Trees in UrBan Areas

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Project Proposal

Prepared by Trees in UrBan Areas

for the City of Austin

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Introduction

Summary

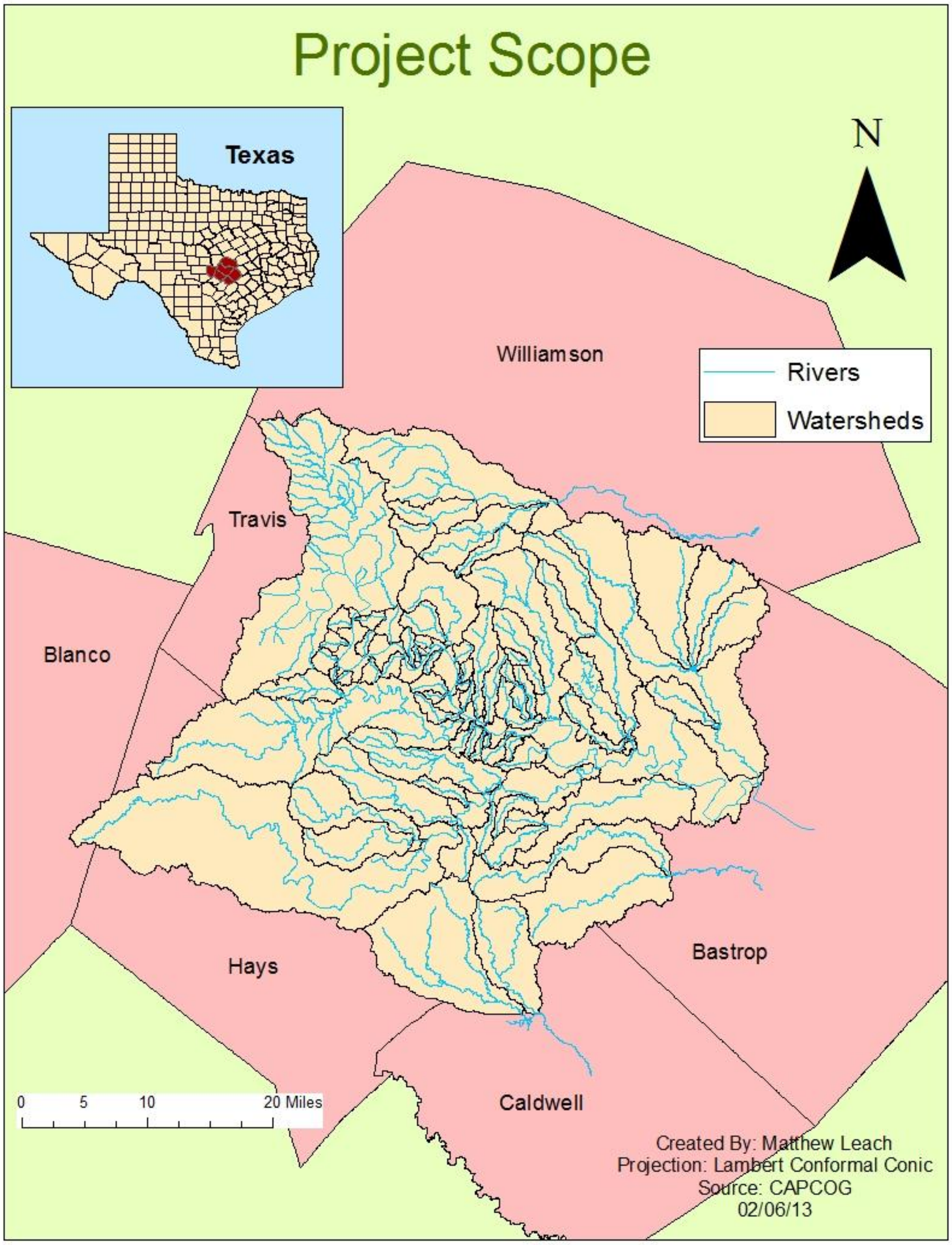
Trees are a resource that everyone can enjoy. Creating a model to help show the percent of areas covered by tree canopies in watersheds can help with land management, including where to plant new trees. The EII water quality sites will help find the watersheds. The implementation of a model to find the percent coverage of trees in a watershed could be used in numerous ways. The City of Austin could use this to see areas that may be not supporting tree growth. While the information used in this model will be for the 2006 tree canopy and a Digital Elevation Model (DEM), it can still be applied to the current tree canopy whenever needed. Finding out this percent coverage of tree canopies will be very helpful to the City of Austin to help maintain and promote tree growth.

