

3.0 EXISTING AND FUTURE NO-BUILD CONDITIONS

To determine if there are deficiencies or problems with the existing highway a detailed analysis was completed looking at traffic volumes, highway geometrics, truck traffic, vehicle speeds, levels of service, crash rates, and other key issues. The analysis considered current and future traffic conditions assuming no changes to the current highway. In support of the analysis, highway and traffic data was collected from a variety of sources including:

- KYTC Highway Information System database;
- KYTC District 1 data sources;
- Study area field reviews;
- Peak hour turning movement traffic counts;
- 24-hour vehicle classification counts; and
- Field spot speed data collection.

3.1 US 51 Highway Characteristics and Average Daily Traffic Volumes

US 51 is the primary north-south highway in the study area. It is an undivided two-lane highway and is functionally classified as a rural principal arterial. US 51 runs from Cairo, Illinois in the north, south through Wickliffe, to Bardwell. From Bardwell it continues south through Arlington and Clinton before reaching Fulton and the Tennessee line.

In 2002, US 51 carried approximately 2,600 vehicles per day (vpd) north of Bardwell and 2,800 vpd south of Bardwell. In town, traffic peaks at approximately 5,600 vpd between US 62 and Elsey Ave. (KY 123). Figure 4 (Appendix B) shows average daily traffic volumes on US 51.

A summary of the highway characteristic data for US 51 is presented in Table 1 (Appendix A) and Figure 5 (Appendix B). The highway has adequate lane widths of approximately 11 feet in most portions of the study area. The shoulders are paved and average 2-3 feet, but there are some areas, especially in town, with minimal shoulders. There are portions of US 51 with wide driveways and perpendicular parking areas adjacent to the highway. There are also utility poles and other objects in close proximity to the travel way, restricting the clear zone. There are currently no substantial sections of US 51 with curb and gutter in the study area. Refer to Figure 6 (Appendix B) for pictures.

The posted speed limit through Bardwell ranges from 55 mph on the outskirts of town, to 25 mph in the center of town. The typical right-of-way (ROW) width through town is 50 feet with wider rights-of-way north and south of town as shown in Figure 5. Sidewalks are present along portions of US 51 through town, but there are discontinuities in the system. Some sidewalks are in good condition, but the majority are in disrepair (see Figure 6).

At the southern end of the town, near the First United Methodist Church, is a sharp curve that limits sight distance. Southeast from the curve is a steep hill leading into the town (see Figure 6). Both of these sections present challenges for through truck traffic. Intersection corner radii at the US 51 / US 62 and US 51 / KY 123 (Elsey Avenue) intersections are inadequate for large trucks. Field observations confirmed that trucks

have a difficult time turning at these locations without crossing into the opposing traffic lane (Refer to Figure 6 – Top Left Picture).

There is one traffic signal on US 51, at the Jennings Street intersection. The signal is not currently warranted according to recent traffic count data. All other intersections are STOP controlled on the minor (or side) street approach. There are no left turn lanes to or from US 51, though this does not create a capacity problem at present.

3.2 Other Study Area Roadways and Average Daily Traffic Volumes

Other important roadways in the study area include US 62, KY 123, KY 1022, and KY 1181. Table 2 presents summary information for each highway. Current traffic volume data is shown in Figure 4 (Appendix B). **US 62** is a major east-west highway through the study area. US 62 is the main route from Bardwell east to Paducah. It is a two-lane undivided highway and is functionally classified as a Rural Major Collector. US 62 enters Bardwell from the east at the north end of town and then runs to the north as US 62 / US 51. It carries 2,400 to 3,000 vpd east of US 51. **KY 123** (Elsey Avenue) runs east-west through the study area. KY 123 runs from Bardwell west to Columbus, KY. It is a two-lane undivided highway and is classified as a Rural Major Collector. It carries between 900 and 2,000 vehicles per day through the study area.

