NOVEMBER 21, 2018

TECHNICAL MEMO #2

(ROADWAY SAFETY AND TRAFFIC OPERATION ANALYSIS)

Mn 220 N Corridor Study

Prepared for: Grand Forks - East Grand Forks Metropolitan Planning Organization

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1. Introduction

This memo is the second in a series of technical memos for the Mn 220 N (Mn 220) Corridor Study project.

2. Existing and Future Conditions

Refer to Technical Memorandum 1 for documentation of the existing and future conditions assessment.

3. Roadway Safety and Traffic Operation Analysis

In order to understand and identify safety considerations and transportation mobility deficiencies, a safety and traffic operation analysis was completed for existing and future conditions.

3.1 Roadway Safety

The number, location, type, and severity of crashes in the study area were analyzed to help identify and address safety problem areas. Crash data can be analyzed to identify problem intersections or segments, crash patterns, and probable causes. If the root causes of crashes can be identified, a means to reduce the number and severity of crashes may be developed.

The GF-EGF MPO recently completed crash history performance measures for the metropolitan area as part of the 2045 MTP[1]. Those crash statistics are based on upon data provided by MnDOT for years 2012-2015. The Mn 220 Corridor Study provides a closer evaluation of the safety characteristics specific to the corridor and are generally consistent to the 2045 MTP. The MPO will update remaining corridors throughout East Grand Forks as data is provided by MnDOT. Historical crash data for Mn 220 from the most recently available five-year period (2011-2015) was obtained from the MnDOT Crash Mapping Analysis Tool (MnCMAT). In addition, police reports were requested and reviewed to further evaluate the details of specific crashes reported at 17th Street and the US 2/Mn 220 intersections.

3.1.1 Key Factors in Safety Analysis

In examining the crash data obtained, four key factors were considered: (1) crash rate, (2) critical crash rate, (3) crash severity, and (4) crash type distribution.

Crash Rate

History has proven that crashes are a function of exposure. Roadways with higher traffic volumes experience more crashes than similar roadways with lower volumes. Rather than simply documenting the number of crashes that occur over a segment or at an intersection, crash rates

[1] Grand Forks-East Grand Forks MPO 2045 Metropolitan Transportation Plan, Figure 3-20

must be considered. Crash rates normalize different locations with varying traffic volumes, providing a useful tool in comparing the locations with respect to safety.

The first key factor in safety analysis is the crash rate. Intersection crash rates are defined by the number of crashes occurring per million entering vehicles (MEV). Intersections with high volumes can be compared to intersections with low volumes using the intersection crash rate. Actual crash rates at specific locations can be compared to average or typical values for a roadway of the same type.

Critical Crash Rate

Crash occurrence is somewhat random by nature. Identifying every segment or intersection with a crash rate above the average value in an analysis would produce a large amount of data that may not be statistically relevant with respect to safety deficiencies. The critical crash rate, the second key factor in safety analysis, identifies locations that have a crash rate higher than similar facilities by a statistically significant margin. The critical crash rate is calculated by adjusting the system-wide average based on the amount of exposure and a statistical constant indicating level of confidence. Although varying confidence levels are often utilized, the 99.5 percentile confidence interval was selected for this safety analysis. At locations where the actual crash rate exceeds the critical crash rate, it is 99.5 percent certain that the crashes are a result of deficiencies in the segment or intersection design.

Crash Severity

The third key factor in safety analysis is crash severity. Crash severity quantifies how severe the crashes are at a particular location. In the crash data obtained from MnCMAT, crashes are categorized into five major categories of severity:

- Property Damage – No injuries occurred
- Possible Injury – An injury may have occurred
- Non-Incapacitating Injury – A minor injury occurred
- Incapacitating Injury – An injury occurred that cause impairment
- Fatal – A fatality occurred in the crash

The purpose of analyzing this statistic is to identify locations that may experience a low crash rate but have a high percentage of injury or fatal crashes. These occurrences are often found at high speed low volume rural intersections, and improvement alternatives to address crash severity may yield a different set of solutions than for high crash/low severity instances. Conversely, locations which have high crash rates with a large proportion of property damage crashes may not warrant as much priority when deficiencies are being addressed. Critical severity rate and critical K/A rate (combination of Type K (Fatal) and Type A (Incapacitating Injury) crashes) in **Table 3-1** are also based on the same statistical method but with lower confidence level of 80 percent as a more conservative cut-off for significance. Of the 110 crashes observed along the Mn 220 corridor, 99 occurred at intersections and only two were reported as a Type A serious injury. Zero fatalities were reported.

Crash Type Distribution

The fourth key factor in safety analysis is crash type distribution. Each crash is classified as one of the following types:

- Rear End
- Sideswipe (Passing)
- Right Angle
- Head On
- Sideswipe (Opposite Direction)
- Other

The crash type distribution for the above critical intersections was investigated to determine if there are any underlying factors that could be creating the unsafe conditions. **Figure 3-1** illustrates the crash type diagrams by intersection.

3.1.2 Crash Summary

Crash data was analyzed for the most recent five years available, 2011-2015. **Table 3-1** summarizes intersection crash rates along the evaluation corridor. As shown, a total of 99 crashes have occurred over the five-year study period, with half of them occurring at the US 2/Mn 220 intersection.

