

APPENDIX E

Meeting Summaries

Meeting Minutes

DATE: March 20, 2020

SUBJECT: Lone Oak Road (US 45) Reversible Lanes Feasibility Study
From Clinton Road (KY 339) to Jackson Street (US 62/KY 731)
(MP 6.135 to MP 9.224)
KYTC Item No. N/A
Meeting with LFUCG

A meeting with the Lexington-Fayette Urban County Government (LFUCG) division of traffic was held at the Phoenix Building in Lexington, Kentucky on March 5, 2020 at 1:30 p.m. EST. The following individuals were in attendance:

Jason Allinder	LFUCG – Traffic
Joel Webber	LFUCG – Traffic
Dan O’Dea	Stantec Consulting Services Inc.
Len Harper	Stantec Consulting Services Inc.
Jacob Huber	KYTC – Central Office Planning
Graham Winchester	Stantec Consulting Services Inc.

The purpose of the meeting was to discuss the Reversible Lane System (RLS) on Nicholasville Road in Lexington, Kentucky. The RLS on US 27 first became operational on March 5, 1979 and has remained in operation for 41 years.

The following is a summary of the discussion:

Operational facts

The Nicholasville Road RLS extends 2.2 miles between Moore Drive and Conn Terrace. 0.8 miles within these limits are 7 seven lanes and 1.4 miles are 5 lanes. During non-peak hours, the RLS system operates with a center two-way left turn lane and either 3-1-3 or 2-1-2 configuration respectively. During peak hours the two-way left turn lane toggles to a 4-1-2 configuration with 4 through lanes in the peak direction and 2 through lanes in the non-peak direction for the seven-lane segment. Similarly, the center two-way left turn lane toggles to a 3-1-1 configuration with 3 through lanes in the peak direction and 1 through lane in the non-peak direction for the five-lane segment.

There are 14 overhead spans supporting lane-use control signals, and there is one signal controller per RLS span. Each controller has an internal local clock which is updated by central system clock in Traffic Operations Center. The traffic signals and lane-light spans throughout the corridor are interconnected to the Traffic Operations Center via fiberoptic cables allowing for continuous monitoring capability. Note that the lack of a Traffic

Operations Center with fiberoptic connection to the RLS would not preclude KYTC District 1 from operating and maintaining a RLS.

The transition period for the RLS spans and traffic signals to/from off-peak timing / display from/to peak timing / display or vice versa occurs within a single traffic signal cycle (2 - 3 minutes). This is necessary because the each of left-turn and through signal indications at the intersections for the Nicholasville Road approaches moves to correspond with the applicable lane use during a single cycle of the traffic signal timing.

The Kentucky Transportation Research Center (formerly Division of Research, Kentucky Department of Transportation) completed a study called Evaluation of Reversible Lanes (Nicholasville Road; Lexington, Kentucky) in July 1980 – approximately 1.5 years after implementation. It is a before and after study evaluating operational and safety impacts which can be downloaded from https://uknowledge.uky.edu/ktrc_researchreports/794/.

Maintenance

Maintenance issues for RLS spans are similar to that of typical traffic signal. The redundancy of spans does mitigate the effect of a single lane-light span being blank (loss of power) or operating with incorrect display (loss of clock).

Unique Issues

The left-turn signal indications at signalized intersections from Nicholasville Road approaches make the signal timing very complicated. The reason for this complexity is that left-turn signal indications from Nicholasville Road are applicable from 3 different approach lanes depending on the time of day. The applicable signal indications particularly for left-turn movements move with the lane assignments. This results in scenarios of both a signal head(s) being darkened over an unused lane as well as displaying a CIRCULAR red and yellow indications for a protected-only left movement instead of a red ARROW. Both of these scenarios are actually counter to typical MUTCD standards. MUTCD SECTION 4D.05 01 states that “when a traffic control signal is being operated in a steady (stop-and-go) mode, at least one indication in each signal face shall be displayed at any given time”. MUTCD Section 4d.19 03 states that “when a separate left-turn signal face is provided for a protected only mode left turn, it shall be capable of displaying, the following signal indications: steady left-turn RED ARROW, steady left-turn YELLOW ARROW, and left-turn GREEN ARROW.” LFUCG officials have discussed these scenarios with FHWA officials, but no alternatives could be determined. Finally, LFUCG acknowledged that the complexity of the programming of the signal timing to accomplish the variable per-approach signal indications was not achieved with LFUCG staff but rather by contracting with an expert specializing in the firmware of the controller.

LFUCG operates the RLS prior to and following home UK football games. The RLS is pre-programmed to activate 3 hours before kickoff to facilitate inbound traffic heading toward

the stadium and 3 hours after the expected end of the game to facilitate outbound traffic leaving the stadium. LFUCG staff is not available to manually operate the RLS on gamedays. Other observations from LFUCG staff

The Nicholasville Road RLS does improve the primary peak direction but significantly adversely effects the non-peak particularly in the five-lane segment particularly during the PM.

The complexity of the timing program actually increased when converting controllers from Type 170 Controller to ASC 3 Econolite Controller.

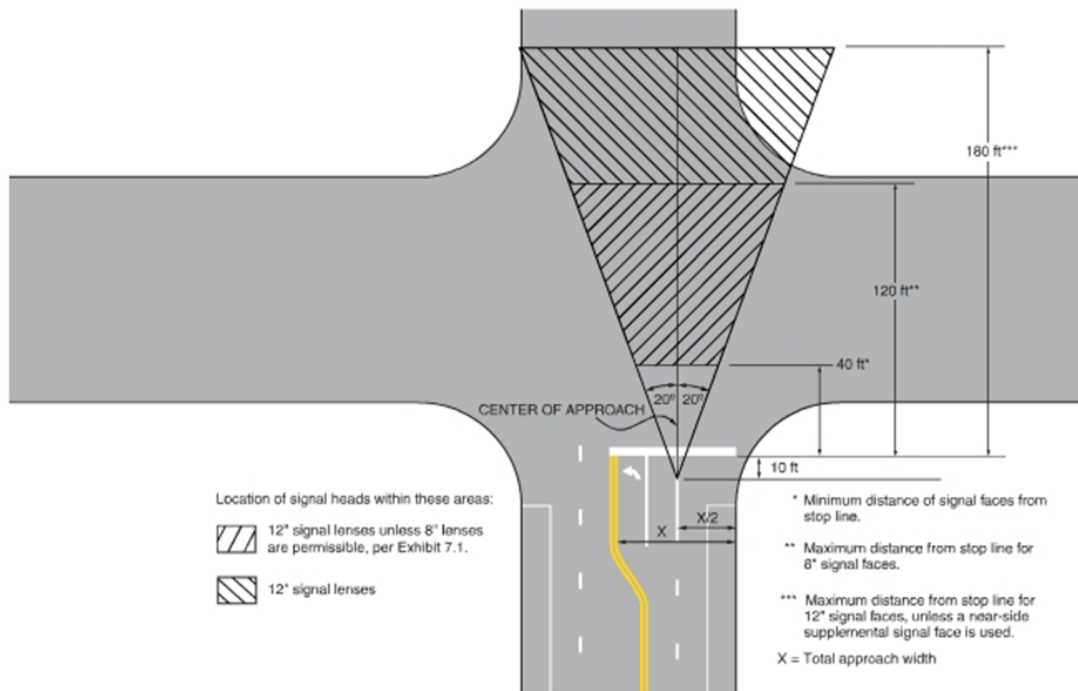
LFUCG officials stated that motorists are occasionally observed travelling in the two-way left turn as a through lane either unwittingly or on purpose but did not believe that there was high rate of crashes attributable to the RLS.

RLS lanes are not deactivated for major holidays.

Opinion of Potential KYTC District Needs for RLS

It is recommended that the traffic signal indications for the Lone Oak Road approaches be on spans or mast arms on the far-side of the intersection. The reason that this is recommended is so that signal indications when centered over the applicable lanes during non-peak hours will still be clearly visible from adjacent lanes when the RLS is active. The MUTCD (Chapter 4D) requires that at least one signal face (but preferably both of the minimum of two primary signal faces required for the through movement, or the major turning movement if there is no through movement) be located within a cone of 20 degrees to the left or to the right of the "center of the approach lanes extended." If the minimum visibility requirements can be satisfied for all scenarios of the RLS with traffic signal indications in a common location, then the traffic signal timing programming is significantly simplified.

Minimum Visibility Requirements



It appears that most existing signal spans would remain MUTCD compliant for minimal visibility requirements for adjacent lanes if the RLS was active. Due to a diagonal span, only the intersection of Lone Oak Road and Clinton Road may need further scrutiny to ensure that the signal indications for the northbound Lone Oak Road approach would remain compliant. Note: This intersection is south of Friendship Drive (outside of anticipated RLS zone) so this sentence may not necessary.

It is recommended that the protected / permissive left turn traffic signal indications for the Lone Oak Road approaches be flashing yellow left turn arrow type (FYLTA) instead of traditional 5-section type. The reason that this is recommended is that FYLTA indications are centered over the middle lane during non-peak hours and would be more conspicuous from adjacent lanes when the RLS is active. 5-section signal indications are typically mounted over lane lines instead of being mounted of the center of the turn lane. Also, it is envisioned that while the RLS is active, permissive left-turn movements across three opposing through lanes of the peak direction from the non-peak direction would likely be prohibited. A FYLTA indication would allow left-turn movements to operate as protected when necessary but as permissive during other periods. The intersection of Lone Oak and Berger Road has one 5-section signal head for the southbound Lone Oak approach and the intersection of Lone Oak Road & Parkview Drive has a 5-section signal head for both northbound and southbound approaches. It is recommended that the intersections be modified with FYLTA indications.

THE MUTCD offers guidance on the horizontal and vertical location of the devices stating that the indications shall be visible at all times for 2300 feet under normal atmospheric conditions, unless otherwise physically obstructed. It is advised that lane control signals shall be installed such that at least one and preferably two signals at all times. Based on these criteria and the designed spacing on other RLS corridors, it is envisioned that approximately 20(?) lane-control signal spans would be required between US-62 (Jackson Street) and KY-1286 (Friendship Drive).

