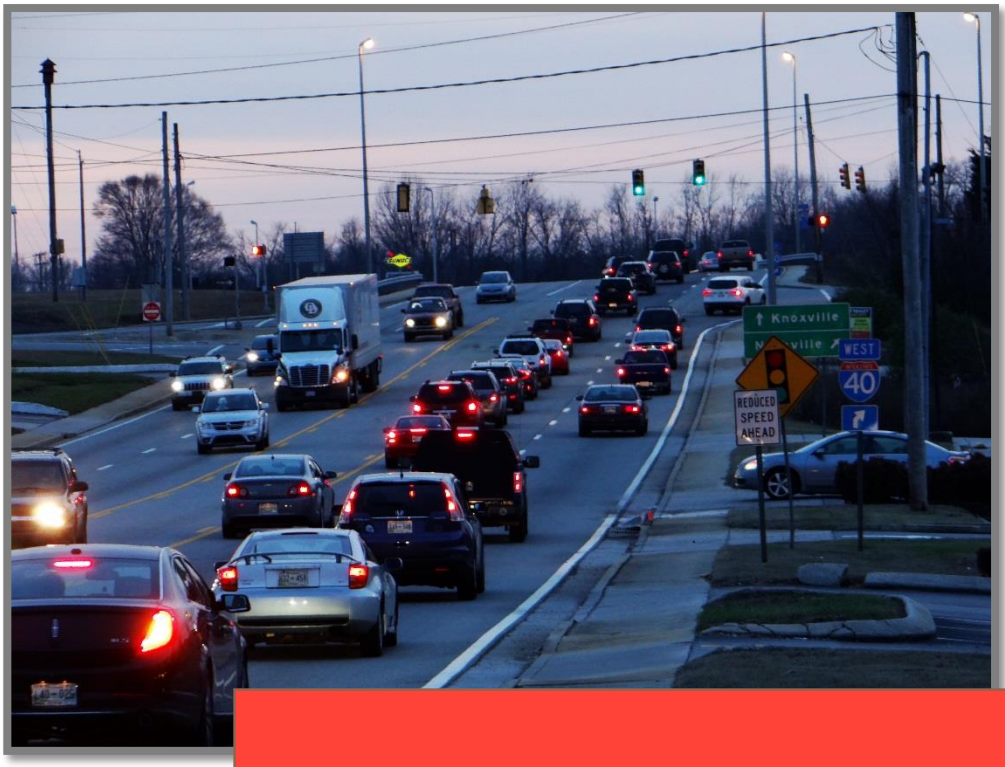

Cookeville Corridor Analysis

SAFETY ANALYSIS

June 2017

TN TDOT Department of Transportation

wsp

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1 Introduction

A safety analysis was conducted along the primary study corridors in order to identify issues related to existing traffic operational conditions. Field work was conducted in January 2017 during both the morning and evening peak hours to note issues such as narrow or faded lane markings, missing or faded traffic signs, sight distance obstructions, unsafe turning locations, and other safety issues that could lead to higher crash probabilities. Crash data and traffic volumes from the last four full available years (2012 through 2015) was also obtained from the Tennessee Department of Transportation (TDOT) and analyzed. Findings from the field observations and analysis of crash data are discussed below.

2 Data Collection

2.1 Field Observations

Downtown Area

- Downtown "gridlock" safety issues: During the peak hour, grid-lock was observed in downtown Cookeville around the Square (**Figure 1**). During this time, sight distances were obstructed by vehicles blocking intersections.
- There is evidence at some curbs in downtown of trucks over-running the curbs, which indicates that pedestrians may not be safe at those locations.

Figure 1: Left Turn Queue at Broad St./Jefferson Ave.

S. Jefferson Avenue (SR 136) Corridor

- The five intersections between Bunker Hill Road and Neal Street (S. Jefferson Avenue/Bunker Hills Road, S. Jefferson Avenue/I-40 eastbound, S. Jefferson Avenue/I-40 westbound, S. Jefferson Avenue/Dubois Road, and S. Jefferson Avenue/Neal Street) are all very close, which result in blocked intersections during peak hours. The short distance between intersections makes it difficult for trucks to maneuver and often leaves intersections blocked.

General Issues

- Along many of the corridors access management and driveway spacing is an issue, as there is no hard median to prevent left turns in and out of the corridors.
- Acceleration lengths on I-40 downstream of the on-ramps from S. Willow Avenue (SR 135) and S. Jefferson Avenue (SR 136) are very short, which makes merging feel unsafe (**Figure 2**).
- The S. Willow Avenue (SR 135)/Jackson Street intersection was perceived to be the least safe in Cookeville by city staff. Staff mentioned a fatal crash at the intersection in January of 2017, which

was noted but is not reflected in the crash data analysis since it falls outside the period of TDOT's most recent available crash data.

