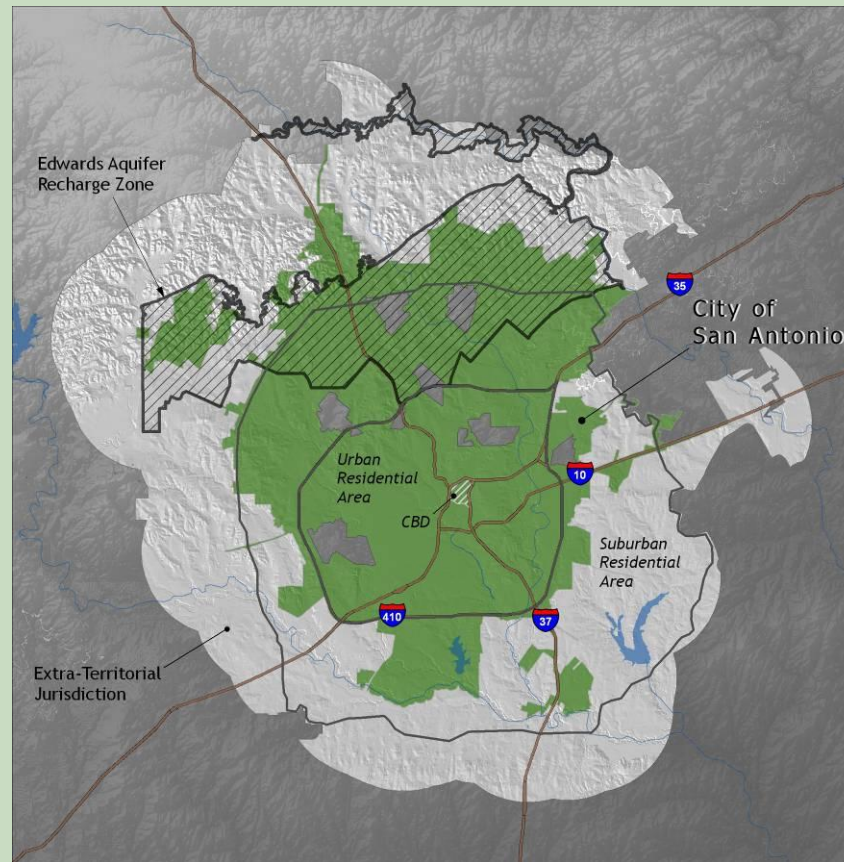


San Antonio

Urban Ecosystem Analysis



December 2008

Project Objectives

- Identify landcover change trends
- Identify 2007 landcover and quantify its ecosystem benefits
- Literature review of city policies
- Literature review of tree canopy goals
- Recommend tree canopy goals

Goal: To provide San Antonio with the data and tools to make better informed decisions

Methods

- Two sources of data: Landsat and High resolution
- Urban Ecosystem Analysis: CITYgreen software
 - Stormwater Runoff
 - Air and Water Quality
 - Carbon Storage
 - Carbon Sequestration

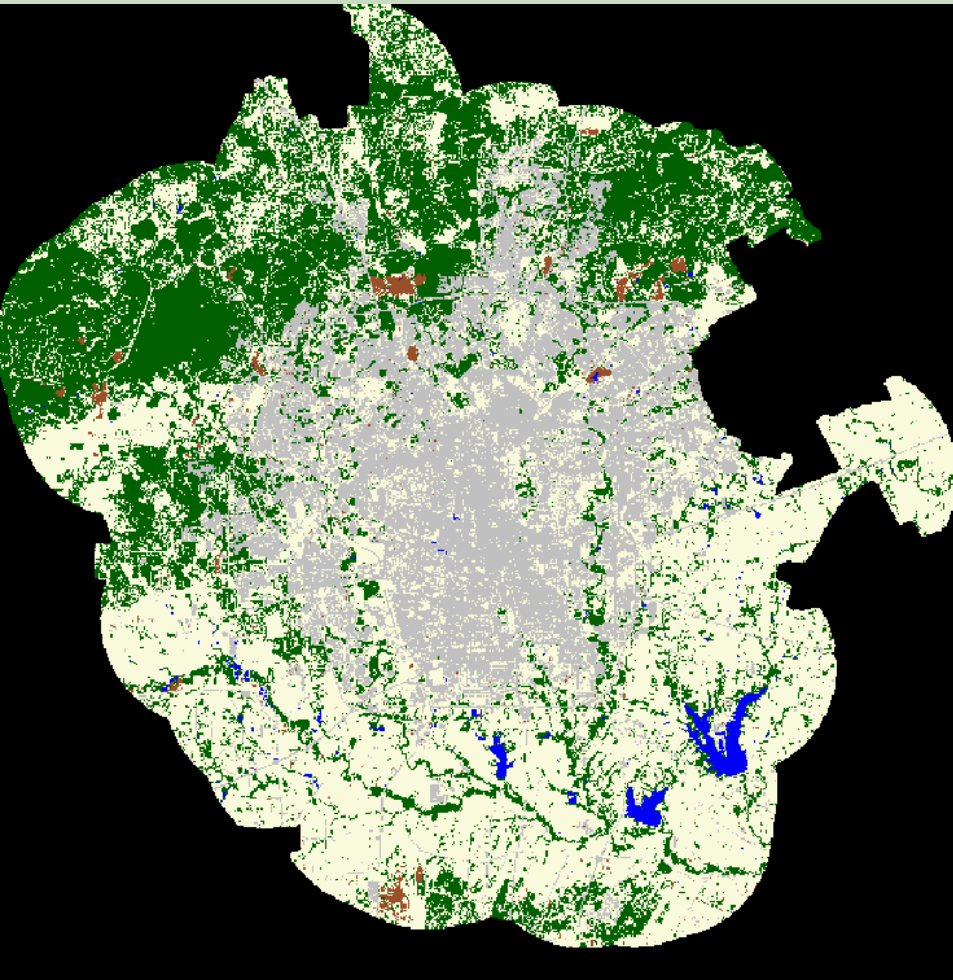
Landsat Satellite Data

- Moderate resolution: 30 meter pixel
- Landcover changes over time 2001-2006
- Classification: Uses new NLCD methodology
- Resolution suited for landcover over large areas for general trends

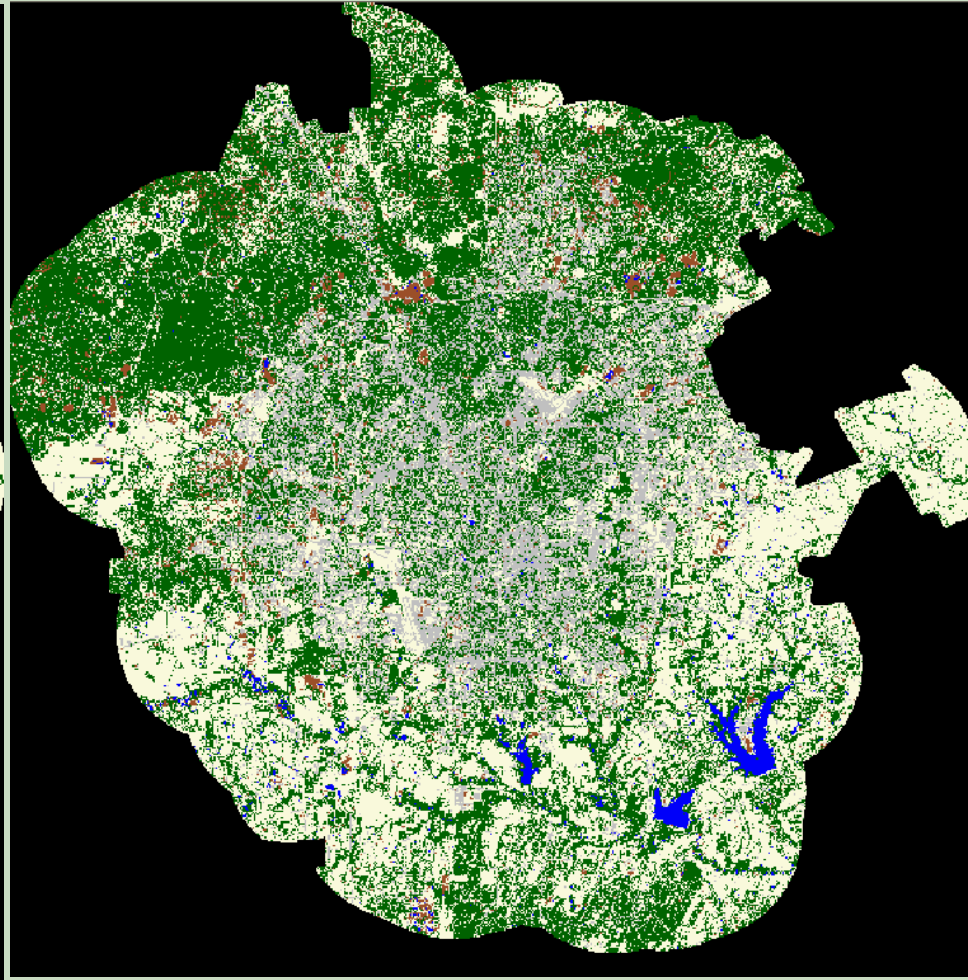
High Resolution Data

- Digital Multispectral Camera aerial
- 2 ft. pixel resolution
- 2007 landcover
- Suited for small areas: COSA, EARZ, Council Districts, land use areas for detailed analysis and modeling