Some agencies that operate RLS also have robust communication from each traffic signal and lane control signal to a Traffic Operations Center. While this may be ideal, it is not necessarily a requirement. However, it is recommended that the District has a means to remotely communicate with each traffic signal and lane-control signal within the RLS primarily to ensure that internal clocks are updated periodically. The presence of antennas at each of the existing traffic signals on the Lone Oak Road indicates that the District is already communicating wirelessly. The augmentation of the existing communication system to include new lane-control signals would be required.

As stated above, if the minimum visibility requirements can be satisfied for all scenarios of the RLS with traffic signal indications in a common location, then the traffic signal timing programming would be relatively simple. However, if the visibility requirements cannot be satisfied for all scenarios of the RLS with traffic signal indications in a common location, then it may be necessary to implement variable-location traffic signal indications like the Nicholasville Road RLS in Lexington. The development of a complex traffic signal timing program would then be required which may involve contracting with an expert specializing in the firmware of the controller. It is recommended that use of variable-location signal indications and associated timing program be avoided if possible.

Additional District staff and/or contractor maintenance staff should be considered. It would be envisioned that additional resources may be initially required to both observe operation and respond to operational issues which may be actual or perceived. After the RLS has been activated and local drivers have had time to adapt, it is envisioned that the expected annual maintenance for each lane-control signal would be like that of a typical traffic signal.

The meeting ended at approximately 12:00 p.m. EDT.

Meeting Minutes

TO: Jacob Huber
Co-Project Manager
KYTC Central Office
200 Mero Street
Frankfort, KY 40622

Chris Kuntz
Co-Project Manager
KYTC District Office #1
5501 Kentucky Dam Road
Paducah, KY 42003

FROM: Len Harper
Project Manager
Stantec Consulting Services Inc.

DATE: May 5, 2020

SUBJECT: Lone Oak Road (US 45) Reversible Lanes Feasibility Study
From Clinton Road (KY 339) to Jackson Street (US 62/KY 731)
(MP 6.135 to MP 9.224)
KYTC Item No. N/A
Project Team Meeting No. 1

The first project team meeting for the subject project was held via a BlueJeans Teleconference on April 3, 2020 at 9:30 a.m. CDT. The following individuals were in attendance:

Jay Balaji	KYTC – Central Office Planning
Stacey Courtney	Purchase Area Development District (PADD)
Stephen De Witte	KYTC – Central Office Planning
Harold Gibson	KYTC – District 1 Project Delivery & Preservation
Jessica Herring	KYTC – District 1 Planning
Tom Hines	KYTC – District 1 Traffic
Jacob Huber	KYTC – Central Office Planning
Chris Kuntz	KYTC – District 1 Project Development Branch Manager
Tim Layson	KYTC – Central Office Design
Jim LeFevre	Purchase Area Development District (PADD)
Henry Luken	KYTC – District 1 Traffic
Mikael Pelfrey	KYTC – Central Office Planning
Kyle Poat	KYTC – District 1 Chief District Engineer
Steve Ross	KYTC – Central Office Planning
David Souleyrette	KYTC – Central Office Planning
Scott Thomson	KYTC – Central Office Planning
Zach Thorpe	KYTC – District 1
James Tilley	KYTC – District 1 Traffic
Brian Aldridge	Stantec Consulting Services Inc.
Mark Butler	Stantec Consulting Services Inc.
Dan O’Dea	Stantec Consulting Services Inc.

Len Harper Stantec Consulting Services Inc.
Graham Winchester Stantec Consulting Services Inc.

Len Harper welcomed everyone and, after introductions, said the purpose of the meeting was to discuss the progress to date for the Lone Oak Road (US 45) Reversible Lanes Feasibility Study.

The following enumerated items were discussed.

1. The purpose of the meeting is to present the results from the existing conditions analysis and to get feedback from the project team on the traffic forecasts assumptions and the potential improvement concepts.
2. This project is federally funded with Federal Statewide Planning and Research (SPR) funds and is being performed under Stantec's 2018-2020 KYTC Statewide Modeling Contract as Letter Agreement No. 3. Future phases of the project are not funded in *Kentucky's FY 2020 – FY 2022 Biennial Highway Plan*.
3. There is one additional project along the study portion of US 45 listed in *Kentucky's FY 2020 – FY 2022 Biennial Highway Plan*.
 - Item No. 1-153.00: Improve KY 1286 (Friendship Road) from milepoint 3.6 to milepoint 6.4 in Paducah. This project is currently under design with right-of-way acquisition scheduled to begin in 2021 (\$2.48 million) and utility relocation scheduled to begin in 2022 (\$2.31 million).
4. A second project in the study area is Item No. 1-9012.00: a Highway Safety Improvement Program (HSIP) project at the intersection of US 45 and Kennedy Road. This project is currently under design but is not listed in *Kentucky's FY 2020 – FY 2022 Biennial Highway Plan*.
5. In 2019, Stantec worked with KYTC and the City of Paducah on the *Paducah Small Urban Area Study*. This study investigated transportation issues related to safety and congestion in Paducah and the surrounding area. As part of the study, a high priority long-term project was identified to look at the feasibility of converting Lone Oak Road to reversible lanes.
6. Highlights from the existing conditions analysis were discussed. The study portion of US 45 is 3.089 miles in length from Clinton Road in the south to Jackson Street (US 62) to the north. This section of US 45 is a rural principal arterial with a posted speed limit ranging from 35 to 45 miles per hour (mph). There are three typical sections: four ten-foot lanes with a center two-way left-turn lane (TWLTL) between Clinton Road and I-24, five 11-foot lanes with a raised median at the I-24 interchange, and four 11-foot lanes with a TWLTL from I-24 to US 62.

7. Historical KYTC traffic counts show an Annual Average Daily Traffic (AADT) on the study portion of US 45 of approximately 27,300 vehicles per day (vpd) south of the I-24 interchange and 19,700 vpd to the north. South of the I-24 interchange, there are 1,300 vehicles per hour (vph) (63 percent) traveling northbound into Paducah and 750 vph (37 percent) traveling southbound during the AM peak hour (7:00 a.m. – 8:00 a.m.). During the PM peak hour (4:30 p.m. – 5:30 p.m.), there are 900 vph (39 percent) traveling northbound into Paducah and 1,400 vph (61 percent) traveling southbound.

North of the I-24 interchange, there are 1,000 vph (71 percent) traveling northbound into Paducah and 400 vph (29 percent) traveling southbound during the AM peak hour. During the PM peak hour, there are 700 vph (39 percent) traveling northbound into Paducah and 1,100 (61 percent) vph traveling southbound.

Cummins Consulting Services, PLLC collected 13-hour turning movement counts classified as autos, light trucks, heavy trucks, trucks, and pedestrians (6 AM - 7PM CST). Using MioVison technology, travel time and origin-destination data were also collected for use in the simulation model. Data was collected at the following signalized intersections:

- | | |
|---|--|
| <ol style="list-style-type: none"> 1) Lone Oak Road (US 45) at Clinton Road (KY 339) 2) Lone Oak Road (US 45) at Lovelaceville Road (KY 1322) 3) Lone Oak Road (US 45) at Friendship Road (KY 1286) 4) Lone Oak Road (US 45) at Lakeview Drive 5) Lone Oak Road (US 45) at Bleich Road 6) Lone Oak Road (US 45) at I-24 southbound ramp | <ol style="list-style-type: none"> 7) Lone Oak Road (US 45) at I-24 northbound ramp 8) Lone Oak Road (US 45) at Kennedy Road 9) Lone Oak Road (US 45) at Highland Boulevard 10) Lone Oak Road (US 45) at Berger Road (KY 1310) 11) Lone Oak Road (US 45) at Parkview Drive 12) Lone Oak Road (US 45) at Jackson Street (US 62) |
|---|--|

Additional 30-minute counts were taken by KYTC District 1 at the following unsignalized intersections and driveways:

- | | |
|---|---|
| <ul style="list-style-type: none"> • Goad Drive/KY 6041 • Brett Chase Road/Cave Thomas Drive • Concord Avenue • Lansing Avenue • Charleston Avenue | <ul style="list-style-type: none"> • John E. Robinson Avenue • Austin Street • Augusta Avenue • Maryland Street • Banks Market • Plantation Drive |
|---|---|

- Glenn Street
- Temple Israel Cemetery
- Kenton Street
- Carson Street
- Mohawk Drive
- Iroquois Drive
- Martin Circle
- Nolan Drive
- Whitehaven Rest Area
- Birch Street/Mercy Health
- Medical Center Drive/Sycamore Street
- Hickory Street
- Oak Street
- Walnut Street
- Chestnut Street
- Plum Street
- Goodman Street/Hannan Plaza

Five- to ten-minute spot counts were also taken by Stantec at driveways that were being utilized during the peak hours. These counts were used to derive estimated hourly demand at the following locations:

- Huck's Food and Fuel
- Dollar General
- Wendy's
- Superway
- BP
- CVS
- Family Dollar
- Marathon Gas
- McDonald's

8. An Existing (2020) peak hour simulation model was developed for the study portion of US 45 using TransModeler version 5.0. This model, along with a calibration memo, was provided to KYTC prior to Project Team Meeting No. 1.

Letter-based "Level of service" (LOS) grades provide a qualitative framework for describing the operational conditions and evaluating the adequacy of the existing roadway. In urban areas such as this, LOS "D" or better is desirable. During the AM peak hour, all signalized intersections in the study area operate at a desirable LOS, as shown in **Figure 1**. During the PM peak hour, the US 62 intersection operates at an undesirable LOS E, as shown in **Figure 2**.