Figure 2: I-40 Eastbound On-Ramp from S. Willow Avenue (SR 135)

From Google Streetview, June 2014

2.2 Recent Crash Data

Crash data used in this analysis was obtained from TDOT via the Tennessee Roadway Information Management System (TRIMS). TRIMS contains georeferenced crash data for crashes occurring on all roadways in the state. This data includes:

- Crash location (description and latitude/longitude data)
- Manner of crash
- Weather and time of day
- Driver and occupant data and behavior
- Vehicle information

The log mile extents along each corridor for which crash data was collected are listed in

Table 1. This analysis focused on crashes along each corridor route and did not review crashes that occurred on intersecting side-streets along the study roadway segments.

Table 1: Roadway Extents of Crash Data Obtained via TRIMS

Corridor	Log Mile Begin	Log Mile End
Willow Ave. (SR 135)	7.764	8.681
S. Jefferson Ave. (SR 136)	2.172	4.133
Jefferson Ave.	0.603	0.641
N. Washington Ave. (SR 136)	4.134	5.119
10th St.	0.000	2.131
Broad St.	0.000	1.540
US 70N (SR 24)	16.410	22.990
Jackson St.	1.451	1.586

2.3 Traffic Volumes

AADT volumes for 2012-2015 were obtained from TDOT. A list of stations used and their corresponding AADT is included in **Appendix A**. AADT volumes were averaged in cases where multiple AADT count stations were located within a given segment. This analysis contains two short segments that cross I-40, one on S. Willow Avenue (SR 135) and another on S. Jefferson Avenue (SR 136); AADT volumes used for the safety analysis on these segments were the average of the AADTs at the nearest count location north and south of the interchange.

2.4 Statewide Average Crash Rates

The latest available statewide average crash rates (2012-2014) were obtained from TDOT.

3 Crash Analysis

3.1 Study Corridors Segmentation

To account for differences in roadway conditions that influence crashes (such as geometry, lane configuration, access density, and traffic volume), the study corridors were subdivided into segments with similar attributes and cross-sections throughout their extent.

Table 2 lists these subdivided segments by route, termini (in log mile), and length in miles.

Table 2: Study Roadway Segments

Route	Begin Segment		End Segment		Length (Mi.)
	Log Mile	Location	Log Mile	Location	
S. Willow Ave. (SR 135)	7.76	S. of Gould Dr.	8.68	N. of Interstate Dr.	0.92
S. Willow Ave. (SR 135)	8.68	N. of Interstate Dr.	11.64	N. of 12th St.	2.96
S. Jefferson Ave. (SR 136)	2.17	S. of Bunker Hill Rd.	2.56	N. of Interstate Dr.	0.39
S. Jefferson Ave. (SR 136)	2.56	N. of Interstate Dr.	4.13	N. of Broad St.	1.61*
	0.60		0.64		
N. Washington Ave. (SR 136)	4.13	E. Spring St. (US 70N, SR 24)	5.12	N. of E 10th St.	0.98
E. 10th St.	0.00	N. Washington Ave.	2.13	Hwy. 111 NB Ramps	2.13
Broad St.	0.92	Spring St. W. of Downtown	1.54	Cedar St.	0.63
Broad St.	0.00	Cedar St.	0.91	E. Spring St. (US 70N, SR 24) E. of Downtown	0.91
W. Broad St. (US 70N, SR 24)	16.41	Jackson St.	18.00	Broad St. W. of Downtown	1.59
W. Spring St. (US 70N, SR 24)	18.00	Broad St. W. of Downtown	19.73	Broad St. E. of Downtown	1.73
E. Spring St. (US 70N, SR 24)	19.74	Broad St. E. of Downtown	21.08	E. of Hwy. 111 NB Ramps	1.34
E. Spring St. (US 70N, SR 24)	21.11	E. of Hwy. 111 NB Ramps	22.99	I-40 EB Ramps	1.88

**Includes 1.57 miles on S. Jefferson Avenue (SR 136) and 0.04 miles on N. Jefferson Avenue*

3.1.1 Segment Crash Rates and Severity

The study period for this analysis is January 1, 2012, to December 31, 2015. Analysis of safety conditions along the study corridors consisted of looking at annual crash types and rates as well as comparing year-to-year trends from 2012 to 2015. Only one fatal crash occurred along Spring Street (US 70N, SR 24) in downtown Cookeville in 2015. About 3 percent of the total 3,344 crashes resulted in an incapacitating injury, while 77 percent involved only property damage.

Study area crashes were also compared to statewide crashes on similar roadway segments for the time period for which stateside average crash rates were available, 2012-2014.

