



Memorandum

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Date: December 16, 2009

CC: Jeff McKerrow
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TranSystems Project No.: P101080286

Subject: U.S. 56 Corridor Study Traffic Analysis
KDOT Project No. 56-106 KA-1496-01 CMS:006091032

At your request and authorization, TranSystems has prepared the following traffic analysis for the U.S. 56 Corridor Study. The purpose of this analysis was to assess existing and projected future design year 2040 traffic conditions at several key intersections and along three roadway segments within the 22-mile study corridor from U.S. 59 to I-35. A map illustrating the location of the study corridor is included on the attached *Exhibit 1*.

Study Area and Data Collection

The study intersections for this project include:

- U.S. 59 and U.S. 56
- 8th Street and U.S. 56
- 6th Street and U.S. 56
- 2200 Road and U.S. 56
- K-33 Highway and U.S. 56
- Edgerton Road (8th Street) and U.S. 56
- 1st Street and U.S. 56
- 4th Street and U.S. 56
- 199th Street and U.S. 56
- 191st Street and U.S. 56
- Four Corners Road and U.S. 56
- Center Street and U.S. 56
- Elm Street and U.S. 56
- Mulberry Street and U.S. 56
- Moonlight Road and U.S. 56
- Cedar Niles Road and U.S. 56

Turning-movement traffic counts were collected at each of the study intersections, with the exception of the intersections within the City of Gardner, from 6:30 to 8:30 A.M. and from 4:00 to 6:00 P.M. on a typical weekday between the dates of March 10, 2009 and April 8, 2009. Counts for the intersections within Gardner were provided by HDR, Inc.

In addition to the study intersections, the following three roadway segments were assessed:

- U.S. 56 between U.S. 59 and Baldwin City
- U.S. 56 between Baldwin City and Edgerton
- U.S. 56 between Edgerton and Gardner

Machine traffic counts were collected at each of the three locations listed above during the week of February 16, 2009 through February 20, 2009.

Future Year 2040 Traffic Projections

Future year 2040 traffic volume projections were developed for the study corridor based on a combination of historical trends and outputs from the Gardner Travel Demand Model. The model was developed by HDR, Inc. and is based on the Olathe Travel Demand Model. There are P.M. and daily models with a base year of 2004 and a design year of 2030. In the Gardner area of the project, the model was used to estimate traffic growth to 2030 then that growth was added to existing traffic volumes and factored up to the identified project design year of 2040 based on historical growth trends. Note that A.M. peak hour model growths were estimated by reversing the P.M. peak hour growths and reducing them by a factor of 0.8. For the portion of the study corridor west of 199th Street where the Gardner model ends, only historical trends were used to increase the existing traffic volumes to the 2040 design year. Below, *Table 1* briefly summarizes the general methodology used for developing 2040 projections for each segment of the study corridor.

Table 1 2040 Traffic Volume Projection Methodology	
Location	Projection Method
West of Baldwin City	Existing plus 1.9% per year (2009 to 2040)
Baldwin City	Existing plus 2.1% per year (2009 to 2040)
Between Baldwin City and Edgerton	Existing plus 1.9% per year (2009 to 2040)
Edgerton	Existing plus 1.7% per year (2009 to 2040)
Between Edgerton and Gardner	Existing plus 2030 model growth plus 1.5% per year (2030 to 2040)
Gardner	Existing plus 2030 model growth plus 1.3% per year (2030 to 2040)

It should be noted that projecting traffic conditions for a 30-year design horizon may yield overly conservative estimates. The results should be viewed in this context.

Traffic Operations Assessment

Traffic operations were assessed for Existing and Future Year 2040 Conditions. The study intersections were evaluated based on the methodologies outlined in the Highway Capacity Manual (HCM), 2000 Edition, published by the Transportation Research Board. The operating conditions at an intersection are graded by the “level of service” experienced by drivers. Level of service (LOS) describes the quality of traffic operating conditions and is rated from “A” to “F”. LOS A represents the most desirable condition with free-flow movement of traffic with minimal delays. LOS F generally indicates severely congested conditions with excessive delays to motorists. Intermediate grades of B, C, D, and E reflect incremental increases in the average delay per stopped vehicle. Delay is measured in seconds per vehicle. *Table 2* shows the upper limit of delay associated with each level of service for signalized and unsignalized intersections.

