

2015

STRIDE

Southeastern Transportation Research,
Innovation, Development and Education Center

Final Report

A Regional Land Use-
Transportation Decision Support
Tool for Mississippi
(2012-003S)



John Poros, Mississippi State University

Brian J. Morton, Ph.D., University of North Carolina at Chapel Hill

Joseph Huegy, MRP, North Carolina State University

August 2015



DISCLAIMER

The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the information presented herein. This document is disseminated under the sponsorship of the U.S. Department of Transportation’s University Transportation Centers Program, in the interest of information exchange. The U.S. Government assumes no liability for the contents or use thereof.

ACKNOWLEDGMENT OF SPONSORSHIP

This work was sponsored by a grant from the Southeastern Transportation Research, Innovation, Development and Education Center.

AUTHORS

John Poros
Carl Small Town Center
College of Architecture, Art + Design
Mississippi State University
Mississippi State, Mississippi

Brian J. Morton*
Center for Urban and Regional Studies
The University of North Carolina at Chapel Hill
Chapel Hill, North Carolina

Joseph Huegy
Institute for Transportation Research and Education
North Carolina State University
Raleigh, North Carolina

*Corresponding author

TABLE OF CONTENTS

DISCLAIMER	i
ACKNOWLEDGMENT OF SPONSORSHIP.....	i
AUTHORS.....	ii
LIST OF FIGURES	v
LIST OF TABLES	viii
ABSTRACT.....	ix
EXECUTIVE SUMMARY	x
CHAPTER 1: INTRODUCTION.....	1
CHAPTER 2: CURRENT LAND USES AND SOCIOECONOMIC CONDITIONS	4
Regional Demographics.....	4
Lee County and Tupelo.....	10
Union County and New Albany.....	13
Pontotoc County and Pontotoc.....	15
Chickasaw County and Houston.....	16
CHAPTER 3: THE TWO ALTERNATIVE FUTURES EXPLORED USING COMMUNITYVIZ.....	18
The Heritage Hills: A Plan for Growth.....	18
Tupelo	20
New Albany	33
Pontotoc	49
Houston.....	65

CHAPTER 4: THE TWO ALTERNATIVE FUTURES EXPLORED USING AN INTEGRATED TRAVEL DEMAND – LAND USE MODEL 83

 Summary of the Travel Demand-Land – Use Model..... 83

 Scenario Assessments and Comparisons 89

CHAPTER 5: CONCLUSION 98

LIST OF REFERENCES 99

APPENDIX: DEVELOPING THE TRANSPORTATION NETWORK AND TRAVEL DEMAND PARAMETERS..... A-1

 Highway Network..... A-1

 Transit Network A-3

 Tanglefoot Trail A-3

 Calibration of Travel Demand Parameters A-3

LIST OF FIGURES

Figure 1-1. Northeast Mississippi, case-study counties and towns, and Tanglefoot Trail.	1
Figure 2-1. Density.	5
Figure 2-2. Age: youth/elderly.....	6
Figure 2-3. Per capita income.	7
Figure 2-4. Housing values.	8
Figure 2-5. Employment and industry.	9
Figure 2-6. Furniture industry.....	10
Figure 3-1. Tupelo current roads build-out.....	23
Figure 3-2. Current housing dwelling units per acre.	24
Figure 3-3. Build-out dwelling units per acre.	25
Figure 3-4. Density difference between base build-out and current housing.	26
Figure 3-5. High school/Natchez Trace development.	27
Figure 3-6. High school/Natchez Trace retail site before.	28
Figure 3-7. High school/Natchez Trace retail proposal.	28
Figure 3-8. High school/Natchez Trace retail view.	29
Figure 3-9. Natchez Trace site before.....	29
Figure 3-10. Natchez Trace proposal.....	30
Figure 3-11. East Tupelo diagram.	31
Figure 3-12. View South Veteran's Boulevard proposal.	32
Figure 3-13. Current zoning and existing buildings.	34

Figure 3-14. Current dwelling units per acre. 35

Figure 3-15. Five minute walking distance..... 36

Figure 3-16. Ten minute walking distance. 37

Figure 3-17. Seven mile biking distance..... 38

Figure 3-18. Bicycle path/trail suitability. 39

Figure 3-19. Base residential build-out..... 40

Figure 3-20. Density difference base zoning build out versus current housing..... 41

Figure 3-21. Carter Avenue development..... 42

Figure 3-22. Carter Avenue after facing south. 43

Figure 3-23. Carter Avenue looking north before. 43

Figure 3-24. Carter Avenue looking north after. 44

Figure 3-25. Park Plaza Drive development. 45

Figure 3-26. Plaza Drive before..... 45

Figure 3-27. Plaza Drive after..... 46

Figure 3-28. Density difference between new zoning build-out and current housing conditions. 47

Figure 3-29. Density difference between new zoning build-out and base zoning build-out. 48

Figure 3-30. Pontotoc 5 minute walk radius..... 50

Figure 3-31. Pontotoc 10 minute walk radius..... 51

Figure 3-32. Existing buildings and buildable area. 52

Figure 3-33. Base zoning residential build-out..... 53

Figure 3-34. Base zoning commercial build-out..... 54

Figure 3-35. Base zoning build-out dwelling units per acre..... 55

Figure 3-36. Density difference between base zoning build-out and current zoning. 56

Figure 3-37. New neighborhoods overall plan. 57

Figure 3-38. New community around sportsplex. 58

Figure 3-39. Turtle Creek Road development. 59

Figure 3-40. 8th Street development..... 60

Figure 3-41. 8th Street development view..... 60

Figure 3-42. Coffee Street development..... 61

Figure 3-43. Coffee Street development view..... 62

Figure 3-44. New zoning dwelling units per acre..... 63

Figure 3-45. Density difference, new zoning versus base zoning build-out..... 64

Figure 3-46. Current density..... 66

Figure 3-47. Houston walking distances..... 67

Figure 3-48. Houston biking distances. 68

Figure 3-49. Base zoning build-out. 69

Figure 3-50. Base zoning build-out dwelling units per acre..... 70

Figure 3-51. Base zoning build-out - current dwelling units per acre. 71

Figure 3-52. New zoning build-out..... 72

Figure 3-53. Zoomed in new zoning build-out. 73

Figure 3-54. Tanglefoot Trailhead Park..... 74

Figure 3-55. Aerial of Trailhead neighborhood before..... 75

Figure 3-56. Aerial of Trailhead neighborhood after..... 76

Figure 3-57. View of Trailhead neighborhood. 77

Figure 3-58. Washington Street before. 78

Figure 3-59. Washington Street after. 79

Figure 3-60. Downtown Houston before. 80

Figure 3-61. Downtown Houston after. 80

Figure 3-62. Bicycle suitability analysis of Houston: citywide. 81

Figure 3-63. Bicycle suitability analysis of Houston: detail. 82

Figure 4-1. Causal structure in TRANUS-based models. 84

Figure 4-2. Model’s study area: counties, largest towns, and analysis zones. 86

Figure 4-3. Auto manufacturing employment growth. 92

Figure 4-4. Road network: base scenario (top) and growth scenarios (bottom). 93

Figure 4-5. Two towns scenario: change in total number of households. 94

Figure 4-6. Two towns scenario: change in commercial employment. 95

Figure 4-7. Four towns scenario: change in total number of households. 96

Figure 4-8. Four towns scenario: change in commercial employment. 97

LIST OF TABLES

Table 3-1. Population Estimates and Projections 19

Table A-1. Link Types A-2

Table A-2. Link Capacity A-2

Table A-3. Transit Services A-3

Table A-4. Overlap Factors..... A-4

ABSTRACT

The Mississippi Hills National Heritage Area was historically known for agriculture and furniture manufacture, but now a high-tech, transportation-based economy is emerging. Toyota recently opened a vehicle factory that will employ 2,000 people in a village west of Tupelo. Another quite different development is simultaneously occurring. The 43-mile Tanglefoot Trail was recently opened, built on the GM&O Railroad line linking Houston to New Albany.

The current development pattern is a fascinating juxtaposition of historical small towns and a 21st-century boom driven by the automobile/aerospace economy. Two starkly different futures may be easily imagined. In one, Tupelo continues to expand at a rapid pace and New Albany also expands, but they eclipse the region's smaller and declining towns. An alternative development pattern would spread growth among Houston, Pontotoc, New Albany, and Tupelo.

The project conducted build-out analyses, prepared renderings of different development visions, and developed an integrated land use – travel demand model to assess the household travel behavior that could be induced by two hypothetical development scenarios. In one scenario, growth in population and commercial establishments is concentrated in New Albany and Tupelo. In the other, growth occurs in New Albany and Tupelo as well as Houston and Pontotoc.

EXECUTIVE SUMMARY

Located between the Mississippi Delta to the west and the foothills of Appalachia to the east, the Mississippi Hills National Heritage Area was historically known for cotton and dairy production and furniture manufacture. A new high-tech, transportation-based economy has begun to develop. Toyota recently opened a vehicle assembly plant that will employ 2,000 people near the village of Blue Springs (west of Tupelo). Another quite different development is also occurring. The 43-mile Tanglefoot Trail was opened in 2014, built on the GM&O Railroad line linking Houston to New Albany, near the area's center and Toyota's Blue Springs plant.

The current development pattern is a fascinating juxtaposition of small towns and villages built when agriculture and furniture manufacture dominated and a 21st-century boom driven by the automobile/aerospace economy. The area's residents, businesses, and local governments face the unprecedented challenge of sustaining the rural community character on which heritage-based tourism depends while accommodating a booming industrial economy.

Two starkly different futures may be easily imagined. In one, Tupelo continues to expand at a rapid pace and New Albany also expands, but they eclipse the region's smaller and declining towns. An alternative development pattern would spread growth among more of the region's larger towns: Houston, Pontotoc, New Albany, and Tupelo.

While there are multiple performance criteria that could be used as the basis of a comparative evaluation of the two development futures, one of the most important criteria is transportation efficiency, which accounts for the distance someone travels to achieve a given daily activity schedule, and which directly correlates with fossil fuel consumption and vehicular emissions of air pollutants. An increase in vehicle miles traveled per person indicates a decrease in transportation efficiency because travelers consume more resources (e.g., time and money) to pursue their daily routines, whereas a decrease in vehicle miles traveled per person indicates an increase in transportation efficiency. Decreasing vehicle miles traveled per person will typically decrease fuel consumption per person and vehicular emissions per person, although the latter decreases may not be proportional to the change in VMT per person.

When all growth occurs in New Albany and Tupelo, the projected change (compared to conditions in the year 2000) in daily per capita VMT is a decrease of 0.74 miles per person. When all growth occurs in the four largest towns, the projected change is a decrease of 0.19 miles per person. Judging the growth scenarios on the basis of transportation efficiency—thus accounting directly for the distance someone travels to achieve a given daily activity schedule and indirectly for fuel consumption and air pollutant emissions—both scenarios perform equally well.

CHAPTER 1: INTRODUCTION

Located between the Mississippi Delta to the west and the foothills of Appalachia to the north, the Mississippi Hills National Heritage Area was historically known for cotton and dairy production and furniture manufacture (Figure 1-1). A new high-tech, transportation-based economy has begun to develop. Toyota recently opened a vehicle assembly plant that will employ 2,000 people near the village of Blue Springs (west of Tupelo). Another quite different development is also occurring. The 43-mile Tanglefoot Trail was opened in 2014, built on the GM&O Railroad line linking Houston to New Albany, near the area's center and Toyota's Blue Springs plant.

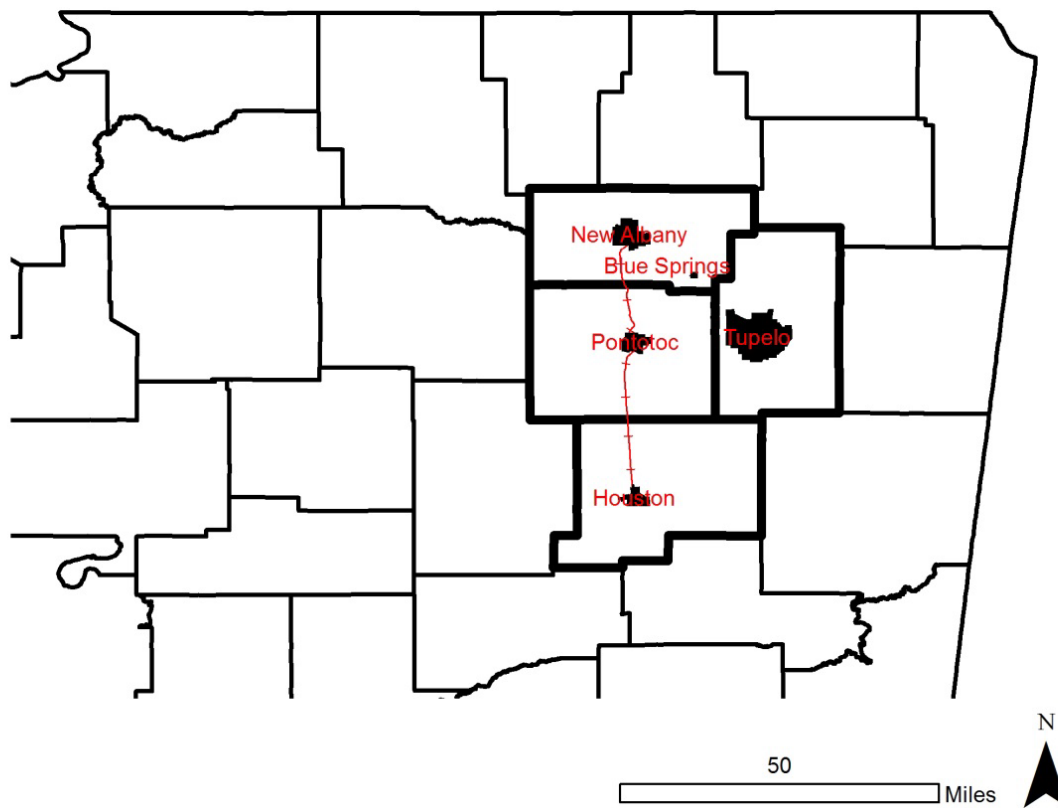


Figure 1-1. Northeast Mississippi, case-study counties and towns, and Tanglefoot Trail.

The current development pattern is a fascinating juxtaposition of small towns and villages built when agriculture and furniture manufacture dominated and a 21st century boom driven by the automobile/aerospace economy. The area's residents, businesses, and local governments face the

unprecedented challenge of sustaining the rural community character on which heritage-based tourism depends while accommodating a booming industrial economy.

Two starkly different futures may be easily imagined. In one, Tupelo continues to expand at a rapid pace and New Albany also expands, but they eclipse the region's smaller and declining towns. An alternative development pattern would spread growth among more of the region's larger towns: Houston, Pontotoc, New Albany, and Tupelo.

Our project provides the region with two analytical tools that will help inform discussions of the benefits and costs of different development trajectories. One is a suite of CommunityViz based models of Houston, Pontotoc, New Albany, and Tupelo that have been used to project the increase in households that could reside in each town under two different assumptions about allowable density as well as the further assumption that build-out occurs. The “base zoning” assumption represents the current zoning. The “new zoning” assumption allows increased residential density near each town's downtown and increases density the most nearest the Tanglefoot Trail.

More than 60 maps and photo-realistic renderings show building footprints and streetscapes to illustrate the towns' plan and appearance after growth. The streetscape and building proposals were developed after visits to the towns and our long experience working with these towns to understand the opportunities and needs of these towns. In many cases, the plans and renderings were presented back to the town in community meetings to gather feedback and spark new thought about opportunities for development and enhancement.

The other analytical tool that we developed is an aggregate (zonal) integrated land use – travel demand of four counties. It predicts the household travel patterns—trip generation, trip distribution, mode choice, and traffic assignment—that could result from realization of each growth scenario. This model is closely linked to the CommunityViz models. The latter provides constraints on the maximum number of households that may reside in each analysis zone in Houston, Pontotoc, New Albany, and Tupelo.

Using the land use – travel demand, we developed and assessed two scenarios to predict the travel behavior that could be induced by the direct and indirect growth caused by expansion of automobile manufacturing under two assumptions about the location of population growth and growth in the commercial establishments that provide the goods and services demanded by the new residents. In the Two Towns Scenario, the new households and commercial jobs are located in New Albany and Tupelo. In the Four Towns Scenario, the new households and commercial jobs are located in New Albany and Tupelo as well as Houston and Pontotoc. Land use in both scenarios is governed by “new zoning.”

While there are multiple performance criteria that could be used as the basis of a comparative evaluation of the two development futures, one of the most important criteria is transportation efficiency, which accounts for the distance someone travels to achieve a given daily activity

schedule, and which directly correlates with fossil fuel consumption and vehicular emissions of air pollutants. An increase in vehicle miles traveled per person indicates a decrease in transportation efficiency because travelers consume more resources (e.g., time and money) to pursue their daily routines, whereas a decrease in vehicle miles traveled per person indicates an increase in transportation efficiency. Decreasing vehicle miles traveled per person will typically decrease fuel consumption per person and vehicular emissions per person, although the latter decreases may not be proportional to the change in VMT per person.

The land use-travel demand model may be used to design and assess many other scenarios involving hypothetical development patterns and changes in transportation infrastructure that we did not include in our scenarios. For example, the locations of the new households attracted to the four largest towns could be concentrated in fewer locations (zones), or dispersed to a greater number of locations, than in our Four Towns Scenario.

The model that we have developed is in the public domain, and the modeling platform is open-source. Anyone may download the modeling platform (TRANUS) at no cost from this Web site: <http://www.tranus.com/tranus-english/download-install>. Brian J. Morton at the University of North Carolina would be the source of the files that would be needed to either replicate the Two Towns Scenario and the Four Towns Scenario or to design and assess another scenario that could be compared to the Base Scenario, Two Towns Scenario, or Four Towns Scenario (bjmorton@unc.edu).

Although the tool that we developed would not need to be recalibrated before using it to design and assess additional scenarios, new TRANUS users should not expect to be able to immediately pick up where we have left off. As is common with flexible and sophisticated tools used for town and regional planning, the modeling platform that we use has a steep learning curve. Users new to TRANUS would probably need to invest several months of full-time effort to learn the basics of model structure, construction, and calibration. Another month would probably be required to obtain a minimum level of proficiency in scenario design and assessment, interpretation of results, and thematic mapping (assuming pre-existing familiarity with a geographical information system).

CHAPTER 2: CURRENT LAND USES AND SOCIOECONOMIC CONDITIONS

Our study area, Union, Pontotoc, Chickasaw, and Lee counties in Mississippi are part of a larger area known historically as the Northeast Hills and now as the Heritage Hills. This region stretches from DeSoto County south of Memphis to the Alabama border and from Tennessee to the north to Clay and Webster County to the south. The area is characterized by rolling hills, being at the foothills of the Appalachian Range, and rocky soils. The history of the area in some ways is more tied to eastern Tennessee and northwestern Alabama than to the flat, lush lands of the Delta, the woodlands of central Mississippi or the Gulf Coast. The study area centers around the micropolis of Tupelo with smaller towns ringing Tupelo. The area is connected by Highway 45 in the north-south direction and Highway 78 in the east-west direction. Highway 78 connects the region with Memphis to the west and Birmingham to the east while Highway 45 connects the region with the Gulf Coast and Jackson, TN. In addition, a number of smaller state highways connect the smaller towns in an east-west and north-south net of roads.

The region is also connected by waterways and rail. The Tennessee-Tombigbee Waterway runs to the east of Tupelo and connects the Mississippi River with Mobile Bay. The Kansas City Southern Railroad passes through Tupelo and connects the region to Jackson, MS and the Gulf Coast while the Burlington Northern Railroad connects the region to Memphis and Atlanta.

REGIONAL DEMOGRAPHICS

The larger region of the Heritage Hills does contain some larger cities including Southhaven (pop. 48,982), Olive Branch (pop. 33,484), and Tupelo (pop. 34,546). Southhaven and Olive Branch are located right on the Mississippi-Tennessee border near the suburbs of Memphis. They are also both located on State Highway 78, which allows for easy access to Memphis. In our study area, Tupelo, while similar in population to Olive Branch, draws much of its population due to its location at the intersection of Highways 78 and 45 as well as being the intersection of the Burlington Northern and Kansas City Southern railroad lines. New Albany (pop. 8,024), located between these three locations, has a much smaller population in comparison to Southhaven or Tupelo. New Albany does have a larger population than many of the towns surrounding it because of its central location in the region along Highway 78. Pontotoc and Houston, some of the other towns in our study area have respectively a population of 5,625 and 3,567. Interspersed between these larger towns are some very small towns such as Ecu (pop. 893), Sherman (pop. 548) and Blue Springs (pop. 229). Figure 2-1, Figure 2-2, Figure 2-3, Figure 2-4, Figure 2-5, and Figure 2-6 portray the region's density; age distribution; personal income; housing values; and economic structure.

The population densities of these areas follow the same trend as the total population. The largest population density in the Heritage Hills region is Oxford, MS with 23,000 persons per square

mile, due to the fact that Oxford is home to The University of Mississippi. Most of the other urban areas have far less density. Southaven has 1,441 persons per square mile while Tupelo has 676. New Albany’s population density is approximately 470 people per square mile. In comparison, the central area of a city like Memphis, Tennessee has about 2,500 persons per square mile. On the whole, even in urban areas the densities are quite low.

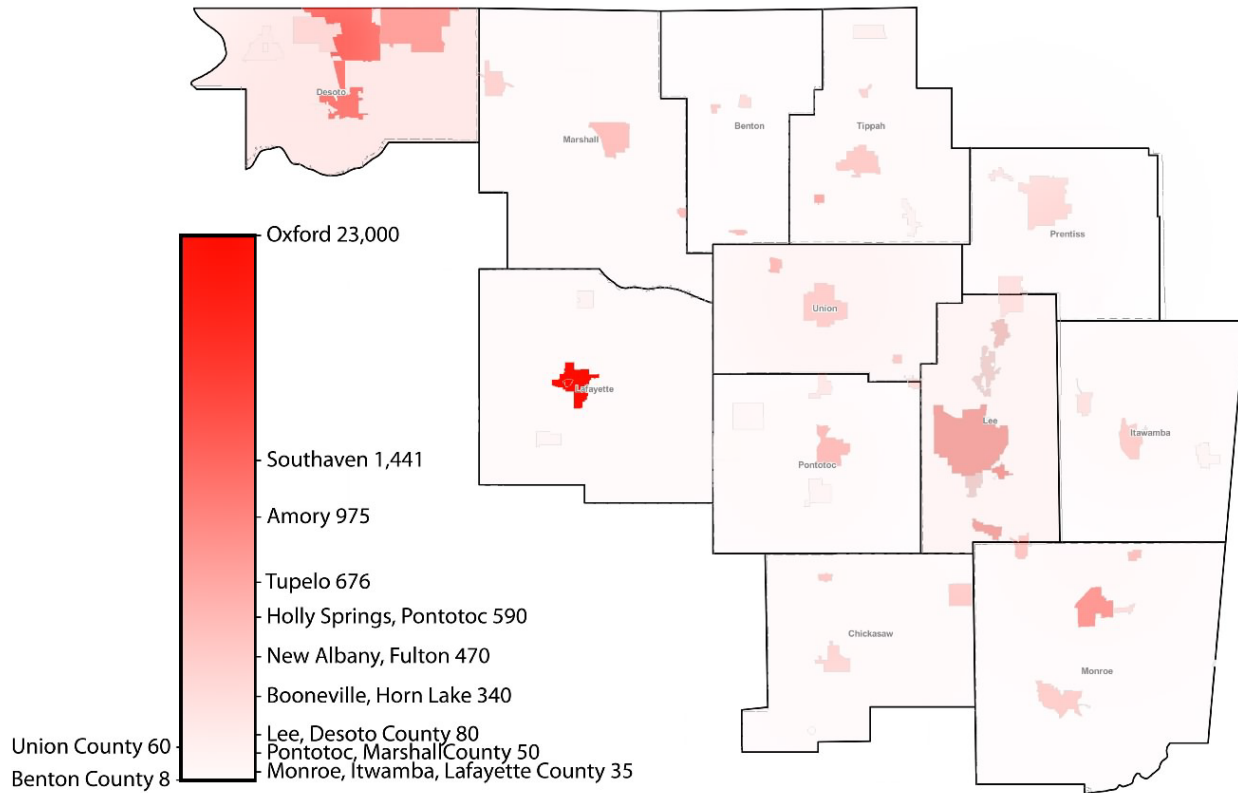


Figure 2-1. Density.

Racial and ethnic make-up of the area in some counties follows the historical pattern of nearly all white population for the Heritage Hills area. For Union County the racial mix is 81% white, 15% black and 4% other. Pontotoc County has a similar large white population with 80% white, 14% black, 6% other. However in Lee County the mix is more representative of Mississippi as a whole with 65% white, 27% black and 8% other as is the racial make-up in Chickasaw County, white 54%, black, 42% black and 4% other.

Also, overall, the Heritage Hills region is much younger than older. In Union County, the population aged 18 and under is 26% while those aged 65 and older are only 15%. Lee and Chickasaw Counties are similar with 27% and 26% under 18 and 13% and 14% over 65 respectively. Pontotoc County is slightly different with 19% under 18 and 11% over 65.



Figure 2-2. Age: youth/elderly.

In terms of socioeconomics, the average per capita income for the state of Mississippi in 2010 was \$31,186 while the national average for per capita income was \$40,584. Desoto County, whose average was \$24,435, is the highest in the area and still falls significantly below the state and national average. The per capita incomes for our study areas are much lower. Union County is \$17,765, Pontotoc is \$17,482, Chickasaw is \$15,932 and Lee is the highest at \$21,365. The median home value in Mississippi at the end of 2012 was \$141,500. In Union County, the mean home value was \$73,661, in Pontotoc \$87,171, in Chickasaw \$62,934. Lee County had the highest valuation with a mean home value of \$114,300.

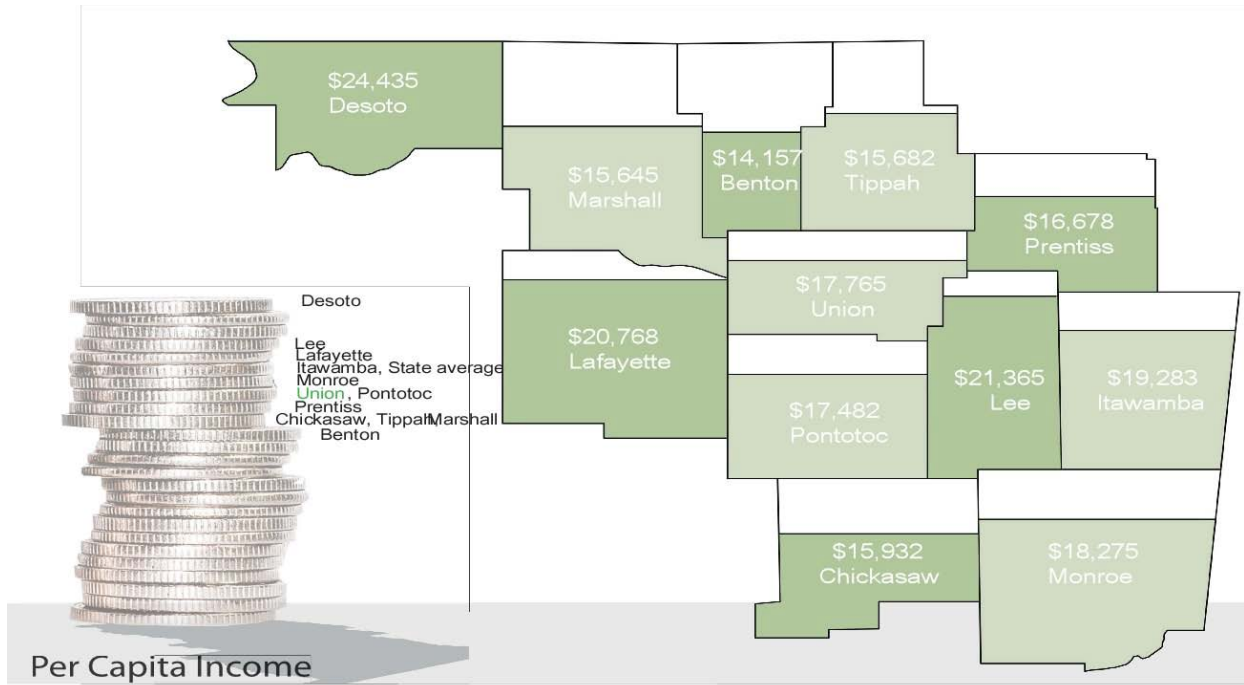
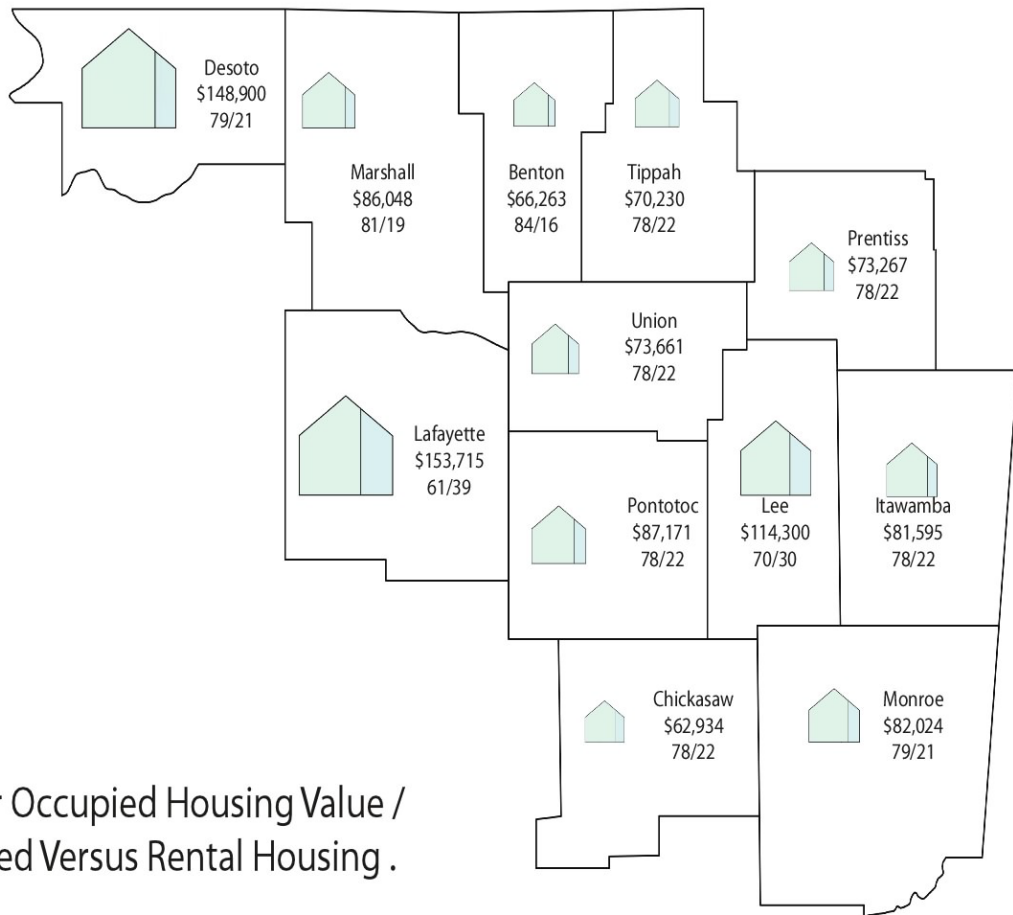


Figure 2-3. Per capita income.



Median Owner Occupied Housing Value / Owner Occupied Versus Rental Housing .

Figure 2-4. Housing values.

Jobs in the three county study area are concentrated in manufacturing and health care with lesser employment in retail, warehousing and education. A significant portion of the industry in the Northeastern Mississippi region is manufacturing. Lee County has the greatest number of manufacturing jobs with 10,700 followed by Pontotoc County with 6,210. In the other counties of our study area Chickasaw County has 3,550 and Union 1,550 manufacturing jobs. The other large employer is health care with 9,550 in Lee County and much smaller numbers in the other study area counties; Union 1,225, Pontotoc 750, and Chickasaw 440.

Northeast Mississippi Employment and Industry

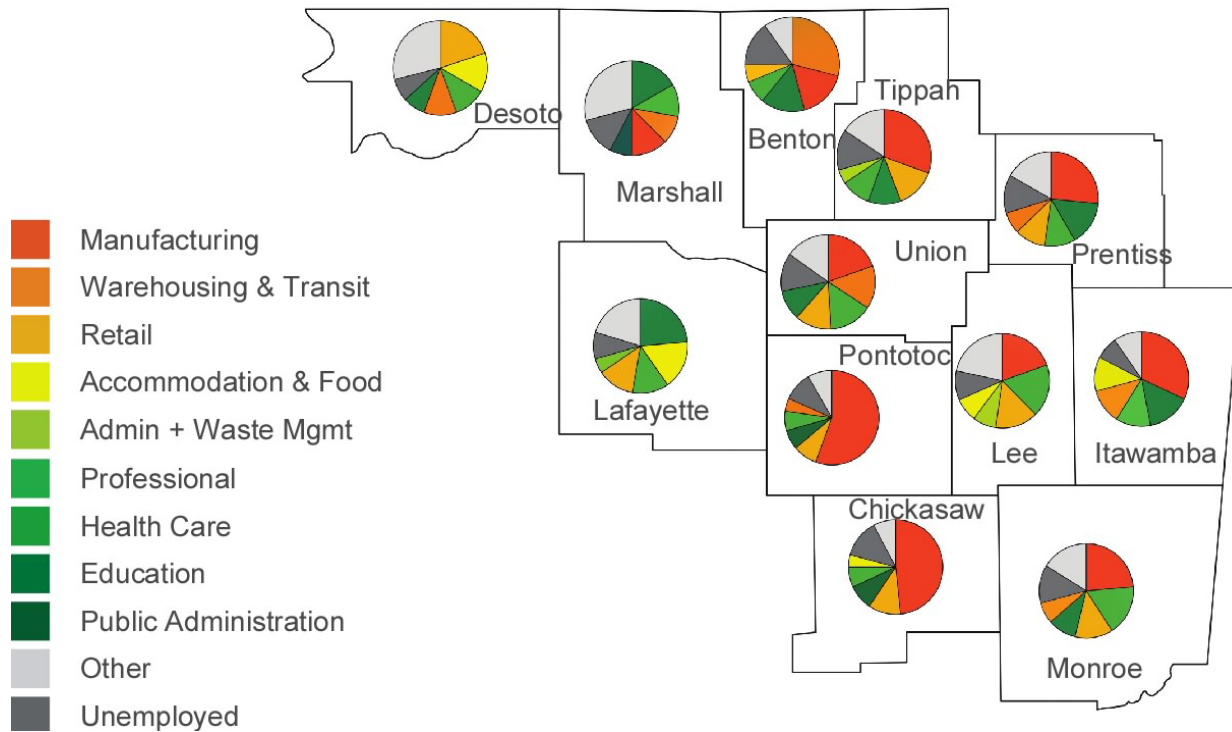


Figure 2-5. Employment and industry.

The furniture manufacturing field in Mississippi has been struggling for several years now. Between 2003 and 2010, there was a 49% decrease in the number of people employed in the furniture manufacturing field within Union County. This decrease is largely due to foreign manufacturers increasing exports of furniture.