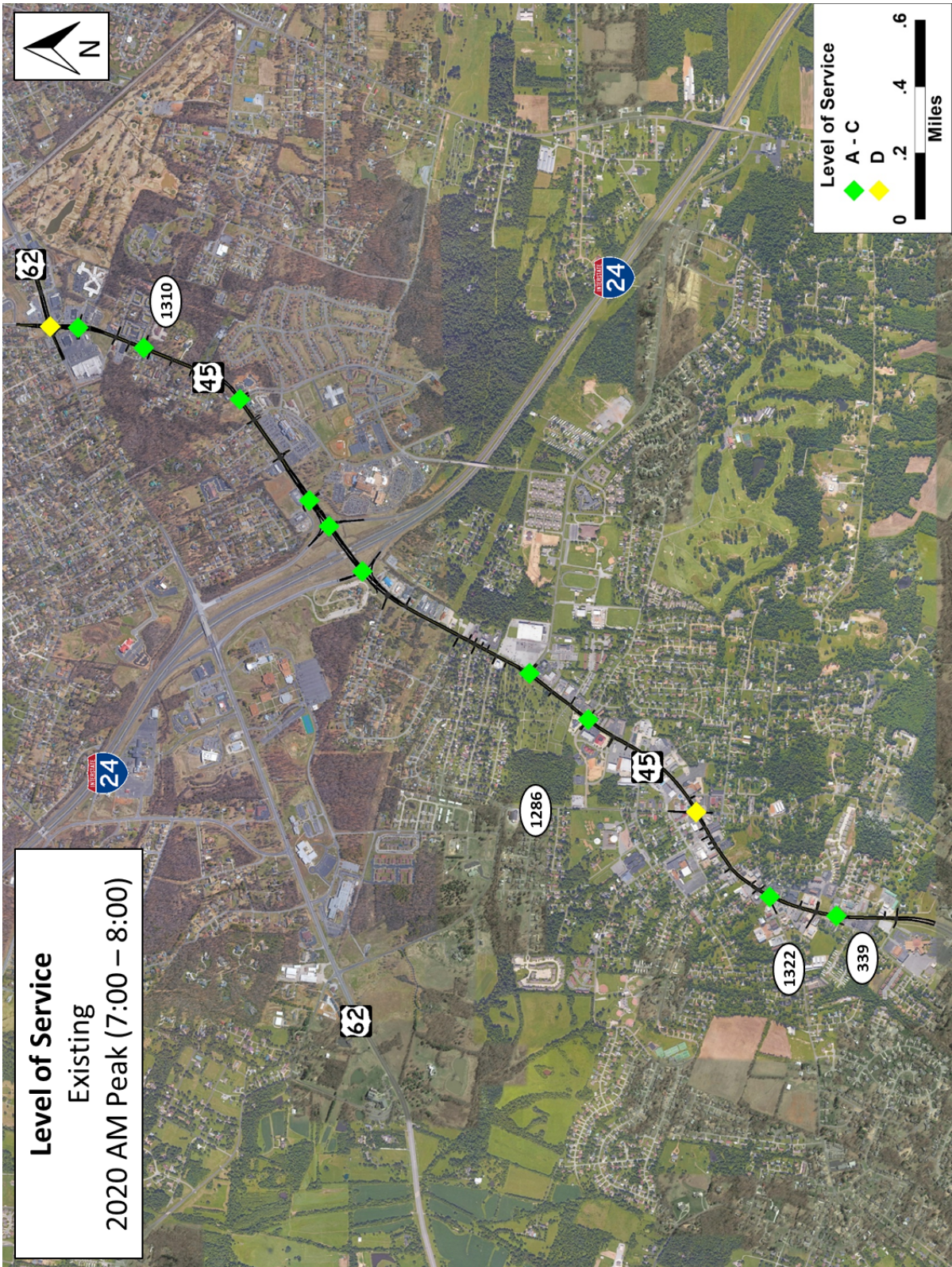


Figure 1: 2020 AM Peak Hour Level of Service

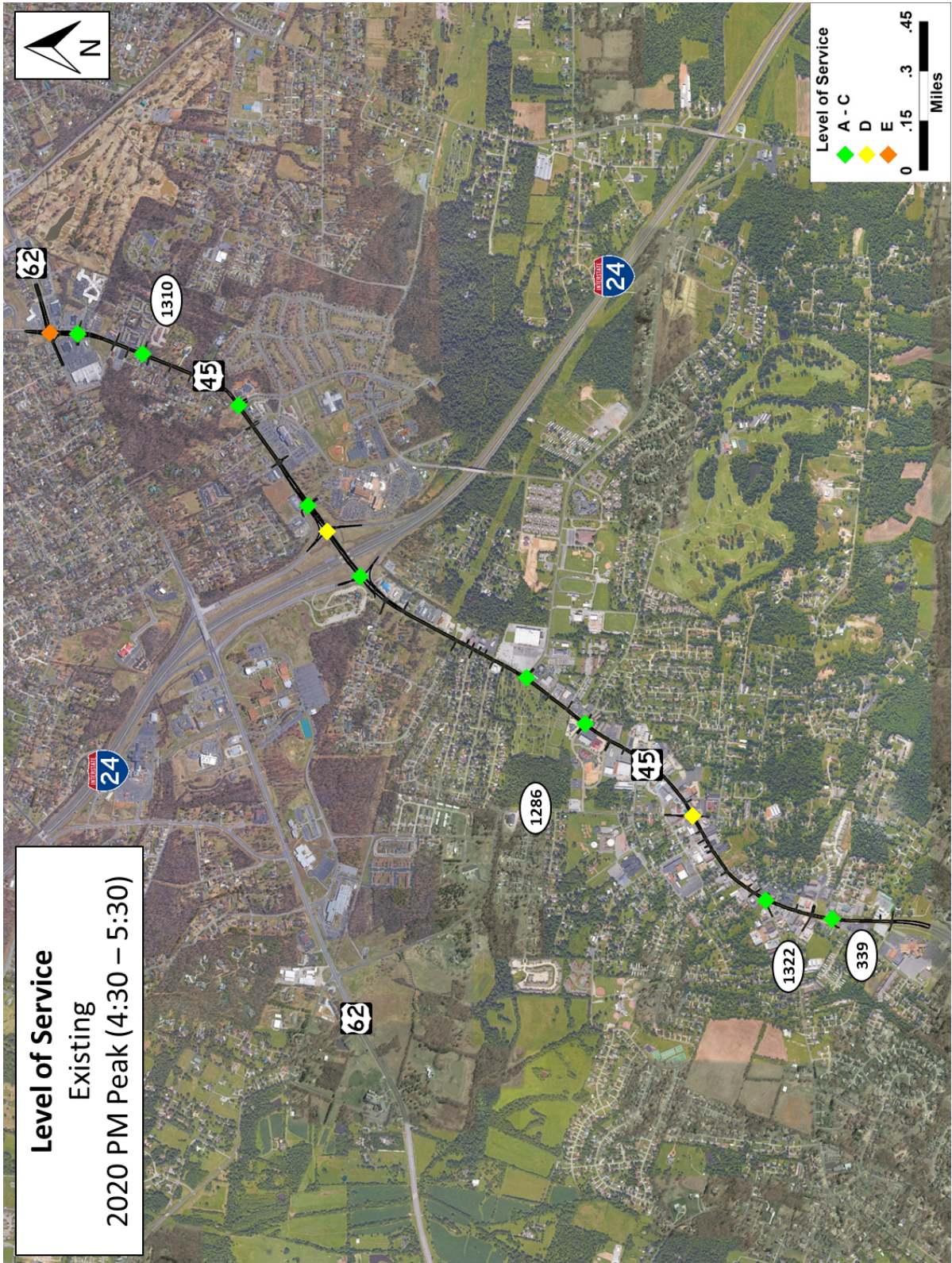


Figure 2: 2020 PM Peak Hour Level of Service

9. Preliminary traffic forecasts for the year 2030 were developed based on annual growth rates from the McCracken County Travel Demand Model and historical growth rates from KYTC count stations, as shown in **Table 1**. A Traffic Forecast Memorandum will be developed that summarizes this effort and submitted to Central Office Planning for review.
 - It was noted by the project team that US 45 is not only used by McCracken County residents but also by residents of growing counties nearby. The McCracken County TDM reflects outside growth in external stations, which were updated in 2018.

Table 1: Proposed Annual Growth Rates

Lone Oak Road (US 45) Segment	KYTC Historical Annual GR	McCracken County TDM Annual GR	Proposed Annual GR
South of Lovelaceville	1.20%	1.39%	1.50%
Between Lovelaceville & Friendship	0.54%	0.89%	
Between Friendship & Lakeview	0.58%	0.69%	0.75%
Between Lakeview & I-24	0.15%	0.35%	
Between I-24 & Berger	0.19%	0.20%	0.50%
Between Berger & Jackson	0.19%	0.37%	

Based on these No-Build growth rates, south of the I-24 interchange, there are expected to be 1,400 vph (64 percent) traveling northbound into Paducah and 800 vph (36 percent) traveling southbound during the 2030 AM peak hour (7:00 a.m. – 8:00 a.m.). During the 2030 PM peak hour (4:30 p.m. – 5:30 p.m.), there are expected to be 1,000 vph (40 percent) traveling northbound into Paducah and 1,500 vph (60 percent) traveling southbound.

North of the I-24 interchange, there are expected to be 1,100 vph (73 percent) traveling northbound into Paducah and 400 vph (27 percent) traveling southbound during the 2030 AM peak hour. During the 2030 PM peak hour, there are expected to be 750 vph (41 percent) traveling northbound into Paducah and 1,100 (59 percent) vph traveling southbound.

- It was noted that based on a Highway Capacity Software (HCS) analysis, the average capacity on the study area portion of Lone Oak Road during the peak hours is 1,100 vehicles per hour per lane

The 2030 Existing plus Committed (E+C) network will include the following projects:

- The relocation of KY 1286 (Friendship Road) (Item No. 1-153.00). Stantec has been working with QK4 on revised traffic forecasts for this project.
- The relocation of Lone Oak Middle School to Bleich Road
- The Highway Safety Improvement Program (HSIP) project at the US 45 intersection with McCauley Street/Kennedy Road

10. Len led a discussion of preliminary improvement concepts. Stantec will develop the design and construction cost estimates. KYTC District 1 will provide right-of-way and utility cost estimates for each improvement concept. The following preliminary improvement concepts are being considered:

- **Spot Improvements**
 - Additional turn lanes
 - Traffic signal timing optimization
 - Intersection improvements
- **Reversible Lanes**
 - Only south of the I-24 interchange (From Clinton Road to I-24)
 - For the entire US 45 study area
- **Widening Lone Oak to Seven Lanes**

11. The American Association of State Highway and Transportation Officials (AASHTO) suggests that reversible operations are justified when “65 percent or more of the traffic moves in one direction during peak hours.” Implementing reversible lanes will encourage additional traffic to use US 45 in the peak direction and divert traffic to alternate routes in the non-peak direction during the peak periods, which will increase the directional splits. Although it is a daily model, the McCracken County TDM was used to estimate this diversion, which showed a 15 percent increase in traffic in the peak direction and a 20 percent decrease in traffic in the non-peak direction. Both the AM (3 lanes NB/1 lane SB) and PM (1 lane NB/3 lanes SB) scenarios were analyzed, as shown in **Figure 3** and **Figure 4**.

