CITY OF EL PASO, TEXAS
AGENDA ITEM
DEPARTMENT HEAD'S SUMMARY FORM

DEPARTMENT: Capital Improvement Department

AGENDA DATE: April 2, 2018

CONTACT PERSON/PHONE: Lauren Baldwin, Sustainability Coordinator, 212-1835

DISTRICT(S) AFFECTED: All Districts

STRATEGIC GOAL:
Goal 1: Cultivate an environment conducive to strong economic development
Goal 3: Promote the visual image of the city
Goal 7: Enhance and sustain El Paso's infrastructure network
Goal 8: Nurture and promote a healthy sustainable community

SUBJECT:

Discussion on green infrastructure best practices and how this concept can enhance stormwater management in the region.

BACKGROUND / DISCUSSION:

Green infrastructure (GI) uses vegetation, soils, rocks, and mulch, and other elements to manage water and create healthier urban environments. GI is a patchwork of natural areas that enhance resilience by increasing permeable surface area, deliver air and water quality benefits, AND provide habitat for wildlife. While green infrastructure typically refers to *passive* rainwater harvesting methods (raingardens, green parking, green streets, permeable surfaces, green roofs, etc.), it can also include *active* rainwater harvesting (rain barrels and cisterns). Passive rainwater harvesting is essentially shaping the earth to slow the velocity of runoff, infiltrate it into the soil and direct it to where it can be beneficially used by vegetation. Medians, parks, parkways, and residential front and back yards are ideal locations for passive rainwater harvesting. GI offers an opportunity to increase the amount of green space in the community, provide food and habitat for pollinators and other wildlife, improve the amount of water that infiltrates into our groundwater supply, filter and sustainably manage stormwater, and improve parkways.

El Paso has started to incorporate green infrastructure into City projects, including design projects in parkways, medians, and parks. Other leaders in the El Paso community, such as UTEP and a few private sector developers, have also started to include green infrastructure in their designs.

SELECTION SUMMARY:

N/A

PROTEST

☒ No protest received for this requirement.

☐ Protest received.

COUNCIL REPRESENTATIVE BRIEFING:

Was a briefing provided? ☒ Yes or ☐ Not Applicable (Routine)
If yes, select the applicable districts.

- ☐ District 1
- ☒ District 2
- ☐ District 3
- ☐ District 4
- ☐ District 5
- ☐ District 6
- ☐ District 7
- ☐ District 8
- ☐ All Districts

PRIOR COUNCIL ACTION:
N/A

AMOUNT AND SOURCE OF FUNDING:

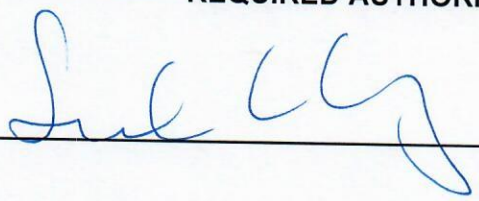
N/A

BOARD / COMMISSION ACTION:

N/A

**********REQUIRED AUTHORIZATION**********

DEPARTMENT HEAD:



Lauren Baldwin
Sustainability Coordinator
City Of El Paso

Green Infrastructure

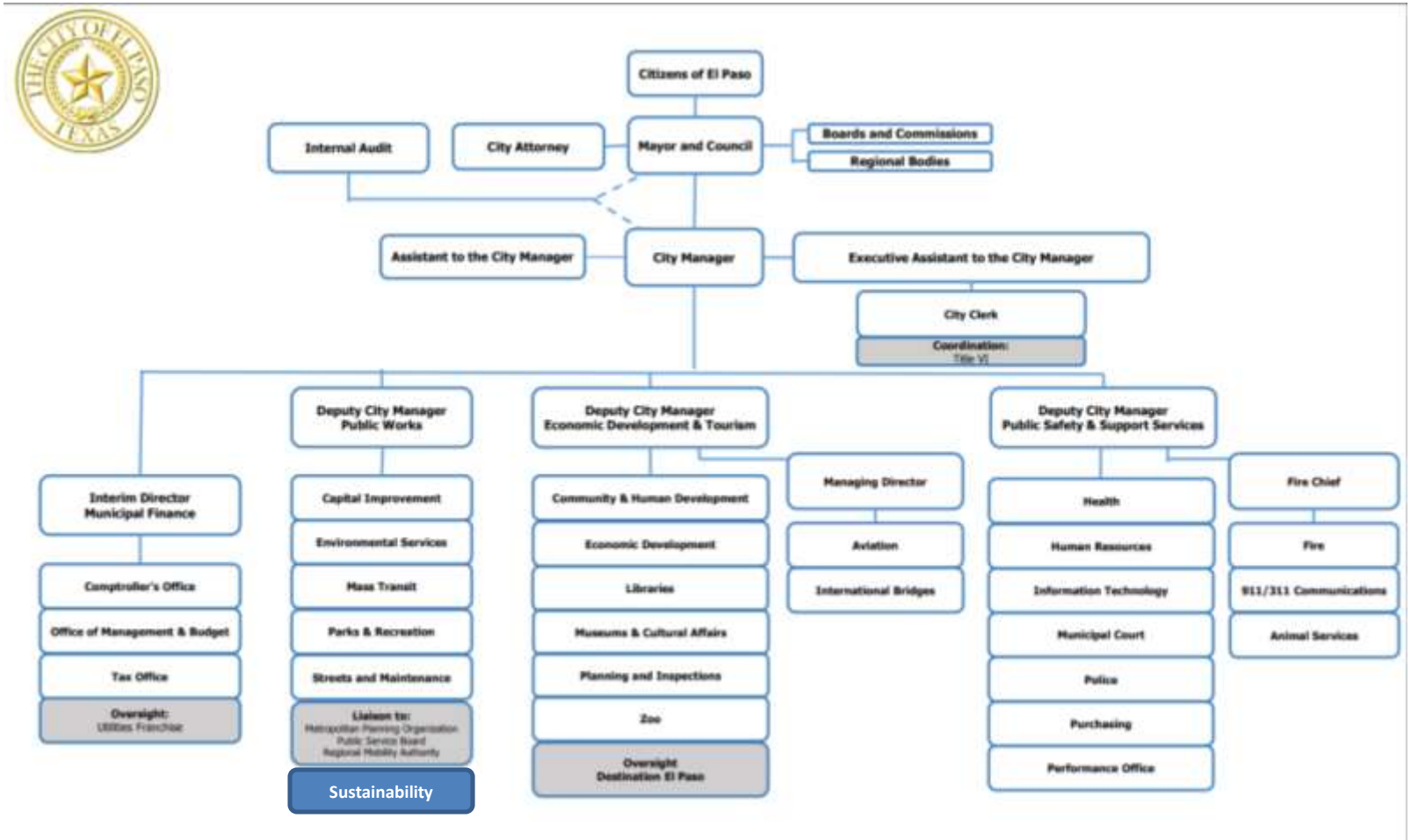
Strategic Goals Addressed

- **Goal 1: Cultivate an environment conducive to strong economic development**
  - 1.2: Enhance visitor revenue opportunities
    - Catalyze eco-tourism as an economic development driver focused on El Paso's unique and authentic urban desert identify
- **Goal 3: Promote the visual image of the city**
  - 3.3: Set one standard for infrastructure across the city
- **Goal 7: Enhance and sustain El Paso's infrastructure network**
  - 7.5 Set one standard for infrastructure across the city
    - Institutionalize sustainable building design and development practices for all city-owned and operated property
    - Design and implement infrastructure projects that maximize co-benefits, simultaneously addressing climatic and social stressors such as flooding, heat, and energy and citizen mobility
- **Goal 8: Nurture and promote a healthy sustainable community**
  - 8.5 Improve air quality throughout El Paso

Where is Sustainability?

- **2008** – Sustainability Office formed (CM, ESD, ED, Gen. Svcs…)
- **2013** – COEP receives 100 Resilient Cities recognition and funding to hire CRO for two years (Dec. 2014- Dec. 2016)
- **2015** – Office of Resilience and Sustainability formed (CRO + Sustainability Coordinator + Resilience AmeriCorps volunteers)
- **2017** – City Council votes to incorporate Resilience Strategy actions into Strategy Plan
  - Summer 2017: CRO serves as Interim Director of Community and Human Development
  - Summer 2017: Sustainability Coordinator embedded in Public Works portfolio directly reporting to DCM to influence sustainability within infrastructure-related departments (CID, Parks, ESD, SaM, Sun Metro)
- **2018** – Resilience Strategy released

Where is Sustainability?



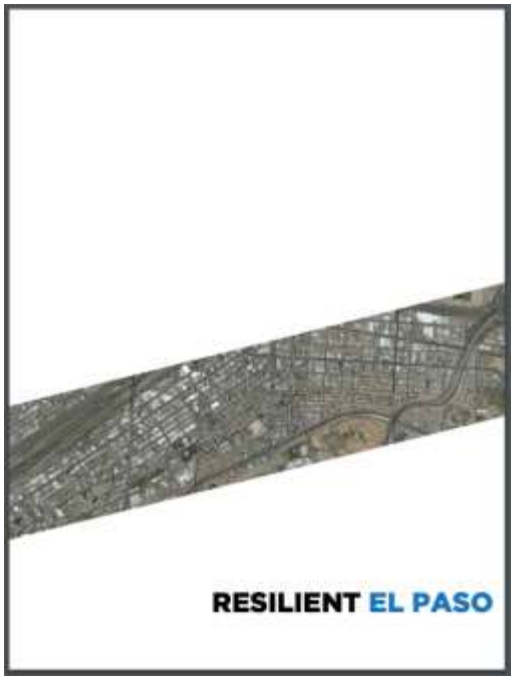
Background: Green Infrastructure

- **January 2007 - *"Toward a Bright Future – A Green Infrastructure Plan For El Paso Texas"***
  - Halff Associates
  - Very open-space related (need, existing, opportunities, recommendations, implementation)

- **February 2017**
  - Resilience Strategy actions integrated into Strategic Plan
- **August 2017**
  - Green infrastructure workshop and demonstration project
- **December 2017**
  - Presented to OSAB

Resilience Strategy Integration

- **ACTION 1.4.1** **Address identified environmental challenges by deploying best practices and identifying key performance-based metrics to assess infrastructure resilience.**
- Best practices for reducing runoff volume, improving water quality, minimizing heat island effect and maximizing energy efficiency will be prioritized as infrastructure development projects are implemented. **A keen focus will be placed on how to effectively deploy green infrastructure with capacity to address not only water management**, but also improve air quality, enhance walkability, and beautify public spaces.



