Proposal: Austin Tree-Canopy Resource, Phase II

Urban Forestry Program and Urban Forestry Board, City of Austin, Texas

Spring 2012, Geography 4427, Texas State University
February 22, 2012

Client:

Urban Forestry Program and Urban Forestry Board, City of Austin, Texas

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Introduction

Summary

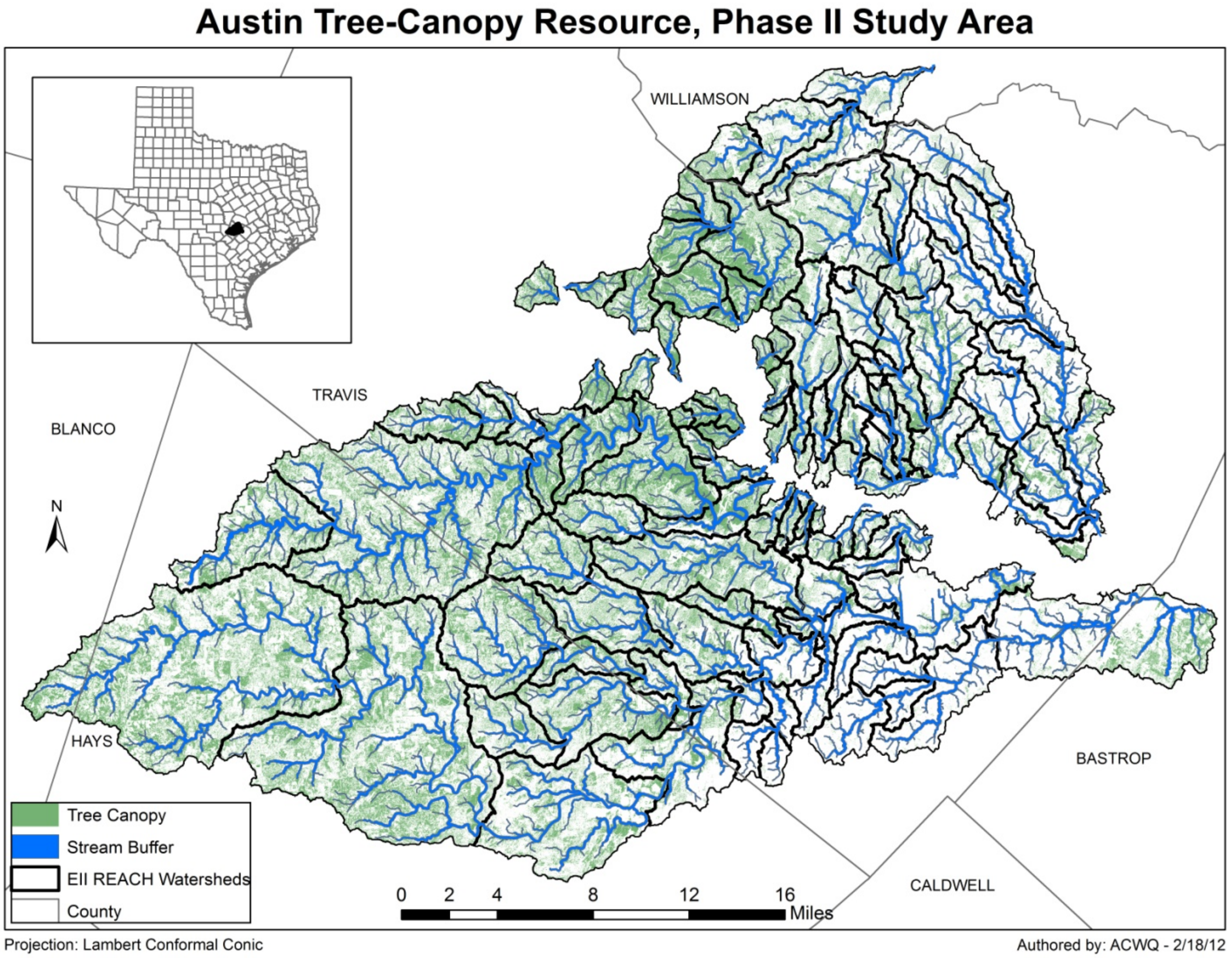
When people look at a tree, they do not realize the importance all of the parts can have. The canopy of the tree is one of the most important elements not only to the tree, but the environment around it. The Austin Urban Forestry Program approached Austin Canopy and Water Quality seeking information about this relationship. As GIS analysts and environmental researchers the team at ACWQ possesses the skills and knowledge needed to complete this task.

