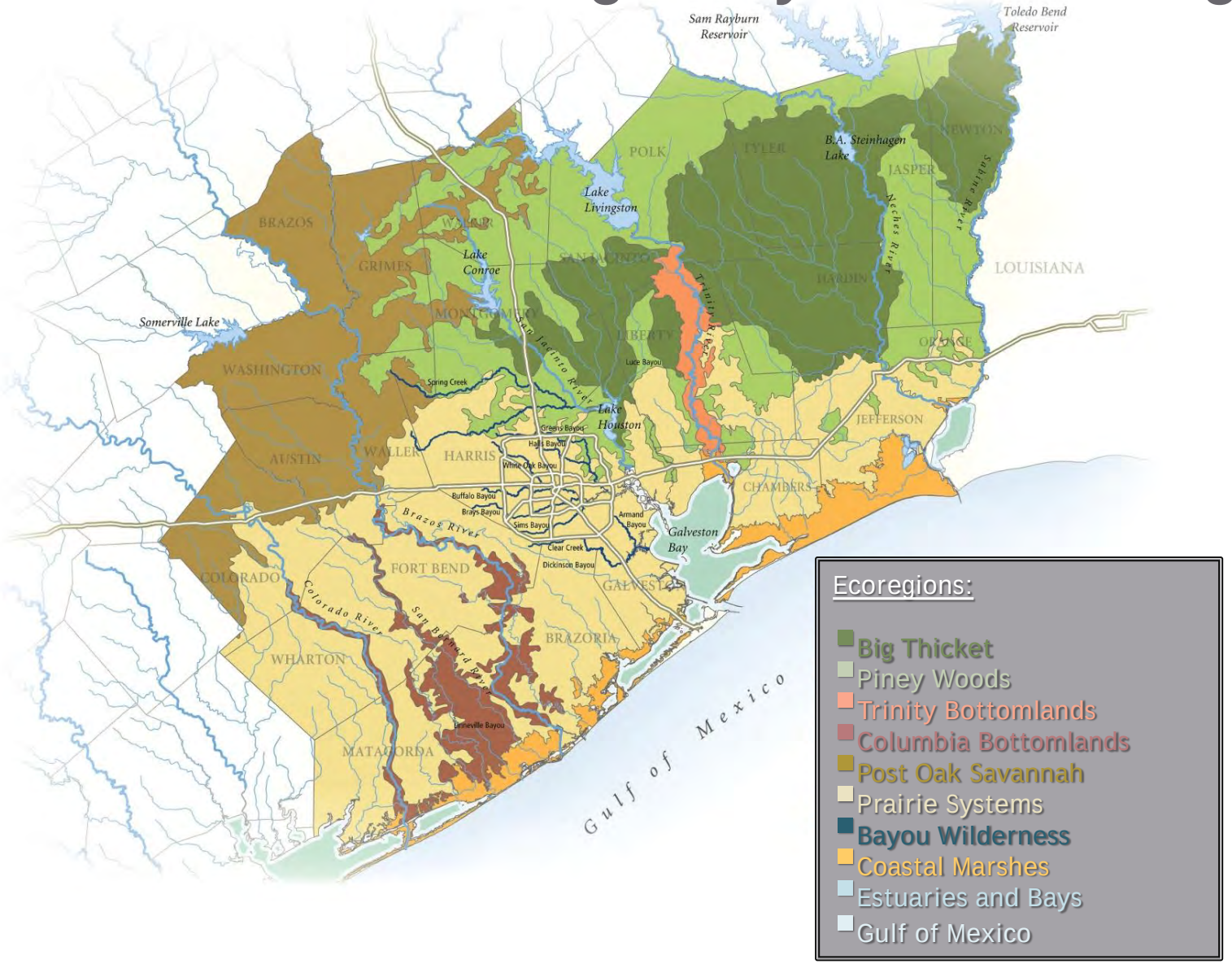


Ecosystem Services in the Greater Houston Region

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

And, over 8 million people living around these ecoregions and waterways

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

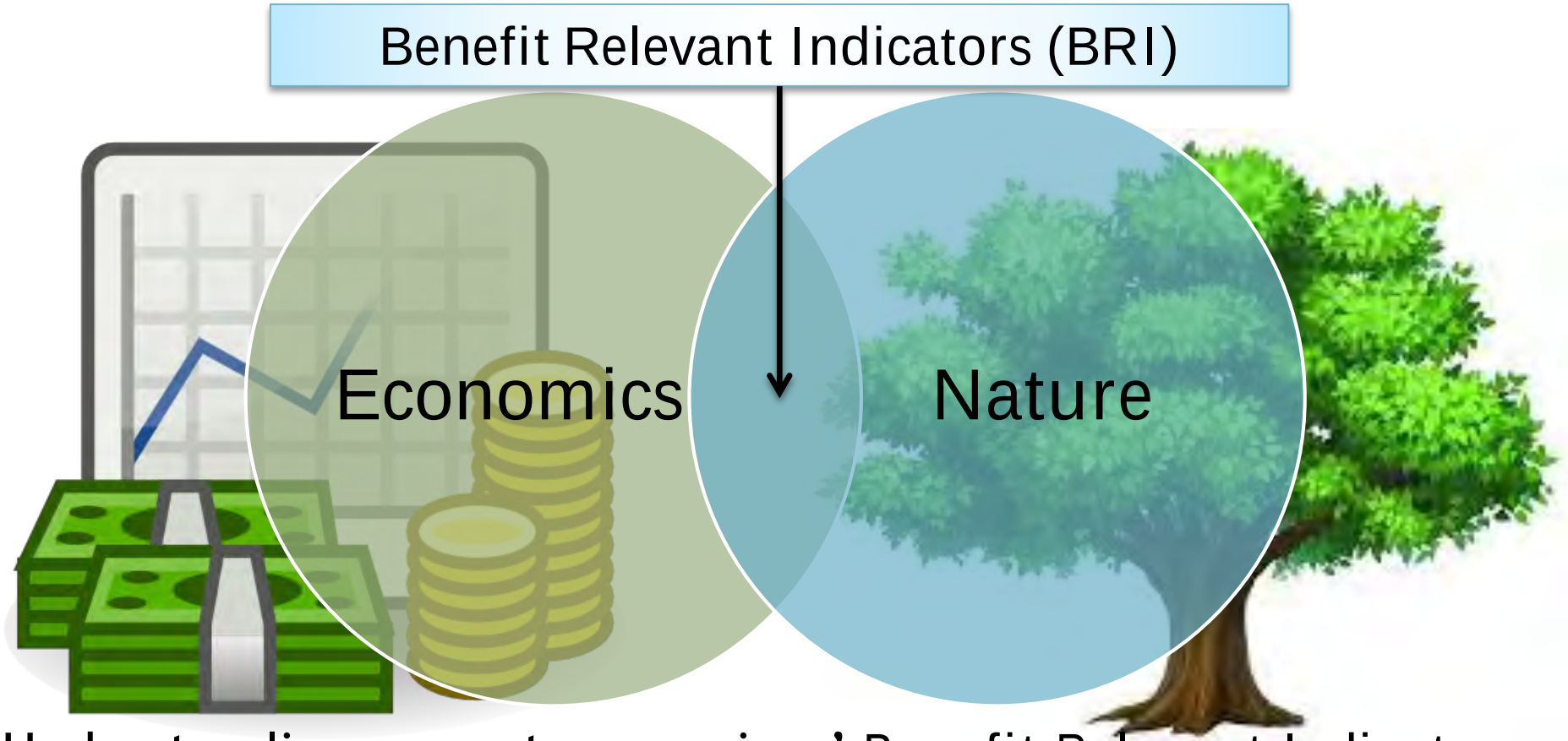
Benefit Relevant Indicators:

Red Cup Season

Starbucks Mobile App

Pumpkin Spice Latte

Photo source: Starbucks.com



Understanding ecosystem services' Benefit Relevant Indicators (BRIs) and Values, where available, allow for more informed