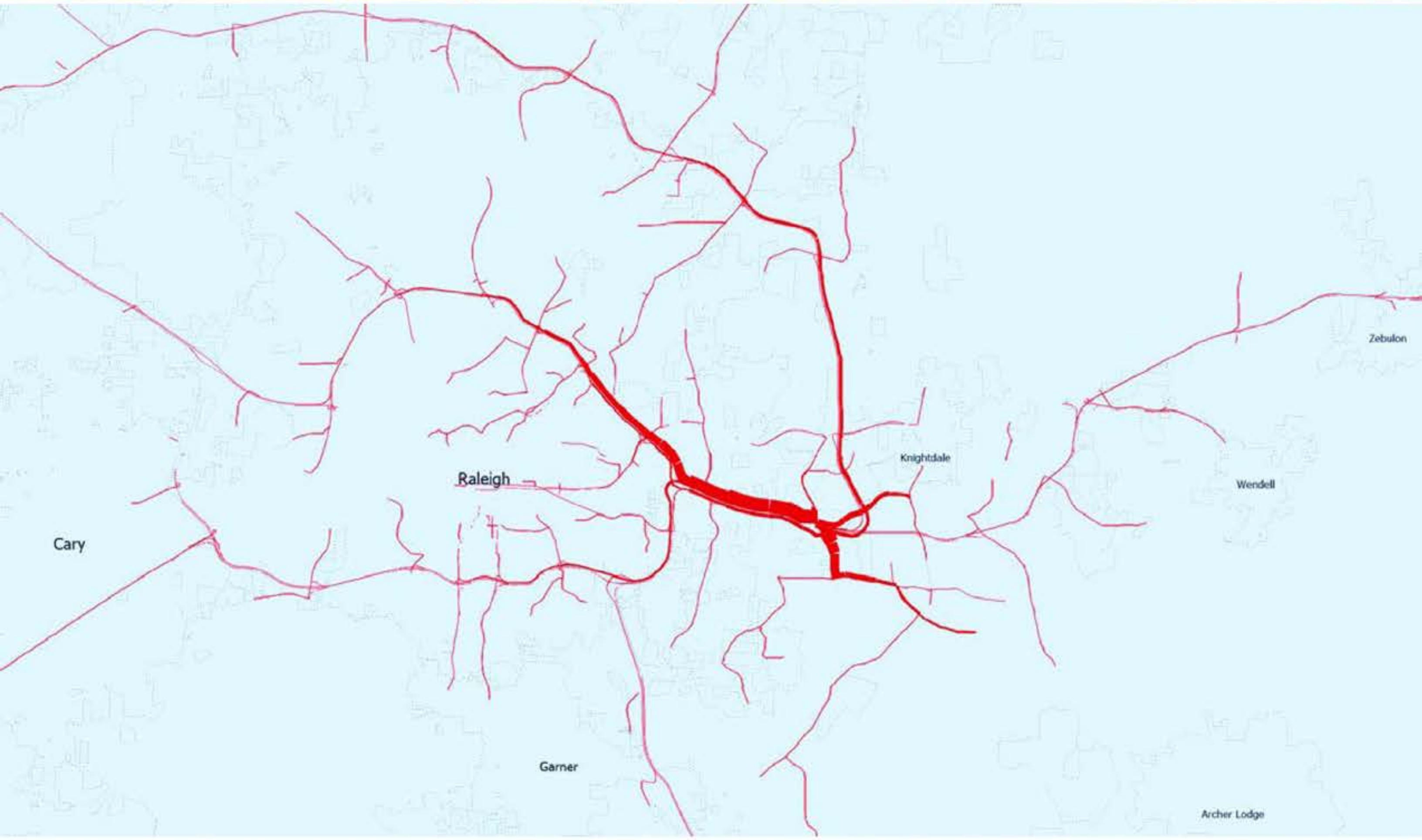

I-87 Knightdale Corridor Study

prepared for

Capital Area MPO

prepared by

Baseline Mobility Group, Inc.

with

RSG, Inc.

NC Capital Area Metropolitan Planning Organization

October, 2018

BASELINE MOBILITY

report

I-87 Knightdale Corridor Study

Final Report

prepared for

Capital Area Metropolitan Planning Organization (CAMPO)

prepared by

Baseline Mobility Group, Inc.

with

RSG, Inc.

date

October 10, 2018

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Executive Summary

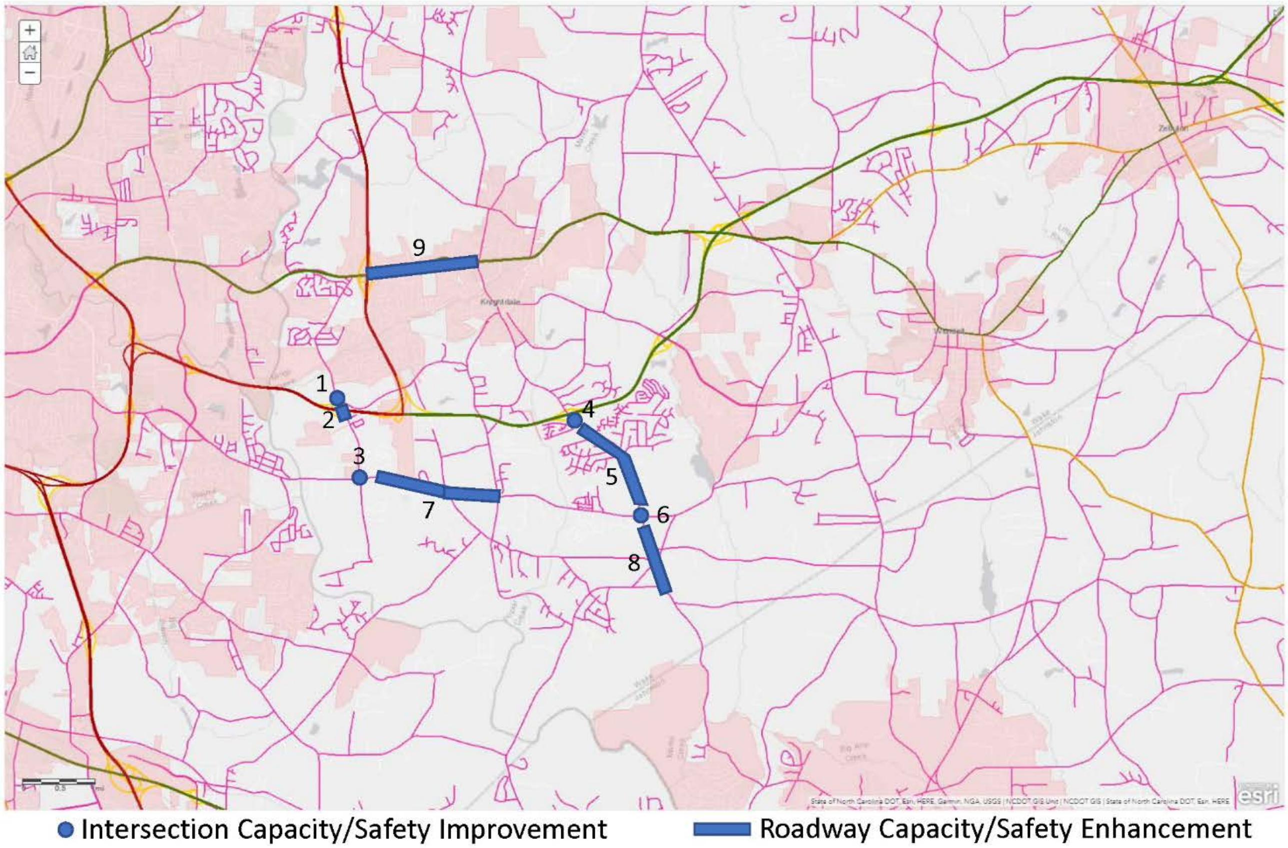
The Capital Area Metropolitan Planning Organization (CAMPO) initiated the I-87 Knightdale Corridor Study in response to local needs of evaluating traffic congestion and safety issues at several interchange areas along the Interstate Highway 87 (I-87) in and around Knightdale. The I-87 corridor between I-440 and US 64 Business is a freeway facility with 70 miles per hour (mph) posted speed and 6- to 10-lane cross-sections.

The I-87 corridor is increasingly serving statewide travel needs as it connects the Capital Area with the I-95 corridor to the northeast near Rocky Mount via US 64, and to the southeast near Wilson via US 264.The I-87 corridor has experienced over 15 percent annual growth in AADT in recent years.

To address this rapid growth in traffic along the corridor, this study evaluated the origin-destination (O-D) profiles of several study area interchanges by applying the latest Triangle Regional Model (TRMv6). The study area interchanges included four interchanges, namely Hodge Road, Smithfield Road, Wendell Falls Parkway, and US 64 Business. The O-D profiles were developed for AM and PM peak hour conditions under two future network scenarios: 1) Pre-540 - Future Year (2035) network without completion of the Eastern Wake Expressway project (TIP# R-2829), and 2) Post-540 – Future Year (2035) network with completion of the Eastern Wake Expressway project. This demand analysis show that the Hodge Road interchange will likely experience up to 40 percent reduction in peak period traffic due to completion of the I-540 Outer Loop project. Similarly, the Wendell Falls Parkway interchange is anticipated to have up to 15 percent less traffic demand, and the US 64 Business interchange would have up to 8 percent less traffic demand due to the I-540 project. In contrast, the Smithfield Road interchange will likely experience an increase in traffic demand, up to 25 percent, once the I-540 Outer Loop is completed.

Detailed reviews of traffic congestion and safety performance measures revealed several congested intersections and unsafe sections along Hodge Road, Smithfield Road, and Poole Road. These issue areas were then compared to the adopted Knightdale Comprehensive Plan, Knightdale Development Permits, Wake County Land Use Plan, Wake County Rezoning Applications, and CAMPO's Metropolitan Transportation Plan (MTP) to assess appropriate mitigation strategies that are consistent and fills the gap. This evaluation led to several project recommendations to address traffic congestion and safety issues in the study area that seem to be unaffected by the I-540 Outer Loop project (R-2829). These project recommendations are targeted for small scale projects that are implementable within the next 5 to 15 years, will provide immediate congestion relief, and will improve potentially hazardous roadway sections and intersections,

The project recommendations are summarized next in a map and a table.


9
Knightdale
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Intersection Capacity/Safety Improvement
Roadway Capacity/Safety Enhancement

Roadway or Intersection	Project Map ID	Segment Length	Project Description	Complete By
Hodge Road Overpass Bridge and Bridge Approaches	1	1000 ft	Widen the current 3-lane bridge to 5-lane bridge to provide additional northbound and southbound lanes between the two ramp signals	2030
Hodge Road/WB I-87 Ramps/Old Faison Rd Intersection	2	n/a	In addition to implementing the additional turn lanes that are committed by the Stone River and Silver Stone developer, recommend restriping and widening as necessary to have 2 receiving lanes at the EB On-ramp that drops to one lane prior to freeway merge. Also, recommend modifying the signal operation to allow for protected LT movements on all approaches and coordination with the EB I-87 ramp signal.	2025
Hodge Road and Poole Road Intersection	3	n/a	In addition to implementing the additional turn lanes that are committed by the Silver Stone developer, provide an additional southbound left-turn lane to provide double left. Also widen Poole Road's east leg to accommodate southbound double left turn to eastbound movement.	2025
Smithfield Road/EB I-87 Ramps Intersection	4	n/a	Widen the off-ramp to provide an additional right-turn lane. Also widen the south leg by at least 1,000 feet to provide an additional southbound lane; Modify signal timing to reoptimize between the ramp terminals.	2025
Smithfield Road between I-87 and Poole Road	5	1.8 miles	Widen to 4-lane roadway	2025
Smithfield Road and Poole Road Intersection	6	n/a	Provide left-turn lanes on all approaches; Also provide eastbound right-turn lane on Poole Rd	2025
Poole Road between future I-540 to Bethlehem Road	7	1.58 miles	Widen to 4-lane roadway	2035
Smithfield Road between Poole Road and Mial Plantation Rd	8	1.0 mile	Widen to 4-lane roadway	2035
US 64 Business between I-540 and N Smithfield Road	9	1.52 miles	Improve signal timing and implement safety improvements by accommodating pedestrian crossings, advance trafficr signage, and access management.	2035

1.0 Introduction

The Capital Area Metropolitan Planning Organization (CAMPO) initiated the I-87 Knightdale Corridor Study in response to local needs of evaluating traffic congestion and safety issues at several interchange areas along the Interstate Highway 87 (I-87) in and around Knightdale as depicted in the study area map shown in Figure 1.1. The I-87 corridor in Knightdale overlaps with the US 64/US 264 highway designations between the Raleigh Beltline (I-440) and the US 64 Business for approximately ten miles. The I-87 corridor also overlaps with the I-495 designation between Raleigh Beltline (I-440) and Northern Wake Expressway (I-540). The I-87 corridor between I-440 and US 64 Business is a freeway facility with 70 miles per hour (mph) posted speed and 6- to 10-lane cross-sections.

I-87 corridor has experienced over 15 percent annual growth in AADT in recent years

The I-87 corridor is increasingly serving statewide travel needs as it connects the Capital Area with the I-95 corridor to the northeast near Rocky Mount via US 64, and to the southeast near Wilson via US 264. The I-87 corridor between I-440 and US 64 Business observed the highest Annual Average Daily Traffic (AADT) volume of 90,000 vehicles per day in 2016, just west of the Hodge Road interchange. The same location observed AADT volume of 78,000 vehicles per day in 2015. In essence, the I-87 corridor has experienced over 15 percent annual growth in AADT in recent years.

To address this rapid growth in traffic along the corridor, this study evaluated the origin-destination (O-D) profiles of several study area interchanges by applying the latest Triangle Regional Model (TRMv6). The study area interchanges included the I-87/Hodge Rd interchange, the I-87/I-540 interchange, the I-87/Smithfield Rd interchange, the I-87/Wendell Falls Pkwy interchange, and the I-87/US 64 Business interchange (see Figure 1.1). This model-based O-D profiles were developed for AM and PM peak hour conditions under two future network scenarios:

- Pre-540 - Future Year (2035) MTP network without completion of the Eastern Wake Expressway project (TIP# R-2829)
- Post-540 – Future Year (2035) MTP network with completion of the Eastern Wake Expressway project (TIP# R-2829) that completes I-540 Outer Loop in Raleigh

The objective of this Pre-540 and Post-540 analyses was to identify potential capacity, operational or safety improvement needs at I-87 interchanges in Knightdale that are not affected by the R-2829 project and that can ease the most pressing traffic and safety issues in the study area within the next 5 to 15 years.

Figure 1.1 Study Area Map

2.0 Existing Conditions

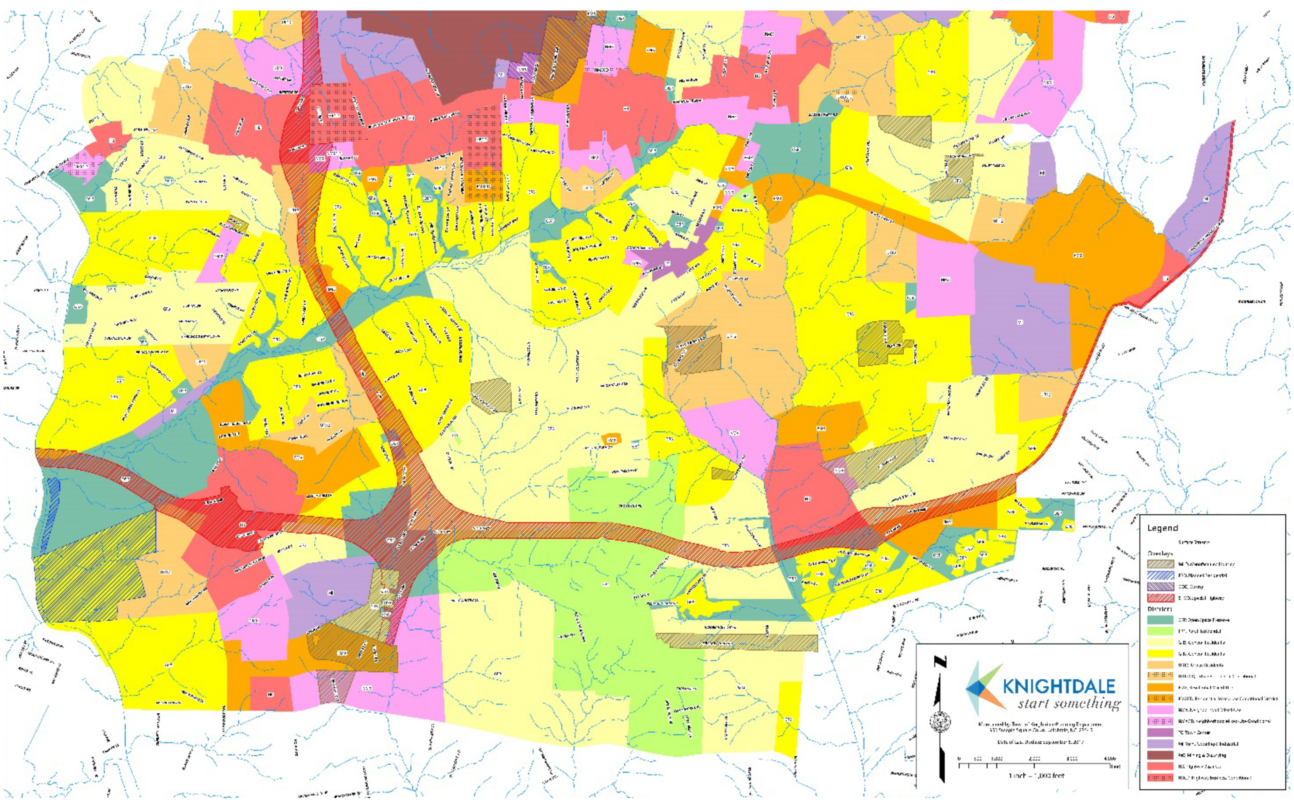
This section presents a summary of existing land use, transportation, traffic and safety conditions in the study area based on readily available data from state and local sources.

2.1 Land Use & Development Pattern

The I-87 corridor through the Town of Knightdale has predominantly residential land uses on both sides of the corridor that ranges from rural residential uses to residential mixed-uses. The commercial uses are focused at the interchange areas with New Hope Road, Hodge Road, Smithfield Road, Wendell Falls Pkwy, and US 64 Business. This is reflected in the Town of Knightdale's zoning map (see Figure 2.1 that shows residential uses in different hues of yellow and commercial uses in shades of red and pink) and the Wake County's Land Use Plan (see Figure 2.2 that shows residential uses in different hues of yellow and community activity areas in purple).

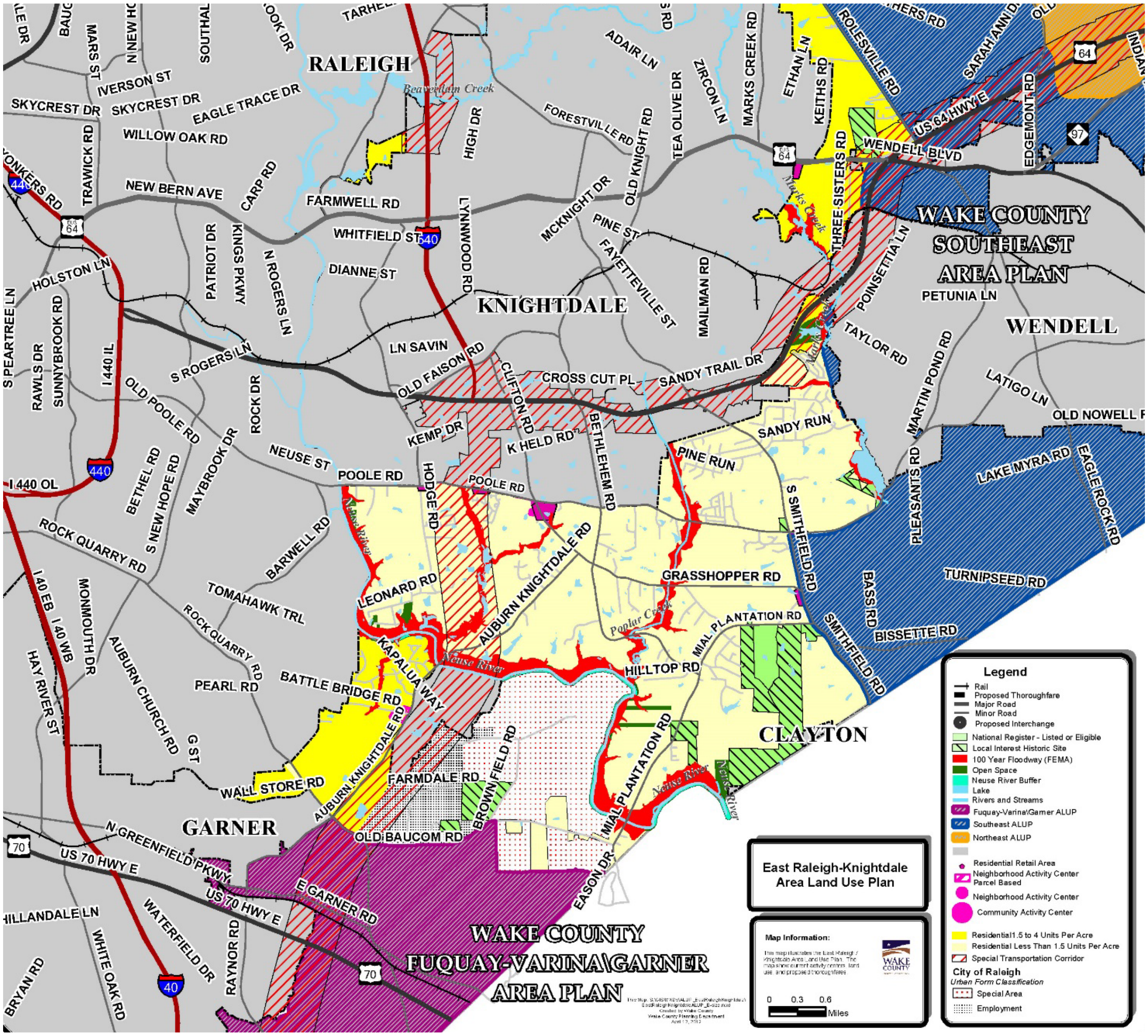
As part of the 2035 Comprehensive Plan of the Town of Knightdale (*KnightdaleNext*, June 2018), the Town has identified several I-87 interchange areas including the Hodge Road interchange, the Smithfield Road interchange, and the Wendell Falls Parkway interchange as priority investment areas around activity centers.

Figure 2.1 Town of Knightdale Zoning Map



Source: Town of Knightdale

Figure 2.2 Wake County Land Use Plan – East Raleigh and Knightdale Area



Source: Wake County Planning

2.2 Study Area Roadways

The geometric and traffic characteristics of the study area roadways are summarized in Table 2.1.

Table 2.1 Characteristics of the Study Area Roadways

Roadway	Segment	Cross-section	Functional Class	Posted Speed	2014 AADT	2015 AADT	2016 AADT
I-87	New Hope Rd I/C to Hodge Rd I/C	6-lane Divided	Interstate	70 mph	77,000	78,000	90,000
I-87	Hodge Rd I/C to I-540	8-lane Divided	Interstate	70 mph	74,000	73,000	86,000
I-87	I-540 to Smithfield Rd I/C	6-lane Divided	Other Freeway	70 mph	n/a	70,000	n/a
I-87	Smithfield Rd I/C to Wendell Falls Pkwy I/C	6-lane Divided	Other Freeway	70 mph	n/a	59,000	n/a
I-87	Wendell Falls Pkwy I/C to US 64 Business	6-lane Divided	Other Freeway	70 mph	n/a	54,000	n/a
US 64 Business	I-87 to Keiths Rd	4-lane Divided	Principal Arterial	55 mph	n/a	23,000	n/a
US 64 Business	I-87 to Rolesville Rd	4-lane Divided	Minor Arterial	55 mph	n/a	18,000	n/a
Wendell Falls Pkwy	I-87 to Martin Pond Rd	2-lane	Major Collector	45 mph	n/a	5,000	n/a
Smithfield Rd	I-87 to Sandy Run	2-lane	Minor Arterial	45 mph	n/a	19,000	n/a
Smithfield Rd	Sandy Run to Poole Rd	2-lane	Minor Arterial	45 mph	n/a	13,000	n/a
Smithfield Rd	Poole Rd to Bisette Rd	2-lane	Minor Arterial	45 mph	n/a	7,900	n/a
Poole Rd	New Hope Rd to Barwell Rd	2-lane	Minor Arterial	45 mph	n/a	20,000	n/a
Poole Rd	Barwell Rd to Hodge Rd	2-lane	Minor Arterial	45 mph	n/a	10,000	n/a
Poole Rd	Hodge Rd to Grasshopper Rd	2-lane	Minor Arterial	45 mph	n/a	10,000	n/a
Poole Rd	Grasshopper Rd to Smithfield Rd	2-lane	Minor Arterial	55 mph	n/a	3,500	n/a
Hodge Rd	I-87 to Poole Rd	2-lane	Major Collector	45 mph	n/a	12,000	n/a
Hodge Rd	I-87 to US 64 Business	2-lane	Major Collector	35 mph	n/a	8,400	n/a
Grasshopper Rd	Poole Rd to Smithfield Rd	2-lane	Major Collector	55 mph	n/a	4,100	n/a

Source: NCDOT

2.3 Traffic Congestion Analysis

Traffic congestion in the study area was explored by reviewing INRIX's probe-vehicle based speed data available from the Regional Integrated Transportation Information System (RITIS).[1] The speed data was averaged for the month of May, 2018 for weekdays. The resulting congestion scans in terms of average traveling speed are depicted in Figure 2.3 for AM Peak Hour (8-9 am), and in Figure 2.4 for PM Peak Hour (5-6 pm). These Figures also show similar congestion scans that were readily available from Google Traffic maps.

These congestion scans show 30-40 mph traveling speed during the morning commute hour for westbound I-87 between I-540 and New Hope Road, or approximately 50 percent degradation from the posted speed. Similarly, travel speed deteriorates to 30-40 mph for eastbound I-87 between I-440 and New Hope Road during the afternoon commute hour. In addition, these congestion scans also reveal the following issues for several arterial roadways in the study area:

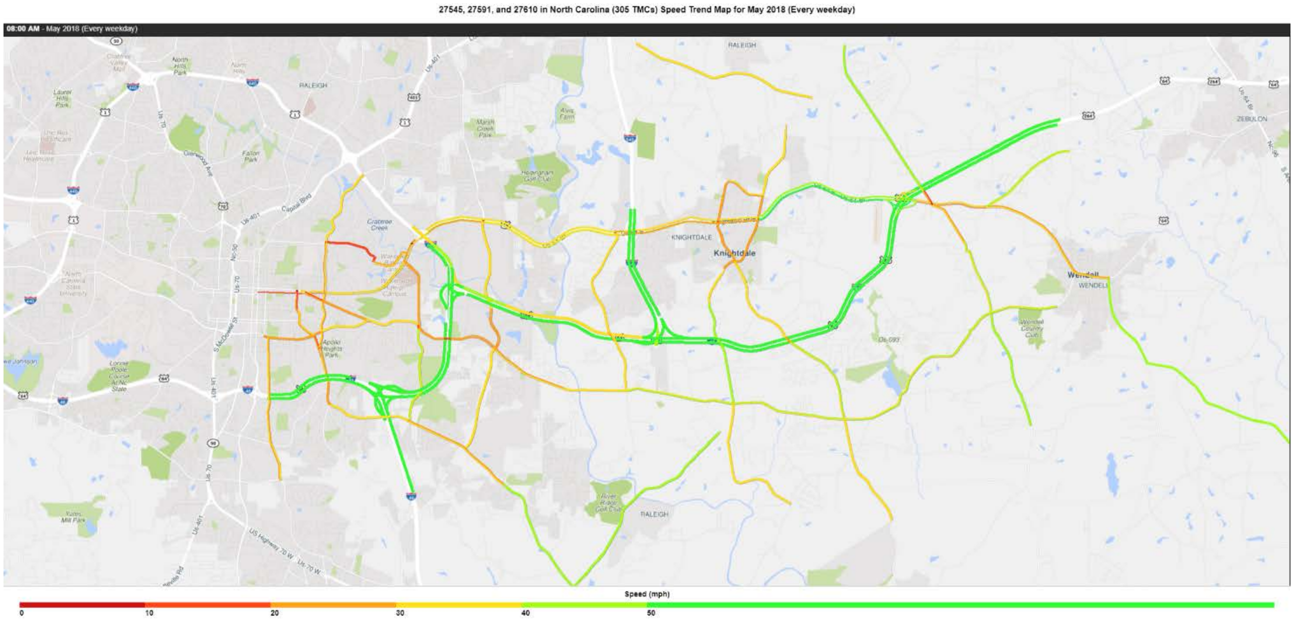
- Hodge Road – I-87 Overpass bridge remains very congested in PM peak hour in both directions
- Smithfield Rd – Southbound direction remains very congested in PM peak hour between I-87 and Poole Rd
- Smithfield Rd - Southbound direction remains very congested in PM peak hour between US 64 Business and First Ave
- First Avenue - Northbound direction remains very congested in PM peak hour between Smithfield Rd and US 64 Business
- US 64 Business - Both directions remain moderately congested in PM peak hour between I-540 and First Avenue