Level of Service (LOS)	Signalized	Unsignalized
A	< 10 Seconds	< 10 Seconds
B	< 20 Seconds	< 15 Seconds
C	< 35 Seconds	< 25 Seconds
D	< 55 Seconds	< 35 Seconds
E	< 80 Seconds	< 50 Seconds
F	≥ 80 Seconds	≥ 50 Seconds

While one of the primary measurements of traffic operations, LOS, applies to both signalized and unsignalized intersections, there are significant differences between how these intersections operate and how they are evaluated. LOS for signalized intersections reflects the operation of the intersection as a whole. While the individual movements may operate with varying LOS ratings, that is largely a function of the signal timings and how the intersection is operating relative to other signals in the vicinity. As an example, in coordinated system of multiple signalized intersections, some minor side-street approaches may have LOS ratings of D, E or even F. This can be the result of the length of time provided to the major movements and do not reflect a condition where the intersection is operating over capacity or is judged to be operating poorly.

Unsignalized intersections, in contrast, are evaluated based on the movement grouping which are required to yield to other traffic. Typically, this is the left-turns off of the major street and the side-street approaches for two-way stop-controlled intersections. Lower LOS ratings (D, E and F) alone do not indicate significant difficulties or the need for additional improvements. Many times there are convenient alternative paths to avoid the longer delays. Other times, the volumes on the unsignalized approaches are relative minor when compared to the major street traffic.

The decision to install a traffic signal, which is often considered when lower LOS ratings are projected, should be based on engineering studies and the warrants for traffic signal installation as outlined in the Federal Highway Administration's Manual on Uniform Traffic Control Devices (MUTCD). Signals are typically not recommended in locations where there are convenient alternative paths, or the installation of a traffic signal would have negative impacts on the surrounding transportation system. For instance, if the new signalized intersection is located too close to existing traffic signals it may not be recommended despite meeting the minimum warrants.

In addition to delay and the corresponding Level of Service, a secondary means of evaluation is often utilized to assess the overall capacity of the intersection or unsignalized movement. This evaluation is a ratio of volume to capacity (v/c) that reflects, regardless of delay, the ability to accommodate the existing or projected traffic volumes over the course of a peak hour. A v/c ratio of 1.00 indicates that the intersection or movement is operating at capacity, while v/c ratios less than or greater than 1.0 indicate under capacity and over capacity conditions, respectively.

The LOS rating deemed acceptable varies by community, facility type and traffic control device. LOS D is commonly considered to be the minimum desirable standard for signalized intersections. However, at unsignalized intersections LOS D, E and above are often accepted for low to moderate traffic volumes where the installation of a traffic signal is not warranted by the conditions at the intersection or the location has been deemed undesirable for signalization for other reasons, e.g. the close proximity of an existing traffic signal or the presence of a convenient alternative path.

The Synchro software package was used to evaluate intersection traffic operations and the HiCAP software package was used to evaluate roadway segment traffic operations.

Existing Conditions Analysis

The results of the Existing Conditions intersection analyses are summarized below in *Table 3*. The study intersections were evaluated with the lane configurations, traffic volumes, and traffic control devices shown on the attached *Exhibits 2* and *3*. The Synchro output worksheets have also been attached for reference.