Crashes were analyzed using the same parameters used by TDOT to identify whether road segments, spots, or intersections are eligible for safety improvement funding. The base parameters are as follows:

- *Exposure rate* (E): defined as the distance traveled by vehicles in a segment of roadway and measured in the analysis by million vehicle-miles (MVM);
- *Actual crash rate* (R): defined as the number of crashes per MVM;
- *Severity index* (SI): the weighted ratio of fatal and injury crashes to total crashes; and
- *Average crash rate* (R_A): defined as the average crash rate on roadways with similar lane configurations and functional classifications throughout the state of Tennessee.

Each study corridor segment was classified by route type, rural/urban land use, location, and highway type in order to determine which statewide crash rates should be used for comparison. Roadway characteristics used for each segment are detailed in **Appendix B.**

Crash rates were calculated for each segment and compared with statewide crash averages. **Table 3** shows the results of this analysis summarized by crash severity and includes the percent difference between the actual crash rates and statewide averages. The calculated crash rates in Cookeville are higher than statewide average crash rates for all crash types on all segments with a calculated crash rate above zero. Of the 58 crash rate comparisons in **Table 3**, 54 of the segment rates are at least 50% higher than statewide averages while 29 segment rates are at least 100% higher than the statewide averages.

Table 3: 2012-2014 Study Area Roadway Segment Crash Rates Compared to Statewide Average Crash Rates, by Severity

Roadway	Segment Start	Segment End	Study Area Crash Rate per MVM Traveled						Statewide Average					
			Fatal Rate	Incap. Rate[a]	Other Inj. Rate[b]	PD Rate[c]	Total Rate	Severe Crash Rate	Fatal Rate	Incap. Rate[a]	Other Inj. Rate[b]	PD Rate[c]	Total Rate	Severe Crash Rate
S. Willow Ave. (SR 135)	S. of Gould Dr.	N. of Interstate Dr.	0.0	0.148	1.525	5.213	6.886	0.148	0.015	0.056	0.231	0.739	1.041	0.071
S. & N. Willow Ave. (SR 135)	N. of Interstate Dr.	N. of 12th St.	0.0	0.352	1.599	5.990	7.942	0.352	0.013	0.069	0.660	2.257	2.999	0.082
S. Jefferson Ave. (SR 136)	S. of Bunker Hill Rd.	N. of Interstate Dr.	0.0	0.483	4.471	24.653	29.608	0.483	0.013	0.069	0.660	2.257	2.999	0.082
S. Jefferson Ave. (SR 136)	N. of Interstate Dr.	Broad Street	0.0	0.346	2.423	8.308	11.078	0.346	0.013	0.069	0.660	2.257	2.999	0.082
N. Washington Ave. (SR 136)	E. Spring St. (US 70N, SR 24)	N. of E. 10th St.	0.0	0.122	1.346	6.973	8.440	0.122	0.009	0.095	0.580	2.078	2.762	0.104
E. 10th St.	N. Washington Ave. (SR 136)	Hwy. 111 NB Ramps	0.0	0.275	1.850	6.175	8.300	0.275	0.004	0.062	0.624	2.426	3.115	0.066
Broad St.	W. Spring St. (US 70N, SR 24) W of downtown	Cedar St.	0.0	0.235	0.942	5.887	7.065	0.235	0.014	0.102	0.770	2.608	3.493	0.116
Broad St.	Cedar St.	E. Spring St. (US 70N, SR 24) E. of Downtown	0.0	0.176	1.756	13.523	15.455	0.176	0.004	0.062	0.624	2.426	3.115	0.066
W. Broad St. (US 70N, SR 24)	Jackson St.	Broad St. W. of Downtown	0.0	0.000	0.892	2.332	3.223	0.000	0.026	0.125	0.442	1.117	1.709	0.150
W. Spring St. (US 70N, SR 24)	Broad St. W. of Downtown	Broad St. E. of Downtown	0.0	0.195	2.683	10.340	13.218	0.195	0.009	0.095	0.580	2.078	2.762	0.104
E. Spring St. (US 70N, SR 24)	Broad St. E. of Downtown	E. of Hwy. 111 NB Ramps	0.0	0.261	2.301	5.595	8.157	0.261	0.026	0.125	0.442	1.117	1.709	0.150
E. Spring St. (US 70N, SR 24)	E. of Hwy. 111 NB Ramps	I-40 EB Ramps	0.0	0.423	0.664	3.622	4.708	0.423	0.026	0.125	0.442	1.117	1.709	0.150

[a] Incapacitating Injury Rate; [b] Other Injury Rate; [c] Property Damage Rate

Note 1: Crash rates for the study area are higher than statewide average crash rate for all categories except fatal crash rate and wherever study area rates are zero.

Note 2: Most recent available statewide crash data is from 2012-2014 hence statewide comparison was done for crashes during 2012, 2013 and 2014.

