TDOT

I-40 / I-81 Corridor Feasibility Study

Task 2.0

Assessment of Deficiencies

Technical Memorandum

August 2007

EXECUTIVE SUMMARY

In 2005 the Tennessee Department of Transportation (TDOT) completed the State's first 25-Year Long Range Transportation Plan (PLAN *Go*). A major component of the 25-Year Vision Plan included the advancement of a 10-Year Strategic Investment Plan. The 10-Year Strategic Investment Plan established three interrelated core investment initiatives: Congestion Relief, Transportation Choices, and Key Corridors.

The Interstate 40/Interstate 81 (I-40/I-81) Corridor from Bristol to Memphis was identified through the statewide planning effort as a strategic statewide corridor and several projects along the corridor are included in the 10-Year Plan as a high priority. The purpose of the I-40/I-81 Corridor Feasibility Study is begin to develop a more detailed understanding of the deficiencies of the corridor and to develop corridor level multi-modal solutions to address these deficiencies. The study will consider improvements to the I-40/I-81 corridor, will look at parallel arterials to I-40/I-81 that could be used for local travel and rail lines that could be candidates for freight diversion from the interstate, and will also consider major inter-modal hubs located along the corridor.

The study's final product will be a prioritized listing of multi-modal projects that can be considered by TDOT for the Department's transportation improvement program. Identified multi-modal solutions will address capacity, operations and maintenance, safety, freight movement, inter-modal connections, and economic access issues along the study corridor.

The study area for the I-40/I-81 corridor extends from Memphis to Bristol, a distance of about 550 miles, and traverses 27 of the 95 counties within Tennessee. The study area falls within nine of the twelve Rural Planning Organization (RPO) boundaries and eight of the eleven Metropolitan Planning Organization (MPO) and Transportation Planning Organization (TPO) areas. Numerous cities including Memphis, Jackson, Nashville, Lebanon, Cookeville, Crossville, Knoxville, Sevierville, Jefferson City, Ridgeway, Kingsport, Johnson City and Bristol are dependent upon this corridor for commerce, tourism, and daily access. The study area also includes parallel Class I railroads, including their junctions with short-line railroads.

Task 2, Assessment of Deficiencies, identifies issues within the study corridor associated with:

- Capacity/Congestion – Chapter 2 summarizes deficiencies along I-40 and I-81 for 2011, 2016 and 2030 as shown by travel demand modeling and identifies existing bottlenecks based on field observations by stakeholders.

- Operations and Maintenance – Chapter 3 identifies locations along the corridor where poor geometrics hamper traffic flow and includes recommended improvements to Tennessee's Intelligent Transportation System (ITS) and Incident Management programs.

- Safety and Security – Chapter 4 lists I-40 and I-81 segments that have collision rates exceeding the State's critical accident rate and identifies hazardous locations based on field observations by stakeholders.

- Freight Movement/Diversion – Chapter 5 identifies corridor segments where steep grades slow truck movements and impact operations along I-40 and I-81. The chapter also describes a truck/rail diversion tool developed for this corridor feasibility study.

- Economic Access – Chapter 6 lists proposed interchange improvements in the study corridor to improve access to new developments based on plans prepared by TDOT, MPOs, TPOs and RPOs. Proposed new interchanges and interchange improvements suggested by MPO, TPO and RPO representatives also are listed.

- Commuter Travel Demand – Chapter 7 shows commuting patterns to Tennessee's urban areas from analyzing Census information from 2000. This chapter locates existing and planned park-and-ride facilities along I-40 and reviews the effectiveness of existing High Occupancy Vehicle (HOV) lanes on I-40 in Memphis and Nashville.

- Intermodal Facilities – Chapter 8 identifies and locates major intermodal hubs in and adjacent to Tennessee.

In order to identify which segments of I-40 and I-81 have the most serious deficiencies, the 550-mile corridor was divided into 48 independent sections, as shown in **Table ES-1**, using county, Metropolitan Planning Agency (MPA) and RPO boundaries. Each segment was evaluated using the following criteria:

- The number of critical accident locations per mile using TDOT's crash database;

- Existing bottlenecks, measured on a per-mile basis, based on field observations provided during the stakeholder interviews;

- Hazardous areas, also measured on a per-mile basis, based on field observations identified in stakeholder interviews;

- Roadway grades based on severity (percent of grade) and length of severe grade; and

- Portion of segment that operates at a future level-of-service (LOS) D, E or F based on travel demand model results. Segments reaching LOS D or worse by 2011 were considered more critical than those segments becoming congested further into the future (2016 or 2030).

Based on the prevalence of deficiencies, each segment was rated low, medium, high or severe in each of the aforementioned categories. **Table ES-1** summarizes these ratings and provides an overall rating for each segment.

Figure ES-1 through **Figure ES-8** shows the overall ranking for the corridor based on the results in **Table ES-1**. The purple sections (severe) and red segments (high) indicate the portions of I-40 and I-81 with most serious deficiencies or issues.

Table ES-1: I-40/ I-81 Corridor Ranking by Section

Sections (From West to East)	Accident Areas	Bottleneck Areas	Hazardous Areas	Steep Grades	Model V/C	All Factors
MPA-Memphis-Shelby, W of I-240	●	◉	○	●	⊙	◉
MPA-Memphis-Shelby, Between I-240	◉	○	○	◉	●	●
MPA-Memphis-Shelby, E of I-240	◉	○	○	⊙	●	●
MPA-Memphis-Fayette	○	○	●	●	◉	◉
RPO-Memphis Area-Fayette	◉	●	●	●	◉	●
RPO-Southwest-Haywood	●	●	○	○	⊙	⊙
MPA-Jackson-Madison, W of US-45	◉	○	◉	●	●	●
MPA-Jackson-Madison, E of US-45	○	●	●	●	●	●
RPO-Southwest-Henderson, W of Rt22	●	◉	○	○	○	○
RPO-Southwest-Henderson, E of Rt22	●	◉	●	○	○	○
RPO-Southwest-Decatur	◉	●	●	◉	○	⊙
RPO-Northwest-Benton	◉	○	○	○	○	○
RPO-Greater Nashville-Humphreys	●	●	●	○	○	⊙
RPO-South Central West-Hickman	●	●	○	○	○	○
RPO-Greater Nashville-Dickson	⊙	○	●	◉	◉	◉
MPA-Nashville-Williamson	○	○	○	⊙	●	◉
RPO-Greater Nashville-Cheatham	●	○	○	○	◉	◉
MPA-Nashville-Davidson, W of I-440	⊙	○	○	⊙	●	●
MPA-Nashville-Davidson, I-440 to I-265	⊙	○	○	⊙	◉	◉
MPA-Nashville-Davidson, I-265 to I-65	○	○	○	○	◉	⊙

Sections (From West to East)	Accident Areas	Bottleneck Areas	Hazardous Areas	Steep Grades	Model V/C	All Factors
MPA-Nashville-Davidson, I-65 to I-24	⊙	○	○	◉	⊙	⊙
MPA-Nashville-Davidson, I-24 section	⊙	◉	○	⊙	◉	◉
MPA-Nashville-Davidson, E of I-24	⊙	○	●	⊙	◉	●
MPA-Nashville-Wilson, W of US-231	○	○	○	⊙	●	⊙
MPA-Nashville-Wilson, E of US-231	○	○	◉	●	◉	◉
RPO-Dale Hollow-Smith	○	○	○	○	●	⊙
RPO-Center Hill-Putnam, W of Rt-111	◉	○	○	●	⊙	⊙
RPO-Center Hill-Putnam, E of Rt-111	◉	○	●	●	⊙	⊙
RPO-Center Hill-Cumberland, W of US-127	○	○	○	○	⊙	○
RPO-Center Hill-Cumberland, US-127 to US-70	○	○	◉	○	◉	⊙
RPO-Center Hill-Cumberland, E of US-70	●	●	◉	◉	○	◉
RPO-East Tennessee South-Roane, W of US-27	●	◉	○	◉	○	○
RPO-East Tennessee South-Roane, US-27 to R-t58	◉	○	○	⊙	◉	◉
RPO-East Tennessee South-Roane, E of Rt-58	⊙	○	○	●	○	○
RPO-East Tennessee South-Loudon	◉	○	◉	⊙	⊙	⊙
MPA-Knoxville-Knox, W of I-640	⊙	○	●	●	●	●
MPA-Knoxville-Knox, Between I-640	●	○	○	●	●	●
MPA-Knoxville-Knox, E of I-640	⊙	○	●	◉	●	◉
RPO-East Tennessee South-Sevier	◉	○	○	○	⊙	○
RPO-East Tennessee South-Jefferson	◉	●	◉	◉	◉	●
MPA-Lakeway-Jefferson	●	●	◉	⊙	⊙	●

Sections (From West to East)	Accident Areas	Bottleneck Areas	Hazardous Areas	Steep Grades	Model V/C	All Factors
MPA-Lakeway-Hamblen	⊙	●	○	●	⊙	⊙
RPO-East Tennessee North-Hamblen	●	●	◉	⊙	⊙	◉
RPO-First Tennessee-Greene	⊙	●	○	◉	○	○
RPO-First Tennessee-Washington	○	○	○	◉	○	○
MPA-Kingsport-Washington	○	○	○	◉	○	○
MPA-Kingsport-Sullivan	⊙	○	○	◉	●	●
MPA-Bristol-Sullivan	○	○	●	○	⊙	○

Scale represents corridor sections with:
○ = low deficiencies/issues (first quartile) ⊙ = medium deficiencies/issues (second quartile)
◉ = high deficiencies/issues (third quartile) ● = severe deficiencies/issues (highest quartile)

Figure ES-1: Overall Section Ranking in Memphis

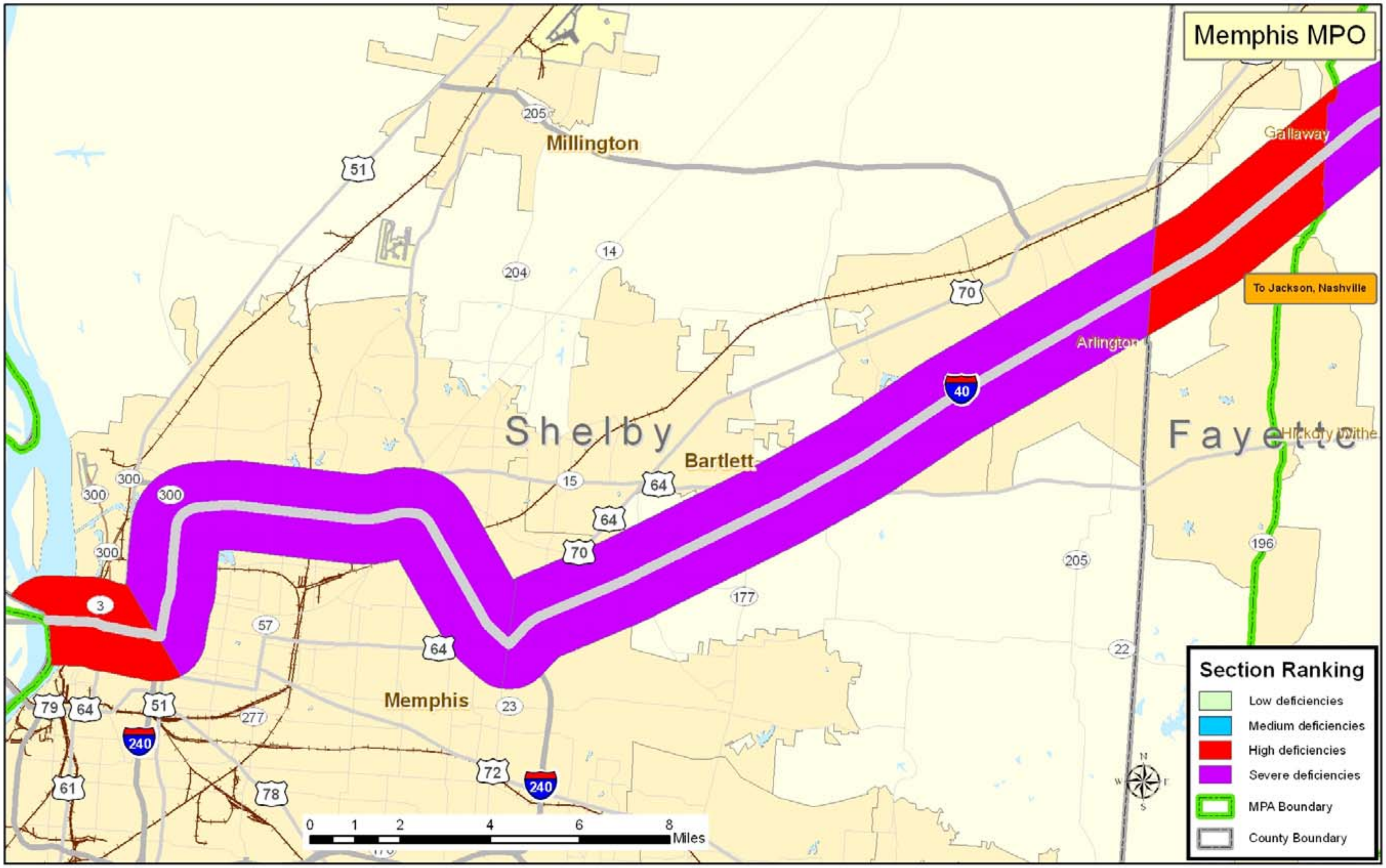


Figure ES-2: Overall Section Ranking (Memphis to Jackson)

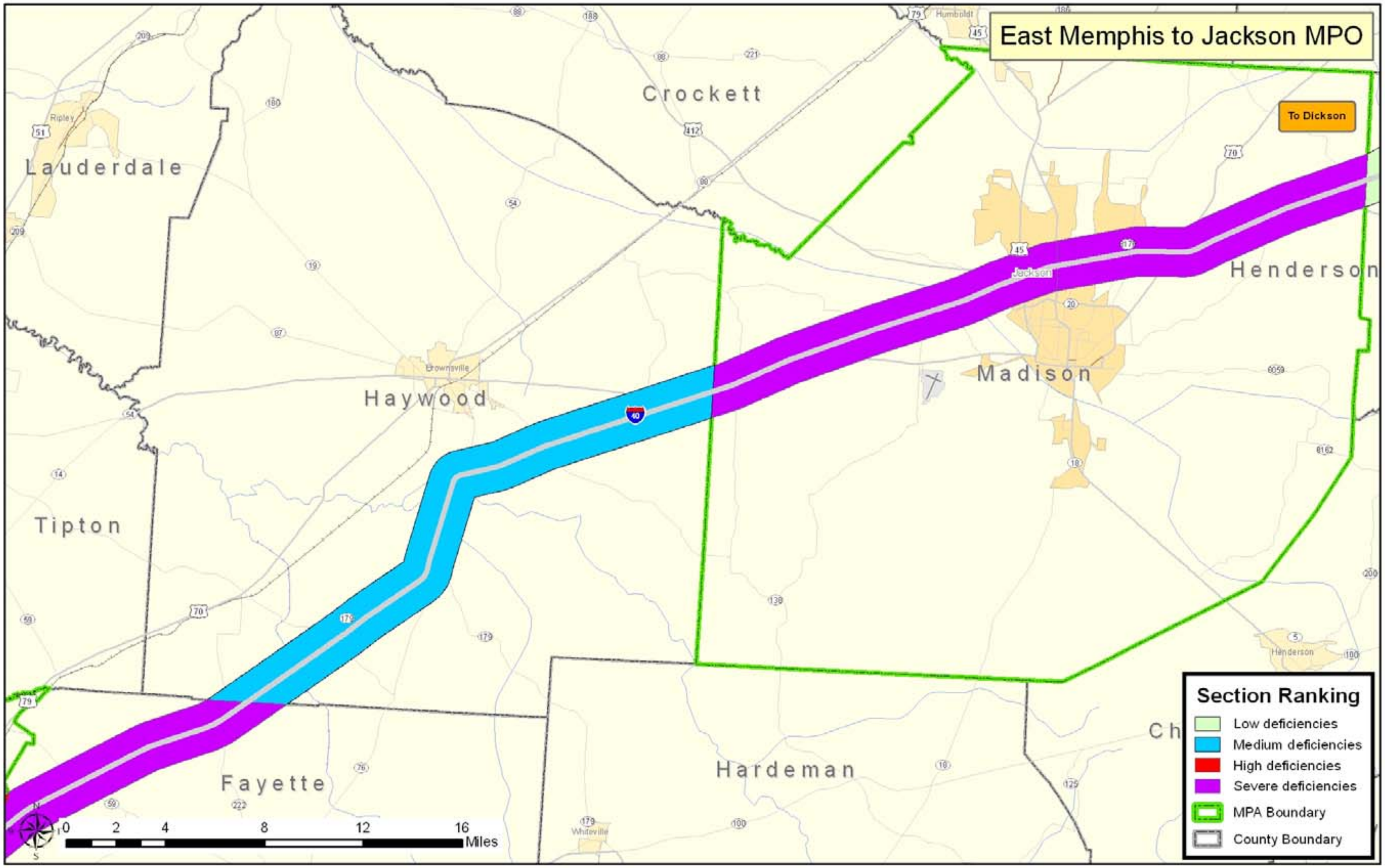


Figure ES-3: **Overall Section Ranking (Jackson to Nashville)**

Figure ES-4: Overall Section Ranking in Nashville Region

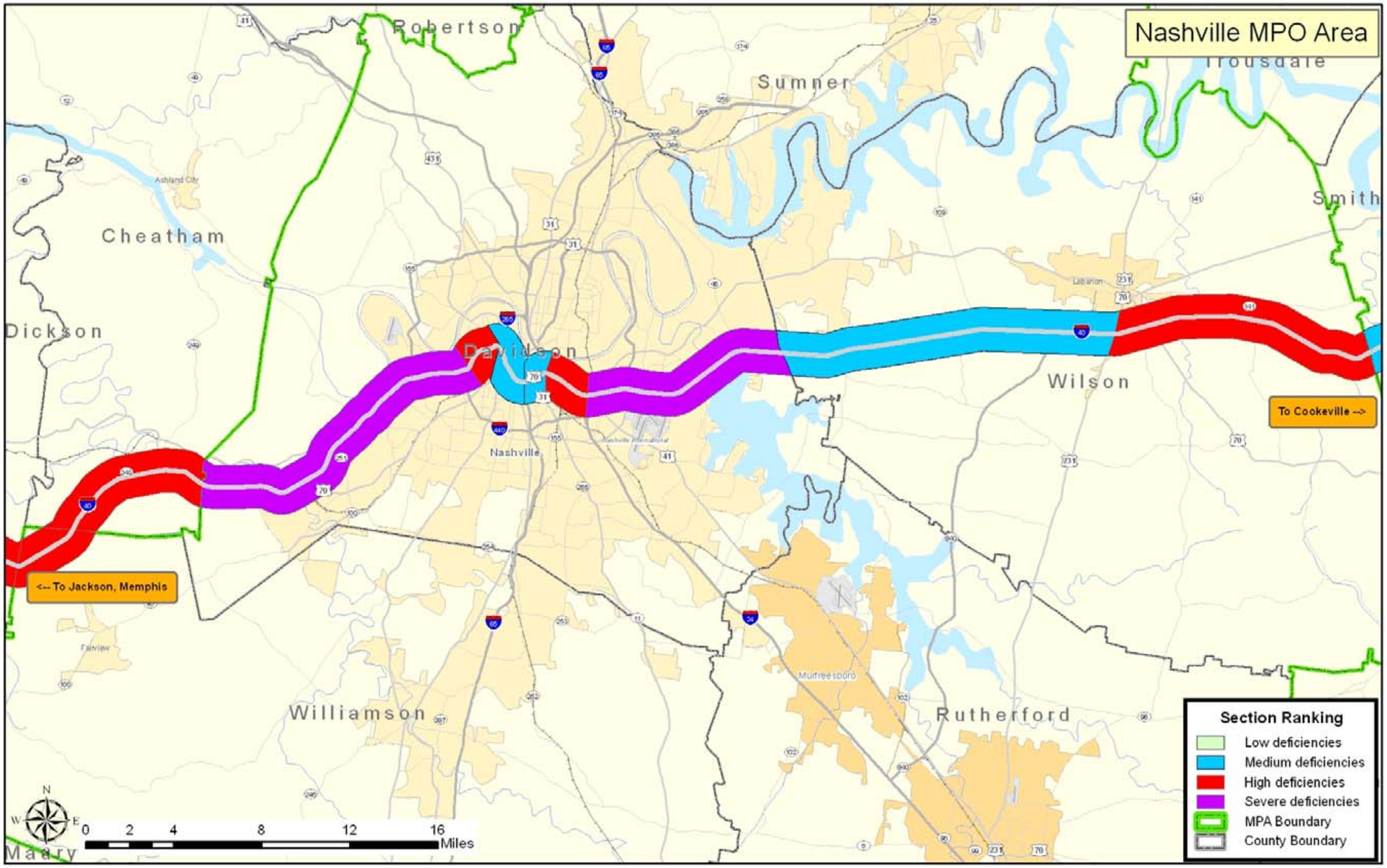


Figure ES-5: Overall Section Ranking (Nashville to Cookeville)

Figure ES-6: Overall Section Ranking (Cookeville to Knoxville)

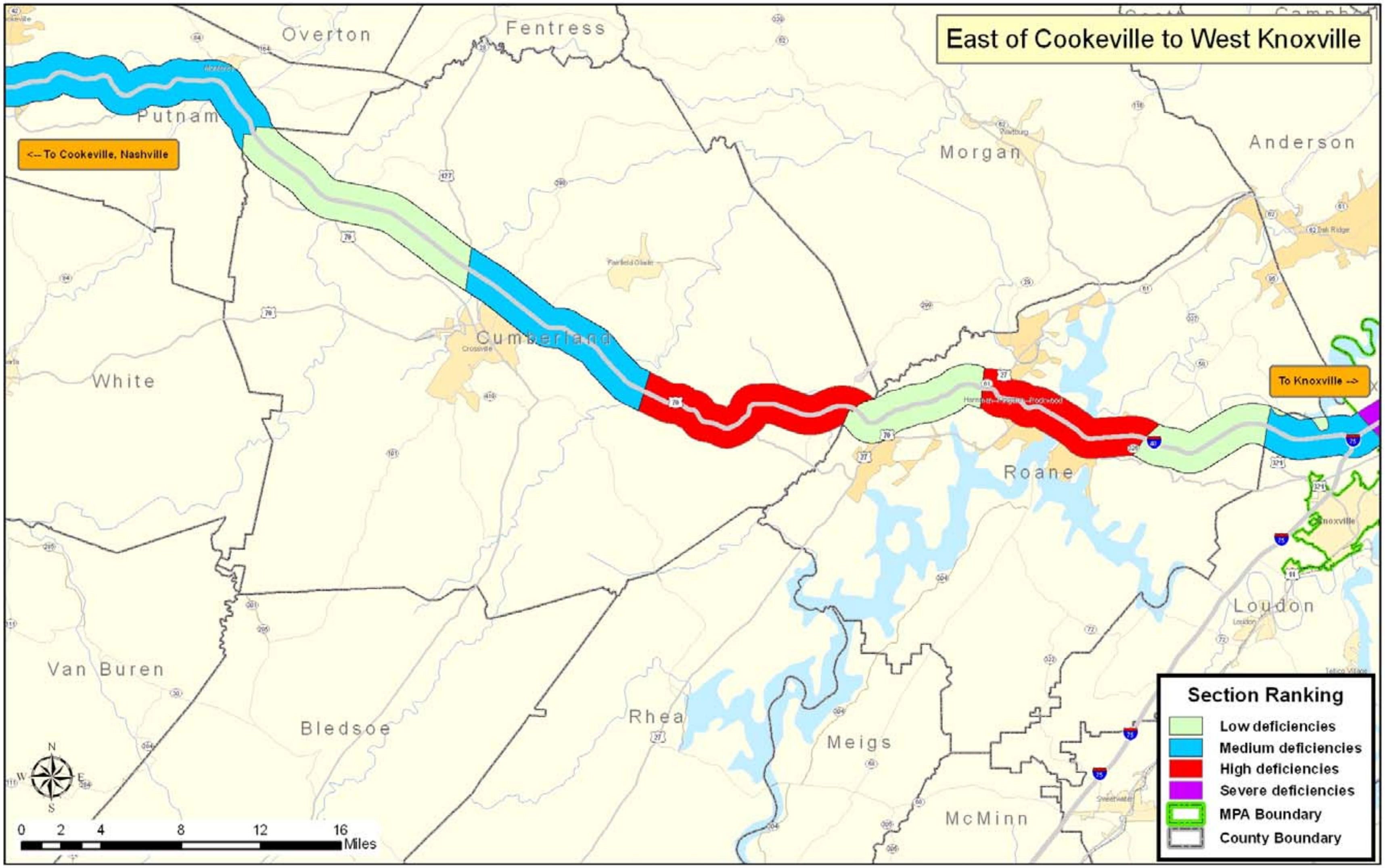


Figure ES-7: Overall Section Ranking (Knoxville to Lakeway)

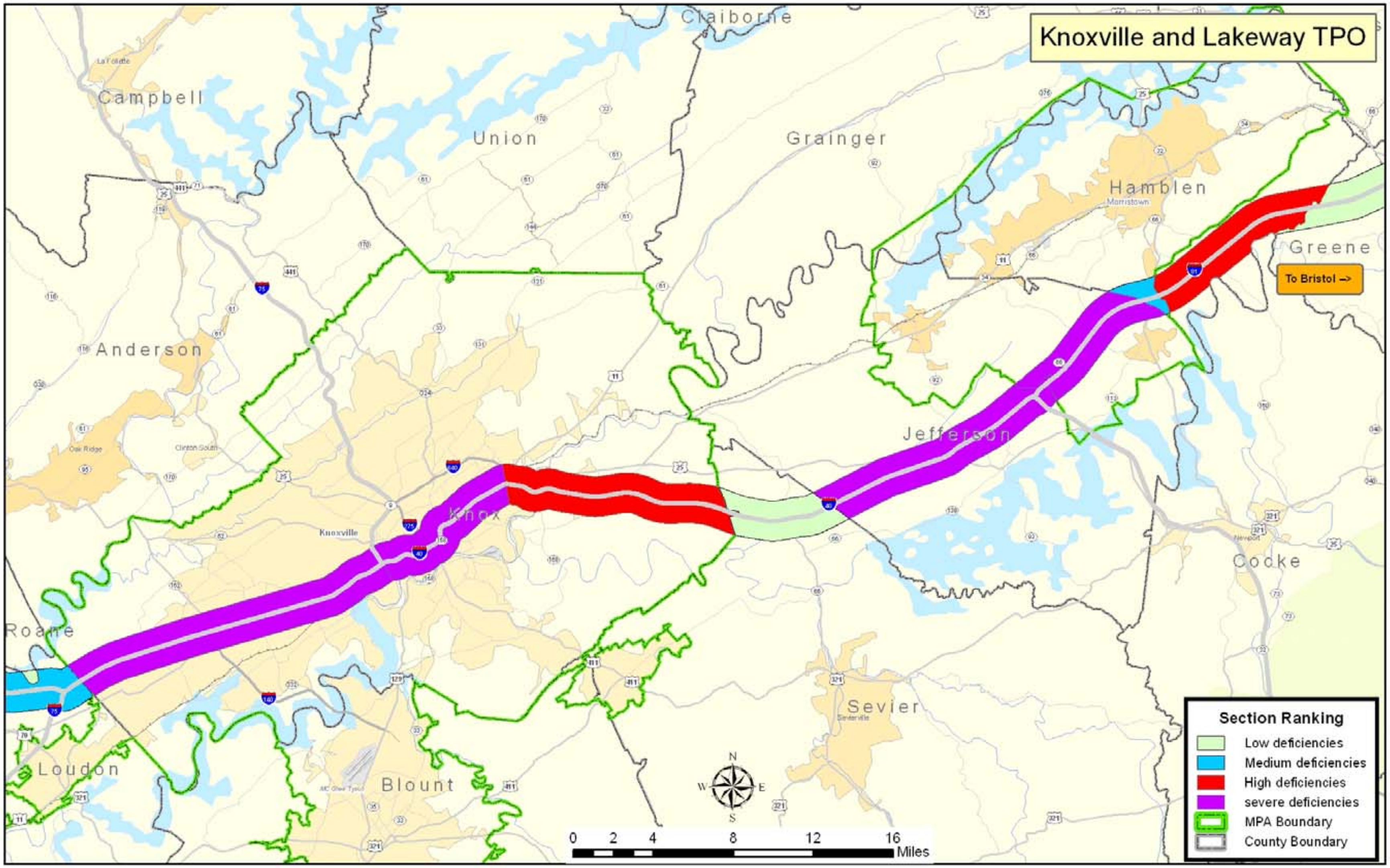


Figure ES-8: Overall Section Ranking (Lakeway to Bristol)

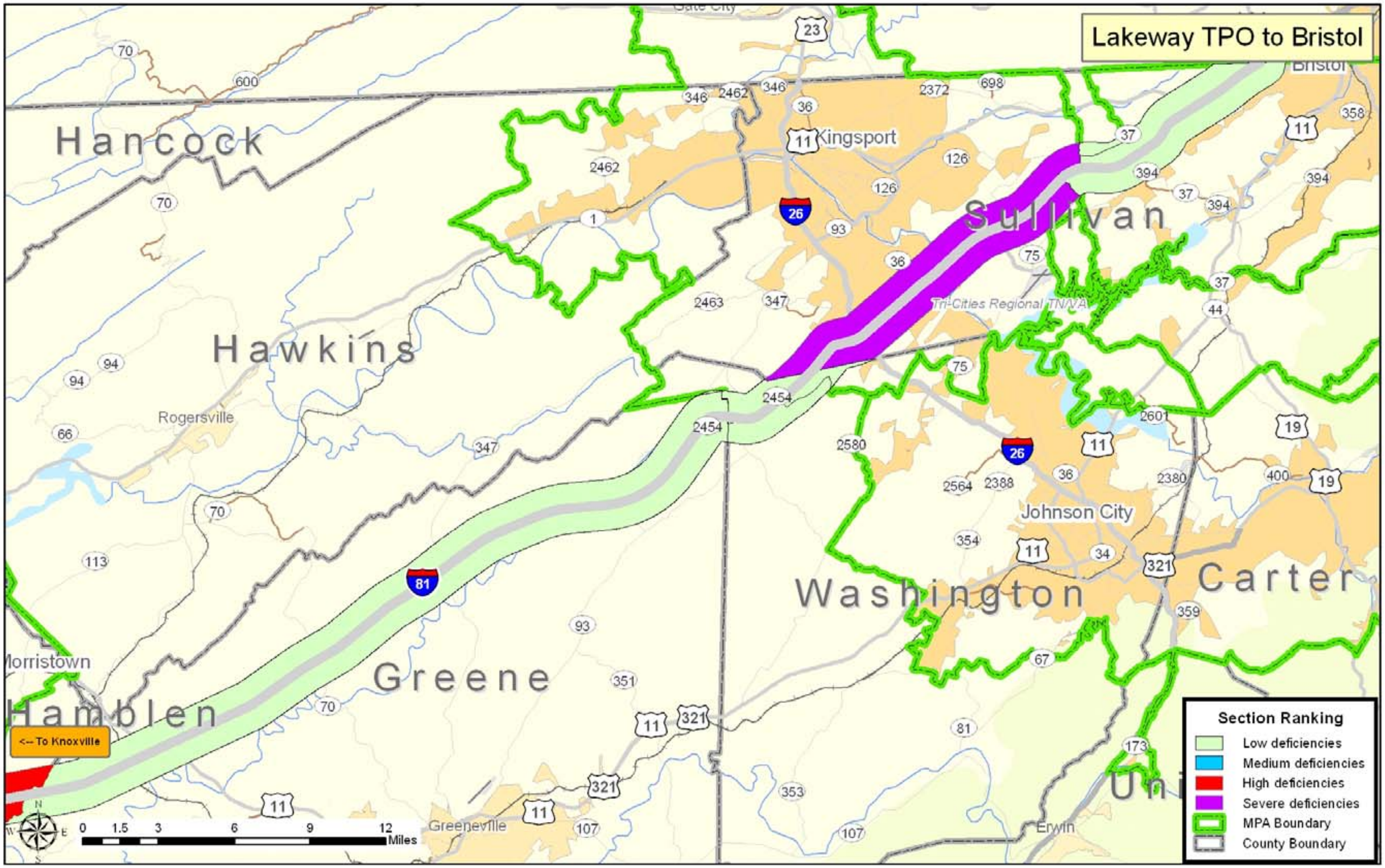


TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

1.1 Project Background

In 2005 the Tennessee Department of Transportation (TDOT) completed the State's first 25-Year Long Range Transportation Plan (PLAN *Go*). A major component of the 25-Year Vision Plan included the advancement of a 10-Year Strategic Investment Plan. The 10-Year Strategic Investment Plan established three interrelated core investment initiatives: Congestion Relief, Transportation Choices, and Key Corridors.

