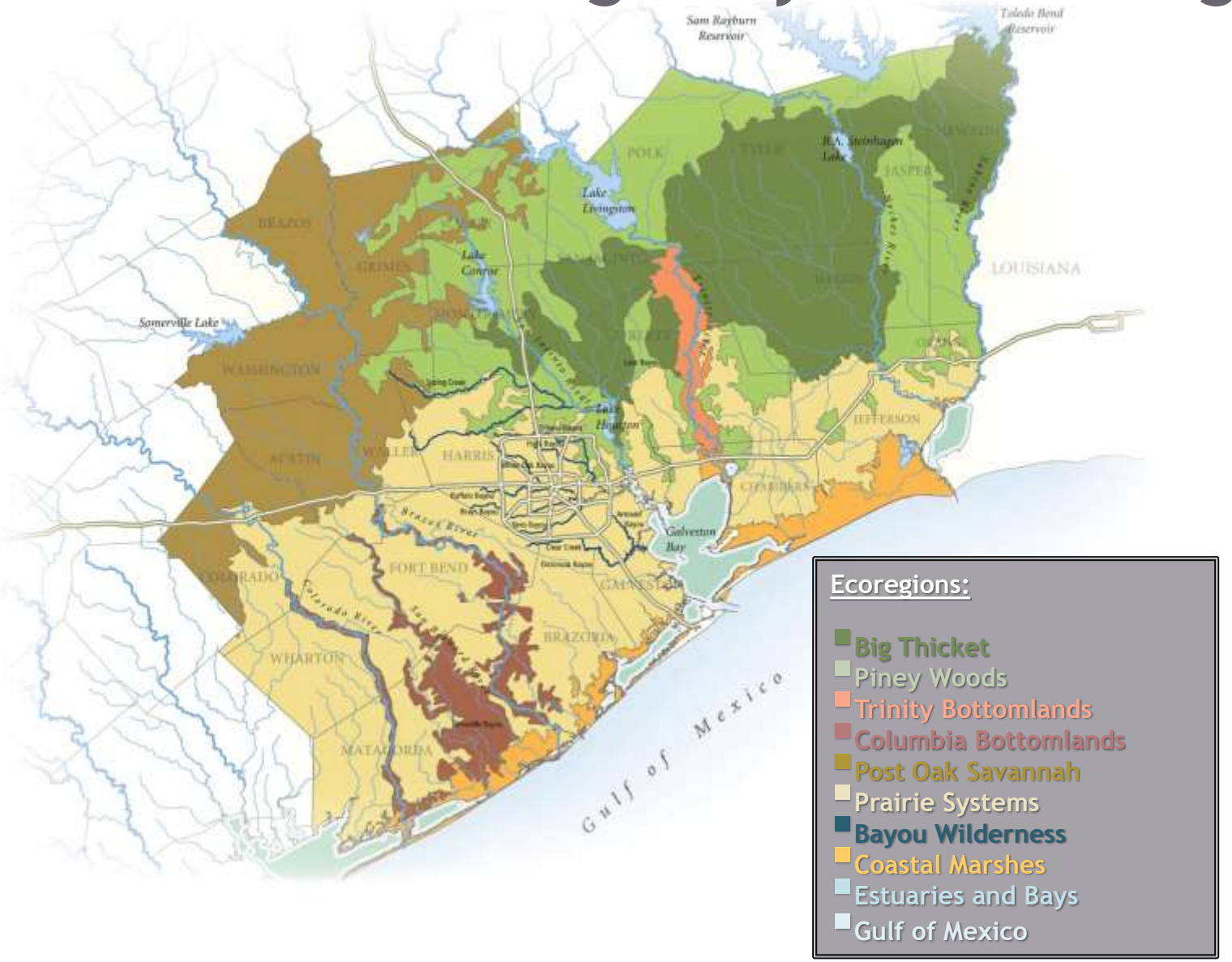


# Ecosystem Services in the Greater Houston Region

A case study analysis and recommendations for policy initiatives

HOUSTON WILDERNESS
*It's Our Nature*

