

Ecosystem Services in the Greater Houston Region

Based on Ecosystem Services Primer

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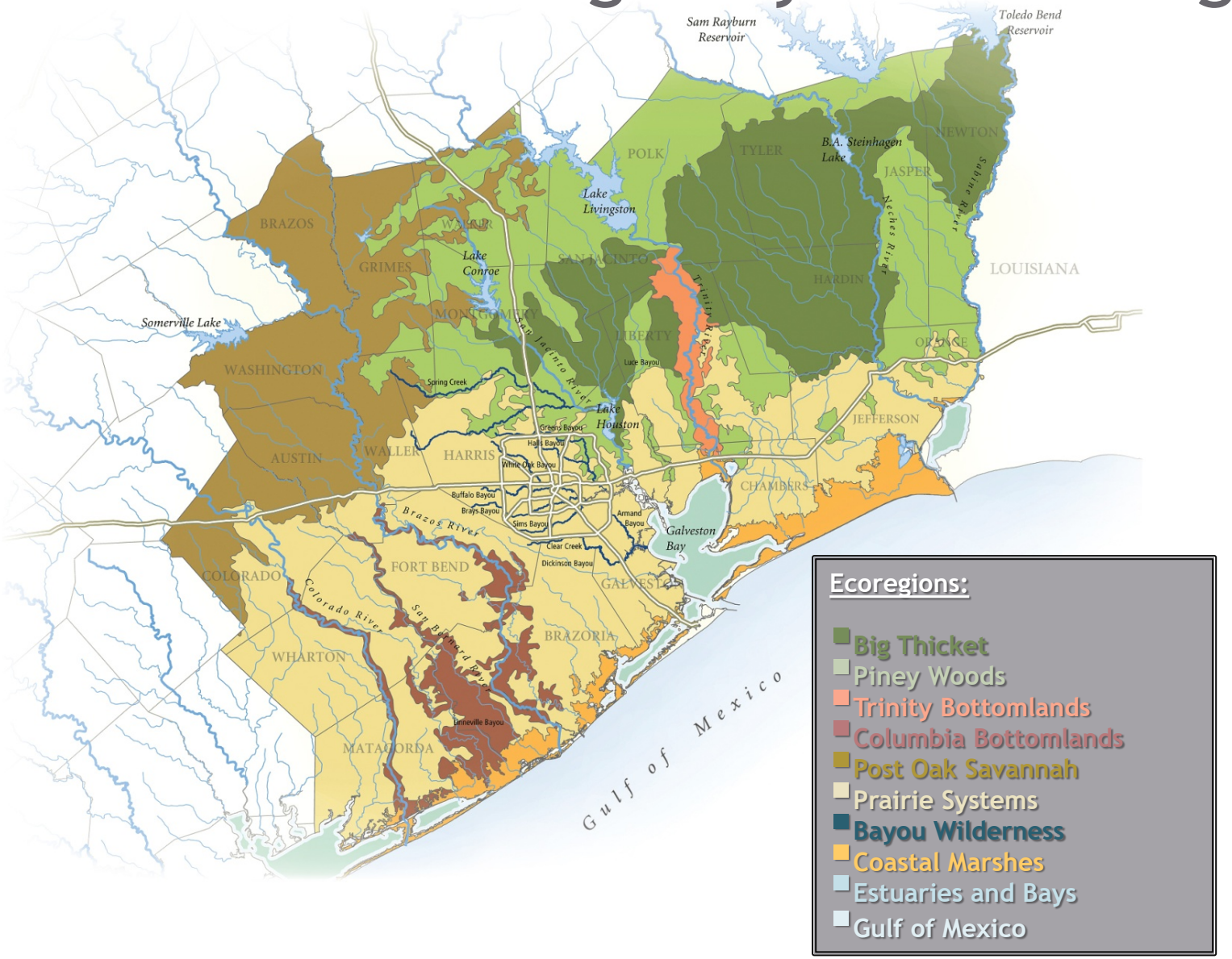
February/March 2019

HOUSTON WILDERNESS
It's Our Nature

Houston is an Ecologically Diverse Region



Ecoregions:

- Big Thicket
- Piney Woods
- Trinity Bottomlands
- Columbia Bottomlands
- Post Oak Savannah
- Prairie Systems
- Bayou Wilderness
- Coastal Marshes
- Estuaries and Bays
- Gulf of Mexico

The 8+ County Region surrounding Houston has 10 distinct ecoregions

There are over 20 major bayous and creeks that run 40-miles each like fingers through the Houston Region and flanked by 3 major rivers

And, over 6.5 million people living around these ecoregions and waterways

Local Ecosystem Service Benefits

Wetlands and Estuaries

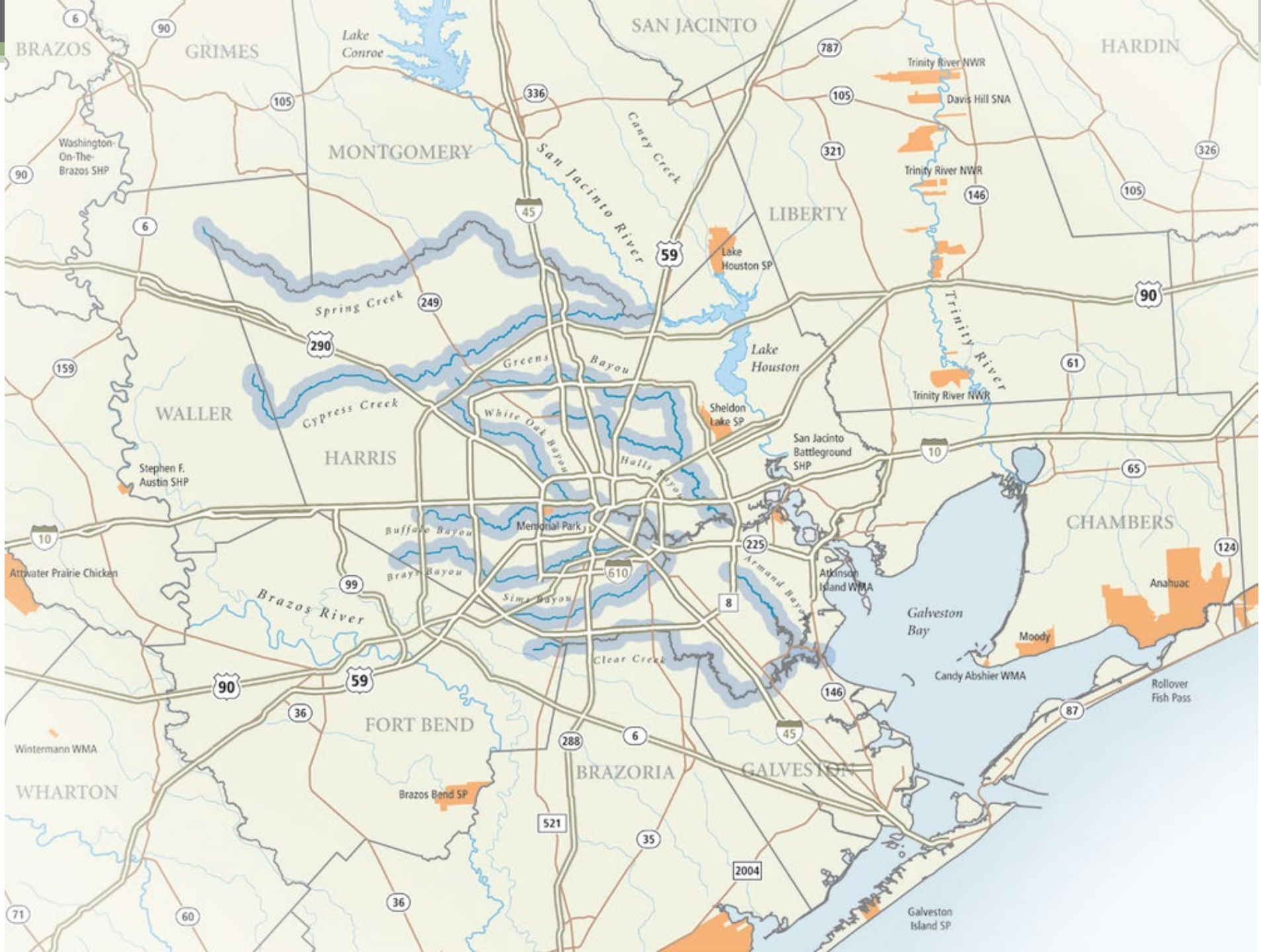
- 1. Recreation
- 2. Recharge aquifers
- 3. Flood prevention
- 4. Freshwater inflows to estuaries
- 5. Wildlife viewing
- 6. Carbon sequestration
- 7. Erosion control
- 8. Water quality improved