communication between scientists, industry, policy and other decision-makers regarding the benefits and uses of ecosystems to human wellbeing.

Benefit Relevant Indicator Examples:

Fishing related BRIs

Better BRIs

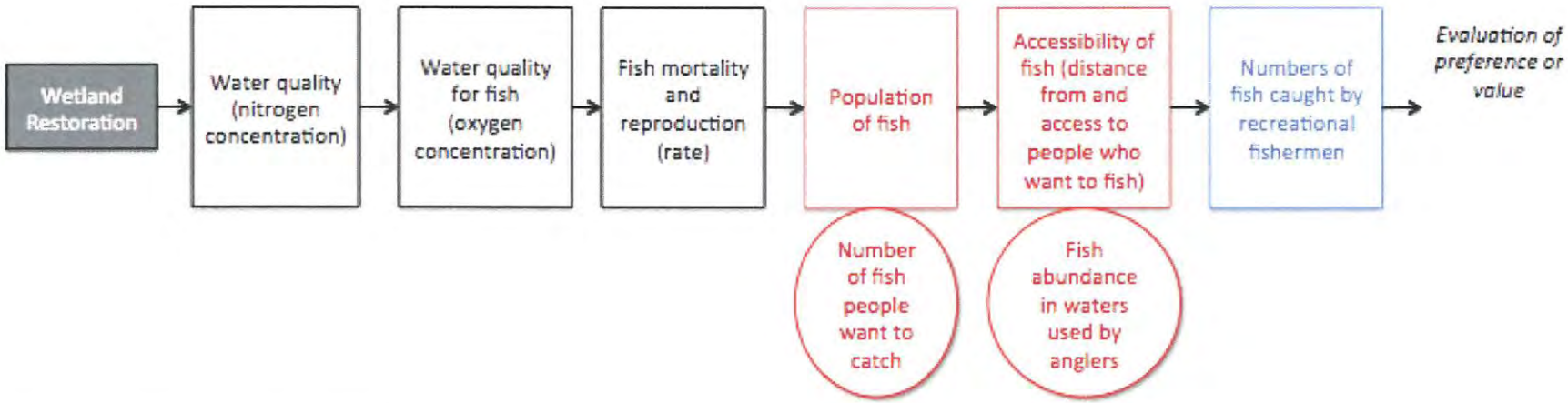
- Increased abundance of fish in a lakes used by recreational anglers
- Number of recreational anglers with access to lakes with improved fish abundance
- Number of recreational fishing days due to improved fish abundance in lakes
- Additional catch by anglers due to improved fish abundance in lakes