The Interstate 40/Interstate 81 (I-40/I-81) Corridor from Bristol to Memphis was identified through the statewide planning effort as a strategic statewide corridor and several projects along the corridor are included in the 10-Year Plan as a high priority. The purpose of the I-40/I-81 Corridor Feasibility Study is begin to develop a more detailed understanding of the deficiencies of the corridor and to develop corridor level multi-modal solutions to address these deficiencies. The study will consider improvements to the I-40/I-81 corridor, will look at parallel arterials to I-40/I-81 that could be used for local travel and rail lines that could be candidates for freight diversion from the interstate, and will also consider major inter-modal hubs located along the corridor.

The study's final product will be a prioritized listing of multi-modal projects that can be considered by TDOT for the Department's transportation improvement program. Identified multi-modal solutions will address capacity, operations and maintenance, safety, freight movement, inter-modal connections, and economic access issues along the study corridor.

The study area for the I-40/I-81 corridor extends from Bristol to Memphis, a distance of about 550 miles. The study area traverses 27 of the 95 counties within Tennessee and falls within nine of the twelve Rural Planning Organization (RPO) boundaries and eight of the eleven Metropolitan Planning Organization (MPO) and Transportation Planning Organization (TPO) areas. Numerous cities including Memphis, Jackson, Nashville, Lebanon, Cookeville, Crossville, Knoxville, Sevierville, Jefferson City, Ridgeway, Kingsport, Johnson City and Bristol are dependent upon this corridor for commerce, tourism, and daily access. The study area also includes parallel Class I railroads, including their junctions with short-line railroads.

1.2 Purpose of Report

The Technical Memorandum for Task 2, Assessment of Deficiencies, identifies deficiencies within the study corridor associated with:

- Capacity/Congestion
- Operations and Maintenance
- Safety and Security
- Freight Movement/Diversion
- Economic Access
- Intermodal Facilities

The Technical Memorandum includes tables of deficiencies for three time horizons:

- Short-range, about five years (to 2011);
- Mid-range, a ten-year time period (by 2016); and
- Long-range, by a horizon year of 2030.

1.3 Organization and Content

Deficiencies and corridor issues identified through this task are presented as follows:

- Chapter 2, Congestion/Capacity Bottlenecks, includes a brief summary of the adjustments made to Tennessee's Statewide Travel Demand Model and urban travel demand models for Nashville, Memphis, Knoxville, Jackson, Bristol, Kingsport, Johnson City, and Lakeway. This group of TransCAD models uses population and employment projections and committed roadway improvements to estimate 2030 congestion levels. Committed improvements include those in TDOT's Transportation Improvement Program (TIP), which extends to 2008-2009. Chapter 2 includes a list and description of deficiencies in the corridor related to auto and truck capacity for each of the three time horizons. The chapter also displays existing bottlenecks based on field observations identified during stakeholder interviews.

- Chapter 3, Operations and Maintenance, identifies locations along I-40, I-81 and parallel arterials where poor geometrics affect traffic flow, again based on field observations. Interviews with representatives of TDOT, the Tennessee Highway Patrol and Commercial Vehicle Compliance provided the list of locations in this chapter. The chapter also lists recommended improvements in Tennessee's Intelligent Transportation System (ITS) and Incident Management programs based on input from the aforementioned interviewees.

- Chapter 4, Safety and Security, lists I-40/I-81 segments that have collision rates which exceed the state's critical accident rate. The chapter also includes information on crash locations based on field observations mentioned during interviews with the persons listed under Chapter 3. Interviews with representatives of Tennessee's MPOs, TPOs and RPOs also provided information on I-40 and I-81 accident locations based on field observations.

- Chapter 5, Freight Movement and Diversion, identifies corridor segments where steep grades slow truck movements and potentially impact operations along I-40/I-81. This chapter also describes a truck/rail freight diversion tool which will be used in later phases of the study.

- Chapter 6, Economic Access, identifies proposed interchanges along I-40 and I-81 to improve access to new developments based on plans prepared by TDOT, MPOs or RPOs. Additional new interstate interchanges to accommodate foreseeable land developments along the corridor were determined through stakeholder interviews with MPO, TPO and RPO representatives.

- Chapter 7, Commuter Patterns, displays commuting patterns to Tennessee's urban areas based on an analysis of 2000 Census information for the state. This chapter also identifies existing and planned park and ride facilities in the study corridor and discusses the effectiveness of existing High Occupancy Vehicle (HOV) lanes along I-40 in Nashville and Memphis.

- Chapter 8, Inter-Modal Facilities, identifies and maps major intermodal hubs in and adjacent to Tennessee.

2.0 CONGESTION/CAPACITY BOTTLENECKS

The identification of I-40/I-81 segments projected to be deficient in terms of auto and truck capacity for the three future time periods was based on TDOT's Statewide Model and urban travel demand models for the Nashville, Memphis, Knoxville, Jackson, Bristol, Kingsport, Johnson City, and Lakeway. This group of TransCAD models uses population and employment projections and committed roadway improvements to estimate 2030 congestion levels. Committed improvements include those in TDOT's latest Transportation Improvement Plan (TIP), which extends to 2008-2009.

Based on interviews with TDOT's Directors of Regions 1, 2, 3 and 4 and representatives of the Tennessee Highway Patrol, existing capacity bottlenecks along I-40 and I-81 were identified. These capacity bottlenecks were based on field observations.

2.1 Adjustments to the Statewide and Urban Travel Demand Models

Several refinements were made to the Statewide and MPO travel demand models to finalize previously identified 2030 LOS deficiencies and to determine interim year deficiencies for 2011 and 2016. All model runs using the Statewide Model assumed an existing-plus-committed (E+C) highway network. Therefore, along the I-40/I-81 corridor, the E+C network was checked for accuracy against MPO Transportation Improvement Programs (TIPs) and interim year elements of MPO Long-Range Transportation Plans (LRTPs). Adjustments were made to number of coded lanes to reflect programmed facility widening, and future planned corridors were added or removed from the network, as necessary.

In the case of MPO models, adjustments were made to external trip estimates on I-40 and I-81 to achieve consistency with future year forecasts from the Statewide Model. **Table 2-1** provides a summary of MPO model external trips and Statewide Model trips at the same location, after adjusting external trips for the years 2011, 2016, and 2030. MPO model network coding for the I-40/I-81 corridor was also reviewed and corrected where necessary. E+C or interim year model networks were not available in some cases. Therefore, base year networks were sometimes adjusted to current I-40/I-81 conditions and then loaded with interim year and future year trips for the purposes of identifying deficient segments.

Unfortunately, none of the models included files for the interim years of 2011 and 2016 so straight-line interpolations were used for the MPO models to estimate socioeconomic and external forecasts for these years. MPO data for years closest to 2011 and 2016 were used, where alternate interim years were available. Listed below is a summary of the years for each MPO model, as provided by TDOT staff:

- Bristol – 2005 and 2030
- Jackson – 1999, 2020 and 2035
- Kingsport – 2004, 2015 and 2030

- Knoxville – 2005, 2014, 2020 and 2030
- Memphis – 2004, 2017 and 2030
- Morristown – 2004 and 2030
- Nashville – 2006 and 2030

Attempts to incorporate the Jackson and Morristown models into the travel demand forecasting process were later abandoned. External trips for the Jackson model are derived directly from the Statewide Model, which minimizes any differences between the two models. The Morristown model follows prompts, rather than a batch process, for execution. Because 1) this process added considerable effort to executing the model, 2) the Knoxville model provided overlap, and 3) Morristown is a very small MPO area, a combination of the Knoxville and Statewide models was used for this section of I-81.

The TDOT Statewide Model is based on an origin-destination matrix estimation process. Because there is no socioeconomic data for this model, trip tables were interpolated for the years 2011 and 2016 based on the available 2003 and 2030 matrices.

2.2 Congested Segments Based on Models

Urban area LOS deficiencies were identified for the years 2011, 2016, and 2030, using the refined and interpolated MPO models, where appropriate. TDOT's Statewide Model was used to forecast deficiencies for all rural corridor segments. Volume/capacity (v/c) breakpoints used in TDOT's EVE database, as described in Technical Memorandum 1, were used to approximate LOS for each model network link. **Table 2-2** through **Table 2-4** itemizes deficient corridor segments for the years 2011, 2016, and 2030, respectively. All model runs assume that only existing or E+C projects are in place.

Table 2-1: MPO Model External Trip Adjustments

#	Location	Year 2011		Year 2016		Year 2030	
		Total Volume	SWM-MPO	Total Volume	SWM-MPO	Total Volume	SWM-MPO
1	SWM (Arkansas State Line)	60,875		63,004		71,465	
2	Memphis MPO Model St Line	65,017	-4,142	73,738	-10,734	95,683	-24,218
3	Memphis MPO Model East	37,837		44,023		64,246	
4	SWM (Memphis East)	37,547	-290	39,418	-4,605	58,146	-6,100
5	SWM (Jackson West)	37,547		39,418		58,146	
6	Jackson West	n/a	n/a	n/a	n/a	53,240	4,906
7	Jackson East	n/a	n/a	n/a	n/a	49,186	
8	SWM (Jackson East)	33,007	n/a	34,927	n/a	42,673	-6,513
9	SWM (Nashville West)	40,926		43,855		56,253	
10	Nashville West	40,814	112	44,800	-945	55,963	290
11	Nashville East	52,185		58,072		74,558	
12	SWM (Nashville East)	49,897	-2,288	57,101	-971	75,064	506
13	SWM (Knoxville West)	45,229		48,059		64,003	
14	Knoxville West	44,709	520	47,613	446	62,306	1,697
15	Knoxville I-40 East	36,327		42,645		51,003	
16	SWM (I-40 East)	36,327	0	40,091	-2,554	51,015	12
17	Knoxville I-81 North	51,744		58,422		79,159	
18	SWM (Knoxville I-81 North)	51,956	212	58,203	-219	77,279	-1,880
19	SWM (Morristown South)	55,032		60,007		78,812	
20	Morristown South	n/a	n/a	n/a	n/a	65,118	13,694
21	Morristown North	n/a	n/a	n/a	n/a	55,195	
22	SWM (Morristown North)	37,363	n/a	47,938	n/a	58,990	3,795
23	SWM (Kingsport South)	31,519		33,558		39,869	
24	Kingsport South	34,542	-3,023	39,286	-5,728	39,032	837
25	Kingsport North	35,672		40,645		54,570	
26	SWM (Kingsport North)	52,577	16,905	55,817	15,172	65,002	10,432
27	Bristol North Model Boundary	47,574		50,668		59,344	
28	SWM (Bristol North Boundary)	50,960	3,386	53,390	2,722	60,049	705

Table 2-2: Deficient Segments (LOS D, E, F) in 2011 based on Model Forecasts

Route	From	To
I-40	SR 14 (Jackson Ave)	I-240 East
I-40	I-240 East	SR 177 (Germantown Pkwy)
I-40	US-64 (Stage Road)	SR 205 (New Airline Rd)
I-40	US-45 (Keith Short Bypass)	Christmasville Rd/Dr. Fe Wright Dr
I-40	SR 46 (Dickson)	US-70 (Sparta Pike-Lebanon)
I-40	SR 96 (Buffalo Valley)	SR 56 (Silver Point)
I-40	US-70N (Poplar Grove)	US-70N (Monterey)
I-40	Market Street (Crab Orchard)	Pine Ridge Road
I-40	Gallaher Road	Buttermilk Road (Bradbury)
I-40	SR 298 (Genesis Rd-Crossville)	SR 101 (Peavine Rd-Crossville)
I-40	Pine Ridge Rd (S. Harriman)	SR 58 (Gallaher Rd-Lawnville)
I-40	Linwood Rd (Linwood)	SR 141 (Silver Point)
I-40	I-75 South	N. Cherry St (Knoxville)
I-40	I-640 East	US-11 E (Asheville Hwy)
I-81	US-25E (Morristown)	SR 160 (Enka Hwy-Morristown)

Table 2-3: Deficient Segments (LOS D, E, F) in 2016 based on Model Forecasts

Route	From	To
I-40	Arkansas State Line	I-240 Midtown
I-40	SR 14 (Jackson Ave)	SR 222 (Stanton-Somerville Rd)
I-40	US-45 (Keith Short Bypass)	Christmasville Rd/Dr. Fe Wright Dr
I-40	SR 46 (Dickson)	US-70 (Sparta Pike-Lebanon)
I-40	SR 96 (Buffalo Valley)	SR 56 (Silver Point)
I-40	US-70N (Poplar Grove)	US-70N (Monterey)
I-40	Market Street (Crab Orchard)	Pine Ridge Road
I-40	Gallaher Road	Buttermilk Road (Bradbury)
I-40	Buttermilk Road	I-75 South
I-40	US-127	SR 298 (west of Crossville)
I-40	SR 298 (Genesis Rd-Crossville)	SR 101 (Peavine Rd-Crossville)
I-40	Pine Ridge Rd (S. Harriman)	SR 58 (Gallaher Rd-Lawnville)
I-40	Linwood Rd (Linwood)	SR 141 (Silver Point)
I-40	I-75 South	N. Cherry St (Knoxville)
I-40	I-640 East	SR 66 (Winfield Dunn Pkwy)
I-81	US-25E (Morristown)	SR 160 (Enka Hwy-Morristown)

Table 2-4: Deficient Segments (LOS D, E, F) in 2030 based on Model Forecasts

Route	From	To
I-40	Arkansas State Line	I-240 Midtown
I-40	I-240 Midtown	SR 76 (Anderson Ave-Brownsville)
I-40	US-70 (Brownsville)	SR 223 (Jackson)
I-40	SR 223 (Jackson)	US-70 East (Jackson)
I-40	SR 48 (Oak Grove)	SR 46 (Dickson)
I-40	SR 46 (Dickson)	SR 96 (Buffalo Valley)
I-40	SR 96 (Buffalo Valley)	SR 56 (Silver Point)
I-40	US-70N (Poplar Grove)	US-70N (Monterey)
I-40	Market Street (Crab Orchard)	Pine Ridge Road
I-40	SR 101 (Peavine Rd-Crossville)	Pine Ridge Rd (S. Harriman)
I-40	Pine Ridge Rd (S. Harriman)	SR 58 (Gallaher Rd-Lawnville)
I-40	Gallaher Rd	I-75 South
I-40	I-75 South	US11W (Rutledge Pike)
I-40	I-640	Midway Rd (Thorngrove)
I-40	SR 66 (Snyder Rd)	Deep Springs Rd (Dumplin)
I-40	SR 92 (Dandridge)	I-81
I-81	SR 341 (Roy J. Messer Hwy)	SR 340 (Fish Hatchery Rd)
I-81	I-181/I-26	SR 357 (Airport Pkwy)
I-81	SR 126 (Memorial Blvd)	US-11W (State St-Bristol)

2.3 Existing Capacity Bottlenecks

Representatives of TDOT’s Regions 1, 2, 3 and 4 and the Tennessee Highway Patrol provided locations along I-40 and I-81 that are considered to be current capacity bottlenecks based on field observations. These locations are shown in **Figure 2-1** through **Figure 2-8**, along with the deficient segments identified for 2011, 2016 and 2030 discussed in the previous section.

Figure 2-1: Congested I-40 Segments in Memphis

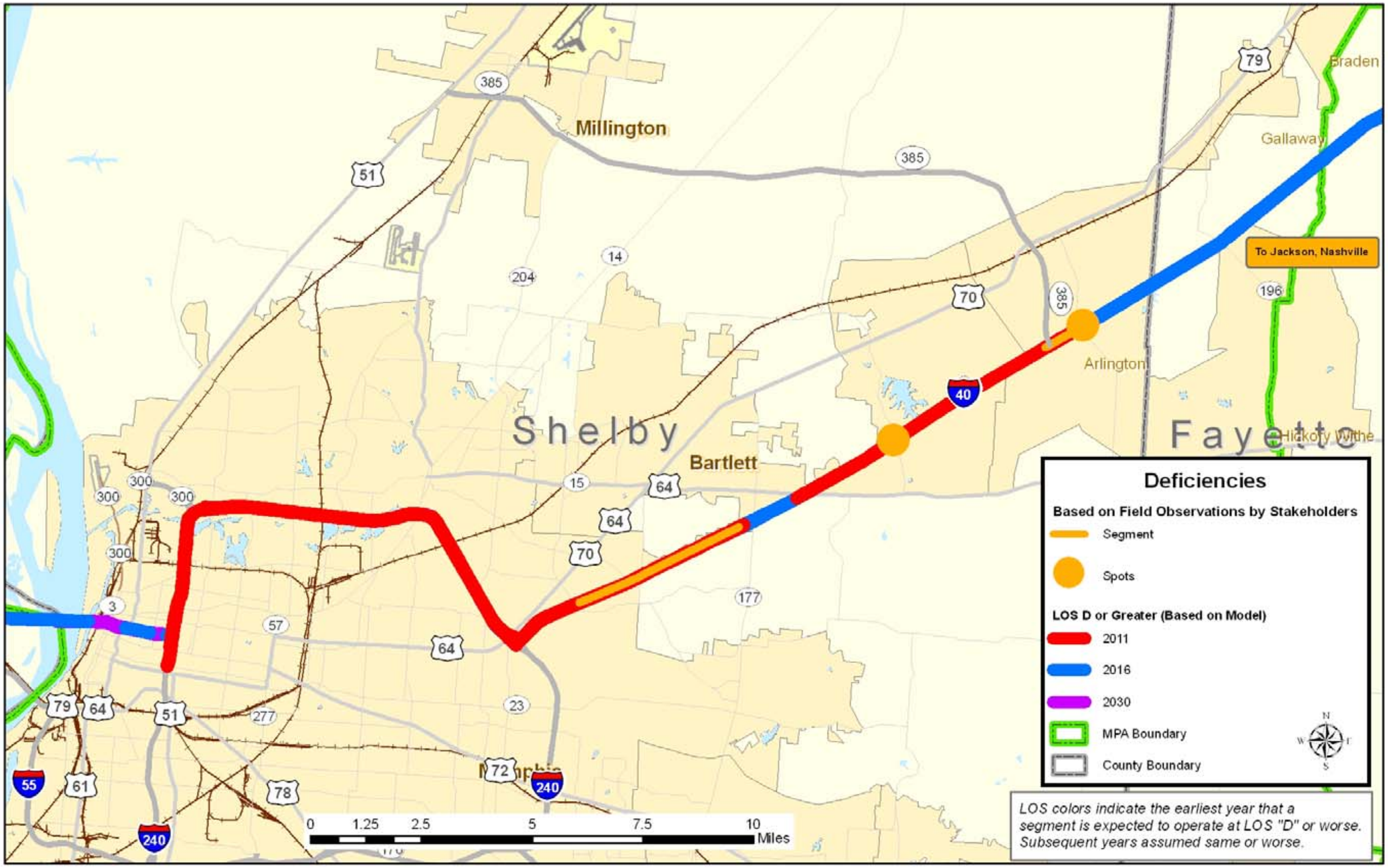


Figure 2-2: Congested I-40 Segments (Memphis to Jackson)

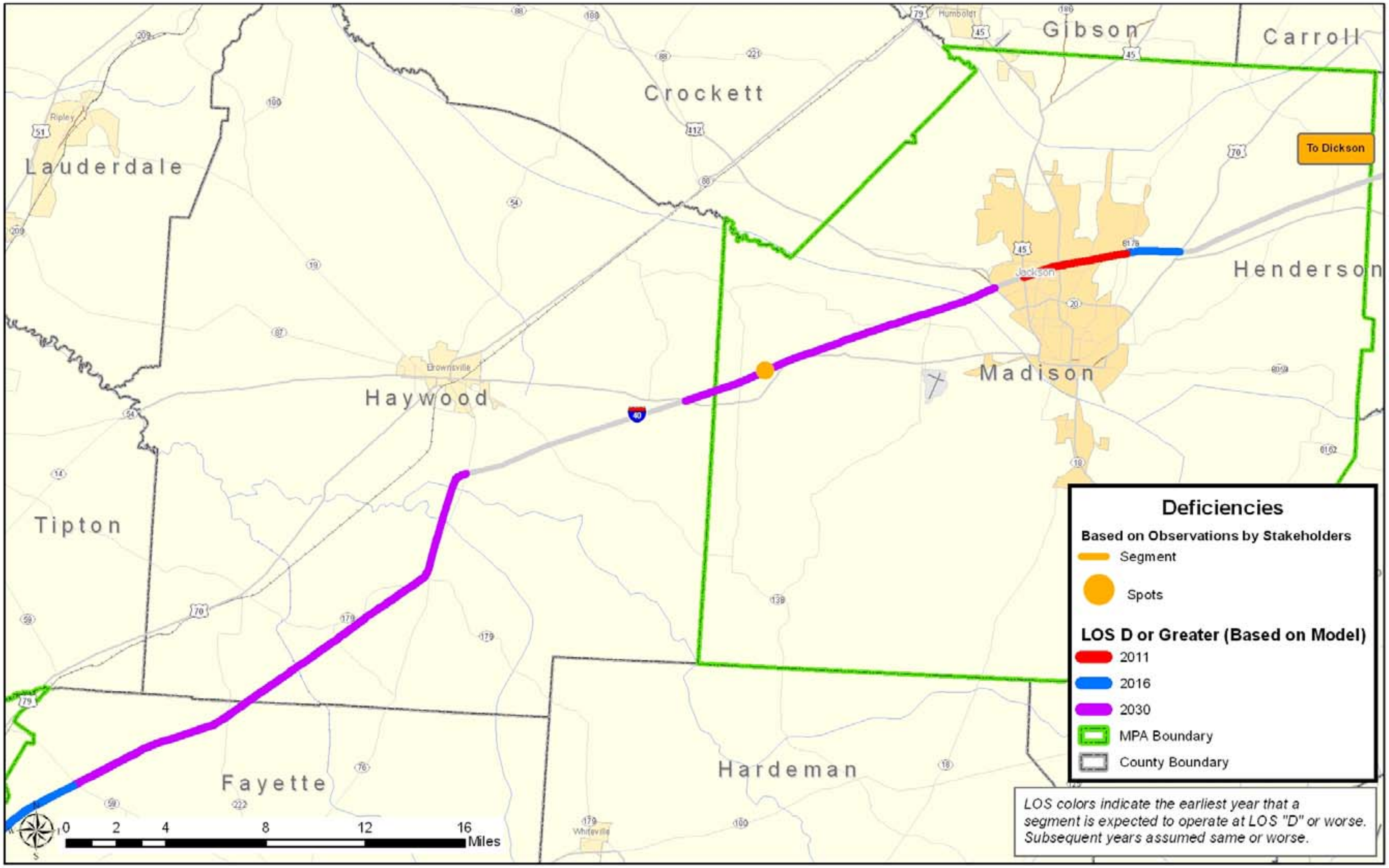


Figure 2-3: Congested I-40 Segments (Jackson to Nashville)

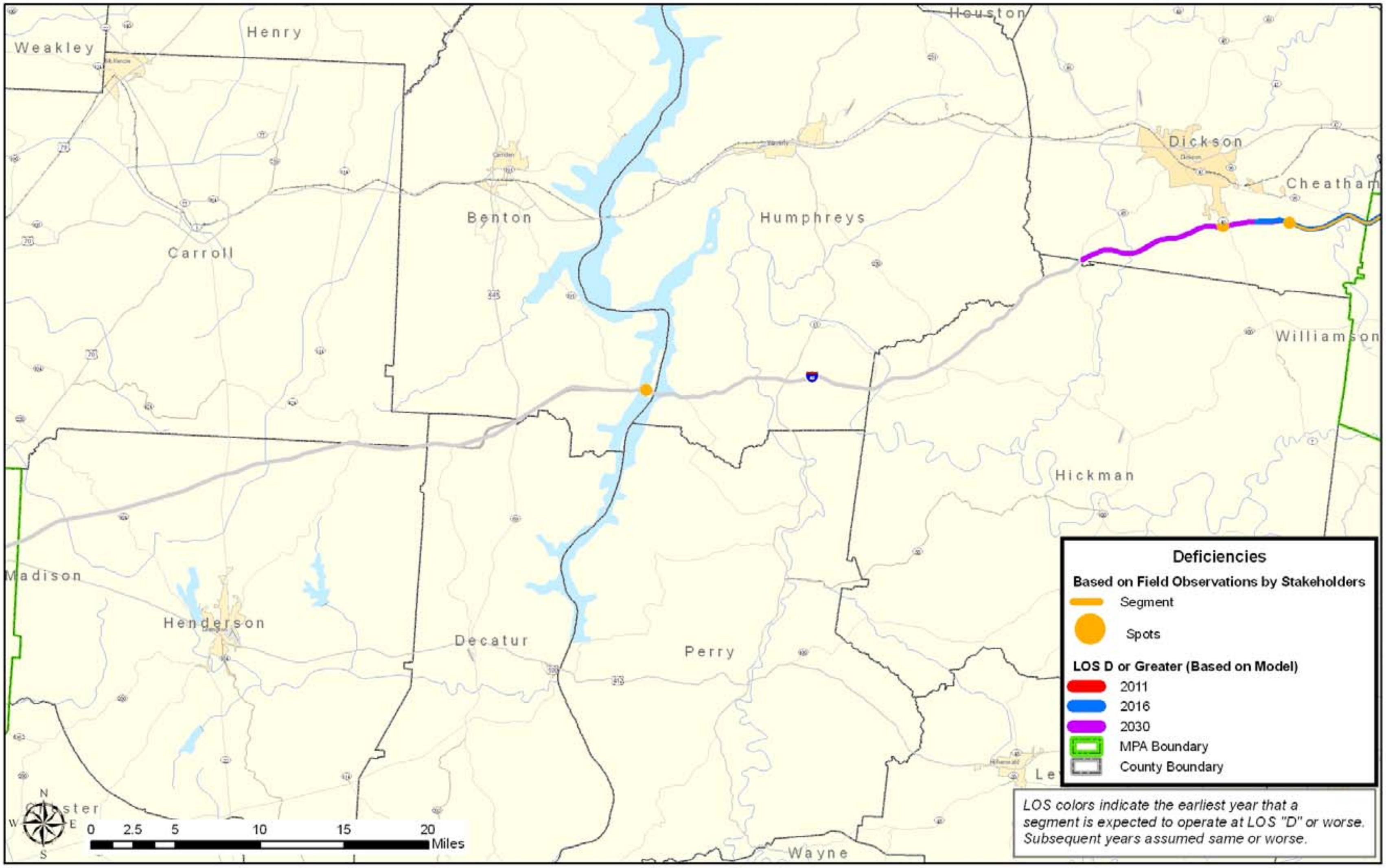


Figure 2-4: Congested I-40 Segments in Nashville Region

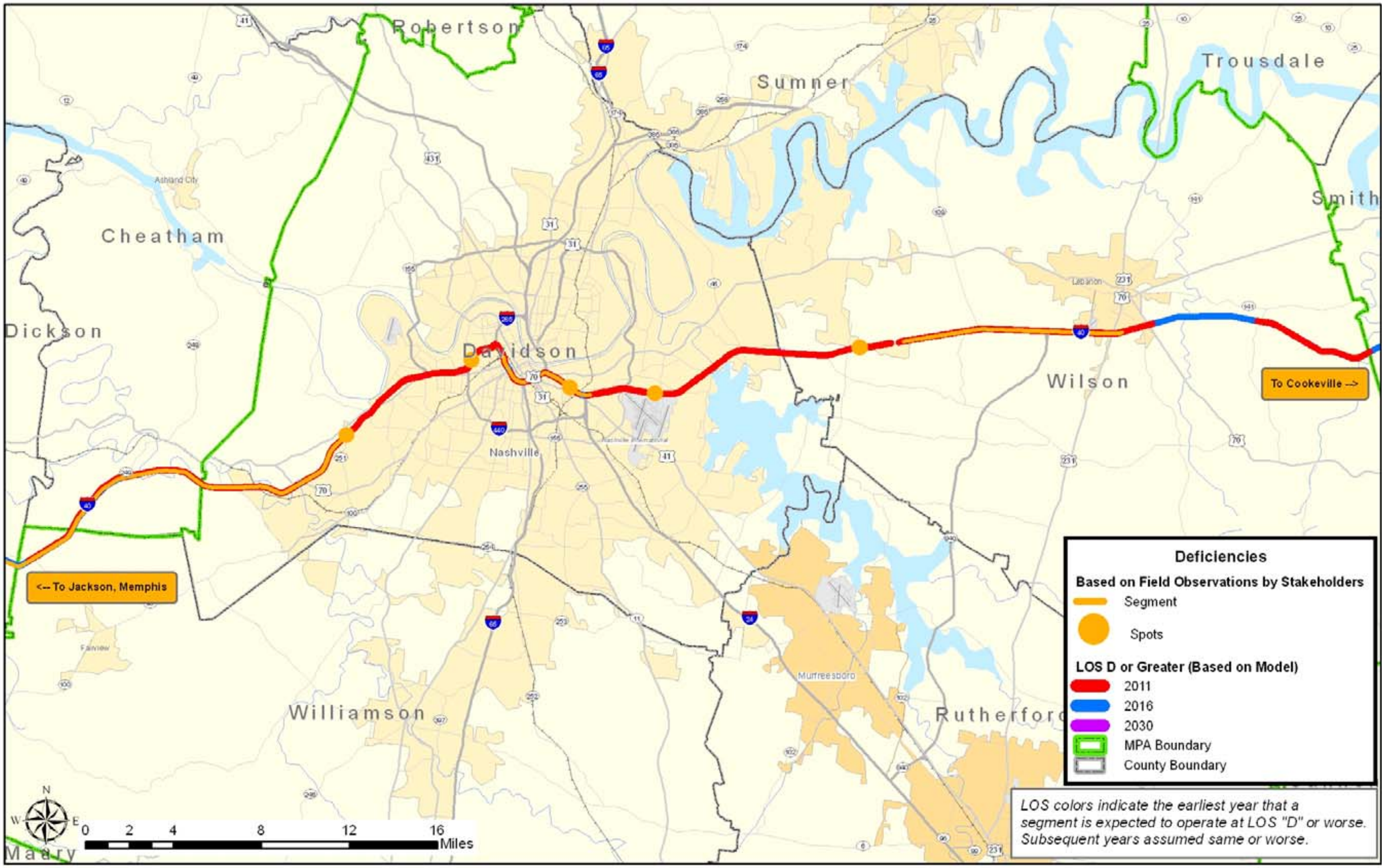


Figure 2-5: Congested I-40 Segments (Nashville to Cookeville)

