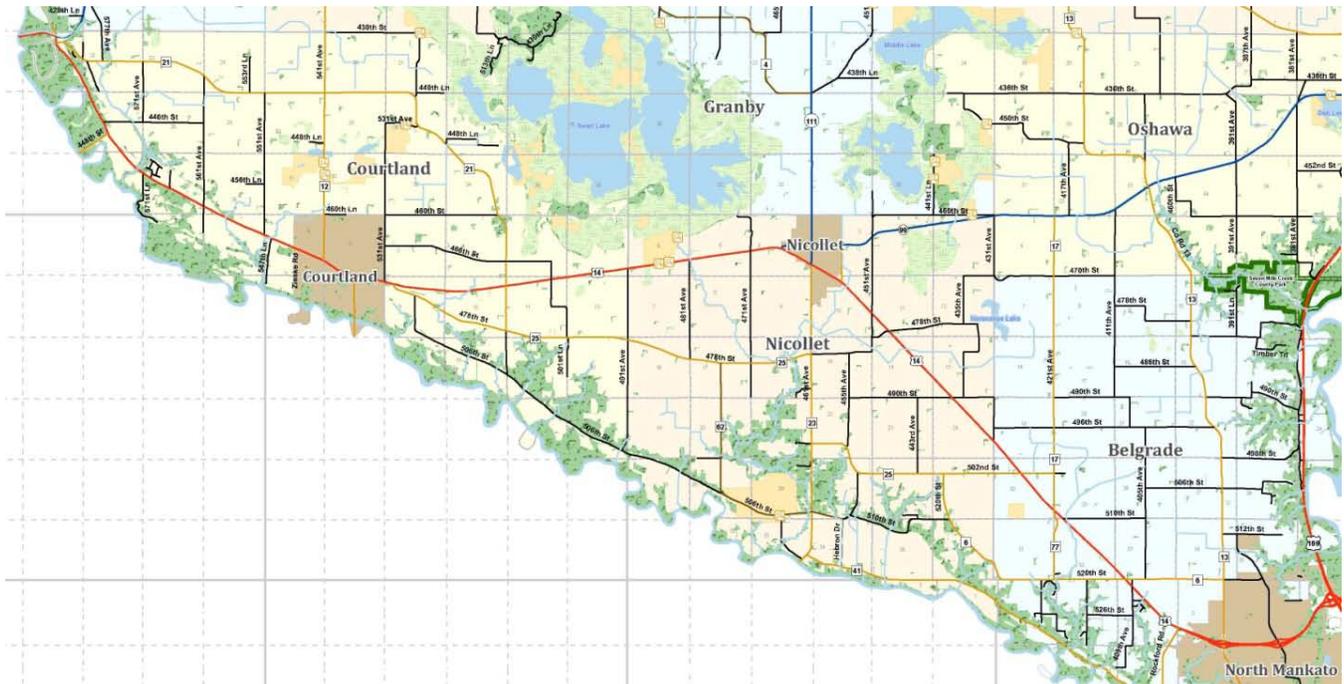




U.S. Highway 14: Mankato to New Ulm

Road Safety Audit Review Technical Report

April 17, 2012



Prepared By



1.0 INTRODUCTION	2
1.1 ROAD SAFETY AUDIT REVIEW (RSAR) TEAM	2
1.2 ROAD SAFETY AUDIT REVIEW PROCESS	3
1.3 USTH 14 PARTNERSHIP MEETING	3
1.4 MNDOT DISTRICT 7 MEETING	4
2.0 BACKGROUND	5
2.1 CORRIDOR HISTORY	5
2.1.1 <i>Implemented Safety Projects</i>	5
2.1.2 <i>Programmed Improvement Projects</i>	6
2.2 CRASH HISTORY	7
2.3 INTERSECTIONS	12
2.4 BEHAVIORAL ISSUES	14
2.5 TRAFFIC VOLUMES	15
2.6 HEAVY COMMERCIAL (HC) TRAFFIC	18
2.7 VEHICLE SPEED PROFILES	19
3.0 FIELD REVIEW OBSERVATIONS	20
3.1 SEGMENTS	20
3.1.1 <i>Road Geometry</i>	20
3.1.2 <i>Field Access</i>	20
3.1.3 <i>Urban Geometry</i>	20
3.2 INTERSECTIONS	21
3.2.1 <i>Skewed Angle Intersections</i>	21
3.2.2 <i>Signs and Pavement Markings</i>	21
3.2.3 <i>Systemic Evaluation of Nicollet County</i>	21
4.0 POTENTIAL IMPROVEMENT STRATEGIES	22
4.1 SEGMENTS	22
4.1.1 <i>Four-Foot Buffer</i>	22
4.1.2 <i>Twelve-Foot Buffer</i>	23
4.1.3 <i>2+1 Road</i>	23
4.1.4 <i>Four-Lane Expressway</i>	24
4.1.4 <i>Lighting</i>	24
4.1.5 <i>Corridor Speed Study</i>	24
4.1.6 <i>Living Snow Fence</i>	24
4.2 INTERSECTIONS	25
4.2.1 <i>Access Management</i>	25
4.2.2 <i>Signing</i>	25
4.2.3 <i>Pavement Marking</i>	26
4.2.4 <i>Channelization</i>	26
4.2.5 <i>Curb Extensions</i>	26
4.2.6 <i>Systemic Intersection Evaluation</i>	27
4.2.7 <i>USTH 14/MNTH 15/CSAH 21</i>	27
4.2.8 <i>USTH 14/CSAH 37</i>	29
4.2.9 <i>USTH 14/561st Ave</i>	30
4.2.10 <i>USTH 14/4th St</i>	30
4.2.11 <i>USTH 14/MNTH 99</i>	30
4.2.12 <i>USTH 14/MNTH 111 (North Leg)/CSAH 23 (South Leg)</i>	31
4.3 BEHAVIORAL FACTORS	32
4.3.1 <i>Enforcement</i>	32
4.3.2 <i>Seat Belt Usage</i>	34
4.3.3 <i>Driver Distraction</i>	35
4.3.4 <i>Commercial and Farm Vehicle Traffic</i>	36
5.0 CONCLUSIONS/SUGGESTIONS	37
5.1 CORRIDOR FACTS	38
5.2 FACTORS CONTRIBUTING TO CRASHES	39
5.3 SUGGESTED ENGINEERING IMPLEMENTATION	39

1.0 Introduction

The Trunk Highway (USTH) 14 corridor between New Ulm and North Mankato in Nicollet County (Figure 1), Minnesota has been the scene of 250 crashes from 2006 to 2010. Eleven of those crashes resulted in a fatality or a severe injury¹. As a result of these crashes and concerns expressed by area residents, the Minnesota Department of Transportation (MnDOT) decided to conduct a safety investigation to determine if the number and severity of crashes is unusual, to determine the primary factors contributing to the crashes and to develop and evaluate potential alternative short term improvement strategies.

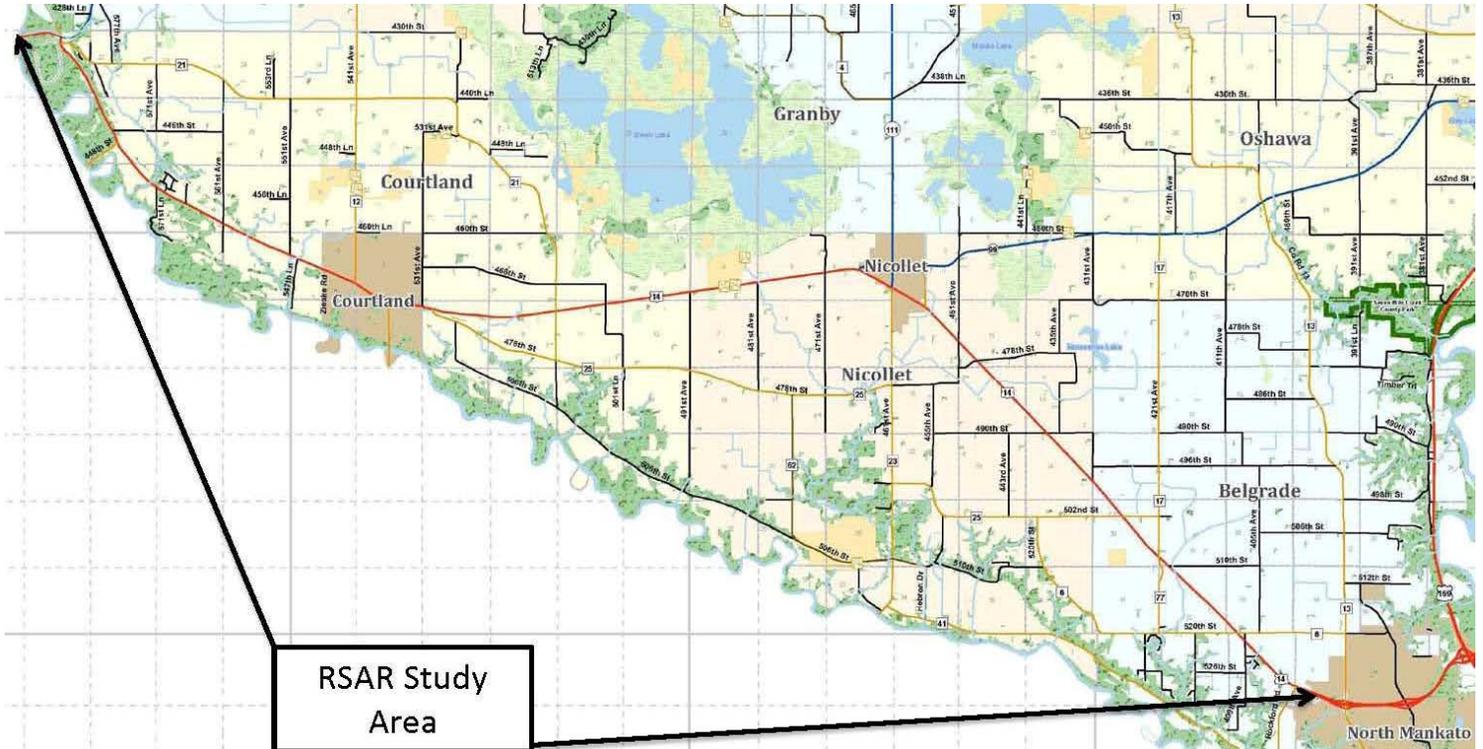


Figure 1 - RSAR Study Area

MnDOT retained CH2M HILL, Inc. to assemble a review team and to prepare a Road Safety Audit Review of the USTH 14 corridor. The review team provides a fresh view of the corridor.

1.1 Road Safety Audit Review (RSAR) Team

CH2M HILL assembled an independent team of safety experts representing MnDOT, the Federal Highway Administration, the Minnesota State Patrol and the private sector. Table 1 lists the review team.

¹ The RSAR focused its analysis on the crash data available at the time of the study from 2006-2010. Since then, 2011 crash data has become available. From 2007-2011, USTH 14 was the scene of 8 fatal crashes and 5 severe injury crashes, a total of 13 severe crashes.

Name	Agency
Brad Estochen	MnDOT State Safety Engineer
Derek Leuer	MnDOT Safety Engineer
Chu Wei	MnDOT Safety Engineer
Thomas Dumont	MnDOT District 3 Traffic Engineer
Jim Rosenow	MnDOT Geometrics
Will Stein	Federal Highway Administration MN Division Safety Engineer
Paul Skoglund	Minnesota State Patrol
Howard Preston	CH2M HILL Project Manager
Cheri Marti	CH2M HILL Driver Behavior Safety Specialist
KC Burke	CH2M HILL Project Engineer

Table 1 - RSAR Team

1.2 Road Safety Audit Review Process

The USTH 14 Road Safety Audit Review process included the following steps:

1. Crash data from 2006 to 2010 was assembled using the Minnesota Crash Mapping Analysis Tool (MnCMAT) and analyzed for location, frequency, type, severity, time of day, light conditions, weather conditions and road conditions (USTH 14:Mankato to New Ulm Road Safety Audit Briefing Book).
2. Traffic volumes for the corridor were documented.
3. Crash diagrams for intersections with severe crashes were prepared.
4. Two meetings were held, one with the USTH 14 Partnership, elected officials, local law enforcement and MnDOT District 7 staff, and one follow-up meeting with MnDOT District 7 management.
5. After the meetings, the team examined the corridor and intersections in the field, recorded observations and suggestions and discussed possible mitigation strategies.

1.3 USTH 14 Partnership Meeting

The team participated in a meeting at the District 7 MnDOT office on January 18, 2012, the day prior to the Road Safety Audit Review with the USTH 14 Partnership. The members of the Partnership, including elected local officials, law enforcement and area residents shared their concerns and observations of the highway. The USTH 14 Partnership was formed in 1998 and is an advocacy organization supporting the four-lane expansion of Highway 14.

Main topics of discussion during the meeting included:

- Diagonal Intersections – Many of the intersections are at grade and at angle intersecting points making it difficult for drivers on the minor road approaches to see traffic on the highway (Figure 2).



Figure 2 - Diagonal Intersection (USTH 14 and CSAH 25)



Figure 3 - USTH 14 westbound between CSAH 6 and CSAH 17

- Unforgiving Road – With 2-lane traffic, as soon as a vehicle crosses the center line it poses a great danger to roadway users since there typically isn't time to react and correct the action prior to a crash (Figure 3).

- Crash Characteristics – High percentage of severe head on collisions.

- Age Distribution – Wide range of drivers using the roadway from young to elderly, all with different destinations and purposes for using the highway. Mankato is becoming a main medical and shopping area, causing a lot of people to be using the highway for medical care.

- Roadway Use – Highway was originally designed to accommodate rural travel patterns, but current traffic indicates that is no longer the only use of the highway. Multi-modal use throughout the corridor with different driving conduct. Interregional traffic as well as heavy commercial and farm traffic are using highway. Many vehicles use the USTH 14 corridor through the region as opposed to the Interstate to the south.
- Traffic Volumes/Vehicle Gaps – Traffic along the corridor has increased significantly since its original design. During peak periods, it is difficult to find an adequate gap to cross or turn onto the highway. It is also difficult for the State Patrol to enforce laws since they feel there is no safe place to park and turning around under heavy traffic is difficult.
- Semi-trucks – High percentage of trucks traveling between New Ulm and Mankato. Many independent farmers own their own trucks and are not regulated for training, licensing, etc. When trucks are lined up, passing is difficult and dangerous.
- Speed – Many people appear to be moving too fast through the corridors, while others traveling at or below the speed limit also present a danger as drivers get impatient and take risks passing the vehicle or multiple vehicles at one time.

1.4 MnDOT District 7 Meeting

The RSAR team met the morning of January 19, 2012 prior to a field review of the corridor with MnDOT District 7 management regarding the Audit.

Many of the discussion topics reiterated those from the USTH 14 Partnership Meeting and included:

- Driver Behavior – Drivers are taking risks on this corridor for unknown reasons.
- Age Distribution
- Traffic Volumes
- Semi-trucks
- Speed

However, the primary topic of discussion involved the Districts commitment to expanding USTH 14 to four lanes from North Mankato to New Ulm. Over recent years, MnDOT has also already implemented some short term solutions that are listed later in this document.

A Corridor Management Plan and Final Environmental Impact Statement (FEIS) have been completed for the USTH 14 corridor from New Ulm to North Mankato and propose a 4-lane divided expressway for this corridor. The proposed upgrade will generally follow the existing route between Nicollet and North Mankato with proposed bypasses of Courtland and Nicollet. Currently, there is no set timeline for construction of a 4-lane expressway; however MnDOT District 7 would like to construct it within the next 20 years, thus the focus of the RSAR Team on short term/low cost solutions that would not put the expansion project at risk of being deferred further into the future.