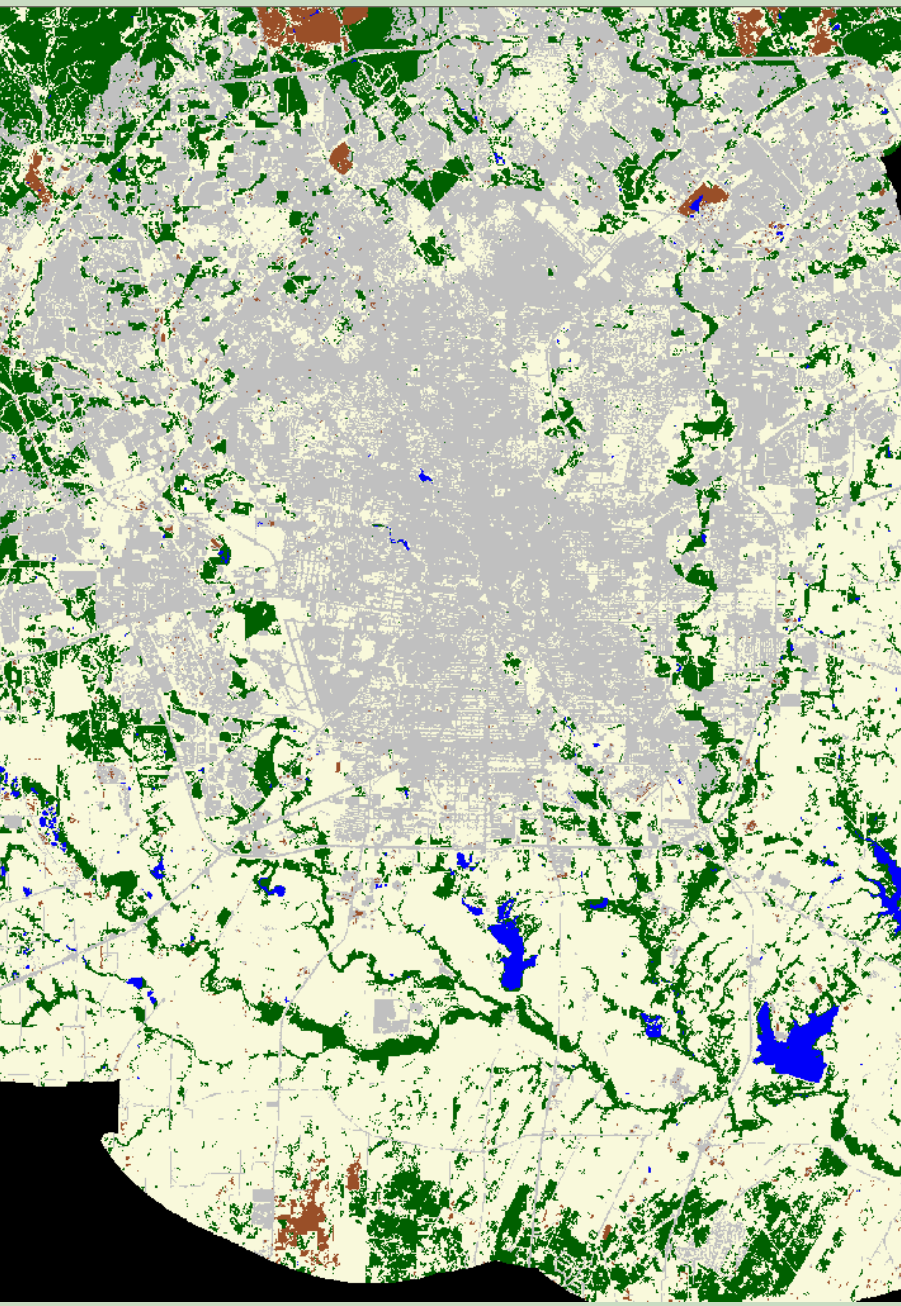
Landsat vs High Resolution Imagery



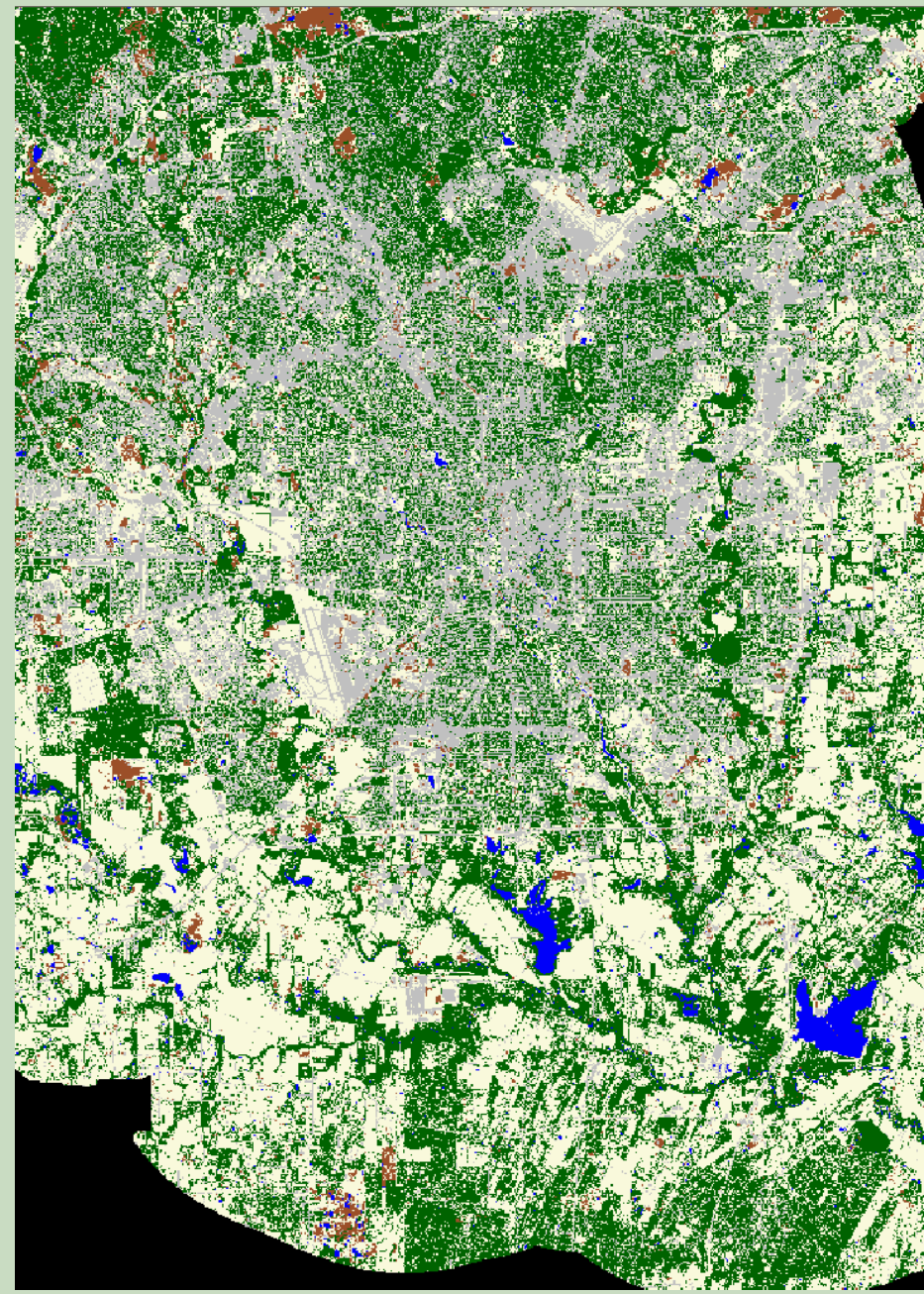
**Landsat imagery
(30 meter pixel size)**



