The Urban Growth of Tyler, Texas from 1947 to 2014

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3 December 2014

Overview

My mother has often told me that when she was a little girl in the 50's and 60's, the city of Tyler, Texas was much smaller. In her memory, the south side of town ended at Rose Hill Cemetery, but now that same area is in the heart of the city. Even since my family moved back there in 2004, we have seen a significant amount of growth to the south. The goal of this project is to track the urban growth of Tyler over time by recording its urban extent at specific points in time, and attain some quantitative data on that growth. Urban growth is here defined as the expansion of industrial complexes, shopping and consumer centers, suburbs, and golf courses. Golf courses will be considered "urban" because they alter the natural landscape and require lots of upkeep. However, farms will not be considered urban areas even though they alter the natural landscape because they are conventionally considered rural.

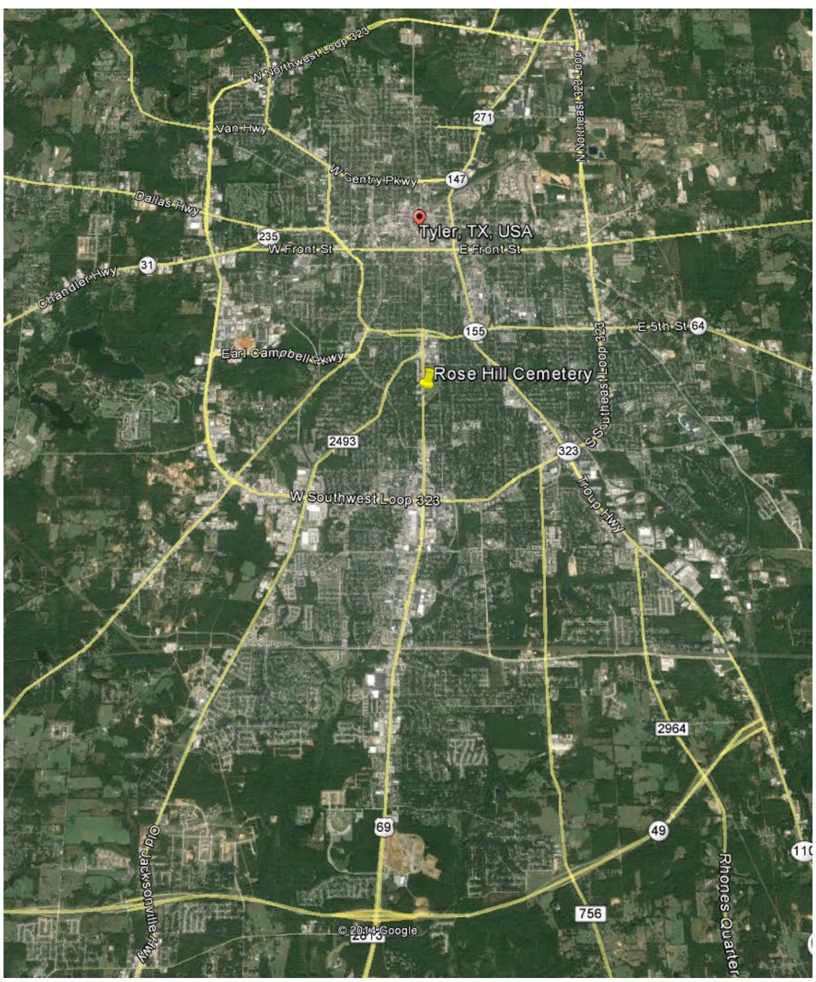


Figure 1. This satellite photo from Google Earth shows Tyler, Texas in 2014. Rose Hill Cemetery is marked with a pin to demonstrate the city's growth from the anecdotal story mentioned above.

Data Collection

1) 2005 Aerial Photo Data for Smith County (which contains Tyler, Texas) was downloaded from the Center for Space Resources' 2005 NAIP Imagery Data through the MAGIC portal. This data was chosen mostly because it is GIS ready.
2) Aerial Photos for 1947, 1965, and 1980 were found and downloaded from USGS's Earth Explorer online map viewer. This was one of the few places I could find really old aerial images. To find appropriate data, I searched the "Aerial Photo Single Frames" dataset for a specific area. See below.