Infrastructure – What is it?

- Infrastructure manages our access to food, water, energy, transportation, communication, waste disposal, and other critical services.
- "Infrastructure" has been synonymous with engineered systems that support basic functions of modern industrialized society.

Green Infrastructure (GI) can include:

Green streets and alleys

Green parking

Rainwater harvesting

Green roofs

Bioswales

Permeable pavements

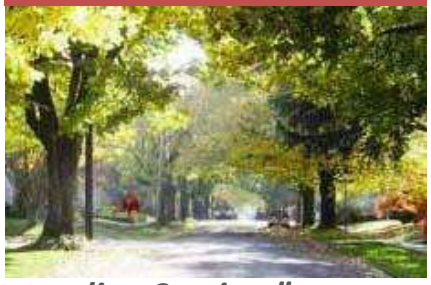
Rain gardens

Downspout disconnection

Land conservation

Planter boxes

Urban tree canopy



Berms, swales, basins

Image courtesy of Watershed Management Group

Figure 1. Conceptual drawing of a curb cut and basin in the Right-of-Way (ROW).

El Paso Examples:

Country Club Road

El Paso Examples:
Country Club Road

El Paso Examples:

Viscount Hike and Bike

El Paso Examples:

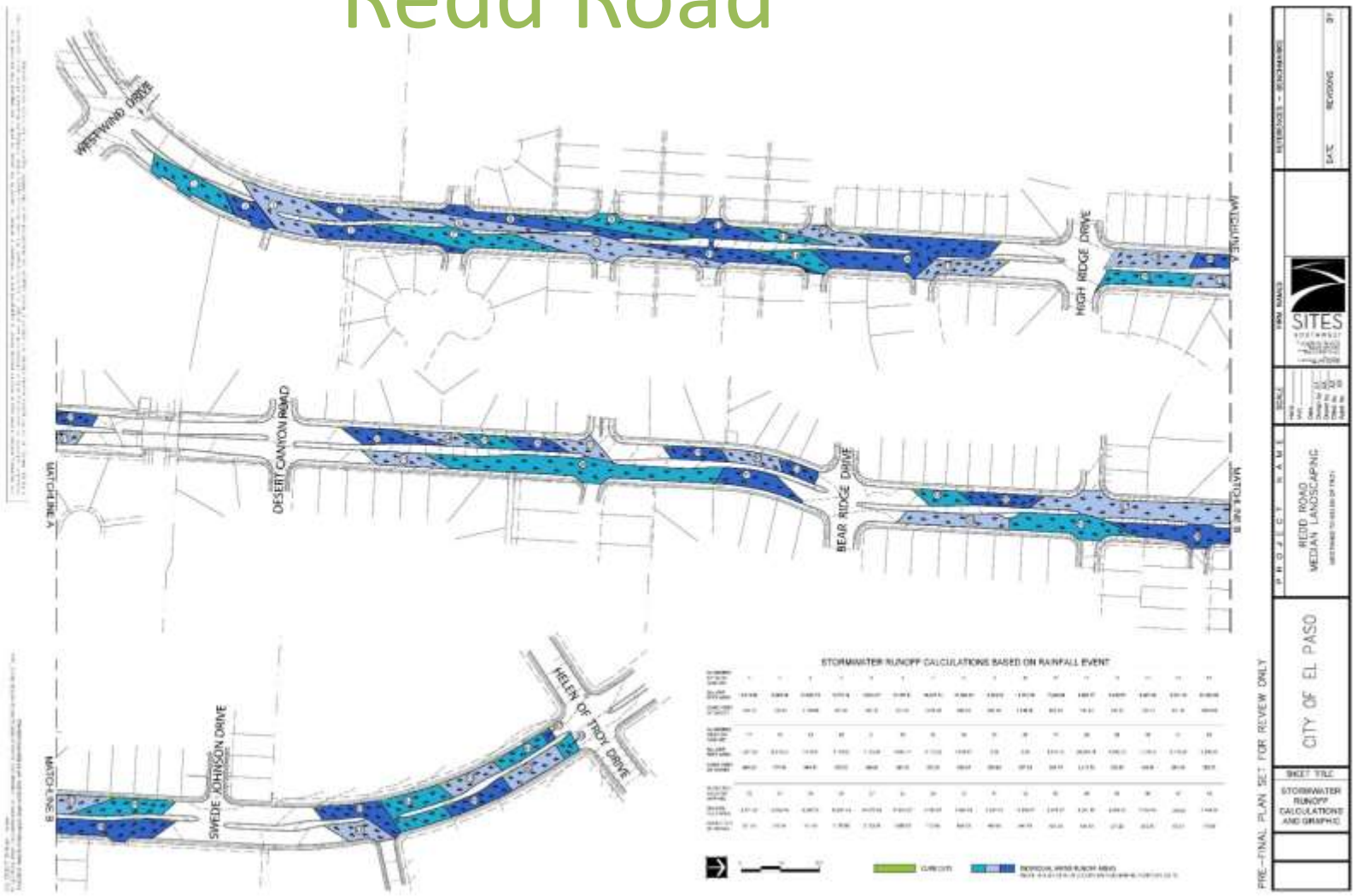
Knights Blvd

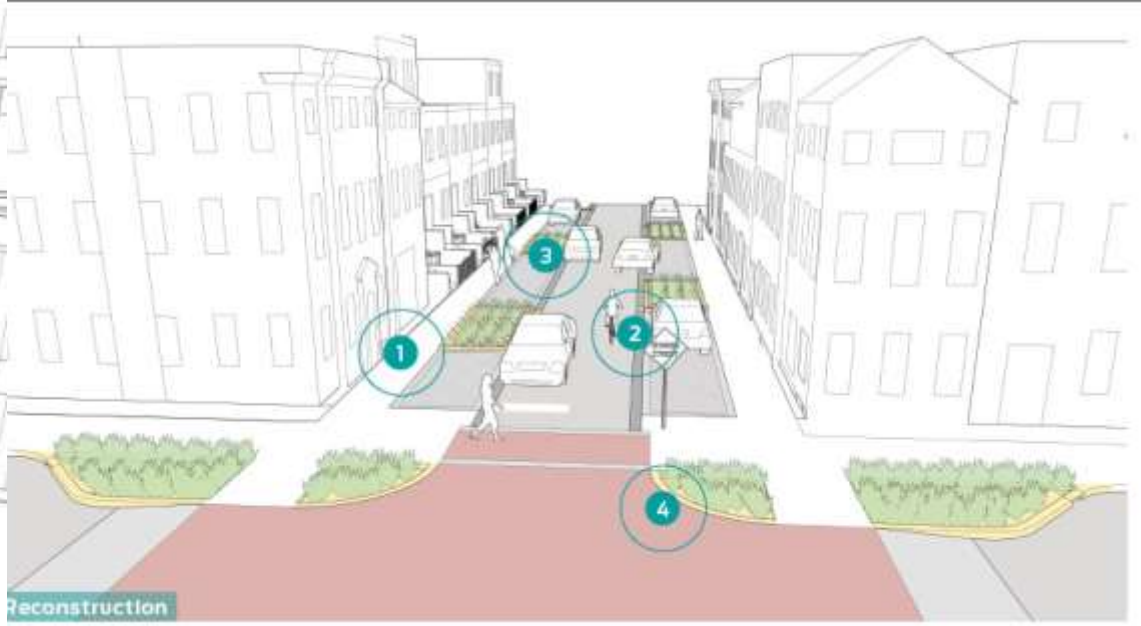
El Paso Examples:

Riverbend

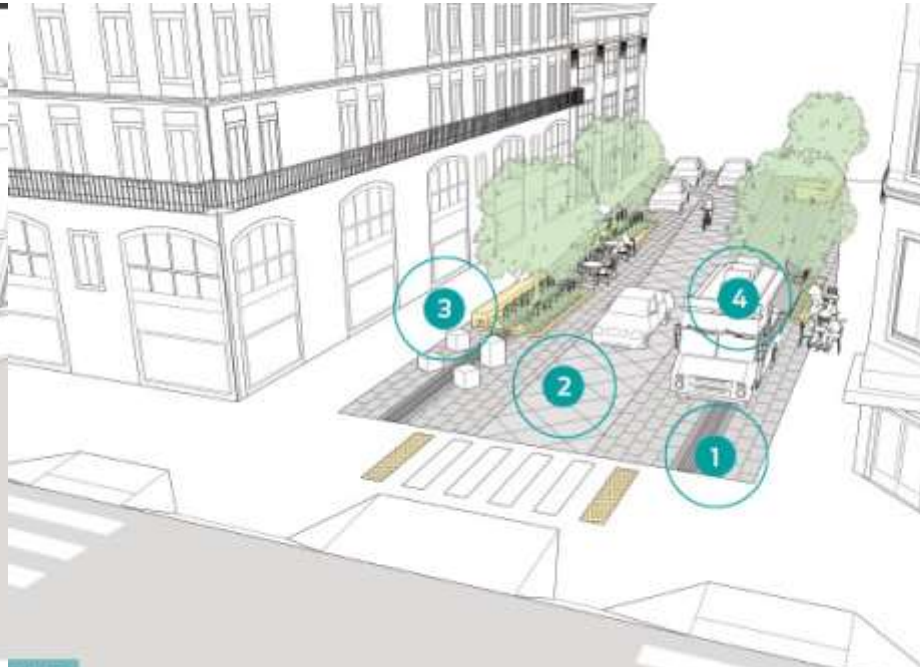
El Paso Examples:

