I-55/75/26
Multimodal Corridor Study
▶Technical Memorandum 2: Assessment of Existing and Future Deficiencies

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TN TDOT Department of Transportation

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Technical Memorandum 2: Assessment of Existing and Future Deficiencies

Introduction

Safe, efficient, and equitable multimodal surface transportation infrastructure is critical to promoting the wellbeing and economic vitality of the people of Tennessee. The state's freeways form the backbone of that transportation system, complemented by state highways, local roads, airports, railroads, transit systems, bicycle and pedestrian facilities, and waterborne navigation facilities. Tennessee's interstate highways carry about 30% of all vehicle miles traveled in the state, and 80% of all truck miles[1], making them the key component of the roadway system, facilitating the movement of people and goods across the state and across the country. Developing a multimodal transportation system that meets the changing needs of Tennessee's residents, businesses, and visitors will support the state's growth and provide a range of safe transportation options.

The purpose of the I-55/75/26 Multimodal Corridor Study is to evaluate potential transportation improvements to address existing and emerging issues in the system. The analysis is centered on study areas surrounding four Interstate corridors: I-55 in southwestern Tennessee, I-155 in northwestern Tennessee, I-75 in the east-central part of the state, and I-26 in eastern Tennessee. Together, these corridors represent more than 200 miles of freeway traveling through urban and rural counties, supported by a robust network of state and local roadways, rail, air, transit, and non-motorized transportation facilities.

The study will consider innovative, long-range approaches to multimodal issues and opportunities in these corridors. Solutions will be developed to address traffic and congestion, operations and safety, expanded transportation choice, and the ways in which the transportation system supports economic growth, freight movement and access to employment.

The study involves four core activities:

- Gathering and evaluating transportation, demographic, economic, and other data.
- Assessing existing and expected future system deficiencies to develop goals and performance measures for each corridor.
- Developing and evaluating feasible multimodal solutions to meet those goals.
- Prioritizing actions to implement those solutions.

This report documents an evaluation of existing and forecasted transportation deficiencies in each corridor. Data were analyzed to identify capacity and safety issues, problems for freight movement and facilities maintenance, and opportunities to improve multimodal options. Travel trends were correlated with projections for population and employment growth and planned improvements to create a comprehensive snapshot of existing and future conditions in the corridors, including key issues to be addressed by future project phases.

Summaries of the existing and future deficiencies for each corridor follow this page. Additional details can be found in the section specific to that corridor noted in the Table of Contents.

Figure 1. Study Corridors

Four interstate corridors - I-55, I-155, I-75 and I-26 - are included in the study.

1- TDOT, Interstate 65 Multimodal Corridor Study, Technical Memorandum 1, 2016

Figure 2. Existing Deficiencies and Future Needs — I-55

INTERSTATE 55 75 26 CORRIDOR STUDY

I-55 Existing Deficiencies and Future Needs

Additional information about the existing deficiencies and future needs for the I-55 corridor can be found in Technical Memorandum 2.

Legend:
- Deficiencies and needs supported by data analysis
- Deficiencies and needs identified by stakeholders

Traffic Operations

- Existing and forecasted areas of traffic congestion:
  - "I-240"
  - "I-55 bridge over the Mississippi River"
  - "Crump Blvd."
  - McLemore Ave.
  - US-61 (S. 3rd St.)
  - "Holmes Rd."

Safety

- High crash rates related to inadequate signage from the Mississippi River Bridge to the Crump Blvd. interchange and at the I-240 interchange.
- High crash rates due to small radii of ramps at the US-61 (S. 3rd St.) and I-240 interchanges.
- High crash rates at Brooks Rd. due to inadequate drainage in rain events.
- "High crash rates related to short merge/diverge areas at the Crump Blvd. interchange and at US-61 (S. 3rd St.)."
- "Inadequate signage at various locations throughout the corridor."

Freight

- Insufficient overnight truck parking.
- Freight bottleneck located at the Mississippi River crossing due to geometry of the interchange and capacity of the bridge.
- Freight bottleneck located on Lamar Ave., a parallel route to I-55.
- "Need new interchange to serve Port of Memphis and relieve truck congestion."

Economic Development

- Employment growth projected at all I-55 interchanges.
- Future growth along the I-55 corridor will likely be in the freight, logistics and warehousing sectors.
- "New interchange desired at I-55 and Holmes Rd."

Transit / Bike & Ped / TDM

- Minimal park-and-ride facilities.
- Lack of regional transit.
- Lack of bicycle and pedestrian accommodations at interchanges.
- "The airport is not served by frequent transit service."

Transportation System Management

- Need for improved signal coordination on streets adjacent to I-55.
- Need for dynamic speed limit signs and end of queue advance warning systems for incident management.

Pavement & Structures

- One structurally deficient bridge.
- Two bridges eligible for replacement.
- 12 bridges eligible for rehabilitation.
- The Mississippi River bridges were not built to withstand earthquakes and the nearest interstate crossing is 60 miles away.

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Figure 3. Existing Deficiencies and Future Needs — I-155

INTERSTATE 55 75 26 CORRIDOR STUDY

I-155 Existing Deficiencies and Future Needs

Additional information about the existing deficiencies and future needs for the I-155 corridor can be found in Technical Memorandum 2.

Traffic Operations

- "Congestion identified at the I-155 interchange with Lake Rd. due to slow moving farm equipment."

Safety

- Higher crash rates at the Mississippi River Bridge and on I-155 between SR-182 and SR-78 due to inadequate lighting, small inside shoulder width near roadway barriers, and animal crossings from the nearby forested areas.
- Bicycle/pedestrian crashes are present near the I-155/SR-78 interchange – an area with commercial land uses that drive non-motorized travel.
- "Safety issues on the segment of I-155 west of Dyersburg due to the presence of snow and ice in hilly areas with no adequate warning system."
- "Safety issues at US-412 interchange due to sharp curves that lead to truck rollovers."
- "Safety issue due to the presence of cable barriers with inadequate shoulder width."

Freight

- Insufficient truck parking facilities.
- Truck volumes are expected to increase by 91% between 2010 and 2040.

Transit / Bike & Ped / TDM

- The I-155 study area is not served by any fixed-route transit services.
- Lack of bicycle and pedestrian accommodations at interchanges.

Transportation System Management

- Consider work zone management, traffic incident management, traffic signal coordination on adjacent arterials, and improved bicycle and pedestrian crossings.

Pavement & Structures

- Two bridges eligible for rehabilitation:
  - I-155 over the Mississippi River
  - I-155 over Lewis Creek (east of SR-78)

Economic Development

- Employment growth projected at all four I-155 interchanges (SR-181, SR-182, SR-78 and US-412)
- Employment growth is likely to occur in anticipation of the proposed I-69 corridor east of the study limits.
- "Additional development in the Dyersburg North Industrial Park is anticipated to increase truck volumes on US-412 and I-155."

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Figure 4. Existing Deficiencies and Future Needs — I-75

INTERSTATE 55 75 26 CORRIDOR STUDY

I-75 Existing Deficiencies and Future Needs

Additional information about the existing deficiencies and future needs for the I-75 corridor can be found in Technical Memorandum 2.

Legend:
- Deficiencies and needs supported by data analysis
- Deficiencies and needs identified by stakeholders

Traffic Operations

Existing and forecasted areas of traffic congestion:

- I-24 to the Georgia State Line
- "US-64 bypass to SR-60"
- SR-72 to I-40
- "Shared I-40/I-75"
- Western Ave. to I-275/I-640
- Merchants Dr. to SR-131
- SR-170 to SR-63
- "Hamilton County Line to SR-20"
- "I-75 at I-24 and at I-640/275"
- Congestion due to weave / merge areas near SR-320 and SR-153 interchanges

Safety

- High crash rates related to limited visibility, narrow inside shoulders, and steep grades in Jellico Mountain area.
- High crash rates related to peak hour congestion near SR-61, Merchants Dr., Western Ave., US-64, Brainerd Rd., and the I-75/I-24 interchange
- High crash rates related to horizontal curves / exit ramps at the McMinn County Rest Area and SR-60 interchanges
- Highest density of bicycle/pedestrian crashes are near the interchanges along shared I-40/I-75 segment. Parallel facilities & crossovers lack pedestrian / bicyclist infrastructure
- "Fog near SR-308 and SR-163 (near Hiwassee River)"

Transportation System Management

- Only one park-n-ride lot in the Knoxville area.
- "No opportunity to access alternate route when I-75 closed due to fog near Hiwassee River or due to crashes between US-74 and US-11 in Ooltewah. Need advance alerts for drivers north of US-74."

Pavement & Structures

- Hamilton County has the lowest pavement quality. Portions of pavement in several counties were last resurfaced in early 2000s.
- Four structurally deficient bridges; 54 eligible for rehabilitation.

Freight

- Insufficient truck parking between Chattanooga and Knoxville.
- Truck traffic north of Knoxville is projected to double.
- Potential bottlenecks located in Campbell County, just north of SR-25W, and in Knox County from Watt Rd. to I-275.
- "Need truck climbing lane over White Oak Mountain, southbound, south of US-74"

Transit / Bike & Ped / TDM

- Lack of regional transit connection between Chattanooga and Cleveland, as well as Knoxville and Oak Ridge and Knoxville and Alcoa.
- More commuter and express routes on and along I-75 are needed, as well as connection to Knoxville airport.
- No paved shoulder, wide-outside-lane, or bicycle lane available through the interchanges at SR-2 and SR-317. Sidewalk provided through interchange at only 3 of the 35 US or State Route crossings.

Economic Development

- Employment growth projected near interchanges in Knoxville, Cleveland and Chattanooga, as well as US-64 and SR-308 interchanges in Bradley County .
- "New interchange needed in Cleveland at SR-312"

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Figure 5. Existing Deficiencies and Future Needs — I-26

INTERSTATE 55 75 26 CORRIDOR STUDY

I-26 Existing Deficiencies and Future Needs

Additional information about the existing deficiencies and future needs for the I-26 corridor can be found in Technical Memorandum 2.

Legend:	Deficiencies and needs supported by data analysis Deficiencies and needs identified by stakeholders

Traffic Operations

- Geometric issues at I-26 & I-81 interchange. Inadequate ramp length contributes to congestion at the merge/diverge areas.
- Traffic bottleneck identified between I-26 interchanges with SR-91 and SR-400.
- "Geometric issues at the I-26 & Eastern Star Rd. interchange."
- "Truck climbing lanes desired at the following locations:
  - Eastbound I-26 near Unaka Ave./Watauga Ave.
  - Westbound I-26 near Eastern Star Rd., State of Franklin Rd., and Unaka Ave./Watauga Ave."
- "Congestion identified at the following I-26 interchanges:
  - I-81
  - SR-75 (Suncrest Dr.)
  - SR-381 (State of Franklin Rd.)
  - US-11E / SR-36 (N. Roan St.)"

Safety

- High crash rates related to roadway geometry, animal crossings, narrow shoulders and inadequate lighting identified between US-11W and SR-347.
- Bicycle/pedestrian crashes are present near the I-26 and SR-91 interchange.
- High crash rates near the SR-91 and US-321 interchanges. Rear end collisions and weaving/congestion related issues.
- North and south of the community of Flag Pond near the North Carolina border there are curves/steep inclines, narrow shoulders and weather-related crashes.

Freight

- Insufficient overnight truck parking.
- Projected increase in truck percentage between Kingsport and Johnson City.
- Freight bottleneck located between US-11W and Meadowview Pkwy.
- Freight bottleneck located between Flag Pond Rd. and North Carolina state line near the interchange with Upper Higgins Creek Rd.
- Freight bottleneck located at Clear Branch Access between Boones Creek Rd. and State of Franklin Rd.

Economic Development

- Employment growth projected at the interchanges with I-81 and SR-75.
- "Employment growth is anticipated in Johnson City."

Transit / Bike & Ped / TDM

- Minimal park and ride facilities.
- Lack of regional transit connection between Johnson City and Kingsport.
- Lack of bicycle and pedestrian accommodations at interchanges.

Transportation System Management

- Identify locations for additional ITS elements such as CCTV cameras.
- Consider systems to improve incident management response.

Pavement & Structures

- Washington County has the lowest pavement quality.
- 15 bridges eligible for rehabilitation.

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I-55 Corridor

▶Assessment of Existing and Future Deficiencies

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I-55 Corridor

1. Introduction

The I-55 corridor serves as a backbone for economic development and growth in the region. As population and employment continue to grow, new travel demands place pressure on the Interstate as well as parallel and intersecting highways. This results in increased traffic congestion, travel times, and conflicts, which threaten the corridor's ability to sustain future growth.

A previous technical memorandum (Technical Memorandum 1) for this study provided a data and information inventory for the corridor. This technical memorandum (Technical Memorandum 2) assesses existing and future deficiencies and needs along the I-55 corridor by examining transportation issues including land use, economic development, highway capacity, travel demand, safety, Intelligent Transportation Systems (ITS), freight, transit, and non-motorized travel. An assessment of these topics will help identify ways to improve safety and enhance transportation services throughout the corridor.

This analysis focuses on the trend scenario for the I-55 corridor, which predicts existing and future conditions if current practices, plans, and policies remain unchanged. To supplement the technical analysis, public workshops and surveys were used to generate feedback from citizens and stakeholders located throughout the corridor.

1.1 Defining the Trend Scenario

The trend scenario establishes the existing and projected transportation conditions along the I-55 corridor and serves as the baseline for identifying needs and, ultimately, proposed improvements. The 2010 and 2040 Tennessee Statewide Travel Demand Model (TSM) trend scenarios were originally developed by the Tennessee Department of Transportation (TDOT) in 2017 (Phase 3/Version 3). As part of this study, the trend scenarios were updated and validated based on the following:

- Population and employment data and projections from Woods and Poole Economics, Inc.
- Projects currently programmed for construction in TDOT's Statewide Transportation Improvement Program (STIP)
- Projects currently programmed for construction in the Memphis Metropolitan Planning Organization's (MPO) FY2017-2020 Transportation Improvement Program(TIP)
- Recent MPO travel demand model projections of socioeconomic data, traffic volumes, and travel times
- Recent Transearch freight data and projections

Additional detail regarding model validation and updates can be found in separate technical

Figure 1-1. Study Corridors

The I-55 corridor is being studied as part of a larger corridor study that also includes I-155, I-75, and I-26.

memoranda ("TN Corridor Study – Trend Scenario Memo" and "TN Corridor Study – Model Documentation Memo") prepared for this study.

Table 1-1 and Figure 1-2 show the programmed projects included in the Memphis MPO's FY2017-2020 TIP. All but the signal coordination project are included in the 2040 "Existing plus Committed (E+C)" network for the updated 2040 trend scenario.

Table 1-1. Corridor Programmed Projects* — I-55

Memphis MPO FY2017 - 2020

Figure 1-1 ID	Route and Project Limits	Improvement	Cost	Fiscal Year	Horizon Year	Lead Agency/ Funding Type	TIP# or STIP#
1	I-55 Interchange at Crump Blvd.	Interchange modification	$74,278,000	2017	2020	TDOT/NHPP	TIP # TN-IM-2011-01
2	I-240 Midtown (I-55 to I-40)	Widen from 6 to 8 lanes	$51,000,000	2019	2025	TDOT/NHPP	TIP # NHS-2002-01
3	Elvis Presley Blvd. (Shelby Dr. to Brooks Rd.)	Construct a 6 lane roadway; Widen from 4 to 6 lanes; Landscaping; Improved ped/ bicycle/bus stop facilities	$32,976,500	2017	2020	Memphis/ TDOT/ENH/ NHPP	TIP # ENH-2010-01
4	Holmes Rd. (Millbranch to Tchulahoma)	Widen from 2/4 to 7 lanes	$30,078,700	Unknown		STBG	TIP # STP-M-2002-14
5	US-61 (Third St.) from Vance Ave. to Winchester Rd.	Signal Coordination	$27,618,700	2017	NA	CMAQ-M/ CMAQ-S	TIP # CMAQ-2002-09

* Only projects listed in the TIP or STIP are included in this table.

Source: Memphis MPO FY2017-2020 TIP

NHPP = National Highway Performance Program

ENH = Enhancement Grant

STBG = Surface Transportation Block Grant

CMAQ = Congestion Mitigation and Air Quality Improvement

2. Land Use and Economic Development

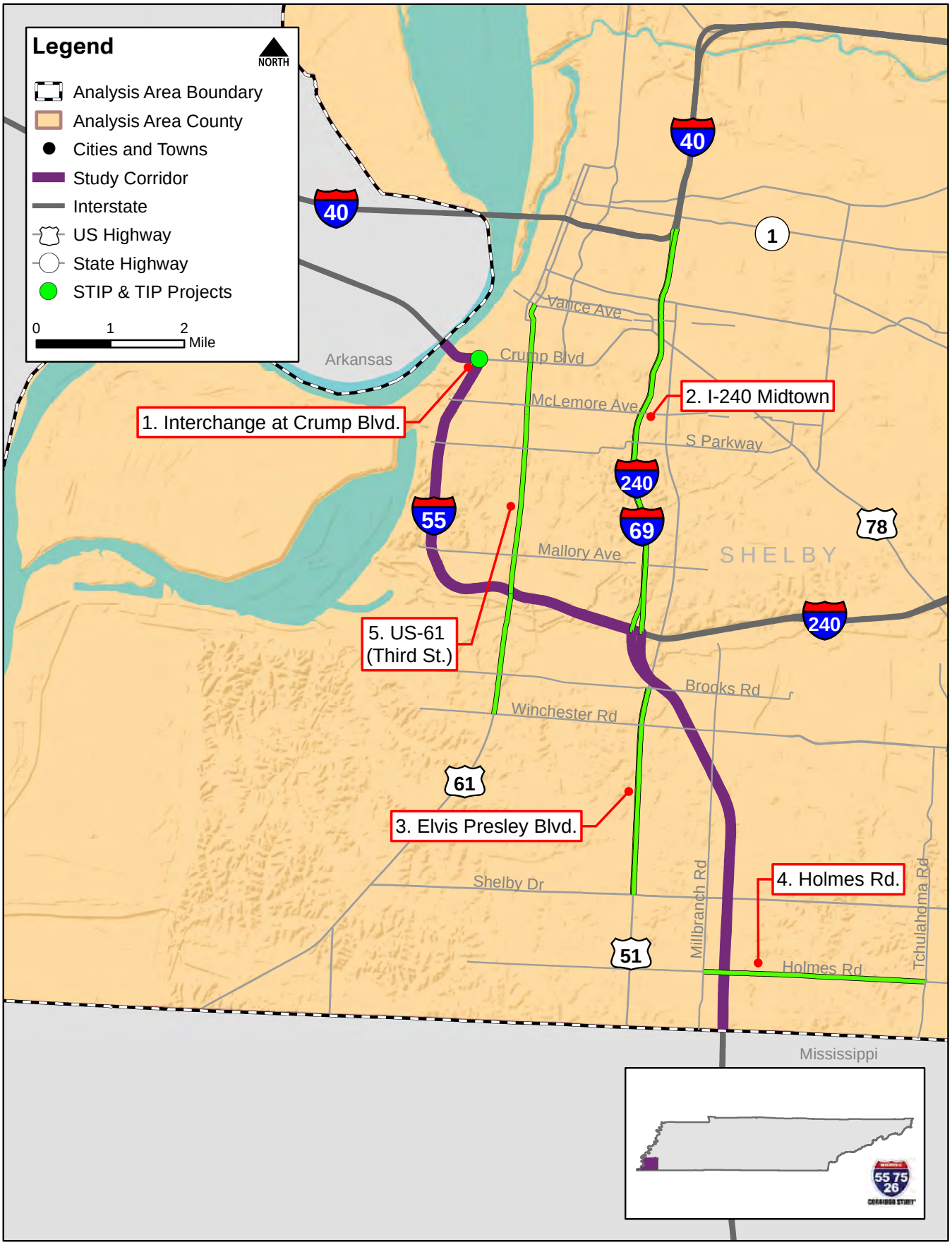
In any region, the need for improvements to the public infrastructure is triggered by growth, both in the number of residents and number of jobs. Examining historic development patterns as well as anticipated growth trends can provide a glimpse into the future and what challenges may await the transportation system.

2.1 Population and Employment Projections

A high-level review of population and employment projections from Woods & Poole, Inc. was undertaken for the area surrounding the I-55 corridor, more specifically Shelby County (Figure 2-1).

Figure 2-1. Study Area — I-55

Figure 1-2. Corridor Programmed Projects* — I-55



* Only projects listed in the TIP or STIP are included in this figure.

Source: Memphis MPO FY2017-2020 TIP

Overall, Shelby County is expected to see an additional 75,000 residents and 230,000 jobs by 2040. This represents an 8% increase in people and 37% increase in employment since 2010 (Figures 2-2 and 2-3).

Interchange access to Interstate corridors provides communities with the ability to attract businesses and provides accessibility to economic centers for employment. As such, population and employment projections from the TSM were also examined in more detail near the interchanges along the I-55 corridor as shown in Tables 2-1 and 2-2. Areas in the immediate vicinity (approximately a one mile radius) of an I-55 interchange are expected to grow by approximately 5,000 people and 12,500 jobs, a 14% and 15% increase, respectively. There are eight interchanges along the I-55 corridor in Memphis. Together, these interchanges provide access to the following neighborhoods/areas:

Downtown

- The Downtown area is served primarily by a single interchange at Crump Boulevard, just east of the Mississippi River. This area is expected to continue to account for the highest number of employees compared to other interchange areas along the corridor. In addition, this same area is expected to become the most populous area along the corridor by 2040.

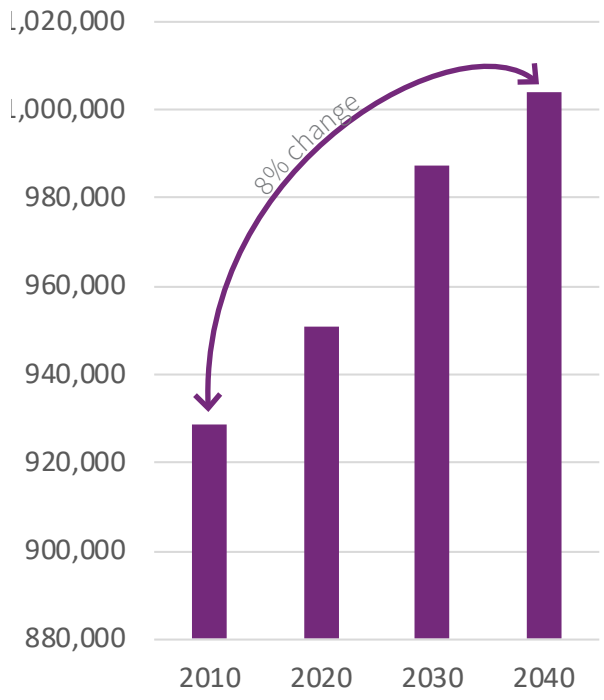
South Memphis

- The I-55 corridor serves as the southern and western boundaries for the South Memphis neighborhood. Interchanges in this area include Crump Boulevard, McLemore Avenue, South Parkway, Mallory Avenue, 3rd Street (US-61), and I-69. Near the corridor, these interchanges provide access to many freight-related industries such as the Fed-Ex shipping hub; however, the land uses quickly give way to more established residential areas further from the corridor. The majority of land in this area is already fully developed, which somewhat limits opportunity for new development, but potentially creates possibilities for redevelopment in the future.

Whitehaven/Memphis Airport

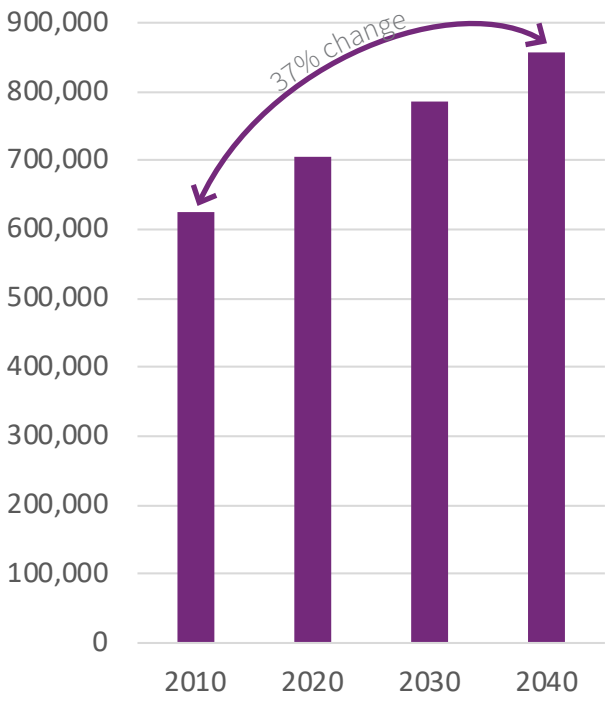
- The I-55 corridor is located directly to the west of the Memphis Airport and runs through the Whitehaven community, which is home to Graceland. Whitehaven primarily consists of residential developments in the southern portion of the community, near the Mississippi state line, but also has significant commercial development along major roadway corridors. These major roadway corridors often include access to I-55, as is the case with Brooks Road and Shelby Drive. Specifically, to the north along Brooks Drive, development is relatively dense

Figure 2-2. Shelby County Growth Trends, Population



Source: Woods & Poole, Inc., 2018

Figure 2-3. Shelby County Growth Trends, Employment



Source: Woods & Poole, Inc., 2018

Table 2-1. Interchange Population and Employment Growth — I-55

	2010	2040	Population Growth	
			Number	Percent
Population	36,180	41,240	5,060	14%
Employment	82,940	95,440	12,500	15%

Source: Tennessee Statewide Travel Demand Model (TSM)

and mostly related to employment and freight-related uses. Any future development in this neighborhood would likely occur farther from the I-55 interchanges where land is still available.

2.2 Planned and Proposed Development

Existing development patterns and in-progress plans will direct much of the forecasted population and employment growth over the next 20 years. Existing land use and development patterns were documented in Section 3-7 in Technical Memorandum 1. As mentioned there, future growth along the I-55 corridor is limited with some residential and commercial development expected to occur in the far northern portion of the study area near downtown Memphis. In addition, Graceland, which is a major tourist attraction in the area, has future expansion plans in mind and is primarily served by I-55. Many areas surrounding the I-55 corridor are poised for redevelopment and growth, most of which would likely manifest in the warehousing, freight, and industrial employment sectors.

2.3 Existing and Future Deficiencies and Needs

The following summarizes the key findings related to growth and development along the I-55 corridor.

A. Corridor Population and Employment Growth: The I-55 corridor runs through the southern portion of Memphis and Shelby County, which has a heavy industrial employment presence with its proximity to major freight transportation facilities. Over the next 20 years, Shelby County as a whole is expected to see approximately 75,000 additional residents and 230,000 additional jobs. At 37%, employment growth will significantly outpace population growth (8%).

B. Interchange Area Employment Growth: As shown in Tables 2-1 and 2-2, growth in close proximity of existing I-55 interchanges will strongly tilt toward employment, with approximately 2.5 jobs added for every new resident, for a total of approximately 12,500 new jobs within the interchange areas. Managing travel to, from, and within existing and emerging employment centers near interchanges will continue to present opportunities and challenges especially as it relates to growing peak hour demands at these locations.

C. Planned and Proposed Development: Areas along the I-55 corridor are currently home to a variety of land uses, primarily consisting of established residential, commercial, and freight-related developments. Given its proximity to the Memphis Airport as well as its connectivity across the Mississippi River, future growth along the I-55 corridor will likely be in the freight, logistics, and warehousing sectors, with many in-progress plans driving the location and pace of this development.

3. Highway Capacity and Travel Demand

As population and employment growth occurs in the I-55 study area, the demand on the roadway network also increases. This analysis considers historic traffic volumes in conjunction with predicted future 2040 traffic volumes to evaluate the following capacity and demand conditions in the corridor:

- 2010 traffic volumes and projected 2040 traffic volumes
- Travel patterns
- Volume-to-Capacity ratios
- Bottlenecks
- Travel time and delay

3.1 Traffic Volumes and Projections

TDOT collects and maintains Annual Average Daily Traffic Volume (AADT) data on roadways across the state. Figure 3-1 shows the 2017 AADT volumes recorded in the Tennessee Roadway Information Management System (TRIMS) at 12 count stations along I-55. As shown, daily volumes range from 83,590 vehicles per day (VPD) (16% trucks) near the Mississippi border, to 107,760 VPD (12% trucks) near the I-55/I-240/I-69 junction. Near the Arkansas border, volumes decrease to 53,180 VPD (49% trucks). The number of travel lanes varies from eight near the Mississippi state line to four near the Arkansas state line. For reference, the capacity of level four-lane, urban freeway facilities, similar to I-55, ranges from 79,200 VPD to 99,000 VPD. The capacity of a similiar eight-lane urban freeway facility ranges from 158,000 VPD to 198,000 VPD (Highway Capacity Manual 2010 Exhibit 10-8).

The I-55 corridor carries a high percentage of truck traffic unique to other Tennessee Interstate corridors. Nationally recognized logistics hubs such as the International Port of Memphis and the Memphis International Airport, as well as five Class 1 railroads and the associated intermodal/distribution facilities, are responsible for short and long haul trips that directly impact the corridor. As the half-way point for the planned I-69 corridor linking Canada to Mexico, the study area is expected to see continued growth in transportation and logistics industries.

Table 3-1 is populated with data obtained from the TSM, which provides base year (2010) daily trip information and forecasts the daily trips that will be made in 2040 based on projected growth and land use changes. As shown, total daily trips in Shelby County are expected to reach 6.3 million by 2040, representing a 19% increase over total trips in 2010. According to projections based on Woods & Poole data, the corresponding population and employment increases in the area are 8% and 37%, respectively.

Table 3-1. Area Daily Trip Breakdown 2010 and 2040 — I-55

	Daily Trips		
Trip Types	**2010**	**2040**	**% Change**
Personal Trips	5,066,100	5,955,900	18%
Truck Trips	238,000	360,400	51%
Total Trips	**5,304,100**	**6,316,300**	**19%**
Percent Truck Trips	4.5%	5.7%	27%

Source: Tennessee Statewide Travel Demand Model

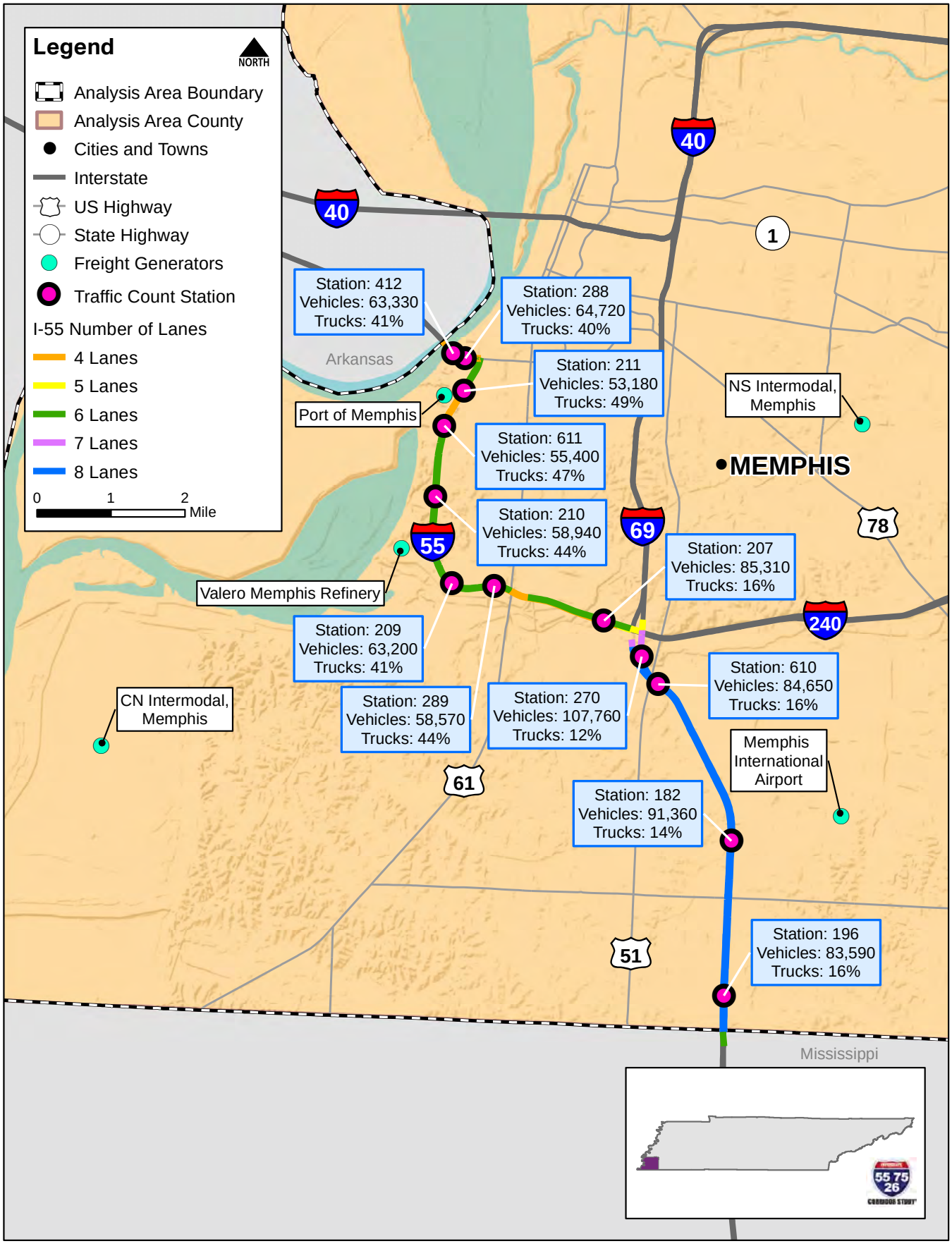
The TSM was used to calculate the total daily vehicle miles traveled (VMT) on each type of roadway facility in Shelby County. Table 3-2 indicates a total 23% increase in VMT over the 2010 base year total. With exception to rural local roads, all facilities will experience increases in VMT over the study period. Urban Interstate/ Expressway and arterial facilities are expected to see the highest percent changes in VMT. Further analysis

Table 3-2. Vehicle Miles Traveled by Functional Class — I-55

		Total Daily VMT (1,000s)		
	Functional Class	**2010**	**2040**	**% Change**
Urban	Interstate	6,040	7,056	17%
	Expressway	1,259	2,086	66%
	Arterial	11,060	13,565	23%
	Collector	1,516	1,766	16%
	Local Road	37	45	22%
Rural	Interstate	121	226	-
	Arterial	495	609	23%
	Collector	184	206	12%
	Local Road	14	14	0%
Analysis Area Total		**20,726**	**25,572**	**23%**
Total VMT/Trip		**3.91**	**4.05**	**4%**

Source: Tennessee Statewide Travel Demand Model

Figure 3-1. 2017 Average Annual Daily Traffic Volumes — I-55



Source: Tennessee Roadway Information Management System (TRIMS) - 2017

indicates that trip lengths within the study area, both in 2010 and 2040, average approximately four miles per trip, suggesting that motorists are making more trips of the same length.

3.2 Travel Patterns

Major Trip Destinations (O-D Pairs)

Origin-Destination (O-D) data, obtained from the TSM, was evaluated to determine the most common trip origin and destinations in Shelby County, as well as travel times between well-known locations along the I-55 corridor. As expected, most of the frequently traveled O-D pairs are in close proximity, with travel times between 3 and 10 minutes. Figure 3-3 shows the expected change in time required to travel O-D routes along I-55 between 2010 and 2040. As shown, travel times are expected to increase by less than one minute on trips under 15 minutes, and by up to six minutes on trips over 15 minutes.

Census County-to-County Work Flow

The U.S. Census Bureau provides origin and destination data for work trips per county. Figure 3-4 illustrates information obtained from their interactive, web-based tool, OnTheMap. The figure shows the most common employment destinations for workers living in Shelby County and adjacent counties. For example, of 24,000 employees who live in Tipton County, 57% work in Shelby County. Likewise, 64% of workers living in Fayette County commute to Shelby County for work; 47% of DeSoto County's workers are employed in Shelby County; and 30% of workers living in Crittenden, Arkansas cross the Mississippi for work each day. Eighty-five percent of workers living in Shelby County are also employed within Shelby County.

3.3 Volume-to-Capacity Ratios

Vehicle capacity, as defined in the Highway Capacity Manual, is the maximum number of vehicles that can pass a given point during a specific period of time under prevailing roadway, traffic, and control conditions. Roadway conditions include number of travel lanes, design speed, lane widths, shoulder widths, horizontal and vertical alignments, and the number of access points to adjacent parcels. Traffic conditions include vehicle type, specifically the percentage of heavy vehicles that impact travel speed and occupy more space, the distribution of vehicles traveling in each direction, and the driver population (commuter versus non-commuter). Given this definition, it is apparent that the capacity of a facility can change from one segment to another and from one time of day to another time of day.

Figures 3-5 and 3-6 illustrate the 2010 and 2040 peak period volume-to-capacity (VC) ratios (obtained from the TSM) for each Interstate segment. Where the volume-to-capacity ratio is greater than 1.0, drivers experience poor operating conditions and high delay, represented as level-of-service (LOS) F (see Figure 3-2). As shown, south of I-240 and between US-61 and Crump Boulevard interchange, congestion on I-55 is expected to increase such that motorists begin to experience minimal delays by 2040. All other segments are expected to carry volumes that exceed capacity by 2040. Note that the TSM model output reflects completion of the Crump Boulevard interchange modifications, which will improve safety and add capacity through the interchange. West of the interchange, however, future flows remain constrained by the four lanes provided on the Mississippi River bridge.

Figure 3-2. LOS Characteristics

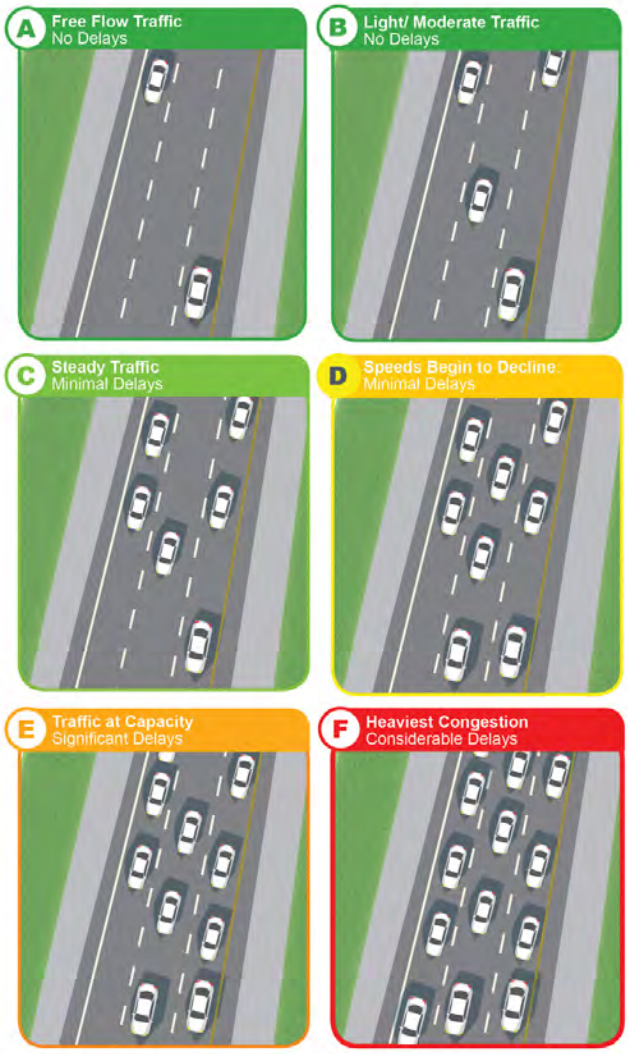
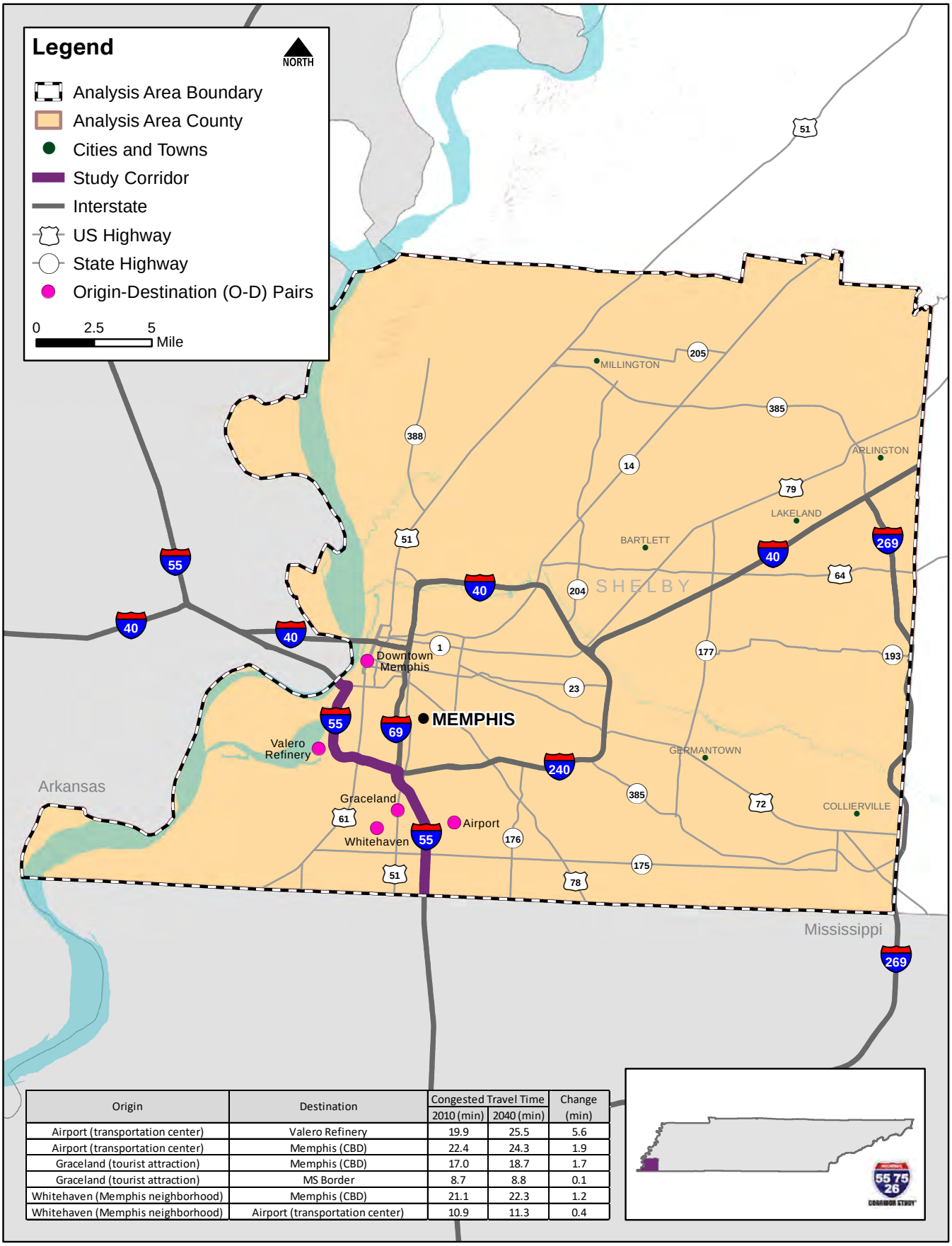


Figure 3-3. Major Trip Origin-Destination Pairs — I-55*

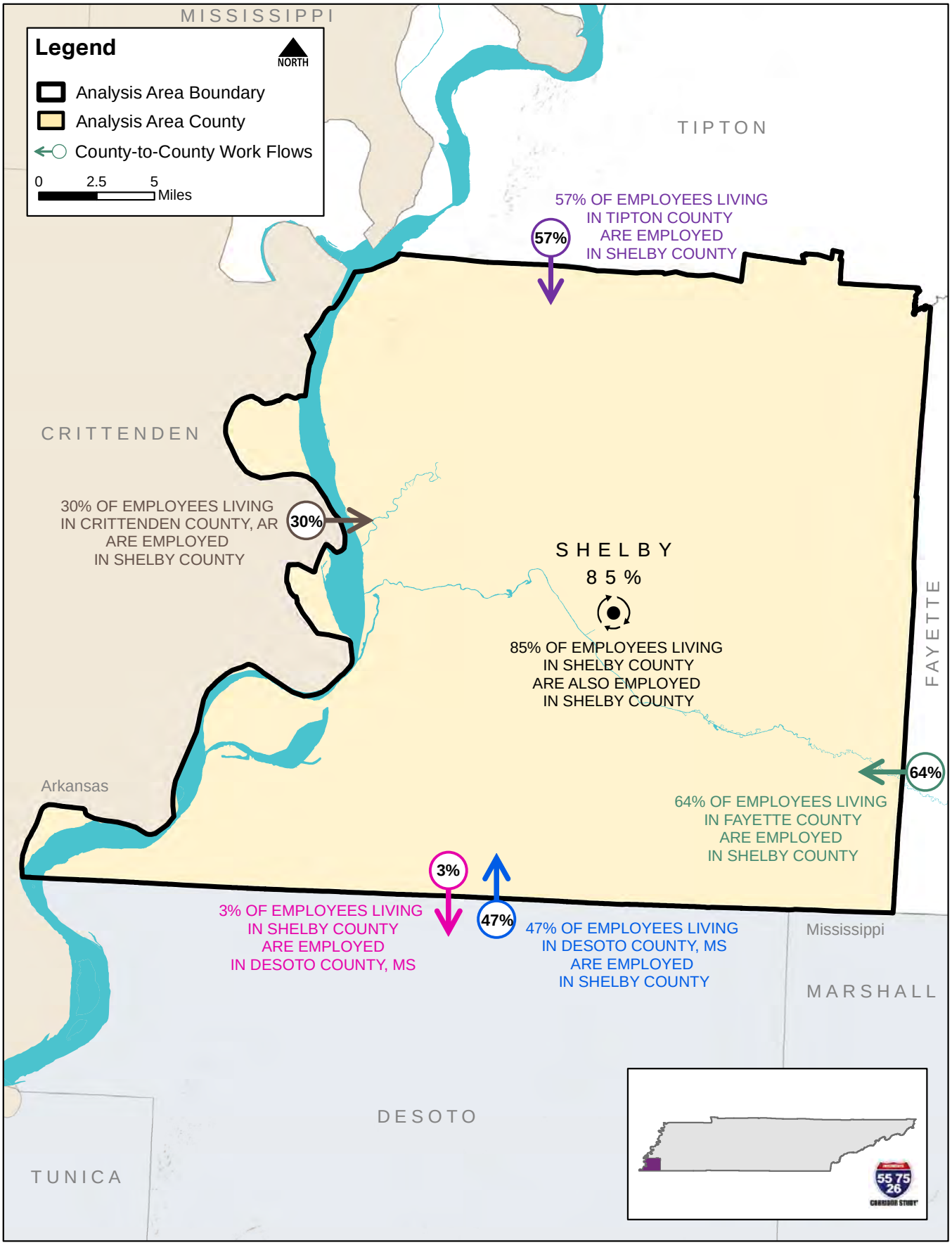


Origin	Destination	Congested Travel Time		Change
		2010 (min)	2040 (min)	(min)
Airport (transportation center)	Valero Refinery	19.9	25.5	5.6
Airport (transportation center)	Memphis (CBD)	22.4	24.3	1.9
Graceland (tourist attraction)	Memphis (CBD)	17.0	18.7	1.7
Graceland (tourist attraction)	MS Border	8.7	8.8	0.1
Whitehaven (Memphis neighborhood)	Memphis (CBD)	21.1	22.3	1.2
Whitehaven (Memphis neighborhood)	Airport (transportation center)	10.9	11.3	0.4

Source: Tennessee Statewide Travel Demand Model (TSM)

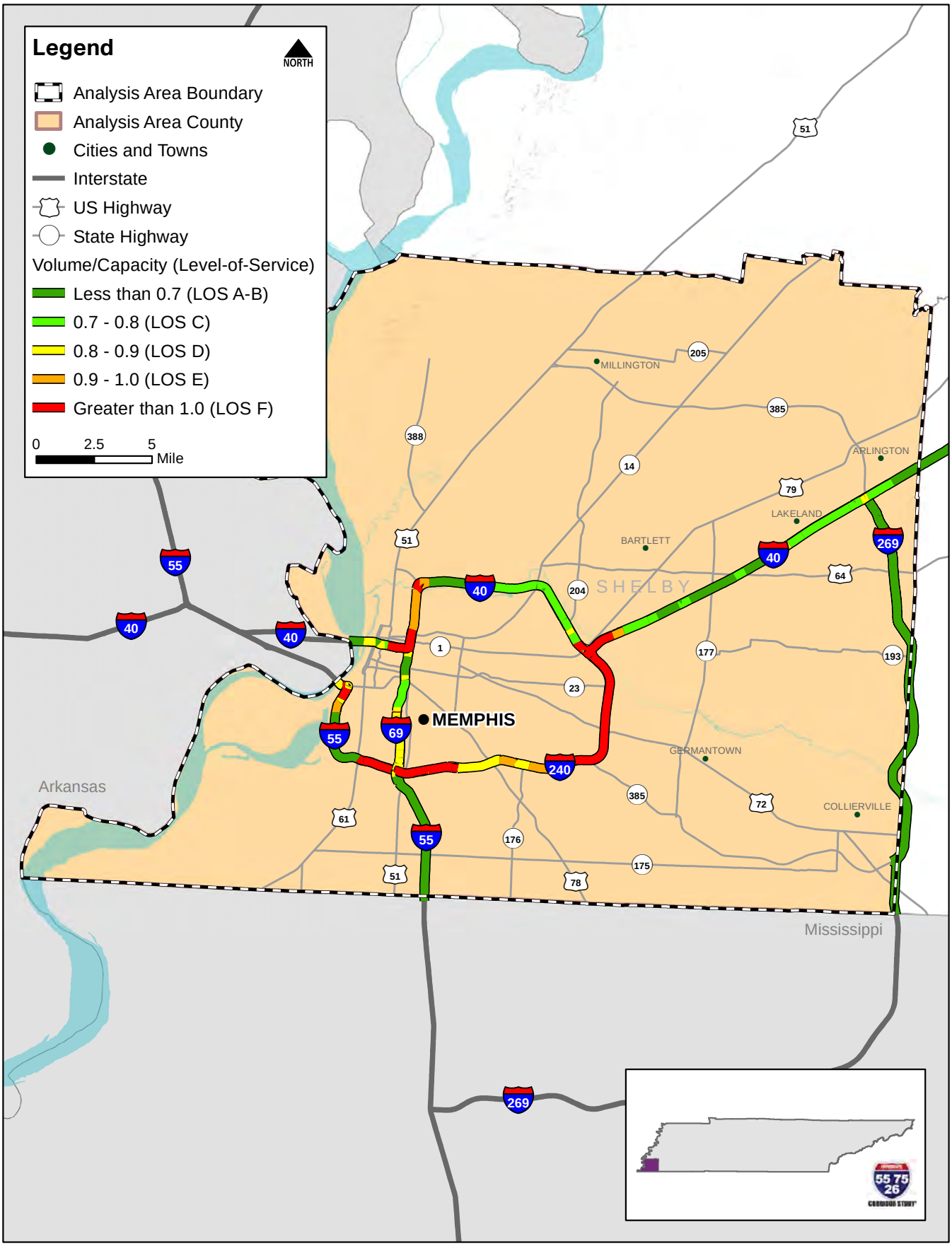
* Congested travel times are from model data.

Figure 3-4. County-to-County Work Flow (2015) — I-55



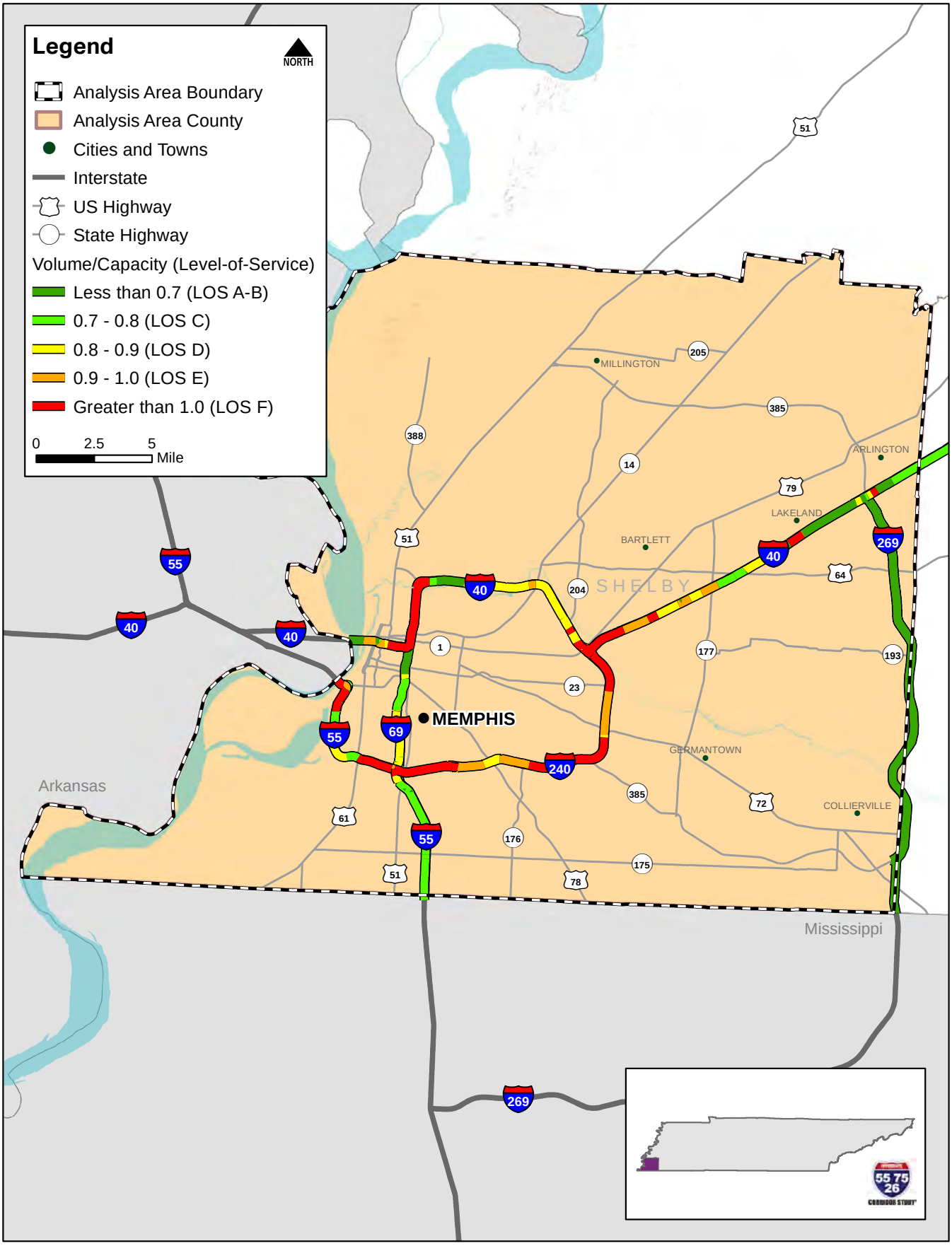
Source: U.S. Census Bureau, Center for Economic Studies: OnTheMap

Figure 3-5. Peak Period Volume-to-Capacity Ratios/Level-of-Service (2010) — I-55



Source: Tennessee Statewide Travel Demand Model (TSM)

Figure 3-6. Peak Period Volume-to-Capacity Ratios/Level-of-Service (2040) — I-55



Source: Tennessee Statewide Travel Demand Model (TSM)

As an Interstate begins to reach capacity and delay increases, motorists tend to seek alternative, parallel routes. This is referenced here as the spillover effect. Figure 3-7 shows the projected increases in average daily traffic (ADT) on arterials parallel to I-55 in congested segments. As shown, volumes on Florida Street and S. 3rd Street are expected to increase by 30-40%, as are volumes on E. Brooks Road to the south. According to the TSM, these segments are expected to maintain approximately half their capacity in 2040 and operate at LOS A or B.

3.4 Bottlenecks

Bottlenecks occur when the capacity or flow of a facility is suddenly restricted. This can be caused by geometric changes (lane reductions, merge/diverge areas, interchanges), changes in speed limit, or unexpected traffic incidents. TDOT's traffic management centers and HELP program work diligently to quickly address unexpected incidents; however, improvements to bottleneck areas created by geometric changes must be planned and programmed.

Figure 3-8 shows the TSM 2040 directional and peak period volume-to-capacity ratios at two bottleneck locations on I-55. The first location is near the McLemore interchange. Southbound I-55 drops from three lanes to two lanes at the southbound off-ramp to McLemore Avenue. The third lane is reintroduced approximately 1,400 feet south as the on-ramp from McLemore Avenue. The lane drop also occurs in the northbound direction between the McLemore Avenue ramps.

The second bottleneck location is just east of another lane drop - through the 3rd Street interchange. At this location, however, approximately 45% of the I-55 traffic enters/exits from 3rd Street, resulting in sufficient capacity on I-55 through the interchange and to the north. The bottleneck areas occur south of the interchange, near the northbound exit ramp to 3rd Street and south of the southbound on ramp from 3rd Street. Congestion at these locations is most likely due to weave and merge areas caused by high number of vehicles weaving to exit in the northbound direction and merging onto I-55 in the southbound direction. The effect of the weave/merge areas is amplified by the total volume on I-55 south of 3rd Street, which is approaching the capacity of a six-lane facility. As indicated, at both bottleneck locations, the PM volume-to-capacity ratio exceeds 1.0.

3.5 Travel Time and Delay

Tables 3-3 and 3-4 show the total daily vehicle hours traveled (VHT) and peak hour vehicle hours of delay (VHD) for each roadway type within Shelby County. As shown, the total VHT is expected to increase by 32% by 2040. This is a higher percentage increase than that of VMT, suggesting that though motorists are making

Table 3-3. Vehicle Hours Traveled by Functional Class — I-55

	Functional Class	Total Daily VHT (1,000s) 2010	2040	% Change
Urban	Interstate	122	159	30%
	Expressway	22	36	64%
	Arterial	500	652	30%
	Collector	63	88	40%
	Local Road	2	2	23%
Rural	Interstate	2	3	79%
	Arterial	10	11	20%
	Collector	5	6	13%
	Local Road	< 1	< 1	0%
Analysis Area Total		**725**	**958**	**32%**
Total Vehicle Mins Traveled/Trip		**8.20**	**9.10**	**11%**

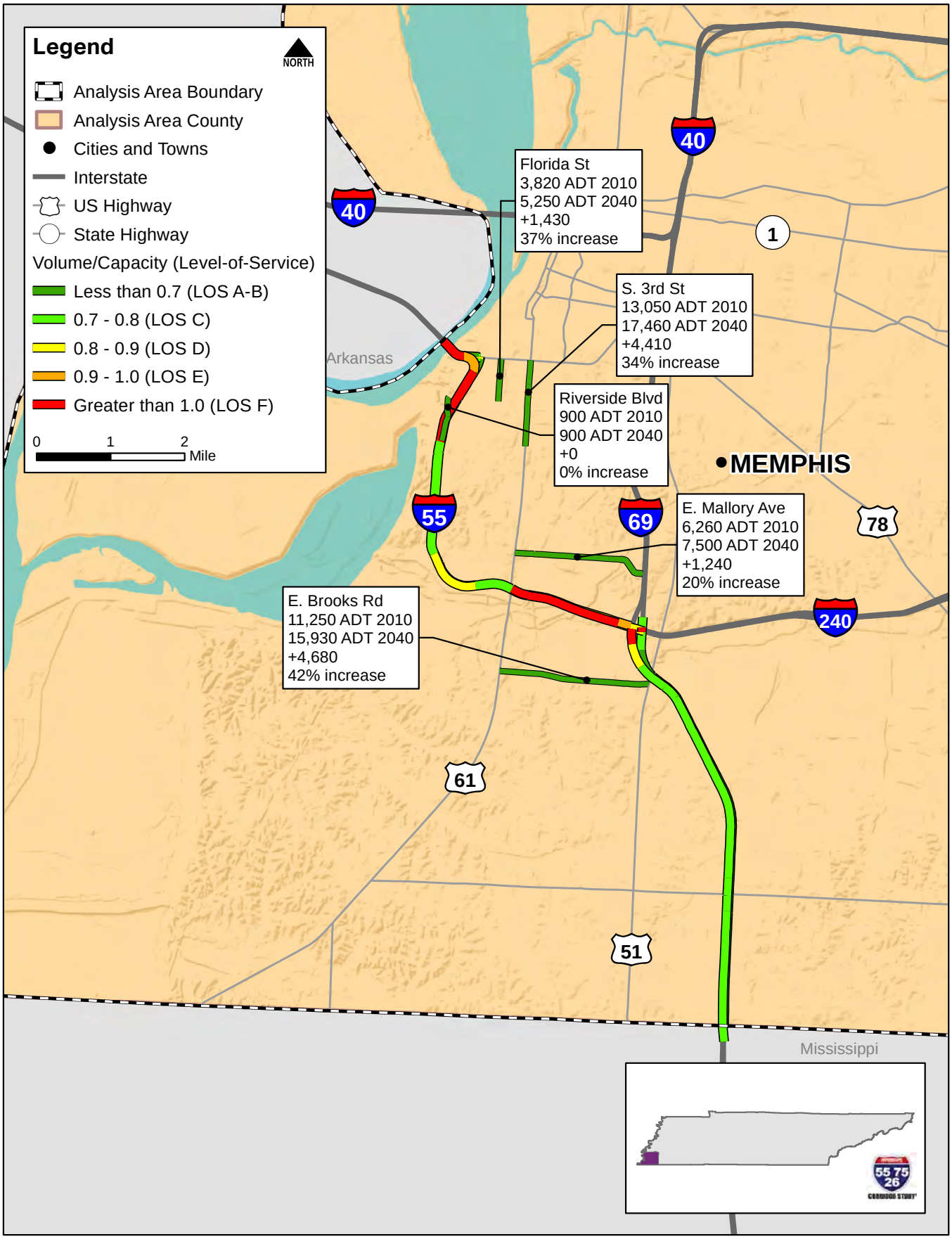
Source: Tennessee Statewide Travel Demand Model (TSM)

Table 3-4. Vehicle Hours Delay by Functional Class — I-55

	Functional Class	Peak Hour VHD 2010	2040	% Change
Urban	Interstate	1.62	2.34	45%
	Expressway	0.19	0.33	70%
	Arterial	16.16	19.09	18%
	Collector	4.20	4.54	8%
	Local Road	0.11	0.11	6%
Rural	Interstate	0.01	0.00	-
	Arterial	0.07	0.06	-15%
	Collector	0.10	0.13	28%
	Local Road	0.01	0.01	0.0%
Analysis Area Total		**22.47**	**26.61**	**18%**

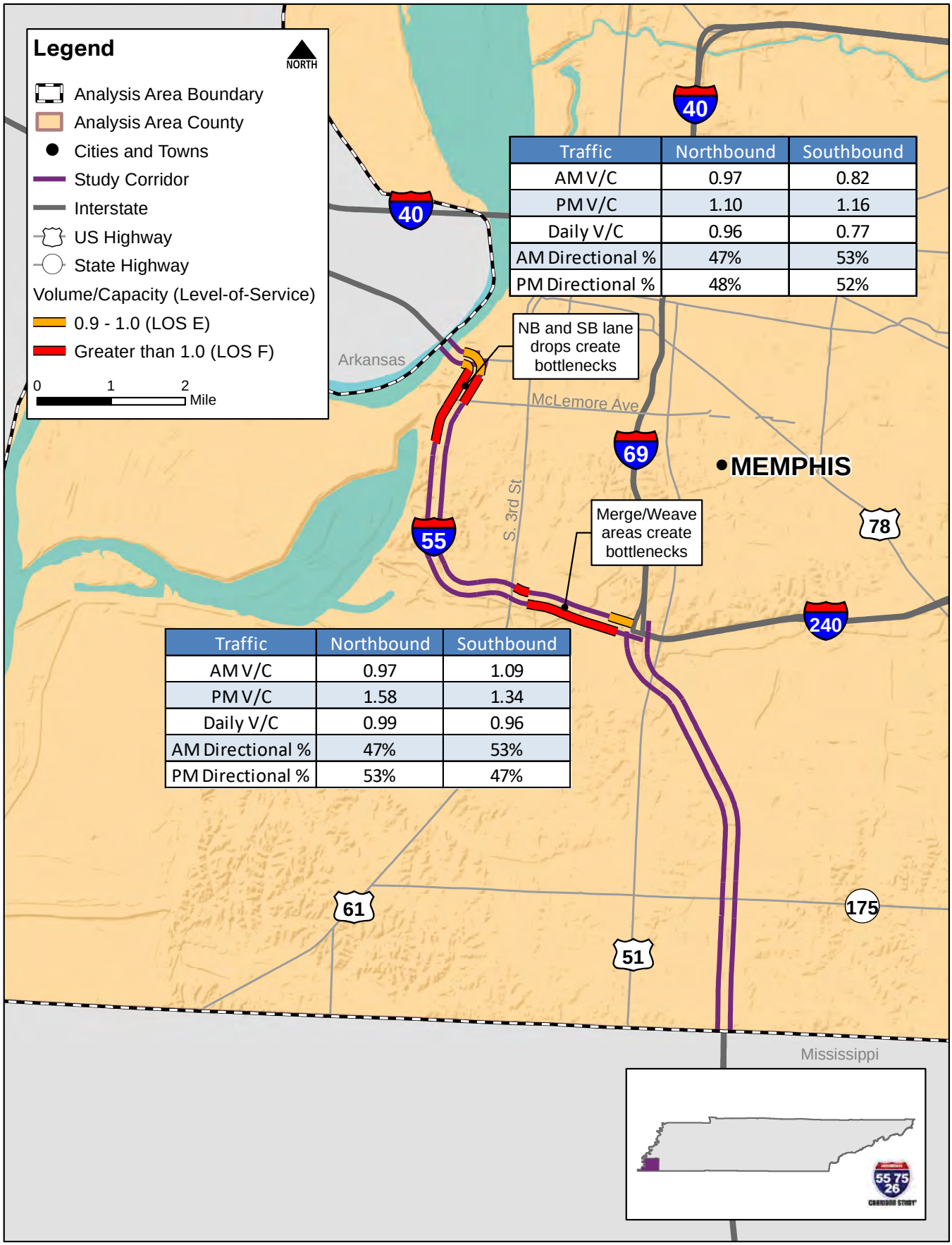
Source: Tennessee Statewide Travel Demand Model (TSM)

Figure 3-7. Spillover Effect (2040) — I-55



Source: Tennessee Statewide Travel Demand Model (TSM)

Figure 3-8. Bottleneck Locations — I-55



Source: Tennessee Statewide Travel Demand Model (TSM)

more trips of approximately the same length, the trips are taking longer. This is indicative of systemwide congestion – a conclusion which is further supported by the peak hour vehicle hours of delay and peak hour average speeds, particularly in urban areas. As shown in Tables 3-4 and 3-5, in urban areas, peak hour delay is expected to increase and peak hour speeds are expected to decrease, with the most significant changes on urban interstates and expressways. Note that VHD and speeds indicate that urban arterials and collectors were already congested in 2010.

Table 3-5. Average Peak Hour Speeds by Functional Class — I-55

		Peak Hour Average Speeds (mph)		
	Functional Class	2010	2040	% Change
Urban	Interstate	46	41	-10%
	Expressway	61	57	-6%
	Arterial	25	24	-3%
	Collector	25	25	0%
	Local Road	23	23	-3%
Rural	Interstate	72	74	4%
	Arterial	53	54	2%
	Collector	37	37	-1%
	Local Road	38	38	0%

Source: Tennessee Statewide Travel Demand Model (TSM)

TSM data for peak hour VHD and average travel speeds in rural areas of the corridor indicate minor change in delay and travel speeds. Rural Interstates will continue to flow with an average travel speed of approximately 75 mph; arterials at approximately 55 mph; and collectors and local roads just over 35 mph. Note that rural routes comprise only 10% of the lane miles in the corridor study area and carry less than 4% of the VMT.

3.6 Existing and Future Deficiencies and Needs

The biggest area of concern identified by stakeholders/ the public, the I-55 interchange at Crump Blvd, will be addressed through a programmed project (Table 1.1) and therefore, does not appear as a future deficiency in Figures 3-6 and 3-7. A summary of future conditions and expected 2040 deficiencies, based on analyses of TSM data, includes:

A. Daily Personal Vehicle and Truck Trips: Total daily trips in Shelby County are expected to reach 6.3 million by 2040, representing a 19% increase over total trips in 2010. According to projections based on Woods & Poole data, the corresponding population and employment increases in the area are 8% and 37%, respectively. Truck trips represent approximately 4.5% of total trips in 2010 and 5.7% of total trips in 2040.

B. Vehicle Miles Traveled: A 23% increase in VMT over the 2010 base year total is anticipated by 2040. With the exception of rural local roads, all facilities will experience increases in VMT over the study period. Urban Interstate/expressway and arterial facilities are expected to see the highest percent changes in VMT. Trip lengths within the study area, both in 2010 and 2040, average approximately four miles per trip.

C. Major Trip Destinations: Travel times between common origin and destinations along the corridor are expected to increase by less than one minute on trips under 15 minutes, and by up to six minutes on trips over 15 minutes. This is consistent with expected changes in VHD and average travel speeds, which indicate that most urban Interstates, arterials and collectors already experience peak hour congestion and will experience greater congestion by 2040.

D. Volume-to-Capacity Ratios: As shown in Figure 3-7, after completion of all programmed projects, significant congestion is only expected at the following locations:

- I-55 between the I-55 bridge over the Mississippi River and the Crump Boulevard interchange
- I-55 near the McLemore Avenue interchange
- I-55 between the 3rd Street interchange and the I-240 interchange

Analyses of these segments indicate bottlenecks near the McLemore Avenue interchange and the 3rd Street interchange, likely the result of lane drops and weave/merge areas, respectively.

As discussed in Chapter 9 of this Tech Memo, the Tennessee Freight Plan lists potential bottleneck locations based on level-of-service and truck speed data. The following location, which corresponds with TSM analysis results, was specified in the Freight Plan:

- I-55 north of West McLemore Avenue to the Arkansas State Line, including the Crump Boulevard interchange

4. Safety Analysis

As growth in population and employment occur in Tennessee, so do the traffic volumes on the Interstates and the extensive roadway system that feeds them. Increased traffic volumes and vehicle miles traveled, as well as congested travel conditions, increase the likelihood of traffic incidents. Crash data was collected from TRIMS and analyzed to identify trends in potential safety issues along the I-55 corridor. In total, 1,837 crashes occurred along the I-55 corridor for the five-year period spanning 2014-2018. Of these, 403 resulted in an injury and seven resulted in a fatality. Overall, the total number of crashes and the number of injury crashes both trended downward in this time period while the number of fatalities remained relatively constant. Table 4-1 shows the crash trends for the I-55 corridor for this five-year time period.

Table 4-1. Crash Trends — I-55

	Year				
	2014	2015	2016	2017	2018
Total Crashes	396	414	275	388	364
Injuries	97	80	54	91	81
Fatalities	1	1	2	2	1

Note: All crashes occurred in Shelby County

Source: Tennessee Roadway Information Management System (TRIMS) - 2017

4.1 Crash Analysis

Using TDOT's traffic volumes collected in 2018, crash rates were calculated for the I-55 study corridor during the five-year period spanning 2014-2018. These rates are reported in terms of crashes per million vehicle miles traveled. Figure 4-1 shows the comparison of these rates to the statewide averages for facilities of a similar type. More specifically, the statewide average crash rate is 0.528 crashes per million vehicle miles traveled for rural freeways and 1.112 crashes per million vehicle miles for urban freeways. I-55 crash rates were compared to the Tennessee statewide averages based on the following metrics:

- **Below Average**: Locations with crash rates below the statewide average
- **Average**: Locations with crash rates at or within 15 percent above the statewide average
- **Above Average**: Locations with crash rates between 15 and 100 percent above the statewide average
- **Significantly Above Average**: Locations with crash rates greater than or equal to 100 percent higher than the statewide average

Areas where the crash rates were significantly above statewide averages were identified as hot spots and are shown in Figure 4-1 in red. Table 4-2 shows the miles of I-55 in Shelby County and proportion of miles that have crash rates significantly above average. In addition, Table 4-2 shows the number of crashes that occurred on those hot spot roadway segments between 2014 and 2018. Many of the hot spot locations coincide with interchanges with major roadways. Within these areas, crashes were examined by severity as well as the manner in which the collision occurred to determine if there were any obvious trends in the crashes that have occurred.

Table 4-2. Hot Spot Crashes — I-55

County	Total Miles in County	Number of Miles in Hot Spots	Crashes 2014-2018
Shelby	12.3	1.3 (11%)	939

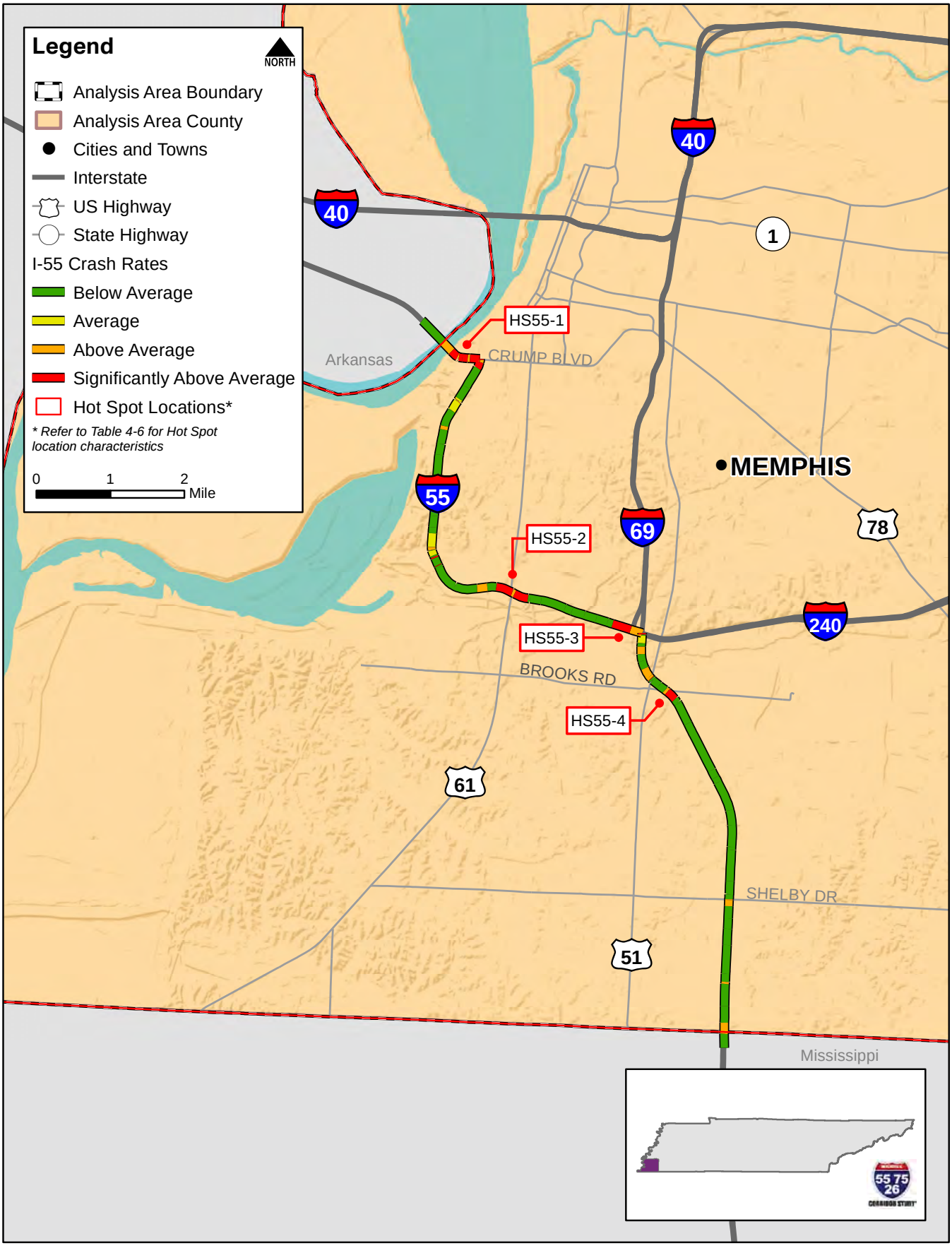
Source: Tennessee Roadway Information Management System (TRIMS) - 2017

Potential Crash Factors

For the I-55 corridor, all crash hot spot locations were classified as urban based on the functional classification of the Interstate segment. As shown in Table 4-2, approximately 1.3 miles of the I-55 corridor are identified as a crash hot spot. This represents 11% of the mileage for the whole corridor.

There were 939 crashes in these urban hot spots between 2014 and 2018. The crash patterns for these locations in comparison to the overall crash statistics for the whole corridor are shown in Tables 4-3, 4-4, and 4-5. Given that the crash hot spots are all located in the urban area, crash patterns at these locations are similar to those for the entire I-55 corridor, as expected. In the crash hot spots, approximately half of the crashes not involving a motor vehicle were the result of vehicles crashing into a concrete traffic barrier or guardrail.

Figure 4-1. Crash Rates (2014-2018) — I-55



Source: Tennessee Statewide Travel Demand Model

Table 4-3. Collision Trends — I-55

Manner of Collision	Hot Spot Crashes		I-55 Corridor	
Angle	176	19%	349	19%
Head-On	3	0%	5	0%
No Collision with Vehicle	259	28%	558	30%
Other	53	6%	132	7%
Rear-End	253	27%	451	25%
Sideswipe	195	21%	342	19%

Source: Tennessee Roadway Information Management System (TRIMS) - 2017

Table 4-4 shows the relatively insignificant difference in lighting conditions within crash hot spots and along the I-55 corridor.

Table 4-4. Lighting Trends — I-55

Lighting Conditions	Hot Spot Crashes		I-55 Corridor	
Dark – Lighted	206	22%	463	25%
Dark – Not Lighted	24	3%	44	3%
Dawn/Dusk	47	5%	97	5%
Daylight	643	68%	1,194	65%
Unknown	19	2%	39	2%

Source: Tennessee Roadway Information Management System (TRIMS) - 2017

Similarly, for the severity of crashes, there is little discernable difference in crash characteristics between hot spots and the corridor as a whole. As shown in Table 4-5, approximately 20% of all crashes resulted in an injury and approximately 80% resulted in property damage only. There were a total of four fatalities in crash hot spots from 2014-2018. Three additional fatalities occurred along the corridor in this same time period.

Table 4-5. Severity Trends — I-55

Crash Severity	Hot Spot Crashes		I-55 Corridor	
Fatal	4	0%	7	0%
Injury	174	19%	403	22%
Property Damage	761	81%	1,427	78%

Source: Tennessee Roadway Information Management System (TRIMS) - 2017

Crash Characteristics

In addition to analyzing the hot spots for different hot spots and corridor-wide characteristics, similar crash characteristics were examined for each hot spot to discern if any patterns indicated deficiencies that could be addressed. Table 4-6 shows the results of this analysis. In general, each of the hot spots were examined for trends in severity, prevalent collision types, non-vehicular accident events, lighting/weather conditions, relation to ramps and interchanges, as well as horizontal and vertical curvature. From these trends, potential crash factors are identified for each location, which will inform the development of safety project solutions.

Pedestrian and Bicycle Crashes

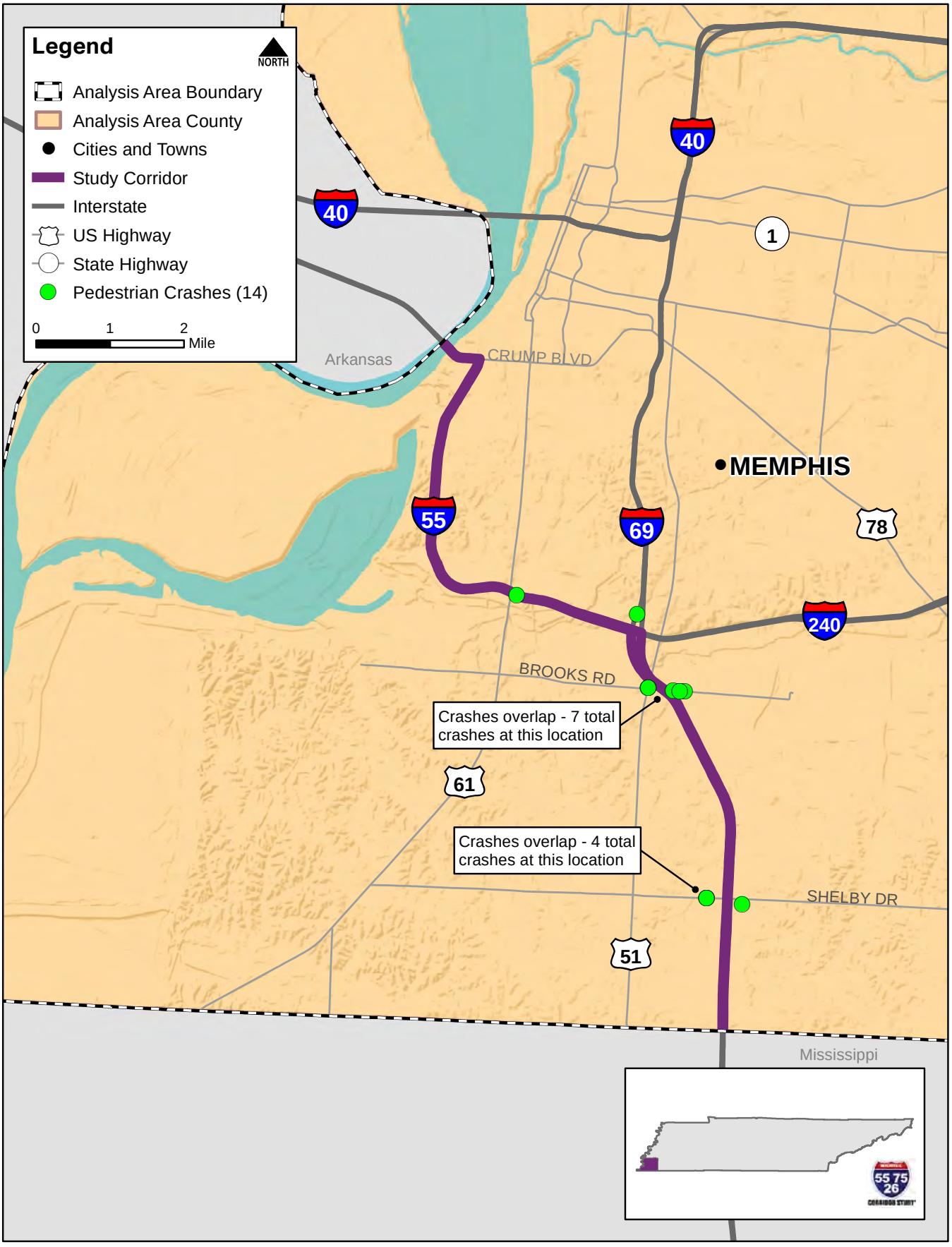
While there was only a single pedestrian crash that actually occurred on the I-55 corridor, there were a number that occurred in close proximity to the corridor. Pedestrian and bicycle safety on streets that parallel and intersect I-55 impacts the effectiveness of the transportation system to provide travel options across the corridor. To determine the impact of I-55 on non-motorized safety in the study area, pedestrian and bicyclist crashes within 500 feet of I-55 ramps were analyzed for the five-year period spanning 2014-2018. In total, there were 14 non-motorized crashes, all of which were pedestrian crashes. Of these, three crashes resulted in a fatality and 11 crashes resulted in an injury or possible injury. Interestingly, the majority of these crashes occurred near the ramps for Brooks Road and Shelby Drive. Figure 4-2 shows the location of these crashes.

Table 4-6. Hot-Spot Crash Location Characteristics – I-55

	Hot Spot ID			
	HS55-1	**HS55-2**	**HS55-3**	**HS55-4**
Termini	Mississippi River Bridge to Crump Boulevard Interchange	South 3rd Street	I-240/ I-55 Southbound	Brooks Road
Number of Crashes	328	238	283	78
Severity (Fatal or Injuries)	16% (52)	21% (50)	22% (63)	14% (11)
Prevelant Collision Types	20% (67) Angle 20% (35) Non-Vehicle 33% (109) Rear-End 26% (85) Sideswipe	18% (44) Angle 48% (115) Non-Vehicle 16% (39) Rear-End 16% (38) Sideswipe	17% (47) Angle 30% (86) Non-Vehicle 28% (78) Rear-End 23% (65) Sideswipe	19% (15) Angle 50% (39) Non-Vehicle 22% (17) Rear-End
Non-Vehicle Trends	35% (23) Roadway Barrier	49% (56) Roadway Barrier 18% (21) Utility Poles/ Signs/Posts	48% (41) Roadway Barrier	69% (27) Roadway Barrier
Lighting/ Weather	3% (9) in Dark-Unlit Conditions 11% (37) in Rain/ Snow	5% (12) in Dark-Unlit Conditions 35% (84) in Rain/ Snow	1%(4) in Dark-Unlit Conditions 21% (59) in Rain/ Snow	3% (2) in Dark-Unlit Conditions 50% (39) in Rain/ Snow
Interchange Related	42% (138)	34% (80)	42% (118)	19% (15)
Curvature Issues	Data Unavailable	Data Unavailable	Data Unavailable	Data Unavailable
Potential Crash Factors	• Inadequate signing for I-55 movements • Prevalent weaving issues and short merge/diverge area • High access point density	• Short merge/ acceleration lanes • Small radii for ramps potentially prevent adequate acceleration time/ distance	• Inadequate signing for I-55/I-240 movements • Short merge/ acceleration lanes on I-55 SB before Exit-Only lane for Brooks Road • Small radii and grade separation of ramps potentially prevent adequate acceleration time/ distance from I-240 to I-55	• Inadequate drainage in rain events

Source: Tennessee Roadway Information Management System (TRIMS) - 2017

Figure 4-2. Bicycle and Pedestrian Crashes (2014-2018) — I-55



Source: Tennessee Roadway Information Management System (TRIMS) - 2017

4.2 Existing and Future Deficiencies and Needs

Crashes were analyzed over the five-year period from 2014 to 2018, with crash hot spots identified as locations with crash rates significantly above the statewide average. The safety analysis also examined potential factors at crash hot spots, including crash types, area type, and roadway lighting. Pedestrian and bicycle crashes were examined near interchange ramps. Key findings of the analysis include:

A. Crash Rates and Hot Spots: Hot spots, ranging from individual roadway segments to longer corridor sections, totaling just over one mile of I-55 were documented. Hot spots include:

- Mississippi River Bridge to Crump Boulevard interchange
- South 3rd Street
- I-240/I-55 southbound
- Brooks Road

Additionally, injuries and fatalities resulting from reported crashes from 2014 to 2018 were documented for the study area. Overall, the total number of crashes and the number of injury crashes both trended downward in this time period and the number of fatalities remained relatively constant.

B. Crash Types: Crash types were examined for the identified hot spots, but then were also compared to crashes along the entire corridor to examine trends in crash characteristics. For both the I-55 corridor as well as the specific hot spots, the predominant crash types are angle, rear-end, and crashes with objects other than motor vehicles. Crash characteristics in hot spots were similar to those found along the I-55 corridor as a whole.

C. Pedestrian and Bicycle Crashes: Pedestrian and bicycle crashes within 500 feet of an I-55 interchange ramp were also analyzed. In total, there were 14 pedestrian crashes in this area. Improved non-motorized mobility across the I-55 corridor will be imperative as urban areas continue to grow.

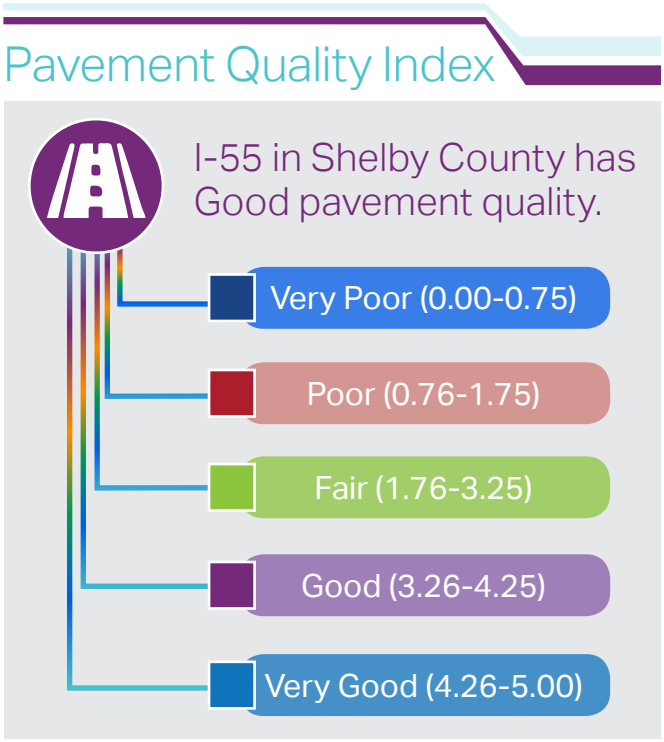
5. Operations and Maintenance

5.1 State of Good Repair

Pavement Sufficiency Rating

TDOT collects and maintains pavement management data for all roads included in the state's network. The Pavement Quality Index (PQI), expressed on a scale from 0-5, is the overall measure of a pavement's roughness and distress. According to TDOT, roadways with a PQI between 1.75 and 3.25 are considered to be in fair condition. Those with a PQI less than 1.75 are considered to be in poor condition. The PQI is calculated based on both the Pavement Distress Index and the Pavement Smoothness Index, the latter of which is a function of the International Roughness Index (IRI). The IRI measures the number of vertical deviations over a section of road, and has been used as a performance measure toward goals set by the Federal Highway Administration (FHWA) since 1998. As of 2006, FHWA designated an IRI equal to 95 inches/mile or less to be representative of a road with good ride quality. The percentage of Interstate miles with IRI less than or equal to 95 inches/mile is shown in Table 5-1. Also shown is the average PQI for Interstates and state routes within the study area that are included on the National Highway System.

Table 5-1 and Figure 5-1 also indicate dates of most recent resurfacing for segments of I-55 (as of 2017), as well as TRIMS sign inventory data, which is used as an indicator of maintenance.



Bridge Conditions

TDOT routinely inspects and evaluates the 19,822 structures designated as public highway bridges in the state. These include bridges owned and maintained by TDOT, as well as those owned and maintained by local governments. TDOT designates a bridge as "structurally deficient" if one or more major structural components are rated in poor condition, or if its load carrying capacity is well below current design standards. Via the Better Bridge Program, the state addressed deficiencies on 193 of the 200 structurally deficient state-owned bridges in 2013. Figure 5-2 shows bridge condition data, obtained from TRIMS, for the I-55 Corridor. As shown, the Illinois Central Railroad bridge over I-55, built in 1963, is designated as structurally deficient.

The Federal Highway Administration's (FHWA) Highway Bridge Replacement and Rehabilitation Program (HBRRP) provides funds to assist states in replacing or rehabilitating deficient highway bridges located on any public road. To be eligible, a bridge must carry highway traffic, be deficient and have a sufficiency rating of 80 or less. The sufficiency rating of an individual bridge, on a scale of 0 to 100, is based on structural adequacy and safety, serviceability and functional obsolescence,

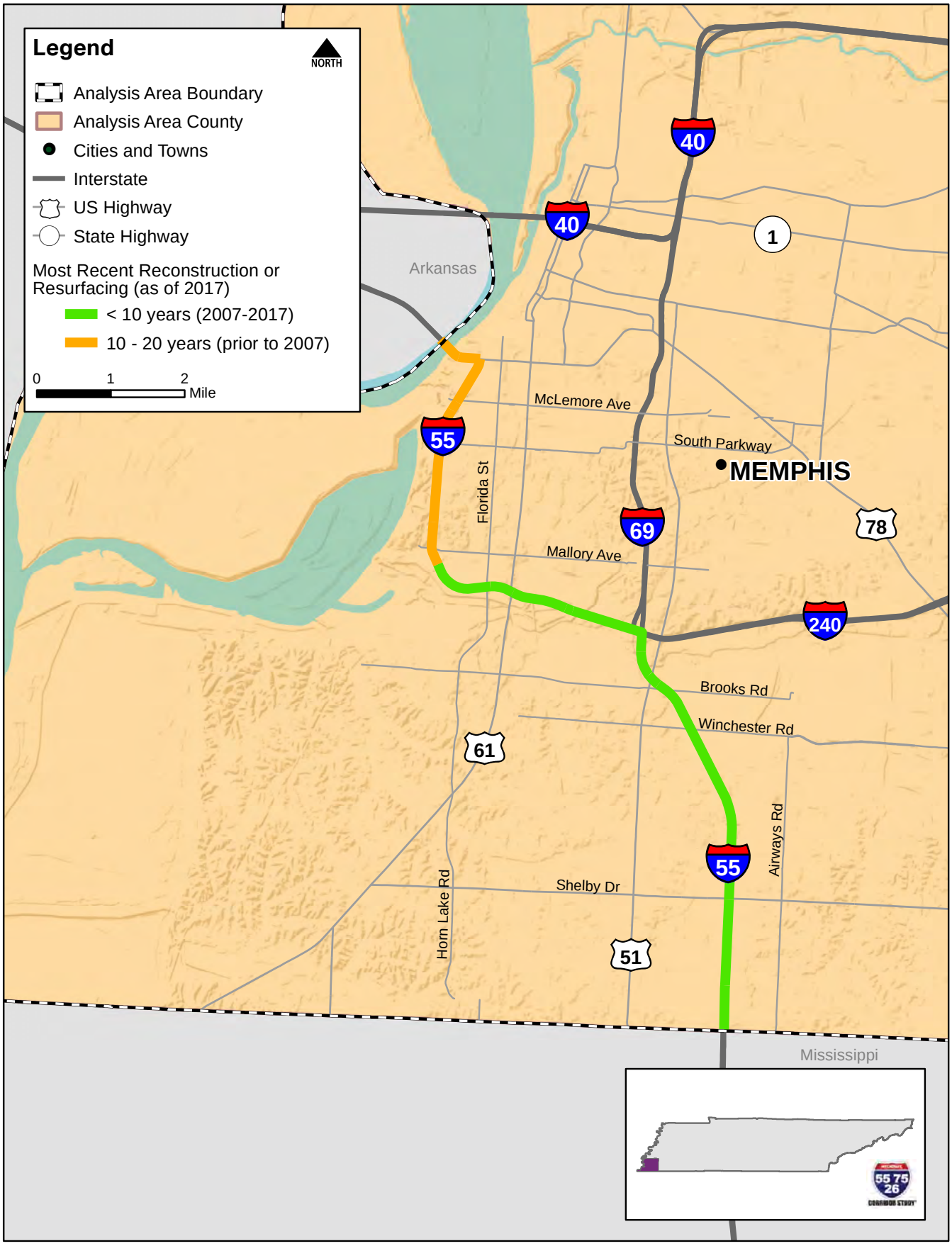
Table 5-1. Operations and Maintenance by County (as of 2017) — I-55

County	Most Recent Resurfacing (Letting Date)	% of Corridor with Good Ride Quality*	Average PQI	Avg PQI on NHS State Route	Sign Inventory Condition	Max AADT (2017)	% Trucks (2017)
Shelby	2008 (L.M. 0.0-5.25) 2009 (L.M. 5.25-5.74) 2012 (L.M. 5.75-8.05) 2001 (L.M. 8.05-12.11)	81%	4.07 Good	3.07	90% GOOD 8% FAIR 2% POOR	107,800	12%

* Good ride quality defined as an IRI equal to 95 or less

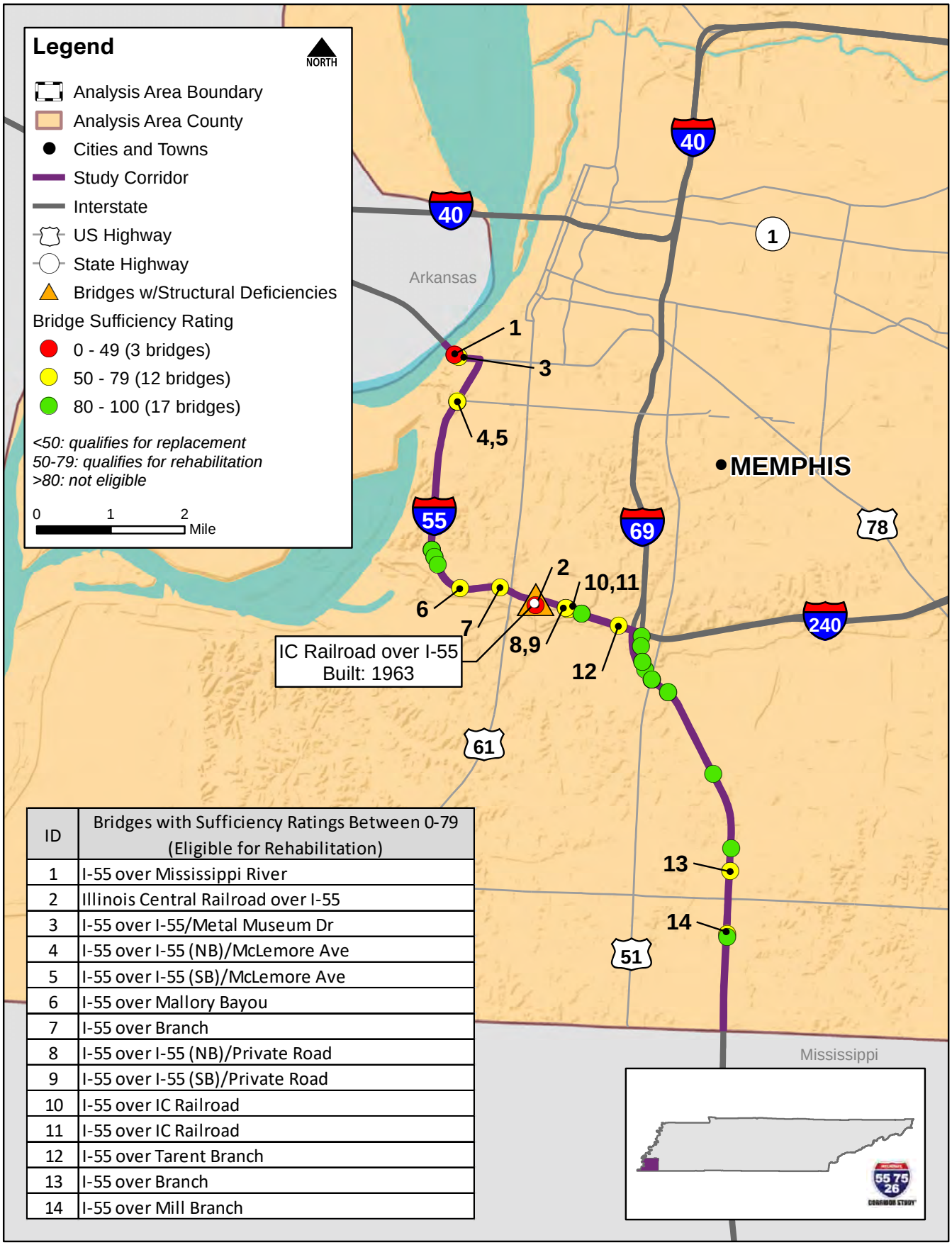
Source: Tennessee Roadway Information Management System (TRIMS) - 2017

Figure 5-1. Most Recent Reconstruction or Resurfacing with Bridge Conditions — I-55



Source: Tennessee Roadway Information Management System (TRIMS) - 2017

Figure 5-2. Bridge Sufficiency Ratings — I-55



ID	Bridges with Sufficiency Ratings Between 0-79 (Eligible for Rehabilitation)
1	I-55 over Mississippi River
2	Illinois Central Railroad over I-55
3	I-55 over I-55/Metal Museum Dr
4	I-55 over I-55 (NB)/McLemore Ave
5	I-55 over I-55 (SB)/McLemore Ave
6	I-55 over Mallory Bayou
7	I-55 over Branch
8	I-55 over I-55 (NB)/Private Road
9	I-55 over I-55 (SB)/Private Road
10	I-55 over IC Railroad
11	I-55 over IC Railroad
12	I-55 over Tarent Branch
13	I-55 over Branch
14	I-55 over Mill Branch

Source: Tennessee Roadway Information Management System (TRIMS) - 2017

and essentiality for public use[1]. A rating of 0 is the worst possible bridge. A sufficiency rating that is less than 50 is eligible for replacement and a sufficiency rating of less than 80 but greater than 50 is eligible for rehabilitation.

Sufficiency rating data was collected from TRIMS and used to identify the number of bridges elgible for rehabilitation or replacement along I-55. Of the 31 bridges on I-55 in the study area, there are two bridges with a sufficiency rating of less than 50. The Mississippi River Bridge, with a rating of 48, is a candidate for replacement under this program. The previously mentioned Illinois Central Railroad bridge over I-55 is the other candidate. There are 12 bridges with ratings between 50 and 80 and the remaining 17 bridges have sufficiency ratings greater than 80.

5.2 Traffic Incident Management (TIM)

Responding to traffic incidents in an effective and timely manner reduces congestion, wasted fuel, and the likelihood of secondary crashes. The time it takes to respond to an incident and clear the roads is directly related to the likelihood of a secondary crash. This response time can be greatly reduced using ITS technologies, including monitored CCTV cameras, radar detectors to determine travel speeds, and DMS to direct/notify drivers. The highly coordinated incident management process requires accurate and efficient communication among numerous agencies, including:

- Law enforcement
- Fire and rescue
- Emergency medical services
- Public safety communicators
- Emergency management officials
- Towing and recovery
- Hazardous materials contractors (when applicable)
- Traffic information outlets

According to FHWA, national best practices in scene management strategies include:

- Incident command systems
- Response vehicle parking plans
- High-Visibility safety apparel and vehicle markings
- On-Scene emergency lighting procedures
- Clearance laws, such as “Move Over”
- Effective traffic control
- End-of-Queue advance warning systems
- Alternative route plans

In addition to TDOT’s HELP program, which has been incorporating the latest ITS technologies and strategies since its inception in 1999, TDOT has also established specific, regional Interstate incident management plans focusing on major incidents (those that will require total roadway closure for at least two hours). Goals of these living plans include decreased response time and planned detour routes with appropriate signing so that motorists experience minimal delay in moving toward their destinations. The plans also detail work zone traffic control and point to the regional transportation management centers as the “home base” of coordination and communication during an event. The plans are distributed to regional TDOT Maintenance and Incident Management staff so that the defined detour routes can be implemented quickly upon confirmation of an incident. The Region 4 incident management plan notes that for incidents on I-55, detours will be coordinated with the City of Memphis. Traffic can be diverted a much shorter distance by using city streets, however city approval must be received before this can be done. Detouring traffic on I-55 is handled by the Memphis Police Department.

Over the last several years, TDOT has taken extra steps to improve traffic incident management, coordination, and safety on the Interstate system within Tennessee. In 2014, in response to proposals by the Tennessee Highway Patrol, TDOT and the Tennessee Department of Safety and Homeland Security opened a TIM Training facility in Nashville. The facility allows emergency responders hands-on quick clearance training in a safe environment[3]. In 2017, Tennessee initiated an annual Highway Safety and Operations Conference with the intent to bring together those involved in highway safety statewide for brainstorming and discussion of best practices[4].

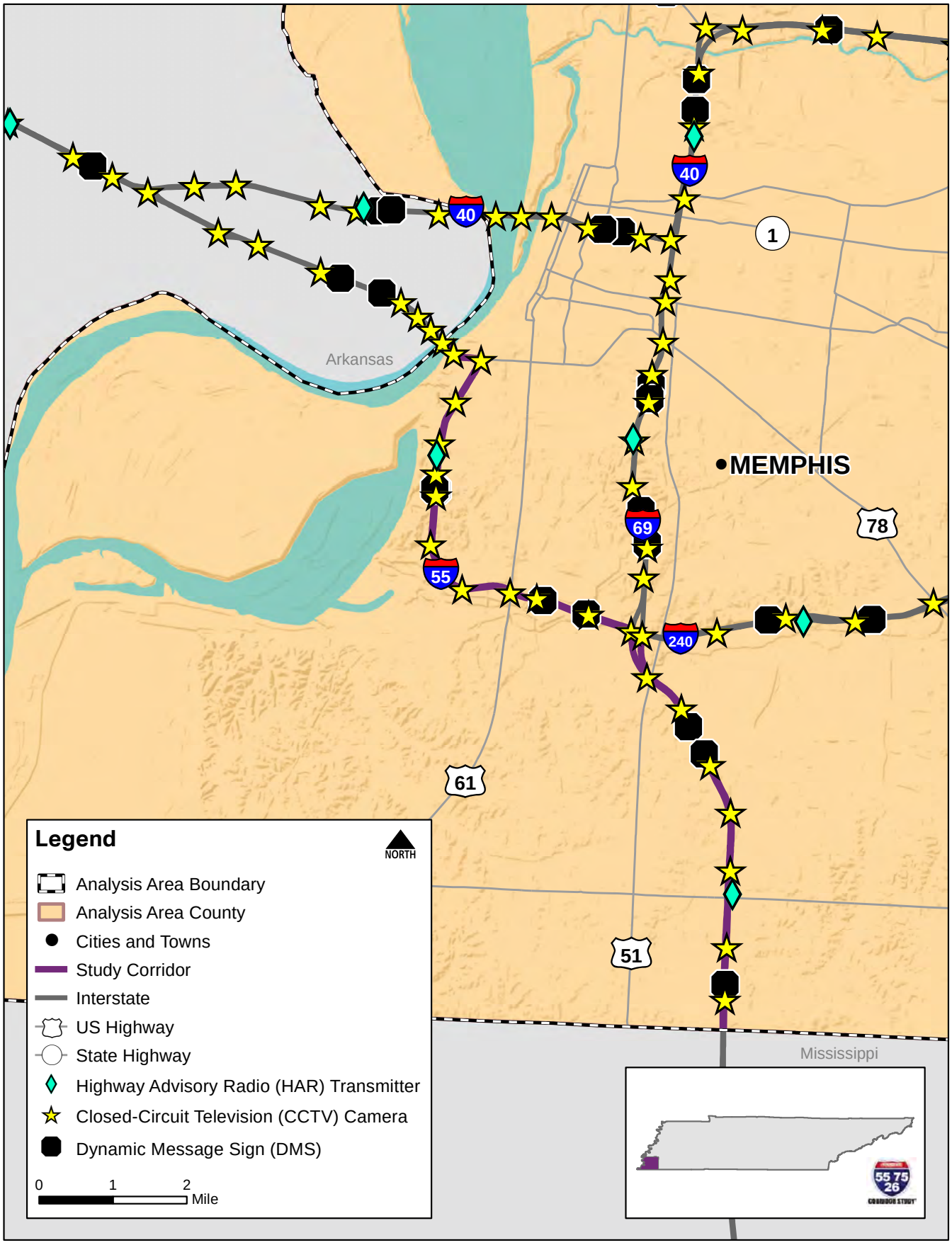
5.3 Intelligent Transportation Systems (ITS)

ITS Device Inventory

TDOT’s Smartway system relies on evolving technology, as well as teams of operators and technicians who monitor the technical systems and provide hands-on assistance through the state’s HELP program. Four transportation management centers (TMCs) located across the state anchor the systems operations and communication. From these locations, operators oversee 517 cameras, 174 message signs, 1,015 roadway detection systems and 49 video detection systems across the state. They also maintain communication with the public via messages on dynamic message signs, TN 511 updates, and the SmartWay website.