Table 3-1. Intersection Crash Rate Summary (2011-2015)

Intersection	Traffic Control	Total Crashes[1]	Total Entering Volume[2]	Crash Rate per MEV	State Average Crash Rate[3]	Crash Critical Rate[4, 5]	Crash Severity Rate[6]	State Average Severity Rate[3]	Crash Severity Critical Rate[4, 5]	K/A Crashes	K/A Rate	State Average K/A Rate	K/A Critical Rate[4, 5]
Mn 220 at 9th Street	Urban Through-Stop	2	16,005,250	0.12	0.18	0.48	0.19	0.26	0.45	0	0.00	0.33	5.29
Mn 220 at 10th Street	Urban Through-Stop	7	20,412,625	**0.34**	0.18	0.45	**0.34**	0.26	0.43	0	0.00	0.33	4.41
Mn 220 at US 2	Low Volume, Low Speed	49	38,446,667	**1.27**	0.52	0.83	**1.90**	0.71	0.90	1	**2.60**	0.42	3.06
Mn 220 at 14th Street	Low Volume, Low Speed	18	25,565,208	**0.70**	0.52	0.91	**0.94**	0.71	0.94	1	**3.91**	0.42	4.02
Mn 220 at 15th Street	Urban Through-Stop	2	18,645,417	0.11	0.18	0.46	0.11	0.26	0.44	0	0.00	0.33	4.72
Mn 220 at 17th Street	Urban Through-Stop	13	18,417,292	**0.71**	0.18	0.46	**0.81**	0.26	0.44	0	0.00	0.33	4.76
Mn 220 at 20th Street	Urban Through-Stop	2	13,206,917	0.15	0.18	0.52	0.15	0.26	0.48	0	0.00	0.33	6.14
Mn 220 at 23rd Street	Urban Through-Stop	6	11,193,333	**0.54**	0.18	0.55	**0.80**	0.26	0.50	0	0.00	0.33	7.00
Mn 220 at 140th Street	Rural Through-Stop	0	6,588,250	0.00	0.25	0.83	0.00	0.41	0.81	0	0.00	1.05	13.76

[1] Crash Data obtained from MnCMAT and detailed police crash reports.
[2] AADT obtained from MnDOT Traffic Data Map
[3] MnDOT's 2015 Green Sheets were used to determine the State average crash rate.
[4] The critical rate is a statistically adjusted crash rate to account for random nature of crashes
[5] A 99.5% confidence level was assumed for critical crash rate and an 80% confidence level was assumed for critical severity and K/A rate.
[6] Severity rate factors: 5 for Fatal Crashes, 4 for A type, 3 for B type, 2 for C type, and 1 for Property Damage Crashes

Two intersections along Mn 220 have calculated crash rates (CR) above the critical rate:

- US 2 at Mn 220 (CR of 1.27 vs. 0.83)
- Mn 220 at 17th Street (CR of 0.71 vs. 0.46)

Three intersections along Mn 220 have calculated crash severity rates (SR) above the critical rate:

- US 2 at Mn 220 (SR of 1.9 vs. 0.9)
- Mn 220 at 17th Street (SR of 0.81 vs. 0.44)
- Mn 220 at 23rd Street (SR of 0.8 vs 0.50)

While the Mn 220 at 10th Street NE intersection does not have crash rates above the critical rate, the crash rate and crash severity rate are both above state average for an urban through-stop (CR of 0.34 and SR of 0.34). None of the intersections along the corridor have K/A (Fatal / Incapacitating Injury) rates above critical, but the US 2 at Mn 220 and Mn 220 at 14th Street intersections have K/A rates above the state average for low volume, low speed signalized intersections (K/A rate of 2.6 and 3.9 respectively). However, this statistic can be a little misleading as both intersections only recorded one Type A crash each. Without these crashes their K/A rate would be zero; therefore, these occurrences are under-represented. **Figure 3-1** illustrates the existing crash hot spot locations and crash type diagrams by intersection.

3.1.3 Pedestrian and Bicycle Crash Summary

There were no pedestrian-related crashes reported during the study period. Bicycle-related crashes are also denoted in **Figure 3-1**. The following intersections had bicycle-related crashes:

- DeMers Avenue at 10th Street (1 bicycle crash)
- US 2 at Mn 220 (1 bicycle crash)
- Mn 220 at 14th Street (1 bicycle crash)

Detailed crash reports regarding these crashes were not available, so the contributing factors are unclear in most cases. However, it is quite clear that crashes involving non-motorized traffic is occurring in the southern, more urban, section of the corridor.

3.1.4 Corridor Performance Measures

The Safety Performance Measures (PM) Final Rule also establishes the process for State Departments of Transportation (DOTs) and Metropolitan Planning Organizations (MPOs) to establish and report their safety targets, and the process that FHWA will use to assess whether State DOTs have met or made significant progress toward meeting their safety targets. The following summarizes the key corridor safety PM's for 2011-2015 five-year period.