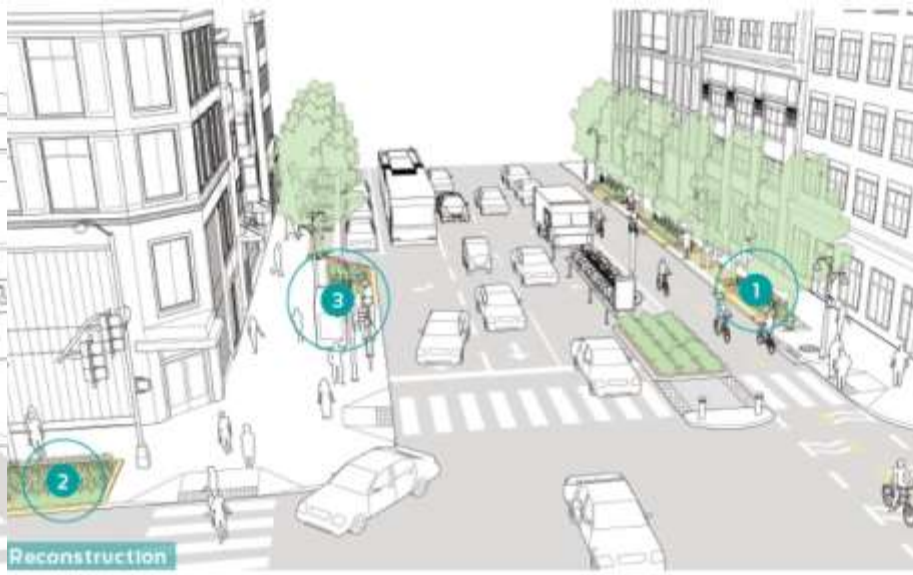
Redd Road





Examples from NACTO's new Urban Street Stormwater Guide





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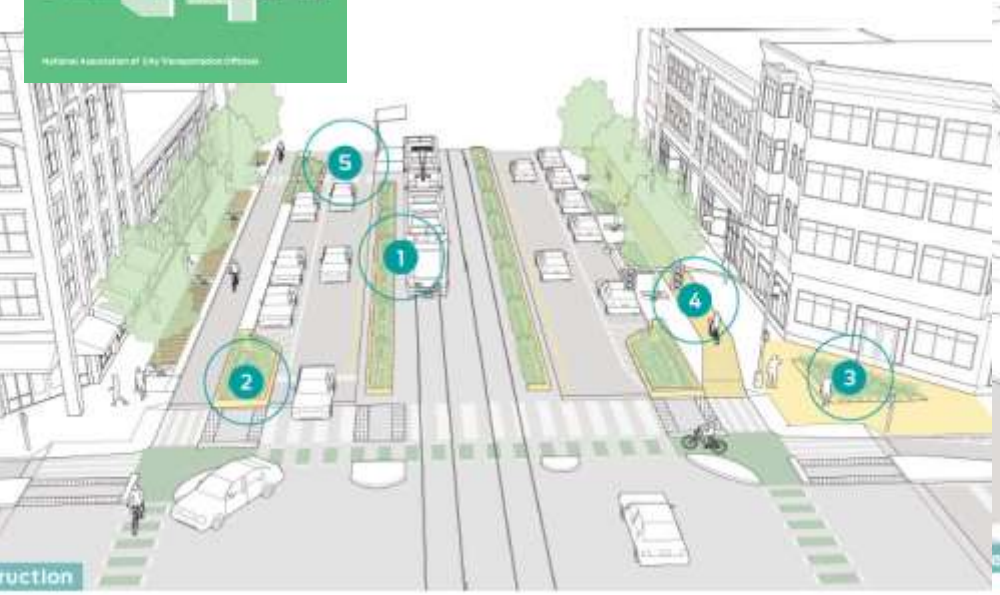


El Paso Examples:

Sun Metro's New TOC

El Paso Examples:

San Jacinto Plaza

El Paso Examples:

San Jacinto Plaza

El Paso Examples:

UTEP

El Paso Examples:

UTEP

El Paso Examples:

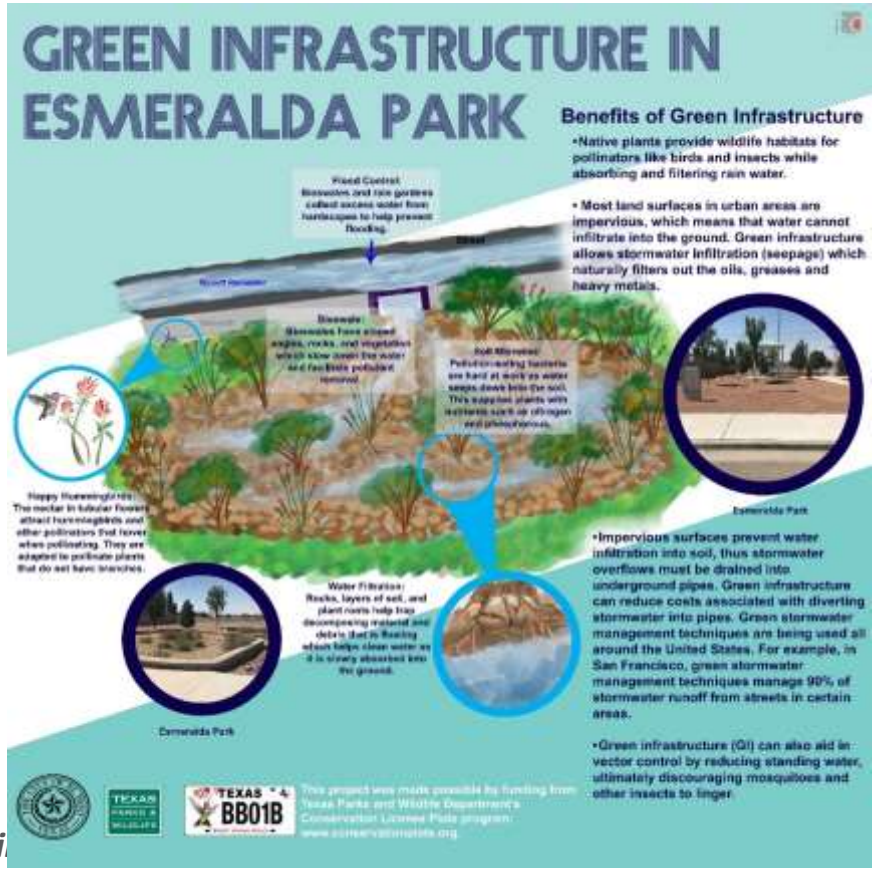
Esmeralda Park

BEFORE

El Paso Examples:

Esmeralda Park

DESIGN AND CONSTRUCTION



El Paso Examples:

Esmeralda Park

El Paso Examples:

Esmeralda Park

AFTER

"Delivering Outstanding Services"

El Paso Examples:

Esmeralda Park

AFTER

El Paso Examples:

Esmeralda Park

AFTER

El Paso Examples:

Esmeralda Park

AFTER

El Paso Examples:

Esmeralda Park

Rainwater Capture Estimates:

13,529 gallons of water, which is the equivalent of 21.21% of the potential runoff in a 0.43 inch storm

AFTER A RAIN STORM

El Paso Examples:
Rim Road

El Paso Examples:

Kennedy Law

El Paso Examples:

7400 Via Canutillo Dr.

El Paso Examples:

7400 Via Canutillo Dr.


THIS GARDEN IS A COLLABORATION
between the students of Coronado High School,
the Texas A&M AgriLife Extension Service and
Master Gardeners, the City of El Paso Office of
Resilience & Sustainability, and Sunset Gardens.


Project VIDA

Examples from other cities:

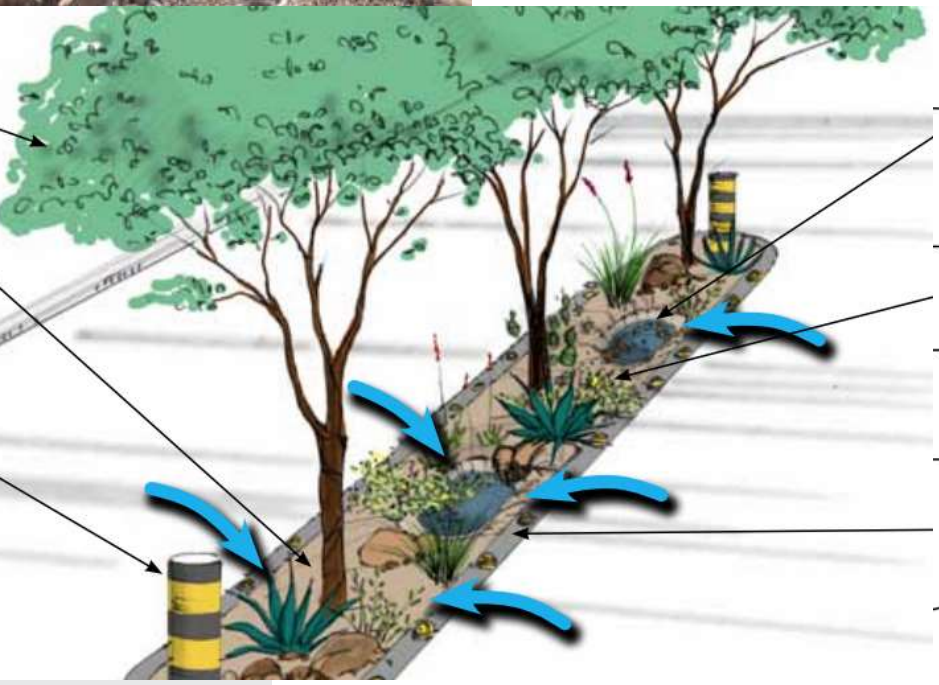
TUCSON'S ANNUAL RAIN GARDEN BENEFITS:

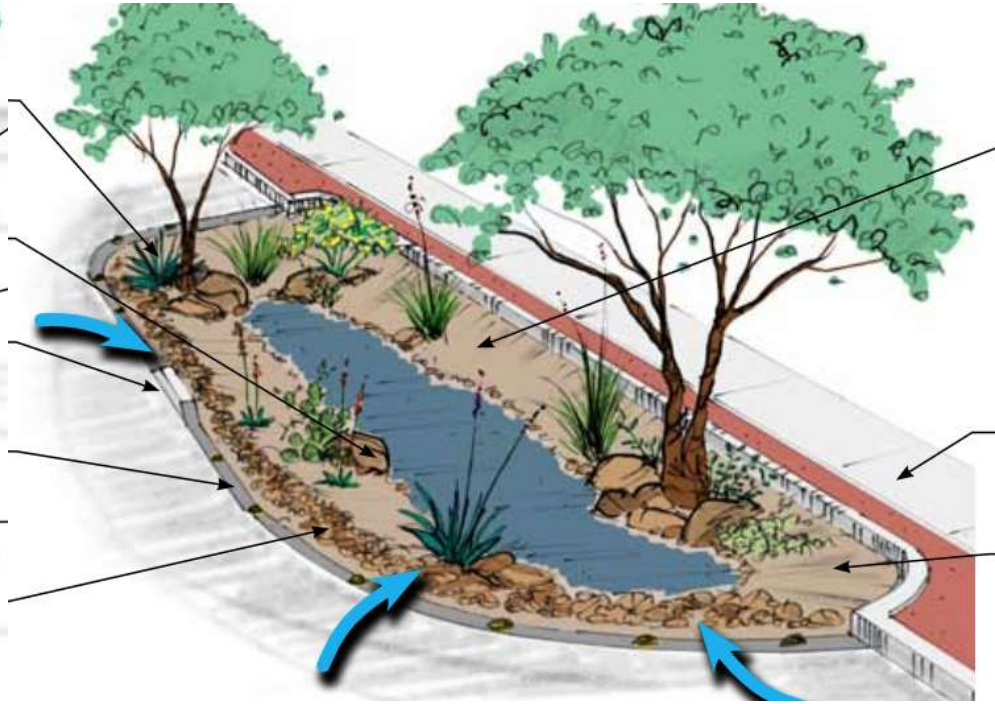
1 Streetside Rain Garden **Costs $500** → **Captures 12,000 gallons** of stormwater

Provides $2,600 in community benefits **&** **4,000 gallons** of groundwater recharge

500 Streetside Rain Gardens **Cost $250,000** → **Capture 6,000,000 gallons** of stormwater

Provide $1,300,000 in community benefits **&** **2,000,000 gallons** of groundwater recharge






Rain Gardens
Making a Beautiful Difference!
Why Build a Rain Garden?
A Typical Rain Garden...
Did you know...
Why use native plants?


Audubon Rain Garden Project
A rain garden is a shallow depression filled with hardy, low-maintenance native plants whose deep roots allow stormwater runoff to soak into the soil better than grass sod or non-native plants. By absorbing this runoff, they help keep our streams healthier by reducing flooding, erosion and pollution, and provide habitat for birds and other wildlife.
Audubon

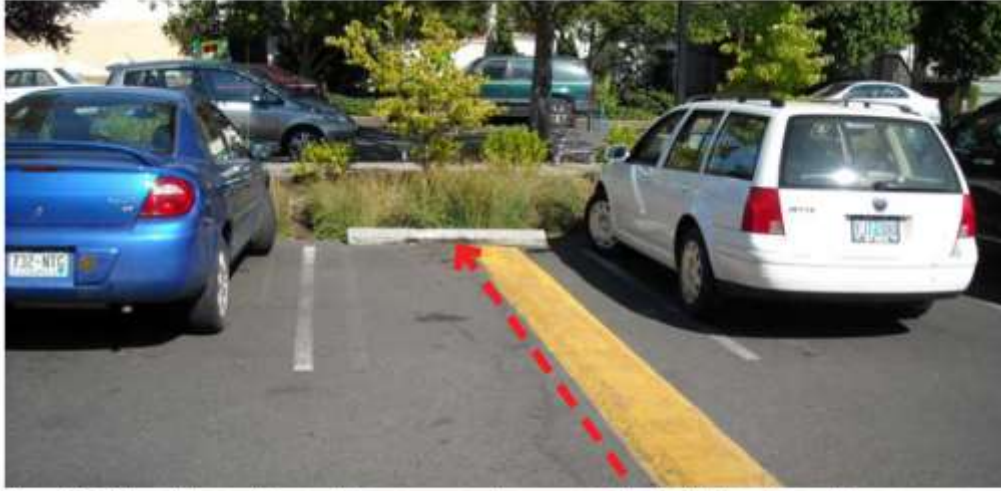
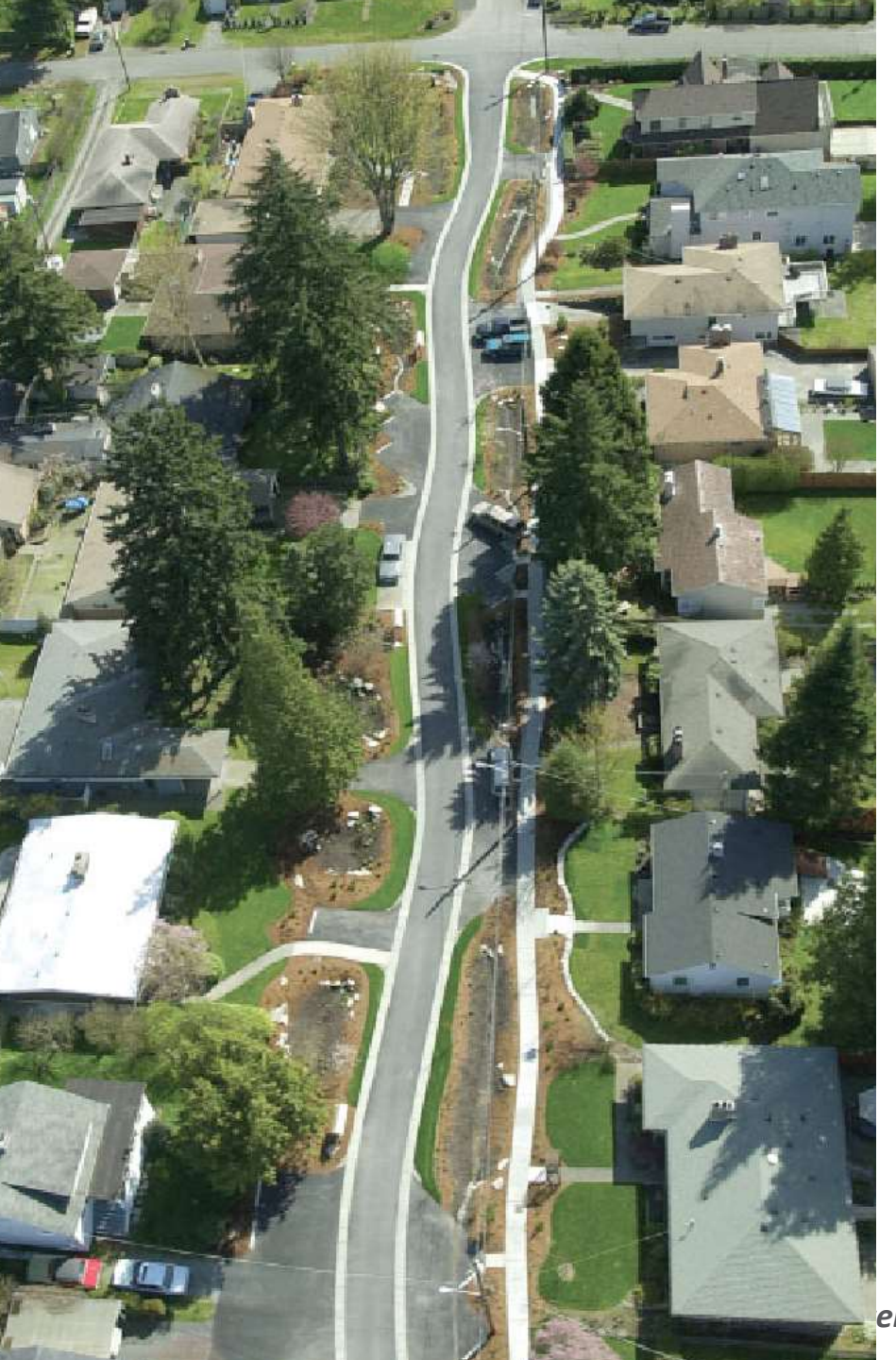


Figure I-3: *This asphalt speed bump redirects stormwater into a vegetated swale. Without the speed bump, stormwater runoff would enter the vegetated swale much lower in the system, bypassing some of the area available for treatment.*


PHELPS
STOP
NO PARKING
PARK
PARALLEL


Before


After



Variations of sidewalk scuppers allowing stormwater to flow under sidewalk.

liv

Figure E-6: **Vegetated Swale Example**

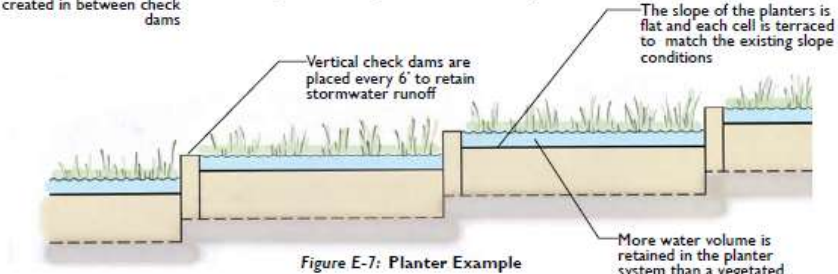
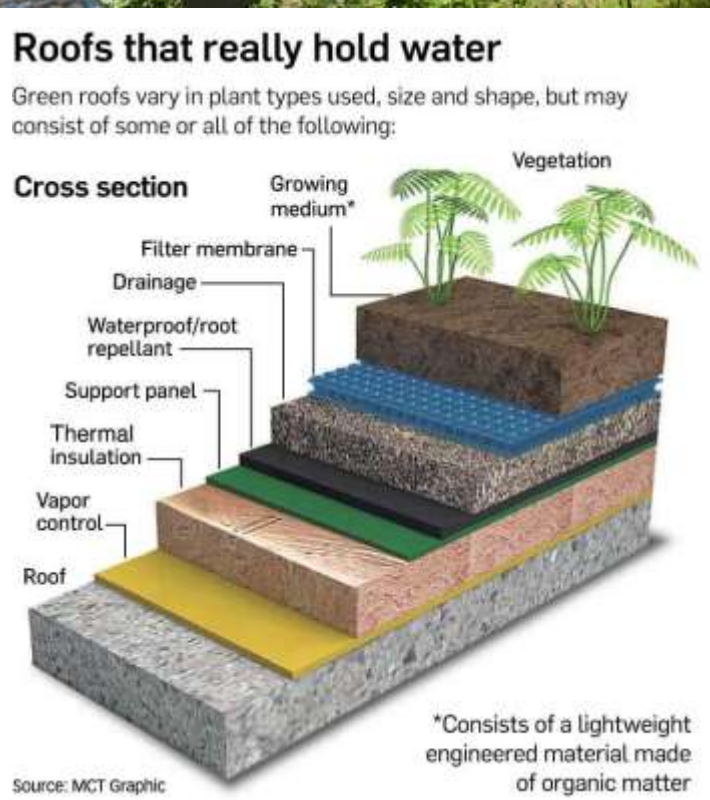


Figure E-7: **Planter Example**

Cooling Corridors – Las Cruces, NM



"We successfully designed and fabricated accurately scaled prototypes of a green roof and a conventional white roof and began testing in simulated conditions of 115-70°F with relative humidity of 13%... Our green roof model resulted in a 14°C (**25.45°F) difference** in temperature for the air below the green roof compared to the air below the white roof."