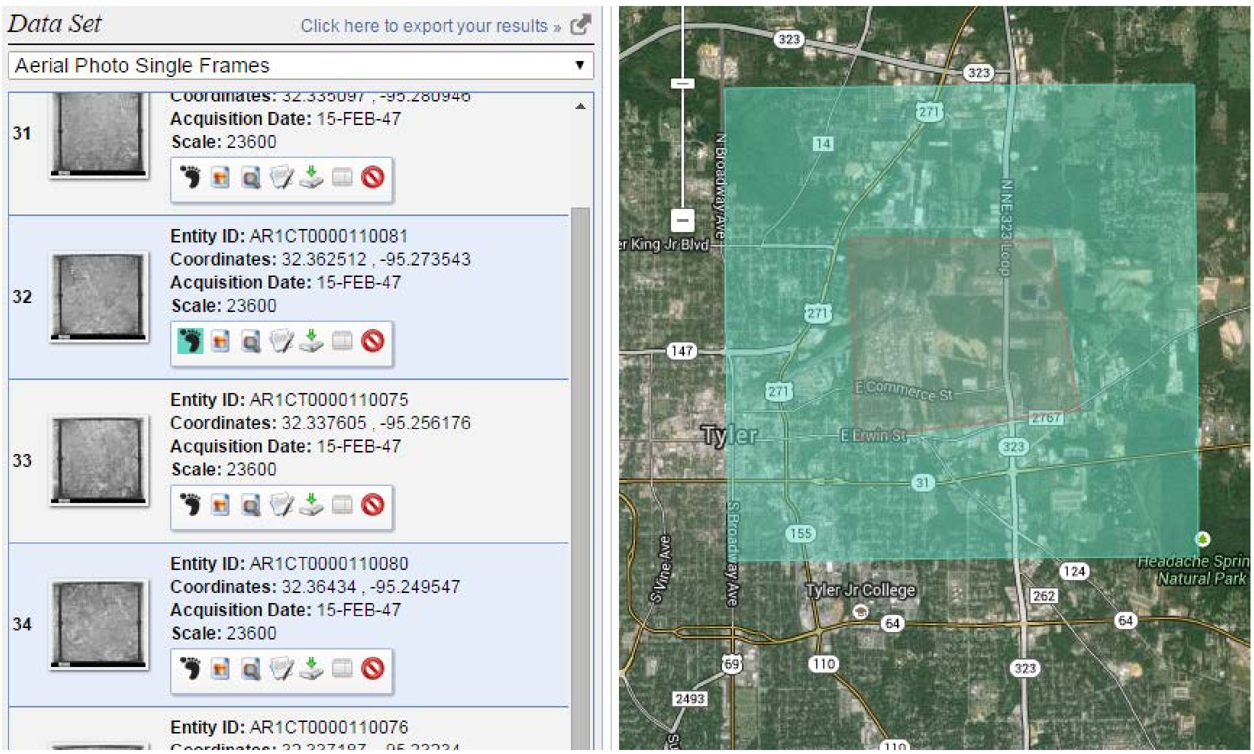


Figure 2. The red polygon is the "search" area, and the blue-green square is the footprint of a 1947 aerial photo.

3) I downloaded the "2014 TIGER/Line Shapefiles: Urban Areas" from the US Census Bureau's website to use as a reference for my urban areas. Even though the shapefile downloaded is for the entirety of the US, the resolution works just fine for the Tyler area. Conveniently, it was already spatially referenced correctly.

Data Preprocessing

The 2005 aerial data from the Center for Space Resources' 2005 NAIP Imagery Data was mostly GIS ready when it was downloaded. However, in the bottom right hand corner, it was showing the UTM meter coordinates as decimal coordinates. (Numbers like 284,000 by 3,580,000 were being displayed as decimal degrees.) Fortunately, the way to fix this was relatively simple because all I had to do was open the Data Frame Properties window, and change the map units to meters from decimal degrees.

Starting with 1947 aerial photo of the southwest section of Tyler, I started cropping the aerial photos with Photoshop in order to remove some of the non-aerial photo portions of the image.

Figure 3. The 1947 aerial photo of the southeast corner of Tyler right before the crop was finalized.

Data Processing

The first step of my project was to georeference the aerial photos onto the 2005 NAIP data. To do this, I would find some identifiable landmark (which often meant finding a distinct intersection) and link it between the old photo and the newer NAIP data.

Figure 4. This is a link of the same intersection between a 1947 aerial photo (top) and the 2005 NAIP imagery data (bottom).

After georeferencing several points, I saved the link table.

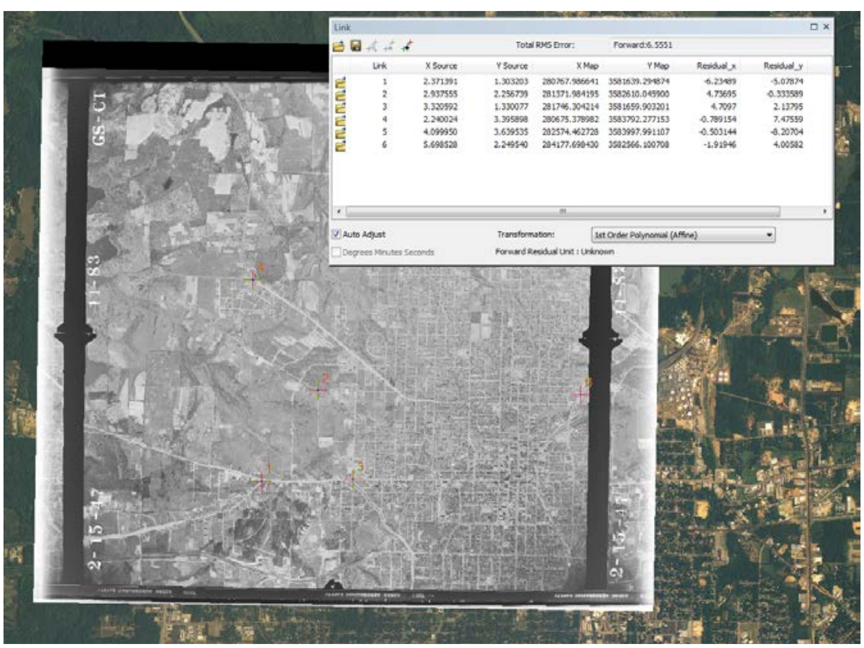


Figure 5. This is the 1947 aerial photo of the northeast corner of Tyler with its georeferenced links to the 2005 NAIP data.

After that, I rectified the image so that the spatial data stays associated with the image. The result is a new image that automatically loads into the correct position because it has spatial reference data associated with it.

Figure 6. The rectified image of the 1947 northeast corner of Tyler.

This process is repeated until all of Tyler is visible. Collections of aerial photos were made for 1947, 1965, and 1980.

