# SAN ANTONIO CLIMATE READY

## “Water Sponge/Carbon Sink” City

## September 17, 2019

**Brenden Shue,**
**Trinity University Intern**

**Lissa Martinez,**
**CAAP Technical Committee Member**

**Deborah Reid,**
**Technical Director GEAA**

# Topics to be covered

- Background.
- Current knowledge.
- What are the economic justifications?
- What is San Antonio’s potential?
- What are possible incentive programs?
- Conclusions and how do we use this information?

# Background

1. Greater Edwards Aquifer Alliance Task Force's Stormwater management recommendations with an emphasis on green infrastructure.

2. City of San Antonio Climate Action and Adaptation Plan (CAAP) with emphasis on emission reduction and mitigation strategies.

- A favorite mitigation strategy was to maximize carbon sequestration of public green spaces.
- Mechanisms to implement include policies, ordinances, incentives and lots and lots of education (perceptions of aesthetics).

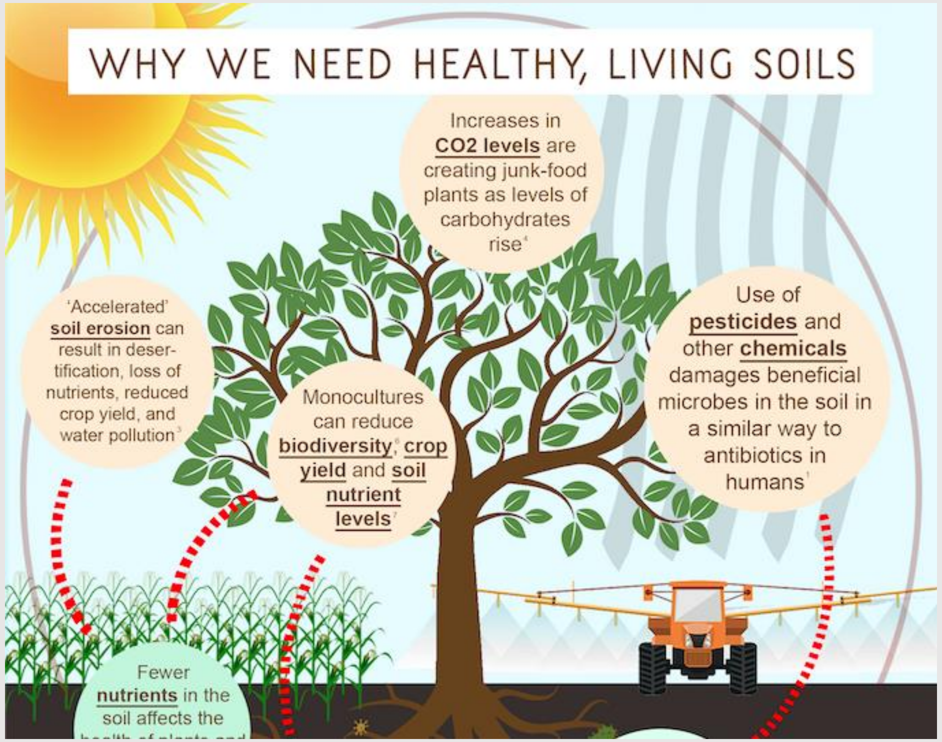
3. The same practices that will improve carbon sequestration are ones that will also improve stormwater management; all through the use of green infrastructure.

# Current Knowledge: Water Storage & Carbon Sequestration

1. Lots of new research emerging, but there is little local data.

2. Therefore data collected globally and nationally can only be used as guidance.

3. Research has been focused on agriculture lands but is increasing for other ecosystems:
   - Turf
   - Prairie
   - Forest
   - Wetland
   - Riparian/floodplain




4. From this research we can create recommendations to increase potential for water storage and carbon sequestration. And in addition understand what types of ecosystems provide the greatest potential.

| Ecosystems Potentials | Stormwater Run-off Reductions | Sediment Removal Depending on size | Net Carbon sequestration (Mg* C ha-1yr-1) |
|---|---|---|---|
| Turf/lawns<br>Minimal inputs<br>BMPs used | 10-57% | 24-73% | 0.7<br>1.3 |
| Prairie | 37-98% | Up to 95% | 0.7 |
| Forest/trees | 65% | 70-90% | 0.84 |
| Active Riparian/ Floodplain Forest | 9-100% | 92-96% Mix vegetation w trees | 3.4<br>68-158** |
| Wetland | NA | NA | 1.6-4.7, 10** |
| Prairie Pothole Wetlands | NA | Effective, but wetland is lost | 50-70** |
| LID Feature | First 1.5 " of event | 80% | ?? |

* Mg = Ton , ** Not given as net so unable to compare directly

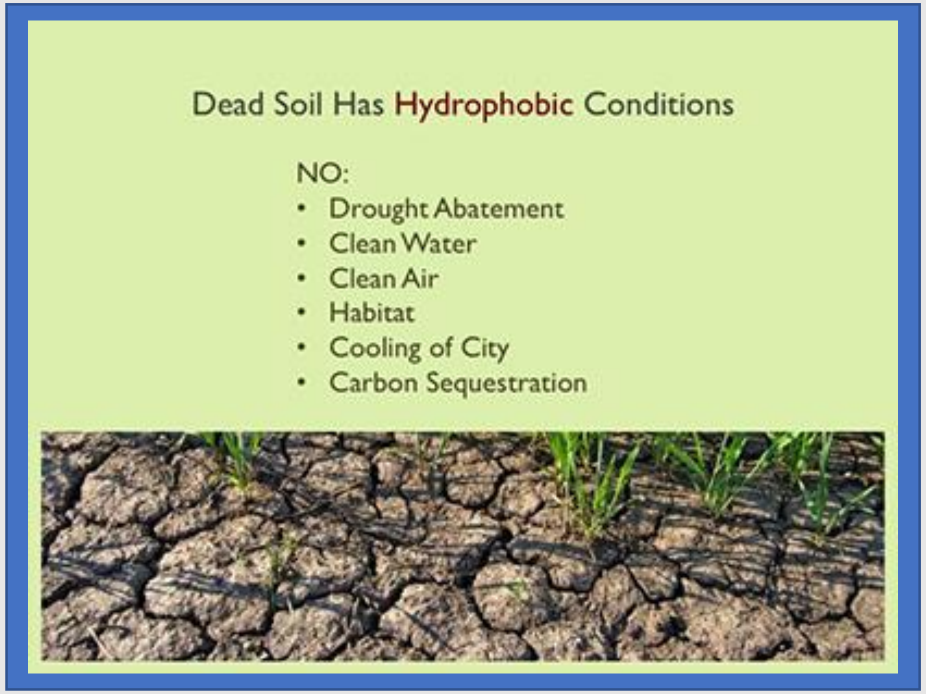
# How do we use this information?