Prairies

- 1. Aesthetic beauty
- 2. Eco-tourism
- 3. Water supply
- 4. Decrease flooding
- 5. Biodiversity
- 6. Control soil erosion
- 7. Carbon sequestration
- 8. Avoided engineered system costs
- 9. Water quality

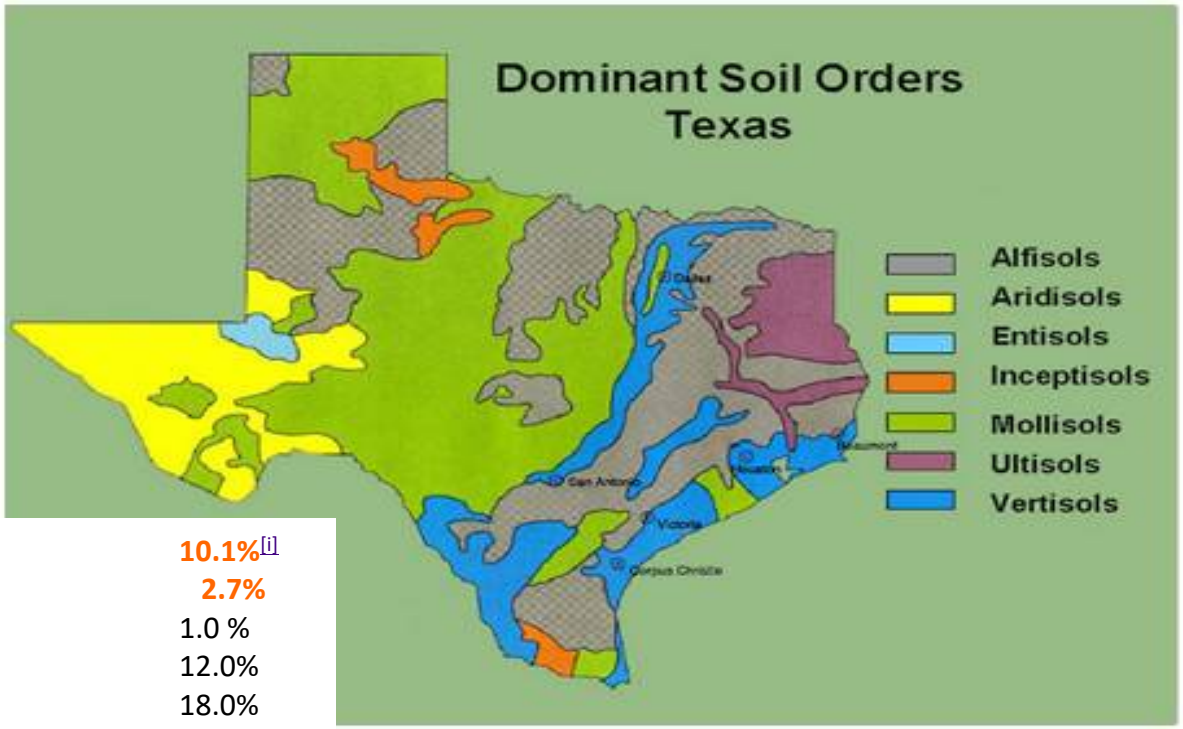
Forests

- 1. Recharge aquifer
- 2. Retains storm water
- 3. Eco-tourism
- 4. Adds aesthetics to city
- 5. Outdoor activities
- 6. Noise control, property values
- 7. Reduced health costs
- 8. Carbon sequestration
- 9. Reduced energy use/costs


BRAZOS
GRIMES
SAN JACINTO
HARDIN
MONTGOMERY
LIBERTY
WALLER
HARRIS
FORT BEND
BRAZORIA
GALVESTON
CHAMBERS
WHARTON
Lake Conroe
San Jacinto River
Caney Creek
Spring Creek
Greens Bayou
White Oak Bayou
Hulls Bayou
Cypress Creek
Buffalo Bayou
Brays Bayou
Sims Bayou
Clear Creek
Armand Bayou
Brazos River
Trinity River
Lake Houston
Galveston Bay
Trinity River NWR
Davis Hill SNA
Lake Houston SP
Sheldon Lake SP
San Jacinto Battleground SHP
Memorial Park
Atkinson Island WMA
Candy Abshier WMA
Moody
Anahuac
Rollover Fish Pass
Galveston Island SP
Brazos Bend SP
Washington-On-The-Brazos SHP
Stephen F. Austin SHP
Attwater Prairie Chicken
Wintermann WMA
6
90
105
336
787
321
326
146
45
59
249
290
159
61
10
65
225
124
610
99
8
36
288
521
35
2004
71
60
87