# Houston is an Ecologically Diverse Region

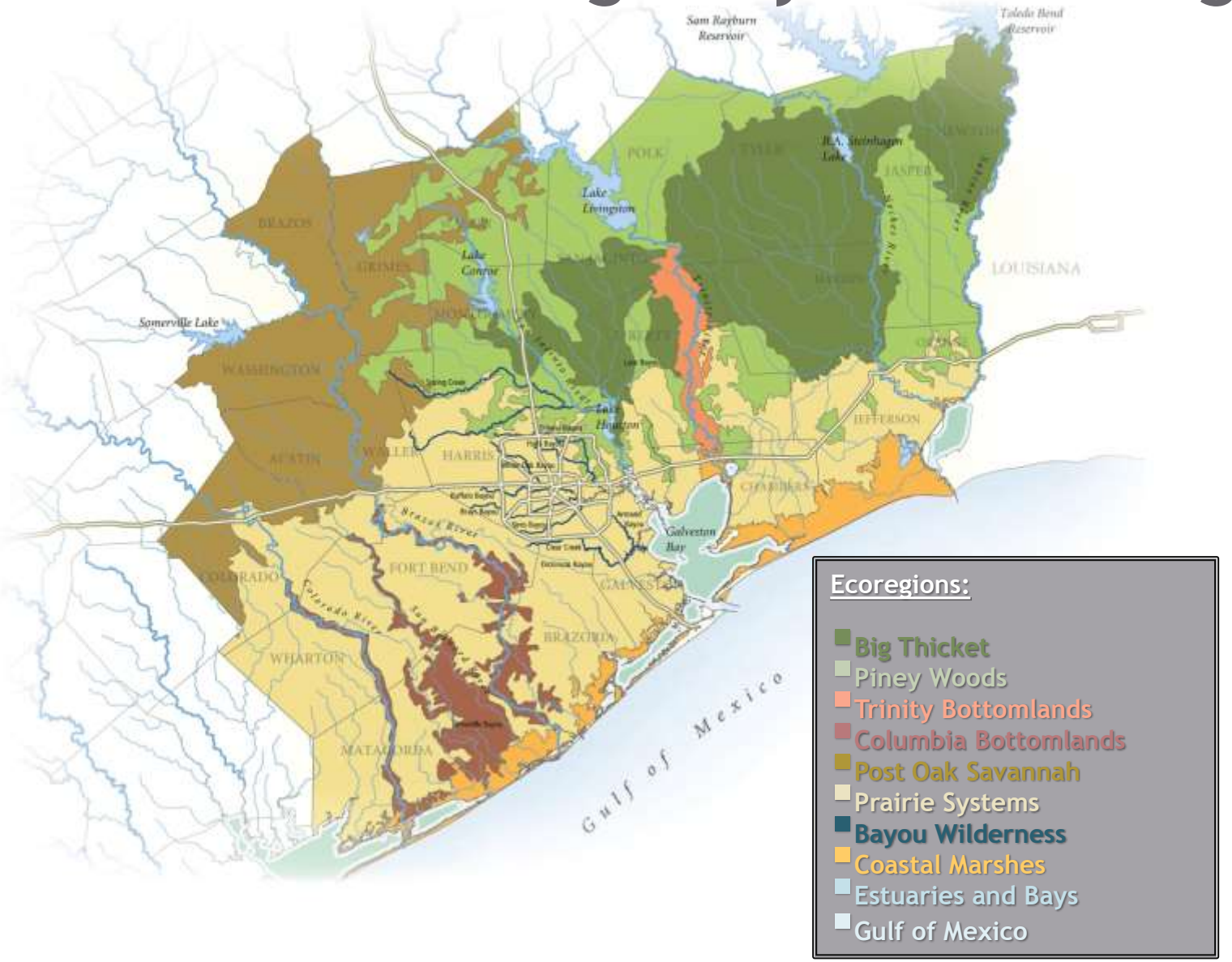


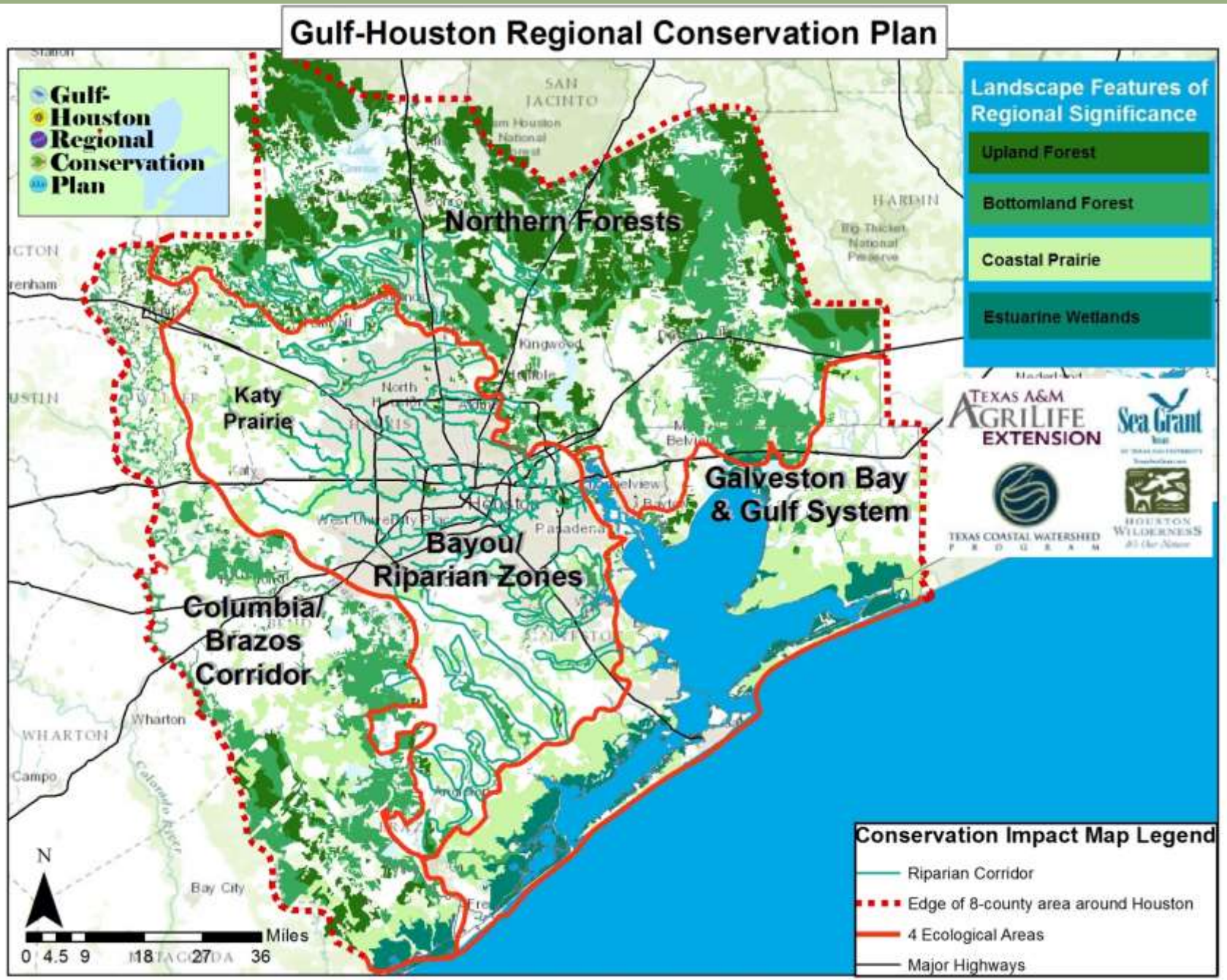
The 13+ County Region surrounding Houston has 10 distinct ecoregions