Flood risk related BRIs

Better BRIs

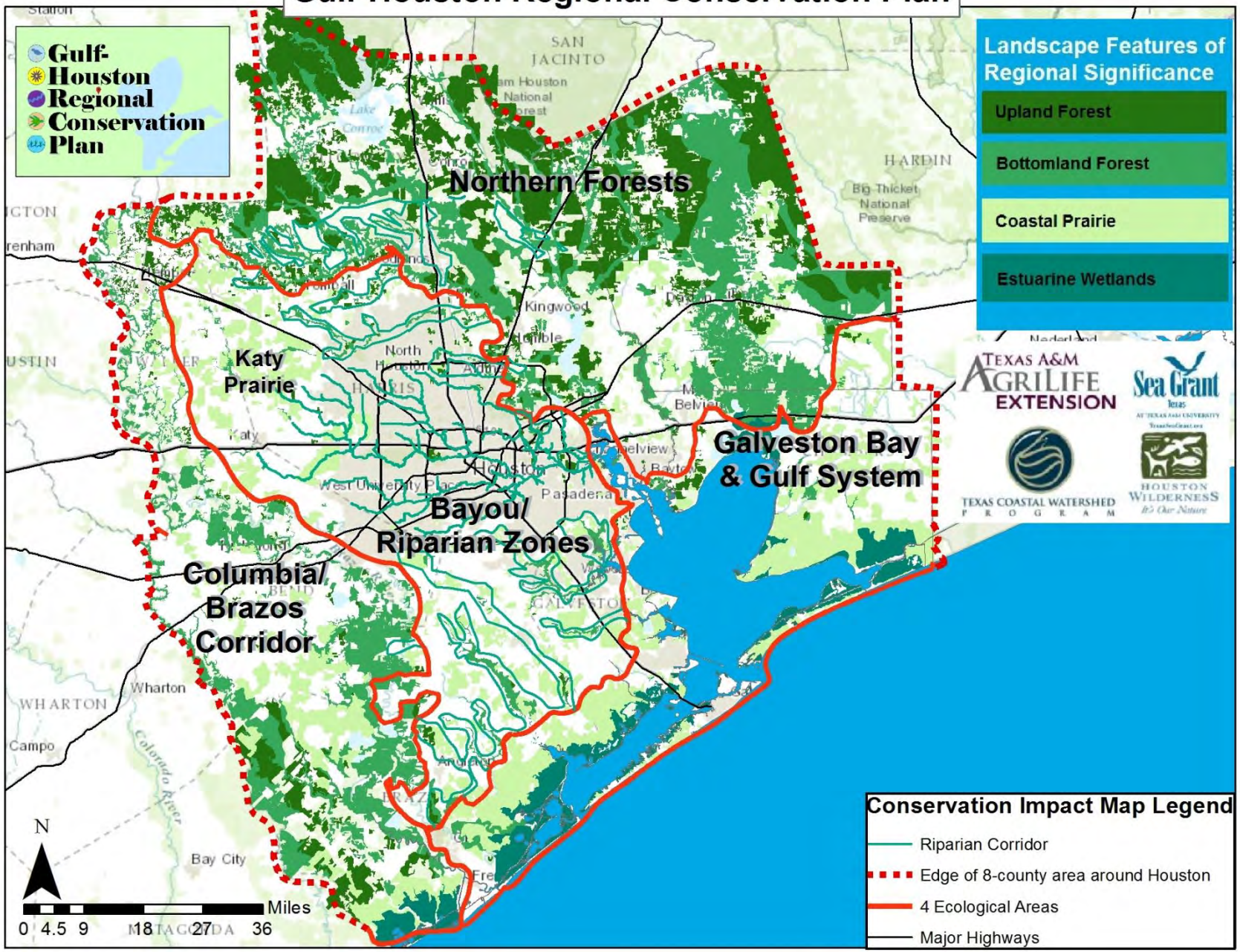
- Reduced frequency of river flooding in heavily populated areas
- Number of residents in areas experiencing reduced frequency of river flooding
- Value of residential properties in areas experiencing reduced frequency of river flooding
- Avoided property damages due to reduced frequency of river flooding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