- **Number of Traffic Fatalities.** There have been zero reported fatalities for the Mn 220 corridor.
- **Traffic Fatality Rate.** Rate is 0.0, since there have been no reported fatalities during the study period.

- **Number of Crash Related Serious Injuries.** The total number of serious crashes (Type A) reported is 2. One each at Mn 220/14th Street and US 2. The five-year rolling average for the corridor is 0.4 Type A crashes per year.
- **Serious Injury Rate.** The traffic related serious injury rate per 100 million vehicle miles traveled was found to be 15.46. For 2018, the region established a target of 5.93 or lower.
- **Number of Non-Motorized Fatalities and Serious Injuries**. Three non-motorized crashes were found for the last five-year period (0.6 per year). Of these crashes, none were reported to be of serious injury or fatality.

3.1.5 Crash Hot Spot Analysis

Understanding crash patterns is key to identifying contributing factors and the appropriate countermeasures to address the deficiencies Based on the observed crash, severity and characteristics of crashes observed, intersection hot spot analyses were completed for the following intersections

- DeMers Avenue at 10th Street NE
- US 2 at Mn 220
- Mn 220 at 14th Street
- Mn 220 at 17th Street
- Mn 220 at 23rd Street

The hot spot analyses are summarized in **Table 3-2** through **Table 3-6**, below and on the following pages.

Table 3-2. DeMers Avenue at 10th Street NE Hot Spot Analysis

Metric	Description
Crash Rate	0.34 exceeds statewide average 0.18
Severity Rate	0.34 exceeds statewide average 0.26
Summary	7 crashes during the 2011-2015 time period. Four of these crashes were right angle or left turn related (57%). One of the recorded right-angle crashes was actually a bicycle making a right turn into traffic and being struck.
Crash Type Observations	• 3 of the 4 right angles involved eastbound motorists failing to yield right of way. Two of those 3 crashes the eastbound motorist collided with a westbound 10th Street motorist. Only 1 crash involved a right angle with a motorist on DeMers Avenue. • 1 side swipe crash was recorded for the southbound direction, likely attributed to the lane merge located in the intersection vicinity.
At Fault Motorist Age	29% younger than age of 25 14% older than age 60
Other Factors	2 to 1 lane transition at intersection

