GIS/GPS-TECHNOLOGY BASED TREE INVENTORY AND SPATIAL MODELING TRAINING FOR COLLEGE AND HIGH SCHOOL STUDENTS

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ABSTRACT

In this study an innovative tree inventory process using GIS and GPS technologies was developed to collect baseline data about trees. It was the partnership of Southern University with Baton Rouge Green, a local non-profit greening organization and Lee High, a local High School. CITYGREEN, a desktop GIS software package, provided the resources to analyze the ecological and economic value of trees in relationship to storm water management, energy conservation, carbon storage, and air pollution. . The baseline data for each tree was uploaded using a GPS data dictionary. Tree inventories were conducted for two projects. The first project involved Southern University students, who applied the methodology to carry out an inventory of the existing public street trees in the Old South Baton Rouge neighborhood. In teams of five, students identified the campus tree species, diameter at breast height (DBH), height, health, and observed growing conditions. The location of 194 trees were referenced on each sector map with points and numbers and cross referenced on accompanying attribute data tablesThe result of the tree

inventory showed the distribution of tree species. In the second project over 125 environmental science students from Robert E. Lee High School, under the guidance of teacher Ed Drangmeister completed a tree inventory of the 220 trees currently growing on their campus. The data collected was uploaded onto CITYGREEN to determine the benefits of campus trees.

INTRODUCTION

The project utilized GIS technology to quantify areas that require systematic green infrastructure planning in Louisiana, evaluate the potential impact of its implementation, and avail the analysis to the public as a way of encouraging environmental stewardship of natural resources in Louisiana. The principal investigators worked with high school, baccalaureate and masters-degree students to address this issue. Students received research training and participated in research that provide information on GIS applications in green infrastructure to local government officials, and individual residents.

Vegetative cover or green spaces drives water balance, enhance air quality and boosts aesthetic value. Interconnectivity of green spaces to make them ecologically functional is defined as green infrastructure. Green spaces are critical to natural resources management and environmental pollution mitigation. Green infrastructure provides the ecological framework for environmental, social and economic sustainability. Green infrastructure enhances transportation planning, economic development and re-development and makes the community more desirable as a home and workplace.

The project produced and utilized maps and spatial data that would incorporate green infrastructure planning to natural resources management. Students were exposed to state-of-the-art research technology that will equip them with skills to utilize spatial technologies and sciences to tackle and address research problems in the food and agricultural sciences. Research utilizing GIS technologies is a methodology that will be applicable to natural resources management, environmental health, nutrition, environmental sciences and agriculture. The GIS and GPS applications were divided into two approaches, the first one was a) Spatial Technology application in Urban Tree Inventory Management, while b) GIS Applications in Ecosystem Modeling.

Old South Baton Rouge

Trees are not just for looks in Old South Baton Rouge; they are an integral component of the neighborhood infrastructure providing economic and ecological benefits that enhance the quality of life of its residents. Old South Baton Rouge is an established neighborhood strategically located between Louisiana State University and downtown Baton Rouge, Louisiana. The geographic boundaries of the neighborhood are Government Street on the North; East State Street/Chimes Street on the South; Park Boulevard/Dalrymple Drive on the East; and River Road on the West.

CITYGREEN ^{TM} Workshops for High School Teachers and Students.

. Dr. Fulbert Namwamba, of Southern University of Southern University and Peggy Davies of baton Rouge Green, trained teachers in GIS, and application of Citygreen Software. Peggy Davies of Baton Rouge Baton Rouge Green and Ed Drangmeister worked together at the Lee High School Computer Lab to classify land use categories on a regional geo-referenced image of the Bayou Duplantier Watershed .

