Trees in UrBan Areas

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Progress Report

Prepared by Trees in UrBan Areas

for the City of Austin

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Introduction

The City of Austin, Texas, Urban Forestry Program contacted Trees In UrBan Areas (TUBA) in January 2013 to discuss a project analyzing tree canopy in Austin watersheds. In a February 20th presentation, TUBA proposed to create watersheds from Austin water sampling points and calculate tree canopy in those watersheds, providing the client with a way to further water quality analysis and its relationship to tree coverage. Final deliverables are expected to be complete by May 3, 2013. This progress report provides an update on what work has been accomplished and what the next steps are, as well as an overall assessment of how the project is going.

Project Description

The goal of this study is to associate percent tree canopy cover to a particular water quality sampling station. To achieve this, the following objectives were proposed.

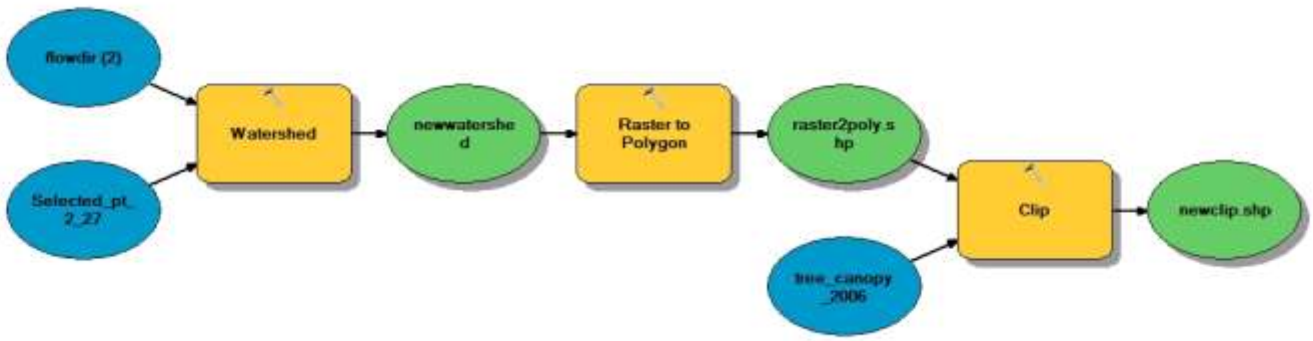
1. Develop a replicable model to create watersheds from sampling points
2. Perform a pilot project to demonstrate this model to the client
3. Repeat process for as many sampling points as project timeline allows
4. Calculate percentage of tree canopy cover for each watershed created

Tree canopy is just a piece of the puzzle when it comes to water quality in urban areas. It might be misleading to attempt to show a simple correlation between trees and water quality. A comprehensive assessment of water quality factors in the Austin area would include consideration of land use and impervious cover, among other things. This kind of multivariate analysis is beyond the scope of this project, due to time and data constraints. Instead, TUBA will provide a detailed methodology for this watershed-level analysis that could be replicated for such factors as impervious cover, as data becomes available.

Proceeding Period

Model Development

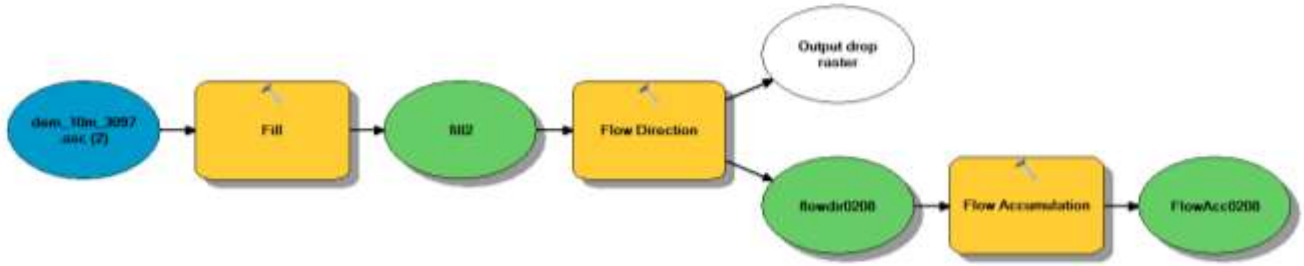
In deciding to create a pilot project TUBA felt the need to create a model to handle the creation of the layers. This model (as shown below) is what was done to create the pilot project. We took the flow direction and the selected point, out of the 122 EII sites provided to us by the City of Austin, and made a watershed from this point. This was then made into a polygon to make it possible to have the canopy and the watershed overlay with each other. This was used to calculate the percent coverage of the canopy to the watershed. This model can be then replicated and used, with some minor adjustments, to create watersheds for all 122 points of the EII water quality sites.