Furniture Industry in Northeast Mississippi

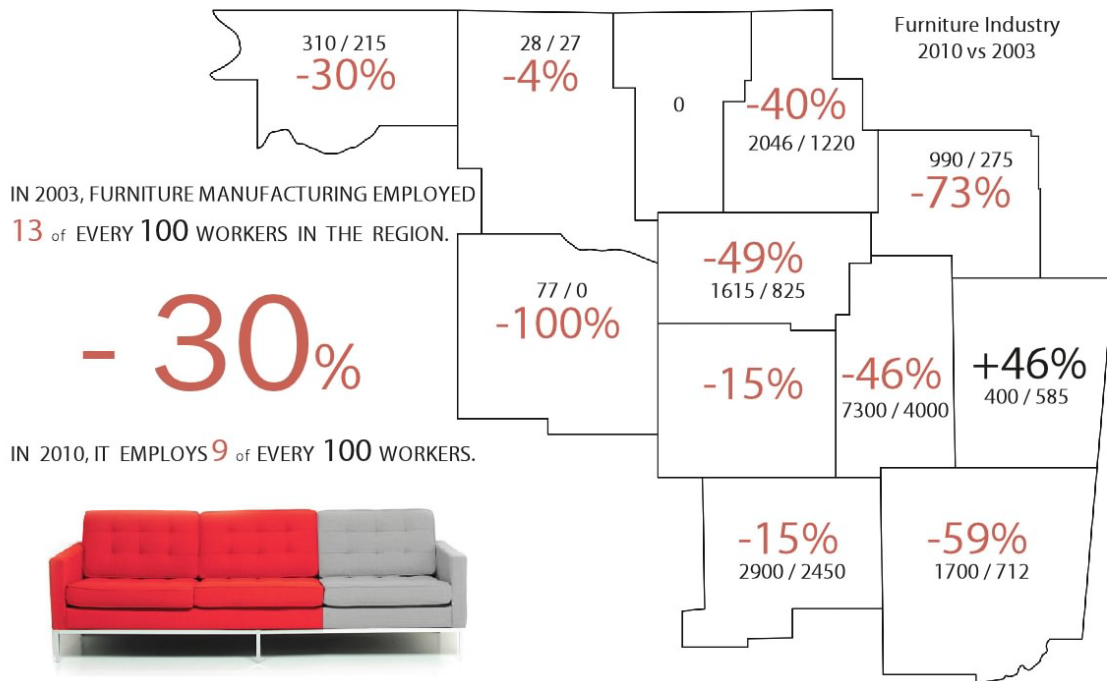


Figure 2-6. Furniture industry.

LEE COUNTY AND TUPELO

Lee County contains the micropolis of Tupelo, which is the economic center of the northeast Mississippi region. The land for Tupelo and its surrounds was obtained from the Chickasaw Indians by the Treaty of Pontotoc in 1832. The Chickasaws had used as the site of their capital the nearby highland ridges which overlooked the area’s broad rich valleys. Subsequently the old Indian trails were improved to form a primitive road system. By 1848, settlers from the eastern seaboard states, mostly Scotch-Irish many of which were devout Protestants (1), moved in and established themselves as planters. In 1859 the Mobile and Ohio Railroad was laid in an area where nothing but cyprus and tupelo gum trees could survive. In 1860, two settlers, William R. Harris and Christopher Orr (2) filed their plat and wanted a lyrical name to attract prospective immigrants, and hence the name Tupelo was adopted.

The Civil War interrupted the progress of the area, an area important because of the railroad and supply of grain. By the conflict’s end, tumble-down ruins marked the location of recently built structures. The railroad, which served as the lifeline in the cotton economy, was in desperate straits. All of the railroad’s bridges, trestleworks, warehouses and station buildings both north and south of Tupelo were destroyed by Union forces over a 180-mile distance.

On October 6, 1866, Lee County was formed and on April 15, 1867 Tupelo was selected as the county seat raising Tupelo from “the status of village to town and later into an industrial city.”

(3). In 1875, the town of 100 people consisted of three stores, a bank, a courthouse and several business houses with no sidewalks or paved streets. After a period of rivalry between towns, in 1887, the Memphis and Birmingham Railroad (later called the Frisco) joined the Mobile and Ohio track in Tupelo, providing expanded opportunities to link with other major centers and allowed Tupelo to rapidly develop. As the economic depression of the 1890's came about, cotton prices dipped to a low five cents a pound. The ruinous agricultural conditions compounded by the boycotts forced local merchants to seek alternative bases for the town's economy. By the end of the decade in 1899 Tupelo began the biggest industrial boom in its history prior to the 1950's.

“In 1914, Lee County had the distinction of having a stretch of forty-nine miles of paved highway which was the first concrete road South of the Mason-Dixon line” (4). With the effects of the boll weevil in 1916 and the change of the foreign market consumption of cotton, the cotton crop was virtually destroyed and left town merchants with outstanding debts that could not be collected. Bankers worked with farmers to establish livestock programs that were to revolutionize the farm, bringing about diversification and balance. In 1927, Tupelo became a home to the Carnation Milk Company, the first in the South.

In 1920, according to The Daily Journal, the first community hospital was established in the YMCA building. In 1921, more than 2000 citizens each contributed at least one dollar, with the aid of the Commonwealth Fund, to build the North Mississippi Community Hospital. In 1933, Tupelo became the first U.S. city to purchase Tennessee Valley Authority power with Congressman John Rankin's assistance in co-authoring the bill. In celebration of this milestone purchase, on November 18, 1934, President F.D. Roosevelt visited Tupelo and gave a speech to 75,000 people at the City Park (now Robins-Noble Field) (5).

On April 5, 1936, a tornado struck a couple of subdivisions and the heart of Tupelo. “In 33 seconds, 201 people were killed and 1,000 injured. In half a minute, Tupelo received the most disastrous blow ever delivered to a Mississippi town up to that time. Within six months, however, Tupelo had built new homes, repaired the churches, and designed new schools” (3). A statement was made about the tornado much later, in 1985, by Jack Reed, owner of a Tupelo department store, said that the tradition of community involvement was strengthened by the tornado, “The tragedy of the tornado was a cohesive factor...and there was no old money in Tupelo. It didn't have a planter society. Everybody had to hustle. And they did” (6).

In 1948, the Community Development Foundation (CDF) was formed, becoming the economic development organization for the area and also serves as the Chamber of Commerce. “Being, at the time, a town of only 11,000 people, Tupelo recognized that its future lay not within its own municipal limits but among its 120,000 neighbors who lived within a radius of 25 miles” (7). By 1957, Tupelo businessmen and industrialists had poured nearly \$400,000 into the CDF program working towards developing the skills of its rural residents. Between 1947 and 1957, 1,700 industrial jobs were added in the city and nearly every industrial plant within the town had expanded its facilities. “From 1950 to 1980, the area's manufacturing employment increased 530

percent, compared to the state average of 150 percent” (6). Transportation systems were improved with a four-lane highway system running in the east-west and north-south directions, completed in 1983. A multi-million dollar improvement program provided Tupelo with a commercial airport capable of handling jet aircraft and providing a terminal building. Also, the Tennessee-Tombigbee Waterway was built eighteen miles east of Tupelo which provides a fresh water outlet to the Gulf of Mexico for added transportation opportunities.

Tupelo also consistently promoted community involvement and quality of life for its residents. In 1968, as a result of the outstanding progress made in development and in people care programs, Tupelo was awarded the “All American City” Award co-sponsored by Look magazine and the National Municipal League. Tupelo is known in Mississippi for its high standards for public education and the community support towards maintaining those standards. “In the early 1960s, Lee County was the first county in Mississippi to integrate its schools. By doing so, it avoided the public-relations debacles that for years shadowed Little Rock, Oxford and other Southern cities that resisted the civil-rights movement” (8). In the April, 1996 issue of Redbook recognized Tupelo High School as one of the top 65 high schools in the country, recognized for both its academic achievements as well as its outstanding extracurricular programs.

Tupelo today is a transitioning from an economy centered around furniture and low tech manufacturing to a high tech manufacturing and health care/services future. Most recently, Toyota put into operation an assembly plant in Blue Springs, Mississippi. Producing 150,000 Corollas a year and providing 2,000 direct jobs, the assembly plant is supplied by plants throughout the Heritage Hills area. Furniture manufacturing is still an important employer in the area with Tecumseh, Furniture Brands International, Hancock Fabrics, Inc., Magnolia Fabrics headquartered in Tupelo. Cooper Tire & Rubber and Hunter Douglas also operate large plants in Tupelo.

One of the largest employers and in fact the largest rural hospital in the country is the North Mississippi Medical Center in Tupelo. The hospital employs 6,315 persons and had operating revenues of \$1.8 billion (9). Tupelo is also known for its quality of life, having won the "All American City Award" given by the National Civic League four times.

Tupelo is centered around Main Street with a downtown commercial area of generally two story buildings built after the tornado of 1936. A block north of Main Street is the courthouse square with the new and old county courthouses. To the east of the historic Main Street opposite from the arena, a new, pedestrian-oriented downtown area has been developed with a new city hall, town green, shops and offices to accommodate future downtown growth. Surrounding the downtown core to the north, west and south are higher density historic neighborhoods consisting of detached housing on small lots. The historic crossroads of Tupelo and main vehicular spines are Main Street running east to west and Gloucester Street which runs north and south. The railroad lines also cross at the intersection of Main and Gloucester Streets, making this intersection literally the crossroads of the community.

Gloucester Street is the commercial strip for Tupelo with strip centers and automotive-oriented commercial buildings from its southernmost to northernmost extent. Approximately 1-1/2 miles north of the Main Street Gloucester intersection is Barnes Crossing, a large shopping mall and suburban retail center. Some higher end residential has developed north of this area in recent years, but here beyond the city limit is the town of Saltillo. To the west of the central core is the airport with postwar and more contemporary housing developments surrounding. To the south of the Main and Gloucester intersection is the North Mississippi Medical Center, as pointed out before, the largest rural hospital in the country. To the west of the Medical Center across Gloucester Street are a series of post-war and contemporary suburban developments. Further to the south on Gloucester starts the town of Verona.

Vehicular traffic in Tupelo has steadily increased as the city has grown in population. The most traveled roads in Tupelo are the major highways, Highway 45 and 78 with 20,000 to 30,000 annual average daily traffic according to counts from the Mississippi Department of Transportation. However, Main Street and Gloucester Street have traffic counts almost as high with 15,000 to 25,000 vehicles. Other roads such as McCullough Boulevard have very heavy traffic counts, 20,000 to 40,000 because of the many commercial businesses on that road.

Tupelo began to respond to the increase in traffic twenty-one years ago with their Major Thoroughfare Program. This program had the goal of enlarging Main and Gloucester Streets as well as creating a northern loop of roads connecting West Tupelo with the Barnes Crossing retail district. With many of these projects complete, Tupelo has embarked on a new study to guide a future period of potentially greater growth given the arrival of the Toyota assembly plant nearby. Whether additional road building and widening or an approach emphasizing greater pedestrian friendly development as outlined in Tupelo's strategic plan is the future direction will be seen (10).

UNION COUNTY AND NEW ALBANY

New Albany was founded in 1840 on a ridge overlooking the Little Tallahatchie River at the intersection of two historic Chickasaw Indian trade trails. Being on the Little Tallahatchie, New Albany developed as a river port and trading center. In 1870, Union County was formed from parts of neighboring Lee, Pontotoc, and Tippah Counties with New Albany as the county seat. The Gulf and Chicago Railroad (later the Gulf, Mobile and Ohio) made its way through New Albany in 1889 to connect Pontotoc, Mississippi to Middleton, Tennessee and beyond to Chicago. The Kansas City, Memphis and Birmingham Railroad intersected the Gulf, Mobile and Ohio in New Albany about the same time to tie the city to the rest of the country in both east-west and north-south directions.

New Albany continued as a transportation crossroads. The Bankhead Highway, an informal, east west route from Washington D.C. to San Diego, California designated in 1917, ran through New

Albany, giving its name to the eponymous Bankhead Street in town (11). This route would later become Highway 78. After World War II, the Union County Development Association was formed to help find employment for returning veterans. One of the Association's first successes was to attract Stratford Furniture in 1948. Morris Futorian, the head of Stratford and a Russian emigrant, built the first assembly-line furniture plant in North Mississippi. The region is still today the number one producer of upholstered furniture in the U.S. (12).

New Albany is today the home to "approximately 30 industries that produce everything from medical uniforms to automobile engine parts to high-tech industrial equipment" (13). New Albany is also the home to Baptist Memorial Hospital-Union County, a 153 bed facility (14). Furniture is still a major business in New Albany with Albany Industries, Kevin Charles Furniture, and Hillcraft Furniture. New Albany also has a Walmart distribution center just outside the city limits.

New Albany is the northern end of the Tanglefoot Trail, a 40 mile bike/hike path from New Albany to Houston, Mississippi along the path of the former Gulf, Mobile & Northern Railroad. The trail will include several "whistle stops" i.e. rest stops, in the towns of Ecu, Pontotoc and other areas along the way. The Trail is predicted to have 100,000 visitors a year and an economic impact of \$5,000,000 for the region.

The Little Tallahatchie River, which runs through New Albany, lies in a valley between two ridges. The downtown area lies at the base of the eastern ridge and the newer areas of the city are located on the western ridge. The strip commercial areas of the city line Highway 78 and two main entrances into the city, Highway 15 and Highway 30. The residential areas of the city are located along two ridges that split across the Tallahatchie River with the historic downtown and residential on the east ridge and newer commercial and residential on the west. Industrial areas are scattered throughout the city but lie mainly along the main highways and railways. An older commercial/industrial corridor is Carter Avenue, the third entrance into the city from Highway 78. Within the city, there is only one important east to west linkage, Bankhead Street which is also the main street of the city. The pedestrian linkages within New Albany includes the Katherine Dye Nature Trail in the Park Along the River, which links the Sportsplex south of Highway 78 to the downtown area. The most important bicycle and pedestrian linkage is the Tanglefoot Trail, a bike and walking trail that connects New Albany with Pontotoc and Houston 43 miles to the south. The trail follows the rail bed of the former Gulf, Mobile and Ohio railroad. The trail will include several "whistle stops" with amenities for users such as water fountains and bathrooms. In New Albany, the Tanglefoot Trail will end at the center of the downtown area.

There are several different districts that might be distinguished socially and geographically within the city of New Albany: the Railroad District, Carter Avenue, North Side, South Side, East District, the Sportsplex, Lowlands and West Bankhead. The Railway District contains warehouses dating back to the beginning of the city along two major railway lines. The Carter Avenue district, an entrance to the city, also links back to the railroad both physically and

historically containing warehouses, light industry and auto dealerships. The North Side district is a higher income residential neighborhood and the South Side district is a lower income residential neighborhood; both are older neighborhoods with well-established housing. The East New Albany district, located along Highway 178, is another entry point to the city. The East District is a new commercial strip for the city with some newer residential subdivisions as well. The Sportsplex district is a large recreational facility with baseball fields, soccer fields, tennis and playgrounds and is at the start of the Katherine Dye Trail and the Little Tallahatchie River. The Little Tallahatchie Lowlands district encompasses the low topographical area along the Little Tallahatchie River to the south of Highway 78. The West Bankhead district is a newer residential and commercial district across the river to the west of the downtown area. This West Bankhead District is another entrance to the city along Highway 30 which to the south of Highway 78 includes retail and to the north the hospital.

PONTOTOC COUNTY AND PONTOTOC

Pontotoc is located on a ridge that divides waters east and west; east of Pontotoc waters flow into the Tombigbee River Basin while west of Pontotoc the waters flow into the Yazoo River Basin. The town of Pontotoc was founded by General Thomas McMackin, who moved from Hendersonville (now Bryant, MS) in 1834, purchasing the land for the town from the Chickasaw. McMackin immediately began to subdivide and sell the land, establishing a hotel. In 1840, the first courthouse was built. McMackin also donated land in Pontotoc for a women's college known as Pontotoc Female Academy and later as Chickasaw College (15). In the 1930's Pontotoc became the summer capital of Mississippi when Governor Bilbo kept executive offices there.

Pontotoc's early economic fortunes were due to its ideal location as a trading post in the interior of Mississippi. Once the Gulf Mobile and Northern Railroad was extended to Pontotoc in 1888, the natural resources of timber and cotton were better able to be harvested. Pontotoc was also one of the leading poultry markets in Mississippi of the 1930's (16). Furniture manufacturing became a leading industry in Northeast Mississippi in the 1950's and Pontotoc still has many furniture manufacturing plants including Lane Furniture, Southern Motion, Golden Chair, and Genesis Furniture.

Today, Pontotoc is still not only the geographical but the population center for the county. With close to 6000 residents and the county seat, most retail and other services in the county can be found in Pontotoc. Pontotoc has a number of retail stores including a Wal-Mart Supercenter, fourteen restaurants, a coffee house and services such as lawyers, accountants, and an architect. Pontotoc has a 25 bed hospital with emergency care, a nursing home, and hospice care. Pontotoc also has a number of fitness/wellness centers. Recreational opportunities in Pontotoc include Howard Stafford Park with an 80-acre lake within the city limits as well as number of team sports leagues organized through the Pontotoc Park and Recreation Commission (17).

Pontotoc city schools are all "successful" and the elementary school and junior high are "high performing" as assessed by the Mississippi Department of Education for 2009. Mean prices for detached houses in Pontotoc were \$10,000 below the Mississippi average and monthly rents were about \$50 less than the Mississippi average in 2008 (18).

Pontotoc is connected to the region by Highway 278 which runs between Tupelo and Oxford and Highway 15, which runs from Biloxi on the Gulf Coast of Mississippi north into Tennessee. The City of Pontotoc as stated above is located on a ridge. The town is developed linearly along Main Street, which runs along the top of the ridge. At the south end of Main Street there is a large square ringed by two story 19th century commercial buildings and commanded by the courthouse. A small neighborhood of early 20th century housing extends south from the square. At the north end of Main Street are all of the city schools. Between the two, 19th and 20th century commercial and office buildings line Main Street, generally one story and sometimes two. To the west of Main Street, the ridge drops off in elevation. In the valley ran the former Gulf, Mobile and Ohio line where the Tanglefoot Trail now runs. Along the trail are a series of industrial and warehouse buildings from the era of the railroad. Further west from the Tanglefoot Trail is another ridge parallel to Main Street where Highway 15, the commercial strip for Pontotoc runs. The strip continues north until it reaches Highway 278, where there is a Walmart and a small retail center.

Housing is scattered throughout the area, mostly suburban tract housing neighborhoods spanning from east of Main Street to west of Highway 15. The housing is very low density from slightly under one quarter acre lots to much larger lots. The housing follows a loose grid of streets, but there is very little connectivity between the subdivisions. The only streets that provide any real connectivity east to west are Oxford Street, which Main Street dead ends to in the north, Reynolds Street, and Coffee Street.

CHICKASAW COUNTY AND HOUSTON

The beginnings of Houston, Mississippi, date back to 1837 when it was organized as the county seat of Chickasaw County, known as the "Mother County". This moniker was given due to the fact that the counties of Clay, Calhoun, and Webster were connected and branched off from parts of Chickasaw County. At the time, it occupied over 1,000 square miles, but in 1852, Calhoun County acquired part of Chickasaw County, with Clay and Webster Counties acquiring parts of it in 1872. Today, Chickasaw County only occupies over 500 square miles of the original "Mother County".

Established on February 9, 1836, Chickasaw County was named for the Native American tribe that occupied the northern part of Mississippi. In 1877, the county was divided into two judicial districts, with Houston as the first and Okolona as the second. The community of Houlika, an old Native American name, is considered the oldest community in the county. The land on which the

town was founded was donated by a local judge, on the condition that it be named for celebrated Indian fighter, Sam Houston.

Houston is a culturally immersed town; the first Andrew Carnegie library in the state was built in 1909, after then-superintendent of schools, L.B. Reid, wrote to Carnegie of Houston's need for a public library. Bukka White, also known as Booker T. Washington White, a legendary Delta blues musician and first cousin to the great blues legend, B.B. King, was also thought to be born in a farmhouse near Houston in 1909. Additionally, each year, the city celebrates their agricultural heritage with the semi-annual Flywheel Festival.

Chickasaw also has a solid manufacturing base: "Although Chickasaw County ranks 50th in population among Mississippi's counties, it ranks 14th in manufacturing facilities and 15th in manufacturing jobs. Five of the top 100 companies in Mississippi are either located in Chickasaw County or have their headquarters here" (19). The major employer in Houston, MS is Franklin Furniture, an upholstered furniture manufacturer with 1,300 employees. Chickasaw County has only one school in the district, pre-K to 12th grade, with 650 students while the city of Houston has its own school district with five schools.

Houston is a classic courthouse square town. Looking from the courthouse placed at the center of the square is a downtown of one and two story 19th century retail buildings immediately surrounding the square. The town is laid out on a grid of streets with the major roads linking the town to other towns, Highway 8 and Highway 15 running through the square. Highway 8 links Houston to Aberdeen to the east and Calhoun City to the west, the county seats of the two adjoining counties. As mentioned before, Highway 15 runs the entire length of the state of Mississippi from south to north.

Commercial and retail areas line Highway 8 while industrial areas like the Franklin Furniture manufacturing plant are north of the town center on Highway 15. The old Gulf, Mobile and Ohio railroad line which is now the Tanglefoot Trail parallels Highway 15 to the west and is lined with warehouse and industrial buildings. To the east of the town's center are Joe Brigance Memorial Park, the elementary school and the hospital. Housing is scattered throughout the town with a larger, suburban density housing district to the southwest of the town center. A small number of early twentieth century bungalow housing is east of the downtown on Highway 8, but most of the housing is of later vintage and lower density.

CHAPTER 3: THE TWO ALTERNATIVE FUTURES EXPLORED USING COMMUNITYVIZ

THE HERITAGE HILLS: A PLAN FOR GROWTH

The Heritage Hills region is one of the few that has seen growth in population recently in Mississippi (20). The location of a Toyota assembly plant in Blue Springs Mississippi in 2010 has led to expectations of much higher population growth in the region. New Albany, only 13 miles away from the plant, foresees growing from a population of 8,400 to around 15,000 people based on the experience of other areas where auto plants have located (21). The advent of Tier I suppliers, those companies that make large scale components for the assembly plant such as seats and dashboards, will spread population growth in the region.

As with the nation as a whole, rural populations have tended to move to areas either adjacent to large metropolitan areas or in micropolitan centers rather than in rural counties (22). These exurban or micropolitan areas offer their residents access via car to jobs and amenities in the metropolis that are absent from rural counties. Likewise, employers look for a plentiful and skilled/educated labor force which can be found in metropolitan or micropolitan centers. This shift has tended to push residents out of small towns, particularly young people looking for greater opportunity in employment. The shift in employment in rural areas from agricultural to service and retail also favors these population centers at the edge of the metropolis and in the micropolis.

In the Heritage Hills region, Tupelo is the micropolis that has attracted much of the population and job growth. *Site Selection* magazine ranked Tupelo as second in U.S. micropolitan areas for industrial growth in 2013 with 900 new jobs and \$78 million in capital improvement (23). Tupelo also has the highest median household income in the region, \$38,954, while a suburb, Saltillo, has an even higher median household income of \$52,181. The Mississippi median household income is \$36,919 (24).

While most of the counties in the Heritage Hills region have gained population between 2010-12, the increase in population has occurred in the largest towns of those counties for the most part. In Tupelo, New Albany and Pontotoc, population has grown 2.1% to 2.9%, with Tupelo having the greatest population growth (25). In Lee County, population increases in the city of Tupelo account for 43% of all the population increase in the county. In Union County, Pontotoc's population increase accounts for 62% of the county's increase, while in Chickasaw County, Houston only accounts for 26% of the county's population growth. In either case, the largest towns in the counties have been the major beneficiaries of any population growth.

If existing trends in the Heritage Hills region continue, Tupelo will continue to grow at a greater rate than the other towns in the region, while towns such as Pontotoc and New Albany will grow in relation to much smaller towns such as Houston, New Houlika, and Sherman. The population

projections put out by the research arm of the Mississippi Institutes of Higher Learning tell the story. A summary of the population projections is shown in Table 3-1 below.

Table 3-1. Population Estimates and Projections

County	2012 Population	2025 Population	Change	Change (%)
Lee	85,042	92,628	7,586	68%
Union	27,414	29,560	2,146	19%
Pontotoc	30,594	32,978	2,384	21%
Chickasaw	17,416	16,451	-965	-9%
Total	160,466	171,617	11,151	

2012 population estimate from U.S. Census Bureau State and County Quickfacts. 2025 population estimate from MS IHL Office of Policy Research and Planning Population Projections, Feb. 2012.

As seen in the table, 68% of the growth in the study area is expected to occur in Lee County, and as we have established, much of that growth will occur around the city of Tupelo rather than in the county.

In the comprehensive plan for the city of Tupelo, the estimate is that by 2025 the city will have approximately 52,077 residents consuming around 8,162 acres of new land. With a 2,221 acre annexation, the comprehensive plan has identified 9,462 acres of land, which meets the need for new land but does not leave much left. Tupelo's comprehensive plan emphasizes greater density in existing neighborhoods and for new development and more biking/walking as well (26). In its projected growth of the city from approximately 30,000 to 50,000 residents, Tupelo expects to take up a large amount of the population demand of the region.

For the other towns, the population increase expected by 2025 is less. As stated before, New Albany is hoping to almost double their population to 15,000, although the population projections from IHL above seem to contradict this desire. The City of Pontotoc in their 2007 Comprehensive Plan sees their population increasing from 5,787 in 2012 to 7,808 in 2025, which is a modest increase. The question for this region becomes whether this trend of a larger micropolis with smaller or even dying small towns around it is a sustainable future for the region.

Our project is designed to give this region a tool to ask those questions. By modeling the existing conditions in the region and comparing the total number of vehicle (car) miles travelled to an alternate development pattern, we can begin to speculate on question like this. The more

sustainable pattern would have the least number of car miles traveled and would also increase the use of alternate transportation such as bicycling or walking.

An alternate development pattern would be to spread future development to all of the major towns in the region: Houston, Pontotoc, New Albany as well as Tupelo. Our hypothesis is that the car miles travelled for the region will decrease because people will be closer to where they work, shop and recreate with this more balanced growth. New development in these towns in this alternative is designed to be close to the downtown core to increase residential density, and promote bicycling and walking. New development is also planned to take advantage of the Tanglefoot Trail, the 42 mile bicycle/walking trail running through Houston, Pontotoc, and New Albany. The alternative development plans take advantage of the Tanglefoot Trail as a means of transportation and an economic development opportunity for the town.

These alternate development patterns will be compared to how development would occur in the future if existing planning and zoning does not change. The tool we have used to allow for this comparison is CommunityViz, an ArcGIS based software tool. What CommunityViz allowed us to do was to model an entire town, including all of the buildings in a town and their existing uses. The zoning and all easements, such as the flood plain and excessive slopes, were then input to the model. With the existing conditions determined, the model can place new buildings into the city and thus determine how many new housing units and commercial space could be developed in the city given those conditions. This build-out, as it is called, gives a graphic and numerical projection of the possible new growth in the town. The build-out is a hypothetical projection but is not a prediction of the most likely future development pattern. Our next step was to alter the zoning and propose several new developments in each town based on the principles listed above for new development. The alternative growth model was then run to determine the build-out with the new conditions.

Following are development plans for the four major towns in the study area: Tupelo, New Albany, Pontotoc, and Houston. The plans first look at the existing zoning and development pattern of each town and try to extrapolate using the CommunityViz software the potential population capacity that each town has with no changes to the planning and zoning of the town. The alternative development plans are then presented with maps, renderings and the build-out of the proposed changes. The alternative development is then compared with the existing condition to determine how the changes affected the build-out of the town.

TUPELO

Tupelo is the micropolis that most of the study area revolves around for employment and retail. As we have noted earlier, when new population growth comes to the region, this growth tends to move to Tupelo. Many of these reasons have to do with the quality of life to be found in Tupelo. The public school system in Tupelo has always been perceived to be one of the best in the state.

When the Alexander vs. Holmes decision in 1969 finally terminated segregated schools in the state, whites-only private academies sprang up in many Mississippi towns to perpetuate segregation. In Tupelo, the decision to integrate schools was made in the 1960's, effectively preventing the appearance of academies and preventing the splitting of students and resources between public and private that happened in many Mississippi communities (8). In 2012-13, Tupelo was a 'B' level district according to the statewide accountability standards.

The City of Tupelo has also invested in their downtown and recreational facilities to improve the quality of life. In 1999, the city developed a new civic center, known as the Fairpark District, that integrated a new city hall along with a town square, office, restaurants and retail with the existing Bancorp South Arena, which brings in nationally known entertainment and sports. Tupelo is also the regional center for shopping with the Barnes Crossing Mall and numerous other shopping and restaurant venues.

Tupelo has built many new sports and recreational facilities. As well as a baseball sportsplex, basketball and tennis facilities, Tupelo has a soccer complex large enough to hold state tournaments. Tupelo completed in 2014 a new aquatics center with a competitive/recreational pool and a separate pool for teaching swimming. Tupelo also has 14 other parks throughout the city. With so many different opportunities and amenities, newcomers and longtime residents see Tupelo as the place to live and work in the region.

With these positives, as we have seen in the statistics, the Tupelo area is growing and will continue to grow in the future. The key to the previous statement, however, is that the area is growing. According to the 2010 Census, the city of Tupelo grew only 1% in the decade between 2000 and 2010 while nearby Guntown and Saltillo grew by 76% and 40% respectively (27). The mayor of Saltillo credits his town's growth to a good school system, proximity to the Barnes Crossing Mall, and slightly less expensive housing. In either case, the area is growing and new housing is required.

While for many areas, this growth would be welcomed, the Tupelo comprehensive plan makes it clear that new development in Tupelo will need to be much denser and better use of existing areas need to occur for Tupelo to accommodate the growth they foresee. In the Comprehensive Plan, one of the goals is "Orderly, Efficient Land Use Patterns." This is described as:

The city will strive for a more compact development form that will help Tupelo to maximize efficiency with regard to transportation, energy expenditure, land use, infrastructure investment, and more. Curbing 'sprawl' will not only preserve valuable open space, environmental quality and community integrity, it will also save public and private funds for new infrastructure by making use of existing facilities (28).

Transportation is a large part of Tupelo's vision for compact development. In regard to transportation, the Comprehensive Plan states:

The most significant move Tupelo can make is to reduce the number and distance of car trips that we can take by bringing our homes and destinations closer together. This reduction in fuel use means both money in our pockets for other uses, and a step in the direction of an economy that has less environmental downside (29).

As mentioned in the introduction, Tupelo is aware that the brunt of Heritage Hill's growth is expected to occur there. The question is whether Tupelo can and should accommodate the growth that is projected if there is not a regional vision for growth in the Heritage Hills region.

Our modeling of Tupelo's potential growth shows the effects of staying the current course and not following the direction of the comprehensive plan in the *Current Roads Build-Out* (Figure 3-1). In this first model, the existing zoning map and regulations are adhered to. No new roads or developments are introduced, the model assumes that new growth occurs in existing areas where there is the appropriate amount of space. The Current scenario also assumes that the density of housing units does not change from the existing zoning. While the reality of development is that new roads would be created, the Current Roads Build-Out scenario creates a baseline to measure other scenarios by.

New single family residential is spread throughout the city, mostly in clusters at the outskirts of the city limits. New multifamily housing is sparse and again scattered throughout the city. New roads and neighborhoods have not been defined, so this housing generated by the model simply fills in available sites along existing roads and in existing neighborhoods. The number of housing units increases by 3,333 which given Tupelo's average persons per household from the U.S. Census, translates to a population increase of 8,399 persons. This is about half of what Tupelo believes it will need by 2025.

If we look at the dwelling units per acre (DUA) citywide, then another aspect of the projected growth emerges. The density of the housing currently is quite low, overall for the city it is 1.1 dwelling units per acre. As seen on the diagram entitled *Current Housing Dwelling Units per Acre* (Figure 3-2), Tupelo is composed of a cluster of fairly dense neighborhoods (4-7 DUA) surrounded by sparsely populated land. When the dwelling units per acre for the build-out condition is diagrammed, the new dwelling units are placed for the most part not in areas near the dense downtown, but in more sparsely populated areas away from the downtown (Figure 3-3). This is more clearly illustrated in the diagram that subtracts the current housing build-out density from the current housing density, showing the amount and placement of added housing density from the scenario where Tupelo stays the current course (Figure 3-4).

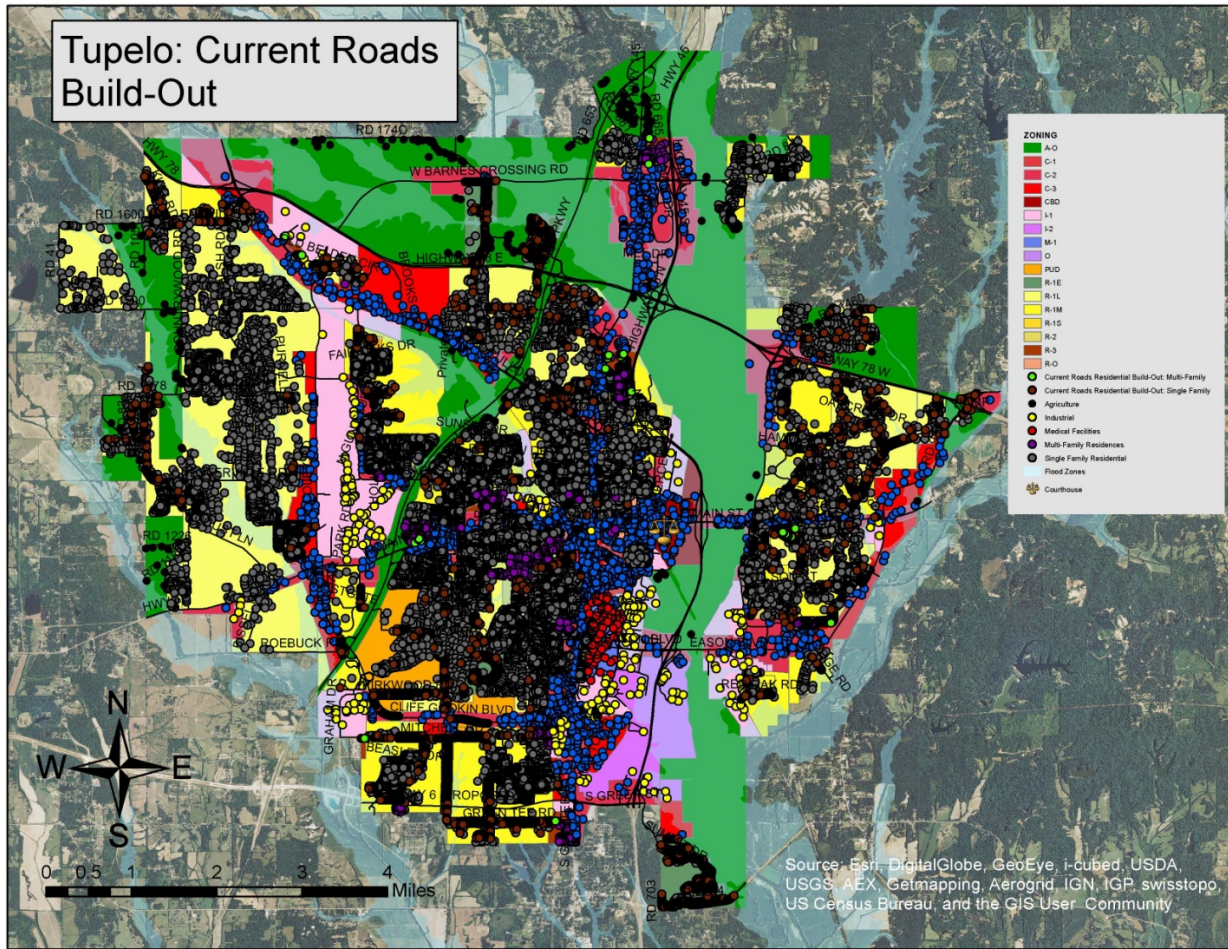


Figure 3-1. Tupelo current roads build-out.