2.0 Background

2.1 Corridor History

USTH 14 is a MnDOT medium priority interregional corridor. USTH 14 is a major east-west corridor for the southern Minnesota. The audit area is predominantly a rural, 2-lane roadway with all access provided at through-stop, at-grade intersections with many of them intersecting at a skew angle. An Environmental Impact Statement was completed in December 2011 and proposes a 4-lane divided expressway between New Ulm and North Mankato. Other portions of USTH 14 are under construction or have already been converted to a 4-lane divided expressway to the east of North Mankato.

2.1.1 Implemented Safety Projects

MnDOT has implemented a number of low cost safety improvements along the USTH 14 corridor between New Ulm and North Mankato in recent years, including:

- Prior to 2006
 - Shoulder rumble strips (Figure 4)



Figure 4 - Shoulder (edgeline) and centerline rumble strips

- 2002 (Summer)
 - Flashing beacons on advance warning Intersection Ahead signs at USTH 14 & Minnesota Trunk Highway (MNTH) 111/County State Aid Highway (CSAH) 23 (Figure 5)
 - Red beacon (indicating stop) on MNTH 111/CSAH 23

- 2008 (Summer)
 - Installation of solar powered, LED enhanced two-way traffic sign @ RP 127.2 (Figure 6)

- 2009 (Summer)
 - Centerline Rumble Strips (Figure 4)
 - Intersection lighting at:
 - Nicollet CSAH 72
 - 451st Avenue
 - Nicollet CSAH 25
 - Nicollet CSAH 17
 - Nicollet CSAH 6
 - Township Road 125 (522nd Street)

- 2010 (Spring)
 - Dynamic Speed Display Signs (Figure 7)



Figure 5 - Flashing beacon at USTH 14 & MNTH 111/CSAH 23



Figure 6 - Two-way traffic sign

2.1.2 Programmed Improvement Projects

The present two-lane bridge over the Minnesota River in New Ulm is proposed to be replaced with a 4-lane section and raised in 2018.



Figure 7 - Dynamic speed display sign

2.2 Crash History

Crash data was gathered from 2006 to 2010 through the MnCMAT database. A complex breakout of crash data is in Appendix A – USTH 14: Mankato to New Ulm Road Safety Audit Briefing Book. In order to provide a comparison to other similar roadways, crashes along rural 2-lane highways throughout the state were also documented.

- The USTH 14 corridor from New Ulm to North Mankato has had 250 crashes from 2006 to 2010. When normalized for the volume of traffic traveling along the highway, the frequency of crashes results in a crash rate of 0.7 crashes per million vehicle miles traveled (MVM). This is consistent with statewide rural 2-lane highways and expressways (Figure 8).

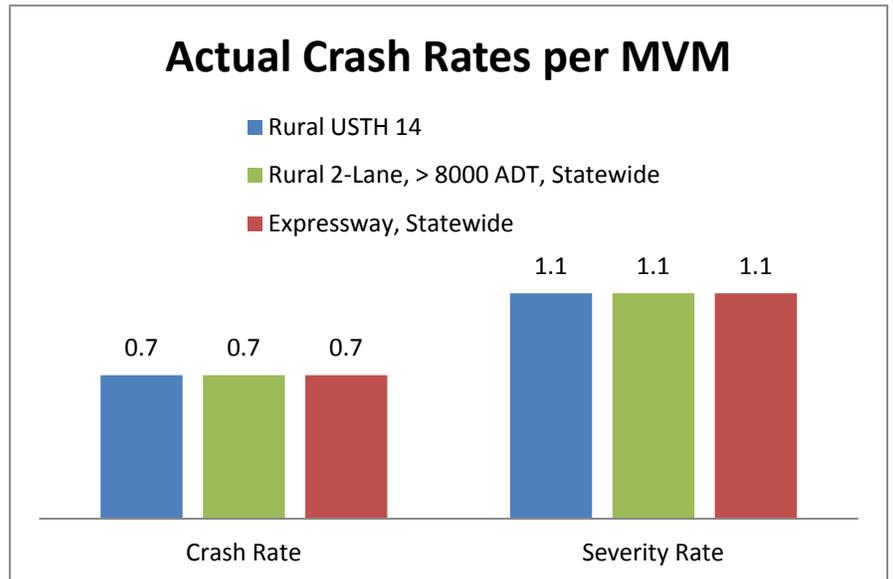


Figure 8 - Actual crash rates

- Of the total 250 crashes, 7 involved a fatality, 4 involved a serious injury and the remaining 239 involved either a minor injury or were classified as property damage only.
- The corridor severity rate is 1.1 MVM, which is also consistent with statewide rural 2-lane highways and expressways (Figure 8).

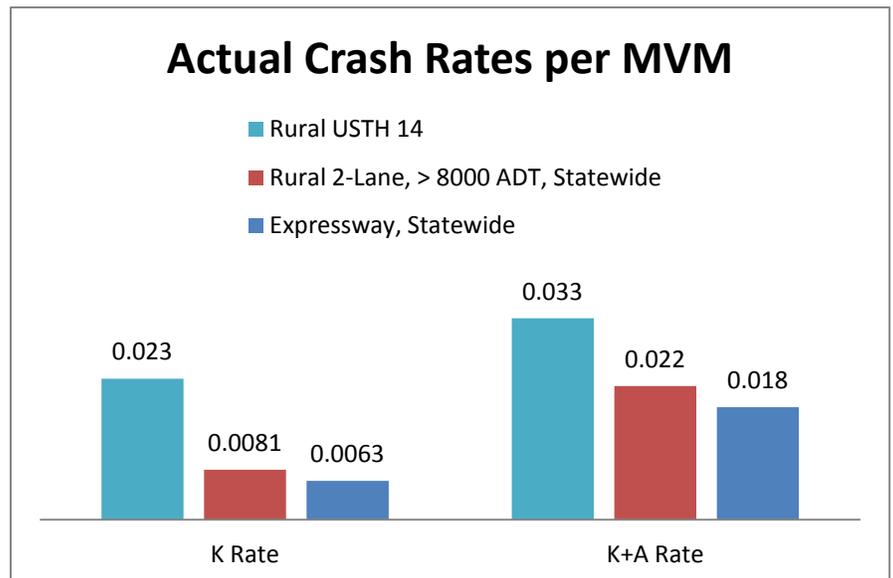


Figure 9 - Actual severe crash rates

- When the fatal (K) and severe injury rates (A) are removed and viewed independently from other crashes consistent with current practice in safety analysis, the rates are higher than the averages for comparable rural 2-lane highways and expressways.

The actual fatal crash rate along USTH 14 is 0.023 MVM compared to 0.0081 and 0.0063 MVM statewide. The actual fatal and severe injury rate combined is 0.033 MVM compared to 0.022 and 0.018 MVM statewide (Figure 9).

- The percentage of severe (K and A) crashes is 4.88% compared to statewide rural 2-lane percentage of 2.94% and expressway of 2.63%. This is nearly twice the expected amount of severe crashes (Figure 10).

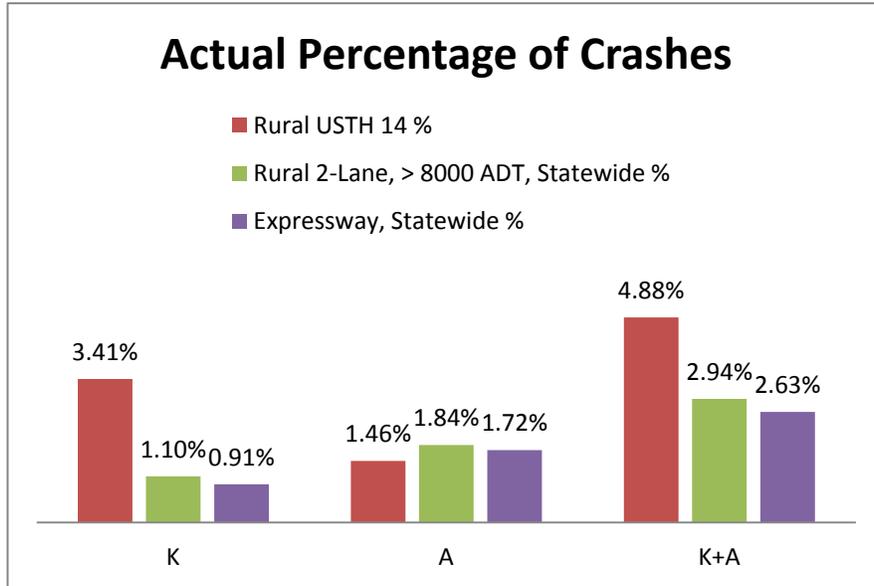


Figure 10 - Actual percentage of crashes

- The percentage of severe (K) crashes is three times the expected amount of severe crashes on rural 2-lane roads statewide.
- 70% of severe crashes along the USTH 14 corridor were classified as head on or sideswipe opposing. This is 3 times greater than the average on a typical rural 2-lane Minnesota road of which only 23% of severe crashes are typically head on or sideswipe opposing (Figure 11).

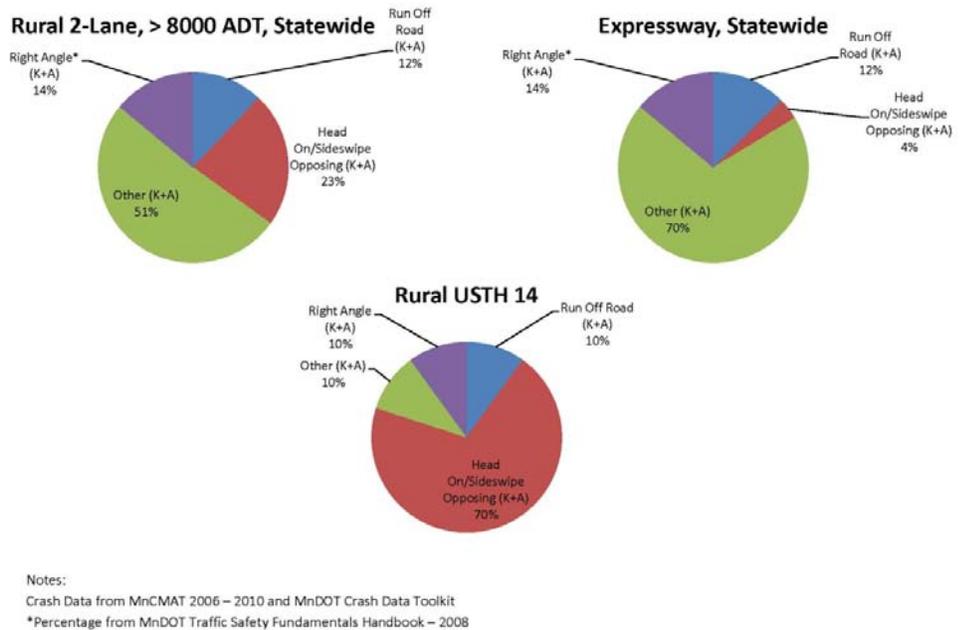


Figure 11 - Actual crash type comparison (K+A)

Based on the data analysis and comparisons, the following conclusions can be made about the USTH 14 corridor between New Ulm and North Mankato:

- 1.) The overall crash rate on this segment of USTH 14 is 0.7 crashes per million vehicle miles. This is almost identical to crash rates on rural 2-lane roadways and expressways throughout the state of Minnesota. The actual total number of crashes and rate of crashes is equal to the expected values.
- 2.) The overall severe crash rate (K+A) is 0.033 crashes per million vehicle miles and this is 1.5 times more than what would be expected on similar rural 2-lane roads and expressways.
- 3.) The number and rate of severe crashes is between 50% and 85% higher than on comparable roadways.
- 4.) The fatal crash rate (K) is 0.023 crashes per million vehicle miles and this is 2.9 times more than what would be expected on similar rural 2-lane roads and expressways.
- 5.) The most frequent type of severe crash is a head on/sideswipe opposing crash. The number of these severe head on/sideswipe opposing crashes is three times greater than what is expected based on the experience of other high volume 2-lane roads in Minnesota.

A variety of characteristics of the crashes along this segment of USTH 14 were analyzed including time of year, day of week, time of day, driver age and gender.

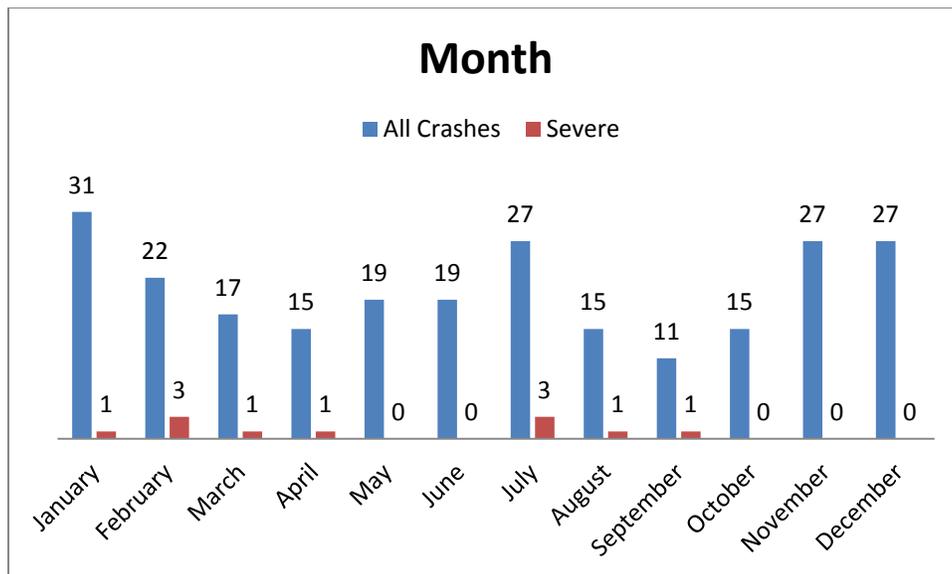


Figure 12 - Crashes by month

Figure 12 is a breakout of months in which crashes occurred along the corridor. For the study area, overall crashes were highest during the winter months, but the most frequent severe crashes were equally distributed between February and July.

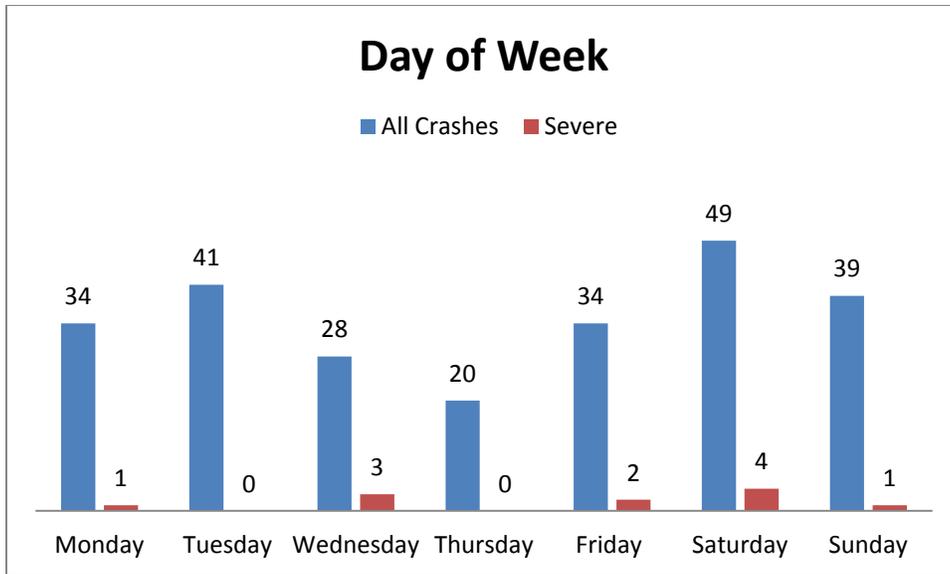


Figure 13 - Crashes by day of week

Figure 13 is a breakout of crashes by day of the week. Over 60% of the severe crashes occur on Friday, Saturday and Sunday. The data is consistent with statewide data in that most severe crashes occur on Fridays, Saturdays or Sundays and the total crashes are more evenly distributed across the week.