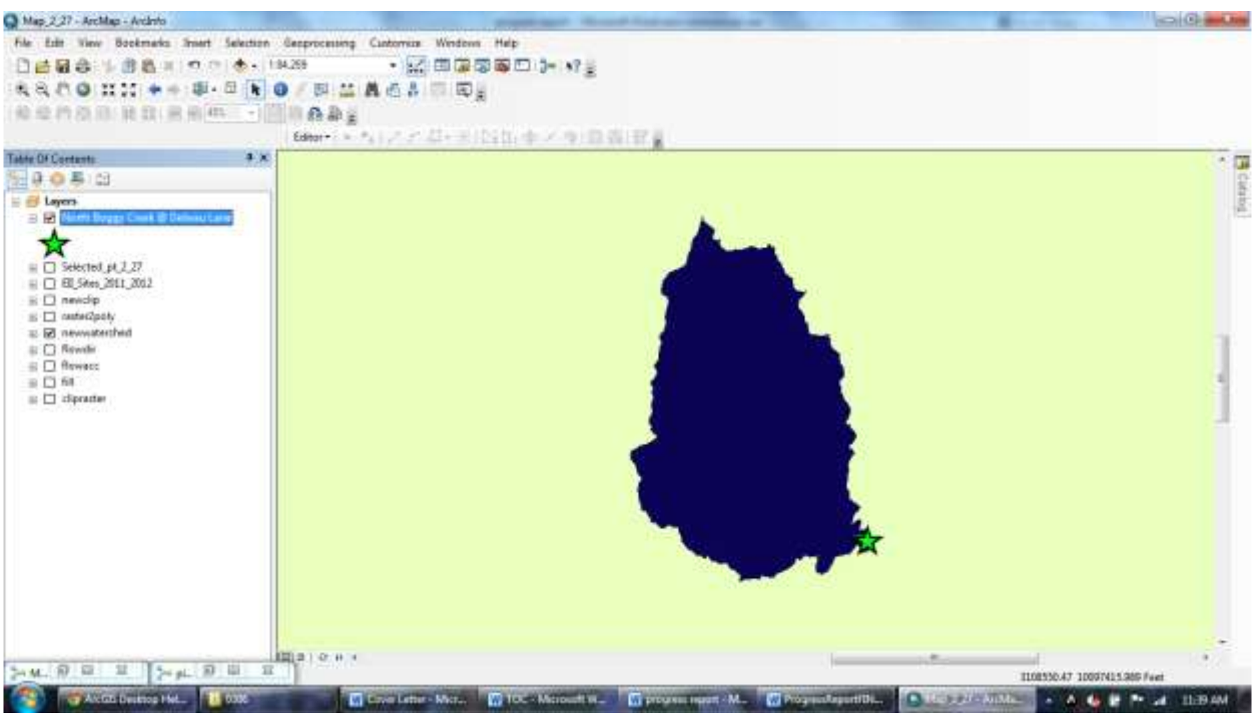
<u>Pilot Project</u>

Before performing watershed delineations and establishing percentage canopy coverage on all EII station points, we decided to begin with one random point. This decision was made to confirm that one delineation could be done successfully before attempting to perform the delineations on all EII Station points.

