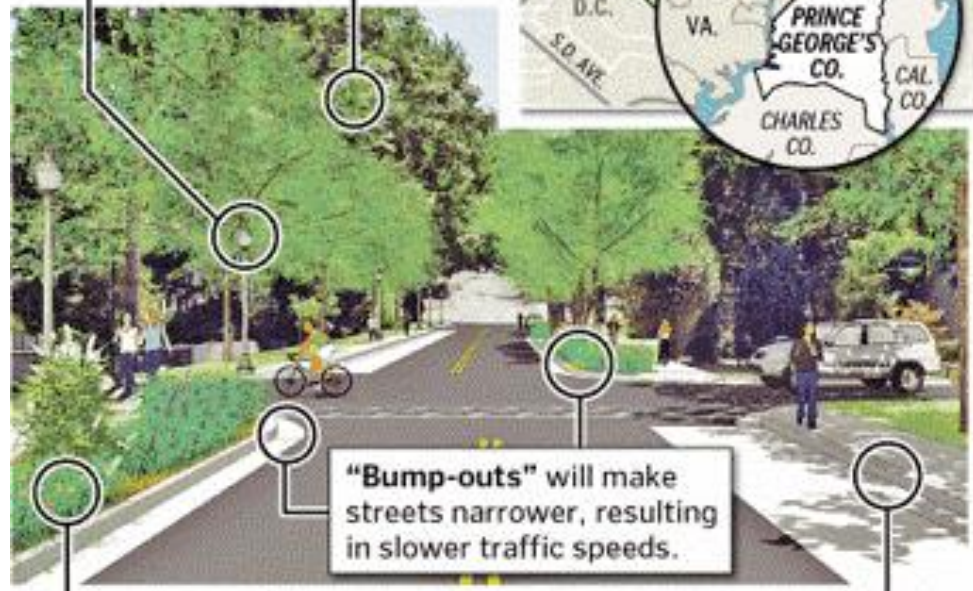
Edmonston, MD Green Street: Decatur Street

Prince George's County, MD



Wind-powered LED lighting.

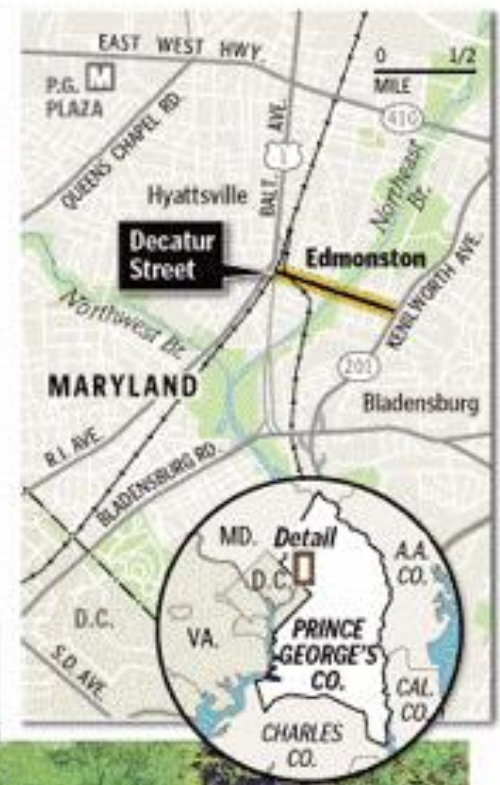
Native trees will provide shade and reduce heat.