Purpose and Objectives

The purpose of ACWQ's research will be to establish the percentage of canopy coverage within buffers around stream reaches defined by the Urban Forestry Program. The main goal will be to determine the impact of the canopy on the water quality of the reaches and watershed system as a whole. We will also establish the relationship between water quality, soil type, impervious cover and vegetation. Time permitting we will analyze the accuracy of the canopy layer against an aerial image in Arc globe, of the smallest watershed. The information collected from our research will be very valuable to future land use plans, development and environmental policy.

Scope

Our research will be done along stream reaches defined by the Urban Forestry Program. Specific buffer areas relating to canopy will be assigned to the reaches encompassing an area no larger than 400 feet.


Austin Tree-Canopy Resource, Phase II Study Area
WILLIAMSON
TRAVIS
BLANCO
HAYS
BASTROP
CALDWELL
N
Tree Canopy
Stream Buffer
EII REACH Watersheds
County
0 2 4 8 12 16 Miles
Projection: Lambert Conformal Conic
Authored by: ACWQ - 2/18/12

Literature Review

Water Quality

Urbanization increases the land area that is covered with impermeable surfaces such as streets, sidewalks, driveways, and building rooftops. As a result, rain falling on these surfaces flows quickly into sewers, which increases the incidence and severity of flooding. Tree canopies intercept rainfall, thereby reducing peak discharge into stormwater sewers. This interception allows for groundwater recharge, filters toxins and impurities, reduces the cost of stormwater disposal, and averts flooding and sedimentation of waterways. Soil, amount of rain, and other factors also affect stormwater runoff rates. The amount of tree canopy in urban environments, however, is a “controllable” element that significantly and measurably affects stormwater runoff rates and volumes.

Within the last fifteen years, many cities have become aware of the direct relationship between tree canopy and the ecosystem services they provide. Trees reduce the volume of stormwater runoff by capturing rain on their leaves and branches, the water is then put back into the water cycle via evapotranspiration. Trees absorb water pollutants and other water filtrates into the soil for a gradual release into streams, rather than running off the land, and extending water availability into dry months when it’s most needed.

Runoff pollution is a major contributor to the decrease of water quality and is often overlooked environmental problem. A single large-sized tree can release 400 gallons of water into the atmosphere a day. One acre of trees produces enough oxygen for 18 people every day. One acre of tree absorbs enough carbon dioxide per year to match that emitted by driving a car 26,000 miles. Planting a tree can keep water clean and drinkable.

Vegetation

An assessment performed by the University of Tirana, Albania analyzes vegetation cover and its watershed at Prespa lakes. Human impacts on ecosystems have damaged vegetative cover, especially in reference to the last 50 years, as economic development has permanently devastated biological and landscape diversity. Vegetation types affect soil consistency, water balances in the watershed, organic matter nutrient balance and erosion rates; decreasing the amount of vegetative cover reduces the groundwater recharge, increases the runoff, and reduces the unit water yield.

The specific study area was the Prespa National Park which is located in the Southeastern part of Albania, and includes Lakes Macro and Micro Prepa and their catchment's areas. It was found that as a result of overgrazing more than 10% of the vegetative cover was prone to erosion or had become sparsely vegetated. The reduction of forest vegetation was reduced mostly by wood cutting and logging. The lowest slopes were most exploited from the agricultural use.

Overall, the overexploitation of the forests and shrubs combined with the overgrazing, agricultural, and logging were the reasons of the decrease of the vegetation cover of the Prespa watershed.

Soil

According to Soil Quality for Environmental Health there is a definite correlation between soil and water quality. Large amounts of soil are carried into water bodies through runoff. This sediment can collect behind dams, in streams, storm sewers, and other water bodies. As time goes by and the accumulation of sediment increases, water clarity will decrease. Another factor created by soil runoff is eutrophication. Eutrophication is the process of excess nitrogen and phosphorous being leached or washed out of the soil and into waterways. This excess nitrogen and phosphorus can lead to a reduction in oxygen available to fish, and an increase in plant and algae growth. Soil erosion is caused by a lack of vegetation which when there, holds the soil together. This would suggest that soil and water quality can be tied to the tree canopy.