- It was noted that these diversion percentages are consistent with what happened in Lexington when Nicholasville Road was converted to reversible lanes. They are also typical of what you see with road diets.
- It was also noted that although vehicles would divert to parallel routes such as US 60 and US 62, these trips would be in the off-peak direction. In fact, peak direction trips on these alternate routes would decrease, which would provide congestion relief.

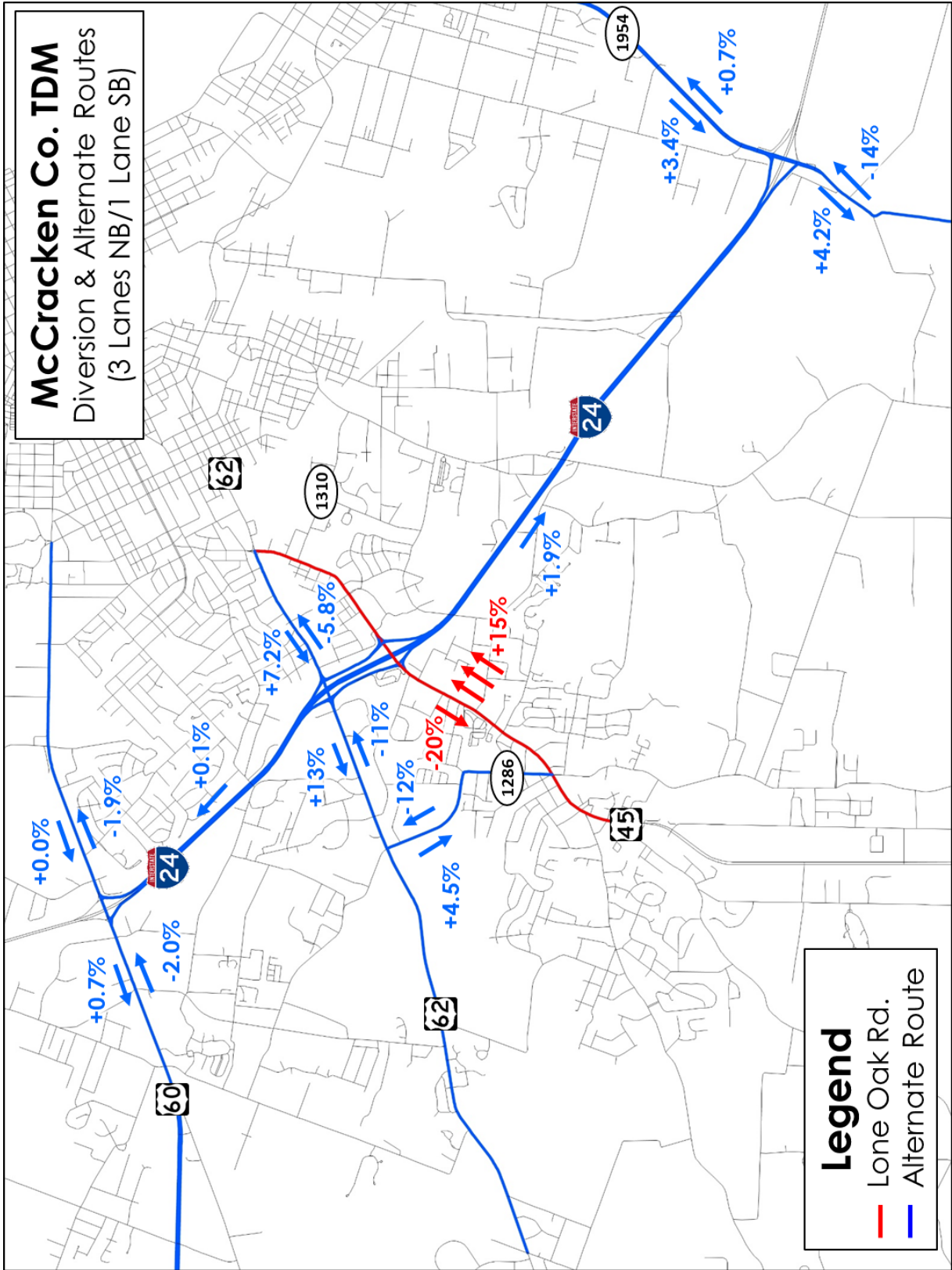


Figure 3: McCracken County TDM Diversion (3 Lanes NB/1 Lane SB)

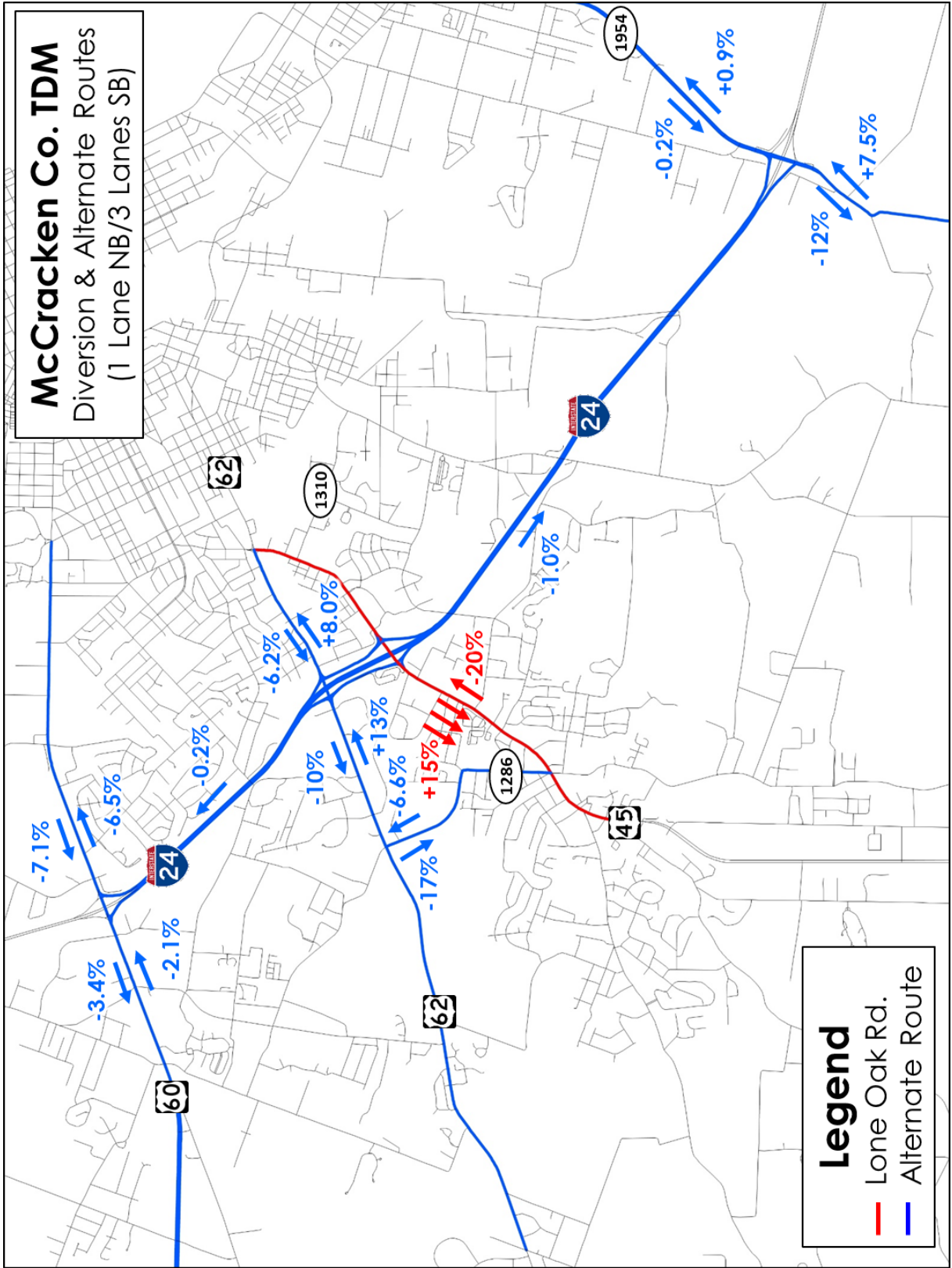


Figure 4: McCracken County TDM Diversion (1 Lane NB/3 Lanes SB)

Taking into account the growth rates, diversion, and a capacity estimate of 1,100 vehicles per hour per lane, the volume-to-capacity ratio on US 45 between KY 1322 (Clinton Road) and KY 1286 (Friendship Road) would exceed one by 2033, as shown in **Table 2**. Other portions of US 45 are not expected to have a volume-to-capacity ratio greater than one until after 2040. **It was noted that a more detailed traffic analysis is needed using the simulation model to truly understand the future capacity needs along the corridor.**

Table 2: Preliminary 2030 Reversible Lanes Traffic Summary

Route	Beg	End	2030 AM Build			Year when additional capacity would be required*	2030 PM Build			Year when additional capacity would be required*
			NB	SB	Growth Rate		NB	SB	Growth Rate	
US 45	Clinton Road	Friendship Road	2,100	700	1.50%	2033	950	2,075	1.50%	2034
	Friendship Road	Bleich Road	1,600	650	0.75%	2040+ (Beyond Horizon Year)	750	1,675	0.75%	2040+ (Beyond Horizon Year)
	Bleich Road	I-24	1,650	675		2040+ (Beyond Horizon Year)	850	1,650		2040+ (Beyond Horizon Year)
	I-24	Jackson Street	1,250	350	0.50%	2040+ (Beyond Horizon Year)	600	1,250	0.50%	2040+ (Beyond Horizon Year)

*Assuming 1,100 veh/ln/hr

- Question: What is the likelihood that an outer loop, which would affect traffic on US 45, is constructed?
Answer: With no local or political support, it is very unlikely that an outer loop is constructed anytime soon.