Table 3 Intersection Operations Existing Conditions							
Intersection		A.M. Peak Hour			P.M. Peak Hour		
		LOS ¹	Delay ²	v/c ³	LOS ¹	Delay ²	v/c ³
	<i>Movement</i>						
Douglas County	U.S. 59 and U.S. 56 <i>Multi-way Stop Control (All Movements)</i>	B	14.3	---	C	16.5	---
Baldwin City	8th Street and U.S. 56						
	<i>Eastbound Left-turn</i>	A	8.0	0.03	A	8.1	0.04
	<i>Westbound Left-turn</i>	A	8.4	0.02	A	7.9	0.04
	<i>Northbound Left-turn</i>	C	24.3	0.11	C	21.0	0.12
	<i>Northbound Shared Through / Right-turn</i>	B	15.0	0.22	B	13.1	0.18
	<i>Southbound Left-turn</i>	D	26.6	0.13	C	22.9	0.19
	<i>Southbound Shared Through / Right-turn</i>	B	11.9	0.12	B	13.3	0.17
	6th Street and U.S. 56 <i>Signalized Intersection (All Movements)</i>	A	8.7	0.41	A	9.0	0.46
Douglas County	2200 Road and U.S. 56						
	<i>Eastbound Left-turn</i>	A	1.0	0.02	A	1.6	0.02
	<i>Westbound Left-turn</i>	A	0.3	0.00	A	0.3	0.01
	<i>Northbound</i>	B	11.5	0.07	B	12.9	0.11
	<i>Southbound</i>	B	10.7	0.08	B	12.3	0.15
	K-33 Highway and U.S. 56						
	<i>Eastbound Left-turn</i>	A	0.1	0.00	A	0.1	0.00
	<i>Westbound Left-turn</i>	A	1.5	0.01	A	1.8	0.04
	<i>Northbound</i>	B	10.9	0.14	B	11.7	0.12
	<i>Southbound</i>	B	10.6	0.03	B	11.8	0.02
Edgerton	8th Street/Edgerton Road and U.S. 56						
	<i>Eastbound Left-turn</i>	A	0.1	0.00	A	0.1	0.00
	<i>Westbound Left-turn</i>	A	1.4	0.01	A	1.0	0.02
	<i>Northbound</i>	B	10.8	0.11	B	10.7	0.05
	<i>Southbound</i>	B	12.4	0.04	B	12.4	0.05
	1st Street and U.S. 56						
	<i>Westbound Left-turn</i>	A	1.3	0.02	A	1.2	0.03
	<i>Northbound</i>	B	11.1	0.12	B	11.0	0.07
	4th Street and U.S. 56						
	<i>Westbound Left-turn</i>	A	0.06	0.01	A	0.9	0.02
<i>Northbound</i>	B	11.0	0.05	B	12.1	0.09	

1 - Level of Service
 2 - Delay in seconds per vehicle
 3 - Volume/Capacity Ratio

Table 3 Continued Intersection Operations Existing Conditions								
Intersection <i>Movement</i>		A.M. Peak Hour			P.M. Peak Hour			
		LOS ¹	Delay ²	v/c ³	LOS ¹	Delay ²	v/c ³	
Johnson County	Sunflower / 199th Street and U.S. 56							
		Eastbound Left-turn	A	0.2	0.01	A	0.1	0.00
		Westbound Left-turn	A	0.1	0.00	A	0.1	0.00
		Northbound	B	11.8	0.01	B	11.4	0.01
		Southbound	B	10.2	0.02	B	11.3	0.01
	191st Street and U.S. 56							
		Eastbound	B	11.5	0.02	B	11.9	0.01
		Westbound	B	11.9	0.02	B	11.4	0.01
		Northbound Left-turn	A	0.1	0.00	A	0.1	0.00
		Southbound Left-turn	A	0.2	0.00	A	0.0	0.00
	Four Corners Road and U.S. 56							
		Eastbound Left-turn	A	0.9	0.02	A	0.5	0.01
	Westbound Left-turn	A	0.1	0.00	A	0.1	0.00	
	Northbound	B	12.5	0.07	B	12.5	0.07	
	Southbound	A	9.8	0.03	B	11.4	0.03	
Gardner	Center Street and U.S. 56 <i>Signalized Intersection (All Movements)</i>		B	17.6	0.61	B	15.9	0.68
	Elm Street and U.S. 56 <i>Signalized Intersection (All Movements)</i>		B	12.2	0.42	B	10.6	0.51
	Mulberry Street and U.S. 56 <i>Signalized Intersection (All Movements)</i>		A	9.6	0.48	A	5.7	0.50
	Moonlight Road and U.S. 56 <i>Signalized Intersection (All Movements)</i>		C	20.3	0.81	B	19.7	0.92
	Cedar Niles Road and U.S. 56 <i>Signalized Intersection (All Movements)</i>		C	24.7	0.80	C	30.6	0.76