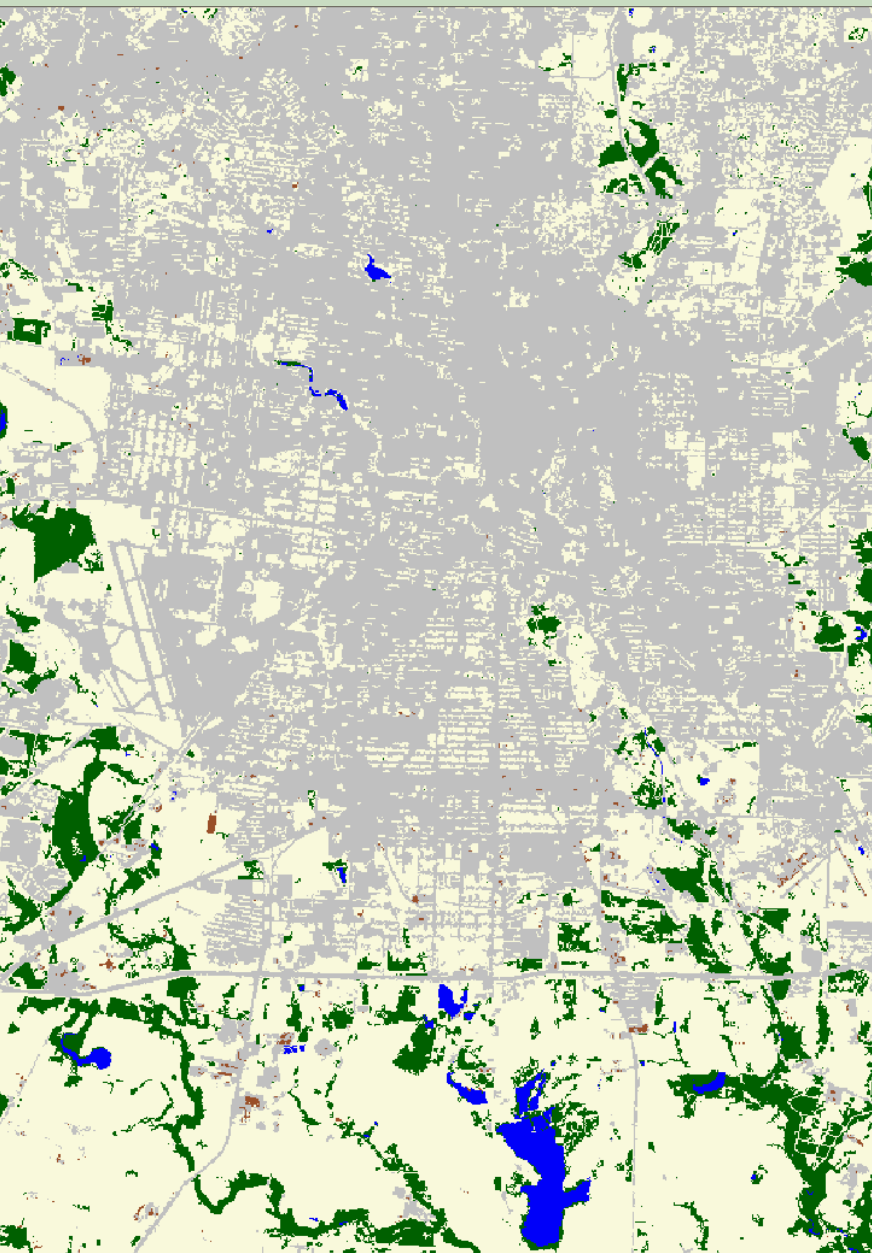
**High resolution imagery
(6 foot pixel size)**



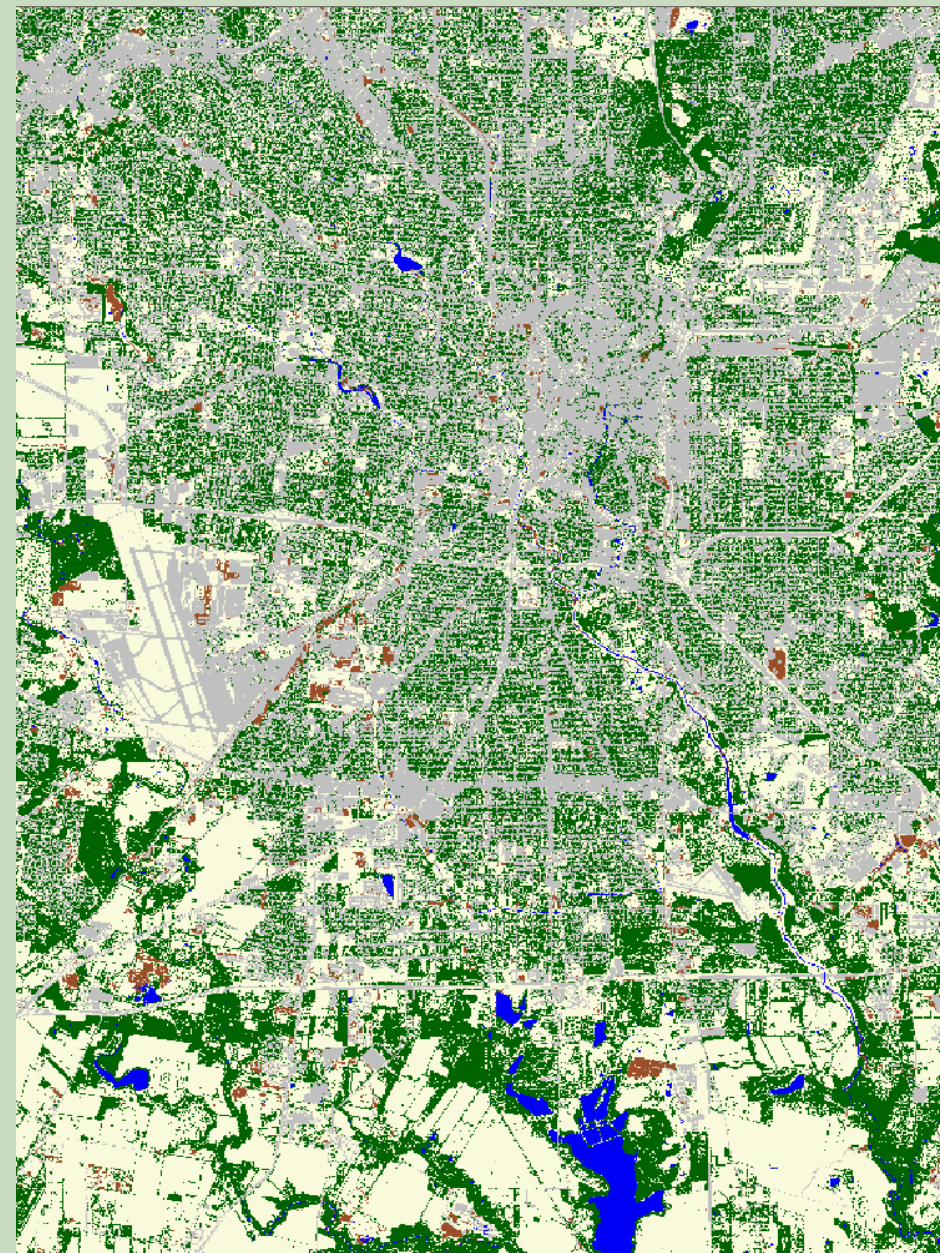
Landsat imagery (30 meter pixel size)



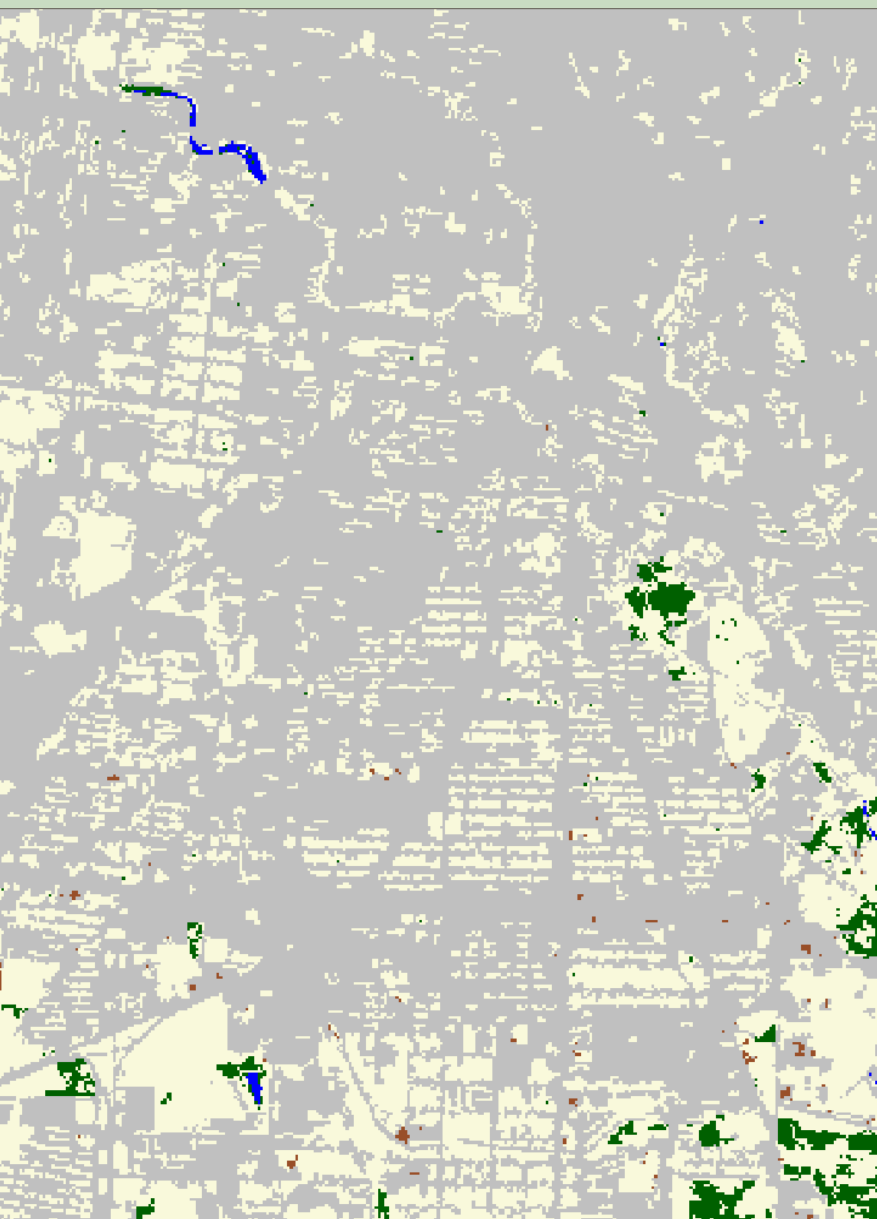
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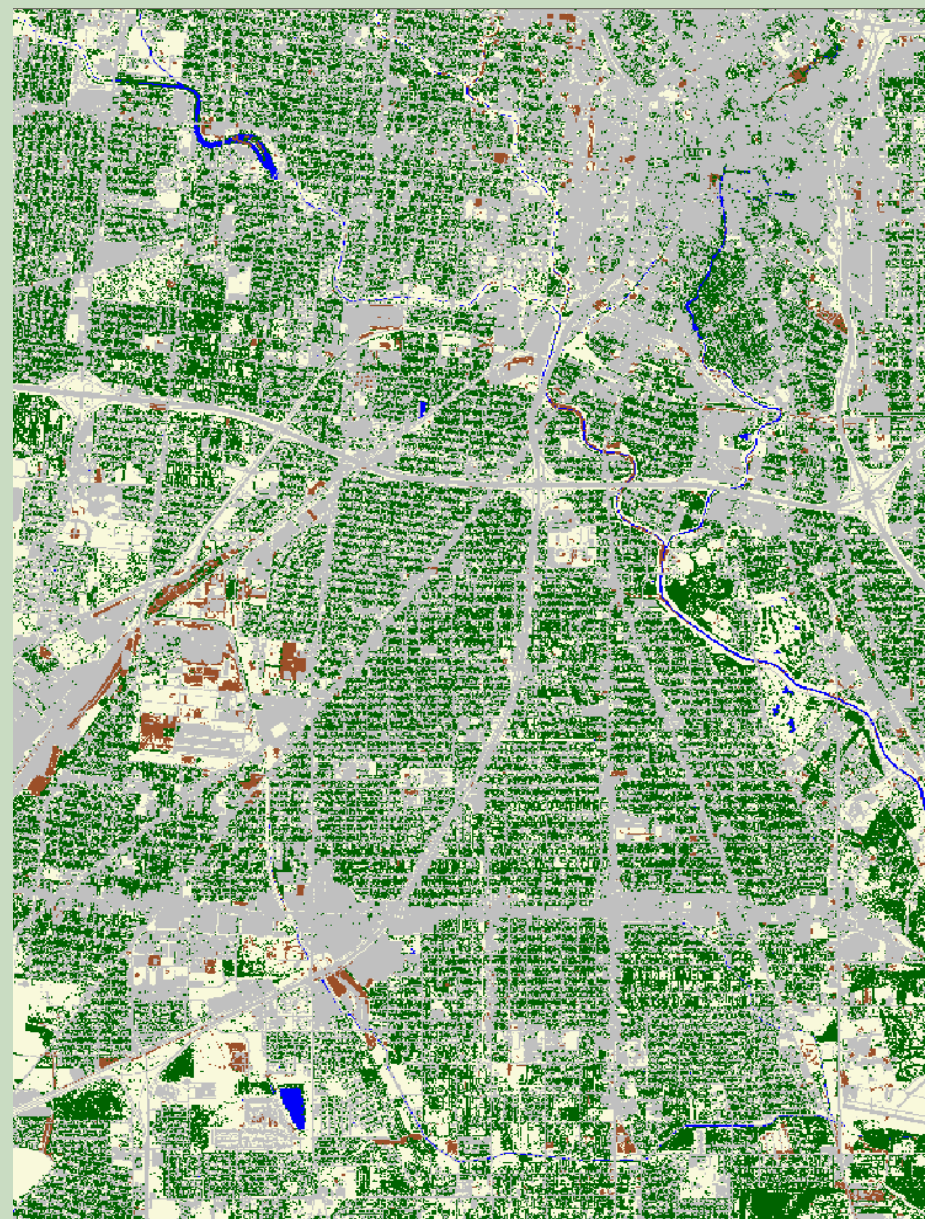
Landsat imagery (30 meter pixel size)