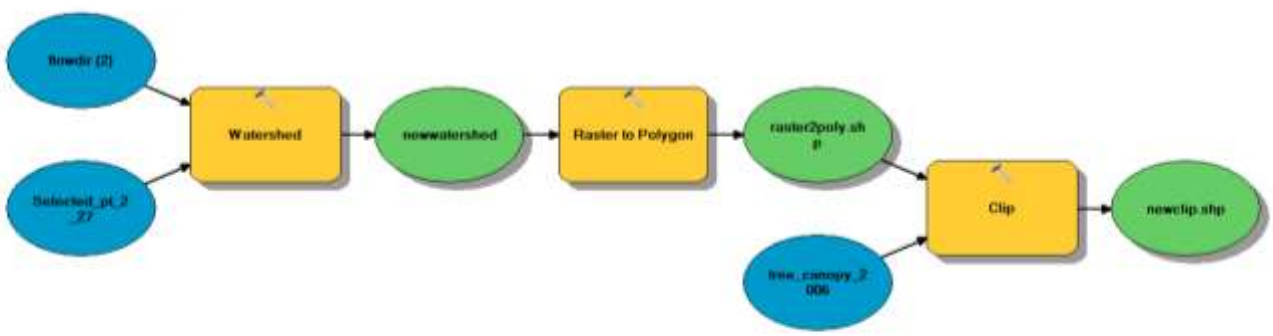
The first step involved acquiring the Digital Elevation Models (DEM), which were needed to determine flow direction to the EII stations resulting in a picture of the upstream area feeding water to the EII point. The DEMs were downloaded from the Texas Natural Resource Information System (TNRIS) website, one from the area of East Austin and one from West Austin. Both were needed to cover all the EII points and their potential watersheds. The acquired DEMs were projected onto ARC map and mosaicked to prevent gaps between rasters. The next step after mosaicking the rasters was filling sinks in the DEMs. This tool was used to remove small imperfections in the data that would impede true flow direction and accumulation. After the fill was completed, a flow-direction tool was used to create a raster of flow direction from each cell to its steepest downslope neighbor. The next step was using the flow accumulation tool to create a raster of accumulated flow into each cell, which would establish that the EII stations were in high accumulation lines (rivers, creeks, streams). These steps of creating fill, direction, and accumulation rasters were the first part of our pilot project and hydrologic model, and are indicated by our model below.

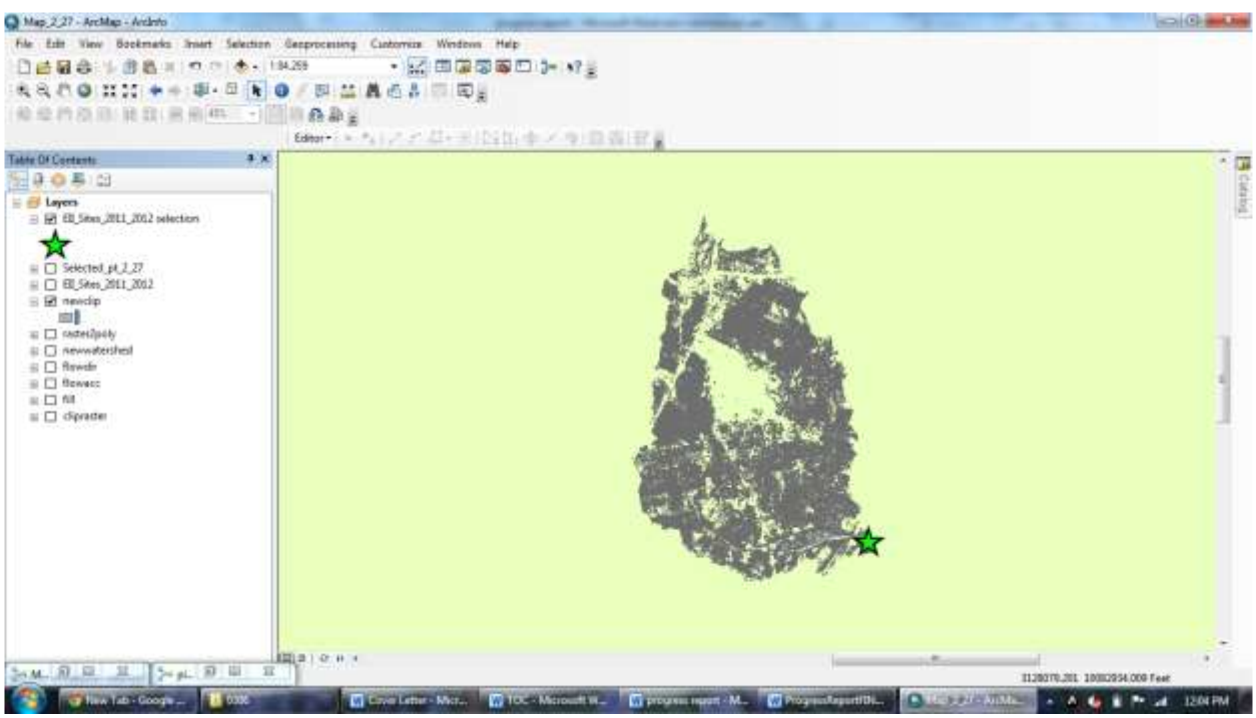


The next phase of the pilot project involved introducing the EII station points, which are water quality reading stations along streams and rivers in Austin. This data was provided by the City of Austin Parks Department in the form of a points shape file. This file includes 122 points with location and water quality information. For our initial pilot project, only one point was used and chosen at random. The point chosen was North Boggy Creek @ Delwau Lane. After its selection, the use of the accumulation lines established that this point was in a flow location. The next step was to use the watershed tool on this point using the flow-direction raster. The watershed tool was used to show the contributing area of drainage above the random point we selected. The watershed delineation was successful because the drainage was visualized into a watershed raster, pictured below.