There are over 14 major bayous and creeks that run 40-miles each like fingers through the Houston Region and flanked by 3 major rivers

And, over 10 million people living around these ecoregions and waterways

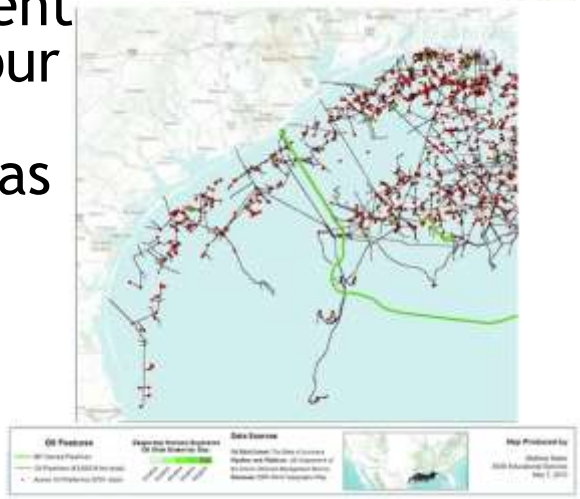
# Houston is an Ecologically Diverse Region




Gulf-Houston Regional Conservation Plan
Gulf-Houston Regional Conservation Plan
Landscape Features of Regional Significance
Upland Forest
Bottomland Forest
Coastal Prairie
Estuarine Wetlands
Northern Forests
Katy Prairie
Galveston Bay & Gulf System
Bayou/ Riparian Zones
Columbia/ Brazos Corridor
Texas A&M AgriLife Extension
Sea Grant
Texas Coastal Watershed Program
Houston Wilderness
Conservation Impact Map Legend
Riparian Corridor
Edge of 8-county area around Houston
4 Ecological Areas
Major Highways
N
Miles
0 4.5 9 18 27 36

# Gulf Coastal Wetlands Natural Capital, Protection for Energy

- Texas has 58,600 miles of pipeline, a significant portion residing in the coastal zone
- The broad protective swath of wetlands enabled the safe development of oil and gas architecture
- Wetlands are in different states of change and our coastal defenses need bolstering in some areas
- Restoring this natural protective defense is integral with energy security

Slide adapted from CH2M HILL. Images from EIA and Matthew Baker.

# Ecosystem Function Vs. Service: The Frappuccino Example

Function

Service

http://weheartit.com/entry/177106938/via/starbucks, http://www.starbuckcoffee.net, http://www.huffingtonpost.ca/2014/03/17/water-and-weight-loss-_n_4979104.htm