Purpose

The objective of this study was to find tree canopy coverage in watersheds and find the percentage of the watershed covered by the tree canopy. Our goals for this study are to be able to create a model to help us solve this problem, and to create a pilot project that will create a watershed that contains one water quality point. Then that model could be taken and applied to any year of tree canopy data or any water quality point, for the City of Austin and find the percent tree canopy coverage of the data for that year.

Scope

The geographic extent of the study area is the greater Austin area with some of the surrounding counties. These counties are included because they contain the watersheds for Austin. The temporal aspect of the study will be in 2006, but can be adapted to other years of data.


Project Scope
Texas
N
Williamson
Rivers
Watersheds
Travis
Blanco
Hays
Bastrop
Caldwell
0 5 10 20 Miles
Created By: Matthew Leach
Projection: Lambert Conformal Conic
Source: CAPCOG
02/06/13

Literature Review

Overview

With the increased amounts of impervious cover that are the hallmark of urbanization, stormwater runoff flows more quickly into rivers and other bodies of water. This rapid movement of water eliminates the natural processes which remove some toxins. It also increases the chances of flooding, damages aquatic habitats, and transports urban nonpoint source pollutants directly to streams (Matteo, Randhir, and Bloniarz 2006). While the relationship between impervious cover and water quality has been well-documented in recent years, less research has been dedicated to innovative ways to lessen this impact without putting a complete stop to urban development.

Similar Studies

Based on two separate studies conducted by Patrice Melancon and S.N. Miller, TUBA has determined to utilize an eight-cell pour point model in constructing stream networks for our study area. In Melancon's paper, which concentrates on developing a water quality model to assist in implementing better land management practices, she goes into great detail on the steps she took to create a watershed network. Emphasizing the importance of filling sinks within the digital elevation model so as to maintain continuity of the modeled flow, she discusses the eight-cell pour point method to calculate flow direction as well as upstream accumulation.

Miller's 2005 paper on a simulation model called AGWA (Automated Geospatial Watershed Assessment) also utilized this model in creating input data for computing runoff. "The extraction of stream networks is to accumulate the channel source area upslope of each pixel through a network of cell-to-cell drainage path... the watershed is then further subdivided into upland and channel elements as a function of the stream network density" (Miller 6). Though worded differently, this is the same method as employed in Melancon's work.

Because both authors described in great detail the method they took and the reasoning behind it, TUBA will be able to construct a model sequencing these same steps and apply it toward a digital elevation model of our study area. Though Melancon's work is based more than a decade ago via ArcView, the principles can be used in ESRI's latest edition of ArcMap through tools within the Spatial Analyst toolbox and its Hydrology tools.

The Ann Arbor Tree Canopy Assessment (2010) was coordinated between multiple government agencies and AMEC Earth Infrastructure to map the existing urban canopy and help prioritize tree planting. The deliverables included a land cover layer, a current urban tree canopy (UTC) image database and a priority tree planting database with UTC calculator. The project used a top down approach beginning with mapping land cover and over laying the categories onto census blocks, and creek sheds, then using UTC metrics to determine where it is biophysically possible to plant trees in the city's differing geographic boundaries. This is useful to TUBA because of the nature of trying to find public areas in an urban area.

The results found that the UTC in the City of Ann Arbor comprised of possible vegetation at (23.7%), other possible UTC (5.1%), and possible impervious UTC (14.6). With 67% of the UTC falling into residential and recreational lands and 16% being public right of ways the results show evidence of that the city's UTC has enough suitable areas to increase the UTC from 33% to 44% coverage. The last step was to prioritize of the areas where increasing the UTC would take place based on four factors: ability to impact energy use from shade, surrounding tree canopy, impervious area, and size. Using these factors to rank the new planting areas researchers were able to maximize the impact of the new tree growth and determine where to plant new trees. This study would help TUBA with the method of finding the percent coverage of trees in a given watershed. This in turn will help lead to better land management practices.