Houston
— Galveston Bay
Colorado River —
— Brazos River
Sediment
— Lavaca River

Soil Content of the 8-County Gulf-Houston Region



•**Alfisols**: Mod. weathered (clay/sand)	**10.1%**[i]
•**Vertisols**: Shrink/swell (mainly clay)	**2.7%**
•**Andisols**: Volcanic ash	1.0 %
•**Aridisols**: Very dry	12.0%
•**Entisols**: Newly formed	18.0%
•**Gelisols**: Frozen	9.1%
•**Histosols**: Organic, wet	1.2%
•**Inceptisols**: Slightly developed	15.3%
•**Mollisols**: Deep, fertile	7.0%
•**Oxisols**: Very weathered	7.5%
•**Ultisols**: Weathered	8.1%
•**Spodosols**: Sandy, acidic	4.0%

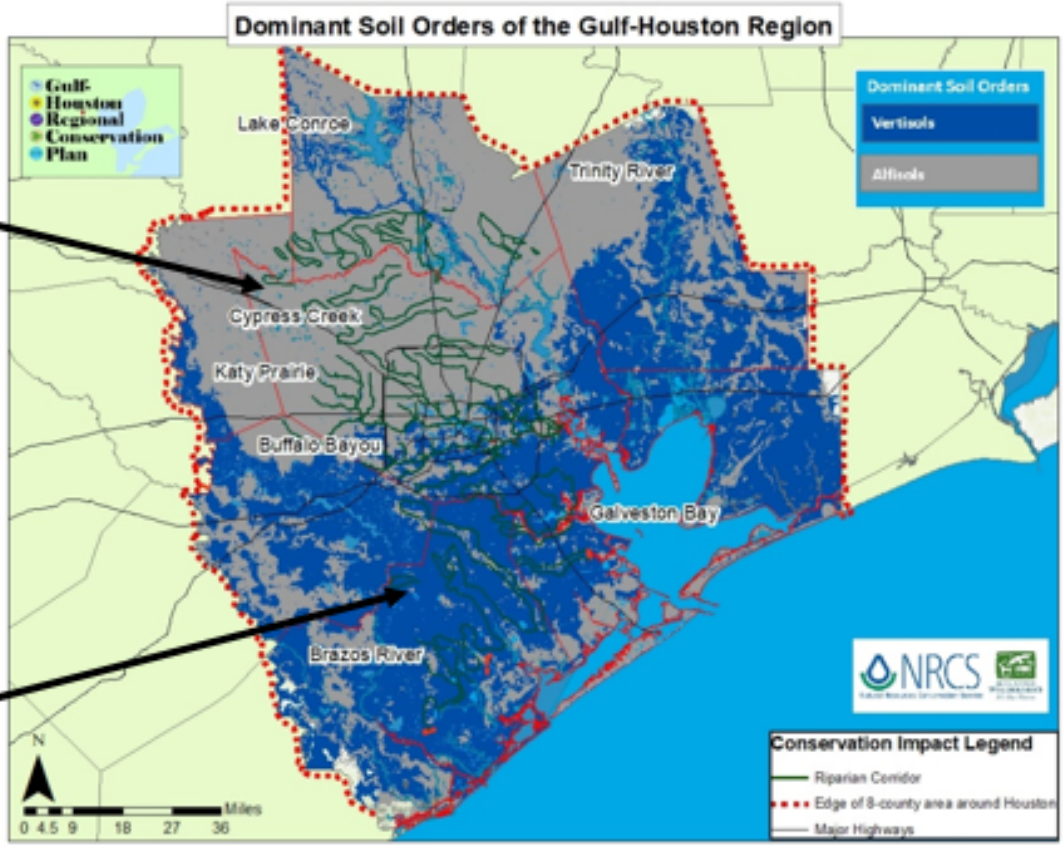
[https://globalrangelands.org/topics/rangeland-ecology/twelve-soil-orders

In Greater Houston's Post-Harvey Riparian World

Vertisols and Alfisols in the 8-County Region

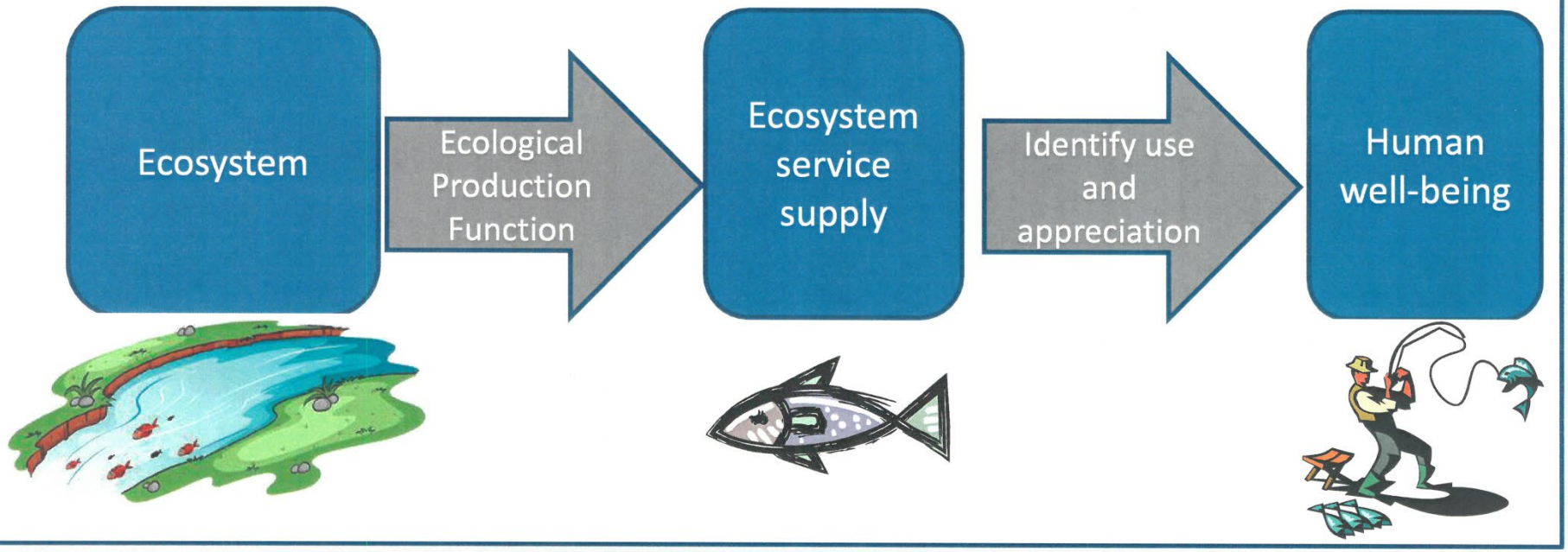
Alfisols contain topsoil and up to 20-40 inches of sandy loam (sand mixed with clay) before reaching a clay pan. These soils typically form under grassland vegetation.[iv] Surface runoff is slow to very slow, permeability is very slow, and the available water holding capacity is high[7] due to high clay content at depth.