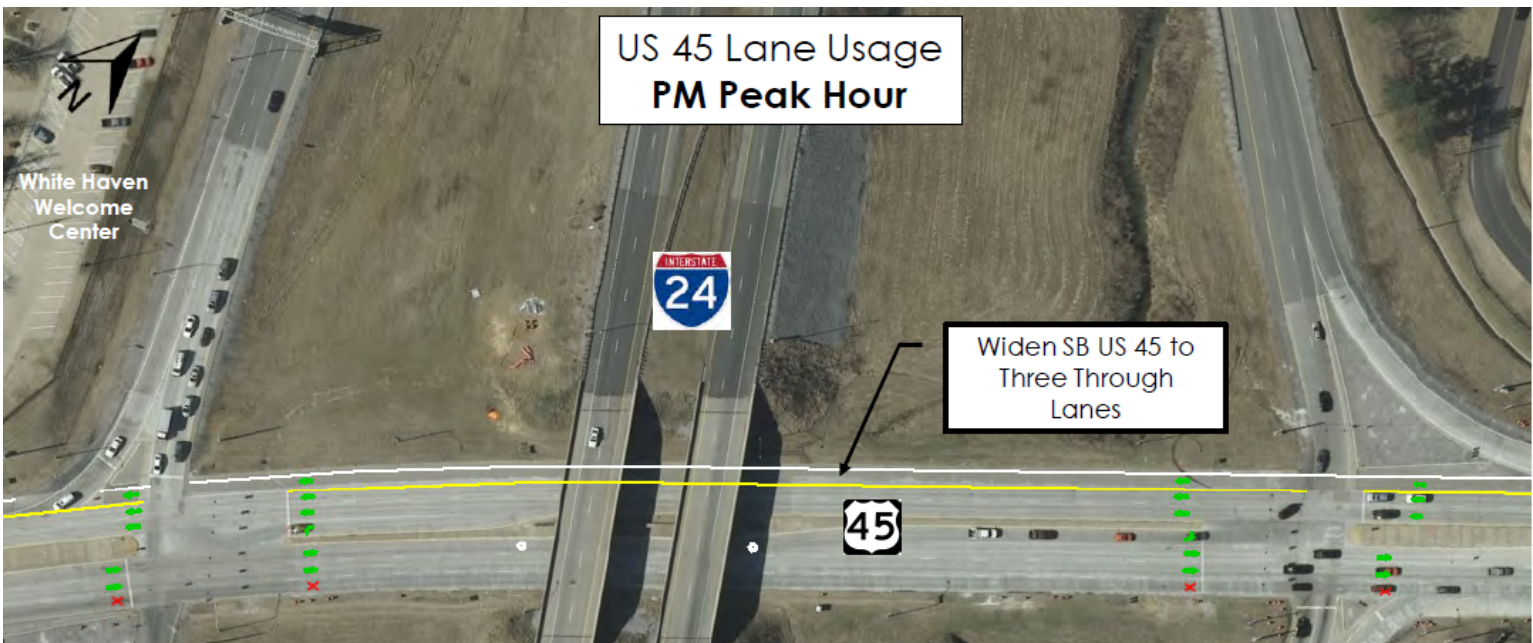
12. Dan O’Dea led a discussion of the reversible lane concept. One of the main issues with this concept is the change in typical section through the I-24 interchange. On this portion of US 45 there are three northbound through lanes and two southbound through lanes with left-turn lanes in each direction separated by a raised median. The following options are under consideration through the interchange:

- Widening southbound US 45 to include three through lanes – During the off-peak and the AM peak, northbound US 45 would operate normally while the outside southbound lane would be closed, as shown in **Figure 5**. During the PM peak, southbound US 45 would operate normally while the outside northbound lane would be closed, as shown in **Figure 6**.
- A double-crossover diamond (DCD)
- Ending the reversible lanes south of the I-24 interchange

Figure 5: US 45 Lane Usage at I-24 (Off Peak and AM Peak)



Figure 6: US 45 Lane Usage at I-24 (PM Peak)



Installing reversible lanes would also require the following traffic operations and maintenance updates by KYTC District 1:

- Signal Replacements
 - Convert the five-section protected/permissive left-turn signal heads to flashing yellow left-turn arrow signal heads at the Berger Road and Parkview Drive intersections
 - Install a box span at the Clinton Road intersection
- Lane-Use Signals
 - The Manual on Uniform Traffic Control Devices (MUTCD) recommends at least one and preferably two spans are visible to motorists at all times
- Central Operation System/Computer
 - Remote monitoring of local controllers and synchronization of internal clocks will be required
 - Lane-control signals operate with Type 170/2070 controllers
- Specialized Signal Timing Software
 - Will have to be purchased.
- Additional KYTC staff and/or contractor maintenance staff
 - After activation, additional staff may be necessary to observe and respond to real and perceived operational issues until the public adapts
 - Annual maintenance for a lane-control signal would be equal to that of a typical traffic signal

13. The seven-lane widening concept involves widening to either side of US 45 to avoid major transmission lines and reduce right-of-way costs. The following is a high-level estimation of where widening would occur on US 45:

- Clinton Street to Friendship Road – Two-lane widening would occur on the east side of US 45 to avoid the transmission lines on the west side.
 - It was noted that disturbed sidewalks will be replaced
- Friendship Road to I-24 – Two-lane widening would occur on the west side to avoid the transmission lines on the east side of US 45 with an exception at Mt. Kenton Cemetery.
- I-24 Interchange – One-lane widening would occur on the west side of US 45
- I-24 to Jackson Street – Two-lane widening would occur on the east side to avoid the transmission lines on the west side of US 45

14. The next step is for Stantec to finalize the traffic forecasts and analyze the improvement concepts before the second project team meeting in May.

- It was noted that if reversible lanes are moved forward as a feasible alternative, there will be a meeting to inform a small group of local officials/stakeholders

The meeting ended at approximately 12:00 p.m. EDT.

Meeting Minutes

TO: Jacob Huber
Co-Project Manager
KYTC Central Office
200 Mero Street
Frankfort, KY 40622

Chris Kuntz
Co-Project Manager
KYTC District Office #1
5501 Kentucky Dam Road
Paducah, KY 42003

FROM: Len Harper
Project Manager
Stantec Consulting Services Inc.

DATE: August 17, 2020

SUBJECT: Lone Oak Road (US 45) Reversible Lanes Feasibility Study
From Clinton Road (KY 339) to Jackson Street (US 62/KY 731)
(MP 6.135 to MP 9.224)
KYTC Item No. N/A
Project Team Meeting No. 2

The final project team meeting for the subject project was held via a BlueJeans Teleconference on August 6, 2020 at 1:00 p.m. CDT. The following individuals were in attendance:

Jay Balaji	KYTC – Central Office Planning
Stacey Courtney	Purchase Area Development District (PADD)
Stephen De Witte	KYTC – Central Office Planning
Jessica Herring	KYTC – District 1 Planning
Tom Hines	KYTC – District 1 Traffic
Jacob Huber	KYTC – Central Office Planning
Chris Kuntz	KYTC – District 1 Project Development Branch Manager
Matthew Lawson	KYTC – Central Office Planning
Jim LeFevre	Purchase Area Development District (PADD)
Mikael Pelfrey	KYTC – Central Office Planning
Kyle Poat	KYTC – District 1 Chief District Engineer
Steve Ross	KYTC – Central Office Planning
David Souleyrette	KYTC – Central Office Planning
Scott Thomson	KYTC – Central Office Planning
Brian Aldridge	Stantec Consulting Services Inc.
Dan O’Dea	Stantec Consulting Services Inc.
Len Harper	Stantec Consulting Services Inc.
Graham Winchester	Stantec Consulting Services Inc.

Len Harper welcomed everyone and, after introductions, said the purpose of the meeting was to discuss the conclusions for the Lone Oak Road (US 45) Reversible Lanes Feasibility Study. The following is a summary of the analysis and results.

Introduction

In 2018, Stantec worked with the Kentucky Transportation Cabinet (KYTC) and the City of Paducah on the *Paducah Small Urban Area (SUA) Study*. This study investigated existing and future traffic needs within the city of Paducah and sought to determine how to best facilitate growth in the community. The study considered a long-term project to implement reversible lanes on Lone Oak Road (US 45) from Clinton Road (KY 339) to Jackson Street (US 62/KY 731). This commercial section of US 45 is one of the most congested roadways in Paducah during AM and PM peak periods. Traffic during daily commuter periods is directionally imbalanced, with most traffic traveling northbound into Paducah during the morning and southbound out of town during the afternoon.

KYTC initiated the Lone Oak Road (US 45) Reversible Lanes Feasibility Study to evaluate the feasibility of reversible lanes on this portion of US 45, as shown in **Figure 1**.