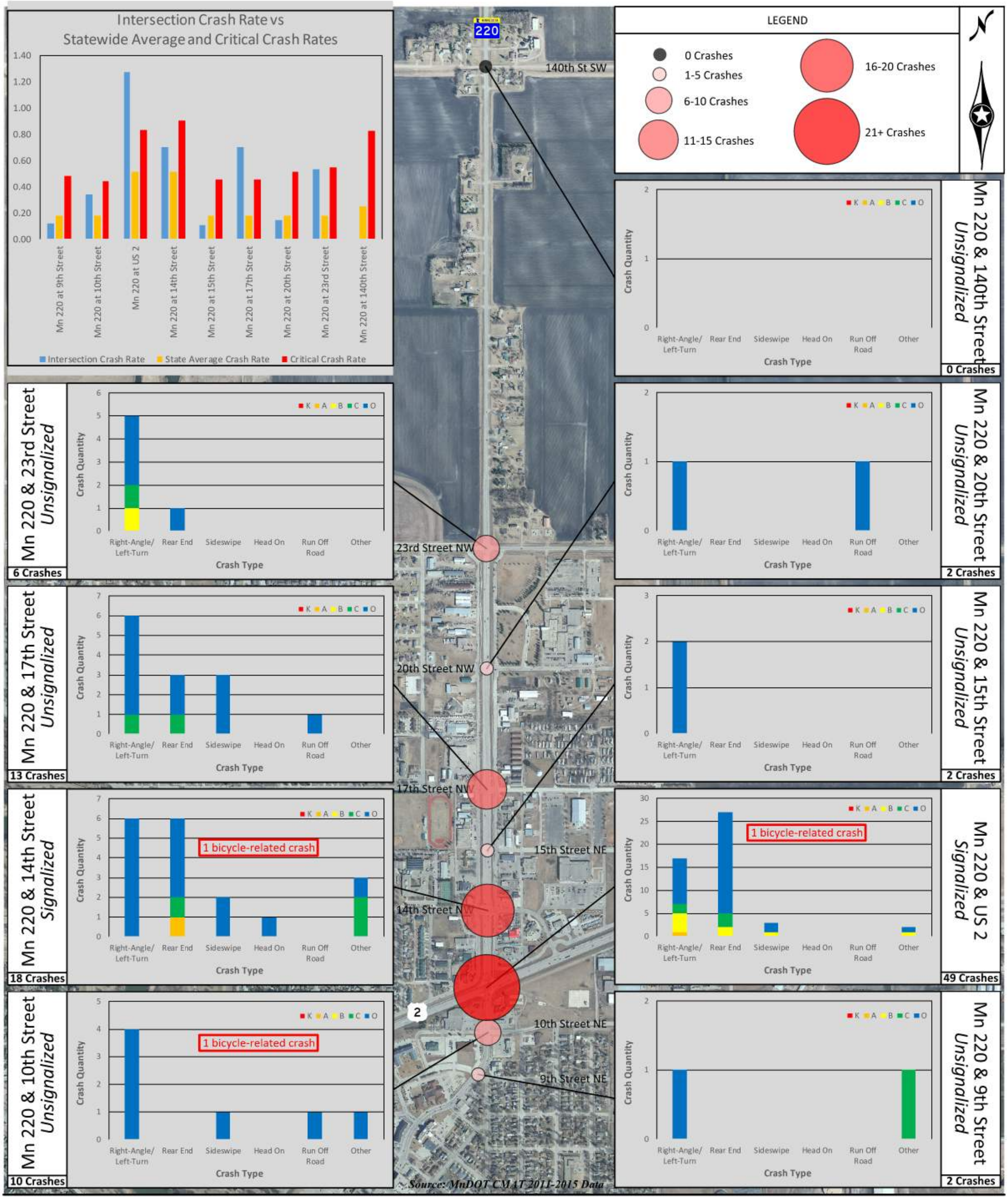

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Figure 3-1
Crash Hot Spot Locations and Crash Type Diagrams

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Table 3-3. US 2 at Mn 220 Hot Spot Analysis

Metric	Description
Crash Rate	1.27 exceeds critical rate of 0.83
Severity Rate	1.90 exceeds critical rate of 0.90
Summary	49 crashes during the 2011-2015 time period. Of these, 17 (35%) were right-angle or involved left-turns. 26 of the 49 crashes (53%) were rear-end crashes. Although the 26 crashes appear to be significant, this number is similar to the expected crash percentage of total crashes experienced statewide at signalized intersections.
Crash Type Observations	• 9 of the 17 right-angle/left-turn crashes involved a motorist making a left turn movement. • 8 of the 9 left-turn crashes involved a left-turning motorist on the east or west leg failing to yield on a permissive green ball. 50% (4) of these involved an eastbound left turn motorist failing to yield the right of way. Two involved a westbound motorist failing to yield the right of way. One involved an eastbound motorist running the red light, presumably striking a westbound motorist turning on the green arrow. The last crash had unknown details. • 1 of the 9 left turn crashes involved a southbound motorist striking a westbound through vehicle. Details are unknown. • 8 right angle crashes occurred. Four of the 8 involved a southbound motorist failing to yield (running the red light). The other four occurred on each of the remaining three approaches. • 4 of the 26 rear end crashes were denoted as occurring on the right turn channelized islands. The crash records indicate that an additional 16 of the 26 may also be related to right turn movements; however, the information isn't clear enough to make this determination. Actual police reports have been requested, and further evaluation of the 26 rear end crash occurrences will be completed later.
At Fault Motorist Age	37% younger than age of 25 8% older than age 60
Other Factors	• Intersection skew • Cross product of left turning motorists versus opposing through vehicles • lateral left turn lane alignment • high speed channelized right turn movements resulting in poor visibility • Signal timing and signal head placement

Table 3-4. Mn 220 at 14th Street Hot Spot Analysis

Metric	Description
Crash Rate	0.70 exceeds statewide average rate of 0.52
Severity Rate	0.94 exceeds statewide average rate of 0.71
Summary	18 crashes during the five year study period. Of these, the predominate crash types included 6 (33%) right-angle/left-turns and 6 rear end (33%)
Crash Type Observations	• 3 of the 6 rear end crashes involved southbound motorists, 2 were northbound (during AM school arrival) and 1 westbound. The factors largely involved vehicles stopped in traffic, following too closely, in the case of the westbound motorist, sun in the eyes. • 3 of the 6 right angle crashes found eastbound motorists failing to yield and being struck by southbound or northbound vehicles. Two involved northbound motorists failing to yield and 1 crash involved a westbound left turn motorists colliding with an eastbound through vehicle. • No particular trend in time of day was noted; however, 50% of the crashes occurred on wet, snow or ice packed roadway surface.
At Fault Motorist Age	33% younger than age of 25 22% older than age 60
Other Factors	None Noted

Table 3-5. Mn 220 at 17th Street Hot Spot Analysis

Metric	Description
Crash Rate	0.71 exceeds critical rate of 0.46
Severity Rate	0.81 exceeds critical rate of 0.44
Summary	13 crashes during the 2011-2015 time period. Of these, 6 (46%) were right-angle or involved left-turns
Crash Type Observations	• 4 of the 6 right-angle/left-turn involved an eastbound motorist failing to yield. Two of these involved southbound motorists and two involved northbound motorists. • 1 of the 6 involved a westbound motorist being struck by a northbound vehicle. • 1 of the 6 involved a northbound left turn motorist failing to yield right of way to a southbound vehicle. • 3 sideswipe crashes were reported. One of these involved a chemically impaired motorist. The other two involved two eastbound motorists attempting to make right turns onto Mn 220 and colliding. • Nearly all crashes were reported on weekdays between 9 a.m. and 5 p.m., with 38% of them occuring between 9-10 a.m.
At Fault Motorist Age	23% younger than age of 25 8% older than age 60
Other Factors	None Noted