Vertisols are clay-rich soils (40-75% clay content) that shrink when dry, swell when wet, and consist of topsoil sitting atop a deep clay pan. When dry, vertisols form large cracks that may be more than three feet deep and several inches wide.[v] These cracks greatly influence the infiltration and runoff behavior particularly during rain events, and are responsible for many building foundation and road repairs.[vi] Vertisols typically form under grassland vegetation and are self-mulching, highly fertile soils due to their high clay content.[vii] The vertisol's self-mulching allows for unique surface features called **gilgai**, which consists of subtle topographic changes of microhighs surrounding circular microlows



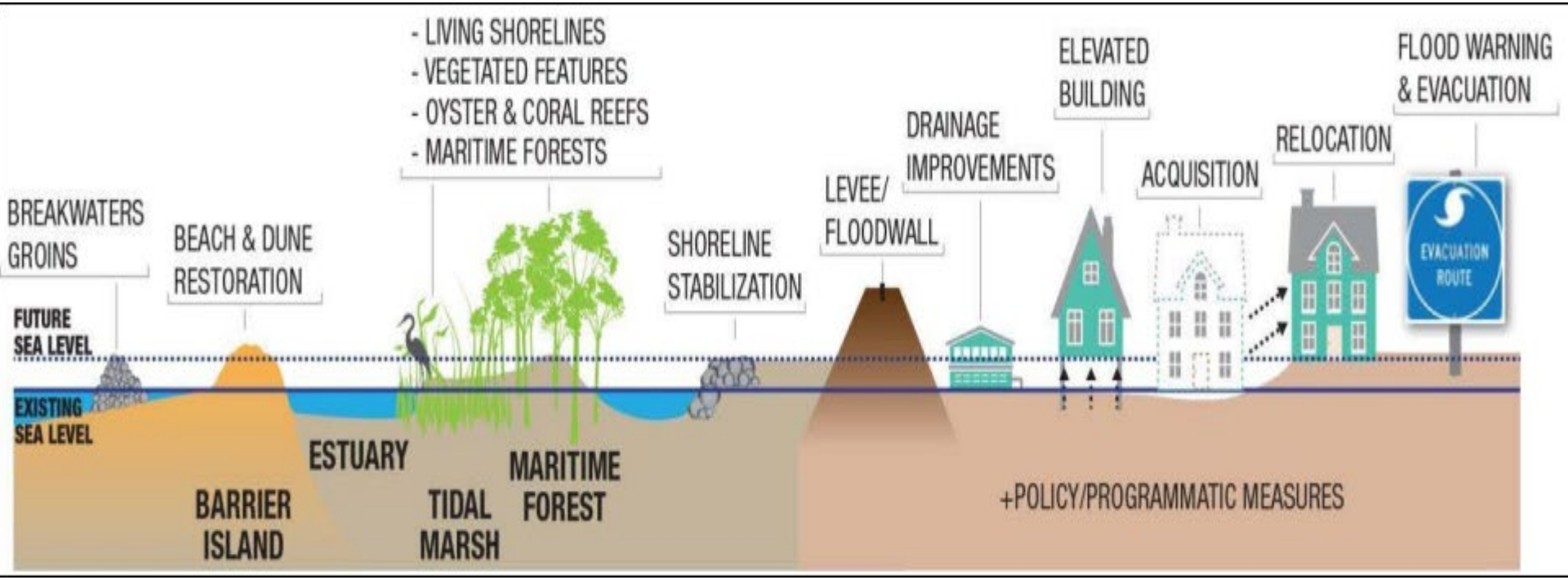
How does ecosystem services information get used in planning?

Baseline (current conditions, business as usual)



Coastal Integrated "Lines of Protection"

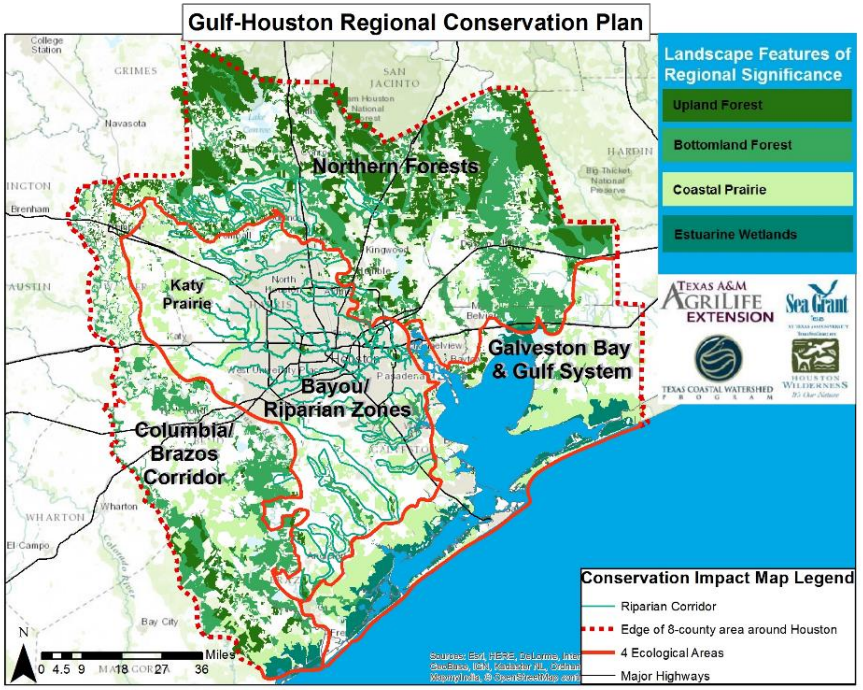
- Combination of natural and structural features
- Increasing levels of protection from offshore to inshore



Slide adapted from GalvCorps, 2014 Coastal Protection & Restoration Project.