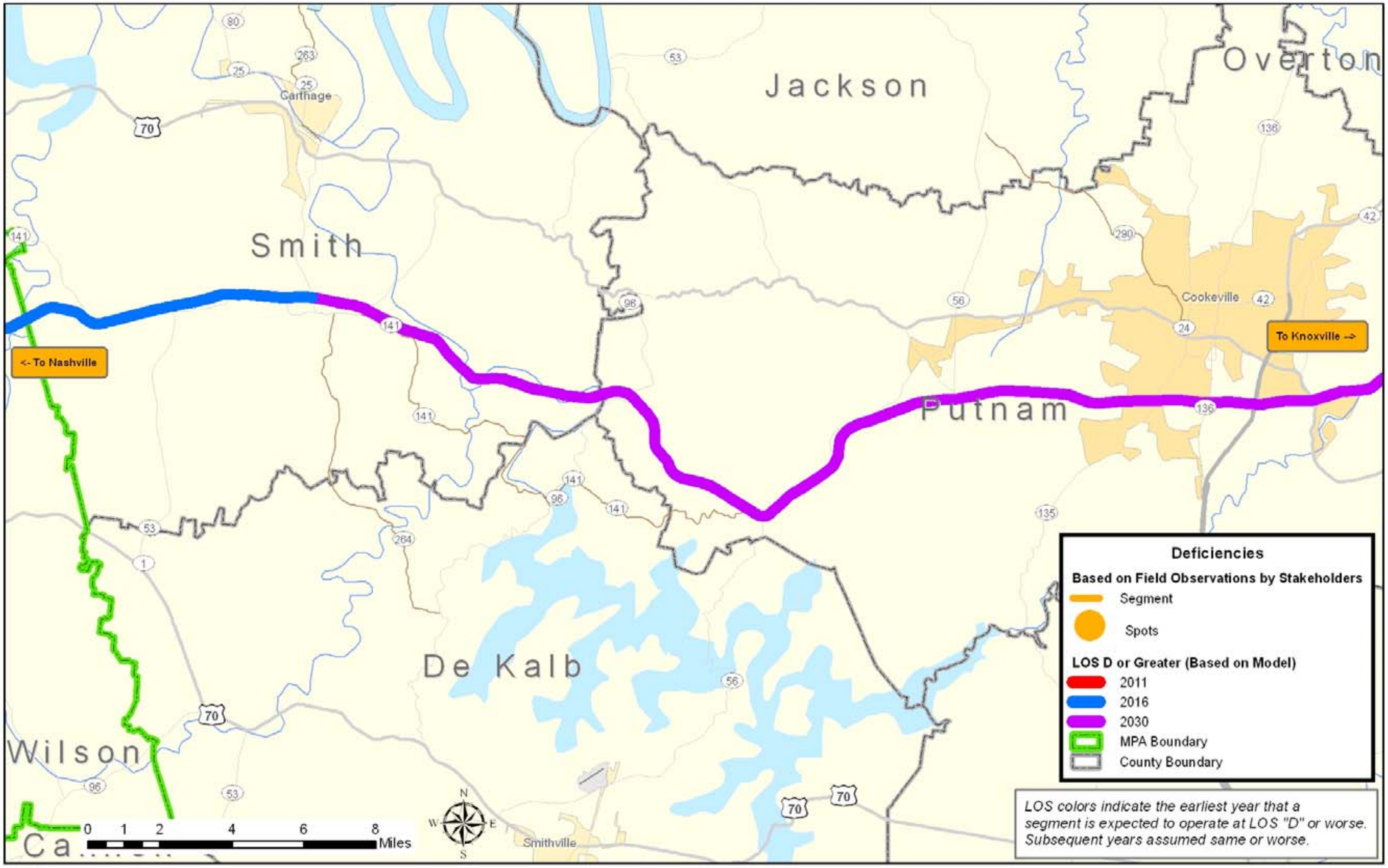


Figure 2-6: Congested I-40 Segments (Cookeville to Knoxville)

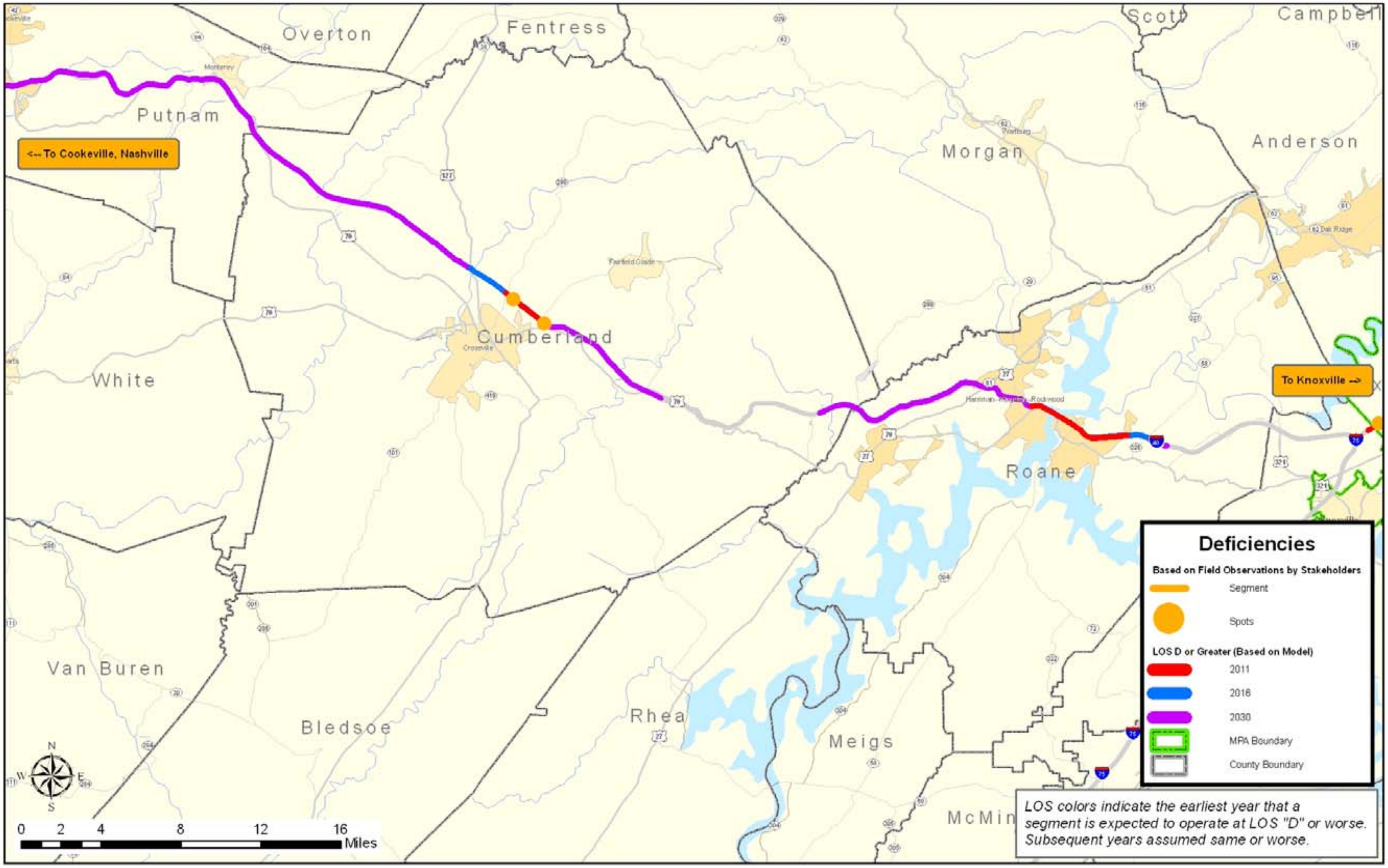


Figure 2-7: Congested I-40 and I-81 Segments (Knoxville to Lakeway)

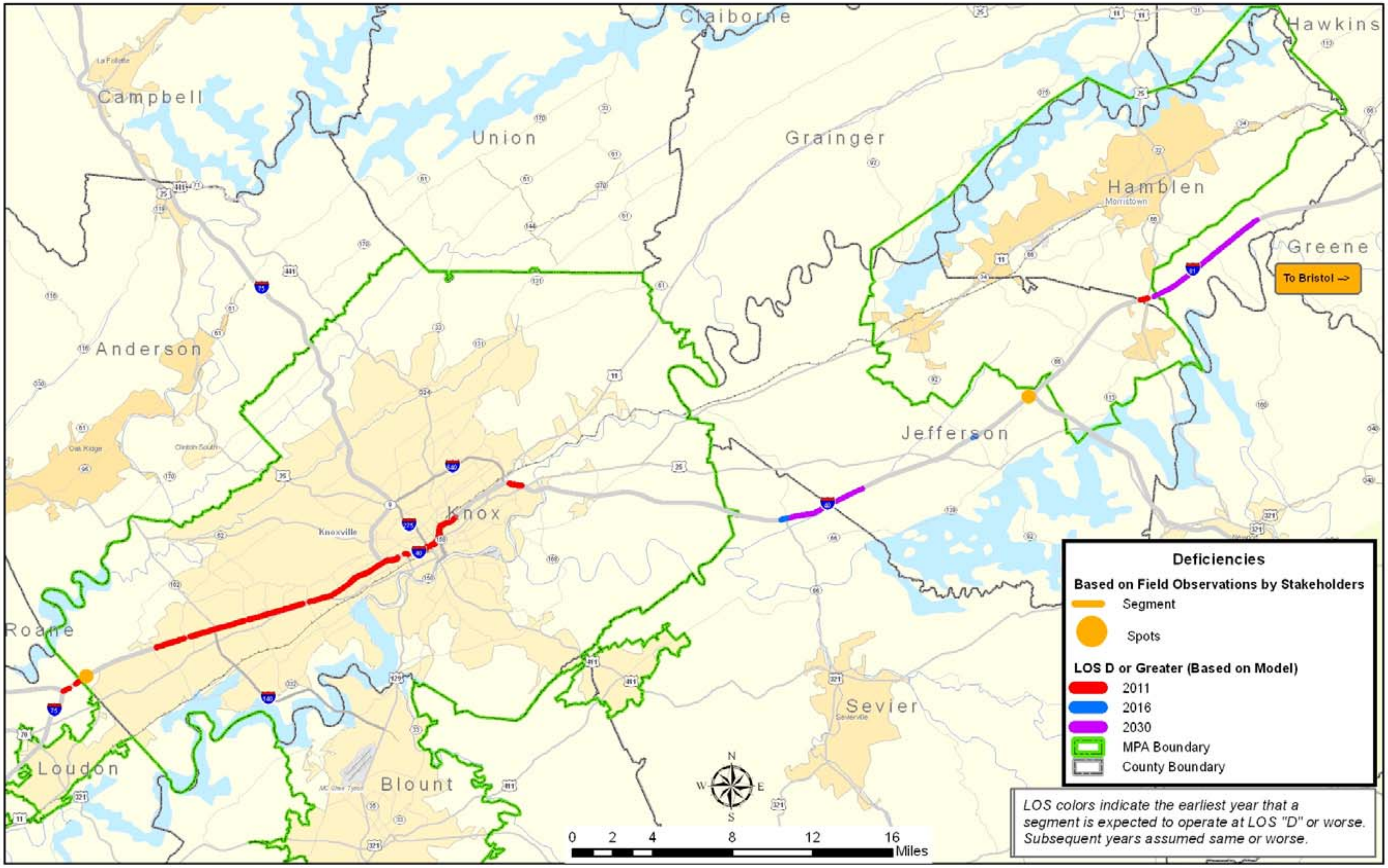
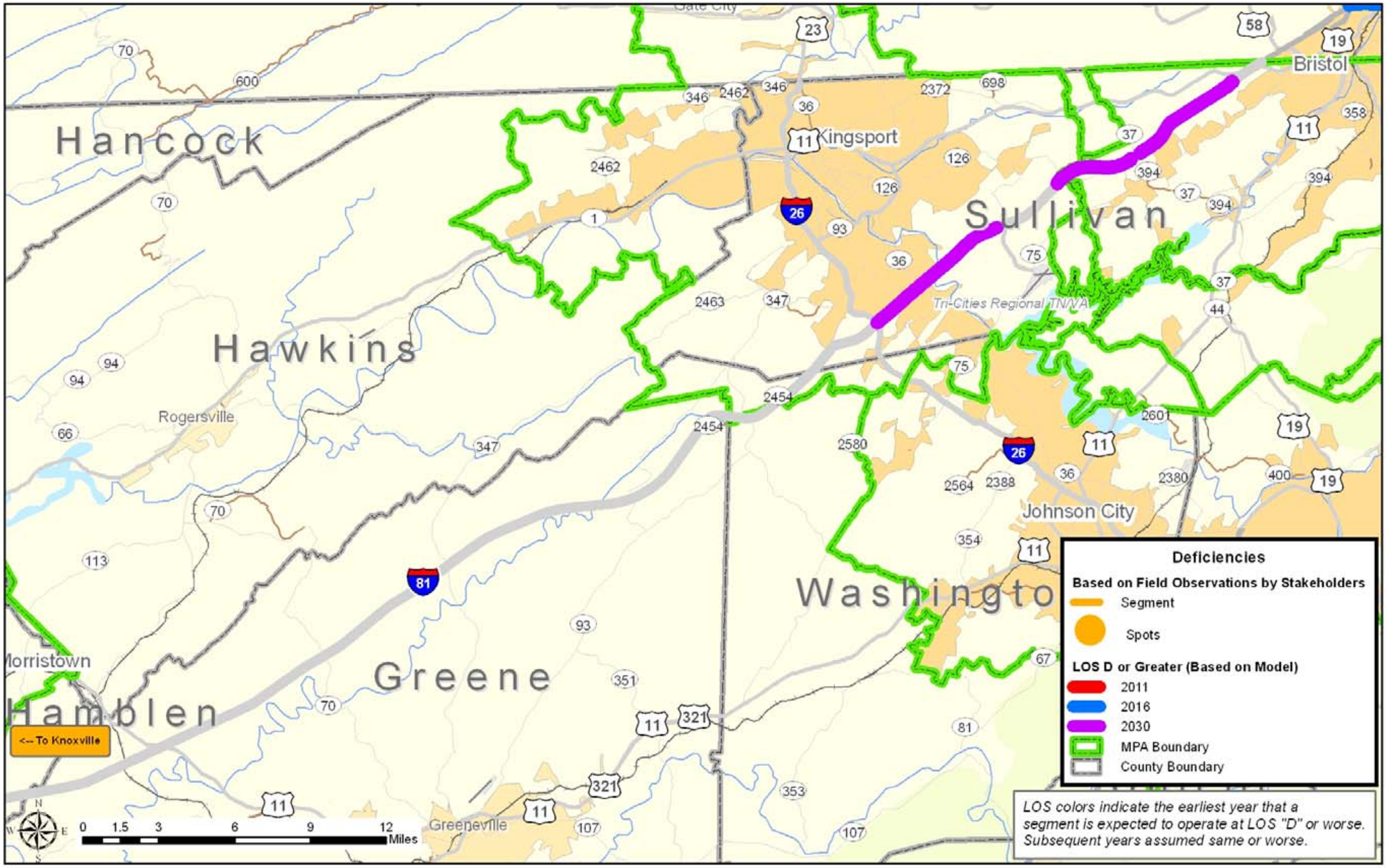


Figure 2-8: Congested I-81 Segments (Lakeway to Bristol)



3.0 OPERATIONS AND MAINTENANCE

Locations along I-40 and I-81 where steep grades, sight distance issues or poor geometrics regularly affect traffic flow were identified through interviews with TDOT Region Directors and TDOT's Incident Management Program manager. Interviews also were conducted with representatives of the Tennessee Department of Safety including the Highway Patrol and the Commercial Vehicle Compliance office to obtain their input on this topic. **Table 3-1** lists the individuals interviewed to identify deficiencies in this category, which are based on field observations.

The interviews also identified actions to expand Tennessee's Intelligent Transportation System (ITS) and the current Incident Management program (HELP), which are also summarized in this chapter.

Table 3-1: Operations & Maintenance Stakeholder Interviewees

Name	Title	Organization/Division or Agency
Fred Corum	Regional Director	TDOT, Region 1
Bob Brown	Regional Director	TDOT, Region 2
Winston Gaffron	Regional Director	TDOT, Region 3
Chuck Rychen	Regional Director	TDOT, Region 4
Frank Horne	Director	TDOT, Incident Management Program
Tracy Trott	Lieutenant Colonel	Tennessee Highway Patrol/Department of Safety
Danny Wilson	Lieutenant Colonel	Tennessee Highway Patrol/Department of Safety
Steve Binkley	Captain	Commercial Vehicle Enforcement/ Department of Safety

3.1 Operations Deficiencies

The seven stakeholder interviews (the two Highway Patrol interviews were conducted jointly) identified a number of locations that currently experience operational issues, either continuously or during adverse weather conditions. The significant operational issues identified are listed below:

- I-40 and I-81 experience capacity problems in urban areas, at some interchanges, and on steep mountain grades. Most stakeholders suggest that I-40 and I-81 traffic could justify a basic six-lane cross section across the state.

- There are several areas, including the Gorge area on I-40 near the North Carolina state line, Roane Mountain, and Monterey Mountain, which have steep grades and curves. The speed differential between trucks and autos caused by these steep grades and curves is the major cause of incidents in rural areas.

- Certain mountainous roadway sections in the Cumberland Plateau area and in the Gorge area experience problems when wet or icy.

- Several major river crossings, such as I-40 at the Tennessee River (both east and west Tennessee), I-40 at Percy Priest Dam and I-40 at the Holston River, also experience problems during wet or icy conditions.

- Lack of truck parking areas and spaces for overnight truck parking is major problem statewide.

- The interchange of I-81 and I-40 needs additional capacity.

- Interchanges on I-40 at Genesis Road and Peavine Road in Cumberland County need ramp and bridge improvements.

- Additional capacity is needed through downtown Nashville from I-40/I-24 to I-40/I-440.

- Additional roadway capacity is needed from the existing eight-lane sections in Nashville out to SR-840, both east and west of the city.

3.2 Recommended ITS and HELP Program Improvements

The following ITS and operations improvements were recommended during the stakeholder interviews:

3.2.1 ITS Deployment Recommendations

- The Highway Patrol expressed interest in being able to view TDOT camera images statewide and particularly the rural ITS locations now being implemented. The Highway Patrol would like cameras and signs in more rural areas.

- I-40 at the North Carolina line (Gorge area) has steep grades, curves and ice problems. Because there are no alternate routes, ITS and a weather station would be helpful.

- The Tri-Cities area should be considered for ITS equipment.

- The section of I-40 near the Tennessee River bridge (west Tennessee) has accident problems when wet or icy because of the grades, and ITS equipment such as closed circuit television (CCTV), dynamic message signs (DMS), highway advisory radio (HAR) and bridge monitoring security cameras would be helpful.

- Monterey Mountain should be considered for ITS equipment.

- ITS equipment is needed on I-40 in the Nashville area out to SR-840 in both directions.

3.2.2 HELP Deployment Recommendations

- The Highway Patrol considers HELP services as justified in Tri-Cities and Crossville.

- HELP service in middle Tennessee should be expanded outside Davidson County.

- HELP should to be expanded to 24/7 operations statewide.

- Expand HELP coverage in Nashville on I-40 to SR-840 in both directions.

- Expand HELP on I-40 in Memphis east to the Arlington area.

3.2.3 Other Operational Improvement Recommendations

- TDOT should provide traveler information in rest areas.
- Truck advisory signs and speed warning signs are needed across the state; trucks should be encouraged to drive slower when roads are wet or icy.
- Gates in concrete barrier walls are needed to allow quick access to incident scenes, and remote control from emergency/HELP vehicles is needed.
- Crash investigation sites are needed at key locations across the state.
- In areas with twin bridges, a system should be researched to allow traffic in both directions to use one bridge if the second bridge is blocked for a substantial amount of time. To accomplish this emergency maneuver, a cone-handling system and a crossover area would be needed.
- The existing cloverleaf interchanges in Jackson are in need of review. Connector-distributor (CD) roads are needed between Exits 76 and 87.
- Lighting at interchanges in highly developed or used areas, such as Jackson's interchanges.

4.0 SAFETY AND SECURITY

The Technical Memorandum for Task 1, Systems Inventory and Data Collection, identified locations along the study corridor where accidents exceed the critical accident rate based on information provided by TDOT. TDOT's critical accident rate takes into account traffic exposure and is unique for each location. The use of this measure ensures that the accident rate at a location is not due to chance but to some unfavorable characteristic of local conditions.

In Task 2, the aforementioned crash data was supplemented with field observations provided during interviews conducted with the Regional Directors in TDOT Regions 1, 2, 3 and 4 and the Director of TDOT's Incident Management Program. Representatives of the Tennessee Highway Patrol and Commercial Vehicle Compliance also offered input on locations with a high number or severity of crashes and identified areas which occasionally experience hazardous weather conditions, such as fog, high winds or ice and snow. Interviews conducted with representatives of Tennessee's MPOs, TPOs and RPOs added to this list of safety issues in the I-40 and I-81 corridor, again based on field observations of existing conditions.

Table 4-1 lists locations along the study corridor where accidents exceed TDOT's critical accident rate. **Figure 4-1** to **Figure 4-8** are maps of locations where the number of accidents exceed the critical accident rate as well as locations along I-40 and I-81 suggested during the stakeholder interviews.

This document is covered by 23 USC Section 409, and its production pursuant to a public document records request does not waive the provisions of Section 409.

Table 4-1: Critical Accident Locations from TDOT's Crash Database

ID	Route	From	To	Seg-ments	Spots
1	I-40	Arkansas/Tennessee SL	Levee Rd	6	15
2	I-40	N Watkins St (Exit 2)			1
3	I-40	Jackson Ave (Exit 8)			2
4	I-40	Covington Pike (Exit 10)	Whitten Rd (Exit 14)	3	10
5	I-40	Appling Rd (Exit 15)	N Germantown Pkwy (Exit 16)	1	8
6	I-40	East of SR 222 (Stanton Rd)			1
7	I-40	East of SR 192 (Mercer Rd)			1
8	I-40	US 70 (Exit 66)	SR 138 (Providence Road - Exit 68)	1	1
9	I-40	West of SR 104 (Exit 101)			1
10	I-40	SR 114 (Camden Rd - Exit 116)			1
11	I-40	US 641 (Exit 126)			1
12	I-40	West of SR 191 (Birdsong Rd - Exit 133)			1
13	I-40	SR 191 (Birdsong Rd - Exit 133)	Benton/Humphreys CL	1	5
14	I-40	West of SR 13 (Exit 143)			1
15	I-40	SR 13 (Exit 143)			1
16	I-40	West of SR 46 (Exit 172)			3

ID	Route	From	To	Seg-ments	Spots
17	I-40	West of SR 96 (Exit 182)	SR 96 (Exit 182)		3
18	I-40	SR 249 (Luyben Hills Rd - Exit 188)			1
19	I-40	Cheatham/Davidson CL	McCrory Ln (Exit 192)	2	1
20	I-40	McCrory Ln (Exit 192)	West of Briley Pkwy (Exit 204)		8
21	I-40	West of Briley Pkwy (Exit 204)	I-440 (Exit 206)	2	7
22	I-40	I-440 (Exit 206)	I-65 (Exit 208)	1	3
23	I-40	I-65 (Exit 208)	East of Briley Pkwy (Exit 204)	7	29
24	I-40	East of Briley Pkwy (Exit 215)	East of Donelson Pike (Exit 216)	1	5
25	I-40	East of Donelson Pike (Exit 216)	East of Old Hickory Blvd (Exit 221)		4
26	I-40	SR 171 (Mt Juliet Rd - Exit 226)	SR 109 (Exit 232)		4
27	I-40	SR 109 (Exit 232)	US 70 (Sarta Pike - Exit 239)		6
28	I-40	Linwood Rd (Exit 245)	SR 141 (Exit 254)		3
29	I-40	West of SR 53 (Gordonsville Hwy - Exit 258)	SR 96 (Medley Amonette Rd - Exit 268)		7
30	I-40	SR 136 (Jefferson Ave - Exit 287)			1
31	I-40	US 70 N (Spring St - Exit 290)	US 70 N/SR 84 (Holly St - Exit 300)	1	2
32	I-40	West of Plateau Rd (Exit 311)	East of Plateau Rd (Exit 311)		2
33	I-40	Market St (Exit 329)	SR 299 (Westel Rd - Exit 338)	1	3
34	I-40	SR 299 (Airport Rd - Exit 340)	US 27/SR 61 (Roane St - Exit 347)	2	10
35	I-40	Pine Ridge Rd (Exit 350)			2
36	I-40	East of SR 326 (Gallaher Rd - Exit 356)	East of US 321 (Exit 364)		4
37	I-40	Lovell Rd (Exit - 374)			1
38	I-40	I-140 (Exit 376)	I-640 (Exit 385)	4	15
39	I-40	I-275 (Exit 388)	5th St (Exit 389)	3	8
40	I-40	US 11 W (Rutledge Pike - Exit 392)	Ashville Hwy (Exit 394)	2	9
41	I-40	West of Snyder Rd (Exit 407)	Deep Springs Rd (Exit 412)		3
42	I-40	Deep Springs Rd (Exit 412)	US 25 W/US 70 (Exit 415)		3
43	I-40	US 25 W/US 70 (Exit 415)	SR 92 (Exit 417)		2
44	I-40	I-81 (Exit 421)			2
45	I-81	I-81 (Exit 421)	SR 341 (Exit 4)		1
46	I-81	Hamblen/Greene county line	SR 172 (Exit 36)		6
47	I-81	SR 172 (Exit 36)	Greene/Washington county line		2
48	I-81	Washington/Sullivan county line	I-181 (Exit 46)		3
49	I-81	I-181 (Exit 46)	South Fork Holston River		3
50	I-81	South Fork Holston River	Tennessee/ Virginia State line		2