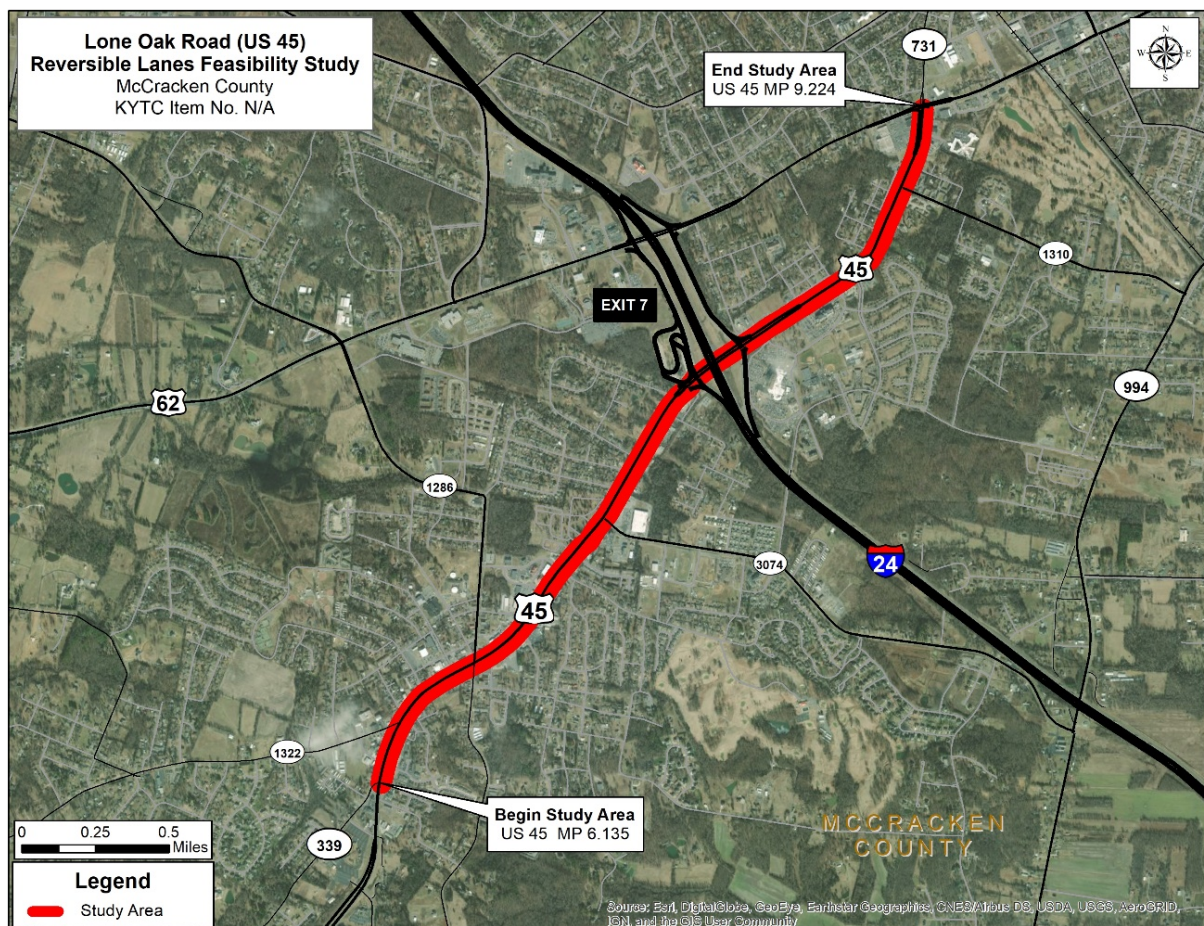


Figure 1: Study Area

Existing Roadway Characteristics

The study portion of US 45 is 3.089 miles in length from Clinton Road to Jackson Street (US 62). This rural principal arterial has a posted speed limit ranging from 35 to 45 miles per hour (mph). While providing the most direct connection to I-24 and downtown Paducah from the community of Lone Oak, US 45 has experienced both residential and commercial growth over the past 20 years. Additionally, this commercial stretch of US 45 includes trip attractors such as restaurants, grocery stores, hospitals, schools, and banks, among others.

Existing Typical Section

As shown in **Figure 2.**, there are three typical sections on the study portion of US 45: four ten-foot lanes with a center two-way left-turn lane (TWLTL) between Clinton Road and I-24, five 11-foot lanes with a raised median at the I-24 interchange, and four 11-foot lanes with a TWLTL from I-24 to US 62.

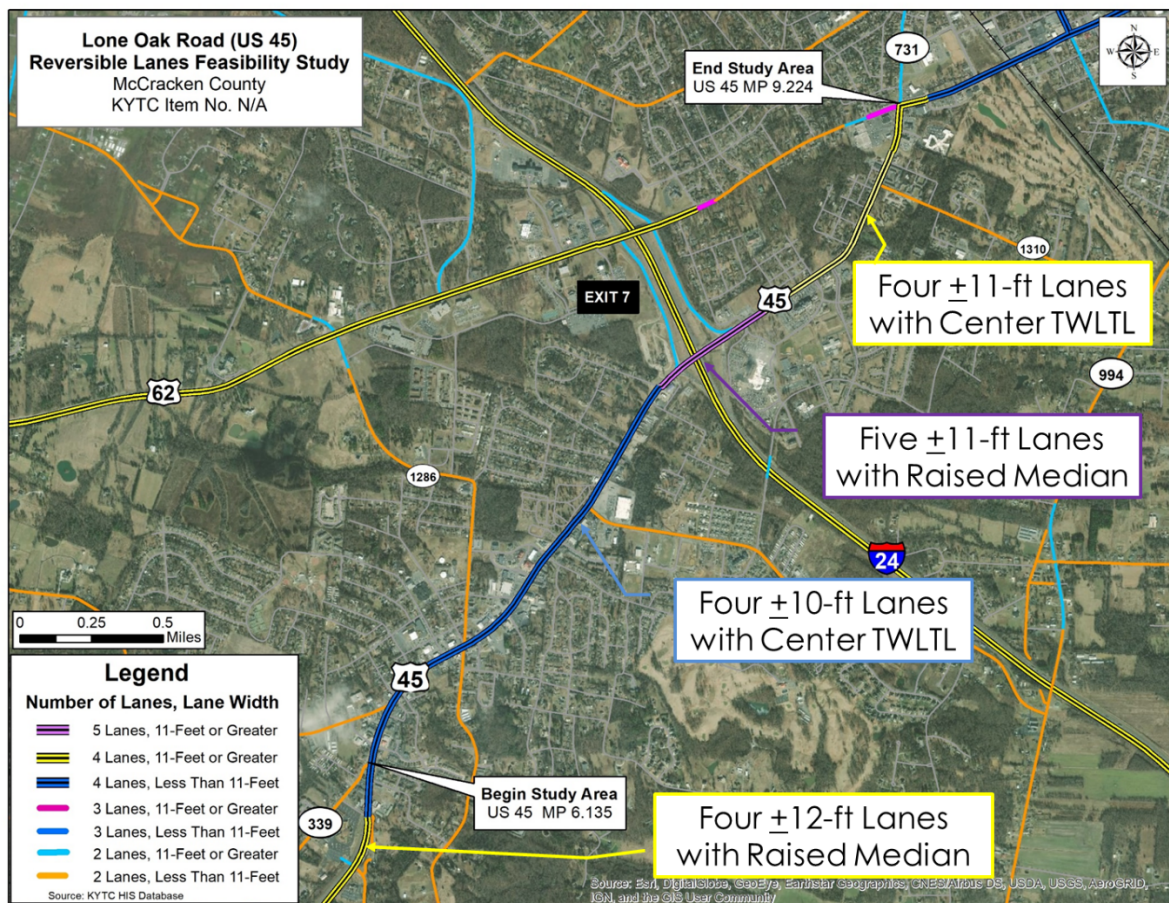


Figure 2: US 45 Typical Sections

Safety Analysis

A crash analysis was performed for the period between July 1, 2014 – June 30, 2019 using crash data from the Kentucky State Police database. Over this five-year period, a total of 921 crashes were reported along the study portion of US 45, one of which resulted in a fatality

and 200 (22 percent) of which resulted in an injury. The most prominent crash types were rear end crashes (375 crashes, 41 percent) and angle (310 crashes, 34 percent).

Crashes for the five-year period were geospatially referenced and compared to statewide data to identify locations experiencing above average crash rates. The critical crash rate factor (CRF) is a measure of safety, expressed as a ratio of the crash rate at the location compared to the critical crash rate for similar roadways throughout the state. A CRF of 1.0 or greater may indicate that crashes are occurring due to circumstances not attributed to random occurrence. There is one high crash segment and eight high crash spots with CRFs greater than 1.0, as shown in **Figure 3**.

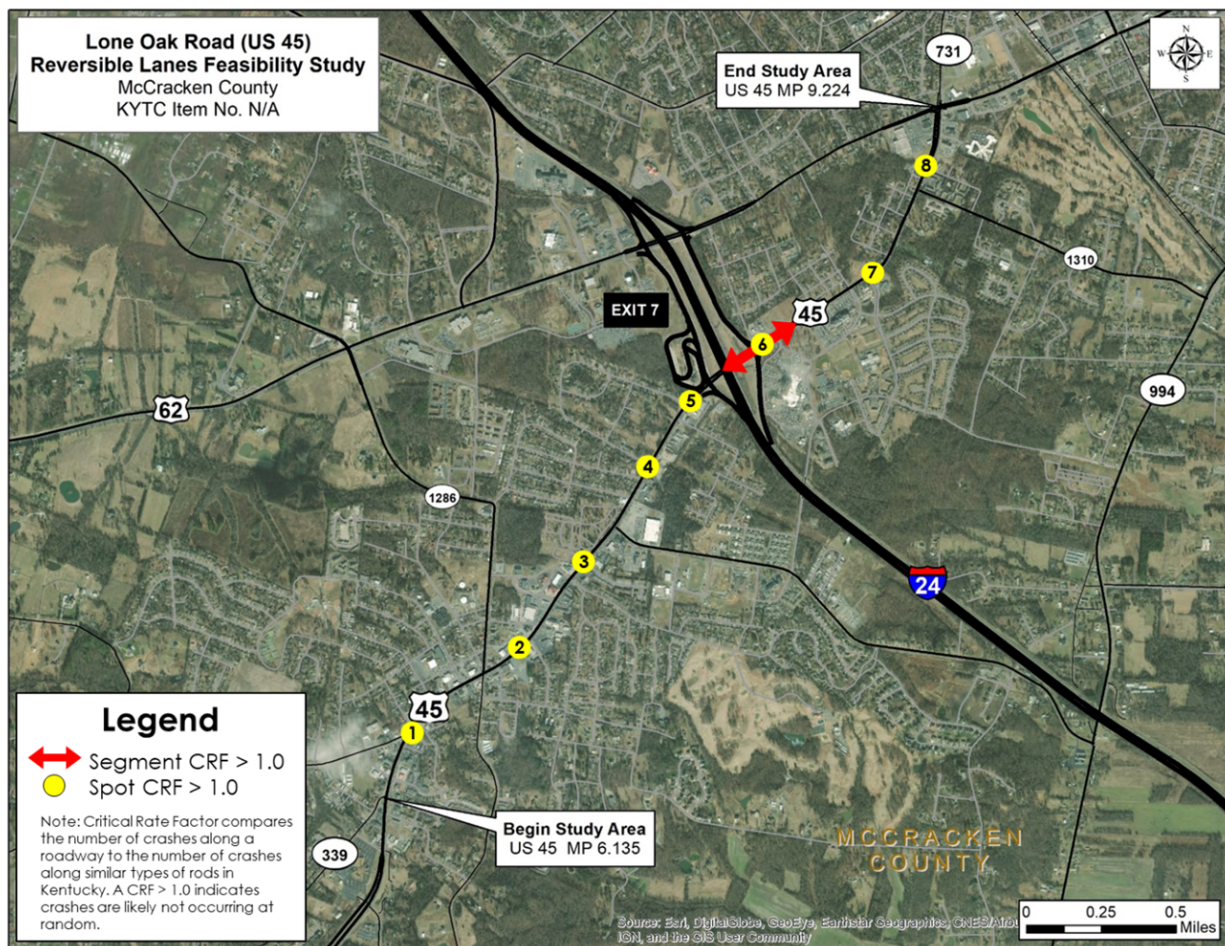


Figure 3: CRF Analysis

The number of excess expected crashes (EEC) at a location is a measure of the crash frequency at a site compared to what is expected based on current conditions (geometrics, traffic, etc.). A positive EEC indicates more crashes are occurring than should be expected. Based on results from the Kentucky Transportation Center (KTC) analysis, there are fewer crashes than would be expected to occur on US 45 except for the portion near US 62. A summary of the EEC analysis is shown in **Table 1**.