Three Key Goals of Gulf-Houston RCP

Gulf-Houston Regional Conservation Plan



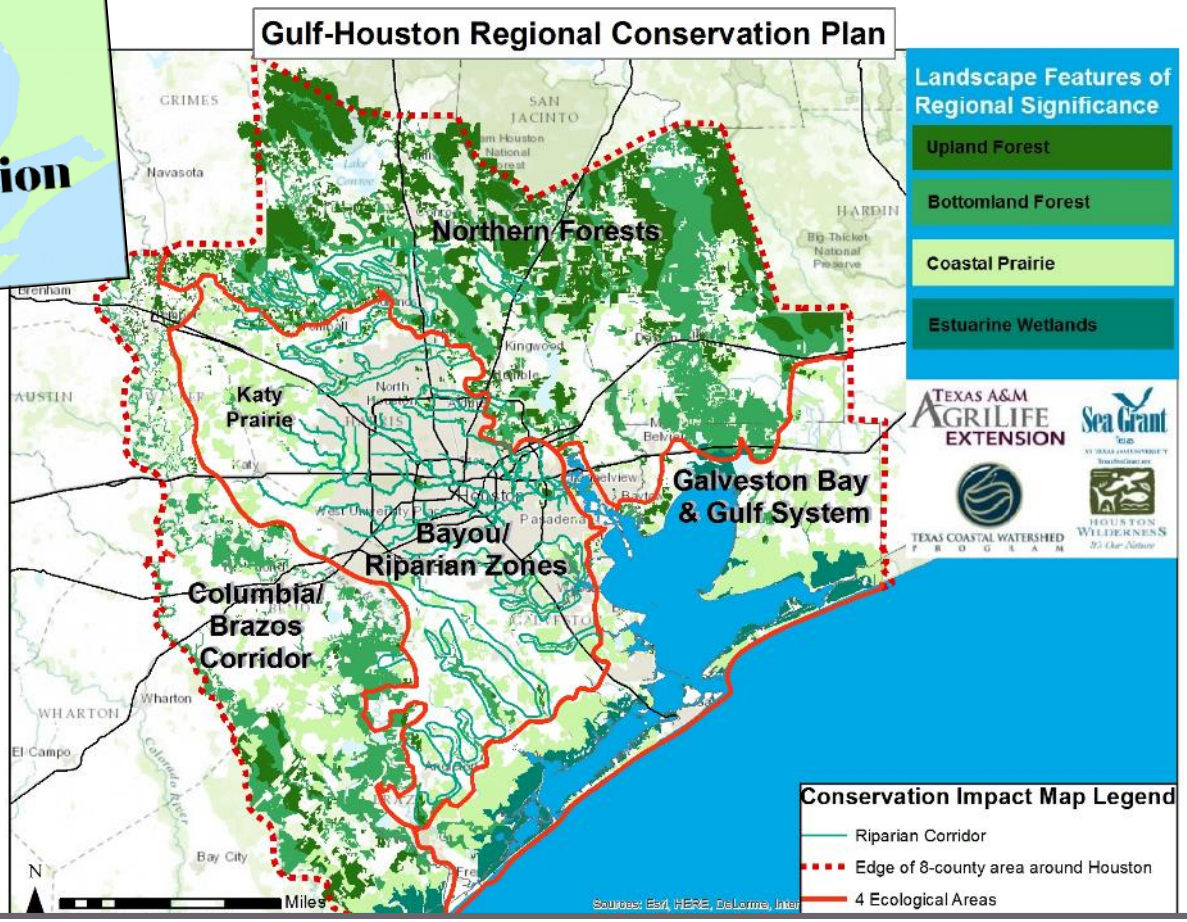
(1) Increase the current 9.7% in **protected/preserved land,** in the 8-county region to ***24% of land coverage by 2040,***

(2) Increase and support the region-wide land management efforts to install **biostabilization** techniques on private and public lands to ***50% of land coverage by 2040,*** and

(3) advocate for an increase of **0.4% annually** in **air quality offsets** through carbon absorption in native soils, plants, trees, and oyster reefs throughout the 8-county region

24% by 2040 Strategy - Regional Resilience

Gulf-Houston Regional Conservation Plan



THE 24% BY 2040 STRATEGY: The Gulf-Houston Regional Conservation Plan (GulfHoustonRCP.org) is a long-term collaborative of environmental, business and governmental entities working together to create enhanced environmental services, continuity and connectivity for the **8-County Gulf-Houston Region:**

26% is developed land-use
9.2% is protected nature-based infrastructure
64.8% is undeveloped

24% nature-based infrastructure is needed by 2040

Where is the 9.6% in the 8-County Region?

County	Total Land Cover (acres)	Total Developed Land %	Land Currently Protected % (w/ acres)	Available Undeveloped Land%
Harris	1,095,040	51%	**2.5%** (122,064)	46.5%
Montgomery	663,616	32%	**1.3%** (62,081)	66.7%
Fort Bend	554,624	25%	**0.4%** (19,065)	74.6%
Liberty	740,096	13%	**0.7%** (36,004)	86.3%
Waller	326,336	12%	**0.2%** (9,305)	87.8%
Galveston	235,008	10%	**0.5%** (22,796)	89.5%
Brazoria	878,080	10%	**2.7%** (135,043)	87.3%
Chambers	378,496	8%	**1.3%** (62,498)	90.7%
Total	**4,871,296**	**26%**	**9.6%**	**64.4%**

Gulf-Houston RCP Key Goal - *50% in Nature-Based Stabilization*

	Percentage
Adding non-protected areas on corporate and residential lands – 550,456	4%
Maintaining & Enhancing protected/preserved lands – 477,879	11.3%
Adding 15% in protected/preserved lands – 730,694	9.7%
Adding 10% non-protected areas on agricultural lands – 487,129	15%
TOTAL	10%
	50%

Nature-Based Stabilization = Use of native plants and trees in Low-Impact Development (LIDs), public private drainage and detention areas, riparian corridors and waterways, levees and reservoirs, reforestation and afforestation, coastal breakwaters and living shorelines, oyster reefs

Benefit Relevant Indicator Examples:

Fishing related BRIs

Better BRIs

- Increased abundance of fish in a lakes used by recreational anglers
- Number of recreational anglers with access to lakes with improved fish abundance
- Number of recreational fishing days due to improved fish abundance in lakes
- Additional catch by anglers due to improved fish abundance in lakes

Flood risk related BRIs

Better BRIs

- Reduced frequency of river flooding in heavily populated areas
- Number of residents in areas experiencing reduced frequency of river flooding
- Value of residential properties in areas experiencing reduced frequency of river flooding
- Avoided property damages due to reduced frequency of river flooding in heavily populated areas