# 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

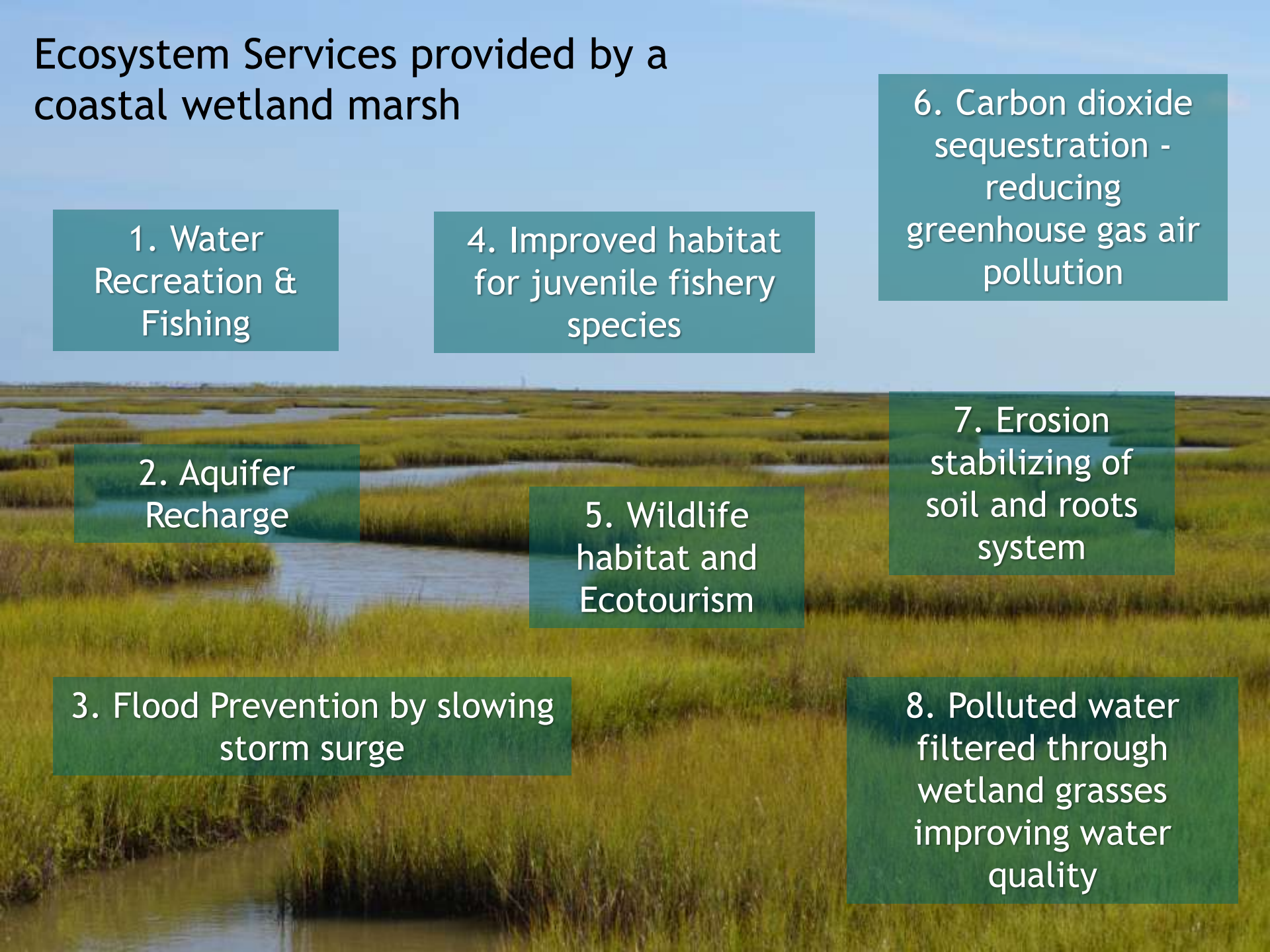
## Prairies

- 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

# Ecosystem Services provided by a coastal wetland marsh



1. Water Recreation & Fishing

2. Aquifer Recharge

3. Flood Prevention by slowing storm surge

4. Improved habitat for juvenile fishery species

5. Wildlife habitat and Ecotourism

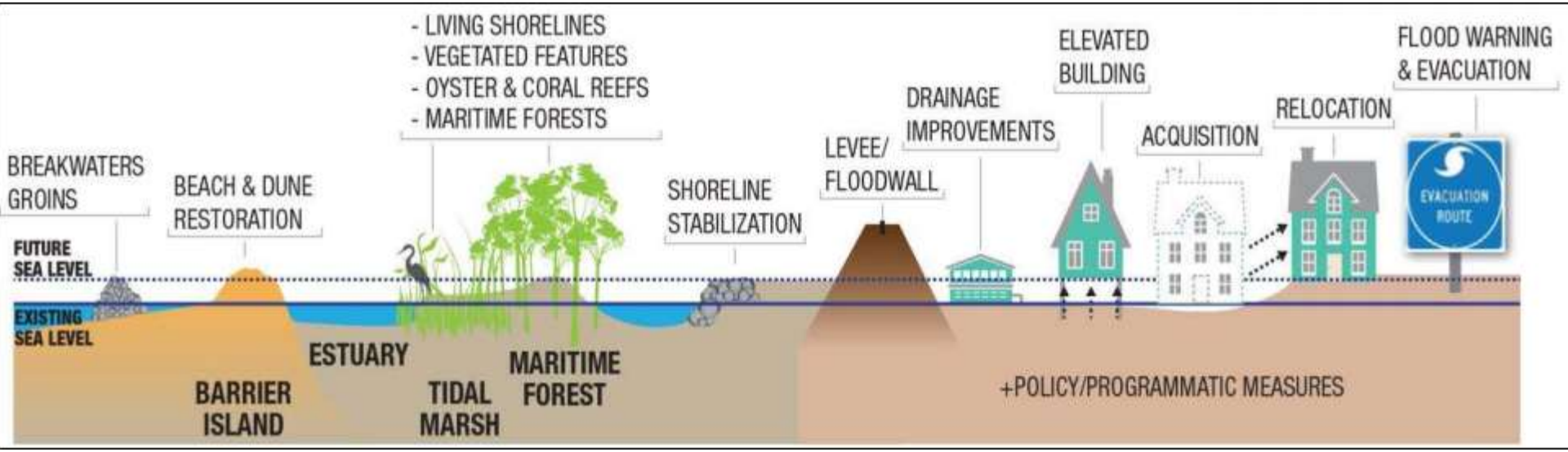
6. Carbon dioxide sequestration - reducing greenhouse gas air pollution

7. Erosion stabilizing of soil and roots system

8. Polluted water filtered through wetland grasses improving water quality

# Integrated "Lines of Protection"

- Multiple Lines—combination of natural and structural features
- Increasing levels of protection from offshore to inshore




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

# Blue Carbon

- Blue Carbon is opening paths for new revenue.
- Projects will be able to claim the benefits using carbon stocks.
- Wetlands are being explored as a sector.
- Verified Carbon Standard
- American Carbon Registry