Source: Jenkins, Bryan M. , Bhat, Ashwini , Botros, Christopher , Fong, Karen , Patel, Vishal, Valladares, Carmen , Watts, Andre. *Implementation of Green Roof Sustainability in Arid Conditions.* UC Davis. 2009.

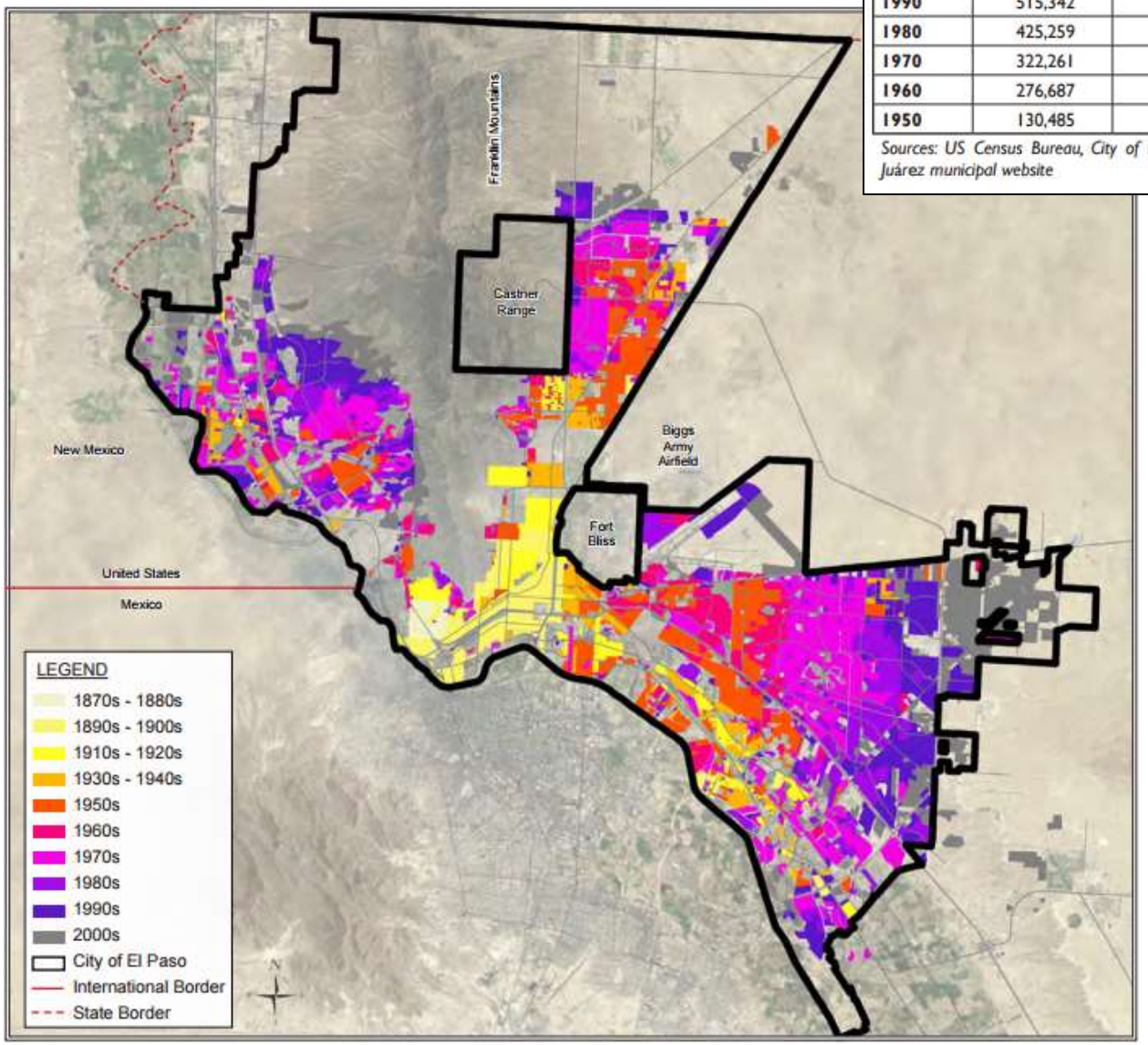

"In Philadelphia, developers became leaders in advocating for the market value that green infrastructure could provide to projects. We saw progressive developers able to educate other developers, their financial backers, and the market. Their work showed that green infrastructure could provide for both the bottom line and for their sense of corporate identity and placemaking." | MAMI HARA, GENERAL MANAGER/CEO, SEATTLE PUBLIC UTILITIES; FORMER DEPUTY COMMISSIONER, PHILADELPHIA WATER DEPARTMENT

Trends: Population Growth

POPULATION TRENDS

	City of El Paso	El Paso County	Ciudad Juárez
2010	649,121	800,647	1,313,338
2000	563,662	679,622	1,218,817
1990	515,342	591,610	798,499
1980	425,259	479,899	649,275
1970	322,261	359,291	407,370
1960	276,687	314,070	262,119
1950	130,485	194,968	122,566

Sources: US Census Bureau, City of El Paso Planning Division, Ciudad Juárez municipal website



Impact of Development – Los Angeles example

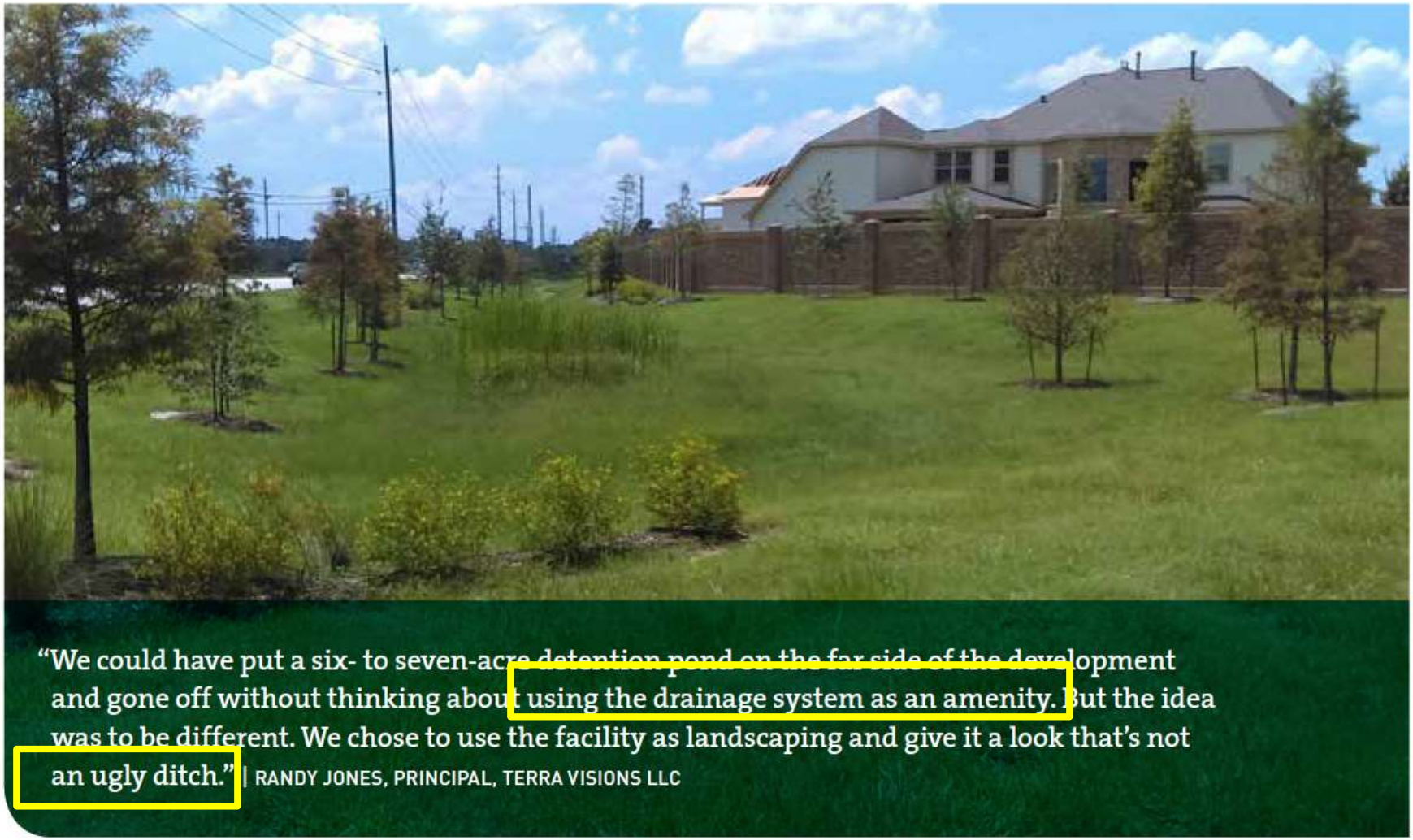
- "In the 1920s, approximately 5% of precipitation in the Los Angeles region flowed to the sea.
- Today, extensive impervious cover and massive stormwater conveyance systems deliver 50% of the rain falling in the region to the sea, even as more than 80% of the city's water demand is met by costly imports from distant locations"
- More impervious cover means less absorption which means more water that needs to be managed.

