AFFORDABLE DENSITY WITH DUPLEXES:
Developing Duplex Housing Along Major Transportation Routes in Austin, Texas

Erin Stark M. Arch | CRP 386 Introduction to GIS | December 14, 2009
EXECUTIVE SUMMARY

The goal of this project is to identify suitable land parcels within the city of Austin for affordable housing, specifically duplexes and semi-detached developments. The small scale of these buildings allows the culture and scale of the neighborhoods to be maintained while doubling their density. These housing types also work within Austin’s existing zoning practices which eliminate the need for rezoning and allows for faster implementation. Only parcels within walking distance from new mass transit systems are considered, as to decrease the amount of single-occupant vehicle traffic in the city. These types of developments benefit lower economic classes by providing a secondary source of income. Likewise, neighborhood associations can erect this type of housing and rent to families who meet the affordable housing criteria. Proximity to mass-transit lines will also decrease family transportation budgets. In this study, I look at demographic criteria in census tracts within Austin’s city limits to pinpoint areas around transit stations with the greatest need for density and affordable housing. I then chose a station with high potential, the MLK Jr. Station, and studied parcels within walking distance. After eliminating parcels that did not fall into my chosen criteria, I proposed ideal parcels for duplex and semi-detached housing developments.

INTRODUCTION

A major concern for cities around the world is the negative trend of urban sprawl. As a result, efforts are being made to encourage populations to relocate back into cities’ urban cores. Creating higher-density housing and making the new developments affordable for various family types, ethnicities, and economic classes are two significant steps in this process.

The benefits of city densification are broad and would lead to improvements at multiple scales. One of the most apparent changes would be curbing our ravenous consumption of open lands. The rate at which Austin’s population is growing, if we continue to develop outward instead of upward, the amount of open lands surrounding the city will shrink considerably. This outward development burdens the city with hefty fees to create new infrastructure and provide annually maintenance for these new communities. By developing in already constructed areas, these infrastructure costs can be spent elsewhere. An initial motivation for families to move to city outskirts was the desire to find more affordable housing. Though some would argue that affordable housing is present within the city’s urban core, it is often in poor condition and resides in undesirable neighborhoods. By moving outside the city, families were able to obtain larger homes for a smaller price. However, what these families did not anticipate were the added transportation costs for commuting to and from the city and within their own sprawling suburban neighborhoods. Developing more affordable housing in desirable areas within...
the city would result in a significant reduction in the average family’s transportation costs.

In many cities, building codes and zoning regulations exist that prohibit the development of higher housing densities and mixed-use development. Advancements need to be made within local governments to make way for these smarter-neighborhood design strategies. However, the rezoning and legislative process often takes time, and there are some building types that fit within existing zoning regulations that can achieve positive results. Duplexes and semi-detached homes offer the benefits of higher density housing but can be inserted into many single-family zoned areas.

Double homes offer many advantages that can help us maintain a more sustainable lifestyle within our communities. The site benefits alone are plentiful. By building two dwellings on a site that would normally house a single family, we cut land consumption by half and double density within the neighborhood. In the case of a duplex, the amount of impervious cover is also cut by half. Though they do not create as much density as apartment buildings, duplexes are cheaper to construct and have the ability to retain a “sense of place” within the neighborhood. Given the scale of the building, the designer can participate more readily in retaining the local culture and feel of a particular city.

Many people believe a detached single-family house is the only way to satisfy their need for privacy and sufficient space between themselves and their neighbors, and to express their individuality. It is indeed a paradox that mass-produced houses bought “off the shelf” and constructed in identical versions across the country are favored over individually designed semidetached homes.¹

The potential for affordability is another advantage of duplexes. Savings to the family begin with the decreased purchase price that often accompanies a duplex home. The energy costs are also significantly less than a single family detached house, due to the fact that less exterior surface leads to lower operating and heating costs.² An additional financial benefit that spurred the onset of these dwelling types is the secondary income families can acquire through renting the second home on their property. A final noteworthy point in regards to affordability is the large variety of family types this type of home can accommodate. By appealing to a wider market, the need for affordable housing is more widely met.

It is about tailoring housing to changing needs and about ensuring that dwellings retain their utility value as society changes. Dwellings must provide a high quality of accommodation over the long term.³

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Austin, Texas is no stranger to the problems of urban sprawl and could significantly benefit from adopting new community design and housing strategies. An increase in medium-density housing developments in Austin would benefit the environment, strengthen community ties, reduce the cost of living and help promote a more sustainable way of life.