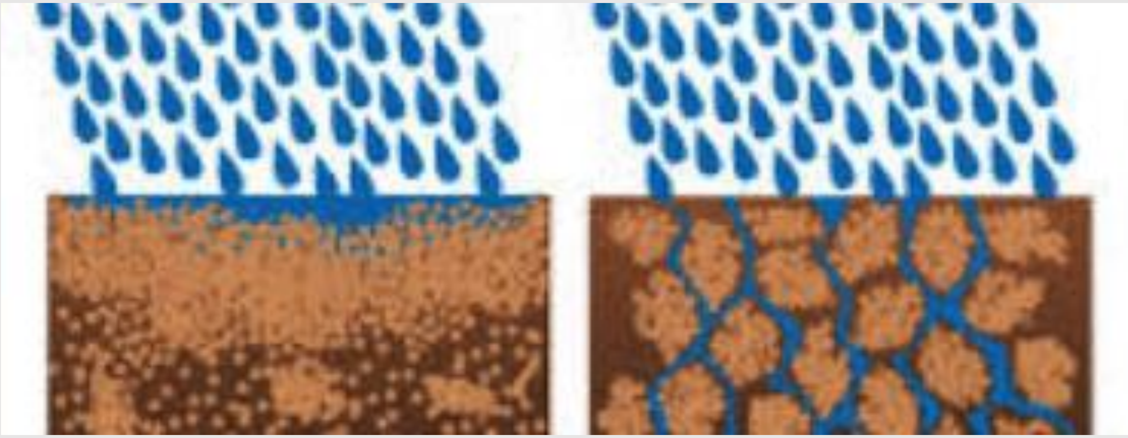
These dead and compacted soils no longer provide ecosystem services.

# Using Information: starting with the low hanging fruit

Modifying soil and vegetation practices have minimum costs and could save money.

- Goals
  1. Increase infiltration into the soil
  2. Increase soil water storage
- Results
  1. Reduce stormwater runoff and peak flows
  2. Improve water quality
  3. Reduce need for irrigation and temperatures
  4. Build healthier soils, encourage more vibrant landscapes and create resilience
  5. Sequester more carbon dioxide
- Barriers
  1. Lack of education
  2. Public perceptions and habits