Table 1: Excess Expected Crash (EEC) Analysis

Route	Beg MP	End MP	Predicted Number of Crashes	Actual Number of Crashes	EEC
US 45	6.1	7.4	165	141	-24
	7.4	8.5	128	93	-35
	8.5	8.9	35	8	-27
	8.9	9.2	9	19	10

Source: Kentucky Transportation Center

Existing Traffic

Historical KYTC traffic counts show an Annual Average Daily Traffic (AADT) on the study portion of US 45 of approximately 27,300 vehicles per day (VPD) south of the I-24 interchange and 19,700 VPD to the north. **Table 2** shows the peak hour volumes and splits north and south of the I-24 interchange.

Table 2: 2020 Peak Hour Traffic Summary

Segment	Direction	AM Peak		PM Peak	
		Volume	Split	Volume	Split
South of I-24	NB	1,300	63%	900	39%
	SB	750	37%	1,400	61%
North of I-24	NB	1,000	71%	700	39%
	SB	400	29%	1,100	61%

An existing (2020) peak hour simulation model was developed to analyze the study portion of US 45. Currently, the existing roadway has enough capacity to accommodate traffic demand during both peak periods. Congestion is caused by delay at the signalized intersections. Several individual intersection turning movements, including KY 1286 (Friendship Road), the I-24 interchange, and US 62 (Jackson Street) have unmet demand during the peak periods. Based on results from the simulation model, all signalized intersections in the study area operate at LOS D or better during the AM peak. During the PM peak, however, the US 62 intersection operates at an undesirable LOS E.

Future Traffic Analysis

Traffic forecasts for the year 2030 were developed based on annual growth rates from the McCracken County Travel Demand Model and historical growth rates from KYTC count stations, as shown in **Table 3**.

Table 3: US 45 Annual Growth Rates (2020-2030)

Lone Oak Road (US 45) Segment	KYTC Historical Annual GR	McCracken County TDM Annual GR	Proposed Annual GR
South of Lovelaceville	1.20%	1.39%	1.50%
Between Lovelaceville & Friendship	0.54%	0.89%	
Between Friendship & Lakeview	0.58%	0.69%	0.75%
Between Lakeview & I-24	0.15%	0.35%	
Between I-24 & Berger	0.19%	0.20%	0.50%
Between Berger & Jackson	0.19%	0.37%	

Based on these growth rates, 2030 peak hour traffic volumes and directional splits were developed, as shown in **Table 4**.

Table 4: 2030 No-Build Peak Hour Traffic Summary

Segment	Direction	AM Peak		PM Peak	
		Volume	Split	Volume	Split
South of I-24	NB	1,630	64%	1,100	39%
	SB	930	36%	1,720	61%
North of I-24	NB	1,150	69%	890	45%
	SB	520	31%	1,100	55%

Improvement Concept Analysis

Over the course of the study, several corridor-wide improvement concepts were evaluated, including an Existing plus Committed (E+C) scenario, a reversible lanes system (RLS) south of I-24, an RLS along the entire study corridor, and a seven-lane widening.

The E+C scenario assumes the Friendship Road Project (Item No. 1-153) between US 62 and US 45 will be constructed by 2030. It also assumes the Relocated Friendship Road/US 45 intersection includes the additional turn lane recommendations from this study, which includes three lanes on the Relocated Friendship Road approach (LT, Thru, RT) and two lanes (LT and RT/Thru) on the Lakeview Drive approach.

A second Highway Safety Improvement Program (HSIP) project was included in the E+C scenario. The addition of dedicated left-turn lanes at the US 45 and Kennedy Road intersection (Item No. 1-9012) were assumed to be constructed by 2030.

Based on results from the 2030 traffic simulation model, traffic operations along US 45 are expected to be similar for the E+C and RLS scenarios. This is because traffic is not expected to reach capacity by 2030, so the full benefit of an RLS will not be experienced. Cost estimates were also developed for the improvement concepts, shown in **Table 5**.

Table 5: Cost Estimates

Cost Estimate	Reversible Lanes to I-24 *	Reversible Lanes to US 62 *	Seven Lane Widening
Design	\$ 300,000	\$ 500,000	\$ 1,600,000
Right-of-Way	\$ 0	\$ 0	\$ 19,000,000
Utility	\$ 0	\$ 0	\$ 12,000,000
Construction	\$ 1,700,000	\$ 3,300,000	\$ 10,700,000
Total	\$ 2,000,000	\$ 3,800,000	\$ 43,300,000

* The construction cost for the Reversible Lane Concepts assumes it will be constructed as part of an already scheduled resurfacing project.

Warrant Analysis for Reversible Lanes

There is a general agreement on the conditions that warrant reversible operations and the basic requirements for their effective use, summarized as follows.

1. **Limited right-of-way (or ability to acquire it).**
2. **65 percent or more of the traffic moves in one direction during peak hours.**
3. **Predictable patterns of high demand and/or congestion.**
4. **Volumes at or near capacity.**

1. Limited right-of-way:

Existing right-of-way on the study portion of US 45 ranges from 56 feet to 72 feet. Parking lots and some adjacent businesses would have to be purchased and the adjacent utility lines would need to be relocated before widening could occur. Acquiring the additional right-of-way and relocating the existing utilities was estimated by District 1 to cost \$31 million, which likely makes a seven-lane widening project non-viable.

2. 65 percent or more of the traffic moves in one direction during peak hours:

A 2030 traffic analysis that includes Existing plus Committed (E+C) projects and diversion of traffic for the reversible lanes was performed. The diversion analysis found adding capacity in the peak direction through the RLS implementation would increase demand in the peak direction by about 15%. Similarly, decreasing capacity in the off-peak direction would reduce demand in the off-peak direction by about 20%. **Table 6** presents a summary of the 2030 RLS peak hour traffic volumes and directional splits.

Table 6: 2030 RLS Peak Hour Traffic Summary

Segment	Direction	AM Peak		PM Peak	
		Volume	Split	Volume	Split
South of I-24	NB	1,800	69%	950	33%
	SB	790	31%	1,900	67%
North of I-24	NB	1,280	74%	750	38%
	SB	450	26%	1,210	62%

3. Predictable patterns of high demand and/or congestion

The study portion of US 45 is one of the most congested roadways in Paducah during morning and afternoon peak periods. Traffic during these daily commuter periods is directionally imbalanced, with most traffic traveling northbound into Paducah during the morning and southbound out of town during the afternoon. Based on field review, data collection, and a traffic simulation model, there were found to be several turning movements with unmet demand during the peak periods. This included the KY 1286 (Friendship Road) approach, the left-turns from both directions of US 45 to I-24, and the shared right/through lane on the westbound Jackson Street approach.

4. Volumes at or near capacity:

Based on results from the 2030 simulation model, volume-to-capacity (V/C) ratios for the E+C scenario are under 1.0 south of I-24, as shown in **Figure 4**. During the PM peak, the northbound (off-peak) lane is above capacity for both RLS concepts. Capacity is not an issue north of I-24 for any of the concepts, with all V/C ratios under 0.72, as shown in **Figure 5**.