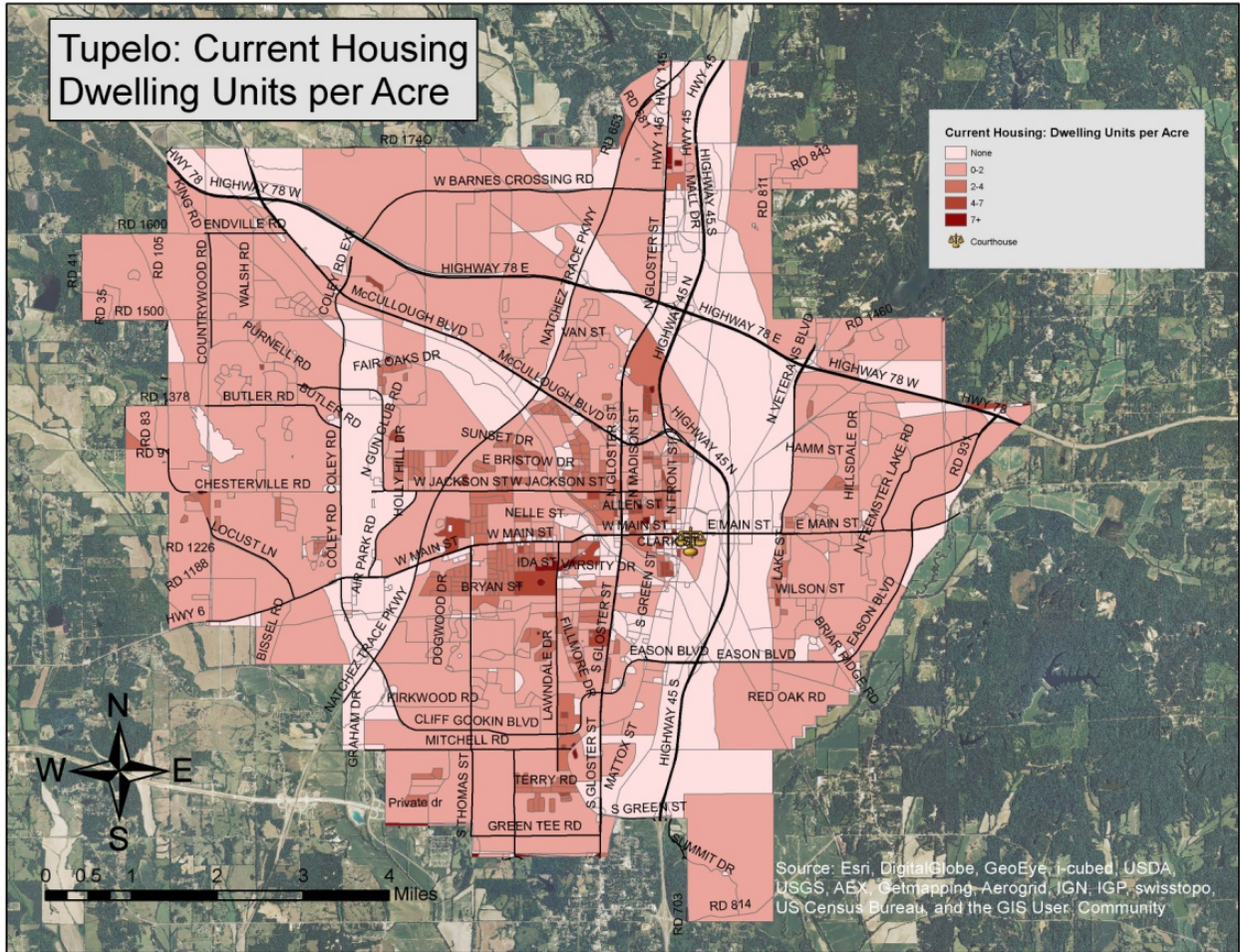


Figure 3-2. Current housing dwelling units per acre.

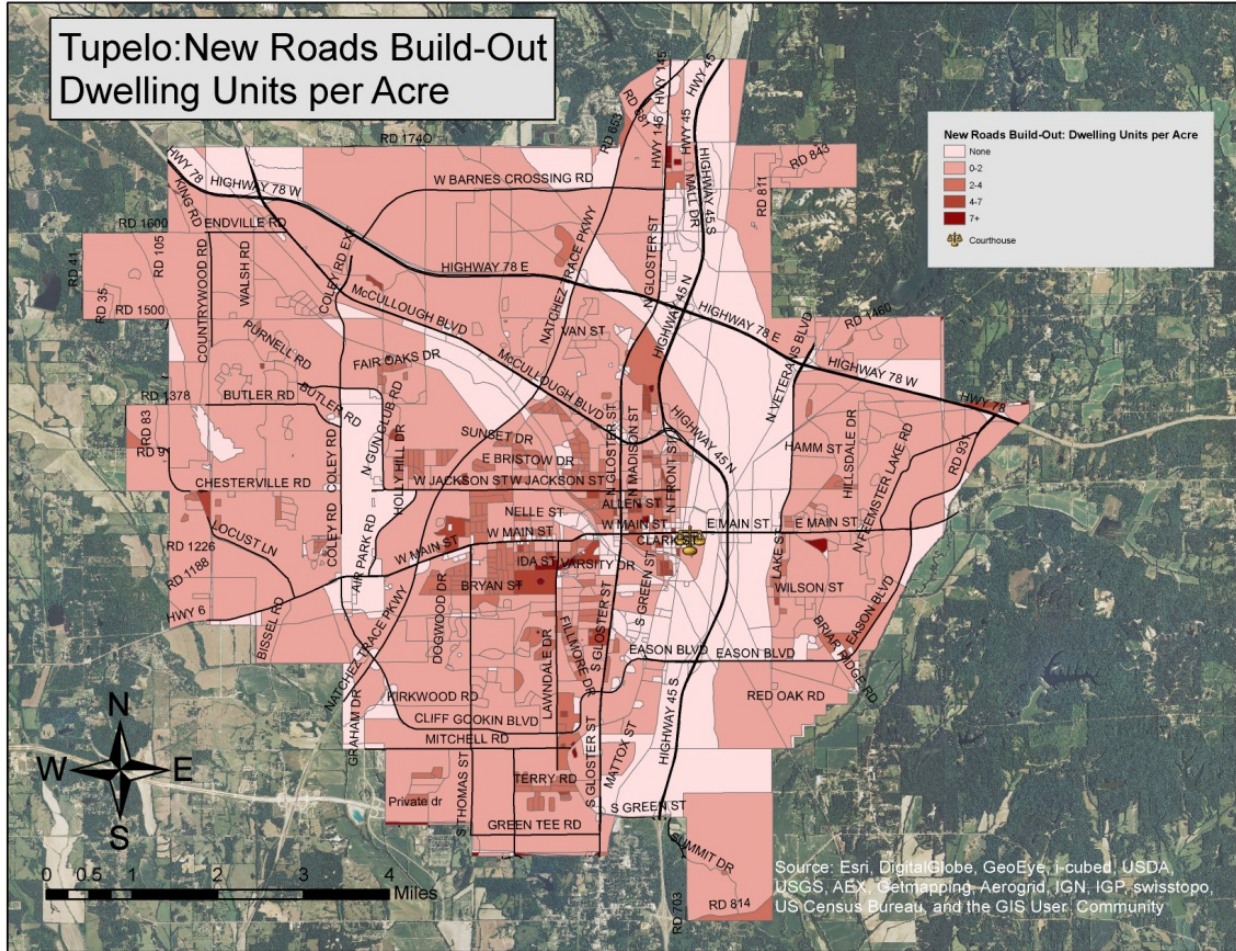


Figure 3-3. Build-out dwelling units per acre.

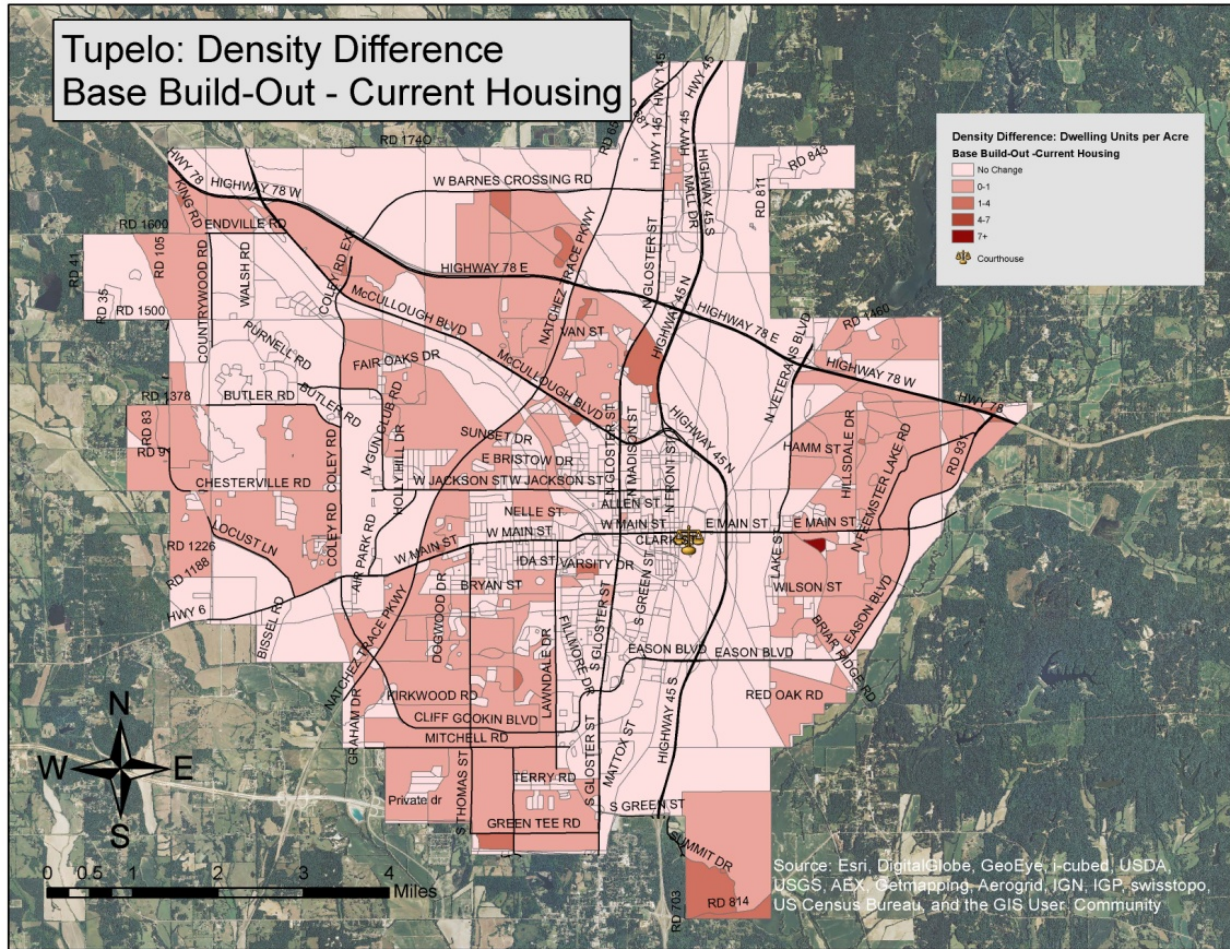


Figure 3-4. Density difference between base build-out and current housing.

The effects of the *Current Roads Build Out* on the city of Tupelo would be counter to the goals of the Comprehensive Plan. Mostly single family houses would be spread throughout the city without the density required to make walking feasible and sidewalks a necessity. Homes and destinations would not be brought closer together and so the assumption would be that vehicle miles travelled would be increased. Most importantly, without the addition of new roads and developments, Tupelo will not be able to meet its goals for growth.

The second scenario, *New Roads Build Out* envisions three new developments within the Tupelo city limits. These developments are placed in accordance with the goals of the comprehensive plan in areas that will bring homes and destinations together to reduce automotive trips. The density of these new developments is also designed to be 7 DUA and above to help the walkability of these residential areas. The developments are either mixed-use, again to reduce the need to drive, or have pedestrian connections to amenities such as parks, schools or retail.

The first development is on a site opposite of Tupelo High School and adjacent to the Natchez Trace. The new neighborhood is placed so that residents can easily access the high school, the

Natchez Trace, and the soccer complex west of the Trace (Figure 3-5). The new neighborhood is divided into two sections, with a retail area below Kirkwood Road and a residential area closer to the Natchez Trace. The advantage of this overall location for development is that pedestrian/biking connections can be made to the high school for students, the soccer complex for recreation, and the Natchez Trace, a 444 mile National Park Service scenic parkway, for cyclists. The retail south of Kirkwood Road is on Cliff Gookin Boulevard opposite from the high school. The retail fills a need with the high school and the large residential area to the east that has little retail nearby. A pedestrian path links the residential neighborhood with the retail (Figure 3-6, Figure 3-7, Figure 3-8).

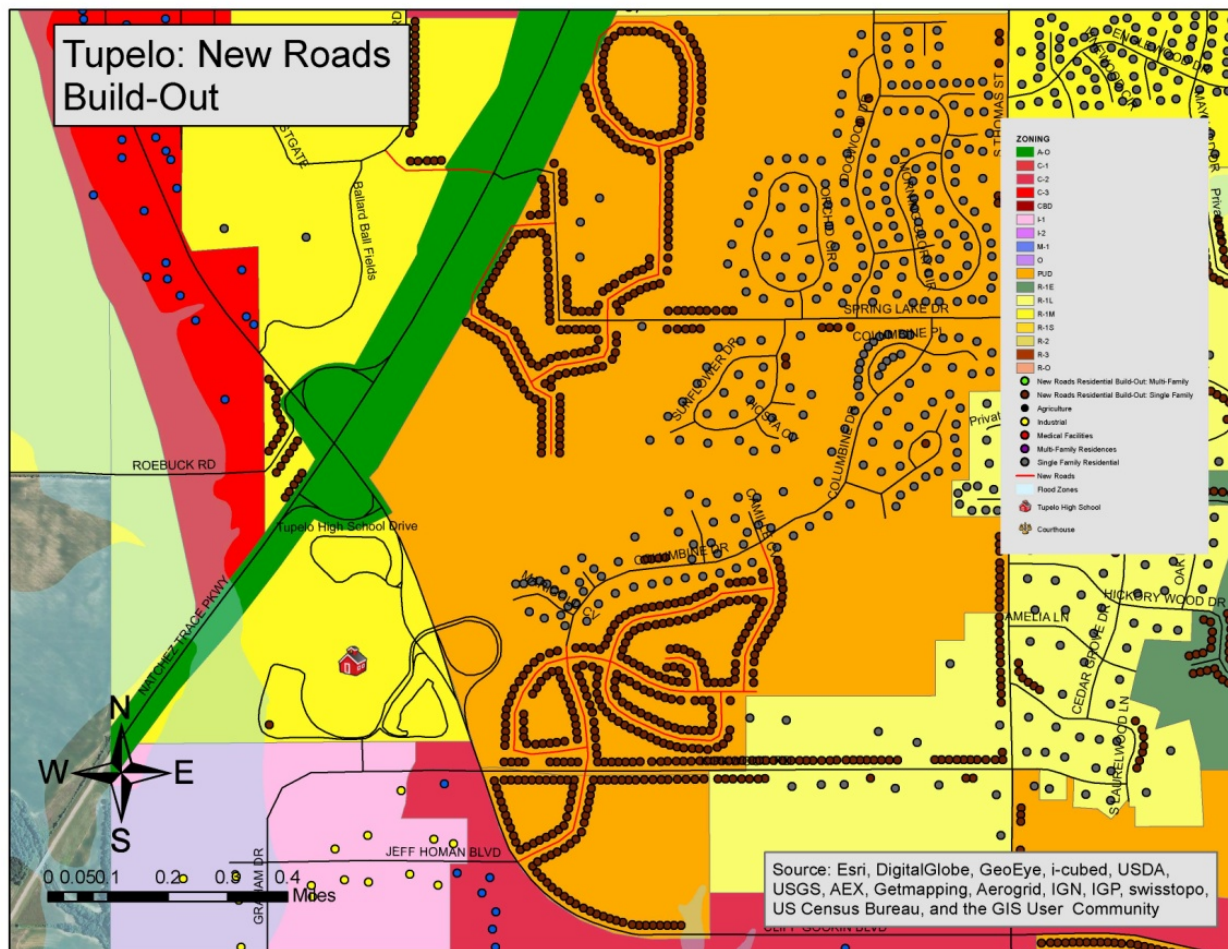


Figure 3-5. High school/Natchez Trace development.



Figure 3-6. High school/Natchez Trace retail site before.



Figure 3-7. High school/Natchez Trace retail proposal.



Figure 3-8. High school/Natchez Trace retail view.

The residential area is placed closer to the Natchez Trace north of Kirkwood Road and to the south and west of an existing pond (Figure 3-9). The neighborhood would have approximately 125 single family units with 17 multifamily units right on Kirkwood Road. An existing road connection under the Natchez Trace Parkway on Rutherford Road/Springlake Drive would be used to add a bike/walking lane that would connect both new neighborhoods and the high school to the soccer fields (Figure 3-10).



Figure 3-9. Natchez Trace site before.



Figure 3-10. Natchez Trace proposal.

Another development is proposed for east Tupelo, close to both Veteran's Park, where the new natatorium has been built, and just north of the campus of the University of Mississippi and Itawamba Community College in Tupelo. The east Tupelo area has been targeted by the city for future growth and the presence of both recreational activities and a college campus close to the downtown area make it a desirable area. As shown on the diagram, a stretch of Veteran's Boulevard adjacent to a current residential area has been targeted for apartments because it is between the university campuses and Veteran's Park to the north (Figure 3-11).

As shown in the rendering, a series of five story blocks would be built along Veteran's Boulevard with a large biking/walking path that would connect the university campuses with Veteran's Park (Figure 3-12). The apartment housing is meant to attract certainly the university students, but also young people interested in living near the downtown and recreation. The first floor of the apartment blocks will be mostly devoted to parking as a necessary amenity but also to protect the units from the nearby flood zone.

While the two developments proposed are small in the context of Tupelo, the effect on the dwelling units in the city is quite large, increasing the number of dwelling units from 3,333 to 3,854. This translates to an estimated increase in population of 9,712 or about 15% over the *Current Build-Out* model. Several more of these higher density developments and Tupelo can conceivably come closer to the approximately 16,000 increase in population its planners believe the city needs by 2025.

The higher density scenario calculated makes the assumption that all the new development is occurring within the city limits of Tupelo. As we have seen, this has not been the case for the Tupelo area. While the city has worked hard to attract residents, many have decided to live in the

suburbs north of the city. Tupelo's goal of more compact development is not just to fit more within their city limits; compact development will benefit the region as a whole. If new development continues to spread to nearby communities and the only transportation mode is private vehicles, routes to and from the city of Tupelo to these outer areas will become more congested. Continual road improvements will be made with little return in terms of preventing congestion or shortening commute times. A cycle of transportation and infrastructure spending will be started that has no satisfying conclusion in terms of the commute endured by citizens or overall quality of life.

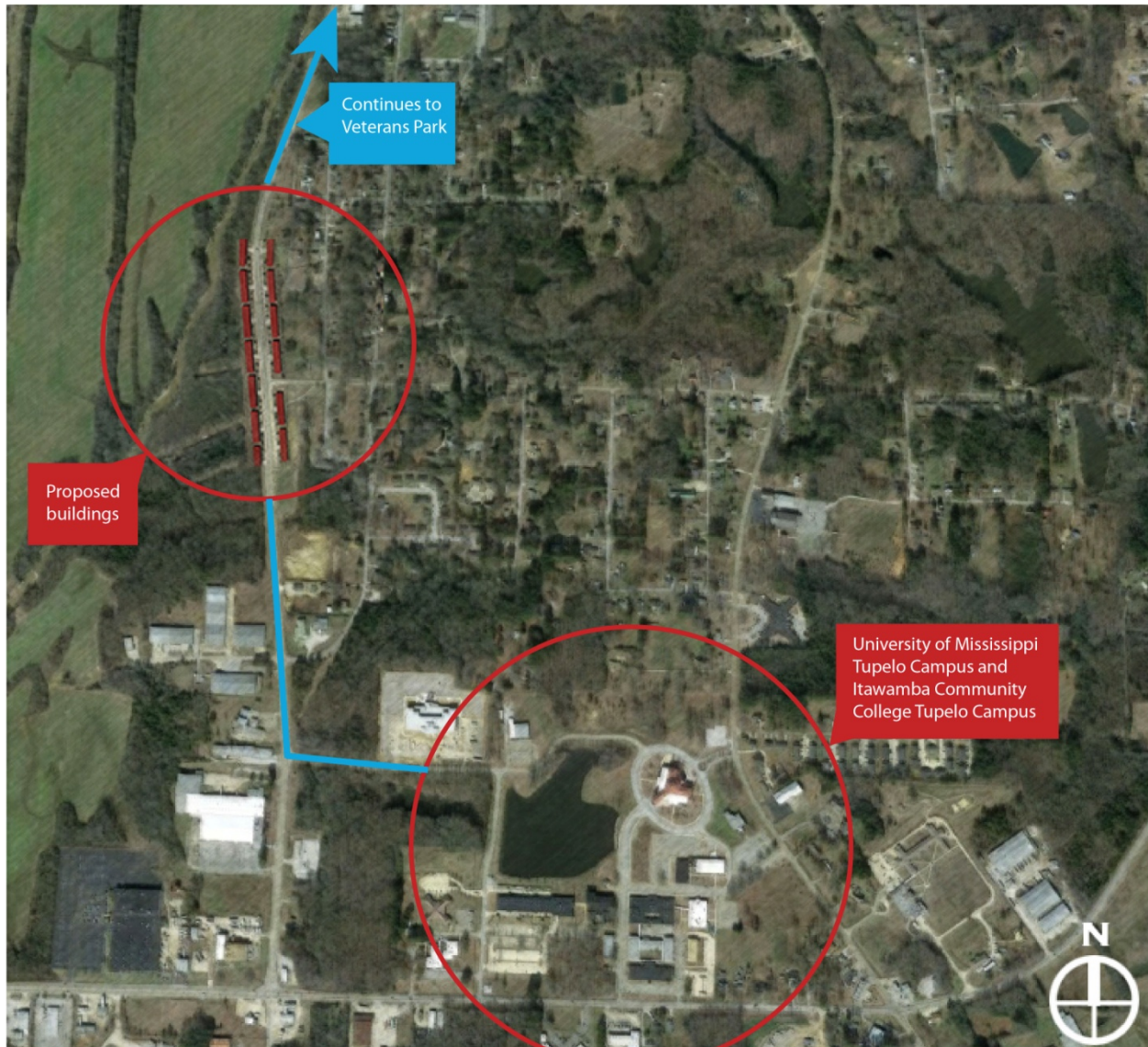


Figure 3-11. East Tupelo diagram.



Figure 3-12. View South Veteran's Boulevard proposal.

As seen by extrapolating our models, Tupelo could accommodate the Mississippi Institutes of Higher Learning estimated 11,000 person increase for all four counties in the study area by 2025. The question is whether one city accommodating all of the growth is the best strategy for that region. Would spreading population growth throughout the region create not only less vehicle miles travelled and less emissions, but more overall opportunity and greater future growth for the region? Studies have shown that the most prosperous and growing areas of the south are mainly those associated with metropolitan areas but also so-called "emergent" counties near major interstates that allow easy access to large, metropolitan areas (30). Could a strategy of developing around metropolitan areas and in these areas near major highways be the best way to handle future population growth in the Heritage Hills area? This study will begin to at least begin to answer the questions regarding transportation networks and growth.

NEW ALBANY

New Albany is between Memphis, TN and Tupelo, MS on Highway 78. Close to both the Blue Springs Toyota Assembly Plant (12 miles away) and to Tupelo (29 miles away), New Albany is well positioned to take advantage of the new job opportunities in the region. New Albany had a population in 2010 of 8,034 residents which should increase according to the IHL estimates previously cited for Union County.

The city of New Albany is well positioned to grow with a school system that is ranked districtwide as a ‘B’, a 153 bed hospital, a 70 acre sportsplex, a city museum, a vibrant downtown and is one of the starting points of the Tanglefoot Trail (31). The median home price in Union County is \$73,661, much less than in Lee County with \$114,300. These quality of life advantages should give New Albany an edge in drawing new residents away from the Tupelo area.

New Albany is divided into two halves, each on a ridge overlooking the Little Tallahatchie River. On the east ridge is the historic downtown and residential areas and on the west ridge a much newer extension of the city which includes the hospital and retail. Bankhead Street running east to west connects the two halves together with the Tallahatchie River Bridge spanning across. Approximately a mile south of Bankhead Street runs Highway 78, the limited access highway that ties Memphis, Tennessee with Tupelo, Mississippi and finally Birmingham Alabama. The sportsplex is immediately to the south of highway 78 and adjacent to a retail and commercial area.

There are three major entrances to the city. Carter Avenue leads most directly to the historic downtown area and also parallels the Tanglefoot Trail. Highway 15 defines the eastern edge of the city, links New Albany with Pontotoc, and thus forms another entrance. Finally, Highway 30 to the west leads to the major retail areas in New Albany and the hospital. Most of the new development, both commercial and residential, has branched off either from the Highway 15 or 30 entrance.

In the Current Zoning and Existing Buildings diagram, most of the existing commercial buildings are in the western half of New Albany while existing residential areas are in the east (Figure 3-13). The zoning shows residential areas surrounded by agricultural zones and floodplain, while commercially zoned areas tend to hug Highway 78, the downtown and Highway 30. In the Current Dwelling Units per Acre diagram, there are very few areas of higher density, mostly in the downtown area and then scattered throughout (Figure 3-14). For the most part the town has a density of zero to two dwelling units per acre, extremely low and not conducive to walkability or bikeability.

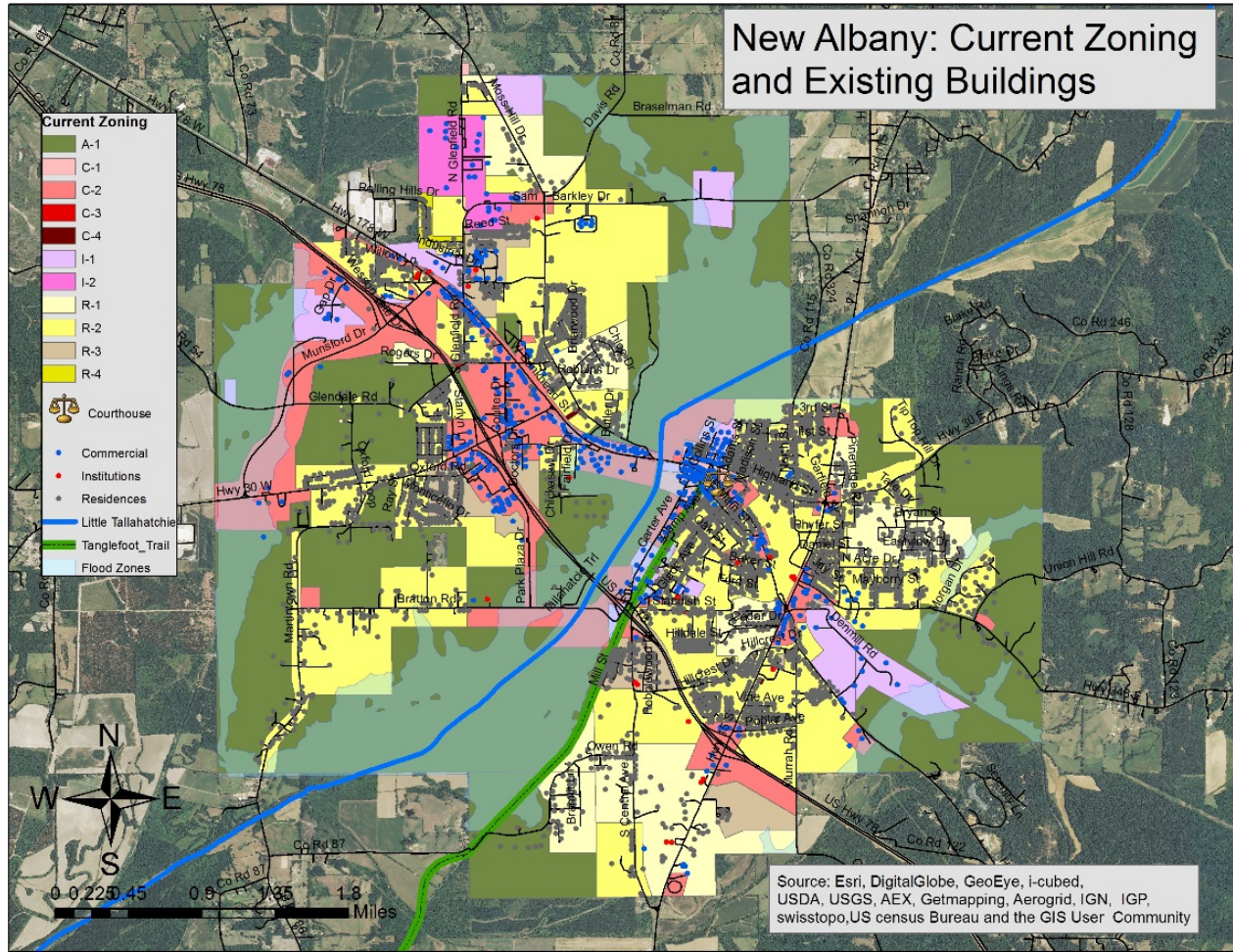


Figure 3-13. Current zoning and existing buildings.

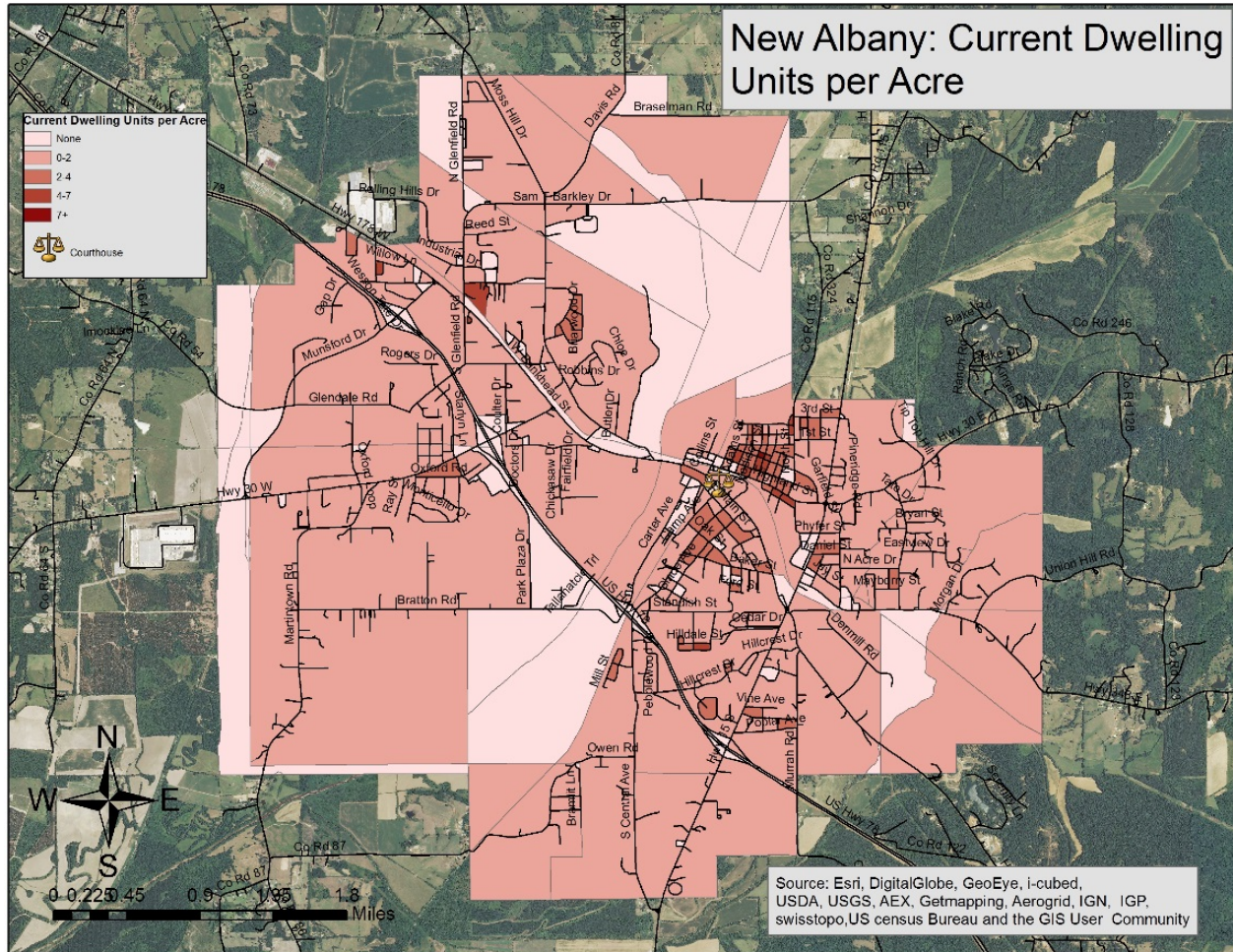


Figure 3-14. Current dwelling units per acre.

The potential for pedestrian and bike accessibility in New Albany is considerable. Within a five minute walk, the entire downtown business district is accessible (Figure 3-15). Within a ten minute walk, most of the residential neighborhoods in the east side of New Albany can reach the downtown (Figure 3-16). Within a seven mile biking radius, the average ride for bicycle commuters, the entire town is more than accessible (Figure 3-17). In the analysis of road suitability for bicycle lanes, several roads are good to excellent candidates, including Bankhead Street, Carter Avenue, and Highland Street, thoroughfares that link residential, recreational and commercial areas (Figure 3-18).

If zoning is left alone, and population in New Albany grows, then housing will continue to be developed along some main corridors at the outskirts of town as illustrated in the base Zoning Residential Build-out diagram (Figure 3-19). The number of single family housing units could increase by 2,141 units just with the existing zoning. According to the 2008-2012 American Community Survey, there are 496 existing, attached multifamily structures in New Albany.

These multifamily units could more than double, increasing by 270 under the existing zoning. For commercial units, the number could potentially increase by 1,047.

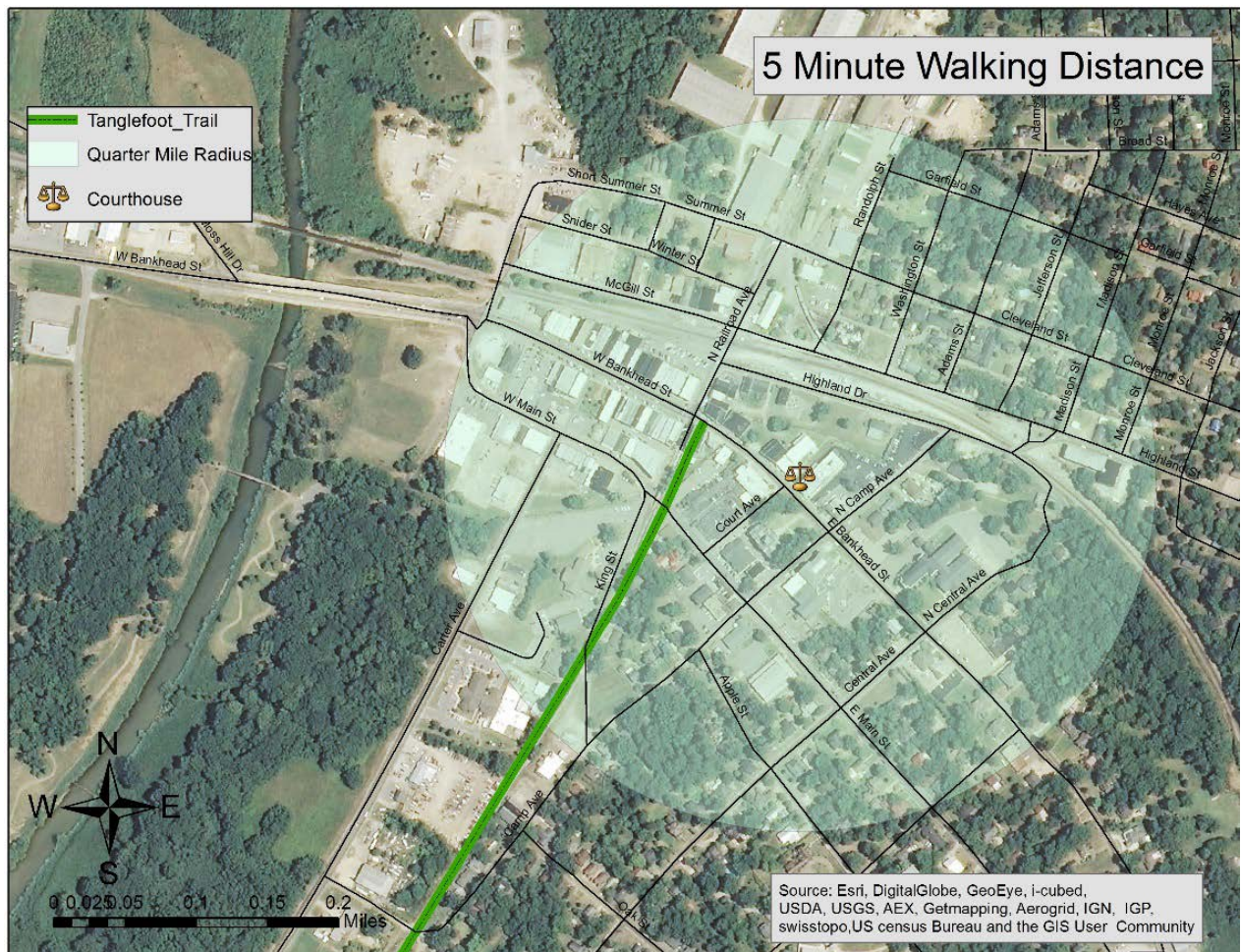


Figure 3-15. Five minute walking distance.