Benefits of Tree Shade in Pavement Longevity

Studies show that the deterioration of pavement is greatly reduced by the presence of shade trees along a roadway. Asphalt roads are built with a combination of aggregate filler, asphalt cement, and a binder laid upon layers of compacted gravel and dirt. Over time the binder will evaporate due to the heat leaving the roads to developing small cracks which over time will grow larger. Eventually water will penetrate into theses cracks and compromise the subgrade and creating large holes in the roadway. Routine maintenance of filling and covering cracks is the recommended treatment to extend the roadways life. The study showed that over a 30 year period, a typical segment of roadway, an area of 125ft by 35ft, cost $4791.00 to maintain. A segment which had small-stature trees cost an average of $4142.00 for maintenance. Finally, a segment of roadway with large-stature trees cost $2900.00 to maintain. It is concluded that having roadway lined with small-stature tress will save 17% in cost over a 30 year period while large-stature trees will save 58% in cost.

Proposal

Data

ESRI ArcGIS 10, a geographic information system a (GIS)-based program, will be used to evaluate selected benefits provided by the tree canopy. We will assess the quantity and distribution of tree canopy indices along specific stream reaches in the greater Austin area.

The GIS data sets required to develop tree canopy indices for stream reaches in Austin will be provided by the City of Austin's Urban Forestry Program, and by downloading the essential datasets from agency websites.

Data Set	Source
Tree Canopy	City of Austin (COA)
Watershed	City of Austin (COA)
Creeks	City of Austin (COA)
County Lines	City of Austin (COA)
City boundary	City of Austin (COA)
EII REACH Watersheds	COA Urban Forestry Program
Soil Type	USDA Natural Resources Conservation Services
DEM	COA Urban Forestry Program
Habitat (Eco Regions)	Texas Parks & Wildlife (TPWD)
Hydrology	Texas Parks & Wildlife (TPWD)
Water Quality Monitoring Stations	Texas Commission on Environmental Quality (TCEQ)
Impervious Cover	United States Geological Survey (USGS)

Methodology

Tools such as GIS allow for large-scale assessments for tree canopy planning that can include parks, forests, and possible green-space linkages. These spatial analyses and inventories provide current, comprehensive information vital to tree canopy decision-making and identify opportunities for a coordinated effort to guide future development in a manner that will take advantage of all the social and ecological functions available from the trees.

The procedures necessary for determining the quantity and distribution of tree canopy along the specific stream reaches and identifying the impact the tree canopy can have on water quality as it relates to soil, impervious cover, and ecologic region, will be separated into four phases.

Phase I: *Literature Research and Review*

Phase II: *Data Gathering and Preparation*

Phase III: *Manipulate and Analyze Data*

Phase IV: *Interpret Results and Finalize Deliverable's*

Tree canopy analyses will involve interpretation of geospatial data to provide information associated with the quantity and distribution of tree canopy defined by the stream reach buffer. Findings can be used to gauge the amount of influence trees have on the environment. As the first-tier in monitoring urban forest changes, periodic analysis of canopy cover can indicate whether there is a net loss or gain in canopy cover over time. Policies and management can then focus on relative needs for new plantings, preservation of existing forest cover, and routine care of existing urban forest resources.

Phase I: *(Literature Research and Review)* Tree canopy analysis initially involves research and analysis of literature that is relevant and potentially beneficial in assisting in the development and interpretation of geospatial data being used to assess the quantity and distribution of tree canopy along the specific stream reaches.

Phase II: *(Data Gathering and Preparation)* Geospatial datasets will be collected using a variety of methods; primary datasets will be provided by The City of Austin's Urban Forestry Program and downloaded from various state and federal agencies. The data will be organized and imported into ESRI ArcMap program.

Phase III: *(Manipulate and Analyze Data)* Some of the primary datasets provided for the project, include the tree canopy layer, clipped by watershed reach designation EII, and a stream buffer dataset approximately two hundred feet either side from centerline of stream. A Digital elevation model (DEM) will be used to define the height of the tree canopy. The tree canopy layer and the stream buffer layer will be used in determining the tree canopy present within the stream buffer.

The Raster Calculator provides a powerful tool for performing multiple tasks. Performing mathematical calculations using operators and functions, allow for detailed spatial analysis providing the quantity and distribution of canopy within the stream buffer. Other spatial data such as impervious cover, water quality monitoring stations, habitat and soil types will assist in establishing a thorough analysis of the tree canopy and the surrounding areas. Several base layers including; city, county boundary, hydrology (creeks, rivers, lakes) layers will be used to visually orientate and provide reference.

Phase IV: *(Interpret Results and Finalize Deliverable's)* Upon completion of this project the ACWQ will have defined the quantity and distribution of tree canopy along the specific stream reaches throughout the greater Austin area. The tree canopy data will indicate the potential for new tree plantings in sparse areas along the specific stream reaches. Analyses will show the amount of area occupied by other urban surfaces that impede or facilitate planting, such as buildings, pavement, water, grass, and bare soils. Relations between existing tree canopy and planting potential among different land use types (e.g., residential, commercial, industrial) will be helpful in prioritizing future plantings.