Table 3-6. Mn 220 at 23rd Street Hot Spot Analysis

Metric	Description
Crash Rate	0.54 exceeds statewide average rate of 0.18
Severity Rate	0.80 exceeds critical rate of 0.50
Summary	6 crashes during the 2011-2015 time period. Of these, 5 (83%) were right-angle or involved left-turns
Crash Type Observations	• 3 of the 5 right angle/left turn crashes involved a westbound motorist failing to yield the right of way and turning into a southbound motorist. • 2 of the 5 right angle/left turn crashes involved a southbound left turn motorist failing to yield the right of way to a northbound through vehicle. • 5 of the 6 crashes occurred between 730 a.m. and 1100 a.m.
At Fault Motorist Age	33% younger than age of 25 16% older than age 60
Other Factors	None Noted

3.2 Mobility

Preserving and improving mobility of Mn 220 is an important priority and goal for the study. An assessment of the existing quality of mobility (traffic operations) for the corridor and intersections was completed. The quality of traffic flow and mobility is measured using Level of Service (LOS) methodology. LOS analysis was performed for the study area for each of the study design years (existing, 2030 and 2045). The discussion of the capacity including LOS is included in the following sections.

3.2.1 Level of Service Methodology

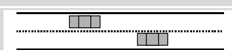
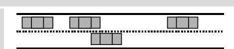
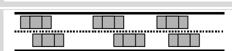
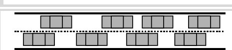
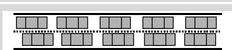
The concept of LOS is a method to estimate the quality of traffic flow through intersections and along roadway segments. In general, the capacity of a street is a measure of its ability to accommodate a certain volume of moving vehicles. Typically, street capacity refers to the maximum number of vehicles that can be expected to be accommodated in a given time period under the prevailing roadway characteristics and conditions. The LOS methodology is standardized by the Transportation Research Board (TRB) and is applied uniformly regardless of jurisdictional boundaries. The method uses algorithms that are based on delay and driver expectations of acceptable delay or traffic flow to assign a LOS grade.

LOS results are categorized on a LOS A to LOS F scale. LOS A represents high quality traffic operations where motorists experience little or no delay (i.e. free flow conditions). Conversely, LOS F corresponds to low quality operations with significant delays and potentially congestion.

The LOS grade for an intersection as a whole is based on the weighted average delay of each movement. The delays can vary greatly based on traffic volume, lane geometry, and intersection traffic control (e.g. traffic signal, through-stop, all-way-stop). Grades are different at unsignalized and signalized intersections; due to drivers anticipating longer delays at signalized intersections.

Although the measure of effectiveness used in determining LOS for each facility (e.g. arterial street vs. rural highway vs. signalized intersection) may differ, the concept of the LOS grade is the same. The general relationship between capacity and LOS is displayed in **Table 3-7**.

Table 3-7. Level of Service

LOS	Description		Facility Type	Signalized Intersection	Un-Signalized Intersection	Urban Street LOS	
			Volume to Capacity Ratio	Intersection Delay (Seconds / Vehicle)	Intersection Delay (Seconds / Vehicle)	Average Travel Speed (mph)	
						Base Speed (45 mph)	Base Speed (30 mph)
A		**Free Flow.** Low volumes and no delays.	0 - 0.6	0 - 10	0 - 10	>36	>24
B		**Stable Flow.** Speeds restricted by travel conditions, minor delays.	0.61 - 0.7	>10 - 20	>10 - 15	>30	>20
C		**Stable Flow.** Speeds and maneuverability closely controlled due to higher volumes.	0.71 - 0.8	>20 - 35	>15 - 25	>23	>15
D		**Stable Flow.** Speeds considerably affected by change in operating conditions. High density traffic restricts maneuverability, volume near capacity.	0.81 - 0.91	>35 - 55	>25 - 35	>18	>12
E		**Unstable Flow.** Low speeds, considerable delay, volume at or slightly over capacity.	0.91 - 1.00	>55 - 80	>35 - 50	>14	>9
F		**Forced Flow.** Very low speeds, volumes exceed capacity, long delays with stop and go traffic.	> 1.0	> 80	> 50	<=14	<=9

Source:
1. Highway Capacity Manual, 6th Edition (Published 2016), Transportation Research Board, Exhibit 18-1 for Signalized Intersections, Exhibit 19-8 for Un-Signalized Intersections, and Exhibit 16-3 for Urban Street Facilities.
2. Transportation Research Board (TRB), Highway Capacity Manual, Special Report 209

3.2.2 Planning Level Analysis of Capacity by Facility Type

The Mn 220 corridor consists of a varying typical section and design type within the study area. Most of the urban design area (9th Street to just 23rd Street) is a four-lane roadway with only two traffic signals. North of 23rd Street follows a rural design with two lanes and no traffic control devices to interrupt the mainline traffic flow. An assessment was completed to determine whether the current lane facilities will be enough to accommodate the future traffic volumes or if additional travel lanes may be required. The assessment is a planning level analysis that compares the existing and forecast daily traffic volumes (AADT) against estimated capacity thresholds for various facility types. **Figure 3-2** illustrates this comparison.