Use of BRIs to assess the fishing benefits derived from wetland restoration

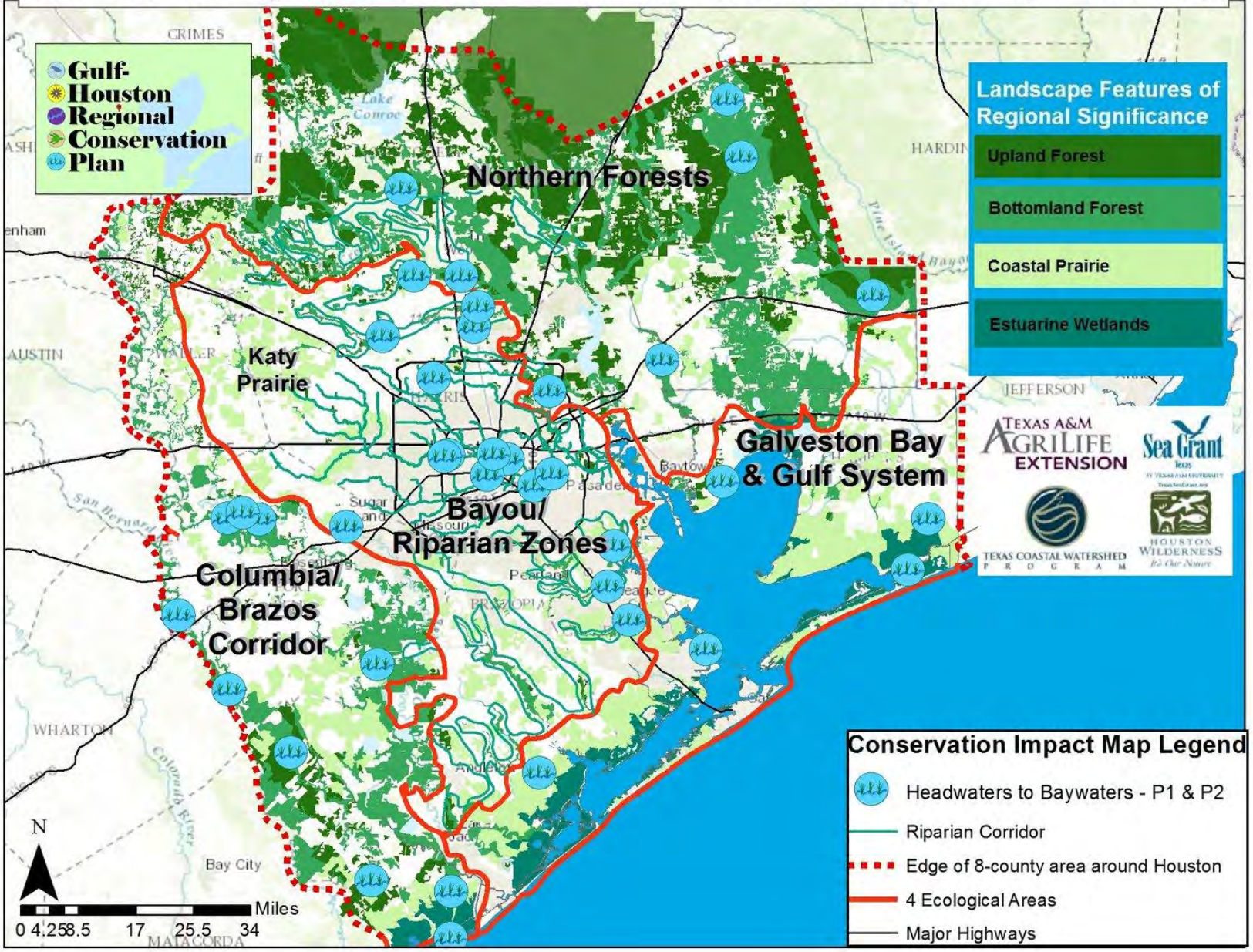


Note: Black text indicates an ecological assessment and indicators; red text indicates extension to an ecosystem services assessment and indicators, with ovals illustrating BRIs; and blue text indicates measures of social benefit and value.

Gulf-Houston Regional Conservation Plan



Gulf-Houston Regional Conservation Plan - Headwaters to Baywaters (Phase 1 & 2)



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 & Riparian

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

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

Ecosystem Services Provided by a Prairies & Riparian Corridors

1. Water Quality enhancementby reduced pollution & nutrients into watersheds

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. Aesthetics that increase property values

