Final Report

June 2021

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INTRODUCTION

The Broadway corridor is a US Highway, a truck route, and a major arterial through the City of Minot. To tens of thousands of motorists and freight carriers, it's the regional connection between Minot and the rest of the world. It is an important corridor for Minot's transit service, bicyclists, and pedestrians. It is surrounded by varying development styles ranging from strip-style commercial developments, dense downtown developments, big box stores, and industrial uses. To business owners, it's home where access and safety are constantly in competition. To many of Minot's residents, it's a significant barrier whose speeds and congestion limit access to major destinations by bike or foot. How this corridor functions for all its users is crucial to how the City of Minot's transportation network functions as a whole.

STUDY AREA AND BACKGROUND

This study will evaluate the corridor of Broadway from the north city limits of Minot to the southern city limits. In the nearly six-mile-long corridor, this study will focus on the functionality of 22 intersections shown in Figure 2 and listed below.

- 46th Avenue N
- 36th Avenue N
- 30th Avenue N
- 21st Avenue N
- 11th Avenue N
- University Avenue
- 4th Avenue N
- Central Avenue
- 1st Avenue S
- 2nd Avenue S
- 3rd Avenue S
- Burdick Expressway
- 11th Avenue S
- 16th Avenue S
- 20th Avenue S
- US 2 W Ramps
- US 2 E Ramps
- 28th Avenue
- 31st Avenue
- 33rd Avenue
- 37th Avenue
- 40th Avenue

It is important to note that the southern segment of the Broadway corridor, from 20th Avenue S to the southern Minot city limits, will undergo more detailed analysis and consideration throughout the duration of this report. This is due to the anticipated construction needs along this segment.

PREVIOUS STUDIES

36th Avenue N Median Removal Study (2019)

The City of Minot Engineering Department studied the potential to remove a median along 36th Avenue N east of North Broadway. The study was initiated by a request from an adjacent development requested improved access. Specifically, the developer desired improved accessibility to their site which would be accessed solely from the frontage road approximately 50 feet east of North Broadway. The study concluded that traffic operations would likely not be affected, but that removal of the median was not recommended due to safety concerns. The increase of crash conflict points from the median removal would be detrimental with anticipated traffic volumes. Ultimately, Council voted to remove the median. However, NDDOT rejected the median's removal. This case study provides relevant context for city access management priorities within the corridor. This example should be consulted for similar locations within the study corridor where volumes and geometry could produce similar safety concerns.

Figure 1: Conflict Points for Median v. No Median on 36th Avenue N

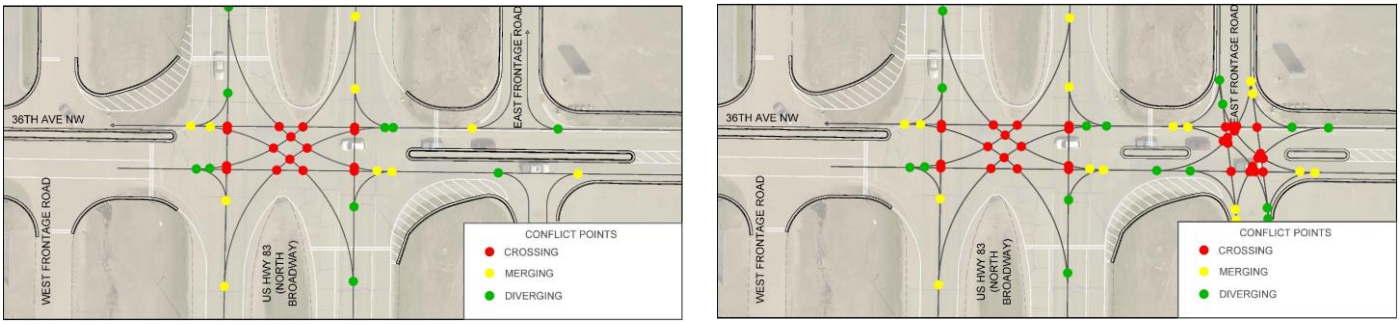
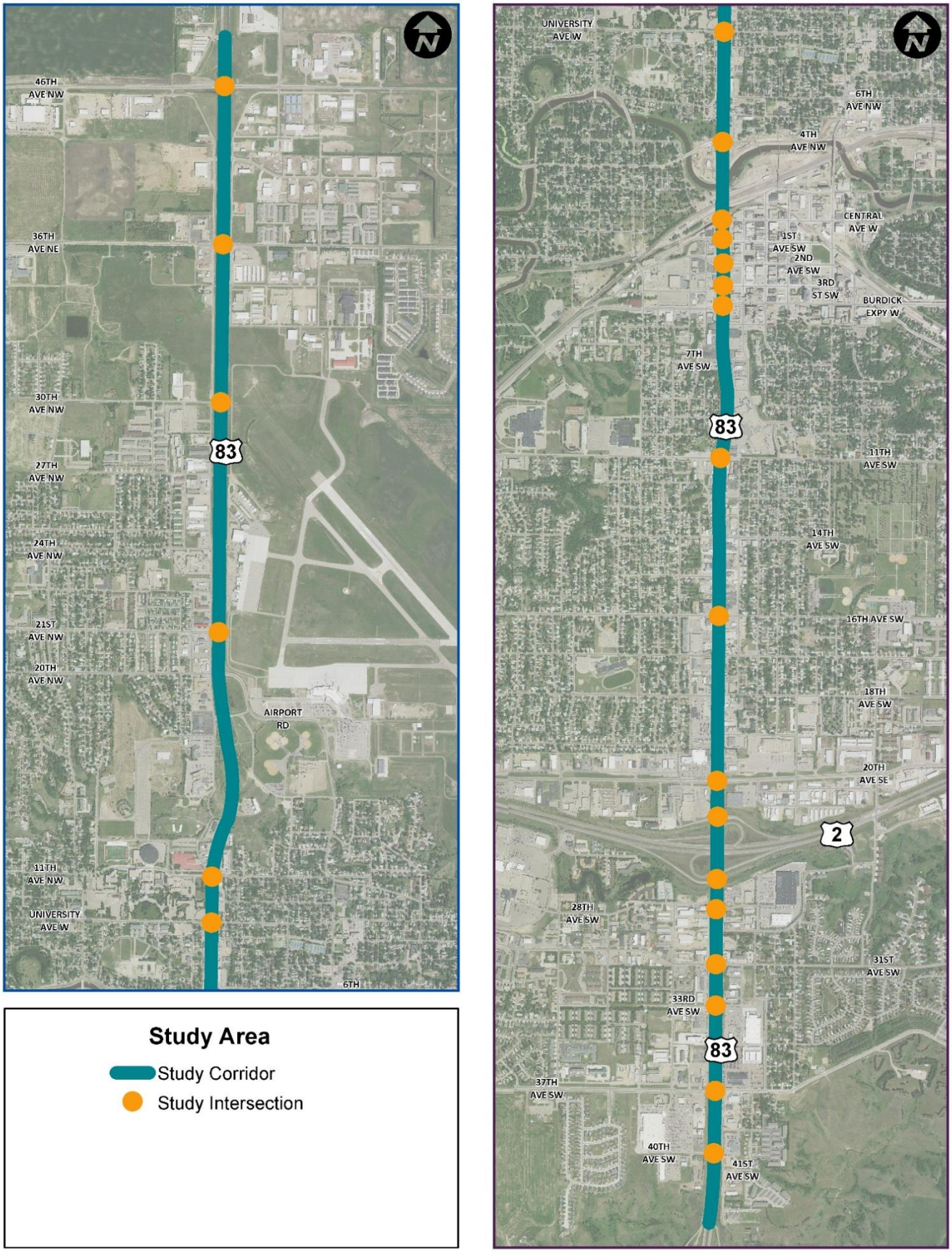


Figure 2: Study Area



City of Minot, ND 2035 Long Range Transportation Plan (LRTP) (2015)

The Minot Area Long Range Transportation Plan translates identified needs with specific actionable projects, prioritized improvements to accommodate growth, and the cities financial capacity. It presented new transportation initiatives and strategies. The plan identifies Broadway as one of three major US highways that can accommodate long haul trips within North Dakota and has contributed to the recent substantial economic growth for the City of Minot.

The 2035 LRTP identified multiple transportation issues along Broadway. This document studied nine intersections along the Broadway corridor, and nearly every intersection had a crash and severity rate that exceeded acceptable thresholds. The existing conditions traffic analysis for Broadway revealed the roadway is currently nearing capacity with sections of light congestion and significant peak hour queueing at signalized intersections. The document also examined pedestrian and bicycle needs and recommended adoption of a Complete Streets policy, but no specific facilities along Broadway were identified. Overall, the 2035 LRTP identified the short term need for a six-lane expansion of the southern segment of Broadway, and minor improvements to the northern segment to maximize existing infrastructure.

City of Minot Comprehensive Plan (2012)

The comprehensive plan did not recommend any specific improvements for Broadway, but it did identify capacity needs and diminishing existing traffic operations for the corridor. The comprehensive plan did explicitly lay out plans to complete the Ring Route around the south side of the City in effort to match the existing northwest and northeast bypass roadways. While likely outdated, the key recommendations and issues identified for Broadway in this document are consistent with other planning studies.

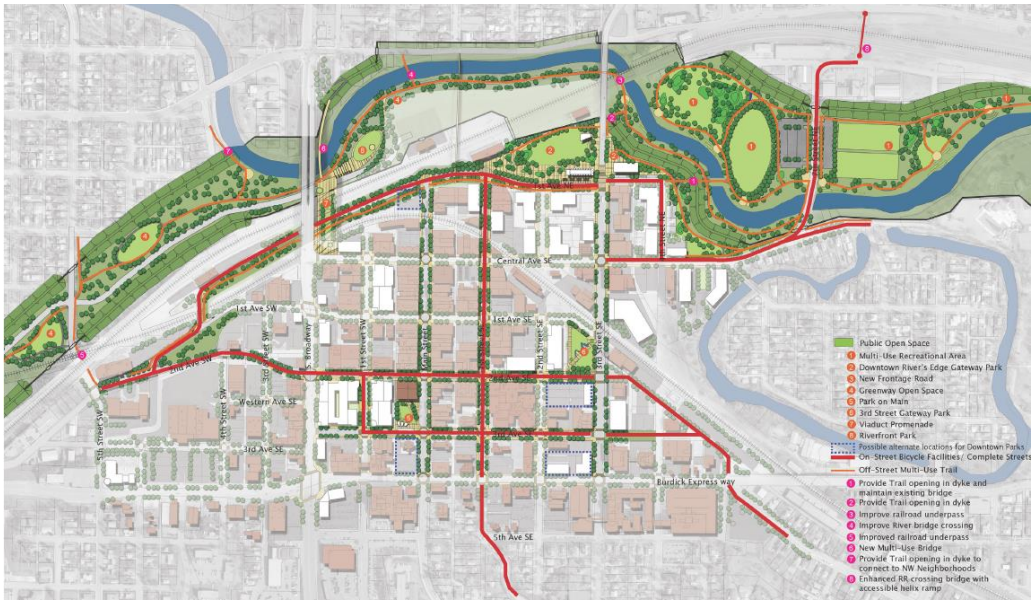
Comprehensive Service Analysis Volume II (2013)

Volume II of the Comprehensive Service Analysis provides detail on the phased plan for future transit service in Minot. The goals and service planning principles provide guidance for how transit services in Minot should be allocated and designed to meet community needs that adhere to financial, political, and land use development constraints. The guidance provided in this document will become essential to determining multi-modal level of service and how transit will have an impact on bicycle and pedestrian facilities and level of service within the Broadway corridor.

River Front and Center Plan (2014)

The Minot River Front and Center Downtown and Neighborhood Plan was completed in 2014 in response to the 2011 floods and 2012 Comprehensive Plan update. This plan evaluated downtown, along with six additional neighborhoods, including two adjacent to the Broadway corridor. Multimodal access and circulation was a significant focus of this plan, especially around downtown. The plan also identified a series of principles and recommendations around downtown including opportunities for infill and redevelopment and multimodal recommendations. First Street was the preferred north-south corridor for on-street bicycle facilities through downtown, with 2nd Avenue serving as the preferred east-west corridor for on-street bicycle facilities, as shown in Figure 3. In addition to these facilities, off-street facilities were identified along Broadway north of the Mouse River, and along University Avenue and 6th Avenue.

Figure 3: River Front and Center Open Space and Connectivity Plan



EXISTING PHYSICAL CONDITIONS

Land Use

Land use can have many implications on the efficiency of the transportation network. For example, a primarily industrial corridor will have peak traffic flows often associated with shift work and must accommodate heavy truck movements while a primarily residential corridor will have strong peaking and directional characteristics as people go to-and-from work and will also see higher bicycle and pedestrian activity.

Generally, the Broadway corridor is surrounded by strip and big box commercial developments. This type of development creates prolonged afternoon and evening peak hours during the weekday and continue to generate traffic through the weekend and often around holidays. There are other sensitive and unique land uses throughout the six-mile corridor:

- The Minot Airport is situated on the east side of Broadway between and around 20th Avenue N to 30th Avenue N. The airport creates natural peaks before and after major flights. Major freight carriers, like FedEx, rely on regular truck deliveries to the airport. The airport could also present challenges to potential widening or grade changes.
- Minot State University is located on the west side of Broadway surrounding University Avenue. Universities often see higher rates of walking, biking, and transit use.
- Downtown is south of the railway and Mouse River. Downtown is the most densely populated employed area in the community. There are significant redevelopment opportunities in Minot's downtown with the relocation of the Trinity Health System. City and County services are also located in downtown. Minot has focused on landscaping and multimodal facilities in downtown in recent years.
- Multiple parks and schools are located near the Broadway corridor. These locations may see higher bicycle and pedestrian activity.

Figure 4 shows the existing land use along the Broadway corridor.

Infrastructure

Construction History

As a major arterial in Minot, significant investments have been made over the years to improve safety, operations, and pavement quality. Figure 5 shows a brief summary of the major construction projects that have occurred over the years.

Planned Construction

The City of Minot's current Capital Investment Plan (CIP) for 2019 to 2023 does not identify any Broadway projects. However, there are multiple projects that will be adjacent to or impact the Broadway corridor, including 31st Avenue S. This planning study will provide recommendations for improvements to be programmed after 2023, likely to include Broadway south of 20th Avenue S.

Figure 4: Existing Land Use

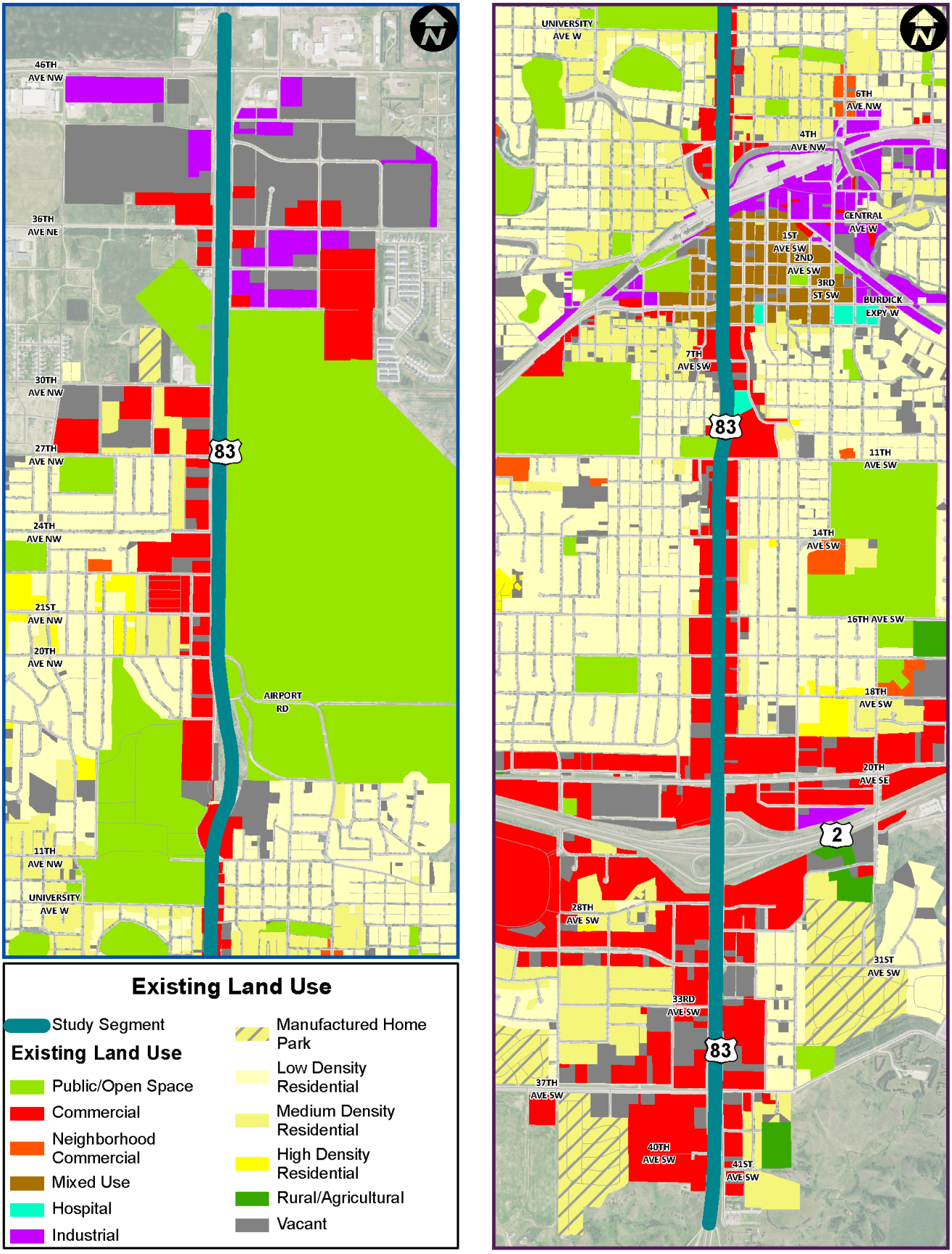
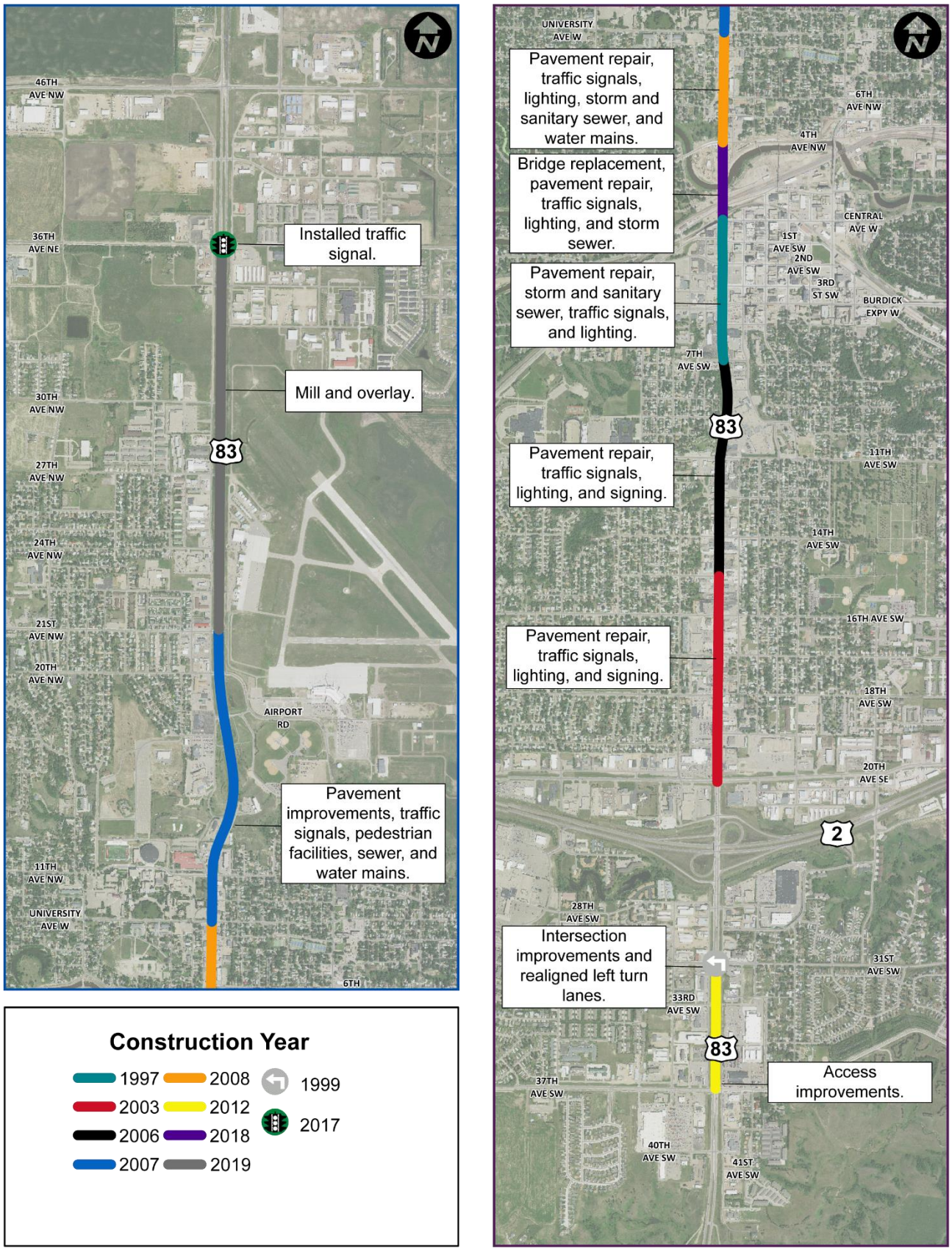


Figure 5: Construction History



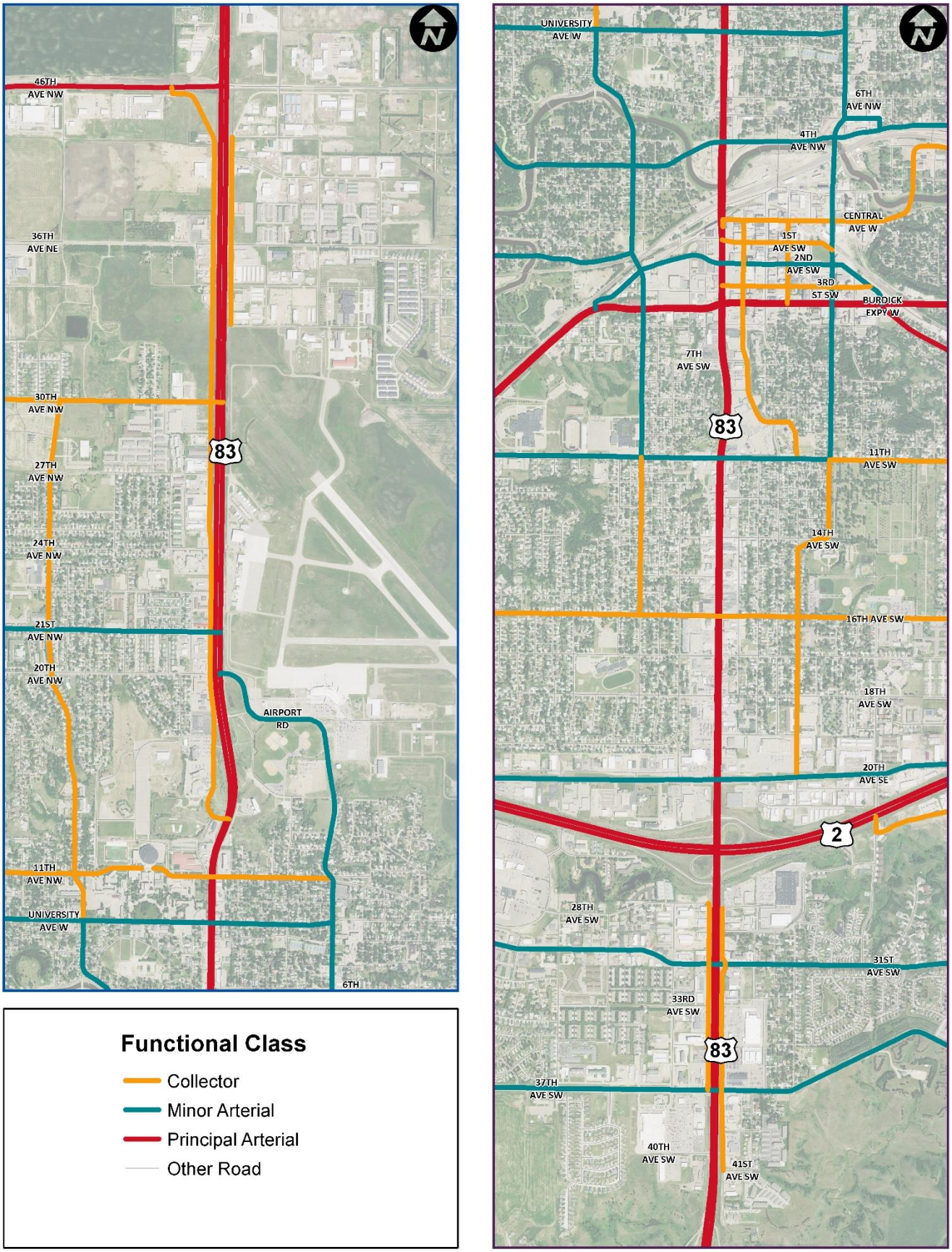
Typical Sections

Throughout the study area, the context and typical design of the corridor evolves multiple times.

- From South of Minot to 37th Avenue, the corridor is a four-lane divided rural highway with turn lanes at access points and no curb or gutter.
- From 37th Avenue to the south side of the interchange with US 2, the corridor is a four-lane raised median divided highway, with turn lanes at access locations.
- From the US 2 interchange to 2nd Street N, Broadway is a five-lane section that includes a two-way left turn lane (TWLTL), except where Broadway crosses rail lines and the Mouse River, where it is four lanes.
- North of 2nd Street N, Broadway goes back to a rural divided highway with no curb or gutter.

Figure 6: Roadway Typical Sections

Figure 7: Functionally Classified Roadways



Pavement Conditions

Studies have found timely pavement rehabilitation has the potential to be six to 14 times more cost-effective than rebuilding a deteriorated road. Another study found that rough roads add an average of $599 to the annual cost of car ownership due to damaged tires, suspension, reduced fuel efficiency, and accelerated vehicle depreciation.

The City of Minot maintains a Pavement Condition Index (PCI) database for all major roads in the city. PCI considers multiple factors, including pavement distress and smoothness of the ride. Table 1 shows how PCI is used to determine the general condition of the roadway and approximately how long until improvements need to be made.

Table 1: PCI and Improvement timeframe

PCI Rankings		Time Until Improvement Needed
Good	86-100	No improvements needed in near future
Satisfactory	71-85	6-10 years
Fair	56-70	1-5 years
Poor	41-55	Rehabilitate as soon as possible
Very Poor	25-40	Reconstruct as soon as possible
Serious	10-24	Reconstruct as soon as possible
Failed	<10	Reconstruct as soon as possible

Based on the most current information from the City of Minot there are three sections considered to be in Poor or Very Poor condition, where rehabilitation should be considered. These areas are:

- Northbound lanes between 7th Avenue S and 11th Avenue S
- Southbound lanes between the US 2 eastbound off ramp to 28th Avenue S
- Northbound lanes between 31st Avenue S and 33rd Avenue S

All other areas are in Fair or better condition. PCI is shown in Figure 9.

Figure 8: Southbound Broadway with Very Poor Pavement Condition

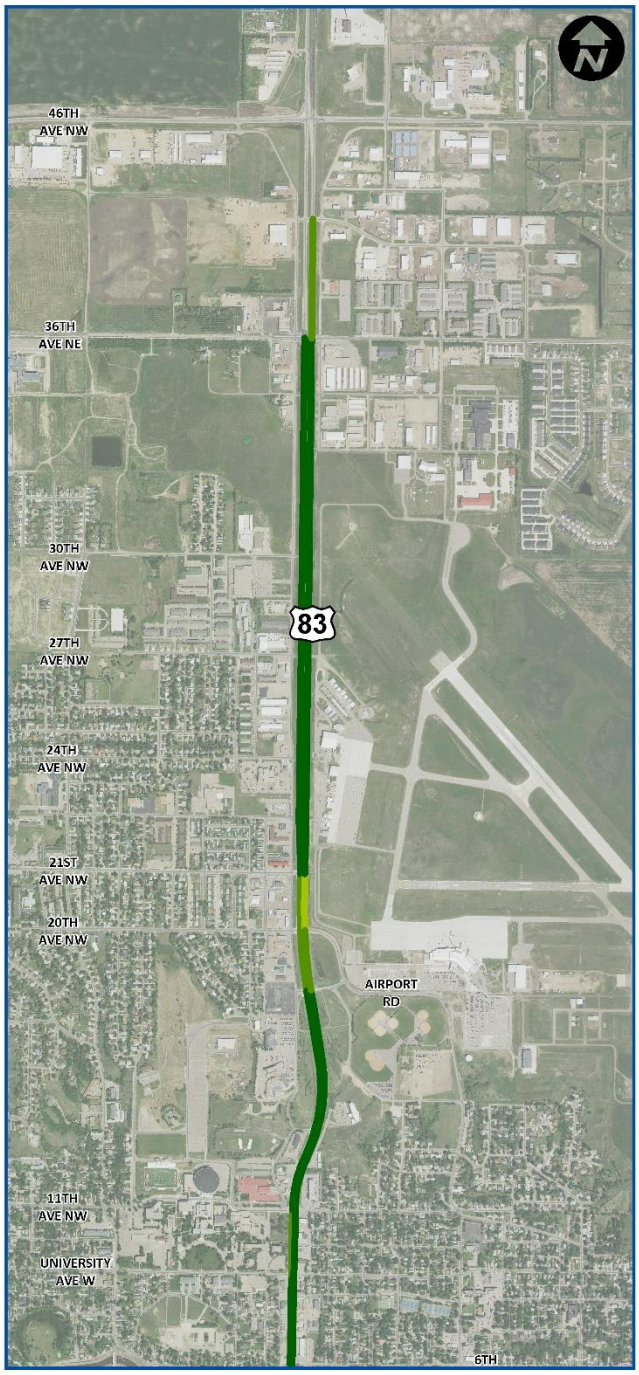
Bridge Conditions

Bridges are regularly inspected to verify their condition. Inspections report a variety of conditions, including deck condition, superstructure, and substructure conditions. Conditions range from poor to excellent. There are only two bridges in the study area:

- The bridge (#0002146366) over US 2 was built in 1977. This bridge includes six lanes and a bridge roadway width of 90 feet. Its last inspection occurred in November 2017 and was found to be in good condition.
- The bridge (#0083200649) over the BNSF railway was built in 2018. This bridge includes four lanes and a bridge roadway width of 73 feet. It was inspected upon completion of construction and found to be in excellent condition.

Bridge conditions are shown in Figure 9.

Figure 9: Infrastructure Conditions



Infrastructure Condition

PCI		Bridge Conditions
Good	Poor	Poor
Satisfactory	Very Poor	Fair
Fair	Serious	Good
	Failed	Excellent

Utilities

Major utilities are typically located within road right-of-way. There are many reasons for this including but not limited to: cost of right-of-way acquisition, ease of access, and necessity for the functioning of items related to transportation (i.e. lights, signals, etc.).

Public Utilities

Public utilities are those that are owned and maintained by the City. The following sections discuss public utilities in the study area.

Storm Water Management

Storm sewers collect and direct storm water and melted precipitation to watersheds to prevent ponding in undesired locations. Water is moved via drainage ditches in the right-of-way for rural sections. Urban sections of the corridor typically use gutters and storm sewers. The storm sewer is estimated to be in good to fair condition along the corridor. The storm water collected along the corridor runs into one of three watersheds:

- Mouse River (crosses Broadway just south of 3rd Avenue N)
  - Drains all water north of 15th Avenue S
- Puppy Dog Coulee (crosses Broadway just north of 28th Avenue S)
  - Drains all water 37th Avenue S to 15th Avenue S
- First Larson Coulee (crosses Broadway south of Minot City Limits)
  - Drains all water south of 37th Avenue S

Water Mains

Water mains are the main trunk lines that are used to disperse water to the remaining parts of the city. The watermain facilities along the corridor are summarized in Table 2, with multiple other lines crossing the corridor:

Table 2: Water Main Locations

Segment	Placement	Size	Type
41st Avenue S to 28th Avenue S	Parallel to roadway, both sides	6-12 inches	PVC
20th Avenue S to Avenue A	Under southbound lanes	6-10 inches	PVC
5th Avenue S to 3rd Avenue S	Under northbound and southbound lanes	NB: 6 inch, SB: 12-16 inches	PVC and Cast Iron
4th Avenue N to 2nd St N	Under southbound lanes	6-12 inches	PVC
19th Avenue N to 22nd Avenue N	Parallel to west edge of corridor	12 inch	PVC
24th Avenue N to 27th Avenue N	Parallel to west edge of corridor	6 inch	PVC
30th Avenue N to 34th Avenue N	Parallel to east edge of corridor	12 inch	PBC

Sanitary Sewer

Sanitary sewer transports sanitary waste from homes and businesses to the wastewater treatment plant. All lines are currently estimated to be in fair to good condition but should be considered for replacement as other major projects in the area are completed. The sanitary sewer facilities along the corridor is summarized in Table 3.

Table 3: Sanitary Sewer Locations

Segment	Placement	Size	Type
40th Avenue S to 28th Avenue S	Parallel to west edge	8-10 inches	PVC
20th Avenue S to 15th Avenue S	Under Northbound lanes	8-15 inches	PVC and Vitrified Clay Pipe (VCP)
5th Avenue S to Central Avenue	Under Northbound lanes	12-18 inches	PVC and VCP
4th Avenue S to 2nd St N	Under Southbound lanes	8-20 inches	PVC and VCP
21st Avenue S to 42nd Avenue S	Under east frontage road	8-12 inches	PVC

Private Utilities

Private utilities are those that are owned and maintained by private companies. Sometimes these have shared uses between public and private entities. These can include both above and below ground power lines, gas lines, and communication lines.

Above Ground

There are no overhead power lines that run along Broadway but there are several crossings at intersections along the corridor including:

- 37th Avenue S
- 31st Avenue S
- 17th Avenue S
- 16th Avenue S
- 13th Avenue S
- 2nd Avenue S
- 4th Avenue N
- 11th Avenue N

Under Ground

Several types of underground utilities were identified along the corridor. Utilities identified include

- Electric lines owned by Xcel Energy, Montana Dakota Utilities, and Verendrye.
- Gas lines are believed to be present and owned by Montana Dakota Utilities.
- Telecommunications lines owned by Midcontinent Communications and SRT. SRT lines are shared by the City.

There are no major upgrades planned for the private utilities currently. However, SRT does have some plans for connecting more traffic signals to the City's network, this is described in more detail in a later section.

Right-of-Way

Right-of-way (ROW) is the available space owned by NDDOT and/or City of Minot on which the Broadway corridor resides. ROW is often a constraining factor in developing alternatives, because acquiring additional ROW can be costly, increase project delivery deadlines, or stop a project altogether. ROW widths vary along the corridor, depending on the location.

The existing right-of-way, as measured from centerline of Broadway, varies along the corridor and is summarized in Table 4. Ample ROW is available along the majority of the corridor; however, ROW is significantly smaller in a few locations in the downtown areas (11th Avenue S to 11th Avenue N). ROW encroachments occur in two areas, 20th Avenue S to 11th Avenue S and Burdick Expressway to Central Avenue. The encroachments primarily consist of overhead signs protruding into the right-of-way.

Figure 10: Overhead Signs Encroach in ROW

Table 4: Right-of-Way Summary

Segment	West ROW Width (typical)	East ROW Width (typical)	Total ROW
41st Avenue S to 37th Avenue S	130' & 160'	150'	280'-310'
37th Avenue S to 28th Avenue S	130'	130'	260'
22nd Avenue S to 20th Avenue S	100'	100'	200'
20th Avenue S to 11th Avenue S	50'	50'	100'
11th Avenue S to 7th Avenue S	40'	60'	100'
7th Avenue S to 11th Avenue N	40'	40'	80'
11th Avenue N to 19th Avenue N	90' to 240'	60' to 170'	150'-410'
19th Avenue N to 27th Avenue N	100'	135'	235'
27th Avenue N to 34th Avenue N	180'	135'	315'
34th Avenue N to 36th Avenue N	180'	175'	355'
36th Avenue N to 46th Avenue N	195'	175'	370'

Lighting

Roadway lighting is vital aspect of corridor safety. Multiple studies have shown a reduction in crashes per vehicle mile traveled when roadway lighting is improved, in some cases reducing crash rates up to 60 percent. Broadway is lit by overhead luminaires on the west and east sides of the roadway. Most of the luminaires along the project are High Pressure Sodium (HPS), with LED lighting between 2nd Avenue S and 4th Avenue N as part of the Broadway Viaduct Bridge project. Decorative lighting is present between 4th Avenue N to 11th Avenue N with High Intensity Discharge (HID) luminaries. Light standard heights and mast arms lengths vary along the corridor, with especially short light standards adjacent to the airport, to prevent obstruction into the airspace.

Figure 11: Different Lighting Styles Along Broadway Corridor

EXISTING MULTIMODAL TRAFFIC CONDITIONS

Traditionally, transportation planning approaches have placed special emphasis on achieving certain levels of service for vehicular traffic, with cycling, walking, and other modes sometimes being an afterthought. An auto-centric approach does not respond well to demand for other travel modes and can lead to uninviting or even unsafe facility design for roadway users that cannot or choose not to drive. To provide a more complete evaluation of a transportation system, multimodal levels of service (MMLOS) were used to better account for all potential transportation opportunities due to an unbalanced emphasis on automobile traffic. The MMLOS includes vehicular, freight, bicycle, pedestrian, and transit modes. Each of the sections below will detail issues and existing operations for each specific modal environment, concluding with an unweighted multimodal level of service.

VEHICULAR CONDITIONS

Traffic Data Collection

In March of 2020, traffic volumes and speeds were collected at four locations along the corridor for 48 hours during the middle of the week:

- Broadway between 24th Avenue N and 27th Avenue N
- Broadway between 6th Avenue S and 7th Avenue S
- Broadway between 14th Avenue S and 12th Avenue S
- Broadway between 37th Avenue S and 33rd Avenue S

Turning movement counts were collected at each study intersections. Most intersections were collected in early March 2020, prior to COVID-19 related traffic patterns changes. The remaining were collected by NDDOT in the fall of 2019. Table 5 shows each intersection, how data was collected, by who and the amount of processed data available. Twelve-hour counts from Central Avenue to 40th Avenue S were balanced by calculating the total north/south imbalance for each hour interval and applying that difference to regional routes (Broadway and US 2). Full counts are in Appendix A.

Table 5: Turning Movement Counts

Intersection	Collection Date	Collected By	Data Available
46th Avenue N	12/3-4/2019	NDDOT	24 Hours
36th Avenue N	3/4/2020	City of Minot/KLJ	Peak Hours
30th Avenue N	3/4/2020	City of Minot/KLJ	Peak Hours
21st Avenue N	9/16-17/2019	NDDOT	24 Hours
11th Avenue N	9/16-17/2019	NDDOT	24 Hours
University Avenue	3/11/2020	City of Minot/KLJ	Peak Hours
4th Avenue N	3/11/2020	City of Minot/KLJ	Peak Hours
Central Avenue	3/11/2020	City of Minot/KLJ	12 Hours
1st Avenue S	3/11/2020	City of Minot/KLJ	12 Hours
2nd Avenue S	3/11/2020	City of Minot/KLJ	12 Hours
3rd Avenue S	3/11/2020	City of Minot/KLJ	12 Hours
Burdick Expressway	12/3-4/2019	NDDOT	24 Hours
11th Avenue S	9/16-17/2019	NDDOT	24 Hours
16th Avenue S	3/4/2020	City of Minot/KLJ	12 Hours
20th Avenue S	9/16-17/2019	NDDOT	24 Hours
US 2 WB Ramps	9/16-17/2019	NDDOT	24 Hours
US EB Ramps	9/16-17/2019	NDDOT	24 Hours
28th Avenue S	3/4/2020	City of Minot/KLJ	12 Hours
31st Avenue S	10/7-8/2019	NDDOT	24 Hours
33rd Avenue S	3/4/2020	City of Minot/KLJ	12 Hours
37th Avenue S	3/4/2020	City of Minot/KLJ	12 Hours
40th Avenue S	3/4/2020	City of Minot/KLJ	12 Hours

Traffic Trends

Traffic Volumes and Distributions

The Broadway corridor currently carries between 11,700 and 25,200 vehicles each day, with the highest volumes occurring around the US 2 interchange and the lowest volumes occurring on the northern and southern edges of the corridor. Traffic volumes, including heavy truck traffic, is shown in Figure 16.

Throughout the corridor the daily and directional distribution trends vary depending on their location and land use context.

- North of 24th Avenue N, there are definitive morning and evening peaks in traffic. This is common on commuter corridors as motorists travel into Minot for work in the morning and return home in the evening, especially with shift changeover at the Minot Air Force Base. Throughout the course of a day, traffic is split nearly evenly. Figure 12 shows the daily and directional traffic trends for this location.
- Around 8th Avenue S, the proximity to downtown and strip commercial developments create a steadier flow of traffic throughout the day. Throughout the course of a day, traffic is split nearly evenly. Figure 13 shows the daily and directional traffic trends for this location.
- Around 14th Avenue S, the proximity to commercial and restaurant uses still create steadier flow of traffic throughout the day, but also show peaks around mealtimes and after work shopping trips. The land uses surrounding the corridor here result in longer evening peak hours. Figure 14 shows the daily and directional traffic trends for this location.
- South of 33rd Avenue S, there is a small peak during the morning commute hours but traffic volumes continue to increase until around 7 PM. Figure 15 shows the daily and directional traffic trends for this location.

Figure 12: 24th Avenue N to 27th Avenue N Traffic Volumes

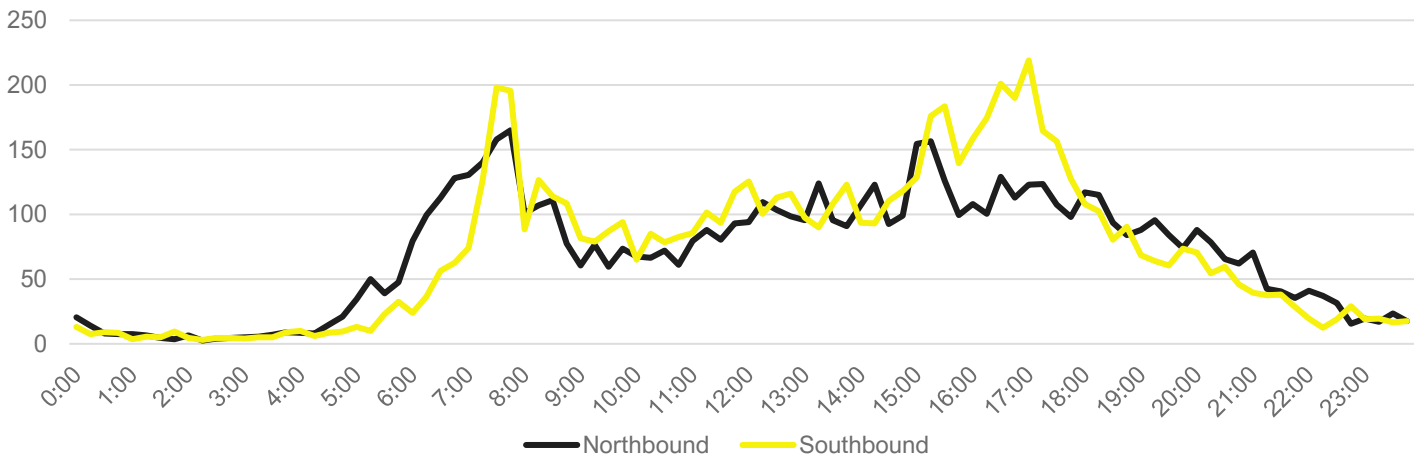


Figure 13: 8th Avenue S to 7th Avenue S Traffic Volumes

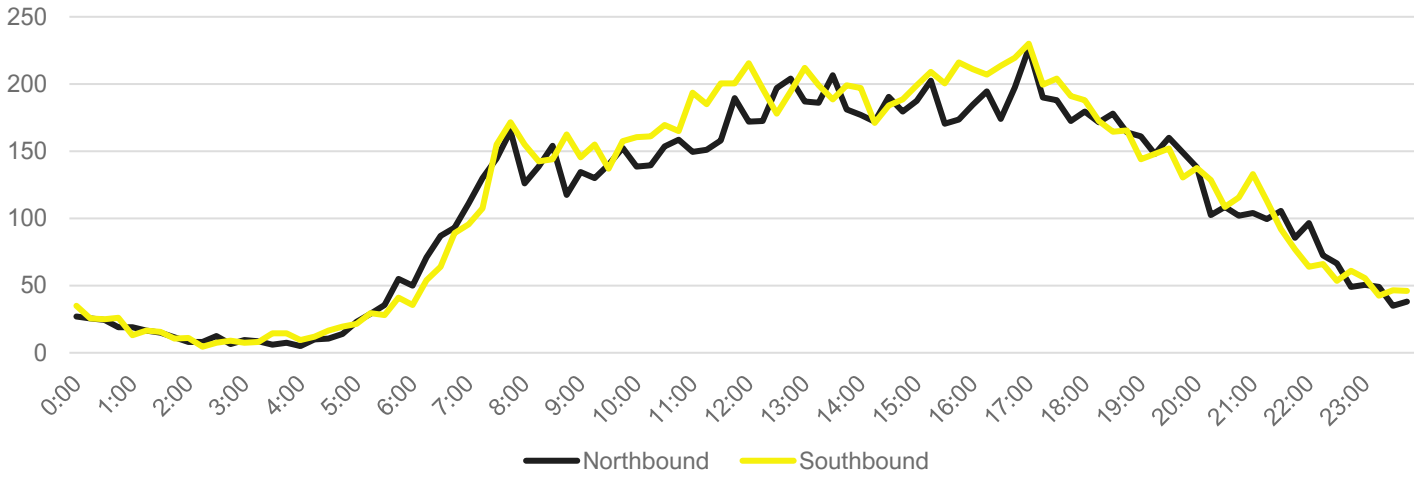


Figure 14: 14th Avenue S to 13th Avenue S Traffic Volumes

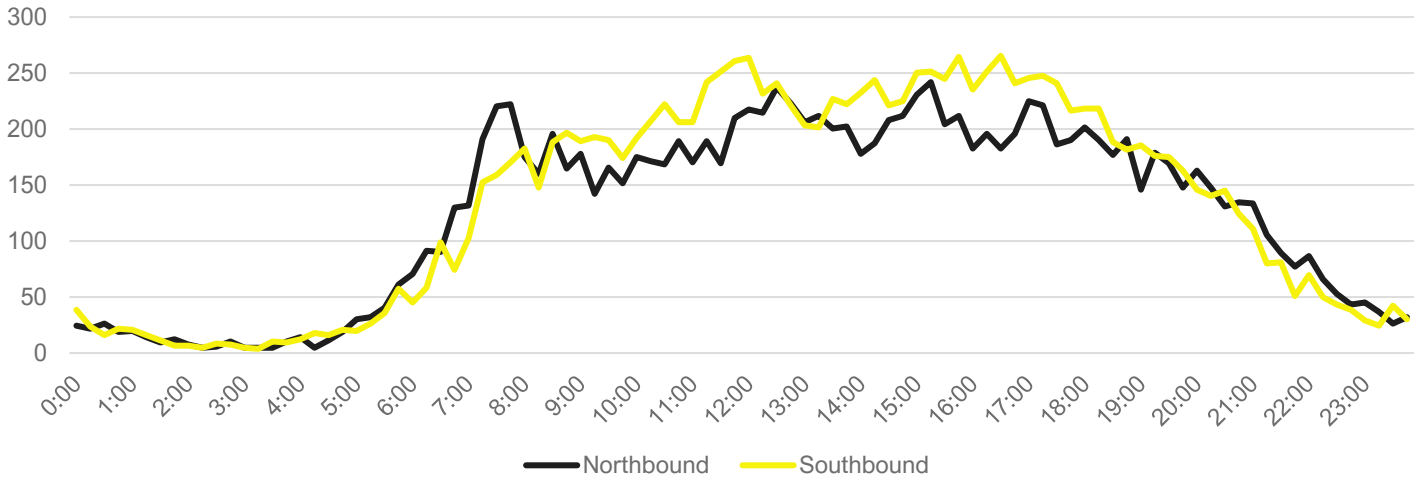


Figure 15: 37th Avenue S to 33rd Avenue S Traffic Volumes

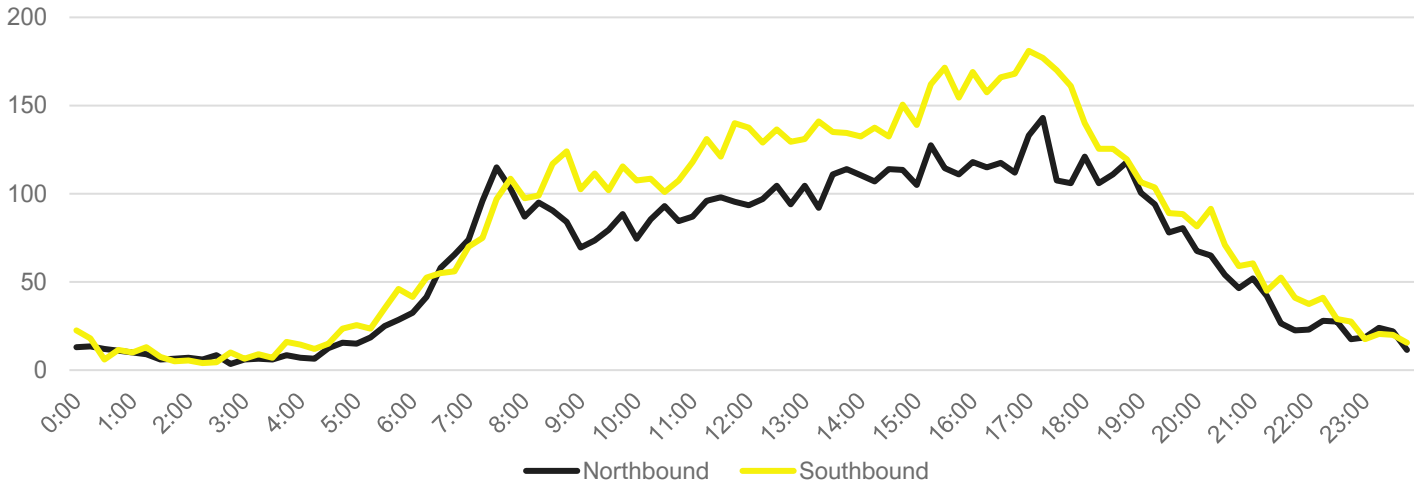
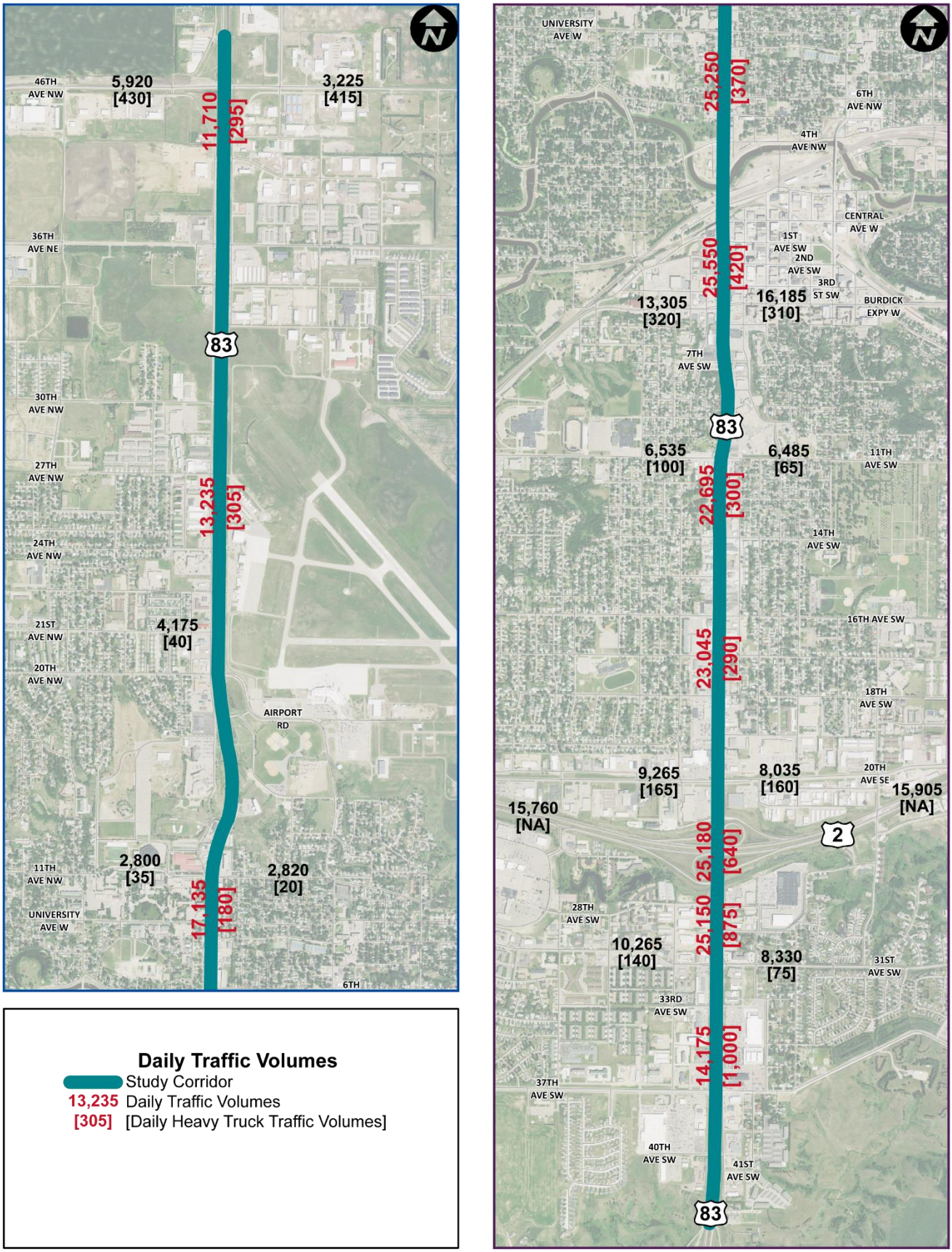


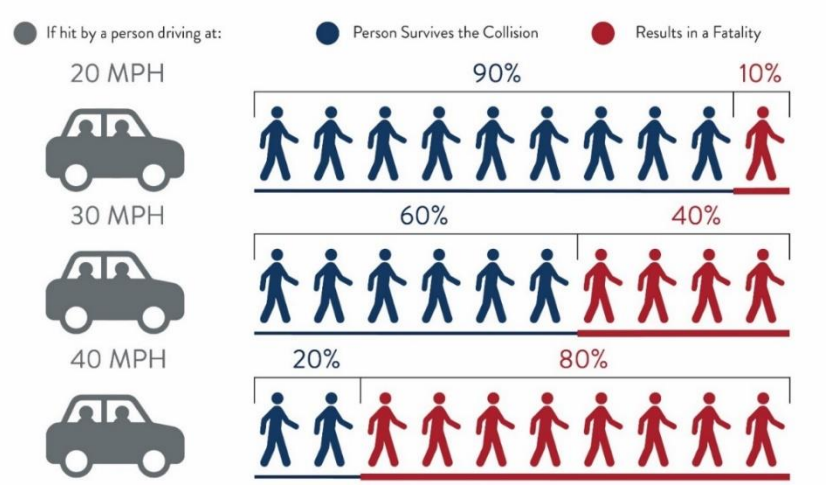
Figure 16: Existing Traffic Volumes



Traffic Speeds

Research has shown that speeds a driver chooses to travel are a function primarily of roadway design, context, and congestion, not necessarily the posted speed limit. Higher speeds contribute to increased severity of vehicular crashes and increases the likelihood that a vehicle-pedestrian crash results in a fatality. At 20 miles per hour, there is a 90 percent chance a pedestrian survives a crash. At 30 miles per hour, there is a 60 percent chance a pedestrian survives a crash. At 40 miles per hour, there is just a 20 percent chance a pedestrian survives a crash.

Figure 17: Relationship between Speed and Pedestrian Survivability



Speed Results

Speeding trends vary widely depending on the location of the corridor.

- North of 24th Avenue N, the 85th percentile speed is more than 10 miles per hour higher than the posted speed limit of 40 miles per hour. Excessive speeding appears to be the worst during the day, as opposed to later in the evening when there is less traffic on the roadway. Figure 18 shows this area's traffic speed trends for a typical day.
- Around 8th Avenue S, the 85th percentile speed is less than five miles per hour higher than the posted speed limit of 35 miles per hour. However, given this area's proximity to downtown, social services, and shopping destinations, it likely sees more pedestrian and bicycle activity and makes the speed trends more concerning. Figure 19 shows this area's traffic speed trends for a typical day.
- Around 14th Avenue S, the 85th percentile speed is less than five miles per hour higher than the posted speed limit of 35 miles per hour. Figure 20 shows this area's traffic speed trends for a typical day.
- South of 33rd Avenue S, the 85th percentile speed is less than five miles per hour higher than the posted speed limit of 40 miles per hour. Figure 21 shows this area's traffic speed trends for a typical day.

Figure 18: 24th Avenue N to 27th Avenue N Traffic Speeds

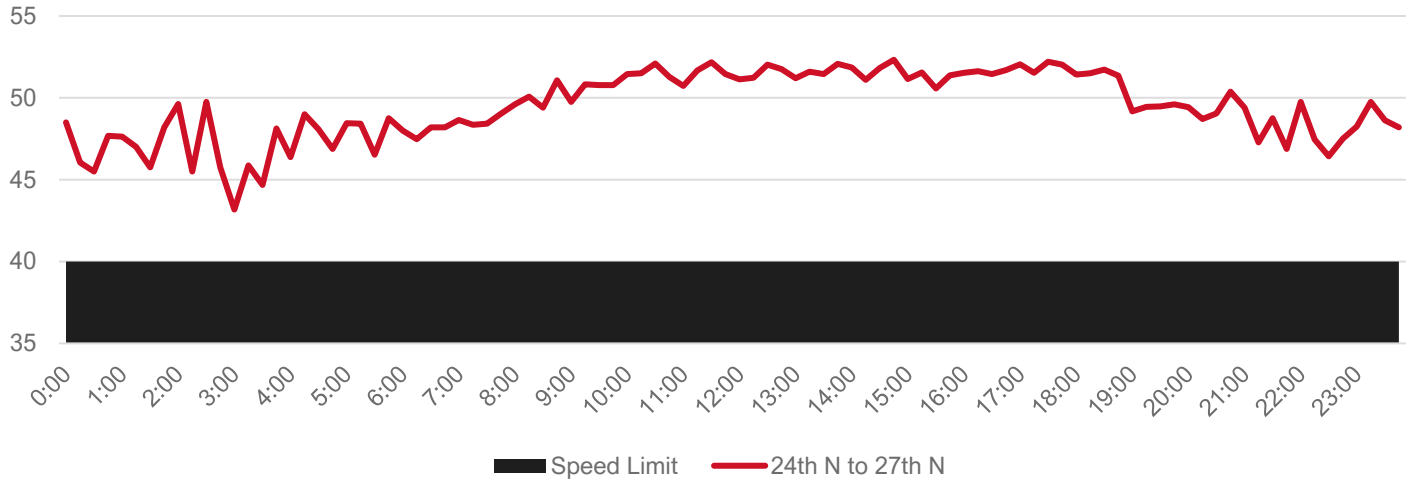


Figure 19: 7th Avenue to 8th Avenue Traffic Speeds

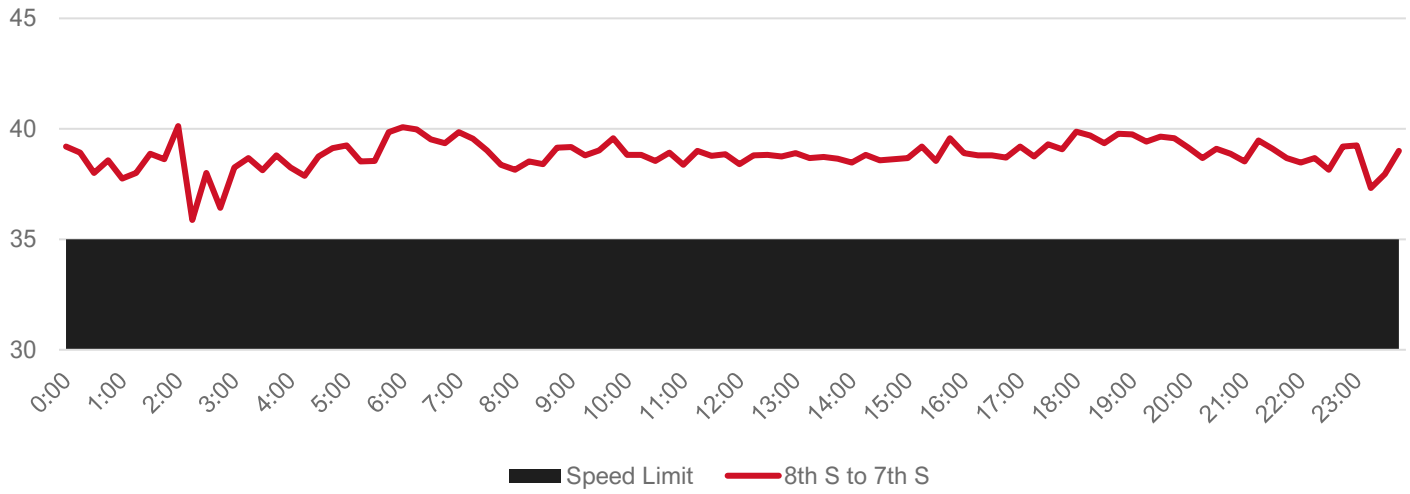


Figure 20: 13th Avenue S to 14th Avenue S Traffic Speeds

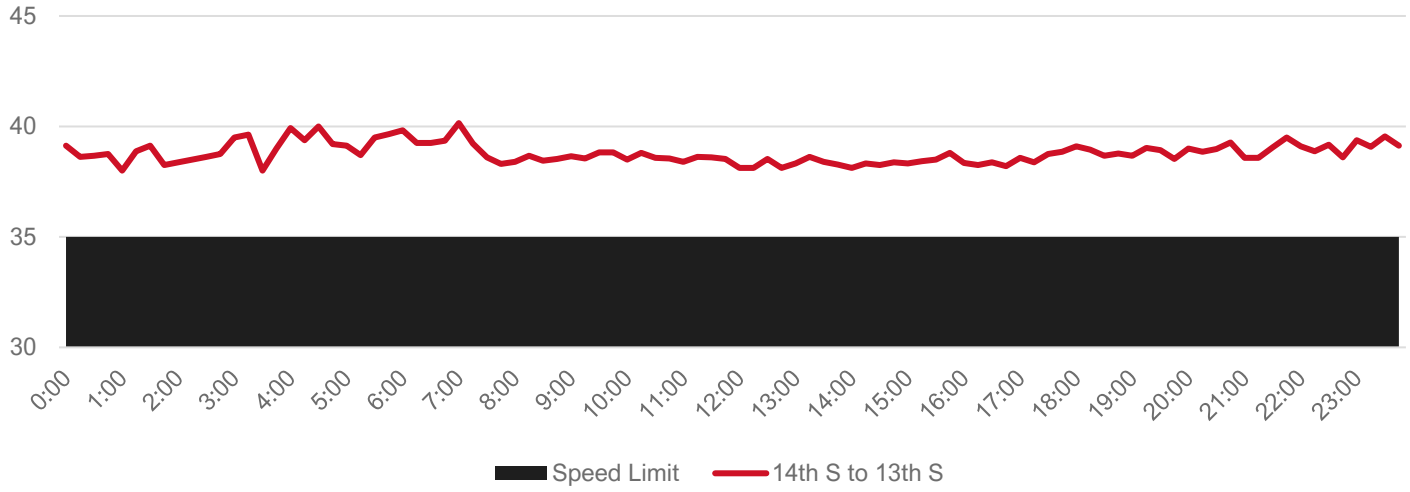
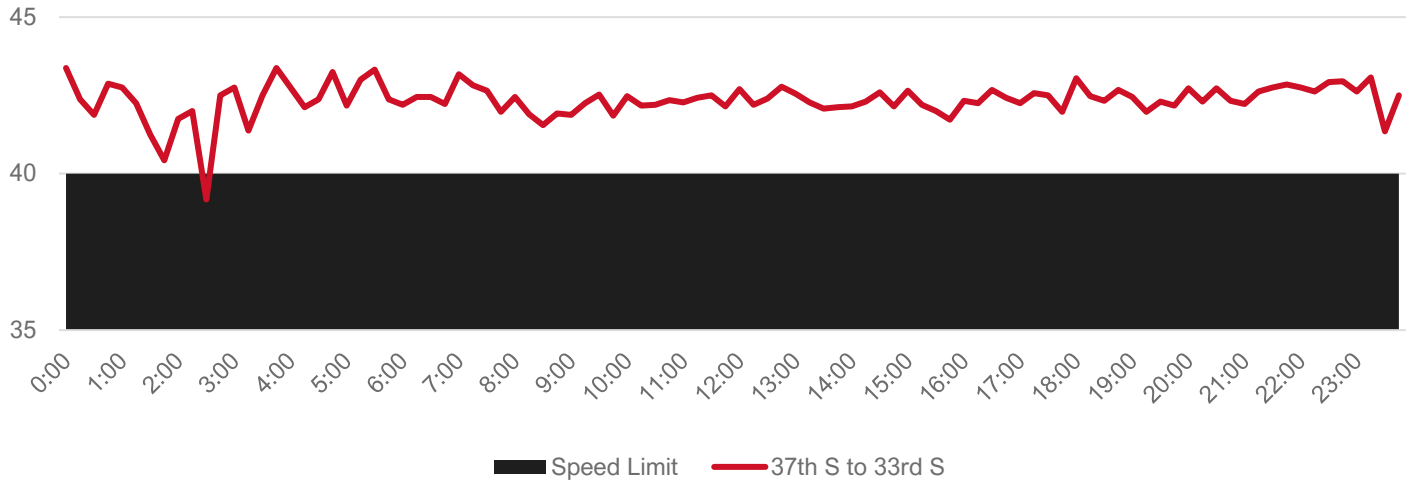


Figure 21: 33rd Avenue S to 37th Avenue S Traffic Speeds



Traffic Control

Selecting the appropriate traffic control device requires consideration of traffic safety, patterns and volumes, roadway geometry, lane configurations and multimodal aspects. The *Manual of Uniform Traffic Control Device* (MUTCD) provides guidance and standards on the installation of traffic control methods which considers vehicular volume, pedestrian volumes, and crash frequency thresholds for multiple roadway contexts. Warrant analysis does not require all-way stops or traffic signals to be installed and typically it is best if multiple warrants are met before a signal is placed. However, the analysis highlights the locations that may benefit from traffic control upgrades or removal. Research conducted by FHWA found that that removing unwarranted traffic signals may decrease all crash types up to 24 percent, decrease injury crashes up to 53 percent, and decrease rear end crashes up to 20 percent. However, research has also found that installing traffic signals where warranted can decrease all crash types up to 34 percent, decrease injury crashes up to 40 percent, and decrease angle crashes up to 67 percent.

A warrant analysis was completed for each of the study intersections based on the collected turning movement volumes. Where a full eight hours of data was not available turning movements were extrapolated based on distributions from the NDDOT Traffic Report and the peak hour data that was available. Generally, intersections have the traffic control that is warranted, with two exceptions:

- 28th Avenue is currently stop controlled but meets multiple traffic signal warrants. Given the proximity to the US 2 interchange, a traffic signal may have negative implication to signal progression and queueing related crashes.
- 33rd Avenue is a three-quarter access with side-stop control but does not meet any warrants.

Additional analysis will be completed later in this study to identify appropriate traffic control at these locations. Table 6 shows the summary results of the warrant analysis for all intersections in the study area. Existing traffic control is shown in Figure 22.

Table 6: 2020 Traffic Control Warrant Analysis

Intersection	Existing Traffic Control	1A	1B	2	3
46th Avenue N	Traffic Signal	8/8	7/8	7/4	5/1
36th Avenue N	TWSC	0/8	0/8	0/4	0/1
30th Avenue N	TWSC	0/8	0/8	0/4	0/1
21st Avenue N	TWSC	0/8	0/8	0/4	0/1
11th Avenue N	Traffic Signal	1/8	13/8	11/4	9/1
University Avenue	Traffic Signal	0/8	7/8	4/4	0/1
4th Avenue N	Traffic Signal	1/8	10/8	5/4	1/1
Central Avenue	Traffic Signal	5/8	12/8	6/4	6/1
1st Avenue S	TWSC	0/8	0/8	0/4	0/1
2nd Avenue S	Traffic Signal	5/8	13/8	11/4	8/1
3rd Avenue S	TWSC	0/8	0/8	0/4	0/1
Burdick Expressway	Traffic Signal	16/8	16/8	12/4	10/1
11th Avenue S	Traffic Signal	13/8	14/8	14/4	14/1
16th Avenue S	Traffic Signal	12/8	14/8	9/4	7/1
20th Avenue S	Traffic Signal	14/8	16/8	8/4	8/1
US 2 WB Ramps	Traffic Signal	15/8	15/8	10/4	10/1
US EB Ramps	Traffic Signal	16/8	16/8	4/4	4/1
28th Avenue S	TWSC	5/8	14/8	4/4	1/1
31st Avenue S	Traffic Signal	15/8	14/8	12/4	12/1
33rd Avenue S	TWSC (3/4)	0/8	1/8	0/4	0/1
37th Avenue S	Traffic Signal	14/8	12/8	12/4	11/1
40th Avenue S	TWSC	0/8	1/8	0/4	0/1

Traffic signal spacing is an important consideration when identifying corridor-wide traffic control needs. Traffic signals spaced too closely can often create challenges with natural traffic progression and can even have direct impacts such as spillback. Spillback is when queues from a traffic signal negatively impact an upstream signal (i.e., through blockage or reduced traffic flow and speeds). Signals spaced too far apart, can create challenges as well, by making platooning difficult to maintain and inducing challenging side street delays. Signal spacing is best at one-half mile spacing but can function at one-quarter mile spacing. Consistent spacing is also important to signal progression. Along Broadway, there are several locations with dense signal spacing. This includes the south segment, which has five signals in less than one mile, with another (28th Avenue) warranted for a new signal. In the middle segment, there are 6 signals in just over one mile between Burdick Expressway and 11th Avenue North.

Intelligent Transportation Systems

Intelligent Transportation Systems (ITS) refers to a wide variety of technologies that can be implemented by a City or agency. These technologies can include basic communications on signal controllers to manage clocks to ensure efficient corridor progression or as advanced as the ability for controllers to communicate with connected vehicles. Communications to signals are vital to allowing real-time monitoring around the City as well as ensuring all signals are operating on the same time so that coordination can be properly applied.

Currently, the City of Minot has a variety of communication methods to various signals throughout the city.

- All signals in the study area have at least one communication method, except 20th Avenue S which has no communications.
- Two segments of Broadway are currently coordinated: Broadway from 11th Avenue N to Burdick Expressway and Broadway from 20th Avenue S to 31st Avenue S.
- The majority (eight) of the signals in the corridor have a Wi-Fi connection, five have dial-up connections, four are connected by fiber, three are connected by radio, and one is connected by DSL.
- The city is currently working with a local internet provider to use their infrastructure to connect to multiple signals on Broadway. As of July 2020, the cabinet, controller, and video detection at the Broadway intersections with 2nd Avenue S, Burdick Expressway, 11th Avenue S, 20th Avenue S, US 2 WB Ramps and US 2 EB Ramps.
- The city also has multiple ITS projects included in their capital improvement plan. In 2022, the city plans on implementing a Traffic Management System, and additional ITS infrastructure in 2022 and 2024. The tentative plan for connection at each signal is listed in Table 7.

Table 7: Fiber Installation Plan

Intersection	Expected Fiber Connection	Intersection	Expected Fiber Connection
46th Avenue N	2020	11th Avenue S	2021
11th Avenue N	2022	16th Avenue S	2021
University Avenue	Existing	20th Avenue S	2020
4th Avenue N	Existing	US 2 WB Ramps	Existing
Central Avenue	2023	US EB Ramps	2020
2nd Avenue S	2022	31st Avenue S	2020
Burdick Expressway	2023	37th Avenue S	2021

Figure 22: Existing Traffic Control

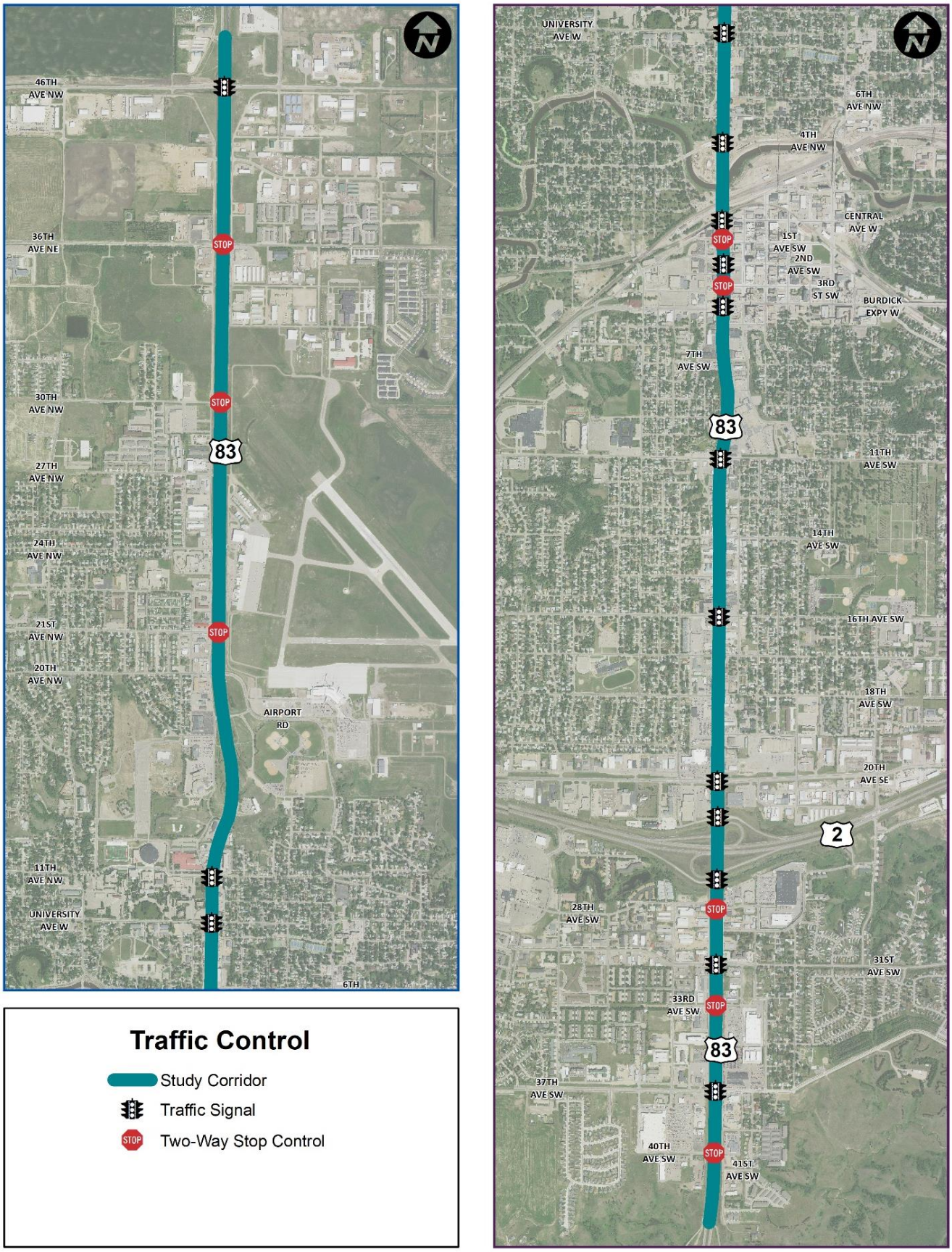
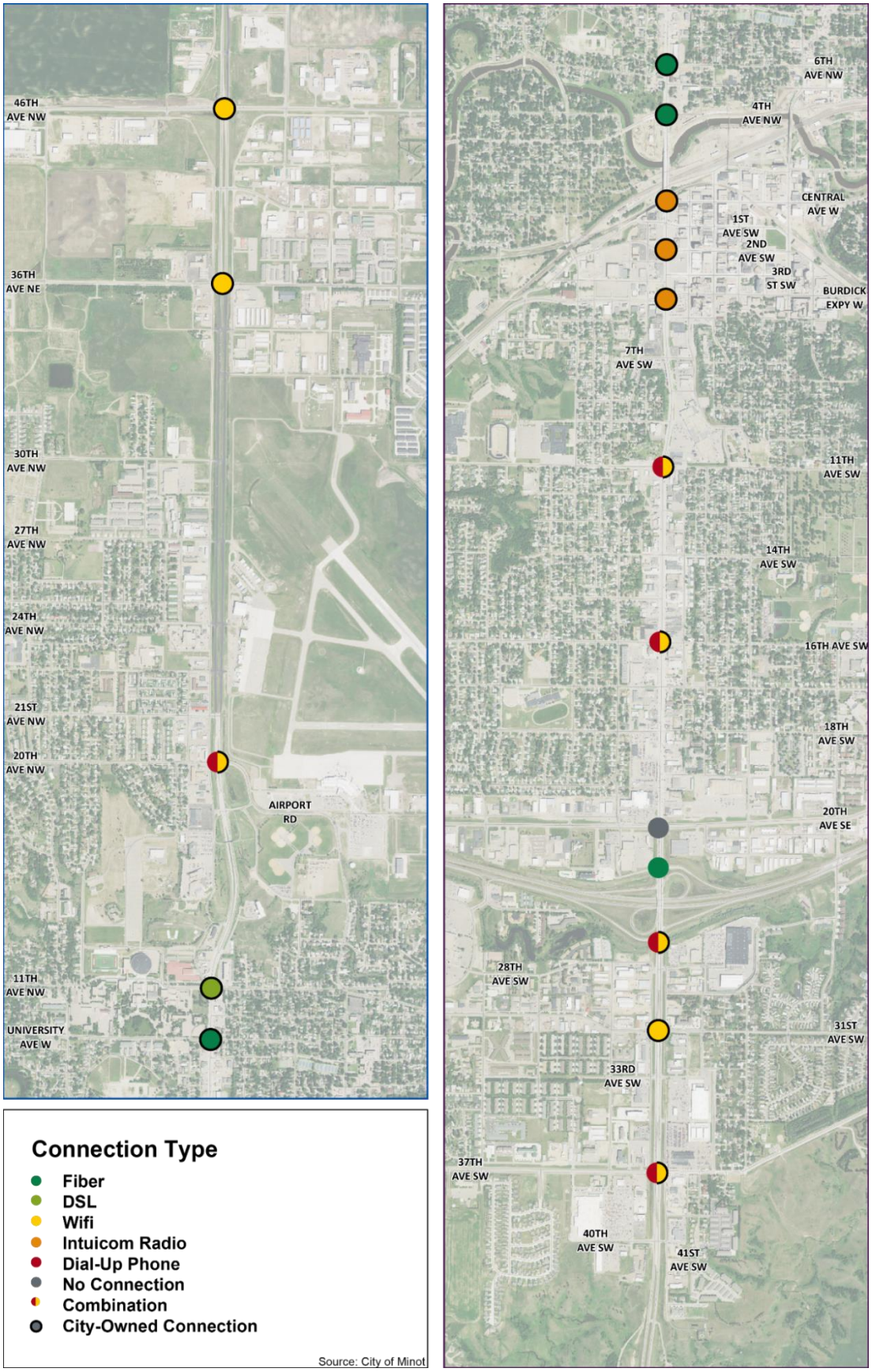


Figure 23: Existing ITS Deployments



Vehicular Level of Service

Vehicular traffic operations were analyzed along the corridor. Intersection capacity analysis was evaluated in terms of delay and level of service (LOS). LOS is a term used to describe the operational performance of transportation infrastructure elements; it assigns a letter grade value that corresponds to specific traffic characteristics within a given system, as shown in Table 8. At intersections, LOS is a function of average vehicle delay, whereas LOS for a roadway section is defined by the average travel speed. LOS A represents free flow traffic whereas LOS F represents gridlock. LOS E and F is considered deficient, in accordance with the NDDOT *Traffic Operations Manual* published in June 2015.