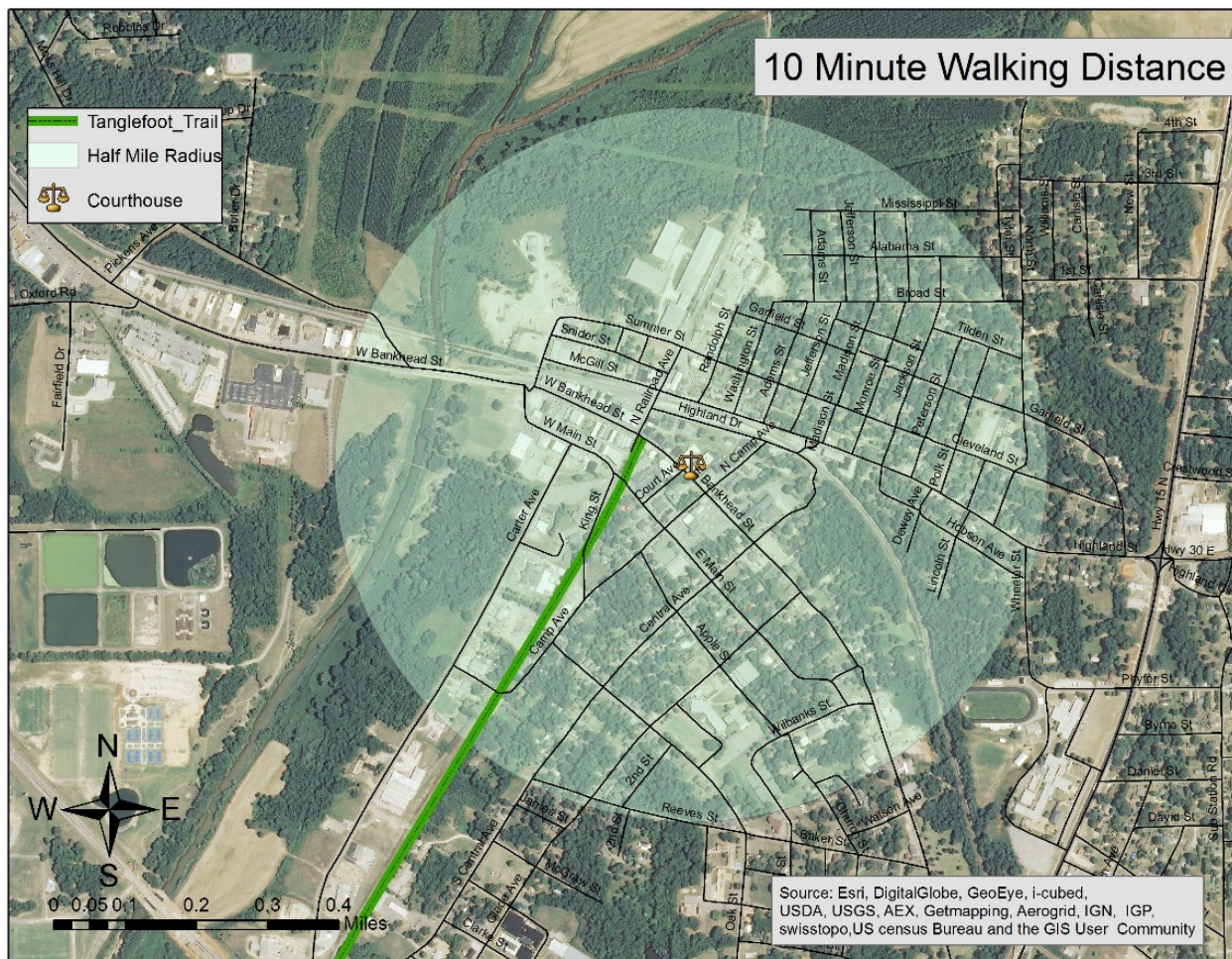


Figure 3-16. Ten minute walking distance.

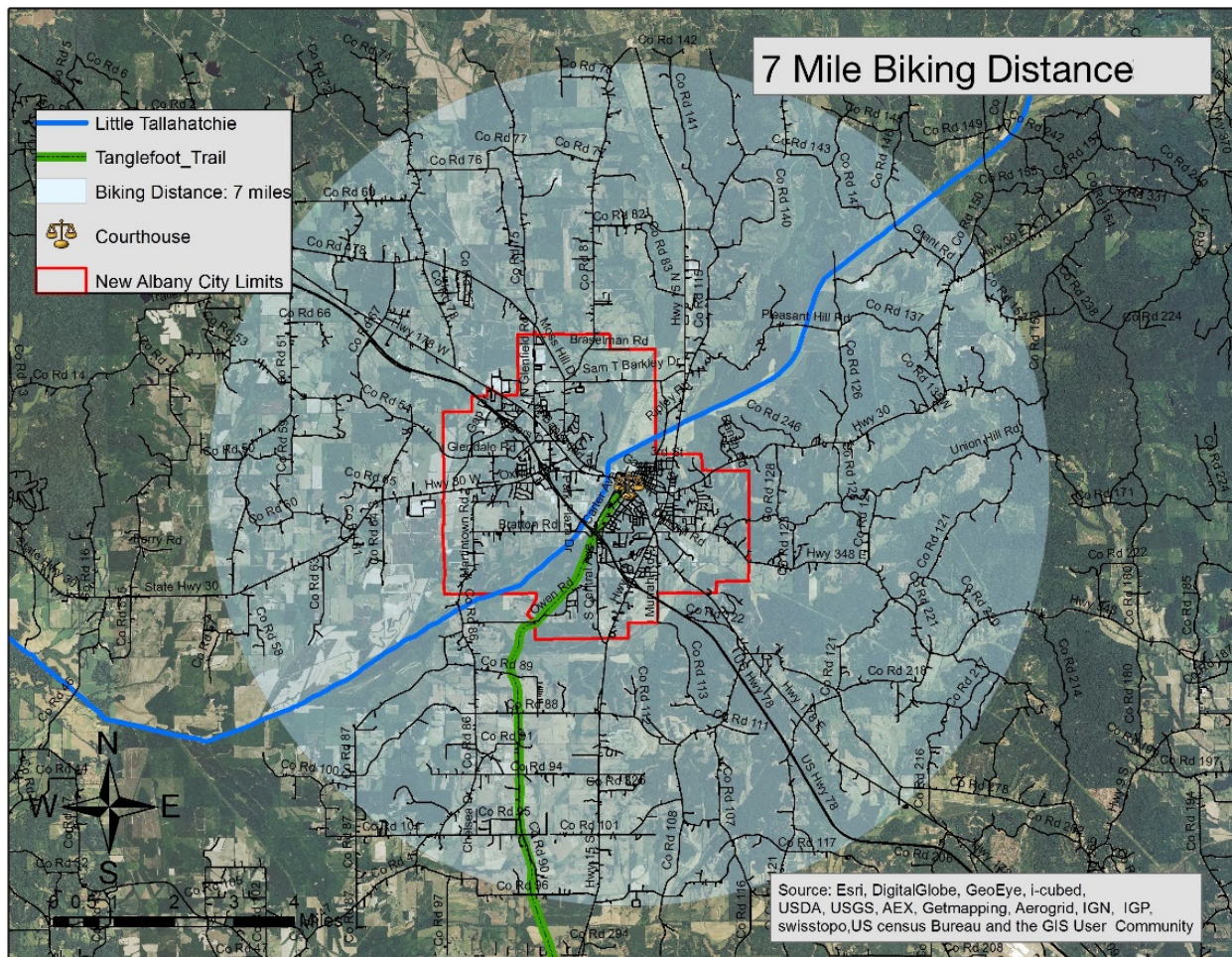


Figure 3-17. Seven mile biking distance.

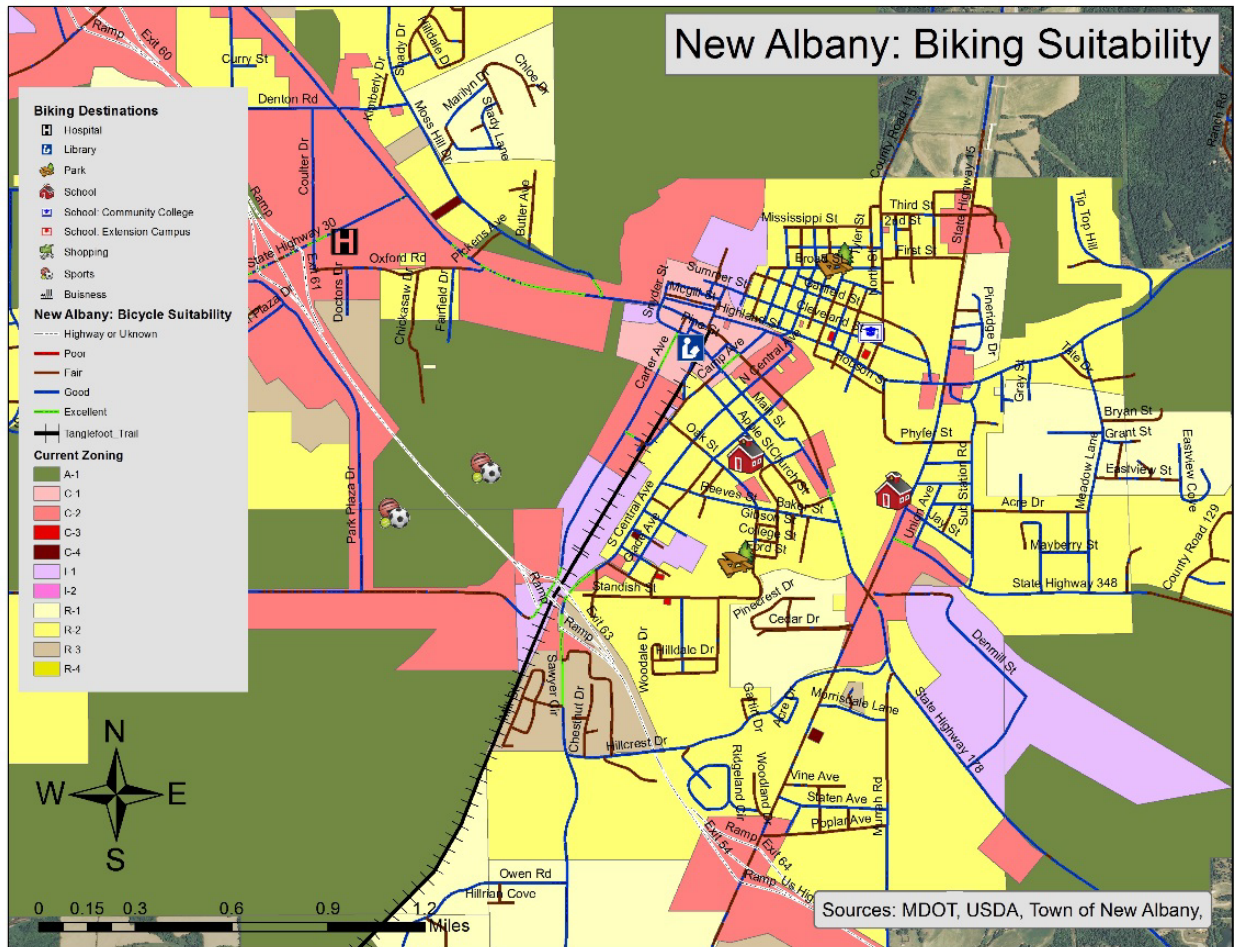


Figure 3-18. Bicycle path/trail suitability.

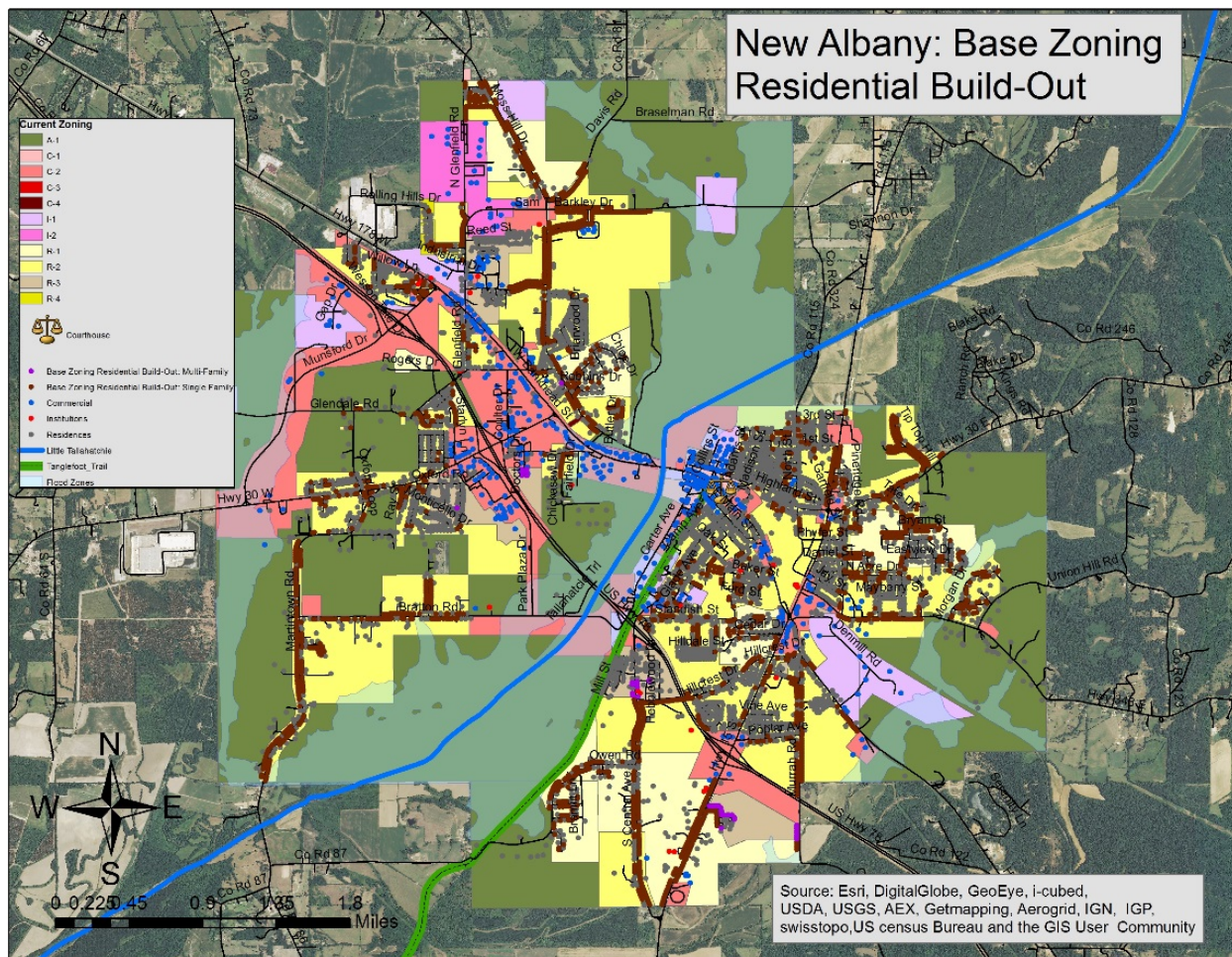


Figure 3-19. Base residential build-out.

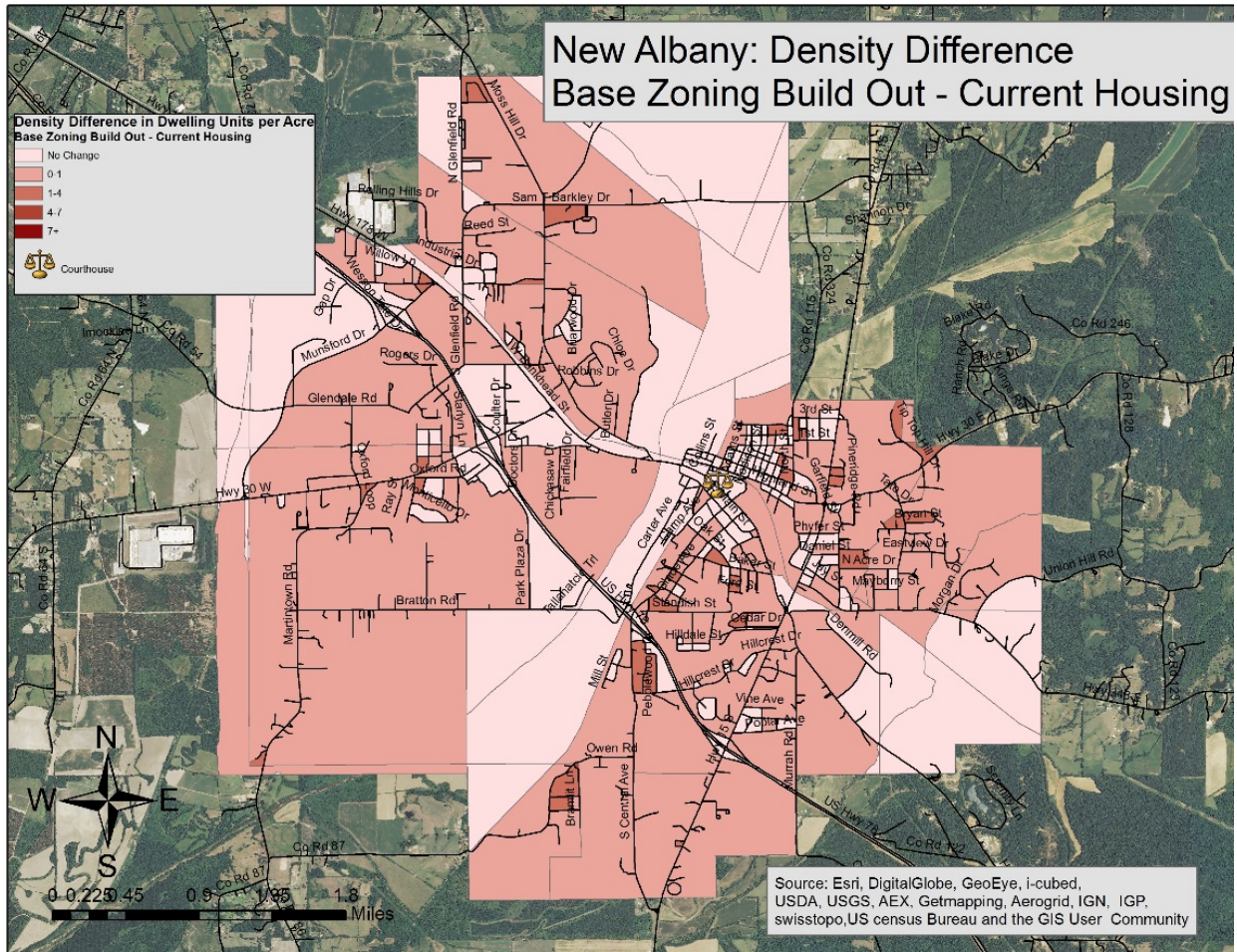


Figure 3-20. Density difference base zoning build out versus current housing.

While under the existing zoning, the number of housing and commercial units increase, the location of these new units does very little to increase the housing density, therefore walkability of New Albany. As shown in the Base Zoning Dwelling Units per Acre Diagram, very little has changed in terms of residential density. The Density Difference Base Zoning Build-out – Current Housing makes this even more clear (Figure 3-20). For most of the town, the density has increased by a range of zero to one dwelling unit per acre. Only in scattered small pockets has the density increased significantly, from one to four dwelling units per acre.

As the Toyota plant has come on line, one of the major housing needs the community has is for more rental housing. In meetings with New Albany officials and citizens, the lack of rental housing was cited as an impediment to attracting Toyota workers to live in New Albany. For this reason, the New Zoning proposal focused on increasing multifamily, rental housing. This new multifamily housing is targeted in three areas close to the downtown to allow residents to walk or bike easily to the downtown and also to recreational areas.

The first area is along Carter Avenue, the traditional entrance into the city. The Carter Avenue entrance has become a remnant of the time when it was the main commercial and industrial boulevard in the city. When the railroad line was active, most of the industries located on Carter with the parallel railroad track at their back entrance. With the decline of the railroad, rise of the highway, and eventual transformation of the right of way to the Tanglefoot Trail, this location became much less desirable as an industrial location. Still, many businesses are still located on Carter Avenue because a lack of an overwhelming reason to move their facilities.

Carter Avenue is not a good industrial site anymore for another reason as well, The Park Along the River/Arboretum. This park connects the Sportsplex to the south with the downtown area through a trail that follows the Little Tallahatchie River. Carter Avenue parallels the park to the east and then just to the east of Carter Avenue is the Tanglefoot Trail. With Carter Avenue between these two important recreational attractions, the remaining commercial and recreational uses, auto dealers, fabrication shops etc. are not the highest and best use of this area.

The proposal for Carter Avenue relocates the existing businesses to allow for new multifamily housing to be developed. The housing would be placed between the Park Along the River/Arboretum and the Tanglefoot Trail on a newly formed Carter Avenue (Figure 3-21). In addition, we propose a small lake be formed from the Park on the River land to have better flood control of the area given that housing will placed nearby as well as provide greater recreational opportunities for the residents (Figure 3-22, Figure 3-23, Figure 3-24).



Figure 3-21. Carter Avenue development.

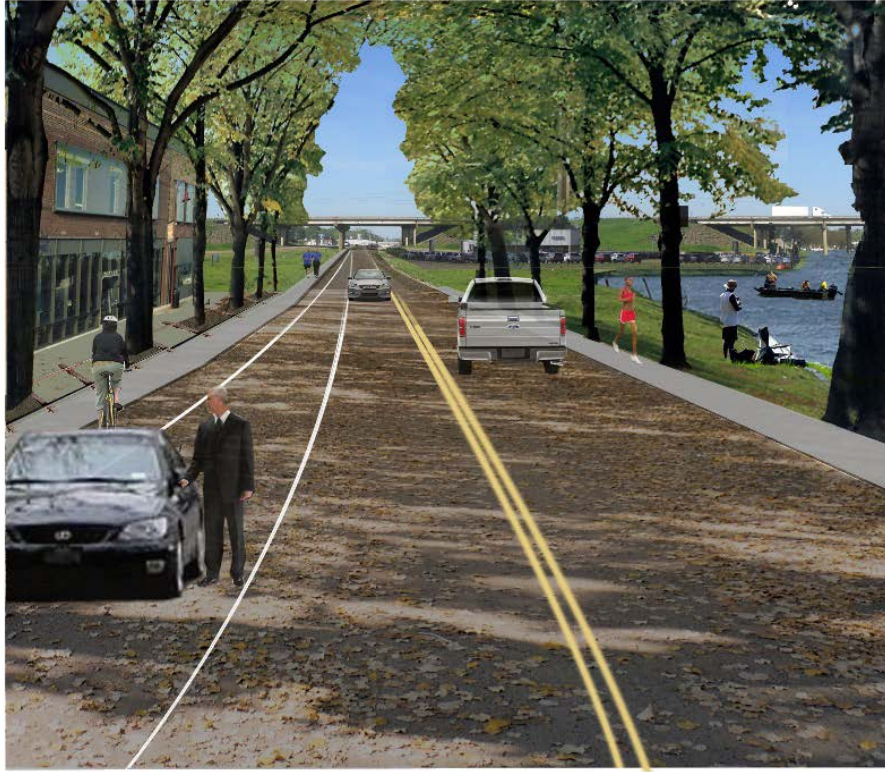


Figure 3-22. Carter Avenue after facing south.



Figure 3-23. Carter Avenue looking north before.



Figure 3-24. Carter Avenue looking north after.

The other large site for multifamily development is across from the Sportsplex on Park Plaza Drive. Park Plaza Drive along the north has the major shopping area for New Albany with a Super Walmart and two small strip developments. The proposal builds on this retail area by proposing pedestrian oriented retail on Park Plaza Drive with a large housing complex to the west (Figure 3-25). The placement across from the Sportsplex allows residents of the multifamily housing to easily access playing fields, the Park Along the River and the downtown beyond as well as the Tanglefoot Trail. The retail across from the Sportsplex could provide the users of the Sportsplex the opportunity to walk over for food and services, especially for tournaments and other large events. This retail would not be dependent just on business from the Sportsplex, however, but also be linked to the existing retail on Park Plaza Drive as well as drawing business from the new multi-family complex (Figure 3-25, Figure 3-26, Figure 3-27).



Figure 3-25. Park Plaza Drive development.



Figure 3-26. Plaza Drive before.



Figure 3-27. Plaza Drive after.

Finally, there are some areas off of Highway 30 that seem to have potential for development. In particular we have shown development between Dewey Avenue and Highway 30 because it is within walking distance of the downtown, yet accessible from Highway 30 as well. This development would be single family housing to fit into the scale of the neighborhood surrounding the development.

The effect of these developments as well as increasing the allowable density in the zoning had a considerable effect in raising the quantity of multi-family housing in New Albany when modeled in CommunityViz. The number of multi-family units jumped from 270 additional units created in the base zoning scenario to over 2,574 units, a 950% increase. For single family housing, the increase is much less, from 2,141 to 2,303, an 8% increase. The difference in density between the New Zoning Build-out and either the Current Housing or the Base Zoning is substantial (Figure 3-28, Figure 3-29). In the Carter Avenue and Park Plaza Drive areas, the residential density climbs to more than 7 DUA due to the multifamily housing developments. There are also substantial gains in other areas due to the higher density in the zoning allowed, particularly between Bratton Road and Highway 30.

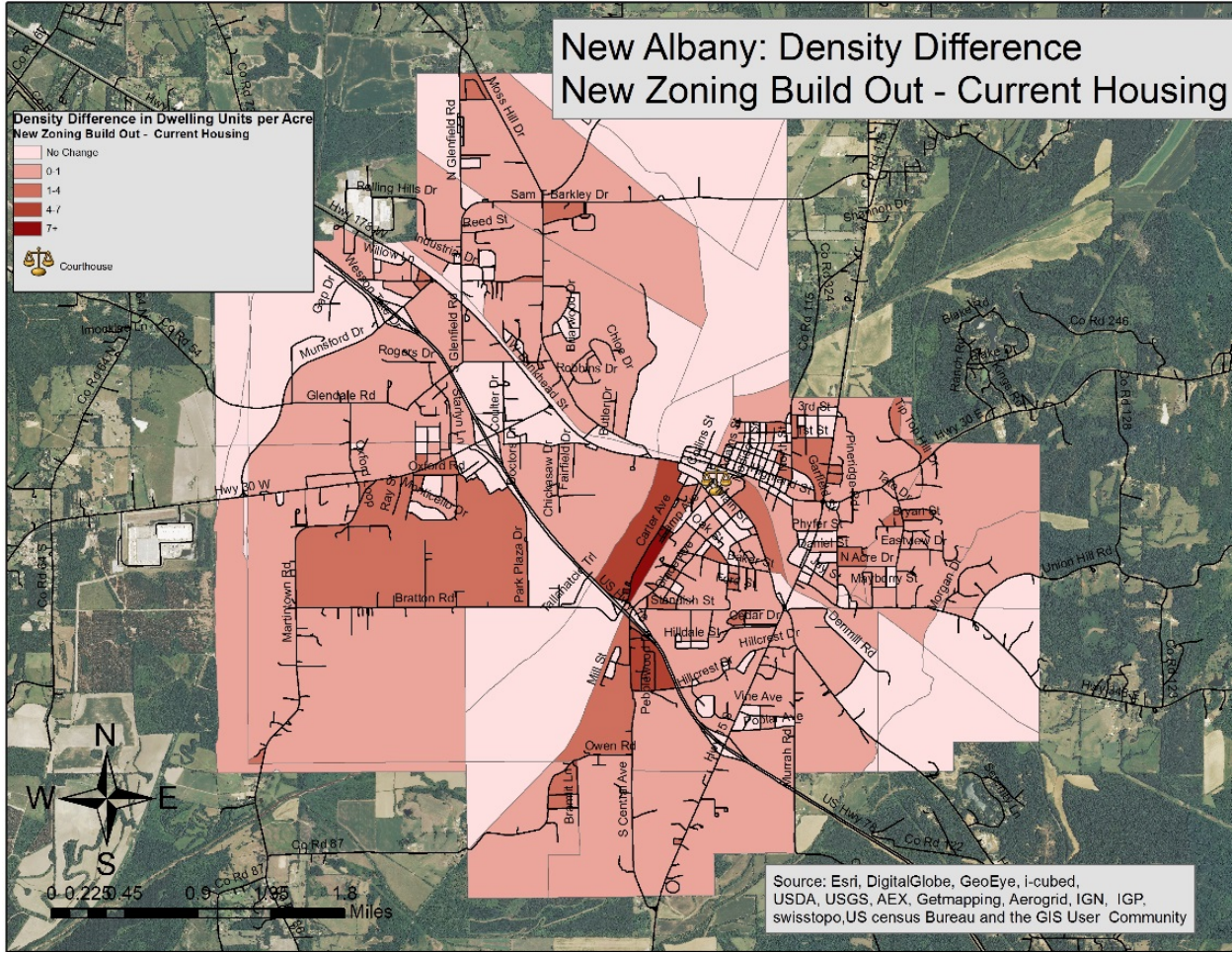


Figure 3-28. Density difference between new zoning build-out and current housing conditions.

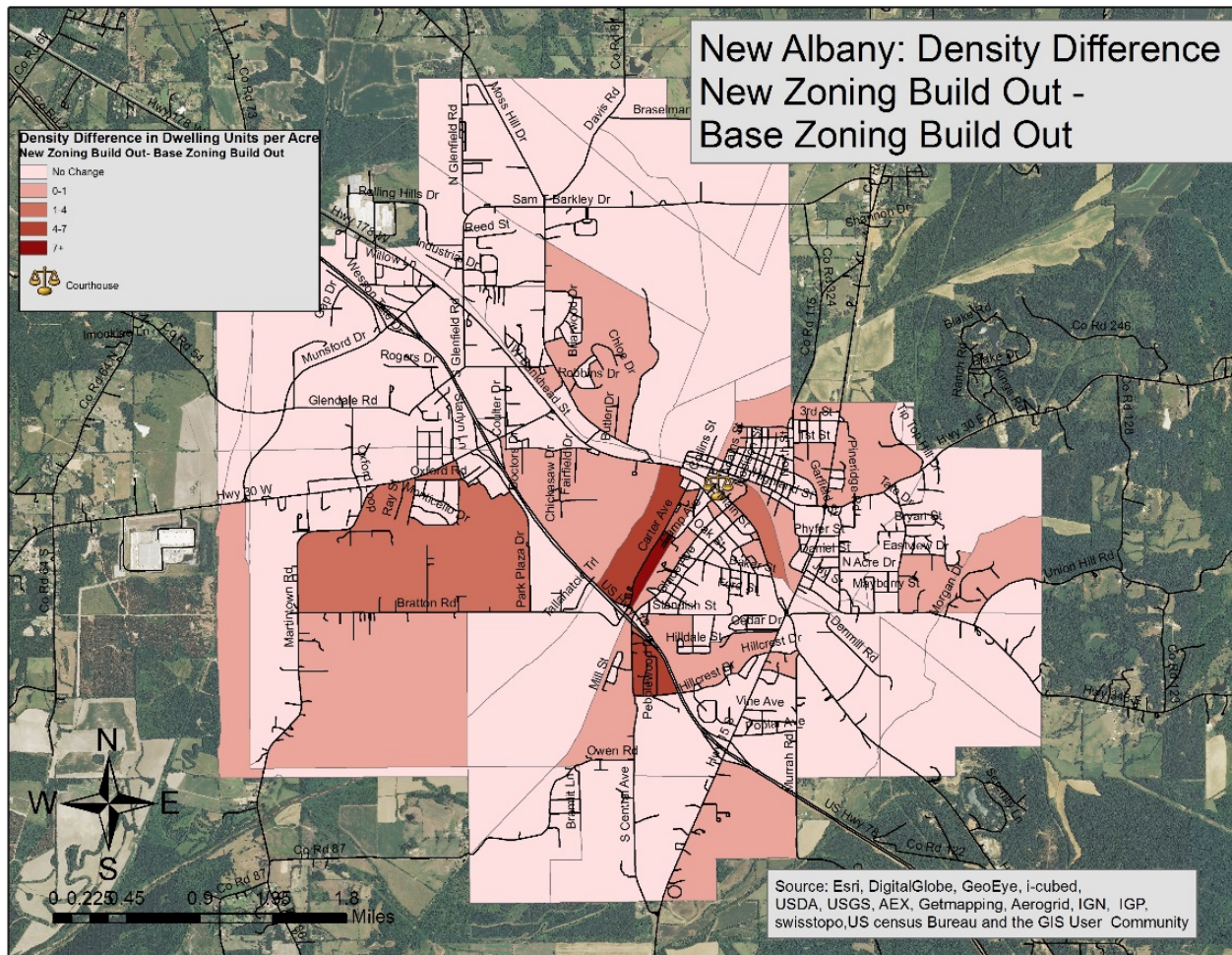


Figure 3-29. Density difference between new zoning build-out and base zoning build-out.

With an average of 2.72 persons per household, the increase in population from the current state to the potential population with the New Zoning is 13, 217, more than doubling and almost tripling the existing population. Continuing the existing zoning, the population would increase by 6,534, which would not quite double the population as desired by New Albany. To reach their goal, New Albany should encourage some multi-family development as well as increased density for single family development. Most importantly, the city needs to take greater advantage of the natural, cultural and recreational resources that it already has to attract new residents. The Tanglefoot Trail, Park Along the River, the Sportsplex and the easily accessible downtown are keys to the quality of life in New Albany. Making these resources readily available to new residents will give New Albany an advantage over other towns in attracting new residents.

PONTOTOC

Pontotoc, MS is located at the crossroads of two larger cities, Oxford and Tupelo, and two smaller cities, Houston and New Albany. Only 18.5 miles from Tupelo, 34 miles from Oxford, and 19 miles from the Toyota assembly plant in Blue Springs, Pontotoc is positioned between a numbers of industries and institutions for employment. Furniture manufacturing has been a backbone industry since the 1950's and Pontotoc is positioned near several large manufacturing plants including Lane Furniture, Southern Motion, and Golden Chair.

As described in the narrative profile of the area, Pontotoc has a high performing school system and lower than the state average house prices. In addition, Pontotoc is a Gateway town on the Tanglefoot Trail, a 44.5 mile rails-to-trails bicycling/walking path in the Heritage Hills region. All of these geographical and quality of life advantages should make Pontotoc a good choice for population growth.

Pontotoc county's population is projected to increase 21% (+2,834) by 2025. As noted before, most of the population increase in these rural areas will be in or adjacent to the major town, in this case Pontotoc. The basic pattern of the town has a historic downtown area occupying a north south ridge which defines Main Street. Intersecting the northern edge of the downtown is Highway 9, an east west road that links Pontotoc with Tupelo and Oxford, MS. To the west of the historic downtown on a parallel ridge to Main Street is the commercial strip of Pontotoc on Highway 15. Between the two ridges in the valley running north-south is the Tanglefoot Trail. As seen on the 5 minute and ten minute walk maps, most of the downtown is easily walked within ten minutes (Figure 3-30, Figure 3-31).

The U.S. Census lists the number of housing units in 2010 as 2,325. The map shows single-family residential is fairly evenly scattered throughout the city limits. There are a few concentrations of multi-family housing scattered throughout as well, but multi-family is in the minority. According to the U.S. Census, between 2008-12 the percentage of housing units in Pontotoc that are multi-family is around 12% (32). The zoning for Pontotoc shows mostly residentially zoned areas with a commercial corridor along Highway 15 (Figure 3-32).

In the base build-out, new residential shown in the brown dots fills out along the existing roads where possible and raises the number of housing units from the existing 2,325 to 3,106 units. Given the average persons per household in Pontotoc of 3.04, the population increase would be 2,390 persons, a percentage increase of 140% (Figure 3-33). In terms of new commercial space, the build-out added 1,572 units (Figure 3-34). The new commercial is placed mostly along Highway 15, which runs north-south through Pontotoc, with an additional concentration of new commercial in the historic downtown. As with the other base build-outs, both the residential and commercial areas are diffused throughout the city, not significantly increasing the dwelling units per acre (DUA) over 7 (Figure 3-35). As shown in the Density Difference Base Zoning Build-Out - Current Housing diagram, densities are increased overall by 1 to 7 dwelling units per acre,

but there are few places where the concentration is great enough (7+) to create more walkable, bikeable areas (Figure 3-36).