Hodge Road Overpass bridge remains very congested

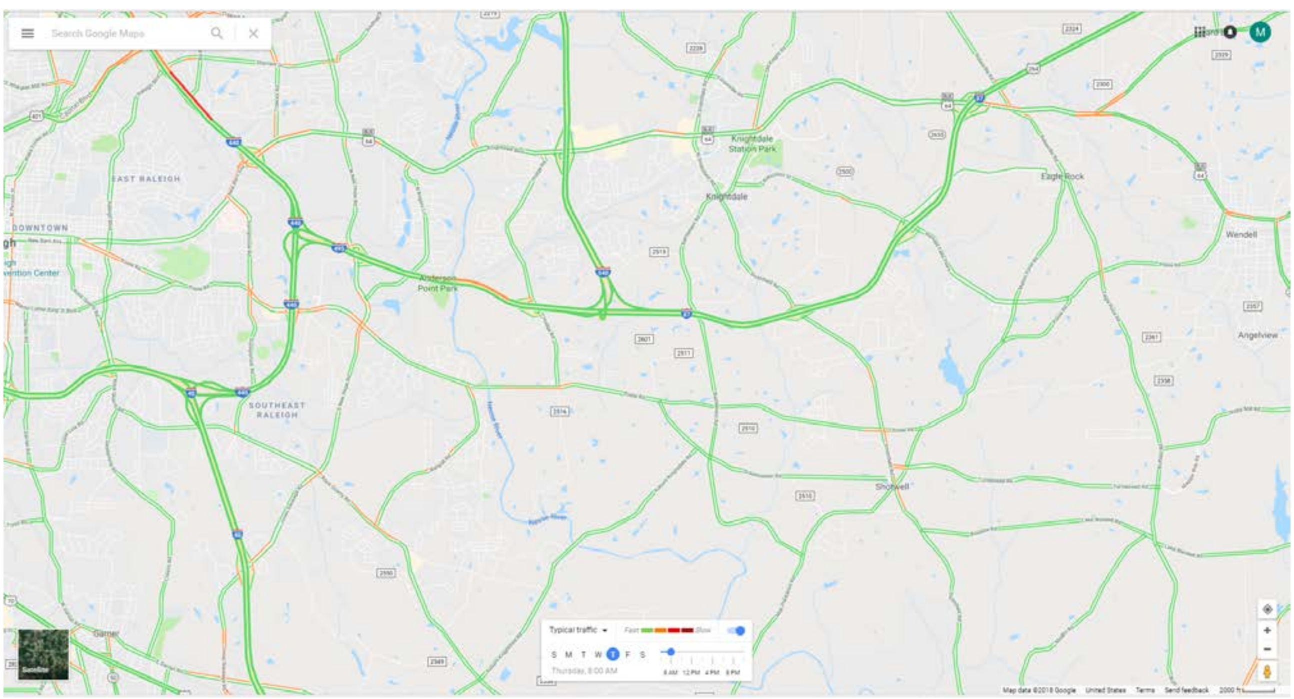
Smithfield Rd remains very congested between I-87 and Poole Rd

[1] RITIS data was accessed via the web portal (https://www.ritis.org/intro)

Figure 2.3 Average Weekday Traffic Congestion Scans – 8 to 9 AM

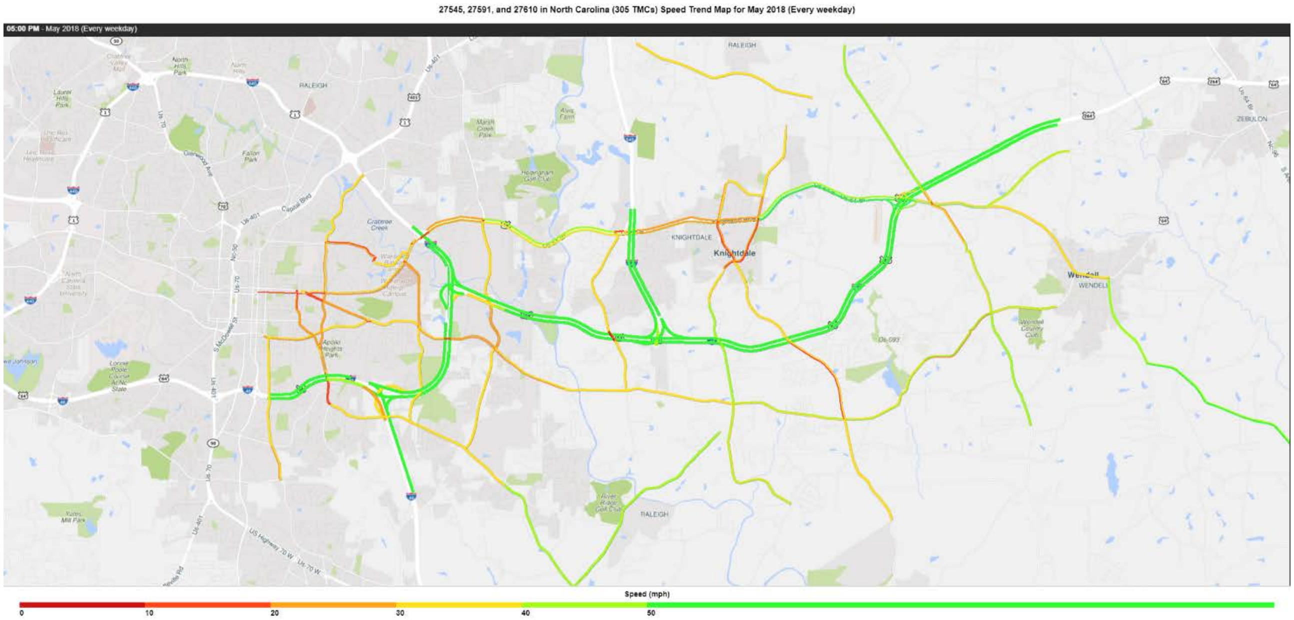


Source; RITIS, Average for all weekdays in May 2018

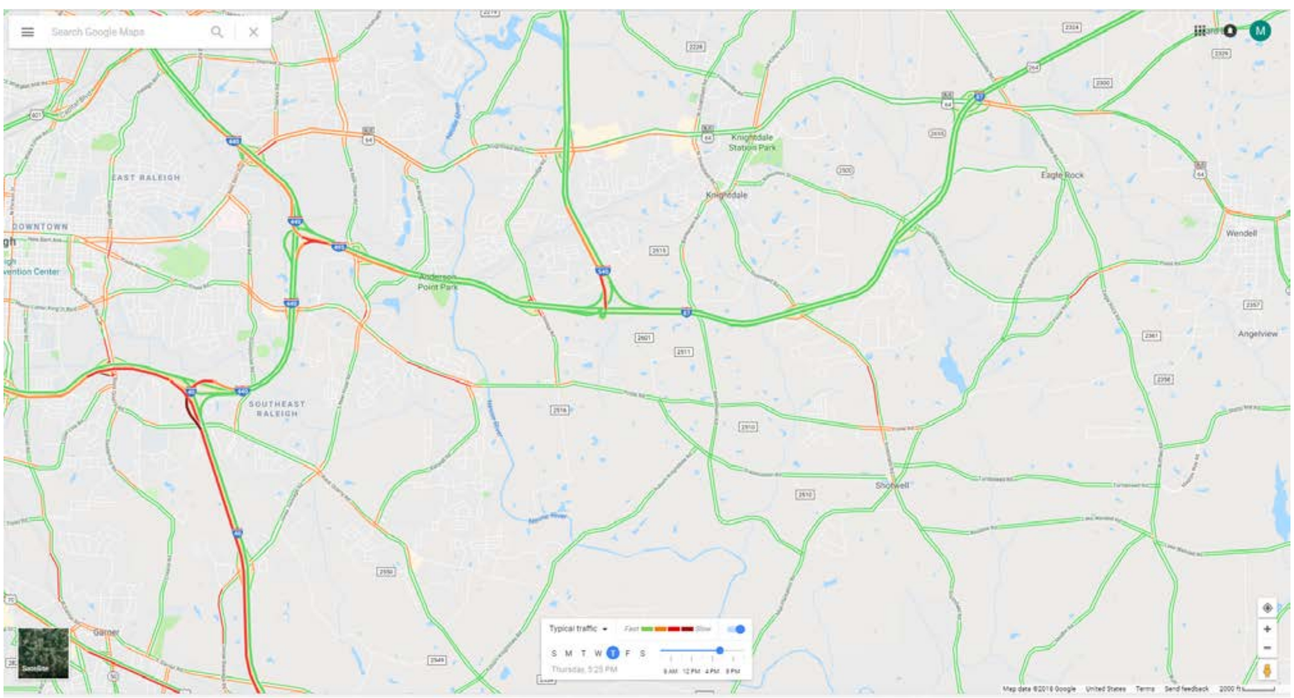


Source; Google Traffic, Typical Thursday Speed Conditions

Figure 2.4 Average Weekday Traffic Congestion Scans – 5 to 6 PM



Source; RITIS, Average for all weekdays in May 2018



Source; Google Traffic, Typical Thursday Speed Conditions

2.4 Field Observations of Traffic Conditions

In addition to developing traffic congestion scans using readily available data from RITIS and Google Traffic, field observations were made in June, 2018 during PM peak hours for data verification and also to observe queuing at selected intersections and interchanges. The field observations revealed the following traffic bottleneck areas:

- Hodge Road Overpass – Observed to have recurring traffic backups on the bridge during PM peak hour. However, no queue spillovers were observed on to I-87 mainline (see picture below).

- I-87 Eastbound Exit #425 to Smithfield Road – Observed to have recurring traffic backups during PM peak hour. At certain peak times, off-ramp queuing backed up to I-87 mainline creating unsafe conditions (see the picture below).

- I-87 Eastbound Ramps and Smithfield Road Intersection – Observed to have recurring traffic backups during PM peak hour. Takes multiple signal cycles to dissipate queues on the off-ramp and the southbound approach. Queuing was observed along southbound Smithfield Road at downstream locations.

- Hodge Road and Poole Road Intersection – Observed to have significant recurring queuing for southbound left-turn movements during PM peak hour (see the picture below).

- Smithfield Road and Poole Road Intersection - Observed to have significant recurring queuing for southbound Smithfield Road approach during PM peak hour (see the picture below).

2.5 Traffic Safety Analysis

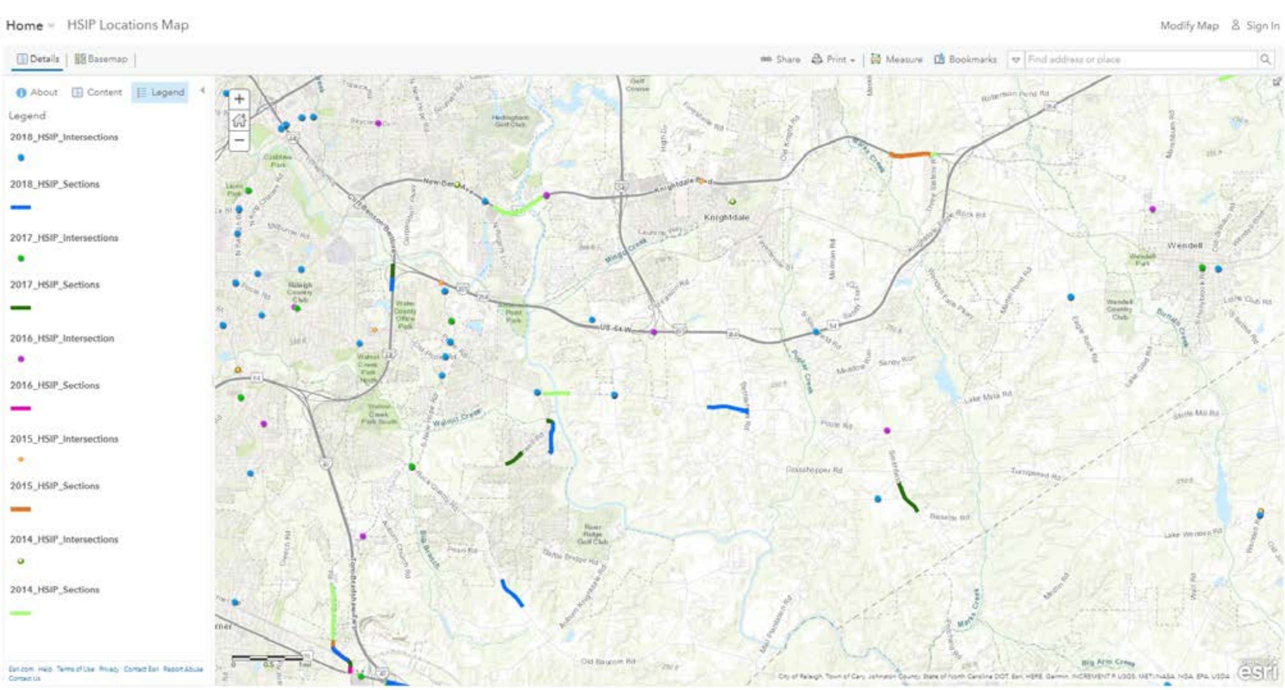
This study analyzed readily available crash data and statistics for the study area roadways from NCDOT's Traffic Safety Division. This safety analysis included reviews of Intersection safety warrants and Section safety warrants that the NCDOT develops based on latest 5-year crash data. The intersection safety warrants included the following key warrants:

- Frontal Impact
- Last Year Increase
- Frequency with a Severity Index Minimum
- Night Location

The key section safety warrants included the minimum total crashes and per mile crashes combined with run-off road, wet conditions, and night conditions. The safety analysis results are summarized in Figure 2.5 to identify the potentially hazardous locations that are exceeding at least one safety warrant.

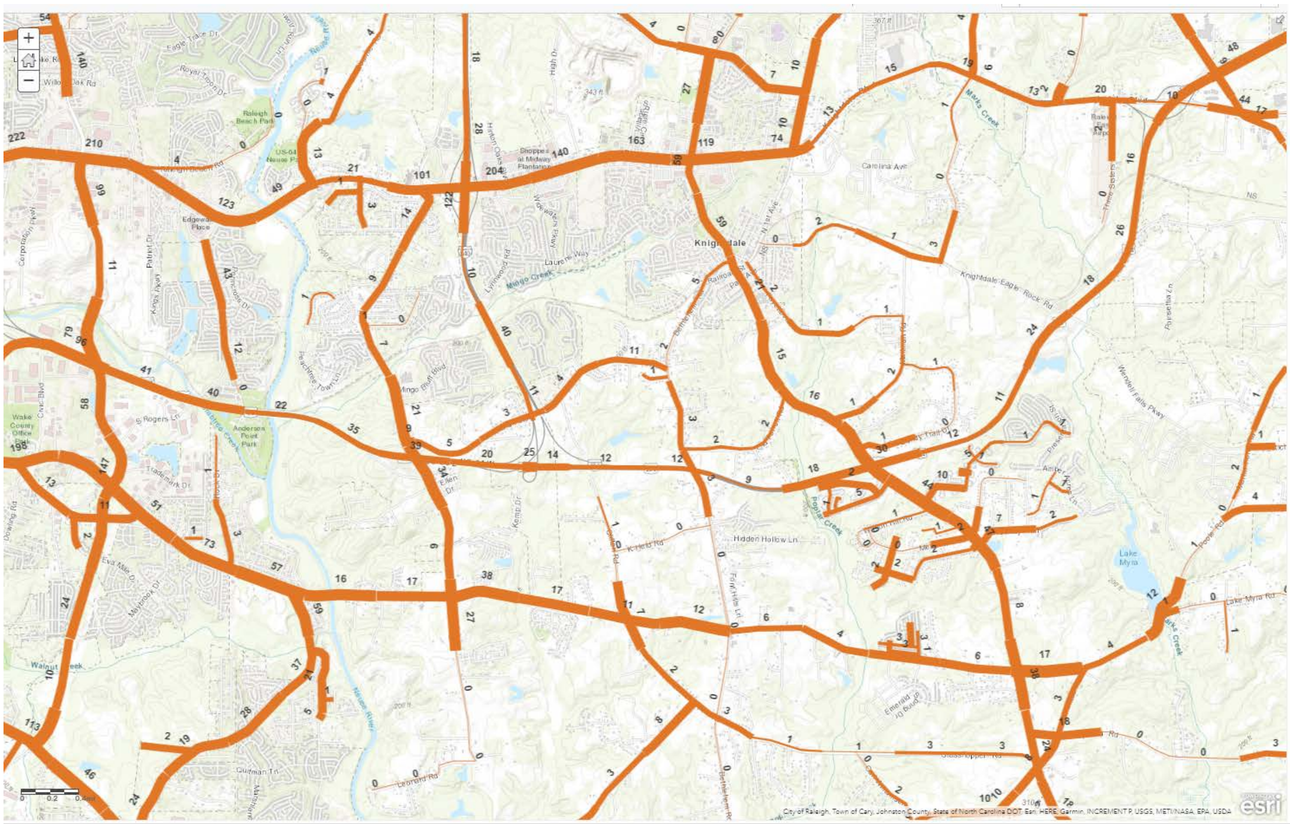
In addition, several maps were prepared based on NCDOT's Combined Safety Score (see Figures 2.6, 2.7, 2.8, and 2.9), observed fatal crashes (see Figure 2.10) and total crash frequency (see Figure 2.11). These maps helped identify the safety issue areas along Hodge Rd/I-87 interchange area, Smithfield Road/I-87 interchange area, several segments along Poole Road, and several segments along US 64 Business.

Figure 2.5 Potentially Hazardous Locations Exceeding At Least One Safety Warrant



Source: NCDOT Highway Safety Improvement Program; HSIP Intersections and Sections by Year (2014-2018)

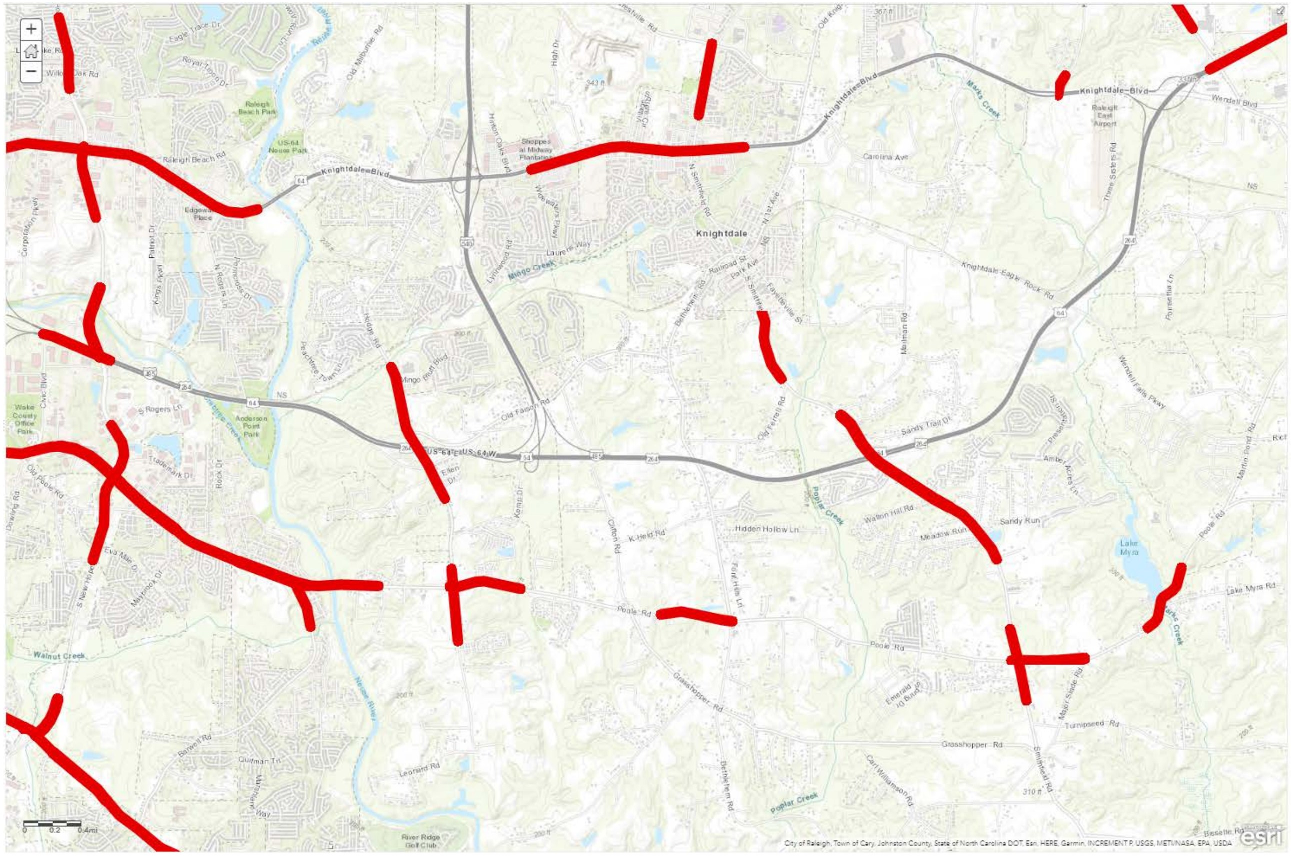
Figure 2.6 Combined Safety Score and Total Number of Crashes



Source: NCDOT; Planning Level Safety Scoring with 5-yr Crashes (2012-2016)

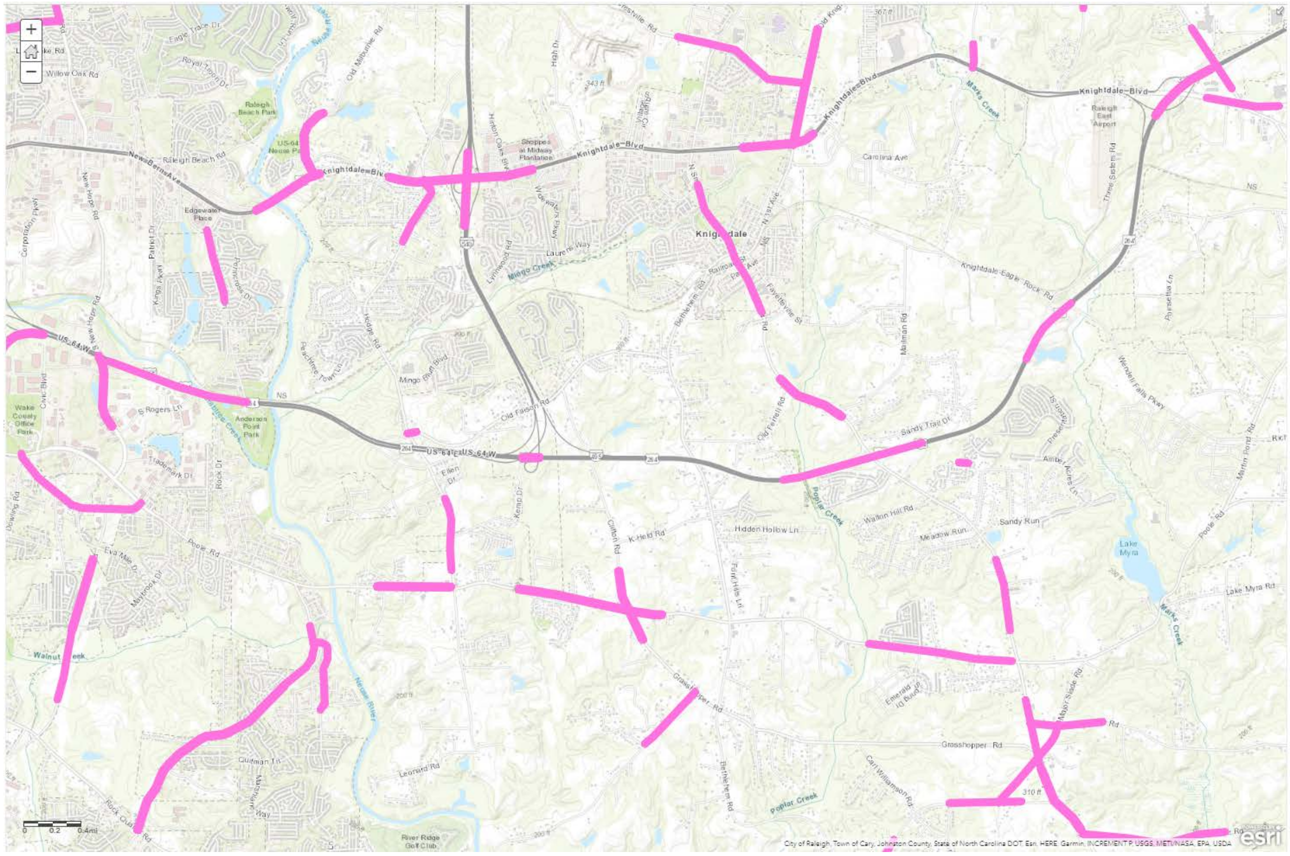
Note: Line width on this map is scaled to Combined Safety Score and the Numeric Labels indicate the Total Number of Crashes observed during the 5-year period.

Figure 2.7 Segments with Combined Safety Score Between 80 to 100



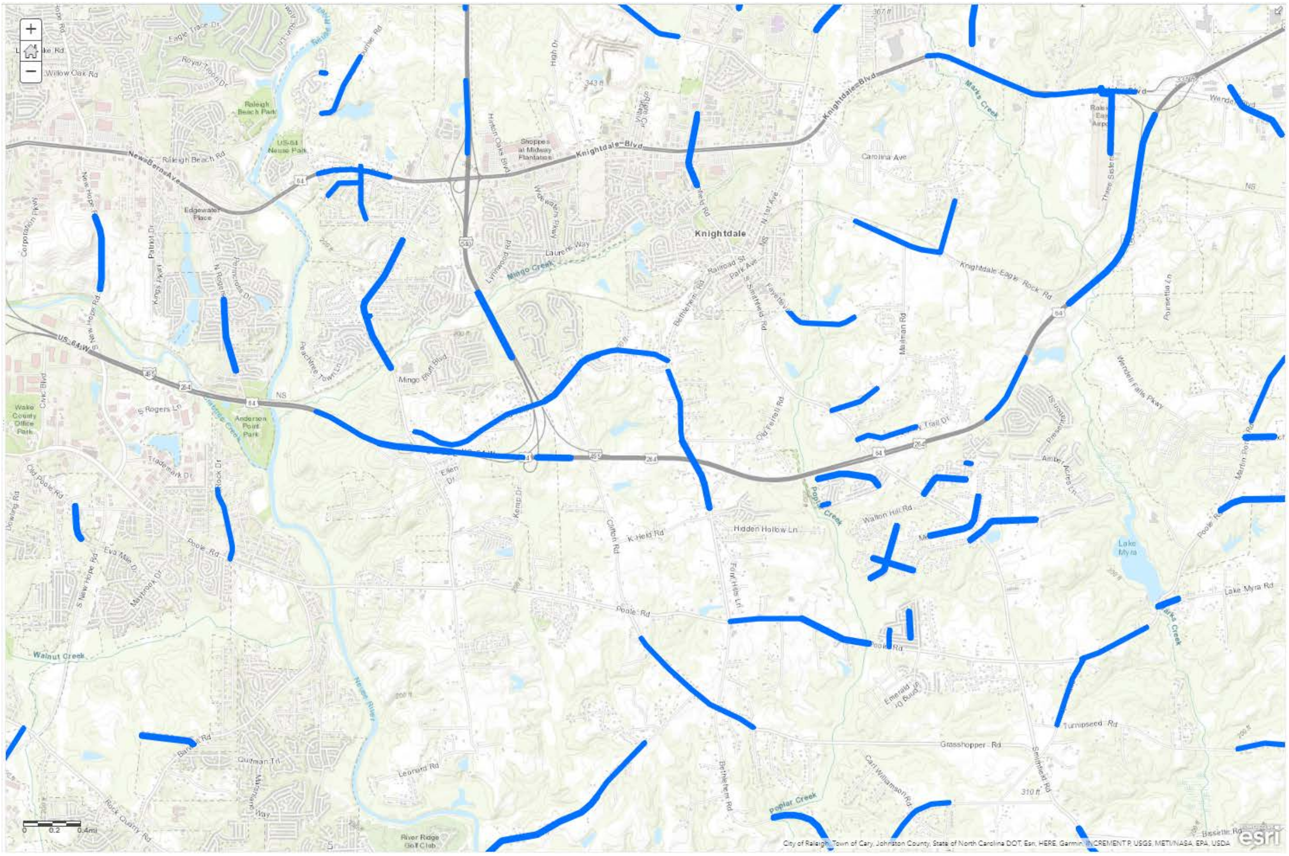
Source: NCDOT; Planning Level Safety Scoring with 5-yr Crashes (2012-2016)

Figure 2.8 Segments with Combined Safety Score Between 60 to 80



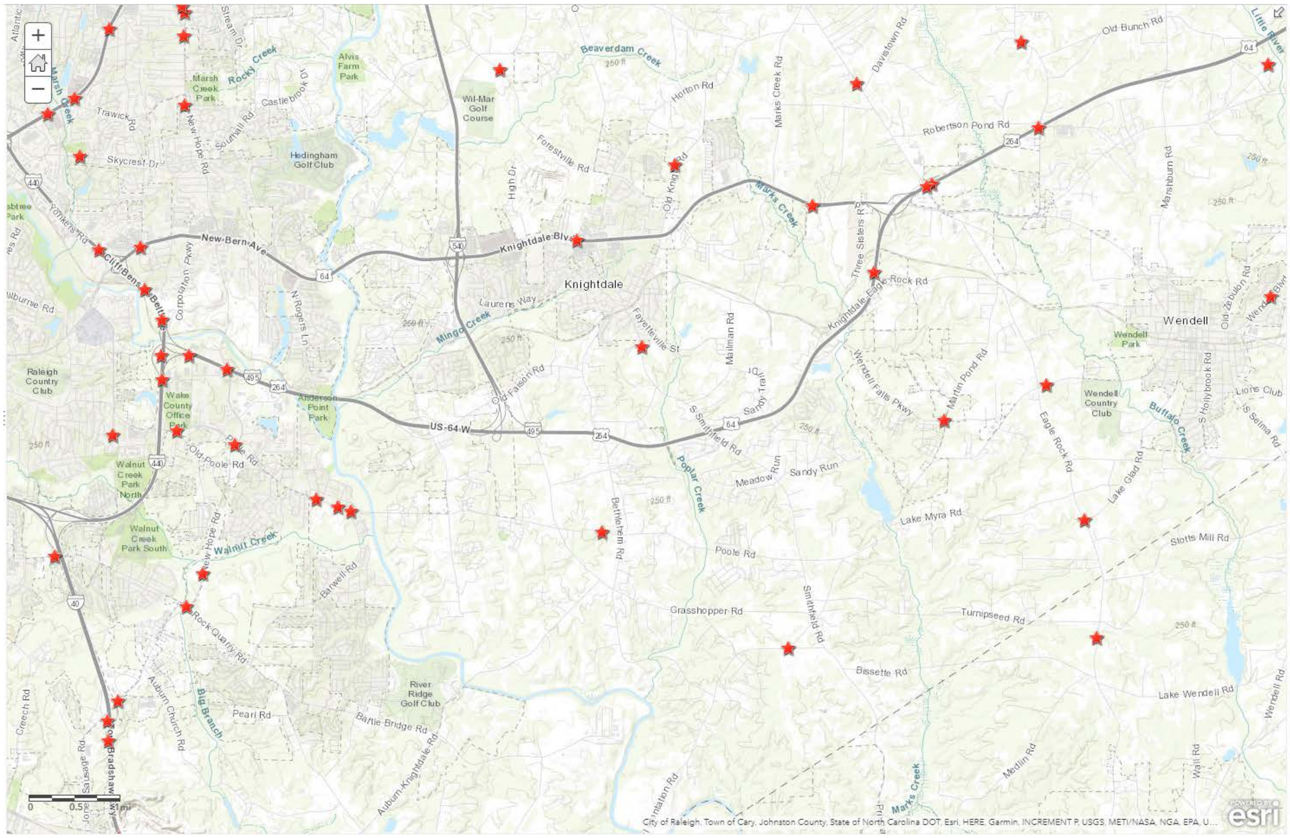
Source: NCDOT; Planning Level Safety Scoring with 5-yr Crashes (2012-2016)

Figure 2.9 Segments with Combined Safety Score Between 40 to 60



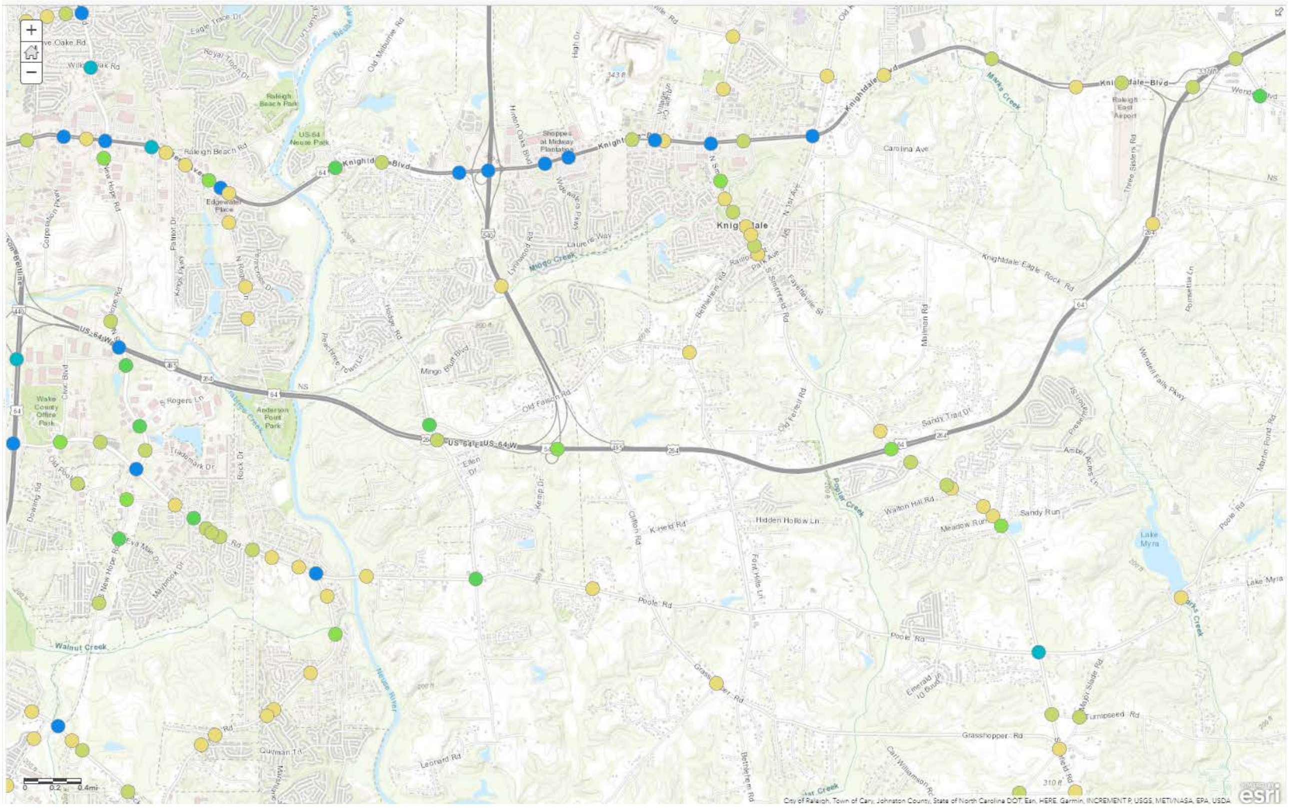
Source: NCDOT; Planning Level Safety Scoring with 5-yr Crashes (2012-2016)

Figure 2.10 Fatal Crashes within the Last 5 Years (2013-2017)



Source: NCDOT Traffic Safety Division

Figure 2.11 Total Crash frequency by Intersection within the Last 5 Years (2012-2016)



Legend

Total Crash Frequency By Intersection

- 5 to 9
- 10 to 19
- 20 to 29
- 30 to 39
- 40 to 49
- 50 and above

Source; NCDOT Traffic Safety Division

3.0 Future Conditions

This section presents a summary of projected land use growth in the study area, planned developments in the area, planned transportation improvement projects as adopted in the CAMPO's 2045 Metropolitan Transportation Plan (MTP), and expected future travel demand profiles of the I-87 corridor interchanges. The travel demand profiles were prepared for two network scenarios: before and after the I-540 Outer Loop's Phase II project (R-2829) from I-40 to I-87 is built by year 2035. These travel demand profiles and future condition analysis is based on the latest Triangle Regional Model's (TRMv6) 2035 land use and network assumptions.