This report investigates the potential for medium-density housing solutions in Austin, Texas. Austin’s population is doubling every ten years and has struggled to find a solution for better mass transit within the city. A new metro rail and street car line hope to solve some of Austin’s transportation problems. By developing higher-housing density along these new transit lines, we can increase the number of commuters using these modes of transportation and help to reduce urban sprawl. Affordable housing is a major concern for lower income families, who have been forced to move outside the city in search of lower housing costs. Affordable housing is defined as 80% of the MFI (median family income), and in 2009 Austin’s MFI is $73,000. Developing affordable housing in closer proximity to downtown and mass-transit lines will reduce family transportation costs, vehicular CO2 emissions and land consumption. For these reasons I will only be considering land parcels that sit within the city limits of Austin.

Medium-density housing, such as duplexes and semi-detached homes, allows for an increase in density while maintaining local culture and scale. These types of construction allow for a scale that fits within existing neighborhood guidelines and zoning patterns. Without these restrictions, these housing systems can be implemented at a much faster rate than larger housing developments. Maintaining local culture includes both building aesthetics and existing demographics. The goal of affordable housing is to allow a diversity of economic classes and ethnicities to reside in the same neighborhood. This type of housing could be constructed by individuals, but neighborhood associations could also play a significant role in the development of these types of medium-density housing. Particularly, given their ability to make it either affordable or transitional housing. This project will show the high potential within Austin, areas in which are in greatest need for denser more affordable housing, and specific parcels that meet monetary, zoning and spatial criteria.

HYPOTHESIS & RESEARCH QUESTION

Hypothesis: I believe that medium-density housing solutions, such as duplexes, have great potential in Austin, Texas. They have the ability to create both affordability and density. The demographics of Austin, with its high variety of economic classes, family types and ethnicities, also make this an ideal city for this type of housing. Neighborhoods in close proximity to downtown and incoming rail stations are still largely filled with single-
family detached homes. Duplexes and semi-detached homes can double density in these areas and allow new residents access to these new transit lines.

**Research Question:** Where are these new stations located and how much area is encompassed within reasonable walking distances? What areas of Austin have the greatest need for increased density and affordable housing? What parcels fit within current zoning practices and meet the economic criteria for developing affordable housing?

**METHODOLOGY**

**Data Acquisition**

Given the nature of my study, I knew that both spatial and numerical data would be needed. My study was restricted to Austin, so local resources, which were already well-known, would be sufficient. Demographic data was found on the ESRI website from the 2000 census, along with the shapefile for the census tracts themselves. Most geographic data was taken from the City of Austin (COA) website and some from the Capital Area Council of Governments (CAPCOG) website.

The data that required the most searching was for the new Austin metrorail redline and streetcar lines. I was able to find the redline shapefile on the Capital Metro (CAPMetro) website. However, I could not find a shapefile for the redline stations. Using the station addresses from the CAPMetro website, I was able to geocode the points and created my own station shapefile. For the streetcar lines (which are still in a non-constructed state), I contacted Ross Clark, the GIS Supervisor for Regional Mapping Communications and Technology Management in the City of Austin. Mr. Clark was able to locate the Riverside and Manor streetcar lines and emailed me the shapefiles. I was unable to locate any files regarding proposed streetcar stations.

**Descriptive Mapping**

After collecting my data, I began a series of maps that began at a large scale and ended at a small scale.

**Large scale:**
- Looked at Travis county, Austin city limits, metro lines (redline and streetcar).
- Looked at ¼ mile walking radii around redline stations and ½ walking radii around Riverside streetcar line.
- Clipped parcels that did not fall within these radii.
- Using census data, investigated census tracts for Travis county, paying close attention to tracts that fall within walking radii.
- Census tract data used:
Median household income – Looking for areas with low household income because these areas would benefit from affordable housing.

- Rental units as a percentage of total housing units – Looking for areas with high percentage of renters because these areas would benefit from affordable housing.

- Average family size – Looking for areas with large average family size because larger families have larger bills and thus, may benefit from affordable housing.

- Housing units divided by census tract area – Looking for areas with low housing density which could benefit from duplexes which increase density.