1- Federal Highway Administration. Accessed 08/22/2019. https://www.fhwa.dot.gov/legsregs/directives/fapg/cfr0650d.htm
2- https://www.tn.gov/tdot/traffic-operations-division/transportation-management-office/interstate-incident-management-plan.html
3- https://www.tn.gov/tdot/traffic-operations-division/transportation-management-office/training.html
4- https://www.tn.gov/tdot/traffic-operations-division/transportation-management-office/interstate-incident-management-plan.html

Figure 5-3. Intelligent Transportation System Components — I-55



Source: Tennessee Department of Transportation

Figure 5-3 focuses on the I-55 corridor, showing locations of Highway Advisory Radio (HAR) transmitters, Closed Circuit Television (CCTV) cameras and Dynamic Message Signs (DMS). A detailed inventory and location map of existing Intelligent Transportation System (ITS) components in Shelby County are included in Section 3.2 of Technical Memorandum 1. In addition to planned ITS and Transit Projects shown in Figure 4-5 of Technical Memorandum 1, it should be noted that the Memphis MPO amended the Transportation Improvement Program (TIP) in August of 2018 to include an ITS expansion on SR-385 from Piperton to Germantown. The expansion is expected to add a power and communication network, CCTV cameras, DMS and Radar Detection System (RDS) at a total cost of $4.0 million.

5.4 ITS State of Practice

While TDOT maintains a robust ITS system, reviewing national best practices is pertinent in an era of ever-evolving technology. Below are brief summaries of national examples for various ITS focus areas, intended to highlight recent advances. This list of strategies and solutions is not specific to I-55.

Transportation System Management and Operations (TSM&O)

Transportation System Management and Operations (TSM&O) is "a set of strategies that focus on operational improvements that can maintain and even restore the performance of the existing transportation system before extra capacity is needed.[5]" As vehicle miles traveled increases and funding decreases, TSM&O strategies- which can also benefit quality of life, economic vitality, and safety- have received more focus from state transportation departments and metro regions.

TDOT's Traffic Operations Division consists of the following offices, which support TSM&O: Headquarters Traffic Engineering, Intelligent Transportation Systems, and Transportation Management. Recognizing the demand for and benefit of operational improvements, TDOT's Traffic Operations Division includes in its list of responsibilities a national best practice review for TSM&O[6].

The following is FHWA's current list[7] of TSM&O strategies and solutions, many of which could be utilized on the I-55 corridor. Asterisks note the strategies that TDOT has implemented in various parts of the state.

- Work Zone Management*
- Traffic Incident Management* (Regional Incident Management Plans)
- Special Event Management*
- Road Weather Management*
- Transit Management
- Freight Management
- Traffic Signal Coordination
- Traveler Information* (SmartWay)
- Ramp Management
- Congestion Pricing
- Active Transportation and Demand Management*
- Integrated Corridor Management* (I-24 Corridor)
- Access Management*
- Improved Bicycle and Pedestrian Crossings
- Connected and Automated Vehicle Deployment

Managed Lanes

Managed lanes programs implement pricing and/or incentives for use of dedicated travel lanes – either existing or new construction. These strategies can be adapted in response to changes in demand which results in more reliable travel times, via personal vehicle or transit. Examples of managed lanes include high-occupancy-toll (HOT) lanes, which have been implemented in at least nine states; dedicated bus-rapid-transit (BRT) lanes, such as the Gold Line in St. Paul, MN, that will parallel nine miles of I-94; reversible lanes; and high-occupancy-vehicle (HOV) lanes. Tennessee has dedicated, peak hour HOV lanes on portions of I-65, I-40 and I-55 in the Nashville and Memphis metropolitan areas. See Section 8.3 for further discussion about HOV lanes on I-55. These lanes are divided from the standard travel lanes only by striping, and therefore rely on public awareness and enforcement to maintain effectiveness. In some states, physically divided HOV lanes are being combined with HOT lanes and/or BRT strategies.

Active Traffic and Demand Management (ATDM)

States and regions with continuously monitored transportation systems have the ability via new technology to actively monitor capacity and interact with drivers in real time. Active Traffic and Demand Management (ATDM) strategies also boast significant safety benefits. Specific strategies, potentially pertinent to I-55, include dynamic ridesharing, on-demand transit, dynamic pricing, predictive traveler information, dynamic lane use/shoulder control, dynamic speed limits, queue warning, adaptive ramp metering, and dynamic way-finding.

5- https://ops.fhwa.dot.gov/tsmo/index.htm
6- https://www.tn.gov/tdot/traffic-operations-division/transportation-management-office.html
7- https://ops.fhwa.dot.gov/tsmo/index.htm

Freight Applications

Because freight trucks play a key role in transportation networks, it is critical to integrate them into ITS. By increasing the overall efficiency of freight trucks, congestion, travel time, travel stop time, and fuel consumption are all reduced. Although large logistics companies often have an in-house ITS in place, local governments can implement systems to help smaller companies, and transportation networks as a whole.

Freight Advanced Traveler Information System (FRATIS) is a collection of methods to help optimize freight operations. The first aspect of this system deals with real-time data, such as current arterial speeds/volumes, weather conditions, road closures, etc. that optimize routes. The second aspect focuses on arrivals and destinations. By combining and analyzing weigh station, delivery point, intermodal terminal, overnight parking, and other information, dry runs, wasted miles, and traffic jams are reduced.

Work Zone Mobility and Safety

Work Zone Mobility and Safety programs are designed to maximize safety, minimize delays, and establish consistency throughout work zones. Every Day Counts (EDC) is an ongoing model created by FHWA that provides a wide variety of innovative ideas to help increase efficiency of roadway projects with a focus on safety.

Many states have implemented safety specific campaigns, such as TDOT's Work With Us. This is a multimedia campaign that aims to remind motorists to take extra caution when passing highway workers. Using an array of delivery methods, such as online videos and graphics or DMS, the Work With Us campaign is able to reach a larger audience than traditional safety campaigns.

Integrated Corridor Management (ICM)

Various aspects of corridors are often individually managed by different entities for different goals. Collaboration with transportation professionals in other networks across the corridor allows entities to share resources and information and more effectively meet their goals. Integrated Corridor Management (ICM) aims to improve accessibility, safety, and mobility of users within the corridor through this cooperation between stakeholders. By combining data into a universal system, all appropriate stakeholders, including managers and users, can make more informed decisions for the corridor as a whole. A few attributes of a successful ICM system as described by the FHWA are outlined below:

- Institutional Support
- Multimodal Capabilities and Alternative Transit Options
- Centralized Data Hub
- Public Engagement

Connected Vehicle Technology

Many technologies are being developed that help drivers by providing their vehicles with information about their environment. By communicating with nearby vehicles, traffic signals, work zones, toll booths, or other surroundings, these vehicles will improve efficiency and safety, not just for the user, but others as well. Likewise, these Connected Vehicles (CV) also send information back out to their environment. The devices the CVs communicate with will also provide data, such as speed and volumes, to DOTs to help improve the transportation system. One of the most likely methods for this communication to occur is through Dedicated Short-Range Communication (DSRC). Similar to Wi-Fi, this technology can securely, reliably, and quickly share information between vehicles and surrounding infrastructure.

Governments can help foster growth of connected vehicles by setting up a system in which companies can begin introducing these technologies. TDOT has begun the DSRC Statewide Guidance document as a living resource for implementing a CV project within the state. Although currently in the early stages, once complete, it will provide a reference for organizations to begin implementing these technologies within the state.

Autonomous Vehicle Technology

In May 2017, the Tennessee General Assembly ruled in favor of companies testing autonomous vehicles (AVs) on Tennessee roads so long as federal and state safety standards are met and proper insurance is obtained. Because concerns with CV and AV technology are so closely related, preparation for widespread use is similar. Organizations will use resources such as the DSRC Statewide Guidance document to safely and legally implement AV technology in the future.

Contrary to fully autonomous vehicles, the use of semi-autonomous vehicles is already widespread. For example, since April 2017, platooning has been permitted on Tennessee roads. This is the method in which freight trucks use a system that automatically controls speed and braking by communicating between participating vehicles. This not only improves efficiency by increasing aerodynamics as the trucks can drive closer together, but also safety because the system will automatically apply brakes if it senses a hazard.

5.5 Existing and Future Deficiencies and Needs

A. Pavement Sufficiency Rating: Eighty-one percent of the roadway miles on I-55 in Shelby County have an IRI equal to or less than 95 inches/mile indicating "Good" ride quality, with a PQI of 4.068. TRIMS maintenance history (as of 2017), shows the segment of I-55 from Horn Lake Road (L.M. 8.05) to the Mississippi River (L.M. 12.11) should be considered next for resurfacing.

B. Bridge Conditions: The Illinois Central Railroad Bridge, built in 1963, is the only bridge along I-55 that is designated as structurally deficient. Of the 31 bridges on I-55 in the study area, only 12 had sufficiency ratings low enough to be eligible for rehabilitiation under the FHWA's HBRRP. Two bridges had sufficiency ratings low enough to be eligible for replacement - the Illinois Central Railroad bridge and the bridge over the Mississippi River.

C. ITS Devices: The I-55 Corridor is fully integrated into TDOT's SmartWay System and HELP program, with 21 cameras, 23 speed detectors, 7 digital message signs and access to 25 HELP trucks. SmartWay expansion plans include additional mainline fiber to connect existing Intelligent Transportation System (ITS) devices on I-40 in Shelby County and the addition of Closed Circuit Television (CCTV) cameras and Radar Detection Systems (RDS) on I-55 near the McLemore Avenue and Crump Boulevard interchanges. TDOT has also placed high priority on replacing the existing wireless connection across the Mississippi River bridge with fiber optic connection.

D. ITS Strategies: Both TDOT and local agencies continue to invest in TSM&O strategies and technologies. Foreseeing continued growth in traffic volumes and limited funding for increased capacity, consideration should be given to the effectiveness of the existing high-occupancy-vehicle (HOV) lanes on I-55. TDOT is currently considering ITS strategies to assist with enforcement; however, alternative uses for this pavement width, including HOT lanes or dedicated BRT lanes could promote rideshare and use of public transportation while addressing demand and maintaining travel speeds further into the future.

Freight applications and signal coordination on adjacent arterial streets could alleviate some congestion due to the heavy vehicle percentages on I-55. Dynamic speed limit signs and end of queue advance warning systems for incident management and commonly congested areas could also be deployed to address safety on the corridor.

Coordination should continue between TDOT and local agencies/programs as each further develops its ITS toolbox:

- Memphis Area Transit Authority (MATA) (as it continues to develop Automatic Vehicle Location or AVL on transit vehicles)
- City of Memphis Traffic Operations Center
- Shelby County Congestion Management Program (county-wide effort)
- City of Bartlett
- City of Germantown
- City of Millington
- Town of Collierville

6. Transit

The I-55 study area is served by the Memphis Area Transit Authority (MATA). MATA offers fixed bus service across Shelby County as well as several trolley routes in downtown Memphis. Despite substantial transit coverage, MATA has seen a continual decrease in ridership over the last several years[8]. As part of the Memphis 3.0 comprehensive plan, MATA's existing network was evaluated and recommendations were made for transit improvement throughout the greater Memphis region.

Figure 6-1 shows MATA's routes and areas of high employment concentration. While MATA provides good coverage to the City of Memphis, regional connections are missing, especially to eastern suburbs with high employment concentrations.

6.1 Fixed-Route Transit Service

MATA currently offers over 40 fixed bus routes throughout Shelby County, three fixed trolley routes serving downtown Memphis and MATAplus, an on-demand paratransit service. Existing bus routes connect with the Memphis Amtrak station and the Memphis International Airport. However, airport connections often require a transfer to the airport shuttle causing excessive layovers for users. Currently over 500,000 residents in Shelby County have access to transit within ½ mile of their residence[9]. Unfortunately, most of the transit that is accessible to residents has long headways of 30 minutes or more and limited service on nights and weekends. There are also limited north-south connections. While a few bus routes offer limited stop services, no true commuter routes exist[10]. Of the 11 routes identified as being in close proximity to I-55, only one, Route 280, is a limited stop service route. Table 6-1 identifies these routes.

Table 6-1. Routes with Close Proximity to I-55

Route Number	Current Daily Ridership
Route 7: Air Park	398
Route 12: Florida	392
Route 13: Lauderdale	178
Route 17: McLemore	384
Route 28: Holmes	145
Route 280: Airways Limited Stop	40
Route 30: Brooks	302
Route 32: East Parkway	588
Route 42: Crosstown	2,264
Route 46: Whitehaven	126
Route 69: Winchester	594

Source: Memphis Area Transit Authority (MATA)

6.2 Transit Plans

MATA Short-Range Transit Plan

The MATA Short-Range Transit Plan was released in the summer of 2012. The plan contained a thorough analysis of MATA's existing service as well as offering a recommended alternative that would improve service within MATA's existing budget. Before determining a preferred alternative, the plan first outlined a needs assessment of MATA's current service. The needs assessment included the following shortfalls of existing service[11]:

- MATA service doesn't reach new and emerging employment and service markets
- MATA has been shrinking both in level-of-service and ridership due to budget constraints
- MATA's service reliability needs improvement
- Not enough routes traveling north/south
- MATA's current network has overlapping service on some corridors

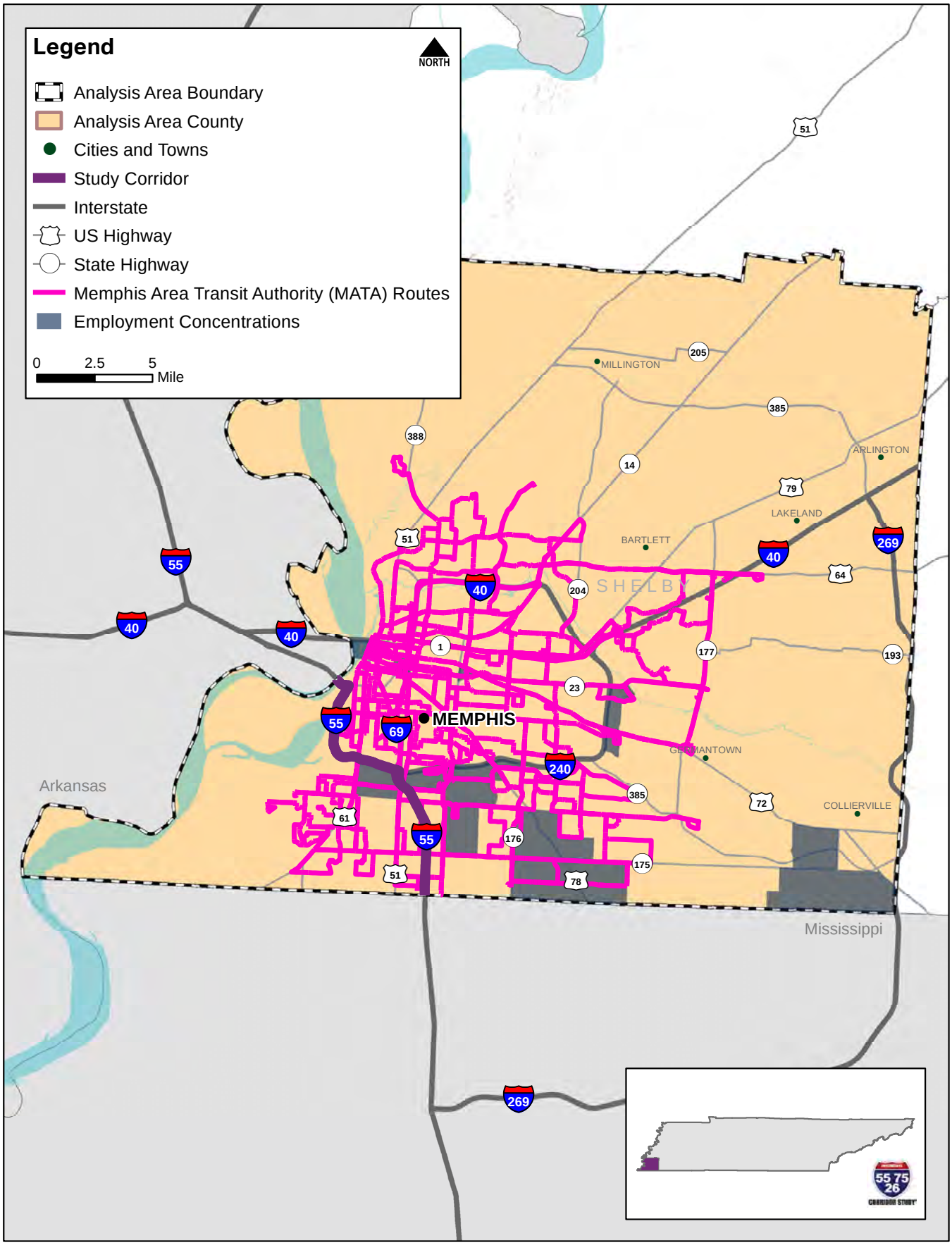
The Plan's recommended alternative attempts to address the above shortfalls in service through an improved system network. The new network would be structured around a series of transit hubs with route hierarchy. The new network would reduce redundancies, improve wait times, increase access to jobs and improve reliability. The proposed network can be seen in Figure 6-2.

Livability 2040: Connecting People and Places (Memphis MPO Long-Range Transportation Plan)

Livability 2040, Memphis's Long-Range Transportation plan, was written shortly after the release of the Short-Range Transit Plan in 2013. Livability 2040

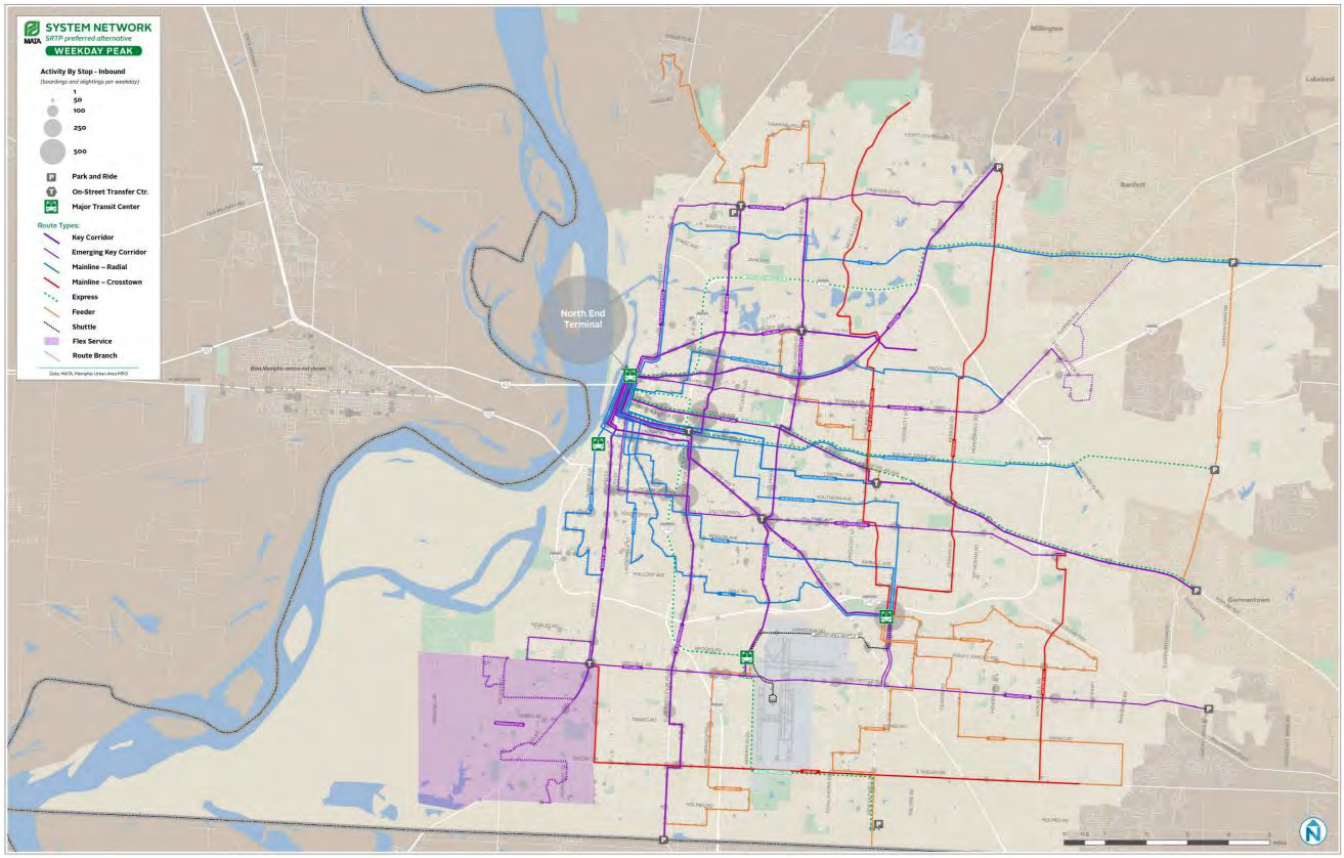
8- American Public Transit Association. Access 3/6/2019. https://www.apta.com/resources/statistics/Documents/Ridership/2018-Q2-Ridership-APTA.pdf
9- Memphis 3.0 Transit Vision. Access 3/6/2019. https://docs.wixstatic.com/ugd/100a0d_67ea22e3bc5147a6889a754d8da14b9f.pdf
10- Memphis 3.0 Transit Vision. Access 3/6/2019. https://docs.wixstatic.com/ugd/100a0d_67ea22e3bc5147a6889a754d8da14b9f.pdf
11- Memphis Area Transit Authority Short- Range Transit Plan. Accessed 03-11-2019. https://www.memphismpo.org/sites/default/files/public/mata-short-range-transit-plan.pdf

Figure 6-1. Transit Operations — I-55



Source: Memphis Area Transit Authority (MATA)

Figure 6-2. Proposed Transit Network - MATA Short-Range Transit Plan



Source: Memphis Area Transit Authority (MATA)

acknowledges the recommendations made in the short-range transit plan in addition to listing TIP projects related to transit scheduled for 2014 – 2017. Livability 2040 also acknowledges the growing need for transportation access in DeSoto County, Mississippi (just south of the I-55 study area), and other growing suburban communities. Finally, Livability 2040 prioritizes improving north/south connections through modifying facility design and maximizing level-of-service[12].

Memphis 3.0

Memphis recently underwent a comprehensive plan update, Memphis 3.0. Within this comprehensive plan was an entire section focused on transit that included an overhaul to the MATA system. The draft vision of the Memphis 3.0 Transit Plan is currently available. The main recommendation in the draft vision plan includes more frequent service, improved weekend service and better access to jobs via bus service[13]. The recommended improvements would only be possible with an increase to MATA's yearly budget. However, results from the Memphis 3.0 Transit Visions surveys show that a budget increase is supported by Memphis residents[14].

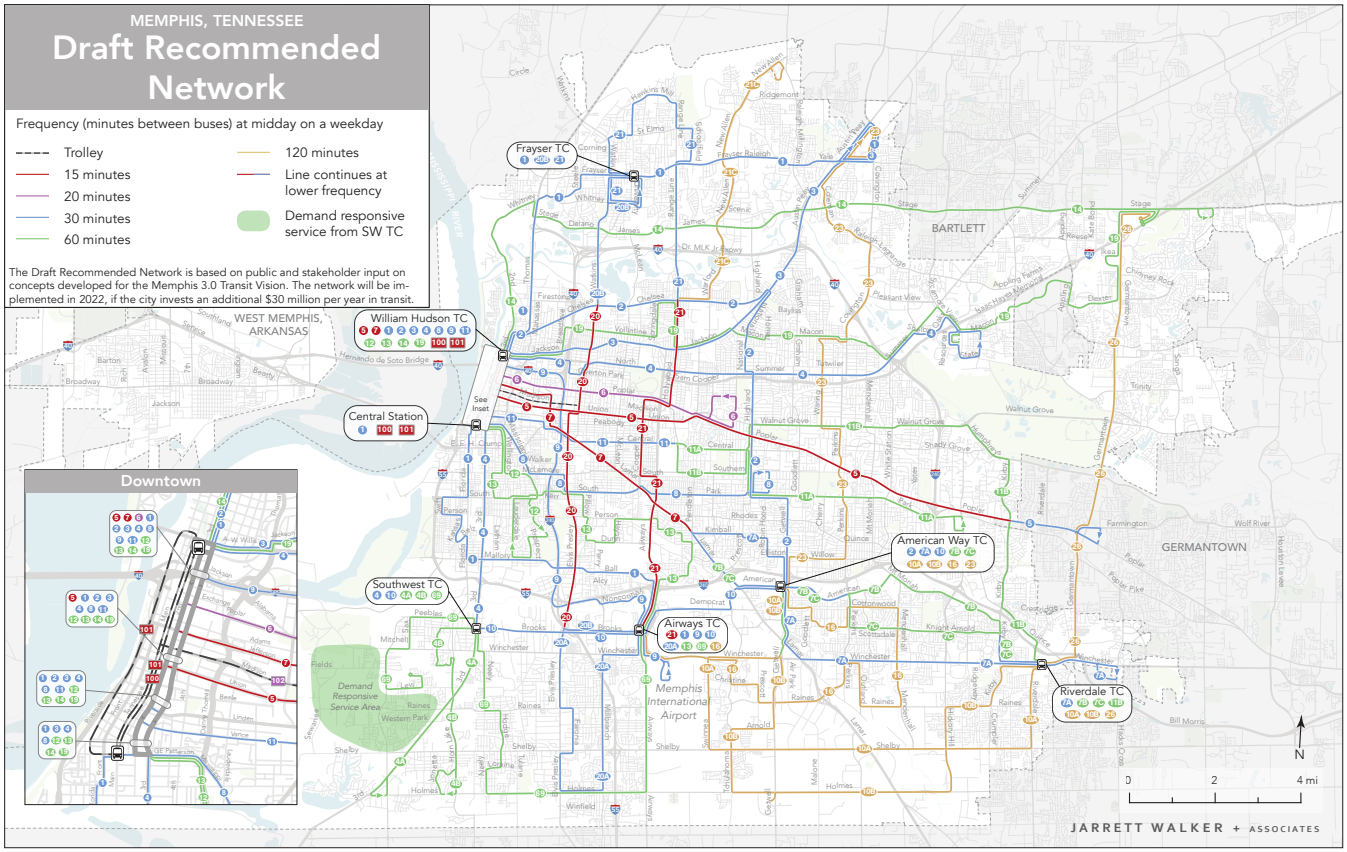
The recommended network includes maintaining existing downtown trolley service and altering existing bus routes in order to increase access to jobs. In addition to altering existing routes, the recommended network also includes increasing bus frequency and making the service more predictable and reliable. Increasing bus frequency will also improve transfers between routes as wait time at a transfer will be reduced. The proposed network can be seen in Figure 6-3.

Memphis MPO DeSoto County Transit Feasibility Study

DeSoto County is located directly south of Shelby County in Mississippi. DeSoto County is currently

12- Livability 2040. Accessed 3-12-2019. http://www.memphismpo.org/sites/default/files/public/livability-2040-all-chapters.pdf
13- Memphis 3.0 Transit Vision Draft Recommended Network. Accessed 03-06-2019. https://docs.wixstatic.com/ugd/100a0d_67ea22e3bc5147a6889a754d8da14b9f.pdf
14- Memphis 3.0 Transit Vision Draft Recommended Network. Accessed 03-06-2019. https://docs.wixstatic.com/ugd/100a0d_67ea22e3bc5147a6889a754d8da14b9f.pdf

Figure 6-3. Proposed Transit Network - Memphis 3.0 Transit Plan



Source: Memphis 3.0 Transit Vision Draft Recommended Network

experiencing rapid population growth, which led to a study by Memphis MPO, MATA and DeSoto County. Although DeSoto County is outside of the study area for I-55, the study's results could directly impact MATA.

The transit feasibility study considered DeSoto County's population, employment, travel patterns and public input as part of the study. The study also considered different types of transit services that could be offered including the cost and benefit of each. Final recommendations are to[15]:

- Hire a mobility manager to expand and advertise existing transit services offered to persons with disabilities, the elderly and veterans
- Create a flexible voucher program
- Develop commuter service to Shelby County and Tunica Casinos
- Operate fixed-route or flex-route bus service along Godman Road

The results of the study verify that transit service will need to expand beyond Shelby County in order to continue serving the growing Memphis region.

6.3 Transit Analysis

O-D Pairs

In Section 3, major trip destinations (O-D pairs) were identified along the I-55 corridor. Key O-D pairs include:

- Airport to Valero Rifinery
- Airport to Downtown Memphis
- Graceland to Downtown Memphis
- Graceland to Mississippi Border
- Whitehaven to Downtown Memphis
- Whitehaven to Airport

These trips occur on I-55 and are projected to see an increase in travel time due to forecasted congestion. Currently, all of the identified O-D pairs in the I-55 corridor can be made using fixed-route transit provided by MATA.

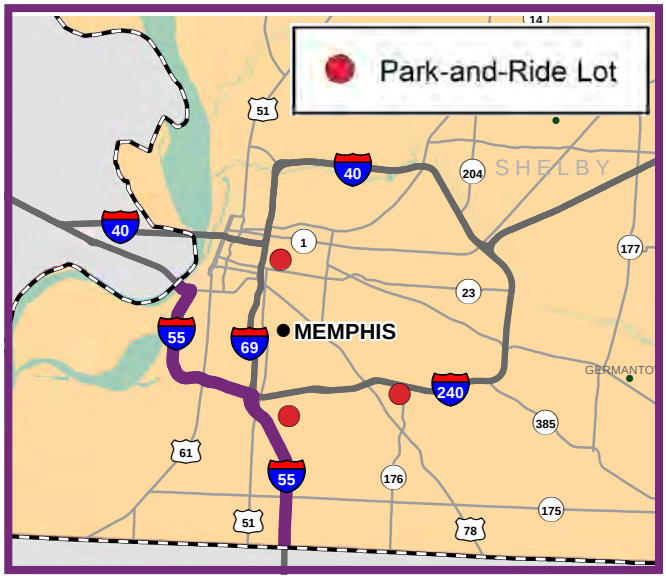
Park-and-Ride Lots

MATA manages three park-and-ride lots within Memphis's municipal limits, as shown in Figure 6-4.

15-Memphis MPO DeSoto County Transit Feasibility Study. Accessed 03-11-2019. https://www.memphismpo.org/sites/default/files/public/DESOTO%20Transit%20Feasibility%20Study%20FINAL.pdf

While these park-and-ride lots offer a great service to transit users, their locations are within MATA's service area and therefore, don't attract as many commuters as they could if some park-and-ride locations were located outside of the service area. Offering park-and-ride locations at the edge of MATA's service area could allow commuters to make a portion of their commute by bus, reducing congestion on corridors like I-55. For example, many commuters coming into Memphis travel along I-55 from northern Mississippi. A strategic park-and-ride location at the border of Tennessee and northern Mississippi could help reduce congestion on I-55.

Figure 6-4. Park-and-Ride Lots — I-55



Source: Memphis Area Transit Authority (MATA)

Zero-Vehicle Households Compared to High Job Concentrations

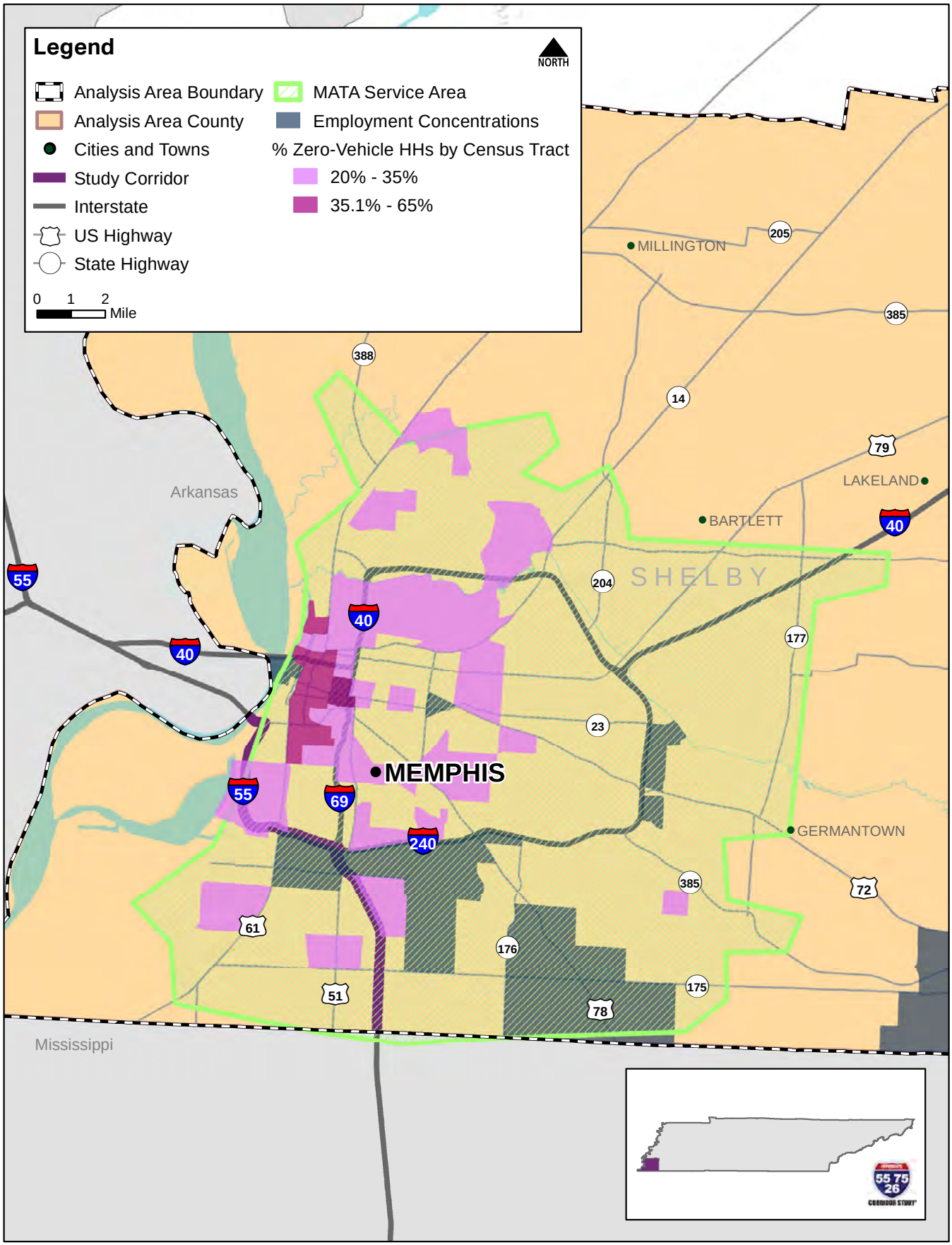
Figure 6-5 highlights high concentrations of households with no access to a vehicle in relation to areas of high employment concentrations. The limits of existing fixed transit service are also identified. The figure demonstrates high levels of zero-vehicle households throughout the greater Memphis area. Fortunately, the concentrations of zero-vehicle households are within the MATA service area and therefore, have access to fixed-route transit. While the zero-vehicle household populations largely have access to transit service, a large majority of the population relies solely on MATA's services to get around Memphis. Efficient and reliable transit service within the existing service area is paramount.

6.4 Existing and Future Deficiencies and Needs

A. Fixed-Route Transit Service: Memphis's existing transit service provided by MATA covers a great deal of the Memphis city limits and even into suburbs within Shelby County. Unfortunately, this service has long headways of 60 minutes in most places and often requires transfers to get to and from destinations. MATA also offers limited night and weekend service making it difficult for users dependent on their service or those working odd hours.

B. Mississippi/Arkansas: The greater Memphis region includes parts of northern Mississippi and eastern Arkansas that are not serviced by MATA. Employees who live outside of Shelby County do not have transit options to get to and from work and other important services located in Shelby County.

Figure 6-5. Zero-Vehicle Households and Transit Service — I-55



Source: U.S. Census Bureau, Memphis Area Transit Authority

7. Walking and Bicycling

In order to serve all transportation users, bicycle and pedestrian infrastructure is necessary in many locations, especially along transit corridors, at transit stops, in dense neighborhoods and in downtown areas. The I-55 corridor is surrounded by bicycle and pedestrian infrastructure as it falls within the City of Memphis. While Shelby County is a dense environment with bicycle and pedestrian infrastructure, there are gaps in coverage. Existing infrastructure is often designed to minimum design standards or is segmented by an Interstate facility. Most existing bicycle and pedestrian facilities are supported locally or regionally, however, some state-wide bicycle routes are in development through TDOT.

7.1 U.S. and State Bicycle Routes

Currently, Tennessee has one existing statewide bicycle route, U.S. Bicycle Route 23, running north to south through the middle of the state. This route runs along existing state and U.S. highways. The route is signed with 'Bike Route' signs, but no other bicycle accommodations exist. Other U.S. bicycle routes are planned in Tennessee including one route running east to west through Memphis, Nashville and Knoxville (USBR 80). Additionally, a route is planned north to south to the east (USBR 22) and west (USBR 35/25) of Nashville and a second route (USBR 45) along the Mississippi River or Tennessee's western boundary.

In addition to U.S. bicycle routes, TDOT has statewide bicycle routes planned throughout the state. Two planned bicycle routes are within the I-55 corridor study area, including:

- Memphis to Chattanooga
- Memphis to Nashville

These planned state bicycle routes are proposed along existing U.S., state and even county highways throughout the state of Tennessee. The planned state bicycle routes within the I-55 corridor study area can be seen in Figure 7-1.

7.2 Bicycle and Pedestrian Connectivity Through Interchanges

Unless planned for ahead of time, geometric limitations created by Interstate structures often result in discontinuous pedestrian and bicycle accommodations on cross-streets through an interchange. Where bicycle lanes and sidewalk may be present on either side of the Interstate, the cross-section through the interchange may be limited to only vehicular traffic - discouraging multi-modal connectivity from one side to the other.

Futhermore, ramp intersections often create bicycle lanes and sidewalk paths that are difficult to navigate, and in some cases unsafe. As shown in Figure 7-1 and Table 7-1, I-55 interchanges with U.S. and state routes were evaluated to determine connectivity for pedestrians and bicyclists across the Interstate. Where pedestrian and bicycle accommodations existed on the cross-street, free-flow right turns at ramp interchanges were noted. While free-flow right turns have operational benefits, the movement allows vehicles to maintain higher rates of speed off the ramp and through the intersection, putting pedestrians and bicyclists at a disadvantage. Motorists traveling at higher speeds are less likely to yield to pedestrians; and higher intersecting speeds are more difficult for bicyclists to judge and maneuver.

AADT on the cross-roads was also noted as the volume of traffic influences mobility for pedestrians and bicyclists.

Noteworthy are the interchanges of I-55 with SR-175 (Shelby Drive) and with SR-3/US-51 (Elvis Presley Boulevard).

- On SR-175, the existing sidewalk and crosswalk at the northbound off-ramp leads pedestrians to the off-ramp shoulder where they must walk 20 to 25 feet before accessing a set of steps leading to sidewalk on an adjacent frontage road. No bicycle accommodations exist at this interchange.
- On SR-3/US-51, no bicycle accommodations are provided at this interchange. Sidewalk is provided; however, the existing sidewalk is discontinuous, leaving pedestrians stranded on SR-3, east of the southbound off-ramps. AADT volumes near these interchanges ranged from 30,000 to 41,900 vpd in 2018.

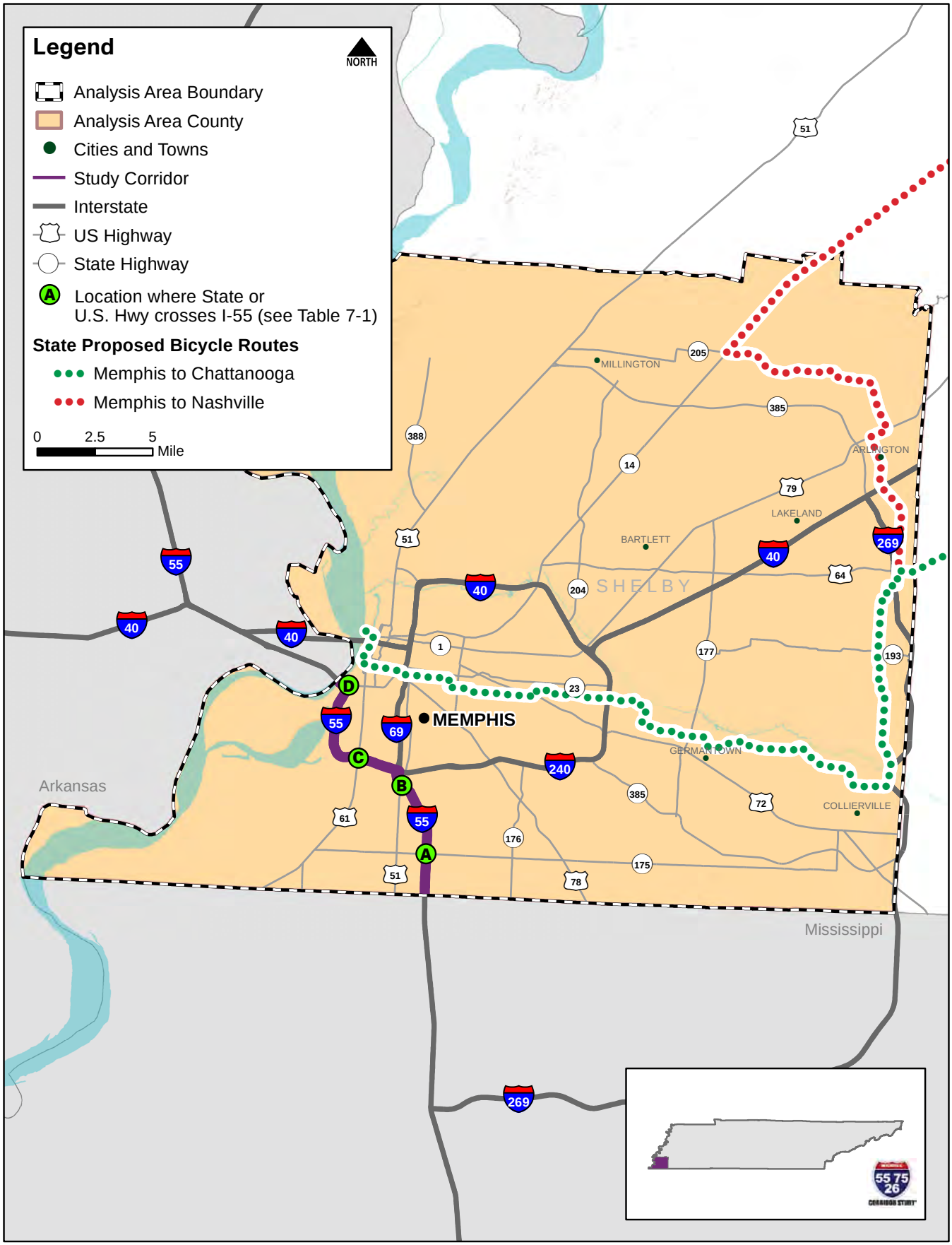
No bicycle accommodations are provided at these interchanges.

7.3 Regional and Local Bicycle and Pedestrian Plans

The Memphis area has several bicycle and pedestrian plans. In general, these plans look to identify missing links or gaps in existing bicycle and pedestrian service and areas where service could be extended. Some key ways to identify areas that would benefit from bicycle and pedestrian infrastructure include:

- One to three miles around population dense neighborhoods, transit service, activity centers (hospitals, schools, parks, etc.)
- Known areas with populations with no access to a vehicle

Figure 7-1. Planned State Bicycle Routes and U.S./State Highway Crossings — I-55



Source: Tennessee Department of Transportation

Table 7-1. Locations Where a U.S. or State Highway Crosses I-55

Map Letter	State Route/ U.S. Hwy Crossings	Crossroad AADT (2018)	Bicycle Lane/ Multi-Use Path?	Paved Shoulder >2'?	Sidewalk?	Free-Flow Right with Bicycle/Ped Facilities?
A	SR-175 (Shelby Dr.)	41,900 (E)* 30,200 (W)**	No	No	Yes	Yes
B	SR-3/US-51 (Elvis Presley Blvd.)	34,000 (W)	No	No	Yes	Yes
C	SR-14/US-61 (3rd St.)	21,900 (E) 34,600 (W)	No	No	Yes (Discontinuous through NB on/off ramps)	Yes
D	SR-1/US-70 (Crump Blvd.)	13,600 (N*** leg)	South and west legs of the interchange are Interstate facilities (no ped/bicycle facilities allowed). Ped/Bicycles can cross north leg via Channel 3 Drive overpass, which provides sidewalk. Ped/ Bicycles can cross south leg via independent pedestrian bridge. No ped/bicycle facilities provided for crossing east leg (Crump Blvd.)			

* East approach; ** West approach; ***North

Source: TDOT Traffic History website, Google Earth

Memphis 2014 Regional Bicycle and Pedestrian Plan

The Memphis 2014 Regional Bicycle and Pedestrian Plan was created to identify areas that may need more bicycle and pedestrian infrastructure in the Memphis MPO. In order to determine where the greatest needs are, the Plan first outlines existing bicycle and pedestrian infrastructure. Several hundred bicycle and pedestrian projects were identified in the Plan. Since funding was not available for projects, the Plan prioritizes projects based on their location and total impact to the surrounding community. In addition to construction projects, the Plan outlines some policy changes such as adopting a complete streets ordinance[16].

Memphis Urban Area MPO 2017 Bicycle and Pedestrian Report

The 2017 Bicycle and Pedestrian Report is a document created to highlight the bicycle and pedestrian improvements the Memphis MPO has made since the 2014 Bicycle and Pedestrian Plan. The report highlights projects that have been completed since the 2014 plan.

7.4 Existing and Future Deficiencies and Needs

A. State Bicycle Routes: At three cross-roads (SR-175, SR-3/US-51, and SR-14/US-61) no paved shoulder, wide outside lane, or bicycle lane is available for bicyclists. Sidewalk is provided through all of the interchanges, and free-flow right turns from ramps exist at all interchanges. Sidewalk is discontinuous at locations within the SR-175 and SR-3/US-51 interchanges. Pedestrian safety should be prioritized in evaluating solutions for the I-55 corridor.

B. Regional and Local Bicycle and Pedestrian Plans: Memphis has several bicycle and pedestrian plans outlining existing infrastructure and highlighting proposed improvements. The plans demonstrate that Memphis has a great existing network of sidewalks throughout the City and into suburban communities. However, much of the existing sidewalk network is in poor condition and not up today's standards. Additionally, a lack of bicycle infrastructure on larger connecting routes can be seen throughout the Memphis region.

16- 2014 Regional Bicycle and Pedestrian Plan. Accessed 03/08/2019. http://www.memphismpo.org/sites/default/files/public/Chapter1.pdf.

8. Transportation Demand Management

Transportation Demand Management (TDM) is a set of strategies that influence travel behavior to reduce single-occupancy vehicle (SOV) travel. Ranging from ridesharing, bicycling, teleworking, taking transit, car sharing and on-demand or real-time applications, TDM strategies redistribute commuter travel across a variety of alternatives and away from daily peak periods. TDM programs represent a flexible, low-cost way to engage residents, travelers, businesses and local governments in the effort to reduce commuter travel and the associated impacts on the community including traffic congestion and emissions.

Eligible TDM activities (defined by the Congestion Mitigation and Air Quality Improvement Program or CMAQ), range from traveler information services, shuttles, employer-based programming, parking initiatives, public education and outreach activities, telework promotion, transportation management associations (TMAs), carpool and vanpool services (ridematching, marketing, guaranteed ride home, subsidies), and car sharing. In addition, the use of technology directly intersects TDM and represents a significant opportunity to change travel behaviors. Examples of related technology include:

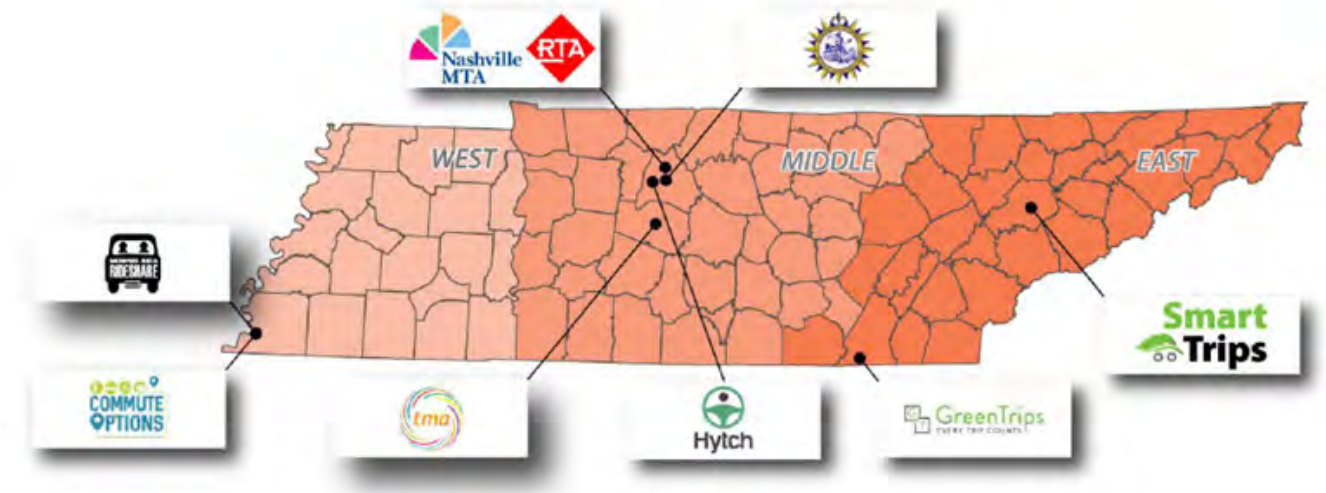
- Private sector mobile applications for ride booking that are supplementing and replacing traditional ridematching
- Services (e.g., Waze) that are integrating with local transportation agencies
- Connected and autonomous vehicles that will impact SOV travel and air quality
- Intelligent digital signage to encourage alternative mode use
- "Big data" sets including INRIX, AirSage, BlueTOAD, and StreetLight to further direct TDM efforts based on commuting patterns and origin/destination data
- The influence of Smart Cities on commute behavior and increasing throughput efficiency

TDOT developed a Statewide Transportation Demand Management (TDM) Plan in 2017. The plan provided a dynamic structure for trip reduction strategies suitable for immediate implementation, but flexible enough to accommodate the demands of future transportation and travel. The Plan positioned TDOT as the TDM program leader – connecting and coordinating regional TDM efforts with the local partners responsible for program implementation within each of the state's five urban areas, including the Memphis region (Figure 8-1).

TDOT's current 25-year Long-Range Transportation Plan Mobility Policy Paper established the foundation that the state's transportation system should encompass mobility options and travel choices that promote a strong transportation system connecting residents to jobs, schools, services and attractions. The Plan describes the provision of viable alternatives to the SOV as a central element of TDOT's vision of an efficient and effective multimodal transportation system. TDM represents low-cost alternatives that can help TDOT expand and enhance mobility, system efficiency, and environmental protection by reducing congestion and improving air quality.

The primary goal of statewide TDM programming is to reduce SOV travel by promoting alternative modes that include carpooling, vanpooling, taking transit, bicycling, walking, alternative work arrangements and on-demand or shared services. The Statewide TDM Plan is further supported through the following key objectives:

Figure 8-1. TDOT's Local Partners — Existing Programs



Source: 2017 TDOT Statewide Demand Management Plan

1. Decrease traffic congestion and air pollution
2. Support and enhance TDM programming in the state's five major urban areas
3. Increase customer access to programs and services
4. Streamline the administration and evaluation of TDM programming
5. Increase awareness and support for TDM initiatives in the state

The following six key recommendations resulted from the Plan. These recommendations were based on stakeholder engagement, commuter and employer surveying (statewide), and analysis of national best practices.

1. Introduce a standard Commuter Program structure
2. Establish a statewide TDM brand
3. Identify a statewide TDM coordinator (team)
4. Maintain core TDM services for regional implementation
5. Increase accountability
6. Develop standard operating procedures for administration of TDM projects

8.1 Mode Choice

Based on 2012-2016 U.S. Census data, 82.7% of commuter trips made within Shelby County are single-occupancy vehicle trips, which is up less than one percentage point when compared to the previous 2006-2012 estimates. As shown in Table 8-1, almost 10% of trips are made by some form of rideshare, and only 1.5% are made by transit. These numbers are comparable to Tennessee as a whole. Nationally, the number of single-occupancy vehicle trips is lower and transit is higher. Note that Other Travel Modes includes "work-from-home," which is on the rise nationally.

8.2 Travel Reduction

Memphis Area Rideshare (MAR) is the local TDM program run by the Shelby County Department of Health's Air Quality Improvement Division and is primarily funded with Congestion Mitigation and Air Quality (CMAQ) funds administered by TDOT's Long-Range Planning Division. The program offers vanpool service (through Commute with Enterprise) and an Emergency Ride Home (ERH) program that provide taxi vouchers to registered users of carpools, vanpools, bicycles, and transit. Currently, the vanpool program operates 49 vanpools within the Memphis area; resulting in an estimated reduction of

Table 8-1. Commuter Modal Split — I-55

Origin-Destination Pair	Single-Occupancy Vehicle	Rideshare (Car, Truck, Vanpool)	Transit	Other Travel Mode (Bicycle, Ped, Motorcycle, etc.)
West Memphis, AR to Memphis	90.6%	6.9%	0.9%	1.6%
Horn Lake, MS to Memphis	90.6%	7.7%	0.8%	0.9%
Southaven, MS to Memphis	91.9%	7.6%	0.3%	0.2%
Arlington to Memphis	89.1%	8.6%	0.0%	2.3%
Bartlett to Memphis	94.2%	5.2%	0.0%	0.6%
Collierville to Memphis	94.9%	4.7%	0.0%	0.4%
Germantown to Memphis	94.9%	4.1%	0.0%	1.0%
Millington to Memphis	92.5%	6.1%	0.0%	1.4%
Study Area	82.7%	9.9%	1.5%	5.9%
Tennessee	83.6%	9.1%	0.8%	6.5%
Nationwide	76.4%	9.3%	5.1%	9.1%

Source: U.S. Census Bureau (2012-2016) via CTPP

over 345,000 vehicle-miles of travel per month. MAR also promotes transportation mobility options through frequent employer education and outreach activities.

Innovate Memphis is a non-profit think tank whose mission is to bring together public and private to "create strategies and collaborative opportunities, and seek ways to improve communities and neighborhoods throughout the city [Memphis]." One area of concentration is Transportation and Mobility, which houses the Commute Options program that serves as a clearinghouse for mobility options in and around the Memphis region. The Commute Options program includes regional branding and marketing materials that are used for distribution at community and employer-based activities and rely on the existing vanpool and ridematching services through Memphis Area Rideshare. Innovate Memphis is also working to include support strategies such as parking management and bicycle-sharing. Overall, Innovate Memphis allows partners to test ideas and concepts, tweak and customize them and set them up for success and then pass them to another organization to sustain, which means they could look to Memphis Area Rideshare for a program transition in the future.

8.3 HOV Lanes

HOV lanes are currently enforced on I-55 in Memphis between the hours of 7:00 AM-9:00 AM (inbound) and 4:00 PM-6:00 PM (outbound). Table 8-2 shows the length of these lanes and the 2017 AADT carried on the respective portions of Interstate. Since 2009, Tennessee has offered a Smart Pass program which allows owners of low-emissions and energy-efficient vehicles to apply for a decal that enables them to drive in the HOV lanes without the minimum occupancy requirement. As of January 2019, 4,236 vehicles were registered in the Smart Pass program, including 164 in Shelby County.

Speeds

As a result of the Smart Pass program, which allows an exemption to the HOV lane occupancy, TDOT is required under the FAST Act to monitor and evaluate the HOV operations. TDOT's HOV 2018 Certification report shows that over a 12-month monitoring period, only 0.5% of the total days showed an average HOV lane speed less than or equal to 45 mph.

Violation Rates

According to a study prepared by Tennessee State University and Vanderbilt University in 2018, 80-85% of vehicles utilizing signed HOV lanes statewide have only one occupant. Specific results pertaining to the Memphis area are shown in Table 8-3. As shown, violation rates in the Memphis area are slightly higher than the statewide averages. The study also indicated that during peak hours, HOV lanes on I-55 carried 23% of the traffic with 77% utilizing the general purpose lanes.

Table 8-3. HOV Lane Observed Violation Rates — I-40 and I-55

Route	Inbound Rate	Outbound Rate
I-40 East of Memphis	87%	86%
I-55 South of Memphis	88%	86%

Source: TSU/Vanderbilt 2018 Study

8.4 Park-and-Ride Facilities

MATA manages three park-and-ride lots throughout Shelby County (see Figure 6-2). As indicated in Table 8-4, the lots offer a total of 211 spaces, plus bicycle parking. The lots are ADA accessible and provide sidewalks to encourage multi-modal trips. The Airway Transit Center, with 113 automobile parking spaces, is located adjacent to the I-55 corridor.

Table 8-2. HOV Lane Limits in the Memphis Region

Route	Begin HOV Lanes	End HOV Lanes	Total Miles	2017 AADT
I-55 (Northbound)	TN/MS State Line	Brooks Road	4.72	83,600-91,400
I-55 (Southbound)	Elvis Presley Blvd	TN/MS State Line	5.38	
I-40 (Eastbound)	Sycamore View Rd	SR-15/US-64	6.95	119,500-168,900
I-40 (Westbound)	SR-15/US-64	Sycamore View Rd	6.24	

Source: TDOT HOV 2018 Certification Report; TRIMS

Table 8-4. Park-and-Ride Lot Inventory — I-55

Lot Location	# of Parking Spaces	ADA Accessible	Sidewalks	Bicycle Parking
American Way Transit Center (3921 American Way)	36	✓	✓	✓
Airways Transit Center (3033 Airways Blvd)	113	✓	✓	✓
Madison Park & Ride Lot (North side of Madison Ave)	62	✓	✓	✓

Source: Google Earth

8.5 Existing and Future Deficiences and Needs

The Statewide TDM Plan identified a number of ways regional TDM programs can support TDOT with managing mobility. Moving forward, TDOT should continue to work with the regional TDM programs to push more equitable multi-modal travel in the urban areas. Table 8-5 also lists some recommendations that statewide and regional TDM programs can pursue, as noted in the 2017 TDOT Statewide Demand Management Plan.

Additional needs identified as part of this study:

A. Mode Switch: Nearly one in ten study area commuters travels to work with a shared ride. This rate exceeds the national average and demonstrates a willingness of Shelby County commuters to embrace modes other than driving alone. Expanding ride-share programs (information clearing house, guaranteed ride home programs, etc.) may move more people out of their single-occupancy vehicles.

B. HOV Enforcement: The violation rate for HOV lanes on I-55 is approaching 90 percent. Additonal enforcement could improve the efficiency of the HOV system.

Table 8-5. TDM Strategies and State-of-Practice Examples

Strategy	Details

Statewide or regional programs are more likely to succeed and produce desired outcomes.	• Statewide examples, each managed by the state's Department of Transportation, include:
	  • Connecticut: CTrides
	  • Delaware: Rideshare Delaware
	  • Massachusetts: MassRIDES
	  • New York: NY511 Rideshare
	  • Washington: Rideshare Online
	• Large regional examples used for guidance include:
	  • Atlanta, GA: Georgia Commute Options (GCO)
	  • San Francisco, CA: 511 SF Bay
	  • South Florida: South Florida Commuter Services

Focus limited resources on outreach, public relations, and incentives.	• Targeted outreach efforts and incentives have a more direct and measureable impact on travel behavior and mode shift than mass advertising. • Public relations and recognition activities also provide support at a much lower cost than mass advertising.

Incentives work.	• Models for best practices exist in:
	  • Atlanta, GA: GCO incentives including Gimme Five
	  • Birmingham, AL: CommuteSmart Get Green
	  • Las Vegas, NV: Club Ride Rewards
	  • San Francisco, CA: 511 SF Bay
	  • San Diego, CA: iCommute
	• Incentives generate trial use and the opportunity for on-going evaluation. Success has been demonstrated across large-scale implementation and corridor and/or mode-specific trials.

TDM programs should not rely on technology alone.	• TDM programs need to leverage existing technology in a way that does not compromise core program offerings • Launching a new technology (e.g., mobile app) is not going to change behavior alone • Reserve funds for outreach and marketing the technology • Human interaction remains a key component of trip planning/ education and behavior change
Relationships create mode shift.	• Commuter-to-commuter or co-worker success stories • Employer and stakeholder relationships are invaluable • One-on-one TDM program trip planning and educational activities • Employer encouragement and support can significantly influence employees
Don't ignore the core services.	• Keep it simple • Services should be both multi-modal and mode-neutral • Examples: ridematching, guaranteed ride home, employer outreach

Source: 2017 TDOT Statewide Demand Management Plan

9. Freight and Intermodal Facilities

This section summarizes the existing and expected future conditions of freight movement through the corridor in Tennessee. Freight facilities, including major generators and intermodal facilities, are described. In addition, the potential for diverting freight from the dominant mode – truck – to rail, air, or barge, is assessed.

The data used in this analysis include Transearch 2016 (current) and 2045 (forecast), the Tennessee Statewide Travel Demand Model (base year 2010, forecast year 2040), Airports Council International data, and Waterborne Commerce Statistics.

9.1 Freight Movement

Freight movement is an important element of a regional and national economy, as more efficient modes and routes enable improved logistics and result in reduced transportation costs. These cost savings can then be reallocated to growth, providing better jobs and higher wages in the area. The existing and future freight flows in the region were analyzed using the most current available data and existing conditions.

The I-55 corridor area encompasses Memphis, TN and is the approximate midpoint along a larger corridor that connects the Chicago, IL and Great Lakes regions in the north to LaPlace, LA at the southern terminus. LaPlace is the location of the Port of South Louisiana and the largest grain port in the U.S[17]. Memphis is a hub for freight traffic, most notably as the headquarters of FedEx Corporation. In addition, the I-55 corridor is on the western edge of the "auto west corridor," along which automobile assembly and support services are expanding in the U.S. The region benefits from its proximity to Mexico's automobile manufacturing industry and the domestic auto production facilities along the I-75 and I-69 corridors[18]. The automobile industry is just-in-time and depends highly on trucking. Figure 9-1 shows the expected growth in truck volume throughout the corridor. Steady growth in truck volumes are anticipated on I-55 and adjacent routes.

The I-55 corridor also boasts easy access to water, rail, and air modes. Table 9-1 shows the total tonnage and value of inbound and outbound freight in the I-55 corridor study area. As shown, truck is the predominant mode both in 2016 and in 2045 for the inbound and outbound directions. Air and rail freight make up a negligible portion of freight traffic, and water represents a small but measurable share of the total. Tonnage by all modes is projected to grow. Inbound and outbound truck tonnages are estimated to grow by 1.7 and 1.6 percent, respectively, year over year. Truck value is projected to grow faster than tonnage in both directions.

Table 9-1. Inbound and Outbound Freight Volumes by Mode for 2016 and 2045 — I-55

		2016		2045		% Growth CAGR*	
	Mode	Tons	Value	Tons	Value	Tons	Value
Inbound	Rail	62,198	$367M	102,848	$575M	1.7%	1.6%
	Truck	24,430,059	$46.8B	39,494,191	$81.6B	1.7%	1.9%
	Air	375,521	$41.7B	648,280	$86.8B	1.9%	2.6%
	Water	5,921,151	$1.59B	8,239,256	$2.22B	1.1%	1.2%
	Total	**30,788,929**	**$90.5B**	**48,484,575**	**$171B**	**1.6%**	**2.2%**
		2016		**2045**		**% Growth CAGR***	
	Mode	Tons	Value	Tons	Value	Tons	Value
Outbound	Rail	259,388	$356M	288,084	$492M	0.4%	1.1%
	Truck	20,979,616	$471B	33,680,552	$86.8B	1.6%	2.1%
	Air	530,271	$64B	1,133,650	$112B	2.7%	2.0%
	Water	3,540,041	$1.13B	5,044,554	$1.46B	1.2%	0.9%
	Total	**25,309,315**	**$113B**	**40,146,840**	**$201B**	**1.6%**	**2.0%**

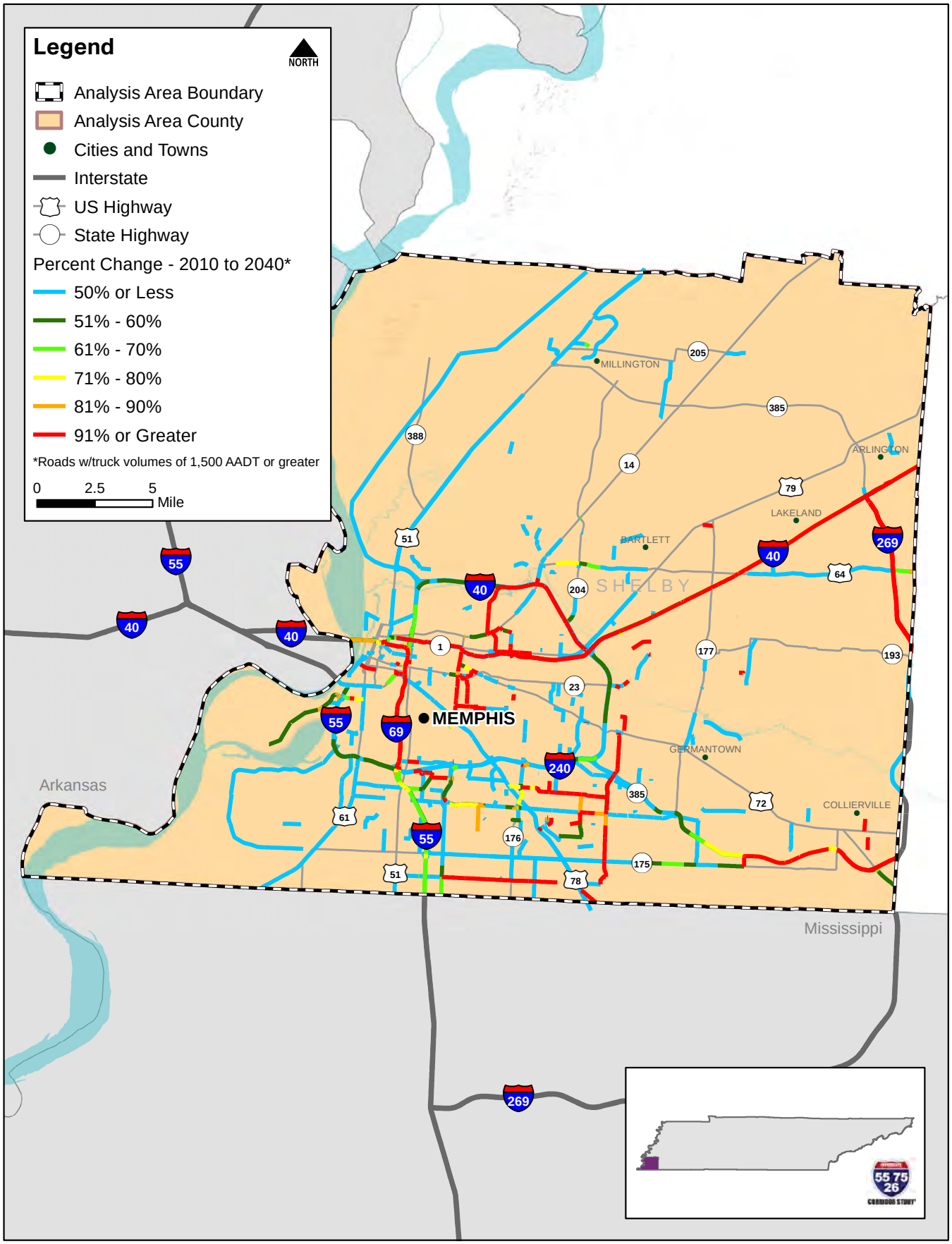
*CAGR: Compound Annual Growth Rate

Source: Transearch (2016 and 2045)

17- Port of South Louisiana, Facts at a Glance, http://portsl.com/facts-at-a-glance/

18- Cuneo et al, Area Development, "The Changing Geography of the American Auto Industry," 2014, https://www.areadevelopment.com/Automotive/Advanced-Industries-2014/changing-geography-of-american-auto-industry-2262541.shtml

Figure 9-1. Growth in Truck Volume from 2010 to 2040 — I-55



Source: Tennessee Statewide Travel Demand Model

9.2 Inbound and Outbound Freight Demand: 2016 and 2045

Inbound/Outbound Freight by Commodity

The top commodities shipped into and from the I-55 corridor study area of Shelby County are summarized using 2016 Transearch data. The data shown are limited to the top 15 commodities by tonnage and make up approximately 98 percent of the tonnage. Inbound and outbound, the largest commodity category is uncategorized freight or Other, which also includes tonnages outside of the top 15 commodities. Outside of Other, rail intermodal drayage to and from ramps make up over nearly a fifth of the tonnage inbound and outbound, followed by other important goods like leather, warehousing coal, miscellaneous shipments, food, and air freight. The top commodities inbound and outbound are largely similar and are dominated by truck mode. See Table 9-2 for the inbound commodities and Table 9-3 for the outbound commodities.

Table 9-2. Inbound Freight Tonnage by Commodity, 2016 — I-55

Commodity	Total Tonnage	Share of Total Tonnage
Other	16,170,420	52.5%
Rail Intermodal Drayage to/ from Ramp	5,468,558	17.8%
Leather or Leather Products	1,896,341	6.2%
Warehouse & Distribution Center	1,469,663	4.8%
Coal	1,084,891	3.5%
Misc. Freight Shipments	1,048,304	3.4%
Air Freight Drayage to/from Airport	902,401	2.9%
Food or Kindred Products	861,925	2.8%
Textile Mill Products	734,727	2.4%
Ordnance or Accessories	270,016	0.9%
Apparel or Related Products	239,429	0.8%
Furniture or Fixtures	194,893	0.6%
Electrical Equipment	182,582	0.6%
Lumber or Wood Products	171,046	0.6%
Pulp, Paper or Allied Products	93,732	0.3%
Grand Total	**30.8M**	**100%**

Source: Transearch (2016)

Truck Origins and Destinations by Entry and Exit Roads: 2016 vs. 2045

Using the Transearch database for 2016 and 2045, the data show that the majority of the region's truck traffic in terms of tonnage and value comes into the state and ultimately the corridor area from I-40 followed by I-55. Some commodities are coming into Tennessee from as far as I-81 in the northeastern part of the state. However, the great majority of the region's inbound shipments are by air, rail, or water, or truck on other routes, as denoted by the Other category in Table 9-4 and Table 9-5. Shipments from I-40 are growing the fastest with just over a two percent compound annual growth rate (CAGR). Table 9-4 lists the tonnage and value for inbound trade to Tennessee by the first road used within Tennessee, or the entry road used to enter Tennessee on its way to a destination in the I-55 corridor area.

Table 9-3. Outbound Freight Tonnage by Commodity, 2016 — I-55

Commodity	Total Tonnage	Share of Total Tonnage
Other	8,735,006	34.5%
Rail Intermodal Drayage to/ from Ramp	4,835,777	19.1%
Warehouse & Distribution Center	4,711,349	18.6%
Leather or Leather Products	1,706,191	6.7%
Misc. Freight Shipments	1,332,578	5.3%
Food or Kindred Products	1,296,447	5.1%
Air Freight Drayage to/from Airport	901,658	3.6%
Apparel or Related Products	510,473	2.0%
Coal	487,486	1.9%
Ordnance or Accessories	283,254	1.1%
Electrical Equipment	134,884	0.5%
Fabricated Metal Products	131,375	0.5%
Primary Metal Products	102,323	0.4%
Machinery	72,217	0.3%
Lumber or Wood Products	68,297	0.3%
Grand Total	**25.3M**	**100%**

Source: Transearch (2016)

Table 9-4. Inbound Freight Tonnage and Value for 2016 and 2045 by Entry Road — I-55

		2016		2045		% Growth CAGR*	
	Entry Road	Tons	Value	Tons	Value	Tons	Value
Inbound	I-24	16,548	$10.5M	22,703	$16.2M	1.1%	1.5%
	I-40	5,018,580	$11.1B	9,113,846	$19.5B	2.1%	2.0%
	I-55	3,149,304	$2.1B	4,480,473	$3.88B	1.2%	2.1%
	I-65	437,405	$580B	619,165	$862M	1.2%	1.4%
	I-75	39,140	$49.3M	44,013	$52.7M	0.4%	0.2%
	I-81	150,356	$299M	252,840	$583M	1.8%	2.3%
	Other	21,977,596	$76.3B	33,951,535	$146B	1.5%	2.3%
	Total	**30.8M**	**$90.5B**	**48.5B**	**$171B**	**1.6%**	**2.2%**

*CAGR: Compound Annual Growth Rate

Source: Transearch (2016 and 2045)

Table 9-5. Outbound Freight Tonnage and Value for 2016 and 2045 by Exit Road — I-55

		2016		2045		% Growth CAGR*	
	Exit Road	Tons	Value	Tons	Value	Tons	Value
Outbound	I-24	23,536	$29.1M	44,295	$54.4M	2.2%	2.2%
	I-40	4,113,913	$9.68B	6,800,750	$17.7B	1.7%	2.1%
	I-55	2,310,124	$1.81B	3,321,430	$3.66B	1.3%	2.4%
	I-65	729,683	$1.28B	1,240,723	$2.81B	1.8%	2.7%
	I-75	282,299	$343M	673,960	$837M	3.0%	3.1%
	I-81	679,434	$826M	1,246,778	$1.73B	2.1%	2.6%
	Other	17,170,326	$98.5B	26,818,904	$174B	1.5%	2.0%
	Total	**25.3M**	**$113B**	**40.1M**	**$201B**	**1.6%**	**2.0%**

*CAGR: Compound Annual Growth Rate

Source: Transearch (2016 and 2045)

For goods leaving the I-55 corridor or Shelby County, the same major Interstates are the destinations as the origins: I-24, I-40, I-55, I-65, I-75, and I-81. I-40 is the most heavily-used corridor for goods leaving Shelby County, followed by I-55. The growth in truck traffic using I-75 is the highest overall, at over three percent per year followed by I-24 and I-81. Outbound tonnages of goods traveling on I-55 are growing by 1.3 percent per year while value grows by 2.4 percent per year. The exit roads shown in Table 9-5 show the last route used by outbound freight from the I-55 corridor area within Tennessee or the route used to exit the state.

Through Truck Traffic: 2016 and 2045

The truck through traffic in the corridor was assessed using Transearch 2016 data and GIS software. The through tonnage was estimated by summing the tonnages found on roadway segments across the state while excluding the I-55 study area as an origin or destination. The remaining traffic is, therefore, neither originating nor destined to the corridor area and drives through.

Through traffic is important as it can make up a sizeable portion of the region's truck activity and therefore congestion in the corridor. Although through traffic is destined elsewhere and therefore does not have as large of a direct economic impact in the study area as

originating or terminating traffic would, it does impact other regions and an efficient transportation network encourages more efficient deliveries and reduces shipping costs. In addition, the trucks traveling through the region may purchase services such as fuel, food, and lodging making small but measureable impacts. As shown in Figure 9-2, the I-55 corridor in Tennessee shows high volumes of through truck traffic in 2016 typically in the range of 5 to 10 million tons, but some segments show volumes up to 40 million tons. This is comparable with the volumes found along I-40 in the area.

Of note, rail, water, and air would also have through traffic traversing the study corridor; however, data limitations do not allow for estimating or mapping these movements.

9.3 Intermodal Facilities: Air, Rail, and Water

The Memphis region has multimodal access and is an important gateway particularly for air and maritime cargos. The region is home to the Memphis International Airport, co-location of the FedEx headquarters, and a major Mississippi River port at the Port of Memphis. The major air, rail, truck, and maritime facilities in the corridor area as well as the volume-to-capacity ratios anticipated for traffic in 2040 along I-55 are shown in Figure 9-3.

Air

Located adjacent to the I-55 corridor, the Memphis International Airport (MEM) is the busiest cargo airport on the continent and second-busiest in the world. The major tenant at MEM is FedEx, with over 11,000 employees and 34 million square feet of leased space at the airport. In addition to FedEx, the United Parcel Service (UPS) also operates out of MEM with nearly 300,000 square feet of space. Currently undergoing expansion, the UPS facility will soon employ 950 at MEM. FedEx operates nearly 400 flights per day, handling 180,000 packages and 245,000 per hour at MEM. With the facility expansion, UPS will handle 59,800 packages per hour[19]. FedEx represents nearly 99 percent of the cargo passing through the airport[20].

The Airports Council International shows a total of 4.3 million metric tons of unloaded freight and mail in 2017, second globally to the Hong Kong airport[21]. More recently, originating cargo from MEM totaled 2.4 million tons in 2018, according to the Bureau of Transportation Statistics' T3 Summary of U.S. Air Carrier Airport Activity[22]. Total cargo activity, inclusive of freight and mail, at MEM has shown growth of about 1.5 percent per year since 2010, with a recent slow-down to less than one percent per year since 2015. The total cargos at MEM for 2010 to 2017 are shown in Figure 9-4. Recent trade wars between the U.S. and trade partners have caused tensions that have affected global supply chains[23].

The importance of cargo operations at MEM are shown in Table 9-6 as estimated in the 2017 Economic Assessment of the Impact of the Memphis International Airport[24]. These industries are important because they provide services to the transportation sector or they rely on the transportation sector to move their products. As shown, there is a variety of supporting industries impacted not only from direct spending but also from multiplier impacts of spending labor incomes.

Access to MEM is of vital importance particularly by truck, as the majority of parcels and packages are shipped by truck. Monitoring congestion on the region's Interstates, including I-55, will allow for timely deliveries of trucks and parcels to and from the airport.

Rail

Five Class I railroads colocate in Memphis with intermodal yards, including CSX, Norfolk Southern (NS), Canadian National, BNSF Railway, and Union Pacific. Many shortlines also connect to these Class Is and serve western Tennessee. Rail facilities in the I-55 study area include:

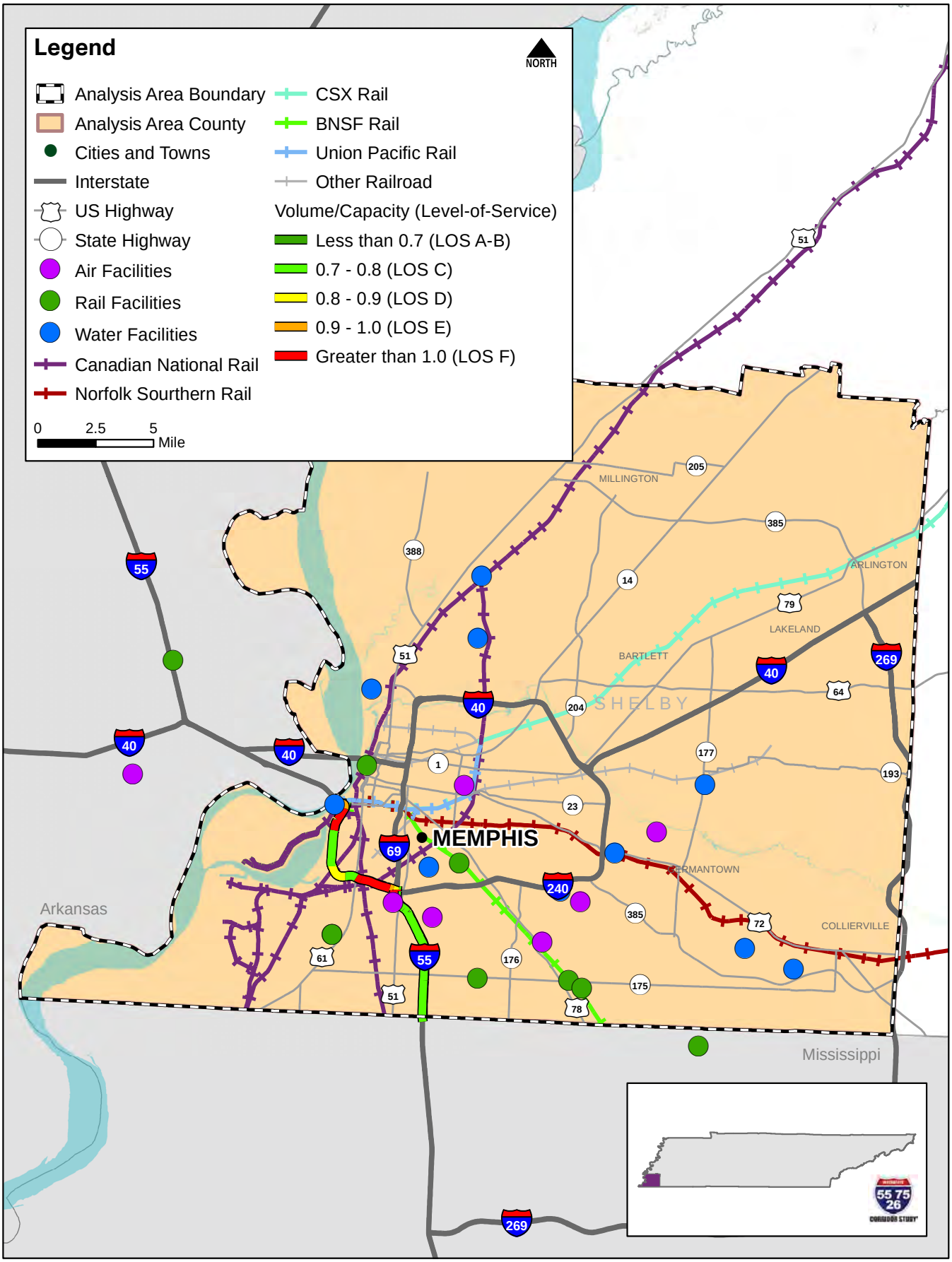
- CSX has an intermodal facility in the Frank C. Pidgeon Industrial Park on the Port of Memphis property.
- NS has an intermodal facility in Rossville to the east of Memphis as part of the Crescent Corridor. The facility is a link for freight moving between the Great Lakes and the Gulf of Mexico. NS also has the Forrest Yard in downtown Memphis.
- The BNSF Memphis Yard is located along Lamar Avenue within blocks of Memphis International Airport. Located on 185 acres, the intermodal yard is an important freight generator in the region for both truck and rail traffic.
- CN has its Harrison Yard south of downtown Memphis and an intermodal facility within the Frank C. Pidgeon Industrial Park, and is an

19- http://www.flymemphis.com/properties-and-cargo
20- https://www.commercialappeal.com/story/money/industries/logistics/2018/04/19/fedex-keeps-memphis-airport-no-2-world-ranking-despite-flat-growth-2017/532815002/
21- https://aci.aero/data-centre/annual-traffic-data/cargo/2017-cargo-summary-annual-traffic-data/
22- https://www.transtats.bts.gov/Oneway.asp?Field_Desc=Airport%20Code&Field_Type=Char&Sel_Cat=ORIGIN&Lookup_Table=L_AIRPORT&Sel_Var=REV_PAX_ENP_110&Sel_Stat=Sum&Data_Type=CAT&Percent_Flag=0&Display_Flag=0
23- Garland, Max, Memphis Commercial Appeal, March 25, 2019, https://www.commercialappeal.com/story/money/industries/logistics/2019/03/25/memphis-international-airport-fedex-cargo-growth/3270017002/
24++- http://www.flymemphis.com/Areas/Admin/Images/Upload_20181912092527.pdf

Figure 9-2. Through Truck Traffic Tonnage in the Study Area for 2016 — I-55

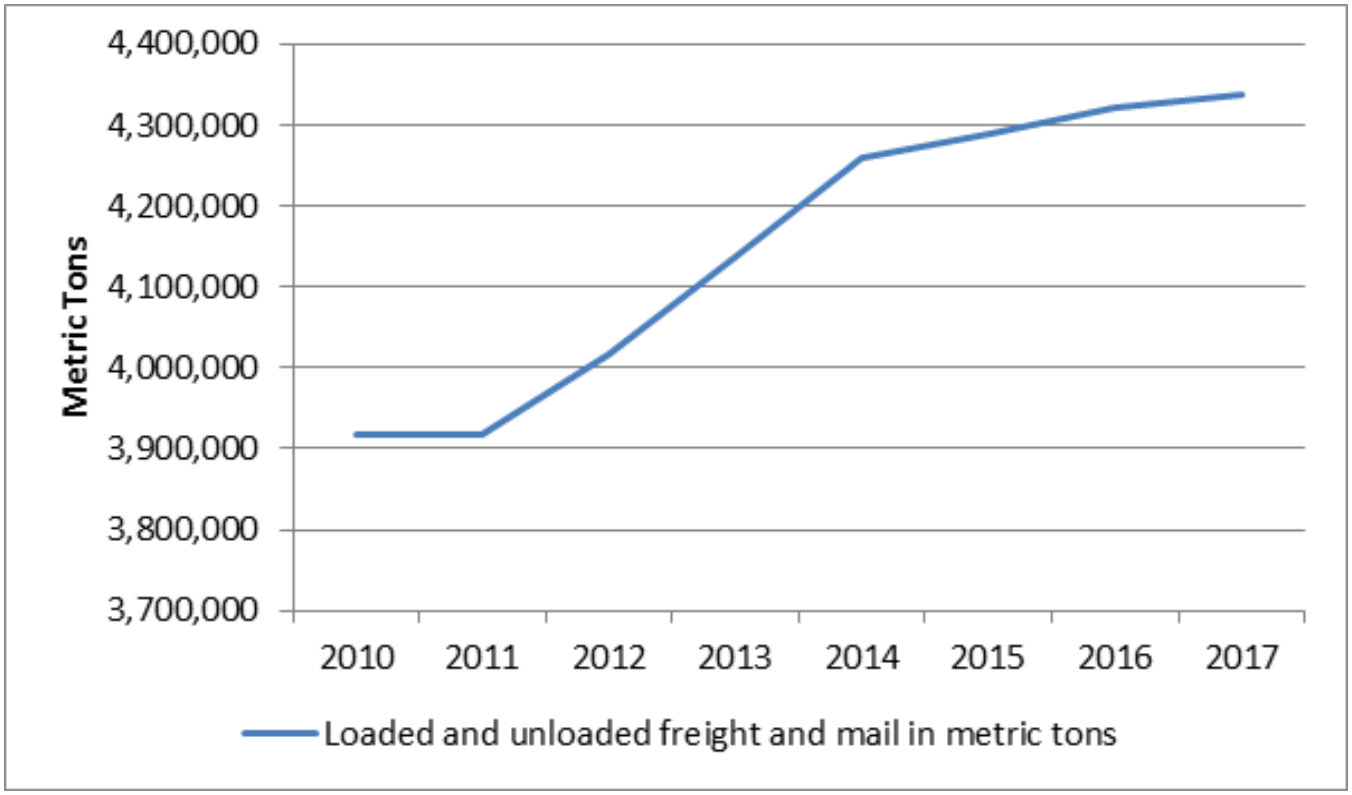
Source: Transearch (2016)

Figure 9-3. Freight Facilities — I-55



Source: InfoUSA and Tennessee Statewide Travel Demand Model

Figure 9-4. Air Cargo at Memphis International Airport, 2010-2017



Source: Airports Council International

Table 9-6. Top Ten Industries Affected by MEM Freight Operations, Ranked by Employment, FY2015

Industry	Employment	Labor Income	Value Added	Output
Transport by air	41,806	$2,854M	$4,895M	$12,629M
Food services and drinking places	8,876	$218M	$293M	$546M
Real estate establishments	2,579	$47M	$277M	$361M
Scenic and sightseeing transportation and support activities for transportation	2,193	$44M	$45M	$157M
Wholesale trade businesses	1,427	$118M	$208M	$300M
Private hospitals	1,341	$103M	$112M	$201M
Employment services	1,242	$32M	$35M	$45M
Offices of physicians, dentists, and other health practitioners	1,121	$111M	$113M	$166M
Nursing and residential care facilities	785	$27M	$31M	$48M
Commercial and industrial macinery and equipment rental and leasing	774	$77M	$116M	$218M

Source: The University of Memphis

important link between the Gulf of Mexico and Illinois, Iowa and Nebraska, and connects to Canadian ports[25].

- UP operates on only 14 miles of track between an intermodal facility in Marion, Arkansas and Memphis, but creates an important connection to the Class I for the Memphis region[26].

Water

The International Port of Memphis is located in the I-55 corridor on the banks of the Mississippi River in the states of Tennessee and Arkansas. The port is the second largest inland port on the shallow draft portion of the Mississippi River and the fifth largest inland port in the country[27]. It spans 15 miles along the Mississippi, with 68 waterfront facilities and terminals handling commodities such as petroleum, tar, asphalt, cement, steel, coal, salt, fertilizers, rock, gravel, and grain[28]. Nearly all of the port's facilities are located on Presidents Island. The port has rail access by Canadian National and CSX Railroads.

According to the U.S. Army Corps of Engineers' Waterborne Statistics Database, Memphis shipped 11.5 million short tons in 2017 domestically. No import or export traffic was recorded. The 11.5 million short tons places Memphis at 47th in terms of overall tonnage handled at U.S. ports[29]. The Valero Memphis Refinery, Tennessee's only refinery, is located at the International Port of Memphis and has a throughput capacity of 195,000 barrels per day[30].

The port recently earned a $1.7 million Competitive Rail Connectivity Grant from TDOT to improve rail service at the Presidents Island terminal. Capacity is estimated to increase by 15 percent, and officials hope it will spark further investment in docks, storage, and warehousing. Presidents Island is at capacity, and the rail extension is the first expansion in decades on the island. The project should reduce the number of truck trips in the region, allowing for transfer to rail and potentially barge[31].

9.4 Freight Diversion: From Truck to Rail/Water/Air

Although the U.S. and Tennessee economies are much less dependent on goods production than they once were, shipping of finished and unfinished goods is still vital to the economic strength of the region. The dominant shipper locations are:

1. Sites where the commodity is grown, logged, or mined
2. Where it is processed or manufactured
3. Distribution sites/centers where products and commodities are aggregated for more efficient shipment.

Table 9-7 provides a basic overview of the relationship between some of the major industry sectors and their primary mode of goods movement, and the correlation between tonnage and value. As shown, products of low value and high tonnage are ideal for travel by water and rail, while truck and air modes typically carry lighter and more valuable cargoes. This section will assess the potential for shifting some shipments from truck to rail or air in order to increase highway capacity.

Table 9-7. Tonnage, Value, and Value per Ton for All Shipments Into, Out of, and Through Tennessee, 2016

	Total Tons	Total Value	Value per Ton
Air	0.166M	$23B	$139,028
Truck	44.5M	$82B	$1,852
Rail	1,870M	$1,810B	$968
Water	0.216M	$0.14B	$626
Total	**1.91B**	**$1.91T**	**$1,000**

Source: Transearch 2016

Freight Diversion Potential: Existing Freight Volumes

Freight primarily travels in the I-55 corridor by truck, as evidenced by prior tables and figures. However, there is potential for some commodities to divert to other modes that are more cost-effective than truck. In order to assess which products could divert from truck, Transearch was used to summarize the existing (2016) volumes destined for (inbound) and originating from (outbound) the corridor. As shown in Table 9-8,

25- Tennessee Department of Transportation, Tennessee Statewide Multimodal Freight Plan, 2018, https://www.tn.gov/content/dam/tn/tdot/long-range-planning/TDOT_FreightPlan_02.27.18.pdf
26- Tennessee Department of Transportation, Tennessee Statewide Multimodal Freight Plan, 2018, https://www.tn.gov/content/dam/tn/tdot/long-range-planning/TDOT_FreightPlan_02.27.18.pdf
27- International Port of Memphis, http://portofmemphis.com/
28- International Port of Memphis, About the Port, http://portofmemphis.com/about/
29- US Army Corps of Engineers, USACE Digital Library, Waterborne tonnage for principal US ports and all 50 states and US territories, CY 2017, https://usace.contentdm.oclc.org/digital/collection/p16021coll2/id/2969
30- Tennessee Department of Transportation, Tennessee Statewide Multimodal Freight Plan, 2018, https://www.tn.gov/content/dam/tn/tdot/long-range-planning/TDOT_FreightPlan_02.27.18.pdf
31- Risher, Wayne, Daily Memphian, "Port of Memphis lands state grant for major rail upgrade," January 17, 2019, https://dailymemphian.com/article/2471/Port-of-Memphis-lands-state-grant-for-major-rail-upgrade

Table 9-8. Inbound Freight Diversion Potential, 2016 — I-55

Commodity	Air	Rail	Truck	Water
Apparel or Related Products	3%	0%	31%	66%
Electrical Equipment	16%	27%	57%	0%
Fabricated Metal Products	33%	0%	66%	0%
Food or Kindred Products	1%	0%	37%	62%
Leather or Leather Products	0%	0%	74%	26%
Machinery	44%	0%	56%	0%
Nonmetallic Minerals	0%	0%	21%	79%
Ordnance or Accessories	0%	0%	78%	22%
Petroleum or Coal Products	29%	0%	71%	0%
Primary Metal Products	8%	1%	53%	37%
Rubber or Misc. Plastics	27%	1%	72%	0%
Transportation Equipment	30%	0%	70%	0%

Source: Transearch (2016)

the majority of the inbound commodities with diversion potential are coming into the corridor region by truck. Other modes have potential for diverting commodity traffic when their timing needs and handling needs are similar. Costs are typically related to the speed at which products need to get to the consumer, and as such air and truck are typically more expensive modes. Rail and water are slower modes that are better suited for products that do not have a short delivery window.

In order to assess the commodities for which this may be true, it was assumed that goods are potential candidates for diversions if they are currently transported by two or more modes for between 20 percent and 80 percent of the total tonnage. This range showcases that there is a sizeable portion of product moving by more than one mode, and therefore the commodity's individual handling needs can be accommodated at different facilities. Table 9-8, therefore shows that, for example, 31 percent of the tonnage for apparel or related products travels by truck and 66 percent by water. The remaining three percent is shipped by air. Because most of the apparel or related products are moved by water, it can be inferred that time is not as important of a factor in choosing the mode as cost. Therefore, there is potential for even greater volumes of apparel or related products to move by water, freeing up valuable highway capacity for other commodity shipments and auto traffic. It is important to note, however, that the commodity tonnages constitute a small share of the total tonnage handled in the corridor, but based on the developed criteria, the majority of high-volume commodities are not good candidates for diverting away from truck.

In addition to the inbound freight with diversion potential, Transearch was used to assess the outbound freight diversion potential in Table 9-9. A similar methodology was employed, selecting outgoing commodities that ship 20 to 80 percent of their tonnage by multiple modes. In the outgoing direction, however, there is a more even split of truck with air. This likely has to do with the FedEx facility's location within the corridor area, where they ship a large variety of products including those one would not typically expect to see shipped by air such as

Table 9-9. Outbound Freight Diversion Potential, 2016 — I-55

Commodity	Air	Rail	Truck	Water
Ordnance or Accessories	0%	0.1%	67%	33%
Electrical Equipment	24%	1%	76%	0%
Fabricated Metal Products	20%	5%	76%	0%
Machinery	47%	1%	52%	0%
Lumber or Wood Products	13%	60%	28%	0%
Misc. Manufacturing Products	34%	3%	63%	0%
Textile Mill Products	4%	34%	8%	55%
Clay, Concrete, Glass or Stone	21%	5%	75%	0%
Rubber or Misc. Plastics	74%	2%	24%	0%
Petroleum or Coal Products	38%	2%	60%	0%
Shipping Containers	73%	0%	28%	0%
Farm Products	56%	0%	44%	0%
Nonmetallic Minerals	73%	0%	27%	0%

Source: Transearch (2016)

shipping containers, petroleum or clay products, and nonmetallic minerals. Nonetheless, there is potential for diverting additional tonnage away from truck to air, rail, and water modes, thereby further reducing congestion in the I-55 corridor.

Freight Diversion Potential: Freight Volume Projections

The potential for future volumes to divert from truck to rail, water, or air was assessed using the Transearch database's 2045 projections for the study area. Using a similar methodology as for the existing freight volumes, the top inbound and outbound commodities that are transported by multiple modes were summarized in Table 9-10 and Table 9-11. The top two modes between which the commodity is shipped are highlighted to indicate the potential for diversion. For inbound and outbound, all commodities are shipped by truck and one other mode. For the products that are low value but high volume, they could potentially switch to rail or water more easily than air. For products that are time sensitive and lower volume, diverting from truck to air may be possible.

It is important to note that for the majority of products that are typically shipped by a mode, the volumes are usually low and therefore, the modal split is less significant than the percentages may indicate. For example, waste or scrap materials are not typically shipped by air, but Table 9-10 shows 77 percent of inbound waste or scrap material comes by air and the remaining 23 percent by truck. In total, although waste or scrap material is a top commodity inbound to the study area, it represents only .04 percent of all inbound tonnage. Even leather or leather products represent less than seven percent of the total tonnage.

Table 9-10. Inbound Freight Diversion Potential, 2045 — I-55

Commodity	Air	Rail	Truck	Water
Leather or Leather Products	0%	0%	74%	26%
Food or Kindred Products	1%	0%	40%	58%
Apparel or Related Products	4%	1%	34%	61%
Electrical Equipment	12%	24%	64%	0%
Ordnance or Accessories	0%	0%	79%	21%
Machinery	37%	0%	63%	0%
Fabricated Metal Products	25%	0%	75%	0%
Primary Metal Products	10%	1%	51%	38%
Nonmetallic Minerals	0%	0%	25%	75%
Instruments, Photo Equipment, Optical Equip, Lab or Scientific Equipment	75%	0%	25%	0%
Transportation Equipment	21%	0%	79%	0%
Waste or Scrap Materials	77%	0%	23%	0%
Petroleum or Coal Products	31%	0%	69%	0%

Source: Transearch (2045)

Table 9-11. Outbound Freight Diversion Potential, 2045 — I-55

Commodity	Air	Rail	Truck	Water
Ordnance or Accessories	0%	0%	61%	39%
Machinery	31%	1%	68%	0%
Lumber or Wood Products	18%	40%	43%	0%
Misc. Manufacturing Products	50%	3%	47%	0%
Clay, Concrete, Glass or Stone	19%	4%	77%	0%
Rubber or Misc. Plastics	68%	2%	30%	0%
Petroleum or Coal Products	23%	4%	73%	0%
Transportation Equipment	58%	0%	42%	0%
Shipping Containers	77%	0%	23%	0%
Farm Products	51%	0%	49%	0%
Nonmetallic Minerals	46%	0%	54%	0%
Farm Products	56%	0%	44%	0%
Nonmetallic Minerals	73%	0%	27%	0%

Source: Transearch (2045)

9.5 Other Emerging Freight Issues

As the U.S. economy continues to shift towards a services focus, more finished goods will need to be shipped in from other parts of the world that have greater manufacturing strengths[32]. The demand for just-in-time purchases through e-commerce will only increase, placing further pressure on I-55 and other study area highways as goods are delivered to ports on the Gulf, East, and West Coasts and trucked, barged, or railed inland to Tennessee and elsewhere. These shipments will continue to result in congestion, but expansion projects to the M-55 (marine highway along the Mississippi River) and Canadian National networks could offer some relief for highways.

E-Commerce

E-commerce is the economy of transactions online, including the buying and selling of products. The e-commerce platform has exploded in recent decades with the introduction of companies like eBay and Amazon that sell and transport goods to purchasers with predictable delivery windows. Over time, e-commerce has increased further with the advent of social media, as customers enjoy the convenience of shopping from home no matter the time of day, the ability to price compare and read reviews, and ultimately have the product shipped directly to their doorstep. Brick and mortar retailers including giants like Walmart and Target have felt the pressure to also include online stores to keep up with consumer demands, and while online sales worldwide are increasing as a share of the overall retail economy, the year to year growth of ecommerce sales has slowed from 25 percent in 2015 to a projected 19 percent by 2020, as shown in Figure 9-5.

While e-commerce growth may be slowing down, it is unlikely the market is going anywhere anytime soon. As a result, the nation's infrastructure network has had to accommodate the increase in truck traffic that is used to ship the products in the common two day delivery window offered by Amazon and others. A recent study by the American Transportation Research Institute (ATRI) notes that ecommerce is changing the way retailers do business and affecting distribution networks and the trucking industry on the whole[33]. Trucking distances are decreasing on average from 800 miles in 2000 to 500 miles in 2018 as companies build more distribution centers. These regional distribution centers are being constructed especially in the Midwest to take advantage of multiple transportation

Figure 9-5. Retail E-Commerce Sales Worldwide, 2015-2020

Source: Ecommerce Guide, "What is Ecommerce?" https://ecommerceguide.com/guides/what-is-ecommerce/

modes and the accessibility to large population concentrations. For example, Amazon's Tennessee distribution and fulfillment facilities are in Memphis, Nashville, and north of Cleveland, TN, and Walmart distribution centers are in Memphis, south of Nashville, and northeast of Knoxville. Last-mile fulfillment centers are becoming increasingly important and represented 73 percent of the industrial real estate market in 2017, a growth of 15 percent from 2016.

All of these changes to the dynamic of the retail market have resulted in demands on the trucking industry and therefore the highway network. Driver shortages, hours of service regulations, driver retention, and scarcity of truck parking are all issues that have developed along with the growth in ecommerce. The trucking industry will continue to evolve and respond to consumer demands while the nation's aging infrastructure is expected to accommodate the growth in truck traffic that comes with it[34].

MARAD M-55 Project

In April 2019, the USDOT Maritime Administration (MARAD) awarded $3.15 million to the Port of New Orleans for a Baton Rouge-New Orleans Shuttle on the M-55, the marine highway along the Mississippi River. The project would expand the Container on Barge

32- The Atlantic, "The American Economy is Experiencing a Paradigm Shift," https://www.theatlantic.com/sponsored/citi-2018/the-american-economy-is-experiencing-a-paradigm-shift/2008/
33- https://www.ccjdigital.com/atri-e-commerce-reshaping-trucking-industry-operations/
34 - Lockridge, Deborah, Truckinginfo.com, "How is the Growth of E-Commerce Affecting Trucking?" February 5, 2019, https://www.truckinginfo.com/324451/how-is-the-growth-of-e-commerce-affecting-trucking

Service offered at the two ports and provide the funds to buy vessels specifically for use in this service. The project would help divert trucks from the highway to M-55 along the southern portion of the I-10 corridor[35]. Although not directly related to the I-55 corridor, expanded barge capacity in the Mississippi River could extend north with new intermodal facility construction or development of existing facilities, thereby extending the region of influence of the container shuttle and removing additional trucks from the region's roads.

9.6 Truck Parking

Truck parking facilities in the region are both public and private. As shown in Figure 9-6, there are limited locations on I-55 for truck drivers to stop and rest or sleep overnight. The one public and four private rest stops in the study area are not adjacent to I-55 and would therefore be inconvenient for trucks to utilize unless they are also using I-40 or I-240, along which some of the stops are located. Nonetheless, TDOT should ensure that the locations are well-signed so that they are easier for truckers to access, if needed. With Hours of Service regulations that mandate rest periods and the number of hours of consecutive work that are allowed without sleeping[36], it is important that drivers are offered a selection of locations throughout their journey where they can rest and possibly eat, shower, and sleep overnight. Without proper rest, drivers risk fines and crashes.

9.7 Existing and Future Deficiencies and Needs

Truck is the primary mode of transporting freight in the I-55 corridor, accounting for nearly 80 percent of inbound and 82 percent of outbound freight in the study area in 2016. Truck volumes are expected to grow by at least 51 percent from 2010 to 2040, with the portion closer to the Mississippi state border growing at a faster rate of 61 to 70 percent as shown in Figure 9-1. A number of parallel corridors are also showing high growth, indicating that traffic is and will continue diverting to other routes as a result of the low level-of-service on I-55 between the junction with I-69 and I-240 and the Arkansas state border (shown in Figure 9-4). The crossing at the Mississippi River is a noted bottleneck due to the geometry of the interchange and capacity of the bridge. The corridor sees high volumes of through traffic with over five million tons annually, comparable to volumes seen on I-40 and I-240 in the Memphis area. The corridor has limited public and private truck parking, but there are opportunities to divert freight from truck to rail and air.

The region is particularly important for air freight as the headquarters of FedEx, where freight and mail volumes have grown by 10 percent between 2010 and 2017. With the increasing emphasis on e-commerce, air freight can be expected to continue its growth in coming decades. Therefore, truck access to and from the airport will be critical to support the just-in-time supply chain demanded by today's consumers. Finally, as noted in Section 9.4, there are a number of commodities that could be diverted away from truck to rail or air in the inbound and outbound directions. Diverting freight from truck to other modes is important because it alleviates capacity and congestion, reducing idling, delays, and the potential for crashes for all Interstate users.

