

# Final Report

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Mandan-Bismarck Corridor Improvement Study

*Mandan and Bismarck, North Dakota*  
July 27, 2016



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# Mandan-Bismarck Corridor Improvement Study: Final Report

## 1.0 Introduction

### 1.1 Purpose and Need

The Bismarck-Mandan MPO requested a transportation study to evaluate the potential improvement of 20 corridors located in the cities of Mandan and Bismarck. The two primary objectives of the Corridor Improvement Project are to improve traffic operations along the corridors and to reduce crashes by applying low-cost alternative solutions such as access management, signal modifications, geometry and lane reconfiguration, signing, and traffic calming measures.

The corridors selected by the Bismarck-Mandan MPO to be included within the study for the City of Bismarck include the following (Figure 1):

- Washington-street (Calgary Avenue to Divide Avenue)
- Divide Avenue (Schafer Street to Bismarck Expressway)
- 4<sup>th</sup> Street (Century Avenue to Boulevard Avenue)
- 7<sup>th</sup> Street (Boulevard Avenue to Rosser Avenue)
- 9<sup>th</sup> Street (Boulevard Avenue to Rosser Avenue)
- Front Avenue/Memorial Highway (Main Avenue to 12<sup>th</sup> Street)
- 26<sup>th</sup> Street (Divide Avenue to Airway Avenue)
- 19<sup>th</sup> Street (Divide Avenue to LaSalle Drive)
- Ward Road (Edwards Avenue to Divide Avenue)

The corridors selected for the City of Mandan include the following (Figure 2):

- Main Street/Business I-94 (ND Highway 25 to Twin City Drive)
- Sunset Drive/6<sup>th</sup> Avenue NW (Main Street to Old Red Trail)
- ND Highway 6 (Main Street to 19<sup>th</sup> Street NW)
- Old Red Trail (Mandan Avenue to Sunset Drive)
- Mandan Avenue/ND Highway 1806 (Main Street to Old Red Trail)
- 3<sup>rd</sup> Street (ND Highway 6 to Memorial Highway)
- 19<sup>th</sup> Street (ND Highway 6 to ND Highway 1806)
- Collins Avenue (Main Street to Old Red Trail)
- ND Highway 1806 North (Old Red Trail to 38<sup>th</sup> Street)
- ND Highway 1806 South (Main Street to 19<sup>th</sup> Street)
- Division-street (Sunset Avenue to 8<sup>th</sup> Avenue NE)

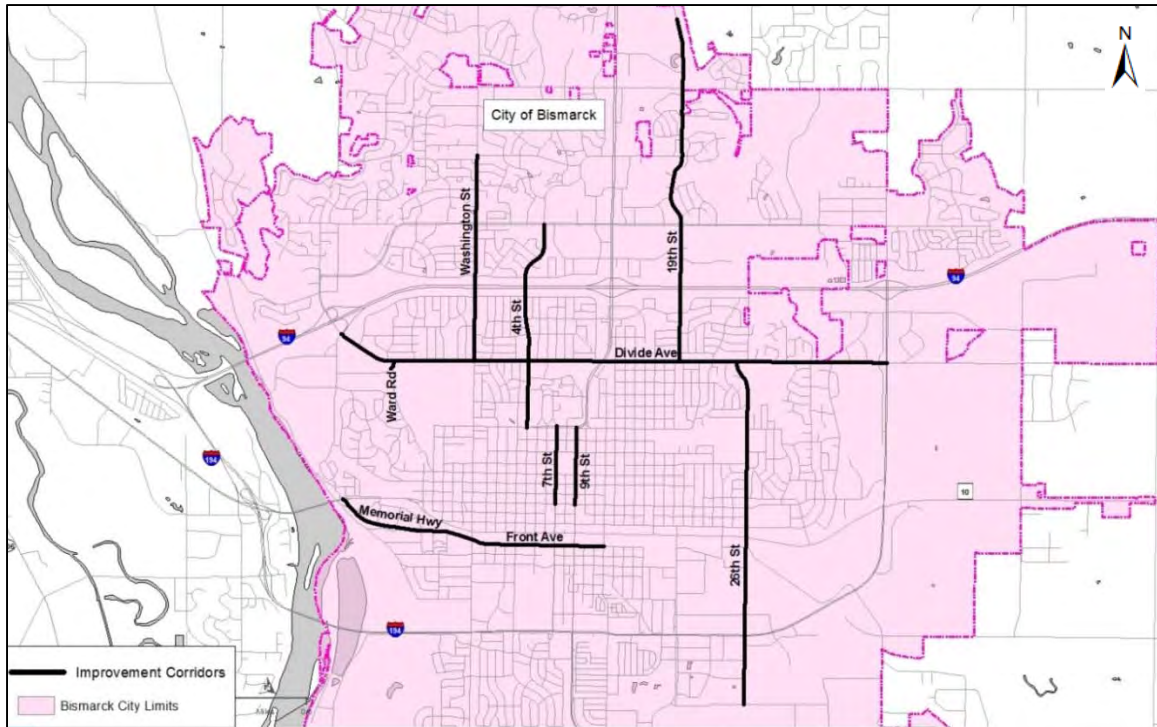


Figure 1. Bismarck Improvement Corridors

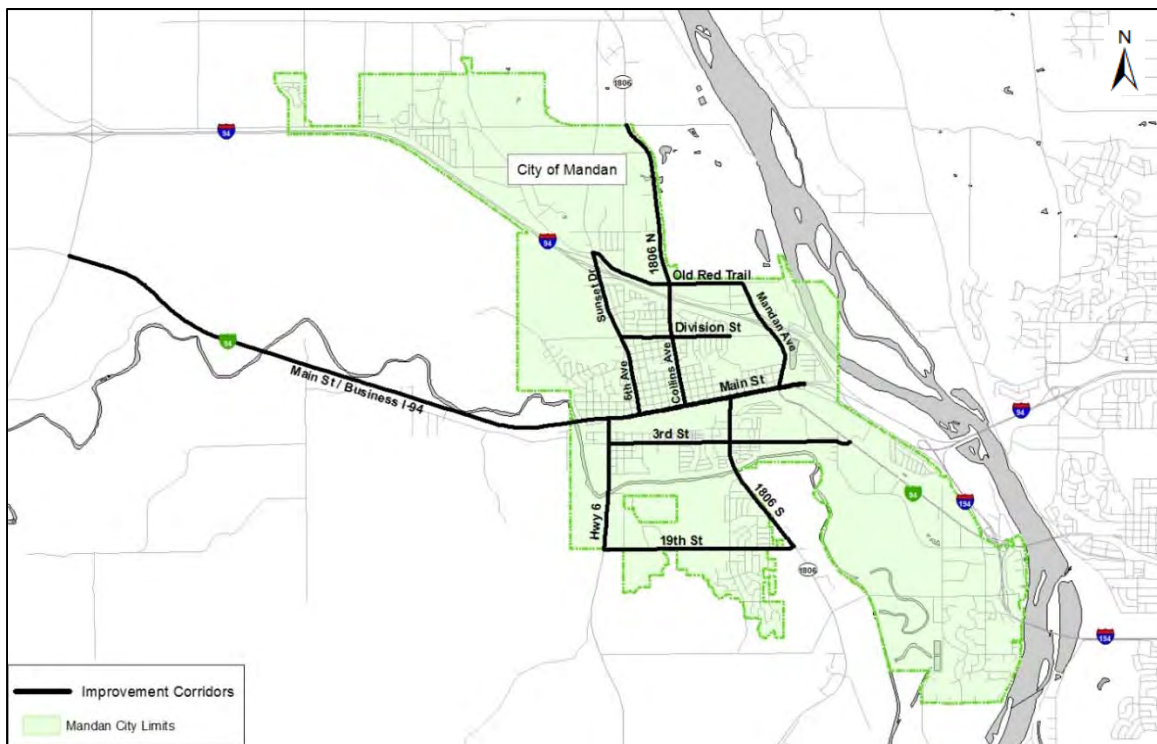


Figure 2. Mandan Improvement Corridors

In addition, as part of the initial proposal, an assessment was requested to determine the need of a potential truck route for the City of Mandan to alleviate heavy vehicle traffic along Main Street/Business I-94 between ND Highway 25 and Twin City Drive.

## 1.2 Background

Figure 3 shows the functional classification of roadways in Mandan and Bismarck. Most corridors included in the study are categorized as either minor arterials or principal arterials, meaning these roadways provide mobility for high volumes of traffic daily. While Ward Road is classified as a collector, a portion of its northern-most segment and intersection with Divide Avenue was included in the study because many drivers utilize it to travel north and south between Interstate 94 and Main Avenue. The alternatives discussed in this report have been identified as ways to improve the safety and traffic operations of each corridor to help them function as the arterials they are intended to be.

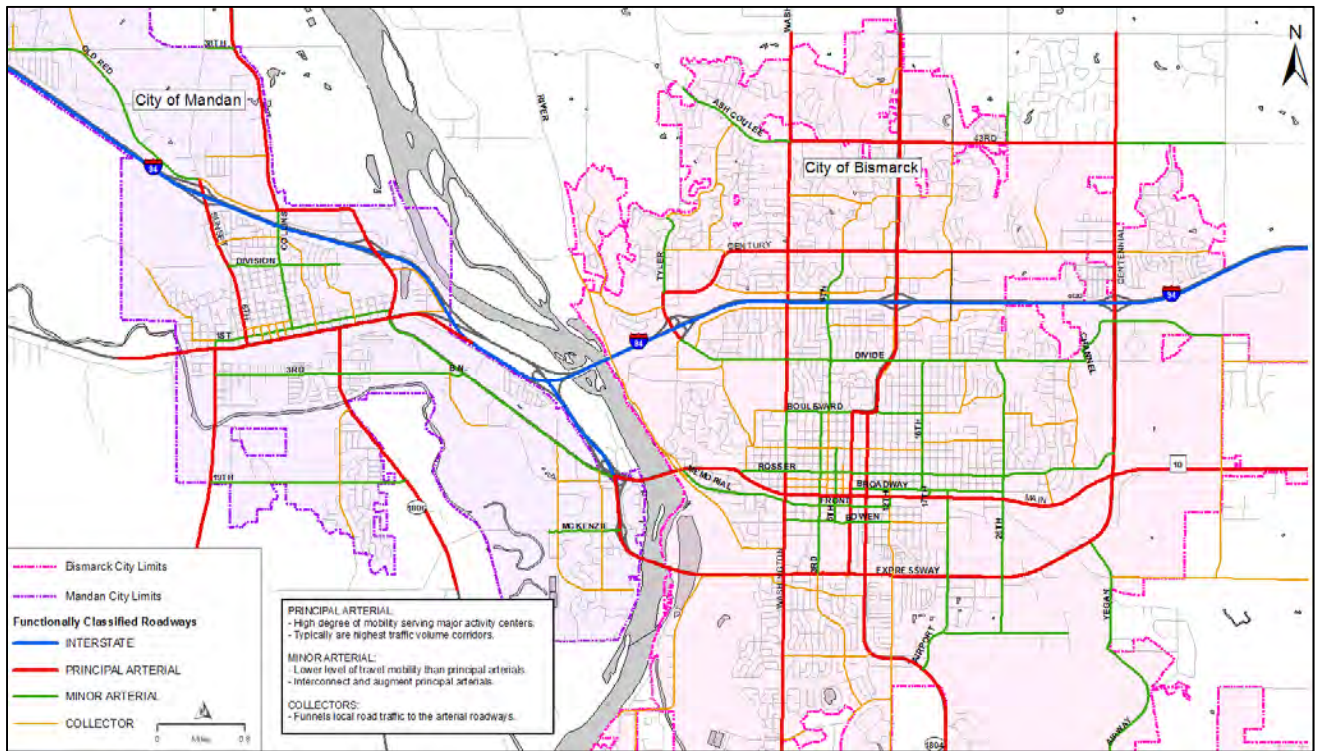


Figure 3. Functional Classification of Mandan and Bismarck Roads

## 2.0 Methodology

### 2.1 Existing 2014 Traffic Operations

The existing traffic operations of the corridors were analyzed in Technical Memo #1 (Appendix D) submitted to the MPO on January 25, 2016. The assessment was conducted using a planning-level Level of Service (LOS) approach based on the ARTPLAN analysis program within the Highway Capacity Manual (HCM). Using this methodology, characteristics such as daily traffic volumes, signal timings, and basic roadway geometry at major intersections were taken into account and used as inputs to generate generalized peak hour estimates of traffic operations for each corridor.

The 2014 Average Daily Traffic (ADT) and hourly Miovision traffic volume counts were provided by NDDOT for the major roadway segments within the study area. In addition to geometry, segment lengths, and segment speed inputs, additional corridor-specific inputs were included if available as well. The proportion of turning traffic was applied at major intersections. Heavy vehicle percentages were applied in correlation with each segment, ranging from 1% to 23% throughout the Mandan and Bismarck corridors. K-factors, which are the percentages of daily traffic occurring during the peak hour, ranged between 7% and 12%. D-factors, the percentage of travel in the peak direction during the peak period, ranged between 51% and 70%.

The ARTPLAN software is useful in incorporating the ADT volumes, segment length, peak hour directional distribution, on-street parking, and lane configuration to create a planning level analysis. The program results are driven by signalized intersection and the associated signal timings and turning lane configurations of each in the peak direction. The program does not take into account access density.

A safety analysis was also conducted and the results are presented in Technical Memo #1. NDDOT provided crash data for the calendar years of 2012, 2013, and 2014. All crashes that met the reportable crash threshold limits set by the State of North Dakota were included. The data provided by NDDOT contained crash report information that allowed crashes to be categorized based on characteristics such as location, manner of collision, and severity. This information was used to identify which intersections or roadway segments within the study area experienced the most crashes, as well as what types of crashes occurred. Crash rates were also developed to serve as a tool to prioritize and distinguish which corridors and intersections have the highest need for potential safety improvements. Each crash rate takes into account the total number of crashes during the study year period, ADT, and segment length. Segment crash rates are measured in crashes per million vehicle-miles of travel (MVM), while intersection crash rates are measured in crashes per million entering vehicles (MEV) in accordance with FHWA safety guidelines.

### 2.2 Forecasted 2040 Traffic Operations (No-Build)

The Mandan and Bismarck Corridor Improvement Study traffic forecasts were developed through a series of steps detailed in Technical Memo #2-3 (Appendix E), and submitted to the MPO on April 25, 2016. As discussed in Memo #2-3, traffic growth rates were forecasted



for corridor segments by evaluating outputs from the Bismarck-Mandan MPO travel demand model. The year 2014 ADT volumes were used as the baseline data source for the analysis and forecasts. The modeled growth rates were prorated to a rate reflecting growth as a 30-year trend from the model to the year 2040. The prorated growth factor was then associated with each segment in the studied corridors where an ADT count was available to develop 2040 ADT forecasts. Growth rate factors were interpolated at corridor segments where data was not available. The forecasted growth rates are relatively consistent across most corridors, which verified that interpolating between segments did not skew the results. Each segment's forecasted growth rates were reviewed for appropriateness by calculating the peak hour percentage of daily traffic (often referred to as "K-factors"). 2014 K-factors were then compared to 2040 K-factors for consistency.

Using the constraints of the existing infrastructure, also referred to as the No-Build Alternative, the forecasted 2040 traffic volumes were applied to determine the estimated 2040 LOS for each corridor segment located within the Bismarck-Mandan study area. The 2040 LOS results are provided in Figure. 2040 LOS results are provided in Appendix B and followed the same methodology as was used for Memo #1.

### **2.3 Potential Truck Route**

To determine existing truck patterns on Main Street through central Mandan, three different sources of data were used to assess truck flows, focusing primarily on through-movements. These sources include:

- A StreetLight commercial vehicle flow dataset, purchased from StreetLight Data, Inc.
- Assessing current corridor truck patterns based on NDDOT truck counts from various locations within the corridor.
- Conducting interviews with major trucking companies and locations that generate truck traffic in and around Mandan to understand truck travel patterns.

The process of evaluating the data from the mentioned sources, as well as their results, are included and discussed in the memo titled, "Evaluation of Truck Patterns Through Mandan Memo" submitted on November 25, 2015 (Appendix F). The memo concluded that while Main Street is the most direct route for many truck trips in Mandan, a route south of Main Street would provide the most direct option for an alternate truck route. In addition, the aggregate pit and asphalt plant located west of Mandan accounts for approximately 66% of the truck traffic along Main Street as was determined based on interviews with local truck generators and traffic counts available from NDDOT. Based upon conversations with the aggregate pit owner, the aggregate pit will be relocated in the near future due to lack of available natural resources within the area. Also, the asphalt plant will be relocated in the near future to the Twin City Industrial Site in East Mandan.

An assessment of the potential truck route alternatives was provided in the memo titled, "Mandan Truck Route Assessment" submitted on April 25, 2016 (Appendix G).

## **2.4 Development and Evaluation of Corridor Alternatives**

The alternatives proposed for each corridor were developed through LOS and safety analysis, as well as through site visits, collaboration with the major entities involved with the study, and public informational meetings and feedback from area residents.

### **2.4.1 PUBLIC INVOLVEMENT**

To encourage public participation and to solicit public input, an interactive webpage was developed and three rounds of public input meetings were conducted in the cities of Mandan and Bismarck. The study corridors and the existing conditions were presented at first round of public input meetings held on January 26<sup>th</sup>, and 28<sup>th</sup>, 2016. Preliminary alternatives for corridors within both cities were presented at the second round of public meetings held on March 29<sup>th</sup> and 31<sup>st</sup>, 2016. At the third round of public meetings held on June 1<sup>st</sup> and 2<sup>nd</sup>, 2016 the alternatives were discussed in further detail and analyzed to determine to what extent their effectiveness will have on traffic operations and safety. Through this process, the most beneficial mitigation efforts could be identified and given focus. Included in Appendix H is a summary of the public involvement activities, public meeting presentations and public comments received.

### **2.4.2 COST/BENEFIT ANALYSIS**

Each alternative was quantified and associated costs were determined utilizing the North Dakota Department of Transportation 2016 Average bid prices. The unit costs were adjusted to include miscellaneous items and contingencies

### **2.4.3 FEASIBILITY**

Each set of corridor alternatives also underwent a cost analysis, as well as a comparison of its advantages and disadvantages, and social impacts. Additional consideration was given for constructability and determining what level of difficulty would be involved in implementation.

### 3.0 Existing 2014 Traffic Operations

#### 3.1 Mandan and Bismarck 2014 Existing LOS

The estimated existing LOS for Mandan and Bismarck corridors are provided in Figure 4. The analysis is based on 2014 traffic volumes and the figure depicts segment LOS.

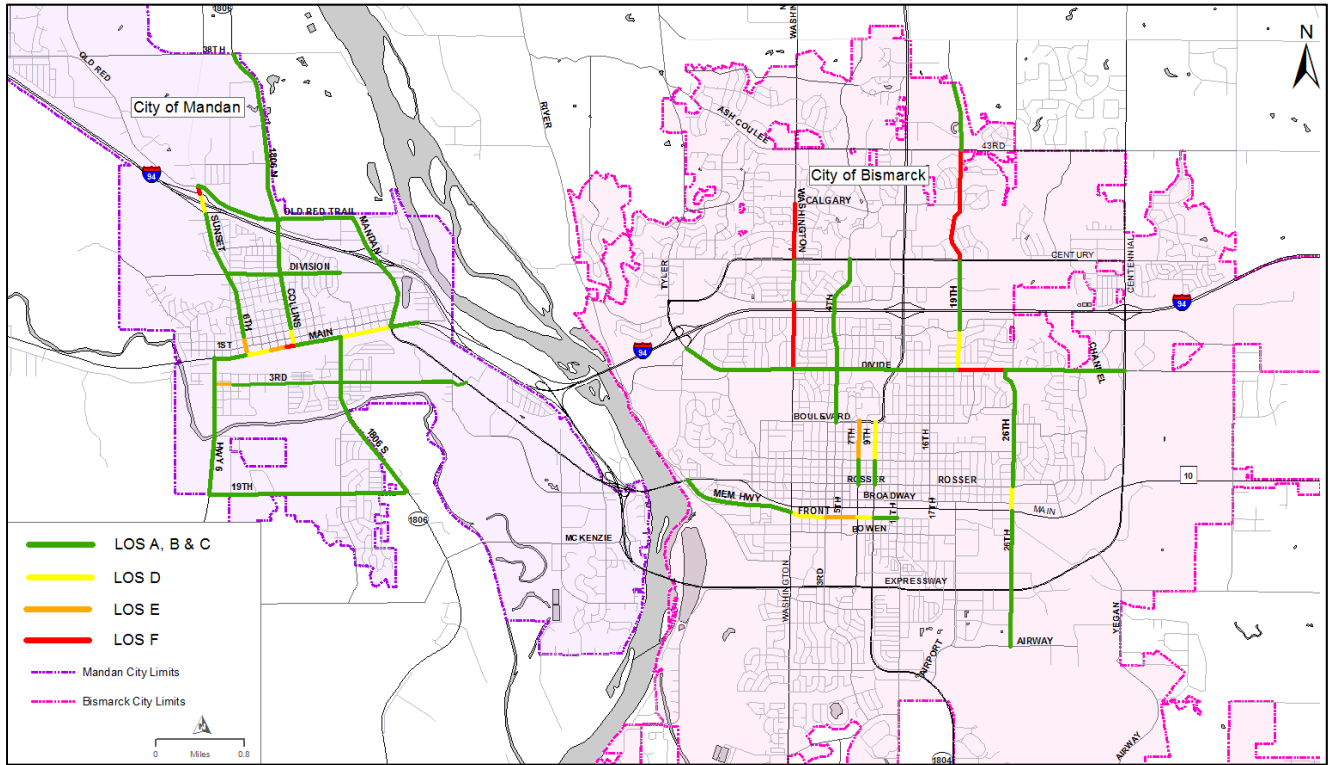


Figure 4. Bis-Man Corridors 2014 Existing LOS

Complete LOS results are provided in Appendix A. The results are shown for the through-movement intersection LOS at each main (primarily signalized) intersection as well as the corridor segment.

#### 3.2 Mandan Safety Analysis

There were a total of 259 intersection crashes and 183 segment crashes that occurred on the City of Mandan study corridors between 2012 and 2014. 19 (7%) of the 259 intersection crashes resulted in injury, while 16 (9%) of the 183 segment crashes were injury-related. The intersections that experienced the highest number of injury-related crashes were the intersections of Main Street and ND Highway 1806 S, and the intersection of ND Highway 1806 S and Burlington Street SE. The roadway segment that experienced the most injury-related crashes was Main Street between ND Highway 6 and Twin City Drive, with one fatality and three non-incapacitating injury crashes being reported during the study period.

Once again, visual comparisons of Mandan corridor crashes by manner of collision and severity can be found in Technical Memo #1 (Appendix D). Main Street between ND Highway 6 and Twin City Drive experienced the highest frequency of angle crashes in



comparison with other corridors, comprising approximately 33% of its total crashes. 3<sup>rd</sup> Street and ND Highway 1806 S experienced the highest total rear-end crashes.

A list of segment crash rates, measured in crashes per million vehicles-miles of travel (MVM), for the Mandan corridor segments is provided in Table 1. These rates take into account the total number of segment crashes during the study year period, ADT, and segment length and provide a comparison between the relative corridors. As was noted previously, Main Street was separated into two segments from ND Highway 25 to ND Highway 6 and from ND Highway 6 to Twin City Drive. The corridor with the highest crash rate of 2.11 crashes/MVM was identified as Main Street between ND Highway 6 and Twin City Drive. Highway 1806 S had the second highest segment crash rate of 1.89 crashes/MVM, followed by Sunset Drive/6<sup>th</sup> Avenue with a crash rate of 1.84 crashes/MVM. Sunset Drive/6<sup>th</sup> Avenue also had the highest segment injury crash rate of 0.32 crashes/MVM. 3<sup>rd</sup> Street was determined to have the second highest injury crash rate of 0.21 crashes/MVM.

**Table 1. Mandan Corridor Segment Crash Rates**

Corridor	Total Segment Crashes	Segment Crash Rate (Crashes/MVM)	Total Segment Injury Crashes	Segment Injury Crash Rate (Crash/MVM)
Main Street (ND Highway 6 to Twin City Drive)	61	2.11	4	0.14
ND Highway 1806 S	25	1.89	2	0.15
Sunset Drive / 6th Avenue	23	1.84	4	0.32
Collins Avenue	11	1.65	0	0.00
3rd Street	23	1.64	3	0.21
ND Highway 6	9	1.47	1	0.16
ND Highway 1806 N	9	1.15	1	0.13
Old Red Trail	8	0.92	0	0.00
19th Street	2	0.63	0	0.00
Main Street (ND Highway 25 to ND Highway 6)	8	0.55	1	0.07
Mandan Avenue	4	0.55	0	0.00
Division Street	0	0.00	0	0.00

Ten intersections having the highest crash frequency were analyzed to determine intersection crash rates. A comparison of intersection crash rates, measured as crashes per million entering vehicles (MEV), is provided in Table 2.

The Mandan intersection with the highest study area crash rate was ND Highway 1806 S and Burlington Street SE with 1.06 crashes/MEV. This intersection also had the highest injury crash rate at 0.18 crashes/MEV. The intersection with the second highest crash rate was 3<sup>rd</sup> Street and ND Highway 1806 S with 1.05 crashes/MEV, followed by the intersection of Main Street and ND Highway 1806 S at 0.98 crashes/MEV. Main Street and ND Highway 1806 S also had the second highest injury crash rate of 0.08 crashes/MEV.



**Table 2. Mandan Corridor Intersection Crash Rates**

Intersection	Total Intersection Crashes	Intersection Crash Rate (Crash/MEV)	Total Intersection Injury Crashes	Intersection Injury Crash Rate (Crash/MEV)
ND Highway 1806 S / Burlington Street SE	12	1.06	2	0.18
3rd Street / ND Highway 1806 S	20	1.05	1	0.05
Main Street / ND Highway 1806 S	24	0.98	2	0.08
Sunset Drive / Old Red Trail	13	0.75	1	0.06
Main Street / ND Highway 6	7	0.73	0	0.00
3rd Street / Memorial Highway	11	0.56	1	0.05
Main Street / Mandan Avenue / Memorial Highway	17	0.52	1	0.03
Sunset Drive / 8th Street NW	7	0.45	1	0.06
Main Street / Collins Avenue	6	0.39	0	0.00
Main Street / Twin City Drive	7	0.29	0	0.00

### 3.3 Bismarck Safety Analysis

There were a total of 524 reported intersection crashes and 716 reported segment crashes occurring on Bismarck corridors within the study area between the years of 2012, 2013 and 2014. 42 (8%) of those intersection crashes were injury-related, while 20 (3%) of those segment crashes were injury-related. There were no reported fatalities during the study period for any of the Bismarck corridors.

Intersection and segment crashes occurring on Bismarck corridors were analyzed based on both manner of collision and severity. Visual comparisons of crash locations by manner of collision and severity for both intersection and segment crashes on the Bismarck corridors can be found in Technical Memo #1 (Appendix D). Divide Avenue was found to have the highest number of total segment crashes (186 crashes), and it experienced the highest total of head-on collisions (4 crashes) and non-collision with motor vehicle crashes (19 crashes) as well. Washington Street, 9<sup>th</sup> Street, and Divide Avenue experienced the highest total crashes resulting in injury.

The segment crash rates for the Bismarck corridors are provided in Table 3 and are measured in crashes per million vehicle-miles of travel (MVM). The corridors are listed in order of highest to lowest in accordance with their segment crash rate value. Crash rates provide a consistent method of comparison in terms of relative safety and are based on 2014 ADT volumes. 2014 traffic volumes were assumed similar to each of the two years prior, so the yearly ADT volumes were not averaged. A more detailed analysis in the future, should the City choose to implement any of the alternatives for a specific corridor, could incorporate an averaged associated ADT for the critical crash rates for each segment. A location with a higher crash rate shows that it experiences higher crash frequencies in



relation to traffic volume and the overall length of the corridor compared to another location with a lower crash rate.

**Table 3. Bismarck Corridor Segment Crash Rates**

Corridor	Total Segment Crashes	Segment Crash Rate (Crashes/MVM)	Total Segment Injury Crashes	Segment Injury Crash Rate (Crash/MVM)
9th Street	89	11.30	3	0.38
7th Street	63	9.16	1	0.15
Memorial Highway-Front Avenue	72	6.99	2	0.19
Washington Street	119	5.55	5	0.23
Divide Avenue	186	4.63	5	0.12
4th Street	51	3.72	2	0.15
26th Street	75	3.39	1	0.05
Ward Road	4	2.62	0	0.00
19th Street	57	2.59	1	0.05

Based on the analysis, 9<sup>th</sup> Street and 7<sup>th</sup> Street were found to have the highest segment crash rates for corridors studied within the City of Bismarck at 11.30 and 9.16 crashes per million vehicle-miles of travel (MVM), respectively. Memorial Highway – Front Street was found to have the third highest segment crash rate at 6.99 crashes per million vehicle-miles of travel.

The ten intersections shown to experience the highest level frequency of crashes over the three-year period were selected and examined further to determine intersection crash rates. A comparison of intersection crash rates, measured as crashes per million entering vehicles (MEV), is provided in Table 4.



**Table 4. Bismarck Corridor Intersection Crash Rates**

<b>Intersection</b>	<b>Total Intersection Crashes</b>	<b>Intersection Crash Rate (Crash/MEV)</b>	<b>Total Intersection Injury Crashes</b>	<b>Intersection Injury Crash Rate (Crash/MEV)</b>
Front Avenue / 3rd Street	30	1.55	2	0.10
4th Street / Century Avenue	29	1.28	2	0.09
Front Avenue / 9th Street	17	1.12	2	0.13
Front Avenue / 7th Street	20	1.02	1	0.05
9th Street / Avenue C	20	1.00	2	0.10
Divide Avenue / Schafer Street	33	0.98	1	0.03
4th Street / Boulevard Avenue	15	0.84	2	0.11
7th Street / Rosser Avenue	15	0.63	4	0.17
Divide Avenue / State Street	28	0.59	2	0.04
Washington Avenue / Century Avenue	13	0.43	1	0.03

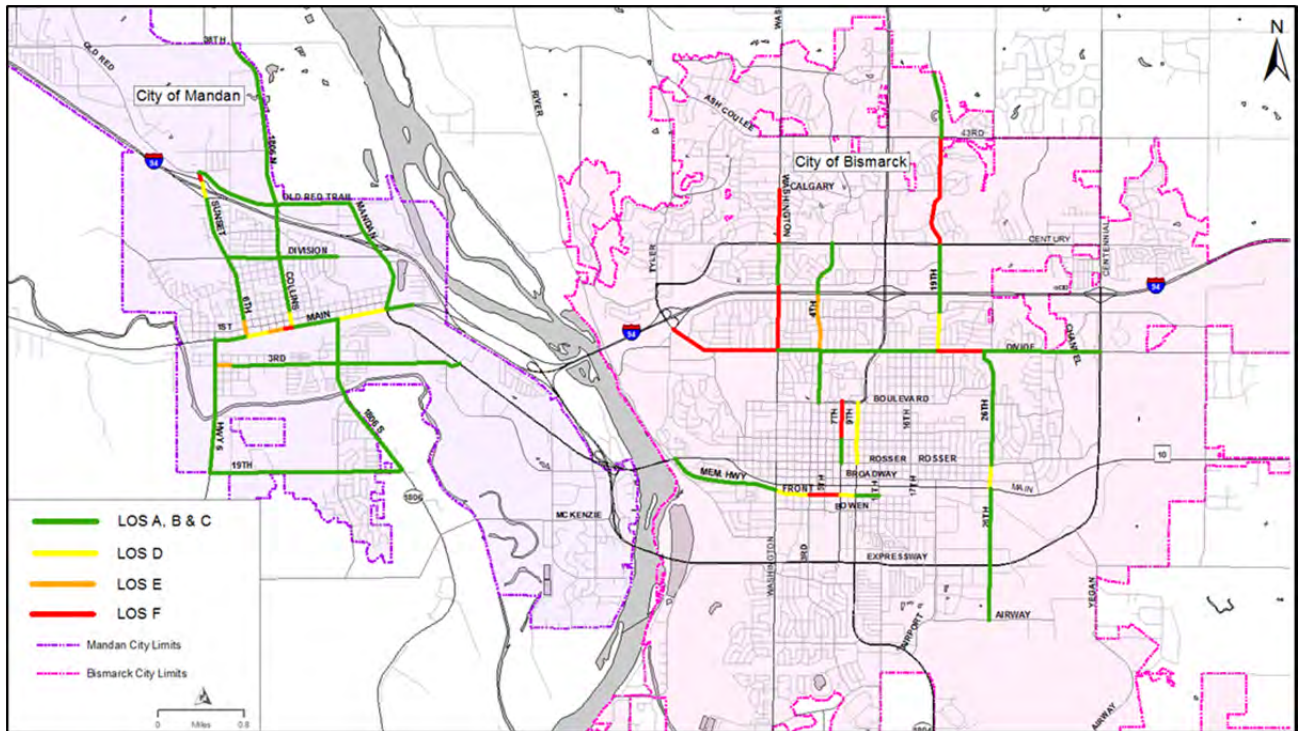
The Bismarck intersection with the highest intersection crash rate was identified as Front Avenue and 3<sup>rd</sup> Street with 1.55 crashes per million entering vehicles. The intersection of 4<sup>th</sup> Street and Century Avenue had the second highest crash rate at 1.28, and the intersection of Front Avenue and 9<sup>th</sup> Street had the third highest at 1.12. The intersection with the highest injury crash rate was identified as 7<sup>th</sup> Street and Rosser Avenue. For details regarding crash types and severity for the selected intersections of the Mandan and Bismarck corridors, please refer to Technical Memo #1's safety analysis in Appendix D of this report.

## 4.0 Forecasted 2040 Traffic Operations (No-Build)

### 4.1 Mandan and Bismarck 2040 Forecasted LOS

Using the constraints of the existing infrastructure also referred to as the no-build alternative, the forecasted 2040 traffic volumes were applied to determine the estimated 2040 LOS for each corridor segment located within the Bismarck-Mandan study area. The 2040 LOS results are provided in Figure 5. 2040 No-Build LOS results are provided in Appendix B and followed the same methodology as was used for Technical Memo #1.

Comparing the 2014 and 2040 LOS results, there is no variance for corridors Mandan but several corridors in Bismarck are projected to see deterioration in LOS by the year 2040. Divide Avenue from Schafer Street to Washington Street will decrease from LOS A to LOS F. 4<sup>th</sup> Street from Interstate Avenue to Divide Avenue will decrease from LOS C to LOS D. 7<sup>th</sup> Street from Boulevard Avenue to Rosser Avenue will decrease from LOS E to LOS F. Finally, Front Avenue from 3<sup>rd</sup> Street to 7<sup>th</sup> Street will decrease from LOS E to LOS F.





## 5.0 Development and Evaluation of Alternatives

### 5.1 Development of Alternatives

The objective of the study was to develop low-cost solutions to aid in improving traffic operations, as well as enhancing safety by reducing crashes along each selected corridor. The LOS of each corridor was re-evaluated with the proposed mitigation characteristics applied and used to help measure the effectiveness of each measure. 2040 Build LOS results are provided in Appendix B. Due to the choice of program used for analyzing traffic operations, some corridors do not show a change or improvement in LOS because the improvements, especially safety related, is not able to be recognized by the program. For example, improvements such as signing, pavement marking, left-turn offsets and parking reconfigurations will improve the safety and understanding of roadway users although it may not significantly alter the expected LOS under forecasted volumes. In addition, the program analyzes the LOS for the through-movement of the major roadway in the peak direction only. Therefore, any changes to signalization in terms of phasing, timing, or updating to flashing yellow arrow (FYA) are not measurable in this study and would require a more detailed intersection analysis to determine how LOS would be improved or changed. The program also does not take into account access density for each segment, but rather focuses on left turns at major signalized intersections.

In addition, the alternatives presented are meant for long-term planning purposes only, not as actual design. Prior to implementation, an additional field review and further traffic analysis should be done to review existing roadway widths and a more detailed analysis conducted to determine the necessary lane widths for proposed typical sections. Parking will also need to be evaluated in more detail prior to alternative implementation.

### 5.2 Mandan Corridor Alternatives

The following list provides the proposed alternatives for each corridor within the study areas of Mandan. The cost analysis associated with each can be found in Appendix C. A no-build alternative is proposed for certain segments where forecasted traffic is expected to function at acceptable levels or where future changes are constrained by existing parameters.

#### **MAIN STREET (ND HIGHWAY 25 TO TWIN CITY DRIVE)**

Recommended Alternative:

- No-build between ND Highway 25 and 10<sup>th</sup> Avenue NW (ND Highway 6).
- Install 3-lane section between 10<sup>th</sup> Avenue NW and 3<sup>rd</sup> Avenue NE.
  - Maintain on-street parking on north side, except for areas near intersection where a few stalls will be eliminated to incorporate extended right-turn lane.
  - Add on-street parking on the south side.
  - Lengthen right-turn lane at major intersections.
- Coordinate all traffic signals and add protected left turn phasing at all signalized intersections.
- Re-stripe all crosswalks and improve all crosswalks.
- Install Pedestrian Hybrid Beacon (HAWK beacon) at un-signalized intersections, if warranted.

- Add advanced pedestrian crossing signage at the intersections of 2<sup>nd</sup> Avenue NW and 4<sup>th</sup> Avenue NW.

Advantages:

- 3-lane sections remove left-turning vehicles from through movements, allowing through traffic on the major roadway to remain uninterrupted.
- Protected left turn phasing at all intersections will more adequately empty turning queues and improve intersection capacity.
- Coordination of traffic signals will improve efficiency of corridor by allowing through vehicles to travel further before being required to stop at signal.
- Improved pedestrian signing and beacons raises driver awareness and may improve pedestrian safety.
- In year 2040, Segment LOS improves from E to D between 6<sup>th</sup> Avenue NW and 3<sup>rd</sup> Avenue.
- In year 2040, Segment LOS improves from F to E between 3<sup>rd</sup> Avenue NW and 1<sup>st</sup> Street.

Disadvantages:

- Elimination of parking at areas of extended right-turn lanes may receive opposition from nearby businesses.



Figure 6. 3-Lane Section and Parking Example on Main Street

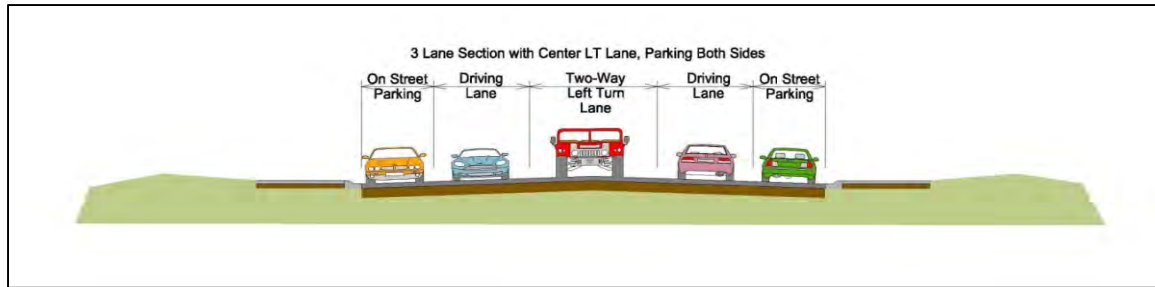


Figure 7. 3-Lane Section with Parking Typical Section

**SUNSET DRIVE / 6<sup>TH</sup> AVENUE (MAIN STREET TO OLD RED TRAIL)**

Recommended Alternative:

- No-build between Main Street and North ramp terminal of the I-94/Sunset Drive Interchange.
- Intersection of Sunset Drive and Old Red Trail.
  - Install a dedicated right turn lane for northbound to eastbound traffic on Sunset Drive.
  - Remove island on the west approach of Old Red Trail, and remove the channelized right-turn lane.
  - Narrow the through lane for the southbound traffic immediately south of the intersection.
  - Add clear advanced signage for drivers on the westbound I-94 off-ramp.
- South ramp terminal of the I-94/Sunset Drive Interchange.
  - Install signal control on channelized right turn on eastbound-to-southbound approach.
- Coordinate timing of signals at the I-94 westbound and eastbound ramp terminals with the signal at Old Red Trail.

Advantages:

- Reconfiguration of lanes and improved signing/pavement markings at the intersection of Old Red Trail and Sunset Drive may improve driver understanding and comprehension and reduce confusion regarding which lane the driver needs to be in.
- In year 2040, Segment LOS improved from F to E between North and South Interchange intersections.

Disadvantages:

- Changes would impact other intersections. Both I-94 ramp intersections and signalization must be integrated as well, which requires additional planning and coordination.



Figure 8. Lane Striping and Reconfiguration at Sunset Drive and Old Red Trail Intersection

**ND HIGHWAY 6 (19<sup>TH</sup> STREET TO MAIN STREET)**

Recommended Alternative:

- No-build between 19<sup>th</sup> Street and Main Street.
- Intersection of ND Highway 6 and 19<sup>th</sup> St.
  - Install a southbound left turn lane and a northbound right turn lane (Currently under development and includes intersection lighting).
  - Install advance intersection signing.

Advantages:

- Implementing designated turn lanes at the intersection of ND Highway 6 and 19<sup>th</sup> Street helps remove turning vehicles from the through movement and allows through traffic to remain uninterrupted.
- Improved advanced signing and lighting at the intersection of ND Highway 6 and 19<sup>th</sup> will improve visibility and driver expectation.



Figure 9. Turn Lanes on ND Highway 6 at 19th Street Intersection

**OLD RED TRAIL (MANDAN AVENUE TO SUNSET DRIVE)**

Recommended Alternative:

- No-build between Mandan Avenue and Sunset Dr.
- Intersection of Old Red Trail and Mandan Avenue.
  - Flatten horizontal curve.
  - Add advance intersection signing.
  - Consolidate Tesoro access to one approach as a radial “T” intersection.
  - Provide left and right turn lanes.

Advantages:

- Realignment of the intersection of Old Red Trail and Mandan Avenue will eliminate the need for speed reduction and increase driver visibility.
- Right turn lane for northbound trucks into Tesoro at intersection of Old Red Trail and Mandan Avenue removes turning vehicle from the through movement and allows for through traffic on Old Red Trail to remain uninterrupted.

Disadvantages:

- Realignment of the roadway would be costly and require ROW acquisition.



Figure 10. Realignment of Old Red Trail

**MANDAN AVENUE (MAIN STREET TO OLD RED TRAIL)**

Recommended Alternative:

- No-build between Main Street and Old Red Trail.
- Intersection of Mandan Avenue and Main Street.
  - Update and restripe the pavement markings on intersection approaches.
  - Add lane extension skips through the intersection to help drivers navigate.
  - Add overhead lane designation signs on mast arms of traffic signal.

Advantages:

- Updating the overhead signing and striping, including lane extension skips through the intersection, helps improve driver understanding and aids them in navigating through the intersection more efficiently.

Disadvantages:

- No disadvantages have been identified.



Figure 11. Intersection Guidance Striping at Mandan Avenue and Main Street Intersection

### 3<sup>RD</sup> STREET (ND HIGHWAY 6 TO MEMORIAL HIGHWAY)

Recommended Alternative:

- No-build between ND Highway 6 and Memorial Highway.
- Intersection of 3<sup>rd</sup> Street and 9<sup>th</sup> Avenue.
  - Replace 4-way stop with 2-way stop.
  - Add Pedestrian Signing.
  - Install Pedestrian Hybrid Beacon (HAWK beacon), if warranted.
- Intersection of 3<sup>rd</sup> Street and 8<sup>th</sup> Avenue.
  - Replace 4-way stop with 2-way stop.
  - Add Pedestrian Signing.
  - Install Pedestrian Hybrid Beacon (HAWK beacon).
- Intersection of 3<sup>rd</sup> Street and Memorial Highway.
  - Add curb and gutter or guardrail along radius to prevent erosion and enhance safety of turning vehicles.

Advantages:

- Elimination of 4-way stops between ND Highway 6 and 8<sup>th</sup> Street allows for through movement on major roadway to remain uninterrupted.

- Implementation of curb or guardrail along the radius at the intersection of 3<sup>rd</sup> Street and Memorial Highway may improve the safety of turning vehicles.
- In year 2040, Segment LOS improves from E to A between ND Highway 6 and 8<sup>th</sup> Avenue

Disadvantages:

- Eliminating control on the major roadway requires vehicles on minor approach to wait longer for an acceptable opening.



Figure 12. School Zone Requiring Pedestrian Signing on 3<sup>rd</sup> Street



Figure 13. Installation of Curb or Guardrail at Intersection of 3<sup>rd</sup> Street and Memorial Highway



**19<sup>TH</sup> STREET (ND HIGHWAY 6 TO ND HIGHWAY 1806)**

Recommended Alternative:

- Extend the existing urban section from Ridge Drive to ND Highway 6 with a 3-lane section.
  - No on-street parking.
- Extend the existing urban section from 14<sup>th</sup> Avenue SE to ND Highway 1806 with a 3-lane section.
  - No on-street parking.
- Provide turn lanes to all major intersections between Ridge Drive and ND Highway 6.
- 3-lane section between Ridge Drive and 14<sup>th</sup> Avenue SE.
  - No on-street parking.

Advantages:

- Providing turn lanes at all major intersections helps remove turning vehicles from the through movement, allowing through traffic on the major roadway to remain uninterrupted.
- Installation of 3-lane section and elimination of on-street parking between Ridge Drive and 14<sup>th</sup> Avenue SE improves through traffic along major roadway.

Disadvantages:

- Elimination of parking may receive opposition from nearby residents.
- Extension of the urban section will be costly.



**Figure 14. Continuation of Urban 3-Lane Section on 19th St**



Figure 15. Example of Implementation of 3-Lane Section on 19<sup>th</sup> Street

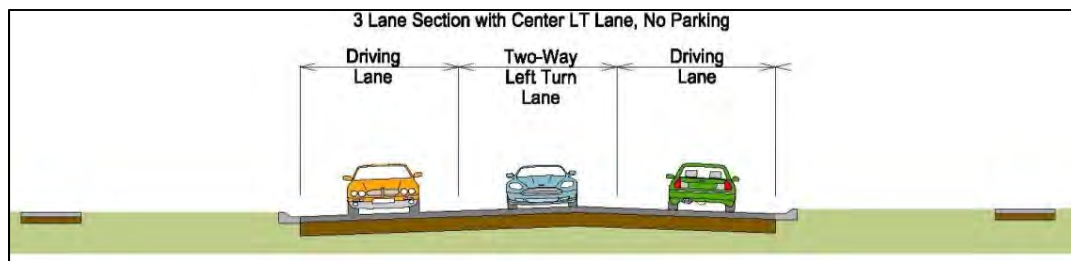


Figure 16. 3-Lane Typical Section

**COLLINS AVENUE (MAIN STREET TO OLD RED TRAIL)**

Recommended Alternative:

- No-build between Main Street and Old Red Trail.
- Intersection of Collins Avenue and 5<sup>th</sup> Street NE Improve sight distance by offsetting retaining walls at the 5<sup>th</sup> Street NE, 7<sup>th</sup> Street NE and Division Street intersections.
- Intersection of Collins Avenue and 14<sup>th</sup> Street.
  - Replace 4-way stop with a 2-way stop.
  - Signalize if warranted.
- Intersection of Collins Avenue and Old Red Trail.
  - Because of the proposed Starion Sports Complex intersection improvements may be needed.
    - Install traffic signal and left turn lanes in all quadrants or consider installing a roundabout.

Advantages:

- Installation of traffic signal or roundabout at intersection of Old Red Trail and Collins Avenue increases overall intersection capacity.
- Elimination of 4-way stop at intersection of 14<sup>th</sup> Street and Collins Avenue allows for major roadway through movements to remain uninterrupted.
- Offsetting the retaining wall further away from the street at the intersection of Division Street and Collins Avenue improves sight distance on the east approach of Division.
- In year 2040, Segment LOS improves from F to D between Old Red Trail and 14<sup>th</sup> Street.
- In year 2040, Segment LOS improves from F to B between 14<sup>th</sup> Street and 2<sup>nd</sup> Street.

Disadvantages:

- Eliminating control on the major roadway requires vehicles on minor approach to wait longer for an acceptable gap to complete their turning movement.
- Implementing traffic signal or roundabout may require ROW acquisition and high initial costs.
- Replacing and offsetting retaining wall requires coordination with additional entities, such as landowners and utility companies.



Figure 17. Lane Configuration and Possible Traffic Signal at Collins Avenue and Old Red Trail Intersection

**ND HIGHWAY 1806 N (38<sup>TH</sup> STREET TO OLD RED TRAIL)**

Recommended Alternative:

- No-build between Old Red Trail and 38<sup>th</sup> Street
- Intersection of ND Highway 1806 N and 27<sup>th</sup> Street NW
  - Installation of left turn lane on northbound ND Highway 1806 N at the intersection of 27<sup>th</sup> Street.
  - Installation of right turn lane on southbound ND Highway 1806 at the intersection of 27<sup>th</sup> Street.
  - Provide right/left turn lanes on the eastbound minor approach 27<sup>th</sup> Street at intersection with ND Highway 1806 N.
  - Install a Pedestrian Hybrid Beacon (HAWK beacon) at the pedestrian crossing, if warranted.

Advantages:

- Installation of left turn lane on northbound ND Highway 1806 N at the intersection of 27<sup>th</sup> Street will help remove turning vehicles from the through traffic on the major corridor.
- Installation a HAWK beacon pedestrian crossing at the intersection with 27<sup>th</sup> Street will raise driver awareness and may improve pedestrian safety.



Figure 18. Turn Lanes on ND 1806N at 27<sup>th</sup> St

**ND HIGHWAY 1806 S (MAIN STREET TO 19<sup>TH</sup> STREET SE)**

Recommended Alternative:

- 3-lane section between 3<sup>rd</sup> Street SE to Main Street.
  - No on-street parking.
- Intersection of ND Highway 1806 S and 3<sup>rd</sup> Street SE.
  - Extend curb and gutter around radius to control access into the gas station.

- Align left turn lane offsets on the east and west approaches.
- Utilize the boulevard on the east approach between the curb and sidewalk to improve intersection lane geometry without eliminating on-street parking.
- Intersection of ND Highway 1806 S and Burlington Street.
  - Add a pedestrian crossing and sidewalk along the east side of ND Highway 1806 S (6<sup>th</sup> Avenue SE).
  - Install traffic signal if warranted.
  - If signal is not warranted install a Pedestrian Hybrid Beacon (HAWK beacon) at the pedestrian crossing.
  - Install left turn lane on ND Highway 1806 S on the south approach and right turn lane on north approach for vehicles turning onto Burlington Street.
- Just south of the intersection of 3<sup>rd</sup> Street and ND Highway 1806 S, the southbound through movement quickly merges from two through lanes to one with minimal transition length.
  - Use one lane as a right turn lane on the north approach and drop it at the intersection. Therefore only one lane is carried through the intersection and eliminates the need for merging.
  - Incorporate a dedicated left turn lane.
- No-build between 3<sup>rd</sup> Street SE and 19<sup>th</sup> Street SE.

#### Advantages:

- 3-lane sections remove left-turning vehicles from through movements, improving uninterrupted flow for through movements.
- Protected left turn phasing at all intersections may be more effective at emptying turning queues and improve intersection capacity.
- Improved pedestrian signing and beacons raises driver awareness and improves pedestrian safety.
- Implementing traffic signal at Burlington-street intersection may reduce crashes as this intersection experienced high crash rates.
- Realign intersection approaches and lane geometry at the intersection with 3<sup>rd</sup> Street will improve driver sight distance.
- In year 2040, Segment LOS improves from F to D with the addition of traffic signal at Burlington Street.

#### Disadvantages:

- Realignment of the roadway would be costly and require ROW acquisition.

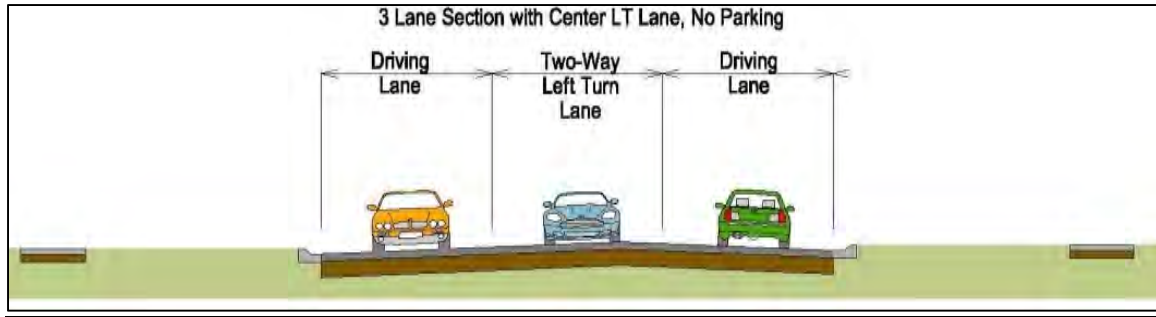


Figure 19. 3-Lane Typical Section



Figure 20. Lane and Curb Configuration at Intersection of ND Highway 1806 S and 3rd St

(Note: Aerial image is out of date, additional buildings currently exist in northeastern quadrant of intersection)



Figure 21. Turn Lanes and Possible Signal at ND 1806S and Burlington Street Intersection

**DIVISION-STREET (SUNSET AVENUE TO 8<sup>TH</sup> AVE NE)**

Recommended Alternative:

- No-build between Sunset Drive and 8<sup>th</sup> Avenue NE.
- At the intersection of Sunset Drive and Division Street:
  - Restripe stop bar on Division Street closer to perpendicular travel lane on Sunset Drive to increase sight distance on approach.
  - Maintain roadside vegetation and prune trees as necessary to provide adequate sight distance for drivers on Division Street approach.
- At the intersection of Division Street and 6<sup>th</sup> Avenue:
  - Eliminate yield and stop control for Division Street approaches and allow for free through movement.
  - Make 6<sup>th</sup> Avenue approaches stop controlled.
- At the intersection of Division Street and Collins Avenue:

- As previously mentioned, offset retaining wall further from roadway to provide increased sight distance for drivers on east Division Street approach.

Advantages:

- Updating pavement marking stop bar and maintain roadside vegetation will aid drivers visibility and improve safety at the intersection with Sunset Drive.
- Eliminating stop and yield control on major roadway improves capacity and efficiency of major through movements through the intersection along Division Street and 6<sup>th</sup> Avenue.

Disadvantages:

- Elimination yield and stop control on Division-street and reassigning 6<sup>th</sup> Avenue traffic with stop control may take drivers some time to get accustomed to.



Figure 22. Intersections of Division St/Sunset Drive and Division St/6th Ave



### 5.3 Bismarck Corridor Alternatives

The following list provides the proposed alternatives for each corridor within the study areas of Bismarck. The cost analysis associated with each can be found in Appendix C. A no-build alternative is proposed for certain segments where forecasted traffic is expected to function at acceptable levels or where future changes are constrained by existing parameters.

#### **WASHINGTON-STREET (DIVIDE AVENUE TO CALGARY AVENUE)**

Recommended Alternative:

- 3-lane section from Divide Avenue to Calgary Avenue.
  - No on-street parking.
- Reduce the number of driveways (vehicle access points) from Washington Street to the Northbrook Tesoro Gas Station, closest to the intersection with Central Avenue.
- Washington Street & Century Avenue Intersection.
  - Re-align the Century Avenue left turn lanes to remove negative offsets.
  - Install Flashing Yellows (FYA) on all approaches.
  - Relocate light poles.
- Improve coordination of traffic signals between Interstate Avenue and Turnpike Avenue.

Advantages:

- 3-lane sections remove left-turning vehicles from through movements, allowing through traffic on the major roadway to remain uninterrupted.
- Reducing negative offset of left-turn lanes at the intersection of Washington Street and Century Avenue improves sight distance for turning vehicles and improves safety.
- Flashing Yellow Arrows (FYA) on all approaches at the intersection of Washington-street and Century Avenue improves safety and allows for protected-permissive phasing. In recommendation of alternative, negative offsets will be removed from left-turn lanes where FYA applied.
- Coordination of traffic signals at Interstate Avenue and Turnpike Avenue allows for improved traffic flow.
- Closing vehicle access points at the intersection of Washington Street and Central Avenue improves safety by eliminating excessive conflict points and allows through traffic along major corridor to be uninterrupted by turning vehicles.

Disadvantages:

- Closed access points at Washington Street and Central Avenue may raise issues with Northbrook Tesoro gas station.
- Reducing left turn offset at intersection of Washington Street and Century Avenue may be costly due to the amount of curb removal, pavement replacement, and lighting improvements.
- Public acceptance of elimination of parking spaces.



Figure 23. Example of Implementation of 3-Lane Section on Washington St

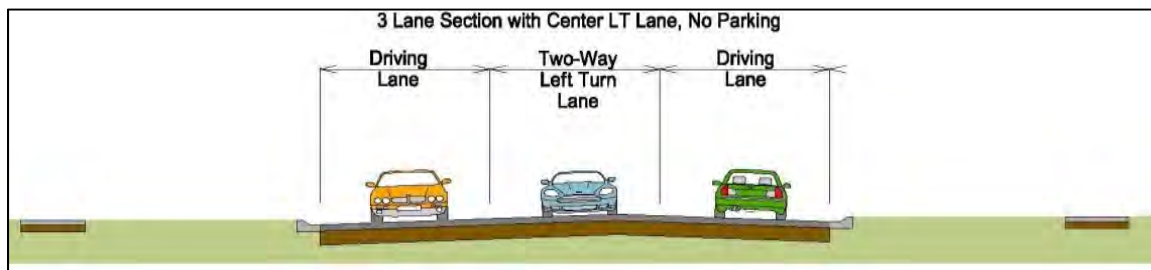


Figure 24. 3-Lane Typical Section

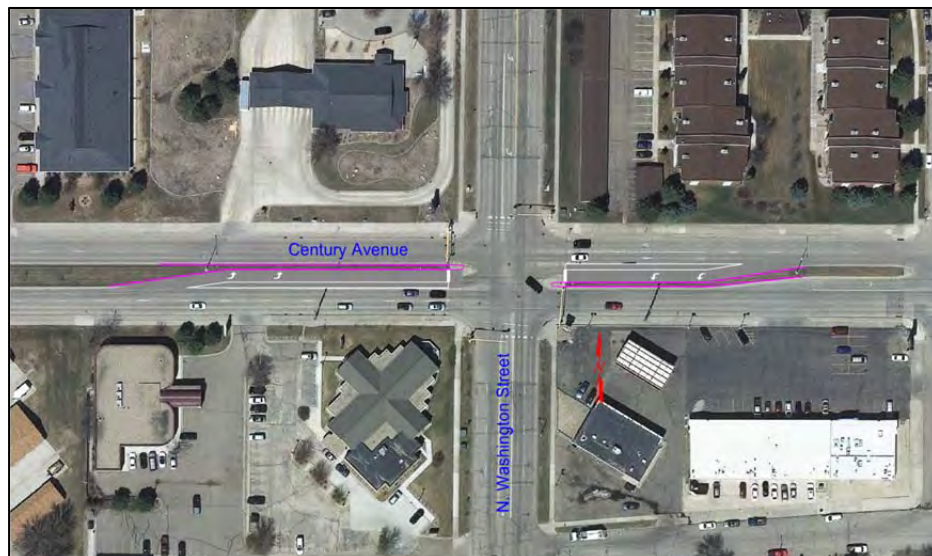


Figure 25. Realignment of Left-Turn Offsets at Washington Street and Century Avenue Intersection



Figure 26. Closed Access Points at Northbrook Tesoro

**DIVIDE AVENUE (SHAFER STREET TO BISMARCK EXPRESSWAY)**

Recommended Alternative:

- 3-lane section from Shafer Street to 26<sup>th</sup> Street. (This recommendation is consistent with the NDDOT Local Safety Plan recommendation)
  - No on-street parking.
  - Keep bike lanes from Shafer Street to Washington Street and State Street to 26<sup>th</sup> Street.
  - Enhance visibility of bike lane pavement markings.
  - Keep share the road signage from Washington Street to State Street.
- Divide Avenue & Washington Street Intersection.
  - Increase curb radius in each quadrant.
- Divide Avenue & 4<sup>th</sup> Street Intersection.
  - Increase length of Divide Avenue left turn lanes.
  - Install Flashing Yellows (FYA) on all approaches.

Advantages:

- 3-lane sections remove left-turning vehicles from through movements, allowing for uninterrupted flow for the through movement.
- Eliminating on-street parking allows for wider lane widths and increases visibility for drivers and bicyclists.
- Flashing Yellow Arrows (FYA) on all approaches at the intersection of Washington Street and Divide Avenue improves safety and could be integrated into protected-permissive phasing.
- Increasing storage length for westbound left turning vehicles on Divide Avenue reduces congestion by removing backed up left-turning vehicles waiting to turn from the through traffic movements.
- Increasing the radius on each quadrant of the intersection of Washington Avenue and Divide Avenue allows heavy vehicles (i.e. delivery trucks, etc.) to complete turning movements without encroaching on opposing lanes of traffic.

Disadvantages:

- Increasing radius at intersection may potentially require more ROW acquisition and opposition from nearby residents.
- Public acceptance of elimination of parking.



Figure 27. Example of Implementation of 3-Lane Section on Divide Ave

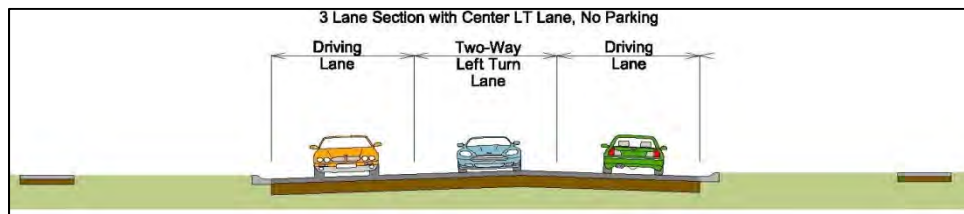


Figure 28. 3-Lane Typical Section



Figure 29. Example Implementation of 3-Lane Section with Bike Lanes on Divide Ave

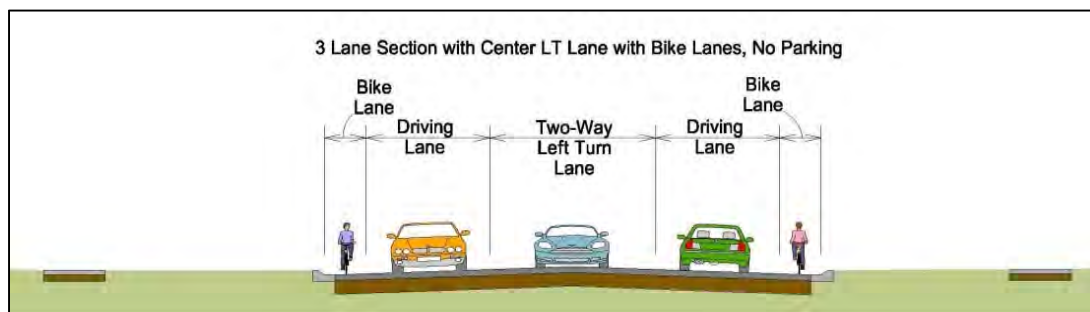


Figure 30. 3-Lane Typical Section with Bike Lanes

**4<sup>TH</sup> STREET (BOULEVARD AVENUE TO CENTURY AVENUE)**

Recommended Alternative:

- 3-lane section from Boulevard Avenue to Century Avenue (This recommendation is consistent with the NDDOT Local Safety Plan recommendation).
  - No on-street parking.
  - Improve street lighting from Interstate Avenue to Century Avenue.
- 4<sup>th</sup> Street & Century Avenue Intersection.
  - Re-align the Century Avenue left turn lanes to remove negative offsets.
  - Install Flashing Yellows (FYA) on all approaches.
  - Relocate light poles.
- Divide Avenue & 4<sup>th</sup> Street Intersection.
  - Increase length of Divide Avenue left turn lanes.
  - Install Flashing Yellows (FYA) on all approaches.
- Coordinate traffic signals along Boulevard Avenue between 3<sup>rd</sup> Street and 7<sup>th</sup> Street.

Advantages:

- 3-lane sections remove left-turning vehicles from through movements, allowing for uninterrupted flow for the through movements.

- Eliminating on-street parking allows for wider lane widths and increases visibility for drivers and bicyclists.
- Flashing Yellow Arrows (FYA) on all approaches at intersections improves safety by increasing caution amongst left-turning drivers and increases the left-turning movement capacity by allowing for protected-permissive phasing.
- Improving the left-turn offsets at the intersection of 4<sup>th</sup> Street and Century Avenue increases the sight distance for drivers and improves safety.
- Improving street lighting increases the visibility of roadway conditions and pedestrians.

Disadvantages:

- Reducing left turn offset at intersection of 4<sup>th</sup> Street and Century Avenue may be costly due to amount of curb removal, pavement replacement, and lighting improvements.
- Push back from local residents and businesses due to elimination of on-street parking.