Gray v. Green Infrastructure

Gray Infrastructure

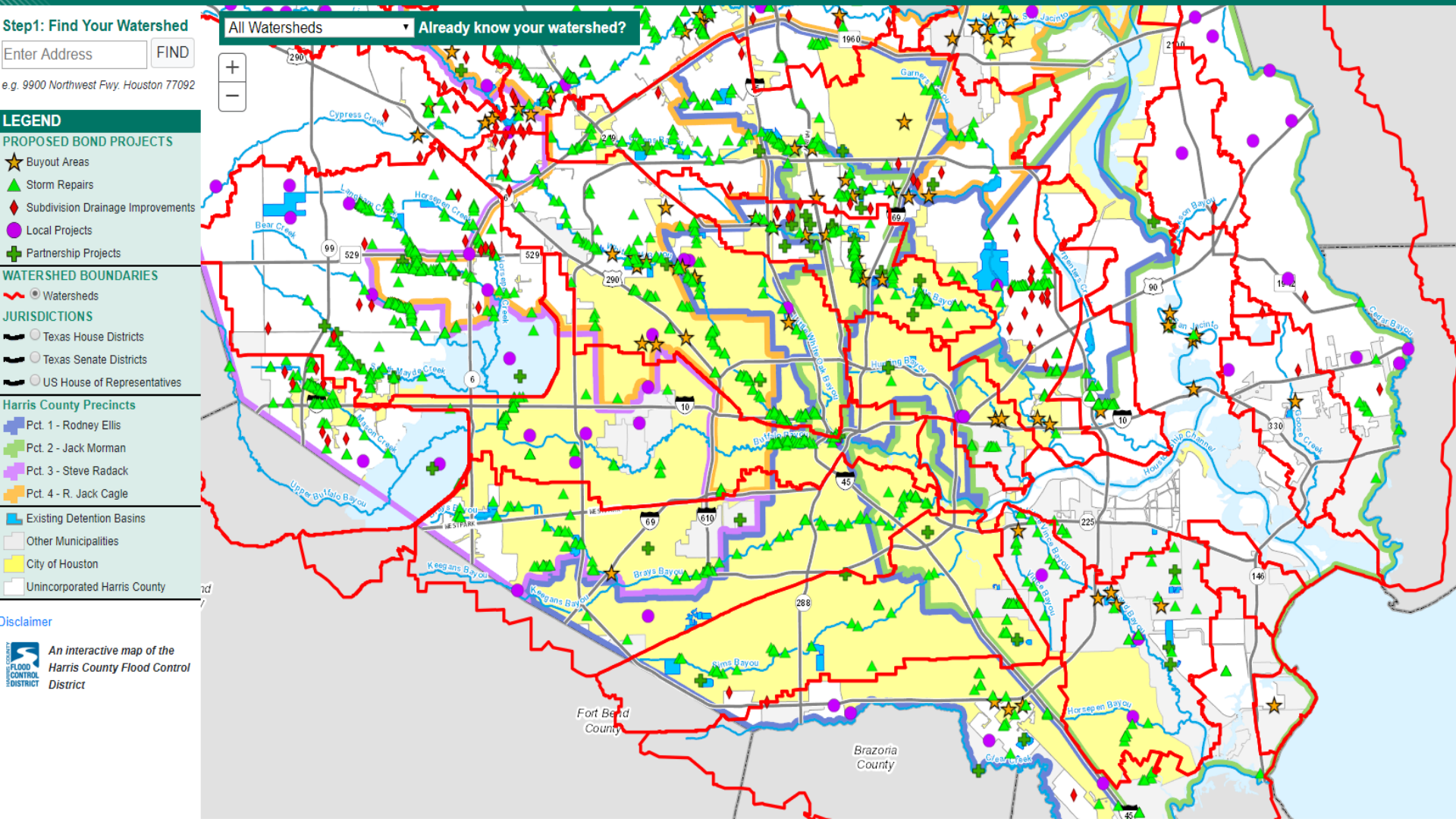
- Mechanical processes
- Man-made
- Facilities, buildings
- Artificial
- Complete a function

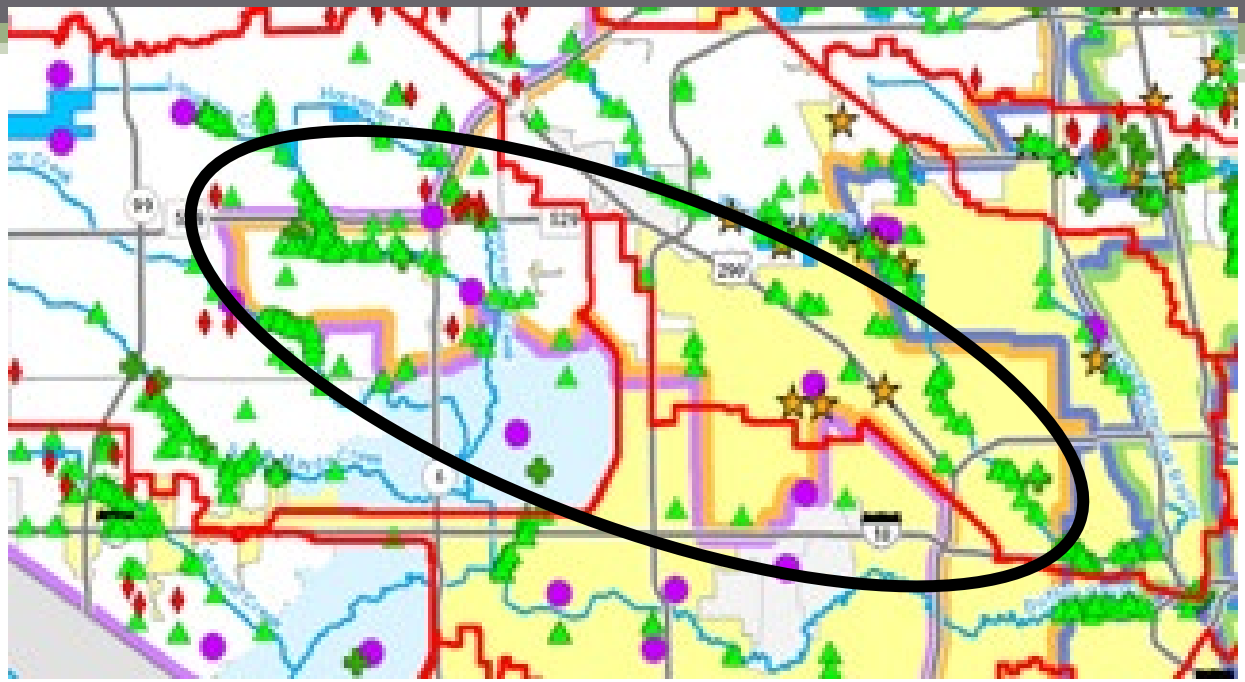
Green Infrastructure

- Naturally occurring processes
- Existing or engineered/ enhanced natural areas
- Ecosystem services
- Complete a function

Green infrastructure is the most direct way to include ecosystem services into development decisions