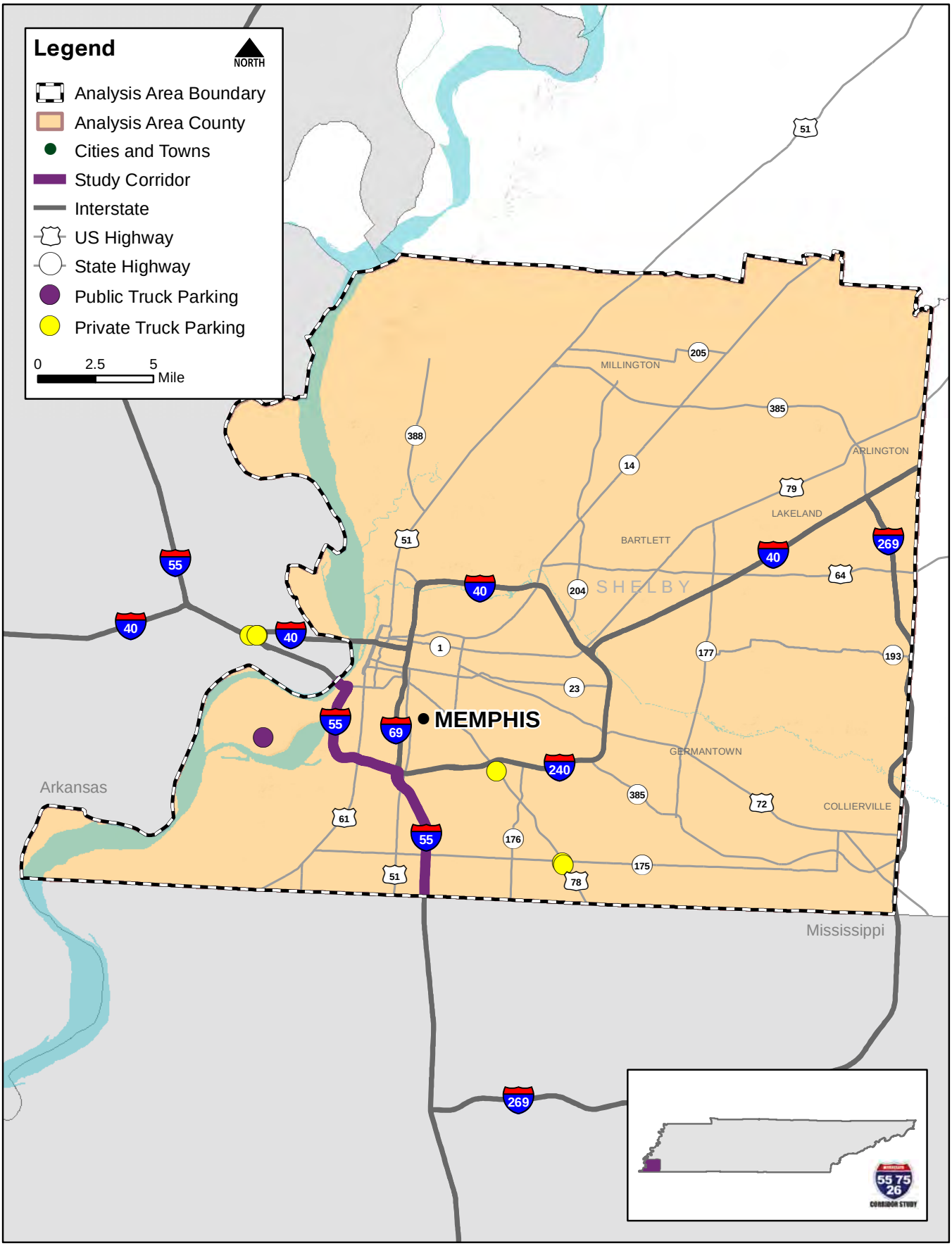
A. Lamar Avenue: Lamar Avenue in Memphis is a bottleneck for freight traffic in the region. Adjacent to the BNSF intermodal yard and the Memphis International Airport, truck traffic is a constant issue for the City of Memphis and the study area. The June 2011 Lamar Avenue Corridor Study found that the greatest benefit would be through adding lanes at a cost of $89.1 million. Intersection upgrades would also be necessary and could be implemented in a shorter timeframe. Signal optimization is currently used in the corridor to manage traffic flow, but the projected growth in truck traffic and cargo shipments by both air and rail will continue to exacerbate the congestion in this corridor[37].

B. Mississippi River Bridges: The Tennessee Statewide Multimodal Freight Plan (2018) notes the I-55 Mississippi River bridge (as well as the I-40 Mississippi River Bridge) was not built to withstand earthquakes. With the nearest Interstate crossing 60 miles away near Helena-West Helena, Arkansas, an earthquake resulting in the loss of the bridges would result in economic costs to the region and nation estimated at $4.2 to $4.3 billion. The cost of constructing another bridge that would accommodate vehicles and rail traffic is a high priority project in the state, but is estimated to cost over $1 billion[38].

C. Bottleneck Locations: The Tennessee Freight Plan also lists one potential bottleneck location on the I-55 corridor. The bottleneck is from north of West McLemore Avenue to the Arkansas State Line. The bottleneck involves an interchange with Crump Boulevard near downtown Memphis.

35- American Association of State Highway Transportation Officials, "MARAD Provides $6.79M for Three Marine Highway Projects," April 26, 2019, https://aashtojournal.org/2019/04/26/marad-provides-6-79m-in-grants-for-three-marine-highway-projects/
36- Federal Motor Carrier Safety Administration, Summary of Hours of Service Regulations, March 9, 2017, https://www.fmcsa.dot.gov/regulations/hours-service/summary-hours-service-regulations
37- Tennessee Department of Transportation, Tennessee Statewide Multimodal Freight Plan, 2018, https://www.tn.gov/content/dam/tn/tdot/long-range-planning/TDOT_FreightPlan_02.27.18.pdf
38- Ibid.

Figure 9-6. Truck Rest Areas in the Study Area (Public and Private) — I-55



Source: InfoUSA

I-155 Corridor

▶Assessment of Existing and Future Deficiencies

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I-155 Corridor

1. Introduction

The I-155 corridor serves as a backbone for economic development and growth in the region. As population and employment continue to grow, new travel demands place pressure on the Interstate as well as parallel and intersecting highways. This results in increased traffic congestion, travel times, and conflicts.

A previous technical memorandum (Technical Memorandum 1) for this study provided a data and information inventory for the corridor. This technical memorandum (Technical Memorandum 2) assesses existing and future deficiencies and needs along the I-155 corridor by examining transportation issues including land use, economic development, highway capacity, travel demand, safety, Intelligent Transportation Systems (ITS), freight, transit, and non-motorized travel. An assessment of these topics will help identify ways to improve safety and enhance transportation services throughout the corridor.

This analysis focuses on the trend scenario for the I-155 corridor, which predicts existing and future conditions if current practices, plans, and policies remain unchanged. To supplement the technical analysis, public workshops and surveys were used to generate feedback from citizens and stakeholders located throughout the corridor.

1.1 Defining the Trend Scenario

The trend scenario establishes the existing and projected transportation conditions along the I-155 corridor and serves as the baseline for identifying needs and, ultimately, proposed improvements. The 2010 and 2040 Tennessee Statewide Travel Demand Model (TSM) trend scenarios were originally developed by the Tennessee Department of Transportation (TDOT) in 2017 (Phase 3/Version 3). As part of this study, the trend scenarios were updated and validated based on the following:

- Population and employment data and projections from Woods and Poole Economics, Inc.
- Projects currently programmed for construction in TDOT's FY2017-2020 Statewide Transportation Improvement Program (STIP)
- Recent Transearch freight data and projections

Additional detail regarding model validation and updates can be found in separate technical memoranda ("TN Corridor Study – Trend Scenario Memo" and "TN Corridor Study – Model Documentation Memo") prepared for this study.

The FY2017-2020 STIP was reviewed to identify programmed projects along the I-155 corridor. No programmed improvement projects other than a renovation of the Welcome Center at the Missouri border were listed.

Figure 1-1. Study Corridors

The I-155 corridor is being studied as part of a larger corridor study that also includes I-55, I-75, and I-26.

2. Land Use and Economic Development

In any region, the need for improvements to the public infrastructure is triggered by growth, both in the number of residents and number of jobs. Examining historic development patterns as well as anticipated growth trends can provide a glimpse into the future and what challenges may await the transportation system.

2.1 Population and Employment Projections

A high-level review of population and employment projections from Woods & Poole, Inc. was undertaken for the counties surrounding the I-155 corridor, more specifically Dyer, Lake, Lauderdale, and Obion counties, as shown in Figure 2-1. According to Woods & Poole Economics data, these counties are expected to see a slight overall decrease in residents and an approximate 9% increase in jobs by 2040 (Figures 2-2 and 2-3). More specifically, much of the growth in the study area counties is expected to be employment-related as the area continues the development of Port of Cates Landing in Tiptonville and looks to the future construction of the I-69 corridor (see Figure 2-1) to improve roadway connectivity to other major markets. The future I-69 corridor is ultimately envisioned to

Figure 2-1. Study Area — I-155

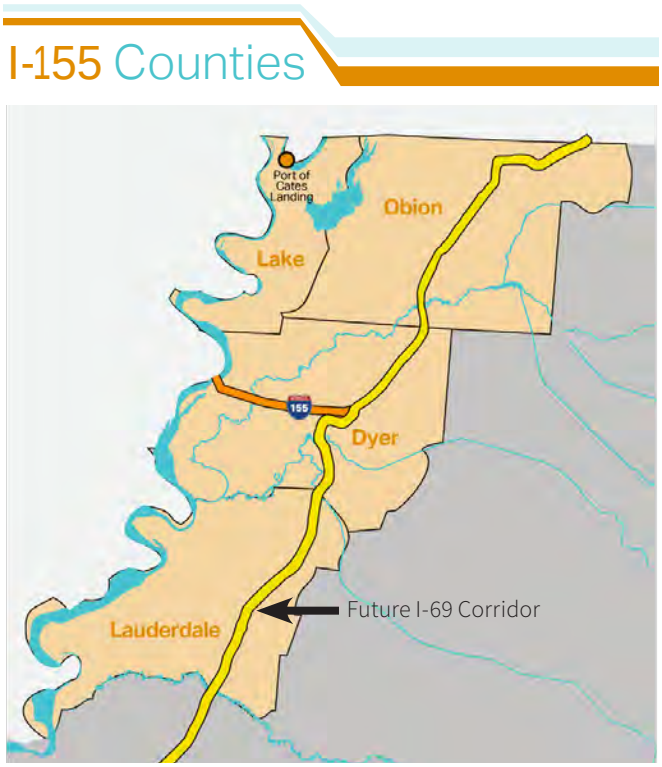
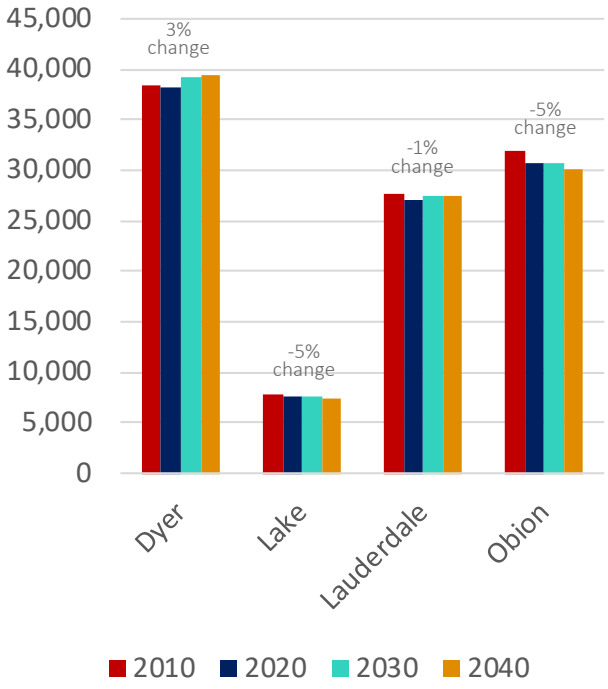
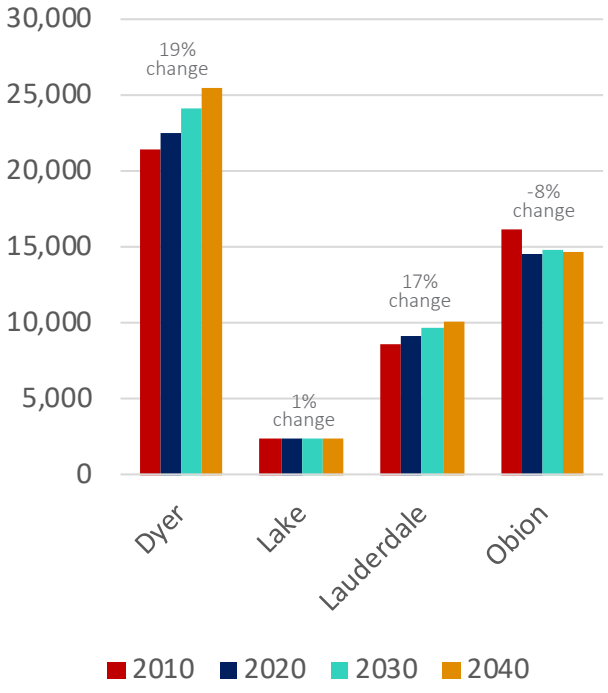


Figure 2-2. County Growth Trends, Population — I-155



Source: Woods & Poole Economics, Inc., 2018

Figure 2-3. County Growth Trends, Employment — I-155



Source: Woods & Poole Economics, Inc., 2018

link the Mexican and Canadian borders and has three segments in Tennessee that extend through Dyersburg, Millington, and Memphis. The completion of this corridor has the potential to increase desirability for the areas surrounding the I-155 corridor for both residents and employers.

Interchange access to Interstate corridors provides communities with the ability to attract businesses and provides accessibility to economic centers for employment. As such, population and employment projections from the TSM were also examined in more detail near the interchanges along the I-155 corridor as shown in Tables 2-1 and 2-2.

Table 2-1. Interchange Population Growth — I-155

	2010	2040	Population Growth	
			Number	Percent
Dyer County	6,870	7,760	890	13%

Source: Tennessee Statewide Travel Demand Model (TSM)

Table 2-2. Interchange Employment Growth — I-155

	2010	2040	Employment Growth	
			Number	Percent
Dyer County	9,680	12,910	3,230	33%

Source: Tennessee Statewide Travel Demand Model (TSM)

There are a total of four interchanges along the I-155 corridor in Dyer County. These provide access to major U.S and state routes such as SR-181 (Great River Road), SR-182 (Lenox-Nauvoo Road), SR-78 (Lake Road), and US-412. SR-181 and SR-182 provide access to north-south routes that serve agricultural and low-density residential developments. SR-78 and US-412 provide access to the City of Dyersburg, which has a relatively significant amount of both residential and non-residential development. Areas in the immediate vicinity (approximately a one mile radius) of an I-155 interchange, which are only located in Dyer County, are expected to grow by approximately 1,000 people and 3,300 jobs, a 13% and 33% increase, respectively. As shown, growth along I-155 heavily favors employment, with nearly four jobs added for every additional resident. Based on current trends in workforce/residential locations as well as unemployment, it is likely that these additional employees will be a mix of existing residents as well as residents from surrounding counties.

2.2 Planned and Proposed Development

Existing development patterns and in-progress plans will direct much of the forecasted population and employment growth over the next 20 years. Existing land use and development patterns were documented in Section 3-7 in Technical Memorandum 1. As mentioned there, it is not anticipated that any significant growth will soon occur in the areas immediately adjacent to the I-155 corridor. However, should the future I-69 corridor be constructed, additional growth, particularly in freight-related land uses, could come to this area. In addition, the successful marketing of the Port of Cates Landing, north of the I-155 corridor, could also bring increases in both employment and residential development.

2.3 Existing and Future Deficiencies and Needs

The following summarizes the key findings related to growth and development along the I-155 corridor.

A. Corridor Population and Employment Growth: Counties along the I-155 corridor are expected to see an overall decline in population, but are also anticipated to see a small increase in employment over the next 20 years. The small amount of population growth expected in this area will likely occur in Dyer County, near the I-155 corridor. Employment growth is expected to occur primarily in Dyer and Lauderdale counties with a combined 5,600 additional jobs in these counties.

B. Interchange Area Employment Growth: Growth near the existing I-155 interchanges will strongly tilt toward employment, with nearly four jobs added for every new resident, for a total of approximately 3,200 new jobs within the interchange areas. Much of this growth is likely to occur in anticipation of the proposed I-69 corridor, which would create new opportunities for connecting employment centers to these interchange areas and other markets.

C. Planned and Proposed Development: The future development surrounding the I-155 corridor is likely to be limited to areas in the immediate vicinity of the corridor near Dyersburg. However, significant public investment in the I-69 corridor and private investment in the Port of Cates Landing could result in additional growth and development along the corridor.

3. Highway Capacity and Travel Demand

As employment growth occurs in the I-155 study area, the demand on the roadway network also increases. This analysis considers historic traffic volumes in conjunction with predicted future 2040 traffic volumes to evaluate the following capacity and demand conditions in the corridor:

- 2010 traffic volumes and projected 2040 traffic volumes
- Travel patterns
- Volume-to-Capacity ratios
- Travel time and delay

3.1 Traffic Volumes and Projections

TDOT collects and maintains Annual Average Daily Traffic Volume (AADT) data on roadways across the state. Figure 3-1 shows the 2017 AADT volumes recorded in the Tennessee Roadway Information Management System (TRIMS) at four count stations along I-155. As shown, daily volumes range from 10,350 vehicles per day (VPD) (38% trucks) near the Missouri border in Dyer County, to 14,100 VPD (29% trucks) near Dyersburg. Throughout the corridor, seven to eight percent of the total daily volume occurs during the peak hours. The capacity of level, four-lane rural freeway facilities, such as I-155, ranges from 58,000 VPD to 75,000 VPD (Highway Capacity Manual 2010 Exhibit 10-9).

Table 3-1. Area Daily Trip Breakdown 2010 and 2040 — I-155

	Daily Trips		
Trip Types	**2010**	**2040**	**% Change**
Personal Trips	410,700	487,700	19%
Truck Trips	19,400	24,000	23%
Total Trips	430,100	511,700	19%
Percent Truck Trips	4.5%	4.7%	4.0%

Source: Tennessee Statewide Travel Demand Model (TSM)

Table 3-1 is populated with data obtained from the TSM, which provides base year (2010) daily trip information and forecasts the daily trips that will be made in 2040 based on projected growth and land use changes. As shown, total daily trips in the four-county area are expected to reach approximately 512,000 by 2040, representing a 19% increase over total trips in 2010. According to projections based on Woods & Poole data, the corresponding population and employment increases in the area are -1% and 9%, respectively.

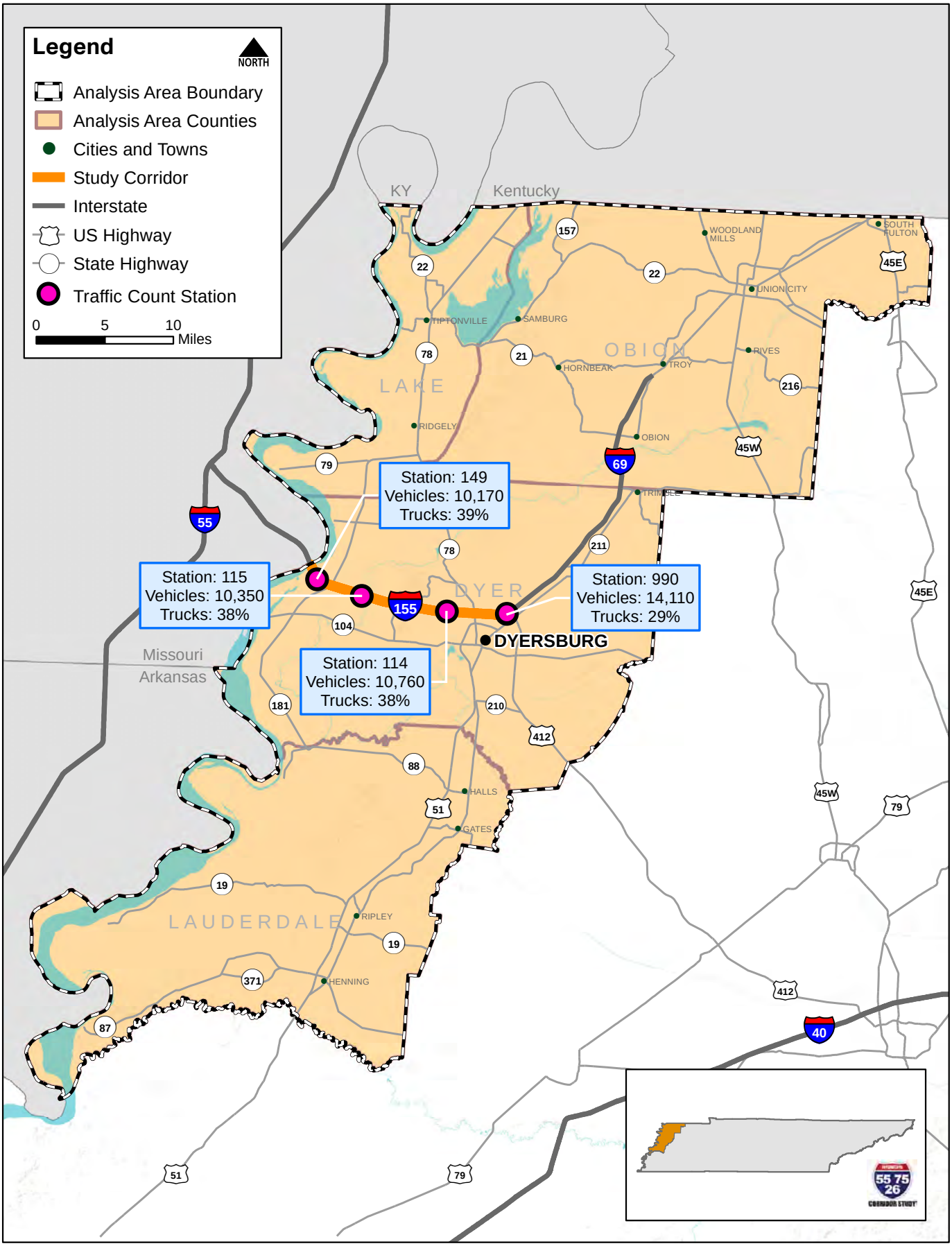
The TSM was used to calculate the total vehicle miles traveled (VMT) on each type of roadway facility in the four-county study area. Table 3-2 indicates a total 26% increase in VMT over the 2010 base year total. Urban and rural interstates and expressways are expected to see the highest percent changes in VMT – primarily due to the construction of I-69 around Union City in Obion County, which is approaching completion. The average number of miles traveled per trip, across all functional classifications, increases from 5.7 to 6.0 miles/trip by 2040.

Table 3-2. Vehicle Miles Traveled by Functional Class — I-155

		Total Daily VMT		
	Functional Class	**2010**	**2040**	**% Change**
Urban	Interstate	39,400	53,926	37%
	Expressway	24,623	114,241	364%
	Arterial	516,215	555,817	8%
	Collector	70,920	76,093	7%
	Local Road	3,621	3,640	1%
Rural	Interstate	121,302	195,860	60%
	Arterial	1,018,314	1,285,508	26%
	Collector	632,497	770,364	22%
	Local Road	2,496	2,476	-1%
Analysis Area Total		**2,430,388**	**3,057,926**	**26%**
Total VMT/Trip		**5.65**	**5.98**	**6%**

Source: Tennessee Statewide Travel Demand Model (TSM)

Figure 3-1. 2017 Average Annual Daily Traffic Volumes Along I-155



Source: Tennessee Roadway Information Management System (TRIMS) - 2017

3.2. Travel Patterns

Major Trip Destinations (O-D Pairs)

Origin-Destination (O-D) data, obtained from the TSM, was evaluated to determine the most common trip origin and destinations in the study area, as well as travel times between well-known locations. The average travel time between frequently traveled O-D pairs is approximately 10 minutes. As shown in Figure 3-3, travel times are not expected to increase significantly by 2040.

Census County-to-County Work Flow

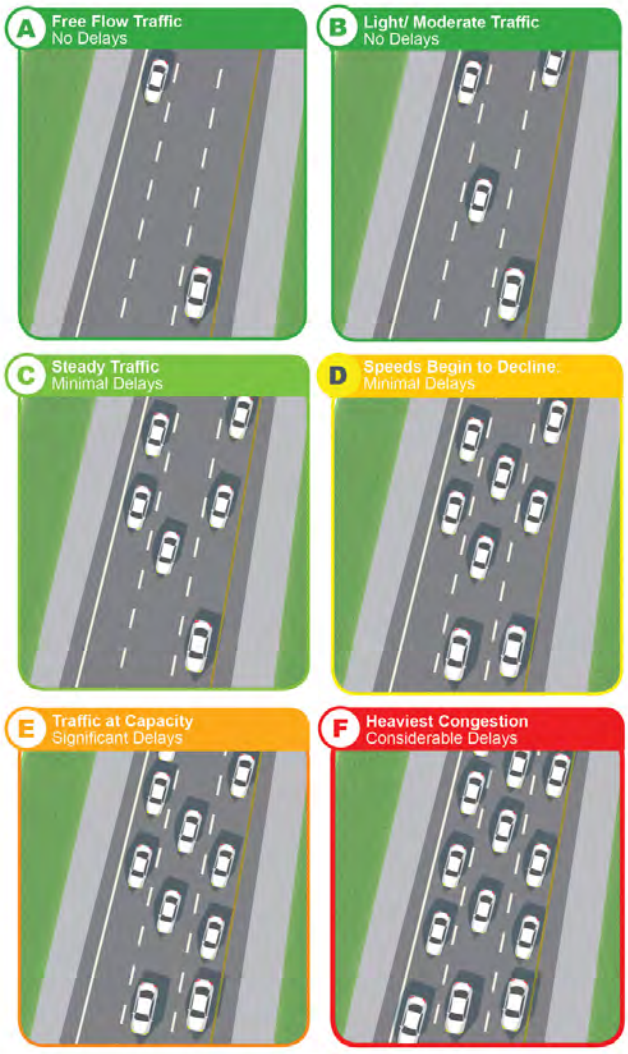
The U.S. Census Bureau provides origin and destination data for work trips per county. Figure 3-4 illustrates information obtained from their interactive, web-based tool, OnTheMap. The figure shows the most common employment destinations for workers living in each county. For example, of the 14,000 employees who live in Dyer County, 58% also work in Dyer County. Six percent work in Madison County, 4% work in Shelby County, 3% work in Lauderdale County, 2% work in Gibson County, 2% work in Obion County, and 3% work in Mississippi. The remaining 22% work in other counties. Completion of I-69 in the study area is expected to promote development and associated jobs, and will provide increased mobility for workers in northwest Tennessee.

3.3 Volume-to-Capacity Ratios

Vehicle capacity, as defined in the Highway Capacity Manual, is the maximum number of vehicles that can pass a given point during a specific period of time under prevailing roadway, traffic, and control conditions. Roadway conditions include number of travel lanes, design speed, lane widths, shoulder widths, horizontal and vertical alignments, and the number of access points to adjacent parcels. Traffic conditions include vehicle type, specifically the percentage of heavy vehicles that impact travel speed and occupy more space, the distribution of vehicles traveling in each direction, and the driver population (commuter versus non-commuter). Finally, the type of traffic control (stop signs versus traffic signals) used on non-Interstate facilities also affects capacity. Given this definition, it is apparent that the capacity of a facility can change from one segment to another and from one time of day to another time of day.

Figures 3-5 and 3-6 illustrate the 2010 and 2040 peak period volume-to-capacity (VC) ratios (obtained from the TSM) for each Interstate segment. Where the volume-to-capacity ratio is greater than 1.0, drivers experience poor operating conditions and high delay, represented as level-of-service (LOS) F (see Figure 3-2). As shown, I-155 currently operates at LOS A/B and is expected to continue with good levels of service into 2040.

Figure 3-2. LOS Characteristics



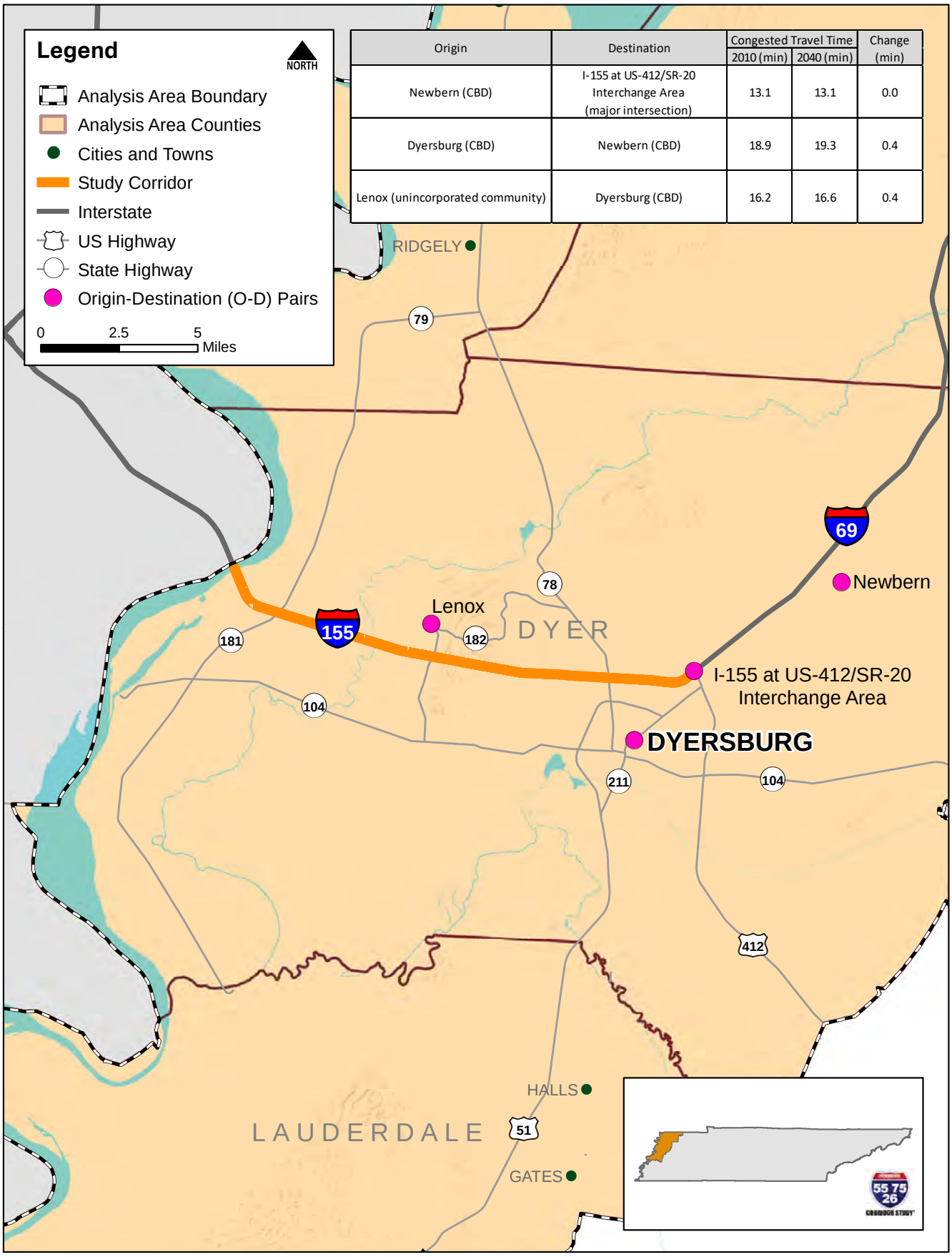
3.4 Travel Time and Delay

Tables 3-3 and 3-4 show the total vehicle hours traveled (VHT) and vehicle hours of delay (VHD) for each roadway type. As shown, the total VHT is expected to increase by 20%, which is on par with the increase in total VMT. Negligible change is expected to occur in the delay experienced by motorists in the study area between 2010 and 2040. Consistent with the capacity and LOS analyses, these analysis results indicate that the roadway network within the study area has excess capacity. This excess capacity is sufficient to maintain LOS A/B for projected 2040 vehicular trips. The projected average peak hour speeds, shown in Table 3-5 further this conclusion.

3.5 Existing and Future Deficiencies and Needs

As shown in Figure 1-6 in the Public Outreach section of this report, stakeholders identified one location with existing congestion problems: the I-155/SR-78 (Lake Road) interchange. Stakeholders noted congestion

Figure 3-3. Major Trip Origin-Destination Pairs — I-155*

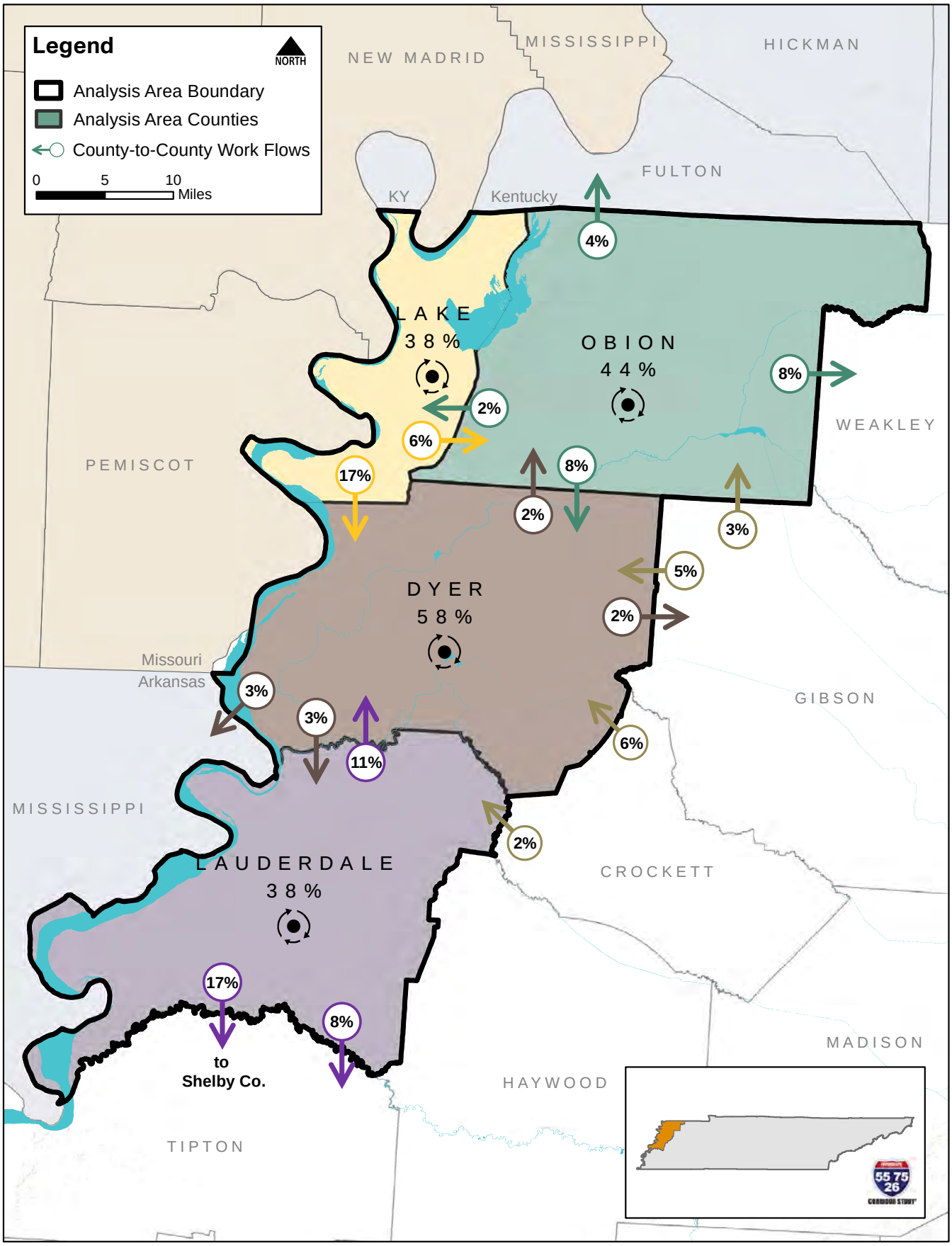


Origin	Destination	Congested Travel Time		Change
		2010 (min)	2040 (min)	(min)
Newbern (CBD)	I-155 at US-412/SR-20 Interchange Area (major intersection)	13.1	13.1	0.0
Dyersburg (CBD)	Newbern (CBD)	18.9	19.3	0.4
Lenox (unincorporated community)	Dyersburg (CBD)	16.2	16.6	0.4

Source: Tennessee Statewide Travel Demand Model (TSM)

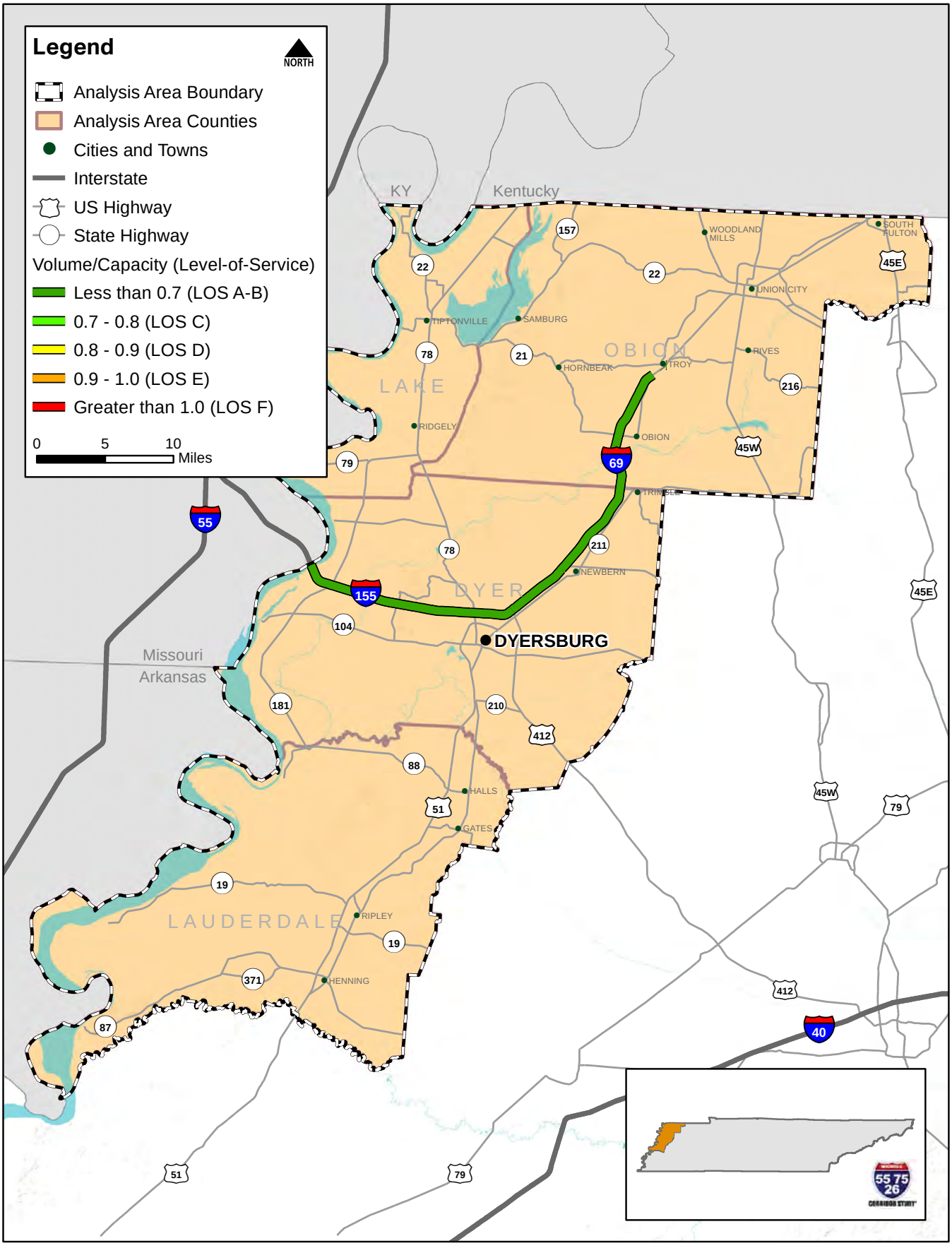
* Congested travel times are from model data.

Figure 3-4. County-to-County Work Flow (2015) — I-155



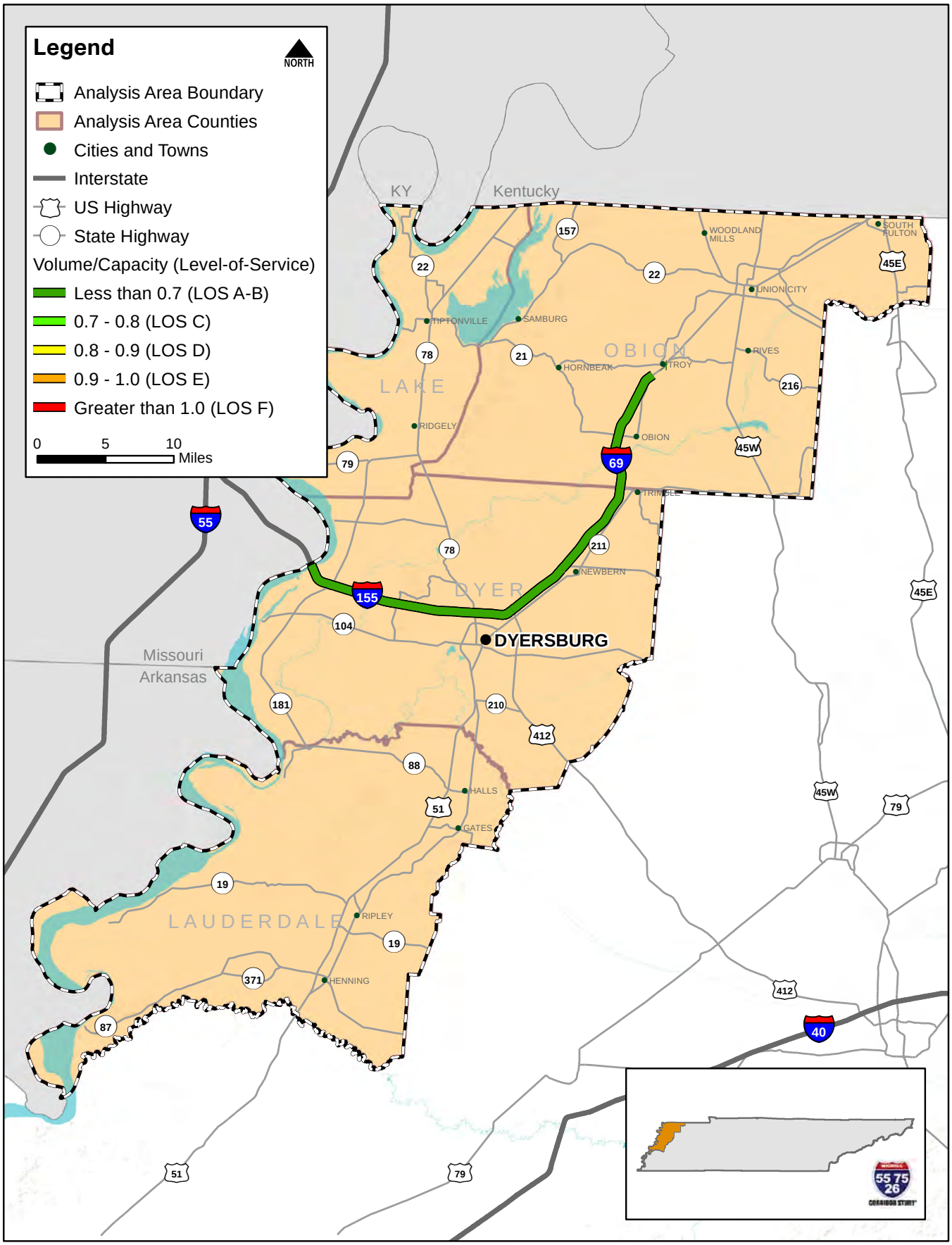
Source: U.S. Census Bureau, Center for Economic Studies: OnTheMap

Figure 3-5. Peak Period Volume-to-Capacity Ratios/Level-of-Service (2010) — I-155



Source: Tennessee Statewide Travel Demand Model (TSM)

Figure 3-6. Peak Period Volume-to-Capacity Ratios/Level-of-Service (2040) — I-155



Source: Tennessee Statewide Travel Demand Model (TSM)

Table 3-3. Vehicle Hours Traveled by Functional Class — I-155

	Functional Class	Total VHT 2010	Total VHT 2040	Total VHT % Change
Urban	Interstate	518	709	37%
	Expressway	346	1,535	344%
	Arterial	16,972	17,986	6%
	Collector	2,901	3,099	7%
	Local Road	160	161	0%
Rural	Interstate	1,608	2,576	60%
	Arterial	16,725	20,860	25%
	Collector	16,188	19,564	21%
	Local Road	79	78	-1%
Analysis Area Total		**55,497**	**66,568**	**20%**
Total Vehicle Mins Traveled/Trip		**7.7**	**7.8**	**1%**

Source: Tennessee Statewide Travel Demand Model (TSM)

Table 3-4. Vehicle Hours Delay by Functional Class — I-155

	Functional Class	Total VHD 2010	Total VHD 2040	Total VHD % Change
Urban	Interstate	0.00	0.00	-
	Expressway	0.00	0.00	-
	Arterial	0.84	0.84	0%
	Collector	0.36	0.36	1%
	Local Road	0.03	0.03	0%
Rural	Interstate	0.00	0.00	-
	Arterial	0.03	0.04	36%
	Collector	0.50	0.52	3%
	Local Road	0.01	0.01	0%
Analysis Area Total		**1.77**	**2.00**	**2%**

Source: Tennessee Statewide Travel Demand Model (TSM)

Table 3-5. Average Peak Hour Speeds by Functional Class — I-155

	Functional Class	Average Speeds (mph) 2010	Average Speeds (mph) 2040	Average Speeds (mph) % Change
Urban	Interstate	76	76	0%
	Expressway	72	72	0%
	Arterial	29	29	0%
	Collector	23	23	0%
	Local Road	21	21	0%
Rural	Interstate	76	76	0%
	Arterial	56	56	0%
	Collector	38	38	0%
	Local Road	33	33	0%

Source: Tennessee Statewide Travel Demand Model (TSM)

problems due to slow moving farm equipment. The following conclusions regarding future deficiencies were drawn based on analysis of the TSM data.

A. Daily Personal Vehicle and Truck Trips: Total daily trips in the four-county area are expected to reach approximately 512,000 by 2040, representing a 19% increase over total trips in 2010. This increase in trips significantly exceeds the expected population and employment increases in the area, which are -1% and 9%, respectively. Completion of I-69 in Obion County is expected to promote new development and increase mobility – both of which will result in increased trips.

B. Vehicle Miles Traveled: TSM output indicates a total 26% increase in VMT over the 2010 base year. Urban and rural Interstates and expressways are expected to see the highest percent changes in VMT – primarily due to the construction of I-69 around Union City in Obion County, which is approaching completion. The average number of miles traveled per trip, across all functional classifications, increases from 5.7 to 6.0 miles/trip by 2040.

C. Major Trip Destinations: Travel times are not expected to increase significantly by 2040.

D. Volume-to-Capacity Ratios: The analysis results indicate that I-155 has excess capacity. This excess capacity is sufficient to maintain level-of-service (LOS) A/B for projected 2040 vehicular trips.

4. Safety Analysis

As growth in population and employment occur in Tennessee, so do the traffic volumes on the Interstates and the extensive roadway system that feeds them. Increased traffic volumes and vehicle miles traveled, as well as congested travel conditions, increase the likelihood of traffic incidents. Crash data was collected from the TRIMS and analyzed to identify trends in potential safety issues along the I-155 corridor. In total, 189 crashes occurred along the I-155 corridor for the five-year period spanning 2014-2018. Of these, 42 resulted in an injury and three resulted in a fatality.

Overall, the total number of crashes and the number of injury crashes trended upward in this time period while the number of fatalities trended slightly downward. Table 4-1 shows the crash trends for the I-155 corridor for this five-year time period.

4.1 Crash Analysis

Table 4-1. Crash Trends — I-155

	Year				
	2014	2015	2016	2017	2018
Total Crashes	30	47	40	33	39
Injuries	6	8	11	8	9
Fatalities	2	0	0	1	0

Note: All crashes occurred in Dyer County.

Source: Tennessee Roadway Information Management System (TRIMS) - 2017

Using TDOT's traffic volumes collected in 2018, crash rates were calculated for the I-155 corridor during the five-year period spanning 2014-2018. These rates are reported in terms of crashes per million vehicle miles traveled. Figure 4-1 shows the comparison of these rates to the statewide averages for facilities of a similar type. More specifically, the statewide average crash rate is 0.528 crashes per million vehicle miles traveled for rural freeways and 1.112 crashes per million vehicle miles for urban freeways. I-155 crash rates were compared to the Tennessee statewide averages based on the following metrics:

- **Below Average**: Locations with crash rates below the statewide average
- **Average**: Locations with crash rates at or within 15 percent above the statewide average
- **Above Average**: Locations with crash rates between 15 and 100 percent above the statewide average
- **Significantly Above Average**: Locations with crash rates greater than or equal to 100 percent higher than the statewide average

Areas where the crash rates were significantly above statewide averages were identified as hot spots and are shown in Figure 4-1 in red. Table 4-2 shows the miles of I-155 in Dyer County and the number and proportion of miles that have crash rates significantly above average. In addition, Table 4-2 shows the number of crashes that occurred on those hot spot roadway segments between 2014 and 2018. Many of the hot spot locations coincide with interchanges with major roadways. Within these areas, crashes were examined by severity as well as the manner in which the collision occurred to determine if there were any obvious trends in the crashes that have occurred.

Potential Crash Factors

For the I-155 corridor, all crash hot spot locations were classified as urban or rural based on the functional classification of the Interstate segment. As shown in Table 4-2, approximately one mile of the I-155 corridor is identified as a crash hot spot. This represents 6% of the mileage for the whole corridor.

Table 4-2. Hot Spot Crashes — I-155

County	Total Miles in County	Number of Miles in Hot Spots	Crashes 2014-2018
Dyer	16.0	0.9 (6%)	32

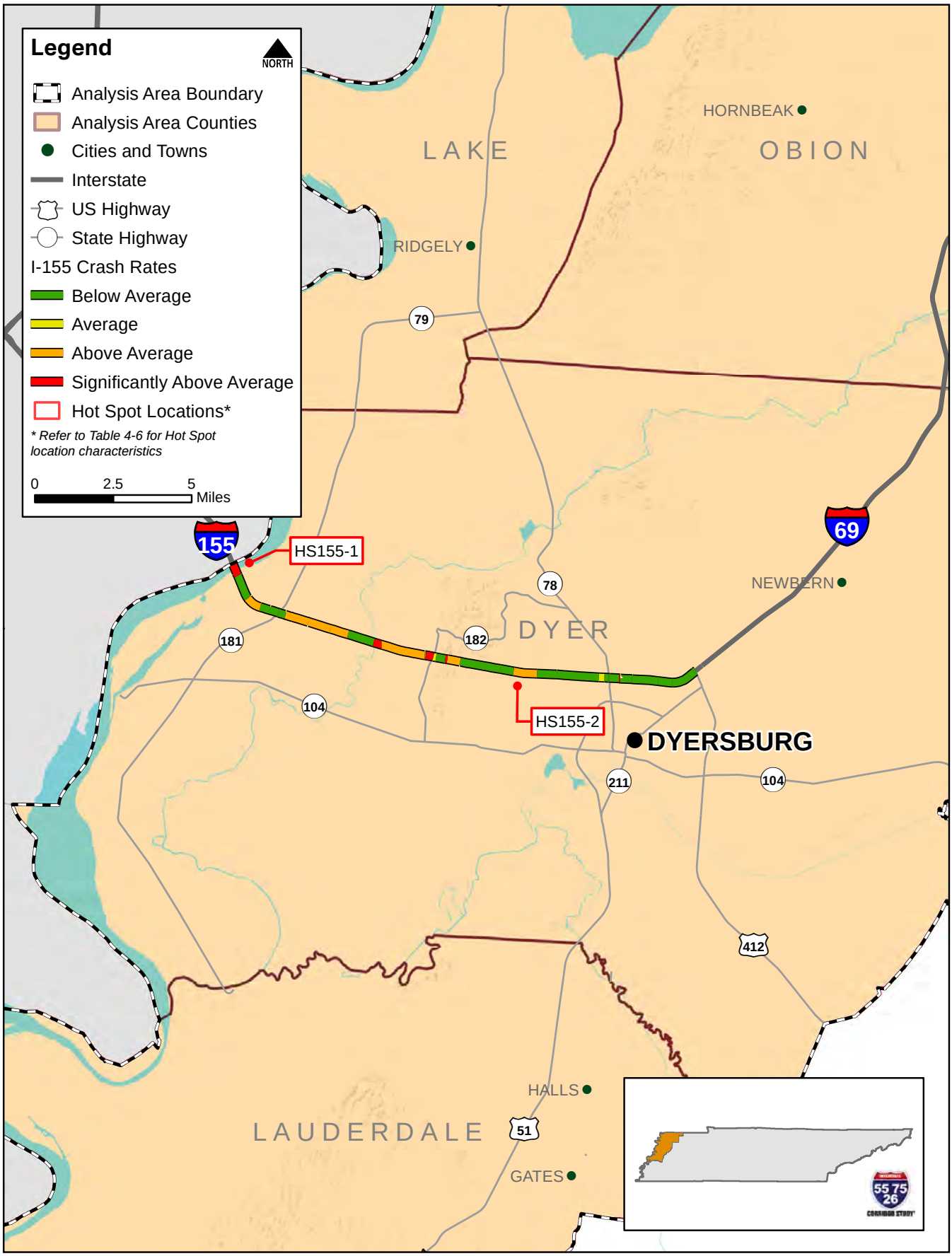
Source: Tennessee Roadway Information Management System (TRIMS) - 2017

There were 32 crashes in these rural hot spots between 2014 and 2018. The crash patterns for these locations in comparison to the overall crash statistics for the whole corridor are shown in Table 4-3, 4-4 and 4-5. Crash patterns at hot spot locations are similar to those for the entire I-155 corridor, as expected. As shown in Table 4-3, in the crash hot spots, approximately half of the crashes not involving a motor vehicle were the result of vehicles crashing into a concrete traffic barrier or guardrail.

All but two of the hot spot crashes occurred on a rural Interstate segment.

Table 4-4 shows the relatively insignificant difference in lighting conditions within crash hot spots and along the I-155 corridor. Similarly, for the severity of

Figure 4-1. Crash Rates (2014-2018) — I-155



Source: Tennessee Statewide Travel Demand Model

Table 4-3. Collision Trends — I-155

Manner of Collision	Hot Spot Crashes		Entire I-155 Corridor	
Angle	2	6%	5	3%
Head-On	-	0%	0	0%
No Collision with Vehicle	26	81%	144	76%
Other	0	0%	4	2%
Rear-End	1	3%	25	13%
Sideswipe	3	10%	11	6%

Source: Tennessee Roadway Information Management System (TRIMS) - 2017

crashes, there is little discernable difference in crash characteristics between hot spots and the corridor as a whole.

As shown in Table 4-5, approximately 20% of all crashes resulted in an injury or fatality and 80% resulted in

Table 4-4. Lighting Trends — I-155

Lighting Conditions	Hot Spot Crashes		Entire I-155 Corridor	
Dark – Lighted	1	3%	6	3%
Dark – Not Lighted	10	31%	60	32%
Dawn/Dusk	5	16%	8	4%
Daylight	12	37%	101	54%
Unknown	4	13%	14	7%

Source: Tennessee Roadway Information Management System (TRIMS) - 2017

property damage only. There was a total of one fatality in crash hot spots from 2014-2018. An additional two fatalities occurred along the corridor in this same time period.

Crash Characteristics

Table 4-5. Severity Trends — I-155

Crash Severity	Hot Spot Crashes		Entire I-155 Corridor	
Fatal	1	3%	3	2%
Injury	5	16%	42	22%
Property Damage	26	81%	144	76%

Source: Tennessee Roadway Information Management System (TRIMS) - 2017

In addition to analyzing the hot spots for different hot spot and corridor-wide characteristics, similar crash characteristics were examined for each hot spot to discern if any patterns indicated deficiencies that could be addressed. Table 4-6 shows the results of this analysis. In general, each of the hot spots were examined for trends in severity, prevalent collision types, non-vehicular accident events, lighting/weather conditions, relation to ramps and interchanges, as well as horizontal and vertical curvature. From these trends, potential crash factors are identified for each location, which will inform the development of safety project solutions.

Pedestrian and Bicycle Crashes

From 2014-2018, there were no pedestrian or bicyclist crashes along the I-155 study corridor or at interchange ramps.

4.2 Existing and Future Deficiencies and Needs

Crashes were analyzed over the five-year period from 2014 to 2018, with crash hot spots identified as locations with crash rates significantly above the statewide average. The safety analysis also examined potential factors at crash hot spots, including crash types, area type, and roadway lighting. Key findings of the analysis include:

A. Crash Rates and Hot Spots: Hot spots, ranging from individual roadway segments to longer corridor sections, totaling approximately one mile of I-155 were documented. Hot spots include:

- Mississippi River Bridge
- SR-182 (Lenox-Nauvoo Road) to SR-78 (Lake Road)

Additionally, injuries and fatalities resulting from reported crashes from 2014 to 2018 were

Table 4-6. Hot-Spot Crash Location Characteristics – I-155

	Hot Spot ID	
	HS155-1	**HS155-2**
Termini	Mississippi River Bridge	SR-182 (Lenox-Nauvoo Road) - SR-78 (Lake Road)
Number of Crashes	13	8
Severity (Fatal or Injuries)	46% (6)	0%
Prevelant Collision Types	69% (9) Non-Vehicle	100% (8) Non-Vehicle
Non-Vehicle Trends	89% (8) Roadway Barrier	50% (4) Roadway Barrier
Lighting/Weather	54% (7) in Dark-Unlit Conditions 31% (4) in Rain/Snow	38% (3) in Dark-Unlit Conditions 25% (2) in Rain/Snow
Interchange Related	No	No
Curvature Issues	N/A	N/A
Potential Crash Factors	• Inadequate lighting in rural areas • Small inside shoulder width near roadway barriers	• Inadequate lighting in rural areas • Small inside shoulder width near roadway barriers • Animal crossings from nearby forested area are common throughout the corridor

Source: Tennessee Roadway Information Management System (TRIMS) - 2017

documented for the study area. Overall, though the total number of crashes is steady, the number of injury crashes trended upward in this time period and the number of fatalities slightly trended downward.

B. Crash Types: Crash types were examined for the identified hot spots, and were compared to crashes along the entire corridor to examine trends in crash characteristics. For both the I-155 corridor as well as the specific hot spots, the predominant crash type was crashes with objects other than motor vehicles, with over half of those crashes occurring with roadway barriers such as guardrails, cable barriers, and others. Crash characteristics in the hot spots were similar to those found along the I-155 corridor as a whole.

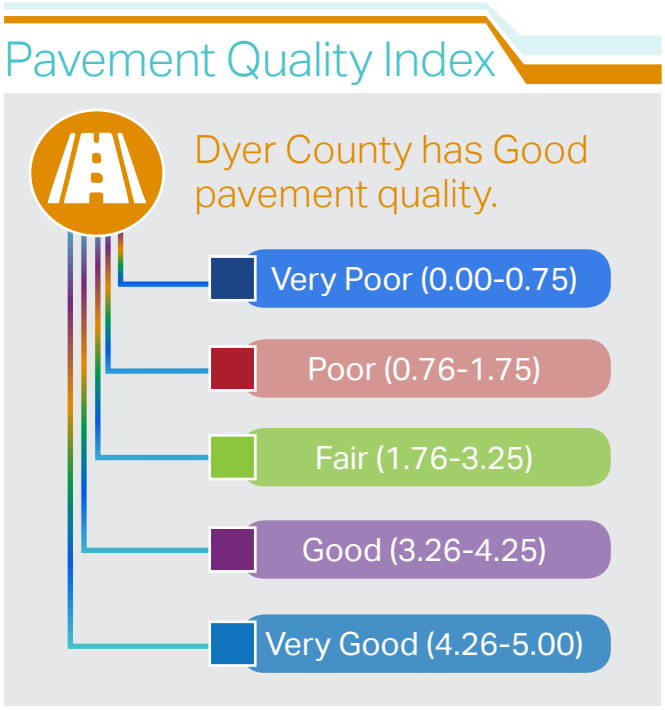
5. Operations and Maintenance

5.1 State of Good Repair

Pavement Sufficiency Rating

TDOT collects and maintains pavement management data for all roads included in the state's network. The Pavement Quality Index (PQI), expressed on a scale from 0-5, is the overall measure of a pavement's roughness and distress. According to TDOT, roadways with a PQI between 1.75 and 3.25 are considered to be in fair condition. Those with a PQI less than 1.75 are considered to be in poor condition. The PQI is calculated based on both the Pavement Distress Index and the Pavement Smoothness Index, the latter of which is a function of the International Roughness Index (IRI). The IRI measures the number of vertical deviations over a section of road, and has been used as a performance measure toward goals set by the Federal Highway Administration (FHWA) since 1998. As of 2006, FHWA designated an IRI equal to 95 inches/mile or less to be representative of a road with good ride quality. The percentage of I-155 Interstate miles with IRI less than or equal to 95 inches/mile is shown in Table 5-1. Also shown is the average PQI for Interstates and state routes within the study area that are included on the National Highway System.

Table 5-1 also indicates dates of most recent resurfacing for I-155 segments in each county (as of 2017), as well as TRIMS sign inventory data, which is used as an indicator of maintenance needs. Figure 5-1 shows the most recent reconstruction or resurfacing for I-155 segments as of 2017.



Bridge Conditions

TDOT routinely inspects and evaluates the 19,822 structures designated as public highway bridges in the state. These include bridges owned and maintained by TDOT, as well as those owned and maintained by local governments. TDOT designates a bridge as "structurally deficient" if one or more major structural components are rated in poor condition, or if its load carrying capacity is well below current design standards. Via the Better Bridge Program, the state addressed deficiencies on 193 of the 200 structurally deficient state-owned bridges in 2013. There are no structurally deficient bridges on the I-155 corridor.

The FHWA's Highway Bridge Replacement and Rehabilitation Program (HBRRP) provides funds to assist states in replacing or rehabilitating deficient highway bridges located on any public road. To be eligible, a bridge must carry highway traffic, be deficient and have a sufficiency rating of 80 or less. The sufficiency rating of an individual bridge, on a scale of 0 to 100, is based on structural adequacy and safety, serviceability and functional obsolescence, and essentiality for public use[1]. A rating of 0 is the worst possible bridge.

Table 5-1. Operations and Maintenance by County (as of 2017) — I-155

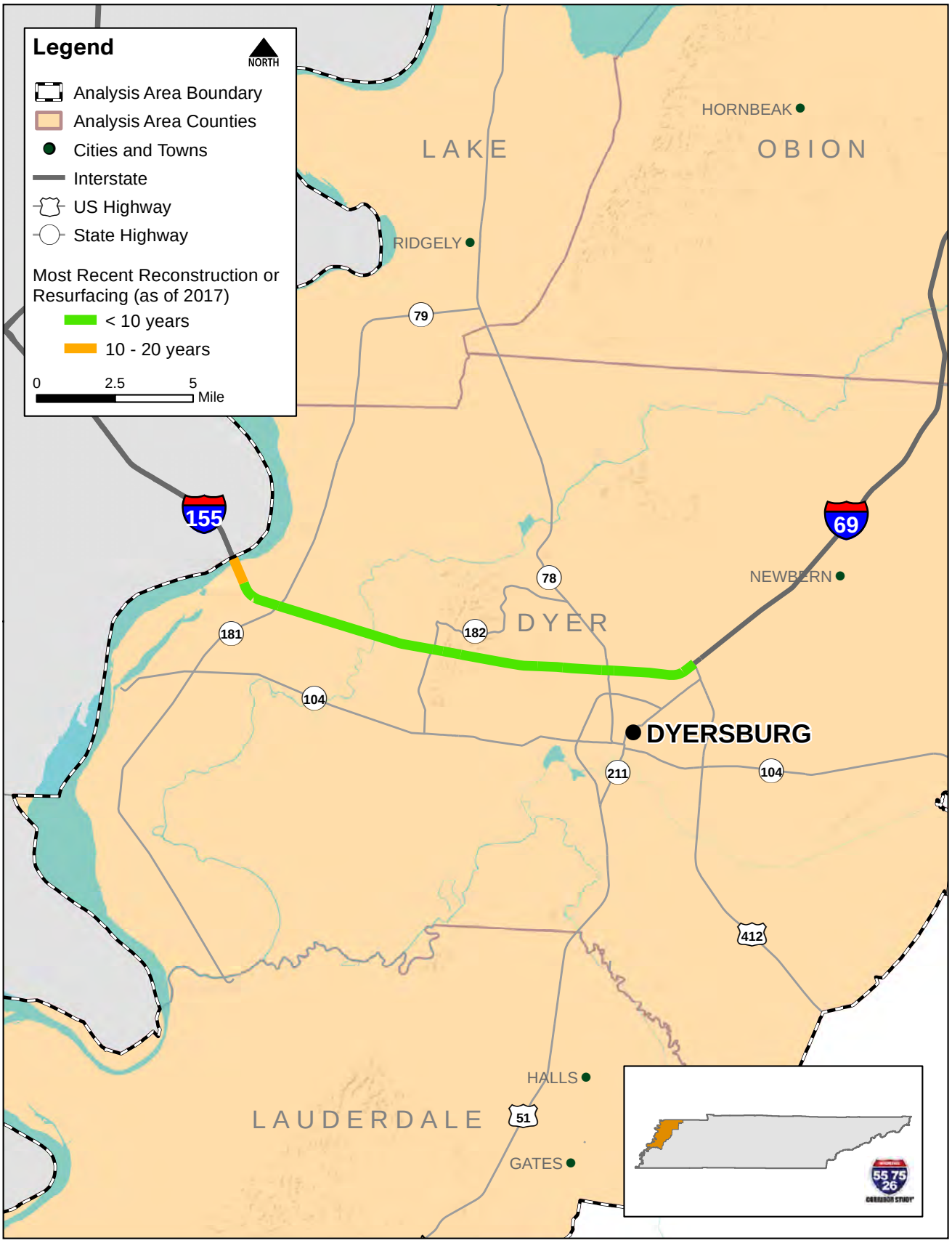
County	Most Recent Resurfacing (Letting Date)	% of Corridor with Good Ride Quality*	Average PQI	Avg PQI on NHS State Route	Sign Inventory Condition	Max AADT (2017)	% Trucks (2017)
Dyer	1999 (L.M. 0.0-0.76) 2010 (L.M. 0.76-9.00) 2009 (L.M. 9.00-15.94)	80.8%	4.07 Good	3.07	96% GOOD 3% FAIR 1% POOR	14,110	29%

* Good ride quality defined as an IRI equal to 95 or less

Source: Tennessee Roadway Information Management System (TRIMS) - 2017

1- Federal Highway Administration. Accessed 08/22/2019. https://www.fhwa.dot.gov/legsregs/directives/fapg/cfr0650d.htm

Figure 5-1. Most Recent Reconstruction or Resurfacing — I-155



Source: Tennessee Roadway Information Management System (TRIMS) - 2017

A sufficiency rating that is less than 50 is eligible for replacement and a sufficiency rating of less than 80 but greater than 50 is eligible for rehabilitation.

Sufficiency rating data was collected from TRIMS and used to identify the number of bridges eligible for rehabilitation or replacement along I-155. Of the 10 bridges on I-155 in the study area, there are no bridges with a sufficiency rating of less than 50. There are two bridges with ratings between 50 and 80 and the remaining eight bridges have sufficiency ratings greater than 80 (Figure 5-2).

5.2 Traffic Incident Management (TIM)

Responding to traffic incidents in an effective and timely manner reduces congestion, wasted fuel, and the likelihood of secondary crashes. The time it takes to respond to an incident and clear the roads is directly related to the likelihood of a secondary crash. This response time can be greatly reduced using ITS technologies, including monitored CCTV cameras, radar detectors to determine travel speeds, and DMS to direct/notify drivers. The highly coordinated incident management process requires accurate and efficient communication among numerous agencies, including:

- Law enforcement
- Fire and rescue
- Emergency medical services
- Public safety communicators
- Emergency management officials
- Towing and recovery
- Hazardous materials contractors (when applicable)
- Traffic information outlets

According to FHWA, national best practices in scene management strategies include:

- Incident command systems
- Response vehicle parking plans
- High-Visibility safety apparel and vehicle markings
- On-Scene emergency lighting procedures
- Clearance laws, such as “Move Over”
- Effective traffic control
- End-of-Queue advance warning systems
- Alternative route plans

TDOT’s HELP program has been incorporating the latest ITS technologies and strategies since its inception in 1999. However, HELP trucks are currently not deployed on I-155. As a result, scene management and crash clearance rest solely on law enforcement and first responders.

TDOT has established specific, regional Interstate incident management plans focusing on major incidents (those that will require total roadway closure for at least two hours). Goals of these living plans include decreased response time and planned detour routes with appropriate signing so that motorists experience minimal delay in moving toward their destinations. The plans also detail work zone traffic control and point to the regional transportation management centers as the “home base” of coordination and communication during an event. The plans are distributed to regional TDOT Maintenance and Incident Management staff so that the defined detour routes can be implemented quickly upon confirmation of an incident. The Region 4 incident management plan includes action / detour plans for I-155 incidents located between Exit 1 (Missouri I-155) and Exit 15 (SR-20 / US-412). The plan currently re-routes eastbound and westbound traffic approximately 230 miles via I-55, I-40 (MS River Crossing) and SR-20[2].

Over the last several years, TDOT has taken extra steps to improve traffic incident management, coordination, and safety on the Interstate system within Tennessee. In 2014, in response to proposals by the Tennessee Highway Patrol, TDOT and the Tennessee Department of Safety and Homeland Security opened a TIM Training facility in Nashville. The facility allows emergency responders hands-on quick clearance training in a safe environment[3]. In 2017, Tennessee initiated an annual Highway Safety and Operations Conference with the intent to bring together those involved in highway safety statewide for brainstorming and discussion of best practices[4].

5.3 Intelligent Transportation Systems (ITS)

ITS Device Inventory

TDOT’s SmartWay system relies on evolving technology, as well as teams of operators and technicians who monitor the technical systems and provide hands-on assistance through the state’s HELP program. Four transportation management centers (TMCs) located across the state anchor the systems operations and communication. From these locations, operators oversee 517 cameras, 174 message signs, 1,015 roadway detection systems and 49 video detection systems across the state. They also maintain communication with the public via messages on dynamic message signs, TN 511 updates, and the SmartWay website.

2- https://www.tn.gov/tdot/traffic-operations-division/transportation-management-office/interstate-incident-management-plan.html
3- https://www.tn.gov/tdot/traffic-operations-division/transportation-management-office/training.html
4- https://www.tn.gov/tdot/traffic-operations-division/transportation-management-office/interstate-incident-management-plan.html

Figure 5-2. Bridge Sufficiency Ratings — I-155

Source: Tennessee Roadway Information Management System (TRIMS) - 2017

Due to the rural nature of this corridor, no advanced SmartWay technology is present along the I-155 corridor. However, motorists can use TN 511 for weather and traffic conditions by phone, as well as the SmartWay App which provides real-time traffic information.

5.4 ITS State of Practice

While TDOT maintains a robust ITS system, reviewing national best practices is pertinent in an era of ever-evolving technology. Below are brief summaries of examples for various ITS focus areas, intended to highlight recent advances. This list of strategies and solutions is not specific to I-155.

Transportation System Management and Operations (TSM&O)

Transportation System Management and Operations (TSM&O) is "a set of strategies that focus on operational improvements that can maintain and even restore the performance of the existing transportation system before extra capacity is needed[5]." As vehicle miles traveled increases and funding decreases, TSM&O strategies- which can also benefit quality of life, economic vitality, and safety,-have received more focus from state transportation departments and metro regions.

TDOT's Traffic Operations Division consists of the following offices, which support TSM&O: Headquarters Traffic Engineering, Intelligent Transportation Systems, and Transportation Management. Recognizing the demand for and benefit of operational improvements, TDOT's Traffic Operations Division includes in its list of responsibilities a national best practice review for TSM&O[6].

The following is FHWA's current example list[7] of TSM&O strategies and solutions. Asterisks note the strategies that TDOT has implemented in various parts of the state.

- Work Zone Management*
- Traffic Incident Management*
- Special Event Management
- Road Weather Management*
- Transit Management
- Freight Management
- Traffic Signal Coordination
- Traveler Information* (SmartWay)
- Ramp Management
- Congestion Pricing
- Active Transportation and Demand Management*
- Integrated Corridor Management* (I-24 Corridor)
- Access Management*
- Improved Bicycle and Pedestrian Crossings
- Connected and Automated Vehicle Deployment

Managed Lanes

Managed lanes programs implement pricing and/or incentives for use of dedicated travel lanes – either existing or new construction. These strategies can be adapted in response to changes in demand which results in more reliable travel times, via personal vehicle or transit. Examples of managed lanes include high-occupancy-toll (HOT) lanes, which have been implemented in at least nine states; dedicated bus-rapid-transit (BRT) lanes, such as the Gold Line in St. Paul, MN, that will parallel nine miles of I-94; reversible lanes; and high-occupancy-vehicle (HOV) lanes. Tennessee has dedicated, peak hour HOV lanes on portions of I-40 and I-55 (Mississippi state line to SR-3) in Memphis as well as I-65 in Nashville. These lanes are divided from the standard travel lanes only by striping, and therefore rely on public awareness and enforcement to maintain effectiveness. In some states, physically divided HOV lanes are being combined with HOT lanes and/or BRT strategies.

Active Traffic and Demand Management (ATDM)

States and regions with continuously monitored transportation systems have the ability via new technology to actively monitor capacity and interact with drivers in real time. Active Traffic Demand Management (ATDM) strategies also boast significant safety benefits. Specific strategies include dynamic ridesharing, on-demand transit, dynamic pricing, predictive traveler information, dynamic lane use/shoulder control, dynamic speed limits, queue warning, adaptive ramp metering, and dynamic way-finding.

Freight Applications

Because freight trucks play a key role in transportation networks, it is critical to integrate them into ITS. By increasing the overall efficiency of freight trucks, congestion, travel time, travel stop time, and fuel consumption are all reduced. Although large logistics companies often have an in-house ITS in place, local governments can implement systems to help smaller companies, and transportation networks as a whole.

Freight Advanced Traveler Information System (FRATIS) is a collection of methods to help optimize freight operations. The first aspect of this system deals with

5- https://ops.fhwa.dot.gov/tsmo/index.htm
6- https://www.tn.gov/tdot/traffic-operations-division/transportation-management-office.html
7- https://ops.fhwa.dot.gov/tsmo/index.htm

real-time data, such as current arterial speeds/volumes, weather conditions, road closures, etc. that optimize routes. The second aspect focuses on arrivals and destinations. By combining and analyzing weigh station, delivery point, intermodal terminal, overnight parking, and other information, dry runs, wasted miles, and traffic jams are reduced.

Work Zone Mobility and Safety

Work Zone Mobility and Safety programs are designed to maximize safety, minimize delays, and establish consistency throughout work zones. Every Day Counts (EDC) is an ongoing model created by FHWA that provides a wide variety of innovative ideas to help increase efficiency of roadway projects with a focus on safety.

Many states have implemented safety specific campaigns, such as TDOT's Work With Us. This is a multimedia campaign that aims to remind motorists to take extra caution when passing highway workers. Using an array of delivery methods, such as online videos and graphics or Digital Message Signs (DMS), the Work With Us campaign is able to reach a larger audience than traditional safety campaigns.

Integrated Corridor Management (ICM)

Various aspects of corridors are often individually managed by different entities for different goals. Collaboration with transportation professionals in other networks across the corridor allows entities to share resources and information and more effectively meet their goals. Integrated Corridor Management (ICM) aims to improve accessibility, safety, and mobility of users within the corridor through this cooperation between stakeholders. By combining data into a universal system, all appropriate stakeholders, including managers and users, can make more informed decisions for the corridor as a whole. A few attributes of a successful ICM system as described by the FHWA are outlined below:

- Institutional Support
- Multimodal Capabilities and Alternative Transit Options
- Centralized Data Hub
- Public Engagement

Connected Vehicle Technology

Many technologies are being developed that help drivers by providing their vehicles with information about their environment. By communicating with nearby vehicles, traffic signals, work zones, toll booths, or other surroundings, these vehicles will improve efficiency and safety, not just for the user, but others as well. Likewise, these Connected Vehicles (CV)also send information back out to their environment. The devices the CVs communicate with will also provide data, such as speed and volumes, to DOTs to help improve the transportation system. One of the most likely methods for this communication to occur is through Dedicated Short-Range Communication (DSRC). Similar to Wi-Fi, this technology can securely, reliably, and quickly share information between vehicles and surrounding infrastructure.

Governments can help foster growth of connected vehicles by setting up a system in which companies can begin introducing these technologies. TDOT has begun the DSRC Statewide Guidance document as a living resource for implementing a CV project within the state. Although currently in the early stages, once complete, it will provide a reference for organizations to begin implementing these technologies within the state.

Autonomous Vehicle Technology

In May 2017, the Tennessee General Assembly ruled in favor of companies testing autonomous vehicles (AVs) on Tennessee roads so long as federal and state safety standards are met and proper insurance is obtained. Because concerns with CV and AV technology are so closely related, preparation for widespread use is similar. Organizations will use resources such as the DSRC Statewide Guidance document to safely and legally implement AV technology in the future.

Contrary to fully autonomous vehicles, the use of semi-autonomous vehicles is already widespread. For example, since April 2017, platooning has been permitted on Tennessee roads. This is the method in which freight trucks use a system that automatically controls speed and braking by communicating between participating vehicles. This not only improves efficiency by increasing aerodynamics as the trucks can drive closer together, but also safety because the system will automatically apply brakes if it senses a hazard.

5.5 Existing and Future Deficiencies and Needs

A. Pavement Sufficiency Rating: According to TDOT's 2017 Pavement Management Report, 91% of Interstates in Tennessee have a Good or Very Good pavement quality index (PQI). I-155 falls into the Good range, with a PQI of 4.068. Based on the TRIMS maintenance history (as of 2017) shows I-155 was most recently resurfaced in 2009/2010.

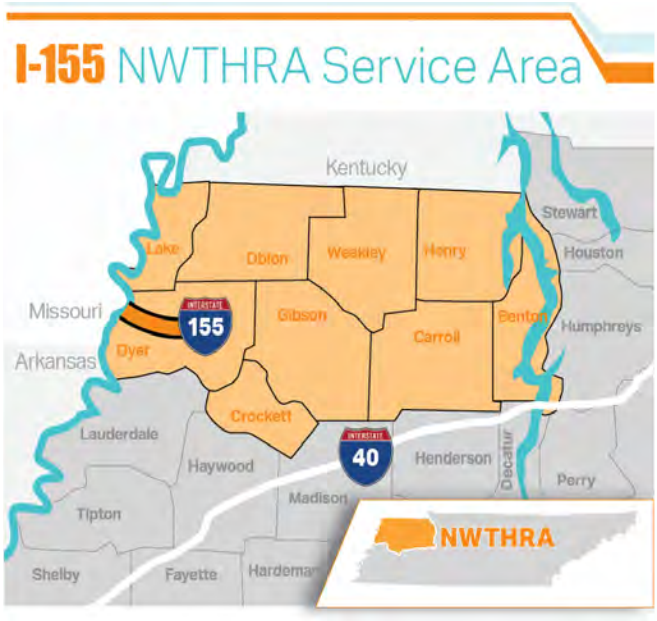
B. Bridge Conditions: No bridges along I-155 are designated as structurally deficient. Of the 10 bridges on I-155 in the study area, only two had sufficiency ratings low enough to be eligible for rehabilitiation under the Federal Highway Administration's (FHWA) Highway Bridge Replacement and Rehabilitation

C. ITS Strategies: As traffic on I-155 grows, congestion can be mitigated through TSM&O measures including: work zone management, traffic incident management, specific access management guidelines for development on adjacent arterials, and improved bicycle and pedestrian crossings.

6. Transit

The I-155 corridor study area is located in an area of Tennessee with low population density. Although no fixed-route public transit is offered within the corridor area, the Northwest Tennessee Human Resource Agency (NWTHRA) Public Transportation Program offers on-demand service for residents in the area. See Figure 6-1 for a map of the NWTHRA service area. Fares can be as low as $1.00 round trip and the service will transport riders as far as Memphis, Jackson, and Nashville. Services are offered from 6:00 a.m. to 6:00 p.m. Monday through Friday.

Figure 6-1. NWTHRA Service Area



Source: NWTHRA

7. Walking and Bicycling

In order to serve all transportation users, bicycle and pedestrian infrastructure is necessary in many locations, especially in locations where the Interstate is a barrier to multimodal travel. In the I-155 study area, there is limited bicycle and pedestrian infrastructure. The existing bicycle and pedestrian accommodations are limited to village and town centers. Where there are existing facilities they often fall short with gaps in service, minimum design standards or are segmented by an Interstate facility. Most existing bicycle and pedestrian facilities are supported locally or regionally, however, some state-wide bicycle routes are in development by TDOT.

7.1 U.S. and State Bicycle Routes

Currently Tennessee has one existing statewide bicycle route, US Bicycle Route 23, running north to south through the middle of the state. This route runs along existing state and U.S. highways. The route is signed with 'Bike Route' signs but no other bicycle accommodations exist. Consideration was given to the existing roadway factors along the route including: shoulder presence, width, traffic volumes, percentage of trucks, etc. Other U.S. Bicycle Routes are planned in Tennessee including one route running east to west through Memphis, Nashville and Knoxville (USBR 80). Additionally, a route is planned north to south to the east (USBR 22) and west (USBR 35/25) of Nashville and a second route (USBR 45) along the Mississippi River or Tennessee's western boundary. USBR45 will likely intersect I-155 when a route is determined.

In addition to the U.S. Bicycle Routes, TDOT has statewide bicycle routes planned throughout the state. Several planned bicycle routes intersect or run parallel to the I-155 corridor, including:

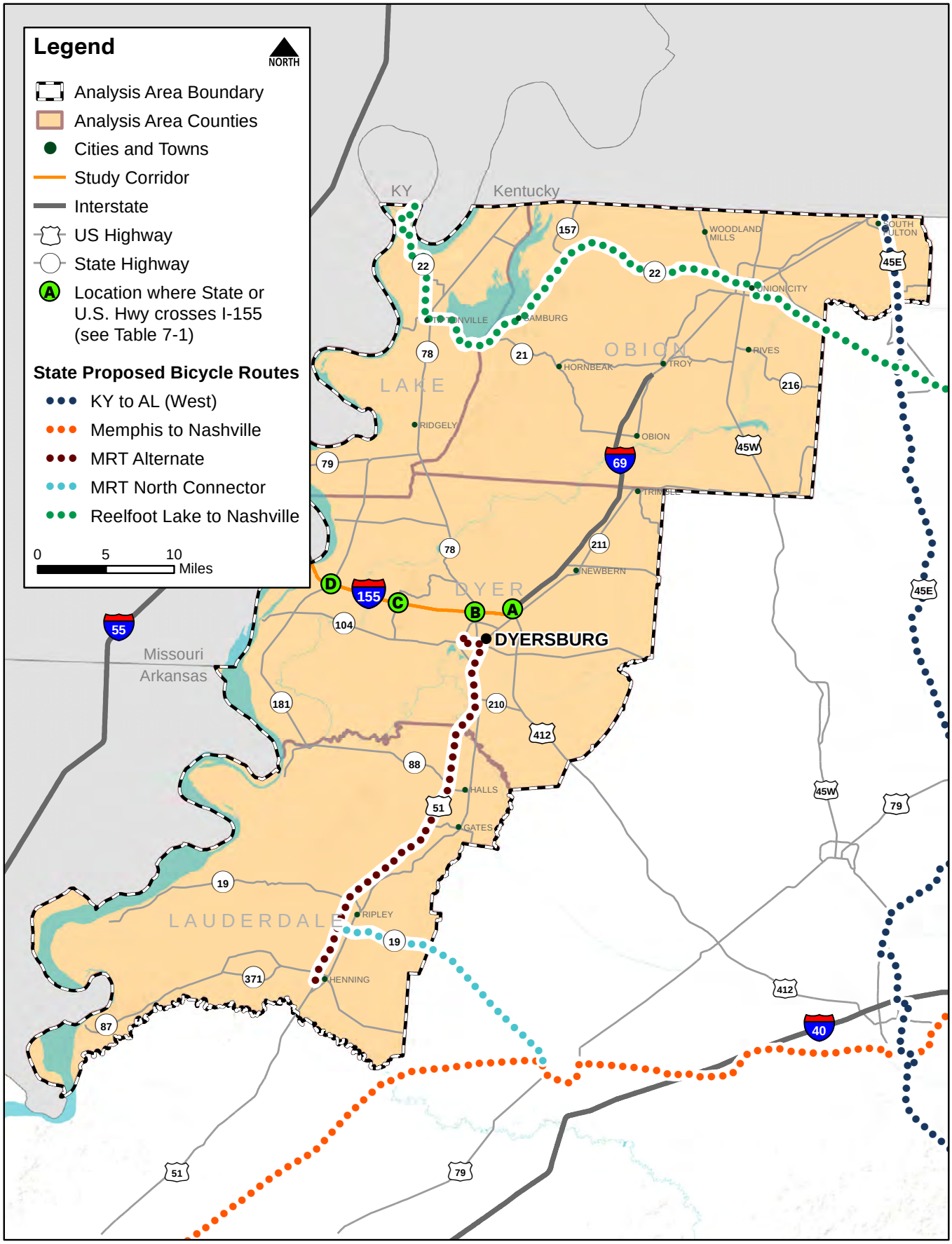
- Kentucky to Alabama (West)
- Memphis to Nashville
- MRT Alternate
- MRT North Connector
- Reelfoot Lake to Nashville

These planned state bicycle routes are proposed along existing U.S., state and county highways. The planned state bicycle routes within the I-155 corridor study area can be seen in Figure 7-1.

7.2 Bicycle and Pedestrian Connectivity Through Interchanges

Unless planned for ahead of time, geometric limitations created by Interstate structures often result in discontinuous pedestrian and bicycle accommodations on cross-streets through an interchange. Where bicycle lanes and sidewalk may be present on either side of the Interstate, the cross-section through the interchange may be limited to only vehicular traffic - discouraging multi-modal connectivity from one side to the other. Futhermore, ramp intersections often create bike lane and sidewalk paths that are difficult to navigate, and in some cases unsafe. As shown in Figure 7-1 and Table 7-1, I-155 interchanges with U.S. and state routes were evaluated to determine connectivity for pedestrians and bicyclists across the Interstate. Where pedestrian and bicycle accommodations existed on the cross-street, free-flow right turns at ramp interchanges were

Figure 7-1. Planned State Bicycle Routes and U.S./State Highway Crossings — I-155



Source: Tennessee Department of Transportation

Table 7-1. Locations Where a U.S. or State Highway Crosses I-155

Map Letter	State Route/U.S. Hwy Crossings	Crossroad AADT (2018)	Bicycle Lane/ Multi-Use Path?	Paved Shoulder >2'?	Sidewalk?	Free-Flow Right with Bicycle/Ped Facilities?
A	SR-20/US-412/SR-3/US-51	14,400 (W)*; 11,800 (S)**	Freeway-Style Facilities No Bicycle/Pedestrian Activity Allowed			
B	SR-78 (Lake Rd)	6,600 (N)***; 26,300 (S)	No	Yes	No	Yes
C	SR-182 (Lenox Nauvoo Rd)	1,000 (N)	No	No	No	N/A
D	SR-181 (Great River Rd)	600 (N); 700 (S)	No	Yes	No	No

* West approach; ** South approach; ***North approach

Source: TDOT Traffic History website, Google Earth

noted. While free flow right turns have operational benefits, the movement allows vehicles to maintain higher rates of speed off the ramp and through the intersection, putting pedestrians and bicyclists at a disadvantage. Motorists traveling at higher speeds are less likely to yield to pedestrians; and higher intersecting speeds are more difficult for bicyclists to judge and maneuver.

AADT on the cross-roads was also noted as the volume of traffic influences mobility for pedestrians and bicyclists. No interchanges on I-155 feature designated bicycle or pedestrian facilities on the cross road, although SR-78 and SR-181 have paved shoulders. SR-20 and SR-78 have traffic volumes in excess of 10,000 vpd.

7.3 Regional and Local Bicycle and Pedestrian Plans

There are no bicycle and pedestrian plans for communities adjacent to the I-155 corridor, including Dyersburg. The Town of Halls, located south of I-155, has the only official bicycle and pedestrian plan in the study area. While the I-155 study area is rural in nature, more bicycle and pedestrian plans could be used in order to ensure safe travel for all users. Key indicators for areas that would benefit from bicycle and pedestrian infrastructure include:

- One to three miles around population dense neighborhoods and activity centers (hospitals, schools, parks, etc.)
- Known areas with populations with no access to a car

Town of Halls

The Halls Pedestrian and Bicycle Plan was adopted in 2016. The purpose of the study was to identify, document and analyze existing needs and opportunities for bicycle and pedestrian infrastructure to support all transportation users. The plan inventoried existing sidewalks and their current condition. Although the Town of Halls has a good sidewalk network, much of it is in bad repair or doesn't meet current standards. The plan outlines priority areas and recommendations based on existing infrastructure. While the plan does recommend some bicycle facilities improvements, the main focus is on pedestrian accommodations[8].

7.4 Existing and Future Deficiencies and Needs

Improvements are needed to local and regional bicycle and pedestrian infrastructure in the I-155 study area. For example, accommodations could be improved on cross streets that intersect I-155, particularly through interchange areas in urban settings.

A. State Bicycle Routes: None of the proposed state bicycle routes intersect or run parallel (and in close proximity) to I-155. The proposed U.S. bicycle route along the Mississippi River, USBR45 would likely intersect I-155. At this time, a specific alignment has not been identified.

B. Regional and Local Bicycle and Pedestrian Plans: Few bicycle and pedestrian plans exist in the I-155 study area. The Town of Halls Bicycle and Pedestrian Plan outlines an overall lack of bicycle facilities and an existing sidewalk network that is in poor repair and not up to current standards. A larger emphasis on the importance of bicycle and pedestrian accommodations throughout the I-155 corridor is needed.

C. Interchange Connectivity: As development increases at interchanges with I-155, demand for safe, convenient pedestrian and bicycle facilities will grow. Commercial and residential land uses generate non-motorized trips. Improvements to freeway interchanges should include sidewalks, shared-use paths, and consideration for eliminating free-flow right turns.

8- Town of Halls Pedestrian and Bicycle Plan. Accessed 04/09/2019. https://www.tn.gov/content/dam/tn/tdot/long-range-planning/Halls_PedBike_Plan_Final.pdf

8. Transportation Demand Management

Transportation Demand Management (TDM) is a set of strategies that influence travel behavior to reduce single-occupancy (SOV) travel. Ranging from ridesharing, bicycling, teleworking, taking transit, car sharing and on-demand or real-time applications, TDM strategies redistribute commuter travel across a variety of alternatives and away from daily peak periods. TDM programs represent a flexible, low-cost way to engage residents, travelers, businesses and local governments in the effort to reduce commuter travel and the associated impacts on the community including traffic congestion and emissions.

Eligible TDM activities (defined by the Congestion Mitigation and Air Quality Improvement Program or CMAQ), range from traveler information services, shuttles, employer-based programming, parking initiatives, public education and outreach activities, telework promotion, transportation management associations (TMAs), carpool and vanpool services (ridematching, marketing, guaranteed ride home, subsidies), and car sharing. In addition, the use of technology directly intersects TDM and represents a significant opportunity to change travel behaviors. Examples of related technology include:

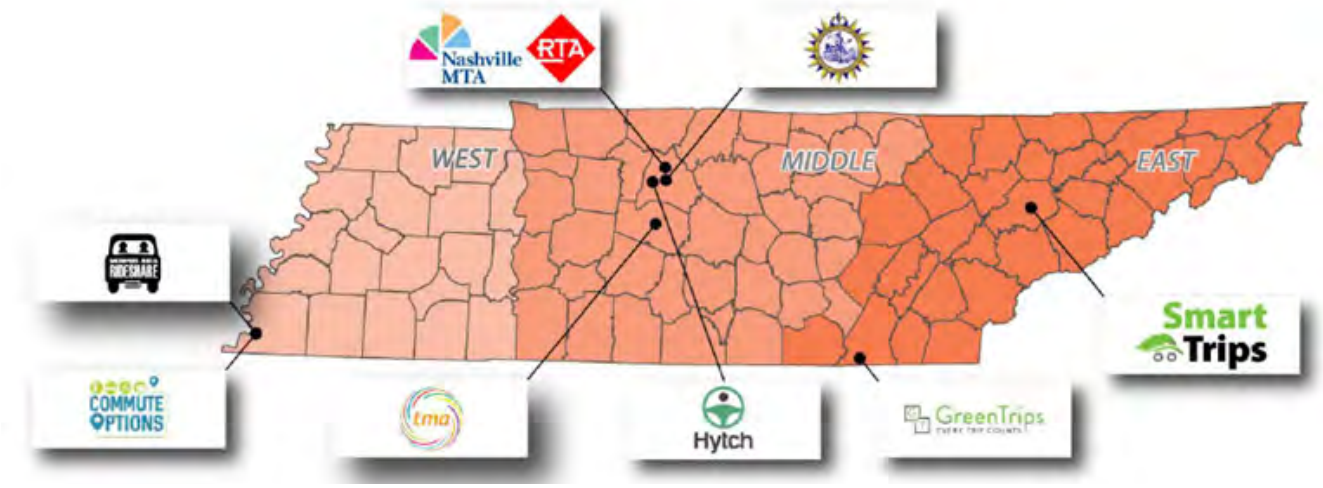
- Private sector mobile applications for ride booking that are supplementing and replacing traditional ridematching
- Services (e.g., Waze) that are integrating with local transportation agencies
- Connected and autonomous vehicles that will impact SOV travel and air quality
- Intelligent digital signage to encourage alternative mode use
- "Big data" sets including INRIX, AirSage, BlueTOAD, and StreetLight to further direct TDM efforts based on commuting patterns and origin/destination data
- The influence of Smart Cities on commute behavior and increasing throughput efficiency

TDOT developed a Statewide Transportation Demand Management (TDM) Plan in 2017. The plan provided a dynamic structure for trip reduction strategies suitable for immediate implementation, but flexible enough to accommodate the demands of future transportation and travel. The Plan positioned TDOT as the TDM program leader – connecting and coordinating regional TDM efforts with the local partners responsible for program implementation within each of the state's five urban areas (Figure 8-1).

TDOT's current 25-year Long-Range Transportation Plan Mobility Policy Paper established the foundation that the state's transportation system should encompass mobility options and travel choices that promote a strong transportation system connecting residents to jobs, schools, services and attractions. The Plan describes the provision of viable alternatives to the SOV as a central element of TDOT's vision of an efficient and effective multimodal transportation system. TDM represents low-cost alternatives that can help TDOT expand and enhance mobility, system efficiency, and environmental protection by reducing congestion and improving air quality.

The primary goal of statewide TDM programming is to reduce SOV travel by promoting alternative modes that include carpooling, vanpooling, taking transit, bicycling, walking, alternative work arrangements and on-demand or shared services. The Statewide TDM Plan is further supported through the following key objectives:

Figure 8-1. TDOT's Local Partners — Existing Programs



Source: 2017 TDOT Statewide Demand Management Plan

1. Decrease traffic congestion and air pollution
2. Support and enhance TDM programming in the state's five major urban areas
3. Increase customer access to programs and services
4. Streamline the administration and evaluation of TDM programming
5. Increase awareness and support for TDM initiatives in the state

The following six key recommendations resulted from the Plan. These recommendations were based on stakeholder engagement, commuter and employer surveying (statewide), and analysis of national best practices.

1. Introduce a standard Commuter Program structure
2. Establish a statewide TDM brand
3. Identify a statewide TDM coordinator (team)
4. Maintain core TDM services for regional implementation
5. Increase accountability
6. Develop standard operating procedures for administration of TDM projects

8.1 Mode Choice

Based on 2012-2016 U.S. Census data, 88.8% of commuter trips made within the four-county study area are single-occupancy vehicle trips. As shown in Table 8-1, 5.9% of trips are made by some form of rideshare, and only 0.2% are made by transit. The number of personal auto trips is higher and the number of rideshare and transit trips are significantly lower than Tennessee as a whole. This is expected given the predominantly rural nature of the study area. Nationally, the number of single-occupancy vehicle trips is lower and transit is higher. Note that Other Travel Modes includes "work-from-home," which is on the rise nationally. Table 8-1 also shows the mode split for a sampling of city-to-city origin and destinations.

There are currently no vanpool programs, HOV lanes, or park-and-ride facilities in the I-155 study area.

8.2 Existing and Future Deficiencies and Needs

The Statewide TDM Plan identified a number of ways regional TDM programs can support TDOT with managing mobility. They can also provide needed assistance on selected corridors when capacity is at a premium – especially during large construction projects. For example, in 2017, when a massive fire collapsed a bridge on heavily traveled I-85 in Atlanta, GA, it was clear that commuting patterns would be severely disrupted during reconstruction. Georgia Commute Options, Atlanta's TDM Program, worked with GDOT to help spread the word about the alternative travel options in the area (e.g., carpool, vanpool, transit, etc.) and worked with employers and employees to help manage the "chaos." Moving forward, TDOT should continue to work with the regional TDM programs to push more equitable multi-modal travel in the urban areas. The I-155 corridor does not currently contain an urban area TDM program. Given the low levels of congestion on I-155, a TDM program is a low priority for this area.

Table 8-1. Commuter Modal Split — I-155

Origin-Destination Pair	Single-Occupancy Vehicle	Rideshare (Car, Truck, Vanpool)	Transit	Other Travel Mode (Bicycle, Ped, Motorcycle, etc.)
Hayti, MO to Dyersburg	100.0%	0.0%	0.0%	0.0%
Halls to Dyersburg	96.2%	3.1%	0.0%	0.0%
Newbern to Dyersburg	100.0%	0.0%	0.0%	0.0%
Ridgely to Dyersburg	96.3%	3.0%	0.0%	0.0%
Study Area (4 Counties)	88.8%	5.9%	0.2%	5.0%
Tennessee	83.6%	9.1%	0.8%	6.5%
Nationwide	76.4%	9.3%	5.1%	9.1%

Source: U.S. Census Bureau (2012-2016)

9. Freight and Intermodal Facilities

This section summarizes the existing and future conditions of freight movement through the corridor. Freight facilities, including major freight generators and intermodal facilities, are described. In addition, the potential for diverting freight from the dominant mode – truck – to rail, air, or barge, is assessed.

The data used in this analysis include Transearch 2016 (current) and 2045 (forecast), and the Tennessee Statewide Travel Demand Model (base year 2010, forecast year 2040).

9.1 Freight Movement

Freight movement is an important element of a regional and national economy, as more efficient modes and routes enable improved logistics and result in reduced transportation costs. These cost savings can then be reallocated to growth, providing better jobs and higher wages in the area. The existing and future freight flows in the region were analyzed using the most current available data and information regarding existing and future conditions.

The I-155 corridor area encompasses Dyersburg, TN and surrounding counties, and is a connection to the approximate midpoint of the larger I-55 corridor that connects the Chicago, IL and Great Lakes regions in the north to LaPlace, LA at the southern terminus. Other important destinations along the I-55 corridor include St. Louis, MO, Memphis, TN, and Jackson, MS. LaPlace, at the southern end of the corridor, is the location of the Port of South Louisiana and the largest grain port in the U.S[9]. Figure 9-1 shows the forecasted truck volume growth in the I-155 corridor. Truck volumes are forecasted to double on I-155 over a 30 year period. Four grain elevators are located in the study area, taking advantage of the convenient barge access down the Mississippi River. Dyersburg is a small city with a population of nearly 17,000[10] and serves as an important centralized location for a larger rural population in northwest Tennessee, southeast Missouri, northeast Arkansas, and southwest Kentucky. With accessible transportation modes including Interstate, barge, rail, and air, the location has potential for growth, especially as the I-69 corridor plans for future extensions.

Table 9-1 shows the total tonnage and value of inbound and outbound freight in the I-155 corridor study area. As shown, truck is the predominant mode both in 2016 and in 2045 for the inbound and outbound directions. Air and rail freight make up a negligible portion of freight traffic, but both are projected to grow, though there is notably no inbound air cargo traffic. The inbound truck tonnage is estimated to grow by 0.7 percent while outbound is projected to grow faster at 0.9 percent, year over year. Truck value is projected to grow faster than tonnage in both directions[11].

Table 9-1. Inbound and Outbound Freight Volumes by Mode for 2016 and 2045 — I-155

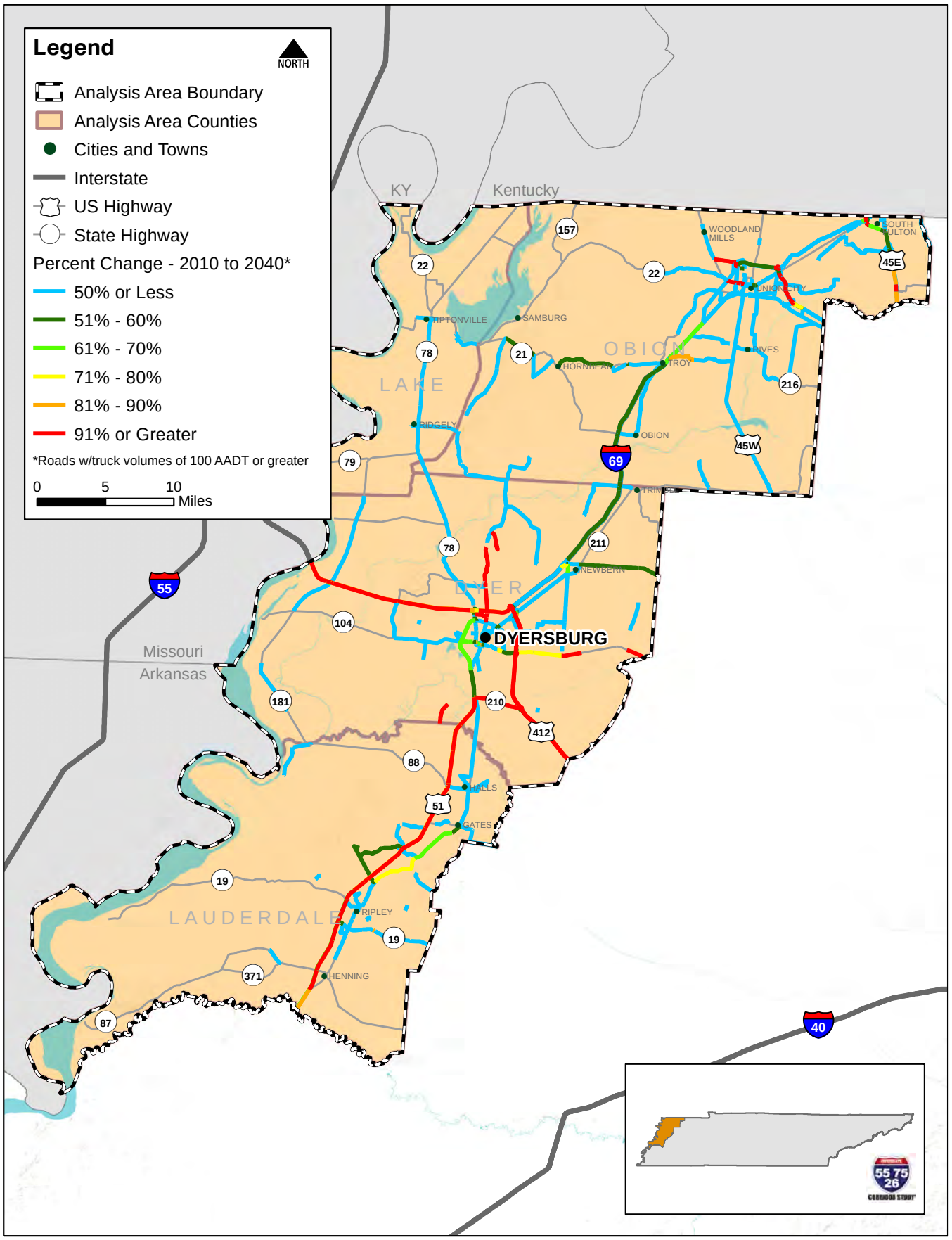
		2016		2045		% Growth CAGR*	
	Mode	Tons	Value	Tons	Value	Tons	Value
Inbound	Rail	2,419	$12M	5,053	$20M	2.6%	1.9%
	Truck	3,211,362	$1,500M	3,885,354	$2M	0.7%	1.1%
	Water	412,757	$164M	580,495	$213M	1.2%	0.9%
	Total	**3,626,538**	**$1,670M**	**4,470,903**	**$2,275M**	**0.7%**	**1.1%**
		2016		**2045**		**% Growth CAGR***	
	Mode	Tons	Value	Tons	Value	Tons	Value
Outbound	Air	7	$2M	23	$4M	4.3%	3.5%
	Rail	85,085	$234M	111,487	$278M	0.9%	0.6%
	Truck	2,432,082	$2,310M	3,142,067	$3,940M	0.9%	1.9%
	Water	1,052,789	$260M	1,336,168	$345M	0.8%	1.0%
	Total	**3,569,962**	**$2,800M**	**4,589,746**	**$4,560M**	**0.9%**	**1.7%**

*CAGR: Compound Annual Growth Rate

Source: Transearch (2016 and 2045)

9- Port of South Louisiana, Facts at a Glance, http://portsl.com/facts-at-a-glance/
10- Census 2017 ACS 5-year estimate, https://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml
11- Tennessee Department of Transportation, Interstate 69 Corridor, https://www.tn.gov/tdot/projects/region-4/interstate-69-corridor.html

Figure 9-1. Growth in Truck Volume from 2010 to 2040 — I-155



Source: Tennessee Statewide Travel Demand Model

9.2 Inbound and Outbound Freight Demand: 2016 and 2045

Inbound/Outbound Freight by Commodity

The top commodities shipped into and from the I-155 corridor study area are summarized using 2016 Transearch data. The data shown are limited to the top 15 commodities by tonnage and make up approximately 99 percent of the tonnage. Inbound and outbound, the largest commodity category is uncategorized freight or Other, which also includes tonnages outside of the top 15 commodities. Outside of Other, textile mill products, miscellaneous freight shipments, food or kindred products, farm products, leather lumber or wood products, and warehouse and distribution center make up much of the inbound and outbound tonnage. The top commodities inbound and outbound are largely similar and are dominated by truck mode. See Table 9-2 for the inbound commodities and Table 9-3 for the outbound commodities.