Figure 31. Example of Implementation of 3-Lane Section on 4th Street

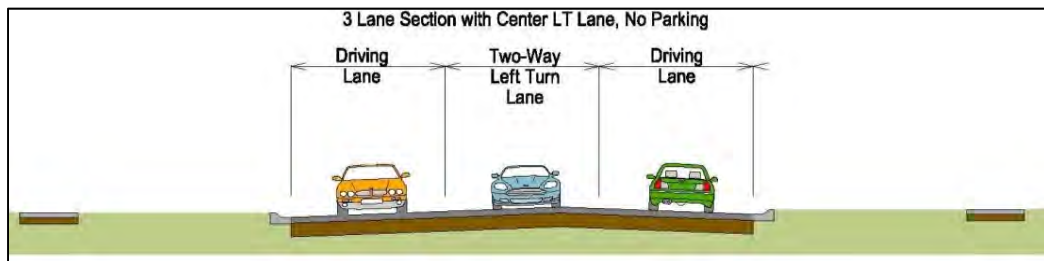


Figure 32. 3-Lane Typical Section



**Figure 33. Left Turn Offsets at Intersection of 4th Street and Century Avenue Intersection**

**7<sup>TH</sup> STREET (BOULEVARD AVENUE TO ROSSER AVENUE)**

Recommended Alternative:

- Install 3 through lanes from Boulevard Avenue to Rosser Avenue.
  - No parking on west side.
- Improve lighting along 7<sup>th</sup> Street corridor, especially in the school zone at Bismarck High School.
- Move stop bars further back from crosswalks.
- Install “Stop Here for Pedestrian” signing to get vehicles to stop further away from crosswalks.
- Add supplemental signing and pavement markings to all pedestrian crossings to increase visibility.

Advantages:

- 3-through-lane section with no parking allows for wider lane widths and allowing through traffic on the major roadway to remain uninterrupted.
- Improves sight distance of pedestrian crossing facilities.
- Improved lighting increases visibility for drivers to see pedestrians in school zone.
- Moving stop bars further from the crosswalk and installing supplemental or additional pedestrian signing increases driver awareness for pedestrians in school zone.
- Segment LOS improved from F to D between Boulevard and E Avenue C.

Disadvantages:

- Elimination of on-street parking may result in opposition from nearby houses and students.



Figure 34. Example Implementation of 3-Through Lane Section with Parking on 7th St

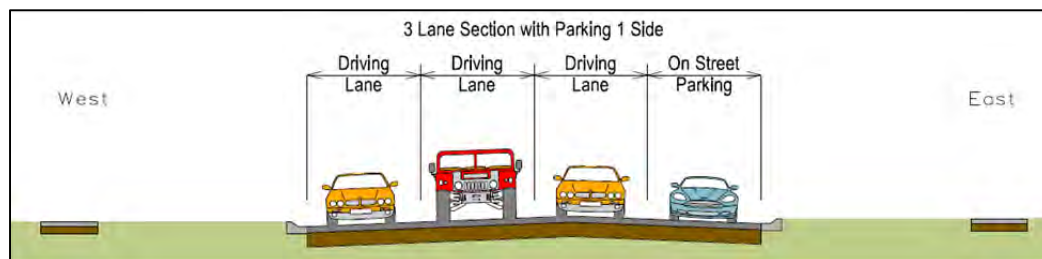


Figure 35. 3-Through Lanes with Parking Typical Section

**9<sup>TH</sup> STREET (BOULEVARD AVENUE TO ROSSER AVENUE)**

Recommended Alternative:

- Install 3 through lanes from Rosser Avenue to Boulevard Avenue.
  - No parking on east side.
- Improve lighting along 9<sup>th</sup> Street corridor, especially in the school zone at Bismarck High School.
- Move stop bars further back from crosswalks.
- Install “Stop Here for Pedestrian” signing to get vehicles to stop further away from crosswalks.



- Add supplemental signing and pavement markings to all pedestrian crossings to increase visibility.

Advantages:

- 3-through-lane section with no parking allows for wider lane widths and allowing through traffic on the major roadway to remain uninterrupted.
- Improves sight distance of pedestrian crossing facilities.
- Improving lighting, stop bars, and installing supplemental or additional pedestrian signing helps raise driver awareness of pedestrians in school zone.
- Segment LOS improved from D to C between Rosser and E Avenue C.
- Segment LOS improved from D to C between E Avenue C and Boulevard.

Disadvantages:

- Elimination of on-street parking may result in opposition from nearby houses, students, and Bismarck public schools.



Figure 36. Example of Implementation of 3-Through Lane Section with Parking on 9th St

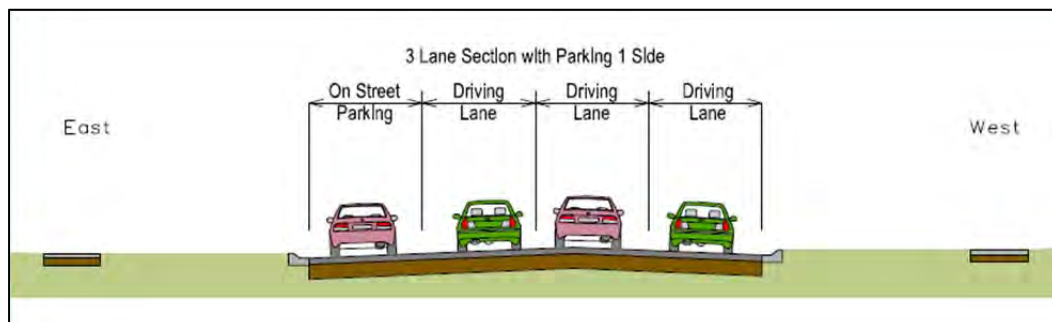


Figure 37. 3-Through Lanes with Parking Typical Section

### Front Ave/Memorial Highway (Main Avenue to 12<sup>th</sup> Street)

#### Recommended Alternative:

- No-build between Main Avenue and Washington Street.
- 3-lane section from Washington Street to 12<sup>th</sup> Street. (This recommendation is consistent with the NDDOT Local Safety Plan recommendation).
  - No on-street parking.
- Front Street & 3<sup>rd</sup> Street Intersection.
  - Install Flashing Yellows (FYA) on all approaches.
- Eliminate 2 access points from strip mall north of Front Street near Washington Street.

#### Advantages:

- 3-lane sections remove left-turning vehicles from through movements, allowing for more effective uninterrupted flow of the through movements.
- Flashing Yellow Arrows (FYA) on all approaches at intersections improves safety by increasing caution amongst left-turning drivers and increases the left-turning movement capacity by allowing for protected-permissive phasing.
- Elimination of access points on north side of Front Ave, just east and west of Mandan St, improves safety by eliminating excessive conflict points and allows through traffic along major corridor to be uninterrupted by turning vehicles.

#### Disadvantages:

- Closed access points may receive opposition from nearby businesses due to implication with parking lot flow.
- Unconventional lane widths must be approved to incorporate 3-lane-section with elimination of parking.
- Elimination of on-street parking may receive opposition from nearby businesses.

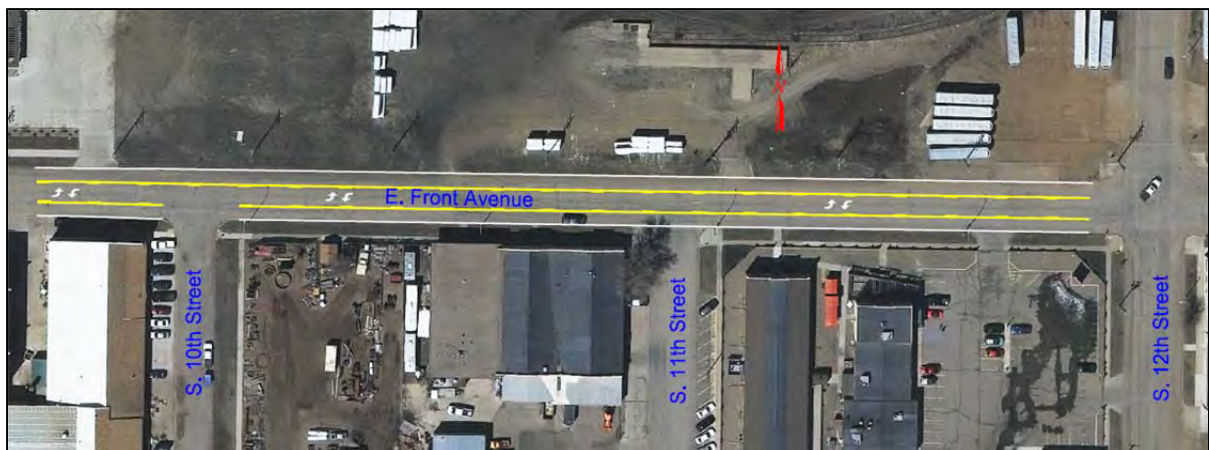


Figure 38. Example of Implementation of 3-Lane Section on Front/Memorial

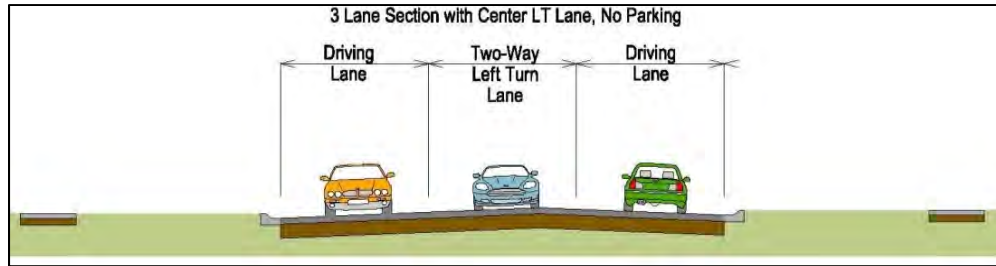


Figure 39. 3-Lane Typical Section



Figure 40. Example of Closing Access on Front

**26<sup>TH</sup> STREET (AIRWAY AVENUE TO DIVIDE AVENUE)**

Recommended Alternative:

- No-build between Airway Avenue and Main Avenue.
- 3-lane section from Main Avenue to Ave D.
  - No on-street parking from Thayer Avenue to Avenue D.
- No-build between Avenue D and Divide Avenue.

Advantages:

- 3-lane sections remove left-turning vehicles from through movements, allowing for more effective uninterrupted flow of the through movements.

Disadvantages:

- Elimination of on-street parking may receive opposition from nearby homes and/or businesses.
- Due to existing radii at intersection of 26<sup>th</sup> Street and Boulevard Avenue, it would be difficult for WB truck traffic to turn North without hitting curb or going into opposing lane.



Figure 41. Example of Implementation of 3-Lane Section on 26th Street

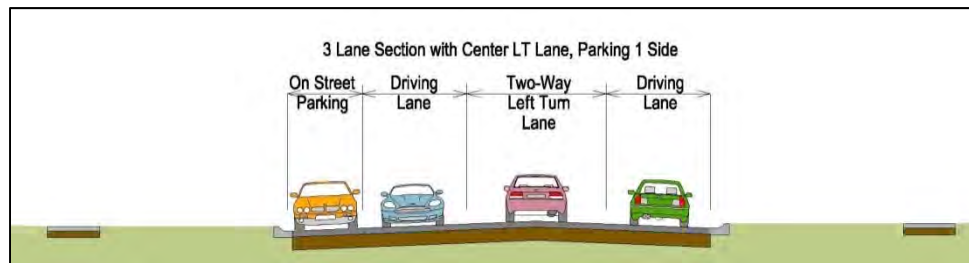


Figure 42. 3-Lane Typical Section with Parking

**19<sup>TH</sup> STREET (DIVIDE AVENUE TO LASALLE DRIVE)**

Recommended Alternative:

- 3-lane section from Divide Avenue to Capitol Avenue.
  - No on-street parking.
- Between Capitol Avenue and Century Ave, extend 3-lane section further south to accommodate turn lane at Basin Electric access.
- 3-lane section from Century Avenue to LaSalle Drive. (This recommendation is consistent with the NDDOT Local Safety Plan recommendation).
  - Eliminate on-street parking.
- Between Yucca Ave and 43<sup>rd</sup> Avenue.
  - Extend urban section from where it ends south of Yucca Avenue to 43<sup>rd</sup> Avenue and stripe as a 3-lane section with no parking.

- Provide left turn lane and a right/through lane on south approach at intersection with 43<sup>rd</sup> Avenue.

Advantages:

- 3-lane sections remove left-turning vehicles from through movements, allowing for more effective uninterrupted flow of the through movements.
- Realigning the north and south 19<sup>th</sup> Street approaches at the intersection of 19<sup>th</sup> Street and 43<sup>rd</sup> Avenue will improve intersection sight distance for drivers and improve lane continuity as well as driver expectation.
- Implementing designated left and right turn lanes at the intersection of 19<sup>th</sup> Street and 43<sup>rd</sup> Avenue helps separate turning vehicles from the through movements, allowing the major corridor traffic to be uninterrupted.

Disadvantages:

- Extending the urban section and realignment of 19<sup>th</sup> Street to 43<sup>rd</sup> Avenue is costly and will require ROW acquisition.
- Elimination of on-street parking may receive opposition from nearby homes/businesses.

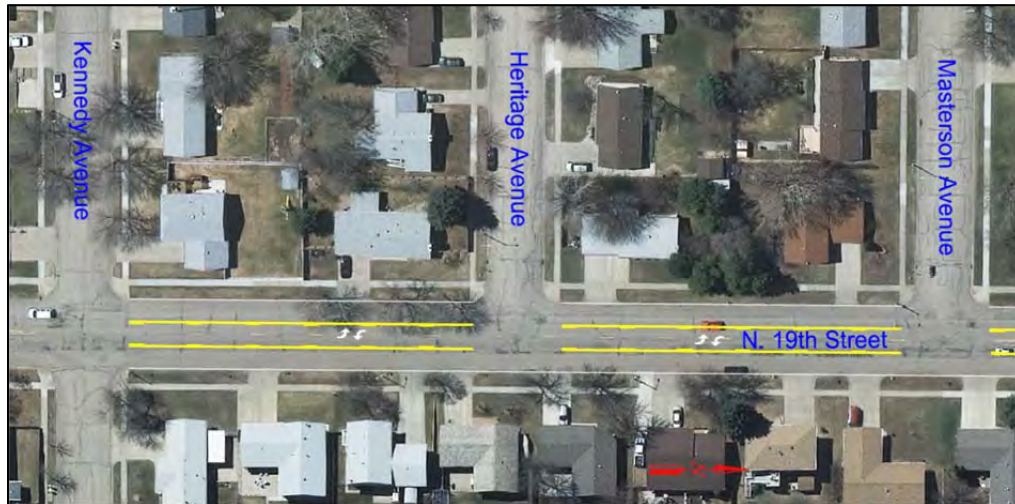


Figure 43. Example of Implementation of 3-Lane Section on 19th Street

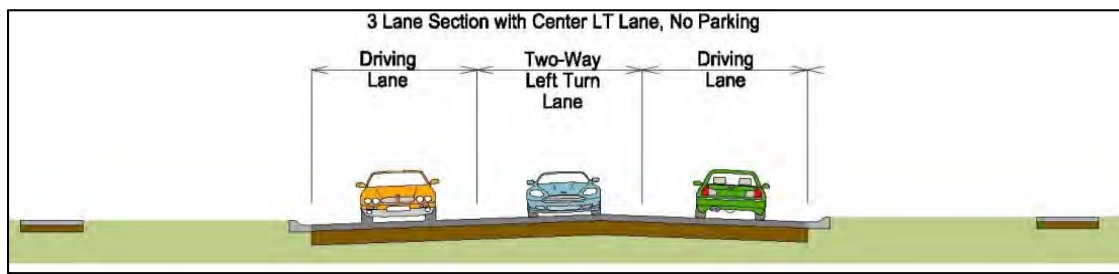


Figure 44. 3-Lane Typical Section with No Parking



Figure 45. Turn Lane and Approach Realignment at 19th Street and 43rd Street Intersection

**WARD ROAD (DIVIDE AVENUE TO EDWARDS AVENUE)**

Recommended Alternative:

- Realignment of Ward Road and College Drive.

Advantages:

- Realignment of Ward Road to result in 90 degree angle with Divide Avenue would increase sight distance for drivers at the intersection.
- Allows Ward Road to serve as a direct connection to Divide Avenue.

Disadvantages:

- Realignment of the roadway would be costly and may require ROW acquisition.



Figure 46. Ward Road Realignment

## 6.0 Conclusions

Based on the safety analysis and the existing and forecasted LOS results, various alternatives were developed for each corridor within the study area. Some alternatives focus more on traffic operations and efficiency, while others are meant to mitigate safety concerns and crashes. Project stakeholders were included in the development of the preliminary alternatives and provided helpful insight. Utilizing various aspects of each of the proposed alternatives will be beneficial in improving not only traffic operations along each corridor, but also improve the safety at major intersections by reducing either the frequency of crashes or severity of crashes. Ultimately these improvements will assist in helping each corridor operate appropriately according to its functional classification.

At intersections with negative left-turn offsets, such as the intersection of Washington-street and Century Avenue in Bismarck, realigning the turn lanes will be beneficial in improving sight distance for turning vehicles so drivers can view oncoming traffic. Improving overhead signing and pavement markings at large intersection such as that of Mandan Avenue and Main Street in Mandan will help drivers navigate more safely and efficiently. At signalized intersection, the implementation of Flashing Yellow Arrows (FYA) will help raise driver awareness in yielding to oncoming vehicles, as well as providing extended protected-permissive phasing so a higher volume of turning vehicles can make the turning movements. Where FYA is applied, left-turn offsets will need to be eliminated.

Reconfiguration of lanes along corridor segments resulted in either the elimination of some or all on-street parking and focused on left turn lanes. To accommodate corridors with high access density, such as Main Street in Mandan for example, 3-lane typical sections were utilized to help separate turning traffic from the main through traffic and improve efficiency.



## 7.0 Recommendations

### 7.1 Implementation

The recommendations for low-cost alternatives to be applied to each corridor were determined based on an evaluation of LOS, social impacts, a comparison between advantages and disadvantages, cost comparisons, as well as overall construction feasibility. The alternatives presented in this report are the recommended low-cost solutions for improving traffic operations and enhancing overall safety of the study area corridors. Prioritization should be given to alternatives that improve safety and driver expectation relating to signing, striping, signalization, and improved visibility at intersections and pedestrian facilities.

It is recommended that a more thorough evaluation be conducted as a separate study before the future implementation of any of the proposed alternatives. This further analysis should include any site-specific traffic volumes and turning movement counts, signalization timings, and should also take into consideration details regarding existing utilities and nearby landowners as relevant to the proposed alternative project location. Also, as a planning level study, assumptions were made regarding signalization timings based on minimum requirements required by the Signal Timing Manual. Should any of the alternatives be implemented in the future, a more accurate analysis would need to be conducted to determine real green time and cycle lengths for intersection LOS and capacity analysis. Further intersection analysis will determine if a particular intersection meets the warrants for a traffic signal modification such as FYA. Lighting should be evaluated along the corridors as necessary as well.

Existing speed limits were not evaluated in this study. Many of the corridors serve as arterials while also being located in residential areas. Upon the future implementation of an alternative at a specific site location, speed limits can be re-evaluated at that time.

Regarding the potential for a truck route in Mandan, in consideration of the significant reduction of the truck traffic on Main Street due to the relocation of the aggregate pit and the asphalt plant, and the cost for improvement of 45<sup>th</sup> Street from ND Highway 6 to ND Highway 1806 to serve as a truck route for a small volume of trucks, the no-build alternative is recommended.

For the corridors where a 3-lane roadway section is recommended, the restriping of the roadway to a 3-lane section can be incorporated with other corridor maintenance requiring restriping, such as chipping seals and overlay projects.

Figures 47 and 48 show the proposed typical sections for the recommended alternatives for each corridor within the study area.

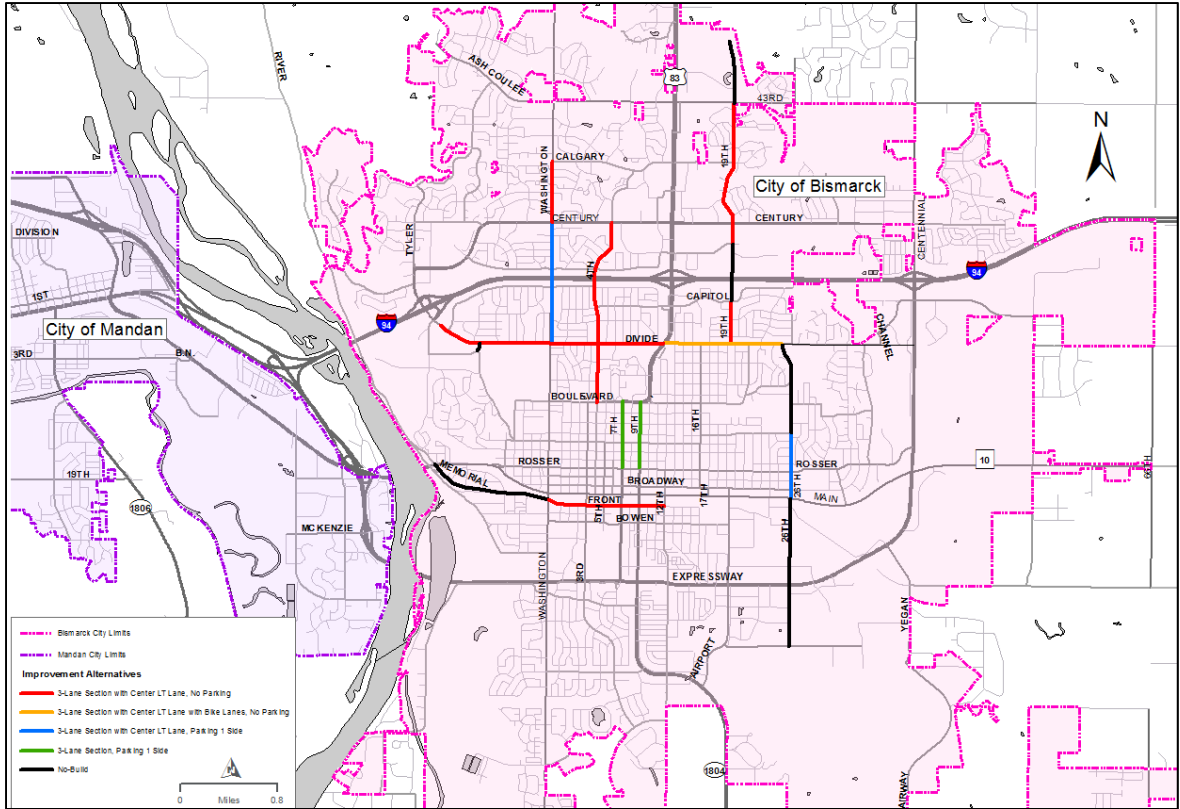


Figure 47. Bismarck Corridors Recommended Alternative Typical Sections

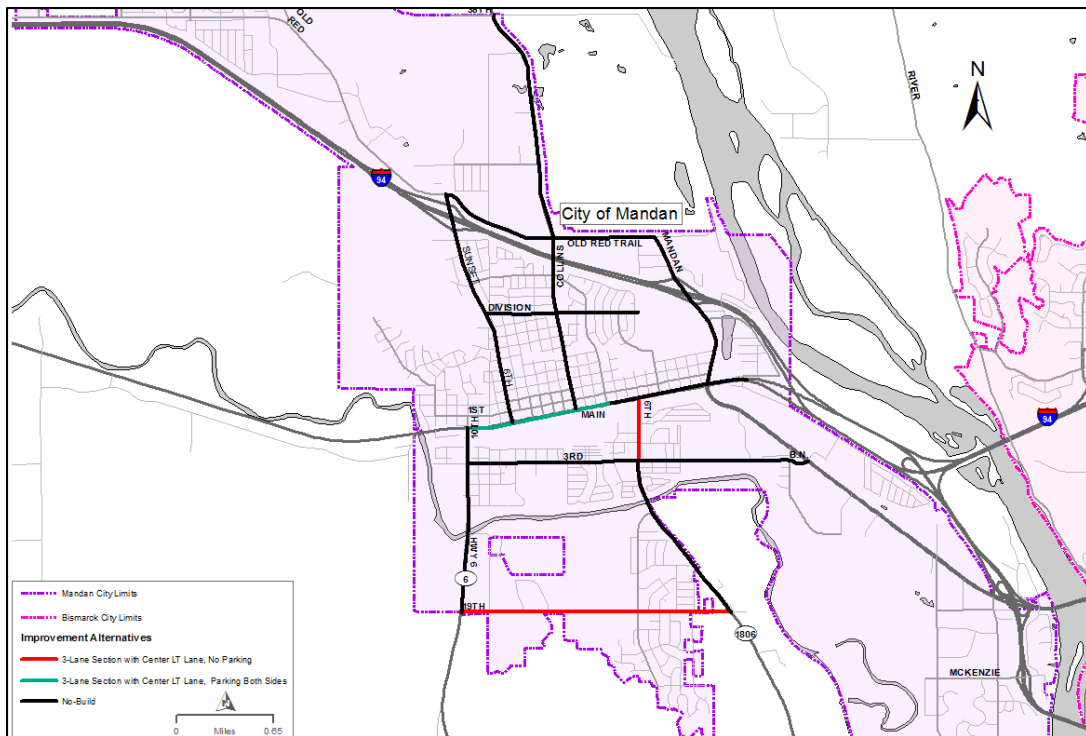


Figure 48. Mandan Corridors Recommended Alternative Typical Sections

## 7.2 Prioritization

Two lists prioritizing the corridors for each city are provided below. These lists may be used as a guideline when deciding which corridor should be studied further for alternative implementation as funds are made available. The prioritization ranking is based on forecasted 2040 LOS, as well as the segment and intersection crash rates associated with each corridor and its major intersections.

The Bismarck corridors are listed in order of highest priority (1) to lowest priority (9) below:

1. 9<sup>th</sup> Street (Boulevard Avenue to Rosser Avenue)
2. 7<sup>th</sup> Street (Boulevard Avenue to Rosser Avenue)
3. Washington-street (Calgary Avenue to Divide Avenue)
4. Front Avenue/Memorial Highway (Main Avenue to 12<sup>th</sup> Street)
5. Divide Avenue (Schafer Street to Bismarck Expressway)
6. 19<sup>th</sup> Street (Divide Avenue to LaSalle Drive)
7. 26<sup>th</sup> Street (Divide Avenue to Airway Avenue)
8. 4<sup>th</sup> Street (Century Avenue to Boulevard Avenue)
9. Ward Road (Edwards Avenue to Divide Avenue)

The Mandan corridors are listed in order of highest priority (1) to lowest priority (11) below:

1. Main Street /Business I-94 (ND Highway 25 to Twin City Drive)
2. Collins Avenue (Main Street to Old Red Trail)
3. 3<sup>rd</sup> Street (ND Highway 6 to Memorial Highway)
4. Sunset Drive/6<sup>th</sup> Avenue NW (Main Street to Old Red Trail)
5. ND Highway 1806 South (Main Street to 19<sup>th</sup> Street)
6. ND Highway 6 (Main Street to 19<sup>th</sup> Street NW)
7. Old Red Trail (Mandan Avenue to Sunset Drive)
8. Mandan Avenue/ND Highway 1806 (Main Street to Old Red Trail)
9. ND Highway 1806 North (Old Red Trail to 38<sup>th</sup> Street)
10. 19<sup>th</sup> Street (ND Highway 6 to ND Highway 1806)
11. Division-street (Sunset Avenue to 8<sup>th</sup> Avenue NE)



# APPENDIX A

## 2014 Level of Service (Existing)



## 2014 Level of Service – Mandan Corridors

### Sunset Drive/6th Ave

Segment	2014 ADT (vpd)	Through Movement Intersection LOS	Segment LOS
Old Red Trail - N Interchange	12850	F	F
N Interchange - S Interchange	10600	C	D
S Interchange - 2nd St	5095	B	B
2nd St- 1st St	4665	B	E
1st St - Main St	4130	B	E

### Highway 6

Segment	2014 ADT (vpd)	Through Movement Intersection LOS	Segment LOS
19th - Main st	5730	C	B

### Old Red Trail

Segment	2014 ADT (vpd)	Through Movement Intersection LOS	Segment LOS
Sunset Dr - Collins Ave	5000	B	A
Collins Ave - Mandan Ave	5800	B	B

### Mandan Ave

Segment	2014 ADT (vpd)	Through Movement Intersection LOS	Segment LOS
Old Red Trail -Main St	5800	B	A

### Division Street

Segment	2014 ADT (vpd)	Through Movement Intersection LOS	Segment LOS
6th St - ND 1806	1000	B	B
ND 1806 - 8th Ave	1000	B	B

### Main Street

Segment	2014 ADT (vpd)	Through Movement Intersection LOS	Segment LOS
Hwy 25 - 10th Ave NW	2350	B	A
10th Ave NW - 6th Ave NW	7060	B	C
6th Ave NW - 3rd Ave NW	8075	B	D
3rd Ave NW - 1st St	10275	C	E
1st St - Collins Ave	13405	D	F
Collins Ave - 6th Ave NW	15270	C	B
6th Ave NW - Memorial Hwy	19820	D	D
Memorial Hwy - Twin City Dr	20090	C	C

### 3rd Street SW

Segment	2014 ADT (vpd)	Through Movement Intersection LOS	Segment LOS
Hwy 6 - 9th Ave	1800	B	E
9th Ave - 8th Ave	1800	B	E
8th Ave - 1806	5225	B	A
1806 - Memorial Hwy	8600	E	B

### 19th Street SE

Segment	2014 ADT (vpd)	Through Movement Intersection LOS	Segment LOS
Hwy 6 - 8th Ave	2070	B	A
8th Ave - ND 1806	1620	B	B

### Collins Ave

Segment	2014 ADT (vpd)	Through Movement Intersection LOS	Segment LOS
Old Red Trail - 14th St	5730	B	C
14th St - 2nd St	5340	B	B
2nd St - Main St	4175	B	D

### Highway 1806 N

Segment	2014 ADT (vpd)	Through Movement Intersection LOS	Segment LOS
38th St - Old Red Trail	4455	B	A

### Highway 1806 S

Segment	2014 ADT (vpd)	Through Movement Intersection LOS	Segment LOS
19th St - 3rd St	7500	C	A
3rd St - Main St	10305	B	B



## 2014 Level of Service – Bismarck Corridors

### Washington St

Segment	2014 ADT (vpd)	Through Movement Intersection LOS	Segment LOS
Divide Ave - Interstate Ave	13950	F	F
Interstate Ave - Century Ave	11730	B	B
Century Ave - Calgary	12250	E	F

### 4th Street

Segment	2014 ADT (vpd)	Through Movement Intersection LOS	Segment LOS
Boulevard - Divide	9885	C	C
Divide - Interstate	8915	C	C
Interstate - Century	5560	B	C

### 9th Street

Segment	2014 ADT (vpd)	Through Movement Intersection LOS	Segment LOS
Rosser - E Ave C	13820	C	C
E Ave C - Boulevard	12040	B	D

### 26th St

Segment	2014 ADT (vpd)	Through Movement Intersection LOS	Segment LOS
Airway Ave - Bismarck Expressway	8515	C	B
Bismarck Exp - Main Ave	10050	B	A
Main Ave - Rosser	9595	C	D
Rosser - Divide Ave	10045	C	B

### Ward Rd

Segment	2014 ADT (vpd)	Through Movement Intersection LOS	Segment LOS
Ewards Ave - Divide Ave	5000	A	A

### Divide Ave

Segment	2014 ADT (vpd)	Through Movement Intersection LOS	Segment LOS
Bismarck Expressway - 26th St	15170	B	B
26th St - 19th St	10945	F	F
19th St - State St	10360	B	B
State St - 4th St	11245	C	C
4th St - Washington St	13625	C	C
Washington St - Schafer St	5520	B	A

### 7th Street

Segment	2014 ADT (vpd)	Through Movement Intersection LOS	Segment LOS
Boulevard - E Ave C	10535	C	E
E Ave C - Rosser	12270	B	C

### Front Ave - Memorial Hwy

Segment	2014 ADT (vpd)	Through Movement Intersection LOS	Segment LOS
Main Ave - Washington	5850	C	A
Washington - 3rd St	5605	C	D
3rd St - 5th St	5150	C	E
5th St - 7th St	5150	C	E
7th St - 9th St	3700	B	D
9th St - 12th St	2460	B	C

### 19th St

Segment	2014 ADT (vpd)	Through Movement Intersection LOS	Segment LOS
Divide - Capitol	11995	C	D
Capitol - Century	11185	B	A
Century - 43rd Ave	8360	F	F
43rd Ave - LaSalle Dr	2905	C	C



# APPENDIX B

## 2040 Level of Service



## 2040 Level of Service – Mandan Corridors

Sunset Drive/6th Ave		No Build		Build	
Segment	2040 ADT (vpd)	Through Movement Intersection LOS	Segment LOS	Through Movement Intersection LOS	Segment LOS
Old Red Trail - N Interchange	20599	F	F	A	F
N Interchange - S Interchange	13695	D	F	C	E
S Interchange - 2nd St	6891	B	B	C	B
2nd St- 1st St	5430	B	F	B	F
1st St - Main St	4200	B	E	B	E

Highway 6		No Build		Build	
Segment	2040 ADT (vpd)	Through Movement Intersection LOS	Segment LOS	Through Movement Intersection LOS	Segment LOS
19th - Main St	10801	D	B	D	B

Old Red Trail		No Build		Build	
Segment	2040 ADT (vpd)	Through Movement Intersection LOS	Segment LOS	Through Movement Intersection LOS	Segment LOS
Sunset Dr - Collins Ave	8374	C	B	C	B
Collins Ave - Mandan Ave	11403	F	F	F	F

Mandan Ave		No Build		Build	
Segment	2040 ADT (vpd)	Through Movement Intersection LOS	Segment LOS	Through Movement Intersection LOS	Segment LOS
Old Red Trail -Main St	11403	F	F	F	F

Division Street		No Build		Build	
Segment	2040 ADT (vpd)	Through Movement Intersection LOS	Segment LOS	Through Movement Intersection LOS	Segment LOS
6th St - ND 1806	1485	B	B	B	B
ND 1806 - 8th Ave	1212	B	B	B	B

Main Street		No Build		Build	
Segment	2040 ADT (vpd)	Through Movement Intersection LOS	Segment LOS	Through Movement Intersection LOS	Segment LOS
Hwy 25 - 10th Ave NW	5201	B	A	B	A
10th Ave NW - 6th Ave NW	11501	C	D	C	D
6th Ave NW - 3rd Ave NW	12855	D	E	B	D
3rd Ave NW - 1st St	14395	E	F	C	E
1st St - Collins Ave	16998	F	F	C	F
Collins Ave - 6th Ave NW	18706	C	B	C	C
6th Ave NW - Memorial Hwy	26400	F	F	F	F
Memorial Hwy - Twin City Dr	29171	F	F	F	F





## 2040 Level of Service – Mandan Corridors (Continued)

3rd Street SW		No Build		Build	
Segment	2040 ADT (vpd)	Through Movement Intersection LOS	Segment LOS	Through Movement Intersection LOS	Segment LOS
Hwy 6 - 9th Ave	3100	B	E	B	A
9th Ave - 8th Ave	3100	B	E	B	A
8th Ave - 1806	5502	B	A	B	A
1806 - Memorial Hwy	10767	F	F	F	F

19th Street SE		No Build		Build	
Segment	2040 ADT (vpd)	Through Movement Intersection LOS	Segment LOS	Through Movement Intersection LOS	Segment LOS
Hwy 6 - 8th Ave	2699	B	A	B	A
8th Ave - ND 1806	2001	B	B	B	B

Collins Ave		No Build		Build	
Segment	2040 ADT (vpd)	Through Movement Intersection LOS	Segment LOS	Through Movement Intersection LOS	Segment LOS
Old Red Trail - 14th St	10782	F	F	C	D
14th St - 2nd St	8416	F	F	C	B
2nd St - Main St	4801	B	D	B	D

Highway 1806 N		No Build		Build	
Segment	2040 ADT (vpd)	Through Movement Intersection LOS	Segment LOS	Through Movement Intersection LOS	Segment LOS
38th St - Old Red Trail	20301	F	F	F	F

Highway 1806 S		No Build		Build	
Segment	2040 ADT (vpd)	Through Movement Intersection LOS	Segment LOS	Through Movement Intersection LOS	Segment LOS
19th St - 3rd St	12311	F	F	F	F
3rd St - Burlington St	14901			B	D
Burlington St - Main St	14901	B	C	B	C



## 2040 Level of Service – Bismarck Corridors

<b>Washington St</b>		<b>No Build</b>		<b>Build</b>	
<b>Segment</b>	<b>2040 ADT (vpd)</b>	<b>Through Movement Intersection LOS</b>	<b>Segment LOS</b>	<b>Through Movement Intersection LOS</b>	<b>Segment LOS</b>
Divide Ave - Interstate Ave	16400	F	F	F	F
Interstate Ave - Century Ave	20300	C	C	C	C
Century Ave - Calgary	30000	F	F	F	F

<b>4th Street</b>		<b>No Build</b>		<b>Build</b>	
<b>Segment</b>	<b>2040 ADT (vpd)</b>	<b>Through Movement Intersection LOS</b>	<b>Segment LOS</b>	<b>Through Movement Intersection LOS</b>	<b>Segment LOS</b>
Boulevard - Divide	10300	C	C	C	C
Divide - Interstate	11900	E	D	E	D
Interstate - Century	10050	C	C	C	C

<b>9th Street</b>		<b>No Build</b>		<b>Build</b>	
<b>Segment</b>	<b>2040 ADT (vpd)</b>	<b>Through Movement Intersection LOS</b>	<b>Segment LOS</b>	<b>Through Movement Intersection LOS</b>	<b>Segment LOS</b>
Rosser - E Ave C	14900	C	D	B	C
E Ave C - Boulevard	13350	B	D	B	C

<b>26th St</b>		<b>No Build</b>		<b>Build</b>	
<b>Segment</b>	<b>2040 ADT (vpd)</b>	<b>Through Movement Intersection LOS</b>	<b>Segment LOS</b>	<b>Through Movement Intersection LOS</b>	<b>Segment LOS</b>
Airway Ave - Bismarck Exp	10200	C	B	C	B
Bismarck Exp - Main St	10450	B	A	B	A
Main St - Rosser	9600	C	D	C	D
Rosser - Divide Ave	10600	C	B	C	B

<b>Ward Rd</b>		<b>No Build</b>		<b>Build</b>	
<b>Segment</b>	<b>2040 ADT (vpd)</b>	<b>Through Movement Intersection LOS</b>	<b>Segment LOS</b>	<b>Through Movement Intersection LOS</b>	<b>Segment LOS</b>
Ewards Ave - Divide Ave	6600	A	A	A	A



## 2040 Level of Service – Bismarck Corridors (Continued)

<b>Divide Ave</b>		<b>No Build</b>		<b>Build</b>	
Segment	2040 ADT (vpd)	Through Movement Intersection LOS	Segment LOS	Through Movement Intersection LOS	Segment LOS
Bismarck Expressway - 26th St	6050	B	A	B	A
26th St - 19th St	13950	F	F	F	F
19th St - State St	13700	C	C	B	C
State St - 4th St	12050	C	C	C	C
4th St - Washington St	12100	C	C	C	D
Washington St - Schaffer St	15350	E	F	F	F

<b>7th Street</b>		<b>No Build</b>		<b>Build</b>	
Segment	2040 ADT (vpd)	Through Movement Intersection LOS	Segment LOS	Through Movement Intersection LOS	Segment LOS
Boulevard - E Ave C	12500	F	F	C	D
E Ave C - Rosser	14300	B	C	C	C

<b>Front Ave - Memorial Hwy</b>		<b>No Build</b>		<b>Build</b>	
Segment	2040 ADT (vpd)	Through Movement Intersection LOS	Segment LOS	Through Movement Intersection LOS	Segment LOS
Main Ave - Washington	6300	C	A	C	A
Washington - 3rd St	6500	D	D	D	D
3rd St - 5th St	7300	D	F	D	F
5th St - 7th St	7300	F	F	F	F
7th St - 9th St	5500	B	D	B	D
9th St - 12th St	2800	B	C	B	C

<b>19th St</b>		<b>No Build</b>		<b>Build</b>	
Segment	2040 ADT (vpd)	Through Movement Intersection LOS	Segment LOS	Through Movement Intersection LOS	Segment LOS
Divide - Capitol	12400	C	D	C	D
Capitol - Century	14700	C	B	C	B
Century - 43rd Ave	13600	F	F	F	F
43rd Ave - LaSalle Dr	4400	F	F	B	B



# APPENDIX C

## Cost Analysis









## Cost Analysis (Continued) – Bismarck Corridors

**Front Ave/Memorial Highway Corridor**

	Removals	Epoxy Pavement Markings	Signing	Curb & Gutter	Flashing Yellow Signals	Segment Total
3-lane section from Washington and 12th	\$ 11,786	\$ 19,231	\$ 10,400			\$ 41,417
Eliminate accesses	\$ 4,953			\$ 3,250		\$ 8,203
Intersection Front Ave and 3rd street					\$ 23,000	\$ 23,000
Install FYA on all approaches and install new signal controller						
				<b>Corridor Total</b>		<b>\$ 72,620</b>

**26th Street Corridor**

	Removals	Epoxy Pavement Markings	Signing	Segment Total
3-lane section from Rosser Ave and Main Ave	\$ 5,379	\$ 11,652	\$ 6,240	\$ 23,272
		<b>Corridor Total</b>		<b>\$ 23,272</b>

**19th Street Corridor**

	Removals	Epoxy Pavement Markings	Signing	Curb & Gutter	Asphalt Paving	Concrete Sidewalk	Segment Total
3-lane section from Capitol Ave and Divide Ave	\$ 3,783	\$ 5,789	\$ 4,160				\$ 13,732
3-lane section from Century Ave to LaSalle Dr	\$ 9,038	\$ 14,636	\$ 17,680				\$ 41,354
Intersection of 19th St and 43rd St							
Option #1 Realign intersection south of 43rd St	\$ 4,013	\$ 2,543	\$ 3,630		\$ 93,180		\$ 103,366
Option #2 Extend 40' Pavement from Valley Loop Dr. to 43rd St		\$ 3,298	\$ 1,598	\$ 79,950	\$ 447,265	\$ 88,000	\$ 620,111
				<b>Corridor Total</b>			<b>\$ 778,563</b>

**Ward Road Corridor**

	Removals	Epoxy Pavement Markings	Signing	Curb & Gutter	Asphalt Paving	Bike Path Paving	Concrete Sidewalk	Driveway Paving	Segment Total
Realignment of Ward Road and College Drive intersection	\$ 76,245	\$ 4,102	\$ 5,963	\$ 47,450	\$ 156,245	\$ 25,556	\$ 17,967	\$ 20,085	\$ 353,612
							<b>Corridor Total</b>		<b>\$ 353,612</b>

Note: The above costs were developed utilizing lengths and areas measured in Microstation and multiplied by a unit cost based on the North Dakota Department of Transportation 2016 Average bid prices. The unit costs were adjusted to include miscellaneous items and a 30% contingency.





# APPENDIX D

## Technical Memo #1

# Memo

Date: Monday, January 25, 2016

Project: Mandan and Bismarck Corridor Improvement Study – Bismarck-Mandan MPO

To: Agency Representatives

From: HDR

Subject: Technical Memo #1

## 1.0 Introduction

The Bismarck-Mandan MPO has requested a transportation study to evaluate potential improvement of 20 corridors located in the cities of Mandan and Bismarck. Maps of the study areas are provided in Figures 1 and 2.

The purpose of this memorandum (the Memo) is to provide an analysis of the existing conditions of each of the identified corridors. Traffic operations in terms of Level of Service (LOS) and volume-to-capacity (v/c) ratios are also evaluated, as well as unique corridor characteristics such as safety, lane configurations, and multimodal utilization.

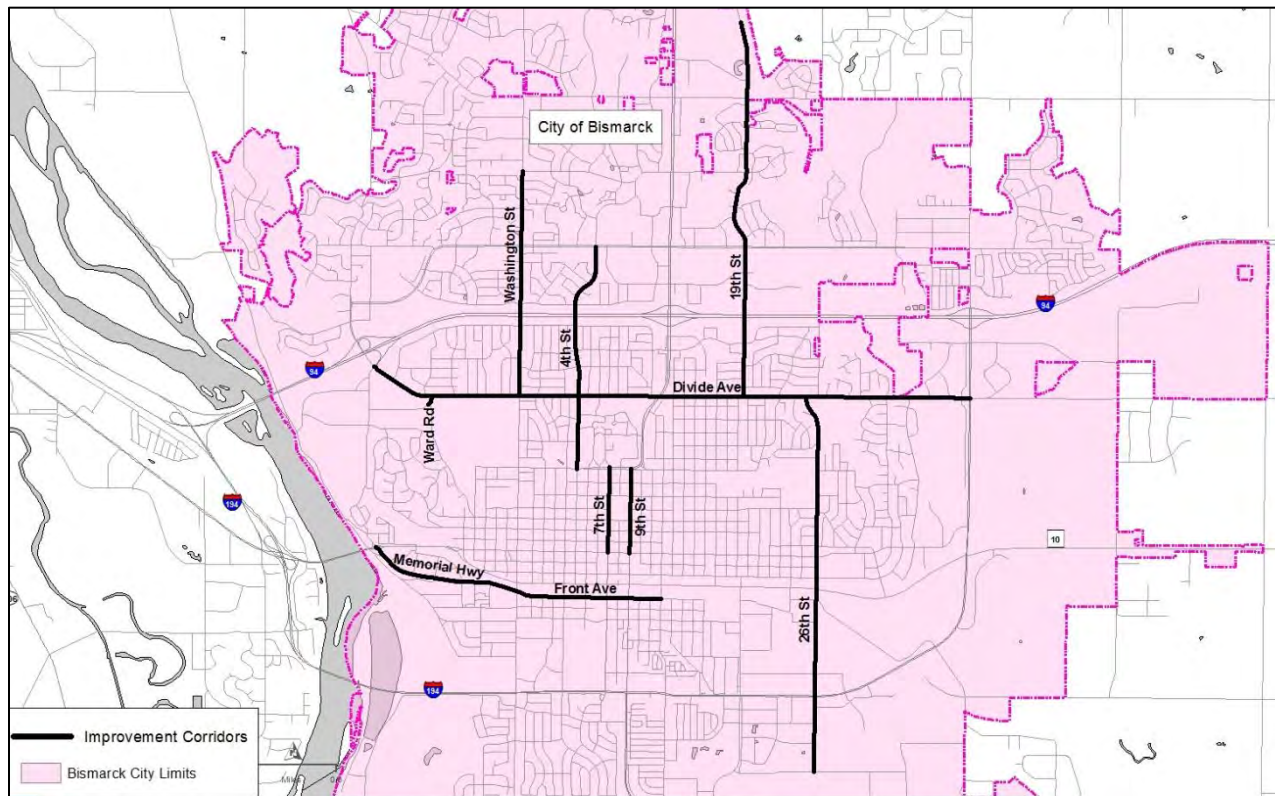


Figure 1. Bismarck Improvement Corridors

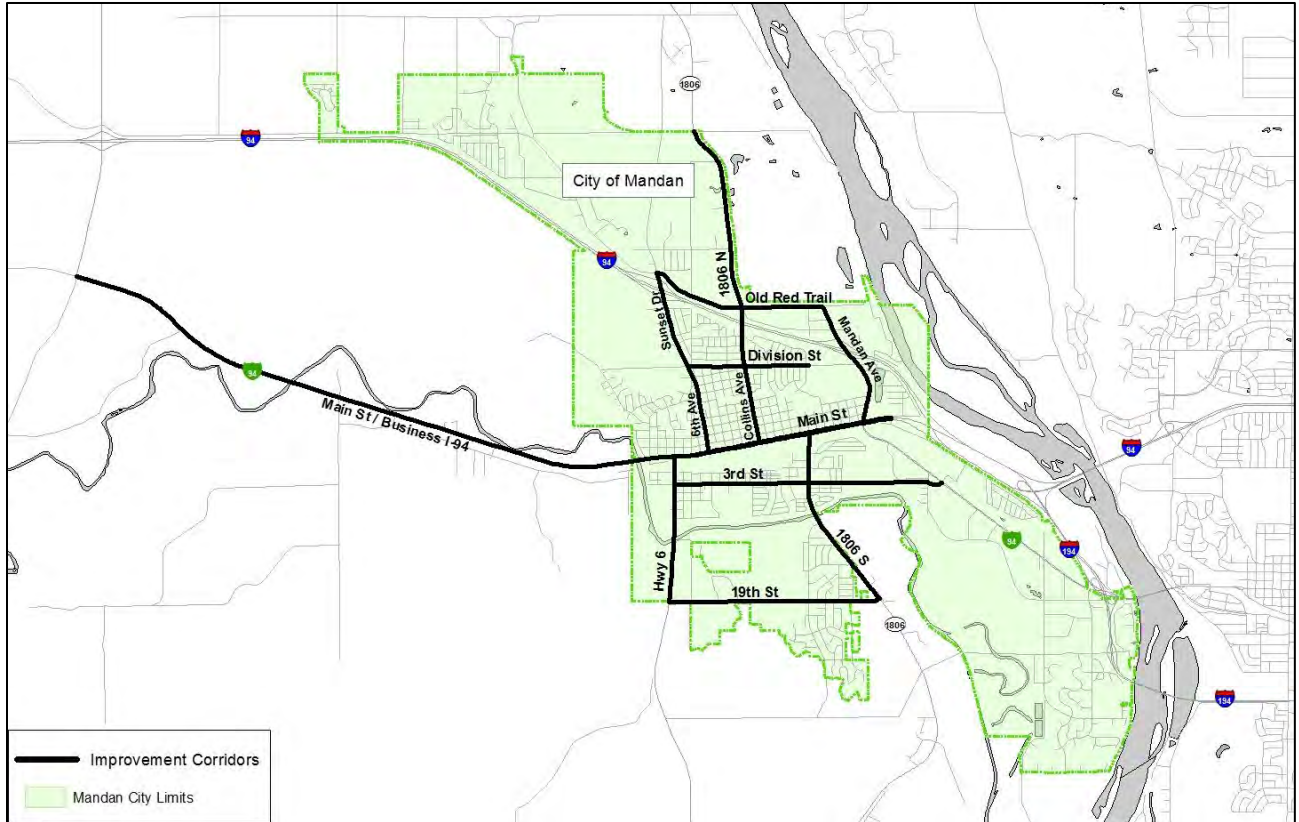


Figure 2. Mandan Improvement Corridors

## 2.0 Purpose and Need

The purpose of the corridor improvements is to increase the level of safety and mobility for the traveling public along the corridors by examining roadway deficiencies and incorporating feasible improvements throughout. The improvements are needed to reduce congestion, improve connectivity across Mandan and Bismarck, and reduce crashes throughout the study corridors.

The corridors that have been selected by the Bismarck-Mandan MPO for the study include the following for the City of Bismarck:

- Washington Street (Calgary Avenue to Divide Avenue)
- Divide Avenue (Schafer Street to Bismarck Expressway/ND Highway 810)
- 4<sup>th</sup> Street (Century Avenue to Boulevard Avenue)
- 7<sup>th</sup> Street (Boulevard Avenue to Rosser Avenue)
- 9<sup>th</sup> Street (Boulevard Avenue to Rosser Avenue)
- Front Avenue/Memorial Highway (Main Avenue to 12<sup>th</sup> Street)
- 26<sup>th</sup> Street (Divide Avenue to Airway Avenue)
- 19<sup>th</sup> Street (Divide Avenue to LaSalle Drive)
- Ward Road (Edwards Avenue to Divide Avenue)

The corridors that have been selected for the City of Mandan include the following:

- Main Street /Business I-94 (ND Highway 25 to Twin City Drive)
- Sunset Drive/6<sup>th</sup> Avenue NW (Main Street to Oil Red Trail)
- ND Highway 6 (Main Street to 19<sup>th</sup> Street NW)
- Old Red Trail (Mandan Avenue to Sunset Drive)
- Mandan Avenue/ND Highway 1806 (Main Street to Old Red Trail)
- 3<sup>rd</sup> Street (ND Highway 6 to Memorial Highway)
- 19<sup>th</sup> Street (ND Highway 6 to ND Highway 1806)
- Collins Avenue (Main Street to Oil Red Trail)
- ND Highway 1806 North (Old Red Trail to 38<sup>th</sup> Street)
- ND Highway 1806 South (Main Street to 19<sup>th</sup> Street)
- Division Street (Sunset Avenue to 8<sup>th</sup> Avenue NE)

2014 Average Daily Traffic (ADT) volumes and hourly traffic volume data for specified locations were provided by NDDOT. Site visits were conducted by HDR to observe and verify lane configurations, speed limits, and identify any potential sight distance or safety concerns.

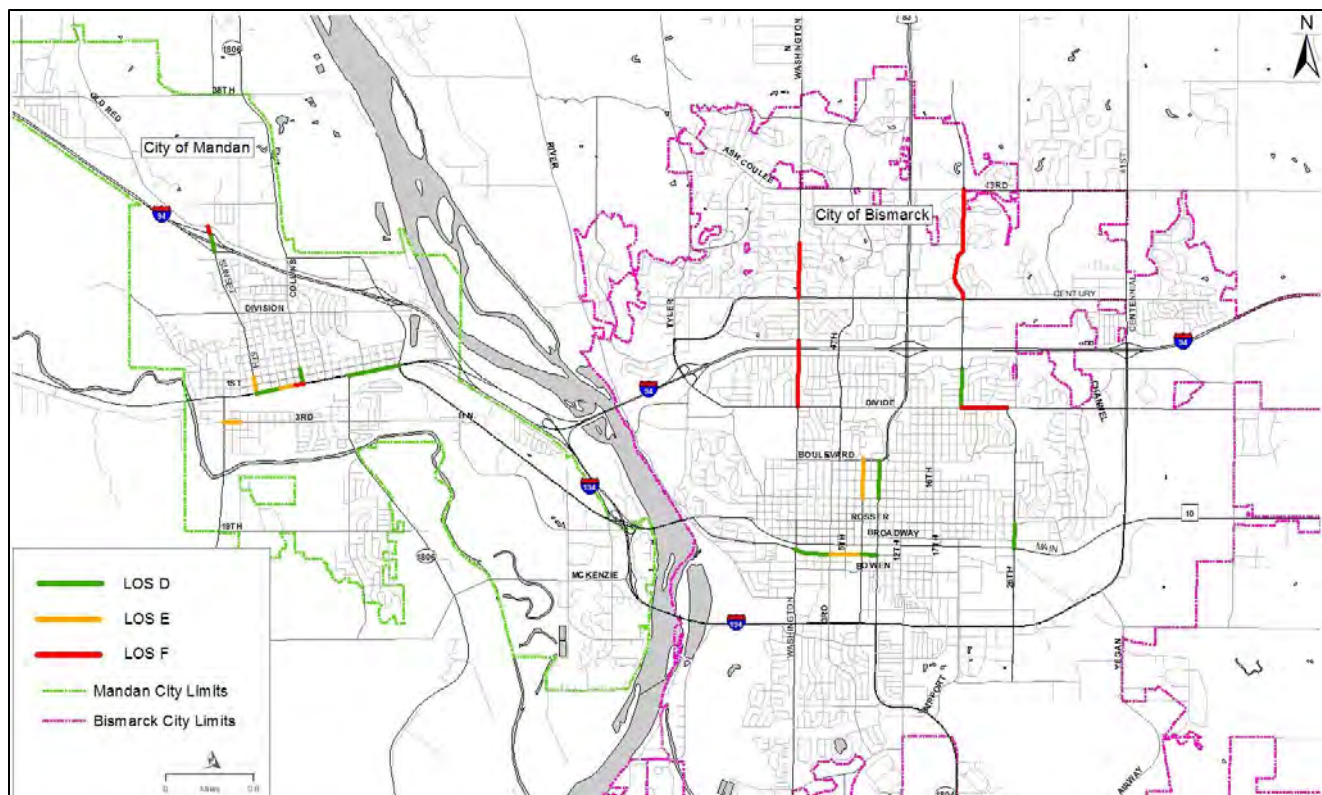
### **3.0 Traffic Operations**

The existing traffic operations of the corridors were assessed using a planning-level volume-to-capacity and LOS approach based on the ARTPLAN analysis program within the HCS software. Using this methodology, characteristics such as daily traffic volumes, signal timings, and basic roadway lane geometry at the major intersections are used as inputs and are tailored with corridor-level information on peak hour traffic levels and heavy truck percentage estimates to generate generalized, locally-specific peak hour estimates of traffic operations. The 2014 ADT and hourly Miovision traffic volumes counts were provided by NDDOT for the major roadway segments within the study area. In addition to geometric, segment length, and segment speed inputs, additional corridor-specific inputs included:

- Proportion of turning traffic: percentage of peak traffic at the intersection turning left or right.
- Heavy vehicle percentage: percentage of peak traffic that is heavy trucks. For the Mandan and Bismarck corridors, the heavy vehicle percentages ranged from 1% to 23%.
- K-factor: percentage of daily traffic that occurs during the peak hour. For the Mandan and Bismarck corridors, the k-factors ranged from 7% to 12% of daily traffic.
- D-factor: percentage of travel in peak direction during peak period. For the Mandan and Bismarck corridors, the d-factors ranged from 51% to 70%.

### **3.1 Bismarck Corridor Traffic Operations Analysis**

The estimated level of service for each corridor segment located within the Bis-Man study area is provided in Figure 3. The analysis is based on 2014 traffic volumes and the figure depicts only the segments identified to have LOS of D, E and F. Segments experiencing LOS D through F under existing 2014 traffic volumes are most likely to experience worsening conditions and operations under long-range forecasted traffic volumes in the years to come.



**Figure 3. Bis-Man Corridor Estimated 2014 Existing LOS**

Complete LOS results are provided in Appendix A. The results are shown for the through-movement intersection LOS at each main (primarily signalized) intersection as well as the LOS along each corridor segment. The through-movement intersection LOS is based on control delay for the primary through movements at the intersection. This LOS measure takes into account turning percentages and can be used as a method of showing when a corridor may require expansion or other improvement. For example, if the through movement LOS is D then the corridor is likely near capacity at the intersections, while a through movement of LOS E or F means expansion of the corridor should be assumed necessary at the planning level.

The segment LOS reflects the quality of travel along each corridor. For the analysis, each corridor is broken up into smaller segments with major intersections on each end to determine each segment's LOS. It is based on the combination of travel time delay due to intersection control and the travel speed for each segment. While it provides similar indication as to whether the road will likely require widening as the through-movement LOS, since it is based on travel speed, it is much better for creating an aggregate performance level for the corridor.

### 3.2 Bicycle Operations

Due to the presence of on-street bicycle lanes along various corridors, further assessment was given to this mode of transit to provide a generalized overview of its current efficiency. Figure 4 is a map provided by the Bismarck-Mandan MPO of designated bike routes and shared road usage within the City of Bismarck. Mandan does not currently have any designated on-street bike routes. As shown in Figure 4, currently Divide Avenue and Rosser Avenue consist of alternating segments of bike lanes and shared road signage. 16<sup>th</sup> street provides share the road signage from the intersection with Divide Avenue to Rosser Avenue. 26<sup>th</sup> Street incorporates shared road signage between the intersections of Divide Avenue and Railroad Avenue, and then provides a designated bike lane between Railroad Avenue and Bismarck Expressway. Wachter Avenue consists of share the road signage only.

The concept of Bicycle LOS is meant to correspond to the cyclist’s perception of comfort and service that a roadway provides to bicyclists as a function of various roadway factors. The Bicycle LOS is similar to vehicle LOS methodology from HCM. It is based on delay encountered at the intersections and focuses on facility attributes such as the volume and speed of adjacent vehicles, heavy vehicle presence, and the presence of on-street parking. The bicycle LOS was determined for Divide Avenue and 26<sup>th</sup> Street as those corridors were included in the study. Divide Avenue was found to have an overall bicycle LOS of D due to the corridor alternating between a shared use lane and designated bike lane. 26<sup>th</sup> Street had an overall bicycle LOS of D for the length of the study corridor.

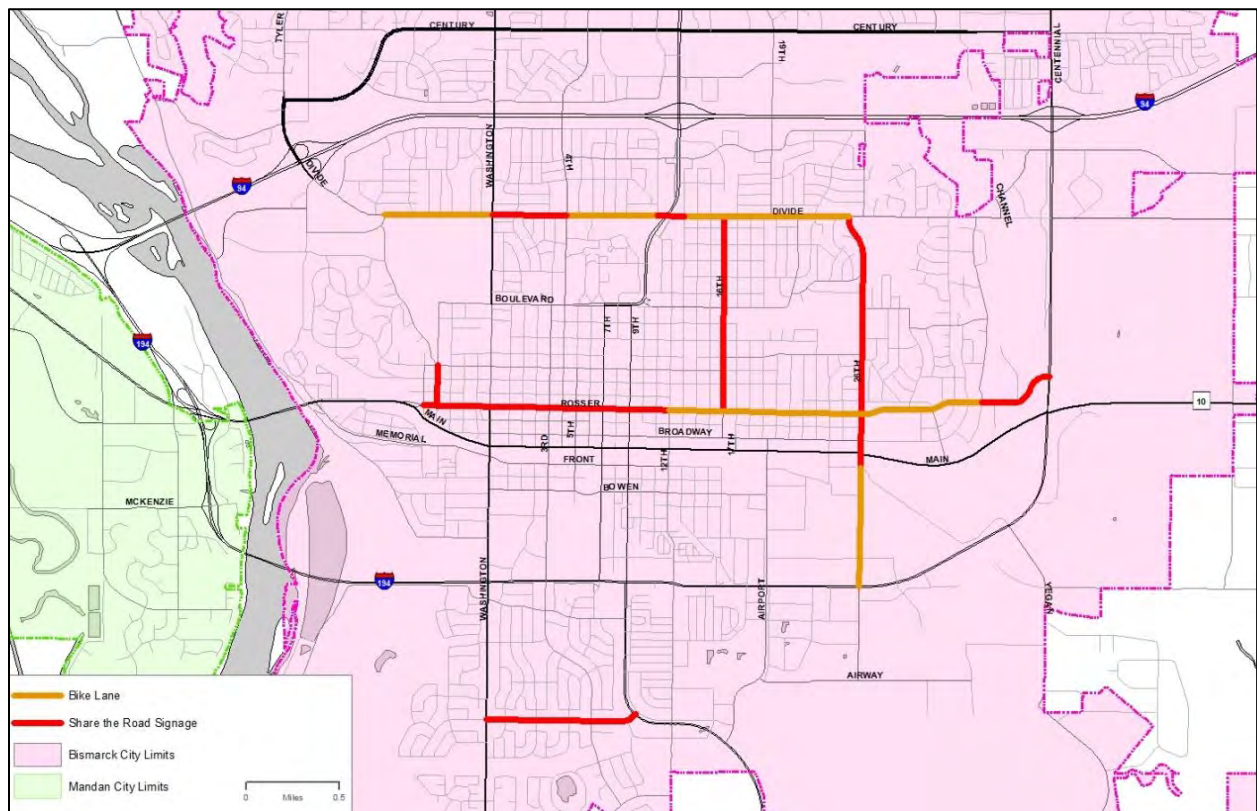


Figure 4. City of Bismarck On-Street Bike Facilities

## 4.0 Safety Analysis

The NDDOT provided crash data for the calendar years of 2012 to 2014. Only crashes that met the reportable crash threshold limits set by the State of North Dakota were provided by NDDOT. For the purpose of this report, the term “crash” is considered reportable by the North Dakota Crash Standards.

The data provided by the NDDOT contains crash report information for each collision that designates it as taking place on either a roadway segment or at an intersection, followed by the associated crash characteristics and injuries as well. This information was used to separate the crashes for the analysis for each corridor segment and intersection. A summary of total crashes and total injury-related crashes for all corridors and intersections within the study area is provided in Table 1.