Trends: More extreme weather events

Trends: “Nuisance flooding”

Opportunity for Increased Permeability

Opportunity for Creative Development



Opportunity for Creative Development

Opportunity to Complement Grey Infrastructure with GI

el paso WATER

who we are | public information | customer service | purchasing | conservation | water | reclaimed | wastewater

Stormwater:
- About
- Rates
- FAQs
- Environmental

Stormwater Master Plan: Improving the System

El Paso County Stormwater Master Plan

County Stormwater Master Plan

City of El Paso Master Plan: Improving the System

Stormwater Master Plan
Master Plan Community Advisory Committee Report

The El Paso Stormwater Master Plan, approved by the Public Service Board and City Council in 2009, lays out the capital improvement projects that prepare the city for major rain events. The projects are financed through cash funding and bonds.

In the first three years, these master plan projects improved flood control in watersheds throughout the city. More than 50 percent of the flood risk was addressed or reduced. Typical improvements include the following:

- Additional ponds
- Expanded street inlets
- Enlarged culverts
- Expanded reservoirs
- Additional storm drains
- Enlarged culvert crossings and road underpasses
- Lining earthen channels

The master plan study evaluated all areas of the city, but focuses on areas where flood risk is particularly high. This focus on major threats produces a more cost-effective and useful plan. Ultimately, about 100 projects were recommended. EPWU staff recommended an additional $80 million in projects that address localized flooding issues.

The master plan uses standards consistent with those used by other Texas and Southwest communities. As a result, it has been well received by regulators, insurers, infrastructure financiers and other parties. The master plan forms the basis of significant reductions to flood risk, economic, transportation and health and safety issues in the El Paso communities.

Future Projects

Watershed	System	Scope
Central	Cabada	New pump station in Gateway West Pond
		Cabada Pump Station wet well improvements
	Magnolia	Increase crest or improve spillway on Dam No. 7
		Replace principal spillway on Dam No. 9
	Dallas	Dallas Pump Station Improvements Phase 2
		Add capacity to Dallas system
		Dam 8 Upgrade – outlet tower improvements
East	Eastwood Dam	Under review
	Pico Norte	Improve storm drain system to Pico Norte Pond
	Jesuit Basin	Add pipes to capture flow
		Add new detention pond
	Americas	Add detention sediment basin - Socorro Athletic Complex No. 1
		Add detention sediment basin - Socorro Athletic Complex No. 2
Mission Valley	Mesa Drain Upstream	Thomas Manor Pond and Pump Station Improvements
	Playa Drain	Remove Structures - Yarbrough and Playa Drain
		Install new pump station and culverts - Vocational /Riverside
		Install new pump station - Basin C/Shaver Park
Northeast	Northeast Sump	Northeast Sump Excavation
		Expand facility - Alps to Hondo Pass
		Retention for flows in Threadgill/Tobin Drain
		Install pipes to flow to Northgate Dam

http://www.epwu.org/stormwater/master_plan.html

Thank You

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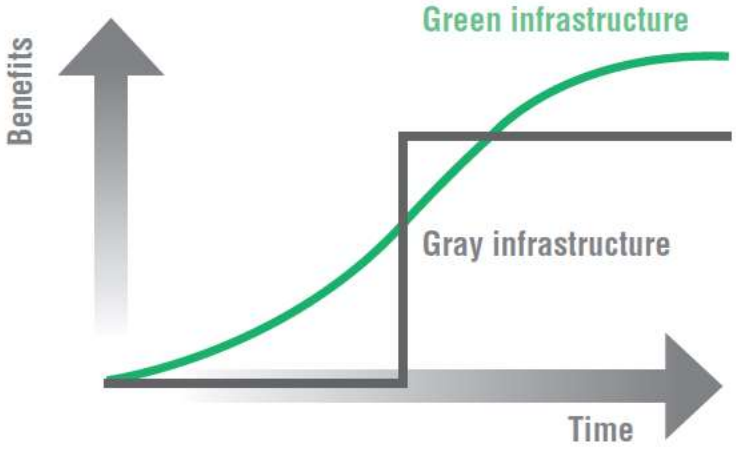
Benefits of GI



Over time, green infrastructure provides increasing benefits, in contrast with gray infrastructure. *(NYC Green Infrastructure Plan, Executive Summary)*

- GI uses vegetation, soil and rocks to manage rainwater where it falls.
- Added benefits include:
  - Wildlife habitat
  - Healthier watershed
  - Slow down runoff velocities and reduce potential for flooding
  - Reduce erosion
  - Increase infiltration and reduced ponding
  - Reduce pollutants (water and air)
  - Recharge local groundwater
  - Community beautification
  - Reduce urban heat island effect
  - Sequester carbon
  - Increased land value
  - Improved human health

Benefits span across different departments

- **EPWU** – GI can reduce "nuisance flooding" or "localized flooding"
- **Economic Development** – GI can create more attractive spaces, which means more visitors (and increased property value), which means increased tax revenue
- **Office of Emergency Management** – GI can help slow water velocities and capture rain across the city, meaning reduced risks associated with extreme flooding. Plus, the increased green space means reduced risks associated with extreme heat
- **Public Health** – GI can reduce standing water which means reduced breeding areas for mosquitos which reduces risk of disease outbreaks
- **Environmental Services** – GI can reduce standing water, which means reduced costs associated with vector control
- **Streets and Maintenance** – GI channels the water off the roads meaning less water ponding on streets, leading to fewer potholes

RESEARCH AND CASE STUDIES

Case Study – Lancaster, Pennsylvania

- For the 25- year green infrastructure scenario, the avoided capital costs associated with implementing green infrastructure instead of all gray infrastructure is $120 million and the avoided operational cost is $661,000 per year.
- The total cost to implement GI is $141 million over 25 years OR $77 million IF incorporated into planned projects.

TOTAL CALCULATED BENEFITS OF CASE STUDY

The sum total of the benefits calculated for Lancaster's Plan in this case study came to an **estimated value of more than $120 million in avoided gray infrastructure capital costs and nearly $5 million in annual benefits** beginning after the 25-year implementation period. The value of the benefits provided by green infrastructure can be compared to the estimated cost. The Plan estimates a total capital cost of $141 million for the long-term implementation scenario, and a total marginal cost of $77 million if green infrastructure is incorporated into planned projects.

Total Calculated Benefits (at Long-Term 25-Year Implementation)	
Estimated Value from Water Benefits Reduced CSS Gray Infrastructure Capital Costs (one-time) Reduced Pumping and Treatment Costs (per year)	 $120,000,000 $661,000
Estimated Value from Energy Benefits (per year)	$2,368,000
Estimated Value from Air Quality Benefits (per year)	$1,023,000
Estimated Value from Climate Change Benefits (per year)	$786,000
Estimated Value from other Qualitative Benefits	Not calculated
TOTAL **Avoided Capital Costs** **Annual Benefits**	 **$120,000,000** **$4,838,000**

Source: EPA https://www.epa.gov/sites/production/files/2015-10/documents/cnt-lancaster-report-508_1.pdf

Case Study – NYC

- In the 1990s, NYC avoided spending $6-$8 billion on new grey infrastructure water filtration and treatment plants by instead purchasing and protecting watershed land in the Catskill Mountains for about $1.5 billion

Source: Environmental Finance Center, Syracuse University - http://www.esf.edu/outreach/gi/documents/Environmental_Finance_Center_Brochure.pdf

Case Study – Kansas City, MO

- *10,000 Rain Gardens* is a public initiative in Kansas City, Missouri, to support the improvement of water quality with rain gardens and other green solutions.

- In 2005, Kansas City began the initiative to address its stormwater and overflow control issues. The goal of the program was to install 10,000 rain gardens, vegetated swales, and rain barrels in the greater metropolitan area.

Source: EPA

Case Study – Charlotte, NC

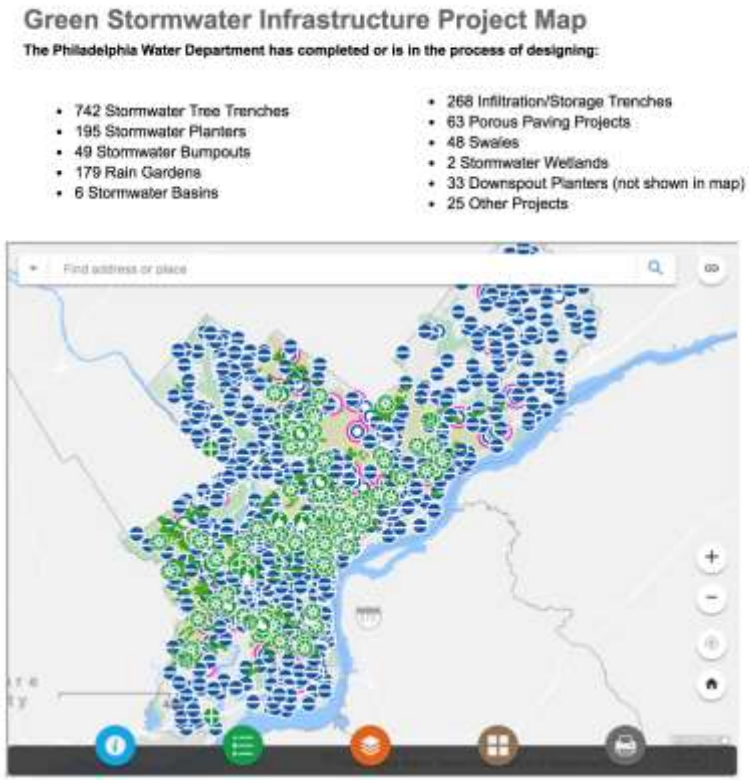
- Landsat images for the Charlotte, NC, area covering a time span from 1984 to 2003 revealed a 20% loss in tree cover and open space, while urban surfaces increased by 127%.
- The loss of green infrastructure, valued at $5.3 billion, dramatically increased the volume of stormwater that the county manages.