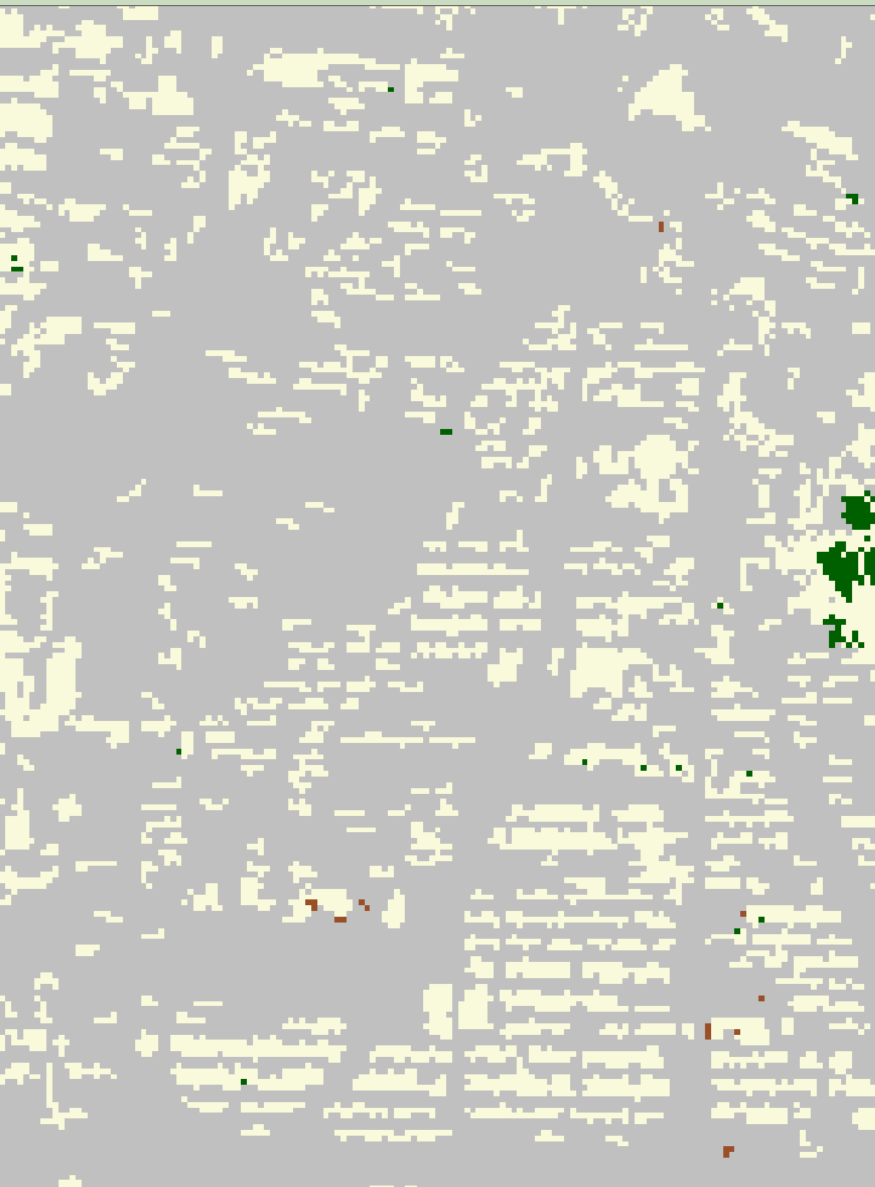
High resolution imagery (6 foot pixel size)



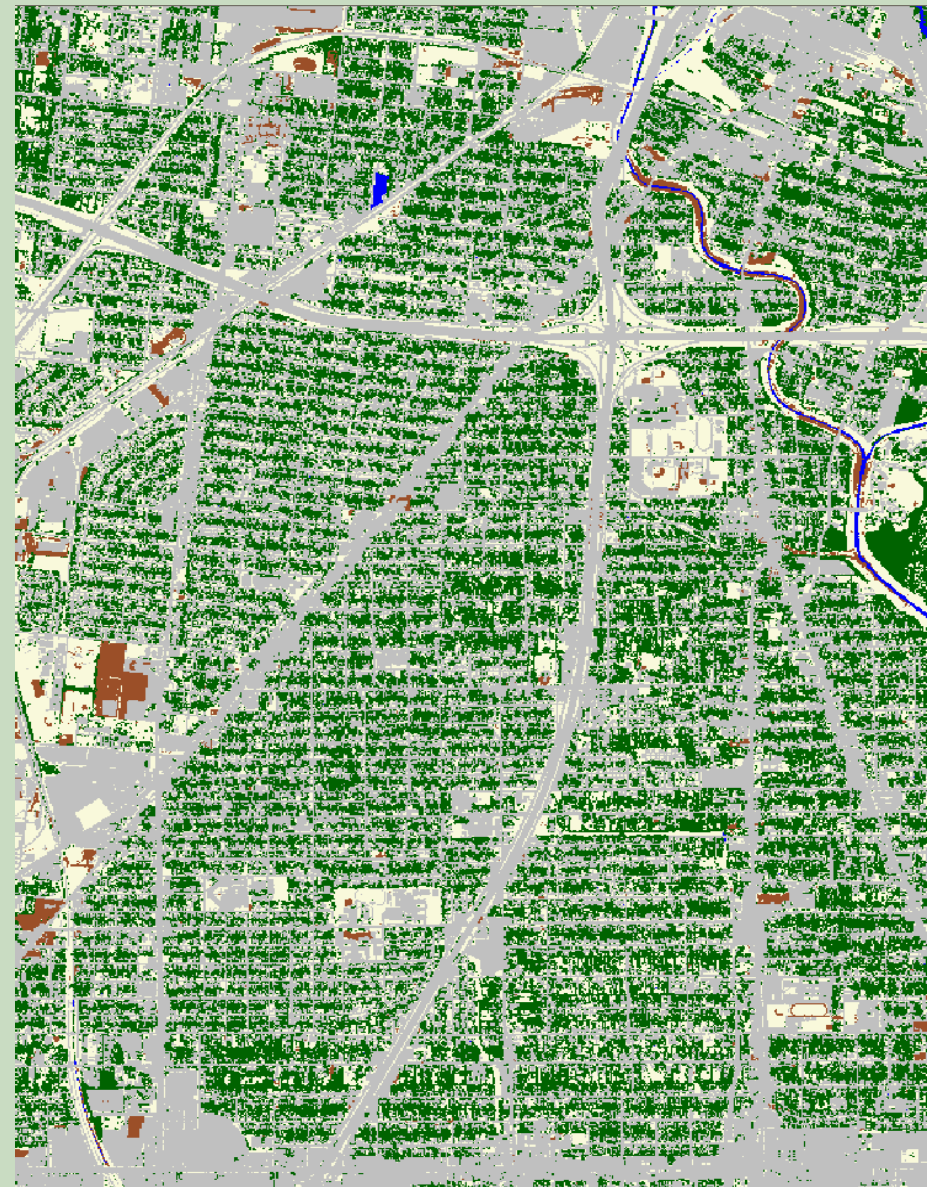
Landsat imagery (30 meter pixel size)