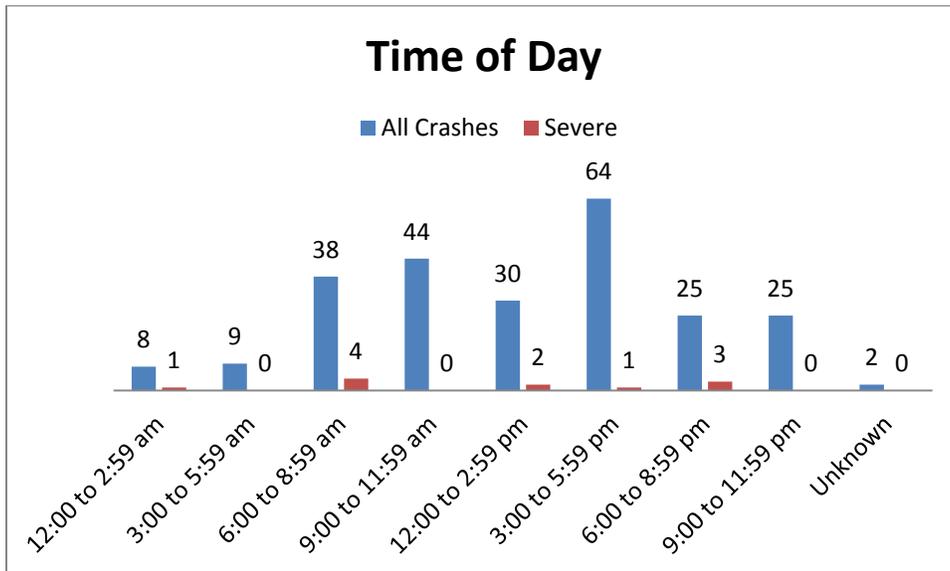


Figure 14 - Crashes by time

Figure 14 shows the time of day the crashes along the USTH 14 occurred. More severe crashes occurred between 6:00 to 8:59 am; however, far more crashes occurred from 3:00-5:59 pm--a timeframe when work related trips and total traffic volume peak. Most recent 2009 statewide data shows crashes were concentrated in the afternoon time frame with 43% of all crashes occurring between 12 and 6 pm. The USTH 14 data is consistent with the statewide data.

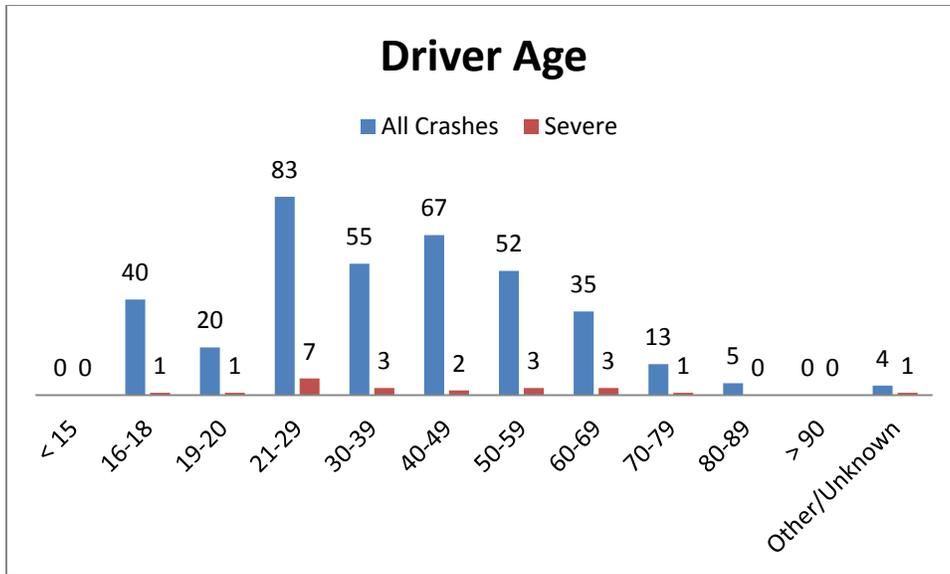


Figure 15 - Crashes by driver age

Figure 15 shows the ages of all drivers involved in a crash along the USTH 14 corridor. Driver age and experience historically plays a role in the number of crashes those individuals are involved in. There is an increase among crashes involving drivers in the 21 to 29 age range along the corridor, including a peak in severe crashes. This data is consistent with 2009 statewide data in which drivers aged 15 to 24 accounted for 26.0% of all crashes. The data also indicates that more vulnerable age groups, young and elderly drivers, are not overrepresented in the data.

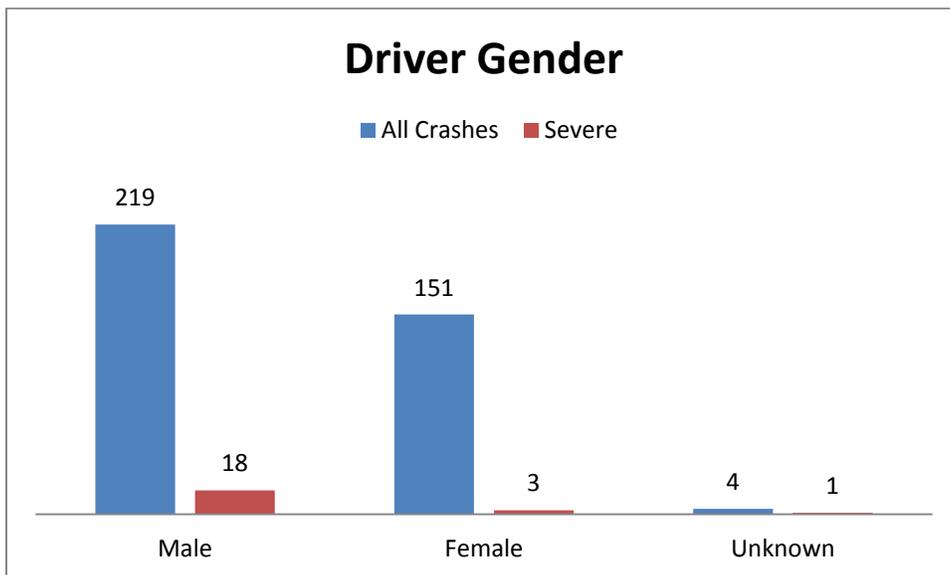


Figure 16 - Crashes by driver gender

Figure 16 shows the gender of all drivers involved in a crash along the USTH 14 corridor. A majority of the crashes along the corridor involved male drivers, with more male drivers involved in severe crashes.

In 2009, 56.2% of drivers in all crashes and 73.4% in fatal crashes were male. The USTH 14 crashes are consistent with the statewide distribution.

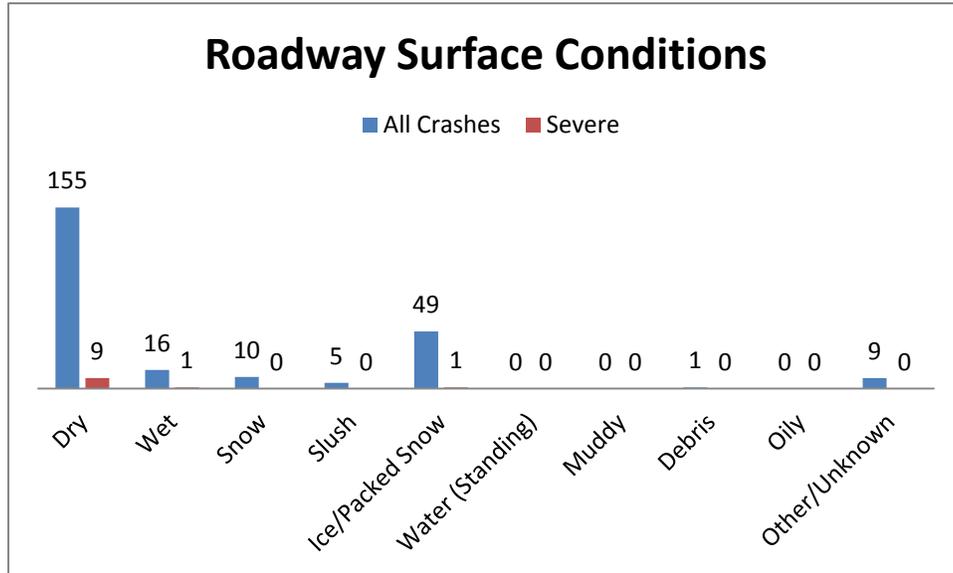


Figure 17 - Crashes by roadway surface condition

Figure 17 shows the roadway surface condition of all crashes along the USTH 14 corridor. 9 of the 11 severe occurred under dry conditions.

There appear to be no unusual trends in terms of driver age, weather/surface conditions, time of day, etc. The USTH 14 crash data is consistent with statewide/expected data.

2.3 Intersections

Out of 250 total crashes along the USTH 14 corridor, 93 of those crashes were intersection related. Six out of the 11 severe crashes in the corridor were intersection related (Note – segment and intersection crashes were collected separately and overlap in some locations). Critical crash rates were used as a basis to determine which intersections along the corridor to focus on for short-term, low cost solutions. The critical crash rate accounts for the design of the facility, type of intersection control, amount of exposure and the random nature of crashes and is considered to be the best technique for identifying hazardous locations.

There are a total of 47 intersections with public roads between New Ulm and North Mankato. Fifteen of the intersections had no crashes from 2006 to 2010 and 40 of the 47 intersections averaged less than one crash per year. All of these were eliminated from further review by the RSAR team. There were 5 intersections with crash rates equal to or over the critical crash rate (highlighted in red, Figure 18). These were the intersections the RSAR team focused on during the field review.

Intersection Comparison

Intersecting Roadway	Configuration	Entering ADT	Total Crashes*	Crashes per Year	Crash Rate	Expected Rate	Critical Rate	Crash Cost	Rear End/Sideswipe	Angle/Turning	Run Off Road	Head On	K	A	B	C	PD	
1	MNTH 15	X Rural	9640	36	7.2	2.0	0.4	0.7	\$ 1,639,000.00	3	15	6	4	0	0	4	9	23
2	CSAH 21	X Rural	5965	1	0.2	0.1	0.4	0.8	\$ 91,000.00	0	0	1	0	0	0	0	1	0
3	446th St	T Rural	5754	0	0	0.0	0.4	0.8	\$ -	0	0	0	0	0	0	0	0	0
4	CSAH 37	X Rural	9700	12	2.4	0.7	0.4	0.7	\$ 629,000.00	0	7	1	3	0	0	2	3	7
5	171st Ave	T Rural	8027	3	0.6	0.2	0.4	0.7	\$ 115,000.00	1	1	1	0	0	0	0	1	2
6	Hillcrest Lane	T Rural	8027	4	0.8	0.3	0.4	0.7	\$ 1,063,000.00	2	0	1	0	1	0	1	1	1
7	561st Ave	T Rural	8027	5	1	0.3	0.4	0.7	\$ 139,000.00	1	2	1	0	0	0	0	1	4
8	551st Ave	T Rural	8027	2	0.4	0.1	0.4	0.7	\$ 148,000.00	0	0	0	2	0	0	1	0	1
9	547th Lane	X Rural	8027	0	0	0.0	0.4	0.7	\$ -	0	0	0	0	0	0	0	0	0
10	Unknown Rd 3 W of CSAH 12	X Rural	8185	2	0.4	0.1	0.4	0.7	\$ 24,000.00	2	0	0	0	0	0	0	0	2
11	Unknown Rd 2 W of CSAH 12	X Rural	8185	0	0	0.0	0.4	0.7	\$ -	0	0	0	0	0	0	0	0	0
12	Unknown Rd W of CSAH 12	X Rural	8185	0	0	0.0	0.4	0.7	\$ -	0	0	0	0	0	0	0	0	0
13	CSAH 12	X Urban	7895	2	0.4	0.1	0.3	0.6	\$ 24,000.00	1	0	0	1	0	0	0	0	2
14	Red Shoe Dr	X Urban	7485	2	0.4	0.1	0.3	0.6	\$ 103,000.00	2	0	0	0	0	0	0	1	1
15	Ski-Doo Dr	X Urban	7485	0	0	0.0	0.3	0.6	\$ -	0	0	0	0	0	0	0	0	0
16	5th St	T Urban	7485	0	0	0.0	0.3	0.6	\$ -	0	0	0	0	0	0	0	0	0
17	4th St	X Urban	8260	9	1.8	0.6	0.3	0.6	\$ 632,000.00	5	2	0	0	0	1	1	0	7
18	3rd St	X Urban	7469	3	0.6	0.2	0.3	0.6	\$ 115,000.00	3	0	0	0	0	0	0	1	2
19	2nd St	X Urban	7469	1	0.2	0.1	0.3	0.6	\$ 12,000.00	0	1	0	0	0	0	0	0	1
20	1st St	T Urban	7469	1	0.2	0.1	0.3	0.6	\$ 12,000.00	0	0	0	0	0	0	0	0	1
21	Fiemeyer Dr (W end)	X Urban	7285	1	0.2	0.1	0.3	0.6	\$ 12,000.00	0	0	0	0	0	0	0	0	1
22	Fiemeyer Dr (E end)	X Urban	7285	0	0	0.0	0.3	0.6	\$ -	0	0	0	0	0	0	0	0	0
23	531st Ave	X Urban	7285	0	0	0.0	0.3	0.6	\$ -	0	0	0	0	0	0	0	0	0
24	CSAH 25	X Rural	7295	1	0.2	0.1	0.4	0.7	\$ 136,000.00	0	0	0	1	0	0	1	0	0
25	CSAH 21	X Rural	7215	3	0.6	0.2	0.4	0.7	\$ 273,000.00	2	0	1	0	0	0	0	3	0
26	503rd Ave	X Rural	7154	0	0	0.0	0.4	0.7	\$ -	0	0	0	0	0	0	0	0	0
27	491st Ave	T Rural	7127	0	0	0.0	0.4	0.7	\$ -	0	0	0	0	0	0	0	0	0
28	481st Ave	X Rural	7127	0	0	0.0	0.4	0.7	\$ -	0	0	0	0	0	0	0	0	0
29	471st Ave	X Rural	7154	0	0	0.0	0.4	0.7	\$ -	0	0	0	0	0	0	0	0	0
30	MNTH 99	X Urban	7250	15	3	1.1	0.3	0.6	\$ 1,319,000.00	5	2	5	0	1	0	2	1	11
31	MNTH 111/CSAH 23	X Urban	8675	12	2.4	0.8	0.3	0.6	\$ 674,000.00	3	7	0	0	0	0	3	2	7
32	Pine St	X Urban	7185	1	0.2	0.1	0.3	0.6	\$ 12,000.00	1	0	0	0	0	0	0	0	1
33	Elm Street	X Urban	7595	1	0.2	0.1	0.3	0.6	\$ 12,000.00	1	0	0	0	0	0	0	0	1
34	CSAH 42	T Rural	7275	1	0.2	0.1	0.4	0.7	\$ 136,000.00	0	1	0	0	0	0	1	0	0
35	Unknown Street N of 451st Ave	X Rural	7054	0	0	0.0	0.4	0.7	\$ -	0	0	0	0	0	0	0	0	0
36	451st Ave	T Rural	7054	0	0	0.0	0.4	0.7	\$ -	0	0	0	0	0	0	0	0	0
37	478th St	X Rural	7054	0	0	0.0	0.4	0.7	\$ -	0	0	0	0	0	0	0	0	0
38	490th St	X Rural	7054	3	0.6	0.2	0.4	0.7	\$ 115,000.00	1	0	1	0	0	0	0	1	2
39	431st Ave	X Rural	7027	1	0.2	0.1	0.4	0.7	\$ 136,000.00	0	0	0	0	0	0	1	0	0
40	CSAH 25	X Rural	7233	2	0.4	0.2	0.4	0.7	\$ 148,000.00	1	0	1	0	0	0	1	0	1
41	Unknown Street S of CSAH 25	T Rural	7027	1	0.2	0.1	0.4	0.7	\$ 91,000.00	0	0	1	0	0	0	0	1	0
42	CSAH 17	X Rural	8068	2	0.4	0.1	0.4	0.7	\$ 24,000.00	0	0	1	1	0	0	0	0	2
43	510th Street	X Rural	8854	1	0.2	0.1	0.4	0.7	\$ 824,000.00	0	0	0	1	1	0	0	0	0
44	CSAH 6	T Rural	9495	3	0.6	0.2	0.4	0.7	\$ 848,000.00	1	2	0	0	1	0	0	0	2
45	409th Ave	T Rural	8854	1	0.2	0.1	0.4	0.7	\$ 12,000.00	0	0	0	0	0	0	0	0	1
46	522nd St	X Rural	8827	2	0.4	0.1	0.4	0.7	\$ 915,000.00	0	0	0	1	1	0	0	1	0
47	CSAH 41	T Rural	9610	4	0.8	0.2	0.4	0.7	\$ 48,000.00	2	0	1	0	0	0	0	0	4
Intersection Totals			362877	138	27.6	0.2	0.4	0.4	\$ 10,481,000.00	37	40	22	14	5	1	18	27	87