3.1 Land Use Growth Projections

The I-87 corridor study utilized the land use growth projections that were included as part of the TRMv6 model files obtained from the NCSU-ITRE's TRM Service Bureau as of March, 2018. In addition to ITRE's model files, the study also utilized several MTP networks and other macros that were obtained subsequently from the CAMPO in April, 2018.

To facilitate review of the underlying 2035 land use projections by the Project Steering Committee (PSC), several bar chart plots were developed for the study area to depict the areas of significant population and employment growth. These plots are depicted in Figure 3.1 for Base Year (2013) and Future Year (2035) population figures by Traffic Analysis Zones (TAZs) within the study area. Figure 3.2 shows a similar plot of Base Year (2013) and Future Year (2035) population figures by TAZs, but for a bigger study area focusing on the Johnston County TAZs. It should be noted that the legends on the bar chart used the label "TOT_POP_2034" to reflect the Pre-540 or 2034 network scenario, although the underlying land use data is same as the Post-540 or 2035 network scenario. For modeling convenience, the Pre-540 network scenario was labeled as the 2034 scenario.

These figures show significant amount of population growth in the study area and Johnston County TAZs. These population forecasts are based on the CAMPO's CommunityViz land use allocation model that starts with regionwide control totals and allocates growth to individual TAZs based on a host of land capacity, zoning compatibility, market assessment, accessibility, and policy variables.

Similarly, Figure 3.3 shows a bar chart comparison of TAZ employments for years 2013 and 2035, and Figure 3.4 shows a bar chart comparison of projected daily trips by year 2035.

Figure 3.1 Study Area Population by TAZs – 2013 vs. 2035

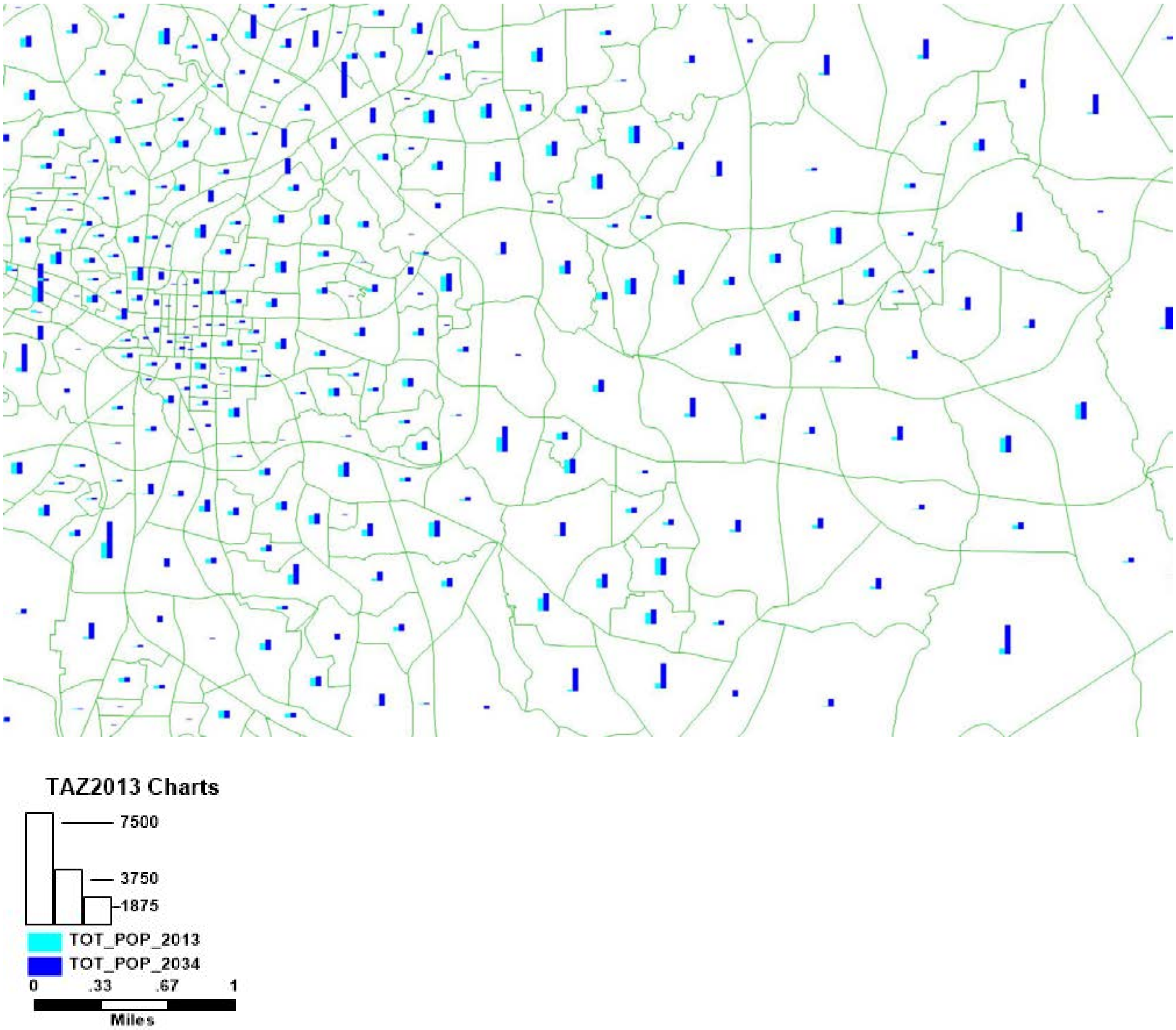


Figure 3.2 Johnston County Population by TAZs – 2013 vs. 2035

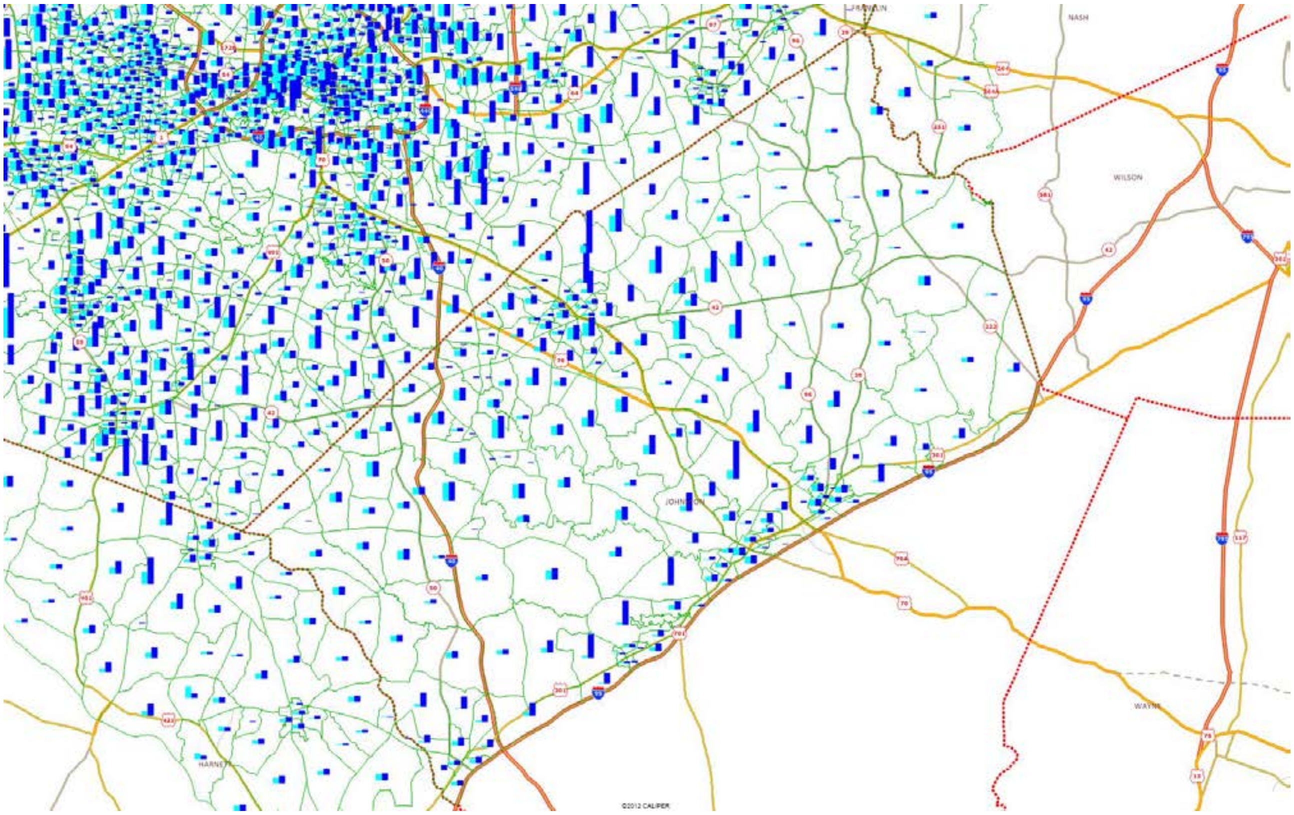


Figure 3.3 Study Area Employment by TAZs – 2013 vs. 2035

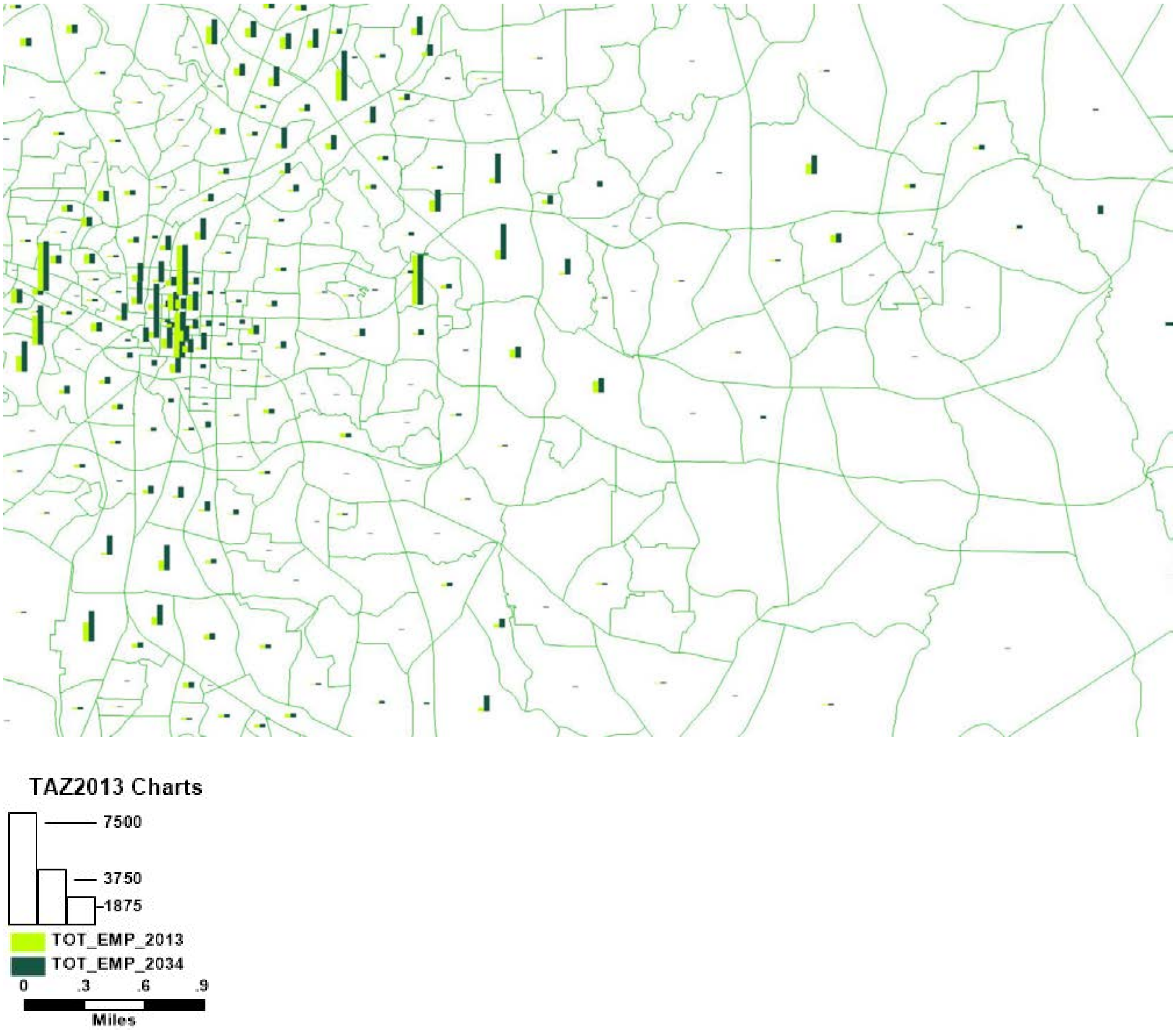
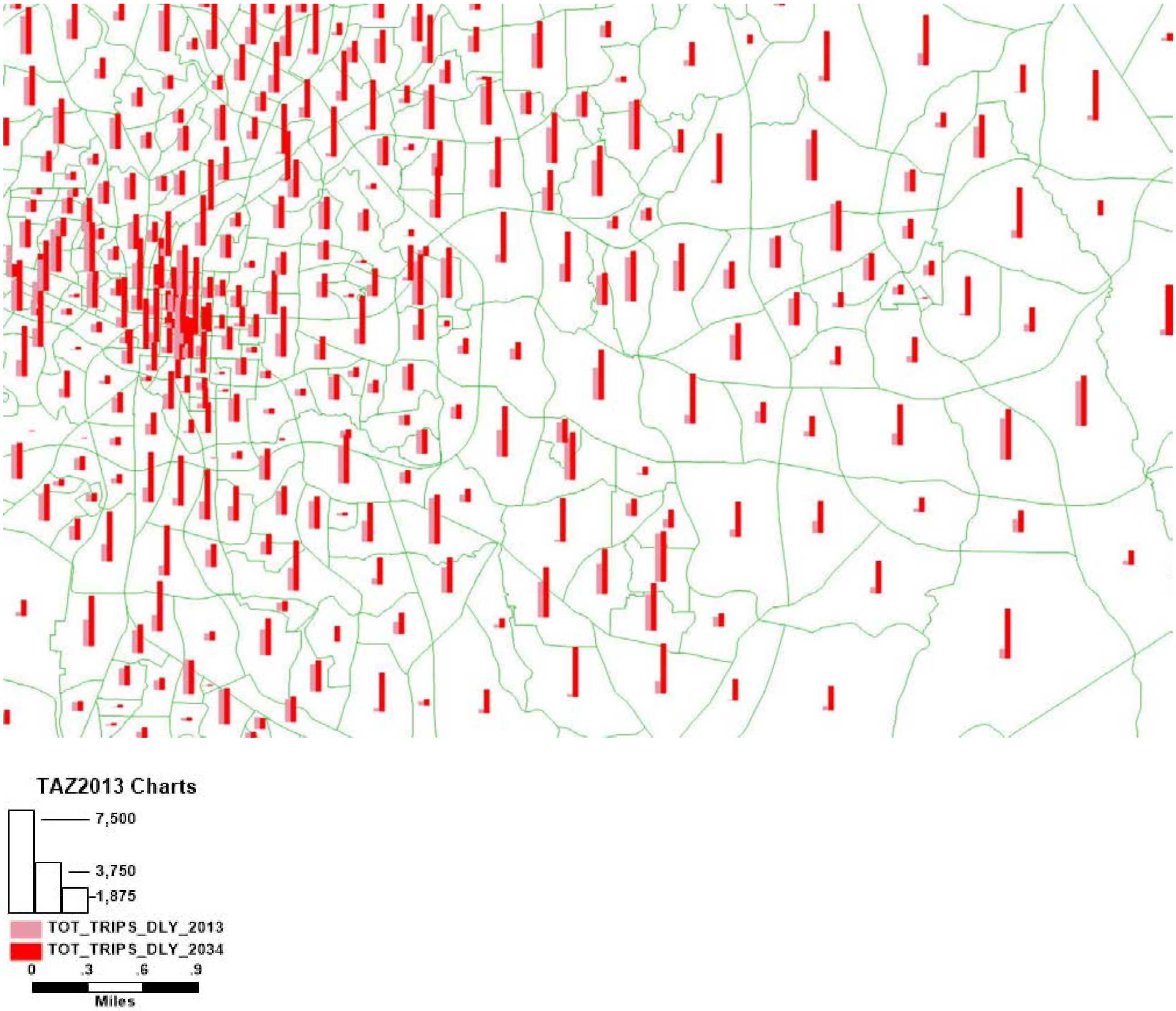


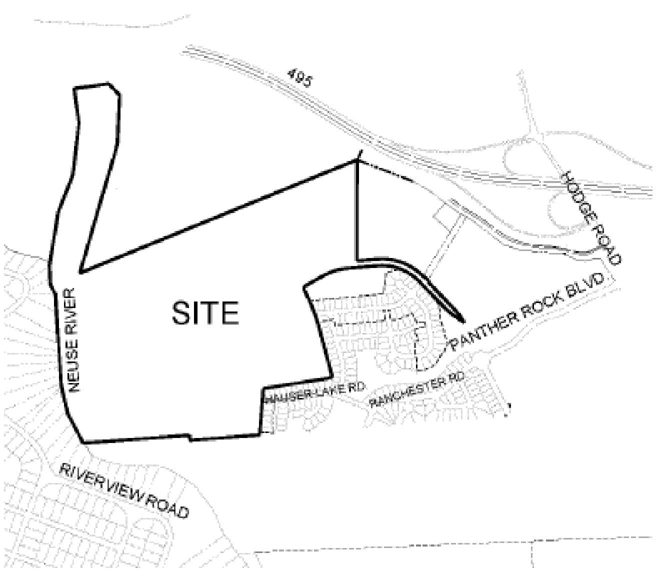
Figure 3.4 Study Area Daily Trips by TAZs – 2013 vs. 2035



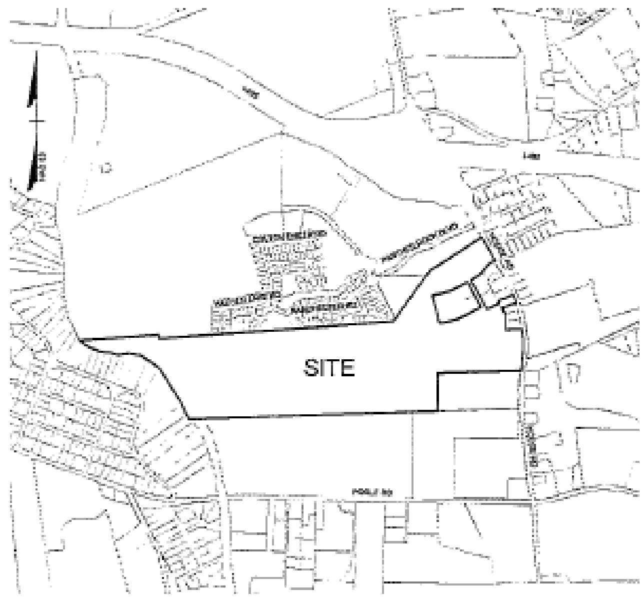
3.2 Permitted and Other Development Plans

Town of Knightdale has defined targeted investment areas as part of their new comprehensive plan that includes land within the current Town limits as well as closely surrounding land in the current extraterritorial jurisdiction (ETJ) areas. Town of Knightdale is also planning to develop infrastructure in these areas to encourage active living with a comprehensive network of walkable streets and more compact and efficient development pattern. A summary of the current development plans in and around Knightdale that are relevant to this corridor study area are summarized in Table 3.1. These developments are large-scale residential project along Hodge Rd between I-87 and Poole Road (see vicinity maps below).

Stone River Vicinity Map



Silver Stone Vicinity Map



In addition, Wake County Board of Commissioners has recently accepted several rezoning applications (e.g., Rezoning cases ZP-868-08 and ZP-888-15) that are seeking to rezone land parcels in the northeast and northwest quadrants of the Poole Road/Smithfield Road intersection from Residential (R-30) to Conditional Use-General Business (CU-GB) and Conditional Use-Heavy Commercial (CU-HC) categories to allow for retail and office development projects. These rezoning applications are likely to be followed up with development proposals near the Smithfield Road/Poole Rd intersection in the next 5-10 years.

Table 3.1 Current Development Plans in the Study Area

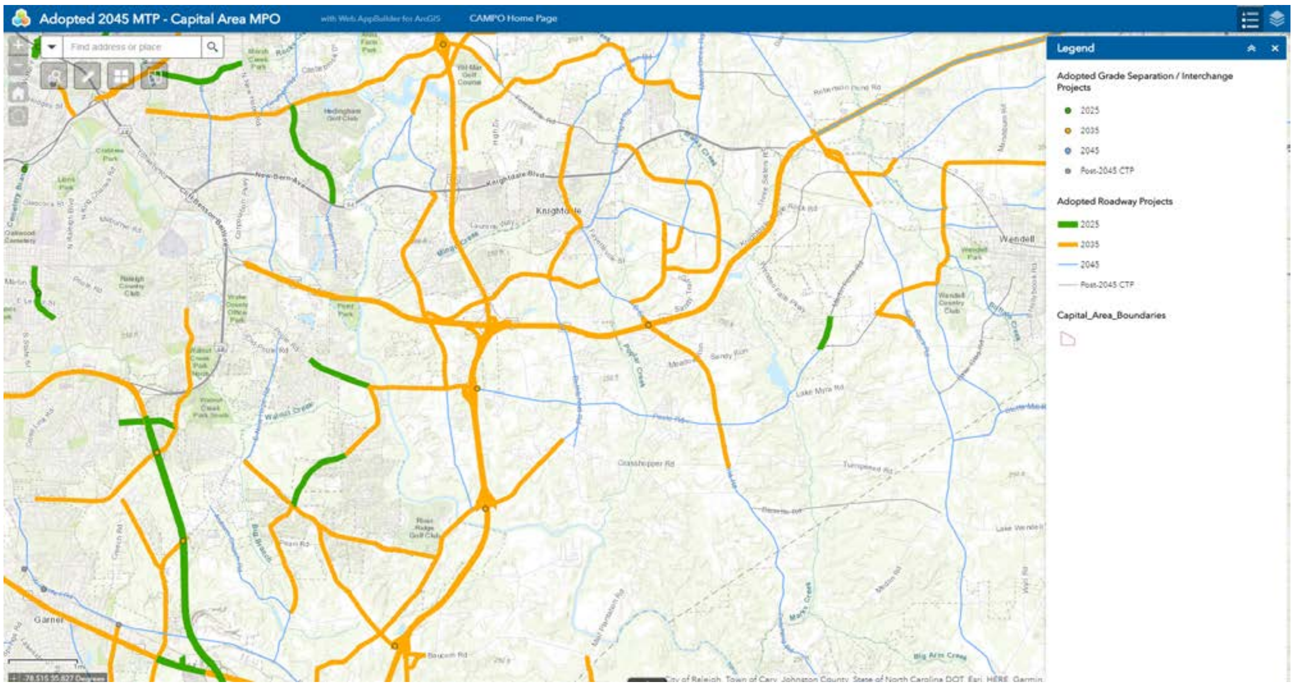
Development Name and Location	Size and Mix	Phases & Build-out Year	Roadway Access	Permit Status	Committed Off-site Roadway Improvements
Stone River, located at the SW quadrant of the I-87/Hodge Rd I/C; North and West of the Cheswick Subdivision in Knightdale	163.76 acres 299 SF Lots 102 TH Lots	5 Phases by Year 2023	Access via Panther Rock Blvd and Water Tower Rd	Construction Drawing Review	• Eastbound RT Lane at Hodge Rd/I-87 EB Ramps • Widen Southbound Hodge Rd from I-87 EB Ramps to Panther Rock Blvd/Ellen Dr • Westbound LT Lane at Hodge Rd/I-87 WB Ramps
Silver Stone, located at the SW quadrant of the I-87/Hodge Rd I/C; South of the Cheswick Subdivision in Knightdale	158.55 acres 275 SF Lots 103 TH Lots	6 Phases by Year 2023	Access via New Site Driveways connecting to Hodge Rd	Utility Allocation Agreement Amendment	• Eastbound LT Lane at Hodge Rd/I-87 EB Ramps • Northbound RT Lane at Hodge Rd/I-87 WB Ramps • Widen Southbound Hodge Rd from I-87 EB Ramps to Site Driveway • Widen Northbound Hodge Rd from Site Driveway to North of Water Tower Rd/Faison Ridge Ln • Westbound RT Lane at Hodge Rd/Poole Rd intersection
Cheswick, located at the SW quadrant of the I-87/Hodge Rd I/C	Remaining 64 SF Lots	Phases 2B and 3 by Year 2020	Access via Panther Rock Blvd	Permitted	N/A
Hodge Rd Business Park, located at the NE quadrant of Hodge Rd/Kemp Dr	1 million SQFT of Warehouse	Year 2020	Access via Site Driveway on Hodge Rd	Permitted	N/A

Source: Town of Knightdale

3.3 Planned Roadway Projects

The study area includes several planned projects as shown in Figure 3.5, including the last phase of the I-540 Outer Loop between I-40 and I-87 that is anticipated to be funded by year 2035. These projects are shown in green lines (year 2025 projects) and orange lines (year 2035 projects). A summary description of these study area planned projects by year 2035 is presented in Table 3.2. It should be noted that other long-range projects with funding year 2045 and beyond have not are not included in the Table because of the fact that the corridor study focused on year 2035 conditions.