The Urban Forestry and Water Quality Assessments Tools (2009) report shows four different approaches to examining urban forestry and water quality. First with CITYGreen, which is a GIS and Excel based tool to assess the benefit of trees and then replacement costs as well as comparing current and future tree canopies. The second involved i-Tree which used elevation data to calculate the hydrology of the study area, and canopy orientation together to generate reports on pollution levels and runoff volume. The third model to the assessment utilizes an EPA Storm Water Management Model (SWMM) which uses elevation, stream networks area, weather, and runoff to show current and predict future pollutant loads.

The last phase of the project uses Western Washington Hydrology Model (WWHM) which is similar to SWMM with regards to inputs, but focuses on not only trees but other urban vegetation, such as grass or bushes. The WWHM includes soil types and long term rain data to develop current statistics on maximum and minimum flows and probabilities on future discharge and volume with current conditions and with new growth. The Urban Forestry and Water Quality Assessments Tools show four different ways communities are dealing with urban trees and their effect on water conditions and quality. This will help TUBA with possible applications of our study after it is completed. Although we will not have the time or resources to complete this type of task, our model will be an excellent starting point for future studies on this topic.

Proposal

Data

The data in the list below will be obtained and utilized in ESRI ArcMap 10 for TUBA's study for the City of Austin's Urban Forestry Program.

- Digital Elevation Model (TNRIS) – raster layer
- Watershed network (obtained through GIS tools)
- Tree Canopy Coverage (City of Austin) – polygon shapefile
- Environmental Integrity Index (EII) Water Quality Stations (City of Austin) – point shapefile
- Watershed Boundaries (City of Austin) – polygon shapefile

Methodology

TUBA's procedures will consist of five stages: literature research, acquisition of data, implementation of techniques to analyze data, examination of the results, and finalization of our deliverables.

Stage 1 (Literature Research): We will initially be performing research on relevant studies related to tree canopy coverage. Pertinent material will also be studied in regards to modeling watershed networks from digital elevation models. Based on the procedures applied in these prior studies, TUBA will be better capable of formulating how we will approach our analysis, as well as which tools will be utilized. Such information can prove valuable in the analytical process we'll develop, as well as interpreting the results.

Stage 2 (Acquisition of Data): TUBA will gather the required datasets from the City of Austin's Urban Forestry Program, in addition to related state and local online data depositories. The data will then be imported into ESRI's ArcMap 10.

Stage 3 (Implementation of Techniques): TUBA will begin with a pilot project of one watershed to cultivate a model for delineating a hydrology network. The first step implemented in the pilot model will be to fill sinks and small imperfections in the data. The next step will be creating a raster for each cell showing flow direction to its lowest elevated neighbor. Then using the determined flow direction a flow accumulation raster will be created that will display accumulated flow to each cell. The final step to creating the pilot watershed will include the flow direction raster output and one EII water station point. All water that falls/flows upstream to this point will be visualized with a raster of the contributing catchment area in the form of a watershed. Next we will overlay the watershed layer with the 2006 canopy layer to determine canopy coverage. These models can then be replicated for as many watersheds as possible within the time constraints of the spring semester.

Stage 4 (Examination of Results): Once we have concluded our analysis of the data, TUBA will be able to determine the percentage of canopy coverage per watershed in the study area.

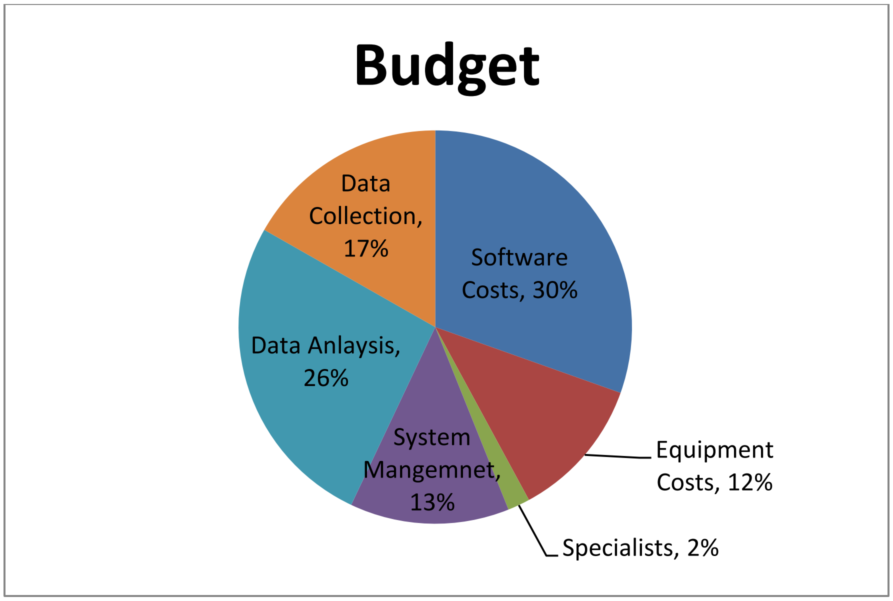
Stage 5 (Finalization of Deliverables): The last portion of TUBA's study involves preparing the results in a report to be given to the City of Austin's Urban Forestry Program (see *Final Deliverables*). This report will include a detailed methodology so that our model can be easily replicated and applied to other projects.