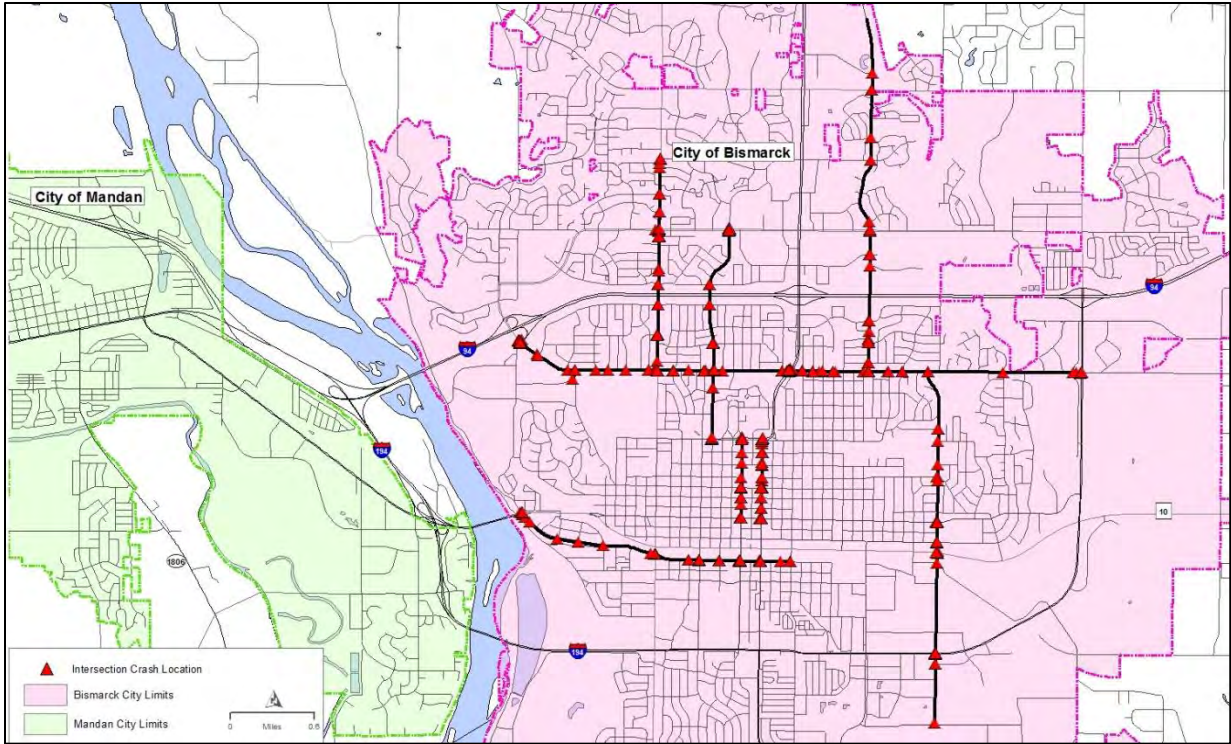
**Table 1. Crash Frequency for Study Area**

Location	Total Intersection Crashes	Injury-Related Intersection Crashes	Total Segment Crashes	Injury-Related Segment Crashes
<b>City of Bismarck</b>				
2012	207	14	220	8
2013	170	15	271	3
2014	147	13	225	9
<b>Total</b>	<b>524</b>	<b>42</b>	<b>716</b>	<b>20</b>
<b>City of Mandan</b>				
2012	76	8	56	5
2013	99	6	61	5
2014	84	5	66	6
<b>Total</b>	<b>259</b>	<b>19</b>	<b>183</b>	<b>16</b>

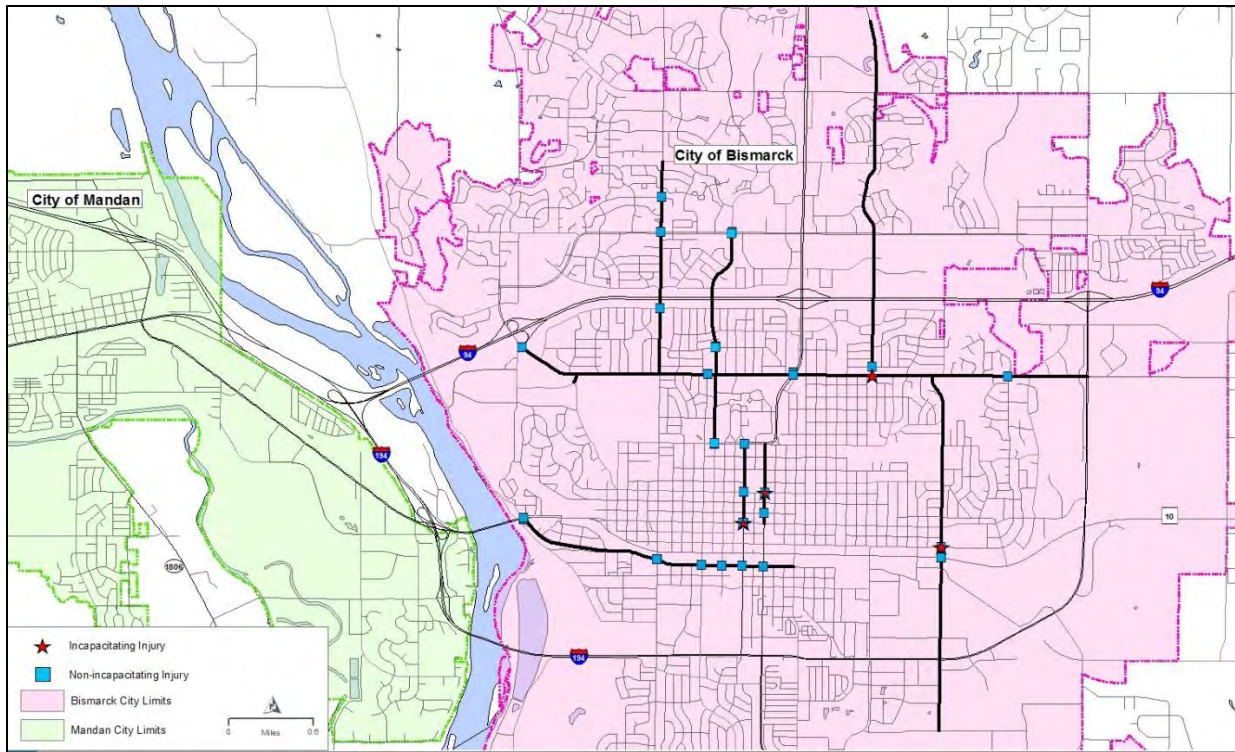
### 4.1 City of Bismarck Crashes

Total crashes occurring on Bismarck corridors were separated into two categories: intersection-related or segment-related, based on how they were classified in the crash reports received from NDDOT. Crashes resulting in incapacitating and non-incapacitating injuries were also given extra consideration. The NDDOT crash data showed no fatalities occurring between the years 2012 to 2014 for any of the study corridors located within Bismarck. Bismarck intersection crashes are shown in Figure 5. Figure 6 provides the locations of injury-related intersection crashes.

Bismarck segment crashes are provided in Figure 7. Figure 8 provides the locations of injury-related segment crashes.



**Figure 5. Bismarck Intersection Crashes 2012-2014**



**Figure 6. Bismarck Intersection Injury-Related Crashes 2012-2014**



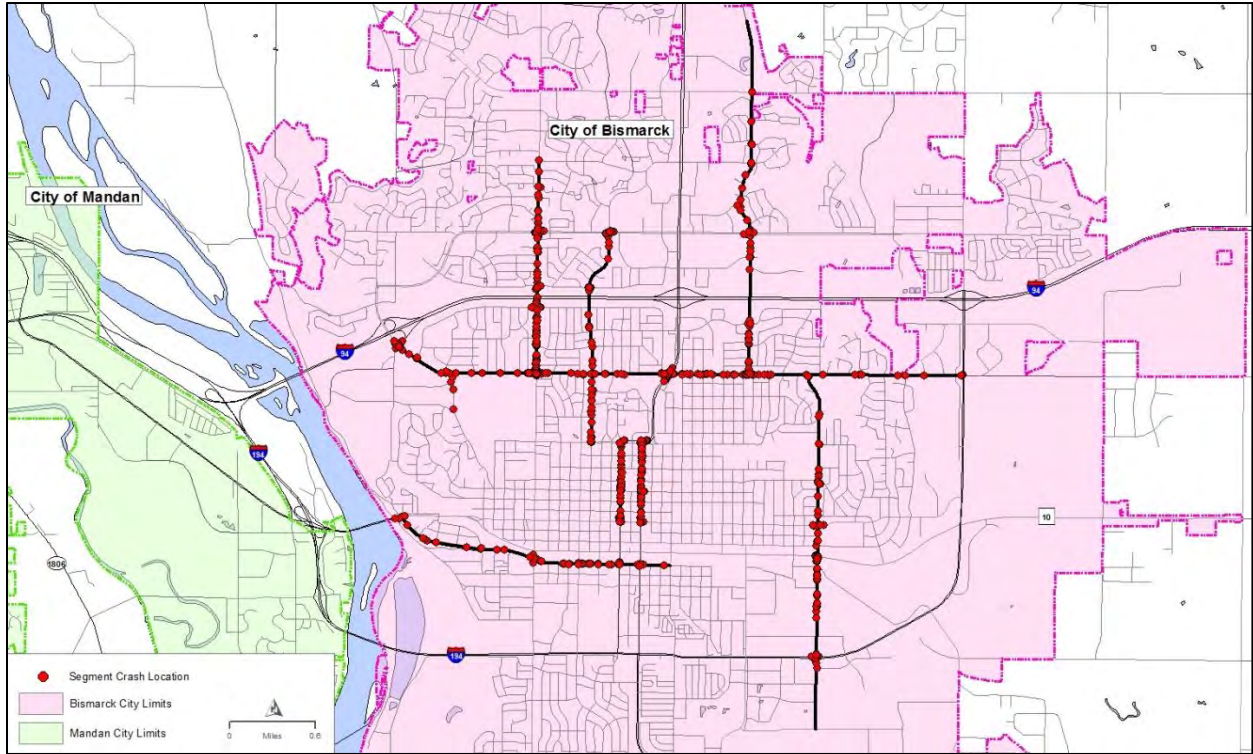


Figure 7. Bismarck Segment Crashes 2012-2014

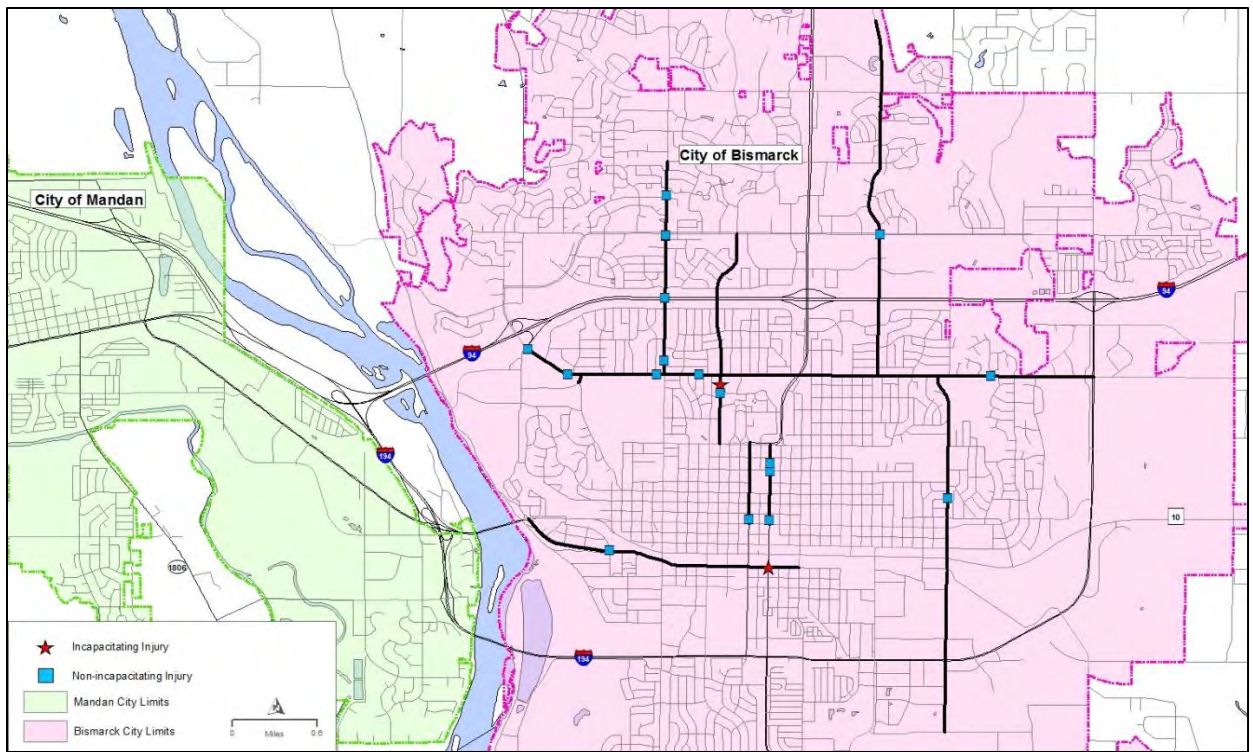


Figure 8. Bismarck Segment Injury-Related Crashes 2012-2014

### Number of Injury-Related Crashes by Location in Bismarck

The intersections that experienced the most crashes resulting in incapacitating injuries between 2012 and 2014 were:

- 26<sup>th</sup> St and Broadway: 1 incapacitating crash
- 7<sup>th</sup> Street and E Rosser Ave: 2 incapacitating crashes
- 9<sup>th</sup> Street and E Ave C: 1 incapacitating crash
- Divide Ave and 19<sup>th</sup> St: 1 incapacitating crash

The segments that experienced the most injury-related crashes between 2012 and 2014 were:

- Washington Street: 5 non-incapacitating injury-related crashes
- Memorial-Front Street: 1 incapacitating and 1 non-incapacitating injury-related crashes
- Divide Avenue: 5 non-incapacitating injury-related crashes
- 9<sup>th</sup> Street: 3 non-incapacitating injury-related crashes
- 4<sup>th</sup> Street: 1 incapacitating and 1 non-incapacitating injury-related crashes

### Manner of Collision by Location in Bismarck

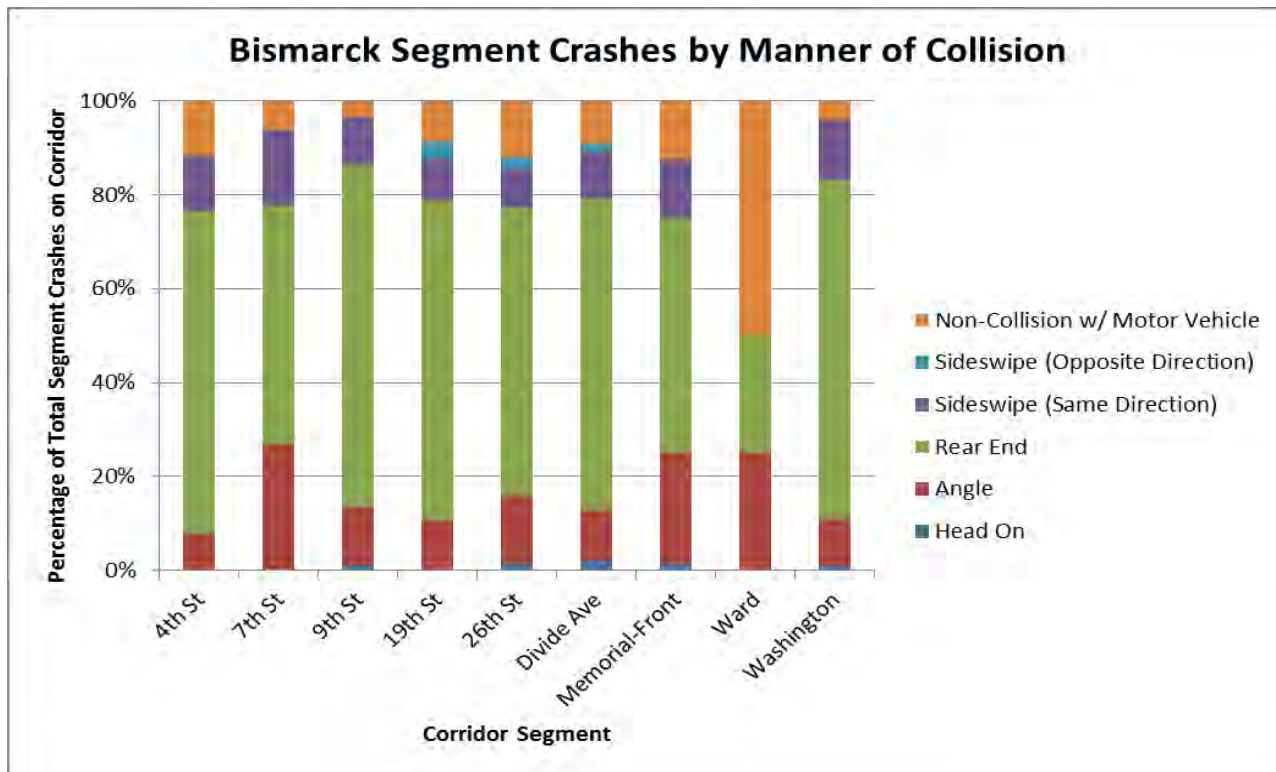
Bismarck segment crashes were analyzed by manner of collision. The most common crash type to occur along segments was rear end crashes, as shown in Figure 7. Divide Ave had the highest number of total segment crashes, as well as having the highest total of head-on collisions (4 crashes) and non-collision with motor vehicle crashes (19 crashes). Washington Street, 9<sup>th</sup> Street, and Divide experienced the highest total crashes resulting in injury, as shown in Table 2 and Figure 9.

**Table 2. Bismarck Segment Crashes by Manner of Collision 2012-2014**

Segment	Head On	Angle	Rear End	Sideswipe (SD)*	Sideswipe (OD)*	Non-Collision w/ Motor Vehicle	Total
4th St	0	4	35	6	0	6	51
7th St	0	17	32	10	0	4	63
9th St	1	11	65	9	0	3	89
19th St	0	6	39	5	2	5	57
26th St	1	11	46	6	2	9	75
Divide Ave	4	20	123	19	3	17	186
Memorial-Front	1	17	36	9	0	9	72
Ward	0	1	1	0	0	2	4
Washington	1	12	86	15	0	5	119

\*SD = Same Direction

\*OD = Opposite Direction



**Figure 9. Bismarck Segment Crashes by Manner of Collision 2012-2014**

Intersection crashes were analyzed along each study corridor. The ten intersections shown to experience the highest level frequency of crashes over the three-year period were selected and examined further to determine intersection crash rates and comparisons of crash characteristics. Table 3 and Figure 10 show a crash comparison for each of the selected intersections based on manner of collision.

**Table 3. Bismarck Intersection Crashes by Manner of Collision 2012-2014**

Intersection	Head On	Angle	Rear End	Sideswipe (SD)*	Sideswipe (OD)*	Non-Collision w/ Motor Vehicle	Total
Memorial Hwy / 3rd St	0	24	4	1	0	1	30
4th St / Century Ave	1	24	4	0	0	0	29
Front Ave / 9th St	0	14	0	1	0	2	17
Front Ave / 7th St	0	18	0	2	0	0	20
9th St / Ave C	0	19	0	0	0	1	20
Divide Ave / Schaffer St	0	11	19	0	0	3	33
4th St / Boulevard Ave	0	11	3	0	0	1	15
7th St / Rosser Ave	0	12	0	1	0	2	15
Divide Ave / State St	1	7	16	3	0	1	28
Washington Ave / Century Ave	0	4	7	0	0	2	13

\*SD = Same Direction

\*OD = Opposite Direction

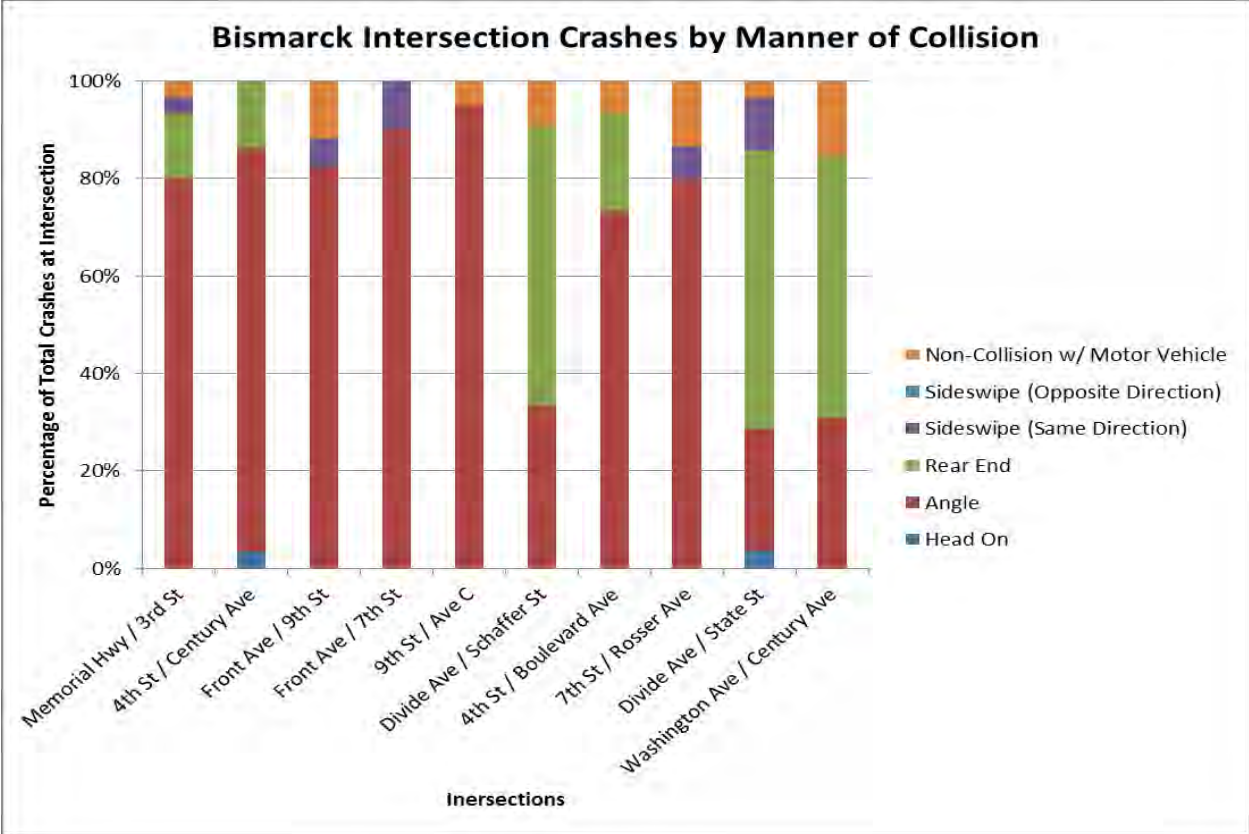


Figure 10. Bismarck Intersection Crashes by Manner of Collision 2012-2014

The intersections of Divide Ave/ Schaffer St and Divide Ave/ State St experienced the most rear end collisions with 19 (58%) and 16 (57%) respectively. Only two head-on collisions were reported during the study period, one occurring at the intersection of 4<sup>th</sup> St/ Century Ave and one at the intersection of Divide Ave/ State St.

**Crash Severity by Location in Bismarck**

Segment crashes were also analyzed based on severity. Table 4 provides the crash values while Figure 11 provides a visual comparison of the severity of crash percentages experienced by each corridor. 4<sup>th</sup> Street and Memorial Highway – Front Ave were the only corridors that experienced crashes resulting in incapacitating injuries. Ward Rd was the only corridor segment to consist of 100% property-damage only (PDO) crashes (7 crashes).

Table 4. Bismarck Segment Crashes by Severity 2012-2014

Segment	Fatality	Incapacitating Injury	Non-incapacitating Injury	Possible Injury	Property Damage Only	Total
4th St	0	1	1	8	41	51
7th St	0	0	1	12	50	63
9th St	0	0	3	18	68	89
19th St	0	0	1	12	44	57
26th St	0	0	1	11	63	75
Divide Ave	0	0	5	24	157	186
Memorial-Front	0	1	1	15	55	72
Ward	0	0	0	0	4	4
Washington	0	0	5	24	90	119

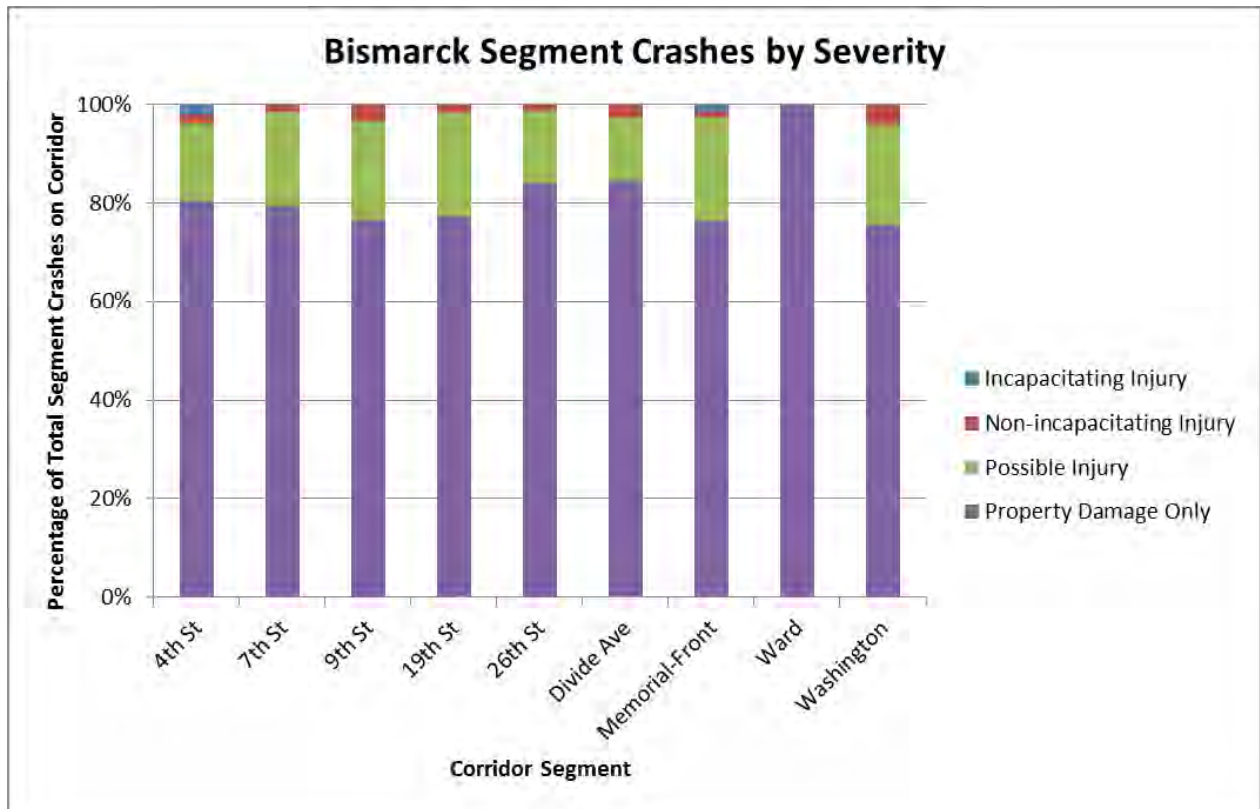
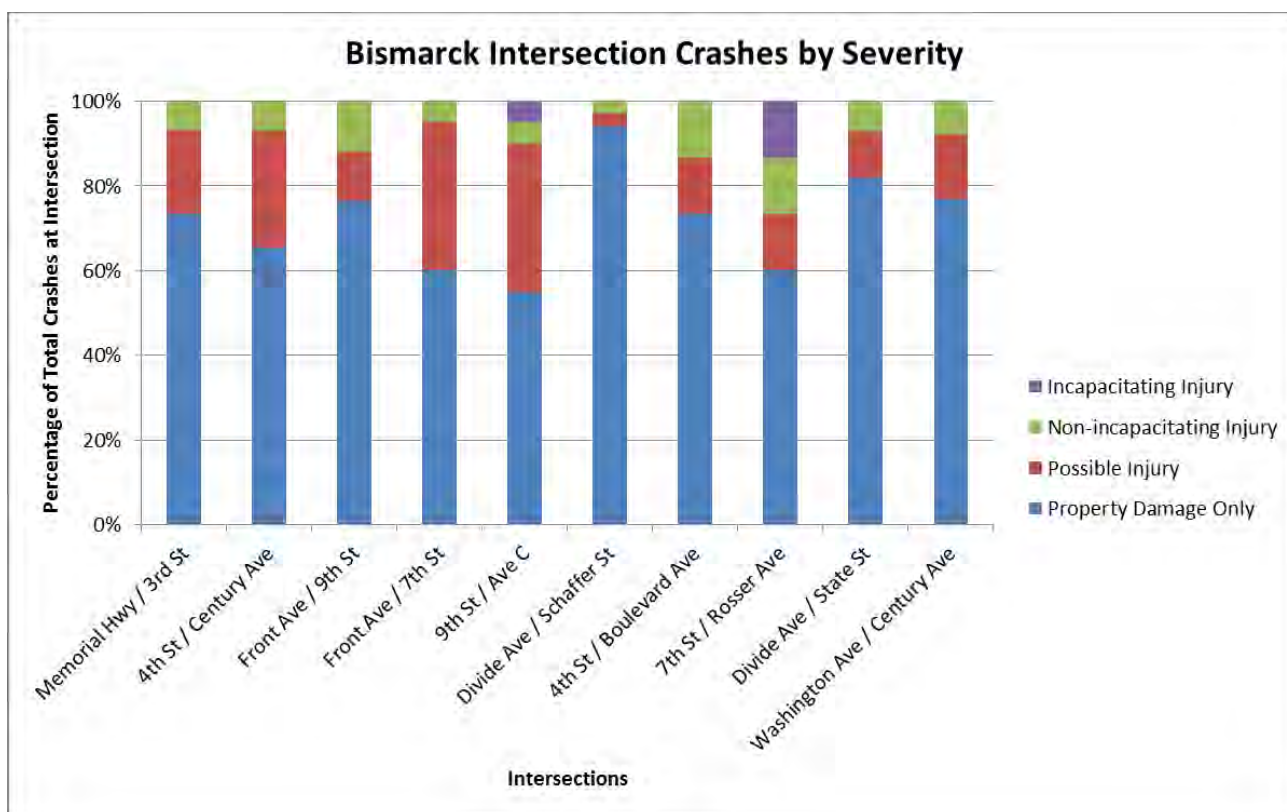


Figure 11. Bismarck Segment Crashes by Severity 2012-2014

Table 5 and Figure 12 show comparisons of intersection crashes based on severity.

**Table 5. Bismarck Intersection Crashes by Severity 2012-2014**

Intersection	Fatality	Incapacitating Injury	Non-incapacitating Injury	Possible Injury	Property Damage Only	Total
Memorial Hwy / 3rd St	0	0	2	6	22	30
4th St / Century Ave	0	0	2	8	19	29
Front Ave / 9th St	0	0	2	2	13	17
Front Ave / 7th St	0	0	1	7	12	20
9th St / Ave C	0	1	1	7	11	20
Divide Ave / Schaffer St	0	0	1	1	31	33
4th St / Boulevard Ave	0	0	2	2	11	15
7th St / Rosser Ave	0	2	2	2	9	15
Divide Ave / State St	0	0	2	3	23	28
Washington Ave / Century Ave	0	0	1	2	10	13



**Figure 12. Bismarck Intersection Crashes by Severity 2012-2014**

The intersection of 7<sup>th</sup> St / Rosser experienced the highest total number of injury-related crashes. The intersections of 9<sup>th</sup> St / Ave C and 7<sup>th</sup> St / Rosser Ave were also the only intersections to experience incapacitating injuries. 9<sup>th</sup> St / Ave C also had one of the highest angle crash percentages of 95%, as shown previously in Figure 10.

### Crash Rates by Location in Bismarck

Based on the crash data, ADT available, and segment lengths, crash rates were then calculated for each intersection and corridor segment to provide a consistent method of comparison in terms of relative safety. These crash rate values serve as a tool to prioritize and distinguish which corridors and intersections have the highest need for potential safety improvements. Each crash rate takes into account the total number of segment crashes during the study year period, ADT, and segment length. A list of segment crash rates, measured in crashes per million vehicle-miles of travel (MVM) in accordance with FHWA safety guidelines, for the Bismarck corridor segments is provided in Table 6. The corridors are listed in order of highest to lowest in accordance with their segment crash rate value.

**Table 6. Bismarck Corridor Segment Crash Rates**

Corridor	Total Segment Crashes	Segment Crash Rate (Crashes/MVM)	Total Segment Injury Crashes	Segment Injury Crash Rate (Crash/MVM)
9th St	89	11.30	3	0.38
7th St	63	9.16	1	0.15
Memorial Hwy –Front Ave	72	6.99	2	0.19
Washington St	119	5.55	5	0.23
Divide Ave	186	4.63	5	0.12
4th St	51	3.72	2	0.15
26th St	75	3.39	1	0.05
Ward Rd	4	2.62	0	0.00
19th St	57	2.59	1	0.05

Based on the analysis, 9<sup>th</sup> Street and 7<sup>th</sup> Street were found to have the highest segment crash rates for corridors studied within the City of Bismarck at 11.30 and 9.16 crashes per million vehicle-miles of travel, respectively. Memorial Highway – Front Street was found to have the third highest segment crash rate at 6.99 crashes per million vehicle-miles of travel. The 9<sup>th</sup> St and Washington Ave corridors were also found to experience the highest number of injury-related crashes crash rates, resulting in either incapacitating or non-incapacitating injuries as previously shown in Figure 11.

The ten intersections shown to experience the highest level frequency of crashes over the three-year period were selected and examined further to determine intersection crash rates. A comparison of intersection crash rates, measured as crashes per million entering vehicles (MEV), is provided in Table 7:

**Table 7. Bismarck Corridor Intersection Crash Rates**

<b>Intersection</b>	<b>Total Intersection Crashes</b>	<b>Intersection Crash Rate (Crash/MEV)</b>	<b>Total Intersection Injury Crashes</b>	<b>Intersection Injury Crash Rate (Crash/MEV)</b>
Front Ave / 3rd St	30	1.55	2	0.10
4th St / Century Ave	29	1.28	2	0.09
Front Ave / 9th St	17	1.12	2	0.13
Front Ave / 7th St	20	1.02	1	0.05
9th St / Ave C	20	1.00	2	0.10
Divide Ave / Schafer St	33	0.98	1	0.03
4th St / Boulevard Ave	15	0.84	2	0.11
7th St / Rosser Ave	15	0.63	4	0.17
Divide Ave / State St	28	0.59	2	0.04
Washington Ave / Century Ave	13	0.43	1	0.03

The Bismarck intersection with the highest intersection crash rate was identified as Memorial Highway and 3<sup>rd</sup> Street with 1.55 crashes per million entering vehicles. The intersection of 4<sup>th</sup> Street and Century Ave had the second highest crash rate at 1.28, and the intersection of Front Ave and 9<sup>th</sup> Street had the third highest at 1.12. The intersection with the highest injury crash rate was identified as 7<sup>th</sup> Street and Rosser Ave.

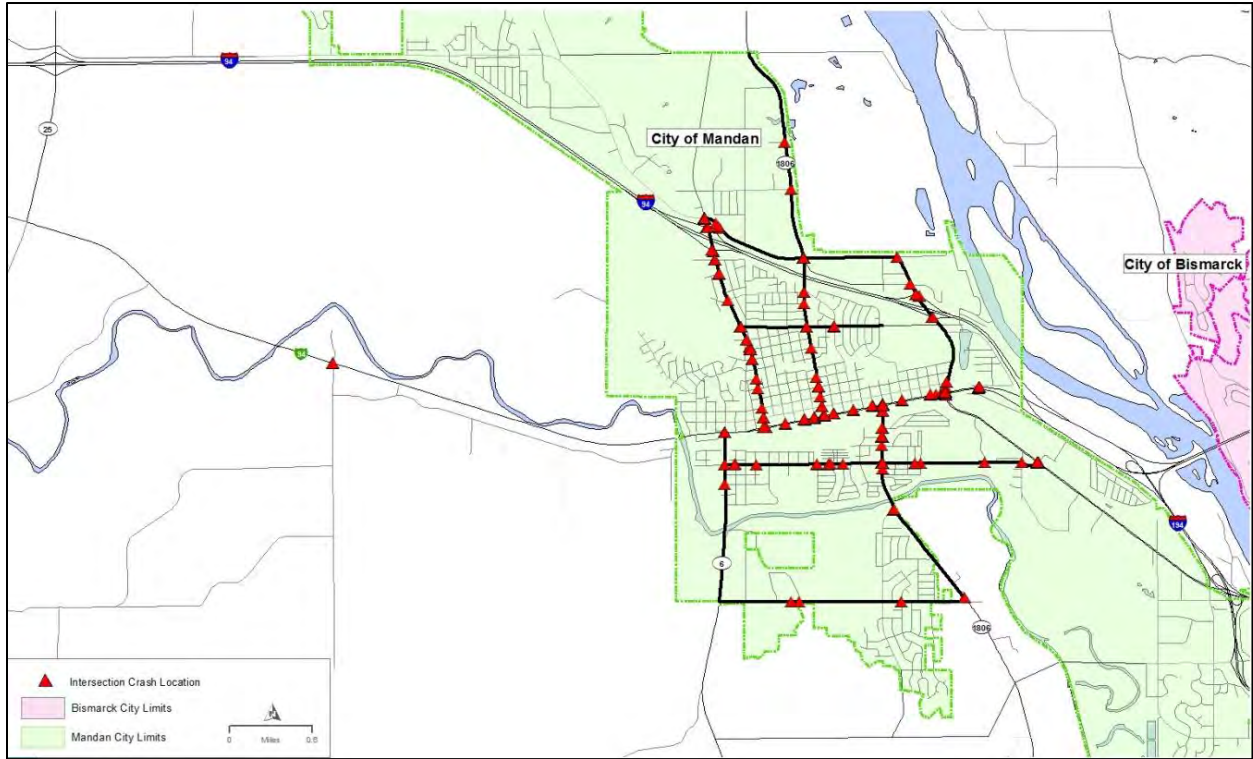
**Site Visit Observations**

The majority of the study corridors located within the City of Bismarck share similar characteristics in that they are two-lane undivided roadways, less than 35 mph speed limits, and located within residential or urban setting. 7<sup>th</sup> St and 9<sup>th</sup> St differ from the rest in that they are one-way directional travel only, each running adjacent to Bismarck Public High School and several nearby churches. The 19<sup>th</sup> Street corridor extends from Divide Avenue to north of 43<sup>rd</sup> Street. The corridor experiences variation in its typical section and grade north of its intersection with Century Ave and approaching the intersection with 43<sup>rd</sup> Ave.

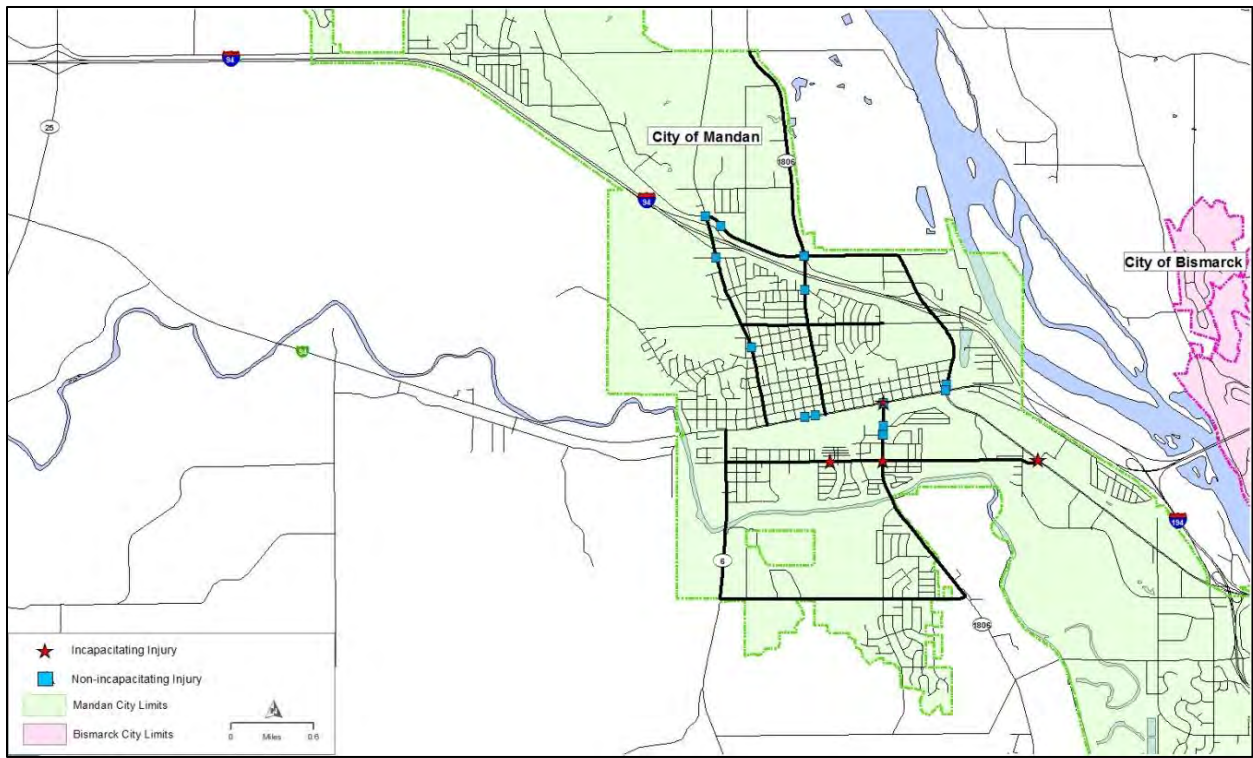
**4.2 City of Mandan Crashes**

Similarly to what was done for the City of Bismarck crash analysis, total crashes were identified as either intersection- or segment-related. They were then classified based on severity. Overall intersection crash locations for the City of Mandan are shown in Figure 13. The most severe of those intersection crashes resulting in either a fatality, incapacitating or non-incapacitating injuries are provided in Figure 14. Segment crashes are provided in Figure 15, with corresponding severity locations provided in Figure 16.





**Figure 13. Mandan Intersection Crashes 2012-2014**



**Figure 14. Mandan Intersection Injury-Related Crashes 2012-2014**

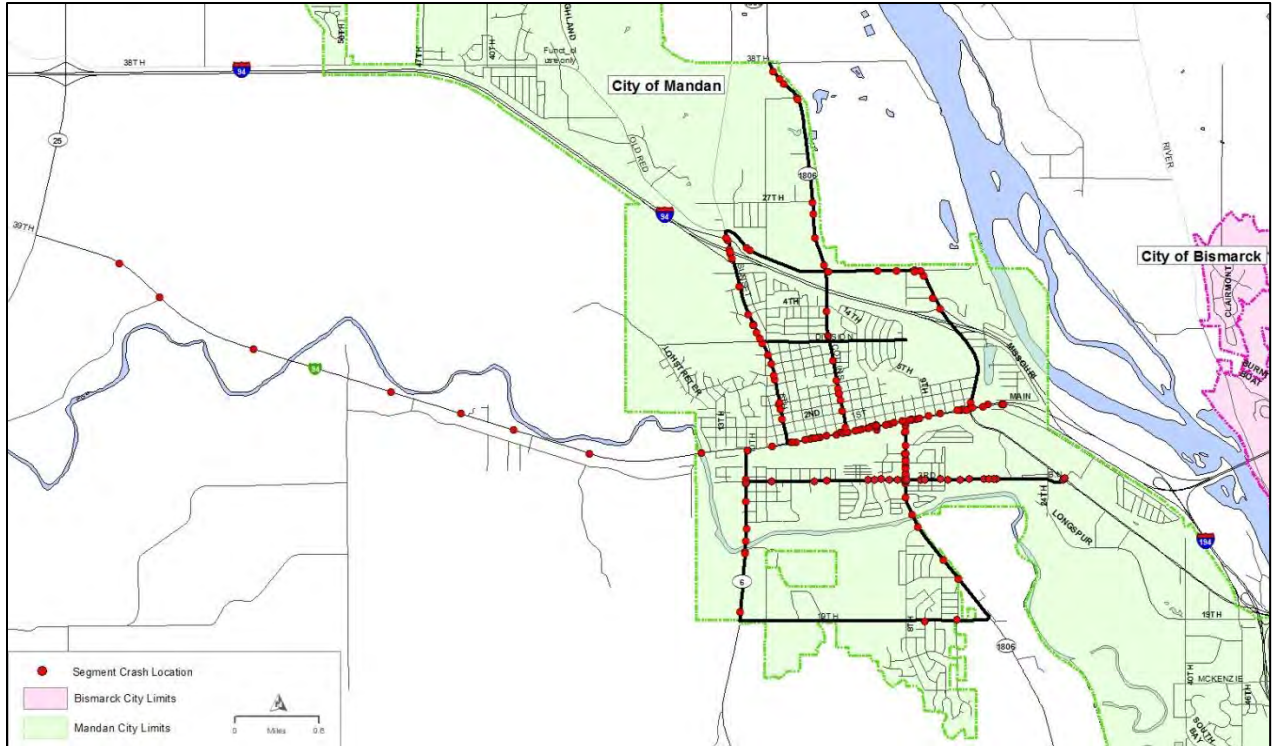


Figure 15. Mandan Segment Crashes 2012-2014

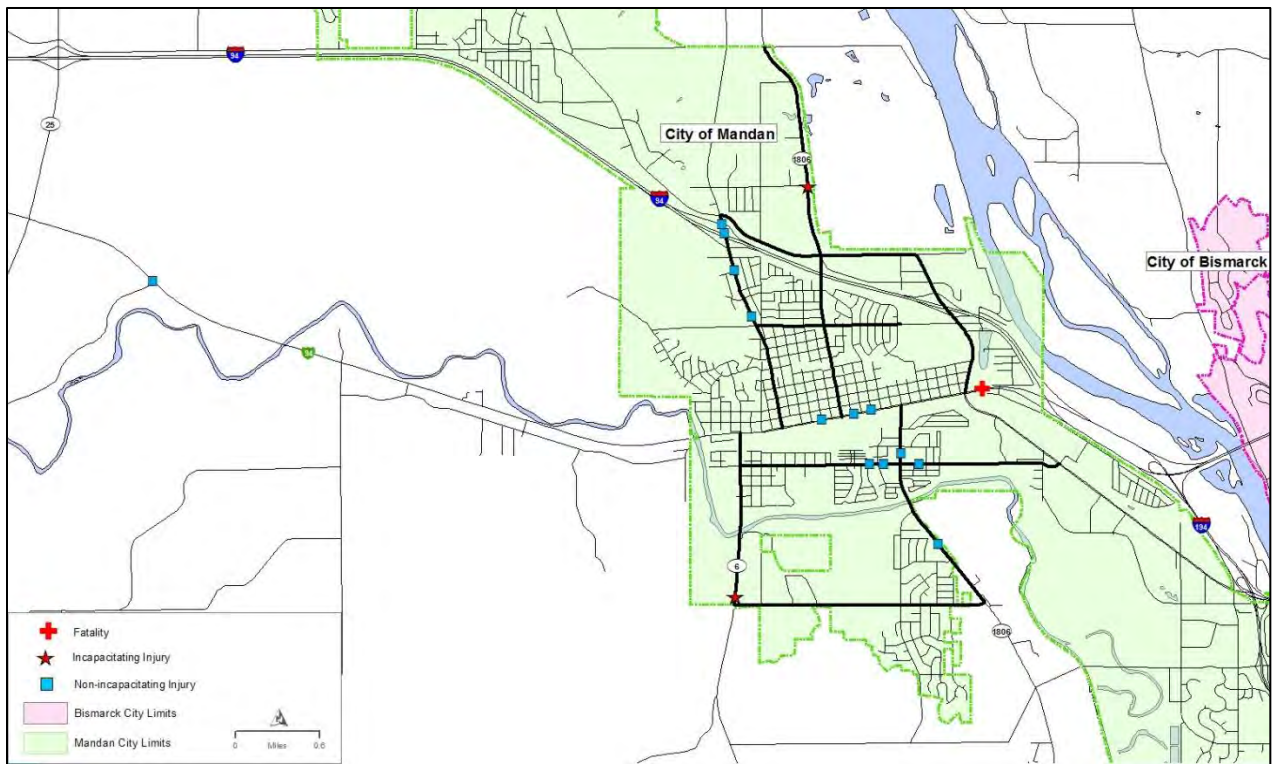


Figure 16. Mandan Segment Injury-Related Crashes 2012-2014

### Number of Crashes by Location in Mandan

The intersections that experienced the most injury-related crashes between 2012 and 2014 were:

- Main St and ND 1806 S: 1 incapacitating and 1 non-incapacitating injury-related crashes
- ND 1806 S and Burlington St SE: 2 non-incapacitating injury-related crashes
- 3<sup>rd</sup> St and Memorial Highway: 1 incapacitating injury-related crash
- 3<sup>rd</sup> St and ND 1806 S: 1 incapacitating injury-related crash

The segments that experienced the fatality and most injury-related crashes between 2012 and 2014 were:

- Main Street: 1 fatality and 3 non-incapacitating injury-related crashes
- 3<sup>rd</sup> Street: 3 non-incapacitating injury-related crashes
- Sunset Dr / 6<sup>th</sup> Ave: 4 non-incapacitating injury-related crashes

### Manner of Collision by Location in Mandan

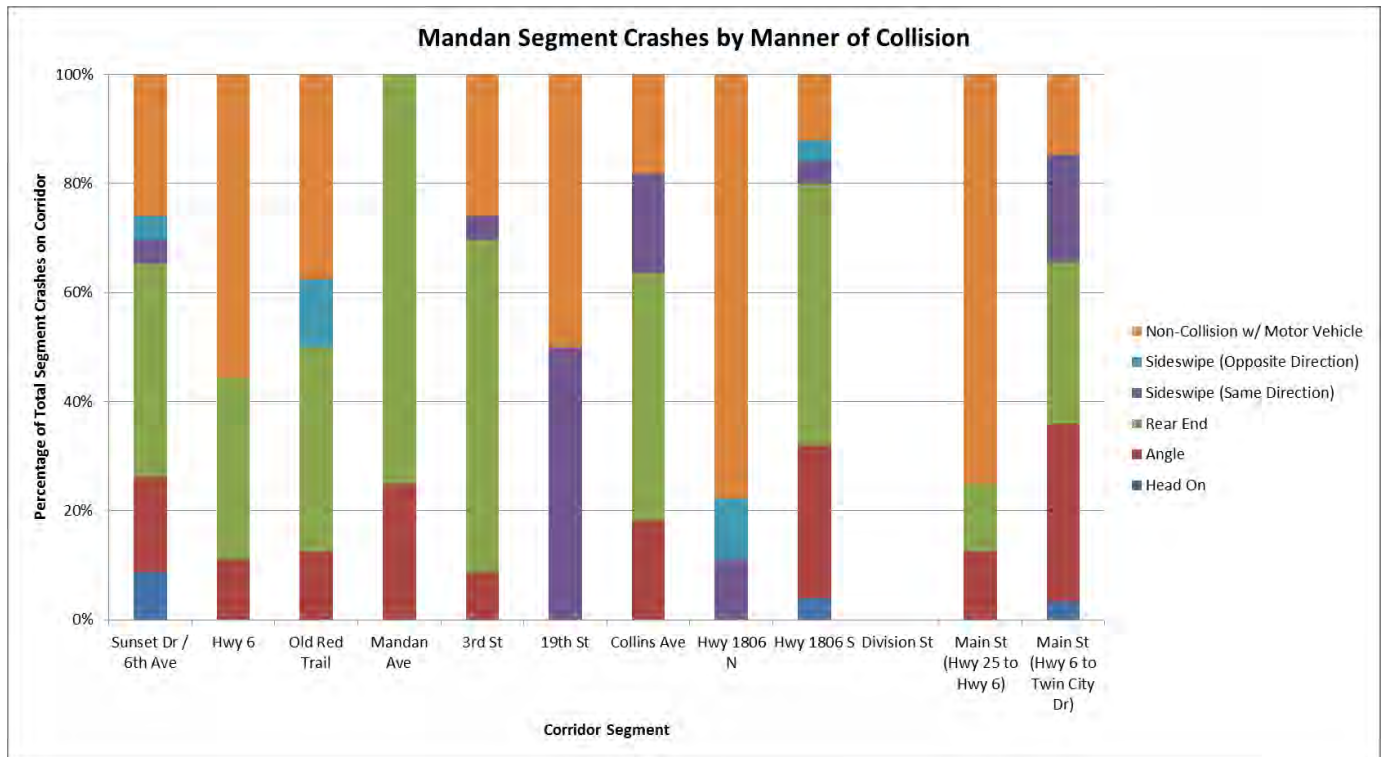
The total overall segment crashes were analyzed based on manner of collision, as shown in Table 8 and Figure 17. Division Street experienced zero segment crashes during the study period. It is important to note that the Main Street corridor was analyzed as two separate segments: the west portion between ND Hwy 25 and ND Hwy 6, and the east portion between ND Hwy 6 and Twin City Drive. The reason for this separation is due to the difference in characteristics such as ADT, speed limit, and rural vs urban setting between the two portions of roadway.

**Table 8. Mandan Segment Crashes by Manner of Collision 2012-2014**

Segment	Head On	Angle	Rear End	Sideswipe (SD)*	Sideswipe (OD)*	Non-Collision w/ Motor Vehicle	Total
Sunset Dr / 6th Ave	2	4	9	1	1	6	23
Hwy 6	0	1	3	0	0	5	9
Old Red Trail	0	1	3	0	1	3	8
Mandan Ave	0	1	3	0	0	0	4
3rd St	0	2	14	1	0	6	23
19th St	0	0	0	1	0	1	2
Collins Ave	0	2	5	2	0	2	11
Hwy 1806 N	0	0	0	1	1	7	9
Hwy 1806 S	1	7	12	1	1	3	25
Division St	0	0	0	0	0	0	0
Main St (Hwy 25 to Hwy 6)	0	1	1	0	0	6	8
Main St (Hwy 6 to Twin City Dr)	2	20	18	12	0	9	61

\*SD = Same Direction

\*OD = Opposite Direction



**Figure 17. Mandan Segment Crashes by Manner of Collision 2012 - 2014**

Main Street between ND Hwy 6 and Twin City Dr experienced the most angle crashes in comparison to other corridors, comprising approximately 33% of its total crashes. 3<sup>rd</sup> Street and Hwy 1806 S had the highest total rear-end crashes totaling to 14 (61%) and 12 (48%) respectively. Sunset Drive, Highway 1806 S, and Main St were the only segments to experience head-on collisions.

Intersections were also analyzed along each study corridor in Mandan to identify the ten intersections shown to experience the highest frequency of crashes over the three-year period. Table 9 and Figure 18 show the crash comparisons for each of the selected intersections based on manner of collision. Three intersections were reported to have three head-on collisions each: 3<sup>rd</sup> St / ND 1806 S, 3<sup>rd</sup> St/Memorial Hwy, and Main St/ND 1806 S. The intersection with the highest total of nine angle crashes (75% of the intersection's crashes) was determined to be ND 1806 S and Burlington St SE, while the intersection with the highest total of 13 rear end crashes (54% of the intersection's total crashes) was found to be Main St and ND 1806 S.

Table 9. Mandan Intersection Crashes by Manner of Collision 2012-2014

Intersection	Head On	Angle	Rear End	Sideswipe (SD)*	Sideswipe (OD)*	Non-Collision w/ Motor Vehicle	Total
Sunset Dr / Old Red Trail	1	4	7	1	0	0	13
Main St / Mandan Ave / Memorial Hwy	0	7	8	1	0	1	17
3rd St / ND 1806 S	3	8	2	3	0	4	20
3rd St / Memorial Hwy	3	5	0	2	0	1	11
Main St / ND 1806 S	3	7	13	0	0	1	24
ND 1806 S / Burlington St SE	1	9	1	0	0	1	12
Sunset Dr / 8th St NW	0	4	3	0	0	0	7
Main St / Twin City Dr	0	4	3	0	0	0	7
Main St / ND Hwy 6	1	2	3	0	0	1	7
Main St / Collins Ave	0	4	0	1	0	1	6

\*SD = Same Direction

\*OD = Opposite Direction

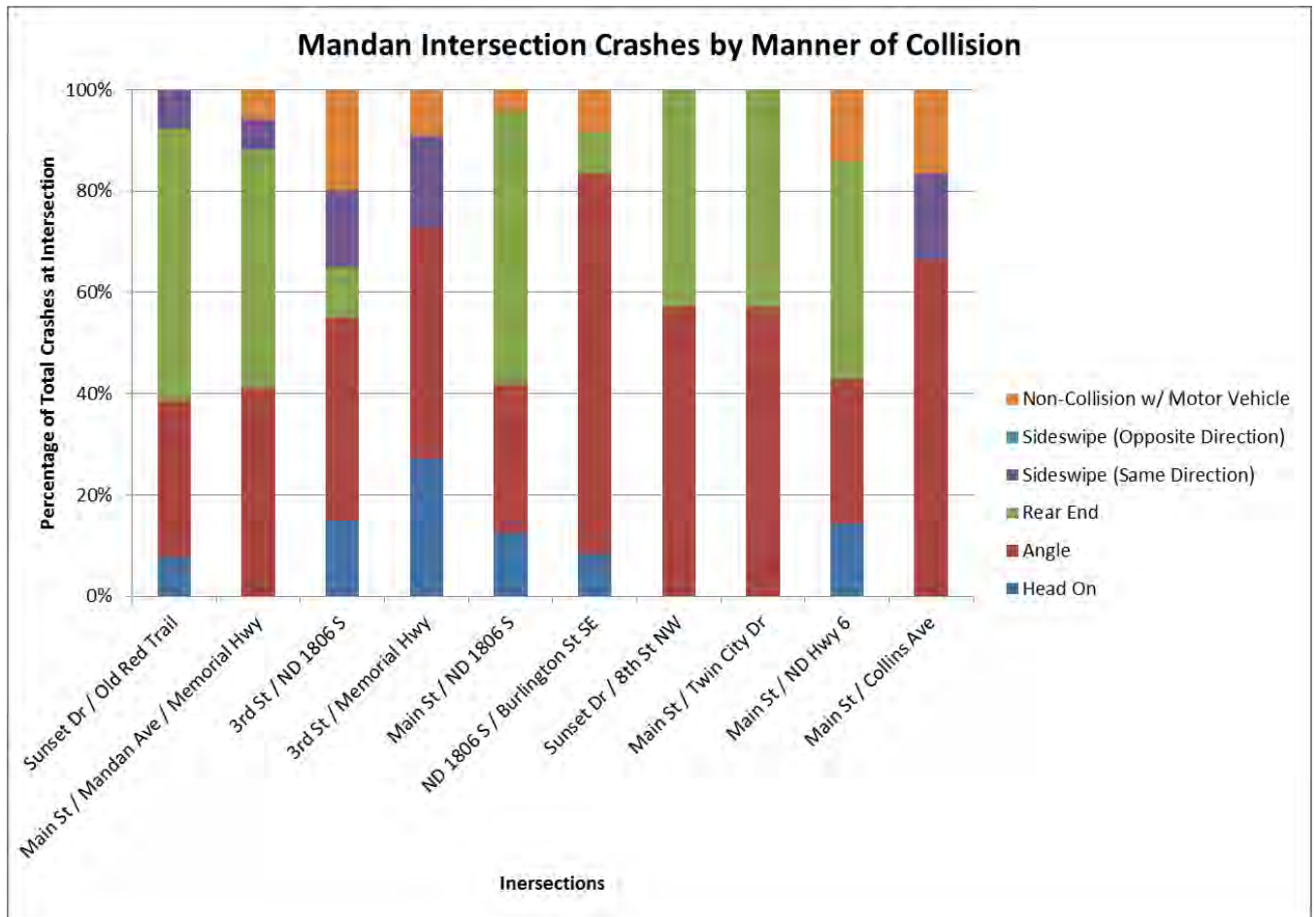


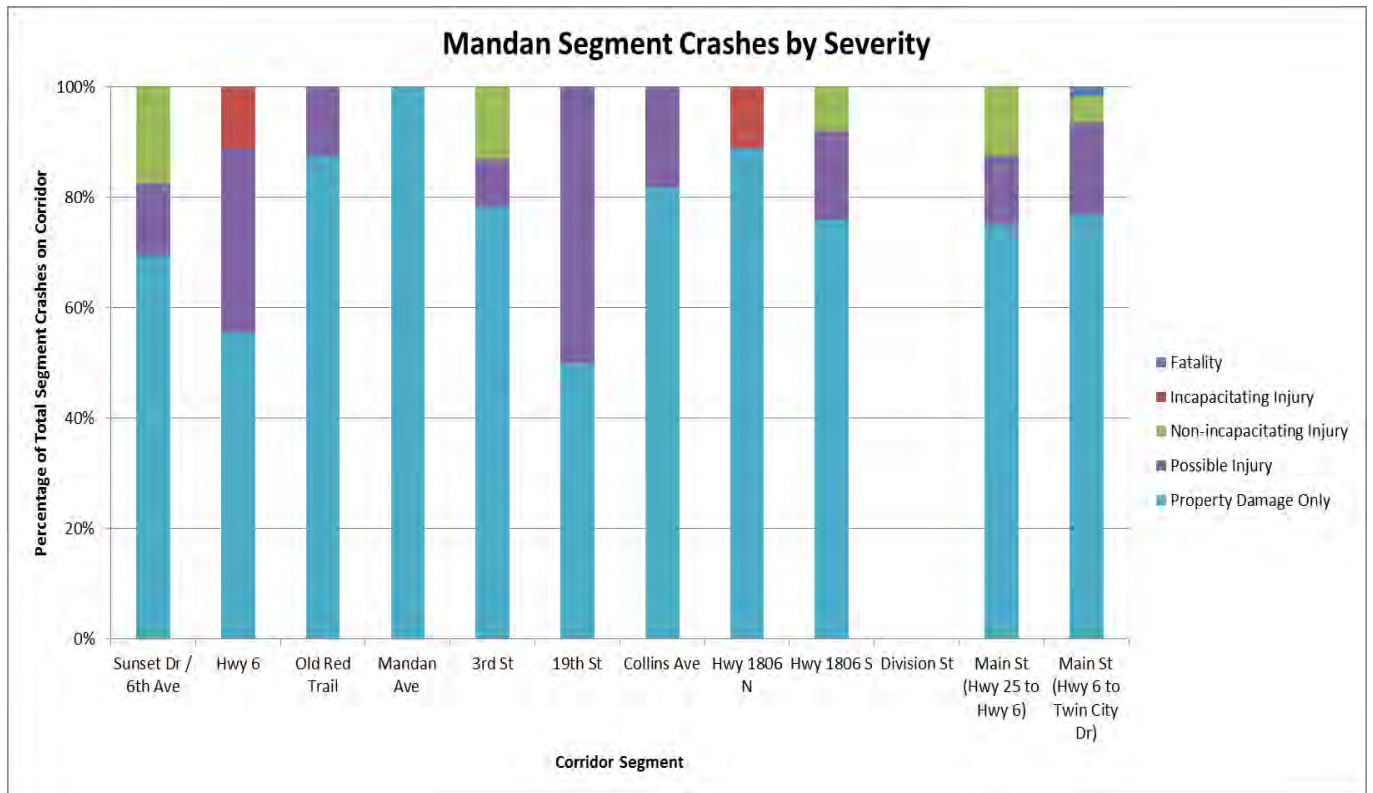
Figure 18. Mandan Intersection Crashes by Manner of Collision 2012-2014

### Crash Severity by Location in Mandan

Segment crashes were also analyzed based on severity. Table 10 gives the total number of crashes for each segment based on severity. Figure 19 provides a visual comparison of the severity of crashes experienced by each corridor. Main Street was the only corridor within the study to experience a fatality. The fatality occurred as a non-collision with motor vehicle type crash in 2012 and involved a motorcycle. Incapacitating injury-related crashes occurred on two corridors: ND 1806 N, and the south portion of Highway 6 near 19<sup>th</sup> Street.

**Table 10. Mandan Segment Crashes by Severity 2012-2014**

Segment	Fatality	Incapacitating Injury	Non-incapacitating Injury	Possible Injury	Property Damage Only	Total
Sunset Dr / 6th Ave	0	0	4	3	16	23
Hwy 6	0	1	0	3	5	9
Old Red Trail	0	0	0	1	7	8
Mandan Ave	0	0	0	0	4	4
3rd St	0	0	3	2	18	23
19th St	0	0	0	1	1	2
Collins Ave	0	0	0	2	9	11
Hwy 1806 N	0	1	0	0	8	9
Hwy 1806 S	0	0	2	4	19	25
Division St	0	0	0	0	0	0
Main St (Hwy 25 to Hwy 6)	0	0	1	1	6	8
Main St (Hwy 6 to Twin City Dr)	1	0	3	10	47	61



**Figure 19. Mandan Segment Crashes by Severity 2012 - 2014**

Table 11 and Figure 20 show comparisons of intersection crashes based on severity.