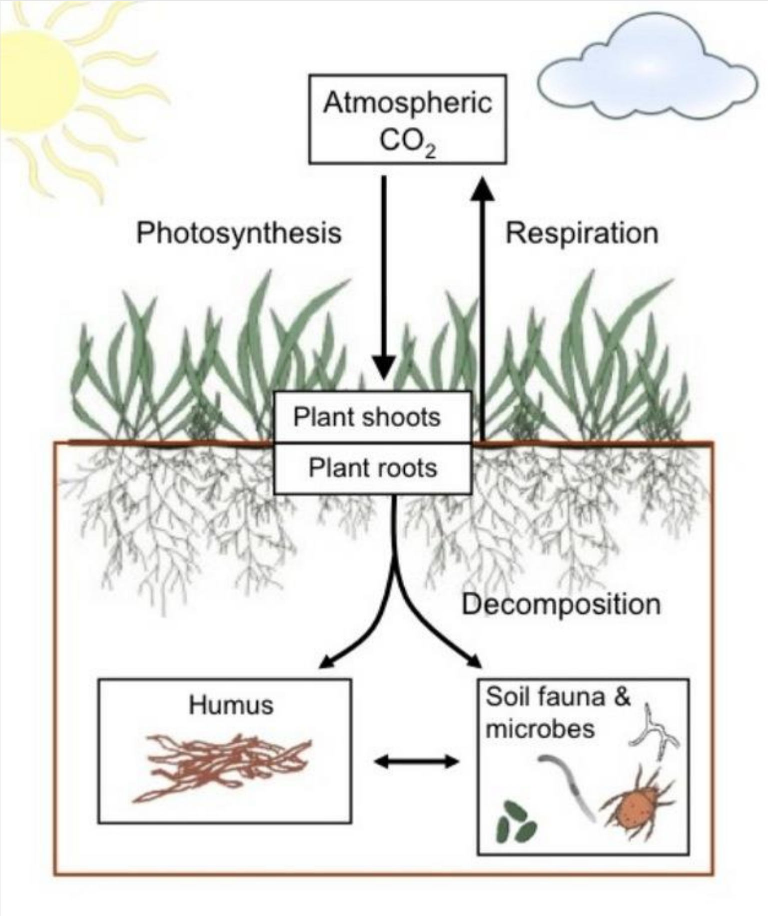


# Modifying soil and vegetation practices

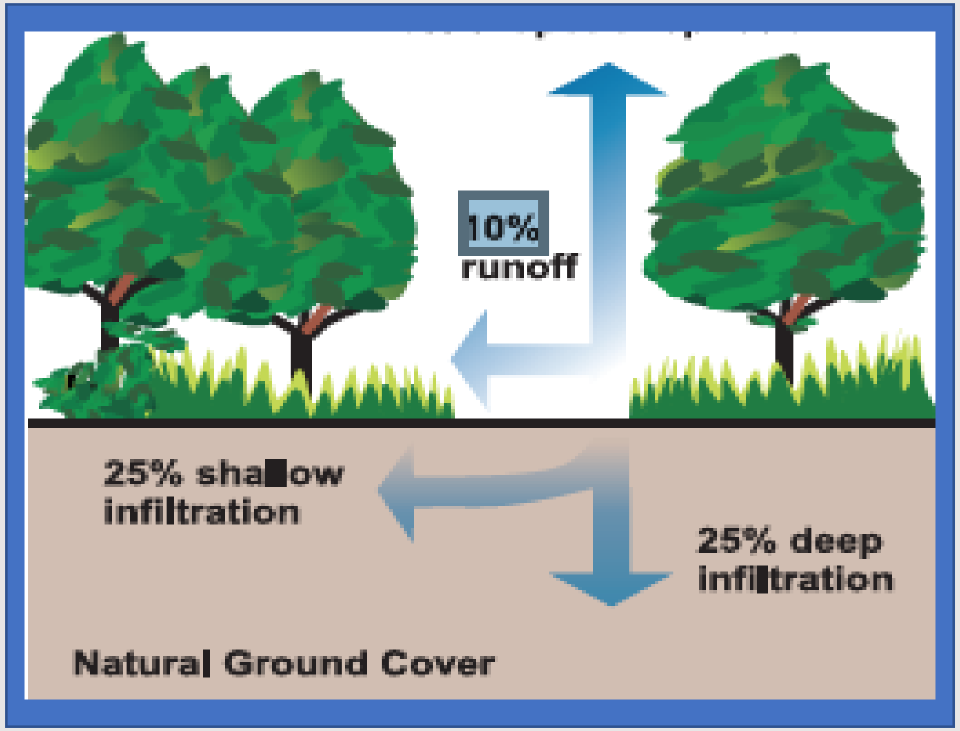
**Increasing infiltration and water storage capacity:**

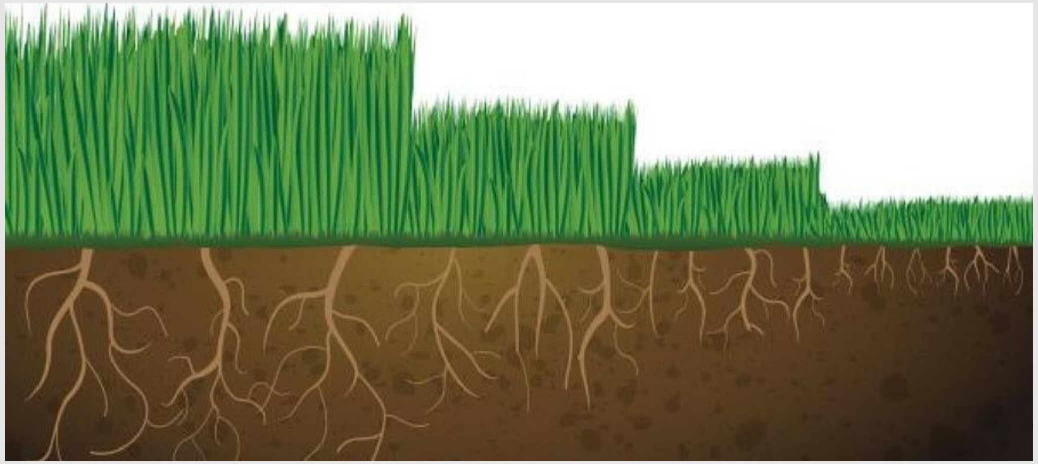
- Increasing soil organic matter (SOM) by 1% can store an additional 20,000 gal water/acre.