Figure 3.5 2045 Metropolitan Transportation Plan (MTP) Projects in the Study Area



Source: CAMPO

Table 3.2 Planned Projects in the Study Area by Year 2035

Roadway Segment	MTP Project ID (STIP ID)	Segment Length (miles)	Project Description	Funding Horizon Year
Barwell Rd from Rock Quarry Rd to Berkeley Lake Rd	A683a	1.15	Widen to 3-lane to provide turn lane	2025
Martin Pond Rd from Poole Rd to Wendell Falls Pkwy	A174c	0.50	Widen to 4-lane roadway	2025
Poole Rd from Maybrook Dr to Barwell Rd	A49a	1.00	Widen to 4-lane roadway	2025
Auburn-Knightdale Rd from Grasshopper Rd to Raynor Rd	A203	7.58	Widen to 4-lane roadway	2035
Barwell Rd from Berkeley Lake Rd to Poole Rd	A683b	1.2	Widen to 3-lane to provide turn lane	2035
Forestville Rd Extension from Old Knight Rd to Mailman Rd	A589	3.52	New 2-lane roadway	2035
Hodge Rd from US 64 Business to Poole Rd	A403a	3.15	Widen to 4-lane roadway	2035
I-540 Eastern Wake Expressway from I-40 (South) to I-87/I-540 Interchange	F3 (R-2829)	10.8	New tolled 6-lane freeway with 5 new interchanges (including one at Poole Rd) and 2 modified interchanges at terminus locations	2035
I-87 from I-440 to US 64 Business	A639	9.73	Widen to 8 lanes freeway and Convert the Smithfield Rd interchange to diverging diamond	2035
Mailman Rd from Smithfield Rd to Robertson St/Knightdale-Eagle Rock Rd	A591	1.45	Widen to 4-lane roadway	2035
Old Faison Rd from Bethlehem Rd to Smithfield Rd	A580	0.76	New 4-lane connector roadway	2035
Old Faison Rd from Hodge Rd to Bethlehem Rd	A579	2.06	Widen to 4-lane roadway	2035
Poole Rd from Barwell Rd to Future I-540	A49b	1.57	Widen to 4-lane roadway	2035
Rolesville Rd from Kioti Dr to Old Tarboro Rd	A148a1	0.7	Widen to 4-lane roadway	2035
Rolesville Rd from Old Tarboro Rd to Martin Pond Rd	A148a2	0.75	Widen to 4-lane roadway	2035
Smithfield Rd from Forestville Rd to Bethlehem Rd	A51	1.57	Widen to 4-lane roadway	2035
Smithfield Rd from I-87 to Major Slade Rd	A112a	2.60	Widen to 4-lane roadway	2035

Source: CAMPO 2045 MTP

3.4 Travel Demand Analysis

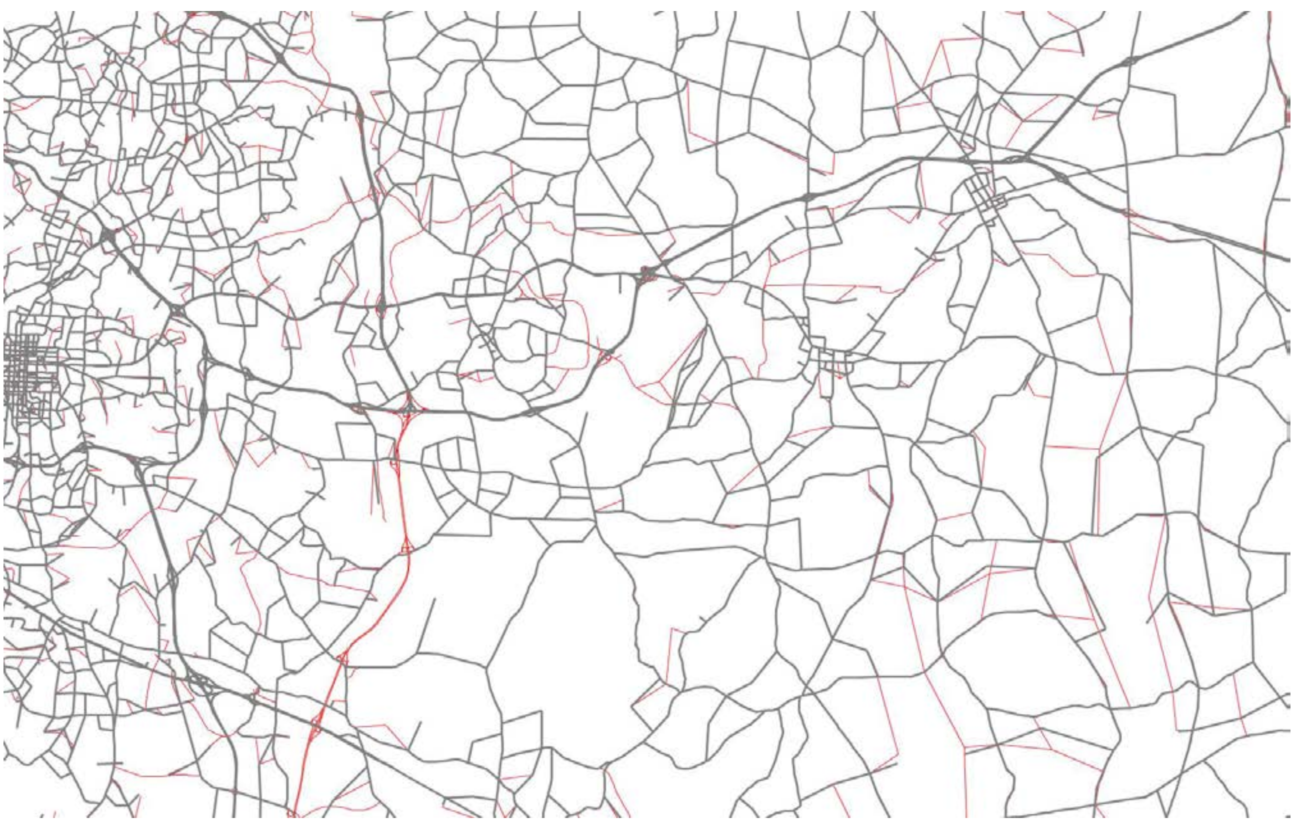
This section presents a detailed look at travel pattern anticipated at the I-87 Knightdale corridor interchanges using the region's latest travel demand model TRMv6. This TRMv6 has a 2013 Base Year network and multiple future year networks of which the 2025 and 2035 MTP networks were utilized for the travel demand analysis. The model files were provided by the TRM Service Bureau and CAMPO in March and April of 2018.

It should be mentioned that the study team explored the use of Big Data-to validate the TRMv6-generated travel demand pattern, however, because of the compressed study schedule it was deemed infeasible for such validation effort.

3.4.1 Modeled Networks

Two future year (2035) network scenarios were modeled for understanding the travel needs and issues prior to completion of the I-540 Outer Loop in Knightdale. As illustrated in Figure 3.6, one network included the I-540 Outer Loop project R-2829 (shown in red links along with other embedded future projects coded in the TRMv6), and the other future year network did not include R-2829. However, both scenarios utilized the same 2035 socio-economic data to estimate future travel demand. These two model scenarios are labeled as: Pre-540 and Post-540 scenarios.

Figure 3.6 2035 MTP Network Overlaid on 2013 Base Year Network



3.4.2 I-87/Hodge Road Interchange

The Hodge Road service interchange with I-87 is a partial cloverleaf design with loop ramps in the northwest and southwest interchange quadrants. Signalized ramp terminals exist on both sides of the 3-lane Hodge Road overpass. The demand analysis included conducting select-links analysis of the Hodge Road interchange using the 2035 TRM for two network scenarios: Pre-540 and Post-540.

The results of this analysis are summarized in a series of Pre-540 and Post-540 maps:

- First, in terms of Travelshed during AM and PM peak periods to show how trips are flowing into and out of the interchange using different roads and the relative peak hour volume illustrated by line width (labeled as CritFlow on the map legend), and

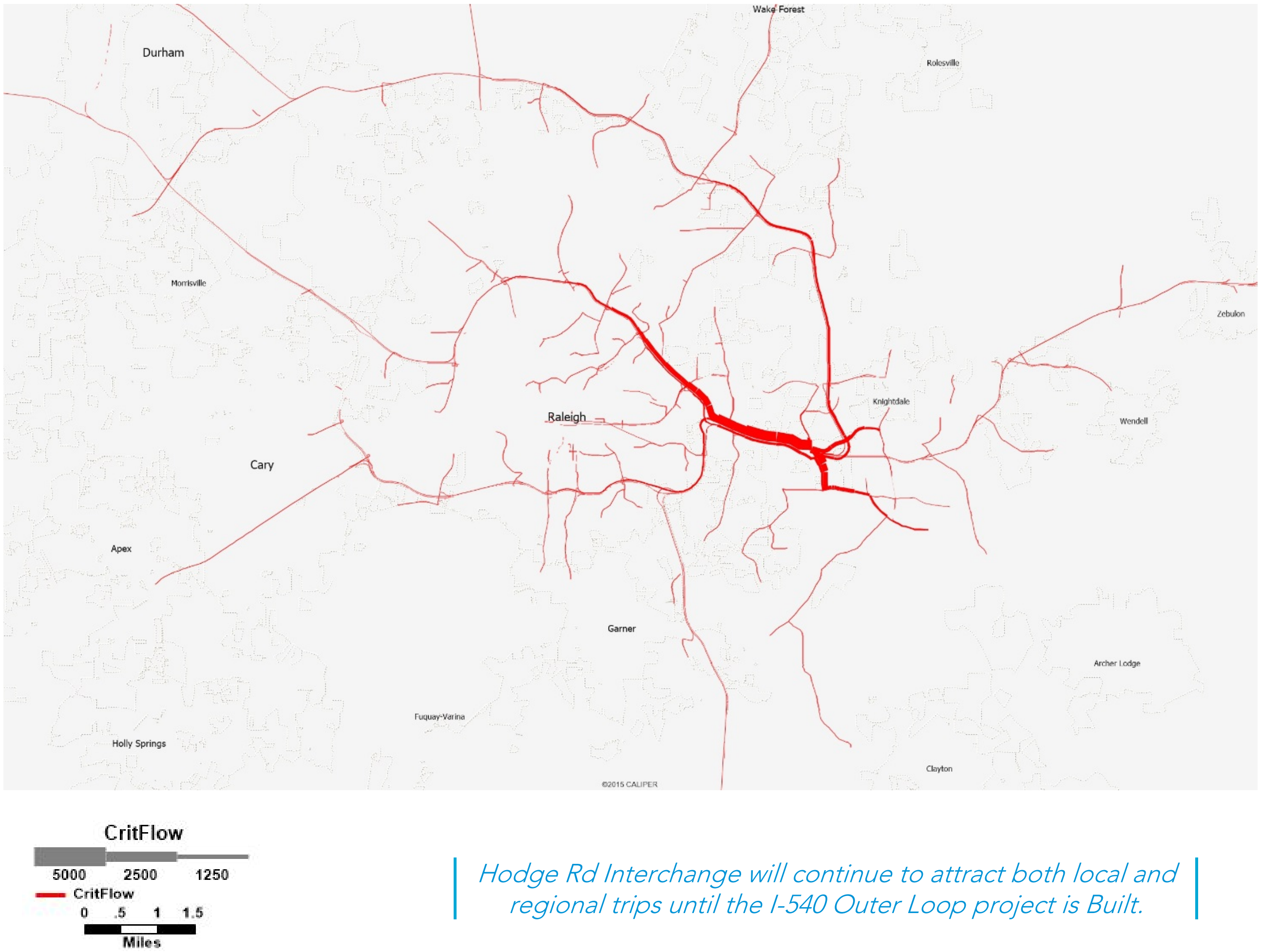
- Second, in terms of zonal origins and destinations (O-Ds) during AM and PM peak hours to show the interchange influence area and relative magnitude of that influence by size of the pie charts (pie charts also show the breakdown of trip origins in red, and trip destinations in blue).

The Travelshed maps are presented in Figures 3.7 through 3.10. The trip O-D maps are presented in Figures 3.11 through 3.14. These maps are meant to be compared visually pairwise for Pre-540 and Post-540 conditions. For example, Figures 3.7 and 3.8 was compared side by side visually to explore the changes in the AM peak hour Travelshed due to the I-540 Outer Loop project as both maps were prepared using the same geographic extent and volume scale. Similarly, Figures 3.9 and 3.10 was compared side by side to explore the changes in the PM peak hour Travelshed. In should be mentioned here that these Travelshed maps were prepared using a minimum threshold of 10 trips to reduce clutter. Consequently, these Travelshed maps have a few gaps in the routes at the peripheral areas.

The same comparative evaluation was performed for the peak hour Trip O-D maps. For example, Figures 3.11 and 3.12 was compared side by side visually to explore the changes in the AM peak hour Trip ODs due to the I-540 Outer Loop project as both maps were prepared using the same geographic extent and pie chart scale. Similarly, Figures 3.13 and 3.14 was compared side by side to explore the changes in the PM peak hour Trip O-Ds.

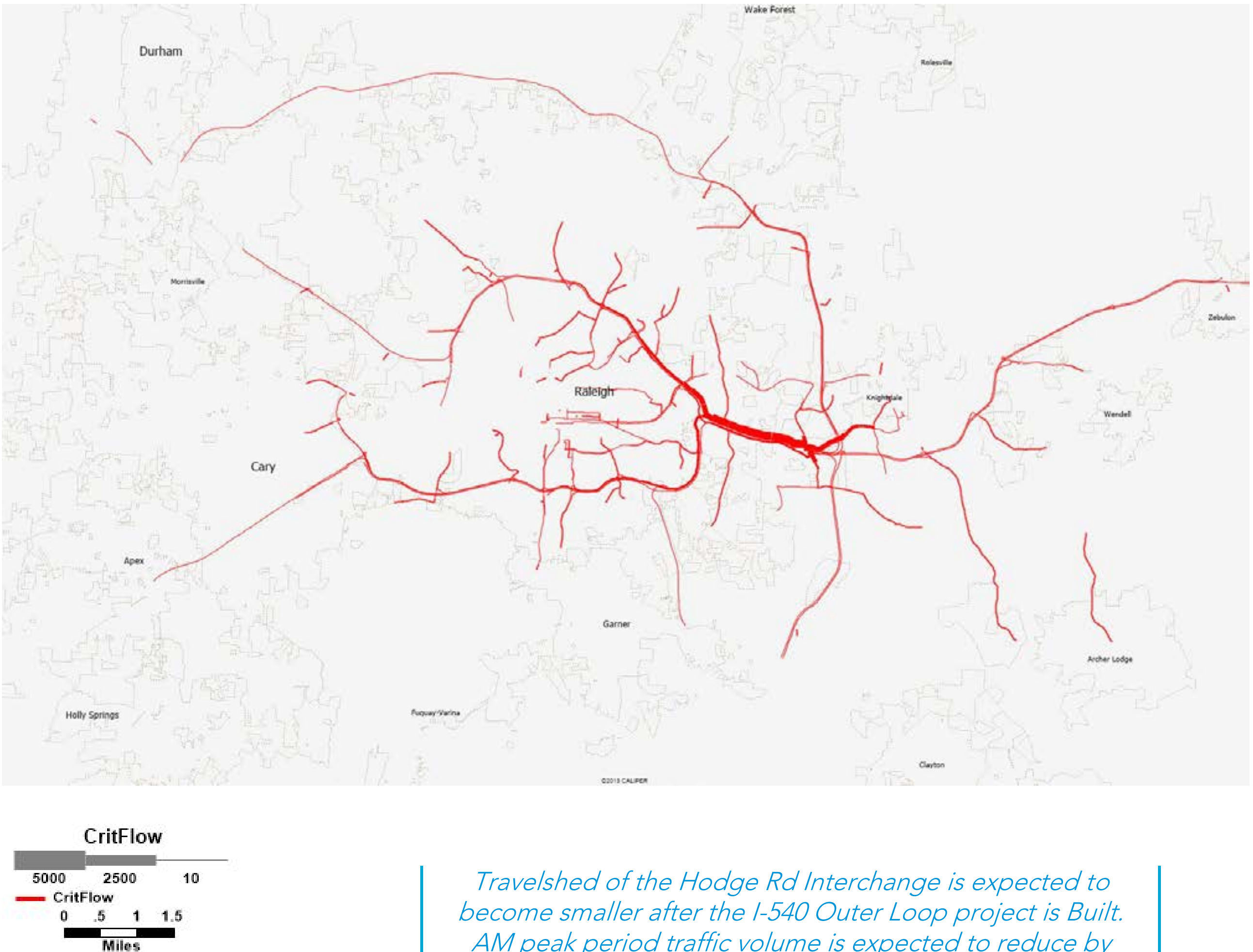
Our conclusions from these pairwise comparisons are noted in call out texts presented under each of the demand analysis map.

Figure 3.7 Pre-540 Travelshed of Hodge Road Interchange – AM Peak Period



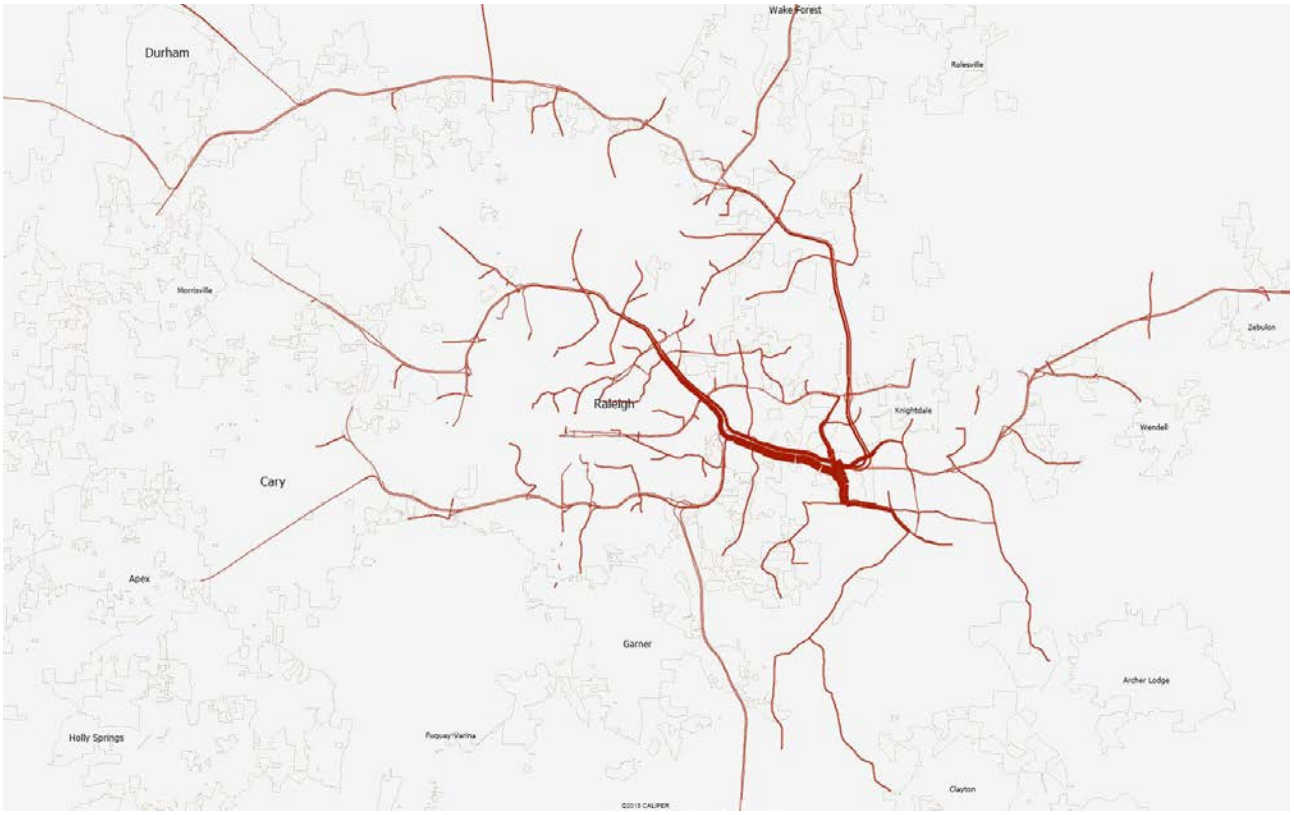
Hodge Rd Interchange will continue to attract both local and regional trips until the I-540 Outer Loop project is Built.

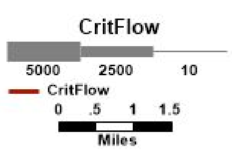
Figure 3.8 Post-540 Travelshed of Hodge Road Interchange – AM Peak Period



Travelshed of the Hodge Rd Interchange is expected to become smaller after the I-540 Outer Loop project is Built. AM peak period traffic volume is expected to reduce by approximately 40 percent.

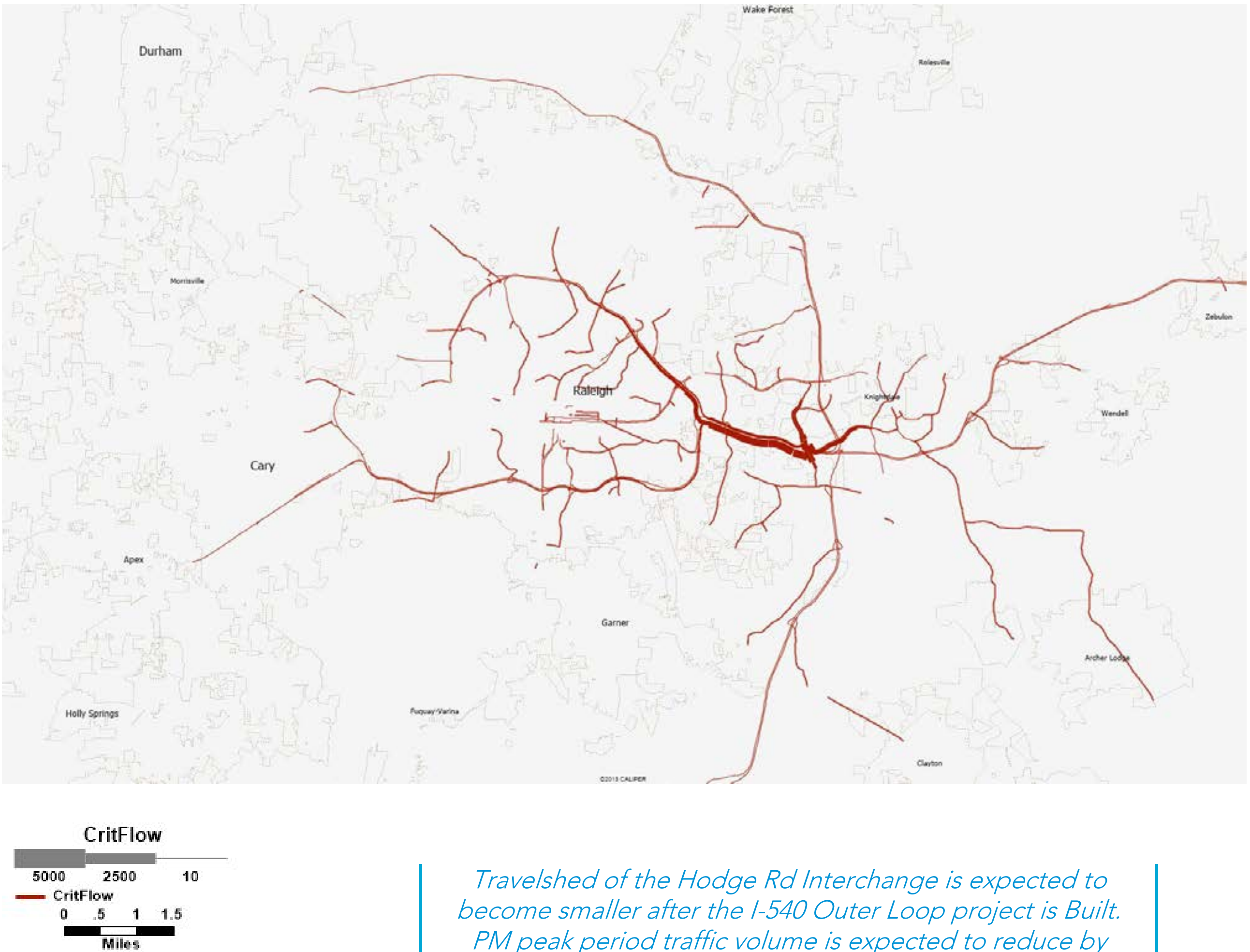
Figure 3.9 Pre-540 Travelshed of Hodge Road Interchange – PM Peak Period





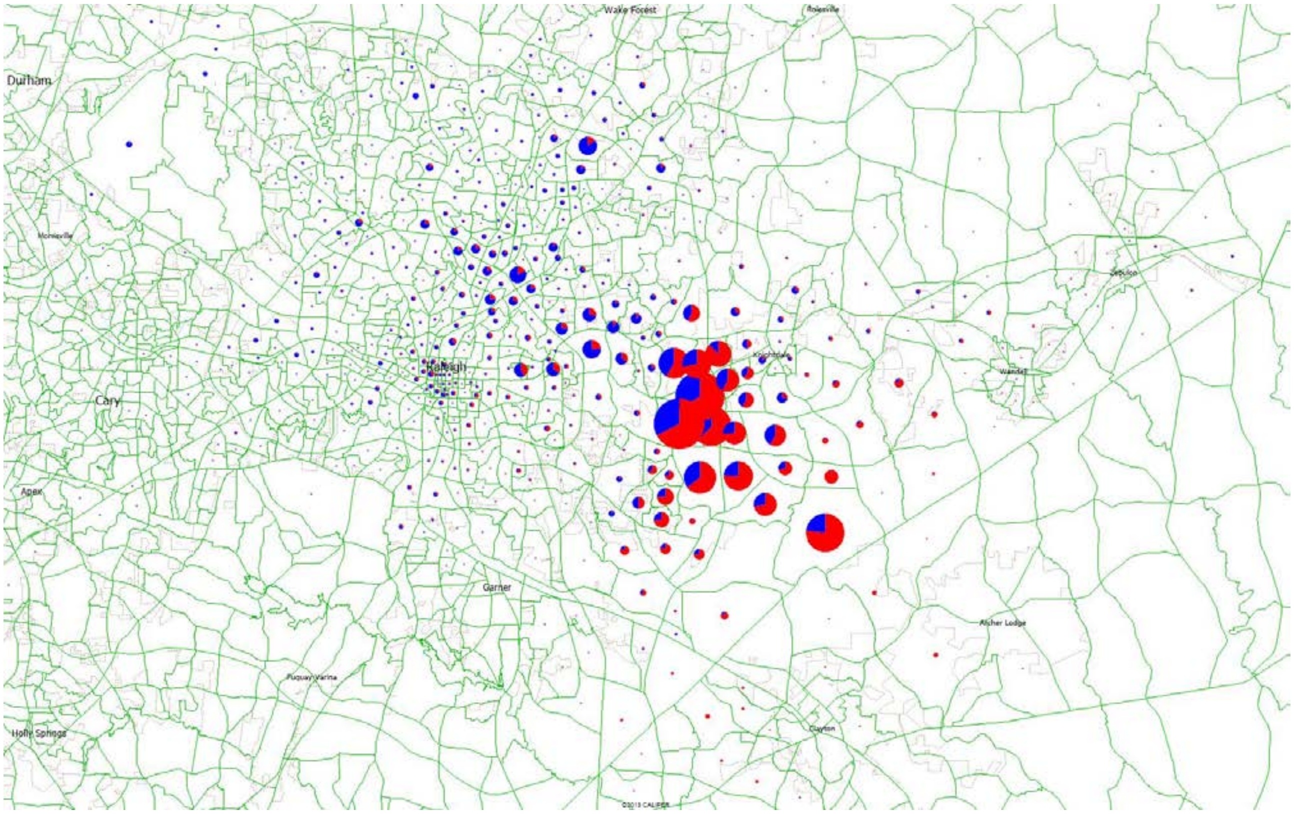
Hodge Rd Interchange will continue to attract both local and regional trips until the I-540 Outer Loop project is Built.

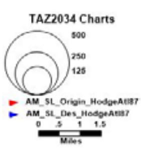
Figure 3.10 Post-540 Travelshed of Hodge Road Interchange – PM Peak Period



Travelshed of the Hodge Rd Interchange is expected to become smaller after the I-540 Outer Loop project is Built. PM peak period traffic volume is expected to reduce by approximately 36 percent.

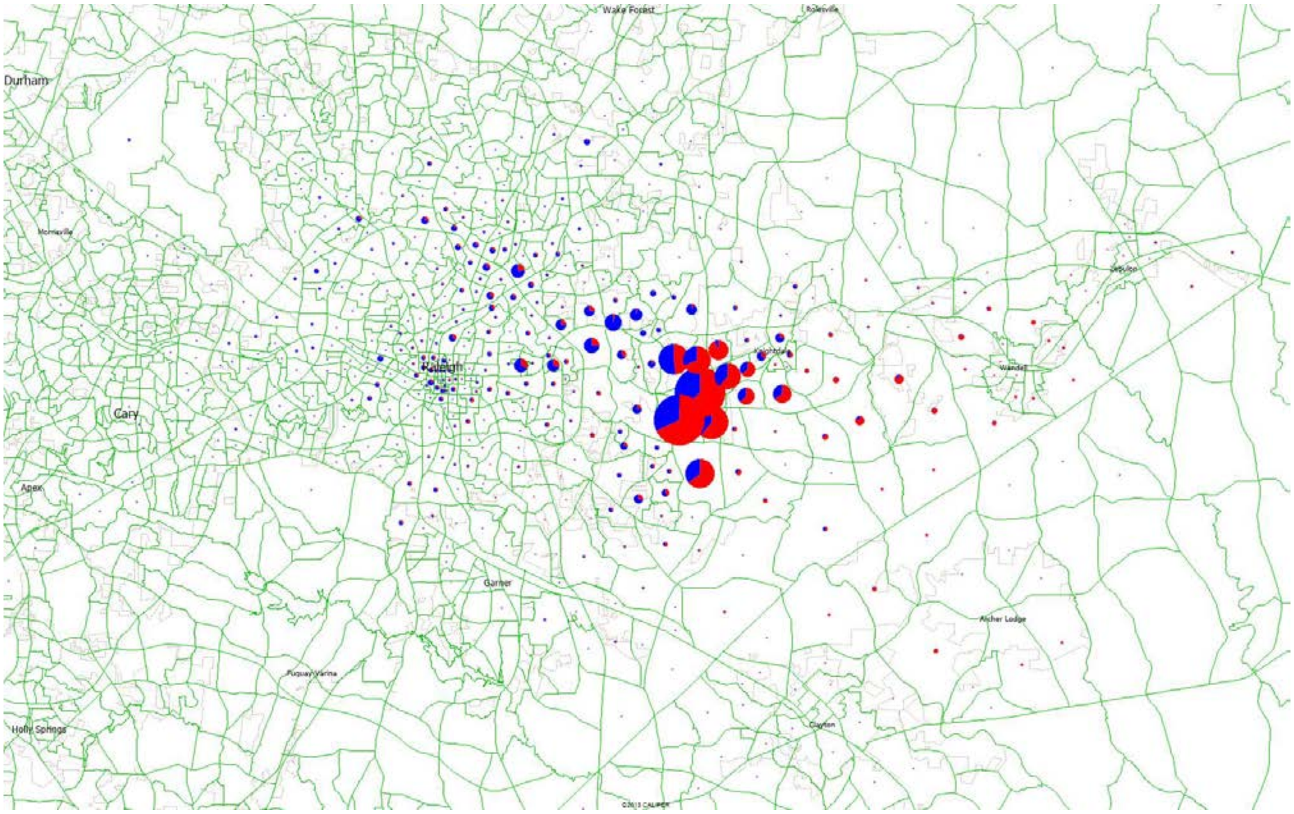
Figure 3.11 Pre-540 Trip O-D of Hodge Road Interchange – AM Peak Hour

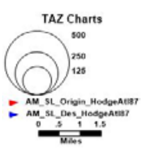




Hodge Rd Interchange will continue to attract both local and regional trips until the I-540 Outer Loop project is Built. However, not many Johnston County trips are expected to use the interchange based on current zonal accessibilities defined in the TRMv6.