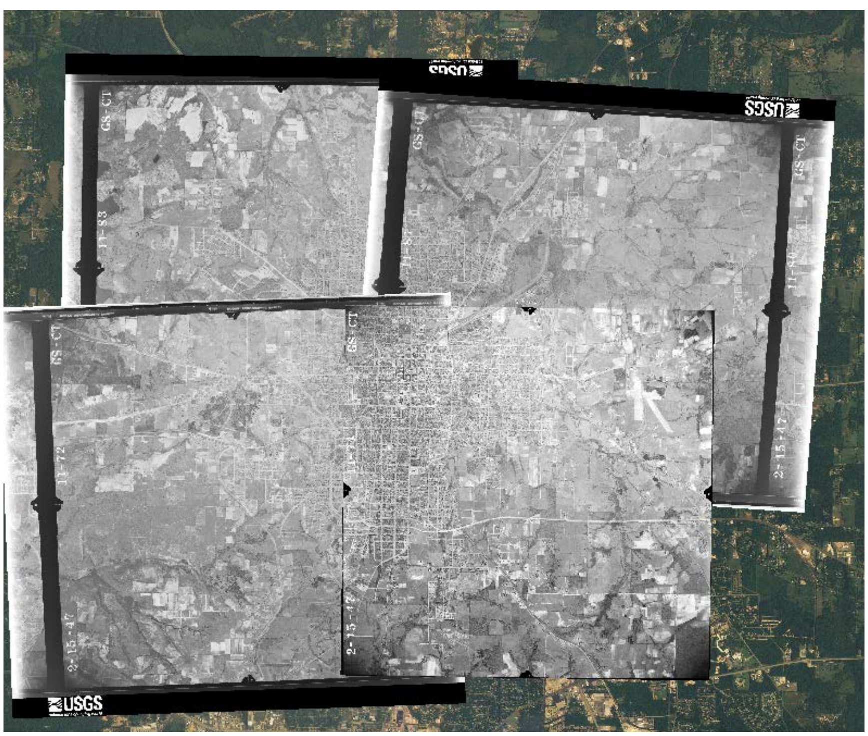


Figure 7. The collection of aerial photos from 1947

After georeferencing the aerial photos, I needed to digitize the urban boundaries of Tyler. To do this, I first created a feature dataset within my geodatabase called “Urbanization” with the same projected coordinate system as my NAIP data (UTM, NAD83, Zone 15N).

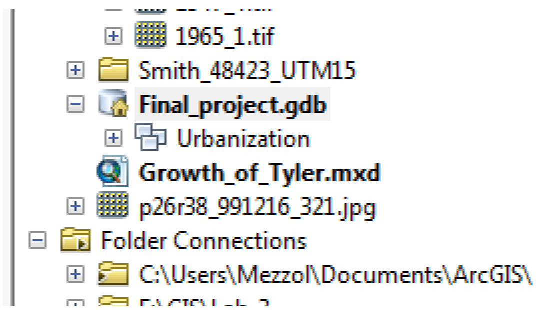


Figure 8. The Urbanization feature dataset within the Final_project geodatabase

Within the Urbanization dataset, I made a line feature class called “urban_edge” and added a field called “Year” as a short integer.

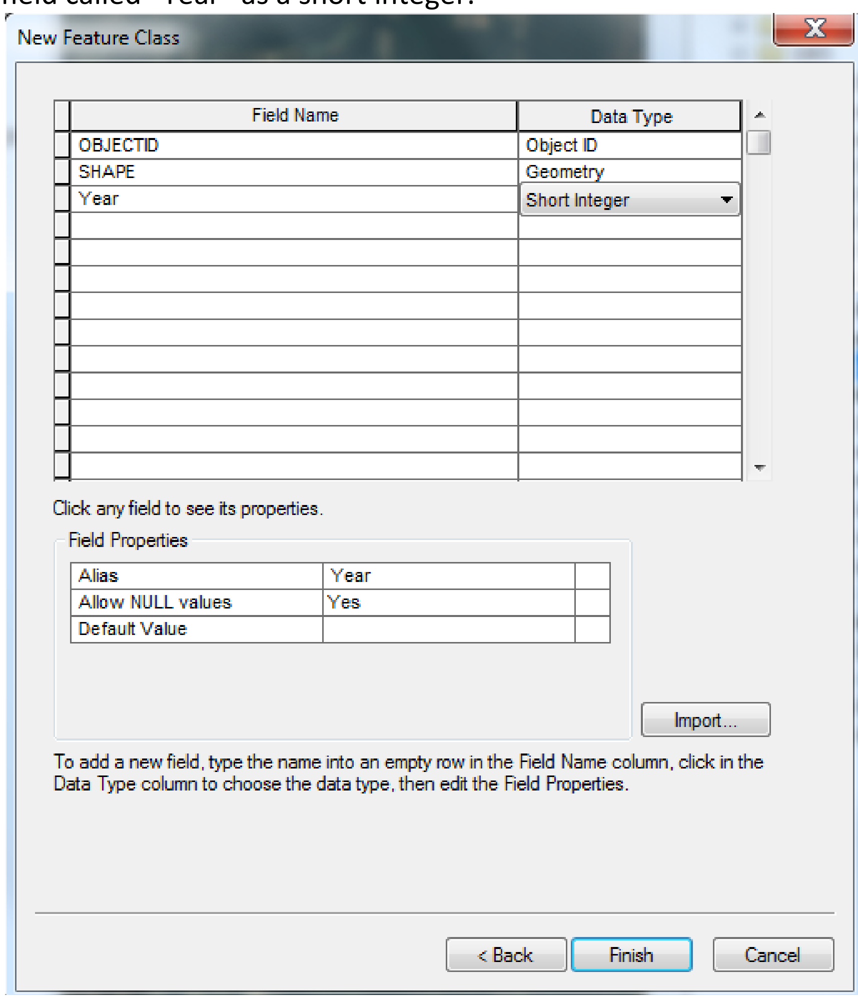


Figure 9. Creating the new urban_edge feature class with the Year field

Then, I made the Year domain with the values 1947, 1965, 1980 and 2005. Next, I assigned the Year domain to the Year feature class by navigating to the Fields tab in the urban_edge feature class, selecting the Year field, and setting the domain to Year.