Two different methodologies were used to complete the traffic operations analysis. For the segment from 46th Avenue N to Central Avenue, Synchro software was used. Synchro applies deterministic equations published in the *Highway Capacity Manual* (HCM) and is an industry and NDDOT standard. This method of analysis is appropriate for suburban contexts where access spacing and traffic interactions are less complex. For the segments south of Central Avenue, Vissim Software was used. Vissim uses microsimulation to simulate the movement of every vehicle through a network and collects detailed information for associated performance measures like delay, queue lengths, travel times, and density. Vissim Software is more appropriate for capacity analysis in these segments because it more accurately captures complex merging, diverging, and weaving interactions and the interactions between vehicles and queue lengths.

Table 8: Level of Service Thresholds

Control Delay (Sec/Veh)		Level of Service
Unsignalized	Signalized	
≤ 10	≤ 10	A
10 – 15	10 – 20	B
15 – 25	20 – 35	C
25 – 35	35 – 55	D
35 – 50	55 – 80	E
> 50	> 80	F

Daily Operations

Under current traffic conditions, most of the study intersections operate acceptably during both the AM and PM peak hour. However, three intersections operate deficiently during at least one peak hour:

- 16th Avenue S operates deficiently during the PM peak hour at LOS E.
- 28th Avenue S's minor approaches operate deficiently during the AM peak hour at LOS E. This is common on stop controlled minor approaches with high volume major approaches.
- 40th Avenue S's minor approaches operate deficiently during the PM peak hour at LOS E. This is common on stop controlled minor approaches with high volume major approaches.

Under current conditions, all segments operate at LOS D or above. The segment between 16th Avenue S and 20th Avenue S operates at LOS D, likely associated with the dense access spacing and high traffic volumes.

Table 9: Peak Hour Level of Service

Intersection	Control Type	AM Peak		PM Peak		Intersection	Control Type	AM Peak		PM Peak	
		LOS	Delay	LOS	Delay			LOS	Delay	LOS	Delay
46th Avenue N	Signal	B	19	A	8	Burdick Expressway	Signal	B	19	C	26
36th Avenue N	Signal	C	24.9	C	21	11th Avenue S	Signal	B	18	B	18
30th Avenue N	Stop	C	17	C	17	16th Avenue S	Signal	D	40	E	55
21st Avenue N	Stop	C	16	C	15	20th Avenue S	Signal	B	19	C	30
11th Avenue N	Signal	A	9	A	12	US 2 WB Ramps	Stop	A	1	A	1
University Avenue	Signal	B	12	B	15	US EB Ramps	Signal	A	3	A	5
4th Avenue N	Signal	B	12	B	13	28th Avenue S	Stop	E	37	D	28
Central Avenue	Signal	A	3	A	5	31st Avenue S	Signal	B	18	C	23
1st Avenue S	Stop	B	13	C	17	33rd Avenue S	Stop	A	9	B	10
2nd Avenue S	Signal	A	7	A	7	37th Avenue S	Signal	B	19	C	25
3rd Avenue S	Stop	A	9	B	13	40th Avenue S	Stop	B	14	E	37

Travel Time and Reliability

Along corridors with dense traffic control spacing, metering of traffic can often minimize the overall deficiencies at any one location. What this mean is that traffic delays are distributed at upstream and downstream signals, preventing the full effect of congestion to occur at any one location. To understand this phenomenon, travel time analysis was conducted. Generally, the corridor operates effectively, even during peak hours. On a typical day, traveling between Central Avenue and 40th Avenue S takes around 6.8 minutes, compared to the free flow travel time of five minutes. Even during the peak hours, the travel time remains under seven minutes.

Travel time reliability measures the extent of unexpected delay, as measured from day-to-day and across different times of the day. Most travelers are less tolerant of unexpected delays because they cannot be incorporated into planned travel time, resulting in late arrivals; alternatively budgeting twice as long as needed for a trip also can result in wasted time. The Level of Travel Time Reliability (LOTTR) is defined as the ratio of the 85th percentile travel time to an average travel time for all vehicles. An LOTTR of 1.50 and greater indicate severe unreliability. For example, a LOTTR of 2.00 means that motorists should plan for twice the amount of travel time to arrive at their destinations on time.

Generally, the Broadway corridor operates very reliably throughout a typical day, with travel time variation around 30 to 45 seconds, even during the peak hours. Figure 24 shows the average travel times by time of day for selected segments of the corridor along with free flow travel times. The consistent travel times means the LOTTR is very good, at 1.09 or better at all locations. This means travelers can plan for nearly the same travel time regardless of the time they chose to travel.

Figure 24: Average Daily Travel Times

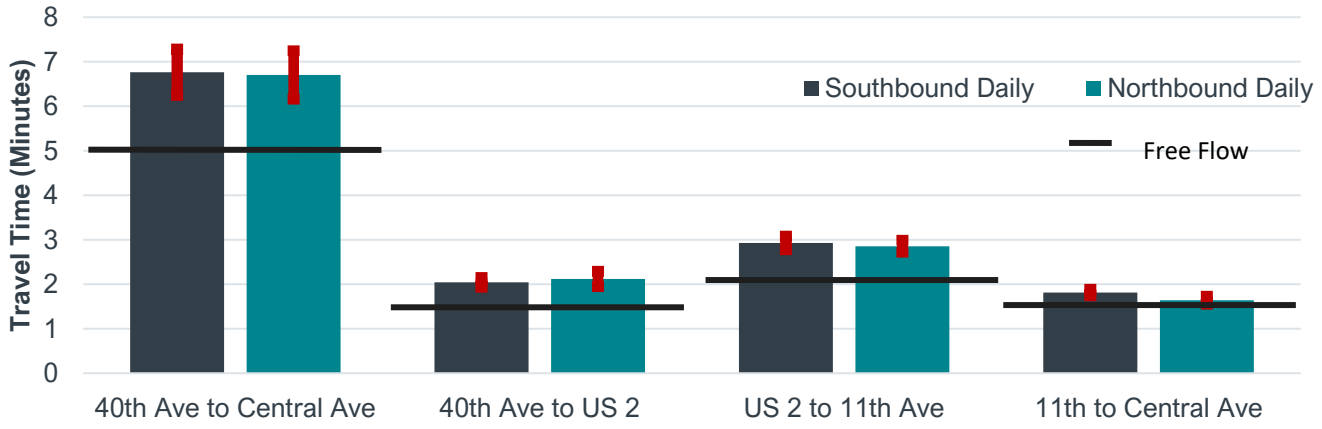
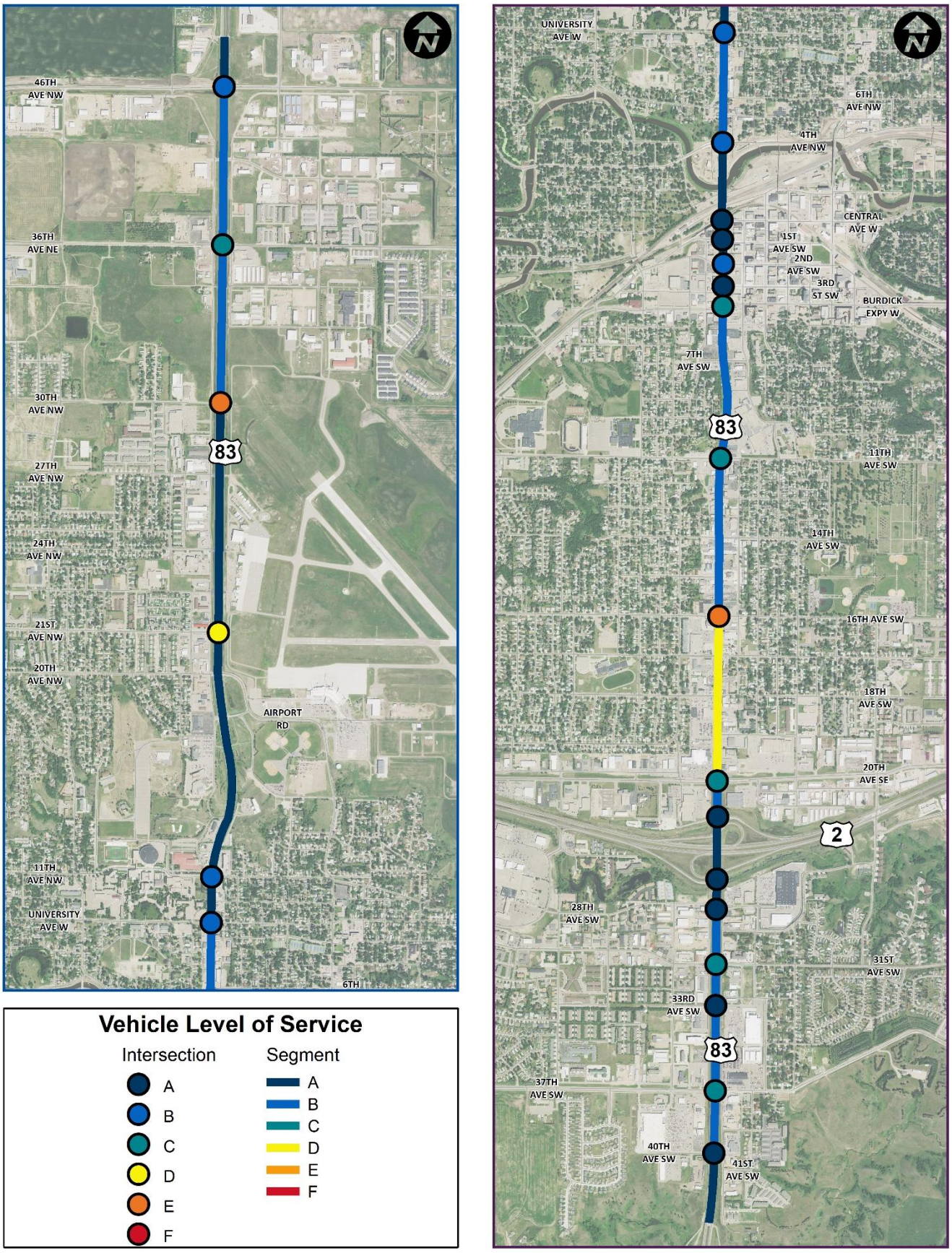


Figure 25: Existing Vehicular Level of Service



Freight Conditions

The Broadway corridor is an important freight connection to and through Minot, with connections to the Minot Air Force Base and Canadian border to the north and south to Bismarck and I-94. While the completion of the US 83 bypass from 46th Avenue N to US 2 along the western edge of Minot has changed how trucks use the Broadway corridor, it remains a critical corridor for freight movements and Minot's businesses.

Generators

Freight generators are businesses and locations that create large amounts of truck traffic. Typical freight generators include agriculture, manufacturing, and transportation and warehousing companies. Some commercial retail businesses may generate regular truck traffic as well. Figure 28 shows the likely freight traffic generators along the Broadway corridor.

Truck Routes

The City of Minot does not have designated truck routes but does have weight restrictions and spring weight restrictions on multiple roadways connecting to the Broadway corridor. Higher weight limits likely indicate higher use of heavy truck traffic. Broadway from southern city limits to just north of US 2 is designated as Restricted by Legal Weight, and north of US 2 there is an eight-ton weight limit. This weight restriction may be limiting for certain traffic, pushing them onto US 2 and the northwest bypass. Figure 28 shows the truck weight restrictions.

Existing Truck Traffic

Broadway is one of the primary freight routes through the City of Minot, carrying between 305 and 995 trucks each day (2.3 to 7.0 percent). Truck activity is lowest on the northern end of the corridor between 24th Avenue N and 27th Avenue N and highest on the southern edge between 33rd Avenue S and 37th Avenue S. This is attributable to the US 83 NW and NE truck bypasses, but no SW or SE bypasses. Truck traffic is shown in Figure 16.

Freight Level of Service

Freight haulers rely on travel time reliability, so they can make their deliveries on-time and minimize delays. Travel time reliability measures the extent of unexpected delay, as measured from day-to-day and across different times of the day. While the overall travel time reliability uses a ratio of the 85th percentile travel time to the average travel time, the freight level of service uses the 95th percentile travel time for trucks only. For intersections, Freight LOS uses the vehicular level of service discussed above. Freight level of service thresholds are shown in Table 10.

Table 10: Freight Level of Service

Level of Service	LOTTR 95th Percentile
A	1.0
B	1.0 – 1.25
C	1.25 – 1.60
D	1.60 – 2.0
E	2.0 – 2.5
F	> 2.5

Daily Operations

Truck freight travel time reliability was completed using Vissim microsimulation between Central Avenue and 40th Avenue S. Throughout the course of a typical day, freight level of service is C or better. There are limited operational issues north of Central Avenue, so truck level of service was assumed to be acceptable based on volume to capacity ratios and intersection level of service.

Travel time through the corridor is less reliable for freight vehicles than passenger vehicles. This is more than likely due to added stopping and start up times for large vehicles when progression along the corridor is stopped due to traffic signals. This also affects all vehicles behind the freight vehicles. The frequent signal spacing along the corridor, when not perfectly timed, can create frustrating delays for freight carriers. Freight speeds are shown in Figure 26, with freight LOTTR shown in Figure 27, and freight level of service is shown in Figure 29.

Figure 26: Average Truck Speed

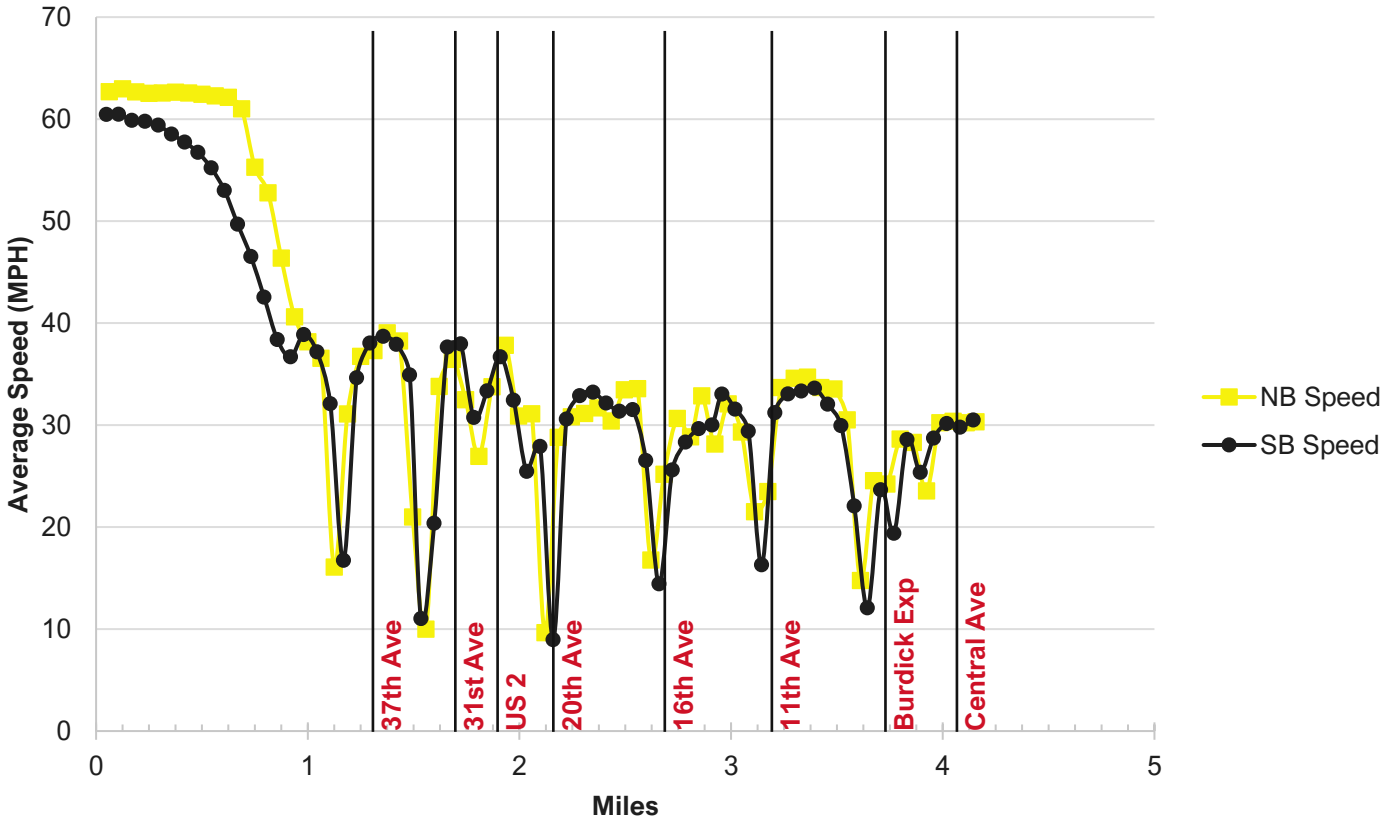


Figure 27: Freight LOTTR

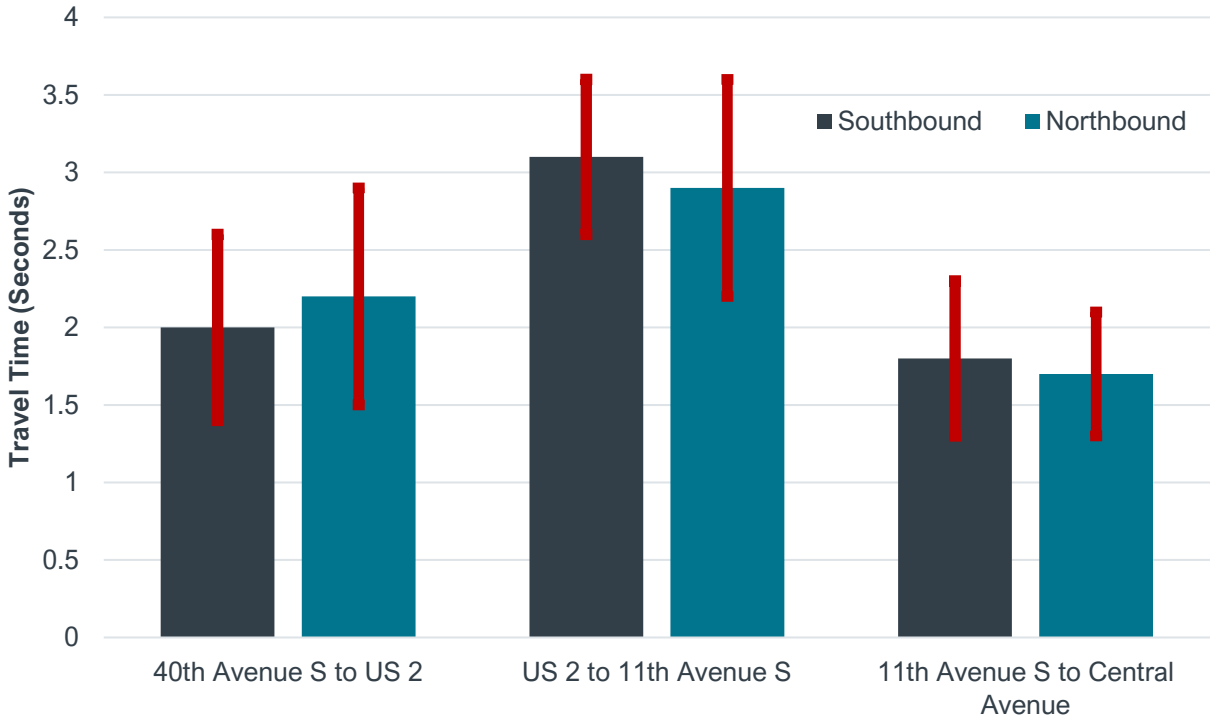


Figure 28: Freight Generators and Truck Routes by Weight

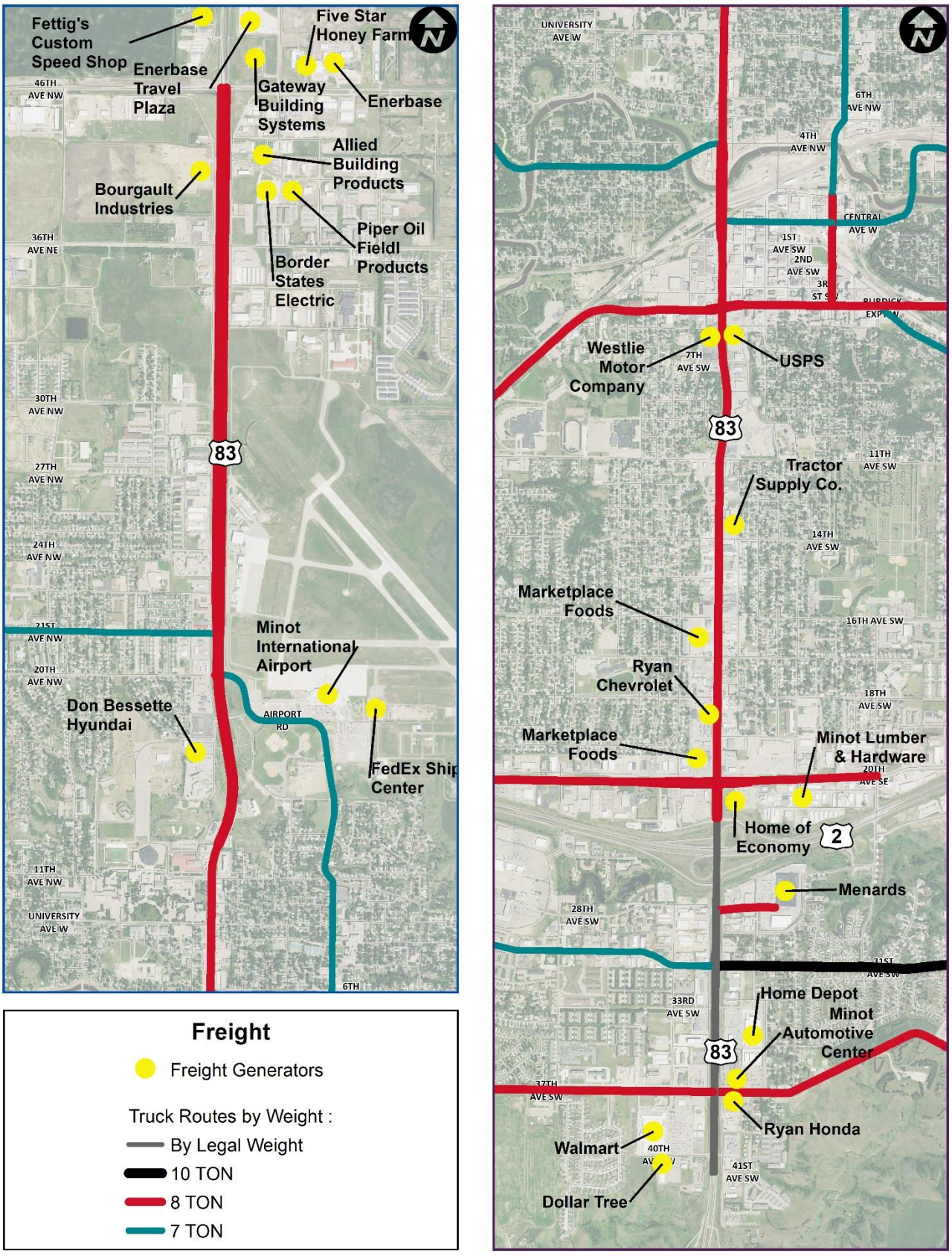
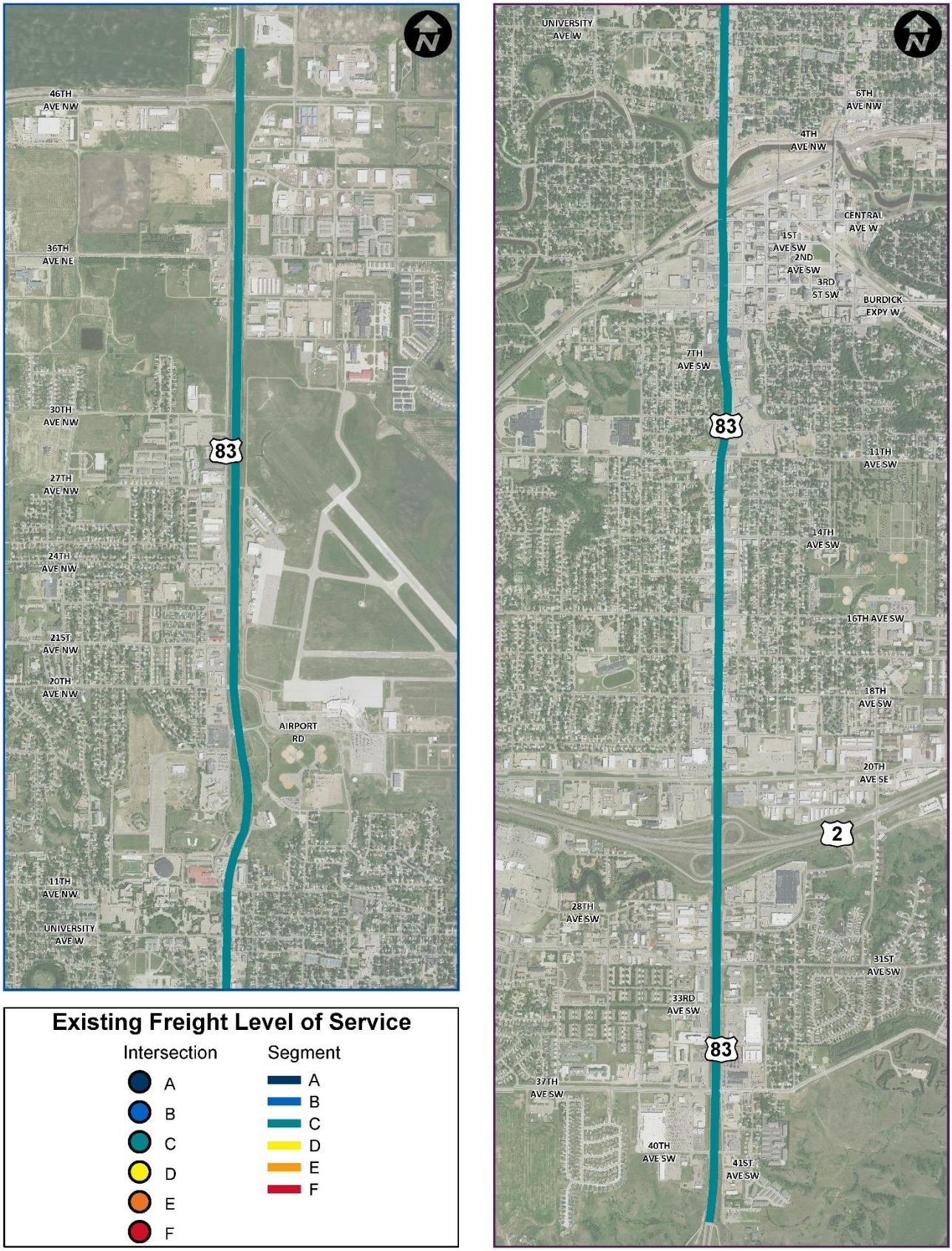


Figure 29: Existing Freight Level of Service



Pedestrian Conditions

Enhancing the ability of people to walk and bike involves providing adequate infrastructure and linking urban design, streetscapes, and land use to encourage walking and biking. Designing roadways to accommodate all types of users is commonly termed “complete streets” which come with many benefits:

- Streets designed with sidewalks, raised medians, traffic-calming measures and treatments for travelers with disabilities improves pedestrian safety. Research has shown that sidewalks alone reduce vehicle-pedestrian crashes by 88 percent.
- Multiple studies have found a direct correlation between the availability of walking and biking options and obesity rates. The Centers for Disease Control and Prevention recently named adoption of complete streets policies as a recommended strategy to prevent obesity.
- Complete streets offer inexpensive transportation alternatives to roadways. A recent study found that most families spend far more on transportation than food.
- Research has found that people who live in walkable communities are more likely to be socially engaged and trusting than residents living in less walkable communities.

Complete streets does not mean that all modes should be accommodated on all roads. Instead, communities should look to create a comprehensive network of facilities that similarly serve all modes of transportation. Broadway may not be the appropriate corridor to serve vehicles, trucks, transit, pedestrians, and bicycles.

Pedestrian Amenities and Facilities

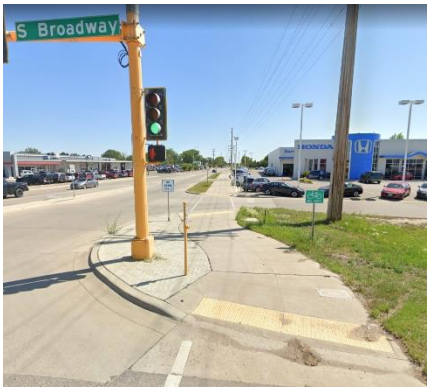
The availability of pedestrian facilities varies throughout the study corridor:

- Between 46th Avenue N and 21st Avenue N there are no pedestrian facilities
- From 21st Avenue N to 20th Avenue N there is a shared use path on the west side of Broadway. At 20th Avenue N, to South of 2nd Street N, there is a shared-use path on the west side and a sidewalk on the east side. These facilities include a narrow grassy boulevard between them and the roadway.
- North of 11th Avenue N to 19th Avenue S there are sidewalks on both sides. In most areas, these facilities are directly adjacent to Broadway.
- South of 19th Avenue S there are no facilities.

At most signalized intersections, there are marked crosswalks, pedestrian push buttons, and countdown timers.

- There is a pedestrian overpass west of the Sertoma Sports Complex, which connects the park to the shared use path that runs along Broadway to 21st Avenue.
- 20th Avenue N, 11th Avenue N, University Avenue, 6th Avenue N, 4th Avenue N, 2nd Avenue S, Burdick Expressway, 11th Avenue S, 16th Avenue S have pedestrian signals, marked crosswalks, push buttons, and countdown timers on all approaches. The location of the push buttons impact people’s ability to use the corridor if they require

Figure 30: Crossing Challenges Along Broadway



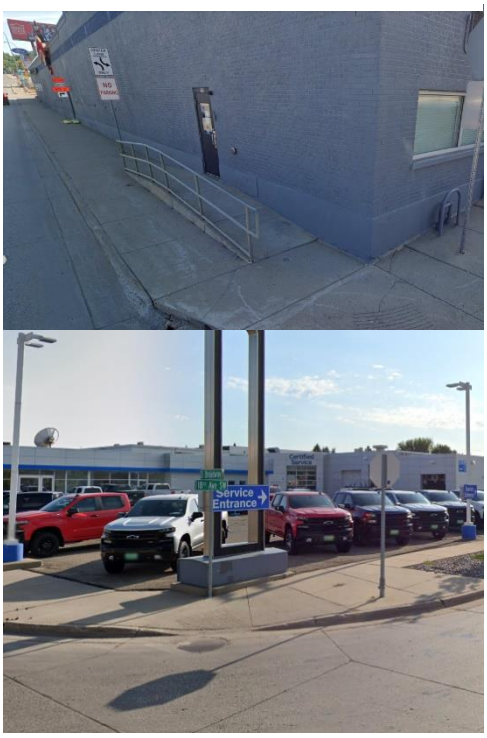
mobility devices. Lack of ADA compliant curb ramps may also limit people's ability to use these crossings, especially south of the River.

- At the 31st Avenue traffic signal, only the crossing of the north approach is marked. There are no facilities on any other approach. This crossing includes a raised median; however, it is not wide enough to act as a pedestrian refuge island.
- At the 37th Avenue traffic signal, only the crossing of the south approach is marked. There are no facilities on any other approach.

Comfort and Accessibility

Many of these facilities, especially those directly adjacent to the roadway and in Minot's core, are not wide enough, are in poor condition, or see regular encroachments from property owners, parked vehicles, and city-owned utilities and signage. In addition to the lower comfort on these facilities, there are also accessibility issues for those with mobility challenges, like pedestrians with low or no vision, or mobility devices, like wheelchairs and walkers. The Americans with Disabilities Act (ADA) requires pedestrian routes to be constructed with multiple features to ensure facilities are accessible to users of all ages and abilities. While identifying every ADA non-compliant location is outside the scope of this study, there are regularly occurring ADA challenges throughout the corridor.

Figure 31: Pedestrian Facilities with Encroachments and Broken Pavement



- At intersections, curb ramps, detectable warning panels, and proper cross slopes should be installed to allow pedestrians to enter and exist the sidewalk without obstructions. There are multiple intersections that do not include these features.
- At driveways, design requires proper grading and slopes to ensure pedestrians, especially those using mobility devices do not get drawn into the street. Opportunities to eliminate access or provide the proper slope should be considered, especially in the urban core area where density and pedestrian access is highest.
- On sidewalks, the minimum width is four feet which should be clear of any obstruction that might include cracks, overgrown vegetation, street furniture, utilities, etc. When possible, a two-foot buffer should be incorporated between the sidewalk and the roadway.

Given the wide cross-section, heavy traffic volumes, and high speeds, crossing Broadway is very challenging and for pedestrians can feel unsafe.

Crashes

Over the past five years, there were nine pedestrian crashes. Eight of these crashes resulted in injuries, including three non-incapacitating injuries and one incapacitating injury.

Five of the nine pedestrian crashes occurred at traffic signals. Two of which, occurred when a driver ran a red light. Three other crashes occurred as pedestrians tried to cross Broadway at an uncontrolled location and misjudged the speed and gap availability on the high-speed, high-volume corridor. All of the crashes occurred in the urban section of the corridor, where pedestrian activity is highest and where there were pedestrian facilities on at least one side of the roadway. Pedestrian crashes are shown in Figure 33. In addition to these crashes, there was recently a crash that resulted in a fatality at 17th Avenue S. There is no traffic control at this location.

Generators

Pedestrian and bicycle generators are types of land uses or attractions that people are inclined to walk or bike to, like a school, park, coffee shop, shopping and restaurants. As the longest and most continuous corridor in Minot, Broadway provides access to a significant number of these kinds of generators. Generators are shown in Figure 32, in the Bicycle Conditions section. The most notable pedestrian generators along the corridor include:

- Sertoma Sport Complex
- Schools and Universities including Minot State University, private and public elementary, middle, and high school campuses.
- Parks including Skudlarek Park, Hammond Park, and Scandinavian Heritage Park.
- Downtown which includes restaurants and city and county services.

Pedestrian Level of Service

Pedestrian level of service (PLOS) incorporates a metric for segments (roadways between two intersections) and intersections. The *Highway Capacity Manual* provides a pedestrian level of service calculation for intersections that incorporates traffic volumes, speed, and the physical characteristics of the intersection. For segments, PLOS incorporates the number of travel lanes, traffic volumes, traffic speeds, truck traffic, and buffer width. Access density was also incorporated into the calculations for PLOS. Access density creates conflict points for pedestrians and often creates ADA challenges. Where access density was twice as dense as the allowable spacing, the LOS was reduced. For example, if access density was 300 percent higher than allowable, this would degrade the LOS by three full grades or to LOS F, whichever was higher.

Under current conditions, PLOS is highly variable depending on the segment of the corridor.

- North of 21st Avenue N and south of 20th Avenue S there are no facilities, so the segment is PLOS F. Signalized intersections with facilities, including 31st Avenue S and 37th Avenue S do see acceptable intersection PLOS. However, other intersections within these segments see deficient intersection PLOS.
- Between 11th Avenue S and 20th Avenue S extremely dense access points, combined with the pedestrian facilities adjacent to the roadway result in LOS F.
- The core of Broadway, between 21st Avenue N and 11th Avenue S sees segment PLOS C. The pedestrian facilities on both sides provides pedestrian mobility for most users, with some areas of deficiencies like sidewalk obstructions, narrow sidewalks, and high vehicle speeds with facilities directly adjacent to the roadway.
- Unsignalized intersections, especially along Broadway's core see intersection PLOS C or better. This is due to the high level of service on the stop controlled approaches (east and west approaches). However, the uncontrolled approaches (north and south approaches) are deficient at PLOS F. Despite the acceptable intersection PLOS, crossing Broadway at these intersections remains deficient.

Figure 34 shows the existing pedestrian level of service.

Figure 32: Bicycle and Pedestrian Infrastructure and Generators

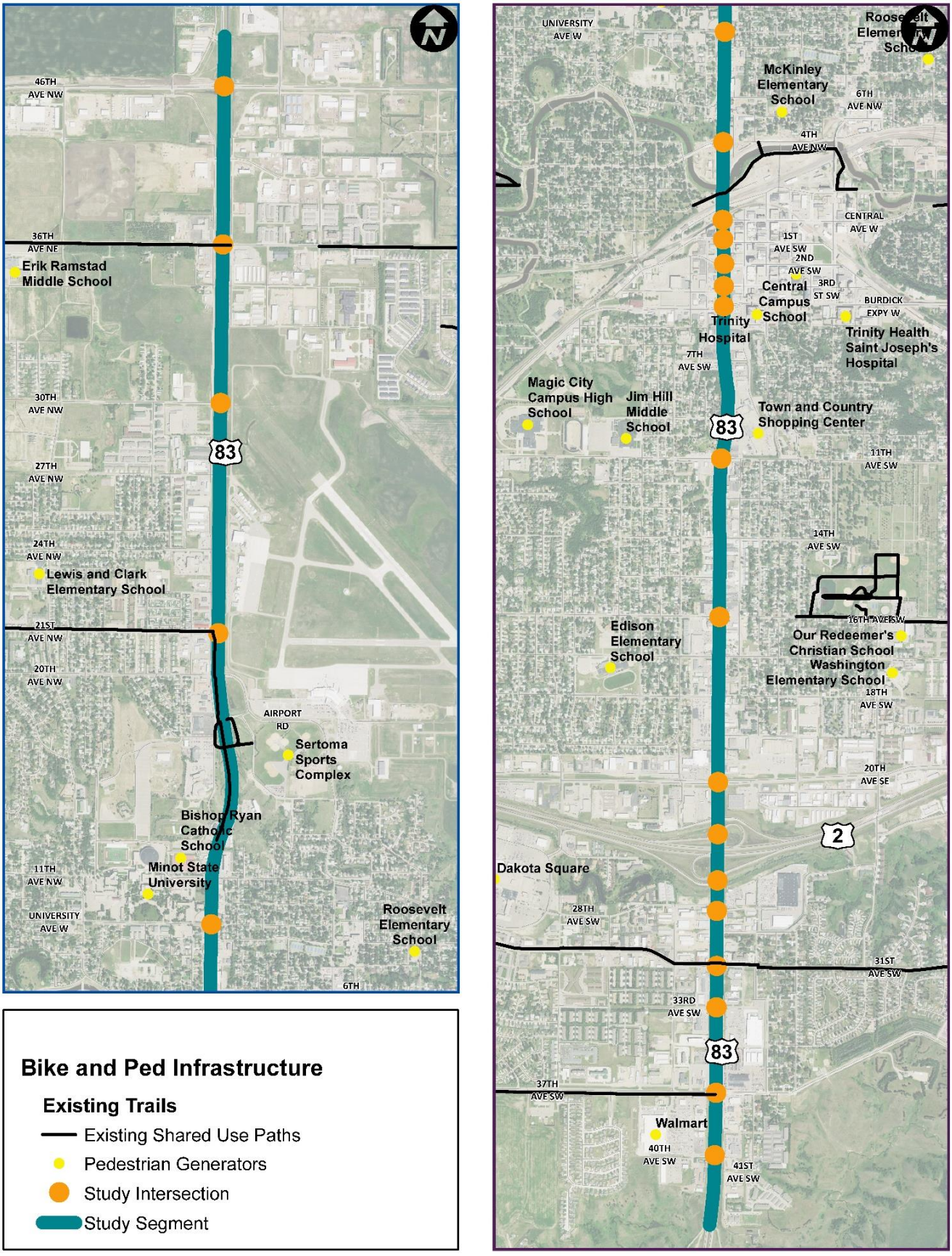


Figure 33: Pedestrian and Bicycle Crashes

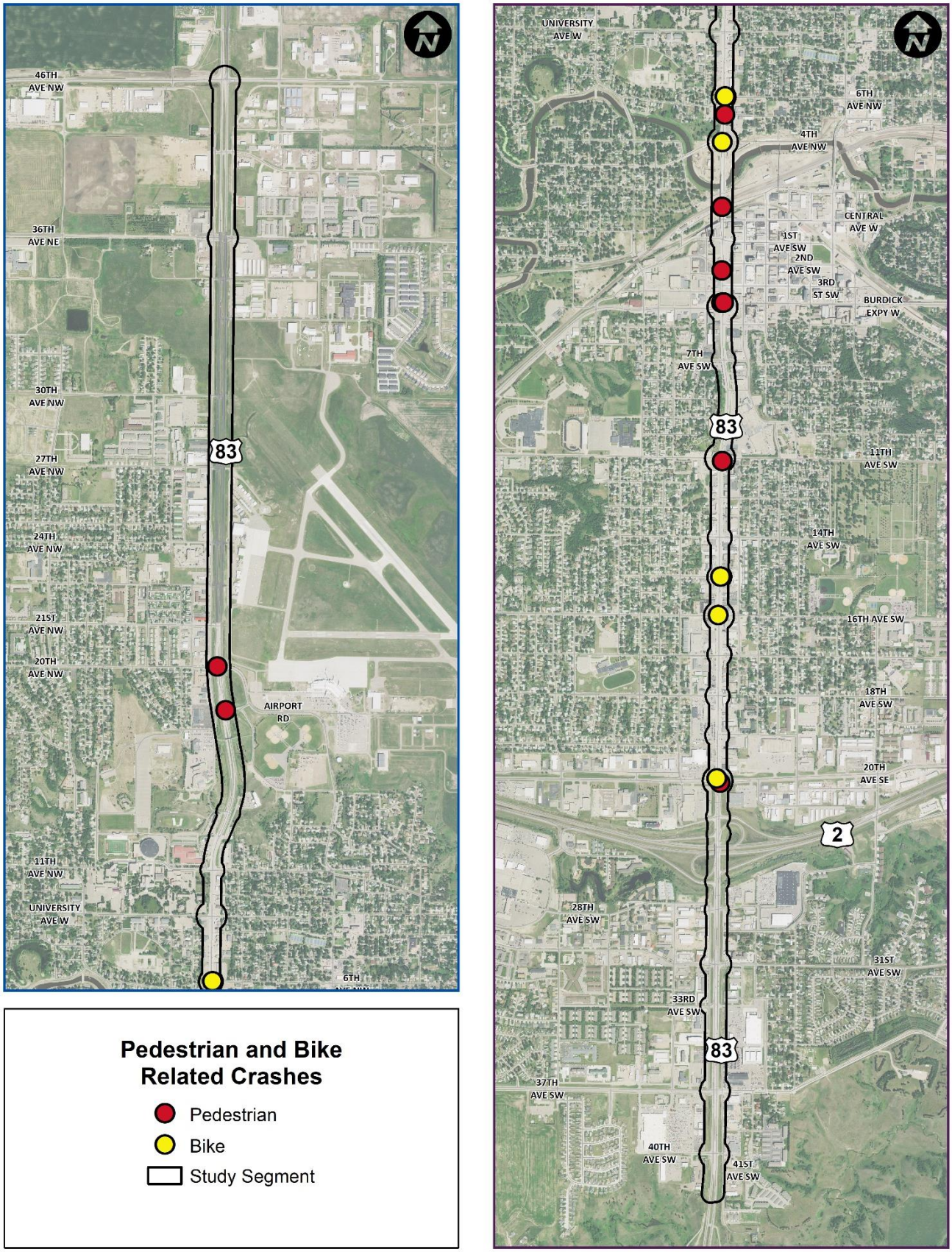
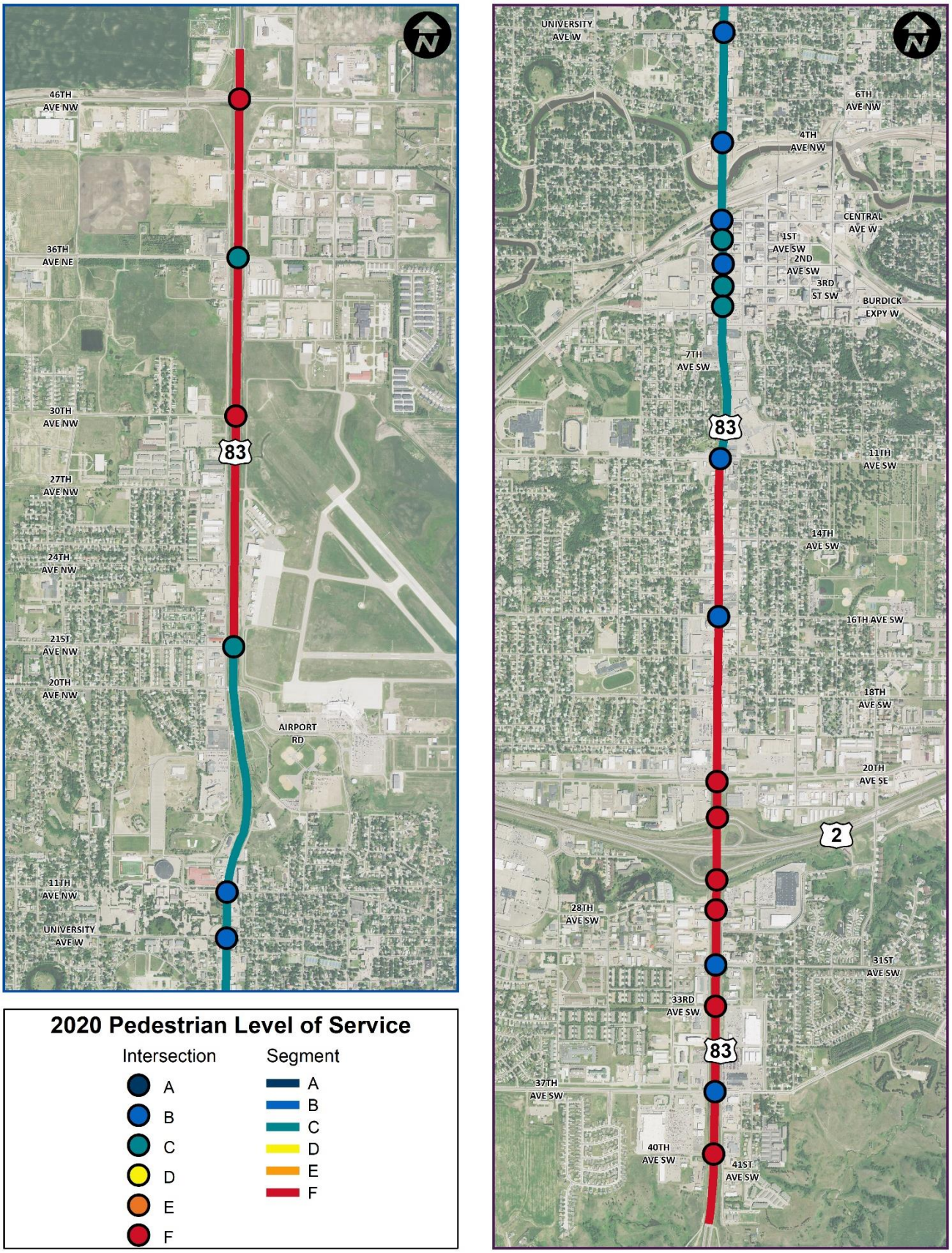


Figure 34: Existing Pedestrian Level of Service

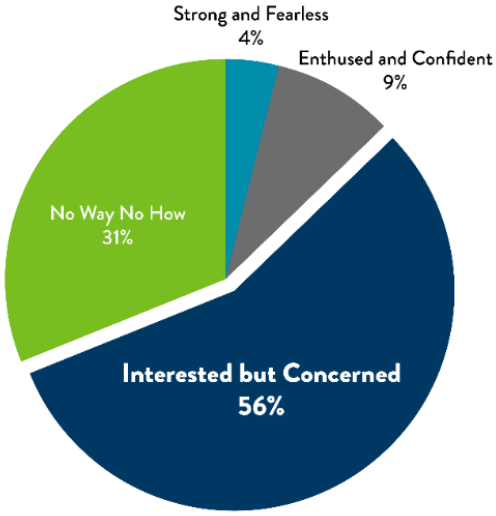


Bicycle Conditions

National research has found that there are generally four levels of interests/abilities when it comes to cycling.

- Strong and Fearless riders are those that are very comfortable without bike lanes. They will ride under most roadway and traffic conditions.
- Enthused and Confident riders will ride their bikes with appropriate infrastructure.
- Interested but Concerned riders are interested in biking more but are not comfortable with the infrastructure or have other barriers to biking.
- No Way No How are unable or uninterested in bicycling and no change to the environment or infrastructure is likely to encourage them to cycle more.

Figure 35: Cyclist Types and Their Behavior



Nearly three-quarters of Strong and Fearless, Enthused and Confident, and Interested but Concerned cyclists had ridden at least once in the last 30 days for transportation or recreation. Improving infrastructure and the environment can help encourage these three types of cyclists to choose bicycling more.

Bicycle Amenities and Facilities

The City of Minot prohibits riding a bicycle upon a sidewalk within a business district and on any sidewalk or other roadway where signed. Throughout the study area, there are limited shared-use paths available for bicyclists to use, shown in Figure 32. Many of the primary generators are in or near downtown, in which bicyclists would not be able to use the sidewalk. The lack of bicycle facilities throughout the corridor, either along or across, limits people's ability to use bicycles as their primary mode of transportation, especially for those people who do not fall in the strong and fearless category discussed above. However, paved shoulders on the edge of the roadways may serve as a functional space for bicyclists to travel in the absence of other facilities with more separation. Bicycle travel on paved shoulders may function on multilane roads with moderate to high volumes, speeds and heavy traffic, but fails to provide a low-stress experience in such condition. There are some segments of the corridor that have paved shoulders ranging from eight to 12 feet on both sides of the roadway but they transition to right turn lanes at the intersection approaches.

Bicycle Crashes

Over the past five years, there were five bicycle crashes. Three resulted in a possible injury and two in a non-incapacitating injury. Four of the five crashes occurred at traffic signals, which are generally associated with improved bicycle safety. Three of the five crashes involved turning vehicles that failed to yield to the bicycle in the crosswalk. This is common on busy intersections where drivers are looking for gaps in traffic make permitted turning movements and do not notice pedestrians or bicycles. Bicycle crashes are shown in Figure 33.

Bicycle Level of Service

Bicycle level of service (BLOS) incorporates a metric for segments (roadways between two intersections) and intersections. The *Highway Capacity Manual* provides a BLOS calculation for intersections that incorporates traffic volumes, speed, and the physical characteristics of the intersection. The intersection BLOS score is an indication of the typical bicyclist's perception of the overall crossing experience. For segments, BLOS incorporates traffic volumes, roadway width, speed, truck traffic, pavement condition, on-street parking, and shoulder width. Access density was also incorporated into the calculations for PLOS. Access density creates conflict points for pedestrians and often creates ADA challenges. Where access density was twice as dense as the allowable spacing, the LOS was reduced. For example, if access density was 300 percent higher than allowable, this would degrade the LOS by three full grades or to LOS F, whichever was higher.

Based on the methodologies discussed, the BLOS at the study corridor is shown in Figure 36. Throughout the corridor BLOS D or worse is experienced because there is no continuous bicycle facility. The paved shoulders present on segments transitions into right turn lanes at intersection approaches, and thus BLOS becomes unacceptable. South of 20th Avenue S, all intersections excluding 31st Avenue S and 37th Avenue S experience BLOS F due to lack of bicycle crossing facilities.

Transit Conditions

Minot City Transit is the transit provider for the City of Minot providing regular fixed route service. They partner with Souris Basin Transportation to provide paratransit service, which is a door-to-door service that users must schedule in advance. Minot City Transit runs six regular routes Monday through Friday between 7 AM and 7 PM. All six of these routes either cross or run along the Broadway corridor.

Minot's main bus transfer point is the Minot Municipal Auditorium, located west of Broadway along 4th Street S, between Burdick Expressway and 2nd Avenue S. All routes begin and end at the Auditorium. To access downtown and other services, like the post office, Central Campus, the YWCA, and Ward County Social Services, all east of Broadway, transit users must cross Broadway. While both 2nd Avenue S and Burdick Expressway are signalized, 3rd Avenue S is a more direct route. Identifying pedestrian crossing improvements at this location may help support safe crossings for transit users.

Minot City Transit operates a flag stop service, meaning a rider can be picked up at any street corner along the route or at a fire hydrant in the middle of a long block. Flag stop service requires high quality sidewalk facilities along all transit routes to ensure the service remains accessible to all users, including those with mobility challenges.

Transit Level of Service

Transit quality of service is generally determined by service hours, frequency, and the directness of transit routes. For this analysis, service hour was selected. Service frequency is an important metric for fixed route for determining the availability of transit service to potential users. The more frequent transit service provides more opportunities for immediate travel and makes it a more competitive mode choice. The frequency thresholds are shown in Table 11. Generally, each route in Minot City Transit is on a 60-minute headway, for LOS E. However, because the routes are one direction with loops and some overlapping routes, there are areas that see LOS C (20th Avenue S to 31st Avenue S), while other areas see LOS E (University Avenue to 20th Avenue S, 31st Avenue S to 37th Avenue S). North of University Avenue and south of 37th Avenue S, there is no transit service provided. These segments operate at LOS F. The transit LOS is shown in Figure 38.

Table 11: Transit Level of Service Thresholds

Vehicles per hour	Level of Service
>6	A
5-6	B
3-4	C
2	D
1	E
<1	F

Existing Multimodal Level of Service

Vehicular, freight, pedestrian, bicycle, and transit levels of service were calculated independently throughout the study area. The unweighted multimodal level of service combines each of the five modal levels of service into a single multimodal level of service, which is shown by segment and intersection in Figure 39. Six of the study intersections currently operate at deficient LOS when considering all modes of service. Four of the six are on the northernmost edge of the corridor. This is due to the lack of bicycle, pedestrian, and transit facilities in those areas. The two other deficient areas occur near the center of the corridor, again due to a lack of connected pedestrian and bicycle facilities.

With Steering Committee and public input, the level of service can be weighted to reflect the priorities for the study area and identify and prioritize the deficiencies the community cares most about.

Figure 36: Existing Bicycle Level of Service

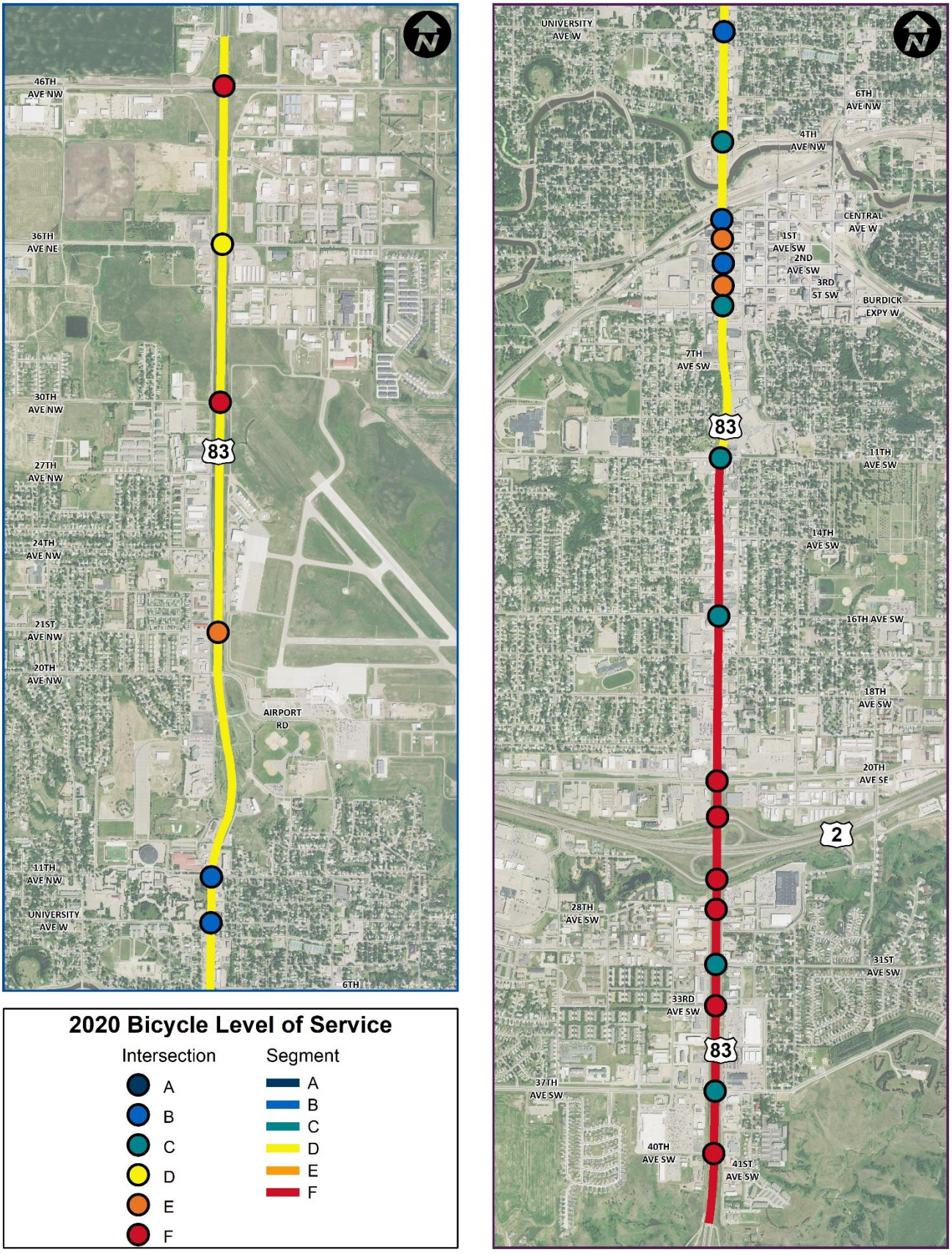


Figure 37: Transit Routes

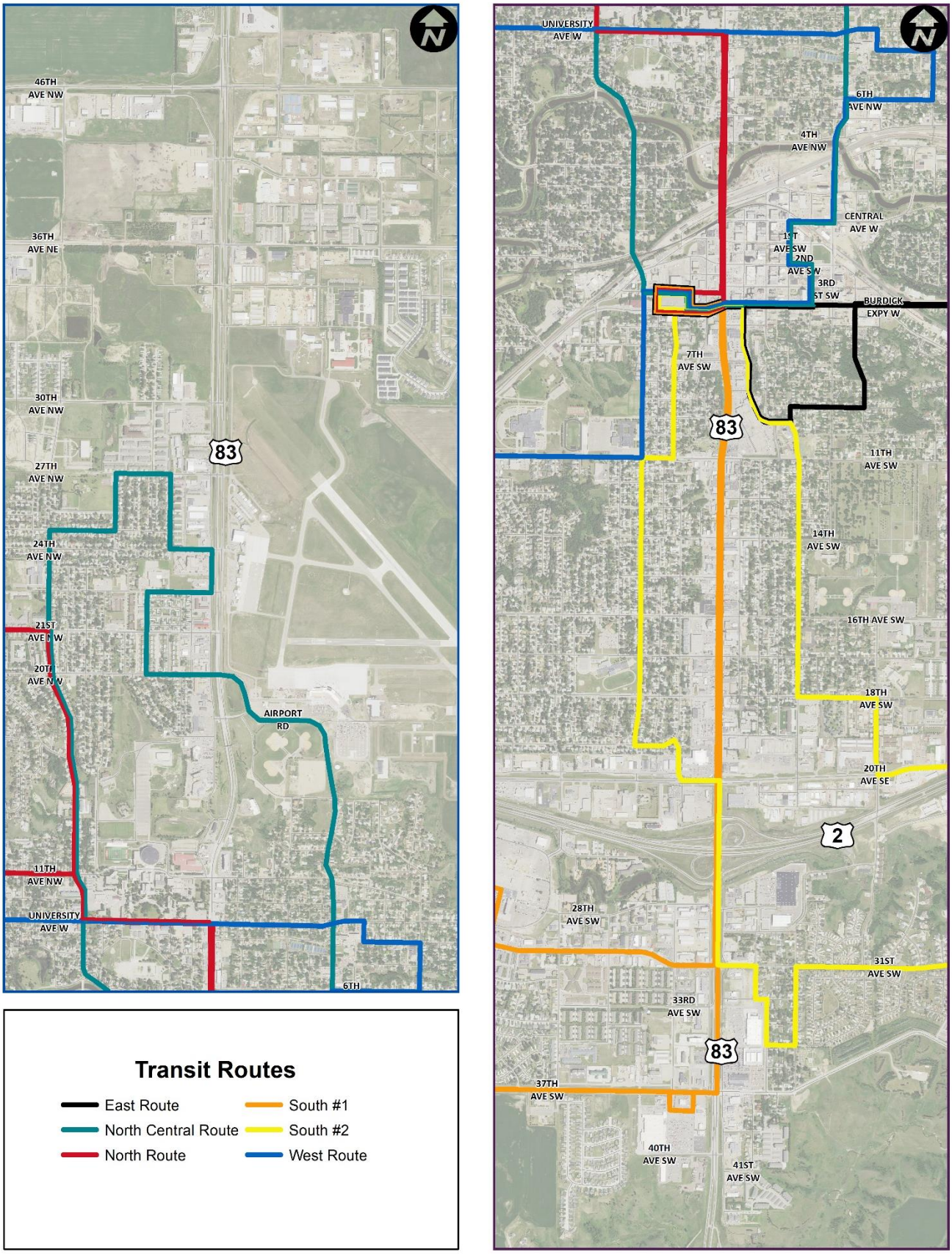
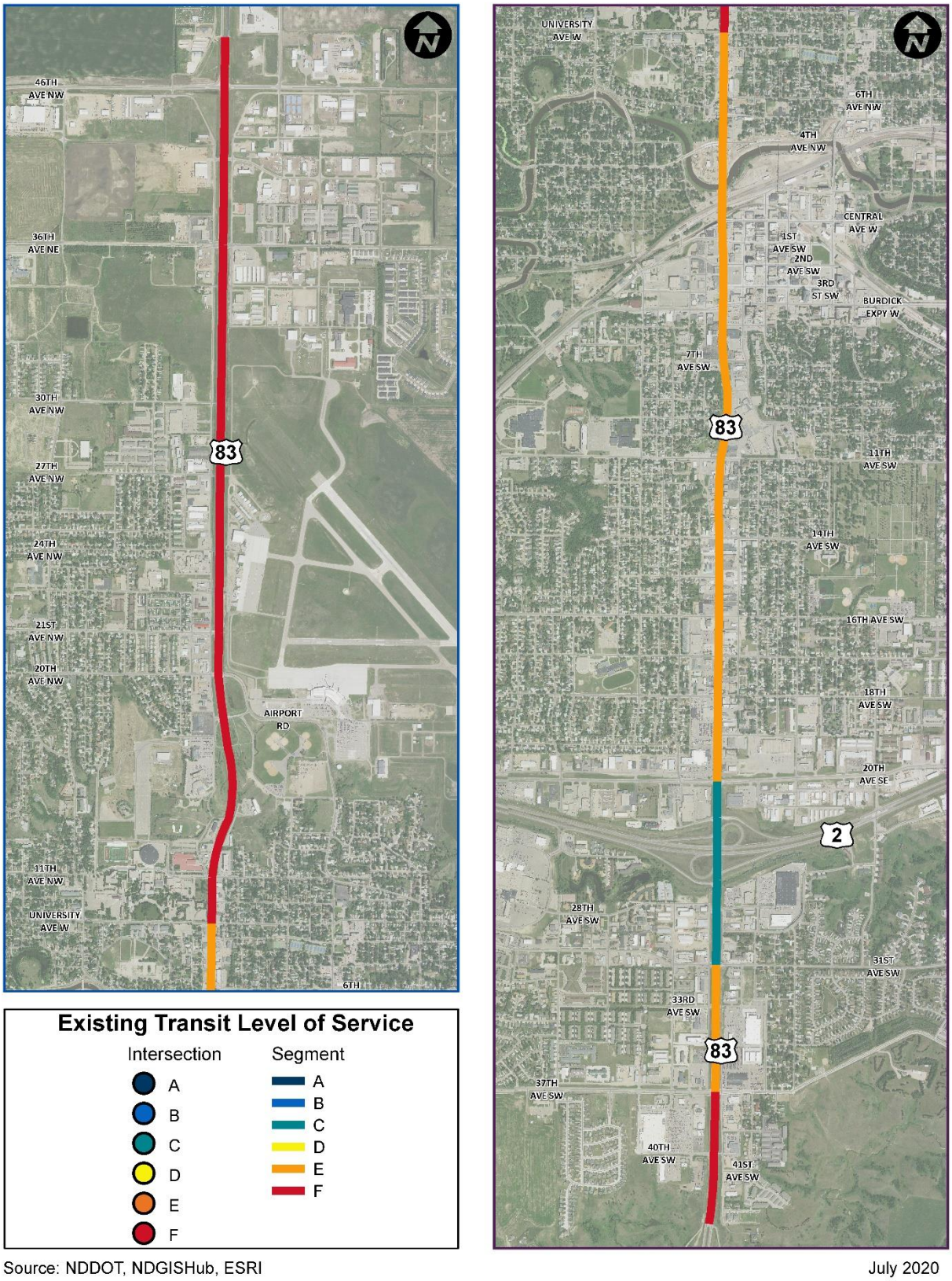


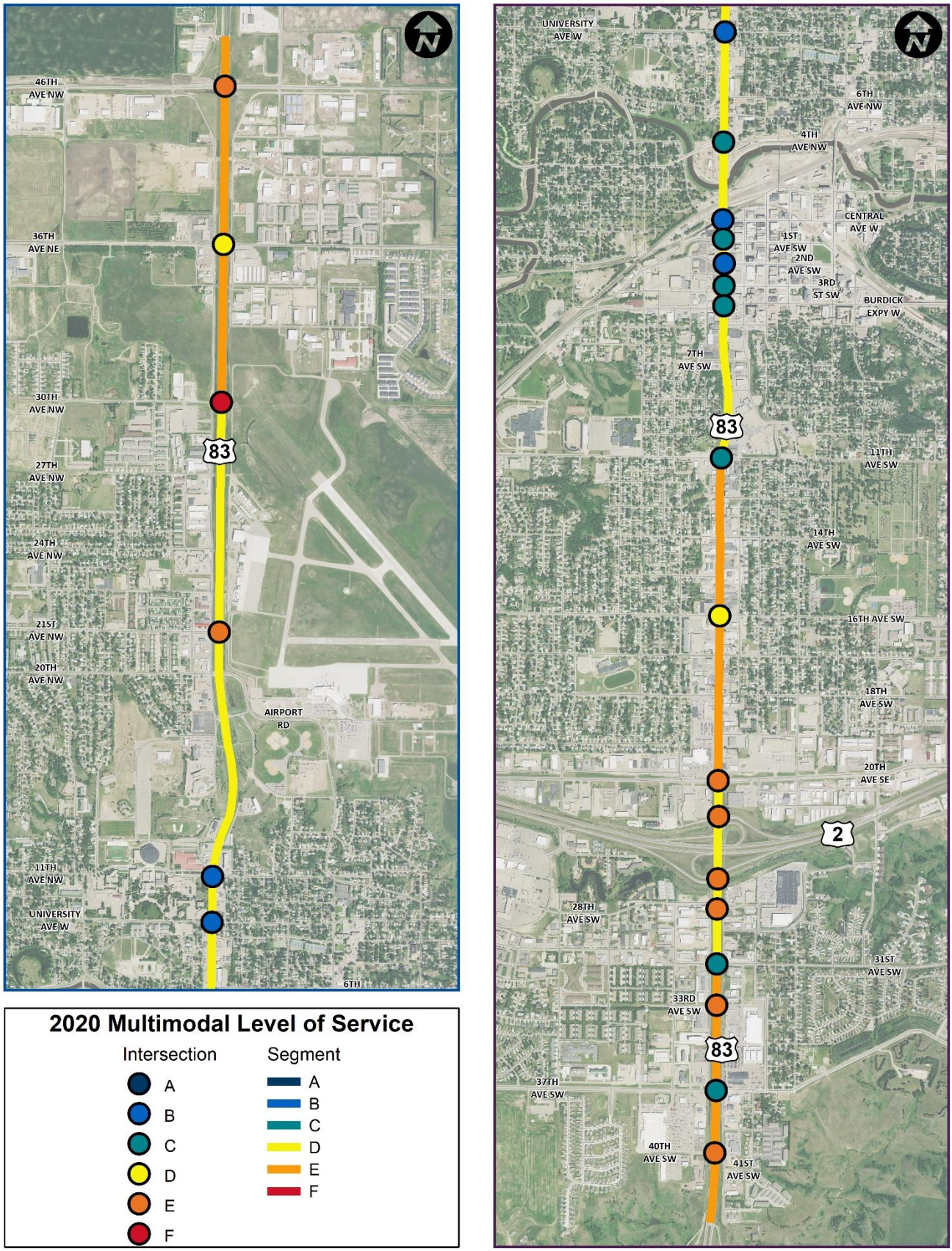
Figure 38: Existing Transit Level of Service



Source: NDDOT, NDGISHub, ESRI

July 2020

Figure 39: Existing Multimodal Level of Service

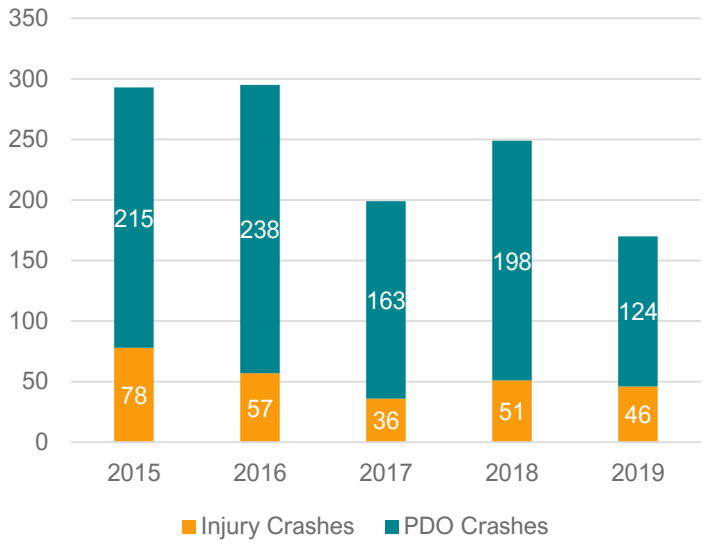


Crash History

Reviewing historic crash information can help identify existing deficiencies that can be addressed through this study. Five years of crash records between January 1, 2015 through December 31, 2019 were provided by NDDOT. There were 1,168 crashes reported during this period in the nearly six-mile corridor. This total corresponds to an average of 234 crashes per year with 22.3 crashes per year resulting in an injury, including the minor injury classification. There were no traffic fatalities reported during the analysis period. Figure 43 shows the crash density along the study corridor.

Using the 2018 FHWA's *Crash Costs for Highway Safety Analysis* produced by the Federal Highway Administration (FHWA), estimates crash costs of **$12.26 million per year**.

Figure 40: Crashes per Year



Crash Trend Analysis

Based on the analyzed data, the most prevalent crash trends are listed below:

- 65 percent of crashes occurred at intersections.
- 47 percent of crashes were rear end type crashes.
- 37 percent of crashes occurred between 4th Avenue S and 20th Avenue S.
- 31 percent of crashes were angle type crashes.
- 8 percent of crashes occurred at 20th Avenue S.
- 2 percent of crashes involved heavy vehicles (trucks).

These trends are evaluated in more depth in the following sections.

Critical Crash Locations

To identify overrepresented crash locations within the study corridor, the critical crash rate analysis method was used. The critical crash analysis method uses statistical analysis to help determine if differences between observed crash rates and typical crash rates are statistically significant and likely attributable to roadway design or traffic control. This method calculates location-specific crash rates and compares those rates against crash rates for similar facilities. MnDOT data was used for this critical crash analysis because it is the most comprehensive and highest quality data set currently available.

Intersections and segments with crash rates above the critical rate are considered overrepresented and in need for further review because there is a high probability that conditions at the site are contributing to the higher crash rate. Based on this analysis, these locations experience critical crash rates:

- Broadway from 46th Avenue N to 21st Avenue N
- Broadway from 11th Avenue N to 20th Avenue S
- 46th Avenue N
- 30th Avenue N
- 20th Avenue S
- 33rd Avenue S
- 40th Avenue S

Many of the locations with critical crash rates see crash rates significantly over the critical rate. For example, the 33rd Avenue S intersection's crash rate of 1.54 is 300 percent higher than the critical rate of 0.38. The segment of Broadway from Burdick Expressway to 20th Avenue S sees a crash rate of 3.23, which is 310 percent higher than the critical rate of

1.04. These high crash rates require a thorough evaluation to identify crash trends that may be able to be mitigated through this project.

The rest of the Broadway corridor segments had crash rates greater than the average, but less than critical crash rates for similar facilities. Intersections and segments with crash rates under the critical crash rate does not mean that crash trends and issues do not exist. Figure 44 shows the intersection and segment crash rates.

Crash Severity

Crash severity is important for implementation of safety related counter measures needed to compare and assess the roadway. It is categorized based on the most severe injury of the crash. For example, if a crash involved two vehicles that resulted in one incapacitating injury and two possible injuries, the crash is reported as incapacitating injury. There are five levels of crash severity including fatality, incapacitating injury, non-incapacitating injury, possible injury, and property damage.

Within the study period, there were 268 reported crashes that resulted in an injury, and 938 crashes that resulted in property damage only. Crash severity rates can also be compared to statewide and critical rates, like the critical crash rate.

- Broadway from 4th Avenue S to 20th Avenue S experienced a severity rate higher than the critical rate.
- All other segments between 46th Avenue N to 4th Avenue S have severity rates higher than average but below the critical rate.
- Ten intersections have severity rates higher than average, but none above the critical rate. These intersections include 46th Avenue N, 36th Avenue N, 30th Avenue N, 1st Avenue S, Burdick Expressway, 16th Avenue S, 20th Avenue S, 33rd Avenue S, 37th Avenue S, and 40th Avenue S.

Figure 45 shows the location of crashes by severity at the study intersections. The larger the chart, the more crashes that occurred at that intersection.