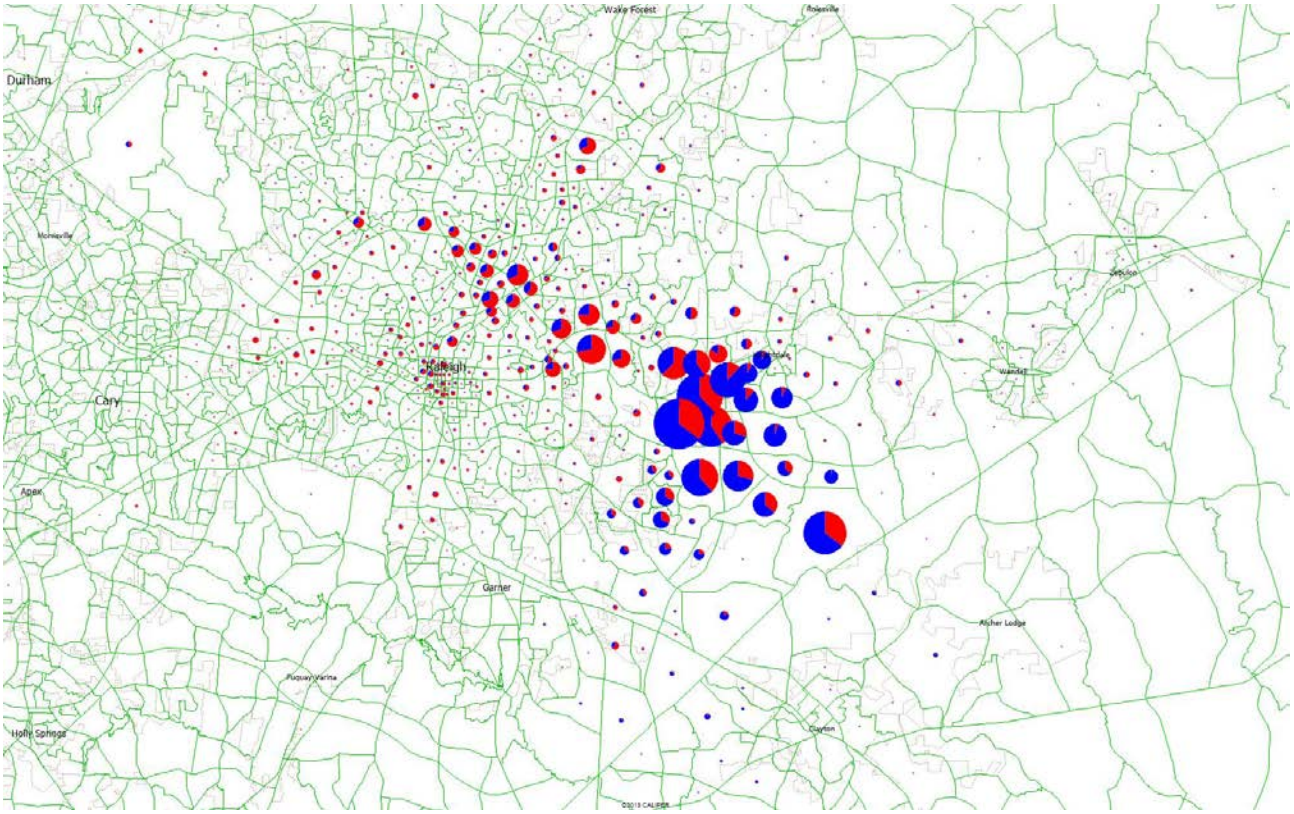
Figure 3.12 Post-540 Trip O-D of Hodge Road Interchange – AM Peak Hour

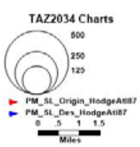




Hodge Rd Interchange is expected to serve more local trips after the I-540 Outer Loop project is Built. Consequently, AM peak hour trip ODs are expected to reduce by 40 percent

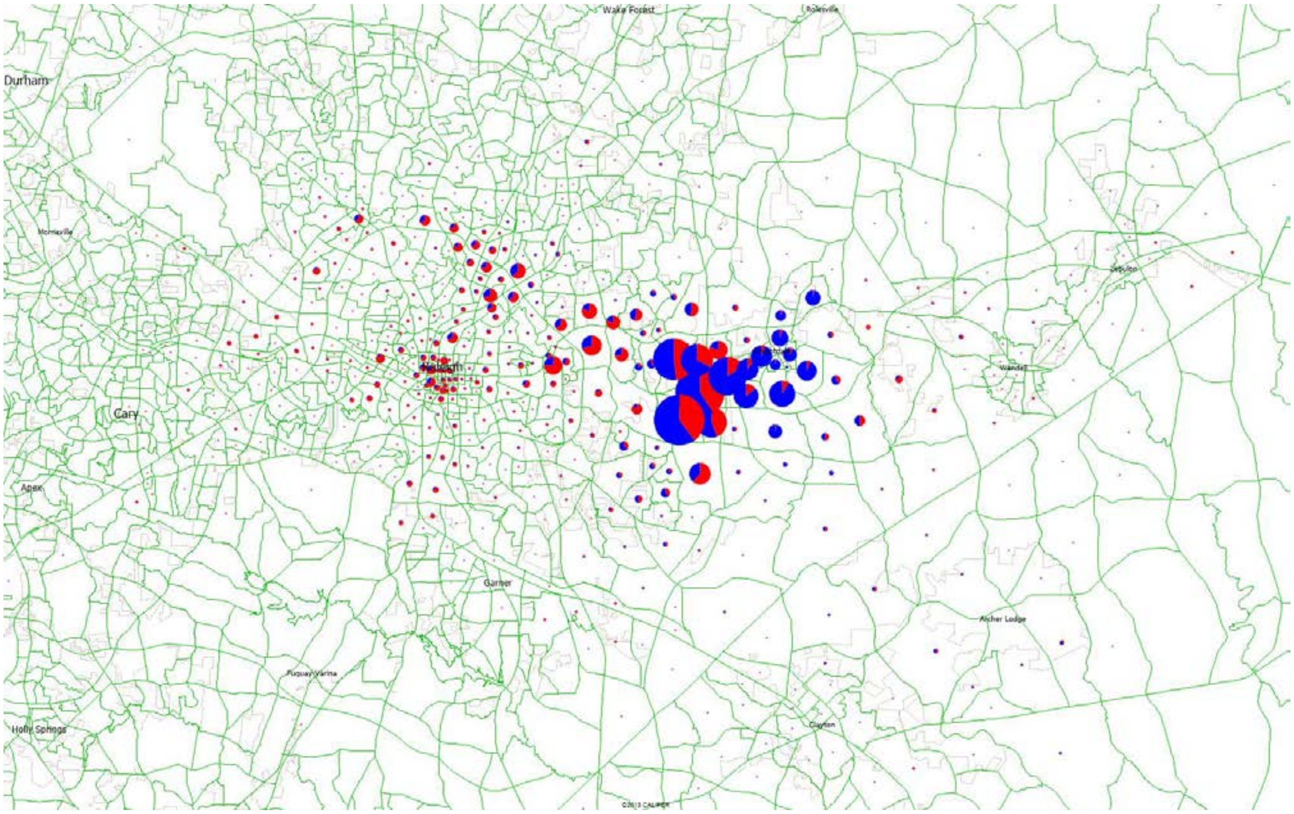
Figure 3.13 Pre-540 Trip O-D of Hodge Road Interchange – PM Peak Hour

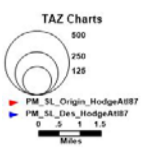




Hodge Rd Interchange will continue to attract both local and regional trips until the I-540 Outer Loop project is Built. However, not many Johnston County trips are expected to use the interchange based on current zonal accessibilities defined in the TRMv6.

Figure 3.14 Post-540 Trip O-D of Hodge Road Interchange – PM Peak Hour





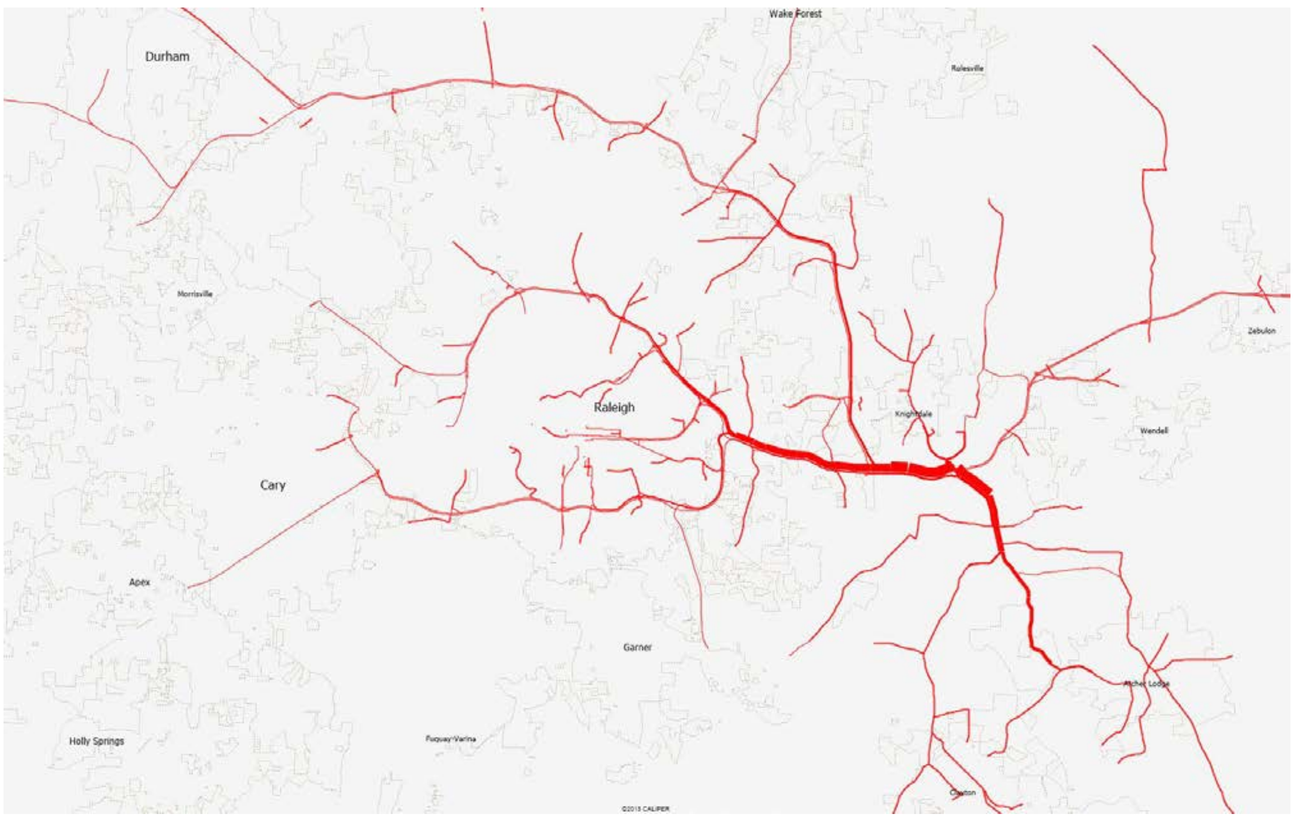
Hodge Rd Interchange is expected to serve more local trips after the I-540 Outer Loop is Built. Consequently, PM peak hour trip ODs are expected to reduce by 36 percent

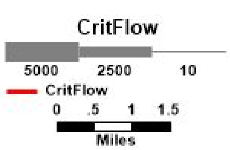
3.4.3 I-87/Smithfield Road Interchange

The Smithfield Road service interchange with I-87 is a traditional diamond design with signalized ramp terminals on both sides of the Smithfield Road underpass. The demand analysis included conducting select-links analysis of the Smithfield Road interchange using the 2035 TRM for two network scenarios: Pre-540 and Post-540.

As described before in section 3.4.2, the results of this analysis are summarized and compared in a series of similar Pre-540 and Post-540 maps, presented in Figures 3.15 through 3.22. Our conclusions from these pairwise comparisons are noted in call out texts presented under each of the demand analysis map.

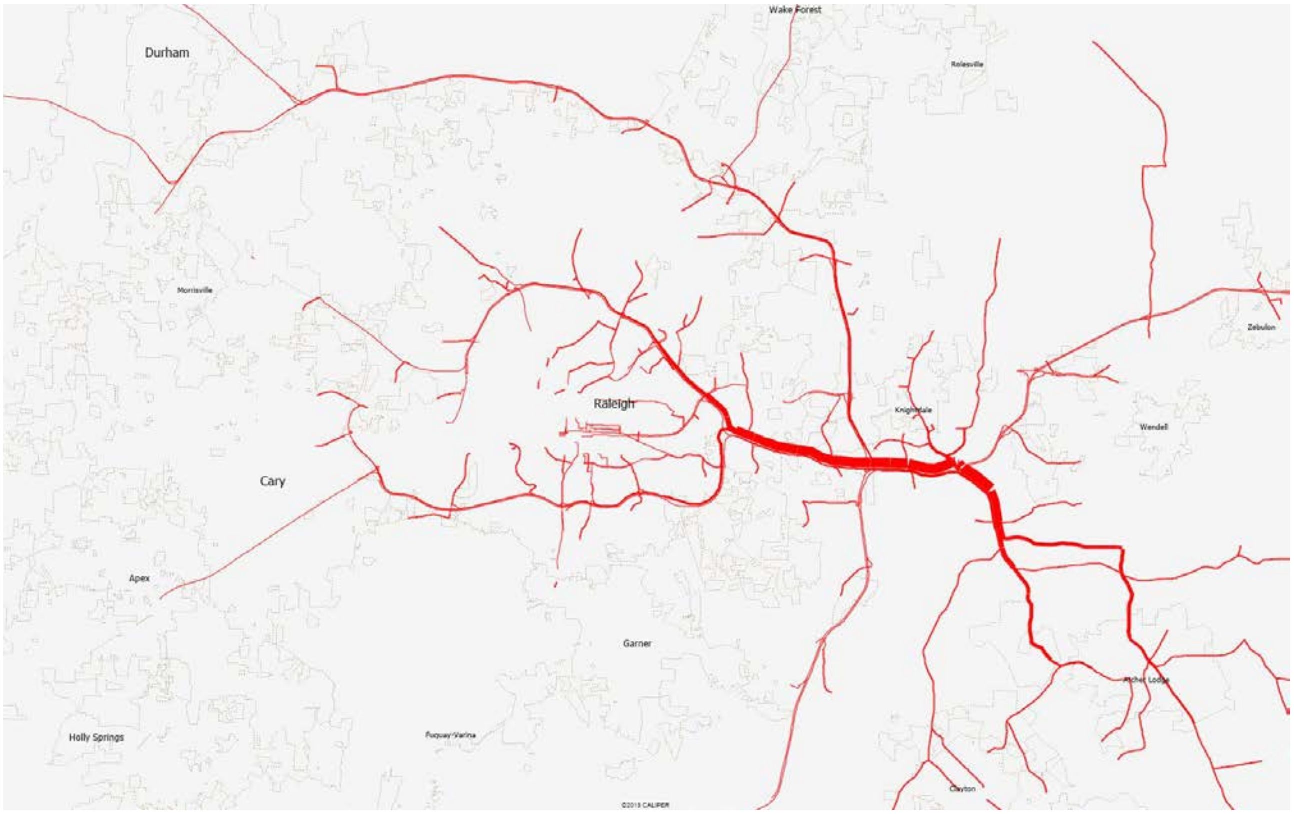
Figure 3.15 Pre-540 Travelshed of Smithfield Road Interchange – AM Peak Period

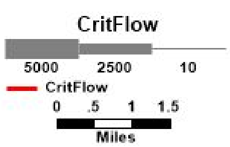




Smithfield Rd Interchange will continue to attract both local and regional trips until the I-540 Outer Loop project is Built.

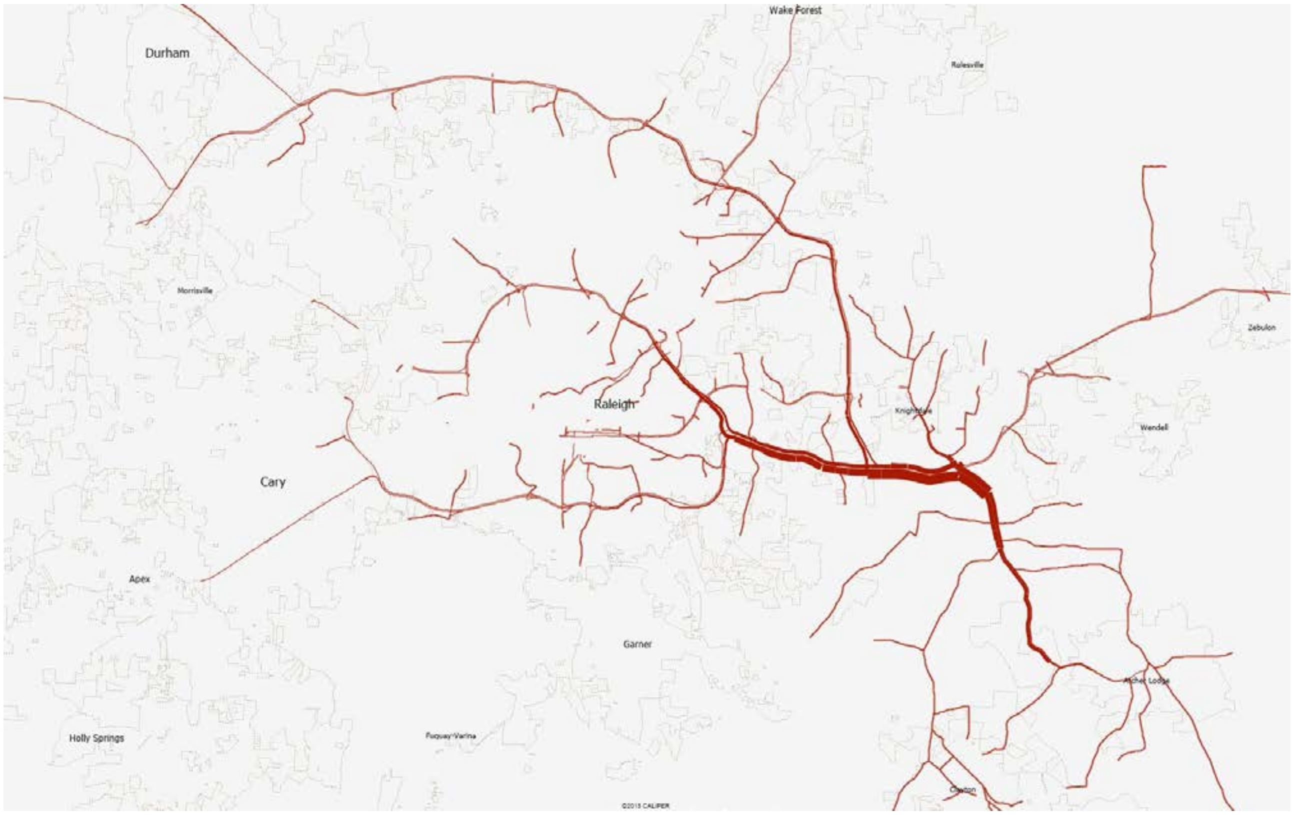
Figure 3.16 Post-540 Travelshed of Smithfield Road Interchange – AM Peak Period

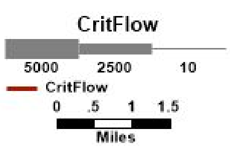




Travelshed of the Smithfield Rd Interchange is expected to become larger after the I-540 Outer Loop project is Built. AM peak period traffic volume is expected to increase by approximately 25 percent.

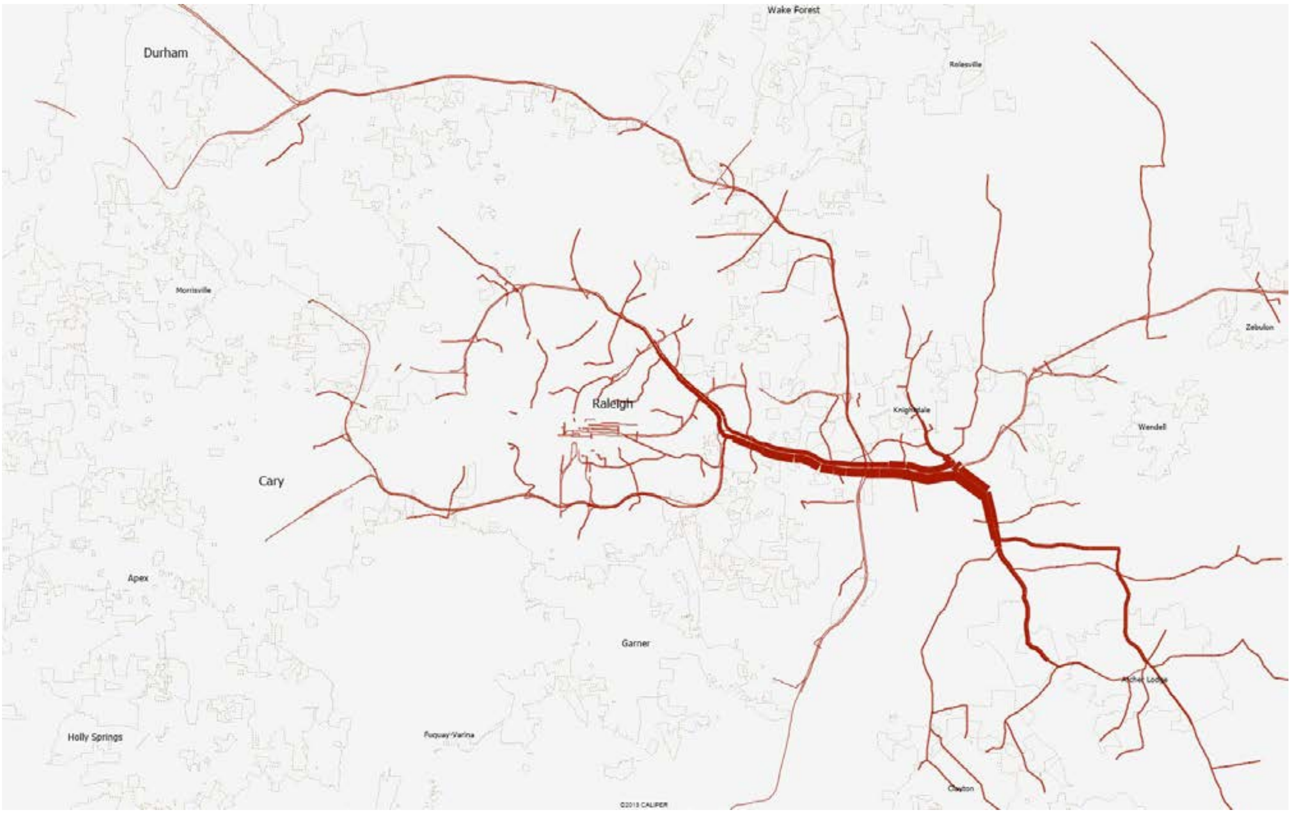
Figure 3.17 Pre-540 Travelshed of Smithfield Road Interchange – PM Peak Period

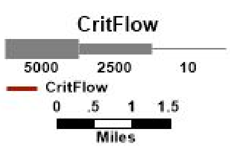




Smithfield Rd Interchange will continue to attract both local and regional trips until the I-540 Outer Loop project is Built.

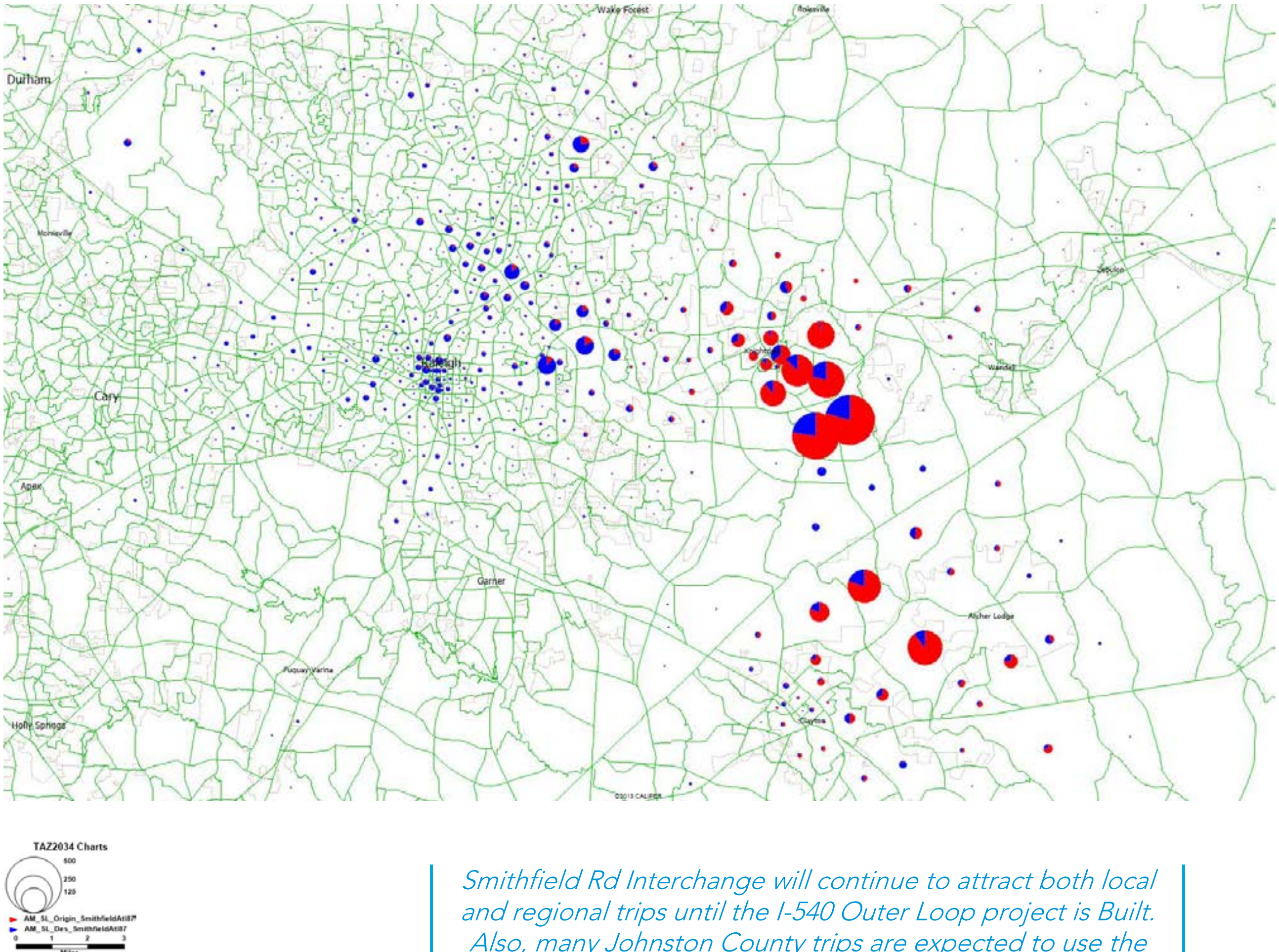
Figure 3.18 Post-540 Travelshed of Smithfield Road Interchange – PM Peak Period





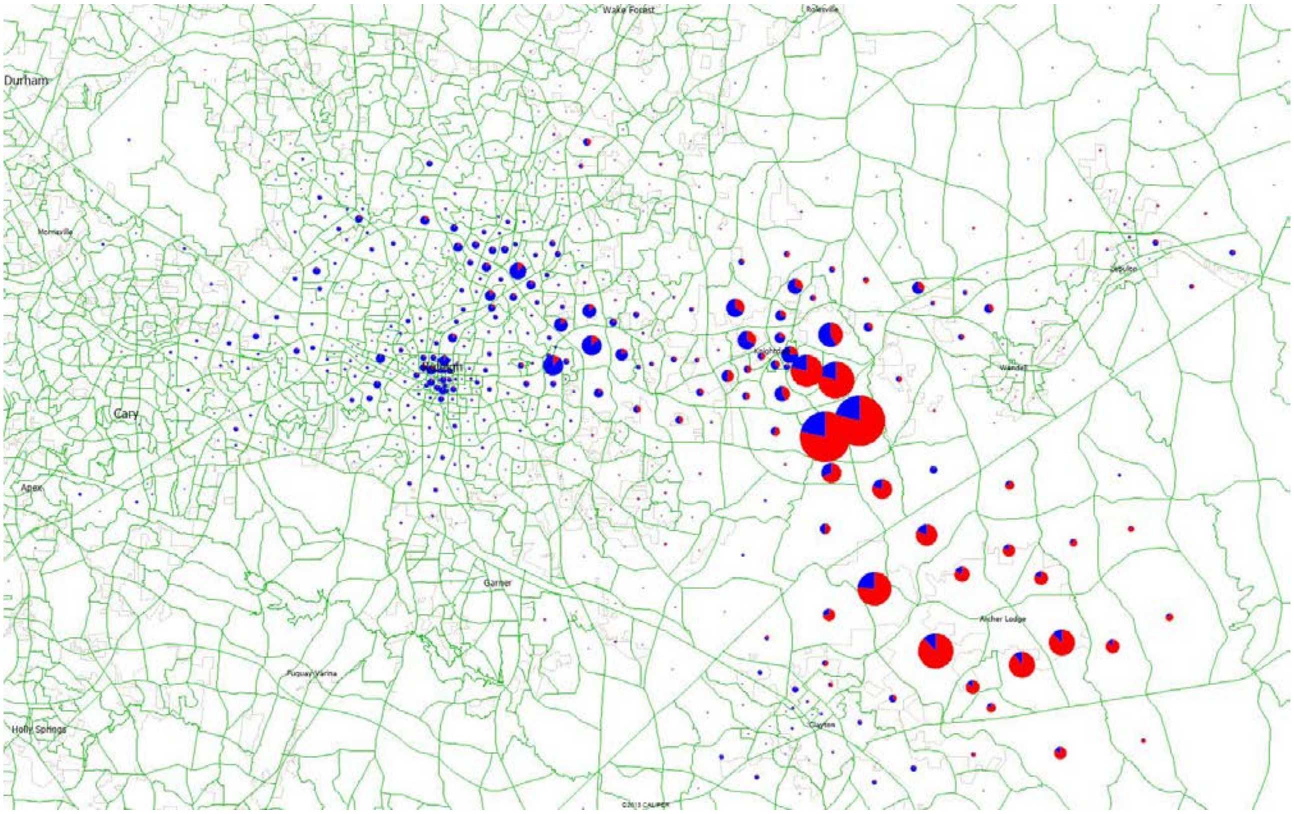
Travelshed of the Smithfield Rd Interchange is expected to become larger after the I-540 Outer Loop project is Built. PM peak period traffic volume is expected to increase by approximately 22 percent.