High resolution imagery (6 foot pixel size)



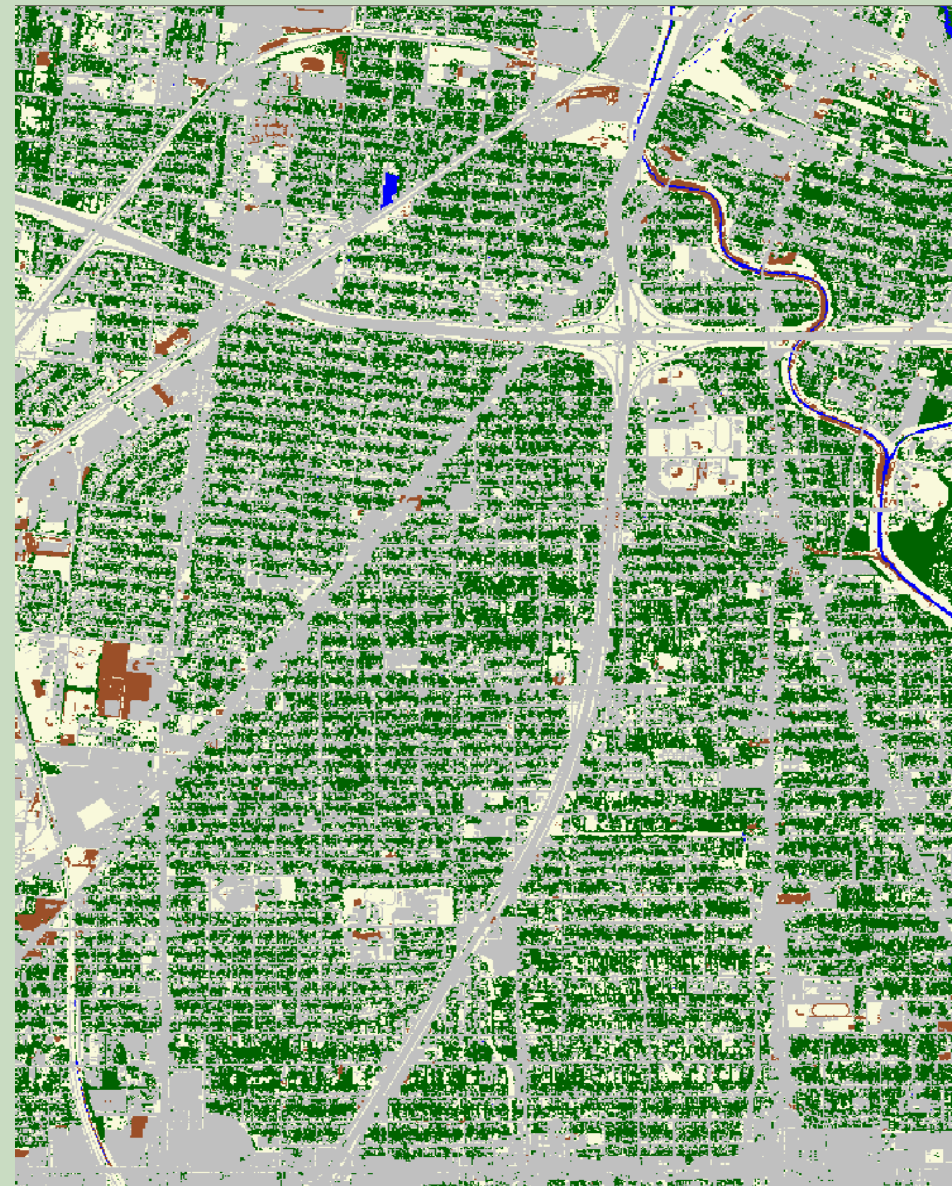
Landsat imagery (30 meter pixel size)



High resolution imagery (6 foot pixel size)



Landsat imagery (30 meter pixel size)

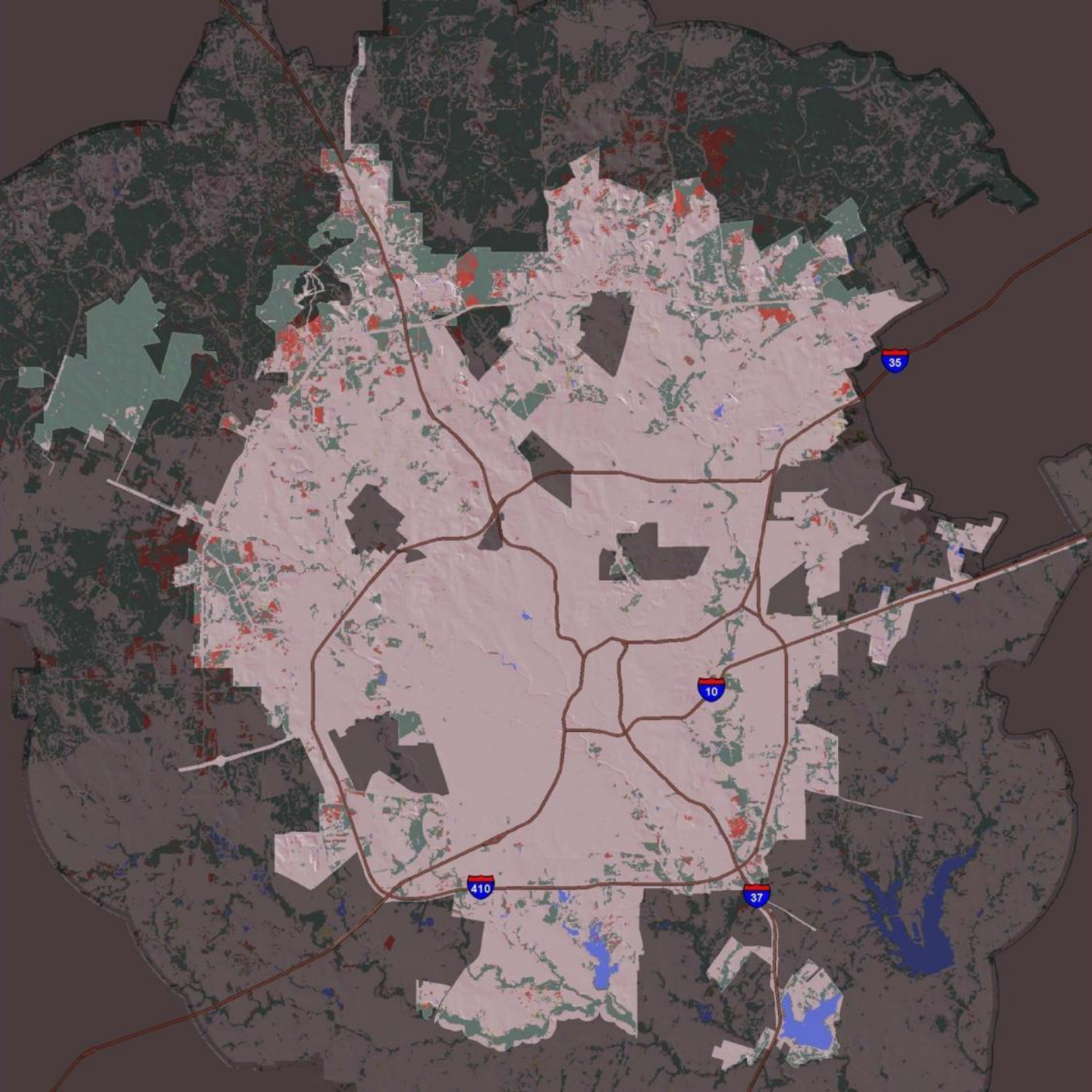


High resolution imagery (6 foot pixel size)