Table 2: Summary of Study Area Roadway Characteristics

ROUTE	FROM MP	TO MP	VEHICLE CLASS	ADT	R.O.W. (FT.)	LANE WIDTH (FT.)	NUMBER OF LANES	POSTED SPEED LIMIT MPH
US 62	0	0.31	Rural Major Collector	3,010	60	10	2	35
	0.31	0.5	Rural Major Collector	2,570	60	10	2	45
	0.5	1.062	Rural Major Collector	2,750	60	10	2	55
	1.062	2.868	Rural Major Collector	2,380	60	10	2	55
KY 123	6.034	6.7	Rural Major Collector	920	60	9	2	55
	6.7	7.39	Rural Major Collector	910	60	9	2	55
	7.39	7.6	Rural Major Collector	1,450	50	10	2	35
	7.6	7.703	Rural Major Collector	2,040	60	10	2	35
KY 1022	0	1.806	Rural Local	50	40	8	2	55
	1.806	4.863	Rural Minor Arterial	70	40	8	2	55
KY 1181	0	1.6	Rural Minor Collector	390	60	9	2	55
KY 1372	2.054	3.47	Rural Local	300	50	10	2	55
KY 1377	6.413	8.459	Rural Minor Collector	730	50	10	2	55
KY 1591	3.947	5.897	Rural Local	420	50	9	2	55

Source: KYTC Highway Information System

3.3 Truck Volumes

To determine the current truck volumes on US 51, directional 48-hour vehicle classification counts were conducted at four locations in the study area as shown on Figure 7 (Appendix B). The results, given in Table 3, indicate that 22 percent of the observed traffic north of Bardwell is truck traffic (13 percent being semi-trailer traffic) and 15 percent of the traffic south of Bardwell is truck traffic (9 percent semi-trailers). Based on these volumes the percent trucks near the center of town is about 9 percent (5 percent semi-trailers). Counts were also taken on US 62 and KY 1181, both east of Bardwell. At these locations, 12 and 7 percent, respectively, was truck traffic, with 4 percent semi-trailer traffic on US 62. Most of the truck traffic on US 62 turns north on US 51.

Table 3: 2002 Vehicle Classification Counts

Location	Total Vehicles Per Day	Cars, 2-Axle Trucks, and Motorcycles	Buses and Trucks with 3-4 Axles	Trucks with 5 or more axles (semi-trailers)	Total Truck %
Station 1: US 62 East of Bardwell – Milepoint 1.162	2,260	1,979 (88%)	184 (8%)	97 (4%)	12
Station 2: US 51/62 North of Bardwell – Milepoint 8.180	2,930	2,287 (78%)	275 (9%)	368 (13%)	22
Station 3: KY 1181 East of Bardwell – Milepoint 0.250	409	379 (93%)	28 (7%)	2 (0%)	7
Station 4: US 51 South of Bardwell – Milepoint 6.621	3,181	2,700 (85%)	195 (6%)	286 (9%)	15

The range of 15 to 22 percent trucks on US 51 is somewhat higher than the statewide average for similar rural principal arterials, which is 13.4¹ percent. Historic classification counts on US 51 were obtained to examine historic trends. Three classification counts were conducted in the study area between 1979 and 2001 as shown in Table 4. During that time, the average truck percentages at these locations increased from 11.1 percent to 15.3 percent. The historical data combined with the current truck count numbers indicates that truck percentages may have increased over time. Regardless, it is clear that trucks make up a substantial portion of the traffic stream.

Table 4: Historic Vehicle Classification Counts on US 51

Location	Year	Axles per Truck	Percent Trucks
US 51 Near KY 1181 (Milepoint 6.2)	1979	3.756	11.1%
US 51 Near KY 1181 (Milepoint 6.3)	1991	3.913	11.2%
US 51 at Elsey Ave. (Milepoint 7.4)	1996	3.506	15.3%

Source: KYTC Multimodal Programs 2001 Vehicle Classification Database

3.4 Spot Speeds

Speed data was collected on US 51 to determine vehicle speeds relative to the posted speed limit. The data was collected manually by recording vehicle description and the time of passage at two points separated by a distance of 100 feet. Vehicle speeds were calculated by comparing the times the same vehicle passed each endpoint. Directional speed data were collected at two locations on US 51; one north and one south of Bardwell as shown on Figure 7 (Appendix B). The posted speed limit on US 51 north and south of Bardwell is 55 mph. As drivers approach the corporate limits, the speed limit drops to 45 mph, then 35 mph, and then again to 25 mph for a short stretch in downtown Bardwell (see Figure 7 in Appendix B). The speed survey locations were just beyond the corporate limits where the speed limit changes from 55 mph to 45 mph.