1 – Level of Service
2 – Delay in seconds per vehicle
3 – Volume/Capacity Ratio

As shown in *Table 3*, the analysis results indicate that all study intersections currently operate within desirable levels of service during the A.M. and P.M. peak hour periods of a typical weekday.

Below in *Table 4* are the Existing Conditions capacity analysis results for the three primary rural roadway segments within the project. The HiCAP analysis worksheets for these analyses have been attached for reference.

Table 4 Roadway Segment Operations Existing Conditions				
Location	A.M. Peak Hour		P.M. Peak Hour	
	LOS ¹	v/c ²	LOS ¹	v/c ²
U.S. 56 between U.S. 59 and Baldwin City	C	0.170	C	0.170
U.S. 56 between Baldwin City and Edgerton	C	0.120	C	0.110
U.S. 56 between Edgerton and Gardner	D	0.119	D	0.150

1 – Level of Service
2 – Volume/Capacity Ratio

Future Year 2040 Conditions Analysis

The results of the Future Year 2040 Conditions intersection analyses are summarized in *Table 5*. Listed below are the changes that have been proposed at each of the study intersections for the design year of 2040. These changes were proposed to improve both traffic operations and safety throughout the corridor. Schematic diagrams that illustrate these improvements can be found on the attached *Exhibit 4*. The projected 2040 traffic volumes used in the analyses are included on the attached *Exhibit 5*. The Synchro output worksheets for these analyses have also been attached for reference. Note that for a conservative estimate of traffic operations, trucks were considered to account for 5% of the total traffic on the street network.

U.S. 59 and U.S. 56: The existing at-grade intersection is currently being converted into a diamond interchange with ramp terminal intersections on U.S. 56. All four ramps will be single lane with stop control in place on the off-ramp approaches. Left-turn lanes will be in place on U.S. 56 between the two ramp intersections.

8th Street and U.S. 56: Peak hour traffic volumes are projected to be near the level needed to warrant the installation of a traffic signal. A traffic signal was considered to be installed in this location.

6th Street and U.S. 56: Install a northbound left-turn lane.

2200 Road and U.S. 56: Install a westbound left-turn lane and a southbound left-turn lane.

K-33 and U.S. 56: Install a northbound left-turn lane, an eastbound right-turn lane, and a westbound right-turn lane.

Egerton Road and U.S. 56: Install a northbound left-turn lane, a southbound left-turn lane, an eastbound right-turn lane, and a westbound right-turn lane.

1st Street and U.S. 56: No change.

4th Street and U.S. 56: No change.

199th Street and U.S. 56: Grade separate 199th/Sunflower over U.S. 56 and construct a two-lane quadrant roadway in the northeast quadrant of the existing intersection.

191st Street and U.S. 56: Remove the east leg of the intersection (191st Street) and realign the west leg to intersect U.S. 56 at a right angle. Install a southbound left-turn lane on U.S. 56 at 191st Street.

Four Corners Road and U.S. 56: Remove the south leg of the intersection (Four Corners Road) and realign the north leg to intersection U.S. 56 at a right angle. Install a westbound right-turn lane on U.S. 56 at Four Corners Road.

Center Street and U.S. 56: Install left-turn lanes on the eastbound and westbound approaches to the intersection and install right-turn lanes on the northbound, westbound, and southbound approaches.