METHODOLOGY

In order to collect baseline data about the existing public street trees in the Old South Baton Rouge neighborhood with the goal of tracking their growth annually, Southern University Urban Forestry faculty and graduate level urban forestry students developed an innovative tree inventory process using GIS and GPS technology in partnership with Baton Rouge Green, a local non-profit greening organization. During 2004 we will use the classified image to execute a regional analysis. Dr. Fulbert Namwamba, GIS Specialist with Southern University, worked with Baton Rouge Green and Ed Drangmeister to resolve the difficulties experienced with the Seagate Crystal Report Software. The Seagate Crystal Report Software is now working properly and executing urban ecosystem analysis report summaries After completing the regional analysis, we will have completed CITYgreen training for Ed Drangmeister. The CITYgreen support team, Baton Rouge Green staff and Dr. Fulbert Namwamba, will continue to provide ongoing assistance as may be needed by Ed Drangmeister as he implements the project with new students.

RESULTS

Old South Baton Rouge Tree Inventory Summary

The result of the tree inventory is presented in A-E Sector Aerial Maps *(see the map delineating the location of each sector)*. The location of 194 trees are referenced on each sector map with points and numbers and cross referenced on accompanying attribute data tables. The baseline data in each attribute table includes tree species code, diameter at breast height in inches, height class classification number (1) < 25 feet (2) 25-45 feet (3) >45 feet, tree health classification number (1) removal recommended (2) very poor (3) poor (4) fair (5) good, maintenance, conflicts, common tree name, street name, ground cover and direction. The result of the tree inventory showed that the largest percentage of public street trees are Crape Myrtles (52%), followed by Little Gem Magnolias (14%), Bradford Pear (8%), Bald cypress (7%), Live Oak (3%), Chinese Tallow (2%), Chinese Elm (2%) and the remaining trees at 1% respectively are River Birch, Eastern Red Cedar, American Elm, Winged Elm, Hackberry, Loblolly Pine, Southern Magnolia, Red Maple, Silver Maple, Burr Oak, Water Oak and Pecan. Over 75% of the public street trees were planted along Nicholson Road by Baton Rouge Green and East Washington Street by the City/Parish DPW Office of Landscape & Forestry.

Lee High Citygreen Modeling

After resolving the Seagate Crystal Report Software problems, Dr. Fulbert Namwamba, Baton Rouge Green and Ed Drangmeister were able to execute a CITYgreen Local Analysis of the Lee High School campus using data gathered by the students. Included with the report are three different CITYgreen analysis scenarios that we worked on together to generate. The R E Lee High analysis report summarizes benefits based on the current tree coverage found on the school campus:

- Annual Air Pollution Removal Savings: $ 1,031.80
- Annual Energy Savings: $ 3,420.00
- Annual Storm water Savings: $41,206.39
- Total Annual Savings: $45,658.19

The Twenty Lee High analysis report summarizes benefits based on a twenty year growth model and the resulting increased benefits:

- Annual Air Pollution Removal Savings: $ 1,054.04
- Annual Energy Savings: $ 6,228.00
- Annual Storm water Savings: $46,090.29
- Total Annual Savings: $53,372.33

The Fifty Lee High analysis report summarizes benefits based on a fifty year growth model and the resulting increased benefits:

- Annual Air Pollution Removal Savings: $ 1,156.66
- Annual Energy Savings: $ 8,640.00
- Annual Storm water Savings: $46,090.29
- Total Annual Savings: $55,886.95