- Weighted data using the following values
  - Median Household Income – 40%
  - Average Family Size – 20%
  - Percentage of Renters – 10%
  - Housing Density – 30%

- This allowed me to discern which walking radii encompassed the census tracts most in need of double housing developments.

- I selected the MLK Jr. station located at 1719 Alexander Ave in east Austin.

Small Scale:

- Looked at MLK Jr. station and parcels that are located in ¾ mile walking radius.

- Removed parcels not zoned SF-3, zoning category that allows for duplex development.

- Removed parcels that were above $200,000 in market value, cost of land and existing structure.

- Used proximity to major streets, city of Austin parks, and the MLK Jr. station to evaluate which parcels had the greatest value.

- Proximity data used and weighted values:
  - Major streets – Looking for parcels located far from major streets to reduce noise and danger to children – 20%
  - City of Austin parks – Looking for parcels located near parks to provide green space for residents – 40%
  - MLK Jr. station – Looking for parcels located close to station to decrease walking distance for transportation – 40%

- This allowed me to limit my search of parcels to only those that fell within the top two classes after the established rankings.

- I then removed parcels that had the following criteria:
  - Parcels less than 5000 square feet in area.
  - Parcels that were more than $130,000 in market value.
  - Parcels that did not have the ideal solar orientation for passive design, the long sides of the parcel facing east-west.

- I then selected seven parcels that remained, in which I felt warranted further on-site investigation.
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4. Usable Parcels within Walking Distance
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7. Census Tract Average Family Size
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11. MLK Jr. Metro Redline Station
12. Zoned Parcels around MLK Jr. Station
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18. Top Ranking Parcels
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21. Top Parcels in ¼ Mile Walking Radius
22. Parcels with Ideal Orientation
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AFFORDABLE DENSITY WITH DUPLEXES: Acceptable Walking Distances to Trains

Indicated Below: .75 mile walking radius around Austin metro redline stations and .5 mile walking radius along the proposed Riverside streetcar line.
AFFORDABLE DENSITY WITH DUPLEXES: Acceptable Walking Distances to Trains

Indicated Below: .75 mile walking radius around Austin metro redline stations and .5 mile walking radius along the proposed Riverside streetcar line.
AFFORDABLE DENSITY WITH DUPLEXES: Usable Parcels within Walking Distance

Indicated Below: Parcels that sit within walking radius of redline stations

- redline stations
- redline rail
- .75 mile walking radius
- usable parcels
- austin city limits

Erin Stark - map created 12.10.09
Coordinate System: NAD 1983 Stateplane
Texas Central FIPS 4203 Feet
Datum: GSC North American 1983
Sources: COA, CAPCOG, Cap Metro, ESRI
AFFORDABLE DENSITY WITH DUPLEXES: Usable Parcels within Walking Distance

Indicated Below: Parcels that sit within walking radius of proposed Riverside streetcar line.

Erin Stark - map created 12.10.09
Coordinate System: NAD 1983 Stateplane
Texas Central FIPS 4203 Feet
Datum: GSC North American 1983
Sources: COA, CAPCOG, Cap Metro
AFFORDABLE DENSITY WITH DUPLEXES: Census Tract Median Household Income

Indicated Below: Median household income for Austin census tracts, looking for areas with low-income families.

Median household income in dollars:
- 0 - 21411
- 21412 - 40871
- 40872 - 61927
- 61928 - 97177
- 97178 - 165112

Map created by Erin Stark - 12.10.09
Coordinate System: NAD 1983 Stateplane
Texas Central FIPS 4203 Feet
Datum: GSC North American 1983
Sources: COA, CAPCOG, Cap Metro, ESRI
AFFORDABLE DENSITY WITH DUPLEXES: Census Tract % of Rental Housing

Indicated Below: % of renter occupied housing in total housing for Austin census tracts, looking for areas with high percentage of renters.
AFFORDABLE DENSITY WITH DUPLEXES: Census Tract Average Family Size

Indicated Below: Average family size for Austin census tracts, looking for areas with high average family size.
AFFORDABLE DENSITY WITH DUPLEXES: Census Tract Housing Density

Indicated Below: Percentage of housing units for census tract area, looking for areas with low housing density.
AFFORDABLE DENSITY WITH DUPLEXES: Census Tract Suitability Rasterizations

- Median Household Income: Low-Income Best 40%
- % of Rental Units: High Rental % Best 10%
- Average Family Size: Large Family Size Best 20%
- Housing Units per Area: Low-Density Area Best 30%

Erin Stark - map created 12.10.09
Coordinate System: NAD 1983 Stateplane
Datum: GSC North American 1983
Sources: COA, CAPCOG, Cap Metro, ESRI
Indicated Below: Census tract suitability rankings derived from analysis of median household income, % of rental units, average family size and housing density.