Notes:
 Crash Data from MnCMAT 2006-2010
 Expected Crash Data from MnCMAT District 7, 2006-2010, 2-lane undivided intersections
 Expected Crash Rates and State/Regional Ranks from MnDOT Crash Data Toolkit 2010
 Expected/Critical Crash Rates are for MnDOT District 7
 *Segment and intersection crashes were collected separately and overlap in some locations

Figure 18 – Intersection Crashes



2.4 Behavioral Issues

Crash data for the two-lane segment of Highway 14 from New Ulm to North Mankato indicate that driving over the centerline, driver distraction, and failure to yield are the primary behavioral factors associated with crashes (Figure 19). Based on identified primary contributing factors, 27% of severe crashes along USTH 14 involved a vehicle driving over the centerline and this is approximately twice what would be expected based on statewide averages (Figure 20). Eighteen percent of severe crashes involved a distracted driver, but this is approximately equal to what would be expected based on statewide averages (Figure 20). Two other points stand out regarding the characteristics associated with the severe crashes along USTH 14. First, speed was cited as a factor in nine percent of the severe crashes and this is considerably lower than the statewide average of twenty-one percent. Second, there appears to be a lack of seat belt use in 36% of the serious crashes which is a critical factor in the resulting occupant fatalities and serious injuries.

Research indicates that motorists are 6 times more likely to need hospital care if unbelted in a crash. Statewide, Minnesota’s seatbelt use rate is 92.7 percent. Regionally, south central Minnesota, including Nicollet County, seatbelt usage is 73.2 percent--significantly lower than the statewide average.

Annually, nearly 75 percent of unbelted traffic deaths occur on Greater Minnesota roads. Minnesotans that are least likely to buckle up and more likely to be killed in crashes are young drivers, particularly males and residents in Greater Minnesota. Each year, motorists ages 15–29 account for about 40 percent of all unbelted deaths and 50 percent of all unbelted serious injuries — yet this group

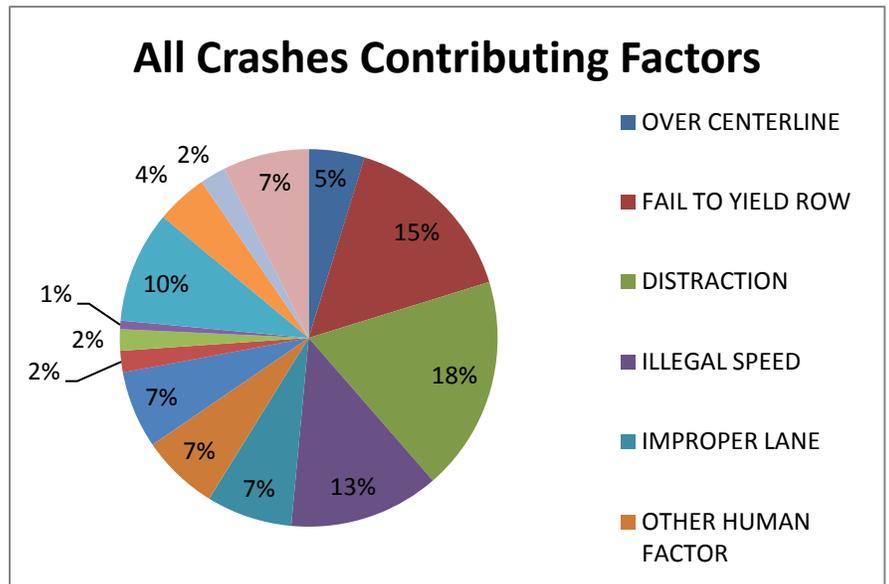


Figure 19 - All crashes contributing factors on USTH 14

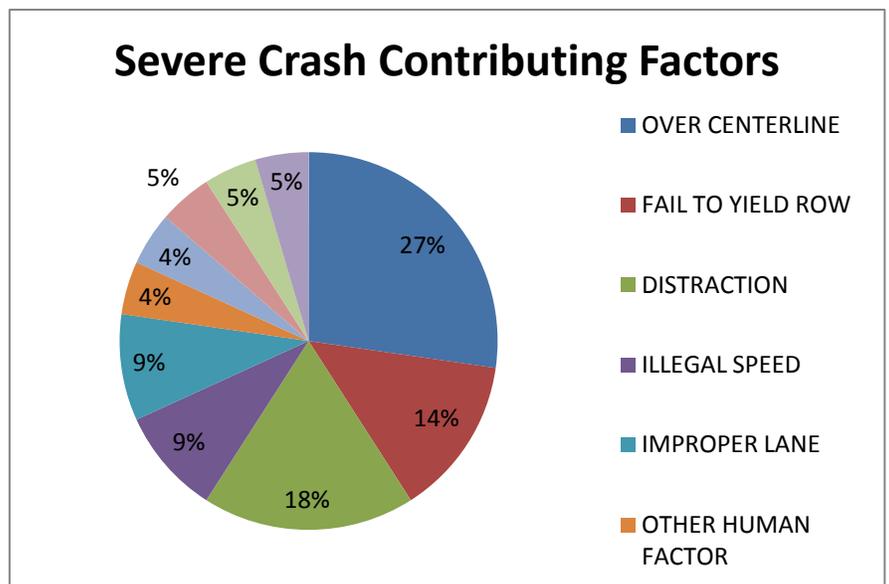


Figure 20 - Severe crashes contributing factors on USTH 14

represents only 24 percent of all licensed drivers. Similarly, crash data for the TH 14 safety audit reflects motorists ages 16—29 account for 41 percent of severe crashes. Males were 5 times more likely to be fatally or severely injured.

2.5 Traffic Volumes

It was suggested that traffic volumes are increasing along the corridor to a point where a 2-lane, undivided roadway may not provide a reasonable quality of traffic operations, especially for future volumes.

Traffic volume information for USTH 14 was obtained from MnDOT volume maps from 2007, 2009 and 2011. Existing traffic volumes along the corridor average 7,200 vehicles per day with 12.6% percent heavy vehicle traffic.

For comparison, Interstate 90 runs east/west across Minnesota, south of USTH 14 and in 2009 had existing traffic volumes ranging from 7,600 to 8,800 (average) vehicles per day in Faribault County. In 2005, approximately 22.5% of the vehicles along Interstate 90 were heavy commercial vehicles.

Historic traffic volumes demonstrate an increasing trend in the traffic along USTH 14 between New Ulm and North Mankato. Between 2009 and 2011, traffic volumes along USTH 14, as well as throughout the state, have been flat. While this trend is expected to be temporary, future growth is expected to be modest. Figure 21 displays historic USTH 14 average daily traffic (ADT) volumes and heavy commercial ADT along with traffic projections using different methods. One method calculated a linear projection based on extrapolating existing historic traffic volumes. This resulted in a 1.43 percent annual increase in traffic and a 2029 traffic forecast of 9,550 ADT. Another method takes the last known traffic data and multiplies by a documented projection factor (1.6 for Nicollet County, 2011 State Aid Traffic Projection Factor) to obtain a traffic forecast 20 years into the future of 11,580 ADT (2029). The FEIS was calculated when growth was increasing and predicted a 2029 traffic volume of 12,120 ADT. The recent flat growth on the corridor would likely lower the FEIS 2029 ADT projection.

Average Nicollet County USTH 14 ADT

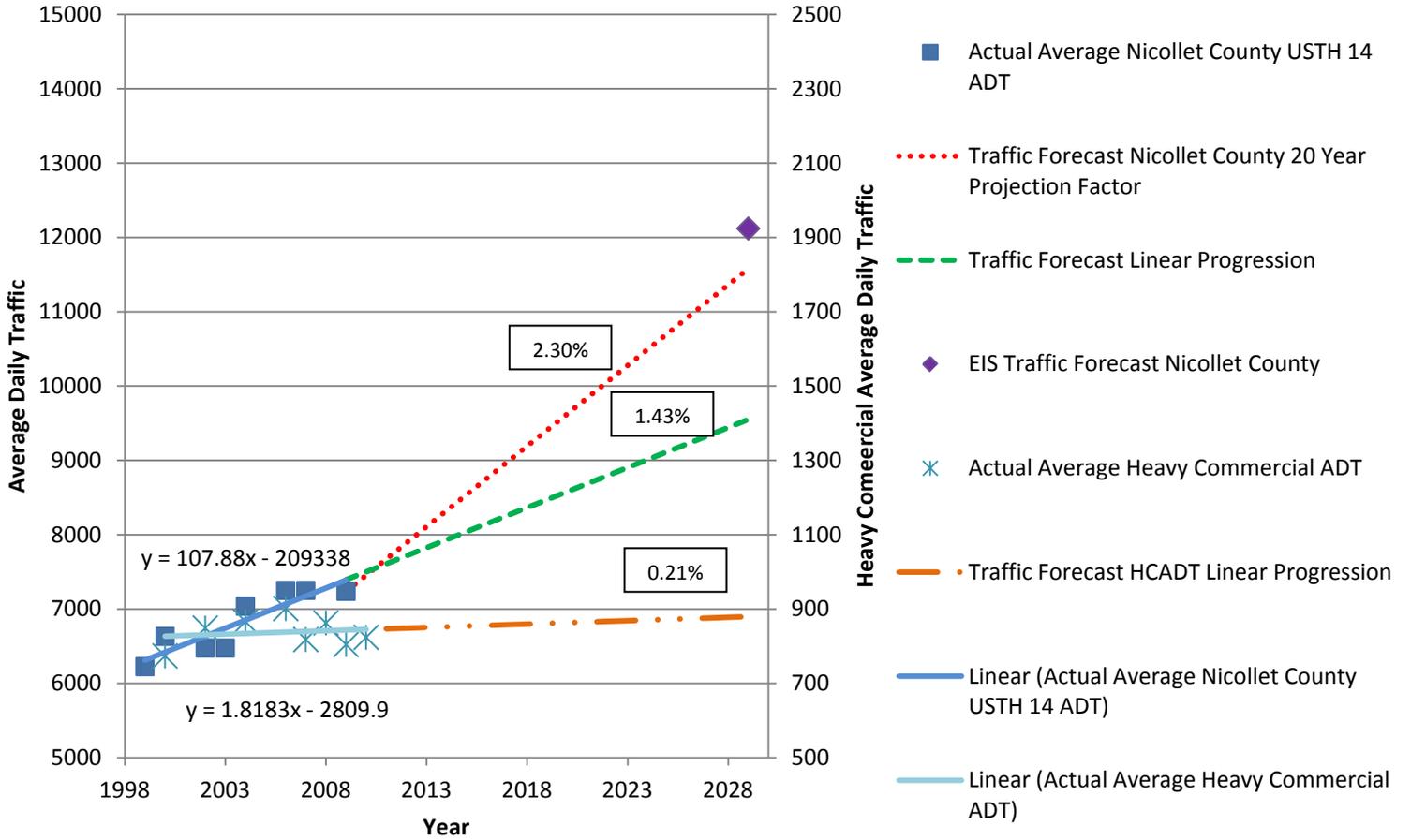


Figure 21 - Historic/forecast daily traffic volumes

A traditional operational performance measure for roadways is level of service. A letter, A through F, is assigned to a roadway or intersection based on performance, with A being the best (no congestion) and F being the worst (gridlock). MnDOT has not formally adopted any performance measure for operations of 2-lane rural roadways. However, a mid level of service C has been used in some studies since it represents a condition with moderate levels of congestion during peak traffic periods, but with little or no congestion during the remainder of the day.

Using the current ADT, capacity assumptions and peak hour percentages, the existing roadway is likely operating near the level of service A/B boundary. During peak hours, the existing roadway operates at a level of service C. In the future, the forecasts show that, without any improvements, the roadway will likely operate in the level of service C/D range which would be considered poor roadway operations, especially in greater Minnesota. Should the roadway be converted to 4-lane expressway with turn lanes, the roadway would likely operate near the level of service A/B boundary under future traffic forecasts. Figure 22 demonstrates how the level of service of each type of roadway is affected by ADT based on capacity assumptions.

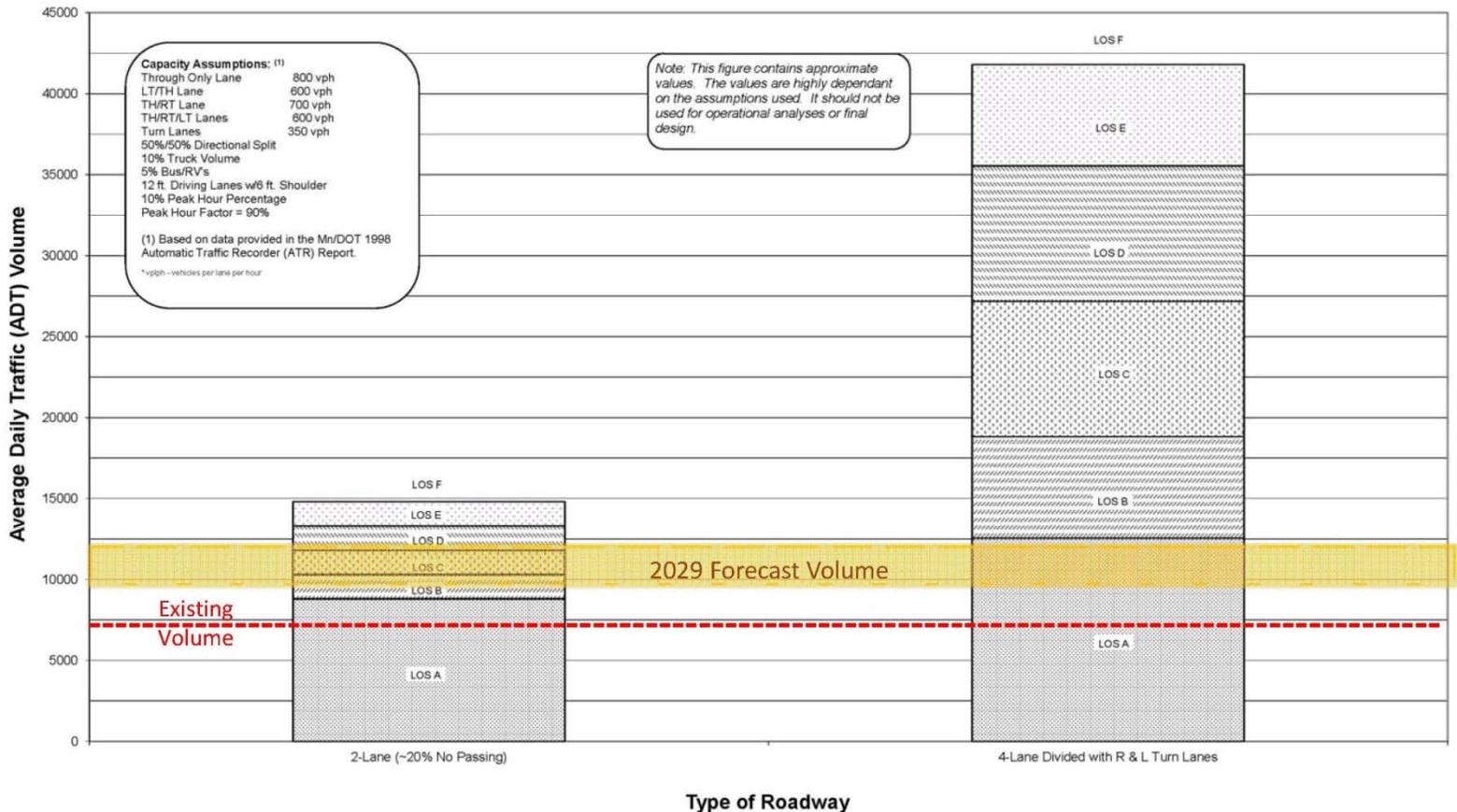


Figure 22 - Estimated daily level of service

2.6 Heavy Commercial (HC) Traffic

It was suggested that large increases in heavy commercial vehicles are contributing to and are overrepresented in crashes along USTH 14.