Figure 3-30. Pontotoc 5 minute walk radius.

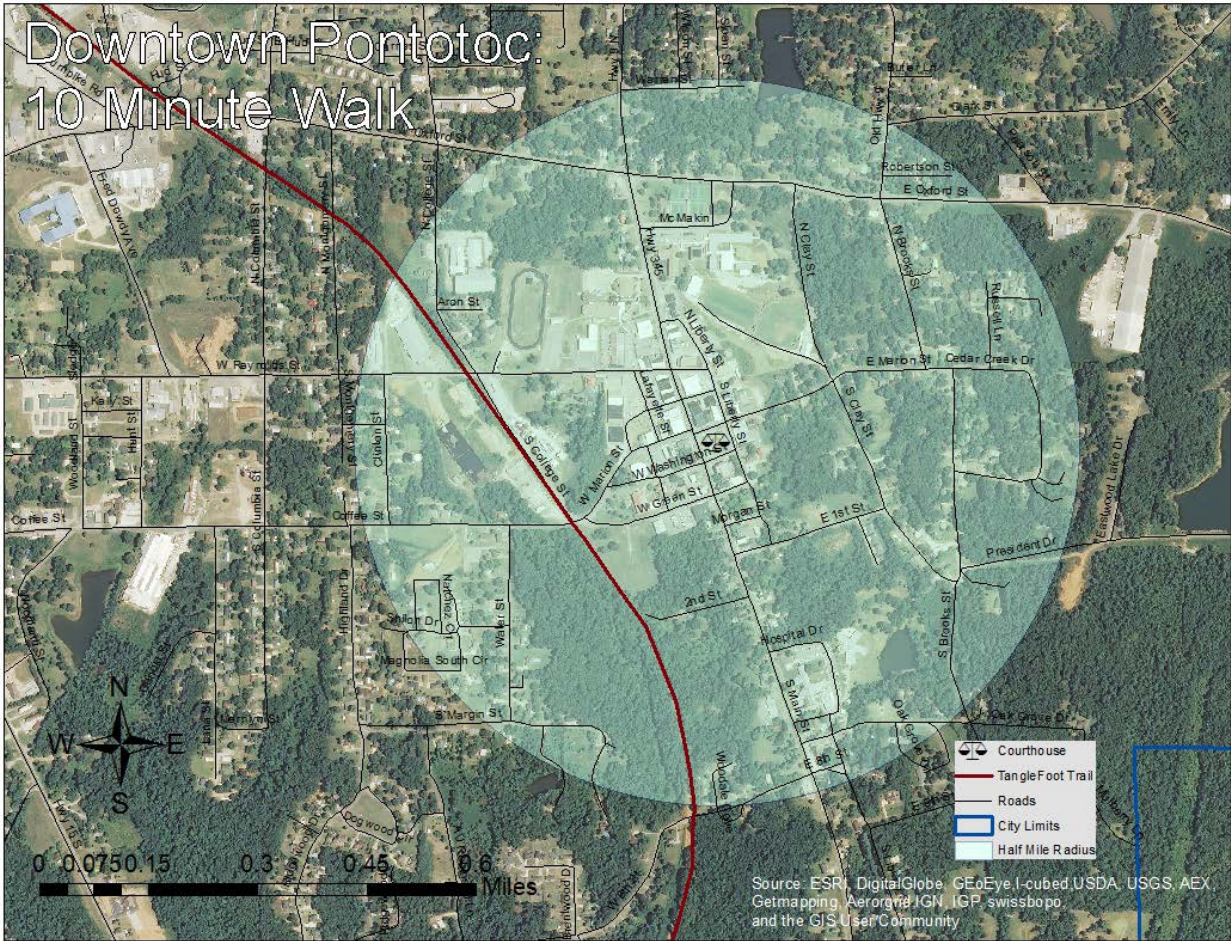


Figure 3-31. Pontotoc 10 minute walk radius.

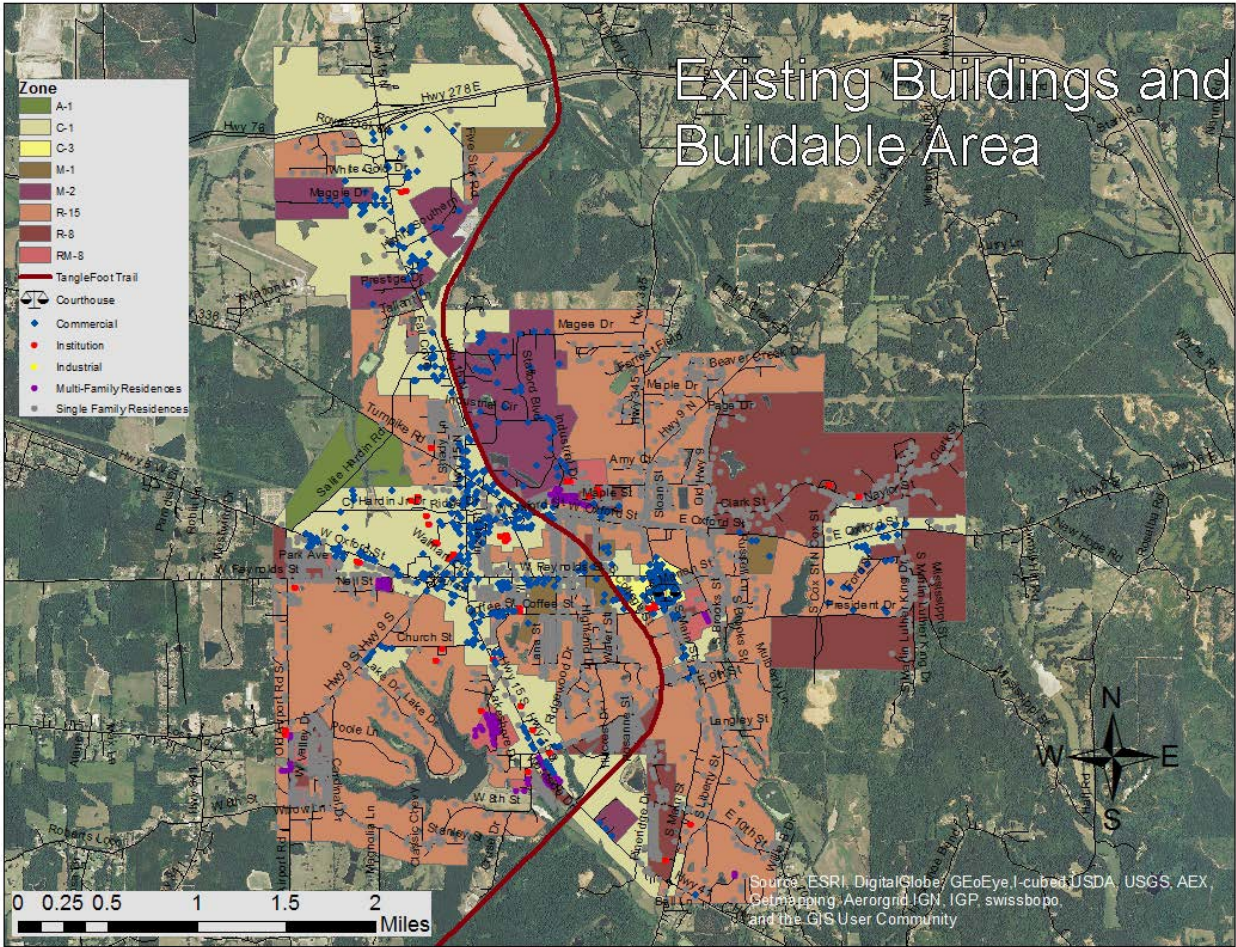


Figure 3-32. Existing buildings and buildable area.

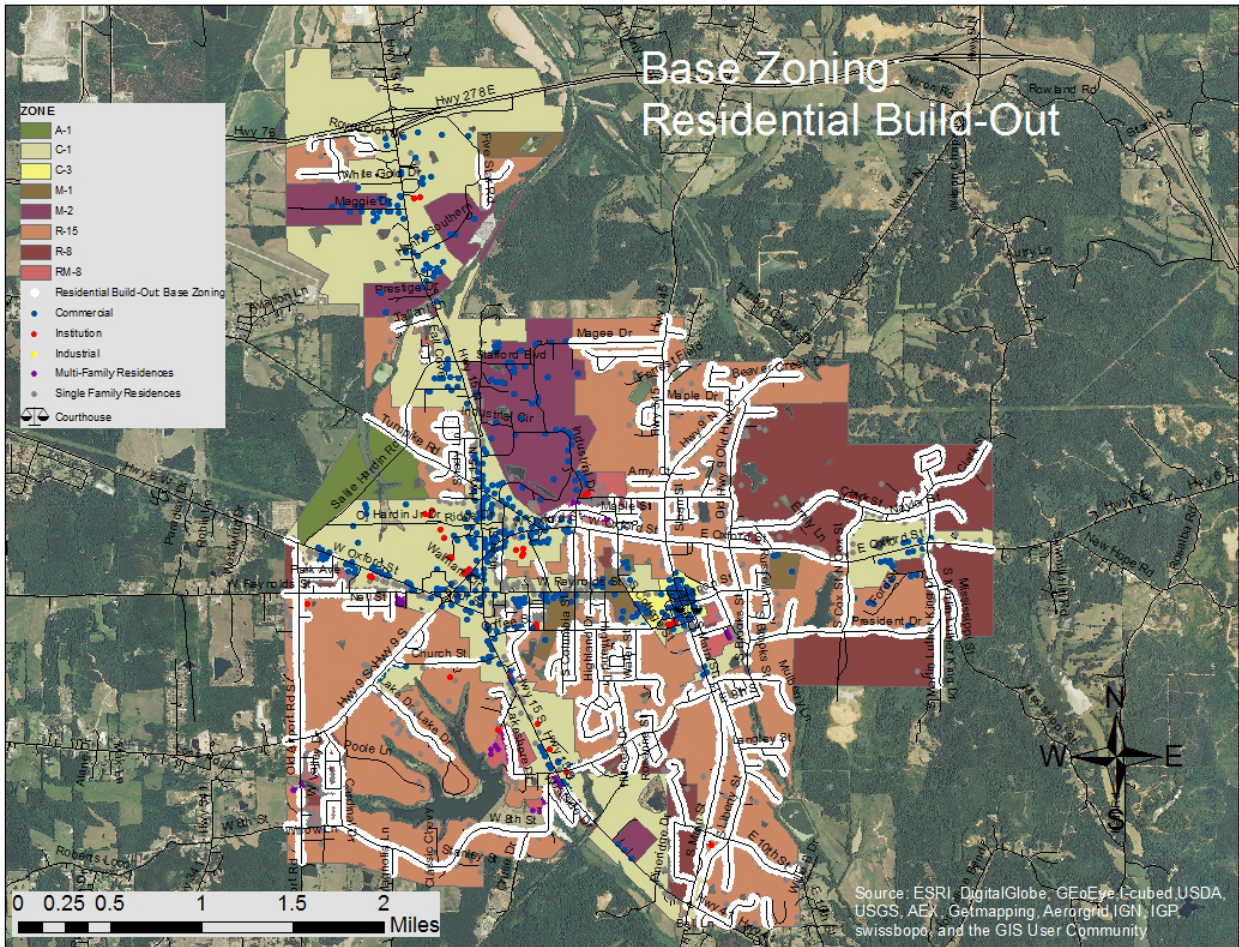


Figure 3-33. Base zoning residential build-out.

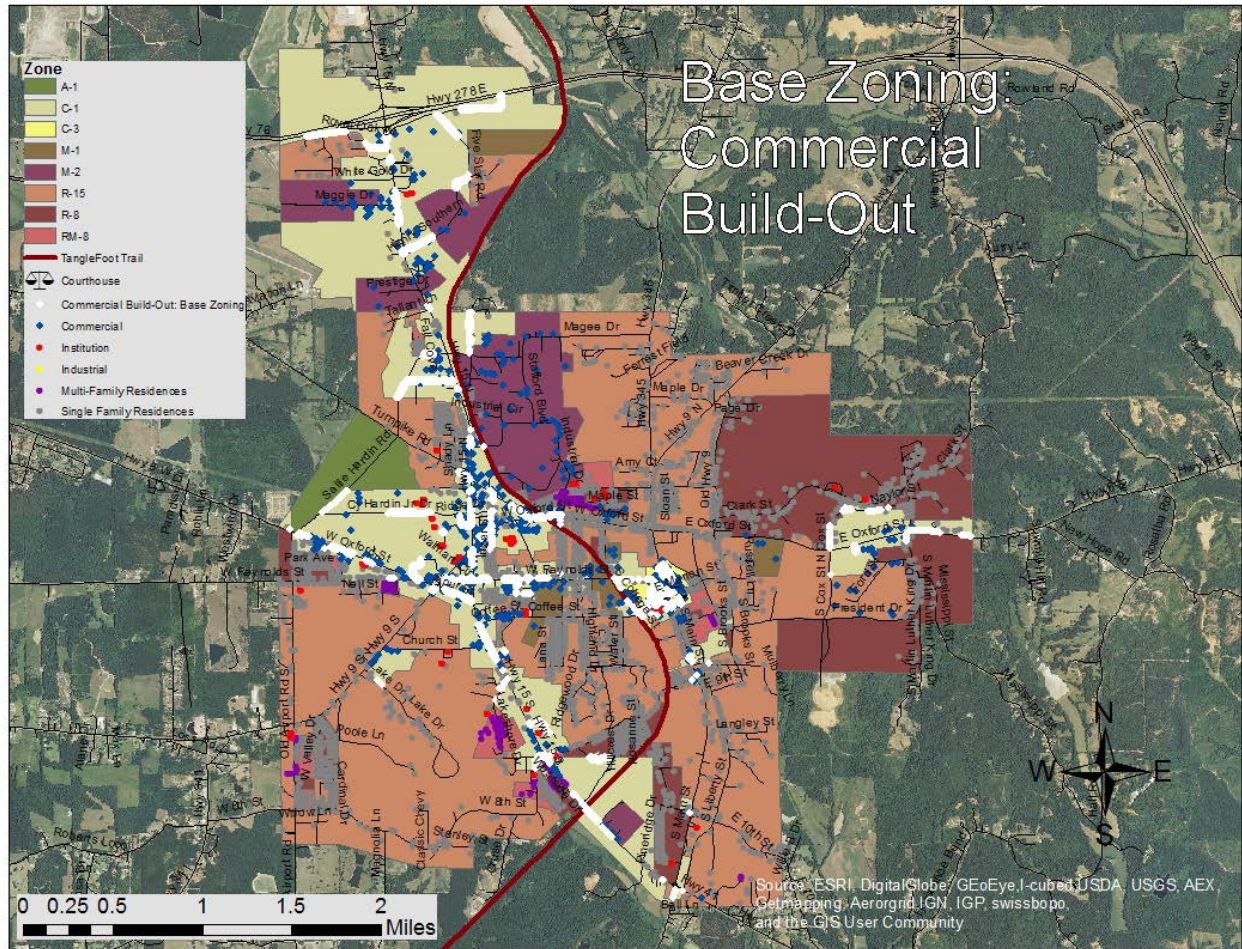


Figure 3-34. Base zoning commercial build-out.

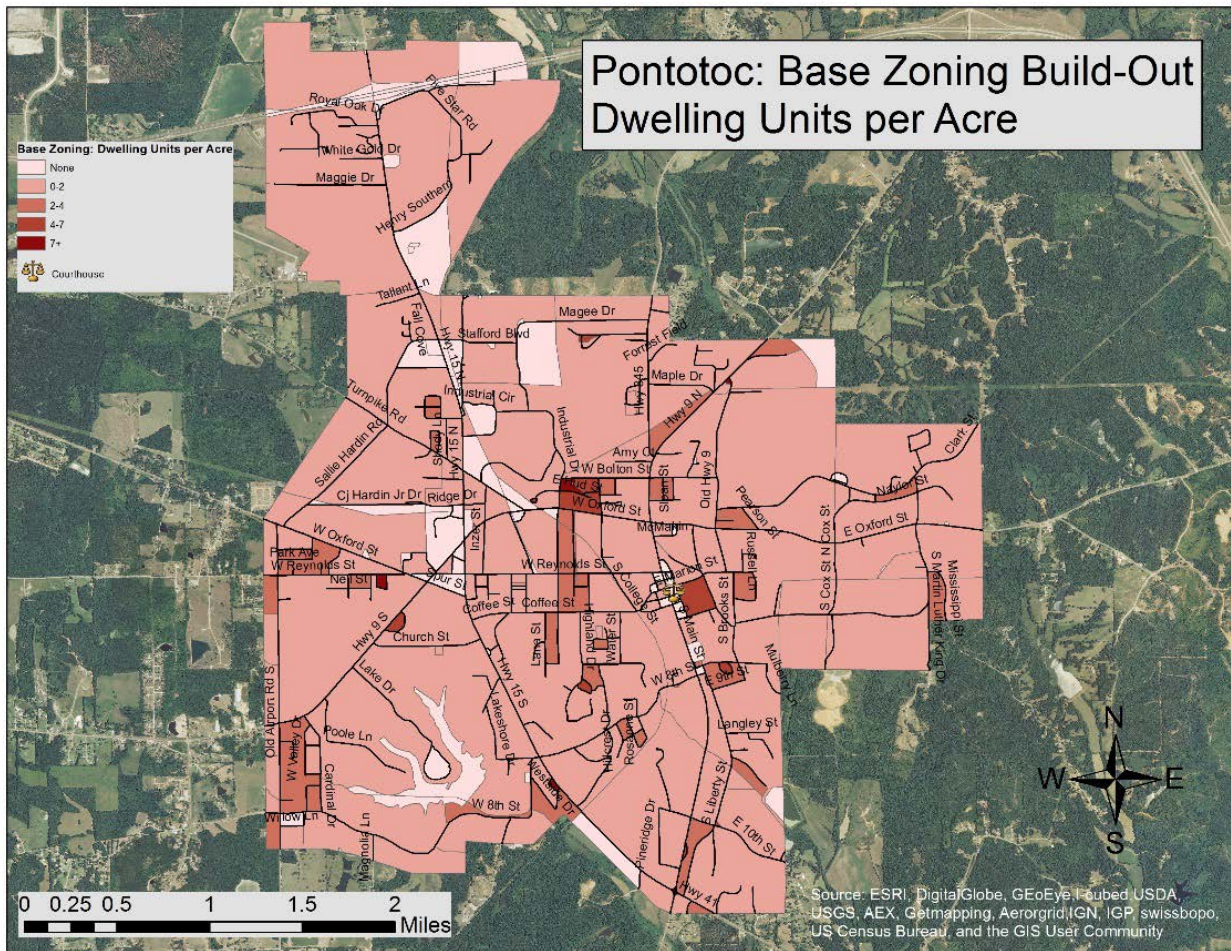


Figure 3-35. Base zoning build-out dwelling units per acre.

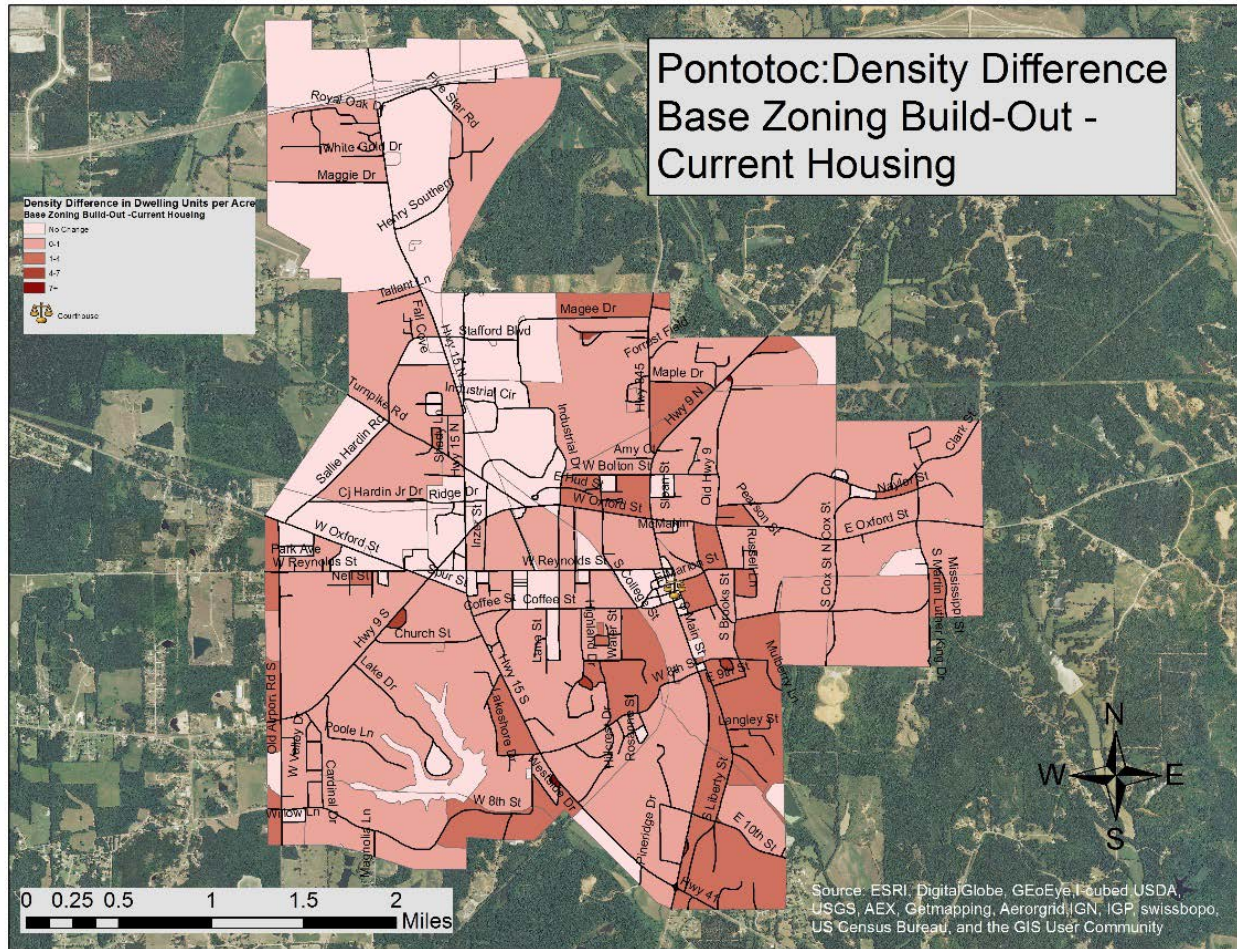


Figure 3-36. Density difference between base zoning build-out and current zoning.

In looking for opportunities to make new walkable, dense neighborhoods in Pontotoc, locations were selected that tried to take advantage of existing amenities (Figure 3-37). A large community is proposed surrounding the existing sportsplex which will allow residents to walk to the playfields and amenities of the sportsplex, but also easily bike to the downtown area (Figure 3-38). By placing a residential neighborhood here, placing more recreational activities and amenities at the sportsplex would also make sense.

Several opportunities exist in Pontotoc for residential development. One opportunity exists in the lowland area between Amy Court and Turtle Creek Drive, taking advantage of the topography to create a neighborhood as part of the wooded area (Figure 3-39). The block bounded by North Clay and North Brooks Street to the east and west and East Marion Street and east Oxford Street to the north and south could be developed more densely. This block is adjacent to the high school and also close to the middle school which would allow students to walk to school.

The major opportunities for residential development are connected to the Tanglefoot Trail. South of 8th Street adjacent to the trail and to the west of South Main Street is an area that could be

developed with single family residential neighborhood (Figure 3-40). A path connection running through the center of the neighborhood to the Tanglefoot Trail would allow all residents access. A view of the trail before and how the new neighborhood would appear from the trail is shown in Figure 3-41.

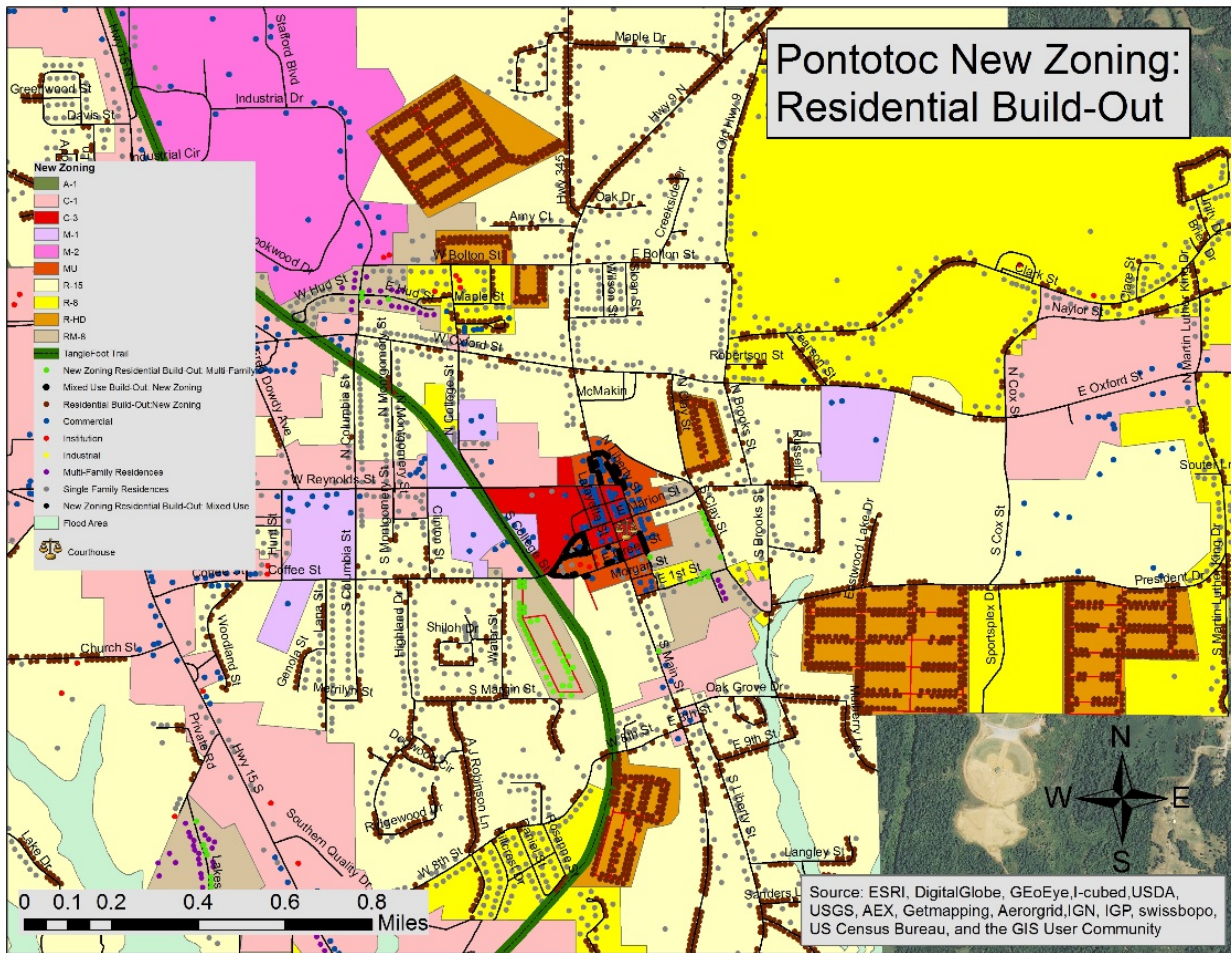


Figure 3-37. New neighborhoods overall plan.

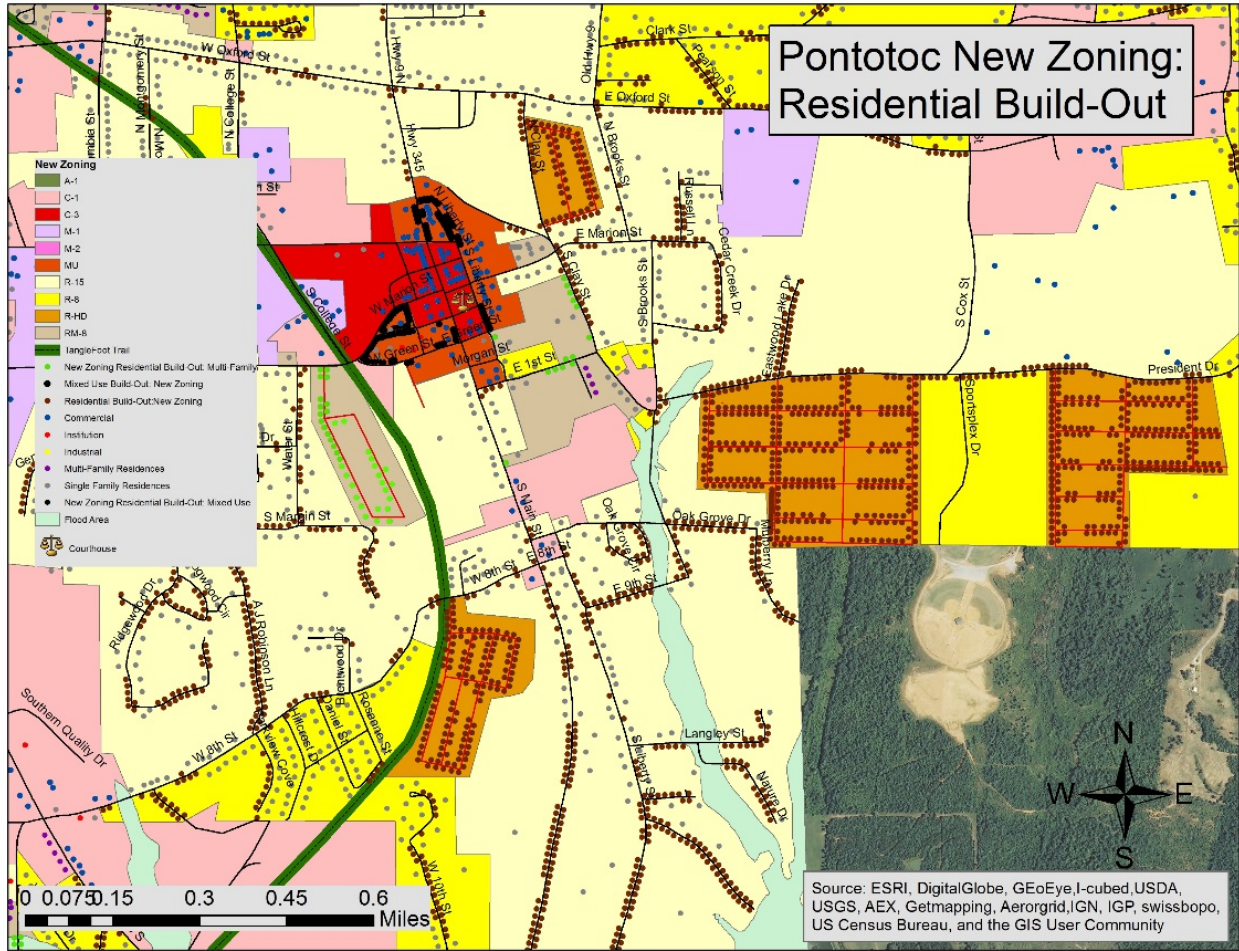


Figure 3-38. New community around sportsplex.

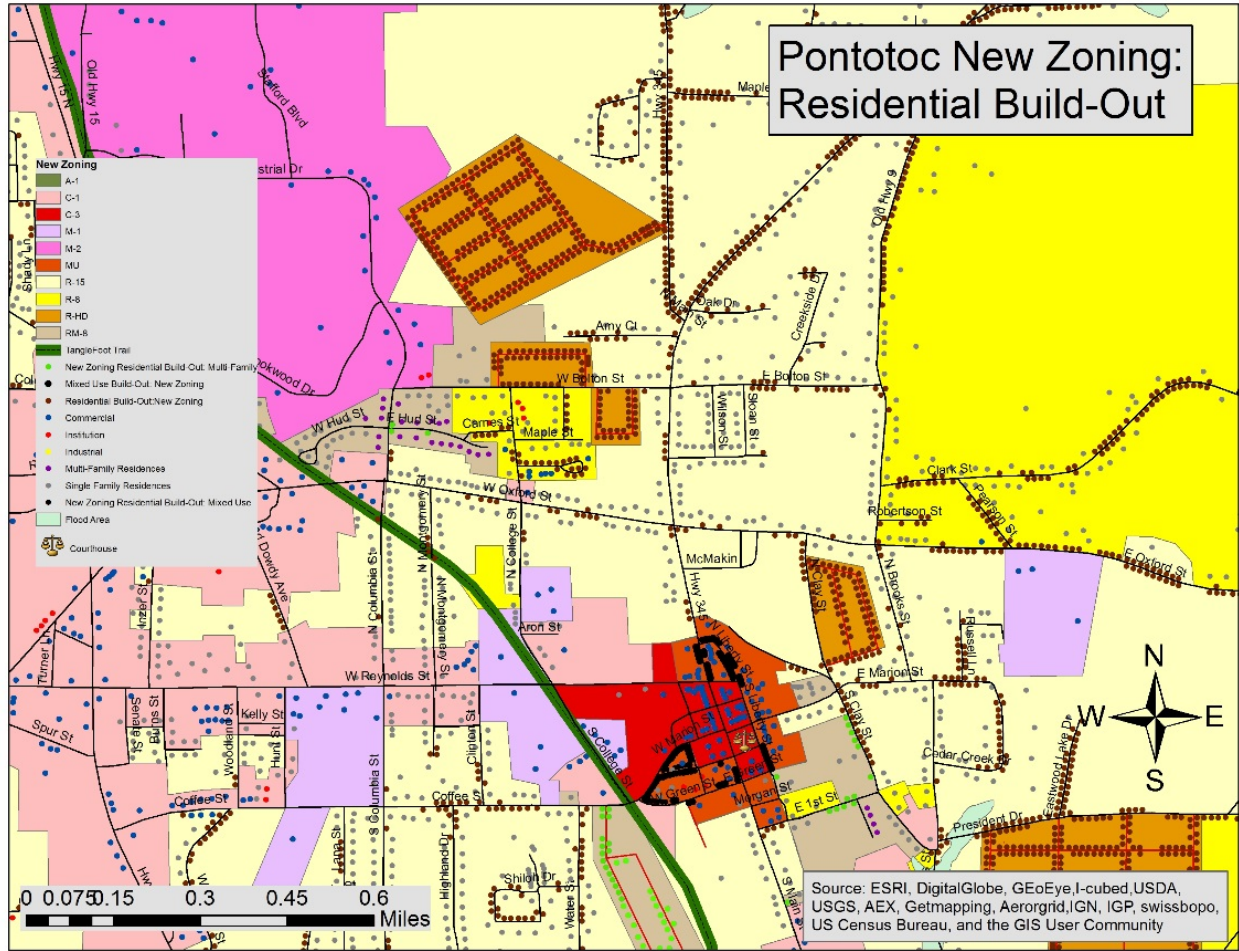


Figure 3-39. Turtle Creek Road development.



Figure 3-40. 8th Street development.



Figure 3-41. 8th Street development view.

Further north on the trail, south of Coffee Street is an area closest to the downtown and on the Tanglefoot Trail. Having proximity to the downtown as well as the trail could be a very attractive location for younger residents not ready to buy a house in Pontotoc. The proposal for this property would be a ring of apartment houses around a large public park space (Figure 3-42). One side of the development would be adjacent to the Tanglefoot Trail and provide the multifamily complex access to the Trail as well as access for Trail users to the park. The complex would define an edge to the trail and increase the safety of the Trail by placing residents who would naturally "watch over" the Trail adjacent to it (Figure 3-43).



Figure 3-42. Coffee Street development.



Figure 3-43. Coffee Street development view.

By proposing these new developments and changing the zoning to allow for more density, the number of housing units increases to 4,209 from the previous maximized base zoning of 3,106 units and the existing 2,325 units, an increase of 181% over the existing number of units. The key to the new developments and changes are the number of high density (7+ DUA) areas created (Figure 3-44). The change is best illustrated in the Density Difference New Zoning Build-Out - Base Zoning Build-Out diagram (Figure 3-45). The diagram shows how the density of dwelling units increased considerably along Main Street into the downtown area between the maximized existing zoning and the planned new developments and new zoning that allow for more density. By creating these higher density zones particularly in conjunction with the historic downtown, walking and biking is encouraged rather than car trips. The 5 Minute and 10 Minute Walking Distance diagrams show that the proposed multi-family housing is within a five minute walk of the downtown while all of the new housing development proposed is within a ten minute walk (Figure 3-30, Figure 3-31).