The next phase of the pilot project was to find the percentage canopy coverage of the selected point watershed. The first step in this phase was converting the watershed from a raster to a polygon using the raster-to-polygon tool for easier manipulation of the data. After the conversion, the 2006 City of Austin tree canopy data was projected onto our map. This data was acquired from the City of Austin GIS Department website and has the entire 2006 tree canopy in Austin. This could be used to determine the canopy coverage of our watershed. After projecting the canopy data over the watershed, a clip was conducted to isolate only canopy coverage over our delineated watershed. This was the last step in our pilot project model and resulted in a visualization of only the canopy that was in our watershed boundary. Below are the model used to conduct this canopy analysis, and a snapshot of the canopy coverage in our pilot watershed.





The next and final step was to determine the percent of canopy coverage in the watershed. This was done by calculating the area of the clip using geometry tool in the clip attribute table. We then found the area of the watershed polygon in the layers attribute table under "area." Finally, we divided the clip tree canopy area by the watershed polygon area, and got 28% coverage in the watershed.

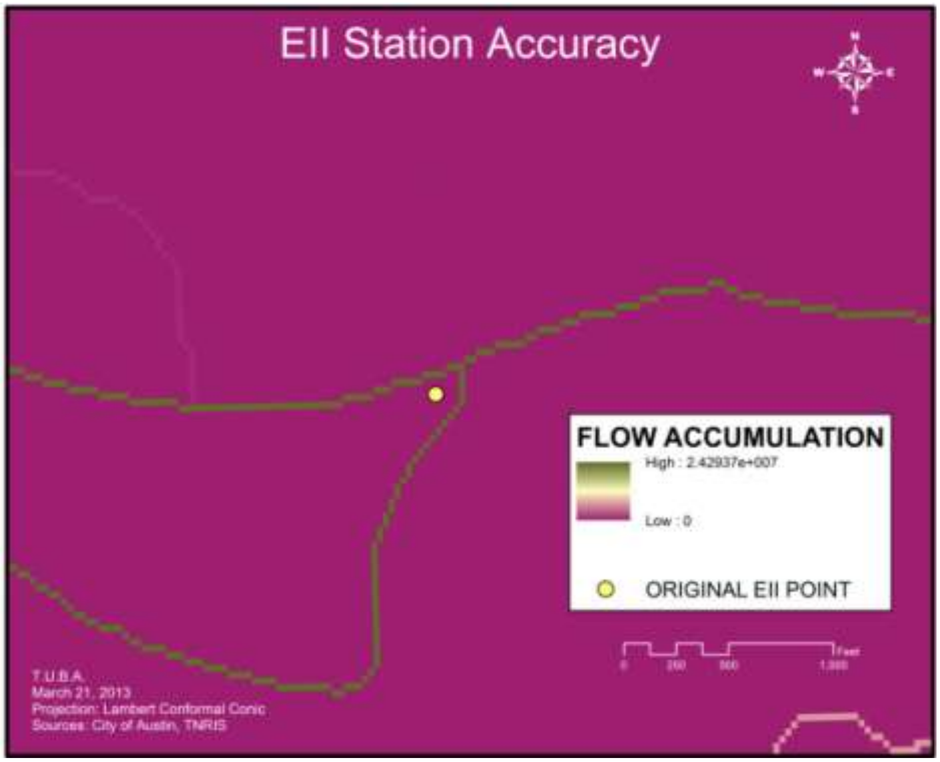
The result was a successful pilot project using our models to find canopy cover.

Problems: During conversion of raster to polygon, small corners were cut resulting in a less area in the polygon than our original raster – this is a minor consideration, but may need to be addressed at a later point.