The heavy commercial vehicle traffic from 2000 to 2010 along USTH 14 has increased at an annual rate of 0.21% per year. However, contrary to public perception, the rate of increase is significantly less than the projected increase for all traffic along USTH 14 (1.43% per year). Using linear projection equations to predict future traffic along the corridor, all traffic is increasing at a rate almost 7 times faster than the heavy commercial vehicle traffic. Figure 20 demonstrates how all traffic is increasing at a steeper rate than the heavy vehicle traffic along the corridor.

According to MnDOT the heavy commercial vehicle traffic along the corridor accounts for 12.6% of the daily traffic volumes, whereas the statewide rural average is 8.9%. However, in the crashes along USTH 14 occurring between 2006 and 2010, heavy commercial vehicles are underrepresented with only 9% (35 out of 374 vehicles) involved in a crash (Figure 23). Of the 35 heavy commercial vehicles involved in crashes, 57% (20 heavy vehicles) were in a crash involving 2 vehicles. Of the crashes involving heavy vehicles and 3 vehicles, one crash had all 3 heavy vehicles involved and another crash had 2 heavy vehicles involved with one other vehicle type (Figure 24).

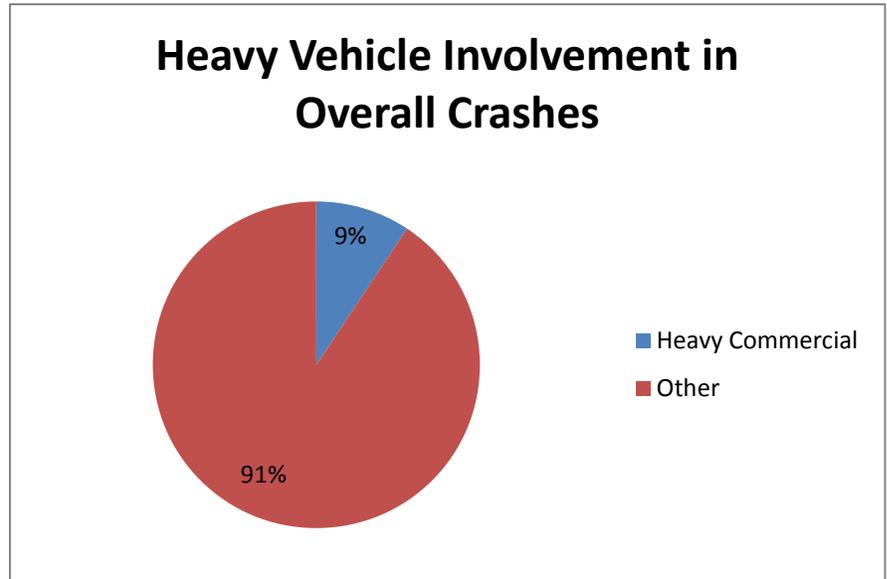


Figure 23 - All crashes vehicle type

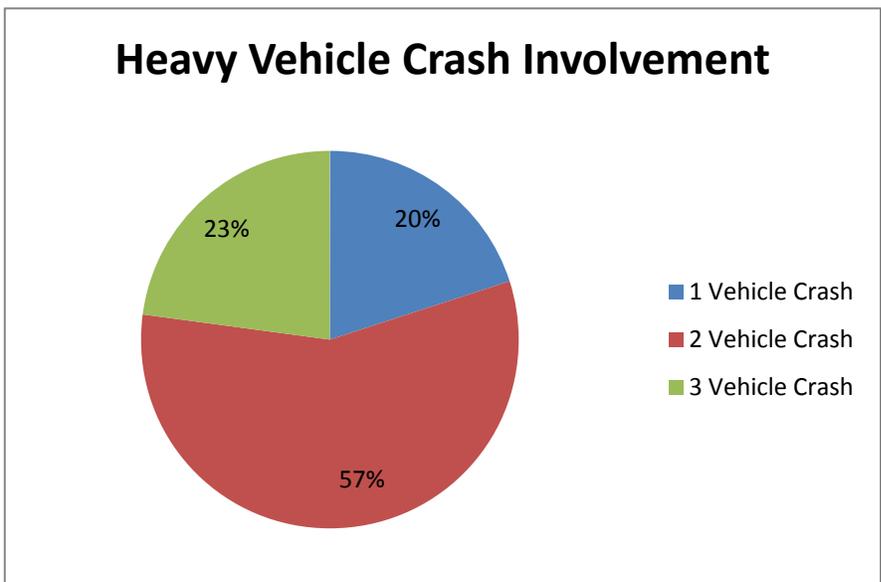


Figure 24 - Type of crash and total number of heavy vehicles involved

Heavy commercial vehicles were involved in 18% (4 out of 22 vehicles) of the severe crashes along USTH 14 from 2006 to 2010 (Figure 25). This is approximately twice the involvement rate for heavy vehicles compared to statewide averages, but caution is advised because this difference may not be statistically significant due to the relatively small number of severe crashes along USTH 14.

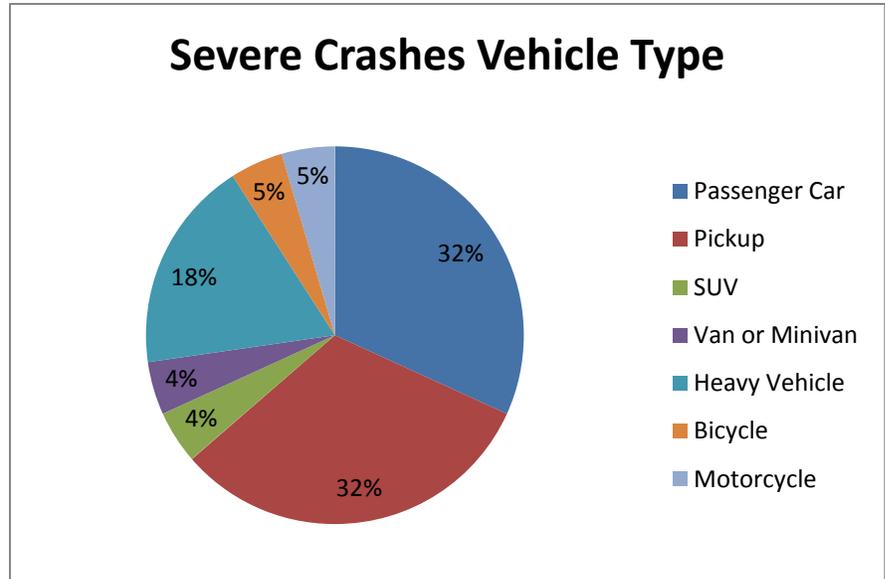


Figure 25 - Severe crashes vehicle type

2.7 Vehicle Speed Profiles

MnDOT District 7 performed two speed studies along the corridor in 2010 to document speed profiles. The 85th percentile speed is the speed at which 85 percent of the traffic is traveling at or below in free flowing conditions and is considered to be the primary performance measure for determining recommended speed limits.

The first study documented the speed profile along USTH 14 between Nicollet and North Mankato. The study found the 85th percentile speed through this segment of the corridor was consistent between 61 and 65 MPH. The speed study concluded the dynamic speed display signs (your speed is XX) installed along the corridor, in an attempt to reduce roadway speeds, only temporarily improved compliance and that the effects of the signs diminished with distance; it appears that there was no effect when drivers were less than 1 mile from the sign.

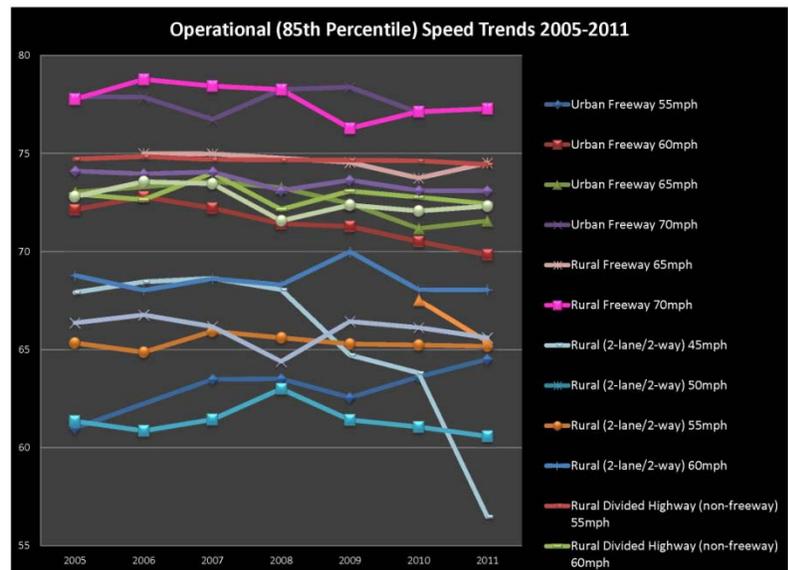


Figure 26 - Speed trends on Minnesota roadways

The second study observed speeds through the City of Courtland where the speed limit is reduced from 55 MPH to 35 MPH. The study showed the 85th percentile speeds in this area to vary from 1 to 6 MPH over the posted speed limit.

The speeds along USTH 14 are not different than speeds on similar rural 2-lane roadways. Speed studies on rural 2-lane roadways in Minnesota with posted 55 MPH speed limits determined an average 85th percentile speed of 65.2 MPH (Figure 26). Similarly, on a rural divided highway with a 65 MPH speed limit, the average 85th percentile speed is 74.5 MPH, 9.5 MPH over the posted speed limit.

3.0 Field Review Observations

Following the MnDOT District 7 meeting, the RSAR team conducted a field review of the corridor. The key observations of the team are documented in the following paragraphs.

3.1 Segments

3.1.1 Road Geometry

The RSAR team reviewed the existing roadway geometry throughout the corridor. The corridor consists of:

- 12 foot lane widths
- At least 8 foot paved shoulder widths (10' typical)
- Adequate clear zone outside of travel lanes
- Good horizontal alignment – no sharp curves
- Good vertical alignment – no steep grades
- Reasonable passing opportunities
 - 22.6% no passing from USTH 15 to Courtland
 - 39.4% no passing from Courtland to Nicollet
 - 20.8% no passing from Nicollet to North Mankato

3.1.2 Field Access

The team noted multiple field access for farmers throughout the corridor (Figure 27). From observations, it appeared that many fields and residences had more than one access point along USTH 14.



Figure 27 - Field access along USTH 14

3.1.3 Urban Geometry

When approaching urban areas along USTH 14, the 2-lane roadway does not significantly change and the visual cues do not strongly represent a change in the roadway from rural to urban, including signing, street lighting and roadway cross-section. Through the City of Courtland, the existing USTH 14 cross-section is two, 12-foot lanes with 8-foot paved outside shoulders and curb and gutter on each side (Figure 28). At the time the RSAR team was present (approximately 2:30 PM), very few of the on street parking spaces were in use.



Figure 28 - On street parking through Courtland

3.2 Intersections

3.2.1 Skewed Angle Intersections

The segment of USTH 14 from the City of Nicollet to North Mankato runs on a diagonal to southeast/northwest. This alignment causes many of the intersecting roads that run east/west or north/south to cross USTH 14 at a skewed angle. The RSAR team noted that, in general, intersections at skewed angles tend to have higher crash rates than those that intersect at a perpendicular angle. The skewed angle makes it more difficult for drivers on the minor road approaches to view oncoming highway traffic as they must look over their shoulder to see behind them.

3.2.2 Signs and Pavement Markings

The RSAR team noted a few locations where signing and marking could be updated at intersections, such as larger stop signs to grab drivers' attention or adjusting stop bar locations and skews (Figure 29).



Figure 29 – Stop sign at CSAH 37 and USTH 14

3.2.3 Systemic Evaluation of Nicollet County

A review of the Nicollet County roadway system is currently underway as part of MnDOT's County Roadway Safety Plans project and preliminary results identify a number of county intersections with USTH 14 as high priority candidates for safety project implementation based on a systemic risk assessment.

The systemic assessment considers intersection characteristics that have been observed to be overrepresented at intersections with severe crashes. Risk factors include skew, on/near a curve, nearby development, railroad crossings and locations of previous stop signs along the roadway and total crashes. Based on these factors, the county road intersections are ranked from highest risk to lowest.

USTH 14 intersections with CSAH 17, CSAH 37, CSAH 21 and CSAH 25 are all within the top 25 county ranked intersections. While this is not a full snapshot of the USTH 14 corridor, it demonstrates and confirms that USTH 14 is a high priority corridor in terms of crashes and some of the suggested projects through the County Road Safety Plan project could be considered for the corridor.

4.0 Potential Improvement Strategies

4.1 Segments

The key segment related issue is the large number of severe crashes associated with vehicles crossing the centerline and being involved in head on crashes, the majority occurring on the segment from North Mankato to Nicollet. This is particularly troubling given that MnDOT has already installed centerline rumble strips (in 2009) and that centerline rumble strips are considered to be a proven effective safety strategy. Given that these severe crashes continue to occur, the RSAR team suggests that District 7 consider the feasibility of widening or reconstructing the cross section of USTH 14 in order to provide a buffer area between opposing traffic lanes.

Techniques that involve widening and/or reconstructing the cross-section include:

- Providing a 4-foot wide buffer area
- Providing a 12-foot wide buffer area
- Building a 2+1 road
- Building a 4-lane divided expressway

If the roadway is not reconstructed and the existing cross section is used to widen the space between opposing traffic, a thick mill and overlay will be required given the inability of the existing shoulder to accommodate heavy traffic for all techniques except the expressway. The overlay option for the 4-foot buffer (described in 4.1.1), 12-foot buffer (4.1.2) and the 2+1 road technique (4.1.3) will require a design variance as the shoulder widths would not meet MnDOT standards (Road Design Manual). Additional techniques do not widen the cross-section, but may assist drivers in selecting appropriate driving speeds and may reduce weather related conditions on the roadway.

These techniques include:

- Lighting
- Corridor Speed Study
- Living Snow Fence

Suggested implementation locations throughout the corridor are discussed in section 5.3.

4.1.1 Four-Foot Buffer

This technique involves widening the roadway in order to create a four-foot wide buffer area (with rumble strips) between the opposing lanes (Figure 30). This technique does not provide a physical barrier to separate the lanes; it merely provides some additional space so that an errant vehicle has some room to recover before entering the opposing lane. This technique has been tried in a number of places, including the USTH 12 bypass of Long Lake; however, no crash reduction factor has been developed. It should



Figure 30 - Four-foot buffer with rumble strips

be noted that in the five years since USTH 12 was constructed, there has only been 1 head on crash, likely due to driver confusion due to the adjacent railroad making the roadway appear to be a 4-lane divided roadway.

This technique would not require complete reconstruction of USTH 14. It could be accomplished with an overlay and a slight narrowing (one foot) of the existing lanes and shoulders.