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

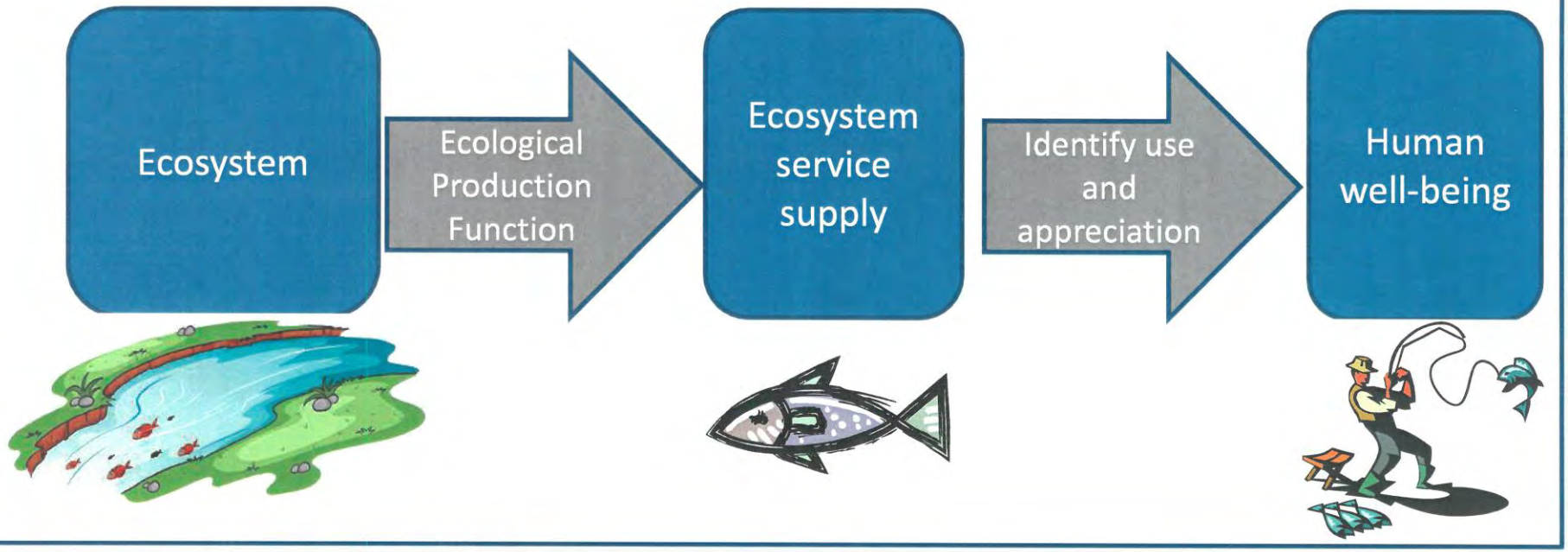
8. Sequesters carbon

9. Reduced energy costs by shading buildings

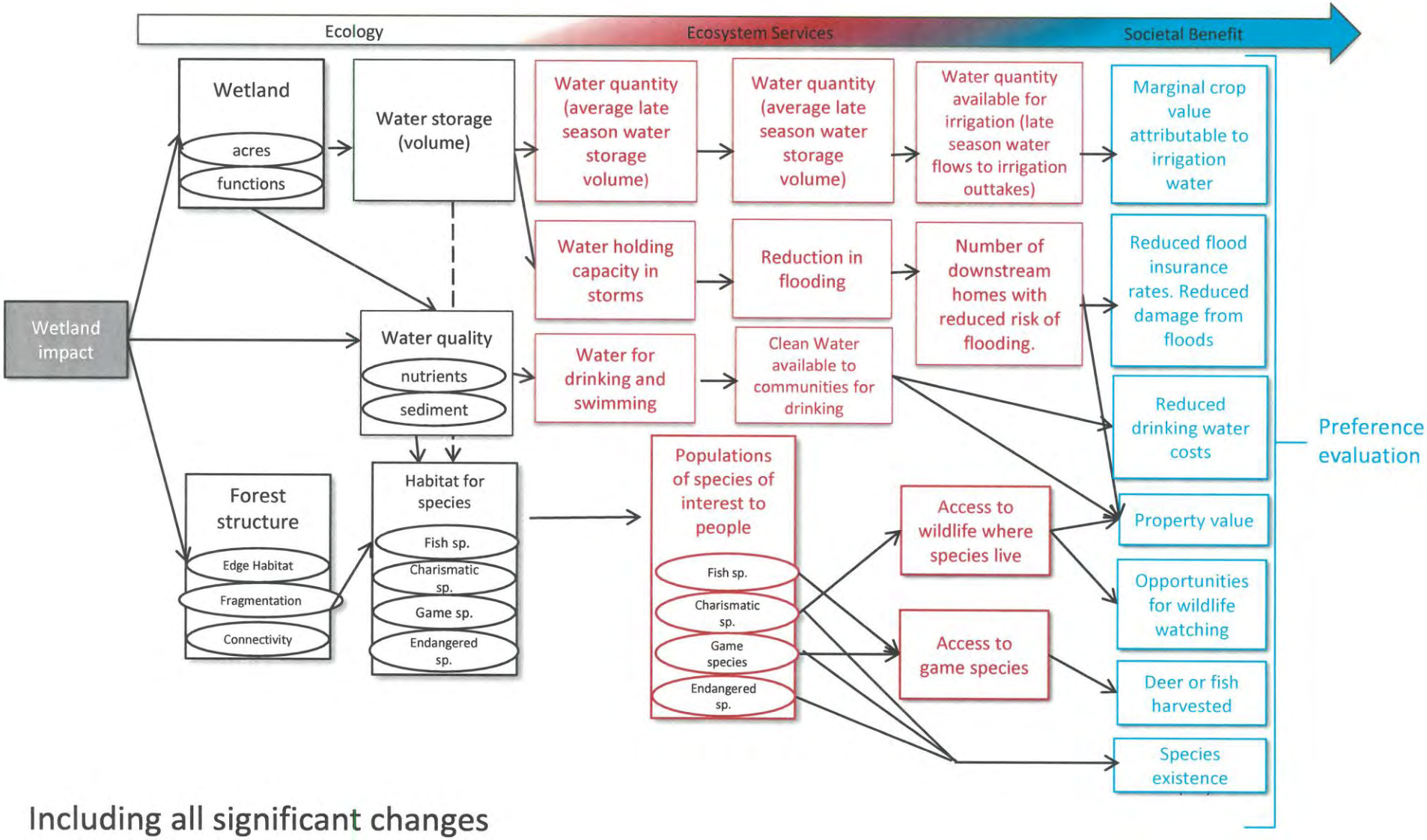
http://jimolive.photoshelter.com/gallery-image/Memorial-Park/G0000tg7eebE3gkU/I0000tZ8P3.E6bbU/C0000wD6dE72H88s

How does ecosystem services information get used in planning?