City of San Antonio

Landsat Analysis

Tree Canopy Loss
2001 - 2006



Edwards Aquifer Recharge Zone

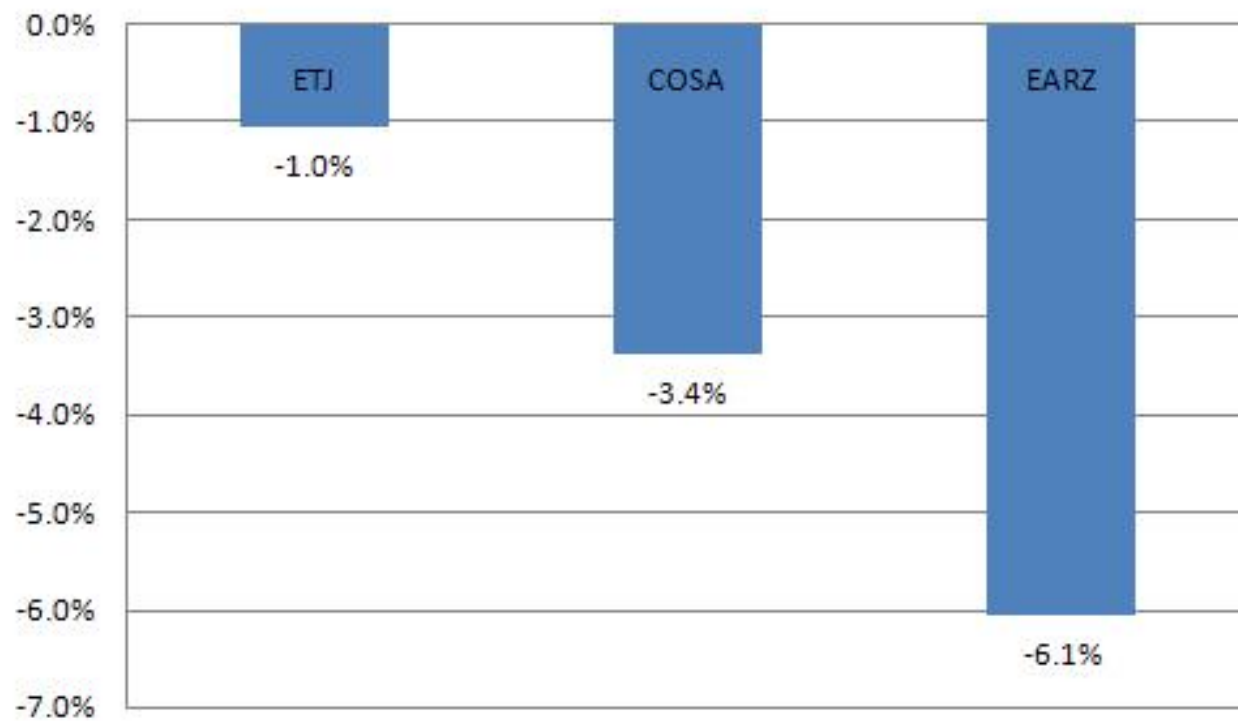
Landsat Analysis

Tree Canopy Loss
2001 - 2006

Portions of aquifer outside
San Antonio ETJ

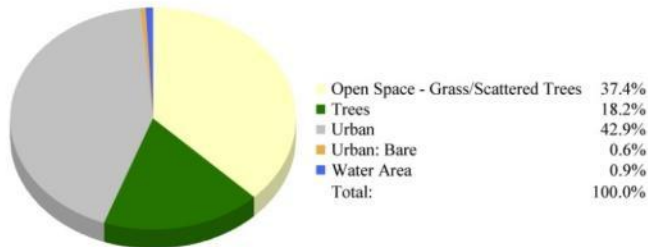


Tree Loss 2001-2006

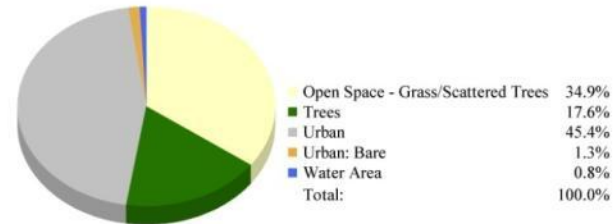


City of San Antonio, Texas
Landsat Analysis
2001 - 2006

2001 Landcover



2006 Landcover



Air Quality Results

Landcover Change (acres)

Landcover	2001	2006	Change
Tree Canopy:	54,420	52,587	-3%
Air Pollution Benefits			
Pollutants Removed (lbs):	6,112,360	5,906,392	-205,968
\$ Amount:	\$14,558,304	\$14,067,733	-\$490,572
Carbon Stored (tons):	2,341,787	2,262,875	-78,911
Carbon Sequestered (tons):	18,231	17,617	-614

Lbs. Removed per Year

Pollutant	2001	2006
Carbon Monoxide:	291,065	281,257
Nitrogen Dioxide:	970,216	937,522
Ozone:	2,522,561	2,437,558
Particulate Matter:	1,503,835	1,453,160
Sulfur Dioxide:	824,683	796,894
Total:	6,112,360	5,906,392

By absorbing and filtering out nitrogen dioxide (NO₂), sulfur dioxide (SO₂), ozone (O₃), carbon monoxide (CO), and particulate matter less than 10 microns (PM₁₀) in their leaves, urban trees perform a vital air cleaning service that directly affects the well-being of urban dwellers. This model, UFORE, developed by the US Forest Service, estimates the annual air pollution removal rate of trees within a defined study area for the pollutants listed below. To calculate the dollar value of these pollutants, economists use "externality" costs, or indirect costs borne by society such as rising health care expenditures and reduced tourism revenue. The actual externality costs used in the model is set by the each state, Public Services Commission.

Stormwater Results

Stormwater Volume Change Summary

2-yr, 24-hr Rainfall: 3.75 in.

Curve Number reflecting 2001 conditions: 80.98 *

Curve Number reflecting 2006 conditions: 81.67 *

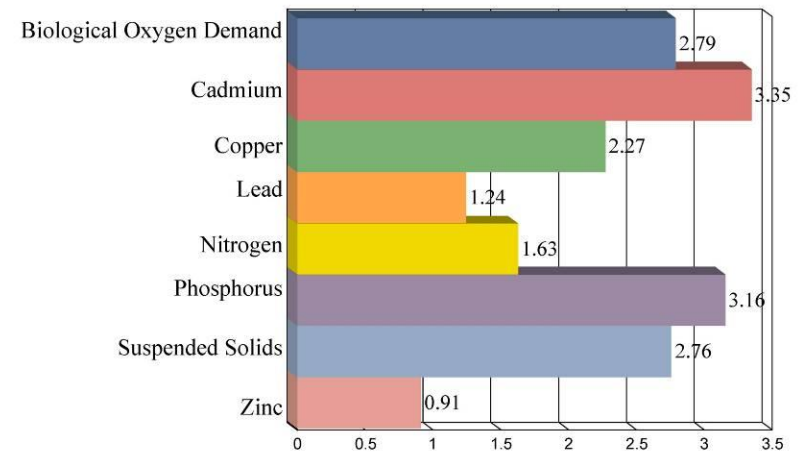
Change in stormwater volume due to
landcover change: 57,957,865 cu. ft.

Construction cost, per cu. ft. of
stormwater, to build retention facility : \$0.64

Cost of stormwater retention resulting
from landcover change: **\$37,093,034**

Water Quality (Contaminant Loading)

Percent Change in Contaminant Loadings from 2001 conditions to 2006 conditions



* The CITYgreen stormwater calculations are based on a curve number index (ranging from 30-100) developed by the Natural Resources Conservation Service (NRCS) to represent the potential for stormwater runoff within a drainage area. The higher the curve number the more runoff will occur. The change in curve number reflects the increase in the volume of stormwater runoff. Curve numbers used in the stormwater analysis were calibrated to the San Antonio area using actual storm event discharge records and stratified by soil type and land use (Pape-Dawson Engineers and American Forests, 2008).

Stormwater Analysis

- Tie stormwater runoff to 100% landcover
- Calibrate CN formulas to local data
- Local stream gage data
 - NRCS, SARA, COSA, Pape Dawson

Stormwater values based on local
construction costs= \$.64/cubic foot.

Loss in Ecosystem Benefits 2001-2006

2001-2006	Tree Canopy Change	Loss of Air Pollution Removal Value	Loss in Storm water Value @ \$.64/cu ft.	Loss of Carbon Stored	Loss of Carbon Sequestered
	%	dollar value	dollar value	tons	tons
ETJ	-1.2%	-\$704,000	-\$60 million	-113,000	-882
COSA	-3.4%	-\$491,000	-\$37 million	-79,000	-614
EARZ	-6.0%	-\$858,000	-26 million	-138,000	-1,074

Landsat Satellite data

30 meter pixel resolution

City of San Antonio 2007

38% tree canopy

28% open space

30% impervious

3 % bare soil

1% water

**6 ft. pixel
resolution data**



High Resolution Imagery Improvements

- Imagery collection- added infrared band
- Imagery resolution-2ft. Vs. 1-meter
- Classification-better able to discern landcover

Tree canopy has not increased, new technology allows us to better capture what is there

San Antonio Ecosystem Benefits 2007

- \$ 30 million air quality value/yr.
- \$ 623 million stormwater mitigation value
- 4.8 million tons carbon storage
- 38,000 tons carbon sequestration/yr.