To ensure that an observed crash rate differs significantly from the average crash, the *critical crash rate* (R_C) is used to determine whether the actual crash rate is significantly higher than average. The critical crash rate is a threshold value, calculated for a given roadway segment, spot, or intersection, that determines whether the actual crash rate significantly deviates from the average crash rate for roadways with similar characteristics. The critical crash rate is calculated with 99% confidence using the average crash rate of the set of roadway segments, spots, or intersections and the exposure rate as follows:

$$R_C = R_A + 2.327\sqrt{\frac{R_A}{E} + \frac{1}{2E}}$$

Where:

- R_C is the critical crash rate;
- R_A is the average crash rate for a set of roadway segment, spots, or intersection with similar characteristics; and
- E is the exposure rate of a given roadway segment, spot, or intersection.

The critical crash rate provides a statistical test for the crash rate of a given roadway segment, spot, or intersection. If the observed crash rate for a given roadway segment, spot, or intersection exceeds the critical crash rate (expressed as an *actual-to-critical crash rate ratio,* R/R_C, over 1.0), then the relative excess is statistically attributable to more than random variation. According to the TDOT Traffic Monitoring and Forecasting Manual, when $R/R_C > 4.0$, the site is placed on the Hazard Location Listing and is eligible for Hazard Elimination Safety Program funds.

Table 4 lists the crash rate, statewide average crash rate, critical crash rate, actual-to-critical crash rate ratio, and other parameters by segment for the study period.

Table 4: Calculated Crash Rate and Parameters by Segments for the 2012-2014 Study Period

Route	Begin Log Mile	End Log Mile	Exposure Rate (E) (MVM)	Crash Rate (R) (CRASH /MVM)	State-wide Avg. (R_A) (CRASH /MVM)	Critical Crash Rate (R_C) (CRASH /MVM)	Crash Ratio (R/R_C)	SEVERITY INDEX (SI)
S. Willow Ave. (SR 135)	7.76	8.68	20.332	6.886	1.041	1.592	4.33	0.243
S. & N. Willow Ave. (SR 135)	8.68	11.64	73.786	7.942	2.999	3.475	2.29	0.246
S. Jefferson Ave. (SR 136)	2.17	2.56	8.275	29.608	2.999	4.460	6.64	0.167
S. Jefferson Ave. (SR 136)	2.56	4.13	37.553	11.078	2.999	3.670	3.02	0.250
	0.60	0.64						
N. Washington Ave. (SR 136)	4.13	5.12	16.350	8.440	2.762	3.749	2.25	0.174
E. 10th St.	0.00	2.13	40.001	8.300	3.115	3.777	2.20	0.256
Broad St.	0.92	1.54	4.246	7.065	3.493	5.722	1.23	0.167
Broad St.	0.00	0.91	5.694	15.455	3.115	4.924	3.14	0.125
W. Broad St. (US 70N, SR 24)	16.41	18.00	14.581	3.223	1.709	2.540	1.27	0.277
W. Spring St. (US 70N, SR 24)	18.00	19.73	20.502	13.218	2.762	3.640	3.63	0.218
E. Spring St. (US 70N, SR 24)	19.74	21.08	19.124	8.157	1.709	2.431	3.36	0.314
E. Spring St. (US 70N, SR 24)	21.11	22.99	16.566	4.708	1.709	2.486	1.89	0.231

As illustrated in **Table 3**, each of the segment crash rates exceeded the statewide average during the 2012-2014 study period. **Table 4** illustrates that each study area segment crash ratio (Crash Rate divided by Critical Crash Rate) also exceeds 1.0. This means that the segment crash rate is higher than the statewide average with 99% confidence. Further, along many of the segments, the crash ratio (R/R_c) was much higher than 1.0, with crashes exceeding the Hazard Elimination Safety Program threshold (4.0) along these two segments:

- S. Willow Avenue (SR 135) between Gould Drive and Interstate Drive
- S. Jefferson Avenue (SR 136) between Bunker Hill Road and Interstate Drive

According to Appendix A of the TDOT's January 2015 *Guidance for Preparing Road Safety Audits*, the qualifying criteria for interstates, state routes, and functionally classified local routes is as follows:

- At least 3 years of analysis
- A study corridor <5 miles in length
- At least five crashes
- One fatal crash or incapacitating injury crash **and** a segment severe crash to statewide average severe crash ratio greater than 1.0

All segments analyzed for this study met these four criteria except for one segment, W. Broad Street (US 70N, SR 24) between Jackson Street and Broad Street west of downtown, because this segment did not have any fatal or incapacitating injury crashes during the years analyzed.