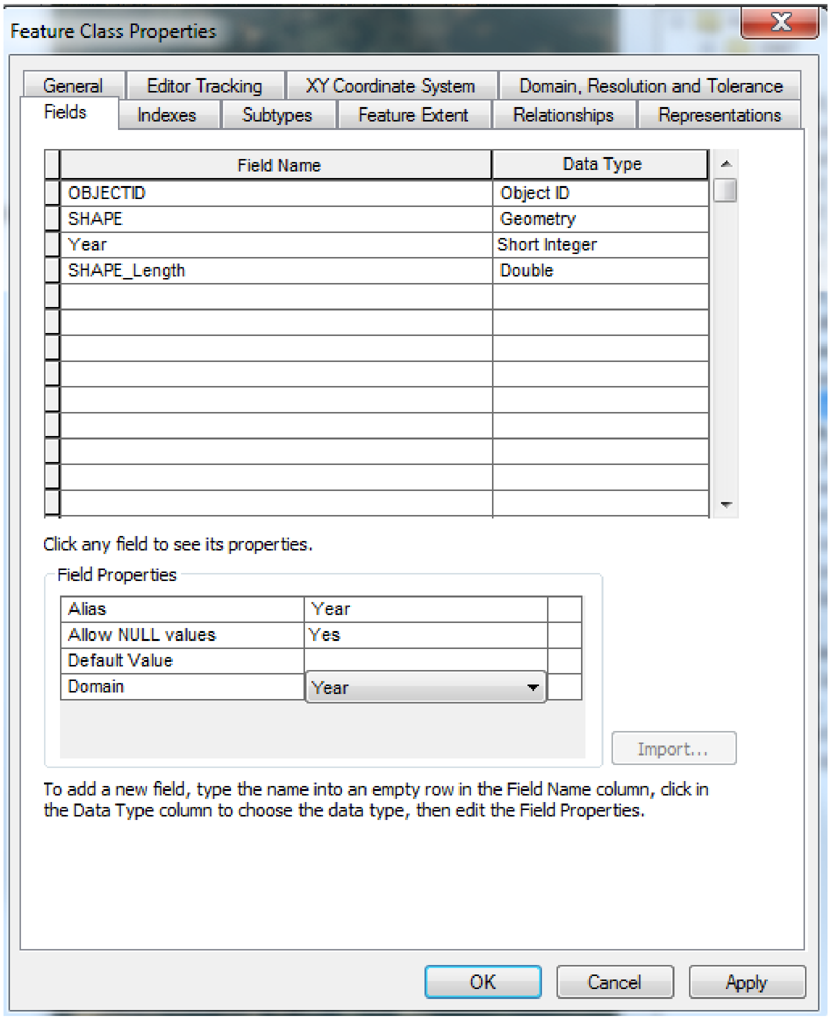


Figure 10. Assigning the Year domain to the urban_edge feature class

After that, I started editing the urban_edge feature class to define the urban boundary of Tyler. I began with the 1947 aerial photos in order to trace the "nucleus" of the city. When I sketched a line, I traced them at the edge of streets or near where buildings ended, and assigned the boundary to a certain year.