Truck Origins and Destinations by Entry and Exit Roads: 2016 vs. 2045

Using the Transearch database for 2016 and 2045, the data show that the majority of the region's truck traffic in terms of tonnage and value comes in from US-51, I-155, and I-40. Some commodities are coming into the corridor from as far as I-81 in the northeastern part of the state. However, the great majority of the region's inbound and outbound shipments are by modes other than truck (air, rail, or water), or by truck on other non-Interstate routes, and are included in the Other category in Table 9-4 and Table 9-5. Shipments from I-155 are growing the fastest with a 1.3 percent compound annual growth rate (CAGR) in tonnage. The value of goods coming from the I-75 corridor is growing the fastest at 1.9 percent per year. The I-59 corridor shows a negative growth rate from 2016 to 2045 in

Table 9-2. Inbound Freight Tonnage by Commodity, 2016 — I-155

Commodity	Total Tonnage	Share of Total Tonnage
Other	2,485,272	68.5%
Textile Mill Products	283,278	7.8%
Misc. Freight Shipments	278,254	7.7%
Farm Products	148,682	4.1%
Leather or Leather Products	145,161	4.0%
Warehouse & Distribution Center	91,758	2.5%
Coal	47,756	1.3%
Furniture or Fixtures	38,003	1.0%
Clay, Concrete, Glass or Stone	24,705	0.7%
Rail Intermodal Drayage to/ from Ramp	18,364	0.5%
Ordnance or Accessories	17,194	0.5%
Crude Petrol or Natural Gas	15,326	0.4%
Pulp, Paper or Allied Products	11,649	0.3%
Food or Kindred Products	10,706	0.3%
Lumber or Wood Products	10,431	0.3%
Grand Total	**3.63M**	**100.0%**

Source: Transearch (2016)

Table 9-3. Outbound Freight Tonnage by Commodity, 2016 — I-155

Commodity	Total Tonnage	Share of Total Tonnage
Other	2,770,650	77.6%
Food or Kindred Products	179,731	5.0%
Misc. Freight Shipments	148,055	4.1%
Lumber or Wood Products	105,813	3.0%
Leather or Leather Products	80,633	2.3%
Warehouse & Distribution Center	76,882	2.2%
Apparel or Related Products	71,655	2.0%
Rail Intermodal Drayage to/ from Ramp	52,203	1.5%
Machinery	33,801	0.9%
Farm Products	13,096	0.4%
Fabricated Metal Products	12,670	0.4%
Primary Metal Products	12,067	0.3%
Electrical Equipment	10,360	0.3%
Rubber or Misc. Plastics	1,357	0.0%
Furniture or Fixtures	989	0.0%
Grand Total	**3.57M**	**100.0%**

Source: Transearch (2016)

Table 9-4. Inbound Freight Tonnage and Value for 2016 and 2045 by Entry Road — I-155

		2016		2045		% Growth CAGR*	
	Entry Road	Tons	Value	Tons	Value	Tons	Value
Inbound	I-155	683,509	$317M	980,755	$416M	1.3%	0.9%
	I-24	24,115	$5M	34,282	$7M	1.2%	1.2%
	I-40	209,317	$200M	267,755	$291M	0.9%	1.3%
	I-55	147,058	$81M	162,046	$104M	0.3%	0.9%
	I-59	605	$1M	522	$1.M	-0.5%	-0.9%
	I-65	13,063	$4M	17,658	$5M	1.0%	0.9%
	I-75	35,623	$30M	49,766	$51M	1.2%	1.9%
	I-81	7,041	$6M	9,671	$8M	1.1%	1.1%
	US 51	1,350,236	$489M	1,459,368	$675M	0.3%	1.1%
	Other	1,155,970	$542M	1,489,081	$718M	0.9%	1.0%
	Total	**3.63M**	**$1.67B**	**4.47M**	**$2.28B**	**0.7%**	**1.1%**

*CAGR: Compound Annual Growth Rate

Source: Transearch (2016 and 2045)

Table 9-5. Outbound Freight Tonnage and Value for 2016 and 2045 by Exit Road — I-155

		2016		2045		% Growth CAGR*	
	Exit Road	Tons	Value	Tons	Value	Tons	Value
Outbound	I-155	283,566	$266M	398,673	$443M	1.2%	1.8%
	I-24	16,550	$3M	12,143	$3M	-1.1%	0.5%
	I-40	364,962	$609M	505,267	$1,140M	1.1%	2.2%
	I-55	203,671	$119M	411,459	$253M	2.5%	2.6%
	I-59	533	$0.07M	301	$0.04M	-2.0%	-1.8%
	I-65	3,409	$1M	4,014	$2M	0.6%	2.2%
	I-75	62,541	$122M	110,341	$230M	2.0%	2.2%
	I-81	21,215	$47M	39,430	$107M	2.2%	2.9%
	US 51	747,754	$746M	867,926	$1,250M	0.5%	1.8%
	Other	1,865,761	$892M	2,240,192	$1,140M	0.6%	0.8%
	Total	**3.57M**	**$2.8B**	**4.59M**	**$4.56B**	**0.9%**	**1.7%**

*CAGR: Compound Annual Growth Rate

Source: Transearch (2016 and 2045)

tonnage and value, but also represents a negligible share of the inbound totals. Table 9-4 lists the tonnage and value for inbound trade to Tennessee by the first road used within Tennessee, or the entry road used to enter Tennessee on its way to a destination in the I-155 corridor area.

For goods leaving the I-155 corridor, the same major Interstates are the destinations as the origins: I-155, I-24, I-40, I-55, I-59, I-65, I-75, I-81, and US-51. US-51 is the most heavily-used destination corridor for goods leaving the study area, followed by I-40. The growth in truck traffic using I-55 is the highest overall, at over two percent per year. Outbound tonnages and value of goods traveling on I-155 are growing by 0.9 percent per year and 1.7 percent per year, respectively. Two corridors, I-24 and I-59, show a negative growth rate, though they represent a negligible share of the tonnage and total value. The exit roads shown in Table 9-5 show the last route used by outbound freight from the I-155 corridor area within Tennessee or the route used to exit the state.

Through Truck Traffic: 2016 and 2045

The truck through traffic in the corridor was assessed using Transearch 2016 data and GIS software. The through tonnage was estimated by summing the tonnages found on roadway segments across the state while excluding the I-155 study area as an origin or destination. The remaining traffic is, therefore, neither originating nor destined to the corridor area and drives through.

Through traffic is important as it can make up a sizeable portion of the region's truck activity and therefore congestion in the corridor. Although through traffic is destined elsewhere and therefore does not have as large of a direct economic impact in the study area as originating or terminating traffic would, it does impact other regions and an efficient transportation network encourages more efficient deliveries and reduces shipping costs. In addition, the trucks traveling through the region may purchase services such as fuel, food, and lodging, making small but measureable impacts. As shown in Figure 9-2, the I-155 corridor in Tennessee shows high volumes of through truck traffic in 2016 in the range of 1 to 5 million tons. This is comparable with the volumes found along SR-51 and SR-412 in the area.

Of note, rail, water, and air would also have through traffic traversing the study corridor; however, data limitations do not allow for estimating or mapping these movements.

9.3 Intermodal Facilities: Air, Rail, Truck, and Water

The I-155 corridor study area has multimodal access and is an important gateway for cargos traveling between northwestern Tennessee and Missouri. I-155 is the only road connecting Tennessee and Missouri. The major air, rail, truck, and water facilities in the corridor area as well as the anticipated 2040 volume-to-capacity ratios for traffic along I-155 are shown in Figure 9-3.

Air

The Dyersburg Regional Airport (DYR) is a general aviation airport located 2 miles south of Dyersburg. Services include aviation fuel, aircraft ground handling and parking, passenger services, flight training, rental cars, and air freight. The air cargo services are low-volume, as indicated in Table 9-1[12].

Rail

There is one Class I and one shortline railroad operating in the corridor.

- Canadian National (CN) Class I railroad operates in the corridor from Memphis to Paducah, KY with a connection to the TennKen shortline in Dyersburg.
- Part of the West Tennessee Rail Group, the shortline railroad TennKen operates from Dyersburg to Hickman, KY and interchanges with CN in Dyersburg. The rail yard in Dyersburg provides services for the CN line including railcar storage and maintenance, plastics car drop-gate cleaning, and transloading[13].

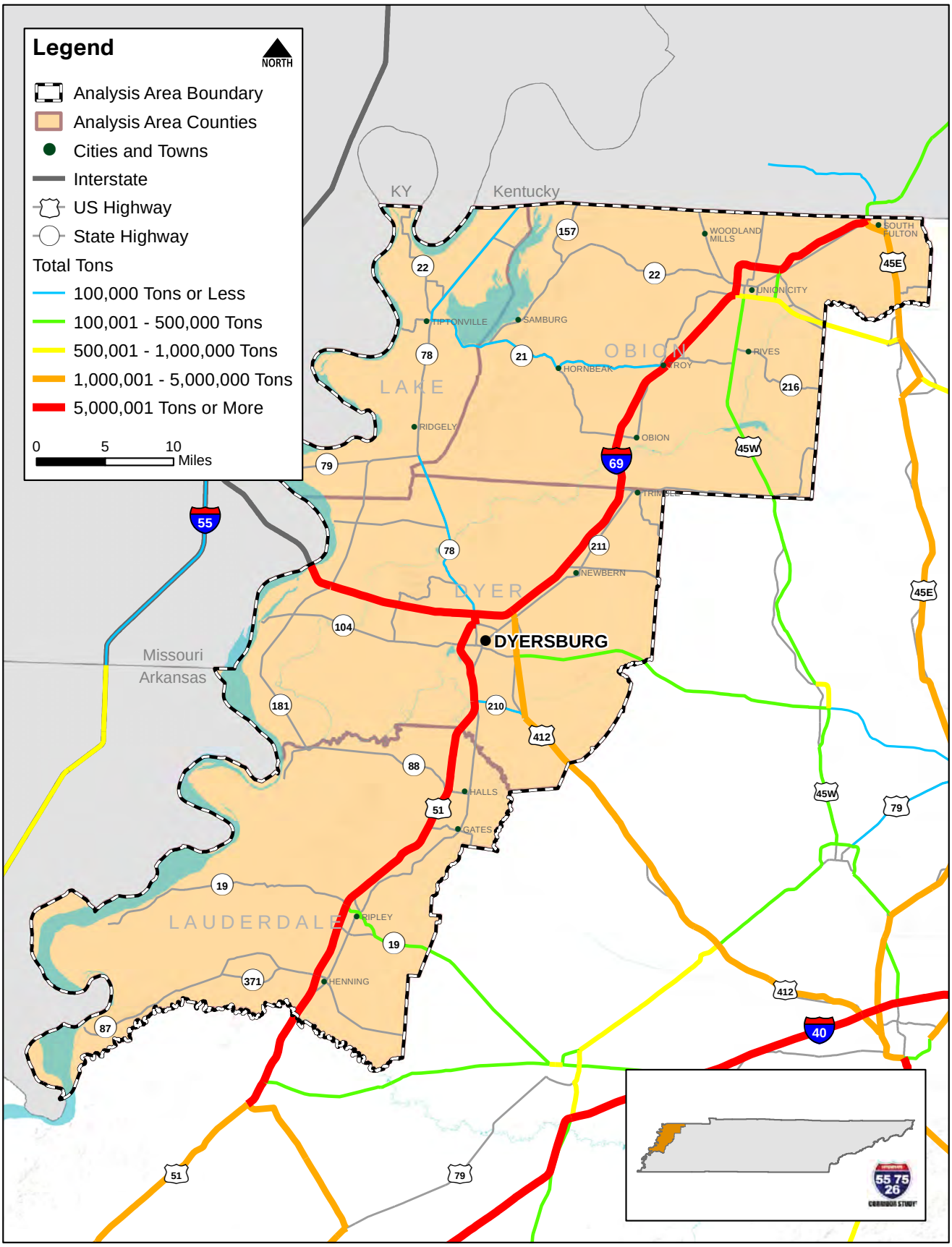
Truck

Freight generating facilities for trucks typically include industrial parks, of which there are two in the I-155 corridor area.

- The Dyersburg Industrial Park is located one mile from I-155 in Dyer County. The site has a former textile facility, a tool and dye shop, and other industry support services[14]. A number of other industrial facilities and manufacturing companies are located in the area as well.
- Dyersburg North Industrial Park is under development and adjacent to I-155 on 240 acres[15].

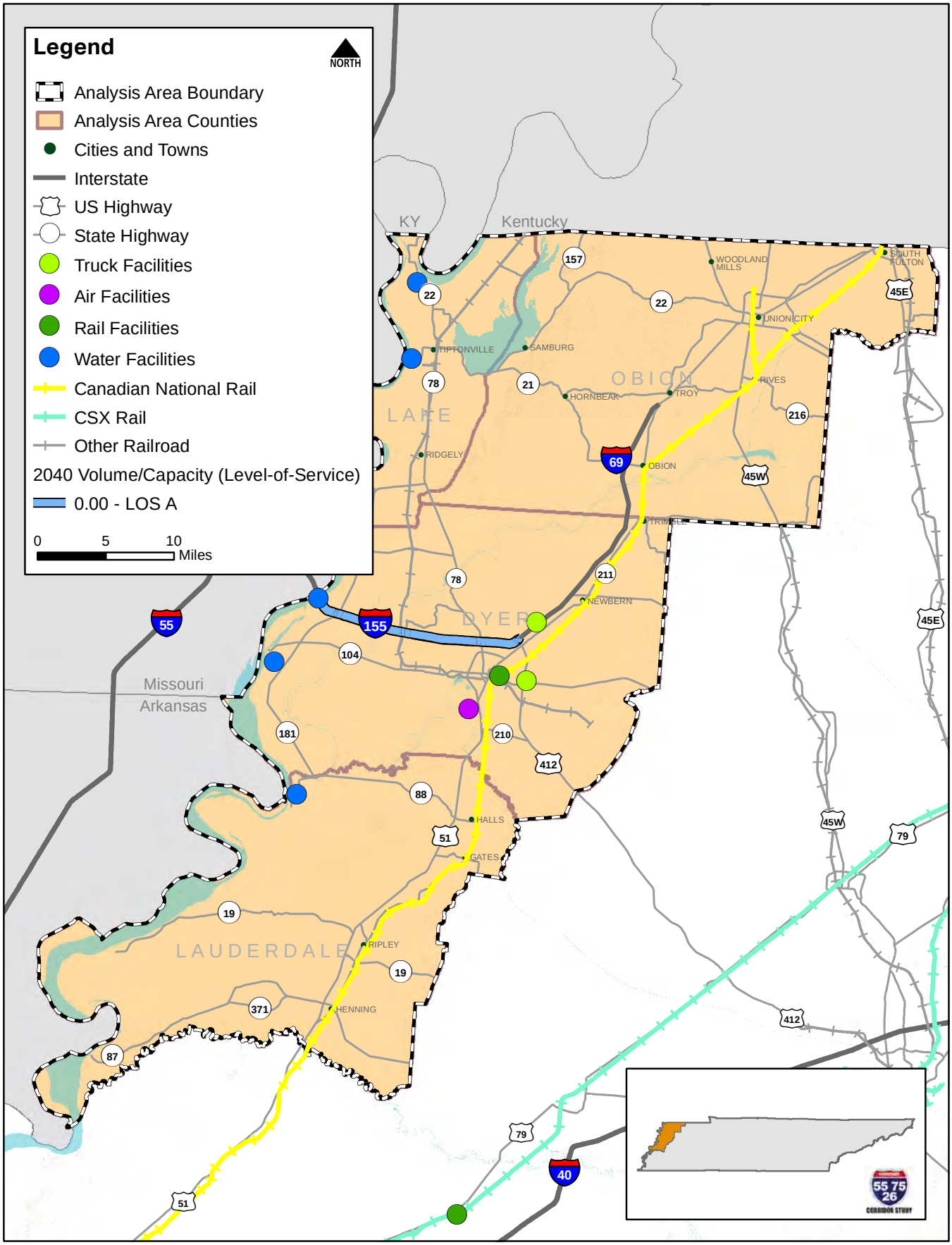
12- Dyersburg, Tennessee, Airport Services, https://www.dyersburgtn.gov/airport/airport_services.html
13- West Tennessee Rail Group, TennKen Railroad, https://www.wtnnrr.com/tennken
14- Preferred Southern Sites, Dyersburg: Northwest Tennessee's Regional Hub, http://archive.sb-d.com/archivesite/www.sb-d.com/issues/fall2004/advertisers/Dyersburg.html
15- Preferred Southern Sites, Dyersburg: Northwest Tennessee's Regional Hub, http://archive.sb-d.com/archivesite/www.sb-d.com/issues/fall2004/advertisers/Dyersburg.html

Figure 9-2. Through Truck Traffic Tonnage in the Study Area for 2016 — I-155



Source: Transearch (2016)

Figure 9-3. Freight Facilities — I-155



Source: InfoUSA and Tennessee Statewide Travel Demand Model

The Dyer Chamber of Commerce lists a number of manufacturing businesses in town[16], each of which sends out and receives shipments via truck. The largest employer listed is ERMCO, a distribution transformer manufacturer employing more than 1,000 located in the industrial park. The other large businesses include Dot Foods, Ford Asphalt Plant, Heckethorn Manufacturing, HEXPOL Compounding, NSK Steering Systems America, Inc., Nortek Global HVAC, PolyOne Corporation, and Rough Country Suspension, all of which have over 100 employees.

In addition to the truck generators within Dyersburg, Tyson Foods is constructing a new processing plant in Humboldt, TN, just outside of the corridor area. The facility, which includes a hatchery, feed mill, and processing plant, are all expected to be operational by the end of 2020. Expected to employ over 1,500, the facility expects to process 1.6 million chickens per week at full operations[17].

Water

Located along the Mississippi River, the corridor area has easy access to areas north and south of Tennessee, including the Gulf of Mexico and beyond. The water facilities located in the corridor area include: grain loading facilities and the Port of Cates Landing north of Dyersburg in Lake County.

Four grain loading facilities on the river are important export locations for the region's grain growers. Two facilities serve Gunge Grain with locations in Finley and Dyersburg, while two Cargill Grain elevators are located in Halls and Tiptonville.

Opened in 2013, the Port of Cates Landing is a new river port on the Mississippi north of Dyersburg[18]. Built at a cost of $55 million[19], the port offers loading and unloading, storage, and barge or truck transportation. The port boasts a strategic location at mile marker 900 and is situated above the 100-year flood plain. The access to the Gulf of Mexico is unimpeded by locks, allowing for year-round access to the site. In addition, the port does not require levee protection, and has a draft of 14 feet below the low water reference plain; however the Mississippi River is maintained with a navigation draft of nine feet, potentially limiting shipments from the Port of Cates Landing. Adjacent to the port is a 345-acre industrial park, and there are plans to extend highway and rail access to the site for future developments[20].

9.4 Freight Diversion: From Truck to Rail/Water/Air

Although the U.S. and Tennessee economies are much less dependent on goods production than they once were, shipping of finished and unfinished goods is still vital to the economic strength of the region. The dominant shipper locations are:

- Sites where the commodity is grown, logged, or mined
- Where it is processed or manufactured
- Distribution sites/centers where products and commodities are aggregated for more efficient shipment

Table 9-6 provides a basic overview of the relationship between some of the major industry sectors and their primary mode of goods movement, and the correlation between tonnage and value. As shown, products of low value and high tonnage are ideal for travel by water and rail, while truck and air modes typically carry lighter and more valuable cargoes. This section will assess the potential for shifting some shipments from truck to rail or air in order to increase highway capacity.

Table 9-6. Tonnage, Value, and Value per Ton for All Shipments Into, Out of, and Through Tennessee, 2016

	Total Tons	Total Value	Value per Ton
Air	0.166M	$23B	$139,028
Truck	44.5M	$82B	$1,852
Rail	1,870M	$1,810B	$968
Water	0.216M	$0.14B	$626
Total	**1.91B**	**$1.91T**	**$1,000**

Source: Transearch (2016)

16- Dyersburg Chamber of Commerce, Manufacturers Directory, https://www.dyerchamber.com/images/Manufacturer-Directory-for-Website.pdf
17- Friedman, Adam, Jackson Sun, "Tyson Foods facility in Humboldt is on track for December 2020, December 18, 2018, https://www.jacksonsun.com/story/news/2018/12/18/tyson-foods-humboldt-facility-open-end-2020/2282376002/
18- Ramsey, Austin, WKMS, "Cates Landing Opens in Impoverished Lake County," June 13, 2013, https://www.wkms.org/post/cates-landing-opens-impoverished-lake-county#stream/0
19- State Gazette, "Port Authority meets at Cates Landing," November 13, 2015, https://www.stategazette.com/story/2249994.html
20- Northwest Tennessee, "Port of Cates Landing is America's Newest Multimodal Inland Port," https://www.northwesttn.com/news-archive/67-port-of-cates-landing

Freight Diversion Potential: Existing Freight Volumes

Freight primarily travels in the I-155 corridor by truck, as evidenced by prior tables and figures. However, there is potential for some commodities to divert to other modes that are more cost-effective than truck. In order to assess which products could divert from truck, Transearch was used to summarize the existing (2016) volumes destined for (inbound) and originating from (outbound) the corridor. As shown in Table 9-7, the majority of the inbound commodities with diversion potential are coming into the corridor region by truck. Other modes have potential for diverting commodity traffic when their timing needs and handling needs are similar. Costs are typically related to the speed at which products need to get to the consumer, and as such air and truck are typically more expensive modes. Rail and water are slower modes that are better suited for products that do not have a short delivery window.

In order to assess the commodities for which this may be true, it was assumed that goods are potential candidates for diversions if they are currently transported by two or more modes for between 20 percent and 80 percent of the total tonnage. This range showcases that there is enough of a portion of product moving by more than one mode to indicate that the commodity's individual handling needs can be accommodated at different facilities. As shown in Table 9-7, there are limited inbound commodities with diversion potential in 2016. Table 9-7 shows that, for example, 80 percent of the tonnage for electrical equipment travels by truck and 20 percent by rail.

Table 9-7. Inbound Freight Diversion Potential, 2016 — I-155

Commodity	Rail	Truck	Water
Electrical Equipment	20%	80%	0%
Rubber or Misc. Plastics	73%	27%	0%

Source: Transearch (2016)

Because some of the electrical equipment is already moved by rail, it can be inferred that time is not as important of a factor in choosing the mode as cost for that share of the product. Therefore, there is potential for even greater volumes of electrical equipment to move by rail, freeing up valuable highway capacity for other commodity shipments and auto traffic. The majority of rubber or miscellaneous plastics already travel by rail, but there is still potential for additional tonnage to divert from truck to rail. It is important to note, however, that the commodity tonnages constitute a small share of the total tonnage handled in the corridor.

In addition to the inbound freight with diversion potential, Transearch was used to assess the outbound freight diversion potential in Table 9-8. A similar methodology was employed, selecting outgoing commodities that ship 20 to 80 percent of their tonnage by multiple modes. More commodities show potential for diversion in the outgoing direction than incoming, and a greater portion of outbound shipments are by rail than the inbound direction. There is also potential for diverting additional tonnage to water thereby reducing truck congestion in the I-155 corridor.

Table 9-8. Outbound Freight Diversion Potential, 2016 — I-155

Commodity	Rail	Truck	Water
Apparel or Related Products	20%	80%	0%
Fabricated Metal Products	48%	48%	4%
Primary Metal Products	1%	64%	34%
Electrical Equipment	79%	19%	2%
Rubber or Misc. Plastics	45%	55%	0%
Chemicals or Allied Products	53%	47%	0%
Textile Mill Products	73%	27%	0%
Misc. Manufacturing Products	12%	19%	68%

Source: Transearch (2016)

Freight Diversion Potential: Freight Volume Projections

The potential for future volumes to divert from truck to rail or water was assessed using the Transearch database's 2045 projections for the study area. Using a similar methodology as for the existing freight volumes, the top inbound and outbound commodities that are transported by multiple modes were summarized in Table 9-9 and Table 9-10. The two modes between which the commodity is shipped are highlighted to indicate the potential for diversion. As with the 2016 inbound data, electrical equipment and rubber or miscellaneous plastics could divert from truck to rail. More commodities in the outbound direction have potential to divert in 2045 than the inbound direction, and the outbound direction also includes commodity movement by rail for clay, concrete, glass or stone. Most commodities, however, could switch from truck to rail.

Table 9-9. Inbound Freight Diversion Potential, 2045 — I-155

Commodity	Rail	Truck	Water
Electrical Equipment	28%	72%	0%
Rubber or Misc. Plastics	73%	28%	0%

Source: Transearch (2045)

Table 9-10. Outbound Freight Diversion Potential, 2045 — I-155

Commodity	Air	Rail	Truck	Water
Chemicals or Allied Products	0%	54%	47%	0%
Clay, concrete, glass Or Stone	68%	32%	0%	0%
Electrical Equipment	0%	73%	23%	3.6%
Fabricated Metal Products	0%	35%	63%	2.8%
Misc. Manufacturing Products	0.2%	18%	22%	60%
Primary Metal Products	0%	1.3%	64%	35%
Rubber or Misc. Plastics	0%	37%	63%	0%
Textile Mill Products	0%	73%	27%	0%
Other	0%	0.7%	58%	41%

Source: Transearch (2045)

9.5 Truck Parking

Truck parking facilities in the region are both public and private. As shown in Figure 9-4, there is one private stop on I-155 for truck drivers to stop and rest or sleep overnight and one public stop off the corridor. With Hours of Service regulations that mandate rest periods and the number of hours of consecutive work that are allowed without sleeping[21], it is important that drivers are offered a selection of locations throughout their journey where they can rest and possibly eat, shower, and sleep overnight. Without proper rest, drivers risk fines and crashes.

9.6 Other Emerging Freight Issues

As the U.S. economy continues to shift towards a services focus[22], more finished goods will need to be shipped in from other parts of the world that have greater manufacturing strengths. The demand for just-in-time purchases through e-commerce will only increase, placing further pressure on I-155 and other study area highways as goods are delivered to ports on the Gulf, East, and West Coasts and trucked, barged, or railed inland to Tennessee and elsewhere.

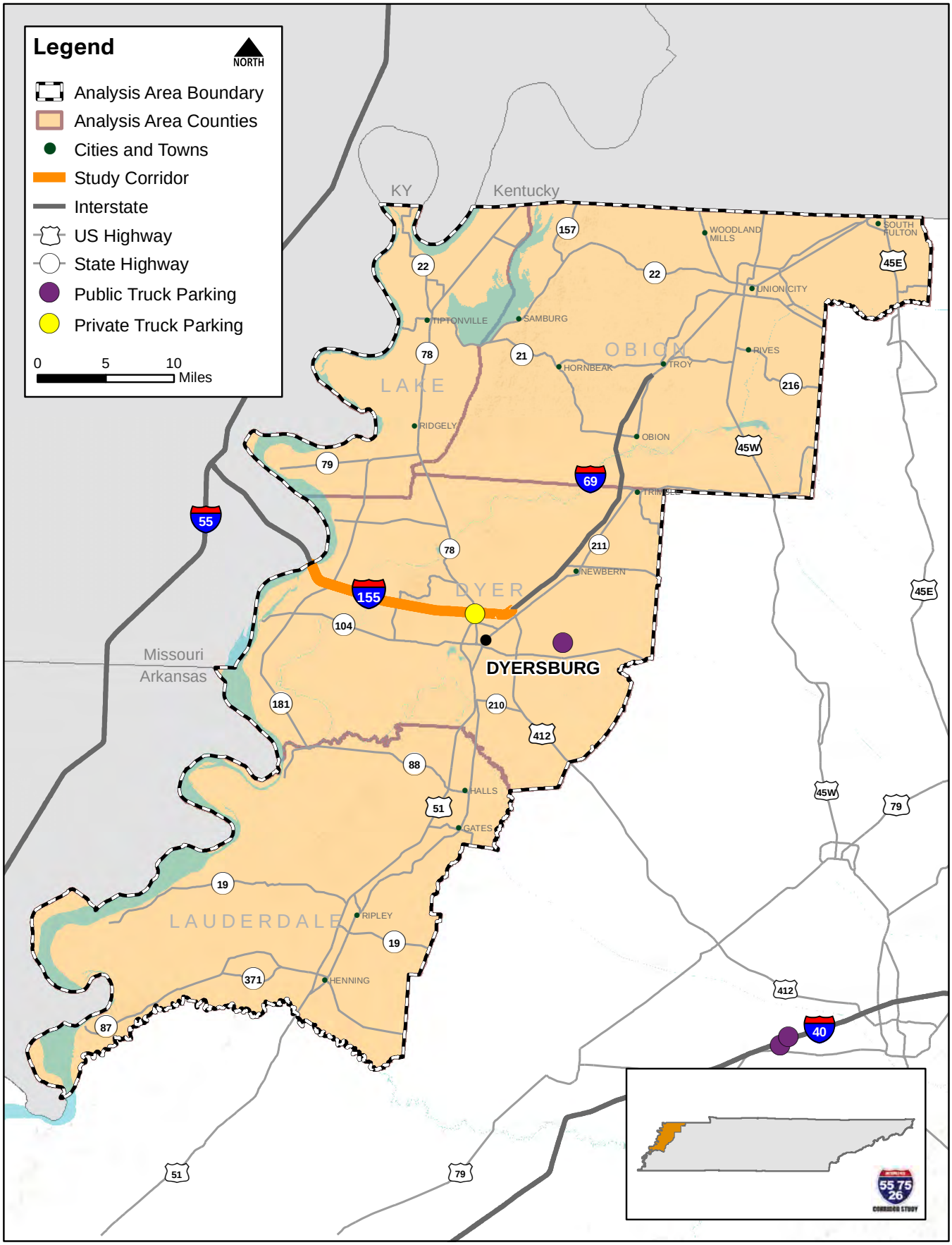
E-Commerce

E-commerce is the economy of transactions online, including the buying and selling of products. The e-commerce platform has exploded in recent decades with the introduction of companies like eBay and Amazon that sell and transport goods to purchasers with predictable delivery windows. Over time, e-commerce has increased further with the advent of social media, as customers enjoy the convenience of shopping from home no matter the time of day, the ability to price compare and read reviews, and ultimately have the product shipped directly to their doorstep. Brick and mortar retailers including giants like Walmart and Target have felt the pressure to also include online stores to keep up with consumer demands, and while online sales worldwide are increasing as a share of the overall retail economy, the year to year growth of ecommerce sales has slowed from 25 percent in 2015 to a projected 19 percent by 2020, as shown in Figure 9-5.

While e-commerce growth may be slowing down, it is unlikely the market is going anywhere anytime soon. As a result, the nation's infrastructure network has had to accommodate the increase in truck traffic that is used to ship the products in the common two day delivery window offered by Amazon and others. A recent study by the American Transportation Research Institute (ATRI) notes that ecommerce is changing the way retailers do business and affecting distribution networks and the trucking industry on the whole[23]. Trucking distances are decreasing on average from 800 miles in 2000 to 500 miles in 2018 as companies build more distribution centers. These regional distribution centers are being constructed especially in the Midwest to take advantage of multiple transportation modes and the accessibility to large population concentrations. For example, Amazon's Tennessee distribution and fulfillment facilities are in Memphis,

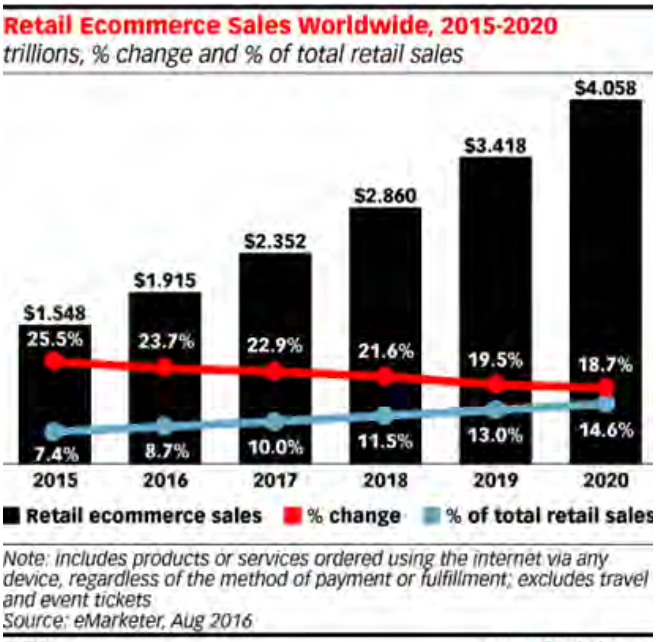
21- Federal Motor Carrier Safety Administration, Summary of Hours of Service Regulations, March 9, 2017, https://www.fmcsa.dot.gov/regulations/hours-service/summary-hours-service-regulations
22- The Atlantic, "The American Economy is Experiencing a Paradigm Shift," https://www.theatlantic.com/sponsored/citi-2018/the-american-economy-is-experiencing-a-paradigm-shift/2008/
23- https://www.ccjdigital.com/atri-e-commerce-reshaping-trucking-industry-operations/

Figure 9-4. Truck Rest Areas in the Study Area (Public and Private) — I-155



Source: InfoUSA

Figure 9-5. Retail E-Commerce Sales Worldwide, 2015-2020



Source: Ecommerce Guide, "What is Ecommerce?" https://ecommerceguide.com/guides/what-is-ecommerce/

Nashville, and north of Cleveland, TN, and Walmart distribution centers are in Memphis, south of Nashville, and northeast of Knoxville. Last-mile fulfillment centers are becoming increasingly important and represented 73 percent of the industrial real estate market in 2017, a growth of 15 percent from 2016.

All of these changes to the dynamic of the retail market have resulted in demands on the trucking industry and therefore the highway network. Driver shortages, hours of service regulations, driver retention, and scarcity of truck parking are all issues that have developed along with the growth in ecommerce. The trucking industry will continue to evolve and respond to consumer demands while the nation's aging infrastructure is expected to accommodate the growth in truck traffic that comes with it[24].

MARAD M-55 Project

In April 2019, the USDOT Maritime Administration (MARAD) awarded $3.15 million to the Port of New Orleans for a Baton Rouge-New Orleans Shuttle on the M-55, the marine highway along the Mississippi River. The project would expand the Container on Barge Service offered at the two ports and provide the funds to buy vessels specifically for use in this service. The project would help divert trucks from the highway to M-55 along the southern portion of the I-10 corridor[25]. Although not directly related to the I-155 corridor, expanded barge capacity in the Mississippi River could extend north with new intermodal facility construction or development of existing facilities, thereby extending the region of influence of the container shuttle and removing additional trucks from the region's roads.

9.7 Existing and Future Deficiencies and Needs

Truck is the primary mode of transporting freight in the I-155 corridor, accounting for nearly 88 percent of inbound and 68 percent of outbound freight in the study area in 2016. Truck volumes are expected to grow by at least 91 percent from 2010 to 2040 as shown in Figure 9-1. The corridor sees high volumes of through traffic with over five million tons annually, but notably the corridor is expected to operate at LOS A in 2040. As a result, there are no bottlenecks or anticipated challenges for truck freight in the corridor. There are opportunities nearby for using the Mississippi River to transport goods, especially grain, and there are rail and air facilities in Dyersburg. The corridor lacks many public and private truck parking facilities. In addition, as noted in Section 9.4, there are few opportunities for commodities to divert away from truck to rail in the inbound direction, but there are more options in the outbound direction.

As noted in the Tennessee Statewide Multimodal Freight Plan (2018), a project that could impact the I-155 study area is the potential expansion of I-69.

A. Statewide Projects: Proposed projects as found in the Tennessee Freight Plan include[26]:

- Conduct a location and environmental study from south of Dry Hill Road to I-155. The project is partially funded by the IMPROVE Act but is not part of the National Highway Freight Network (NHFP) or Critical Freight Corridors (CFC).
- Project W-44 would create a new 4-lane interstate segment of I-69 from I-69 in Memphis to I-155. The project is estimated to cost $959 million and would benefit economic efficiency, productivity, and competitiveness, reduce congestion, and require multistate coordination. It is not located on the NHFP/CFC but is a high priority project for the state.

B. Bottleneck Locations: The Tennessee Freight Plan lists 32 potential bottleneck locations statewide based on level-of-service and truck speed data. However, no bottlenecks are noted on I-155.

24- Lockridge, Deborah, Truckinginfo.com, "How is the Growth of E-Commerce Affecting Trucking?" February 5, 2019, https://www.truckinginfo.com/324451/how-is-the-growth-of-e-commerce-affecting-trucking
25- American Association of State Highway Transportation Officials, "MARAD Provides $6.79M for Three Marine Highway Projects," April 26, 2019, https://aashtojournal.org/2019/04/26/marad-provides-6-79m-in-grants-for-three-marine-highway-projects/
26- Tennessee Department of Transportation, Tennessee Statewide Multimodal Freight Plan, 2018, https://www.tn.gov/content/dam/tn/tdot/long-range-planning/TDOT_FreightPlan_02.27.18.pdf

I-75 Corridor

▶Assessment of Existing and Future Deficiencies

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I-75 Corridor

1. Introduction

The I-75 corridor serves as a backbone for economic development and growth in the region. As population and employment continue to grow, new travel demands place pressure on the Interstate as well as parallel and intersecting highways. This results in increased traffic congestion, travel times, and conflicts, which threaten the corridor's ability to sustain future growth.

A previous technical memorandum (Technical Memorandum 1) for this study provided a data and information inventory for the corridor. This technical memorandum (Technical Memorandum 2) assesses existing and future deficiencies and needs along the I-75 corridor by examining transportation issues including land use, economic development, highway capacity, travel demand, safety, Intelligent Transportation Systems (ITS), freight, transit, and non-motorized travel. An assessment of these topics will help identify ways to improve safety and enhance transportation services throughout the corridor.

This analysis focuses on the trend scenario for the I-75 corridor, which predicts existing and future conditions if current practices, plans, and policies remain unchanged. To supplement the technical analysis, public workshops and surveys were used to generate feedback from citizens and stakeholders located throughout the corridor.

1.1 Defining the Trend Scenario

The trend scenario establishes the existing and projected transportation conditions along the I-75 corridor and serves as the baseline for identifying needs and, ultimately, proposed improvements. The 2010 and 2040 Tennessee Statewide Travel Demand Model (TSM) trend scenarios were originally developed by the Tennessee Department of Transportation (TDOT) in 2017 (Phase 3/Version 3). As part of this study, the trend scenarios were updated and validated based on the following:

- Population and employment data and projections from Woods and Poole Economics, Inc.
- Projects currently programmed for construction in TDOT's Statewide Transportation Improvement Program (STIP)
- Projects currently programmed for construction in the Cleveland Metropolitan Planning Organization's (MPO) Transportation Improvement Program (TIP); the Chattanooga/Hamilton County/North Georgia Transportation Planning Organization's (TPO) TIP; and the Knoxville Regional TPO's TIP (all FY2017-2020)
- Recent MPO travel demand model projections of socioeconomic data, traffic volumes, and travel times

Figure 1-1. Study Corridors

The I-75 corridor is being studied as part of a larger corridor study that also includes I-55, I-155, and I-26.

- Recent Transearch freight data and projections

Additional detail regarding model validation and updates can be found in separate technical memoranda ("TN Corridor Study – Trend Scenario Memo" and "TN Corridor Study – Model Documentation Memo") prepared for this study.

Table 1-1 shows the programmed projects included in TDOT's FY2017-2020 STIP, the Cleveland MPO's FY2017-2020 TIP, the Chattanooga Transportation Planning Organization's (TPO) FY2017-2020 TIP, and the Knoxville Regional TPO's FY2017-2020 TIP. Figures 1-2 and 1-3 show all of the projects included in Table 1-1. Of these projects, major capacity and interchange projects for which funding has already been allocated are included in the 2040 "Existing plus Committed (E+C)" network for the updated 2040 trend scenario.

Table 1-1. Corridor Programmed Projects* — I-75

	Figure 1-1 ID	Route and Project Limits	Improvement	Cost	Year	Lead Agency/ Funding Type	TIP# or STIP#
Cleveland MPO FY 2017-2020 TIP	1	Adkisson Dr (Norman Chapel Rd to Paul Huff Pkwy)**	Widen from 2 to 3 lanes	$3,000,000	2019-2020	City of Cleveland/ U-STBG	TIP # 2013-05
	2	Cleveland MPO Area	Transit operations	$5,700,000	2017-2020	CUATS/5307	TIP # 2017-02
			Transit capital purchases	$551,000	2017-2019	CUATS/5310/5339	TIP # 2017-03
	3	I-75 From Near Interchange 33 (SR-308) to Near Bradley/ McMinn Co Line	Widen I-75 from 4 lanes to 6	$26,624,000	201-2020	IMPROVE ACT	TIP #1733025
Chattanooga TPO FY2017 - 2020 TIP	4	ADA Paratransit	Non-Fixed-Route ADA Paratransit Services	$1,600,000	2017-2020	CARTA/5307	TIP # CPARATRANSIT
	5	SR-317 (Adamson Cir to west of Bonnyshire Dr)**	Widen from 2 to 4 lanes	$20,700,000	2019	TDOT/NHPP	TIP # 33050
	6	Goodwin Rd (Gunbarrel Rd to Hamilton Place Blvd)	New 4 lane roadway	$19,091,000	2018-2020	Chattanooga/ STBG-M	TIP # GOODWIN
	7	I-75 from north of SR-2 to near SR-311	Widen from 4 to 6 lanes	$116,900,000	2017-2020	TDOT (IMPROVE Act)	TIP # 1733025
	8	I-75 at Hamilton Place Mall Interchange	Interchange Improvements - Expand to Full-Access Facility	$49,500,000	2017-2020	TDOT (IMPROVE Act)	TIP # 1733015
	9	I-75 at I-24	Interchange Improvements - Widen I-75 and I-24, New Bridges	$149,700,000	2017-2020	TDOT (IMPROVE Act)	TIP # 33020

* Table is continued on next page

** These projects are modeled in the 2040 trend scenario.

Source: Cleveland MPO, Chattanooga TPO and Knoxville Regional TPO FY2017-2020 TIPs; Tennessee FY2017-2020 STIP

U-STBG = Urban Surface Transportation Block Grant

NHPP = National Highway Performance Program

STBG-M = Metropolitan Surface Transportation Block Grant

Table 1-1. Corridor Programmed Projects (continued) — I-75

	Figure 1-1 ID	Route and Project Limits	Improvement	Cost	Year	Lead Agency/ Funding Type	TIP# or STIP#
Knoxville Regional TPO FY 2017 - 2020 TIP	10	Papermill Dr (Weisgarber Rd to Kingston Pk)	Reconstruct with turn lanes and bicycle/ped facilities	$18,492,000	2020	City of Knoxville/ L-STBG	TIP # 17-2017-015
	11	Farragut Advanced Traffic Management System Phase 1	Upgrade signal system to centrally controlled system	$2,925,000	2017-2019	Town of Farragut/ CMAQ	TIP # 17-2017-024
	12	KAT Route 22	BRT bus stops/ Passenger Information Systems	$6,395,000	2017-2019	City of Knoxville/ CMAQ	TIP # 17-2017-028
	12	TPO PlanningArea - Section 5307 Funds	Transit funding	$34,246,000	2017-2020	City of Knoxville/ Section 5307	TIP # 17-2017-200
	12	TPO Planning Area - Section 5310 Funds	Transit funding	$4,543,000	2017-2020	TPO/MPC/Section 5310	TIP # 17-2017-201
	12	City of Knoxville - Section 5339 Funds	Transit funding	$3,050,000	2017-2020	City of Knoxville/ Section 5339	TIP # 17-2017-202
	12	TPO Planning Area - Smart Trips Ridesharing Program	Rideshare operation	$494,000	2018-2020	TPO/MPC/CMAQ	TIP # 17-2017-209
	13	I-75 from near SR-131 to near SR-170 (Raccoon Valley Rd)**	Widen from 4 to 6 lanes	$98,000,000	2017-2020	TDOT (IMPROVE Act)	TIP # 17-2017-056
TN STIP FY 2017 - 2020	14	SR-63 (SR-297 to west of Stinking Creek Rd) (Campbell County)	Construct truck climbing lane and intersection improvements	$6,025,000	2019	TDOT/STBG	STIP # 1707015
	15	I-75 from Near MM 135 to Near MM 160 (SR-9)	ITS Expansion	$11,400,000	2019	TDOT/NHPP	STIP # 1707040
	16	Interchange at SR-30 and SR-305	Interchange improvements	$2,000,000	2017-2018	TDOT/NHPP	STIP #1754005
	17	I-75 from near MM109.6 to near SR-61	ITS Expansion	$3,600,000	2017-2020		00471075176
	18	I-75 at SR-61 Interchange	Install ITS Instrumentation + Communications	$500,000			17011075444
	19	I-75 Interchange at I-640/I-275 (Sharps Gap)**	Interchange Reconstruction	$88,000,000	201-2020	TDOT (IMPROVE Act)	00471075173

** These projects are modeled in the 2040 trend scenario.

Source: Cleveland MPO, Chattanooga TPO and Knoxville Regional TPO FY2017-2020 TIPs; Tennessee FY2017-2020 STIP

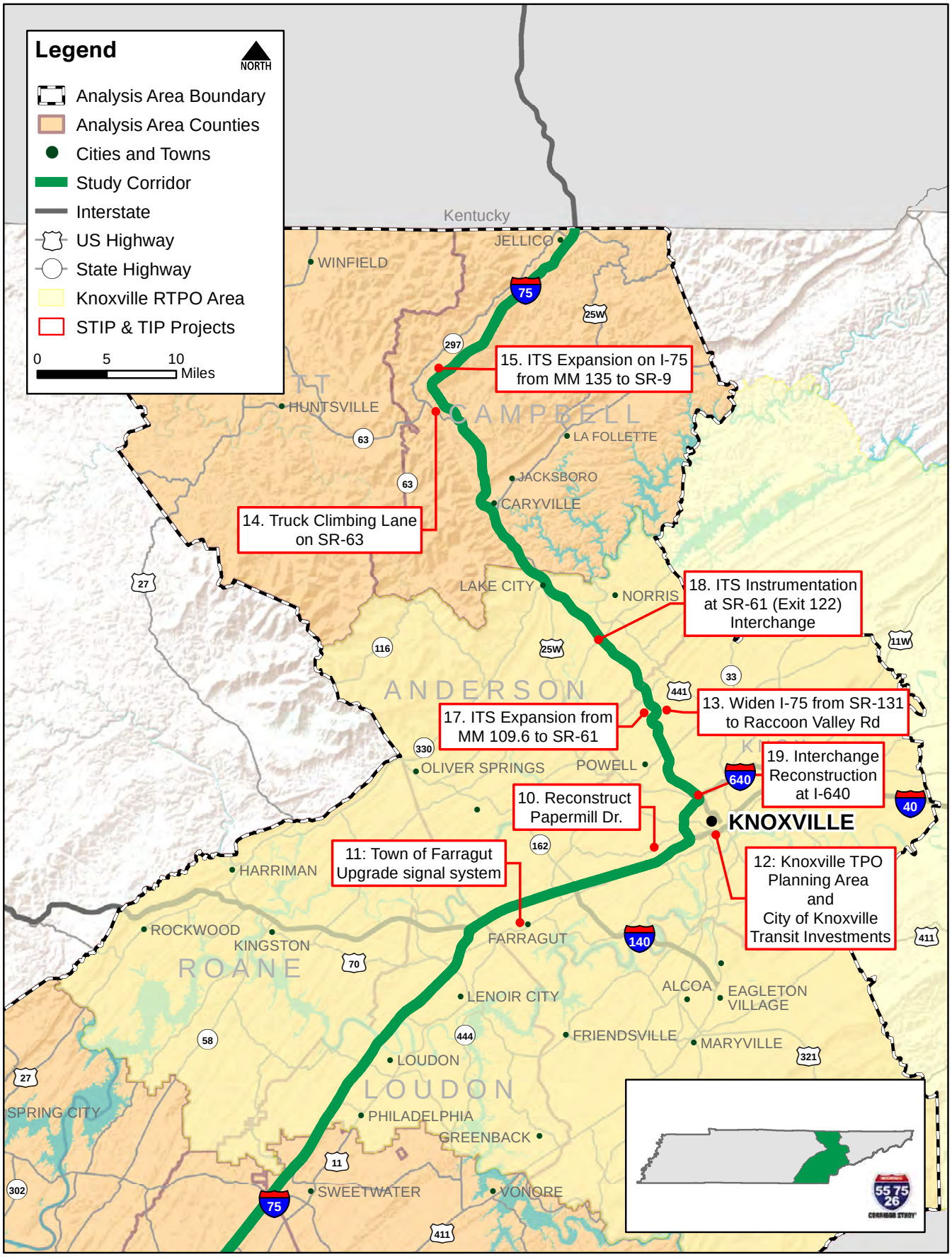
L-STBG = Local Surface Transportation Block Grant

CMAQ = Congestion Mitigation and Air Quality Improvement

MPC = Knoxville-Knox County Planning Commission (formerly known as Metropolitan Planning Commission)

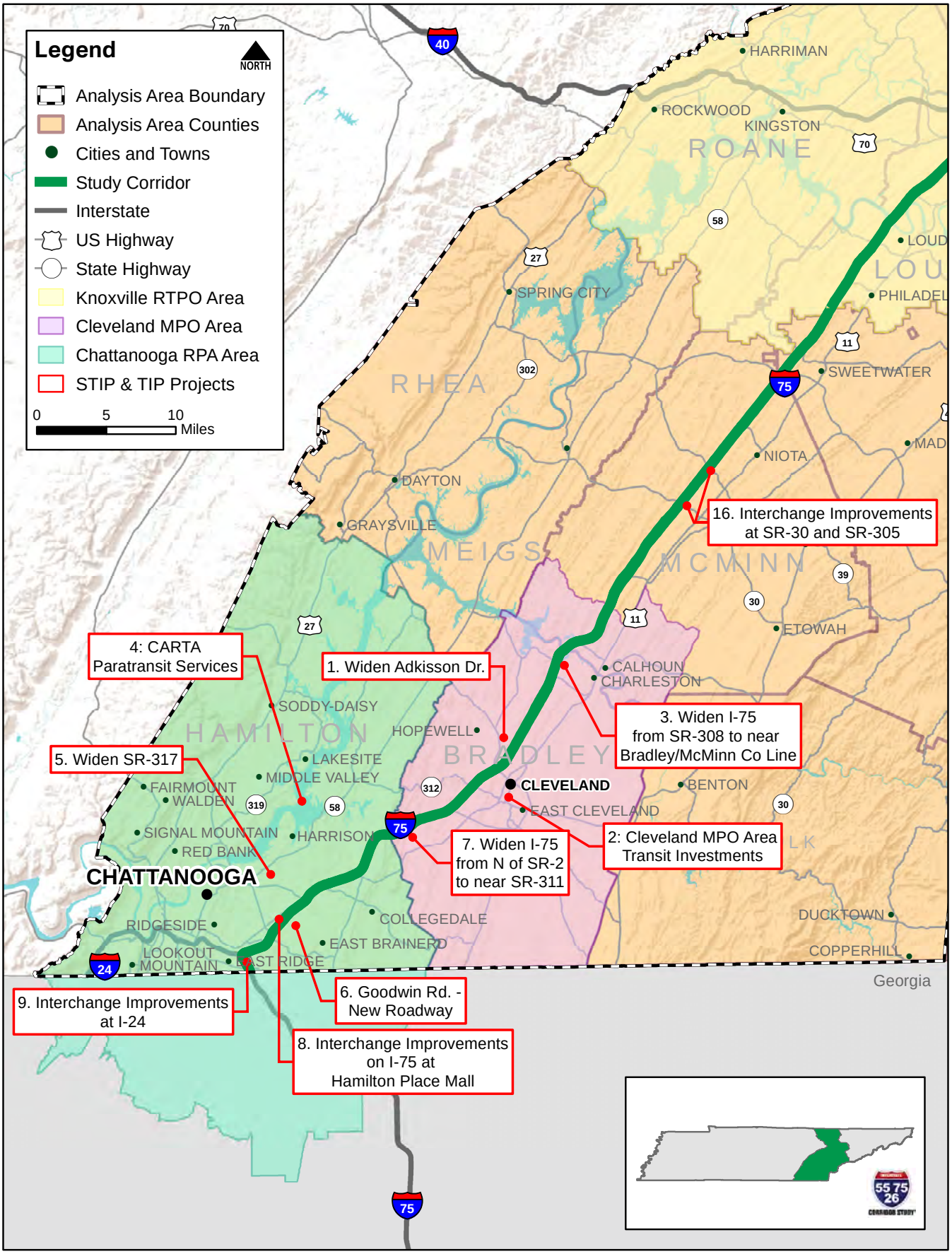
NHPP = National Highway Performance Program

Figure 1-2. Corridor Programmed Projects — I-75 (north)



Source: Cleveland MPO, Chattanooga TPO and Knoxville Regional TPO FY2017-2020 TIPs; Tennessee's FY2017-2020 STIP

Figure 1-3. Corridor Programmed Projects — I-75 (south)



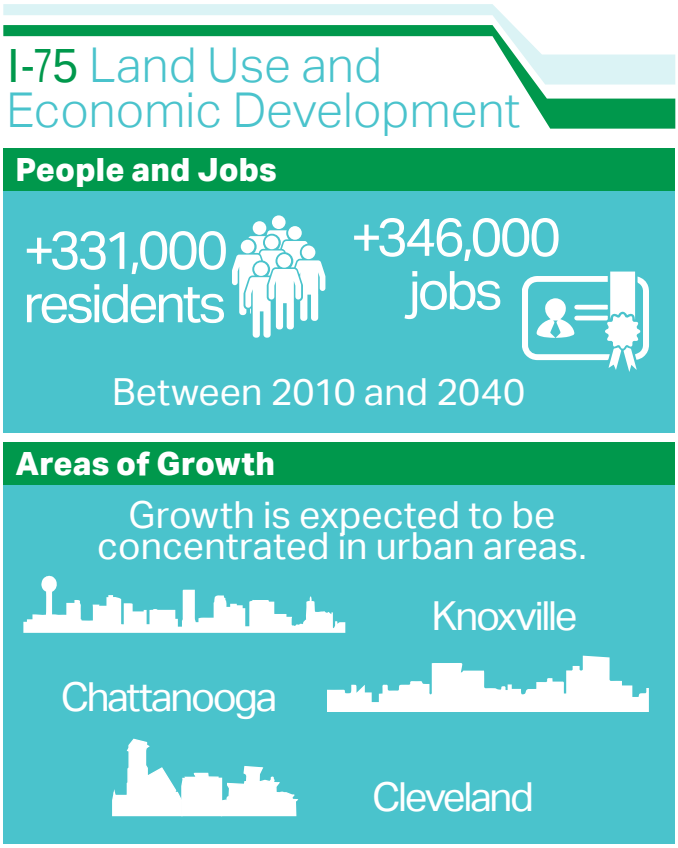
Source: Cleveland MPO, Chattanooga TPO and Knoxville Regional TPO FY2017-2020 TIPs; Tennessee's FY2017-2020 STIP

2. Land Use and Economic Development

In any region, the need for improvements to the public infrastructure is triggered by growth, both in the number of residents and number of jobs. Examining historic development patterns as well as anticipated growth trends can provide a glimpse into the future and what challenges may await the transportation system.

2.1 Population and Employment Projections

A high-level review of population and employment projections from Woods & Poole, Inc. was undertaken for the counties surrounding the I-75 corridor. More specifically this analysis includes Anderson, Blount, Bradley, Campbell, Hamilton, Knox, Loudon, McMinn, Meigs, Monroe, Polk, Rhea, Roane, and Scott counties, as shown in Figure 2-1. These counties are expected to see an additional 331,000 residents and 346,000 jobs by 2040. This represents a 24% increase in people and 43% increase in employment since 2010. Of this growth, those counties that are located within a metropolitan planning organization (MPO) area, denoted by an asterisk in Figures 2-2 and 2-3, are expected to see over 90% of the study area's growth.



Interchange access to Interstate corridors provides communities with the ability to attract businesses and provides accessibility to economic centers for employment. As such, population and employment projections from the Tennessee Statewide Travel Demand Model (TSM) were also examined in more detail near the interchanges along the I-75 corridor as grouped by county and shown in Tables 2-1 and 2-2. Areas in the immediate vicinity (approximately a one mile radius) of an I-75 interchange are expected to grow by approximately 77,000 people and 91,000 jobs, a 35% and 46% increase, respectively. As shown, growth is slightly tilted towards employment with these areas seeing approximately 1.2 jobs for every additional resident. Additionally, Knox, Hamilton, and Bradley counties, which include the urban areas of Knoxville, Chattanooga, and Cleveland, respectively, are projected to see the vast majority of growth along the Interstate. High growth interchange locations within these areas include:

Hamilton County (Chattanooga Area)

- SR-153, which provides access to the Chattanooga Airport and the Hamilton Place Mall
- Shallowford Road, which provides access to the Hamilton Place Mall and a significantly sized commercial area
- Volkswagen Drive, which serves Volkswagen Chattanooga and Enterprise South
- US-64, which provides parallel access to Cleveland, TN via US-64/Lee Highway

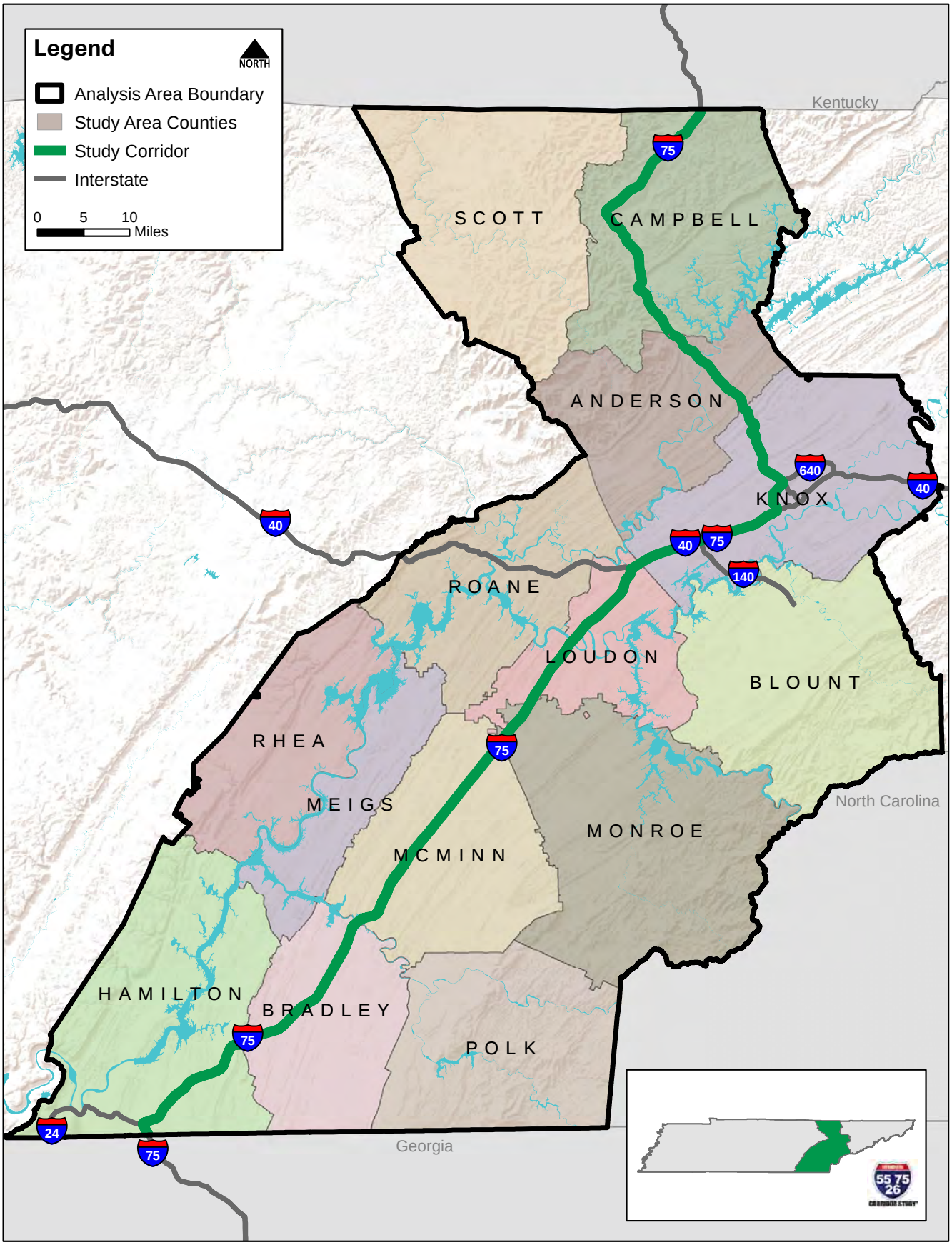
Bradley County (Cleveland Area)

- US-64, which serves as east access into Cleveland and provides access to a significant amount of industrial employment within Bradley County
- SR-60 (25th Street NW), which provides direct access into Cleveland and the city's largest employment and commercial activities
- Paul Huff Parkway, which also serves a large concentration of Cleveland's newest commercial uses
- SR-308 (Lauderdale Memorial Highway), which serves several large employers including an Amazon Fullfillment Center, General Electric, Wacker Polysilicon, and Olin Corporation.

Knox County (Knoxville Area)

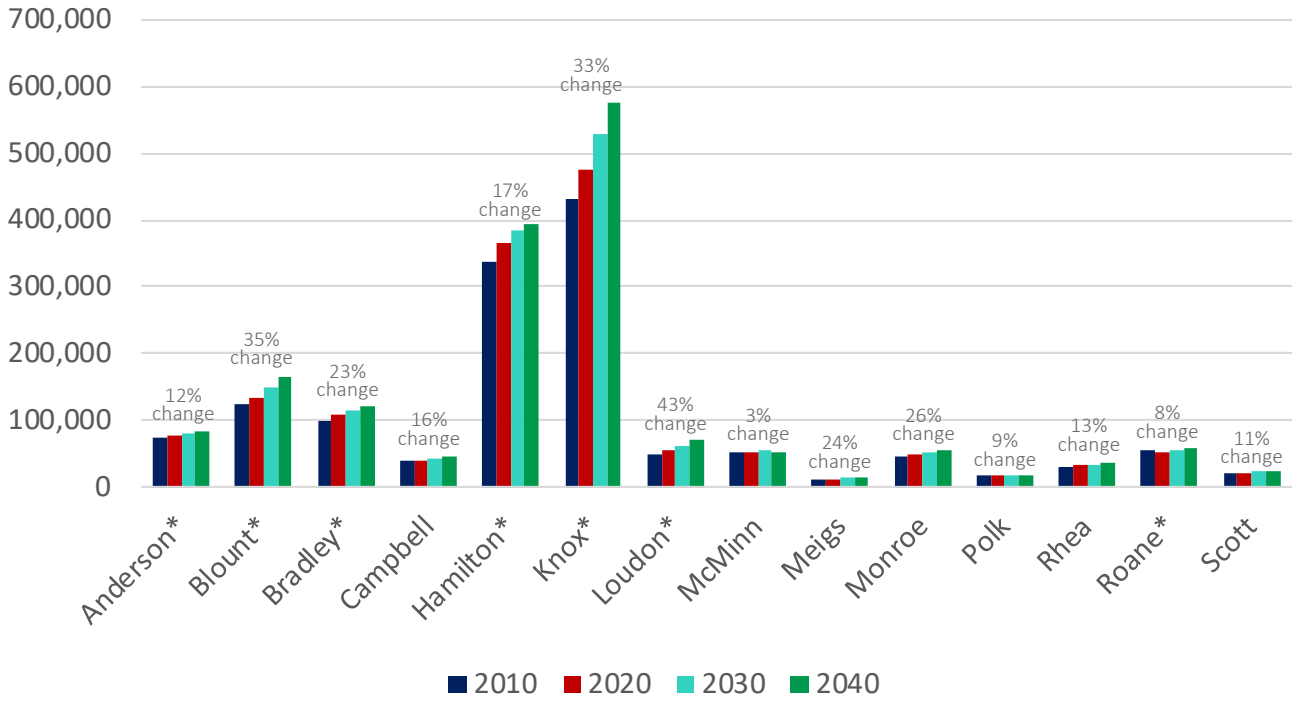
- Numerous interchanges within Knox County have and continue to experience high levels of growth relative to population and employment
- Watt Road, which currently sees a large amount of truck traffic also has tremendous potential for commercial and residential development

Figure 2-1. Study Area Counties — I-75



Source: U.S. Census Bureau

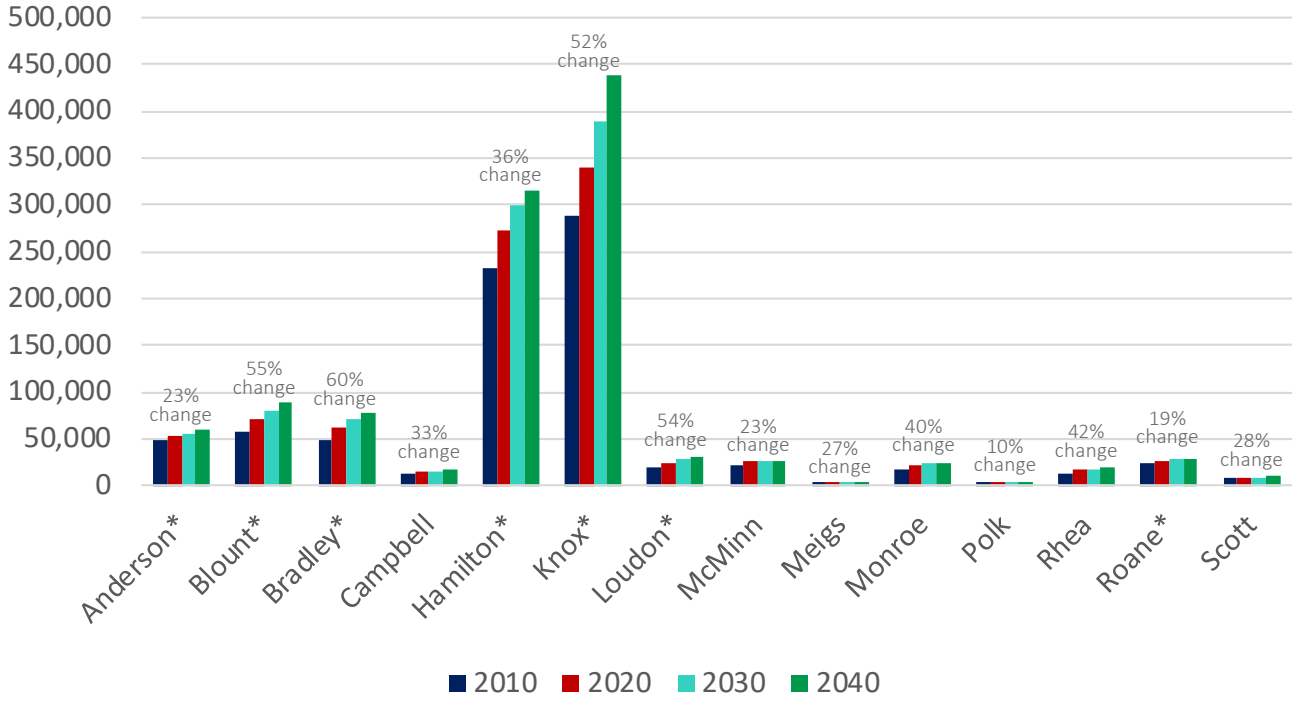
Figure 2-2. County Growth Trends, Population — I-75



*County located within an MPO area

Source: Woods & Poole Economics, Inc., 2018

Figure 2-3. County Growth Trends, Employment — I-75



*County located within an MPO area

Source: Woods & Poole Economics, Inc., 2018

Table 2-1. Interchange Population Growth — I-75

	2010	2040	Population Growth	
			Number	Percent
Anderson	13,170	15,960	2,790	21%
Bradley	24,830	36,230	11,400	46%
Campbell	11,580	15,520	3,940	34%
Hamilton	45,980	59,490	13,510	29%
Knox	85,270	111,380	26,110	31%
Loudon	23,080	38,060	14,980	65%
McMinn	14,740	17,810	3,070	21%
Monroe	5,650	7,200	1,550	27%
Total	**224,300**	**301,650**	**77,350**	**35%**

Source: Tennessee Statewide Travel Demand Model (TSM)

Table 2-2. Interchange Employment Growth — I-75

	2010	2040	Employment Growth	
			Number	Percent
Anderson	5,720	10,460	4,740	83%
Bradley	13,300	22,100	8,800	66%
Campbell	3,990	4,630	640	16%
Hamilton	49,550	66,160	16,610	34%
Knox	97,420	145,390	47,970	49%
Loudon	12,600	21,060	8,460	67%
McMinn	12,530	15,270	2,740	22%
Monroe	4,000	4,910	910	23%
Total	**199,110**	**289,980**	**90,870**	**46%**

Source: Tennessee Statewide Travel Demand Model (TSM)

- Campbell Station Road, which serves the Town of Farragut and is a southern access point into Turkey Creek, a major commercial center
- SR-131 (Lovell Road), which provides access to both commercial and residential development
- SR-162/I-140, which provides access to high growth areas in Knox and Anderson counties and serves as a direct access route to the McGhee Tyson Airport
- Interchanges north of SR-162/I-140 to downtown Knoxville, which serve a large amount of retail uses and are some of the most populated areas of south Knox County
- Interchanges at Merchant Drive, Callahan Drive, and SR-131 (Emory Road), which serve both residential and commercial developments
- SR-170 (Raccoon Valley Road), which is largely rural in nature but serves a number of industrial uses that are very truck dependent

2.2 Planned and Proposed Development

Existing development patterns and in-progress plans will direct much of the forecasted population and employment growth over the next 20 years. Existing land use and development patterns were analyzed using the TSM and documented in Section 3-7 in Technical Memorandum 1. As mentioned there, future growth around the I-75 corridor is expected to occur primarily near the urban areas of Knoxville, Cleveland, and Chattanooga. Near Knoxville, additional growth in commercial and light industrial development is expected to occur near the I-75 interchanges; however, much of the transportation infrastructure is already built out in these areas, which will limit development. The I-75 interchanges and major routes that provide access to the City of Cleveland are expected to continue to see growth in residential with some industrial/distribution and commercial development as well. In Chattanooga, the growth near the corridor is expected to be primarily residential in nature, but could potentially include additional commercial and/or industrial developments, specifically near the Tennessee-Georgia border.

2.3 Existing and Future Deficiencies and Needs

The following summarizes the key findings related to growth and development along the I-75 corridor.

A. Corridor Population and Employment Growth: Communities along the I-75 corridor are generally expected to experience increases in population and employment, adding approximately 331,000 more residents and 346,000 more jobs between 2010 and 2040. Both population and employment growth are expected to be concentrated in counties containing major urban areas such as Knoxville, Cleveland, and Chattanooga.

B. Interchange Area Employment Growth: Growth in close proximity to existing I-75 interchanges will slightly tilt toward employment, with approximately 1.2 jobs added for every new resident, for a total of approximately 91,000 new jobs within the interchange areas. Existing congestion near these interchanges, especially in the urban areas, will exacerbate the challenge of providing access to and from the I-75 corridor for employment centers near the interchanges.

C. Planned and Proposed Development: Areas that currently have the highest amount of development activity continue to attract the greatest interest in future growth. These areas are largely within the major urban areas of Knoxville, Cleveland, and Chattanooga. While Knox County is seeing a relatively steady amount of growth near the I-75 corridor, areas to the north and south of Knox County have the greatest potential for future growth. In Bradley County, the interchanges at US-64 and SR-308 (Lauderdale Memorial Highway) are anticipated to see the greatest employment growth. In Hamilton County, much like Knox County, growth appears to be evenly dispersed, although the Volkswagen Drive interchange, which serves Volkswagen Chattanooga and Enterprise South, and SR-153, which provides access to the Chattanooga Airport and areas north of Hamilton County, will likely see the greatest amount of future growth and development.

3. Highway Capacity and Travel Demand

As population and employment growth occurs in the I-75 study area, the demand on the roadway network also increases. This analysis considers historic traffic volumes in conjunction with predicted future 2040 traffic volumes to evaluate the following highway capacity and demand conditions in the corridor:

- 2010 traffic volumes and projected 2040 traffic volumes
- Travel patterns
- Volume-to-Capacity ratios
- Bottlenecks
- Travel time and delay

3.1 Traffic Volumes and Projections

TDOT collects and maintains Annual Average Daily Traffic Volume (AADT) data on roadways across the state. Figure 3-1 shows the 2017 AADT volumes recorded in the Tennessee Roadway Information Management System (TRIMS) at 20 count stations along I-75. As shown, daily traffic volumes are highest on the shared I-40 / I-75 segment through Knoxville (210,400 vehicles per day) and near the Georgia state line in Chattanooga (129,800 vehicles per day). Near the Kentucky border in Campbell County, volumes decrease to approximately 25,400 vehicles per day (VPD). For reference, the capacity of four lane rural freeway facilities, such as I-75 in McMinn County, ranges from 52,000 VPD to 67,000 VPD (Highway Capacity Manual 2010 Exhibit 10-8 and 10-9). Six-lane urban freeways carry 106,000 to 138,000 VPD.

The number of travel lanes and speed limit vary throughout the corridor, in relation to the adjacent land uses. As shown in Table 3-1, the majority of the corridor provides four travel lanes and a speed limit between 65 and 70 miles per hour (the speed limit in the Knoxville area was reduced from 70 mph to 65/55 mph for air quality issues in 2006).

Table 3-2 is populated with data obtained from the TSM, which provides base year (2010) daily trip information and forecasts the daily trips that will be made in 2040 based on projected growth and land use changes. As shown, total daily trips in the 14-county area are expected to reach 10.5 million by 2040, representing a 36% increase over total trips in 2010. According to projections based on Woods & Poole data described in Technical Memorandum 1, the corresponding population and employment increases in the area are 24% and 43%, respectively.

Table 3-1. Roadway Characteristics by County – I-75

County	# of Travel Lanes	Land Use	Speed Limit (mph)
Hamilton	4-8	Commercial	55-65
Bradley	4	Rural	70
Mcminn	4	Rural	70
Monroe	4	Rural	70
Loudon	4	Rural	70
Loudon (I-40/ I-75 Section)	6	Rural	65
Knox (I-40/I-75 Section)	6-8	Commercial	55-65
Knox	4-6	Commercial & Rural	55-65
Anderson	4	Rural	65
Campbell	4	Rural	65-70

Source: Tennessee Roadway Information Management System (TRIMS) - 2017

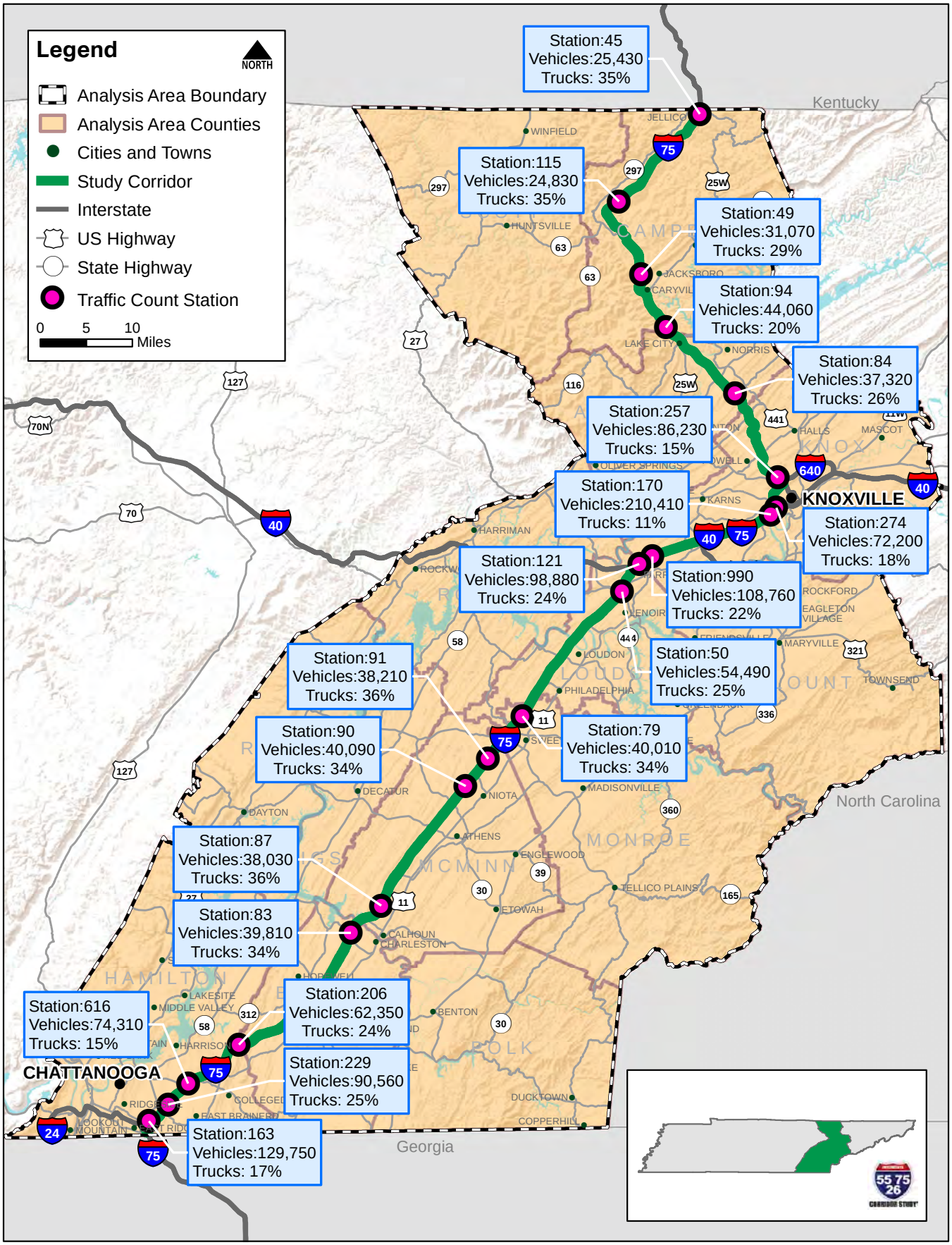
Total daily trips are expected to increase 36% between 2010 and 2040.

Table 3-2. Area Daily Trip Breakdown 2010 and 2040 – I-75

	Daily Trips		
Trip Types	2010	2040	% Change
Personal Trips	7,425,300	10,135,600	37%
Truck Trips	298,600	397,200	33%
Total Trips	**7,723,900**	**10,532,800**	**36%**
Percent Truck Trips	4%	4%	-2%

Source: Tennessee Statewide Travel Demand Model (TSM)

Figure 3-1. 2017 Average Annual Daily Traffic Volumes Along I-75



Source: Tennessee Roadway Information Management System (TRIMS) - 2017

The TSM was used to calculate the total vehicle miles traveled (VMT) on each type of roadway facility in the 14-county study area. Table 3-3 indicates a total 35% increase in VMT over the 2010 base year total. Urban collectors are expected to see the highest percent changes in VMT; although most urban and rural classifications are expected to see significant increases. The exception is rural local roads, on which trips are expected to increase by only 16%. Further analysis indicates that trip lengths within the study area, both in 2010 and 2040 average approximately five miles per trip.

Table 3-3. Vehicle Miles Traveled by Functional Class – I-75

	Functional Class	Total VMT (1,000s) 2010	2040	% Change
Urban	Interstates	9,482	11,927	26%
	Expressway	1,352	1,802	33%
	Arterials	13,032	17,547	35%
	Collectors	1,944	2,926	51%
	Local Roads	59	80	36%
Rural	Interstates	5,501	7,654	39%
	Arterials	3,996	5,692	42%
	Collectors	2,663	3,732	40%
	Local Roads	42	49	16%
Analysis Area Total		**38,071**	**51,409**	**35%**
Total Vehicle Mins Traveled/Trip		**4.93**	**4.88**	**-1%**

Source: Tennessee Statewide Travel Demand Model (TSM)

3.2. Travel Patterns

Major Trip Destinations (O-D Pairs)

Origin-Destination (O-D) data, obtained from the TSM, was evaluated to determine the most common trip origin and destinations in the study area, as well as travel times between well-known locations. As expected, most of the frequently traveled O-D pairs are in close proximity, with travel times between 3 and 5 minutes. Figure 3-2 and Table 3-4 show congested travel times between well-known trip origins and destinations along the corridor. As shown, travel times are generally expected to increase by less than 10 minutes on trips in rural portions of the corridor. Within urban parts of the corridor, trip lengths are expected to increase by 10 to 20 minutes.

Census County-to-County Work Flow

The U.S. Census Bureau provides origin and destination data for work trips by county. Figure 3-3 illustrates information obtained from their interactive, web-based tool, OnTheMap. The figure shows the most common employment destinations for workers living in each county. For example, of the 16,000 employees who live in Monroe County, 42% are actually employed within Monroe County. Eight percent work in Loudon County, 10% work in McMinn County, and 11% commute to Knox County. The remaining 29% work in other counties. Knox County, including the City of Knoxville, draws high percentages of county-to-county work trips from across the study area – receiving 34% of workers living in Anderson County, 32% of workers living in Loudon County, 19% of workers living in Campbell County and 9% of workers living in Scott County. Sixty-eight percent of workers living in Knox County also work within the county.

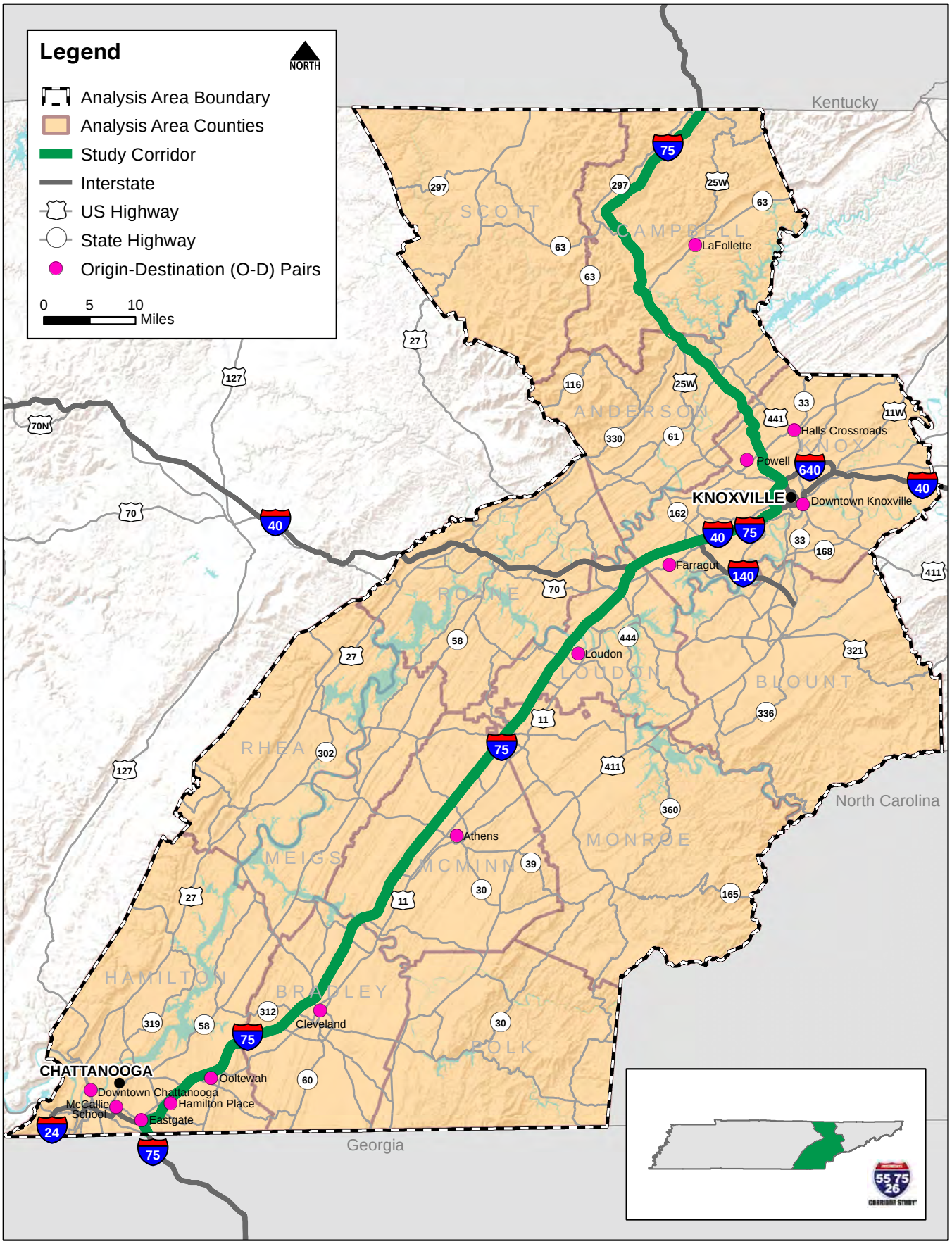
Hamilton County, including the City of Chattanooga, is also a large work-trip generator, drawing 22% of the workers living in Bradley County; 18% from Rhea and Meigs Counties; and high percentages of the workforce available in Dade, Walker, and Catoosa Counties, Georgia. The percentages of workers commuting from these counties in Georgia to Hamilton County represent approximately 23,200 individuals.

3.3. Volume-to-Capacity Ratios

Vehicle capacity, as defined in the Highway Capacity Manual (HCM), is the maximum number of vehicles that can pass a given point during a specific period of time under prevailing roadway, traffic, and control conditions. Roadway conditions include number of travel lanes, design speed, lane widths, shoulder widths, horizontal and vertical alignments, and the number of access points to adjacent parcels. Traffic conditions include vehicle type, specifically the percentage of heavy vehicles that impact travel speed and occupy more space, the distribution of vehicles traveling in each direction, and the driver population (commuter versus non-commuter). Finally, the type of traffic control (stop signs versus traffic signals) used on non-interstate facilities also affects capacity. Given this definition, it is apparent that the capacity of a facility can change from one segment to another and from one time of day to another time of day.

Figures 3-4, 3-5, 3-6, and 3-7 illustrate the 2010 and 2040 peak period volume-to-capacity (VC) ratios (obtained from the TSM) for each Interstate segment. Where the volume-to-capacity ratio is greater than 1.0, drivers experience poor operating conditions and high delay, represented as level-of-service (LOS) F (see Figure 3-8). As shown in Figures 3-4 and 3-5, the majority of the I-75 corridor currently operates well with LOS A, B and C.

Figure 3-2. Major Trip Origin-Destination Pairs — I-75



Source: Tennessee Statewide Travel Demand Model (TSM)

Table 3-4. Major Trip Origin-Destination Pairs — I-75*

Origin	Destination	Congested Travel Time		Change (min)
		2010 (min)	2040 (min)	
Knoxville (CBD)	Farragut (Knoxville suburb)	39	56	17
Knoxville (CBD)	Powell (unincorporated community)	22	30	8
Knoxville (CBD)	Halls Crossroads (unincorporated community)	27	40	13
Athens (county seat - McMinn Co)	Loudon (county seat - Loudon Co)	35	41	6
Cleveland (CBD)	Athens (county seat - McMinn Co)	37	43	6
Cleveland (CBD)	Ooltewah (Chattanooga suburb)	23	25	2
Cleveland (CBD)	Chattanooga (CBD)	47	54	7
Chattanooga (CBD)	McCallie School (college-preparatory school)	10	12	2
Chattanooga (CBD)	Hamilton Place (retail)	27	34	7
Hamilton Place (retail)	Ooltewah (Chattanooga suburb)	13	12	-1
LaFollette (CBD)	Knoxville (CBD)	48	65	17

Source: Tennessee Statewide Travel Demand Model (TSM)

* Congested travel times are from model data.

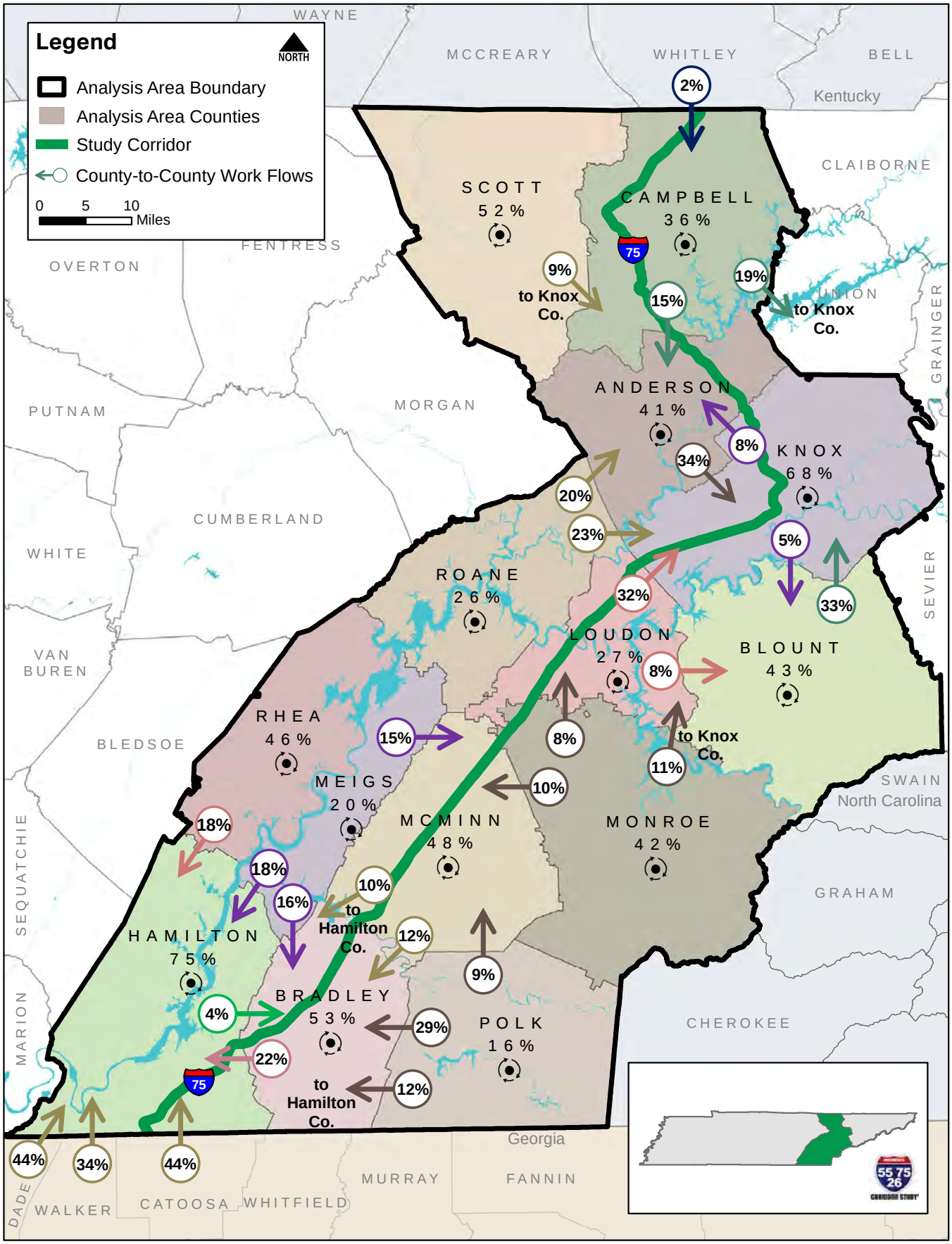
Exceptions are as follows:

- Shared I-40/I-75 segment west of Knoxville
- I-75/I-640 interchange area in Knoxville
- I-75/SR-131 interchange area north of Knoxville
- I-75 segment between US-74 and near US-11 (Lee Hwy) south of Cleveland
- I-75/SR-153 & SR-320 interchange areas near Chattanooga
- I-24/I-75 interchange area in Chattanooga

By 2040, many rural segments of I-75 are expected to experience increased congestion, notably segments in Loudon and Bradley counties, as well as Anderson County and southern Campbell County. Note that existing congestion between US-74 and US-11 south of Cleveland is resolved due to a programmed widening project. As shown in Figure 3-7, significant congestion will be expected on segments of I-75 between I-640 and SR-131/Emory Road north of Knoxville and the I-75/SR-153 interchange near Chattanooga. Field observations confirmed that the northbound exit ramp queues at SR-131/Emory Road backed up to Callahan Drive/Exit 110.

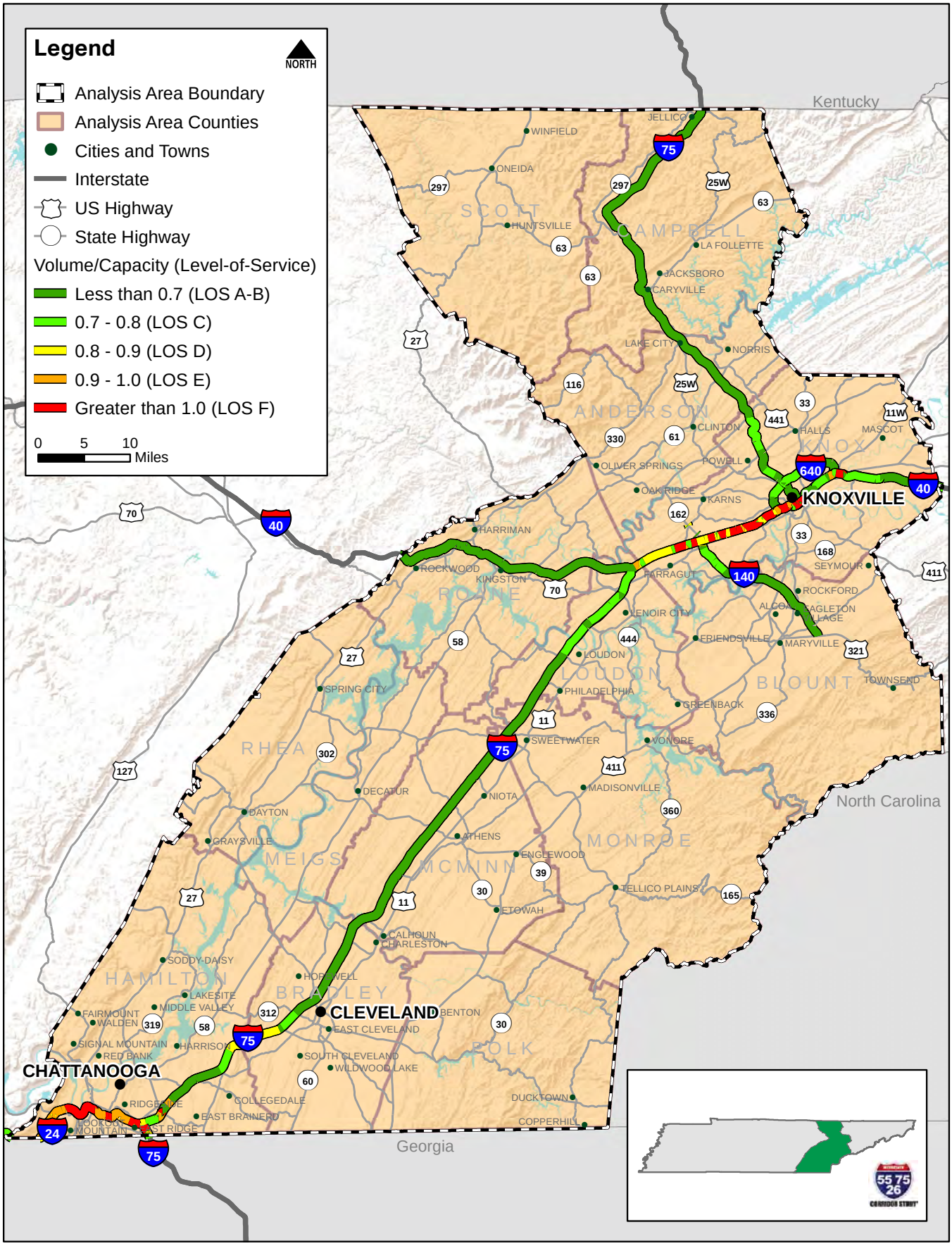
As an Interstate begins to reach capacity and delay increases, motorists tend to seek alternative, parallel routes. This is referenced here as the spillover effect. Figure 3-9 shows the projected increases in average daily traffic (ADT) on arterials parallel to I-75 in congested segments. As shown, volumes on Kingston Pike are expected to increase by 36-72%. Volumes on Central Avenue Pike and US-11/Brainerd Road are expected to increase by 62% and 23%, respectively. Note that much of Central Pike Avenue will also reach capacity by 2040. In Loudon County, volumes on the existing four-lane rural interstate facility will exceed capacity by 2040, resulting in significant delay particularly between US 321 and SR-324 near Lenoir City. Motorists are expected to use Harrison Road/ Loudon Ridge Road as an alternate route. Volumes on Harrison Road/Loudon Ridge Road are expected to increase by 33% between 2010 and 2040.

Figure 3-3. County-to-County Work Flow (2015) — I-75



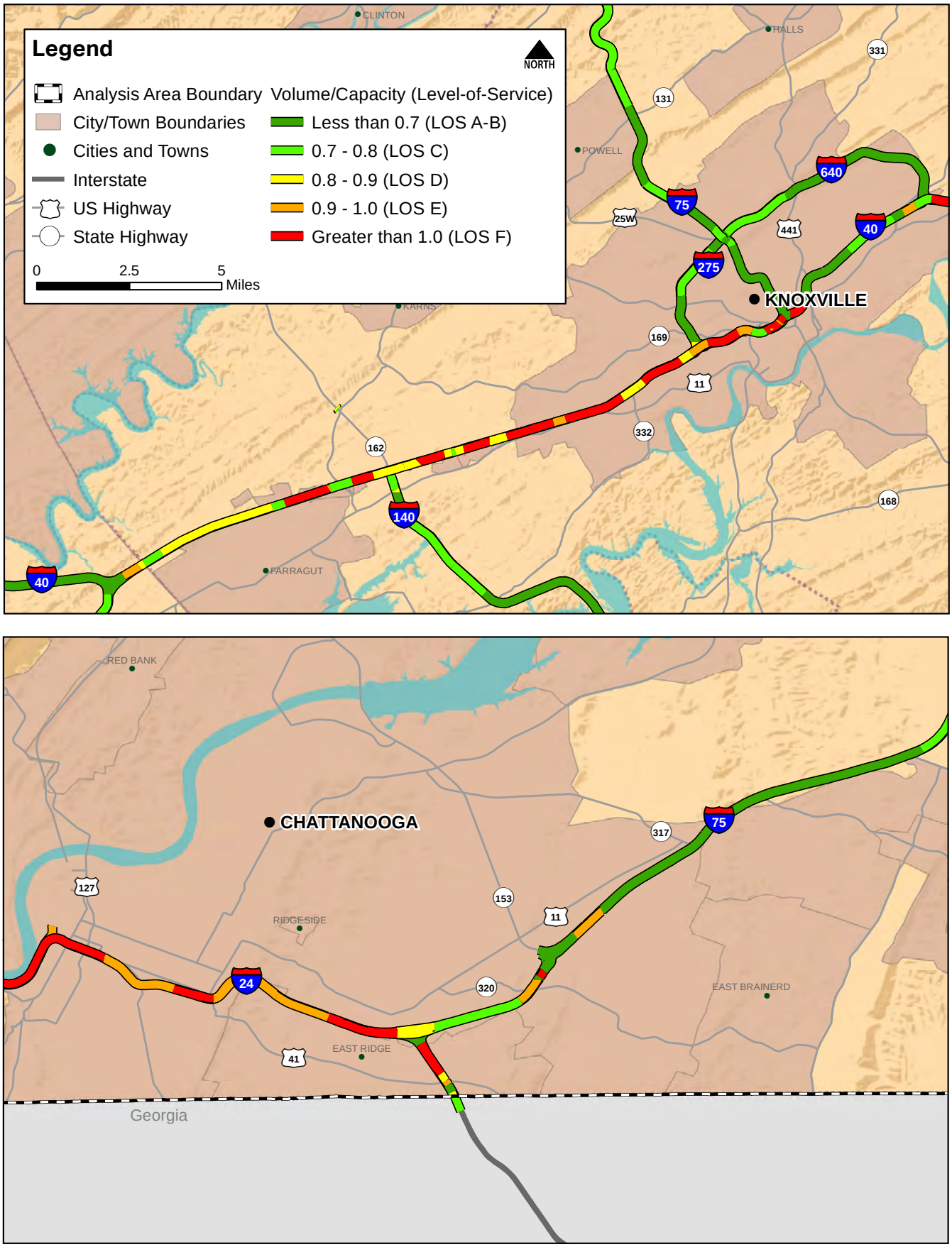
Source: U.S. Census Bureau, Center for Economic Studies: OnTheMap

Figure 3-4. Peak Period Volume-to-Capacity Ratios/Level-of-Service (2010) — I-75



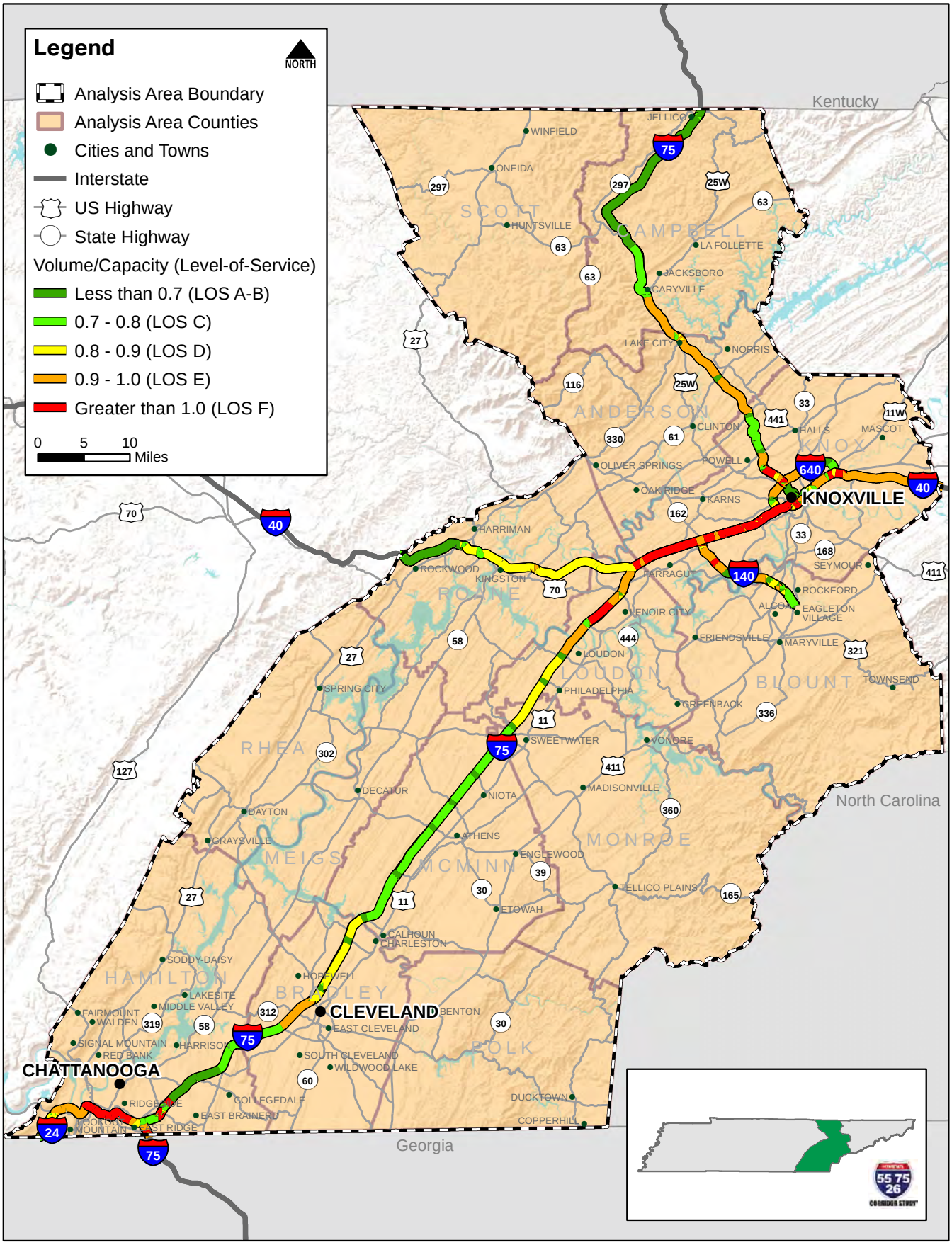
Source: Tennessee Statewide Travel Demand Model (TSM)

Figure 3-5. Peak Period Volume-to-Capacity Ratios/Level-of-Service (2010) Zoom — I-75



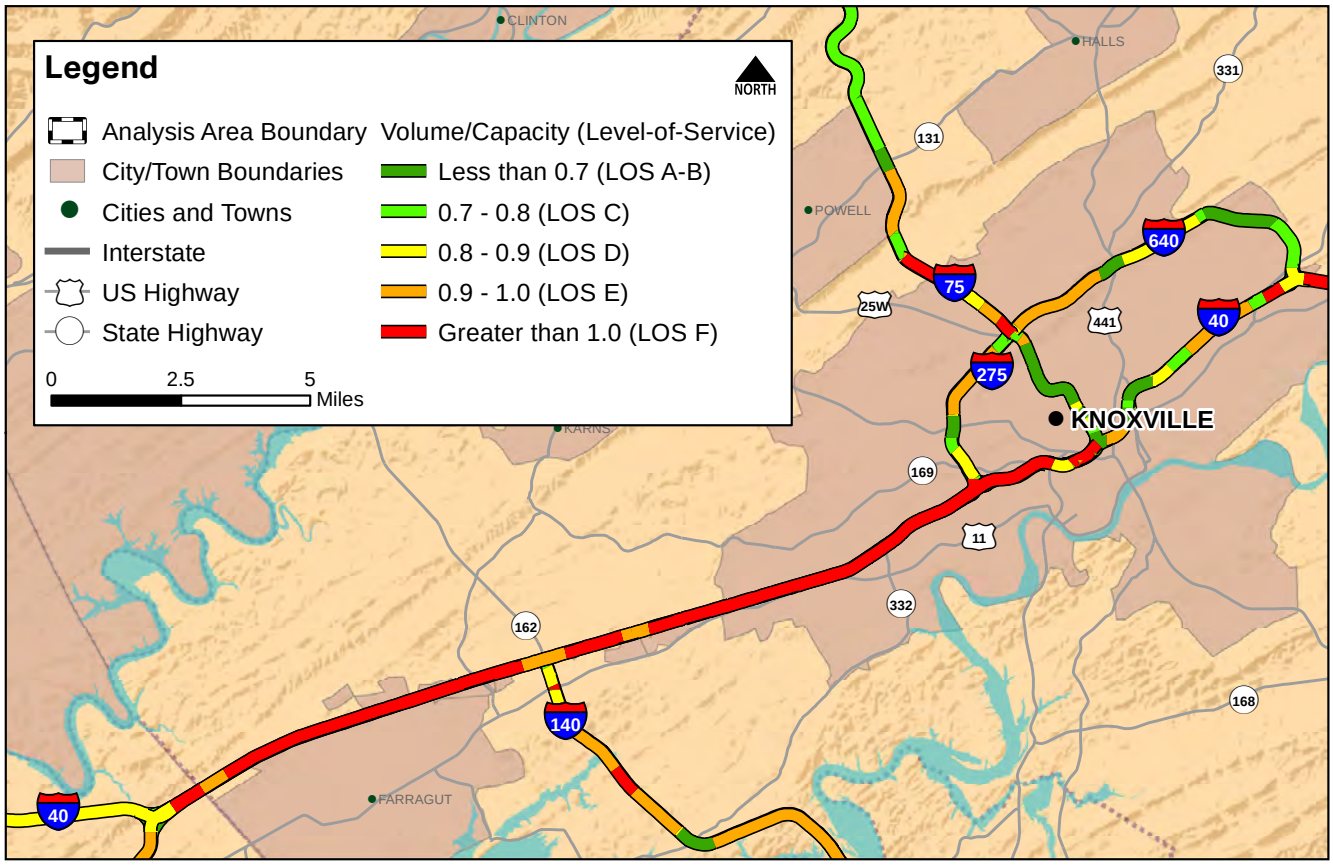
Source: Tennessee Statewide Travel Demand Model (TSM)

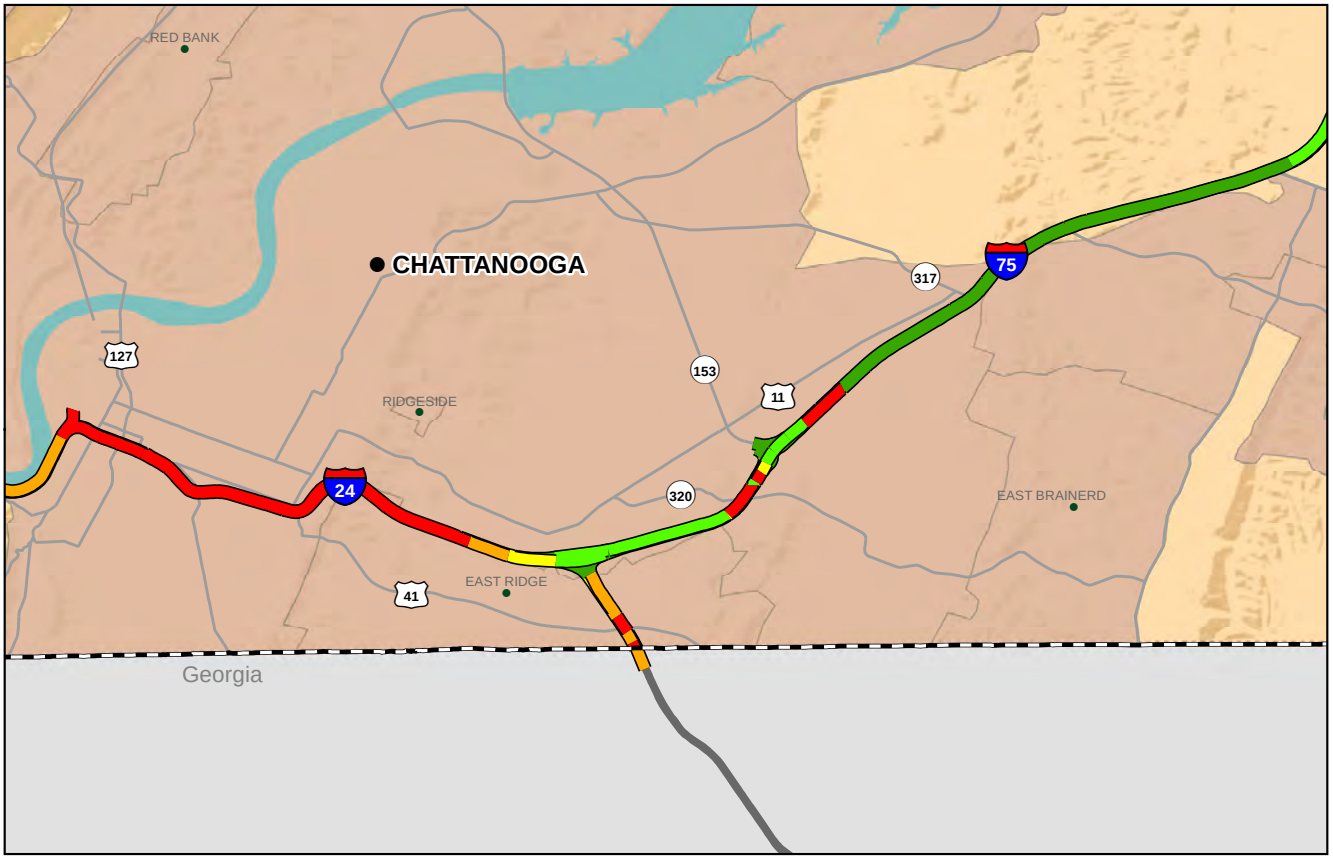
Figure 3-6. Peak Period Volume-to-Capacity Ratios/Level-of-Service (2040) — I-75



Source: Tennessee Statewide Travel Demand Model (TSM)

Figure 3-7. Peak Period Volume-to-Capacity Ratios/Level-of-Service (2040) Zoom — I-75*

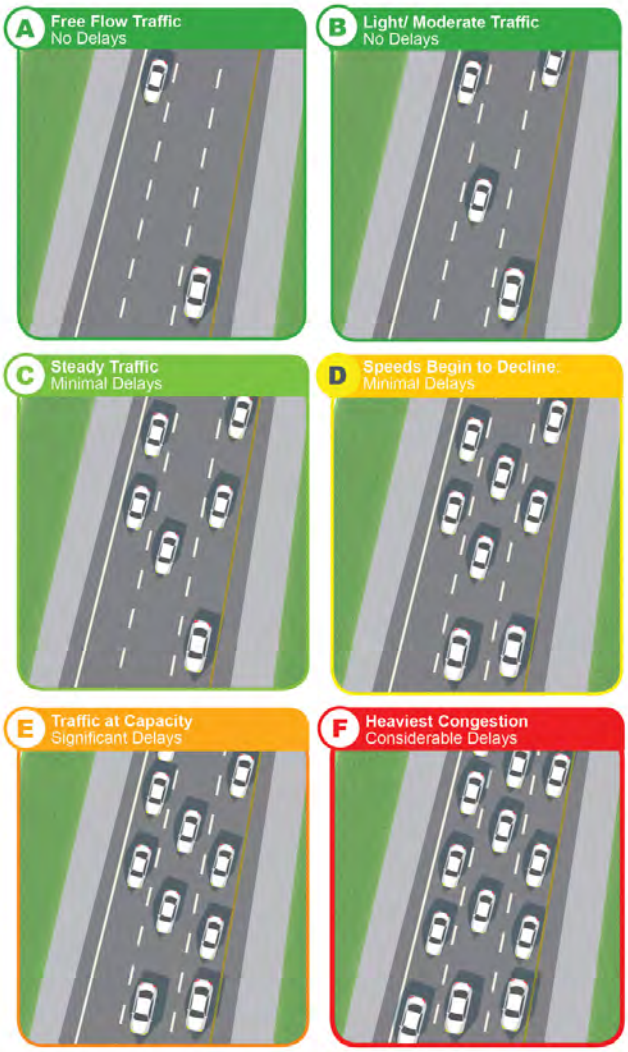




Source: Tennessee Statewide Travel Demand Model (TSM)

*This map reflects the I-24/I-75 interchange improvements that are currently underway.