3.2 Manner of Collision

Crashes along each segment were also summarized by the manner of collision in order to identify whether a particular type of crash was more prevalent in a particular study segment. The results of this analysis are shown in **Table 5.** Further analysis was conducted to identify any crash trends or patterns and potential countermeasures that could be helpful along a particular roadway segment.

Table 5: Crashes, by Manner of Collision, for 2012-2015

Roadway	Segment Start	Segment End	Number of Crashes, by Manner of Collision							
			Angle	Head-On	Rear-End	Sideswipe	Rear to Rear	Rear to Side	No Collision w/Vehicle	Other/ Unknown
S. Willow Ave. (SR 135)	S. of Gould Dr.	N. of Interstate Dr.	16%	1%	59%	11%	0%	1%	5%	6%
S. & N. Willow Ave. (SR 135)	N. of Interstate Dr.	N. of 12th St.	32%	2%	45%	11%	1%	1%	3%	5%
S. Jefferson Ave. (SR 136)	S. of Bunker Hill Rd.	N. of Interstate Dr.	31%	2%	45%	12%	0%	1%	6%	3%
S. Jefferson Ave. (SR 136)	N. of Interstate Dr.	Broad Street	30%	2%	44%	12%	0%	1%	3%	7%
N. Washington Ave. (SR 136)	E. Spring St. (US 70N, SR 24)	N. of E. 10th St.	38%	1%	40%	10%	0%	2%	4%	5%
E. 10th St.	N. Washington Ave. (SR 136)	Hwy. 111 NB Ramps	14%	2%	68%	4%	0%	0%	9%	4%
Broad St.	W. Spring St. (US 70N, SR 24) W of downtown	Cedar St.	43%	0%	23%	7%	0%	0%	17%	10%
Broad St.	Cedar St.	E. Spring St. (US 70N, SR 24) E of downtown	38%	2%	26%	16%	1%	9%	2%	6%
W. Broad St. (US 70N, SR 24)	Jackson St.	Broad St. W. of Downtown	17%	0%	51%	9%	0%	0%	19%	4%
W. Spring St. (US 70N, SR 24)	Broad St. W. of Downtown	Broad St. E. of Downtown	32%	1%	48%	4%	0%	3%	5%	6%
E. Spring St. (US 70N, SR 24)	Broad St. E. of Downtown	E. of Hwy. 111 NB Ramps	25%	3%	58%	6%	1%	1%	3%	4%
E. Spring St. (US 70N, SR 24)	E. of Hwy. 111 NB Ramps	I-40 EB Ramps	17%	5%	47%	10%	0%	0%	21%	0%

Rear end collisions were the most common crash type along every segment except for the two Broad Street segments, where angle crashes were the most common crash type. The high occurrence of angle crashes along Broad Street corresponds with field observations that downtown area angle parking limits sight distance at unsignalized intersections, which in some instances causes drivers to enter the intersection without being able to see oncoming traffic.

4 Intersection Crash Analysis – S. Willow Avenue/W. Jackson Street

An intersection crash analysis was performed for the intersection of S. Willow Avenue (SR 135)/W. Jackson Street, identified by city staff as an area of potential concern. Both S. Willow Avenue and W. Jackson Street are 5-lane facilities (4 lanes with a center turn lane) at the intersection, as shown in **Figure 3**.

Figure 3: S. Willow Avenue (SR 135)/W. Jackson Street

Each approach features two through lanes (one of which is a shared through-right) and an exclusive left-turn lane. The speed limit along S. Willow Avenue (SR 135) at this location is 40 mph, and the speed limit along W. Jackson Street is 35 mph. This signalized intersection operates as an actuated-uncoordinated intersection, and each left-turn signal phase operates in protected-permissive mode in the peak hours.

Figure 4: S. Willow Avenue (SR 135) at W. Jackson Street facing northeast (W. Jackson Street is seen sloping down toward the intersection)

This analysis is based on the same parameters discussed in the "Segment Crash Rates and Severity" section with the only difference being that exposure and crash rates for intersection crashes are measured using Million Entering Vehicles (MEV). The AADT count locations and values that were used to calculate MEV at this intersection are included in **Appendix A**. The number of entering vehicles in a year was calculated by summing the AADT values of each location to determine the average number of vehicles entering the intersection per day and multiplying that by the number of days in a year. The resulting number of entering vehicles per year was summed and divided by 1 million to calculate MEV.

Table 6 shows the results of this analysis.

Table 6: S. Willow Avenue and W. Jackson Street - Intersection Crash Rate and Parameters, 2012-2014

Intersection	Exposure Rate (E) (MEV)	Crash Rate (R) (CRASH/MEV)	Statewide Crash Rate (R_A) (CRASH/MEV)	Critical Crash Rate (R_C) (CRASH/MEV)	Crash Ratio (R/R_C)	SEVERITY INDEX (SI)
S. Willow Ave. (SR 135)/W. Jackson St.	47.702	3.794	0.879	1.205	3.149	0.166

The analysis shows that the actual crash rate is higher than both the statewide average and the critical crash rate. The actual-to-critical crash ratio at the intersection is 3.149.