Erin Stark - map created 12.10.09
Coordinate System: NAD 1983 Stateplane
Texas Central FIPS 4203 Feet
Datum: GSC North American 1983
Sources: COA, CAPCOG, Cap Metro, ESRI
Indicated Below: MLK Jr. station selected for further analysis because of its proximity to high ranking census tracts.

MLK Jr. Station
1719 Alexander Ave.
AFFORDABLE DENSITY WITH DUPLEXES: Zoned Parcels around MLK Jr. Station

Indicated Below: Parcels within .75 mile walking radius of MLK Jr. station that are zoned SF-3 for duplex development

Erin Stark - map created 12.10.09
Coordinate System: NAD 1983 Stateplane
Texas Central FIPS 4203 Feet
Datum: GSC North American 1983
Sources: COA, CAPCOG, Cap Metro, ESRI
MLK Jr. station
redline rail
.75 mile walking radius
parcel market value in dollars

0 - 193810
193811 - 453873
453874 - 1097747
1097748 - 2442451
2442452 - 4372282

Erin Stark - map created 12.10.09
Coordinate System: NAD 1983 Stateplane
Texas Central FIPS 4203 Feet
Datum: GSC North American 1983
Sources: COA, CAPCOG, Cap Metro, ESRI

Indicated Below: Parcels located within .75 mile walking radius and their listed market value (price of land and existing structure)
AFFORDABLE DENSITY WITH DUPLEXES: Suitable Parcels around MLK Jr. Station

Indicated Below: All parcels zoned sf-3 for duplex development. Those in blue have a market value below 200,000 dollars.
AFFORDABLE DENSITY WITH DUPLEXES: Factors in Parcel Suitability Analysis

Indicated Below: Suitable parcels, major roads, coa parks, existing flood plain, and MLK Jr. station

MLK Jr. station
major roads
redline rail
.75 mile walking radius
.5 mile walking radius
parcels
flood plain
coa parks
suitable parcels

Erin Stark - map created 12.10.09
Coordinate System: NAD 1983 Stateplane
Texas Central FIPS 4203 Feet
Datum: GSC North American 1983
Sources: COA, CAPCOG, Cap Metro, ESRI
AFFORDABLE DENSITY WITH DUPLEXES: Parcel Suitability Rasterization

Indicated Below: Rasterized versions of parcels prior to suitability analysis with % of importance

Proximity to Major Roads: Farthest Best 20%

Proximity to Parks: Closest Best 40%

Proximity to MLK Jr. Station: Closest Best 40%

Erin Stark - map created 12.10.09
Coordinate System: NAD 1983 Stateplane
Texas Central FIPS 4203 Feet
Datum: NAD North American 1983
Sources: COA, CAPCOG, Cap Metro, ESRI
Indicated Below: Parcel suitability rankings derived from analysis of proximity to major roads, parks and the MLK Jr. metro station. Parcels shown in red removed because located in flood plain.
AFFORDABLE DENSITY WITH DUPLEXES: Top Ranking Parcels

Indicated Below: Parcels holding a ranking of 1 or 2 in the parcel suitability analysis.
Indicated Below: Parcels with a ranking of 1 or 2 from the parcel suitability analysis and over 5000 ft in area
AFFORDABLE DENSITY WITH DUPLEXES: Top Ranking Parcels below $130,000

Indicated Below: Parcels with a ranking of 1 or 2 from the parcel suitability analysis, over 5000 feet in area, and below $130,000 in market value.

Erin Stark - map created 12.10.09
Coordinate System: NAD 1983 Stateplane
Texas Central FIPS 4203 Feet
Datum: GSC North American 1983
Sources: COA, CAPCOG, Cap Metro, ESRI
AFFORDABLE DENSITY WITH DUPLEXES: Top Parcels in 1/4 Mile Walking Radius

Indicated Below: Suitable parcels within quarter mile walking radius of MLK Jr. metro station.
AFFORDABLE DENSITY WITH DUPLEXES: Parcels with Ideal Orientation

Indicated Below: Suitable potential parcels with ideal north-south orientation for passive design.
AFFORDABLE DENSITY WITH DUPLEXES: 7 Final Parcels for Duplex Development

Indicated Below: Final selection of potential parcels that are ideal for duplex development.