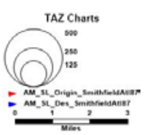
Figure 3.19 Pre-540 Trip O-D of Smithfield Road Interchange – AM Peak Hour



Smithfield Rd Interchange will continue to attract both local and regional trips until the I-540 Outer Loop project is Built. Also, many Johnston County trips are expected to use the interchange based on current zonal accessibilities defined in the TRMv6.

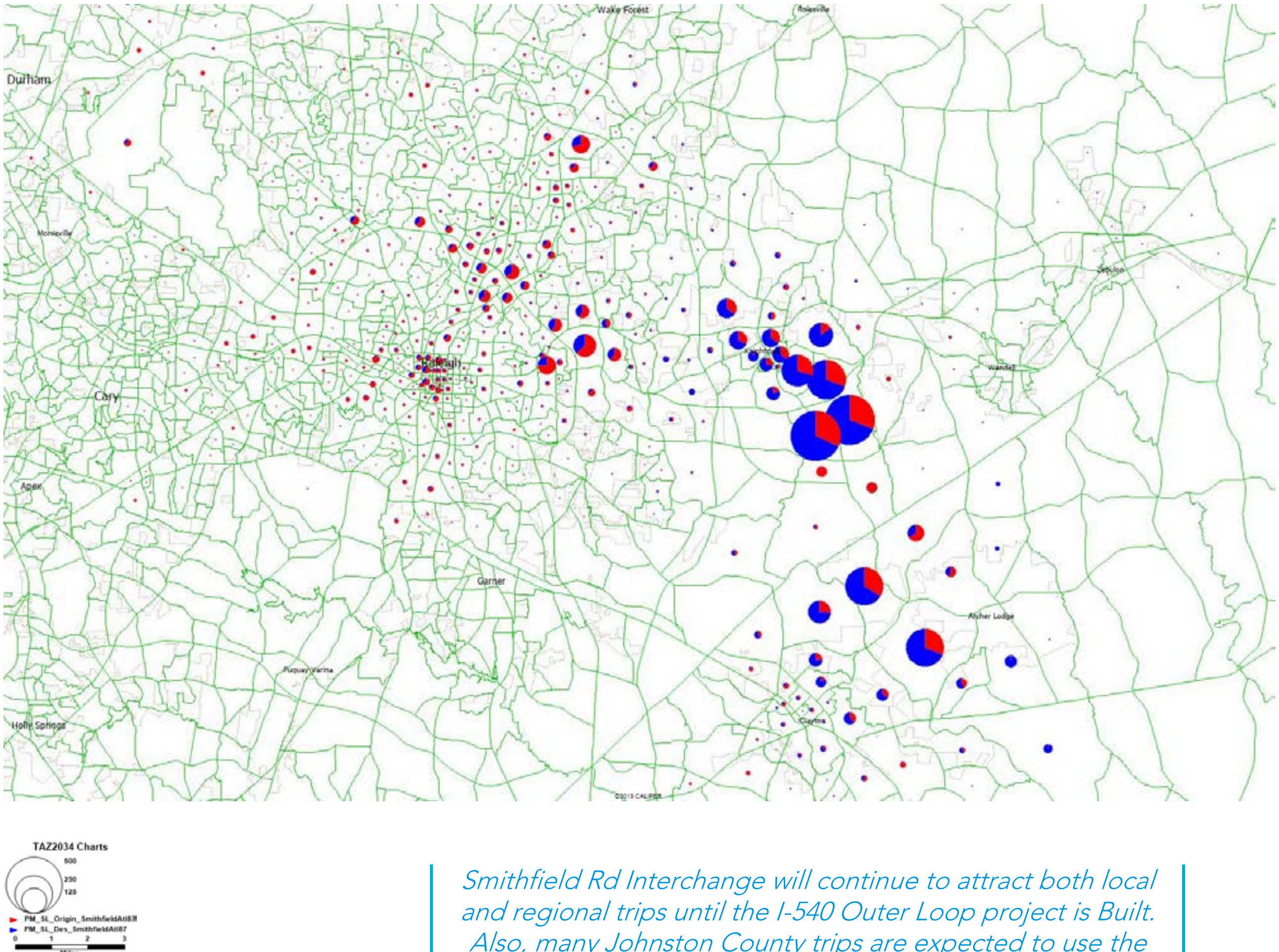
Figure 3.20 Post-540 Trip O-D of Smithfield Road Interchange – AM Peak Hour





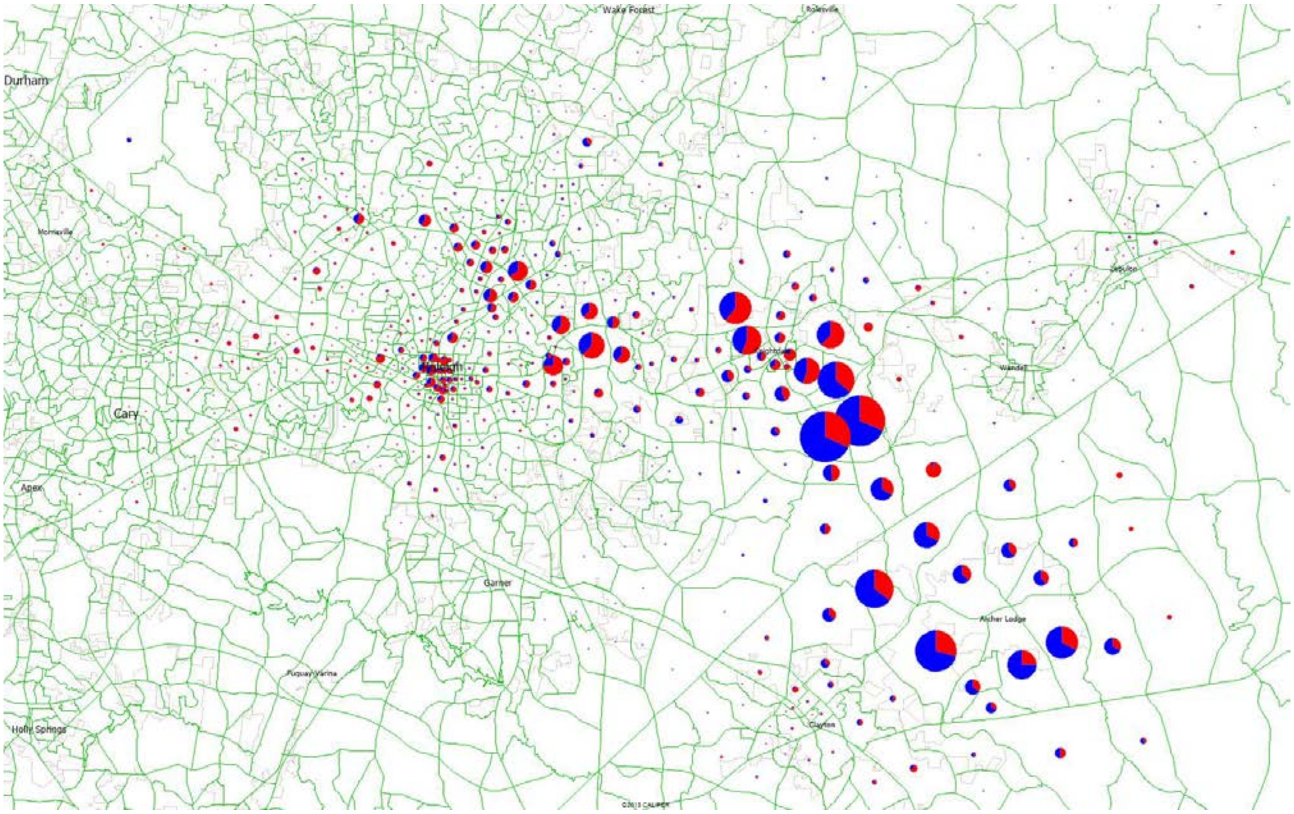
Smithfield Rd Interchange is expected to serve more regional trips after the I-540 Outer Loop is Built. Consequently, AM peak hour trip ODs are expected to increase by 25 percent

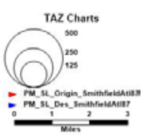
Figure 3.21 Pre-540 Trip O-D of Smithfield Road Interchange – PM Peak Hour



Smithfield Rd Interchange will continue to attract both local and regional trips until the I-540 Outer Loop project is Built. Also, many Johnston County trips are expected to use the interchange based on current zonal accessibilities defined in the TRMv6.

Figure 3.22 Post-540 Trip O-D of Smithfield Road Interchange – PM Peak Hour





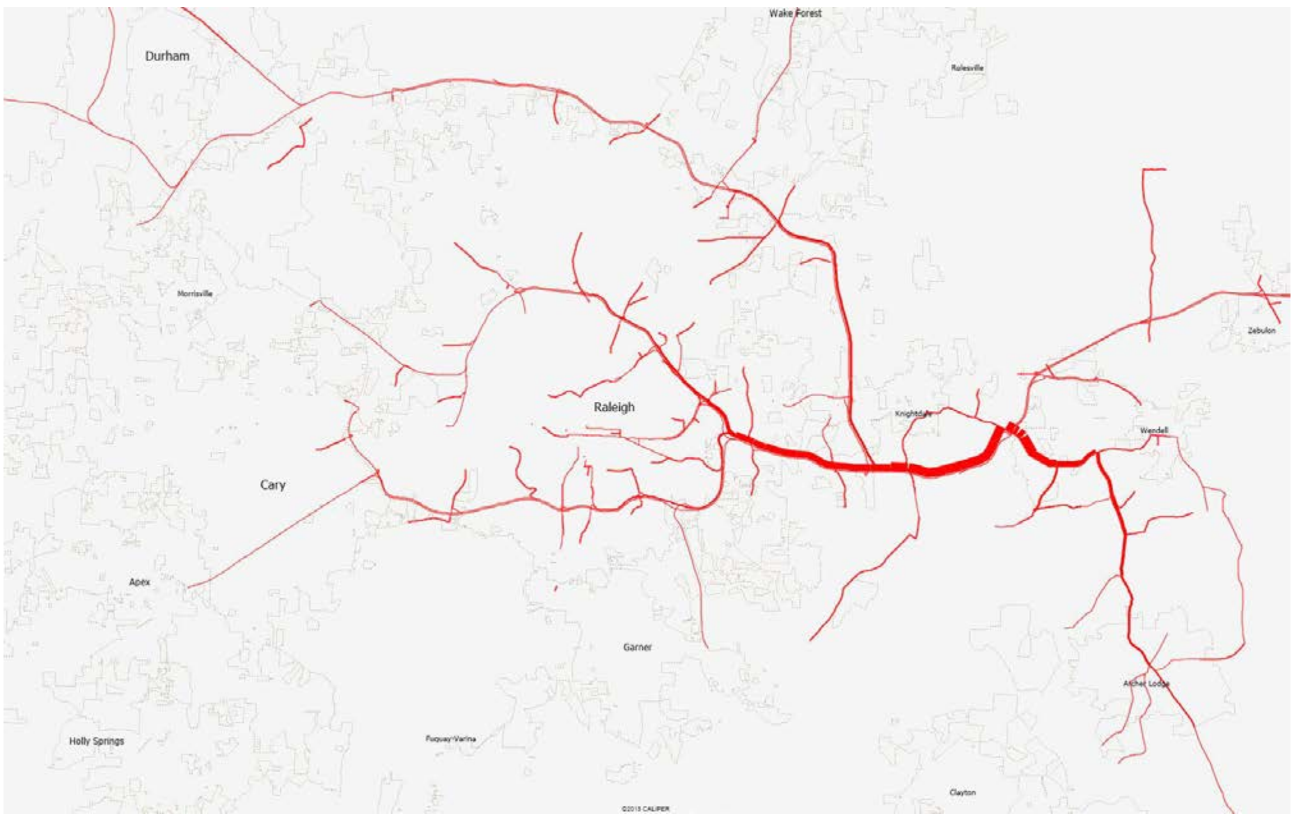
Smithfield Rd Interchange is expected to serve more regional trips after the I-540 Outer Loop is Built. Consequently, PM peak hour trip ODs are expected to increase by 22 percent

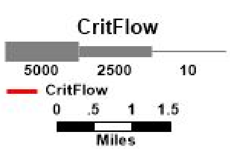
3.4.4 I-87/Wendell Falls Parkway Interchange

The Wendell Falls Parkway service interchange with I-87 is a partial cloverleaf design with loop ramps in the northwest and southwest interchange quadrants. Signalized ramp terminals exist on both sides of the 5-lane Wendell Falls Parkway overpass. The demand analysis included conducting select-links analysis of the Wendell Falls Parkway interchange using the 2035 TRM for two network scenarios: Pre-540 and Post-540.

As described before in section 3.4.2, the results of this analysis are summarized and compared in a series of similar Pre-540 and Post-540 maps, presented in Figures 3.23 through 3.30. Our conclusions from these pairwise comparisons are noted in call out texts presented under each of the demand analysis map.

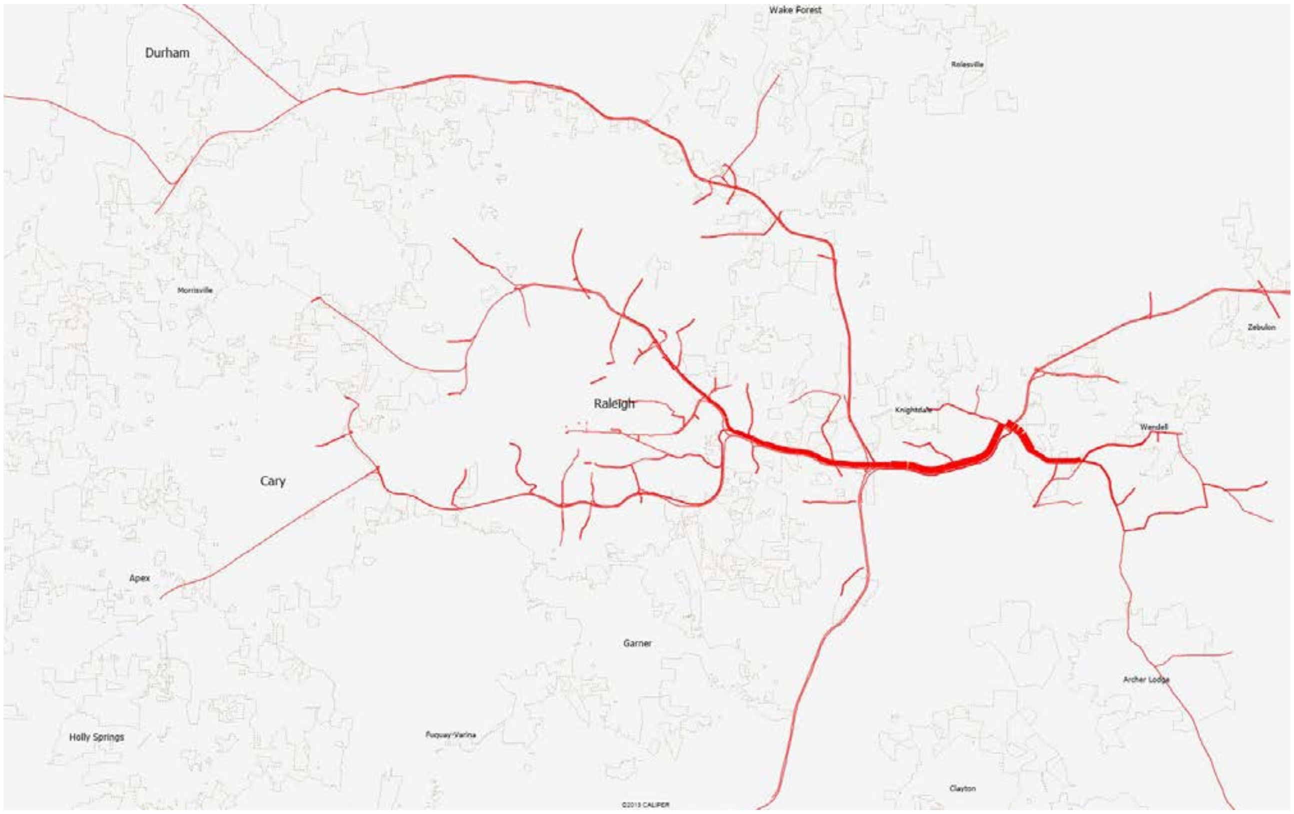
Figure 3.23 Pre-540 Travelshed of Wendell Falls Parkway Interchange – AM Peak Period

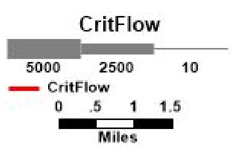




Wendell Falls Pkwy Interchange will continue to attract both local and regional trips until the I-540 Outer Loop project is Built.

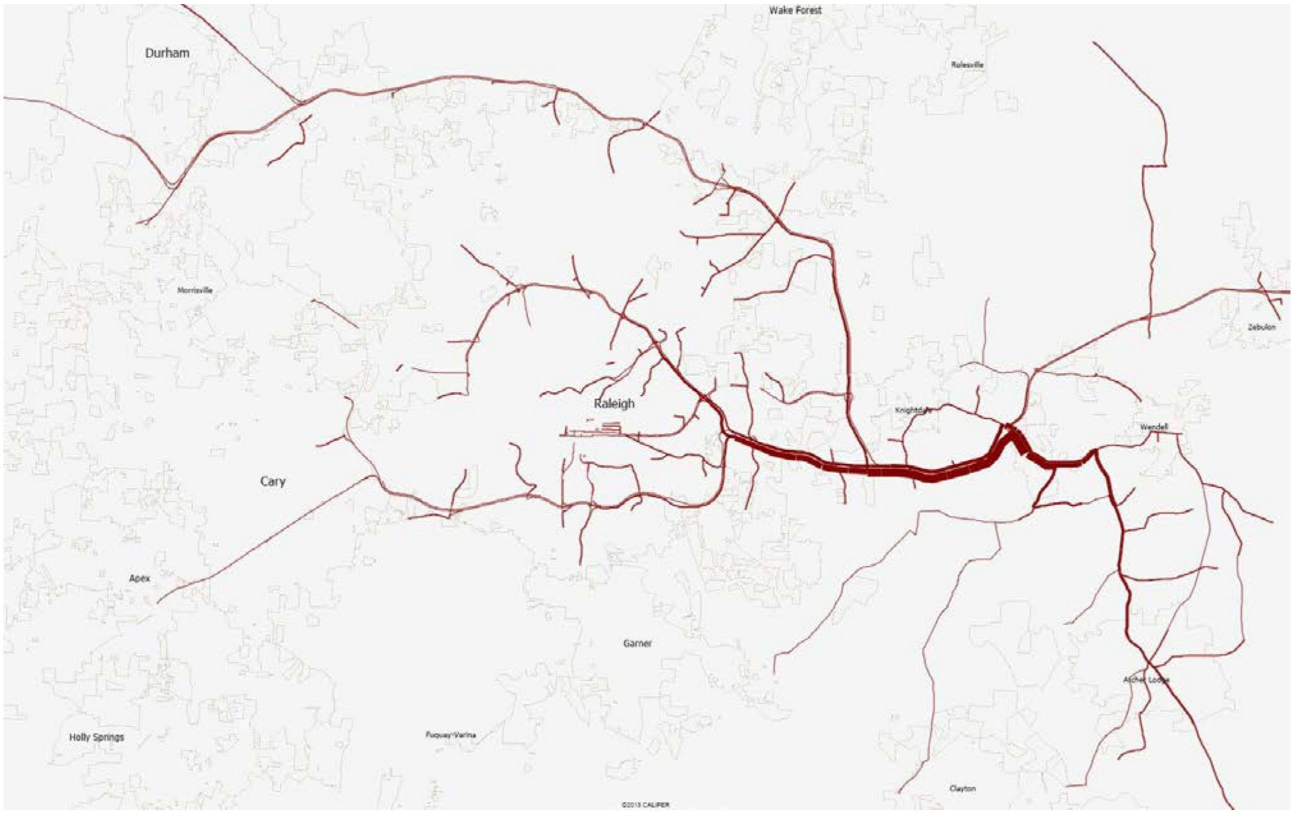
Figure 3.24 Post-540 Travelshed of Wendell Falls Parkway Interchange – AM Peak Period

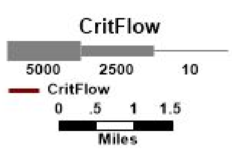




Travelshed of the Wendell Falls Pkwy Interchange is expected to become smaller after the I-540 Outer Loop project is Built. AM peak period traffic volume is expected to reduce by approximately 15 percent.

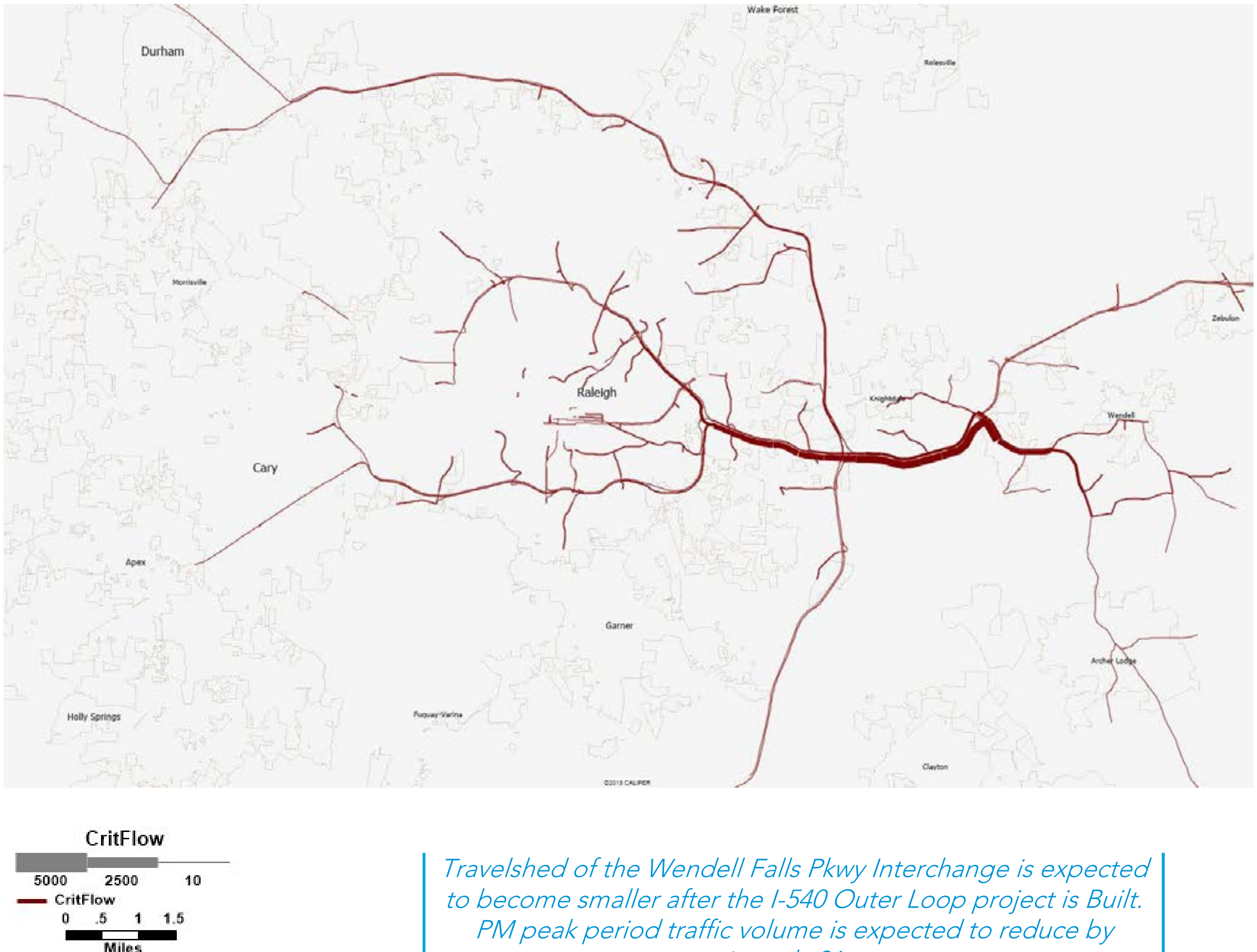
Figure 3.25 Pre-540 Travelshed of Wendell Falls Parkway Interchange – PM Peak Period





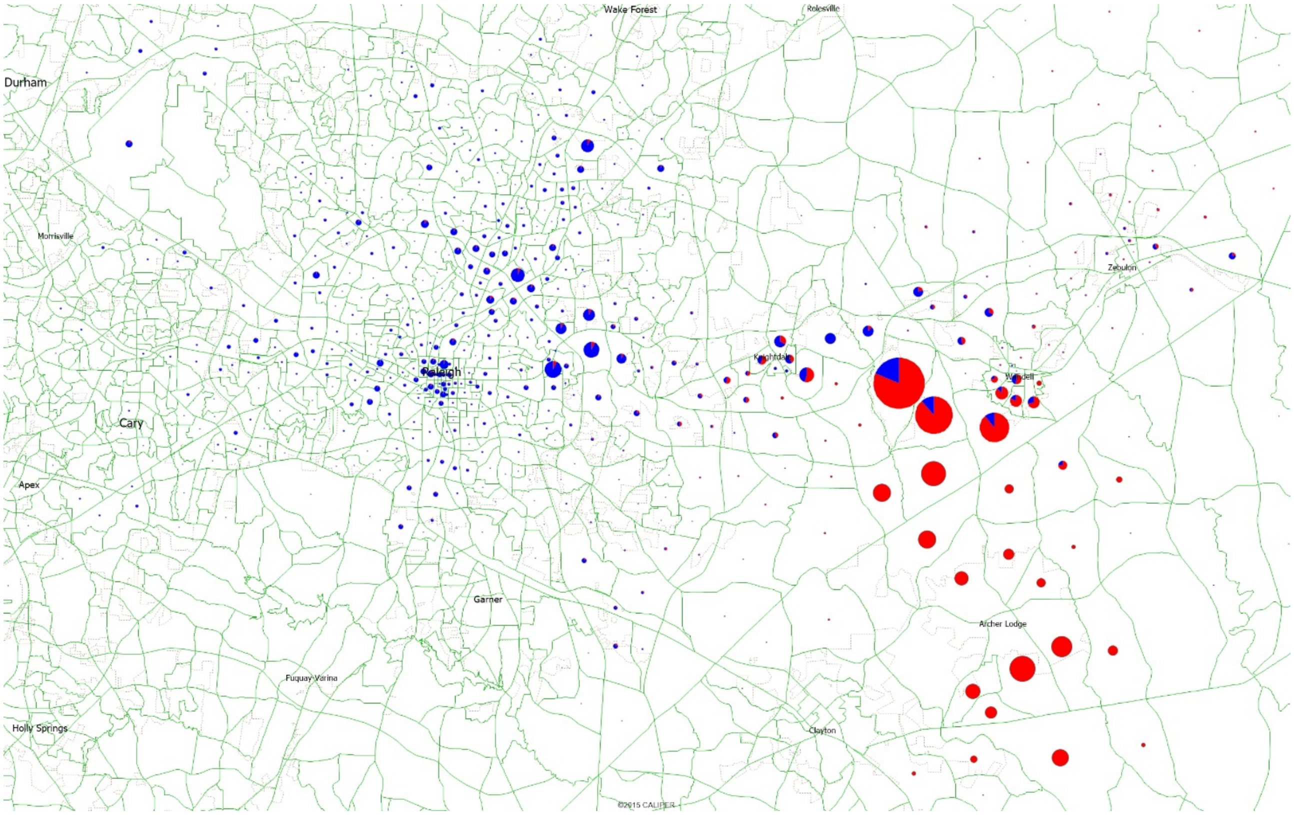
Wendell Falls Pkwy Interchange will continue to attract both local and regional trips until the I-540 Outer Loop project is Built.

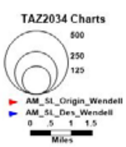
Figure 3.26 Post-540 Travelshed of Wendell Falls Parkway Interchange – PM Peak Period



Travelshed of the Wendell Falls Pkwy Interchange is expected to become smaller after the I-540 Outer Loop project is Built. PM peak period traffic volume is expected to reduce by approximately 21 percent.

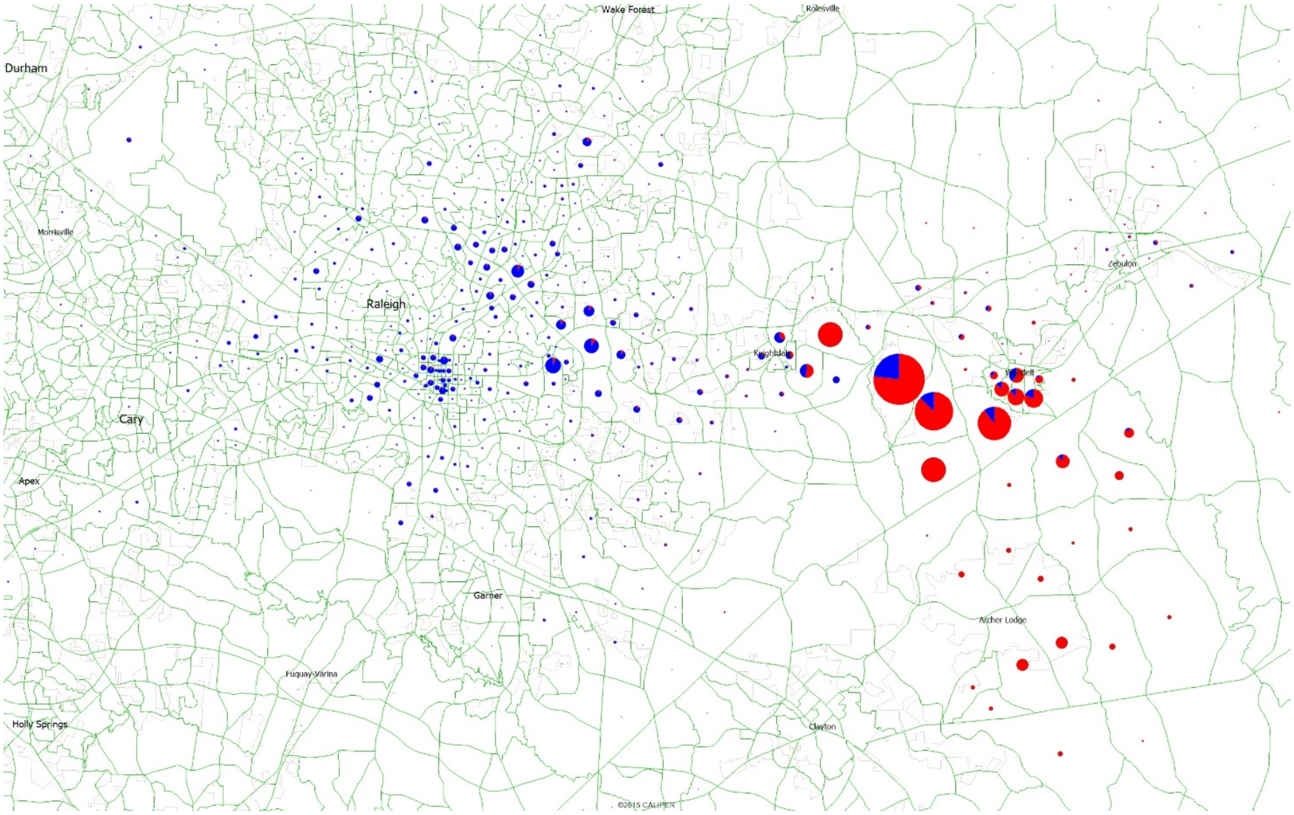
Figure 3.27 Pre-540 Trip O-D of Wendell Falls Parkway Interchange – AM Peak Hour

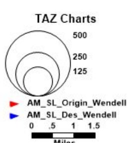




Wendell Falls Pkwy Interchange will continue to attract both local and regional trips until the I-540 Outer Loop project is Built. Also, many Johnston County trips are expected to use the interchange based on current zonal accessibilities defined in the TRMv6.