¹ Traffic Forecasting Report 2002, KYTC Division of Multimodal Programs, August 2002, Page 20.

In speed studies the most significant statistic is the 85th percentile speed. The 85th percentile speed is the speed threshold at or below which 85 percent of the motorists travel. Generally, speed limits are set within five mph of the 85th percentile speed.

Table 5 presents a summary of the speed statistics for US 51. As shown in the table, the 85th percentile speeds were within 5 mph of the posted speeds at both locations. At Station 1 (north of Bardwell), the northbound 85th percentile speed of 59 mph was four mph above the posted 55 mph speed limit. Southbound, the 85th percentile speed was five mph higher than the 45 mph posted speed limit. This is not unusual, as drivers often do not begin decelerating until after they have entered the lower speed zone. At Station 2 (south of Bardwell), the southbound 85th percentile speed was two mph higher than the 55 mph posted speed limit, while the northbound 85th percentile speed was five mph above the posted 45 mph speed limit. Again, the observed speeds were not unusual for transition zones.

Table 5: US 51 Speed Data Summary

Statistics	Station 1 (North of Town)		Station 2 (South of Town)	
	<i>Northbound</i>	<i>Southbound</i>	<i>Northbound</i>	<i>Southbound</i>
Location (Milepoint)	8.068	8.068	6.55	6.55
Number of Observations	33	33	45	42
Minimum Speed (mph)	31	30	22	31
Maximum Speed (mph)	80	57	64	67
Mean (mph)	51	43	42	48
50th Percentile (mph)	51	42	42	49
85th Percentile (mph)	59	50	50	57
Posted Speed Limit (mph)	55	45	45	55
Difference (85 th -Posted)	+4	+5	+5	+2

3.5 Traffic Analysis Methodology

Study Intersections and Highway Segments

The US 51 study in Bardwell focused on critical intersections and highway segments in the study area. Specifically, traffic operations were examined at the following locations:

Intersections

- US 51 at US 62 – Unsignalized
- US 51 at Jennings Street – Signalized
- US 51 at KY 123 (Elsey Ave.) – Unsignalized
- US 51 at KY 1181 – Unsignalized
- US 51 at KY 1377 – Unsignalized

Highway Segments

- US 51 south of Bardwell
- US 51 north of Bardwell

Intersection Analysis

For this analysis the Highway Capacity Software package (HCS 2000) was used to assess the morning and afternoon (AM and PM) peak hour traffic operating conditions for both current and future years. This software package implements the Highway

Capacity Manual intersection analysis method. For each study intersection, average vehicle delays were calculated as well as the resulting levels of service.

Level of service (LOS) is a qualitative measure of expected traffic conflicts, delay, driver discomfort, and congestion. Levels of service are described according to a letter rating system ranging from LOS A (free flow, minimal or no delays – best conditions) to LOS F (stop and go conditions, very long delays – worst conditions). For intersections the Highway Capacity Manual defines levels of service based on the average delay due to signal or STOP control as shown in Table 6.

In general terms, a facility is considered to have reached its physical capacity at LOS E. However, for rural conditions, LOS C is often considered the threshold for desirable traffic conditions. In this study, levels of service below this threshold are noted as undesirable and warrant improvement. LOS C corresponds to ≤ 35 seconds of delay per vehicle at a signalized intersection and ≤ 25 seconds of delay at an unsignalized intersection.