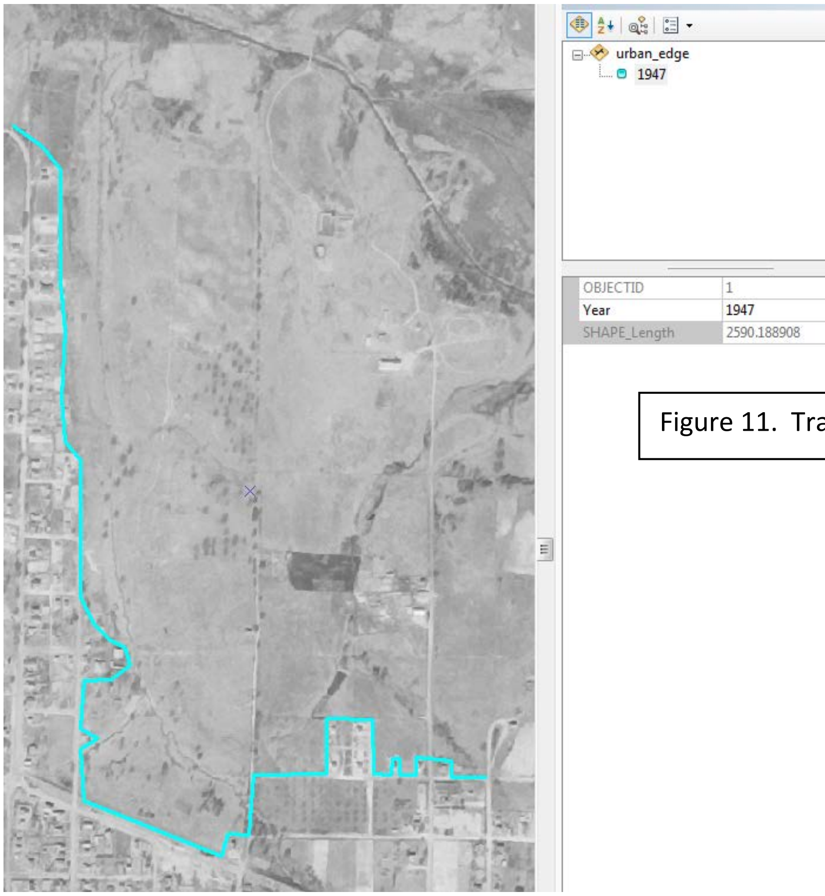


Figure 11. Tracing urban boundaries for 1947

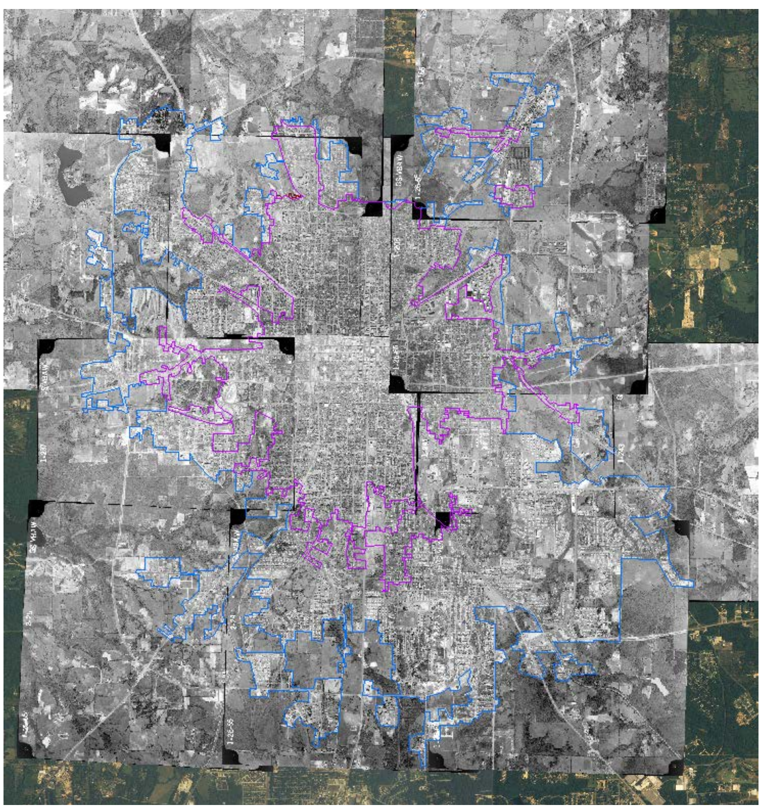


Figure 12. Aerial photos of Tyler in 1965 with the urban outline of Tyler in 1947 (purple) and 1965 (blue)

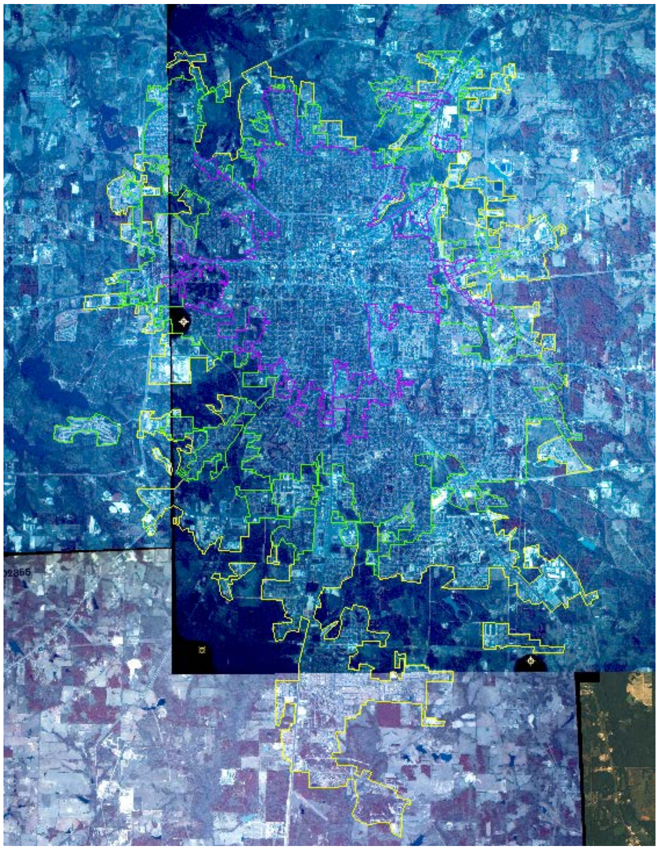


Figure 13. Aerial photos of Tyler in 1980 with the urban outline of Tyler in 1947 (purple), 1965 (blue), and 1980 (yellow)