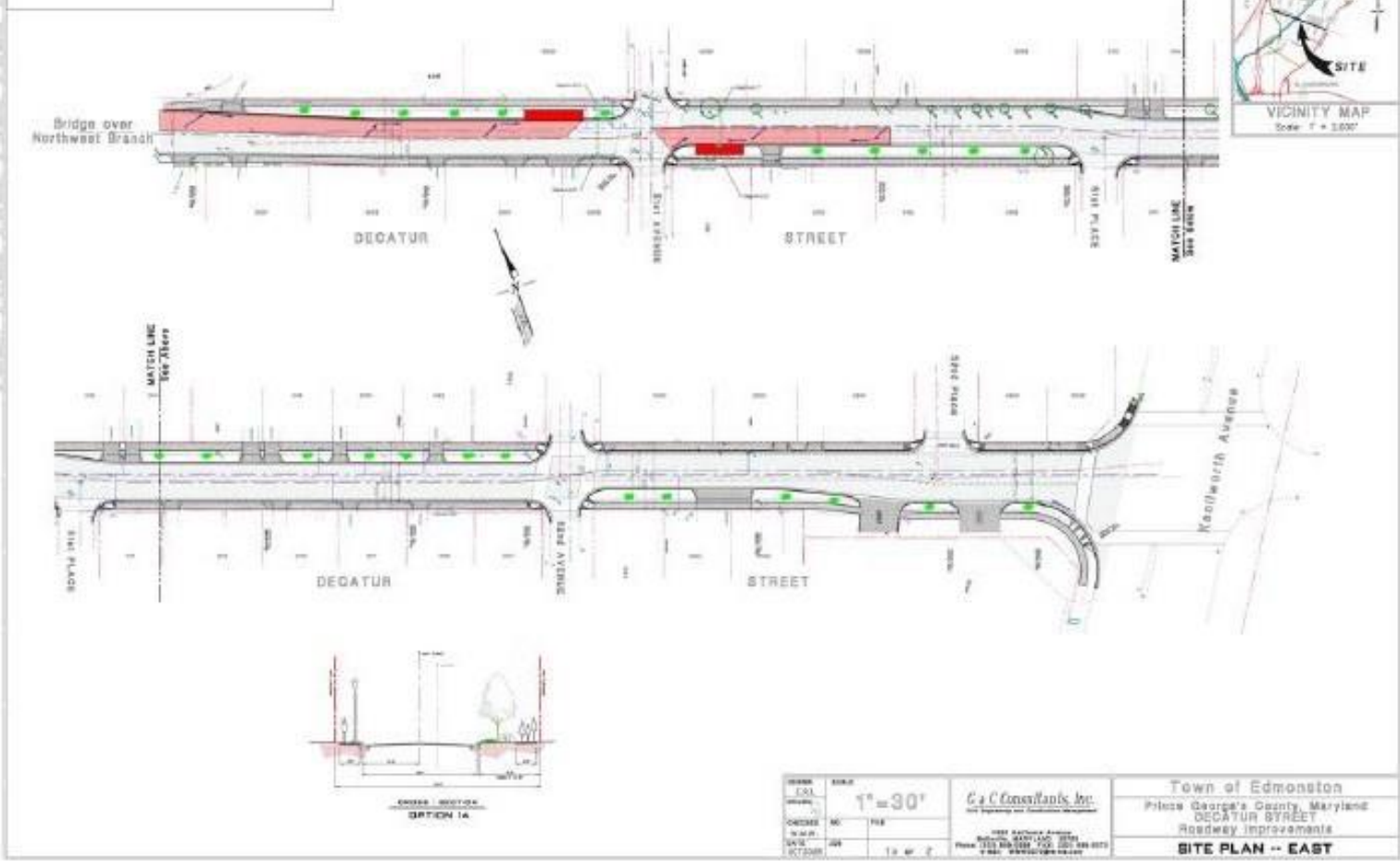
"Bump-outs" will make streets narrower, resulting in slower traffic speeds.