4.1.2 Twelve-Foot Buffer

This technique also involves widening the existing roadway in order to create a twelve-foot wide buffer between the opposing lanes. As with the previous technique, there is no barrier to prevent errant vehicles from entering the opposing lane, the buffer merely provides a recovery space (Figure 31). In areas with no intersections, the center twelve feet is marked out with paint and in the vicinity of intersections, the markings transition into left turn lanes.

This technique addresses head on crashes two ways; first by providing the buffer and second by the fact that passing maneuvers are prohibited. This twelve-foot buffer with painted left turn lanes has been tried in a number of places, including MNTH 5 in Lake Elmo. No crash reduction factor has been developed however; the project in Lake Elmo resulted in a 100% reduction in head on crashes and a 56% reduction in rear end and sideswipe crashes (which happens to be the most frequent type of crash along USTH 14).



Figure 31 - Twelve-foot buffer with rumble strips

This technique could involve either total reconstruction or an overlay with the reallocation of the pavement with narrowing of both the lanes and shoulders.

This technique has one additional benefit in that it could be extended through the urban areas of Courtland and Nicollet. In typical urban applications, the three-lane cross section has been proven effective at reducing crashes and vehicle speeds.

4.1.3 2+1 Road

This technique places 2 full lanes in one direction and 1 in the other with a median separation of 4-feet in which cable barrier can be placed to prevent vehicles from crossing over to oncoming lanes (Figure 32). This layout allows for vehicles to pass throughout the corridor as the direction of the 2+1 alternates between travel directions, typically at one to two mile intervals. This technique has been used in Europe and has been found to virtually eliminate head on crashes since it restricts passing to the 2-lane sections and adds cable barrier to prevent crossover vehicles. The Crash Modification Factors (CMF) Clearinghouse, which determines the long-term expected reduction in crashes based on study sites, does not have a CMF for a 2+1 Road, 4-foot buffer (4.1.1) or 12-foot buffer (4.1.2) technique at this time.



Figure 32 – 2+1 road

4.1.4 Four-Lane Expressway

Converting two-lane USTH 14 to a four-lane divided expressway would substantially reduce the head on crashes. The forty- to sixty-foot depressed median has proved to be a sufficient buffer to catch errant vehicles in almost all cases. It should be noted, however, that the average fatal crash rate and severe injury crash rate are identical for both two-lane highways and expressways. This indicates that while expressways may be effective at reducing severe head on crashes, they are subject to an increase in other types of severe crashes, namely right angle crashes at the at-grade intersections. This points to the need to consider more strictly managing access at expressway intersections as well as considering alternate intersection treatments such as three-quarter intersections, indirect turns (both described in section 4.2.1), or right in-right out access.

Converting two-lane USTH 14 to a four-lane expressway between New Ulm and North Mankato is MnDOT's stated goal, however this expansion is not in MnDOT's 20 Year Plan due to funding constraints. Given these constraints, converting the entire 25 mile segment to an expressway is not considered to be a feasible short term solution, especially when much of the roadway west of Nicollet is on new alignment (bypasses of Nicollet and Courtland). However, most of the future expressway between Nicollet and North Mankato is on the present alignment and less expensive than acquiring new right of way. This segment is where 20% of the head on crashes and over 50% of severe crashes occur.

4.1.4 Lighting

Illumination aids drivers by providing light beyond vehicle lighting to help delineate the roadway and see other vehicles and/or pedestrians. The installation of continuous street lighting at specific locations throughout the corridor (page 41) would benefit drivers by allowing for better nighttime visibility of potential hazards and would help define segments of USTH 14 as urban or rural in an effort to manage speed throughout the corridor.

4.1.5 Corridor Speed Study

The RSAR team recommends using the recent speed studies (section 2.7) and performing speed studies in the locations without recent studies performed. Determining existing operations will help to determine proper speed limits, advisory speeds, no passing zones and proper placement of traffic control signs and markings.

Two dynamic speed signs were noted eastbound outside of Nicollet and westbound just outside of North Mankato. Studies have shown these signs to be effective, but their effectiveness relies greatly on where they are placed and whether or not they are enforced.

4.1.6 Living Snow Fence

Living snow fences are designed plantings of trees and/or shrubs along roadways where blowing snow appears to be an issue. This vegetation then traps and controls blowing and drifting snow from blowing across and covering the roadway. This would benefit locations where snow covered roads play a role in crashes along the corridor, though sometimes the benefits are minimal.

4.2 Intersections

The RSAR team observed several intersections throughout the corridor with a main focus on the five intersections with crash rates higher than the critical crash rate. Based on observations, some of strategies could be implemented throughout the corridor on multiple intersections, while other strategies are intersection specific. These strategies are safety driven and traffic operations will need to be evaluated in the future for corridor mobility.

4.2.1 Access Management

The density of access (the number of private and public access points per mile) has been proven to be a factor that contributes to an increase in crashes.

Eliminating access points or restricting turning maneuvers at intersections is a proven strategy for reducing crashes and, in particular, severe, right angle crashes. The corridor should be reevaluated for possible locations where access can be modified or removed to reduce the number of conflict points along the corridor.

Field Access – Field access can be removed by combining adjacent or nearby access into one main field access point. The need for field access has been reduced in some areas as the result of consolidation of farm land and ownership.

Close Access – Some of the intersections along the corridor could be closed or restricted to allow only a right in/right out with no turning movements as there are other streets nearby that could be used to access USTH 14 (Figure 33).

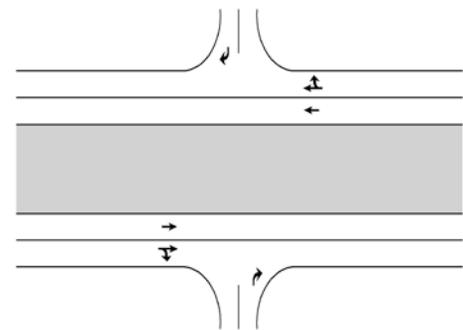


Figure 33 - Right in/right out access

Indirect Turns – Indirect turns should be considered long term for the corridor when a median is present under the proposed 4-lane freeway. Indirect turns involve constructing a channelizing island in the median to restrict crossing maneuvers and then providing upstream and downstream median openings to accommodate U-turns (Figure 34).

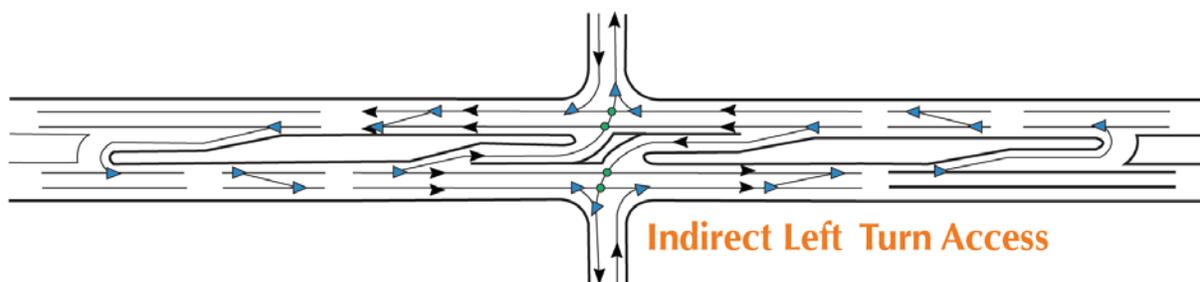


Figure 34 - Indirect turn

4.2.2 Signing

Signs reinforce the rules and hazards of the roadway. It is very important to have properly sized signs with adequate retroreflectivity to help drivers make decisions. The speed limit sign sizes should be

reviewed throughout the corridor to make sure they are consistent with current guidelines. In addition, larger sized stop signs should be considered at locations where large numbers of crashes occur.

4.2.3 Pavement Marking

Pavement marking plays an important role to drivers by communicating the intended path and alignment of the road. Based on observations from the field review, the RSAR team noted many vehicles squaring to the skewed intersections in order to provide better visibility to highway traffic. Throughout the corridor, stop bars could be placed square to the intersection to encourage drivers to stop at a perpendicular angle to the intersection for better views of oncoming highway vehicles. In addition, at locations where visibility is decreased due to an obstruction or roadway alignment, stop bars can be moved forward to encourage drivers to stop beyond the obstruction to provide better sight distance to oncoming highway traffic.

4.2.4 Channelization

Channelization involves removing turning vehicles from main roadway traffic into separate turning lanes (Figure 35). This reduces rear end crashes as slower, turning vehicles are removed from through traffic and also helps other drivers see the intent of a turning vehicle. Channelization strategies should be considered throughout the corridor to assist in removing slower and/or stopped traffic from through, high speed lanes.



Figure 35 - Channelized left turn lane

4.2.5 Curb Extensions

Curb extensions extend existing sidewalk out into the parking lane (Figure 36). This improves safety for pedestrians and motorists. Curb extensions are typically used for traffic calming, with the narrower roadway encouraging motorists to drive slower and encouraging pedestrian to cross at crosswalks while providing pedestrians a shorter exposed distance to cross. Curb extensions also have an indirect effect of encouraging vehicles to pull out farther around obstacles to view oncoming traffic.



Figure 36 - Curb extension

The City of Courtland has multiple intersections with structures or other obstacles built near the existing road and sidewalk making it difficult for vehicles on minor roadways to see oncoming traffic on USTH 14. Adding curb extensions will encourage traffic along USTH 14 to slow down through the city and also allow for minor street vehicles to pull forward beyond the existing buildings to better see oncoming traffic.

4.2.6 Systemic Intersection Evaluation

The MnDOT County Roadway Safety Plans (CRSP) project has developed a flow-chart for low-cost project solutions for County Road intersections based on existing intersection conditions and crash history (Figure 37). This flow-chart can also be referenced in the future should more low-cost, short-term projects be considered worthwhile. While some of the intersections don't currently meet some of the requirements in the flow chart, future traffic projections indicate that many criteria will be met throughout the USTH 14 corridor to warrant more than only upgraded signs, marking and adding street lights to these intersections. A more thorough, intersection specific discussion of these projects follows for intersections where these projects may be worthwhile.

Project Development – High Priority Rural Intersections

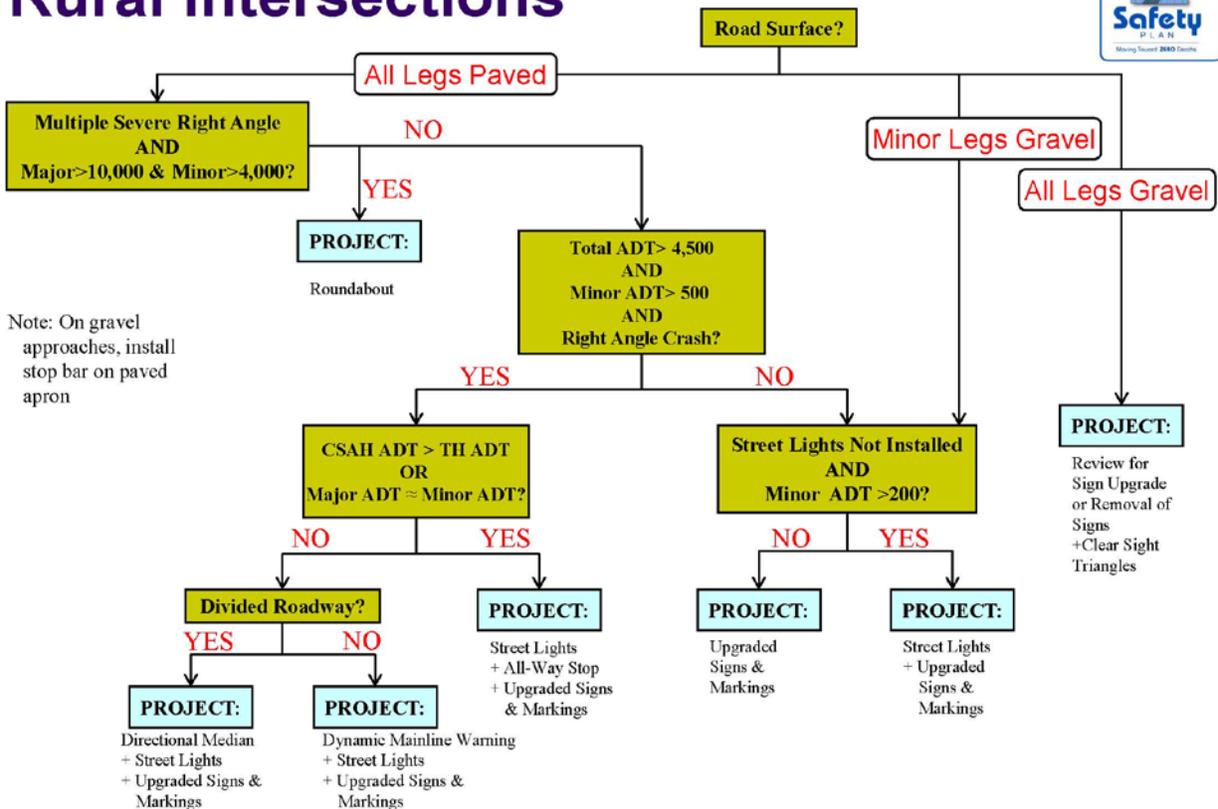


Figure 37 - CRSP Intersection project flow chart

4.2.7 USTH 14/MNTH 15/CSAH 21

The intersection of USTH 14, MNTH 15 and CSAH 21 has a crash rate higher than the critical crash rate and the most complex geometry of any intersection along the corridor. The intersection is on curvature, steep grades, a skewed angle and has a large number of turning vehicles. The intersection has had a

history of crashes and previous safety investments, including street lights, channelization and turn lanes. The traffic control of the intersection is also unusual as the high traffic volumes are on the south and east legs of the intersections. The east leg (USTH 14 westbound approach) has to stop to proceed on USTH 14 to the south and this may confuse drivers. The FEIS identified an interchange as the preferred solution for this intersection, however the RSAR team did not feel an interchange is a short term solution. More study will be needed to determine the intersection control in the future and evaluate funding, right of way acquisition, difficult topography, elevation differences, etc. The RSAR team suggests the following strategies be considered for implementation at this location:

- **Roundabout:** Roundabouts are proven to reduce all crashes at intersections by 39% and fatal crashes by 89%. They reduce vehicle speeds, have fewer conflict points and reduce collision angles compared to stop sign or traffic signal controlled intersections. The existing intersection configuration requires westbound traffic along USTH 14 to stop at a thru-stop intersection even though the major volumes of the intersection occur on this leg. Westbound USTH 14 traffic must then make a left turn to continue on USTH 14. A roundabout reduces the amount of conflict points a vehicle has from a 4-legged intersection (Figure 38).



Figure 38 - Roundabout

Based on the CRSP flow-chart (Figure 37), the existing traffic at this intersection warrants a dynamic warning sign, however, given the traffic volumes at this location, the sign would be activated and flashing almost all of the time. Over time, this sign would no longer assist drivers to approaching vehicles, so this project would not be recommended for this location. Taking into account future traffic and multiplying by the calculated linear growth factor (1.43) or the documented projection factor (1.6 for Nicollet County), traffic volumes will warrant a signal or roundabout in the future. Using the forecasted traffic data, based on the CRSP flow-chart, a roundabout would be suggested for this intersection.

Due to the cost of implementing a roundabout and the existing steep grade into the intersection from MNTH 15, the RSAR team suggests completing this work with the New Ulm USTH 14 Minnesota River Bridge work to be started in 2018. The proposed Minnesota River Bridge is proposed to be raised, thus allowing the USTH 14/MNTH 15/CSAH 21 intersection to be raised and assist with the steep grade of MNTH 15.

- **Signal:** The RSAR team noted that intersection volumes would be high enough to consider traffic signals in the future in some locations along the corridor. While traffic signals do not eliminate right angle crashes, they reduce the need for the driver on the minor road to determine a proper gap to merge into traffic. While a roundabout is generally considered a safer form of at-

grade intersection, a signalized option should also be considered for this location based on traffic analysis, land needs, etc.