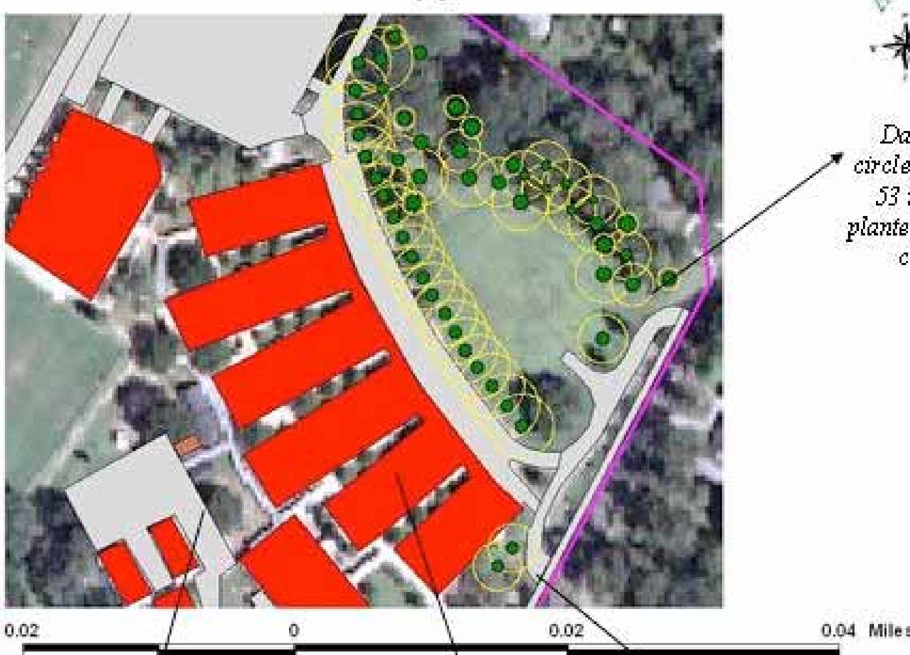
Baton Rouge Green has asked Richard Himel, Ferris Engineering, to provide a more accurate figure for the Greater Baton Rouge Area for storm water retention construction cost in cubic feet. The storm water retention construction cost figures used in the three analyses were figures provided by American Forest, which may vary in our region. We will provide updated analyses once the local figure has been substituted for the American Forest storm water retention construction cost figures. CITYgreen 5.0 manuals (11) were purchased as a permanent resource for the Lee High School Computer Lab. In addition, Hyperstudio Software was purchased to begin to develop a multi-media presentation for community outreach meetings (i.e. Baton Rouge Green Board Meeting, EBRP School Board Meeting, LADEQ Interagency Meeting, etc.).

CONCLUSIONS

Students at all levels were trained in GIS/GPS application in resolving environmental issues in their own neighborhoods. In the process the students at all levels were trained in multitasking, research, and report writing. In the process practical solutions were provided for neighborhood environments and watershed protection. The work was part of a larger project sponsored by Louisiana Department of Environmental Quality and the City of Baton Rouge.

Robert E. Lee High School
New Tree Canopy 2015

CITYgreen



Dark green circles represent 53 new trees planted on school campus

Grey objects represent impervious surfaces

Red objects represent school buildings

Yellow outlined circles represent tree canopy growth in ten years according to CITYgreen analysis

Baton Rouge Green

AMERICAN FORESTS
americanforests.org

Analysis Report

CITYgreen

Site Statistics

Analysis Area: R E Lee High

Scenario: Current Conditions

Area:

0.04 sq. miles
27.46 acres
11.11 hectares

Landcover Distribution:		Acres
0%	Cropland	0.00
33%	Impervious	8.93
0%	Open Space/Pasture/Meadow	0.00
0%	Shrubs	0.00
15%	Tree Canopy	4.09
67%	Urban Land Use	18.53
0%	Water	0.00

Ecological Benefits

Air Pollution Removal

Air Quality Reference City: Austin

	lbs Removed	Dollar Value
Ozone:	175.95	$540.00
Sulfur Dioxide:	53.57	$40.28
Nitrogen Dioxide:	70.05	$215.00
Particulate Matter:	110.57	$226.62
Carbon Monoxide:	22.74	$9.90
Total:	**432.87**	**$1,031.80**

Residential Cooling Effects

Average Annual Cooling Cost per Home:		$2,000.00
Number of Homes:	11	
Savings from Trees:		$3,420.00
Savings from Roofs:		$0.00
Total Savings:		**$3,420.00**
Savings per Home:		$310.91
Kilowatt-hours Saved:	62,181.82	
KWHs Saved per Home:	5,652.89	
Carbon Generation Avoided:	2,076,627.73 lbs.	
Carbon Generation Avoided per Home:	188,784.34 lbs.	