Adapted from CH2M HILL

# Ecosystem Services Provided by a Prairie

1. Aesthetic enhancement increasing property values

2. Increased wildlife habitat & ecotourism

3. Recharges groundwater

4. Flood control through Rainfall absorption by soil and plants

5. Provides seed bank for future agriculture and restoration projects

6. Roots prevent soil erosion

7. Absorption of carbon dioxide and other air pollutants

8. Replaces expensive drainage systems and retention ponds

9. Reduced runoff of pollution and nutrients into watersheds

# Ecosystem Services Provided by a Forest

1. Cleaner water through root systems and recharges aquifers

2. Provides storm water retention

3. Provides habitat for wildlife and birds that people & ecotourism

4. Improved quality of life for residents

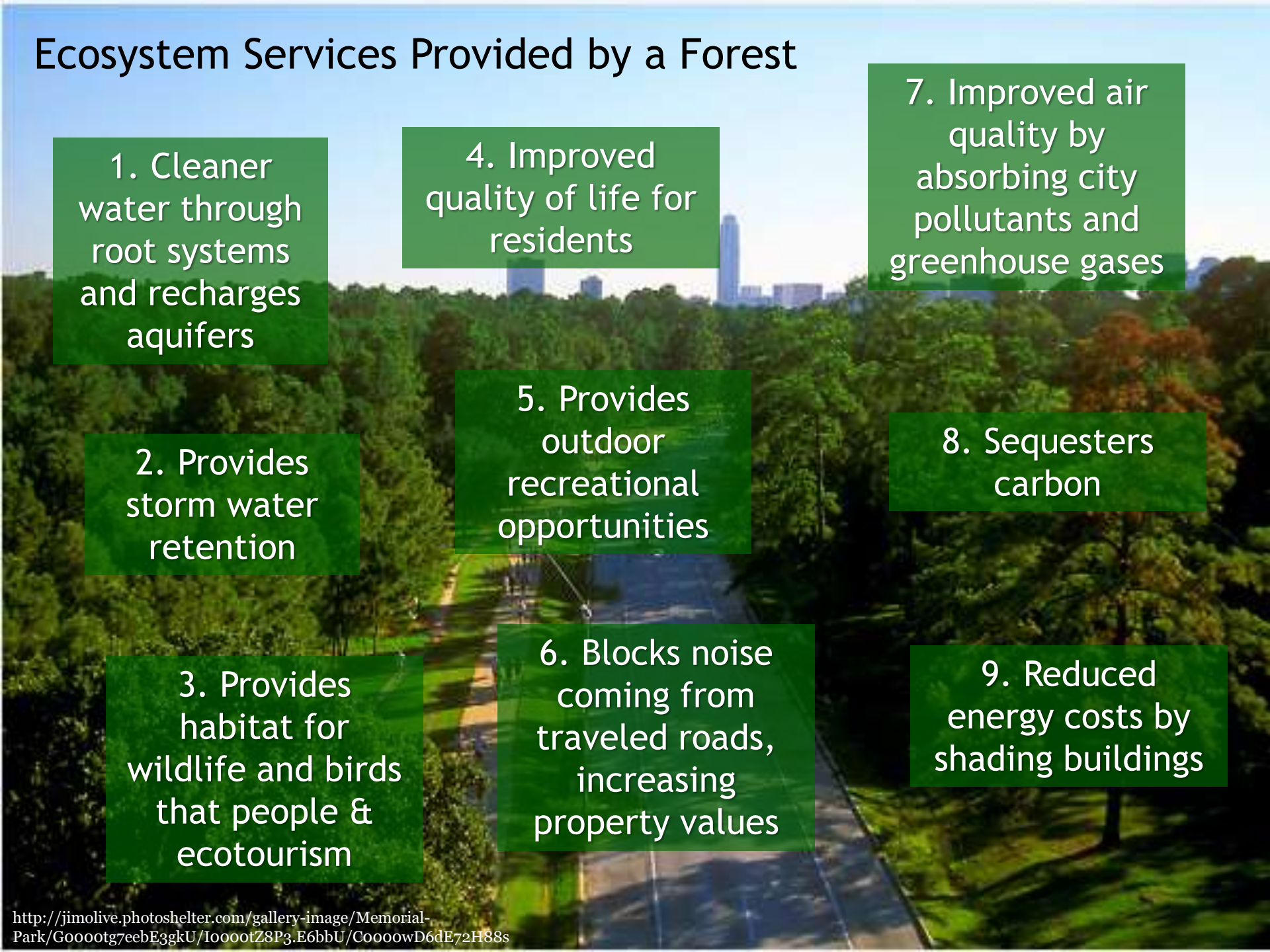
5. Provides outdoor recreational opportunities

6. Blocks noise coming from traveled roads, increasing property values

7. Improved air quality by absorbing city pollutants and greenhouse gases

8. Sequesters carbon

9. Reduced energy costs by shading buildings



http://jimolive.photoshelter.com/gallery-image/Memorial-Park/G0000tg7eebE3gkU/I0000tZ8P3.E6bbU/C0000wD6dE72H88s

# Potential Reforestation Sites for Ozone Non-attainment Zones and $NO_x$ Limited

- Reforestation of peri-urban lands could be a cost-competitive $NO_x$ control approach in many other existing U.S. $O_3$ non-attainment areas.