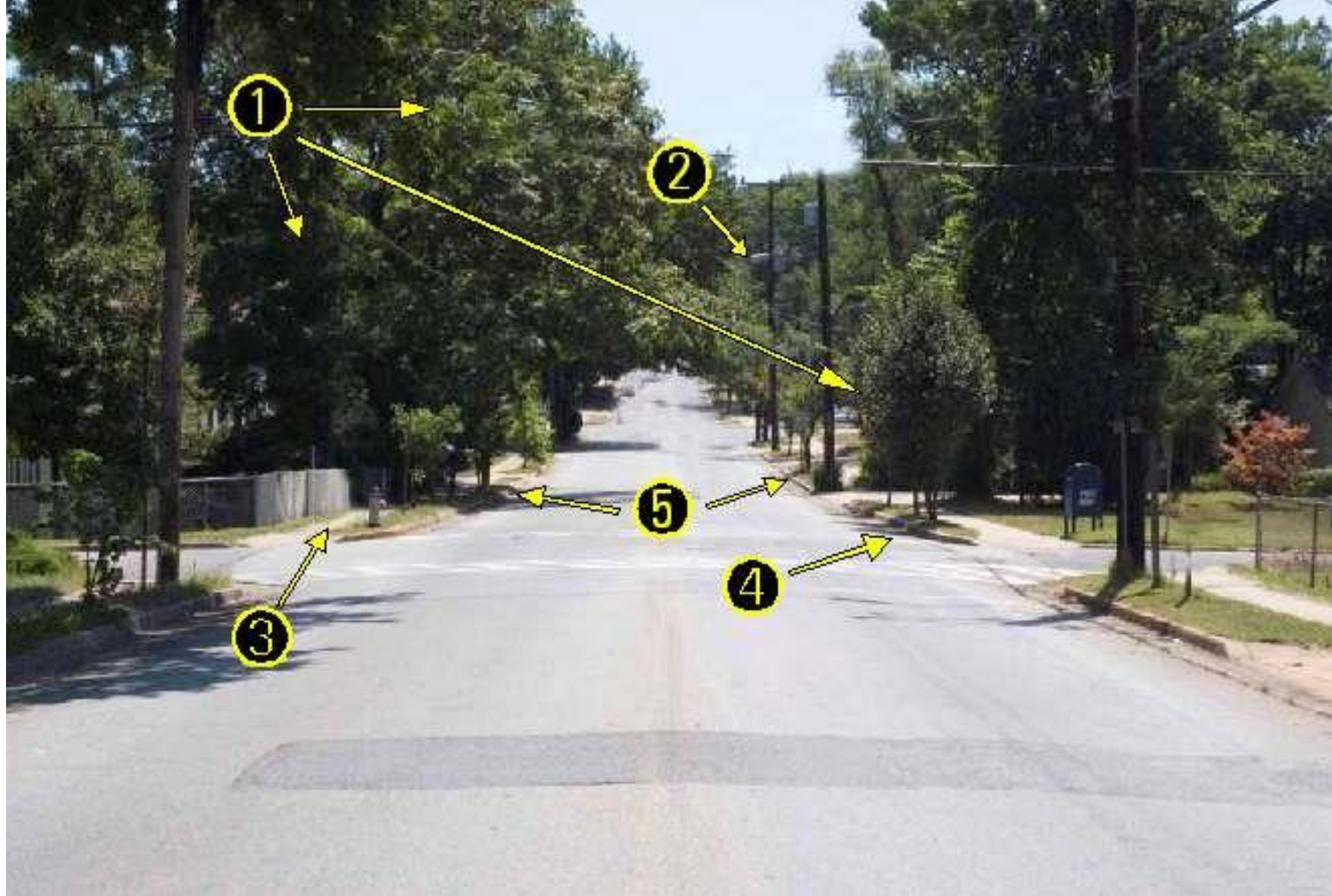
Rain gardens will reduce runoff from storms.

Lighter colored pavements will reduce heat. Permeable concrete will be installed, allowing water to move through to the soil below.