Implications

Ultimately, this study will allow the Urban Forestry Program to examine canopy coverage and enable better land management. Additionally, our model will provide the City of Austin a tool into which future data can be implemented as it becomes available, as well as historical data. With the canopy coverage percentage for water quality stations, the City of Austin will also be able to analyze water quality correlation.

Budget

Data Collection			
	Total Hours (10 hours/week * 4 weeks * 4 consultants)	160	
	Hourly Rate	$20	
	Total		$3,200
Data Analysis			
	Total hours (10 hours/week * 5 weeks * 4 consultants)	200	
	Hourly Rate	$25	
	Total		$5,000
System Management			
	Project Manger		
	Total Hours	50	
	Hourly Rate	$50	
	Total		$2,500
Specialists			
	Graphic Designer		
	Total Hours	10	
	Hourly Rate	$35	
	Total		$350
Equipment Costs			
	Supplies ($200/workstation * 4 workstations)	$800	
	Maintenance ($200/workstation * 4 workstations)	$800	
	Depreciation ($9000 [total value of equipment]/36 (equipment life in months) * 2.5 (months equipment will be in exclusive use of project)	$625	
	Total		$2225
Software Cost			
	Arc GIS 10: ($25,000 ESRI License fee/12 months) * (2.5 months of use)	$5,208	
	Adobe Illustrator	$599	
	Total		$5,807
Total Cost			$19,082



Time Line											
	Week 1	**Week 2**	**Week 3**	**Week 4**	**Week 5**	**Week 6**	**Week 7**	**Week 8**	**Week 9**	**Week 10**	**Week 11**
Dates	*18-Feb.*	*25-Feb.*	*4-Mar*	*11-Mar.*	*18-Mar.*	*25-Mar.*	*1-Apr.*	*8-Apr.*	*15-Apr.*	*22-Apr.*	*29-Apr.*
Literature Review											
Data Collection											
Data Processing and Analysis											
Data Interpretation											
Final Deliverables											

Important Dates

Wednesday, January 16	Formation of teams
Wednesday, January 23	Receiving Projects from client
Wednesday, February 20	Proposal presentations to client
Monday, March 25	Progress report to client
Friday, May 3	Project presentations

Final Deliverables

- Detailed Final Report including model
- Professional Poster for display in Geography Department
- CD containing:
  - All Data
  - Metadata
  - Proposal and Progress, and Final reports
  - Poster
  - PowerPoint presentations
  - Instructions on how to use CD

Conclusions

The final goal of this study is to provide the City of Austin Urban Forestry Department with a usable model to prioritize future tree plantings. Our creation of watersheds from water quality sampling points will enable the client to relate specific sampling points to the amount of tree canopy in their respective watersheds. A detailed methodology report will enable the client to update the report as data becomes available. This project will assist the Urban Forestry Department in further research on the relationship between water quality and tree canopy.

Participation

Alix Scarborough

Cover, Table of Contents, Literature Review, Conclusion, Participation, Editing

Melissa Keen

Data, Methodology, Implications, Literature Review

Matthew Leach

Scope Map, Literature Review, Budget, Timetable, Methodology

Chad Sydow

Summary, Purpose, Scope, Final Deliverables, Literature Review

References

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Northern Research Station, USDA Forest Service. (2009, March 13). Urban Tree Effects on Water Flow and Quality. Retrieved from http://nrs.fs.fed.us/units/urban/focus/water_quality_quantity/

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