Figure 4-1: Memphis

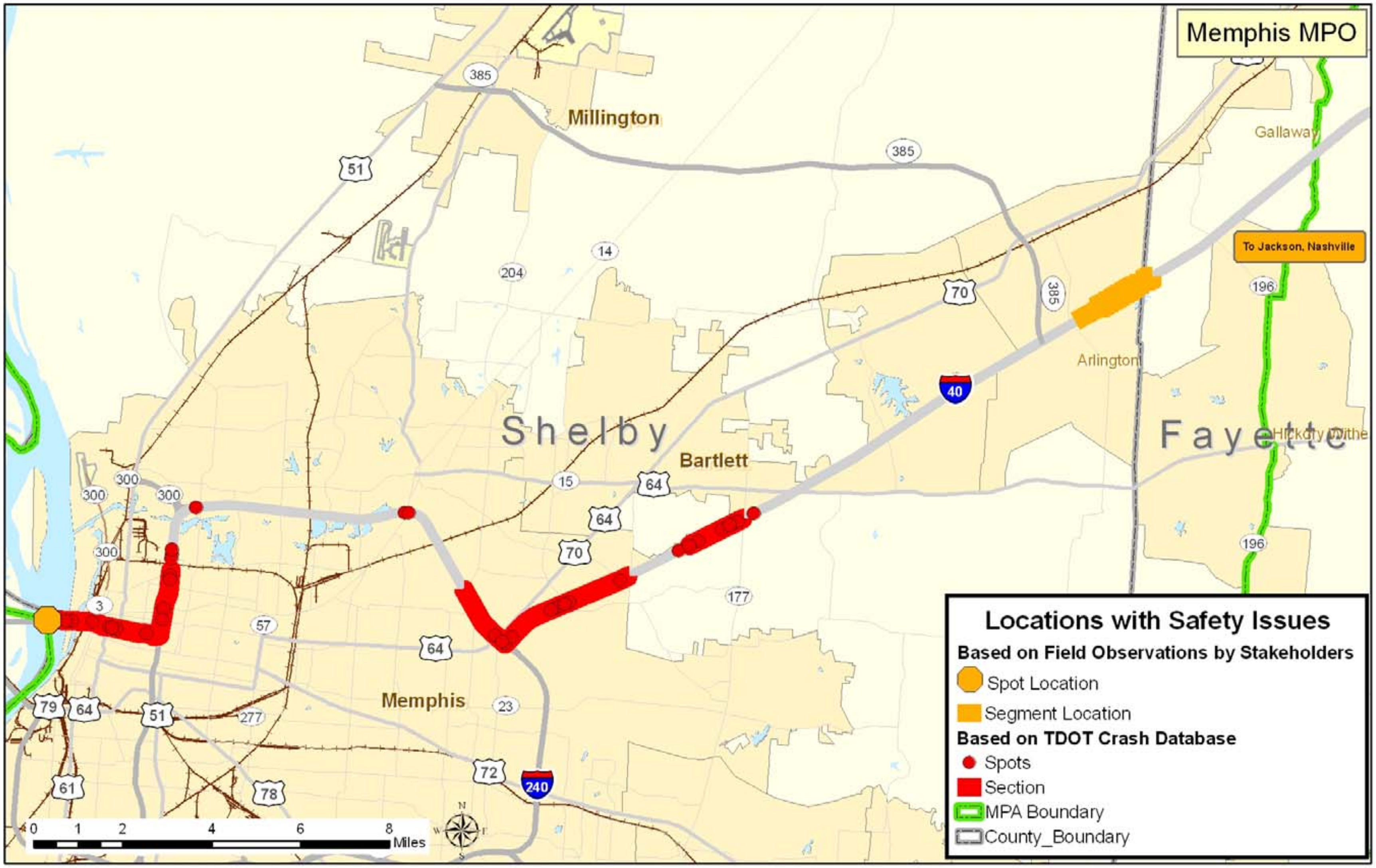


Figure 4-2: Memphis to Jackson

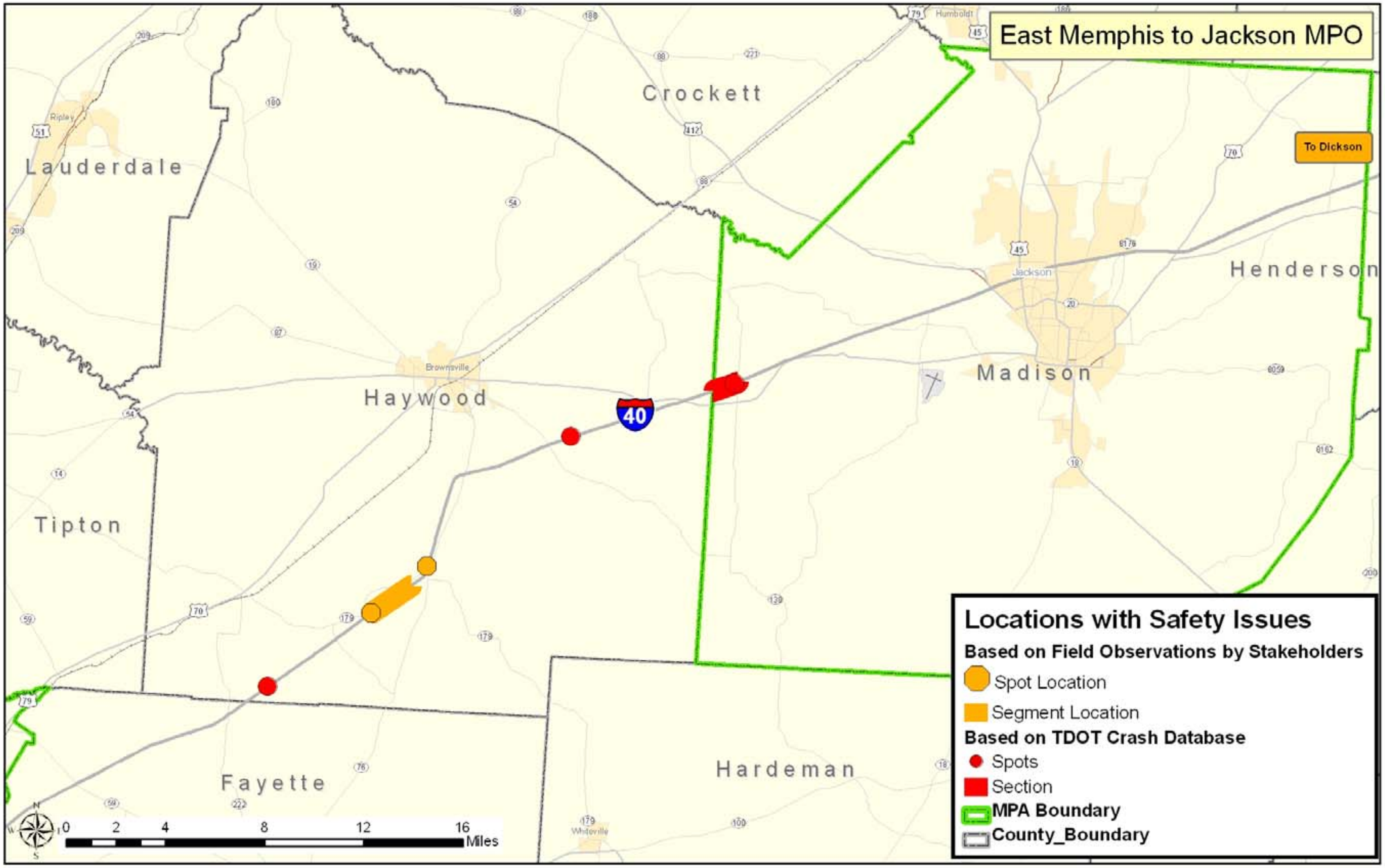


Figure 4-3: Jackson to Nashville

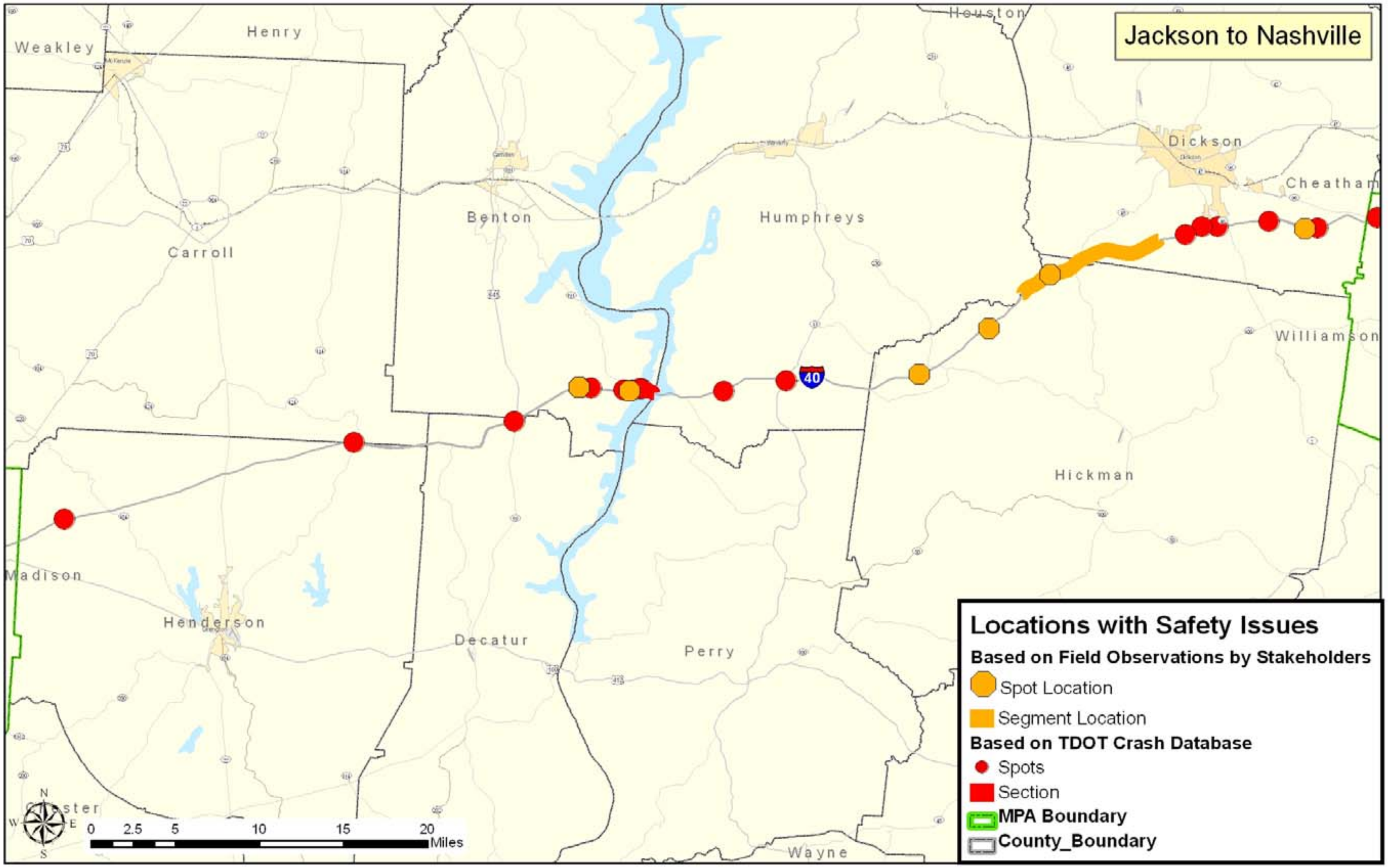


Figure 4-4: Nashville Region

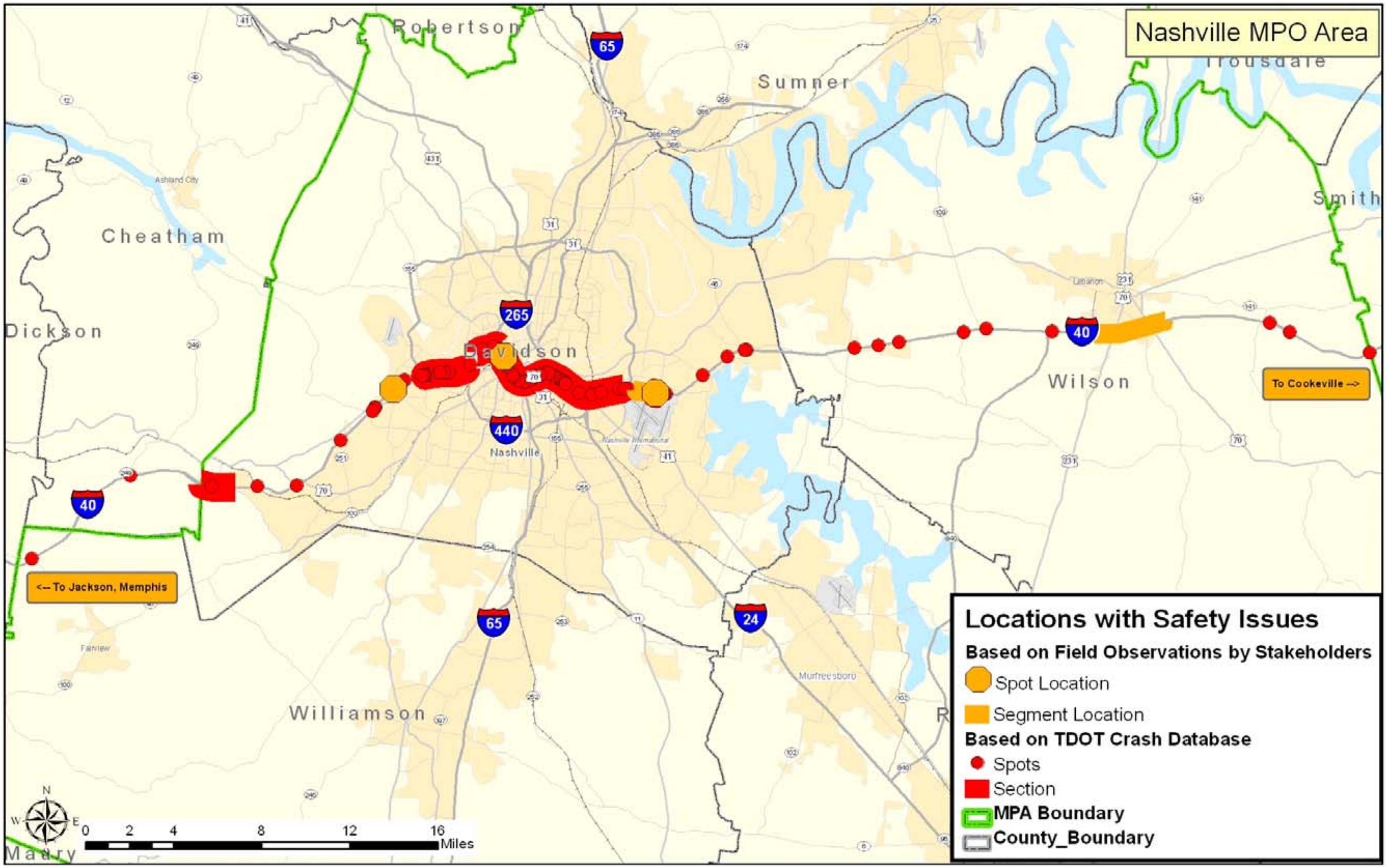


Figure 4-5: Nashville to Cookeville

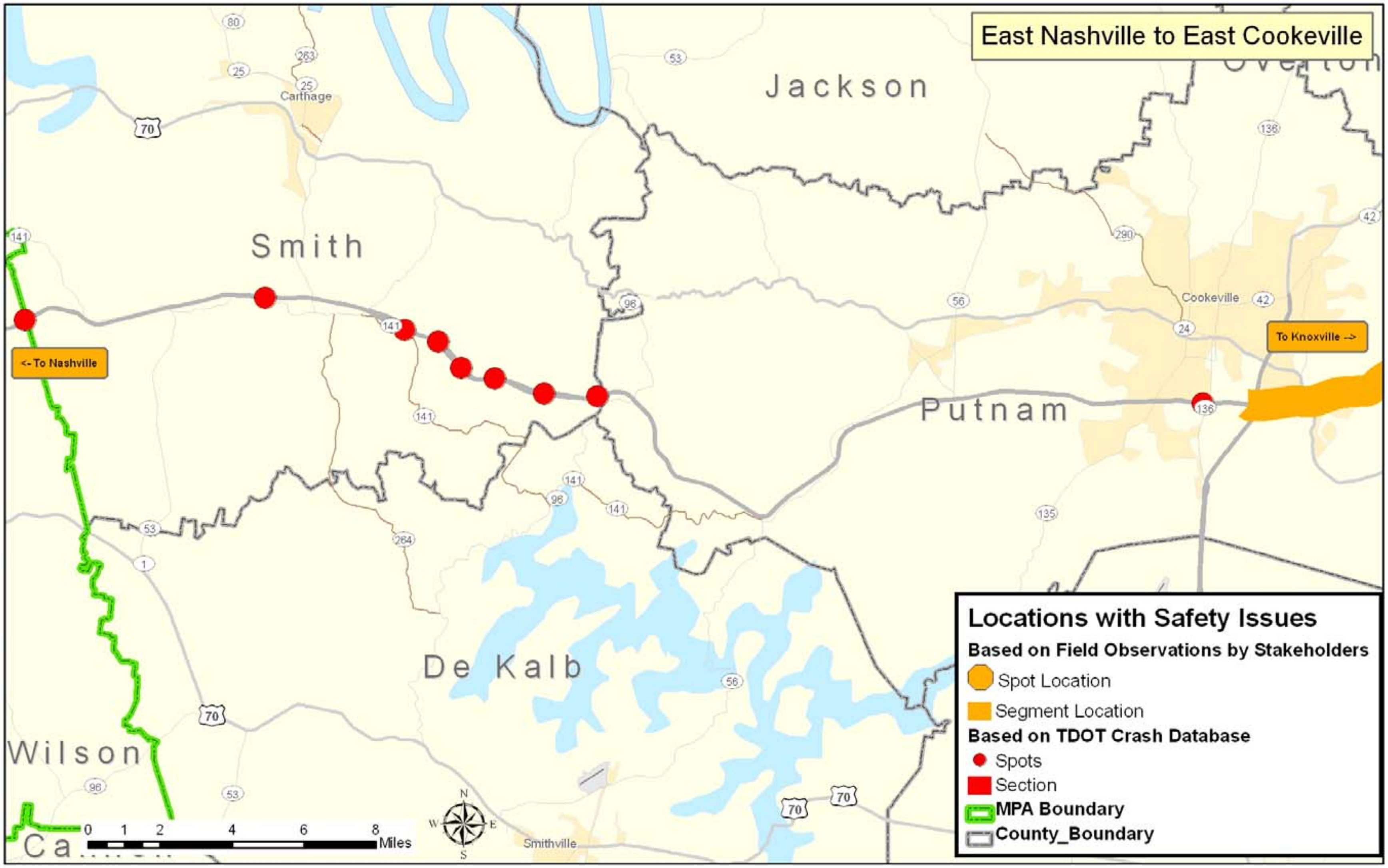


Figure 4-6: Cookeville to Knoxville

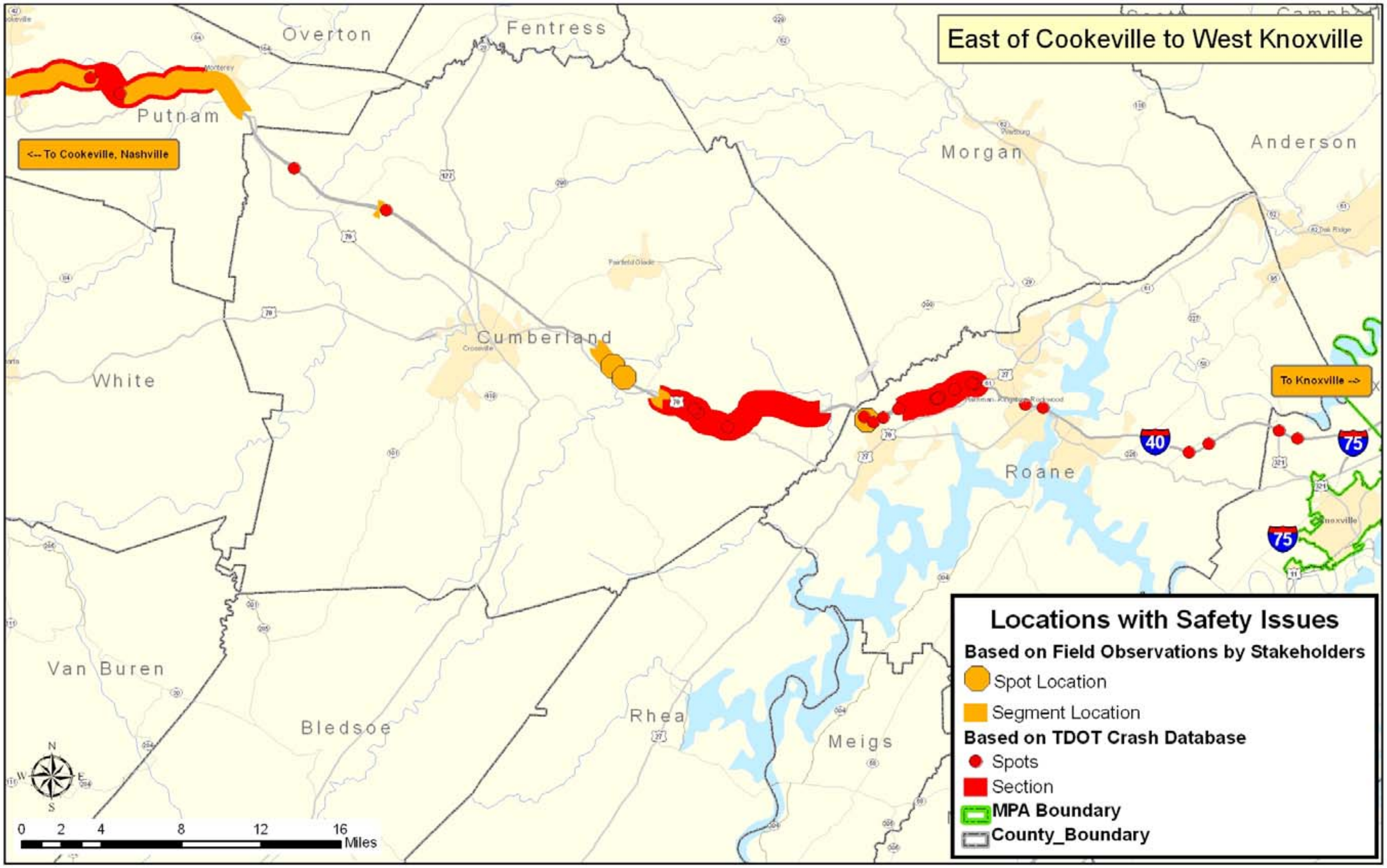


Figure 4-7: Knoxville to Lakeway

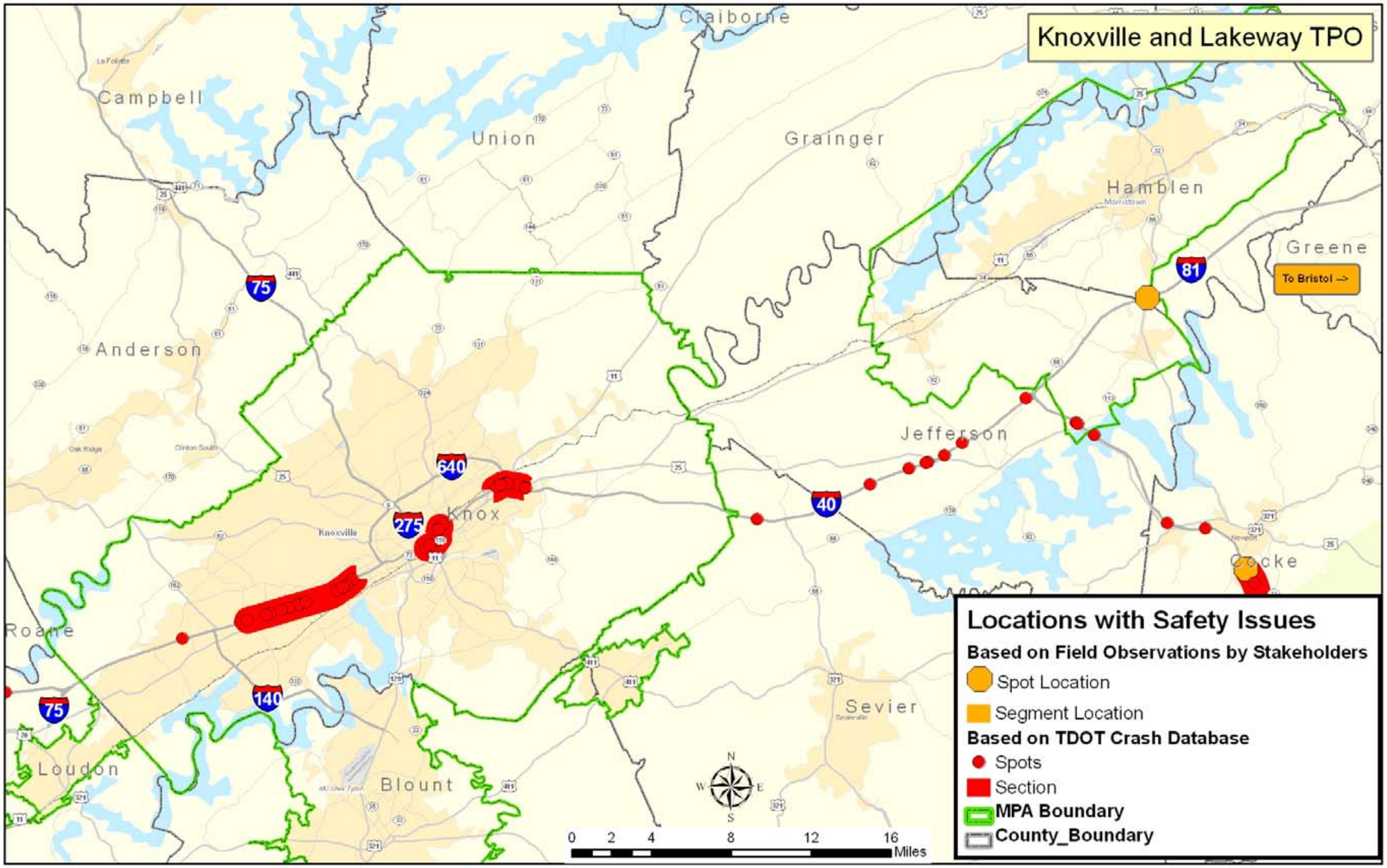
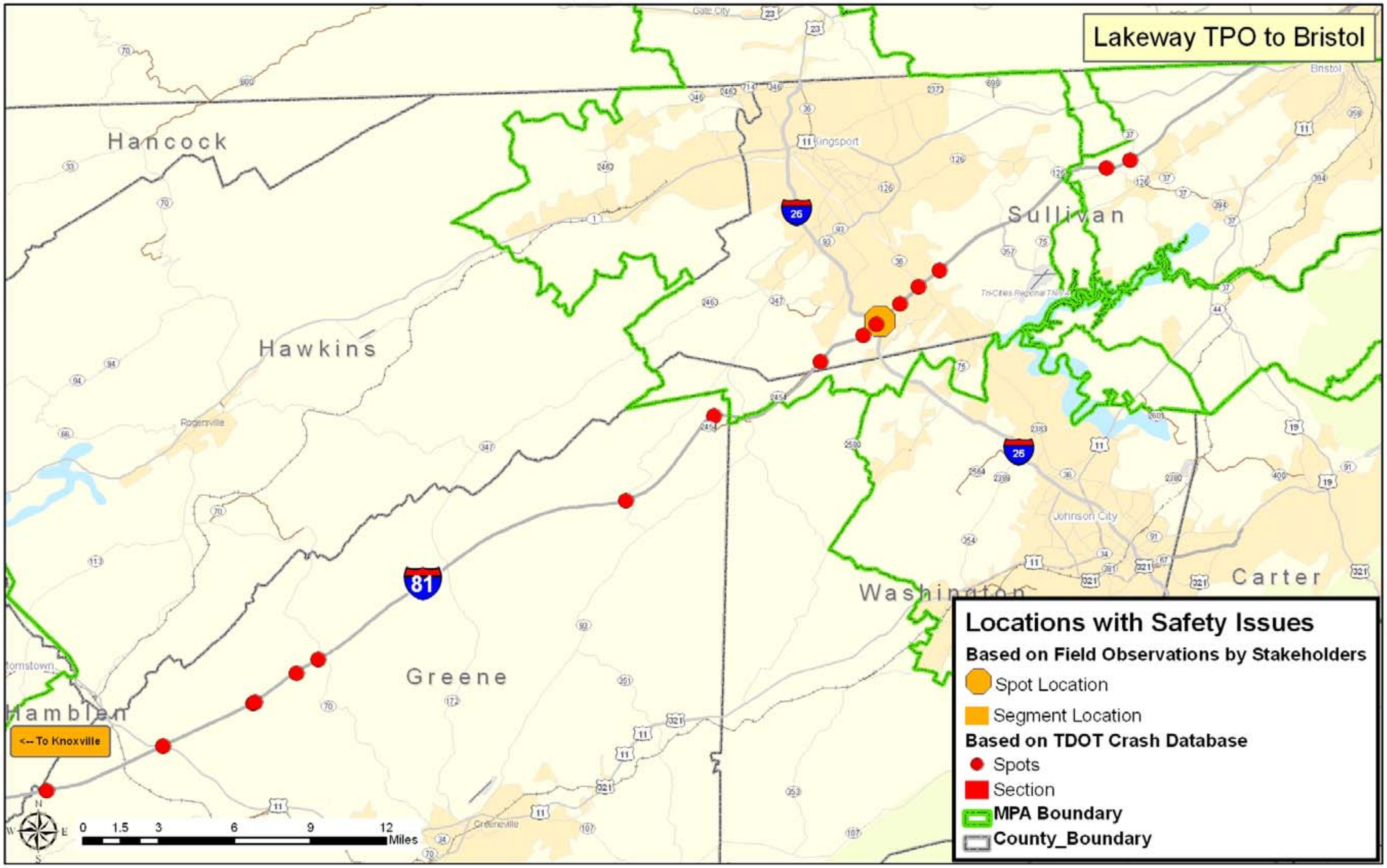


Figure 4-8: Lakeway to Bristol



5.0 FREIGHT MOVEMENT AND DIVERSION

5.1 Freight Movement Impacts on Safety and Operations

Under Task 2, the I-40/I-81 corridor was reviewed to identify those segments that did not meet the steepness and length of grade criteria specified in *A Policy on Geometric Design of Highways and Streets* published by the American Association of State Highway and Transportation Officials (AASHTO). These locations are displayed in **Figure 5-1** through **Figure 5-8**. However, a truck climbing lane may or may not be warranted for any of these segments depending on the projected traffic volumes for the time period which is analyzed.

During interviews with representatives of the Tennessee Department of Safety, they provided their field observations about the availability and issues related to trucks along I-40/I-81. Truck parking is an issue for the entire I-40/I-81 corridor. Because there is insufficient parking for motor carriers at both State-owned rest areas and privately-owned truck stops, drivers park overnight along the interstate and in other parking lots. The Department of Safety is working with the Tennessee Trucking Association to address this problem. The location of State-owned rest areas is also shown in **Figure 5-1** to **Figure 5-8**.

A preliminary truck model run was performed for 2003 and 2030 to develop initial estimates of truck activity outside the urban areas along the corridor. It should be noted that the model was further validated and calibrated after this preliminary run, so the final truck volumes will likely be slightly different than those shown below in **Table 5-1**. The table shows that the model estimates the truck volumes for the western and central portions of the corridor as generally being between 10,000 and 11,000 trucks per day. The eastern portion of the state has more variability in the truck volumes. Just west of the I-40/I-75 merge, truck volumes decrease to 8,200. The I-40/I-75 merged interstate has the highest volume with 18,400 trucks per day followed to the east by the second highest truck volume on the corridor on I-40 just before the I-81 junction. The I-81 segment of the corridor has the lowest truck model volumes with around 8,000 trucks per day. It should be noted that truck volumes inside the urban areas will likely have the highest values, but this will need to be confirmed through use of the urban travel demand models.

The model indicates that the growth is roughly even throughout the state. Most locations roughly double between 2003 and 2030 in terms of truck volumes. All but the two most eastern locations along the corridor have 2003 to 2030 truck volume growth between 113 percent and 133 percent.