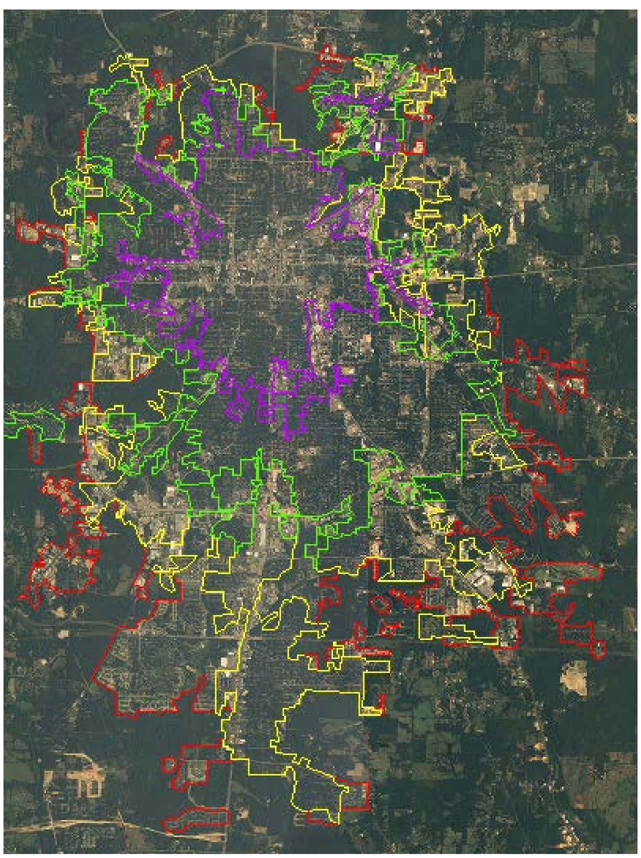
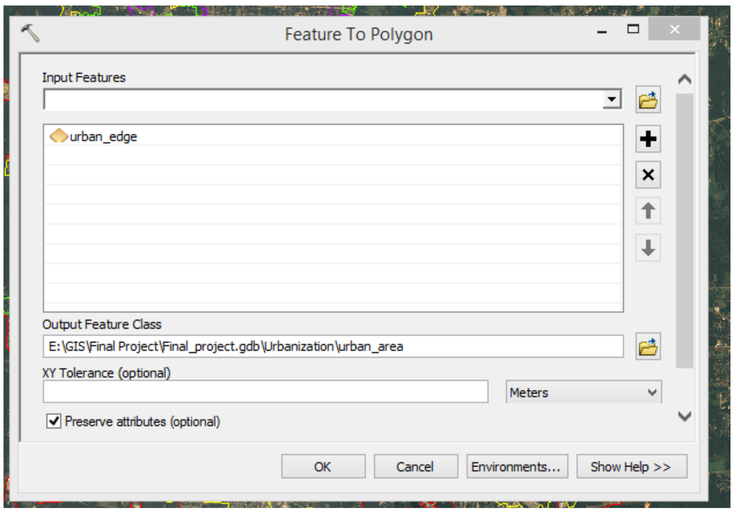


Figure 14. 2005 NAIP imagery of Tyler with the urban outline of Tyler in 1947 (purple), 1965 (blue), 1980 (yellow), and 2005 (red)

After tracing the outline of the city, I created a topology to make sure the polygons would turn out ok. I chose the feature class urban_edge, and added the rules “must not overlap”, “must not self-intersect”, and “must not have dangles”. The topology revealed 5 errors, which were quickly fixed.

Next, I used the “Feature to Polygon” tool to create a polygon feature class called urban_area from the urban_edge feature class. I saved it to my Urbanization dataset so that I could assign domains to the polygons.



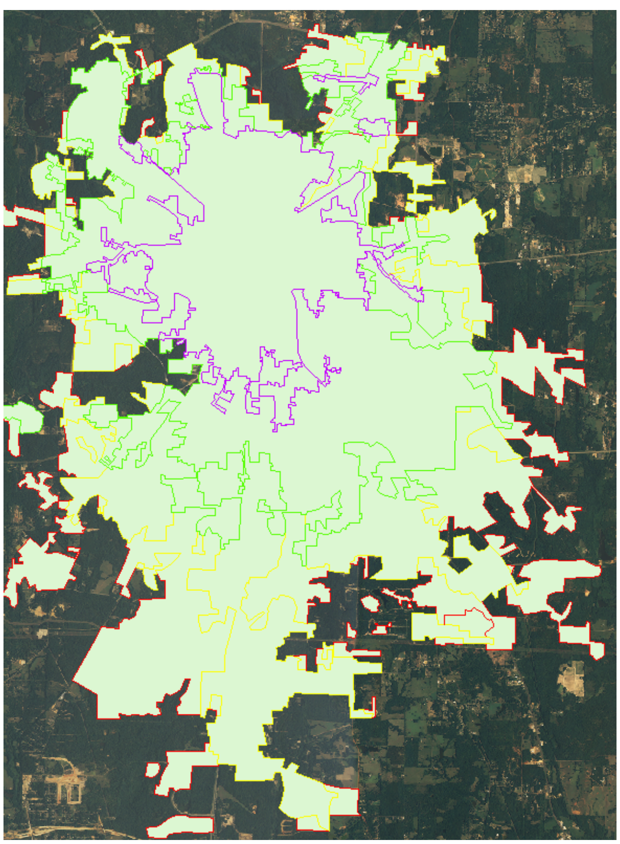


Figure 15. Creating the urban_area polygon feature class (above) and the immediate result (left)

I added a field to the urban_area feature class called Year that was associated with the Year domain.