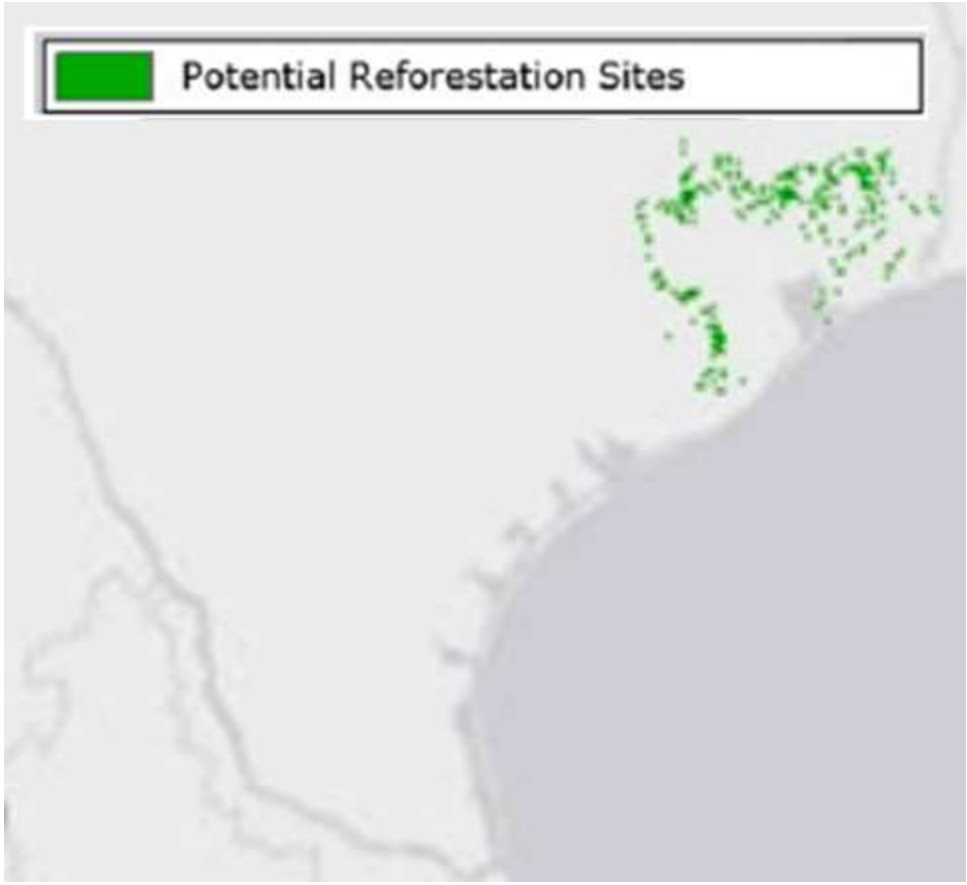



Image adapted from Kroeger et al., 2014 “Reforestation as a novel abatement and compliance measure for ground level ozone.”

# Services Provided by Local Ecosystems

| | Water Supply | Water Quality | Erosion Control | Flood Protection | Air Quality | Energy Savings | Carbon Sequestration | Recreation/ Wildlife Habitat |
|---|---|---|---|---|---|---|---|---|
| **Wetlands/ Estuaries** | ✓ | ✓ | | ✓ | ✓ | | ✓ | ✓ |
| **Prairies** | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ |
| **Forests** | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

Realizing the true value of ecosystem services and the potential economic burden on the region if those services are compromised depends on local ecosystem services studies

When the tangible value of services is understood, policy decisions can be made that take into consideration all economic factors, including ecosystem services.

# 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**

# 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

# Local Examples of Green Infrastructure

## Dow Chemical- Seadrift, TX

•Dow Chemical needed a solution for wastewater treatment at its Seadrift site, as the current treatment facilities were not meeting EPA effluent guidelines

•The cost of building a sequencing batch reactor and constructing a wetland in the current tertiary pond were compared; the wetland saved Dow $124-$129 million in costs over the lifetime of the solution


DiMuro, J. L., F. M. Guertin, R. K. Helling, J. L. Perkins, and S. Romer. *A Financial and Environmental Analysis of Constructed Wetlands for Industrial Wastewater Treatment*. 2014.

**Infrastructure need:**
Water Quality, Water Detention/Retention and Reduce Nutrient Load

**Solution:**

•Reduction in suspended solids and balance of pH levels

•Provide wildlife habitat and aesthetic for surrounding community

•**Cost to Construct:** **$1.4 Million**

# Dow Chemical- Valuing Nature

- Dow Chemical's Seadrift, Texas project to use reconstructed wetland for wastewater treatment has yielded more than $200 million in net present value.

- The cost of construction for the wetland was $1.4 million and took 18 months to complete. The gray infrastructure alternative, a sequencing batch reactor, would have cost $40 million and taken 48 months to complete construction.

From Dow Chemical 2025 Sustainability Goals & DiMuro et al., 2014. "A Financial and Environmental Analysis of Constructed Wetlands for Industrial Wastewater Treatement.