Erin Stark - map created 12.10.09
Coordinate System: NAD 1983 Stateplane
Texas Central FIPS 4203 Feet
Datum: GSC North American 1983
Sources: COA, CAPCOG, Cap Metro, ESRI
ANALYSIS

Analyzing a larger scale through to a smaller scale gives great insight into the extensive impact that this type of housing can have in the Austin area. The large scale maps highlight the proximity of these new transit lines and stations to both Austin’s downtown area and the University of Texas (UT) campus. Both areas create high volumes of traffic that travel to and from these locations on a daily basis. Thus, these transit lines could potentially alleviate a significant amount of traffic congestion and CO2 emissions. In order to be effective, commuters must have easy access these trains and the areas directly around the stations are of high value and importance.

The demographic census tract studies also indicate high potential for medium-density housing in metro station areas. The median household income levels are highest in the western part of Austin. The eastern part of Austin, where a majority of the redline stations and the Riverside streetcar line are located, have the lowest income levels. The highest percentage of renters run down the center of Austin from north to south with the highest values falling along the Riverside streetcar line and also around the UT campus area. The average family size is highest in the east part of Austin and lowest in the central and western areas of the city. Housing density in Austin is greatest through the center running north to south and as one moves west or east the density decreases rapidly. After the suitability analysis, tracts with the highest potential are locate in the far east tracts of Travis county, with the second highest potential near the southeast stations of MLK Jr. and the Plaza Saltillo station.

After selecting the MLK Jr. station for further analysis, the maps show a narrowing of suitable parcels through zoning and economic criteria. Even with those parcel eliminations, a large number of parcels remain. This indicates the high degree to which this type of development can be implemented around this particular station. After a proximity, suitability analysis with major roads, parks and the station, parcels were given a ranking from one to six and parcels within the floodplain were eliminated. Though these rankings were helpful in my pursuit to narrow down the number of parcels, it must be remembered that the rankings are somewhat subjective. They should not detract from the significant fact that a large number of these parcels are adequate for duplex development. That being said, I continued to narrow the field.

I reduced the market value to below $130,000 with the idea that if a neighborhood association is buying lots to develop affordable housing, reducing land and construction costs will allow them to keep renting prices low. I also eliminated all parcels fewer than 5000 square feet in area because it will be used for two dwellings. I chose to look at only those within a ¼ mile radius of the station, ensuring that the parcel residents were likely to walk to the train station. Finally, I eliminated all parcels that did not have the ideal solar orientation, north-south. Again, these factors were, to some degree, subjective and those parcels I eliminated were still well-suited for medium-density housing solutions.
My final selection of seven parcels was extremely subjective. I weighed the rankings with the parcel’s geographical positioning and its proximity to various entities. I tried to include parcels with different attribute, so as to make the future, on-site analysis more varied.

CONCLUSION

In conclusion, I believe this report has clearly indicated the high potential for implementing medium-density housing in Austin, Texas. The data has shown that areas around new transit stations have demographic characteristics that will benefit greatly from the new public transit lines and affordable housing developments. As Austin continues to grow, it is imperative that the city does not continue to consume land at its current rate of expansion. By densifying already developed areas, the city can conserve open lands, increase commuter traffic along new rail lines, and reduce vehicular traffic problems. Duplex and semi-detached homes can provide density and affordability without drastically changing the character and scale of the cherished Austin neighborhoods. These types of dwellings can also preserve and promote a diverse population with a range of economic classes, ethnicities and family types.
REFERENCES


   March 17, 2006.