Figure 5 shows a breakdown of the crashes at the intersection during the study period by crash type. Forty percent of the crashes at the intersection during the study period were rear-end collisions, which was followed closely by angle crashes at 34 percent.

Rear-end crashes were further analyzed to determine the direction vehicles were traveling at the time of collision. **Table 7** summarizes the distribution of rear-end crashes at the intersection. More than 80% of the total rear-end crashes occurred on either the northbound or southbound approach.

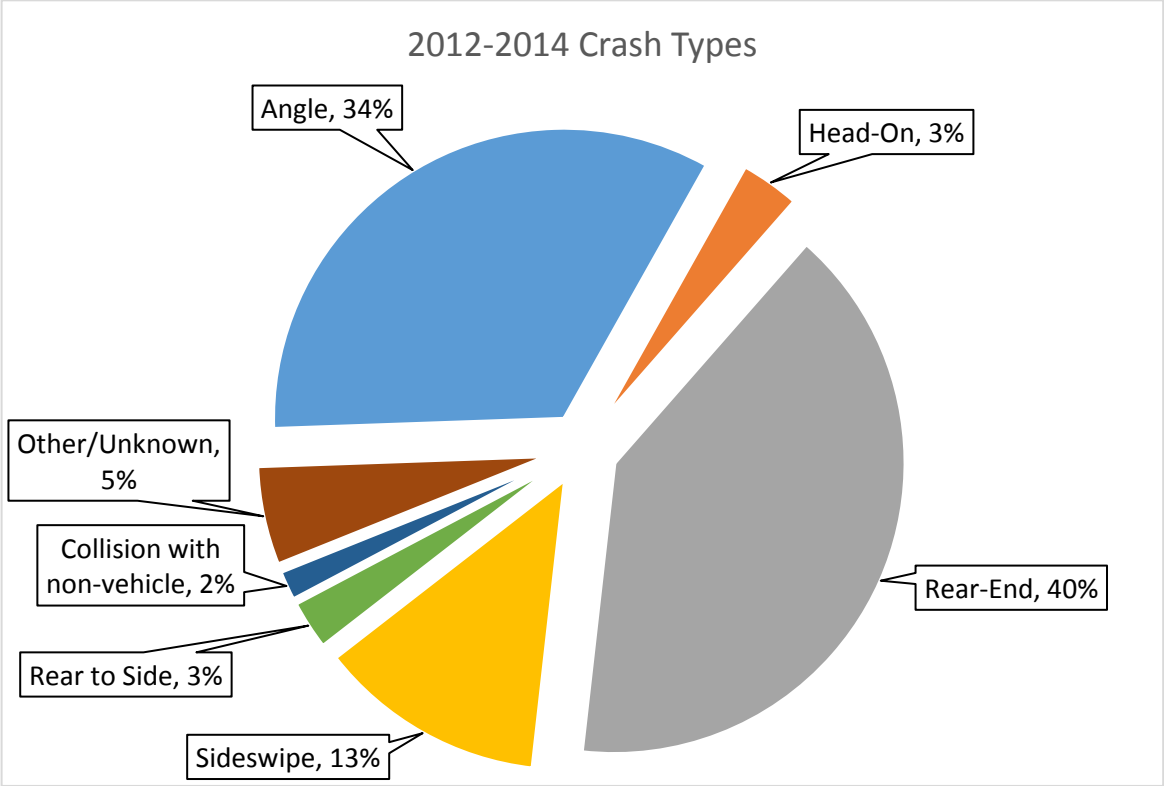
Table 7: Rear-End Crashes (2012-2014) by Direction of Travel

S. Willow Avenue (SR 135)		W. Jackson Street		Rear-end crashes
Northbound	Southbound	Eastbound	Westbound	
18 (40.9%)	14 (31.8%)	7 (15.9%)	5 (11.4%)	44 (100.0%)

Crash severity was also analyzed by direction for all crash types. No correlation was found between the vehicle direction and the crash severity.

One cause for high numbers of rear-end and angle crashes at a signalized intersection is inadequate yellow clearance time. Traffic signal timing at S. Willow Avenue (SR 135)/Jackson Street should be reviewed to ensure that vehicles have enough time to clear the intersection. A speed study at this intersection would assist the traffic signal retiming effort by revealing true motorist behavior at this intersection. Additionally, installation of advanced "be prepared to stop when flashing" signs in advance of the intersection could reduce rear-end and angle crashes by providing advance warning to approaching motorists that the traffic light will be red when they arrive at the signal.