Elm Street and U.S. 56: Install left-turn lanes on the eastbound and westbound approaches to the intersection.

Mulberry Street and U.S. 56: Install left-turn lanes on the eastbound and westbound approaches to the intersection.

Moonlight Road and U.S. 56: Install a third through lane each direction on U.S. 56. On the southbound approach to the intersection install a second left-turn lane and a separate right-turn lane. On the westbound approach install a right-turn lane with an exclusive receiving lane on northbound Moonlight Road.

Cedar Niles Road and U.S. 56: Install a third through lane each direction on U.S. 56. Add a southbound right-turn lane and reconfigure the northbound approach to provide dual left-turn lanes, a shared through / right-turn lane, and a right-turn lane. This will require the addition of a fourth lane on the northbound approach. These changes will allow for the removal of split signal phasing for northbound and southbound, which will improve the overall efficiency of the intersection.

Table 5 Intersection Operations Future Year 2040 Conditions								
Intersection		A.M. Peak Hour			P.M. Peak Hour			
		LOS ¹	Delay ²	v/c ³	LOS ¹	Delay ²	v/c ³	
		<i>Movement</i>						
Douglas County	Southbound U.S. 59 Ramps and U.S. 56	<i>Westbound Left-turn</i>	A	7.9	0.05	A	7.9	0.10
		<i>Southbound</i>	C	18.8	0.48	E	37.1	0.79
		Northbound U.S. 59 Ramps and U.S. 56						
			<i>Eastbound Left-turn</i>	A	8.4	0.08	A	8.4
<i>Northbound</i>			C	15.8	0.38	C	16.0	0.33
Baldwin City	8th Street and U.S. 56 <i>Signalized Intersection (All Movements)</i>		B	12.5	0.69	B	14.7	0.48
	6th Street and U.S. 56 <i>Signalized Intersection (All Movements)</i>		C	27.3	0.91	C	30.1	0.84
Douglas County	2200 Road and U.S. 56	<i>Eastbound Left-turn</i>	A	7.9	0.04	A	8.5	0.05
		<i>Westbound Left-turn</i>	A	8.3	0.01	A	7.9	0.02
		<i>Northbound</i>	C	20.6	0.30	D	31.6	0.47
		<i>Southbound Left-turn</i>	C	20.7	0.16	D	27.1	0.35
		<i>Southbound Shared Through / Right-turn</i>	B	12.4	0.12	C	15.1	0.20
	K-33 Highway and U.S. 56	<i>Eastbound Left-turn</i>	A	7.5	0.01	A	8.2	0.01
		<i>Westbound Left-turn</i>	A	8.3	0.03	A	8.2	0.08
		<i>Northbound Left-turn</i>	C	17.9	0.26	D	25.8	0.31
		<i>Northbound Shared Through / Right-turn</i>	B	11.8	0.16	B	11.7	0.11
		<i>Southbound</i>	B	14.5	0.13	C	19.0	0.11
Edgerton	8th Street/Edgerton Road and U.S. 56	<i>Eastbound Left-turn</i>	A	7.7	0.01	A	8.4	0.01
		<i>Westbound Left-turn</i>	A	8.6	0.03	A	8.0	0.05
		<i>Northbound Left-turn</i>	C	19.0	0.08	C	22.7	0.10
		<i>Northbound Shared Through / Right-turn</i>	B	14.0	0.23	B	12.2	0.10
		<i>Southbound Left-turn</i>	D	26.8	0.17	C	23.3	0.10
		<i>Southbound Shared Through / Right-turn</i>	B	13.5	0.05	C	18.5	0.14
	1st Street and U.S. 56	<i>Westbound Left-turn</i>	A	1.6	0.03	A	1.7	0.06
		<i>Northbound</i>	C	17.2	0.32	C	16.5	0.22
	4th Street and U.S. 56	<i>Westbound Left-turn</i>	A	1.1	0.02	A	1.3	0.04
		<i>Northbound</i>	C	15.5	0.14	C	20.1	0.29