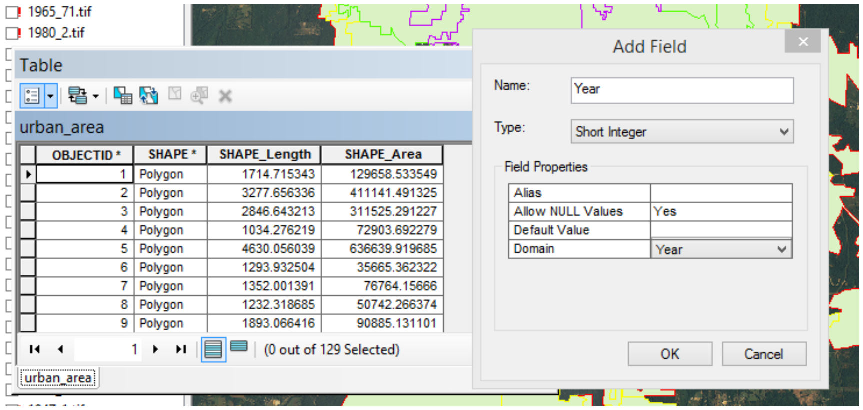


Figure 16. Assigning the Year domain with the Year field in the urban_area attribute table

Then I started assigning years to the polygons.

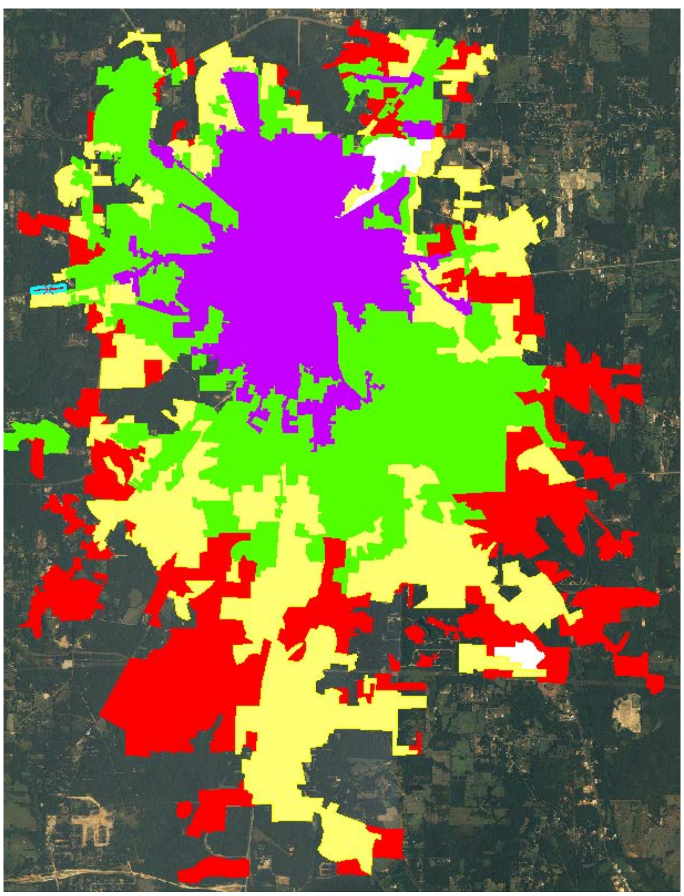


Figure 17. Polygons of Tyler's urban extent in 1947 (purple), 1965 (green), 1980 (yellow), and 2005 (red)

At this point, I loaded in the US Census Bureau's urban area shape file as a reference, which encompasses some of the smaller town and communities around Tyler, but unfortunately, provides no differentiation between local municipalities.