Figure 5: S. Willow Avenue (SR 135)/W. Jackson Street - Intersection Crashes by Manner of Collision



5 Reversible Lane Crash Analysis – Fisk Road

A reversible lane operation exists on Fisk Road between E. 10th Street and Shag Rag Road. Fisk Road has a posted speed of 30 mph and has a total of three lanes including a center two-way left-turn lane. During the afternoon peak, the center lane operates as a second through-lane in the northbound direction. There is also an at-grade railroad crossing within this reversible lane segment of Fisk Road.

Some studies have found an increased rate of crashes on roads with reversible lanes, compared to crash rates on similar roads that have a two-way left turn lane rather than a reversible lane. An analysis was therefore undertaken to determine if any safety concerns currently exist within this section of Fisk Road. According to the National Cooperative Highway Research Program (NCHRP) Synthesis 340[1] on Convertible Roadways and Lanes, there are three primary types of incidents associated with reversible lanes on arterial roadways:

1. Left turns in front of traffic moving in the same direction
2. Left turns from side streets or driveways into the direction reversible roadway
3. Left turning traffic is struck by the opposing traffic or from behind in a reversible lane where left turns have been prohibited during the operation of reversible lanes

[1] National Cooperative Highway Research Program. (2004) *NCHRP Synthesis 340: Convertible Roadways and Lanes.* Washington D.C.: Transportation Research Board

For this analysis, crash data was collected for the one-mile segment of Fisk Road between E. 10th Street and Shag Rag Road during the years 2012 through 2014, which corresponds with the years of the latest available statewide crash data. Of the 16 total crashes recorded, 11 crashes were property damage only, 3 crashes involved a non-incapacitating injury, 2 crashes resulted in incapacitating injuries, and there were no fatalities. **Table 7** summarizes the results of this analysis. While the total crash rate on Fisk Road is below the statewide average, the severe crash rate is higher than the statewide average, which corresponds with the reversible-lane crash pattern identified in the NCHRP Synthesis 340.

Table 7: 2012-2014 Fisk Road Crash Rates Compared to Statewide Average Crash Rate, by Severity

Roadway	Segment Start	Segment End	Fatal Rate	Incap. Rate[a]	Other Inj. Rate[b]	PD Rate[c]	Total Rate	Severe Crash Rate
Fisk Road	E. 10th Street	Shag Rag Road	**Study Area Crash Rate per Million Vehicle Miles Traveled**					
			0.00	0.37	0.56	2.05	2.98	0.31
			Statewide Average per Million Vehicle Miles Traveled					
			0.014	0.102	0.770	2.608	3.493	0.116

[a] Incapacitating Injury Rate; [b] Other Injury Rate; [c] Property Damage Rate
Note: Study area crash rates that are higher than statewide average crash rates are highlighted in red

However, further analysis of the data reveals that only 1 of the 16 crashes during the 3-year time period from 2012 to 2014 occurred while the reversible lane operations were activated. This crash was a rear-end collision that did not result in any injuries. Overall, the reversible lane does not appear to present any safety issues under existing conditions. However, the City should monitor this segment for any increase in the crash types previously mentioned to ensure continued safety along this corridor.

6 Recommendations

This section contains preliminary recommendations based on the crash analysis and existing conditions observations. Recommendations for future corridor improvement will take the findings of this report into consideration to ensure that recommended improvement will enhance the safety along corridors.

- Immediate action to enhance safety along the corridors should be to improve traffic flow though optimizing signal operations. This would include signal coordination, optimized offsets, improved phasing patterns, and adequate clearance times.
- A longer term improvement to improve traffic flow and enhance safety is to implement access management strategies along the major corridors. Access management reduces the potential for angle crashes at midblock locations by limiting the number of driveways along major thoroughfares. A detailed access management study could be used to determine what access strategies would be most effective at specific locations in Cookeville.
- In downtown Cookeville, creating clear zones with parking restrictions near intersections can help improve safety and traffic flow by improving sight distance at intersections. Improving sight distance of oncoming traffic allows drivers to better judge when it is safe to turn. Additionally, restricting parking near intersections improves visibility of pedestrians at street corners who may be preparing to cross the street.