Table 6: LOS Criteria for Intersections

LOS	Signalized Intersections Control Delay (seconds/vehicle)	Unsignalized Intersections Control Delay (seconds/vehicle)
A	≤ 10	≤ 10
B	$>10 - 20$	$>10 - 15$
C	$>20 - 35$	$>15 - 25$
D	$>35 - 55$	$>25 - 35$
E	$>55 - 80$	$>35 - 50$
F	>80	>50

Source: Highway Capacity Manual (2000)

Rural Two-Lane Highway Analysis

A peak hour traffic operations analysis was prepared for segments of US 51 north and south of town using the Highway Capacity Software two-lane road analysis package. This is based on the 2000 Highway Capacity Manual (Chapter 20) methodology. For this method, there are two classes of roadways: Class I highways include higher speed arterials and daily commuter routes, while Class II highways include lower speed collector roadways and roads primarily designed to provide access. Driver expectations regarding speed and flow are important in determining a highway's class. US 51, as the main arterial and as the major through-route, is a Class I highway.

Levels of Service for Class I highways are based on the estimated average travel speeds and percent time vehicles spend following other vehicles as shown in Table 7. Again, LOS C is the threshold used for desirable traffic operations in this study. Operations below this threshold are noted as undesirable and warrant improvement. For Class I highways, LOS C corresponds to an average travel speed of >45 miles per hour with ≤ 65 percent of the time spent following another vehicle.

Table 7: LOS Criteria for Two-Lane Highways

Class I Highways		
LOS	Percent Time Spent Following	Average Travel Speed
A	≤ 35	>55
B	$>35 - 50$	$>50 - 55$
C	$>50 - 65$	$>45 - 50$
D	$>65 - 80$	$>40 - 45$
E	>80	≤ 40
F	LOS F applies whenever the flow rate exceeds the capacity	

Source: Highway Capacity Manual (2000)

3.6 Existing Traffic Operating Conditions

Intersection Level of Service and Delay

In order to evaluate the current traffic conditions at the five study intersections, a.m. and p.m. peak period turning movement counts were conducted at each location. Figure 8 (Appendix B) shows the intersection controls and turning movement volumes. The approaches to all intersections are single lane approaches (i.e. there are no turn lanes).

The resulting 2002 levels of service are LOS B or better for all locations, as shown in Table 8. Figure 9 (Appendix B) illustrates the levels of service graphically. On Figure 9, the LOS displayed for the unsignalized intersections is that of the stop-controlled approach with the highest delay (the HCM method does not calculate whole intersection levels of service for unsignalized intersections).

Table 8: 2002 Intersection LOS Summary

Int. No.	Intersection	Type	LOS	
			AM	PM
1	US 51 / US 62*	2-Way STOP	B	B
2	US 51 / Jennings Street	Signal	B	B
3	US 51 / KY 123 (Elsev Ave.)*	2-Way STOP	B	B
4	US 51 / KY 1181*	1-Way STOP	A	A
5	US 51 / KY 1377*	1-Way STOP	A	A

* LOS is for the intersection approach with the highest delay.

Two-Lane Highway Level of Service and Delay

The current traffic volumes and roadway characteristics were used to evaluate operating conditions on US 51 north and south of Bardwell. The analysis showed that both highway segments are currently operating at LOS C with average travel speeds of just under 48 to 50 mph and a percent time-spent following ranging from 42 to 53 percent. This indicates that the roadways north and south of Bardwell are functioning in an acceptable manner. The segment levels of service are illustrated on Figure 9 (Appendix B).