Implications

For the City of Austin's Urban Forest Program this project will determine an overview of how tree canopy is beneficial to water quality. This study, with additions of previous data collected, will aid in locations for planting additional trees to benefit in maintaining a high water quality. This study will also show the amount of impervious cover in the watersheds and types of vegetation that is located there. The study will give an overview of the types of soils in the area and how they are correlated with the vegetation and impervious cover in the watersheds. The data collected will also show the benefit of canopy cover in helping the longevity of pavement and how more trees planted along the roadway will reduce cost of maintenance.

Timetable

As for the progression of our project, we intend on spending the first week simultaneously collecting data, processing it and beginning the data analyses which will last 3 weeks; completed on the 3rd week. On the 3rd week we will also begin and finish the data interpretation. Week 4 through 6 will be spent developing the model. At the end of developing the model during week 6 we will also begin our website development. The website will be completed by week 7. Week 8 and 9 will be dedicated to preparing our final deliverables. And the final week of May 4th, we will have our final deliverables turned in.

Austin Tree-Canopy Resource, Phase II

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10*
	27-Feb	5-Mar	12-Mar	19-Mar	26-Mar	2-Apr	9-Apr	16-Apr	23-Apr	30-March to May 4
Data Collection										
Data Processing										
Data Analysis										
Data Interpretation										
Model Development										
Website Development										
Prepare Final Deliverables										
Final Deliverables										

*Week 10 begins March 30th and ends May 4th for project purposes; we will submit Final Deliverables to you on Friday, May 4, 2012.

Budget

Data Collection	
Total Hours (10 hours/week*10 weeks*4 consultants)	40
Hourly Pay	$20.00
Total	**$800.00**
Data Analysis	
*Total Hours (10 hours/week*10 weeks*2 consultants +5 hours/week * 10 weeks * 2 consultants)*	300
Hourly Pay	$20.00
Total	**$6,000.00**
System Management	
Total Hours (5 hours/week*10 weeks*1 consultants	50
Hourly Pay	$40.00
Total	**$2,000.00**
Web Design	
Total Hours (5 hours/week*10 weeks*1 consultants)	50
Hourly Pay	$20.00
Total	**$1,000.00**
Software Cost	
ESRI License fee	$5,200.00
Adobe Dreamweaver License fee	$2,500.00
Total	**$7,700.00**
Travel Expenses	
Travel distance (30 miles *4 consultants * 4 trips)	480
Cost per mile $0.50	0.50
Total	**240.00**
Equipment Cost	
Supplies ($150/workstation * 4 workstations)	$600.00
Maintenance ($200/workstation * 4 workstations)	$800.00
Depreciation (8,000 [total value of computers]/36 (equip life in months) * (2.5 months equipment will be in exclusive use for project)	$2,222.00
Total Equipment Cost	**$3,622.00**
Total Cost	**$21,362.00**

Final Deliverables

1. CD's
    - All Data
    - Metadata
    - Microsoft Power Point Presentation
    - Proposal, Progress, and Final Reports
2. Website
3. Final Report
    - Data
    - Maps
    - Metadata
    - References
5. Professional Poster to be displayed in Evans Liberal Arts Building

Conclusions

This proposal defines the purpose and techniques that ACWQ will employ to meet the tasks presented by the Austin Urban Forestry Program. When completed, our analysis will provide the Urban Forestry Program with exact percentages of tree canopy by stream reach. Furthermore, our analysis will provide insight in the relationship between tree canopy and water quality. Through our literature review the client will also learn the impact that soil, impervious cover, and vegetation can have on water quality and how this can be tied back to the tree canopy. The proposal also contains our proposed budget and timetable for completion of the project.

Participation

All team members took part in the creation of the proposal; however, all members were solely in charge of specific sections. Eli Pruitt, GIS Analyst and Editor, put together the entirety of the introduction: summary, purpose and objectives, and scope; also, the literature review of Soil Types and the conclusion. Duane Massa, GIS Analyst and Web Developer, composed the literature review of the Impervious Cover and Street Pavement/Cycles, the implications, budget and references section. Lowell Hughes, GIS Analyst and Remote Sensing Analyst, wrote the Water Quality literature review, data, methodology, and final deliverables sections. Ashley Zavala, Project Manager and GIS Analyst, created the logo, cover, table of contents, literature review of Vegetation, timetable and participation section. All team members took part in the editing process.

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