Appendix A:
Segment AADT for Crash Analysis & Comparison

TDOT Traffic Count Stations on Study Corridors

TDOT Count Station No.	Roadway	Location	AADT (Vehicles/Day)			
			2012	2013	2014	2015
141000132	S. Willow Ave. (SR 135)	South of I-40	13,802	15,063	16,490	14,925
141000051	S. Willow Ave. (SR 135)	South of Fairground St.	25,363	25,215	25,453	24,690
141000098	S. Willow Ave. (SR 135)	North of Spring St.	23,742	24,140	24,918	22,426
141000099	N. Willow Ave. (SR 135)	South of 12th St.	18,283	19,175	18,550	16,076
141000083	S. Jefferson Ave. (SR 136)	South of I-40	14,428	14,990	14,975	14,836
141000101	S. Jefferson Ave. (SR 136)	South of Fairground St.	25,291	23,331	23,737	22,776
141000049	S. Jefferson Ave. (SR 136)	South of Jackson St.	25,022	25,113	24,796	24,357
141000075	S. Jefferson Ave. (SR 136)	North of Proffitt St.	13,777	16,320	14,151	15,138
141000185	N. Washington Ave. (SR 136)	North of Broad St.	13,578	14,413	13,562	11,523
141000079	N. Washington Ave. (SR 136)	South of E. 10th St.	16,753	16,206	16,357	16,640
141000028	E. 10th St.	West of Fisk Rd.	17,685	16,454	16,775	17,010
141000108	E. 10th St.	East of Old Kentucky Rd.	18,290	17,034	16,519	17,505
141000119	Broad St.	West of N. Willow Ave. (SR 135)	6,074	6,200	6,324	6,004
141000113	Broad St.	East of Cedar St.	4,808	5,025	5,043	4,504
141000149	Broad St.	East of N. Jefferson Ave.	6,547	6,409	6,460	6,942
141000025	W. Broad St. (US 70, SR 24)	West of Davidson Ave.	7,720	8,568	8,140	7,789
141000145	W. Spring St. (US 70, SR 24)	West of S. Willow Ave. (SR 135)	7,927	8,881	9,002	8,341
141000074	E. Spring St. (US 70, SR 24)	East of Flemming Ave.	9,959	11,112	11,370	10,760
141000047	E. Spring St. (US 70, SR 24)	East of Hudgens St.	12,947	13,119	12,999	13,802
141000109	E. Spring St. (US 70, SR 24)	East of Whitson Chapel Rd.	8,411	7,676	8,032	8,623

TDOT Count Stations used for Intersection Analysis

TDOT Count Station No.	Roadway	Location	AADT (Vehicles/Day)			
			2012	2013	2014	2015
141000051	S. Willow Ave. (SR 135)	South of Fairground St.	25,363	25,215	25,453	24,690
141000176	Jackson St.	West of S. Willow Ave. (SR 135)	18,524	17,857	18,158	18,260

Appendix B:
Segment Characteristics for Crash Analysis & Comparison

Roadway Segment Characteristics

Roadway	Segment Start	Segment End	Route Type[a]	Rural/ Urban	Location	Highway Type[b]
S. Willow Ave. (SR 135)	S. of Gould Dr.	N. of Interstate Dr.	IS & SR	Rural	Section	4 OR MORE W TL
S. & N. Willow Ave. (SR 135)	N. of Interstate Dr.	N. of 12th St.	IS & SR	Urban	Section	4 OR MORE W TL
S. Jefferson Ave. (SR 136)	S. of Bunker Hill Rd.	N. of Interstate Dr.	IS & SR	Urban	Section	4 OR MORE W TL
S. Jefferson Ave. (SR 136)	N. of Interstate Dr.	Broad Street	IS & SR	Urban	Section	4 OR MORE W TL
N. Washington Ave. (SR 136)	E. Spring St. (US 70, SR 24)	N. of E. 10th St.	IS & SR	Urban	Section	2 OR 3 LN W/TL
E. 10th St.	N. Washington Ave. (SR 136)	Hwy. 111 NB Ramps	FUNCT.	Urban	Section	2 OR 3 LN W/TL
Broad St.	W. Spring St. (US 70, SR 24) W. of Downtown	Cedar St.	FUNCT.	Urban	Section	2 OR 3 LN
Broad St.	Cedar St.	E. Spring St. (US 70, SR 24) E. of Downtown	FUNCT.	Urban	Section	2 OR 3 LN W/TL
W. Broad St. (US 70, SR 24)	Jackson St.	Broad St. W. of Downtown	IS & SR	Rural	Section	2 OR 3 LN
W. Spring St. (US 70, SR 24)	Broad St. W. of Downtown	Broad St. E. of Downtown	IS & SR	Urban	Section	2 OR 3 LN W/TL
E. Spring St. (US 70, SR 24)	Broad St. E. of Downtown	E. of Hwy. 111 NB Ramps	IS & SR	Rural	Section	2 OR 3 LN
E. Spring St. (US 70, SR 24)	E. of Hwy. 111 NB Ramps	I-40 EB Ramps	IS & SR	Rural	Section	2 OR 3 LN

[a] IS & SR = Interstate & State Route; FUNCT = all urban non-state routes

[b] 4 or MORE w/ TL = 4 or more lanes with turn lane