Figure 41: Crashes by Severity

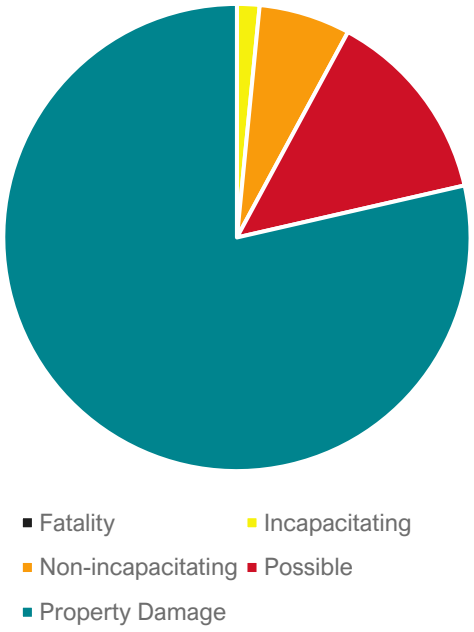
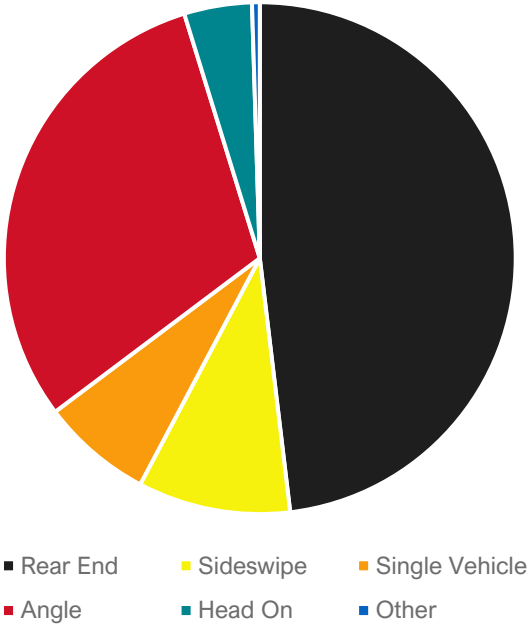


Figure 42: Crashes by Type



Crash Type

Identifying crash type at roadways assists in developing counter measures to mitigate or minimize the crash type. Rear end (550) and angle (363) crashes were the most typical crash types along the corridor, making up 47 and 31 percent respectively. Dense access spacing, failing to stop, following too closely, and speeding are few factors in a substantial proportion of rear end crashes along the corridor. Figure 46 shows the crashes by crash type at the study intersections during the analysis period. The larger the chart, the more crashes that occurred at that intersection.

Figure 43: Corridor Crash Density

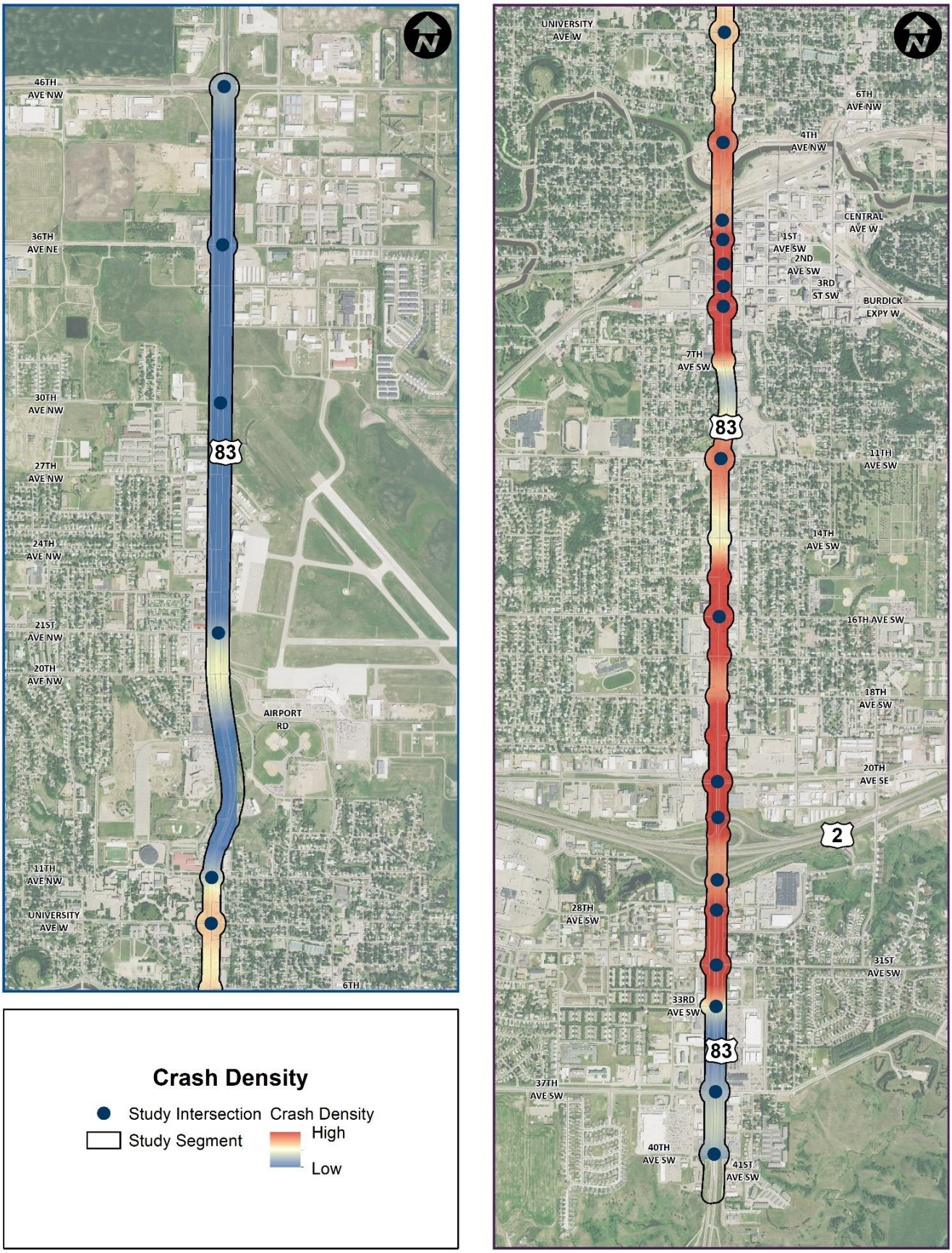


Figure 44: Corridor Crash Rates

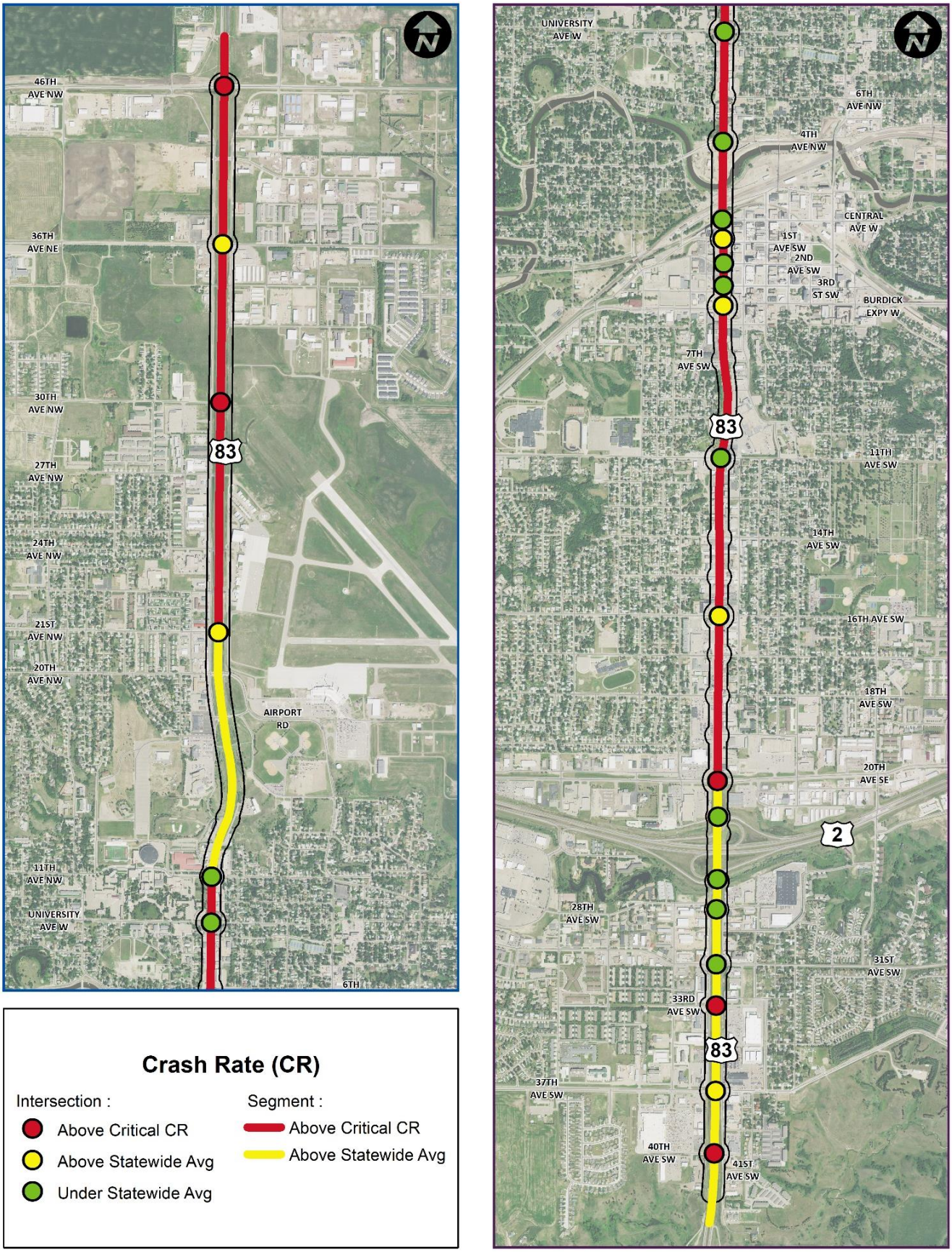


Figure 45: Corridor Crash Severity

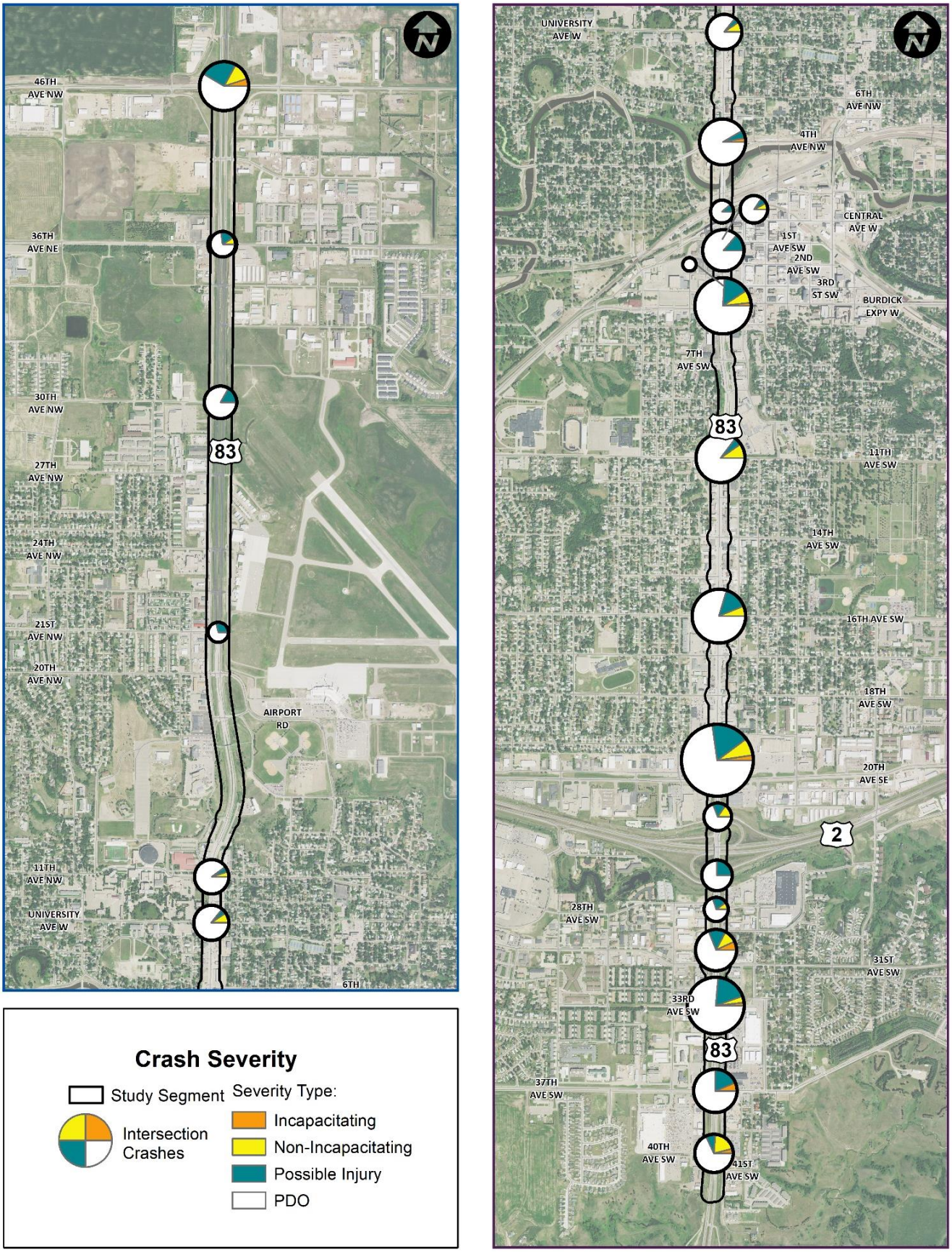
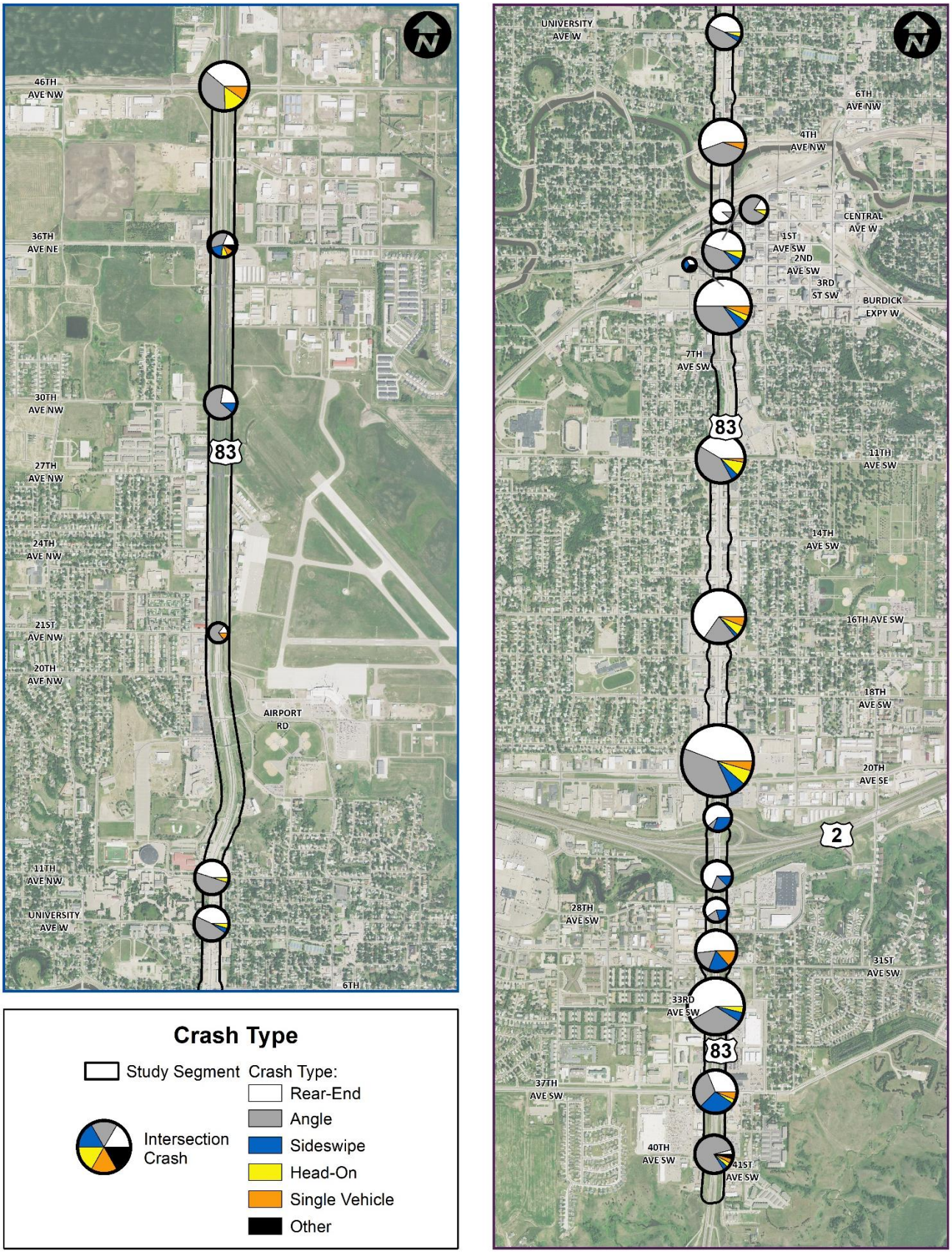


Figure 46: Intersection Crash Types



Crash Hotspots

Using the trends identified in the previous sections, additional analysis and evaluation was completed for multiple locations in the study area, primarily focusing on areas with above average or critical crash rates.

46th Avenue N to 21st Avenue N (Rural 4-Lane Divided Segment)

There were 103 crashes (23 segment and 80 intersection related) reported in this nearly 1.7-mile segment of Broadway between 46th Avenue N and 21st Avenue N. The segment's observed crash rate (0.56) is greater than the critical crash rate (0.52) for similar type of facility.

46th Avenue N (Signal Control)

Figure 47: 46th Avenue Cross Section

There were 41 crashes reported during the analysis period that corresponded to 8.2 crashes per year and is a critical crash location. There were 16 rear end crashes (39 percent). Rear end crashes are often the most common type of crashes at signalized intersections. There were no prevailing directional trends (31 percent occurred on the southbound approach and 31 percent on the east approach). Four (25 percent) of rear end crashes occurred during the AM peak hours and four (25 percent) during the PM peak hours.

There were 15 angle crashes (37 percent). Forty percent of angle crashes occurred between vehicles on the northbound and southbound approaches. Four angle crashes (27 percent) occurred due to red-light running. High speeds and lack of left-turn phasing may be contributing to this trend. However, left-turn phasing will be incorporated when the NW bypass expansion project is completed.

This traffic signal is the first signal for southbound traffic and given the design, operations and context, it can be expected that traffic speeds are high, making stopping difficult, leading to rear-end and angled crashes. According to the NDDOT Traffic Operations Manual: "Traffic signals in rural areas are discouraged for several reasons including violation of driver expectations and difficulty in servicing and maintaining signals in remote locations." There is a *Be Prepared to Stop* advanced warning flashers currently in place.

36th Avenue N (Signal Control)

There were 11 crashes (one non-incapacitating, two minor injury, eight PDO crashes) reported during the analysis period. The observed crash rate (0.42) is greater than the statewide average (0.25) but less than critical crash rate (0.52) for similar types of facilities. There were four angle crashes reported, which are common at thru-stop controlled intersections on high-speed facilities. The analysis did not indicate any other trends of the contributing factors for these crashes.

30th Avenue N (Two-Way Stop Control)

There were 18 crashes reported during the analysis period. The observed crash rate (0.68) is greater than the critical crash rate (0.52) for similar types of facilities. There were 12 angle related crashes reported. Of these crashes, seven (58 percent) involved vehicles traveling in the south and east directions. Angled crashes are common at thru-stop controlled intersections on high-speed facilities at high-volume locations. Additionally, seven crashes (58 percent) occurred during the AM and PM peak hours. The uninterrupted traffic flow on Broadway creates insufficient gaps for the minor approach traffic to enter the intersection and may be contributing to the high number of angle crashes.

Figure 48: Southbound Approach of 30th Avenue N

21st Avenue N to 11th Avenue N (Urban 4-Lane Divided Segment)

There were 74 crashes (21 segment and 53 intersection related) reported in the nearly 0.8-mile segment of Broadway between 21st Avenue N and 11th Avenue N. The observed crash rate (0.75) is greater than the statewide average (0.62) but less than critical crash rate (1.02) for similar types of facilities. Angle and rear end crashes were the most typical type of segment related crash in the segment.

21st Avenue N (Two-Way Stop Control)

There were seven crashes (two minor injury, and five PDO crashes) reported during the analysis period. The crash rate observed is greater than the statewide average but less than critical crash rate for similar types of facilities. Four (57 percent) occurred during the hours of 3 and 4 PM, which may be attributed to elementary school traffic.

Five of the seven crashes (71 percent) were angle crashes. Three of these crashes occurred when eastbound traffic failed to yield to northbound traffic.

Figure 49: Eastbound Approach of 21st Avenue N

11th Avenue N to North of the River (5-Lane Undivided Segment)

There were 153 crashes (68 segment and 85 intersection related) reported in the 0.64-mile segment of Broadway between 11th Avenue and the Mouse River. The observed crash rate (2.71) is greater than the critical crash rate (1.23) for similar types of facilities. There were 42-segment related rear end crashes observed. Following too close was among the highest contributing factor for the rear end crashes in the segment. There are 32 private driveway access points in this segment, which is significantly higher than access spacing guidelines. The dense access spacing creates misaligned driveways causing unexpected slowdowns throughout the corridor. Signal spacing is also likely a contributing factor to the high crash rate along this segment of the corridor. Traffic signal spacing on urban arterials through similar contexts is typically one-quarter to one-half mile and this segment of the corridor has four traffic signals in one-half mile, with two occurrences of signals spaced 750 feet or closer.

11th Avenue N (Signal Control)

There were 20 crashes (one non-incapacitating, one minor injury and 18 PDO crashes) reported during the analysis period. The crash rate observed is below the statewide average and critical crash rate for similar types of facilities.

Fifteen (80 percent) of the crashes were for the southbound approach, all but one of which were rear end or angle crashes. Half of all the intersection crashes can be attributed to either following too closely or traveling too fast for conditions. This may also be a contributing factor to the number of southbound crashes, as southbound vehicles are traveling downhill and coming from a high-speed, over-capacity area where excess speeding may be expected.

Figure 50: Southbound Approach at 11th Avenue N Intersection

North of River to Burdick Expressway (5-Lane undivided)

There were 131 crashes (43 segment and 88 intersection related) reported in the 0.4-mile segment. The observed crash rate (2.52) is greater than the critical crash rate (1.33) for similar types of facilities. Rear end crashes were the most frequent type of crashes in the segment. There are 34 public and private driveway access points in the segment. Once again, signal spacing is likely a contributing factor to the high crash rate along this segment of the corridor. While signal spacing through downtowns are frequently tightly spaced to support pedestrian/bicycle movements, signal spacing on urban arterials is typically one-quarter to one-half mile. This segment of the corridor has three traffic signals within one-quarter mile.

1st Avenue S (Two-Way Stop Control)

There were 13 crashes (one incapacitating injury, one minor injury, and 11 PDO crashes) in the analysis period. The crash rate observed is above the statewide average, but below the critical crash rate for similar types of facilities.

Angle crashes made up 77 percent of all crashes at this intersection. There are no obvious time of day or directional trends associated with these angle crashes. However, lack of traffic control on Broadway combined with high traffic volumes, adjacent traffic signals and speeds may result in fewer gaps in traffic for vehicles to make their turning movements. As drivers wait, they may become frustrated and accept a smaller gap. This is a common occurrence at thru-stops or principal arterials.

Figure 51: 1st Avenue S Intersection

Burdick Expressway to 20th Avenue (5-Lane undivided)

There were 433 crashes (221 segment and 212 intersection related) reported in the nearly 1.5-mile segment. There were two incapacitating injury related crashes reported during the analysis period. The first incident was reported in July 2017 where the motorist travelling northbound was speeding and failed to negotiate the curve north of 11th Avenue S. The second incident was reported in June 2016 where the motorists travelling southbound lost control and ran off road.

The observed segment related crash rate (3.23) is more than the segment related critical crash rate (1.04) for similar types of facilities. Segment related rear end and angle crashes were the most frequent type of crashes in the segment. Most of the crashes (63 percent) occurred along the southbound direction. There are 115 private driveway access points in the segment that corresponds to 77 private driveway access points per mile. The rear end crashes may be the result of traffic expecting the motorist in front of them to proceed through but instead the motorist stops to access the driveway. Another challenge of uncontrolled access spacing is how this distributed traffic to many different locations, which prevents any one location from warranting a traffic signal. The lack of control and the uninterrupted traffic flow on mainline creates excessive delay and inadequate gaps for vehicles on driveways to cross. As a result, motorists become impatient and take greater risks while attempting to enter the traffic stream at driveways, which increases the possibility of angle crashes.

Burdick Expressway (Signal Control)

There were 54 crashes (one incapacitating, four non-incapacitating, eight minor injury, and 41 PDO crashes) reported during the analysis period. The incapacitating crash incident was reported in March 2016. The motorist travelling southbound was following too close to the vehicle ahead and rear ended the vehicle at the traffic signal.

The observed crash rate (0.77) is greater than the statewide crash rate (0.70) but less than critical crash rate (0.96) for similar types of facilities. Rear end (27) and angle (19) crashes were the most frequent type of crashes at the intersection. Rear end crashes are often the most common type of crashes at signalized intersections. Rear-end crashes are common on highly trafficked intersections where longer than expected queues and delays are common. Nine of the 27 (33 percent) rear end crashes occurred during the AM and PM peak hours.

Most of the angle-related crashes were attributed to motorists running red lights, failing to yield, and speeding. Thirteen of the nineteen angle crashes were from turning vehicles on the major (north and south) approaches. These approaches have protected/permitted left-turn phasing, whereas the East-West approaches are protected only. Conversion to protected-only phasing has been proven to reduce angled crashes but often comes at a significant operational cost. In 2019, the intersection was changed to westbound-lead and eastbound lag, which may address the angle crash trends.

Figure 52: Northbound Approach at 16th Avenue S

16th Avenue S (Signal Control)

There were 49 crashes (three non-incapacitating, seven minor injury, and 39 PDO crashes) reported during the analysis period. This corresponds to 9.8 crashes per year. The observed crash rate is higher than the state average but lower than the critical crash rate.

Rear end (32) crashes were the most frequent type of crash at the intersection. Sixty percent of the rear end crashes included vehicles going north. Only 28 percent of these rear end crashes occurred during the AM or PM peak hour. Poor signal progression may be contributing to this crash trend.

20th Avenue S to 40th Avenue S (Urban 4-Lane Divided)

There were 274 crashes (31 segment, and 243 intersection-related) reported during the analysis period. The segment observed segment related crash rate (0.65) greater than the statewide average (0.62) but less than the critical crash rate (0.93) for similar types of facilities. Rear end (19) and sideswipe (10) crashes were the most observed type of crashes in the segment.

20th Avenue S (Signal Control)

There were 88 crashes (two incapacitating, seven non-incapacitating, 15 possible injury, and 64 PDO crashes) reported during the analysis period. This corresponds to 17.6 crashes at the intersection per year, and annual crash cost of $1.1 million, which is the highest among all the intersections in the study corridor. This intersection is ranked number 39 on NDDOT's 2016-2018 Urban High Crash Locations list, the most recently published list. The first incapacitating crash incident was a right-angle crash that was reported in April 2019, where the vehicle attempting to turn left from the eastbound approach failed to yield to the westbound vehicle. The second crash was reported in October 2015, where the motorist travelling southbound lost control and ran off road.

Figure 53: Eastbound Traffic on 20th Avenue S

Rear end (39) crashes were the most frequent type of crashes reported at the intersection. Two-thirds of these rear end crashes occurred on the north or south approaches. Southbound traffic often sees long queues due to poor lane utilization that impact driver expectancy while northbound experiences poor corridor progression due to the interchange signal timing.

There were 33 angle crashes at this intersection. Although the intersection allows permitted left-turns, 55 percent of these crashes occurred between perpendicular directions (i.e., north versus west). These are typically the most likely to result in a serious crash and most likely to be resolved by implementation of a traffic signal. This means that red-light running (six occurrences officially noted) and failure to yield (often caused by speeding) are contributing to this safety issue. This often occurs at intersections with poor operations, where drivers would rather risk driving through a yellow light than wait another full cycle length.

US 2 Interchange (Signal Control)

The US 2 west and east ramp intersections saw 29 total crashes (two non-incapacitating, six possible injury, and 21 PDO crashes) reported during the analysis period. The observed crash rate at these two intersections are below the average crash rate for similar types of facilities.

At these two intersections there were 19 rear end crashes, which is 65 percent of all crashes. Ten of these rear end crashes occurred in the southbound direction. Eight of the rear end crashes occurred during the AM and PM peak hours. It is likely poor stop-and-go traffic during the peak hours is contributing to the rear-end crash trends.

28th Avenue S (Two-Way Stop Control)

There were 10 crashes (one non-incapacitating, two possible injury, and seven PDO crashes) reported during the analysis period. The observed crash rate is lower than the average crash rate for similar types of facilities.

Rear end crashes were the most common type of crashes at this location. Six of the 10 crashes were rear end. Five of these rear end crashes occurred between 1 PM and 3 PM. The proximity to the US 2 interchange intersections and their queues may interfere with driver expectation at this intersection.

31st Avenue S (Signal Control)

There were 29 crashes (two incapacitating, three non-incapacitating, four possible injury, and 20 PDO crashes) reported during the analysis period. The observed crash rate is lower than the average crash rate for similar types of facilities.

Nearly half of the crashes that occurred at this intersection were rear-end crashes. Of these rear ends, seven occurred on the east approach going west and six occurred on the north approach going southbound. For eastbound traffic, there is dense access spacing, with seven access points in 650 feet. This creates undue friction along this approach. For the northbound trend, it is likely the traffic signal is creating unexpected queues, resulting in rear end crashes.

There were also five angle crashes at this location. Four of the five angle crashes involved a vehicle on the east approach. Poor operations and outdated signal timing may be contributing to this trend.

33rd Avenue S (Two-Way Stop Control)

There were 55 crashes (one incapacitating, two non-incapacitating, 10 possible injury, and 42 PDO crashes) reported during the analysis period. The incapacitating crash incident was reported in December 2019, where the vehicle travelling northbound was speeding and rear ended the vehicle ahead. The observed crash rate (1.54) is greater than the critical crash rate (0.38) for similar types of facilities.

Figure 54: Queueing at 31st Avenue Impacts Crash Trends at 33rd Avenue S

Rear end (32) and angle (18) crashes were the most frequent type of crashes reported at the intersection. More than 70 percent of the rear end crashes occurred on the north or south approaches. Only five of the rear end crashes occurred during either the AM or PM peak hour. Speeding and following too close are among the contributing factor for the rear end crashes at the intersection. This is noteworthy, considered Broadway is uncontrolled at 33rd Avenue. Meaning the congestion from downstream traffic signals has created enough speed differential to create rear end crashes. It is likely these crashes are mostly the result of congestion at upstream traffic signals but occurring around 33rd Avenue.

Nearly 40 percent of angle crashes occurred during the AM or PM peak hours. The intersection is a three-quarter intersection that restricts minor approach traffic to turn left. The uninterrupted traffic flow on Broadway creates insufficient gaps for the major approach traffic to turn left. As a result, motorists become impatient and take greater risks while attempting to turn left, which increases the possibility for angle crashes.

Figure 55: Three-Quarter Access at 33rd Avenue S

37th Avenue S (Signal Control)

There were 32 crashes (two incapacitating, six possible injury, and 24 PDO) reported during the analysis period. The observed crash rate is higher than the average crash rate for similar types of facilities but lower than the critical rate.

There were 10 angle crashes at this intersection, two of which resulted in an incapacitating injury. Seven of these crashes occurred with major approach and minor approach conflicts. This may indicate poor operations are causing drivers to take risks instead of sitting through another signal cycle or that signal timing may not be providing enough time to clear the intersection from opposing movements.

There were 10 rear end crashes at this intersection as well, four of which occurred during the AM and PM peak hours. Six of the rear end crashes involved northbound vehicles. This intersection is the first traffic signal as drivers enter Minot and they may not be prepared to stop, resulting in rear end crashes.

40th Avenue S (Two-Way Stop Control)

There were 25 crashes (one incapacitating, five non-incapacitating, two possible injury, and 17 PDO crashes) reported during the analysis period. The incapacitating crash incident, which was an angle type was reported in December 2017, where a traffic travelling eastbound failed to yield to traffic travelling westbound. No clear contributing factor was reported for the incident. The observed crash rate (0.82) is greater than critical crash rate (0.39) for similar types of facilities.

Figure 56: Southbound Traffic from the Eastbound Approach

Angle crashes were 80 percent of crashes that occurred at this intersection. Of these angle crashes, 85 percent involved vehicles heading south and east. The eastbound approach serves a major commercial development including a strip mall, multiple restaurants, and Wal-Mart. Seven of the angle crashes occurred during or after 5 PM, typical of shopping and restaurant trips. The uninterrupted traffic flow on Broadway, compounded by high-speeds and high volumes creates insufficient gaps for the major approach traffic to turn left. As a result, motorists become impatient and take greater risks while attempting to turn left, which increases the possibility for angle crashes.

Surrogate Safety Assessment Model Results

To establish a baseline for future safety comparisons between alternatives, simulated vehicle conflicts were tabulated from Vissim simulation results using the Surrogate Safety Assessment Model (SSAM). SSAM uses Vissim modeled vehicle trajectory information to analyze vehicle-to-vehicle interactions to identify conflict events and near-miss conflicts. This analysis considers vehicle speeds, deceleration characteristics, typical gap acceptance behavior, traffic volumes, and site-specific vehicle paths to quantify predicted conflicts for rear-end, crossing, and lane change crash types. It is important to note that simulated conflicts may not directly correlate to crashes, rather the tool is intended to identify conditions with a high *potential* for crashes.

Simulation results from an average of ten 12-hour Vissim model runs were used for this analysis and show the potential change of each crash type. Under the existing conditions, there were 7,628 total simulated conflicts. These conflicts were split between crossing conflicts (angle), rear end, and lane change (sideswipe). Table 12 shows the SSAM conflict results compared to the historic crash data. Generally, the SSAM results are very similar to the historical crash trends experienced on the Broadway corridor. These results will be used to compare future conditions and alternatives concepts in the next steps of this study.

Table 12: SSAM and Historic Crash Trends

Crash Type	Historical	SSAM
Crossing	37%	36%
Rear-End	46%	49%
Lane Change	7%	15%

Access Management

Access management is the process of balancing the competing needs of traffic movement and land access. Access points introduce conflict and friction into the traffic stream. Allowing dense, uncontrolled access spacing results in safety, operational, and aesthetic deficiencies:

- According to NCHRP Report 420, Impact of Access Management Techniques, every unsignalized driveway increases the corridor crash rate by approximately two percent.
- Research included in the Highway Capacity Manual found that roadway speeds were reduced an average of 2.5 miles per hours for every ten access points per mile.

Within the city of Minot, there are nearly 150 access points along the six-mile Broadway corridor. However, 80 percent of these access points are along one mile between 11th Avenue S and 20th Avenue S. NDDOT's design manual states the minimum desirable spacing of access points in urban areas is 400 to 600 feet, which is approximately eight to 13 per mile.

North of 11th Avenue N and south of 20th Avenue S, the Broadway corridor is under the upper limit of recommended access points per mile. However, the segments between see very dense access spacing. Table 13 shows the recommended access spacing and actual number of access points along Broadway. Figure 57 shows where accesses are located and their type.

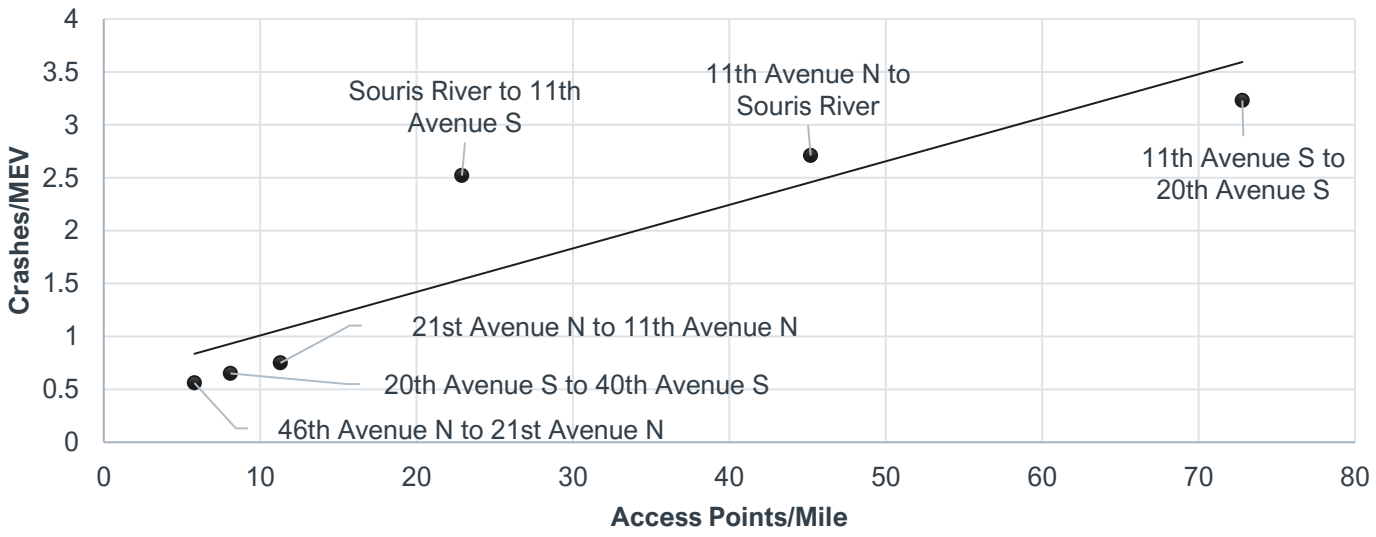
Table 13: Number of Access Points per Mile

Segment	# of Access Points	Miles	Existing Access Points per Mile	Recommended Access Points per Mile	% Over Recommended Access Points per Mile
46th Avenue N to 21st Avenue N	10	1.72	5.8	No More than 13	Under
21st Avenue N to 11th Avenue N	9	0.80	11.3		Under
11th Avenue N to Mouse River	28	0.62	45.2		**+347.7%**
Mouse River to 11th Avenue S	19	0.83	22.9		**+176.2%**
11th Avenue S to 20th Avenue S	75	1.03	72.8		**+560.1%**
20th Avenue S to 40th Avenue S	11	1.36	8.1		Under

Relationship to Corridor Safety

There is a very strong relationship between access density and safety. The segments of Broadway that see the highest access density, 11th Avenue N to 20th Avenue S, also see the highest crash rates. The segment between 11th Avenue S and 20th Avenue S has 75 access points in just over one mile. This is 560 percent higher than the recommended access density. This segment's crash rate is 3.23, which is 310 percent higher than the critical crash rate for that type of facility. Alternatively, the segment between 20th Avenue S and 40th Avenue S has just 8 access points per mile, which is forty percent fewer than the recommended access density. This segment's crash rate is 0.65, which is 30 percent lower than the critical crash rate for that type of facility.

Table 14: Access Density and Crash Rates



Access Utilization

Anecdotally, Minot residents often comment on how they know "every road that is not Broadway" and the challenges with making left-turns onto and off-of the corridor at unsignalized intersections. Data was collected at all driveways and intersections (75 total) between 11th Avenue S and 20th Avenue S to understand how often vehicles make left turns at the unsignalized intersections, as shown in Figure 58 and Figure 59. During the off-peak hour that was counted, 43 percent of driveways had less than five left-turns. During the peak hour that was counted, 50 percent of driveways had less than five left-turns.

Figure 57: Access Summary

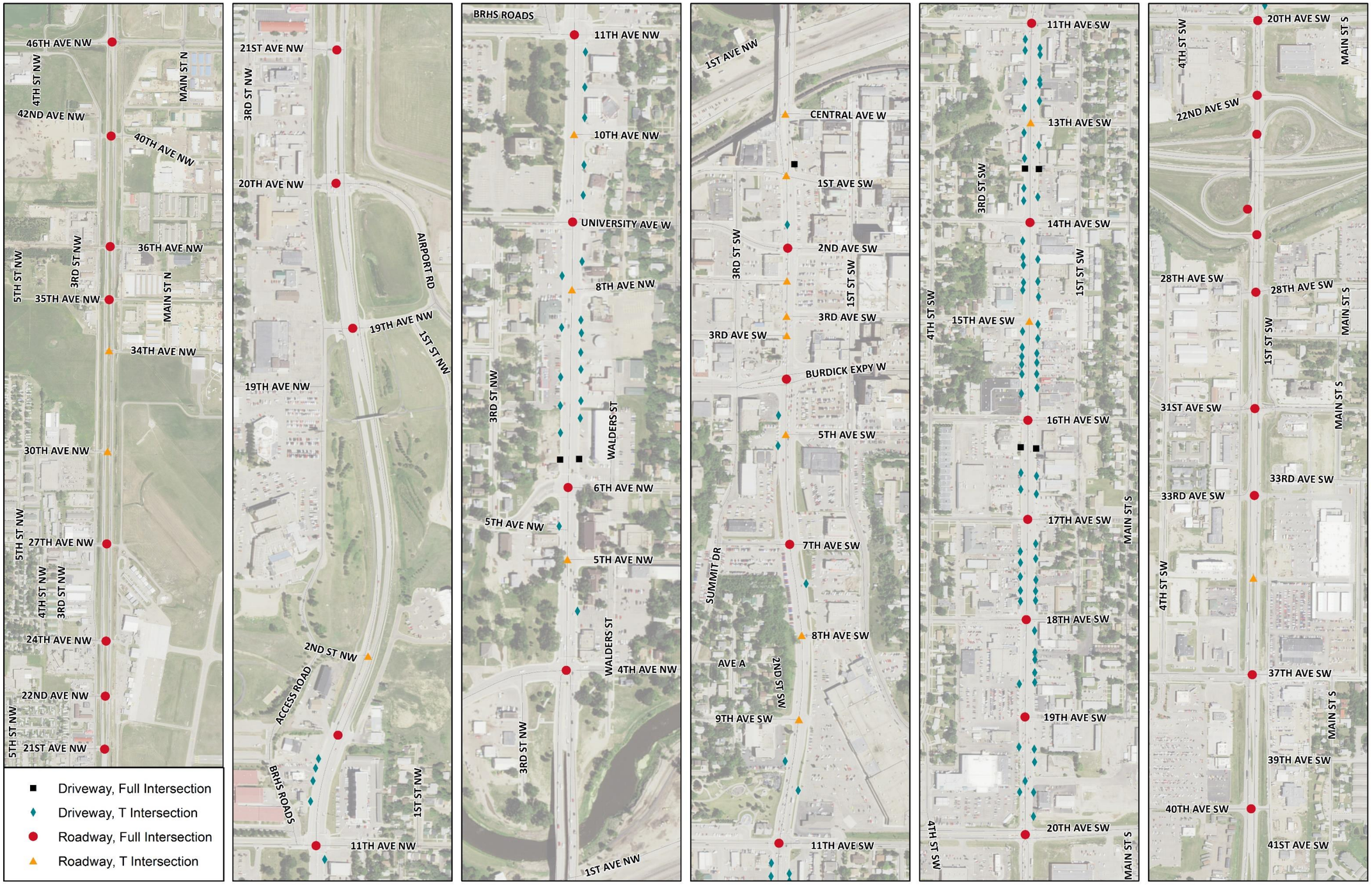


Figure 58: Access Utilization During Non-Peak Hour

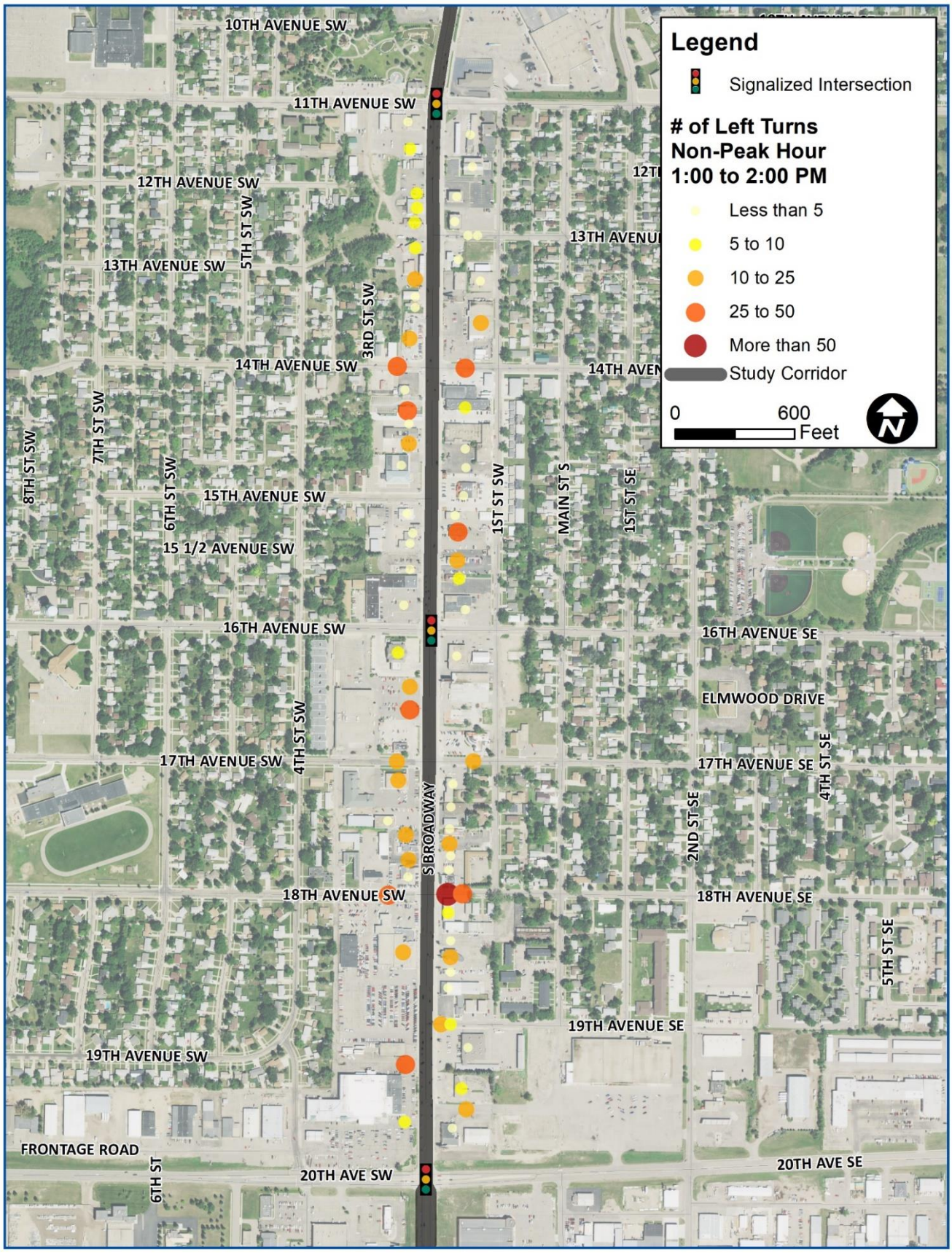
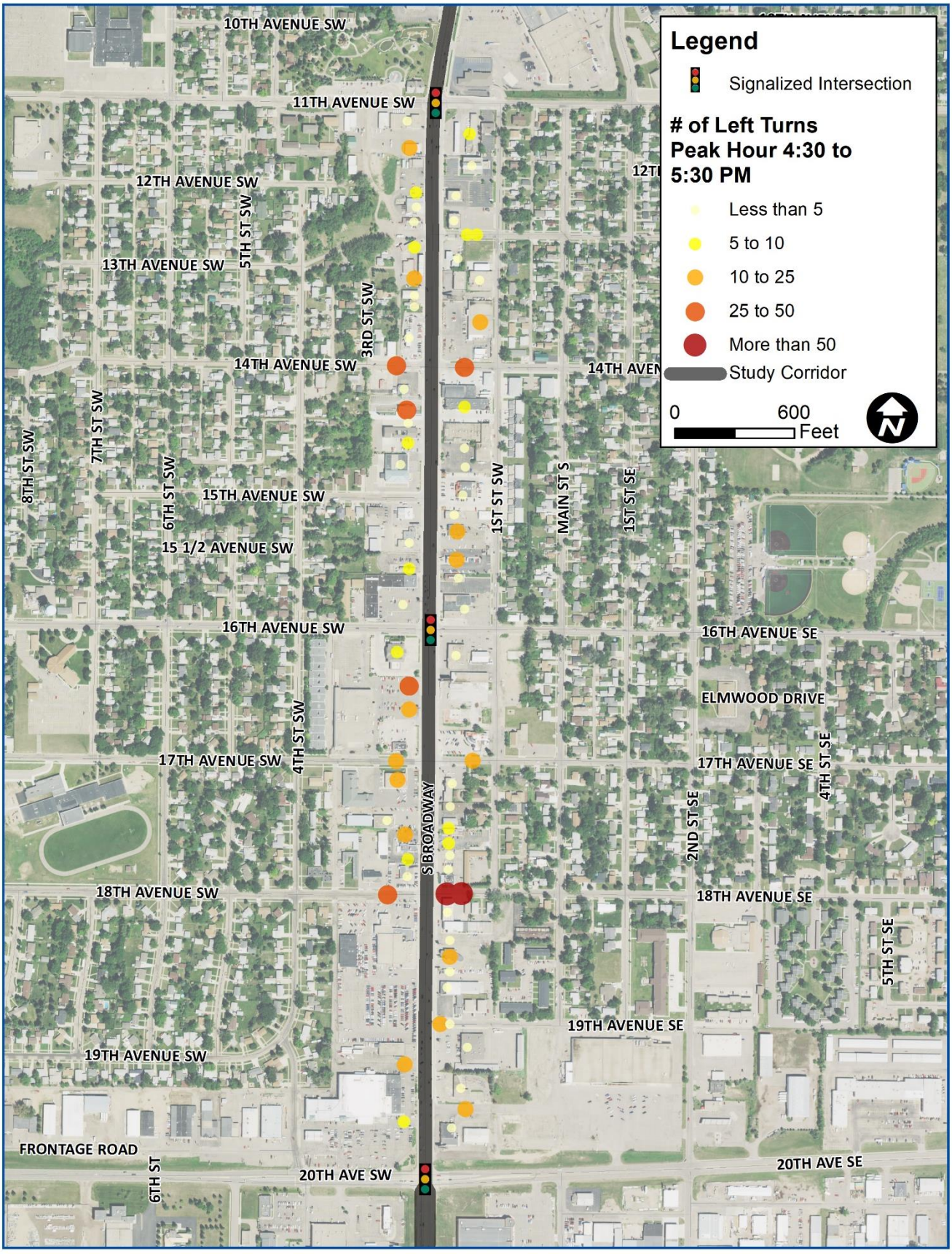


Figure 59: Access Utilization During Peak Hour



ENVIRONMENTAL CONDITIONS

The existing environmental conditions, or affected environment, are the baseline conditions in a given area. The affected environment consists of the baseline resources that could constrain alternatives development or be impacted by a project. This documentation assists in the development of the potential future National Environmental Policy Act (NEPA) documentation as well as to assist in identifying potential constraints when developing build alternatives. The corridor assessment includes the Broadway corridor and adjacent properties including associated sidewalks, intersections, and properties.

This section contains an overview of the current environmental conditions within 200 feet of the Broadway corridor that could affect alternatives development. A desktop assessment of the corridor was completed using a variety of federal, state, and local resources to identify potential environmental constraints and impacts that projects along the corridor could encounter. As project alternatives are developed and refined, this assessment of impacts will also become more refined.

REGULATED MATERIALS/WASTE

Regulated materials/waste and contaminated properties can be hazardous to human health and the environmental well-being of an area. The Environmental Protection Agency (EPA) is the federal agency that regulates the remediation of hazardous waste and contaminated areas. In addition to the EPA, the North Dakota Department of Environmental Quality (NDDEQ) Division of Waste Management is responsible for enforcing state and federal environmental laws to regulate where and how materials are stored and their ultimate disposal.

- The NDDEQ operates the Brownfields Program, a program used by the Department to assess and cleanup sites where there is release or substantial threat of release of a hazardous material, pollutant or contaminant. A review of Brownfields Sites in North Dakota did not identify any within or near the Broadway corridor.
- A search of the EPA's Envirofacts to identify and locate hazardous waste handlers, identified several commercial businesses within and adjacent to the corridor (e.g., gas and service stations, auto dealerships, hospital and dental offices, etc.). It is anticipated that a number of these businesses have underground storage tanks as well.
- A search of the EPA's Superfund sites to identify locations requiring long-term response to clean-up hazardous material contaminants did not identify any within or near the Broadway corridor.

To fully determine the extent of potential contaminated properties within the Broadway corridor, it is recommended a Phase I Environmental Site Assessment be completed prior to any right-of-way acquisition or construction activities in the corridor.

SOCIAL AND ECONOMIC

All transportation projects have some level of associated social and economic impacts. In general, projects aimed at improving transportation corridors have beneficial overall social and economic impacts. Temporary social and economic impacts could occur during construction activities as a result of reduced mobility through construction zones.

Existing roadway right-of-way varies along the corridor and is generally constrained by existing development. Improvements along the corridor may require acquisition of right-of-way and/or temporary easements. Coordination with landowners and/or residents would be required for any acquisitions, access changes, or relocations in accordance with state and federal law, including the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

ENVIRONMENTAL JUSTICE

Consistent with Executive Order (EO) 12898 - Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, measures must be taken to avoid disproportionately high, adverse impacts on minority or low-income communities.

The EPA's EJSCREEN tool and the U.S. Census Bureau's American Fact Finder was used to review demographics within 200 feet of the Broadway corridor for low-income and/or minority populations.

Minority and low-income population data for the corridor and the city of Minot was obtained. The minority population of the corridor is 20 percent and the low-income population is 43 percent, while the minority population of the city of Minot is 16 percent and the low-income population is 23 percent. The low-income population within the corridor are more than 10 percentage points greater than the respective population within the city of Minot. Therefore, the low-income populations within the study area are considered environmental justice populations.

Should impacts during construction activities along the corridor happen to be limited to the area where the identified environmental justice population is located, this population has the potential to experience disproportional impacts on a temporary basis. Permanent impacts of projects along the corridor are intended to improve the transportation corridor for all users; however, the following potential impacts would need to be assessed: splitting existing neighborhoods, promoting social isolation of a particular population, reduction of neighborhood community access or mobility, or promotion the separation of residences or sections of a neighborhood from community facilities or services.

Pedestrians and Bicyclists

The assessment corridor includes several pedestrian and bicyclist generators, such as Sertoma Sports Complex, Bishop Ryan High School, Minot State University, Trinity Hospital, as well as, commercial areas, and residential areas. Existing sidewalks extend primarily within the middle of the assessment area on one or both sides of Broadway, from 20th Avenue S to 11th Avenue N. At 11th Avenue N, the sidewalk converts to a multi-use path extending north to 21st Avenue N. Four other multi-use paths provide a connection to the Broadway corridor.

Improvements to the corridor would have the potential to improve the pedestrian and bicyclist network within the assessment corridor.

Water Resources

Surface Water

Surface water resources generally include lakes, rivers, streams, floodplains, and wetlands. Water resources were desktop-evaluated using US Department of Agriculture (USDA) National Aerial Imagery Program (NAIP) aerial imagery, US Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) maps, FEMA FIRMs, US Geological Survey (USGS) National Hydrography Dataset (NHD), and various mapping tools.

The Mouse River and two associated drainages occur within the assessment corridor. To fully determine the extent of aquatic resources within the Broadway corridor, it is recommended a field wetland delineation be completed during the growing season.

Any direct impacts on surface water would likely require a Section 404 permit from the US Army Corps of Engineers (USACE). Indirect impacts on surface water during any project construction activities should be minimized by implementing erosion and stormwater best management practices.

Floodplains

Floodplains constitute land situated along rivers and their tributaries that are subject to periodic flooding with a one percent chance of being flooded in any given year, on the average interval of 100 years or less. EO 11988 - Floodplain Management requires federal agencies to take actions to reduce the risk of flood losses and flood impacts on human safety, health, and welfare, whenever possible. Pursuant to EO 11988, potential effects on floodplains must be evaluated and alternatives that avoid adverse effects and incompatible development in floodplains must be evaluated. If it is found that the only practicable alternatives require siting in a floodplain, it is necessary to design or modify the project to minimize potential harm to or within the floodplain. The North Dakota Floodplain Management Act of 1981 stipulates that the 100-year base flood elevations cannot be increased because of the proposed project.

These flood protection measures are to be applied to new construction or rehabilitation. Projects within Floodways or Special Flood Hazard Areas identified on Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRMs) are required to obtain permits from local floodplain administrators.

The assessment corridor includes a floodway associated with the Mouse River and floodplain, Zone AE. Zone AE, as defined by FEMA, are high risk areas subject to inundation by the 1-percent-annual-chance flood event. Mandatory flood insurance is required, and floodplain permits and management apply to this area. Beyond Zone AE is Zone X. Zone X are moderate-to-low risk areas subject to inundation by the 0.2-percent-annual-chance flood event. Floodplain permits for construction are not required in these areas.

Noise

Noise is generally defined as unwanted sound, and can be intermittent or continuous, steady or impulsive, stationary or transient. Noise levels discernible by humans and animals are dependent on several variables, including distance and ground cover between the source and receiver and atmospheric conditions. Perception of noise is affected by intensity, frequency, pitch and duration. Noise levels corresponding to human hearing are quantified by A-weighted decibels (dBA).

Any transportation project within the assessment corridor having Federal Highway Administration (FHWA) involvement would require a noise analysis in accordance with Procedures for Abatement of Highway Traffic Noise and Construction Noise (23 CFR 772) for “Type 1” projects. These projects include new construction, substantial alteration of horizontal and/or vertical alignment, addition of through-traffic lanes (including restriping). The first step in a noise analysis is assigning each land use an activity category and identifying sensitive noise receptors (i.e., areas of frequent human use). A computer model is then used to determine whether traffic noise impacts are anticipated and if noise abatement (e.g., implementation of noise barriers) is necessary.

Activity categories within the assessment corridor include:

1) Residential (Category B)
2) Non-residential land uses such as Bishop Ryan High School and Scandinavian Heritage Park, multi-use paths, etc. (Category C or D, depending on whether frequent human use occurs outside or inside, respectively)
3) Restaurants, offices, etc. (Category E)
4) Retail, utilities, etc. (Category F)
5) Presumably undeveloped lands that are not permitted for development (Category G).

If improvements to the corridor would be considered Type I projects, a noise analysis would be required for areas with activity categories B through E.

Historic and Archaeological Preservation

Section 106 of the National Historic Preservation Act (54 U.S.C. § 306108) requires that federal agencies consider the effects of their undertakings on historic properties. A historic property is any prehistoric or historic district, site, building, structure, or object included on, or eligible for inclusion on, the National Register of Historic Places (NRHP). The Section 106 review process is defined in regulations promulgated by the Advisory Council on Historic Preservation (ACHP), “Protection of Historic Properties” (36 CFR Part 800).

There are publicly listed historic properties on the NRHP within the assessment corridor, the US Post Office at 100 1st St SW, and Minot Commercial Historic District and Minot Industrial Historic District. Confidential historic properties or historic properties that have yet to be identified may also be present along the corridor. Projects along the corridor should include a records search at the State Historic Preservation Office (SHPO) records, field cultural resources inventory, and coordination with the SHPO to ensure all historic properties are identified and properly handled.

Section 4(f) Resources

Section 4(f) of the Department of Transportation Act (23 U.S.C. 138) prohibits federal transportation agencies from approving the use of significant public parks, recreational areas, wildlife and waterfowl refuges, or public and private historical sites unless no feasible and practicable avoidance alternative exists. If such an avoidance alternative is not available, only the alternative with the least harm, including all possible planning to minimize harm, can be approved.

Section 4(f) is likely applicable to Via-View Park, Scandinavian Heritage Park, the grounds of Bishop Ryan High School and Minot State University, multi-use paths, and the US Post Office, Minot Commercial Historic District and Minot Industrial Historic District. In addition, sites determined to be on or e*ligible* for listing on the NRHP that may be identified during project-specific surveys and coordination would be protected by Section 4(f).

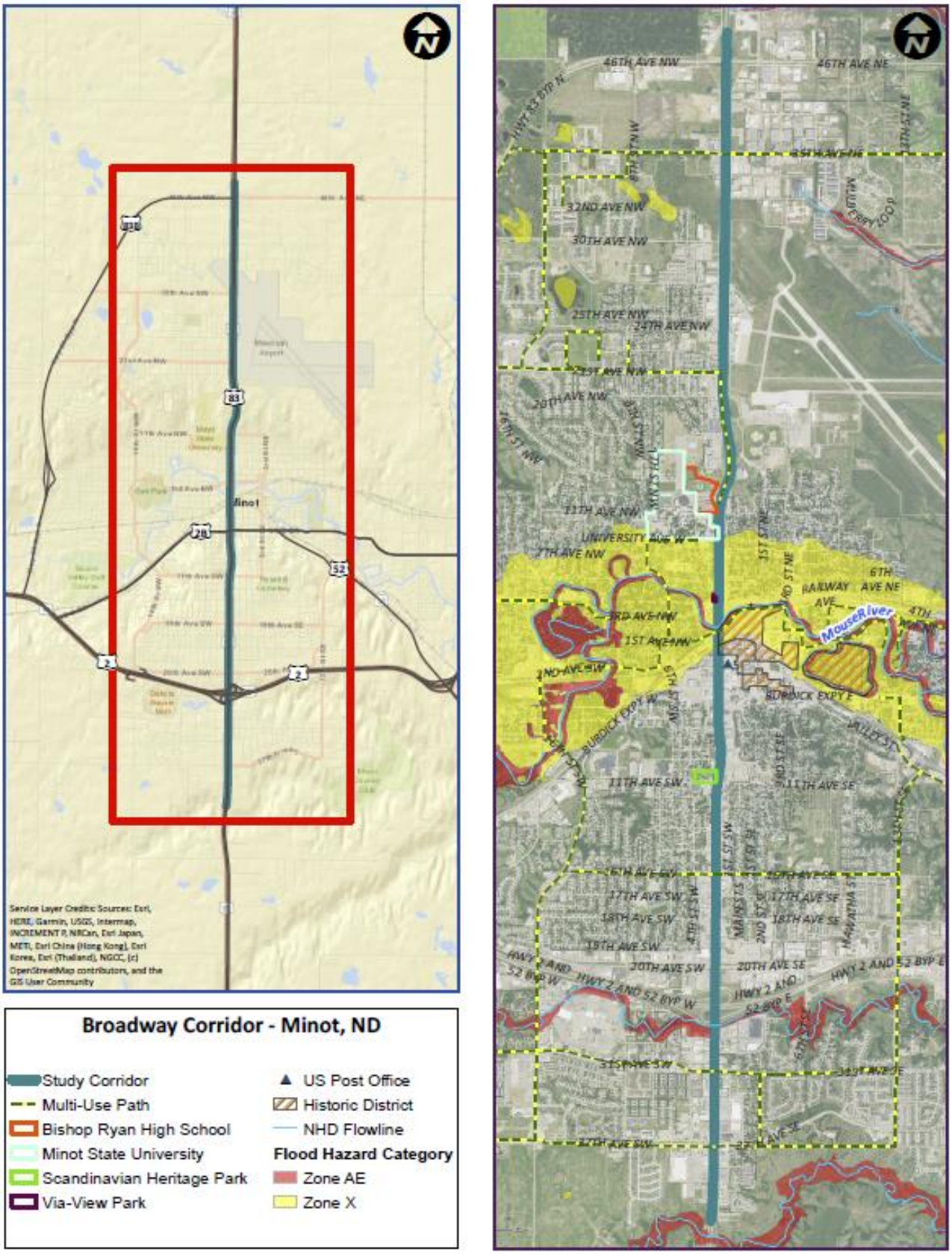
Should projects along the corridor include FHWA involvement, the FHWA would need to determine which properties Section 4(f) applies to and can only approve the project alternative(s) that avoid Section 4(f) resources if any such alternatives exist. If no feasible and prudent avoidance alternative exists, coordination with the official(s) with jurisdiction over the affected Section 4(f) resource(s) would be required to minimize and mitigate for impacts and identify the alternative(s) with least harm. Any Section 4(f) approval by the FHWA would require the appropriate coordination and documentation (e.g., Section 4(f) evaluation) efforts.

Section 6(f) Resources

Section 6(f) of the Land and Water Conservation Act requires that the conversion of lands or facilities acquired with Land and Water Conservation Funds (LWCF) be coordinated with the Department of Interior through the North Dakota Parks and Recreation Department (NDPRD). When such a conversion occurs, replacement in-kind is typically required.

According to the NDPRD's North Dakota LWCF Project and Grant Listing (2007-2018), there are no projects within the Broadway corridor having received LWCF funding.

Figure 60: Environmental Conditions Summary



ISSUES AND OPPORTUNITIES

The physical conditions, existing multimodal traffic conditions, and environmental conditions evaluated a range of qualitative and quantitative data surrounding the Broadway corridor to understand the issues and opportunities, which is summarized below. This, along with public input and the future conditions analysis was used to develop and analyze alternatives to improve the corridor for all users.

Infrastructure

The Broadway corridor has received regular investment over the last thirty years, resulting in most of the corridor having high quality infrastructure.

- There are some areas of poor pavement conditions, especially around the US 2 interchange.
- Public and private utilities may require coordination during future construction projects.
- Narrow ROW and ROW encroachments, especially in the urban core could limit potential improvements.

Multimodal Level of Service

The level of service along the Broadway corridor varies widely depending on your mode of travel.

- For vehicles, the operations are quite good on mainline Broadway resulting in frequent speeding. At uncontrolled side street locations, the high speeds and high traffic volumes on Broadway result in deficient peak hour operations. These long delays create the perception of poor operations on Broadway.
- For freight, the corridor is very reliable but the dense signal spacing can create some friction and frustration.
- For pedestrians, the narrow sidewalks, often adjacent to the roadway and sometimes in poor condition or with obstructions is very uncomfortable. Dense access spacing creates safety issues and makes ADA compliance challenging. Additionally, the lack of safe crossing facilities can create an unsafe pedestrian experience and reduce people's willingness to walk.
- For bicycles, there are no dedicated facilities throughout most of the corridor. The roadway is uncomfortable for nearly all cyclists and the sidewalks are unsuitable.
- For transit, service is mostly infrequent and is unlikely to support most choice riders.
- Ultimately, most of the corridor operates at LOS D or E, reflecting poor operations for pedestrians, bicycles, and transit users.

Crash History

There were 1,168 crashes reported over the last five years in the nearly six-mile corridor. Multiple segments and intersections have crash rates higher than the critical rate. Many of the locations with critical crash rates see crash rates significantly over the critical rate. For example, the 33rd Avenue S intersection's crash rate of 1.54 is 300 percent higher than the critical rate of 0.38. The segment of Broadway from Burdick Expressway to 20th Avenue S sees a crash rate of 3.23, which is 210 percent higher than the critical rate of 1.04. These high crash rates require a thorough evaluation to identify crash trends that may be able to be mitigated through this project.

Despite the high rate of crashes, only one segment had a severity rate higher than the critical rate: Broadway between Burdick Expressway and 20th Avenue S.

Access Management

Within the city of Minot, there are nearly 150 access points along the six-mile Broadway corridor. However, 80 percent of these access points are along one mile between 11th Avenue S and 20th Avenue S. The high access density is highly correlated with the high crash rates along the corridor. The same segment has a crash rate that is 310 percent higher than the critical rate for that type of facility. Alternatively, the segment between 20th Avenue S and 40th Avenue S has just 8 access points per mile, which is forty percent fewer than the recommended access density. This segment's crash rate is 0.65, which is 30 percent lower than the critical crash rate for that type of facility.

ENVIRONMENTAL CONDITIONS

The environmental conditions assessment identified multiple potential constraints within the Broadway corridor for future build alternatives. These will depend on the type and location of the build alternatives and may not be applicable for all situations.

- Sensitive noise receptors, a noise analysis may be necessary.
- Section 4(f) properties, a Section 4(f) analysis may be necessary.
- Water resources, special floodplain or USACE permitting may be necessary.
- Two historic districts and one historic site.

TRAFFIC PROJECTIONS METHODOLOGY

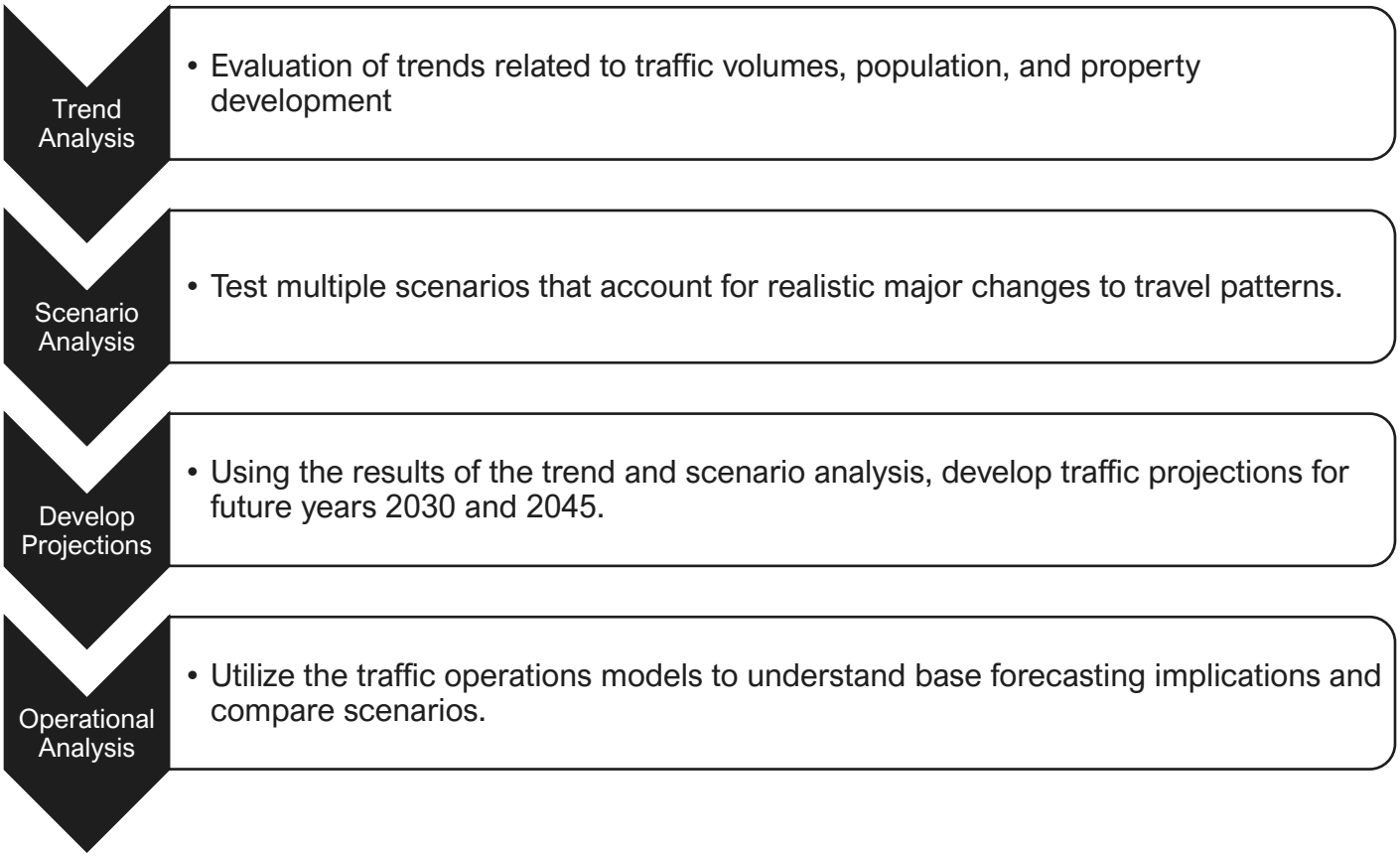
This future traffic conditions analysis has been prepared to document analysis and recommendations related to assumed future traffic conditions along the Broadway corridor in Minot. This analysis will support eventual recommendations for transportation improvements throughout the study area.

METHODOLOGY

Many of the most recent planning efforts in Minot were completed during the peak period of oil and gas activity in western North Dakota (2010 to 2015). These planning efforts were completed when future conditions were difficult to project given the unpredictable nature of oil and gas activity and development related to these industries. Since 2015, rapid growth has subsided, with development trends since 2015 more closely following typical trends for the region.

Given the major growth that was seen in Minot between 2010 and 2015, a traffic projections methodology was developed to account for more typical growth, taking into consideration the long-term impacts of development that has occurred in the area in the last five to ten years. This process is summarized in Figure 61.

Figure 61: Traffic Projections Methodology



Using the results of the trend analysis, scenario analysis and operational analysis, the Steering Committee will be consulted to determine what forecasting assumptions should be used in the Alternatives Analysis phase of this study.

Trend Analysis

Traffic Volume Trends

Traffic volumes dating back to the 1990s were obtained from the North Dakota Department of Transportation (NDDOT) to evaluate growth trends that have been observed over the past five years, ten years, and 20 years. Trend analysis focused on three segments of the corridor:

- North segment: 11th Avenue North to 46th Avenue North/US 83 Bypass
- Middle segment: US 2 to 11th Avenue North
- South segment: 40th Avenue South to US 2

Trend analysis was segmented to account for different land use composition and density along the corridor, and to consider the greater development potential on the north and south ends of the study area since the middle segment is generally built out. See Figure 63 for expected growth areas.

To start trend analysis, locations in each segment of the Broadway corridor with several data points were evaluated to observe high-level trends and potential variations throughout the study area. Further growth rate analysis that includes more locations on the corridor is presented later in this report.

Trends from 1991 to 2019 and previously developed 2035 traffic projections are shown in Figure 62.

- **North segment**: Between 1991 and 2004 the north segment carried around 9,000 ADT, with volumes remaining generally stable in this time period. Traffic growth was seen during the Bakken oil boom, peaking in 2014, before dropping in 2015. Traffic volumes on the north segment have returned to around the 2014 peak of around 12,000 ADT in 2019.
- **Middle segment**: Between 1991 and 2004, the middle segment carried around 25,000 ADT, reaching a peak of 30,000 ADT in 2014 during the Bakken boom before dropping in 2015. Traffic volumes remain lower than the 2014 peak, with around 26,000 ADT in 2019.
- **South segment**: Between 1991 and 2004 the south segment carried around 9,000 ADT, with volumes remaining generally flat in this time period. Bakken oil and gas activity resulted in rapidly increasing traffic volumes, peaking in 2014 at around 23,000 ADT, before dropping in 2015. Traffic volumes remain lower than the 2014 peak, however are still greatly elevated compared to pre-boom levels, with around 19,000 ADT in 2019. The south segment has experienced the greatest amount of adjacent development during this time frame.