“UnSprawl Case Study: Cohousing in Tucson, Arizona”. Terrain: A Journal of the
APPENDIX
ALL MAPS USE THE FOLLOWING PROJECTION, DATUM AND DATA SOURCES:

Coordinate System: NAD 1983 Stateplane Texas Central FIPS 4203 Feet
Datum: GSC North American 1983
Sources:

Map 1:
1. Import counties.shp, select Travis County, export data to create new travis_county.shp, remove counties.shp
2. Import citylimits.shp, select Austin, export data to create new austin_limits.shp, remove citylimits.shp
3. Import railroads_2003.shp, austin_sanantonio_commuter_rail.shp, Riverside.shp, Manor.shp, Long_Center.shp
4. Import STR_ADDRESS.shp
5. Clip all imported files in steps 3 and 4 using travis_county.shp as boundary
6. Import parcels_shp, clip file using austin_limits.shp as boundary
7. Create stations point shapefile
   a. create address locator
   b. geocode 9 metrorail station addresses
8. Create .5 mile buffer around all stations

Map 2:
1. Zoomed in version of Map 1

Map 3:
1. Import austin_limits.shp, travis_county.shp, austin_sanantonio_commuter_rail.shp, Riverside.shp, parcels_shp, stations.shp, redline_metrorail.shp
9. Erase all parcels that do not intersect with buffer zones and create new shapefile walking_parcel.shp

Map 4:
1. Import austin_limits.shp, travis_county.shp, austin_sanantonio_commuter_rail.shp, Riverside.shp, parcels_shp, stations.shp, redline_metrorail.shp
9. Erase all parcels that do not intersect with buffer zones and create new shapefile walking_parcs.shp

Map 5:
1. Import austin_limits.shp, travis_county.shp, austin_sanantonio_commuter_rail.shp, Riverside.shp, parcels.shp, stations.shp, redline_metrorail.shp
   a. Import census_tracts.shp (after joining with table tract_level_data_2000)
   b. Modify symbology of census_tracts.shp to represent income levels for Travis county

Map 6:
1. Import austin_limits.shp, travis_county.shp, austin_sanantonio_commuter_rail.shp, Riverside.shp, parcels.shp, stations.shp, redline_metrorail.shp
   a. Import census_tracts.shp (after joining with table tract_level_data_2000)
   b. Modify symbology of census_tracts.shp to represent rental units divided by total units for Travis county

Map 7:
1. Import austin_limits.shp, travis_county.shp, austin_sanantonio_commuter_rail.shp, Riverside.shp, parcels.shp, stations.shp, redline_metrorail.shp
   a. Import census_tracts.shp (after joining with table tract_level_data_2000)
   b. Modify symbology of census_tracts.shp to represent average family sizes for Travis county

Map 8:
1. Import austin_limits.shp, travis_county.shp, austin_sanantonio_commuter_rail.shp, Riverside.shp, parcels.shp, stations.shp, redline_metrorail.shp
   a. Import census_tracts.shp (after joining with table tract_level_data_2000)
   b. Modify symbology of census_tracts.shp to represent total housing units divided by census tract area for Travis county

Map 9:
1. Import austin_limits.shp, travis_county.shp, austin_sanantonio_commuter_rail.shp, Riverside.shp, parcels.shp, stations.shp, redline_metrorail.shp
2. Using spatial analyst tool, dissolve, convert features to raster, classify with 6 categories and natural breaks, and use raster calculator with the following equation:
   a. (income * .4) + (fam_size * .2) + (renters * .1) + (housing * .3)
3. Convert raster to features and intersect with census_tracts.shp.

Map 10:
1. Import austin_limits.shp, travis_county.shp, austin_sanantonio_commuter_rail.shp, Riverside.shp, parcels.shp, stations.shp, redline_metrorail.shp
2. Using spatial analyst tool, dissolve, convert features to raster, classify with 6 categories and natural breaks, and use raster calculator with the following equation:
a. \((\text{income} \times .4) + (\text{fam\_size} \times .2) + (\text{renters} \times .1) + (\text{housing} \times .3)\)

3. Convert raster to features and intersect with census\_tracts.shp.

**Map 11:**
1. Zoomed in version of map 10

**Map 12:**
1. Import austin\_limits.shp, travis\_county.shp, austin\_sanantonio\_commuter\_rail.shp, Riverside.shp, parcels\_shp, stations.shp, redline\_metrorail.shp, import zoned\_parcels.shp
2. Using symbology show only parcels zoned sf-3

**Map 13:**
1. Import austin\_limits.shp, travis\_county.shp, austin\_sanantonio\_commuter\_rail.shp, Riverside.shp, parcels\_shp, stations.shp, redline\_metrorail.shp, import zoned\_parcels.shp
2. Using symbology show market value of parcels