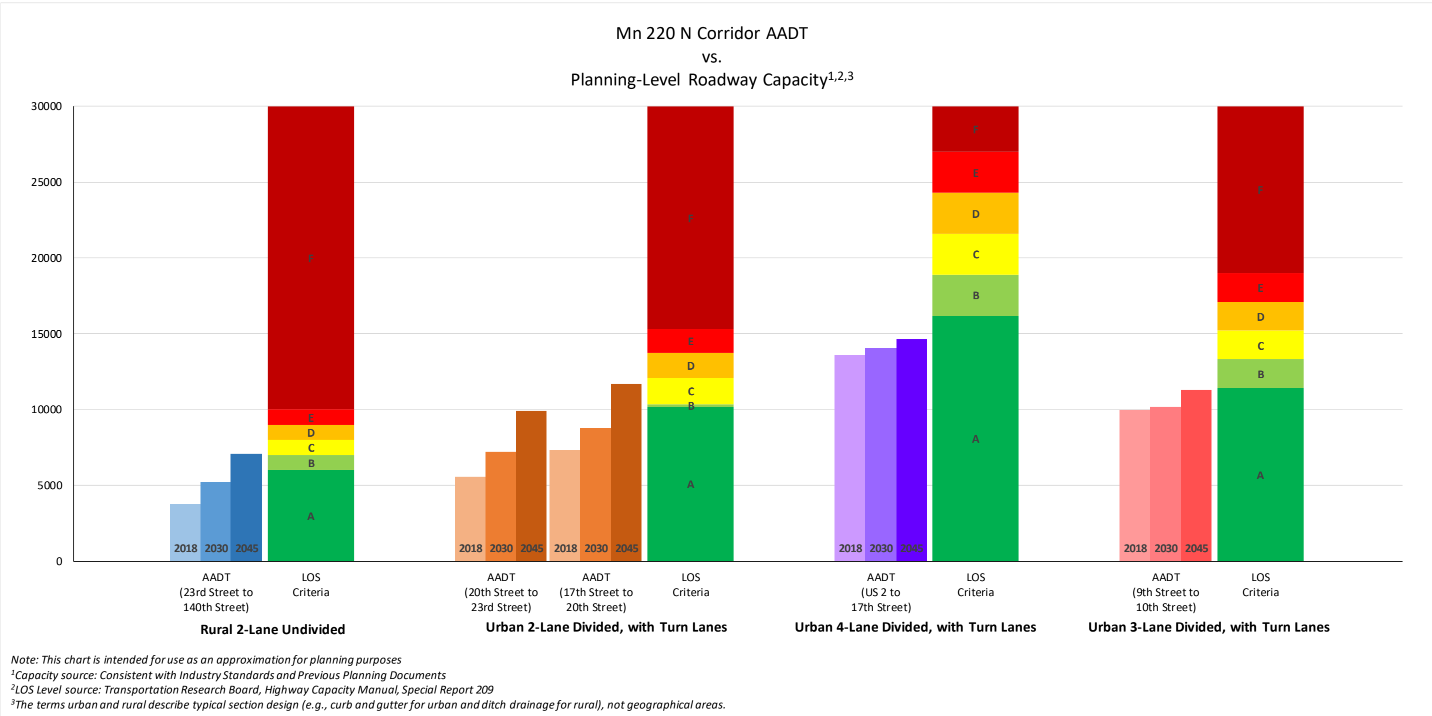


Figure 3-2. Corridor Capacity Assessment by Facility Type

As shown in **Figure 3-2**, the forecast daily traffic volumes for each corridor segment are well within the available capacity of the facility type. Absent the installation of any new traffic control devices that would interrupt traffic flow on Mn 220, the existing typical cross-section roadway design has excess capacity. North of 23rd Street, the forecast 2045 AADT suggest that the addition of turn lanes is likely appropriate.

3.2.3 Arterial and Intersection Performance

To understand the benefit of improvements that will be developed, a baseline must be established for comparison. This “No Build” analysis was completed for existing conditions and forecasted 2030 and 2045 volumes with applicable planned improvements identified in Section 2. **Table 3-8** and **Table 3-9** summarize the arterial performance of the Mn 220 corridor over the existing and future analysis years for the a.m. and p.m. peak hours, respectively.

Table 3-8. Arterial Performance Summary – AM Peak Hour

Direction	Segment	Base FFS (mph)	2018 Existing		2030 Forecast		2045 Forecast	
			Average Speed (mph)	LOS	Average Speed (mph)	LOS	Average Speed (mph)	LOS
Northbound	9th Street NE to 17th Street NW	30	19.2	C	18.9	C	18.1	C
	17th Street NW to 23rd Street NW	45	41.8	A	42.0	A	41.9	A
	23rd Street NWto 140th Street SW	45	46.8	A	46.3	A	45.2	A
Southbound	140th Street SW to 23rd Street NW	45	44.3	A	43.4	A	42.4	A
	23rd Street NW to 17th Street NW	45	43.0	A	42.7	A	43.0	A
	17th Street NW to 9th Street NE	30	19.5	C	19.2	C	18.1	C