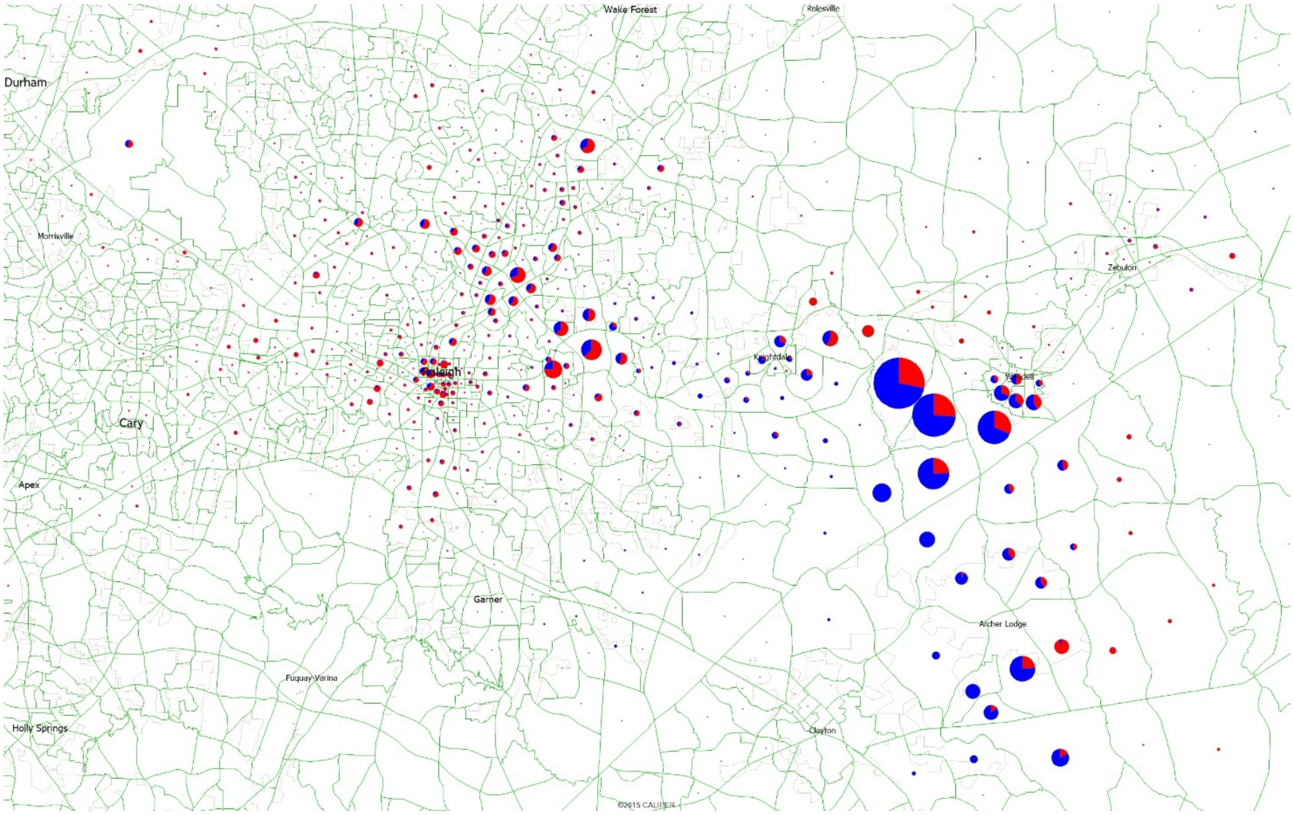
Figure 3.28 Post-540 Trip O-D of Wendell Falls Parkway Interchange – AM Peak Hour

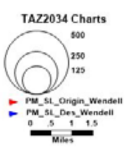




Wendell Falls Pkwy Interchange is expected to serve more local trips after the I-540 Outer Loop project is Built. Consequently, AM peak hour trip ODs are expected to reduce by 15 percent

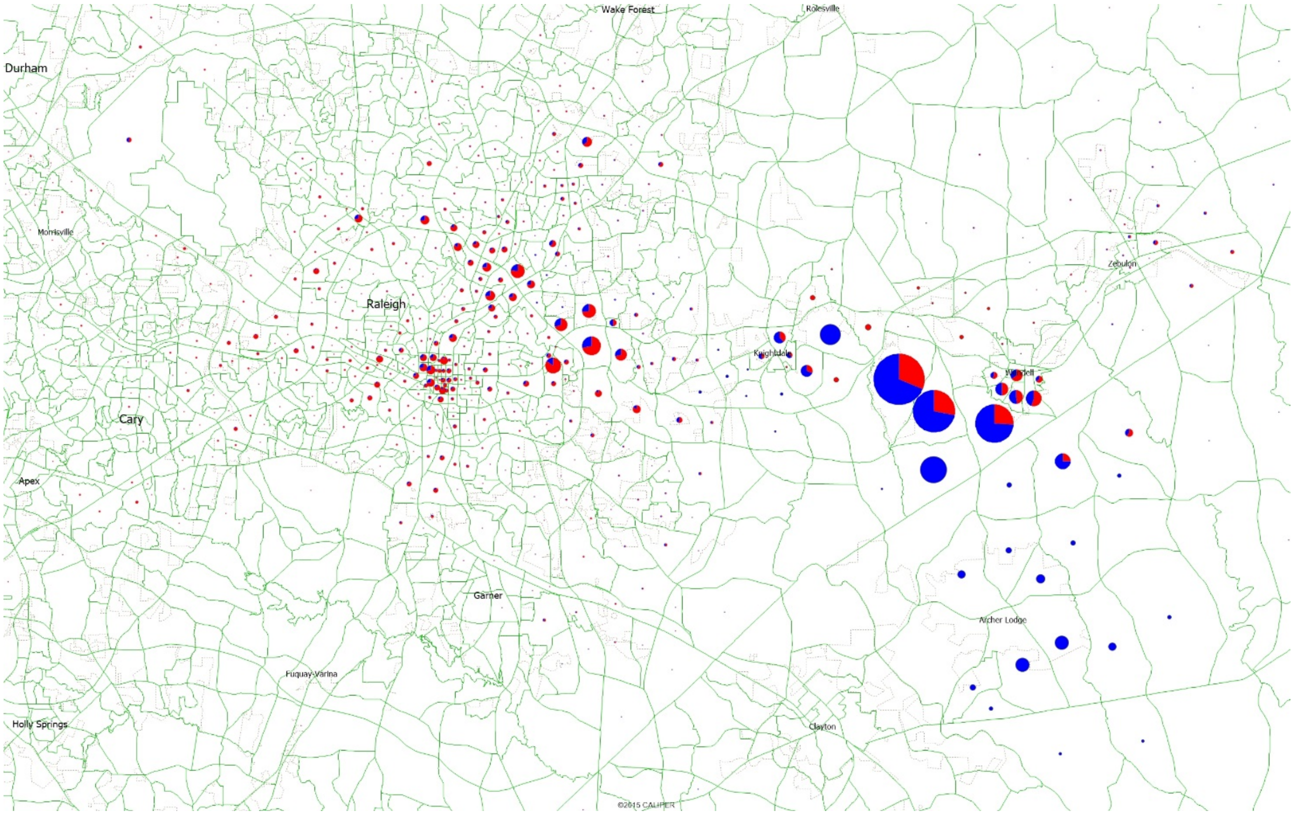
Figure 3.29 Pre-540 Trip O-D of Wendell Falls Parkway Interchange – PM Peak Hour

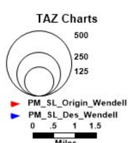




Wendell Falls Pkwy Interchange will continue to attract both local and regional trips until the I-540 Outer Loop project is Built. Also, many Johnston County trips are expected to use the interchange based on current zonal accessibilities defined in the TRMv6.

Figure 3.30 Post-540 Trip O-D of Wendell Falls Parkway Interchange – PM Peak Hour





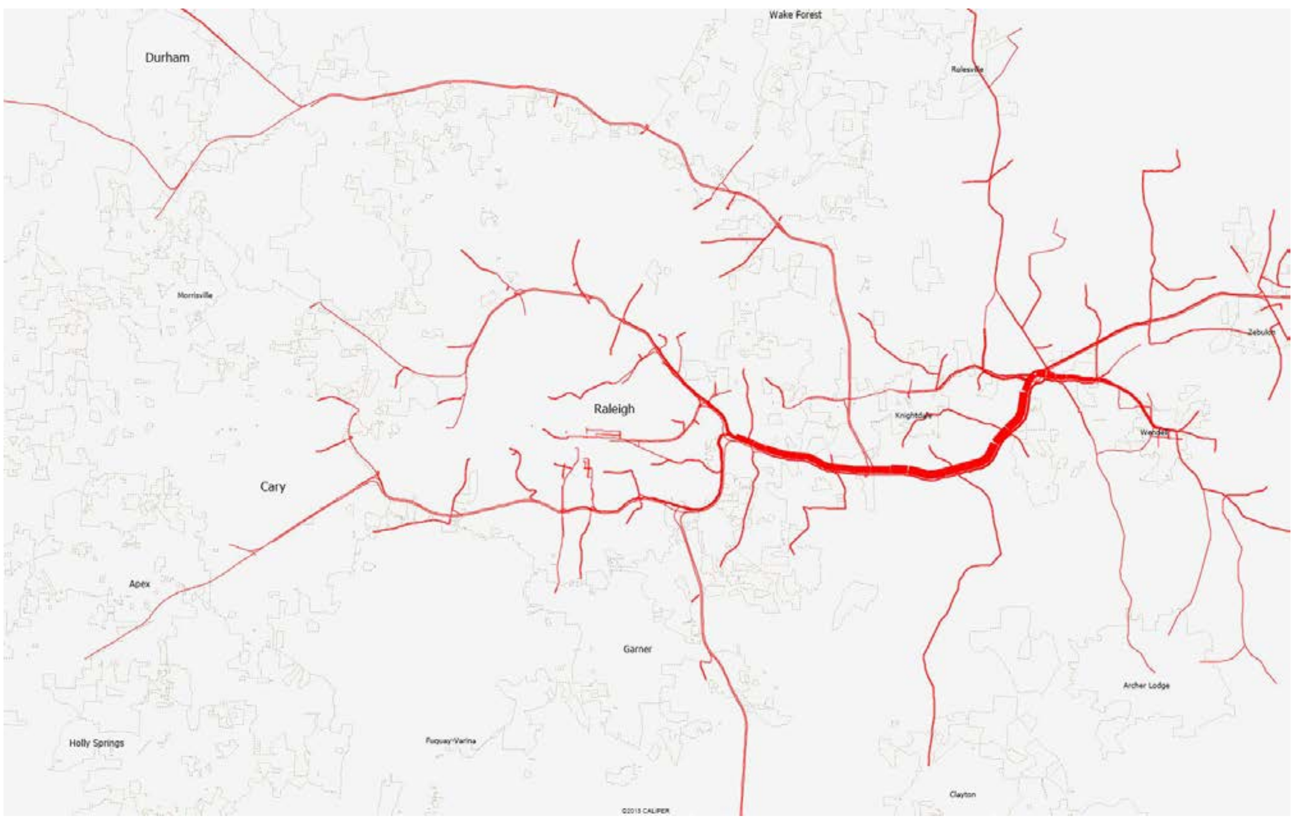
Wendell Falls Pkwy Interchange is expected to serve more local trips after the I-540 Outer Loop project is Built. Consequently, PM peak hour trip ODs are expected to reduce by 21 percent

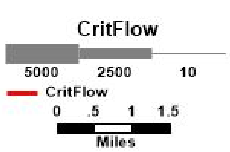
3.4.5 I-87/IUS 64 Business Interchange

The US 64 Business service interchange with I-87 is a hybrid design with a loop ramp at the northeast quadrant and a direct flyover ramp for eastbound US 64 Business to eastbound US 64/US 264 movement. The interchange has signalized ramp terminals on both sides of the US 64 Business underpass. The demand analysis included conducting select-links analysis of the US 64 Business interchange using the 2035 TRM for two network scenarios: Pre-540 and Post-540.

As described before in section 3.4.2, the results of this analysis are summarized and compared in a series of similar Pre-540 and Post-540 maps, presented in Figures 3.31 through 3.38. Our conclusions from these pairwise comparisons are noted in call out texts presented under each of the demand analysis map.

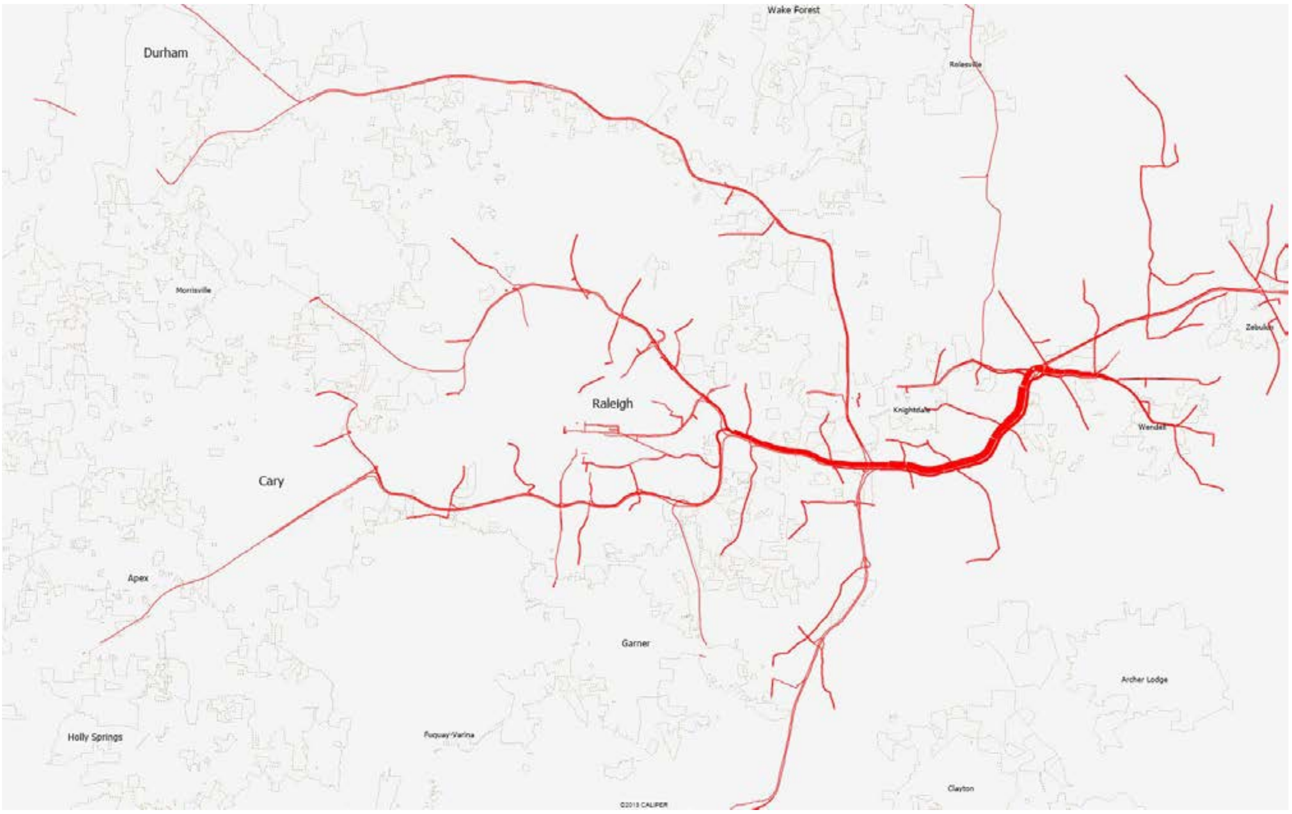
Figure 3.31 Pre-540 Travelshed of US 64 Business Interchange – AM Peak Period

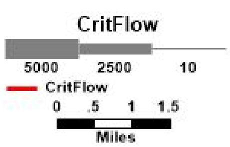




US 64 Business Interchange will continue to attract both local and regional trips until the I-540 Outer Loop project is Built.

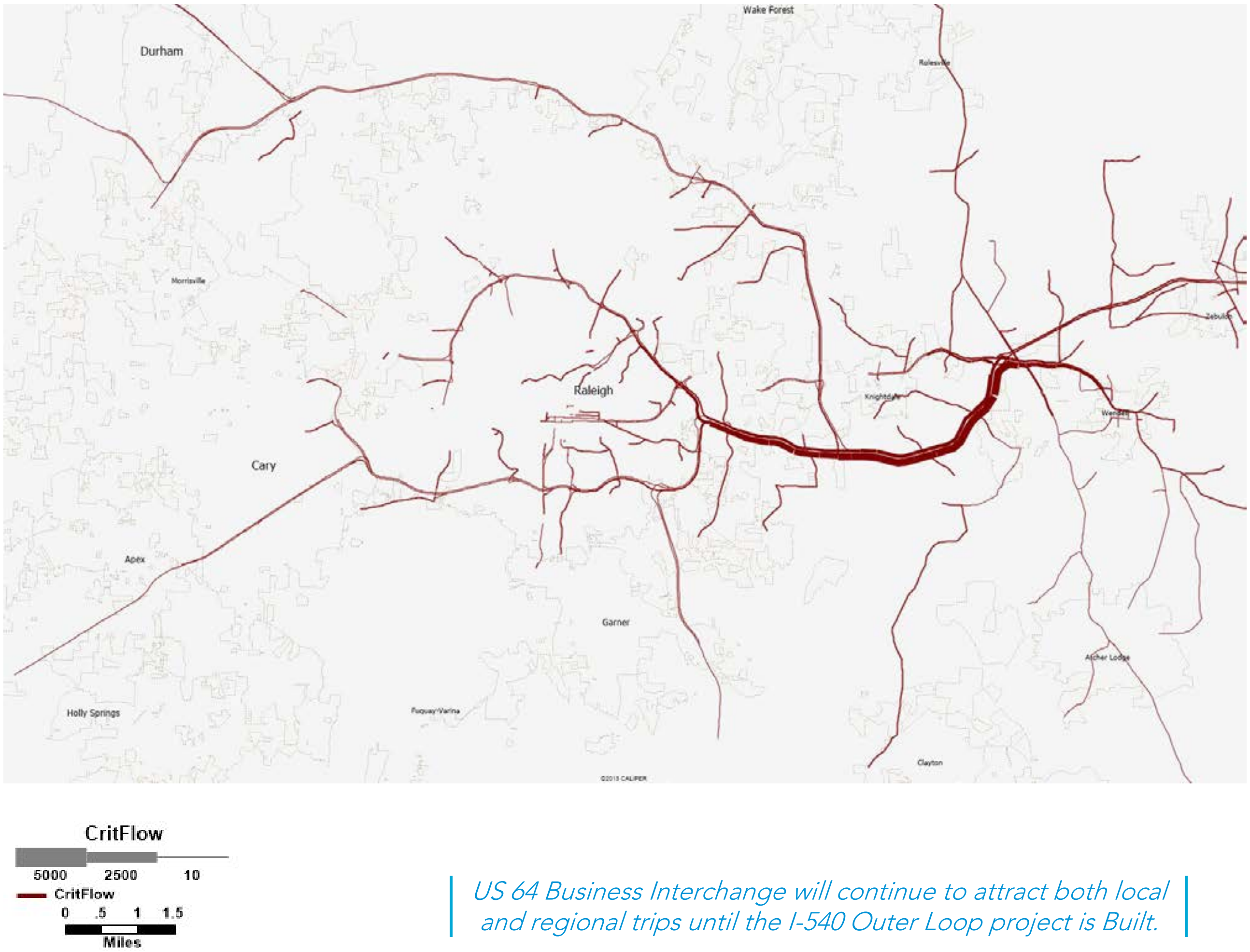
Figure 3.32 Post-540 Travelshed of US 64 Business Interchange – AM Peak Period





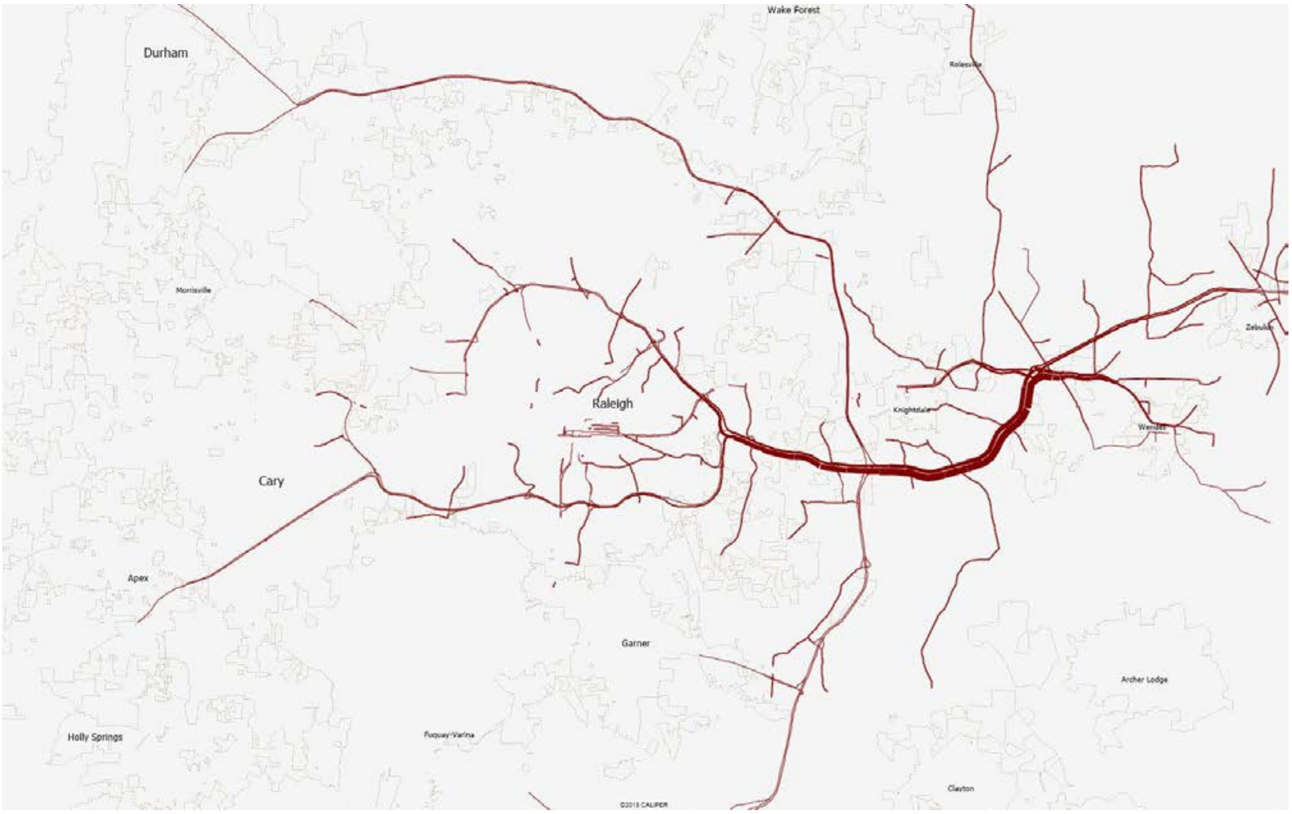
Travelshed of the US 64 Business Interchange is expected to become slightly smaller after the I-540 Outer Loop project is Built. AM peak period traffic volume is expected to reduce by approximately 8 percent.

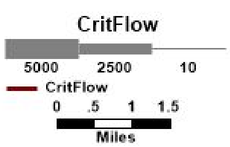
Figure 3.33 Pre-540 Travelshed of US 64 Business Interchange – PM Peak Period



US 64 Business Interchange will continue to attract both local and regional trips until the I-540 Outer Loop project is Built.

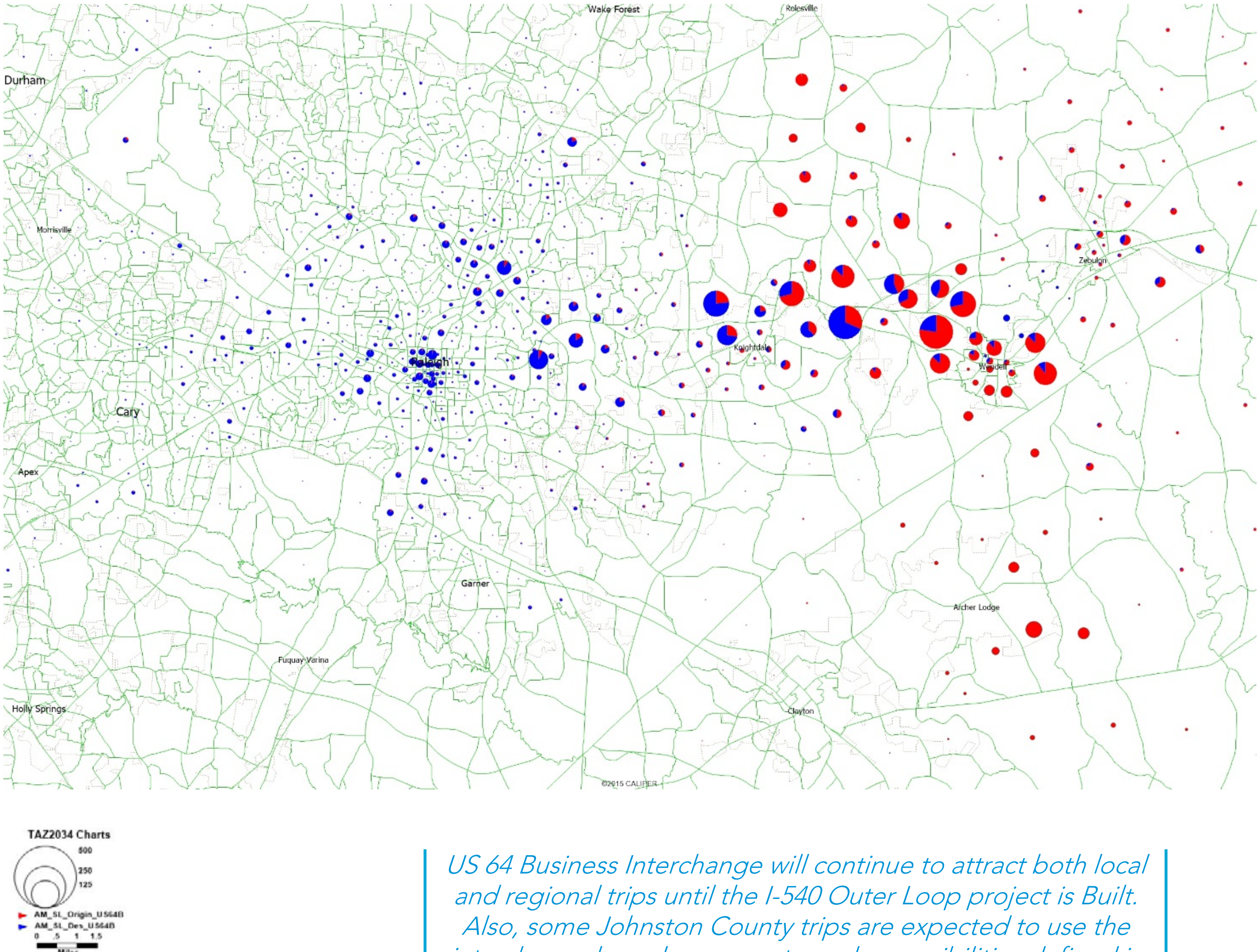
Figure 3.34 Post-540 Travelshed of US 64 Business Interchange – PM Peak Period





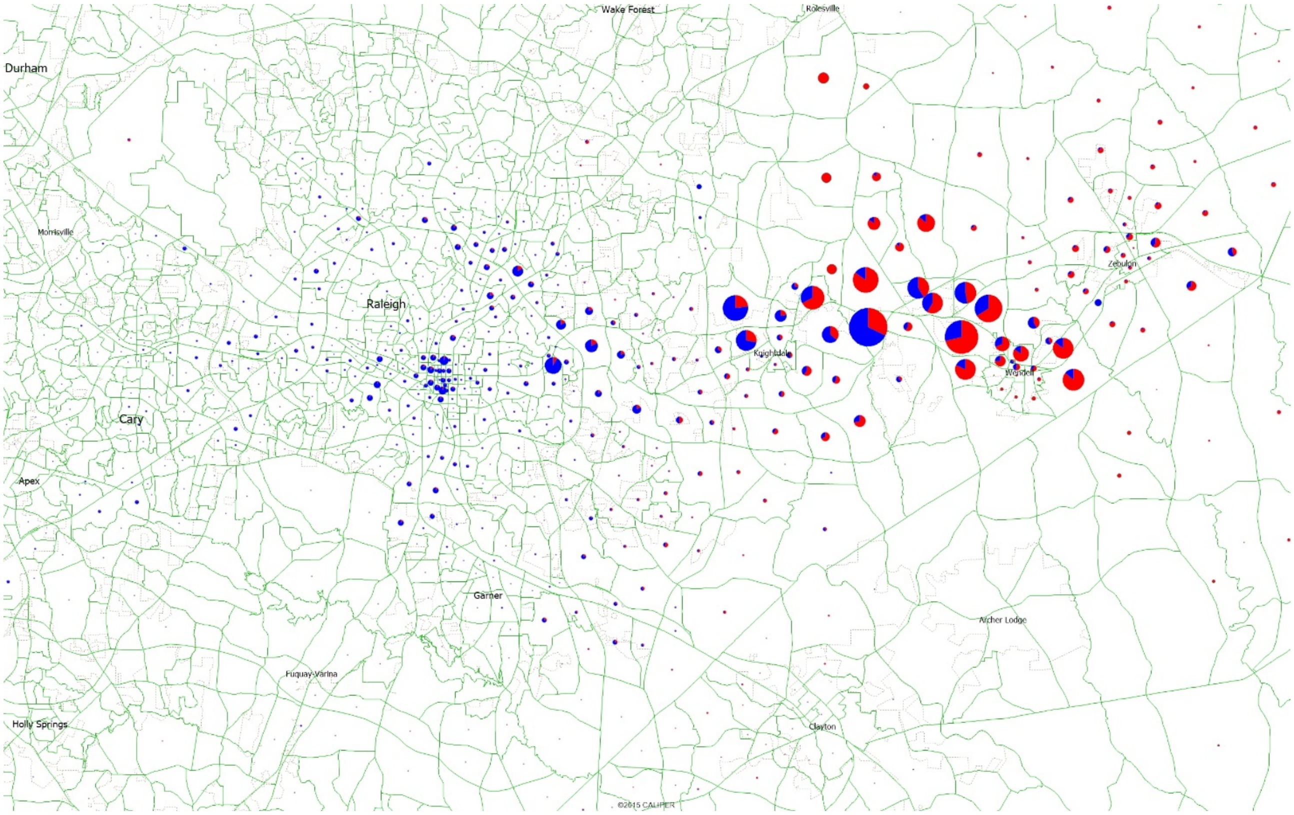
Travelshed of the US 64 Business Interchange is expected to become slightly smaller after the I-540 Outer Loop project is Built. AM peak period traffic volume is expected to reduce by approximately 3 percent.