Current Period

When examining the attribute table for the provided EII water quality points, we noticed there were comments on a few that indicated a possible low level of accuracy for the data. Accuracy of location is important because, in order to delineate the associated watershed for each water quality point, it is necessary for the EII station point data to lie properly on the water accumulation raster layer. This, combined with being unaware as to how the points were collected, prompted our team to attempt to verify all the point locations.

We began by nullify any cells in our raster which had less than 300 upstream cells, leaving us with an accumulation network which met the minimum requirements of being classified as rivers. Upon zooming in, it appeared as though many of the points weren't overlaying accurately on our accumulation raster (see figure on next page).



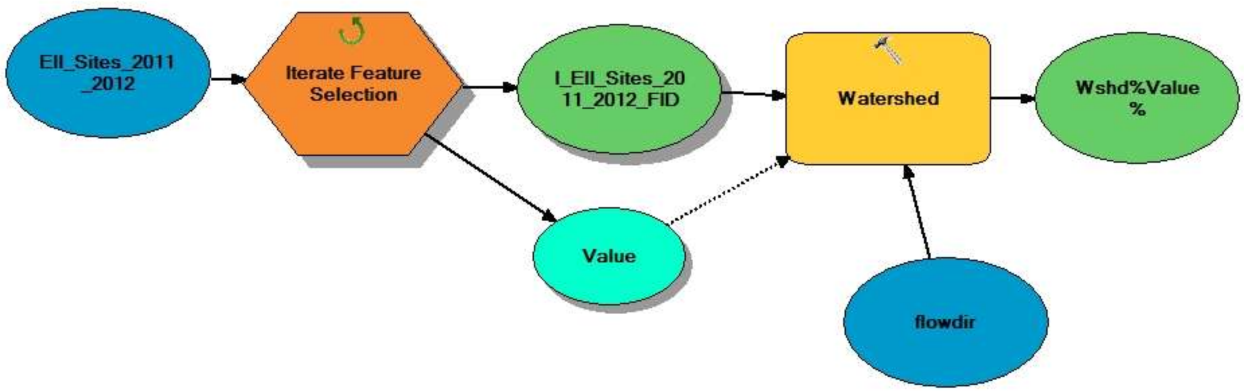
In our second step, we intended to "snap" the EII points to the nearest accumulation line. To do this, we used the Stream to Feature tool to convert our raster layer into a compatible vector layer of line features. However, when we went in to edit the points by "snapping" them to the nearest stream line, none of the 122 points moved. At this revelation, we changed the color ramp to have several colors, instead of just two to three. This allowed us to see the smaller streams that weren't initially visible because of their proximity to much larger accumulation flows.

However, with the snapping tool, there is still a chance a point might be one cell off due to tolerance. In light of this, we still intend to go through and check that each point is on an accumulation line. It will be noted which points were moved, as well as the distance. We also intend to compile and compare these points with satellite imagery in preparation for our next phase of work, where some points may results in very small watersheds. For example, we will be able to determine a point has a small watershed because it is source of a stream, a well, etc.

Next Period

Watershed Creation

Below is the model that will be used to create the watersheds for all of the EII water quality sites. In this model, we used an Iterate Feature Selection tool which would run the model for the value we specify among the EII sites. We chose the FID, or Feature ID, because it is never repeated in the attribute table of the EII sites. This will allow for the model to run every watershed for every water quality point. The result will be a delineated watershed for each EII station point.



Tree Canopy

The final step of this project will be determining the percentage of tree canopy within each watershed. With calculating the tree canopy, we discovered that there may be areas inside the watershed that cannot support tree growth. These areas include lakes and other surfaces where trees cannot be planted. These areas can be taken out of the watershed percent coverage calculation to create a better estimate of areas where trees are more or less plentiful. With these unplantable areas removed, the tree canopy percentage calculation will be more meaningful for land management. This will all depend on the amount of time TUBA has to devote to polishing the project off. We plan to build this feature into the model and make it easier to see where the best areas to look for land management opportunities are.

Conclusion

This project is progressing along the expected timetable thus far, and is expected to be completed on time. As is typical with GIS, we have encountered small obstacles, but all have been overcome so far. These are documented earlier in this report. The final deliverables for this project are as follows.

- Replicable GIS model for creating watersheds and calculating tree canopy
- Shapefiles with watersheds we created from each water quality sampling point
- Calculated percentage of tree canopy in each of these watersheds
- Final report

Participation

Alix Scarborough

Introduction, Project Description, Conclusion

Melissa Keen

Current Period

Matthew Leach

Pilot Project

Chad Sydow

Model Development, Next Period