By creating these new residential neighborhoods, the hope is not only to reduce vehicular travel, but to draw new residents to Pontotoc by making the amenities and strengths of Pontotoc more evident and accessible. The Tanglefoot Trail could be a draw for many people passionate about bicycling or running and looking to be in the center of the Mississippi Heritage Hills region. The excellence of the Pontotoc City School District is another draw. By placing new housing near the downtown based schools, students can safely walk to and back from school, eliminating the need for parents ferrying especially older students to school and activities. The time saved and flexibility gained by both parents and students, as well as the reduction in vehicle miles, helps everyone.

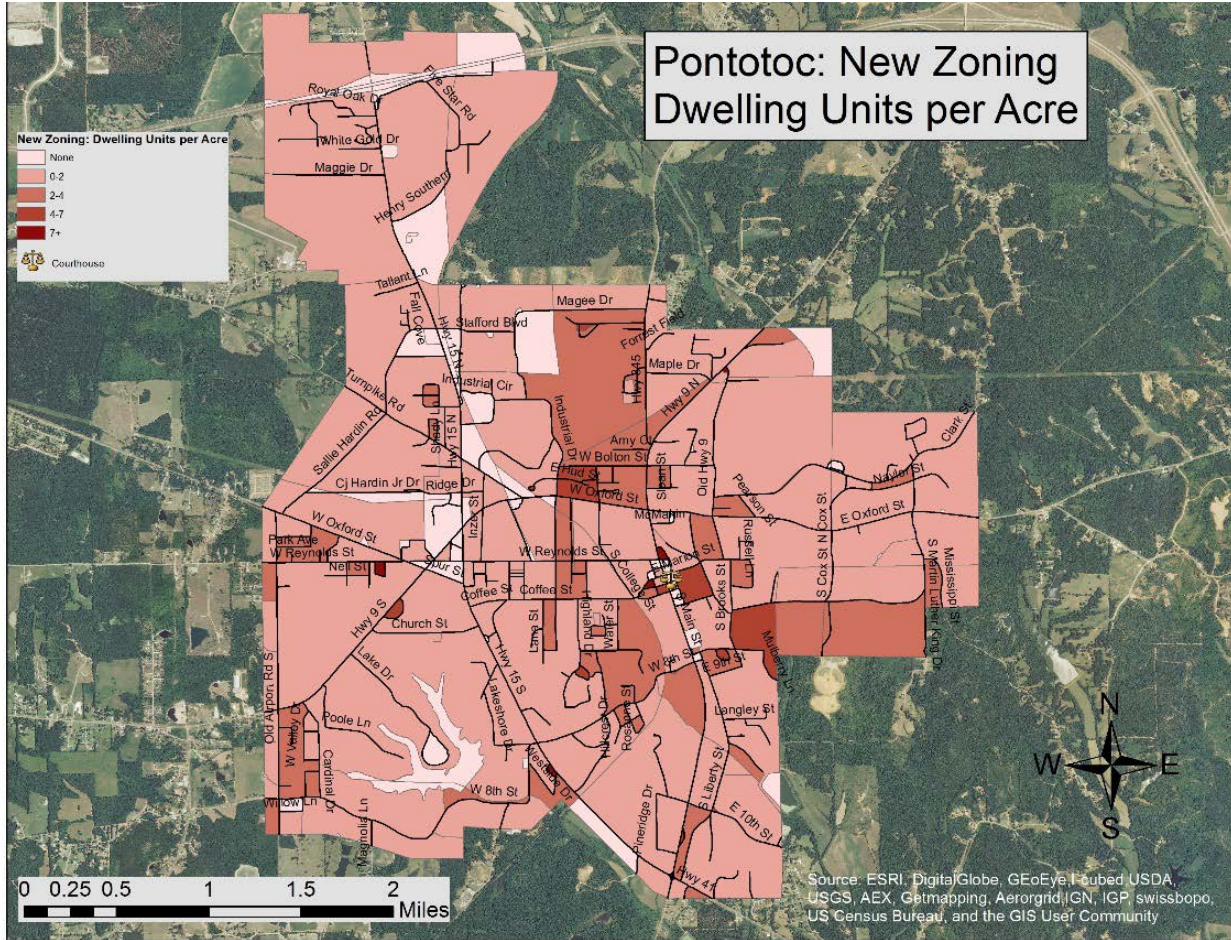


Figure 3-44. New zoning dwelling units per acre.

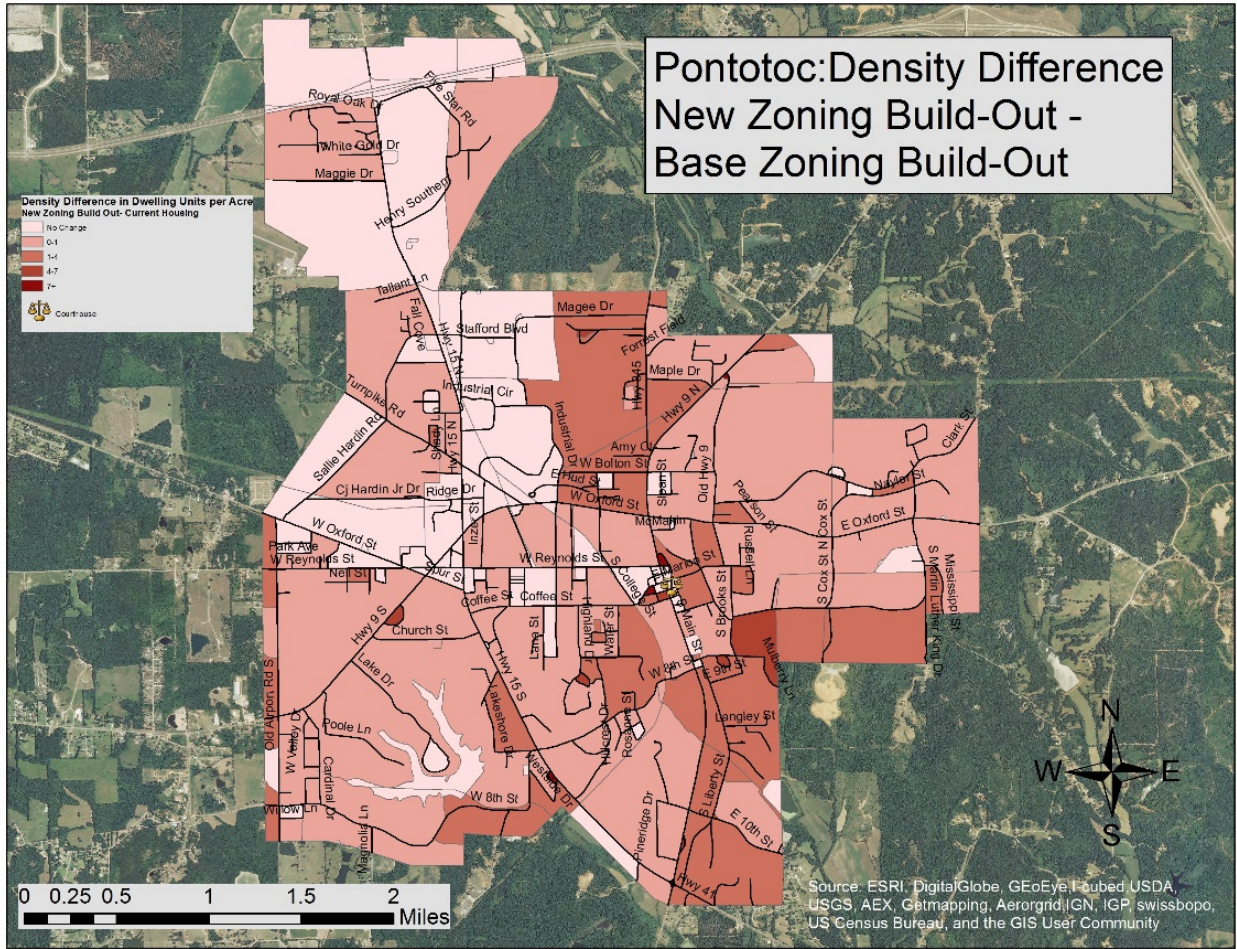


Figure 3-45. Density difference, new zoning versus base zoning build-out.

As a Gateway town on the Tanglefoot Trail with a good school system and a central location in the region, Pontotoc has the potential to become a larger residential community. Focusing on the quality of life issues for the town; housing, schools, health care, and recreation are key to the success of a strategy centered around making Pontotoc a great place to live in the Heritage Hills region.

HOUSTON

Houston, Mississippi is at the southwestern edge of the study area. Houston is equidistant between Tupelo and Starkville, each about 38 miles away. Starkville is the home of Mississippi State University, the largest university in the state. By being so close to Starkville, Houston has a connection to the Golden Triangle, an economically growing region defined by Starkville, West Point and Columbus, Mississippi.

Houston is at the beginning of the just opened Tanglefoot Trail, a 44 mile bicycling and walking trail that is expected to draw riders from not only the entire northeast Mississippi region, but nationally as well. The trail head is located west of Houston's downtown in a lower income neighborhood with industrial/waste sites. In addition, the Natchez Trace Parkway, a 444 mile scenic drive which is routinely travelled by bicyclists is located 7 miles from Houston.

The existing zoning in Houston defines two commercial corridors along Highway 8 east to west and Highway 389, north to south. These roads meet at Houston's downtown, which is the nexus of the commercial zones. Existing residential areas fan out from these commercial spines mainly to the east and north of the town. The housing is mostly single family detached with a good proportion of mobile homes; almost a quarter of all residential structures are attached, multifamily dwellings. Areas of higher density (7 Dwelling Units per Acre +) are only a few: a block north of West Depot Street between North Pontotoc and North Jackson Street, the area between West Church Street and West Harrington Street to the south, and a small block near Woodland Circle. For the most part, the town has a density of four dwelling units per acre and below (Figure 3-46).

The town is nevertheless fairly compact, it takes approximately 20 minutes to walk from one end of town to another (Figure 3-47). Bicycling covers even more ground. The maximum average bicycle commute in the United states is seven miles. With that radius, the Houston incorporated limits are more than easily covered as well as connections to the Natchez Trace (Figure 3-48).

The potential for growth for such a low density is great even without changing the zoning to allow for increased density. The Build Out of Base Zoning scheme continues the existing pattern of residential development along the commercial corridors by filling in lots along the existing roadways (Figure 3-49). By doing so, the Build Out of Base Zoning provides 1011 more single family residences and 23 more multi-family residences than exist today. This increase in housing would translate to around 2,800 new residents that could be accommodated in Houston. The

housing density obtained from the Build Out of Base Zoning shows, however, that housing is evenly spread over the entire city and does not contribute to the walkability of neighborhoods, which would be designated by an increase in 7+ DUA (Figure 3-50). As seen in the Density Difference Base Zoning Build-Out - Current Housing diagram, very few areas have gained considerable density by simply building out the city to the maximum that the existing zoning allows (Figure 3-51).

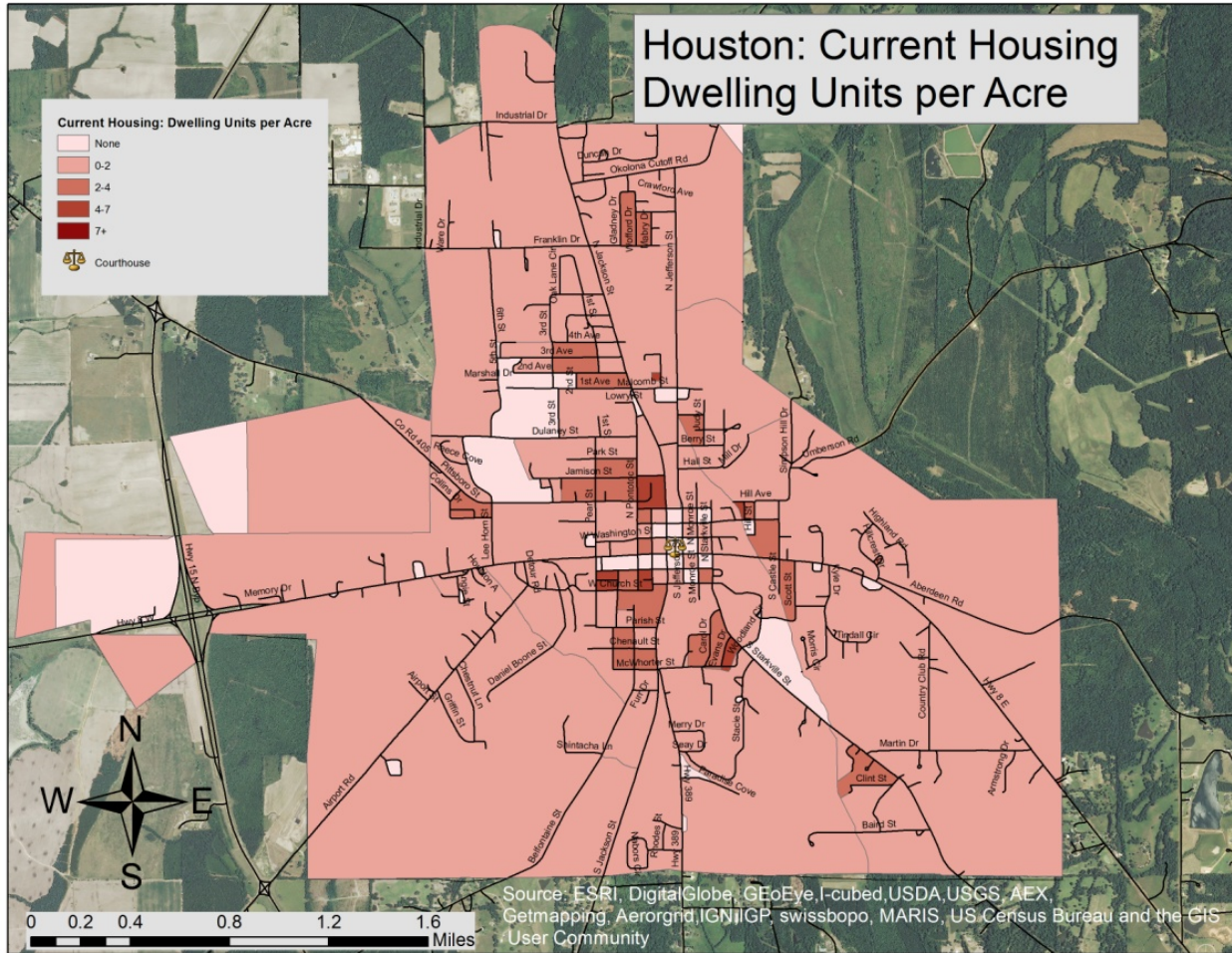


Figure 3-46. Current density.

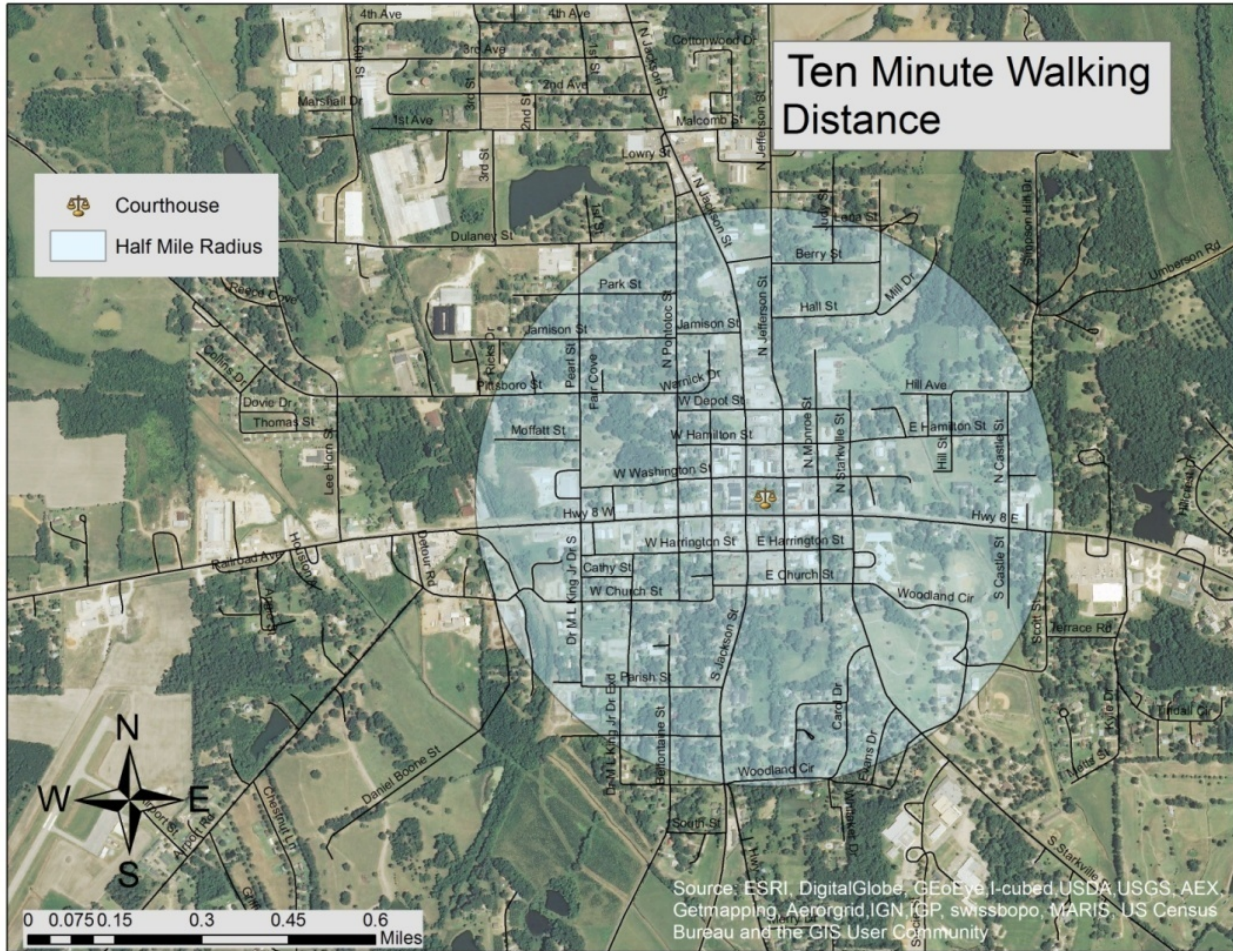


Figure 3-47. Houston walking distances.

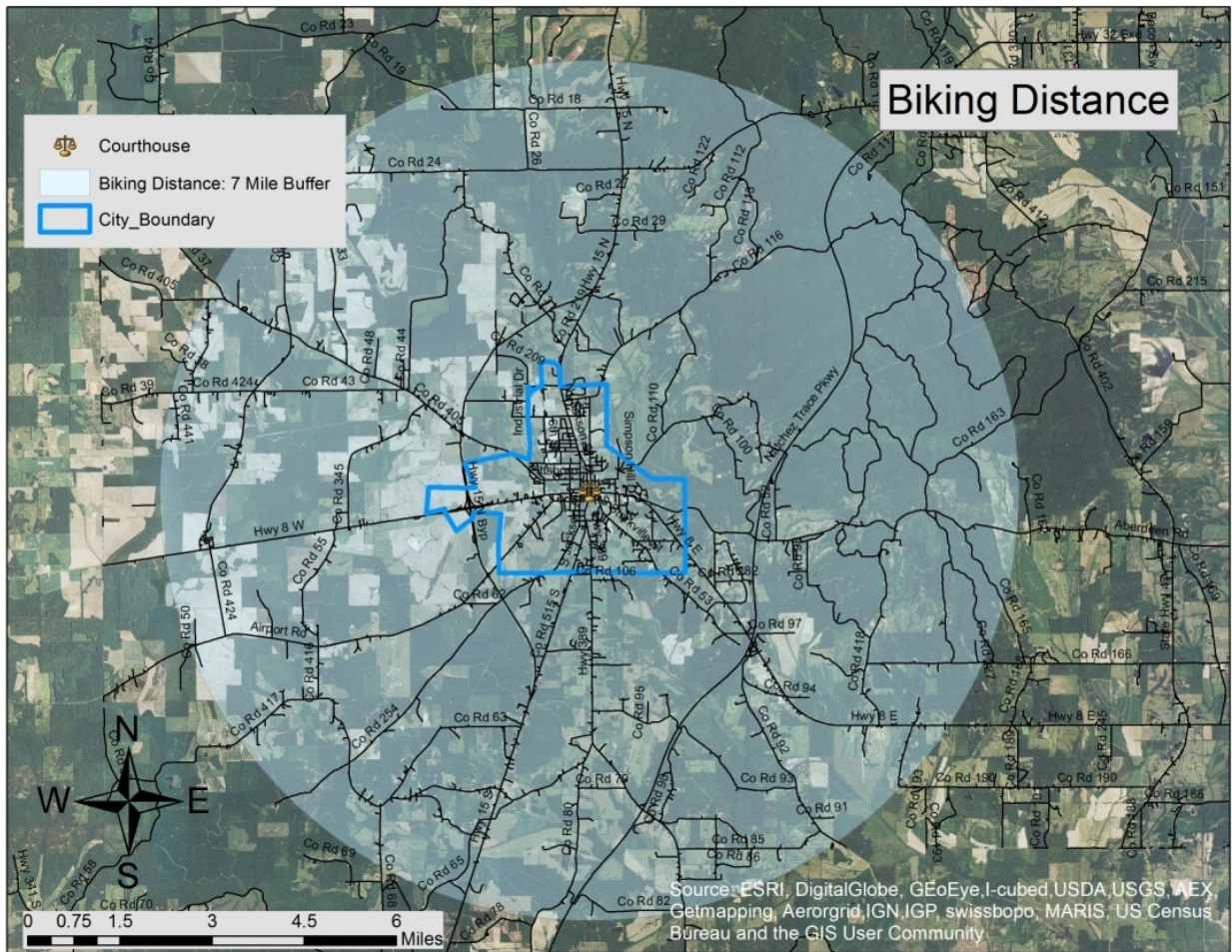


Figure 3-48. Houston biking distances.

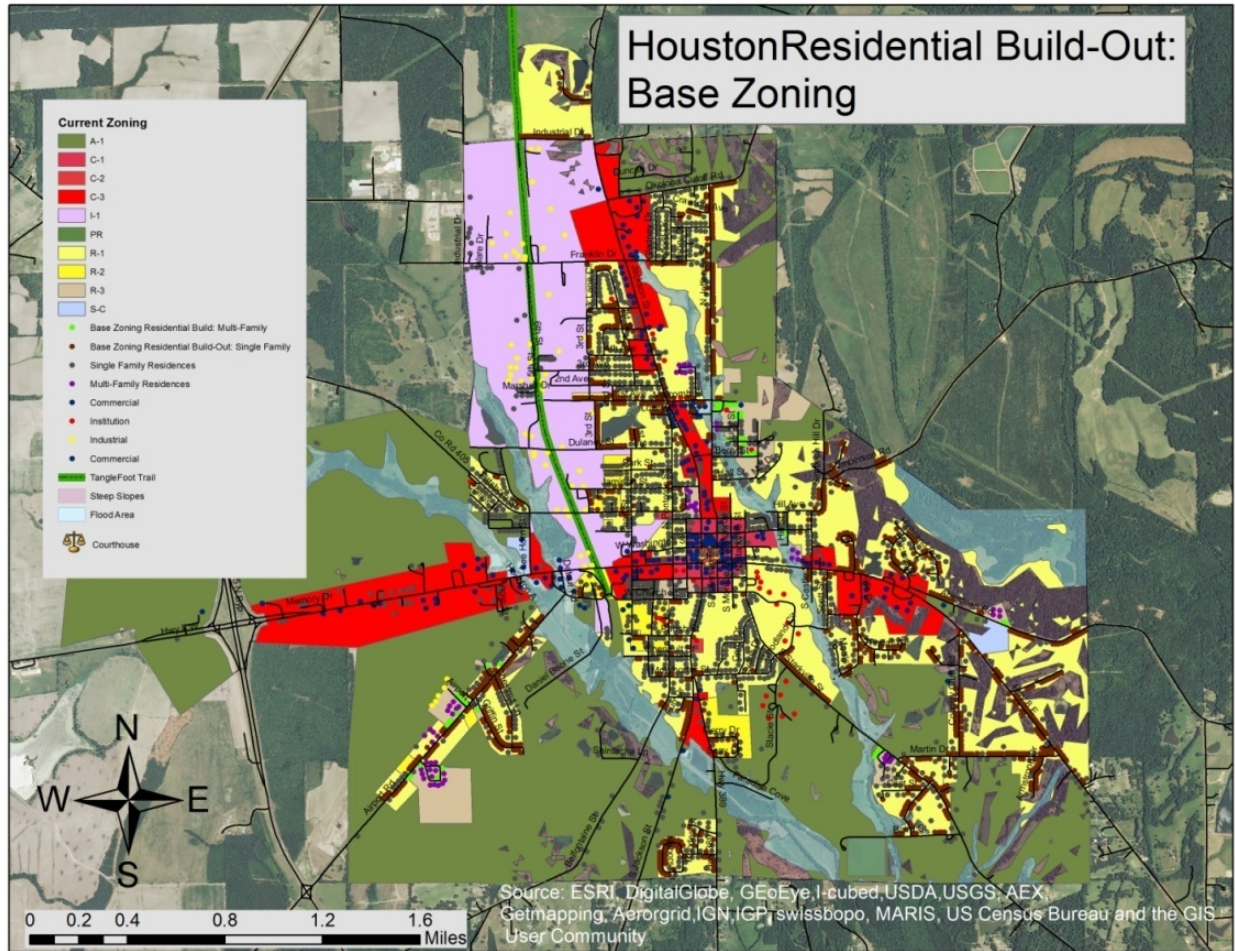


Figure 3-49. Base zoning build-out.

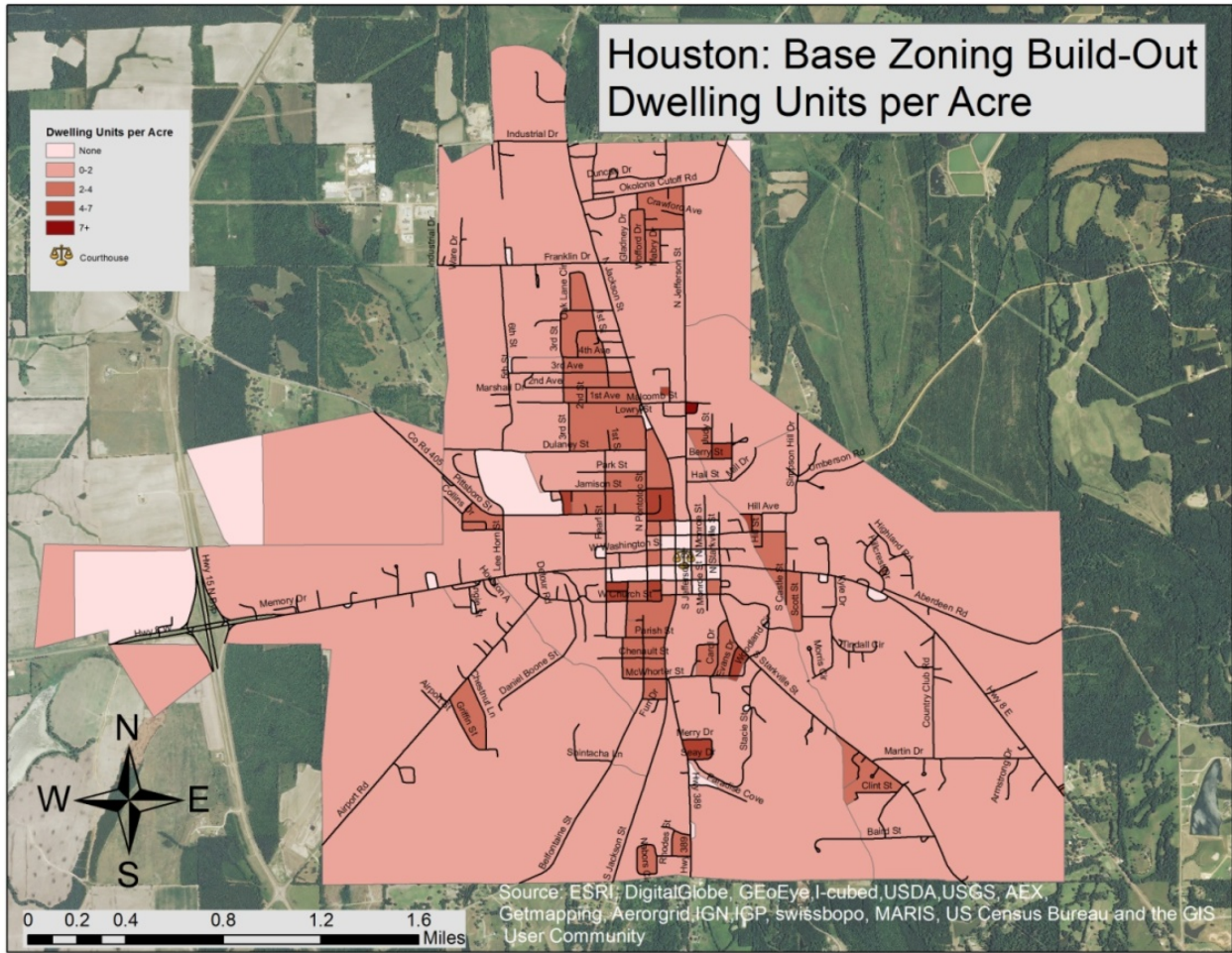


Figure 3-50. Base zoning build-out dwelling units per acre.

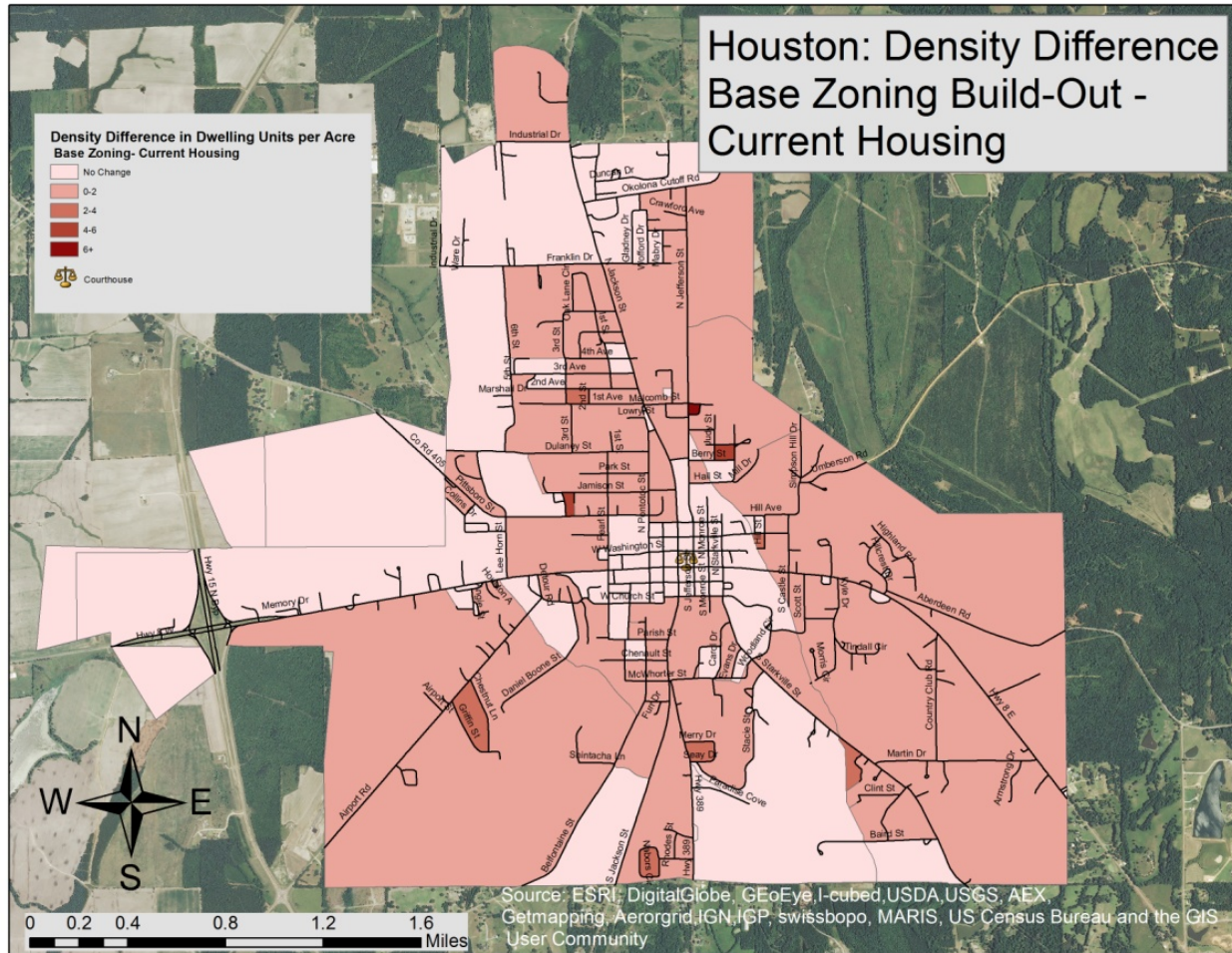


Figure 3-51. Base zoning build-out - current dwelling units per acre.

In the New Zoning Build-Out, certain areas in the city are targeted for new, more dense residential development (Figure 3-52). The areas include single family housing to the west of the town center, north and south of Highway 8, an area south of East Church Street, and the area northeast of the town center between Hill Avenue and Mill Street (Figure 3-53). In addition, single family residences have been added to a number of streets including Airport Road, North Jefferson Street, South Starkville Street, and east of town on Martin Drive and Highway 8. New Multifamily residences are proposed on Highway 8 west of the town center as well as north and south of the Houston's main square.

The New Zoning Build-Out increases the new single family residences to 2558, an increase of over 250% over the Built-Out of Base Zoning. The number of multifamily housing actually decreases in this scenario due to editing the more random placement that the model creating in the first scenario to 23 buildings. The estimated new residents would be approximately 6,800, about a 240% increase from the Base Scenario. The City of Houston according to the 2010 Census has 3,623 residents, so this would treble the population of the town.

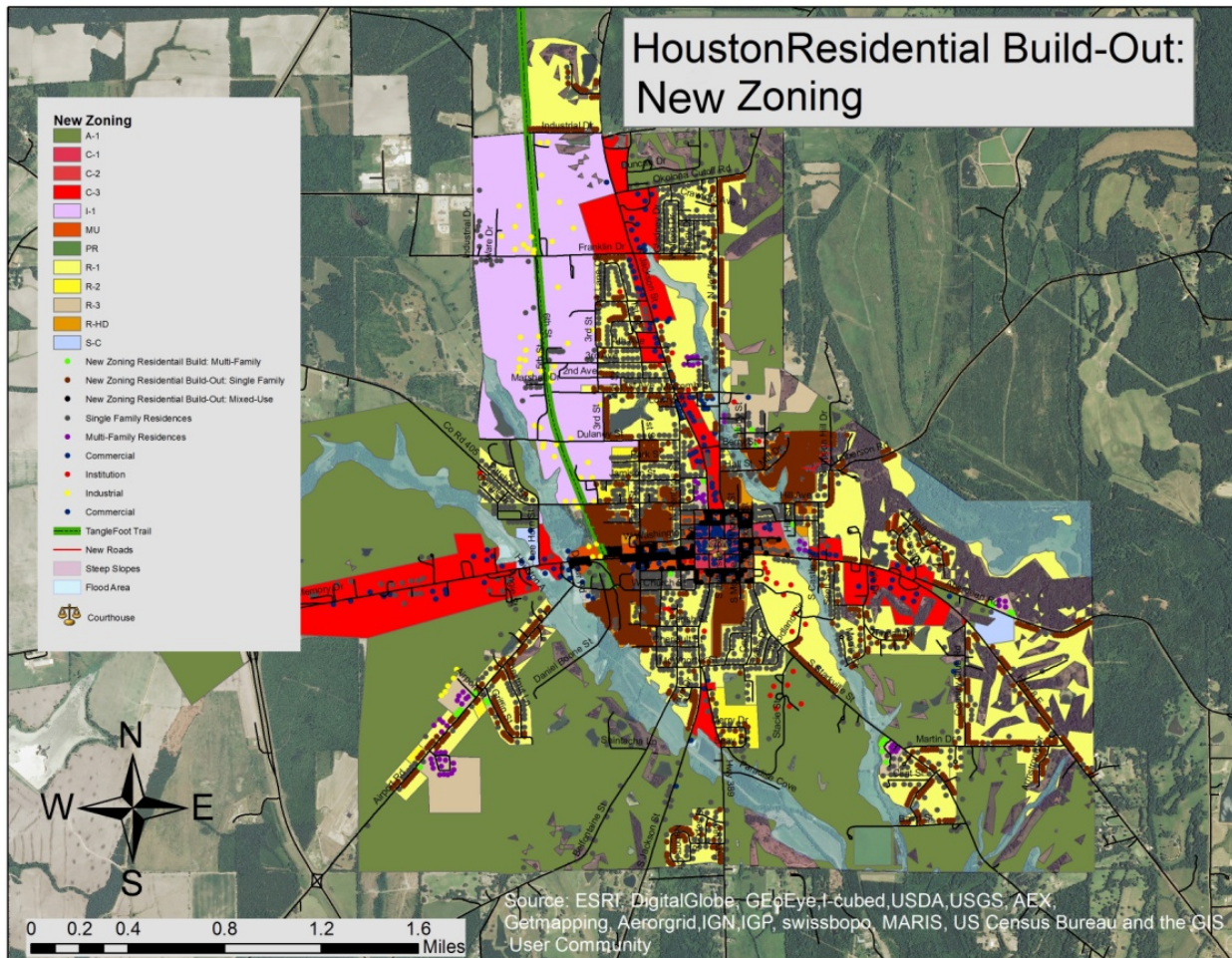


Figure 3-52. New zoning build-out.