Figure 62: Traffic Growth Overview 1991 to 2019

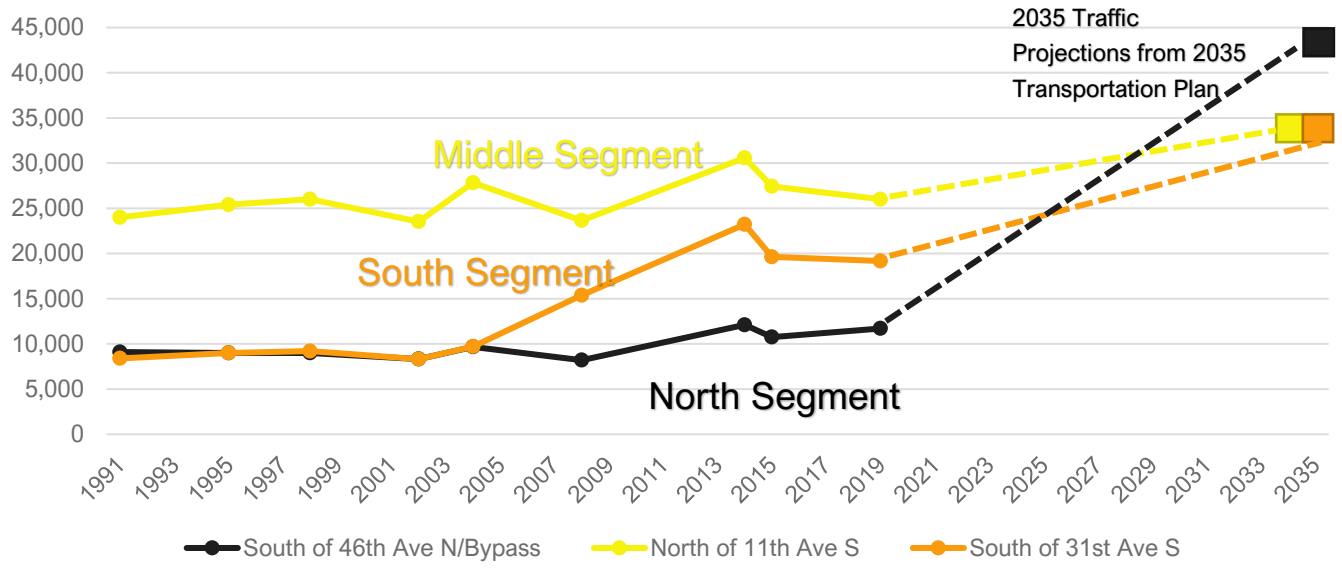
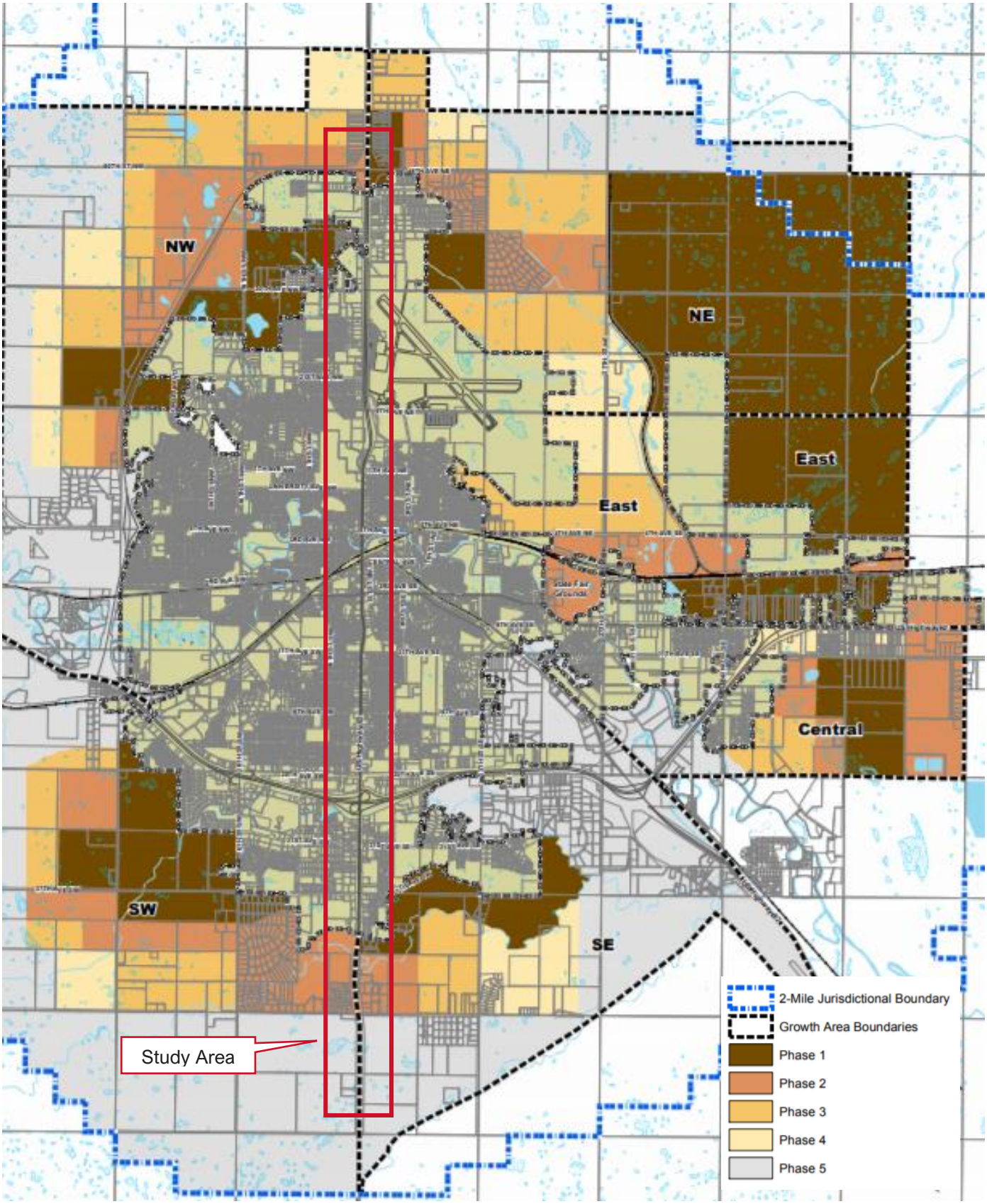


Figure 63: Expected Growth Areas



Source: Minot 2012 Comprehensive Plan

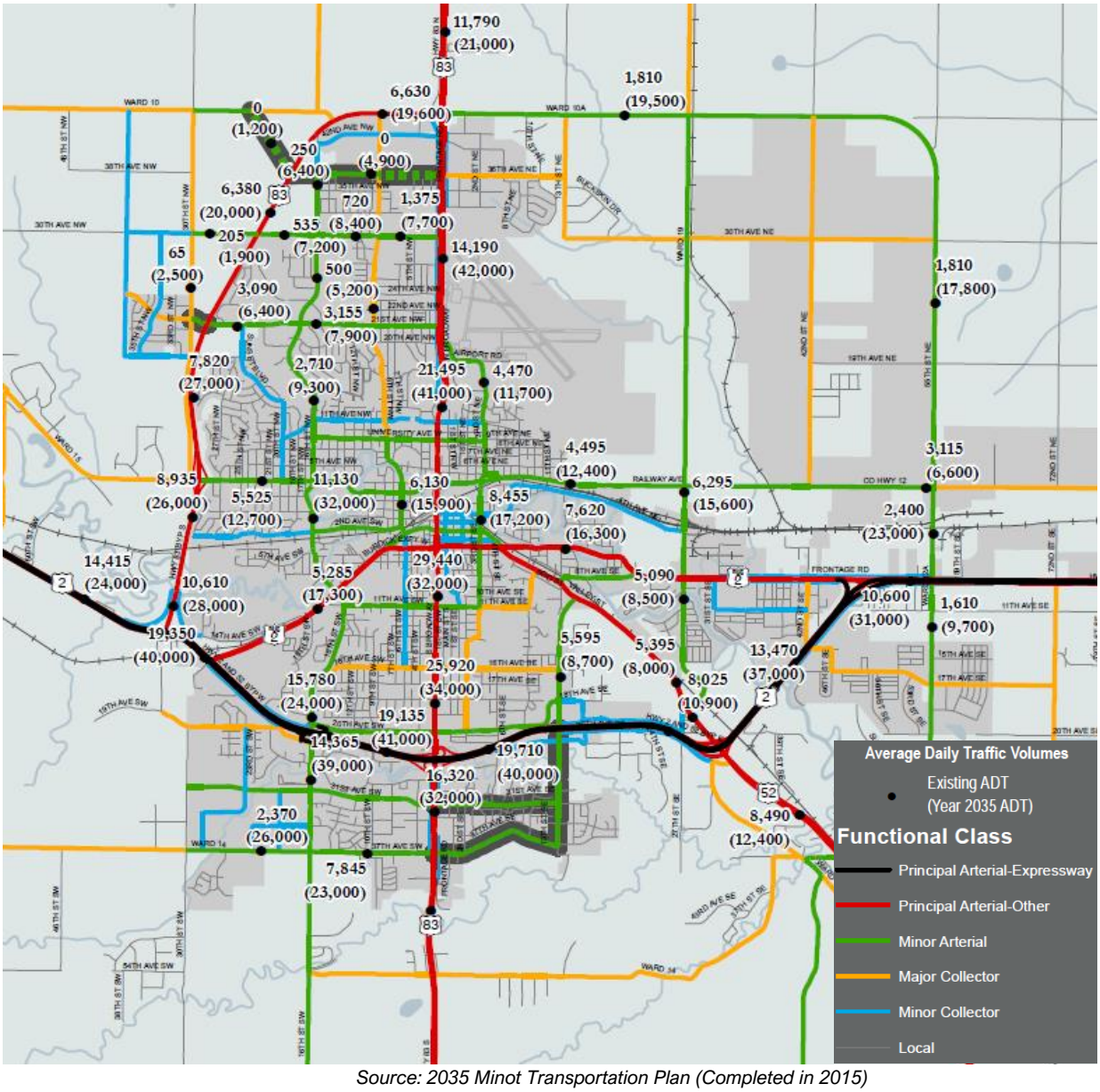
Traffic Projections from Previous Planning Efforts

Data discussed above shows that previous traffic projections may be too aggressive given the new transportation landscape after the Bakken oil boom. A detailed review unveiled that traffic projection refinement is necessary. This is not surprising, given the level of uncertainty related to growth at the time this report was completed. Below are a few examples of why this conclusion was drawn:

- **North Segment:** Between 11th Avenue North and 30th Avenue North, where 2015 volumes range between 14,000 and 21,000 ADT, with 2035 traffic projections doubling to around 42,000 ADT. This aggressive level of growth is mostly unprecedented aside from unusual circumstances or major metropolitan areas.
- **Middle Segment**: Between Burdick Expressway and 11th Avenue South, the 2012 ADT that was used to forecast traffic (29,440) was 46 percent higher than the most recent ADT at this same location in 2019 (20,125).
- **South Segment**: between US 2 and 31st Avenue, the 2012 ADT that was used to forecast traffic (16,320) was 54 percent higher than the most recent ADT at this same location in 2019 (25,150).

Traffic projections from the 2035 Minot Transportation plan are shown in Figure 64.

Figure 64: Traffic Projections from 2035 Minot Transportation Plan



Source: 2035 Minot Transportation Plan (Completed in 2015)

Detailed Traffic Volume Trends

After the high-level review of growth trends from the 1990s, a more detailed review of trends in the study area was conducted, taking into consideration all data available rather than focusing on only locations with large data sets.

North Segment: 46th Avenue North/US 83 Bypass to 11th Avenue North

- Broadway/US 83 Trends
  - 20 year trends: Average traffic growth of 0.5 percent per year
    - Considers traffic counts conducted at 46th Avenue North, 30th Avenue North, 21st Avenue North, and 11th Avenue North
  - Ten year trends: Average traffic growth of 2.0 percent per year
    - Considers traffic counts conducted at 46th Avenue North, 30th Avenue North, 21st Avenue North, and 11th Avenue North
  - Five year trends: Average traffic decrease of 1.7 percent per year
    - Considers traffic counts conducted at 46th Avenue North, 30th Avenue North, 21st Avenue North, and 11th Avenue North
- 46th Avenue North/US 83 Bypass Trends
  - Five year trend: Average traffic growth of 0.8 percent per year on the east approach and average traffic decrease of 1.1 percent on the west approach
  - No data was available to identify ten and 20 year trends
- All other side streets
  - Gaps in data limited ability to draw five, ten, or 20 year trends
  - Based on all available data points, an average annual traffic growth rate of 4.3 percent was identified for side streets
    - Data was only available at 30th Avenue North and 21st Avenue North

Middle Segment: 11th Avenue North to US 2

- Broadway/US 83 Trends
  - 20 year trends: Average traffic decrease of 0.1 percent per year
    - Considers traffic counts conducted at University Avenue, 4th Avenue North, Burdick Expressway, 11th Avenue South, 16th Avenue South, and 20th Avenue South
  - Ten year trends: Average traffic decrease of 0.1 percent per year
    - Considers traffic counts conducted at Burdick Expressway, 11th Avenue South, and 20th Avenue South
  - Five year trends: Average traffic decrease of 4.4 percent per year
    - Considers traffic counts conducted at 4th Avenue North, Burdick Expressway, 11th Avenue south, 16th Avenue South, and 20th Avenue South
- Burdick Expressway Trends
  - East approach:
    - 20 year trend: 0.1 percent traffic growth per year
    - Ten year trend: 0.3 percent traffic growth per year
    - Five year trend: 0.2 percent traffic growth per year
  - West approach:
    - 20 year trend: 1.0 percent traffic growth per year
    - Ten year trend: 0.4 percent traffic decrease per year

- Five year trend: 1.1 percent traffic growth per year

- All other side streets
  - Gaps in data limited ability to draw five, ten, or 20 year trends
  - Based on all available data points, an average annual traffic decrease of 0.6 percent was identified for side streets

South Segment: US 2 to 40th Avenue South

- Broadway/US 83 Trends
  - 20 year trends: Average traffic growth of 2.8 percent per year
    - Considers traffic counts conducted at US 2, 31st Avenue South, and 37th Avenue South
  - Ten year trends: Average traffic growth of 1.8 percent per year
    - Considers traffic counts conducted at US 2, 31st Avenue South, and 37th Avenue South
  - Five year trends: Average traffic decrease of 1.2 percent per year
    - Considers traffic counts conducted at US 2, 31st Avenue South, and 37th Avenue South

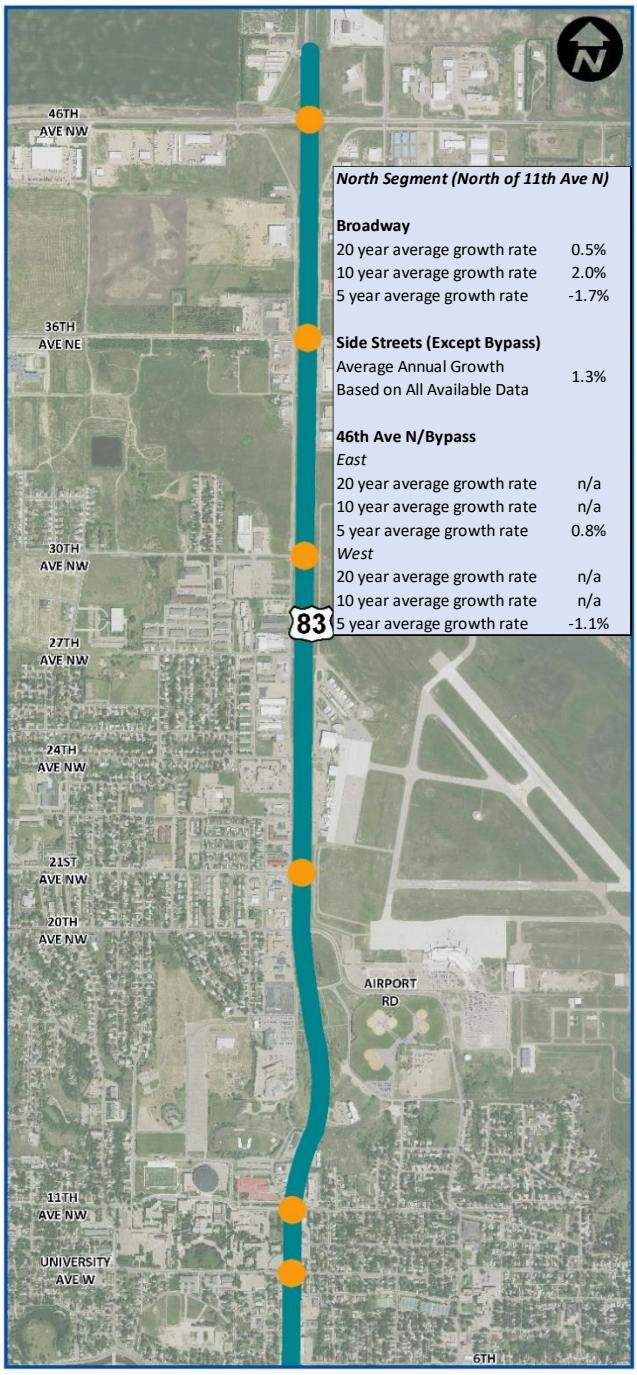
- US 2 Trends
  - East approach:
    - 20 year trend: 0.9 percent traffic growth per year
    - Ten year trend: 0.9 percent traffic growth per year
    - Five year trend: 3.9 percent traffic decrease per year
  - West approach:
    - 20 year trend: 2.7 percent traffic growth per year
    - Ten year trend: 4.0 percent traffic growth per year
    - Five year trend: 2.3 percent traffic decrease per year

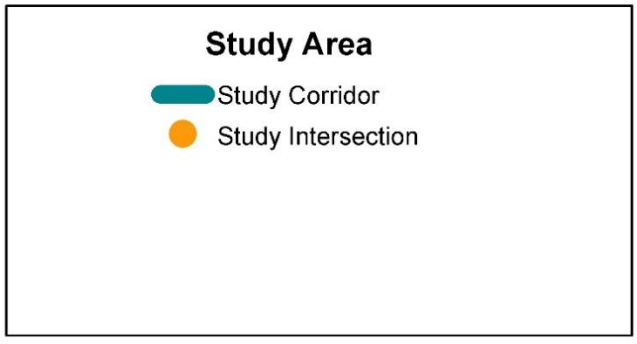
- All other side streets
  - Gaps in data limited ability to draw five, ten, or 20 year trends
  - Based on all available data points, an average annual traffic growth of 3.1 percent was identified for side streets

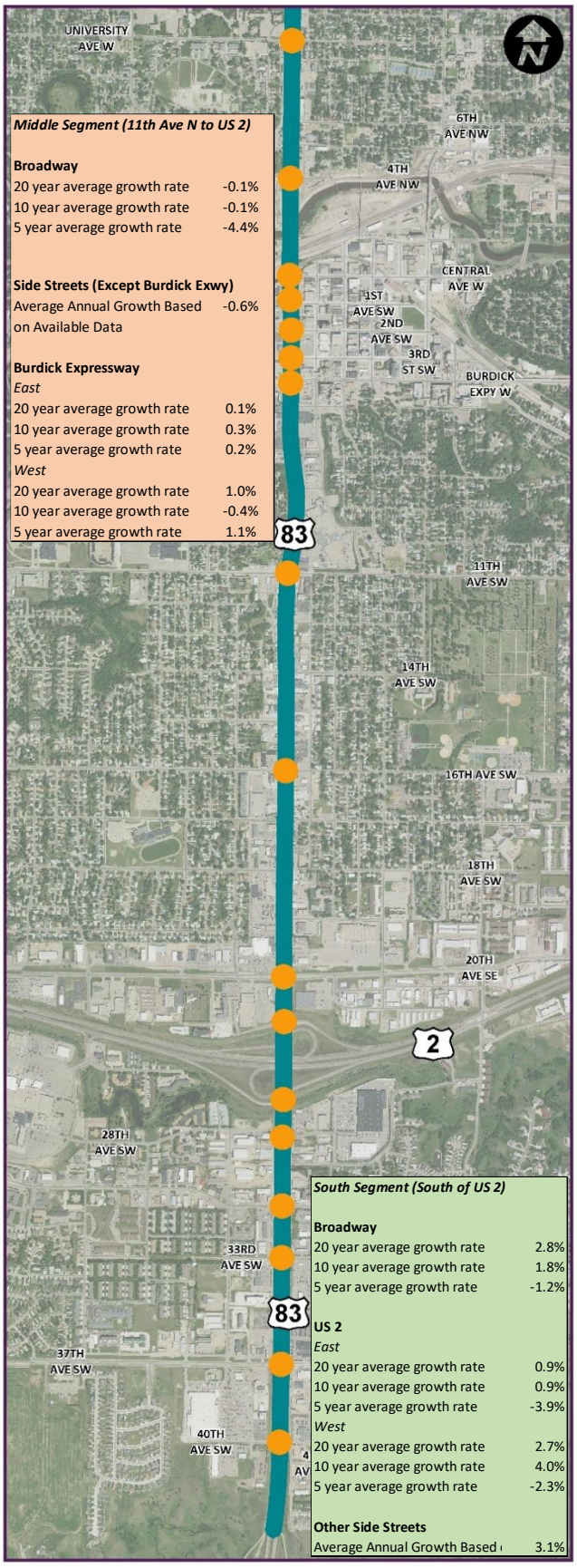
Key Traffic Trend Observations

- Over the past five years, traffic volumes on Broadway have decreased throughout the study area, with the greatest decrease seen between 11th Avenue North and US 2
- Looking at the 20 year trend, volumes on Broadway have remained constant or experienced modest growth north of US 2, with more significant annual growth observed south of US 2
- Side street volumes have seen growth on the north and south ends of the Broadway corridor, with a modest decrease in side street volumes between 11th Avenue North and US 2.
- Side street volumes have grown more considerably on the south end of the corridor, where more development has occurred in recent years. More discussion related to study area development trends is presented later in this report.
- A summary of growth trends discussed in this section is shown in Figure 65.

Figure 65: Overall Study Area Traffic Trends 1998-2019





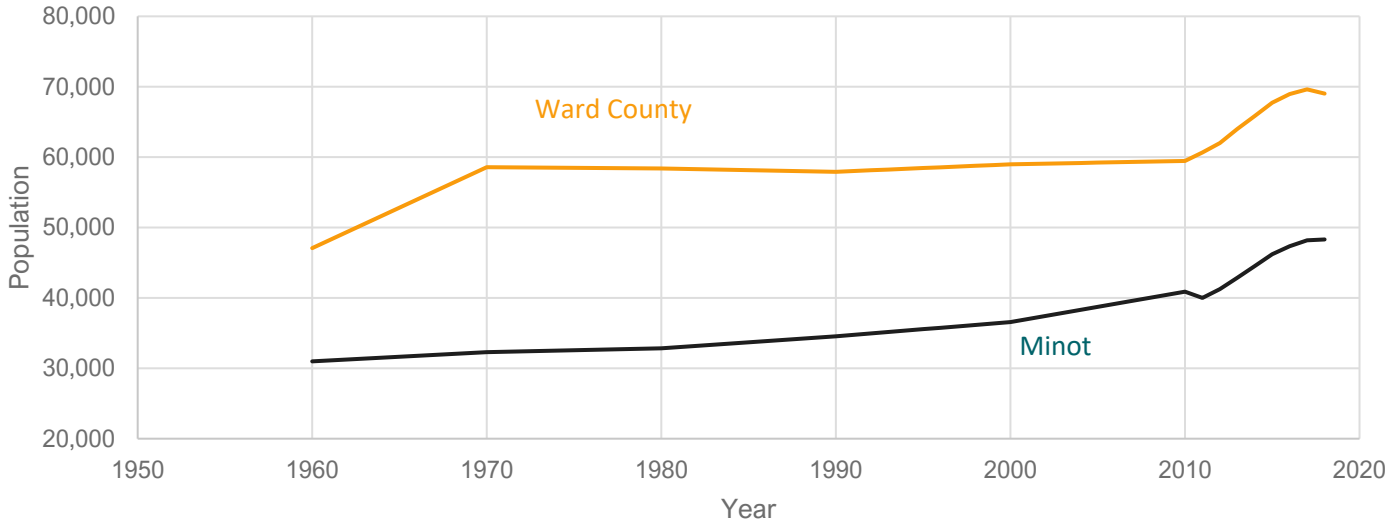


Demographic Trends

Population data for both Minot and Ward County was analyzed from 1960 to the present, however trend analysis will focus on the time period after 1990. Analysis is focusing on the period after 1990 since Ward County's population remained level between 1970 and 1990, with Minot's population only growing by around seven percent in this same time period, or an average annual growth of around 0.3 percent per year.

Population data for Minot and Ward County between 1960 and 2018 is shown in Figure 66.

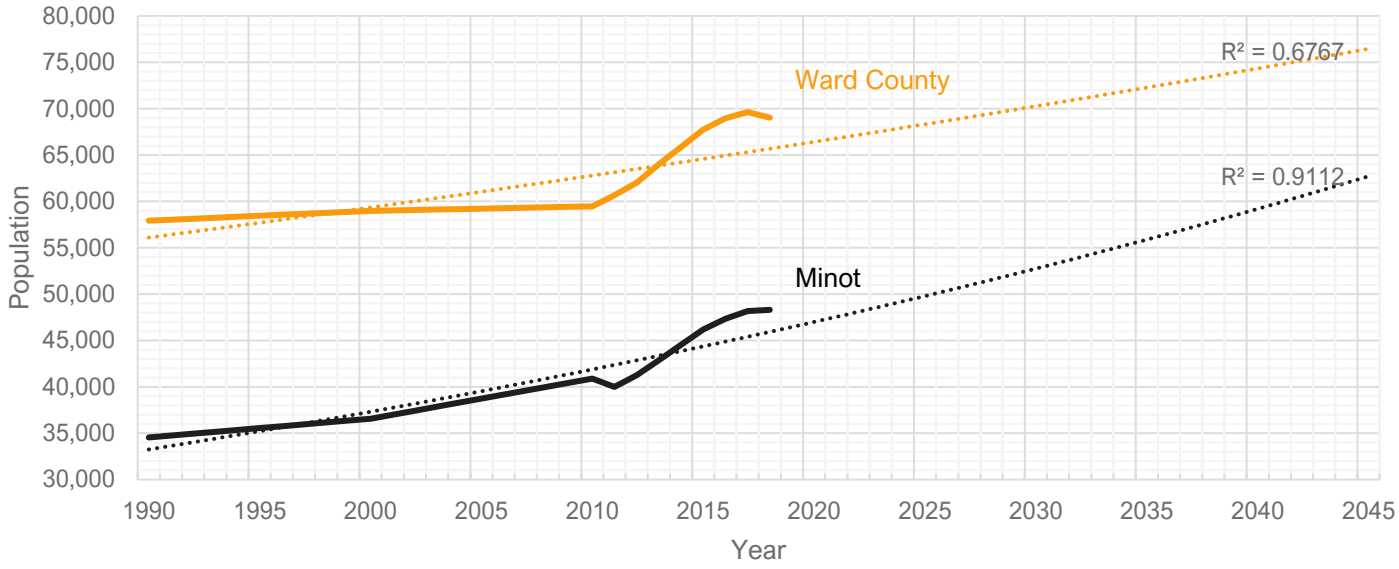
Figure 66: Population Data 1960-2018



Demographic Trendline Analysis

Trendlines were developed for both Minot and Ward County based on the 1990 to 2018 dataset, with an exponential trendline being best-fit. Trendlines are shown in Figure 67. Note that the exponential trendline much better matches the Minot dataset compared to the Ward County dataset.

Figure 67: Demographic Trendlines



Based on the trendline analysis, demographic projections were made for 2025, 2030, and 2045. Projections for 2025 and 2030 were made by linear interpolation between the 2018 population and 2045 population projections from the trendlines. Projections are shown in Table 15.

Table 15: Demographic Projections

Year	Minot	Ward County
2018	48,300	69,000
2025	51,981	70,815
2030	54,611	72,111
2045	62,500	76,000

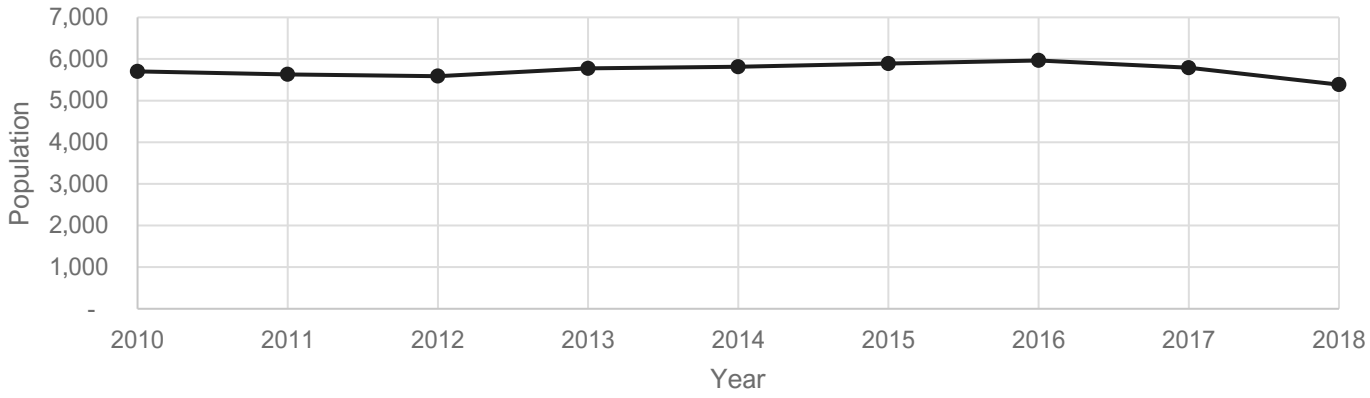
Previous Population Projections

The North Dakota Census Office projected future population through 2040 as part of a 2016 study. This study forecast much more significant growth than the trendlines above, estimating that the Ward County population will reach 99,600 by 2040, which is 35 percent higher than the trendline above shows. These projections are likely quite aggressive given that 2020 projections from the same study estimated a Ward County population of 79,000, compared to the population of 69,000 today.

Minot Air Force Base

Census data for the Minot Airforce Base was also evaluated to understand traffic potential to and from the north of the study area. The Air Force Base is unique in that it's considered North Dakota's 14th most populous city but given the characteristics of a military base is far more reliant on the City of Minot than a normal city of this size. Based on available data, the base population has remained generally level since 2010. Given the lack of available projection data for the Air Force base, it was assumed that this would remain relatively constant through the study horizon, with some ebbs and flows in between possible.

Figure 68: Annual Population Growth vs. Annual Traffic Growth

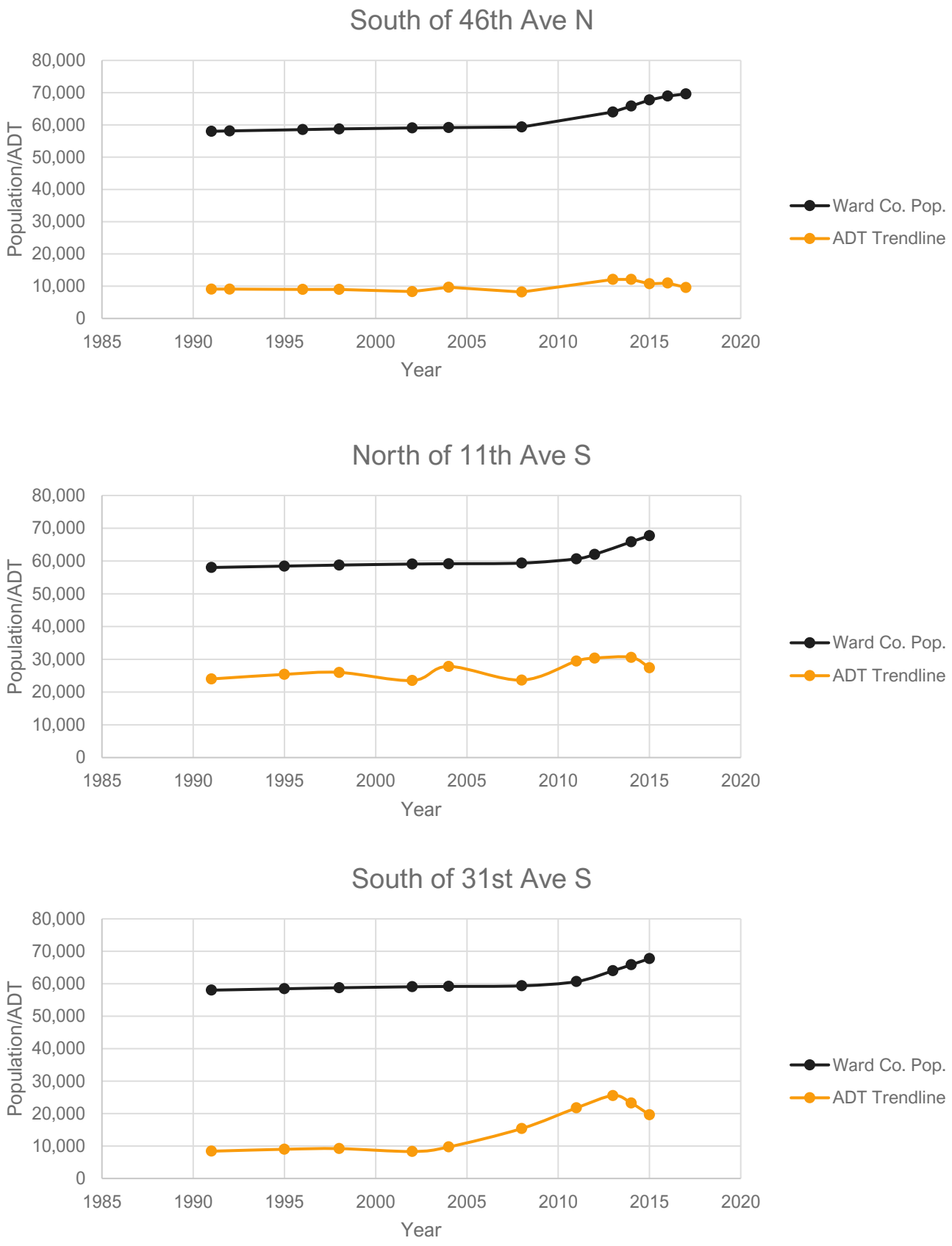


Source: American Community Survey (US Census Bureau)

Correlation to Traffic Growth

A review of annual traffic growth to annual Ward County population growth shows a very weak correlation between the two when comparing specific ADT values. It should be noted that Census estimates from the peak oil and gas activity may not include many temporary workers that were in Minot during that time, likely contributing to the variation. However, when compared to the ADT trendline, a clear correlation is revealed. This can be seen from data at three different locations on Broadway that is shown in Figure 69. Traffic data was compared to the population of Ward County since Minot is the location for many services for the county, and energy-related development was not only limited to Minot.

Figure 69: Annual Population Growth vs. Annual Traffic Growth



Development Trends

Like traffic volume trend analysis, development trends since the late 1990s were evaluated using aerial imagery. Google Earth aerial imagery from 1997, 2009, and 2016 was referenced to identify when and where development occurred. Note that this is high-level analysis and did not evaluate development density or specific land uses in detail, rather this analysis is instead intended to show where development has generally occurred in the study area.

Development from 1997 to 2009

Between 1997 and 2009, the majority of development occurred on the south end of the Broadway corridor, however some development was also occuring on the north end of the corridor.

On the south segment of the corridor, most developed acres were residential, however Wal Mart was constructed just south of 37th Avenue South, with hotels starting to be constructed just north of 37th Avenue South. Note that by 2009 only the Holiday Inn was built, with Comfort Inn and Suites and My Place built by 2013.

On the north segment of the corridor, development included multi-family residential, large lot single family residential, and light industrial land uses.

Development from 2009 to 2016

Between 2009 and 2016, most development was focused on the north end of the corridor, with land uses being primarily single and multi-family residential, with some industrial uses closer to 46th Avenue North. Development was less signficant on the south end of the corridor, however Home Depot was constructed by 2016.

Correlation to Traffic Growth

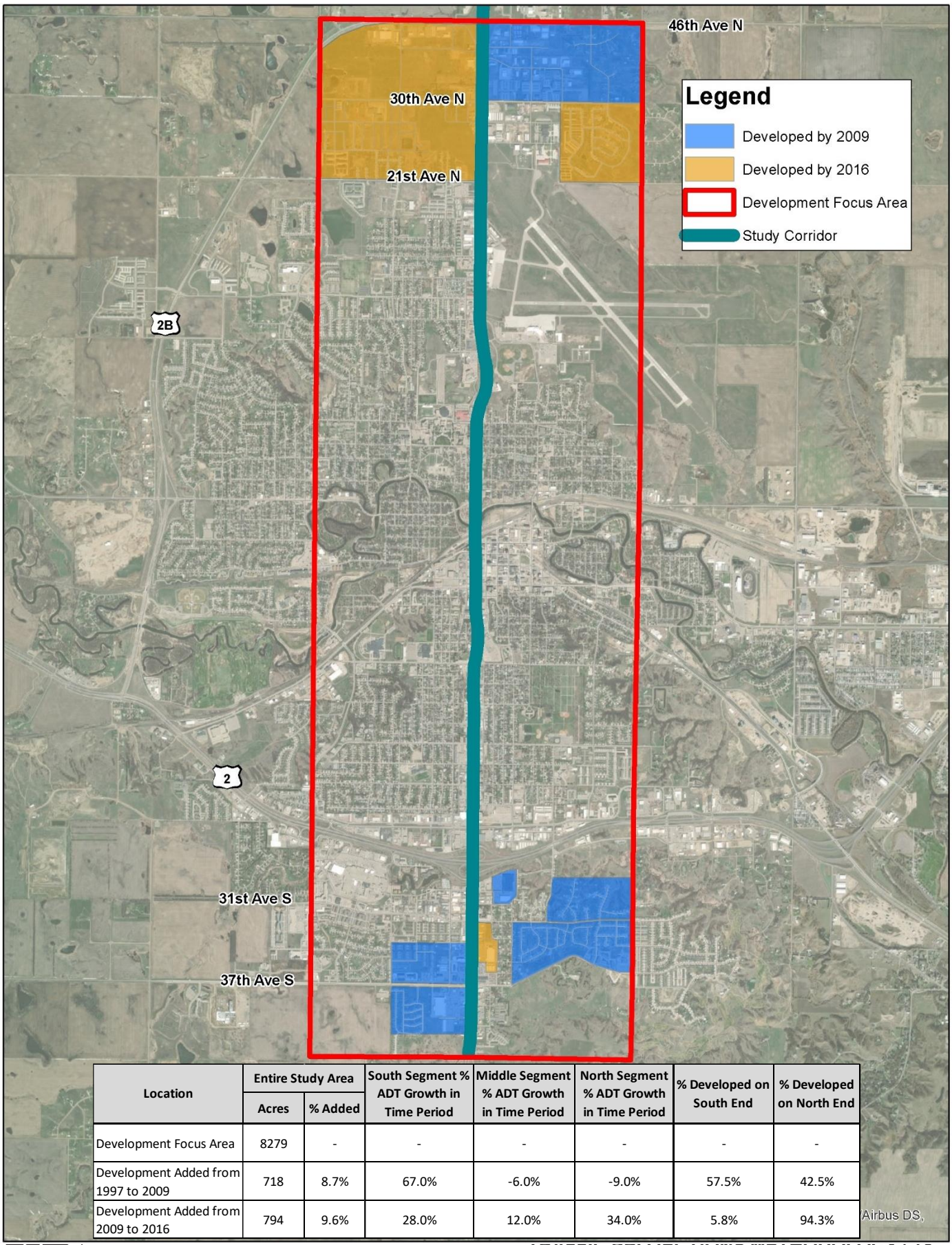
Analysis of traffic growth data in the same time frame as development did not reveal a strong correlation between developed acreage and traffic growth. For example, while around 300 acres of land were developed on the north end of the corridor between 1997 and 2009, traffic volumes were nine percent lower in 2009 than in 1997. Another example of the imperfect relationship between acres developed and traffic is on the south end of the corridor, where only around six percent of developed acres were located between 2009 and 2016, however traffic volumes increased by 28 percent. This analysis does explain certain spikes in the historic traffic data.

Growth areas and comparisons to traffic volumes are shown in Figure 70.

Trend Analysis Summary

The trend analysis detailed in this section underscores the complexity involved in traffic forecasting. Pinpointing historic correlations that explain traffic ebbs and flows to the point where future forecasting can be easily accomplished is not possible. Traffic growth involves a mix of economic factors (highlighted by energy activity), population factors (as highlighted by growth trends) and direct changes (as highlighted by the development patterns). There is no perfect correlation. As such, engineering judgement will be required to mesh these factors using historic data and understanding future expectations.

Figure 70: Development Since 1997



Location	Entire Study Area		South Segment % ADT Growth in Time Period	Middle Segment % ADT Growth in Time Period	North Segment % ADT Growth in Time Period	% Developed on South End	% Developed on North End
	Acres	% Added					
Development Focus Area	8279	-	-	-	-	-	-
Development Added from 1997 to 2009	718	8.7%	67.0%	-6.0%	-9.0%	57.5%	42.5%
Development Added from 2009 to 2016	794	9.6%	28.0%	12.0%	34.0%	5.8%	94.3%

Scenario Analysis

Transportation professionals are aware of changing travel behavior associated with sociological and technological changes, however developing data-based traffic projections with unknown future transportation landscape can be difficult. Scenario analysis provides a risk-based approach to traffic forecasting that allows the team to compare a wider array of variables to better understand possible traffic condition outcomes.

Potential Changes in the Transportation Landscape

To help establish assumptions for potential transportation changes in the future, a visioning workshop was held with the project Steering Committee in July 2020.

Key items related to potential transportation changes in the area that were discussed at the workshop include:

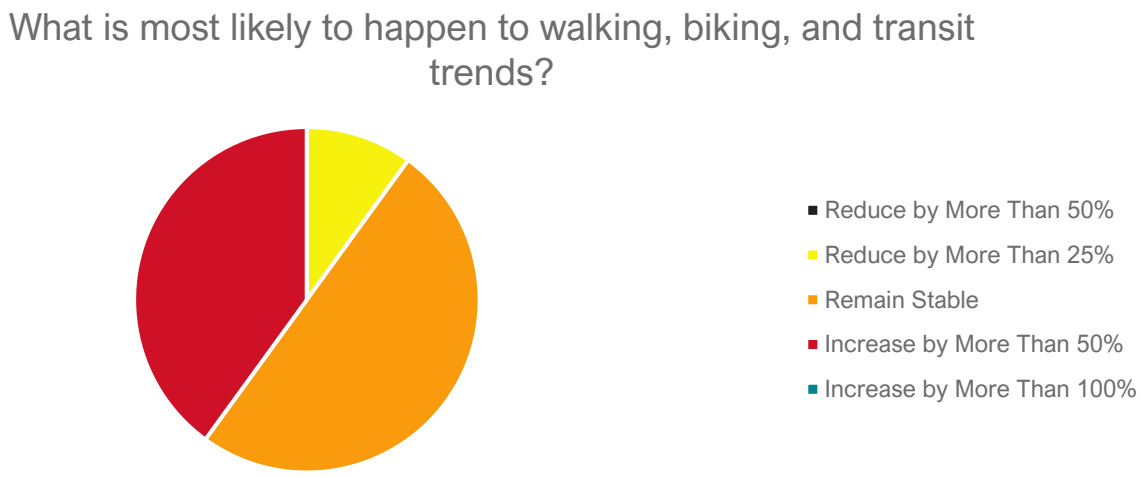
- Mode choice
- Long-term impacts from COVID-19
- Population growth
- Regional traffic changes
- Connected and Autonomous Vehicles
- Impacts from future transportation infrastructure improvements

Steering committee members were polled regarding their thoughts related to the above items, with polling results summarized below.

Mode Choice

Reducing reliance on automobile use can temper traffic growth, with a higher proportion of travel being done by walking or biking. Cycling and walking have become more popular with some demographic cohorts, especially younger people. The Steering Committee was asked what they thought the long-term trends related to non-automobile use would be. Most of the committee believed multimodal traffic would remain at similar levels or increase by 50 to 100 percent. For reference, current multimodal use is around two percent.

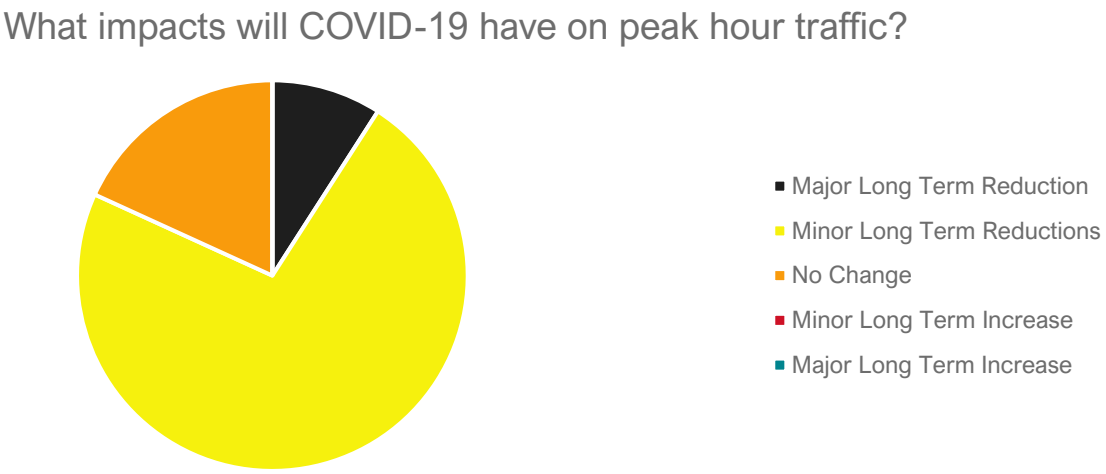
Figure 71: Steering Committee Feedback – Future of Multimodal Traffic



COVID-19 Impacts

The transportation impacts from COVID-19 could be long-term, with recent studies showing that over half of people prefer working from home (WFH), and 98 percent of people would like to work from home occasionally. A higher prevalence of working from home can have positive impacts on congestion since commuting time periods are the highest traffic times of day. Contrarily, other studies have found that the COVID-19 has reduced transit use nationwide as commuters find ways to social distance. Although the existing transit share of daily commuting is a modest, this perception has the chance to minimize transit's overall modal share into the future. The recent WFH and transit trends have tangible impacts to traffic patterns and congestion, particularly during peak periods. The Steering Committee was asked their opinion on the long-term impacts of COVID-19, and most of the committee believes there will be minor reductions in traffic in the long term, with no member believing traffic will increase.

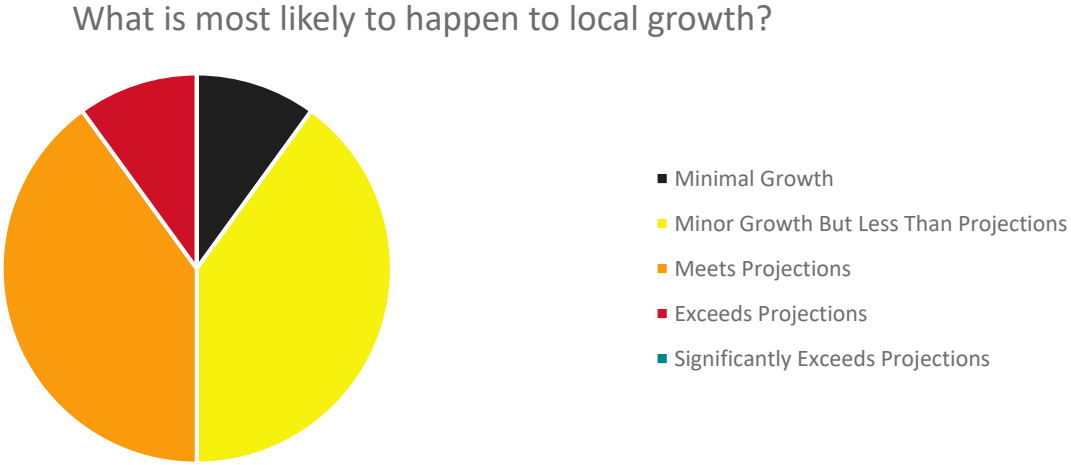
Figure 72: Steering Committee Feedback - COVID-19 Impacts



Population Growth

Estimating future population growth is a difficult exercise given the unpredictable growth that was experienced during the peak of the Bakken oil boom. Recent population trends since Bakken activity subsided have shown more typical growth, indicating that projections that were previously developed may assume unrealistic growth. For context, a 2016 demographic study by the North Dakota Census Office assumed Ward County would have a population of 79,000 by 2020, with the most recent census data showing a county population of 69,000. Making transportation planning assumptions based on unrealistic population projections could result in overbuilding roadways, where the extra funds could instead be used to solve other issues. Steering committee members were asked what kind of population growth they expect, with the majority believing growth would either meet previous projections or be lower than previous projections.

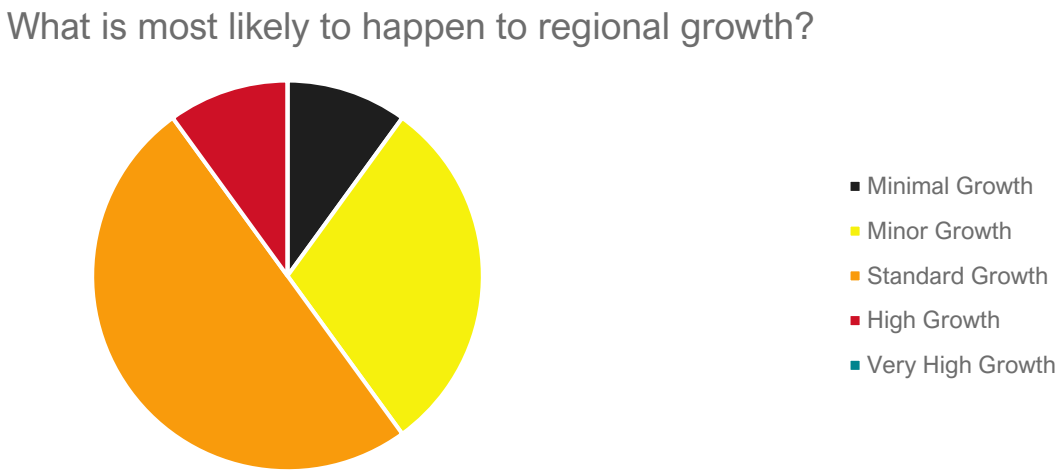
Figure 73: Steering Committee Feedback – Estimated Population Growth



Regional Traffic Growth

Like Minot population growth, regional traffic growth during the peak of the Bakken oil boom was rapid and unpredictable, with previous forecasts assuming significant growth into the future. A look at recent trends shows more typical growth compared to the peak of the Bakken boom, therefore keeping projections reasonable can help make transportation recommendations more in line with actual future needs. The Steering Committee was asked their opinions related to regional traffic growth, with the majority of the Steering Committee believing that regional traffic will follow more typical growth rates compared to what was seen during peak Bakken activity.

Figure 74: Steering Committee Feedback – Estimated Regional Traffic Growth



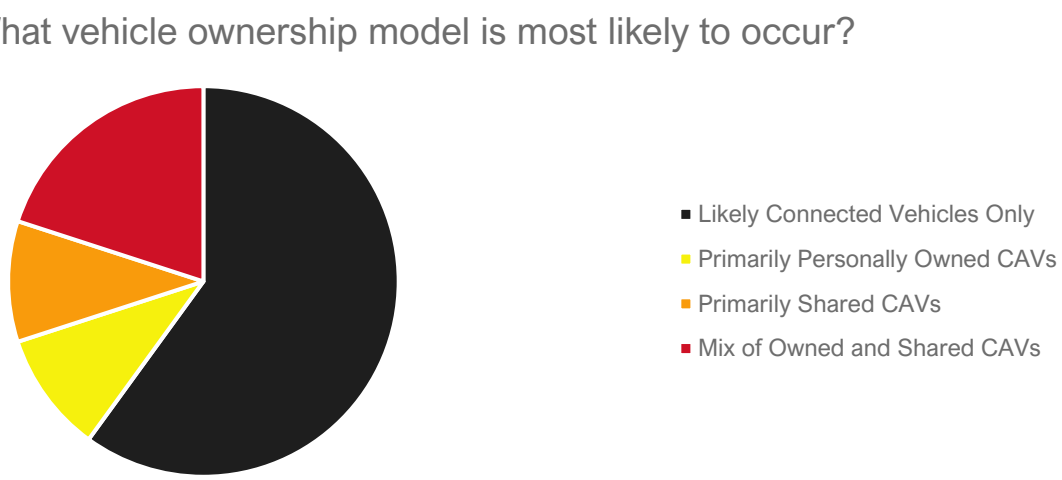
Connected and Autonomous Vehicles (CAV)

Connected and autonomous vehicles (CAV) have become more prevalent, with further adoption being expected in the future. While it is understood that the prevalence of CAV will increase, there is little consensus about potential adoption rates and possible impacts. Some studies indicate that vehicle miles traveled could increase precipitously (2x-5x) as travel becomes more productive and convenient. Other studies indicate owning a personal CAV may be cost prohibitive for more individuals resulting a fleet of shared vehicles, reducing overall traffic volumes. Establishing an estimation of future CAV use is important for traffic forecasting since studies have shown that CAV could increase vehicle-miles traveled.

The Steering Committee was asked about their opinions related to CAV adoption and what the ownership model of CAV will look like. Over half of the committee believes that CAV will become more prevalent through 2045, however these vehicles will not make up more than 25 percent of the vehicle composition. Most of the committee also believes that most CAV adoption will trend toward being connected only (i.e. not fully autonomous).

Figure 75: Steering Committee Feedback – CAV Adoption

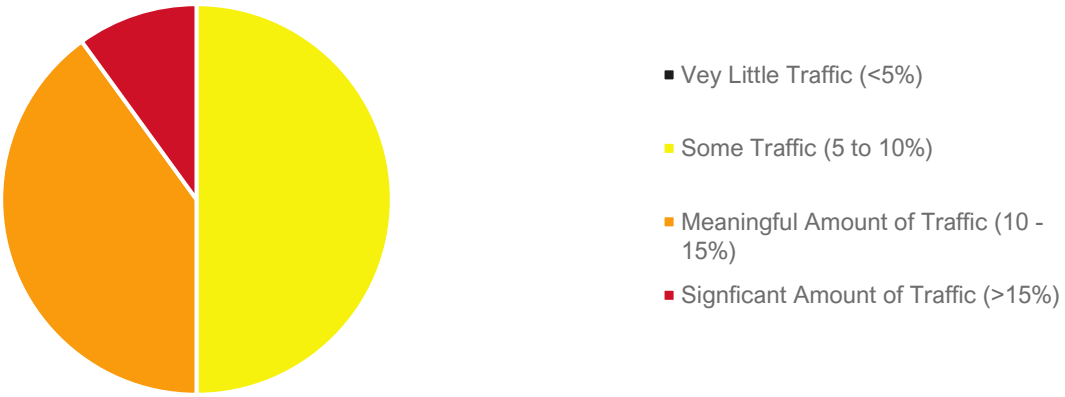
Figure 76: Steering Committee Feedback – CAV Ownership Model



Traffic Impacts from Future Roadway Infrastructure

An expanded transportation network could impact traffic volumes throughout the study area, with a major potential future roadway being the southwest portion of the US 83 bypass. The Steering Committee was asked about how much traffic they believe would use future routes, and the committee unanimously agreed that some traffic would choose new roadways, however opinions regarding the extent of traffic impacts were mixed. Over half the committee believes that traffic impacts would be somewhat modest (5 to 10 percent of traffic using other routes than Broadway), however some members believe this impact could be higher.

Figure 77: Steering Committee Feedback – Estimated Regional Traffic Growth



Subject to Change Analysis

The Steering Committee was also asked to provide guidance related to the potential for land use changes in the future. Using committee guidance and other factors shown in Table 16, the stability of a given parcels current development was determined. For this exercise, a parcel is considered unstable if some type of redevelopment is considered likely.

Table 16: Parcel Stability Status Determination

Land Use	Determining Factors
Tax-assessed properties Ex. residential, commercial, industrial	Improvement value vs. Land value
Tax-exempt properties Ex. parks, schools, municipal	-Property condition -Proximity to Souris River Floodplain -Current and potential future use
Trinity Health properties	Separate set of factors due to under-construction new facility
Properties adjacent to Souris River	Additional uncertainty beyond assessment-based approach

Based on the factors listed above, study area parcels were categorized as stable or unstable, with results shown in Figure 78. It is important to note this exercise is for high-level traffic estimating purposes and is not intended to identify specific parcels that will be redeveloped.

- On the north end of the Broadway corridor, many unstable parcels are currently undeveloped, and are intuitively candidates for future development

Around 26 percent of parcels were identified as unstable, with potential redevelopment in the future

- Between US 2 and University Avenue, many smaller parcels could see some type of redevelopment, however traffic generation characteristics of redeveloped parcels will likely remain like today's composition given the lack of major site opportunities, aside from the Trinity Hospital site in Downtown.

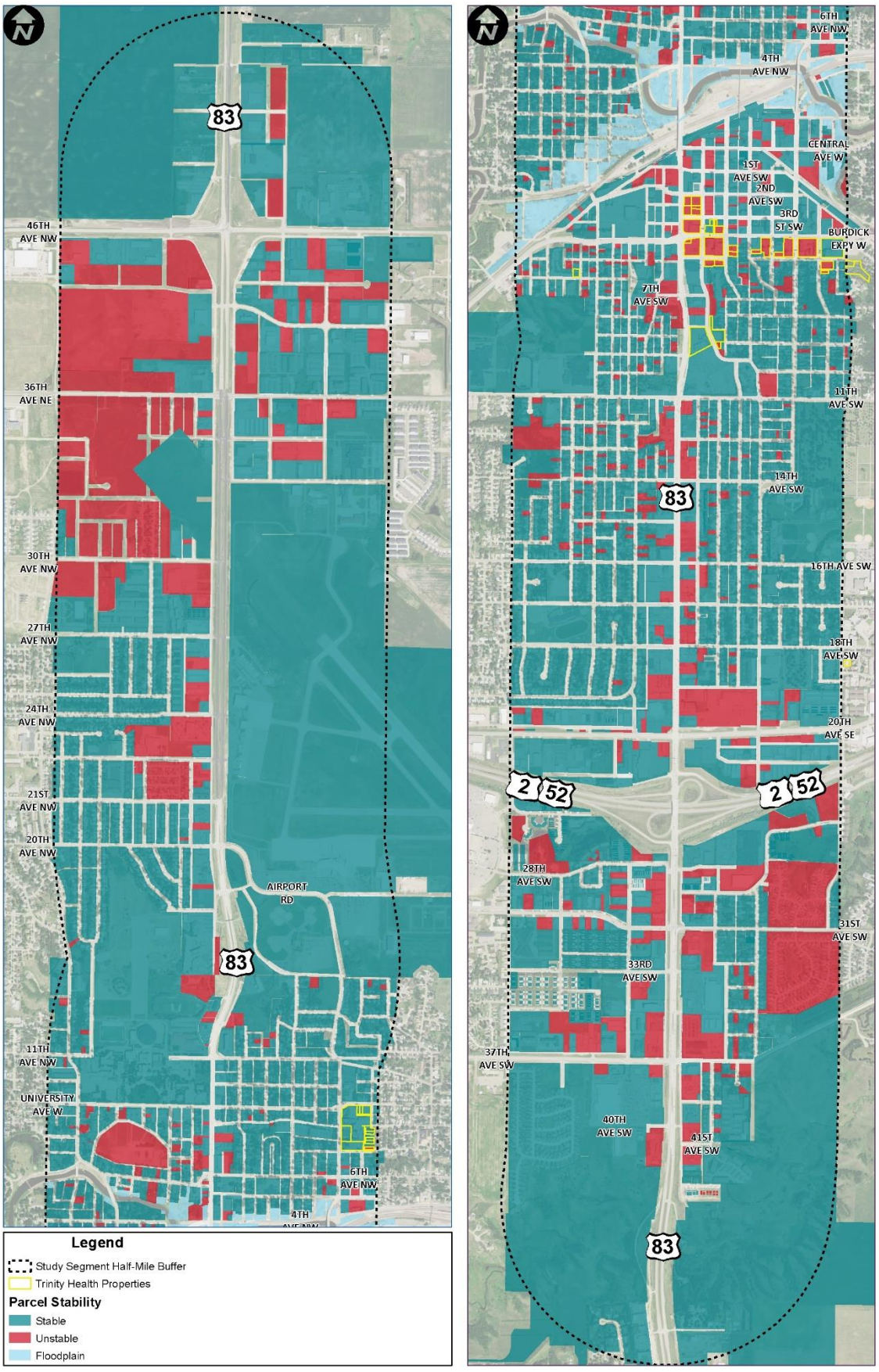
Around 14 percent of parcels were identified as unstable, with potential redevelopment in the future

- On the south end of the corridor, most unstable parcels are either undeveloped or residential areas that were developed prior to most growth in the south part of Minot

Around 21 percent of parcels were identified as unstable, with potential redevelopment in the future. This is highlighted by the new Trinity Regional Healthcare Campus and Medical District site.

The Steering Committee was split into two groups and asked to determine areas of growth in the future. After a detailed assessment the two groups came to two converging conclusions. The first group felt the Subject to Change analysis provided good planning level assumption for potential change with a few minor changes. This group believe that any of the unstable properties could change over the next 20 years. The second group concluded that aside from the Trinity campus in downtown, very little would change over the next two years due to the challenging access along the corridor and small lot sizes, normally most challenging for major redevelopment efforts.

Figure 78: Parcel Stability Status



TRAFFIC PROJECTIONS

Recommended Baseline Growth Rates

Based on the analysis documented in this report as well as input from the Steering Committee, the following growth rates are recommended to develop baseline traffic projections. These projections assume similar travel behavior as exists today.

North Segment – 46th Avenue North/US 83 Bypass to 11th Avenue North

- Broadway/US 83: Apply a **one percent annual growth rate.**
  - Based on the 20 year traffic growth trend of 0.5 percent per year, including an additional 0.5 percent per year growth to account for development potential in north Minot.
  - Over a 25 year period, this would increase traffic by 28 percent.
    - For reference, traffic volumes increased by 29 percent between 1991 and 2019.
- 46th Avenue North/US 83 Bypass: Apply a **one percent annual growth rate.**
  - Based on the 0.8 percent annual growth observed over the past five years on the east approach, rounding up to consider development potential in the area.
- Other Side Streets
  - 36th Avenue North: Apply a **two percent annual growth rate** on west approach, and **one percent annual growth** on the east approach.
    - Considers greater development potential on west side of Broadway.
    - A two percent growth rate over 25 years would increase traffic by 64 percent, and a one percent growth rate would increase traffic by 28 percent.
  - 30th Avenue North: Apply **1.5 percent annual** growth rate.
    - Considers development potential along 30th Avenue. The lower growth rate compared to 36th Avenue North is due to 30th Avenue being developed today than 36th Avenue North.
    - A 1.5 percent annual growth rate over 25 years would increase traffic by 45 percent.
  - 21st Avenue North: Apply a **one percent annual** growth rate.
    - Considers development potential along 21st Avenue near the junction with the US 83 bypass
  - 11th Avenue North: Apply a **0.5 percent annual** growth rate.
    - Considers some traffic growth potential associated with Minot State University.
    - A 0.5 percent growth rate over 25 years would increase traffic by 13 percent.

Middle Segment – 11th Avenue North to US 2

- Broadway/US 83: Apply a **0.5 percent annual** growth rate.
  - Considers growth on the north and south ends of the corridor, with some of this traffic also using the middle corridor segment.
  - This would increase traffic by 13 percent by 2045.
    - For reference, 2019 traffic volumes are about equal to 1998 volumes.
- Burdick Expressway: Apply a **one percent annual** growth rate.
  - Considers the trends seen over the past twenty years.
  - Also reflects growth expectations since this is a major east-west corridor in Minot.
- US 2: Apply a **one percent annual** growth rate.
  - Considers the trends seen over the past twenty years.
  - Also reflects growth expectations since this is a major corridor for all northern North Dakota.
- Other Side Streets: **Assume no growth.**

Based on the core of Minot being build out, with trends showing a decrease in traffic .

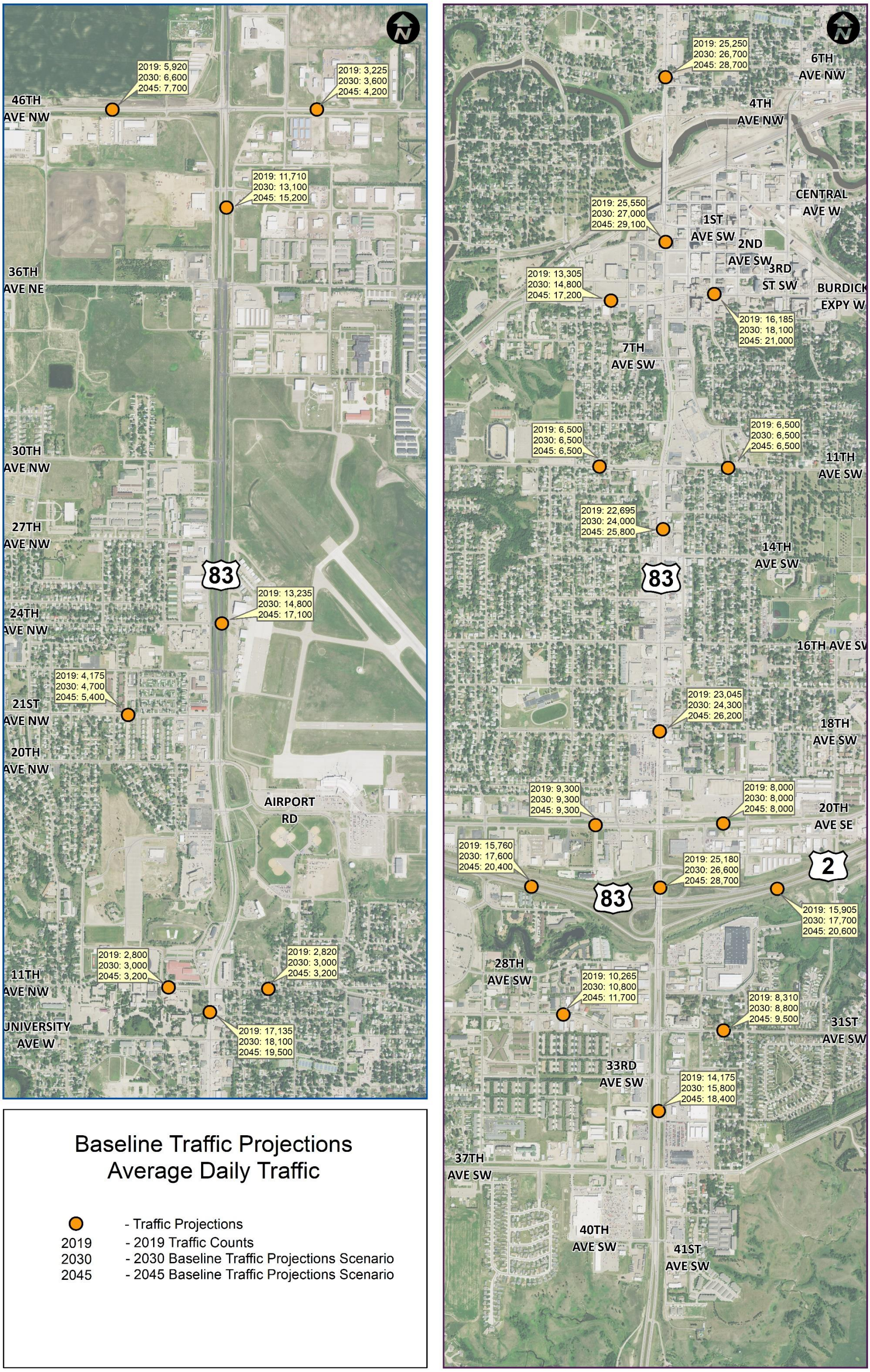
South Segment – US 2 to 40th Avenue South

- Broadway/US 83: Apply a **one percent annual** growth rate.
  - Accounts for some traffic growth due to the south end of the corridor being a Minot growth area.

Given the construction of Wal-Mart, Home Depot, and other retail since 1998, it is unlikely the 2.8 percent average annual growth seen between 1998 and 2019 traffic counts will continue. Trends since 2015 show a 2.3 percent annual decrease in traffic.

- Side Streets
  - 28th Avenue South: **Assume no growth.**
    - The area along 28th Avenue is built-out and connectivity is limited.
  - 31st Avenue South: Apply a **0.5 percent annual** growth rate.
    - This considers some potential development on the west approach, and provides a slightly conservative estimate on the mostly built-out east approach.
  - 33rd Avenue South: **Assume no growth.**
    - The area along 33rd Avenue is built-out and connectivity is limited.
  - 37th Avenue South: Apply a **two percent annual** growth rate.
    - Takes into consideration the new Trinity Regional Healthcare Campus and some development potential along 37th Avenue.
  - 40th Avenue South: Apply a **0.5 percent annual growth rate** on the west approach, and a **one percent annual growth rate** on the east approach.
    - Assumes some growth could occur on the Wal-Mart approach due to population growth in the area.
    - A higher growth rate is assumed on the east approach since more development could possibly occur here.

Figure 79: Baseline Traffic Projections



Scenarios for Analysis

To help plan for a range of potential futures, three future scenarios that assume transportation behavior changes were developed. These scenarios will make adjustments to the baseline future projections that are discussed on Pages 85 and 86. Adjustments to the baseline traffic projections are based on feedback from the Steering Committee then packaged into complimenting packages. Figure 80 shows the scenario projections, with the details discussed below.

Livability Scenario

This scenario assumes study area traffic growth is lower than the baseline future projections, with reduced growth being a function of the following:

- Working from home becoming more widespread.
  - Reduce future traffic on functionally classified roadways by ten percent.
- Redeveloped parcels will have greater mixed-use prevalence, reducing automobile trips.
  - Reduce traffic from local roadways (non-functionally classified) by three percent.
- Regional traffic growth continues to follow observed trends.

Auto-Centric Scenario

This scenario assumes that connected and autonomous vehicles (CAV) adoption significantly increases in the future, achieving a 50 percent adoption rate by 2045. While the extent has been debated, many planning experts believe that increased CAV use can lead to more sprawling development patterns and longer commutes since travelers could perform other tasks during their commute.

- Assumes a 10 percent total increase in future traffic throughout the study area
  - Based on proliferation of CAV 10 percent increase on functionally classified roads.
  - Increased regional growth and investment in subject to change areas adds 10 percent to non-functionally classified roads.

Regional Investment Scenario

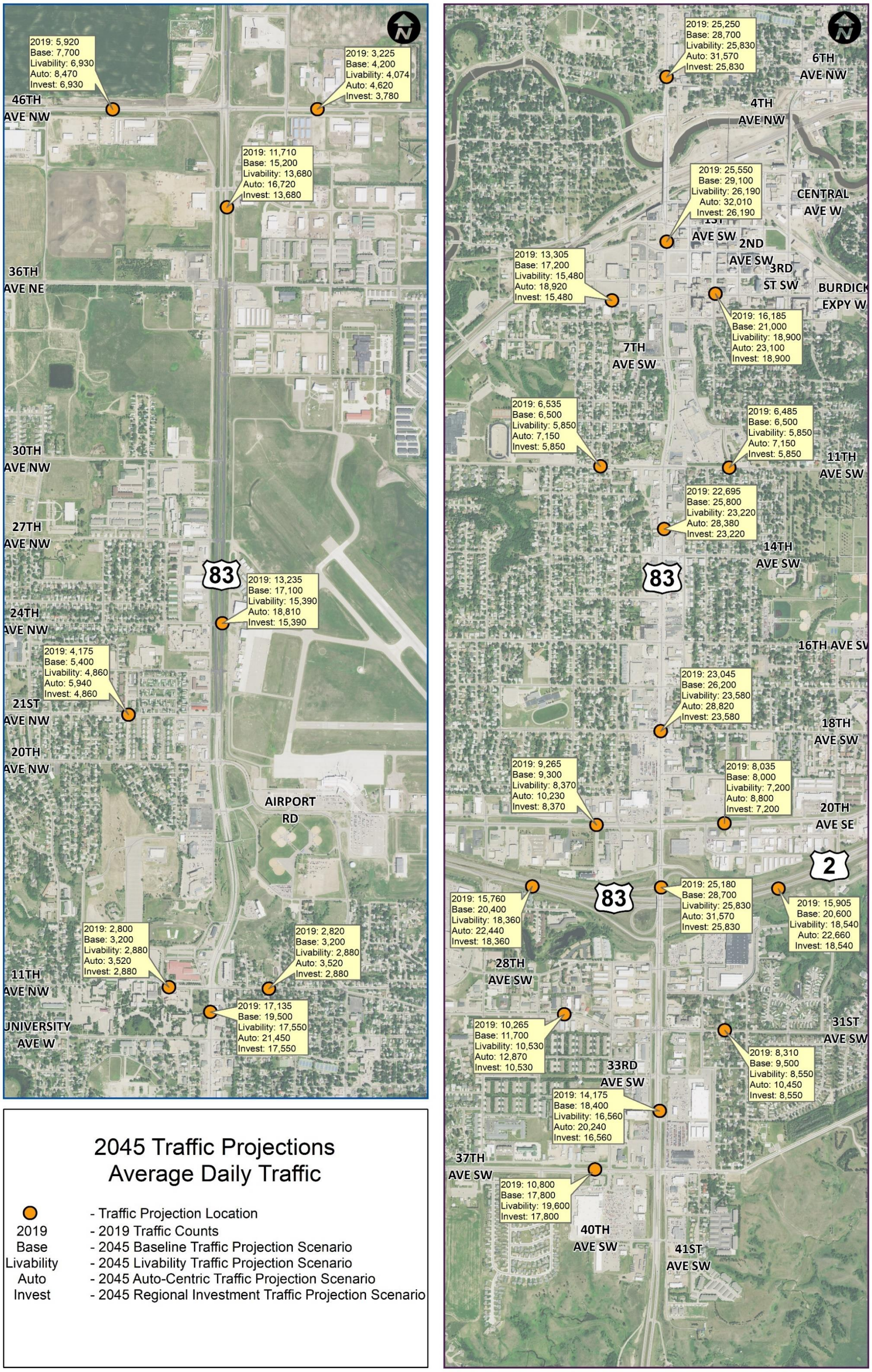
The Regional Investment Scenario assumes that improvements are made to the regional transportation network, with some property redevelopment also occurring.

- Expanded transportation network (including SW US 83 bypass) reduces reliance on Broadway/US 83.

Reduce future traffic by ten percent on functionally classified roadways.

- Areas adjacent to possible redevelopment will assume some traffic growth.
  - Investment in developing subject to change areas adds 10 percent traffic to the roads leading to these properties.
  - Assumes that traffic growth from redevelopment cancels out traffic reduction from expanded roadway network.

Figure 80: 2045 Traffic Projections for Base, Livability, Auto-Centric, and Regional Investment Scenario



Source: NDDOT, NDGISHub, ESRI

September 2020

FUTURE MULTIMODAL TRAFFIC CONDITIONS

Traditionally, transportation planning approaches have placed special emphasis on achieving certain levels of service for vehicular traffic, with cycling, walking, and other modes sometimes being an afterthought. An auto-centric approach does not respond well to demand for other travel modes and can lead to uninviting or even unsafe facility design for roadway users that cannot or choose not to drive. To provide a more complete evaluation of a transportation system, multimodal levels of service (MMLOS) were used to better account for all potential transportation opportunities due to an unbalanced emphasis on automobile traffic. The MMLOS includes vehicular, freight, bicycle, pedestrian, and transit modes. Each of the sections below will detail issues and existing operations for each specific modal environment, concluding with an unweighted multimodal level of service.

VEHICULAR LEVEL OF SERVICE

Vehicular traffic operations were analyzed along the corridor. Intersection capacity analysis was evaluated in terms of delay and level of service (LOS). LOS is a term used to describe the operational performance of transportation infrastructure elements; it assigns a letter grade value that corresponds to specific traffic characteristics within a given system, as shown in Table 8. At intersections, LOS is a function of average vehicle delay, whereas LOS for a roadway section is defined by the average travel speed. LOS A represents free flow traffic whereas LOS F represents gridlock. LOS E and F is considered deficient, in accordance with the NDDOT *Traffic Operations Manual* published in June 2015.

Two different methodologies were used to complete the traffic operations analysis. For the segment from 46th Avenue N to Central Avenue, Synchro software was used. Synchro applies deterministic equations published in the *Highway Capacity Manual* (HCM) and is an industry and NDDOT standard. This method of analysis is appropriate for suburban contexts where access spacing and traffic interactions are less complex. For the segments south of Central Avenue, Vissim Software was used. Vissim uses microsimulation to simulate the movement of every vehicle through a network and collects detailed information for associated performance measures like delay, queue lengths, travel times, and density. Vissim Software is more appropriate for capacity analysis in these segments because it more accurately captures complex merging, diverging, and weaving interactions and the interactions between vehicles and queue lengths.

Table 17: Level of Service Thresholds

Control Delay (Sec/Veh)		Level of Service
Unsignalized	Signalized	
≤ 10	≤ 10	A
10 – 15	10 – 20	B
15 – 25	20 – 35	C
25 – 35	35 – 55	D
35 – 50	55 – 80	E
> 50	> 80	F

North of Central Avenue

Other than stop-controlled intersections at 30th Avenue N and 21st Avenue N, 2045 traffic operations are expected to be acceptable through 2045 under all scenarios. LOS F is expected at the stop-controlled intersections under each 2045 scenario, which include 30th Avenue N and 21st Avenue N. Both intersections provide connectivity to the US 83 Bypass to the west and potential growth pockets in between. It is likely that these two intersections will require some form of traffic control in the future to achieve acceptable levels of service. The intersection at 21st Avenue N will be particularly challenging providing that a traffic signal already exists one block south at 20th Avenue N/Airport Road. This may require one of these intersections to receive access control to maintain acceptable operations on the side street and mainline.

The Auto-Centric scenario results in slightly poorer operations, however each existing signalized intersection is expected to operate at LOS C or better, except LOS D during the AM peak at the 46th Avenue N intersection. These results are not overly surprising, as a four-lane high-speed corridor can generally carry upwards of 25,000 vehicles per day without issue. Even the most aggressive projections do not forecast volumes above 21,000 vehicles per day on this segment.