Figure 3-8. LOS Characteristics



3.4. Bottlenecks

Bottlenecks occur when the capacity or flow of a facility is suddenly restricted. This can be caused by geometric changes (lane reductions, merge/diverge areas, interchanges, steep grades), changes in speed limit, or unexpected traffic incidents. TDOT's traffic management centers and HELP program work diligently to quickly address unexpected incidents; however, improvements to bottleneck areas created by geometric changes must be planned and programmed. As shown in Figure 3-10, which is based on the 2040 TSM, two bottleneck locations are identified near the Knoxville area and two in the Chattanooga area.

Near Knoxville, bottlenecks were identified northbound on I-75 at the SR-131 interchange and on I-75, north of I-640. During a field review, congestion was observed during PM peak hours at northbound I-75 from SR-131/Emory Road to MM 109.4, northbound I-75 from Merchants Drive to MM 108, and on the I-640 ramp to northbound I-75. Note that the shared segment of I-40/I-75 is shown to have a volume-to-capacity greater than 1.0 during the AM and PM peak periods. While lane drops do occur between the North Cedar Bluff Road and Buckingham Drive interchanges and at the Old Weisgarber Road interchange, delays experienced on this segment are primarily due to the volumes exceeding the roadway capacity and are amplified by the proximity of the 12 interchanges along this segment.

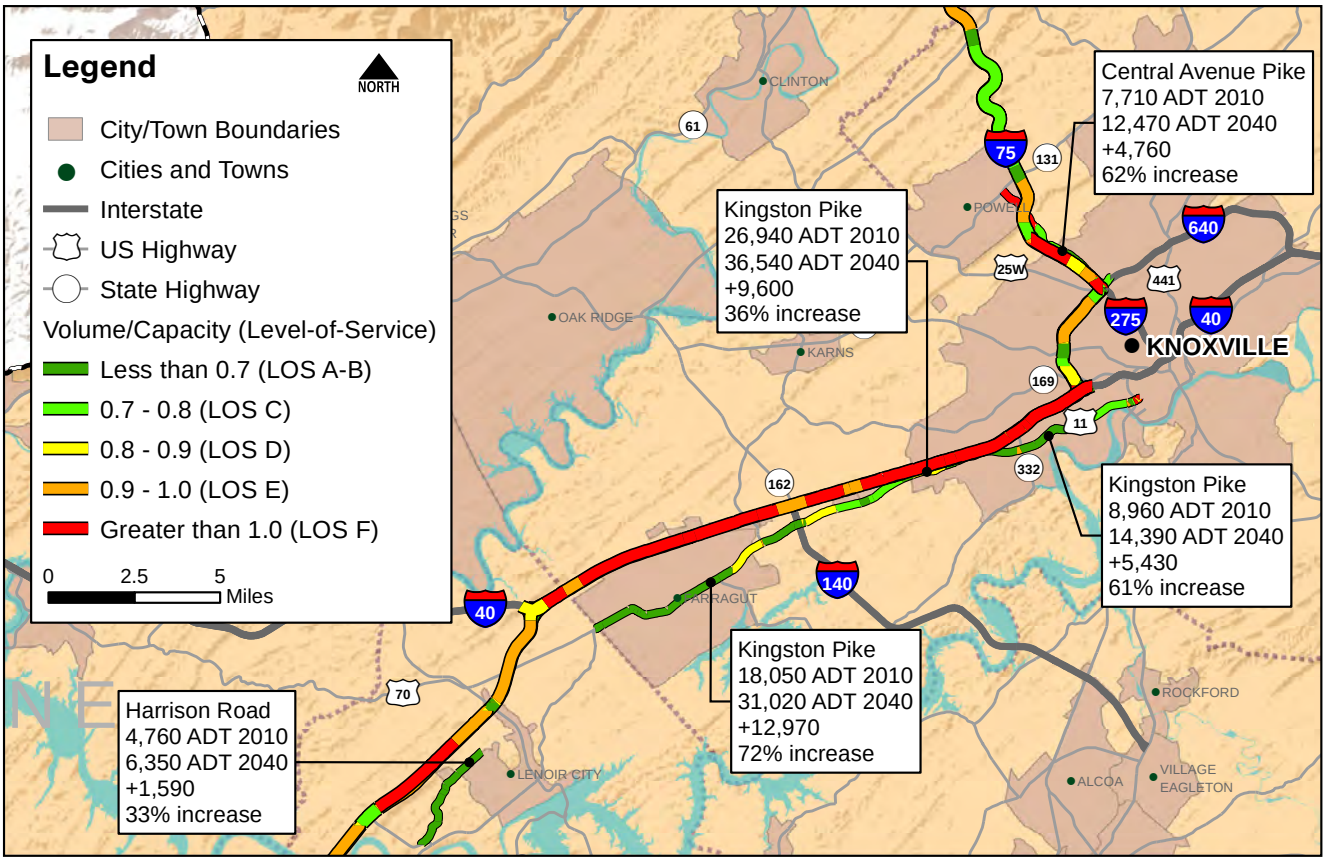
North of I-640, on the existing roadway geometry, two merges occur within approximately 1,200 feet. The eastbound and westbound ramps from I-75/I-640 merge and then merge again with northbound I-275 traffic. A northbound I-75 lane is then dropped at Merchants Drive, creating a weave area. In the southbound direction, north of I-640, a single lane ramp is provided for vehicles following I-75 to I-640 westbound. It should be noted that all directional ramps associated with this interchange currently provide only one travel lane. TDOT has allocated $88 million of IMPROVE Act funds to reconstruct this interchange and add auxiliary lanes in each direction on I-75. The project, which is currently in design phase, is included in the E+C network and is therefore reflected in the TSM model output shown in Figure 3-7. While the new interchange configuration will improve safety and provide opportunity for improved traffic flow, it will still be constrained by the six travel lanes provided on I-75 between I-640 and SR-131, which will be over-capacity in 2040.

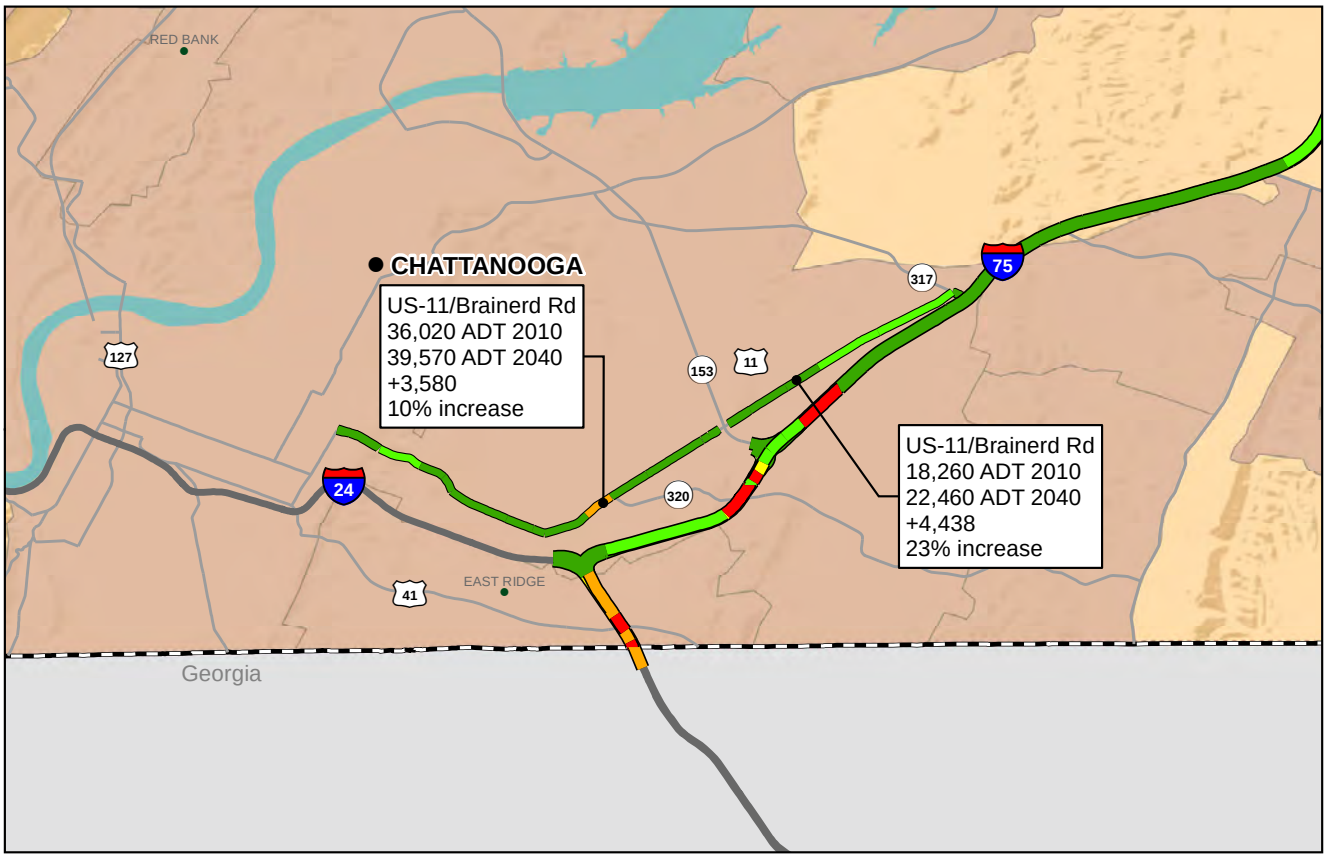
Similarly, TDOT is currently constructing a $149 million modification to the I-24 / I-75 interchange in Chattanooga, which will address many existing deficiencies at this location. However, as the TSM model output in Figure 3-7 indicates, by 2040 volumes on I-24 west of the interchange will exceed capacity, causing congestion through the I-75 interchange. Current STIP projects widen only portions of I-24 through the downtown area.

The I-75/SR-320 interchange near Chattanooga provides two cloverleaf movements for the northbound I-75 on and off ramps. This creates a weaving area of, in this case, approximately 620 feet. As shown, the volume-to-capacity ratios only exceed 1.0 during the PM peak period; however, short weaving segments like this can have a significant impact on adjacent speeds. Travel speeds through this interchange are also likely impacted by merge/weave areas associated with the SR-153 interchange, less than one mile to the north. Similar congestion is expected through this major interchange and north toward the Hamilton Place Mall interchange, which is programmed for modification.

As discussed in Section 9 of this Technical Memorandum, the Tennessee Freight Plan lists potential bottleneck locations based on level-of-

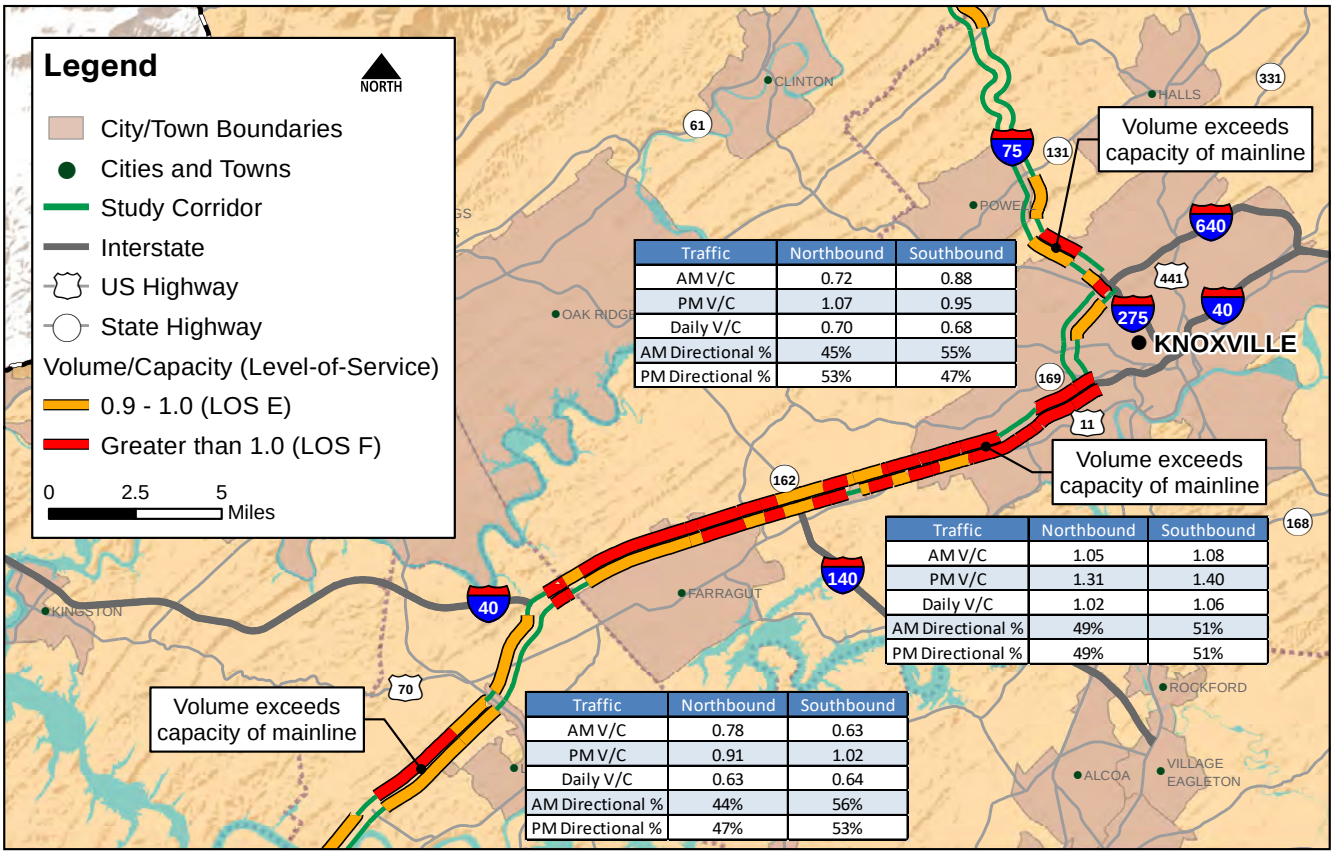
Figure 3-9. Spillover Effect (2040) — I-75

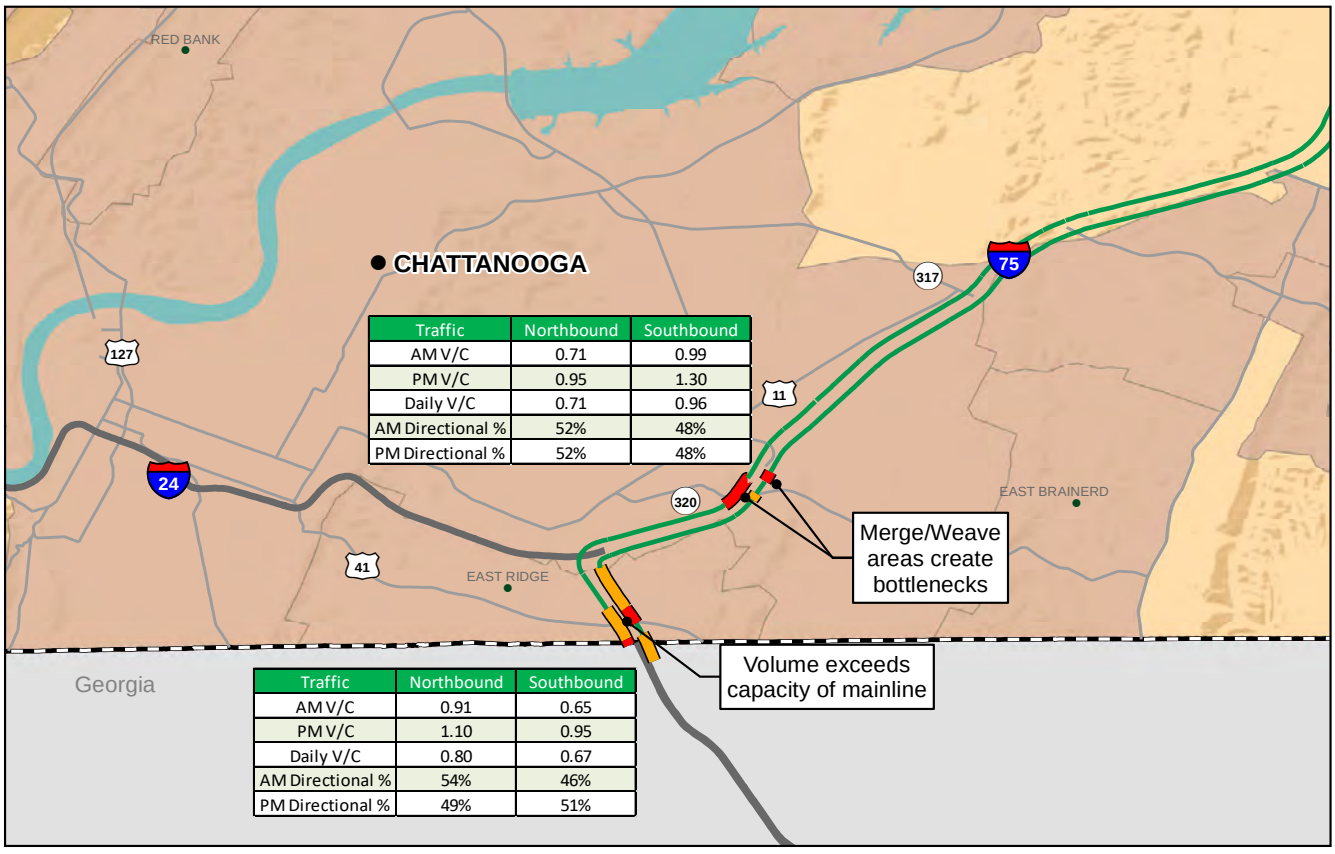




Source: Tennessee Statewide Travel Demand Model (TSM)

Figure 3-10. Bottleneck Locations — I-75





Source: Tennessee Statewide Travel Demand Model (TSM)

service and truck speed data. Both of these locations fall within congested corridors in the greater Knoxville area: Campbell County between mile markers 6.32 and 9.43, north of US-25W and on I-75/I-40 in Knox County, east of Everett/Watt Road to I-275.

3.5. Travel Time and Delay

Tables 3-5 and 3-6 show the total vehicle hours traveled (VHT) and vehicle hours of delay (VHD) for each roadway type. As shown, the total VHT (on all roads within the fourteen county study area) is expected to increase by 65% by 2040, which is almost double the expected VMT increase, implying longer travel times. The average trip length is expected to increase from 8.3 minutes to 10.0 minutes per trip. The largest increases in VHT are expected on urban arterials and collectors, which is likely a reflection of spillover traffic from congested freeway facilities. Vehicle hours of delay is expected to increase by 53% across the study area, with the highest percentage changes on Interstate facilities. Table 3-7, which shows the change in peak hour average speeds by 2040, further suggests that congestion on Interstate facilities will result in slower travel speeds and spillover, particularly in urban areas. The urban arterials and collectors are already experiencing congestion; therefore smaller percentage changes in peak hour travel speeds are indicated.

3.6. Existing and Future Deficiencies and Needs

Many areas of concern identified by stakeholders/members of the public and existing needs identified through TSM analyses will be addressed through programmed projects (Table 1.1) and therefore do not appear as future deficiencies in Figures 3-6 and 3-7. A summary of future conditions and expected 2040 deficiencies include:

A. Daily Personal Vehicle and Truck Trips: Total daily trips in the 14-county area are expected to reach 10.5 million by 2040, representing a 36% increase over total trips in 2010. According to projections based on Woods & Poole data, the corresponding population and employment increases in the area are 24% and 43%, respectively. Truck trips represent approximately 4% of total trips in both 2010 and 2040.

B. Vehicle Miles Traveled: A 35% increase in vehicle miles traveled (VMT) over the 2010 base year total is anticipated by 2040. Urban collectors are expected to see the highest percent changes in VMT; and trip lengths within the study area will reflect those in 2010 at approximately five miles/trip.

C. Major Trip Destinations: Travel times are generally expected to increase by less than 10 minutes on trips in rural portions of the corridor. Within urban parts of the corridor, trip lengths are expected to

Table 3-5. Vehicle Hours Traveled by Functional Class – I-75

	Functional Class	Total VHT (1,000s) 2010	2040	% Change
Urban	Interstate	174	241	38%
	Expressway	20	27	34%
	Arterial	561	1,037	85%
	Collector	76	117	55%
	Local Road	2.25	3.06	36%
Rural	Interstate	75.41	109.36	45%
	Arterial	86	123	43%
	Collector	73	103	42%
	Local Road	1.35	1.56	16%
Analysis Area Total		**1,069**	**1,762**	**65%**
Total Vehicle Mins Traveled/Trip		**1.68**	**2.06**	**22%**

Source: Tennessee Statewide Travel Demand Model (TSM)

Table 3-6. Vehicle Hours Delay by Functional Class – I-75

	Functional Class	Total VHD 2010	2040	% Change
Urban	Interstate	2.37	4.28	80%
	Expressway	0.20	0.36	75%
	Arterial	25.37	36.76	45%
	Collector	4.90	8.52	74%
	Local Road	0.18	0.20	11%
Rural	Interstate	0.43	1.49	250%
	Arterial	0.55	0.83	51%
	Collector	1.49	2.11	41%
	Local Road	0.04	0.05	6%
Analysis Area Total		**35.54**	**54.59**	**54%**

Source: Tennessee Statewide Travel Demand Model (TSM)

Table 3-7. Average Peak Hour Speeds by Functional Class – I-75

	Functional Class	Average Speeds (mph) 2010	2040	% Change
Urban	Interstate	49	40	-19%
	Expressway	62	61	-3%
	Arterial	25	23	-7%
	Collector	24	23	-3%
	Local Road	24	23	-1%
Rural	Interstate	67	54	-20%
	Arterial	47	47	0%
	Collector	35	35	-2%
	Local Road	32	31	-1%

Source: Tennessee Statewide Travel Demand Model (TSM)

increase by 10 to 20 minutes.

D. Volume-to-Capacity Ratios: As shown in Figures 3-6 and 3-7, after completion of all programmed projects, significant congestion is only expected at the following locations:

- I-75 from I-640 to SR 131, north of Knoxville
- Shared I-75 / I-40, west of Knoxville
- I-75 from US-321 to SR-324, near Lenoir City (TDOT IMPROVE Act projects include "I-75 from SR-323 to I-40/I-75 junction." A planning document is underway for this project.)
- I-75 at US-74, near Cleveland
- I-75 at SR-153 & SR-320 interchanges, near Chattanooga
- I-75 / I-24 interchange in Chattanooga

Additionally, many rural segments of I-75 are expected to experience increased congestion, notably segments in Loudon and Bradley counties, as well as Anderson and southern Campbell County. Note that TDOT IMPROVE Act projects include evaluation of I-75 from the Anderson-Campbell County Line to SR-9. This project is in the early stages of development and is not programmed at this time.

E. Spillover Streets: Figure 3-9 identifies streets that are likely to receive spillover traffic as the segments noted above experience more and more congestion. Of these spillover streets, the following are expected to operate at LOS E or F in 2040:

- Central Avenue Pike
- US-11/Brainerd Road

F. Bottleneck Locations: Existing bottlenecks on I-75 at I-640 and at I-24 are being addressed through programmed projects to reconstruct these interchanges. The improvements will improve safety and provide additional capacity for throughput. However, as noted in Section 3.4, by 2040, volumes on adjacent segments of Interstate are expected to exceed the capacity, resulting in queuing and therefore recurring congestion through these interchanges. Additional bottlenecks on I-75 near the SR-153 and SR-320 interchanges are most likely a result of tight weave movements at the SR-153 interchange combined with the proximity of the SR-320 and Hamilton Place interchanges. Finally, the Tennessee Freight Plan identified potential bottleneck locations in Campbell County between

mile markers 6.32 and 9.43, north of US-25W and on I-75/I-40 in Knox County, east of Everett/Watt Road to I-275.

4. Safety Analysis

As growth in population and employment occur in Tennessee, so do the traffic volumes on the Interstates and the extensive roadway system that feeds them. Increased traffic volumes and vehicle miles traveled, as well as congested travel conditions, increase the likelihood of traffic incidents. Crash data was collected from the TRIMS and analyzed to identify trends in potential safety issues along the I-75 corridor. In total, 15,182 crashes occurred along the I-75 corridor for the five-year period spanning 2014-2018. Table 4-1 shows the crash trends for the I-75 corridor for this five-year time period.

Of the 15,182 crashes along the I-75 corridor between 2014 and 2018, 2,849 resulted in an injury and 60 resulted in a fatality. Overall, the total number of crashes as well as the number of injury crashes both trended upward in this time period. However, the number of fatalities has been decreasing over time along the corridor.

4.1. Crash Analysis

Using TDOT's traffic volumes collected in 2018, crash

Table 4-1. Crash Trends – I-75

Total

	County								
	Anderson	Bradley	Campbell	Hamilton	Knox	Loudon	McMinn	Monroe	Total
2014	72	209	240	628	989	163	143	33	**2,477**
2015	100	332	297	863	1,097	197	178	38	**3,102**
2016	123	329	275	785	1,214	195	160	36	**3,117**
2017	137	273	396	819	1,175	204	200	42	**3,246**
2018	101	334	293	872	1,202	184	212	42	**3,240**

Injuries

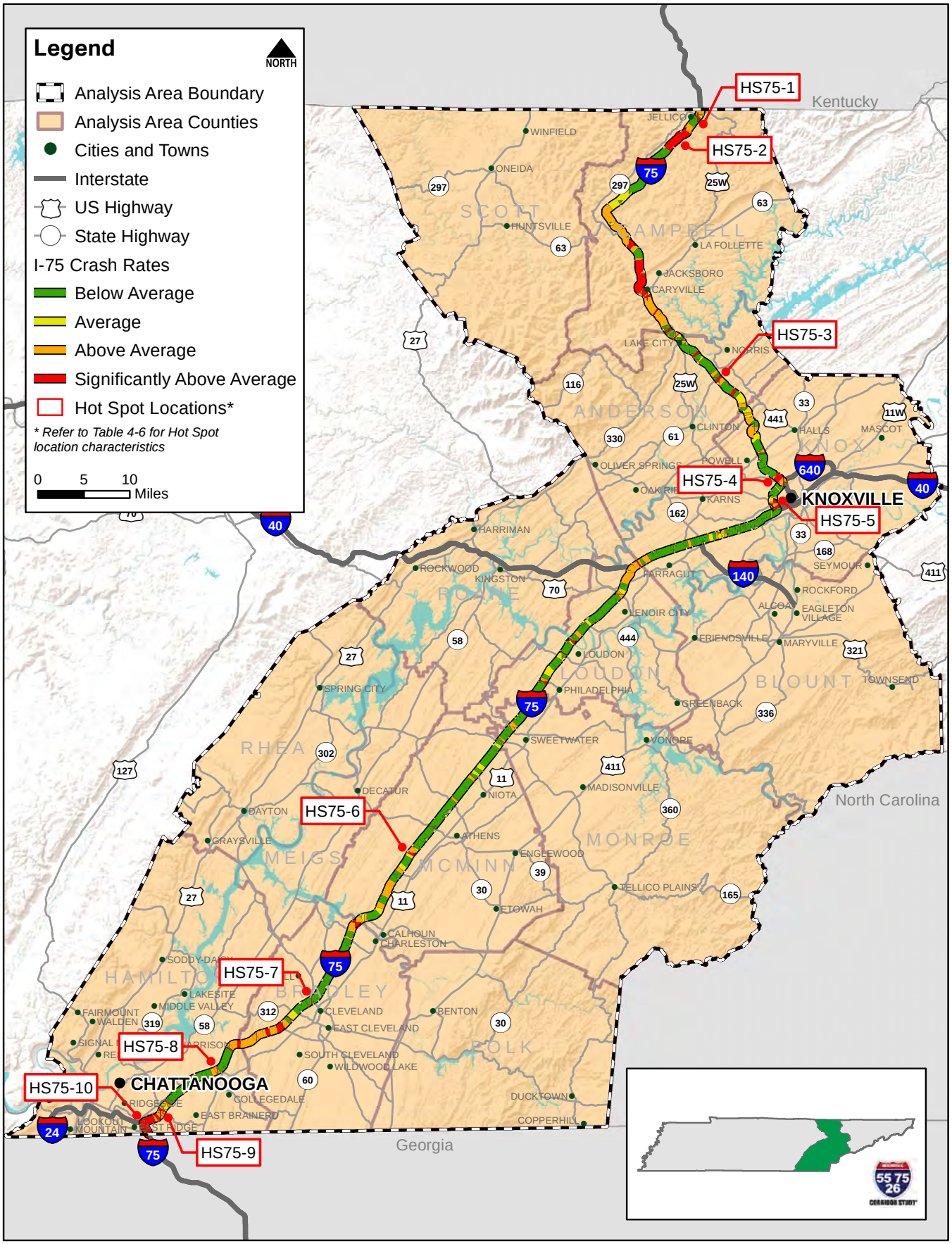
	County								
	Anderson	Bradley	Campbell	Hamilton	Knox	Loudon	McMinn	Monroe	Total
2014	17	46	59	107	158	32	42	12	**473**
2015	11	64	72	137	188	38	42	13	**565**
2016	20	64	46	144	221	44	39	10	**588**
2017	24	55	85	153	206	35	48	15	**621**
2018	16	61	62	156	216	23	47	12	**602**

Fatalities

	County								
	Anderson	Bradley	Campbell	Hamilton	Knox	Loudon	McMinn	Monroe	Total
2014	1	2	3	1	7	3	3	1	**21**
2015	0	0	0	4	7	1	5	1	**18**
2016	0	0	0	1	3	4	2	0	**10**
2017	0	0	0	1	2	2	3	2	**10**
2018	0	0	0	0	0	0	0	1	**1**

Source: Tennessee Roadway Information Management System (TRIMS) - 2017

Figure 4-1. Crash Rates (2014-2018) — I-75



Source: Tennessee Roadway Information Management System (TRIMS) - 2017

rates were calculated for the I-75 study corridor during the five-year period spanning 2014-2018. These rates are reported in terms of crashes per million vehicle miles traveled. Figure 4-1 shows the comparison of these rates to the statewide averages for facilities of a similar type. More specifically, the statewide average crash rate is 0.528 crashes per million vehicle miles traveled for rural freeways and 1.112 crashes per million vehicle miles for urban freeways. I-75 crash rates were compared to the Tennessee statewide averages based on the following metrics:

- **Below Average**: Locations with crash rates below the statewide average
- **Average**: Locations with crash rates at or within 15 percent above the statewide average
- **Above Average**: Locations with crash rates between 15 and 100 percent above the statewide average
- **Significantly Above Average**: Locations with crash rates greater than or equal to 100 percent higher than the statewide average

Areas where the crash rates were significantly above statewide averages were identified as hot spots and are shown in Figure 4-1 in red. Table 4-2 shows the miles of I-75 in each county and the number and proportion of miles that have crash rates significantly above average. In addition, Table 4-2 shows the number of crashes that occurred on those hot spot roadway segments

Table 4-2. Hot Spot Crashes – I-75

County	Total Miles in County	Number of Miles in Hot Spots	Crashes 2014-2018
Anderson	12.1	0.9 (7.4%)	4
Bradley	19.3	1.7 (8.8%)	275
Campbell	31.6	8.0 (25.3%)	510
Hamilton	15.7	3.3 (21%)	1,260
Knox	29.7	1.0 (3.3%)	435
Loudon	19.2	0.44 (2.3%)	48
McMinn	25.0	0.35 (1.4%)	25
Monroe	6.5	0.1 (1.5%)	0
Total	**159.1**	**15.8 (9.9%)**	**2,557**

Source: Tennessee Roadway Information Management System (TRIMS) - 2017

between 2014 and 2018. Within these areas, crashes were examined by severity as well as the manner in which the collision occurred to determine if there were any obvious trends in the crashes that have occurred.

Potential Crash Factors

Urban and rural Interstates have fundamentally different characteristics with regard to density of interchanges, congestion levels, surrounding land use, and travel patterns. Knowing that these characteristics play a role in roadway safety, crashes occurring in hot spot locations were broken down into two categories: crashes that occurred in rural areas and crashes that occurred in more urban areas. For the I-75 corridor, urban and rural hot spot locations were identified based on the functional classification of the Interstate segment. Approximately 11.4 miles of the I-75 corridor are located in rural areas identified as a crash hot spot. This represents 75% of all the hot spot mileage for the corridor. Correspondingly, approximately 3.9 miles of the I-75 corridor (25%) are located in urban areas identified as a crash hot spot.

There were 899 crashes in rural hot spots and 1,658 crashes in urban hot spots between 2014 and 2018. A comparison of the crash patterns for these locations along with the overall crash statistics for all hot spot locations is shown in Table 4-3, 4-4, and 4-5. More specifically, this table highlights different crash patterns that are expected to potentially be different in rural and urban areas, namely the manner of collision and lighting conditions. In urban areas where congestion is more prevalent, it is expected that rear-end crashes are more common than some other types of collisions. As shown, rear-end crashes account for approximately 55% of all hot spot crashes in urban areas, compared to 28% in the rural areas. In rural areas, crashes in hot spots most often did not involve another vehicle. In fact, of the 449 rural crashes that did not involve a motor vehicle, nearly 60% involved vehicles hitting a roadway barrier (e.g. guardrails, cable barrier, fence, etc.) and 5% of crashes involved vehicles hitting an animal, such as a deer. During a field review, it was observed that there were no cable barriers in the median between US-64 and US-74. In both rural and urban areas, sideswipe crashes, most often in the same direction, also account for a significant portion of crashes in the hot spot locations. Of note is that a total of 136 hot spot crashes involved tractor trailers (with a total of 793 along the entire corridor), representing approximately five percent of all hot spot crashes.

Table 4-4 shows the difference in lighting conditions within the crash hot spots along the I-75 corridor. While crashes during daylight hours are the most prevalent in both urban and rural hot spots alike, the percentage of crashes occurring in unlit dark conditions in rural hot spots is approximately five times the corresponding percentage in urban hot spots. During a field review, it was observed that the white striping on concrete sections near Hamilton Place Mall was difficult to see in bright conditions during the day.

For the severity of crashes in hot spots, there is little discernable difference in crash characteristics

Table 4-3. Collision Trends — I-75

Manner of Collision	Urban Areas		Rural Areas		All Crashes
Angle	97	6%	36	4%	5%
Head-On	4	0%	3	0%	0%
No Collision with Vehicle	240	14%	449	50%	27%
Other	143	9%	39	4%	7%
Rear-End	908	55%	248	28%	45%
Sideswipe	266	16%	124	14%	15%

Source: Tennessee Roadway Information Management System (TRIMS) - 2017

Table 4-4. Lighting Trends — I-75

Lighting Conditions	Urban Areas		Rural Areas		All Crashes
Dark – Lighted	225	14%	25	3%	10%
Dark – Not Lighted	62	4%	192	21%	10%
Dawn/Dusk	81	5%	29	3%	4%
Daylight	1,149	69%	613	68%	69%
Unknown	141	9%	40	4%	7%

Source: Tennessee Roadway Information Management System (TRIMS) - 2017

Table 4-5. Severity Trends — I-75

Crash Severity	Urban Areas		Rural Areas		All Crashes
Fatal	0	0%	2	0%	0%
Injury	268	16%	192	21%	18%
Property Damage	1,390	84%	705	78%	82%

Source: Tennessee Roadway Information Management System (TRIMS) - 2017

between urban and rural areas. As shown in Table 4-5, approximately 20% of all hot spot crashes resulted in an injury and 80% resulted in property damage only. There was a total of two fatalities in crash hot spots from 2014-2018, both of which occurred in rural areas.

Geometric Safety Analysis

Given the topography along portions of I-75, the vertical grade of hot spots along the corridor was examined using TRIMS data, where available. The weighted average (by length) percent grade was calcuated using this data. This analysis showed that the weighted average percent grade is approximately 2.5% for hot spots compared to 2.3% for the entire corridor. Although the average grade in hot spots is slightly

higher than the larger corridor, it is not anticipated that the grades along I-75 contribute significantly to the above-average crash rates calculated for these segments of I-75. During a field review, several safety issues related to geometry were observed. These issues included:

- A short weave was created by loop ramps at SR-317/Bonnie Oaks Drive.
- At US-324, the westbound right-turn onto the northbound I-75 on-ramp has a steep downgrade and sharp right turn. The US-324 on-ramp also has a short merge on an upgrade. Truck traffic was also observed at this interchange.
- At the I-75 northbound exit to US-321, there is a steep downgrade with a short deceleration to a 30 mile per hour ramp.
- The Campbell Station Road eastbound exit from I-75 does not have a deceleration lane, only a tapered lane, making it difficult for cars to slow down quickly when leaving I-75.
- The I-75 and Careyville interchange (Exit 134) is a series of short, curvy ramps, including slip ramps.
- Weaving caused by two loop ramps at the US-25W interchange near Jellico.

Table 4-6. Hot-Spot Crash Location Characteristics – I-75*

	Hot Spot ID				
	HS75-1	**HS75-2**	**HS75-3**	**HS75-4**	**HS75-5**
Termini	South 5th Street	Jellico Mountain Area	Charles G. Sevier Highway	Merchants Drive to I-640 Interchange	Western Avenue
Number of Crashes	269	476	30	307	121
Severity (Fatal or Injuries)	26% (71)	19% (90)	20% (6)	17% (53)	18% (22)
Prevelant Collision Types	75% (202) Non-Vehicle 12% (32) Rear-End	48% (230) Non-Vehicle 26% (124) Rear-End 18% (85) Sideswipe	43% (13) Non-Vehicle 33% (10) Rear-End	71% (217) Rear-End 13% (41) Sidewsipe	14% (17) Non-Vehicle 74% (89) Rear-End
Non-Vehicle Trends	59% (120) Roadway Barrier	55% (127) Roadway Barrier	38% (5) Roadway Barrier	N/A	59% (10) Roadway Barrier
Congestion Trends	N/A	N/A	50% (5) of Rear-End Crashes Occurred During Peak Periods	57% (123) of Rear-End Crashes Occurred During Peak Periods	69% (61) of Rear-End Crashes Occurred During Peak Periods
Truck Trends	N/A	12% (59) of Crashes Involved Heavy Vehicles	N/A	N/A	N/A
Lighting/ Weather	19% (50) in Dark-Unlit Conditions 77% (206) in Rain/Snow	22% (107) in Dark-Unlit Conditions 26% (122) in Rain/Snow	17% (5) in Dark-Unlit Conditions	18% (55) in Rain/Snow	24% (21) in Rain/Snow
Interchange Related	N/A	N/A	23% (7)	20% (60)	14% (17)
Curvature Issues	Horiz.: 41% (110) Grade: 4% average	Horiz.: 39% (184) Grade: 3% average	Horiz.:100% (30) Grade: 1% average	Horiz.: 5% (15) Grade: 2% average	Horiz.: 51% (62) Grade: 3% average
Potential Crash Factors	• Limited visibility of roadway barriers in inclement weather • Small inside shoulder width near roadway barriers • Steep grades may cause speeding and loss of control in inclement weather	• Limited visibility of roadway barriers in inclement weather • Small inside shoulder width near roadway barriers • Steep grades may cause speeding and loss of control in inclement weather	• Peak-Hour congestion	• Peak-Hour congestion	• Peak-Hour congestion in AM specifically • Potential weaving issues for vehicles entering on Western Avenue heading SB to I-40/I075 interchange

* Table is continued on next page

Source: Tennessee Roadway Information Management System (TRIMS) - 2017

Table 4-6. Hot-Spot Crash Location Characteristics (continued) – I-75*

	Hot Spot ID				
	HS75-6	**HS75-7**	**HS75-8**	**HS75-9**	**HS75-10**
Termini	McMinn County Rest Area	Georgetown Road	US-64	East Brainerd Road	I-24/I-75 Interchange
Number of Crashes	15	14	145	332	1,695
Severity (Fatal or Injuries)	33% (5)	0%	21% (31)	15% (51)	17% (295)
Prevelant Collision Types	73% (11) Non-Vehicle	43% (6) Non-Vehicle 21% (3) Angle 36% (5) Rear-End	43% (62) Non-Vehicle 34% (49) Rear-End 14% (21) Sideswipe	16% (54) Non-Vehicle 39% (129) Rear-End 28% (92) Sideswipe	18% (300) Non-Vehicle 53% (901) Rear-End 17% (293) Sideswipe
Non-Vehicle Trends	36% (4) Roadway Barrier 55% (6) Vegetation/ Embankment	N/A	73% (45) Roadway Barrier	33% (18) Roadway Barrier	49% (146) Roadway Barrier
Congestion Trends	N/A	60% (3) of Rear-End Crashes Occurred During Peak Periods	45% (22) of Rear-End Crashes Occurred During Peak Periods	50% (65) of Rear-End Crashes Occurred During Peak Periods	47% (427) of Rear-End Crashes Occurred During Peak Periods
Truck Trends	N/A	N/A	10% (15) of Crashes Involved Heavy Vehicles	N/A	5% (93) of Crashes Involved Heavy Vehicles
Lighting/ Weather	33% (5) in Dark-Unlit Conditions	21% (3) in Rain/Snow	23% (33) in Dark-Unlit Conditions 20% (29) in Rain/Snow	21% (69) in Rain/Snow	23% (384) in Rain/Snow
Interchange Related	N/A	71% (10)	28% (40)	17% (57)	N/A
Curvature Issues	Horiz.: 100% (15)	N/A	Horiz.:51% (74) Grade: 2% average	Horiz.: 72% (238) Grade: 2% average	Horiz.: 25% (417) Grade: 2% average
Potential Crash Factors	• Reduced visibility in horizontal curve/ exit ramp during inclement weather and at night	• Small radii for exit ramps	• Peak-Hour congestion • Merging conflicts on entry ramps	• Peak-Hour congestion • Merging/Weaving conflicts on entry ramps in short distance between I-25/I-75 split and East Brainerd Road	• Peak-Hour congestion at I-24/I-75 split

Source: Tennessee Roadway Information Management System (TRIMS) - 2017

Crash Characteristics

In addition to analyzing the hot spots for different urban and corridor-wide characteristics, similar crash characteristics were examined for each hot spot to discern if any patterns indicated deficiencies that could be addressed. Table 4-6 shows the results of this analysis. In general, each of the hot spots were examined for trends in severity, prevalent collision types, non-vehicular accident events, lighting/weather conditions, relation to ramps and interchanges, as well as horizontal and vertical curvature. From these trends, potential crash factors are identified for each location, which will inform the development of safety project solutions.

Pedestrian and Bicycle Crashes

There were 36 non-motorized crashes that occurred

along I-75 or in close proximity to an interchange ramp. Specifically, there were six pedestrian crashes that occurred on I-75, two of which resulted in a fatality and the other four of which resulted in injuries. Pedestrian and bicyclist safety on streets that parallel and intersect I-75 impacts the effectiveness of the transportation system to provide travel options across the corridor. To determine the impact of I-75 on non-motorized safety in the study area, pedestrian and bicyclist crashes within 500 feet of I-75 ramps were analyzed for the five-year period spanning 2014-2018. In total, there were 36 non-motorized crashes involving 10 bicyclists and 26 pedestrians. Of these, three crashes resulted in a fatality and 23 crashes resulted in an injury or possible injury. Geographically, nine of the crashes occurred in Hamilton County, three in Bradley County, one in McMinn County, and 17 in Knox County. Figure 4-2 shows the location of these crashes.

4.2 Existing and Future Deficiencies and Needs

Crashes were analyzed over the five-year period from 2014 to 2018, with crash hot spots identified as locations with crash rates significantly above the statewide average. The safety analysis also examined potential factors at crash hot spots, including crash types, area type, and roadway lighting. Pedestrian and bicycle crashes were examined near interchange ramps. Key findings of the analysis include:

A. Crash Rates and Hot Spots: Crash hot spots were identified as locations with crash rates significantly above the statewide average for similar facilities. Hot spots, ranging from individual roadway segments to longer corridor sections, totaling just over 15 miles of I-75 were documented. Hot spots include:

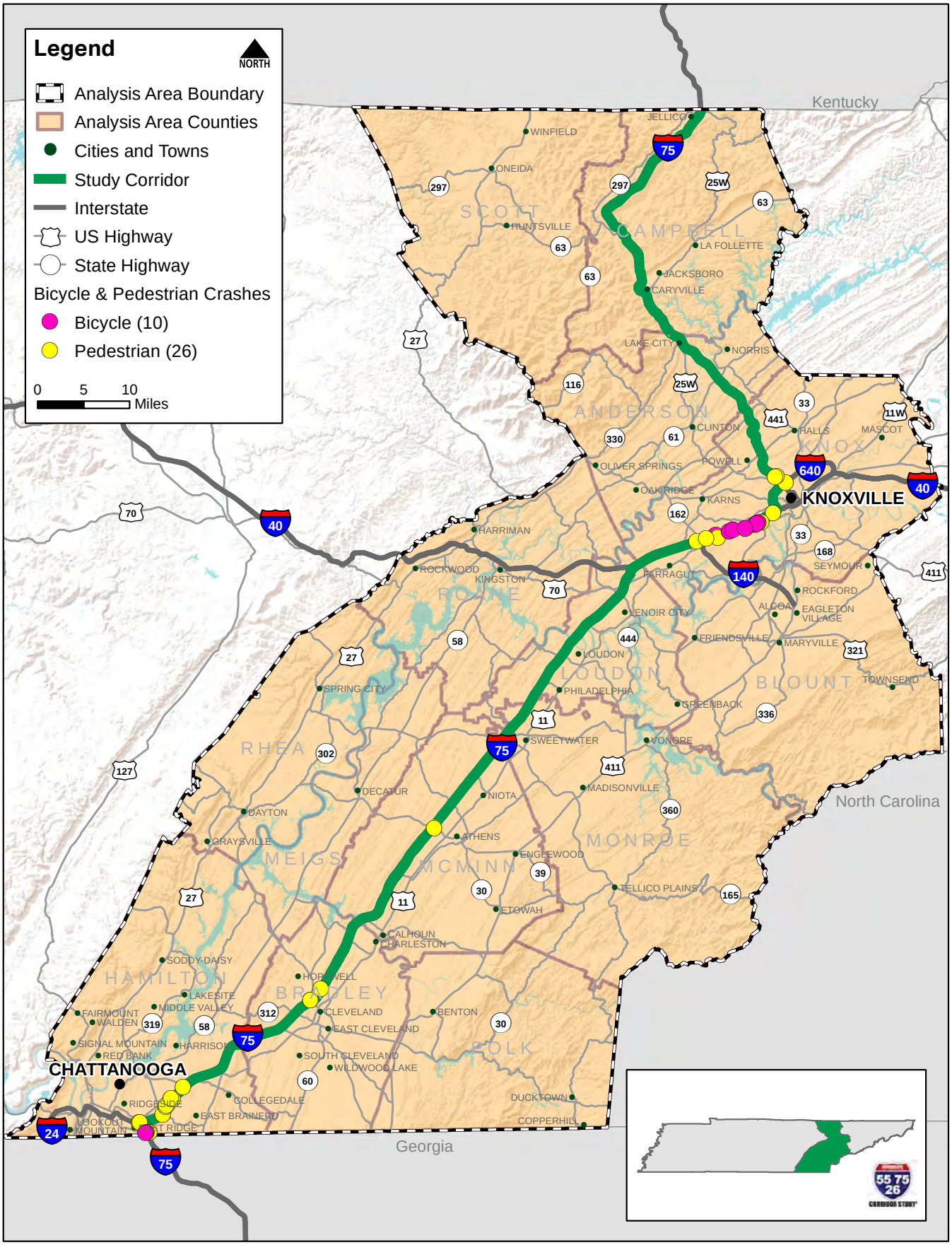
- South 5th Street
- Jellico Mountain Area
- Charles G. Sevier Highway
- Merchants Drive to I-640 Interchange
- Western Avenue
- McMinn County Rest Area
- Georgetown Road
- US-64
- East Brainerd Road
- I-24/I-75 Interchange

Additionally, injuries and fatalities resulting from reported crashes from 2014 to 2018 were compared by county for the study area. While the number of fatalities generally decreased over the five-year period, the number of injuries and overall number of crashes both trended upward.

B. Crash Types: Crash types were initially examined for the identified hot spots, but then were also segregated by area type - rural and urban - to examine trends in crash characteristics. For the hot spot areas, rear-end collisions are the predominant cause of crashes – accounting for approximately 28% of hot spot crashes in rural areas and approximately 55% of hot spot crashes in urban areas. Collisions with objects other than motor vehicles also make up a significant percentage of crashes in rural areas. Sideswipe collisions, predominantly in the same direction, also account for a large portion of crashes in the urban areas. In addition, roadway lighting conditions were examined for both urban and rural areas. Crashes occurring in dark, unlit conditions comprised a larger percentage of crashes in rural hot spots compared to urban hot spots (21% compared to 4%), indicating the potential need for additional Interstate lighting in the more rural areas of the study area.

C. Pedestrian and Bicycle Crashes: Pedestrian and bicycle crashes within 500 feet of an I-75 interchange ramp and along the I-75 corridor were also analyzed for the five-year period 2014-2018. In total, there were 36 crashes involving a pedestrian or bicyclist in this area, the majority of which occurred in Knox County. Of these 36 crashes, 10 involved cyclists and 26 involved pedestrians. Improved non-motorized mobility across the I-75 corridor will be important as urban areas continue to grow.

Figure 4-2. Bicycle and Pedestrian Crashes (2014-2018) — I-75



Source: Tennessee Roadway Information Management System (TRIMS) - 2017

5. Operations and Maintenance

5.1 State of Good Repair

Pavement Sufficiency Rating

TDOT collects and maintains pavement management data for all roads included in the state's network. The Pavement Quality Index (PQI), expressed on a scale from 0-5, is the overall measure of a pavement's roughness and distress. According to TDOT, roadways with a PQI between 1.75 and 3.25 are considered to be in fair condition. Those with a PQI less than 1.75 are considered to be in poor condition. The PQI is calculated based on both the Pavement Distress Index and the Pavement Smoothness Index, the latter of which is a function of the International Roughness Index (IRI). The IRI measures the number of vertical deviations over a section of road, and has been used as a performance measure toward goals set by FHWA since 1998. As of 2006, the Federal Highway Administration (FHWA) designated an IRI equal to 95 inches/mile or less to be representative of a road with good ride quality. The percentage of Interstate miles with IRI less than or equal to 95 inches/mile is shown in Table 5-1. Also shown is the average PQI for Interstates and state routes within the study area that are included on the National Highway System.

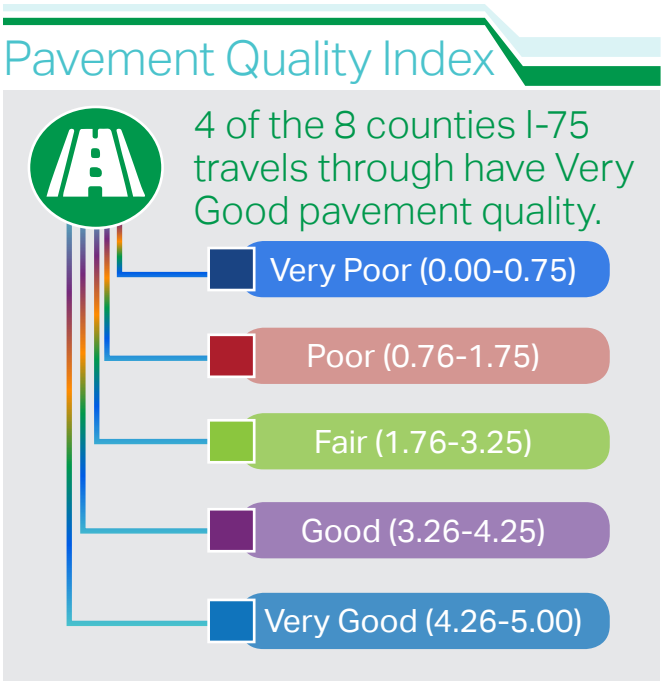


Table 5-1 also indicates dates of most recent resurfacing for I-75 segments in each county (as of 2017), as well as TRIMS sign inventory data, which is used as an indicator of maintenance. As expected, the segments with most pavement distress correspond with the highest maximum annual average daily traffic (AADT). It should be noted, however, that portions of these segments have not been resurfaced since the late 1990s or early 2000s.

Table 5-1. Operations and Maintenance by County (as of 2017) — I-75*

County	Most Recent Reconstruction and Resurfacing (Letting Date)	% of Corridor with Good Ride Quality**	Average PQI	Avg PQI on NHS State Route	Sign Inventory Condition	Max AADT (2017)	% Trucks (2017)
Hamilton	2012 (L.M. 0.0-1.91) 2000 (L.M. 1.91-10.49) 2007 (L.M. 10.49-12.78) 2014 (L.M. 12.78-15.63)	71%	4.0 Good	3.83	94% GOOD 3% FAIR 3% POOR	129,750	17%
Bradley	2014 (L.M. 0.0-2.98) 2007 (L.M. 2.98-9.78) 2009 (L.M. 9.78-15.31) 2007 (L.M. 15.31-17.43) 2006 (L.M. 17.5-19.31)	100%	4.52 Very Good	3.93	91% GOOD 4% FAIR 5% POOR	62,350	24%

* Table is continued on next page

** Good ride quality defined as an IRI equal to 95 or less

Source: Tennessee Roadway Information Management System (TRIMS) - 2017

Table 5-1. Operations and Maintenance by County (as of 2017) — I-75*

County	Most Recent Reconstruction and Resurfacing (Letting Date)	% of Corridor with Good Ride Quality**	Average PQI	Avg PQI on NHS State Route	Sign Inventory Condition	Max AADT (2017)	% Trucks (2017)
McMinn	2006 (L.M. 0.00-4.00) 2017 (L.M. 4.03-13.79) 2007 (L.M. 13.79-17.45) 2007 (L.M. 17.45-25.00)	100%	4.46 Very Good	3.47	91% GOOD 7% FAIR 2% POOR	40,090	34%
Monroe	2016 (L.M. 0.0-6.49)	100%	4.60 Very Good	3.97	86% GOOD 9% FAIR 5% POOR	40,010	34%
Loudon	2013 (L.M. 0.0-7.55) 2002 (L.M. 7.55-7.86) 2009 (L.M. 7.86-18.38)	95%	3.97 Good	3.69	90% GOOD 6% FAIR 4% POOR	54,490	25%
Loudon (I-40/I-75)	1984 (L.M. 4.50-5.58)	95%	3.97 Good	3.69	94% GOOD 6% FAIR	98,880	24%
Knox (I-40/I-75)	2002 (L.M. 0.0-1.98) 2013 (L.M. 1.98-3.29) 1994 (L.M. 3.29-5.75) 2014 (L.M. 5.75-7.11) 2006 (L.M. 7.11-9.81) 1996 (L.M. 9.81-10.15) 2000 (L.M. 10.15 - 11.08) 1995 (L.M. 11.08-12.81) 2002 (L.M. 12.81-14.25) 2015 (L.M. 14.25-16.10)	87%	3.80 Good	3.81	95% GOOD 3% FAIR 2% POOR	210,410	11%
Knox	2013 (L.M. 0.0-3.60) 2009 (L.M. 3.58-6.17) 2005 (L.M. 6.17-8.70) 2010 (L.M. 8.69-13.67)	87%	3.80 Good	3.81	84% GOOD 11% FAIR 5% POOR	86,230	15%
Anderson	2009 (L.M. 0.00-5.21) 2005 (L.M. 5.23-8.28) 2002 (L.M. 8.46-12.12)	98%	4.50 Very Good	3.49	93% GOOD 10% FAIR 7% POOR	51,880	19%
Campbell	2001 (L.M. 0.0-4.96) 2013 (L.M. 4.96-17.37) 2016 (L.M. 5.22-10.30) 2011 (L.M. 17.37-24.4) 2012 (L.M. 24.48-31.64)	88%	4.10 Good	3.51	90% GOOD 5% FAIR 5% POOR	44,060	20%

* Table is continued on next page

** Good ride quality defined as an IRI equal to 95 or less

Source: Tennessee Roadway Information Management System (TRIMS) - 2017

Bridge Conditions

TDOT routinely inspects and evaluates the 19,822 structures designated as public highway bridges in the state. These include bridges owned and maintained by TDOT, as well as those owned and maintained by local governments. TDOT designates a bridge as "structurally deficient" if one or more major structural components are rated in poor condition, or if its load carrying capacity is well below current design standards. Via the Better Bridge Program, the state addressed deficiencies on 193 of the 200 structurally deficient state-owned bridges in 2013. Figure 5-2 illustrates bridge condition data, obtained from TRIMS, for the I-75 corridor. TDOT has identified four structurally deficient bridges along the corridor, including:

- I-75 bridge over the Tennessee River in Loudon County
- I-75 bridge over East Wolf Valley Road in Anderson County
- Dual I-75 bridges over Bruce Gap Road in Campbell County

The Federal Highway Administration's (FHWA) Highway Bridge Replacement and Rehabilitation Program (HBRRP) provides funds to assist states in replacing or rehabilitating deficient highway bridges located on any public road. To be eligible, a bridge must carry highway traffic, be deficient and have a sufficiency rating of 80 or less. The sufficiency rating of an individual bridge, on a scale of 0 to 100, is based on structural adequacy and safety, serviceability and functional obsolescence, and essentiality for public use[1]. A rating of 0 is the worst possible bridge. A sufficiency rating that is less than 50 is eligible for replacement and a sufficiency rating of less than 80 but greater than 50 is eligible for rehabilitation.

Sufficiency rating data was collected from TRIMS and used to identify the number of bridges eligible for rehabilitation or replacement along I-75. Of the 178 bridges on I-75 in the study area, there are no bridges with a sufficiency rating of less than 50. There are 54 bridges with ratings between 50 and 80 and the remaining 124 bridges have sufficiency ratings greater than 80 (Figure 5-2).

5.2 Traffic Incident Management (TIM)

Responding to traffic incidents in an effective and timely manner reduces congestion, wasted fuel, and the likelihood of secondary crashes. The time it takes to respond to an incident and clear the roads is directly related to the likelihood of a secondary crash. This response time can be greatly reduced using ITS technologies, including monitored CCTV cameras, radar detectors to determine travel speeds, and DMS to direct/notify drivers. The highly coordinated incident management process requires accurate and efficient communication among numerous agencies, including:

- Law enforcement
- Fire and rescue
- Emergency medical services
- Public safety communicators
- Emergency management officials
- Towing and recovery
- Hazardous materials contractors (when applicable)
- Traffic information outlets

According to FHWA, national best practices in scene management strategies include:

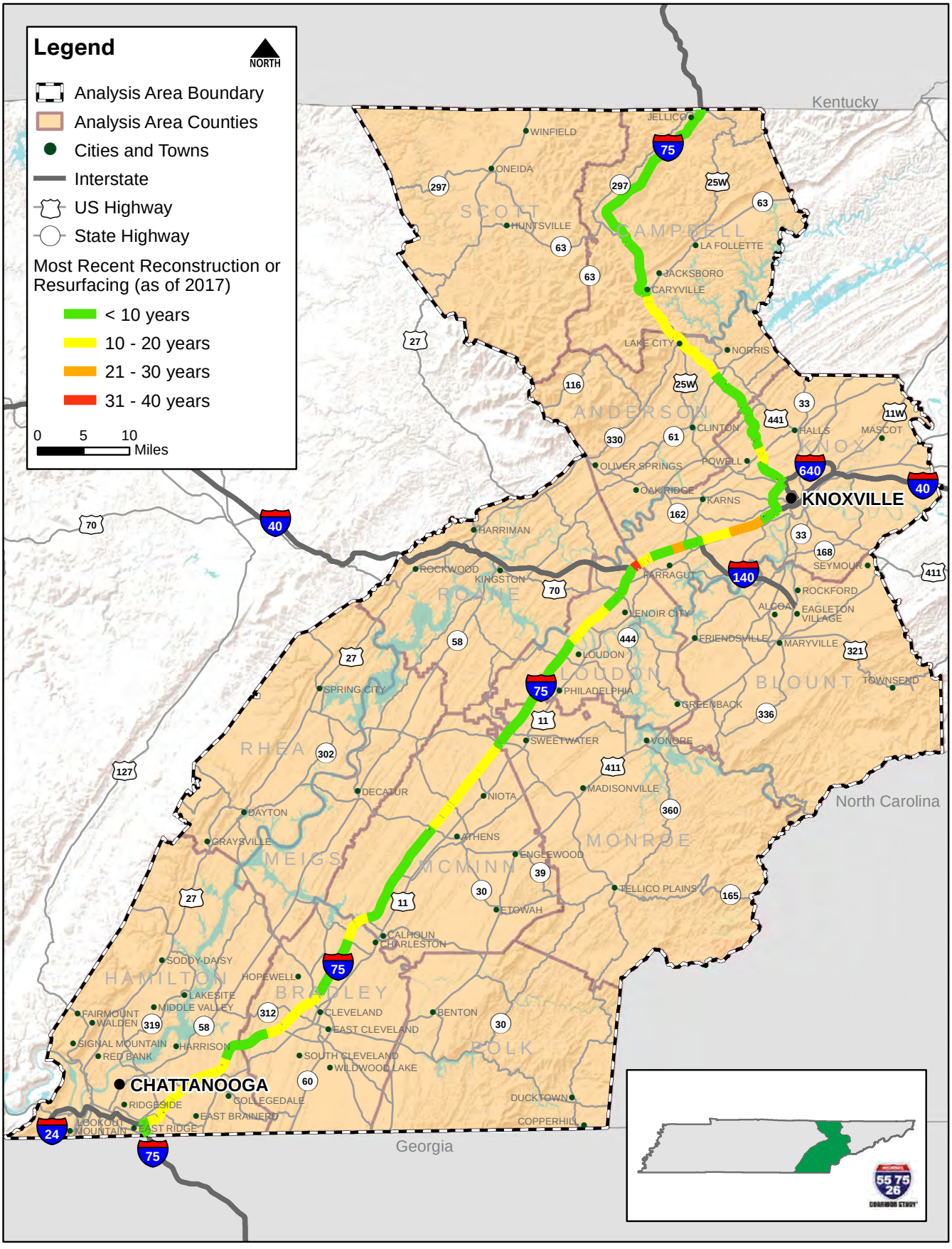
- Incident command systems
- Response vehicle parking plans
- High-Visibility safety apparel and vehicle markings
- On-Scene emergency lighting procedures
- Clearance laws, such as "Move Over"
- Effective traffic control
- End-of-Queue advance warning systems
- Alternative route plans

In addition to TDOT's HELP program, which has been incorporating the latest ITS technologies and strategies since its inception in 1999, TDOT has also established specific, regional Interstate incident management plans focusing on major incidents (those that will require total roadway closure for at least two hours). Goals of these living plans include decreased response time and planned detour routes with appropriate signing so that motorists experience minimal delay in moving toward their destinations. The plans also detail work zone traffic control and point to the regional transportation management centers as the "home base" of coordination and communication during an event. The plans are distributed to regional TDOT Maintenance and Incident Management staff so that the defined detour routes can be implemented quickly upon confirmation of an incident. The Region 1 incident management plan was last updated in 2018. The Region 2 incident management plan was last updated in 2017[2].

Over the last several years, TDOT has taken extra steps to improve traffic incident management, coordination, and safety on the Interstate system within Tennessee. In 2014, in response to proposals by the Tennessee Highway Patrol, TDOT and the Tennessee Department of Safety and Homeland Security opened a TIM Training facility in Nashville. The facility allows emergency

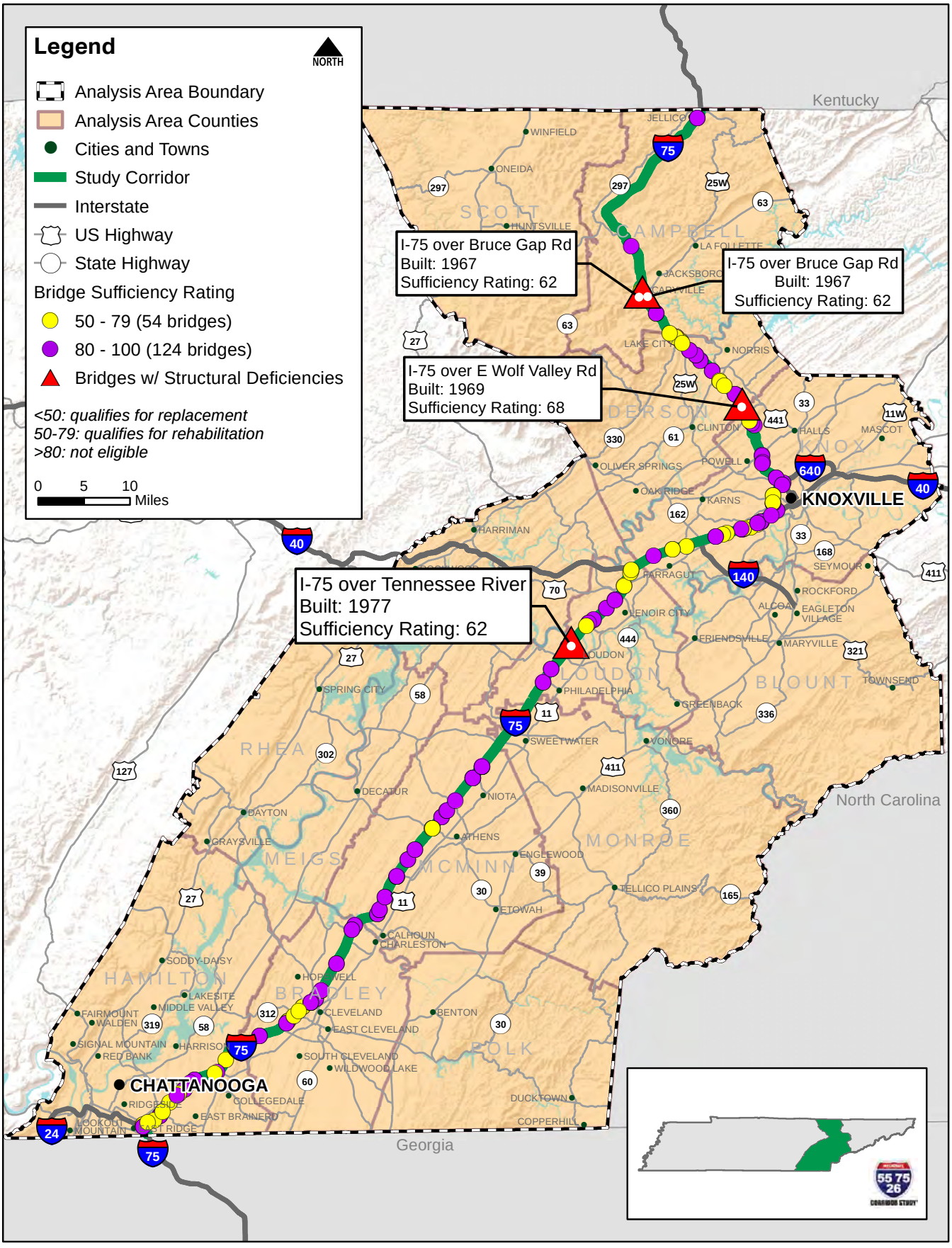
1- Federal Highway Administration. Accessed 08/22/2019. https://www.fhwa.dot.gov/legsregs/directives/fapg/cfr0650d.htm
2- https://www.tn.gov/tdot/traffic-operations-division/transportation-management-office/interstate-incident-management-plan.html

Figure 5-1. Most Recent Reconstruction or Resurfacing — I-75



Source: Tennessee Roadway Information Management System (TRIMS) - 2017

Figure 5-2. Bridge Sufficiency Ratings — I-75



Source: Tennessee Roadway Information Management System (TRIMS) - 2017

responders hands-on quick clearance training in a safe environment[3]. In 2017, Tennessee initiated an annual Highway Safety and Operations Conference with the intent to bring together those involved in highway safety statewide for brainstorming and discussion of best practices[4].

5.3 Intelligent Transportation Systems (ITS)

ITS Device Inventory

TDOT's SmartWay system relies on evolving technology, as well as teams of operators and technicians who monitor the technical systems and provide hands-on assistance through the state's HELP program. Four transportation management centers (TMCs) located across the state anchor the systems operations and communication. From these locations, operators oversee 551 cameras, 183 message signs, 1,107 roadway detection systems and 49 video detection systems across the state. They also maintain communication with the public via messages on dynamic message signs, TN 511 updates, and the SmartWay website. Table 5-2 shows the ITS inventory along the I-75 corridor.

In response to numerous fog-related, severe and fatal crashes on I-75 near the Bradley-McMinn county line, TDOT installed a fog detection and warning system in 1993. This system, which includes forward-scatter visibility sensors, microwave radar vehicle detectors, 21 Closed Circuit Television (CCTV) cameras, six warning signs with flashing beacons, 10 changeable speed limit signs, 10 Digital Message Signs (DMS), and two Highway Advisory Radio (HAR) transmitters, warns drivers within an eight-mile segment of dangerous weather conditions. The Federal Highway Administration (FHWA) has recognized this low visibility warning system as a national best practice for road weather management[5].

Figure 5-3 focuses on Intelligent Transportation System (ITS) devices on I-75 in the Knoxville and Chattanooga areas, showing locations of HAR transmitters, CCTV cameras and DMS. A detailed inventory of existing ITS components on the I-75 Corridor is included in Section 3.2 of Technical Memorandum 1: Corridor Data and Information Inventory. TDOT's HELP program has expanded to cover I-75 from the Georgia state line in Chattanooga to SR-2 and from Watt Road on I-40/I-75 to the I-75/ I-275/US-25W interchange northwest of Knoxville.

In addition to planned ITS and Transit Projects shown in Figure 4-6 of Technical Memorandum 1, it should be noted that the STIP was recently amended to include the following projects applicable to I-75:

Table 5-2. TRIMS ITS Inventory – I-75

County	# ITS Cameras	# ITS Message Signs
Hamilton	15	2
Bradley	12	7
McMinn	13	5
Monroe	0	0
Loudon	10	2
Knox	30	8
Anderson	0	1
Campbell	0	0

Source: Tennessee Roadway Information Management System (TRIMS) - 2017

- STIP # 1707040, Campbell County, I-75 from MM 135 to MM 160.
  - ITS expansion to include installation of power and communication network and ITS devices (CCTV cameras, DMS, Radar Detection System (RDS)). Also the installation of a fog and severe weather detection system over Jellico Mountain.
- STIP# 1754005, McMinn County, I-75 Interchange at SR-30 and SR-305.
  - Interconnecting signals, safety improvements, right turn lanes and realignment of SR-30 at I-75 ramp.

5.4 ITS State of Practice

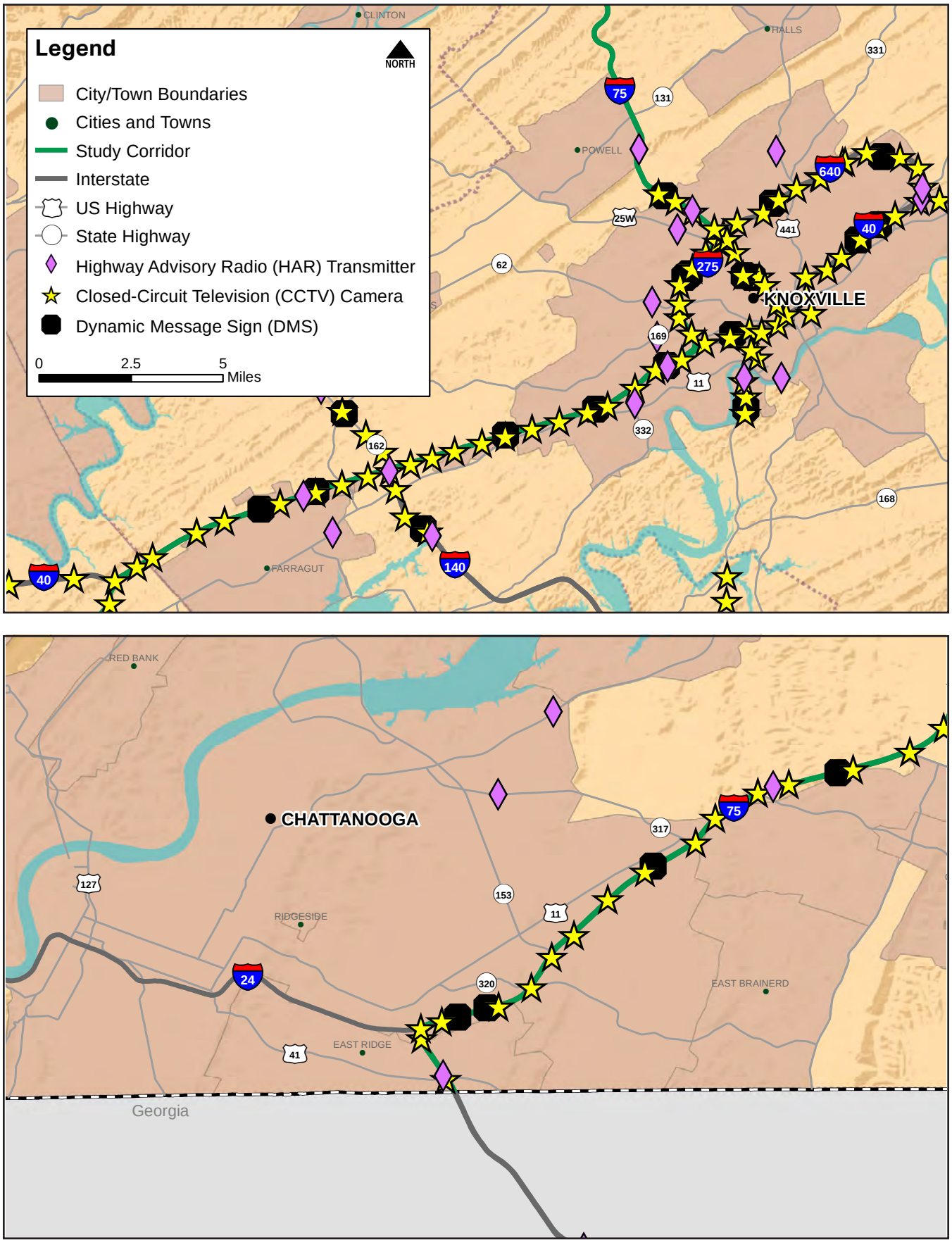
While TDOT maintains a robust ITS system, reviewing national best practices is pertinent in an era of ever-evolving technology. Below are brief summaries of national examples for various ITS focus areas, intended to highlight recent advances. This list of strategies and solutions is not specific to I-75.

Transportation System Management and Operations (TSM&O)

Transportation System Management and Operations (TSM&O) is "a set of strategies that focus on operational improvements that can maintain and even restore the performance of the existing transportation system before extra capacity is needed[6]." As vehicle miles traveled increases and funding decreases, TSM&O strategies- which can also benefit quality of life,

3- https://www.tn.gov/tdot/traffic-operations-division/transportation-management-office/training.html
4- https://www.tn.gov/tdot/traffic-operations-division/transportation-management-office/interstate-incident-management-plan.html
5- https://ops.fhwa.dot.gov/weather/

Figure 5-3. Intelligent Transportation System Components — I-75



Source: Tennessee Department of Transportation

economic vitality, and safety- have received more focus from state transportation departments and metro regions.

TDOT's Traffic Operations Division consists of the following offices, which support TSM&O: Headquarters Traffic Engineering, Intelligent Transportation Systems, and Transportation Management. Recognizing the demand for and benefit of operational improvements, TDOT's Traffic Operations Division includes in its list of responsibilities a national best practice review for TSM&O[7].

The following is FHWA's current example list[8] of TSM&O strategies and solutions, many of which could be utilized on the I-75 Corridor. Asterisks note the strategies that TDOT has implemented in various parts of the state.

- Work Zone Management*
- Traffic Incident Management* (Regional Incident Management Plans)
- Special Event Management*
- Road Weather Management*
- Transit Management
- Freight Management
- Traffic Signal Coordination*
- Traveler Information* (SmartWay)
- Ramp Management
- Congestion Pricing
- Active Transportation and Demand Management*
- Integrated Corridor Management* (I-24 Corridor)
- Access Management*
- Improved Bicycle and Pedestrian Crossings*
- Connected and Automated Vehicle Deployment

Managed Lanes

Managed lanes programs implement pricing and/or incentives for use of dedicated travel lanes – either existing or new construction. These strategies can be adapted in response to changes in demand which results in more reliable travel times, via personal vehicle or transit. Examples of managed lanes include high-occupancy-toll (HOT) lanes, which have been implemented in at least nine states; dedicated bus-rapid-transit (BRT) lanes, such as the Gold Line in St. Paul, MN, that will parallel nine miles of I-94; reversible lanes; and high-occupancy-vehicle (HOV) lanes. Tennessee has dedicated, peak hour HOV lanes on portions of I-65, I-40 and I-55 in the Nashville and Memphis metropolitan areas. These lanes are divided from the standard travel lanes only by striping, and therefore rely on public awareness and enforcement to maintain effectiveness. In some states, physically divided HOV lanes are being combined with HOT lanes and/or BRT strategies.

Active Traffic and Demand Management (ATDM)

States and regions with continuously monitored transportation systems have the ability via new technology to actively monitor capacity and interact with drivers in real time. Active Traffic and Demand Management (ATDM) strategies also boast significant safety benefits. Specific strategies, potentially pertinent to I-75, include dynamic ridesharing, on-demand transit, dynamic pricing, predictive traveler information, dynamic lane use/shoulder control, dynamic speed limits, queue warning, adaptive ramp metering, and dynamic way-finding.

Freight Applications

Because freight trucks play a key role in transportation networks, it is critical to integrate them into ITS. By increasing the overall efficiency of freight trucks, congestion, travel time, travel stop time, and fuel consumption are all reduced. Although large logistics companies often have an in-house ITS in place, local governments can implement systems to help smaller companies, and transportation networks as a whole.

Freight Advanced Traveler Information System (FRATIS) is a collection of methods to help optimize freight operations. The first aspect of this system deals with real-time data, such as current arterial speeds/volumes, weather conditions, road closures, etc. that optimize routes. The second aspect focuses on arrivals and destinations. By combining and analyzing weigh station, delivery point, intermodal terminal, overnight parking, and other information, dry runs, wasted miles, and traffic jams are reduced.

Work Zone Mobility and Safety

Work Zone Mobility and Safety programs are designed to maximize safety, minimize delays, and establish consistency throughout work zones. Every Day Counts (EDC) is an ongoing model created by FHWA that provides a wide variety of innovative ideas to help increase efficiency of roadway projects with a focus on safety.

Many states have implemented safety specific campaigns, such as TDOT's Work With Us. This is a multimedia campaign that aims to remind motorists to take extra caution when passing highway workers. Using an array of delivery methods, such as online videos and graphics or DMS, the Work With Us campaign is able to reach a larger audience than traditional safety campaigns.

6- https://ops.fhwa.dot.gov/tsmo/index.htm
7- https://www.tn.gov/tdot/traffic-operations-division.html
8- https://ops.fhwa.dot.gov/tsmo/index.htm

Integrated Corridor Management (ICM)

Various aspects of corridors are often individually managed by different entities for different goals. Collaboration with transportation professionals in other networks across the corridor allows entities to share resources and information and more effectively meet their goals. Integrated Corridor Management (ICM) aims to improve accessibility, safety, and mobility of users within the corridor through this cooperation between stakeholders. By combining data into a universal system, all appropriate stakeholders, including managers and users, can make more informed decisions for the corridor as a whole. A few attributes of a successful ICM system as described by the FHWA are outlined below:

- Institutional Support
- Multimodal Capabilities and Alternative Transit Options
- Centralized Data Hub
- Public Engagement

Connected Vehicle Technology

Many technologies are being developed that help drivers by providing their vehicles with information about their environment. By communicating with nearby vehicles, traffic signals, work zones, toll booths, or other surroundings, these vehicles will improve efficiency and safety, not just for the user, but others as well. Likewise, these Connected Vehicles (CV) also send information back out to their environment. The devices the CVs communicate with will also provide data, such as speed and volumes, to DOTs to help improve the transportation system. One of the most likely methods for this communication to occur is through Dedicated Short-Range Communication (DSRC). Similar to Wi-Fi, this technology can securely, reliably, and quickly share information between vehicles and surrounding infrastructure.

Governments can help foster growth of connected vehicles by setting up a system in which companies can begin introducing these technologies. TDOT has begun the DSRC Statewide Guidance document as a living resource for implementing a CV project within the state. Although currently in the early stages, once complete, it will provide a reference for organizations to begin implementing these technologies within the state.

Autonomous Vehicle Technology

In May 2017, the Tennessee General Assembly ruled in favor of companies testing autonomous vehicles (AVs) on Tennessee roads so long as federal and state safety standards are met and proper insurance is obtained. Because concerns with CV and AV technology are so closely related, preparation for widespread use is similar. Organizations will use resources such as the DSRC Statewide Guidance document to safely and legally implement AV technology in the future.

Contrary to fully autonomous vehicles, the use of semi-autonomous vehicles is already widespread. For example, since April 2017, platooning has been permitted on Tennessee roads. This is the method in which freight trucks use a system that automatically controls speed and braking by communicating between participating vehicles. This not only improves efficiency by increasing aerodynamics as the trucks can drive closer together, but also safety because the system will automatically apply brakes if it senses a hazard.

5.5 Existing and Future Deficiencies and Needs

A. Pavement Sufficiency Rating: With exception to I-75 in Hamilton County, greater than 87 percent of the roadway miles on I-75 have good ride quality. According to TDOT's 2017 Pavement Management Report, 91% of Interstates in Tennessee have a Good or Very Good pavement quality index (PQI). The majority of Interstate 75 falls into the Good range, with portions in Bradley, McMinn, Monroe and Anderson counties ranking in the Very Good range. Based on TRIMS maintenance history (as of 2017), segments of I-75 in Hamilton, Loudon, and Knox counties have not been resurfaced since the late 1990s/early 2000s.

B. Bridge Conditions: TDOT has identified four structurally deficient bridges along the corridor, including the I-75 bridge over the Tennessee River in Loudon County, the I-75 bridge over East Wolf Valley Road in Anderson County, and the dual I-75 bridges over Bruce Gap Road in Campbell County. Of the 178 bridges on I-75 in the study area, 54 had sufficiency ratings low enough to be eligible for rehabilitiation under the Federal Highway Administration's (FHWA) Highway Bridge Replacement and Rehabilitation Program. No bridges had sufficiency ratings low enough to be eligible for replacement.

C. ITS Devices: The urban areas of the I-75 Corridor are fully integrated into TDOT's SmartWay System and HELP program, with 81 cameras, 140 speed detectors, 26 digital message signs and access to 34 HELP trucks. Chattanooga's Regional ITS Architecture Report was last updated in 2017; Knoxville's was updated in 2012; and TDOT's statewide ITS architecture report was last updated in 2006.

D. ITS Strategies: Both TDOT and local agencies continue to invest in Transportation System Management and Operations (TSM&O) strategies and technologies. Foreseeing continued growth in traffic volumes and limited funding for increased capacity, consideration should be given to strategies such as high-occupancy-toll (HOT) lanes or dedicated bus-rapid-transit (BRT) lanes; freight applications and signal coordination on adjacent arterial streets to alleviate some congestion due

to heavy vehicles; dynamic speed limit signs; and end of queue advance warning systems for incident management and safety on commonly congested areas.

Coordination and enhanced communication should continue between TDOT and local agencies / programs as each further develops its ITS toolbox.

6. Transit

The I-75 study area is served by three transit agencies:

- KAT (Knoxville Area Transit)
- CARTA (Chattanooga Area Regional Transportation Authority)
- CUATS (Cleveland Urban Area Transit System)

All three transit agencies offer several fixed bus routes, two offer on-demand, paratransit service and one offers a free downtown trolley service. Despite three different transit agencies, a vast majority of the I-75 corridor is without mass transit. The existing transit agencies serve local residents but miss regional connections for commuters. Figure 6-1 displays the service area for all three transit operations in the I-75 corridor study area in addition to areas of high employment concentration. While transit coverage is good in urban areas, the map displays the lack of regional connections and missed opportunities to dense employment areas that would be valuable for commuters.

6.1 Fixed-Route Transit Service

Knoxville

KAT offers more than 20 fixed bus routes, a free downtown trolley, and on-demand paratransit services throughout the City of Knoxville. KAT's fixed bus routes reach over 80% of Knoxville residents within a half mile of their home[9]. Still, KAT fixed bus routes have long headways between 30 and 60 minutes during the week and 60 or more minutes on weekends. KAT's fixed bus routes have headways of 15 minutes along main corridor routes and 30-60 minutues on less utilized routes. KAT recently moved operations to a newly completed, state-of-the-art transit center called Knoxville Station. Table 6-1 lists KAT routes near I-75.

KAT bus service provides good access to activity centers within the City of Knoxville but misses key connections in the larger region. One opportunity is the McGhee Tyson airport, the largest airport in the Knoxville region[10]. In addition to key regional activity centers, Knoxville has no true commuter routes and limited service to surrounding communities.

Table 6-1. KAT Routes Near I-75

Route Number	Current Daily Ridership
Route 11: Kingston Pike	1,175
Route 16: Cedar Bluff Connector	123
Route 22: Broadway	1,212
Route 24: Inskip/Breda	109
Route 90: Crosstown	340

Source: Knoxville Area Transit

Knoxville Regional Transit Corridor Study

The Knoxville Regional Transit Corridor Study was sponsored by the Knoxville Regional Transportation Organization (TPO). The study was completed in 2013 and served as the initial phase of planning development to seek Federal Transit Authority (FTA) New Starts or Small Starts funding[11]. The study considered several potential transit corridors in Knox, Blount, Loudon, Sevier, and Anderson counties. Several of the identified transit corridors would close gaps in KAT service including a connection to the Tyson McGhee airport and a connection to suburban communities including Oak Ridge. Though this study was released in 2013, it appears most of the regionally identified transit corridors have not been implemented[12]. Figure 6-2 displays the potential transit corridors identified in the study.

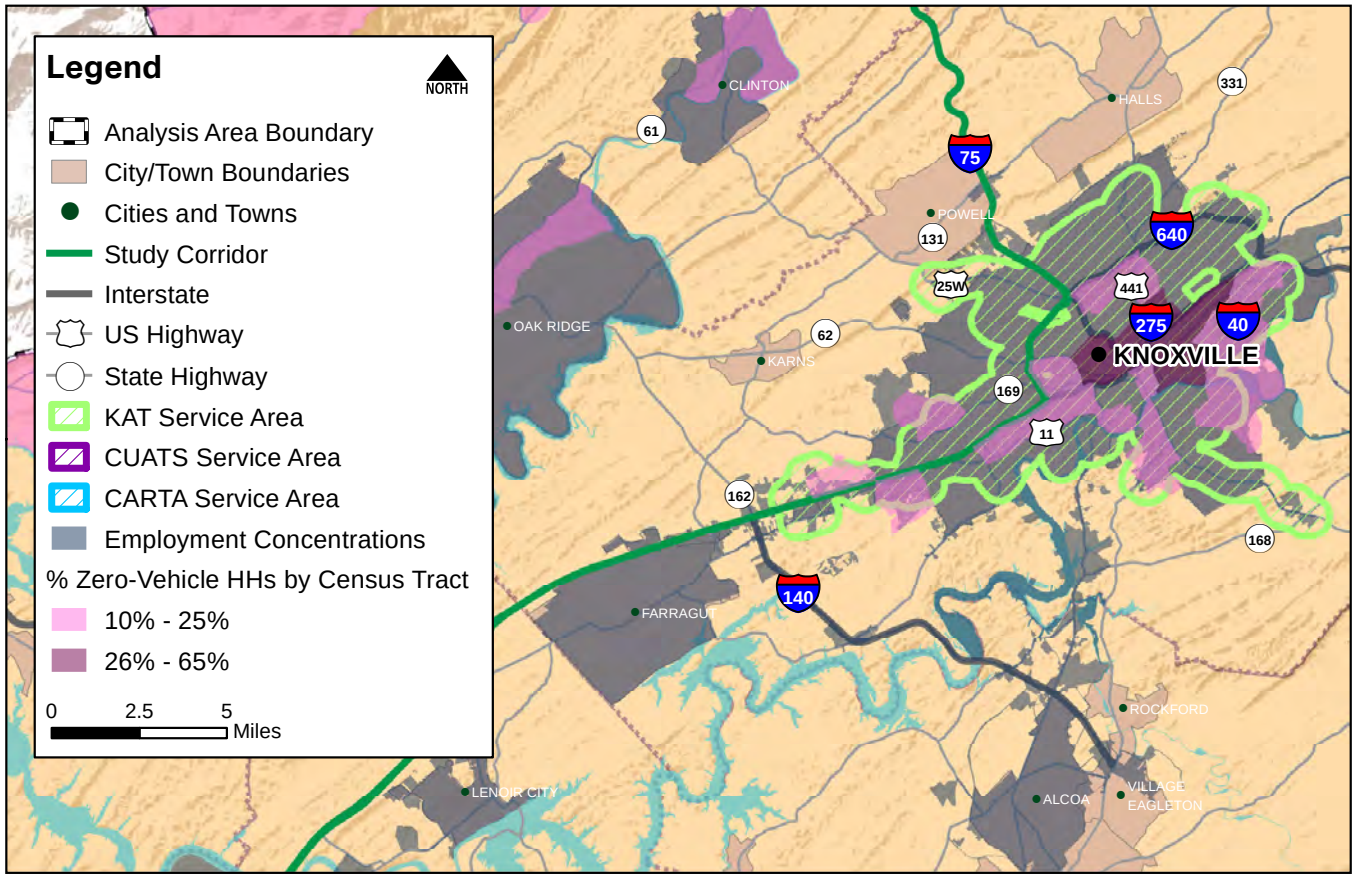
Mobility 2040: Connecting People and Places

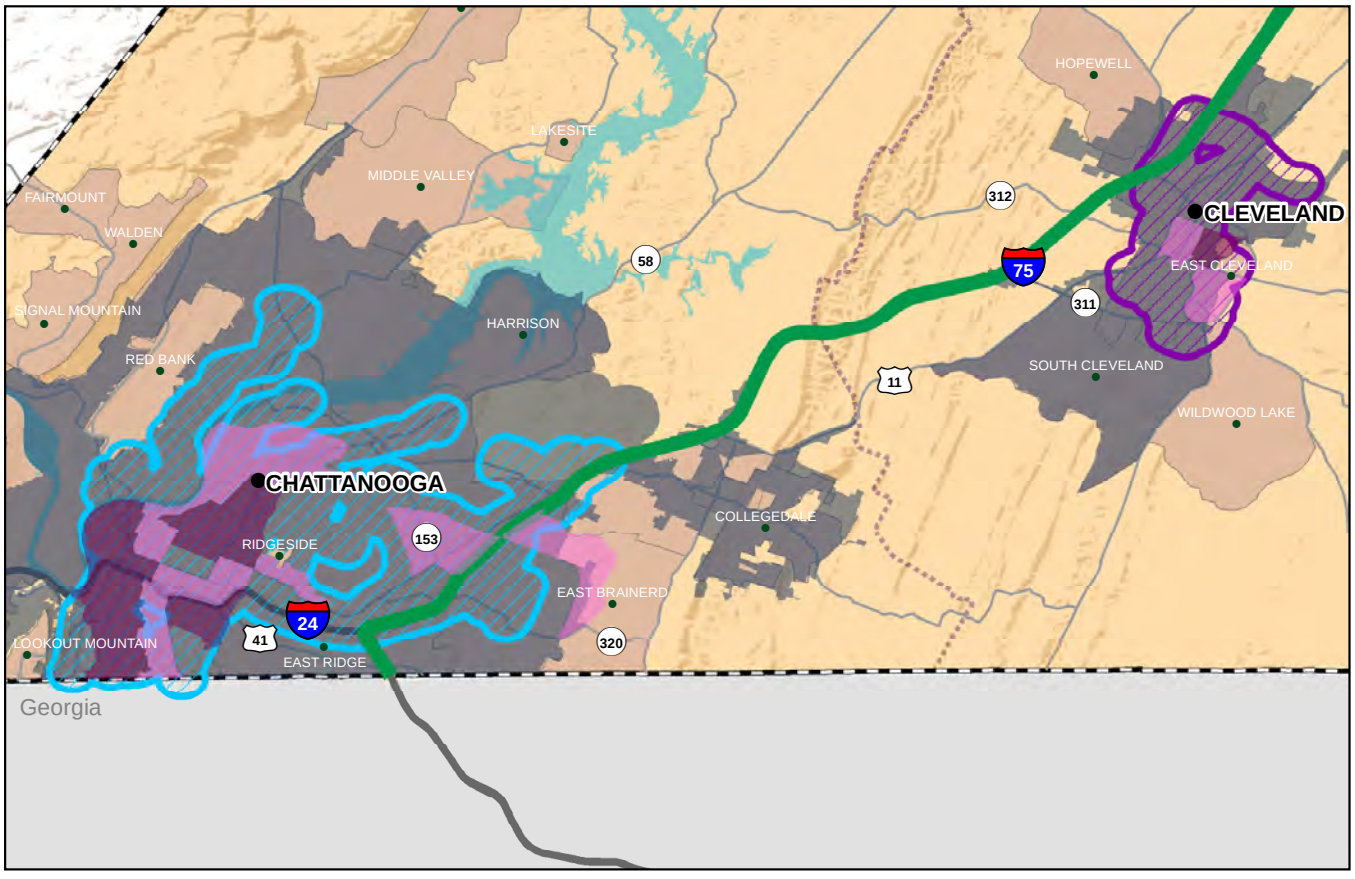
The Mobility Plan 2040 was approved in April 2017 and developed by the Knoxville Regional Transportation Planning Organization (TPO). The plan calls for $900 million in spending for transit from 2018 – 2040. While most of the money will be spent on maintaining existing bus service there is some money available for expansion and modernization[13]. While no specific transit projects are listed, the plan outlines key strategies including:

- Enhance connections between activity centers through access to transit
- Increase mobility and access to opportunities by coordinating land use and transportation planning

9- Knoxville Area Transit. Access 03/11/2019. https://www.katbus.com/172/Bus-Routes
10- Knoxville Area Transit System Map. Accessed 04/15/2019. https://katbus.com/148/Schedules-Maps.
11- Knoxville Regional Transit Corridor Study. Access 03/10/2019. https://knoxtrans.org/plans/rtcs/krtcs_final_2013.pdf
12- Knoxville Regional Transit Corridor Study. Access 03/10/2019. https://knoxtrans.org/plans/rtcs/krtcs_final_2013.pdf
13- Mobility Plan 2040. Access date 03/14/2019. https://knoxmobility.org/wp-content/uploads/2018/09/Mobility-Plan-2040.pdf

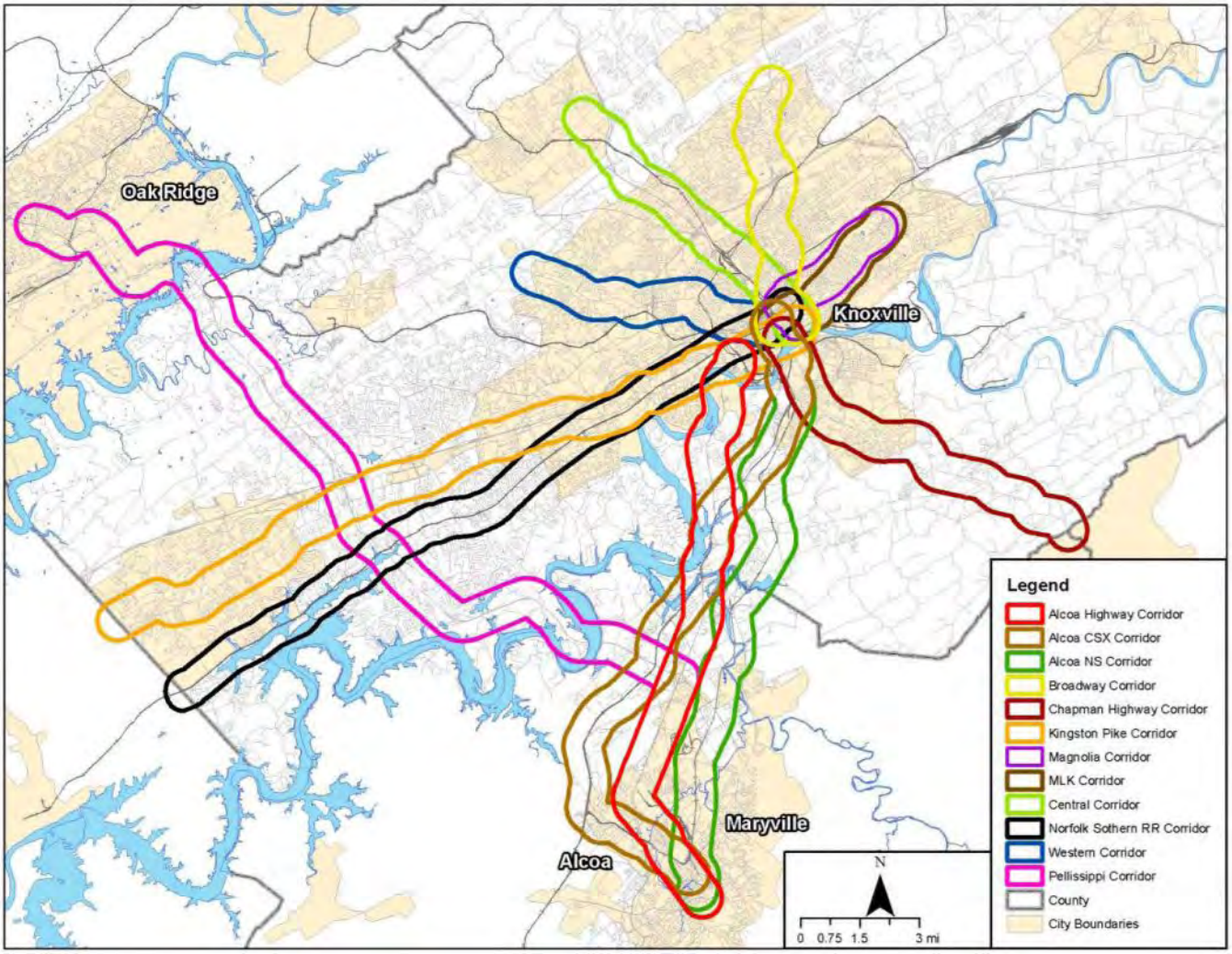
Figure 6-1. Transit Operations — I-75





Sources: U.S. Census Bureau, Knoxville Area Transit, Cleveland Urban Area Transit System, Chattanooga Area Regional Transportation Authority

Figure 6-2. Transit Corridors Studied in the Knoxville Area



Source: Chattanooga Area Regional Transportation Authority

- Promote projects that improve multi-modal connections between existing transit and surrounding communities

The Mobility Plan also notes the number of people commuting to another county for work is increasing. Knox County is the major attractor for employment, with more than 50,000 people commuting to Knox County each day from other counties in the region.

Chattanooga

CARTA offers over twenty fixed bus routes in addition to several dial-a-ride routes, a downtown shuttle and on-demand paratransit service. In addition to these transit services, CARTA also operates nine park-and-ride locations. Several of CARTA's fixed bus routes run near the Chattanooga Metropolitan Airport including Route 19, which serves the airport itself.

While there are no Amtrak stations in the Chattanooga region, CARTA does serve the Greyhound Bus line near the Chattanooga Metropolitan Airport. Despite Chattanooga's MPO extending into the state of Georgia, CARTA's service stops at the Tennessee state line. In addition to not servicing northern Georgia, CARTA has identified several transit gaps including high density neighborhoods, a connection to nearby Cleveland and other activity centers[14]. These transit gaps were identified in Chattanooga's updated long-range transportation plan. Table 6-2 lists CARTA routes near I-75.

CARTA offers fixed bus service throughout the City of Chattanooga, stopping at many key activity centers including the Chattanooga Metropolitan Airport. In addition to serving activity centers, CARTA serves several park and ride lots throughout the region. While CARTA serves a large portion of the Chattanooga region, larger regional connections are missed, including service to Cleveland and northern Georgia.