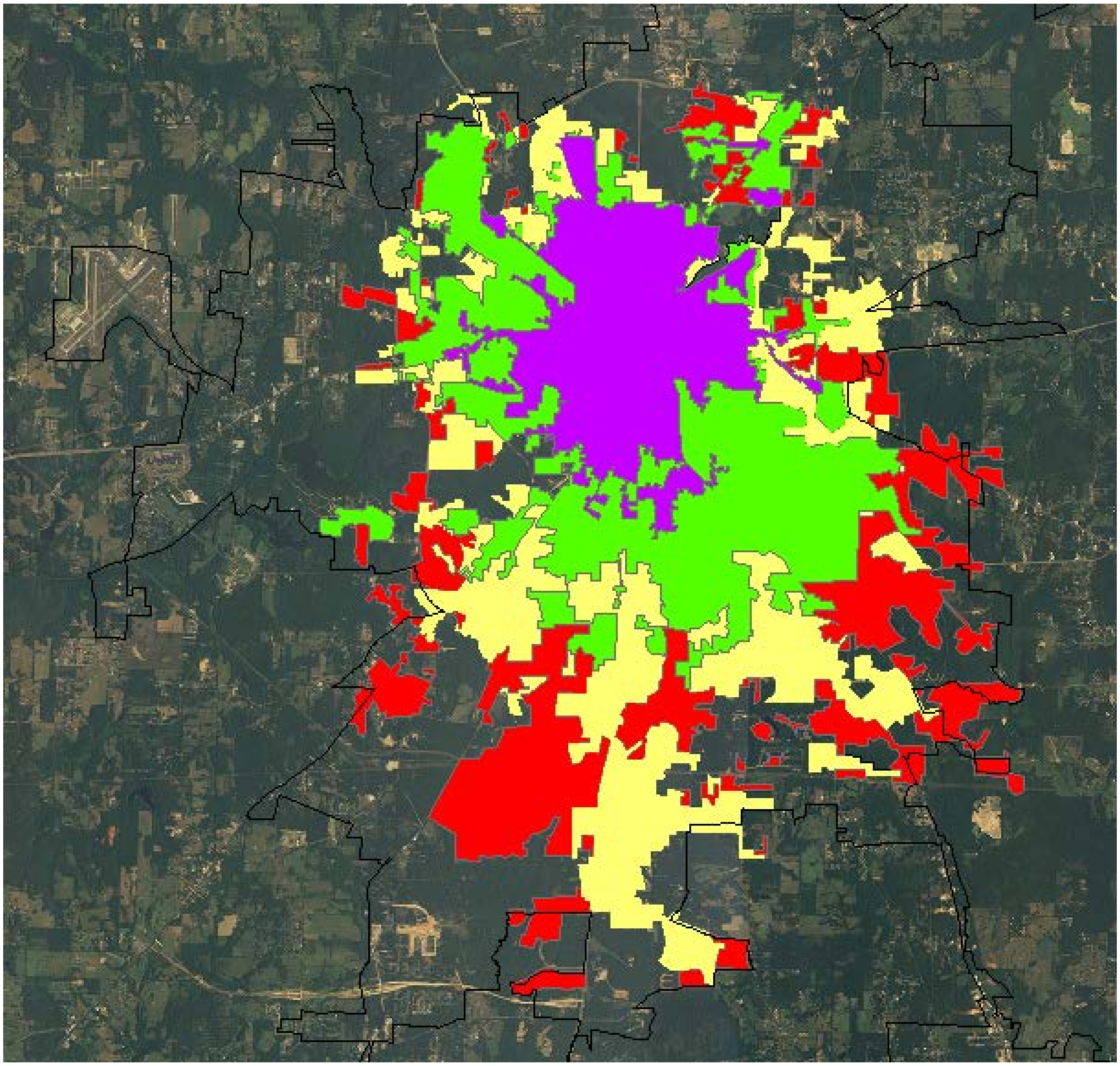


Figure 18. Previous polygons from aerial data and NAIP imagery with the US Census Bureau's urban areas shapefile

At this point, I switched to the layout view and started making the map more appealing to the eye. This included changing the map colors, and adding a grid, scale bar, legend, and title.

To quantify the expansion of Tyler from 1947 to 2005, I highlighted all the polygons for a specific year, recorded the sum of their areas in an excel file, and used these number to find the percent increase in urban area from one snapshot in time to the next.

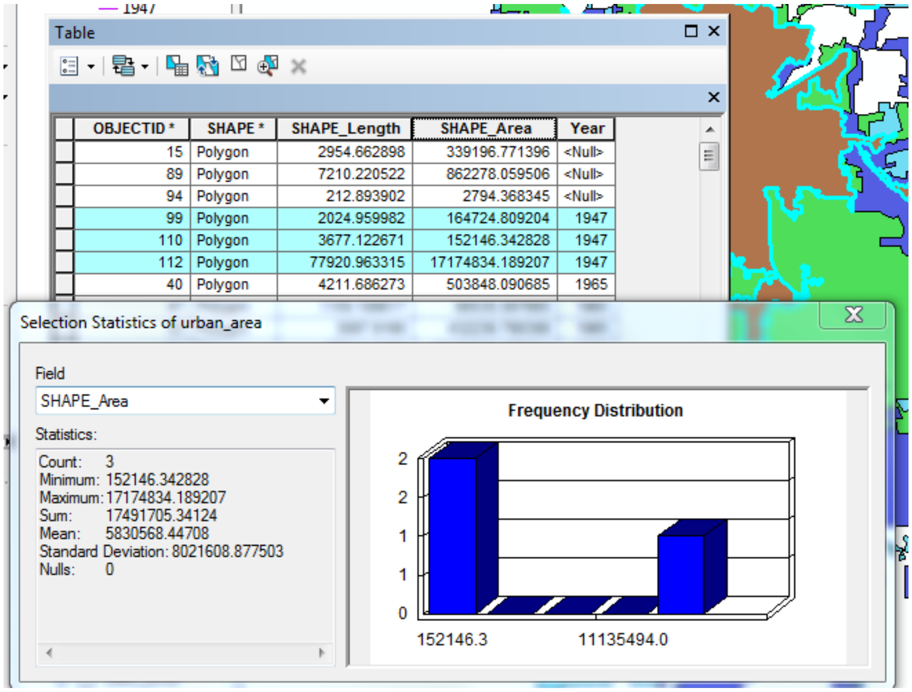


Figure 19. Using data from the urban_area attribute table to find the sum of the area encompassed by the urban extent of Tyler in 1947

A	B	C	D	E
	base	total	% change	total % change
1947	17491705.34	17491705.34	0.0%	0.0%
1965	30397390.38	47889095.72	173.8%	173.8%
1980	29239205.98	77128301.7	61.1%	340.9%
2005	26841030.23	103969331.9	34.8%	494.4%

Figure 20. The excel table that was used the calculate the percent growth of Tyler

Conclusion

Tyler, Texas was once a much smaller town. Since 1947, it has much more than doubled in size spatially. While the city has expanded in all directions, its largest area of growth is to the south. Quantitatively, Tyler grew 173.8% between 1947 and 1965, 61.1% between 1965 and 1980, and 34.8% between 1980 and 2005. The overall, the city has grown 494.4% between 1947 and 2005.

One interesting observation of note, is that as the city expands outwards, it appears to leave some forested areas untouched (at least according to the pre-2014 data). Two examples of this are visible from Figure 18; there are two swathes of mostly forested and undeveloped land on the central-west side and the north-east corner of the city. Whether or not this trend is intentional is unknown, but it is different from the idea that one might expect where the city expands evenly in a given direction, enveloping everything in its path.

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