**Table 7. Mandan Intersection Crashes by Severity 2012-2014**

Intersection	Fatality	Incapacitating Injury	Non-incapacitating Injury	Possible Injury	Property Damage Only	Total
Sunset Dr / Old Red Trail	0	0	1	3	9	13
Main St / Mandan Ave / Memorial Hwy	0	0	1	2	14	17
3rd St / ND 1806 S	0	1	0	5	14	20
3rd St / Memorial Hwy	0	1	0	1	9	11
Main St / ND 1806 S	0	1	1	4	18	24
ND 1806 S / Burlington St SE	0	0	2	2	8	12
Sunset Dr / 8th St NW	0	0	1	1	5	7
Main St / Twin City Dr	0	0	0	1	6	7
Main St / ND Hwy 6	0	0	0	3	4	7
Main St / Collins Ave	0	0	0	2	4	6

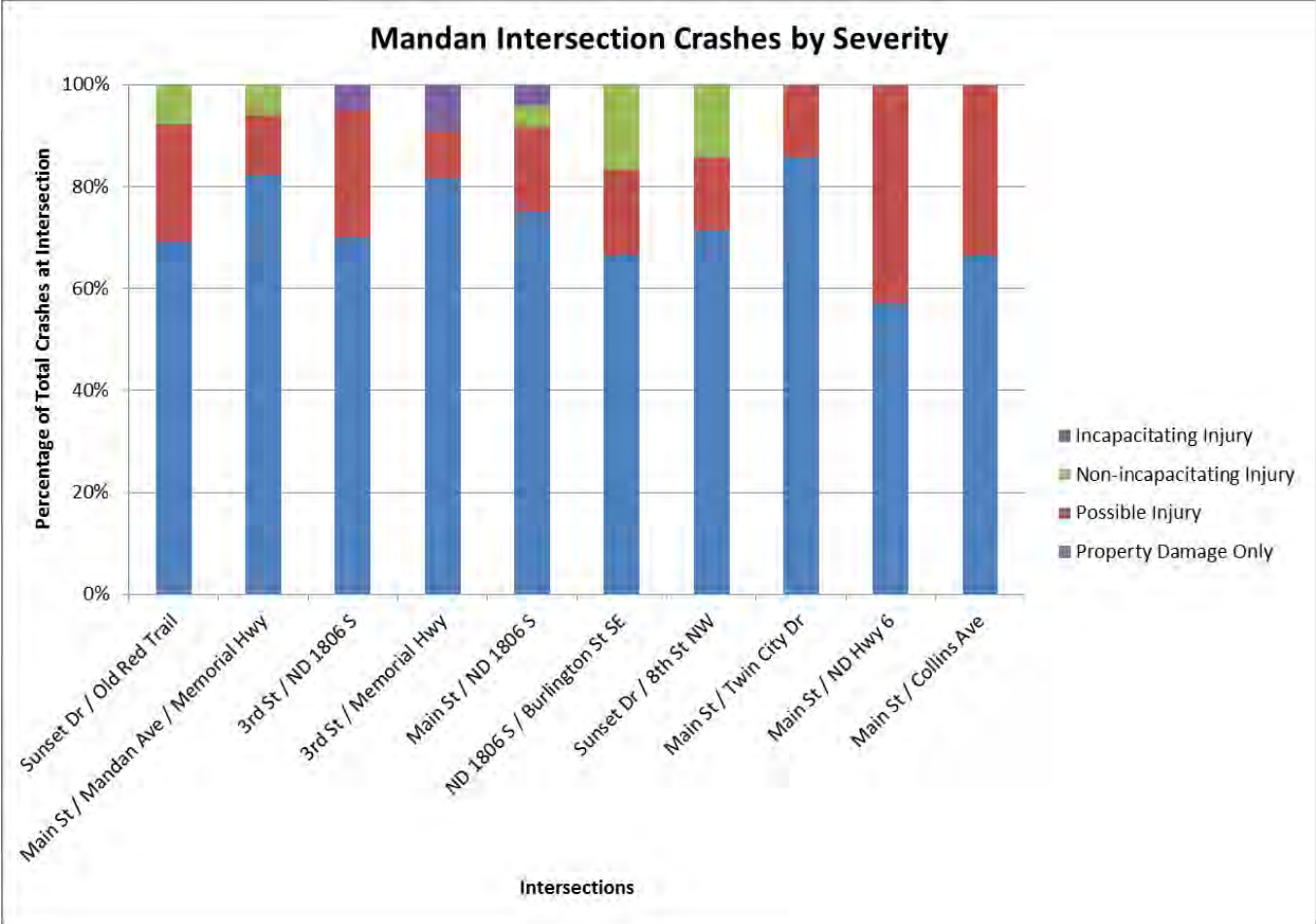


Figure 20. Mandan Intersection Crashes by Severity 2012-2014

**Crash Rates by Location in Mandan**

A list of segment crash rates, measured in crashes per million vehicles-miles of travel (MVM), for the Mandan corridor segments is provided in Table 12. These rates take into account the total number of segment crashes during the study year period, ADT, and segment length and provide a comparison between the relative corridors. As was noted previously, Main St was separated into two segments from Hwy 25 to Hwy 6 and from Hwy 6 to Twin City Dr. The corridor with the highest crash rate of 2.11 crashes/MVM was identified as Main St between Hwy 6 and Twin City Drive. Hwy 1806 S had the second highest segment crash rate of 1.89 crashes/MVM, followed by Sunset Dr/6<sup>th</sup> Ave with a crash rate of 1.84 crashes/MVM. Sunset Dr/6<sup>th</sup> Ave also had the highest segment injury crash rate of 0.32 crashes/MVM. 3<sup>rd</sup> St was determined to have the second highest injury crash rate of 0.21 crashes/MVM.



**Table 8. Mandan Corridor Segment Crash Rates**

Corridor	Total Segment Crashes	Segment Crash Rate (Crashes/MVM)	Total Segment Injury Crashes	Segment Injury Crash Rate (Crash/MVM)
Main St (Hwy 6 to Twin City Dr)	61	2.11	4	0.14
Hwy 1806 S	25	1.89	2	0.15
Sunset Dr / 6th Ave	23	1.84	4	0.32
Collins Ave	11	1.65	0	0.00
3rd St	23	1.64	3	0.21
Hwy 6	9	1.47	1	0.16
Hwy 1806 N	9	1.15	1	0.13
Old Red Trail	8	0.92	0	0.00
19th St	2	0.63	0	0.00
Main St (Hwy 25 to Hwy 6)	8	0.55	1	0.07
Mandan Ave	4	0.55	0	0.00
Division St	0	0.00	0	0.00

Ten intersections having the highest crash frequency were analyzed to determine intersection crash rates. A comparison of intersection crash rates, measured as crashes per million entering vehicles (MEV), is provided in Table 13.

The Mandan intersection with the highest study area crash rate was ND 1806 S and Burlington St SE with 1.06 crashes/MEV. This intersection also had the highest injury crash rate at 0.18 crashes/MEV. The intersection with the second highest crash rate was 3<sup>rd</sup> St and ND 1806 S with 1.05 crashes/MEV, followed by the intersection of Main St and ND 1806 S at 0.98 crashes/MEV. Main St and ND 1806 S also had the second highest injury crash rate of 0.08 crashes/MEV.

**Table 9. Mandan Corridor Intersection Crash Rates**

Intersection	Total Intersection Crashes	Intersection Crash Rate (Crash/MEV)	Total Intersection Injury Crashes	Intersection Injury Crash Rate (Crash/MEV)
ND 1806 S / Burlington St SE	12	1.06	2	0.18
3rd St / ND 1806 S	20	1.05	1	0.05
Main St / ND 1806 S	24	0.98	2	0.08
Sunset Dr / Old Red Trail	13	0.75	1	0.06
Main St / ND Hwy 6	7	0.73	0	0.00
3rd St / Memorial Hwy	11	0.56	1	0.05
Main St / Mandan Ave / Memorial Hwy	17	0.52	1	0.03
Sunset Dr / 8th St NW	7	0.45	1	0.06
Main St / Collins Ave	6	0.39	0	0.00
Main St / Twin City Dr	7	0.29	0	0.00

## Site Visit Observations

Based on site visits, several corridors were identified as having potential sight distance issues along horizontal curves and various intersections. The corridors in particular where concern was noted was the vertical grade and sight distance at the intersection of Sunset Drive and Division St, and horizontal curves along Old Red Trail/Mandan Ave and 19<sup>th</sup> Street. These corridors experience inconsistencies regarding lane widths and shoulder/curb as well.

Main Street was found to experience the most crashes between Highway 6 and Twin City Drive. This 2-mile long segment of Main St has high access density, with approximately 24 cross-streets and over 30 private entries with direct access to the Main Street corridor. In addition, on-street parking is available along some portions as well. Managing the high level of access points could potentially help address the relatively high number of angle, head-on, and opposite-direction sideswiping crashes that occurred along this segment.

## 5.0 Conclusions

Based on the ARTPLAN results, various corridors within the City of Mandan and the City of Bismarck were identified as having a LOS of D or worse under existing 2014 traffic conditions. These corridors can be expected to experience continued travel delays during peak conditions under forecasted conditions of expected traffic growth.

Regarding other modes of travel, future improvements should consider improved connectivity for designated bicycle routes. The bicycle level of service indicates that bicycle service levels are higher when a corridor incorporated a designated bike route throughout its entirety rather than small alternating segments. Also, as potential roadway improvements are considered in the next phase of the study, future on-street bicycle needs (both to current bike routes and planned bike routes in the LRTP) should be considered in any recommendations.

The safety analysis recognized the corridor segments and intersections with the highest crash rates and most severe crashes. While no fatalities occurred for any Bismarck corridors within the three-year study period, there were 42 intersection and 20 segment crashes resulting in incapacitating and non-incapacitating injuries. Bismarck's 9<sup>th</sup> St corridor between Boulevard Ave and Rosser Ave was determined to have both the highest segment crash rate of 11.3 crashes/MVM and the highest segment injury crash rate of 0.38 crashes/MVM. Bismarck's 19<sup>th</sup> St corridor between Divide Ave and LaSalle Dr was found to have the lowest segment crash rate of 2.59 crashes/MVM, while Ward St from Divide Ave to Edwards Ave had the lowest segment injury crash rate of zero. Divide Ave, Washington St, and 9<sup>th</sup> St were found to have the highest occurrences of segment rear-end crashes. Divide Ave was also found to have the highest frequency of head-on collisions as well.

Ten intersections with the highest crash frequencies were also identified within the Bismarck study area. Their intersection crash rates ranged from 0.43 crashes/MEV to 1.55 crashes/MEV, with the intersection of Washington Ave and Century Ave ranking at the lowest and the intersection of Memorial Highway and 3<sup>rd</sup> Street ranking at the highest.

In the City of Mandan there were 16 segment and 19 intersection injury-related crashes that occurred during the three-year study period. Of the 16 injury-related segment crashes, one

consisted of a fatality and occurred on Main St. The segment with the highest segment crash rate was determined to be the Main St corridor between ND Hwy 6 and Twin City Dr with a crash rate of 2.11 crashes/MVM. The segment with the highest injury-related crash rate was Sunset Dr/6<sup>th</sup> Ave at 0.32 crashes/MVM. Division St had values of zero for both segment crash rate and segment injury crash rates. Main St between Hwy 6 and Twin City Dr was found to have the highest total of angle crashes than any other corridor. 3<sup>rd</sup> St and Hwy 1806 S had the highest occurrences of rear-end crashes.

The ten intersections in Mandan with the highest crash frequencies had intersection crash rates ranging from 0.29 to 1.06 crashes/MEV. The intersection of Main St and Twin City Dr had the lowest of 0.29 crashes/MEV and no injuries reported, while the intersection of ND 1806 S and Burlington St SE had the highest intersection rate of 1.06 crashes/MEV as well as the highest intersection injury crash rate of 0.18 crashes/MEV. The intersection of 3<sup>rd</sup> St and ND 1806 S had the second-highest intersection crash rate of 1.05 crashes/MEV.

# APPENDIX A

# Bismarck Corridors

## Washington St

Segment	Through Movement Intersection LOS	Segment LOS
Divide Ave - Interstate Ave	F	F
Interstate Ave - Century Ave	B	B
Century Ave - Calgary	E	F

## 4th Street

Segment	Through Movement Intersection LOS	Segment LOS
Boulevard - Divide	C	C
Divide - Interstate	C	C
Interstate - Century	B	C

## 9th Street

Segment	Through Movement Intersection LOS	Segment LOS
Rosser - E Ave C	C	C
E Ave C - Boulevard	B	D

## 26th St

Segment	Through Movement Intersection LOS	Segment LOS
Airway Ave - Bismarck Exp	C	B
Bismarck Exp - Main St	B	A
Main St - Rosser	C	D
Rosser - Divide Ave	C	B

## Ward Rd

Segment	Through Movement Intersection LOS	Segment LOS
Ewards Ave - Divide Ave	A	A

## Divide Ave

Segment	Through Movement Intersection LOS	Segment LOS
Bismarck Expressway - 26th St	B	B
26th St - 19th St	F	F
19th St - State St	B	B
State St - 4th St	C	C
4th St - Washington St	C	C
Washington St - Schaffer St	B	A

## 7th Street

Segment	Through Movement Intersection LOS	Segment LOS
Boulevard - E Ave C	C	E
E Ave C - Rosser	B	C

## Front Ave - Memorial Hwy

Segment	Through Movement Intersection LOS	Segment LOS
Main Ave - Washington	C	A
Washington - 3rd St	C	D
3rd St - 5th St	C	E
5th St - 7th St	C	E
7th St - 9th St	B	D
9th St - 12th St	B	C

## 19th St

Segment	Through Movement Intersection LOS	Segment LOS
Divide - Capitol	C	D
Capitol - Century	B	A
Century - 43rd Ave	F	F
43rd Ave - LaSalle Dr	C	C

# Mandan Corridors

## Sunset Drive/6th Ave

Segment	Through Movement Intersection LOS	Segment LOS
Old Red Trail - N Interchange	F	F
N Interchange - S Interchange	C	D
S Interchange - 2nd St	B	B
2nd St- 1st St	B	E
1st St - Main St	B	E

## Highway 6

Segment	Through Movement Intersection LOS	Segment LOS
19th - Main st	C	B

## Old Red Trail

Segment	Through Movement Intersection LOS	Segment LOS
Sunset Dr - Collins Ave	B	A
Collins Ave - Mandan Ave	B	B

## Mandan Ave

Segment	Through Movement Intersection LOS	Segment LOS
Old Red Trail -Main St	B	A

## Division Street

Segment	Through Movement Intersection LOS	Segment LOS
6th St - ND 1806	B	B
ND 1806 - 8th Ave	B	B

## Main Street

Segment	Through Movement Intersection LOS	Segment LOS
Hwy 25 - 10th Ave NW	B	A
10th Ave NW - 6th Ave NW	B	C
6th Ave NW - 3rd Ave NW	B	D
3rd Ave NW - 1st St	C	E
1st St - Collins Ave	D	F
Collins Ave - 6th Ave NW	C	B
6th Ave NW - Memorial Hwy	D	D
Memorial Hwy - Twin City Dr	C	C

## 3rd Street SW

Segment	Through Movement Intersection LOS	Segment LOS
Hwy 6 - 9th Ave	B	E
9th Ave - 8th Ave	B	E
8th Ave - 1806	B	A
1806 - Memorial Hwy	E	B

## 19th Street SE

Segment	Through Movement Intersection LOS	Segment LOS
Hwy 6 - 8th Ave	B	A
8th Ave - ND 1806	B	B

## Collins Ave

Segment	Through Movement Intersection LOS	Segment LOS
Old Red Trail - 14th St	B	C
14th St - 2nd St	B	B
2nd St - Main St	B	D

## Highway 1806 N

Segment	Through Movement Intersection LOS	Segment LOS
38th St - Old Red Trail	B	A

## Highway 1806 S

Segment	Through Movement Intersection LOS	Segment LOS
19th St - 3rd St	C	A
3rd St - Main St	B	B



# APPENDIX E

## Technical Memo #2-3

# Memo

Date: Monday, April 25, 2016

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Project: Mandan and Bismarck Corridor Improvement Study – Bismarck-Mandan MPO

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To: Agency Representatives

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From: HDR

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Subject: Technical Memo #2 & #3

## 1.0 Introduction

The purpose of this memorandum (the Memo) is to provide an analysis of the forecasted 2040 traffic operations for each of the corridors within the study area under a no-build alternative. In addition, preliminary low-cost alternatives to help improve traffic operations and safety are identified for each corridor and were presented at the second public input meetings held on March 29<sup>th</sup> and 31<sup>st</sup> of 2016. These alternatives will then be evaluated further to determine their level of effectiveness on improving traffic operations and will be communicated in the next Technical Memo #4. Alternative evaluation will include cost/benefit analysis for each as well as evaluation of Level of Service (LOS), capacity, environmental and social impacts, advantages and disadvantages, cost comparisons, and overall construction feasibility of the alternatives.

Figure 1 shows the functional classification of roadways in Bismarck and Mandan. All corridors included in the study are categorized as either minor arterials or principal arterials, meaning these roadways are major thoroughfares for the city that move high volumes of traffic daily with a high degree of mobility. The alternatives discussed in this Memo have been identified as ways to improve the safety and traffic operation of each corridor to help the roadway function as the arterials they are meant to be.



# BISMARCK-MANDAN IMPROVEMENT CORRIDORS FUNCTIONAL CLASSIFICATION OF ROADS

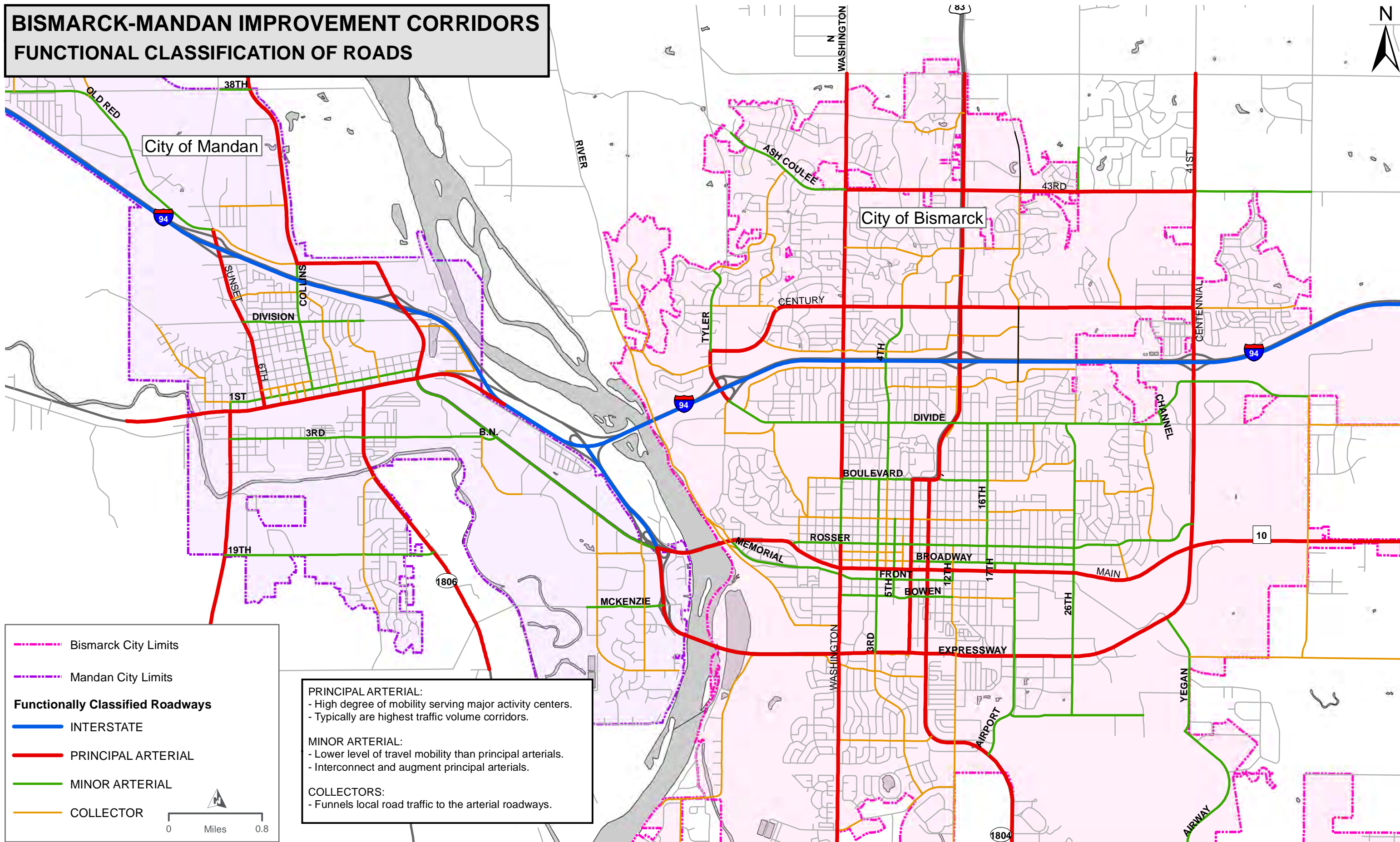


Figure 1: Functional Classification of Roads

## 2.0 2014 Existing Traffic Operations

The 2014 existing conditions LOS methodology, analysis, and results were provided in the previously submitted Technical Memo #1 (Memo #1). 2014 LOS for the Bismarck and Mandan study areas are provided in Figure 2. The results are shown for the through-movement intersection LOS at each main (primarily signalized) intersection as well as the LOS along each corridor segment.

A safety analysis was also conducted as part of Memo #1 and was useful in identifying which corridors and intersections experienced the highest frequency of crashes, severity, as well as what types of crashes were most prevalent. This information proved beneficial in determining which preliminary alternatives were best suited for specific locations and movements. 2014 LOS results are provided in Appendix A.

## 3.0 2040 Forecasted Traffic Operations (No Build)

The Mandan and Bismarck Corridor Improvement Study traffic forecasts were developed through the following steps:

- Traffic growth rates were forecasted for corridor segments by evaluating outputs from the Bismarck-Mandan MPO travel demand model. The modeled growth rates were based on a comparison for 2040 E+C scenario daily traffic volume output compared to 2010 base year daily model output.
  - Year 2014 average daily traffic (ADT) volumes were the baseline data source for the analysis and forecasts. Modeled growth rates (30-year trend from the model) were prorated to a rate reflecting growth from 2014 to 2040. The model forecasts show the near-term period (2010 to 2025) had twice as fast growth as the longer-term period (2026-2040). These model trends led to the assumption that approximately 18% of all forecasted 2010 to 2040 growth had occurred by 2014.
  - The prorated growth factor was then associated with each segment in the studied corridors where an ADT count was available to develop 2040 ADT forecasts. Note that the forecasts for this study use an updated methodology and data that provide slightly different 2040 E+C forecasting results than the 2015-2040 LRTP, since the 2014 ADT counts were not available at the time the LRTP was completed.
- Growth rate factors were interpolated at corridor segments where data was not available. The forecasted growth rates are relatively consistent across most corridors, which verified that interpolating between segments did not skew the results.
- Each segment's forecasted growth rates were reviewed for appropriateness by calculating the peak hour percentage of daily traffic (often referred to as "K-factors"). 2014 K-factors were then compared to 2040 K-factors for consistency.

# BISMARCK-MANDAN IMPROVEMENT CORRIDORS 2014 LEVEL OF SERVICE

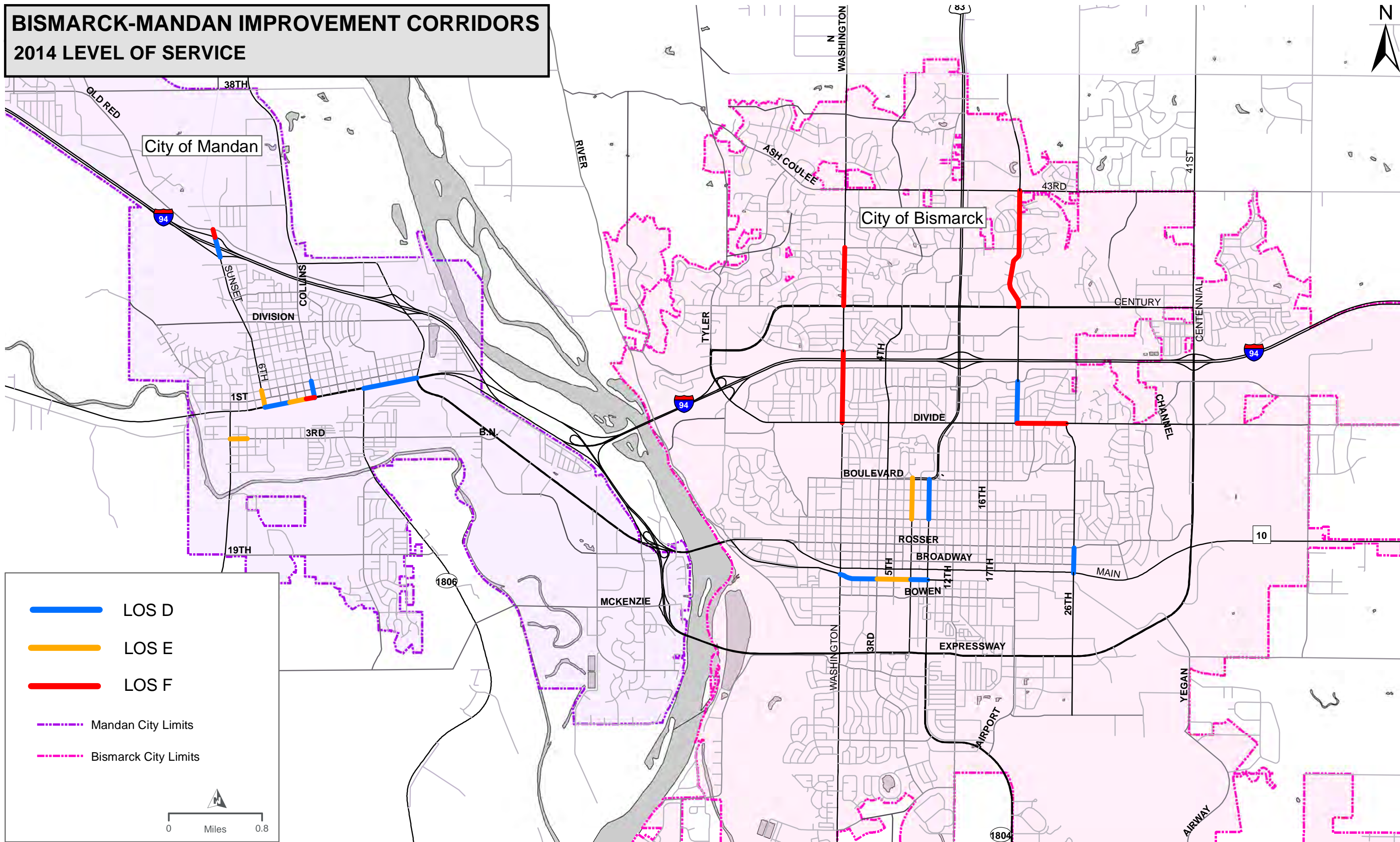


Figure 2: 2014 Level of Service

PATH: \\BIS-SRV01\BISDATA\PROJECTS\00135\TRANSPORTATION\BIS-MAN CORRIDOR IMPROVEMENTS\GIS EXISTING CONDITIONS\2014\LOS\_PUBLIC\INPUTMEETING\_#1.MXD - USER: WSCHROED - DATE: 4/19/2016

Using the constraints of the existing infrastructure also referred to as the no-build alternative, the forecasted 2040 traffic volumes were applied to determine the estimated 2040 LOS for each corridor segment located within the Bismarck-Mandan study area. The 2040 LOS results are provided in Figure 3 and depict only the segments identified to have LOS of D, E and F. 2040 LOS results are provided in Appendix B and followed the same methodology as was used for Memo #1.

Comparing the 2014 and 2040 LOS results, there is no variance for Mandan but several corridors in Bismarck are projected to see deterioration in Level of Service by the year 2040. Divide Ave from Schafer St to Washington St will decrease from LOS A to LOS F. 4<sup>th</sup> St from Interstate Ave to Divide Ave will decrease from LOS C to LOS D. 7<sup>th</sup> St from Boulevard Ave to will decrease from LOS E to LOS F. Finally, Front Ave from 3<sup>rd</sup> St to 7<sup>th</sup> St will decrease from LOS E to LOS F.

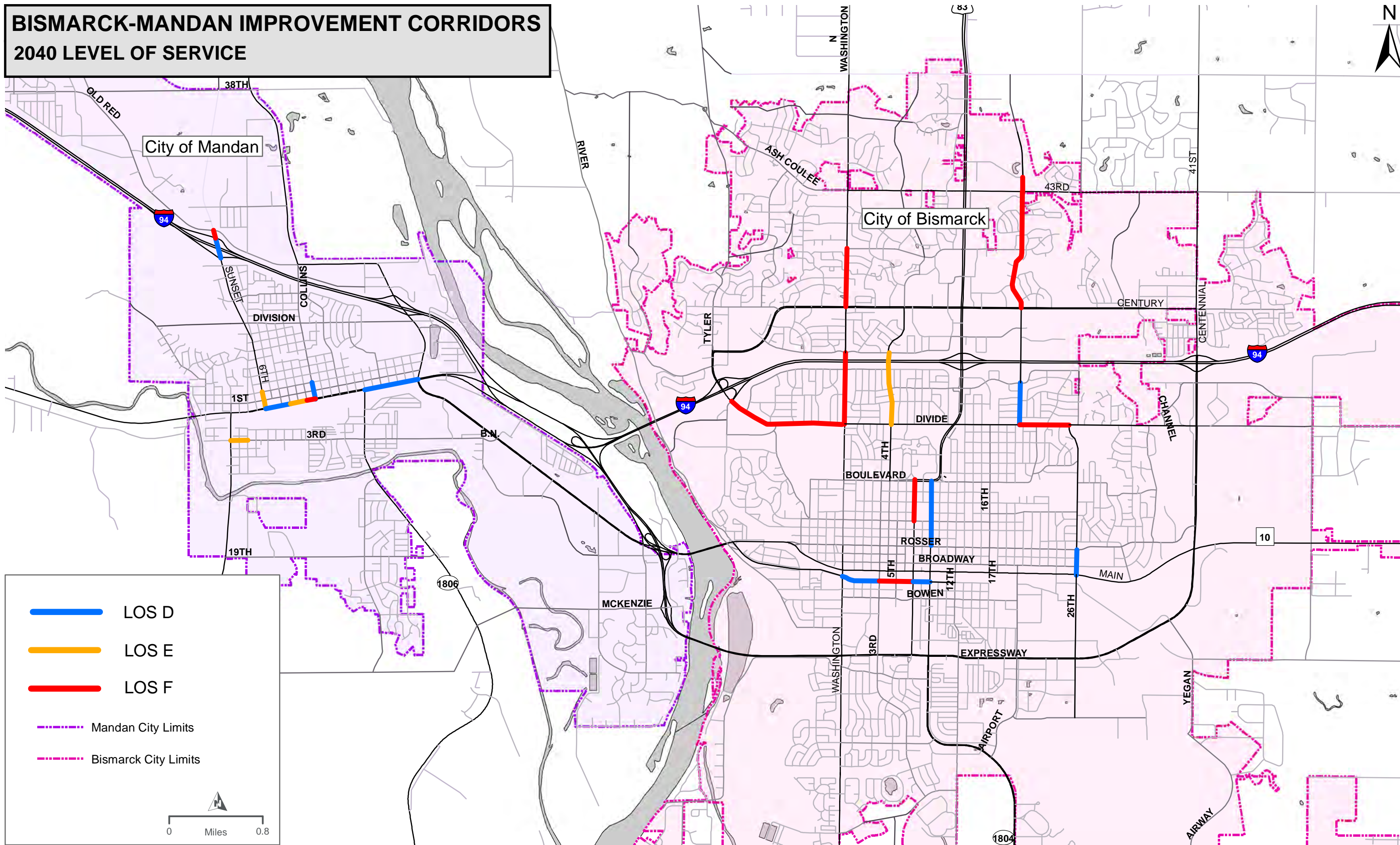
## **4.0 Preliminary Alternatives**

Two of the primary objectives of the Corridor Improvement Project are to improve traffic operations along the corridors and to reduce crashes by applying low-cost alternative solutions such as access management, signal modifications, geometry and lane reconfiguration, signing, and traffic calming measures. With these goals in mind, each corridor and major intersection was analyzed based on LOS and crash data to determine what, if any, alternatives could be applied to improve conditions. The following provides various alternatives for each of the Bismarck and Mandan corridors within the study area.

### **4.1 Mandan Corridor Alternatives**

The major improvement corridors for Mandan are shown in Figure 4 with colored lines that represent the typical section of the proposed alternative with the associated existing conditions shown. Major intersection improvements are also shown in the figure as graphical insets with conceptual representation of the changes for Sunset Drive, Main Street, and the intersection with Mandan Avenue and Old Red Trail. Minor intersection improvements are not shown on this figure but are discussed below in the corridor segment discussion.

# BISMARCK-MANDAN IMPROVEMENT CORRIDORS 2040 LEVEL OF SERVICE



**Legend**

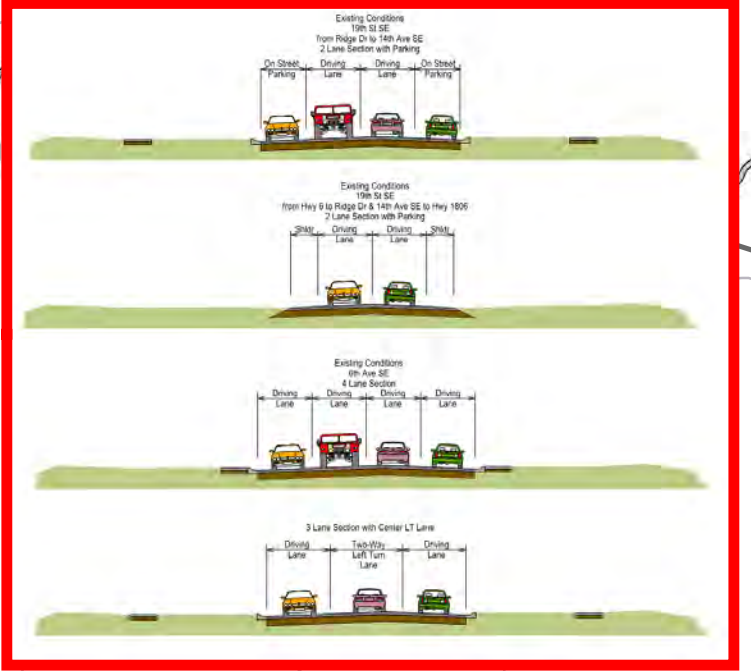
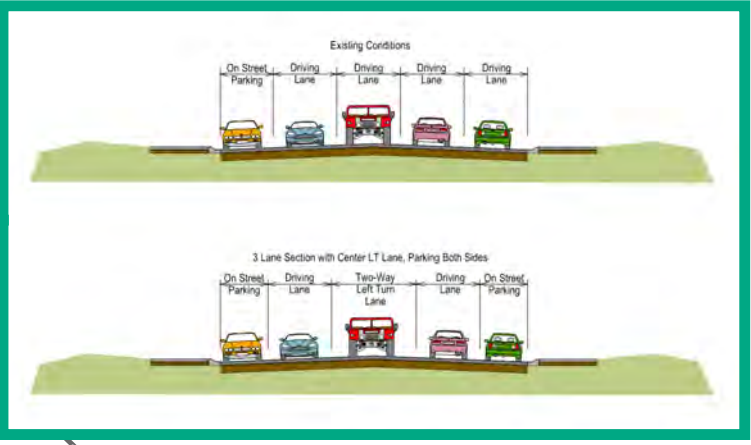
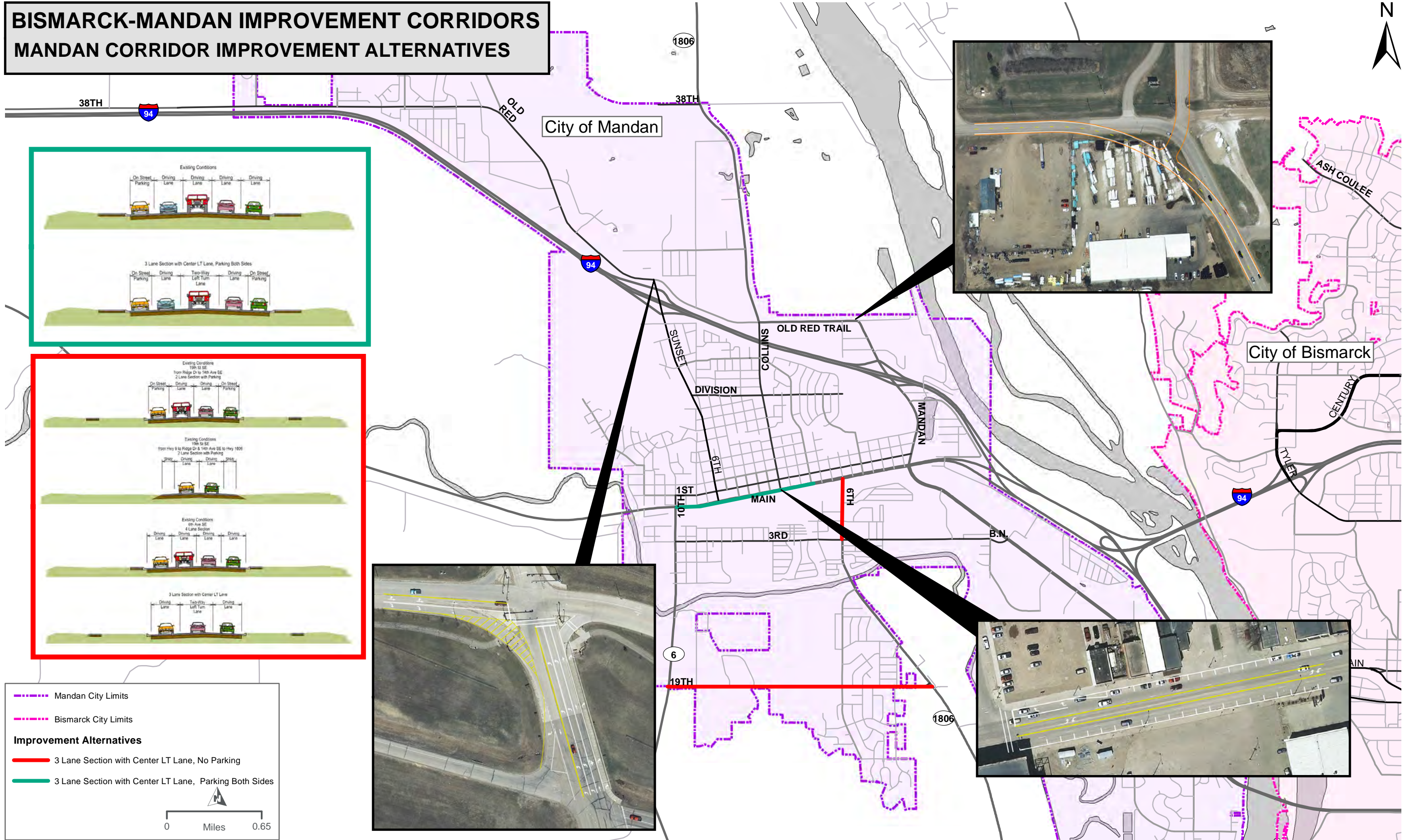
- LOS D
- LOS E
- LOS F
- Mandan City Limits
- Bismarck City Limits

Scale: 0 to 0.8 Miles

Figure 3: 2040 Level of Service

# BISMARCK-MANDAN IMPROVEMENT CORRIDORS

## MANDAN CORRIDOR IMPROVEMENT ALTERNATIVES



- - - Mandan City Limits  
- - - Bismarck City Limits  
**Improvement Alternatives**  
— 3 Lane Section with Center LT Lane, No Parking  
— 3 Lane Section with Center LT Lane, Parking Both Sides

0 Miles 0.65



Figure 4: Mandan Corridor Improvement Alternatives

## **Main Street**

This segment includes the corridor of Main Street between Highway 25 and Twin City Drive. Currently, the corridor consists of very high access density and numerous consecutive signals. On-street parking is essential for businesses on Main St, but parallel parking may be contributing to less-desirable traffic operations.

Proposed alternatives include:

- No-build between Hwy 25 and 10<sup>th</sup> Ave NW (Hwy 6).
- Install 3-lane section between 10<sup>th</sup> Ave NW and 3<sup>rd</sup> Ave NE. Keep on-street parking on north side and add on-street parking on the south side.
  - Provide more right-turn storage by lengthening turn lanes by eliminating two or three parking stalls at major intersections. .
- Add protected left turn phasing at all signalized intersections.
- Coordinate all traffic signals.
- Improve all crosswalks, which have ADA accessible curb ramps.
  - Re-stripe all crosswalks.
  - Install Pedestrian Hybrid Beacon, also known as a HAWK beacon (High-Intensity Activated crossWalk).
  - Add advanced pedestrian crossing signage at those do not already have it (2<sup>nd</sup> Ave NW and 4<sup>th</sup> Ave NW).
    - 8<sup>th</sup> Ave NW
    - 7<sup>th</sup> Ave NW
    - 1<sup>st</sup> Ave NE
    - 2<sup>nd</sup> Ave NE
    - 4<sup>th</sup> Ave NE
    - 8<sup>th</sup> Ave NE
    - 9<sup>th</sup> Ave NE
    - 10<sup>th</sup> Ave NE
    - 11<sup>th</sup> Ave NE
    - 12<sup>th</sup> Ave NE
    - 13<sup>th</sup> Ave NE

## **Sunset Drive / 6<sup>th</sup> Avenue**

This segment includes Sunset Drive and 6<sup>th</sup> Avenue between Old Red Trail and Main St. Based on feedback from attendees at the first public meeting, there is a concern of safety and traffic operations at the intersection of Sunset Drive and Old Red Trail. This is a location that experiences a number of rear-end, side-swipe, and angle crashes.

Proposed alternatives include:

- At the intersection of Old Red Trail and Sunset Dr:
  - Install a dedicated right turn lane for northbound to eastbound traffic on Sunset Dr.
  - Remove island on the west approach of Old Red Trail, and remove the channelized right-turn lane to prevent traffic from merging unsafely with southbound Sunset Drive traffic.

- Narrow the through lane for the southbound traffic immediately south of the intersection and make the right turn lane to the westbound I-94 ramp more defined. This would discourage drivers from inadvertently entering the right turn lane for the ramp.
- Add clear advanced signage for drivers on the westbound I-94 off-ramp, so they know which turn lane they need to be in in order to get where they want to go. This would hopefully prevent drivers from making rushed lane changes in the turn bays immediately north of the off-ramp.
- Install a raised median throughout intersection to allow for advanced signage of lane designations.
- Install signal control on channelized right turn on eastbound-to-southbound approach.
- Regarding signalization at the ramp, look at installing sequential lead-lag or split phase operation.
- Coordinate timing of signals at the I-94 westbound and eastbound ramps with the signal at Old Red Trail.

### **Highway 6**

This segment includes Highway 6 between Main Street and 19<sup>th</sup> Street. The corridor along this section consists of two-lane highway in a rural setting.

Proposed alternatives include:

- Installing a southbound left turn lane and a northbound right turn lane at the intersection of Hwy 6 and 19<sup>th</sup> Street (currently being done 2016).
- Install advance signing to warn drivers of the upcoming Hwy 6 and 19<sup>th</sup> Street intersection.
- Install lighting at Hwy 6 and 19<sup>th</sup> Street intersection to increase visibility for drivers.

### **Old Red Trail**

This corridor consists of Old Red Trail between Sunset Drive and Mandan Avenue.

Proposed alternatives include:

- No-build between Sunset Drive and Mandan Avenue.
- At the intersection of Old Red Trail and Mandan Avenue:
  - Flatten horizontal curve so speed reduction is not necessary, extend curb and gutter, and add advance warning signing.
  - Consolidate Tesoro access to one approach as a radial “T” intersection.
  - Install dedicated left turn lane into Tesoro for eastbound trucks.

### **Mandan Avenue**

Mandan Avenue runs north and south between Old Red Trail and Main Street.

Proposed alternatives include:

- At intersection of Old Red Trail and Mandan Ave:
  - Install right turn lane for northbound trucks into Tesoro.



- For the intersection of Main St and Mandan Ave:
  - Update and restripe the pavement markings on intersection approaches.
  - Add lane extension skips through the intersection to help drivers navigate.
  - Add overhead lane designation signs on mast arms of traffic signal.

### **3<sup>rd</sup> Street**

3<sup>rd</sup> Street runs east and west between Highway 6 and Memorial Highway.

Proposed alternatives include:

- Eliminate 4-way stops between Highway 6 and 8<sup>th</sup> Street and add pedestrian signing near Mary Stark Elementary School.
  - Pedestrian crossing associated with schools will be incorporated as part of the MPO School Safety Crossing Study.
- At the intersection of 3<sup>rd</sup> Street and Memorial Highway:
  - Add curb and gutter or guardrail along radius to prevent erosion and enhance safety of turning vehicles.

### **19<sup>th</sup> Street**

This section of roadway consists of 19<sup>th</sup> Street between Highway 6 and ND 1806. The segment of roadway between HWY 6 and Ridge Drive and between 14<sup>th</sup> Ave SE to HWY 1806 is a two-lane rural section, but is in the process of being heavily developed with residential housing. 19<sup>th</sup> St runs past Fort Lincoln Elementary School. Pedestrian crossing associated with Fort Lincoln Elementary School will be incorporated as part of the MPO School Safety Crossing Study.

Proposed alternatives include:

- Extend the existing urban section from HWY 6 to Ridge Drive and 14<sup>th</sup> Ave SE to HWY 1806.
  - Install 3-lane section.
- Provide turn lanes to all major intersections between Ridge Drive and Hwy 6.
- Install a 3-lane section and eliminate on-street parking for urban segment between Ridge Drive and 14<sup>th</sup> Ave SE.

### **Collins Avenue**

Collins Avenue runs north and south between Old Red Trail and Main Street. There are currently sight distance issues at the east approach of the intersection of Division Street and Collins Ave due to the presence a retaining wall.

Proposed alternatives include:

- In consideration of the Starion Sports Complex to be located at the SE quadrant of the Old Red Trail and Collins Ave intersection, intersection improvements may be advisable:
  - Install traffic signal and left turn lanes in all quadrants.
  - Installation of a roundabout.

- At the intersection of 14<sup>th</sup> Street and Collins Ave:
  - Replace 4-way stop with a 2-way stop, with traffic on Collins Ave being free.
  - Possibly incorporate signalization if warranted.
- At the intersection of Division St and Collins Ave:
  - Offset the retaining wall further back from the street to provide an increase in the sight distance triangle on the east approach of Division.
- Improve sight distance triangle at residential intersections by offsetting retaining walls:
  - 5<sup>th</sup> St NE
  - 7<sup>th</sup> St NE

### **Highway 1806 N**

This section of ND 1806 N runs north and south between 38<sup>th</sup> Street and Old Red Trail. The portion of this corridor is mostly rural; however it is expected to experience a high growth in traffic volumes by the year 2040 due to development.

Proposed alternatives include:

- Installation of left turn lane on northbound ND 1806 N at the intersection of 27<sup>th</sup> Ave.
- At the intersection with 27<sup>th</sup> Ave, install a Pedestrian Hybrid Beacon (aka HAWK beacon) at the pedestrian crossing.

### **Highway 1806 S**

This segment of roadway runs north and south between Main Street and 19<sup>th</sup> Street. Based on the crash data and feedback from attendees at the first public meeting, there is a safety concern regarding the intersection of ND 1806 S and Burlington St SE. Grocery store Dan's Super Market is located near that intersection and there is a high frequency of conflicts between vehicles turning onto Burlington and between vehicles and pedestrians trying to navigate the intersection.

Proposed alternatives include:

- Install a 3-lane section between Main and 3<sup>rd</sup> S.
- At the intersection of Burlington Street and ND 1806:
  - Add a pedestrian crossing and sidewalk along the east side of ND 1806 S (6<sup>th</sup> Ave SE).
  - Install a Pedestrian Hybrid Beacon (aka HAWK beacon) at the pedestrian crossing.
  - Introduce signalization if warranted.
  - Install left turn lane on ND 1806 S on the south approach and right turn lane on north approach for vehicles turning onto Burlington St.
- At the intersection of 3<sup>rd</sup> St and ND 1806 S (6<sup>th</sup> Ave SE):
  - Extend curb and gutter around radius to control access into the gas station.
  - Line up left turn lane offsets on the east and west approaches.
  - Eliminate the boulevard on the east approach between the curb and sidewalk to improve intersection lane geometry without eliminating on-street parking.
- Just south of the intersection of 3<sup>rd</sup> Street and ND 1806 S, the southbound through movement quickly merges from two through lanes to one with very little transition.

- Use one lane as a right turn lane on the north approach and drop it at the intersection. Therefore only one lane is carried through the intersection and eliminates the need for merging.
- Incorporate a dedicated left turn lane.
- No-build between 3<sup>rd</sup> St SE and 19<sup>th</sup> St SE.

### **Division Street**

This portion of the study area includes Division Street between Sunset Drive and 8<sup>th</sup> Avenue NE. The land-use along this corridor is mostly residential.

Proposed alternatives include:

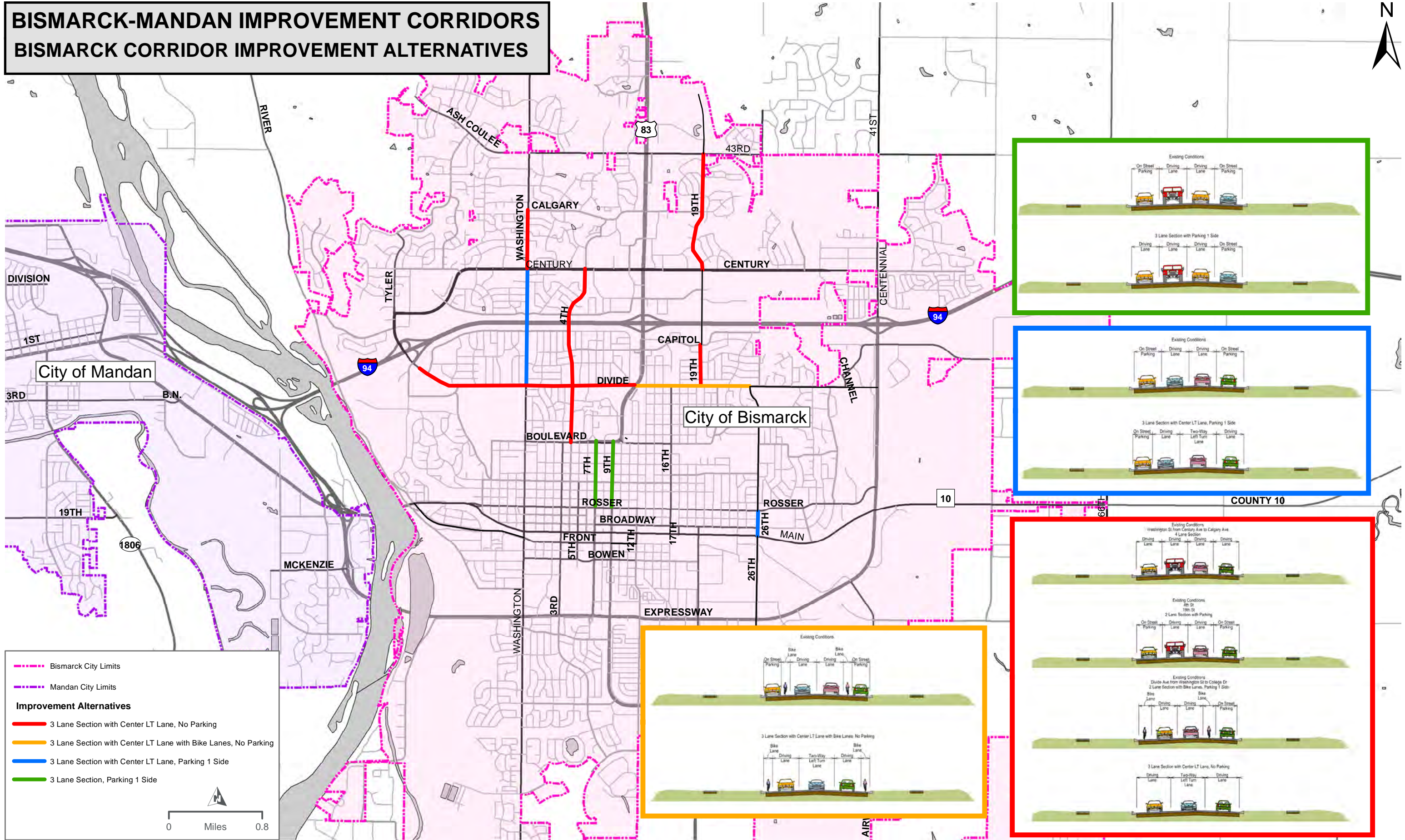
- At the intersection of Sunset Drive and Division Street:
  - Restripe stop bar on Division Street closer to perpendicular travel lane on Sunset Drive to increase sight distance on approach.
  - Maintain roadside vegetation and prune trees as necessary to provide adequate sight distance for drivers on Division Street approach.
- At the intersection of Division Street and 6<sup>th</sup> Avenue:
  - Eliminate yield and stop control for Division Street approaches and allow for free through movement. Make 6<sup>th</sup> Avenue approaches stop controlled.
- At the intersection of Division Street and Collins Avenue:
  - As previously mentioned, offset retaining wall further from roadway to provide increased sight distance for drivers on east Division Street approach.

## **4.2 Bismarck Corridor Alternatives**

The major improvement corridors for Bismarck are shown in Figure 5 with colored lines that represent the typical section of the proposed alternative with the associated existing conditions shown. Minor intersection improvements are not shown on this figure but are discussed below in the corridor segment discussion.

# BISMARCK-MANDAN IMPROVEMENT CORRIDORS

## BISMARCK CORRIDOR IMPROVEMENT ALTERNATIVES



- - - Bismarck City Limits  
- - - Mandan City Limits

**Improvement Alternatives**

- 3 Lane Section with Center LT Lane, No Parking
- 3 Lane Section with Center LT Lane with Bike Lanes, No Parking
- 3 Lane Section with Center LT Lane, Parking 1 Side
- 3 Lane Section, Parking 1 Side

0 Miles 0.8

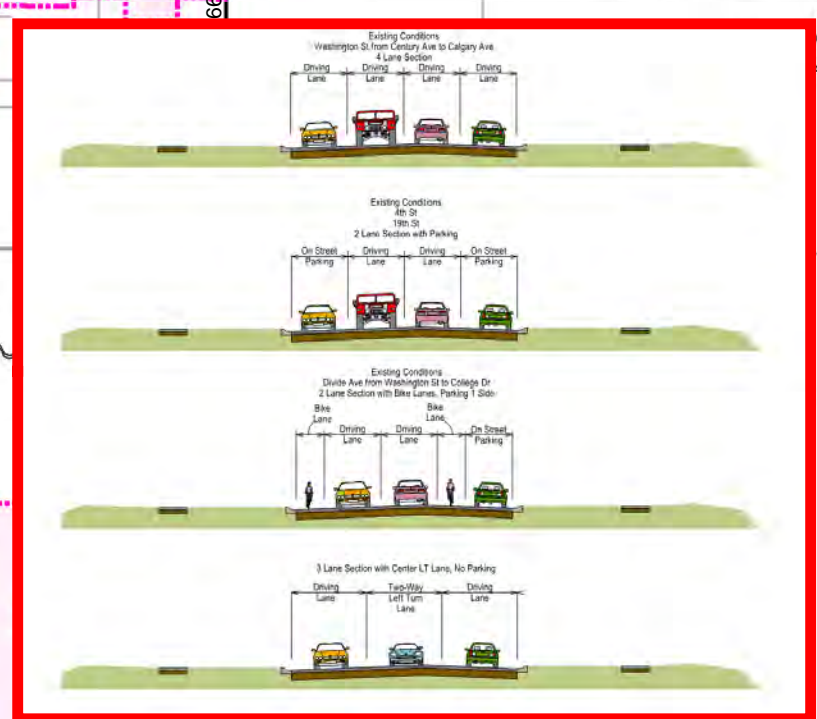
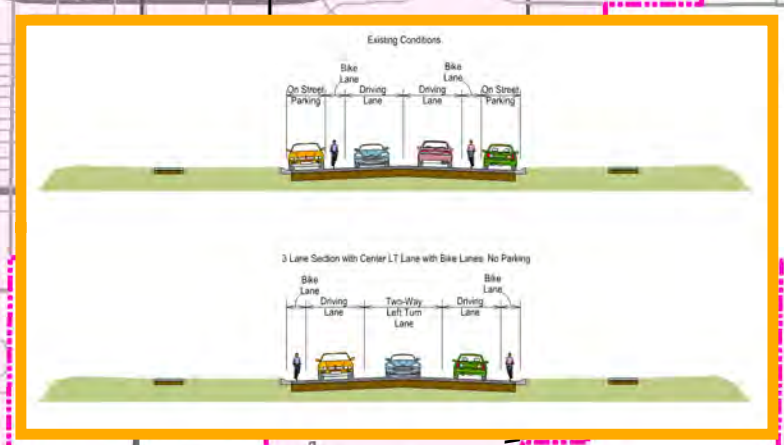
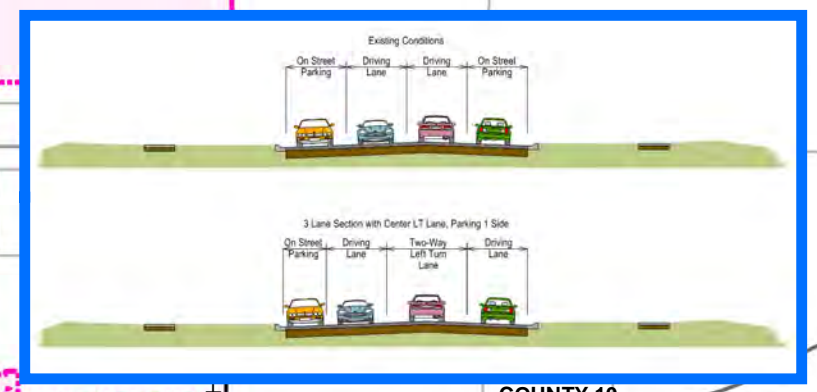
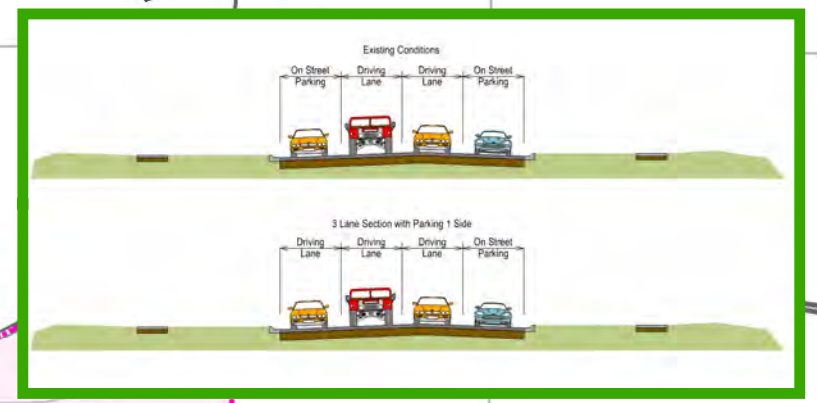


Figure 5: Bismarck Corridor Improvement Alternatives

## **Washington Street**

The Washington Street corridor within the study area includes the portion between Calgary Avenue and Divide Avenue.

Propose alternatives include:

- Install 3-lane section and eliminate on-street parking between Divide Ave and Century Ave.
  - Could also eliminate all parking and raise speed limit to 30-35 mph between cross streets Interstate Ave and Century Ave.
- Install 3-lane section between cross streets Century Ave and Calgary Ave.
- At the intersection of Washington St and Century Ave:
  - Reduce the negative offset of the left-turn lanes by aligning lanes to be in line.
  - Install Flashing Yellow Arrows (FYA) on all approaches at the intersection.
- Coordinate Interstate Ave and Turnpike Ave signals.
- At the intersection of Washington St and W Central Ave:
  - Close two access points (one on Washington St and One on Central) to the Tesoro gas station, closest to the intersection.

## **Divide Avenue**

Divide Avenue runs east and west between Schafer St and Bismarck Expressway.

Proposed alternatives include:

- Install 3-lane section and eliminate on-street parking between Shafer St and State St, utilizing share-the-road signage for bicyclists.
  - Width of roadway could allow for on-street parking remaining on north side from Shafer St to Washington St using share-the-road signage.
- Eliminate on-street parking and keep the bike lanes between Shafer St and Washington St.
- Install 3-lane section and eliminate on-street parking, keep bike lanes between State St and 26<sup>th</sup> St.
  - Could also stripe bike lanes in a different color to increase visibility.
- Eliminate on-street parking between State St and 26<sup>th</sup> St on one side, widen the south sidewalk to a shared-used path width and eliminate bike lanes.
- No-build between 26<sup>th</sup> St and Bismarck Expressway.
- At the intersection of Divide Ave and Washington Ave increase radius to accommodate turning vehicles on west approach.
- At the intersection of Divide Ave and 4<sup>th</sup> Street:
  - Increase storage length for westbound left turning vehicles.
  - Install FYA on all approaches.

## **4<sup>th</sup> Street**

The portion of 4<sup>th</sup> Street included in the study area runs north and south between Century Avenue and Boulevard Avenue.

Proposed alternatives include:

- Install 3-lane section and eliminate parking on entire corridor between Century and Boulevard.
  - Width of roadway could allow for on-street parking remaining on one side from Century Ave to Capitol Ave.
  - Install FYA on all approaches.
- At the intersection of 4<sup>th</sup> St and Century Ave:
  - Install FYA on all approaches.
  - Improve left turn offsets for car storage along Century Ave approaches to increase sight distance.
- At the intersection of 4<sup>th</sup> St and Divide Ave:
  - Lengthen left turn bays on north and south approaches.
  - Add FYA and left turn detection (especially during PM peak hour).
- At the intersection of 4<sup>th</sup> Street and Boulevard Ave:
  - Coordinate signals along Boulevard Ave between 3<sup>rd</sup> St and 7<sup>th</sup> Street to alleviate congestion on east approach of Boulevard Ave.
    - 3<sup>rd</sup> and 4<sup>th</sup> St signals are pre-timed
    - 6<sup>th</sup> St is actuated
    - 7<sup>th</sup>, 8<sup>th</sup>, and 9<sup>th</sup> Streets are pre-timed.

### **7<sup>th</sup> Street**

The segment of 7<sup>th</sup> Street included in the study area consists of the section of roadway between Boulevard Avenue and Rosser Avenue and allows for one-directional southbound traffic only.

Proposed alternatives include:

- Install 3 through lanes and eliminate parking on east side (so driver side car doors are opened to the curb) between Rosser and Boulevard.
- Improve lighting along 7<sup>th</sup> Street corridor, especially in the school zone at Bismarck High School.
- Move stop bars further back from crosswalks.
- Install “Stop Here for Pedestrian” signing to get vehicles to stop further away from crosswalks.

### **9<sup>th</sup> Street**

The segment of 9<sup>th</sup> Street included in the study area consists of the section of roadway between Boulevard Avenue and Rosser Avenue and allows for one-directional northbound traffic only.

Proposed alternatives include:

- Install 3 through lanes and eliminate parking on west side (so driver side car doors are opened to the curb) from Rosser to Boulevard.
- At the intersection of 9<sup>th</sup> Street and Boulevard:
  - Keep existing left turn lane and two right turn lanes.
- Introduce traffic calming measures (table tops, bump outs, etc.).
- Enhance the all pedestrian crossings in school zone to increase visibility.

- Improve lighting along 9<sup>th</sup> Street corridor, especially in the school zone at Bismarck High School.
- Move stop bars further back from crosswalks.
- Enhance all pedestrian crossings along corridor.
- Install “Stop Here for Pedestrian” signing to get vehicles to stop further away from crosswalks.

### **Front Ave/Memorial Highway**

Front Ave / Memorial Highway runs east and west between Main Avenue and 12<sup>th</sup> Street.

Proposed alternatives include:

- No-build between Main Ave and Washington St.
- No-build between Washington St and 12<sup>th</sup> St unless:
  - Unconventional lane widths are approved to allow for a 3 lane section, eliminating on-street parking.
- Eliminate two access points for parking lot on the north side of Front Ave, just east and west of Mandan St.
- At the intersection of Front Ave and 3<sup>rd</sup> Street:
  - Install FYA on all approaches.

### **26<sup>th</sup> Street**

The portion of 26<sup>th</sup> Street included in the study area runs north and south between Divide Avenue and Airway Avenue.

Proposed alternatives include:

- No-build between Divide Ave and Rosser Ave.
- Install 3-lane section, eliminating one side of on-street parking between Rosser Ave and Main Ave.
- No-build between Main Ave and Airway Ave.

### **19<sup>th</sup> Street**

This portion of 19<sup>th</sup> Street runs north and south between Divide Avenue and LaSalle Drive.

Proposed alternatives include:

- Install 3-lane section and eliminate on-street parking from LaSalle Dr to Century Ave.
- At the intersection of 19<sup>th</sup> St and 43<sup>rd</sup>:
  - Realign 19<sup>th</sup> St approaches to line up.
  - Introduce left turn lane and shared right/through lane on northbound 19<sup>th</sup> St approach.
- Add right turn lane for Shiloh and left turn lane for basin electric between Capitol and Century.
  - Require crossing guard wherever there is currently a pedestrian crossing beacon.
- No-build between Century Ave and Capitol Ave.

- Install 3-lane section and eliminate on-street parking between Capitol Ave and Divide Ave.

### **Ward Road**

This section of Ward Road exists between Edwards Avenue and Divide Avenue.

Proposed alternatives include:

- Realignment of Ward Road and College Drive intersection to a 90 degree angle, which would then intersected with Divide at a 90 degree angle.

## **5.0 Conclusions**

Based the forecasted 2040 traffic volumes and the existing and forecasted LOS results, various preliminary alternatives were developed for each corridor within the study area. Some alternatives focus more on traffic operations and efficiency, while others are meant to mitigate safety concerns and crashes. Project stakeholders were included in the development of the preliminary alternatives and provided helpful insight.

Utilizing various aspects of each of the proposed alternatives will be beneficial in improving not only traffic operations along each corridor, but also improve the safety at major intersections by reducing either the frequency of crashes or severity of crashes, and ultimately will assist in helping each corridor operate appropriately according to its functional classification.