2007 Landcover by Geographic Area

Landcover	ETJ	EARZ	COSA	City South
Trees	41%	55%	38%	36%
Open space, grass, scattered trees	40%	20%	28%	55%
Impervious	14%	20%	30%	5%
Bare soil	3%	5%	3%	1%
Water	1%	0%	1%	3%

6 ft. pixel resolution data

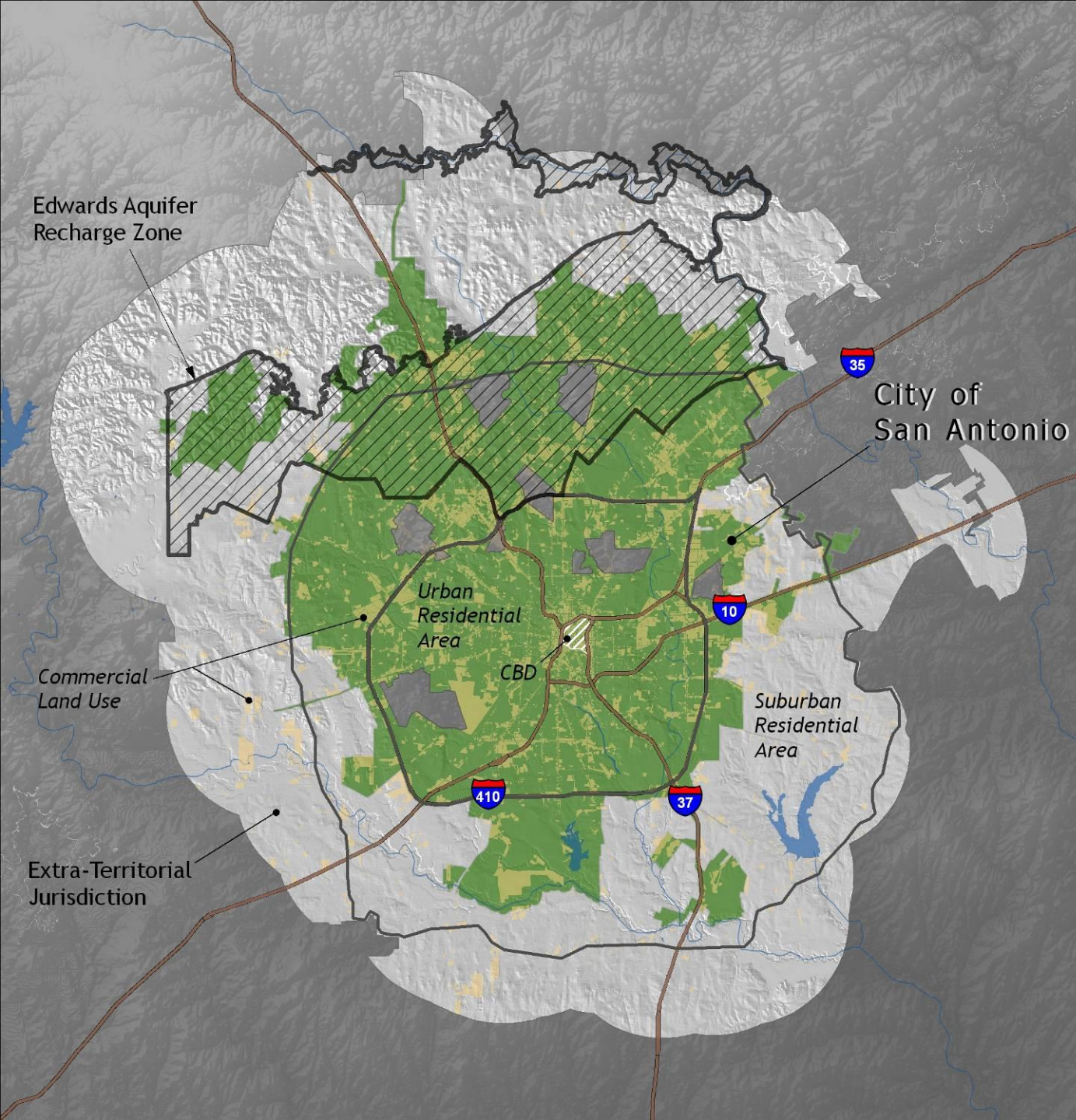
Land Use Sectors

CBD

Urban Res.

**Suburban
Res.**

Commercial



2007 Landcover by Landuse

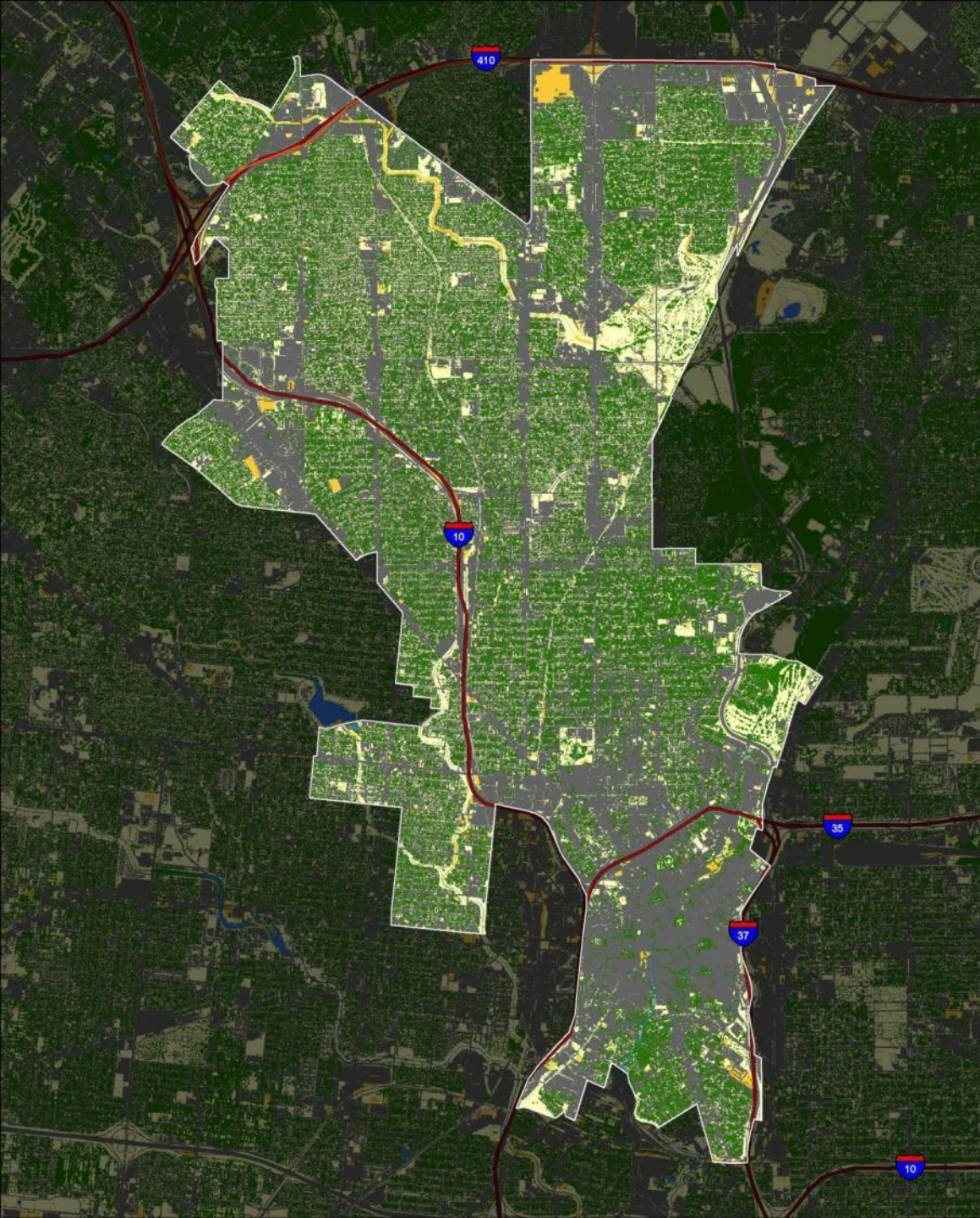
Landcover	CBD	Urban Res.	Suburban Res.	Commercial
Trees	12%	32%	33%	13%
Open space, grass, scattered trees	8%	30%	45%	37%
Impervious	78%	36%	18%	43%
Bare soil	1%	2%	2%	7%
Water	1%	<1%	3%	<1%

6 ft. pixel resolution data

2007 Ecosystem Services by Land Use

	Air Pollution Removal Value	Stormwater Value @ \$.64 per cu. ft	Carbon Stored	Carbon Sequest- ered
	dollar value	dollar value	tons	tons
Urban Res	\$9.2 million	\$210 million	1.5 million	12,000
Suburban Res	\$22.9 million	\$450 million	3.7 million	29,000
CBD	\$35,000	\$1.2 million	5,656	44
Commercial	\$2.4 million	\$54 million	383,000	3,000

City Council District 1



Land Boundary Changes

- Council Districts 3 and 4, increased
- Council District 8 decreased
- ETJ, City South increased
- EARZ within the ETJ increased

Ecosystem Services by Council District

	2007 Tree Canopy	Air Pollution Removal Value	Stormwater Value @ \$.64 per cu. Ft	Carbon Stored	Carbon Sequestered
	%	dollar value	dollar value	tons	tons
Council District 1	29%	\$1,090,078	\$27,407,539	175,345	1,365
Council District 2	26%	\$2,441,039	\$54,844,415	392,655	3,057
Council District 3	36%	\$4,370,426	\$96,999,227	703,008	5,473
Council District 4	30%	\$2,458,209	\$50,203,297	395,417	3,078
Council District 5	29%	\$918,823	\$20,028,650	147,798	1,151
Council District 6	49%	\$4,764,913	\$91,102,838	766,464	5,967
Council District 7	36%	\$1,841,740	\$38,711,826	296,254	2,306
Council District 8	48%	\$4,916,631	\$94,257,126	790,868	6,157
Council District 9	41%	\$3,840,829	\$77,140,134	617,819	4,810
Council District 10	41%	\$3,589,426	\$73,517,793	577,380	4,495

Why Set Tree Canopy Goals?