- SOM is the basis of soil carbon. Increase the SOM and the amount of stored soil carbon is increased.
- Soil can sequester ~ 3x more carbon than above ground vegetation.
- There is a hypothesis that a 2% increase in SOM of the world's soils can soak up the excess $CO^2$ within a decade.



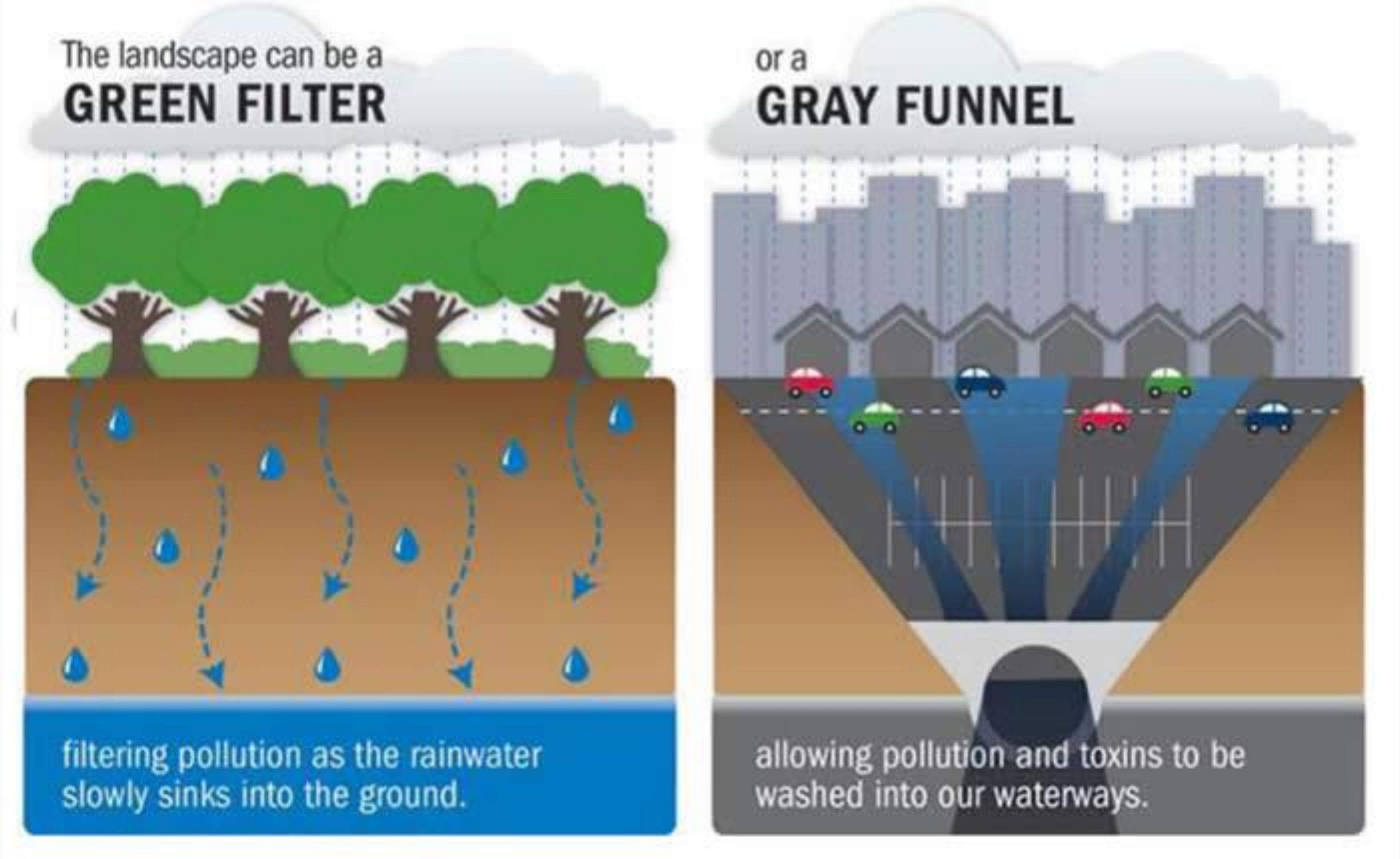
# Increasing infiltration and water storage capacity:

- Undisturbed soils with a continuous living perennial cover is the best strategy for improving water infiltration.
- Mowing practices that allow grass to grow higher can increase infiltration so that a 1”/hr rain event will be absorbed. This will practice will reduce:
  - **Soil water evaporation,**
  - **High soil temperatures which increases** $CO^2$ **release from the soil),**
  - **Soil erosion (sediment is the #1  pollutant in the US).**
- Adding compost increases the SOM and the co-benefits.

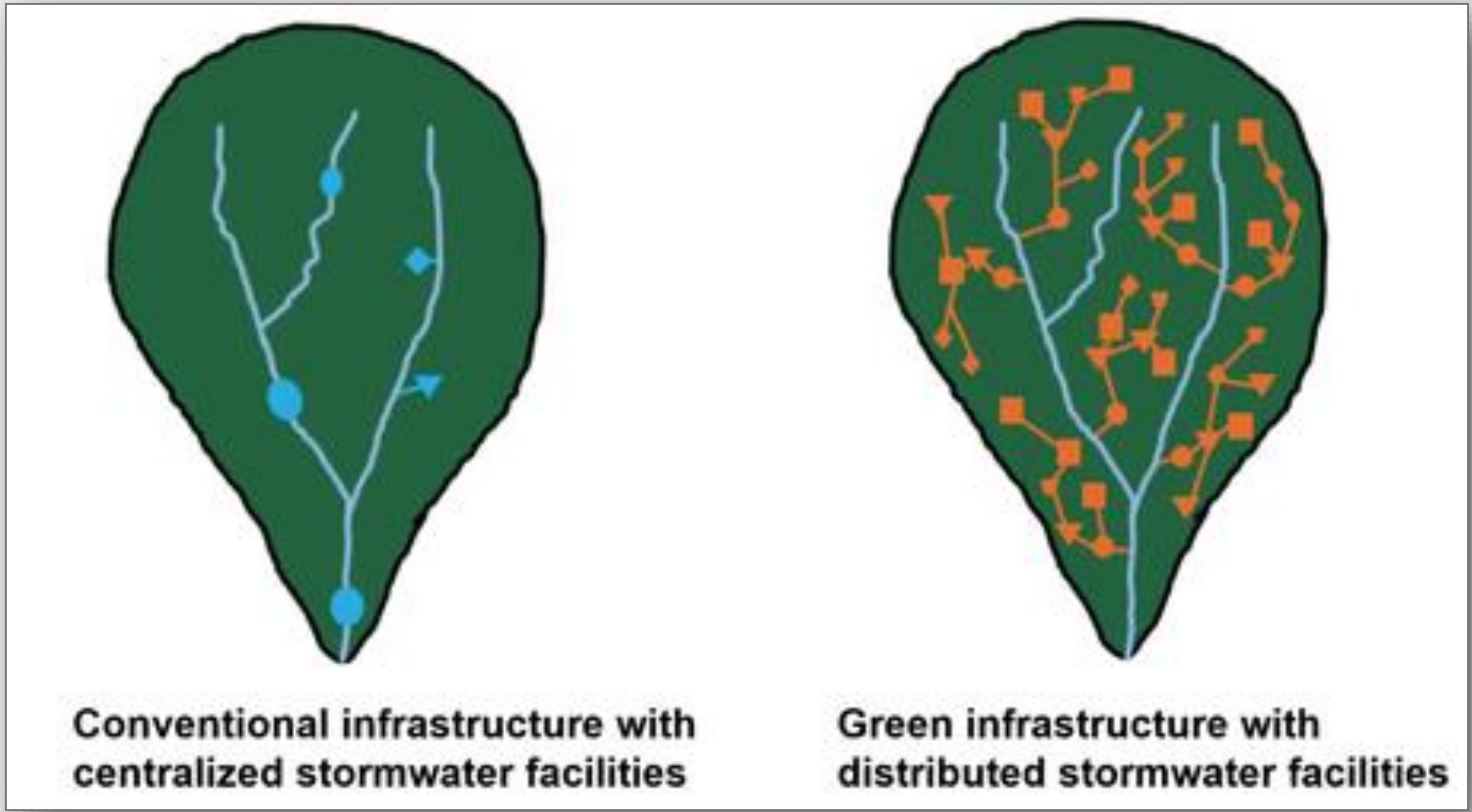


# Use information: not a low hanging fruit, but a paradigm shift beginning with stormwater management



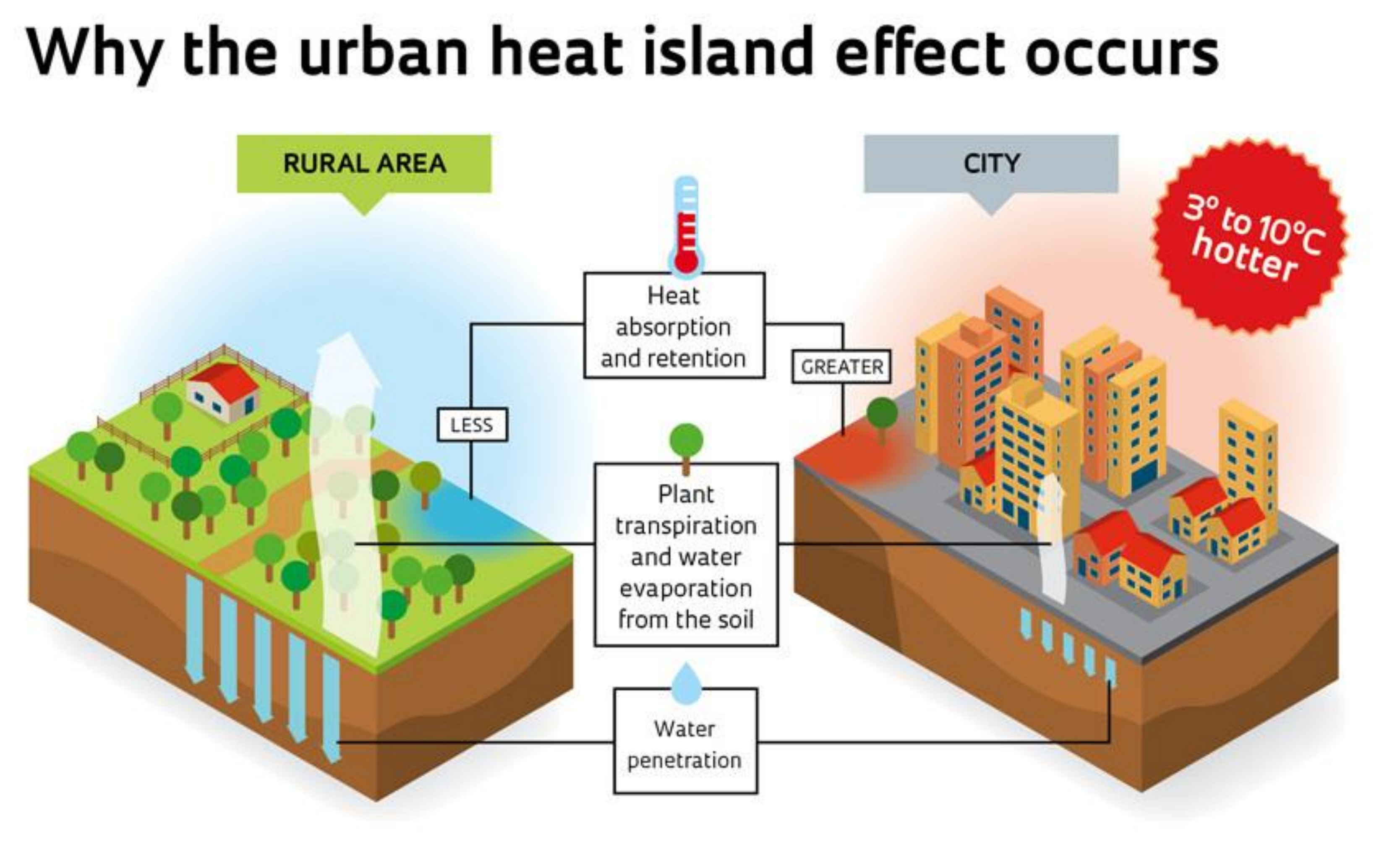
# Currently flood control projects focus on specific areas of flooding vs utilizing a watershed approach




The watershed approach allows neighborhoods to be retrofitted with appropriately scaled green infrastructure, enhancing quality of life within communities; cooling temperatures and storing more soil water and carbon.

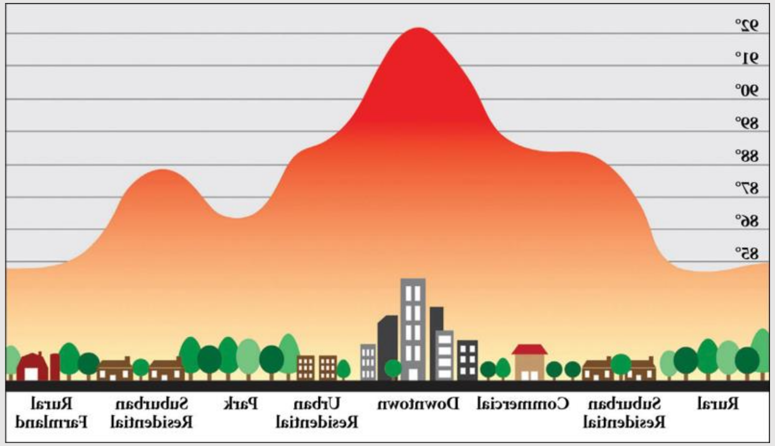
# Other factors to consider

- Policies for climate mitigation on land rarely acknowledge biophysical factors, such as reflectivity, evaporation and surface roughness. Yet such factors can often alter temperatures more than carbon sequestration does.



# Urban Heat Island: San Antonio

- From 1997 to 2010, data recorded that San Antonio’s Urban Heat Island (UHI) is increasing at a rate of 0.8°C per decade (33.44 F).
- A study to measure heat retention of concrete in urban areas found that a summer day with a peak temperature of 90°F, asphalt had an average temperature of 195°F and concrete had an average temperature of 155°F.
- This data illustrates the concern for increasing the use of concrete especially as it relates to gray infrastructure.