# APPENDIX A

## 2014 Level of Service

# Bismarck Corridors

## Washington St

Segment	Through Movement Intersection LOS	Segment LOS
Divide Ave - Interstate Ave	F	F
Interstate Ave - Century Ave	B	B
Century Ave - Calgary	E	F

## 4th Street

Segment	Through Movement Intersection LOS	Segment LOS
Boulevard - Divide	C	C
Divide - Interstate	C	C
Interstate - Century	B	C

## 9th Street

Segment	Through Movement Intersection LOS	Segment LOS
Rosser - E Ave C	C	C
E Ave C - Boulevard	B	D

## 26th St

Segment	Through Movement Intersection LOS	Segment LOS
Airway Ave - Bismarck Expressway	C	B
Bismarck Exp - Main Ave	B	A
Main Ave - Rosser	C	D
Rosser - Divide Ave	C	B

## Ward Rd

Segment	Through Movement Intersection LOS	Segment LOS
Ewards Ave - Divide Ave	A	A

## Divide Ave

Segment	Through Movement Intersection LOS	Segment LOS
Bismarck Expressway - 26th St	B	B
26th St - 19th St	F	F
19th St - State St	B	B
State St - 4th St	C	C
4th St - Washington St	C	C
Washington St - Schafer St	B	A

## 7th Street

Segment	Through Movement Intersection LOS	Segment LOS
Boulevard - E Ave C	C	E
E Ave C - Rosser	B	C

## Front Ave - Memorial Hwy

Segment	Through Movement Intersection LOS	Segment LOS
Main Ave - Washington	C	A
Washington - 3rd St	C	D
3rd St - 5th St	C	E
5th St - 7th St	C	E
7th St - 9th St	B	D
9th St - 12th St	B	C

## 19th St

Segment	Through Movement Intersection LOS	Segment LOS
Divide - Capitol	C	D
Capitol - Century	B	A
Century - 43rd Ave	F	F
43rd Ave - LaSalle Dr	C	C

# Mandan Corridors

## Sunset Drive/6th Ave

Segment	Through Movement Intersection LOS	Segment LOS
Old Red Trail - N Interchange	F	F
N Interchange - S Interchange	C	D
S Interchange - 2nd St	B	B
2nd St - 1st St	B	E
1st St - Main St	B	E

## Highway 6

Segment	Through Movement Intersection LOS	Segment LOS
19th - Main st	C	B

## Old Red Trail

Segment	Through Movement Intersection LOS	Segment LOS
Sunset Dr - Collins Ave	B	A
Collins Ave - Mandan Ave	B	B

## Mandan Ave

Segment	Through Movement Intersection LOS	Segment LOS
Old Red Trail -Main St	B	A

## Division Street

Segment	Through Movement Intersection LOS	Segment LOS
6th St - ND 1806	B	B
ND 1806 - 8th Ave	B	B

## Main Street

Segment	Through Movement Intersection LOS	Segment LOS
Hwy 25 - 10th Ave NW	B	A
10th Ave NW - 6th Ave NW	B	C
6th Ave NW - 3rd Ave NW	B	D
3rd Ave NW - 1st St	C	E
1st St - Collins Ave	D	F
Collins Ave - 6th Ave NW	C	B
6th Ave NW - Memorial Hwy	D	D
Memorial Hwy - Twin City Dr	C	C

## 3rd Street SW

Segment	Through Movement Intersection LOS	Segment LOS
Hwy 6 - 9th Ave	B	E
9th Ave - 8th Ave	B	E
8th Ave - 1806	B	A
1806 - Memorial Hwy	E	B

## 19th Street SE

Segment	Through Movement Intersection LOS	Segment LOS
Hwy 6 - 8th Ave	B	A
8th Ave - ND 1806	B	B

## Collins Ave

Segment	Through Movement Intersection LOS	Segment LOS
Old Red Trail - 14th St	B	C
14th St - 2nd St	B	B
2nd St - Main St	B	D

## Highway 1806 N

Segment	Through Movement Intersection LOS	Segment LOS
38th St - Old Red Trail	B	A

## Highway 1806 S

Segment	Through Movement Intersection LOS	Segment LOS
19th St - 3rd St	C	A
3rd St - Main St	B	B

# APPENDIX B

## 2040 Level of Service

# Bismarck Corridors

## Washington St

Segment	Through Movement Intersection LOS	Segment LOS
Divide Ave - Interstate Ave	F	F
Interstate Ave - Century Ave	C	C
Century Ave - Calgary	F	F

## 4th Street

Segment	Through Movement Intersection LOS	Segment LOS
Boulevard - Divide	C	C
Divide - Interstate	E	D
Interstate - Century	C	C

## 9th Street

Segment	Through Movement Intersection LOS	Segment LOS
Rosser - E Ave C	C	D
E Ave C - Boulevard	B	D

## 26th St

Segment	Through Movement Intersection LOS	Segment LOS
Airway Ave - Bismarck Exp	C	B
Bismarck Exp - Main St	B	A
Main St - Rosser	C	D
Rosser - Divide Ave	C	B

## Ward Rd

Segment	Through Movement Intersection LOS	Segment LOS
Ewards Ave - Divide Ave	A	A

## Divide Ave

Segment	Through Movement Intersection LOS	Segment LOS
Bismarck Expressway - 26th St	B	A
26th St - 19th St	F	F
19th St - State St	C	C
State St - 4th St	C	C
4th St - Washington St	C	C
Washington St - Schaffer St	E	F

## 7th Street

Segment	Through Movement Intersection LOS	Segment LOS
Boulevard - E Ave C	F	F
E Ave C - Rosser	B	C

## Front Ave - Memorial Hwy

Segment	Through Movement Intersection LOS	Segment LOS
Main Ave - Washington	C	A
Washington - 3rd St	D	D
3rd St - 5th St	D	F
5th St - 7th St	F	F
7th St - 9th St	B	D
9th St - 12th St	B	C

## 19th St

Segment	Through Movement Intersection LOS	Segment LOS
Divide - Capitol	C	D
Capitol - Century	C	B
Century - 43rd Ave	F	F
43rd Ave - LaSalle Dr	F	F

# Mandan Corridors

## Sunset Drive/6th Ave

Segment	Through Movement Intersection LOS	Segment LOS
Old Red Trail - N Interchange	F	F
N Interchange - S Interchange	D	F
S Interchange - 2nd St	B	B
2nd St- 1 St	B	F
1st St - Main St	B	E

## Highway 6

Segment	Through Movement Intersection LOS	Segment LOS
19th - Main St	D	B

## Old Red Trail

Segment	Through Movement Intersection LOS	Segment LOS
Sunset Dr - Collins Ave	C	B
Collins Ave - Mandan Ave	F	F

## Mandan Ave

Segment	Through Movement Intersection LOS	Segment LOS
Old Red Trail - Main St	F	F

## Division Street

Segment	Through Movement Intersection LOS	Segment LOS
6th St - ND 1806	B	B
ND 1806 - 8th Ave	B	B

## Main Street

Segment	Through Movement Intersection LOS	Segment LOS
Hwy 25 - 10th Ave NW	B	A
10th Ave NW - 6th Ave NW	C	D
6th Ave NW - 3rd Ave NW	D	E
3rd Ave NW - 1st St	E	F
1st St - Collins Ave	F	F
Collins Ave - 6th Ave NW	C	B
6th Ave NW - Memorial Hwy	F	F
Memorial Hwy - Twin City Dr	F	F

## 3rd Street SW

Segment	Through Movement Intersection LOS	Segment LOS
Hwy 6 - 9th Ave	B	E
9th Ave - 8th Ave	B	E
8th Ave - 1806	B	A
1806 - Memorial Hwy	F	F

## 19th Street SE

Segment	Through Movement Intersection LOS	Segment LOS
Hwy 6 - 8th Ave	B	A
8th Ave - ND 1806	B	B

## Collins Ave

Segment	Through Movement Intersection LOS	Segment LOS
Old Red Trail - 14th St	F	F
14th St - 2nd St	F	F
2nd St - Main St	B	D

## Highway 1806 N

Segment	Through Movement Intersection LOS	Segment LOS
38th St - Old Red Trail	F	F

## Highway 1806 S

Segment	Through Movement Intersection LOS	Segment LOS
19th St - 3rd St	F	F
3rd St - Main St	B	C



# APPENDIX F

## Truck Demands Memo

# Memo

Date: Wednesday, November 25, 2015

Project: Mandan and Bismarck Corridors Improvement Study

To: Steve Saunders, Bismarck-Mandan MPO

From: Rick Stoppelmoor

Subject: Evaluation of Truck Patterns through Mandan

The purpose of this memorandum is to provide an assessment of truck patterns through Mandan for potential truck route analysis. Three different sources of data were used to assess truck flows through Mandan, focusing particularly on through truck movements on Main Street through central Mandan:

- A StreetLight commercial vehicle flow dataset was purchased from StreetLight Data, Inc.
- Conducting interviews with major firms / locations that generate truck traffic in and around Mandan to understand where their trucks came from / went to.
- Assessing current corridor truck patterns based on NDDOT truck counts from the corridor.

## Assessment of StreetLight Data

StreetLight Data's product analyzes data from anonymous mobile devices (phones, GPS systems in vehicles, etc.) and takes that time and location data, analyzes it, and provides commercial or all vehicle mobility patterns for a place.

For this study, the StreetLight data were a summary of origin-destination patterns in Mandan for commercial truck trips. The data provided were summarized from seven (7) months of "typical traffic days" in 2014 and 2015<sup>1</sup> in a format of *Origin Zone – Middle Filter Zone – Destination Zone*. The data allow an understanding of commercial vehicle patterns through the study area, specifically set up to report which major roadways the trips originated from and where they were destined to when passing through the "middle filter" zone of interest – Main Street between 6<sup>th</sup> Avenue NW and Collins Avenue.

## Application of the StreetLight Data

**Figure 1** illustrates the locations of the Origin / Destination zones, along with the Middle Filter Zone on West Main St. As shown, the origin / destination zones covered the major entry and exit points into the central Mandan area, both east and west of the Main Street Filter Zone. Thus, most of the through traffic traveling through central Mandan via West Main Street should be picked up at one zone east of the Filter zone and at one zone west of the Filter zone.

<sup>1</sup> May, August, and November 2014 and January, April, May, and June 2015. The data analyzed were from average weekdays (Monday through Thursday).





STREETLIGHT DATA ORIGIN - DESTINATION ZONES AND MIDDLE FILTER ZONE

(FIGURE 1)

(MANDAN AND BISMARCK CORRIDORS STUDY)

The data received from StreetLight were treated as a relative / proportional data set of travel through the area, with the understanding that the data represent only a sample of all commercial vehicles traveling through the study area. It is not known what portion of the StreetLight data sampled the major truck generators within Mandan (such as trucks accessing the Sunny Pit west of Mandan). Further, it is understood that a large portion of the StreetLight database includes light and medium commercial vehicles, so some of these trucks sampled were likely making local deliveries. To overcome this, stations were set up to identify those commercial trucks that were traveling through central Mandan.<sup>2</sup>

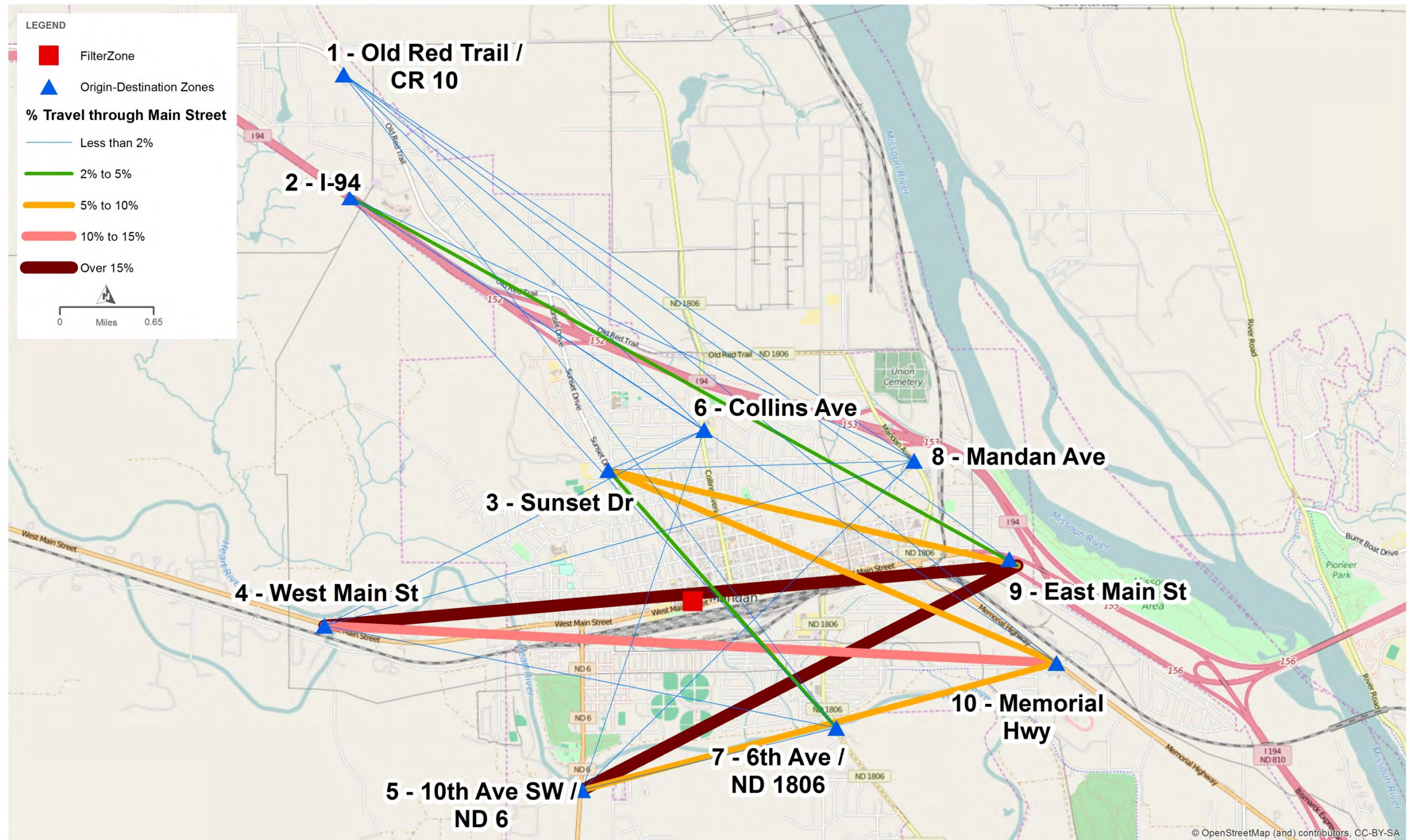
The origin-destination stations were structured to focusing on trucks traveling directly through the study area (of all types), regardless of truck type, that are candidates to use an alternative truck route corridor. The proportional levels of travel through the Main Street Corridor are illustrated in Matrix form in **Table 1**.

**Table 1. Matrix of Proportional Travel through the Main Street Corridor, Percentage by Origin-Destination Pair**

Origin / Destination Zones	1 Old Red Trail	2 I-94 W	3 Sunset Dr	4 West Main	5 ND 6 S	6 Collins Ave	7 ND 1806 S	8 Mandan Ave	9 East Main St	10 Memorial Hwy	Total West to East
1 Old Red Trail	No Data – Both Stations West of Main Street Filter Zone					0.0%	1.0%	0.2%	0.3%	1.1%	2.6%
2 I-94 W						0.0%	0.7%	0.2%	0.8%	1.5%	3.1%
3 Sunset Dr						0.2%	2.8%	0.7%	3.6%	6.0%	13.2%
4 West Main						0.2%	0.2%	0.5%	7.8%	5.1%	13.8%
5 ND 6 S						0.5%	0.0%	0.8%	11.3%	5.6%	18.2%
6 Collins Ave	0.0%	0.0%	0.3%	0.2%	0.8%	No Data – Both Stations East of Main Street Filter Zone					1.3%
7 ND 1806 S	0.0%	0.2%	1.1%	0.5%	0.0%						1.8%
8 Mandan Ave	0.0%	0.3%	0.8%	1.0%	1.1%						3.3%
9 East Main St	0.7%	2.2%	5.8%	7.8%	12.9%						29.4%
10 Memorial Hwy	0.2%	0.5%	3.1%	6.3%	3.3%						13.4%
<b>Total East to West</b>	0.8%	3.1%	11.2%	15.7%	18.2%	0.8%	4.6%	2.3%	23.8%	19.4%	100.0%

The same data are illustrated as “desire lines” in **Figure 2**, where the higher the level of travel between two stations, the thicker the line is depicted.

<sup>2</sup> Upon review of the StreetLight data, a portion of the heavy commercial trucks traveling through Mandan on West Main are likely not captured in the data. Thus it is important to consider the other data sources provided in this memo. However, the travel patterns reflected in the StreetLight data are likely generally representative of through traffic in Mandan.



STREETLIGHT DESIRE LINES OF TRAVEL FREQUENCY BETWEEN ORIGIN / DESTINATION ZONES VIA MAIN STREET

As shown in **Table 1** and **Figure 2**, the highest-frequency O-D patterns through the Main Street corridor, in order are between:

- ND 6 south of Main Street and East Main Street
- West Main Street and East Main Street
- West Main Street and Memorial Highway
- Sunset Drive and Memorial Highway
- Sunset Drive and East Main Street

Commercial vehicle travel patterns from the data indicate:

- The majority of the through travel are direct east-west trips through the Main Street corridor, or are to and from the south. Trip ends on the west side of Mandan are from West Main Street or south on Highway 6 (10<sup>th</sup> Ave SW) and on the east side of Mandan are oriented to I-94 or Memorial Highway.
- The general travel patterns in the StreetLight data would indicate that if an alternate truck route were to have the possibility of moving traffic off of Main Street, a route south of Main Street would provide the most direct option. However, the data indicate that Main Street is the most direct route for many through commercial trips in Mandan.

## Local Interviews of Truck Trip Generators

HDR conducted interviews with several firms and operations that generate high levels of truck trips in November 2015. These data provide insights into the percentage of current locally-generated trucks and patterns through Mandan, particularly from the Sunny Pit. Most operations have defined routes that trucks typically travel. These routes typically connect to the Interstate or Expressway as quickly as possible. That is the case for many of the large Commercial/Industrial operations including Kist Livestock, Tesoro Refinery and Cloverdale Meats where the major connector is close to the business of operation. Though these operations all use separate routes, they are able to directly access an arterial route directly without creating traffic in downtown Mandan, via routes including: Memorial Highway to Interstate 194 (Bismarck Expressway), Old Red Trail to Interstate 94, and Mandan Avenue to Interstate 94. This is the case with the exception of local truck deliveries.

The greatest generator of truck traffic in Mandan is aggregate trucks that are coming from or heading to the Sunny Pit. In discussions with two of the largest operations that use the Sunny Pit, they generate up to 360 truck trips daily on Main Street alone during peak construction seasons. This number does not include private trucks and smaller operations that are hauling from that location also. The primary haul route for these trucks is across the entire length of Main Street from west to east until they merge onto Interstate 94 east of downtown. The only route to avoid Main Street is to “back track” 2.5 miles to the west and use the I-94 Business Loop exit (Exit 147). For trucks oriented to the east, this is a significant amount of out-of-direction travel.

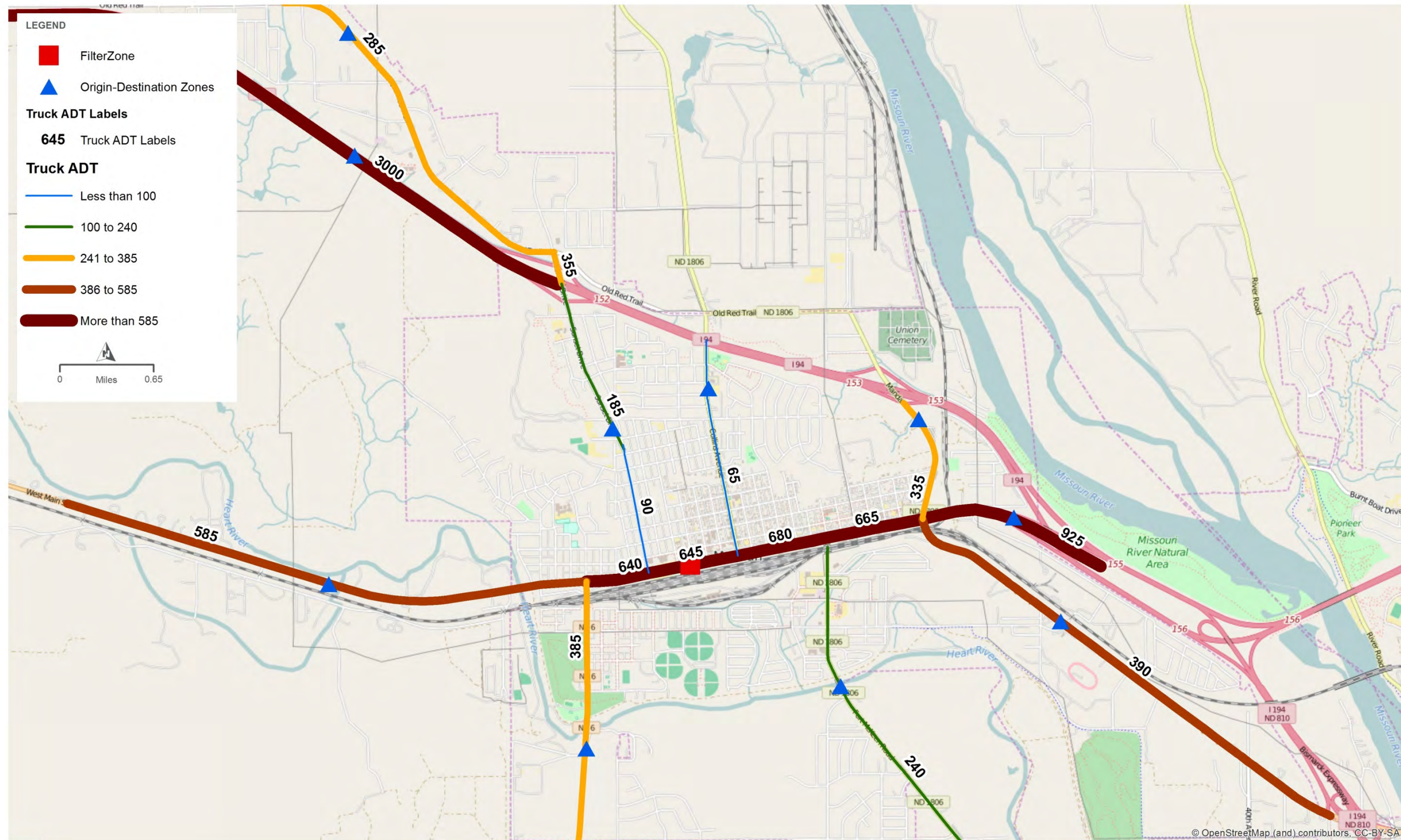
In talking with the owner of the pit, the owner stated that the remaining useful life of the Sunny Pit is between 2 and 5 years. While the owner encouraged the concept of a truck route, they

believed that aggregate trucks from the pit could potentially use it very little since the pit / mining operation would be moved to an undetermined location in the near future. Thus, the closing of the pit at its current location would reduce heavy truck traffic by an estimated 50-60 percent on Main Street through Mandan in the next 2 to 5 years. While there is uncertainty about where the next regional aggregate operation will arise in the future, as it stands a large percentage of Mandan's Main Street truck traffic will disappear with a "Do Nothing" truck route approach. The uncertainty is where in the region the aggregate trucks will be routed when a new pit is established.

## Review of NDDOT Truck Counts

Average Daily Traffic (ADT) truck counts available from NDDOT were reviewed. These data provide some additional reference for evaluating truck patterns through the Main Street corridor. A sample of those truck ADTs taken from the NDDOT website at each of our origin / destination stations is shown in **Figure 3**. In general, the truck ADTs shown in **Figure 3** are somewhat consistent with the desire line travel patterns reflected in **Figure 2**. Specifically:

- Truck volumes are relatively consistent (+/- 5%) through the Main St corridor in Central Mandan. This consistent level of truck traffic between Highway 6 and Memorial Highway indicates there are few major "sinks" or "sources" of truck traffic along the corridor.
- Similar to the Streetlight data, prevailing travel patterns indicate two major movements:
  - Travel directly through Mandan from east to west on Main Street.
  - Travel between locations south of Main (ND 6 and ND 1806 and Memorial Highway) and east and west Main Street.
- There appears to be limited truck traffic traveling between south and north Mandan (via Sunset Drive and Collins Ave / ND 1806).



NDDOT AVERAGE DAILY TRAFFIC (ADT) FOR TRUCKS AT STREETLIGHT ORIGIN / DESTINATION STATIONS

## Summary

Based on a review of all available data sources, it appears that current truck patterns through central Mandan are predominantly:

- Travel directly through Mandan from east to west on Main Street.
- Travel between locations south of Main (ND 6 and ND 1806 and Memorial Highway) and east and west Main Street.

The general travel patterns reflected by the StreetLight data and NDDOT traffic counts indicate that if an alternate truck route were to have the possibility of moving traffic off of Main Street, a route south of Main Street appears to provide the most direct option. However, the data also indicate that Main Street is the most direct route for many truck trips in Mandan.

As noted, the Sunny Pit operation is anticipated to only have 2 to 5 years of remaining serviceable life at its current location. Based on our interview with local truck generators, and the traffic counts available from NDDOT, this operation accounts for at least 60% of the peak seasonal truck traffic along Main Street through Mandan. Thus, there is some uncertainty about the long term truck patterns through Mandan after this mining operation closes and potentially relocates within the area.



# APPENDIX G

## Truck Assessment Memo



# Memo

Date: Monday, April 25, 2016

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Project: Mandan and Bismarck Corridors Improvement Study

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To: Steve Saunders, Bismarck-Mandan MPO and Justin Froseth, Mandan City Engineer

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From: HDR Engineering

Subject: Mandan Truck Route Assessment

The purpose of this memorandum is to provide a summary of the Mandan Truck Route Assessment.

## Existing Truck Patterns

To determine the existing truck patterns on Main Street through central Mandan three different sources of data were used to assess truck flows, focusing particularly on through truck movements (See appendix A Truck Demand Assessment Memorandum):

- A StreetLight commercial vehicle flow dataset was purchased from StreetLight Data, Inc.
- Assessing current corridor truck patterns based on NDDOT truck counts from the corridor.
- Conducting interviews with major trucking companies and locations that generate truck traffic in and around Mandan to understand truck travel patterns.

Based upon the StreetLight Data collected for commercial vehicles, the majority of the truck traffic on Main Street is the result of direct east-west trips. The general travel patterns in the StreetLight data indicates that if an alternate truck route were to have the possibility of moving traffic off of Main Street, a route south of Main Street would provide the most direct option. However, the data indicates that Main Street is the most direct route for many commercial trips through Mandan.

Average Daily Traffic (ADT) truck counts available from NDDOT were reviewed. These data provided some additional reference for evaluating truck patterns through the Main Street corridor. Approximately 645 to 680 trucks per day travel along Main Street between 6<sup>th</sup> Avenue NW and 6<sup>th</sup> Avenue SE.

HDR conducted interviews with several companies and operations that generate high levels of truck trips in November 2015. These interviews provided insights into the percentage of current locally-generated trucks and patterns through Mandan, particularly from the aggregate pit and asphalt plant located west of Mandan. Most local operations have defined routes that trucks typically travel. These routes typically connect to the Interstate or Expressway as quickly as possible.

The aggregate pit generates approximately 360 trucks per day. Based upon conversations with the aggregate pit owner, the aggregate pit will be relocated in the near future due to lack of available natural resources within the area. The proposed location of the new pit may reduce traffic along Main Street in Mandan as trucks will have reduced travel time utilizing other roadways.

The asphalt plant west of Mandan generates approximately 75 trucks per day during the construction season. The asphalt plant will be relocated in the near future to the Twin City Industrial Site in East Mandan, thus further reducing the truck traffic on Main Street. With these two truck-generating sites relocated, truck traffic along Main Street could be reduced by as much as 66%.

## Alternative Truck Routes

The general truck travel patterns indicate that if an alternate truck route were considered to move traffic off of Main Street, a route south of Main Street would provide the most direct option. As discussed previously, truck traffic along Main Street could be reduced by up to two-thirds of current utilization due to the relocation of the aggregate pit and asphalt plant.

ND Hwy 6 accounts for approximately 70 trucks per day on Main Street. Roadway improvements and signed truck routes south of Mandan may further reduce the number of trucks on Main Street.

The east west corridors south of Main Street shown in Figure 1 are the potential truck routes being considered.

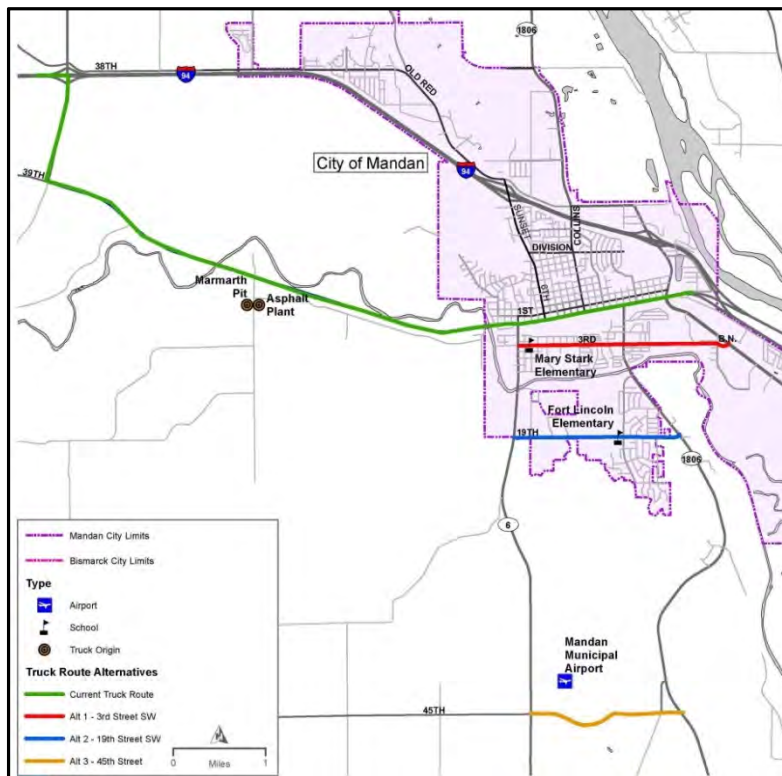


Figure 1: Mandan Truck Route Alternatives

### **3<sup>rd</sup> Street SW from ND Hwy 6 (10<sup>th</sup> Avenue SW) to Memorial Highway**

3<sup>rd</sup> Street SW is an asphalt surfaced 36' wide urban street traversing through established residential neighborhoods. Mary Stark Elementary School is located on the south side of 3<sup>rd</sup> Street SW between 8<sup>th</sup> Avenue SW and 9<sup>th</sup> Avenue SW. The intersections of 8<sup>th</sup> Avenue and 9<sup>th</sup> Avenue with 3<sup>rd</sup> Street are controlled by a four-way stop with marked crosswalks. Except for the signalized intersection at ND Hwy 1806 and the stop signs at Memorial Highway, the remaining intersections with local residential streets are uncontrolled.

Considering the location of Mary Stark Elementary School and the residential neighborhoods, we do not recommend further consideration of this alternative.

### **19<sup>th</sup> Street SW from ND Hwy 6 (10<sup>th</sup> Avenue SW) to ND Hwy 1806**

19<sup>th</sup> Street SW is an asphalt surfaced 24' two lane rural roadway from ND Hwy 6 to Ridge Drive and an asphalt surfaced 45' wide urban street from Ridge Drive to ND Hwy 1806. Currently four residential subdivisions are under development along 19<sup>th</sup> Street from ND Hwy 6 to 8<sup>th</sup> Avenue SW and from 8<sup>th</sup> Avenue SW to ND Hwy 1806. 19<sup>th</sup> Street SW traverses through proposed developments and existing residential neighborhoods. Fort Lincoln Elementary School is located on the south side of 19<sup>th</sup> Avenue SW between Ridge Drive and 8<sup>th</sup> Avenue SE.

In consideration of the location of Fort Lincoln Elementary School and the residential neighborhoods, we do not recommend further consideration of this alternative.

### **45<sup>th</sup> Street (CR 138) from ND Hwy 6 (10<sup>th</sup> Avenue SW) to ND Hwy 1806**

45<sup>th</sup> Street is a 30' wide rural county roadway with a gravel surface from ND Hwy 6 to ND Hwy 1806 and is approximately 4 miles south of Main Street and just south of the Mandan Municipal Airport. Located just south of the Mandan Municipal Airport, this east-west roadway is approximately 1.7 miles long from ND Hwy 6 to ND Hwy 1806. In an effort to handle the increased truck traffic and accommodate trucks in a safe and efficient manner, 45<sup>th</sup> Street would need to be reconstructed to a hard surface roadway with some minor geometric improvements such as increasing the radius of horizontal curves and reducing the slope of the vertical profile at the east end the corridor near ND Hwy 1806. These improvements would require additional right of way and the reconstruction cost would be approximately \$4.6 million.

## **Summary and Recommendation**

In consideration of the significant reduction of the truck traffic on Main Street due to the relocation of the aggregate pit and the asphalt plant, and the cost for improvement of 45<sup>th</sup> Street from ND Hwy 6 to ND Hwy 1806 to serve as a truck route for a small volume of trucks, we recommend the no-build alternative.

## Appendix A

# Memo

Date: Wednesday, November 25, 2015

Project: Mandan and Bismarck Corridors Improvement Study

To: Steve Saunders, Bismarck-Mandan MPO

From: Rick Stoppelmoor

Subject: Evaluation of Truck Patterns through Mandan

The purpose of this memorandum is to provide an assessment of truck patterns through Mandan for potential truck route analysis. Three different sources of data were used to assess truck flows through Mandan, focusing particularly on through truck movements on Main Street through central Mandan:

- A StreetLight commercial vehicle flow dataset was purchased from StreetLight Data, Inc.
- Conducting interviews with major firms / locations that generate truck traffic in and around Mandan to understand where their trucks came from / went to.
- Assessing current corridor truck patterns based on NDDOT truck counts from the corridor.

## Assessment of StreetLight Data

StreetLight Data's product analyzes data from anonymous mobile devices (phones, GPS systems in vehicles, etc.) and takes that time and location data, analyzes it, and provides commercial or all vehicle mobility patterns for a place.

For this study, the StreetLight data were a summary of origin-destination patterns in Mandan for commercial truck trips. The data provided were summarized from seven (7) months of "typical traffic days" in 2014 and 2015<sup>1</sup> in a format of *Origin Zone – Middle Filter Zone – Destination Zone*. The data allow an understanding of commercial vehicle patterns through the study area, specifically set up to report which major roadways the trips originated from and where they were destined to when passing through the "middle filter" zone of interest – Main Street between 6<sup>th</sup> Avenue NW and Collins Avenue.

## Application of the StreetLight Data

**Figure 1** illustrates the locations of the Origin / Destination zones, along with the Middle Filter Zone on West Main St. As shown, the origin / destination zones covered the major entry and exit points into the central Mandan area, both east and west of the Main Street Filter Zone. Thus, most of the through traffic traveling through central Mandan via West Main Street should be picked up at one zone east of the Filter zone and at one zone west of the Filter zone.

<sup>1</sup> May, August, and November 2014 and January, April, May, and June 2015. The data analyzed were from average weekdays (Monday through Thursday).



STREETLIGHT DATA ORIGIN - DESTINATION ZONES AND MIDDLE FILTER ZONE

(FIGURE 1)

(MANDAN AND BISMARCK CORRIDORS STUDY)

The data received from StreetLight were treated as a relative / proportional data set of travel through the area, with the understanding that the data represent only a sample of all commercial vehicles traveling through the study area. It is not known what portion of the StreetLight data sampled the major truck generators within Mandan (such as trucks accessing the Sunny Pit west of Mandan). Further, it is understood that a large portion of the StreetLight database includes light and medium commercial vehicles, so some of these trucks sampled were likely making local deliveries. To overcome this, stations were set up to identify those commercial trucks that were traveling through central Mandan.<sup>2</sup>

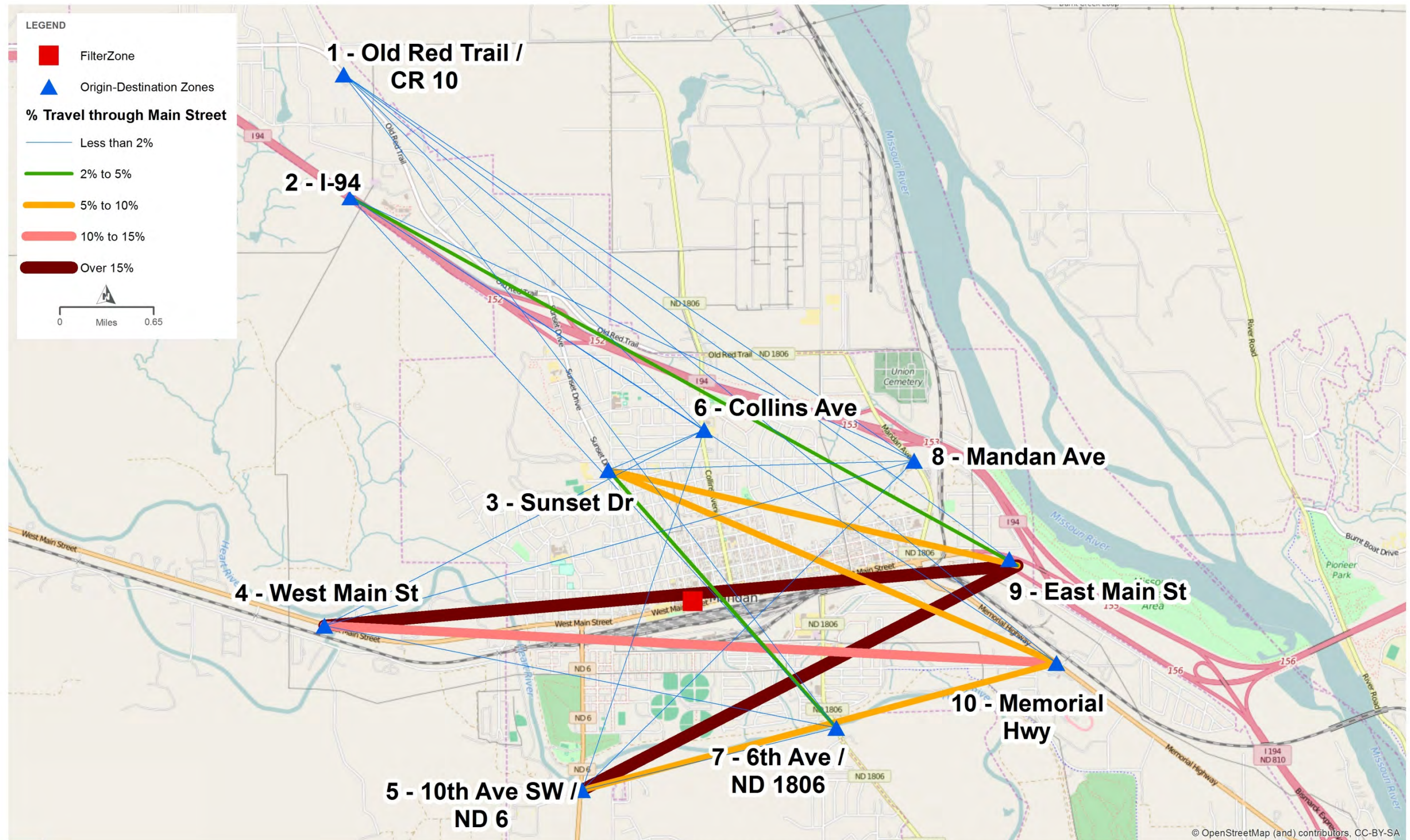
The origin-destination stations were structured to focusing on trucks traveling directly through the study area (of all types), regardless of truck type, that are candidates to use an alternative truck route corridor. The proportional levels of travel through the Main Street Corridor are illustrated in Matrix form in **Table 1**.

**Table 1. Matrix of Proportional Travel through the Main Street Corridor, Percentage by Origin-Destination Pair**

Origin / Destination Zones	1 Old Red Trail	2 I-94 W	3 Sunset Dr	4 West Main	5 ND 6 S	6 Collins Ave	7 ND 1806 S	8 Mandan Ave	9 East Main St	10 Memorial Hwy	Total West to East
1 Old Red Trail	No Data – Both Stations West of Main Street Filter Zone					0.0%	1.0%	0.2%	0.3%	1.1%	2.6%
2 I-94 W						0.0%	0.7%	0.2%	0.8%	1.5%	3.1%
3 Sunset Dr						0.2%	2.8%	0.7%	3.6%	6.0%	13.2%
4 West Main						0.2%	0.2%	0.5%	7.8%	5.1%	13.8%
5 ND 6 S						0.5%	0.0%	0.8%	11.3%	5.6%	18.2%
6 Collins Ave	0.0%	0.0%	0.3%	0.2%	0.8%	No Data – Both Stations East of Main Street Filter Zone					1.3%
7 ND 1806 S	0.0%	0.2%	1.1%	0.5%	0.0%						1.8%
8 Mandan Ave	0.0%	0.3%	0.8%	1.0%	1.1%						3.3%
9 East Main St	0.7%	2.2%	5.8%	7.8%	12.9%						29.4%
10 Memorial Hwy	0.2%	0.5%	3.1%	6.3%	3.3%						13.4%
<b>Total East to West</b>	0.8%	3.1%	11.2%	15.7%	18.2%	0.8%	4.6%	2.3%	23.8%	19.4%	100.0%

The same data are illustrated as “desire lines” in **Figure 2**, where the higher the level of travel between two stations, the thicker the line is depicted.

<sup>2</sup> Upon review of the StreetLight data, a portion of the heavy commercial trucks traveling through Mandan on West Main are likely not captured in the data. Thus it is important to consider the other data sources provided in this memo. However, the travel patterns reflected in the StreetLight data are likely generally representative of through traffic in Mandan.



STREETLIGHT DESIRE LINES OF TRAVEL FREQUENCY BETWEEN ORIGIN / DESTINATION ZONES VIA MAIN STREET



As shown in **Table 1** and **Figure 2**, the highest-frequency O-D patterns through the Main Street corridor, in order are between:

- ND 6 south of Main Street and East Main Street
- West Main Street and East Main Street
- West Main Street and Memorial Highway
- Sunset Drive and Memorial Highway
- Sunset Drive and East Main Street

Commercial vehicle travel patterns from the data indicate:

- The majority of the through travel are direct east-west trips through the Main Street corridor, or are to and from the south. Trip ends on the west side of Mandan are from West Main Street or south on Highway 6 (10<sup>th</sup> Ave SW) and on the east side of Mandan are oriented to I-94 or Memorial Highway.
- The general travel patterns in the StreetLight data would indicate that if an alternate truck route were to have the possibility of moving traffic off of Main Street, a route south of Main Street would provide the most direct option. However, the data indicate that Main Street is the most direct route for many through commercial trips in Mandan.

## Local Interviews of Truck Trip Generators

HDR conducted interviews with several firms and operations that generate high levels of truck trips in November 2015. These data provide insights into the percentage of current locally-generated trucks and patterns through Mandan, particularly from the Sunny Pit. Most operations have defined routes that trucks typically travel. These routes typically connect to the Interstate or Expressway as quickly as possible. That is the case for many of the large Commercial/Industrial operations including Kist Livestock, Tesoro Refinery and Cloverdale Meats where the major connector is close to the business of operation. Though these operations all use separate routes, they are able to directly access an arterial route directly without creating traffic in downtown Mandan, via routes including: Memorial Highway to Interstate 194 (Bismarck Expressway), Old Red Trail to Interstate 94, and Mandan Avenue to Interstate 94. This is the case with the exception of local truck deliveries.

The greatest generator of truck traffic in Mandan is aggregate trucks that are coming from or heading to the Sunny Pit. In discussions with two of the largest operations that use the Sunny Pit, they generate up to 360 truck trips daily on Main Street alone during peak construction seasons. This number does not include private trucks and smaller operations that are hauling from that location also. The primary haul route for these trucks is across the entire length of Main Street from west to east until they merge onto Interstate 94 east of downtown. The only route to avoid Main Street is to “back track” 2.5 miles to the west and use the I-94 Business Loop exit (Exit 147). For trucks oriented to the east, this is a significant amount of out-of-direction travel.

In talking with the owner of the pit, the owner stated that the remaining useful life of the Sunny Pit is between 2 and 5 years. While the owner encouraged the concept of a truck route, they

believed that aggregate trucks from the pit could potentially use it very little since the pit / mining operation would be moved to an undetermined location in the near future. Thus, the closing of the pit at its current location would reduce heavy truck traffic by an estimated 50-60 percent on Main Street through Mandan in the next 2 to 5 years. While there is uncertainty about where the next regional aggregate operation will arise in the future, as it stands a large percentage of Mandan's Main Street truck traffic will disappear with a "Do Nothing" truck route approach. The uncertainty is where in the region the aggregate trucks will be routed when a new pit is established.

## Review of NDDOT Truck Counts

Average Daily Traffic (ADT) truck counts available from NDDOT were reviewed. These data provide some additional reference for evaluating truck patterns through the Main Street corridor. A sample of those truck ADTs taken from the NDDOT website at each of our origin / destination stations is shown in **Figure 3**. In general, the truck ADTs shown in **Figure 3** are somewhat consistent with the desire line travel patterns reflected in **Figure 2**. Specifically:

- Truck volumes are relatively consistent (+/- 5%) through the Main St corridor in Central Mandan. This consistent level of truck traffic between Highway 6 and Memorial Highway indicates there are few major "sinks" or "sources" of truck traffic along the corridor.
- Similar to the Streetlight data, prevailing travel patterns indicate two major movements:
  - Travel directly through Mandan from east to west on Main Street.
  - Travel between locations south of Main (ND 6 and ND 1806 and Memorial Highway) and east and west Main Street.
- There appears to be limited truck traffic traveling between south and north Mandan (via Sunset Drive and Collins Ave / ND 1806).



## Summary

Based on a review of all available data sources, it appears that current truck patterns through central Mandan are predominantly:

- Travel directly through Mandan from east to west on Main Street.
- Travel between locations south of Main (ND 6 and ND 1806 and Memorial Highway) and east and west Main Street.

The general travel patterns reflected by the StreetLight data and NDDOT traffic counts indicate that if an alternate truck route were to have the possibility of moving traffic off of Main Street, a route south of Main Street appears to provide the most direct option. However, the data also indicate that Main Street is the most direct route for many truck trips in Mandan.

As noted, the Sunny Pit operation is anticipated to only have 2 to 5 years of remaining serviceable life at its current location. Based on our interview with local truck generators, and the traffic counts available from NDDOT, this operation accounts for at least 60% of the peak seasonal truck traffic along Main Street through Mandan. Thus, there is some uncertainty about the long term truck patterns through Mandan after this mining operation closes and potentially relocates within the area.

# APPENDIX H

## Public Involvement

To encourage public participation and to solicit public input, an interactive webpage was developed and three rounds of public input meetings were conducted in the cities of Mandan and Bismarck.

The study corridors and the existing conditions were presented at first round of public input meetings held at the Mandan City Hall on January 26, 2016, and at the Bismarck Public Library on January 28, 2016. Not including staff, the attendance at the Mandan Public Meeting was 8 citizens and the attendance at the Bismarck Public Meeting was 10 citizens.

Preliminary alternatives for corridors within both cities were presented at the second round of public meetings held at the Mandan City Hall on March 29, 2016 and at the Bismarck Public Library on March 31, 2016. Not including staff, the attendance at the Mandan Public Meeting was 2 citizens and the attendance at the Bismarck Public Meeting was 3 citizens.

At the third round of public meetings held on at the Bismarck Public Library on June 1, 2016 and at the Mandan City Hall on June 2, 2016 the alternatives were discussed in further detail and analyzed to determine to what extent their effectiveness will have on traffic operations and safety. Through this process, the most beneficial mitigation efforts could be identified and given focus. Not including staff, the attendance at the Mandan Public Meeting was 5 citizens and the attendance at the Bismarck Public Meeting was 7 citizens.

Throughout the duration of the study a total of 7 comments were received by various sources:

- 1 Letter
- 1 Telephone
- 2 Comment forms at public meetings
- 2 Email correspondence
- 1 Web page submittal on Interactive map

Included in this appendix are the public meeting presentations, attendance sheets and comments received.



# Mandan-Bismarck Corridor Improvement Study

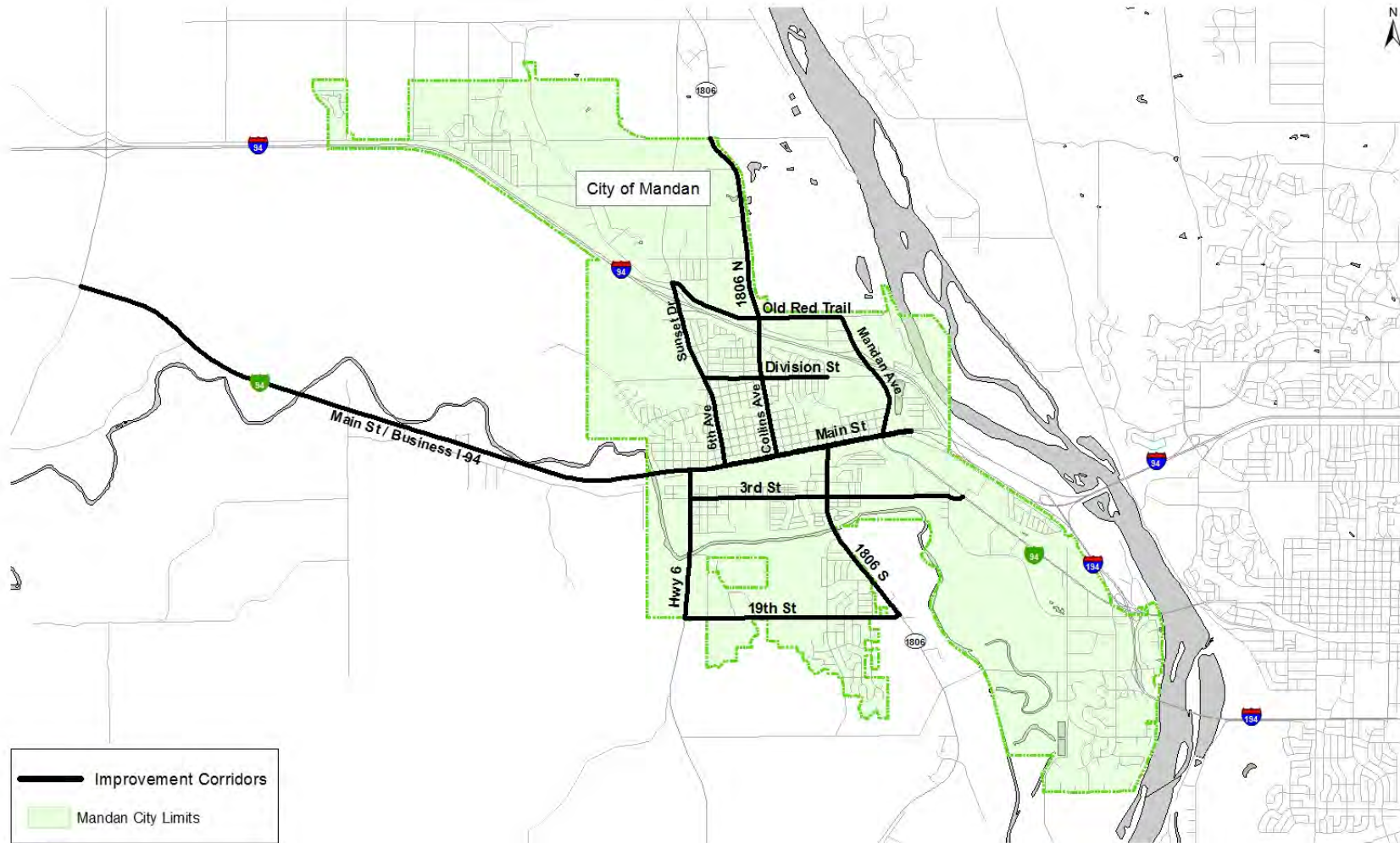
Public Meeting 1  
January 26, 2016  
Mandan City Hall



# Agenda

- **Purpose of the Mandan-Bismarck Corridor Improvement Study**
- **Corridors included in the study**
- **Existing traffic operations within the corridors**
- **Input opportunities**
- **Next steps**

# Mandan Corridors











# Anticipated Schedule



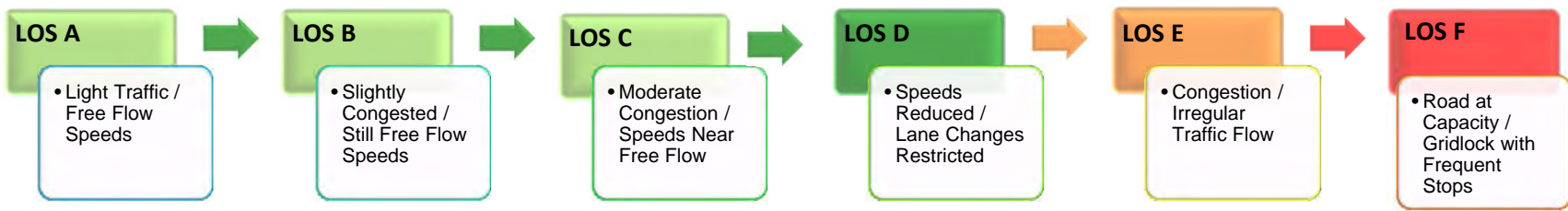
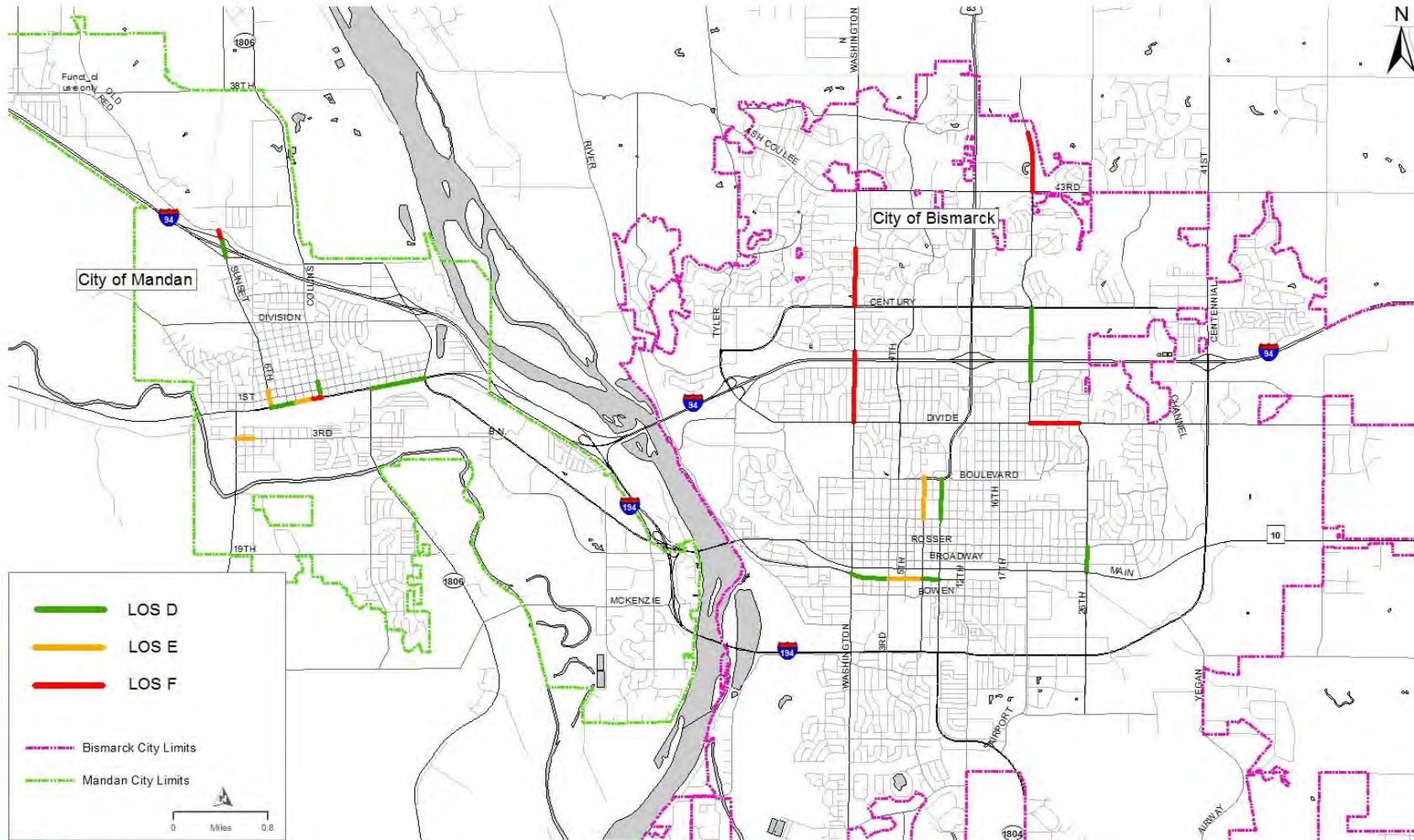
## Progress To Date

- **Gathered existing conditions data**
  - ✓ Existing traffic volumes
  - ✓ Existing vehicle crash data
  - ✓ Site visit of the corridors
- **Analyzed existing conditions data**
- **Initiated the public involvement process**

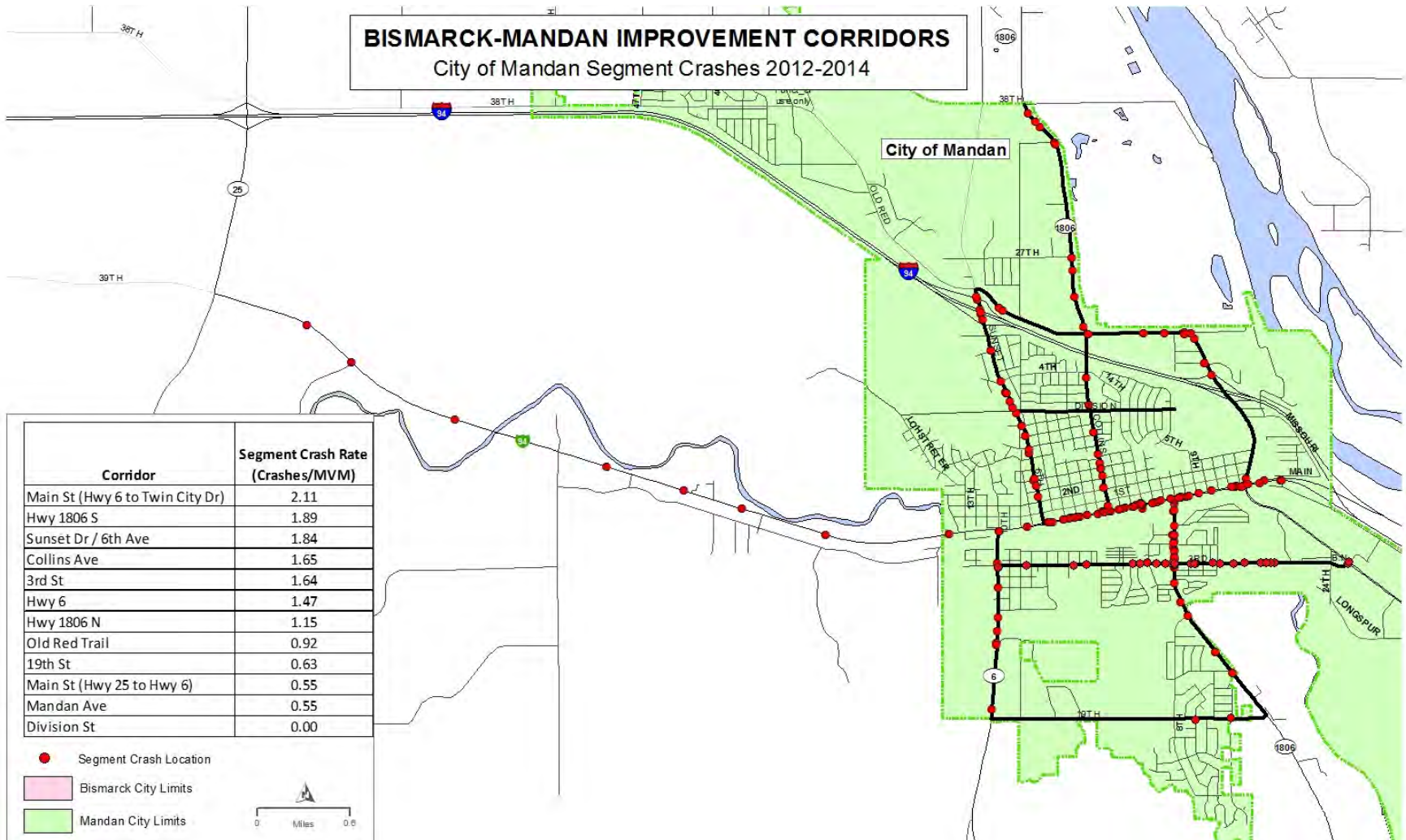
# Level of Service Definition

Level of Service	Flow Conditions	Technical Descriptions
A		Highest quality of service. Free traffic flow with few restrictions on maneuverability or speed. <b>No Delays</b>
B		Stable traffic flow. Speed becoming slightly restricted. Low restriction on maneuverability. <b>No Delays</b>
C		Stable traffic flow, but less freedom to selection speed, change lanes, or pass. <b>Minimal Delays</b>
D		Traffic flow becoming unstable. Speeds subject to sudden change. Passing is difficult. <b>Minimal Delays</b>
E		Unstable traffic flow. Speed change quickly and maneuverability is low. <b>Significant Delays</b>
F		Heavily congested traffic. Demand exceeds capacity and speeds vary greatly. <b>Significant Delays</b>