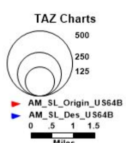
Figure 3.35 Pre-540 Trip O-D of US 64 Business Interchange – AM Peak Period



US 64 Business Interchange will continue to attract both local and regional trips until the I-540 Outer Loop project is Built. Also, some Johnston County trips are expected to use the interchange based on current zonal accessibilities defined in the TRMv6.

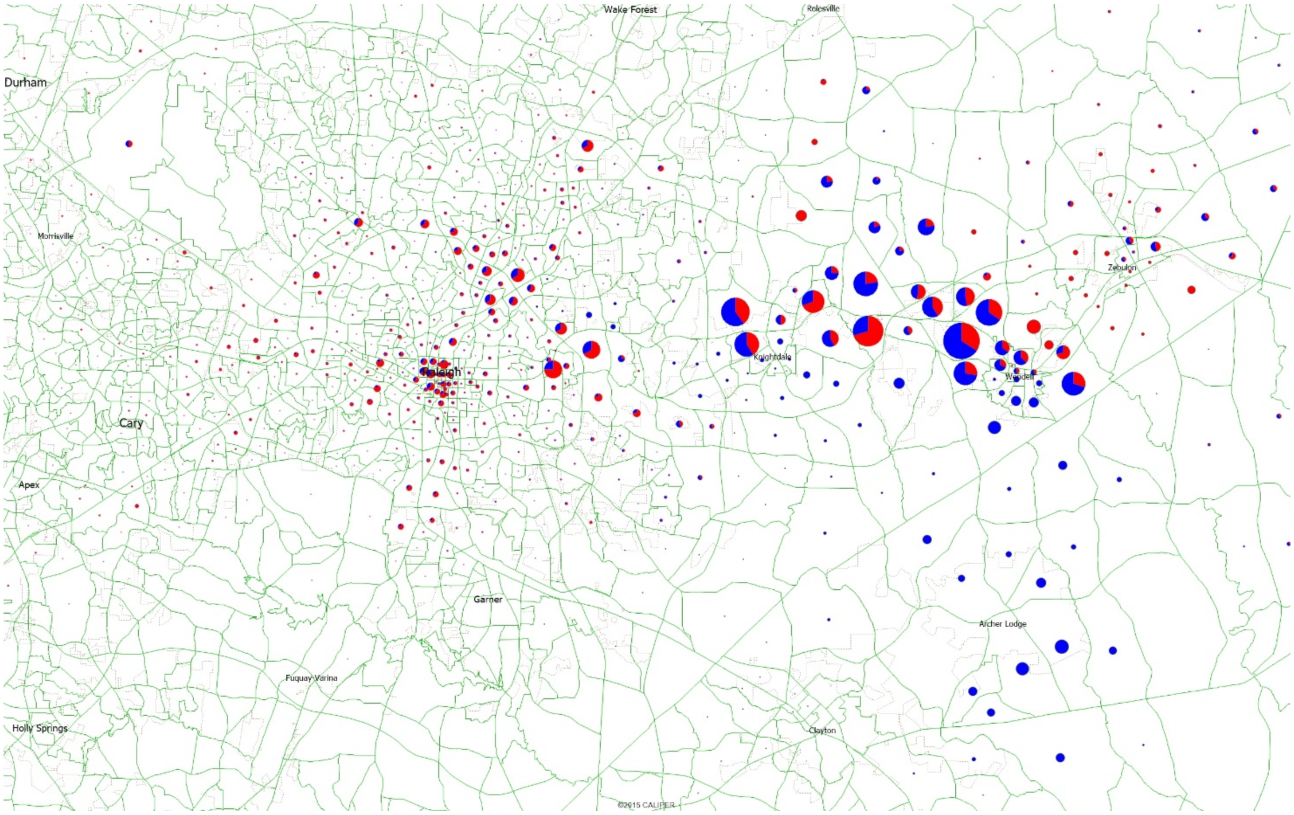
Figure 3.36 Post-540 Trip O-D of US 64 Business Interchange – AM Peak Period

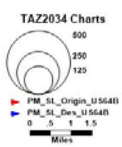




US 64 Business Interchange is expected to serve more local trips after the I-540 Outer Loop project is Built. Consequently, AM peak hour trip ODs are expected to reduce by 8 percent

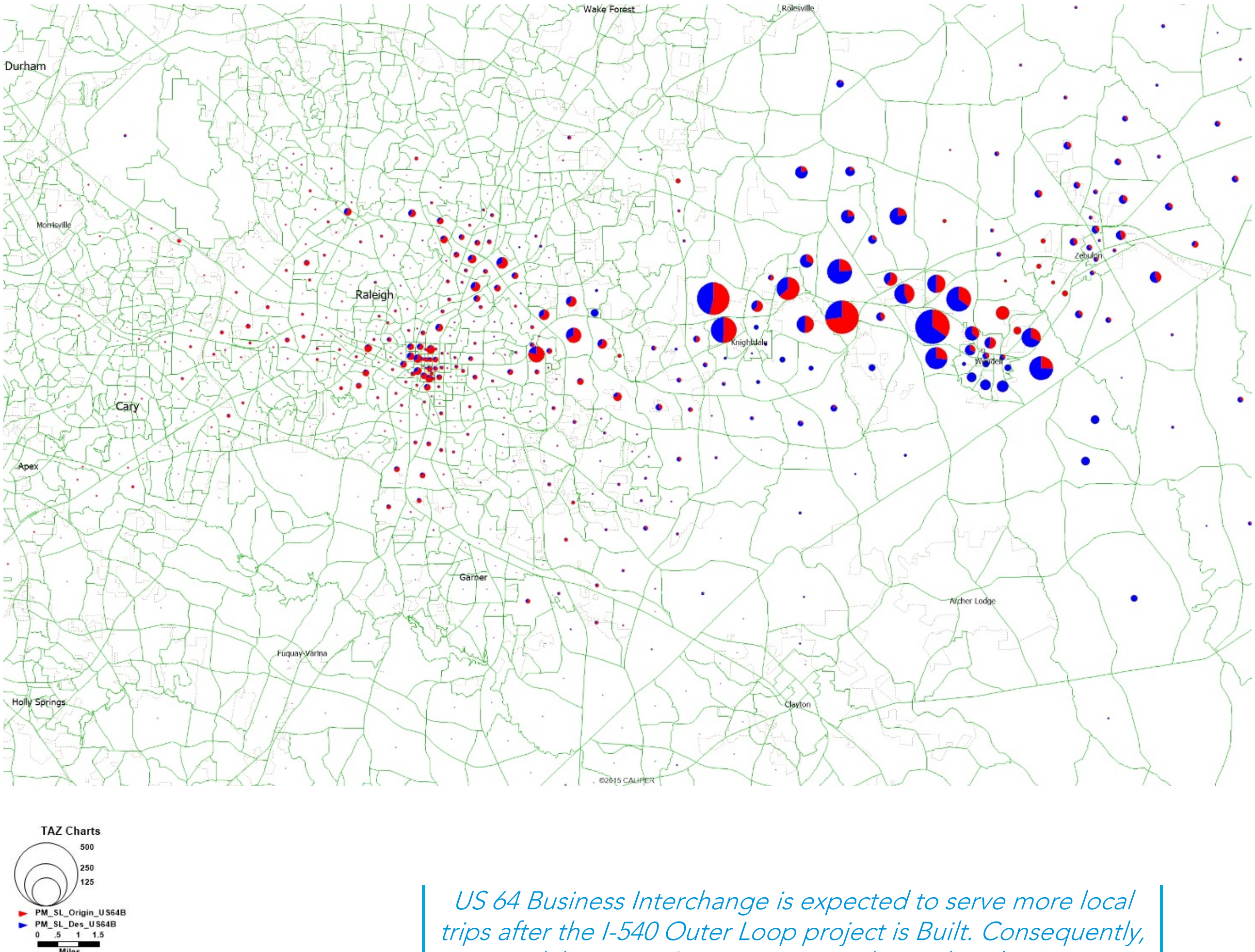
Figure 3.37 Pre-540 Trip O-D of US 64 Business Interchange – PM Peak Period





US 64 Business Interchange will continue to attract both local and regional trips until the I-540 Outer Loop project is Built. Also, some Johnston County trips are expected to use the interchange based on current zonal accessibilities defined in the TRMv6.

Figure 3.38 Post-540 Trip O-D of US 64 Business Interchange – PM Peak Period



US 64 Business Interchange is expected to serve more local trips after the I-540 Outer Loop project is Built. Consequently, AM peak hour trip ODs are expected to reduce by 3 percent

3.5 Volume-to-Capacity Analysis

This section presents a summary of volume over capacity (VOC) analysis using the TRMv6. In this analysis, hourly future volumes are divided by the corresponding hourly modeled capacity and compared across multiple peak hours to obtain the maximum VOC for a roadway segment. In essence, VOC is a performance measure that indicates anticipated level of congestion along each roadway segment. These maximum hourly VOC ratios are plotted in Figure 3.39 for Pre-540 conditions and in Figure 3.40 for Post-540 conditions. These two Figures show VOC in terms of line width. Hence, thicker lines indicate heavier traffic congestion.

Figure 3.39 Maximum Volume-to-Capacity Ratio - Pre-540

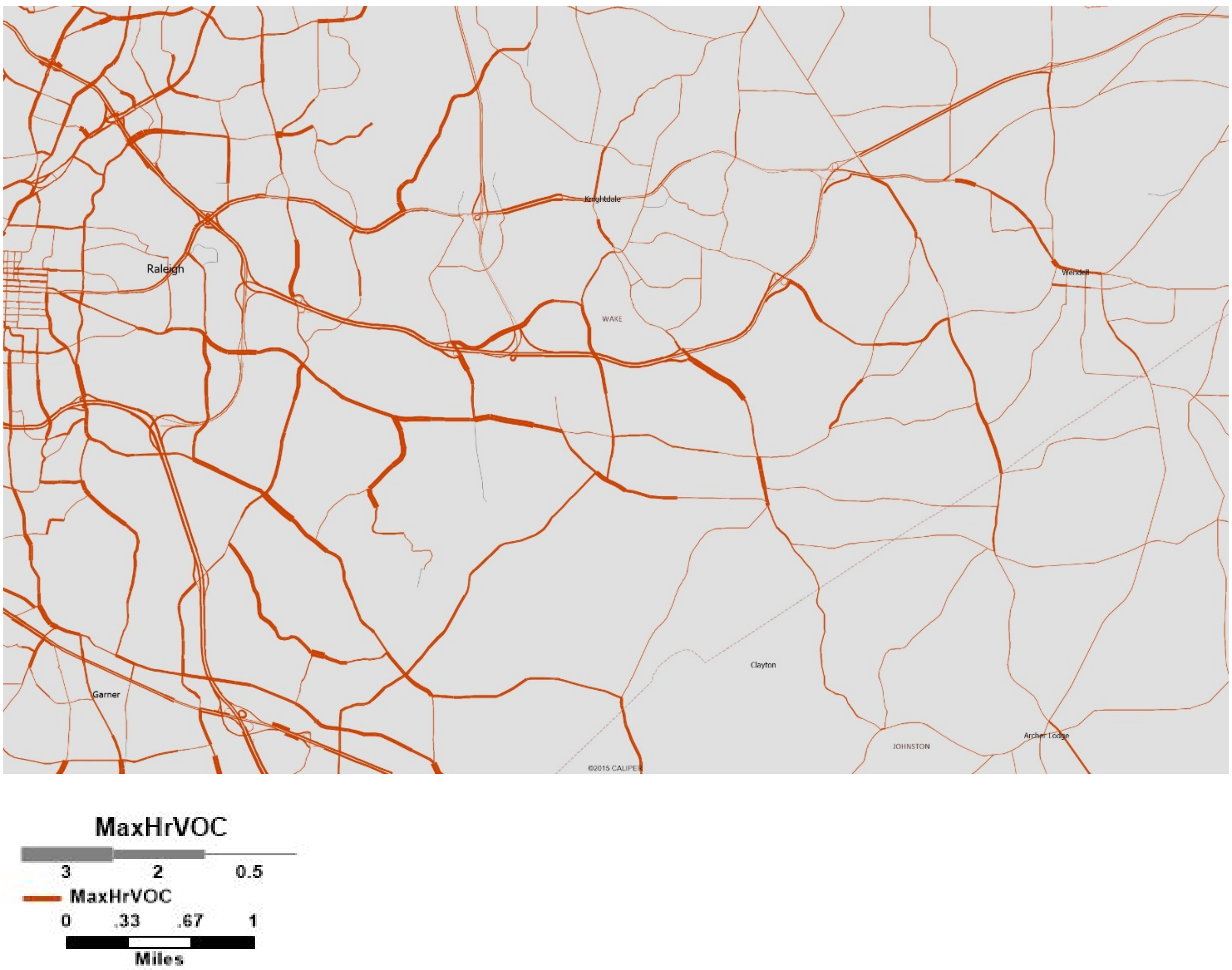


Figure 3.40 Maximum Volume-to-Capacity Ratio - Post-540

The I-87 corridor study area roadways are expected to have lesser degree of traffic congestion after the I-540 Outer Loop project is Built.

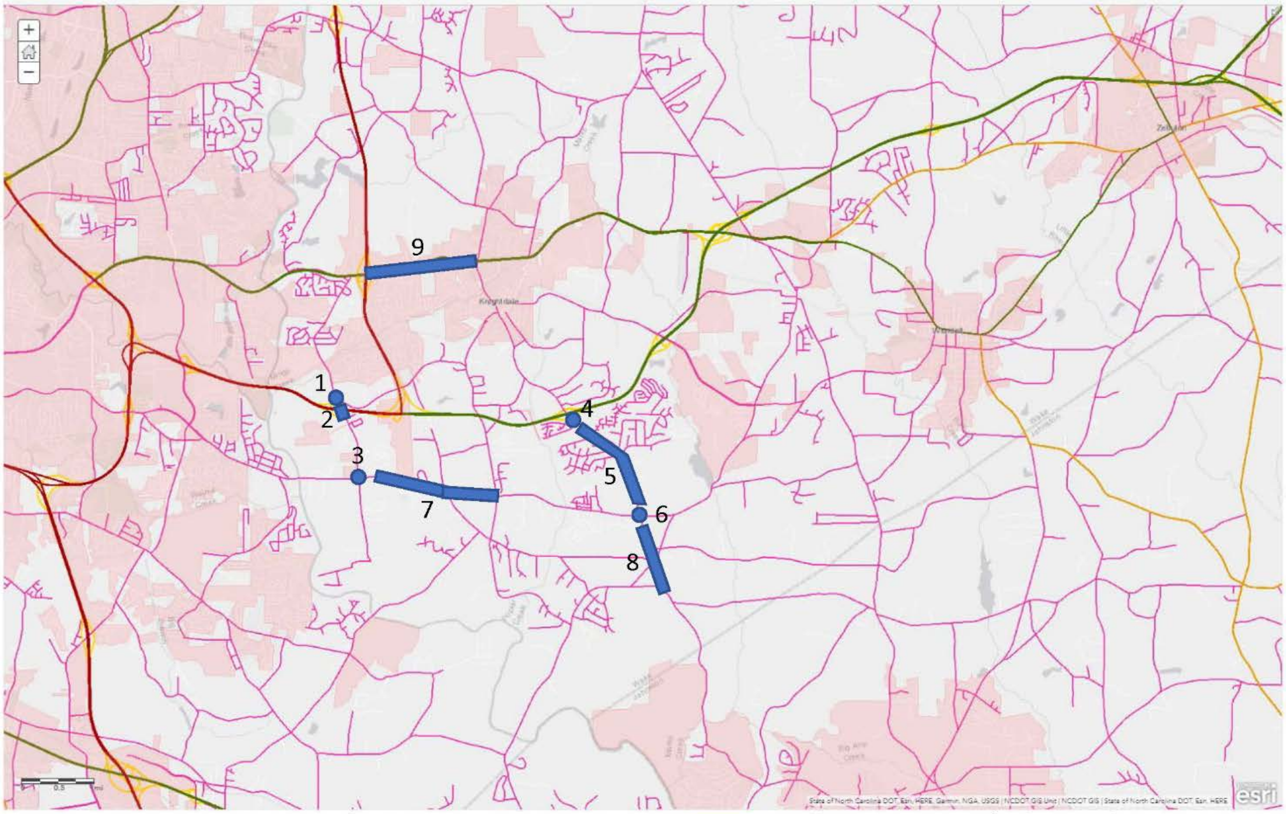
4.0 Project Recommendations

This section presents project recommendations to address traffic congestion and safety issues in the I-87 Knightdale Corridor study area that seem to be unaffected by the I-540 Outer Loop project (R-2829). These project recommendations are targeted for small scale projects that are implementable within the next 5 to 15 years, will provide immediate congestion relief, will improve potentially hazardous roadway sections and intersections, and consistent with the adopted land use plan by Wake County, Town of Knightdale's Comprehensive Plan, and CAMPO's 2045 Metropolitan Transportation Plan (MTP). These project recommendations are summarized in Table 4.1 and depicted in Figure 4.1.

Table 4.1 Project Recommendations

Roadway or Intersection	Project Map ID	Segment Length	Project Description	Complete By
Hodge Road Overpass Bridge and Bridge Approaches	1	1000 ft	Widen the current 3-lane bridge to 5-lane bridge to provide additional northbound and southbound lanes between the two ramp signals	2030
Hodge Road/WB I-87 Ramps/Old Faison Rd Intersection	2	n/a	In addition to implementing the additional turn lanes that are committed by the Stone River and Silver Stone developer, recommend restriping and widening as necessary to have 2 receiving lanes at the EB On-ramp that drops to one lane prior to freeway merge. Also, recommend modifying the signal operation to allow for protected LT movements on all approaches and coordination with the EB I-87 ramp signal.	2025
Hodge Road and Poole Road Intersection	3	n/a	In addition to implementing the additional turn lanes that are committed by the Silver Stone developer, provide an additional southbound left-turn lane to provide double left. Also widen Poole Road's east leg to accommodate southbound double left turn to eastbound movement.	2025
Smithfield Road/EB I-87 Ramps Intersection	4	n/a	Widen the off-ramp to provide an additional right-turn lane. Also widen the south leg by at least 1,000 feet to provide an additional southbound lane; Modify signal timing to reoptimize between the ramp terminals.	2025
Smithfield Road between I-87 and Poole Road	5	1.8 miles	Widen to 4-lane roadway	2025
Smithfield Road and Poole Road Intersection	6	n/a	Provide left-turn lanes on all approaches; Also provide eastbound right-turn lane on Poole Rd	2025
Poole Road between future I-540 to Bethlehem Road	7	1.58 miles	Widen to 4-lane roadway	2035
Smithfield Road between Poole Road and Mial Plantation Rd	8	1.0 mile	Widen to 4-lane roadway	2035
US 64 Business between I-540 and N Smithfield Road	9	1.52 miles	Improve signal timing and implement safety improvements by accommodating pedestrian crossings, advance trafficr signage, and access management.	2035

Figure 4.1 Project Recommendations



● Intersection Capacity/Safety Improvement — Roadway Capacity/Safety Enhancement

5.0 Data and Modeling Recommendations

In support of future studies similar to the I-87 Knightdale Corridor Study, which involve a need to understand and forecast traffic movements through a corridor and/or interchange, we recommend that CAMPO consider the use of passive Origin-Destination (O-D) data and the disaggregation of the Triangle Regional Model (TRM) zone system.

5.1 Passive O-D Data

Passively collected O-D data from smartphones can be a tremendously valuable resource for travel forecasting in general, but especially at the more detailed geographic resolution of individual corridors. Although the use of this new source of data began only roughly ten years ago, it is rapidly becoming a new standard of good practice across the country.

The adoption of these new data sources has been motivated by several factors. Due the lack of special data acquisition equipment or fielding of staff, passively collected data, a by-product of location-aware smartphone applications, can provide information on O-D flows far more cost effectively than traditional data collection methods.

While traditional surveys typically provide observations on 2% or fewer of the O-D pairs in a region (Bernardin et al., 2017a,b), passive O-D data can provide observations of a quarter to a third or more of all O-D pairs. This order of magnitude difference in the completeness of zone O-D patterns revealed from surveys and passive OD data is stark and an important motivation for the use of this new data. (Even so, passive O-D data is best viewed as a complement to survey data because while it provides a level of resolution that survey data cannot, as anonymous data it cannot provide information on traveler demographics or accurately reproduce trip purposes.)

As a result of the poor coverage of O-D space by survey data, the paucity of explanatory variables and other factors, both gravity and traditional destination choice models have poor explanatory power and it is widely acknowledged in both practice (TFResource.org) and research (Zhao and Kockelman, 2002) that the spatial distribution of trips is the largest source of error in both trip-based and activity-based model systems. The use of passive O-D data in data-driven distribution modeling can rectify this.

5.1.1 Types and Sources of Passive O-D Data

There are four main technologies that underlie passive O-D data:

- Cell tower signaling
- GPS (from in-vehicle navigation devices and/or mobile devices)
- WiFi beacons
- Bluetooth beacons

Cell tower signaling was the first technology to produce widely available data for travel forecasting. However, the technology is inferior to later methods in terms of locational precision, noise (from signaling oscillation and load balancing), and temporal sparsity. We therefore no longer recommend it for use.

Navigational GPS data from in-vehicle devices is a common source of passive O-D data for trucks and some other commercial vehicles. Its high precision and large sample size make it a wonderful source of information on truck O-D movements. We would recommend its use wherever truck traffic is significant or of interest. While similar navigational GPS data is also available for private passenger vehicles, it is not recommended both because it has extremely low sample penetration (typically 0.5% or less) and that sample is heavily skewed towards high income travelers since the data is derived primarily from the in-vehicle devices in luxury cars (e.g., BMW, Audi).

WiFi and Bluetooth beacons have not been used independently for the creation of O-D datasets for travel forecasting. Rather, they are used together with GPS by location based services (LBS) which run on smartphones and other mobile devices and support their location aware applications. The logic of the LBS uses a combination of these technologies to provide location data. Different LBS use significantly different logic in support of different types of apps and therefore produce LBS trace data of vastly varied quality. There are significant sources of low quality LBS data which should not be used for travel forecasting due to their extreme temporal sparsity at the device level. To support travel analysis and forecasting, we recommend LBS datasets with a median of at least 100 location observations per device per day or better. Persistent device identifiers are also of critical importance for many travel analysis applications. It is also important, especially for project-level forecasting, that the LBS contains a sufficient mixture of GPS data in order to support the analysis of facility level O-D patterns.

High quality LBS data products are available for transportation analysis from a number of sources, but the two main companies marketing these products are AirSage and Streetlight Data. At various points over the past few years, one or the other of these firms has offered substantially higher quality data and/or better pricing. As little as a year ago Streetlight's data product was clearly superior, but recently AirSage has substantially improved their product and now offers a product of similar or possibly even higher quality while Streetlight's pricing scheme has changed to make their data less cost effective for many applications. In some situations, direct purchases from LBS data providers (e.g., Cuebiq) can be the better than purchasing through AirSage or Streetlight. We therefore recommend that the choice of data provider be evaluated at the time of purchase and not until the application / use case is clearly well defined. We have recommended different vendors to different clients for different applications even over short time frames of as little as two months.

5.1.2 Strategies for the Use of Passive O-D Data

CAMPO may want to want to adopt one of three current strategies for the use of passive O-D data to support regional planning and project forecasting. These strategies differ both in terms of how the data is licensed and in terms of how the data are used technically. Other strategies may become available in the future as new data products and services enter the market.

1. One strategy is to purchase a single, high-quality data product, and incorporate it in the regional travel model. This approach can be cost effective both in terms of the purchase of raw or lightly processed data, and the cost and/or effort of expanding the data and incorporating in the model which is only done once. This approach can support both regional planning as well as project level studies. However, facility specific OD flows are estimated rather than observed in this approach. Therefore, for some, especially high-importance, project level forecasting applications other approaches may be preferable. This method would, however, be our current recommendation for agencies with more limited data budgets.

2. An alternative strategy is to buy a subscription service from a provider. This approach which treats data as a service (DaaS), can also support both regional planning and project forecasting, and can provide higher-quality data for project forecasting with subarea analysis/modeling. To be reasonably cost effective, and for purposes of ensuring quality, it is important to ensure that expansion factors are developed initially for the region and then used consistently through all applications. Given recent pricing, this approach has been too expensive for many agencies, but pricing is not stable as the market is not mature or in equilibrium yet and CAMPO would may want to evaluate the cost close to the time of a possible purchase.

3. The third strategy is to purchase facility-specific O-D data to support individual project forecasts on a case-by-case basis. This approach may be the least expensive for a single project, but often as little as two projects can make it less cost effective than the other solutions. Moreover, data expansion is often neglected or done poorly in this approach. We would therefore recommend this approach only for an exploratory project.

5.1.3 Expansion of Passive O-D Data

All existing commercially available passively collected O-D data are based on incomplete sample frames. These commercially available datasets exclude travelers without mobile devices while they travel, and these datasets include only a select portion of travelers with mobile devices. The LBS datasets are typically over-represented for 25-34 years age group and under-represented for the 65 and older age group.

Moreover, short-distance trips or short-duration activities are often under-represented in the LBS data because they require more frequent observations of position which are not always available. Travel to and from locations with poor coverage can also go un- or under-detected. Failure to account for such biases can lead to erroneous representations and faulty predictions of trip rates, trip lengths, trip flows between origins and destinations, and present and future travel activity and traffic in general.

Demographic biases, although an important problem, are relatively more easily corrected. However, trip-length biases are particularly problematic because they can substantially distort the data, are difficult to measure and correct, and are not well understood by many practitioners.

5.2 TRM Zonal Disaggregation

In order to explore why the Triangle Regional Model (TRMv6) was allocating a high number of trips from Johnston County to the I-87 corridor via Smithfield Rd, the existing TRM zone boundaries in Johnston County were reviewed and compared with five peer counties from other regional models. These peer counties are:

- Cabarrus County, NC
- Berkeley County, SC
- Delaware County, OH
- Williamson County, TN
- Wilson County, TN

These regions were selected due to their similarities with the study region. Each of these regions are on the periphery of metropolitan areas, with similar population growth, and share similar socioeconomic characteristics. These socio-economic characteristics are summarized in Table 5.1.

Table 5.1 Socio-Economic Data for Peer Regions

County	Nearest Metro	Land Area	Households (ACS 2012-2016)	2010 Census Population	2010 Employment	Employment Data Source
Johnston, NC (Modeled)	Raleigh	472.7	N/A	143,958	40,805	TRMv6
Johnston, NC	Raleigh	791.3	63,219	168,878	41,762	LEHD
Cabarrus, NC	Charlotte	361.75	68,289	178,011	59,175	LEHD
Berkeley, SC	Charleston	1,098.9	70,482	177,843	42,222	LEHD
Delaware, OH	Columbus	443.10	66,544	174,214	69,194	LEHD
Williamson, TN	Nashville	582.6	71,043	183,252	91,648	LEHD
Wilson, TN	Nashville	570.8	45,431	113,993	33,009	LEHD

Note: Longitudinal Employer–Household Dynamics (LEHD) data are from the Census Bureau. LEHD data are based on different administrative sources, primarily Unemployment Insurance (UI) earnings data and the Quarterly Census of Employment and Wages (QCEW), and censuses and surveys.

From analysis of the corresponding model inputs – traffic analysis zones (TAZs) and networks – within each of the selected regions, a summary of the average zonal area, employment, households, and network mileage can be found in Table 5.2. The Johnston County model zones are shown to have very high per-zone average of area (2.17 square miles), roadway mileage (4.43 miles), and households (242.88) as compared to the five regions analyzed. While the average zonal employment of Johnston County was the lowest (187.18), the expected future growth of the region still merits additional zonal resolution.

Table 5.2 Zone Analysis of Peer Regions

Region	Agency	Base Year	Model Zones	Avg Area (sq mi)	Avg Roadway Miles	Avg Employment	Avg Households
Johnston County, NC (Modeled)	CAMPO	2013	218	2.17	4.43	187.2	242.9
Cabarrus County, NC	CRTPO	2015	304	1.21	2.66	244.3	237.7
Berkeley County, SC	BCDCOG	2015	200	4.56	4.62	301.1	342.0
Delaware County, OH	MORPC	2015	310	1.47	3.25	305.8	214.4
Williamson County, TN	Nashville MPO	2010	310	1.88	3.88	388.0	209.3
Wilson County, TN	Nashville MPO	2010	208	2.74	8.87	248.3	204.6
Johnston County, NC (Proposed)	CAMPO	2013	240	1.97	4.02	170.0	222.5

Given these facts, it is concluded that at least roughly 20 to 25 additional zones should be considered within the modelled region of Johnston County, particularly in the north where the interaction with I-87 and proximity to Raleigh will likely realize a higher portion of socioeconomic growth. Even with this addition, which would bring the population and area per zone in line with comparable areas, there would still be relatively large amount of network for the zone system, so either further zone splits or a pruning of the network may be necessary.