1 – Level of Service
 2 – Delay in seconds per vehicle
 3 – Volume/Capacity Ratio

Table 5 Continued Intersection Operations Future Year 2040 Conditions							
Intersection <i>Movement</i>		A.M. Peak Hour			P.M. Peak Hour		
		LOS ¹	Delay ²	v/c ³	LOS ¹	Delay ²	v/c ³
Johnson County	199th Street and U.S. 56						
	<i>Eastbound Left-turn</i>	A	0.3	0.01	A	1.7	0.01
	<i>Southbound Left-turn</i>	B	12.8	0.11	B	13.0	0.11
	<i>Southbound Right-turn</i>	B	10.7	0.36	D	25.4	0.73
	191st Street and U.S. 56						
	<i>Eastbound</i>	B	12.7	0.14	C	15.5	0.26
	<i>Northbound Left-turn</i>	A	0.5	0.02	A	2.3	0.02
Four Corners Road and U.S. 56							
	<i>Eastbound Left-turn</i>	A	1.6	0.05	A	3.1	0.05
	<i>Southbound</i>	A	9.8	0.08	B	12.4	0.13
Gardner	Center Street and U.S. 56						
	<i>Signalized (All Movements) No SBRT</i>	F	93.1	1.07	F	95.9	1.26
	<i>Signalized (All Movements) with SBRT</i>	F	85.1	1.07	F	80.8	1.18
	Elm Street and U.S. 56						
	<i>Signalized Intersection (All Movements)</i>	A	9.7	0.64	B	14.5	0.84
	Mulberry Street and U.S. 56						
<i>Signalized Intersection (All Movements)</i>	A	9.8	0.74	B	13.4	0.79	
Moonlight Road and U.S. 56							
<i>Signalized Intersection (All Movements)</i>	F	105.2	1.15	E	75.3	1.01	
Cedar Niles Road and U.S. 56							
<i>Signalized Intersection (All Movements)</i>	F	101.7	1.15	F	141.0	1.40	

1 – Level of Service
 2 – Delay in seconds per vehicle
 3 – Volume/Capacity Ratio

As shown in *Table 5*, the analysis results indicate that most of the study intersections are expected to continue operating within desirable levels of service under the projected 2040 design year traffic conditions. However, there are a few exceptions. Note that drivers on the southbound U.S. 59 off-ramp at U.S. 56 are expected to experience undesirable delays (LOS E) during the P.M. peak hour. Additionally, the Center Street, Moonlight Road, and Cedar Niles Road intersections with U.S. 56 are all expected to operate at undesirable levels of service during both the A.M. and P.M. peak hours under the projected Future Year 2040 Conditions.

Below in *Table 6* are the Future Year 2040 Conditions capacity analysis results for the three primary rural roadway segments within the project. The HiCAP analysis worksheets for these analyses have been attached for reference.

Table 6 Roadway Segment Operations Future Year 2040 Conditions				
Location	A.M. Peak Hour		P.M. Peak Hour	
	LOS ¹	v/c ²	LOS ¹	v/c ²
U.S. 56 between U.S. 59 and Baldwin City	D	0.330	D	0.350
U.S. 56 between Baldwin City and Edgerton	C	0.233	C	0.265
U.S. 56 between Edgerton and Gardner	C	0.222	C	0.186

1 – Level of Service
 2 – Volume/Capacity Ratio



Conclusion

In conclusion, the traffic analyses performed for this study show that existing traffic operations are within acceptable levels. Future traffic operations are expected to be similar to the existing conditions along most of the study corridor, considering the improvements proposed. However, even with significant roadway improvements considered, three of the major study intersections in Gardner (U.S. 56 intersections at Center Street, Moonlight Road, and Cedar Niles Road) are expected to operate with relatively poor levels of service during the peak hours under the projected 2040 traffic volume conditions.

Attachments