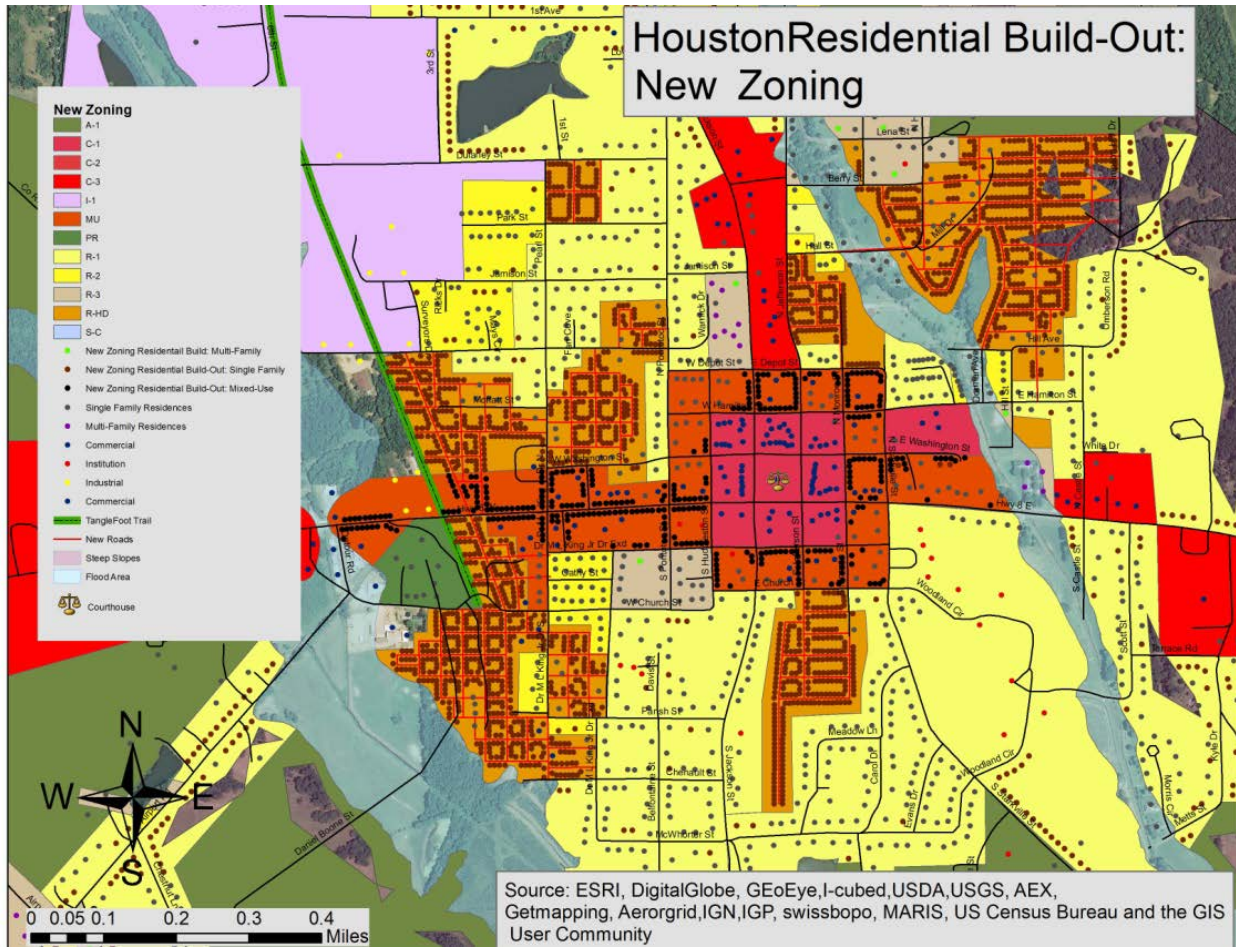


Figure 3-53. Zoomed in new zoning build-out.



Figure 3-54. Tanglefoot Trailhead Park.

The New Zoning Build-Out also more carefully places new development. One of the key areas to increase density and amenity are located adjacent to the Tanglefoot Trail. As outlined above, the Tanglefoot Trail provides an opportunity for Houston to attract not only bicycle tourists, but new residents who would find living at the end of a 44 mile bike trail and close to the Natchez Trace very attractive. A new development single family homes as well as a new park is proposed to mark the end of the Trail. The park will provide a better defined end for the Trail as well as needed amenities such as parking and restrooms (Figure 3-54). The Park also serves as a focus for the new, pedestrian oriented development (Figure 3-57). The new development connects with the existing neighborhood and is aligned with the geometry of the city (Figure 3-55, Figure 3-56). The new development will include sidewalks, bike lanes and denser street oriented, although still single family housing (Figure 3-57).

Another development is placed further up on the trail, just north of Highway 8 and centered about Pearl Street. An access point to the Tanglefoot Trail would be created from the neighborhood for easy access. An additional benefit of this location is a grocery store that would be pedestrian accessible as well as easy access to the downtown area.



Figure 3-55. Aerial of Trailhead neighborhood before.



Figure 3-56. Aerial of Trailhead neighborhood after.



Figure 3-57. View of Trailhead neighborhood.

The remainder of the proposed developments are placed in areas where land is available a short walk from the downtown area. The development near the Woodland Circle area would allow children to easily walk to school. The proposed developments to the northeast of downtown would again be an easy walk to the downtown area.

Other proposals for Houston involve making the downtown area more pedestrian and bike friendly. On Washington Street just west of the Courthouse Square, the density of the courthouse square is extended further to allow for more housing and commercial space. Parallel parking, a bike lane and sidewalks make the street more pedestrian friendly and link it to the new neighborhood proposed to the west of the downtown area (Figure 3-58, Figure 3-59). Around the courthouse square itself, the overly wide streets are proposed to be narrowed to allow for easier pedestrian access and space for events to occur such as markets and festivals (Figure 3-60, Figure 3-61).



Figure 3-58. Washington Street before.



Figure 3-59. Washington Street after.



Figure 3-60. Downtown Houston before.



Figure 3-61. Downtown Houston after.

The bicycle suitability analysis that we conducted for Houston shows that many of the main roads are suitable to be improved with bike lanes (Figure 3-62). Highway 8, the main east-west,

is excellent to good within the city limits. Highway 8 also connects Houston with the Natchez Trace Parkway, a U.S. National Park. A bike lane from the Natchez Trace Parkway to Houston would allow bikers to move from this nationally known parkway to the regional Tanglefoot Trail, allowing a different route and connecting those bicycle tourists with more small towns through the region. In addition, other excellent bike lane candidates such as Jackson Street connect downtown Houston with Franklin Furniture, a main employer in Houston and the region. An intra-city series of lanes could be created with a lane on Highway 8 from the Tanglefoot Trail to the Natchez Trace bisected by a lane from Houston High School on Starkville Rd, through the downtown to Jackson Street ending at Franklin Furniture. With these two routes, most of the major services and amenities in Houston will be accessible by bicycle, including the Trace Regional hospital, Joe Brigance Memorial Park and the Houston Library (Figure 3-63).

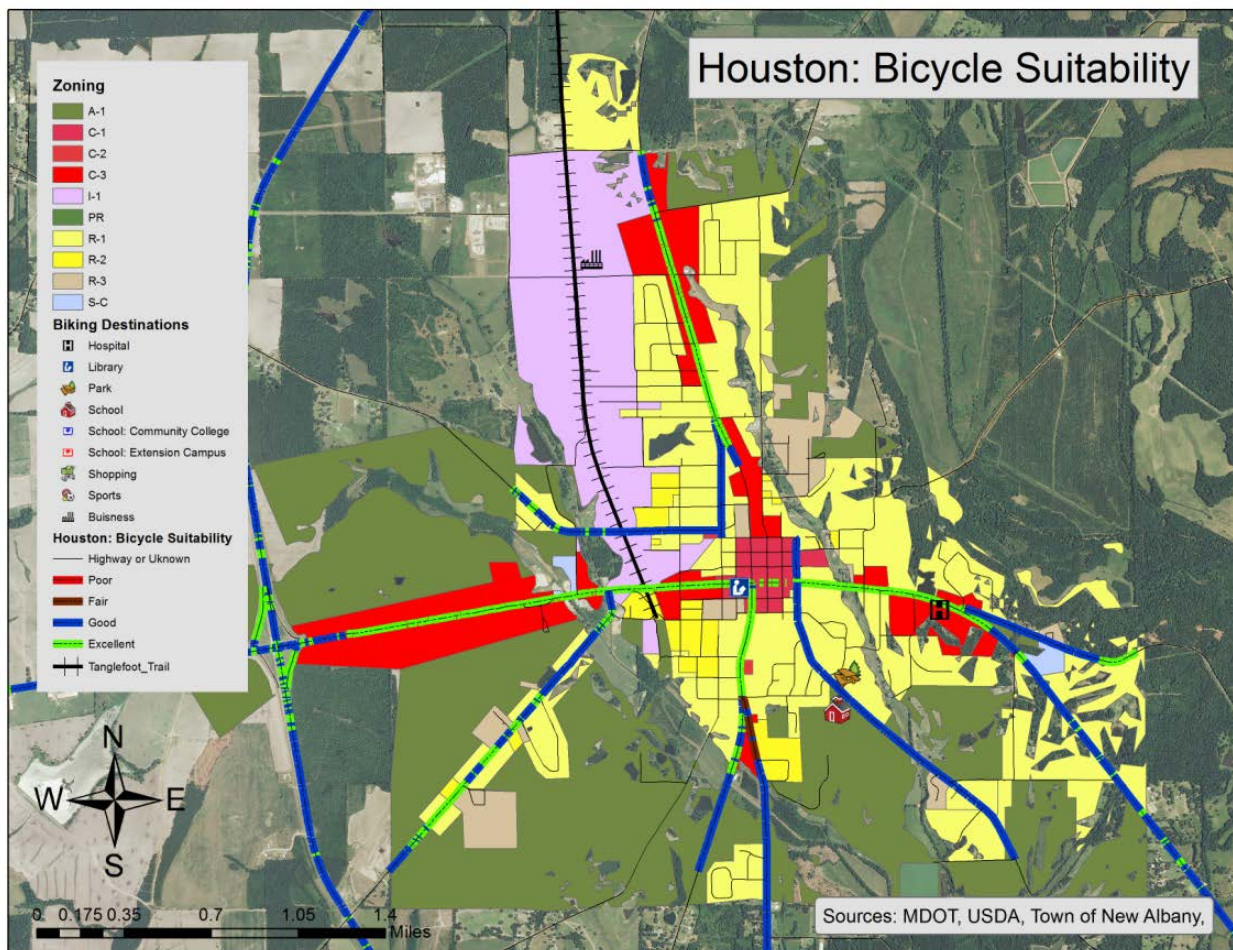


Figure 3-62. Bicycle suitability analysis of Houston: citywide.

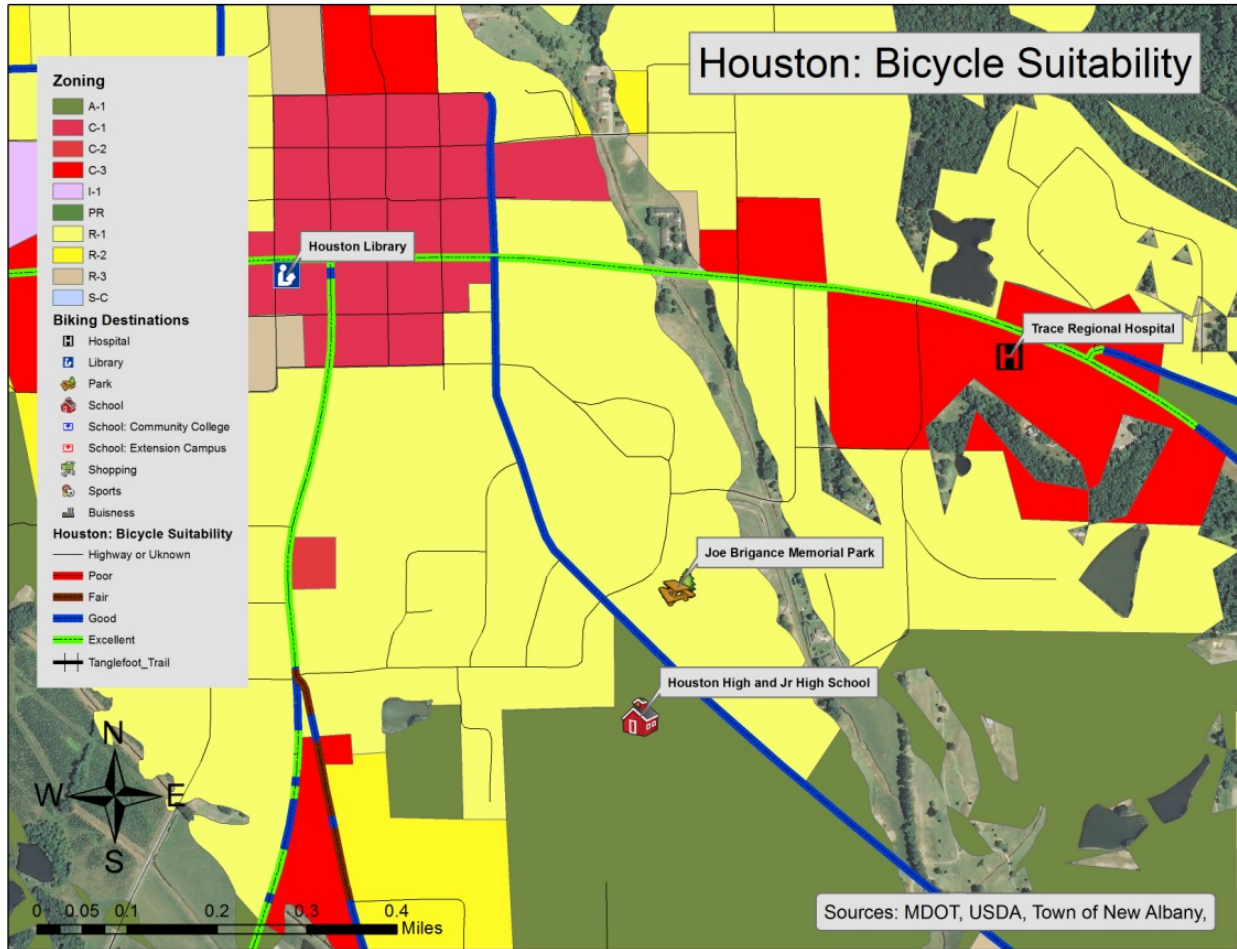


Figure 3-63. Bicycle suitability analysis of Houston: detail.

While Houston is on the edge of our study area and the furthest from the Toyota Assembly and Tier 1 plants, the city has some of the greatest capacity for future growth. Houston's position between Starkville and Tupelo make it ideal as a bedroom community for the region. The presence of the head of the Tanglefoot Trail makes Houston even more desirable as a place to live. Houston can take advantage of its position by developing its amenities as well as encouraging housing that ties into those amenities.

CHAPTER 4: THE TWO ALTERNATIVE FUTURES EXPLORED USING AN INTEGRATED TRAVEL DEMAND – LAND USE MODEL

SUMMARY OF THE TRAVEL DEMAND-LAND – USE MODEL

To predict the household travel patterns—trip generation, trip distribution, mode choice, and traffic assignment—that could result from realization of the growth scenarios, we developed an integrated land use-travel demand model that simulates the study area’s economy and transportation system. The specific modeling platform that we used was TRANUS, developed and maintained by Tomás De La Barra (33).

TRANUS is an open source platform for building models that explicitly represent a study area’s employment; household population; locations of employment and of households; consumption of land and/or floor space; markets for labor, real estate, and goods and services; development constraints and incentives; and transportation system (34). Figure 4-1 is a schematic diagram of the modeling platform’s conceptual framework (35). TRANUS is grounded in economic theory and choice theory: spatial input-output analysis; microeconomics; random utility theory; and discrete choice models (36). TRANUS-based models spatially allocate study-area control totals for population and employment and predict trip distribution, trip generation, modal split, and traffic assignment.

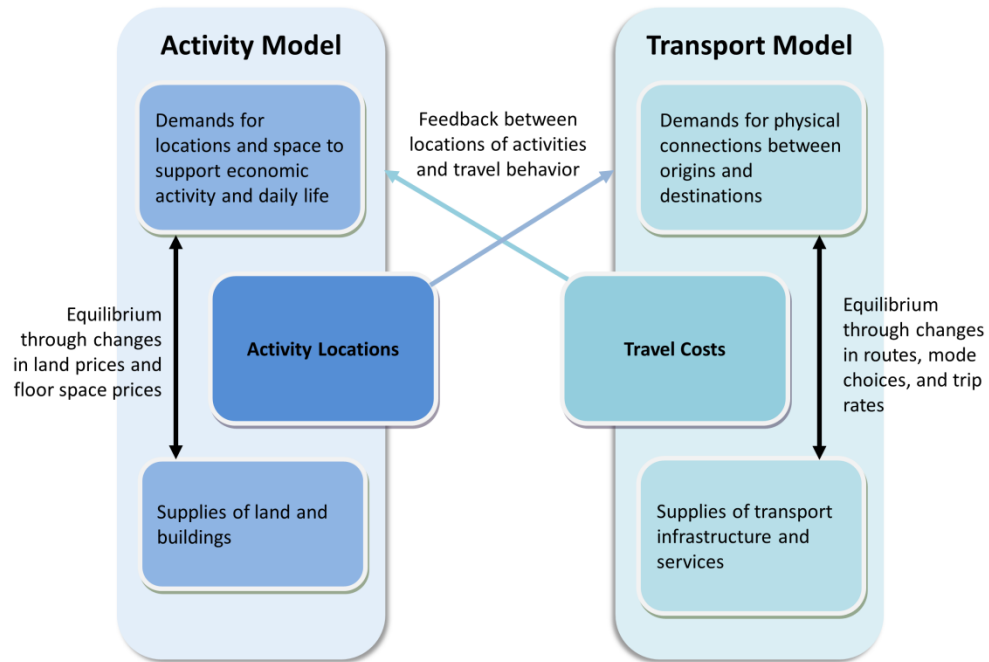


Figure 4-1. Causal structure in TRANUS-based models.

Because TRANUS is based on spatial-input output principles, the flows of goods, services, and labor between sectors is explicitly represented, and the direct and indirect effects of economic growth and population growth on intersectoral flows are intrinsic. Another consequence of the spatial input-output framework is that transportation demand is a derived demand. For example, households’ provision of labor to the economic sectors is the fundamental source of commuters’ demand for the transportation services consumed during the journey to work. Trips may also be directly specified in origin-destination matrices.

The hallmark of TRANUS-based models (and other integrated models) is automatic feedback between the land-use module and the travel-demand module. Consequently, a change in transportation policy or provision stimulates an adaptive evolution of land use. The other side of the coin, also automatically captured by integrated models, is that land use changes affect travel patterns, and the ensuing changes in transportation costs and disutilities stimulate further land use changes in response to the new distribution of destination accessibility.

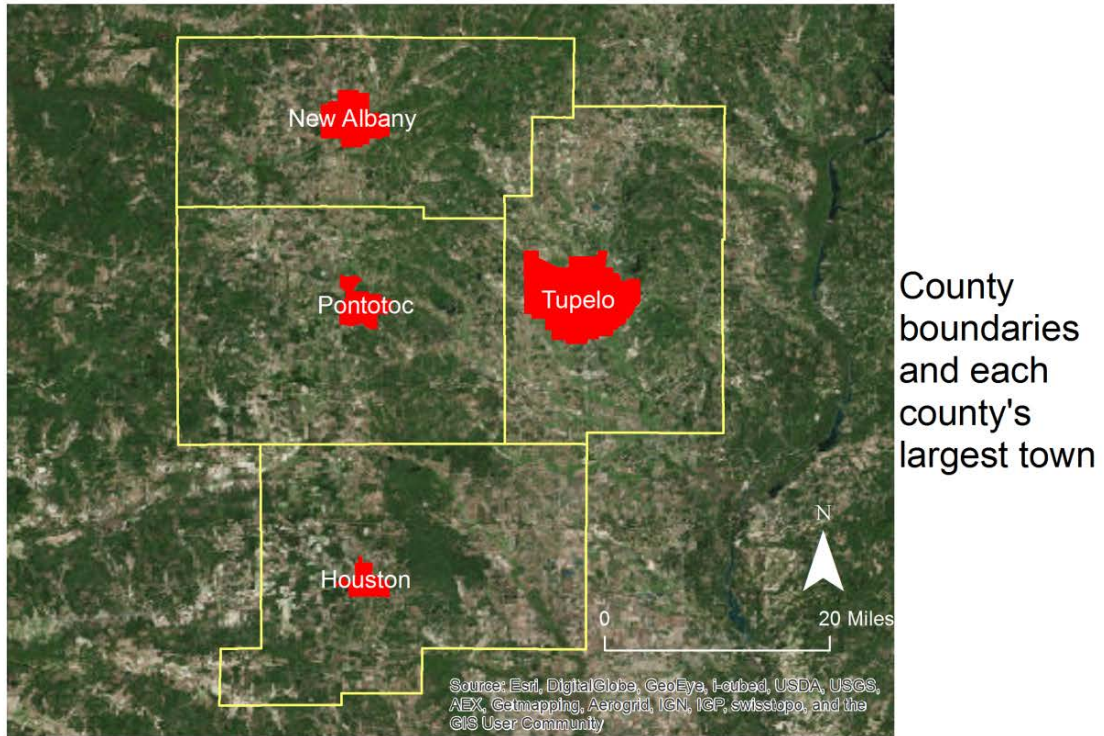
The application of TRANUS created for this study models Chickasaw, Lee, Pontotoc, and Union Counties, including the area’s four largest towns, which are Houston, Tupelo, Pontotoc, and New

Albany (Figure 4-2). The analysis zones are census block groups, of which there are 103; the boundaries are those used for the 2000 decennial census.

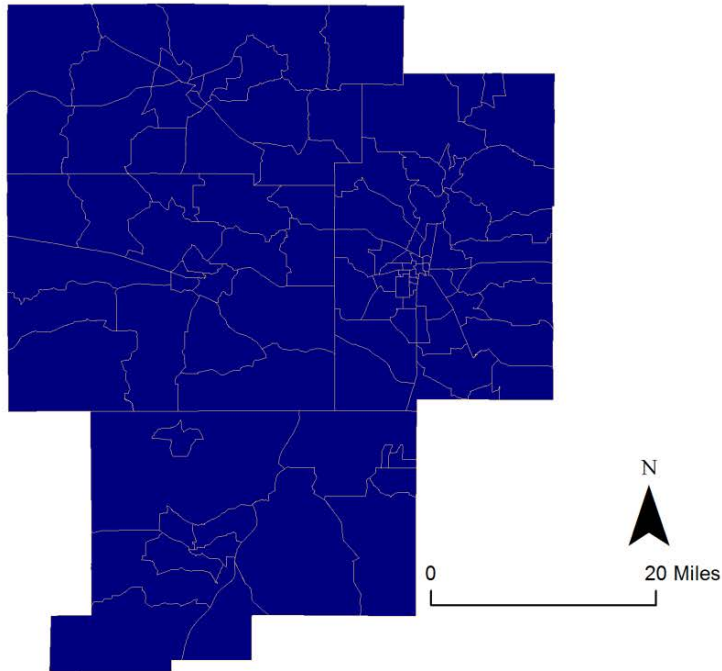
All of the census data that are used are from the 2000 decennial census. At the time we began the project, not all of the required data were available from the 2010 census, in particular the Census Transportation Planning Products.

Employment is divided into three groups or sectors based on the industry in which a worker was employed. Employees are also differentiated by place of residence: they reside either in the study area or outside the study area and inside a 60 mile buffer.

- Agriculture, forestry, fishing and hunting, and mining. In the base scenario, which corresponds to the year 2000, there were 1,019 such jobs in the study area, including 380 filled by workers residing outside the study area.
- Retail trade; information; finance, insurance, and real estate and rental and leasing; professional, scientific, management, administrative, and waste management services; educational, health, and social services; arts, entertainment, recreation, accommodation, and food services; other services (except public administration); and public administration. In the base scenario, there were 35,463 such jobs in the study area, including 21,416 filled by workers residing outside the study area.
- Construction; manufacturing; wholesale trade; transportation and warehousing and utilities. In the base scenario, there were 41,230 such jobs in the study area, including 24,993 filled by workers residing outside the study area.



County boundaries and each county's largest town



Analysis zones (census block groups)

Figure 4-2. Model's study area: counties, largest towns, and analysis zones.

Households are divided into six sectors based on size, age of householder, and other attributes reflecting household composition. In the base scenario, there were 56,336 households in the study area.

- Younger single person (householder is younger than 65 years of age).
- Married couple with children (householder is younger than 65 years of age).
- Married couple without children (householder is younger than 65 years of age).
- Other families with children (householder is younger than 65 years of age)
- Older (householder is at least 65 years of age).
- All other (householder is younger than 65 years of age).

Households are further differentiated by employment status and place of work. “Unemployed” households have no workers. The place of work is either in the study area or outside the study area and inside a 60 mile buffer.

Household employment status, place of work, and place of residence are significant for construction of the travel demand – land use model because those attributes influence the model’s calculations of the trips loaded onto the transportation network. The persons who both reside in and work in the study area generate commuting trips that are endogenous to the model. In the context of TRANUS based models, the endogenous commuting trips are fundamentally explained by the economic exchanges embedded in the labor markets. A business in the study area hires a worker residing in the study area, giving rise to an economic flow which in turn typically induces commuting trips in the home-to-work and work-to-home directions. The process of generating the endogenous commuting trips is specified via the labor demand coefficients and the trip generation coefficients.

Not all commuting trips are endogenous. Those commuting trips that are not endogenous are termed “exogenous,” and they have this defining characteristic: the worker either 1) lives in the study area but works outside it or 2) works in the study area but lives outside it. In TRANUS based models, the exogenous commuting trips are provided as inputs, taking the form of a trip table comprising internal-external and external-internal flows.

Households’ consumption of space is represented by three floor space sectors differentiated by building type. There are three floor space sectors.

- Single family buildings, including detached units, duplexes, and triplexes.
- Multi-unit buildings, including apartments and condominiums.
- Manufactured housing (mobile homes).

Household demand for each building type is specified separately. Households choose both size of housing unit (measured in square feet of floor space) and type of housing unit.

Nine trip purposes are included in the model: six home-based work purposes (one for each household sector); home-based commercial (shopping, doctor's visit, etc.); external commute; and all other (comprising home-based trips (such as going to church and visiting friends) and non-home-based trips (such as going shopping immediately after leaving work). The all other trips are endogenous and patterned on the endogenous commuting trips.

The travel modes are auto, walk, and bike. Fixed route public transit is not available in the study area and hence the mode choice set excludes bus.

The simulation period is 16 hours long and starts at 6:00 AM. The travel day is a typical weekday.

The data on employment are from the 2000 Census Transportation Planning Package; this source was also used to estimate the external commuting trips. The 2000 Census of Population and Housing is the source of the data on households.

The household demand coefficients for the commercial commodities were estimated using the 2002 Consumer Expenditure Survey; Quarterly Census of Employment and Wages; and the U.S. Bureau of Economic Analysis Benchmark Input-Output Data, 2002 Standard Use Table. A demand coefficient was estimated for each household sector.

Residential floor space consumption in the base scenario and the demand curves for residential floor space were estimated using the 2001 American Housing Survey. The survey's sample size did not permit estimation of a separate demand curve for each of the 18 combinations of household sector and building type. Consequently, the model has three different demand curves, one for each building type, all household sectors having the same demand curves. Given both zone-specific floor space consumption by building type and a floor space demand curve for each building type, one may infer the base scenario's market clearing price of floor space for each zone and building type. These prices are then included in the model's database.

Because the model allows households to choose between single-unit structures, multiunit structures, and mobile homes, the parameters of a building-type substitution model must also be estimated. In TRANUS-based models, these parameters determine the proportion of households (in each zone) residing in single-unit buildings, proportion of households residing in multiunit buildings, and proportion of households residing in mobile homes.

Prior to this project, the substitution parameters were calibrated manually using a trial-and-error process. Manual calibration is well known to be tedious and not guaranteed to find the optimal values.

A new methodology was used in this project to calibrate the floor space substitution parameters (37). Calibration was reformulated as an optimization problem and solved automatically. The solutions are the substitution parameters that minimize the difference between the observed and

predicted values of floor space consumption by building type. Eighteen parameters were thus estimated, one for each combination of household type and building type.

Because an input-output model is the core of TRANUS based models representation of a study area's economy, labor demand coefficients must be specified. These coefficients are estimates of business and government demand for labor provided by households; the coefficients are typically expressed as an average number of employees per household. For the Mississippi case study, the coefficients were estimated using 2000 data on employment, households, and labor force participation. Eighteen coefficients were estimated: one for each combination of household sector and industry sector.

In general, the validation test for the model's land use component is whether the base-scenario predicted total numbers of households (by sector), predicted total employment (by sector), and predicted total floor space (by sector) are equal to or very nearly equal to the observed quantities. The case study's model is valid: all predictions are within $\pm 0.1\%$ of the observations.

To accelerate construction of the model, several travel demand parameters were obtained from the research team's TRANUS based model of another low density rural area in the South (in North Carolina and Tennessee). The latter model was developed for a project sponsored by the Transportation Research Board's National Cooperative Highway Research Program: "Impacts of Land Use on Travel Behavior in Small Communities and Rural Areas" (NCHRP 25-36) (38). The borrowed parameters are trip generation rates and values of travel time and waiting time.

The variable cost of operating a privately owned vehicle is included as the monetary component of the generalized cost of travel via the mode. More specifically, the national average per-mile expenditure in the year 2001 on repairs, depreciation, fuel tax, and fuel is used (39).

Limitations of the data on observed travel behavior in the study area compel use of an heuristic approach to validating the travel demand model. The base scenario's predicted mode shares were examined to be sure that bike and walk trips were being generated. Every roadway link's average travel speed was examined to be sure that relatively low speeds (signaling traffic congestion) were predicted where one would expect it and not predicted where one would not expect to see traffic congestion, based on personal knowledge of the study area.

This summary of how the model was constructed presents a high level overview. Many details are beyond the scope of this report, and they are available in the NCHRP 25-36 *Final Report* (38).

SCENARIO ASSESSMENTS AND COMPARISONS

One of the far-reaching choices facing the study area is whether the location of employment and population growth should be concentrated in and near Tupelo and New Albany—the towns

nearest Toyota’s factory and the associated Tier 1 suppliers—or dispersed more evenly throughout, including the towns of Houston and Pontotoc. The fundamental choice therefore is between a “two towns” and a “four towns” growth strategy.

While there are multiple performance criteria that could be used as the basis of a comparative evaluation of the two strategies, one of the most important criteria is transportation efficiency, which accounts for the distance someone travels to achieve a given daily activity schedule, and which directly correlates with fossil fuel consumption and vehicular emissions of air pollutants. An increase in vehicle miles traveled per person indicates a decrease in transportation efficiency because travelers consume more resources (e.g., time and money) to implement their daily routines, whereas a decrease in vehicle miles traveled per person indicates an increase in transportation efficiency. Decreasing vehicle miles traveled per person will typically decrease fuel consumption per person and vehicular emissions per person, although the latter decreases may not be proportional to the change in VMT per person.

The following design principles were applied to develop the operational versions of the Two Towns Strategy and Four Towns Strategy that were assessed with the travel demand-land use model.

- Manufacturing employment increases by 3,108 (total) in the four census block groups containing Toyota’s factory and the Tier 1 suppliers, according to each facility’s employment (Figure 4-3) (40).
- The number of households increases by 5,345. That estimate assumes that all new manufacturing employees and commercial employees are provided by new households living in the study area.
- Commercial employment increases by 1,393. The new jobs are attracted to the census block groups that are the targets for population growth.
- The locations of the new commercial jobs are unconstrained.
- In the Two Towns Scenario, household growth is allowed only in New Albany and Tupelo. For every relevant census block group, the total number of projected new households does not exceed the amount allowed by “new zoning.”
- In the Four Towns Scenario, household growth is allowed only in New Albany, Tupelo, Houston, and Pontotoc. For every relevant census block group, the total number of projected new households does not exceed the amount allowed by “new zoning.”
- The Tanglefoot Trail is open to pedestrians and bicyclists. Bicycle oriented links have been constructed to increase connections to/from the trail (Figure 4-4).

Figure 4-5 and Figure 4-6 show the locations of population growth and commercial employment growth, respectively, for the Two Towns Scenario. Figure 4-7 and Figure 4-8 show the locations of growth for the Four Towns Scenario.

The performance measures for evaluating the growth scenarios are the changes (compared to the Base Scenario) in bike trips per household resident and daily VMT per person (including non-resident workers). In the Two Towns Scenario, the projected change in bike trips per household resident is essentially zero, and the projected change in VMT per person is a decrease of 0.74 miles. In the Four Towns Scenario, the projected change in bike trips per household resident is also essentially zero, and the projected change in VMT per person is a decrease of 0.19 miles.