Baseline (current conditions, business as usual)



ES Conceptual Diagram (logic model)



Including all significant changes

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.

<u>Infrastructure need:</u>
Water Quality, Water Detention/Retention and Reduce Nutrient Load

<u>Solution:</u>
•Reduction in suspended solids and balance of pH levels
•Provide wildlife habitat and aesthetic for surrounding community

•<u>Cost to Construct:</u> $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.

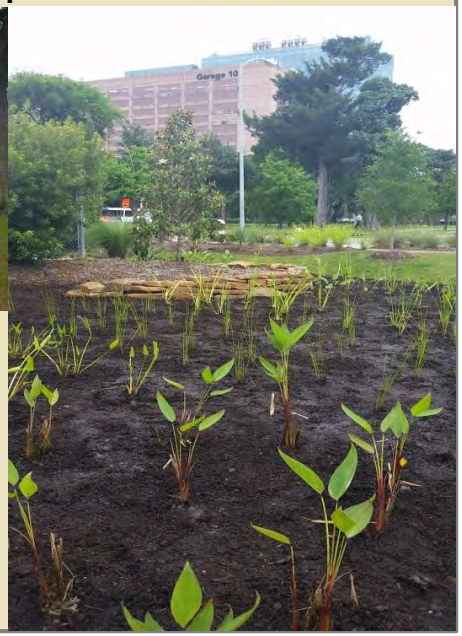
- The cost of construction for the wetland was $1.4 million and took 18 months to complete. The gray infrastructure alternative, a sequencing batch reactor, would have cost $40 million and taken 48 months to complete construction.

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



<u>Infrastructure need:</u> Water Quality, Water Detention/Retention, and Recreation

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

<u>Cost to Construct:</u> $1 Million

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

National Ecosystem Services Classification System (NESCS)