Carbon Storage and Sequestration

Age Distribution of Trees:		Mature
Carbon Storage:	180.86	tons
Carbon Sequestration:	620	pounds/year

Stormwater Control

Average 2-yr. 24-hour Rainfall:	24.00 in.	
Rainfall Distribution Type:	III	
Hydrologic Soil Group:	C	
Average Slope:	1 %	

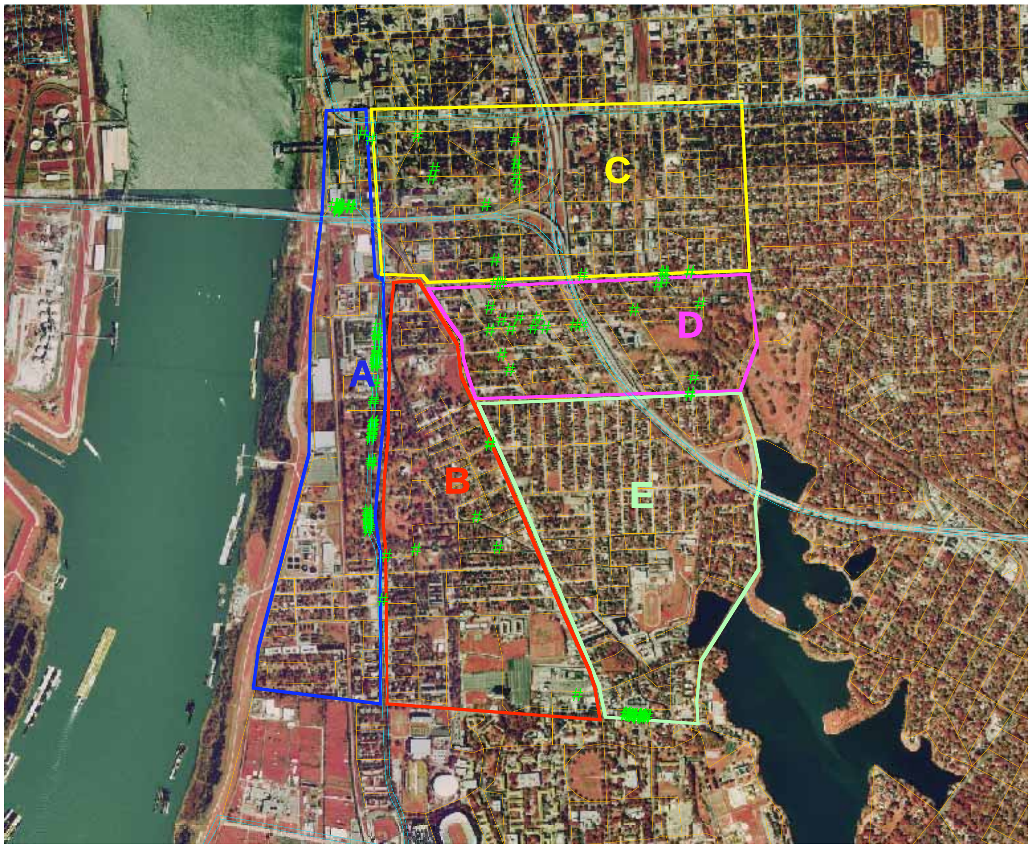
	Conditions: Current	w/o trees*
Curve Number:	94	95
Runoff (in.):	23.25	23.38
Time of Concentration (hrs.):	0.44	0.42
Peak Flow (cu ft/s.):	432.93	443.87
Storage volume needed to mitigate the change in peak flow:	236,317.00	cu. ft.
Construction cost:	$2.00	per cu. ft.
Total	**$472,634.00**	

*Replaced by default landcover: Urban: Commercial/Business

Economic Benefit Summary

Annual Air Pollution Removal Savings:	$1,031.80
Annual Energy Savings:	$3,420.00
Annual Stormwater Savings*:	$41,206.39
Total Annual Savings:	$45,658.19

*Annual Stormwater savings is based on financing over 20 years at 6%



A
B
C
D
E