# Local Examples of Green Infrastructure

## M.D. Anderson – The Prairie Project

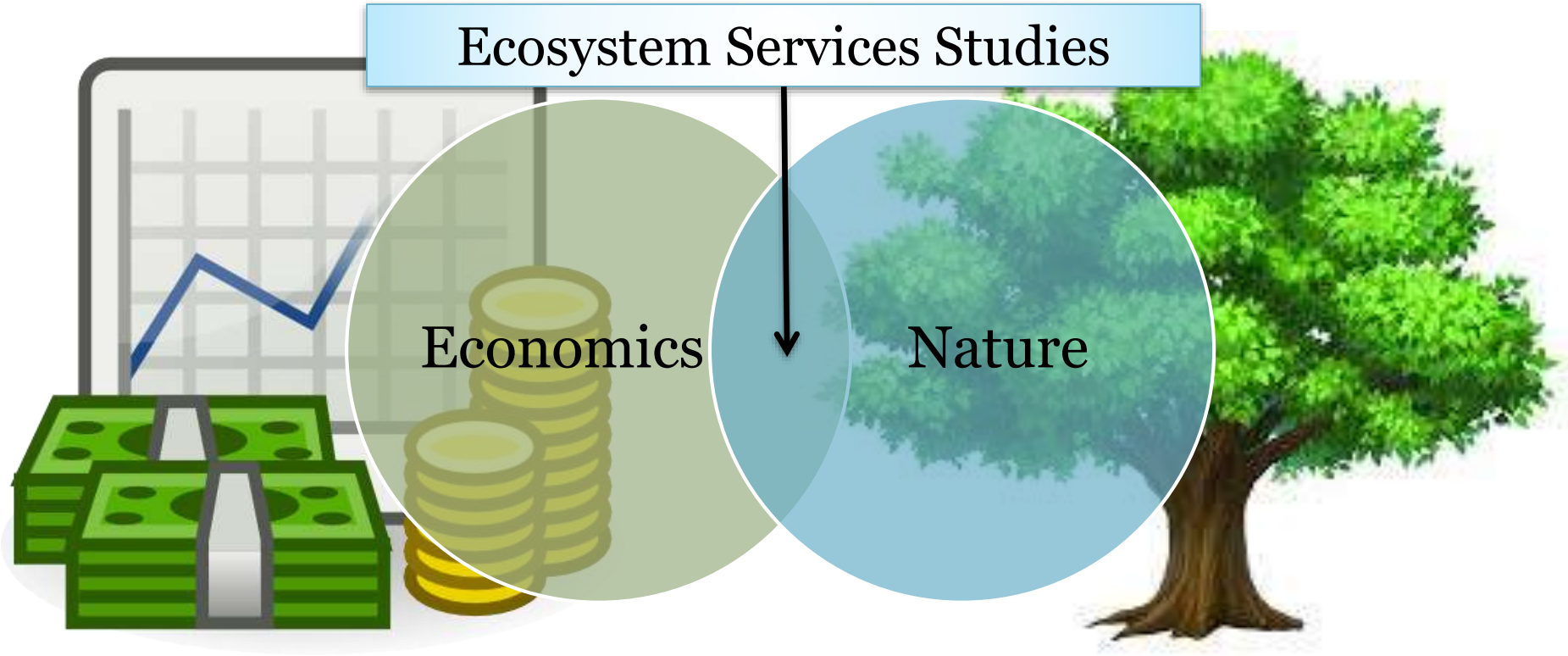
- Developed prairie and wetland green spaces throughout the Texas Medical center
- Serves as a filter for storm water and reduces run off
- Provides  a habitat for many species of wildlife
- Provides recreation opportunities for the patients, visitors and staff in the community
- Provide health benefits for cancer patients through green space access

**Infrastructure need:** Water Quality, Water Detention/Retention, and Recreation

**Solution:** Reduction run off in the area, restored wildlife habitat and created recreation opportunities and stress reducing aesthetic for surrounding community

**Cost to Construct:** $1 Million

# Field of Ecosystem Services Studies




Understanding ecosystem services value allows for informed communication between scientists, industry, and policymakers regarding the benefits of ecosystems to human wellbeing.

# 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

# Study Goals and Scenarios for Using Ecosystem Services Valuation Methods

- Ecological Function

1) Ecological Function Monitoring
2) Spatial-Scale Impact on Function

- Development

3) Outright Losses
4) Substitute Equivalency
5) Building Something New

- Lifetime

6) Energy Savings
7) Insurance Savings
8) Property Value
9) Cost of Illness

# 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
- Benefit Transfer
- Literature Review
- Avoided Cost
- Replacement Cost
- Mitigation/Restoration Cost
- Direct Market Price
- Hedonic Pricing

# Valuation Methods for Calculating the Monetary Value of Ecosystem Services

1) Ecological Function Analysis
2) Direct Market Price
3) Avoided Cost Method
4) Replacement Cost Method
5) Mitigation and Restoration Cost Method
6) Hedonic Pricing
7) 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