14- Chattanooga-Hamilton County/North Georgia 2045 Regional Transportation Plan Update. Accessed 03/11/2019. https://drive.google.com/file/d/1e0PtFWlSnWrkIApDigTFjhhmuGeN7GhX/view

Table 6-2. CARTA Routes Near I-75

Route Number	Current Daily Ridership
Route 3: Enterprise South	64
Route 4: Eastgate/Hamilton Place	1,801
Route 19: Cromwell Road	66

Source: Knoxville Regional Transit Corridor Study

Chattanooga-Hamilton County/North Georgia 2045 Regional Transportation Plan Update

Chattanooga's Transportation Planning Organization (TPO) recently adopted the 2045 Regional Transportation Plan in 2019. The plan outlines existing transportation, deficiencies and future transportation projects throughout the Chattanooga TPO boundary. While CARTA service serves the City of Chattanooga, it falls short in providing service to the surrounding region, including northern Georgia. In addition to not providing service to Northern Georgia, the Regional Transportation Plan outlines other gaps in CARTA service based on identified, high transit demand locations. The plan defines high transit demand areas based on areas of high density, good walkability and areas with high proportion of low-income, minority and elderly residents[15]. The plan continues to note the key priority areas to address are connections to North Georgia, the nearby City of Cleveland and key employment clusters such as Enterprise South. Figure 6-3 depicts the transit gaps identified in the plan.

Cleveland

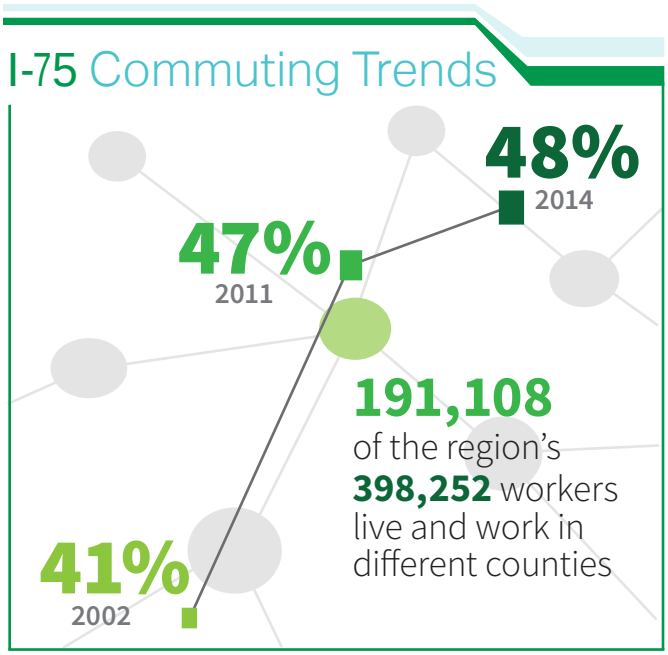
Cleveland Urban Area Transit System (CUATS) offers five fixed bus routes throughout the City of Cleveland. In addition to the five fixed bus routes, CUATS offers an on-demand paratransit service. CUATS service operates Monday – Friday from 6:00am – 7:00pm and is closed on major holidays. Each route operates one bus at a time and takes an hour to complete the route, meaning wait times between buses are 60 minutes. While CUATS serves the City of Cleveland well, no routes extend beyond the City limits and no commuter routes between Chattanooga and Cleveland currently exist. Cleveland Urban Area Metropolitan Planning Organization's 2040 Regional Transportation Plan notes that a large portion of Cleveland's residents commute to Chattanooga for work[16].

CUTAS's Orange Route was identified as a key bus route due to its proximity to I-75. The Orange route doesn't run on I-75 but crosses I-75 several times and runs parallel to the corridor. At this time, daily ridership for CUATS routes is not available.

CUATS offers fixed bus service throughout the City of Cleveland. Despite only having a few bus routes, CUATS does a great job serving major activity centers. CUATS routes begin in downtown Cleveland and loop to a large activity center before heading back downtown. Where CUATS falls short is not providing service on evenings, weekends and holidays. Additionally, existing CUATS service has long headways of 60 minutes.

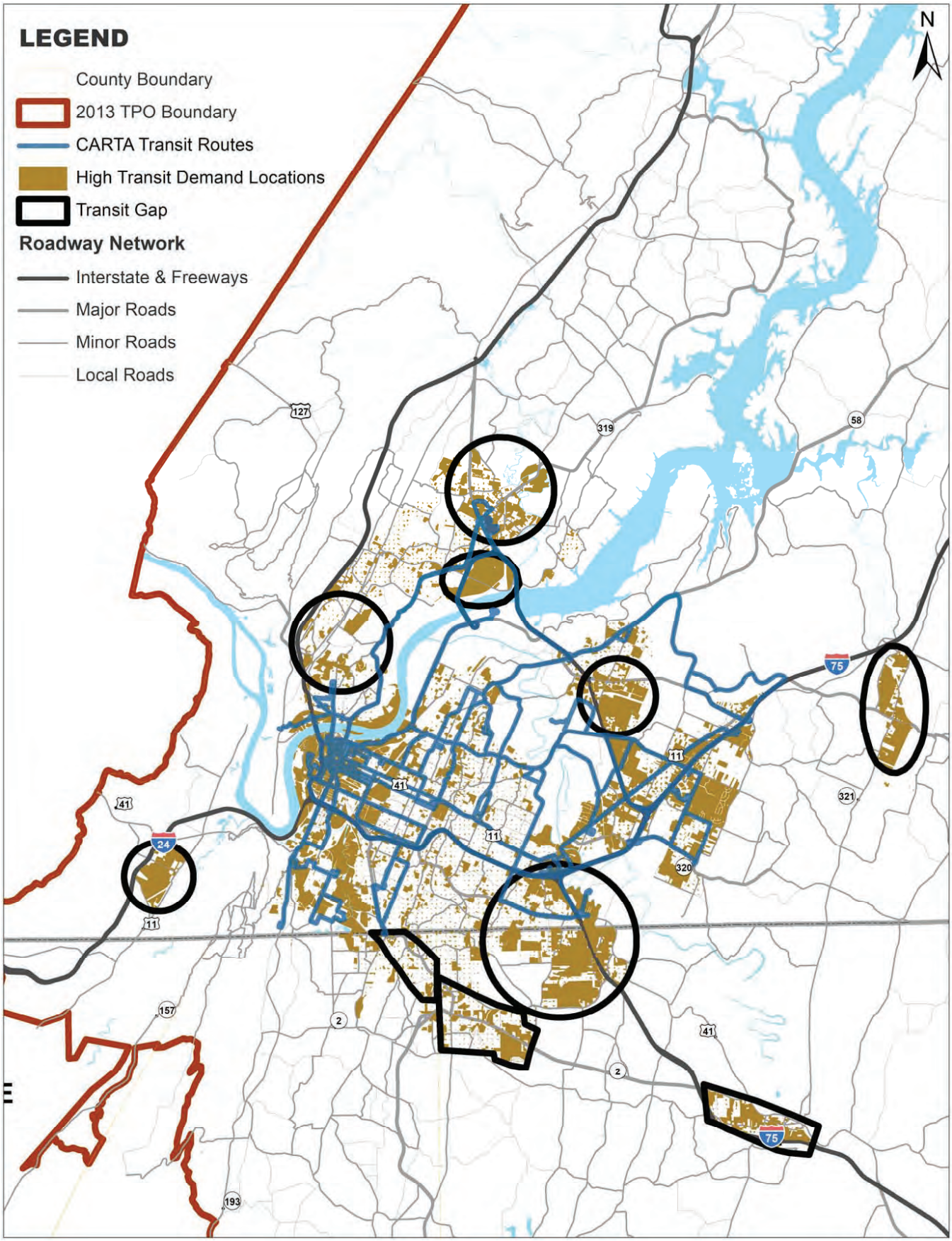
Cleveland Urban Area MPO 2040 Regional Transportation Plan

The Cleveland 2040 Regional Transportation Plan was adopted in 2016 and was one of the first plans completed after Cleveland's MPO expanded to include more of Bradley County and part of McMinn County. Cleveland's expanded MPO boundary is the result of population increase in the area, specifically around the I-75 corridor[17]. The 2040 Regional Transportation Plan highlights several goals including: 'Increase the availability of safe, convenient transportation choices that citizens can use to access jobs, essential services, and community activities[18]. One way they hope to meet this goal is by expanding transit services and hours of operation. The plan outlines several route expansion ideas based on population density as well as a possible new route, the Silver route, which would serve several of Cleveland's largest employers. Finally, a commuter van pool service is discussed as a solution to commuters traveling from Cleveland to Chattanooga[19]. Despite CUATS reaching over 80% of Cleveland's



15- Chattanooga-Hamilton County/North Georgia 2045 Regional Transportation Plan Update. Accessed 03-20-2019. https://drive.google.com/file/d/1e0PtFWlSnWrklApDigTFjhhmuGeN7GhX/view
16- Cleveland Urban Area MPO 2040 Regional Transportation Plan. Accessed 3/20/2019. http://clevelandtn.gov/DocumentCenter/View/995
17- Cleveland Urban Area MPO 2040 Regional Transportation Plan. Accessed 3/20/2019. http://clevelandtn.gov/DocumentCenter/View/995
18- Cleveland Urban Area MPO 2040 Regional Transportation Plan. Accessed 03-20-2019. http://clevelandtn.gov/DocumentCenter/View/995

Figure 6-3. Chattanooga Area Transit Gaps



Source: Chattanooga-Hamilton County/North Georgia 2045 Regional Transportation Plan Update

population within one-half mile, CUATS could do more to serve growing populations outside of the City of Cleveland and for commuters traveling to Chattanooga daily[20].

6.2 On-Demand Transit Services

Demand-Response transit service in the Knoxville area is provided by the Knox County Community Action Committee (CAC). The CAC offers public transportation services to residents of Knox County who live outside of the Knoxville Area Transit (KAT) service area. CAC is a demand-response system that provides rides to any Knox County resident outside of the KAT service area. Rides cost $2, one way.

In addition to CAC, East Tennessee Human Resource Agency (ETHRA) provides transit services to 16 counties including Knox, Blount, Loudon, Anderson, Roane and other surrounding counties.

Transit service for Chattanooga and Cleveland is provided by South East Tennessee Human Resource Agency (SETHRA). SETHRA provides service to nine counties in southeastern Tennessee including the less populated areas of Bradley and Hamilton counties, not served by CARTA or CUATS. SETHRA provides on-demand service in addition to one deviated fixed-route in Athens (McMinn County).

Despite having demand-response transit service in most parts of the I-75 corridor, the service is extremely limited. Most of the transit options require 3 days' notice for rides and each ride costs $2-$5 each way. Additionally, these services are often not available on holidays and weekends and have restrictive hours of operations, often not operating at night. While offering transportation for those who may not have other solutions is a start, better transportation options are needed.

6.3 Transit Analysis

O-D Pairs

In Section 3, major trip destinations (O-D pairs) were identified along the I-75 corridor. Key O-D pairs include:

- Knoxville to Farragut
- Knoxville to Powell
- Knoxville to Halls Crossroads
- Athens to Loudon
- Cleveland to Athens
- Cleveland to Chattanooga

These trips occur on I-75 and are projected to see an increase in travel time due to forecasted congestion. Currently, none of these trips can be made by existing fixed-route transit, forcing more users onto the I-75 corridor. Regional commuter routes could help supplement the identified O-D pairs and reduce congestion on I-75.

Zero-Vehicle Households Compared to High Job Concentrations

Figure 6-1 highlights high concentrations of households with no access to a vehicle in relation to areas of high employment concentrations. The limits of existing fixed transit service in Knoxville, Chattanooga and Cleveland are also identified. The figure demonstrates that areas with the highest concentration of zero-vehicle households are serviced by transit. However, there are pockets within the study area where there are populations of zero-vehicle households without access to fixed-route transit.

Transit Routes on I-75

While Knoxville and Cleveland have fixed transit routes running parallel and even crossing the I-75 corridor, only Chattanooga's CARTA service has routes that run on I-75, including Route 4 and Route 6. CARTA's Route 4 express service uses the I-75 corridor between Hamilton Place Boulevard (Exit 5) and the I-24 and I-75 interchange (Exit 2). CARTA's Route 6 dial-a-ride service uses the I-75 corridor between Bonny Oaks Drive (Exit 7) and Apison Pike/Volkwagen Drive (Exit 9). Comparing where routes 4 and 6 run on I-75 to forecasted congestion (see Figure 3-7) in 2040 shows that these routes will experience increased congestion. In some areas, congestion is anticipated to result in significant delays (see Section 3).

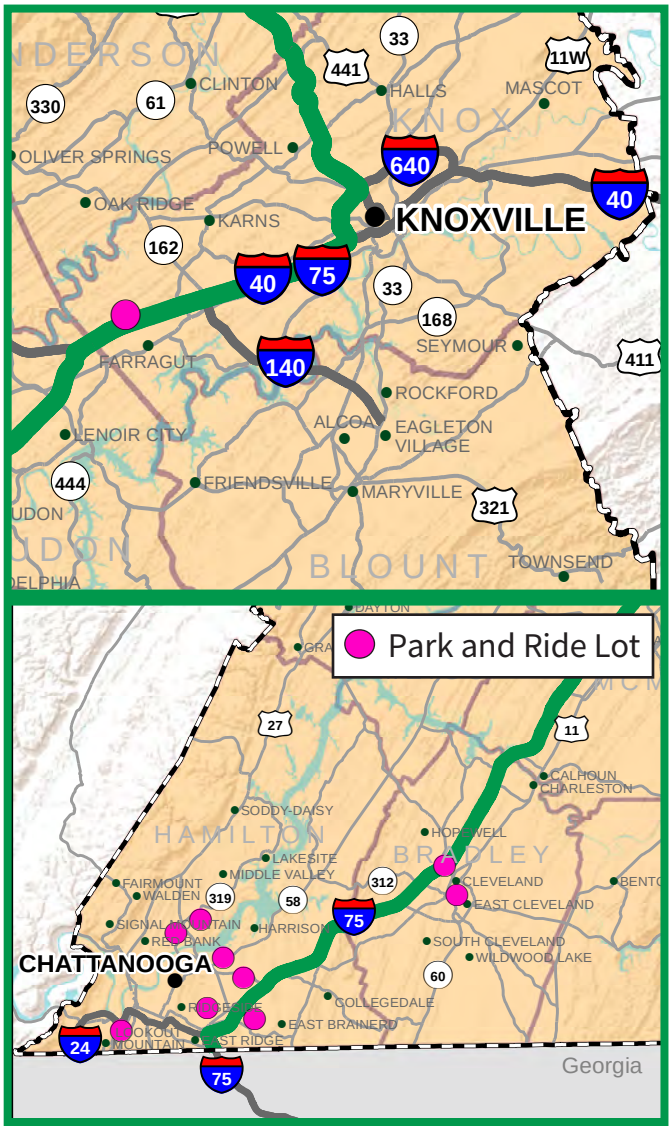
Park-and-Ride Lots

Chattanooga Area Regional Transportation Authority (CARTA) provides park-and-ride locations at points along fixed bus routes throughout the region. Users can park their vehicle in an existing parking lot for free and get on a CARTA bus to start or end their journey. The park-and-ride model allows users from outside of the CARTA service area to take advantage of the bus system and helps reduce congestion on I-75 (see Figure 6-4).

Knoxville and Cleveland could initiate a similar system as CARTA's model takes advantage of existing parking lots and therefore, avoids maintenance and other associated costs. Park-and-Ride lots could also help serve the greater I-75 corridor.

19- Cleveland Urban Area MPO 2040 Regional Transportation Plan. Accessed 03-20-2019. http://clevelandtn.gov/DocumentCenter/View/995
20- Cleveland Urban Area MPO 2040 Regional Transportation Plan. Accessed 03-20-2019. http://clevelandtn.gov/DocumentCenter/View/995

Figure 6-4. Park-and-Ride Facilities — I-75



Source: https://www.townoffarragut.org/253/Transportation-Commuters (Knoxville); Chattanooga Area Regional Transportation Authority

6.4 Existing and Future Deficiencies and Needs

A. Chattanooga – Cleveland Connection: Given the close proximity of Chattanooga and Cleveland and the number of residents that commute between the two cities, a commuter route would give commuters and residents more transportation options. While both cities offer fixed bus routes within their respective city limits, a larger regional public transit connection is missed between one another. The idea of a commuter route between Chattanooga and Cleveland has been mentioned in more than one recent transit study.

B. On-Demand Transit: While rural public transportation options do exist along the I-75 corridor, options are limited. Existing rural transit options require advanced scheduling and are only offered on weekdays during the day. No options are available on holidays, weekday evenings and weekends.

C. Fixed-Route Transit Service: Chattanooga, Cleveland and Knoxville offer existing fixed-route bus service. All three transit operations (CARTA, CUATS and KAT) have limited weekend and evening hours. In addition, Chattanooga and Cleveland have several routes with long headways of 60 minutes, making it difficult for users to get to destinations. More commuter and express routes on and along I-75 are needed.

D. Access to Activity Centers: Many activity centers along the I-75 corridor are not able to be accessed with public transit, including many employee concentrations. Additionally, activity centers that are served by public transit are often on a loop system, requiring transfers and long headways.

E. Knoxville Regional Transit Corridor Study: Routes to Oak Ridge, an area with a large employement concentration, and Alcoa, where Knoxville's airport is located, were recommended in 2013. While improvements to KAT's service have been made, these expanded routes and service haven't been implemented.

7. Walking and Bicycling

In order to serve all transportation users, bicycle and pedestrian infrastructure is necessary in many locations, especially along transit corridors, at transit stops, in dense neighborhoods and in downtown areas. Along the I-75 corridor, most bicycle and pedestrian accommodations are found in urban areas. Existing facilities often fall short, with gaps in service and failure to meet minimum design standards. Additionally, many existing bicycle and pedestrian facilities are segmented by an Interstate facility. Most existing bicycle and pedestrian facilities are supported locally or regionally, however, some state-wide bicycle routes are in development through TDOT.

7.1 U.S. and State Bicycle Routes

Currently, Tennessee has one existing statewide bicycle route, U.S. Bicycle Route 23, running north to south through the middle of the state. This route runs along existing state and U.S. highways. The route is signed with 'Bike Route' signs, but no other bicycle accommodations exist. Other U.S. bicycle routes are planned in Tennessee, including one route running east to west through Memphis, Nashville and Knoxville (USBR 80). Additionally, a route is planned north to south to the east (USBR 22) and west (USBR 35/25) of Nashville and a second route (USBR 45) along the Mississippi River on Tennessee's western boundary.

In addition to U.S. bicycle routes, TDOT has statewide bicycle routes planned throughout the state. Several planned bicycle routes intersect or run parallel to the I-75 corridor, including:

- Chattanooga to Mountain City, which would intersect I-75 in Cleveland
- Chattanooga Connector, which would run parallel to the west of I-75 through Roane, Rhea and Hamilton counties
- Georgia Connector 1 and 2, which would run parallel to the west of I-75 in Hamilton County
- Georgia Connector 3, which would run parallel to the east of I-75 in Polk County
- Jellico to Nashville, which would run parallel to the west of I-75 in Campbell County
- Knoxville to Mountain City Connector, which would run parallel to the east of I-75 in Knoxville
- Kentucky to Jellico/Nashville Connector, which would run parallel to the west of I-75 in Scott County
- Memphis to Chattanooga, which would run parallel to the west of I-75 in Chattanooga
- Nashville to Chattanooga, which would run parallel to the west of I-75 in Chattanooga
- Nashville to Bristol, which would intersect I-75 in Lenoir City

These planned state bicycle routes are proposed mostly along existing US, state and even county highways throughout the state of Tennessee. The planned state bicycle routes within the I-75 corridor study area can be seen in Figure 7-1 and Figure 7-2.

7.2 Bicycle and Pedestrian Connectivity Through Interchanges

Unless planned for ahead of time, geometric limitations created by Interstate structures often result in discontinuous pedestrian and bicycle accommodations on cross-streets through an interchange. Where bicycle lanes and sidewalk may be present on either side of the Interstate, the cross-section through the interchange may be limited to only vehicular traffic - discouraging multi-modal connectivity from one side to the other. Furthermore, ramp intersection often create bicycle lane and sidewalk paths that are difficult to navigate, and in some cases unsafe. As shown in Figures 7-1 and 7-2 and Tables 7-1 and 7-2, I-75 interchanges with U.S. and state routes were evaluated to determine connectivity for pedestrians and bicyclists across the Interstate. Where pedestrian and bicycle accommodations existing on the cross-street, free-flow right turns at ramp interchanges were noted. While free-flow right turns have operational benefits, the movement allows vehicles to maintain higher rates of speed off the ramp and through the intersection, putting pedestrians and bicyclists at a disadvantage. Motorists traveling at higher speeds are less likely to yield to pedestrians; and higher intersecting speeds are more difficult for bicyclists to judge and maneuver.

AADT on the cross-roads was also noted as the volume of traffic influences mobility for pedestrians and bicyclists.

In both cases where a proposed state bicycle route crosses I-75, no interchange is present. Both the crossing at SR-40/SR-312 and SR-2/US-70 provide no bicycle facilities but SR-40/SR-312 does offer a wider shoulder for bicyclists to use.

7.3 Regional and Local Bicycle and Pedestrian Plans

Several regional and local bicycle and pedestrian plans exist for communities in the I-75 study area, most notably in Knoxville and Chattanooga. In general, these plans look to identify missing links or gaps in existing bicycle and pedestrian service and areas where service could be extended. Key indicators for areas that would benefit from bicycle and pedestrian infrastructure include:

- One to three miles around population dense neighborhoods, transit service, activity centers (hospitals, schools, parks, etc.)
- Known areas with populations with no access to a vehicle

Existing regional and local bicycle and pedestrian plans are outlined below.

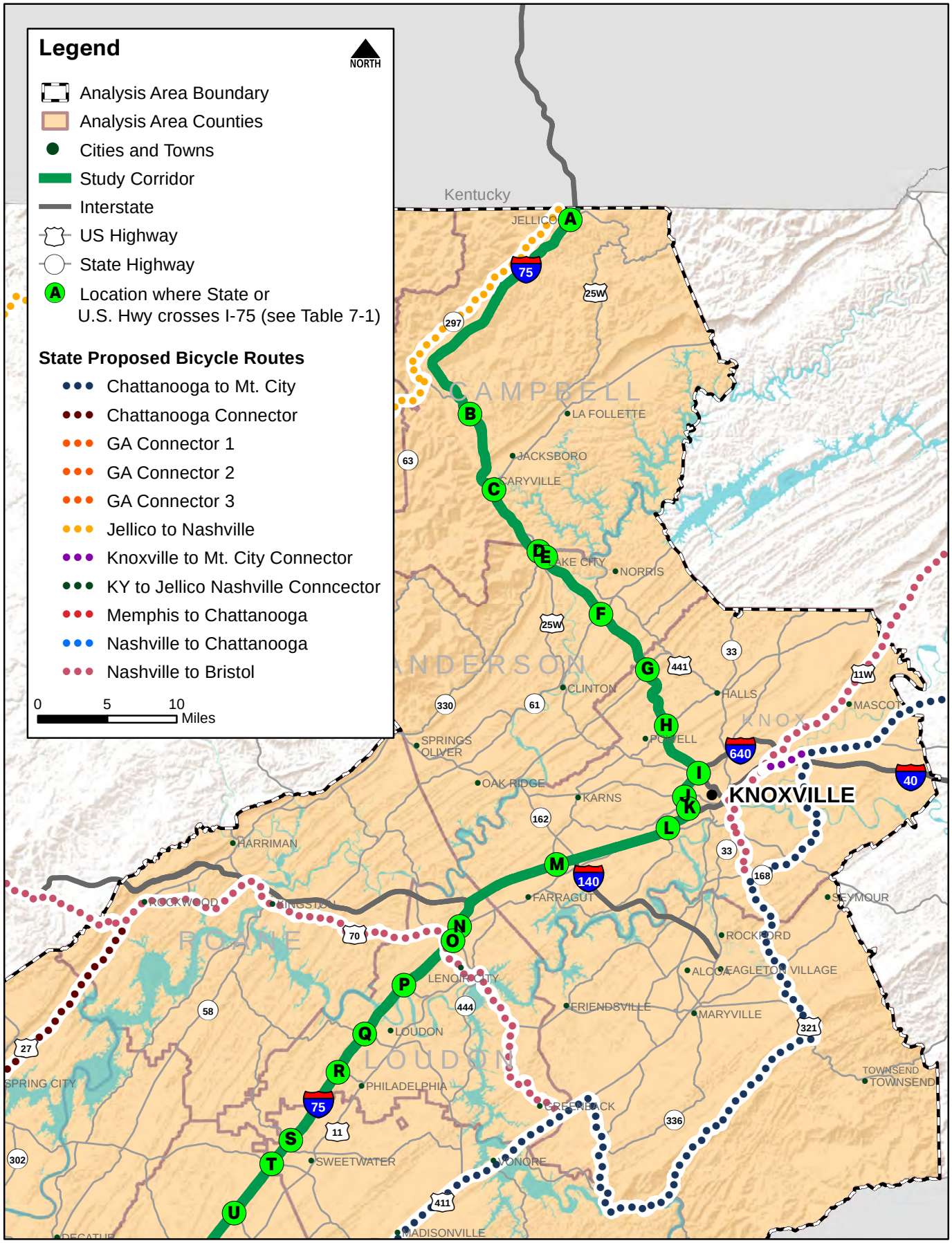
Knoxville Area

The Knoxville Bicycle Facilities Plan was adopted in February 2015 and outlines specific bicycle improvements planned in the greater Knoxville area. Several hundred projects were identified in the plan and over a hundred were ranked and prioritized. Recommendations varied from bicycle lanes to cycle tracks to railroad underpasses and greenways[21].

Pedestrian and bicycle infrastructure is addressed in the region's long-range transportation plan. The plan outlines that regional pedestrian infrastructure is important and that the TPO has seen an increase in pedestrian counts within Knoxville, demonstrating an ever-growing need for improved pedestrian infrastructure. While the plan doesn't outline specific recommendations for pedestrian improvements, it does demonstrate that most communities in the Knoxville TPO require sidewalks to be installed in new developments. Finally, the plan outlines over 120 miles

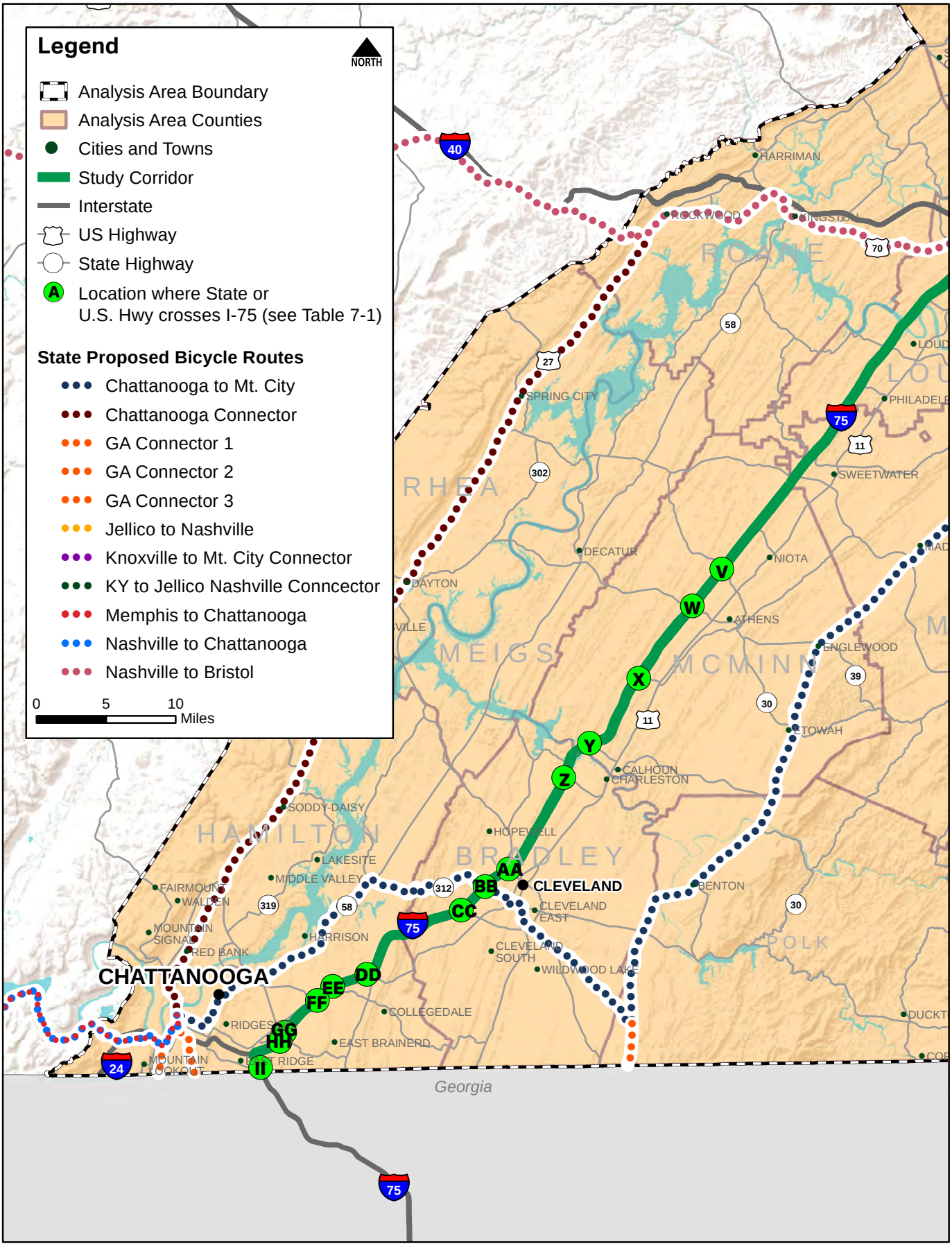
21- Knoxville Bicycle Facilities Plan. Accessed 04/02/2019. http://www.knoxvilletn.gov/UserFiles/Servers/Server_109478/File/Engineering/BicyclePlan/feb2015_finalreport.pdf

Figure 7-1. Planned State Bicycle Routes and U.S./State Highway Crossings (north)— I-75



Source: Tennessee Department of Transportation

Figure 7-2. Planned State Bicycle Routes and U.S./State Highway Crossings (south)— I-75



Source: Tennessee Department of Transportation

Table 7-1. Locations Where a U.S. or State Highway Crosses I-75 (north)

Map Letter	State Route/U.S. Hwy Crossings	Crossroad AADT (2018)	Bicycle Lane/ Multi-Use Path?	Paved Shoulder >2'?	Sidewalk?	Free-Flow Right with Bicycle/Ped Facilities?
A	SR-9/US-25W/5th St	5,700 (W)* 3,200 (E)**	No	Yes (one side)	No	No
B	SR-63/Howard Baker Hwy	6,600 (W)	No	Yes	No	No
C	SR-9/US-25W/Veterans Memorial Hwy	19,700 (E)	No	Yes	No	No
D	SR-9/US-25W/Main St	No counts	No	Yes	No	No
E	SR-71/Norris Frwy	1,900 (W)	No	Yes	No	No
F	SR-61/N Charles G Seivers Blvd	26,300 (W) 20,900 (E)	No	Yes	No	No
G	SR-170/Raccoon Valley Dr	No counts	No	Yes	No	No
H	SR-131/E Emory Rd	26,300 (W) 20,900 (E)	No	Yes	No (sidewalks beyond interchange)	N/A
I	SR-9/US-25W	28,000 (W)	No	Yes	No	No
J	SR-62/Western Ave	44,900 (W) 16,000 (E)	No	No	Yes (one side)	No
K	SR-169/Middlebrook Pike	14,200 (E)	No	No	Yes (one side)	N/A
L	SR-332	26,200 (S)***	No	Yes (one side)	Yes (one side - stops at interchange)	No
M	SR-131/Lovell Rd	17,500 (N)**** 36,400 (S)	No	Yes	No (sidewalks beyond interchange/ overpass)	Yes (pedestrian only)
N	SR-2/Kingston Pike	No counts	No	No	No	N/A
O	SR-73/US-321	16,200 (W) 29,000 (E)	No	Yes	No	No
P	SR-324/Sugarlimb Rd SR-72/Loudon Hwy	5,300 (W) 7,400 (E)	No	Yes	No	No
Q	SR-72/Loudon Hwy	4,500 (W) 13,100 (E)	No	Yes	No	No
R	SR-323/Pond Creek Rd	600 (W) 1,900 (E)	No	Yes	No	No
S	SR-322/Oakland Rd	1,700 (W) 4,400 (E)	No	Yes	No	No
T	SR-68	1,700 (W) 4,400 (E)	No	Yes	No	No
U	SR-309/Union Grove Rd	1,700 (E)	No	Yes	No	No

* West approach; **East approach

*** South approach, **** North approach

Source: TDOT Traffic History website, Google Earth

Table 7-2. Locations Where a U.S. or State Highway Crosses I-75 (south)

Map Letter	State Route/U.S. Hwy Crossings	Crossroad AADT (2018)	Bicycle Lane/ Multi-Use Path?	Paved Shoulder >2'?	Sidewalk?	Free-Flow Right with Bicycle/Ped Facilities?
V	SR-305/Mt Verd Rd	5,100 (W)* 9,100 (E)**	No	Yes	No	No
W	SR-30/Decatur Pike	11,000 (W) 20,100 (E)	No	Yes	No	No
X	SR-39/Riceville Decatur Rd	4,300 (E)	No	Yes	No	No
Y	SR-163/Lamontville Rd	1,900 (W) 2,800 (E)	No	Yes	No	No
Z	SR-308/Lauderdale Memorial Hwy	2,500 (W) 5,000 (E)	No	Yes	No	N/A
AA	SR-60/Georgetown Rd NW	13,000 (NW) 30,500 (SE)	No	Yes	No	N/A
BB	SR-312/Harrison Pike	5,400 (NW) 8,000 (SE)	No	Yes	No	N/A
CC	SR-311/US-74/Pleasant Grove Rd	21,500 (SE)	No	Yes	No	No
DD	SR-2/US-11/Lee Hwy	34,400 (E)	No	Yes	No	No
EE	SR-317 (EB)/SR-378/Apison Pike	9,200 (W) 19,300 (E)	No	Yes	No	No
FF	SR-317 (WB)/Bonny Oaks Dr	24,400 (W) 10,100 (E)	No	Yes	No	No
GG	SR-153	77,800 (W)	No	Yes	No	No
HH	SR-320/Brainerd Rd	14,900 (W) 46,700 (E)	No	Yes	No	No
II	SR-8/Ringgold Rd	25,400 (W) 10,500 (E)	No	Yes	No	No

* West approach; **East approach

Source: TDOT Traffic History website, Google Earth

of existing paved greenway trails and plans to continue adding additional miles to serve both pedestrians and bicyclists[22].

Chattanooga Area

The Chattanooga Area Regional Bicycle and Pedestrian Plan was approved in April 2010 for the Chattanooga Regional Planning Agency (RPA). The Plan takes an inventory of existing bicycle and pedestrian infrastructure throughout the Chattanooga TPO. Existing pedestrian infrastructure inventory includes sidewalks on a large portion of streets, especially in Chattanooga. Existing sidewalk inventory totals 170 miles of sidewalks on arterial and collector roads. Existing bicycle infrastructure includes 90 miles of bicycle infrastructure, a large proportion being bicycle routes with some bicycle lanes and greenways[23].

In addition to evaluating existing bicycle/pedestrian inventory the Plan investigates LOS for both bicycle and pedestrians. LOS is ranked from A – F based on traffic volume, number of lanes, speeds, truck percentages and shoulder width. The Plan found bicycle LOS in the Chattanooga TPO to be pretty good, with 54% of roadways ranking A, B or C. Pedestrian LOS was ranked in a similar fashion but the results were much worse, with over 75% of roadways ranking D, E or F[24].

Finally, in addition to analyzing existing conditions, the Plan recommends improvements for additional bicycle and pedestrian infrastructure including sidewalks, bicycle lanes and more. The recommended bicycle and pedestrian infrastructure expansions total over $300 million in improvements[25]. Some of these improvements will be included in the TPO's long-range transportation plan, but not all recommendations

22-- Mobility Plan 2040: Connecting People and Places. Access date 03/14/2019. https://knoxmobility.org/wp-content/uploads/2018/09/Mobility-Plan-2040.pdf
23- Chattanooga Area Regional Bicycle and Pedestrian Plan. Access date 04/02/2019. https://drive.google.com/file/d/1Z-Ab95AwXfa4GuOBYJWbJpQiZQ1xnr9S/view
24- Chattanooga Area Regional Bicycle and Pedestrian Plan. Access date 04/02/2019. https://drive.google.com/file/d/1Z-Ab95AwXfa4GuOBYJWbJpQiZQ1xnr9S/view
25- Chattanooga Area Regional Bicycle and Pedestrian Plan. Access date 04/02/2019. https://drive.google.com/file/d/1Z-Ab95AwXfa4GuOBYJWbJpQiZQ1xnr9S/view

are accounted for and will take time to implement. Recommendations include on-street bicycle facilities and pedestrian improvements immediately adjacent to the I-75 corridor including a primary bicycle facility on Lee Highway, running parallel to I-75 and E. Bainerd Road, an I-75 interchange in the Chattanooga area.

7.4 Existing and Future Deficiencies and Needs

A. Planned Bicycle Routes: Planned U.S. Bicycle Routes and TDOT state bicycle routes exist adjacent to and intersecting I-75. These routes will be designated on U.S. and State highways with paved shoulders and marked with signs. In most cases, these routes will not augment local or intercity connections significantly.

At two U.S. or state highway interchanges along I-75 (SR-2 and SR-317), no paved shoulder, wide outside lane or bicycle lane is available for bicyclists. Sidewalk is provided through only three U.S. or state route interchanges (SR-62, SR-169, and SR-332), and free-flow right turns from ramps exist at one interchange where pedestrian accommodations are provided (SR-131).

B. Regional and Local Bicycle and Pedestrian Plans: Both Knoxville and Chattanooga have bicycle infrastructure plans outlining priority projects within the city limits. The priorities include improving existing facilities and trails in addition to adding new bicycle infrastructure. The Chattanooga bicycle and pedestrian plan ranks existing infrastructure in addition to priority projects, which provides a more wholistic look at the city's bicycle and pedestrian infrastructure needs. Still, throughout the I-75 corridor a greater emphasis on creating walkable/bikeable areas around I-75 interchanges and existing areas of dense development is needed.

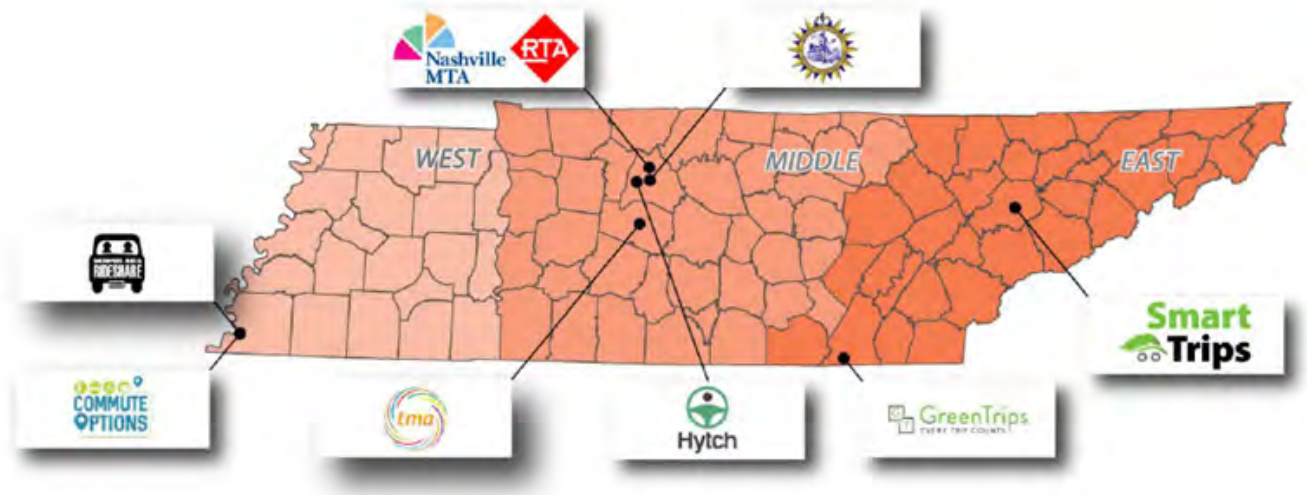
8. Transportation Demand Management

Transportation Demand Management (TDM) is a set of strategies that influence travel behavior to reduce single-occupancy vehicle (SOV) travel. Ranging from ridesharing, bicycling, teleworking, taking transit, car sharing and on-demand or real-time applications, TDM strategies redistribute commuter travel across a variety of alternatives and away from daily peak periods. TDM programs represent a flexible, low-cost way to engage residents, travelers, businesses and local governments in the effort to reduce commuter travel and the associated impacts on the community including traffic congestion and emissions.

Eligible TDM activities (defined by the Congestion Mitigation and Air Quality Improvement Program or CMAQ), range from traveler information services, shuttles, employer-based programming, parking initiatives, public education and outreach activities, telework promotion, transportation management associations (TMAs), carpool and vanpool services (ridematching, marketing, guaranteed ride home, subsidies), and car sharing. In addition, the use of technology directly intersects TDM and represents a significant opportunity to change travel behaviors. Examples of related technology include:

- Private sector mobile applications for ride booking that are supplementing and replacing traditional ridematching
- Services (e.g., Waze) that are integrating with local transportation agencies
- Connected and autonomous vehicles that will impact SOV travel and air quality
- Intelligent digital signage to encourage alternative mode use
- "Big data" sets including INRIX, AirSage, BlueTOAD, and StreetLight to further direct TDM

Figure 8-1. TDOT's Local Partners — Existing Programs



Source: 2017 TDOT Statewide Demand Management Plan

efforts based on commuting patterns and origin/destination data

- The influence of Smart Cities on commute behavior and increasing throughput efficiency.

TDOT developed a Statewide Transportation Demand Management (TDM) Plan in 2017. The plan provided a dynamic structure for trip reduction strategies suitable for immediate implementation, but flexible enough to accommodate the demands of future transportation and travel. The Plan positioned TDOT as the TDM program leader – connecting and coordinating regional TDM efforts with the local partners responsible for program implementation within each of the state's five urban areas, including the Chattanooga and Knoxville regions (Figure 8-1).

TDOT's current 25-year Long-Range Transportation Plan Mobility Policy Paper established the foundation that the state's transportation system should encompass mobility options and travel choices that promote a strong transportation system connecting residents to jobs, schools, services and attractions. The Plan describes the provision of viable alternatives to the SOV as a central element of TDOT's vision of an efficient and effective multimodal transportation system. TDM represents low-cost alternatives that can help TDOT expand and enhance mobility, system efficiency, and environmental protection by reducing congestion and improving air quality.

The primary goal of statewide TDM programming is to reduce SOV travel by promoting alternative modes that include carpooling, vanpooling, taking transit, bicycling, walking, alternative work arrangements and on-demand or shared services. The Statewide TDM Plan is further supported through the following key objectives:

1. Decrease traffic congestion and air pollution
2. Support and enhance TDM programming in the state's five major urban areas
3. Increase customer access to programs and services
4. Streamline the administration and evaluation of TDM programming
5. Increase awareness and support for TDM initiatives in the state

The following six key recommendations resulted from the Plan. These recommendations were based on stakeholder engagement, commuter and employer surveying (statewide), and analysis of national best practices.

1. Introduce a standard Commuter Program structure
2. Establish a statewide TDM brand
3. Identify a statewide TDM coordinator (team)
4. Maintain core TDM services for regional implementation
5. Increase accountability
6. Develop standard operating procedures for administration of TDM projects

8.1 Mode Choice

Based on 2012-2016 U.S. Census data obtained via the Census Transportation Planning Products Program (CTPP), 84.0% of commuter trips made within the 14-county study area are single-occupancy vehicle trips. As shown in Table 8-1, 8.5% of trips are made by some form of rideshare, and only 0.6% are made by transit. These numbers are comparable to Tennessee as a whole. Nationally, the number of single-occupancy vehicle trips is lower and transit is higher. Note that Other Travel Modes includes "work-from-home," which is on the rise nationally. Table 8-1 also shows the mode split for city-to-city origin and destinations along I-75.

Chattanooga's Green Commuter program has been in operation for six years and is the result of a coordinated effort that engaged community stakeholders to serve on an advisory committee directing the program design and launch process. Housed within the Regional Planning Agency (RPA), Green Commuter is run by two outreach team members that are working with 25 local employers with key activities including:

- Maintaining an online ridematching and rewards system
- Hosting an annual employer challenge event
- Promoting all non-SOV modes including carpooling, vanpooling, biking, walking and transit through marketing and outreach
- Actively engaging in community outreach efforts.

The employer partner list includes large employers like Unum, Amazon, University of Tennessee-Chattanooga and Blue Cross Blue Shield, along with a handful of smaller organizations. The rideshare database (RideShark) includes approximately 1,500 commuters with 250 reporting commute data on a monthly basis. Overall, the program appears to be well-planned and executed and includes many of the elements you would expect to see in a regional TDM effort. As the youngest of the existing TDM programs in the state, it appears to be the strongest in outreach and commuter/employer participation.

8.2 Vanpools

Knoxville's Smart Trips program is housed within the Knoxville Regional TPO and has been in operation for approximately 13 years. Serving eight counties, the program staff includes a full-time program coordinator who is supported by a part-time communications team member. Smart Trips promotes carpooling, vanpooling, transit, biking and walking and targets both commuter

Table 8-1. Commuter Modal Split — I-75

Origin-Destination Pair	Single-Occupancy Vehicle	Rideshare (Car, Truck, Vanpool)	Transit	Other Travel Mode (Bicycle, Ped, Motorcycle, etc.)
Farragut to Knoxville	92.5%	7.3%	0.0%	0.2%
Oak Ridge to Knoxville	91.4%	8.9%	0.0%	0.0%
Knoxville to Farragut	96.0%	2.0%	0.0%	2.0%
Cleveland to Athens	100%	0.0%	0.0%	0.0%
Niota to Athens	95.6%	3.6%	0.0%	0.0%
Athens to Cleveland	91.7%	8.3%	0.0%	0.0%
Chattanooga to Cleveland	100%	0.0%	0.0%	0.0%
Cleveland to Chattanooga	92.9%	6.7%	0.0%	0.2%
East Ridge to Chattanooga	87.3%	11.6%	0.0%	1.0%
Harrison to Chattanooga	88.7%	9.8%	0.0%	1.5%
Study Area (14 Counties)	84.0%	8.5%	0.6%	6.7%
Tennessee	83.6%	9.1%	0.8%	6.5%
Nationwide	76.4%	9.3%	5.1%	9.1%

Source: U.S. Census Bureau (2012-2016) via CTPP

and employer audiences. The program includes a ridematching and rewards system (through Rideshark), an annual Commuter Challenge, communications including newsletters and e-blasts, Emergency Ride Home, and annual promotions like Bike Month. Other on-going activities include coordination with Knoxville Area Transit on prize trolley and transportation trivia promotions, weekly orientations for city and county employees, orientations and special events with the Universities, and program advertisements in the downtown alternative paper, the local business journal and Chamber of Commerce publications. While Smart Trips does work with a number of employers throughout the region, they do not maintain an employer partner roster. Instead they have recently launched an employer sponsorship program that features three paid levels. They have three sponsors currently – Scripps, University of Tennessee and Pellissippi State – and anticipate bringing Y12 and Oak Ridge National Labs on board soon. The Smart Trips rideshare database includes approximately 800 commuter participants and they maintain an additional list of 800 stakeholder contacts.

8.3 Park-and-Ride Facilities

Within the I-75 corridor, park-and-ride lots are most prevalent near Chattanooga (see Figure 6-4). Only one park-and-ride lot is available in the Knoxville area. The lot is located on North Campbell Station Road, exit 373 on the shared I-40/I-75 segment. Seventy-four ADA accessible spaces are available in this lot.

In the Chattanooga area, CARTA manages nine lots, all of which are marked spaces within larger parking lots such as United Grocery Outlet, Food City, Concord Baptist Church and Eastgate Town Center.

8.4 Existing and Future Deficiencies and Needs

The Statewide TDM Plan identified a number of ways regional TDM programs can support TDOT with managing mobility. They can also provide needed assistance on selected corridors when capacity is at a premium – especially during large construction projects. For example, in 2017, when a massive fire collapsed a bridge on heavily traveled I-85 in Atlanta, GA, it was clear that commuting patterns would be severely disrupted during reconstruction. Georgia Commute Options, Atlanta's TDM Program, worked with GDOT to help spread the word about the alternative travel options in the area (e.g., carpool, vanpool, transit, etc.) and worked with employers and employees to help manage the "chaos." Moving forward, TDOT should continue to work with the regional TDM programs to push more equitable multi-modal travel in the urban areas. Table 8-2 also lists some recommendations that statewide and regional TDM programs can pursue.

Table 8-2. TDM Strategies and State-of-Practice Examples

Strategy	Details

Statewide or regional programs are more likely to succeed and produce desired outcomes.	• Statewide examples, each managed by the state's Department of Transportation, include:
	  • Connecticut: CTrides
	  • Delaware: Rideshare Delaware
	  • Massachusetts: MassRIDES
	  • New York: NY511 Rideshare
	  • Washington: Rideshare Online
	• Large regional examples used for guidance include:
	  • Atlanta, GA: Georgia Commute Options (GCO)
	  • San Francisco, CA: 511 SF Bay
	  • South Florida: South Florida Commuter Services

Focus limited resources on outreach, public relations, and incentives.	• Targeted outreach efforts and incentives have a more direct and measureable impact on travel behavior and mode shift than mass advertising. • Public relations and recognition activities also provide support at a much lower cost than mass advertising.

Incentives work.	• Models for best practices exist in:
	  • Atlanta, GA: GCO incentives including Gimme Five
	  • Birmingham, AL: CommuteSmart Get Green
	  • Las Vegas, NV: Club Ride Rewards
	  • San Francisco, CA: 511 SF Bay
	  • San Diego, CA: iCommute
	• Incentives generate trial use and the opportunity for on-going evaluation. Success has been demonstrated across large-scale implementation and corridor and/or mode-specific trials.

TDM programs should not rely on technology alone.	• TDM programs need to leverage existing technology in a way that does not compromise core program offerings • Launching a new technology (e.g., mobile app) is not going to change behavior alone • Reserve funds for outreach and marketing the technology • Human interaction remains a key component of trip planning/ education and behavior change
Relationships create mode shift.	• Commuter-to-commuter or co-worker success stories • Employer and stakeholder relationships are invaluable • One-on-one TDM program trip planning and educational activities • Employer encouragement and support can significantly influence employees
Don't ignore the core services.	• Keep it simple • Services should be both multi-modal and mode-neutral • Examples: ridematching, guaranteed ride home, employer outreach

Source: 2017 TDOT Statewide Demand Management Plan

9. Freight and Intermodal Facilities

This section summarizes the existing and future conditions of freight movement through the I-75 C] corridor. Freight facilities, including major generators and intermodal facilities, are described. In addition, the potential for diverting freight from the dominant mode – truck – to rail, air, or barge, is assessed.

The data used in this analysis include Transearch 2016 (current) and 2045 (forecast) and the Tennessee Statewide Travel Demand Model.

9.1 Freight Movement

Freight movement is an important element of a regional and national economy, as more efficient modes and routes enable improved logistics and result in reduced transportation costs. These cost savings can then be reallocated to growth, providing better jobs and higher wages in the area. The existing and future freight flows in the region were analyzed using the most current available data and existing conditions.

The I-75 corridor area in Tennessee ranges from Chattanooga in the south near the border with Georgia, north through Knoxville, and terminates at the Kentucky border. The corridor is part of the larger I-75 corridor that connects the termini of Detroit, MI in the north to Tampa, FL in the south and points in between including Atlanta, GA, Lexington, KY, Cincinnati, OH, and Toledo, OH.

In addition, the I-75 corridor is in the middle of "auto alley," a route along which automobile production and support services have been established for decades in the US. The region benefits from its proximity to other automobile manufacturing industries, high quality highways, access to labor pools, and other domestic auto production facilities along the I-75 corridor[26]. The automobile industry is just-in-time and depends highly on trucking. Figure 9-1 shows the expected growth in truck volume throughout the corridor. As shown, I-75 north of Lenoir City will see the highest percentage change in growth.

The I-75 corridor also boasts easy access to rail and air modes. Table 9-1 shows the total tonnage and value of inbound and outbound freight in the I-75 corridor study area. As shown, truck is the predominant mode both in 2016 and in 2045 for the inbound and outbound directions. Air and rail freight make up a negligible portion of freight traffic, and water represents a small but measurable share of the total. Tonnage by all modes is projected to grow. Inbound and outbound truck tonnages are estimated to grow by 1.9 percent,

Table 9-1. Inbound and Outbound Freight Volumes by Mode for 2016 and 2045 — I-75

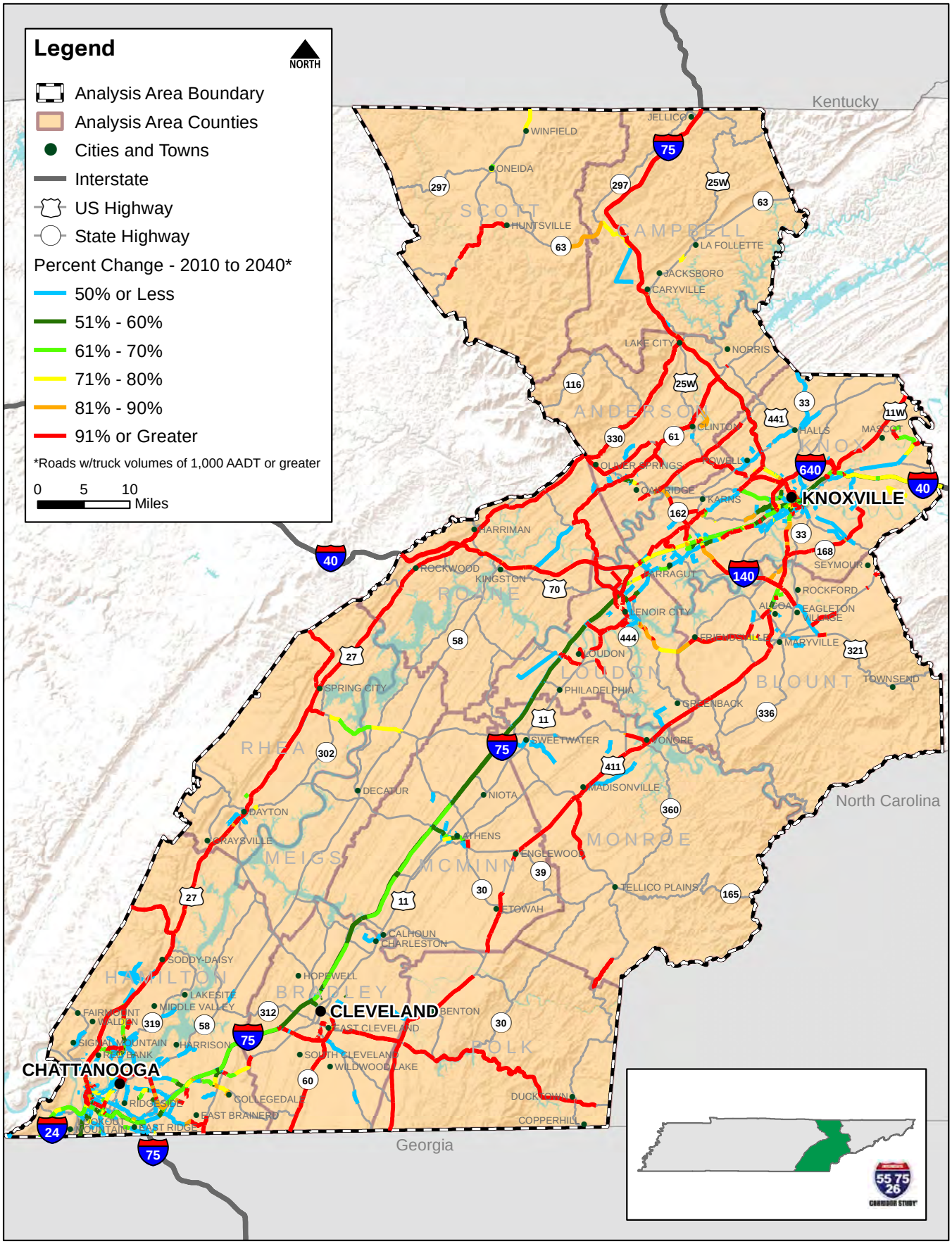
		2016		2045		% Growth CAGR*	
	Mode	**Tons**	**Value**	**Tons**	**Value**	**Tons**	**Value**
Inbound	Air	31,336	$4M	50,592	$8,170M	1.7%	2.7%
	Rail	199,840	$372M	298,828	$589M	1.4%	1.6%
	Truck	37,127,604	$37,137M	64,292,559	$72,600M	1.9%	2.3%
	Water	4,468,734	$765M	6,573,147	$1,090M	1.3%	1.2%
	Total	**41,827,514**	**$42,081M**	**71,215,127**	**$82,400M**	**1.9%**	**2.3%**
		2016		**2045**		**% Growth CAGR***	
	Mode	**Tons**	**Value**	**Tons**	**Value**	**Tons**	**Value**
Outbound	Air	26,174	$2,570M	53,976	$6,910M	2.5%	3.5%
	Rail	605,984	$165M	610,582	$285M	0.0%	1.9%
	Truck	42,839,716	$39,700M	73,791,001	$65,700M	1.9%	1.8%
	Water	1,067,762	$408M	1,847,066	$535M	1.9%	0.9%
	Total	**44,539,636**	**$42,800M**	**76,302,625**	**$73,500M**	**1.9%**	**1.9%**

*CAGR: Compound Annual Growth Rate

Source: Transearch (2016 and 2045)

26- Cuneo et al, Area Development, "The Changing Geography of the American Auto Industry," 2014, https://www.areadevelopment.com/Automotive/Advanced-Industries-2014/changing-geography-of-american-auto-industry-2262541.shtml

Figure 9-1. Growth in Truck Volume from 2010 to 2040 — I-75



Source: Tennessee Statewide Travel Demand Model

year over year. Truck value is projected to grow faster than tonnage in the inbound direction, but slightly slower in the outbound direction.

9.2 Inbound and Outbound Freight Demand: 2016 and 2045

Inbound/Outbound Freight by Commodity

The top commodities shipped into and from the I-75 corridor study area are summarized using 2016 Transearch data. The data shown are limited to the top 15 commodities by tonnage and make up approximately 94 percent of the tonnage. Inbound and outbound, the largest commodity category is uncategorized freight or Other, which also includes tonnages outside of the top 15 commodities. Outside of Other, leather, miscellaneous shipments, warehouse and distribution center, lumber and wood products, and primary metal products make up much of the incoming tonnage. The top commodities inbound and outbound are largely similar and are dominated by truck mode. See Table 9-2 for the inbound commodities and Table 9-3 for the outbound commodities.

Table 9-2. Inbound Freight Tonnage by Commodity, 2016 — I-75

Commodity	Total Tonnage	Share of Total Tonnage
Other	27,308,132	65.3%
Leather or Leather Products	3,406,874	8.1%
Misc. Freight Shipments	2,869,014	6.9%
Warehouse & Distribution Center	2,209,643	5.3%
Lumber or Wood Products	1,009,793	2.4%
Primary Metal Products	703,445	1.7%
Coal	605,014	1.4%
Electrical Equipment	575,436	1.4%
Food or Kindred Products	518,450	1.2%
Textile Mill Products	504,012	1.2%
Pulp, paper Or Allied Products	487,555	1.2%
Ordnance or Accessories	443,639	1.1%
Furniture or Fixtures	418,384	1.0%
Apparel or Related Products	406,235	1.0%
Fabricated Metal Products	361,887	0.9%
Grand Total	**41.8M**	**100.0%**

Source: Transearch (2016)

Table 9-3. Outbound Freight Tonnage by Commodity, 2016 — I-75

Commodity	Total Tonnage	Share of Total Tonnage
Other	29,567,095	66.4%
Leather or Leather Products	3,573,222	8.0%
Misc. Freight Shipments	2,346,024	5.3%
Warehouse & Distribution Center	1,959,640	4.4%
Food or Kindred Products	1,370,911	3.1%
Lumber or Wood Products	1,261,001	2.8%
Ordnance or Accessories	955,210	2.1%
Primary Metal Products	650,061	1.5%
Electrical Equipment	643,713	1.4%
Apparel or Related Products	621,865	1.4%
Printed Matter	383,151	0.9%
Chemicals or Allied Products	337,831	0.8%
Fabricated Metal Products	324,776	0.7%
Rubber or Misc. Plastics	288,321	0.6%
Pulp, paper Or Allied Products	256,816	0.6%
Grand Total	**44.5M**	**100.0%**

Source: Transearch (2016)

Truck Origins and Destinations by Entry and Exit Roads: 2016 vs. 2045

Using the Transearch database for 2016 and 2045, the data show that the majority of the region's truck traffic in terms of tonnage and value comes in from I-75 followed by I-40. Some commodities are coming into the corridor from as far as I-81 in the northeastern part of the state. However, the great majority of the region's inbound shipments are by air, rail, or water, or truck on other non-interstate routes, as denoted by the Other category in Table 9-4 and Table 9-5. Shipments

Table 9-4. Inbound Freight Tonnage and Value for 2016 and 2045 by Entry Road — I-75

		2016		2045		% Growth CAGR*	
	Entry Road	Tons	Value	Tons	Value	Tons	Value
Inbound	I-155	64,035	$80M	102,546	$123M	1.6%	1.5%
	I-24	1,563,106	$2,009M	2,257,809	$3,500M	1.3%	1.9%
	I-40	3,920,957	$5,180M	8,520,258	$12,000M	2.7%	2.9%
	I-55	3,873	$5M	4,370	$7M	0.4%	0.9%
	I-59	1,733,276	$3,052M	2,890,416	$6,240M	1.8%	2.5%
	I-65	384,689	$766M	589,355	$1,240M	1.5%	1.7%
	I-75	11,247,418	$12,900M	21,262,081	$25,300M	2.2%	2.4%
	I-81	1,387,798	$3,259M	2,654,052	$7,620M	2.3%	3.0%
	Other	21,522,361	$14,900M	32,934,240	$26,400M	1.5%	2.0%
	Total	**41.8M**	**$42.1B**	**71.2M**	**$82.4B**	**1.9%**	**2.3%**

*CAGR: Compound Annual Growth Rate
Source: Transearch (2016 and 2045)

Table 9-5. Outbound Freight Tonnage and Value for 2016 and 2045 by Exit Road — I-75

		2016		2045		% Growth CAGR*	
	Exit Road	Tons	Value	Tons	Value	Tons	Value
Outbound	I-155	13,331	$39M	23,991	$74M	2.0%	2.2%
	I-24	2,017,712	$2,310M	2,593,091	$3,270M	0.9%	1.2%
	I-40	4,414,326	$4,440M	8,632,930	$8,280M	2.3%	2.2%
	I-55	332	$0.602M	591	$0.9M	2.0%	1.3%
	I-59	1,702,775	$2,560M	2,612,719	$4,170M	1.5%	1.7%
	I-65	326,740	$578M	467,852	$832M	1.2%	1.3%
	I-75	11,142,879	$13,600M	17,755,853	$21,300M	1.6%	1.6%
	I-81	2,938,909	$4,170M	5,238,474	$6,880M	2.0%	1.7%
	Other	21,982,631	$15,100M	38,977,123	$28,600M	2.0%	2.2%
	Total	**44.5M**	**$42.8B**	**76.3M**	**$73.5B**	**1.9%**	**1.9%**

*CAGR: Compound Annual Growth Rate
Source: Transearch (2016 and 2045)

from I-40 are growing the fastest with nearly a three percent compound annual growth rate (CAGR). Table 9-4 lists the tonnage and value for inbound trade to Tennessee by the first road used within Tennessee, or the entry road used to enter Tennessee on its way to a destination in the I-75 corridor area.

For goods leaving the I-75 corridor, the same major Interstates are the destinations as the origins: I-155, I-24, I-40, I-55, I-59, I-69, I-75, and I-81. I-75 is the most heavily-used corridor for goods leaving the study area, followed by I-40. The growth in truck traffic using I-40 is the highest overall, at over 2 percent per year followed by I-155, I-55, I-81, and other routes. Outbound tonnages and value of goods traveling on I-75 are growing by 1.9 percent per year. The exit roads shown in Table 9-5 show the last route used by outbound freight from the I-75 corridor area within Tennessee or the route used to exit the state.

Through Truck Traffic: 2016 and 2045

The truck through traffic in the corridor was assessed using Transearch 2016 data and GIS software. The through tonnage was estimated by summing the tonnages found on roadway segments across the state while excluding the I-75 study area as an origin or destination. The remaining traffic is, therefore, neither originating nor destined to the corridor area and drives through.

Through traffic is important as it can make up a sizeable portion of the region's truck activity and therefore congestion in the corridor. Although through traffic is destined elsewhere and therefore does not have as large of a direct economic impact in the study area as originating or terminating traffic would, it does impact other regions and an efficient transportation network encourages more efficient deliveries and reduces shipping costs. In addition, the trucks traveling through the region may purchase services such as fuel, food, and lodging, making small but measureable impacts. As shown in Figure 9-2, the I-75 corridor in Tennessee shows high volumes of through truck traffic in 2016 in the range of 1 to 5 million tons. This is comparable with the volumes found along I-40 in the area.

Of note, rail and air would also have through traffic traversing the study corridor; however, data limitations do not allow for estimating or mapping these movements.

9.3 Intermodal Facilities: Air, Rail, and Water

The major air, rail, truck, and maritime facilities in the corridor area as well as the anticipated 2040 volume-to-capacity ratios akibg I-75 are shown in Figure 9-3. As shown, the areas south of Knoxville are the most congested in the corridor. Sections near Chattanooga are also congested, and approximately half of the corridor is expected to have a level-of-service (LOS) of D or worse, indicating high volumes of truck and auto traffic on I-75.

Air

There are three main airports in the corridor, two of which are capable of handling cargo. In Chattanooga, the Chattanooga Metropolitan Airport/Lovell Field is located near downtown and is considered a small-hub primary commercial service facility with cargo service. Knoxville has two airports: the Knoxville Downtown Island located in downtown that functions as a reliever airport for passenger service, and McGhee Tyson Airport located in southern Knoxville just north of the town of Maryville with passenger and cargo services. Downtown Island is the regional airport while McGhee Tyson is, like Chattanooga, a small-hub primary commercial service facility[27].

Chattanooga Metropolitan Airport handles freight and mail cargo. As of March 2019, 2.5 million pounds of cargo have enplaned while 4.7 million pounds have deplaned, year to date. Compared to 2018, enplaned volumes are up 3.4 percent and deplaned volumes are up 4.8 percent[28].

The McGhee Tyson Airport handles cargo on Ameriflight, FedEx Express, UPS Airlines, and Delta services. Led by FedEx and UPS, the airport handled 82.9 million pound of cargo and mail in 2018[29]. As of February 2019, 13.1 million pounds of freight have been handled, a slight decrease from the same period in 2018[30].

Rail

In Chattanooga, Norfolk Southern (NS) has an intermodal yard, Debutts Railyard, in an industrial area northeast of downtown. There are two routes from Chattanooga to Knoxville, from where it converges and continues north to Detroit. The easternmost route is the Crescent Corridor. From Chattanooga, one line heads south towards Atlanta and the other – the Crescent Corridor - towards Birmingham. One of the rail lines parallels I-75 in Tennessee, as shown in Figure 9-3. Foodliner Inc. operates intermodal bulk services on NS's line in Chattanooga.

CSX has a Transflo Terminal service for bulk product in Chattanooga and another in Knoxville. A Total Distribution Services Inc. (TDSI) auto distribution terminal is located in Chattanooga near the Volkswagen plant.

With the NS Cresent Corridor and other rail lines paralleling the I-75 corridor in Tennessee, there is a good potential for diverting truck traffic off of the highway to rail.

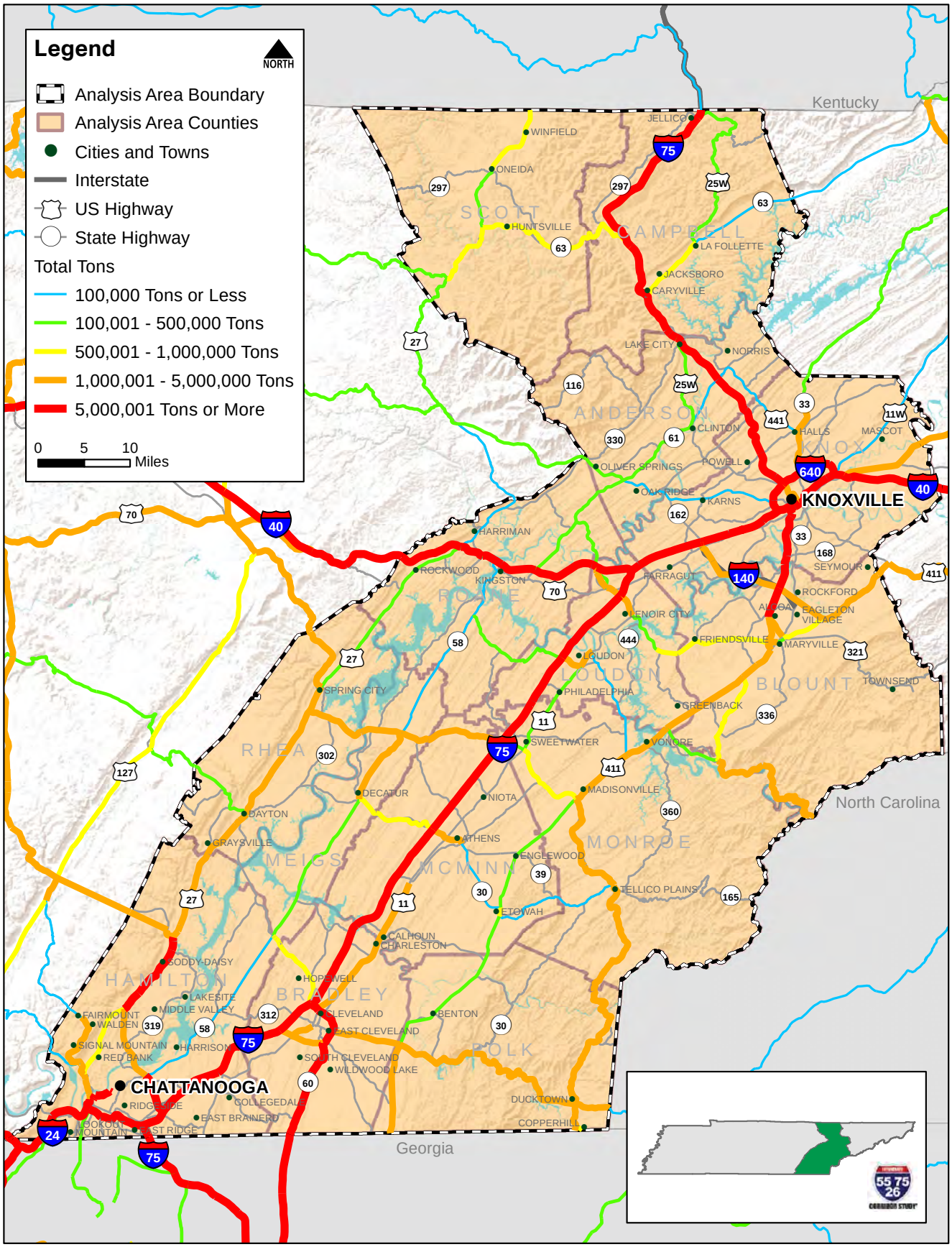
27- Federal Aviation Administration, National Plan of Integrated Airport Systems (2019-2023), Appendix A: List of NPIAS Airports with 5-year Forecast Activity and Development Estimate, https://www.faa.gov/airports/planning_capacity/npias/reports/media/NPIAS-Report-2019-2023-Appendix-A.pdf

28- Chattanooga Metropolitan Airport Authority Operations Summary for the month of March 2019, https://static1.squarespace.com/static/59fb5994ccc5c567ec9813a5/t/5ccc66f671c10b4a011f264b/1556899574900/March+2019+Operating+Summary.pdf

29- Hoar, Lauren, 10News.com, "McGhee Tyson Airport Celebrates 2.22 million passengers on 2-22, February 22, 2019, https://www.wbir.com/article/news/mcghee-tyson-airport-celebrates-222-million-passengers-on-2-22/51-b21534e6-6348-4181-bb9f-dd71c872a596

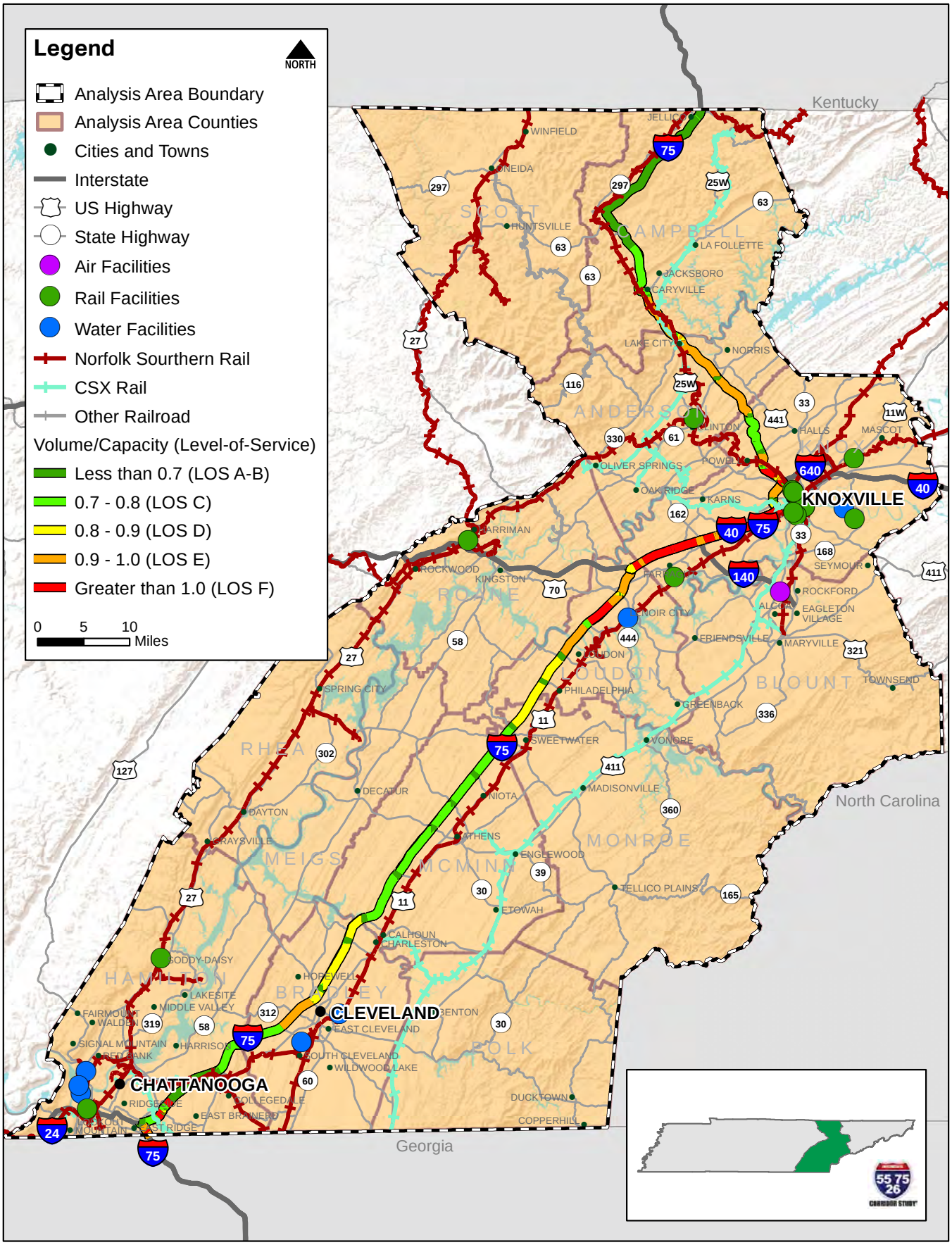
30- Knoxville Airport Aviation Activities Report for February 2019, https://flyknoxville.com/wp-content/uploads/2019/04/Feb-19-stats.pdf

Figure 9-2. Through Truck Traffic Tonnage in the Study Area for 2016 — I-75



Source: Transearch (2016)

Figure 9-3. Freight Facilities — I-75



Source: InfoUSA and Tennessee Statewide Travel Demand Model

In Knoxville, Burkhart Yard, adjacent to the BEI barge terminal, is served by NS and the Knoxville Holston River Railroad. There are two sidings of 1,000 feet with space to accommodate 32 rail cars[31].

Water

The BEI barge terminal is served by NS in Knoxville on the Tennessee River. It transfers 500,000 tons of bulk commodities annually[32].

9.4 Freight Diversion: From Truck to Rail

Although the U.S. and Tennessee economies are much less dependent on goods production than they once were, shipping of finished and unfinished goods is still vital to the economic strength of the region. The dominant shipper locations are:

- Sites where the commodity is grown, logged, or mined
- Where it is processed or manufactured
- Distribution sites/centers where products and commodities are aggregated for more efficient shipment.

Table 9-6 provides a basic overview of the relationship between some of the major industry sectors and their primary mode of goods movement, and the correlation between tonnage and value. As shown, products of low value and high tonnage are ideal for travel by water and rail, while truck and air modes typically carry lighter and more valuable cargoes. This section will assess the potential for shifting some shipments from truck to rail or air in order to increase highway capacity.

Table 9-6. Tonnage, Value, and Value per Ton for All Shipments Into, Out of, and Through Tennessee, 2016

	Total Tons	Total Value	Value per Ton
Air	0.166M	$23B	$139,028
Truck	44.5M	$82B	$1,852
Rail	1,870M	$1,810B	$968
Water	0.216M	$.14B	$626
Total	**1.91B**	**$1.91T**	**$1,000**

Source: Transearch (2016)

Freight Diversion Potential: Existing Freight Volumes

Freight primarily travels in the I-75 corridor by truck, as evidenced by prior tables and figures. However, there is potential for some commodities to divert to other modes that are more cost-effective than truck. In order to assess which products could divert from truck, Transearch was used to summarize the existing (2016) volumes destined for (inbound) and originating from (outbound) the corridor. As shown in Table 9-7, the majority of the inbound commodities with diversion potential are coming into the corridor region by truck.

Table 9-7. Inbound Freight Diversion Potential, 2016 — I-75

Commodity	Air	Rail	Truck	Water
Food or Kindred Products	0.1%	0.7%	52%	47%
Clay, concrete, glass Or Stone	0%	2.9%	37%	60%

Source: Transearch (2016)

Other modes have potential for diverting commodity traffic when their timing needs and handling needs are similar. Costs are typically related to the speed at which products need to get to the consumer, and as such air and truck are typically more expensive modes. Rail and water are slower modes that are better suited for products that do not have a short delivery window.

In order to assess the commodities for which this may be true, it was assumed that goods are potential candidates for diversions if they are currently transported by two or more modes for between 20 percent and 80 percent of the total tonnage. This range showcases that there is a sizeable portion of product moving by more than one mode, and therefore the commodity's individual handling needs can be accommodated at different facilities. Table 9-7 therefore shows that, for example, 52 percent of the tonnage of food or kindred products travels by truck and 47 percent by water. Because most of the food or kindred products are moved by truck but nearly half by water, it can be inferred that time is not as important of a factor in choosing the mode as cost for that half of the product. Therefore, there is potential for even greater volumes of food or kindred products to move by water, freeing up valuable highway capacity for other commodity shipments and auto traffic. It is important to note, however, that the commodity tonnages constitute a small share of the total tonnage handled in the corridor. The majority of high-volume commodities

31-Burkhart Enterprises, Rail Facility, http://www.burkhartenterprises.com/services-and-capabilities/#rail
32- Burkhart Enterprises, River Port, http://www.burkhartenterprises.com/services-and-capabilities/#river

are not good candidates for diverting away from truck.

In addition to the inbound freight with diversion potential, Transearch was used to assess the outbound freight diversion potential in Table 9-8. A similar methodology was employed, selecting outgoing commodities that ship 20 to 80 percent of their tonnage by multiple modes. In the outgoing direction, however, there is a more even split of truck with rail and water as noted by food or kindred products, where each mode moves about a third of the tonnage. There is potential for diverting additional tonnage away from truck to rail and water modes thereby further reducing congestion in the I-75 corridor.

Table 9-8. Outbound Freight Diversion Potential, 2016 — I-75

Commodity	Air	Rail	Truck	Water
Food or Kindred Products	0%	36%	31%	34%
Textile Mill Products	0.3%	9%	29%	62%

Source: Transearch (2016)

Freight Diversion Potential: Freight Volume Projections

The potential for future volumes to divert from truck to rail, water, or air was assessed using the Transearch database's 2045 projections for the study area. Using a similar methodology as for the existing freight volumes, the top inbound and outbound commodities that are transported by multiple modes were summarized in Table 9-9 and Table 9-10. The top two modes between which the commodity is shipped are highlighted to indicate the potential for diversion. For the great majority of inbound and outbound shipments, truck is the primary mode for almost all tonnage.

Table 9-9. Inbound Freight Diversion Potential, 2045 — I-75

Commodity	Air	Rail	Truck	Water
Food or Kindred Products	0.1%	1.2%	62%	36%
Clay, Concrete, Glass Or Stone	0%	2.3%	39%	59%

Source: Transearch (2045)

Table 9-10. Outbound Freight Diversion Potential, 2045 — I-75

Commodity	Air	Rail	Truck	Water
Food or Kindred Products	0%	25%	36%	40%
Textile Mill Products	0.5%	7.0%	28%	65%

Source: Transearch (2045)

Outgoing food or kindred products travel by three modes: rail, truck, and water. Assuming adequate intermodal capacity, there is potential for diverting between any of the modes as they each carry 25 to 40 percent of the tonnage. This trend was also seen in the 2016 data. Typically, bulk commodities like clay are trucked to the nearest barge terminal, so the truck and water shares may already be reflecting an ideal mix of transportation modes for these commodities.

9.5 Truck Parking

Truck parking facilities in the region are both public and private. As shown in Figure 9-4, there are a number of locations on I-75 for truck drivers to stop and rest or sleep overnight, particularly near Knoxville. With Hours of Service regulations that mandate rest periods and the number of hours of consecutive work that are allowed without sleeping[33], it is important that drivers are offered a selection of locations throughout their journey where they can rest and possibly eat, shower, and sleep overnight. Without proper rest, drivers risk fines and crashes.

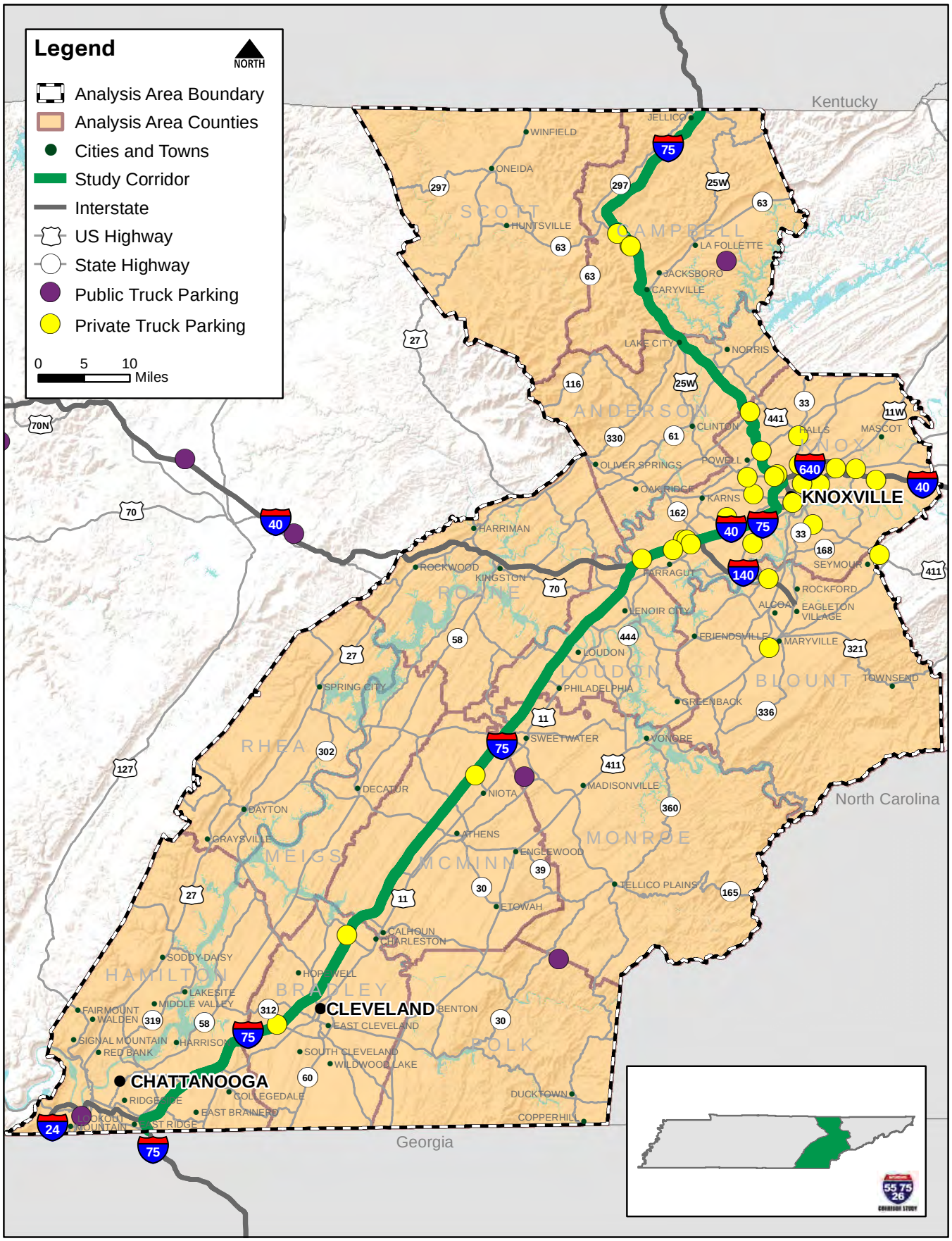
9.6 Other Emerging Freight Issues

As the U.S. economy continues to shift towards a services focus, more finished goods will need to be shipped in from other parts of the world that have greater manufacturing strengths[34]. The demand for just-in-time purchases through e-commerce will only increase, placing further pressure on I-75 and other study area highways as goods are delivered to ports on the Gulf, East, and West Coasts and trucked, barged, or railed inland to Tennessee and elsewhere. These shipments will continue to result in congestion.

33- Federal Motor Carrier Safety Administration, Summary of Hours of Service Regulations, March 9, 2017, https://www.fmcsa.dot.gov/regulations/hours-service/summary-hours-service-regulations

34- The Atlantic, "The American Economy is Experiencing a Paradigm Shift," https://www.theatlantic.com/sponsored/citi-2018/the-american-economy-is-experiencing-a-paradigm-shift/2008/

Figure 9-4. Truck Rest Areas in the Study Area (Public and Private) — I-75



Source: InfoUSA

E-Commerce

E-commerce is the economy of transactions online, including the buying and selling of products. The e-commerce platform has exploded in recent decades with the introduction of companies like eBay and Amazon that sell and transport goods to purchasers with predictable delivery windows. Over time, e-commerce has increased further with the advent of social media, as customers enjoy the convenience of shopping from home no matter the time of day, the ability to price compare and read reviews, and ultimately have the product shipped directly to their doorstep. Brick and mortar retailers including giants like Walmart and Target have felt the pressure to also include online stores to keep up with consumer demands, and while online sales worldwide are increasing as a share of the overall retail economy, the year to year growth of ecommerce sales has slowed from 25 percent in 2015 to a projected 19 percent by 2020, as shown in Figure 9-5.

Figure 9-5. Retail E-Commerce Sales Worldwide, 2015-2020

Source: Ecommerce Guide, "What is Ecommerce?" https://ecommerceguide.com/guides/what-is-ecommerce/

While e-commerce growth may be slowing down, it is unlikely the market is going anywhere anytime soon. As a result, the nation's infrastructure network has had to accommodate the increase in truck traffic that is used to ship the products in the common two day delivery window offered by Amazon and others. A recent study by the American Transportation Research Institute (ATRI) notes that ecommerce is changing the way retailers do business and affecting distribution networks and the trucking industry on the whole[35]. Trucking distances are decreasing on average from 800 miles in 2000 to 500 miles in 2018 as companies build more distribution centers. These regional distribution centers are being constructed especially in the Midwest to take advantage of multiple transportation modes and the accessibility to large population concentrations. For example, Amazon's Tennessee distribution and fulfillment facilities are in Chattanooga, Memphis, Nashville, and north of Cleveland, TN, and Walmart distribution centers are in Memphis, south of Nashville, and northeast of Knoxville. Last-mile fulfillment centers are becoming increasingly important and represented 73 percent of the industrial real estate market in 2017, a growth of 15 percent from 2016.

All of these changes to the dynamic of the retail market have resulted in demands on the trucking industry and therefore the highway network. Driver shortages, hours of service regulations, driver retention, and scarcity of truck parking are all issues that have developed along with the growth in ecommerce. The trucking industry will continue to evolve and respond to consumer demands while the nation's aging infrastructure is expected to accommodate the growth in truck traffic that comes with it[36].

Ports of Charleston and Savannah

The Port of Charleston is located at the southern terminus of I-26 and is an important gateway for freight to the east coast of the United States. Truck and rail traffic originating at the port use the corridor for destinations inland including the nearby metropolitan areas of Atlanta, Columbia, and Charlotte, as well as destinations in Tennessee. In 2018, the Port of Charleston began a $529 million project to deepen the shipping channel from 45 feet to 52 feet, allowing some of the world's largest container ships to call on the port even at low tide.

Not far from the Port of Charleston is the Port of Savannah, which is in the process an expansion similar to that which is underway at Charleston. The Savannah Harbor Expansion Project (SHEP) will deepen the channel from 42 feet to 47 feet, allowing for larger vessels to call on the port at a cost of $973 million. Begun in 2015, many elements of the project are complete or nearly complete, but the inner harbor dredging is still in the design phase. Because of Savannah's proximity to I-26 and I-75, increased maritime volumes would result in highway and rail traffic increases into Tennessee and other locations west.

35- https://www.ccjdigital.com/atri-e-commerce-reshaping-trucking-industry-operations/
36- Lockridge, Deborah, Truckinginfo.com, "How is the Growth of E-Commerce Affecting Trucking?" February 5, 2019, https://www.truckinginfo.com/324451/how-is-the-growth-of-e-commerce-affecting-trucking

As a result of these major infrastructure projects, freight volumes coming from the ports will continue to grow, emphasizing the need for inland port and intermodal facilities to collect and redistribute the goods regionally. Tennessee is considering the potential for inland ports to transfer freight from highway to rail, reducing congestion on the region's already well-utilized interstates.

9.7 Existing and Future Deficiencies and Needs

Truck is the primary mode of transporting freight in the I-75 corridor, accounting for nearly 90 percent of inbound and 96 percent of outbound freight in the study area in 2016. Truck volumes are expected to grow by at least 61 percent from 2010 to 2040, with the section north of Knoxville showing growth of over 91 percent as shown in Figure 9-1. A number of parallel corridors are also showing high growth, indicating that traffic is and will continue diverting to other routes as a result of the low LOS on I-75 in some areas (shown in Figure 9-3). The corridor sees high volumes of through traffic with over five million tons annually, comparable to volumes seen on I-40 and I-24. The corridor has limited public and private truck parking between Chattanooga and Knoxville, but there are opportunities to divert freight from truck to rail in both locations. As noted in Section 9.4, the majority of high-volume commodities are not good candidates for diverting away from truck. However, any diversion of trucks from the corridor alleviates capacity and congestion, reducing idling, delays, and the potential for crashes for all Interstate users.

As noted in the Tennessee Statewide Multimodal Freight Plan (2018)[37], changes to the I-75 corridor study area are underway in the form of new or expanded freight facilities including a potential new intermodal facility in Knoxville and improvements to the Chickamauga Lock on the Tennessee River near Chattanooga.

A. NS Intermodal Facility in Knoxville: There is potential for a new NS intermodal facility located in Knoxville. As described in the Tennessee Freight Plan, the facility is being studied and would likely be located in the Knoxville region (in the New Market area of Jefferson County), serving as an option for trucks to divert to rail along the I-75 corridor.

B. Chickamauga Lock: If the Chickamauga Lock, located seven miles north of Chattanooga on the Tennessee River, closes, truck traffic on I-75 would increase. The lock requires extensive maintenance because of a concrete aggregate problem that, if not addressed, will result in the lock closing. A lock expansion project is underway, but could continue to be delayed due to a lack of funding. Construction of Phase 1 was completed in 2007 but further construction was delayed due to a lack of funding. The next phase was substantially completed in January 2019, and while the final phase of the project is not in the President's 2019 budget, it could be finished by 2024 if funding is secured[38].

C. Bottleneck Locations: The Tennessee Freight Plan lists 32 potential bottleneck locations based on LOS and truck speed data. Two of the locations are on the I-75 corridor. One bottleneck is in Campbell County between mile markers 6.32 and 9.43 north of US-25W. The second bottleneck is on I-75/I-40 in Knox County east of Everett/Watt Road to I-275. During a field review of I-75, an observation was made that a truck climbing lane near MM 132, south of Careyville, could be beneficial.

37- Tennessee Department of Transportation, Tennessee Statewide Multimodal Freight Plan, 2018, https://www.tn.gov/content/dam/tn/tdot/long-range-planning/TDOT_FreightPlan_02.27.18.pdf

38- US Army Corps of Engineers, Chickamauga Lock Replacement Project, https://www.lrn.usace.army.mil/Missions/Current-Projects/Construction/Chickamauga-Lock-Replacement-Project/

I-26 Corridor

▶Assessment of Existing and Future Deficiencies

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I-26 Corridor

1. Introduction

The I-26 corridor serves as a backbone for economic development and growth in the northeast Tennessee region. As population and employment continue to grow, new travel demands place pressure on the Interstate as well as parallel and intersecting highways. This results in increased traffic congestion, travel times, and conflicts, which threaten the corridor's ability to sustain future growth.

A previous technical memorandum (Technical Memorandum 1) for this study provided a data and information inventory for the corridor. This technical memorandum (Technical Memorandum 2) assesses existing and future deficiencies and needs along the I-26 corridor by examining transportation issues including land use, economic development, highway capacity, travel demand, safety, Intelligent Transportation Systems (ITS), freight, transit, and non-motorized travel. An assessment of these topics will help identify ways to improve safety and enhance transportation services throughout the corridor.

This analysis focuses on the trend scenario for the I-26 corridor, which predicts existing and future conditions if current practices, plans, and policies remain unchanged. To supplement the technical analysis, public workshops and surveys were used to generate feedback from citizens and stakeholders located throughout the corridor.

1.1 Defining the Trend Scenario

The trend scenario establishes the existing and projected transportation conditions along the I-26 corridor and serves as the baseline for identifying needs and, ultimately, proposed improvements. The 2010 and 2040 Tennessee Statewide Travel Demand Model (TSM) trend scenarios were originally developed by the Tennessee Department of Transportation (TDOT) in 2017 (Phase 3/Version 3). As part of this study, the trend scenarios were updated and validated based on the following:

- Population and employment data and projections from Woods and Poole Economics, Inc.
- Projects currently programmed for construction in TDOT's Statewide Transportation Improvement Program (STIP)
- Projects currently programmed for construction in the Kingsport Metropolitan Transportation Planning Organization's (MTPO) Transportation Improvement Program (TIP) and the Johnson City MTPO's TIP (both FY2017-2020)
- Recent MPO travel demand model projections of socioeconomic data, traffic volumes, and travel times
- Recent Transearch freight data and projections

Figure 1-1. Study Corridors

The I-26 corridor is being studied as part of a larger corridor study that also includes I-155, I-75, and I-55.

Additional detail regarding model validation and updates can be found in separate technical memoranda ("TN Corridor Study – Trend Scenario Memo" and "TN Corridor Study – Model Documentation Memo") prepared for this study.

Table 1-1 and Figure 1-1 show the programmed projects included in TDOT's 2017-2020 STIP, the Kingsport MTPO's FY2017-2020 TIP, and the Johnson City MTPO's FY2017-2020 TIP. Of these projects, major capacity and interchange projects for which funding has already been allocated are included in the 2040 "Existing plus Committed (E+C)" network for the updated 2040 trend scenario.

Not included in Table 1.1 are improvements to I-26 at the SR-67 interchange in Johnson City. These improvements were completed in 2018 (PIN#112457.00) and are included in the E+C network for the 2040 trend scenario. According to TDOT's STIP Project Viewer, construction included an auxiliary lane on I-26 eastbound, an auxiliary lane on SR-67 northbound, improvements to the I-26 westbound off-ramp, signal modification at the ramp intersections, and lighting on I-26 eastbound. The total cost of these improvements was $4.2 million.

Table 1-1. Corridor Programmed Projects* — I-26

	Figure 1-1 ID	Route and Project Limits	Improvement	Cost	Year	Lead Agency/ Funding Type	TIP #
Kingsport MTPO FY2017 - 2020 TIP	1	Kingsport Area Transit Service (KATS)	Operations	$9,000,000	2017-2021	Kingsport/FTA 5307	TIP # PT-1
			Capital	$2,867,000		Kingsport/FTA 5307	TIP # PT-2a
			Capital	$2,867,000		Kingsport/FTA 5339	TIP # PT-2b
			Planning	$175,000		Kingsport/FTA 5307	TIP # PT-3
	2	Netherland Inn - Stone Drive Connector**	Realignment/ Reconstruction	$6,850,000	2017-2021	L-STBG	L-STBG-1
Johnson City MTPO FY2017 - 2020 TIP	3	I-26: Interchange at SR-354 (Exit 17)**	Diverging Diamond Interchange (DDI)	$14,900,000	2019	TDOT/NHPP/ IMPROVE Act	TIP # 90115
	4	SR-381 from Knob Creek Rd to Browns Mill Rd	Adaptive signal control	$290,000	2019	Johnson City/ STBG-Local	TIP # 2013-02
	5	Systemwide deployment throughout Johnson City	Adaptive signal control	$550,000	2020	STBG-Local	TIP # 2014-11
	6	Johnson City Transit (JCT)	Operations	$12,300,000	2017-2020	JCT/ FTA 5307	TIP # 2017-08
			Captial	$1,060,000	2017-2020	JCT/ FTA 5307	TIP # 2017-09
			Capital	$4,849,400	2017-2020	JCT/ FTA 5307/FTA 5339	TIP # 2017-10
			Operations	$2,677,470	2017-2020	JCT/ FTA 5310	TIP # 2017-11
			Capital	$731,780	2018-2019	JCT/ FTA 5317	TIP # 2017-15
			Operations	$220,000	2019-2020	JCT/ FTA 5316	TIP # 2017-17

* Only projects listed in the TIP or STIP are included in this table.

** These projects are modeled in the 2040 trend scenario.

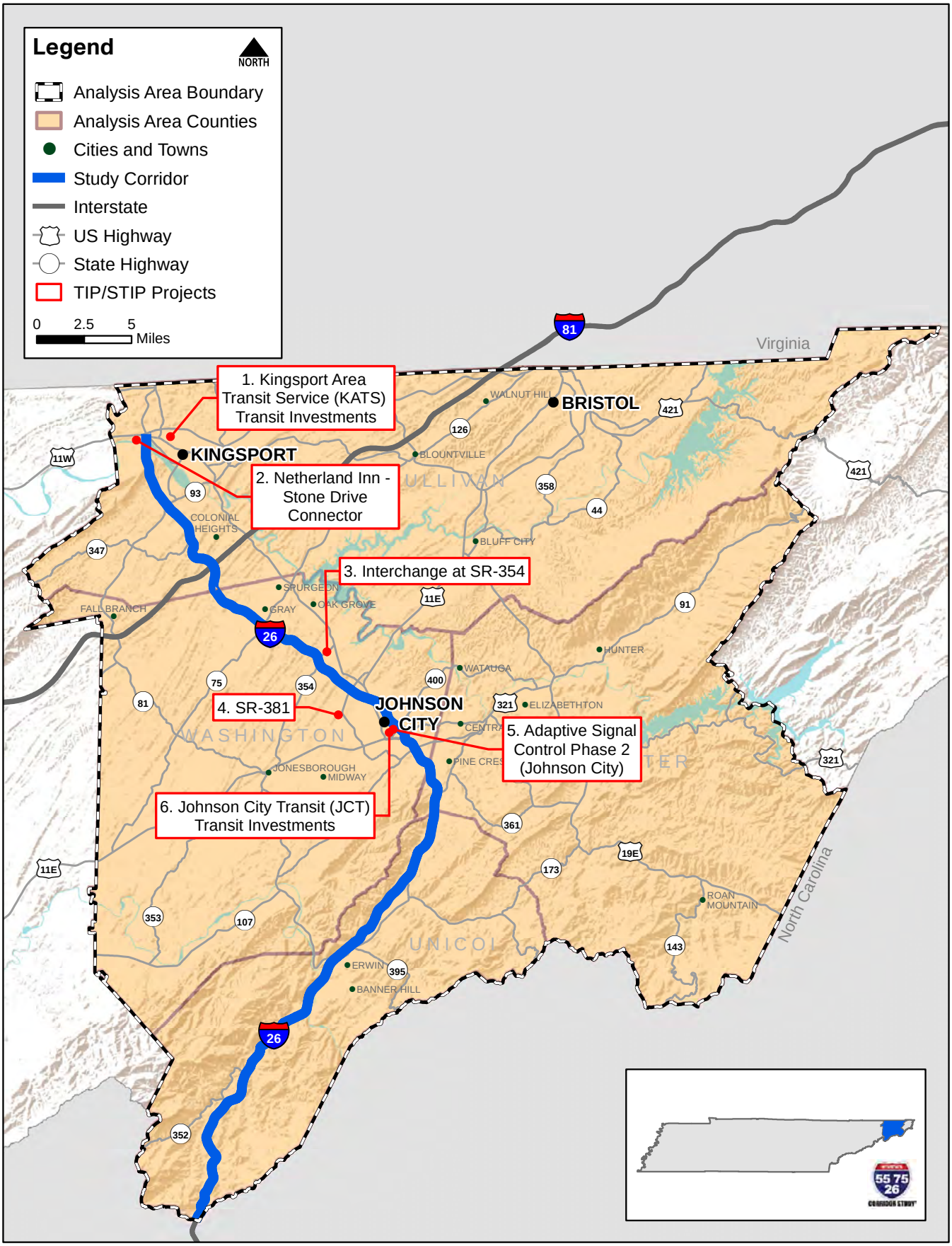
Sources: Johnson City MTPO FY2017-2020 TIP and Kingsport MTPO FY2017-2020 TIP

FTA = Federal Transit Administration

L-STBG = Local Surface Transportation Block Grant Program

NHPP = National Highway Performance Program

Figure 1-1. Corridor Programmed Projects* — I-26



* Only projects listed in the TIP or STIP are included in this figure.

Sources: Johnson City MTPO FY2017-2020 TIP and Kingsport MTPO FY2017-2020 TIP

2. Land Use and Economic Development

In any region, the need for improvements to the public infrastructure is triggered by growth, both in the number of residents and number of jobs. Examining historic development patterns as well as anticipated growth trends can provide a glimpse into the future and what challenges may await the transportation system.

2.1 Population and Employment Projections

A high-level review of population and employment projections from Woods & Poole, Inc. was undertaken for the counties surrounding the I-26 corridor, more specifically Carter, Sullivan, Washington, and Unicoi counties (Figure 2-1). According to Woods & Poole Economics data, these counties are expected to see an additional 52,500 residents and 63,000 jobs by 2040. This represents a 15% increase in people and 33% increase in employment since 2010. Washington County is expected to see the most significant growth in employment and population accounting for approximately 68% of the region's population growth and 59% of the region's employment growth (Figures 2-2 and 2-3).

Figure 2-1. Study Area — I-26

Interchange access to Interstate corridors provides communities with the ability to attract businesses and provides accessibility to economic centers for employment. As such, population and employment projections from the Tennessee Statewide Travel Demand Model (TSM) were also examined in more detail near the interchanges along the I-26 corridor as shown in Tables 2-1 and 2-2. Areas in the immediate vicinity (approximately a one mile radius) of an I-26 interchange are expected to grow by approximately 16,000 people and 33,000 jobs, a 19% and 48% increase, respectively. Similar to the county-wide growth expected, Washington County interchanges are expected to see the highest absolute growth in both population and employment. However, the SR-359/ Okolona Road interchange in Carter County is expected to see the most significant growth in employment in terms of percentage. Interchanges within Washington County that are projected to see the greatest increase in growth include SR-354 (Boones Creek Road), SR-381 (State of Franklin Road), and SR-75 (Bobby Hicks Highway).

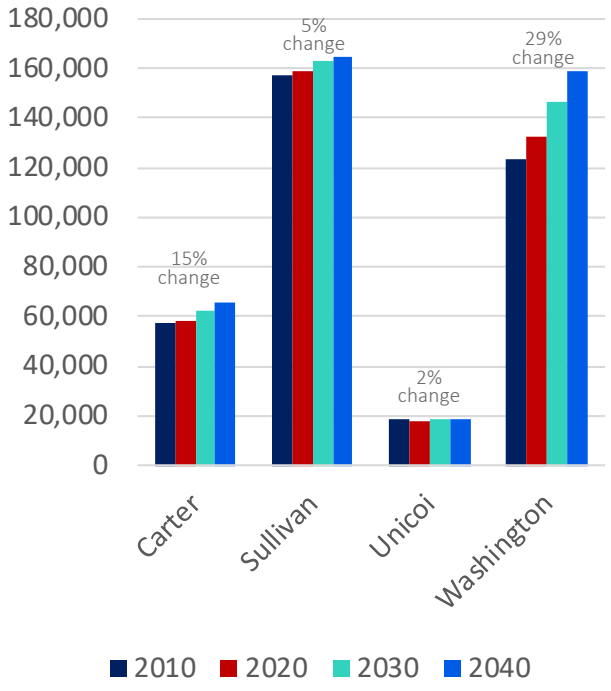
2.2 Planned and Proposed Development

Existing development patterns and in-progress plans will direct much of the forecasted population and employment growth over the next 20 years. Existing land use and development patterns were documented in Section 3-7 in Technical Memorandum 1. As mentioned there, much of the future growth anticipated along the I-26 corridor is poised to occur in and around the major urban areas of Kingsport and Johnson City in Sullivan and Washington Counties, respectively.

Aerospace Park is a direct-airfield development at Tri-Cities Airport that offers 40 acres certified for immediate development and has an additional 120 acres under construction. Aerospace Park has access to I-26 via SR-75 and I-81 via SR-357. The I-26/I-81 interchange area, often referred to as the Tri-Cities Crossing, holds significant development potential, specifically for commercial and/or industrial developments, given its access to the Carolinas, Virginia, and the western portion of Tennessee.