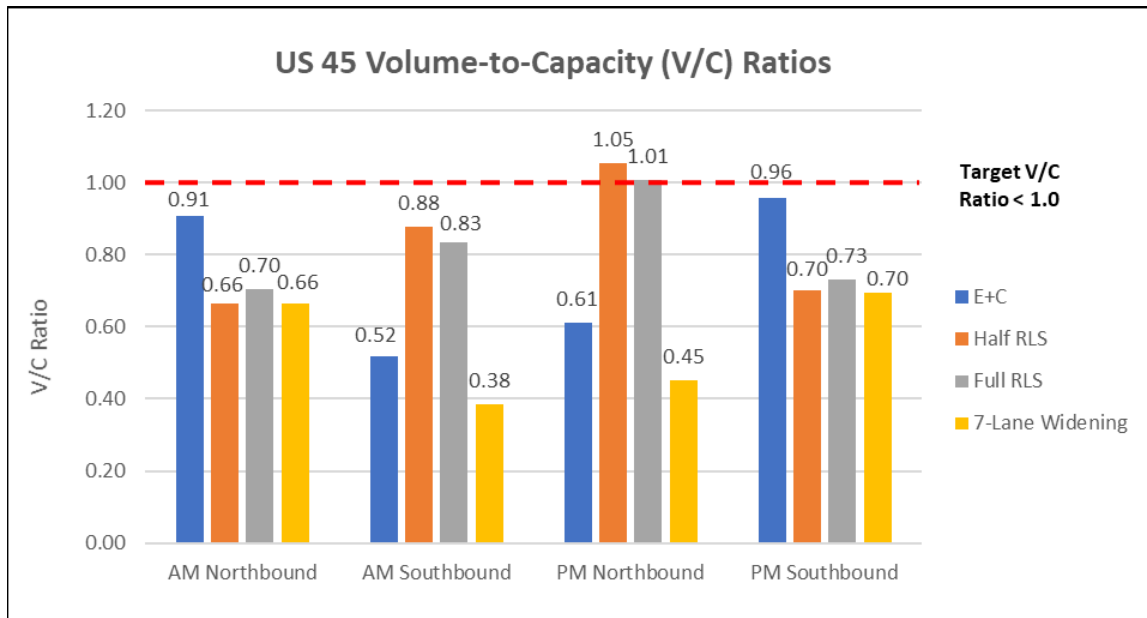


Figure 4: Volume-to-Capacity (V/C) Ratios South of I-24

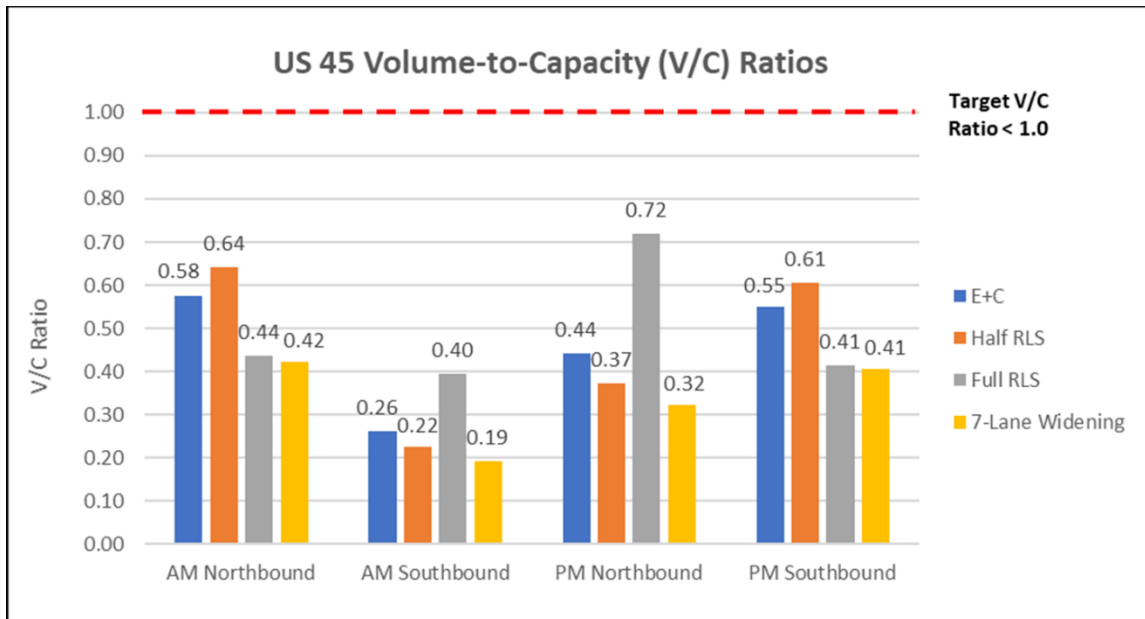


Figure 5: Volume-to-Capacity (V/C) Ratios North of I-24

Conclusions

Reversible lane systems (RLS) are considered one of the most cost-effective methods to increase peak direction capacity of an existing roadway. These systems have generally been well received by the public and typically achieve small safety benefits in addition to the increased roadway capacity. Through an examination of existing conditions, a field review, and a traffic analysis, it has been determined that additional through capacity is likely not needed on US 45 by 2030. Congestion is concentrated at the major signalized intersections, particularly KY 1286. Relocating KY 1286 to the existing Lakeview Drive intersection (as proposed with the KYTC Item No. 1-153 project) and installing additional turn lanes at both the relocated KY 1286 approach as well as the Lakeview Drive approach will significantly improve traffic operations on US 45. Along with this improvement, two additional spot improvements were identified and analyzed.

The US 45 intersection with US 62 (Jackson Street) currently operates at an undesirable LOS E during the PM peak hour. By 2030, queues will become longer and vehicles will experience more delay at this intersection. One of the main issues is the shared right/through lane on the westbound Jackson Street approach. Vehicles are unable to turn right when through traffic backs up, causing longer queues and unmet demand during the PM peak. A potential improvement is to relocate the raised median and restripe the approach to provide a dedicated right-turn lane, as shown in **Figure 6**. This would improve operations at the intersection to LOS D in 2030.

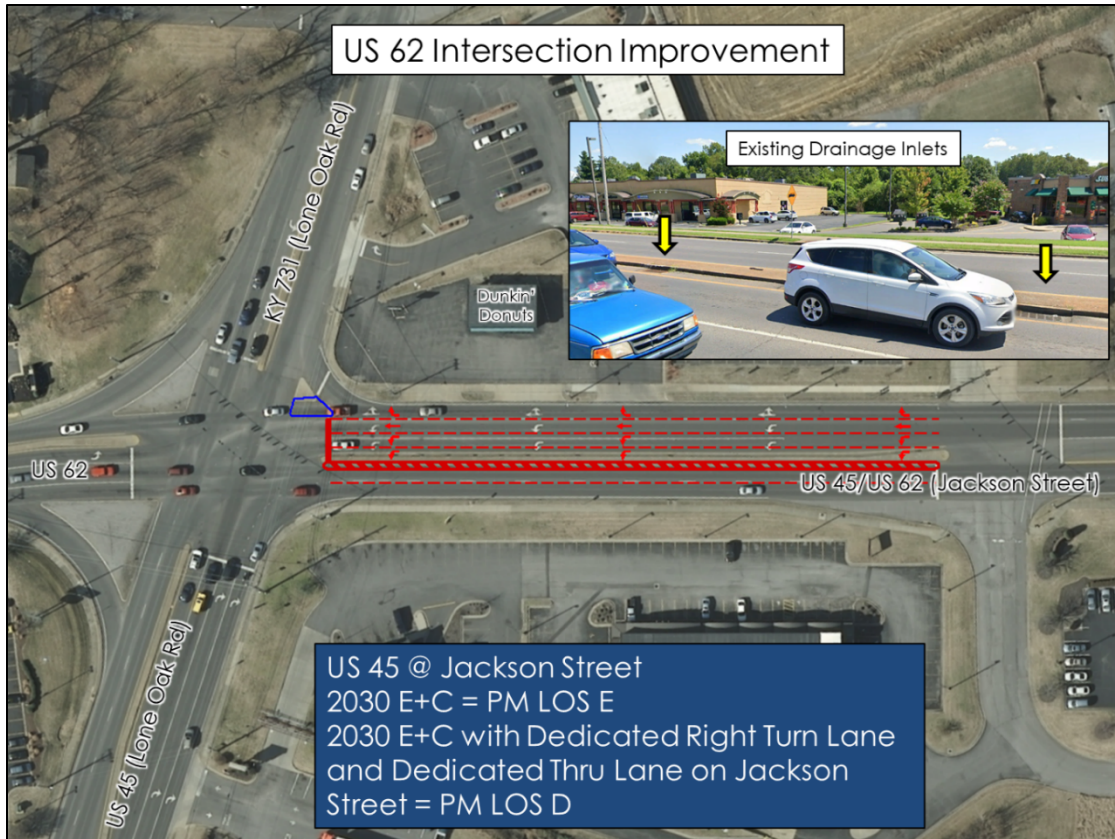
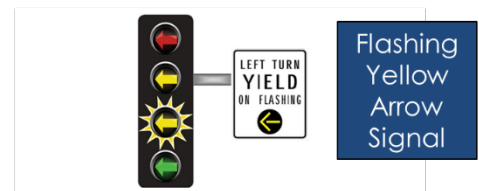


Figure 6: US 62 Intersection Improvement

Another recommended spot improvement is at the I-24 interchange. Currently, the left-turns from both directions of US 45 to I-24 are served by protected left-turn phases. Allowing the lefts to turn during a permissive phase with a flashing yellow arrow (FYA) would result in improvements to traffic operations at both intersections, as shown in **Figure 7**. FYA is only allowed in Kentucky if an intersection meets certain requirements, including sufficient sight distance, traffic flow that meets criteria for permitted left turn phasing, and left turns that do not cross more than three opposing through lanes. The I-24 intersections satisfy these requirements except at the southern ramp terminal, where there are three opposing lanes to the US 45 left turn. While it is recommended that left-turn permissive phasing only be allowed when crossing two lanes or fewer, KYTC has allowed permissive turns across three opposing lanes in several locations.

US 45 @ WB I-24 Ramps
 E+C = AM LOS D
 E+C with FYLTA P/P Phasing = AM LOS C



US 45 @ EB I-24 Ramps
 E+C = PM LOS D
 E+C with FYLTA P/P Phasing = PM LOS C

Figure 7: Protected-Permissive Signal Operations at I-24

Should capacity needs change, implementation of a RLS is a viable alternative to a seven-lane widening given the ratio of the major to minor traffic flow during the peak hour. Installing reversible lanes would require the following traffic operations and maintenance updates by KYTC District 1:

- Signal Replacements
 - Convert the five-section protected/permissive left-turn signal heads to flashing yellow left-turn arrow signal heads at the Berger Road, Parkview Drive, and I-24 intersections. That would be a total of five signal head replacements.
- Lane-Use Signals
 - The Manual on Uniform Traffic Control Devices (MUTCD) recommends at least one and preferably two spans are visible to motorists at all times.
 - For the Half RLS Scenario between Clinton Drive and up-to but not including the I-24 interchange, 15 new lane-use signals are anticipated.
 - For the Full RLS Scenario between Clinton Drive and US 62, 27 lane-use signals are anticipated.
- Central Operation System/Computer
 - Remote monitoring of local controllers and synchronization of internal clocks will be required.
 - The district currently uses cellular connections to set the clocks at the signals along US 45. Similar controllers/cabinets will be needed for the lane-use signals.
- Specialized Signal Timing Software
 - Not needed.
- Additional KYTC staff and/or contractor maintenance staff
 - No additional staff is anticipated.
 - After activation, additional staff may be necessary to observe and respond to real and perceived operational issues during the initial operation period.

The meeting ended at approximately 2:30 p.m. CDT. The next step is for Stantec to complete the draft report.