BOND PROGRAM
INFORMATION & COMMUNITY ENGAGEMENT





Cypress Creek	Local	●	F-21	K129-00-00-X007	Restore Channel Conveyance Capacity on K129-00-00
Cypress Creek	Local	●	F-22	K140-00-00-X015	Restore Channel Conveyance Capacity Along Pillot Gully
Cypress Creek	Local	●	F-23	K163-00-00-E001	Construction of Channel Conveyance Improvements Along K163-00-00
Cypress Creek	Local	●	F-24	K700-01-WMB	Identification, Design and Construction of the K700-02 Environmental Mitigation Bank
Cypress Creek	Local	●	F-88	K500-CONV	Design and Construction of Stormwater Detention Basins in Large Buyout Areas
Cypress Creek	Buyout	★		K100-HMGP	Federal Grant-Funded Volunteer Home Buyouts
Cypress Creek	Storm Repair	▲		K-NRCS	Storm Repairs in Cypress Creek Watershed

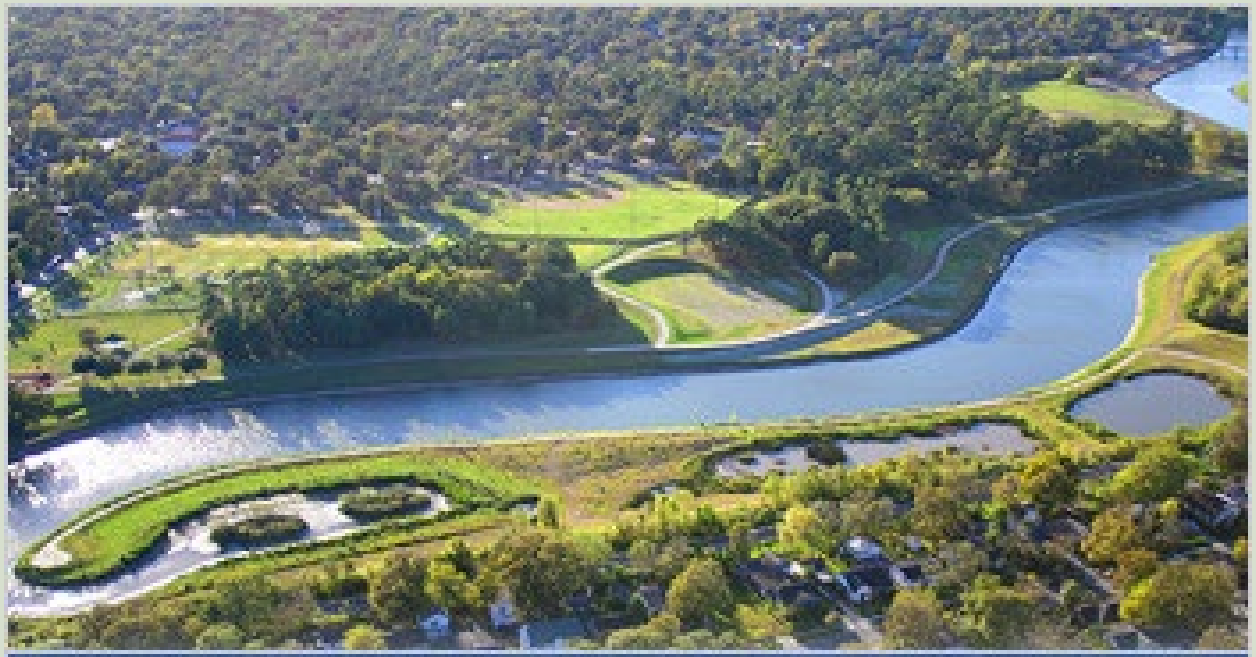
Local Examples of Green Infrastructure

Project Brays

- Provide retention area for heavy rain events
- Develop natural marshlands and green spaces along Brays Bayou
- Improve water quality and reduce the need for treatment
- Provide recreation and tourism opportunities for the community

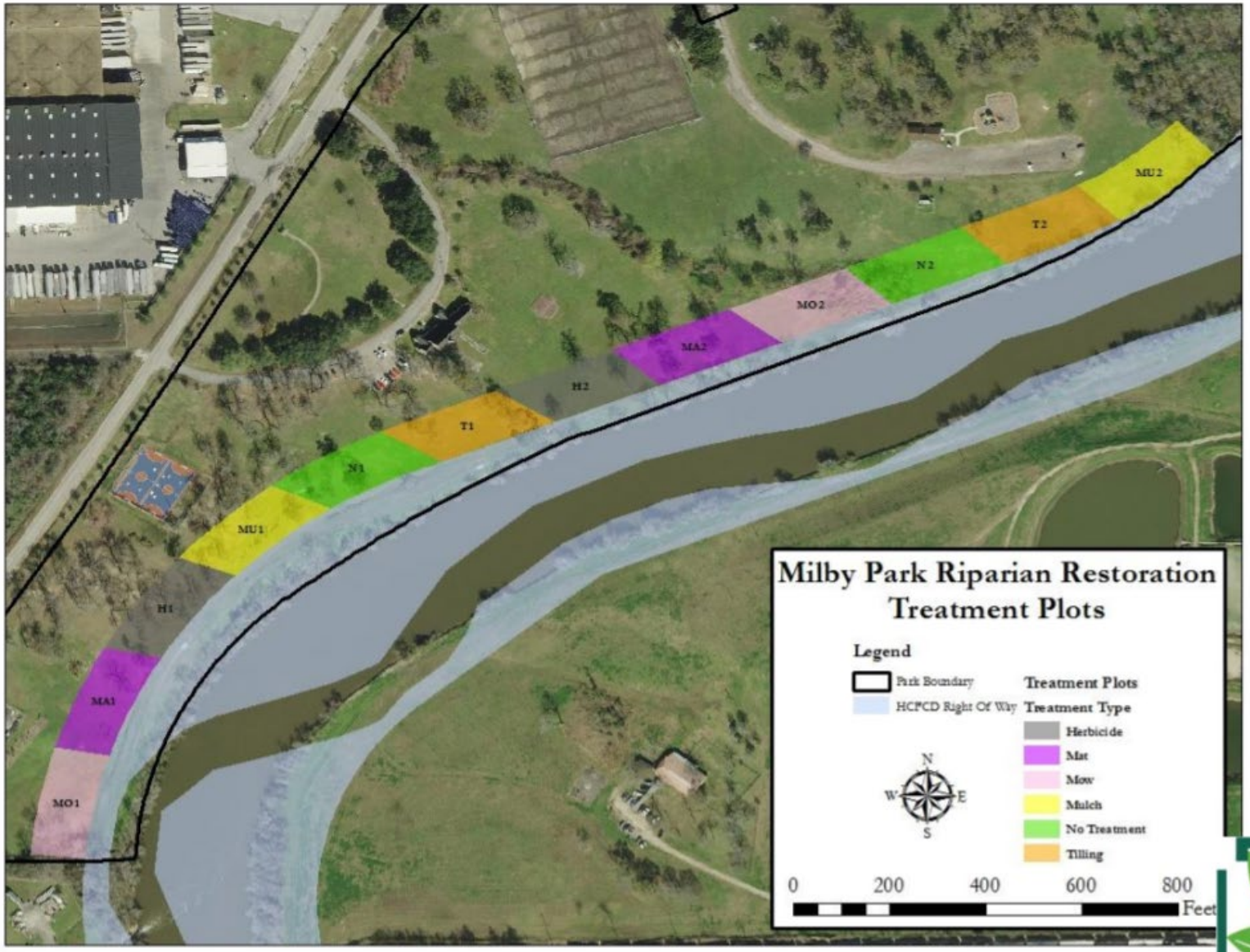
Infrastructure need:
Water Quality, Water Supply, Water Detention/Retention and Flood Control