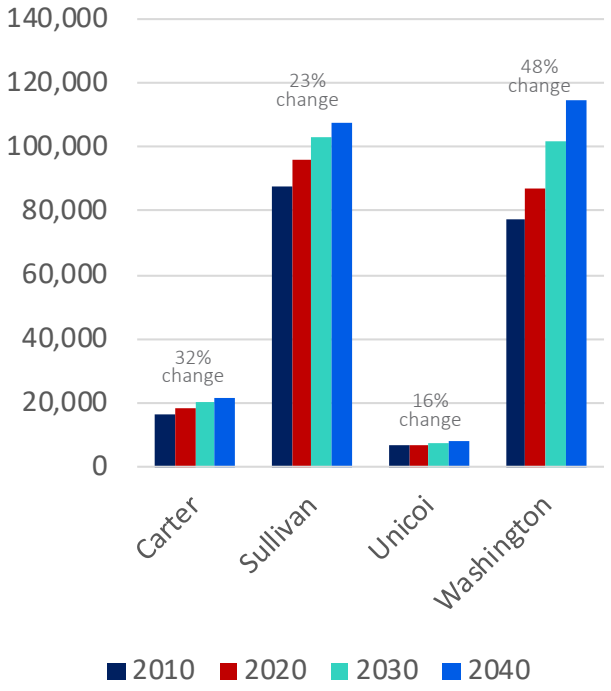
In northern Washington County, Exit 17 for SR-354 (Boones Creek Road) is expected to see significant commercial growth around the interchange and additional residential growth is expected farther from the interchange around the new Boones Creek Elementary School, which opened in August 2019. Exit 19, SR-381 (State of Franklin Road), is home to a large number of commercial businesses and is expected to

Figure 2-2. County Growth Trends, Population – I-26



Source: Woods & Poole Economics, Inc., 2018

Figure 2-3. County Growth Trends, Employment – I-26



Source: Woods & Poole Economics, Inc., 2018

Table 2-1. Interchange Population Growth – I-26

			Population Growth	
	2010	2040	Number	Percent
Carter	3,780	4,590	810	21%
Sullivan	23,100	26,140	3,040	13%
Unicoi	10,790	11,430	640	6%
Washington	44,050	55,290	11,240	26%
Total	**81,720**	**97,450**	**15,730**	**19%**

Source: Tennessee Statewide Travel Demand Model (TSM)

Table 2-2. Interchange Employment Growth – I-26

			Employment Growth	
	2010	2040	Number	Percent
Carter	570	1,830	1,260	221%
Sullivan	22,790	27,790	5,000	22%
Unicoi	3,310	4,350	1,040	31%
Washington	42,200	67,980	25,780	61%
Total	**68,870**	**101,950**	**33,080**	**48%**

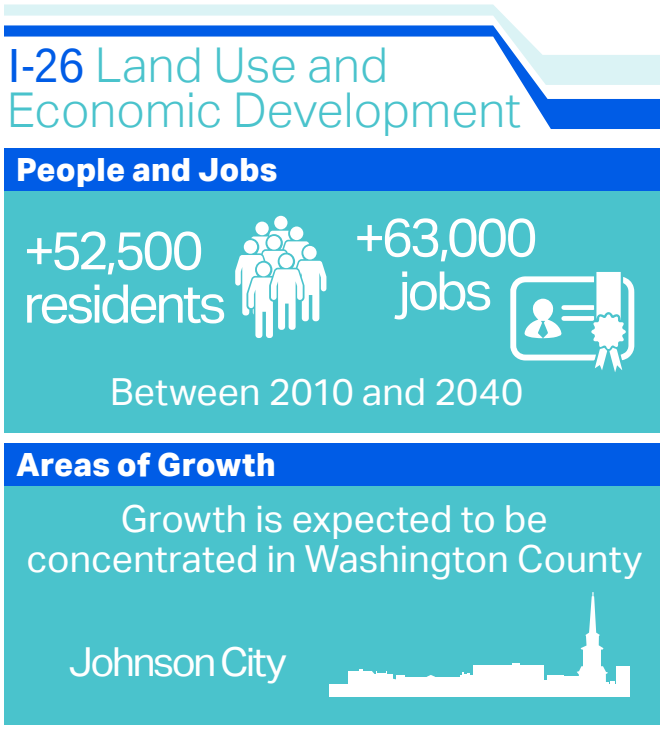
Source: Tennessee Statewide Travel Demand Model (TSM)

see an increase in the land uses that already exist in this area, including additional multifamily residential. Further south on I-26, the exits for downtown Johnson City are expected to see additional growth in the future as urban infill and redevelopment of historic buildings continue to occur for use as commercial and office space. In addition, future growth in industrial land uses could result along the corridor when improvements to I-26 are completed through Asheville, North Carolina.

2.3 Existing and Future Deficiencies and Needs

The following summarizes the key findings related to growth and development along the I-26 corridor.

A. Corridor Population and Employment Growth: Communities throughout the I-26 corridor are expected to experience increases in population and employment, adding approximately 52,500 residents and 63,000 jobs by 2040. Both population and employment growth will be heavily concentrated in Washington County, accounting for nearly 60% of new people and jobs. However, Carter, Sullivan, and Unicoi Counties are all expected to see some amount of future growth, meaning that regional travel demands will continue to increase along the I-26 corridor.



B. Interchange Area Employment Growth: Growth in close proximity to existing I-26 interchanges will strongly tilt toward employment, with two jobs added for every new resident, for a total of approximately 33,000 new jobs within the interchange areas. The expected increase in regional population and employment will create additional demands in these areas that will contribute to peak hour congestion already experienced in the urban areas surrounding the I-26 corridor.

C. Planned and Proposed Development:

Areas that will continue to see the highest amount of future development (relative to commercial and residential growth) include:

- SR-354 (Boones Creek Road)
- SR-381 (State of Franklin Road)

SR-75 (Bobby Hicks Highway) continues to attract employment growth given its central proximity to Kingsport and Johnson City as well as to the Tri-Cities Airport.

Aerospace Park is a direct-airfield development at Tri-Cities Airport that offers a total of 160 acres. Aerospace Park has access to I-26 via SR-75 and I-81 via SR-357.

The I-26/I-81 interchange area, often referred to as the Tri-Cities Crossing, holds significant development potential, specifically for commercial and/or industrial developments.

3. Highway Capacity and Travel Demand

As population and employment growth occurs in the I-26 study area, the demand on the roadway network also increases. This analysis considers historic traffic volumes in conjunction with predicted future 2040 traffic volumes to evaluate the following highway capacity and demand conditions in the corridor:

- 2010 traffic volumes and projected 2040 traffic volumes
- Travel patterns
- Volume-to-Capacity ratios
- Bottlenecks
- Travel time and delay

3.1 Traffic Volumes and Projections

TDOT collects and maintains Annual Average Daily Traffic Volume (AADT) data on roadways across the state. Figure 3-1 shows the 2017 AADT volumes recorded in the Tennessee Roadway Information Management System (TRIMS) at 13 count stations along I-26. As shown, daily volumes range from 8,360 vehicles per day (VPD) (24% trucks) near the North Carolina border in Unicoi County, to 64,230 VPD (6% trucks) near Johnson City. Near the Virginia border in Sullivan County, volumes decrease to approximately 26,560 VPD (7% trucks). Throughout the corridor, eight to nine percent of the total daily volume occurs during the peak hours. The capacity of four-lane rural freeway facilities ranges from 52,000 VPD to 67,000 VPD. The capacity of four-lane urban freeway facilities ranges from 71,000 VPD to 92,000 VPD (Highway Capacity Manual 2010 Exhibit 10-8 and 10-9). I-26 is classified as an urban freeway facility between US-11W and the Carter/Unicoi County Line and through the Town of Erwin.

Table 3-1 is populated with data obtained from the TSM, which provides base year (2010) daily trip information and forecasts the daily trips that will be made in 2040 based on projected growth and land use changes.

As shown, total daily trips in the four-county area are expected to reach 2.3 million by 2040, representing a 23% increase over total trips in 2010. According to projections based on Woods & Poole data, described in Technical Memorandum 1, the corresponding population and employment increases in the area are 15% and 33%, respectively.

Table 3-1. Area Daily Trip Breakdown 2010 and 2040 — I-26

	Daily Trips		
Trip Types	**2010**	**2040**	**% Change**
Personal Trips	1,784,300	2,196,300	23%
Truck Trips	51,200	68,500	34%
Total Trips	**1,835,500**	**2,264,800**	**23%**
Percent truck trips	2.8%	3.0%	8.0%

Source: Tennessee Statewide Travel Demand Model (TSM)

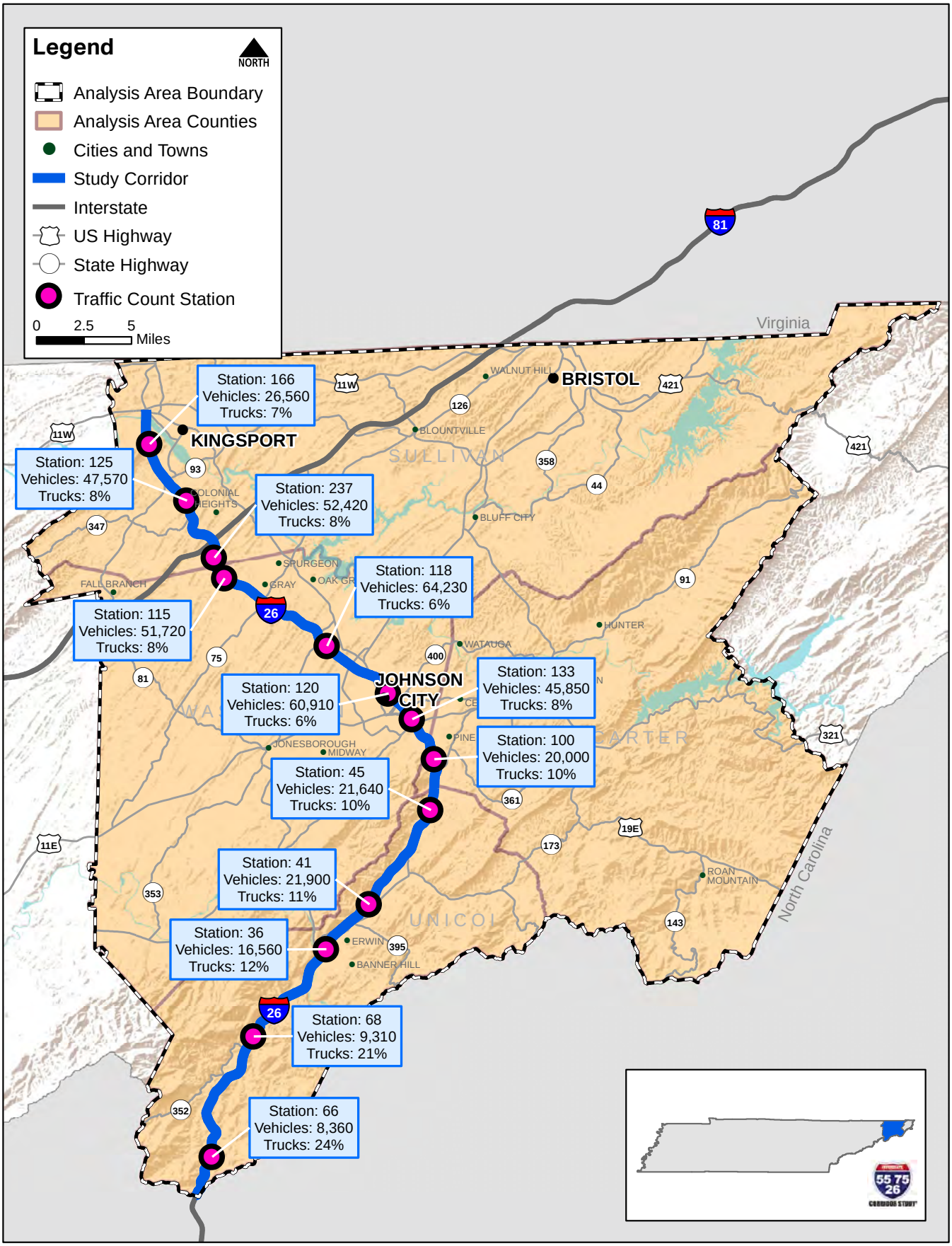
The TSM was used to calculate the total daily vehicle miles traveled (VMT) on each type of roadway facility in the four-county study area. Table 3-2 indicates a total 25% increase in VMT over the 2010 base year total. Rural Interstates are expected to see the highest percent changes in VMT. A comparison of the increase in VMT to the increase in the daily number of trips suggests that the average length of trips will remain the same, at approximately four miles per trip.

Table 3-2. Vehicle Miles Traveled by Functional Class — I-26

		Total Daily VMT (1,000s)		
	Functional Class	**2010**	**2040**	**% Change**
Urban	Interstate	1,733	2,243	26%
	Expressway	169	203	20%
	Arterial	3,764	4,592	22%
	Collector	554	727	31%
	Local Road	21	24	15%
Rural	Interstate	530	713	35%
	Arterial	570	737	29%
	Collector	433	545	26%
	Local Road	1	1	0%
Analysis Area Total		**7,815**	**9,784**	**25%**
Total VMT/Trip		**4.26**	**4.32**	**1%**

Source: Tennessee Statewide Travel Demand Model (TSM)

Figure 3-1. 2017 Average Annual Daily Traffic Volumes Along I-26



Source: Tennessee Roadway Information Management System (TRIMS) - 2017

3.2 Travel Patterns

Major Trip Destinations (O-D Pairs)

Origin-Destination (O-D) data, obtained from the TSM, was evaluated to determine the most common trip origin and destinations in the study area, as well as travel times between well-known locations. Many of the frequently traveled O-D pairs are closer in proximity, with travel times between 5 and 10 minutes. Some, however, represent trips of greater distance. For example, Unicoi to Erwin (approximately 7.1 miles) is one of the most commonly traveled O-D pairs, accommodating approximately 3,150 auto trips/day. Figure 3-3 shows the expected change in time required to travel these routes between 2010 and 2040. As shown, travel times are expected to increase by less than four minutes per trip.

Census County-to-County Work Flow

The U.S. Census Bureau provides origin and destination data for work trips per county. Figure 3-4 illustrates information obtained from their interactive, web-based tool, OnTheMap. The figure shows the most common employment destinations for workers living in each county. For example, of the 61,000 employees who live in Sullivan County, 53% also work in Sullivan County. Eight percent work in Virginia, 16% work in Washington County, 3% work in Hawkins County, and 2% work in Carter County. The remaining 18% work in other counties. Washington County, including Johnson City, draws the largest percentages of county-to-county work trips in the study area – receiving 30% of workers living in Unicoi County, 34% of workers living in Carter County, and 16% of workers living in Sullivan County. Fifty-five percent of workers living in Washington County also work within the county.

Very small percentages of workers living within the study area pass the Tennessee border to work in adjacent states. However, 30% of workers living in Scott County, VA drive to Sullivan County for work. This represents approximately 2,300 workers.

3.3 Volume-to-Capacity Ratios

Vehicle capacity, as defined in the Highway Capacity Manual (HCM), is the maximum number of vehicles that can pass a given point during a specific period of time under prevailing roadway, traffic, and control conditions. Roadway conditions include number of travel lanes, design speed, lane widths, shoulder widths, horizontal and vertical alignments, and the number of access points to adjacent parcels. Traffic conditions include vehicle type, specifically the percentage of heavy vehicles that impact travel speed and occupy more space, the distribution of vehicles traveling in each direction, and the driver population (commuter versus non-commuter). Finally, the type of traffic control (stop signs versus traffic signals) used on non-Interstate facilities also affects capacity. Given this definition, it is apparent that the capacity of a facility can change from one segment to another and from one time of day to another time of day.

Figures 3-5 and 3-6 illustrate the 2010 and 2040 peak period volume-to-capacity (VC) ratios (obtained from the TSM) for each Interstate segment. Where the volume-to-capacity ratio is greater than 1.0, drivers experience poor operating conditions and high delay, represented as level-of-service (LOS) F (see Figure 3-2). As shown, I-26 currently operates very well – with all but one segment in Johnson City at LOS A and B. By 2040, segments of I-26, primarily between Johnson City and Kingsport, will begin to experience increased congestion, noted by LOS D. As indicated in red on

Figure 3-2. LOS Characteristics

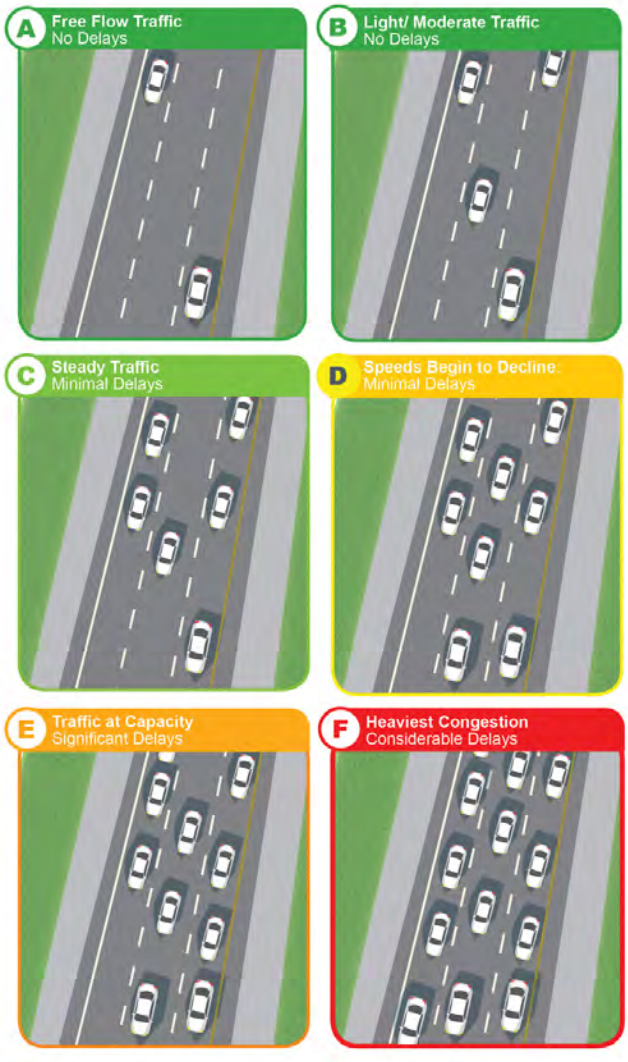
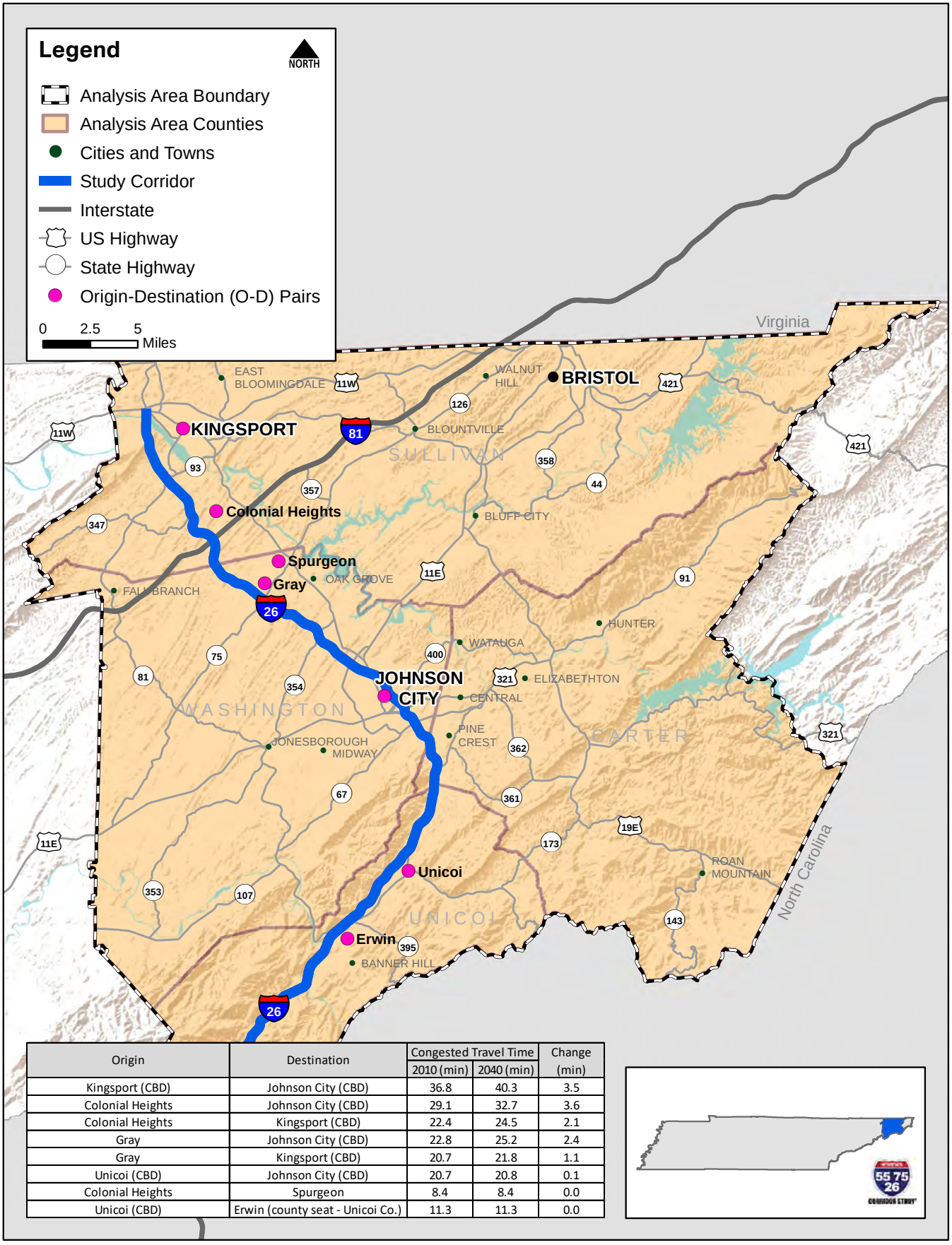


Figure 3-3. Major Trip Origin-Destination Pairs — I-26*

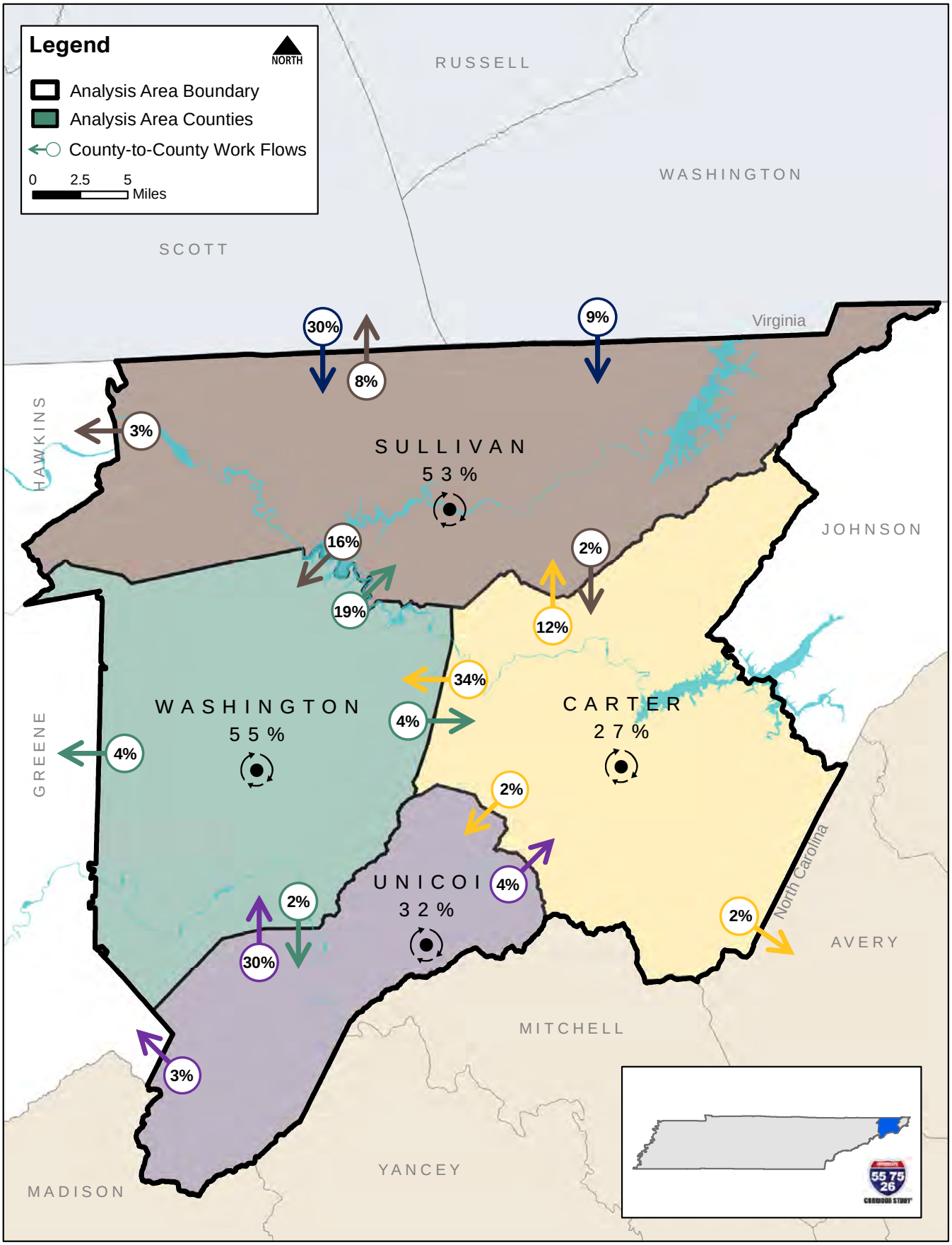


Origin	Destination	Congested Travel Time		Change
		2010 (min)	2040 (min)	(min)
Kingsport (CBD)	Johnson City (CBD)	36.8	40.3	3.5
Colonial Heights	Johnson City (CBD)	29.1	32.7	3.6
Colonial Heights	Kingsport (CBD)	22.4	24.5	2.1
Gray	Johnson City (CBD)	22.8	25.2	2.4
Gray	Kingsport (CBD)	20.7	21.8	1.1
Unicoi (CBD)	Johnson City (CBD)	20.7	20.8	0.1
Colonial Heights	Spurgeon	8.4	8.4	0.0
Unicoi (CBD)	Erwin (county seat - Unicoi Co.)	11.3	11.3	0.0

Source: Tennessee Statewide Travel Demand Model (TSM)

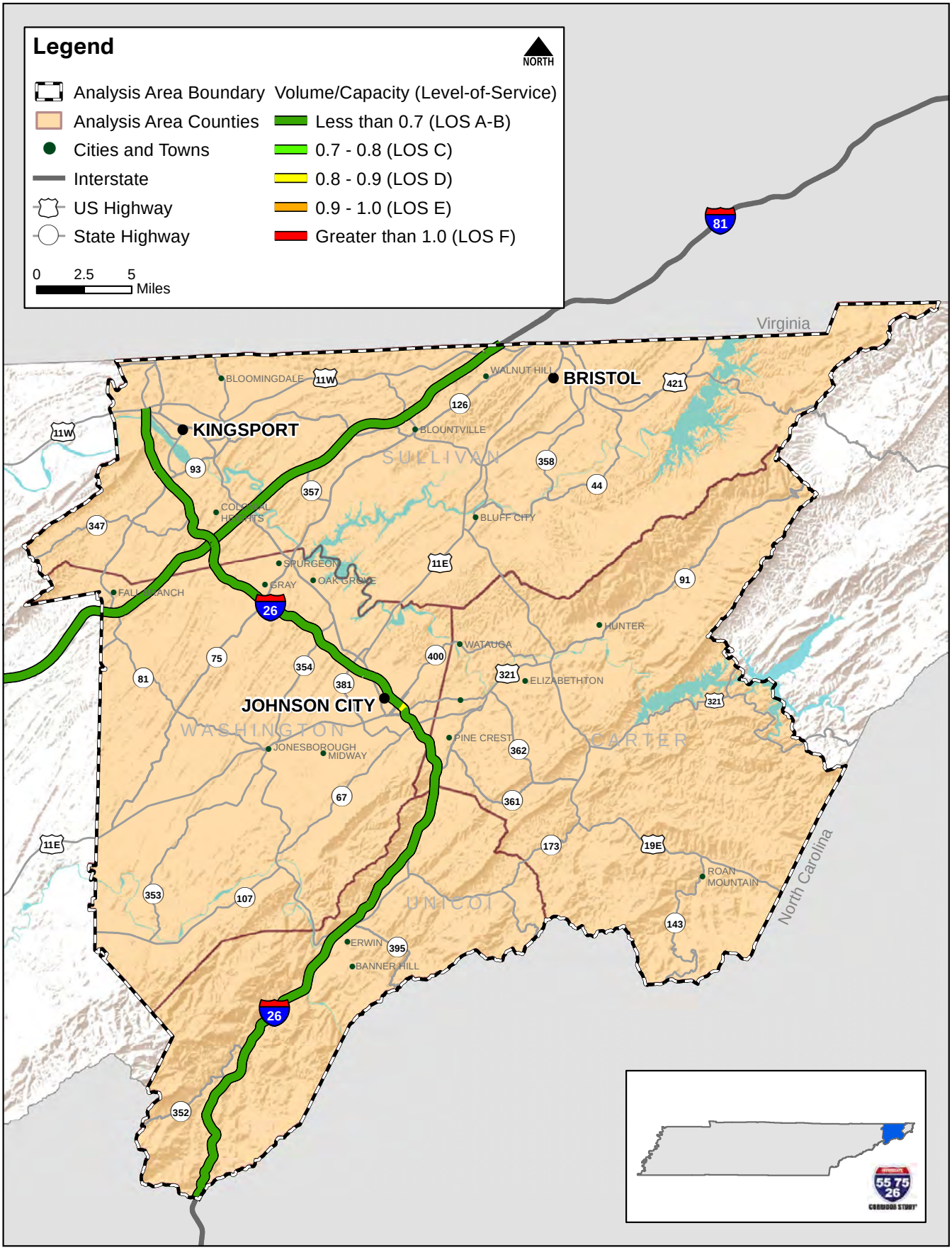
* Congested travel times are from model data.

Figure 3-4. County-to-County Work Flow (2015) — I-26



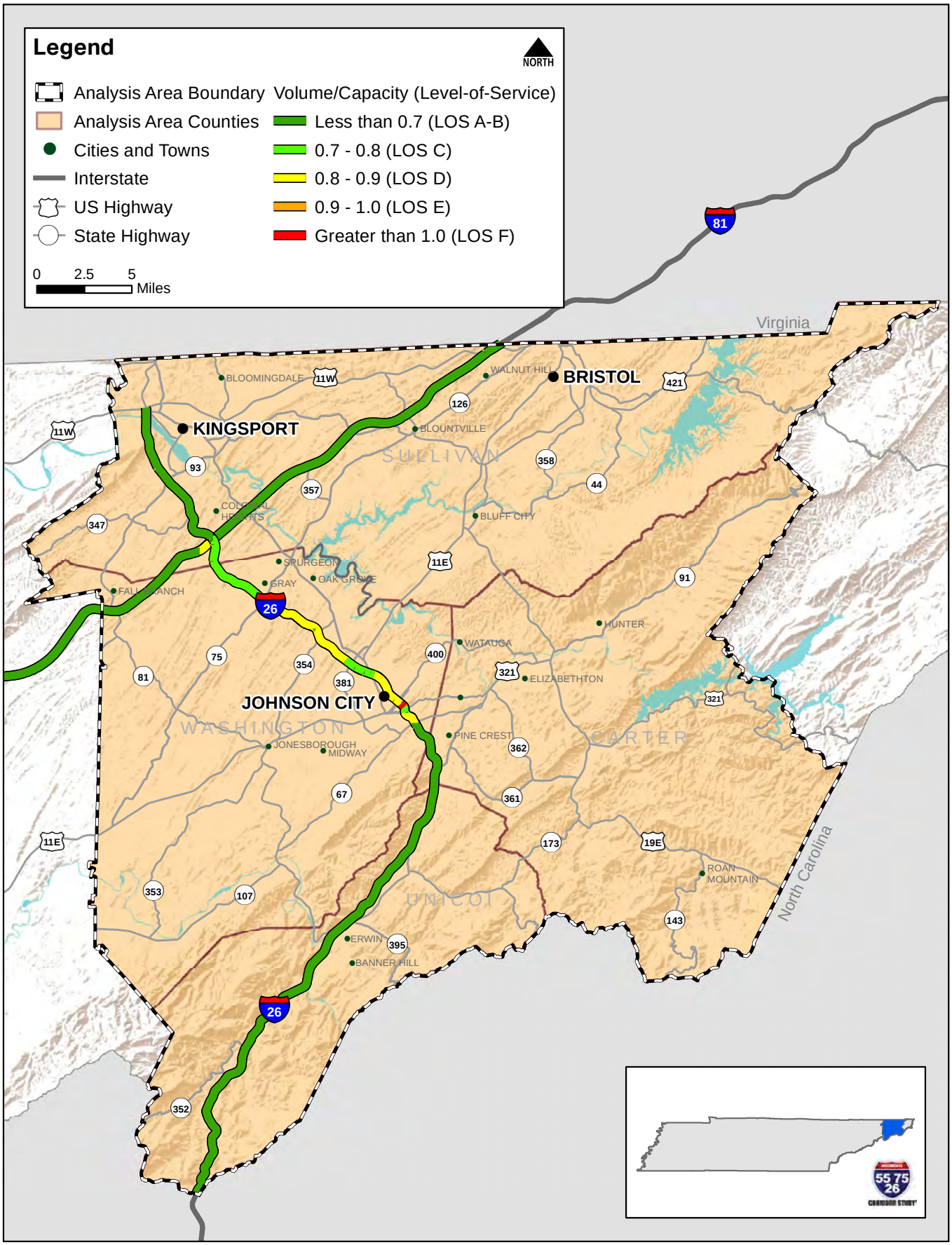
Source: U.S. Census Bureau, Center for Economic Studies: OnTheMap

Figure 3-5. Volume-to-Capacity Ratios/Level-of-Service (2010) — I-26



Source: Tennessee Statewide Travel Demand Model (TSM)

Figure 3-6. Volume-to-Capacity Ratios/Level-of-Service (2040) — I-26



Source: Tennessee Statewide Travel Demand Model (TSM)

Figure 3-5, one short segment of I-26 in the downtown Johnson City area is expected to reach capacity by 2040 and operate at LOS F. This specific segment is further discussed in Section 3.4. It should be noted that the Kingsport MTPO 2040 Long Range Transportation Plan (LRTP) indicated that the following sections of I-26 will operate at LOS E or F in 2040: I-26 at West Stone Drive (US-11W), I-26 at Old Wilcox Drive (SR-93), and I-26 between I-81 and Ford Creek Road, near the county line.

3.4 Bottlenecks

Bottlenecks occur when the capacity or flow of a facility is suddenly restricted. This can be caused by geometrical changes (lane reductions, merge/diverge areas, interchanges), changes in speed limit, or unexpected traffic incidents. TDOT's traffic management centers and HELP truck program (which does not extend to I-26 except for special events) work diligently to quickly address unexpected incidents; however, improvements to bottleneck areas created by geometric changes must be planned and programmed.

Figure 3-6 shows the directional and peak period volume-to-capacity (VOC) ratios at the one bottleneck location expected to become an issue by 2040. In this case, the bottleneck is most likely caused by competing weaving movements as motorists enter I-26 from SR-400 (E. Watauga Avenue) (Exit 22) and others exit I-26 to SR-91 (E. Market Street) (Exit 23) only 1,400 feet to the east. While the volume-to-capacity ratio is exceeded only in the PM peak period, slower travel speeds are expected during the AM peak period due to the complicated weaving maneuvers. The corresponding westbound lanes of I-26, which are expected to operate at LOS E by 2040, will also experience slow traffic due to the weaving movements created by vehicles entering from SR-91 (E. Market Street) and others exiting to SR-400 (E. Watauga Avenue). Eastbound AM peak congestion was observed during a field review starting at the SR-75/Bobby Hicks Highway eastbound entrance ramp where traffic slowed to 20 miles per hour until south of the interchange.

As discussed in Section 9 of this Technical Memorandum, the Tennessee Freight Plan lists potential bottleneck locations based on level-of-service and truck speed data. The plan identified three locations on the I-26 corridor:

- Between US-11W and Meadowview Parkway in Sullivan County
- Between Flag Pond Road and the North Carolina State Line in Unicoi County
- At Clear Branch Access between SR-354 (Boones Creek Road) and SR-381 (State of Franklin Road)

Table 3-3. Vehicle Hours Traveled by Functional Class — I-26

	Functional Class	Total Daily VHT (1,000s) 2010	2040	% Change
Urban	Interstate	25	32	29%
	Expressway	3	4	20%
	Arterial	129	154	19%
	Collector	22	28	31%
	Local Road	0.92	1.04	13%
Rural	Interstate	7.23	9.78	35%
	Arterial	11	15	31%
	Collector	12	16	29%
	Local Road	0.03	0.03	0%
Analysis Area Total		**211**	**259**	**23%**
Total Vehicle Mins Traveled/Trip		**6.89**	**6.87**	**0%**

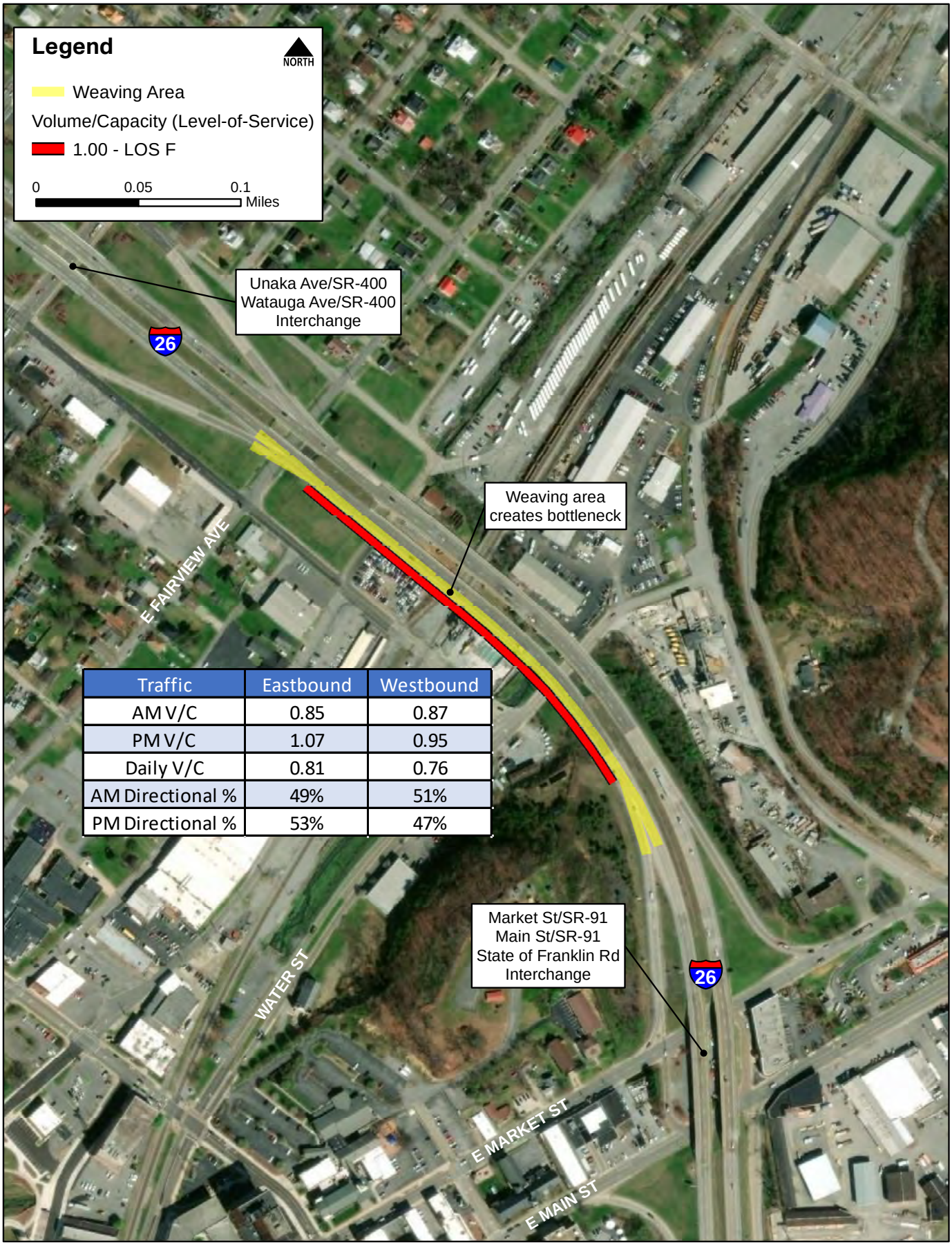
Source: Tennessee Statewide Travel Demand Model (TSM)

Table 3-4. Vehicle Hours Delay by Functional Class — I-26

	Functional Class	Peak Hour VHD 2010	2040	% Change
Urban	Interstate	0.08	0.20	155%
	Expressway	0.00	0.00	120%
	Arterial	5.63	7.15	27%
	Collector	1.34	1.67	24%
	Local Road	0.08	0.08	0%
Rural	Interstate	0.01	0.03	352%
	Arterial	0.01	0.01	11%
	Collector	0.16	0.25	54%
	Local Road	0.00	0.00	0%
Analysis Area Total		**7.32**	**9.40**	**28%**

Source: Tennessee Statewide Travel Demand Model (TSM)

Figure 3-7. Bottleneck Location — I-26



Source: Tennessee Statewide Travel Demand Model (TSM)

Table 3-5. Average Peak Hour Speeds by Functional Class — I-26

	Functional Class	Average Peak Hour Speeds (mph) 2010	2040	% Change
Urban	Interstate	68	63	-7%
	Expressway	54	53	-1%
	Arterial	27	26	-2%
	Collector	24	24	0%
	Local Road	22	22	0%
Rural	Interstate	72	70	-3%
	Arterial	48	49	0%
	Collector	34	34	-1%
	Local Road	34	34	0%

Source: Tennessee Statewide Travel Demand Model (TSM)

3.5 Travel Time and Delay

Tables 3-3 and 3-4 show the total daily vehicle hours traveled (VHT) and peak hour vehicle hours of delay (VHD) for each roadway type. As shown, the total VHT is expected to increase by 23% by 2040, which is on par with the percent increase in VMT. The average trip duration remains consistent as well, at approximately 6.8 minutes per trip. As shown in Table 3-4, the percentage increases in peak hour VHD are high; however, the base year VHD is lower, such that it allows motorists to maintain high peak hour average speeds. The changes in average peak hour travel speeds are detailed in Table 3-5.

3.6 Existing and Future Deficiencies and Needs

The biggest area of concern identified by stakeholders/public, the I-26 interchange at SR-354/Boones Creek Road, will be addressed through a programmed project (Table 1.1) and therefore, does not appear as a future deficiency in Figures 3-6 and 3-7. A summary of future conditions and expected 2040 deficiencies, based on analyses of TSM data, includes:

A. Daily Personal Vehicle and Truck Trips: Total daily trips in the four-county area are expected to reach 2.3 million by 2040, representing a 23% increase over total trips in 2010. According to projections based on Woods & Poole data, the corresponding population and employment increases in the area are 15% and 33%, respectively. Truck trips represent approximately 3% of total trips in both 2010 and 2040.

B. Vehicle Miles Traveled: A 25% increase in vehicle miles traveled (VMT) over the 2010 base year total is anticipated by 2040. Rural interstates are expected to see the highest percent changes in VMT; and trip lengths within the study area will reflect those in 2010 at approximately four miles per trip.

C. Major Trip Destinations: Travel times between common origin and destinations along the corridor are expected to increase by less than four minutes. This is consistent with expected changes in vehicle hours of delay (VHD) and high average travel speeds, which are generally maintained through 2040. It should be noted that the 7% drop in average speeds on urban interstates, shown in Table 3-5, reflects speeds on segments of I-26 between SR-67/US-321 and SR-75/Bobby Hicks Highway, which will begin to decline by 2040 (represented by LOS D in Figure 3-7).

D. Volume-to-Capacity Ratios: As shown in Figure 3-7, after completion of all programmed projects, significant congestion is only expected at the following location:

- I-26 from SR-400 (E. Watauga Ave) (Exit 22) to SR-91 (E. Market Street) (Exit 23)

Analyses of this segment indicated a bottleneck, likely caused by competing weaving movements as motorist enter I-26 from SR-400 and others exit I-26 to SR-91 only 1,400 feet to the east. Volumes exceed capacity in the PM peak period only, but slower travel speeds are expected during the AM peak period due to the complicated weaving maneuvers. The corresponding westbound lanes of I-26 will also experience slow traffic due to the weaving movements created by vehicles entering from SR-91 and others exiting to SR-400.

As discussed in Chapter 9 of this Tech Memo, the Tennessee Freight Plan lists potential bottleneck locations based on level-of-service and truck speed data. The following locations on I-26 were specified:

- Between US-11W and Meadowview Parkway in Sullivan County
- Between Flag Pond Road and the North Carolina State Line in Unicoi County
- At Clear Branch Access between SR-354 (Boones Creek Road) and SR-381 (State of Franklin Road)

4. Safety Analysis

As growth in population and employment occur in Tennessee, so do the traffic volumes on the Interstates and the extensive roadway system that feeds them. Increased traffic volumes and vehicle miles traveled, as well as congested travel conditions, increase the likelihood of traffic incidents. Crash data was collected from TRIMS and analyzed to identify trends in potential safety issues along the I-26 corridor. In total, 2,046 crashes occurred along the corridor for the five-year period spanning 2014-2018. Of these, 378 resulted in an injury and eight resulted in a fatality. Overall, the total number of crashes trended downward in this time period, but the trend in the number of injuries increased. Table 4-1 shows the crash trends for the I-26 corridor for this five-year time period.

Table 4-1. Crash Trends — I-26

Total

County	Year				
	2014	2015	2016	2017	2018
Carter	9	8	3	5	2
Sullivan	83	106	154	100	138
Unicoi	107	118	100	128	116
Washington	283	206	103	128	149
Total	**482**	**438**	**360**	**361**	**405**

Injuries

County	Year				
	2014	2015	2016	2017	2018
Carter	1	2	0	1	1
Sullivan	15	22	40	24	31
Unicoi	17	26	28	23	27
Washington	36	21	15	18	30
Total	**69**	**71**	**83**	**66**	**89**

Fatalities

County	Year				
	2014	2015	2016	2017	2018
Carter	0	0	0	1	0
Sullivan	1	0	0	0	0
Unicoi	2	0	0	1	0
Washington	2	1	0	0	0
Total	**5**	**1**	**0**	**2**	**0**

Source: Tennessee Roadway Information Management System (TRIMS) - 2017

4.1 Crash Analysis

Using TDOT's traffic volumes collected in 2018, crash rates were calculated for the I-26 corridor during the five-year period spanning 2014-2018. These rates are reported in terms of crashes per million vehicle miles traveled. Figure 4-1 shows the comparison of these rates to the statewide averages for facilities of a similar type. More specifically, the statewide average crash rate is 0.528 crashes per million vehicle miles traveled for rural freeways and 1.112 crashes per million vehicle miles for urban freeways. I-26 crash rates were compared to the Tennessee statewide averages based on the following metrics:

- **Below Average**: Locations with crash rates below the statewide average
- **Average**: Locations with crash rates at or within 15 percent above the statewide average
- **Above Average**: Locations with crash rates between 15 and 100 percent above the statewide average
- **Significantly Above Average**: Locations with crash rates greater than or equal to 100 percent higher than the statewide average

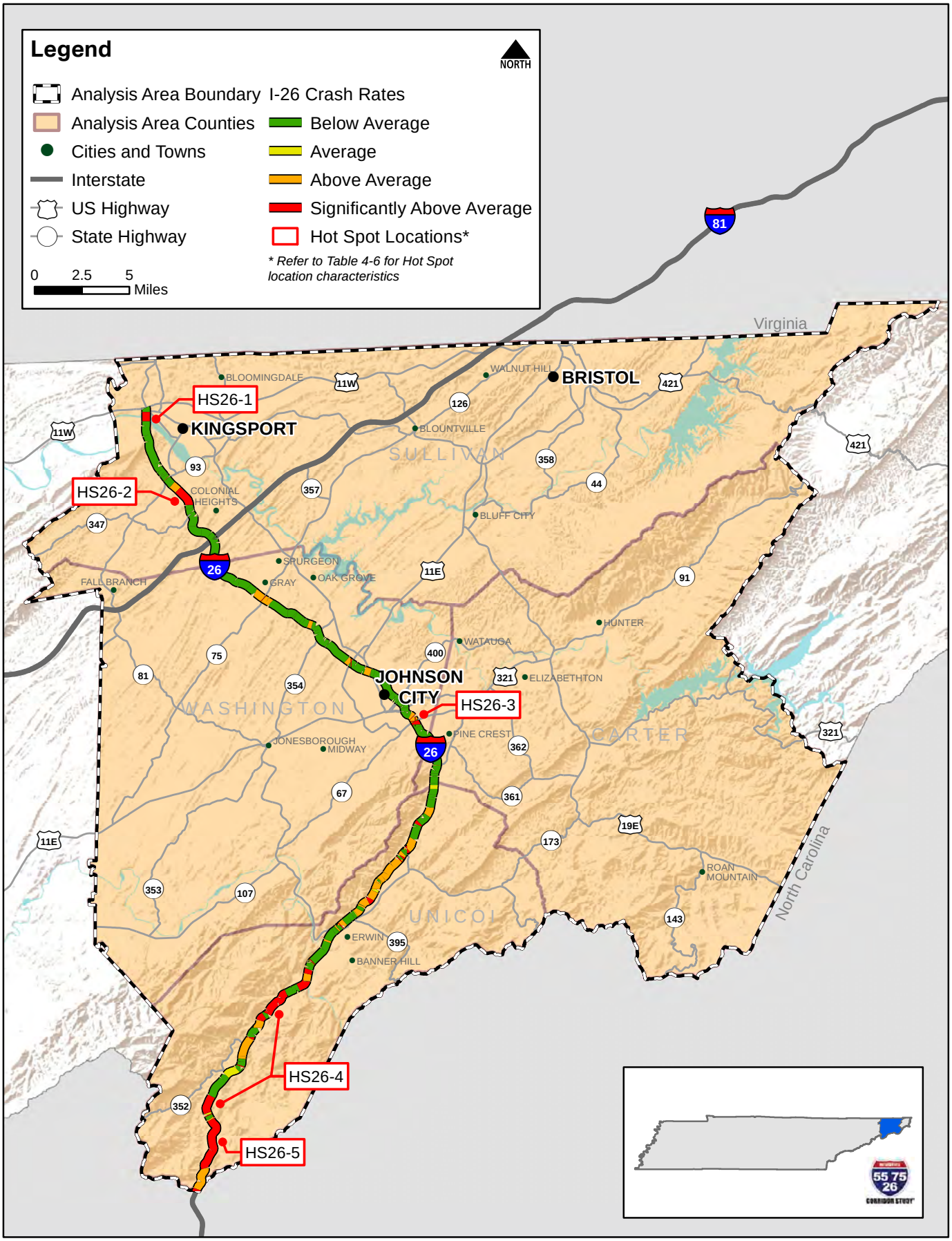
Areas where the crash rates were significantly above statewide averages were identified as hot spots and are shown in Figure 4-1 in red. Table 4-2 shows the miles of I-26 in each county and the number and proportion of miles that have crash rates significantly above average. In addition, Table 4-2 shows the number of crashes that occurred on those hot spot roadway segments between 2014 and 2018. Many of the urban hot spot locations coincide with interchanges with major roadways. In the rural areas, hot spot locations could be a result of geometry of the I-26 corridor through more mountainous regions of the state. Within these areas, crashes were examined by severity as well as the manner in which the collision occurred to determine if there were any obvious trends in the crashes that have occurred.

Table 4-2. Hot Spot Crashes — I-26

County	Total Miles in County	Number of Miles in Hot Spots	Crashes 2014-2018
Carter	2.7	0	0
Sullivan	9.8	1.5 (15.3%)	395
Unicoi	26.7	7.1 (26.6%)	191
Washington	15.1	0.25 (1.7%)	38
Total	**54.3**	**8.9 (16.4%)**	**624**

Source: Tennessee Roadway Information Management System (TRIMS) - 2017

Figure 4-1. Crash Rates (2014-2018) — I-26



Source: Tennessee Statewide Travel Demand Model

Potential Crash Factors

Urban and rural Interstates have fundamentally different characteristics with regard to density of interchanges, congestion levels, surrounding land use, and travel patterns. Knowing that these characteristics play a role in roadway safety, crashes occurring in hot spot locations were broken down into two categories: crashes that occurred in rural areas and crashes that occurred in more urban areas. For the I-26 corridor, urban and rural hot spot locations were identified based on the functional classification of the Interstate segment. Approximately 6.9 miles of the I-26 corridor are located in rural areas and are identified as a crash hot spot. This represents 78% of all the hot spot mileage for the study area corridor. Correspondingly, approximately 1.9 miles of the I-26 corridor (22%) are located in urban areas and are identified as a crash hot spot.

There were 165 crashes in rural hot spots and 459 crashes in urban hot spots between 2014 and 2018. A comparison of the crash patterns for these locations along with the overall crash statistics for all hot spot locations is shown in Tables 4-3, 4-4, and 4-5. More specifically, this table highlights different crash patterns that are expected to potentially be different in rural and urban areas, namely the manner of collision and lighting conditions. In urban areas where congestion is more prevalent, it is expected that rear-end crashes are more common than some other types of collisions. As shown, rear-end crashes account for approximately 16% of all hot spot crashes in urban areas, compared to only 4% in the rural areas. In rural areas, crashes in hot spots most often did not involve another vehicle. In fact, of the 144 rural crashes that did not involve a motor vehicle, 66% involved vehicles hitting a roadway barrier (e.g., guardrails, cable barrier, fence, etc.) and 14% of crashes involved vehicles hitting an animal such as a deer. During a field review, it was observed that no cable barriers or chevrons exist along the non-Interstate/US-23 portion of the corridor (north of I-26).

Table 4-4 shows the difference in lighting conditions within the crash hot spots along the I-26 corridor. While crashes during daylight hours are the most prevalent in both urban and rural hot spots alike, there is also a considerable amount of crashes occuring in dark, unlit conditions in both urban and rural areas.

Table 4-4. Lighting Trends – I-26

Lighting Conditions	Urban Areas		Rural Areas		All Hot Spot Crashes
Dark – Lighted	20	4%	1	1%	3%
Dark – Not Lighted	122	27%	60	36%	29%
Dawn/Dusk	26	6%	8	5%	5%
Daylight	288	63%	89	54%	60%
Unknown	3	1%	7	4%	2%

Source: Tennessee Roadway Information Management System (TRIMS) - 2017

For the severity of crashes in hot spots, there is little discernable difference in crash characteristics between urban and rural areas. As shown in Table 4-5, between 20% and 30% of all hot spot crashes resulted in an injury and between 70% and 80% resulted in property damage only. There was one fatality in a crash hot spot from 2014-2018, which occurred in a rural area.

Table 4-3. Collision Trends – I-26

Manner of Collision	Urban Areas		Rural Areas		All Hot Spot Crashes
Angle	48	11%	5	3%	9%
Head-On	3	1%	0	0%	0.4%
No Collision with Vehicle	293	64%	144	87%	70%
Other	7	2%	4	2%	2%
Rear-End	75	16%	6	4%	13%
Sideswipe	33	7%	6	4%	6%

Source: Tennessee Roadway Information Management System (TRIMS) - 2017

Table 4-5. Severity Trends – I-26

Crash Severity	Urban Areas		Rural Areas		All Hot Spot Crashes
Fatal	0	0%	1	1%	0.1%
Injury	103	22%	48	29%	24%
Property Damage	356	78%	116	70%	76%

Source: Tennessee Roadway Information Management System (TRIMS) - 2017

Geometric Safety Analysis

Given the topography along portions of I-26, the vertical grade of hot spots along the corridor was examined using TRIMS data, where available. The weighted average (by length) percent grade was calcuated using this data. This analysis showed that the weighted average percent grade is approximately 3.1% for hot spots compared to 3.5% for the entire corridor. Worth noting is that some segments have grades as steep as 5% in more mountainous areas of Unicoi County. These steep grades combined with the horizontal curvature of the roadway leading into the Cherokee National Forest could potentially contribute to the above-average crash rate calculated for these segments of I-26. Another geometric safety issue was observed during a field review at the US-321/SR-67 (Exit 24) interchange, where the slow 25 mile per hour loop caused traffic to back up onto the eastbound deceleration lane on I-26.

Crash Characteristics

In addition to analyzing the hot spots for different urban and rural characteristics, similar crash characteristics were examined for each hot spot to discern if any patterns indicated deficiencies that could be addressed. Table 4-6 shows the results of this analysis. In general, each of the hot spots were examined for trends in severity, prevalent collision types, non-vehicular accident events, lighting/weather conditions, relation to ramps and interchanges, as well as horizontal and vertical curvature. From these trends, potential crash factors are identified for each location, which will inform the development of safety project solutions.

Table 4-6. Hot-Spot Crash Location Characteristics – I-26

	Hot Spot ID				
	HS26-1	**HS26-2**	**HS26-3**	**HS26-4**	**HS26-5**
Termini	US-11W/ W. Stone Drive to Meadowview Parkway	SR-93/Wilcox Drive to SR-347/Rock Springs Road	SR-91/ E. Market Street to US-321/University Parkway	Various spot locations in Unicoi County (north of Flag Pond)	Various spot locations in Unicoi County (north of Flag Pond)
Number of Crashes	185	211	48	117	94
Severity (Fatal or Injuries)	22% (41)	25% (52)	10% (5)	21% (25)	32% (30)
Prevelant Collision Types	14% (25) Angle 67% (124) Non-Vehicle 12% (23) Rear-End	10% (22) Angle 68% (143) Non-Vehicle 13% (28) Rear-End	35% (17) Non-Vehicle 50% (24) Rear-End 13% (6) Sideswipe	85% (99) Non-Vehicle	96% (90) Non-Vehicle
Non-Vehicle Trends	56% (70) Roadway Barrier 22% (27) Animal	59% (84) Roadway Barrier 10% (21) Animal	35% (6) Roadway Barrier	61% (60) Roadway Barrier 21% (21) Animal	69% (62) Roadway Barrier
Lighting/ Weather	30% (55) in Dark-Unlit Conditions 25% (46) in Rain/Snow	28% (59) in Dark-Unlit Conditions 27% (56) in Rain/Snow	4% (2) in Dark-Unlit Conditions 25% (12) in Rain/Snow	34% (40) in Dark-Unlit Conditions 26% (30) in Rain/Snow	39% (37) in Dark-Unlit Conditions 46% (43) in Rain/Snow
Interchange Related	15% (28)	13% (28)	38% (18)	7% (8)	3% (3)
Curvature Issues	N/A	Horiz.: 2% (5) Grade: 4% average	Grade: 3% average	Horiz.: 69% (81)	Horiz.: 74% (70) Grade: 5% average
Potential Crash Factors	• Animal crossings from nearby nature preserve • Inadequate lighting at interchange • Small inside shoulder width near roadway barriers • Inadequate signage at interchange	• Inadequate lighting at welcome station ramps/exits • Small inside shoulder width near roadway barriers	• Uphill acceleration required on SB I-26 from SR-91/E. Market Street • Weaving on SB I-26 due to minimal sight distance between the end of acceleration lanes and US-321 (University Parkway)	• Curvature/speeding at night and/or in bad weather conditions	• Curvature/speeding at night and/or in bad weather conditions

Source: Tennessee Roadway Information Management System (TRIMS) - 2017

Pedestrian and Bicycle Crashes

Bicyclists and pedestrians are not permitted on I-26; however, there were a number of bicyclist and pedestrian crashes that occurred in close proximity to the corridor between 2014-2018. Pedestrian and bicycle safety on streets that parallel and intersect I-26 impacts the effectiveness of the transportation system to provide travel options across the corridor. To determine the impact of I-26 on non-motorized safety in the study area, pedestrian and bicyclist crashes within 500 feet of I-26 ramps were analyzed for the five-year period spanning 2014-2018. In total, there were nine non-motorized crashes involving three bicyclists and six pedestrians. Of these, six crashes resulted in an injury or possible injury. All nine non-motorized crashes occurred within the Johnson City city limits, which is expected given the relatively large amount of pedestrian activity in this area compared to others along the corridor. Figure 4-2 shows the location of these crashes.

4.2 Existing and Future Deficiencies and Needs

Crashes were analyzed over the five-year period from 2014 to 2018, with crash hot spots identified as locations with crash rates significantly above the statewide average. The safety analysis also examined potential factors at crash hot spots, including crash types, area type, and roadway lighting. Pedestrian and bicycle crashes were examined near interchange ramps. Key findings of the analysis include:

A. Crash Rates and Hot Spots: Crash hot spots were identified as locations with crash rates significantly above the statewide average for similar facilities. Hot spots, ranging from individual roadway segments to longer corridor sections, totaling just under 9 miles of I-26 were documented. Hot spots include:

- US-11W (W. Stone Drive) to Meadowview Parkway
- SR-93 (Wilcox Drive) to SR-347 (Rock Springs Road)
- SR-91 (E. Market Street) to US-321 (University Parkway)
- Various spot locations in Unicoi County north of Flag Pond

Additionally, injuries and fatalities resulting from reported crashes from 2014 to 2018 were compared by county for the study area. While the number of fatalities generally decreased over the five-year period, the number of injuries generally trended upward.

B. Crash Types: Crash types were initially examined for the identified hot spots, but then were also segregated by area type - rural and urban - to examine trends in crash characteristics. For the hot spot areas, collisions with objects other than a motor vehicle are the predominant cause of crashes – accounting for approximately 70% of hot spot crashes in rural areas and approximately 57% of hot spot crashes in urban areas. Rear-end crashes also make up a significant percentage of crashes in urban areas. In addition, roadway lighting conditions were examined for both urban and rural areas. Crashes occurring in dark, unlit conditions comprised a larger percentage of crashes in rural hot spots compared to urban hot spots (36% compared to 27%), indicating the potential need for additional Interstate lighting in the more rural areas of the study area.

C. Pedestrian and Bicycle Crashes: Pedestrian and bicycle crashes within 500 feet of an I-26 interchange ramp were also analyzed for the five-year period 2014-2018. In total, there were nine crashes involving a pedestrian or bicyclist in this area, all of which occurred near downtown Johnson City. Of these nine crashes, three involved bicyclists and six involved pedestrians. Improved non-motorized mobility across the I-26 corridor will be important as urban areas continue to grow.

Figure 4-2. Bicycle and Pedestrian Crashes (2014-2018) — I-26

Source: Tennessee Roadway Information Management System (TRIMS) - 2017

5. Operations and Maintenance

5.1 State of Good Repair

Pavement Sufficiency Rating

TDOT collects and maintains pavement management data for all roads included in the state's network. The Pavement Quality Index (PQI), expressed on a scale from 0-5, is the overall measure of a pavement's roughness and distress. According to TDOT, roadways with a PQI between 1.75 and 3.25 are considered to be in fair condition. Those with a PQI less than 1.75 are considered to be in poor condition. The PQI is calculated based on both the Pavement Distress Index and the Pavement Smoothness Index, the latter of which is a function of the International Roughness Index (IRI). The IRI measures the number of vertical deviations over a section of road, and has been used as a performance measure toward goals set by the Federal Highway Administration (FHWA) since 1998. As of 2006, FHWA designated an IRI equal to 95 inches/mile or less to be representative of a road with good ride quality. The percentage of Interstate miles with IRI less than or equal to 95 inches/mile is shown in Table 5-1. Also shown is the average PQI for Interstates and state routes within the study area that are included on the National Highway System.

Table 5-1 also indicates dates of most recent reconstruction or resurfacing for I-26 segments in each county (as of 2017), as well as TRIMS sign inventory data, which is used as an indicator of maintenance needs. Figure 5-1 shows the most recent reconstruction or resurfacing for I-26 segments as of 2017. During a field

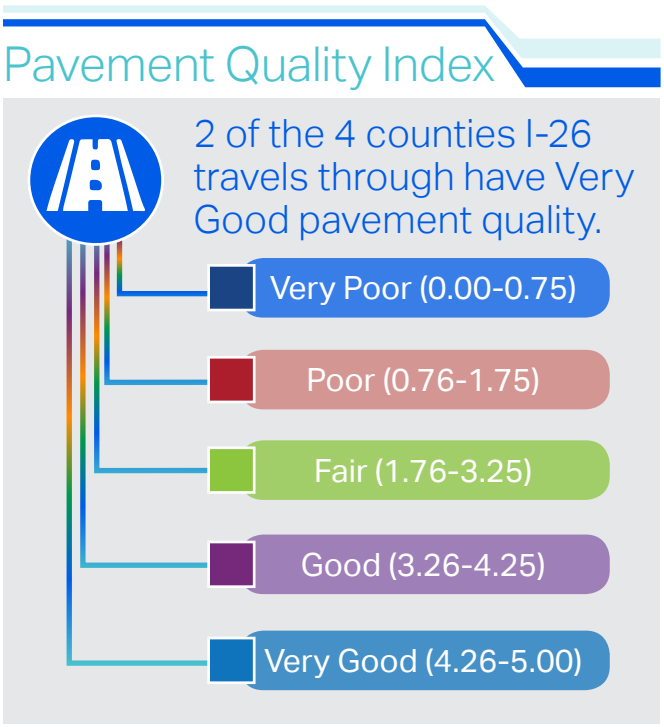


Table 5-1. Operations and Maintenance by County (as of 2017) – I-26

County	Most Recent Resurfacing (Letting Date)	% of Corridor with Good Ride Quality*	Average PQI	Avg PQI on NHS State Route	Sign Inventory	Max AADT (2017)	% Trucks (2017)
Carter	2012 (LM 0.0-2.69)	87%	4.41 Very Good	3.99	96% GOOD 4% FAIR 0% POOR	20,000	10%
Sullivan	2007 (LM 0.0-8.0) 2002 (LM 8.07-9.89)	98%	4.14 Good	3.65	89% GOOD 4% FAIR 7% POOR	52,420	8%
Unicoi	2014 (LM 0.0-7.57) 2010 (LM 7.58-15.83) 2007 (LM 15.83-26.73)	92%	4.26 Very Good	N/A	83% GOOD 59% FAIR 8% POOR	21,900	11%
Washington	2002 (LM 0.0-14.08) 2012 (LM 14.08-15.14)	75%	4.18 Good	4.12	87% GOOD 3% FAIR 10% POOR	64,230	6%

* Good ride quality defined as an IRI equal to 95 or less

Source: Tennessee Roadway Information Management System (TRIMS) - 2017

review, pavement near Johnson City and Kingsport appeared to be recently resurfaced. The pavement along US-23, north of I-26, was observed to be in poor condition.

Bridge Conditions

TDOT routinely inspects and evaluates the 19,822 structures designated as public highway bridges in the state. These include bridges owned and maintained by TDOT, as well as those owned and maintained by local governments. TDOT designates a bridge as "structurally deficient" if one or more major structural components are rated in poor condition, or if its load carrying capacity is well below current design standards. Via the Better Bridge Program, the state addressed deficiencies on 193 of the 200 structurally deficient state-owned bridges in 2013. There are no structurally deficient bridges on the I-26 corridor.

The Federal Highway Administration's (FHWA) Highway Bridge Replacement and Rehabilitation Program (HBRRP) provides funds to assist states in replacing or rehabilitating deficient highway bridges located on any public road. To be eligible, a bridge must carry highway traffic, be deficient and have a sufficiency rating of 80 or less. The sufficiency rating of an individual bridge, on a scale of 0 to 100, is based on structural adequacy and safety, serviceability and functional obsolescence, and essentiality for public use[1]. A rating of 0 is the worst possible bridge. A sufficiency rating that is less than 50 is eligible for replacement and a sufficiency rating of less than 80 but greater than 50 is eligible for rehabilitation.

Sufficiency rating data was collected from TRIMS and used to identify the number of bridges eligible for rehabilitation or replacement along I-26. Of the 141 bridges on I-26 in the study area, there are no bridges with a sufficiency rating of less than 50. There are 15 bridges with ratings between 50 and 80 and the remaining 126 bridges have sufficiency ratings greater than 80 (Figure 5-2).

5.2 Traffic Incident Management (TIM)

Responding to traffic incidents in an effective and timely manner reduces congestion, wasted fuel, and the likelihood of secondary crashes. The time it takes to respond to an incident and clear the roads is directly related to the likelihood of a secondary crash. This response time can be greatly reduced using ITS technologies, including monitored CCTV cameras, radar detectors to determine travel speeds, and DMS to direct/notify drivers. The highly coordinated incident management process requires accurate and efficient communication among numerous agencies, including:

- Law enforcement
- Fire and rescue
- Emergency medical services
- Public safety communicators
- Emergency management officials
- Towing and recovery
- Hazardous materials contractors (when applicable)
- Traffic information outlets

According to FHWA, national best practices in scene management strategies include:

- Incident command systems
- Response vehicle parking plans
- High-Visibility safety apparel and vehicle markings
- On-Scene emergency lighting procedures
- Clearance laws, such as "Move Over"
- Effective traffic control
- End-of-Queue advance warning systems
- Alternative route plans

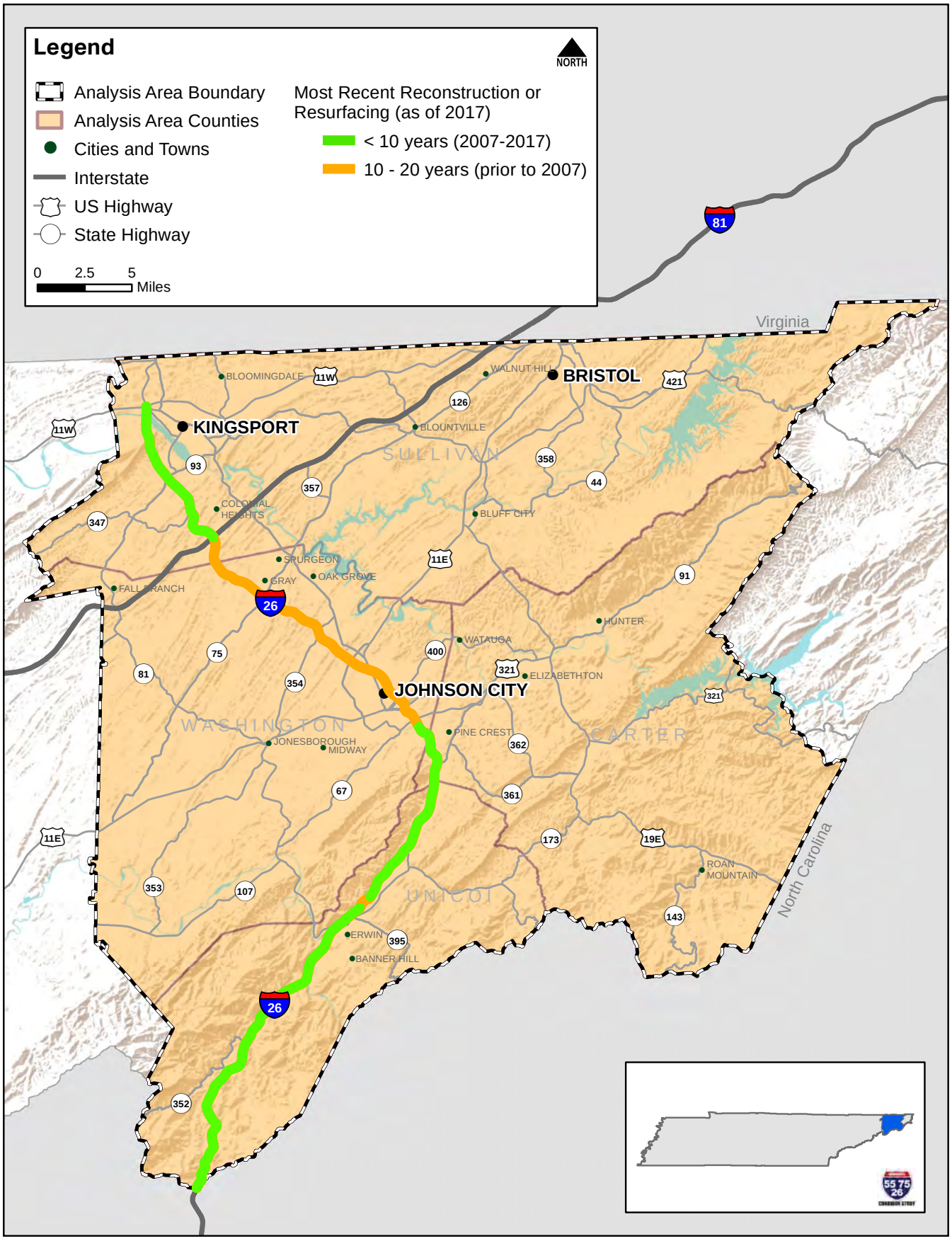
TDOT's HELP program has been incorporating the latest ITS technologies and strategies since its inception in 1999. However, with exceptions for assistance during special events, HELP trucks are currently not deployed on I-26. As a result, scene management and crash clearance rest solely on law enforcement and first responders.

According to the Johnson City MTPO, at the request of the Kingsport and Johnson City MTPOs, TDOT installed 0.2 mile marker signs on I-26 in both the Kingsport and Johnson City urbanized areas. While these signs support the local first responders, maintenance of the 0.2 mile marker signs has become an issue. Stakeholders report that routine maintenance is not always timely.

TDOT has established specific, regional Interstate incident management plans focusing on major incidents (those that will require total roadway closure for at least two hours). Goals of these living plans include decreased response time and planned detour routes with appropriate signing so that motorists experience minimal delay in moving toward their destinations. The plans also detail work zone traffic control and point to the regional transportation management centers as the "home base" of coordination and communication during an event. The plans are distributed to regional TDOT Maintenance and Incident Management staff so that the defined detour routes can be implemented quickly upon confirmation of an incident. The Region 1 incident management plan was last updated in 2018[2].

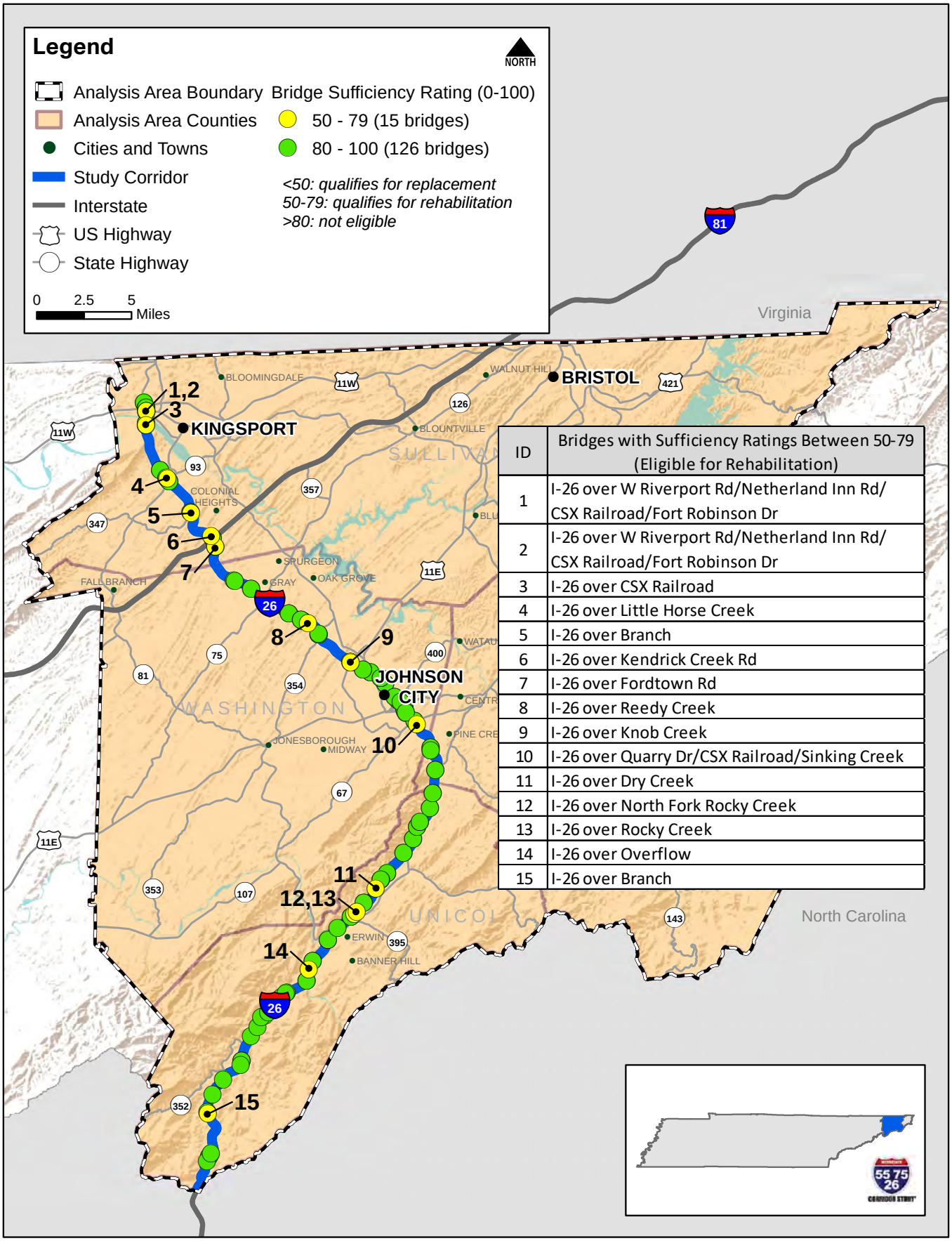
1- Federal Highway Administration. Accessed 08/22/2019. https://www.fhwa.dot.gov/legsregs/directives/fapg/cfr0650d.htm
2- https://www.tn.gov/tdot/traffic-operations-division/transportation-management-office/interstate-incident-management-plan.html

Figure 5-1. Most Recent Reconstruction or Resurfacing — I-26



Source: Tennessee Roadway Information Management System (TRIMS) - 2017

Figure 5-2. Bridge Sufficiency Ratings — I-26



ID	Bridges with Sufficiency Ratings Between 50-79 (Eligible for Rehabilitation)
1	I-26 over W Riverport Rd/Netherland Inn Rd/ CSX Railroad/Fort Robinson Dr
2	I-26 over W Riverport Rd/Netherland Inn Rd/ CSX Railroad/Fort Robinson Dr
3	I-26 over CSX Railroad
4	I-26 over Little Horse Creek
5	I-26 over Branch
6	I-26 over Kendrick Creek Rd
7	I-26 over Fordtown Rd
8	I-26 over Reedy Creek
9	I-26 over Knob Creek
10	I-26 over Quarry Dr/CSX Railroad/Sinking Creek
11	I-26 over Dry Creek
12	I-26 over North Fork Rocky Creek
13	I-26 over Rocky Creek
14	I-26 over Overflow
15	I-26 over Branch

Source: Tennessee Roadway Information Management System (TRIMS) - 2017

Over the last several years, TDOT has taken extra steps to improve traffic incident management, coordination, and safety on the Interstate system within Tennessee. In 2014, in response to proposals by the Tennessee Highway Patrol, TDOT and the Tennessee Department of Safety and Homeland Security opened a TIM Training facility in Nashville. The facility allows emergency responders hands-on quick clearance training in a safe environment[3]. In 2017, Tennessee initiated an annual Highway Safety and Operations Conference with the intent to bring together those involved in highway safety statewide for brainstorming and discussion of best practices[4].

5.3 Intelligent Transportation Systems (ITS)

ITS Device Inventory

TDOT's SmartWay system relies on evolving technology, as well as teams of operators and technicians who monitor the technical systems and provide hands-on assistance through the state's HELP program. Four transportation management centers (TMCs) located across the state anchor the systems operations and communication. From these locations, operators oversee 551 cameras, 183 message signs, 1,107 roadway detection systems and 49 video detection systems across the state. They also maintain communication with the public via messages on dynamic message signs, TN 511 updates, and the SmartWay website.

Currently, SmartWay system elements are limited on the I-26 corridor. As shown in Figure 5-3, five Closed Circuit Television (CCTV) cameras monitor congestion on I-81 near the I-26 interchange, and two Digital Message Signs (DMS) visually communicate information to drivers. Two Highway Advisory Radio (HAR) (S) and one HAR (T) broadcast messages to drivers on I-26 near the I-81 interchange. The Johnson City Traffic Division also operates and manages cameras along I-26. TN 511 provides traffic information and weather condition updates by phone throughout the corridor, and the SmartWay interface provides real-time traffic information.

Johnson City and Kingsport have developed plans for and implemented intelligent transportation system (ITS) elements on the roadway network adjacent to I-26. The Johnson City ITS Architecture and Deployment Plan (updated in 2015), recommends projects ranging from speed monitoring deployment and flood detection/warning systems, to Traffic Operation Center (TOC) implementation, adaptive signal control, and SmartWay expansion. The plan also recommended Interstate reference markers that were subsequently installed by TDOT. The Johnson City MTPO FY2017-2020 Transportation Improvement Program includes Phase 1 of a project to add adaptive signal control on SR-381 in the vicinity of I-26.

The Kingsport ITS Architecture and Deployment Plan, which involved the Virginia Department of Transportation, was adopted in 2008 and additionally recommended speed monitoring systems, freeway off-ramp queue detection, and TDOT SmartWay deployment at the I-26/I-81 interchange. As mentioned above, the latter has been installed.

5.4 ITS State of Practice

While TDOT maintains a robust ITS system, reviewing national best practices is pertinent in an era of ever-evolving technology. Below are brief summaries of national examples for various ITS focus areas, intended to highlight recent advances. This list of strategies and solutions is not specific to I-26.

Transportation System Management and Operations (TSM&O)

Transportation System Management and Operations (TSM&O) is "a set of strategies that focus on operational improvements that can maintain and even restore the performance of the existing transportation system before extra capacity is needed[5]." As vehicle miles traveled increases and funding decreases, TSM&O strategies- which can also benefit quality of life, economic vitality, and safety- have received more focus from state transportation departments and metro regions.

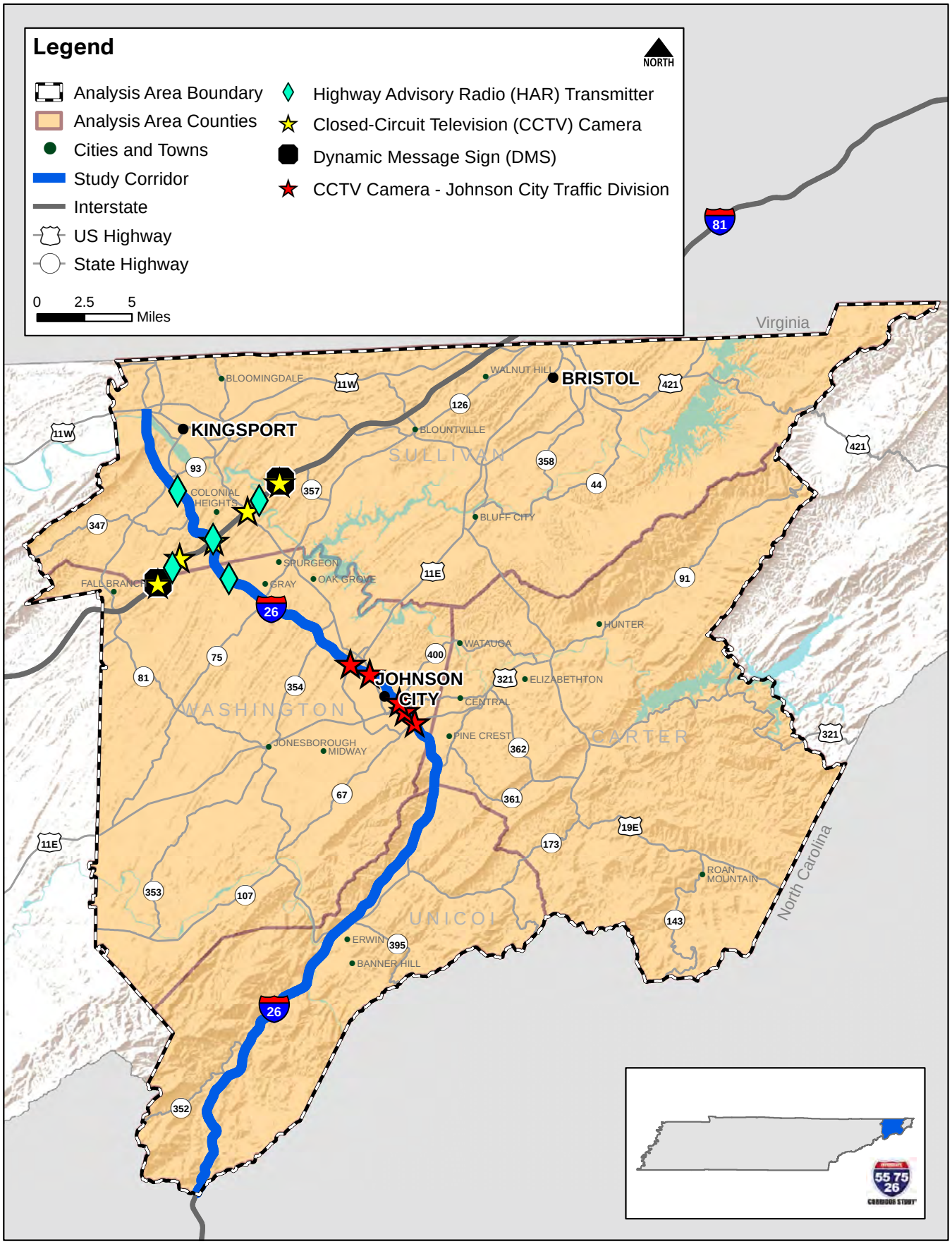
TDOT's Traffic Operations Division consists of the following offices, which support TSM&O: Headquarters Traffic Engineering, Intelligent Transportation Systems, and Transportation Management. Recognizing the demand for and benefit of operational improvements, TDOT's Traffic Operations Division includes in its list of responsibilities a national best practice review for TSM&O[6].

The following is FHWA's current list[7] of TSM&O strategies and solutions, many of which could be utilized on the I-26 corridor. Asterisks note the strategies that TDOT has implemented in various parts of the state.

- Work Zone Management*
- Traffic Incident Management* (Regional Incident Management Plans)
- Special Event Management*

3- https://www.tn.gov/tdot/traffic-operations-division/transportation-management-office/training.html
4- https://www.tn.gov/tdot/traffic-operations-division/transportation-management-office/interstate-incident-management-plan.html
5- https://ops.fhwa.dot.gov/tsmo/index.htm
6- https://www.tn.gov/tdot/traffic-operations-division/transportation-management-office.html
7- https://ops.fhwa.dot.gov/tsmo/index.htm

Figure 5-3. Intelligent Transportation System Components — I-26



Source: Tennessee Department of Transportation

- Road Weather Management*
- Transit Management
- Freight Management
- Traffic Signal Coordination*
- Traveler Information* (SmartWay)
- Ramp Management
- Congestion Pricing
- Active Transportation and Demand Management*
- Integrated Corridor Management* (I-24 Corridor)
- Access Management*
- Improved Bicycle and Pedestrian Crossings*

Managed Lanes

Managed lanes programs implement pricing and/or incentives for use of dedicated travel lanes – either existing or new construction. These strategies can be adapted in response to changes in demand which results in more reliable travel times, via personal vehicle or transit. Examples of managed lanes include high-occupancy-toll (HOT) lanes, which have been implemented in at least nine states; dedicated bus-rapid-transit (BRT) lanes, such as the Gold Line in St. Paul, MN, that will parallel nine miles of I-94; reversible lanes; and high-occupancy-vehicle (HOV) lanes. Tennessee has dedicated, peak hour HOV lanes on portions of I-65, I-40 and I-55 in Nashville and the Memphis metropolitan area. These lanes are divided from the standard travel lanes only by striping, and therefore rely on public awareness and enforcement to maintain effectiveness. In some states, physically divided HOV lanes are being combined with HOT lanes and/or BRT strategies.

Active Traffic and Demand Management (ATDM)

States and regions with continuously monitored transportation systems have the ability via new technology to actively monitor capacity and interact with drivers in real time. Active Traffic and Demand Management (ATDM) strategies also boast significant safety benefits. Specific strategies, potentially pertinent to I-26, include dynamic ridesharing, predictive traveler information, dynamic lane use/shoulder control, dynamic speed limits, queue warning, adaptive ramp metering, and dynamic way-finding.

Freight Applications

Because freight trucks play a key role in transportation networks, it is critical to integrate them into ITS. By increasing the overall efficiency of freight trucks, congestion, travel time, travel stop time, and fuel consumption are all reduced. Although large logistics companies often have an in-house ITS in place, local governments can implement systems to help smaller companies, and transportation networks as a whole.

Freight Advanced Traveler Information System (FRATIS) is a collection of methods to help optimize freight operations. The first aspect of this system deals with real-time data, such as current arterial speeds/volumes, weather conditions, road closures, etc. that optimize routes. The second aspect focuses on arrivals and destinations. By combining and analyzing weigh station, delivery point, intermodal terminal, overnight parking, and other information, dry runs, wasted miles, and traffic jams are reduced.

Work Zone Mobility and Safety

Work Zone Mobility and Safety programs are designed to maximize safety, minimize delays, and establish consistency throughout work zones. Every Day Counts (EDC) is an ongoing model created by FHWA that provides a wide variety of innovative ideas to help increase efficiency of roadway projects with a focus on safety.

Many states have implemented safety specific campaigns, such as TDOT's Work With Us. This is a multimedia campaign that aims to remind motorists to take extra caution when passing highway workers. Using an array of delivery methods, such as online videos and graphics or DMS, the Work With Us campaign is able to reach a larger audience than traditional safety campaigns.

Integrated Corridor Management (ICM)

Various aspects of corridors are often individually managed by different entities for different goals. Collaboration with transportation professionals in other networks across the corridor allows entities to share resources and information and more effectively meet their goals. Integrated Corridor Management (ICM) aims to improve accessibility, safety, and mobility of users within the corridor through this cooperation between stakeholders. By combining data into a universal system, all appropriate stakeholders, including managers and users, can make more informed decisions for the corridor as a whole. A few attributes of a successful ICM system as described by the FHWA are outlined below.

- Institutional Support
- Multimodal Capabilities and Alternative Transit Options
- Centralized Data Hub
- Public Engagement

Connected Vehicle Technology

Many technologies are being developed that help drivers by providing their vehicles with information about their environment. By communicating with nearby vehicles, traffic signals, work zones, toll booths, or other surroundings, these vehicles will improve efficiency and safety, not just for the user, but others as well. Likewise, these Connected Vehicles (CV) also send information back out to their environment. The devices the CVs communicate with will also provide data, such as speed and volumes, to DOTs to help improve the transportation system. One of the most likely methods for this communication to occur is through Dedicated Short-Range Communication (DSRC). Similar to Wi-Fi, this technology can securely, reliably, and quickly share information between vehicles and surrounding infrastructure.

Governments can help foster growth of connected vehicles by setting up a system in which companies can begin introducing these technologies. TDOT has begun the DSRC Statewide Guidance document as a living resource for implementing a CV project within the state. Although currently in the early stages, once complete, it will provide a reference for organizations to begin implementing these technologies within the state.

Autonomous Vehicle Technology

In May 2017, the Tennessee General Assembly ruled in favor of companies testing autonomous vehicles (AVs) on Tennessee roads so long as federal and state safety standards are met and proper insurance is obtained. Because concerns with CV and AV technology are so closely related, preparation for widespread use is similar. Organizations will use resources such as the DSRC Statewide Guidance document to safely and legally implement AV technology in the future.

Contrary to fully autonomous vehicles, the use of semi-autonomous vehicles is already widespread. For example, since April 2017, platooning has been permitted on Tennessee roads. This is the method in which freight trucks use a system that automatically controls speed and braking by communicating between participating vehicles. This not only improves efficiency by increasing aerodynamics as the trucks can drive closer together, but also safety because the system will automatically apply brakes if it senses a hazard.

5.5 Existing and Future Deficiencies and Needs

A. Pavement Sufficiency Rating: Only 75% of I-26 roadway miles in Washington County meet FHWA's "Good" ride quality criteria. TRIMS maintenance history (as of 2017), shows most of I-26 in Washington County was last resurfaced in 2002. Likewise, I-26 in Sullivan County and 11 miles in Unicoi County were last resurfaced in 2007.

B. Bridge Conditions: No bridges along the I-26 corridor are designated as structurally deficient. Of the 141 bridges on I-26 in the study area, only 15 had sufficiency ratings low enough to be eligible for rehabilitiation under the Federal Highway Administration's (FHWA) Highway Bridge Replacement and Rehabilitation Program. No bridges had sufficiency ratings low enough to be eligible for replacement.

C. Traffic Incident Management: TDOT has established a specific, Interstate management plan, focusing on major incidents in Region 1. The Region 1 Plan was last updated in 2018. However, the TDOT HELP Program has yet to expand coverage to include I-26. As a result, scene management and crash clearance rests solely on law enforcement and first responders. In addition, the mile marker signs installed by TDOT along the Interstate have not been well maintained.

D. ITS Devices: Existing TDOT ITS elements along the I-26 corridor are focused near the interchange with I-81 in Kingsport; however, the Johnson City Traffic Division does operate and manage some cameras along I-26. As recommended in the Kingsport and Johnson City ITS architecture plans, the following ITS elements should be considered:

- Signal system upgrades and pre-emption on adjacent arterials
- CCTV cameras
- Flood detection networks
- TOC upgrades
- Freeway monitoring systems
- End of queue advance warning systems

E. ITS Strategies: As traffic on I-26 grows, congestion can be mitigated through Transportation System Management and Operations (TSM&O) measures including: work zone management, traffic incident management, continued use of SmartWay for traveler information, specific access management guidelines for development on adjacent arterials, and improved bicycle and pedestrian crossings. Dynamic speed limit signs and end of queue advance warning systems for incident management and commonly congested areas could also be deployed to address safety on the corridor.

6. Transit

The I-26 study area is served by two transit agencies:

- JCT (Johnson City Transit)
- KATS (Kingsport Area Transit Service)

Both transit agencies offer several fixed bus routes and on-demand, paratransit service. Despite the proximity of JCT and KATS (30 minutes via I-26), each serve their own communities and don't offer commuter service between Johnson City and Kingsport. Figure 6-1 shows the existing transit systems within the I-26 analysis area and the top areas of employment.

6.1 Fixed-Route Transit Service

Johnson City

JCT offers eight fixed-routes in addition to several East Tennessee State University routes known as BUCSHOT routes. While the shorter BUCSHOT routes have frequent headways, JCT's regular eight fixed-routes have less frequent, 60-minute headways. All service is closed on Sundays and limited service is available in the evening. All of JCT's routes begin in downtown Johnson City and head in varying directions, looping back downtown an hour later[8]. JCT's routes offer good coverage to Johnson City residents but don't offer options for commuters traveling outside of Johnson City. Serving commuters is essential as over half of Johnson City residents commute outside of Johnson City for work[9].

JCT bus service provides good access to key activity centers throughout Johnson City. Key activity connections served by JCT include the library, East Tennessee State University, Johnson City Medical Center, Niswonger Children's Hospital, churches, schools and more. While JCT serves many key activity centers within Johnson City, regional level connections are missed. Regional activity centers include a connection to Kingsport, Jonesborough, Elizabethton and the Tri-Cities Airport.

Johnson City Transit Comprehensive Operations Analysis

In December 2017, JCT completed a comprehensive analysis of their existing services including recommendations for transit improvements. A consultant team analyzed existing JCT routes and surveyed JCT drivers and users in order to create recommendations that would provide the best service. Recommendations included adding an express route to Jonesborough running to and from twice in the morning and twice in the evening for commuters. Another commuter focused suggestion was a rideshare program run by JCT to offer rides to two of Johnson City's biggest employers, Citi Commerce Solutions and Frontier Health. Additionally, the analysis suggested increasing the frequency of routes from 60 to 30 minutes. While these suggestions would improve JCT service, they come at a cost of up to an additional $3.6 million in annual operating costs[10].

Johnson City MTPO 2045 Metropolitan Transportation Plan

The 2045 Long-Range Transportation Plan was approved in February 2018 as part of the continuing, comprehensive, and cooperative transportation planning process. The Plan establishes a transportation vision for the urbanized area and identifies specific projects. Public transportation projects outlined in the 2045 Long-Range Plan include[11]:

- Service expansion (increased evening service, same-day service for ADA clients, more frequent service, Sunday service, special event service, and more)
- Information and awareness
- Other investment alternatives (increased rider assistance, first-mile/last-mile improvements, bus stop amenities, and more)

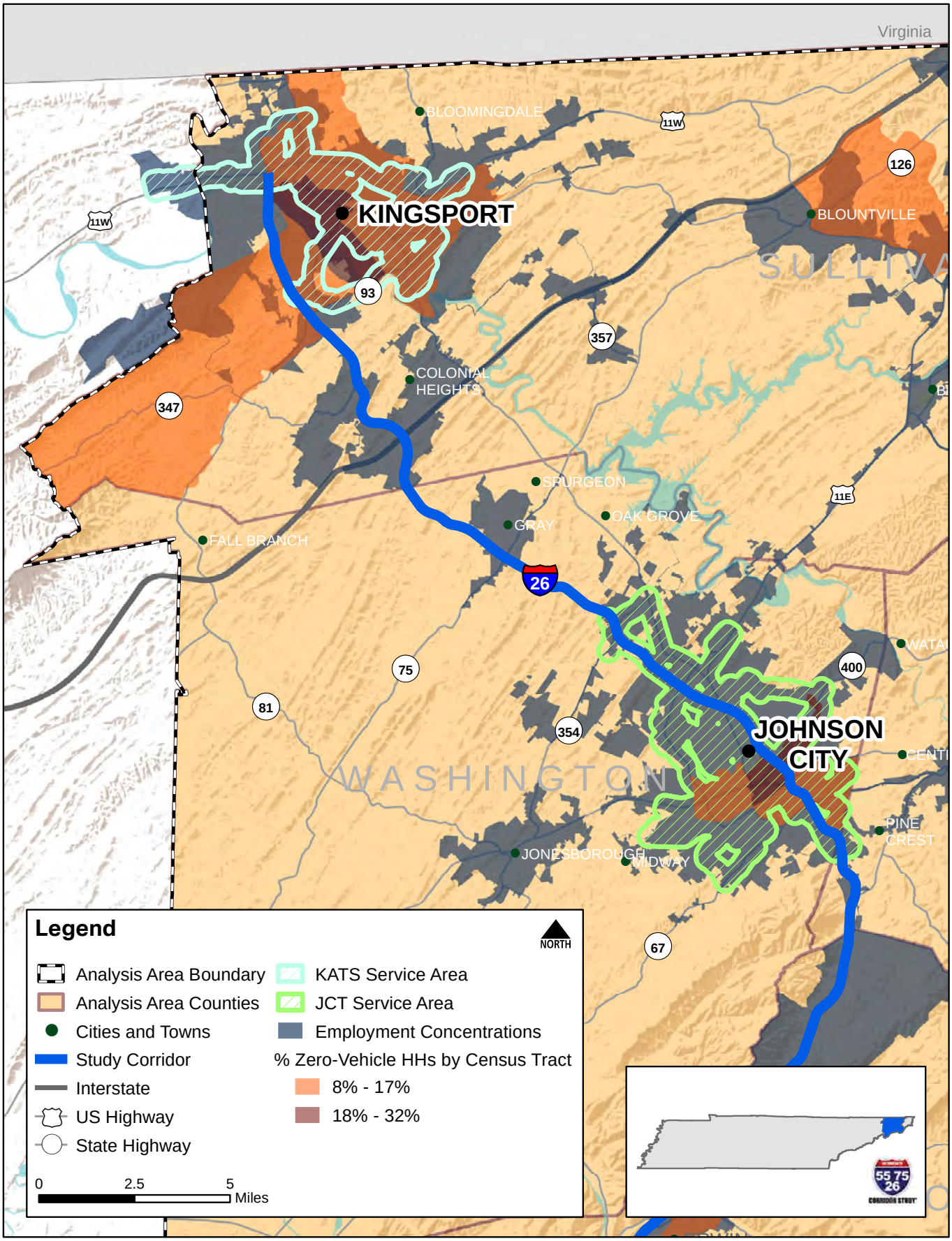
Kingsport

KATS offers six fixed-routes throughout the City of Kingsport. Each route begins and ends at the KATS transit center offering 60-minute frequency from 7:30 a.m. to 5:30 p.m Monday through Friday. Fixed-route bus service is not available on weekday nights or weekends. In addition to KATS six fixed bus routes, KATS offers an on-demand paratransit service[12]. Currently, KATS offers limited service in terms of frequency but does offer access to many key activity centers in the community. Still, KATS falls short on offering commuter service outside of Kingsport and more availability on nights and weekends. Over half of Kingsport residents work outside of the City of Kingsport[13].

KATS bus service provides good access to activity centers in and around the downtown area of Kingsport. Many resources including parks, hospitals, apartments, senior centers and shopping centers can be accessed by KAT bus routes. However, there are missed regional connections including to the Tri-Cities Airport and a connection to Johnson City.

8- Johnson City Transit. Accessed 03/20/2019. http://www.johnsoncitytransit.org/index.html
9- US Census On the Map. Accessed 03/20/2019. https://onthemap.ces.census.gov/
10- Johnson City Transit Comprehensive Operations Analysis. Access 04/01/2019. https://www.jcmpo.org/studies/JCT_COA_Final_20171207.pdf
11- Johnson City Metropolitan Transportation Planning Organization 2045 Metropolitan Transportation Plan. Accessed 10/18-2019. https://www.jcmpo.org/mtp.html
12- Kingsport Area Transit Service. Accessed 03/20/2019. https://kingsporttransit.org/
13- US Census On the Map. Accessed 03/20/2019. https://onthemap.ces.census.gov/

Figure 6-1. Transit Operations — I-26



Source: U.S. Census Bureau, Kingsport Area Transit Service, Johnson City Transit

Kingsport MTPO 2040 Long-Range Transportation Plan

Kingsport's Long-Range Transportation Plan was approved in June 2017 and outlines the need for transit improvements and expansion based on projected population and employment increases in the greater Kingsport region. The Coordinated Public Transit-Human Service Transportation Plan (CPTHSTP), developed for the Tri-Cities region by TDOT is mentioned in the plan as it outlines some transit shortfalls and strategies for improvement. The noted key shortfalls of existing service are a lack of awareness of available service and a lack of coverage and connectivity between urban centers and rural areas[14]. Additionally, the plan notes the importance of increasing service hours to accommodate evening and weekend users, identifying funding sources for capital investments including purchasing fleet vehicles (buses). While the plan outlines some of the key shortfalls of KATS service, including a lack of regional connectivity, low frequency and no service offered on nights and weekends, the plan also notes a lack of available funding to make these improvements.

6.2 On-Demand Transit Services

Rural transit service is offered in both the Johnson City and Kingsport regions by Northeast Tennessee Rural Public Transit (NET Trans). NET Trans offers on-demand transit service to residents in Carter, Greene, Hancock, Hawkins, Johnson, Sullivan, Unicoi and Washington counties. NET Trans provides rides Monday through Friday between 6:00 a.m. and 6:00 p.m. All rides must be scheduled 24 hours in advance. Rides are available within the eight-county region, including to the urbanized areas of Bristol, Kingsport and Johnson City.

Despite having rural transportation services offered along I-26, the service is limited, requiring advance notice of rides and limited availability on weeknights, weekends and holidays.

6.3 Transit Analysis

O-D Pairs

In Section 3, major trip destinations (O-D pairs) were identified along the I-26 corridor. Key O-D pairs include:

- Kingsport to Johnson City
- Colonial Heights to Johnson City
- Spurgeon to Johnson City

While Johnson City and Kingsport provide fixed-route bus service, neither offer a commuter option between the two cities despite evidence that many trips occur. Additionally, trips are generated in Colonial Heights and Spurgeon, which are located between Kingsport and Johnson City.

Zero-Vehicle Households Compared to High Job Concentrations

Figure 6-1 highlights high concentrations of households with no access to a vehicle in relation to areas of high employment concentrations. The limits of existing fixed transit service in Johnson City and Kingsport are also identified. The figure identifies some gaps in service where there are areas of employment concentration but a lack of transit/access for households without access to a vehicle. Some gaps in access that could be filled with extensions of existing service include along the I-26 corridor in the vicinity of Johnson City. These areas contain both high employment concentration and households with no access to a vehicle. Areas surrounding Kingsport to the north and south also have gaps in access.

Transit Routes on I-26

Two JCT routes operate on I-26. The JCT Orange Route uses the I-26 corridor between SR-354 (Exit 17) and SR -91/Market Street (Exit 23), for a total of six miles. The Silver Route uses the I-26 corridor between SR-11E/N. Roan Street (Exit 20) and SR-91/Market Street (Exit 23), for a total of three miles. Comparing these routes to the projected traffic congestion in 2040 (see Figure 3-4) shows that segments utilized by the JCT Orange and Silver routes are anticipated to experience increased levels of congestion. These bus routes could possibly experience delay due to forecasted congestion.

Park-and-Ride Lot

Only one park-and-ride lot currently exists along the I-26 corridor. The lot is located on the north side of Johnson City, along I-26 and is serviced by JCT's Silver Route (Figure 6-2). Additional park-and-ride lots could be strategically placed along the outskirts of the transit service areas in Kingsport and Johnson City to provide transit connections for those commuting by car from outlying areas.

Figure 6-2. Park-and-Ride Lot — I-26

Source: Google Maps

14- Kingsport Metropolitan Transportation Planning Organization 2040 Long-Range Transportation Plan. Accessed 03/20/2019. https://www.kingsporttn.gov/Uploads/KMTPO_2040LRTP_Final%20062017.pdf

6.4 Existing and Future Deficiencies and Needs

A. Johnson City – Kingsport Connection: Given the close proximity (less than 30 miles) and the high number of residents who commute between Johnson City and Kingsport, a commuter route linking both communities should be considered.

B. On-Demand Transit: While rural public transportation is offered by Northeast Tennessee Rural Public Transit, the service provided is very limited and requires users to call in advance. Service is also limited to daytime hours during the week and no service is offered on nights and weekends.

C. Fixed-Route Transit Service: Kingsport and Johnson City both have fixed-route transit service. Both services are similar in that they have several routes that are all loops, starting from a central point and returning an hour later. Therefore, headways are long (30-60 minutes) and transferring becomes difficult as one has to ride the entire loop to transfer to a different bus. Additionally, both Johnson City and Kingsport have limited or no service offered on holidays, nights and weekends. Finally, KATS service area misses segments of the population that are without access to a vehicle.

D. Park-and-Ride Lots: Creating park-and-ride lots around the outskirts of JCT and KATS current service areas would give commuters an alternative transportation option.