Option 1 - Decatur East





Decatur Street Before



Decatur Street After

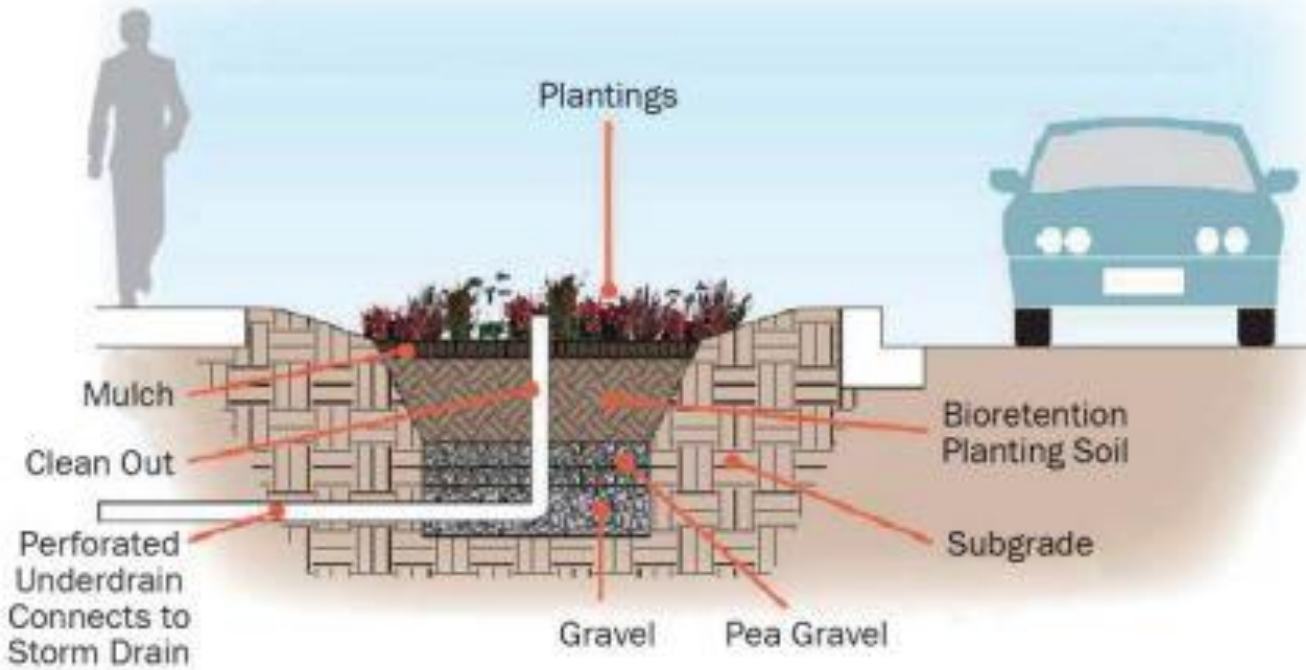


Dennis Avenue Green Street

Montgomery County, MD

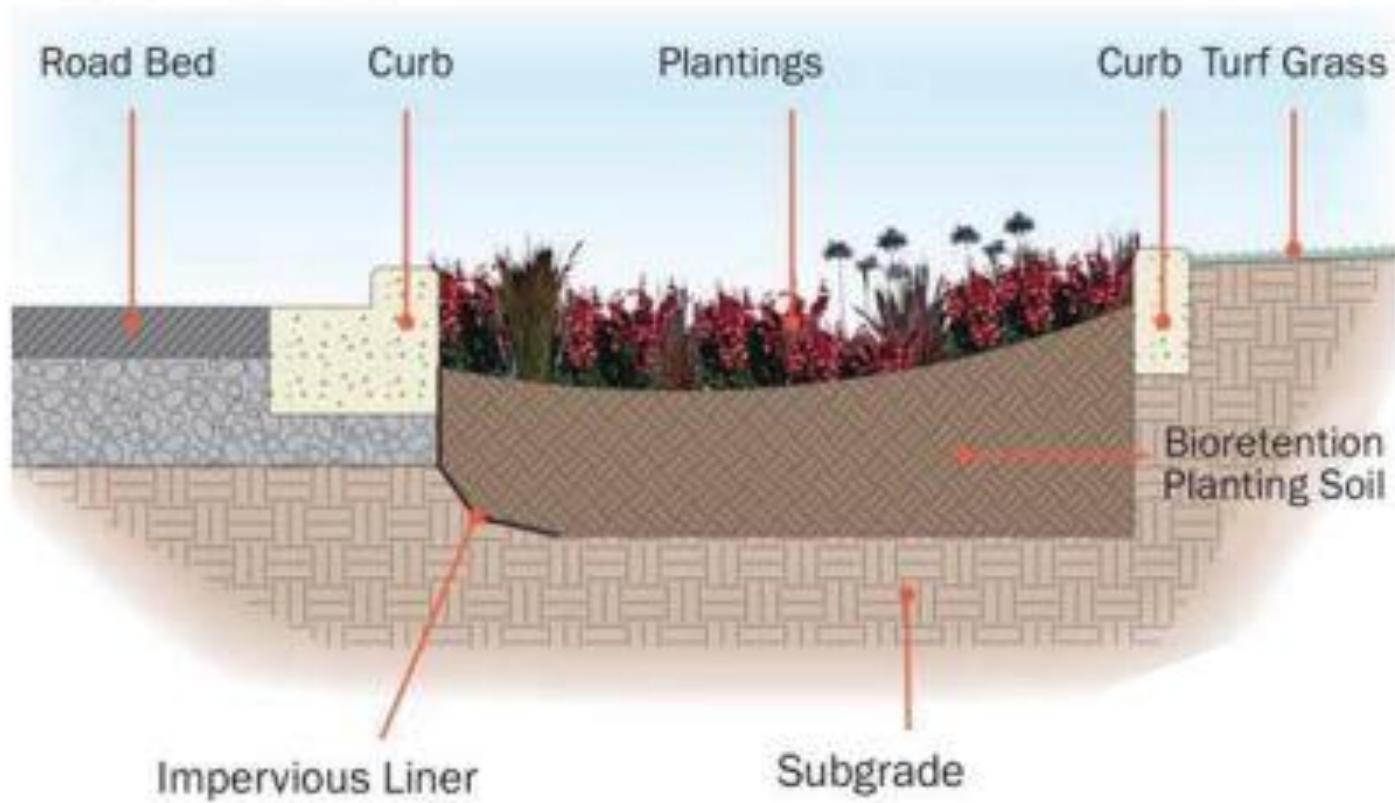


Bioretention Garden



American Society of
Landscape Architects

Curb Extension



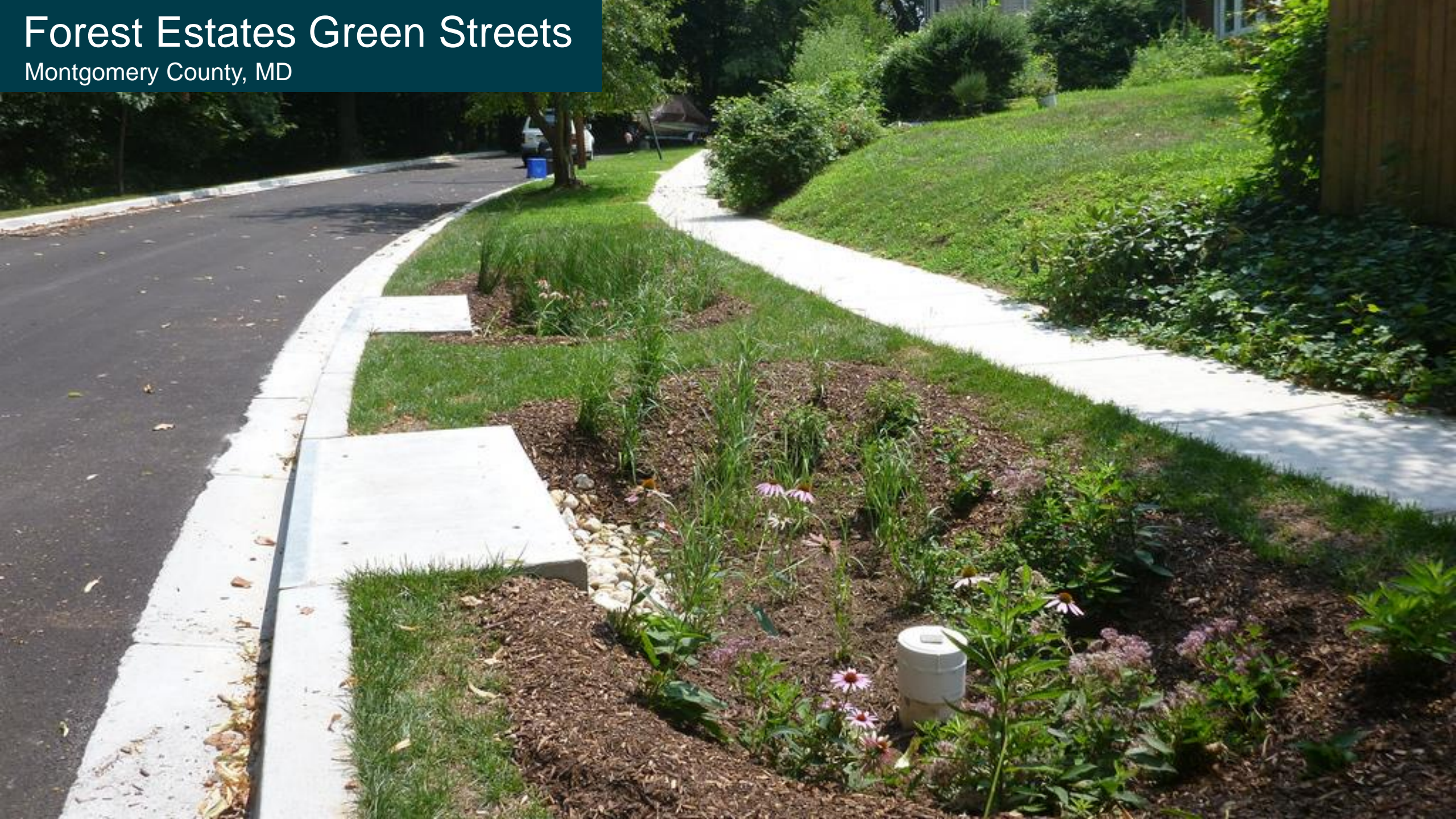
Permeable Surfaces





Forest Estates Green Streets

Montgomery County, MD



Forest Estates Before Green Infrastructure



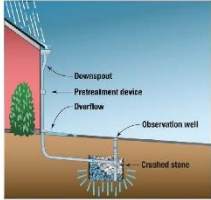
Forest Estates After Green Infrastructure





What is a buried dry well?

A buried dry well is a small underground pit filled with stone that collects rainwater from roof gutters and allows it to absorb into the surrounding soil. Underground piping connects the dry well to the roof downspout. Dry wells are common on residential lots, where there may be three or more dry wells on one lot. Since most are buried and covered with grass, people can recognize their location by an observation well cap that is typically at least 20 feet from the house.



Dry well to catch runoff from roof

Barred dry wells need simple maintenance to keep stormwater flowing into them:
Remove leaves and tree debris from gutters and downspouts



Clean gutters will help keep debris from clogging your dry well.

How to Maintain Your Buried Dry Well
Montgomery County, Maryland, Department of Environmental Protection • Stormwater Facility Maintenance Program • www.montgomerycountymd.gov/stormwater

Actions you can take

Do...

Monthly

- ✓ Inspect your gutters and pretreatment devices after storms to make sure that rain water properly drains to the dry well.
- ✓ Ensure caps on observation wells are fastened.