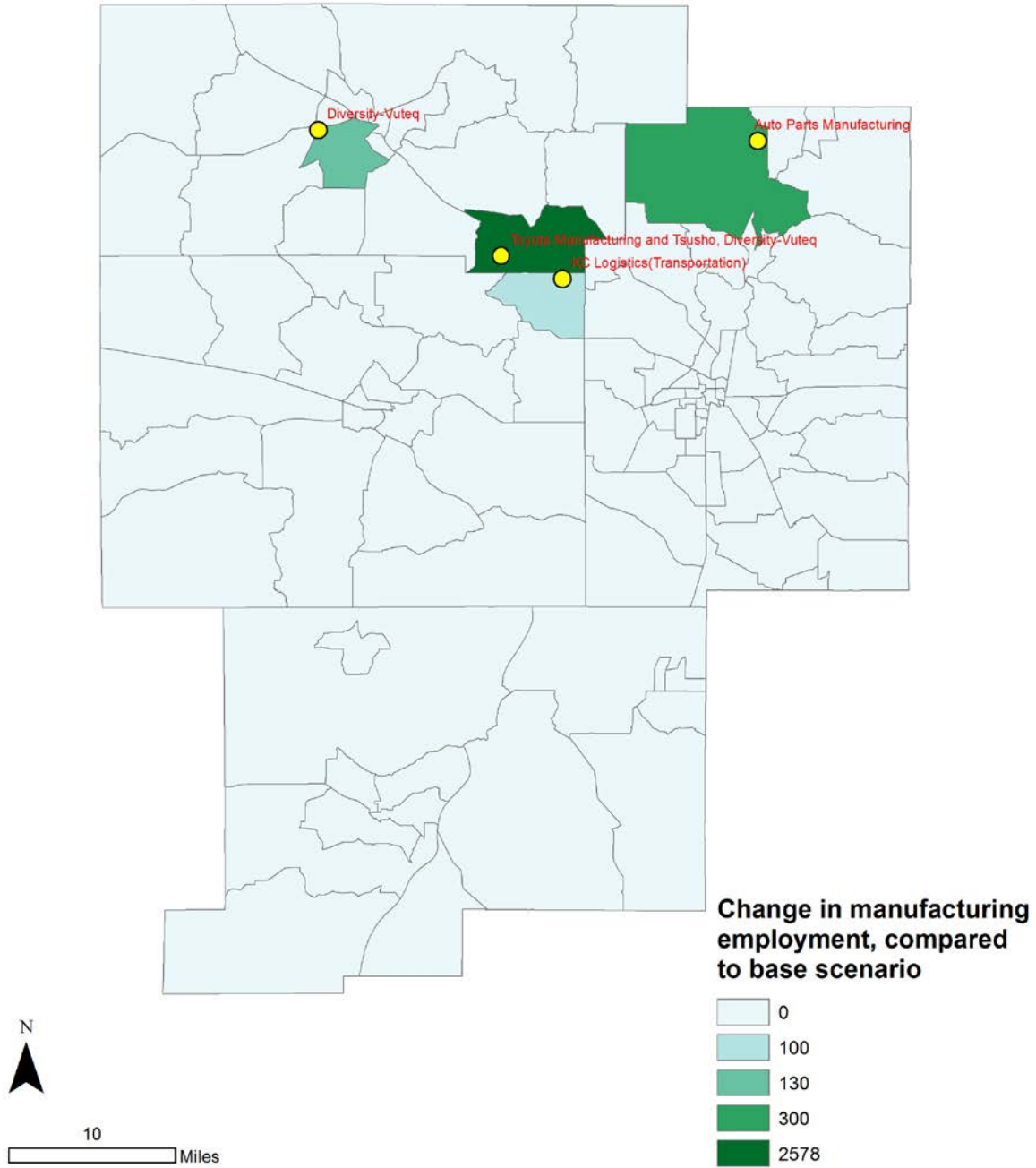


Figure 4-3. Auto manufacturing employment growth.

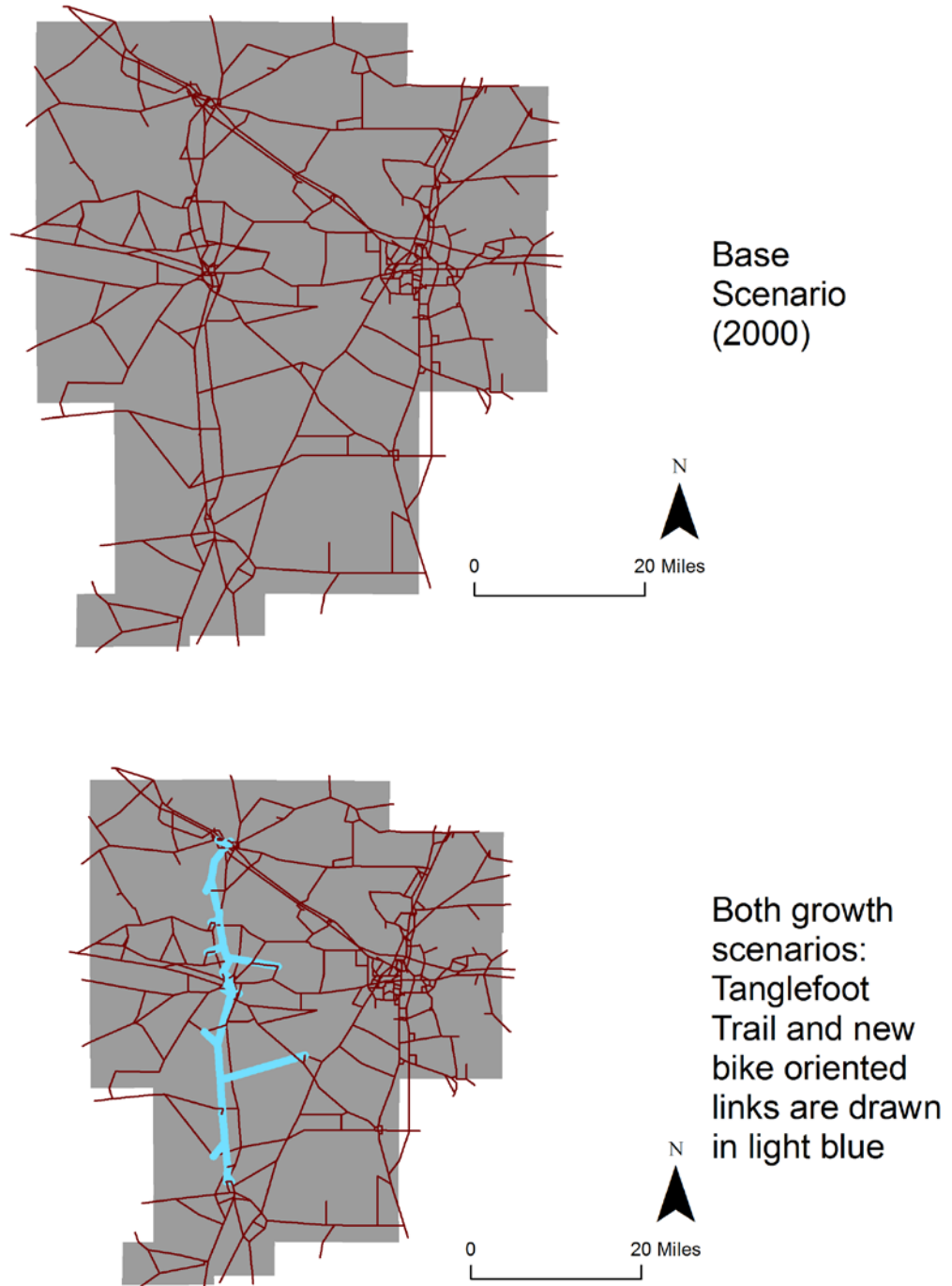


Figure 4-4. Road network: base scenario (top) and growth scenarios (bottom).

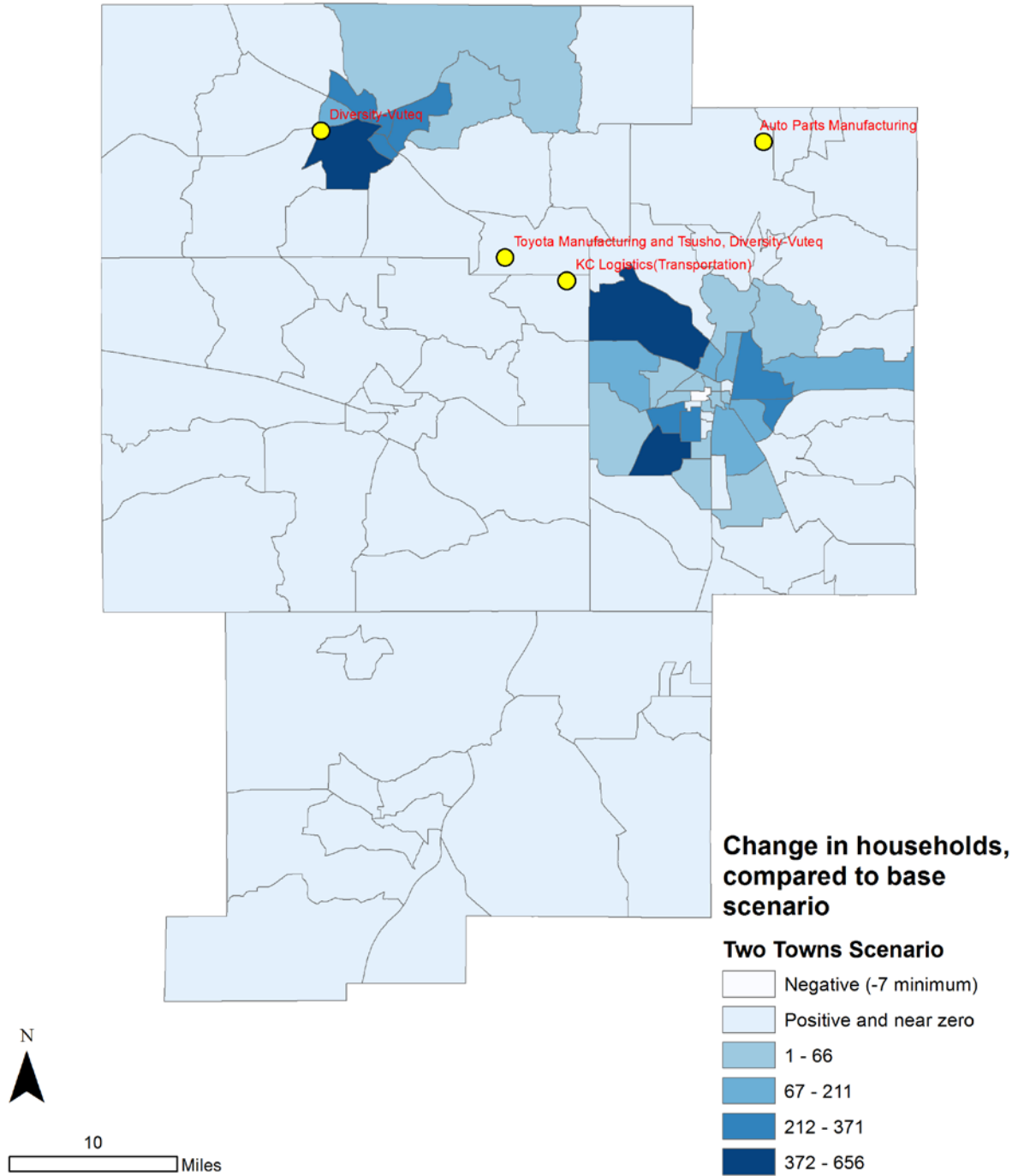


Figure 4-5. Two towns scenario: change in total number of households.

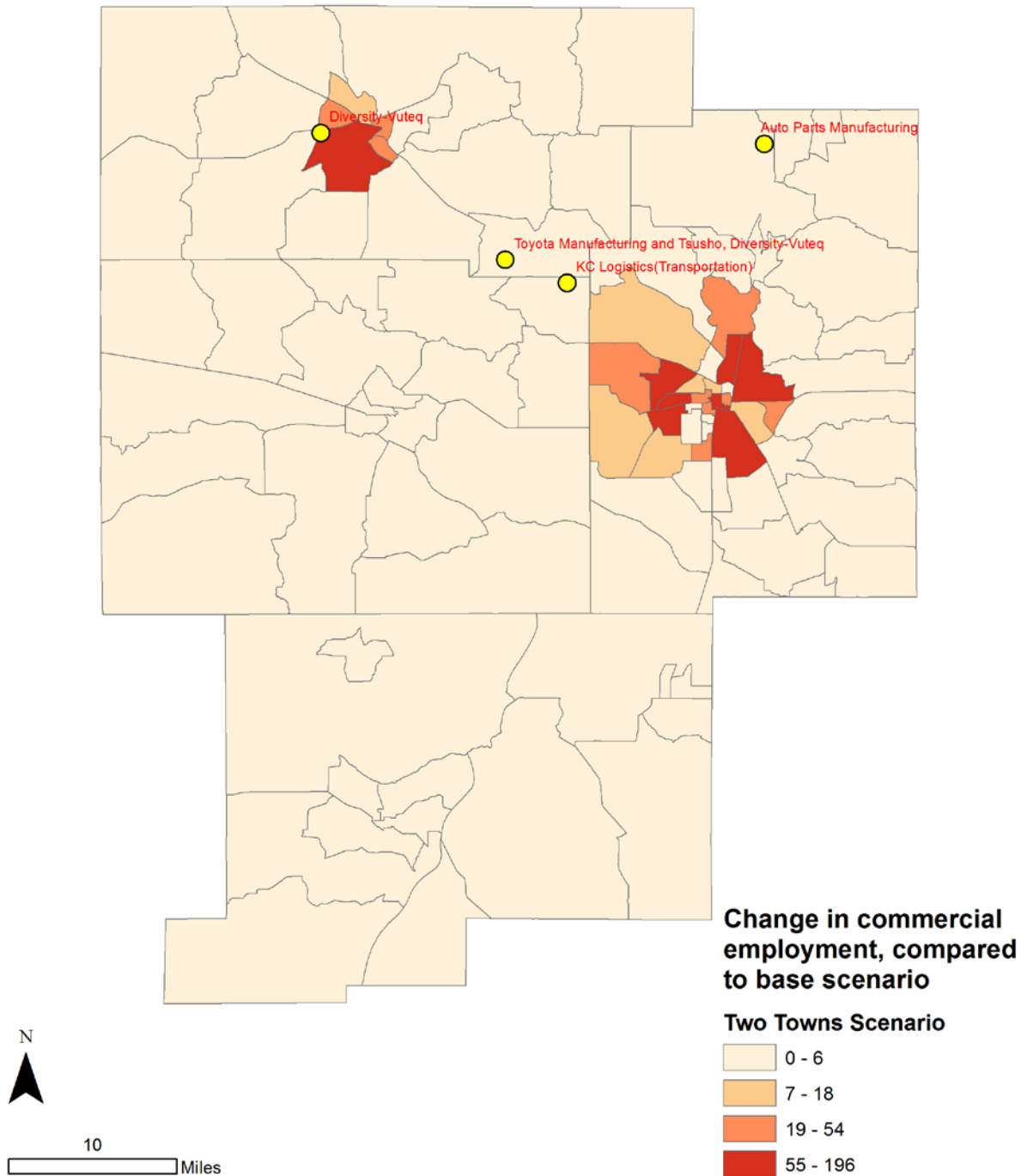


Figure 4-6. Two towns scenario: change in commercial employment.

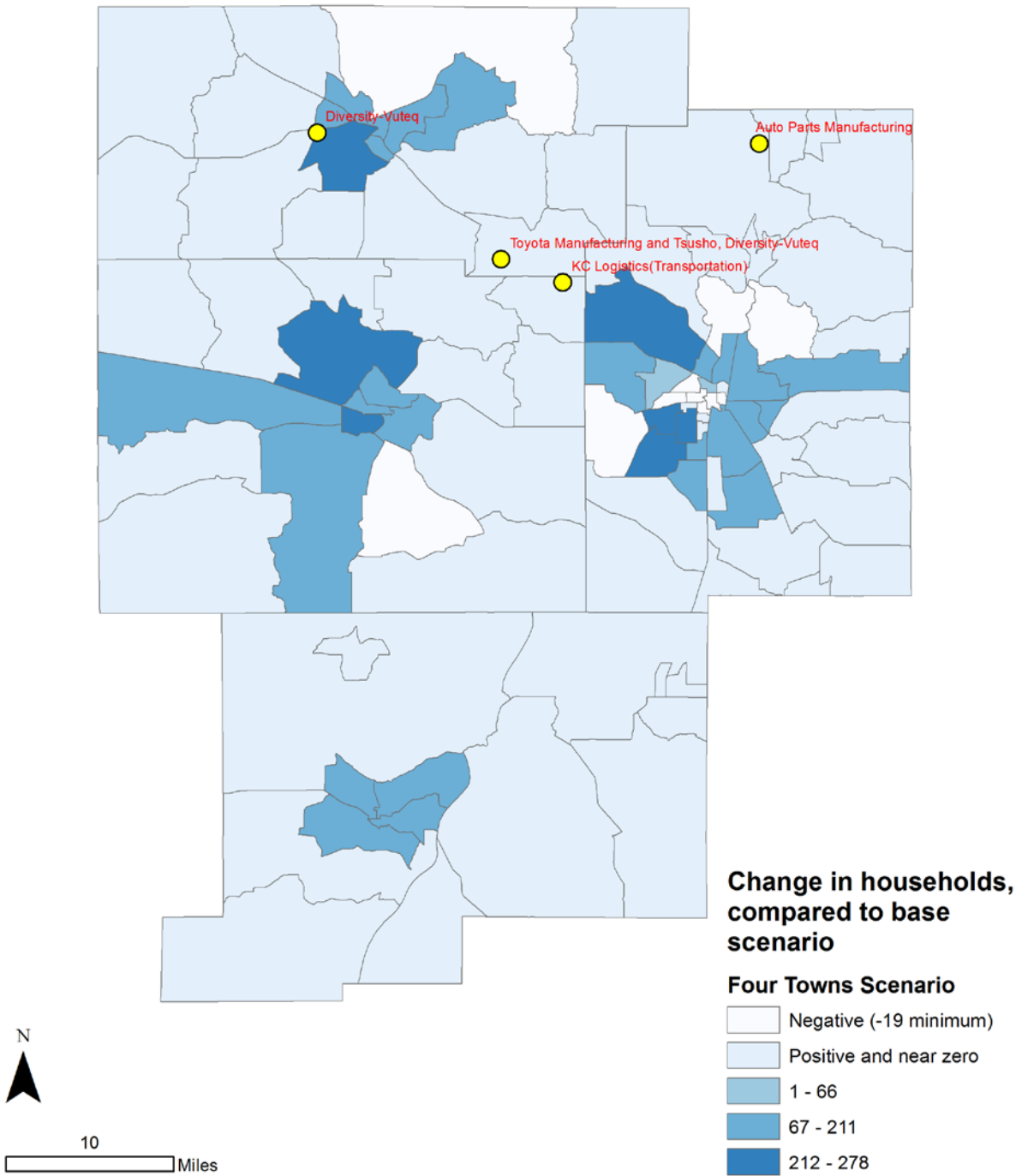


Figure 4-7. Four towns scenario: change in total number of households.

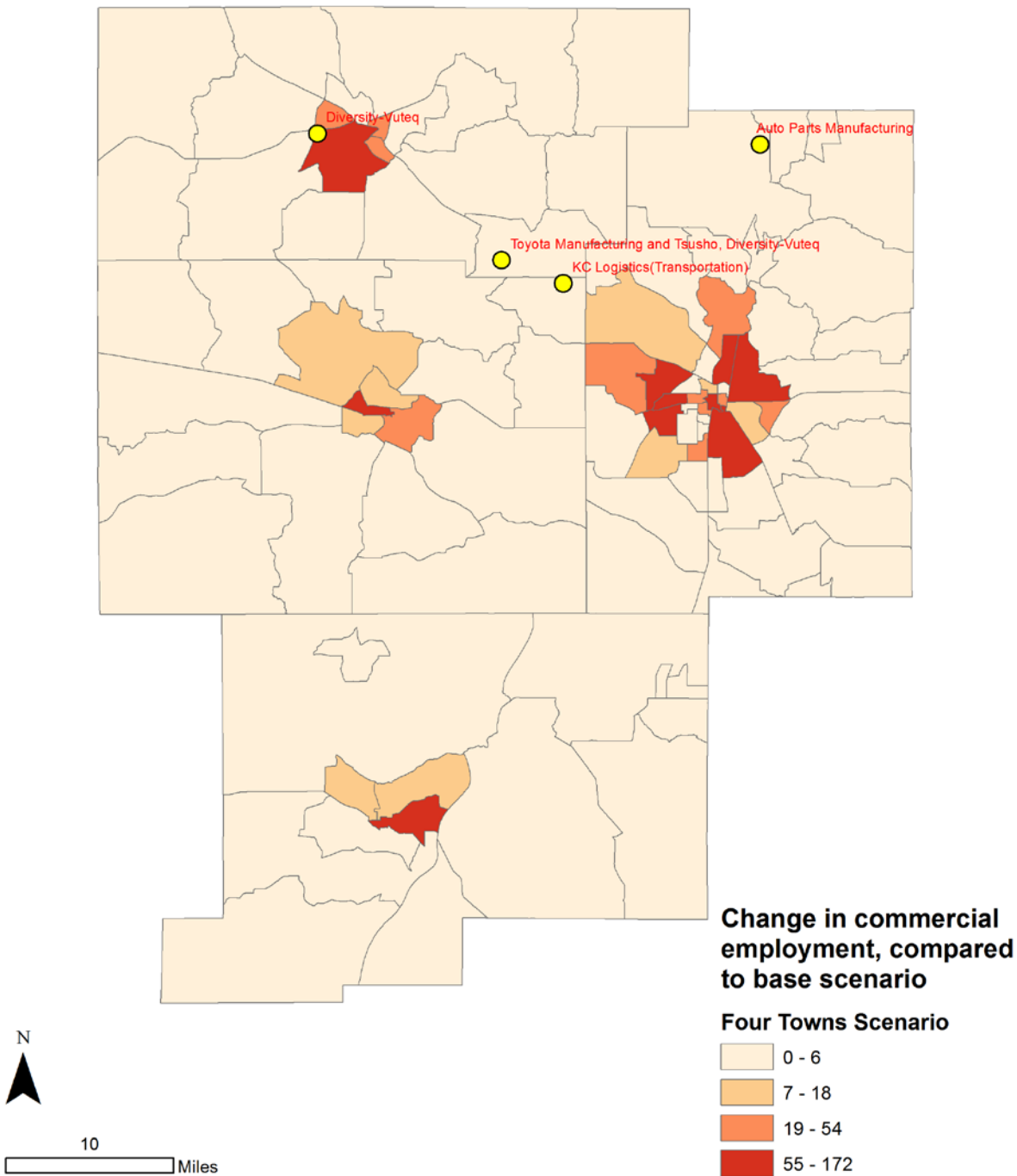


Figure 4-8. Four towns scenario: change in commercial employment.

CHAPTER 5: CONCLUSION

We developed an integrated travel demand – land use model to project the travel behavior that could be induced by the employment and population growth associated with an expansion of automobile manufacturing near New Albany and Tupelo. Two hypothetical growth scenarios were assessed: the Two Towns Scenario and Four Towns Scenario. The Two Towns Scenario concentrates all growth in New Albany and Tupelo. In the Four Towns Scenario, the location and magnitude of new automobile manufacturing are the same as in the Two Towns Scenario, but the growth in population and commercial employment is distributed among the study area's four largest towns: New Albany and Tupelo in the northern counties, and Houston and Pontotoc in the southern counties.

When all growth occurs in New Albany and Tupelo, the projected change (compared to conditions in the year 2000) in daily per capita VMT is a decrease of 0.74 miles per person. When all growth occurs in the four largest towns, the projected change is a decrease of 0.19 miles per person. Judging the growth scenarios on the basis of transportation efficiency—thus accounting directly for the distance someone travels to achieve a given daily activity schedule and indirectly for fuel consumption and air pollutant emissions—both scenarios perform equally well.

Neither growth scenario increases the attractiveness of bicycle travel: in both scenarios, the projected change in bike trips per household resident is essentially zero. Additional interventions evidently would be needed to transform the Tanglefoot Trail into the spine of a new transportation network that encourage active transportation.

The travel demand – land use model developed for this research project provides a tool for future research into the means that could be used to promote bicycle travel for everyday purposes. The model also is appropriate for designing and assessing a broad range of additional scenarios entailing changes in either or both transportation infrastructure and development pattern.

LIST OF REFERENCES

1. Carter, Hodding. Tupelo, Miss. *Saturday Evening Post*. Feb. 17, 1951.
2. Tupelo Started as Gum Pond, Got Name by 1868. *Daily Journal*. Vol. 80, 310. This document stated that James P. Boyce and Judge James L. Orr came up with the name "Tupelo".
3. The History of Tupelo. <http://www.rankin.tupelo.K12.ms.us/CF/TupHist.html>.
4. The History of Tupelo. The fact of Lee county having the first concrete road in the south has never been clearly established according to Ms. Dept. of Archives & History. <http://www.rankin.tupelo.K12.ms.us/CF/TupHist.html>.
5. President Roosevelt's Visit to Tupelo. *Daily Tupelo Journal Centennial Issue 1870-1970*. Vol. 97, 102, pp. 10-D.
6. Riley, Steve. In Tupelo, the People Make a Difference. *Clarion Ledger*. Dec. 15, 1976.
7. Rutherford, Harry. A City Without City Limits. *Mississippi Magic*. May 1957, pp. 13-14.
8. Cooper, Helene. What 'The Wall Street Journal' is Saying about Tupelo. *Clarion Ledger*. March 13, 1994.
9. North Mississippi Health Services, Inc. Consolidated Statement of Operations. <http://www.nmhs.net/documents/internetfinancialsFY2011.pdf>.
10. Our Opinion: Thoroughfare Study Can Provide Guide. *Northeast Mississippi Daily Journal*. October 23, 2012.
11. Armour, Adam. Bankhead Highway Runs Through Itawamba County and American History. *Itawamba County Times*. November 21, 2010.
12. Union County Development Association. History of the UCDA. <http://www.ucda-newalbany.com/ucdahistory.asp>.
13. City of New Albany. Our History. <http://www.visitnewalbany.com/history.asp>.
14. Baptist Memorial Hospital - Union County. Baptist Memorial Health Care. <http://www.baptistonline.org/union-county/>.
15. Brown, Ray C. Colleges That Have Closed, Merged or Changed Names. http://www2.westminster-mo.edu/wc_users/homepages/staff/brownr/MississippiCC.htm.
16. Winston, E. T. *Story of Pontotoc*. Pontotoc : Pontotoc Progress Print, 1931.

17. Pontotoc Progress. Welcome Home to Pontotoc: 2009-2010. Vol. A Special Publication of the Pontotoc Progress.
18. Pontotoc County, Mississippi. http://www.city-data.com/county/Pontotoc_County-MS.html.
19. Chicksaw Development Foundation. <http://houstonms.org/>.
20. United States Department of Agriculture. Atlas of Rural and Small-Town America. <http://www.ers.usda.gov/data-products/atlas-of-rural-and-small-town-america/go-to-the-atlas.aspx>.
21. Beard, Daniel. Toyota Comes to Town. *Southeast Real Estate Business*. June 2007.
22. Johnson, Kenneth. *Demographic Trends in Rural and Small Town America*. Carsey Institute: University of New Hampshire, 2006. p. 3.
23. Ward, Robbie. Tupelo: No. 2 Micropolitan in Industry Growth. *Mississippi Business Journal*. March 4, 2014.
24. Advameg, Inc. Interactive Data Map. <http://www.city-data.com/>.
25. U.S. Bureau of the Census. State and County Quickfacts. <http://quickfacts.census.gov/qfd/#>.
26. Tupelo: The 2025 Comprehensive Plan. December 16, 2008. pp. C6-7.
27. Coz, Emily Le. Guntown, Saltillo See Fastest Growth in Lee County. *Northeast Mississippi Daily Journal*. February 5, 2011.
28. Tupelo: The 2025 Comprehensive Plan. December 16, 2008. p. 8.
29. Tupelo: The 2025 Comprehensive Plan. December 16, 2008. p. Preface.
30. Schultz, Benjamin J. Emerging Patterns of Growth and Change in the Southeast. *Southeastern Geographer*. Winter 2011, Vol. 51, 4, pp. 550-563.
31. Mississippi Department of Education. Accountability Results: Based on 2012-2013 School Year. <http://reports.mde.k12.ms.us/report/Lettergrade.aspx>.
32. United States Bureau of the Census. *State and County QuickFacts: Pontotoc (city), Mississippi*.
33. www.modelistica.com.
34. De La Barra, Tomás. Integrated Land Use and Transport Modeling: The Transus Experience. [ed.] Richard K. Brail and Richard E. Klosterman. *Planning Support Systems: Integrating Geographic Information Systems, Models, and Visualization Tools*. Redlands, CA : ESRI, 2001, pp. 129-156.

35. Figure 4-1 is a modification of Figure 2 in Modelistica, [n.d.], TRANUS: Integrated Land Use and Transport Modeling System, Caracas, Venezuela: Modelistica, <http://www.modelistica.com/GeneralDescriptionTranus.pdf>.
36. De La Barra, Tomás. *Integrated Land Use and Transport Modelling*. Cambridge: Cambridge University Press, 1989.
37. Cappelle, Thomas, et al., et al. "Formulating LUTI Calibration as an Optimization Problem: Estimation of TRANUS Shadow Prices and Substitution Parameters." 2014. Submitted for presentation at the Twenty-Ninth Association for the Advancement of Artificial Intelligence Conference on Artificial Intelligence (to be held in 2015).
38. Morton, Brian J., et al., et al. [Impacts of Land Use on Travel Behavior in Small Communities and Rural Areas: Final Report](#). Transportation Research Board, 2014. TRB Web-only document.
39. U.S. Federal Highway Administration. *Our Nation's Highways: 2000*. n.d. p. 13.
40. Carl Small Town Center. *CREATE: Common Ground: New Albany*. Mississippi State, MS : Carl Small Town Center, 2012. p. 127.
41. <http://www.tanglefoottrail.com/>.
42. www.gis.ms.gov/.
43. <http://sp.mdot.ms.gov/Office%20of%20Highways/Planning/Maps/Pages/Traffic-Volume-Maps.aspx>.

APPENDIX: DEVELOPING THE TRANSPORTATION NETWORK AND TRAVEL DEMAND PARAMETERS

HIGHWAY NETWORK

The highway network for the model was developed based on the MajorRoad geographic file distributed by Caliper Corporation containing national road geography for the United States. The road geography for Chickasaw, Lee, Pontotoc, and Union counties was used to develop a map of roads in the year 2000 to be used in the TRANUS model for the study area. A two mile buffer beyond the four study area counties was used for the extent of the study area road network. Nodes at the edge of the network are external stations (centroids) representing travel from/to outside the study area. Links to include in the model were selected on the basis of representing access to the analysis zones for the project, which are census block groups. These were exported to a new file to create the TRANUS network file and enter appropriate attributes for the links.

The original network contained 4,512 links and 4,316 nodes, and this network was simplified to contain 1,746 links and 662 nodes. The model contains 103 centroids representing block groups in the study area, and 31 external stations representing travel from and to areas outside the study area. Fields for link attributes include ID, origin ID, destination ID, direction, link type ID, distance (miles), posted speed, type, capacity, name, and description. The node file contains ID, X and Y coordinates, and STFID (census ID for block groups). Table A-1 lists the link types used in the network.

Table A-1. Link Types

Link Type ID	Name	Description
1	Connectors	Centroid Connectors
2	Freeway	Freeway links
7	Bicycle Trail	
8	Connectors for Bicycle	
41	Arterial 35mph	Arterial roads 35 mph
42	Arterial 40mph	Arterial roads 40 mph
43	Arterial 45mph	Arterial roads 45 mph
51	Collector 30mph	Collector streets and local roads 30 mph
52	Collector 40mph	Collector streets and local roads 40 mph
61	Highway 45mph	Highway links 45 mph
62	Highway 50mph	Highway links 50 mph
63	Highway 60mph	Highway links 60 mph
85	Collector 45mph	Collector streets and local roads 45 mph

For all link types except freeway (ID 2), Bicycle Trail (ID 7), and Connectors for Bicycle (ID 8) all modes are allowed (auto, walk, and bicycle). For freeway links, only auto mode is allowed. For Bicycle Trail and Connectors for Bicycle, no autos are allowed. Capacities on links were set in vehicles per hour as shown in Table A-2.

Table A-2. Link Capacity

Capacity	Link Attributes
2,040	[Link-Type ID]=2
1,100	[Link-Type ID]=3
930	[Link-Type ID]=4 and Description=4 and PostedSpd>39
880	[Link-Type ID]=4 and Description=2 and PostedSpd>39
880	[Link-Type ID]=4 and Description=4 and PostedSpd<39
830	[Link-Type ID]=4 and Description=2 and PostedSpd<39
660	[Link-Type ID]=5
1,750	[Link-Type ID]=6 and Description=4 or 3
1,200	[Link-Type ID]=6 and Description=2

Speeds were taken initially from the geographic file and were checked and verified using Google Earth. If link speed was not available in the geographic file, it was obtained from Google Earth. Posted speeds for centroid connectors were set to 35 mph. Number of lanes were obtained from Google Earth.

TRANSIT NETWORK

Transit services were reviewed for the organizations that provide services in the study area (Table A-3). The following sources were consulted to determine if transit services are provided in the study area. Mississippi Department of Transportation list of section 5310 elderly and disabled public transportation service approved projects for 2012-13. Mississippi Department of Transportation Public Transit Division list of rural general public transportation contractors. Mississippi Department of Transportation Public Transit Division list of urban systems receiving federal Section 5307 funds. Mississippi Department of Rehabilitation Services: Community Transportation Resource Guide (February 24, 2010). It was determined from this review that no regularly scheduled public transit services are operated in the study area.

Table A-3. Transit Services

Service Provider Name	Service Area	Service Provided
Three Rivers Planning & Dev. Dist.	Chickasaw, Lee, Pontotoc, and Union counties	Specialized Elderly and Disabled services
Area Agency on Aging	Lee County	Transportation to meal sites
Climb Up, Inc.	Chickasaw, Lee, Pontotoc, and Union counties	Specialized Elderly and Disabled services

TANGLEFOOT TRAIL

The Tanglefoot Trail is a rail to trail conversion of a rail line abandoned by the Gulf Mobile and Ohio Railroad that is 43.6 miles long and serves bicycle and pedestrian users from New Albany to Houston (41). The trail was opened in 2013, so is not included in the base year (2000) scenario used for model development and calibration. The geographic location for the trail is available on the Railroads shape file downloaded from the Mississippi Geospatial Clearinghouse (42). The links for the trail were given a link type of seven; allowing only bicycle (12 mph) and pedestrian (4 mph) travel. Where the trail was not connected to adjacent centroids by the road network, bicycle only centroid connectors were added to represent neighborhood access to the trail. The trail is included in the growth scenarios assessed in the course of the project.

CALIBRATION OF TRAVEL DEMAND PARAMETERS

The first test of the network conducted was to determine if paths are built for all zone to zone pairs for all modes. This is controlled in TRANUS by means of the “overlap factor” for each mode for each link type. Initial values for all modes were set equal to one and paths were generated using PASOS (TRANUS path builder). A significant number of zone pairs were not connected using this value for the overlap factor, so the factor was increased to two for all modes except Auto external for all but freeway and bicycle link types, and PASOS was re-run. This

resulted in improvement, but some zone pairs were still not connected for all modes. The overlap factor was increased to four for the auto internal mode for non-freeway, non-bike link types and PASOS was re-run. With this set of overlap factors, paths for all modes were built between all zone pairs. The final settings are shown in Table A-4.

Table A-4. Overlap Factors

Link Type ID	Link Type Description	Auto Internal	Auto External	Walk	Bicycle
1	Connectors	4	1	2	2
2	Freeway (bike and walk prohibited)	2	1	1	1
7	Bicycle Trail	1	1	2	2
8	Connectors for Bicycle	1	1	2	2
41	Arterial 35mph	4	1	2	2
42	Arterial 40mph	4	1	2	2
43	Arterial 45mph	4	1	2	2
51	Collector 30mph	4	1	2	2
52	Collector 40mph	4	1	2	2
61	Highway 45mph	4	1	2	2
62	Highway 50mph	4	1	2	2
63	Highway 60mph	4	1	2	2
85	Collector 45mph	4	1	2	2

Additionally, the model's modal constants were calibrated using a trial-and-error process that aimed to achieve target numbers of walk and bicycle trips. The targets were derived from the study area's CTPP 2000 data, which report estimates of workers by travel mode. These estimates were adjusted with a two-step process. First, the number of workers by mode was multiplied by the typical number of work trips per worker in order to account for the fact that not all workers travel to work on a given weekday, and that some trips will not be direct from home to work but will include a retail or other stop in between. Second, the trips were multiplied by the study area's ratio of total trips to work trips.

The final modal constants for the model are 1.4 for walk, and 5 for bicycle. These result in 676 walk trips and 282 bicycle trips in the base year model. It was decided that using a higher constant for the bicycle mode would remove too much sensitivity from the model when applied for future scenarios (the model would reproduce the constant, rather than reflect change in accessibility from adding walk and bike facilities to the network).

A final check was made for assigned traffic for links in the network that have traffic counts reported for them. Traffic is counted by the Mississippi Department of Transportation and count reports are available on-line for 2004 through 2013 (43).

An estimate of the year 2000 count was made based on the ten years of counts. Only a limited number of counts were taken in the study area. The TRANUS model for the study area does not include a through traffic model, and this complicates making comparisons to observed traffic counts for freeway facilities that probably carry a significant number of through trips. A total of twenty five links were compared and the percent root mean square error was calculated for this small sample. The RMSE value is 35% which is quite good for this model (smaller values indicate a better match to observed counts).