Solution(s):
•Filtration and absorption of pollutants using wetland and prairie grasses
•Community recreational park
•Green spaces that allow for water retention in heavy rain events
•**Cost to Construct:**
$3.2 Million



In 2006, the Brays Bayou Marsh at Mason Park, near the mouth of the bayou was completed.

http://www.projectbrays.org/about.html



houston PARKS & recreation department
www.houstonparks.org

Engineering With Nature®

An Atlas

The Engineering With Nature (EWN) initiative formally began in 2010 within the US Army Corps of Engineers. The approach is building upon good past practices while advancing current and future capabilities that support more sustainable water resources practices, projects, and outcomes.

"Engineering With Nature is an important initiative for the US Army Corps of Engineers."
--James Dalton, USACE Director of Civil Works

Engineering With Nature, An Atlas will be released October 2018

EWN is the intentional alignment of natural and engineering processes to efficiently and sustainably deliver economic, environmental, and social benefits through collaboration.

Over the years, the initiative has grown to include a number of partner organizations and collaborators in the US and abroad. This book highlights successful projects and the contexts in which these projects were developed; it introduces the reader to the wide range of organizations advancing worldwide progress in this field today.

Millennium Ecosystem Assessment (MEA) Classification of Ecosystem Services

- ***Provisioning*** **– provides direct material and consumable benefits**
  - Food and fiber
  - Timber and minerals
  - Fuels
  - Medicinal resources
- ***Cultural Services*** **– provides direct social and spiritual benefits**
  - Recreation
  - Spiritual and historic
  - Science and education
- ***Regulating*** **– provides direct benefits to support and maintain control of ecosystems**
  - Climate regulation
  - Waste treatment
  - Water regulation
  - Nutrient regulation
- ***Supporting Services*** **– provides direct benefits to support and maintain control of ecosystems**
  - Primary production
  - Nutrient cycling
  - Water cycling

From Jim Lester

Ecosystem Service Valuation

Goals

- Function Monitoring
- Spatial Impact on Function
- Outright Losses
- Substitute Equivalency
- Building Something New
- Energy Savings
- Insurance Savings
- Property Value
- Cost of Illness

Methods

- On-site Ecological Function Analysis
- Direct Market Price
- Avoided Cost
- Replacement Cost
- Mitigation/Restoration Cost
- Hedonic Pricing
- Benefit Transfer
- Literature Review

1 Ecological Function Analysis

- Uses on-site measurements of the ecosystem services in a particular location to determine their value
- The measurements that are taken will show the extent of the service in a particular ecosystem
- Once the capacity of the ecosystem service is known, it can be given value when connected to existing markets
- This method is useful when a service might vary considerably from one ecosystem to the next

Use for Ecological Function Monitoring, Spatial Scale Impact on Function, and Building Something New

2 Direct Market Price

- Looks at the actual price of a commodity derived from an ecosystem in an existing market
- Determines the value of the ecosystem service based on the price that is paid by consumers multiplied by the marginal product of the service

Use for Provisioning Ecosystem Services (goods harvested from ecosystem) and some applications for Property Value and for Carbon markets

3 Avoided Cost Method

- Determines the cost that would have been incurred in the absence of the ecosystem service
- The costs that are not incurred are a reflection of the value of the ecosystem service because they are direct savings

Use for Outright Losses, Energy Savings, Insurance Savings, and Cost of Illness

4 Replacement Cost Method

- Determines the cost that would be incurred in the replacement of an ecosystem service with gray infrastructure to accomplish the same task
- An analysis of the current service that is provided would be performed to determine the extent of the service the ecosystem provides, then the cost of building gray infrastructure to achieve the same level of services would be determined

Use for Outright Losses and Substitute Equivalency

5 Mitigation and Restoration Cost Method

- Looks at the cost of getting ecosystem services restored in damaged ecosystems
- Looks at the cost of mitigating the negative impacts of their loss

Use for Ecological Function Monitoring, Spatial-Scale Function on Impact, Outright Losses and Building Something New

6 Hedonic Pricing

- Value recreational and aesthetic services by looking at a surrogate market where the ESS has indirect ties
- Determines the implicit demand for an ecosystem service by looking at how it affects values in a related market, usually real estate, using regression analysis

Use for Property Values

Contributors:

- Deborah January-Bevers
- Lauren Harper
- Lindsey Roche

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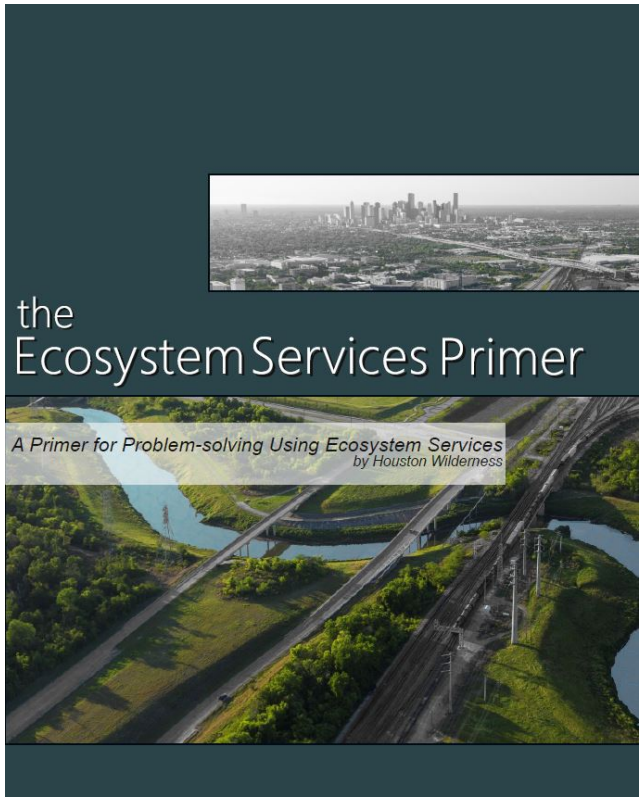

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