Table 3-9. Arterial Performance Summary – PM Peak Hour

Direction	Segment	Base FFS (mph)	2018 Existing		2030 Forecast		2045 Forecast	
			Average Speed (mph)	LOS	Average Speed (mph)	LOS	Average Speed (mph)	LOS
Northbound	9th Street NE to 17th Street NW	30	19.8	C	19.4	C	18.4	C
	17th Street NW to 23rd Street NW	45	41.1	A	40.5	A	41.7	A
	23rd Street NWto 140th Street SW	45	45.3	A	44.6	A	43.5	A
Southbound	140th Street SW to 23rd Street NW	45	44.5	A	44.6	A	43.7	A
	23rd Street NW to 17th Street NW	45	42.3	A	42.7	A	41.3	A
	17th Street NW to 9th Street NE	30	18.1	C	17.2	C	14.3	D

Table 3-10 and **Table 3-11** summarize the overall intersection and worst performing movement delay and associated LOS for the existing, forecast 2030 and forecast 2045 a.m. and p.m. peak hours. Unsignalized intersections with high volume mainlines will frequently perform at an overall LOS A while their side-street through and left-turn movements perform at a significantly lower LOS. This occurs because mainline traffic does not stop (i.e. little to no delay) and overall LOS is the average delay of all vehicles using the intersection. Some motorists, especially on the side-street, are likely to experience much longer delays.

Table 3-10. Intersection Delay and LOS Summary —AM Peak Hour

Intersection Name	Control	MOE	2018 Existing	2030 Forecast	2045 Forecast
Mn 220 at 140th Street SW	Side-Street Stop	Delay/Veh	1.3 / 5.7	2.1 / 11.1	2.3 / 13.0
		LOS	A A	A B	A B
Mn 220 at 23rd Street NW	Side-Street Stop	Delay/Veh	2.6 / 10.0	3.5 / 10.8	5.8 / 17.3
		LOS	A A	A B	A C
Mn 220 at 20th Street NW	Side-Street Stop	Delay/Veh	1.3 / 9.5	1.6 / 11.7	2.3 / 17.7
		LOS	A A	A B	A C
Mn 220 at 17th Street NW	Side-Street Stop	Delay/Veh	2.6 / 18.1	3.1 / 23.7	4.2 / 44.5
		LOS	A C	A C	A E
Mn 220 at 15th Street NW	Side-Street Stop	Delay/Veh	1.6 / 11.6	2.0 / 14.6	1.7 / 12.5
		LOS	A B	A B	A B
Mn 220 at 14th Street NW	Signalized	Delay/Veh	10.3	10.2	9.2
		LOS	B	B	A
US 2 at Mn 220	Signalized	Delay/Veh	19.3	22.8	37.9
		LOS	B	C	D
Mn 220 at 10th Street NE	Side-Street Stop	Delay/Veh	2.9 / 20.5	3.2 / 24.2	4.2 / 32.8
		LOS	A C	A C	A D
Mn 220 at 9th Street NE	Side-Street Stop	Delay/Veh	2.8 / 11.8	2.8 / 12.7	4.8 / 22.2
		LOS	A B	A B	A C

Table 3-11. Intersection Delay and LOS Summary —PM Peak Hour

Intersection Name	Control	MOE	2018 Existing	2030 No Build	2045 No Build
Mn 220 at 140th Street SW	Side-Street Stop	Delay/Veh	2.3 / 6.1	3.0 / 7.5	4.1 / 7.6
		LOS	A A	A A	A A
Mn 220 at 23rd Street NW	Side-Street Stop	Delay/Veh	2.6 / 8.7	3.6 / 10.9	7.0 / 24.3
		LOS	A A	A B	A C
Mn 220 at 20th Street NW	Side-Street Stop	Delay/Veh	2.0 / 11.4	2.6 / 17.0	4.1 / 26.4
		LOS	A B	A C	A D
Mn 220 at 17th Street NW	Side-Street Stop	Delay/Veh	2.8 / 22.5	3.4 / 27.5	11.7 / 139.4
		LOS	A C	A D	B F
Mn 220 at 15th Street NW	Side-Street Stop	Delay/Veh	1.9 / 13.8	2.3 / 19.4	2.4 / 19.3
		LOS	A B	A C	A C
Mn 220 at 14th Street NW	Signalized	Delay/Veh	11.3	11.8	11.6
		LOS	B	B	B
US 2 at Mn 220	Signalized	Delay/Veh	20.2	25.1	44.8
		LOS	C	C	D
Mn 220 at 10th Street NE	Side-Street Stop	Delay/Veh	4.5 / 25.1	5.5 / 29.1	7.8 / 52.2
		LOS	A D	A D	A F
Mn 220 at 9th Street NE	Side-Street Stop	Delay/Veh	1.4 / 20.8	1.5 / 26.7	1.7 / 38.5
		LOS	A C	A D	A E

Note:
(## / ##) = Overall Intersection Delay / Worst Stop Sign Approach Delay

3.2.4 Traffic Operations Analysis Summary

The corridor level traffic operation analysis makes the following conclusions:

- The planning level analysis of the corridor AADT found the existing roadway typical cross-section design to be appropriate lane sizing for the forecast AADT with the corridor expected to have excess capacity into the future.
- The segment of Mn 220 north of 23rd Street is likely to warrant the addition of turn lanes at key locations to maintain optimal mobility and safety of a two-lane rural design. This may suggest a three-lane cross-section will be an appropriate future alternative.
- The urban arterial performance analysis found the corridor is expected to operate at either free-flow or stable-flow depending on the area and time of day. This is largely due in part to the fact there are no interruptions for mainline Mn 220 motorists north of 14th Street. The analysis confirms the planning level evaluation that there is expected to be excess lane capacity along Mn 220 into the future.