**Map 14:**
1. Import austin\_limits.shp, travis\_county.shp, austin\_sanantonio\_commuter\_rail.shp, Riverside.shp, parcels\_shp, stations.shp, redline\_metrorail.shp, import zoned\_parcels.shp, buffers.shp
2. Using symbology show only parcels zoned sf-3 and below $200,000

**Map 15:**
1. Import austin\_limits.shp, travis\_county.shp, austin\_sanantonio\_commuter\_rail.shp, Riverside.shp, parcels\_shp, stations.shp, redline\_metrorail.shp, import zoned\_parcels.shp, floodplain.shp, coa\_parks.shp, major\_streets.shp
2. Arrange to show factors of suitability analysis

**Map 16:**
1. Import austin\_limits.shp, travis\_county.shp, austin\_sanantonio\_commuter\_rail.shp, Riverside.shp, parcels\_shp, stations.shp, redline\_metrorail.shp, import zoned\_parcels.shp, floodplain.shp, coa\_parks.shp, major\_streets.shp
2. Using spatial analyst tool, dissolve, convert features to raster, classify with 8 categories and natural breaks, and use raster calculator with the following equation:
a. \((\text{streets} \times .2) + (\text{parks} \times .4) + (\text{station} \times .4)\)
3. Convert raster to features and intersect with parcels\_clipped.shp.

**Map 17:**
1. Import austin_limits.shp, travis_county.shp, austin_sanantonio_commuter_rail.shp, Riverside.shp, parcels.shp, stations.shp, redline_metrorail.shp, import zoned_parcelrail.shp, floodplain.shp, coa_parks.shp, major_streets.shp
2. Using spatial analyst tool, dissolve, convert features to raster, classify with 8 categories and natural breaks, and use raster calculator with the following equation:
   a. (streets * .2) + (parks * .4) + (station * .4)
3. Convert raster to features and intersect with parcels_clipped.shp.

Map 18:
1. Import austin_limits.shp, travis_county.shp, austin_sanantonio_commuter_rail.shp, Riverside.shp, parcels.shp, stations.shp, redline_metrorail.shp, import zoned_parcelrail.shp, floodplain.shp, coa_parks.shp, major_streets.shp
2. Select by attributes only parcels with 1 or 2 ranking class
3. Erase all other parcels.

Map 19:
1. Import austinLimits.shp, travis_county.shp, austin_sanantonio_commuter_rail.shp, Riverside.shp, parcels.shp, stations.shp, redline_metrorail.shp, import zoned_parcelrail.shp, floodplain.shp, coa_parks.shp, major_streets.shp
2. Import only parcels ranked 1 and 2 classes.
3. Select by attributes only parcels over 5000 feet in shape area.
4. Erase all other parcels.

Map 20:
1. Import austinLimits.shp, travis_county.shp, austin_sanantonio_commuter_rail.shp, Riverside.shp, parcels.shp, stations.shp, redline_metrorail.shp, import zoned_parcelrail.shp, floodplain.shp, coa_parks.shp, major_streets.shp
2. Import 1to2_over5000.shp
3. Select by attributes only parcels under $130,000 in market value.
4. Erase all other parcels.

Map 21:
1. Import austinLimits.shp, travis_county.shp, austin_sanantonio_commuter_rail.shp, Riverside.shp, parcels.shp, stations.shp, redline_metrorail.shp, import zoned_parcelrail.shp, floodplain.shp, coa_parks.shp, major_streets.shp
2. Import 1to2_over5000_under130000.shp
3. Select by location only parcels within quarter_buffer.shp.
4. Erase all other parcels.

Map 22:
1. Import austinLimits.shp, travis_county.shp, austin_sanantonio_commuter_rail.shp, Riverside.shp, parcels.shp, stations.shp, redline_metrorail.shp, import zoned_parcelrail.shp, floodplain.shp, coa_parks.shp, major_streets.shp
2. Import 1to2_over5000_under130000_inbuffer.shp
3. Select by hand all parcels with horizontal orientation (north-south)
4. Erase all other parcels.

Map 23:
1. Import austin_limits.shp, travis_county.shp, austin_sanantonio_commuter_rail.shp, Riverside.shp, parcels.shp, stations.shp, redline_metrorail.shp, import zoned_parcel.shp, floodplain.shp, coa_parks.shp, major_streets.shp
2. Import 1to2_over5000_under130000_inbuffer_oriented.shp
3. Select by hand seven ideal parcels.
4. Erase all other parcels.