Table 18: 2045 Traffic Operations - North of Central Avenue

Intersection	Control	Existing		Base Forecasts		Livability Scenario		Auto-Centric Scenario		Investment Scenario	
		AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
46th Avenue N	Signal	B	A	C	A	C	A	D	B	C	A
36th Avenue N	Signal	C	C	C	C	C	C	C	C	C	C
30th Avenue N	TWSC	C	C	F	F	F	F	F	F	F	F
21st Avenue N	TWSC	C	C	F	F	E	F	F	F	F	F
11th Avenue N	Signal	A	A	A	B	A	A	B	B	A	A
University Avenue	Signal	B	B	B	B	B	B	B	B	B	B
4th Avenue N	Signal	B	B	B	B	B	B	B	B	B	B

Central Avenue to 40th Avenue South

Study Intersections

Traffic operations are expected to be acceptable through 2045 at all study intersections except:

- **1st Avenue South**: LOS E is expected during the AM peak in the Auto-Centric scenario. This intersection has LOS E from the existing conditions and improving in all future scenarios. These counter intuitive results are resulting from more right turns were forecasted that dilute the delay from left and through movements.
- **3rd Avenue South - Westbound**: LOS F is expected between 4 PM and 5 PM in the Auto-Centric scenario.
- **Burdick Expressway**: LOS E is expected between 3 and 4 PM in the Auto-Centric scenario.
- **16th Avenue South**: LOS E is expected throughout most of the study time period (7 AM to 7 PM), however this occurs in the existing condition as well.
- **28th Avenue South**: LOS E or F is expected through at least half of the study time all future scenarios, however this also occurs in the existing conditions.
- **37th Avenue South**: LOS E in the afternoon in the Auto-Centric scenario.
- **40th Avenue South**: LOS E or F is expected for one to three hours in the afternoon for the Baseline, Livability, and Auto-Centric scenarios. LOS E is also expected at noon for the Baseline and Livability scenarios.

While not deficient, operations at LOS D are expected at the following intersections:

- **11th Avenue South:** LOS D in the afternoon in the Auto-Centric scenario.
- **20th Avenue South:** LOS D in afternoon in the Baseline, Livability, and Auto-Centric scenarios.
- **31st Avenue South:** LOS D in the afternoon in the Baseline and Auto-Centric scenarios and LOS D in the AM peak in the Auto-Centric scenario.

Non-Study Intersections

Other non-study intersections between Central Avenue and 40th Avenue S were also analyzed with Vissim along with the study intersections. All non-study intersections are two-way stop-controlled intersections. Table 20 shows the LOS for each intersection at the AM, Mid-day, and PM peaks. The following intersections are expected LOS E or F during the Mid-day and PM peaks for all future scenarios and most existing conditions: 7th Avenue S, 8th Avenue S, 9th Avenue S, 13th Avenue S, 14th Avenue S, 15th Avenue S, 17th Avenue S, and 18th Avenue S.

Additional deficient intersections are:

- **Eastbound 3rd Avenue South:** LOS E is expected during the Mid-day peak in the Auto-Centric Scenario.
- **5th Avenue South:** LOS E or F is expected in the PM peak from Existing and the Baseline, Auto-Centric, and Regional Investment Scenarios.
- **13th Avenue South:** LOS E or F is also expected in the AM peak in the Livability, Auto-Centric, and Regional Investment Scenarios.
- **14th Avenue South:** LOS E or F is also expected in the AM in the Baseline Livability, and Auto-Centric Scenarios.
- **18th Avenue South:** LOS E is expected in the AM peak in the Livability Scenario.

While not deficient, operations at LOS D is expected at 19th Avenue S in the Baseline, Livability, and Regional Investment scenarios.

Summary

When analyzing the results of the microsimulation analysis under the various future scenarios, the following become evident:

- Intersections with traffic control can generally manage the demand along the corridor, even during future scenarios. There are notable exceptions at busy intersections such as Burdick Expressway, 16th Avenue S, 20th Avenue S, 31st Avenue S, and 37th Avenue S. Most of these locations are in the LOS "D" range, but the Auto-centric scenario highlights conditions that minor increases in traffic can bring these intersections into a deficient range.
- Intersections without traffic control are mostly deficient, highlighting the challenging nature of turning left or going through across the corridor during peak hours without traffic control. While traffic control is generally a remedy for this condition, few, of these locations meet warrants, even in 2045. Additionally, new traffic signals at every deficient side street will overburden the mainline corridor causing longer delays, traffic spillback between intersection, and directly impact rear-end crash rates.

Table 19: 2045 Traffic Operations – Study Intersections from Central Avenue to 40th Avenue South

Intersection	Volume Scenario	Control	Level of Service (Hour of Day)											
			7	8	9	10	11	12	13	14	15	16	17	18
Broadway & Central Ave W	Existing	Signal	A	A	A	A	A	A	A	A	A	A	A	A
	Base		A	A	A	A	A	A	A	A	A	A	A	A
	Livability		A	A	A	A	A	A	A	A	A	A	A	A
	Auto-Centric		A	A	A	A	A	A	A	A	A	A	A	A
	Regional Investment		A	A	A	A	A	A	A	A	A	A	A	A
Broadway & 1st Ave S	Existing	TWSC	B	A	C	C	B	D	C	D	E	C	B	D
	Base		D	B	B	B	C	C	B	C	D	C	D	C
	Livability		D	A	B	B	C	D	B	C	C	C	D	B
	Auto-Centric		E	C	C	B	C	C	C	D	C	D	B	D
	Regional Investment		C	A	C	B	B	D	B	C	C	B	C	C
Broadway & 2nd Ave S	Existing	Signal	A	A	A	A	A	A	A	A	A	A	A	A
	Base		A	A	A	A	A	A	A	A	A	A	A	A
	Livability		A	A	A	A	A	A	A	A	A	A	A	A
	Auto-Centric		A	A	A	A	A	A	A	A	B	A	A	A
	Regional Investment		A	A	A	A	A	A	A	A	B	A	A	A
Broadway & WB 3rd Ave S	Existing	TWSC	A	B	B	A	B	A	A	B	B	B	A	A
	Base		A	A	B	B	A	A	B	B	B	B	B	A
	Livability		A	A	B	B	A	A	B	C	B	B	A	A
	Auto-Centric		A	B	C	A	B	B	C	B	B	F	B	A
	Regional Investment		A	B	B	A	A	B	A	C	C	B	A	A
Broadway & Burdick Exp	Existing	Signal	C	B	B	C	C	C	C	C	C	C	C	B
	Base		C	C	C	C	C	D	D	D	D	C	C	C
	Livability		C	C	C	C	C	D	D	D	D	C	C	C
	Auto-Centric		C	C	C	C	C	D	D	E	E	D	C	C
	Regional Investment		C	B	C	C	C	C	C	D	C	C	C	B
Broadway & 11th Ave S	Existing	Signal	B	B	B	B	B	B	B	B	C	C	C	B
	Base		B	B	B	B	B	C	B	C	C	C	C	B
	Livability		B	B	B	B	B	C	B	B	C	C	C	B
	Auto-Centric		B	B	B	B	B	C	C	C	D	D	D	C
	Regional Investment		B	B	B	B	B	B	B	B	C	C	C	B
Broadway & 16th Ave S	Existing	Signal	E	D	C	C	D	E	E	E	E	E	E	D
	Base		E	D	D	D	E	E	E	E	E	E	E	D
	Livability		E	D	D	D	E	E	E	E	E	E	E	D
	Auto-Centric		E	E	D	D	E	E	E	E	E	E	E	E
	Regional Investment		E	D	C	D	D	E	E	E	E	E	E	E
Broadway & 20th Ave S	Existing	Signal	B	B	B	B	C	C	C	C	C	C	C	C
	Base		C	C	B	C	C	C	C	C	C	D	D	C
	Livability		C	C	B	C	C	C	C	C	C	D	D	C
	Auto-Centric		C	C	C	C	C	C	C	C	D	D	D	D
	Regional Investment		C	B	B	B	C	C	C	C	C	C	C	C

Intersection	Volume Scenario	Control	Level of Service (Hour of Day)											
			7	8	9	10	11	12	13	14	15	16	17	18
Broadway & US 2 WB	Existing	Signal	A	A	A	A	A	A	A	A	A	A	A	A
	Base		A	A	A	A	A	A	A	A	A	A	A	A
	Livability		A	A	A	A	A	A	A	A	A	A	A	A
	Auto-Centric		A	A	A	A	A	A	A	A	A	A	A	A
	Regional Investment		A	A	A	A	A	A	A	A	A	A	A	A
Broadway & US 2 EB	Existing	Signal	A	A	A	A	A	A	A	A	A	A	A	A
	Base		A	A	A	A	A	A	A	A	A	A	A	A
	Livability		A	A	A	A	A	A	A	A	A	A	A	A
	Auto-Centric		A	A	A	A	A	A	A	A	A	A	A	A
	Regional Investment		A	A	A	A	A	A	A	A	A	A	A	A
Broadway & 28th Ave S	Existing	TWSC	F	D	F	D	E	F	D	E	C	E	D	D
	Base		E	E	F	F	F	F	C	C	F	F	F	D
	Livability		A	E	F	D	F	F	F	F	E	F	F	D
	Auto-Centric		F	F	F	F	F	F	C	F	F	F	F	F
	Regional Investment		F	D	D	D	E	F	E	C	D	E	F	D
Broadway & 31st Ave S	Existing	Signal	B	B	B	B	B	C	C	C	C	C	C	C
	Base		C	C	C	C	C	D	D	D	D	D	D	C
	Livability		C	C	B	B	C	C	C	C	C	C	C	C
	Auto-Centric		D	C	C	C	C	D	D	D	D	D	D	D
	Regional Investment		C	B	B	B	B	C	C	C	C	C	C	C
Broadway & 37th Ave	Existing	Signal	B	B	B	B	B	B	B	B	C	C	C	C
	Base		C	C	C	B	C	C	C	C	C	D	D	C
	Livability		B	B	B	B	B	C	C	C	C	C	C	C
	Auto-Centric		C	C	C	B	C	C	C	C	C	D	E	D
	Regional Investment		B	B	B	B	B	C	C	C	C	C	C	C
Broadway & 40th Ave S	Existing	TWSC	C	B	B	B	C	C	C	B	C	C	D	C
	Base		C	C	B	B	C	C	E	C	D	D	F	C
	Livability		B	C	C	C	C	D	E	C	D	E	F	C
	Auto-Centric		C	B	B	C	C	C	D	C	E	F	F	C
	Regional Investment		C	C	B	B	B	C	C	B	C	D	C	C

Table 20: 2045 Traffic Operations – Non-Study Intersections from Central Avenue to 40th Avenue South

Intersection	Volume Scenario	Control	Level of Service (Peak)		
			AM	MID	PM
Broadway & Western Ave S	Existing	TWSC	C	A	B
	Base		A	A	B
	Livability		A	A	C
	Auto-Centric		C	C	B
	Regional Investment		A	A	C
Broadway & EB 3rd Ave S	Existing	TWSC	C	C	C
	Base		B	D	B
	Livability		A	D	A
	Auto-Centric		B	E	D
	Regional Investment		B	D	D
Broadway & 5th Ave S	Existing	TWSC	A	C	F
	Base		C	D	E
	Livability		D	A	C
	Auto-Centric		D	A	F
	Regional Investment		A	A	F
Broadway & 7th Ave S	Existing	TWSC	C	D	E
	Base		C	E	F
	Livability		C	E	F
	Auto-Centric		D	F	F
	Regional Investment		C	F	F
Broadway & 8th Ave S	Existing	TWSC	B	F	F
	Base		C	F	F
	Livability		C	F	F
	Auto-Centric		C	F	F
	Regional Investment		C	F	F
Broadway & 9th Ave S	Existing	TWSC	C	F	F
	Base		C	F	F
	Livability		D	F	F
	Auto-Centric		D	F	F
	Regional Investment		D	F	F
Broadway & 13th Ave S	Existing	TWSC	D	F	F
	Base		D	F	F
	Livability		E	F	F
	Auto-Centric		F	F	F
	Regional Investment		F	F	F

Intersection	Volume Scenario	Control	Level of Service (Hour of Day)		
			AM	MID	PM
Broadway & 14th Ave S	Existing	TWSC	D	F	F
	Base		E	F	F
	Livability		E	F	F
	Auto-Centric		F	F	F
	Regional Investment		D	F	F
Broadway & 15th Ave S	Existing	TWSC	C	F	F
	Base		C	F	F
	Livability		D	F	F
	Auto-Centric		D	F	F
	Regional Investment		C	F	F
Broadway & 17th Ave S	Existing	TWSC	D	F	F
	Base		D	F	F
	Livability		D	F	F
	Auto-Centric		D	F	F
	Regional Investment		C	F	F
Broadway & 18th Ave S	Existing	TWSC	C	F	F
	Base		D	F	F
	Livability		E	F	F
	Auto-Centric		D	F	F
	Regional Investment		C	F	F
Broadway & 19th Ave S	Existing	TWSC	B	D	C
	Base		B	D	C
	Livability		B	D	C
	Auto-Centric		B	C	C
	Regional Investment		A	D	C
Broadway & 33rd Ave	Existing	RIRO	A	A	B
	Base		A	A	B
	Livability		A	A	A
	Auto-Centric		A	A	B
	Regional Investment		A	A	B

TWSC - Two Way Stop Control; RIRO - Right In, Right Out Control

Travel Time Analysis

Along corridors with dense traffic control spacing, metering of traffic can often minimize the overall deficiencies at any one location. What this means is that traffic delays are distributed at upstream and downstream signals, preventing the full effect of congestion to occur at any one location. To understand this phenomenon, travel time analysis was conducted. Generally, the corridor is expected to operate consistently, under most scenarios even during peak hours. On a typical day, traveling between Central Avenue and 40th Avenue S takes around seven minutes, or 40 percent longer than the free flow travel time of five minutes. The similarities between existing traffic operations and future traffic operations should be overly confounding, given the corridor once carried volumes like 2045 traffic forecasts during the energy boom and operated in a similar fashion. However, at this time, signal timing optimizing had not occurred in many decades. The traffic modeling for this study assumed signal optimization for each scenario.

During the peak hours, the travel time remains under seven and a half minutes for most scenarios (50 percent over free flow), the one exception is the southbound travel in the Auto-Centric alternative where travel time is closer to nine and a half minutes from 40th Avenue S to Central Avenue, or 90 percent longer than free flow speeds. This highlights the proximity to when the corridor will become overcapacity. Traffic congestion does not build linearly, rather once bottleneck occurs, total breakdown can result resulting in residual impacts for long periods of time as traffic queues resolve.

One interesting nuance is the directionality of traffic along the corridor. As identified in the existing conditions report, far more traffic using Broadway to go south, then finds an alternative route home. Several theories existing for this occurrence, some of which include trip chaining (i.e., stopping at Walmart on your way home from work) and the concept that drivers enter Broadway to the north where congestion is less and continue on the corridor, on the way home they find alternative routes to avoid turning left at the congested intersections.

Figure 81: Travel Times on Broadway between 40th Avenue S and Central Avenue

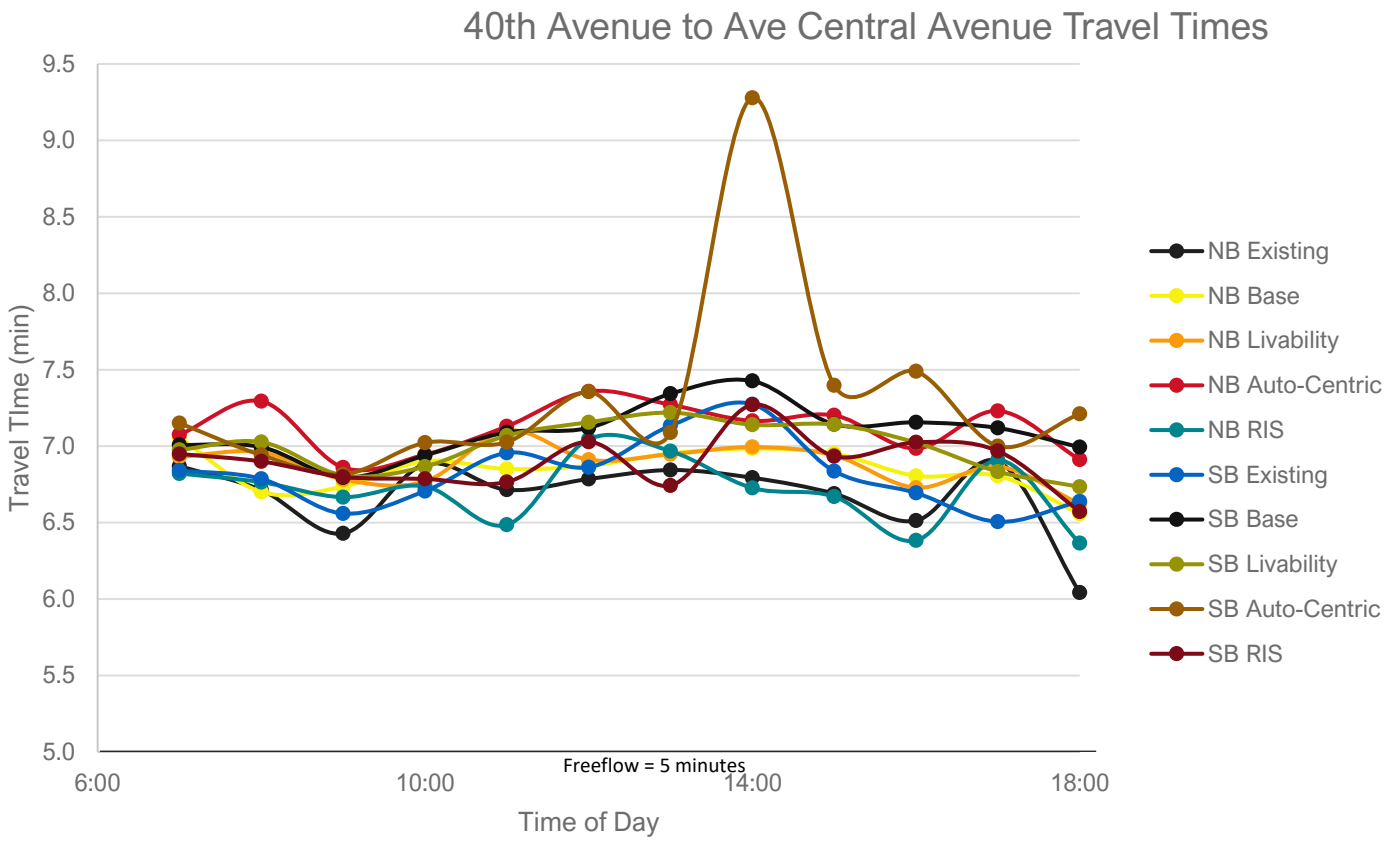


Figure 82: Travel Times on Broadway between 40th Avenue S and US 2

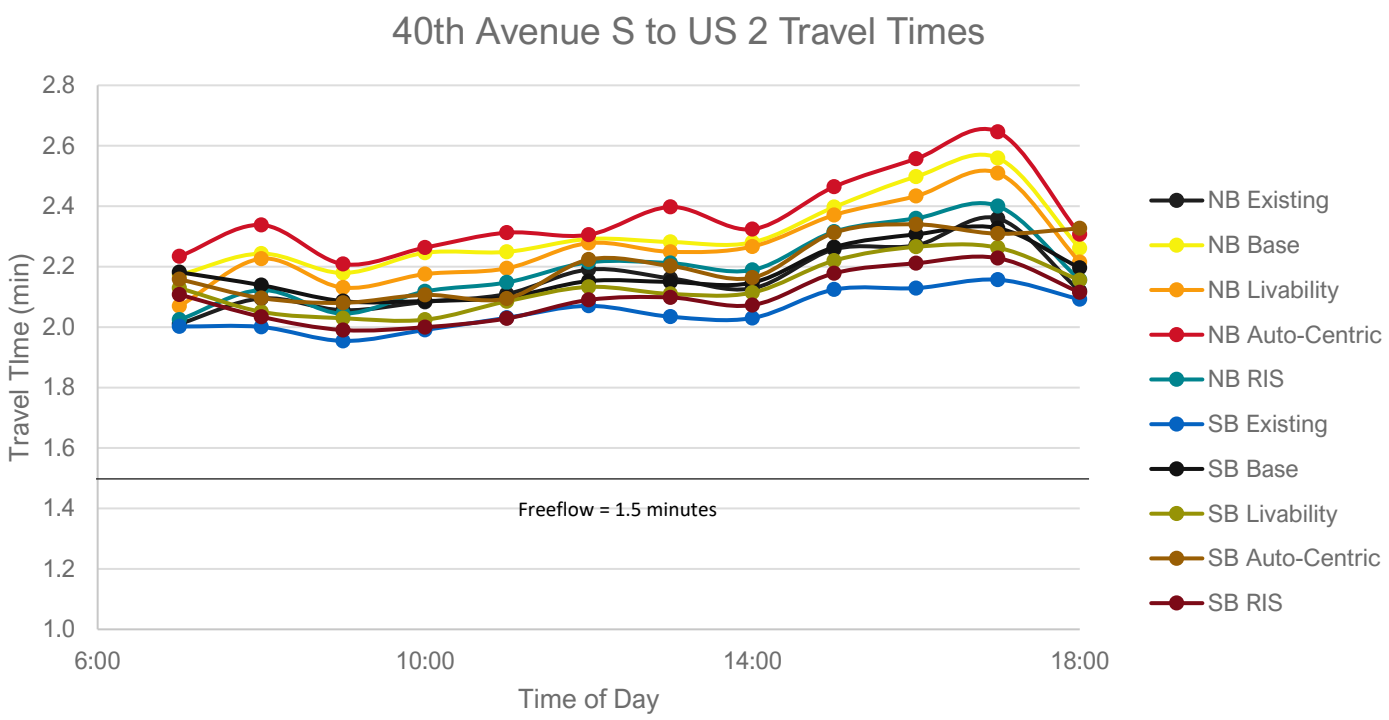


Figure 83: Travel Times on Broadway between US 2 and 11th Avenue S

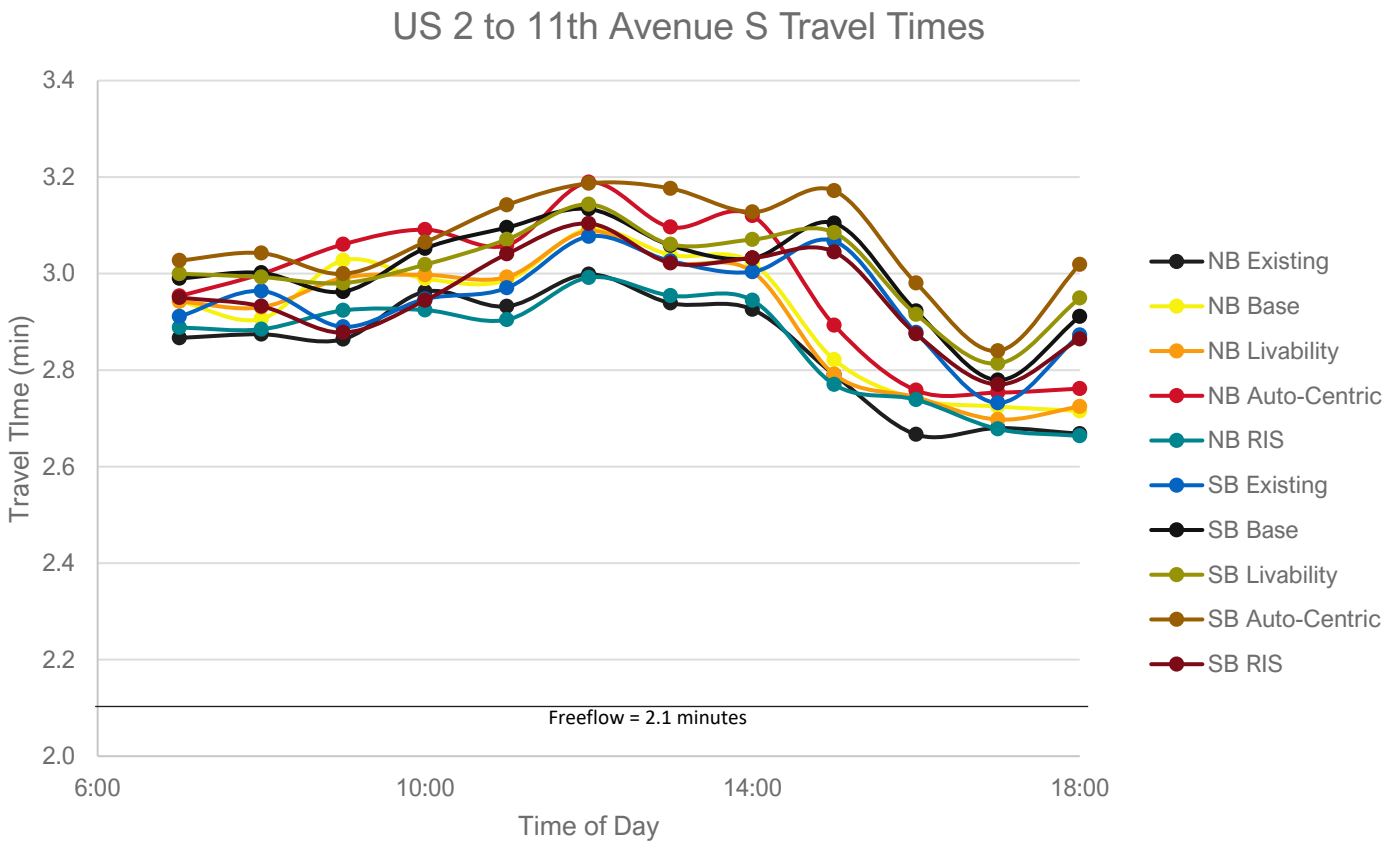
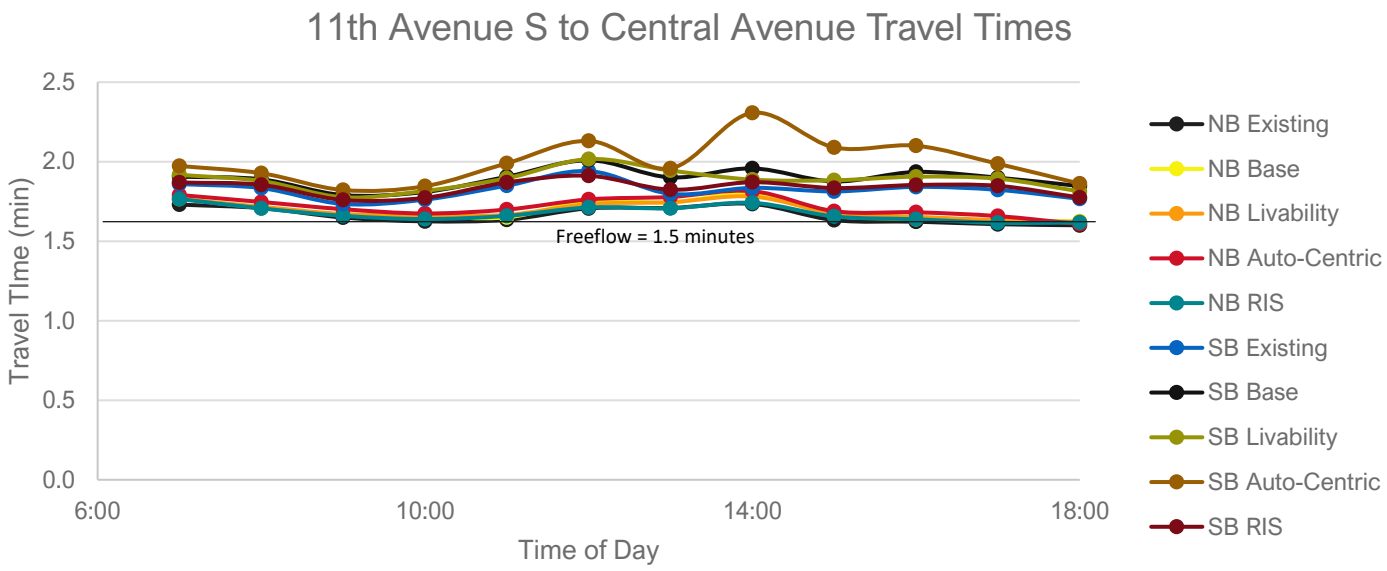


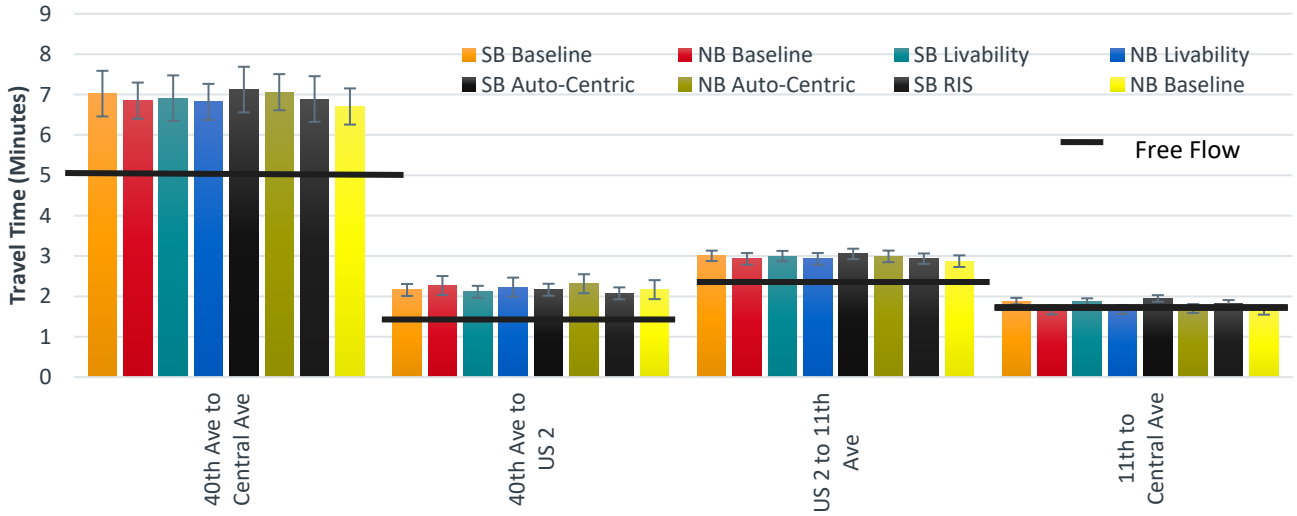
Figure 84: Travel Times on Broadway between 11th Avenue S to Central Avenue



Travel time reliability measures the extent of unexpected delay, as measured from day-to-day and across different times of the day. Most travelers are less tolerant of unexpected delays because they cannot be incorporated into planned travel time, resulting in late arrivals; alternatively budgeting twice as long as needed for a trip also can result in wasted time. The Level of Travel Time Reliability (LOTTR) is defined as the ratio of the 85th percentile travel time to an average travel time for all vehicles. An LOTTR of 1.50 and greater indicate severe unreliability. For example, a LOTTR of 2.00 means that motorists should plan for twice the amount of travel time to arrive at their destinations on time. Consistent travel times would be a LOTTR around 1.0. LOTTR could be acceptable and close to 1.0 even when travel times are double free flow speeds if it reliably takes twice as much time to drive the corridor than free flow speeds.

Generally, the Broadway corridor is expected to operate reliably throughout a typical day in 2045, under all scenarios. Even under the Auto-Centric scenario, LOTTR remains at 1.14 or below. Figure 85 shows the average travel times by scenario for selected segments of the corridor along with free flow travel times and the LOTTR.

Figure 85: 2045 Base Travel Time Reliability



Freight Level of Service

The Broadway corridor is an important freight connection to and through Minot, with connections to the Minot Air Force Base and Canadian border to the north and south to Bismarck and I-94. While the completion of the US 83 bypass from 46th Avenue N to US 2 along the western edge of Minot has changed how trucks use the Broadway corridor, it remains a critical corridor for freight movements and Minot's businesses.

Freight haulers rely on travel time reliability, so they can make their deliveries on-time and minimize delays. Travel time reliability measures the extent of unexpected delay, as measured from day-to-day and across different times of the day. While the overall travel time reliability uses a ratio of the 85th percentile travel time to the average travel time, the freight level of service uses the 95th percentile travel time for trucks only. Freight level of service thresholds are shown in Table 10.

Table 21: Freight Level of Service

Level of Service	LOTTR 95th Percentile
A	1.0
B	1.0 – 1.25
C	1.25 – 1.60
D	1.60 – 2.0
E	2.0 – 2.5
F	> 2.5

Daily Operations

Truck freight travel time reliability was completed using Vissim microsimulation between Central Avenue and 40th Avenue S. Throughout the course of a typical day, freight level of service is C. Travel time through the corridor is less reliable for freight vehicles than passenger vehicles. This is more than likely due to added stopping and start up times for large vehicles when progression along the corridor is stopped due to traffic signals. This also affects all vehicles behind the freight vehicles. The frequent signal spacing along the corridor, when not perfectly timed, can create frustrating delays for freight carriers. Figure 86 shows the 2045 truck travel time reliability, Figure 87 and Figure 88 shows the average truck speeds, and Figure 89 the 2045 freight level of service.

Figure 86: 2045 Truck Travel Time Reliability

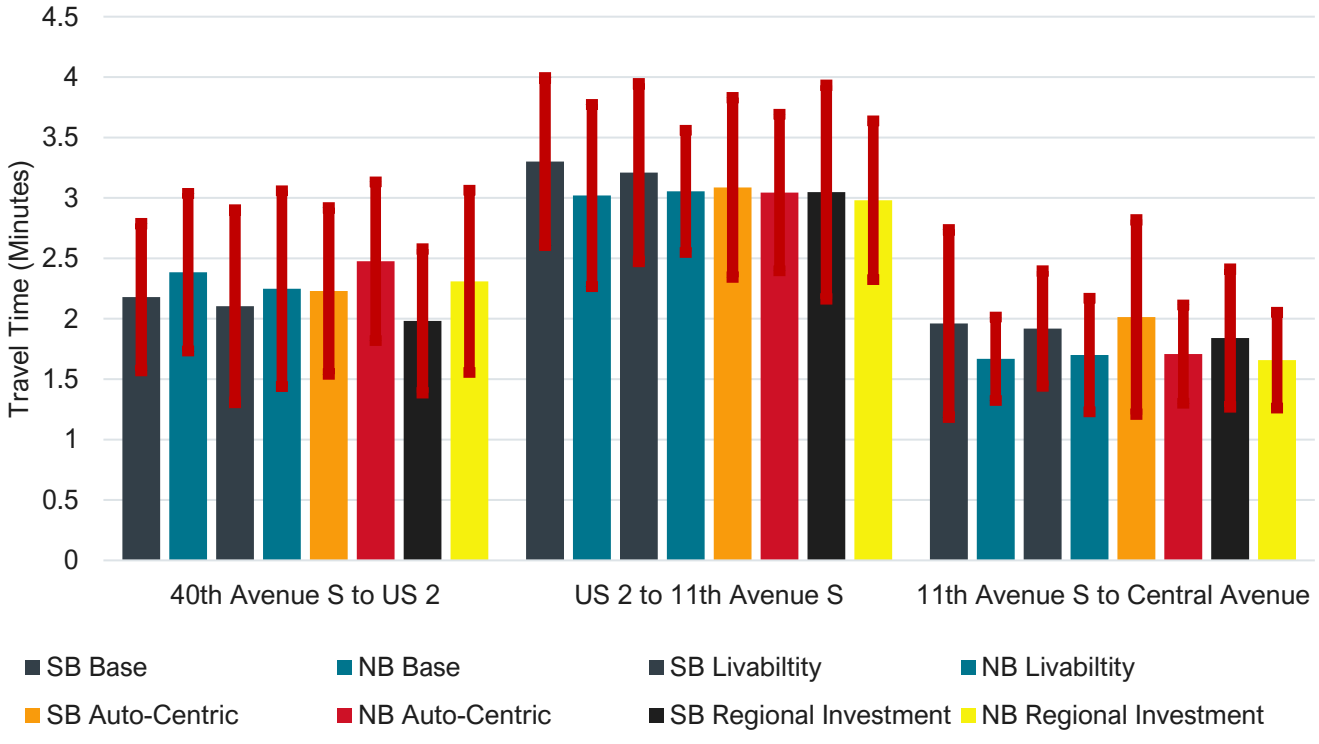


Figure 87: Average Northbound Truck Speed

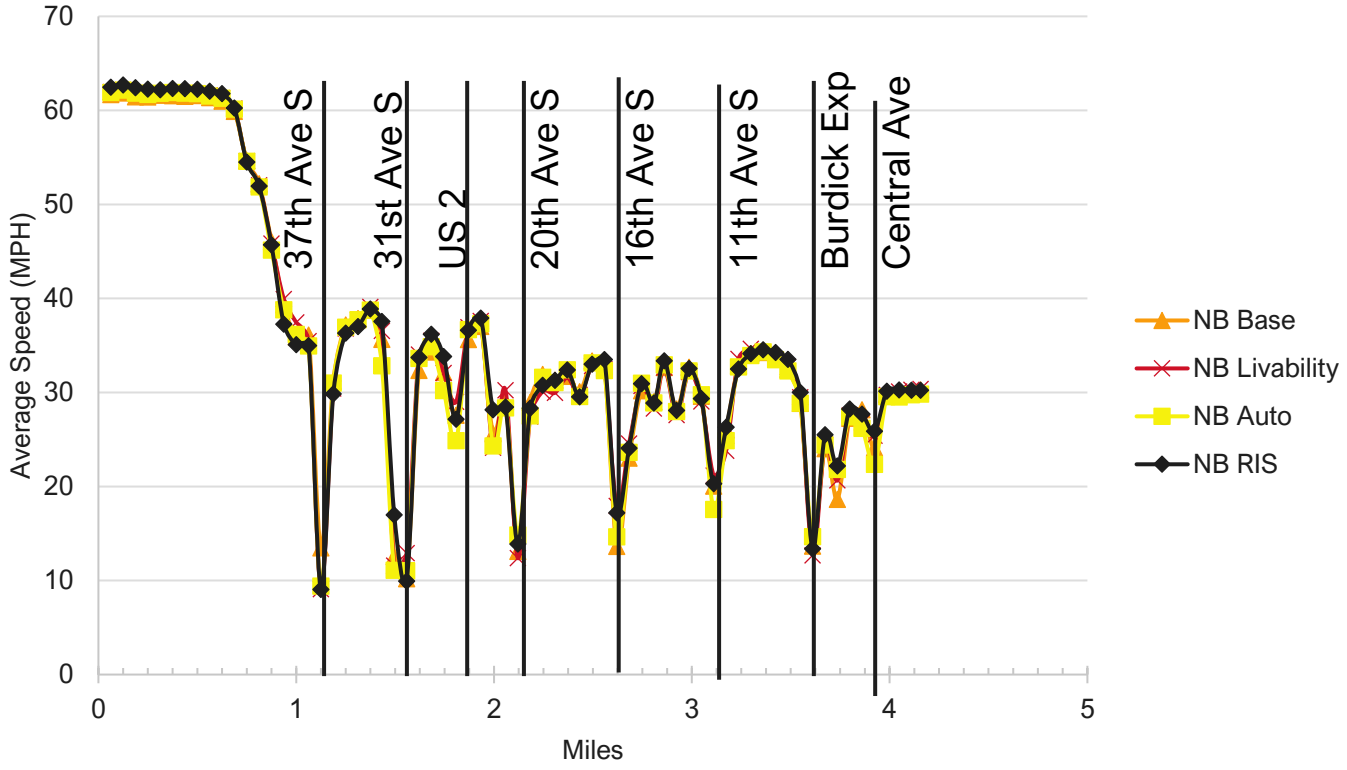


Figure 88: Average Southbound Truck Speed

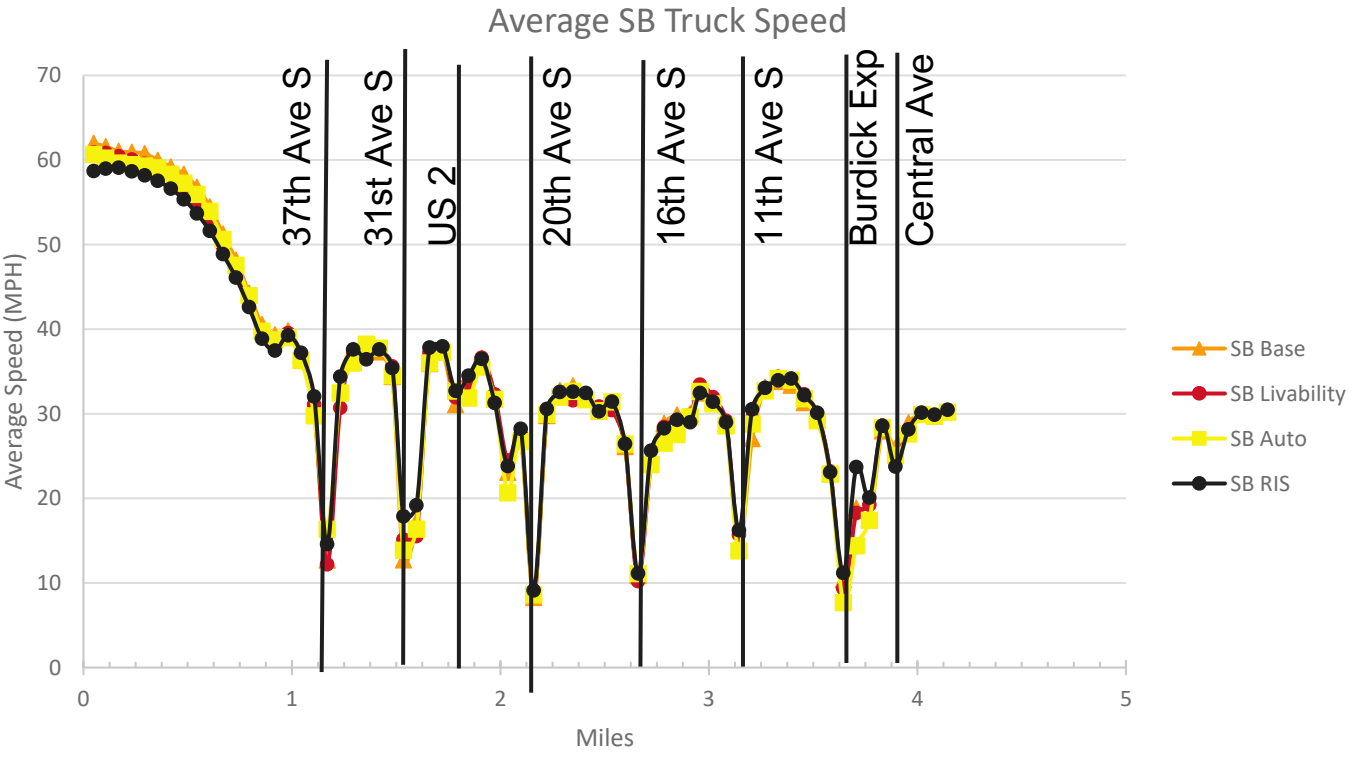
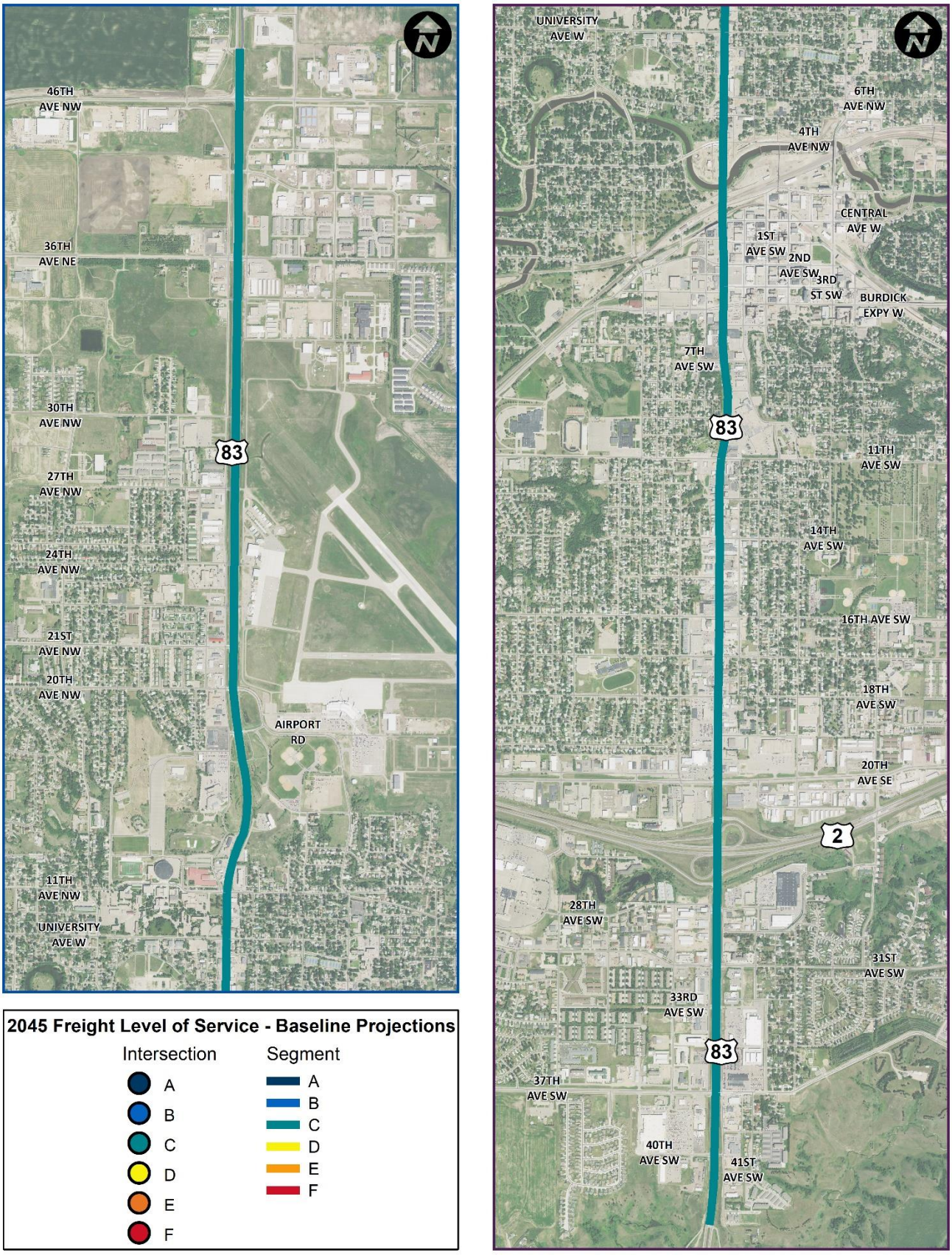


Figure 89: 2045 Base Freight Level of Service



Source: NDDOT, NDGISHub, ESRI

September 2020

Pedestrian Level of Service

Enhancing the ability of people to walk and bike involves providing adequate infrastructure and linking urban design, streetscapes, and land use to encourage walking and biking. Pedestrian level of service (PLOS) incorporates a metric for segments (roadways between two intersections) and intersections. The *Highway Capacity Manual* provides a pedestrian level of service calculation for intersections that incorporates traffic volumes, speed, and the physical characteristics of the intersection. For segments, PLOS incorporates the number of travel lanes, traffic volumes, traffic speeds, truck traffic, and buffer width. Access density was also incorporated into the calculations for PLOS. Access density creates conflict points for pedestrians and often creates ADA challenges. Where access density was twice as dense as the allowable spacing, the LOS was reduced. For example, if access density was 300 percent higher than allowable, this would degrade the LOS by three full grades or to LOS F, whichever was higher.

2045 Base Level of Service

Pedestrian level of service was only evaluated under the base traffic scenario. Generally, the future pedestrian conditions are not expected to change significantly because there are no anticipated changes to the non-motorized infrastructure.

- North of 21st Avenue N and south of 20th Avenue S there are no pedestrian facilities, so these segments are PLOS F. The only exception are the signalized intersections with facilities, which include 31st Avenue S and 37th Avenue. The PLOS is acceptable at these two locations due to their facility, all other intersections within these segments see deficient intersection PLOS.
- 11th Avenue S to 20th Avenue S has extremely dense access points, as well as, pedestrian facilities immediately adjacent to the roadway, this results in a PLOS F.
- The core of Broadway, between University Avenue N and 11th Avenue S, has a segment PLOS of D. The pedestrian facilities on both sides provides pedestrian mobility for most users. However, there are some areas of deficiencies like sidewalk obstructions, narrow sidewalks, and high vehicle speeds with facilities directly adjacent to the roadway.
- Unsignalized intersections, especially along Broadway's core see intersection PLOS C or better. This is due to the high level of service on the stop controlled approaches (east and west approaches). However, the uncontrolled approaches (north and south approaches) are deficient at PLOS F. Despite the acceptable intersection PLOS, crossing Broadway at these intersections remains deficient.

Figure 90 shows the 2045 base pedestrian level of service.

Bicycle Level of Service

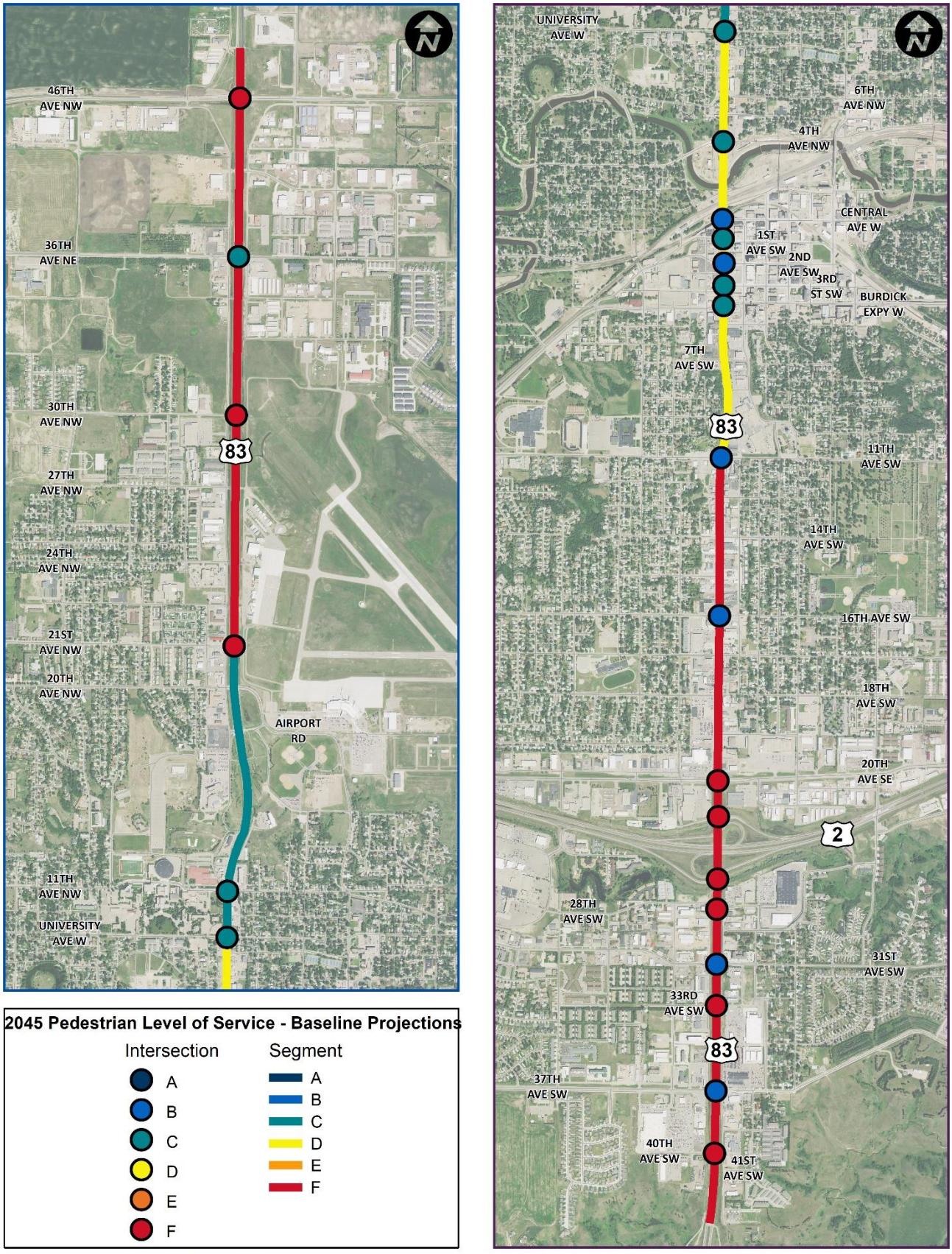
Bicycle level of service (BLOS) incorporates a metric for segments (roadways between two intersections) and intersections. The *Highway Capacity Manual* provides a BLOS calculation for intersections that incorporates traffic volumes, speed, and the physical characteristics of the intersection. The intersection BLOS score is an indication of the typical bicyclist's perception of the overall crossing experience. For segments, BLOS incorporates traffic volumes, roadway width, speed, truck traffic, pavement condition, on-street parking, and shoulder width. Access density was also incorporated into the calculations for PLOS. Access density creates conflict points for pedestrians and often creates ADA challenges. Where access density was twice as dense as the allowable spacing, the LOS was reduced. For example, if access density was 300 percent higher than allowable, this would degrade the LOS by three full grades or to LOS F, whichever was higher.

2045 Base Level of Service

Bicycle level of service was only evaluated under the base traffic scenario. Generally, the future bicycle conditions are not expected to change significantly because there are no anticipated changes to the non-motorized infrastructure.

Based on the methodologies discussed, the BLOS at the study corridor is shown in Figure 91. Throughout the corridor BLOS D or worse is experienced because there is no continuous bicycle facility. The paved shoulders present on segments transitions into right turn lanes at intersection approaches, and thus BLOS becomes unacceptable. South of 20th Avenue S, all intersections excluding 31st Avenue S and 37th Avenue S experience BLOS F due to lack of bicycle crossing facilities.

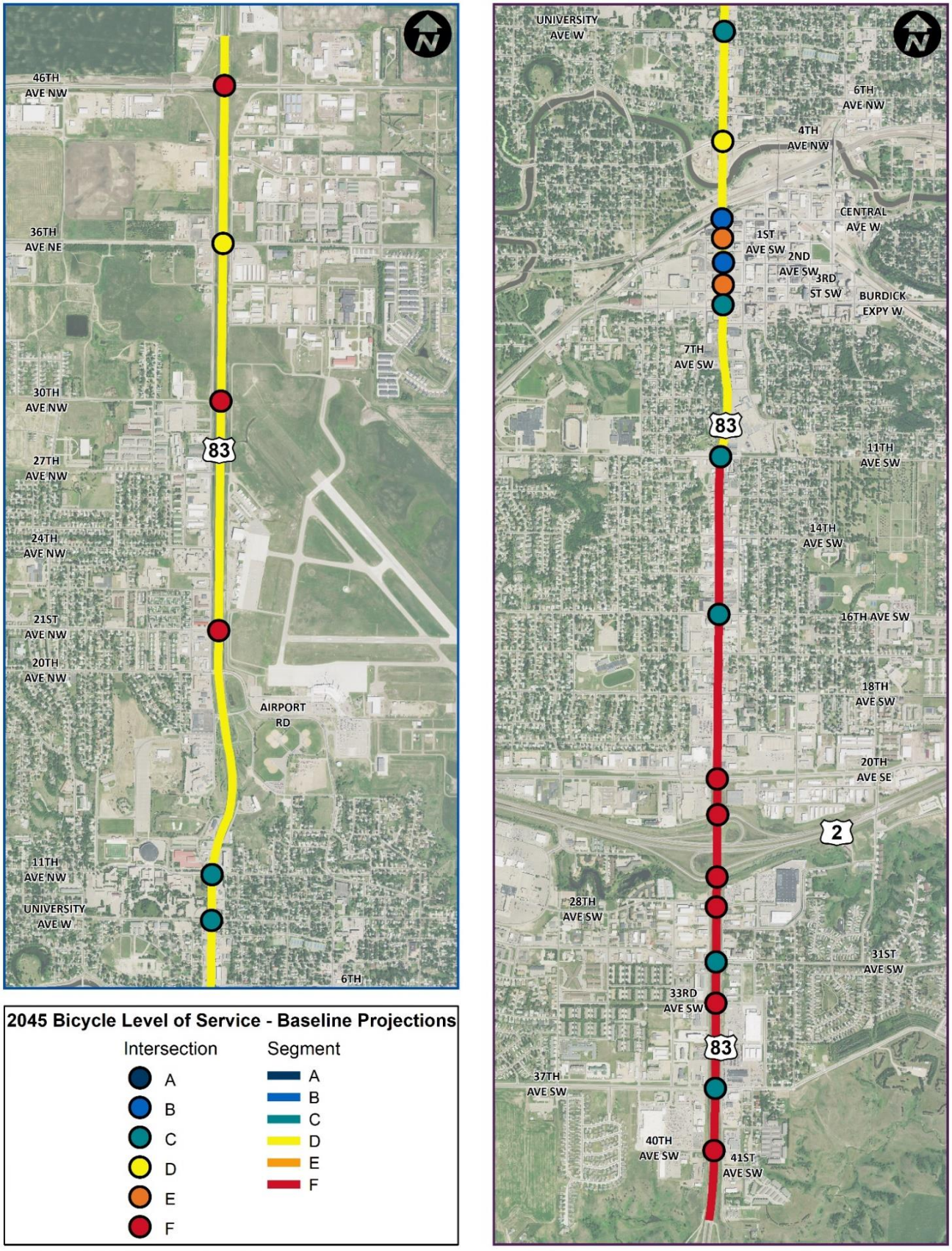
Figure 90: 2045 Base Pedestrian Level of Service



Source: NDDOT, NDGISHub, ESRI

September 2020

Figure 91: 2045 Bicycle Level of Service



Source: NDDOT, NDGISHub, ESRI

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Transit Level of Service

Transit quality of service is generally determined by service hours, frequency, and the directness of transit routes. For this analysis, service hour was selected. Service frequency is an important metric for fixed route for determining the availability of transit service to potential users. The more frequent transit service provides more opportunities for immediate travel and makes it a more competitive mode choice. The frequency thresholds are shown in Table 11.

Table 22: Transit Level of Service Thresholds

Vehicles per hour	Level of Service
>6	A
5-6	B
3-4	C
2	D
1	E
<1	F

2045 Base Level of Service

Generally, each route in Minot City Transit is on a 60-minute headway, for LOS E. However, because the routes are one direction with loops and some overlapping routes, there are areas that see LOS C (20th Avenue S to 31st Avenue S), while other areas see LOS E (University Avenue to 20th Avenue S, 31st Avenue S to 37th Avenue S). North of University Avenue and south of 37th Avenue S, there is no transit service provided. These segments operate at LOS F. The transit LOS is shown in Figure 92. This is unchanged from the existing transit level of service.

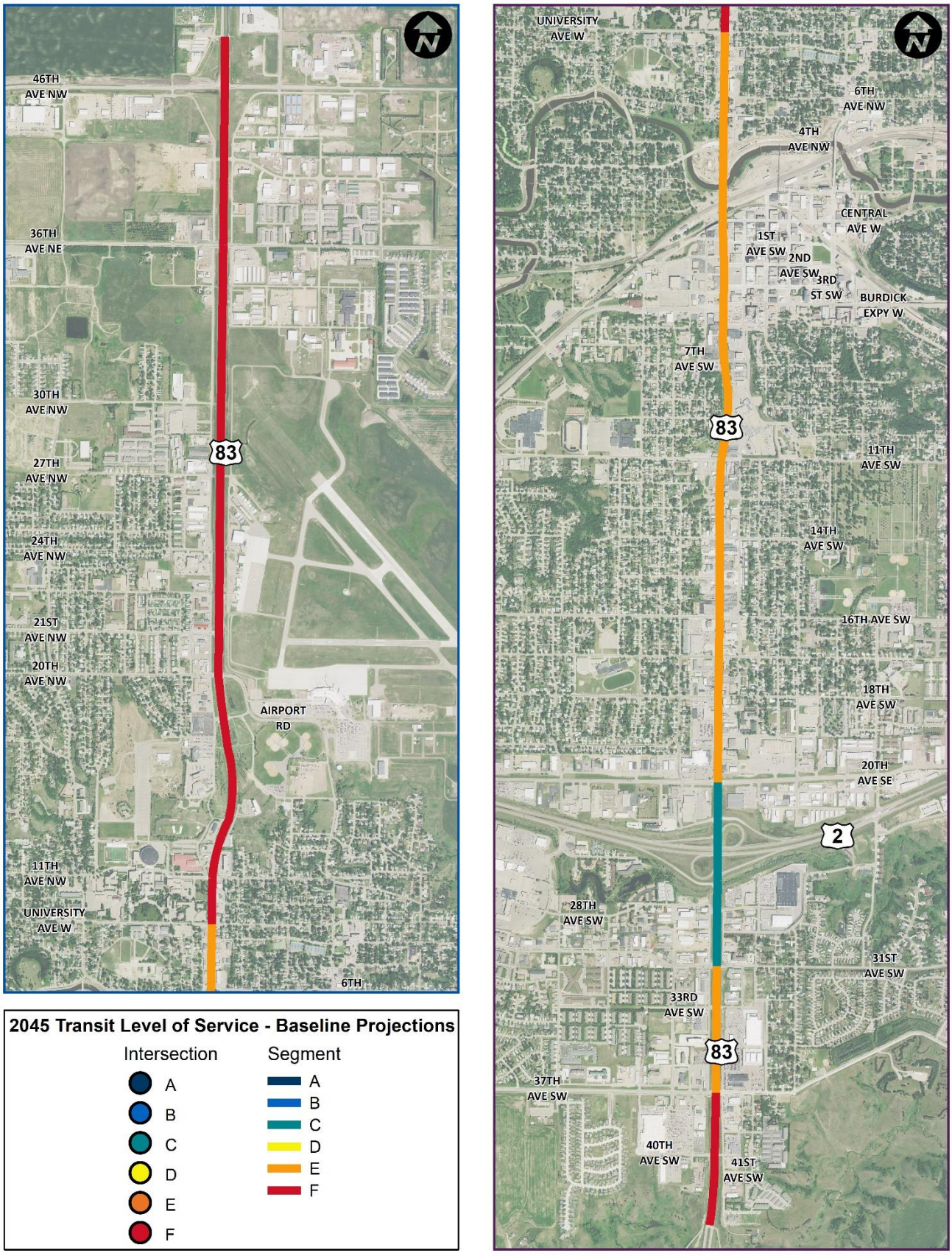
2045 Base Multimodal Level of Service

Vehicular, freight, pedestrian, bicycle, and transit levels of service were calculated independently throughout the study area. The unweighted multimodal level of service combines each of the five modal levels of service into a single multimodal level of service, which is shown by segment and intersection in Figure 93.

Aggregating the modes illustrates a corridor that is clearly imbalanced, failing, or nearly failing throughout most of the corridor. Most roadway users drive, not experiencing the full effects of a deficient level of service throughout the corridor. The lower and deficient levels of service felt by freight, pedestrians, bicycles, and transit weigh down the overall MMLOS. These conditions would improve under the Livability and Infrastructure Investment scenarios but worsen in the Auto-Centric scenario.

With Steering Committee and public input, the level of service can be weighted to reflect the priorities for the study area and identify and prioritize the deficiencies the community cares most about.

Figure 92: 2045 Base Transit Level of Service



Source: NDDOT, NDGISHub, ESRI

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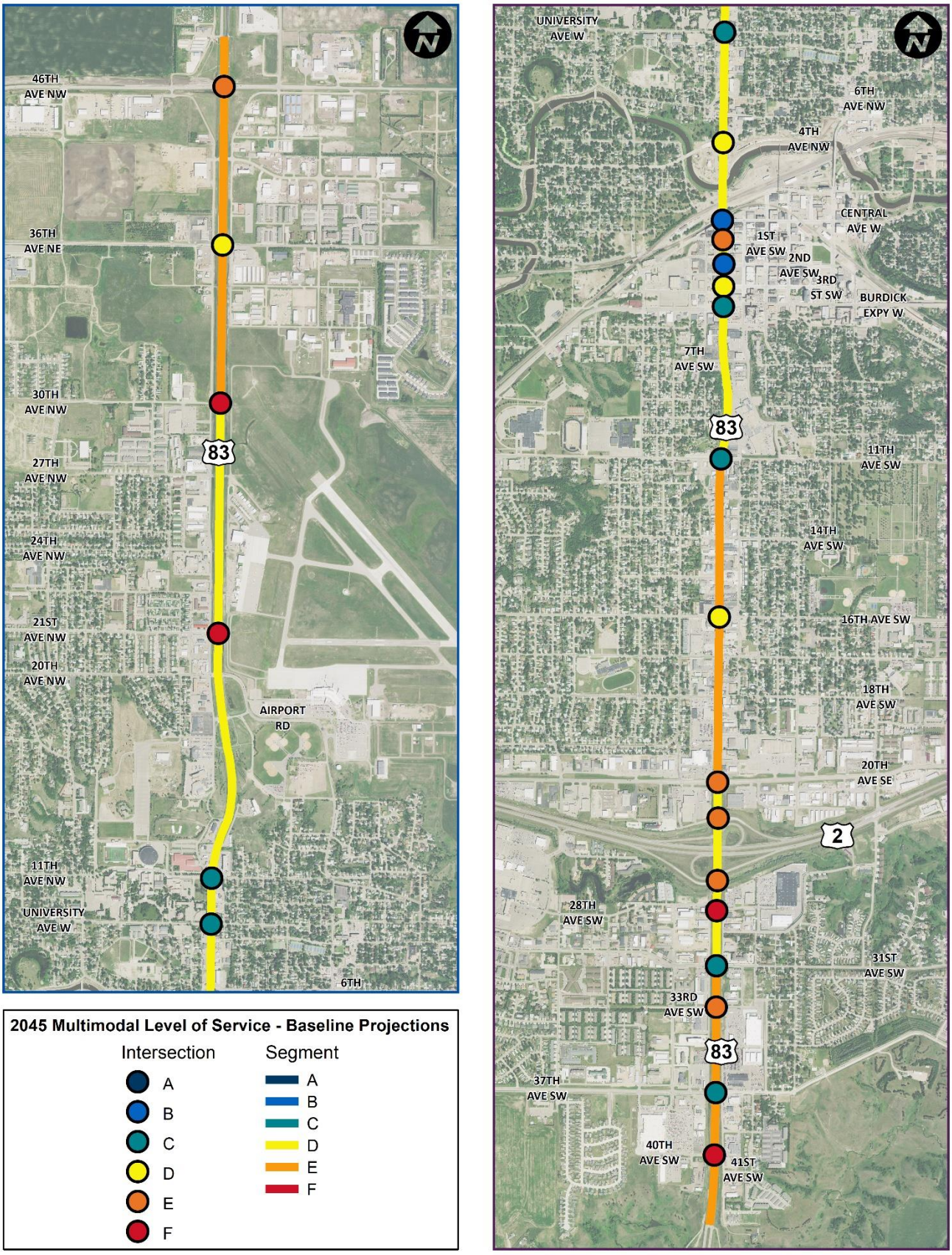
Figure 93: 2045 Base Multimodal Level of Service



Source: NDDOT, NDGISHub, ESRI

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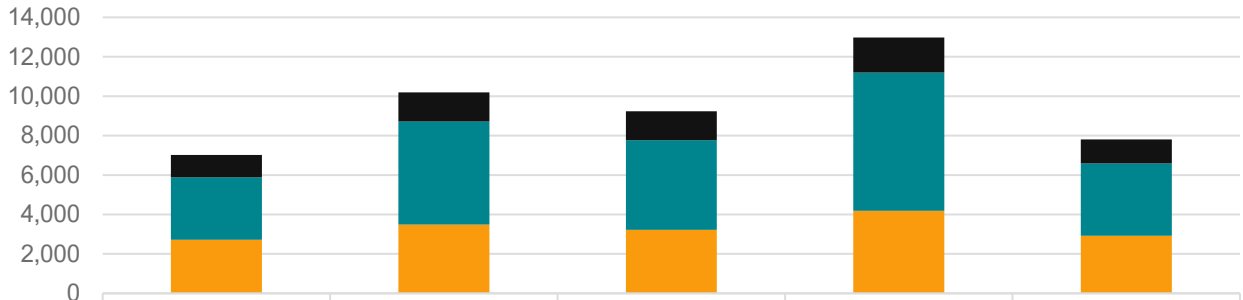
Conflict Analysis

To establish a baseline for future safety comparisons between alternatives, simulated vehicle conflicts were tabulated from Vissim simulation results using the Surrogate Safety Assessment Model (SSAM). SSAM uses Vissim modeled vehicle trajectory information to analyze vehicle-to-vehicle interactions to identify conflict events and near-miss conflicts. This analysis considers vehicle speeds, deceleration characteristics, typical gap acceptance behavior, traffic volumes, and site-specific vehicle paths to quantify predicted conflicts for rear-end, crossing, and lane change crash types. It is important to note that simulated conflicts may not directly correlate to crashes, rather the tool is intended to identify conditions with a high *potential* for crashes.

Simulation results from an average of ten 12-hour Vissim model runs were used for this analysis and show the potential change of each crash type. The conflict comparison is shown in Figure 94 and summarized below.

- Under the 2020 base conditions, there were 7,630 total simulated conflicts.
- Under the 2045 baseline traffic projections, simulated conflicts increase 45 percent to 10,200.
- Under the 2045 livability scenario, simulated conflicts increase 32 percent to 9,240.
- Under the 2045 auto-centric scenario, simulated conflicts increase 85 percent to 13,000.
- Under the 2045 roadway infrastructure scenario, simulated conflicts increase 11 percent to 7,800.

Figure 94: Simulated Conflict Comparison



	2020 Existing	2045 Base	2045 Livability	2045 Auto Centric	2045 RIS
Merging	1,135	1,480	1,471	1,782	1,216
Rear End	3,166	5,227	4,545	7,009	3,667
Crossing	2,721	3,490	3,220	4,188	2,923

Figure 95 and Figure 96 shows the simulated conflicts. A review of the conflict modeling results revealed the following trends:

- For a corridor already either above average expected crash rates or critical crash rates, an increase in conflicts of 45 percent could have serious repercussions. As long queues increase, rear-end crash potential increases. As congestion builds, gaps disappear, drivers get frustrated and take chances, and angled crash potential increases.
- The increase in conflicts, like the increase in congestion is not linear, with the Auto-Centric scenario exhibiting an 40 percent more conflicts than the next scenario. These results illustrate the dangerous nature of operational bottlenecks from a safety perspective.
- One area of concern is in the densely spaced access areas between Burdick Expressway and 16th Avenue S, where driveway spacing is most dense. This area experiences a disproportionate number of angled crashes, compared to the rest of the corridor, the type most likely to result in an injury, or worse.
- Another area of the concern is the south end of the corridor, where traffic is funneled to several bottleneck intersections. The intersections of 31st Avenue S and 37th Avenue S have frontage roads closely spaced to the major intersection creating major conflict hot spots. The proximity between the 20th Avenue S intersection and the US 2 North ramp experiences a high degree of conflicts as well.

Figure 95: SSAM Simulated Conflicts on Broadway Between 20th Avenue S to 40th Avenue S

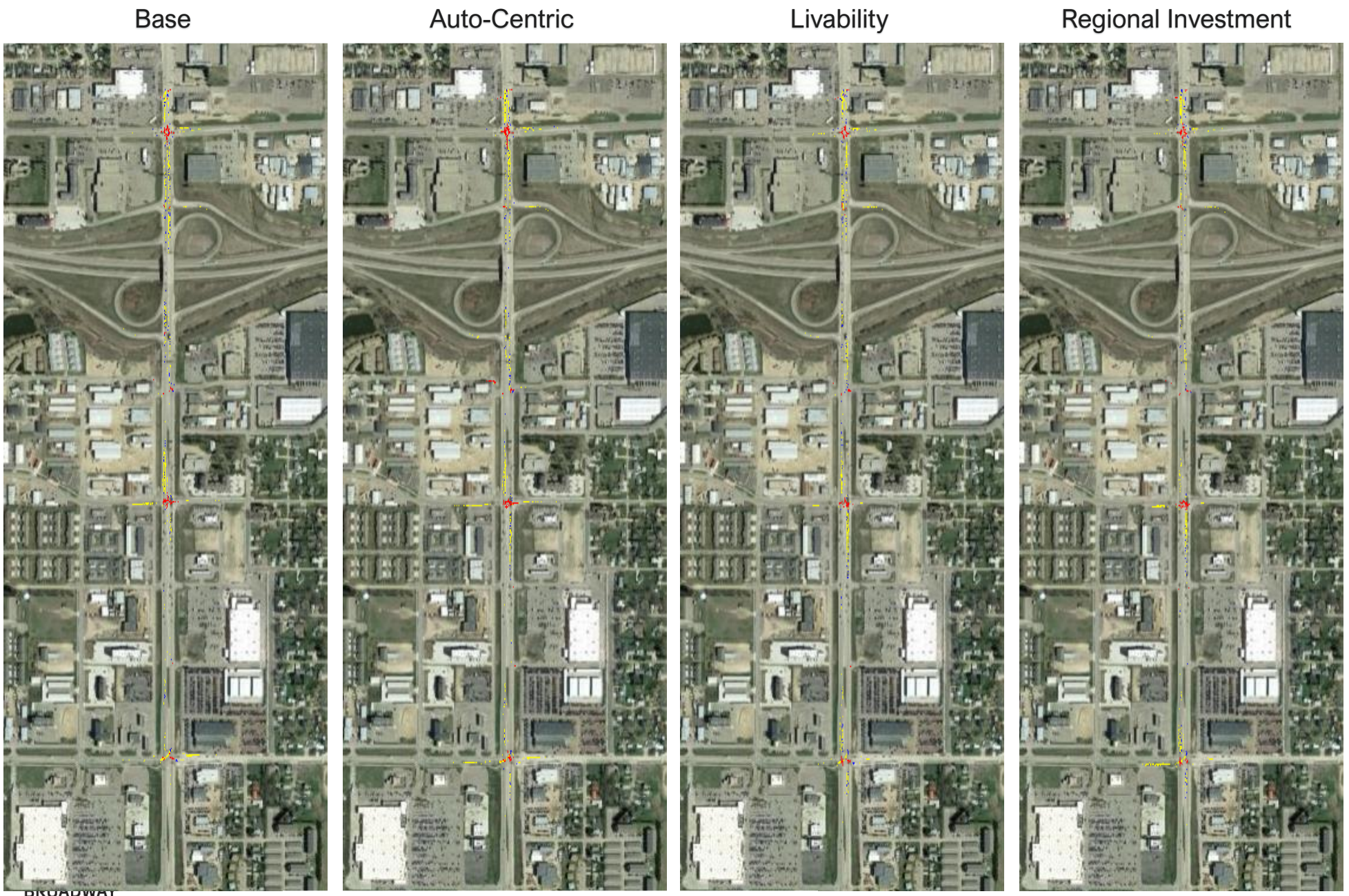


Figure 96: SSAM Simulated Conflicts between 20th Avenue S and 40th Avenue S

PUBLIC INPUT MEETING #1: WHAT WE HEARD

KEY STAKEHOLDER ENGAGEMENT

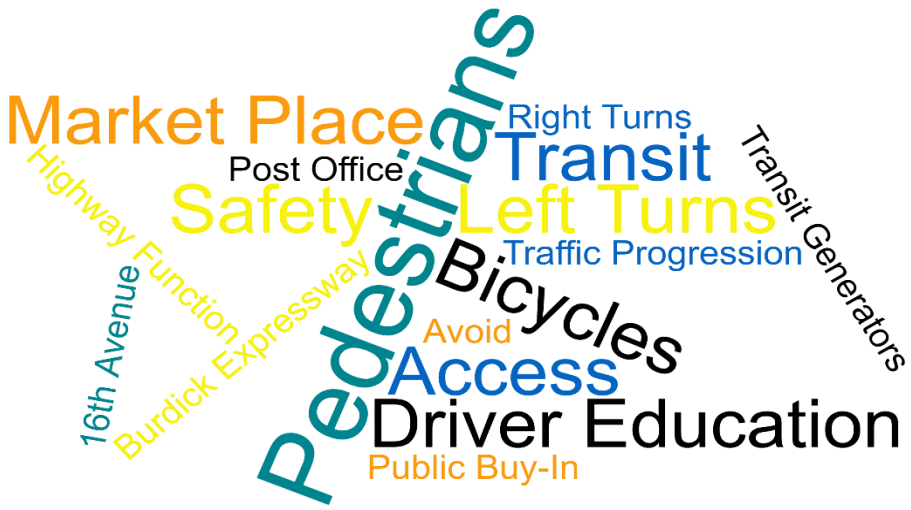
The Broadway Corridor Study is guided by a set of key stakeholders through the Study's Steering Committee. Members of the committee represent the City of Minot (Alderman, Engineering, Transit), the Minot Area Development Corporation, and the North Dakota Department of Transportation. As part of the visioning process, the committee was asked to participate in a Visioning Workshop. There were five activities within the Visioning Workshop. Each of the activities are summarized below.

Goals, Objectives, and Vision Roundtable

The first activity was a Goals, Objectives, and Vision Roundtable, where the committee shared their desired outcomes of this project. The key themes that emerged from this roundtable include

- Dense access spacing makes the corridor uncomfortable and is correlated with high crash rates.
- Improving left turns onto the corridor, especially at unsignalized locations.
- There are areas that are more challenging than others, including the bottlenecks at Burdick Expressway, the Marketplace Foods area, and the post office.
- Public engagement, education, and buy-in are important for moving concepts forward to construction.
- Improvements to the pedestrian and bicycle network is important. Facilities may not be appropriate on the Broadway corridor, but a parallel route needs to be evaluated. There are no facilities over US 2. Pedestrian and cyclist crossings of the corridor need to be evaluated. There are no facilities over US 2. Pedestrian and cyclist crossings of the corridor need to be improved.