On an intersection level, the traffic operation analysis found the following:

- Under the current existing year traffic volumes all intersections operate at LOS C or better during the a.m. and p.m. peak periods. This is not to say there aren't very short periods of higher delay and queueing that correlate with school arrival and exiting time periods; however, on average operate acceptably.
- Under the forecast 2030 horizon, all intersections are expected to operate at an acceptable LOS C or better, with exception to the 17th Street and 10th Street NE intersections. The westbound stopped approach at 17th Street and the westbound stopped approach at 10th Street NE are expected to operate at a LOS D.
- Under the forecast 2045 horizon all intersections are expected to operate at an acceptable LOS C or better, with exception to the following:
    - The US 2 at Mn 220 intersection is expected to degrade to LOS D during both the a.m. and p.m. peak hours. The eastbound left turn movement and southbound through movement (unbalanced lane utilization resulting from the downstream lane drop) are expected to contribute to much of this delay.
    - During the p.m. peak hour, there is expected to be significant delay (LOS E) for westbound left turns at 10th Street NE.
    - Westbound left turns at 17th Street are expected to degrade to LOS E during the a.m. peak hour and at LOS F during the p.m. peak hour.

3.3 Transit System Performance

The GF-EGF recently completed the Transit Development Plan[2] (TDP) for the metropolitan region. Transit service within the Mn 220 corridor operates at acceptable LOS at intersections (comparable to motor vehicles) as limited congestion exists or is projected for the major movements along the transit routes. Over the route, the existing transit LOS may be defined by frequency, on time performance and relative travel time comparison between major destinations

[2] Transit Development Plan, July 2017

versus traveling in a motor vehicle. Specific evaluation specific to Routes 3/4, 6/7 and 12 are not provided in the TDP. However, on average, the transit system routes operate at approximately 82 percent on time (LOS D), and 30-minute headways for Route 3 (LOS D) to 60-minute headways for all other region routes (LOS F). In general, the transit system routes within the region take about three times longer to reach major destinations in comparison to traveling via motor vehicle (LOS C to LOS D).

3.4 Bicycle and Pedestrian Mobility

Bicycle and pedestrian mobility can be defined in the form of perceived comfort and accessibility, measured in terms of Level of Stress (LTS)[3]. The LTS is a rating given to a road segment or crossing indicating the traffic stress it imposes on bicyclists or pedestrians. Levels of traffic stress range from 1 to 4:

- LTS 1: Strong separation from all except low speed, low volume traffic. Simple crossings.
- LTS 2: Except in low speed / low volume traffic situations, cyclists have their own place to ride that keeps them from having to interact with traffic except at formal crossings. Physical separation from higher speed and multilane traffic. Crossings that are easy for an adult to negotiate.
- LTS 3: Involves interaction with moderate speed or multilane traffic, or close proximity to higher speed traffic.
- LTS 4: Involves interaction with higher speed traffic or close proximity to high speed traffic. Difficult intersections to cross.

The LTS evaluation is a high-level measurement that can provide the MPO a useful tool to identify and prioritize roadway segments and intersection crossings throughout the region. **Table 3-12** highlights the LTS evaluation for the Mn 220 corridor and the major intersection crossings.

[3] Level of Traffic Stress, Northeastern University, Peter G. Furth

Table 3-12. Mn 220 Bicycle and Pedestrian Level of Stress Evaluation

Segment or Intersection Crossing	Width of Crossing	Control Type	Level of Traffic Stress [(1)]	Notes
Segment				
Mn 220 - US 2 to 23rd Street			LTS 1	Multi use Trail separated from traffic
Intersection Crossing				
Mn 220 at 9th Street NE	3-Lane	Unsignalized	LTS 1	
Mn 220 at 10th Street NE	4-Lane	Unsignalized	LTS 2	
US 2 at Mn 220	NA	Traffic Signal	LTS 1	Pedestrian crossing indications
Mn 220 at 14th Street	NA	Traffic Signal	LTS 1	Pedestrian crossing indications
Mn 220 at 15th Street	5-Lane	Unsignalized	LTS 2	Tee configuration
Mn 220 at 17th Street	5-Lane	Unsignalized	LTS 4	Speed Limit change to 45 mph
Mn 220 at 20th Street	3-Lane	Unsignalized	LTS 3	High Speed
Mn 220 at 23rd Street	3-Lane	Unsignalized	LTS 3	High Speed
Mn 220 at 140th Street	2-Lane	Unsignalized	LTS 3	High Speed

Source: Level of Traffic Stress Criteria, Northeastern University, Peter G. Furth, Table 1 and Table 6