3.7 Future No-Build Traffic Operating Conditions

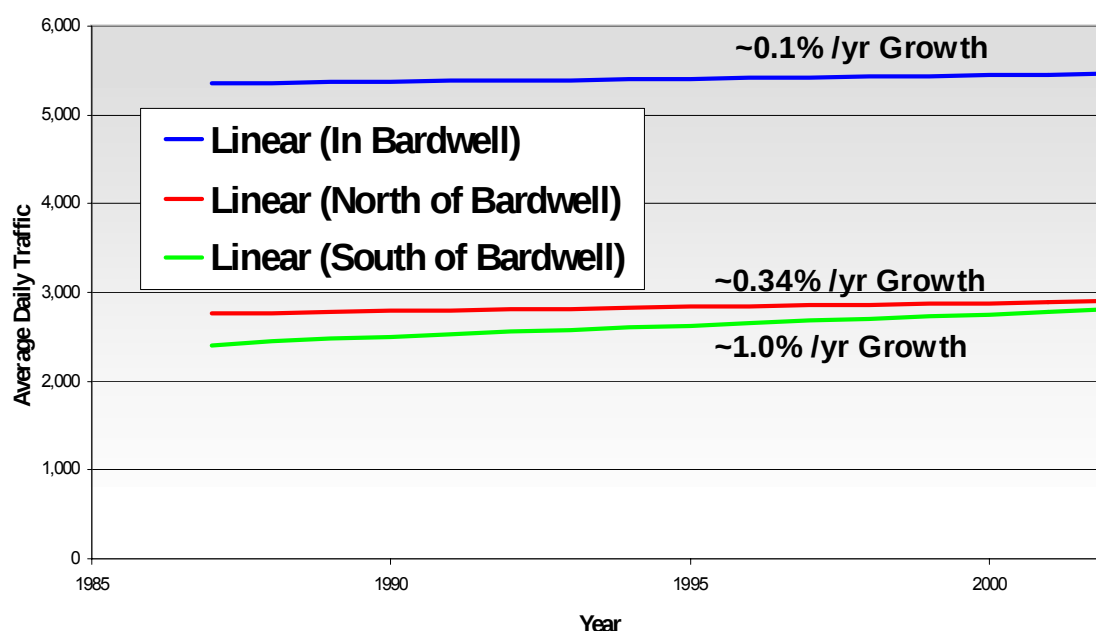
Traffic projections were developed for 2010, 2020, and 2030 to determine how the highway system would function if no improvements (beyond normal maintenance) were made during that time period. This scenario is referred to as the No-Build Scenario. The No-Build Scenario provides a snapshot of future traffic conditions, highlighting expected problems and deficiencies. It also provides a baseline for developing and evaluating possible build alternatives. Typically, projects that are under construction or planned for construction in the KYTC Six-Year Plan are taken into account in this analysis. However, in this study area there are no significant planned projects that would affect the future No-Build traffic conditions. (For further discussion of planned projects refer to Chapter 5.)

Future Traffic Volumes

Traffic growth on US 51 in Bardwell has been modest over the last 15 years with an average growth rate of approximately 0.6% per year at the ten study area count stations (1985 to 2002). In fact, traffic volumes are lower now on US 51 than they were in the

late 1970s due to the construction of I-55 in Missouri. Overall, traffic has declined about 20 to 25 percent since that time. For comparison purposes, historic data for three typical count stations: one in-town, one north of town, and one south of town were examined for 1985 to 2002 using linear interpolation. The results are shown in Figure 10. Traffic growth at the in-town count station was nearly flat at 0.1% annually. Growth north of town was also modest at 0.34% per year. Traffic growth south of town was the highest at approximately 1.0% per year. However, for purposes of this study a 1.5% traffic growth rate was applied to evaluate how traffic conditions would change if the growth rate were higher. Figure 11 (Appendix B) shows average daily traffic volumes (ADT) on US 51 for 2002, 2010, 2020, and 2030 using this higher 1.5% growth rate.

Figure 10: US 51 Historic Traffic Volumes (1987 to Present)



Future Intersection LOS and Delay

No-Build Scenario levels of service for the five key intersections on US 51 were evaluated using the projected traffic volumes. As mentioned previously, all of the intersections currently operate at LOS A and B. However, by 2010 the side street approaches to the US 51 / US 62 intersection may begin to experience unacceptable delays as shown in Table 9. By 2020, the eastbound approach at the intersection of US 51 and KY 123 may also begin to operate poorly. The poor levels of service at these two intersections are directly related to delays for vehicles turning left from the side streets onto US 51. Figure 12 (Appendix B) illustrates the 2030 intersection LOS for each of the five study intersections, giving the LOS for the worst approach for each of the unsignalized intersections.