Seasonally

- ✓ Remove leaves and tree debris from roof gutters and pretreatment devices from April through November.
- ✓ To prevent damage to your mower or to the observation well cap, do not mow over the caps.
- ✓ Repair any damage to gutters/downspouts from winter snow or ice.

As needed

- ✓ Inform contractors working on your property of the dry well's location, to prevent accidentally damaging it.
- ✓ Be sure pretreatment devices are filtering out leaves and sediment before rainwater reaches the dry well.

Don't...

- ✗ Do not remove a dry well or reconfigure your downspouts to direct water somewhere else.
- ✗ Don't place decks, sheds, or other structures on top of a dry well.
- ✗ Don't let children remove the observation well caps.

Why is it important to maintain your buried dry well?

An unmaintained dry well may:

- Cause flooding on other areas of your property if the stormwater is not able to flow into the dry well
 - Cause rainwater to pool on the surface and become a breeding place for insects
 - Require a complete replacement of the facility which can be very expensive
- By maintaining your dry well, you are doing your part to help the environment and protect your local streams and the Chesapeake Bay.

Who is responsible for this maintenance?

As the property owner, YOU are responsible for all maintenance of your dry well.

What are rain gardens, bioswales, and micro-bioretenation facilities?

Rain gardens, bioswales, and micro-bioretenation areas are functional landscaping features that filter rainwater and improve water quality.

Micro-bioretenation areas are typically planted with native plants and have three layers: mulch, a layer of soil, sand, and organic material mixture; and a stone layer. A perforated pipe within the stone layer collects and directs the filtered rainwater from large storms to a storm drain system so the facility drains within 2 days. Micro-bioretenation areas are often located in parking lot islands, cul-de-sac islands, or along roads.

Rain gardens are very similar to micro-bioretenation areas, except they do not have a buried perforated pipe. They often collect water from roof gutters, driveways, and sidewalks. Rain gardens are common around homes and townhomes.

A bioswale is similar to a micro-bioretenation area in the way it is designed with layers of vegetation, soil, and a perforated pipe within the bottom stone layer. Bioswales typically are located along a roadway.

These facilities need simple maintenance, similar to other landscaping areas, including:
-Weeding -Pruning -Mulching
-Removing Trash and Debris



How to Maintain Your Rain Garden, Bioswale, and Micro-Bioretenation Area
Montgomery County, Maryland, Department of Environmental Protection • Stormwater Facility Maintenance Program • www.montgomerycountymd.gov/stormwater

Actions you can take

Do...

Monthly

- ✓ Regularly inspect the facility. Notify DEP if signs of erosion, obstructions, or unhealthy vegetation.
- ✓ Remove weeds and invasive plants.
- ✓ Remove any trash that has washed into the bioretention area or the inlet channels or pipes.
- ✓ Check the facility a few days after a rain storm to make sure that there is not standing water after 2 days.

As needed

- ✓ Cut back dead stems of herbaceous plants in March and remove from the facility.
- ✓ Water new plants during initial establishment of plant growth (first 18 months) and extreme droughts. Watering should only be needed when it has not rained for more than 10 days.
- ✓ Replenish and redistribute mulch to a total depth of 3 inches.
- ✓ Contact DEP if you observe severe erosion.
- ✓ In Fall, remove fallen leaves from the area. Leaves may block the flow of rainwater.

Don't...

- ✗ Don't apply excess salt and sand around the property in winter.
- ✗ Don't store snow and leaves on top of the bioretention area.
- ✗ Don't use fertilizer or pesticide
- ✗ Don't let grass clippings into it

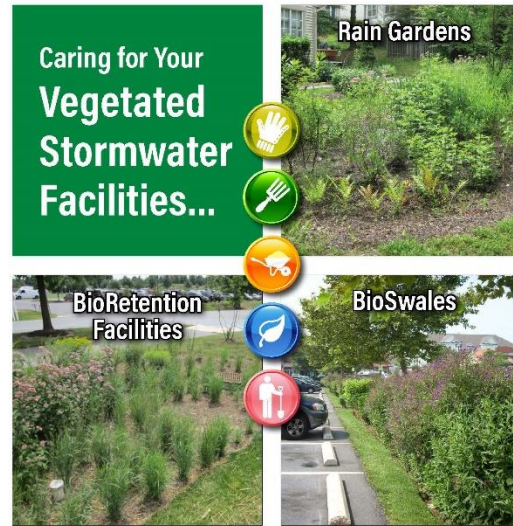
Can I remove the practice?