Table 5-1: Preliminary Truck Model Volume Outputs

Route	General Location	Truck Volumes		
		2003	2030	Growth
I-40	Just east of Memphis	10,600	22,600	113%
I-40	West of Jackson	10,200	22,000	116%
I-40	East of Jackson	10,500	22,900	118%
I-40	Just east of Hwy 840 (outside Nashville, West	10,500	23,700	126%
I-40	Just east of Hwy 840 (outside Nashville) East	11,100	25,800	132%
I-40	Just west of Cookeville	10,600	24,300	129%
I-40	Just east of Cookeville	10,000	23,300	133%
I-40	Just west of I-75 (in Kingston)	8,200	19,100	133%
I-40/I-75	Near I-140	18,400	41,200	124%
I-40	West of I-81 Jct	12,900	29,400	128%
I-81	East of I-40 Jct	8,300	19,100	130%
I-81	West of I-26	6,900	13,900	101%
I-81	At VA State Line	7,500	9,000	20%

These truck volumes indicate that steep grades and curves will have a roughly equivalent impact on trucks outside the urban areas in the western part of Tennessee. However, the steep grades noted in **Figure 5-7** on the merged interstate I-40/I-75 will have a particularly onerous impact on trucks because the truck volumes are particularly high at that location. This is noteworthy because the high percentage of trucks and the high volume of automobiles on this segment will likely lead to significant operational issues. Interviews of TDOT Region staff and the Tennessee Highway Patrol reinforced the notion of locations with steep grades and sharp curves being operationally deficient along I-40/I-81.

High accident locations on the merged portion of I-40/I-75 will have the greatest impact on trucking activity, because of the high truck volumes on this portion of the interstate. There is a long segment along this merged interstate that has a higher accident rate than TDOT's critical accident rate (**Figure 4-7**). This is noteworthy because a combination of high rate of accidents and high volumes of both trucks and automobiles will lead to a higher than normal rate of truck-auto accidents and these accidents are the most severe in terms of property damage, injury and fatalities. The Memphis and Knoxville urbanized areas are also locations where the accident rate is higher than TDOT's critical accident rate (**Figure 4-1** and **Figure 4-4** respectively). These are also likely the locations with the highest truck and auto volumes which further indicate corridor segments where truck-auto incidents are higher than normal.

Figure 5-1: Memphis

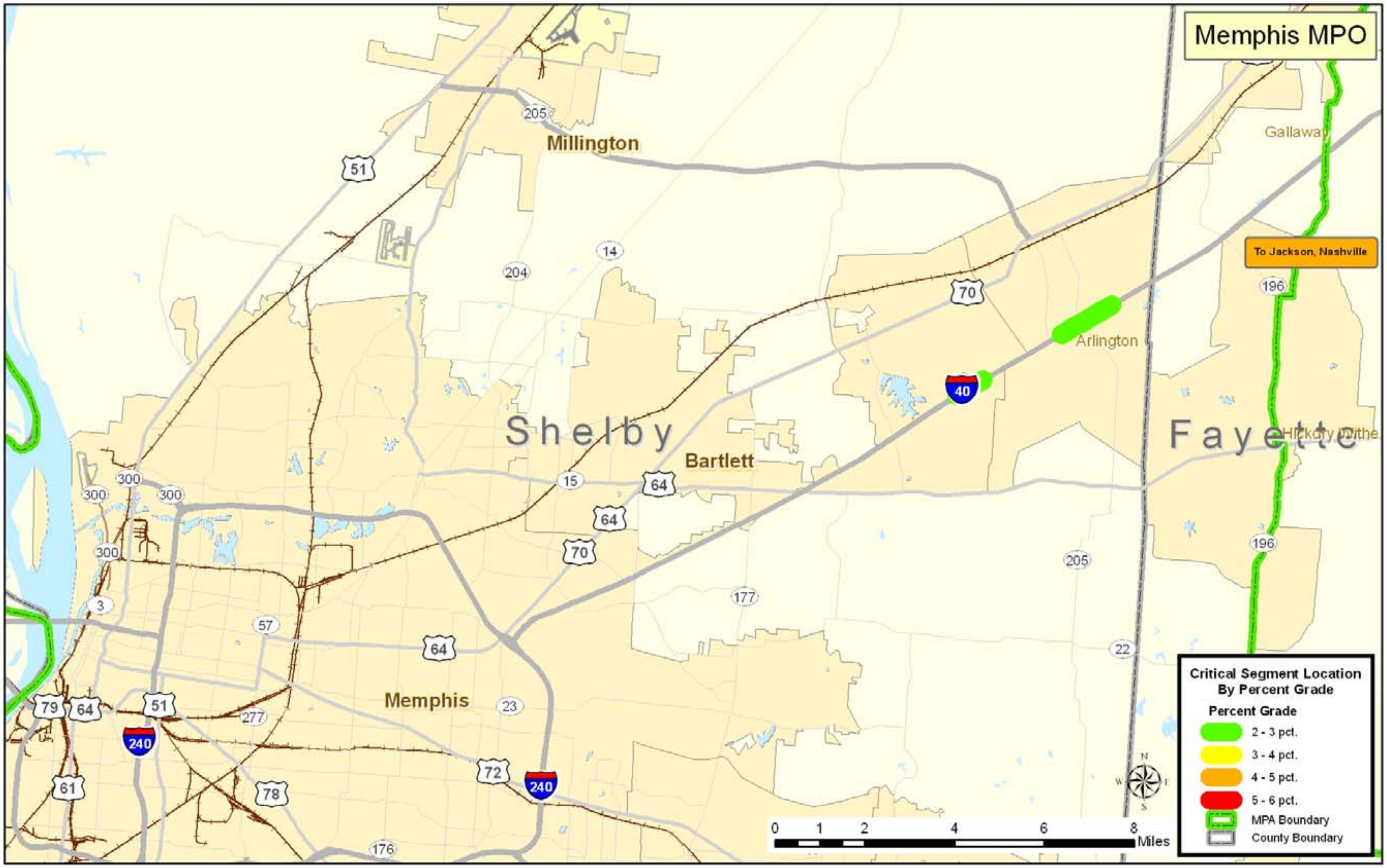


Figure 5-2: Memphis to Jackson

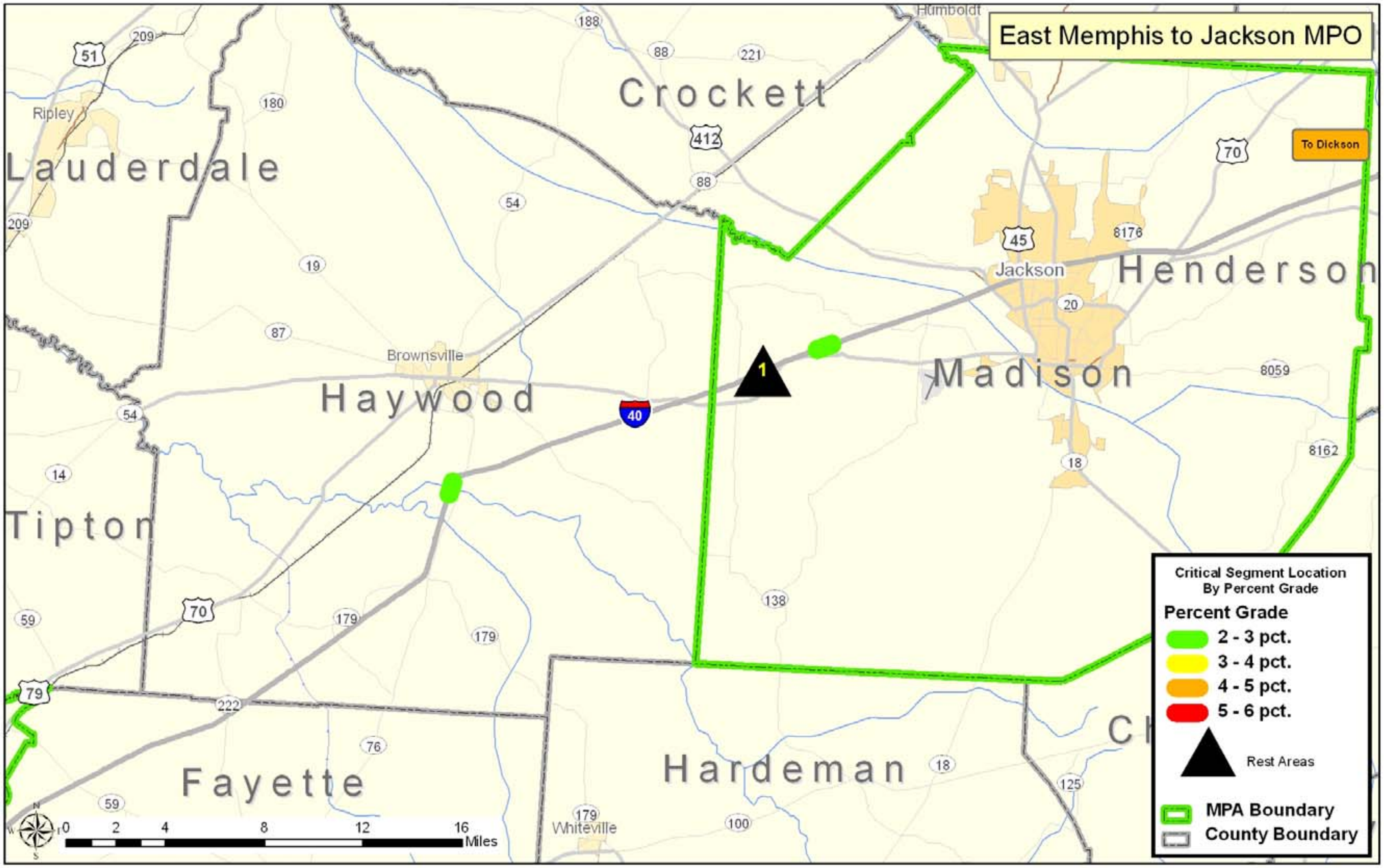


Figure 5-3: Jackson to Nashville

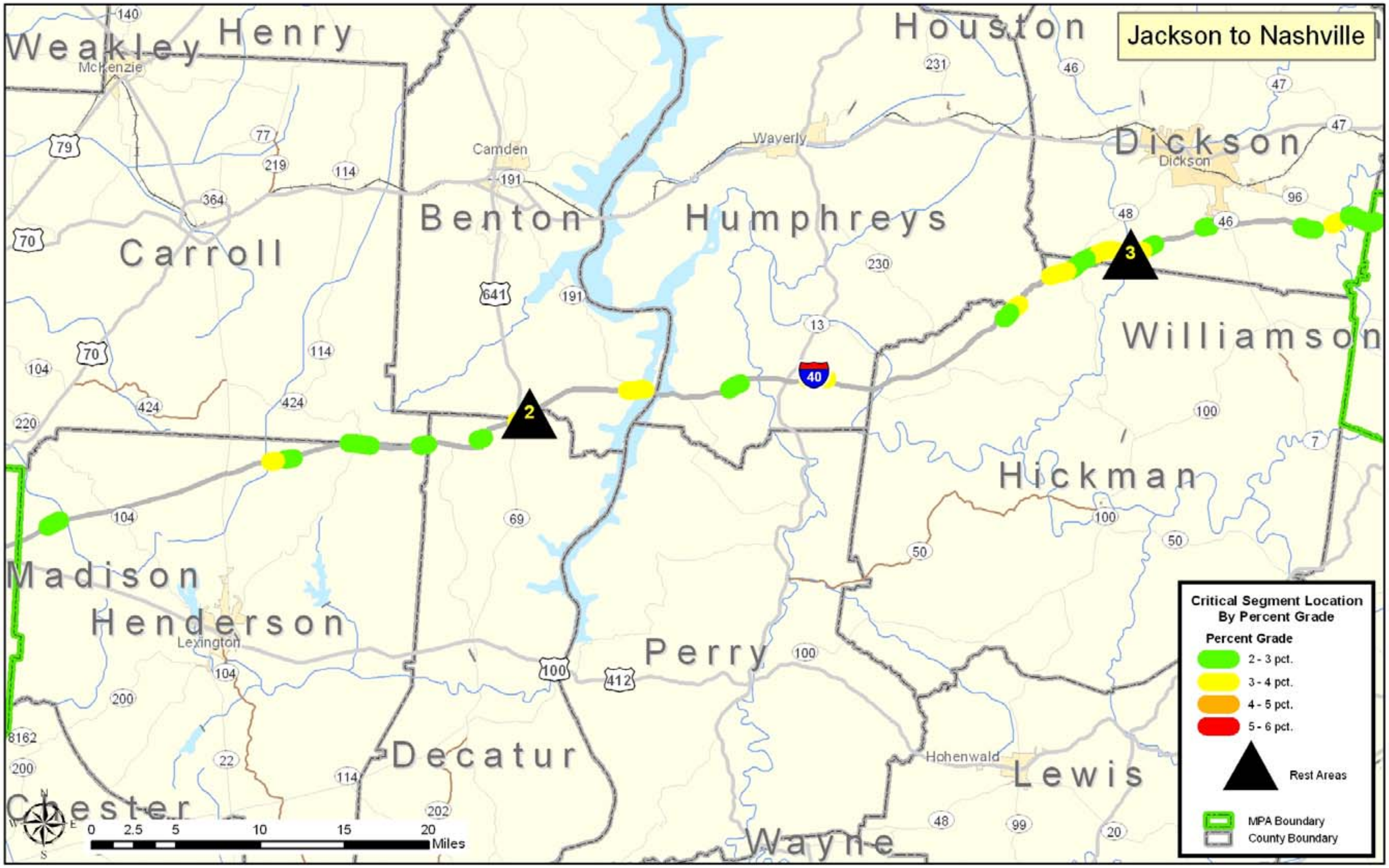


Figure 5-4: Nashville Region

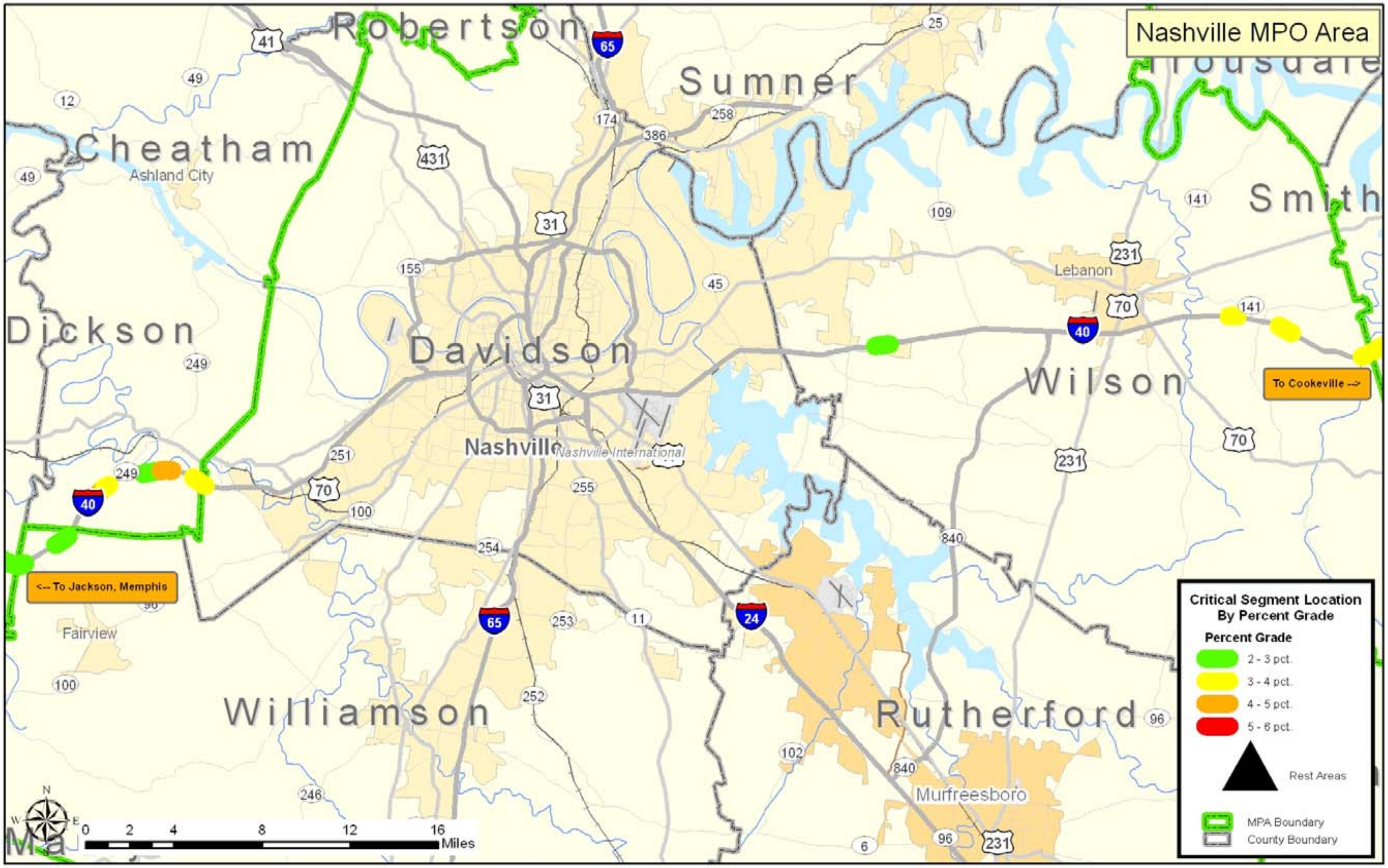


Figure 5-5: Nashville to Cookeville

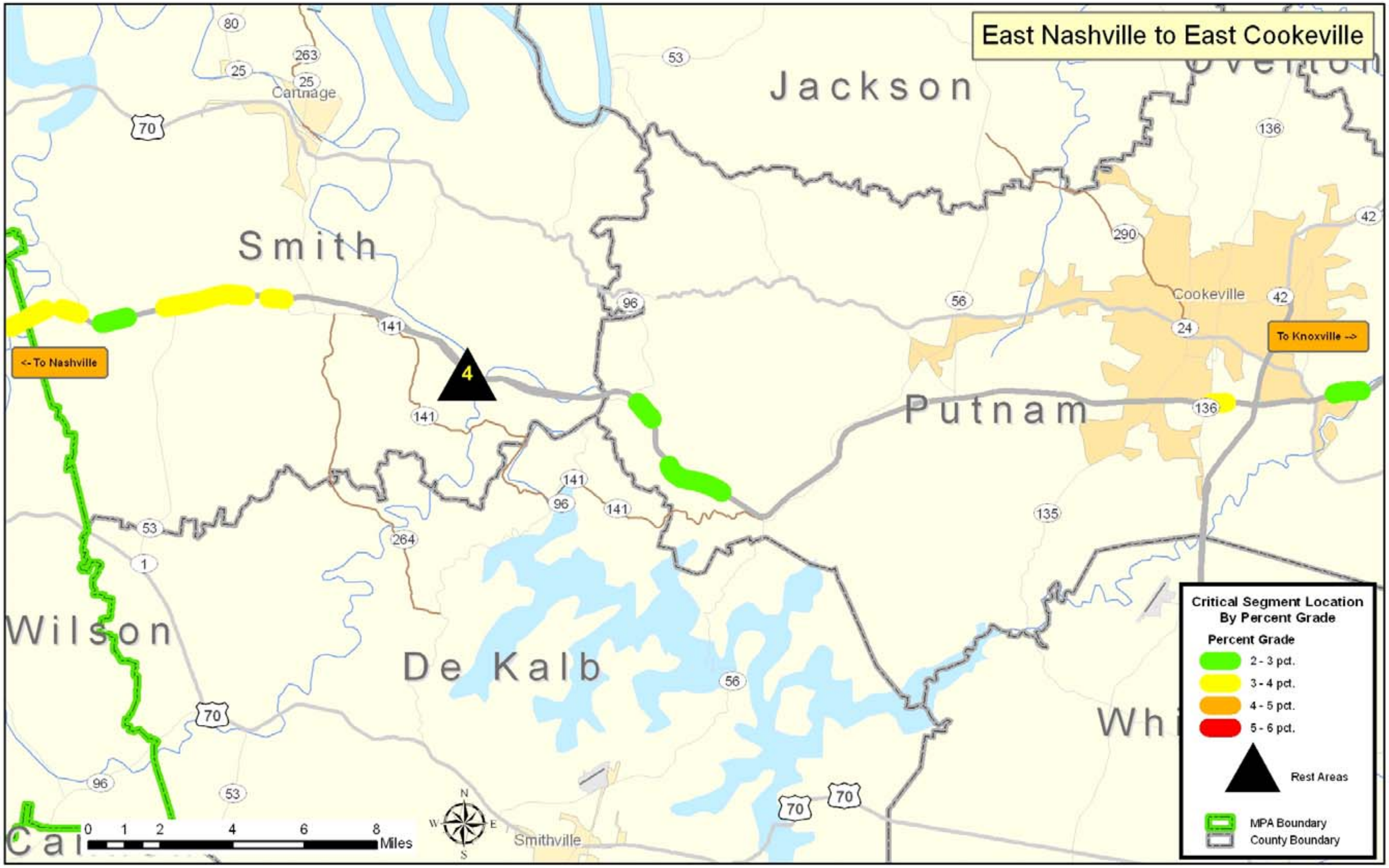


Figure 5-6: Cookeville to Knoxville

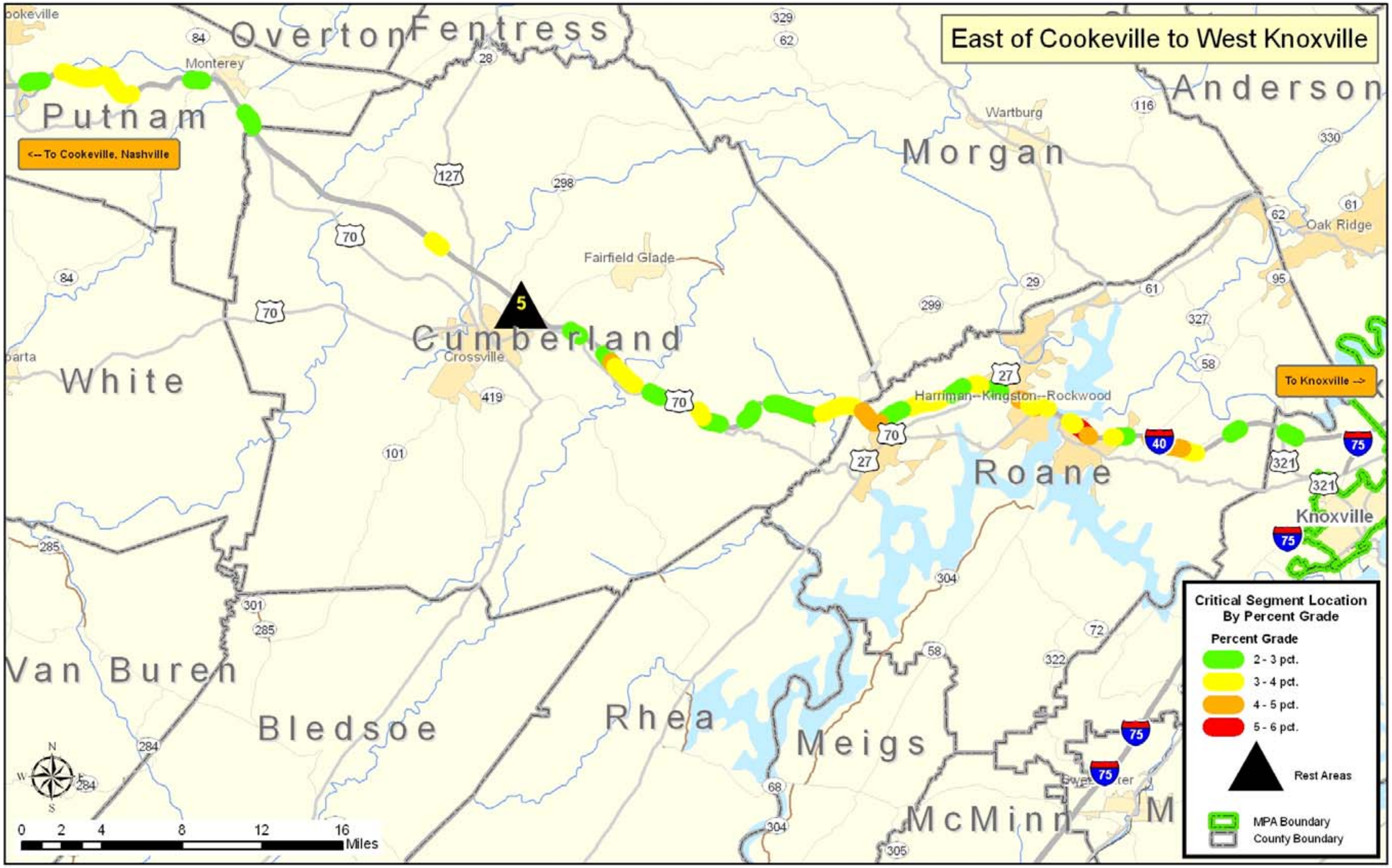


Figure 5-7: Knoxville to Lakeway

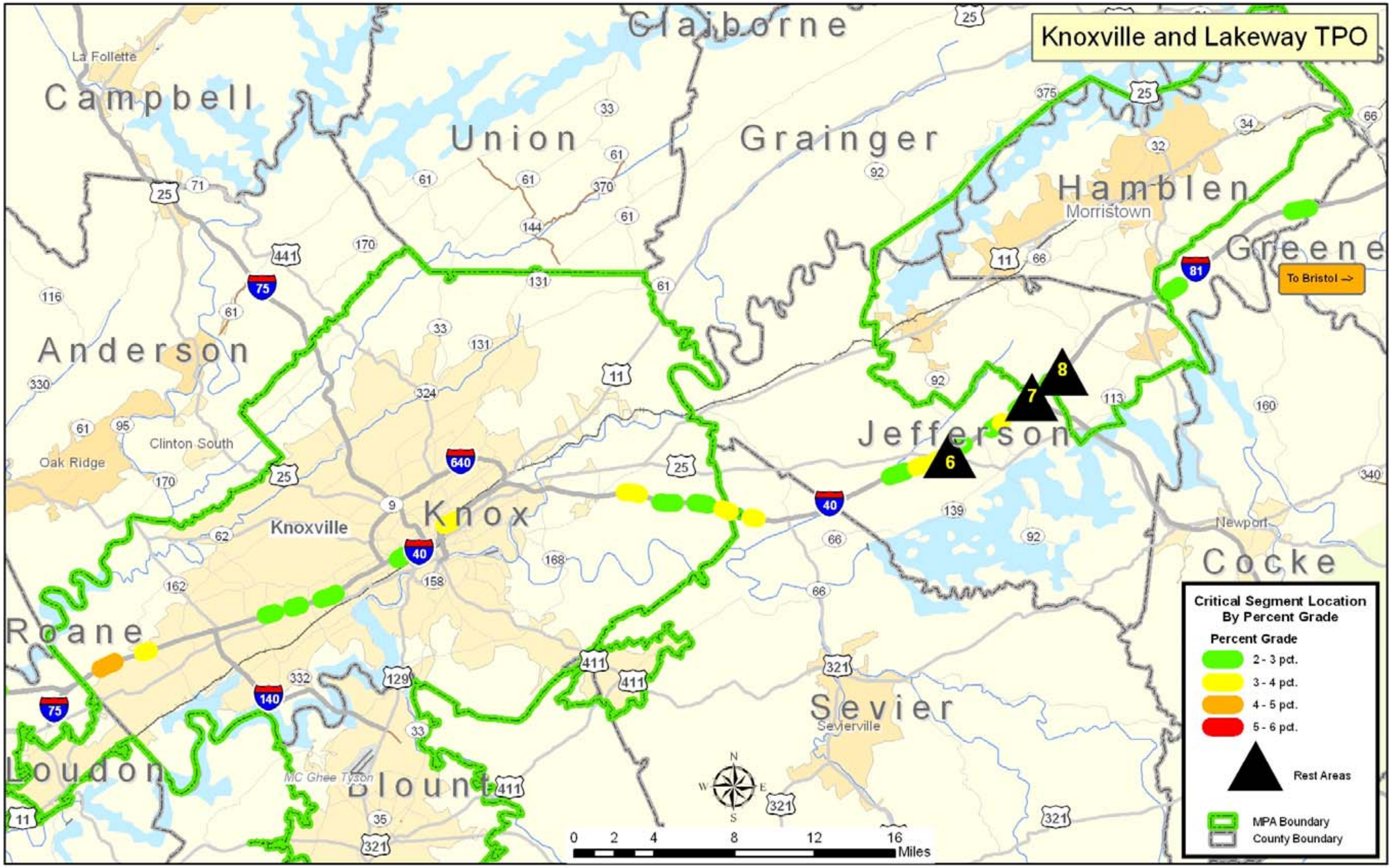
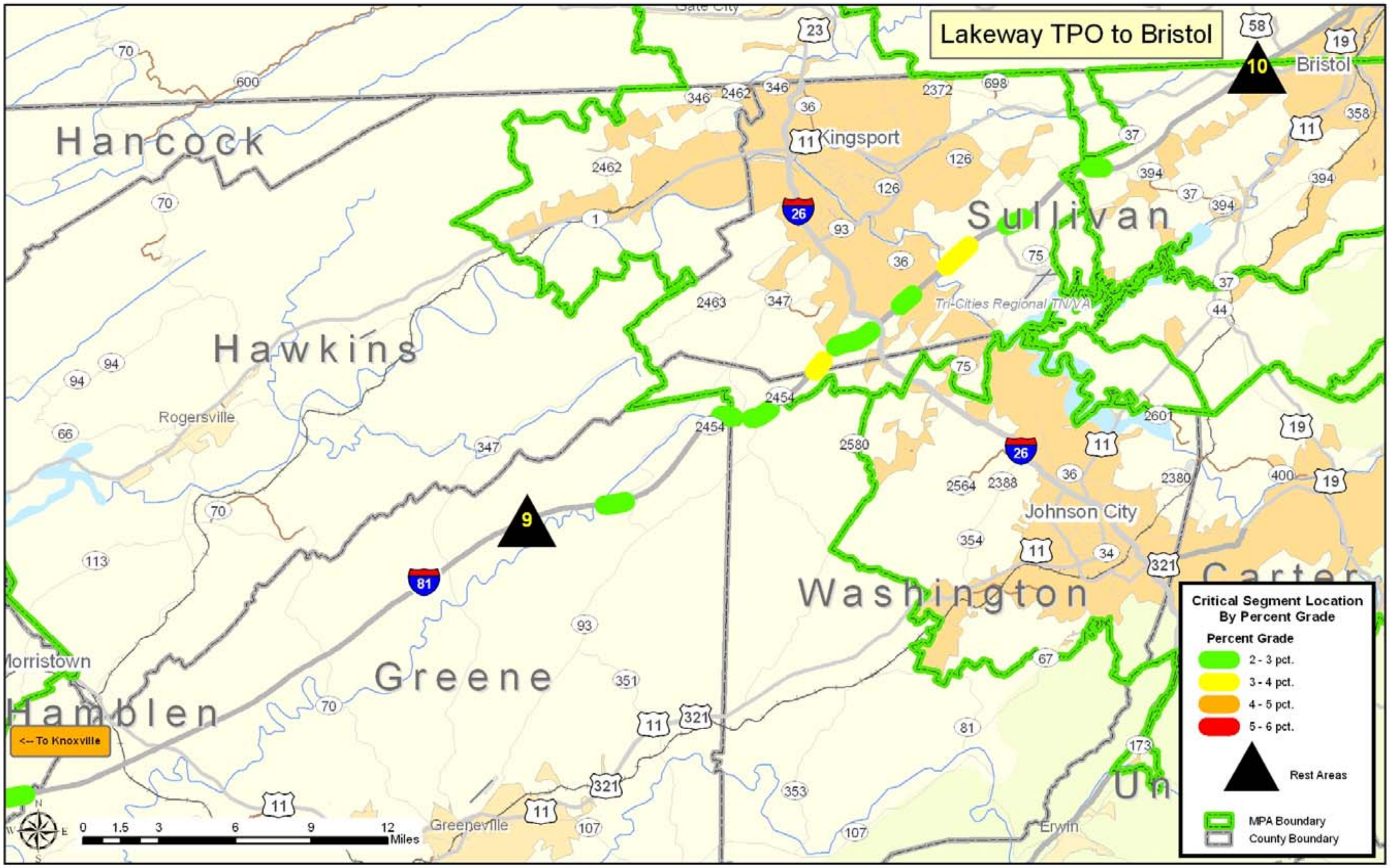


Figure 5-8: Lakeway to Bristol



5.2 Freight/Passenger Diversion to Rail

5.2.1 Truck-Rail Diversion Tool

A truck-rail diversion tool was developed to estimate the amount of freight diverting from truck to rail for scenario analysis of the I-40/I-81 corridor. The diversion is calculated based on the relative cost of shipping for truck and rail, the commodity distribution along the corridor, and the length of haul for freight trips that use the corridor. The truck-rail diversion tool functions as a pre-processor to the TDOT statewide model.