Source: Environmental Finance Center, Syracuse University - http://www.esf.edu/outreach/gi/documents/Environmental_Finance_Center_Brochure.pdf

Case Study – Philadelphia, PA

Philadelphia offers:

- **Rain barrel workshops**
- **Reduced stormwater fees** for GI implementation
- Stormwater **grants up to $100,000** per acre to manage the first one inch of rainwater
- **Interactive tool** that allows commercial property owners to calculate how much they would save by implementing GI



Source: Phillywatersheds.org

water.phila.gov/swexp/parcel/510867/

Apps | El Paso Carpool Pro... | Google | City Webmail | El Paso Gov | Envr. Services | Sustainability | Other Bookmark

Stormwater Credits Explorer | Philadelphia Water | Explore The Map

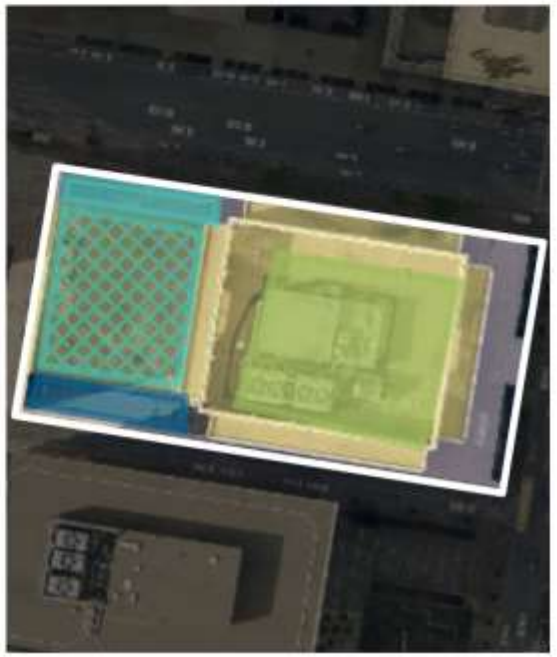
$633
Approximate Monthly Bill

$251
Monthly Bill Reduction

45%
Impervious reduction

ADJUSTMENTS

Type	Managed Area (sq. ft.)	Monthly Reduction	One Year Reduction	Five Year Reduction	Ten Year Reduction
Green Roof	14,686	$142	$1,704	$8,520	$17,040
Permeable Pavement	2,145	$20	$240	$1,200	$2,400
Rain Garden	10,508	$89	$1,068	$5,340	$10,680
Totals	27,339	$251	$3,012	$15,060	$30,120



The credits values provided in the Stormwater Credits Explorer are for estimation purposes only. Actual credit values may be different when projects are actually

Case Study – Tucson, AZ

- **Grant program**
  - To help provide homeowners with the opportunity for rainwater harvesting
  - Grants of up to **$400 are available** to families who have a household income less than or equal to 50% of the area median income.
  - Loans of up to **$2,000** are available to families who have a household income less than or equal to 80% of the area median income.
- **Rebate program**
  - Must attend Rainwater Harvesting Incentives Program Workshop
  - Tucson Water will provide rebates for qualifying rainwater harvesting system costs of up to **$2,000 per property.**

Source: https://www.tucsonaz.gov/water/rainwater-harvesting-rebate

Case Study – Phoenix, AZ

- **Adopted a GI goal:**
  - "Reducing urban heat-island through green-infrastructure (such as "cool roofs", permeable pavement, and stormwater capture) as well as doubling the current tree and shade canopy to 25% by 2030…
  - …Structured shade and trees facilitate increased walking and biking, increase property values, and, most importantly, can be used to create great public gathering spaces in communities."

- Source: Phoenix.gov (https://www.phoenix.gov/sustainability/land)
- Images: Watershed Management Group

Case Study – Houston, TX

Source: http://www.greenhoustontx.gov/compostbinssale.html

HOME GREEN PROJECTS ABOUT US **GREEN HOUSTON** NEWS / EVENTS LINKS CONTACT / SEARCH

GREEN CITY PROJECTS LINKS

- Green Houston Home Page
- Green City Projects Home Page
- Bikeways Program
- Brownfields
- Compost Bin / Rain Barrel Sale
- Electric Vehicles
- Environmental Coordinating Council
- Farmers Market
- Green Building Resource Center
- Green Power Program
- Houston City Energy Proect

COMPOST BIN / RAIN BARREL SALE

Rain Barrels and Compost Bins at Truckload Prices

Order online by Sunday, October 8, 2017 at www.rainbarrelprogram.org/Houston. The 50-gallon rain barrels, which typically retail at $129 and provide homeowners with an affordable alternative to watering from the tap, will be available for $69. Additionally, 65-gallon compost bins, which reduce the volume of garbage needlessly sent to landfills, will be offered for $65. Both come with instructions for easy set-up and use.

Purchases can be picked up Saturday, Oct. 14 from 10 am to 12 pm at the Houston Permitting Center (West) Parking Lot 2, 1002 Washington Ave. GBRC Program Director Steve Stelzer will be available to answer questions and assist all who take part in this offer.

Contact:
832.394.9050

Top Five Reasons to Harvest Rainwater

- Protect our rivers, streams, and ponds from runoff pollution
- Divert water from the municipal storm drain system
- Conserve this vital natural resource and reduce your water bills
- Use rainwater to grow healthy and lush plants
- Control moisture levels around the foundation of your home

Research - American Society of Civil Engineers (ASCE)

- "As cities' stormwater regulations change… green infrastructure (GI) such as green roofs are going to become an **integral part of mitigating stormwater at the source**."

Source: Gerald J. Zaremba, A.M.ASCE[1]; Robert G. Traver, F.ASCE[2]; and Bridget M. Wadzuk, A.M.ASCE[3]. *Impact of Drainage on Green Roof Evapotranspiration.* July 2016.

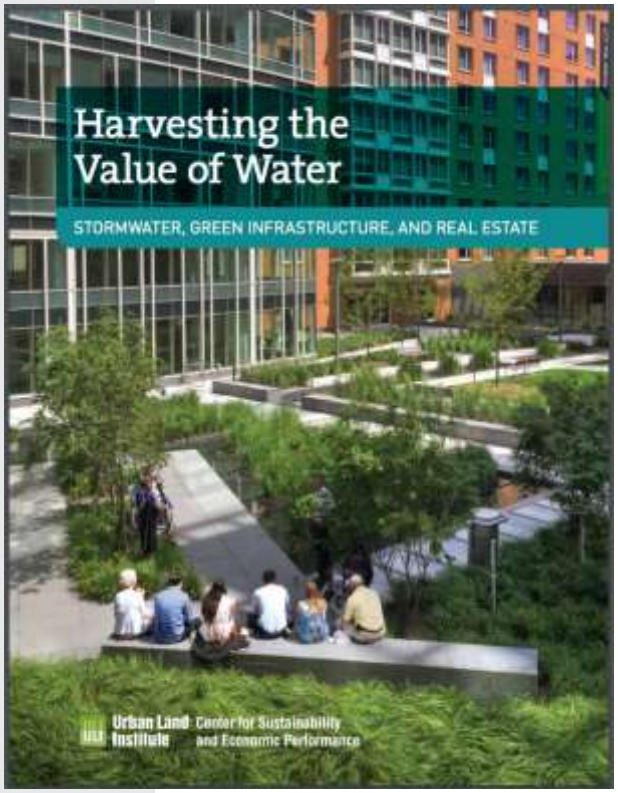
Research - Environmental Protection Agency (EPA)

"Though many green infrastructure practices were first developed and applied in temperate regions, **green infrastructure is perhaps even more relevant in arid and semi-arid climates**…

Communities, researchers, and design professionals in these water-limited regions are increasingly recognizing green infrastructure as a **cost-effective approach** not only to stormwater management, but to water conservation as well."

Source: EPA, *Green Infrastructure in Arid and Semi-Arid Climate*

Research - Urban Land Institute (ULI)



"…market-rate residents want to live in sustainable communities."

-- Leroy Moore, Senior VP and COO, Tampa Housing Authority

Green infrastructure can save space and free up developable land, particularly in comparison to a retention pond alternative. Green infrastructure made retail development feasible on this 6.25-acre site, which could not have accommodated a traditional wet detention pond, the retail facilities, and parking.

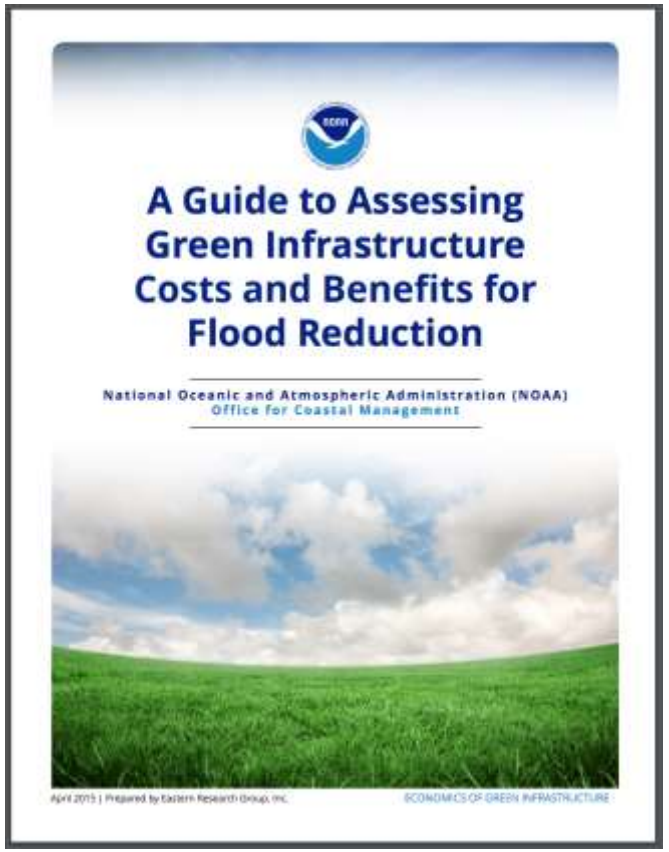
- **District-scale sustainable utilities were a part of the marketing draw for the site.** The market-rate units at Encore! were leased up before the affordable units, which the development team attributes to the location, competitive pricing, and branding. "All of our indications show that market-rate residents want to live in sustainable communities," explains Moore.

Source: EPA, *Green Infrastructure in Arid and Semi-Arid Climate*

Research – National Oceanic and Atmospheric Administration (NOAA)

Duluth Case Study:

"Based on H&H modeling, the peak discharge for the 100-year, 24-hour storm under current conditions if the 76 acre-feet flood reduction target was met was 1,224 cubic feet per second (**20% decrease**) and the peak velocity was 9.53 ft/s (**1% decrease**)."