Figure 4-6. NESCS 4-Group Structure

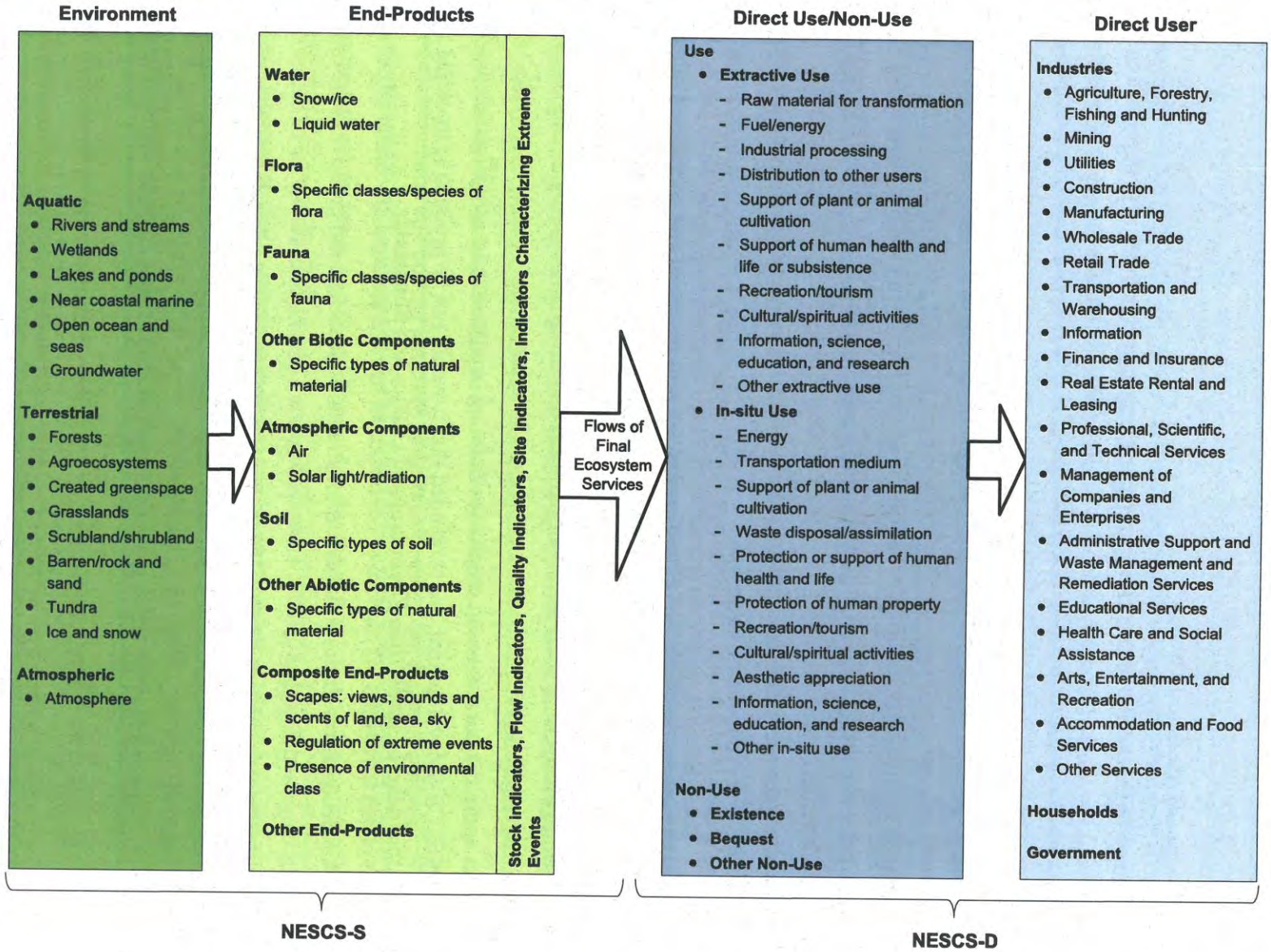


Table 5-7. Example of NESCS-S Categories Associated with Five Wetland Functions

Wetland Function	Environmental Class	Environmental Subclass	End-Product Class	End-Product Subclass	End-Product Examples
Groundwater Recharge	1. Aquatic	16. Groundwater	1. Water	12. Liquid water	
Water Storage	1. Aquatic	12. Wetlands	8. Composite End-Products	82. Regulation of extreme events	Flood Surge Reduction
Water Purification	1. Aquatic	11. Rivers and Streams	1. Water	12. Liquid water	
		14. Near Coastal Marine	3. Fauna	Specific classes/ species of fauna	Fish
Wildlife Habitat Provision	1. Aquatic	12. Wetlands	3. Fauna	Specific classes/ species of fauna	Waterfowl
					Wading birds
Open Space Provision	1. Aquatic	12. Wetlands	8. Composite End-Products	81. Scapes: • views • sounds and scents of land, sea, sky or a combination	Wetland Landscape

EPA – NESCS Framework Design & Policy Application Final Report (2015)

Study Goals and Scenarios for Using Ecosystem Services Valuation Methods

- Ecological Function

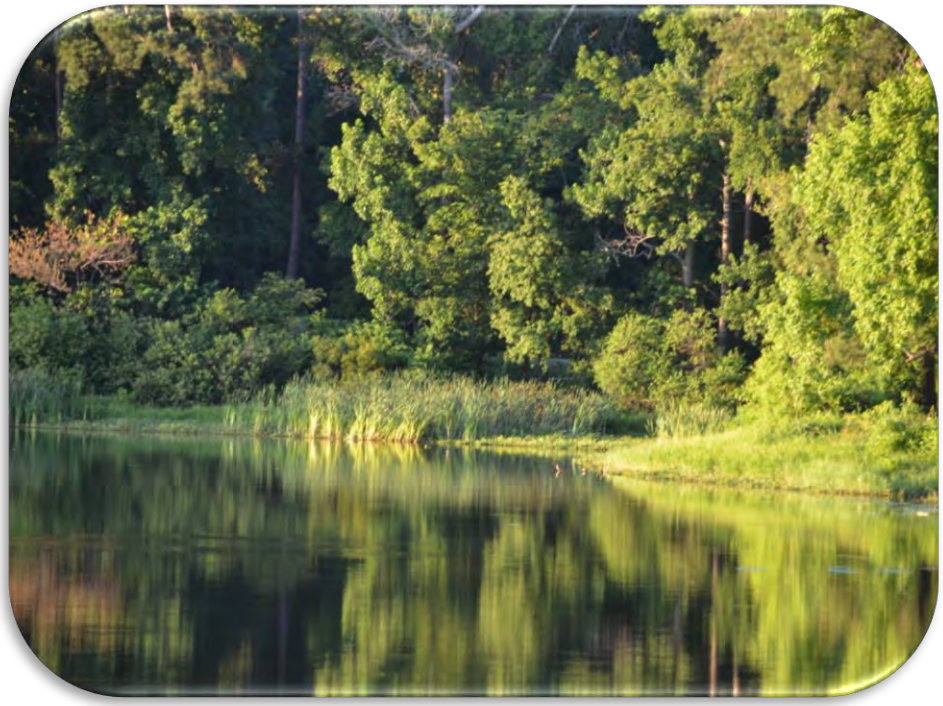
1) Ecological Function Monitoring
2) Spatial-Scale Impact on Function

- 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

- Statistical Quantification of ES
- Large-Scale Impact on ES
- Existing Green v. Development
- Existing Gray v. installing Green
- Neutral Land v. Green Restoration
- Energy Savings
- Insurance Costs v. Savings w ES
- 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

1 Ecological Function Analysis

- Uses on-site measurements of the ecosystem services in a particular location to determine their value and to show the extent of the ES in a particular ecosystem

- Once the capacity of the ecosystem service is known, it can be given value when connected to existing markets

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 to determine the value of the ecosystem 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 if the ecosystem service didn't exist in that location(or cost that would be saved if ES did exist in that location) - direct savings to residents, businesses, infrastructure

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

4 Replacement Cost Method

An analysis of the current ES that is provided would be performed, then the cost of building gray infrastructure to achieve the same level of services would be determined

Use for Outright Losses and Substitute Equivalency, Cost of Illness

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 the loss of ES in another location