# Concrete Emissions

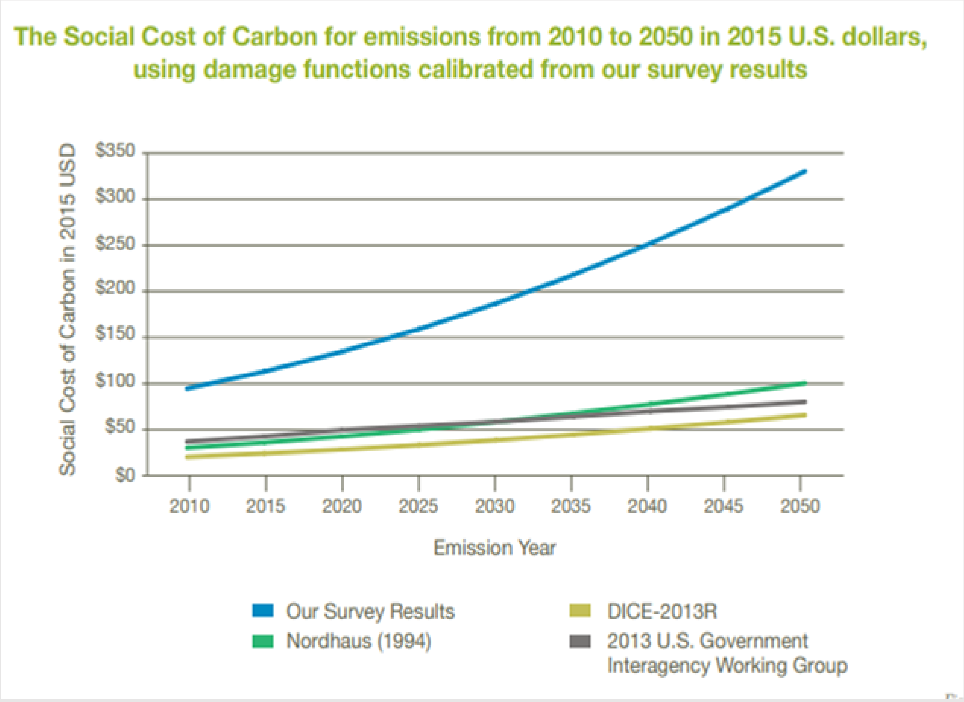
- 100-300 kg of CO2 stored per cubic meter of concrete (170 to 500 lb per yd3)

- A survey by Portland Cement Assoc. states: 2,044 lb of CO2 is emitted per 2,205 lb of manufactured portland cement.

- Study in 2005 states: US cement industry produced roughly 105.7 million tons.

- Societal costs of 1 ton of carbon equates to roughly $40 US.

- Nationally this carbon emission value is $3,932,040,000.



# Economic Justifications

1. Utilizing GI/LID for a storm sewer in Lake Como, MN:

- Reduced spending by $500k compared to proposed gray infrastructure system.
- Addition savings were realized due to environmental services provided through GI/LID

2. A cost assessment n Lancaster, PA:

- Total saved was $120 million by utilizing green infrastructure vs gray infrastructure.
- In addition, plan realized $5 million in annual benefits over 25 year period.

| Total Calculated Benefits (at Long-Term 25-Year Implementation) | |
|---|---|
| Estimated Value from Water Benefits | |
| Reduced CSS Gray Infrastructure Capital Costs (one-time) | $120,000,000 |
| Reduced Pumping and Treatment Costs (per year) | $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** | **$120,000,000** |
| **Annual Benefits** | **$4,838,000** |