Figure 97: Goals, Objectives, and Vision Roundtable Visual Results



Value Profile

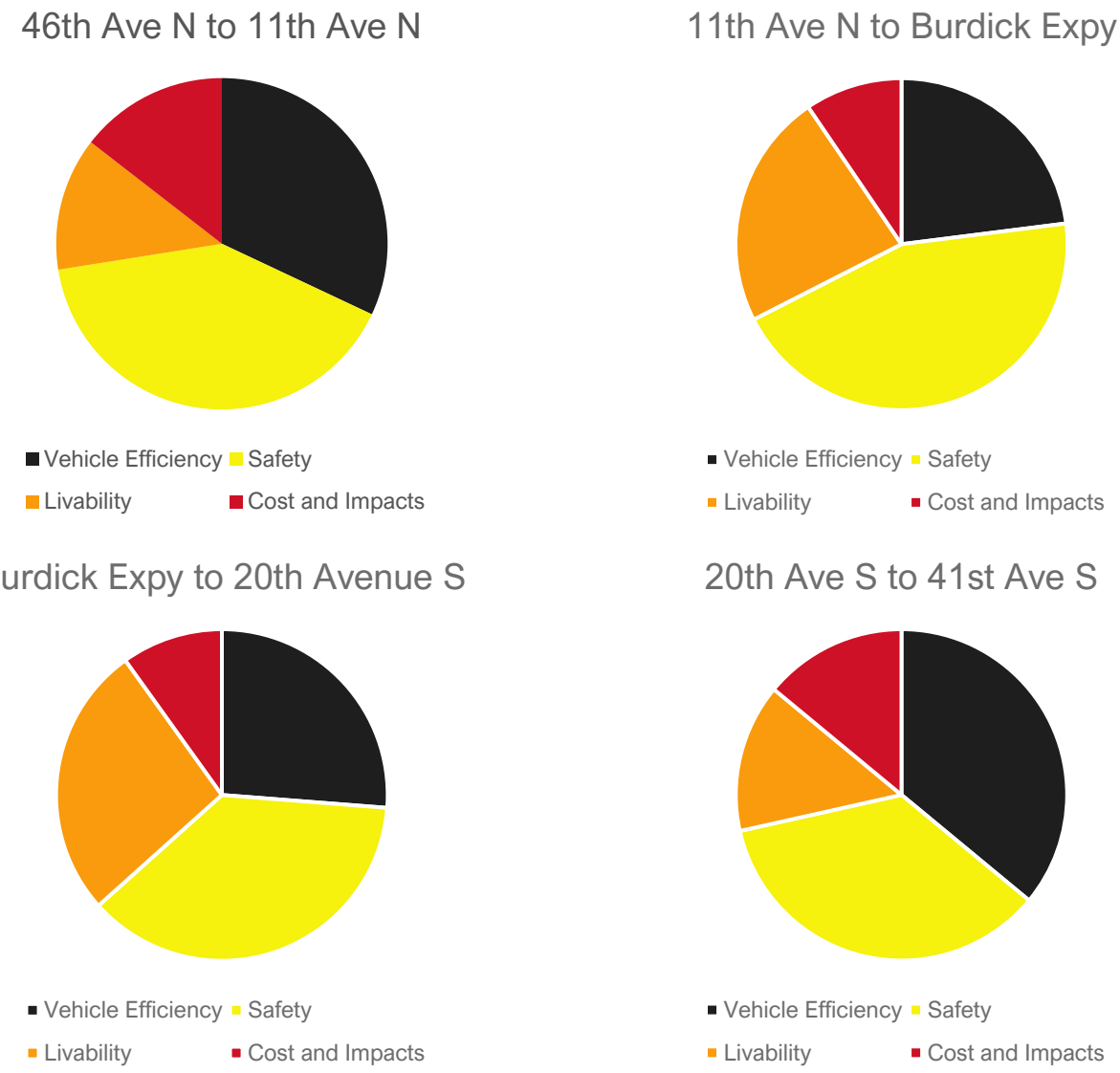
The value profile activity asked participants to place a value, between 1 and 100, to four categories, including vehicle efficiency, safety, livability (bicycle, pedestrian, and transit facilities), and cost and impacts. These values are used to help identify alternatives that meet these values and consider them in the technical evaluation process.

For this activity, the Broadway corridor was broken into four segments:

- Segment 1: 46th Avenue N to 11th Avenue N
- Segment 2: 11th Avenue N to Burdick Expressway
- Segment 3: Burdick Expressway to 20th Avenue S
- Segment 4: 20th Avenue S to 41st Avenue S

Generally, safety was the highest priority across the corridor, ranging from 35 percent (Segment 4) to 45 percent (Segment 3) of each segment's value profile. The second highest priority was vehicle efficiency, ranging from 23 percent (Segment 3) to 36 percent (Segment 4). Overall, there was no significant difference between local committee members and NDDOT committee members for the value profiles, excluding livability in Segment 2. Local members had a significantly higher livability value for this segment than the NDDOT committee members. Figure 98 shows the committee's value profile results.

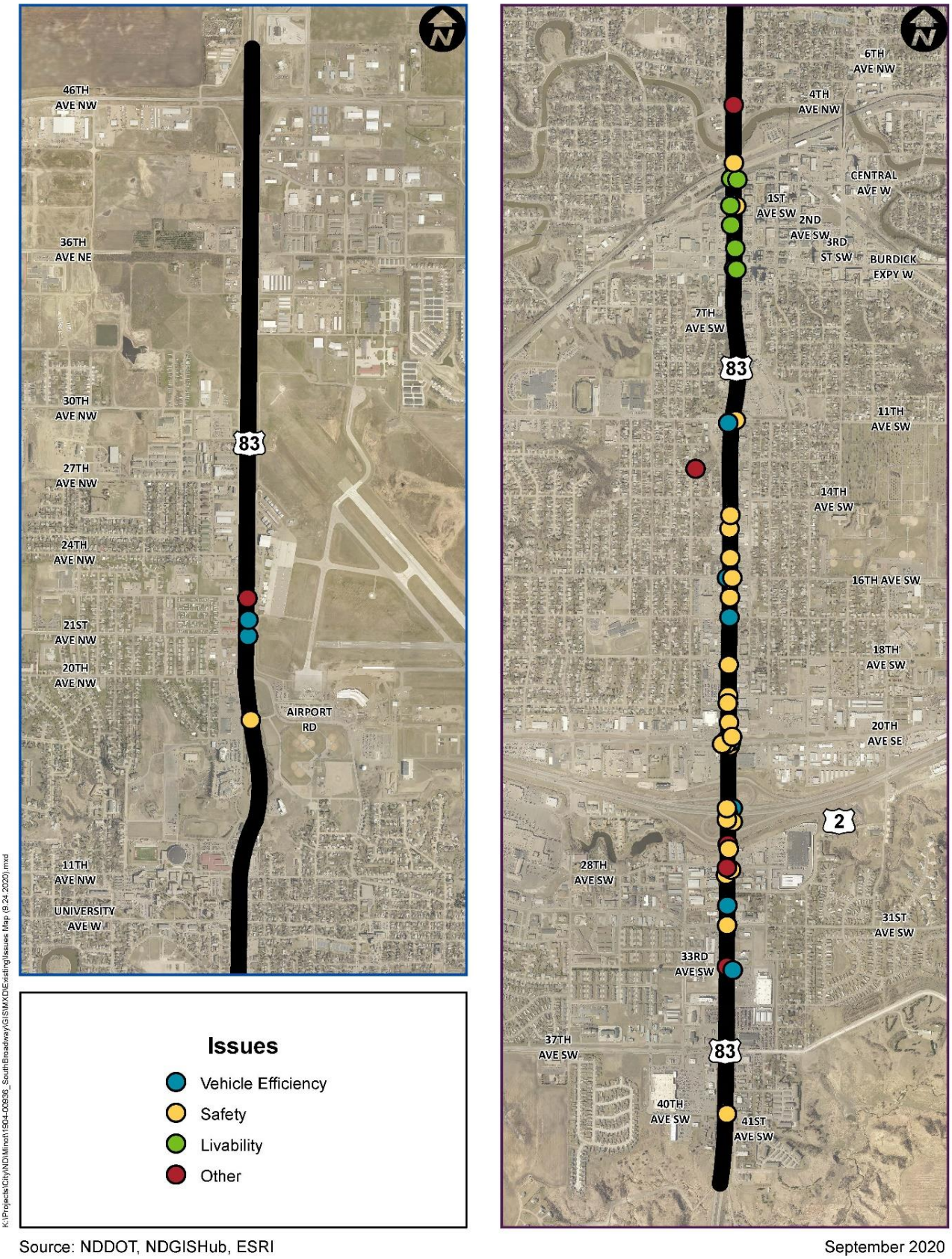
Figure 98: Steering Committee's Value Profile Results



Issues Mapping Activity

The issues mapping activity asked the committee to identify specific issues an opportunities in four categories, including vehicle efficiency, safety, livability, and other. This activity shapes the types and locations of specific improvement alternatives throughout the corridor. The recurring issues were access management, poor signal progression, and difficult pedestrian crossings. Figure 99 shows the committee's issues mapping summary.

Figure 99: Issues Mapping Activity Summary



Source: NDDOT, NDGISHub, ESRI

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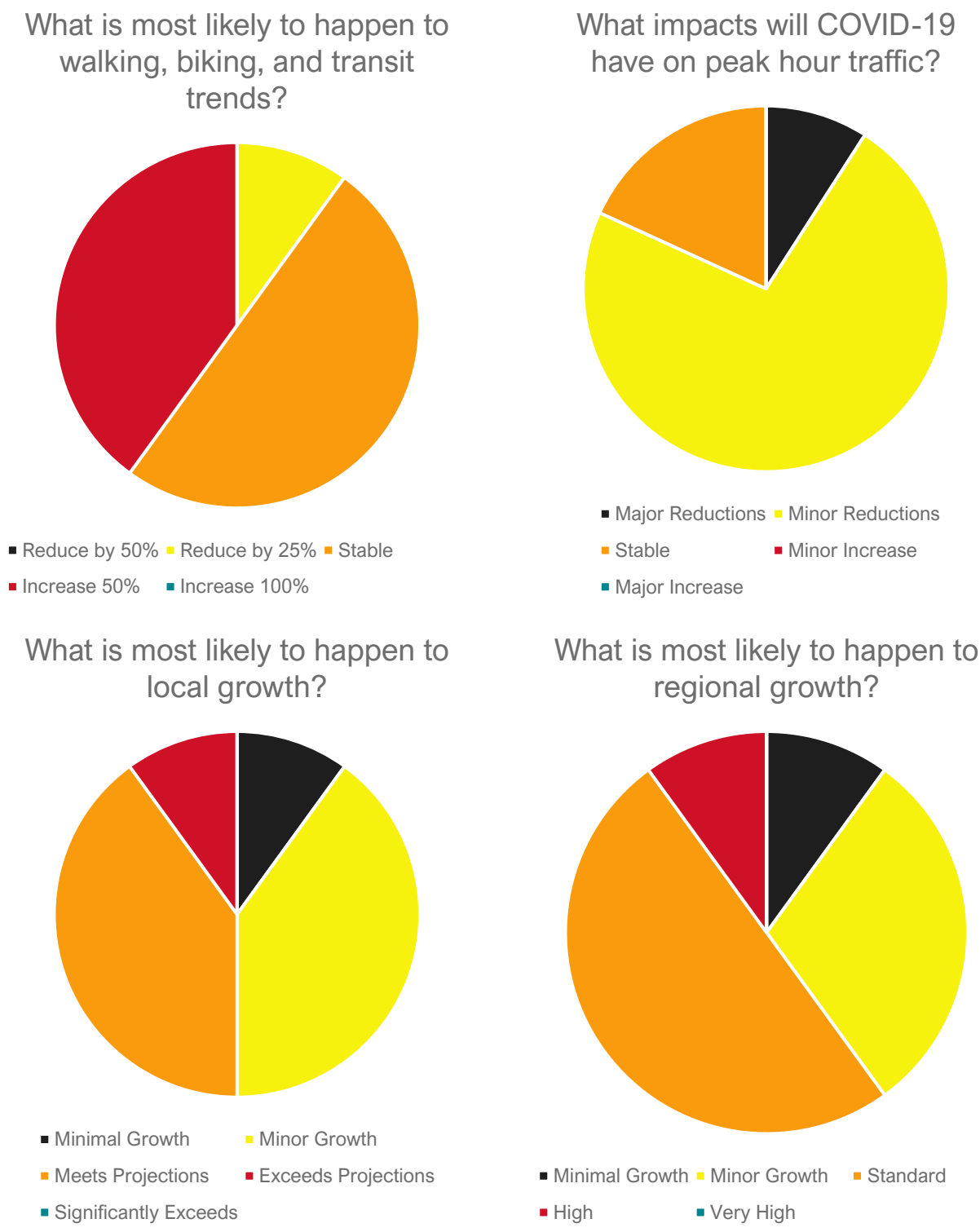
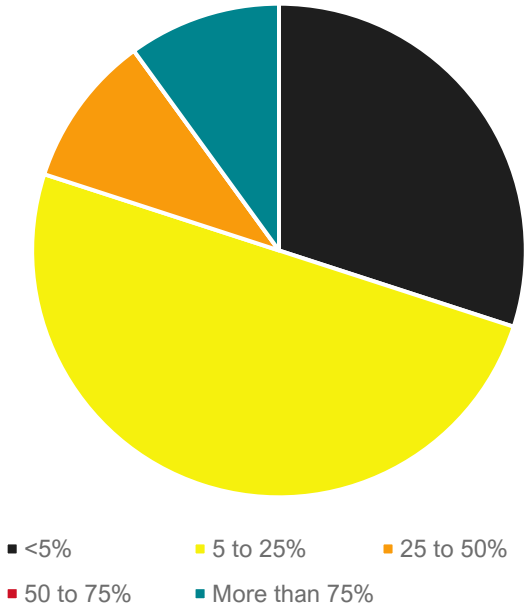
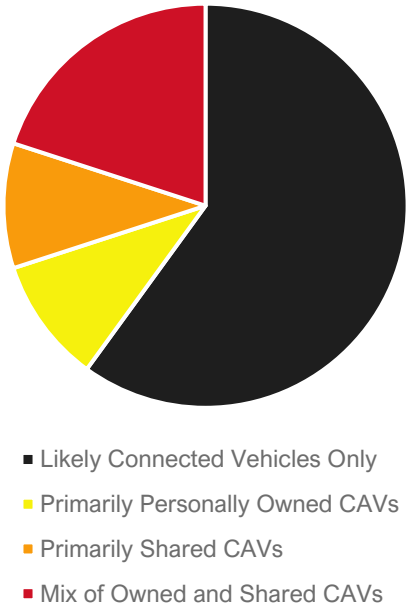
Figure 100: Game Changers Activity Summary



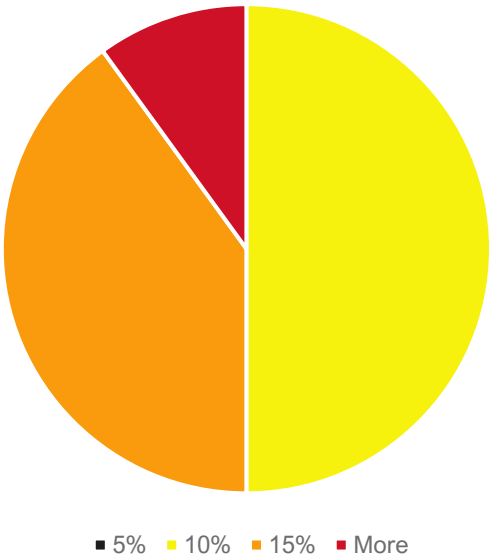
What is most likely to happen with CAV adoption?



What vehicle ownership model is most likely to occur?



How much traffic can be expected to choose other roadways?



Public Engagement

In addition to the Steering Committee, the first round of public engagement focused on identifying and understanding the community's primary issues, needs, and opportunities as it relates to Broadway. Due to the COVID-19 pandemic, the first public input meeting was entirely virtual, held on the project's website: www.movingbroadway.com.

The virtual open house ran from October 19th to November 15th. On the website, the community could view key issue videos, complete a survey, leave comments on an interactive issues map, review project documents, and provide written comments. Ultimately, there were more than 1,200 unique users that visited the project website. From these visitors, there were 146 video views, 150 comments, and 62 survey responses. More details are available in the appendix.

Marketing

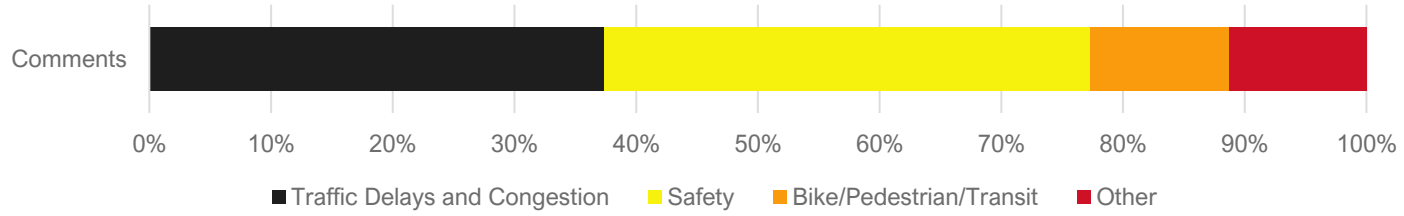
The public input opportunity was marketed through a variety of means, relying heavily on the City of Minot's established communication channels:

- Postcards were sent to more than 5,000 properties within one-half mile of Broadway.
- A box ad and press release was published in the Minot Daily News.
- A project newsletter was sent to key stakeholders and the City's email list.
- A city of Minot Facebook post on October 20th.
- A digital billboard ad along the Broadway corridor.
- An update to the City Council.

Issues and Opportunities

Like the Steering Committee, the public's interactive map allowed participants to leave four types of comments at specific locations along the corridor: traffic delays and congestion, safety, livability (bicycle, pedestrian, and transit), other. There were 150 comments left on the interactive map. Figure 101 shows the distribution of comment types. Safety concerns were the primary comment left at 40 percent, with traffic delays and congestion comprising 37 percent of comments left. Figure 102shows the location of each comment received by comment type.

Figure 101: Distribution of Comment Types

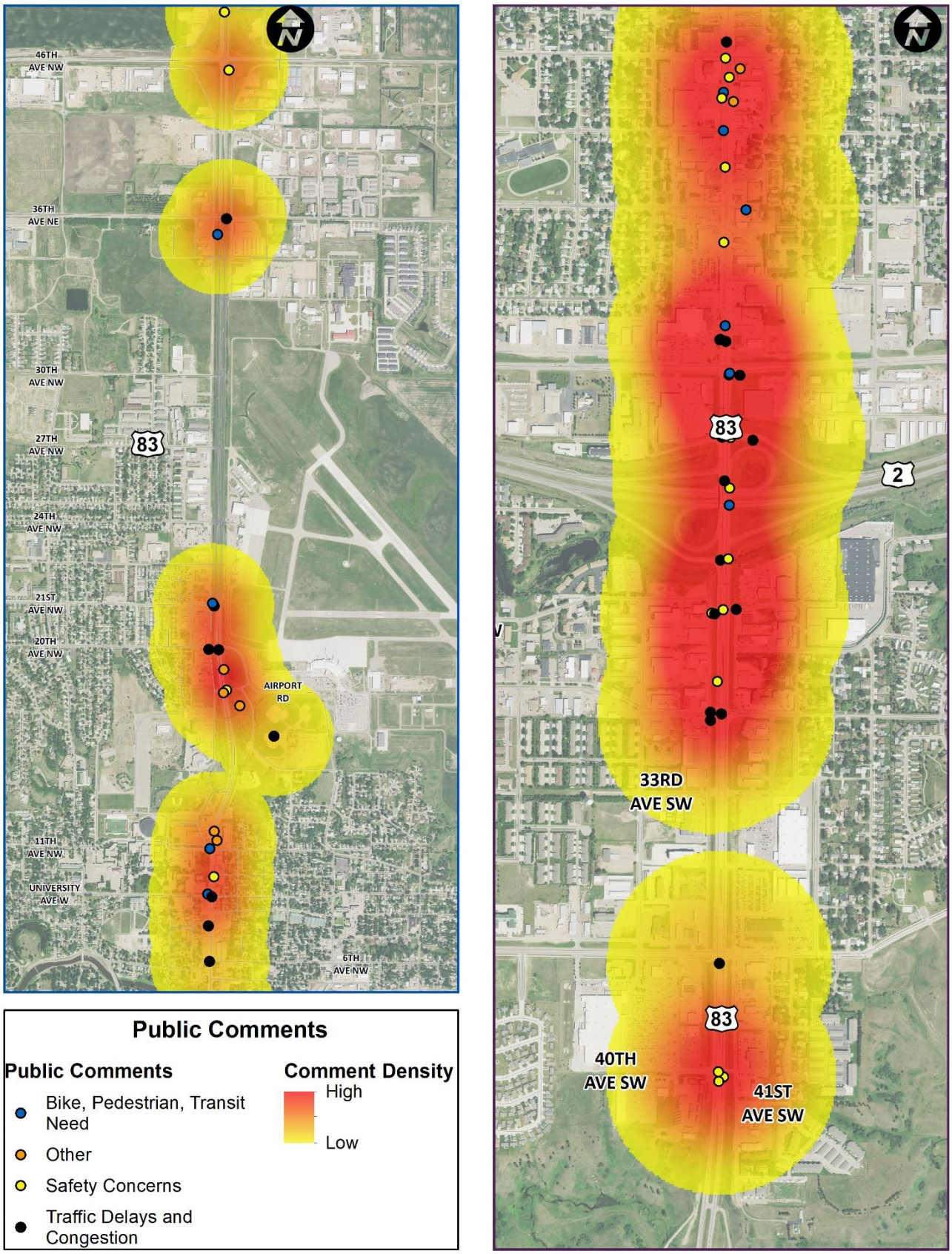


Participants could also "like" other comments. Five comments received eight or more "likes". Table 23 shows the comment location, comment, and number of "likes". All comments received are attached at the end of this document.

Table 23: Most "Liked" Comments

Likes	Comment	Location
13	Right turn on red light very dangerous because of Papa John's. Both Papa John's and building on the sw corner are way too close to Broadway.	2nd Avenue SW
12	There is no way to cross Hwy 2/52 on Broadway as a pedestrian or cyclist. This results in walkers and bikers on the road in high volume periods or late at night.	US 2 Interchange
10	Left turns from either the east or west side of Broadway onto it are impossible from The Computer Store to Slumberland. A lot of folks turn on using the left turn lane in the middle of Broadway to merge in, which is dangerous and illegal.	Between 17th Avenue SW and 18th Avenue SW
9	Vehicles trying to turn north on Broadway from MP Foods screw up traffic all the way up to 20th Ave	North of 20th Avenue SW
8	Building needs more set back from Broadway.	2nd Avenue SW

Figure 102: Comment Type and Location



Community Survey

The community survey incorporated three components: a value profile, a profile of how respondents use the corridor, and how they prefer to be engaged.

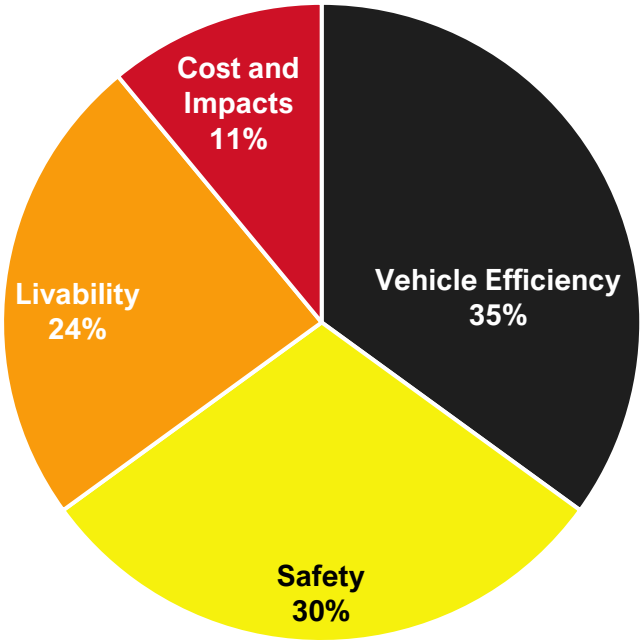
Value Profile

The value profile asked the public to assign a priority to four different categories:

- Vehicle Efficiency: maintaining a high level of vehicle operations/level of service.
- Safety: minimizing conflict potential for all modes of transportation.
- Livability: providing high quality bicycle, pedestrian, and transit facilities and safe and convenient crossing locations.
- Cost and Impacts: reducing the roadway footprint to minimize costs and environmental/property impacts.

There were 23 responses to these questions. The results are summarized in Figure 103. Vehicle efficiency and safety received the highest priority at 35 and 30 percent, respectively. Livability followed with 24 percent and cost and impacts just 11 percent.

Figure 103: Community's Value Profile Results



Travel Patterns on Broadway

Most survey respondents drive the corridor at least weekly and almost never walk, bike, or take transit on or across the corridor. Figure 105 through Figure 108 shows how survey respondents use the Broadway corridor.

Over half of the survey respondents use the middle segment (11th Avenue NW to 20th Avenue SW) and the south segment (20th Avenue SW to southern city limits) at least weekly. While just 38 percent use the north segment (11th Avenue NW to northern city limits) weekly. Figure 106 shows how the community uses each segment of the corridor.

Figure 104: Responses to "How often do you bike on Broadway?"

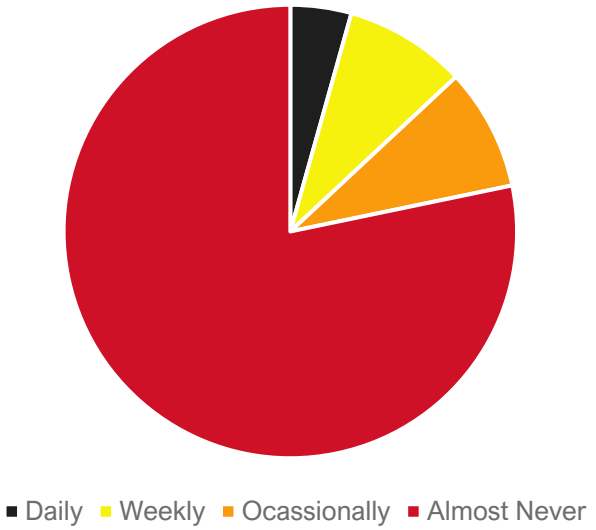


Figure 105: Responses to "How often do you take transit on Broadway?"

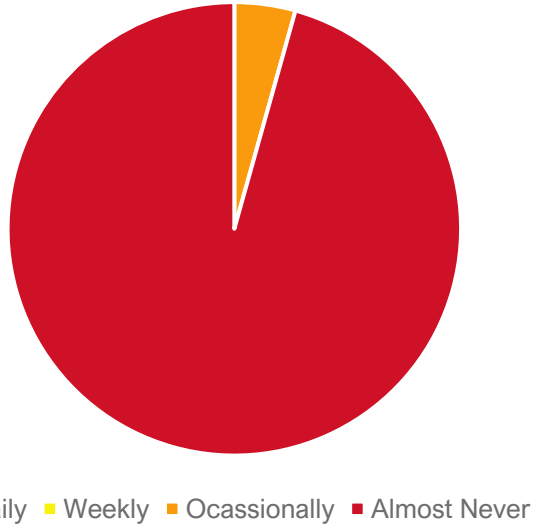


Figure 106: Responses to "How often do you walk on Broadway?"

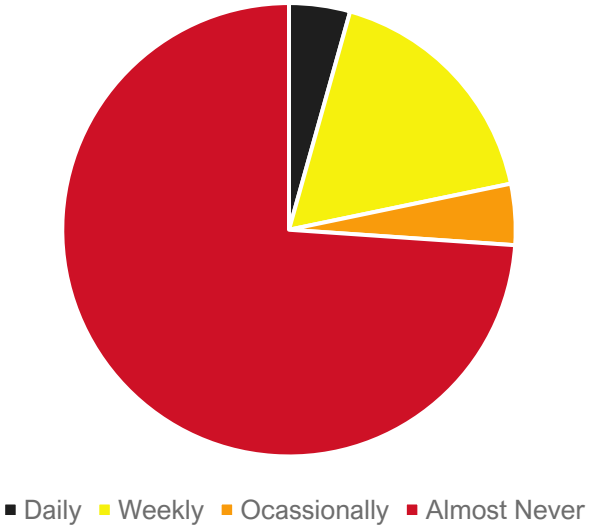


Figure 107: Responses to "How often do you drive on Broadway?"

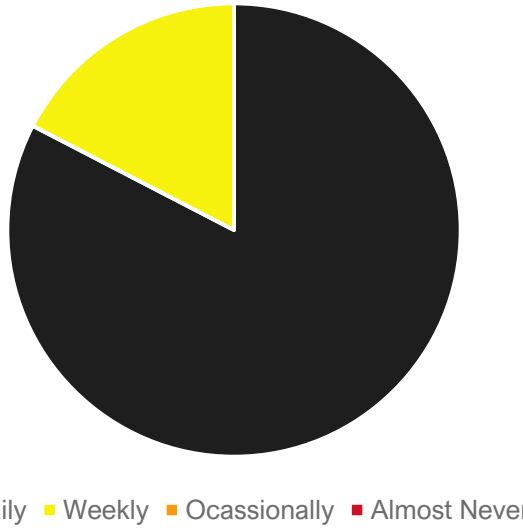
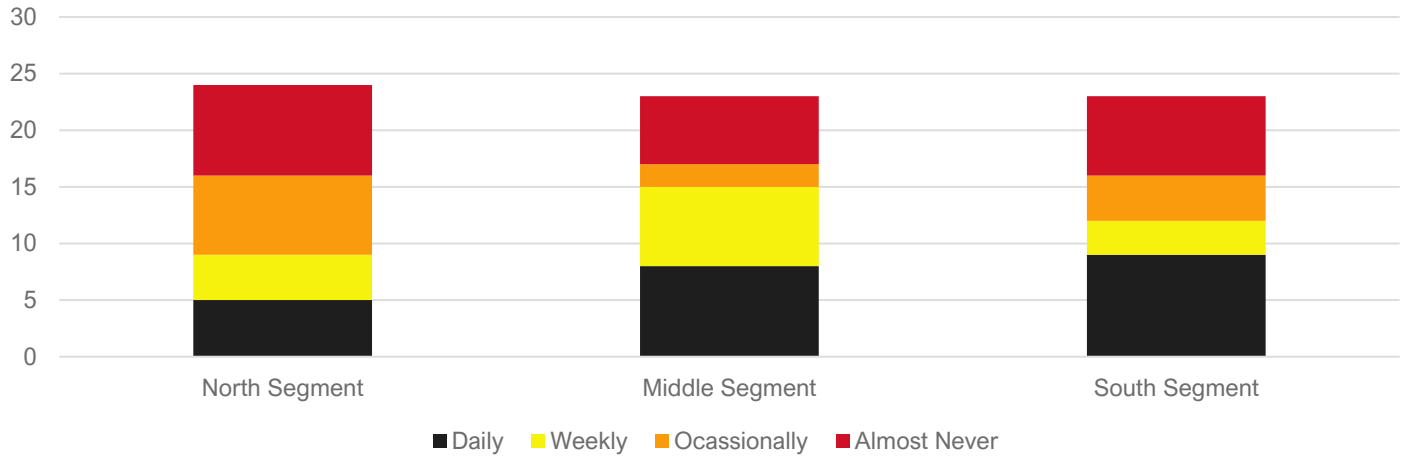


Figure 108: Responses to "How do you use each segment of Broadway?"



EMERGENCY SERVICE CONSIDERATIONS

Emergencies services were interviewed to gather input on the corridor and to gain a different perspective on the needs and deficiencies of the corridor. The fire department, police department, and Trinity Hospital were interviewed. Below is a list of items discussed:

- The need for a ¾ access at 40th Avenue S intersection due to the high crash rate.
- Ensuring turn lane capacity is adequate at 37th Avenue S once new hospital is operational.
- Concerns around the 31st Avenue S intersection once its reconstructed.
- The ¾ striped access at 28th Avenue S intersection needs a concrete median to prevent cross traffic. Discussions of signalizing this intersection also occurred.
- The access to Marketplace Foods just north of 20th Avenue S is problematic, specifically the northbound left-turn as there is no dedicated turn lane.
- Congestion between Burdick Expressway and Central Avenue due to confined ROW and lack of turn lanes.
- General improvements along the corridor include improving signal timing and making sure emergency preemptions are working on signals.

PROJECT PURPOSE AND NEED

PROJECT STATUS

The six-mile Broadway corridor (from the north city limits of Minot to the southern city limits) is a US Highway, truck route, and major arterial through the City of Minot, North Dakota. As a major arterial, significant investments have been made over the years to improve safety, operations, and pavement quality, such as pavement repair, bridge replacement, lighting and signal installation, and storm sewer improvements. Figure 2 shows the study intersections and corridor.

The Broadway corridor has crash and severity rates at nine intersections that exceed acceptable thresholds. The roadway is currently nearing capacity with sections of light congestion and significant peak hour queueing at signalized intersections. Turning onto the corridor at unsignalized locations results in long delays and frequent aggressive maneuvers resulting in crashes. These factors impact traffic operations and safety, indicating that modifications to this corridor are needed.

To begin this process, an in-depth review of the multimodal operations and safety performance of the Broadway corridor was completed and documented in the Existing Conditions Report (ECR). To understand future operations of the corridor, a Future Conditions Report (FCR) was also completed. Based on the information gathered and documented, the purpose for the future alternatives to the Broadway corridor can be developed. In addition to the information compiled in the ECR and FCR, feedback from the City of Minot, North Dakota Department of Transportation (NDDOT), and other stakeholders was taken into consideration when preparing this purpose and need statement.

NEED FOR PROJECT

Capacity

Vehicular traffic operations were analyzed along the corridor. Intersection capacity analysis was evaluated in terms of delay and level of service (LOS). At intersections, LOS is a function of average vehicle delay, whereas LOS for a roadway section is defined by the average travel speed. LOS represents free flow traffic, whereas LOS F represents gridlock. LOS E and LOS F are considered deficient. Under current traffic conditions, most of the study intersections operate acceptably during both the AM and PM peak hour. However, three intersections operate deficiently during at least one peak hour:

- 16th Avenue S (PM peak hour - LOS E).
- 28th Avenue S minor approaches (AM peak hour - LOS E).
- 40th Avenue S minor approaches (PM peak hour - LOS E).

Under current conditions, all roadway segments operate at LOS D or better. The segment between 16th Avenue S and 20th Avenue S operates at LOS D, likely associated with the dense access spacing and high traffic volumes.

Most primary intersections will operate at an acceptable level through 2045. LOS F is expected at two stop-controlled intersections, which is particularly dense between US 2 and 11th Avenue North. Most of these locations have low traffic volumes and would not warrant traffic control upgrades.

Access density also impacts traffic operations in this corridor. Access points introduce conflict and friction into the traffic stream. Allowing dense, uncontrolled access spacing results in safety and operational deficiencies. Within the City of Minot, there are nearly 150 access points along the Broadway corridor (see Figure 57). The segments of Broadway that see the highest access density (e.g., 11th Avenue N to 20th Avenue S) also see the highest crash rates. There are 75 access points in just over one mile between 11th Avenue S and 20th Avenue S. This is 560 percent higher than the recommended access density.

Pedestrian level of service (PLOS) and bicycle level of service (BLOS) incorporate a multimodal analysis metric for segments (i.e., roadways between two intersections) and intersections. For segments, PLOS incorporates the number of travel lanes, traffic volumes, traffic speeds, truck traffic, and buffer width. BLOS incorporates traffic volumes, roadway width, traffic speed, truck traffic, pavement condition, on-street parking, and shoulder width. Under current conditions, PLOS is highly variable depending on the segment of the corridor; the segments are either PLOS F or PLOS C. Throughout most of the corridor, BLOS D or worse is experienced, because there is no continuous bicycle facility. The one exception being the segment from 11th Avenue N to 21st Avenue N which has a side path designed for both pedestrians and bicycles.

System Linkage

The Broadway corridor is an important freight connection to and through Minot, with connections to the Minot Air Force Base and Canadian border to the north and south to Bismarck and Interstate Highway 94 (I-94). While the completion of the US Highway 83 bypass from 46th Avenue N to US Highway 2, along the western edge of Minot, has changed how trucks use the Broadway corridor, freight still moves to/from Minot's businesses along the corridor. The Broadway corridor also provides a regional connection between Minot and the rest of North Dakota and beyond to tens of thousands of motorists and freight carriers.

Transportation Demand

Vehicle Traffic Demand

The City of Minot's *2035 Minot Transportation Plan*, completed January 2015, identifies US Highway 83 (Broadway) as the primary north-south route in Minot. The corridor promotes high-speed travel and regional mobility; however, due to right-of-way (ROW) limitations, multiple access points, and high number of signalized intersections, the corridor is limited with accommodating anticipated traffic volumes. As noted in the Plan, the Broadway corridor is not expected to be mitigated with individual intersection improvements due to either ROW constraints and/or feasibility. The corridor requires large-scale, network-wide improvements to mitigate the poor operations and congestion.

The Broadway corridor currently carries between 11,700 and 25,200 vehicles each day, with the highest volumes occurring around the US Highway 2 interchange and lowest occurring on the northern and southern edges of the corridor. Traffic volumes dating back to the 1990s were obtained from the NDDOT to evaluate growth trends that have been observed over the past five, 10, and 20 years. Trend analysis below indicates that earlier traffic projections may have been too aggressive given the new transportation landscape after the Bakken oil boom. By 2045, the corridor is expected to carry between 15,200 and 28,700, with the highest volumes occurring around the US Highway 2 interchange and lowest occurring on the northern edge of the corridor. Three additional future growth scenarios were evaluated for comparison purposes. Of the three scenarios, each fell within about a +/-3,000 daily traffic range, with two having lower projections than the baseline and one having higher projections.

Pedestrian/Bicyclist Demand

The availability of pedestrian/bicyclist facilities varies throughout the study corridor. There is a shared-use path along the west side of Broadway (from 21st Avenue N to south of 11th Avenue N) and a sidewalk on one or both sides(from 20th Avenue N to south of 20th Avenue S). At most signalized intersections, there are marked crosswalks, pedestrian push buttons, and countdown timers. Many of these pedestrian/bicyclist facilities, especially those adjacent to the roadway, are not wide enough, are in poor condition, or experience frequent encroachment. Given the wide cross-section, heavy traffic volumes, and high speeds, pedestrians/bicyclists crossing Broadway can be challenging and feel unsafe.

Enhancing pedestrian/bicycling abilities involves providing adequate infrastructure and linking urban design streetscapes and land use to encourage pedestrians/bicyclists. Designing roadways to accommodate all types of users is commonly termed "complete streets."

Social Demands or Economic Development

Population data for both Minot and Ward County was analyzed from 1960 to the present. However, trend analysis focused on the time period after 1990, since Ward County's population remained level between 1970 and 1990, with Minot's population only growing by around seven percent in this same time period (i.e., average annual growth of 0.3 percent).

The Broadway corridor is primarily surrounded by strip and big box commercial developments, which create prolonged afternoon and evening peak traffic hours during the weekday and continues to generate traffic through the weekend and around holidays. Thousands of motorists and freight carriers rely on the corridor as the regional connection between Minot and the rest of the world. It is also an important corridor for Minot's transit service and pedestrians/bicyclists. To business owners along the corridor, access and safety are constant issues. To Minot residents along and near the corridor, Broadway's high speed and congestion provide a significant barrier for access to destinations by foot/bike. How this corridor functions for all its users is crucial to how Minot's transportation network functions as a whole.

Modal Interrelationships

Five modal LOS (i.e., vehicular, freight, pedestrian, bicycle, and transit) were calculated independently throughout the Broadway corridor. The unweighted, multimodal level of service (MMLOS) combines each of the five modal LOS into a single MMLOS. Six of the study intersections currently operate at deficient MMLOS, when considering all modes of service, due to the lack of bicycle, pedestrian, and transit facilities in those areas. Four of these intersections are located on the northernmost edge of the corridor, while the other two occur near the center of the corridor.

Aggregating the five modes of service illustrates that the corridor is imbalanced, failing, or nearly failing throughout most of the corridor. Most roadway users drive, not experiencing the full effects of a deficient LOS throughout the corridor. The lower and deficient LOS experienced by freight, pedestrians, bicycles, and transit weigh down the overall MMLOS. With Steering Committee and public input, the LOS was also weighted to reflect the priorities for the study area and identify and prioritize the deficiencies the community is most concerned with. This approach lessened the impact of the poor operations for alternative modes of travel, however still, all of the corridor was either LOS "D" (approach deficient) or LOS "E" (deficient).

Safety

There is a strong relationship between access density and safety. As previously noted, access and safety along the Broadway corridor are constantly in competition. Due to the wide cross-section, heavy traffic volumes, and high speeds, crossing Broadway (whether vehicle or pedestrian/bicyclist) can prove challenging and feel unsafe.

Between 2015 and 2019, there were 1,168 vehicle crashes reported along the Broadway corridor (average of 234 crashes per year). The majority (i.e., 65 percent) of the vehicle crashes occurred at intersections, and only two percent of the crashes involved heavy trucks. Between that same time, there have been nine pedestrian crashes, eight of which resulted in injuries and five of which occurred at traffic signals. All the crashes occurred in the urban section of the corridor, where pedestrian activity is highest.

To identify overrepresented crash locations within the study corridor, the critical crash rate analysis method was used. Intersections and segments with crash rates above the critical rate are considered overrepresented and in need for further review because there is a high probability that conditions at the site are contributing to the higher crash rate. Figure 44 shows segments and intersections where critical or above average currently occur.

Crash hotspots, or locations within the corridor with above-average or critical crash rates were identified along the Broadway corridor:

- 46th Avenue N to 21st Avenue N (rural, four-lane, divided) and 46th Avenue N, 36th Avenue N, and 30th Avenue N intersections.
- 21st Avenue N to 11th Avenue N (urban, four-lane, divided) and 21st Avenue N intersection.
- 11th Avenue N to north of the river (five-lane, undivided) and 11th Avenue N intersection.
- North of River to Burdick Expressway (five-lane, undivided) and 1st Avenue S intersection.
- Burdick Expressway to 20th Avenue (five-lane, undivided) and Burdick Expressway and 16th Avenue S intersections.
- 20th Avenue S to 40th Avenue s (urban, four-lane, divided) and 20th Avenue S, US Highway 2, 28th Avenue S, 31st Avenue S, 33rd Avenue S, 37th Avenue S, and 40th Avenue S intersections.

Identifying crash types assists in developing counter measures to mitigate or minimize the crash type. As noted in the ECR, rear-end (550) and angle (363) crashes were the most common crash types along the corridor, making up 47 and 31 percent, respectively. Dense access spacing, failing to stop, following too closely, and speeding are a few factors in most of the rear-end crashes. Crash severity is important for implementation of safety-related counter measures needed to compare and assess the roadway. There are five levels of crash severity: fatality, incapacitating injury, non-incapacitating injury, possible injury, and property damage. Within the study period, there were 268 crashes that resulted in injury and 938 crashes that resulted in property damage.

Roadway Deficiencies

Bridges are regularly inspected to verify their condition (e.g., deck, superstructure, and substructure conditions). Conditions range from poor to excellent. Of the two bridges within the corridor study area, one is identified as being in good condition and the other in excellent condition.

The City of Minot maintains a Pavement Condition Index (PCI) database for all major roads in the city. PCI considers multiple factors, including pavement distress and smoothness of the ride. Based on the most current information, there are three sections along the Broadway corridor that are in ‘Poor’ or ‘Very Poor’ condition, where rehabilitation should be considered:

- Between 7th Avenue S and 11th Avenue S (northbound lanes)
- Between the US 2 eastbound off ramp to 28th Avenue S (southbound lanes)
- Between 31st Avenue S and 33rd Avenue S (northbound lanes)

All other areas along the corridor are in ‘Fair’ or better condition.

Travel Time Reliability

Travel time reliability measures the extent of unexpected delay, as measured from day-to-day and across different times of the day. The Level of Travel Time Reliability (LOTTR) is defined as the ratio of the 85th percentile travel time to an average travel time for all vehicles. An LOTTR of 1.50 and greater indicate severe unreliability. For example, a LOTTR of 2.00 means that motorists should plan for twice the amount of travel time to arrive at their destinations on time. Generally, the Broadway corridor operates very reliably throughout a typical day, with travel time variation around 30 to 45 seconds, even during the peak hours. The consistent travel times means the LOTTR is very good (i.e., 1.09 or better) at all locations. This means travelers can plan for nearly the same travel time regardless of the time they chose to travel.

Additional Considerations

Potential socioeconomic, environmental, and cultural constraints within the Broadway corridor were identified in the ECR. The evaluation included an overview of the following current environmental conditions within 200 feet of the Broadway corridor that could affect alternatives development.

- Regulated Materials/Waste
- Social and Economic
- Environmental Justice
- Pedestrians and Bicyclists
- Water Resources (Surface Water, Floodplains)
- Noise
- Historic and Archaeological Preservation: US Post Office, Minot Commercial Historic District, and Minot Industrial Historic District (National Register of Historic Places [NRHP]-listed)
- Section 4(f) Resources: Via-View Park, Scandinavian Heritage Park, grounds of Bishop Ryan High School and Minot State University, multi-use paths, US Post Office, Minot Commercial Historic District, and Minot Industrial Historic District
- Section 6(f) Resources

The ECR identified multiple potential constraints within the Broadway corridor for future alternatives (depending on the type and location of the alternative):

- Sensitive noise receptors; a noise analysis might be necessary
- Section 4(f) properties; a Section 4(f) analysis might be necessary
- Two historic districts and one historic site
- Water resources, special floodplain or US Army Corps of Engineers (USACE) permitting might be necessary.

Corridor Vision

The feedback received through the Steering Committee and first public input meeting generally confirmed the technical deficiencies identified through the Existing Conditions Report and Future Conditions Report.

- Safety is the community's biggest concern. Whether it was challenges to access the corridor, speed, pedestrian crossing safety, etc. the community overwhelmingly wants to see safety improvements on the corridor.
- Improving intersection operations. Many comments noted the challenges faced by drivers trying to turn left onto the corridor at unsignalized locations and the lack of traffic signal coordination that impacted the efficiency of the corridor. Additionally, drivers using the center left-turn lane as a merge lane, lack of right-turn lanes, and frequent access reduce the corridor's perceived level of service.
- While the total number of comments related to walking and biking were lower than safety and traffic flow, when compared to the even lower number of commenters who walk or bike regularly on the corridor, a different takeaway can be made. The context of the roadway influences people's desires to walk or bike along or across the corridor.

ALTERNATIVES ANALYSIS

Throughout the technical needs assessment phase and community engagement, the issues on Broadway became clear: safety is the community's biggest concern, improved traffic flow is necessary, and more bicycle and pedestrian facilities and safer crossings are needed.

This alternatives analysis report considered improvements that directly responds to the major issues on the corridor. Alternatives were broken down into three segments:

- North Segment: 46th Avenue N to 11th Avenue N
- Middle Segment: 11th Avenue N to 20th Avenue S

This segment was further broken down into three segments from 11th Avenue N to the Mouse River, Mouse River to Burdick Expressway, Burdick Expressway to 20th Avenue S

- South Segment: 20th Avenue S to 41st Avenue S

The US 2 interchange concepts were analyzed separately.

The alternatives presented in this report were identified in collaboration with the Steering Committee, which is made up of members from City Engineering, City Transit, City Alderman, the Minot Area Development Corporation, NDDOT Local Government, and NDDOT Minot District. The alternatives identified were informed by the key issues and public input.

Evaluation Methods

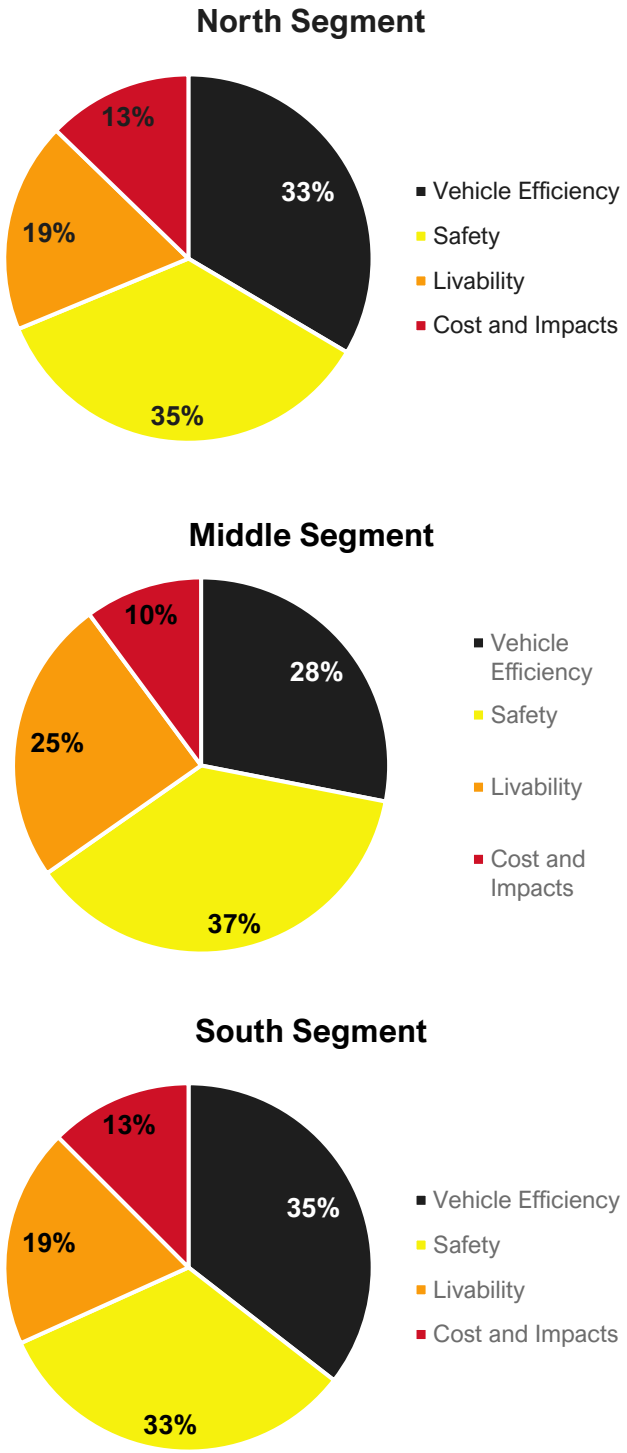
The evaluation approach combined the technical analysis with the community's priorities to ensure the alternatives that are prioritized for implementation best reflect the community the corridor is meant to serve.

Value Profiles

The value profile activity asked participants to place a value, between 1 and 100, on four categories, including vehicle efficiency, safety, livability (bicycle, pedestrian, and transit facilities), and cost and impacts. These values were used to help identify alternatives that meet these values and consider them in the technical evaluation process.

For this activity, the Broadway corridor was broken into three segments, that follow the three segments, noted above. The Steering Committee completed a unique value profile for each segment while the public was asked to complete just one value profile. Most respondents travel each segment of the corridor daily, so their value profile was used equally across each segment. The Steering Committee's and the public's value profile were equally aggregated to create a value profile for each of the four segments, as shown in Figure 109.

Figure 109: Value Profiles for Each Segment of the Corridor



Technical Criteria

Each alternative was evaluated on a set of technical criteria, which follows the value profile criteria. The focus of the technical evaluation was to compare the alternatives to one another in each segment, so the scoring criteria is relative, instead of absolute. The north segment alternatives were compared to the other north segment alternatives, the middle segment to the middle segment, and the south segment to the south segment.

Each criterion had three sub-criteria to test and compare competing interests. For example, improving mainline corridor efficiency can often have negative impacts to side street delays but both factor into the vehicular efficiency criterion. Each criterion and their considerations are discussed below.

Vehicle Efficiency

Vehicle efficiency refers to the ability to travel the network efficiently with limited delays. This criterion includes intersection level of service, travel time, and network efficiency.

- ***Level of Service.*** Each alternative was evaluated based on the number of intersections that are deficient (LOS E and F), approaching deficient (LOS C and D), and acceptable (LOS A and B). More detail on how LOS is determined, and grades set is included in the Existing Conditions Report, with the thresholds shown in Table 8.
- ***Travel Time.*** Each alternative was evaluated based on the amount of time it takes to travel the length of each segment compared to free flow and the no build conditions. Alternative scores were generally calibrated to posted speed limits to prevent showing benefits for not following post speeds.
- ***Network Efficiency.*** Network efficiency considers all delay factors, including circuitous routing requirements. For example, if access points are closed and vehicles must reroute to a full access the network is less direct. This would be compared to the no build condition where drivers have a direct route at each access point but may have to wait much longer at an unsignalized driveway location This is important to assess when access management improvements are considered.

Table 24: Level of Service Thresholds

Control Delay (Sec/Veh)		Level of Service
Unsignalized	Signalized	
≤ 10	≤ 10	A
10 – 15	10 – 20	B
15 – 25	20 – 35	C
25 – 35	35 – 55	D
35 – 50	55 – 80	E
> 50	> 80	F

Based on these factors, each alternative was given a score between one and 10, with one being the worst and 10 being the best. This criterion is between 29 percent and 35 percent of an alternative's total score, depending on the segment, as established by the Steering Committee and public.

Additional Considerations

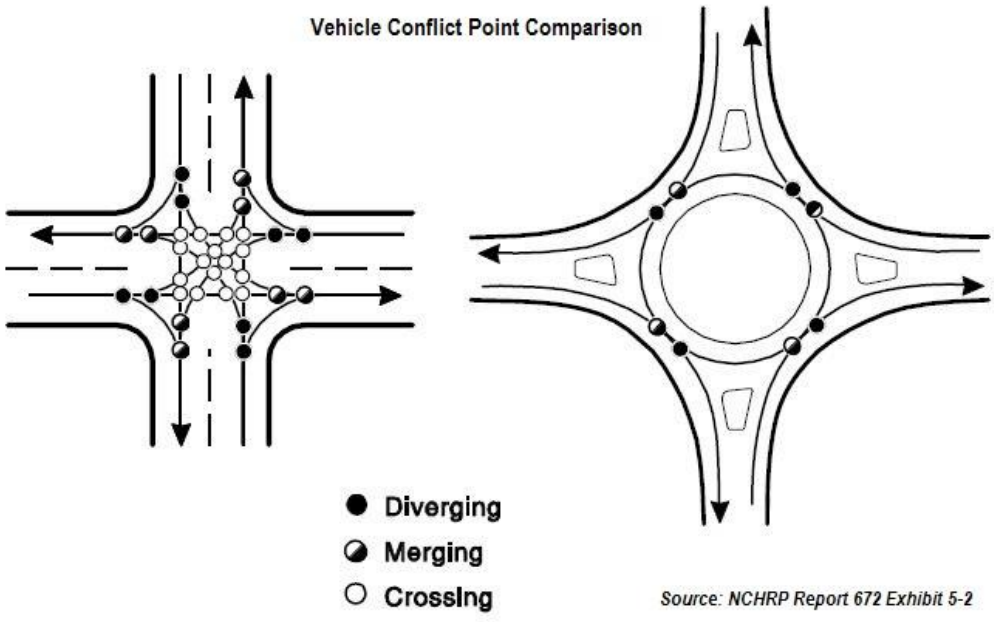
Vissim microsimulation was used from the Mouse River to the southern city limits while Synchro/SimTraffic was used for the segments north of the Mouse River to the northern city limits. Both approaches provide the required outputs.

Safety

Safety is the ability to reduce crash potential by reducing vehicle queue lengths and conflict points. This criterion includes mainline conflict points, side street conflict points, and speed.

- ***Mainline Conflict Potential.*** Using FHWA's surrogate safety assessment model (SSAM), mainline conflicts were evaluated for each alternative. SSAM uses vehicle trajectory files from Vissim microsimulation models to estimate conflict potential using the actual volume, operational, and geometric conditions of each alternative. Vissim was only used between the south termini and the Mouse River. Where SSAM was not available, crash modification factors were used to estimate the mainline conflict potential. More detail on SSAM can be found in the Existing Conditions Report. Conflict potential was further refined using a weighted criteria designed to increase weights on conflicts most likely to result in serious crashes:
  - 3X – Angled Conflict
  - 2X – Rear-End Conflict
  - 1X – Merging Conflict
- ***Side Street Conflict Potential.*** SSAM is not a good comparison tool for access management alternatives that reroute a significant amount traffic to fewer intersections. The reason being is that the model is confined to certain driver behavior criteria that is not completely accurate in the real world. When a driver waits what they perceive to be an excessive amount of time at a side street, they often either become more aggressive, thus increasing their crash potential, or reroute a different direction. The model will force drivers to wait for gaps that may never come in congested future conditions and thus "time out" and resulting in latent (unserved) demand. To estimate the side street conflict potential, the number of conflict points were evaluated where a full access has 32 conflict points, a ¾ access has 12 conflict points, a T-intersection has 9 conflict points, a roundabout has 8 conflict points, and a right-in/right-out access 4 conflict points. An example conflict point diagram is shown in Figure 110.
- ***Severity.*** There is a direct relationship between speed and the severity of a crash. Each alternative was evaluated based on the average network speed.

Figure 110: Conflict Point Diagrams

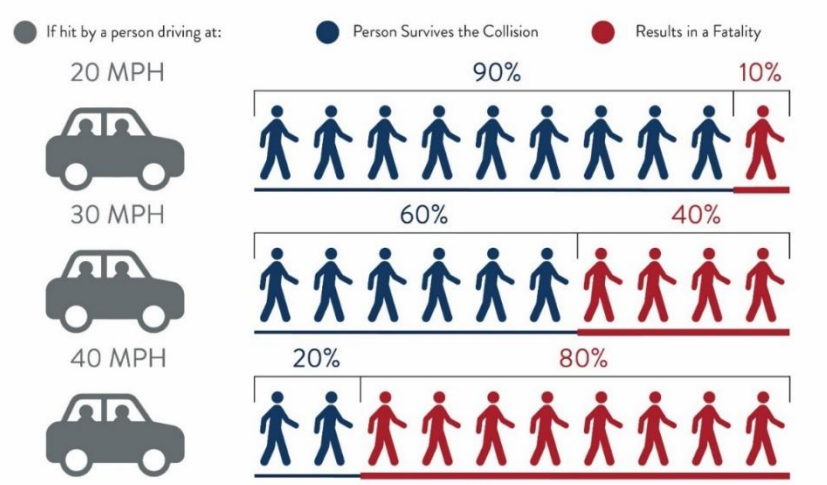


Based on these factors, each alternative was given a score between one and 10, with one being the worst and 10 being the best. This criterion is between 33 percent and 37 percent of an alternative's total score, depending on the segment, as established by the Steering Committee and public.

Livability

How easily and safely we can get from one place to another has a major effect on our quality of life. Livable communities provide their residents with transportation options that connect people to social activities, economic opportunities, and medical care, and offer convenient, healthy, accessible, and low-cost alternatives to driving. Livability within the context of this report directly relates to mode choice and multimodal safety. This criterion includes bicycle, pedestrian, and transit level of service, safety, and crash severity.

Figure 111: Relationship between Speed and Pedestrian Survivability



- ***Multimodal Efficiency.*** Bicycle, pedestrian, and transit level of service reflect the quality of bicycle, pedestrian, and transit facilities on the corridor that would encourage more trips to be taken by alternate modes. Factors such as facility availability, comfort, traffic volumes and speeds, access density and others factor into how these grades are established. More details regarding how these criteria were met are discussed in the Existing Conditions Report.
- ***Multimodal Safety.*** Crash modification factors were used to evaluate improvements to bicycle and pedestrian crossing safety across the corridor.
- ***Severity.*** There is a direct relationship between speed and a pedestrian/cyclist's survivability during a crash event. Each alternative was evaluated based on the average network speed. Often, speeds varied only slightly. Only when noticeable speed differences were found were scores adjusted.

Based on these factors, each alternative was given a score between one and 10, with one being the worst and 10 being the best. This criterion is between 19 percent and 25 percent of an alternative's total score, depending on the segment, as established by the Steering Committee and public.

Additional Considerations

Some alternatives, particularly in the middle segment, have bicycle facilities located on parallel corridors. Details will be provided on those locations and the bicycle level of service will reflect these other facilities.

Cost and Impacts

Cost and impacts evaluated the planning level construction costs, property impacts, and other potential impacts (access, environmental, etc.).

- ***Planning Level Construction Costs.*** The estimated construction costs are direct outputs considering each of the alternative designs and features. Costs developed in this phase of the project were high-level and designed to compare alternatives. More details cost estimates will be considered in later phases of the study.
- ***Property Impacts.*** The number and severity of property impacts from construction. These can be temporary, limited to the construction period, or permanent, requiring relocations. There were no alternatives with direct property impacts upon completion of the alternative brainstorming workshop. This criterion remained should any alternatives be revised.
- ***Other Impacts.*** Other potential impacts were evaluated including access impacts to properties, environmental impacts, or other potential permanent or temporary impacts. The most common impact on this study was access impacts due to frontage road, median or driveway changes.

Based on these factors, each alternative was given a score between one and 10, with one being the worst and 10 being the best. This criterion is between 10 percent and 13 percent of an alternative's total score, depending on the segment, as established by the Steering Committee and public.

Summary of Evaluation

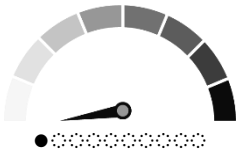
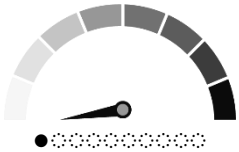
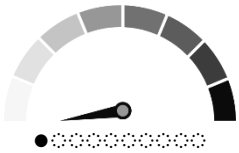
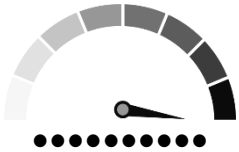
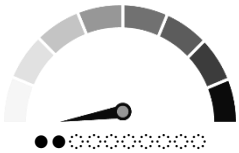
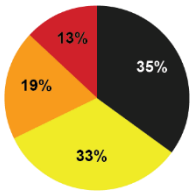
Each alternative was compared on a set of weighted criteria, as discussed above, and summed to provide an alternative's weighted final score. The final score is rounded to the nearest whole number.

In this example for the south segment, the alternative received a final score of 2, following the math shown in the equation below. An example scoring table is shown in Table 25.

$$Weighted\ Final\ Score = (Vehicle\ Efficiency\ Score\ x\ 35\%) + (Safety\ Score\ x\ 33\%) + (Livability\ Score\ x\ 19\%) + (Cost\ and\ Impacts\ Score\ x\ 13\%)$$

$$2.17 = (1\ x\ 35\%) + (1\ x\ 33\%) + (1\ x\ 19\%) + (10\ x\ 13\%)$$

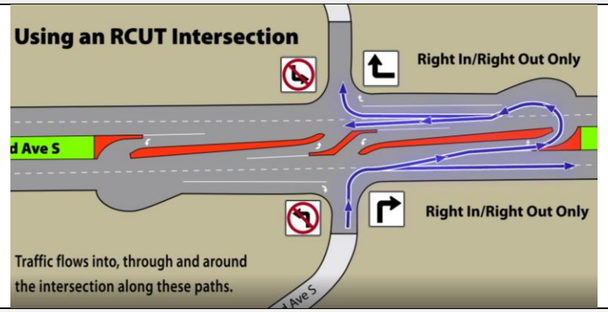
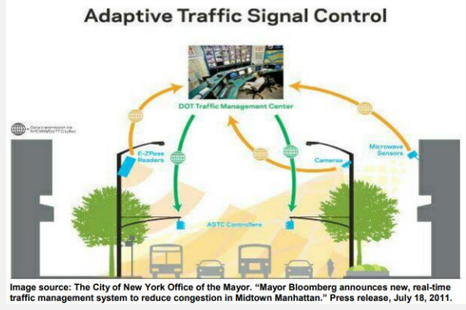
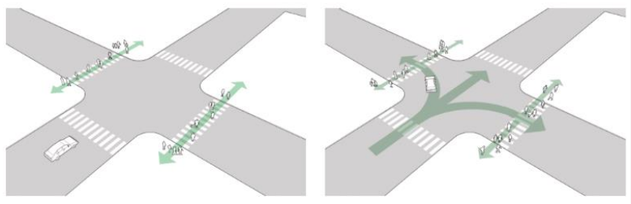
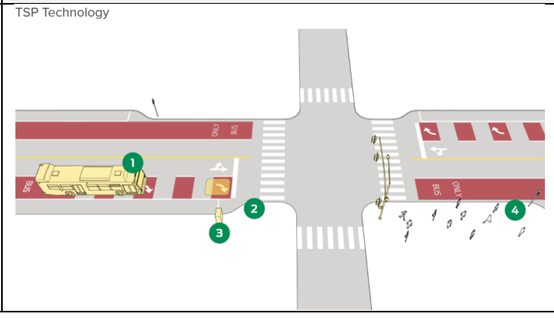
Table 25: Scoring Table Example

	Score	Weight	Key Factors
Vehicle Efficiency			» Discussion of the vehicle efficiency measures
Safety			» Discussion of the safety elements
Livability			» Discussion of the bicycle, pedestrian, and transit facilities
Cost and Impacts			» Discussion of construction costs, property, and environmental impacts
Summary			» Discussion of the major considerations of the alternative

Glossary of Alternatives

Table 26 provides a glossary of common features included in the alternatives that will be discussed later in this analysis.

Table 26: Glossary of Alternatives New or Uncommon to the Area

Alternative		Example	Benefits	Alternative		Example	Benefits
Roundabout	Roundabouts are an alternative to signals or other intersection traffic control, by permitting traffic to travel in one direction around a center island. Single lane roundabouts are very common across North Dakota. Larger, multi-lane roundabouts are not common in-state but are gaining popularity nationally.		» 84% reduction in fatal and serious crashes » FHWA proven safety measure	**Pedestrian Omit on Flashing Yellow Arrow (POOFYA)**	This prohibits permissive left turns when a pedestrian call is placed or during certain parts of the day with high pedestrian activity.		» Eliminates conflicts between left turning vehicles and pedestrians » 28% reduction in pedestrian crashes
Reduced Conflict U-Turn Intersection	RCUT intersections prohibit left turns from side streets by accommodating these movements at specific U-turn locations.		» Reduces 32 conflict points at traditional intersections to 18 conflict points » Reduced costs compared to a traffic signal	**No Right Turn on Red Signs**	Static signs or LED blank out signs that restrict turning movements at a signalized intersection. This reduces or eliminates conflicts between pedestrians and other vehicles by removing the permitted right turn.		» 30% reduction in right angle crashes » 20% reduction in rear end crashes » 28% reduction in pedestrian crashes
Flashing Yellow Arrow	A four section signal head that displays a flashing yellow arrow for permitted left turns, and a green arrow for protected left turn movements. Operations of the signal head can be changed throughout the day to better accommodate traffic patterns.		» Less confusion than traditional green ball indications » The Manual on Uniform Traffic Control Devices now prohibits green ball indications over left turn lanes » Reduces all crashes up to 25% and left turn crashes up to 37%	**Adaptive Signal Control**	Technology that allows for real time modification of signal timing plans to accommodate traffic patterns as they exist in that moment.		» Most studies show an improvement to travel time, control delay, emissions, and fuel consumption by 10% or more » Require Advanced Traffic Management System and state-of-the-art controllers and detection
Leading Pedestrian Interval	Provides 3 to 7 seconds where all traffic movements have red indications to allow pedestrians to enter the intersection and increase visibility.		» 60% reduction in pedestrian crashes » FHWA proven safety measure	**Transit Signal Priority**	A system that modifies signal timing for transit vehicles when near the signal, or when the transit vehicle is running behind schedule. This technology improves reliability of transit routes.		» 10% reduction in bus travel times » Delay reduced up to 50%

North Segment Alternatives: 46th Avenue North to 11th Avenue North

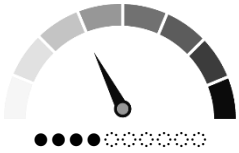
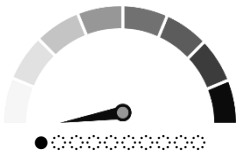
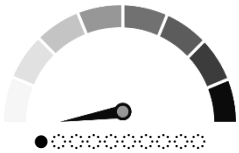
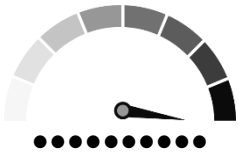
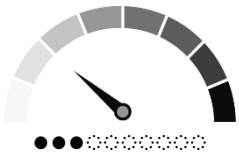
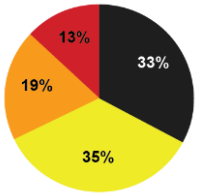
N.0 No Build

Description

Alternative N.0 would make no changes to the north Broadway corridor.

Performance

Table 27: N.0 Performance

	Score	Weight	Key Factors
Vehicle Efficiency			» Traffic signals operate acceptably (LOS C) » Two-way stop-controlled intersections deficient (LOS F)
Safety			» Most of this segment is above the critical crash rate for segment-type crashes » 30th Avenue and 46th Avenue intersections above the critical crash rate (angle and rear-end are the most common) » 4 of 8 intersections above typical crash rates » Serious injury crash reported at 46th Ave N
Livability			» No off-street bicycle or pedestrian facilities north of 21st Avenue » Pedestrian crashes reported near 20th Avenue N and near Airport Road » Limited transit service » 85th percentile speeds around 10 mph higher than posted speed limit (40 mph speed limit)
Cost and Impacts			» Pavement conditions are still acceptable throughout the north segment » No changes results in no costs and no impacts outside of regular maintenance activities
Summary			» Traffic signals operate acceptably » Two-way stop-controlled intersections deficient » Multi-modal facilities lacking

N.1 Traffic Signals and Access Control

Description

Alternative N.1 has the following characteristics between 46th Avenue North and 11th Avenue North:

- Maintains existing traffic control
  - Signal is expected to be close to meeting warrants at 30th Avenue North by 2045, however not quite warranted using the growth rates established in this study. A minor increase to the planned growth rate in this area is likely to warrant a traffic signal in the future (closer to 2045).
- Conversion to ¾ access at 40th Avenue N, 34th Avenue N, 27th Avenue N, and 21st Avenue N
- Conversion to right-in/right-out access at 35th Avenue N and 22nd Avenue N
- Consider moving signal from 20th Avenue N to 21st Avenue N for improved connectivity to the bypass and school

A backage road between 35th Avenue N and 36th Avenue N would be included due to a median that prevents left turns onto the frontage road on the west side of Broadway. The east side would be realigned to provide additional queue storage.

- A trail/sidewalk on the west side of Broadway from 20th Avenue N to 40th Avenue N. The land use north of 30th Avenue is unlikely to need a shared use path in the near-term, so this improvement can be phased in beyond the study horizon.