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

6 Hedonic Pricing

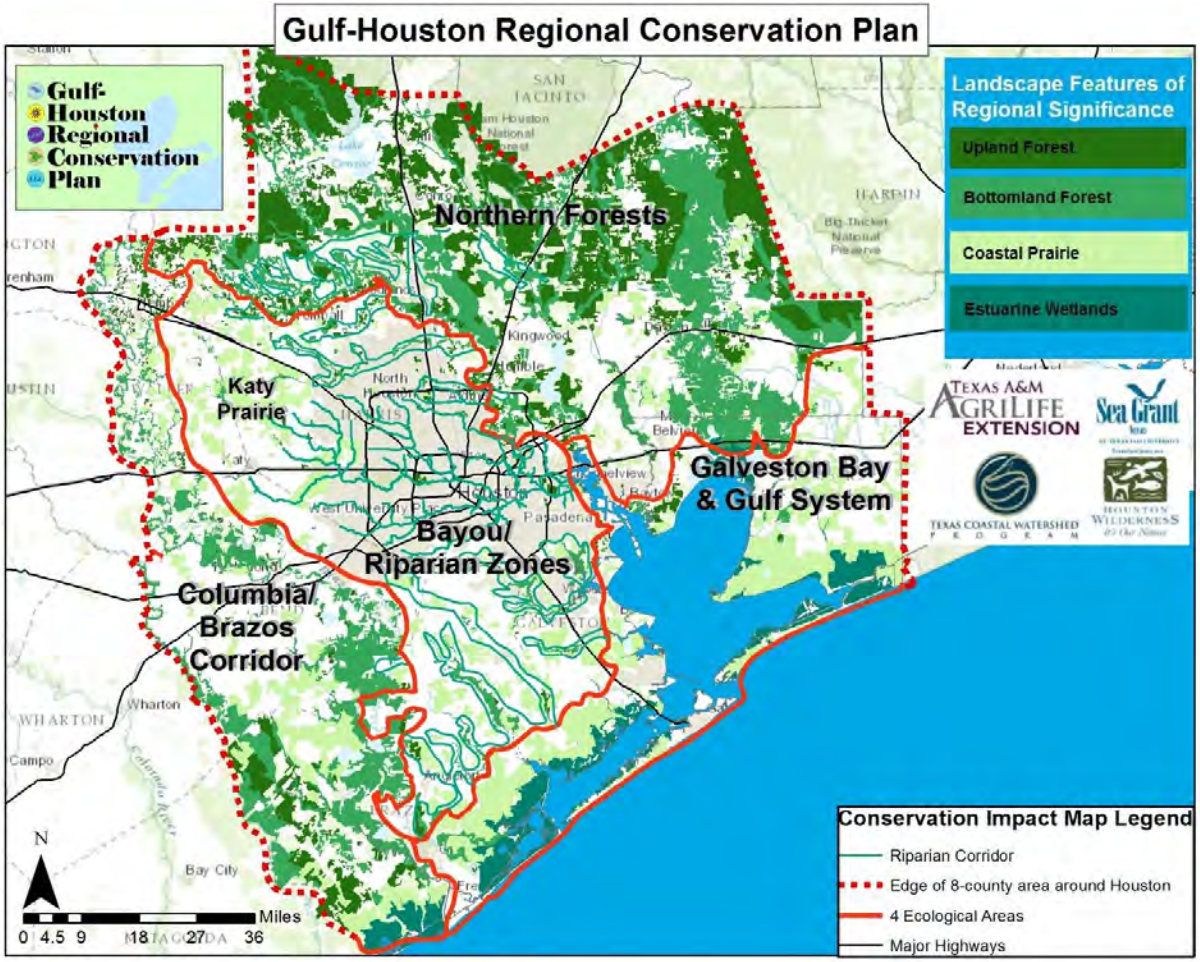
- Values recreational and aesthetic services by looking at existing or surrogate markets where the ES has indirect ties and helps determine the implicit demand for an ES based on property values

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!

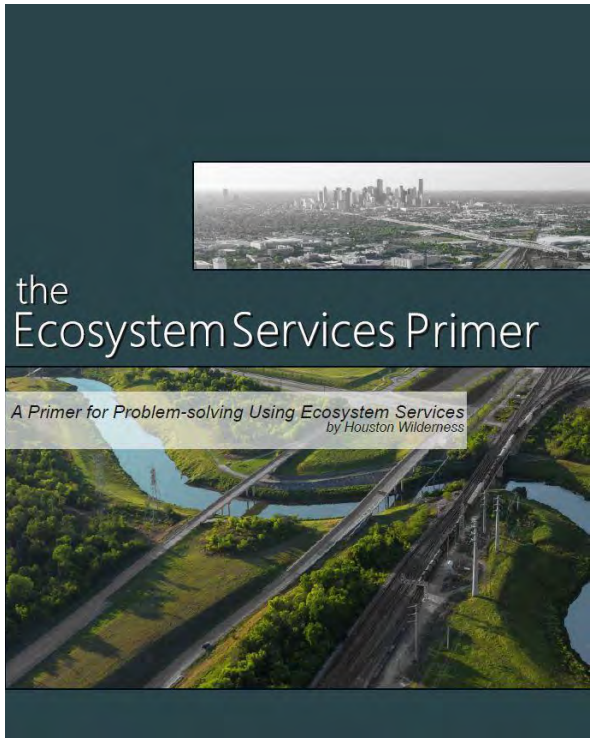
Deborah January-Bevers

Contributors:

- Lauren Harper
- Lindsey Roche

<u>Download the ES Primer</u>:

www.houstonwilderness.org



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