Truck-Rail Diversion Methodologies Considered

There were three methodologies considered in the development of the truck-rail diversion tool:

- “What If” Analysis – An iterative trial and error approach that would be used to arrive at the degree of truck-rail diversion needed to shift a pre-determined number or percentage of trucks to rail.

- Intermodal Transportation and Inventory Cost (ITIC) Model – A Federal Railroad Administration (FRA)-developed, PC-based model that would be used to estimate the diversion generated by the change in level of service and/or price for both truck and rail.

- TDOT Freight Rail Model – An approach that would use the pre-existing TDOT freight rail network and assignment methodology along with commodity-specific, truck-rail cross-elasticities.

It was determined that the “What If” analysis would not provide the flexibility in terms of applying the tool to alternative scenarios that will be considered in future tasks for this study. Additionally, a similar analysis has already been performed in development of the TDOT freight model. Therefore, the “What If” methodology was not selected. The FRA ITIC model requires large amount of truck and rail level of service data that are not readily available for this study. This methodology is best used when there is significant private sector involvement in the model development to ensure that the levels of service are modeled accurately. Additionally, the ITIC model is structured to analyze origin-destination pairs one at a time. This does not match with the origin-destination data available in TDOT’s TRANSEARCH database which has thousands of O-D pairs that would need to be tested individually to develop an output for the ITIC model. Based on these limitations, the ITIC model was not selected as the truck-rail diversion tool.

The pre-existing TDOT freight rail network and assignment was selected as the basis for developing the truck-rail diversion tool for several reasons. First, it runs off of TDOT’s TRANSEARCH database, which is readily available for incorporating into the tool. The TRANSEARCH database also provides a straightforward mode diversion step since it includes both truck and rail flows from identical O-D pairs. Additionally, the traffic analysis zone structure in the TDOT rail network is the state’s counties. This structure will allow for a large amount of flexibility during the alternatives analysis section. One note on the rail network is that it does not include any capacity restrictions. This could result in certain rail lines being assigned rail volumes that are beyond their actual carrying capacities. To mitigate this potential outcome, capacity increases on specific rail lines will be discussed with the Class I railroads if there are alternatives that result in large increases in volume.

Overview of Truck-Rail Diversion Tool Methodology

The steps used to estimate truck-rail diversion when considering alternatives that improve freight rail flows include:

- Run the 2030 No-Build scenario to determine the rail travel distances between all O-D pairs in the rail freight trip table.
- Run the 2030 Build scenario to determine the rail travel distances between all O-D pairs in the rail freight trip table.
- Determine the cost for all O-D pairs based on those distances for the No-Build and Build scenarios.
- Estimate the percentage change in cost for all O-D pairs based on the change in distance between the scenarios.
- Estimate freight diversion by commodity based on changes in rail cost.
- Apply the percentage diversion from truck to rail to the TDOT Freight Model truck tables.

The steps used to estimate truck-rail diversion when considering alternatives that improve truck flows are similar, except that the truck model Build and No-Build scenarios would be used. Changes in truck costs would be estimated using value-of-time data for trucks, and the diversion would be estimated based on these truck cost changes.

Application of Truck-Rail Diversion Tool

To further illustrate how the truck-rail diversion analysis would be applied the amount of truck-rail diversion that would occur from the development of a rail link between Crossville and Cookeville was estimated. Developing this link would enable freight rail to travel from Knoxville to Memphis through Nashville rather than using the current route through Huntsville, Alabama. A schematic of this rail link is shown in the dashed red line in **Figure 5-9.**

The TDOT freight rail network was used as the base case, or No-Build scenario. The missing rail link from Crossville to Cookeville was added to create the 2030 Build scenario. The FRA shapefile was used as a guide for link shape, length, and placement. The assignment scripts in the TDOT Rail Freight Model use a field in the rail network, NEWLENGTH, which is a combination of the actual distance on a rail link plus a penalty developed during validation to match observed flows. The 2030 No-Build and Build scenarios were run using the field NEWLENGTH as an impedance variable. The resulting network skim tables for distances used to determine the change in distance for all O-D pairs.

The change in cost resulting from this change in distance was estimated using rail cost formulas developed as part of the New York City Economic Development Commission Cross Harbor Freight Movement Project. The formulas are:

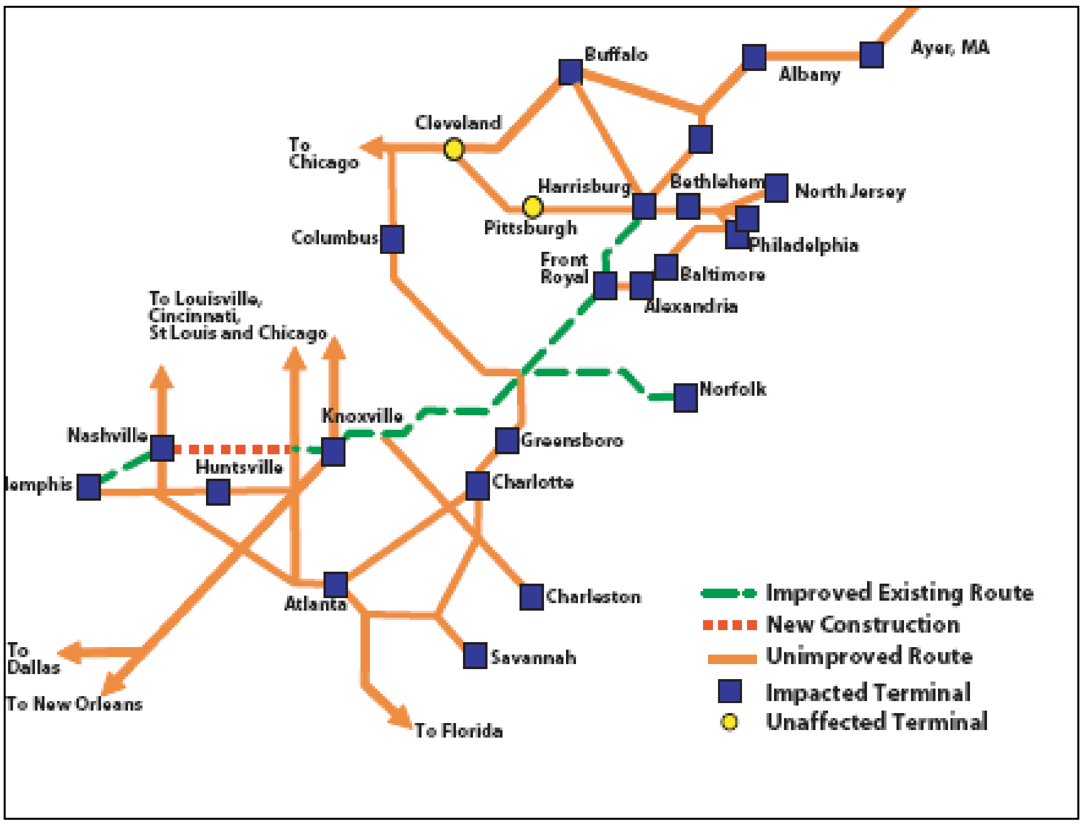
For carload rail, cost/ton = $14.55 + $0.025 * miles

For intermodal rail, cost/ton = $20.84 + $0.028 * miles

These costs are expressed in 2000 dollars, but because this analysis only uses the percentage changes in cost, there was no need to adjust the cost formulas for inflation.

The next step was to apply commodity-specific cross-elasticities to the percent change in cost to obtain the total truck-rail freight diversion. Commodity specific cross-elasticities were developed using estimates from a prior research study done by Adelwahab[1]. These are shown in **Table 5-2**. Descriptions of the commodity groups used in this research, corresponding two-digit STCC codes, and the associated rail-truck cross-price elasticities also are provided in **Table 5-2**.

Figure 5-9: Schematic Showing Nashville-Knoxville Line



Source: *An Evaluation of the Tennessee Rail Plan's Treatment of the Trans-Tennessee Rail Routing.*

[1] *Elasticities of Mode Choice Probabilities and Market Elasticities for Demand: Evidence from a Simultaneous Mode Choice/Shipment-Size Freight Transport Model*, Adelwahab, July 1998.

Table 5-2: Cross-Elasticities by Commodity

Adelwahab Commodity Code	Corresponding Two-digit STCC	Industry Description	Cross Elasticity
1	20 21	Food and kindred products Tobacco products	0.67
2	22 23	Textile mill products Apparel and other finished textile products	0.62
3	28 29	Chemicals and allied products Petroleum and coal	0.96
4	30 31	Rubber/plastics Leather	0.79
5	33 34	Metal Metal products	1.11
6	36 37	Electrical Equipment Transportation Equipment	0.86
7	32	Clay, Concrete, Glass	1.05
8	24 25 26	Lumber Furniture Paper	0.77

A commodity bridge was then developed to associate the estimated commodity categories to those in the TDOT model. The commodity bridge and cross-elasticity values are shown in **Table 5-3**. The cross-elasticities represent the percentage change from truck to rail that would result as a result of a 1 percent change in rail cost. As shown in **Table 5-3**, the cross elasticity for Food Products should be interpreted as a 0.67 percent diversion from truck to rail as a result of a 1 percent reduction in rail cost. As expected, the cross elasticity for high value, low weight goods (e.g. containers and food products) are low compare to those for low value, high weight, time-insensitive goods (e.g., waste materials and primary metals). Because the modal elasticities are dimensionless and there is no change as a result of this project in empty truck usage and/or the conversion from tons to trucks, these percentage changes can be applied to either annual truck tonnage or, as will be the case in this application, to daily truck vehicle trips.

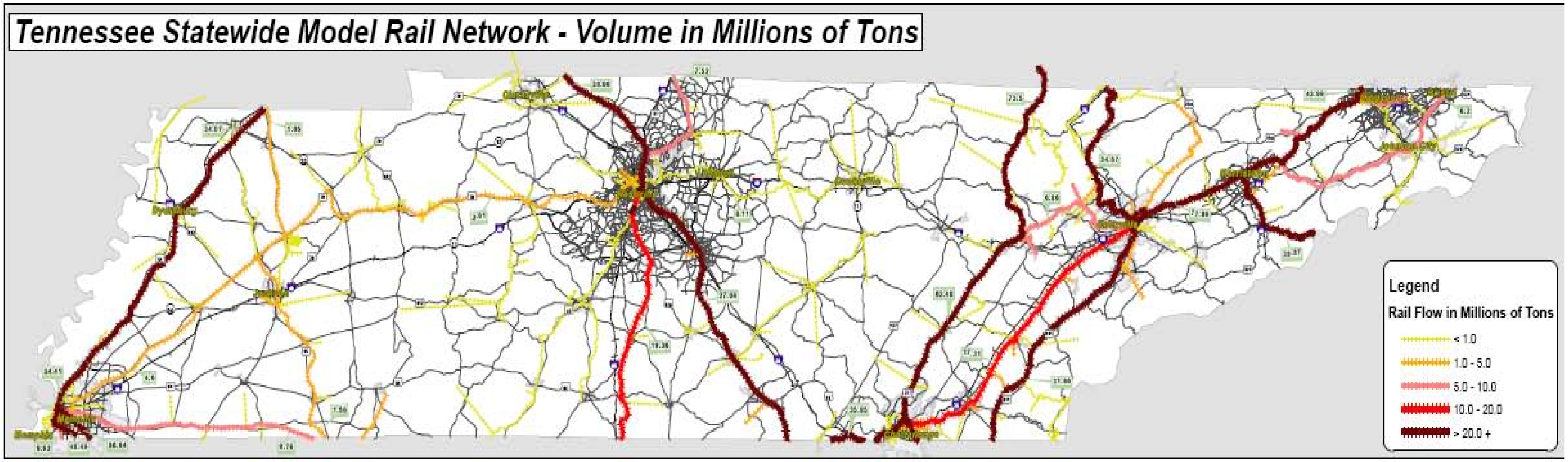
Table 5-3: Commodity Bridge Table

TDOT Commodity Code	TDOT Commodity Name	Adelwahab Commodity Code	Cross Elasticity
1	Petroleum and minerals	3	0.96
2	Food products	1	0.67
3	Chemicals	3	0.96
4	Timber and lumber	8	0.77
5	Agriculture	2	0.62
6	Machinery	6	0.86
7	Paper products	7	1.05
8	Primary metal	5	1.11
9	Waste materials	5	1.11
10	Manufactured household and other	7	1.05
11	Miscellaneous and container	2	0.62

The changes in costs were prepared for each of the 147 rail origin TAZ by 147 rail destination TAZ pairs in the rail model. An equivalency file between the 1397 truck TAZs and the Rail TAZs was developed using TAZ polygon shapefiles provided by TDOT. TDOT provided a table of daily truck flows by TDOT commodity code. As documented in the TDOT Freight Model, these daily truck tables have been adjusted to account for empty trucks and have been validated to observed flows.

The percentage diversion from truck to rail based on the changes in distance based costs and the commodity specific truck-rail cross elasticities were applied to the TDOT Freight Model Truck table. That truck table is used directly in the TDOT Synthetic (highway) Model. The Synthetic model was run with both the Build and No-Build truck trip tables to identify the diversion of truck volumes on specific sections of the highway network. The resulting assignment of the diverted traffic is shown in **Figure 5-10**.

Figure 5-10: Assigned Rail Flows Using Truck-Rail Diversion Analysis Tool



6.0 ECONOMIC ACCESS

In Task 1, the need for additional or enhanced access to I-40 and I-81 was identified through a review of the Long Range Transportation Plans (LRTPs) from the urban areas in the study corridor. The Task 1 Technical Memorandum also listed new interchanges based on Interchange Justification Studies (IJS) prepared by TDOT staff.

In Task 2, representatives of the MPOs and RPOs along the study corridor were asked to identify any new interchanges that had not surfaced through the review of the LRTPs and IJSs. The interviewees from the MPOs and RPOs also revealed foreseeable land developments along the corridor that could have substantial influence on I-40 and I-81 operations, providing information on where and when these developments may occur. The Tennessee Department of Economic and Community Development (TDECD) identified the Tennessee Valley Authority (TVA) certified megasites and other large sites along the I-40/I-81 corridor being marketed for economic development.

Table 6-1 lists the new interchanges or interchange improvements identified to increase access to areas along the study corridor through plans or stakeholder input. **Figure 6-1** and **Figure 6-2** show the location of these proposed interchange projects on I-40 and I-81 along with the TVA megasites and other large development sites.

Table 6-1: New Interchanges or Interchange Improvements for Economic Access

PROJECT	SOURCE	HORIZON YEAR	NOTES
1) I-40 at SR 196 (Hickory Wythe Rd) (Fayette County) – planned interchange	Memphis LRTP, TDOT IJS, In PE in 2007		Access to expanding residential areas
2) I-40 at Central Pike (Wilson County) – planned interchange	Nashville LRTP	2016	Access to developing area of Mt. Juliet
3) I-40 at Mine Lick Creek Rd (Putnam County) – planned interchange	TDOT IJS, EA approved in 2006	2009	Access to potential industrial park
4) I-40 at SR-66 (Exit 407 in Sevier County) – planned interchange improvement	Stakeholder Interview, TPR underway		Access to existing and proposed development
5) I-81 at Exit 56 (Sullivan County) – suggested upgrade	Stakeholder Interview		Increasing industrial development
6) I-81 near US 25 E (Hamblen County) – suggested new interchange	Stakeholder Interview		Access to East Tennessee Progress Center

During interviews with MPO and RPO staff in the Jackson area, and TDOT Region 4 staff, the use of I-40 in the Jackson area as a “main street” was identified. Because of the lack of good east-west parallel roads to I-40 in this area, many people use I-40 as they would an arterial roadway to access the numerous commercial, industrial and institutional uses that have located and are expanding in the north Jackson area. Exit 80 at I-40 and Vann Drive was identified as a problem area in need of upgrading to eliminate confusion related to turn lane and ramp configurations.

Figure 6-1: West of Nashville

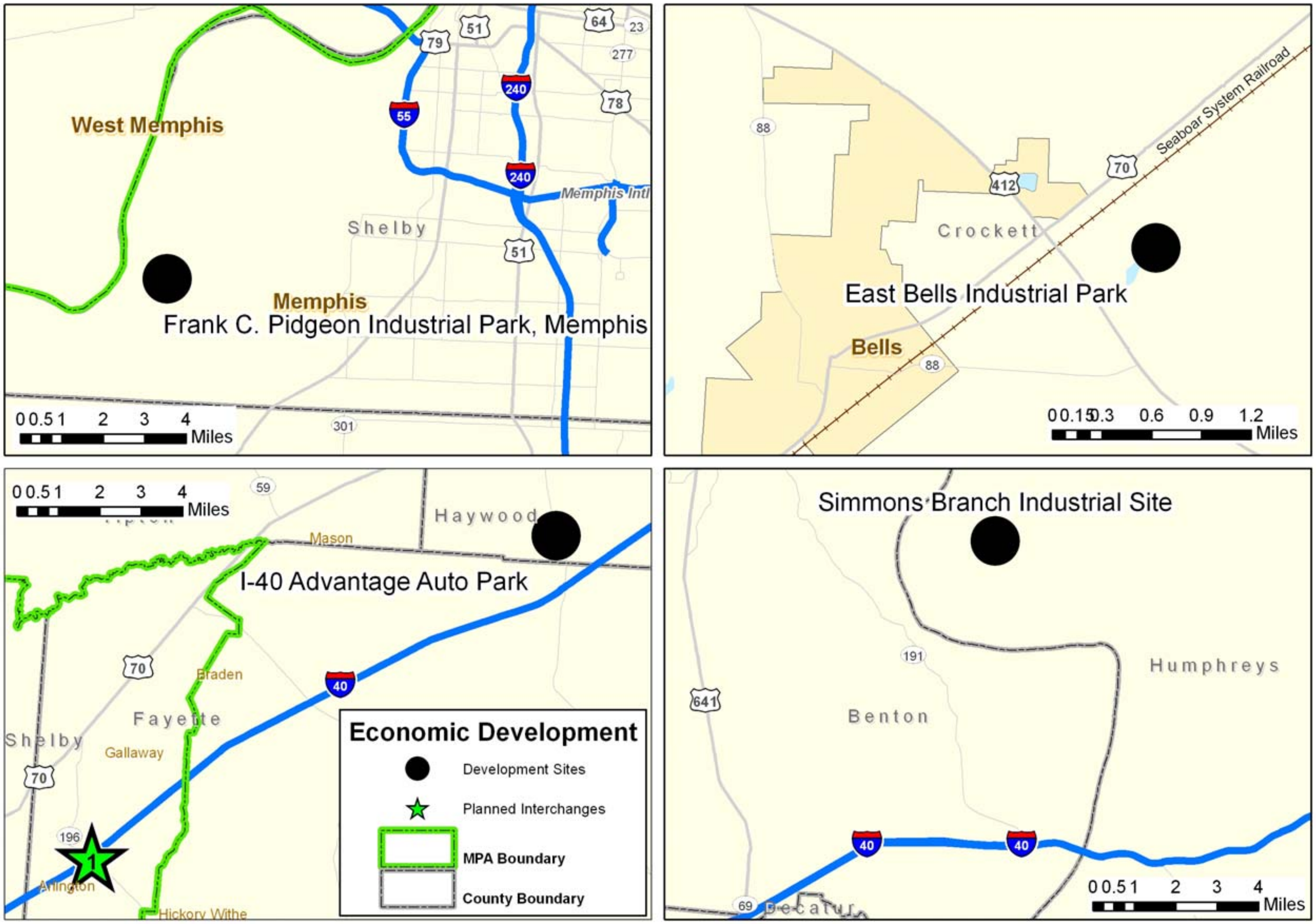
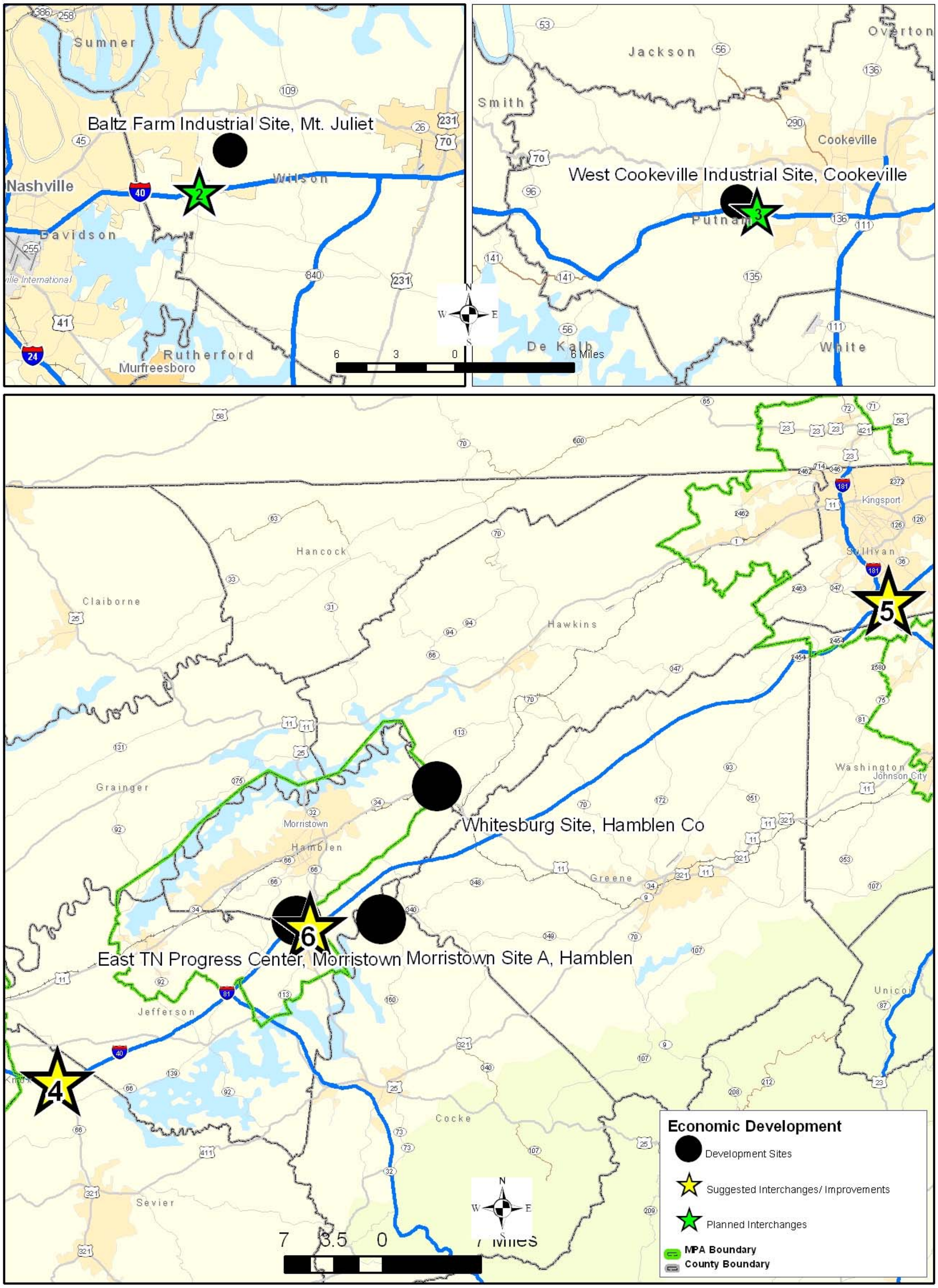


Figure 6-2: East of Nashville



7.0 COMMUTER TRAVEL DEMAND

7.1 Commuter Patterns

In Task 1, Systems Inventory and Data Collection, commuter patterns were reviewed using 2000 Census data from the Census Transportation Planning Package (CTPP) for each metropolitan planning organization (MPO) along the I-40 corridor. Commuter sheds were created for each MPO area based on likely travel routes to the central business district (CBD). The commuter sheds were developed in an attempt to isolate areas that have residence that would typically use I-40 as part of their commuting route to the metropolitan areas CBD.

It was assumed that residences living relatively close to the CBD would be less likely to use the interstate system. This area was defined as the central area. A CBD was defined within the central area as a major destination point for commuters. Other major destination points may exist; however, the CBD was considered the most likely candidate for considering improvements to alternative modes of transportation or providing incentives for car pooling.

Existing and proposed park-and-ride facilities within a five-mile radius of existing interchanges were identified within each metropolitan area. In some areas, the regional long-range transportation plan designated funding for future park-and-ride facilities, but specific locations of these lots have not been established.

7.1.1 Memphis

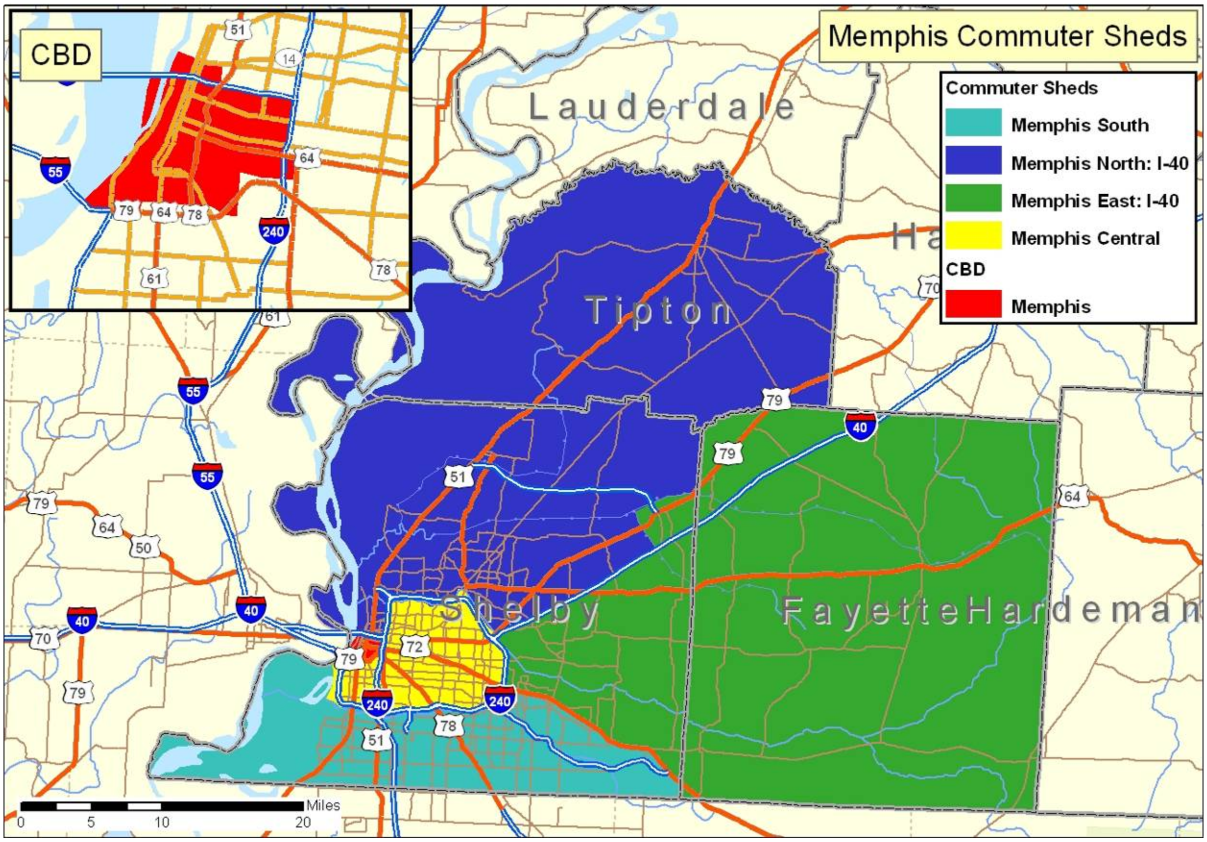
The Memphis MPO includes the City of Memphis and Shelby County. The Memphis MPO region was divided into four general commuter sheds: North: I-40, East: I-40, South, and Central (**Figure 7-1**). It was assumed that most commuters traveling from the North and East commuter sheds would potentially use I-40 as part of their commuter route to the CBD. The South commuter shed area would more likely use I-55 and I-240 to reach the CBD. It is assumed that those living in the Central area would use local routes.