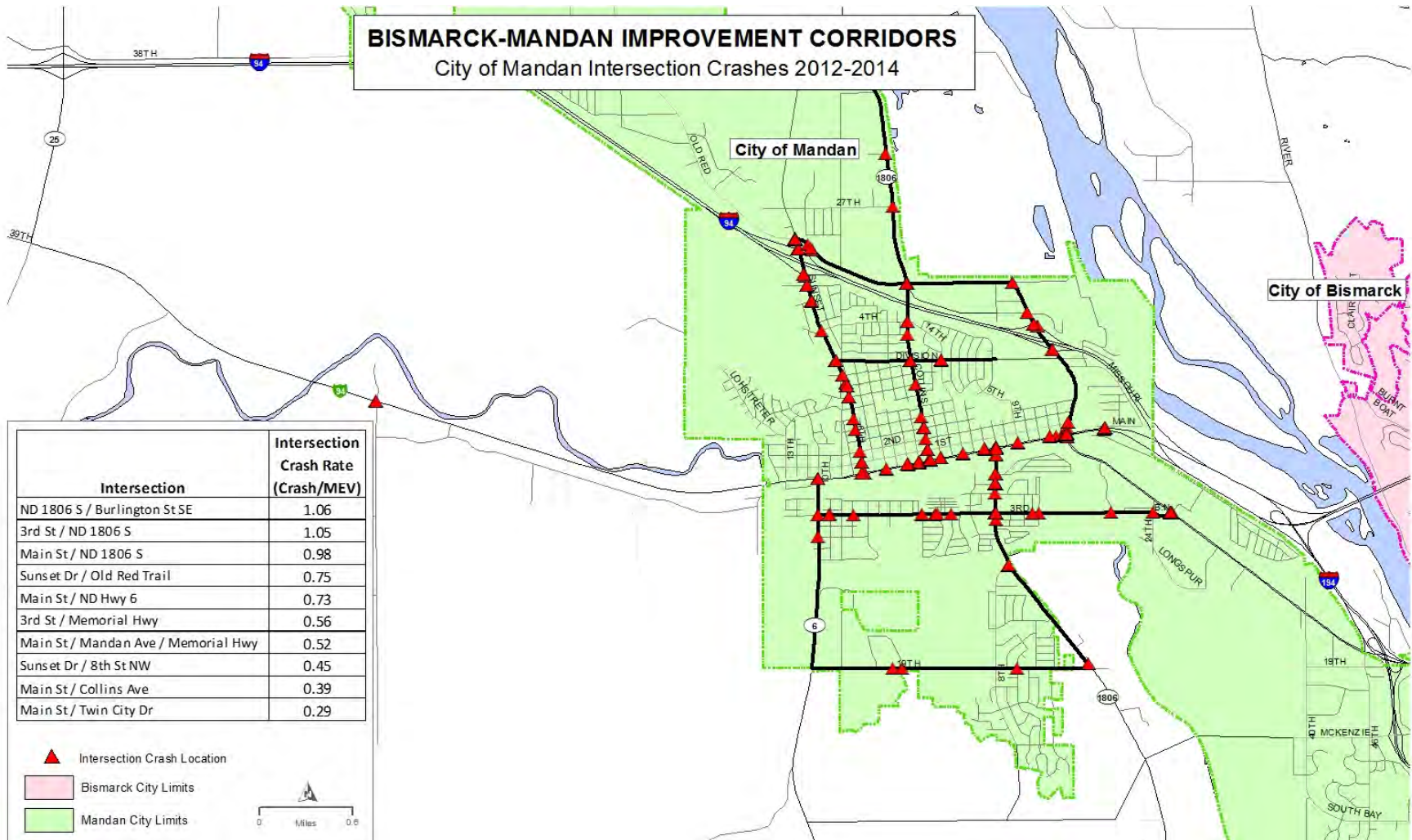
# Analysis- Traffic Operations



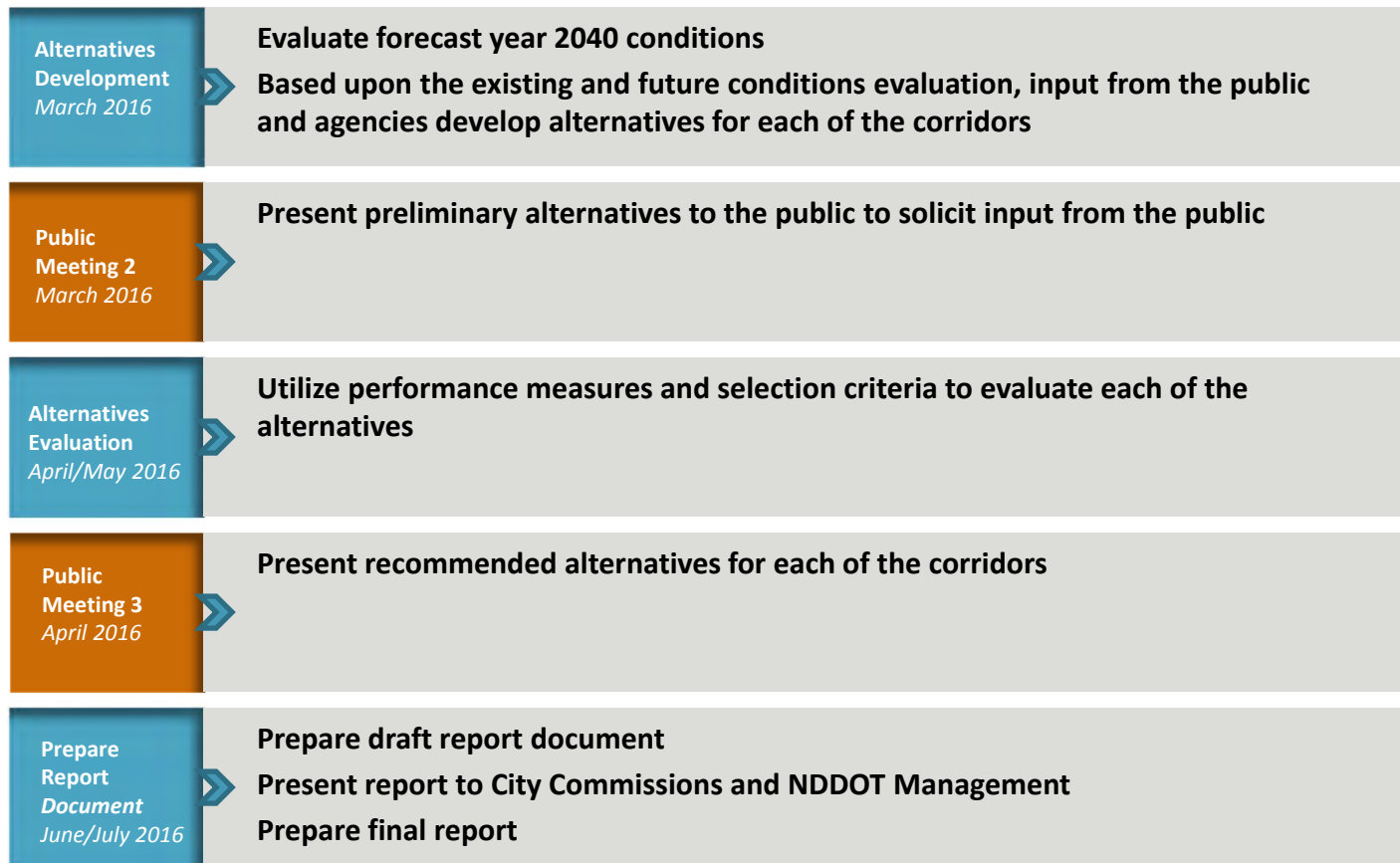
# Analysis- Traffic Crashes



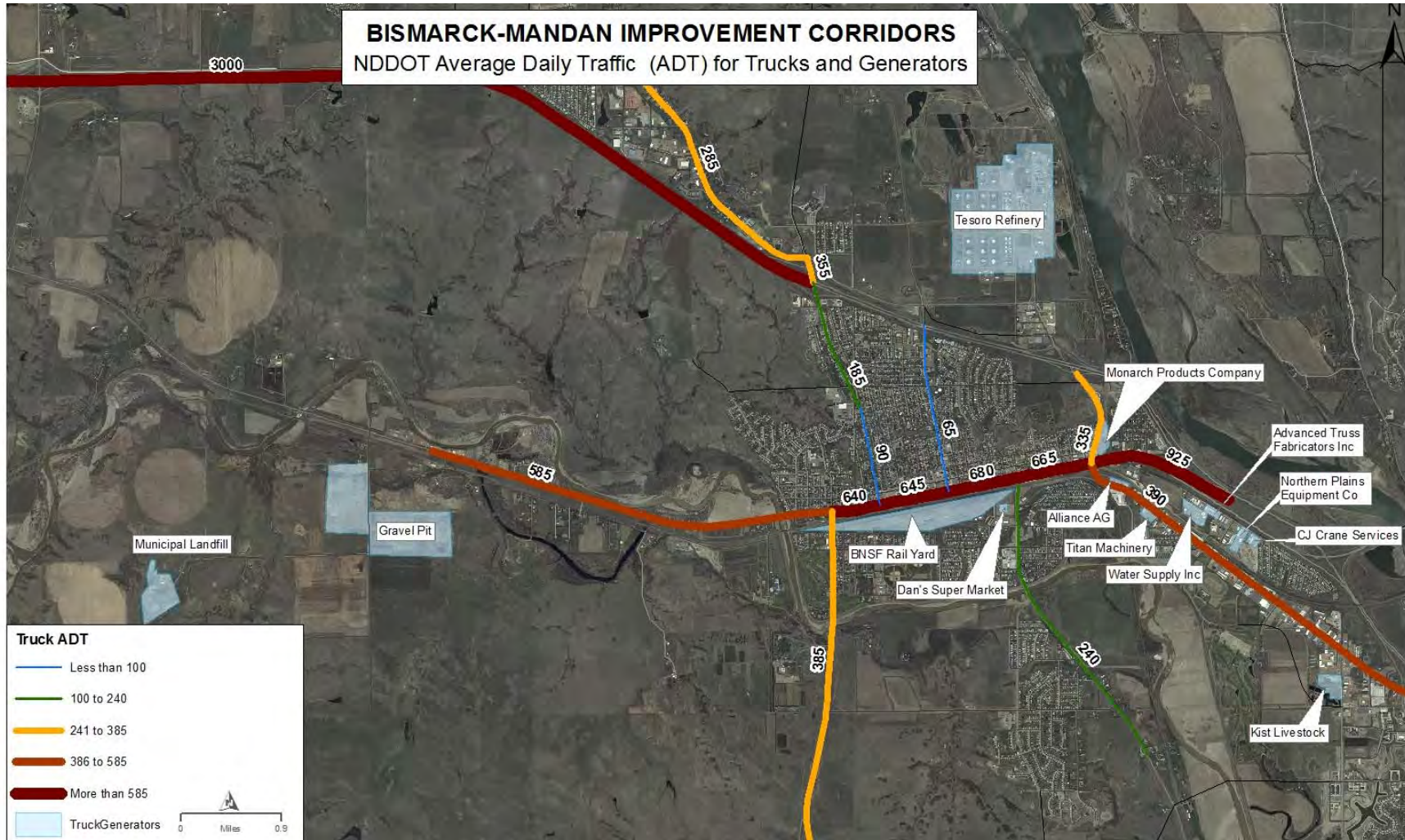
# Analysis- Traffic Crashes



# Next Steps



# Truck Route Evaluation



# Truck Route Next Steps

Alternatives  
Development  
*March 2016*

- Identify alternative truck routes

Alternatives  
Evaluation  
*April/May 2016*

- Utilize performance measures and selection criteria to evaluate each of the alternatives



# Stay Involved

- Complete comment cards
- Go to the Website:  
*[MandanBismarckCorridors.com](http://MandanBismarckCorridors.com)*
- Provide additional comments on our website

# Questions or Comments?



# Thank You!

- Website: [MandanBismarckCorridors.com](http://MandanBismarckCorridors.com)
- Mailed Comments:
  - Rick Stoppelmoor
  - HDR Engineering, Inc.
  - 4503 Coleman St., Suite 105
  - Bismarck, ND 58503

# Bismarck-Mandan



## METROPOLITAN PLANNING ORGANIZATION

Meeting Location Mandan City Hall	Meeting Type	Meeting Date
Project Number	PCN	
Project Description		

Name (Please print) Michelle Erickson		Title/Representing Citizen	
Address 1702 Sunset Dr			
City Mandan	State ND	Zip code 58554	Email michellee@btinet.net

Name (Please print) RAYMOND ROLSHOVEN		Title/Representing SELF	
Address 4521 SANDANER LOOP SE. # 5			
City MANDAN	State ND	Zip code 58551	Email

Name (Please print) Tyler Achtersberg		Title/Representing HDR	
Address 4503 Coleman St			
City Bismarck	State ND	Zip code 58503	Email tyler.achtersberg@Hdria.com

Name (Please print) Whitney Schroeder		Title/Representing HDR	
Address			
City	State	Zip code	Email

Name (Please print) Craig Mizerz		Title/Representing HDR	
Address			
City	State	Zip code	Email

Name (Please print) Rick Stoppelmaier		Title/Representing HDR	
Address			
City	State	Zip code	Email

Name (Please print)		Title/Representing	
Address			
City	State	Zip code	Email

# Bismarck-Mandan

METROPOLITAN PLANNING ORGANIZATION

Meeting Location Mandan City Hall	Meeting Type MPO public meeting	Meeting Date 1-26-2016
Project Number	PCN	
Project Description Corridor Improvement Study		

Name (Please print) JUSTIN FROSTH		Title/Representing CITY OF MANDAN	
Address			
City	State	Zip code	Email

Name (Please print) Allison Arlene Johnson		Title/Representing Johnson's Wrecking	
Address 7293 Bussloop E 94			
City Mandan	State NDak	Zip code 58554	Email

Name (Please print) Bernice Hieber		Title/Representing Mandan citizen	
Address 104 12th St NW			
City Mandan	State ND	Zip code 58554	Email

Name (Please print) Paul E Trause		Title/Representing Self	
Address 2399 Bussloop E 94			
City Mandan	State ND	Zip code	Email

Name (Please print) TIM HELBLING		Title/Representing	
Address 3000 OLD RED TRAIL			
City MANDAN	State ND	Zip code 58554	Email TAHELBLING@YAHOO.COM

Name (Please print) Blaine Engelstad		Title/Representing citizen	
Address 5305 Highland Rd			
City Mandan	State ND	Zip code 58554	Email bfengelstad@live.com

Name (Please print) Ellen Huber		Title/Representing City of Mandan Bus Dev & Comm	
Address 205 2nd Ave NW			
City Mandan	State ND	Zip code 58554	Email ehuber@cityofmandan.com



# Mandan-Bismarck Corridor Improvement Study

Public Meeting 1

January 28, 2016

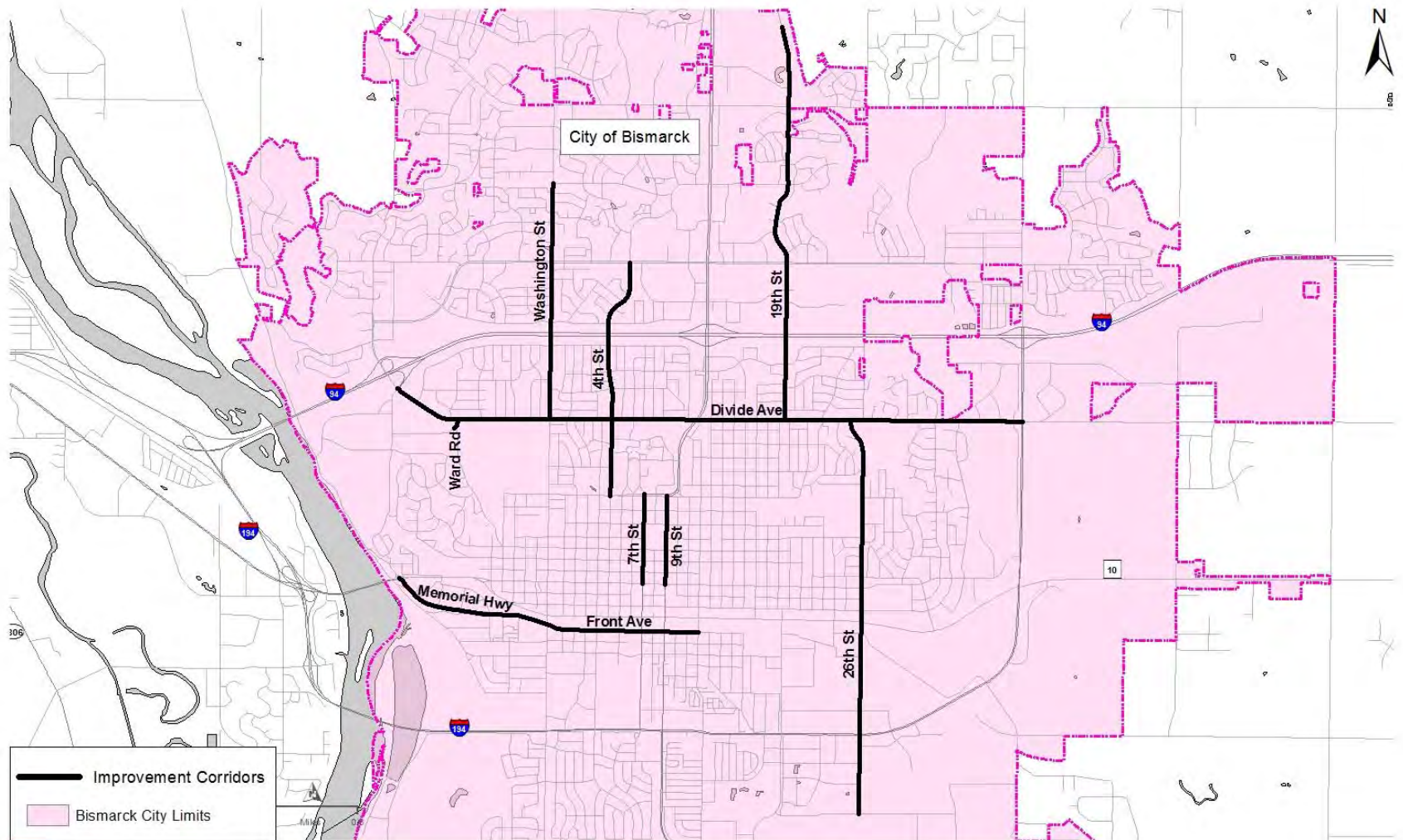
Bismarck Public Library



# Agenda

- **What is the Mandan-Bismarck Corridor Improvement Study**
- **Corridors included in the Study**
- **Existing Traffic Operations within the corridors**
- **Input opportunities**
- **Next Steps**

# Bismarck Corridors











# Anticipated Schedule



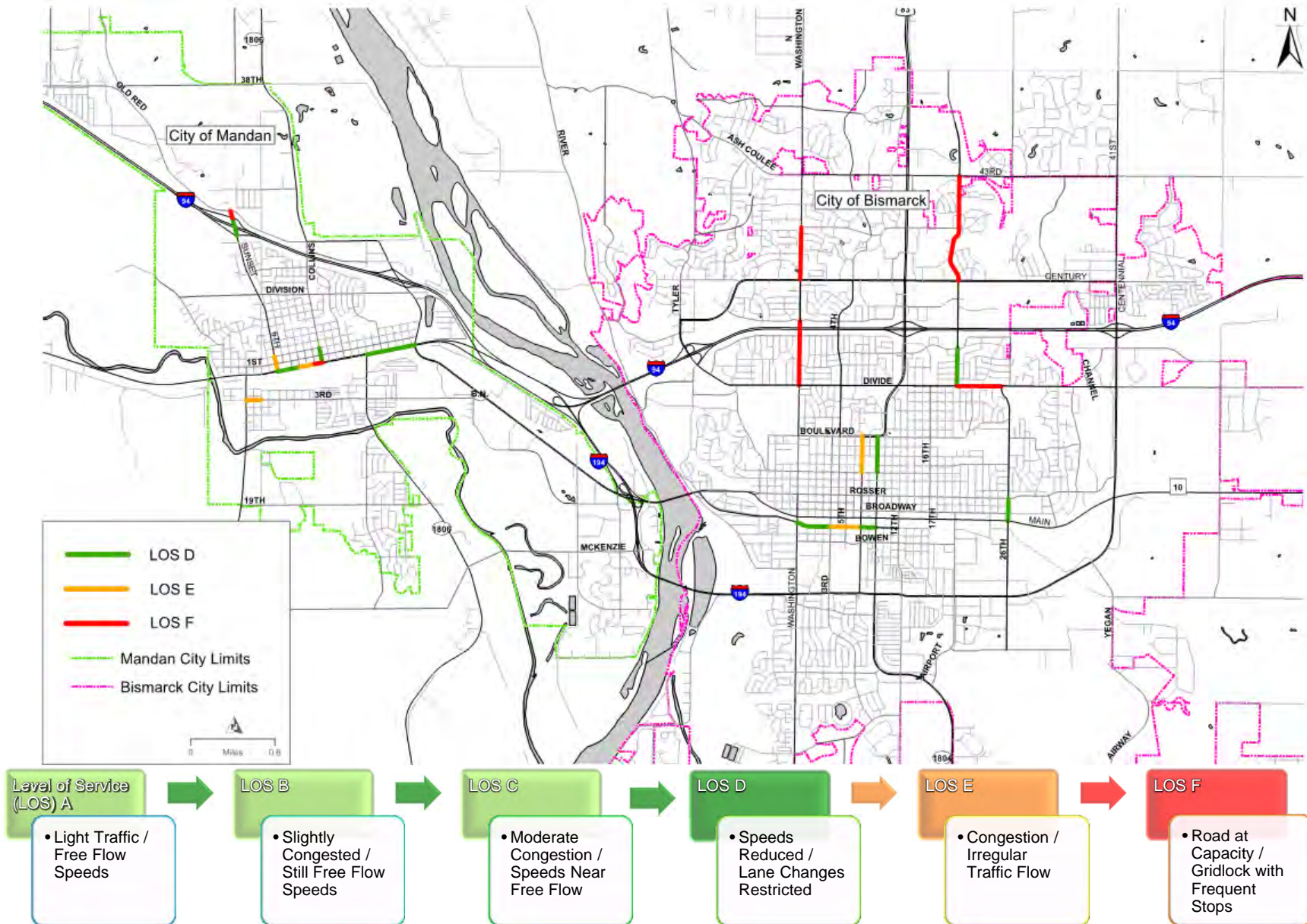
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- **Gathered existing conditions data**
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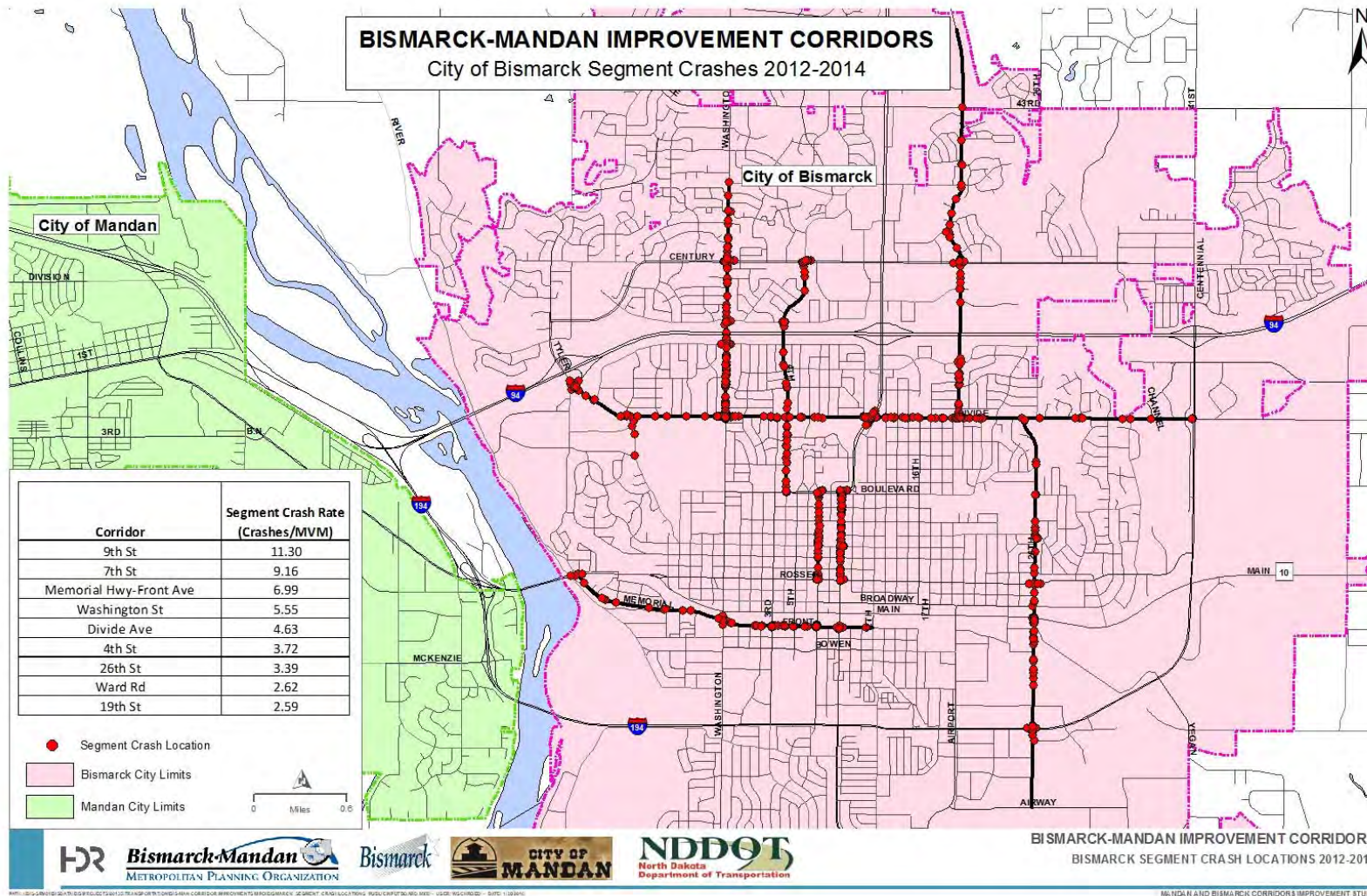
# Level of Service Definition

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F		Heavily congested traffic. Demand exceeds capacity and speeds vary greatly. <b>Significant Delays</b>

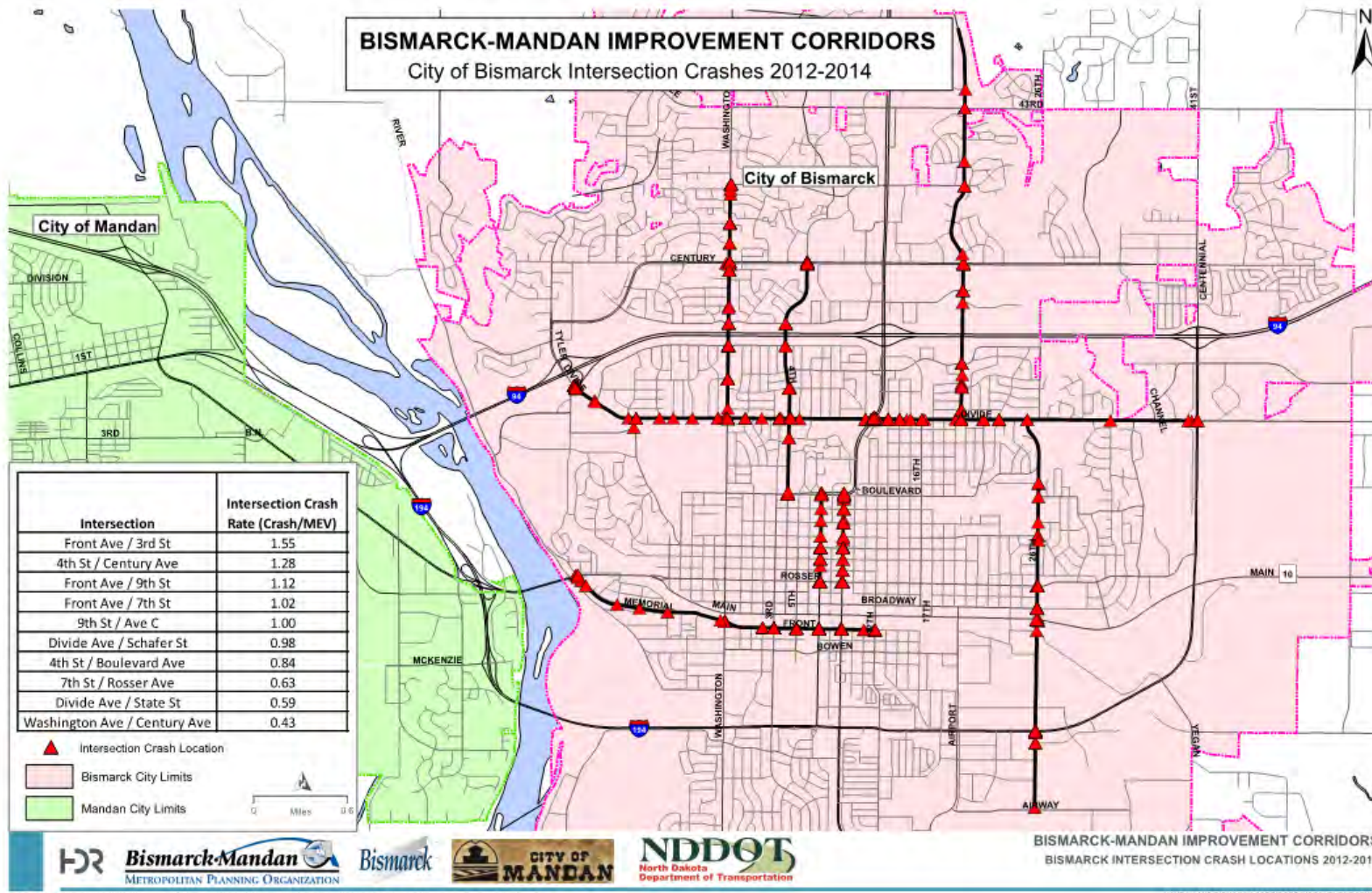
# Analysis- Traffic Operations



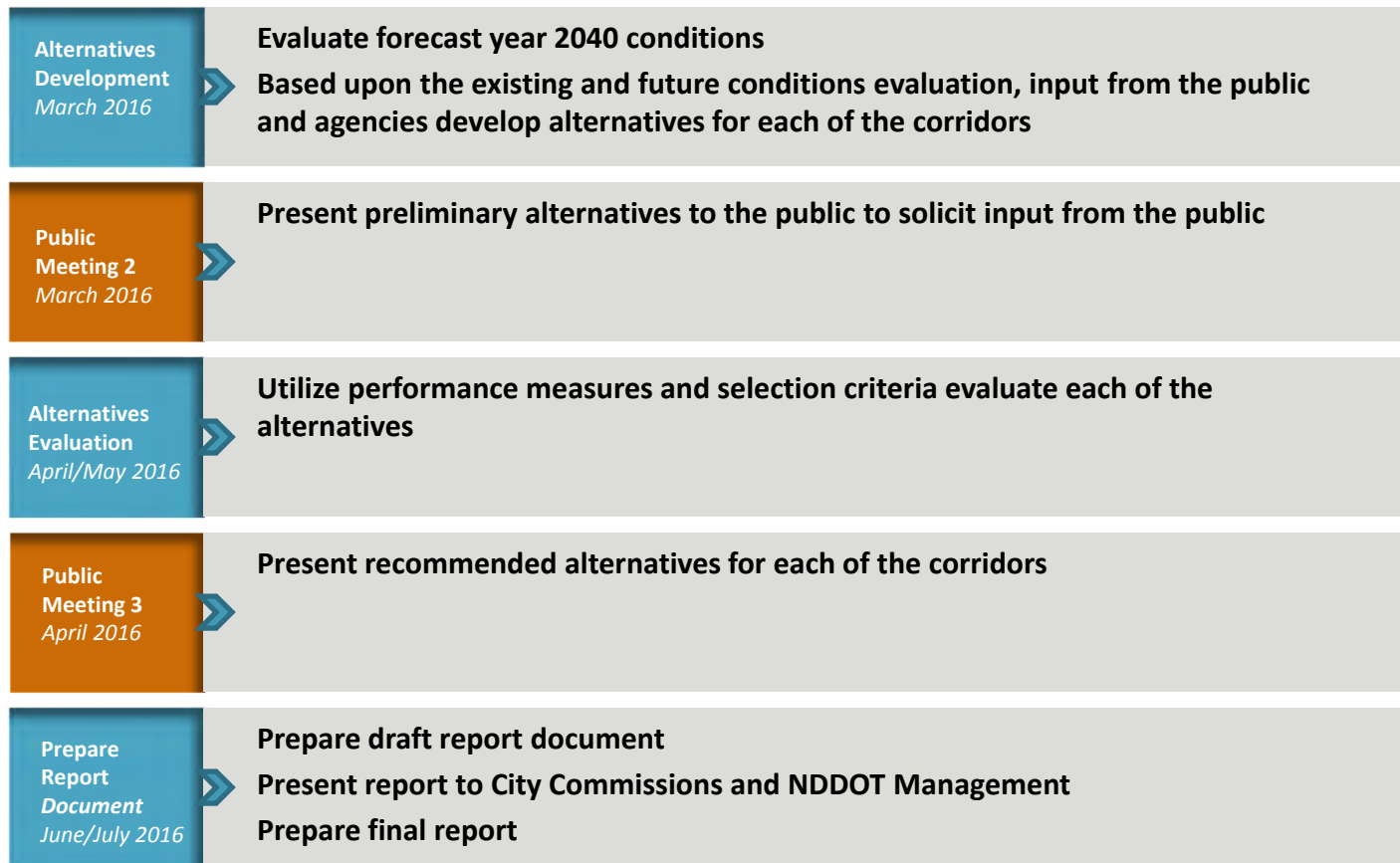
# Analysis- Traffic Crashes



# Analysis- Traffic Crashes



# Next Steps



# Stay Involved

- Complete comment cards
- Go to the Website:  
*[MandanBismarckCorridors.com](http://MandanBismarckCorridors.com)*
- Provide additional comments on our website

# Questions or Comments?





# Thank You!

- Website: [MandanBismarckCorridors.com](http://MandanBismarckCorridors.com)
- Mailed Comments:
  - Rick Stoppelmoor
  - HDR Engineering, Inc.
  - 4503 Coleman St., Suite 105
  - Bismarck, ND 58503

# Bismarck-Mandan



## METROPOLITAN PLANNING ORGANIZATION

Meeting Location	Bismarck Library	Meeting Type	Public Meeting	Meeting Date	1/28/16
Project Number				PCN	
Project Description	corridor Improvement Study				

Name (Please print)	Gabe Schell			Title/Representing	KLTJ
Address					
City	Bismarck	State	ND	Zip code	58503
				Email	gabe.schell@kljeng.com

Name (Please print)	Nancy Guy			Title/Representing	Bismarck City Commission
Address	3212 Winnipeg Dr				
City	Bismarck	State	ND	Zip code	58503
				Email	

Name (Please print)	JOAN MILLNER			Title/Representing	LANA OWNER
Address	1315 N 3RD STREET				
City	BISMARCK	State	ND	Zip code	58501
				Email	

Name (Please print)	Lynn Bohan			Title/Representing	HDR
Address					
City		State		Zip code	
				Email	

Name (Please print)	Whitney Schmeider			Title/Representing	HDR
Address					
City		State		Zip code	
				Email	

Name (Please print)	Craig Mizerz			Title/Representing	HDR
Address					
City		State		Zip code	
				Email	

Name (Please print)	Rick Stoppelmoor			Title/Representing	HDR
Address					
City		State		Zip code	
				Email	

# Bismarck-Mandan



## METROPOLITAN PLANNING ORGANIZATION

Meeting Location <i>Bismarck Library</i>	Meeting Type	Meeting Date
Project Number	PCN	
Project Description		

Name (Please print) <i>ROBERT CLCERSON</i>		Title/Representing	
Address <i>301 W AVE C</i>			
City <i>BISMARCK</i>	State <i>ND</i>	Zip code <i>58501</i>	Email

Name (Please print) <i>Mark A Berg</i>		Title/Representing <i>City of Bismarck</i>	
Address <i>221 N 5th St</i>			
City <i>Bismarck</i>	State <i>ND</i>	Zip code <i>58506</i>	Email <i>mberg@nd.gov</i>

Name (Please print)		Title/Representing	
Address			
City	State	Zip code	Email

Name (Please print)		Title/Representing	
Address			
City	State	Zip code	Email

Name (Please print)		Title/Representing	
Address			
City	State	Zip code	Email

Name (Please print)		Title/Representing	
Address			
City	State	Zip code	Email

Name (Please print)		Title/Representing	
Address			
City	State	Zip code	Email

# Bismarck-Mandan



## METROPOLITAN PLANNING ORGANIZATION

Meeting Location <i>Bismarck Library (Room C)</i>	Meeting Type <i>Public Meeting</i>	Meeting Date <i>1-28-2016</i>
Project Number		PCN
Project Description <i>Corridor Improvement Study</i>		

Name (Please print) <i>Susan Weigel</i>		Title/Representing	
Address <i>1223 N Washington St.</i>			
City <i>Bismarck</i>	State <i>ND</i>	Zip code <i>58501</i>	Email <i>susksch@hotmail.com</i>

Name (Please print) <i>Robert Weigel</i>		Title/Representing	
Address <i>1223 N. Washington. Same as above</i>			
City	State	Zip code	Email

Name (Please print) <i>Sheri Lares</i>		Title/Representing <i>ETWA</i>	
Address <i>4503 Coleman St</i>			
City <i>Bismarck</i>	State <i>ND</i>	Zip code <i>58503</i>	Email <i>Sheri.lares@dot.gov</i>

Name (Please print) <i>Curt Pearson</i>		Title/Representing	
Address <i>924 W Ave B</i>			
City <i>Bismarck</i>	State <i>ND</i>	Zip code <i>58501</i>	Email <i>rlrjazz@bis.midco.net</i>

Name (Please print) <i>Jackie Pearson</i>		Title/Representing	
Address <i>924 W Ave B</i>			
City <i>Bismarck</i>	State <i>ND</i>	Zip code <i>58501</i>	Email <i>jacpear@hotmail.com</i>

Name (Please print) <i>MEL BULLINGER</i>		Title/Representing <i>CITY OF BISMARCK</i>	
Address <i>291 N. 5th St.</i>			
City <i>Bismarck</i>	State <i>ND</i>	Zip code <i>58501</i>	Email

Name (Please print) <i>Linda Vadnais</i>		Title/Representing	
Address <i>1215 N Washington St</i>			
City <i>Bismarck</i>	State <i>ND</i>	Zip code <i>58501</i>	Email



# Mandan-Bismarck Corridor Improvement Study

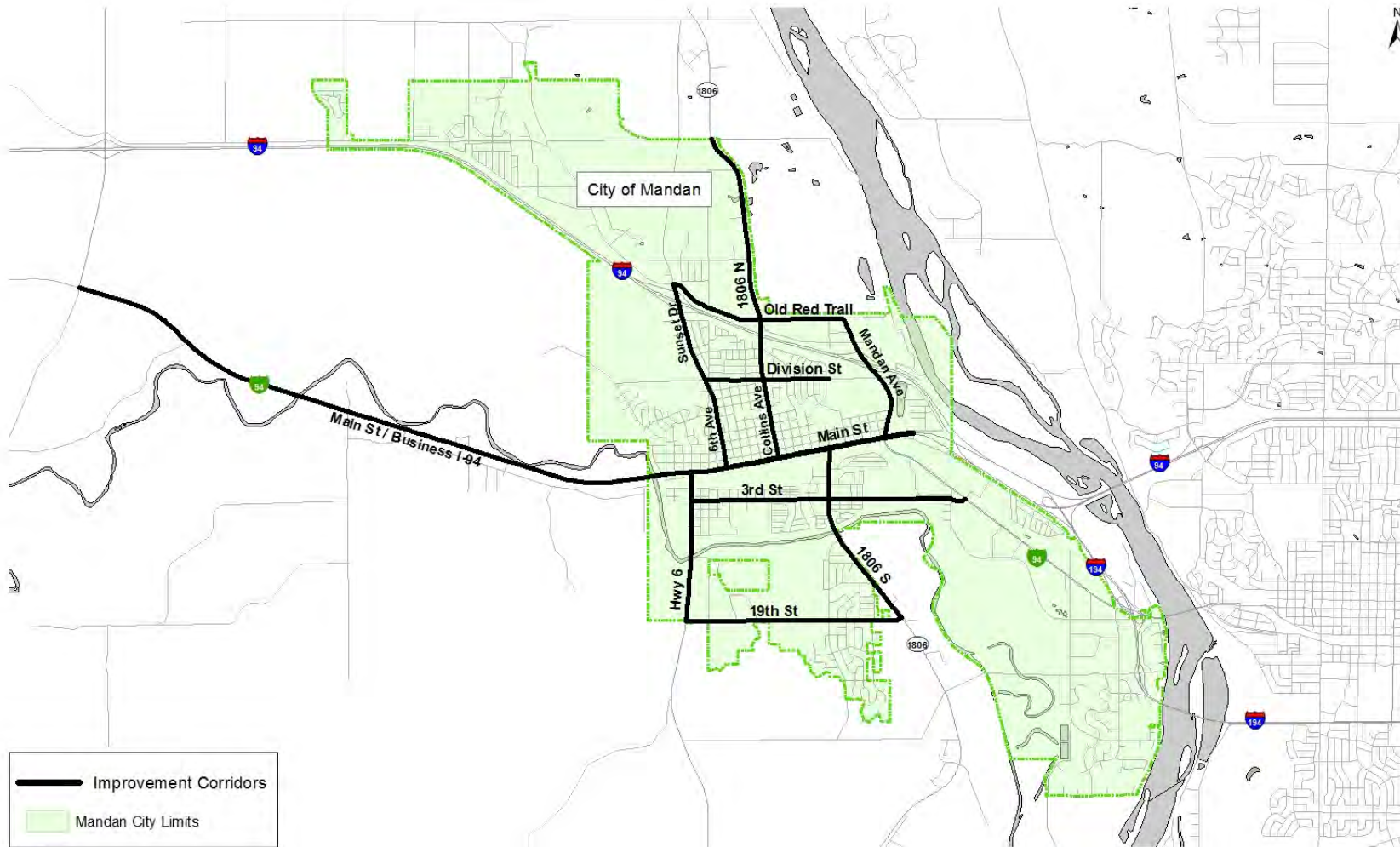
Public Meeting 2

March 29, 2016

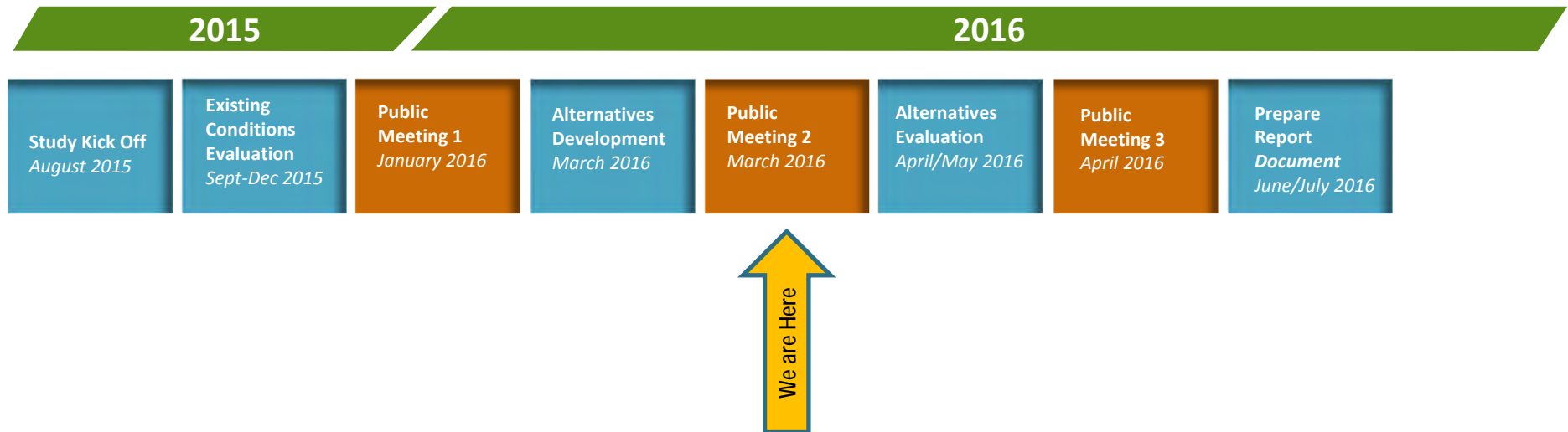
Mandan City Hall



# Mandan Corridors



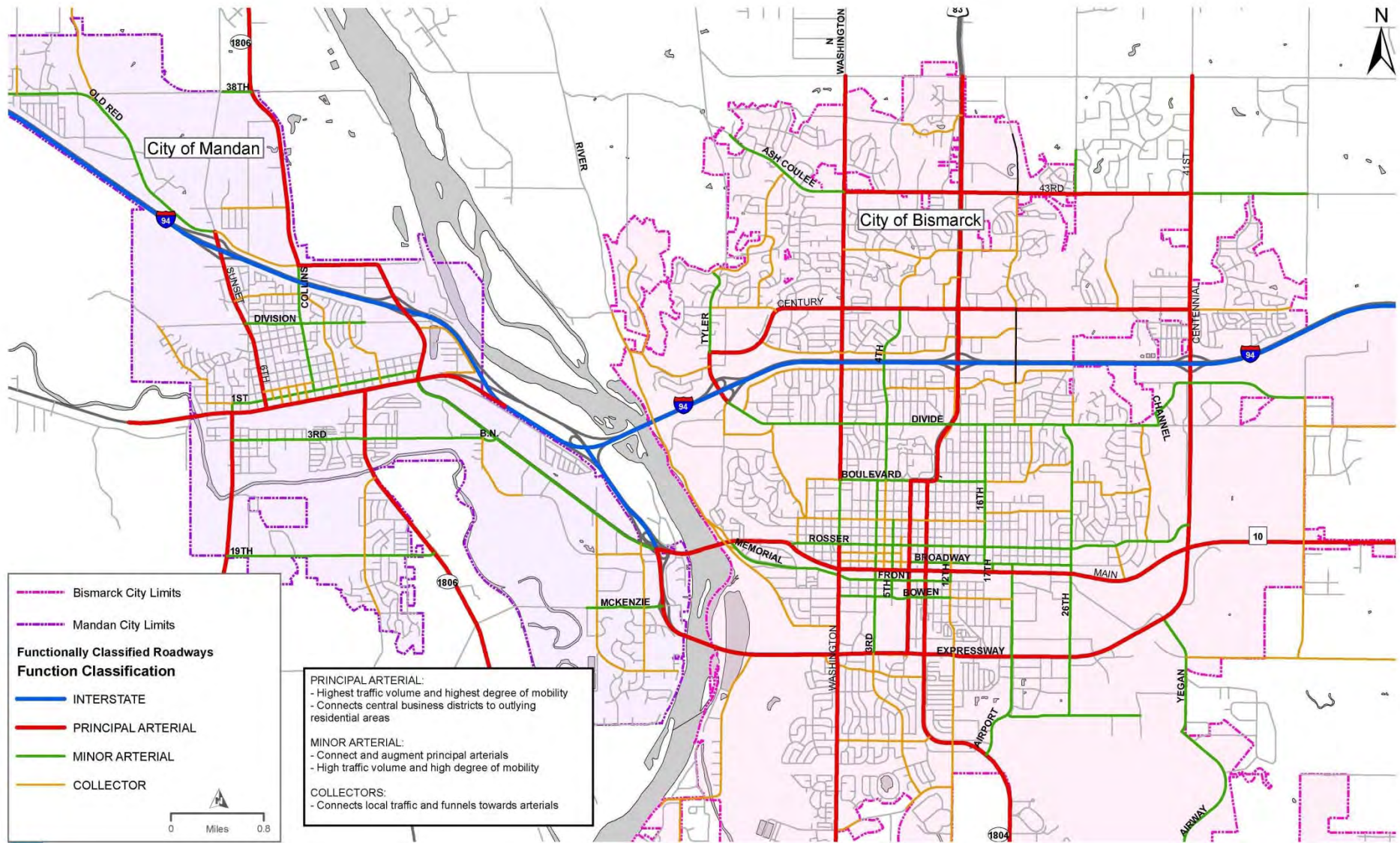
# Anticipated Schedule



## Progress To Date

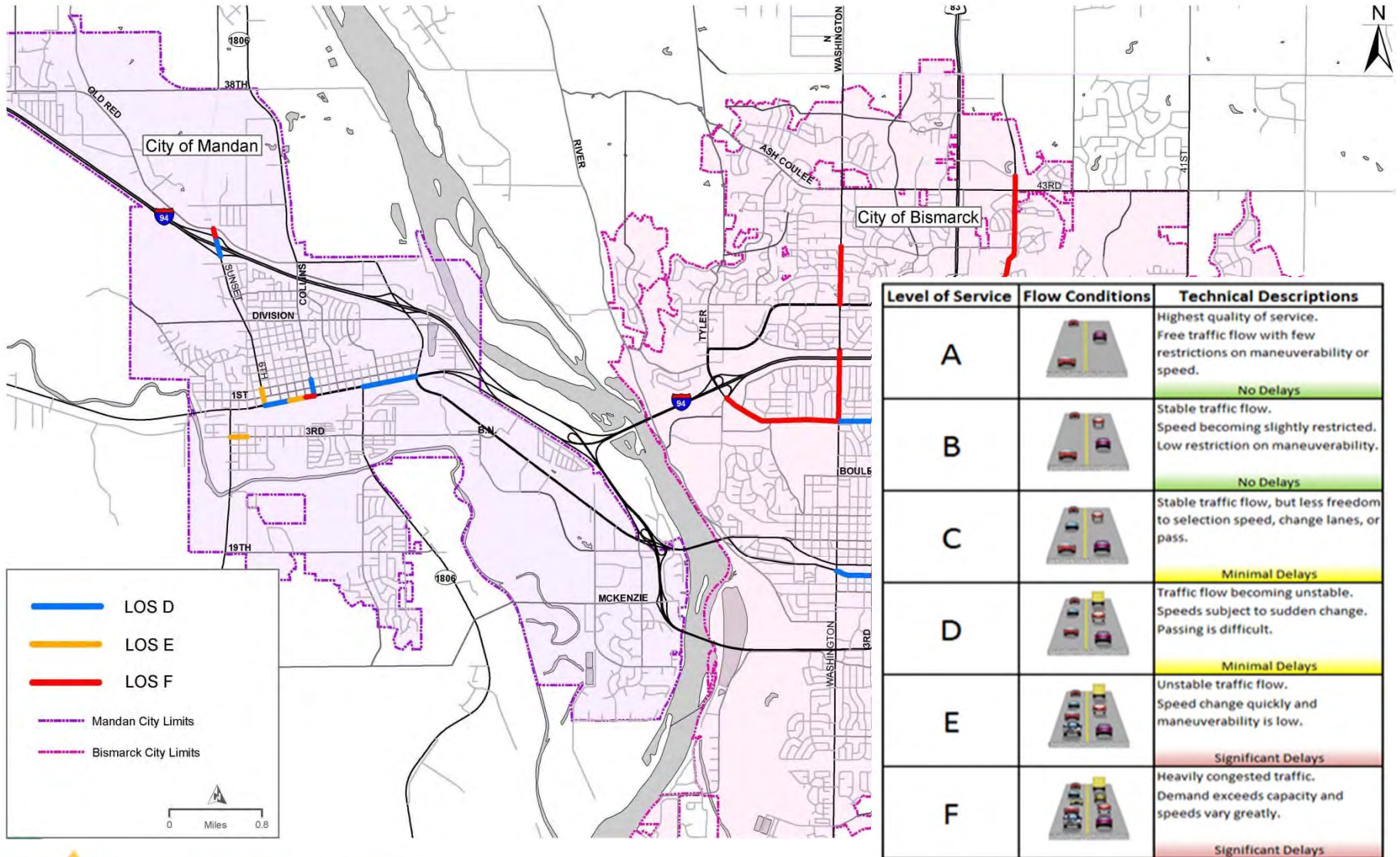
- Gathered existing conditions data
- Analyzed existing conditions data
- Initiated the public involvement process
- Identified Preliminary Improvement Alternatives

# Roadway Functional Classification

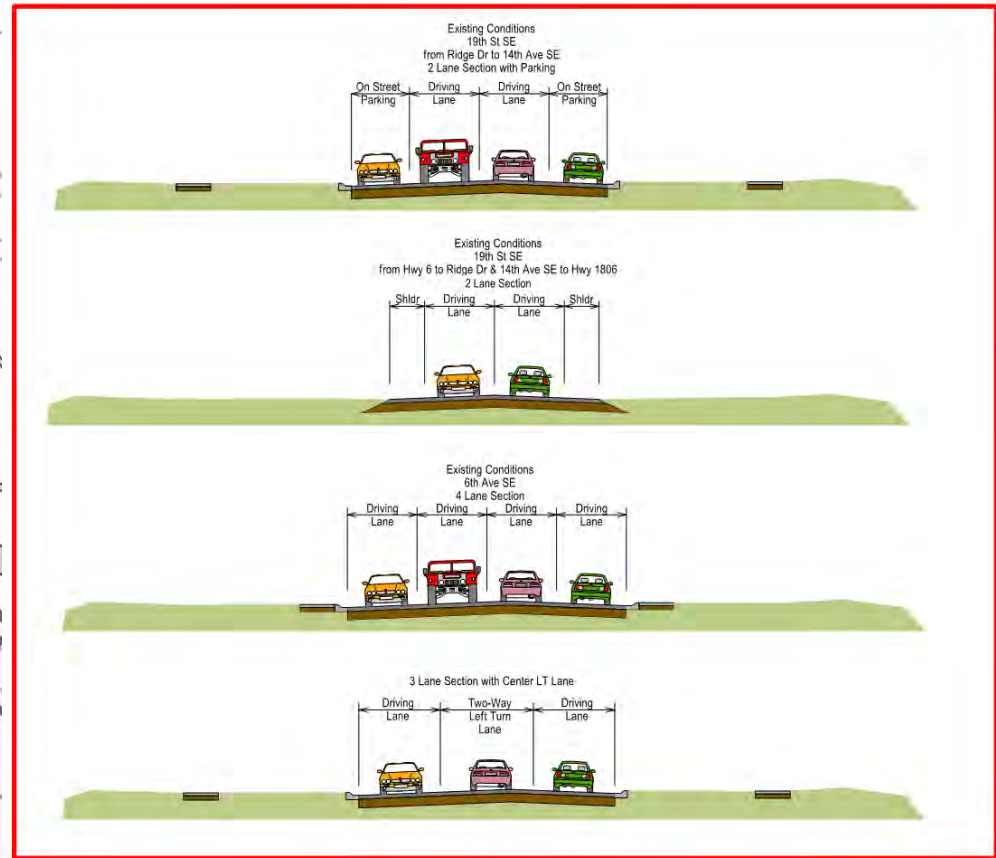
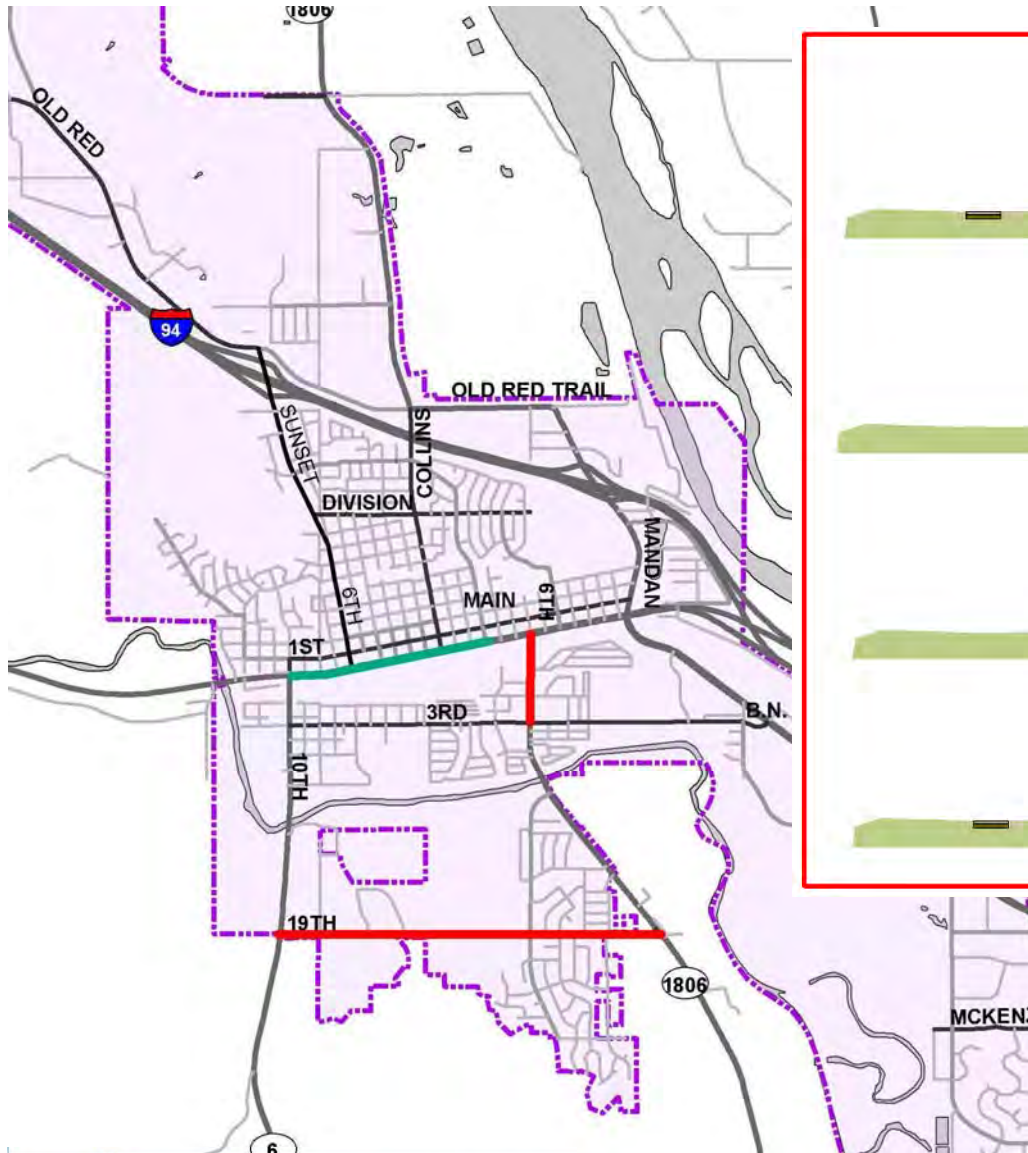




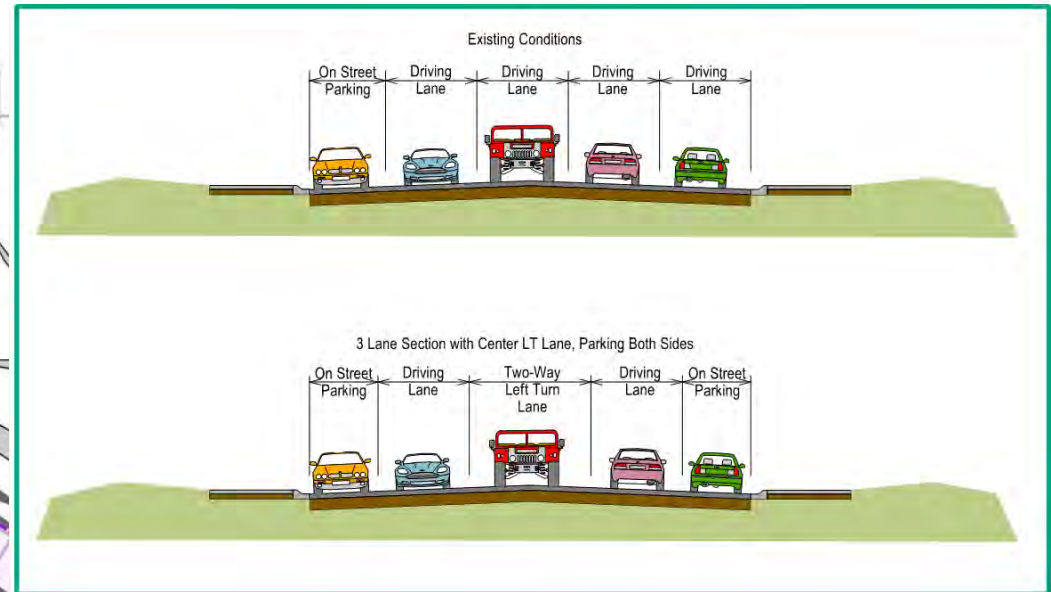
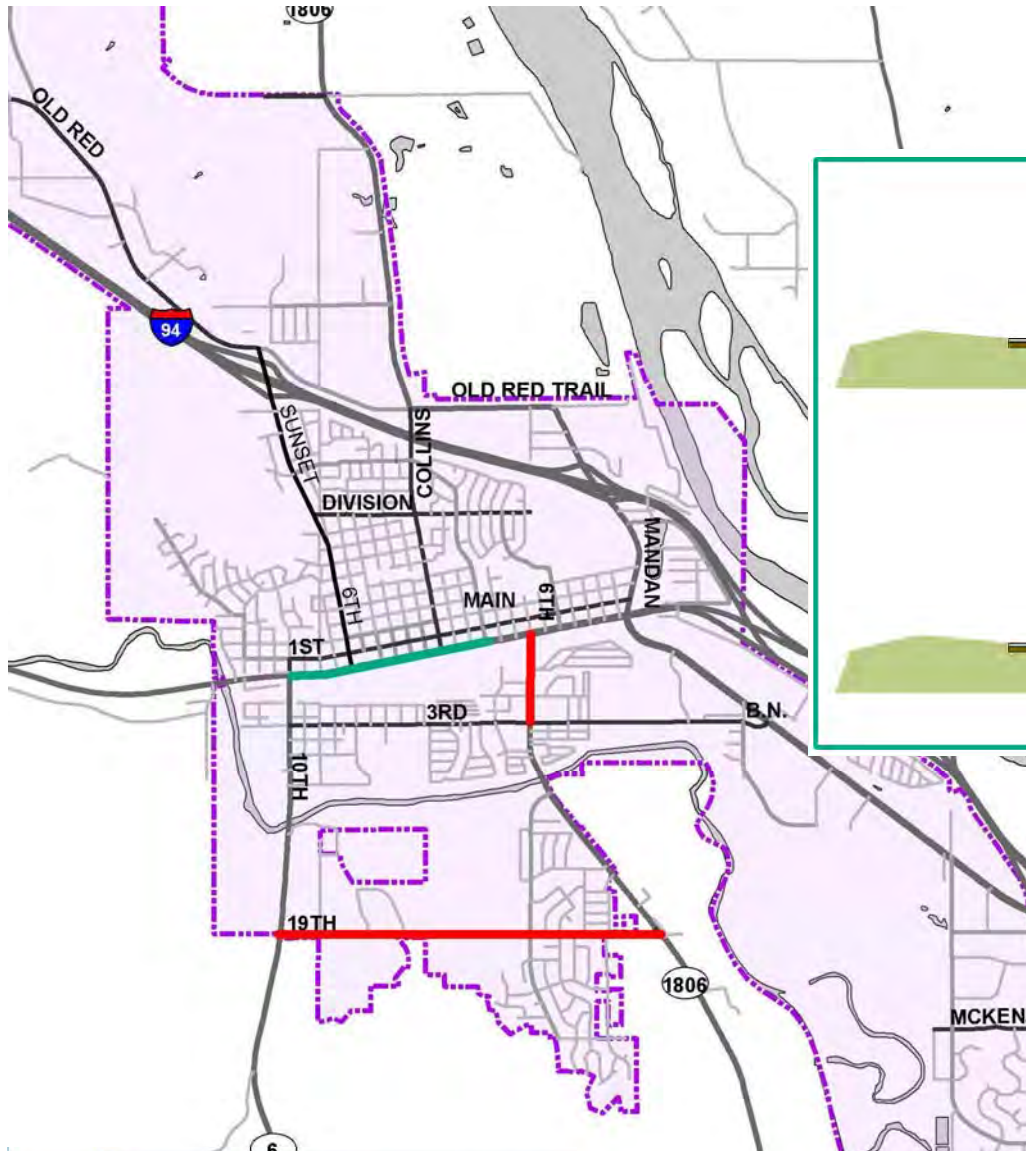
# Projected 2040 Level of Service (LOS)