Table 9: PM Peak Hour Intersection Levels of Service for No-Build Scenario

Int. No	Intersection	Type	Approach	2002		2010		2020		2030	
				Ave. Delay	LOS	Ave. Delay	LOS	Ave. Delay	LOS	Ave. Delay	LOS
1	US 51 / US 62	2-Way STOP	Eastbound	13.1	B	26.7	D	29.8	D	41.7	E
			Westbound	12.9	B	45.7	E	100.2	F	774.5	F
			Northbound	7.6	A	8.0	A	8.1	A	8.2	A
			Southbound	8.1	A	9.1	A	9.2	A	9.6	A
2	US 51 / Jennings Street	Signal	Eastbound	16.4	B	16.3	B	16.6	B	16.6	B
			Westbound	15.8	B	16.1	B	16.3	B	16.3	B
			Northbound	13.4	B	18.2	B	21.2	C	28.0	C
			Southbound	12.7	A	16.4	B	17.6	B	20.9	C
			Whole Int.	13.4	B	17.3	B	19.2	B	24.1	C
3	US 51 / KY 123 (Elsey Ave)	2-Way STOP	Eastbound	10.3	B	21.7	C	31.1	D	61.5	F
			Westbound	12.9	B	17.4	C	21.2	C	23.9	C
			Northbound	7.8	A	8.3	A	8.4	A	8.7	A
			Southbound	7.8	A	8.2	A	8.4	A	8.6	A
4	US 51 / KY 1181	1-Way STOP	Westbound	9.9	A	10.8	B	12.0	B	12.8	B
			Southbound	7.5	A	7.8	A	7.9	A	8.1	A
5	US 51 / KY 1377	1-Way STOP	Westbound	8.8	A	10.1	B	10.1	B	10.4	B
			Southbound	7.6	A	7.9	A	7.9	A	8.1	A

Notes: Only the p.m. peak is shown, as it represents the higher of the two peak periods.
The 2000 Highway Capacity Manual analysis methods were used (implemented by HCS 2000).
2002 LOS analysis employed the peak hour count data collected for the study.
2010-2030 LOS analyses used projected ADT with design hour and directional distribution factors and the turn percentages from 2002 turning movement counts; 2010 and 2020 ADT were based on linear growth.
Average delay is in seconds per vehicle.

Two-Lane Highway Level of Service and Delay

The two-lane highway methodology was used to assess the future traffic conditions on US 51 outside of town. As shown on Table 10, all four study segments will continue to operate acceptably at LOS C through 2030 without improvements. Figure 12 (Appendix B) illustrates the year 2030 segment LOS results.

Table 10: PM Peak Hour Two-Lane Levels of Service for No-Build Scenario

Segment	2002	2010	2020	2030
Stanley Road to KY 1203	C	C	C	C
KY 1203 to Ballard County Line	C	C	C	C
KY 1181 to KY 1377	C	C	C	C
KY 1377 to Bob Brown Road	C	C	C	C

Note: Only the p.m. peak is shown, as it represents the higher of the two peak periods.

3.8 Crash Analysis

The Kentucky Transportation Cabinet provided crash data for a three and one half-year period from January 1, 1998 through June 30, 2001. During this period, 33 crashes occurred on US 51 within the study area (between mileposts 4.928 and 10.725).

Crash rates were computed for five specific segments of US 51 within the study area. Segment crash rates are typically expressed in terms of crashes per 100 million vehicle-miles to take into account the amount of traffic on a particular highway segment. A segment's crash rate is then compared to a statewide critical crash rate for the same type of roadway to identify high crash locations. Highway sections with a crash rate higher than the critical crash rate are considered high crash locations and are potential candidates for safety improvements.

The analysis revealed that Section 3 has a crash rate (455 crashes per 100 million vehicle-miles) that is more than three times higher than the statewide average and 67% higher than the section critical rate as shown in Table 11. This section extends from East Court Street to just north of US 62. For the remaining segments, the observed crash rates were all below the statewide average and section critical rates.