7. Walking and Bicycling

In order to serve all transportation users, bicycle and pedestrian infrastructure is necessary in many locations, especially along transit corridors, at transit stops, in dense neighborhoods and in downtown areas. Along the I-26 corridor, most bicycle and pedestrian accommodations are found in urban areas. Where there are existing facilities, they often fall short with gaps in service, minimum design standards or are segmented by an Interstate facility. Most existing bicycle and pedestrian facilities are supported locally or regionally; however, some state-wide bicycle routes are in development through TDOT.

7.1 U.S. and State Bicycle Routes

Currently, Tennessee has one existing statewide bicycle route, U.S. Bicycle Route 23, running north to south through the middle of the state. This route runs along existing state and U.S. highways. The route is signed with 'Bike Route' signs, but no other bicycle accommodations exist. Other U.S. bicycle routes are planned in Tennessee including one route running east to west through Memphis, Nashville and Knoxville (USBR 80). Additionally, a route is planned north to south to the east (USBR 22) and west (USBR 35/25) of Nashville and a second route (USBR 45) along the Mississippi River or Tennessee's western boundary.

In addition to the U.S. bicycle routes, TDOT has statewide bicycle routes planned throughout the state. Two planned bicycle routes intersect the I-26 corridor, including:

- Chattanooga to Mountain City, which would intersect I-26 in Johnson City
- Nashville to Bristol, which would intersect I-26 at its northern terminus, US-11W, north of Kingsport

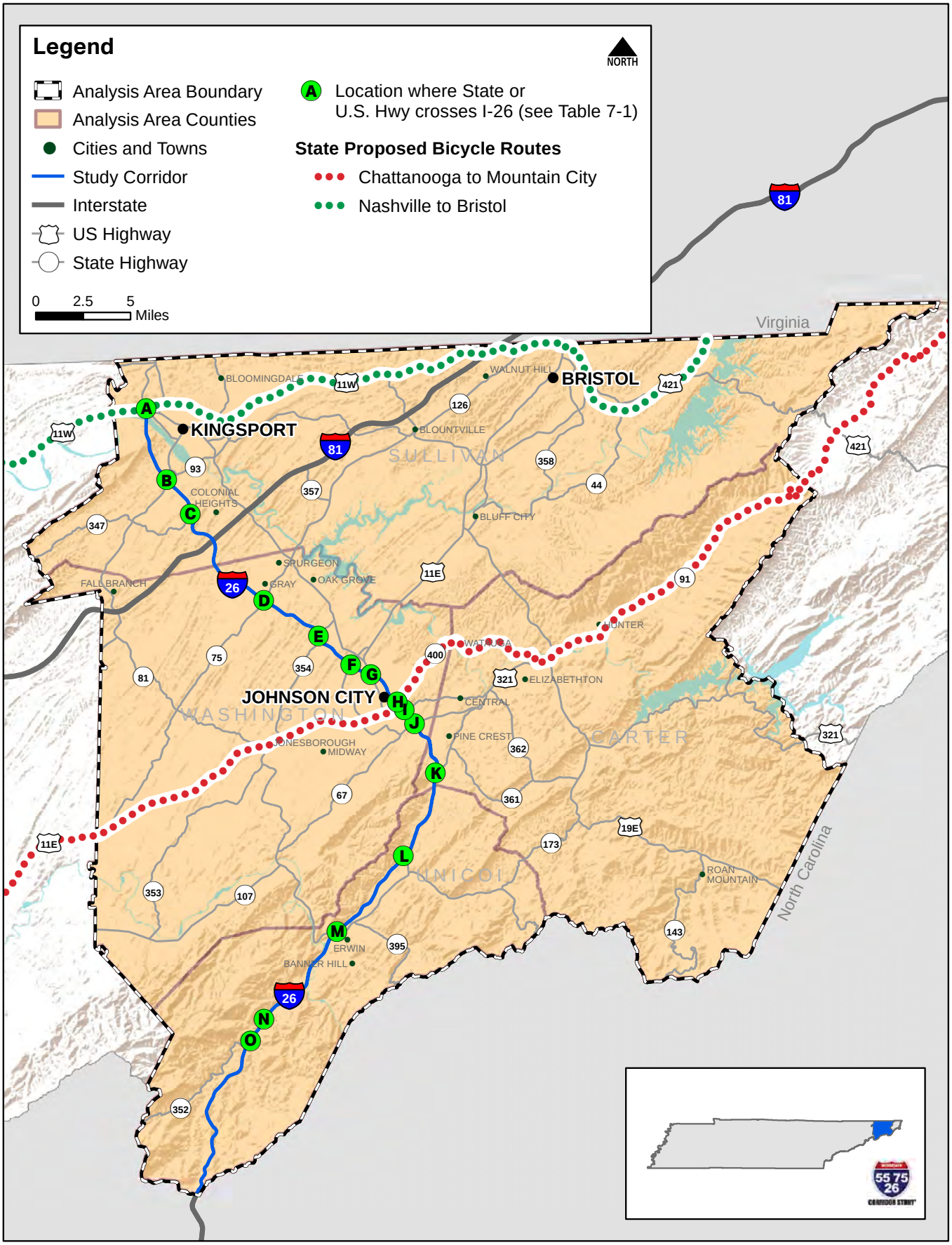
These planned state bicycle routes are proposed mostly along existing U.S., state and even county highways throughout the state of Tennessee. The planned state bicycle routes within the I-26 corridor study area can be seen in Figure 7-1.

7.2 Bicycle and Pedestrian Connectivity Through Interchanges

Unless planned for ahead of time, geometric limitations created by Interstate structures often result in discontinuous pedestrian and bicycle accommodations on cross-streets through an interchange. Where bicycle lanes and sidewalk may be present on either side of the Interstate, the cross-section through the interchange may be limited to only vehicular traffic, which discourages multi-modal connectivity from one side to the other. Futhermore, ramp intersections often create bicycle lanes and sidewalk paths that are difficult to navigate, and in some cases unsafe. As shown in Figure 7-1 and Table 7-1, I-26 interchanges with U.S. and state routes were evaluated to determine connectivity for pedestrians and bicyclists across the Interstate. Where pedestrian and bicycle accommodations existed on the cross-street, free-flow right turns at ramp interchanges were noted. While free-flow right turns have operational benefits, the movement allows vehicles to maintain higher rates of speed off the ramp and through the intersection, putting pedestrians and bicyclists at a disadvantage. Motorists traveling at higher speeds are less likely to yield to pedestrians and higher intersecting speeds are more difficult for bicyclists to judge and maneuver.

AADT on the cross-roads was also noted as the volume of traffic influences mobility for pedestrians and bicyclists.

Figure 7-1. Planned State Bicycle Routes and U.S./State Highway Crossings — I-26



Source: Tennessee Department of Transportation

Table 7-1. Locations Where a U.S. or State Highway Crosses I-26

Map Letter	State Route/U.S. Hwy Crossings	Crossroad AADT (2018)	Bicycle Lane/ Multi-Use Path?	Paved Shoulder >2'?	Sidewalk?	Free-Flow Right with Bicycle/Ped Facilities?
A	SR-1/US-11W (W. Stone Dr.)	29,500 (E)*	No	No	Yes	Yes
B	SR-93 (Wilcox Dr.)	25,500 (E) 13,400 (W)**	No	Yes	No	N/A
C	SR-347 (Rock Springs Rd.)	4,600 (E) 8,300 (W)	No	No	No	N/A
D	SR-75 (Bobby Hicks Hwy)	19,300 (E) 14,500 (W)	No	Yes	No	N/A
E	SR-354 (Boones Creek Rd.)	16,800 (E) 20,500 (W)	Yes	Yes	No	Yes
F	SR-381 (State of Franklin Rd.)	17,100 (E) 27,100 (W)	Yes	Yes	No	Yes
G	SR-34/US-11E (Roan St.)	23,800 (E)	No	Yes	No	N/A
H	SR-400/ E. Watauga Ave./ E. Unaka Ave. (one-way pairs)	6,100 (W) 6,100 (W)	No	Wide Outside Lane	Yes	No
I	SR-91/ E. Market St./ E. Main St. (one-way pairs)	6,900 (E) 7,100 (W)	No	Wide Outside Lane	Yes	No
J	SR-67/US-321 (University Pkwy)	25,300 (W)	No	Yes	No	N/A
K	SR-359 (Carter County)	6,600 (E)	No	Yes	No	N/A
L	SR-173	5,700 (E)	No	Yes	No	N/A
M	SR-81/SR-107 (2nd Street - Erwin)	8,600 (E)	Yes (Ends at SB Ramps)	Yes	Under Structure Only	No
N	SR-36/US-19W (Dewey Frye Rd.)	No Counts	No	Yes	No	N/A
O	SR-352 (Old Asheville Hwy)	1,800 (E) 1,100 (W)	No	No	No	N/A

* East approach; ** West approach

Source: TDOT Traffic History website, Google Earth

Noteworthy are the interchanges of I-26 with the two proposed state bicycle routes: SR-400 and US-11W/SR-1.

- SR-400 crosses I-26 as one-way pairs, through two interchange structures. No bicycle lane is designated; however, sidewalk and a wide outside lane are present.
- US-11W/SR-1 carries sidewalk through the interchange; however, no paved shoulder or bicycle lane is present. AADT volumes near this interchange approached 30,000 vpd in 2018.

7.3 Regional and Local Bicycle and Pedestrian Plans

Bicycle and pedestrian plans exist for communities in the I-26 corridor, most notably in Johnson City and Kingsport. In general, these plans look to identify missing links or gaps in existing bicycle and pedestrian service and areas where service could be extended. Some key ways to identify areas that would benefit from bicycle and pedestrian infrastructure include:

- One to three miles around population dense neighborhoods, transit service, activity centers (hospitals, schools, parks, etc.)
- Known areas with populations with no access to a car.

Existing regional and local bicycle and pedestrian plans are outlined below.

Kingsport Area

The Kingsport Regional Bicycle and Pedestrian Plan was adopted in November 2012 and outlines specific bicycle and pedestrian improvements in Kingsport. In addition to outlining recommended projects, the Plan analyzes existing bicycle and pedestrian infrastructure including identifying where existing bicycle and pedestrian infrastructure is located. The plan also considers bicycle level-of-service and pedestrian level-of-service on existing arterial and collector streets in Kingsport. The Plan outlines that over 75% of roads fall within the D, E and F categories for bicycle level-of-service. Pedestrian level-of-service ranks even lower with over 80% of streets falling within the D, E and F categories[15]. The Kingsport MTPO will update their bicycle and pedestrian plan beginning in late 2019.

Johnson City Area

While a bicycle and pedestrian specific plan doesn't currently exist for Johnson City, bicycle and pedestrian issues are discussed in their Comprehensive Plan. The plan outlines bicycle infrastructure improvements including a bicycle facility network. In addition to creating proposed trails, the Plan emphasizes the importance of end-of-trip facility recommendations including bicycle parking[16].

7.4 Existing and Future Deficiencies and Needs

Improvements are needed to local and regional bicycle and pedestrian infrastructure in the I-26 study area. For example, accommodations could be improved on cross streets that intersect I-26, particularly through interchange areas in urban settings.

A. State Bicycle Routes: The planned TDOT bicycle routes will provide limited bicycle infrastructure, using only bicycle route signs and existing paved shoulders.

   Noteworthy are the interchanges of I-26 with the two proposed state bicycle routes: SR-400 and US-11W/SR-1.

   - SR-400 crosses I-26 as one-way pairs, through two interchange structures. No bicycle lane is designated; however, sidewalk and a wide outside lane are present.
   - US-11W/SR-1 carries sidewalk through the interchange; however, no paved shoulder or bicycle lane is present. AADT volumes near this interchange approached 30,000 vpd in 2018.

B. Regional and Local Bicycle and Pedestrian Plans: The only local bicycle and pedestrian plan in the I-26 corridor study area is from Kingsport. The majority of Kingsport has low bridge and pedestrian level-of-service.

   Johnson City has no specific bicycle and/or pedestrian plan but does outline the need for more bicycle and pedestrian accommodations throughout the city in the Johnson City Comprehensive Plan. The comprehensive plan outlines proposed trails connecting the city and providing recreational space in addition to the need for traditional bicycle and pedestrian accommodations including improved sidewalks and bicycle parking.

8. Transportation Demand Management

Transportation Demand Management (TDM) is a set of strategies that influence travel behavior to reduce single-occupancy vehicle (SOV) travel. Ranging from ridesharing, bicycling, teleworking, taking transit, car sharing and on-demand or real-time applications, TDM strategies redistribute commuter travel across a variety of alternatives and away from daily peak periods. TDM programs represent a flexible, low-cost way to engage

15- Kingsport Regional Bicycle and Pedestrian Plan. Accessed 04/03/2019. https://www.kingsporttn.gov/wp-content/uploads/mpo/KingsportMtpoBikePedPlan_Final.pdf
16- Johnson City Comprehensive Plan. Accessed 04/02/2019. https://www.jcmpo.org/Bike/CityofJCBikewayGreenwayPlan.pdf

residents, travelers, businesses and local governments in the effort to reduce commuter travel and the associated impacts on the community including traffic congestion and emissions.

Eligible TDM activities (defined by the Congestion Mitigation and Air Quality Improvement Program or CMAQ), range from traveler information services, shuttles, employer-based programming, parking initiatives, public education and outreach activities, telework promotion, transportation management associations (TMAs), carpool and vanpool services (ridematching, marketing, guaranteed ride home, subsidies), and car sharing. In addition, the use of technology directly intersects TDM and represents a significant opportunity to change travel behaviors. Examples of related technology include:

- Private sector mobile applications for ride booking that are supplementing and replacing traditional ridematching
- Services (e.g., Waze) that are integrating with local transportation agencies
- Connected and autonomous vehicles that will impact SOV travel and air quality
- Intelligent digital signage to encourage alternative mode use
- "Big data" sets including INRIX, AirSage, BlueTOAD, and StreetLight to further direct TDM efforts based on commuting patterns and origin/destination data
- The influence of Smart Cities on commute behavior and increasing throughput efficiency

TDOT developed a Statewide Transportation Demand Management (TDM) Plan in 2017. The plan provided a dynamic structure for trip reduction strategies suitable for immediate implementation, but flexible enough to accommodate the demands of future transportation and travel. The Plan positioned TDOT as the TDM program leader – connecting and coordinating regional TDM efforts with the local partners responsible for program implementation within each of the state's five urban areas (Figure 8-1).

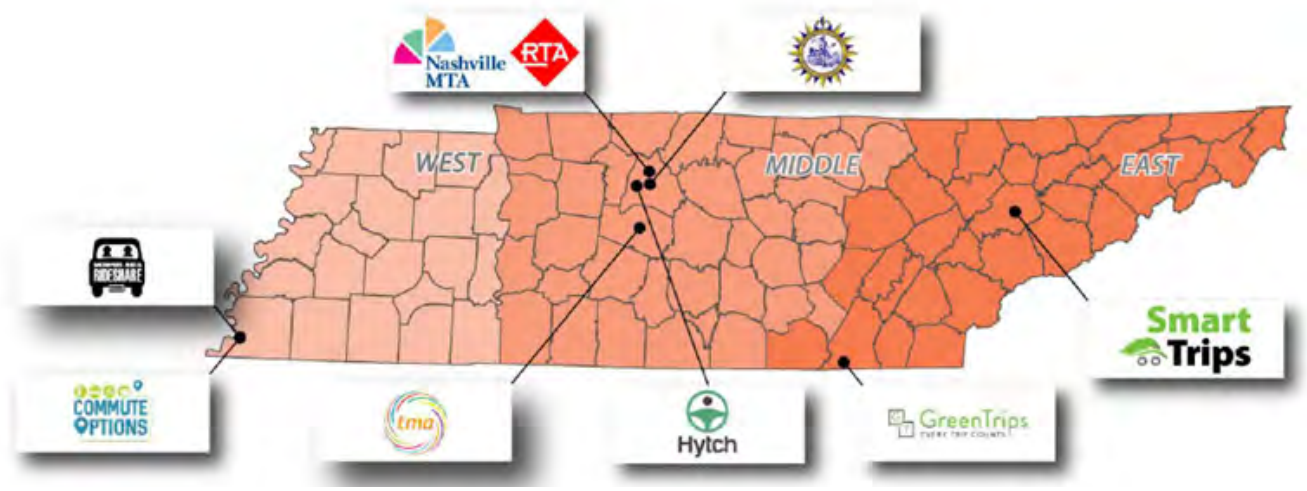
TDOT's current 25-year Long-Range Transportation Plan Mobility Policy Paper established the foundation that the state's transportation system should encompass mobility options and travel choices that promote a strong transportation system connecting residents to jobs, schools, services and attractions. The Plan describes the provision of viable alternatives to the SOV as a central element of TDOT's vision of an efficient and effective multimodal transportation system. TDM represents low-cost alternatives that can help TDOT expand and enhance mobility, system efficiency, and environmental protection by reducing congestion and improving air quality.

The primary goal of statewide TDM programming is to reduce SOV travel by promoting alternative modes that include carpooling, vanpooling, taking transit, bicycling, walking, alternative work arrangements and on-demand or shared services. The Statewide TDM Plan is further supported through the following key objectives:

1. Decrease traffic congestion and air pollution
2. Support and enhance TDM programming in the state's five major urban areas
3. Increase customer access to programs and services
4. Streamline the administration and evaluation of TDM programming
5. Increase awareness and support for TDM initiatives in the state

The following six key recommendations resulted from the Plan. These recommendations were based on stakeholder engagement, commuter and employer surveying (statewide), and analysis of national best practices.

Figure 8-1. TDOT's Local Partners — Existing Programs



Source: 2017 TDOT Statewide Demand Management Plan

1. Introduce a standard Commuter Program structure
2. Establish a statewide TDM brand
3. Identify a statewide TDM coordinator (team)
4. Maintain core TDM services for regional implementation
5. Increase accountability
6. Develop standard operating procedures for administration of TDM projects

8.1 Mode Choice

Based on 2012-2016 U.S. Census data obtained via the Census Transportation Planning Products Program (CTPP), 85.9% of commuter trips made within the four-county study area are single-occupancy vehicle trips. As shown in Table 8-1, 6.9% of trips are made by some form of rideshare, and 0.4% are made by transit. The number of personal auto trips is slightly higher and the number of rideshare and transit trips are slightly lower than Tennessee as a whole. Nationally, the number of single-occupancy vehicle trips is lower and transit is higher. Note that Other Travel Modes includes "work-from-home," which is on the rise nationally. Table 8-1 also shows the mode split for city-to-city origin and destinations.

8.2 Vanpools

No municipal or county commute-to-work vanpool programs are offered in the four-county study area; however, East Tennessee State University (ETSU), located in Johnson City, offers a rideshare program to ETSU faculty, staff and students. The program, known as "Green My Ride," promotes rideshare to and from campus, internships, work, or home for weekends and holiday breaks. The goal of the program is to save money, travel expenses, and gas, as well as reduce environmental impact.

8.3 Park-and-Ride Facilities

One park-and-ride lot is located along I-26, providing rideshare opportunities for those commuting to Johnson City from the northwest (see Figure 6-3). The lot is located at the corner of North State of Franklin Road and West Oakland Avenue. The Kingsport Metropolitan Transportation Planning Organization has recently undertaken a study to evaluate the feasibility of creating park-and-ride lots in the Kingsport metro area. The study will have recommendations including locations, destinations, shared costs and more.

8.4 Existing and Future Deficiencies and Needs

The Statewide TDM Plan identified a number of ways regional TDM programs can support TDOT with managing mobility. They can also provide needed assistance on selected corridors when capacity is at a premium – especially during large construction projects. For example, during I-40 closures to North Carolina, local agencies in the area work with TDOT to re-route traffic. Moving forward, TDOT should continue to work with the regional TDM programs to push more equitable multi-modal travel in the urban areas. The I-26 corridor does not currently contain an urban area TDM program.

Additionally, the region could benefit from additional park-and-ride lots and vanpool programs, potentially between Johnson City and Kingsport.

Table 8-1. Commuter Modal Split — I-26

Origin-Destination Pair	Single-Occupancy Vehicle	Rideshare (Car, Truck, Vanpool)	Transit	Other Travel Mode (Bicycle, Ped, Motorcycle, etc.)
Colonial Heights to Kingsport	98.9%	1.6%	0.0%	0.0%
Spurgeon to Kingsport	81.3%	17.5%*	0.0%	1.0%
Erwin to Johnson City	80.5%	12.7%*	0.0%	7.8%*
Kingsport to Johnson City	90.3%	6.7%	0.0%	2.9%
Study Area	85.9%	6.9%	0.4%	6.9%
Tennessee	83.6%	9.1%	0.8%	6.5%
Nationwide	76.4%	9.3%	5.1%	9.1%

Source: U.S. Census Bureau (2012-2016) via CTPP

* high margin of error

9. Freight and Intermodal Facilities

This section summarizes the existing and future conditions of freight movement through the I-26 corridor. Freight facilities, including major generators and intermodal facilities, are described. In addition, the potential for diverting freight from the dominant mode – truck – to rail, air, or barge, is assessed.

The data used in this analysis include Transearch 2016 (current) and 2045 (forecast) and the Tennessee Statewide Travel Demand Model (base year 2010, forecast year 2040).

9.1 Freight Movement

Freight movement is an important element of a regional and national economy, as more efficient modes and routes enable improved logistics and result in reduced transportation costs. These cost savings can then be reallocated to growth, providing better jobs and higher wages in the area. The existing and future freight flows in the region were analyzed using the most current available data and existing conditions.

The I-26 corridor area in northeastern Tennessee goes through Kingsport and Johnson City and their surrounding counties. The I-26 corridor terminates north of Kingsport and extends to the south as far as Charleston, SC. Other important points along the route include Asheville, NC, Spartanburg, SC, and Columbia, SC.

In addition, the I-26 corridor is on the eastern edge of "auto alley," along which automobile production and support services have been established for decades in the U.S. The region benefits from its proximity to other automobile manufacturing industries, high quality highways and ports, access to labor pools, and other domestic auto production facilities along the I-69 and I-75 corridors[17]. The automobile industry is just-in-time and depends highly on trucking. Figure 9-1 shows the expected growth in truck volume throughout the corridor. As shown, the highest expected growth along I-26 is between Johnson City and I-81 and between SR-93 and US-11W in the Kingsport area.

The I-26 corridor also boasts convenient access to rail and air modes. Table 9-1 shows the total tonnage and value of inbound and outbound freight in the I-26 corridor study area. As shown, truck is the predominant mode both in 2016 and in 2045 for the inbound and outbound directions. Air and rail freight make up a negligible portion of freight traffic, but both are projected to grow. Inbound truck tonnage is estimated to grow by 1.8 percent while outbound is projected to grow more slowly at 0.7 percent, year over year. Truck value is projected to grow faster than tonnage in both directions.

Table 9-1. Inbound and Outbound Freight Volumes by Mode for 2016 and 2045 — I-26

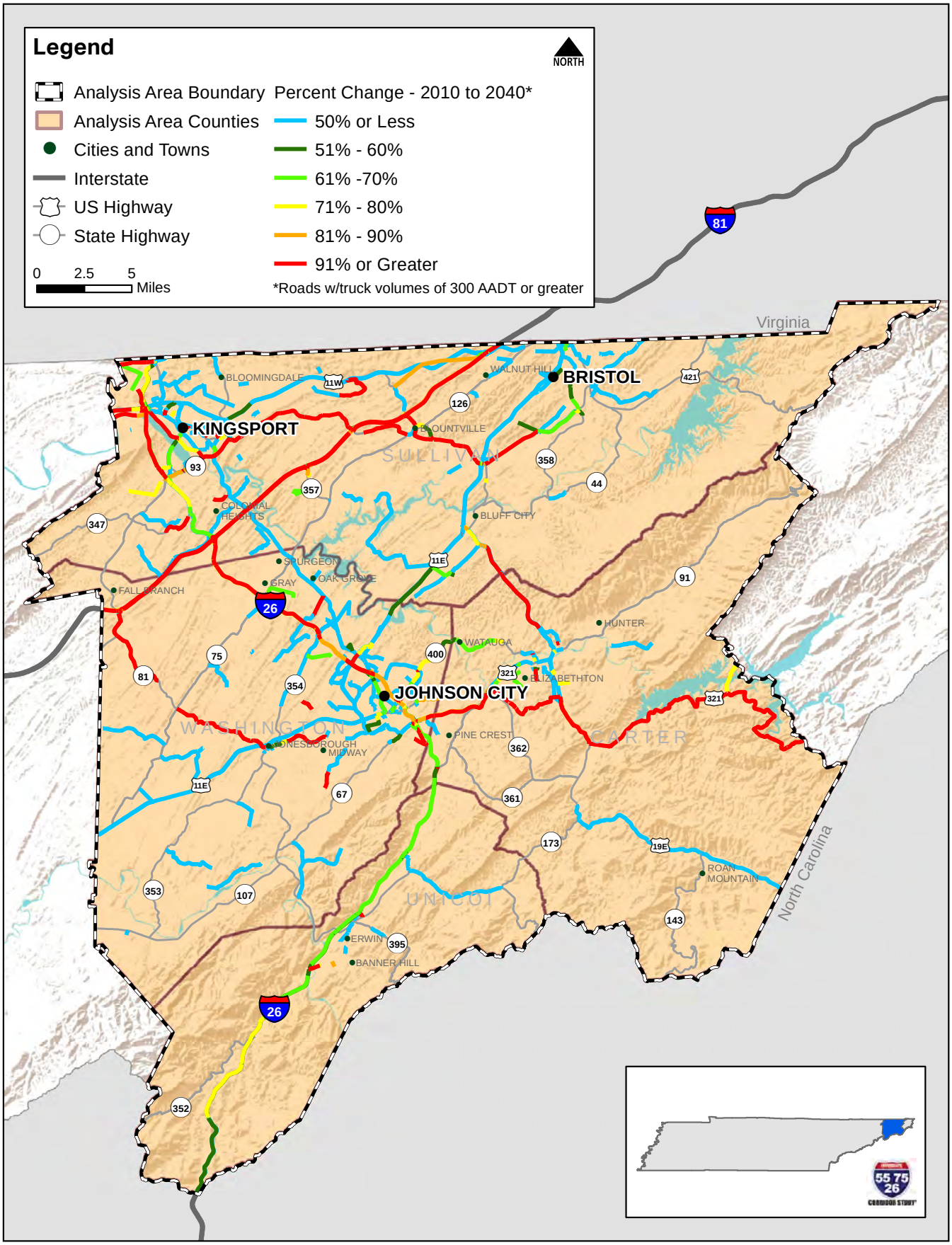
		2016		2045		% Growth CAGR*	
	Mode	Tons	Value	Tons	Value	Tons	Value
Inbound	Air	16	$5M	37	$13M	2.9%	3.3%
	Rail	11,152	$65M	20,182	$103M	2.1%	1.6%
	Truck	9,183,207	$6M	15,192,273	$13,900M	1.8%	2.8%
	Total	**9,194,375**	**$6M**	**15,212,492**	**$14,000M**	**1.8%**	**2.8%**
		2016		**2045**		**% Growth CAGR***	
	Mode	Tons	Value	Tons	Value	Tons	Value
Outbound	Air	9	$1M	16	$2M	2.0%	2.5%
	Rail	39,687	$26M	43,082	$27M	0.3%	0.1%
	Truck	5,310,656	$5M	6,531,025	$7,960M	0.7%	1.8%
	Total	**5,350,352**	**$5M**	**6,574,123**	**$7,990M**	**0.7%**	**1.8%**

* CAGR: Compound Annual Growth Rate

Source: Transearch (2016 and 2045)

17- Cuneo et al, Area Development, "The Changing Geography of the American Auto Industry," 2014, https://www.areadevelopment.com/Automotive/Advanced-Industries-2014/changing-geography-of-american-auto-industry-2262541.shtml

Figure 9-1. Growth in Truck Volume from 2010 to 2040 — I-26



Source: Tennessee Statewide Travel Demand Model

9.2 Inbound and Outbound Freight Demand 2016 and 2045

Inbound/Outbound Freight by Commodity

The top commodities shipped into and from the I-26 corridor study area are summarized using 2016 Transearch data. The data shown are limited to the top 15 commodities by tonnage and make up approximately 97 percent of the tonnage. Inbound and outbound, the largest commodity category is uncategorized freight or "other," which also includes tonnages outside of the top 15 commodities. Outside of "other," leather, warehouse and distribution center, miscellaneous freight shipments, and food or kindred products make up much of the inbound and outbound tonnage. The top commodities inbound and outbound are largely similar and are dominated by truck mode. See Table 9-2 for the inbound commodities and Table 9-3 for the outbound commodities.

Table 9-2. Inbound Freight Tonnage by Commodity, 2016 — I-26

Commodity	Total Tonnage	Share of Total Tonnage
Other	5,934,764	64.5%
Leather or Leather Products	639,561	7.0%
Warehouse & Distribution Center	604,625	6.6%
Food or Kindred Products	402,430	4.4%
Misc. Freight Shipments	261,215	2.8%
Furniture or Fixtures	231,429	2.5%
Textile Mill Products	211,395	2.3%
Coal	186,408	2.0%
Pulp, Paper or Allied Products	151,993	1.7%
Primary Metal Products	145,176	1.6%
Lumber or Wood Products	142,765	1.6%
Apparel or Related Products	98,918	1.1%
Ordnance or Accessories	63,213	0.7%
Electrical Equipment	61,574	0.7%
Fabricated Metal Products	58,912	0.6%
Grand Total	**9.2M**	**100.0%**

Source: Transearch (2016)

Table 9-3. Outbound Freight Tonnage by Commodity, 2016 — I-26

Commodity	Total Tonnage	Share of Total Tonnage
Other	2,764,525	51.7%
Misc. Freight Shipments	519,544	9.7%
Leather or Leather Products	479,566	9.0%
Food or Kindred Products	446,520	8.3%
Lumber or Wood Products	404,792	7.6%
Warehouse & Distribution Center	185,947	3.5%
Primary Metal Products	160,119	3.0%
Rubber or Misc. Plastics	81,799	1.5%
Clay, Concrete, Glass or Stone	64,698	1.2%
Pulp, Paper or Allied Products	62,648	1.2%
Fabricated Metal Products	51,646	1.0%
Machinery	39,586	0.7%
Chemicals or Allied Products	35,680	0.7%
Printed Matter	32,818	0.6%
Misc. Manufacturing Products	20,466	0.4%
Grand Total	**5.35M**	**100.0%**

Source: Transearch (2016)

Truck Origins and Destinations by Entry and Exit Roads: 2016 vs. 2045

Using the Transearch database for 2016 and 2045, the data show that the majority of the region's truck traffic in terms of tonnage and value comes in from I-81 and I-75. Some commodities are coming into the corridor from as far as I-155 in the northwestern part of the state. However, the great majority of the region's inbound and outbound shipments are by air, rail, or water, or truck on other non-Interstate routes, as denoted by the Other category in Table 9-4 and Table 9-5. Shipments from I-155 are growing the fastest with a 2.7 percent compound annual growth rate (CAGR) in tonnage. The value of goods coming from the I-40 corridor is growing the fastest at 3.4 percent per year. Table 9-4 lists the tonnage and value for inbound trade to Tennessee by the first road used within Tennessee, or the entry road used to enter Tennessee on its way to a destination in the I-26 corridor area.

Table 9-4. Inbound Freight Tonnage and Value for 2016 and 2045 by Entry Road — I-26

		2016		2045		% Growth CAGR*	
	Entry Road	Tons	Value	Tons	Value	Tons	Value
Inbound	I-155	16,276	$16M	35,330	$30M	2.7%	2.3%
	I-24	120,419	$91M	164,556	$145M	1.1%	1.6%
	I-40	578,030	$593M	1,126,624	$1,540M	2.3%	3.4%
	I-55	1,652	$3M	2,209	$4M	1.0%	1.8%
	I-59	278,907	$253M	501,238	$564M	2.0%	2.8%
	I-75	1,094,949	$439M	2,228,398	$1,00M	2.5%	2.9%
	I-81	1,309,798	$1,320M	2,055,173	$2,990M	1.6%	2.8%
	Other	5,794,344	$3,650M	9,098,964	$7,750M	1.6%	2.6%
	Total	**9.19M**	**$6.37B**	**15.2M**	**$14B**	**1.8%**	**2.8%**

*CAGR: Compound Annual Growth Rate

Source: Transearch (2016 and 2045)

Table 9-5. Outbound Freight Tonnage and Value for 2016 and 2045 by Exit Road — I-26

		2016		2045		% Growth CAGR*	
	Exit Road	Tons	Value	Tons	Value	Tons	Value
Outbound	I-155	860	$2M	1,249	$3M	1.3%	2.1%
	I-24	22,626	$58M	31,171	$100M	1.1%	1.9%
	I-40	270,082	$375M	359,592	$650M	1.0%	1.9%
	I-55	114	$1M	214	$2M	2.2%	2.1%
	I-59	77,739	$131M	109,023	$250M	1.2%	2.3%
	I-75	400,960	$151M	518,087	$233M	0.9%	1.5%
	I-81	1,281,813	$1,330M	1,577,014	$2,220M	0.7%	1.8%
	Other	3,296,157	$2,700M	3,977,772	$4,520M	0.7%	1.8%
	Total	**5.350M**	**$4.75B**	**6.57M**	**$7.99B**	**0.7%**	**1.8%**

*CAGR: Compound Annual Growth Rate

Source: Transearch (2016 and 2045)

For goods leaving the I-26 corridor, the same major Interstates are the destinations as the origins: I-155, I-24, I-40, I-55, I-59, I-75, and I-81. I-81 is the most heavily-used destination corridor for goods leaving the study area, followed by I-75. The growth in truck traffic using I-55 is the highest overall, although it represents a negligible portion of the total tonnage, at over two percent per year. Outbound tonnages and value of goods traveling on I-26 are growing by 0.7 percent per year and 1.8 percent per year, respectively. The exit roads shown in Table 9-5 show the last route used by outbound freight from the I-55 corridor area within Tennessee or the route used to exit the state.

Through Truck Traffic: 2016 and 2045

The truck through traffic in the corridor was assessed using Transearch 2016 and GIS software. The through tonnage was estimated by summing the tonnages found on roadway segments across the state while excluding the I-26 study area as an origin or destination. The remaining traffic is, therefore, neither originating nor destined to the corridor area and drives through.

Through traffic is important as it can make up a sizeable portion of the region's truck activity and therefore congestion in the corridor. Although through traffic is

destined elsewhere and therefore does not have as large of a direct economic impact in the study area as originating or terminating traffic would, it does impact other regions and an efficient transportation network encourages more efficient deliveries and reduces shipping costs. In addition, the trucks traveling through the region may purchase services such as fuel, food, and lodging making small but measureable impacts. As shown in Figure 9-2, the I-26 corridor in Tennessee shows volumes of through truck traffic in 2016 typically in the range of 1 to 5 million tons, with some segments carrying up to 5.4 million tons. I-26 carries less volume than those found along I-81 in the area.

Of note, rail and air would also have through traffic traversing the study corridor; however, data limitations do not allow for estimating or mapping these movements.

9.3 Intermodal Facilities: Air, Rail, and Truck

The major air, rail, and truck facilities in the corridor area as well as the volume-to-capacity ratios anticipated for traffic in 2040 along I-26 are shown in Figure 9-3.

Air

Tri-Cities Airport serves the northeastern Tennessee region including Kingsport and Johnson City. Located almost 11 miles from the interchange of I-26 with I-81 and seven miles from the I-26 interchange with SR-75, the airport houses U.S. Customs Port Number 2027 and Foreign-Trade Zone number 204[18]. The general aviation airport offers cargo service, though volumes are low as evidenced in Table 9-1. SR-75 was recently widened to accommodate airport traffic and improve accessibility to the new Aerospace Park. The Aerospace Park, located adjacent to the airport, has 40 acres available for development and another 120 acres under preparation for development[19].

Rail

Three rail facilities are located in the corridor with two in Kingsport and one in Johnson City. CSX and Rescar Inc. have facilities in Kingsport. Rescar is a private company that offers maintenance services with rolling stock. CSX operates its Kingsport subdivision through the region and has granted NS trackage rights as well. The CSX line connects most directly to Charlotte, Atlanta, Columbia, Lexington, and Cincinnati. In Johnson City, the East Tennessee Railway LP is a seven mile shortline part of Genesee & Wyoming. It handles chemicals, construction materials, fertilizers, minerals, plastics, and petroleum products and interchanges with CSX and NS, both in Johnson City.

Truck

Freight generating facilities for trucks typically include industrial parks, of which there are two in the I-26 corridor area.

- The Johnson City Industrial Park sits on 200 acres in Washington County. All sites are developed and existing tenants include a variety of warehousing and merchandise companies[20].
- The Washington County Industrial Park is a 190 acre industrial park for warehousing and manufacturing 14 miles from I-26. Three tenants occupy the park currently including a farm equipment supplier, automotive components manufacturer, and bearings maker[21]. There are 87 acres available for future development[22].

9.4 Freight Diversion: From Truck to Rail

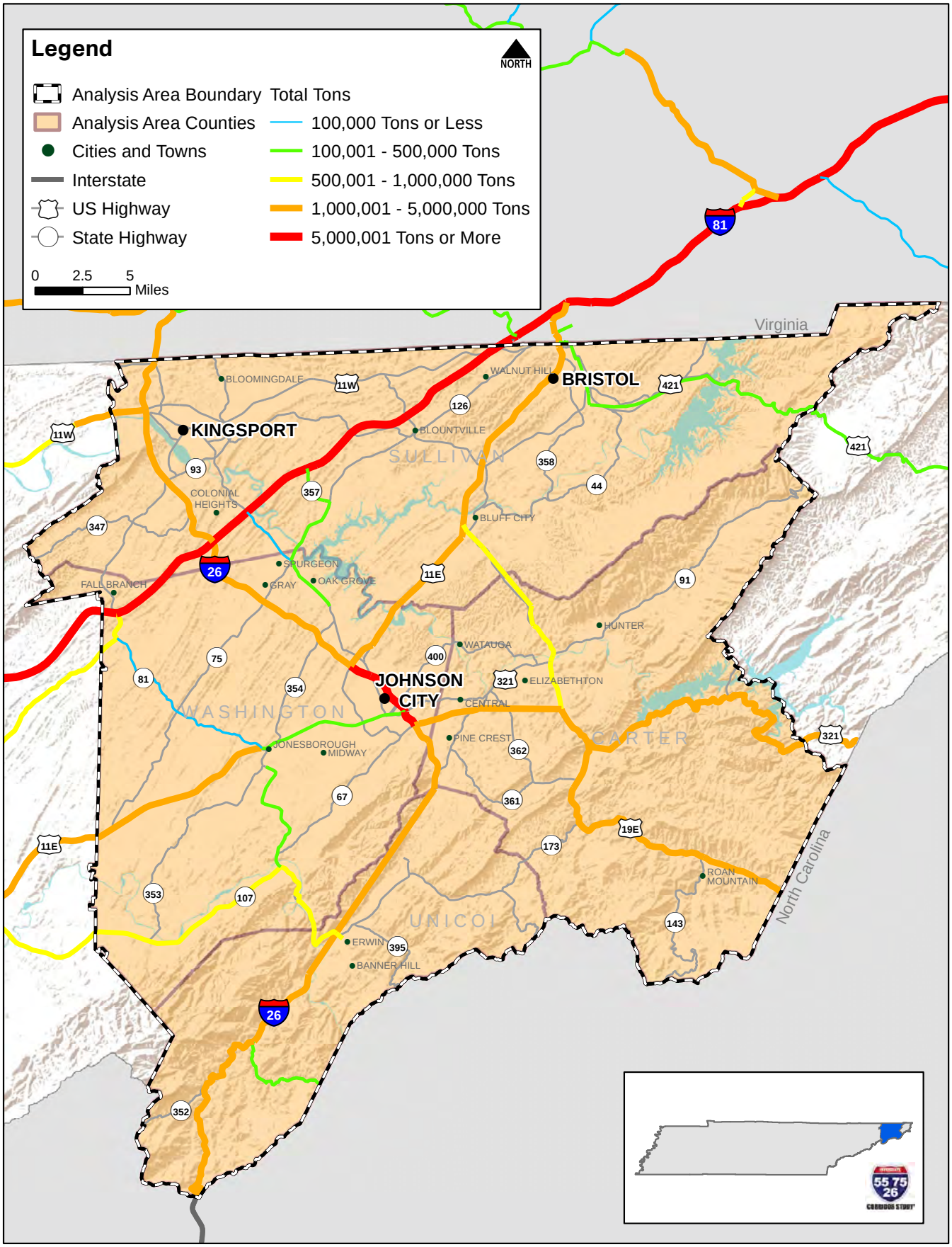
Although the U.S. and Tennessee economies are much less dependent on goods production than they once were, shipping of finished and unfinished goods is still vital to the economic strength of the region. The dominant shipper locations are:

- Sites where the commodity is grown, logged, or mined
- Where it is processed or manufactured
- Distribution sites/centers where products and commodities are aggregated for more efficient shipment

Table 9-6 provides a basic overview of the relationship between some of the major industry sectors and their primary mode of goods movement, and the correlation between tonnage and value. As shown, products of low value and high tonnage are ideal for travel by water and rail, while truck and air modes typically carry lighter and more valuable cargoes. This section will assess the potential for shifting some shipments from truck to rail or air in order to increase highway capacity. Of note, however, is that the mountainous terrain of the I-26 corridor through Tennessee and North Carolina may reduce the potential for diverting high volumes of commodities from truck to rail.

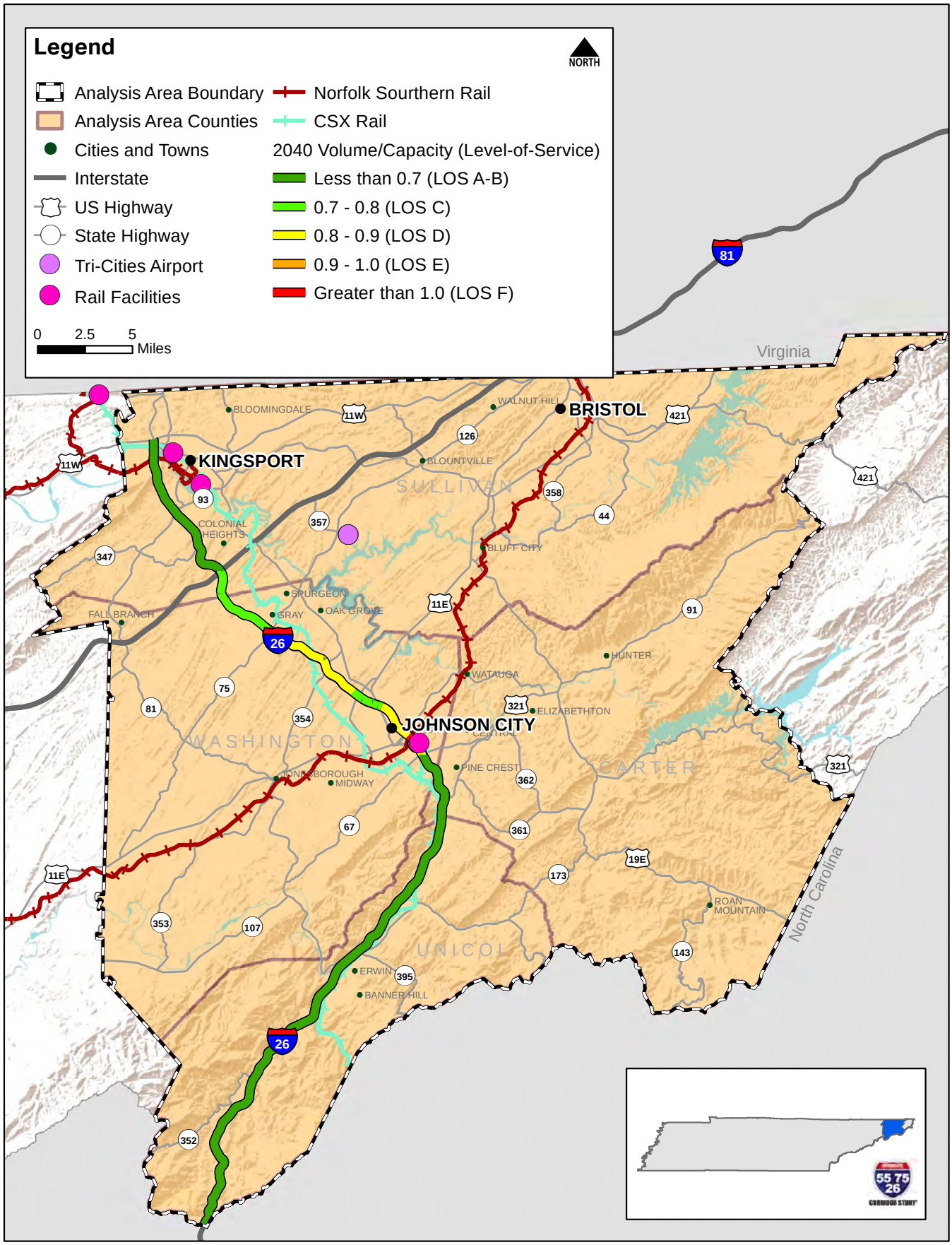
18- Tri-Cities Airport, https://triflight.com/about/
19- TRI Aerospace Park, https://www.triaerospacepark.com/
20- Washington County Economic Development Council, Johnson City Industrial Park, http://www.thewcedc.com/files/OfficeIndustrialParks_JCIP.pdf
21- Baker, Nathan, Johnson City Press, "Washington County Industrial park expanding, preparing for future," March 6, 2018, https://www.johnsoncitypress.com/Business/2018/03/06/Washington-County-Industrial-park-expanding-preparing-for-future
22- Washington County Economic Development Council, Washington County Industrial Park, http://www.thewcedc.com/files/OfficeIndustrialParks_WCIP.pdf

Figure 9-2. Through Truck Traffic Tonnage in the Study Area for 2016 — I-26



Source: Transearch (2016)

Figure 9-3. Freight Facilities — I-26



Source: InfoUSA and Tennessee Statewide Travel Demand Model

Freight Diversion Potential: Existing Freight Volumes

Freight primarily travels in the I-26 corridor by truck, as evidenced by prior tables and figures. However, there is potential for some commodities to divert to other modes that are more cost-effective than truck. In order to assess which products could divert from truck, Transearch was used to summarize the existing (2016) volumes destined for (inbound) and originating from (outbound) the corridor. As shown in Table 9-6, the majority of the inbound commodities with diversion potential are coming into the corridor region by truck. Other modes have potential for diverting commodity traffic when their timing needs and handling needs are similar. Costs are typically related to the speed at which products need to get to the consumer, and as such air and truck are typically more expensive modes. Rail and water are slower modes that are better suited for products that do not have a short delivery window.

Table 9-6. Tonnage, Value, and Value per Ton for All Shipments Into, Out of, and Through Tennessee, 2016

	Total Tons	Total Value	Value per Ton
 Air	.166M	$23B	$139,028
 Truck	44.5M	$84B	$1,852
 Rail	1,870M	$1,810B	$968
 Water	.216M	$0.14B	$626
Total	**1.91B**	**$1.91T**	**$1,000**

Source: Transearch (2016)

In order to assess the commodities for which this may be true, it was assumed that goods are potential candidates for diversions if they are currently transported by two or more modes for between 5 percent and 95 percent of the total tonnage. This range showcases that there is enough of a portion of product moving by more than one mode to indicate that the commodity's individual handling needs can be accommodated at different facilities. As shown in Table 9-7, there are limited inbound commodities with diversion potential in 2016. Table 9-7 shows that, for example, 14 percent of the tonnage for electrical equipment travels by rail and 86 percent by truck.

Table 9-7. Inbound Freight Diversion Potential, 2016 — I-26

Commodity	Air	Rail	Truck
Electrical Equipment	0%	14%	86%
Crude Petrol or Natural Gas	0%	7%	94%

Source: Transearch (2016)

Because some of the electrical equipment is already moved by rail, it can be inferred that time is not as important of a factor in choosing the mode as cost for that share of the product. Therefore, there is potential for even greater volumes of electrical equipment to move by rail, freeing up valuable highway capacity for other commodity shipments and auto traffic. A lower share of crude petrol or natural gas travels by rail than truck, but there is still potential for additional tonnage by rail. Crude petrol or natural gas could also potentially travel by pipeline. It is important to note, however, that the commodity tonnages constitute a small share of the total tonnage handled in the corridor, but based on the developed criteria, the majority of high-volume commodities are not good candidates for diverting away from truck.

In addition to the inbound freight with diversion potential, Transearch was used to assess the outbound freight diversion potential in Table 9-8. A similar methodology was employed, selecting outgoing commodities that ship 5 to 95 percent of their tonnage by multiple modes. As in the ingoing direction, few commodities show great potential for diversion. In the outgoing direction, there is a greater share of rail tonnage than in the inbound direction, though the commodity mix is different. There is potential for diverting additional tonnage of chemicals, printed matter, and apparel from truck to rail modes thereby reducing truck congestion in the I-26 corridor.

Table 9-8. Outbound Freight Diversion Potential, 2016 — I-26

Commodity	Air	Rail	Truck
Chemicals or Allied Products	0%	15%	86%
Printed Matter	0%	37%	63%
Apparel or Related Products	0%	20%	8%

Source: Transearch (2016)

Freight Diversion Potential: Freight Volume Projections

The potential for future volumes to divert from truck to rail or air was assessed using the Transearch database's 2045 projections for the study area. Using a similar methodology as for the existing freight volumes, the top inbound and outbound commodities that are transported by multiple modes were summarized in Table 9-9 and Table 9-10. The two modes between which the commodity is shipped are highlighted to indicate the potential for diversion. For nearly 100 percent of inbound and outbound shipments, truck is the primary mode, and compared to 2016, more tonnage is projected to travel by truck in 2045 than 2016 indicating less potential for diversion from truck to rail. Both commodities listed carry small tonnages, so even with diversions to rail, little highway capacity would be relieved. In addition, crude petrol or natural gas could be transported by pipeline, although currently the data show that no commodities move by pipeline in the corridor.

Table 9-9. Inbound Freight Diversion Potential, 2045 — I-26

Commodity	Air	Rail	Truck
Electrical Equipment	0%	10%	90%
Crude Petrol or Natural Gas	0%	5%	95%

Source: Transearch (2045)

Table 9-10. Outbound Freight Diversion Potential, 2045 — I-26

Commodity	Air	Rail	Truck
Apparel or Related Products	0%	6%	94%
Chemicals or Allied Products	0%	9%	91%
Printed Matter	0%	27%	74%
Textile Mill Products	0%	8%	92%

Source: Transearch (2045)

9.5 Truck Parking

Truck parking facilities in the region are both public and private. However, as shown in Figure 9-4, there are limited locations on I-26 for truck drivers to stop and rest or sleep overnight. There are three public truck stops in the region including the Sam's Gap virtual weigh station near the Tennessee/North Carolina border, one Welcome Center near Kingsport and another Welcome Center near Clear Branch. However, there are no restrooms at the weigh station, and overnight parking is prohibited at Welcome Centers. Nonetheless, TDOT should ensure that the locations are well-signed so that they are easier for truckers to access, if needed. With Hours of Service regulations that mandate rest periods and the number of hours of consecutive work that are allowed without sleeping[23], it is important that drivers are offered a selection of locations throughout their journey where they can rest and possibly eat, shower, and sleep overnight. Without proper rest, drivers risk fines and crashes, especially in mountainous corridors like I-26.

9.6 Other Emerging Freight Issues

As the U.S. economy continues to shift towards a services focus, more finished goods will need to be shipped in from other parts of the world that have greater manufacturing strengths[24]. The demand for just-in-time purchases through e-commerce will only increase, placing further pressure on I-26 and other study area highways as goods are delivered to ports on the Gulf, East, and West Coasts and trucked, barged, or railed inland to Tennessee and elsewhere. These shipments will continue to result in congestion. Contributing to the increases in shipments is the expansions of the Panama Canal and extension of the Suez Canal, both allowing for ever larger ships and greater volumes of commodities to travel the globe.

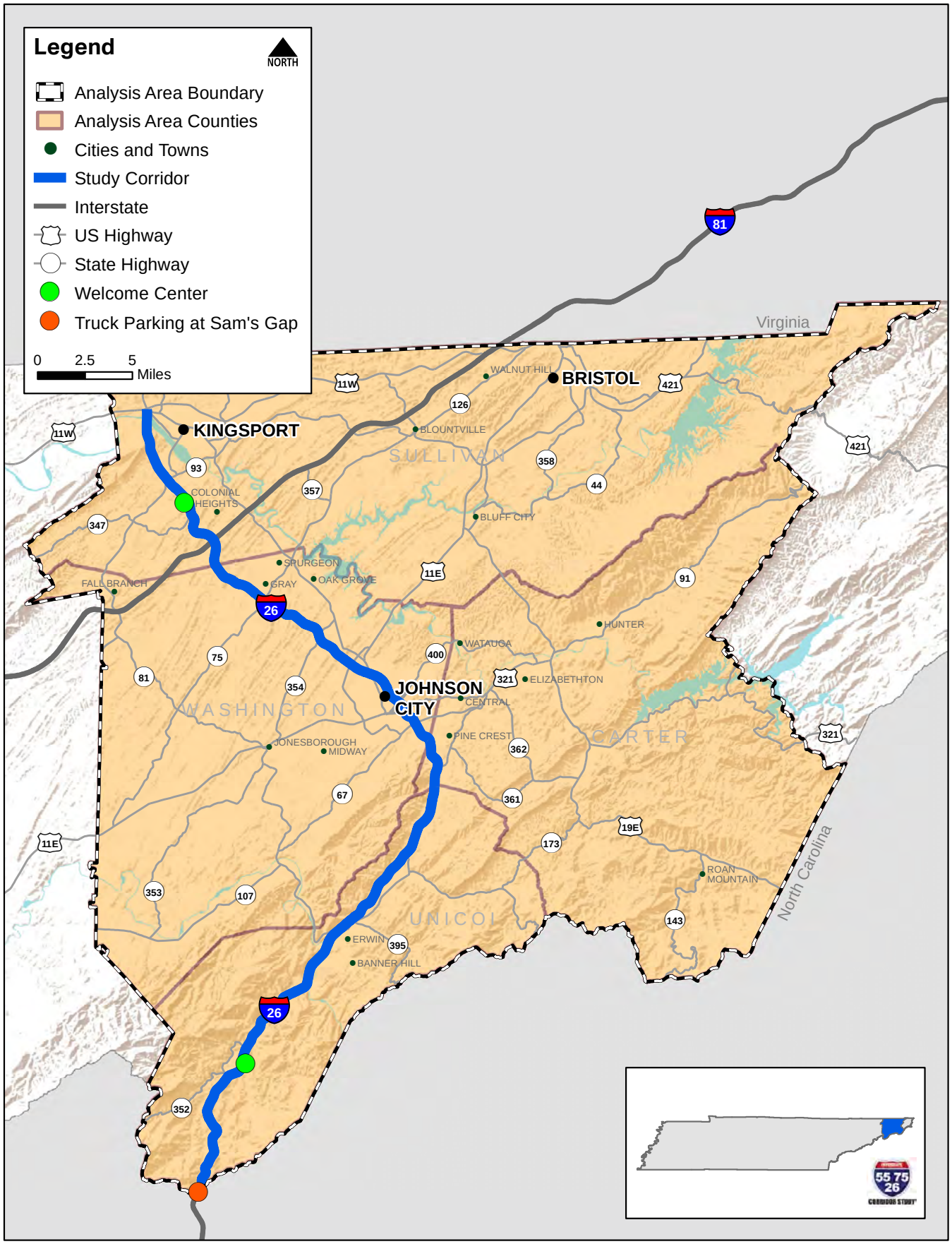
E-Commerce

E-commerce is the economy of transactions online, including the buying and selling of products. The e-commerce platform has exploded in recent decades with the introduction of companies like eBay and Amazon that sell and transport goods to purchasers with predictable delivery windows. Over time, e-commerce has increased further with the advent of social media, as customers enjoy the convenience of shopping from home no matter the time of day, the ability to price compare and read reviews, and ultimately have the product shipped directly to their doorstep. Brick and mortar retailers including giants

23- Federal Motor Carrier Safety Administration, Summary of Hours of Service Regulations, March 9, 2017, https://www.fmcsa.dot.gov/regulations/hours-service/summary-hours-service-regulations

24- The Atlantic, "The American Economy is Experiencing a Paradigm Shift," https://www.theatlantic.com/sponsored/citi-2018/the-american-economy-is-experiencing-a-paradigm-shift/2008/

Figure 9-4. Truck Rest Areas in the Study Area (Public and Private) — I-26



Source: InfoUSA

like Walmart and Target have felt the pressure to also include online stores to keep up with consumer demands, and while online sales worldwide are increasing as a share of the overall retail economy, the year to year growth of ecommerce sales has slowed from 25 percent in 2015 to a projected 19 percent by 2020, as shown in Figure 9-5.

Figure 9-5. Retail E-Commerce Sales Worldwide, 2015-2020

Source: Ecommerce Guide, "What is Ecommerce?" https://ecommerceguide.com/guides/what-is-ecommerce/

While e-commerce growth may be slowing down, it is unlikely the market is going anywhere anytime soon. As a result, the nation's infrastructure network has had to accommodate the increase in truck traffic that is used to ship the products in the common two day delivery window offered by Amazon and others. A recent study by the American Transportation Research Institute (ATRI) notes that ecommerce is changing the way retailers do business and affecting distribution networks and the trucking industry on the whole[25]. Trucking distances are decreasing on average from 800 miles in 2000 to 500 miles in 2018 as companies build more distribution centers. These regional distribution centers are being constructed especially in the Midwest to take advantage of multiple transportation modes and the accessibility to large population concentrations. For example, Amazon's Tennessee distribution and fulfillment facilities are in Memphis, Nashville, and north of Cleveland, TN, and Walmart distribution centers are in Memphis, south of Nashville, and northeast of Knoxville. Last-mile fulfillment centers are becoming increasingly important and represented 73 percent of the industrial real estate market in 2017, a growth of 15 percent from 2016.

All of these changes to the dynamic of the retail market have resulted in demands on the trucking industry and therefore the highway network. Driver shortages, hours of service regulations, driver retention, and scarcity of truck parking are all issues that have developed along with the growth in ecommerce. The trucking industry will continue to evolve and respond to consumer demands while the nation's aging infrastructure is expected to accommodate the growth in truck traffic that comes with it[26].

Impact of Panama Canal Expansion

The new Panama Canal was inaugurated with the first vessel transiting the canal on June 26, 2016[27] and the first vessel to call on an east coast port arriving at the Port of New York and New Jersey on July 8, 2016[28]. The Panama Canal can now allow more and larger (deeper draft, wider, and of greater capacity) ships to pass through this key trade link between Asia and the U.S. east coast. The expansion comprised the addition of a second, larger set of locks allowing for transit "Neo Panamax" ships that have nearly three times the carrying capacity of current Panamax ships. Perhaps more importantly, the new parallel locks significantly increase the capacity of the canal. With high vessel demand, transit through Panama Canal had required an average four days of canal water time (including actual canal transit and wait time) and caused vessels to queue for up to ten days during peak shipping seasons. Vessels carrying passengers or high-value goods often paid extra to jump the queue.

For a reference point, consider that maritime-based trips between Shanghai and the U.S. east coast can range in length from approximately 25 to 36 days. Sailing east from Shanghai, vessels can either dock on the U.S. west coast and use a land bridge to reach the east coast, or follow the all-water route through the Panama Canal. The travel times via the former are faster, but likely more expensive than the latter and the tradeoff may or may not be warranted based on the commodity.

As larger ships continue to be built in the post-Panama Canal expansion era, greater volumes of shipments will inevitably head inland by barge, rail, and truck. The I-26 corridor's southern terminus is at Charleston, SC, an important east coast port facility. As ships increase in size, more truck traffic from Charleston can be expected to travel north via I-26 into the study area.

25- https://www.ccjdigital.com/atri-e-commerce-reshaping-trucking-industry-operations/
26- Lockridge, Deborah, Truckinginfo.com, "How is the Growth of E-Commerce Affecting Trucking?" February 5, 2019, https://www.truckinginfo.com/324451/how-is-the-growth-of-e-commerce-affecting-trucking
27- International Dredging Review, "ACP Marks Opening of Expanded Panama Canal," August 2, 2016, http://www.dredgemag.com/July-August-2016/ACP-Marks-Opening-of-Expanded-Panama-Canal/ Accessed 5/21/2019.
28- International Dredging Review, "East Coast Ports Welcome Post-Panamax Vessels as Expand-ed Canal Opens," August 1, 2016, http://www.dredgemag.com/July-August-2016/EAST-COAST-PORTS-WELCOME-POST-PANAMAX-VESSELS-AS-EXPAND-ED-CANAL-OPENS/ Accessed 5/21/19.

Having the capacity to accommodate the increased volumes of shipments to and from the various distribution centers across the country will allow the study area to remain competitive in an increasingly time-sensitive economy.

Suez Canal Extension

The current focus on the Panama Canal results from the dominance of Asia in the U.S. container trade. With a potential trade shift to India and other parts of Asia, the Suez Canal may become a more significant consideration in the size of vessels that serve the U.S. east coast. The Suez Canal has no locks, and therefore no vessel length restrictions. Ships with a maximum draft of 68.9 feet and beam of nearly 200 feet can navigate the Suez Canal (neo Panamax or super post-Panamax vessels). And, to increase its competitiveness and offer improved two-way travel, the Suez Canal completed an extension in August 2015; a parallel waterway 45 miles in length was created and dredged to depth of 79 feet to accommodate vessels with a 66-foot draft[29].

Ports of Charleston and Savannah

The Port of Charleston is located at the southern terminus of I-26 and is an important gateway for freight to the east coast of the United States. Truck and rail traffic originating at the port use the corridor for destinations inland including the nearby metropolitan areas of Atlanta, Columbia, and Charlotte, as well as destinations in Tennessee. In 2018, the Port of Charleston began a $529 million project to deepen the shipping channel from 45 feet to 52 feet, allowing some of the world's largest container ships to call on the port even at low tide.

Not far from the Port of Charleston is the Port of Savannah, which is in the process an expansion similar to that which is underway at Charleston. The Savannah Harbor Expansion Project (SHEP) will deepen the channel from 42 feet to 47 feet, allowing for larger vessels to call on the port at a cost of $973 million. Begun in 2015, many elements of the project are complete or nearly complete, but the inner harbor dredging is still in the design phase. Because of Savannah's proximity to I-26 and I-75, increased maritime volumes would result in highway and rail traffic increases into Tennessee and other locations west.

As a result of these major infrastructure projects, freight volumes coming from the ports will continue to grow, emphasizing the need for inland port and intermodal facilities to collect and redistribute the goods regionally. Tennessee is considering the potential for inland ports to transfer freight from highway to rail, reducing congestion on the region's already well-utilized interstates.

9.7 Existing and Future Deficiencies and Needs

Truck is the primary mode of transporting freight in the I-26 corridor, accounting for nearly 100 percent of inbound and outbound freight in the study area in 2016. Truck volumes are expected to grow by at least 61 percent from 2010 to 2040, with the portion north of Johnson City to south of the Virginia state border growing at a faster rate of 91 percent as shown in Figure 9-1. Parallel corridors are also showing high growth, indicating that traffic is and will continue diverting to other routes as a result of the lower level-of-service on I-26 between Johnson City and Kingsport (shown in Figure 9-3). The corridor sees high volumes of through traffic with between one and five- million tons annually, with heavier volumes near Johnson City. The corridor has limited public and private truck parking with just two welcome centers and one private parking location. In addition, as noted in Section 9.4, there are limited opportunities for commodities to divert away from truck to rail in the inbound and outbound directions, but there appear to be no capacity issues on the southern part of the corridor despite steep grades that would result in trucking delays. Nonetheless, diverting to rail and air in the corridor would be important because it alleviates capacity and congestion, reducing idling, delays, and the potential for crashes for all Interstate users.

As noted in the Tennessee Statewide Multimodal Freight Plan (2018)[30], changes to the I-26 corridor study area are recommended in the form of elimination of bottleneck locations, interchange improvements, and implementation of intelligent transportation systems (ITS).

A. Bottleneck Locations: The Tennessee Freight Plan lists three potential bottleneck locations on the I-26 corridor. All involve steep grades through mountainous terrain:
   - Between US-11W and Meadowview Parkway in Sullivan County
   - Between Flag Pond Road and the North Carolina State Line in Unicoi County
   - At Clear Branch Access between SR-354 (Boones Creek Road) and SR-381 (State of Franklin Road)

B. Interchange Upgrades: Two interchange upgrades

29- Associated Press, CNBC, "Egypt Unveils Suez Canal extension with pomp-filled ceremony," August ,7, 2015, http://www.cnbc.com/2015/08/07/egypt-unveils-suez-canal-extension-with-pomp-filled-ceremony.html Accessed 5/21/19

30- Tennessee Department of Transportation, Tennessee Statewide Multimodal Freight Plan, 2018, https://www.tn.gov/content/dam/tn/tdot/long-range-planning/TDOT_FreightPlan_02.27.18.pdf

are listed in the Tennessee Freight Plan. Both are partially funded:

- An interchange modification is needed in Washington County at I-26 and SR-354. The project location is on a Critical Freight Corridor (CFC) of the National Highway Freight Network (NHFN). The CFCs are delineated into rural and urban corridors that provide important connections to Interstates, ports, public transportation facilities, and intermodal freight facilities. The project has begun and has an estimated completion date of fall 2020.
- Completed in 2018, the interchange upgrade at I-26 and SR-67 in Washington County added an auxiliary lane and widened eastbound I-26. The interchange is also on the CFC.

C. Statewide Projects: Proposed projects as found in the Tennessee Freight Plan are listed below and include interchange improvements and implementation of ITS.

- E-32 is the I-81/I-26 interchange project estimated to cost $19.7 million. The project would reconstruct the interchange to improve safety. TDOT is also assessing short-term solutions, but reconstruction may be necessary. It scored as a low priority state project.
- E-33 would reconstruct intersections and interchanges between I-26 and Stone Drive West on John B. Dennis Highway (SR-93). The project would improve traffic flow, upgrade signals, and improve geometry thereby increasing economic efficiency, productivity and competitiveness, reducing congestion, and improving safety, security, and resilience. The project is estimated to cost $1.7 million[31] and scored as a low priority state project.
- E-74 would expand ITS options along I-81 between I-26 and the Virginia State Line. The project would improve economic efficiency, productivity, and competitiveness, reduce congestion, improve safety, security, and resiliency, improve state of good repair, use advanced technology, and reduce adverse and burdensome impacts. It is estimated to cost $1.8 million and is scored as a medium priority state project.

31- Tennessee Department of Transportation, Tennessee Statewide Multimodal Freight Plan, 2018, https://www.tn.gov/content/dam/tn/tdot/long-range-planning/TDOT_FreightPlan_02.27.18.pdf

Public Outreach

▶Assessment of Existing and Future Deficiencies

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Figures

Public and Stakeholder Outreach

1. Public and Stakeholder Outreach

The technical analyses of this study phase were complemented by a robust stakeholder and public involvement effort across all four corridors. The data generated by outreach activities – which included public meetings and a survey – was used to focus technical analysis on items that stakeholders perceive as critical, and to prioritize transportation issues to be addressed in each corridor. This section describes public involvement activities in this study phase, summarizes their results and their evaluation, and details how public input shaped the deficiencies assessment for each corridor. This phase of stakeholder involvement also included focused outreach to key stakeholders. The following sections summarize the results for each study corridor and describe how public perceptions were used to guide technical investigations into corridor deficiencies.

1.1 Public Involvement Meetings

In the spring of 2019, Public Involvement Meetings (PIMs) were held in each corridor. The purpose was to:

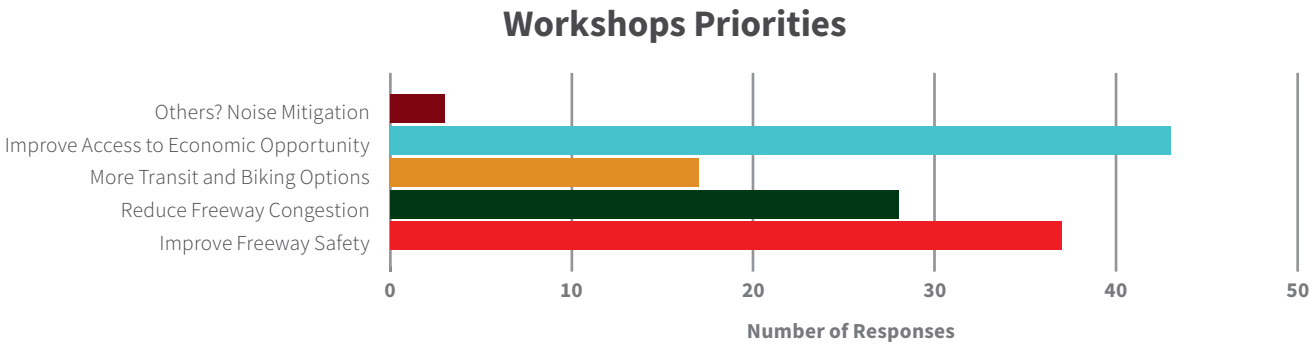
- Aquaint stakeholders with the study and its objectives
- Provide a high-level overview of corridor conditions in terms of traffic, safety, and multimodal travel opportunities
- Gather input on public perceptions of congestion, key areas for improvement, and priorities for the future of the corridor

PIMs were held April 25 in Knoxville, May 9 in Johnson City, May 16 in Memphis, and June 13 in Dyersburg. The meetings featured a presentation, exhibits, and interactive exercises. In all, nearly 100 people signed in at the PIMs, and provided more than 50 specific comments about conditions in their corridors. The comments were mapped (if applicable) to note specific areas of concern, or were noted and included in the data for corridor analysis.

Among notable findings, attendees were asked to rank their priorities for their corridor. Aggregated across all four meetings, the top three issues stakeholders would like to see the study's recommendations address include improving access to economic opportunity, improving safety, and reducing congestion. These results are shown in Figure 1-1. The results will be used to focus technical analysis on deficiencies related to these issues.

It should be noted that small sample size may not reflect the importance of regional variation. The I-26 PIM saw considerably larger attendance than those in the other corridors, so these aggregated results distinctly reflect the priorities of the I-26 study area. Similarly, the I-155 corridor strongly showed a preference for improving economic access. Results for individual corridors are reported in the following sections.

Figure 1-1. Public Meeting Results – Corridor Priorities



Source: TDOT Online Survey

1.2 Online Survey

The Tennessee Department of Transportation (TDOT) fielded an online public survey to gauge public perception of problem areas along the corridors along with public priorities for improvements. By the end of October 2019, nearly 1,000 unique responses had been recorded. The survey questions focused on respondents' use of the corridors, their interest in traveling with alternative modes, key issues to be addressed by the study, specific problem locations along the corridor, and preferences for communications with the study team.

Responses focused on the I-26 corridor during the first months of the survey; through June 30, 2019, nearly 60% of comments related to that corridor. Thirty percent of responses addressed conditions on the I-75 corridor, and 33 responses provided data about the I-55 and I-155 corridors. Therefore, the aggregate results described here should be understood to primarily reflect the perceptions of travelers on I-26 and I-75.

60% of survey comments related to the I-26 corridor.

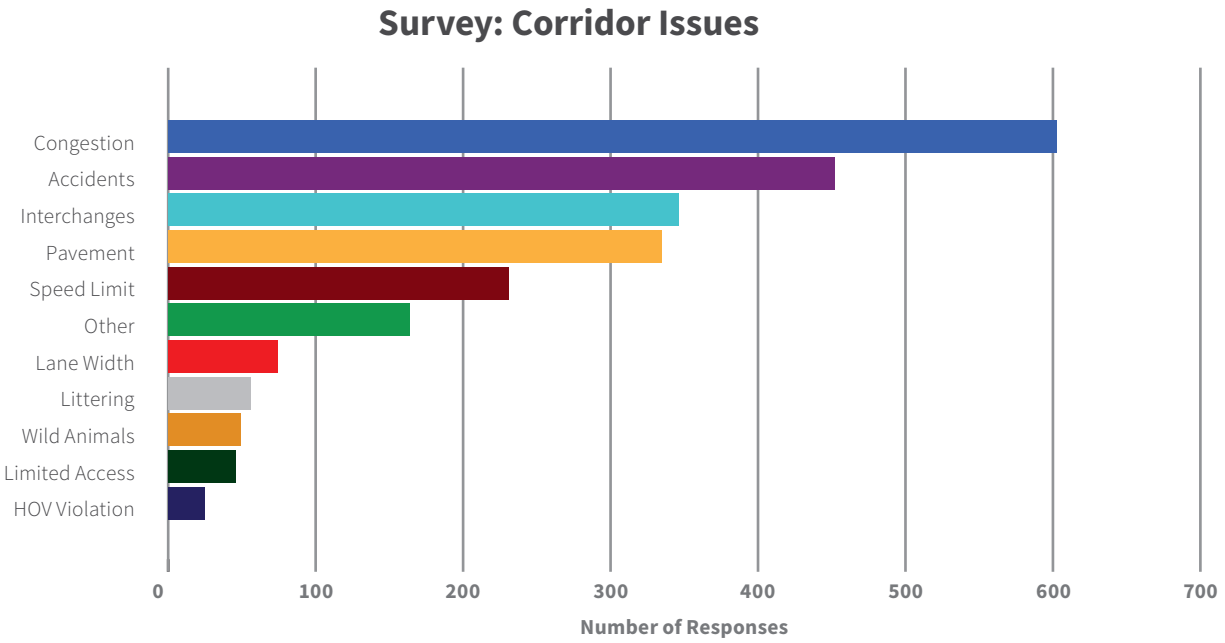
The priority issues identified by survey respondents are shown in Figure 1-2. Reducing congestion, improving safety, and restructuring interchanges emerged as the key issues. Unsurprisingly, this mirrors responses gathered through public meetings.

When asked to identify key improvements on the corridors, respondents identified adding travel lanes as the key effort to be undertaken in the immediate future (see Figure 1-3). Nearly twice as many respondents identified capacity expansion as a priority over all other improvements. It is noteworthy that providing alternative modes of travel is of the least concern to survey respondents. Note that these findings apply primarily to the I-26 corridor. Future survey results may show differing priorities for other corridors. Finally, the study team analyzed the "other" comments in the survey responses. Most of these were reiterations of items previously identified, such as the need for additional capacity and to redesign interchanges to improve traffic flow and safety. Additional items of note include mentions of a need for noise barriers and improved lighting.

Issues of importance to survey respondents varied from one corridor to another. Figure 1-4 shows the relative urgency of corridor problems for each Interstate. For example, congestion is considered the key issue on I-26 and I-75, but concern about congestion is very low among I-155 stakeholders. People in that corridor's study area are far more concerned about pavement maintenance and littering. In the Memphis area (I-55), stakeholder concerns are split more evenly among congestion, pavement maintenance, crashes and interchange design.

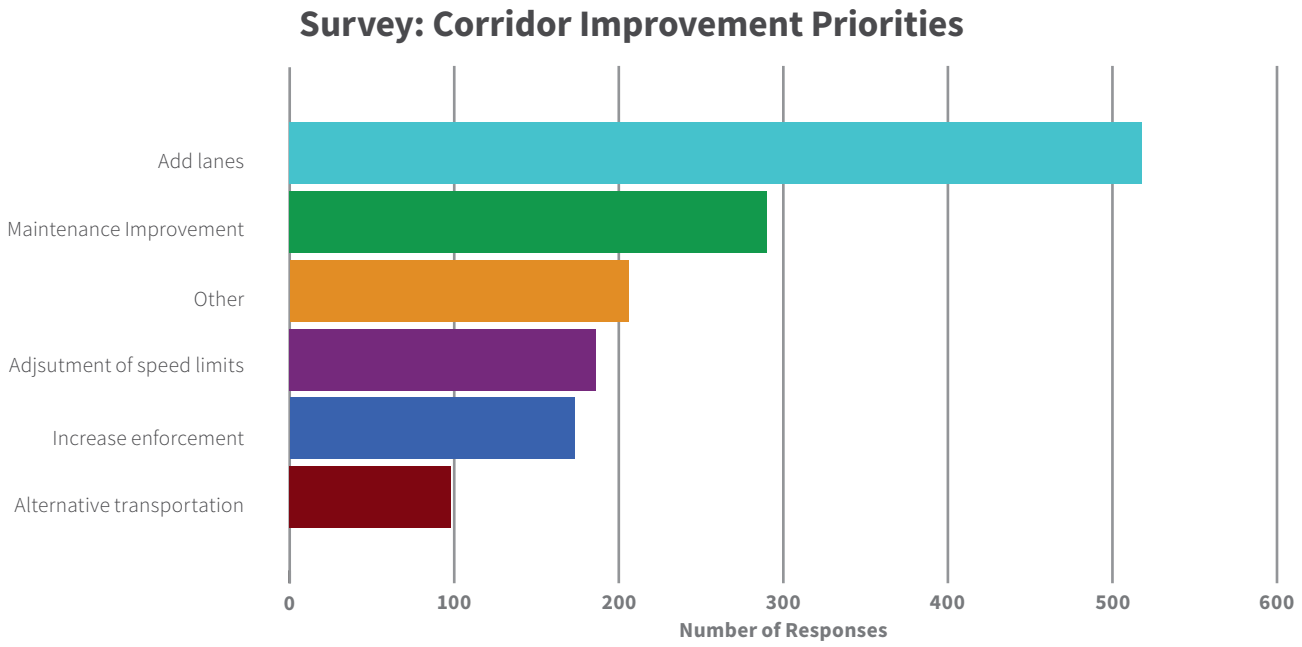
Finally, the survey asked people their preferred method to learn about and contribute to the study. The most common response – selected by three quarters of survey takers – is via social media.

Figure 1-2. Survey Issues – All Corridors



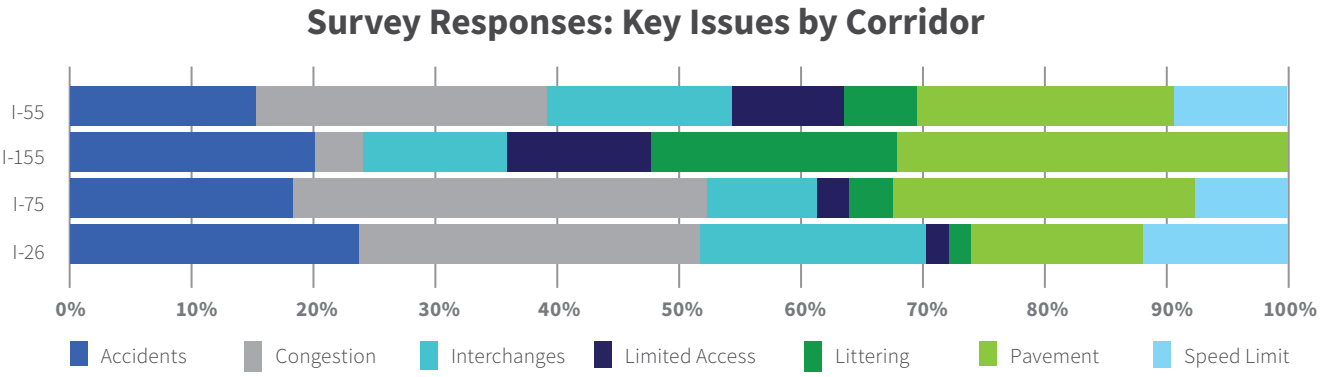
Source: TDOT Online Survey

Figure 1-3. Survey Priorities – All Corridors



Source: TDOT Online Survey

Figure 1-4. Public Input Safety Concerns – All Corridors



Source: TDOT Online Survey

1.3 Corridor Issues and Priority Locations

Through the survey and public meetings, issues and priority locations for improvements were identified for the individual study corridors. The results correspond closely to the more general perceptions expressed at the meetings, focusing on specific areas for improving capacity, safety, and interchange design, primarily. As with the other involvement tools, location-specific input was heavily weighted toward issues in the I-26 and I-75 corridors; however, problem locations were identified in all four study corridors.

I-55 Corridor

Outreach efforts in the I-55 corridor to date have yielded relatively few responses, so the data should not necessarily be taken as representative at this time. Approximately 10 people attended the May 16, 2019 public meeting, leaving 7 specific comments. The online survey generated 19 comments to date related to I-55. Key issues identified for the corridor include:

- Reducing congestion
- Improving pavement condition
- Improving safety

Three locations were singled out as being especially problematic:

- Interchange at I-55 and Crump Boulevard. The unconventional design of the interchange is perceived as leading to severe safety issues and congestion as vehicles attempt to enter, exit, and maneuver to change lanes over very short distances. This chronic congestion affects Interstate travel as the I-55 bridge over the Mississippi River is frequently backed up.
- Interchange at I-55 and I-240. Heavy volumes of traffic attempting to exit to I-55 at this location are perceived to cause congestion, with the two right lanes coming to a standstill during peak hours.
- I-55 at Holmes Road. Two stakeholders called for the addition of an interchange at this location immediately north of the Mississippi state line.

See Figure 1-5 for priority locations in the I-55 corridor.

Attendees discussing the I-55 corridor at the May 16, 2019 public meeting held at the Whitehaven Community Center in Memphis .

I-155 Corridor

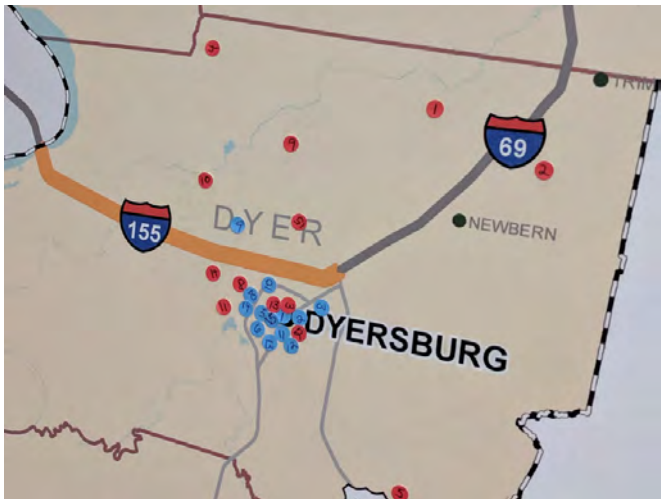
Approximately 30 people attended the June 13, 2019 I-155 public meeting in Dyersburg, leaving 9 written comments. Additionally, 14 survey responses refer to the corridor. Key issues identified for I-155 differ slightly from the other corridors, with an emphasis on promoting regional economic access:

- Improve pavement condition
- Improve safety
- Reduce littering

Two locations were singled out for improvements:

- Safety issues related to design and operations are perceived on the segment of I-155 west of Dyersburg. Several potential factors were identified by stakeholders, including the presence of snow and ice in the hilly areas with no adequate warning system, an interchange with US-412 with sharp curves that leads to truck rollovers, and the presence of cable barriers with inadequate shoulders.
- Stakeholders perceive congestion at the Lake Road interchange exacerbated by the frequent presence of farm equipment forced to use the travel lanes due to inadequate shoulder width.

See Figure 1-6 for priority locations in the I-155 corridor.



A map from the June 13, 2019 public meeting held at the Dyersburg State Community College in Dyersburg.

I-75 Corridor

A public meeting for the 162-mile I-75 corridor was held in Knoxville on April 25, 2019, with approximately 20 people in attendance. Ten written comments were collected. The survey has yielded 305 individual responses to date. People identified these as the most important issues to be addressed in the corridor:

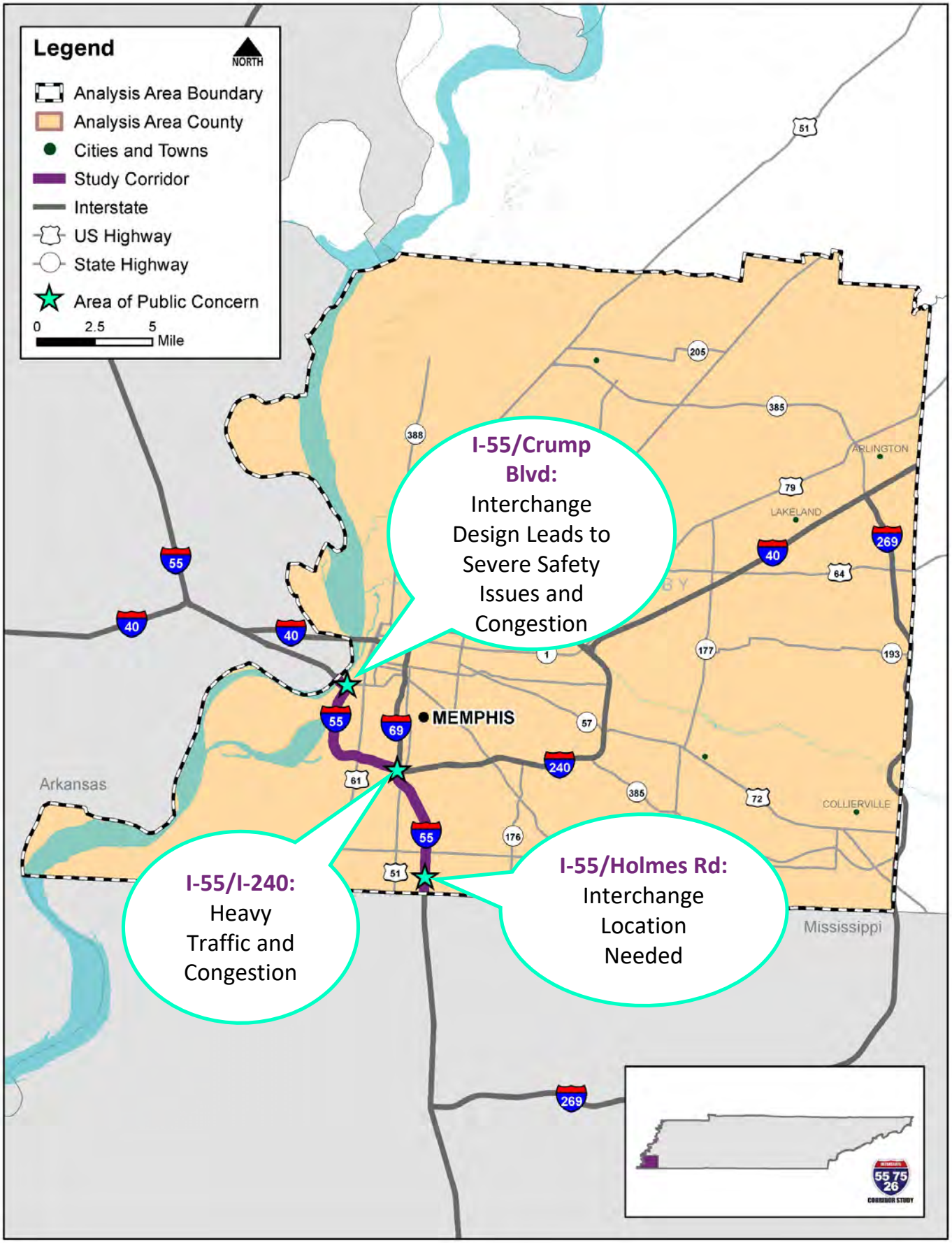
- Reducing congestion
- Improving pavement conditions
- Reducing crashes

Key locations for improvements include:

- The I-75/275/640 interchange on the north side of Knoxville which is perceived as experiencing congestion and safety problems.
- The I-75/Campbell Station Road interchange, which experiences flooding and heavy truck traffic.
- The combined freeway segment of I-40 and I-75 experiences frequent congestion.
- The I-24/I-75 interchange is the site of regular congestion.

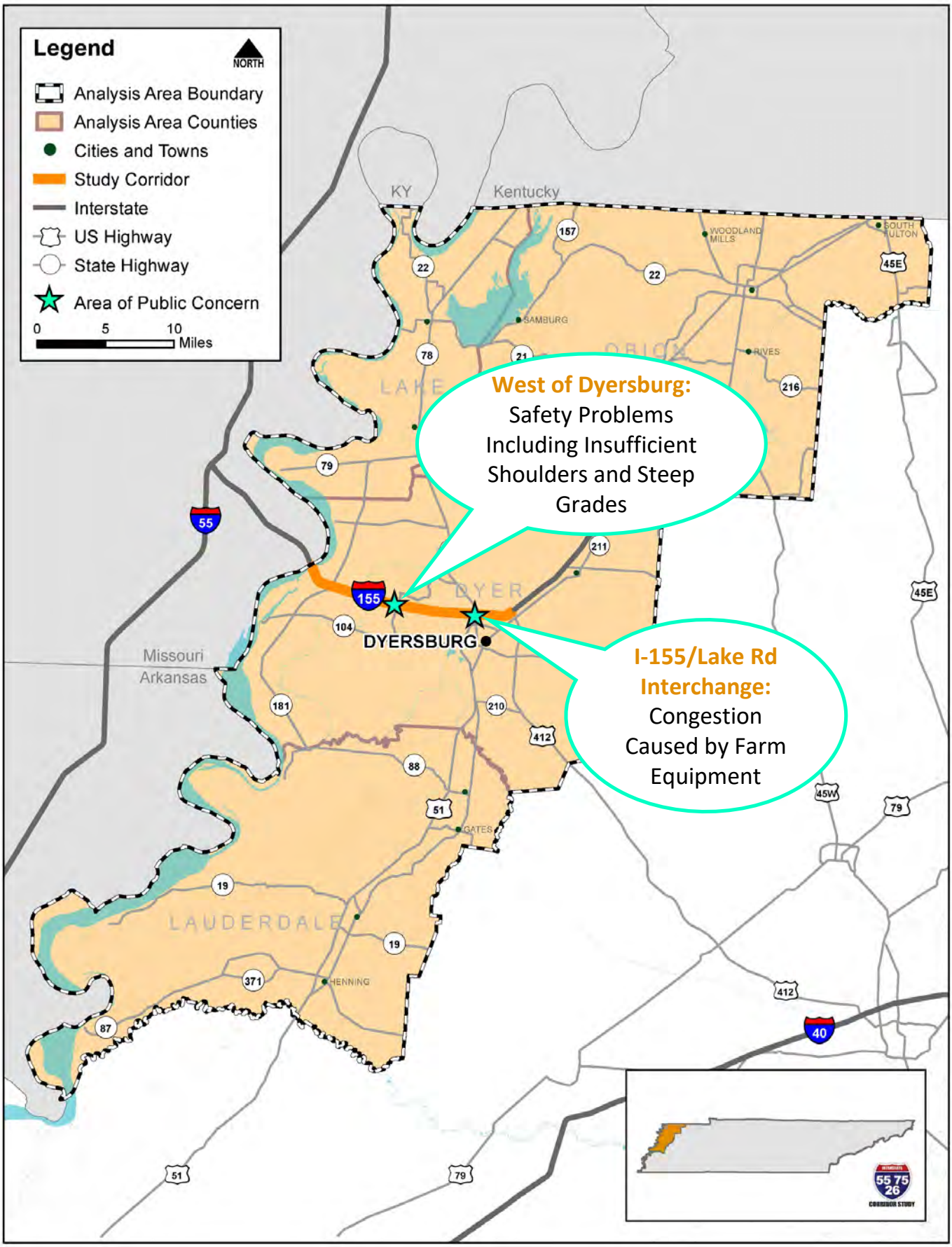
See Figure 1-7 for priority locations in the I-75 corridor.

Figure 1-5. I-55 Corridor Stakeholder Priority Locations



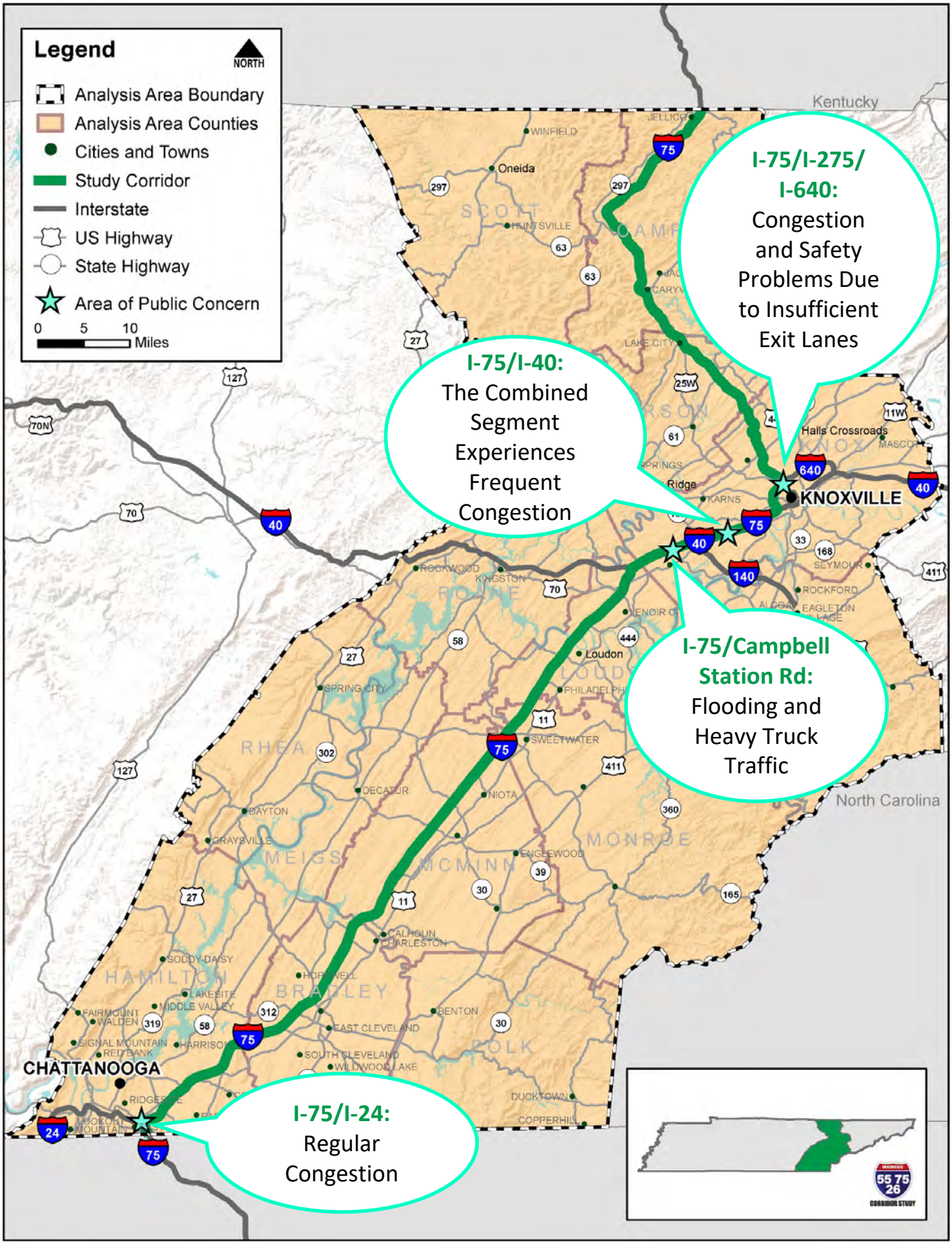
Source: TDOT Online Public Survey and I-55 Public Involvement Meeting (PIM)

Figure 1-6. I-155 Corridor Stakeholder Priority Locations



Source: TDOT Online Public Survey and I-155 Public Involvement Meeting (PIM)

Figure 1-7. I-75 Corridor Stakeholder Priority Locations



Source: TDOT Online Public Survey and I-75 Public Involvement Meeting (PIM)

The public meeting for the I-75 corridor was held on April 25, 2019 in Knoxville at the East Tennessee Historical Society Auditorium.

I-26 Corridor

The I-26 corridor received the highest number of comments and survey responses with 557. Nearly 60% of all comments received to date pertain to issues on I-26. The approximately 40 people attending the May 9, 2019 public meeting in Johnson City account for half of the total attendance at all 4 meetings. Participation in the project outreach activities was heavily promoted by local organizations and agencies, who publicized engagement opportunities to their members and interest lists.

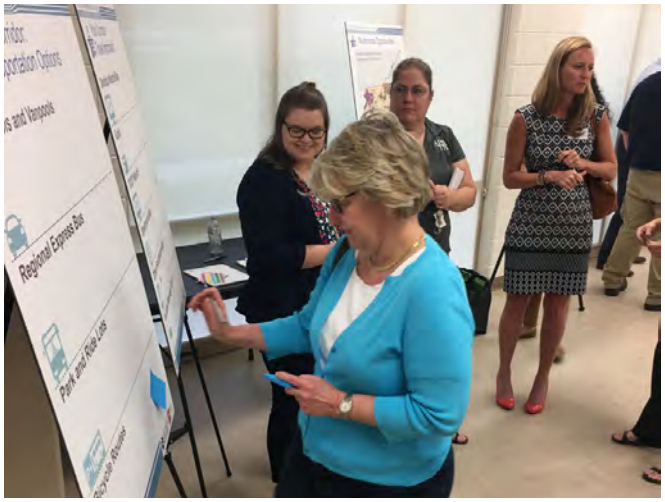
The primary issues stakeholders identified for the project to address include:

- Reducing congestion
- Improving safety
- Improving interchanges
- Improving pavement conditions
- Improving maintenance of signage, cable barriers and guardrails

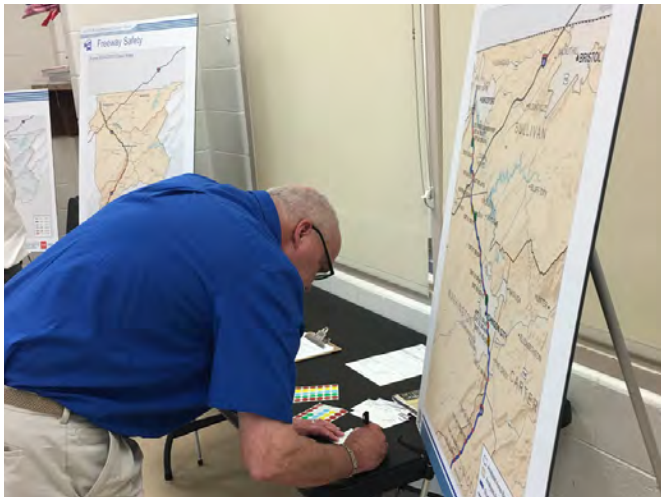
Many areas along the freeway corridor were identified as exhibiting transportation problems. These areas are primarily distributed between Johnson City and Kingsport. The most frequently mentioned locations include:

- The I-26/I-81 interchange. Congestion at this interchange is perceived to create delays and safety issues due to excessive weaving movements and lack of capacity. This interchange received more comments than any other location.
- The I-26/SR-354 (Boones Creek Road) interchange is perceived to have similar problems with lack of capacity.
- The I-26/Bobby Hicks Highway/Suncrest Drive interchange, which serves a commercial and industrial area, is also reported to experience congestion. Field observations confirmed that eastbound exit ramp queues back up onto the Interstate.
- The I-26/SR-382 interchange. This Single Point Urban Interchange is perceived to experience congestion problems.

See Figure 1-8 for priority locations in the I-26 corridor.



Attendees participate in the May 9, 2019 public meeting held at Memorial Park Community Center in Johnson City.

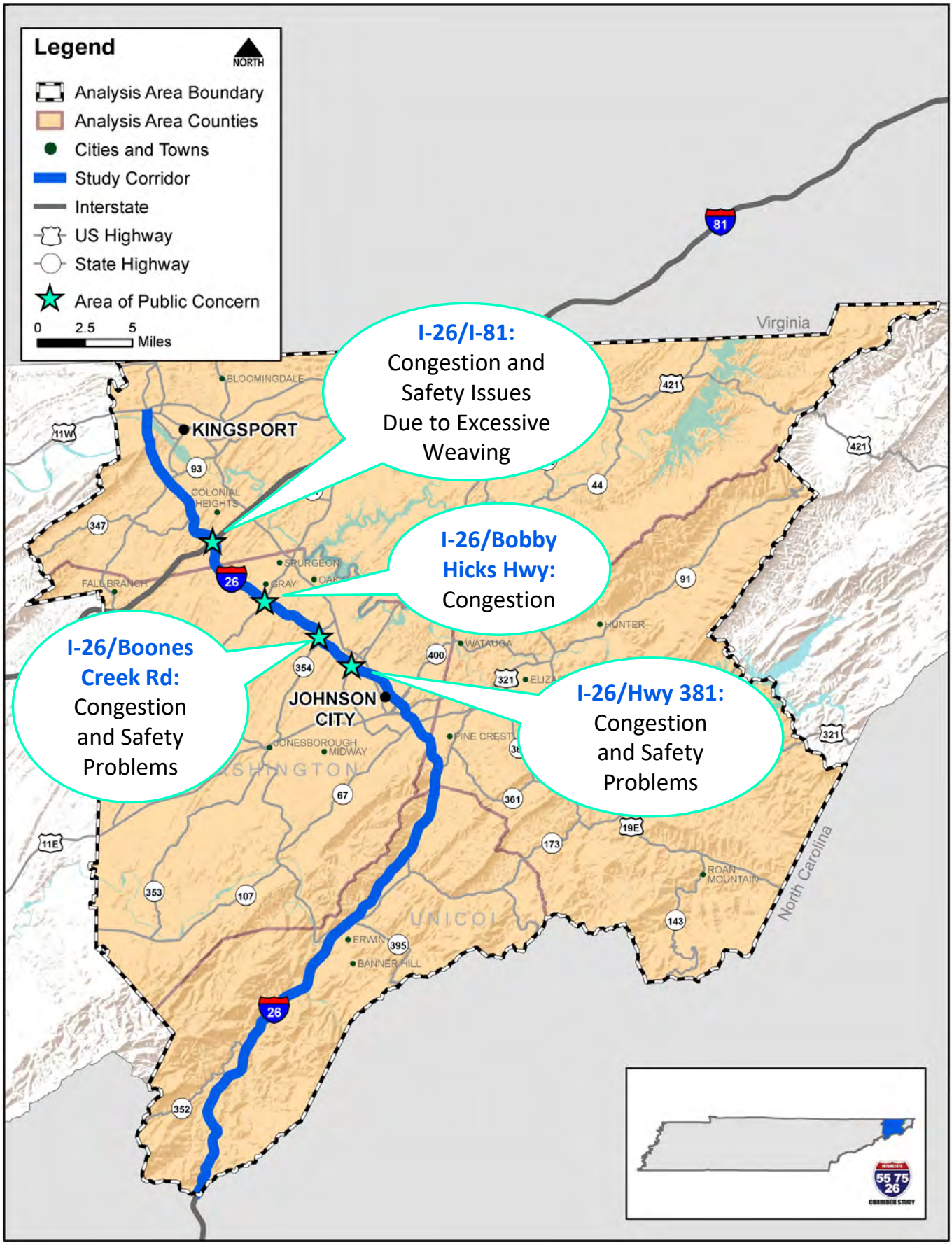


An attendee participates in an interactive activity at the I-26 public meeting.

1.4 Key Stakeholder Interviews

In October 2019, interviews were conducted with key stakeholders in the I-55 and I-75 corridors. Intended to develop insights into specific issues facing those corridors, the interviews focused on freight movement, activity around Memphis International Airport (I-55) and the University of Tennessee, Knoxville campus (I-75), and the economic development climate in and around Knox County (I-75). Key issues identified for these corridors include:

Figure 1-8. I-26 Corridor Stakeholder Priority Locations



Source: TDOT Online Public Survey and I-26 Public Involvement Meeting (PIM)

I-55 Corridor

- Eliminate HOV lanes. Consider options to move truck traffic to the left lane to reduce congestion and conflicts in merge/diverge areas.
- More truck parking areas are necessary.
- The I-55/Crump Boulevard interchange is a significant bottleneck location.
- The I-55/I-240 interchange is critical to the movement of freight in the Memphis area, as it is an access point for FedEx facilities.
- Improved early signage is needed on the I-55 corridor to help motorists make decisions earlier.
- Transit access to the airport could be improved to help bring employees to the area.

I-75 Corridor

- Truck climbing lanes can help maintain safe travel speeds in areas with steep grades.
- The combined Interstate segment with I-75 and I-40 is frequently congested during large university events such as football games and concerts. Park-and-Ride lots could alleviate some congestion.
- The Watt Road and I-140 interchange designs lead to congestion issues.
- The Hardin Valley area – accessed by the Campbell Station Road interchange – is developing rapidly. Congestion will worsen until improvements are made to the transportation system in this area.

1.5 Traditionally Underserved Populations

The robust stakeholder and public involvement effort across all four corridors is complemented and enhanced by a special effort to provide information to and gather input from traditionally underrepresented and underserved populations. Minority and low-income populations, persons with disabilities, young people, and the elderly all exhibit particular transportation needs and priorities, and may benefit disproportionately from balanced transportation investments. Simultaneously, all of these people have been traditionally underrepresented in transportation outreach and decision-making.

In terms of transportation deficiencies and their impact on traditionally underserved populations, analyses were completed to evaluate the spatial distribution of safety and congestion issues across the corridors in relation to the presence of minority and low-income persons (those protected by Executive Order 12898, called “Environmental Justice”). The locations of bicycle and pedestrian crashes were overlaid on census tracts with high concentrations of such populations to determine if these crashes are predominantly occuring in areas where their impacts might be considered disproportionately adverse. Where data were available, the locations of “spillover” routes - those arterials expected to see significant increases in traffic volumes due to freeway congestion - were also plotted in relation to areas with concentrated environmental justice populations.

In every corridor, the location of freeway-related pedestrian and bicycle crashes tend to occur in areas with higher proportions of minority and low-income populations. Similarly, rising automobile and truck traffic on the the spillover routes identified in the I-55 and I-75 corridors have the potential to disproportionately adversely impact persons of color and persons in poverty. These data will be used in future analyses to identify transportation solutions that avoid, minimize, or mitigate such disproportionate impacts.

Finally, census tracts with high proportions of households without access to a motor vehicle were mapped in relation to areas of transit service. These figures are included in the transit sections of each corridor report. Lack of access to a motor vehicle is an indicator of households in poverty (as well as elderly households). Such households are dependent on transit, walking, and bicycling. The I-55 corridor sees particularly high levels of households without cars. Transportation solutions in such areas will include a considerable focus on non-freeway transportation solutions.

In this and future phases of this study, targeted efforts have been made to inform and hear from these traditionally underserved populations. The data generated by outreach activities – which focus on leveraging the reach of professional, governmental, and social organizations to gather study information and to participate in key informant interviews or focus groups – will be used to focus technical analysis on items that stakeholders perceive as critical, and to prioritize transportation issues to be addressed in each corridor.

Federal, state, and local laws, policies, and ordinances specify the relationship between these underrepresented groups and the transportation system planning process. Chief among these are Title VI of the 1964 Civil Rights Act, Executive Order 12898, and the Americans with Disabilities Act. These laws and policies serve as the basis for the project’s outreach efforts to these persons. Future involvement activities and their impact in determining priority projects for each corridor will be summarized in future technical memoranda.

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