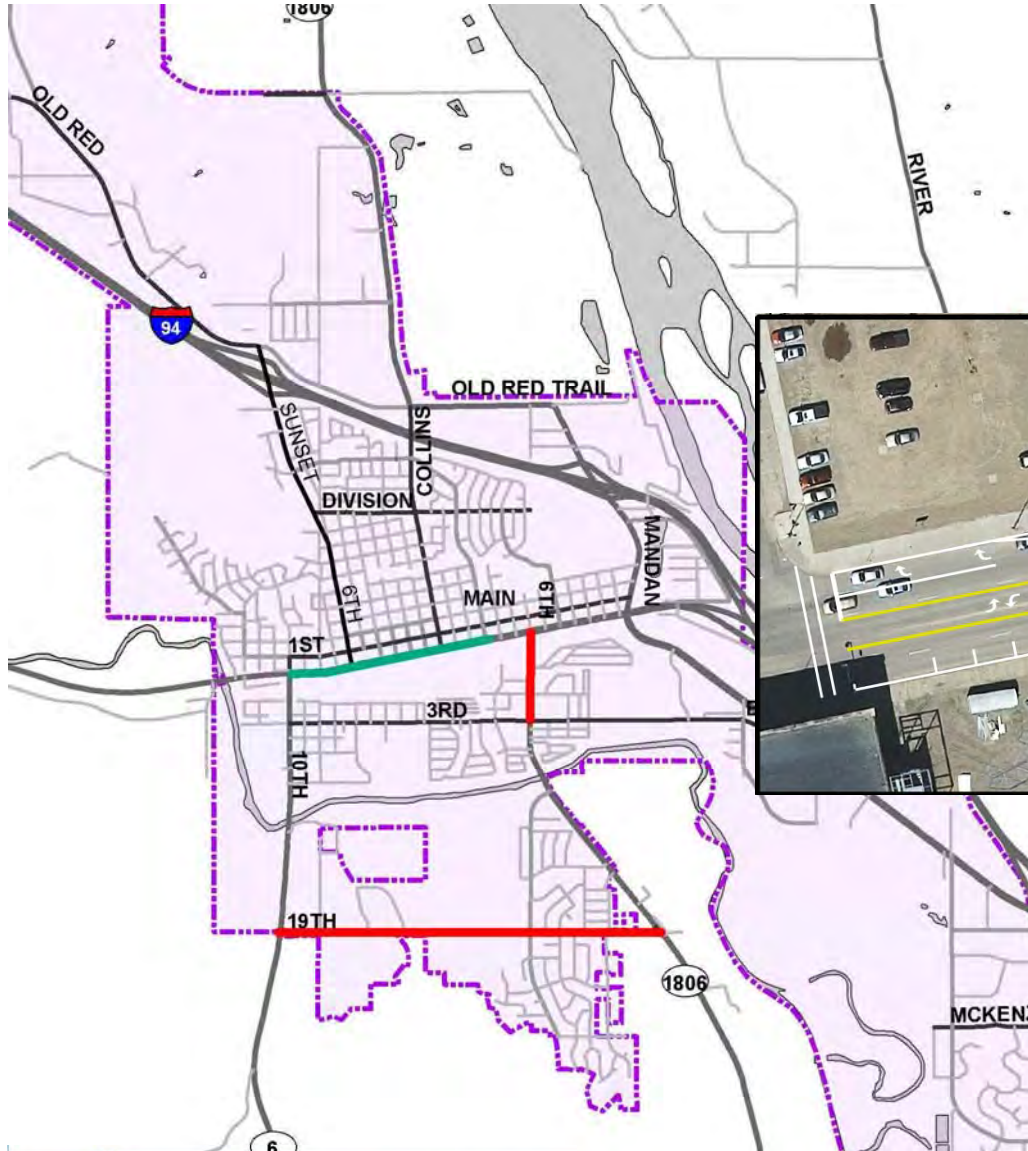
# Preliminary Improvement Alternatives



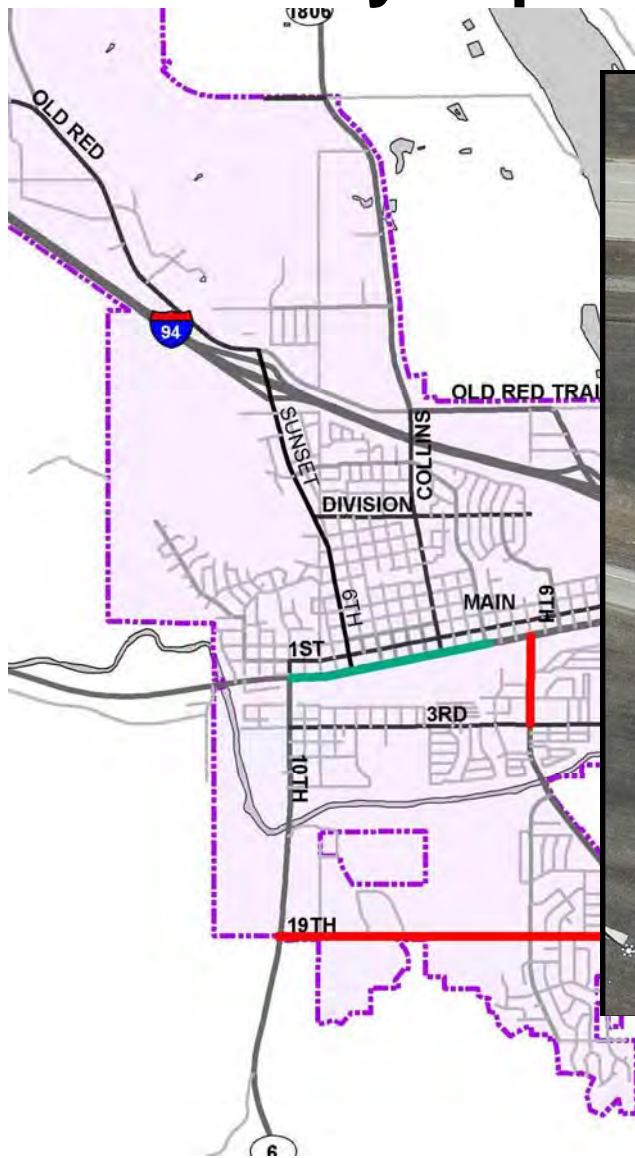
# Preliminary Improvement Alternatives



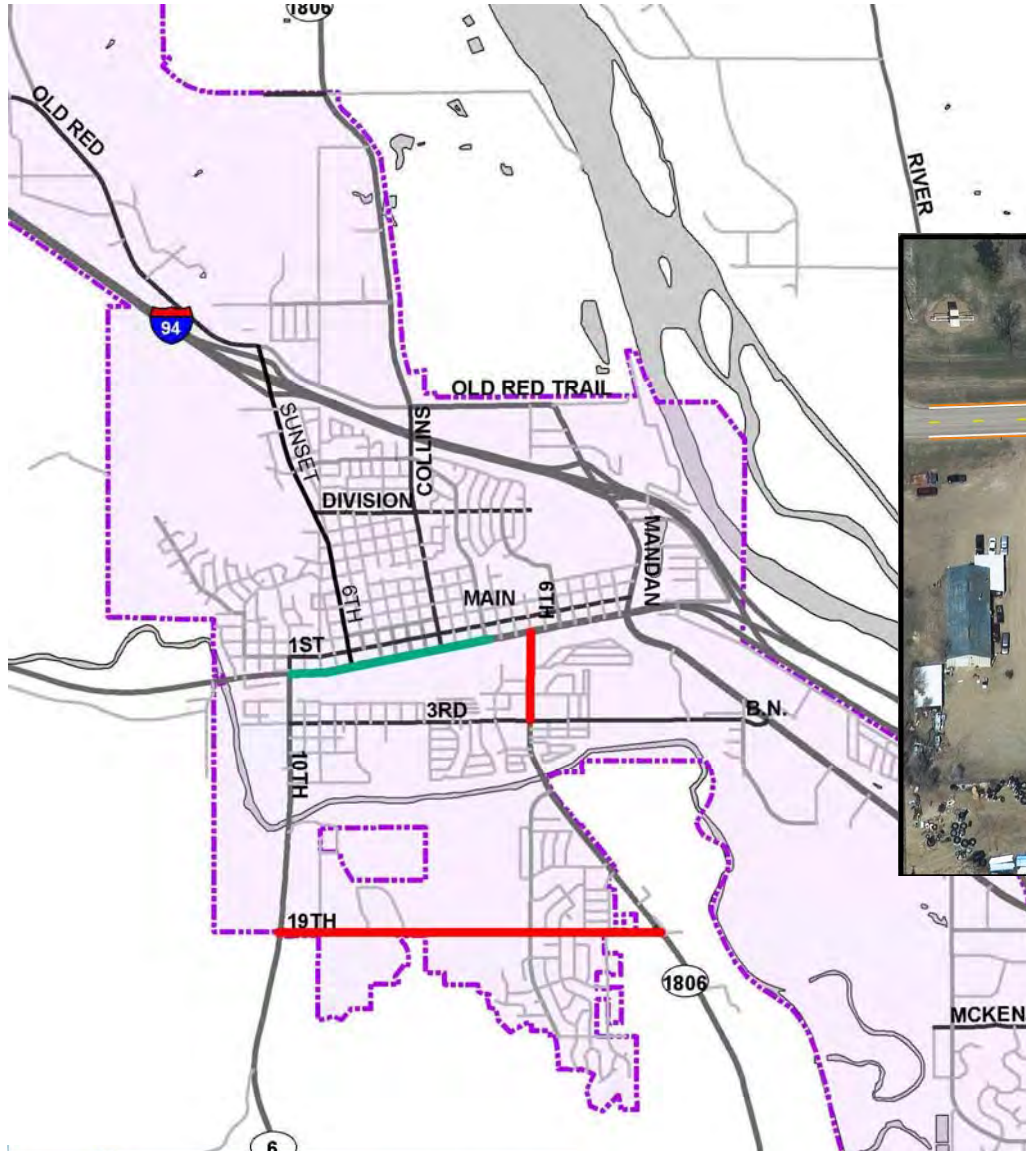
# Preliminary Improvement Alternatives



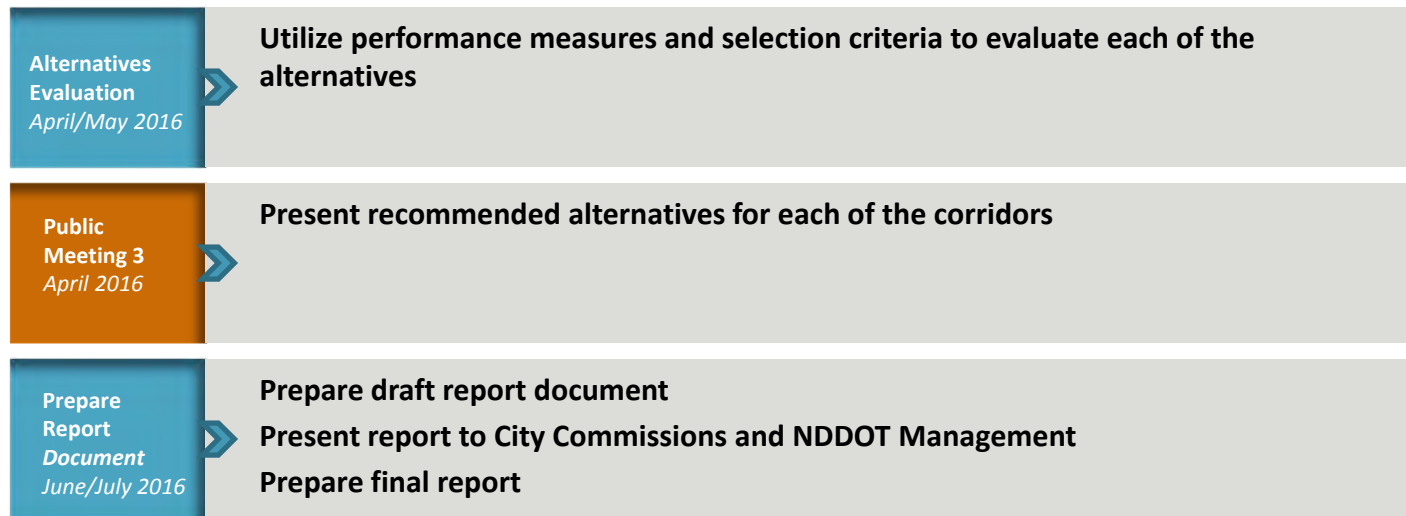
# Preliminary Improvement Alternatives



# Preliminary Improvement Alternatives

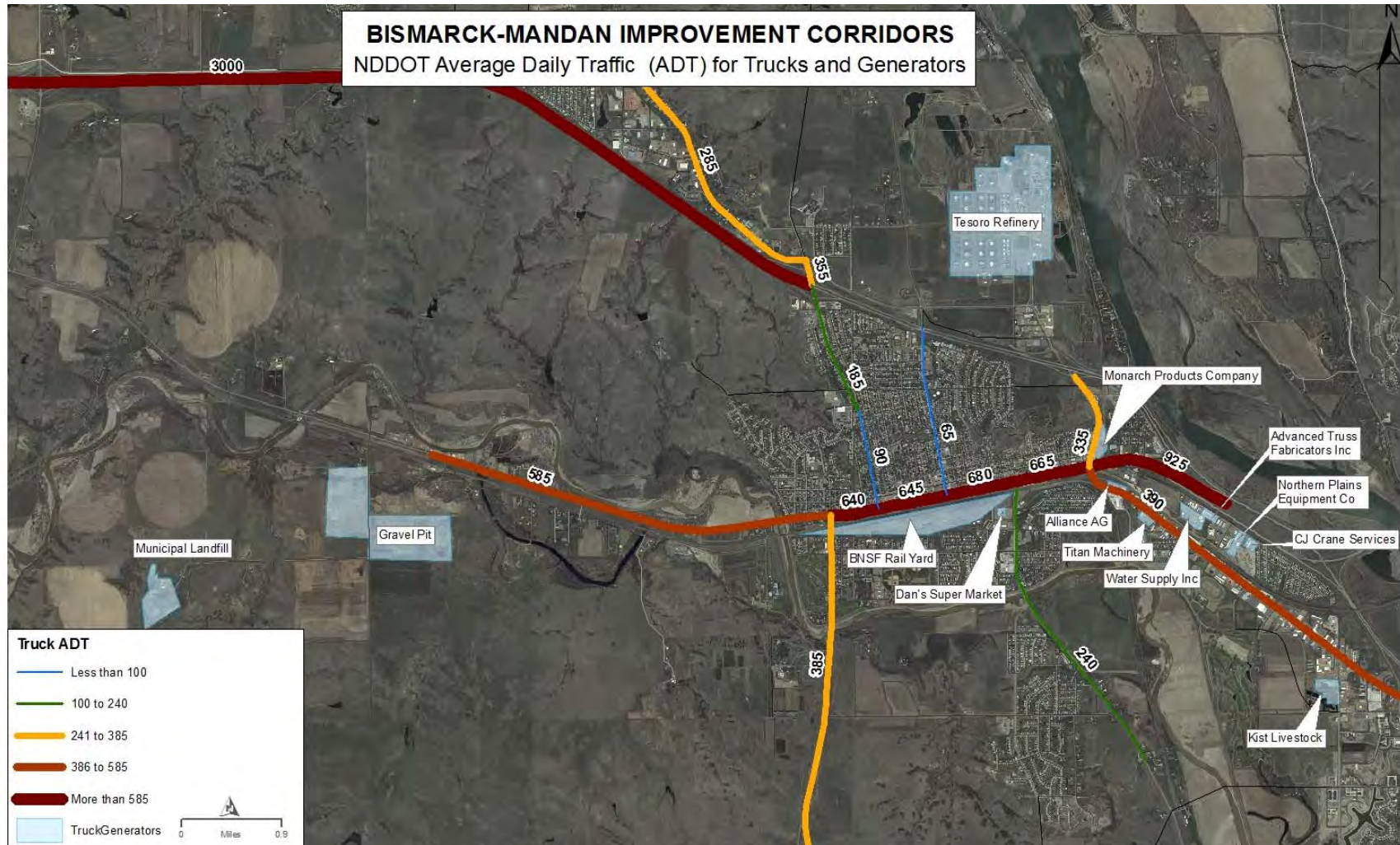


# Next Steps



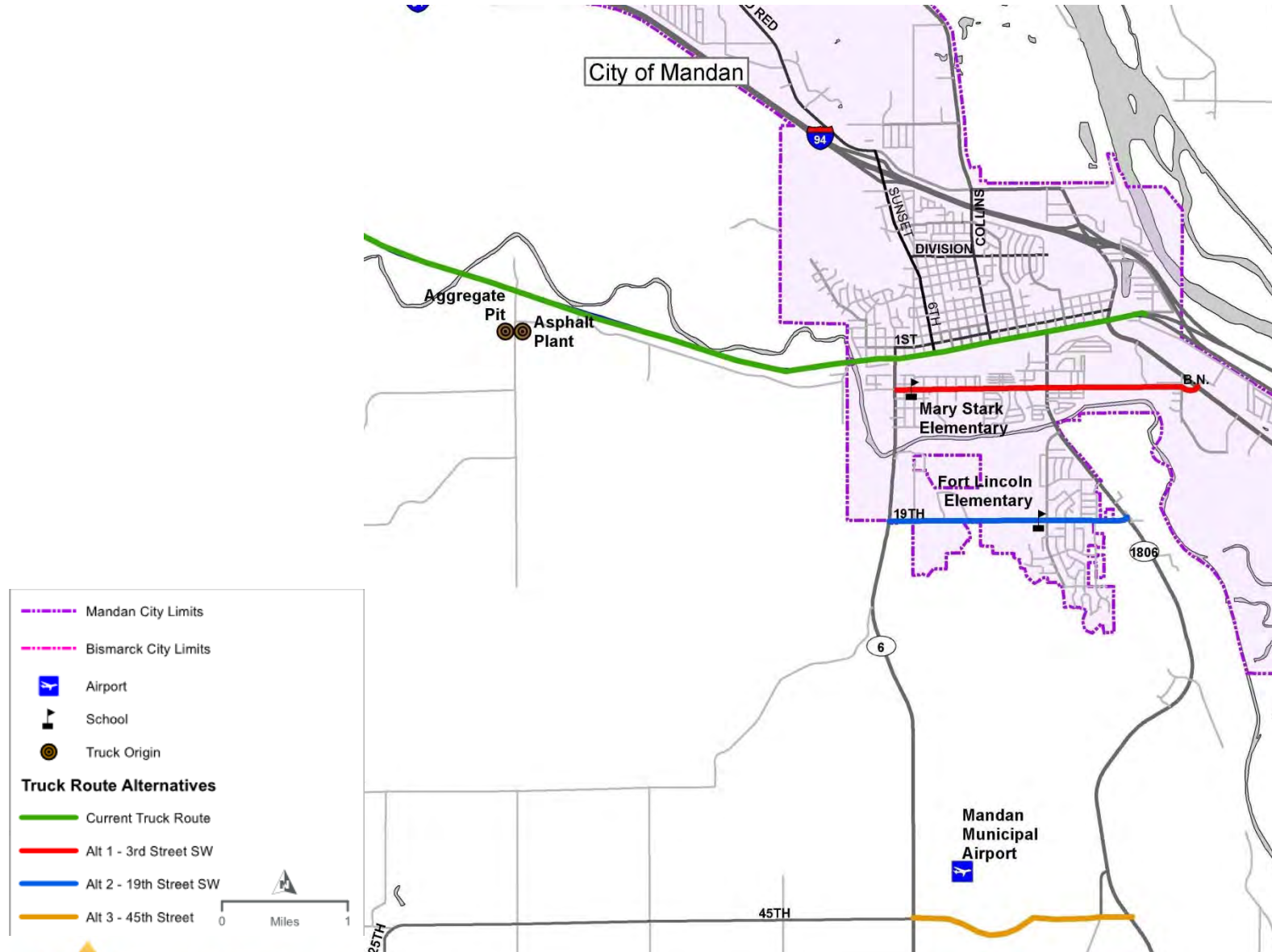
# Truck Route Evaluation

## Current Truck Average Daily Traffic (ADT)





# Truck Route Alternatives



# Truck Route Recommendation

- Relocation of aggregate pit and the asphalt plant
- Anticipated cost for reconstructing 45<sup>th</sup> Street
- The no build alternative is being recommended

# Stay Involved

- Complete comment cards
- Go to the Website:  
*[MandanBismarckCorridors.com](http://MandanBismarckCorridors.com)*
- Provide additional comments on our website

# Questions or Comments?



# Thank You!

- Website: [MandanBismarckCorridors.com](http://MandanBismarckCorridors.com)
- Mailed Comments:
  - Rick Stoppelmoor
  - HDR Engineering, Inc.
  - 4503 Coleman St., Suite 105
  - Bismarck, ND 58503



<b>Meeting Location</b> Mandan City Hall Veterans Memorial Conference Room	<b>Meeting Type</b> Public Input Meeting	<b>Meeting Date</b> 3/29/2016
<b>Project</b> Mandan-Bismarck Corridor Improvement Study		

<b>Name (Please Print)</b> Steve Marouardt		<b>Title/Representing</b> BCC/Resident	
<b>Address</b> 3020 Roosevelt Dr			
<b>City</b> Bismarck	<b>State</b> ND	<b>Zip Code</b> 58503	<b>Email</b>

<b>Name (Please Print)</b> Wanda Knoll		<b>Title/Representing</b> Planning & Zoning - Part Board	
<b>Address</b> 1009 4 Ave N.M			
<b>City</b> Mandan	<b>State</b> ND	<b>Zip Code</b> 58554	<b>Email</b> wanda.knoll@yahoo.com

<b>Name (Please Print)</b> JUSTIN FROSTIA		<b>Title/Representing</b> CITY OF MANDAN	
<b>Address</b>			
<b>City</b>	<b>State</b>	<b>Zip Code</b>	<b>Email</b>

<b>Name (Please Print)</b> Craig Mizera		<b>Title/Representing</b> HDR	
<b>Address</b> 4503 Coleman St.			
<b>City</b> Bismarck	<b>State</b> ND	<b>Zip Code</b> 58503	<b>Email</b> craig.mizera@hdrinc.com

<b>Name (Please Print)</b> Rick Stoppelmoor		<b>Title/Representing</b> HDR	
<b>Address</b> 4565 Coleman St			
<b>City</b> Bismarck	<b>State</b> ND	<b>Zip Code</b> 58503	<b>Email</b> Rick.Stoppelmoor@HDRINC.com

<b>Name (Please Print)</b> Ellen Huber		<b>Title/Representing</b> City of Mandan Business Development & Communications	
<b>Address</b> 205 2nd Ave NW			
<b>City</b> Mandan	<b>State</b> ND	<b>Zip Code</b> 58554	<b>Email</b> ehuber@cityofmandan.com



<b>Meeting Location</b> Mandan City Hall, Veterans Memorial Conference Room	<b>Meeting Type</b> Public Input Meeting	<b>Meeting Date</b> 3/29/2016
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<b>Project</b> Mandan-Bismarck Corridor Improvement Study
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<b>Name (Please Print)</b> Brad Ritter	<b>Title/Representing</b> BMDA
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<b>Address</b> 400 E Broadway Ste 417
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<b>City</b> Bis	<b>State</b> ND	<b>Zip Code</b> 58501	<b>Email</b> -
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<b>Name (Please Print)</b> Jim Neubauer	<b>Title/Representing</b> City Administrator Mandan
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<b>Address</b>
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<b>City</b>	<b>State</b>	<b>Zip Code</b>	<b>Email</b>
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<b>Name (Please Print)</b> Taryn Bohan	<b>Title/Representing</b> HDR
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<b>Address</b>
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<b>City</b>	<b>State</b>	<b>Zip Code</b>	<b>Email</b>
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<b>Name (Please Print)</b>	<b>Title/Representing</b>
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<b>Address</b>
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<b>City</b>	<b>State</b>	<b>Zip Code</b>	<b>Email</b>
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<b>Name (Please Print)</b>	<b>Title/Representing</b>
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<b>Address</b>
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<b>City</b>	<b>State</b>	<b>Zip Code</b>	<b>Email</b>
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<b>Name (Please Print)</b>	<b>Title/Representing</b>
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<b>Address</b>
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<b>City</b>	<b>State</b>	<b>Zip Code</b>	<b>Email</b>
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# Mandan-Bismarck Corridor Improvement Study

Public Meeting 2

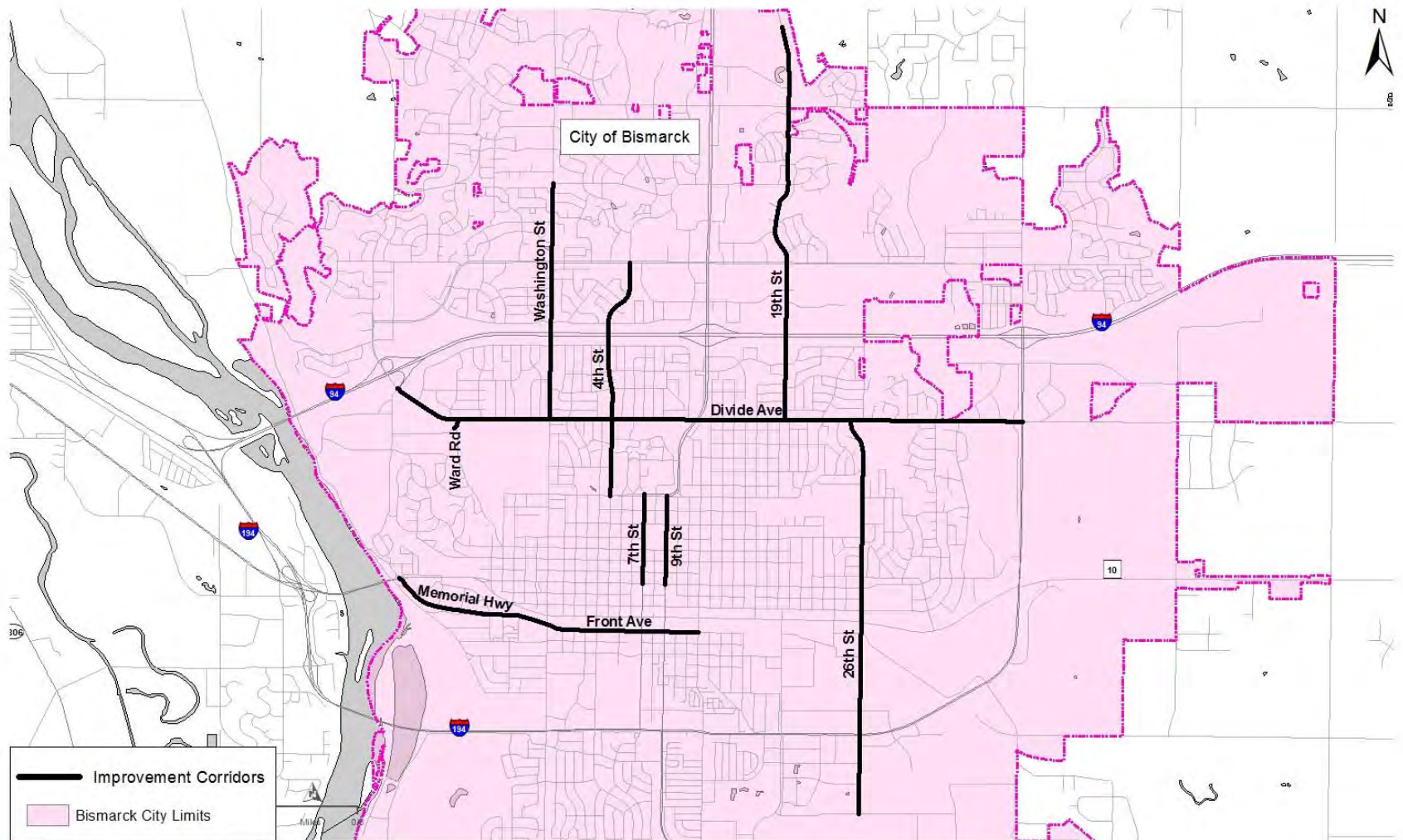
March 31, 2016

Bismarck Public Library

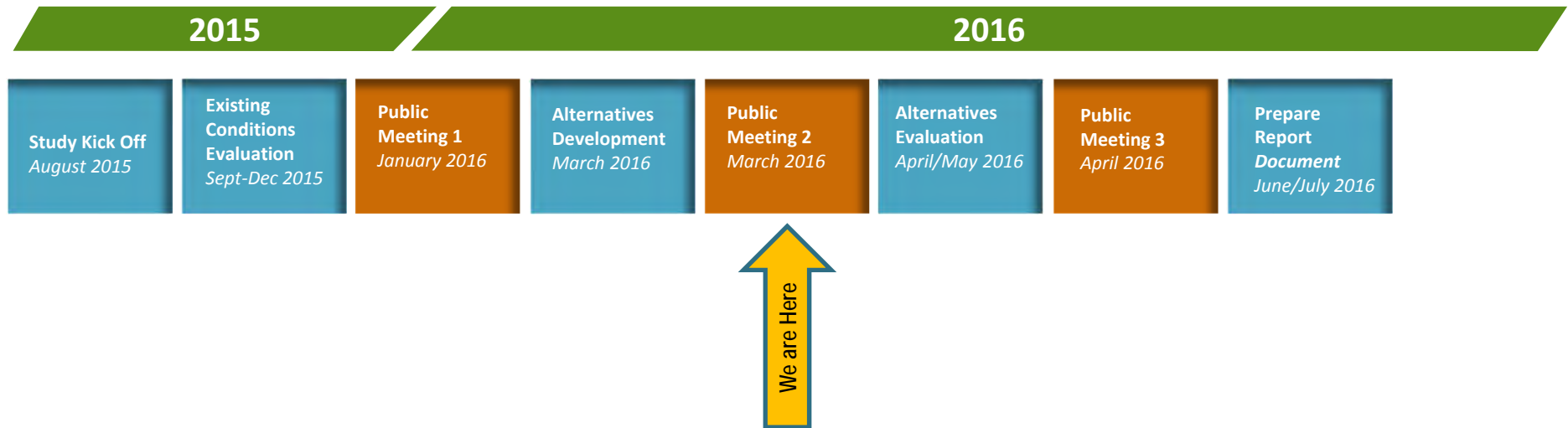




# Bismarck Corridors



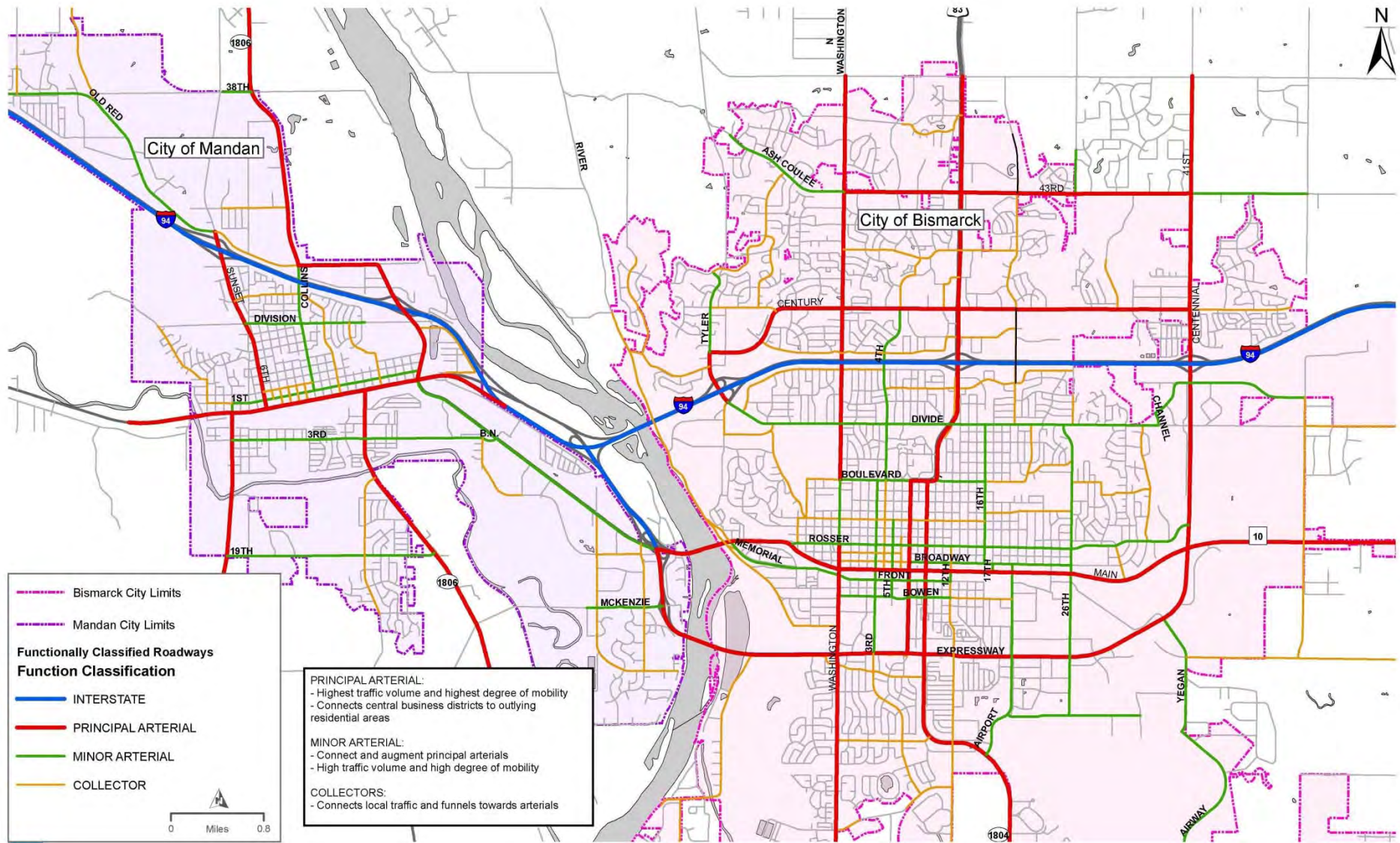
# Anticipated Schedule



## Progress To Date

- Gathered existing conditions data
- Analyzed existing conditions data
- Initiated the public involvement process
- Identified Preliminary Improvement Alternatives

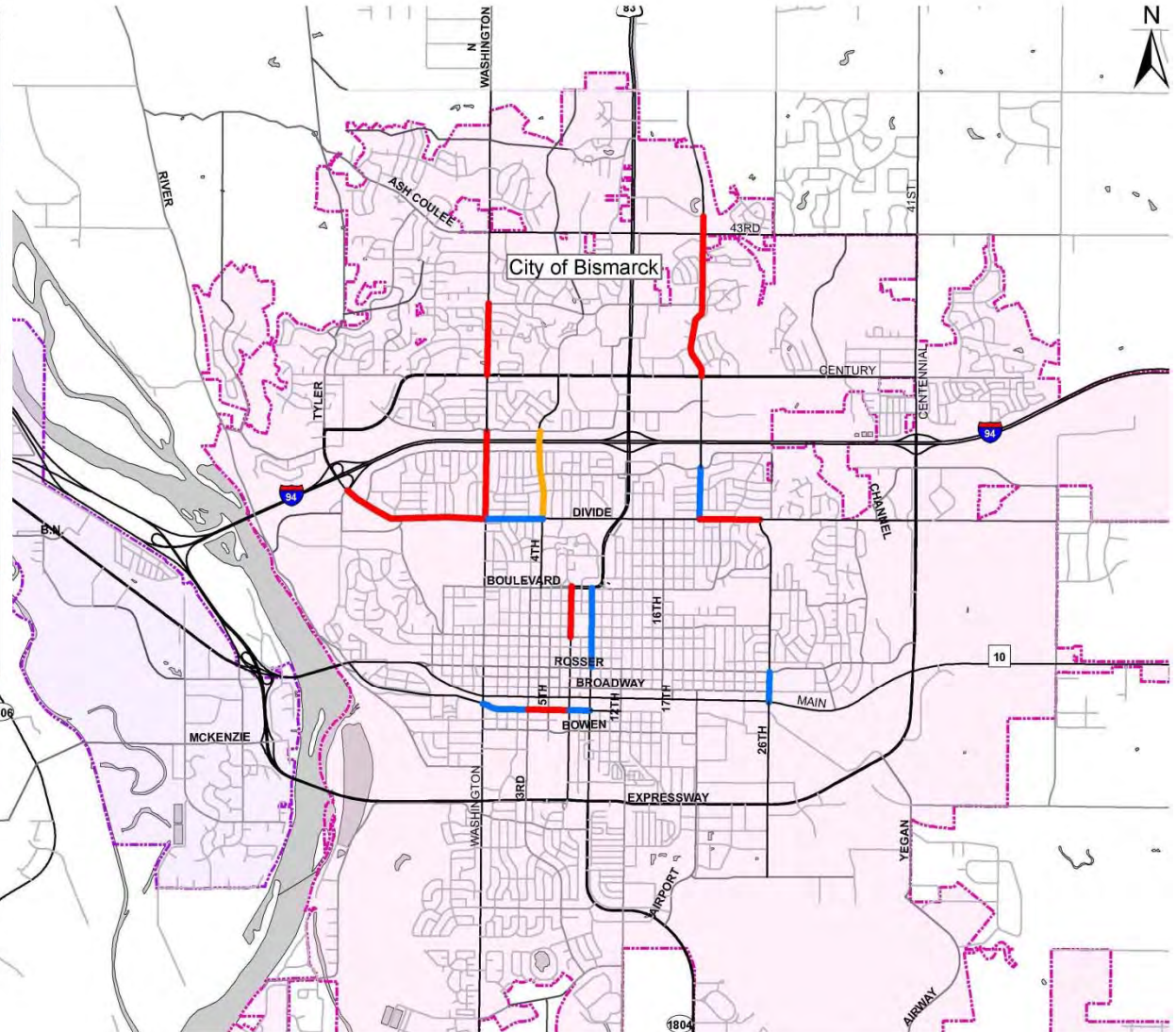
# Roadway Functional Classification



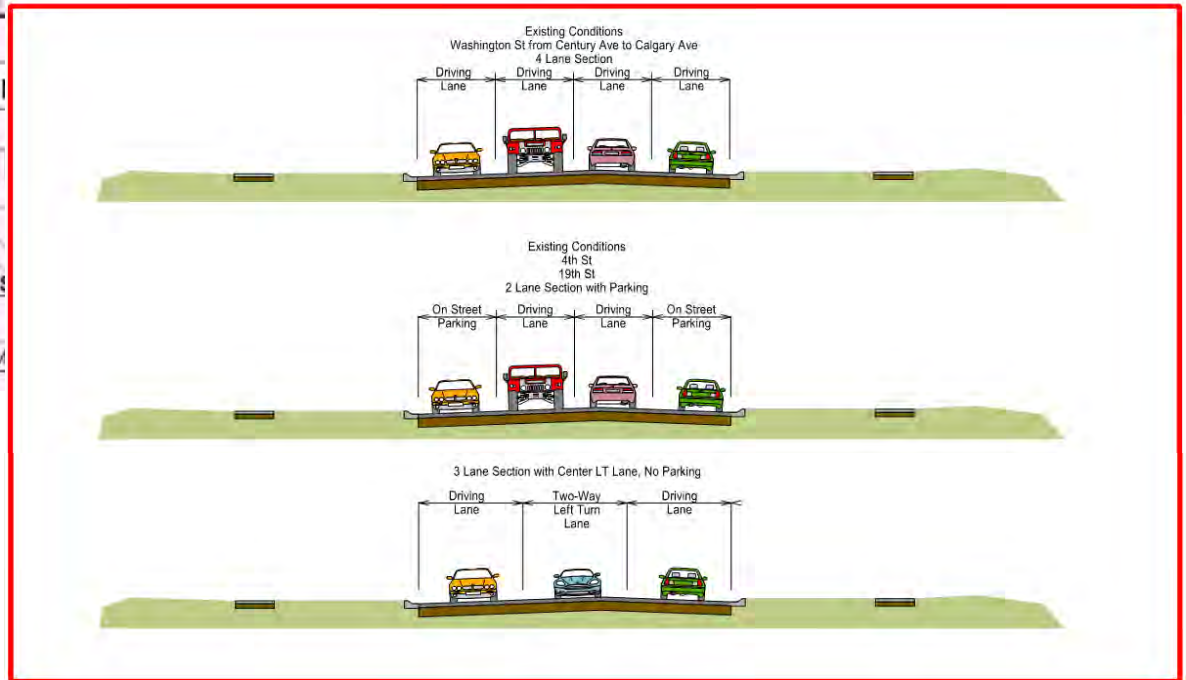
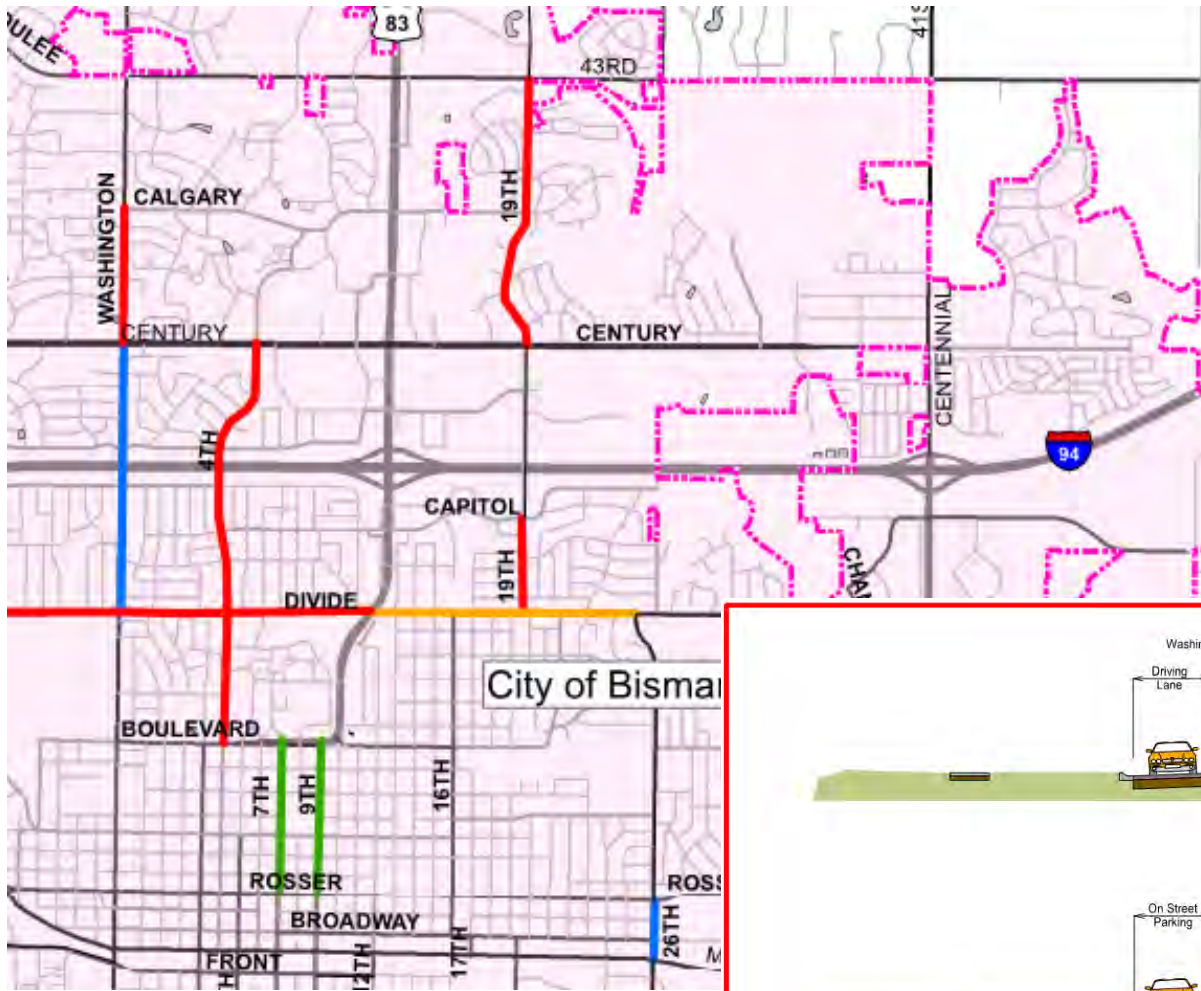
# Projected 2040 Level of Service (LOS)

Level of Service	Flow Conditions	Technical Descriptions
A		Highest quality of service. Free traffic flow with few restrictions on maneuverability or speed. <b>No Delays</b>
B		Stable traffic flow. Speed becoming slightly restricted. Low restriction on maneuverability. <b>No Delays</b>
C		Stable traffic flow, but less freedom to selection speed, change lanes, or pass. <b>Minimal Delays</b>
D		Traffic flow becoming unstable. Speeds subject to sudden change. Passing is difficult. <b>Minimal Delays</b>
E		Unstable traffic flow. Speed change quickly and maneuverability is low. <b>Significant Delays</b>
F		Heavily congested traffic. Demand exceeds capacity and speeds vary greatly. <b>Significant Delays</b>

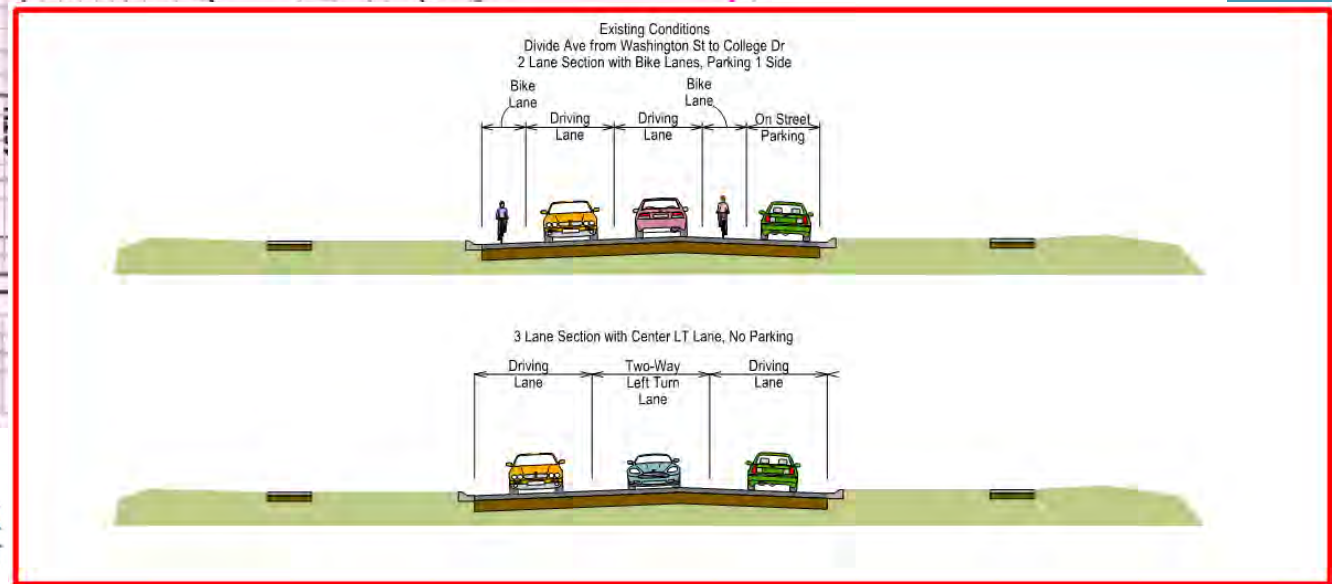
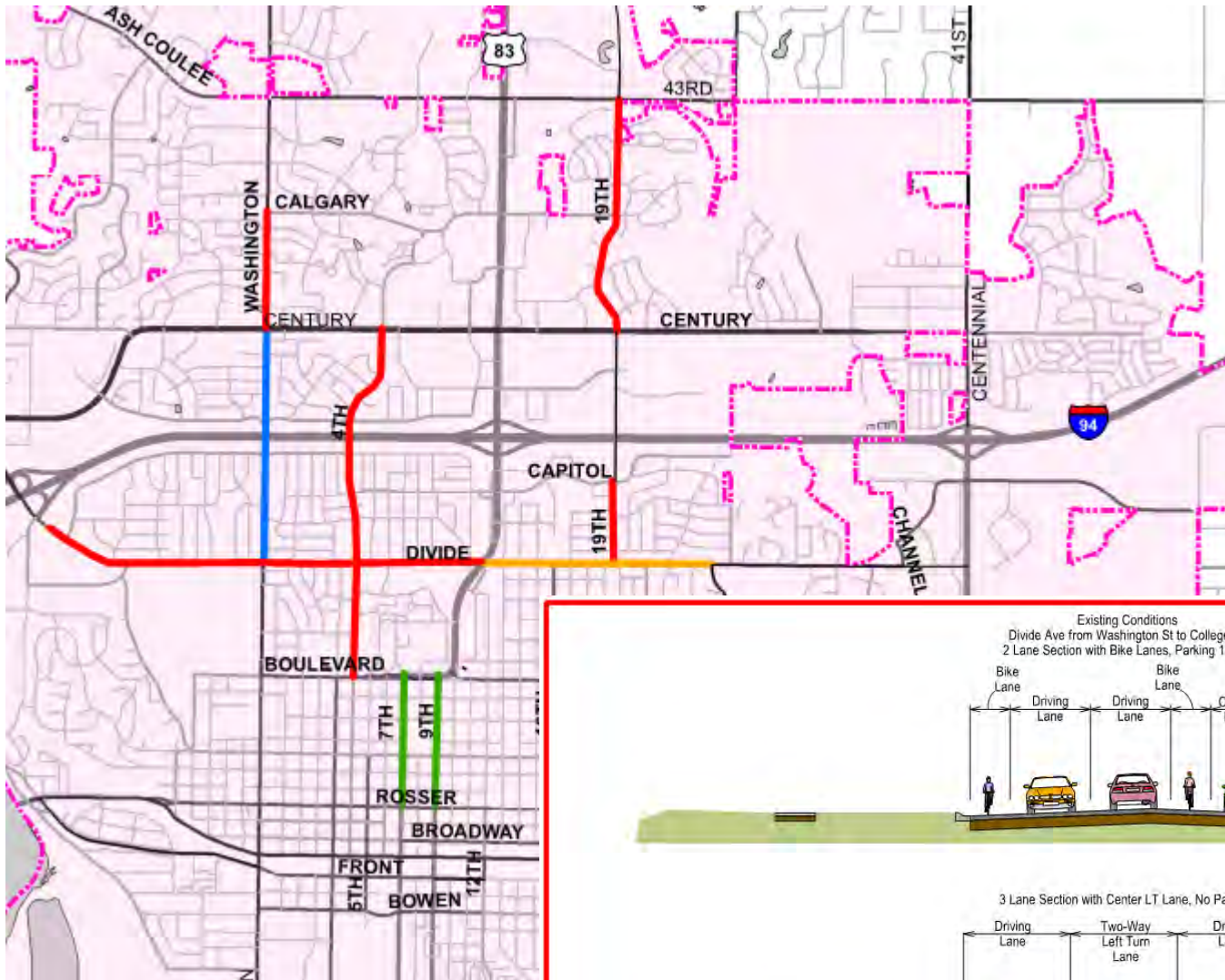
— LOS D  
— LOS E  
— LOS F  
— Mandan City Limits  
— Bismarck City Limits



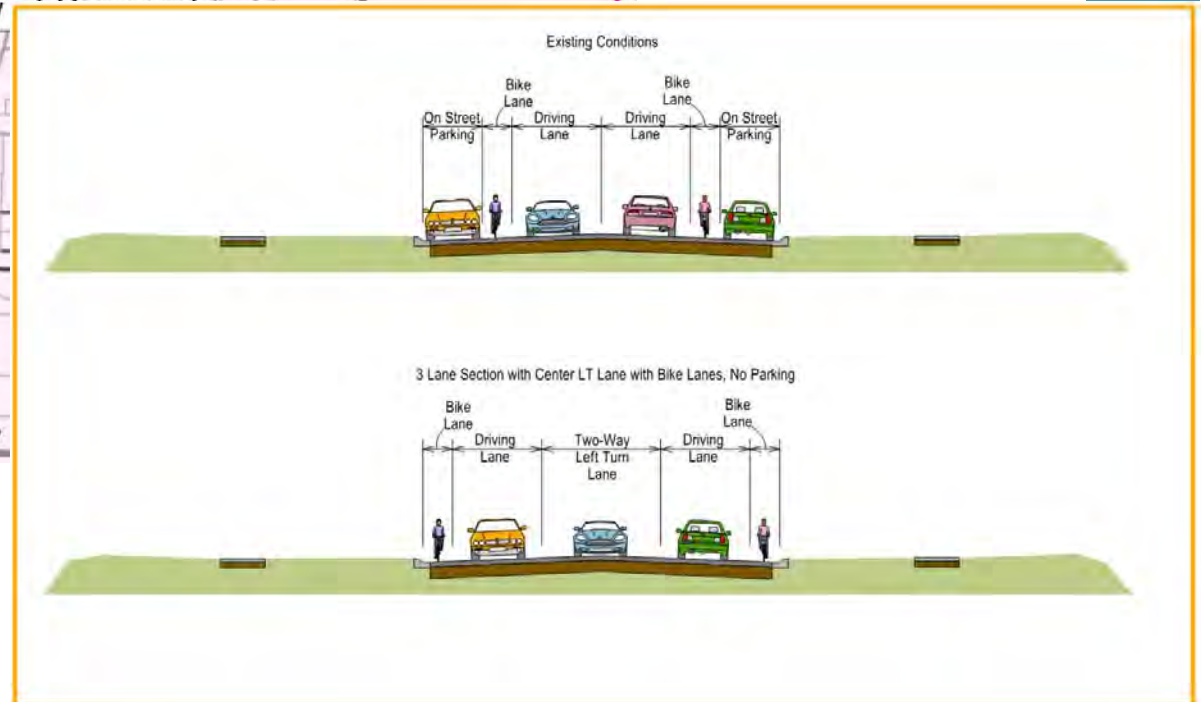
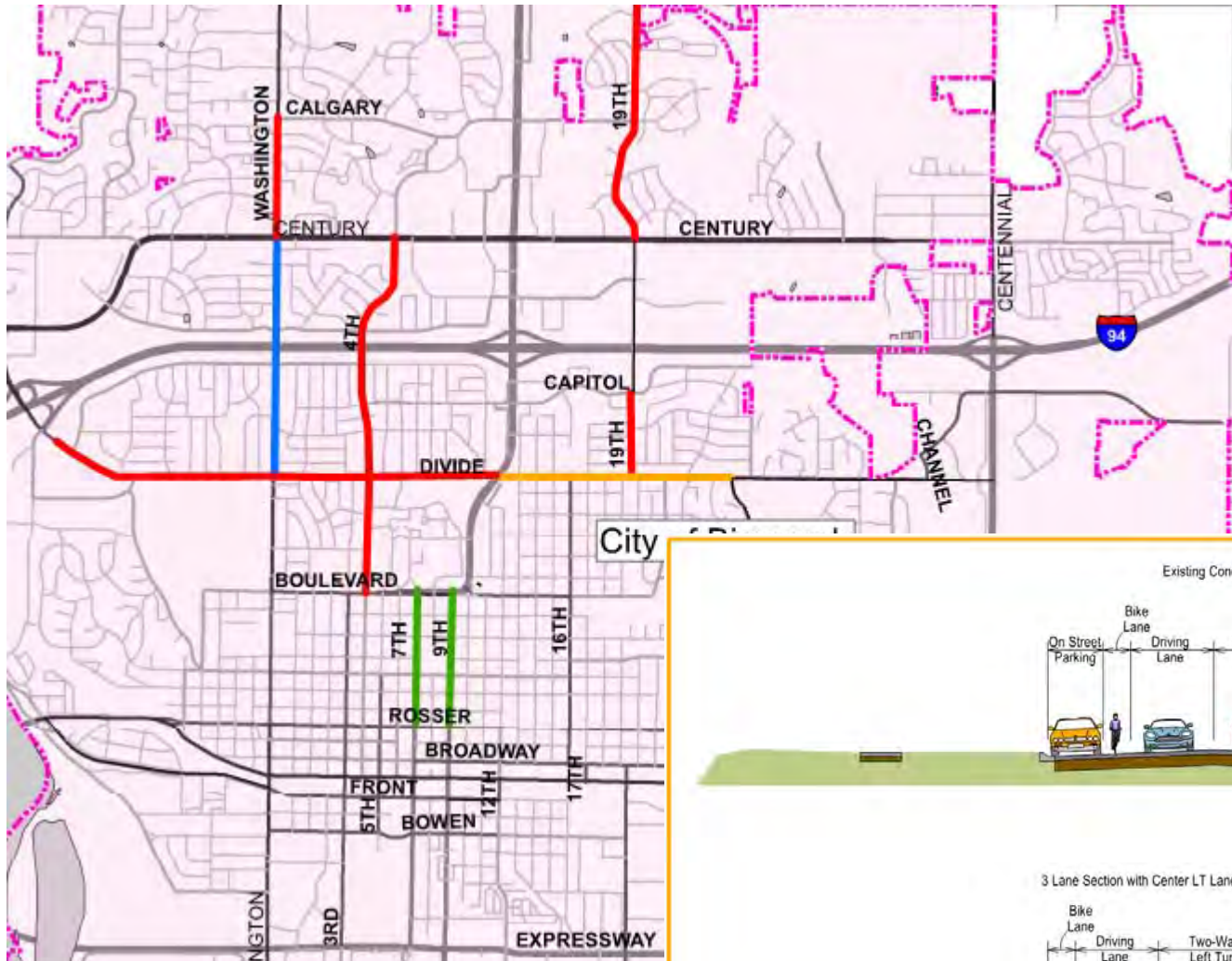
# Preliminary Improvement Alternatives



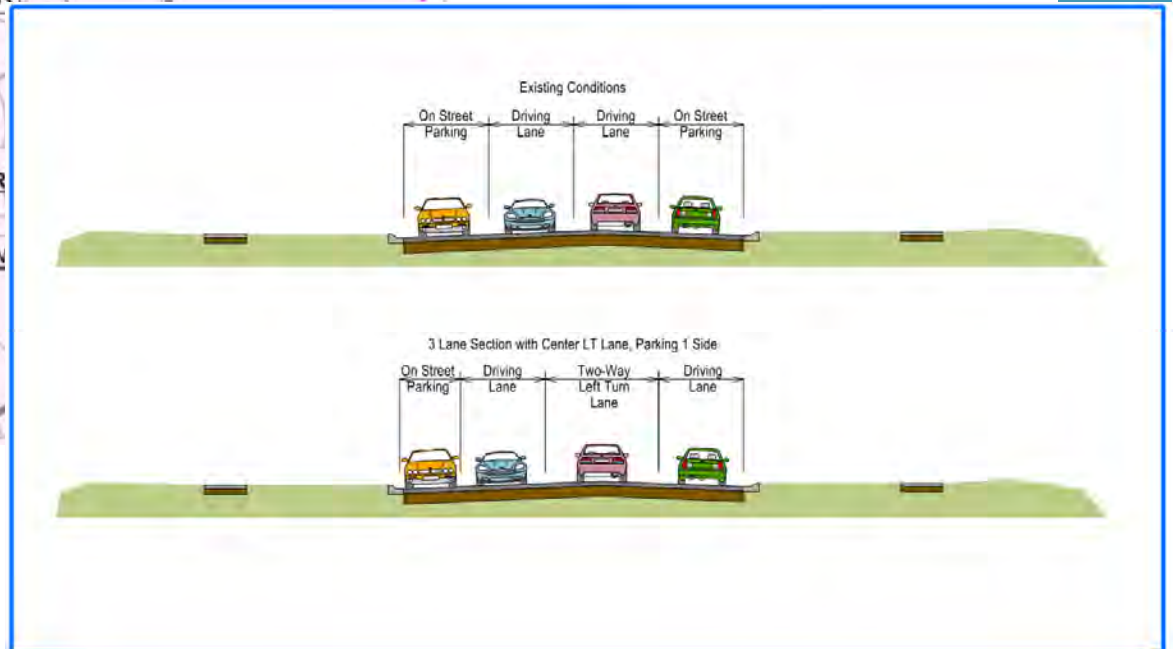
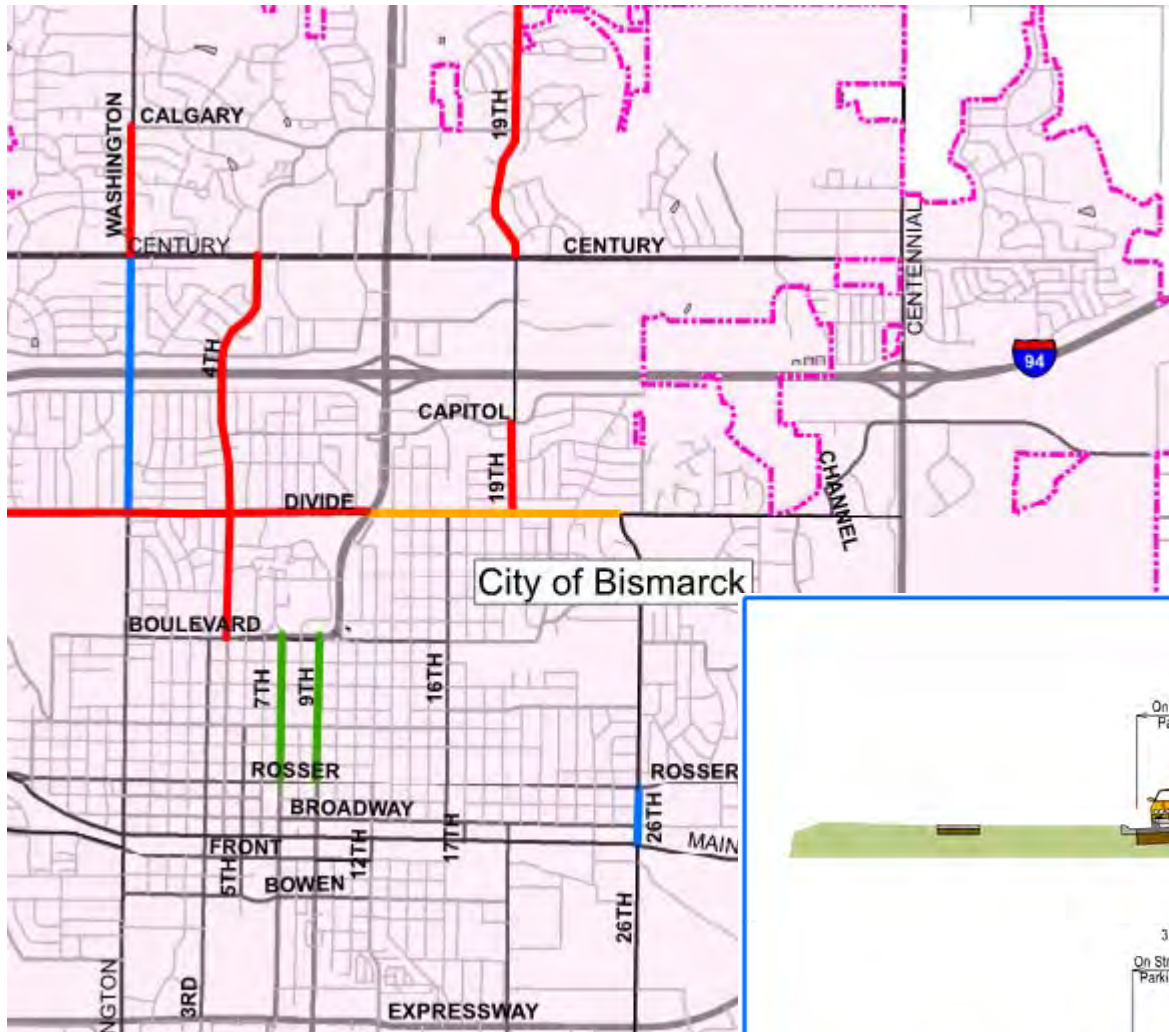
# Preliminary Improvement Alternatives



# Preliminary Improvement Alternatives

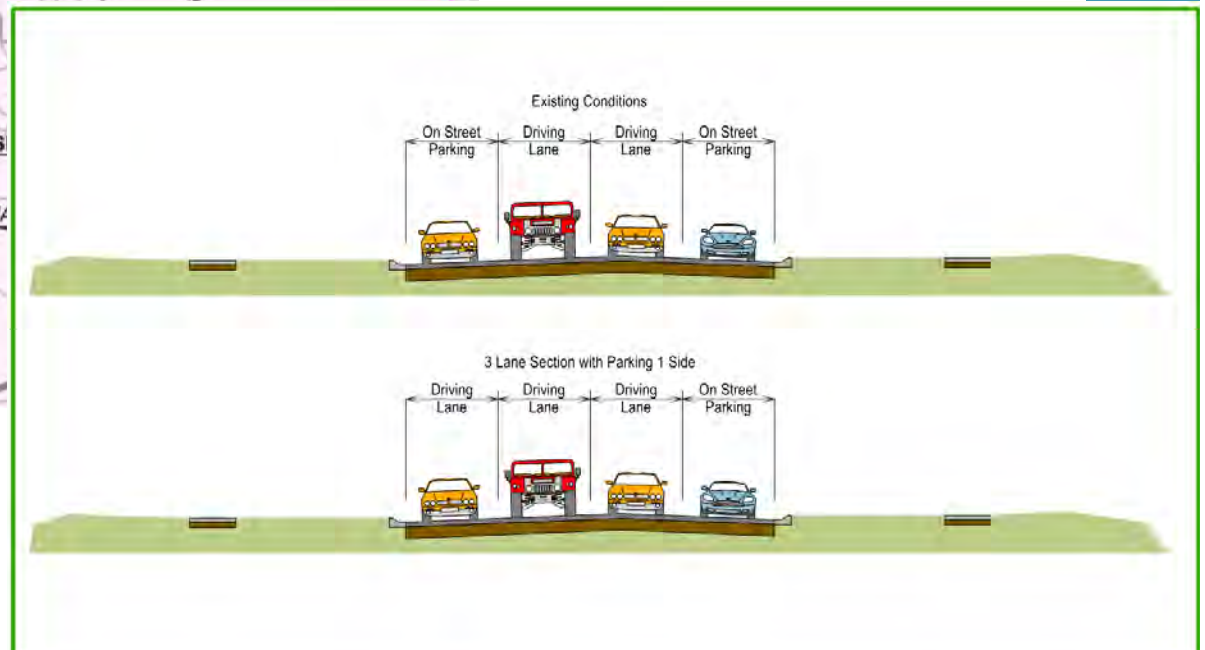
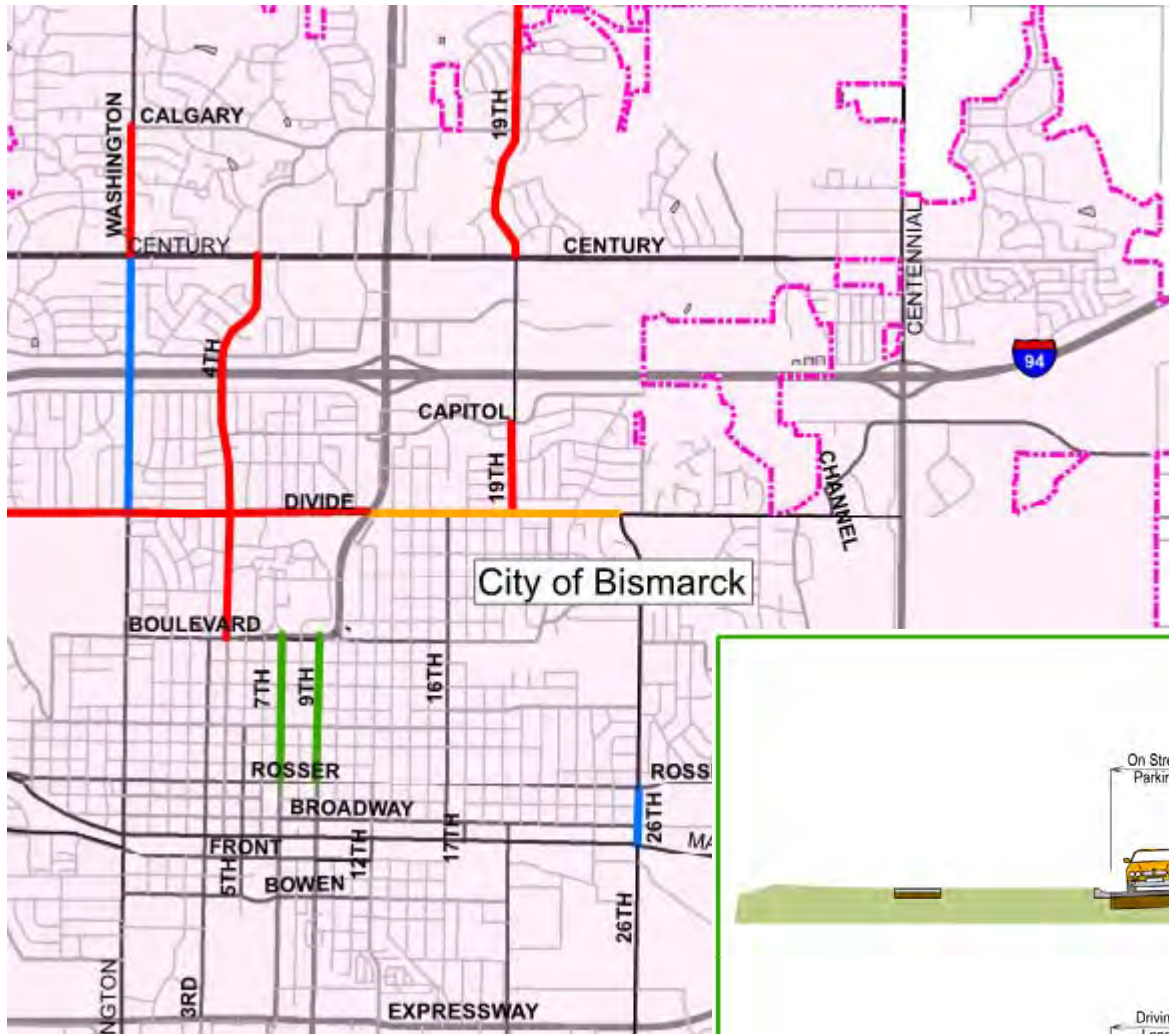