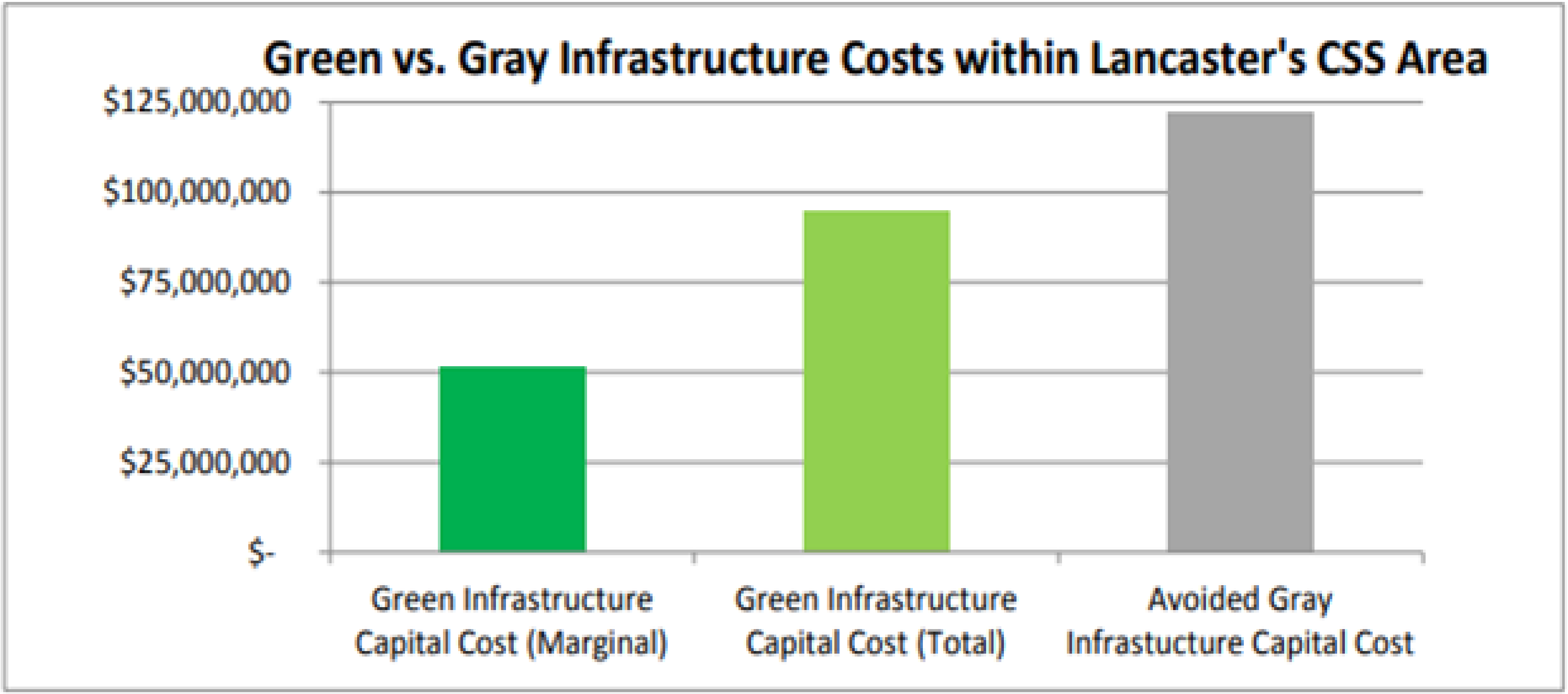



Figure 1: Comparison of avoided gray infrastructure costs to green infrastructure costs within Lancaster's CSS area.

# Sponge City Program Case Study


G.I. Case Study: China

- In 2010, 35 major cities implemented G.I. practices to combat stormwater pollutants and to raise air quality
- Survey found 18.7 million tons of carbon sequestered with a density of 21.34t/ha. Equal to $74 million US.

SPC Case study: China

- 16 major cities receive $400 million in funding for
- GI/LID with the requirement to retain 70% of polluted stormwater
- Stormwater volume reduced: 31% / Flow reduced: 53%

# Ecosystem Analysis: San Antonio

From a 2007 study, San Antonio's 113,011 acres of tree canopy citywide:

- Manages 974 million cubic feet of stormwater
  - Economic value: $624 million
- Manages 12.7 million lbs of air pollutants
  - Economic value $30.2 million per year
- Carbon Storage & Sequestration
  - Storage: 4.9 million tons of Carbon
  - Sequestration: 38,000 tons annually
  - Economic Value: $1,520,000

# Table 4. San Antonio Ecosystem Services with 2007 High Resolution Imagery by Land Use

| | Area | 2007 Tree Canopy | 2007 Tree Canopy | Air Pollution Removal | Air Pollution Removal Value | Carbon Stored | Carbon Sequestered | Stormwater Value | Stormwater Value @ $.64 per cu. ft |
|---|---|---|---|---|---|---|---|---|---|
| | acres | acres | percent | lbs./ yr | dollar value | tons | tons | cu. ft. | dollar value |
| **Urban Res** | 107,484 | 34,576 | 32 | 3,883,518 | $9,249,691 | 1,487,866 | 11,583 | 327,368,176 | $209,515,632 |
| **Suburban Res** | 259,311 | 85,434 | 33 | 9,595,751 | $22,854,981 | 3,676,355 | 28,621 | 702,596,006 | $449,661,444 |
| **CBD** | 1,066 | 131 | 12 | 14,763 | $35,162 | 5,656 | 44 | 1,824,932 | $1,167,956 |
| **Commercial** | 67,796 | 8,915 | 13 | 1,001,331 | $2,384,951 | 383,633 | 2,987 | 83,795,961 | $53,629,415 |

Note that the sum of the land uses stormwater values doesn't total to the citywide value. This is because each land use has a specified soil type, whereas citywide, soil type must be generalized for the entire area. Stormwater calculations listed here are based on a 2-year, 24 hour storm event. Calculations from a 5-year, 24 hour storm event are included in the Map Book as part of this project.

# Potential of Golf Courses: Audubon Texas Golf Course project also provides Habitat


71 restored acres of 154 total = 46% for an increase in soil carbon sequestration

Urban Ecosystem Carbon Management

# The Edwards Aquifer Protection Program Lands includes **156,475** Acres

| | | |
|---|---|---|
| Proposition 3 (2000) | 6,553 acres, in 8 properties | Fee Simple Purchase |
| Proposition 1 (2005) | 90,042 acres, in 33 properties | Conservation Easements (27)<br>Fee Simple Purchase (6) |
| Proposition 1 (2010) | 51,078 acres, in 42 properties | Conservation Easements |
| Proposition 1 (2015) | 8,694 acres, in 19 properties | Conservation Easements |
| Current Status (Active) | **156,475** acres, **102** properties | 14 Fee Simple purchases<br>88 Conservation Easements |