Source: A Guide to Assessing Green Infrastructure Costs and Benefits for Flood Reduction. NOAA. April 2015. https://coast.noaa.gov/data/docs/digitalcoast/gi-cost-benefit.pdf

Research – National Oceanic and Atmospheric Administration (NOAA)

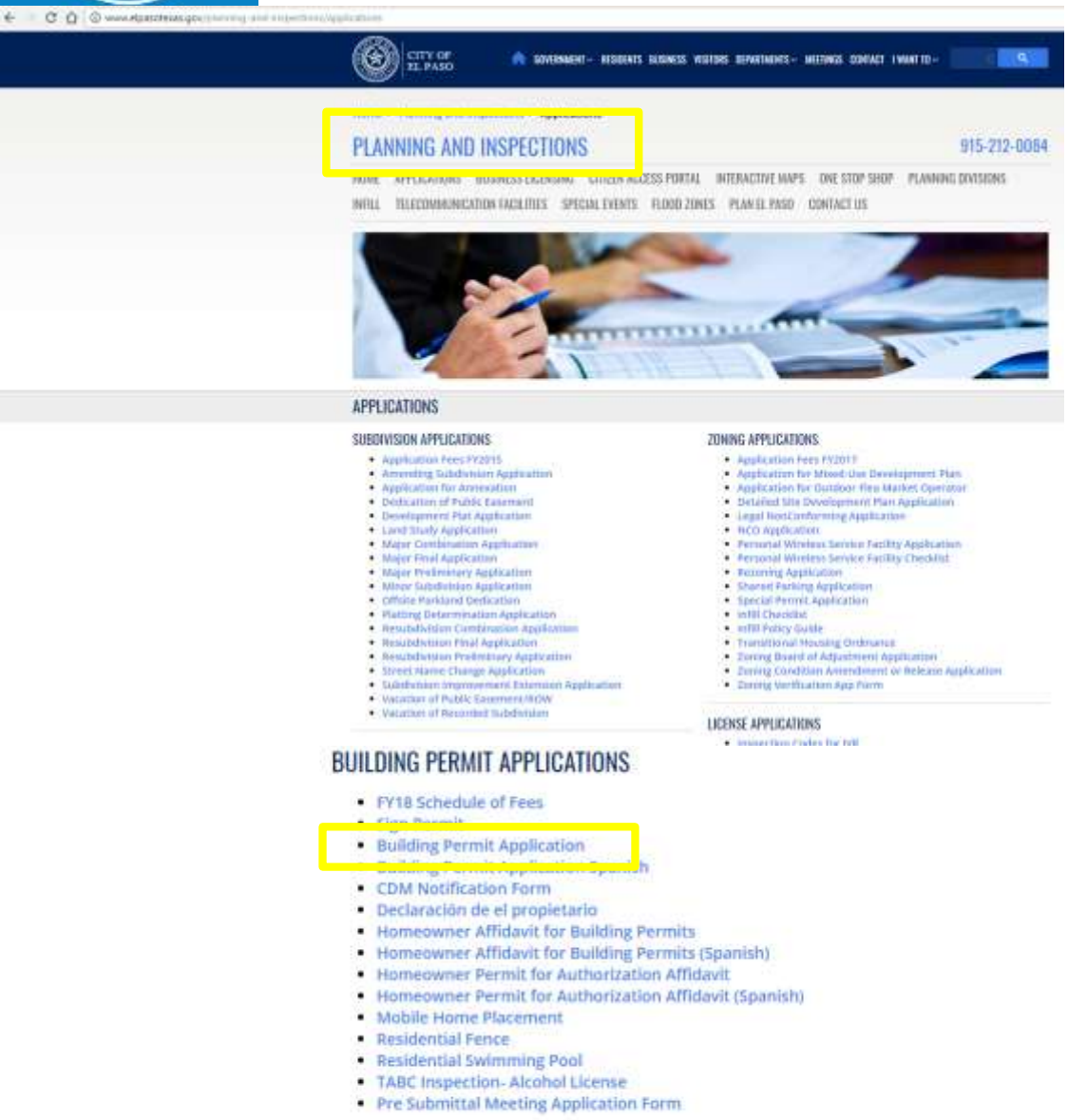
STRUCTURAL DAMAGE ASSESSMENT FOR THE TOLEDO CASE STUDY			
Silver Creek Scenario (all 100-year storm event data)	Number of Buildings Damaged	Maximum Single Building Damage ($)	Total Damage for all Buildings ($)
Current flooding without a green infrastructure strategy	253	$52,000	$738,300
Current flooding with a green infrastructure strategy	159	$53,200	$453,700

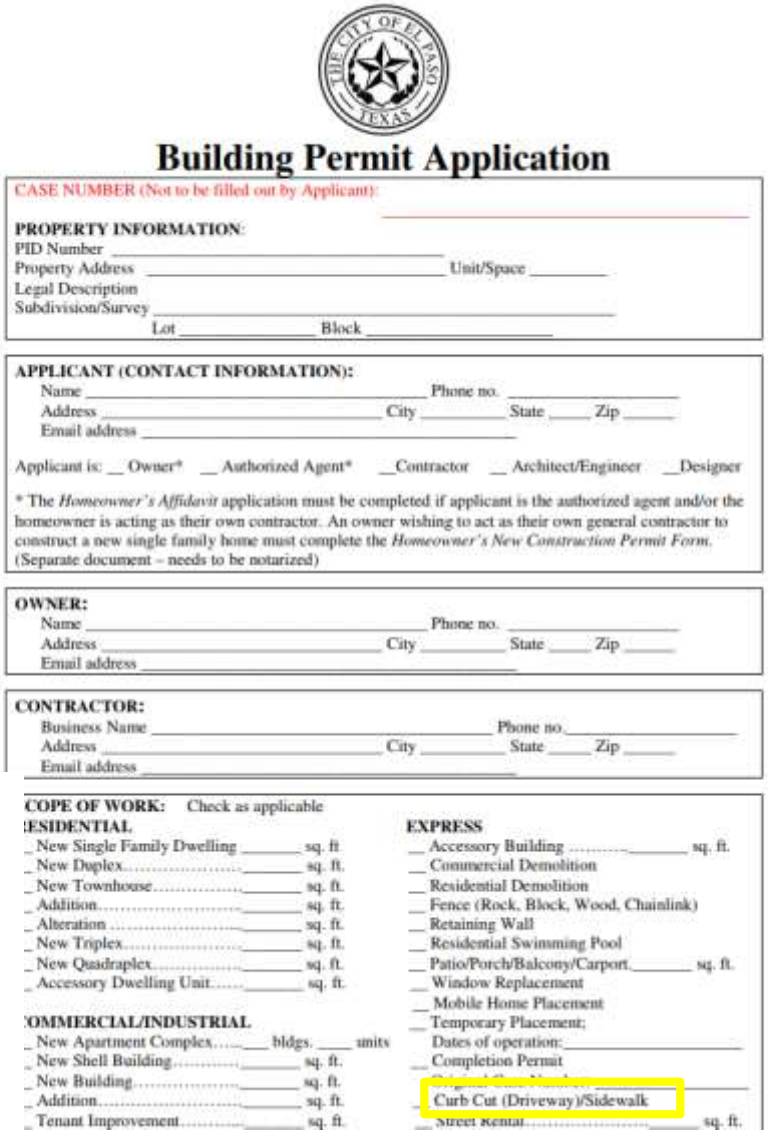
Toledo Case Study:

Reduced costs (**$284,600**) associated with damage for all buildings AND reduced # of buildings damaged with a green infrastructure strategy (**94 fewer buildings damaged**)

Source: A Guide to Assessing Green Infrastructure Costs and Benefits for Flood Reduction. NOAA. April 2015. https://coast.noaa.gov/data/docs/digitalcoast/gi-cost-benefit.pdf

Curb Cut Application Process





Building Permit Application

CASE NUMBER (Not to be filled out by Applicant): _____

PROPERTY INFORMATION:
PID Number _____
Property Address _____ Unit/Space _____
Legal Description
Subdivision/Survey _____
Lot _____ Block _____

APPLICANT (CONTACT INFORMATION):
Name _____ Phone no. _____
Address _____ City _____ State ____ Zip _____
Email address _____

Applicant is: __ Owner* __ Authorized Agent* __Contractor __ Architect/Engineer __Designer

* The *Homeowner's Affidavit* application must be completed if applicant is the authorized agent and/or the homeowner is acting as their own contractor. An owner wishing to act as their own general contractor to construct a new single family home must complete the *Homeowner's New Construction Permit Form.* (Separate document – needs to be notarized)

OWNER:
Name _____ Phone no. _____
Address _____ City _____ State ____ Zip _____
Email address _____

CONTRACTOR:
Business Name _____ Phone no. _____
Address _____ City _____ State ____ Zip _____
Email address _____

COPE OF WORK: Check as applicable

ESIDENTIAL
_ New Single Family Dwelling _____ sq. ft
_ New Duplex _____ sq. ft.
_ New Townhouse _____ sq. ft.
_ Addition _____ sq. ft.
_ Alteration _____ sq. ft.
_ New Triplex _____ sq. ft.
_ New Quadraplex _____ sq. ft.
_ Accessory Dwelling Unit _____ sq. ft.

OMMERCIAL/INDUSTRIAL
_ New Apartment Complex ____ bldgs. ____ units
_ New Shell Building _____ sq. ft.
_ New Building _____ sq. ft.
_ Addition _____ sq. ft.
_ Tenant Improvement _____ sq. ft.

EXPRESS
__ Accessory Building _____ sq. ft.
__ Commercial Demolition
__ Residential Demolition
__ Fence (Rock, Block, Wood, Chainlink)
__ Retaining Wall
__ Residential Swimming Pool
__ Patio/Porch/Balcony/Carport _____ sq. ft.
__ Window Replacement
__ Mobile Home Placement
__ Temporary Placement;
Dates of operation: _____
__ Completion Permit
__ Curb Cut (Driveway)/Sidewalk
__ Street Rental _____ sq. ft.

ing Services"

Recent rains

Recent rains

Recent rains

Recent rains