# Preliminary Improvement Alternatives

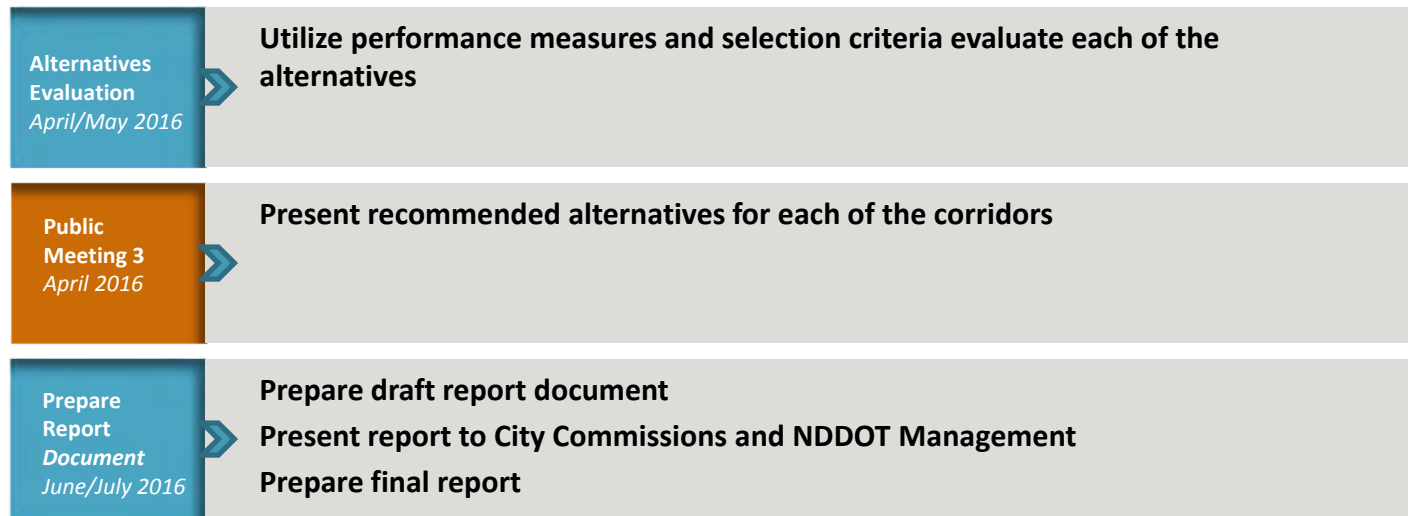




# Preliminary Improvement Alternatives



# Next Steps



# Stay Involved

- Complete comment cards
- Go to the Website:  
*[MandanBismarckCorridors.com](http://MandanBismarckCorridors.com)*
- Provide additional comments on our website

# Questions or Comments?



# Thank You!

- Website: [MandanBismarckCorridors.com](http://MandanBismarckCorridors.com)
- Mailed Comments:
  - Rick Stoppelmoor
  - HDR Engineering, Inc.
  - 4503 Coleman St., Suite 105
  - Bismarck, ND 58503

# Bismarck-Mandan

## METROPOLITAN PLANNING ORGANIZATION

Meeting Location Bismarck	Meeting Type Public Meeting	Meeting Date 3-30-2016
Project Number	PCN	
Project Description Corridor Improvement Study		

Name (Please print) Dan Belohlavek		Title/Representing Tri Energy Coop	
Address			
City Bismarck	State ND	Zip code 58501	Email

Name (Please print) Taryn Bohan		Title/Representing HDR	
Address			
City	State	Zip code	Email

Name (Please print) JOHN MILLNER		Title/Representing	
Address 1315 N 3RD ST			
City BISMARCK	State ND	Zip code 58501	Email

Name (Please print) Steve MARQUARDT		Title/Representing BCC / citizen	
Address 3020 Roosevelt Dr			
City BISMARCK	State ND	Zip code 58503	Email MARQUARDTSteve1@yahoo.com

Name (Please print) Mark Berg		Title/Representing	
Address 7501 North wood Dr			
City Bismarck	State ND	Zip code 58507	Email

Name (Please print) Rick Stuppelrock		Title/Representing HDR	
Address			
City Bismarck	State ND	Zip code 58503	Email

Name (Please print) Donna Fricke		Title/Representing	
Address 918 Senate Dr			
City Bismarck	State ND	Zip code 58501	Email dbnsf14@hotmail.com



# Mandan-Bismarck Corridor Improvement Study

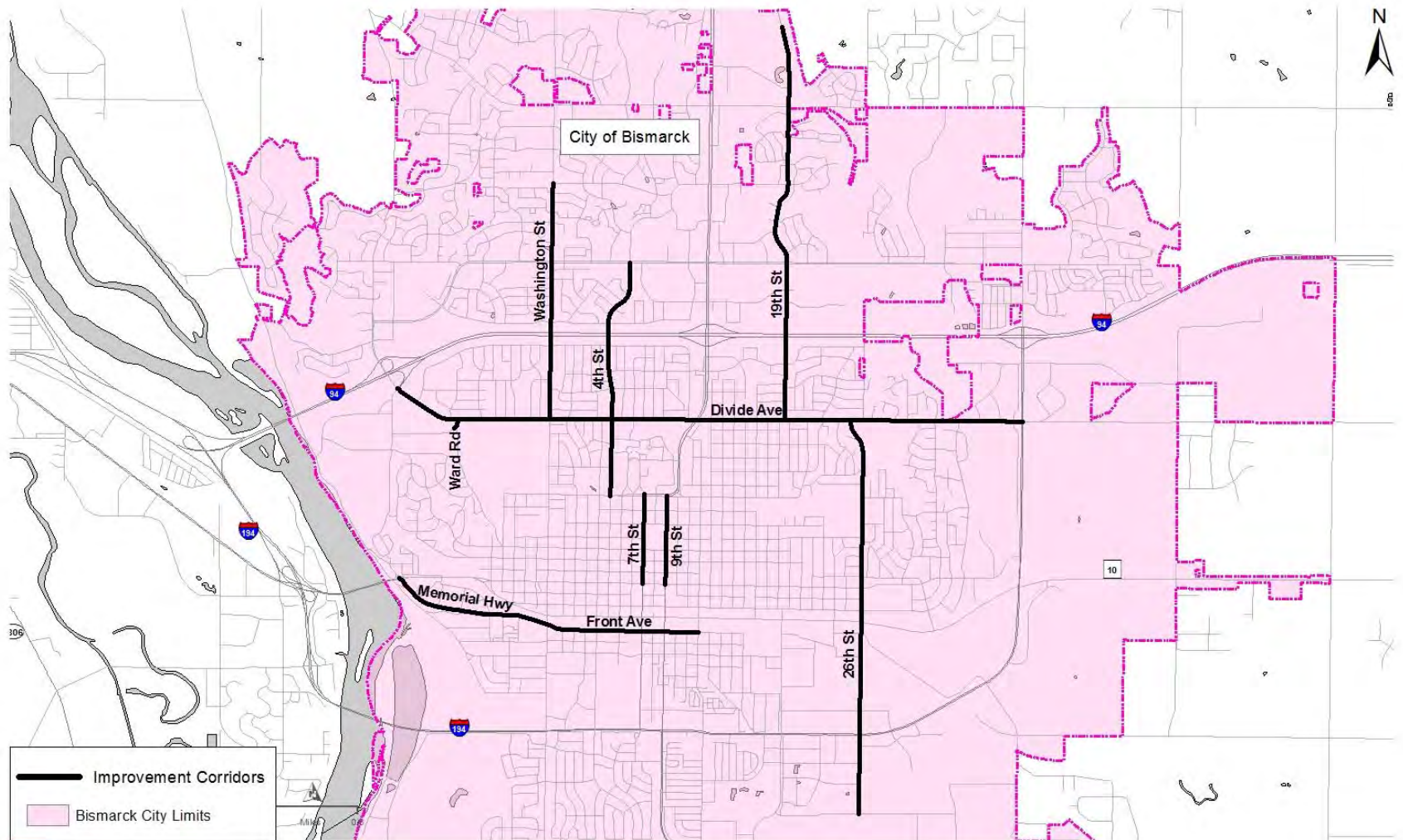
Public Meeting 3 – Alternative  
Evaluation

June 1, 2016

Bismarck Public Library



# Bismarck Corridors





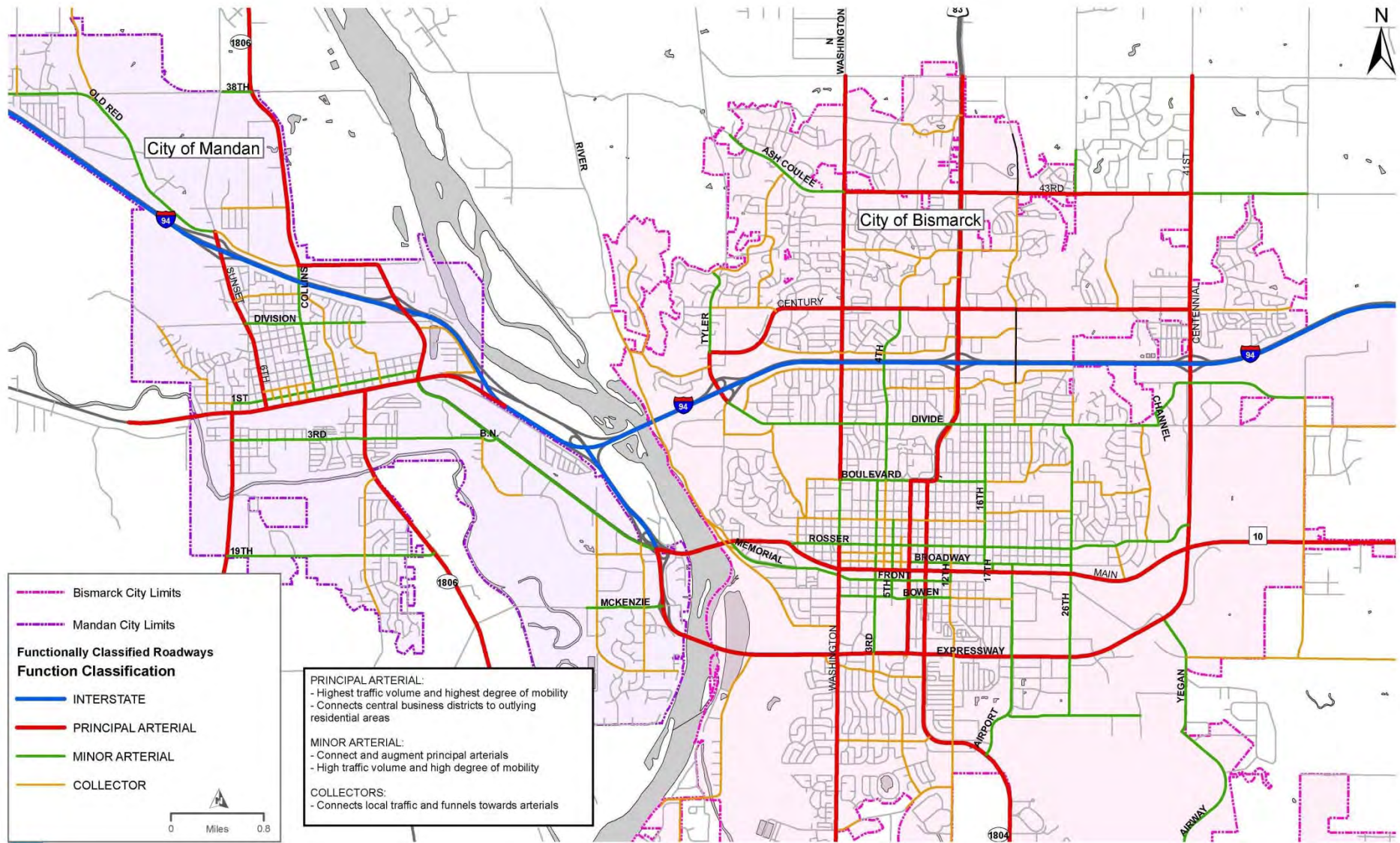
# Anticipated Schedule



## Progress To Date

- Gathered existing conditions data
- Analyzed existing conditions data
- Initiated the public involvement process
- Identified Preliminary Improvement Alternatives
- Evaluated Preliminary Improvement Alternatives

# Roadway Functional Classification

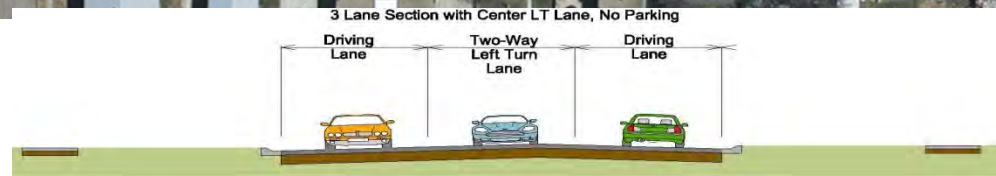


# Washington Street Corridor

## *Divide Avenue to Calgary Avenue*

### Recommended Alternative

- 3-lane section from Divide Avenue to Calgary Avenue
  - No on street parking
- Reduce the number of accesses from Washington St. to the Tesoro Gas Station
- Washington St. & Century Ave. Intersection
  - Re-align the Century Ave. left turn lanes to remove negative offsets
  - Install Flashing Yellows (FYA) on all approaches
- Coordinate traffic signals between Interstate Ave and Turnpike Ave

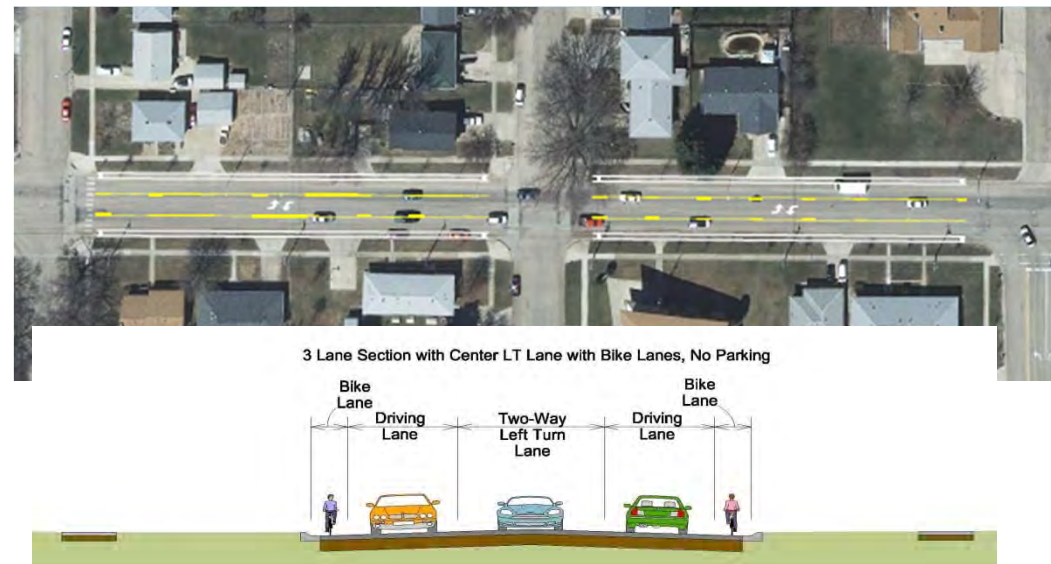
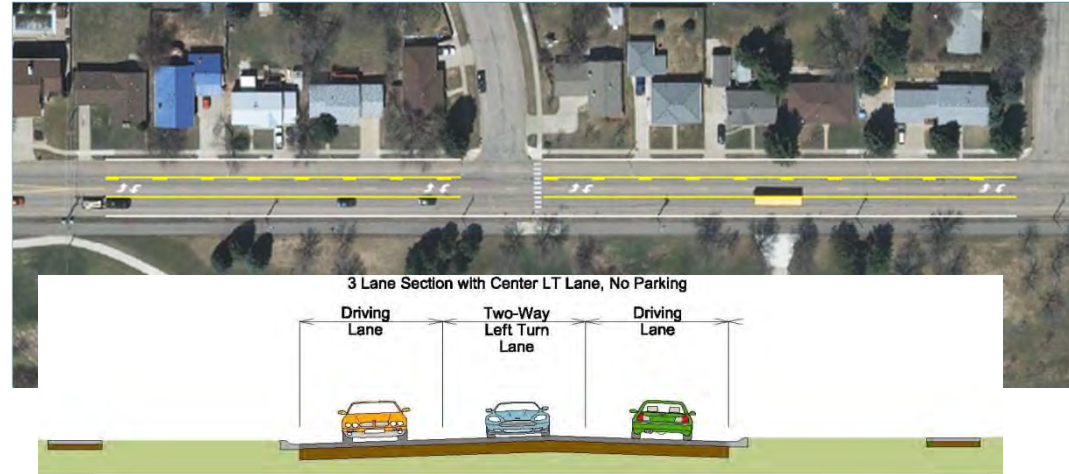


# Divide Avenue Corridor

## *Shafer Street to Bismarck Expressway*

### Recommended Alternative

- 3-lane section from Shafer St. to 26<sup>th</sup> St.
  - No on street parking
  - Keep bike lanes from Shafer St. to Washington St. and State St. to 26<sup>th</sup> St.
  - Enhance visibility of bike lane pavement markings
  - Keep share the road signage from Washington St. to State St.
- Divide Ave. & Washington St. Intersection
  - Increase curb radius in each quadrant
- Divide Ave. & 4<sup>th</sup> St. Intersection
  - Increase length of Divide Ave. left turn lanes
  - Install Flashing Yellows (FYA) on all approaches

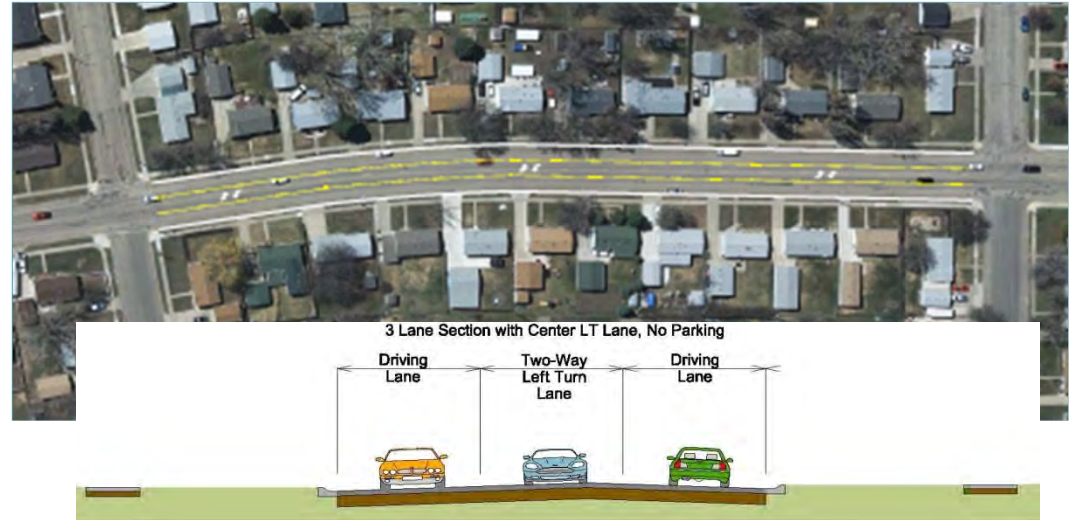


# 4<sup>th</sup> Street Corridor

## *Boulevard Avenue to Century Avenue*

### Recommended Alternative

- 3-lane section from Boulevard Ave. to Century Ave.
  - No on street parking
- 4<sup>th</sup> St. & Century Ave. Intersection
  - Re-align the Century Ave. left turn lanes to remove negative offsets
  - Install Flashing Yellows (FYA) on all approaches
- Divide Ave. & 4<sup>th</sup> St. Intersection
  - Increase length of Divide Ave. left turn lanes
  - Install Flashing Yellows (FYA) on all approaches
- Coordinate traffic signals along Boulevard Ave. between 3<sup>rd</sup> St. and 7<sup>th</sup> St.

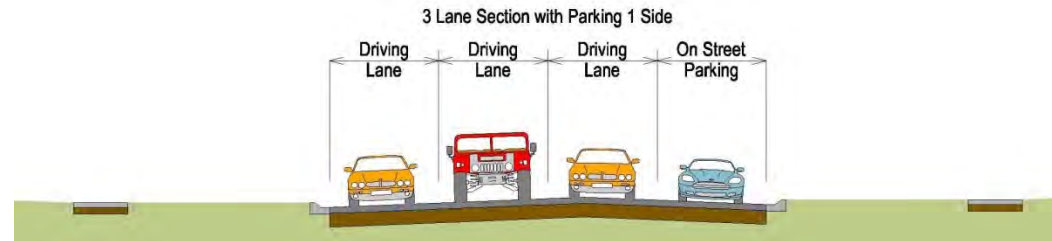


# 7<sup>th</sup> Street Corridor

## *Boulevard Avenue to Rosser Avenue*

### Recommended Alternative

- Install 3 through lanes from boulevard Ave. to Rosser Ave.
  - No parking on west side
- Improve lighting along 7th Street corridor, especially in the school zone at Bismarck High School.
- Move stop bars further back from crosswalks.
- Install “Stop Here for Pedestrian” signing to get vehicles to stop further away from crosswalks.
- Enhance all pedestrian crossings to increase visibility

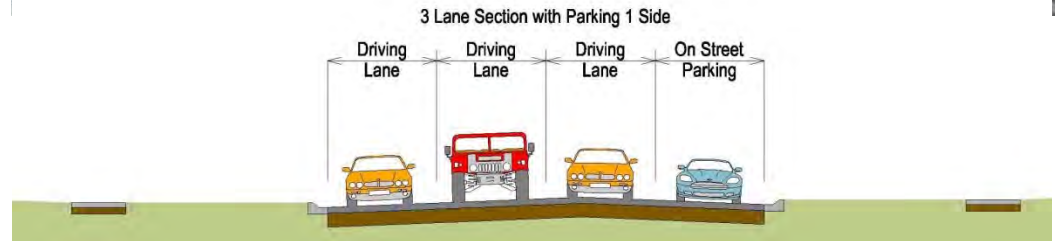


# 9<sup>th</sup> Street Corridor

## *Boulevard Avenue to Rosser Avenue*

### Recommended Alternative

- Install 3 through lanes from Rosser Ave. to Boulevard Ave.
  - No parking on east side
- Improve lighting along 9th Street corridor, especially in the school zone at Bismarck High School.
- Move stop bars further back from crosswalks.
- Install “Stop Here for Pedestrian” signing to get vehicles to stop further away from crosswalks.
- Enhance all pedestrian crossings to increase visibility

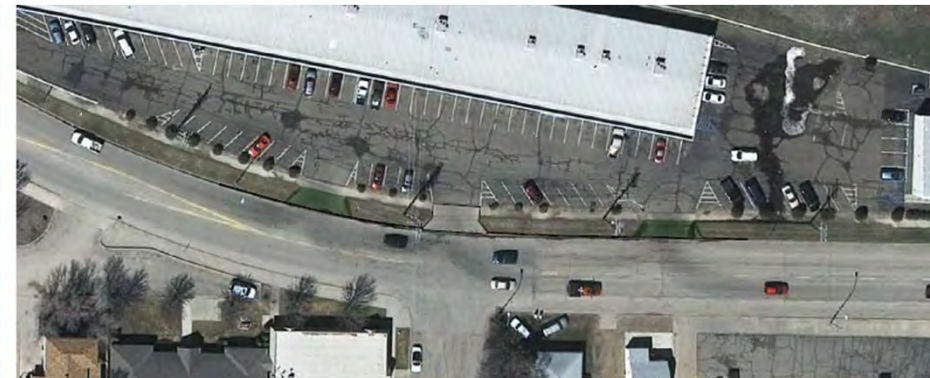
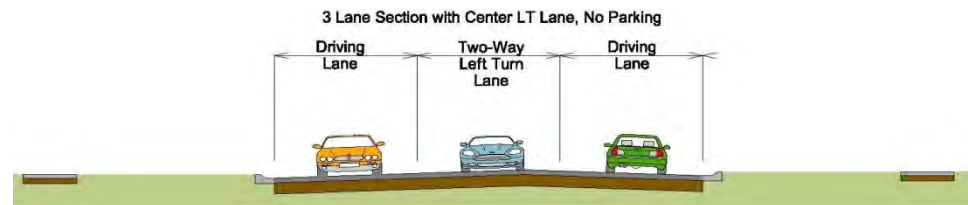


# Front Ave/Memorial Highway Corridor

## Main Avenue to 12<sup>th</sup> Street

### Recommended Alternative

- No build between Main Ave. and Washington St.
- 3-lane section from Washington St. to 12<sup>th</sup> St.
  - No on street parking
- Front St. & 3<sup>rd</sup> St. Intersection
  - Install Flashing Yellows (FYA) on all approaches
- Eliminate 2 accesses from strip mall north of Front St. near Washington St.





# 26<sup>th</sup> Street Corridor

## *Airway Avenue to Divide Avenue*

### Recommended Alternative

- No build between Airway Ave. and Main Ave.
- 3-lane section from Main Ave. to Rosser Ave.
- No build between Rosser Ave. and Divide Ave.



# 19<sup>th</sup> Street Corridor

## *Divide Avenue to LaSalle Drive*

### Recommended Alternative

- 3-lane section from Divide Ave. to Capitol Ave.
  - No on street parking
- No build between Capitol Ave. to Century Ave.
- 3-lane section from Century Ave. to LaSalle Dr.
  - Eliminate on street parking
- 19<sup>th</sup> St & 43<sup>rd</sup> Ave. Intersection
  - Re-align the 19<sup>th</sup> St. approaches
  - Provide left turn lane and a right/through lane on south approach



3 Lane Section with Center LT Lane, No Parking

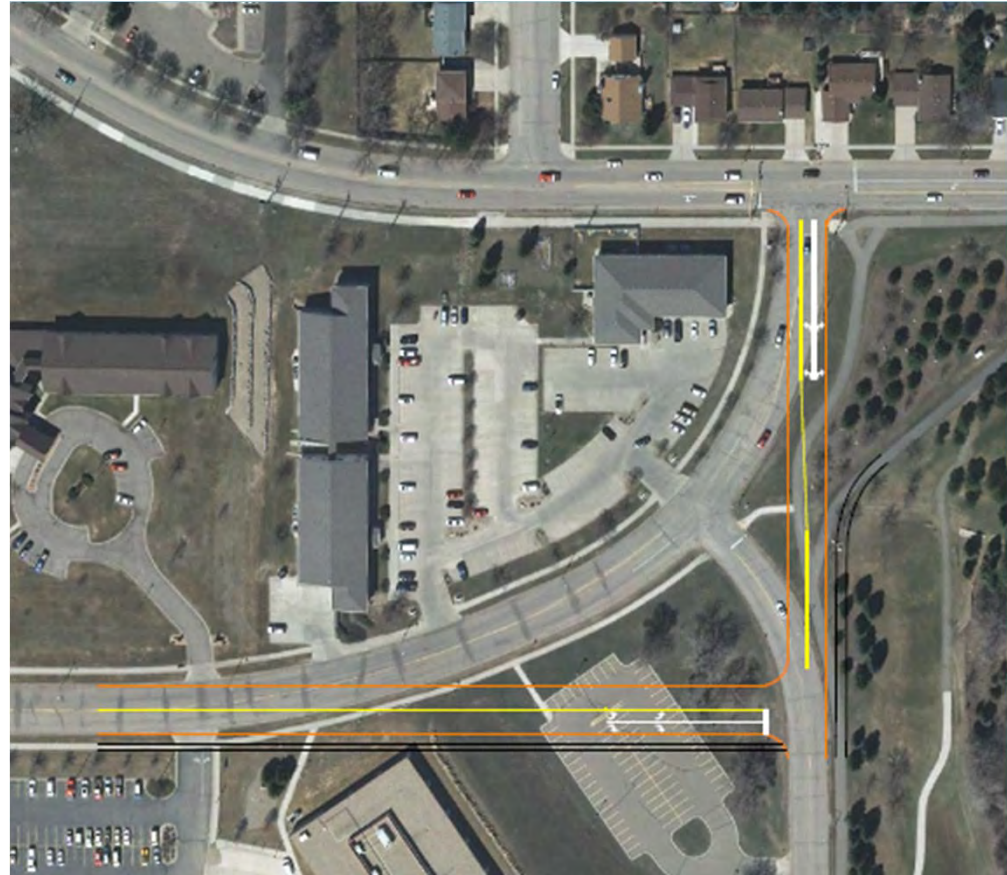


# Ward Road Street Corridor

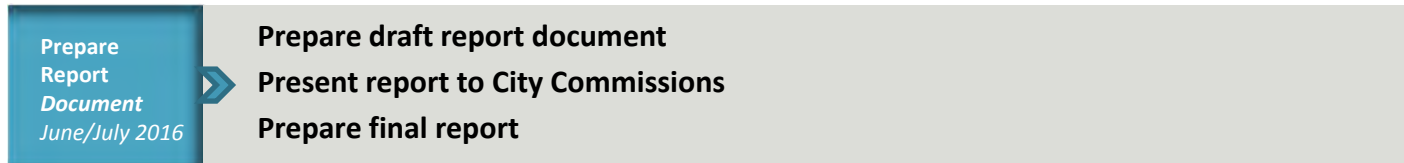
## *Divide Avenue to Edwards Avenue*

### Recommended Alternative

- Realignment of Ward Road and College Drive



# Next Steps



# Stay Involved

- Complete comment cards
- Go to the Website:  
*[MandanBismarckCorridors.com](http://MandanBismarckCorridors.com)*
- Provide additional comments on our website

# Questions or Comments?



# Thank You!

- Website: [MandanBismarckCorridors.com](http://MandanBismarckCorridors.com)
- Mailed Comments:
  - Rick Stoppelmoor
  - HDR Engineering, Inc.
  - 4503 Coleman St., Suite 105
  - Bismarck, ND 58503

# Bismarck-Mandan

## METROPOLITAN PLANNING ORGANIZATION

Meeting Location <i>Bismarck Public Library</i>	Meeting Type <i>Public Meeting</i>	Meeting Date <i>6-1-2016</i>
Project Number	PCN	
Project Description <i>Mandan &amp; Bismarck Corridor Improvement Study</i>		

Name (Please print) <i>Bill Lardy</i>	Title/Representing		
Address <i>450 E Calgary Ave</i>			
City <i>Bismarck</i>	State <i>ND</i>	Zip code <i>58503</i>	Email

Name (Please print) <i>Rick Stoppelman</i>	Title/Representing <i>HDR</i>		
Address <i>4503 COLEMAN SCITE 105</i>			
City <i>Bismarck</i>	State	Zip code	Email

Name (Please print) <i>Ken Schultz</i>	Title/Representing		
Address <i>1974 EAST CAPITOL</i>			
City <i>Bismarck</i>	State <i>ND</i>	Zip code <i>58501</i>	Email

Name (Please print) <i>Robert Olgerson</i>	Title/Representing		
Address <i>301 W AVE C</i>			
City <i>Bismarck</i>	State <i>ND</i>	Zip code <i>58501</i>	Email <i>ROIGELANDIC@OUTLOOK.COM</i>

Name (Please print) <i>MICHAEL HINSHAW</i>	Title/Representing <i>SEH</i>		
Address <i>4808 Weyburn</i>			
City <i>Bismarck</i>	State <i>ND</i>	Zip code <i>58501</i>	Email <i><del>mhinshaw</del> mhinshaw@sehinc.com</i>

Name (Please print) <i>Will Hutchings</i>	Title/Representing <i>MPO</i>		
Address			
City	State	Zip code	Email

Name (Please print) <i>Gabe Schell</i>	Title/Representing <i>City of Bismarck</i>		
Address			
City	State	Zip code	Email



# Bismarck-Mandan

## METROPOLITAN PLANNING ORGANIZATION

Meeting Location <i>Bismarck Public Library</i>	Meeting Type <i>Public Meeting</i>	Meeting Date <i>6-1-2018</i>
Project Number	PCN	
Project Description <i>Mandan &amp; Bismarck Corridor Improvement Study</i>		

Name (Please print) <i>Deb Arnold</i>		Title/Representing	
Address <i>1733 N 4<sup>th</sup> ST</i>			
City <i>Bismarck</i>	State <i>ND</i>	Zip code <i>58501</i>	Email <i>pyanbur@bis.midco.net</i>

Name (Please print) <i>Mark A Berg</i>		Title/Representing	
Address <i>7501 Northwood Dr</i>			
City <i>Bismarck</i>	State <i>ND</i>	Zip code <i>58503</i>	Email <i>maberg7501@gmail.com</i>

Name (Please print) <i>Tom Atkinson</i>		Title/Representing	
Address <i>3056 Greenwood Dr</i>			
City <i>Bismarck</i>	State <i>ND</i>	Zip code <i>58503</i>	Email <i>tdabrat@midco.com</i>

Name (Please print) <i>Craig Mizera</i>		Title/Representing <i>HDR</i>	
Address <i>4503 Coleman St.</i>			
City <i>Bismarck</i>	State <i>ND</i>	Zip code <i>58503</i>	Email

Name (Please print) <i>DAVE WALDRON</i>		Title/Representing <i>Self/Green Acres Landowners</i>	
Address <i>401 Oakfield DR</i>			
City <i>Bismarck</i>	State <i>ND</i>	Zip code <i>58503</i>	Email <i>dave.waldron@gmail.com</i>

Name (Please print)		Title/Representing	
Address			
City	State	Zip code	Email

Name (Please print)		Title/Representing	
Address			
City	State	Zip code	Email



# Mandan-Bismarck Corridor Improvement Study

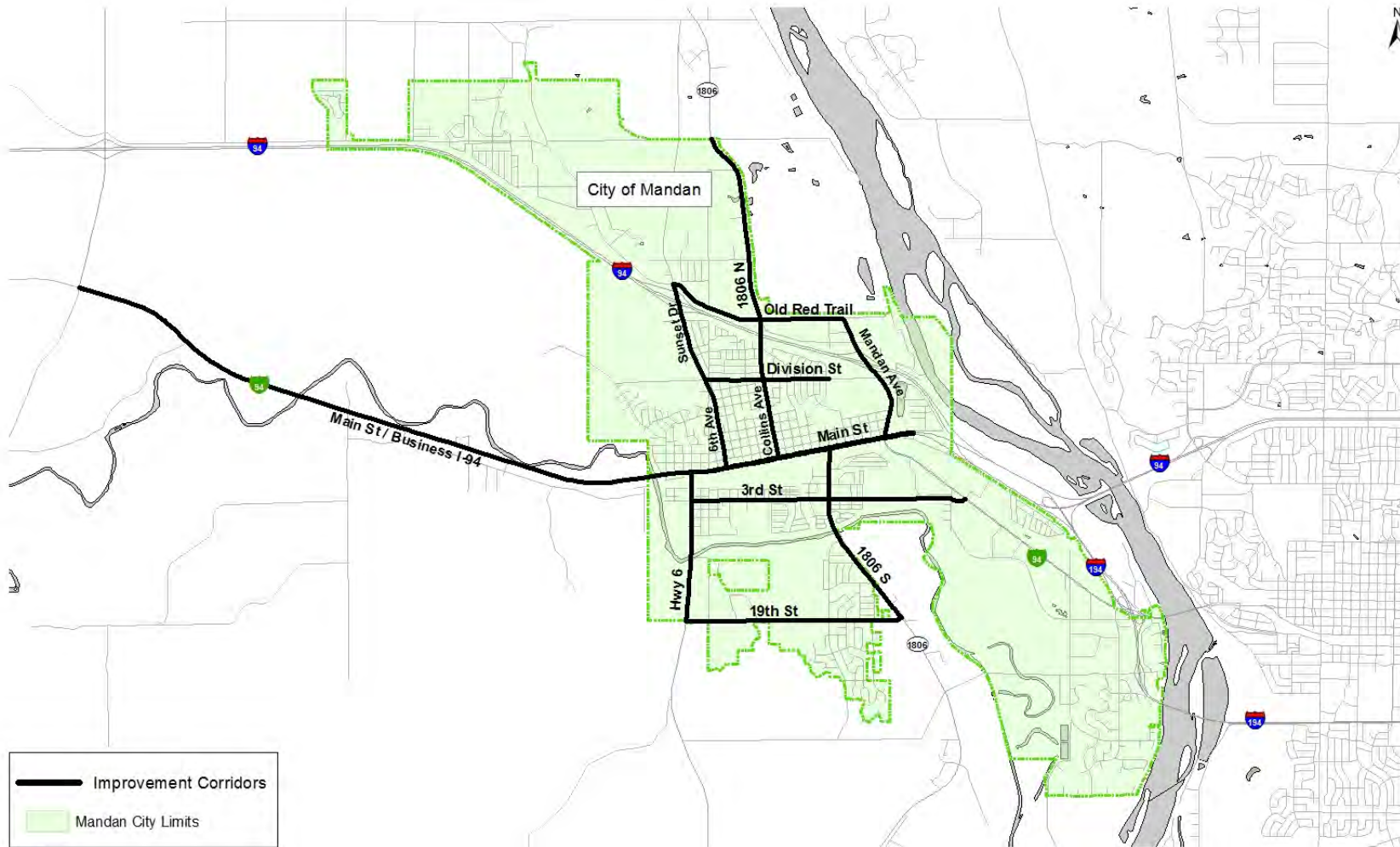
Public Meeting 3 – Alternative  
Evaluation

June 2, 2016

Mandan City Hall



# Mandan Corridors



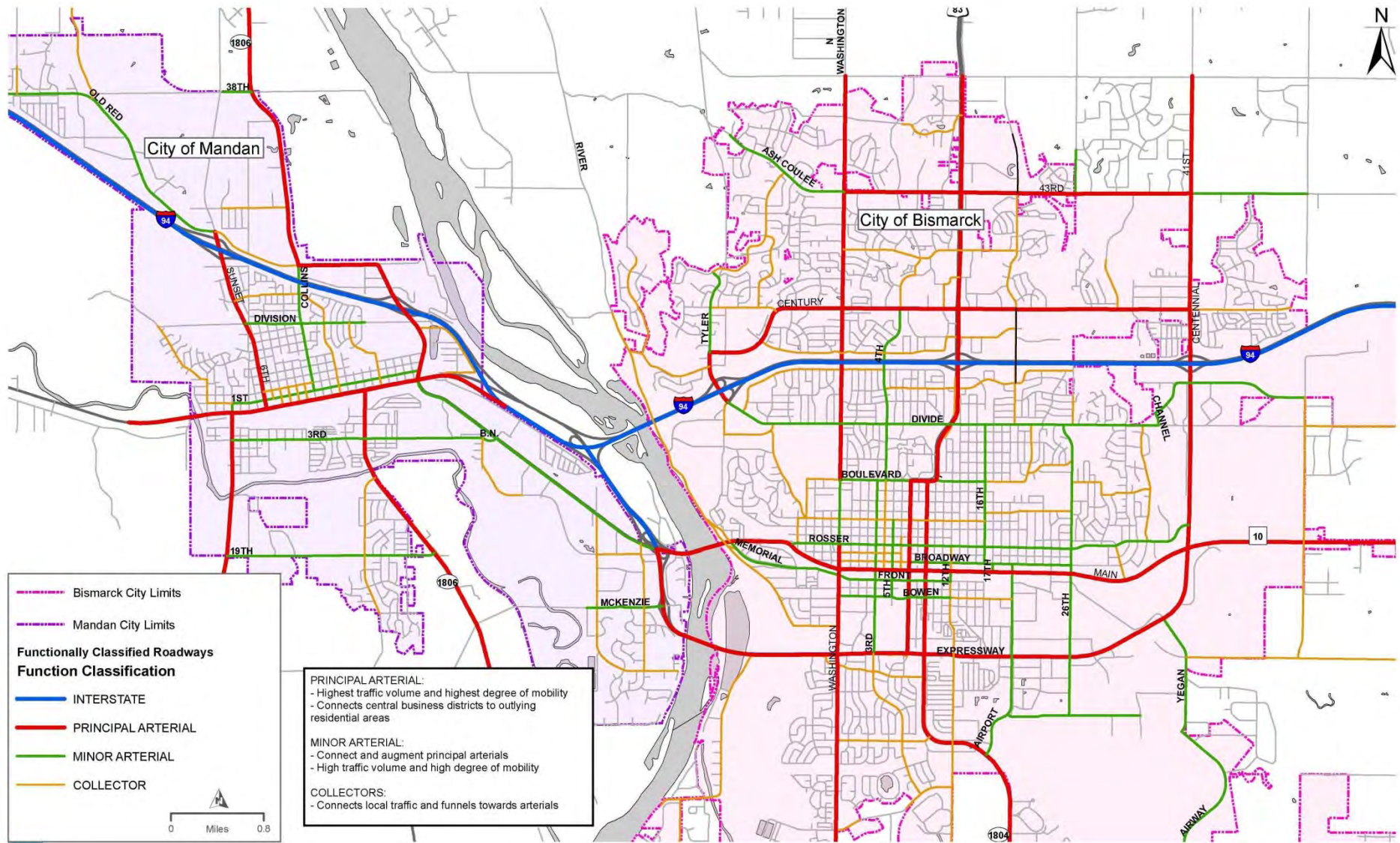
# Anticipated Schedule



## Progress To Date

- Gathered existing conditions data
- Analyzed existing conditions data
- Initiated the public involvement process
- Identified Preliminary Improvement Alternatives
- Evaluated Preliminary Improvement Alternatives

# Roadway Functional Classification



# Main Street Corridor

## *ND Hwy 25 to Twin City Drive*

### Recommended Alternative

- No-build between Hwy 25 and 10th Ave NW (Hwy 6)
- Install 3-lane section between 10th Ave NW and 3rd Ave NE
  - Maintain on-street parking on north side
  - Add on-street parking on the south side
  - Lengthen right-turn lane at major intersections
- Coordinate all traffic signals and add protected left turn phasing at all signalized intersections.
- Re-stripe all crosswalks and improve all crosswalks
- Install Pedestrian Hybrid Beacon, (HAWK beacon) at un-signalized intersections
- Add advanced pedestrian crossing signage at the intersections of 2nd Ave NW and 4th Ave NW



# Sunset Drive/6<sup>th</sup> Avenue Corridor

## *Main St. to Old Red Trail*

### Recommended Alternative

- No-build between Main St. and North ramp terminal of the I-94/Sunset Drive Interchange
- Intersection of Sunset Drive and Old Red Trail
  - Install a dedicated right turn lane for northbound to eastbound traffic on Sunset Dr.
  - Remove island on the west approach of Old Red Trail, and remove the channelized right-turn lane
  - Narrow the through lane for the southbound traffic immediately south of the intersection
  - Add clear advanced signage for drivers on the westbound I-94 off-ramp
- South ramp terminal of the I-94/Sunset Drive Interchange Install signal control on channelized right turn on eastbound-to-southbound approach
- Coordinate timing of signals at the I-94 westbound and eastbound ramp terminals with the signal at Old Red Trail



# ND Highway 6 Corridor

## *19<sup>th</sup> St. to Main St.*

### Recommended Alternative

- No-build between 19<sup>th</sup> St. and Main St.
- Intersection of ND Hwy 6 and 19<sup>th</sup> St
  - Install a southbound left turn lane and a northbound right turn lane (Scheduled for 2016 Construction)
  - Install advance intersection signing
  - Install intersection lighting





# Old Red Trail Corridor

## *Mandan Ave. to Sunset Dr.*

### Recommended Alternative

- No-build between Mandan Ave. and Sunset Dr.
- Intersection of Old Red Trail and Mandan Ave.
  - Flatten horizontal curve
  - Add advance intersection signing
  - Consolidate Tesoro access to one approach as a radial “T” intersection
  - Provide left and right turn lanes



# Mandan Avenue Corridor

## *Main St. to Old Red Trail*

### Recommended Alternative

- No-build between Main St. and Old Red Trail
- Intersection of Mandan Ave. and Main St.
  - Update and restripe the pavement markings on intersection approaches
  - Add lane extension skips through the intersection to help drivers navigate
  - Add overhead lane designation signs on mast arms of traffic signal

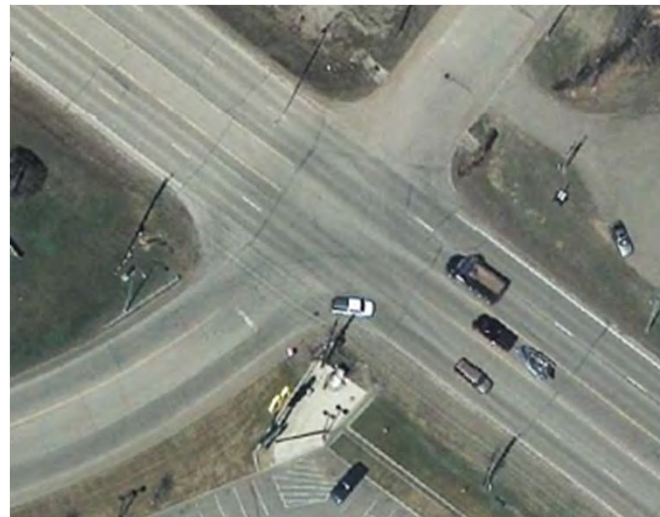


# 3<sup>rd</sup> Street Corridor

## *ND Hwy 6 to Memorial Hwy*

### Recommended Alternative

- No-build between ND Hwy 6 and Memorial Hwy
- Intersection of 3<sup>rd</sup> St. and 9<sup>th</sup> Ave.
  - Replace 4-way stop with 2-way stop
  - Add Pedestrian Signing
  - Install Pedestrian Hybrid Beacon, (HAWK beacon)
- Intersection of 3<sup>rd</sup> St. and 8<sup>th</sup> Ave.
  - Replace 4-way stop with 2-way stop
  - Add Pedestrian Signing
  - Install Pedestrian Hybrid Beacon, (HAWK beacon)
- Intersection of 3<sup>rd</sup> St. and Memorial Hwy
  - Add curb and gutter or guardrail along radius to prevent erosion and enhance safety of turning vehicles

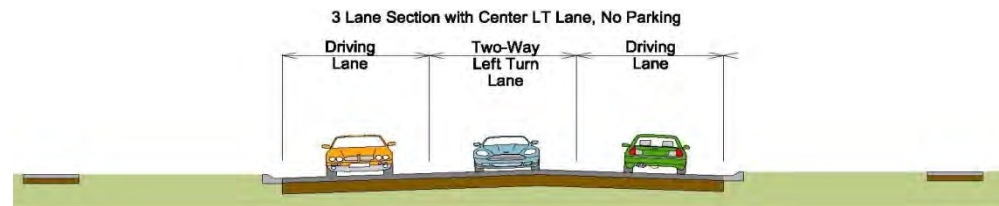


# 19<sup>th</sup> Street Corridor

## ND Hwy 6 to ND Hwy 1806

### Recommended Alternative

- Extend the existing urban section from Ridge Drive to HWY 6 with a 3-lane section
  - No on-street parking
- Extend the existing urban section from 14<sup>th</sup> Ave SE to ND Hwy 1806 with a 3-lane section
  - No on-street parking
- Provide turn lanes to all major intersections between Ridge Drive and ND Hwy 6
- 3-lane section between Ridge Drive and 14<sup>th</sup> Ave SE
  - No on-street parking



# Collins Avenue Corridor

## *Main St. to Old Red Trail*

### Recommended Alternative

- No-build between Main St. and Old Red Trail
- Intersection of Collins Ave. and 5<sup>th</sup> St NE
  - Improve sight distance by offsetting retaining walls at the 5<sup>th</sup> St. NE, 7<sup>th</sup> St. NE and Division St. intersections
- Intersection of Collins Ave. and 14th Street
  - Replace 4-way stop with a 2-way stop
  - Signalize if warranted
- Intersection of Collins Ave. and Old Red Trail
  - Because of the proposed Starion Sports Complex intersection improvements may be needed
    - Install traffic signal and left turn lanes in all quadrants or Install a roundabout.



# ND Hwy 1806N Corridor

## *19<sup>th</sup> St. SE to Main St.*

### Recommended Alternative

- No-build between 19<sup>th</sup> St. SE and 3<sup>rd</sup> St. SE
- Intersection of ND Hwy 1806 N and 27<sup>th</sup> St. NW
  - Installation of left turn lane on northbound ND 1806 N at the intersection of 27<sup>th</sup> Ave
  - Install a Pedestrian Hybrid Beacon (HAWK beacon) at the pedestrian crossing



# ND Hwy 1806S Corridor

## *Old Red Trail to 38<sup>th</sup> St.*

### Recommended Alternative

- No-build between Old Red Trail and 38<sup>th</sup> St.
- 3-lane section between 3<sup>rd</sup> St. SE to Main St.
  - No on-street parking
- Intersection of ND Hwy 1806 S and 3<sup>rd</sup> St. SE
  - Extend curb and gutter around radius to control access into the gas station.
  - Line up left turn lane offsets on the east and west approaches.



# ND Hwy 1806S Corridor

## *Old Red Trail to 38<sup>th</sup> St.*

### Recommended Alternative

- Intersection of ND Hwy 1806 S and Burlington St.
  - Add a pedestrian crossing and sidewalk along the east side of ND 1806 S (6th Ave SE)
  - Install traffic signal if warranted
  - If signal not warranted install a Pedestrian Hybrid Beacon (HAWK beacon) at the pedestrian crossing
  - Install left turn lane on ND 1806 S on the south approach and right turn lane on north approach for vehicles turning onto Burlington St





# Division Street Corridor

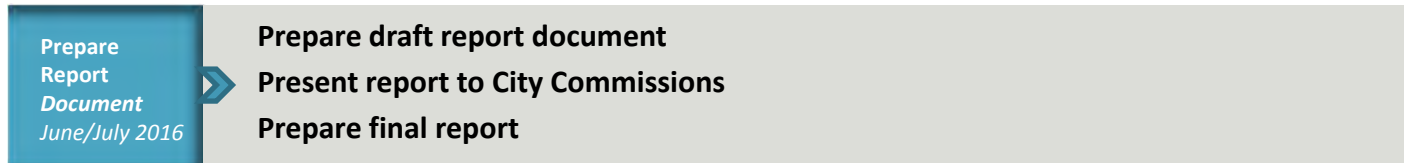
## *Sunset Dr. to 8<sup>th</sup> Ave. NE*

### Recommended Alternative

- No-build between Sunset Dr. and 8<sup>th</sup> Ave. NE
- Intersection of Division St and Sunset Dr.
  - Restripe stop bar
  - Trim vegetation and prune trees
- Intersection of Division St and 6<sup>th</sup> Ave. NW
  - Eliminate yield and stop control for Division Street approaches



# Next Steps



# Stay Involved

- Complete comment cards
- Go to the Website:  
*[MandanBismarckCorridors.com](http://MandanBismarckCorridors.com)*
- Provide additional comments on our website

# Questions or Comments?



# Thank You!

- Website: [MandanBismarckCorridors.com](http://MandanBismarckCorridors.com)
- Mailed Comments:
  - Rick Stoppelmoor
  - HDR Engineering, Inc.
  - 4503 Coleman St., Suite 105
  - Bismarck, ND 58503

# Bismarck-Mandan



## METROPOLITAN PLANNING ORGANIZATION

Meeting Location <i>Mandan City Hall</i>	Meeting Type <i>Public</i>	Meeting Date <i>6-2-2016</i>
Project Number		PCN
Project Description <i>Mandan &amp; Bismarck Corridor Improvement Study</i>		

Name (Please print) <i>Steve Saunders</i>		Title/Representing <i>MPO</i>	
Address <i>221 N 5<sup>th</sup> St</i>			
City <i>Bismarck</i>	State <i>ND</i>	Zip code <i>58506</i>	Email <i>ssaunders@bismarcknd.gov</i>

Name (Please print) <i>Rick Stoppelmoor</i>		Title/Representing <i>HDR</i>	
Address <i>4503 Coleman St Suite 105</i>			
City <i>Bismarck</i>	State <i>ND</i>	Zip code <i>58503</i>	Email <i>Rick.Stoppelmoor@HDRinc.com</i>

Name (Please print) <i>Todd Porter</i>		Title/Representing <i>State Representative</i>	
Address <i>4604 Borden Harbor Dr SE</i>			
City <i>Mandan</i>	State <i>ND</i>	Zip code <i>58554</i>	Email <i>tporter@nd.gov</i>

Name (Please print) <i>JUSTIN FROSIETH</i>		Title/Representing <i>CITY OF MANDAN</i>	
Address			
City	State	Zip code	Email

Name (Please print) <i>GARY BECKER</i>		Title/Representing	
Address <i>1700 SUNSET DR</i>			
City <i>MANDAN</i>	State <i>ND</i>	Zip code <i>58564</i>	Email

Name (Please print) <i>Nathan Toman</i>		Title/Representing <i>State Representative</i>	
Address <i>203 4th Ave NW</i>			
City <i>mandan</i>	State <i>ND</i>	Zip code <i>58554</i>	Email <i>ntoman@nd.gov</i>

Name (Please print) <i>George J Fried</i>		Title/Representing	
Address <i>3525 Hwy 25</i>			
City <i>Mandan</i>	State <i>ND</i>	Zip code <i>58554</i>	Email

# Bismarck-Mandan



## METROPOLITAN PLANNING ORGANIZATION

Meeting Location <i>Mandan City Hall</i>	Meeting Type <i>Public</i>	Meeting Date <i>6-2-2016</i>
Project Number		PCN
Project Description <i>Mandan &amp; Bismarck Corridor Improvement Study</i>		

Name (Please print) <i>Elaine Fred</i>		Title/Representing	
Address <i>3525 Hwy 25</i>			
City <i>Mandan</i>	State <i>ND</i>	Zip code <i>58501</i>	Email

Name (Please print)		Title/Representing	
Address			
City	State	Zip code	Email

Name (Please print)		Title/Representing	
Address			
City	State	Zip code	Email

Name (Please print)		Title/Representing	
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City	State	Zip code	Email

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Name (Please print)		Title/Representing	
Address			
City	State	Zip code	Email

Name (Please print)		Title/Representing	
Address			
City	State	Zip code	Email



JAMES J. COLES, J.D.

400 E. Broadway Suite #301  
Post Office Box 2162  
Bismarck, ND 58502  
FAX: 701-222-8112  
coleslaw@orbitcom.biz  
701-222-8131

January 12, 2016

RECEIVED  
JAN 13 2016

Steve Saunders  
Principal Transportation Planner  
Bismarck MPO  
221 N. 5th St.  
Bismarck, ND 58506-5503

Rick Stoppelmoor  
HDR  
4503 Coleman Street, Suite 105  
Bismarck, ND 58503

RE: Mandan Bismarck Corridor Study (North 7<sup>th</sup> and North 9<sup>th</sup> Streets)

Gentlemen:

As discussed by telephone, I live in the 800 block on North 9<sup>th</sup> Street, across from Bismarck High School. I have lived there since 1981. I wish to register my strong objection to ANY change in the traffic controls or flow that will increase the traffic speeds and/ or traffic volume on any of the study area from Rosser Avenue to Boulevard on either North 7<sup>th</sup> or North 9<sup>th</sup> Streets.

I will start with this basic fact. The people who live in our neighborhood, and I include our students and others who use the high school facilities, are already doing more than our fair share to move traffic through the downtown area. The traffic volume is already incredibly high and traffic speeds mostly do not comply with the posted limit of 25 mph. In addition to general vehicle traffic, we also have some large truck traffic and frequent emergency vehicle traffic at all hours of the day or night. As things now stand in Bismarck we have at least one police car travel by our house at a high rate of speed with the lights and siren on. As you may have noticed, the police rarely deploy a single officer to an incident. This means that we now have multiple cars going to one location, all with lights and sirens on.

This means that any change that increases traffic flow, volume, or speed, will only make these issues much worse. As a result, we in the neighborhood will experience a further

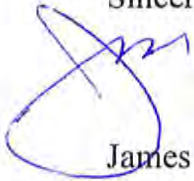


loss of quality of life, less safety, and a corresponding negative impact on our property values.

The reason for my concern is the rather unique circumstances that we have on 9<sup>th</sup> Street. There is a light at Avenue C and 9<sup>th</sup> and then we have no controls until you reach Boulevard. The lack of controls for four blocks coupled with a two lane one-way street lends itself to much mischief on the part of many drivers. First, driving in excess of the 25 mph limit is very common. In addition we have to put up with those that decide to "test" their vehicles by essentially drag racing from the light at Avenue C to Boulevard.

All of these negative issues will be amplified with any changes that increase traffic volume or traffic speeds.

Sincerely;

A handwritten signature in blue ink, appearing to read 'James J. Coles', is written over the printed name below it.

James J. Coles

# Telephone Record

Date: Friday, January 08, 2016

Project: Mandan-Bismarck Corridor Study

Project No:

Call to: Enter Call To

Phone No:

Call from: Jim Coles

Phone No: 701-222-8131

---

Subject: Bismarck 9<sup>th</sup> Street Corridor

---

## **Discussion, Agreement, and/or Action:**

Jim Coles is a resident on 9<sup>th</sup> Street and has safety concerns regarding the high speeds along the 9<sup>th</sup> Street Corridor. He has witnessed that some drivers will race from the traffic signal at the intersection of 9<sup>th</sup> Street and C Avenue to Boulevard. He has also noted that many of the accidents on 9<sup>th</sup> Street are result of distracted driving and running the traffic signal.

Jim believes the drivers will drive at higher speeds because the street is too wide. He has noticed that when numerous cars are parked along 9<sup>th</sup> Street that the traffic slows down.



Thank you for providing input for the development of the Metropolitan Planning Organization's Mandan-Bismarck Corridor Improvement Study. Please use the comment form below to submit a comment.

Name: Ellen Huber  
Organization (if any): City of Mandan Business Development  
Mailing Address: 205 Second Ave NW  
City: Mandan  
County: Morton  
State: ND  
Phone Number: 701-667-3485 Zip: 58554  
Email: ehuber@cityofmandan.com

Comment:

Crashes at 1806 & Burlington St -  
Right on red turn off Main to  
south & from 3rd St north  
mean almost continual flow  
that make it difficult for  
Dan's Supermarket shoppers  
to enter & exit at this  
intersection.

Turning lanes  
could help.

- Dan's  
would  
like a  
traffic  
signal.

Main St - would be interested in  
traffic calming such as  
restoring south side parking  
& reducing to 3 lanes with  
middle turning lane.

File Message Adobe PDF

Reply Reply Forward All Respond

Meeting More

Plat. Info 2016 Team Email Reply & Delete

Quick Steps To Manager Done Create New

Move More

Rules OneNote Actions

Mark Unread

Tags Categorize Follow Up

Translate Editing

Find Related Select

Zoom

You forwarded this message on 1/8/2016 10:49 AM.

From: rfb007@aol.com  
 To: Planning - MPO Shared (Metropolitan Planning Org); ehuber@cityofmandan.com; mbraun@cityofmandan.com; shauna.laber@cityofmandan.com; drohr@cityofmandan.com; stibke@cityofmandan.com  
 Cc:  
 Subject: "Public Meeting"

I am responding to the article in the Jan. 7th Tribune for roadway corridors. The majority of the corridors in Mandan being looked at seem to include the Old Red Trail, and 1806. I live on 1806. The Old Red Trail and 1806 intersection, extending in all directions is a bottleneck that has been getting worse. I am very happy that MPO is looking into it. I know a solution will take time, but it can be stopped from getting worse until that happens. The cause of this bottleneck was the city government bringing in businesses, Wal-mart, apartment buildings, schools, etc., without identifying the traffic problems. So until a solution is found, development in this area should be stopped, including the sports center slated to begin construction in the spring. This facility will compound the already existing problem. City government was eager to bring in development at whatever cost, while ignoring the future traffic problems.

Sincerely, Ron Barth

Sent: Thu 1/7/2016 10:13 AM



Thank you for providing input for the development of the Metropolitan Planning Organization's Mandan-Bismarck Corridor Improvement Study. Please use the comment form below to submit a comment.

Name: Way M Becker

Organization (if any): \_\_\_\_\_

Mailing Address: 1700 Sunset DR

City: Mandan

County: Morton

State: ND

Phone Number: 201663 8754 Zip: 58554

Email: \_\_\_\_\_

Comment:

Need Better traffic enforcement on  
Sunset Dr. We need more than the  
occasional Patrol Drive thru. We need Citations  
issued give a few tickets. Speeding  
will gradually decrease

Line of Sight for I-94E off ramp is  
very poor

Street Light coordination on Main Street  
would be helpful

You forwarded this message on 1/22/2016 1:25:00 PM.

From: Robert Olgeirson <roiceb@icfbid.com>

To: Planning - MPO Shared (Metropolitan Planning Org)

Cc:

Subject: Public Meeting

Sent: Thu 1/21/2016 12:11 PM

**Comment on Improvement Corridors:**

#9 on the website map shows Ward Road from Edwards Avenue to Divide.

I wondered what corridor this project is intended to enhance, and what would improve once it is done. I looked for the impact analysis, cost benefit ratio and all the other things mentioned on the planning corridors web page. Having found none, I looked at the MPO website.

- This project does not appear on the Long Range Transportation Plan 2035 or the 2015-2040 version called Envision 2040.
- The traffic analysis of Ward Road in those studies does not indicate a problem between Edwards and Divide Avenue. That would indicate this project is a solution in search of a problem
- However, it could create a problem- or make an existing ones worse.
  - The traffic studies of Ward Road South of Edwards, toward the intersection of Ward/Avenue C/Griffin etc. show projected level of service (LOS) of LOSE (2040) or LOSF (2035) indicating "congestion, irregular traffic flow" or "Road at capacity, Gridlock with frequent stops" depending on which study examined. This is where Ward Road leads.
  - The traffic studies of Avenue C show similar congestion going east to Washington.
- What I think:
  - This project will only help the traffic reach the points of congestion a little (very little) faster and will not improve overall flow to anywhere.
  - "improvements" like this will guarantee a "No" vote on increased taxes to pay for roads.
- Question:
  - #1 on the map is Washington St. The map shows a longer Improvement Corridor than indicated in the public statements. I presume there is more coming that is not proposed yet? When?

**Engineering by political pull. Past sins:**

- Failure to plan for North-South corridors
- If Tyler Parkway, and the Interstate 94 interchange, had been connected through to Memorial Highway at Main Avenue a lot of red and yellow on the traffic map would not be there.
- #4 on the map is Fourth St. If this is a North South Corridor (it should be) then why was it bent east and dead-ended into a duck pond slough in back of Menards? Logic would indicate that it continue North. Coleman Street is 4th St. recreated, but without the traffic.

Traffic is better on someone else's street.

Robert Olgeirson, Bismarck ND

## Project Website Comments

**Type:** Traffic safety

**Comment:** I live in north 19th street and am aware of the problems facing residents on this street. In fact some people are now trying to sell their homes due to the problems created by opening up 19th street. In fact knowing this, we would not have bought our home here in 1998. Maybe a round about or 2 would stop people from driving here-.the traffic is way to fast - at times people are traveling 40-50 miles per hour by the time they reach my residence, At 8-8:30 am and 5 pm the traffic is very bad- due to the light on 19th st. traffic is backed all the way to the Element. One person moved due to the possibility of getting hit by a car when getting her mail across from her house. the valuation of our homes will decrease because the traffic. Also they need to look into the draining or the slough on the south side of century and 19th st. Water needs to flow and many home owners have had to install pumps in the houses because you stopped the natural flow away from north 19 by putting a slough on the south side of the road- some have 4 pumps going 24/7 since they blocked the natural water flow into hay creek on the south side on century- so in conclusion:traffic speed on 19, light problems causing traffic backup, and the rising water table due to blocking natural drainage. lower the speed limit- but one morning I pulled out of my driveway and a car passed me going south and was forced to stop at the light- why? again speed- and in a hurry to get to work. Maybe people from WSI and Basin can find different routes to take going home and coming to work.

**Date Posted:** 2016-06-02

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