- **All Way STOP:** All Way STOPs have proven effective in locations where traffic patterns are unusual, for example where the high volume approaches are adjacent instead of opposite. STOP signs are low-cost options for controlling an intersection prior to a traffic signal being installed or other intersection control. In the interim, prior to an interchange or roundabout being constructed, the RSAR team recommends converting this intersection to an all-way stop. The All Way STOP will reduce the need for vehicles to judge traffic gaps to make turns.
- **Channelization:** During the field review, the RSAR team noted that it is difficult to tell if oncoming or through vehicles are proceeding straight through the intersection or making a turn. A separated, channelized right turn lane from northbound USTH 14 to eastbound USTH 14 was recently constructed; however the turn lane is only delineated by pavement marking and delineator posts, making it difficult to see if a vehicle is in the turn or through lane. In addition, the team also noted that even with painted channelized turn lanes for the through movements, it is difficult to see which lane a vehicle is in and this could play a role in stopped vehicles determining a gap. The team suggested considering raised median islands at this intersection to help vehicles more easily see turning movements.
- **Pavement Marking:** During the field review, the RSAR team noted that the stop bar at the east leg of USTH 14 westbound traffic was placed far back from the intersection. The team suggested moving the stop bar forward as this may provide better sight distance to oncoming vehicles.

4.2.8 USTH 14/CSAH 37

The intersection of USTH 14 and CSAH 37 is located on a curve and has a history of crashes. This intersection appears to be a bypass of USTH 14 for vehicles to the City of New Ulm. The RSAR team suggests the following strategies be considered for implementation at this location:

- **All Way STOP:** All Way STOPs have proven to be effective in locations where traffic volume patterns are unusual. STOP signs are low-cost options for controlling an intersection prior to a traffic signal being installed or other intersection control. The All Way STOP will reduce the need for vehicles to judge traffic gaps to make turns.

The existing traffic volumes at this intersection are approximately equal between the major leg (USTH 14) and the minor leg (CSAH 37). Based on the CRSP flow-chart (Figure 36), an all way stop with upgraded signs and markings would be recommended for this intersection.

- **Channelization:** Based on the field review, the RSAR team suggested constructing a detached right turn lane for the eastbound USTH 14 to southbound CSAH 37 movement to help visibility for turning drivers from northbound CSAH 37.
- **Signing:** The RSAR team noted that the stop sign for left turns from northbound CSAH 37 could be larger to better grab drivers' attention.

4.2.9 USTH 14/561st Ave

While the intersection of USTH 14 and 561st Avenue does not have a higher than expected crash rate, the intersection is located by Minnesota Lutheran Valley High School (northwest quadrant), creating a large amount of traffic prior to and after each school day merging onto USTH 14. The RSAR team suggests the following strategies be considered for implementation at this location:

- **Gap Assistance Device:** Right angle crashes typically occur at thru-stop intersections due to a driver first stopping at the stop sign, but then advancing through the intersection when there is not a proper gap available. As a result of this, FHWA, MnDOT and other states have been working on a device that will assist drivers on minor road approaches select safe gaps in mainline traffic (Figure 39). This device could help inexperienced drivers select safe gaps while accessing USTH 14.
- **Pavement Marking:** The RSAR team suggested painting the stop bar square to the intersection and adding edge line marking to prevent 2 vehicles from sitting side-by-side at the stop sign to turn right or left.



Figure 39 - Gap assistance device

4.2.10 USTH 14/4th St

The intersection of USTH 14 and 4th Street is located in the City of Courtland. A bank is located in the southwest quadrant near the roadway obstructing clear views of oncoming highway traffic. The RSAR team suggests the following strategies be considered for implementation at this location:

- **Pavement Marking:** It is recommended to consider refreshing the crosswalks at this location and/or moving the stop bar ahead of the stop sign to encourage drivers to pull beyond the existing building on the corner for a better line of sight to oncoming vehicles.
- **Curb Extensions:** Curb extensions would allow drivers to pull out further beyond the existing building while also allowing a better location for pedestrians to cross.

4.2.11 USTH 14/MNTH 99

The intersection of USTH 14 and MNTH 99 has a crash rate higher than the critical crash rate and is located on a curve in the City of Nicollet and visibility is more limited from the minor roadway in this location than at other intersections throughout the corridor. The intersection was also the site of 1 fatal crash between 2006 and 2010. The RSAR team suggests the following strategies be considered for implementation at this location:

- **Close Intersection:** Closing the intersection will force traffic at this intersection to use the USTH 14/MNTH 111 intersection. With this intersection closed, points of conflict throughout the corridor and through the City of Nicollet in particular are reduced.
- **Channelization/Directional Median:** If this intersection remains open, the RSAR recommends considering channelizing the median along USTH 14 to only allow left turns from USTH 14 eastbound onto MNTH 99 northbound, creating a right out only from MNTH 99 to reduce

conflict points in the intersection. The team also noted that the left turn lane from USTH 14 eastbound is very short and should be lengthened if possible to allow vehicles more time to get out of through traffic and slow down to make the turn.

Based on the CRSP flow-chart (Figure 37), the existing traffic at this intersection would warrant a directional median. Based on the RSAR team's observations of the intersection and that there is another outlet to go eastbound at the intersection of USTH 14 and MNTH 111, the team recommended only a partial directional median without allowing U-turns for a vehicle turning left.

- **Acceleration Lane:** Parallel acceleration lanes allow a merging vehicle time to get up to highway speeds prior to merging with traffic (Figure 40). Acceleration lanes can be particularly useful on highways with a heavy flow of through traffic. Acceleration lanes are also beneficial in that they allow both the merging and the through driver time to adjust vehicle speeds so that the merging vehicle may merge safely. If this intersection is to remain open, the RSAR team has suggested adding an acceleration lane for vehicles turning onto westbound USTH 14 from MNTH 99. With the existing intersection located on a curve, this will allow through vehicles more reaction time and visibility for a merging vehicle at MNTH 99.



Figure 40 - Acceleration lane

4.2.12 USTH 14/MNTH 111 (North Leg)/CSAH 23 (South Leg)

The intersection of USTH 14 and MNTH 111 has a crash rate higher than the critical crash rate and is located on a skew in the City of Nicollet. The intersection has had a history of crashes and previous safety investments, including street lights, advance warning signs, turn lanes and flashing beacons above the STOP signs on MNTH 111 and CSAH 23. The RSAR team suggests the following strategies be considered for implementation at this location:

- **Roundabout:** Roundabouts are proven to reduce all crashes at intersections by 39% and fatal crashes by 89%. They reduce vehicle speeds, have fewer conflict points and reduce collision angles compared to stop sign or traffic signal controlled intersections. The RSAR team suggests

considering a roundabout at the USTH 14/MNTH 111 intersection. Based on the field review, the RSAR team noted that the existing intersection appears to be a shortcut for traffic from Mankato to St. Cloud, has high traffic volumes and multiple crashes.

Based on the CRSP flow-chart (Figure 37), the existing traffic at this intersection warrants a dynamic warning sign, however, given the traffic volumes at this location, the sign would be activated and flashing almost all of the time. Over time, this sign would no longer assist drivers to approaching vehicles, so this project would not be recommended for this location. Taking into account future traffic and multiplying by the calculated linear growth factor (1.43) or the documented projection factor (1.6 for Nicollet County), traffic volumes will warrant a signal or roundabout in the future. Using the forecasted traffic data, based on the CRSP flow-chart, a roundabout would be suggested for this intersection.

- **Signal:** Intersection volumes are not currently high enough to consider installing a traffic signal, but would likely be at some point in the future. Traffic signals are not safety devices and do not eliminate right angle crashes, they reduce the need for the driver on the minor road to determine a proper gap to merge into traffic. While a roundabout is generally considered a safer form of at-grade intersection, a signalized option should also be considered for this location based on traffic analysis, land needs, etc.
- **All Way STOP:** All Way STOPs have proven to be effective in locations where the traffic volume patterns are unusual, for example where the high volume legs are on adjacent approaches. STOP signs are low-cost options for controlling an intersection prior to a traffic signal being installed or other intersection control. The All Way STOP will reduce the need for vehicles to judge traffic gaps to make turns.
- **Channelization:** Channelized lanes help direct traffic and reduce confusion by filling in areas with unused, excess pavement. The RSAR suggests considering placing painted channelized lanes for the northbound and southbound MNTH 111 movements.
- **Pavement Marking:** During the field review, the RSAR team noted that most semi-trucks traveling southbound at this intersection square to the intersection as they approach the stop sign. The RSAR team suggesting painting the stop bar square to the intersection to encourage all drivers to do this for better sight lines.

4.3 Behavioral Factors

4.3.1 Enforcement

The enforcement of traffic laws is paramount to an effective highway safety strategy. Enforcement along the study area of Highway 14 is chiefly provided by District 2200 of the Minnesota State Patrol and the Nicollet County Sheriff's Office; North Mankato Police Department provides limited support to the study area's traffic enforcement.

To maximize the public impact of enforcement, research demonstrates that highly visible, saturated and sustained enforcement is most effective in reducing risky driving behaviors and their resulting crashes. High visibility enforcement involves a saturation of three or more squads, public outreach/media, and

the use of visibility tactics such as signs and vests. Sustained enforcement typically involves one to four saturated events a month for the desired timeframe. Highly visible and sustained enforcement are designed to increase the public's perception of enforcement presence and to educate the public on the consequences of non-compliance with traffic laws.

Nicollet County Sheriff's Office and the State Patrol strive to utilize these proven strategies whenever possible. However, due to the tightening of fiscal resources, officer-staffing levels are low; coupled with competing demands, highly visible traffic enforcement is challenging to achieve. With a limited number of officer hours available, much of their on-duty time is dedicated time—responding to calls needing law enforcement assistance—leaving little room to commit time to proactive saturation efforts. District 2200 of State Patrol, an enforcement agency fully dedicated to traffic safety, routinely has only two officers working a patrol shift that extends over ten counties.

To bolster officer hours, the Minnesota Department of Public Safety's Office of Traffic Safety (OTS) offers federally funded grants to state and local agencies to increase enforcement of traffic laws, particularly laws pertaining to impaired driving and seat belt use. The OTS Towards Zero Deaths (TZD) Enforcement Program leverages officers' availability for traffic enforcement through requiring multiple agency cooperation and providing funding for officer overtime. By working together and establishing a coordinated enforcement plan, law enforcement agencies can more successfully conduct high visibility enforcement resulting in stronger public impact. To execute the grant, one agency is designated as the lead agency to coordinate and administer the grant among the agencies involved.

The Nicollet County Sheriff's Office participates in the Blue Earth County TZD enforcement grant, together with North Mankato PD, St. Peter PD, Mankato PD, and Lake Crystal PD. The agencies together determine a shared enforcement strategy based on problem identification of traffic safety issues (the "who, what, why, where and when" of traffic crashes) and the grant requirements. Generally, the study area along Highway 14 in Nicollet County has not been a segment of roadway that has been included as part of the Blue Earth TZD Enforcement Program grant. The exception has been cooperative, multi-agency, and occasionally border-to-border, speed initiatives incorporating high-visibility tactics such as using MnDOT's changeable message boards, conducting roadside TV interviews, and conducting stepped-up enforcement.

In addition, despite competing demands, Nicollet County deputies have donated undedicated time – time not responding to calls—together with State Patrol, to on-duty patrol for traffic enforcement along the study segment of TH14. This multi-agency enforcement is an example of the important unstructured, cooperative enforcement activity that can occur outside of a more structured activity using state-provided overtime grants.

During the audit, law enforcement commented that for the study area, "motorists bring a four-lane attitude of speed and aggressive maneuvers to the two-lane stretch." Minnesota's High Enforcement of Aggressive Traffic (HEAT) program aims to improve roadway safety through education and heightened traffic enforcement within identified high incident zones throughout the state. The HEAT Program, administered by MnDOT, the Department of Public Safety, and the State Patrol, is in its final year;

program evaluation data and available funding will determine the future of HEAT. Highway 14 in Nicollet County is not a designated HEAT zone.

Considerations for Improvement

1. Strengthen the support for additional enforcement log and getting neighboring jurisdictions to help. Brown County elected officials may recognize the value of traffic enforcement (particularly through belt usage and speed/aggressive driving enforcement) through presentations on the community impact of traffic crashes by the Office of Traffic Safety's Law Enforcement Liaison for Southern Minnesota and other traffic safety officials and through elected officials inclusion in South Central TZD Region workshops and steering committee meetings.
2. Explore New Ulm Police Department's participation (Brown County) in the Blue Earth County Sherriff's Office TZD Enforcement Program grant to provide additional cooperative traffic enforcement (for belt usage and speed/aggressive driving) along the study section of TH14.
3. Explore incorporating Highway 14, between North Mankato and Nicollet--the segment involving the greatest number of head-on crashes--as part of the high visibility seat belt saturation efforts of the Blue Earth County TZD Enforcement Program grant as well as the 2012 HEAT aggressive driving/speed enforcement strategy.
4. Examine the award-winning cooperative enforcement program, "Smooth Operator" in the District of Columbia and Maryland including the funding partnership with the state's Federal Motor Carrier Safety Administration. The program is a partnership of law enforcement, public safety officials and other experts that includes law enforcement agencies coordinating efforts to get tough on aggressive drivers as well as an outreach campaign to discourage aggressive driving. Recognizing the increased commercial vehicle traffic along the study area, there may be untapped expanded partnerships for enhanced enforcement. See the following for further information:
<http://www.smoothoperatorprogram.com/about.html>

4.3.2 Seat Belt Usage

Regionally, south central Minnesota, seatbelt usage is 73.2 % (significantly lower than the statewide average) and lack of seat belt use played a role in 36% of the serious crashes along the USTH 14 corridor. Research indicates that motorists are 6 times more likely to need hospital care if unbelted in a crash. This data indicates a need for seat belt enforcement along the corridor.

Minnesota's primary seat belt law allows law enforcement officers to pull motorists over if they are not wearing a seat belt and has already saved lives since its inception in 2009.

Consideration for Improvement

1. Explore incorporating Highway 14 as part of the high visibility, seat belt saturation efforts of the Blue Earth County TZD Enforcement Projgram grant as well as the 2012 HEAT strategy.



4.3.3 Driver Distraction

Distracted or inattentive driving is any activity that diverts a driver's attention away from the primary task of driving, thereby, increasing the risk of a crash. Research indicates that talking on a cell phone uses 39% of the brain's capacity that would ordinarily be devoted to driving. Drivers who use hand-held devices are 4 times more likely to be involved in an injury crash and texting drivers pose the highest risk being 23 times more likely to crash.

To combat driver distraction, Minnesota motorists are required to follow the following laws:

- Total ban on read/compose/send text messages and email, or accessing the Internet using a wireless device while the vehicle is in motion or part of traffic—including stopped in traffic or at a traffic light.
- Cell phone use is banned (including hands-free) for teen drivers during their permit and provisional license stages, except to call 911.
- Cell phone use is banned (Including hands-free) for school bus drivers.
- Hand-held cell phone use is banned for commercial vehicle drivers.
- Distracted drivers can be ticketed for reckless or careless driving when their actions demonstrate a disregard for the safety or rights of others.

Driver inattention or distraction—the second highest crash factor for the study area—contributed to 18 percent of the severe crashes. Statewide, driver distraction is the leading factor contributing to nearly 1 out of 4 multi-vehicle crashes; highest at risk are 15-29 year old drivers. For the study area, 21-29 year old motorists were the highest at-risk motorists at 32 percent of the severe crashes. Distraction is likely a primary factor in these crashes mirroring statewide crash statistics. During the site visit, law enforcement stated that distracted driving crash data are vastly underreported due to law enforcement's challenge in determining distraction as a crash factor.