The CTPP database indicates 173,998 commute trips with a destination within Shelby County (**Table 7-1**).

Table 7-1: Commuting Patterns to Memphis CBD

From	To CBD Total	To CBD Single Occupant Vehicles	To CBD Single Occupant Vehicles (Percent)
North Region (I-40)	5,187	4,452	86%
East Region (I-40)	2,477	2,209	89%
South Region	4,630	3,809	82%
Central	6,355	5,186	82%
CBD	850	307	36%
Other	1,074	916	85%
Total	20,573	16,879	82%

Figure 7-1: Memphis Area Commuter Sheds



Of these trips, 20,573 (12 percent) have a destination within the CBD. The two regions covering the I-40 corridor represents 37 percent of those commuting to the CBD. Eight-two percent of all commuters destined for the CBD drive alone. For the two regions covering the I-40 corridor, 87 percent drive alone to the CBD.

7.1.2 Jackson

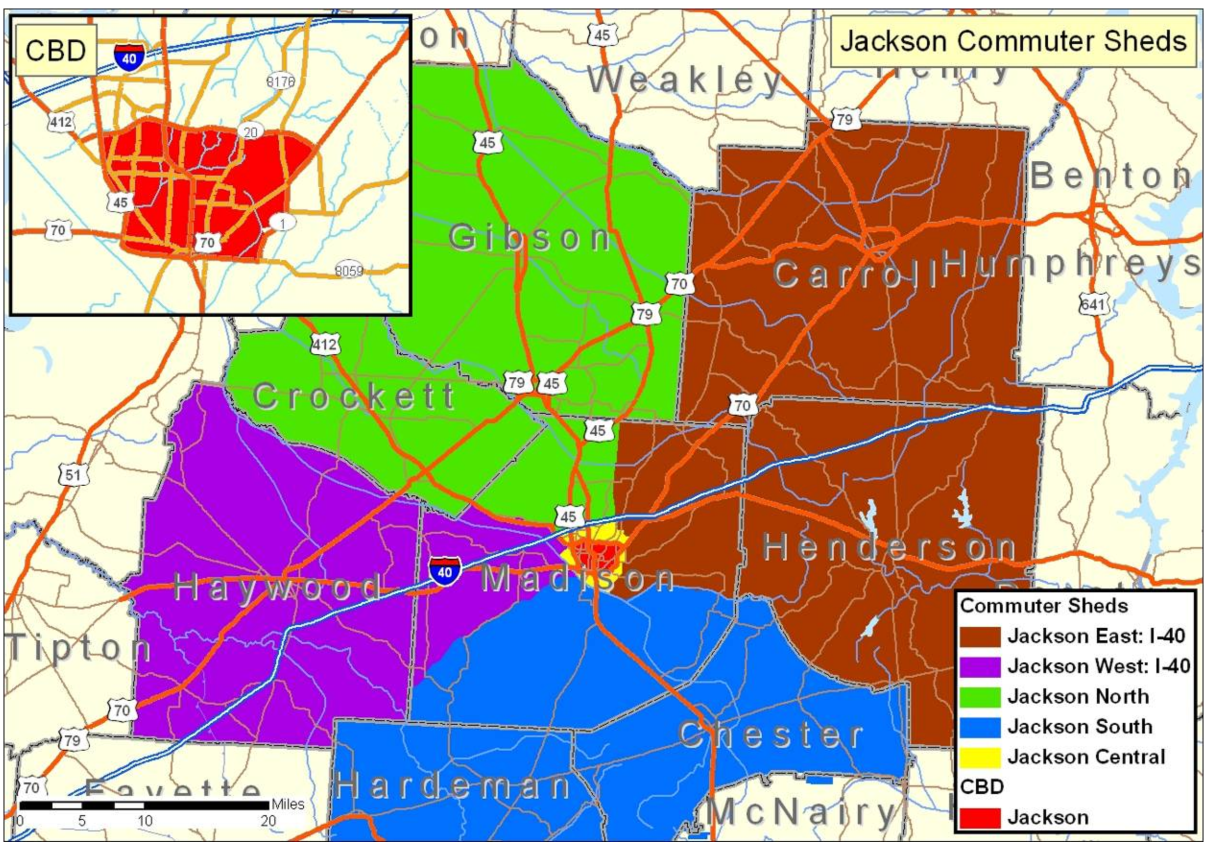
The Jackson MPO includes the City of Jackson and Madison County. The Jackson MPO region was divided into five general commuter sheds: East: I-40, West: I-40, North, South, and Central (**Figure 7-2**). It was assumed that most commuters traveling from the East and West commuter sheds would potentially use I-40 as part of their commuter route to the CBD. The North and South commuter shed area would more likely use US 45 to reach the CBD. It is assumed that those living in the Central area would use local routes.

The CTPP database indicates 34,630 commute trips with a destination within Madison County (**Table 7-2**). Of these trips, 8,375 (24 percent) have a destination within the CBD. The two regions covering the I-40 corridor represents 15 percent of those commuting to the CBD. Eight-six percent of all commuters destined for the CBD drive alone. For the two regions covering the I-40 corridor, 90 percent drive alone to the CBD.

Table 7-2: Commuting Patterns to Jackson CBD

From	To CBD Total	To CBD Single Occupant Vehicles	To CBD Single Occupant Vehicles (Percent)
East Region (I-40)	1,028	931	91%
West Region (I-40)	200	175	88%
North Region	3,424	3,204	94%
South Region	1,483	1,282	86%
Central	585	520	89%
CBD	1,535	1,038	68%
Other	120	90	75%
Total	8,375	7,240	86%

Figure 7-2: Jackson Area Commuter Sheds



7.1.3 Nashville

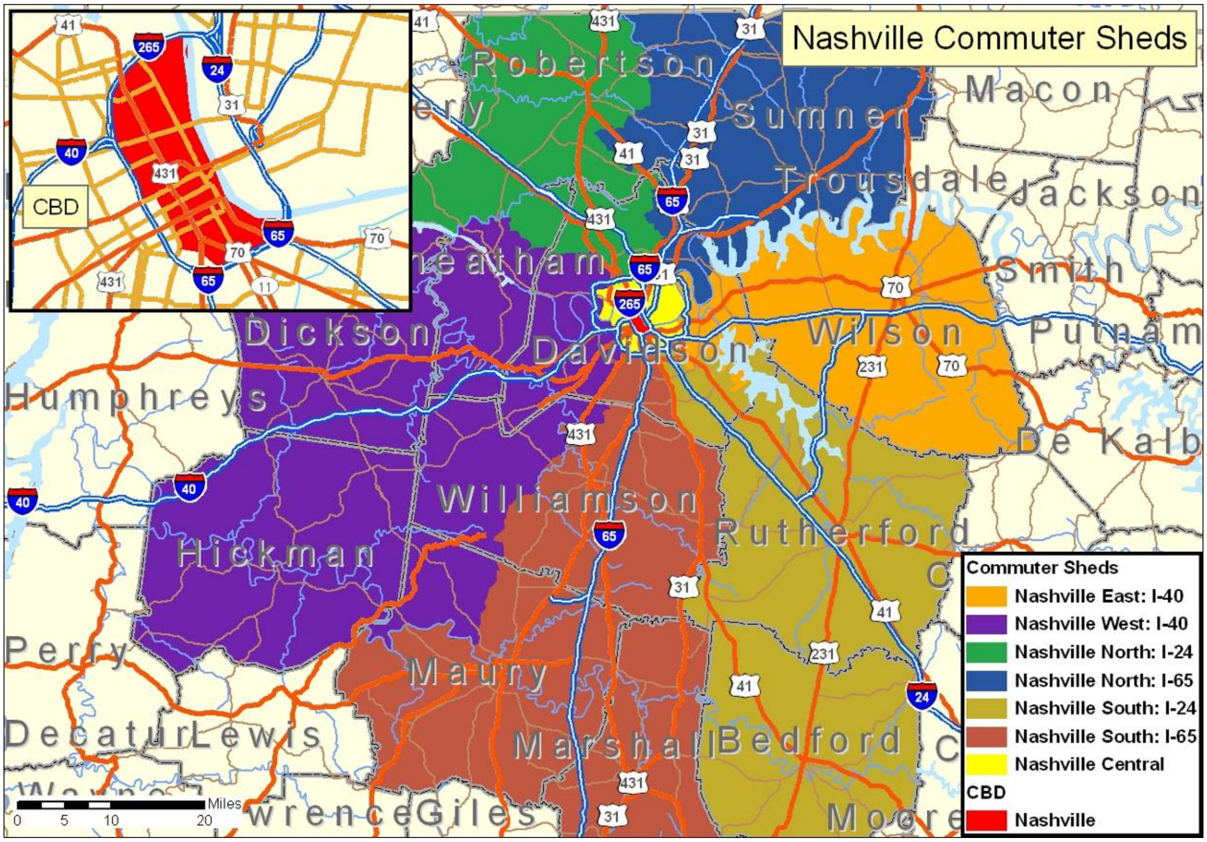
The Nashville MPO includes the City of Nashville and Davidson, Rutherford, Sumner, Williamson, Wilson and parts of Maury and Robertson counties. The Nashville MPO region was divided into seven general commuter sheds: East: I-40, West: I-40, North I-24, North I-65, South I-24, South I-65, and Central (Figure 7-3). It was assumed that most commuters traveling from the East and West commuter sheds would potentially use I-40 as part of their commuter route to the CBD. The North and South commuter shed area would more likely use I-24 and I-65 to reach the CBD. It is assumed that those living in the Central are would use local routes.

The CTPP database indicates 149,209 commute trips with a destination within Davidson County (**Table 7-3**). Of these trips, 35,617 (24 percent) have a destination within the CBD. The two regions covering the I-40 corridor represents 34 percent of those commuting to the CBD. Seventy-nine percent of all commuters destined for the CBD drive alone. For the two regions covering the I-40 corridor, 84 percent drive alone to the CBD.

Table 7-3: Commuting Patterns to Nashville CBD

From	To CBD Total	To CBD Single Occupant Vehicles	To CBD Single Occupant Vehicles (Percent)
East Region: I-40	4,354	3,437	79%
West Region: I-40	7,890	6,916	88%
North Region: I-24	1,545	1,132	73%
North Region: I-65	4,150	3,286	79%
South Region: I-24	5,580	4,589	82%
South Region: I-65	6,470	5,615	87%
Central	4,835	2,944	61%
CBD	400	84	21%
Other	393	245	62%
Total	35,617	28,248	79%

Figure 7-3: Nashville Area Commuter Sheds



7.1.4 Knoxville

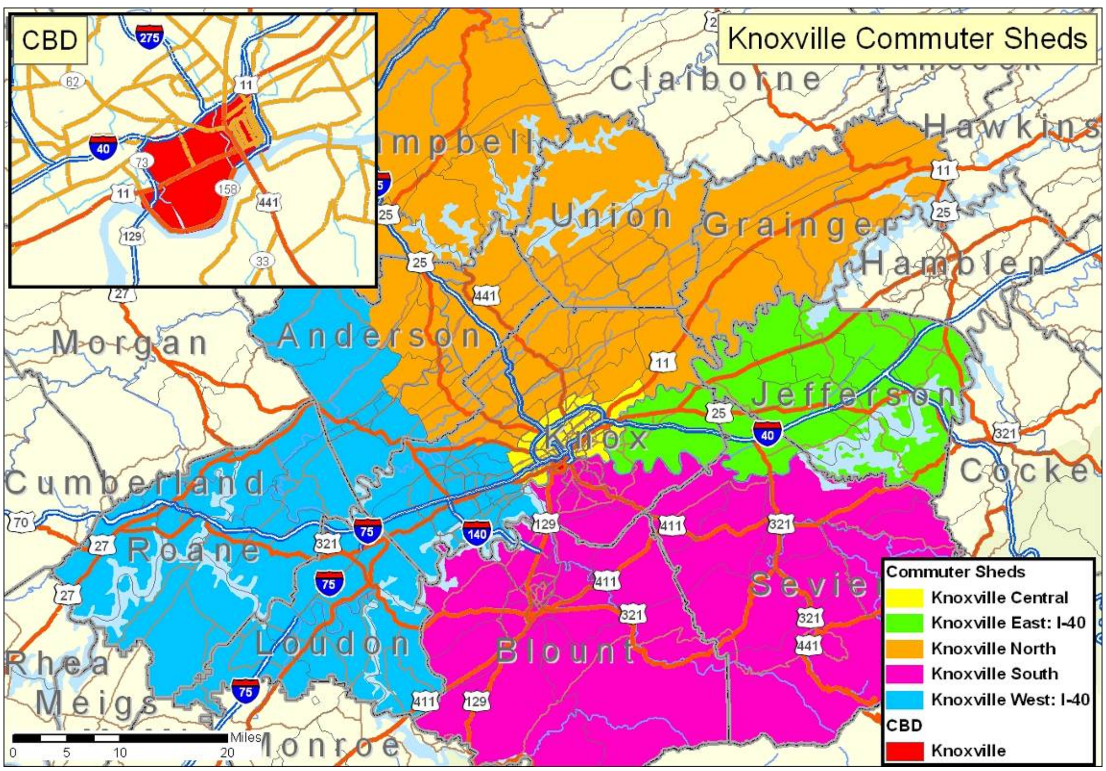
The Knoxville MPO includes the City of Knoxville and Knox, Blount, Loudon, and Sevier counties. The Knoxville MPO region was divided into five general commuter sheds: East: I-40, West: I-40, North, South, and Central (Figure 7-4). It was assumed that most commuters traveling from the East and West commuter sheds would potentially use I-40 as part of their commuter route to the CBD. The North commuter shed area would more likely use I-75 and US 11 to reach the CBD and the South commuter shed area would more likely use US 129 and US 411. It is assumed that those living in the Central are would use local routes.

The CTPP database indicates 93,179 commute trips with a destination within Knox County (**Figure 7-4**). Of these trips, 20,205 (22 percent) have a destination within the CBD. The two regions covering the I-40 corridor represents 32 percent of those commuting to the CBD. Seventy-eight percent of all commuters destined for the CBD drive alone. For the two regions covering the I-40 corridor, 90 percent drive alone to the CBD.

Table 7-4: Commuting Patterns to Knoxville CBD

From	To CBD Total	To CBD Single Occupant Vehicles	To CBD Single Occupant Vehicles (Percent)
East Region: I-40	4,354	3,437	79%
West Region: I-40	7,890	6,916	88%
North Region: I-24	1,545	1,132	73%
North Region: I-65	4,150	3,286	79%
South Region: I-24	5,580	4,589	82%
South Region: I-65	6,470	5,615	87%
Central	4,835	2,944	61%
CBD	400	84	21%
Other	393	245	62%
Total	35,617	28,248	79%

Figure 7-4: Knoxville Area Commuter Sheds



7.2 Park and Ride Facilities

In Task 1, existing park and ride facilities adjacent to I-40 or within a five-mile radius of a current interchange in the study corridor were identified for Memphis, Jackson, Nashville and Knoxville. These park and ride lots are shown in Figure 7-5 to Figure 7-8.

Figure 7-5: Memphis Area Park-and-Ride Facilities

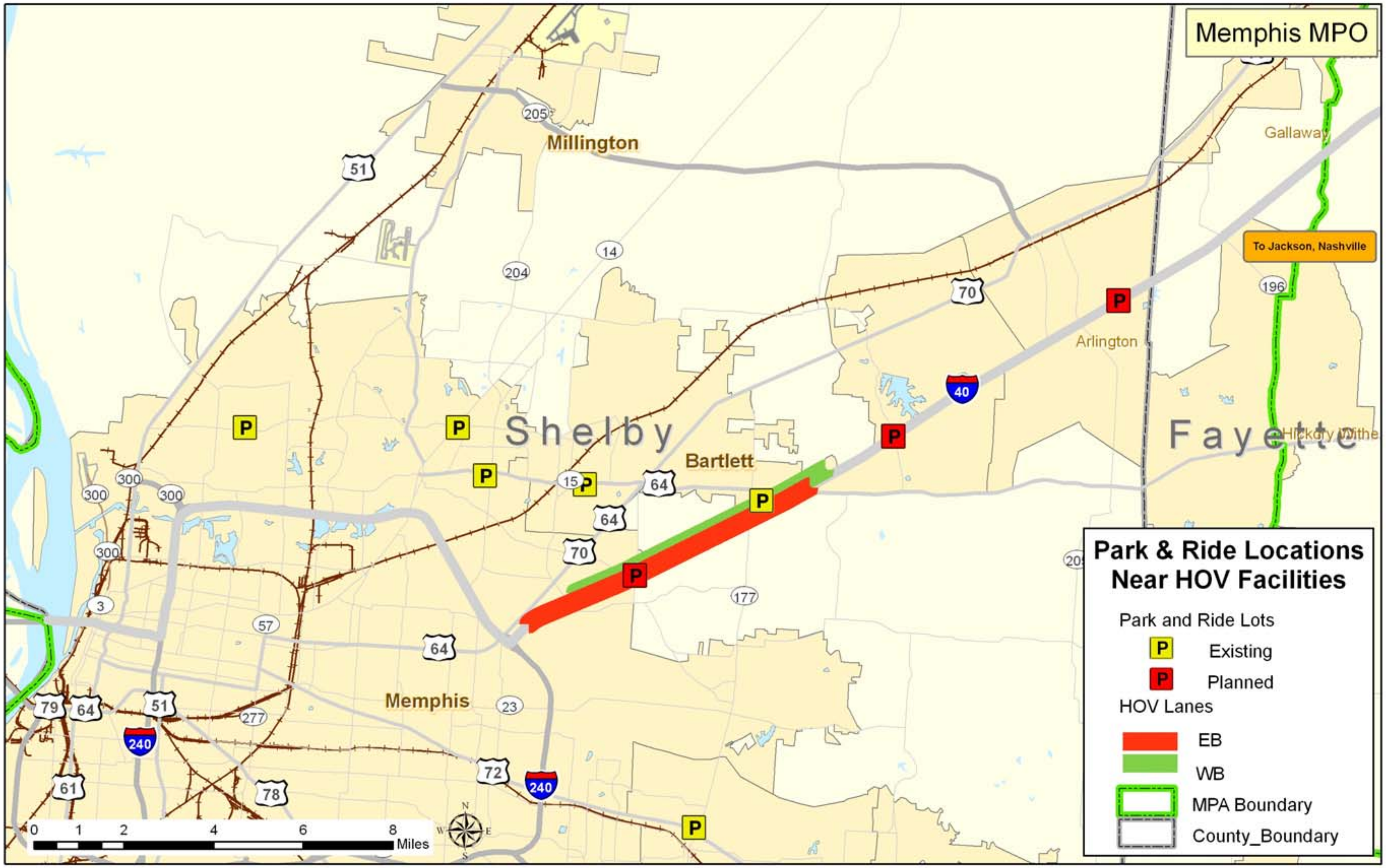


Figure 7-6: Jackson Area Park-and-Ride Facilities

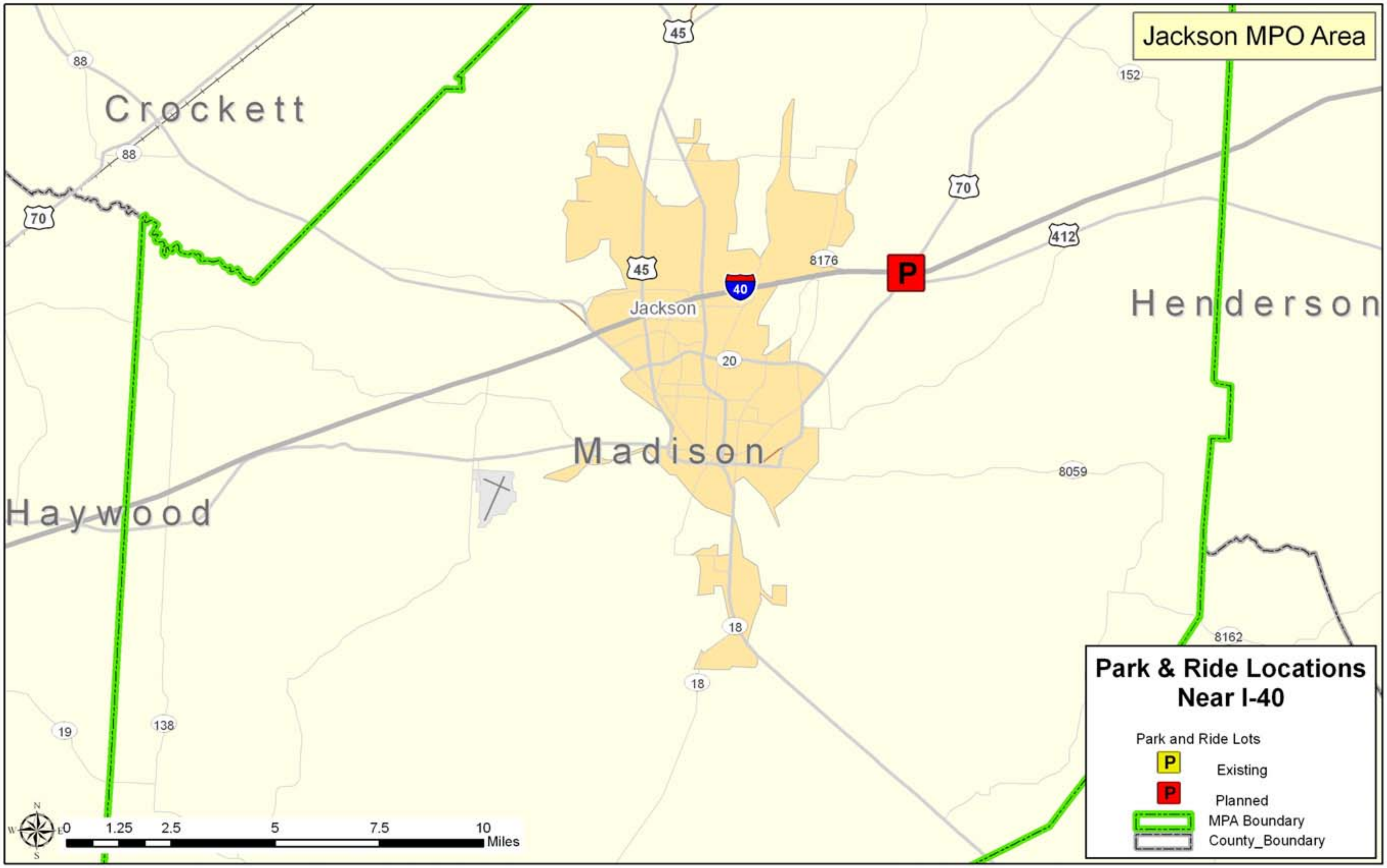


Figure 7-7: Nashville Area Park-and-Ride Facilities

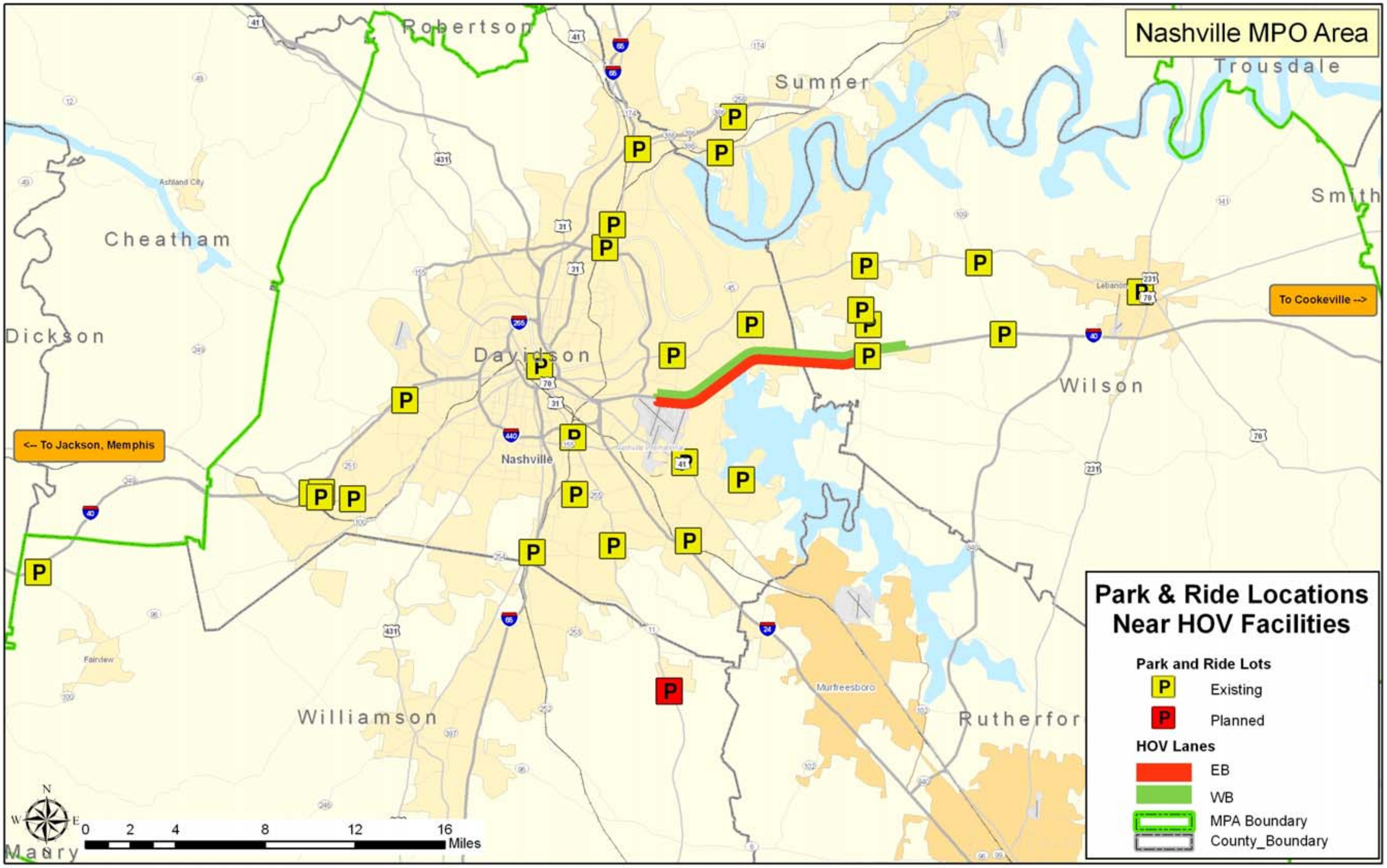
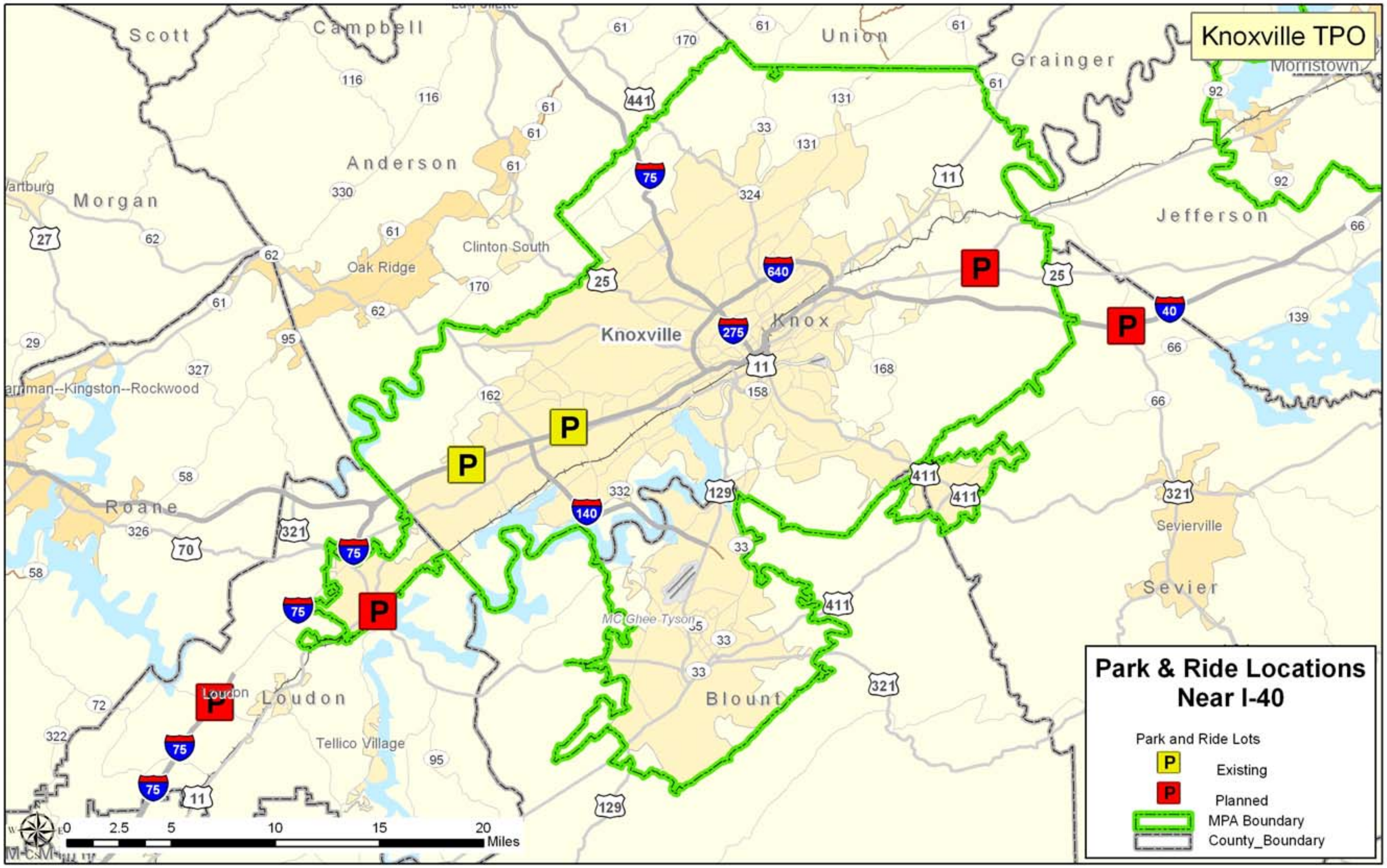


Figure 7-8: Knoxville Area Park-and-Ride Facilities



7.3 Assessment of Effectiveness of I-40 High Occupancy Vehicle (HOV) Lanes in Nashville and Memphis

TDOT supports the development and operation of HOV lanes which meet the goal of maximizing people-moving capability of the highway system while mitigating transportation-related pollution. HOV lanes have been implemented along I-40 in Nashville and Memphis. Both the Nashville facility (Figure 7-9) and the Memphis HOV lanes (Figure 7-10) opened in May 2002.