No, you cannot remove any facilities that were part of your building installation—these are permitted structures and DEP maintains a database of these facility locations. DEP may perform a maintenance inspection of your practice if it is a permitted structure. Contact DEP to find out if you have a permitted structure or if you would like to discuss options for modifying your facility.

Who is responsible for this maintenance?

As the property owner, YOU are responsible for all of the maintenance of your micro-bioretenation facility, rain garden, and bioswale. If you live along a Green Street with rain gardens in the County right-of-way, please see our [Rain Gardens Along the Roadway](#) fact sheet.

You can prolong the life of your rain garden, bioswale, and micro-bioretenation facility and save on maintenance costs by keeping your site clean and regularly inspecting and maintaining the facility to ensure it is functioning properly.



www.montgomerycountymd.gov/stormwater

What is a grass drainage swale?

A grass drainage swale is an open channel that collects water from hard surfaces and allows it to percolate into the ground, reducing the amount of runoff leaving the road or property. The grass covering the side slopes and swale bottom provides a filtration surface for the water and helps to reduce the flow velocity. In steeper areas, some swales have stone or concrete "check dams" across the width to help slow the flow rate, promote infiltration, and prevent erosion. During large storms, swales can direct extra runoff to other stormwater facilities or the storm drain system. Swales are commonly found along roads, parking lots, or between properties of some residential lots.



Grass drainage swale

Actions you can take

Do...

Monthly

- ✓ Inspect your swale after storms to make sure that rainwater has drained and there is no erosion.
- ✓ Remove sediment and debris from in and around the swale.

Seasonally

- ✓ Mow fescues and bluegrass no shorter than 2 1/2 to 3 inches. Remove or compost tall grass clippings.
- ✓ Manually remove any weeds or invasive plants.
- ✓ Remove or compost leaves in autumn. Leaves may smother the grass and block the flow of water.
- ✓ Adjust the mower height to avoid scalping the edges of the side slopes.

As needed

- ✓ Reforest any bare areas and water during the initial establishment period.
- ✓ Contact DEP if you continue to have ongoing erosion problems.

Grass drainage swales need regular maintenance, similar to other landscaped areas, including:
- Removing trash and debris
- Mowing

Don't...

- ✗ Don't use fertilizer or pesticides in your swale.
- ✗ Don't over-mow or mow shorter than 2 1/2 to 3 inches.
- ✗ Don't mow immediately after a rain event.

Who is responsible for this maintenance?

As the property owner, YOU are responsible for all maintenance of your grass drainage swale.

How to Maintain Your Grass Drainage Swale
Montgomery County, Maryland, Department of Environmental Protection • Stormwater Facility Maintenance Program • www.montgomerycountymd.gov/stormwater



BUILDING A COMMUNITY OF PRACTICE AT THE INTERSECTION OF WATER, CLIMATE RESILIENCE, AND EQUITY:

Insights and Opportunities from an Assessment of The Kresge Foundation's Climate Resilient and Equitable Water Systems (CREWS) Initiative



Prepared by Meridian Institute for American Rivers



THE KRESGE FOUNDATION

CREWS

Climate Resilient & Equitable Water Systems

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Smart Policies for a Changing Climate

The Report and Recommendations of the ASLA Blue Ribbon Panel on Climate Change and Resilience



ASLA Blue Ribbon Panel Report
www.asla.org/climatepolicies

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Green Infrastructure: A Blueprint for Climate Resilient Communities

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