Performance

Table 28: N.1 Performance

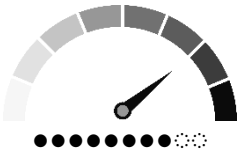
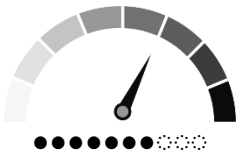
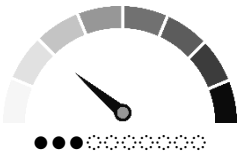
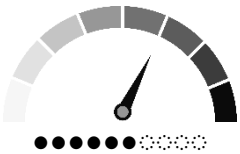
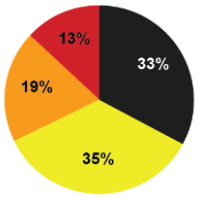
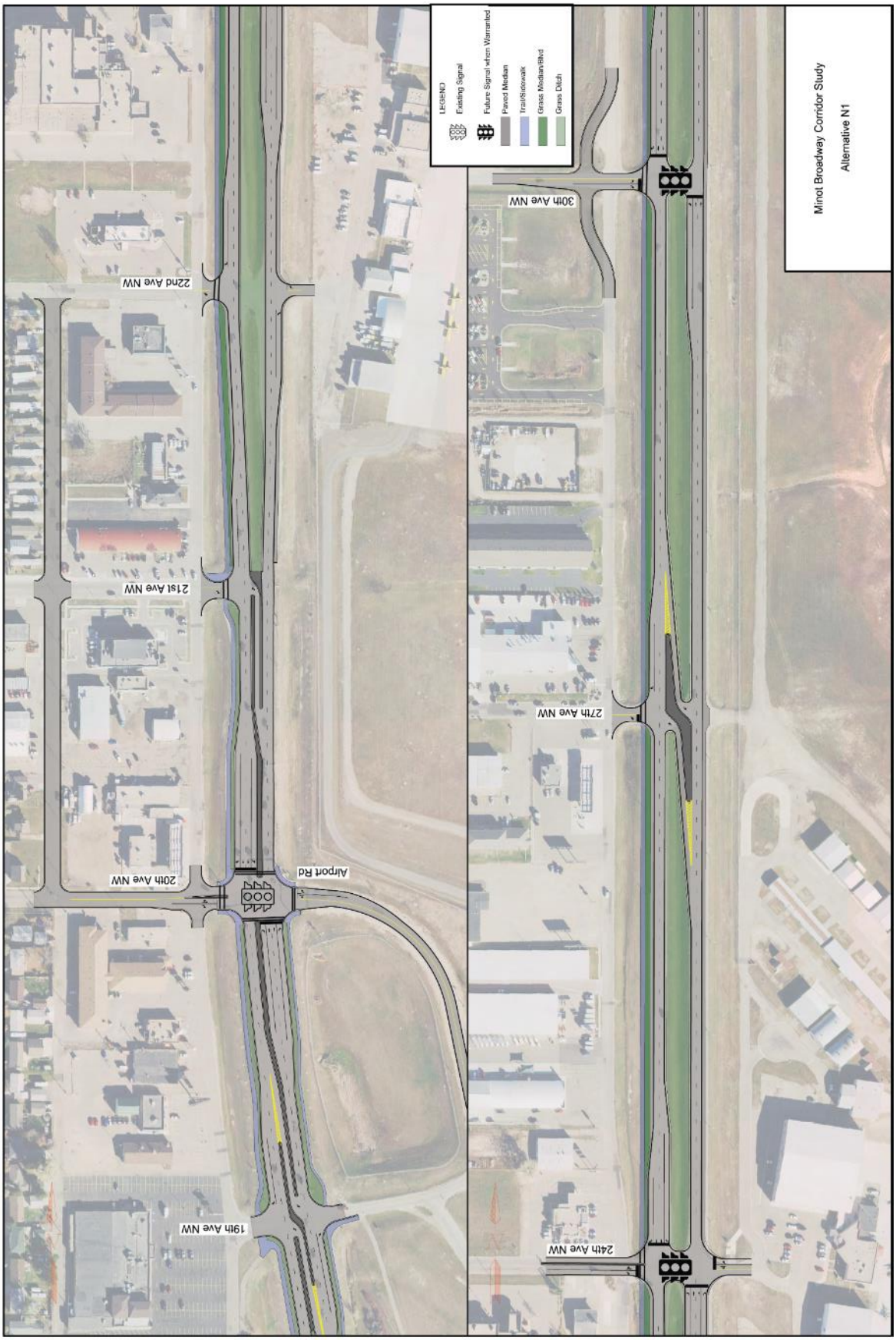
	Score	Weight	Key Factors
Vehicle Efficiency			» Traffic signals operate acceptably (LOS C) » ¾ access at provides acceptable operations » Deficiencies remain where full access is maintained under two-way stop control – signal close to being warranted by 2045 at 30th Avenue N » Peak hour network delay reduced by 37%
Safety			» Access management reduces conflict points by 36% » Access management mitigates some angle crash potential, but traffic speed issues would likely be unresolved
Livability			» Trail on west side improves bicycle/pedestrian network » Vehicle speeds are not expected to change, therefore pedestrian crash severity is expected to be unchanged » Protected crossings at signals, approximately every one-half mile
Cost and Impacts			» Estimated construction cost of $8.1M » Limited ROW acquisition needed for frontage roads, no property impacts » Minor access revisions, but frontage roads ensure easy access to businesses
Summary			» N.1 improves safety and operations at signalized intersections » Access control reduces crash potential (especially angle crash and rear-end crash potential)

Figure 112: N.1 Traffic Signal and Access Control



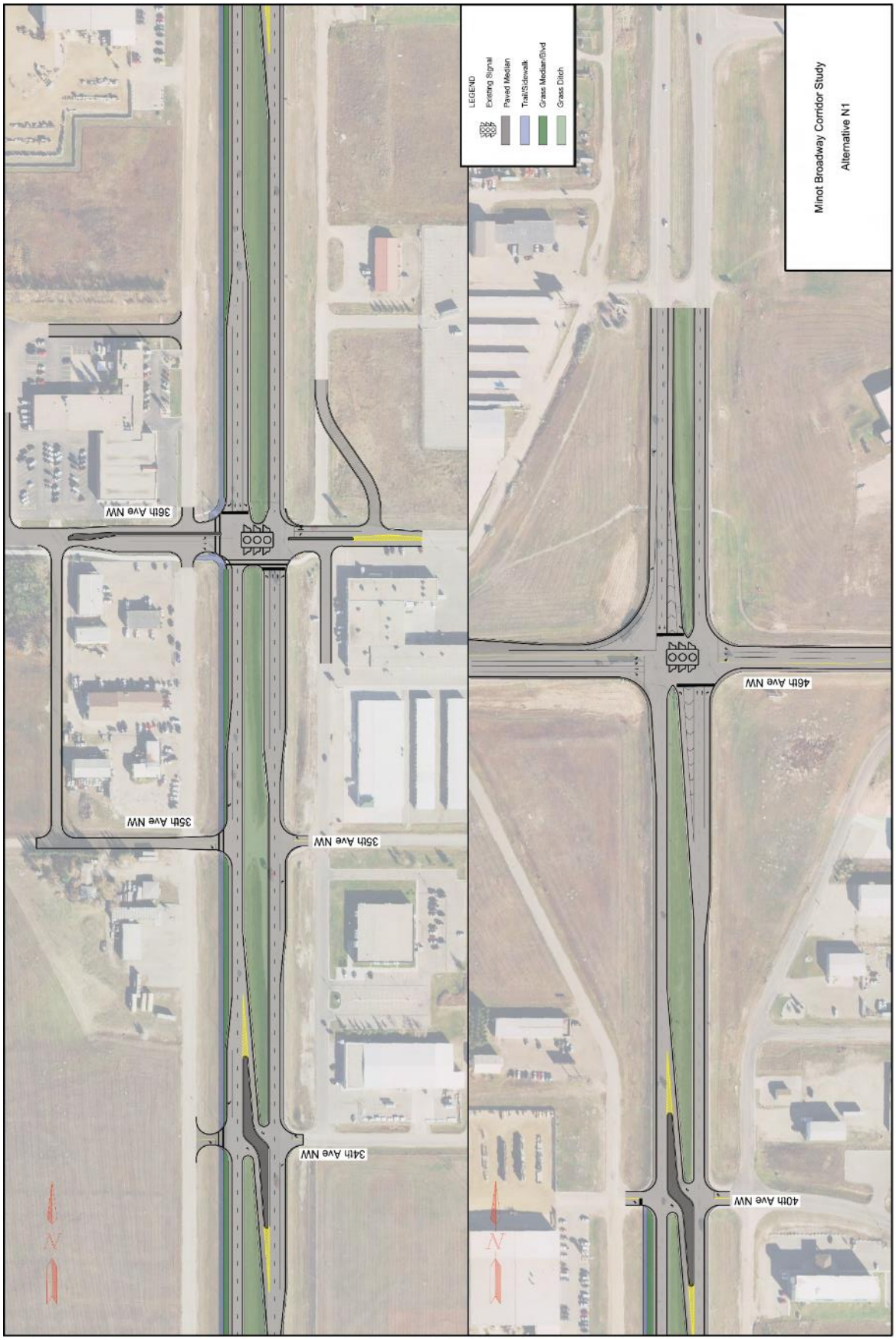
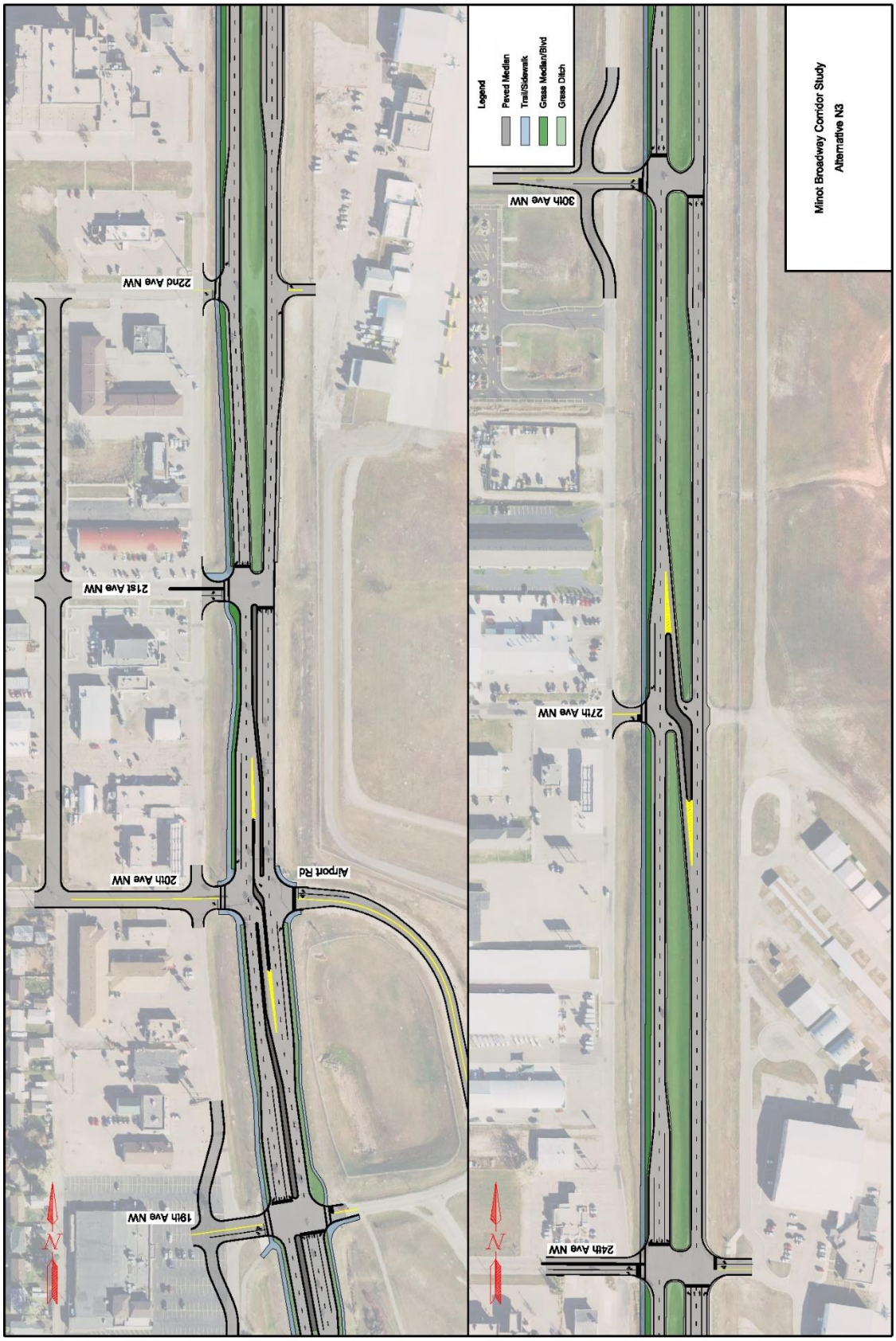

Minot Broadway Corridor Study
Alternative N1
LEGEND
Existing Signal
Paved Median
Trail/Sidewalk
Grass Median/Blvd
Grass Ditch
36th Ave NW
35th Ave NW
35th Ave NW
34th Ave NW
46th Ave NW
40th Ave NW
N
N

Figure 113: Sub-Option for N.1 - Traffic Signal Modification at 21st Avenue NW



N.2 Roundabouts and Restricted Crossing U-Turns (RCUTs)

Description

Alternative N.2 has the following characteristics between 46th Avenue North and 11th Avenue North:

- Roundabouts at 46th Avenue N and 30th Avenue N
- Restricted crossings at 36th Avenue N, 27th Avenue N, 24th Avenue N, and 21st Avenue N
- Due to restricted crossings, U-turns would be included between 36th Avenue N and 40th Avenue N, between 34th Avenue N and 35th Avenue N, and between 21st Avenue N and 22nd Avenue N
- Right-in/right-out access revisions would occur at 40th Avenue N, 34th Avenue, and 22nd Avenue N
- Accesses would be closed at 35th Avenue N and partially at 27th Avenue N
- The 20th Avenue N intersection would remain a full access, signal controlled intersection
- A trail/sidewalk on the west side of Broadway from 20th Avenue N to 40th Avenue N

Performance

Table 29: N.2 Performance

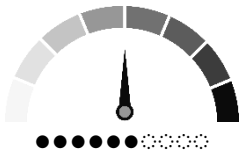
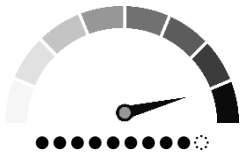
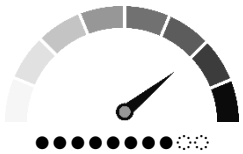
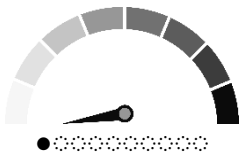
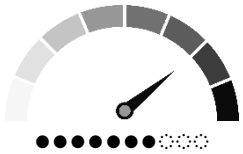
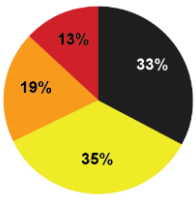
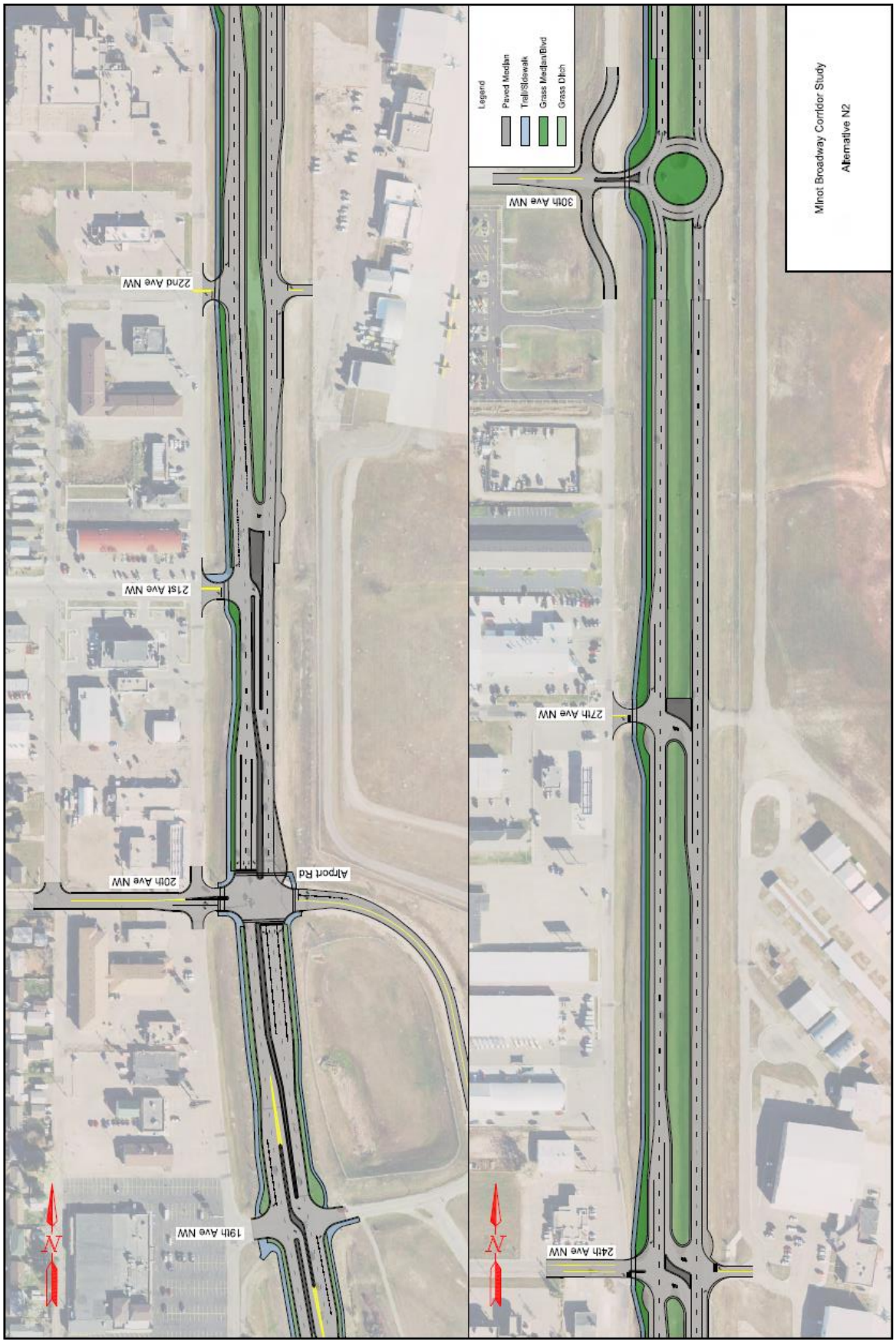
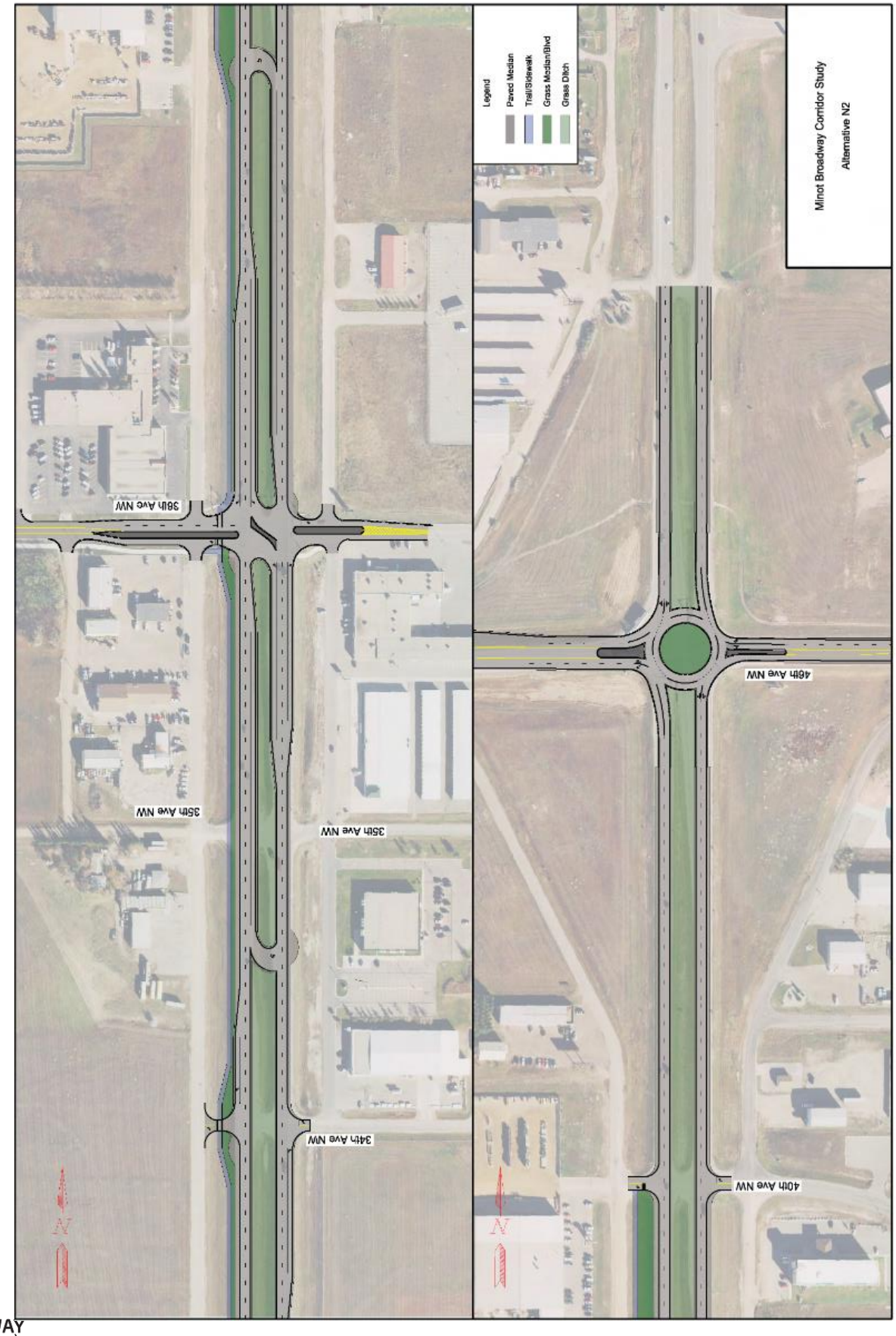
	Score	Weight	Key Factors
Vehicle Efficiency			» Roundabouts operate at LOS C or better through 2045 » ¾ accesses operate at LOS A » Southbound travel times between 46th Ave N and 4th Ave N increase by around 2.5 minutes, however travel speeds more closely match posted speeds » Overall network delay generally unchanged from no-build, despite U-turn requirements from RCUTs
Safety			» Roundabouts and access management reduce conflict points by 59% » Roundabouts are proven to mitigate severe crash types, especially angle crashes (however sideswipe/merging type crashes would be expected to increase with multilane roundabouts) » RCUTs have been found to reduce right-angle crashes by 77%, and reduce all injury crashes by 50%
Livability			» Trail on west side improves bicycle/pedestrian network » Traffic calming effects of roundabouts expected to lower corridor speeds » Crossing Broadway may become more challenging with roundabouts
Cost and Impacts			» Estimated construction cost of $11.1M » Roundabouts have lower annual maintenance costs than signals » Limited ROW acquisition needed for frontage roads, no relocations necessary » Minor access revisions, but frontage roads ensure easy access to businesses
Summary			» Acceptable traffic operations with roundabouts and RCUTs » Safety benefits provided by both roundabouts and access management » Improved livability through addition of shared use path » Costly Improvements for a corridor with acceptable pavement conditions

Figure 114: N.2 Roundabouts and RCUTS




Minot Broadway Corridor Study
Alternative N2
Legend
Paved Median
Trail/Sidewalk
Grass Median/Blvd
Grass Ditch
38th Ave NW
35th Ave NW
35th Ave NW
34th Ave NW
48th Ave NW
40th Ave NW

Summary of North Segment Alternatives

Both concepts that were studied for the north segment of the Broadway corridor are expected to provide improvements. The traffic signals configuration prioritizes vehicle mobility, while the roundabout configuration has greater safety impacts. Both the traffic signal and roundabout configurations improve conditions for non-motorized users, however the traffic calming benefits associated with roundabouts are expected to provide greater crash severity benefits, but at a higher project cost. Both concepts come at a notable cost for a corridor with good pavement conditions.

Table 30: North Segment Alternatives Summary

Alternative	Vehicle Efficiency	Safety	Livability	Cost and Impacts	Weighted Final Score
N.0 Do Nothing	●●●●○○○○○○	●○○○○○○○○○	●○○○○○○○○○	●●●●●●●●●●	●●●○○○○○○○
N.1 Traffic Signals and Access Control	●●●●●●●●○○	●●●●○○○○○○	●●●●●●●○○○	●●●○○○○○○○	●●●●●●○○○○
N.2 Roundabouts and RCUTs	●●●●●●○○○○	●●●●●●●●●○	●●●●●●●●○○	●○○○○○○○○○	●●●●●●●○○○

Middle Segment Alternatives: 11th Avenue North to 20th Avenue South

Since the middle segment covers a 2.5 mile stretch of Broadway between 11th Avenue North and 20th Avenue South, the segment was split into three sub-segments for the purposes of alternatives analysis and scoring. It is possible, if not likely, that a different improvement strategy will fit best at each location.

- Campus Segment (CA): 11th Avenue N to Mouse River
- Downtown Segment (DO): Mouse River to Burdick Expressway
- Commercial Segment (CO): Burdick Expressway to 20th Avenue S

Campus Segment: 11th Avenue N to Mouse River

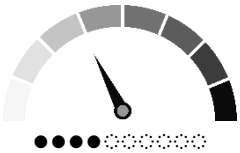
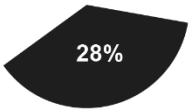
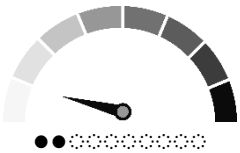
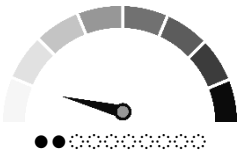
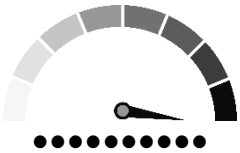
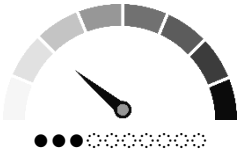
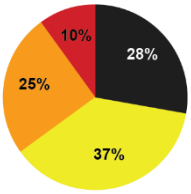
CA.0 No Build

Description

This would maintain the existing roadway and traffic control between 11th Avenue North and the Mouse River.

Performance

Table 31: CA.0 Performance

	Score	Weight	Key Factors
Vehicle Efficiency			» LOS B at signals, but poor side street operations at stop-controlled intersections
Safety			» Segment-type crashes are above the critical crash rate, with angle and rear-end crashes being the most common » High access density, with over 3.5 times more access points than recommended by NDDOT
Livability			» High access density creates many locations where turning vehicles cross the sidewalk » ADA non-compliance on sidewalks at driveways » No existing bicycle facilities » Traffic speeds (around 40 mph) have an approximately 45% chance of resulting in a fatality in the event of a pedestrian crash
Cost and Impacts			» Pavement conditions are still acceptable on this segment » No costs and no impacts outside of regular maintenance activities
Summary			» Dense access spacing increases crash potential and creates a challenging environment for non-motorized users » Poor side street operations at stop-controlled intersections » No bicycle infrastructure, uncomfortable pedestrian infrastructure, and unreliable transit conditions

CA.1 Low Access Management

Description

Alternative CA.1 would have the following characteristics between 11th Avenue North and the Mouse River:

- Maintains existing traffic control
- Access closures at some redundant mid-block accesses
- Provides alternate bicycle route for connectivity, transit signal priority for improved reliability and signal crossing improvements for improve pedestrian safety

Performance

Table 32: CA.1 Performance

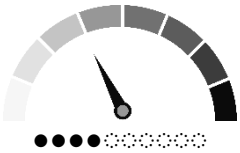
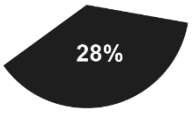
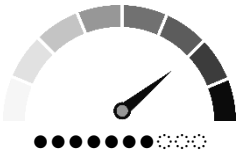
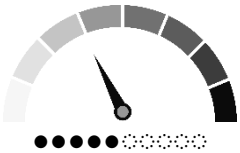
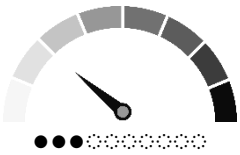
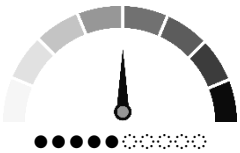
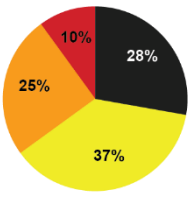
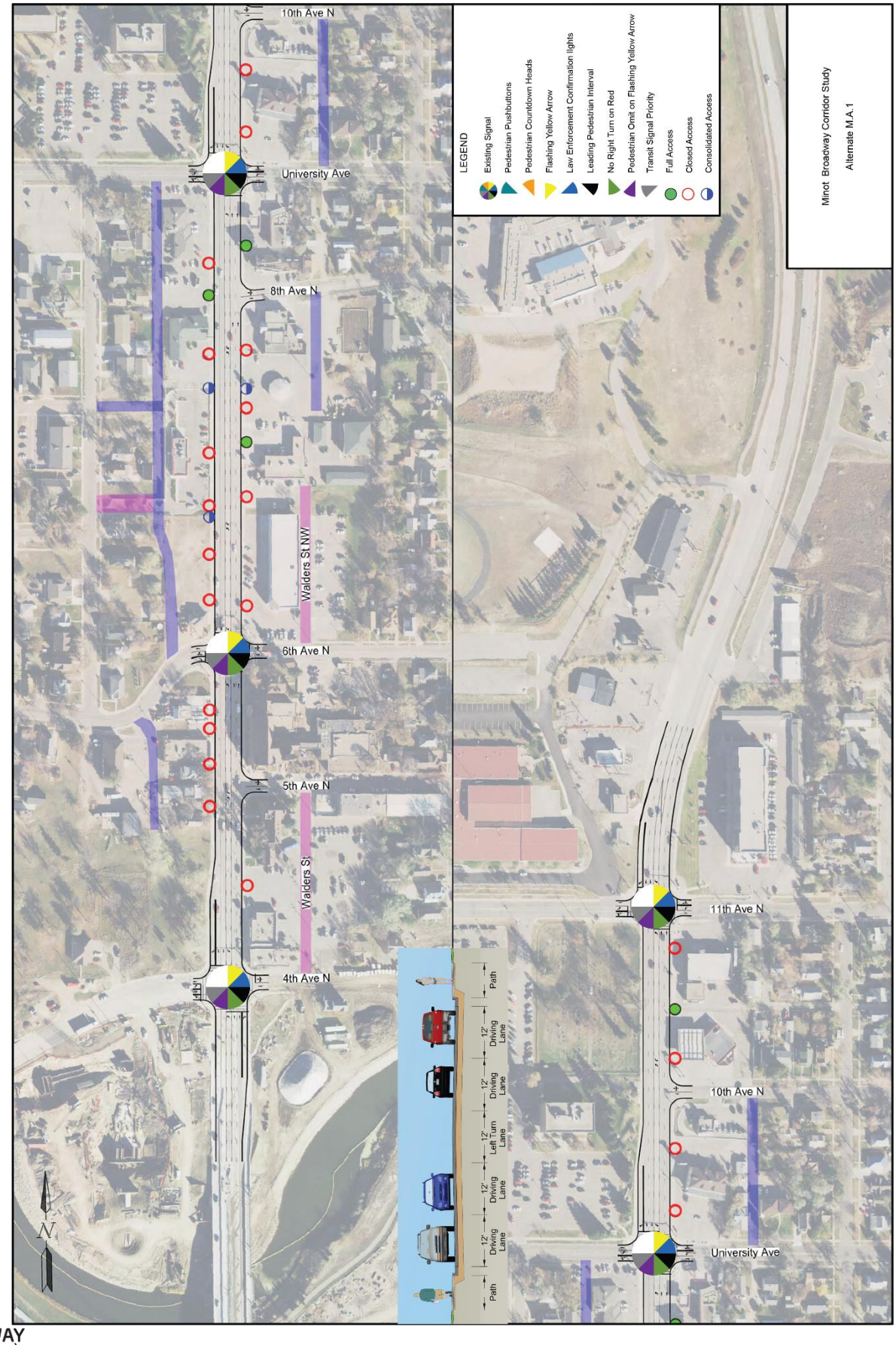
	Score	Weight	Key Factors
Vehicle Efficiency			» Minimal change to levels of service or travel times » LOS B at signals, but poor side street operations remain at stop-controlled intersections
Safety			» Conflict points reduced by 34% » Access management mitigates crash potential (especially angle crashes and rear-end crashes)
Livability			» Access management reduces conflicts between turning vehicles and pedestrians » Pedestrian crossing enhanced with signal upgrades and pedestrian refuge islands » Any changes in vehicle speeds are not expected to be enough to change pedestrian crash severity » Bicycle facilities would need to be located off of Broadway » Transit signal priority improves transit reliability
Cost and Impacts			» Estimated project cost of $6.5 million (assumes project between US 2 and 11th Ave N) » Adding a backage road network would increase project cost by $6.4 million
Summary			» Access management reduces crash potential, improves traffic flow, and reduces conflicts for non-motorized users » Improve pedestrian crossing safety and transit reliability » Costly improvement with many driveway impacts

Figure 115: CA.1 Low Access Management



CA.2 High Access Management

Description

Alternative CA.2 would have the following characteristics between 11th Avenue North and the Mouse River:

- Adds a raised median, converting most accesses to right-in/right-out only accesses
- Maintains existing traffic control, with full access maintained at traffic signals and other critical locations
- Provides alternate bicycle route for connectivity, transit signal priority for improved reliability, and pedestrian refuge islands and signal crossing improvements for improve pedestrian safety.

Performance

Table 33: CA.2 Performance

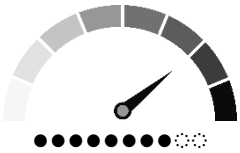
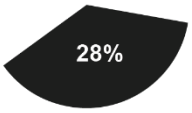
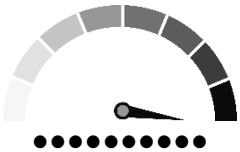
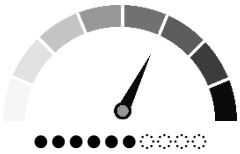
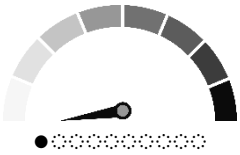
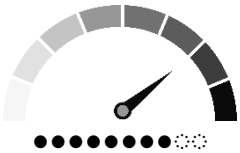
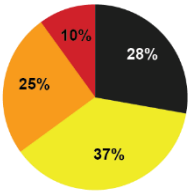
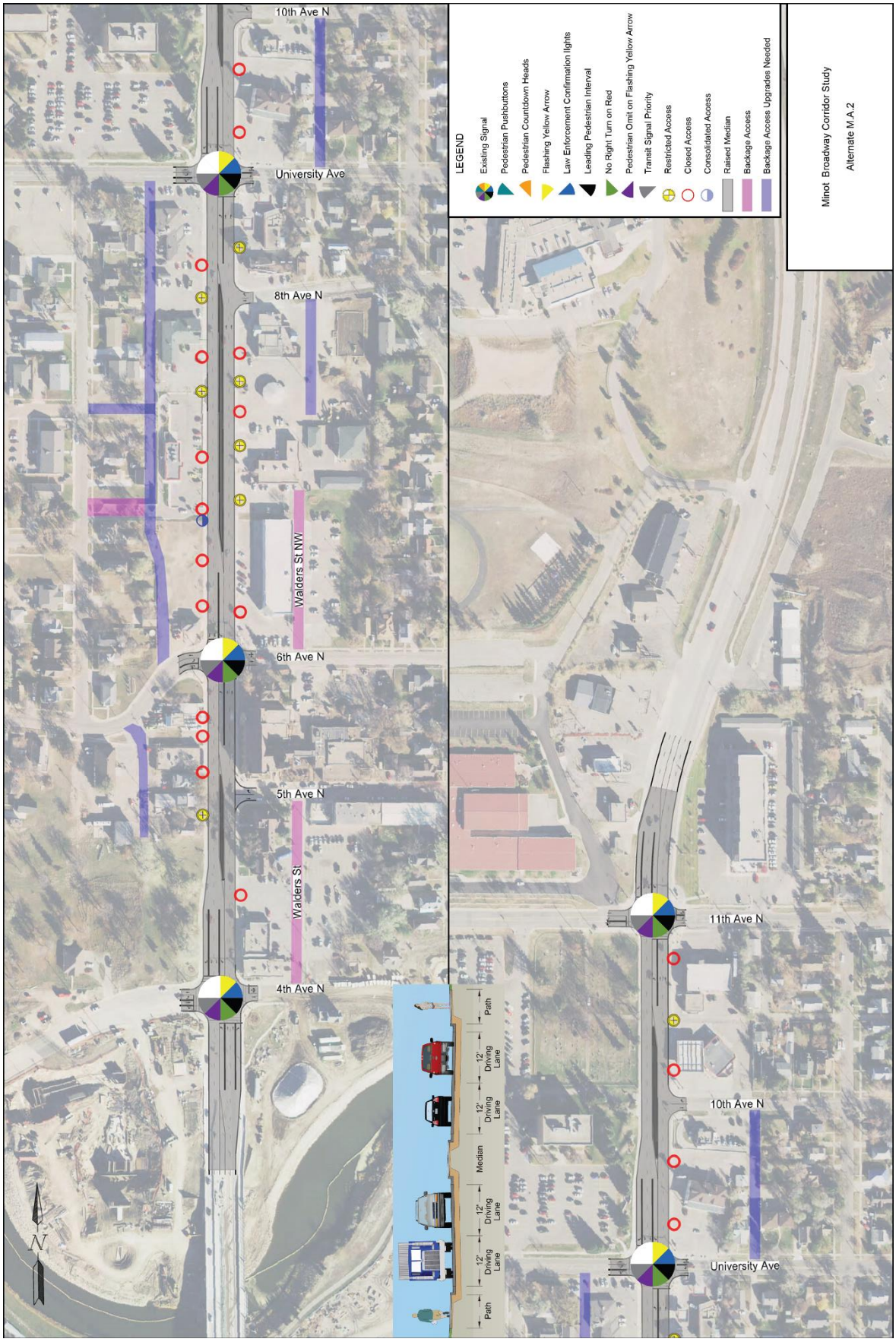
	Score	Weight	Key Factors
Vehicle Efficiency			» Side street operations improved to LOS A with right-in/right-out access configuration
Safety			» Raised median and associated right-in/right-out access configuration reduces conflict points by 58% » Access management reduces crash potential, especially for angle crashes and rear-end crashes
Livability			» Access management reduces conflicts between pedestrians and turning vehicles » Medians provide refuge at pedestrian crossings » Any changes in vehicle speeds are not expected to be enough to change pedestrian crash severity » Bicycle facilities would need to be located off of Broadway » Transit signal priority improves transit reliability
Cost and Impacts			» Estimated project cost of $10.9 million (assumes project between US 2 and 11th Ave N) » Adding a backage road network would increase project cost by $6.4 million » Raised median will change how properties and the corridor are accessed
Summary			» Access management reduces crash potential, improves traffic flow, and reduces conflicts for non-motorized users » Costly improvement with many driveway impacts

Figure 116: CA.2 High Access Management



Summary of Alternatives for Campus Segment (11th Avenue N to Mouse River)

Both access management alternatives improve safety and non-motorized conditions, but the more rigid access management associated with the addition of a raised median would prove added benefits to traffic flow and further safety and livability improvements. CA.2 High Access Management Strategy provides a more realistic implementation strategy. The amount of on-site access revisions and consolidations required for the Low Access Management Alternative will require intense site-by-site negotiations. This has potential impacts to the implementation timeline, costs, and benefits. Overall improvements associated with the raised median however would have greater impact to property and corridor access and would have a higher project cost.

Table 34: Campus Alternatives Summary

Alternative	Vehicle Efficiency	Safety	Livability	Cost and Impacts	Weighted Final Score
CA.0 Do Nothing	●●●●○○○○○○	●●○○○○○○○○	●●○○○○○○○○	●●●●●●●●●●	●●●○○○○○○○
CA.1 Low Access Management (Full Access)	●●●●○○○○○○	●●●●●●●○○○	●●●●●○○○○○	●●●○○○○○○○	●●●●●○○○○○
CA.2 High Access Management (Right-In/Right-Out)	●●●●●●●●○○	●●●●●●●●●●	●●●●●●○○○○	●○○○○○○○○○	●●●●●●●●○○

Downtown Segment: Mouse River to Burdick Expressway

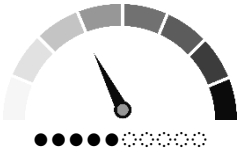
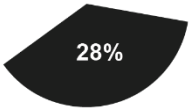
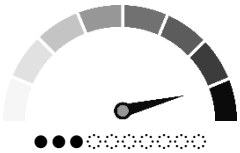
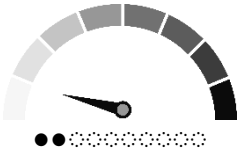
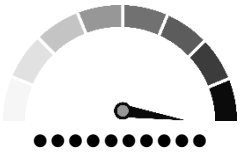
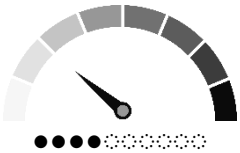
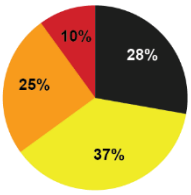
DO.0 No Build

Description

This would maintain the existing roadway configuration and traffic control between the Mouse River and Burdick Expressway.

Performance

Table 35: DO.0 Performance

	Score	Weight	Key Factors
Vehicle Efficiency			» LOS A at traffic signals » LOS C at most stop-controlled intersections, but LOS E at 3rd Avenue S (south junction)
Safety			» High access density, with twice as many access points than recommended by NDDOT » Segment-type crashes are above the critical crash rate, with rear-end crashes being the most common » No intersections are above the critical crash rate
Livability			» High access density creates many locations where turning vehicles cross the sidewalk » Traffic speeds (around 40 mph) have an approximately 45% chance of resulting in a fatality in the event of a pedestrian crash » ADA non-compliance on sidewalks at driveways » No existing bicycle facilities
Cost and Impacts			» Pavement conditions are still acceptable on this segment » No changes results in no costs and no impacts outside of regular maintenance activities
Summary			» Dense access spacing increases crash potential and creates a challenging environment for non-motorized users » Some delays at stop-controlled intersections

DO.1 Low Access Management

Description

Alternative DO.1 would have the following characteristics between the Mouse River and Burdick Expressway:

- Provides alternate bicycle route for connectivity, transit signal priority for improved reliability, and signal crossing improvements for improved pedestrian safety

Performance

Table 36: DO.1 Performance

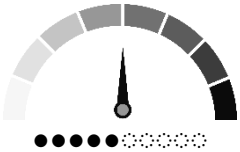
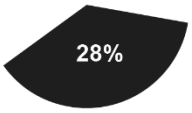
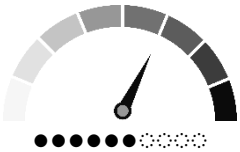
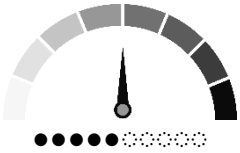
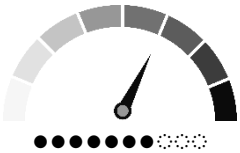
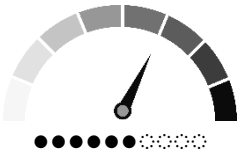
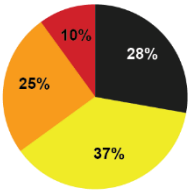
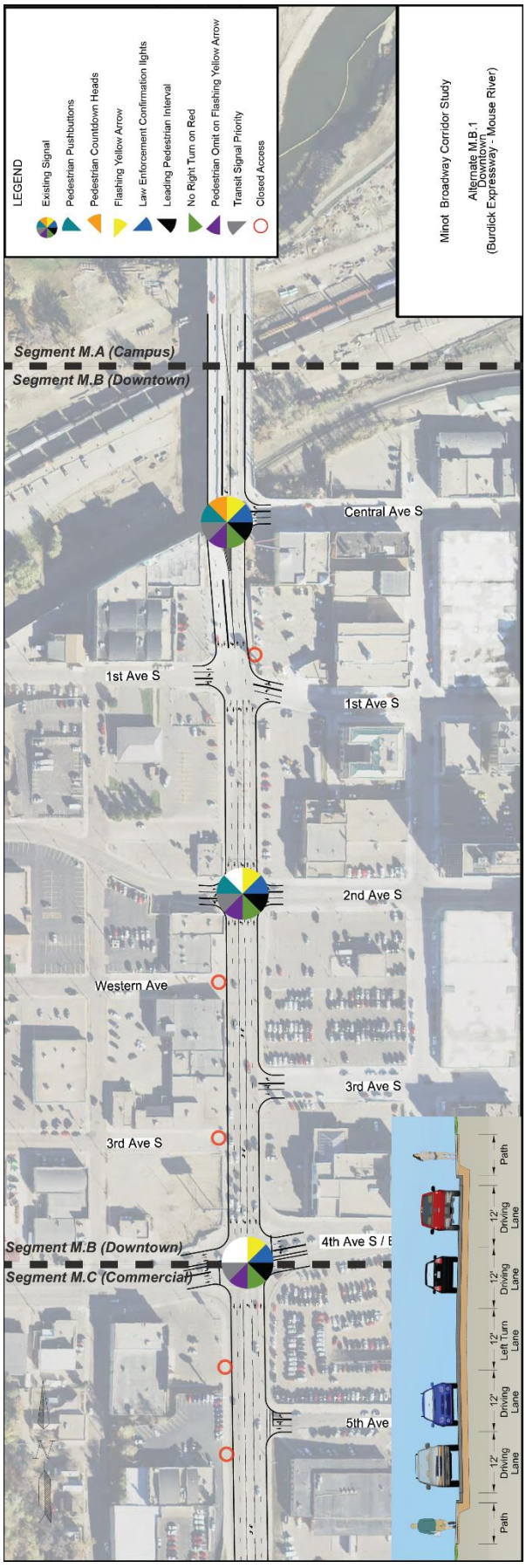
	Score	Weight	Key Factors
Vehicle Efficiency			» Minimal change to levels of service, travel times and overall delays.
Safety			» Closing Western Avenue and 3rd Avenue SW (west side only) reduces conflict points by 24%
Livability			» Pedestrian crossing enhanced with signal upgrades » Bicycle facilities would need to be located off of Broadway » Transit signal priority improves transit reliability
Cost and Impacts			» Minor costs specific to signal improvements
Summary			» Improve pedestrian crossing safety and transit reliability » Off route bike facility improve overall mobility and transportation equity

Figure 117: DO.1 Low Access Management



DO.2 Moderate Access Management

Description

Alternative DO.2 would have the following characteristics between the Mouse River and Burdick Expressway:

- Adds a raised median, converting unsignalized intersections to ¾ accesses (no side street left turns)
- Access closures at some redundant mid-block accesses
- Provides alternate bicycle route for connectivity, transit signal priority for improved reliability, and pedestrian refuge islands and signal crossing improvements for improve pedestrian safety

Performance

Table 37: DO.2 Performance

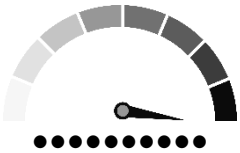
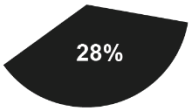
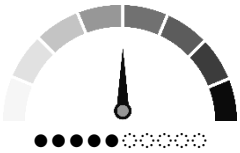
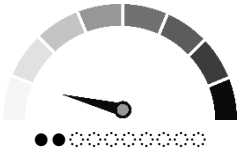
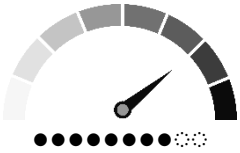
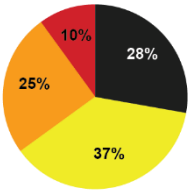
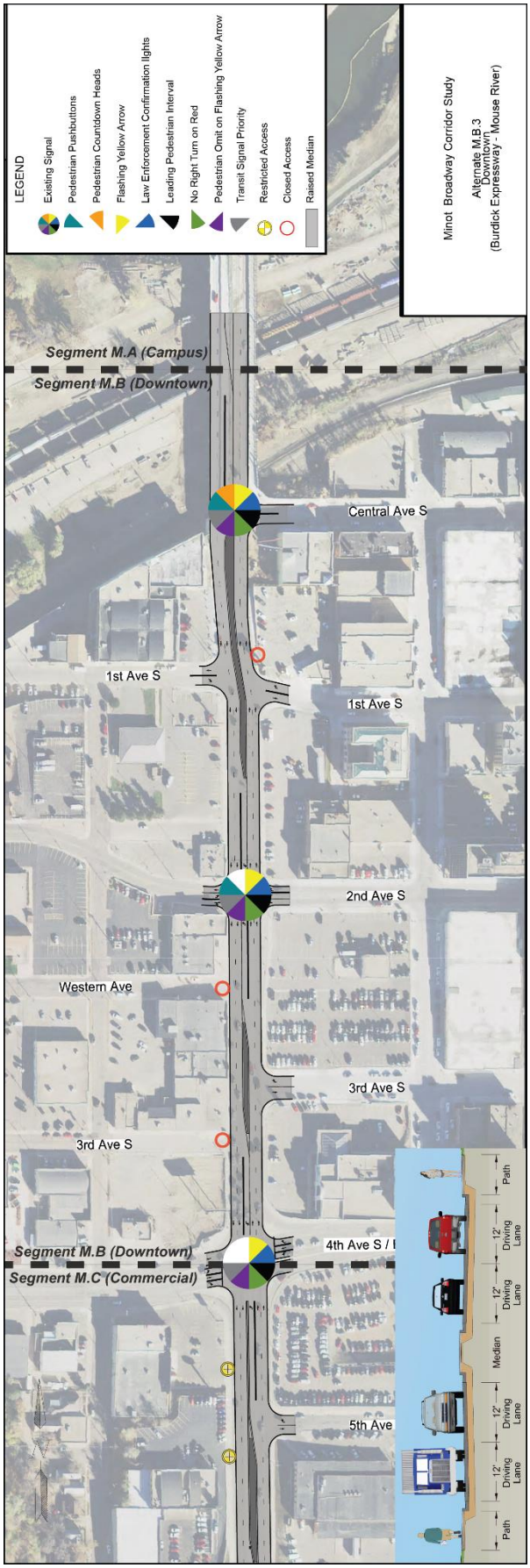
	Score	Weight	Key Factors
Vehicle Efficiency			» Operations at LOS A throughout the segment, except side street LOS C at 3rd Avenue S (south junction) » Reduces daily delay around 26% and peak hour delay around 42% (Data from River to 20th Avenue S) » Northbound travel time between US 2 and Central Avenue increases by around 1 minute; southbound travel time between Central Avenue and US 2 increases by around 40 seconds » Travel time increases are due to rerouted vehicles from access management changing traffic patterns at signals » Less mid-block traffic friction increases peak hour travel speeds around 30%
Safety			» Raised median and associated 3/4 access configuration reduces conflict points by 41% » Access management reduces crash potential, especially for angle crashes and rear-end crashes » Improved gap availability for side street turning movement should limit aggressive driving behavior/decision making. » Simulation results show an 87% reduction in vehicles being unable to turn onto Broadway
Livability			» Access management reduces conflicts between pedestrians and turning vehicles » Pedestrian crossing enhanced with signal upgrades and pedestrian refuge islands » Bicycle facilities would need to be off of Broadway » Transit signal priority improves transit reliability
Cost and Impacts			» Estimated project cost of $10.1 million (assumes project between US 2 and 11th Ave N). Adding a backage road network would increase project cost by $6.4 million » Raised median and ¾ access will change how properties and the corridor are accessed
Summary			» Access management reduces crash potential, improves traffic flow, and reduces conflicts for non-motorized users » Improve pedestrian crossing safety and transit reliability » Costly improvement with many driveway impacts

Figure 118: DO.2 Moderate Access Management



DO.3 High Access Management

Description

Alternative DO.2 would have the following characteristics between the Mouse River and Burdick Expressway:

- Adds a raised median, converting unsignalized intersections to right-in/right-out only access
- Access closures at some redundant mid-block accesses
- Provides alternate bicycle route for connectivity, transit signal priority for improved reliability and pedestrian refuge islands and signal crossing improvements for improve pedestrian safety

Performance

Table 38: DO.3 Performance

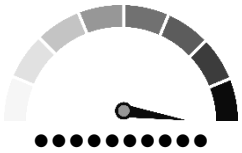
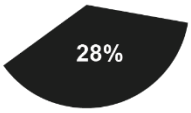
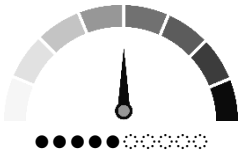
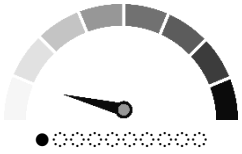
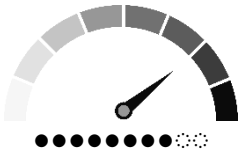
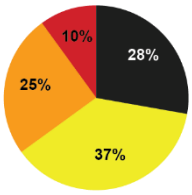
	Score	Weight	Key Factors
Vehicle Efficiency			» Operations at LOS A throughout the segment » Reduces daily delay around 23% and peak hour delay around 37% (Data from River to 20th Avenue S) » Northbound travel time between US 2 and Central Avenue increases around 1 minute; southbound travel time between Central Avenue and US 2 increases around 30 seconds » Travel time increases due to rerouted vehicles from access management changing traffic patterns at signal » Less mid-block traffic friction increases peak hour travel speeds around 30%
Safety			» Raised median and associated RI/RO access configuration reduces conflict points by 47% » Access management reduces crash potential, especially for angle crashes and rear-end crashes » Improved gap availability for side street turning movement should limit aggressive driving behavior/decision making; simulation results show a 60% reduction in vehicles unable to access Broadway
Livability			» Access management reduces conflicts between pedestrians and turning vehicles » Pedestrian crossing enhanced with signal upgrades and pedestrian refuge islands » Bike facilities would need to be off of Broadway » Transit signal priority improves transit reliability
Cost and Impacts			» Estimated project cost of $10.9 million (assumes project between US 2 and 11th Ave N). Adding a backage road network would increase project cost by $6.4 million » Raised median and RIRO will change how properties and the corridor are accessed
Summary			» Access management reduces crash potential, improves traffic flow, and reduces conflicts for non-motorized users » Improve pedestrian crossing safety and transit reliability » Costly improvement with many driveway impacts

Figure 119: DO.3 High Access Management

Summary of Alternatives for Downtown Segment (Mouse River to Burdick Expressway)

All access management alternatives improve safety and non-motorized conditions, but the more rigid access management associated with ¾ accesses or right-in/right-out accesses provide added safety benefits as well as improved traffic flow. DO.1 Low Access Alternative has reduced overall impact to the system given the lack of pronounced improvements. This concept is entirely multimodal focused. More stringent access management will have greater impacts to corridor and property access and higher project costs. When comparing DO.2 Medium and DO.3 High Access Management alternatives, DO.3 High Access Management has a slightly more logical median design structure, which may help with driver expectancy, but both require unique configurations through downtown.

Table 39: Downtown Segment Alternatives Summary

Alternative	Vehicle Efficiency	Safety	Livability	Cost and Impacts	Weighted Final Score
DO.0 Do Nothing	●●●●●○○○○○	●●●○○○○○○○	●●○○○○○○○○	●●●●●●●●●●	●●●●○○○○○○
DO.1 Low Access Management (Full Access)	●●●●●○○○○○	●●●○○○○○○○	●●●●●○○○○○	●●●●●●●●●○	●●●●●○○○○○
DO.2 Moderate Access Management (3/4 Access)	●●●●●●●●●●	●●●●●●●●●○	●●●●●○○○○○	●●○○○○○○○○	●●●●●●●●○○
DO.3 High Access Management (Right-In/Right-Out Access)	●●●●●●●●●●	●●●●●●●●●○	●●●●●○○○○○	●○○○○○○○○○	●●●●●●●●○○

Commercial Segment: Burdick Expressway to 20th Avenue South

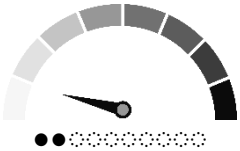
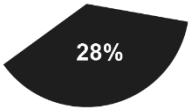
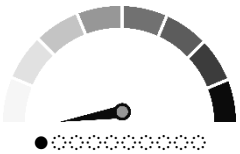
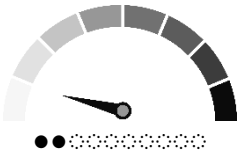
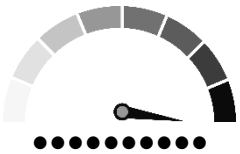
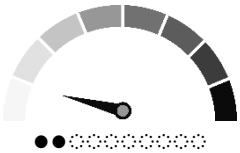
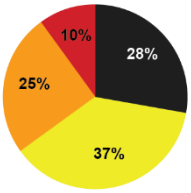
CO.o No Build

Description

This would maintain the existing roadway configuration and traffic control between Burdick Expressway and 20th Avenue South.

Performance

Table 40: CO.0 Performance

	Score	Weight	Key Factors
Vehicle Efficiency			» Operations at LOS B through LOS D at traffic signals (LOS D at 11th Avenue S and 20th Avenue S) » LOS F at 8 of 10 stop-controlled intersections
Safety			» Segment-type crashes are above the critical crash rate » Injury crash rate is above the critical rate » Intersection crash rate is above the critical crash rate at 20th Avenue S » Access density is over four times what is recommended by NDDOT
Livability			» Access density creates many locations where turning vehicles cross the sidewalk » ADA non-compliance on sidewalks at driveways » No existing bicycle facilities » Traffic speeds (around 40 mph) have an approximately 45% chance of resulting in a fatality in the event of a pedestrian crash
Cost and Impacts			» Pavement conditions are still acceptable on this segment » No changes results in no costs and no impacts outside of regular maintenance activities
Summary			» Dense access spacing increases crash potential and creates a challenging environment for non-motorized users » Deficient side street operations at stop-controlled intersections

CO.1 Low Access Management

Description

Alternative CO.1 would have the following characteristics between Burdick Expressway and 20th Avenue South:

- Adds a raised median but maintains full access at all public roadway intersections. Mid-block accesses would become right-in/right-out only
- Maintains existing traffic control
- Access closures at some redundant mid-block accesses
- Provides alternate bicycle route for connectivity, transit signal priority for improved reliability, and pedestrian refuge islands and signal crossing improvements for improve pedestrian safety

Performance

Table 41: CO.1 Performance

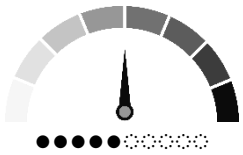
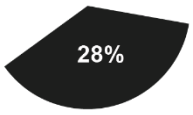
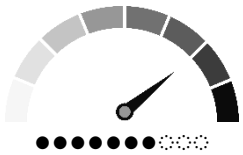
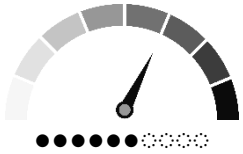
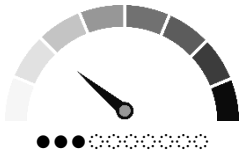
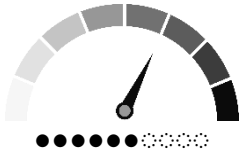
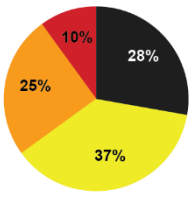
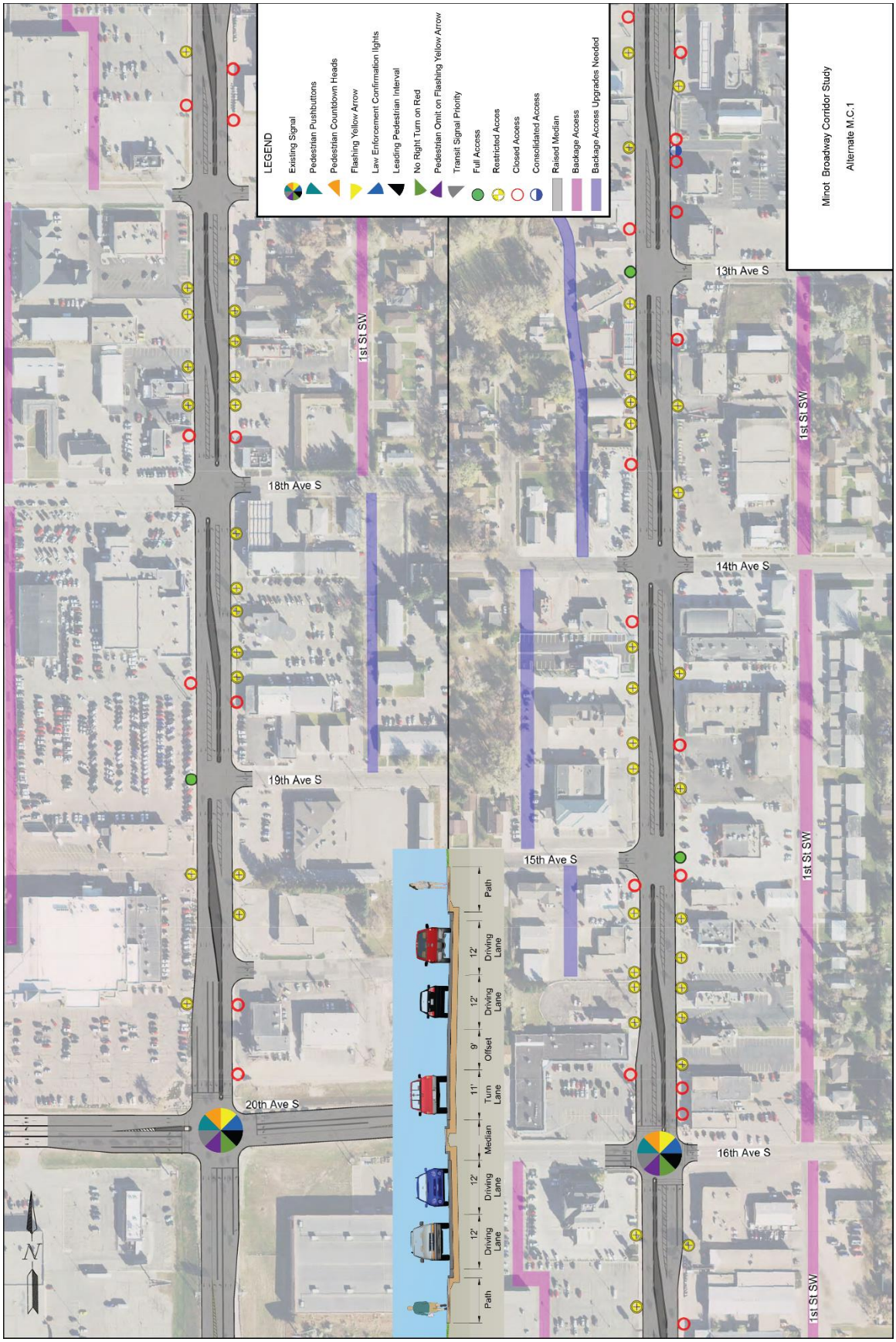
	Score	Weight	Key Factors
Vehicle Efficiency			» Side street LOS F remains at stop-controlled intersections » Reduces peak hour delay around 13%, but average daily delay only reduced around 2% » Northbound travel time between US 2 and Central Avenue increases around 1 minute; southbound travel time increases around 20 seconds » Travel time increases are due to rerouted vehicles from access management changing traffic patterns at signals » Less mid-block traffic friction increases peak hour travel speeds around 10%
Safety			» Conflict points reduced by 53% » Access management mitigates crash potential (especially angle crashes and rear-end crashes)
Livability			» Access management reduces conflicts between turning vehicles and pedestrians » Pedestrian crossing enhanced with signal upgrades and pedestrian refuge islands » Bicycle facilities would need to be off of Broadway » Transit signal priority improves transit reliability
Cost and Impacts			» Estimated project cost of $6.5 million (assumes project between US 2 and 11th Avenue N) » Adding a backage road network would increase project cost by $6.4 million
Summary			» Access management reduces crash potential, improves traffic flow, and reduces conflicts for non-motorized users » Improve pedestrian crossing safety and transit reliability » Costly improvement with many driveway impacts

Figure 120: CO.1 Low Access Management


LEGEND
Existing Signal
Pedestrian Pushbuttons
Pedestrian Countdown Heads
Flashing Yellow Arrow
Law Enforcement Confirmation lights
Leading Pedestrian Interval
No Right Turn on Red
Pedestrian Omit on Flashing Yellow Arrow
Transit Signal Priority
Full Access
Restricted Acces
Closed Access
Consolidated Access
Raised Median
Backage Access
Backage Access Upgrades Needed
Minot Broadway Corridor Study
Alternate M.C.1
18th Ave S
19th Ave S
20th Ave S
15th Ave S
16th Ave S
14th Ave S
13th Ave S
1st St SW
Path
Driving Lane
Median
Turn Lane
Offset
N

CO.2 Moderate Access Management

Description

Alternative CO.2 would have the following characteristics between Burdick Expressway and 20th Avenue South:

- Adds a raised median, converting unsignalized intersections to ¾ accesses (no side street left turns)
- Maintains existing traffic control, with full access maintained at traffic signals
  - Full access also maintained at 14th Avenue South and 7th Avenue south
- Access closures at some redundant mid-block accesses
- Provides alternate bicycle route for connectivity, transit signal priority for improved reliability, and pedestrian refuge islands and signal crossing improvements for improve pedestrian safety

Performance

Table 42: CO.2 Performance

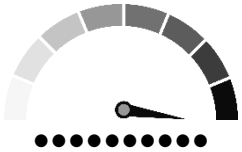
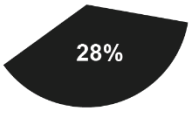
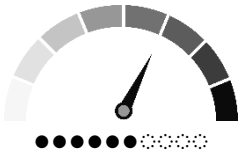
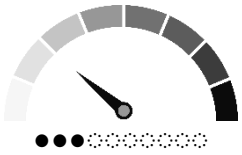
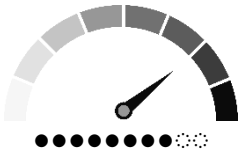
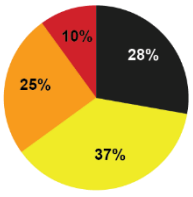
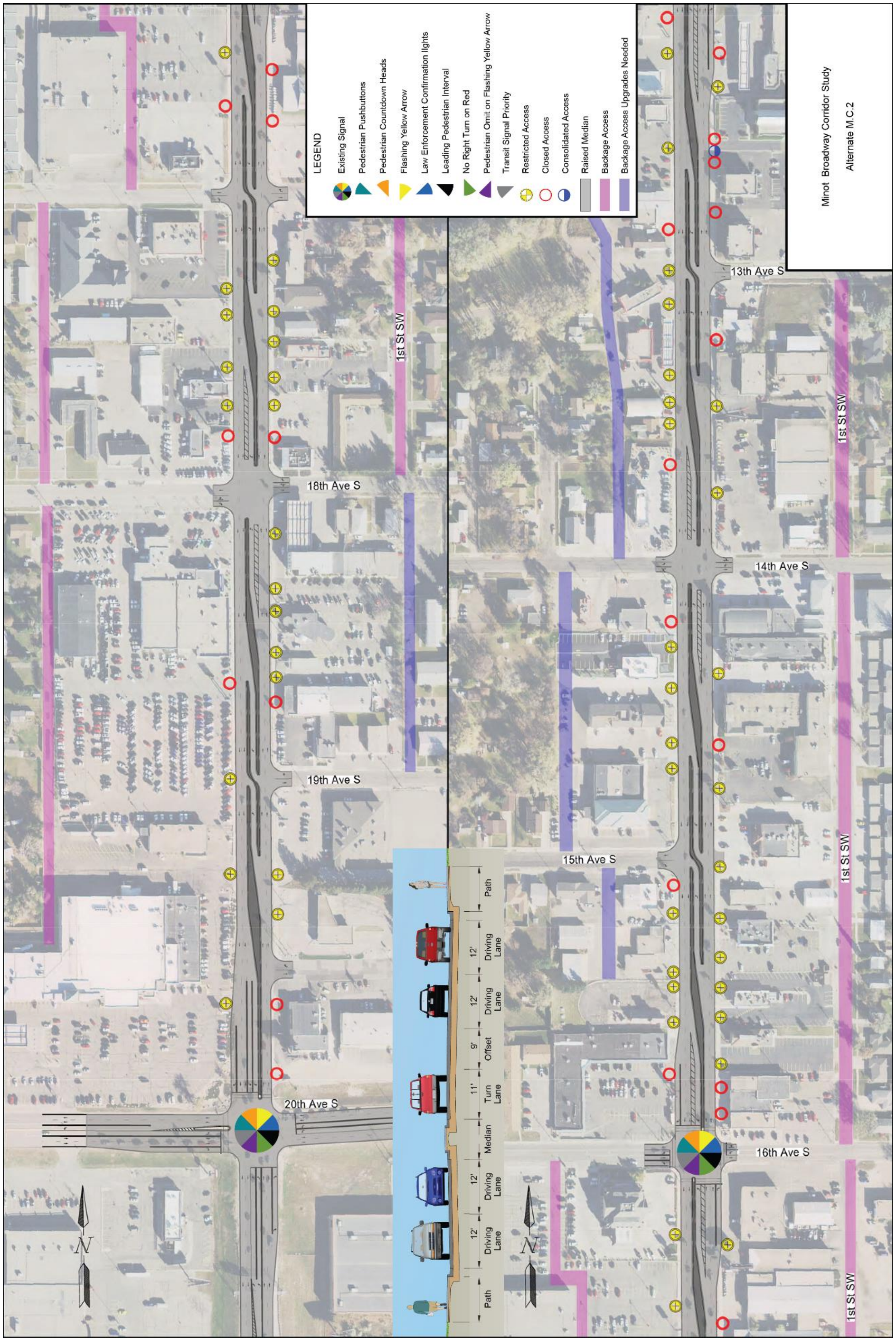
	Score	Weight	Key Factors
Vehicle Efficiency			» Operations at LOS A everywhere except stop-controlled full accesses (LOS E-F) » Reduces daily delay around 26% and peak hour delay around 42% » Northbound travel time between US 2 and Central Avenue increases around 1 minute; southbound travel time increases around 40 seconds » Travel time increases are due to rerouted vehicles from access management changing traffic patterns at signals » Less mid-block traffic friction increases peak hour travel speeds by around 30%
Safety			» Raised median and associated 3/4 access configuration reduces conflict points by 66% » Access management reduces crash potential, especially for angle crashes and rear-end crashes » Improved gap availability for side street turning movement should limit aggressive driving behavior/decision making; simulation results show an 87% reduction in vehicles being unable to turn onto Broadway
Livability			» Access management reduces conflicts between pedestrians and turning vehicles » Pedestrian crossing enhanced with signal upgrades and pedestrian refuge islands » Bicycle facilities would need to be off of Broadway » Transit signal priority improves transit reliability
Cost and Impacts			» Estimated project cost of $14.0 million (assumes project between US 2 and 11th Avenue N) » Adding a backage road network would increase cost by $6.4 million » Raised median and ¾ access will change how properties and the corridor are accessed
Summary			» Access management reduces crash potential, improves traffic flow, and reduces conflicts for non-motorized users » Improve pedestrian crossing safety and transit reliability » Costly improvement with many driveway impacts

Figure 121: Alternative CO.2 Moderate Access Management


LEGEND
Existing Signal
Pedestrian Pushbuttons
Pedestrian Countdown Heads
Flashing Yellow Arrow
Law Enforcement Confirmation lights
Leading Pedestrian Interval
No Right Turn on Red
Pedestrian Omit on Flashing Yellow Arrow
Transit Signal Priority
Restricted Access
Closed Access
Consolidated Access
Raised Median
Backage Access
Backage Access Upgrades Needed
Minot Broadway Corridor Study
Alternate M.C.2
13th Ave S
14th Ave S
15th Ave S
16th Ave S
18th Ave S
19th Ave S
20th Ave S
1st St SW
Path
12'
Driving Lane
9'
Offset
11'
Turn Lane
Median
N

CO.3 High Access Management

Description

Alternative CO.3 would have the following characteristics between the Burdick Expressway and 20th Avenue South:

- Adds a raised median, converting unsignalized intersections to right-in/right-out only accesses
- Full access maintained at traffic signals
  - Signals added at 14th Avenue South and at 18th Avenue South as a result of traffic re-routing making signals warranted at these intersections
- Full access is maintained at 7th Avenue South, even though this would remain under two-way stop control
- Access closures at some redundant mid-block accesses
- Provides alternate bicycle route for connectivity, transit signal priority for improved reliability, and pedestrian refuge islands and signal crossing improvements for improve pedestrian safety

Performance

Table 43: CO.3 Performance

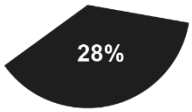
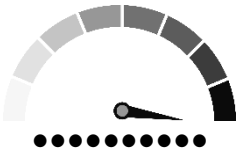
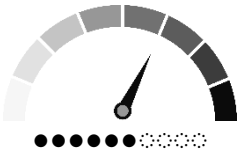
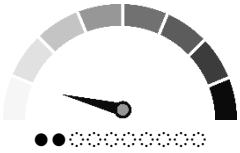
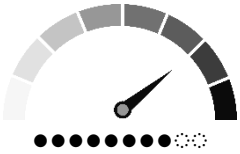
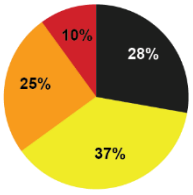
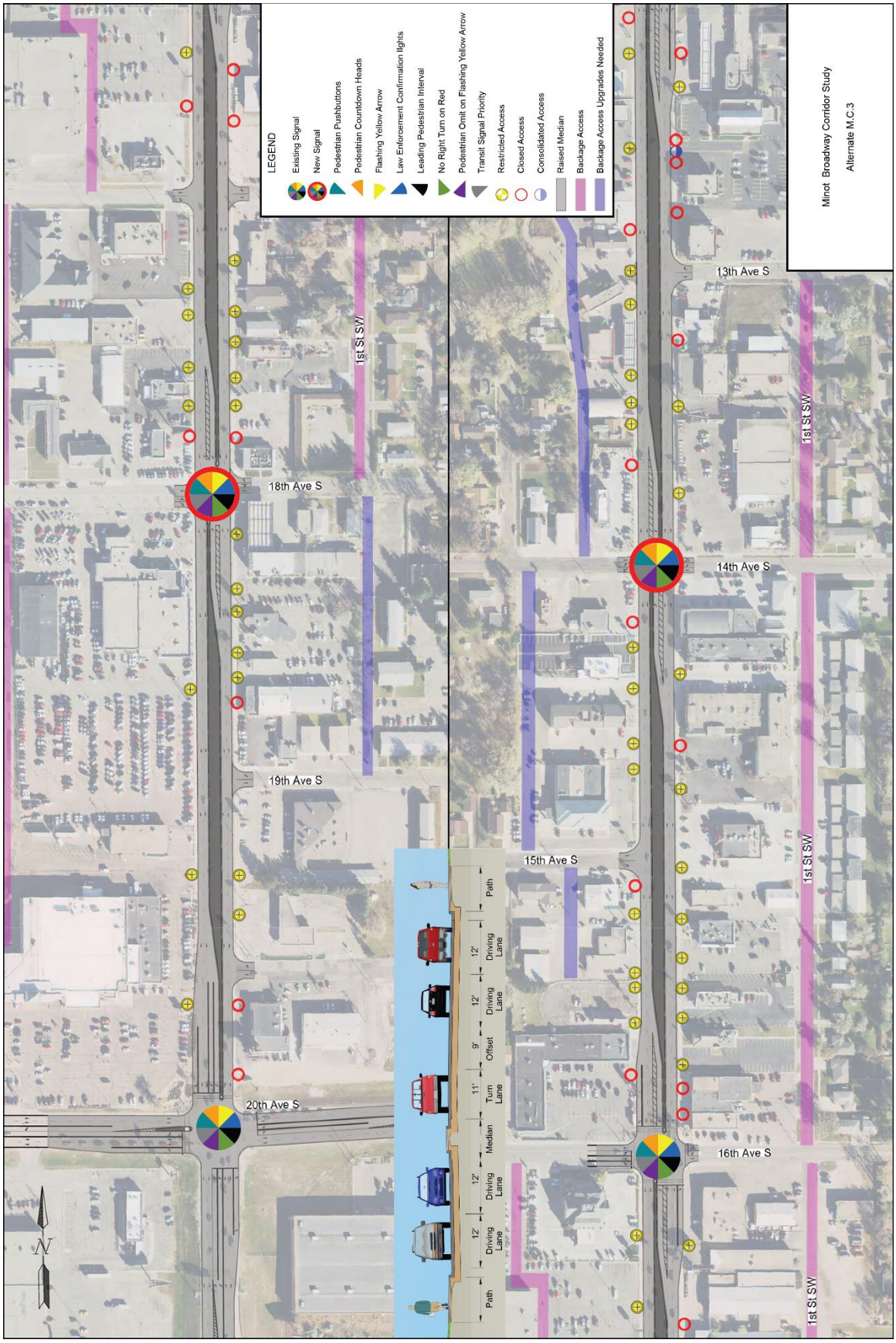
	Score	Weight	Key Factors
Vehicle Efficiency			» Side street operations at stop-controlled intersections are improved everywhere except 7th Avenue South, where LOS F is expected with full access » Reduces daily delay around 23% and peak hour delay around 37% » Northbound travel time between US 2 and Central Avenue increases around 1 minute; southbound travel time increases around 30 seconds » Travel time increases are due to rerouted vehicles from access management changing traffic patterns at signals » Less mid-block traffic friction increases peak hour travel speeds around 30%
Safety			» Raised median and RI/RO access reduces conflict points by 69% » Access management reduces crash potential, especially for angle crashes and rear-end crashes » Improved gap availability for side street turning movement should limit aggressive driving behavior/decision making; simulation results show a 60% reduction in vehicles being unable to turn onto Broadway
Livability			» Access management reduces conflicts between pedestrians and turning vehicles » Pedestrian crossing enhanced with signal upgrades and refuge islands » Bicycle facilities would need to be off of Broadway » Transit signal priority improves transit reliability
Cost and Impacts			» Estimated project cost of $13.4 million (assumes project between US 2 and 11th Ave N). » Adding a backage road network would increase cost by $6.4 million » Raised median and RIRO will change how properties and the corridor are accessed.
Summary			» Access management reduces crash potential, improves traffic flow, and reduces conflicts for non-motorized users » Improve pedestrian crossing safety and transit reliability » Costly improvement with many driveway impacts

Figure 122: CO.3 High Access Management


LEGEND
Existing Signal
New Signal
Pedestrian Pushbuttons
Pedestrian Countdown Heads
Flashing Yellow Arrow
Law Enforcement Confirmation Ilghts
Leading Pedestrian Interval
No Right Turn on Red
Pedestrian Omit on Flashing Yellow Arrow
Transit Signal Priority
Restricted Access
Closed Access
Consolidated Access
Raised Median
Backage Access
Backage Access Upgrades Needed
Minot Broadway Corridor Study
Alternate M.C.3
18th Ave S
19th Ave S
20th Ave S
15th Ave S
14th Ave S
13th Ave S
16th Ave S
1st St SW
Path
12' Driving Lane
12' Driving Lane
Median
11' Turn Lane
9' Offset
12' Driving Lane
12' Driving Lane
Path
N

Summary of Alternatives for Commercial Segment (Burdick Expressway to 20th Avenue South)

All access management alternatives improve safety and non-motorized conditions, but the more rigid access management associated with ¾ accesses or right-in/right-out accesses provide added safety benefits as well as improved traffic flow. More stringent access management will have greater impacts to corridor and property access and higher project costs. The most unique aspect of this segment of the corridor is the increased access management scenarios substantially improve network delay. This phenomenon occurs when turning movements from driveways or other closed public streets are rerouted to full access points and warrant new traffic signals. The results are staggering, with a total delay reduction more than twice versus even CO.1 Low Access Alternative. The difference between the CO.2 Moderate Access and CO.3 High Access alternatives comes down to minor safety benefits provided by CO.3 High Access versus minor operational benefits resulting from less rerouted traffic in CO.2 Moderate Access alternative.

Table 44: Commercial Segment Alternatives Summary

Alternative	Vehicle Efficiency	Safety	Livability	Cost and Impacts	Weighted Final Score
CO.0 Do Nothing	●●○○○○○○○○	●○○○○○○○○○	●●○○○○○○○○	●●●●●●●●●●	●●○○○○○○○○
CO.1 Low Access Management (Full Access)	●●●●●○○○○○	●●●●●●●○○○	●●●●●●○○○○	●●●○○○○○○○	●●●●●●○○○○
CO.2 Moderate Access Management (3/4 Access)	●●●●●●●●●●	●●●●●●●●●○	●●●●●●○○○○	●●●○○○○○○○	●●●●●●●●○○
CO.3 High Access Management (RI/RO Access)	●●●●●●●●●○	●●●●●●●●●●	●●●●●●○○○○	●●○○○○○○○○	●●●●●●●●○○

Potential Modifications to Middle Segment Alternatives

Access Consolidation

High access density is one of the major issues present on the middle segment of the Broadway Corridor. Treatments such as raised medians are one method to mitigate issues associated with frequent access to high-volume roadways, however reducing the number of access points would enhance benefits associated with any of the alternatives presented above. Reducing the number of accesses can be achieved through removing redundant accesses or by consolidating nearby access points into a single access point.

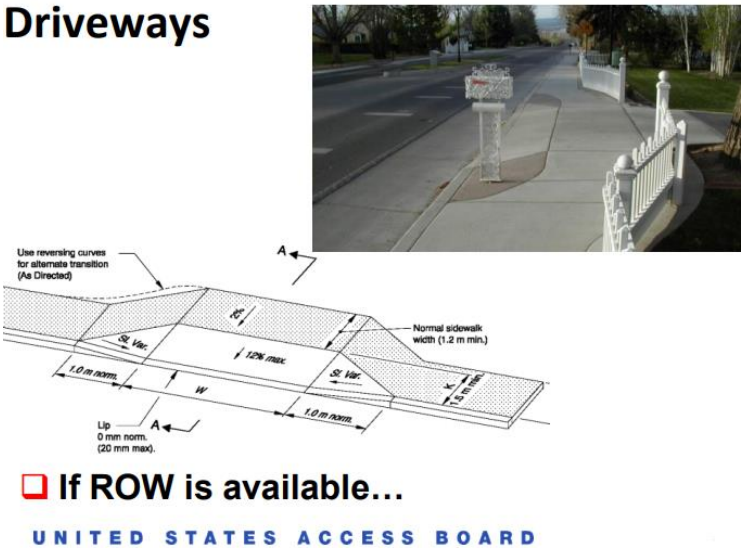
Access consolidation was considered on the segment between 11th Avenue South and 20th Avenue South, where access density is the highest (over four times the access density recommended by NDDOT). The other segments along the corridor had fewer benefits from consolidation, often due to the narrow property widths and grades along the corridor.

Figure 123: Example of Challenging Consolidated Access Location

- Conflict points would be reduced by 79 percent with access consolidation when compared to existing conditions, while maintaining full access at all public roadway intersections. For reference, the low access management alternative (M.1) reduces conflict points by 56 percent. This comparison does require an understanding of how different conflict types impact the safety and severity of crashes. Both the access consolidation and low access management alternative have the same number of crossing conflicts, but a 23 percent difference in right-turn conflicts, which are either rear-ends or sideswipe type crashes. These types of crashes are less likely to be severe injury crashes, less likely to generate erratic behavior caused by long delays and generally are just moved up or down the corridor a few hundred feet. That is not to say further access consolidation is not beneficial, it is just unlikely the difference between these alternatives will be a 23 percent reduction in crashes. Furthermore, access consolidation will require significant outreach and coordination with business owners.
- The extent of impacts and associated cost with major access revisions over a mile segment of roadway could make this infeasible in the short to mid-term. Access consolidations require more than just reconfiguring a driveway. It requires working on-site to revise parking and circulation. Special considerations must be given to sites with drive-throughs, truck loading areas and others. For consolidations to work, a cross-access agreement must be agreed upon by both property owners, unlike a median, which occurs in the NDDOT ROW. The grades, small property sizes and land use types makes consolidated access points particularly challenging on this corridor.
- Project costs would however be offset somewhat by more straightforward ADA improvements. Given the sidewalk's proximity to the roadway, sidewalks would need to be routed around each driveway to meet ADA standards, as shown in Figure 124. Reducing the number of driveways simplifies meeting ADA standards.