Table 11: Segment Crash Analysis

Section	Description	Total Crashes	ADT	Section Length (miles)	Statewide Average Crash Rate	Section Crash Rate	Section Critical Rate	Critical Crash Rate Factor
1	MP 4.928 to 6.00	3	2770	1.072	131	79	282	0.28
2	MP 6.00 to 7.05	4	3390	1.05	131	88	269	0.33
3	MP 7.05 to 7.81	20	4520	0.76	131	455	272	1.67
4	MP 7.81 to 8.81	2	3190	1	131	49	277	0.18
5	MP 8.81 to 10.725	4	2870	1.915	131	57	242	0.24

Notes: Crash data for January 1, 1998 to June 30, 2001

Rates are in crashes per 100 million vehicle-miles.

Critical crash rate factor is the section crash rate divided by the section's critical crash rate.

A crash cluster analysis was also conducted for the study area. Two crash clusters were identified: one between Jennings Street and KY 123 and a second near the Methodist Church as shown on Figure 13 (Appendix B). Both of these locations are within the previously defined high crash section. A spot crash analysis was conducted to determine how the crash rates at these two "spots" compared to the critical spot crash rates for similar facilities (refer to Table 12).

Table 12: Spot Crash Analysis

Location	Begin MP	End MP	No. of Crashes	Analysis Period (Years)	Average ADT	Spot Crash Rate*	Critical Crash Rate*	Ratio of Spot Rate to Critical Rate
Jennings to KY 123	7.3	7.6	11	3.5	4,500	1.91	1.63	1.17
Near Methodist Church	7	7.3	6	3.5	4,500	1.04	1.63	0.64

* Crashes per million vehicles

As indicated in the table, the spot crash rate observed between Jennings Street and KY 123 was higher than the critical crash rate. A review of the crash data showed that six of the 11 crashes were rear-end or backing collisions, two were related to driveways,

and the remaining three were sideswipe crashes. Only one was an injury crash. These crash types are consistent with the area type and highway issues identified previously. The spot crash rate near the Methodist Church was lower than the critical rate. The crash analysis also showed that one fatal crash was recorded near mile point 5.5. Details for all the spot crashes are shown in Tables 13 through 15 (Appendix A).

3.9 Pedestrian and Bicycle Facilities

There are sidewalks on portions of US 51 in Bardwell. However, most segments do not have sidewalks, and there is little continuity between the existing sections. The condition of the existing sidewalks ranges from good to poor, but most are in poor condition. There are no striped crosswalks or pedestrian signals on US 51. Currently, the Ramblin' River Tour bike route on KY 123 runs through Bardwell and the Mississippi River Trail bike route runs north-south west of Bardwell.

3.10 Existing and Future No-Build Traffic and Highway Conditions Summary

An analysis of the existing and future No-Build traffic and highway conditions on US 51 in the Bardwell area was performed considering the following items: average daily traffic volumes, vehicle classification information, speed data, levels of service, highway geometry, pedestrian facilities, and crash data. US 51 currently carries between 2,500 to 5,500 vehicles per day, with 9 to 22 percent truck traffic. Traffic growth in the study area has been modest (<1%) over the last 15 years (however a conservatively high growth rate of 1.5% was employed in the study). There are a number of geometric issues that were identified such as limited shoulders, restricted clear zones, inadequate corner radii, one sharp curve, and deteriorated sidewalks. The speed data did not show any clear problems, though vehicle speeds entering the town in the transition zones are higher than the posted speed limits. The current (2002) levels of service are LOS C or better for all intersections and road segments, indicating little vehicle delay and good traffic operation conditions from a capacity standpoint. However, the side street levels of service at two intersections will drop below LOS C in the future because of delay associated with traffic turning left from the side streets onto US 51. The crash analysis showed that the portion of US 51 between East Court Street and just north of US 62 is a high crash location, with the majority of the crashes being angle and rear end crashes.