TDOT defines a "successful" HOV facility as a lane that carries at least the same number of persons in fewer vehicles than the adjacent non-HOV lanes, based on the purpose of an HOV lane to encourage ridesharing and the use of mass transit. TDOT has set a target (vehicles to persons) for an HOV facility of 800 vehicles transporting 1600 persons, which requires at least two persons per vehicle. The department considers 1600 persons per hour as the number which would be carried in a non-HOV lane at capacity (level-of-service E).

This assessment of HOV lane performance was based on person and vehicle counts from:

Nashville

May 14-15, 2002 (before the HOV lane opened); May 21-22, 2002; and September 13, 2005

Memphis

May 23-24, 2002; October 6, 2005

The aforementioned counts are consistent with TDOT's monitoring procedure which requires count data to be collected on a three-year cycle unless a major change occurs in facility operation. TDOT's monitoring procedure requires annual counts along all lanes when the general purpose (non-HOV) lanes reach capacity. After three years of data collection under capacity conditions, an assessment of the validity of continued HOV facility operation would be conducted in accordance with TDOT procedures. Factors to be considered in the TDOT evaluation procedure include:

- Hourly vehicular/person counts in an HOV lane versus the average person count in the general purpose lanes
- Crash history
- Travel time comparison between HOV facility and general purpose lanes

7.3.1 Review of "Before" Data for the I-40 HOV Facility in Nashville

The limited amount of "before" data for the Nashville HOV facility suggests that percentages of HOVs in the peak hour traffic streams were below national averages, but not by more than two to four percent. Transit services for these candidate corridors appear limited and were not a prerequisite for earmarking the respective corridors for HOV lanes. Still, the influence of transit shows that average vehicle occupancies among eligible 2+ users was between 2.3 to 2.5 per vehicle for the AM and PM periods.

A general "rule of thumb" in trying to estimate HOV demand depends heavily on the availability of travel time benefits, but there are no speed data to generate this estimate. Using TDOT's policy of evaluating person movement parity when other lanes reach capacity, it appears that the travel speeds for most segments of these respective HOV projects are relatively high since the respective volume-to-capacity for the general purpose lanes are not at capacity. This means that it is highly unlikely that a major percentage of the "before" HOVs would opt to use a dedicated lane.

7.3.2 Review of "After" Data for Both I-40 HOV Facilities

The I-40 HOV facility in Memphis clearly is providing a level of benefit that generates a reasonably good volume of HOVs. However, the level of violations along all portions of projects where HOV data has been collected is concerning. The compliance rates vary from 38 to 52 percent for both Memphis and Nashville, which places these projects among the ten most serious for enforcement breaches among more than 120 projects nationwide. The HOV lane vehicle-carrying capacity seems capped by the number of violators (i.e., the mix of eligible and ineligible users represents the same vehicle flow as adjacent lanes). A more aggressive enforcement regiment to address this shortcoming and divert violators may inadvertently create level of service E or worse in the remaining lanes, thus triggering TDOT's procedures to reassess the HOV lane viability. TDOT's evaluation procedures may be inadvertently protecting parity by allowing the person movement of violators to be counted toward total HOV lane flow.

The amount of HOV use seems directly related to the adjacent roadway level of service being experienced, in which higher levels of HOV use are found where travel time savings potential exists, and a lower proportionate level of use is observed where no benefit seems to exist. The lack of speed data makes this observation difficult to confirm with certainty. Some segments such as I-40 in Wilson County reflect a level of HOV use that suggests only between 27 and 39 percent of the "before" volumes are using the HOV lane. Thus, a higher percentage is probably still traveling in the adjacent general purpose lanes, often an indicator that the HOV lane is not providing meaningful travel time savings benefits.

Other factors not able to be ascertained in the limited data sets are whether the lengths of the projects are too short in some instances to offer meaningful benefits, or whether the lack of adequate enforcement and consequent number of violators are adversely affecting desires to travel in the HOV lane (i.e., all lanes offer the same relative level of service).

7.3.3 Needed Information

A more complete assessment of current conditions (encompassing a clearer validation and guidance for policy, design and operational scenarios of the existing I-40 HOV facilities) needs travel time data for the peak period (not just peak hour) so that potential benefits offered by dedicated lanes are determined. This fundamental data set is needed whether the dedicated lane is reserved for HOVs, HOV/toll users or express lane users. Transit levels of use do not seem high enough to affect HOV operation policy.

Enforcement needs for the I-40 HOV lanes are critical to their long-term viability. If enforcement is unlikely to be available based on current experience, this input from affected enforcement agencies and TDOT is needed in order to weigh other lane management options that would offer better efficacy in being self-enforced or self-funded for dedicated enforcement.

Other information needs frequently employed to evaluate HOV lane efficiency and safety includes crash data and person movement data for both carpools and transit services. It is not clear how easy it would be to collect this information from available sources. Public attitudinal data and stakeholder interviews are also valuable resources to ascertain how important project issues, like the number of HOV lane violators, are to the general public and elected officials.

7.3.4 Suggested HOV Facility Evaluation Criteria

Public perceptions of accepted violation levels may not be as critical in settings where benefits, in terms of travel time savings, are marginalized for eligible and ineligible users. For this reason, a small number of HOV projects experiencing enforcement breaches similar to I-40 in Nashville and Memphis have continued to function because they provide some modest level of benefit to HOVs and are not political targets to be converted to general purpose lanes as long as the remaining lanes generally operate below capacity. This dynamic can change if corridor congestion is worsening and noticeable. Pro-active measures are desirable to address project shortcomings prior to becoming politicized. The HOV projects in both Nashville and Memphis may be candidates for reassessment based on a broader criteria base which needs to examine:

- Demand, expressed by potential eligible user groups, in terms of both person movement and potentially vehicle movement;
- Benefits, expressed as time savings differential; and
- Compliance rate as a percentage of eligible to total HOV lane users (not all traffic).

Only the demand criterion for HOV and adjacent lanes is presently being considered in TDOT's evaluation procedures. As HOV lanes are examined in greater detail in Task 3, guidance in applying broader evaluation criteria to candidate projects will be developed to augment the current policy.

Figure 7-9: Memphis Area HOV and Nearby Park-and-Ride Facilities

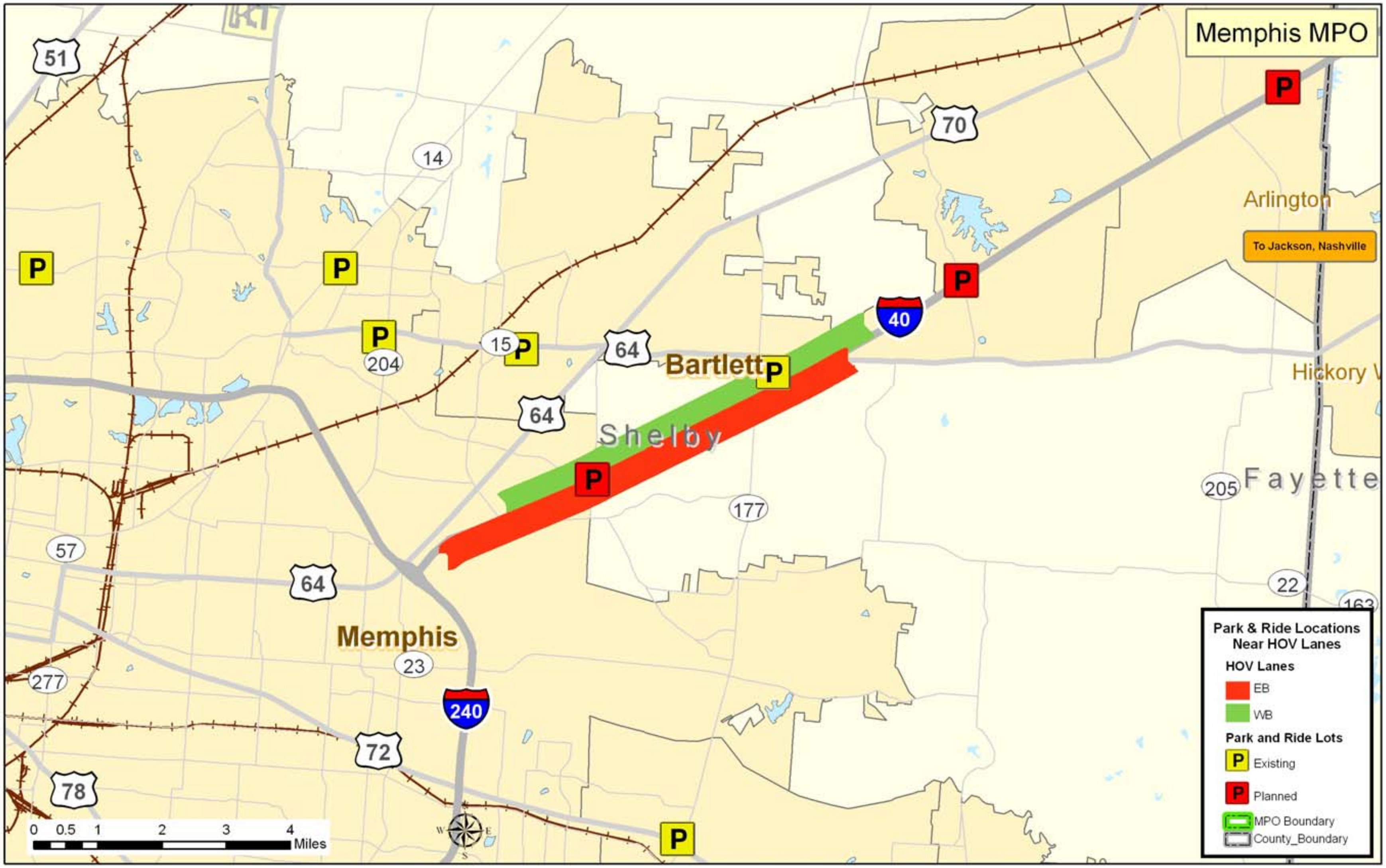
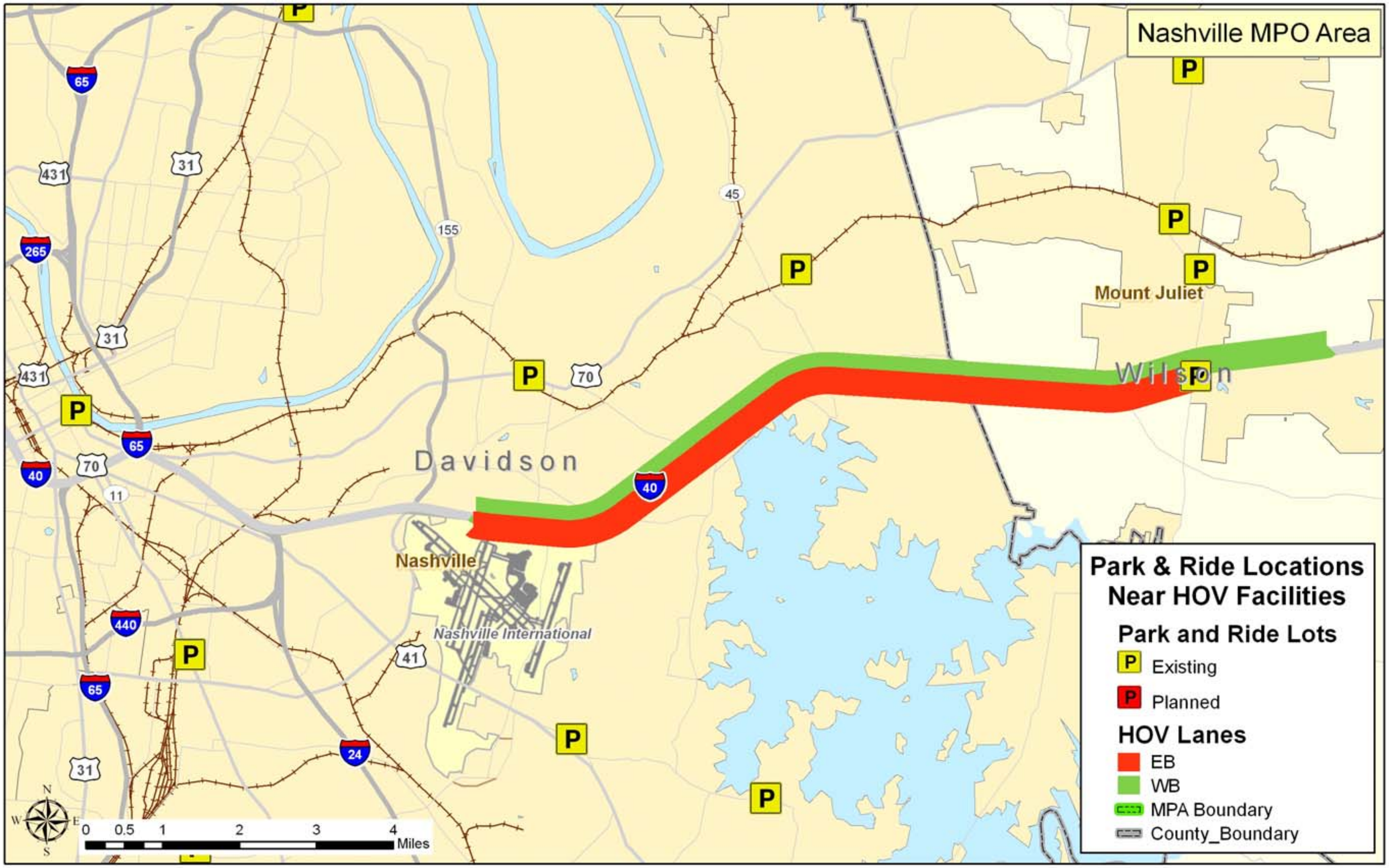


Figure 7-10: Nashville Area HOV and Nearby Park-and-Ride Facilities



8.0 INTERMODAL FACILITIES

The present intermodal facility system serving the State of Tennessee is comprised of nine facilities in select urbanized areas (**Table 8-1**). The Memphis metropolitan area has five intermodal facilities. The intermodal yards in Marion, Arkansas are located just west of the Mississippi River, but still within the Memphis region. There is also a Norfolk Southern facility in Huntsville, Alabama just south of the Tennessee border with Alabama. This facility is included because trucks accessing this facility also have the ability to easily service shippers located in Tennessee.

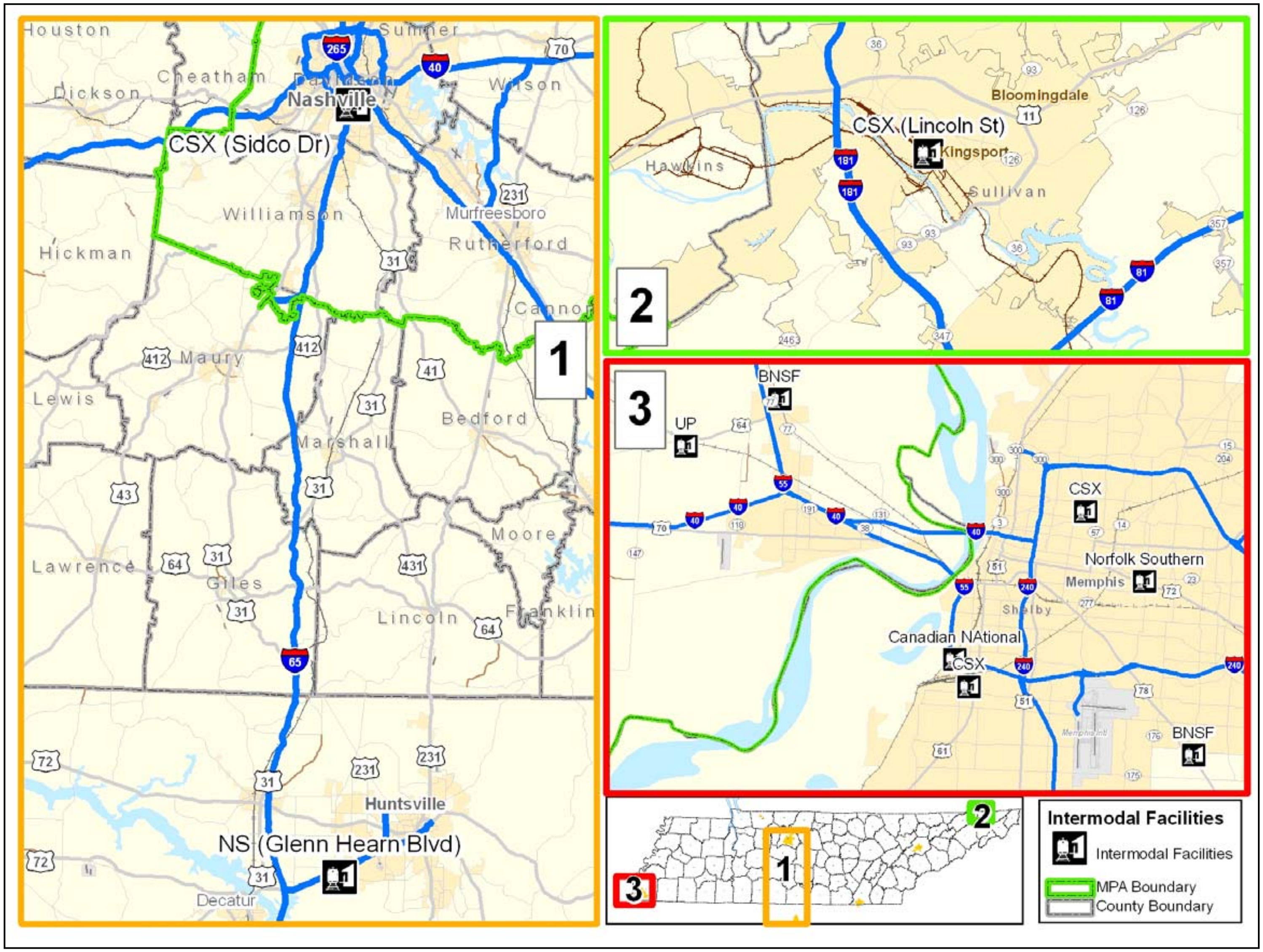
Table 8-1: Intermodal Yards

RAILROAD	NAME OF YARD	LOCATION	DESIGN LIFT CAPACITY (containers)	YEAR 2000 LIFTS
BNSF	Tennessee Yards	Memphis	100,000	148,521
BNSF	Marion Yards	Marion, AR	100,000	72,556
Canadian National/Illinois Central	Johnston Yards	Memphis	125,000	n/a
CSX	Johnston Yards	Memphis	70,000	60,692
CSX	Leewood Yards	Memphis	20,000	15,525
CSX	Radner Yards	Nashville	100,000	83,589
Norfolk Southern	Forrest Yards	Memphis	100,000	75,000
Norfolk Southern	Huntsville Yard	Huntsville, AL	n/a	n/a
Union Pacific	Marion Yard	Marion, AR	450,000	251,000

As noted in the Tennessee Rail System Plan, intermodal congestion is increasingly common due to the trends to consolidating intermodal facilities and moving to an airline-style, hub and spoke system. Additionally, the growth of intermodal containers (8 percent per year) has caused traffic to spike at some of the remaining facilities straining their capacity and creating equipment shortages in cars, trailers and power units. The newly constructed Memphis Super Terminal will address some of the intermodal congestion issues but only for the region surrounding Memphis.

In June 2007, NS announced plans to build an intermodal terminal in east Tennessee as part of the railroad's upgrade of its freight railroad between Louisiana and New Jersey. The site has yet to be determined.

Figure 8-1: Intermodal Yards



9.0 SUMMARY OF DEFICIENCIES

This chapter summarizes deficiencies for I-40 and I-81 for three planning horizons:

- Next five years, to about 2011;
- Next ten years, or approximately 2016; and
- 2030, the long-range planning horizon.

For the initial five-year period, the following information was used to identify deficiencies:

- Roadway capacity deficiencies in 2011 as identified by the statewide travel demand model for rural areas and by the urban travel demand models for the MPOs located along the study corridor (Chapter 2).
- Operations deficiencies based on field observations identified through interviews with Directors of TDOT Regions 1, 2, 3 and 4 and the Director of the department's Incident Management Program. Representatives of the Tennessee Highway Patrol and Commercial Vehicle Enforcement also noted locations that have been observed to experience operational issues either continuously or during adverse weather conditions (Chapter 3).
- Locations along I-40 and I-81 where accidents exceed the critical accident rate (Chapter 4).

Table 9-1 lists the 2011 deficiencies by the aforementioned categories.

Deficiencies for the 2016 and 2030 planning horizons are summarized in **Table 9-2** and **Table 9-3**. The deficiencies listed for these horizon years represent reflect roadway capacity issues identified by the statewide and urban area travel demand models.

Table 9-1: 2011 Deficiencies

Route	From	To	Notes
Capacity Deficiencies Identified from Travel Demand Models			
I-40	SR 14 (Jackson Ave)	I-240 East	
I-40	I-240 East	SR 177 (Germantown Pkwy)	
I-40	US-64 (Stage Road)	SR 205 (New Airline Rd)	
I-40	US-45 (Keith Short Bypass)	Christmasville Rd/Dr. Fe Wright Dr	
I-40	SR 46 (Dickson)	US-70 (Sparta Pike-Lebanon)	
I-40	SR 96 (Buffalo Valley)	SR 56 (Silver Point)	
I-40	US-70N (Poplar Grove)	US-70N (Monterey)	

Route	From	To	Notes
I-40	Market Street	Pine Ridge Road	
I-40	Gallaher Rd	Buttermilk Rd	
I-40	SR 298 (Genesis Rd)	SR 101 (Peavine Rd)	
I-40	Pine Ridge Rd	SR 58	
I-40	Linwood Rd (Linwood)	SR 141 (Silver Point)	
I-40	I-75 South	N. Cherry St (Knoxville)	
I-40	I-640 East	US-11 E	
I-81	US-25E	SR 160	
Operational Deficiencies Based On Stakeholder Field Observations			
I-40	At Roane Mountain (MM 345)		Steep grade and sharp curves
I-40	At Cumberland Plateau (MM 300-307 and MM 329-331)		Freeze quickly and high winds; steep grade at Putnam/Smith County Line
I-40	At Monterey Mountain (MM 292-298)		Steep grade; truck restrictions in left lane difficult to enforce; need EB truck lane
I-40	MM 219-220		Fog and ice at Percy Priest dam
I-40	MM 188-189		Steep grade
I-40	At Dickson County Line (MM 182)		Steep grade
I-40	MM 165-166		Steep grade and ice on Piney River bridge
I-40	At MM 160		Steep grade and ice
I-40	At Tennessee River bridge		Steep grade and rain causes accidents (both directions)
I-40	At MM 56		Steep grade and curve; slick during rain, snow and ice
I-40	Near weigh station at MM 50		Exit and merge lanes need to be lengthened.
Critical Accident Locations from TDOT's Crash Database			
I-40	AS/TN State Line	Levee Rd	6 segments, 15 spot locations
I-40	N Watkins St (Exit 2a)		1 spot location
I-40	Jackson Ave (Exit 8)		2 spot locations
I-40	Covington Pike (Exit 10)	Whitten Rd (Exit 14)	3 segments, 10 spot locations
I-40	Appling Rd (Exit 15)	N Germantown Pkwy (Exit 16)	1 segment, 8 spot locations

Route	From	To	Notes
I-40	East of SR 222 (Stanton Rd, Exit 42)		1 spot location
I-40	East of SR 192 (Mercer Rd, Exit 60)		1 spot location
I-40	US 70 (Exit 66)	SR 138 (Providence Road - Exit 68)	1 segment, 1 spot location
I-40	West of SR 104 (Exit 101)		1 spot location
I-40	SR 114 (Camden Rd - Exit 116)		1 spot location
I-40	US 641 (Exit 126)		1 spot location
I-40	West of SR 191 (Birdsong Rd - Exit 133)		1 spot location
I-40	SR 191 (Birdsong Rd - Exit 133)	Benton/Humphreys CL	1 segment, 5 spot locations
I-40	West of SR 13 (Exit 143)		1 spot location
I-40	SR 13 (Exit 143)		1 spot location
I-40	West of SR 46 (Exit 172)		3 spot locations
I-40	West of SR 96 (Exit 182)	SR 96 (Exit 182)	3 spot locations
I-40	SR 249 (Luyben Hills Rd - Exit 188)		1 spot location
I-40	Cheatham/Davidson CL	McCrory Ln (Exit 192)	2 segments, 1 spot location
I-40	McCrory Ln (Exit 192)	West of Briley Pkwy (Exit 204)	8 spot locations
I-40	West of Briley Pkwy (Exit 204)	I-440 (Exit 206)	2 segments, 7 spot locations
I-40	I-440 (Exit 206)	I-65 (Exit 208)	1 segment, 3 spot locations
I-40	I-65 (Exit 208)	East of Briley Pkwy (Exit 204)	7 segments, 29 spot locations
I-40	East of Briley Pkwy (Exit 215)	East of Donelson Pike (Exit 216)	1 segment, 5 spot locations
I-40	East of Donelson Pike (Exit 216)	East of Old Hickory Blvd (Exit 221)	4 spot locations
I-40	SR 171 (Mt Juliet Rd - Exit 226)	SR 109 (Exit 232)	4 spot locations
I-40	SR 109 (Exit 232)	US 70 (Sarta Pike - Exit 239)	6 spot locations
I-40	Linwood Rd (Exit 245)	SR 141 (Exit 254)	3 spot locations
I-40	West of SR 53 (Gordonsville Hwy - Exit 258)	SR 96 (Medley Amonette Rd - Exit 268)	7 spot locations
I-40	SR 136 (Jefferson Ave - Exit 287)		1 spot location
I-40	US 70 N (Spring St - Exit 290)	US 70 N/SR 84 (Holly St - Exit 300)	1 segment, 2 spot locations
I-40	West of Plateau Rd (Exit 311)	East of Plateau Rd (Exit 311)	2 spot locations

Route	From	To	Notes
I-40	Market St (Exit 329)	SR 299 (Westel Rd - Exit 338)	1 segment, 3 spot locations
I-40	SR 299 (Airport Rd - Exit 340)	US 27/SR 61 (Roane St - Exit 347)	2 segments, 10 spot locations
I-40	Pine Ridge Rd (Exit 350)		2 spot locations
I-40	East of SR 326 (Gallaher Rd - Exit 356)	East of US 321 (Exit 364)	4 spot locations
I-40	Lovell Rd (Exit - 374)		1 spot location
I-40	I-140 (Exit 376)	I-640 (Exit 385)	4 segments, 15 spot locations
I-40	I-275 (Exit 388)	5th St (Exit 389)	3 segments, 8 spot locations
I-40	US 11 W (Rutledge Pike - Exit 392)	Ashville Hwy (Exit 394)	2 segments, 9 spot locations
I-40	West of Snyder Rd (Exit 407)	Deep Springs Rd (Exit 412)	3 spot locations
I-40	Deep Springs Rd (Exit 412)	US 25 W/US 70 (Exit 415)	3 spot locations
I-40	US 25 W/US 70	SR 92 (Exit 417)	2 spot locations
I-40/ I-81	I-81 (Exit 421)		1 spot location
I-81	I-81 (Exit 421)	SR 341 (Exit 4)	1 spot location
I-81	Hamblen/Greene county line	SR 172 (Exit 36)	6 spot locations
I-81	SR 172 (Exit 36)	Greene/Washington county line	2 spot locations
I-81	Washington/Sullivan county line	I-181 (Exit 46)	3 spot locations
I-81	I-181 (Exit 46)	South Fork Holston River	3 spot locations
I-81	South Fork Holston River	Tennessee/ Virginia State line	2 spot locations

Table 9-2: 2016 Capacity Deficiencies

Route	From	To
I-40	Arkansas State Line	I-240 Midtown
I-40	SR 14 (Jackson Ave)	SR 222 (Stanton-Somerville Rd)
I-40	US-45 (Keith Short Bypass)	Christmasville Rd/Dr. Fe Wright Dr
I-40	SR 46 (Dickson)	US-70 (Sparta Pike-Lebanon)
I-40	SR 96 (Buffalo Valley)	SR 56 (Silver Point)
I-40	US-70N (Poplar Grove)	US-70N (Monterey)
I-40	Market Street (Crab Orchard)	Pine Ridge Road

I-40	Gallaher Road	Buttermilk Road (Bradbury)
I-40	Buttermilk Road	I-75 South
I-40	US-127	SR 298 (west of Crossville)
I-40	SR 298 (Genesis Rd-Crossville)	SR 101 (Peavine Rd-Crossville)
I-40	Pine Ridge Rd (S. Harriman)	SR 58 (Gallaher Rd-Lawnville)
I-40	Linwood Rd (Linwood)	SR 141 (Silver Point)
I-40	I-75 South	N. Cherry St (Knoxville)
I-40	I-640 East	SR 66 (Winfield Dunn Pkwy)
I-81	US-25E (Morristown)	SR 160 (Enka Hwy-Morristown)

Table 9-3: 2030 Capacity Deficiencies

Route	From	To
I-40	Arkansas State Line	I-240 Midtown
I-40	I-240 Midtown	SR 76 (Anderson Ave-Brownsville)
I-40	US-70 (Brownsville)	SR 223 (Jackson)
I-40	SR 223 (Jackson)	US-70 East (Jackson)
I-40	SR 48 (Oak Grove)	SR 46 (Dickson)
I-40	SR 46 (Dickson)	SR 96 (Buffalo Valley)
I-40	SR 96 (Buffalo Valley)	SR 56 (Silver Point)
I-40	US-70N (Poplar Grove)	US-70N (Monterey)
I-40	Market Street (Crab Orchard)	Pine Ridge Road
I-40	SR 101 (Peavine Rd-Crossville)	Pine Ridge Rd (S. Harriman)
I-40	Pine Ridge Rd (S. Harriman)	SR 58 (Gallaher Rd-Lawnville)
I-40	Gallaher Rd	I-75 South
I-40	I-75 South	US11W (Rutledge Pike)
I-40	I-640	Midway Rd (Thorngrove)
I-40	SR 66 (Snyder Rd)	Deep Springs Rd (Dumplin)
I-40	SR 92 (Dandridge)	I-81
I-81	SR 341 (Roy J. Messer Hwy)	SR 340 (Fish Hatchery Rd)
I-81	I-181/I-26	SR 357 (Airport Pkwy)
I-81	SR 126 (Memorial Blvd)	US-11W (State St-Bristol)