- Maintain tree canopy as region grows
- Big picture perspective
- Measurable: how are we doing?
- Stratified by land use

On the Cutting Edge:

- **Roanoke, VA**
- **Sacramento Region & Rocklin, CA**
- **Baltimore, MD**
- **Flower Mound, TX**

Recommended Tree Canopy Percentage

	Existing Tree Canopy %	Increase in tree canopy %	Recommended Tree Canopy %
City of San Antonio	38%	2%	40%
Land Use			
CBD	12%	3%	15%
Urban res.	32%	3%	35%
Suburban res.	33%	6%	39%
Commercial	13%	7%	20%
EARZ	55%	0%	55%

Added Value of Increased Tree Canopy

	Additional Air Pollution Removal Value	Additional Stormwater Value @ \$.64 per cu. ft	Additional Carbon Stored	Additional Carbon Sequest- ered
	dollar value	dollar value	tons	tons
COSA	\$1.7 million	\$2.1 million	276,000	2,100
Land Use				
Urban res.	\$814,000	\$1.7 million	131,000	1,000
Suburban res.	\$4.1 million	\$1.9 million	672,000	5,000
CBD	\$8,000	\$3,000	1,200	10
Commercial	\$1.2 million	\$1.8 million	200,000	1,500

Canopy Goals Translated into Trees

Land Use	Existing Tree Canopy %	Increase in tree canopy %	Recommended Tree Canopy %	TOTAL TREES
INSIDE COSA				454,600
CBD	12%	3%	15%	
Urban res.	32%	3%	35%	
Suburban res.	33%	6%	39%	
Commercial	13%	7%	20%	
EARZ	55%	0%	55%	
OUTSIDE COSA				573,700
Suburban res.	33%	6%	39%	
TOTAL TREES				1,028,300

Assume a 27 ft.
diameter tree canopy

Recommendations

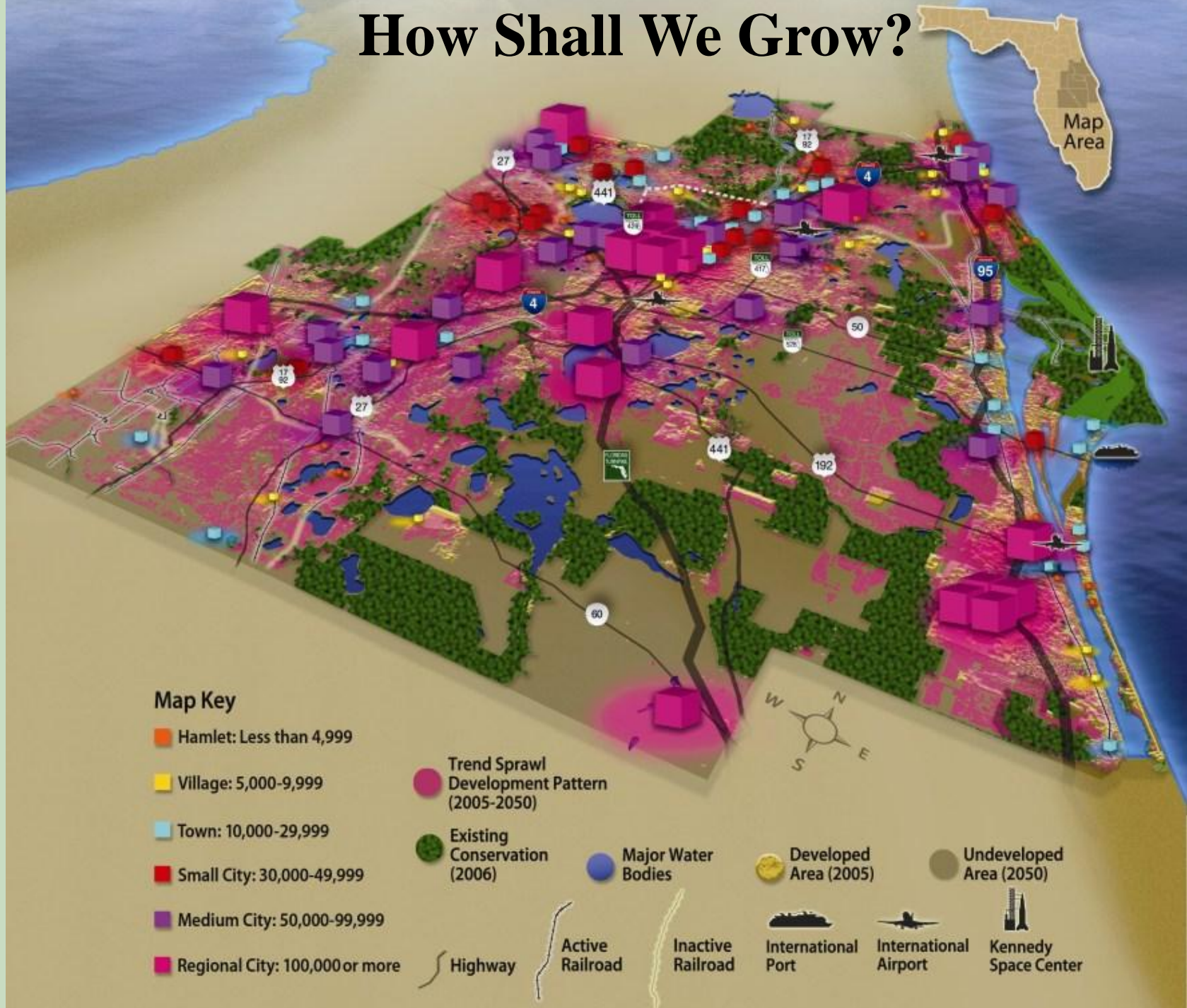
- Establish tree canopy goals
 - Check on progress periodically
- Use CITYgreen to model scenarios
- Share data with all city departments
- Public education: build awareness of ecosystem services of trees and what public can do

Goal: To provide San Antonio with the data and tools to make better informed decisions

How Shall We Grow?



How Shall We Grow?



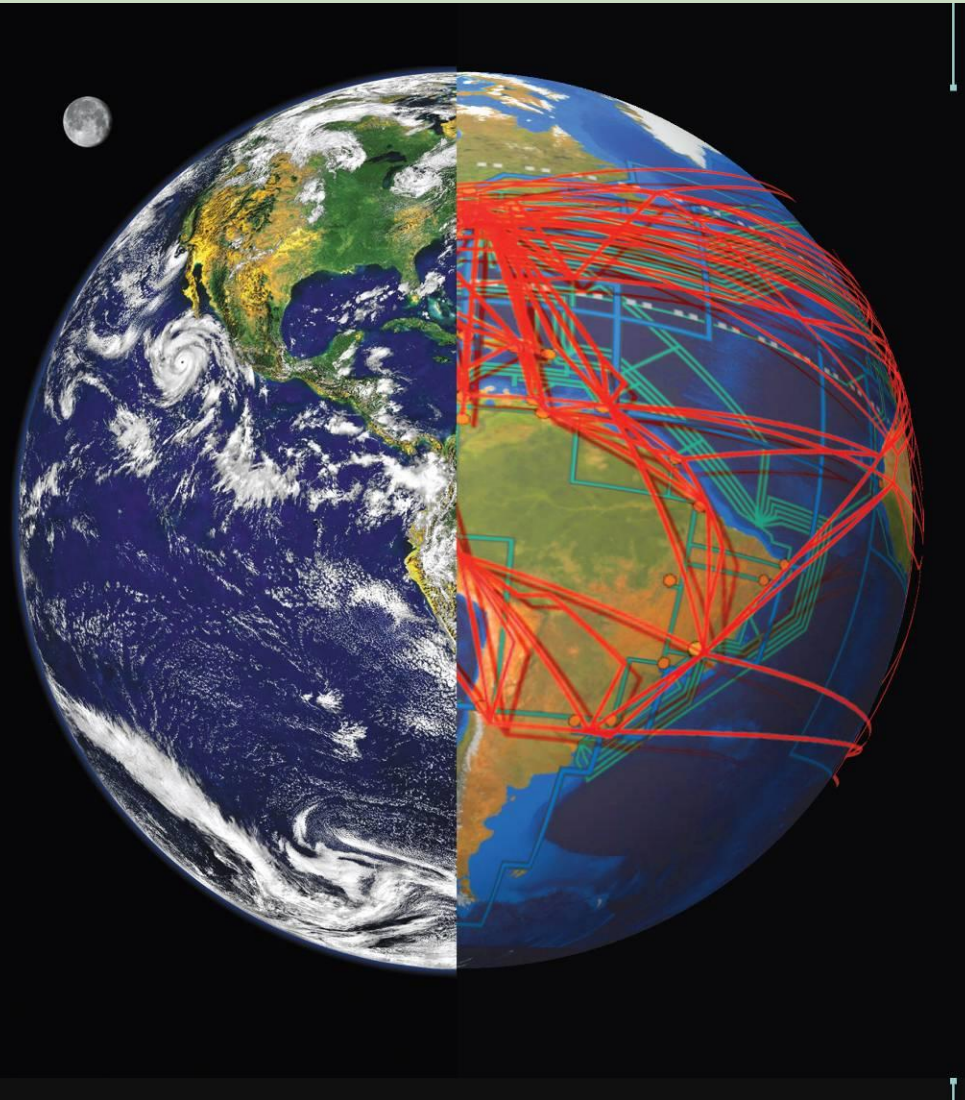
How Shall We Grow?



MyRegion.org



Nature and the Human Network



American Forests Website:

www.americanforests.org