Finally, crash data reveal that severe crashes for the study area are most frequently a result of head-on crashes; crashes that occur when a vehicle crosses the centerline into an approaching vehicle. National rural crash statistics indicate that most head-on crashes more likely result from a driver making an "unintentional" maneuver such as being distracted and crossing the centerline. FMCSA research indicates that passenger vehicles driving left of center to be the most dangerous of unsafe driving acts around commercial vehicles and in a large portion of cases, there is no clear explanation as to why the driver was in the opposing lane—pointing to driver distraction as the suspect crash factor.

Considerations for Improvement:

1. Suggest the Nicollet County representative on the Blue Earth County TZD Enforcement Grant propose TH 14 study area to be included in Minnesota's statewide distracted driving enforcement campaign on April 19, 2012; extend focused enforcement if possible.

Results from the 2010 National Highway Traffic Safety Administration (NHTSA), pilot enforcement campaign confirmed that enhanced enforcement efforts combined with public education outreach would reduce drivers' handheld cell use and texting while driving. Results were measured through the use of observational and public awareness surveys.

The U.S. Department of Transportation offers a variety of creative outreach campaigns for teens, parents, educators, employers, and communities to raise awareness about the dangers of distracted driving. The use of compelling outreach materials is most effective when coupled with an enhanced enforcement campaign.

For further information on the NHTSA enforcement campaign and the U.S. DOT distraction campaign resources, see: <http://distraction.gov/>

2. Encourage area employers to adopt distracted driving policies to encourage safe driving practices of employees while at work. The Minnesota Safety Council offers a sample distracted driving policy: <http://www.minnesotasafetycouncil.org/facts/factsheet.cfm?qs=6ACC71CFDE46D33BF908D7D68B570E85>

4.3.4 Commercial and Farm Vehicle Traffic

During the Highway 14 Partnership meeting held prior to the site visit, stakeholders expressed concern regarding the high volume and high speeds of commercial vehicles and the increased roadway use by farm trucks. Similar concerns for commercial vehicles and farm trucks included not allowing a sufficient gap in traffic and slow acceleration upon entering the roadway and following too close to passenger vehicles.

Audit stakeholders also described that as passenger vehicles approach a slower moving commercial or farm semi vehicle, drivers often become impatient when their progress is slowed and consequently, take greater chances when attempting to pass. Law enforcement confirmed that some passenger vehicles engage in more aggressive, unsafe passing of trucks by passing with insufficient distance to the oncoming traffic and passing multiple vehicles.

Local farmers who once drove smaller implements close to home are today driving much larger semi-trucks and hauling far greater distances along the study area. Law enforcement clarified that road use by farm semi-trucks is primarily within a two-week period during the fall and spring harvest seasons. Stakeholders expressed concern that drivers of farm semi-trucks are not required to obtain a commercial driver's license citing that inexperienced, and untrained drivers of farm trucks are contributing to the study area's crash risk.

Crash data of the study area revealed that heavy vehicles (over 10,000 pound gross vehicle weight) were involved in 18% of fatal and serious injury crashes. Statewide 2010 truck crash data reveal a 14% increase in truck-involved traffic crashes from the previous year and driver distraction was most frequently cited for both truck drivers and non-truck drivers. However, non-truck drivers were more often cited for failure to yield and illegal speed. In Minnesota and nation-wide, statistics show that drivers of passenger vehicles, rather than truck drivers, are responsible for the majority of crashes involving passenger vehicles and large trucks.

Considerations for Improvement:

1. Incorporate “share the road” messaging in enforcement campaigns addressing speed and aggressive driving (including unsafe passing) to reduce truck-involved crashes.

The Federal Motor Carrier Safety Administration’s “Share the Road Safely Program” offers outreach materials including brochures, education materials, research highlights, and public service announcements. Included is a video and complete transcript of, “The Unsafe Driving Acts of Motorists in the Vicinity of Large Trucks” which provides research findings of 23 unsafe passenger vehicle driving acts as the primary causes of truck-vehicle crashes. The following web site provides further information: <http://www.sharetheroadsafely.org/>

2. Encourage local driving schools to strengthen programs to educate teens about safe driving practices around commercial vehicles.

The Commercial Vehicle Safety Alliance’s “Teens and Trucks” program offers educational materials including a lesson plan, video, and student workbook. The program is designed to integrate into existing driver’s education programs and can be used as a stand-alone program for high school events, parent-teacher organizations and community groups. The following web site provides further information: http://www.cvsa.org/programs/teens_and_trucks.php

3. Invite farmers and farming cooperatives to take advantage of free, on-site presentations, offered by the Minnesota State Patrol, addressing a wide variety of vehicle safety topics.

Complete the Commercial Vehicle Section’s “Public Education Request” form under the “Request for Presentation Form” link located under the Training and Outreach website:

<https://dps.mn.gov/divisions/msp/commercial-vehicles/Pages/training-outreach.aspx>

Submit completed request form by fax at (651) 405-6199; or mail to:

MN State Patrol Commercial Vehicle Section
Attention: Training Division
1110 Centre Point Curve #410
Mendota Heights, MN 55120

5.0 Conclusions/Suggestions

Arriving at a package of suggested strategies for MnDOT District 7 staff to consider has been very challenging because identifying the best path forward is not entirely clear, but that is only rarely the case. The RSAR team considered three distinct types of information in the process of generating a suggested approach – first, the clearly undisputed facts about crash and roadway characteristics associated with the USTH 14 corridor, then the less clear opinions about the factors contributing to



crashes and how they relate to the characteristics of the corridor and finally trying to fit everything into the perspective that whatever is suggested needs to be consistent with the Districts long-term objective to extend the four-lane expressway from New Ulm to North Mankato.

5.1 Corridor Facts

- The overall number and rate (the number of crashes normalized for the volume of traffic) of crashes in the corridor is exactly EQUAL to what is expected based on a comparison to other similar two-lane rural roadways around the State.
- The number and rate of fatal crashes in the corridor is 2.9 times greater than what is expected based on the comparison to other similar two-lane rural roadways. This indicates that we can be virtually certain that this difference is based on the characteristics of the corridor as opposed to the random nature of crashes.
- The type of crashes occurring along the USTH 14 corridor is unusual compared to other two-lane rural roadways – there are about one-third fewer road departure crashes and three times as many head on crashes based on statewide averages.
- The location along the corridor where these unusually severe head on crashes are most over represented is the segment between Nicollet and the beginning of the four-lane expressway in North Mankato.
- The number and rate of crashes is significantly GREATER than what is expected at three intersections – USTH 14 at MNTH 15/CSAH 21, USTH 14 at MNTH 99 and USTH 14 at MNTH 111/CSAH 23. The most common crash type at these intersections is an angle crash (almost 40%) and this is approximately 50% higher than at other similar rural thru/stop controlled intersections.
- Widening a two-lane cross-section to provide a buffer between opposing traffic lanes has been tried but has not yet been proven effective at reducing severe head on crashes – primarily because there are too few examples of implementing this strategy. The two examples in Minnesota – the USTH 12 bypass of Long Lake and MNTH 5 in Lake Elmo have so far demonstrated effectiveness at preventing head on crashes. There has been only 1 head on crash on USTH 12 and no head on crashes on MNTH 5 since their construction (5 years). The head on crash on USTH 12 is likely due to driver confusion as the adjacent railroad makes the roadway appear to be a 4-lane divided roadway.
- Widening a cross-section and adding a cable barrier has proven effective at eliminating head on crashes based on research of this strategy conducted in Europe.
- Reconstructing a cross-section to provide a four-lane divided roadway has proven effective at reducing severe head on crashes. However, it must be noted that rural expressways and high volume two-lane roadways have identical crash, severity and fatality rates. Rural expressways appear to be a trade off of fewer severe head on and run off road crashes but more severe angle crashes at intersections assuming that intersection accesses are not modified to reduce conflict points.
- As mitigation for angle crashes at intersections – installing an All Way STOP condition or a Roundabout have been proven effective. However, both strategies come with the potential for impacts beyond crash reduction – the all way stop can significantly disrupt traffic and increase delay

and the Roundabout has the least delay and best safety record, but requires a great deal of Right-of-Way and generally costs around \$1M to implement.

- Traffic signals are not considered a priority safety strategy for the USTH 14 intersections because traffic signals are very simply NOT safety devices – signalized intersections on average have both a higher crash and severity rate than stop controlled intersections and, similar to stop signs, even the most efficient traffic signal installations will increase delay.
- There are NO low cost safety strategies that are likely candidates for implementation to mitigate the head on crashes along the USTH 14 corridor – the District has already implemented all of the counter measures that would be considered applicable; including, paved shoulders, edge and center line rumbles.
- There is only ONE low cost safety strategy that would be a candidate to mitigate the angle crashes at the two key intersections – the installation of an all way stop condition – the District has already implemented a wide variety of countermeasures that would be considered applicable; including, street lighting, upgraded signs and markings, turn lanes and channelization.

5.2 Factors Contributing to Crashes

- The RSAR team concluded that the basic existing design features of USTH 14 are very good – 12 foot travel lanes, wide paved shoulders, traversable side slopes and ditches, a generally straight and only slightly rolling alignment and a very low fraction of no passing zones – are likely NOT contributing to the severe head on crashes. However, in theory, the percent time spent following during peak hours may be high and could be contributing to risky driver behavior throughout the corridor.
- The RSAR team also found two characteristics of the USTH 14 corridor that are associated with high fractions of head on crashes – the density of access and the volume of traffic. In the segment of USTH 14 most at-risk for severe head on crashes (between Nicollet and North Mankato), the density of access is approximately 30% greater than for similar two-lane rural roadways and the volume of traffic (an average of almost 7,700 vehicles per day) is in the upper 5% of all two-lane rural roadways in Minnesota. Both of these characteristics have been found to be associated with a higher fraction of severe head on crashes.
- A review of the crash reports prepared by law enforcement for the most severe crashes in the corridor did not point to any roadway, traffic, weather or driver behavior factors as being over represented, with two exceptions. First, seat belt usage in all of southern Minnesota is noted as being below the statewide average and second, it was concluded that in many of the head on crashes that the driver appeared to have been distracted because there was no other explanation for having driven into the opposing lane.

5.3 Suggested Engineering Implementation

- The RSAR team suggests that District 7 staff consider undertaking a project in the near term to widen the cross-section of USTH 14 as the highest safety priority – with the highest priority location being the segment between Nicollet and North Mankato. The suggested strategies include the 12 foot buffer (painted left turn lanes with passing prohibited), the 2+1 roadway (with cable barrier) or the four-lane expressway. If the District pursues the expressway alternative, it is important to pay particular attention to the intersections as they are the source of most of the severe crashes.

Restricting access is encouraged by using right in/right out or indirect left turn access and other intersection types where appropriate. The 12 foot buffer has demonstrated effectiveness at reducing head on and rear end crashes along the segment of MNTH 5 in Lake Elmo that also has a high volume of traffic and a high density of access. The 2+1 roadway includes the highest degree of prevention of head on crashes with the use of cable barrier but it will also generate concerns about access because most of the intersecting driveways and public road intersections will become right in/out. The near term extension of the expressway toward Nicollet is by far the most consistent with the Districts long term vision for the corridor but it is also the most expensive, would require the acquisition of additional right-of-way and would likely take the longest to implement. None of these strategies is inexpensive – the expected implementation cost for the 6.5 mile segment between North Mankato and Nicollet is approximately \$4 - \$5 M for the 12 foot buffer, \$5 - \$6 M for the 2+1 roadway and around \$14 - \$16 M for the extension of the expressway (Figure 41).

Alternative USTH 14 (Nicollet to North Mankato) Improvement Strategies		
	Length (Miles)	Concept Level Implementation Cost
4-Foot Buffer ^{1,2,3}	6.5	\$ 4,000,000 to \$ 5,000,000
12-Foot Buffer ^{1,2,3}	6.5	\$ 4,000,000 to \$ 5,000,000
2+1 Road ^{1,2,3}	6.5	\$ 5,000,000 to \$ 6,000,000
4-Lane Expressway ^{4,5}	6.5	\$ 14,000,000 to \$ 16,000,000
¹ Strategy requires the pavement to have a bituminous mill and overlay (thick) due to the existing shoulder structure (thickness) being unable to accommodate the traffic being shifted onto it.		
² Strategy will result in a substandard shoulder width (with the proposed shoulder widths being either 2, 5 or 9-feet in width) compared to the standard 10-feet of paved shoulder for a roadway of this character.		
³ Strategy only addresses USTH 14 mainline. As such, intersection improvements suggested within the RSA report are not included in the above cost ranges.		
⁴ Strategy calls for the purchase of additional right of way to construct a second set of lanes adjacent to existing USTH 14, which is included in the above range. This strategy does not include any improvements to the existing USTH 14 lanes.		
⁵ Strategy would include access control treatments such as indirect turns (RCUT), 3/4 intersections, and right-in, right-out accesses to mitigate the potential increase in intersection related crashes associated with two to four-lane expansions.		
Notes:		
The above cost ranges represent implementation of the subject strategy for the 6.5 mile segment between North Mankato and Nicollet.		
Cost ranges are based on recent project costs within District 7, and are preliminary (pre-scoping) cost estimates. As such, final estimate amounts for any of the strategies will vary from the above.		
Funding for any of the above costs is NOT included in any current MnDOT funding program.		

Figure 41 - Improvement strategy chart



- The RSAR team suggests that implementation of a widened cross-section is a matter of urgency – the analysis indicates that the frequency of the severe head on crashes does not appear to be due to the random nature of crashes and is most likely a function of the character of the roadway. However, it is beyond the RSAR team’s assignment to identify the one preferred alternative strategy because that would be highly dependent on identifying potential funding sources and to determine the likelihood and probable timing of successfully securing the necessary funds. It should be noted that the estimated implementation costs for the 12 foot buffer and the 2+1 roadway are in the upper end of the range of costs for funding through the States’ safety program. The cost of extending the expressway is far beyond the limits of the safety program. The District staff needs to identify more accurate cost estimates for the alternative strategies, consider the feasibility of the alternatives based on the District’s other needs and priorities and then determine the availability of potential funding sources.
- The second suggested priority for implementation involves the USTH 14 intersections with MNTH 15 near New Ulm and MNTH 111/CSAH 23 at Nicollet. An interchange at this location is not a short term viable solution. If the District determines that implementing an All Way STOP at these intersections is not feasible due to the delays to through traffic that would be induced, it is suggested that consideration be given to converting these intersections to roundabouts. These two intersections have the highest crash frequencies and rates and the primary types of crashes are angle/turning. Roundabouts have been proven effective at reducing these types of crashes. As was previously mentioned – the primary drawback associated with roundabouts is the implementation cost, which is around \$1M.
- The third suggested priority for implementation deals with attempting to better manage vehicle speeds. Speed was mentioned by the safety partners as being an important issue, but speed was not identified as an unusual factor in the crash reports and the speed profile on USTH 14 is virtually identical to the average for other two-lane rural roadways. The approach to managing vehicle speeds begins with updating the speed profiles all along the corridor and then working with the staff in the Office of Traffic Safety and Technology to determine the preferred speed limit based on an analysis of the data. The follow up to determining the optimum speed limit then involves working with law enforcement to conduct a series of high visibility campaigns in an attempt to increase compliance. A minor component of the speed management effort includes moving the dynamic speed feedback signs from the current rural locations to speed transition zones at Nicollet and Courtland – applications that have proven to be more effective.
- Other lower priority strategies suggested for consideration by District staff includes:
 - USTH 14/MNTH 99 Intersection: Extending the length of the eastbound left turn lane and revising the channelization to prohibit left turns onto eastbound USTH 14.
 - Segment between Courtland and Nicollet: Adding vegetation along the south side of the highway to reduce snow drifting.
 - Segment in Courtland: Removing on street parking and converting the two-lane roadway to a three - lane cross -section.
 - Segment in Nicollet: Convert the two-lane roadway to a three-lane cross-section and add continuous street lighting to reinforce the urban setting.