https://www.sanantonio.gov/EdwardsAquifer

Urban Ecosystem Carbon Management

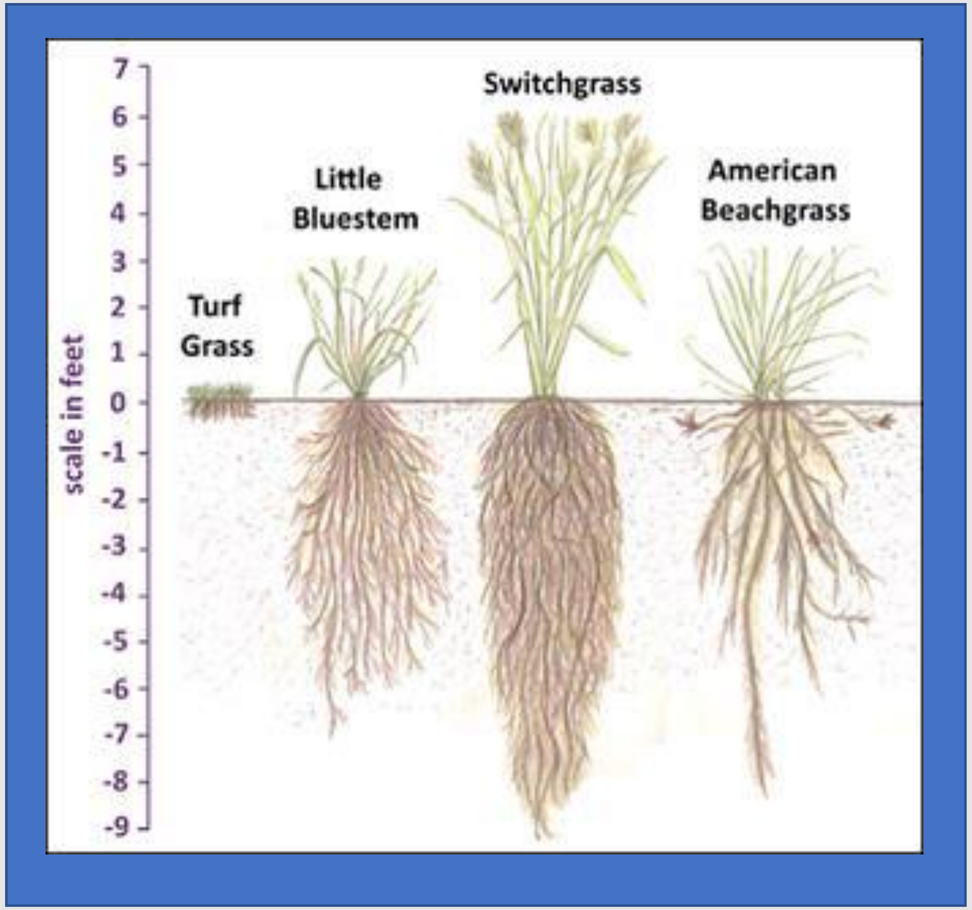
# What “Public” Lands Could We Use?

| | |
|---|---|
| City Parks - more than 240 parks and Botanical Gardens | **15,337.6 Acres** of land, including more than 150 miles of Trails. |
| Howard W. Peak Greenway Trails System | **69 miles** of greenway trails across the city, spanning **1500 acres** funded by Prop 1 local Sales Tax since 2000 |
| Hemisfair | 96.2 Acres with **19.2 Acres** “park” |
| The San Antonio Riverwalk (CoSA and SARA) | 15 mile urban waterway links to 2020 acres of Public Lands (as of 2011) |
| Riparian Areas; natural and engineered. | ~**1300 Miles** of waterways in Bexar County, various levels of impairment |
| San Antonio Natural Areas, funded by Prop 1: Edwards Aquifer Protection. | Crownridge Canyon NA (**200**), Eisenhower Pk (**320**), Friedrich Wilderness Pk (**600**), Hardberger Pk (**311**), Medina River NA(**500**) Walker Ranch Historic Landmark Pk (**77.4?** ) = **2008.4 ACRES** |
| CPS Energy Facilities and ROW | Acreage ??? |

# Urban Ecosystem Carbon Management
# What "Private" Lands Could We Use?

| | | |
|---|---|---|
| Mitchell Lake Wildlife Refuge (SAWS and Audubon Society) | 10750 Pleasanton Rd<br>San Antonio TX 78221 | **600 dry Acres and 600 lake Acres** of reclaimed wetlands |
| Land Heritage Institute | 1349 Neal Rd. 78264 | **1,200** Acre living land museum |
| Oblate School of Theology | 285 Oblate Dr. at Blanco | **41** Acre home to religious order |
| Catholic Cemeteries San Fernando Cemetery III | 1735 Cupples Road,78226 | **130** Acres operated since 1914 |
| BSA McGimsey Scout Park | NW Military Drive | **140** Acres in north central SA |
| Valero Energy Corporation | 1 Valero Way 78249 | **200** Acres at edge of Hill Country |
| Northside ISD elementary schools, 80 campuses | northwest San Antonio | **>1000** Acres, operated since 1950's |

# Summary of the literature review




Ecosystems that provide the greatest benefits with the least amount of inputs (reduced carbon footprint):

1. A complex vegetative cover such as trees with understory or plants growing underneath:
   a) Reduce stormwater runoff and summer temperatures from transpiration and albedo,
   b) Increase water storage and carbon sequestration.
2. Adding a grass filter strip above the tree area, will increase the effectiveness of sediment removal.

3. Recommend: Prairie grasses for medians mowed 2x/yr only, Trees (forest) with understory and a grass filter strip for commercial sites and riparian areas, Yards where lawns are mowed no less than 3-4” high and organic matter (leaves, compost, mulch, etc. is added every year).

# Barriers

- The development community's priorities and conventional designs especially for managing storm water and vegetation.
- Public perception that vegetation can be a problem vs an asset. Fear of higher vegetation that includes safety concerns.
- Lack of education especially within landscape maintenance personnel.

- Time and money:
  1. More time to manage with less equipment; requires maintenance contract to include more specifications and flexibility.
  2. May need to be able to identify plant species.

# How do we use this information?

- Our parks system is an important part of the city's green infrastructure.
- Future directions:
  1. **Increase public education.**
  2. **Use 2020 UDC update process to increase park lands and support LID and Green Infrastructure.**
  3. **Support Parks and TCI to modify management practices and increase restoration efforts.**
  4. **Incentivize effectively the use of LID and natural channel design for stormwater.**

# Conclusions

**Water Sponge:**

- Increasing soil capacity to store water will lead us towards reducing peak flows that cause flooding, improving water quality in our streams and rivers, promoting water conservation, increasing aesthetics with healthier landscapes and provide a slew of co-benefits.

**Carbon sequestration/soil carbon storage:**

- Soil Carbon needs to be an active part of the solution to create climate resilience.

# *Thank you for your attention. Any questions?*

WATER QUALITY

AIR QUALITY

WATER CONSERVATION

TERRESTRIAL AQUATIC HABITAT

BIODIVERSITY

CLIMATE CHANGE AND FLOOD RESILIENCY

AESTHETICS AND COMMUNITY HEALTH

RECREATIONAL ACTIVITIES