# Hedonic Pricing

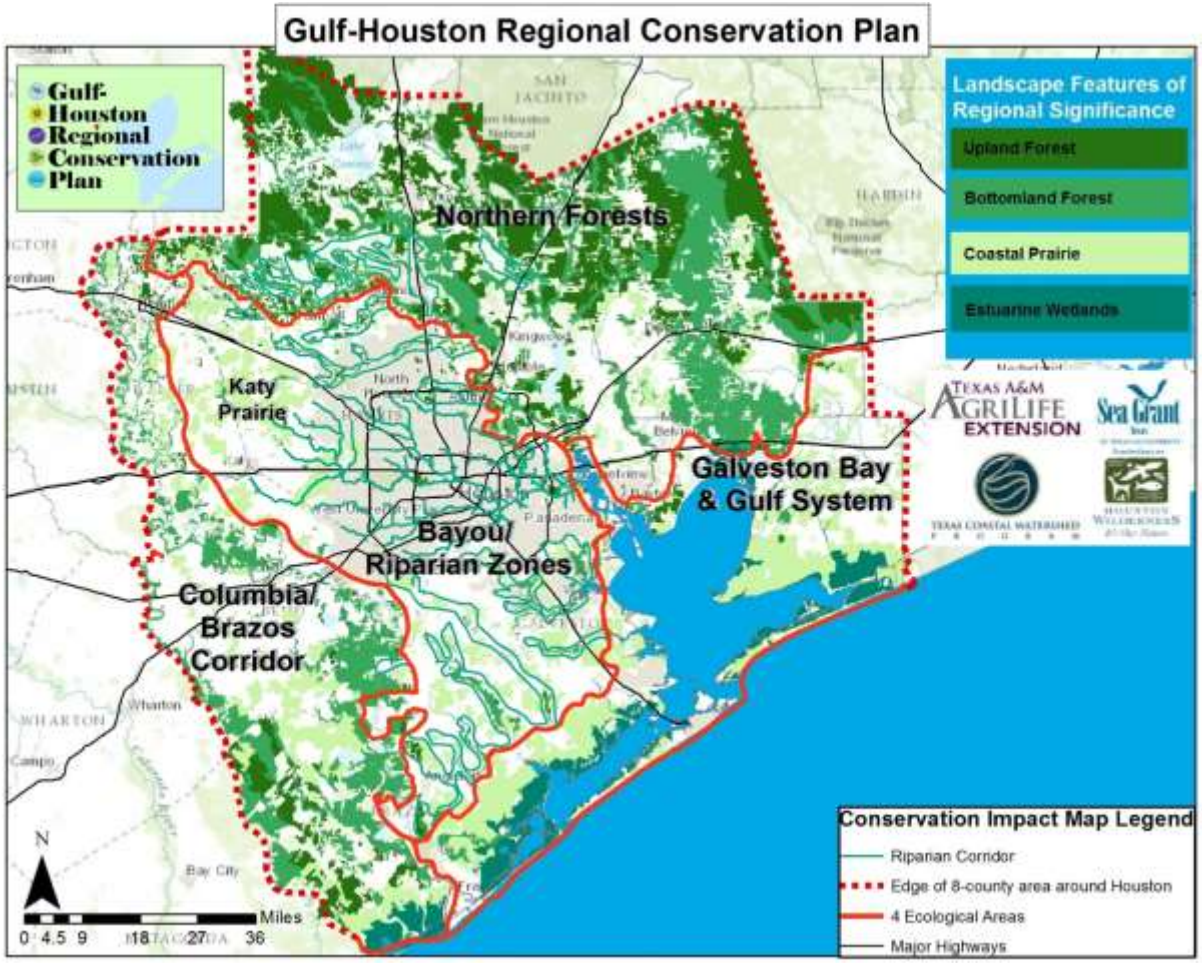
- Value recreational and aesthetic services by looking at a surrogate market where the ESS has indirect ties
- Determines the implicit demand for an ecosystem service by looking at how it affects values in a related market, usually real estate, using regression analysis

Use for Property Values

# Valuation Methods for Case Studies

- Dow Chemical-Seadrift, TX
  - Replacement Cost Method vs. Restoration Cost Method
- Project Brays
  - Onsite Valuation (Ecological Production Function Analysis)
  - Statistical Analysis
  - Avoided Cost Method
  - Mitigation/Restoration Cost Method
- M.D. Anderson Prairie
  - Mitigation or Restoration Cost Method
  - Group Valuation Method

The *Gulf-Houston Plan* contains two phases. Projects and initiatives in Phase One include **280,000 acres** of land acquisition, **15,000** acres in land easements and restoration, and development of over **250 recreational trail miles.**




gulfhoustonrcp.org

# Thank you!

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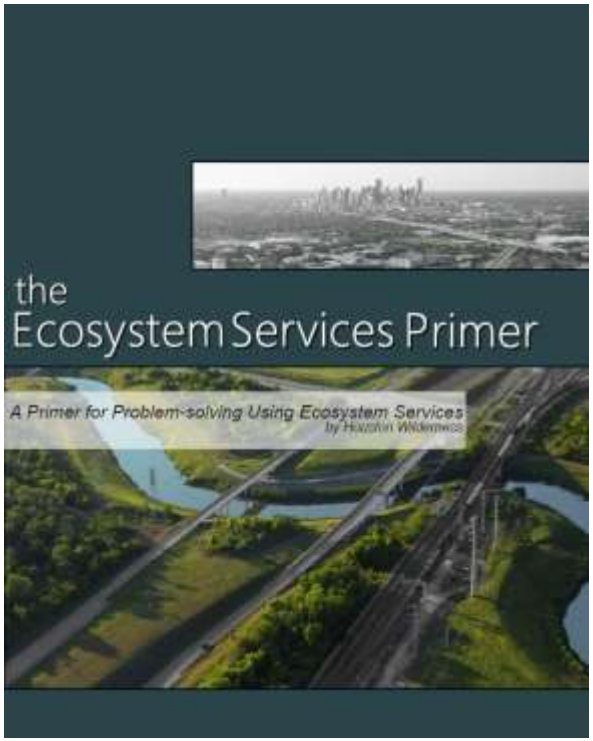
- Lindsey Roche

Download the Primer:
**www.houstonwilderness.org**

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