Figure 124: Driveways Near 18th Avenue S to Consolidate and Meet ADA Standards

Figure 125: ADA Accommodations at Driveways



Adaptive Signal Control

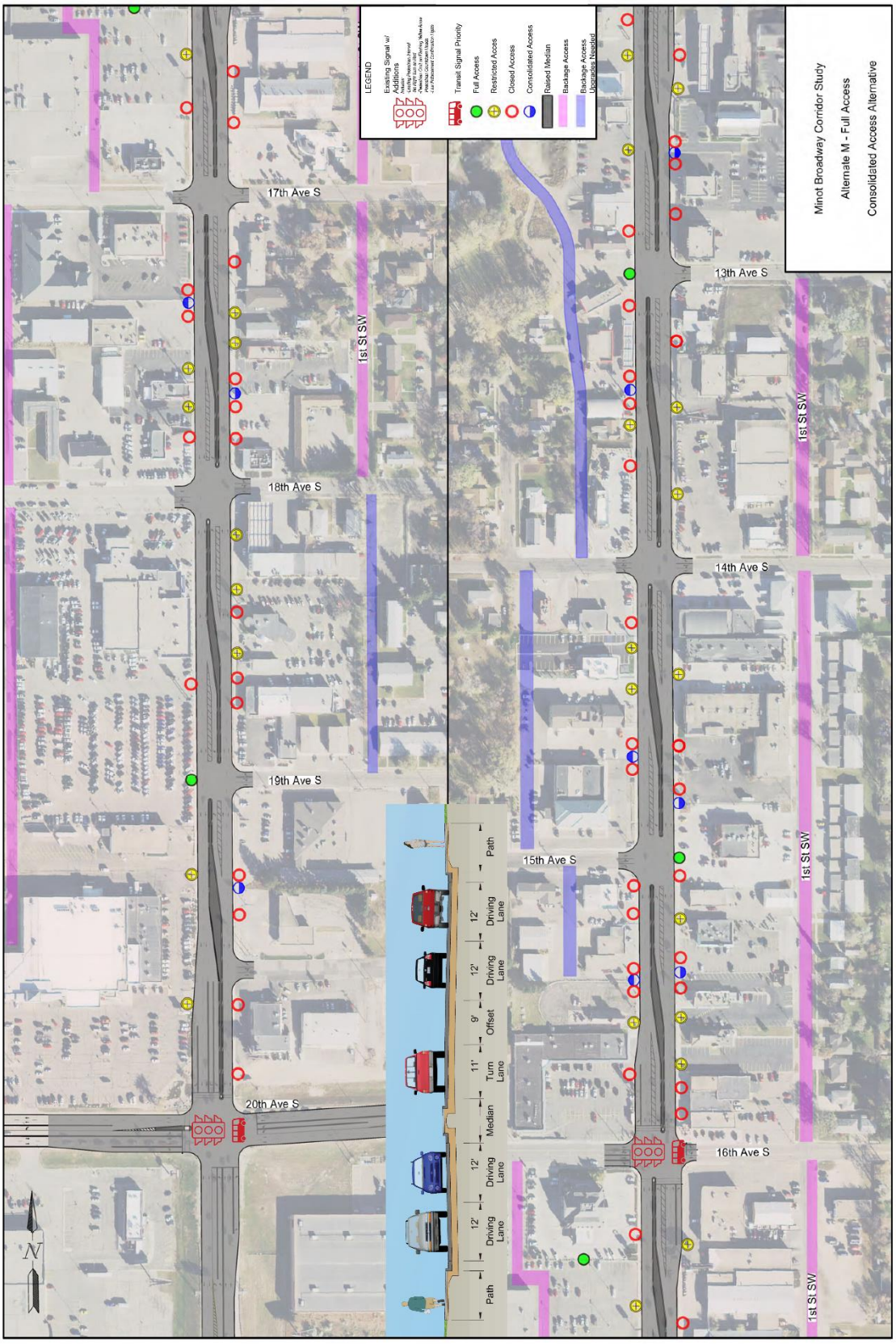
Adaptive signal control (ASC) technology allows traffic signals to better respond to real-time changes in traffic volumes, better allocating green time to approaches where demand is higher. ASC also provides traffic flow benefits during special events, construction, or traffic incidents like accidents or stalled vehicles.

Traffic simulation that included ASC along the Broadway corridor showed the following:

- Under typical traffic conditions, ASC was found to have notable benefits in 2020 when traffic volumes are lower, but the benefits are minimized once traffic volumes increase with future scenarios showing minimal benefits. More specifically, the 2020 conditions showed a 12 percent benefit during the AM peak hour when traffic is light and no benefits during the PM peak hour when traffic is heaviest. The daily delay benefits are around seven percent, when compared to multiple optimized timing plans. This is consistent with national findings. The traffic growth expected through 2045 are enough to minimize the ASC benefits.
- When event scenarios were tested, ASC was able to be more responsive to traffic demand needs on the approaches issues were occurring but had a net negative impact to the overall system, often by breaking mainline coordination. Despite poor mainline operations, ASC would likely prevent extended delays to some movements.

Ultimately, ASC is expected to offer benefits in the short-term, however benefits are diminished as traffic volumes increase without additional roadway improvements. ASC could be an interim solution to improve reactivity of the system to increased side street demands caused by access management, and this may be a powerful tool to ensure there are not any undue complaints or conflicts with local businesses by improving their access to the corridor. Whether this interim benefit is worth the effort is unclear.

Figure 126: Access Consolidation Concept (11th Ave S to 20th Ave S)



US 2 Interchange Alternatives

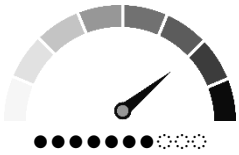
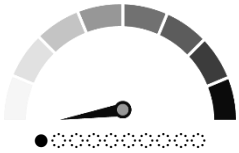
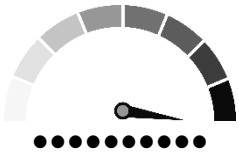
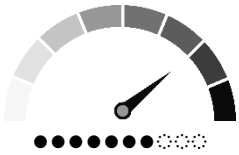
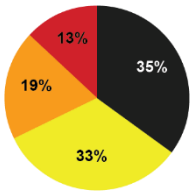
I.0 No Build

Description

Alternative I.0 would make no changes to the existing US 2 interchange. No changes would be made to 22nd Avenue South or 28th Avenue South intersections.

Performance

Table 45: I.0 Performance

	Score	Weight	Key Factors
Vehicle Efficiency			» Signalized intersections operate acceptably » Adjacent intersections (22nd Avenue S and 28th Avenue S) operate deficiently and create weaving issues
Safety			» Crash rate at 20th Avenue S is above the critical crash rate and is ranked #39 on NDDOT's Urban High Crash Location List » Injury crashes reported at 20th Avenue S and 28th Avenue S » Conflicts associated with 22nd Avenue S approach at the north US 2 ramps could be eliminated due to alternate access options that are nearby
Livability			» No bicycle or pedestrian facilities across the interchange » Bicycle and pedestrian crashes report at 20th Avenue S
Cost and Impacts			» Pavement/bridge conditions are still acceptable » No changes results in no costs and no impacts outside of regular maintenance activities
Summary			» There are opportunities to reduce conflicts in the vicinity of the interchange to reduce crash potential

I.1 Access and Spot Improvements

Description

Alternative I.1 has the following characteristics between 20th Avenue South and 28th Avenue South:

- Closes 22nd Avenue (west approach of north ramps intersection)
- Access revision at 28th Avenue to a ¾ access
- Adds bicycle and pedestrian facilities on the bridge
- Pedestrian tunnels could be implemented at loop ramps to eliminate conflicts between turning vehicles and pedestrians

Performance

Table 46: I.1 Performance

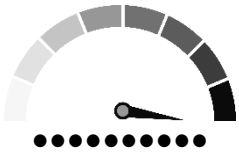
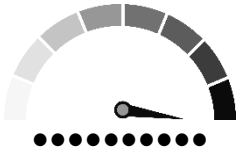
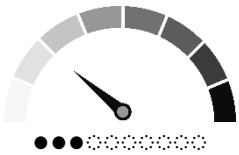
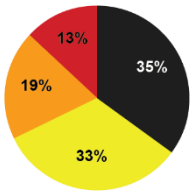
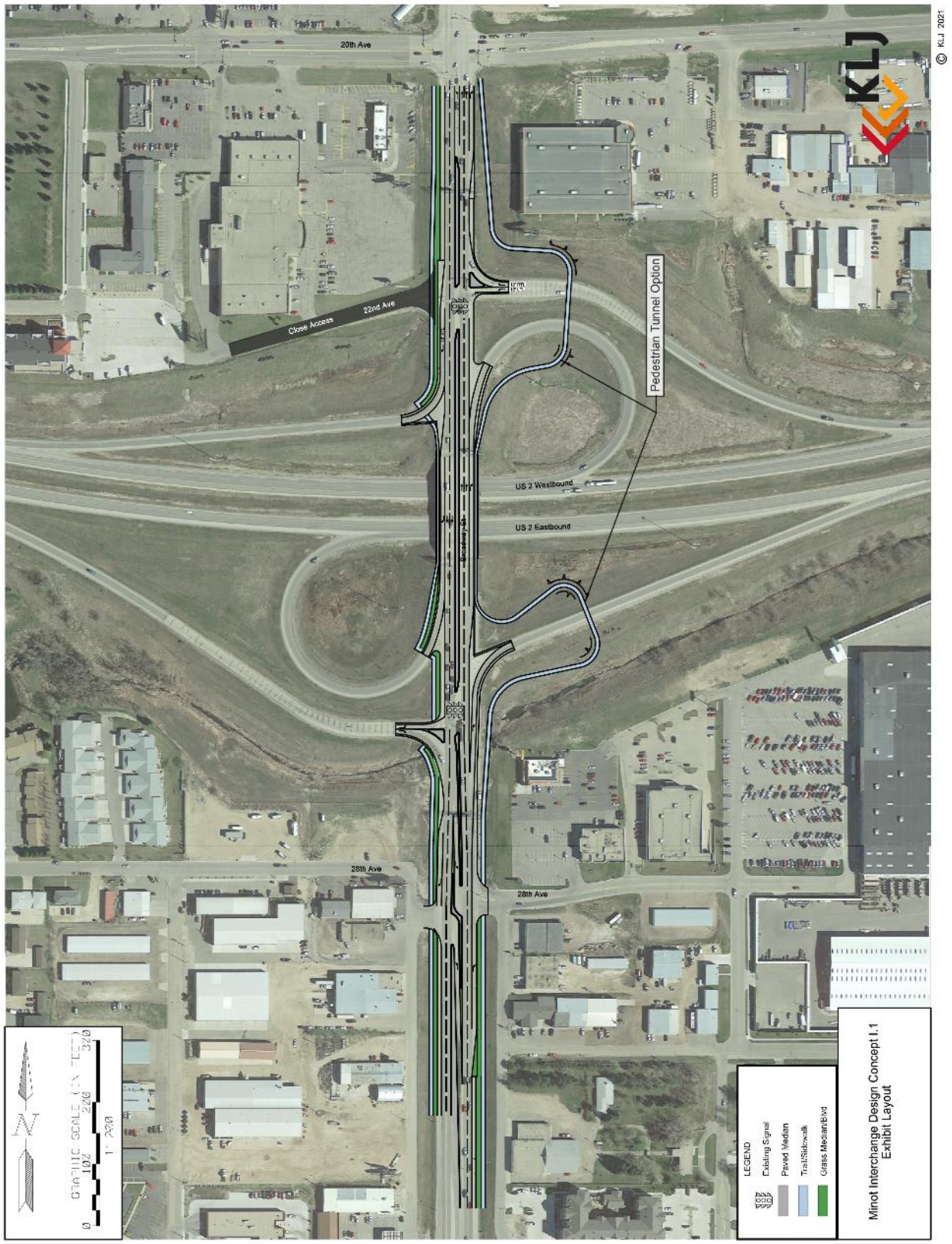
	Score	Weight	Key Factors
Vehicle Efficiency			» Signalized intersections continue to operate at LOS A » No change to daily delays per vehicle
Safety			» Access revisions mitigate potential for angle crashes » Total conflict points reduced by 13 » Weighted conflict analysis from simulation indicates a 17% decrease in conflict potential » Simulated crossing conflicts reduced by 96%, merging conflicts reduced by 11%, and rear end conflicts reduced by 3%
Livability			» Addition of a multi-use trail on the bridge provides a vital connection across US 2 » Adding pedestrian tunnels under the ramps would eliminate conflicts between vehicles and non-motorized users » Significant changes to vehicle speeds are not expected
Cost and Impacts			» Estimated project cost of $4.9 million to $6.2 million, depending on how pedestrian accommodations are implemented
Summary			» Improvements will provide a vital non-motorized connection across US 2 » Access revisions reduce crash potential

Figure 127: I.1 Access and Spot Improvements



Potential Modifications for Access and Spot Improvements (I.1)

Pedestrian comfort and safety can often be an issue at locations with uncontrolled loop ramps, as such designs emphasize vehicle traffic. Pedestrian tunnels are one way to mitigate conflicts at loop ramps. The one challenge with tunnels is that many pedestrians will not use them for the sake of convenience. This is particularly true in the case of steep grades pushing underpasses far away from the natural crossing point, as is the case at the US 2 Interchange. Crossing at grade when not properly designed for such a crossing can surprise drivers and result in underutilized infrastructure. Also, tunnels can be intimidating to some pedestrians as they can be perceived as a safety issue with poor lighting and maintenance. Often tunnels are equipped with cameras and bright lighting to combat this concern. In response to these concerns, two additional options were considered and are presented below.

Sub-Option 1: Control Loop Ramps

This option would reconfigure the loop ramps to bring them perpendicular to Broadway. Loop ramps would then be controlled by the signal like a standard intersection. This reduces the free flow aspect of the loops providing some slight delays and possible rear-end friction from drivers being surprised when a pedestrian crosses the road.

Planning level cost estimates indicate such changes would increase project costs by around 22 percent when comparing to Alternative I.1 but would have a similar cost to Alternative I.1 if pedestrian underpasses were implemented.

Figure 128: Loop Ramp Modification for I.1 Access and Spot Improvements

Option 2: Center Median Facility

This option would utilize the median to place pedestrian crossings downstream of uncontrolled loop ramps, with a sidewalk located on the median between loop ramps. While unconventional, this alternative allows loop ramp movements to continue as they do today, while eliminating conflicts between right turning vehicles and crossing pedestrians. This style of pedestrian crossing is common at diverging diamond interchanges. The downside to this concept is that this strategy requires pedestrians to cross mainline traffic twice and likely switch sides of the road. Also, the center median can be somewhat uncomfortable, even with jersey barrier protection.

Planning level cost estimates indicate such changes would increase project costs by around 27 percent when comparing to Alternative I.1, but only would increase project costs by around 4 percent when compared to Alternative I.1 if pedestrian underpasses were implemented.

Figure 129: Median Sidewalk Modification for I.1 Access and Spot Improvements

The table below provides a summary of key criteria that should be considered when determining the ultimate configuration for accommodating non-motorized users at the interchange:

Table 47: Key Considerations for Non-Motorized Users at the US 2 Interchange

Sub-Option	Pedestrian Comfort	Pedestrian Utilization	Traffic Operations Impacts	Cost
Pedestrian Tunnel	High	Low	Low	High
Control Loop Ramps	High-Medium	High	Medium	Medium
Center Median Facility	Medium-Low	High	Low	Medium

I.2 Continuous T-Interchange

Description

Alternative I.2 has the following characteristics between 20th Avenue South and 28th Avenue South:

- Closes 22nd Avenue S (west approach of north ramps intersection)
- Access revision at 28th Avenue S to a ¾ access
- Adds bicycle and pedestrian facilities on the bridge
- Southbound traffic would only stop at the eastbound ramps and northbound traffic would only stop at the westbound ramps
- Movements from the ramps would merge with moving traffic.

Performance

Table 48: I.2 Performance

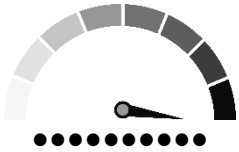
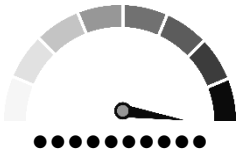
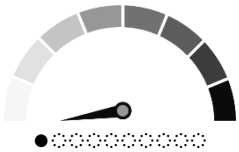
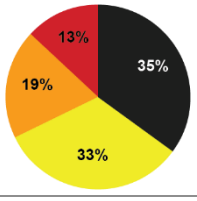
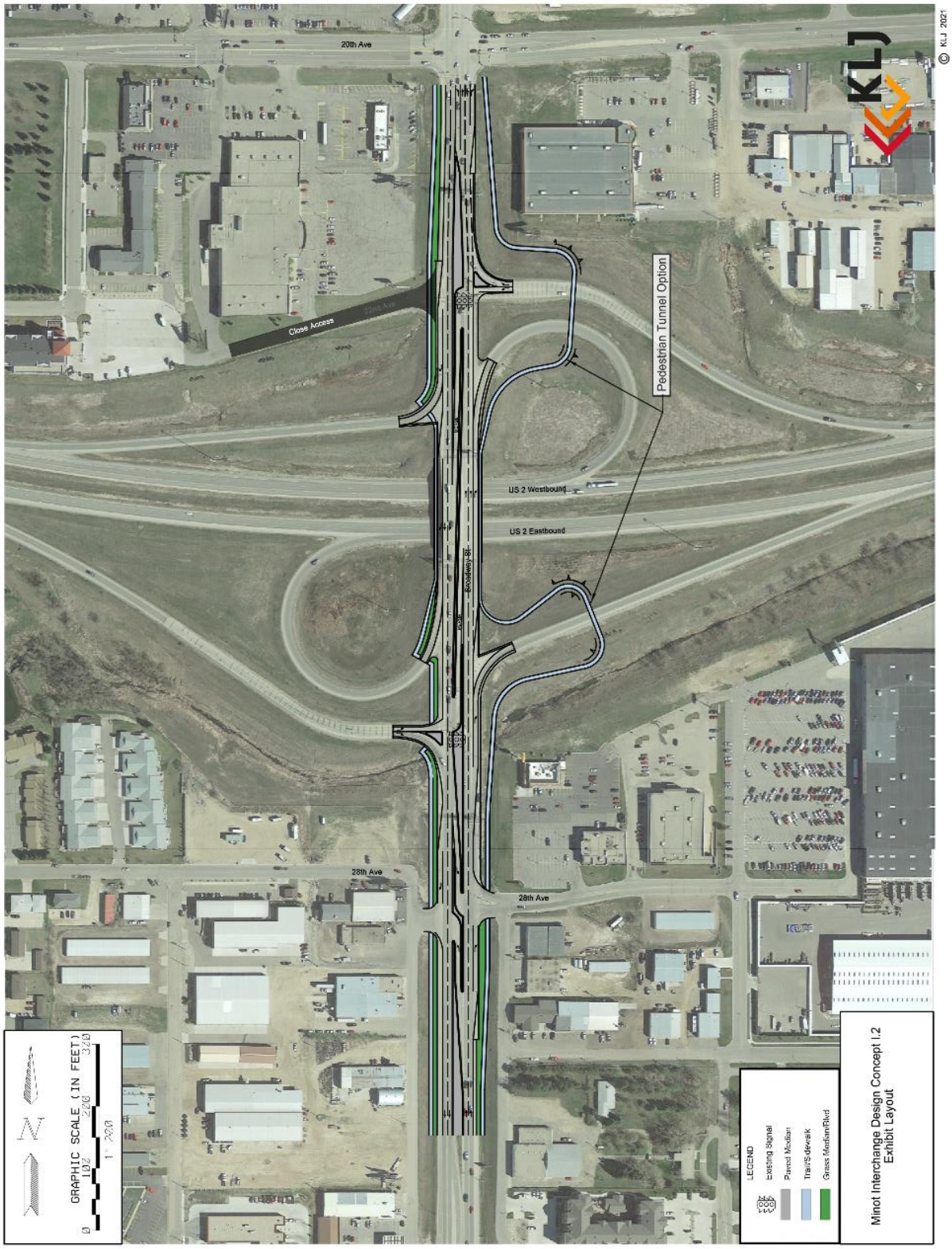
	Score	Weight	Key Factors
Vehicle Efficiency			» Signalized intersections continue to operate at LOS A » 7% reduction in daily delays per vehicle
Safety			» FHWA research shows angle crashes are significantly reduced with a continuous T configuration (around a 90% reduction) » Total crashes reduced around 50% » Modeled results showed a 13% total conflict reduction » Important to note this is an emerging treatment so data is limited
Livability			» Addition of a multi-use trail on the bridge provides a vital connection across US 2 » Adding pedestrian tunnels under the ramps would eliminate conflicts between vehicles and non-motorized users » Vehicle speeds could increase slightly because of less control for through movements on Broadway
Cost and Impacts			» Estimated project cost of $6.8 million to $7.9 million, depending on how pedestrian accommodations are implemented » This is an unconventional configuration and would require public outreach and education
Summary			» Improvements will provide a vital non-motorized connection across US 2 » Revisions are expected to reduce crash potential, especially angle crash potential

Figure 130: I.2 Continuous T Interchange



Summary of US 2 Interchange Alternatives

Both interchange improvement alternatives are expected to reduce crash potential and improve conditions for non-motorized users. Given the acceptable traffic operations at this interchange currently, wholesale operational changes are not specifically necessary. The primary focus of improvements should be how to improve pedestrian and bicycle crossings across the bridge. Both alternatives accomplish this goal, with the I.1 variations doing this more cost-effectively than I.2.

Table 49: US 2 Interchange Alternatives Summary

Alternative	Vehicle Efficiency	Safety	Livability	Cost and Impacts	Weighted Final Score
I.0 – Do Nothing	●●●●●●●●●○	●●●●●●●○○○	●○○○○○○○○○	●●●●●●●●●●	●●●●●●●○○○
I.1 - Access and Spot Improvements	●●●●●●●●●○	●●●●●●●●●●	●●●●●●●●●●	●●●○○○○○○○	●●●●●●●●●○
I.2 - Continuous T Interchange	●●●●●●●●●●	●●●●●●●●●●	●●●●●●●●●●	●○○○○○○○○○	●●●●●●●●●○

South Segment Alternatives

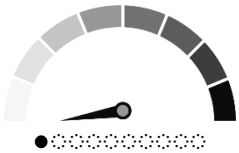
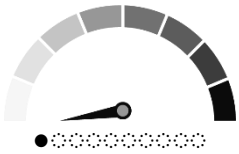
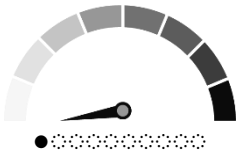
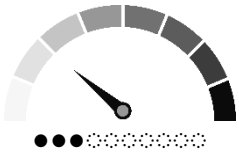
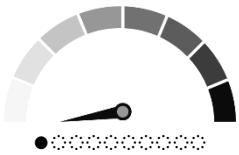
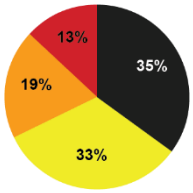
S.0 No Build

Description

Alternative S.0 would make no changes to the existing Broadway corridor between 28th Avenue S and 41st Avenue S.

Performance

Table 50: S.0 Performance

	Score	Weight	Key Factors
Vehicle Efficiency			» Peak hour LOS F at 31st Ave S (signal) » Side street LOS F at 40th Ave S and 28th Ave S (stop control)
Safety			» Intersection crashes at 40th Avenue S and 33rd Avenue S are above the critical crash rate » Rear end crashes and angle crashes are the majority of crashes » Serious injury crashes reported at 28th Avenue S, 31st Avenue S, 33rd Avenue S, 37th Avenue S, and 40th Avenue S
Livability			» No bicycle or pedestrian facilities » Vehicle travel speeds (around 43 mph) have around a 50% change in resulting in a fatality in the event of a pedestrian crash
Cost and Impacts			» Pavement conditions south of US 2 warrant pavement reconstruction or rehabilitation, therefore investments are required independent of other improvements
Summary			» Traffic operations and crash issues justify improvements » Corridor improvements present an opportunity to improve the non-motorized network by providing a vital connection to south Broadway

S.1 Widen Only

Description

Alternative S.1 has the following characteristics between 28th Avenue S and 41st Avenue S:

- Widens the corridor to a six-lane typical roadway section
- Converts unsignalized intersections to ¾ access
- Adds multi-use trails to each side of the corridor

Performance

Table 51: S.1 Performance

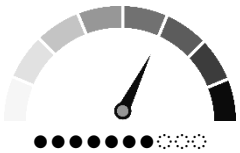
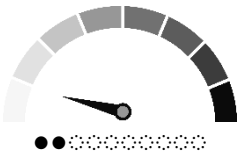
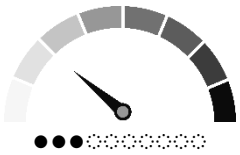
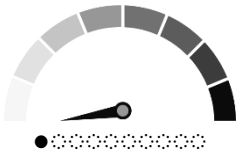
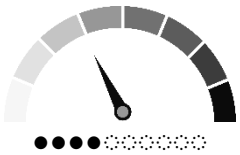
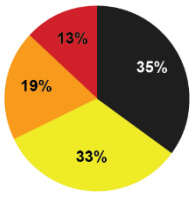
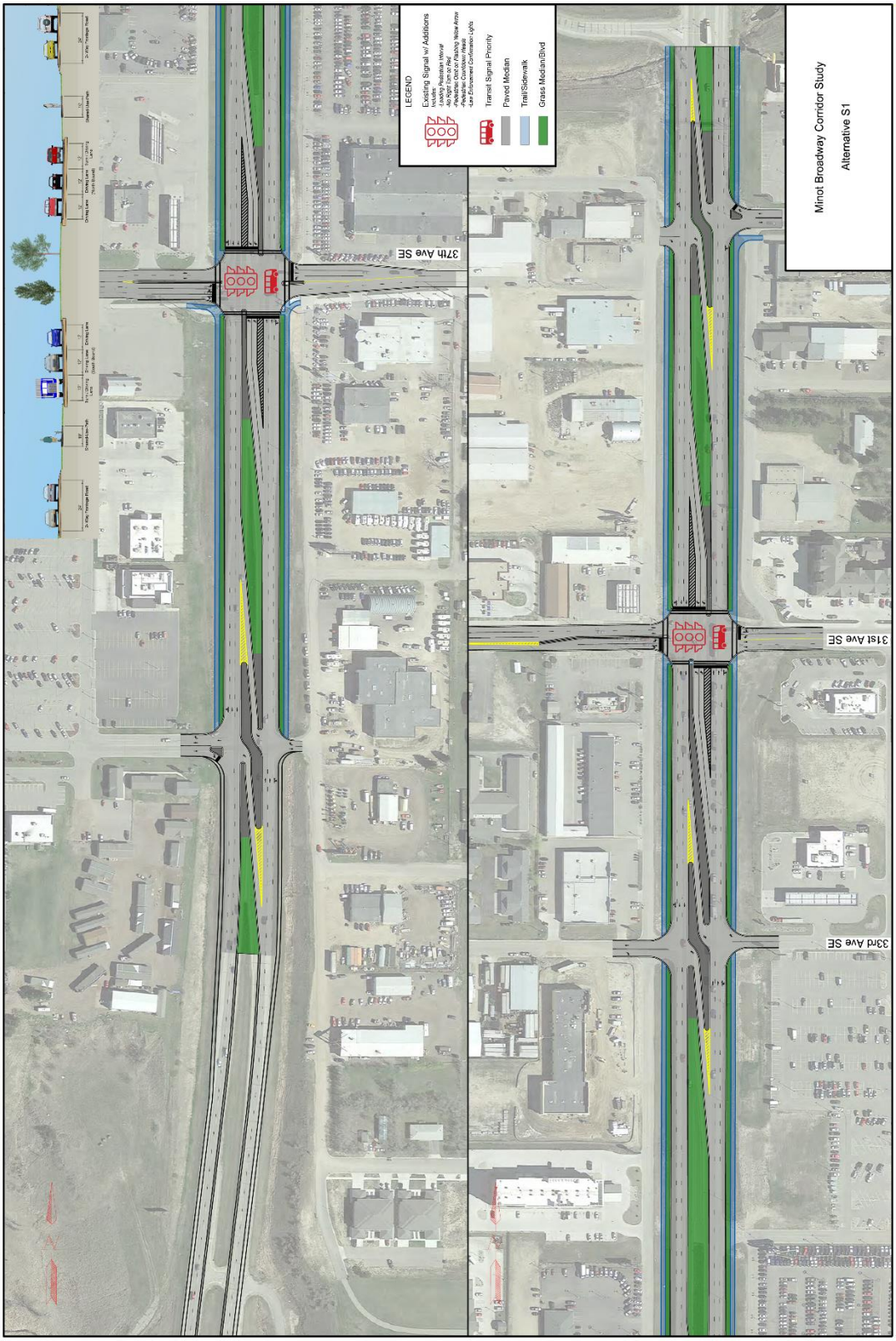
	Score	Weight	Key Factors
Vehicle Efficiency			» Improves operations to LOS C at signals » Side street LOS A at all stop-controlled intersections with ¾ access » Modest travel time increase for both the northbound and southbound directions, with a 20 second increase in each direction between 40th Avenue S and US 2 due to extra phases required at signals if double left turn lanes are present » 15% reduction in average delay per vehicle throughout the day, 20% delay reduction in PM peak
Safety			» At study intersections, weighted conflict analysis from simulation shows a 5% increase in weighted conflicts with rear-end conflicts reduced by 46% but crossing conflicts increased by 64% » Throughout the entire south segment, access revisions reduce conflict points by 24% » Wider roadway section will likely increase traffic speeds, especially during off-peak time periods
Livability			» Addition of multi-use trail combined with access revisions will benefit non-motorized users » Added vehicle lanes increase pedestrian crossing exposure, but refuge from raised medians mitigates this » Wider roadway section will likely result in higher traffic speeds, especially during off-peak time periods
Cost and Impacts			» Estimated project cost of $17.1 million
Summary			» Added vehicle capacity improves traffic operations at the expense of limiting benefits to non-motorized users » Non-motorized conditions are still however improved somewhat by the addition of trails

Figure 131: S.1 Widen Only



S.2 Median and Backage Roads

Description

Alternative S.2 has the following characteristics between 28th Avenue S and 41st Avenue S:

- Converts unsignalized intersections to ¾ accesses
- Creates a backage road network to mitigate impacts associated with access revisions
- Adds multi-use trails to each side of the corridor

Performance

Table 52: S.2 Performance

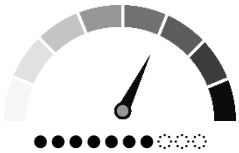
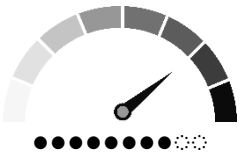
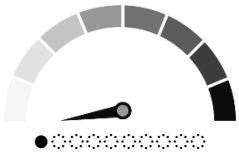
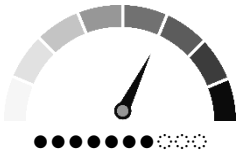
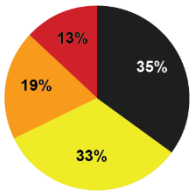
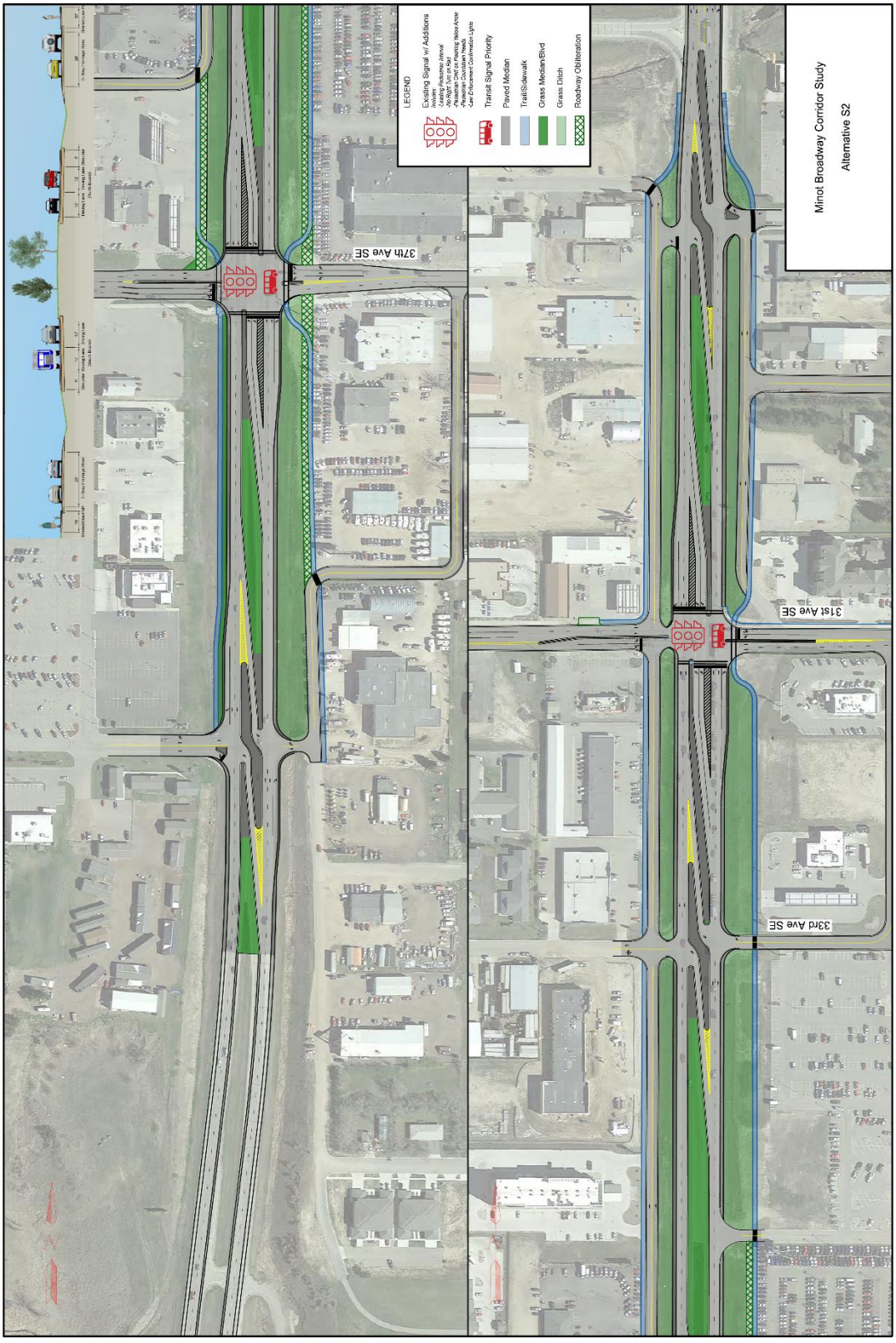
	Score	Weight	Key Factors
Vehicle Efficiency			» LOS D at signals; side street LOS acceptable at all stop-controlled intersections with ¾ access » Northbound travel time between 40th Avenue S and US 2 increases around 20 seconds; southbound travel time increases around 1 minute » Travel time increases are due to reallocation of cycle length across different phases but overall capacity improvements increase peak hour traffic speeds around 7% » 4% reduction in average delay per vehicle throughout the day, 12% delay reduction in PM peak
Safety			» At study intersections, weighted conflict analysis from simulation shows a 18% decrease in weighted conflicts with crossing conflicts decreased by 53% and rear-end conflicts reduced by 3% » Throughout the entire south segment, access revisions reduce conflict points by 48%
Livability			» Addition of multi-use trail combined with access revisions will benefit non-motorized users » Median provides a pedestrian refuge to improve pedestrian crossings » Vehicle speed increases are a result of improving deficiencies expected under future traffic conditions, bringing speeds closer to the expected speed rather than increasing them above what exists today
Cost and Impacts			» Estimated project cost of $17.3 million » Median will restrict some access to frontage roads, creating circuitous routes
Summary			» Improves traffic operations, reduces crash potential, and the non-motorized network

Figure 132: S.2 Median and Backage Roads



S.3 Roundabout Parkway

Description

Alternative S.3 would have the following characteristics between 28th Avenue S and 41st Avenue S:

- Multilane roundabouts at 31st Ave S and at 37th Ave S
- Adds one-way frontage roads to facilitate property access
- Stop-controlled intersections converted to ¾ access
- Adds multi-use trails to each side of the corridor

Performance

Table 53: S.3 Performance

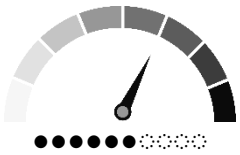
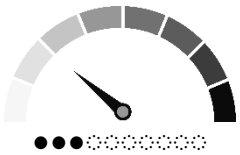
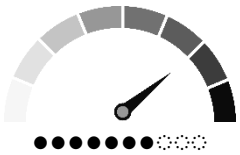
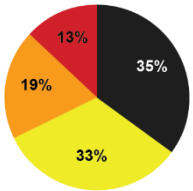
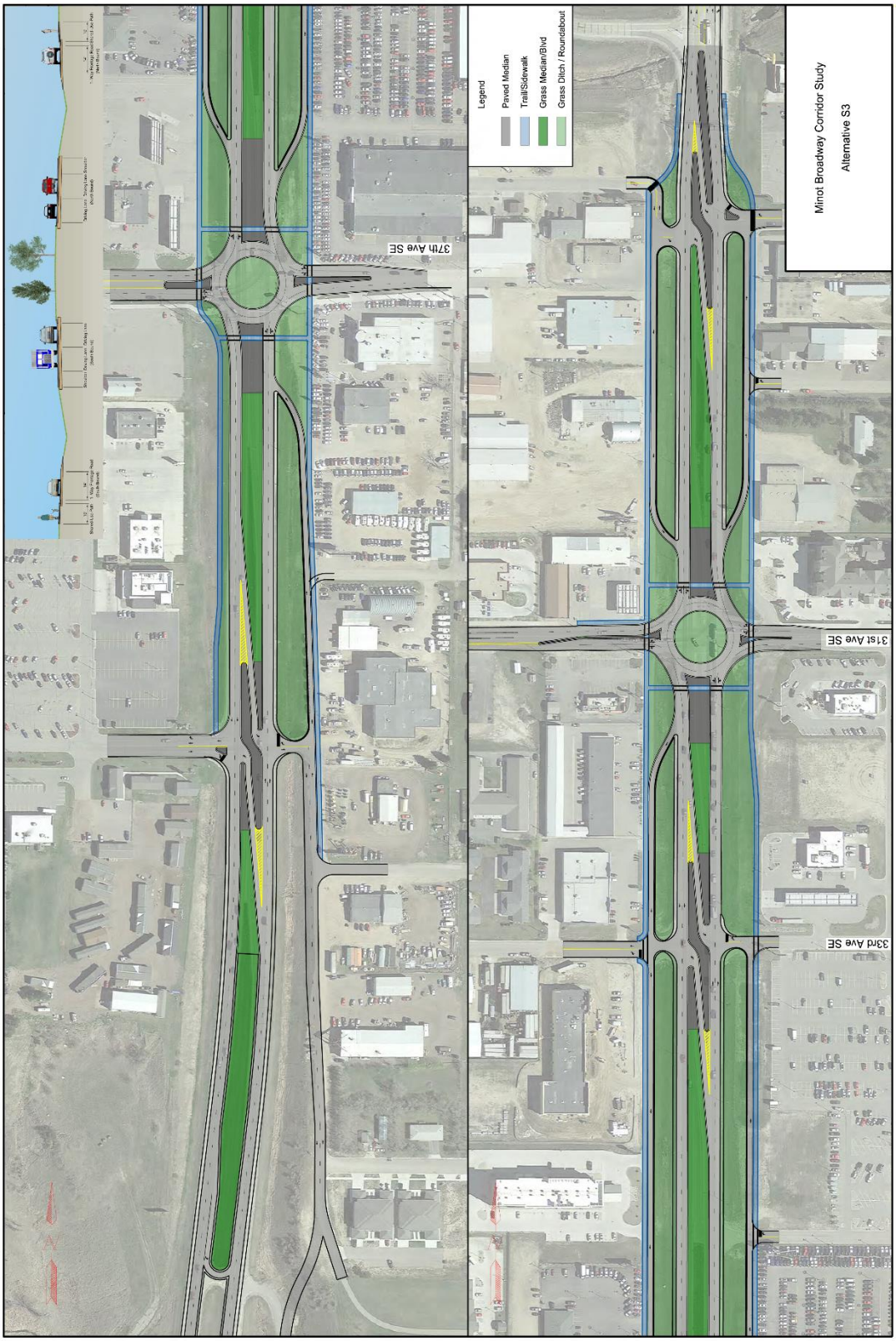
	Score	Weight	Key Factors
Vehicle Efficiency			» LOS D at 31st Avenue S roundabout and LOS B at 37th Ave S roundabout » Minimal changes in travel times between 40th Avenue S and US 2 » Side street LOS B at stop-controlled intersections » 8% increase in average delay per vehicle throughout the day, 5% delay increase in PM peak
Safety			» Weighted conflict analysis from traffic simulation shows an 8% decrease in conflict potential with crossing conflicts decreased by 91%, rear end conflicts increased by 11%, and merging conflicts increased by 617% » Throughout the entire south segment, access revisions and roundabouts reduce conflict points by 79% » Roundabouts are proven to reduce injury crashes due to the reduction in crossing conflicts, however multilane roundabout often result in an increase in sideswipe/merging-type crashes
Livability			» Addition of multi-use trail combined with access revisions will benefit non-motorized users » Median/splitter islands provides a pedestrian refuge to improve pedestrian crossings » Roundabouts will have a traffic calming effect
Cost and Impacts			» Estimated project cost of $13.9 million » One-way access roadway will change how properties are accessed but roundabouts provide logical U-turn opportunities to increase accessibility
Summary			» Improves safety and non-motorized conditions, but changes how properties are accessed, especially as a result of one-way frontage roads » Intersection LOS is improved, but overall delay increases slightly

Figure 133: S.3 Roundabout Parkway



S.4 Signalized Parkway

Description

Alternative S.4 would have the following characteristics between 28th Avenue S and 41st Avenue S:

- Maintains signals at 31st Avenue South and at 37th Avenue South
- Adds one-way frontage roads to facilitate property access
- Stop-controlled intersections converted to ¾ access
- Adds multi-use trails to each side of the corridor

Performance

Table 54: S.4 Performance

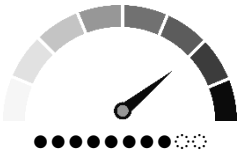
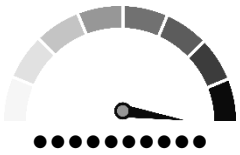
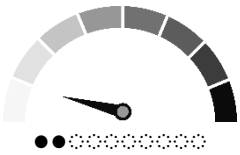
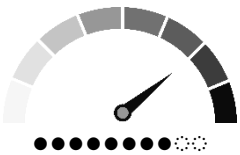
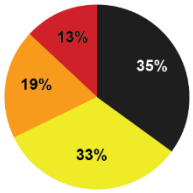
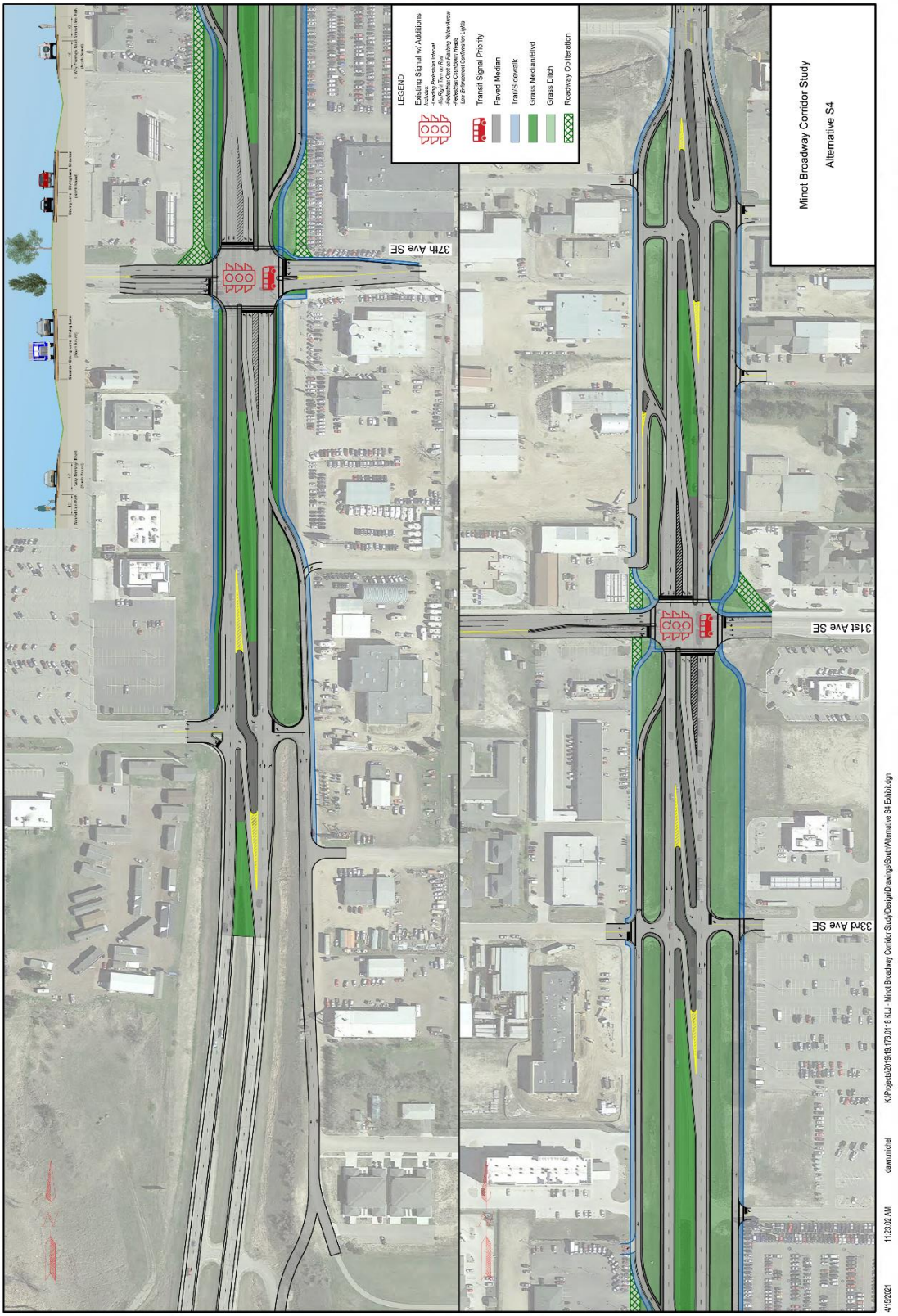
	Score	Weight	Key Factors
Vehicle Efficiency			» LOS D at 31st Avenue S and LOS C at 37th Avenue S » Northbound travel time between 40th Avenue S and US 2 increases around 20 seconds; southbound travel time between increases around 30 seconds » Travel time increases are due to reallocation of cycle length across different phases but overall capacity improvements increase peak hour traffic speeds by around 9% » 13% reduction in average delay per vehicle throughout the day, 20% delay reduction in PM peak
Safety			» Weighted conflict analysis from traffic simulation shows a 23% decrease in conflict potential with crossing conflicts decreased by 11% and rear-end conflicts decreased by 36% » Throughout the entire south segment, access revisions reduce conflict points by 63%
Livability			» Addition of multi-use trail combined with access revisions will benefit non-motorized users » Median provides a pedestrian refuge to improve pedestrian crossings
Cost and Impacts			» Estimated project cost of $14.5 million » One-way access roadways will change how properties are accessed
Summary			» Provides acceptable operations, improves safety, and improves the non-motorized network, but property access is changed with the one-way frontage road configuration

Figure 134: S.4 Signalized Parkway



S.5 Signalized Frontage Roads

Description

Alternative S.5 would have the following characteristics between 28th Avenue S and 41st Avenue S:

- Maintains signals at 31st Avenue South and at 37th Avenue South
- Expands frontage road network (two-way traffic) to facilitate property access
- Stop-controlled intersections converted to ¾ access
- Adds multi-use trails to each side of the corridor

Performance

Table 55: S.5 Performance

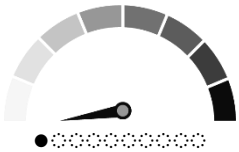
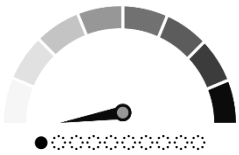
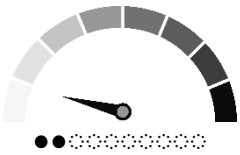
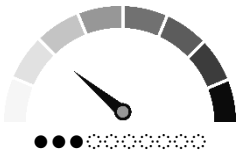
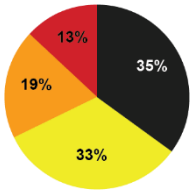
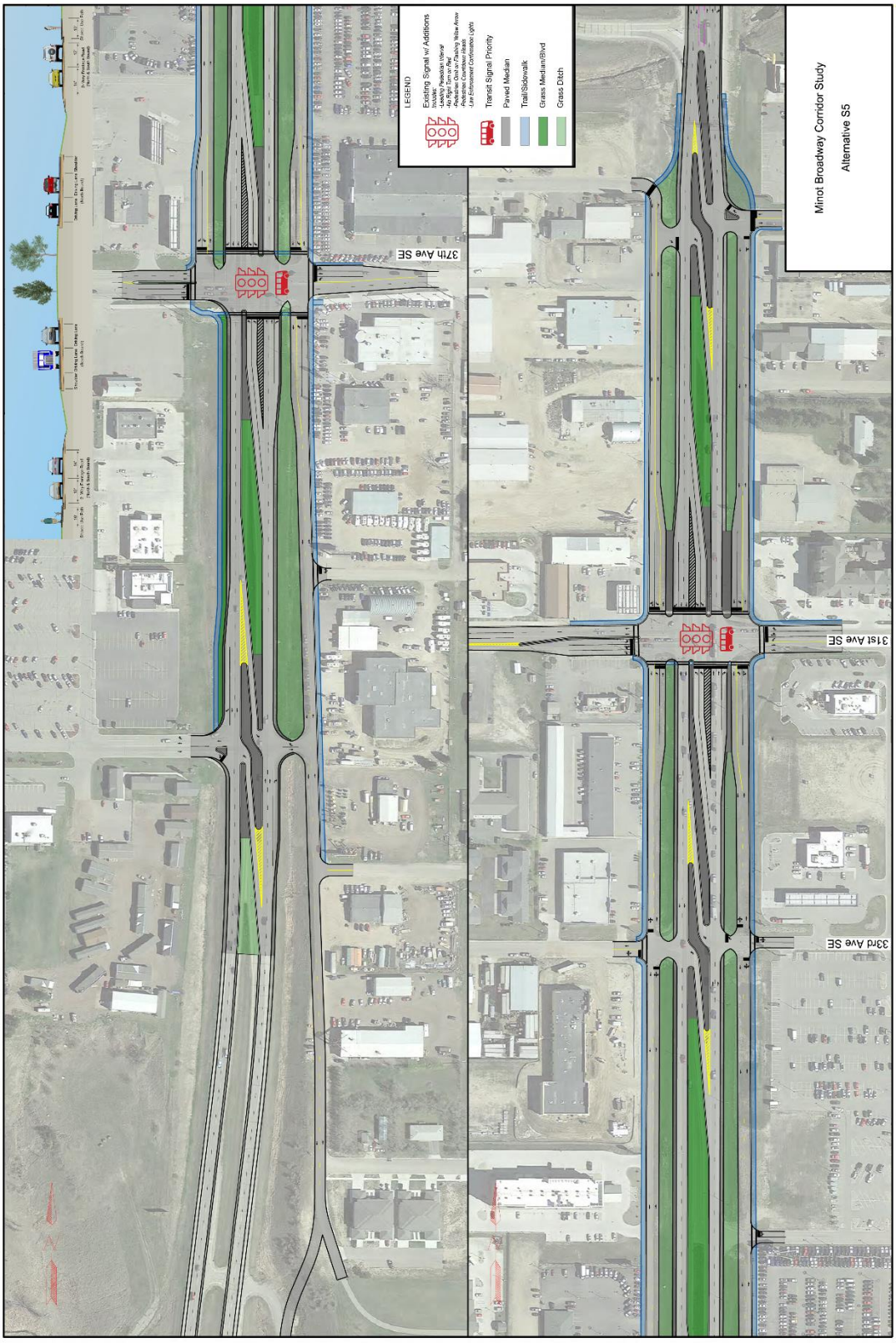
	Score	Weight	Key Factors
Vehicle Efficiency			» LOS F at 37th Avenue S (signal) and LOS E at 31st Avenue S (signal) » 8% increase in average delay per vehicle throughout the day, 44% delay increase in AM peak
Safety			» Weighted conflict analysis from simulation shows an 18% increase in conflict potential with crossing conflicts increased by 18% and rear-end conflicts increase by 11% » Throughout the entire south segment, access revisions reduce conflict points by 8% » Modest conflict resolution compared to other alternatives is a result of conflicts at frontage road intersections
Livability			» Addition of multi-use trail combined with access revisions will benefit non-motorized users » Median provides a pedestrian refuge to improve pedestrian crossings
Cost and Impacts			» Estimated project cost of $17 million
Summary			» No improvement to traffic flow or safety

Figure 135: Signalized Frontage Roads



Summary of South Segment Alternatives

Of the south segment alternative, the widening alternative and the signalized frontage roads alternatives both offer less overall benefits than the other alternatives under consideration. The signalized frontage road does not meet NDDOT LOS criteria, creating a fatal flaw and should be consideration for discarding. Widening appears necessary, with all the other alternatives achieving acceptable operations. The other alternatives all show considerable improvements to traffic flow, safety, and livability, with the signalized parkway alternative having the highest overall score. The parkway alternatives provide orderly flow, without undue conflicts at the frontage road access points. Bi-directional flow would be provided via U-turn capabilities at either traffic signals or roundabouts or use of existing backage roads. The one-way frontage roads may be perceived as an inconvenience to businesses, however the poor operations accessing 31st Avenue and 37th Avenue were found to be more impactful to business access in future conditions.

Table 56: South Segment Alternatives Summary

Alternative	Vehicle Efficiency	Safety	Livability	Cost and Impacts	Weighted Final Score
S.0 - Do Nothing	●○○○○○○○○○	●○○○○○○○○○	●○○○○○○○○○	●●●○○○○○○○	●○○○○○○○○○
S.1 - Widen Only	●●●●●●●○○○	●●○○○○○○○○	●●●○○○○○○○	●○○○○○○○○○	●●●●○○○○○○
S.2 - Median and Backage Roads	●●●●●●●○○○	●●●●●●●●○○	●●●●●●●●●○	●○○○○○○○○○	●●●●●●●○○○
S.3 - Roundabout Parkway	●●●●●●○○○○	●●●●●●●●●○	●●●●●●●●●○	●●●○○○○○○○	●●●●●●●○○○
S.4 - Signalized Parkway	●●●●●●●●○○	●●●●●●●●●●	●●●●●●●●●○	●●○○○○○○○○	●●●●●●●●○○
S.5 - Signalized Frontage Roads	●○○○○○○○○○	●○○○○○○○○○	●●●●●●●●●○	●●○○○○○○○○	●●●○○○○○○○

Left Turn Treatments at Signals on South Broadway

Multiple options for left turn operations at signals exist on the south segment.

- For signalized intersections where widening was not considered, traffic modeling assumes that the single left turn lanes with protected/permitted left turn phasing were maintained along the corridor. Traffic simulation shows improved operations with a single left turn lane at signals with protected/permitted left turn phasing when compared to operations with double left turn lanes with protected-only left turn phasing.
- Where widening was considered, multi-lane protected-only left-turn phasing was utilized to meet NDDOT Traffic Operations Manual standards that factor in sight-distance and lane configuration.

Concept drawings show double left turn lanes to show a conservative footprint. This approach was taken to provide flexibility with operations moving into the future. This would allow for the second left-turn lane to be operational whenever queueing becomes an issue or to combat worsened operations by converting to protected-only phasing due to safety concerns.

Recent NDDOT Traffic Operations Manual standards require that double left turn lanes in North Dakota have been operated with protected only left turn phasing. With flashing yellow arrow left turn signal heads, research has found that protected/permitted double left turn phasing can operate safely if left turn lane offsets on opposing approaches do not obscure sight lines for opposing through vehicles. There are several locations in Fargo operating successful in this fashion and this design is common across the more urbanized areas in the region. Should NDDOT permit this type of operations, further operational and queuing benefits could be expected.

Table 57: Left Turn Phasing Benefits

Left-Turn Conditions	Traffic Operations	Queue Storage	Safety	NDDOT Compliance
Single Left-Turn with Protected/Permitted Phasing	Medium	Low	Medium – with proposed turn lane alignments	Compliant
Double Left-Turn with Protected Only Phasing	Low	Medium	High	Compliant
Double Left-Turn with Protected/Permitted Left-Turn Phasing	High	High	Medium – with proposed turn lane alignments	Non-Compliant but Not Uncommon In-State/Region

Corridor Wide Alternatives

Pedestrian Improvements

The alternatives discussed throughout the corridor all include opportunities to improve the pedestrian experience along the Broadway corridor. The pedestrian facilities and crossing enhancements for each segment are discussed below.

- New facilities north of 21st Avenue N and south of 20th Avenue S. Due to the existing development patterns north of 30th Avenue N, these facilities could likely come during a later phase.
- Pedestrian crossing enhancements at signalized intersections south of 20th Avenue N.
- Americans with Disabilities Act improvements in the middle segment at private driveways.

Figure 136 shows the general locations of these improvements.

Bicycle Facilities and Routing

Accommodating bicycle facilities on Broadway is challenging, especially north of 20th Avenue S, where vehicular traffic is high, access density is extreme, and right-of-way is limited. Adding bicycle facilities on Broadway would either require a road diet that results in significant vehicular delays or widening which results in significant costs and business impacts. For these reasons, alternative routing options were considered. The alternative bicycle routes are shown in Figure 137 and discussed below.

Before implementation, additional traffic analysis should be completed to verify lane widths, turn lane needs, parking occupancy, and other details that may affect the constructability of bicycle facilities along each route. Full-scale planning and design of other corridors is outside of the scope of this report. The goal of this analysis is to ensure the feasibility of proposed routing alternatives.

- ***North segment.*** Bicycle facility options on the north segment, 11th Avenue N to 46th Avenue N, is a mix of a trail on the west side of Broadway with the proposed build alternatives, and off-Broadway facilities.
- ***Middle segment.*** Bicycle facility options on the middle segment follow 8th Street on the west side of Broadway or on 3rd Street and 2nd Street on the east side of Broadway. Multiple routes were considered and studied. It is likely that only one of these routes would be necessary to accommodate bicycles to/from Broadway.
- ***South segment.*** Each of the build alternatives for Broadway south of 20th Avenue S include off-street dedicated pedestrian and bicycle facilities. No alternative routes were considered in this segment.

A summary of the potential alternative routing for bicycle facilities is shown in Table 58. The cost to implement both the west and east side is comparable and both connect to premier biking destinations. However, the west side has lower traffic volumes and facilities with better sight distance, while the east side has lower costs, fewer parking impacts, fewer barriers and located in a more bike facility barren area of the City. Ultimately, both sides are feasible and would be instrumental in creating a high-quality bicycle network through the core of the city. During the city's next comprehensive plan update, consideration should be given to how these routes fit into the larger multimodal network.

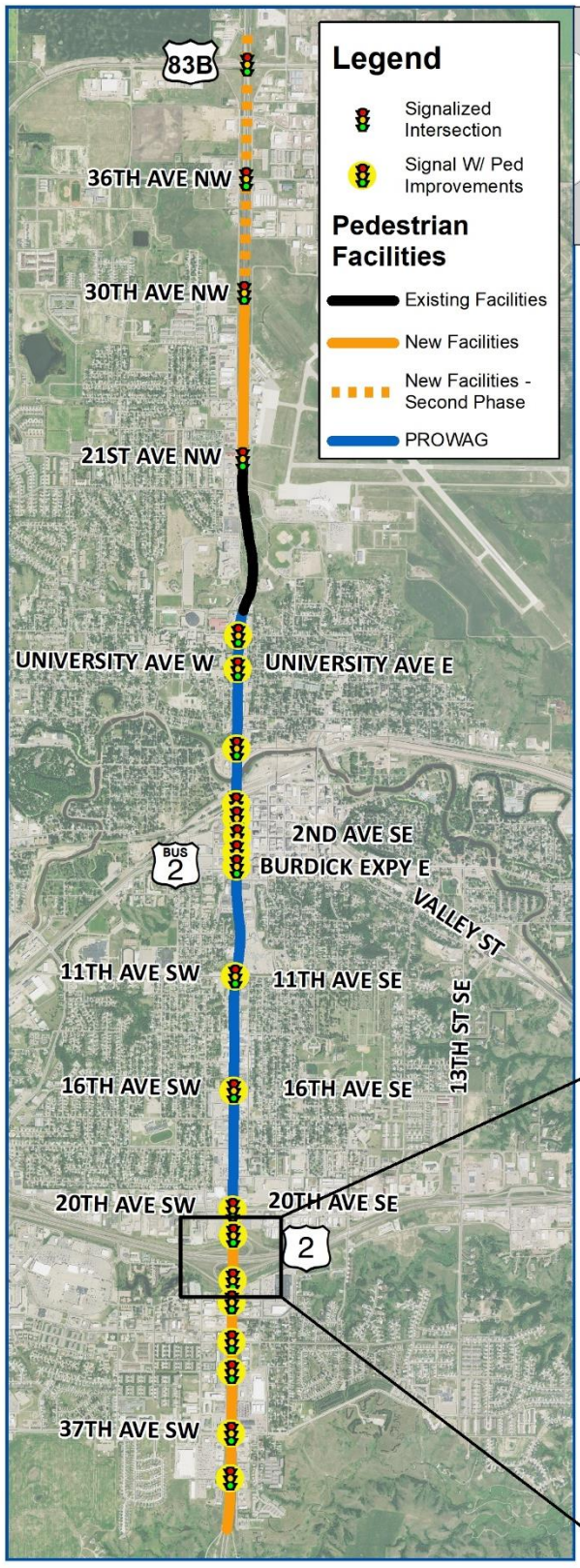
Table 58: Summary of Alternative Bicycle Facilities

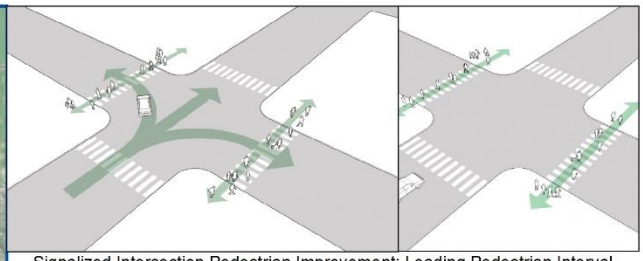
	West Side	East Side
Cost	**Neutral** $585,000	**Neutral** $560,000
Comfort	**Advantage** » Shared lanes on roadways ranging from 2,800 to 6,900 ADT » Bike lanes on roadways ranging from 2,000 to 7,500 ADT	**Disadvantage** » Bike lanes on roadways ranging from 2,600 to 3,300 ADT » Shared Use Path (SUP) in the areas where traffic increases above 8,000 ADT. SUP are often less comfortable for bikers when conflicting with driveways, especially when only on one side of the road. Nearly 65% of bicycle-vehicle crashes on shared use paths occur when a cyclist is riding against the flow of traffic because drivers do not expect cyclists from both directions.
Parking Impacts	**Disadvantage** » 70 blocks of on-street parking potentially removed	**Advantage** » 41 blocks of on-street parking potentially removed
Barriers	**Disadvantage** » Busy crossings include 4th Street SW and 16th Avenue SW connection » Challenging connection under railroad underpass » Limited ROW due to cemetery south of 11th Avenue NW	**Advantage** » Busy crossings include Burdick Expressway and 16th Avenue SE » Challenging crossing at the Mouse River
Regional Benefits	**Disadvantage** » Between Broadway and planned facilities on 16th Street » Connects to Minot State University	**Advantage** » No planned facilities to the east » Connects to the heart of downtown

Additional Considerations

Many of the side streets the off-Broadway bicycle routes follow are low volume and unsignalized. However, when crossing Broadway, additional crossing improvements may be required, like lead bicycle interval (similar to lead pedestrian interval or LPI) or green paint across intersections to bring visibility. It is also possible to require bicycles cross Broadway using the pedestrian crosswalk. By law, this would require bikers to dismount and walk their bike across the street. While inconvenient, it would ensure bikers would have the same benefits provided by the proposed pedestrian crossing enhancements discussed in the previous section.

Figure 136: Corridor Pedestrian Improvements

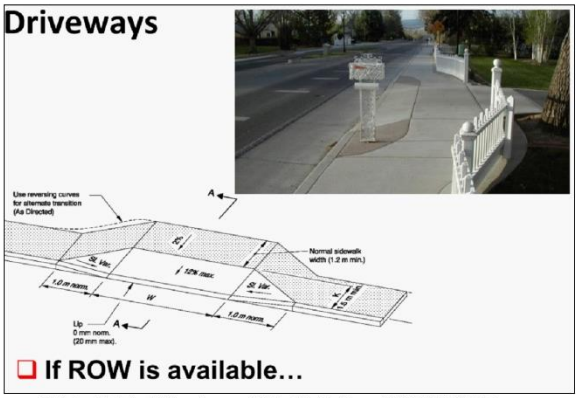




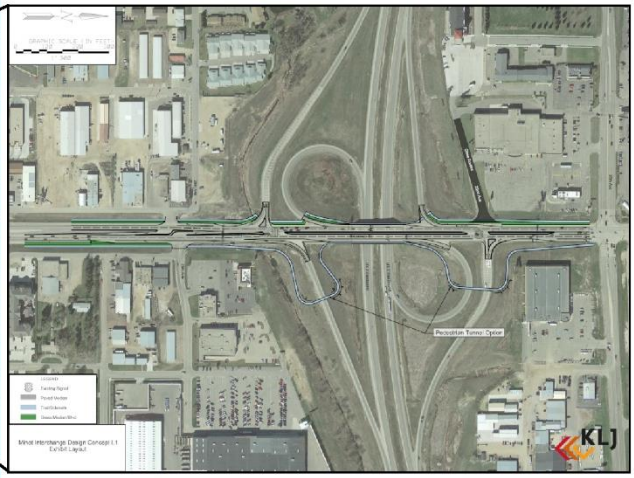
Signalized Intersection Pedestrian Improvement: Leading Pedestrian Interval

Signalized Intersection Pedestrian Improvement: Pedestrian Omit on Flashing Yellow Arrow

Signalized Intersection Pedestrian Improvement: No Right Turn on Red



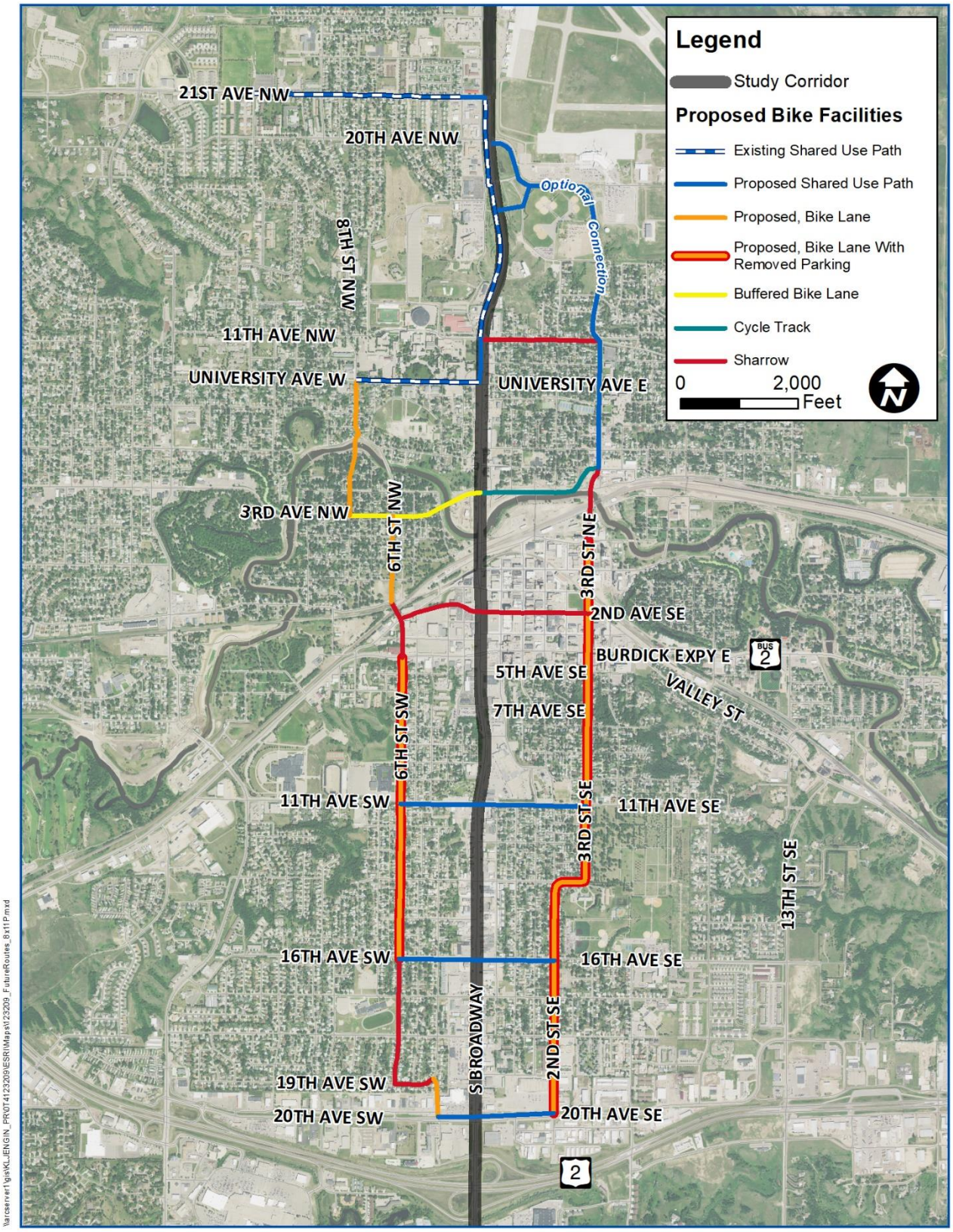
Public Right-of-Way Accessibility Guidelines (PROWAG) Driveways



1 of 3 Proposed Alternatives for Pedestrian Facilities at 2/52 Interchange

March 2021

Figure 137: Alternative Bicycle Routes and Facilities



March 2021

Transit

The Broadway corridor is an important one for Minot City Transit. Three routes run along the corridor and every route must cross the corridor to access the central transfer point at the Civic Auditorium. There are a series of transit improvements that could be considered for the Broadway corridor.

Transit Signal Priority

Transit signal priority (TSP) is a signal technology that can extend green lights or shorten red lights when transit vehicles are detected. This can be done system wide or at certain intersections where long cycle lengths cause delays that impact on-time performance. In areas of extreme congestion, TSP has been shown to increase overall transit travel speeds by 29 percent. If an intersection-level approach is preferred, the intersections of Broadway and Burdick Expressway and 20th Avenue S would likely be the most important intersections to address.

Improved Stop Facilities

Currently, the transit system operates as a flag stop system. This means a rider can hail the bus at any public street corner along a route. The 2013 Comprehensive System Analysis for Minot City Transit recommended a dedicated stop service on Broadway due to the challenges of boarding and alighting on the corridor given the high traffic volumes and speeds. If Minot City Transit moves to dedicated stop service on Broadway, improved stop facilities would be necessary. There is presently a covered shelter at 37th Avenue SW.

At a minimum, dedicated stops should be signed, with information on the route(s) that serve the stop and their time tables. At locations where transfers are possible or ridership is significant to the system, benches and shelters should be considered. Additional effort would be necessary to ensure access to these shelters were ADA compliant. Shelter locations might include University Avenue, 20th Avenue S and 31st Avenue S. Other locations may warrant shelters, but more information on ridership would be necessary to make a determination.

Downtown Transfer Center

The 2013 plan and the updated 5-year service plan both call for the construction of a downtown transfer center. Currently, Minot City Transit uses the Minot City Auditorium for its transfer points. A new transfer location building would provide adequate space for passenger waiting areas, restrooms, ticket vending machines, and a driver break room. This was anticipated to occur in 2021, however reduced revenue due to COVID-19 may delay the project. The preliminary site analysis found existing surface parking lots owned by Trinity Health would be the preferred location. Project development efforts should ensure the surrounding area is accessible by bicycle and by foot and incorporate high quality facilities for both.

Lighting

Street lighting exists along Broadway through the entire study corridor. Lighting is generally high-pressure sodium bulbs on the outside of the roadway. During construction projects, the following lighting improvements should be considered:

- Upgrade to LED lighting, which is more energy efficient than the existing lighting.
- Consider relocating outside of pedestrian access routes (sidewalks and trails) to ensure a minimum width of at least four feet. This may require relocating to medians where provided. The only location where space would allow is between 11th Avenue S and 20th Avenue S where the median is consistent and wide enough to support consistent lighting. In the other areas of the middle segment, individual ROW may need to be acquired to meet ADA standards.
- During project development, complete a lighting evaluation to identify areas of missing and deficient lighting.

Should lighting upgrades be desirable, they will be included in cost estimates in the Implementation Chapter.

Signal Improvements

The City of Minot is in process of upgrading signal cabinets, communications, and signal timing. Additional signal improvements that should be considered as signal replacements and upgrades occur are discussed below.

- Flashing Yellow Arrow. Green ball indications are no longer permitted over left turn lanes. Using flashing yellow arrow (FYA) has been found to reduce all crashes up to 25 percent and left turn crashes up to 37 percent. The City of Minot should seek opportunities to upgrade all signal heads on the corridor with FYA.
- Pedestrian Improvements. The pedestrian accommodations discussed throughout this report should be programmed for pedestrian actuation and located system wide. Where infrastructure is missing (countdown heads, pushbuttons), the city should program funds to update the signals.
    - Lead Pedestrian Interval
    - No Right-Turn on Red
    - POOFYA
    - Countdown Heads
    - Pushbuttons
- Emergency Vehicle Preemption and Transit Signal Priority. Currently only the city's fire department water tanker trucks utilize the emergency vehicle preemption (EVP). With the city upgrading to a central signal system in 2022, there is an opportunity to upgrade to a GPS based system or expand on the existing EVP system. This would tie into transit signal priority systems with a proper hierarchy established, fire above police above transit.
- Upgrade signal timing. The City of Minot is undertaking a city-wide signal timing upgrade. This work should be continued, along with regular maintenance plans to ensure signal timing remains current and appropriate for vehicle traffic trends and patterns.

Accommodating all the new signal features will likely cost around $65,000 per intersection, depending on the existing signal cabinet and components. Table 59 notes the existing signal components and the elements that would need to be added (FYA and no RTOR) or modified/replaced (countdown heads and push buttons) under the existing conditions. Depending on the alternative chosen these amounts may change due to changes in lane configurations and pedestrian facilities.

Table 59: Signal Components and Upgrades

	Existing Items/Facilities	New Countdown Heads	New Push Buttons	New FYA	New No RTOR
46th Avenue N*	» No pedestrian facilities. » All approaches have dedicated left turn lanes, but no dedicated left turn lane signal heads.			4	
36th Avenue N*	» No pedestrian facilities. » Existing FYA on eastbound and westbound approaches. » Three section left-turn protected-only head and phasing for northbound and southbound approaches.				
20th Avenue N	» Pedestrian countdown heads and pushbuttons for all approaches. » Three section left-turn protected-only head and phasing for northbound and southbound approaches. » Three section left-turn permitted-only head and phasing for eastbound and westbound approaches shared left/through lane » LED blankouts (No RTOR) for northbound and southbound approaches.				
11th Avenue N	» Pedestrian countdown heads and pushbuttons for all approaches. » Five section left-turn protected/permitted head and phasing for northbound and southbound approaches. » Three section left-turn permitted only head and phasing for eastbound and westbound approaches.			4	4
University Avenue	» Pedestrian countdown heads and pushbuttons for all approaches. » Five section left-turn protected/permitted head and phasing for northbound approach. » 3 section heads and yield sign for southbound, eastbound, and westbound.			4	4
6th Avenue N	» Pedestrian countdown heads and pushbuttons for all approaches. » Three section left-turn protected-only head and phasing for eastbound and westbound approaches. » Three section left-turn permitted-only head and phasing for northbound and southbound approaches.			4	4
4th Avenue N	» Pedestrian countdown heads and pushbuttons for all approaches. » Five section left-turn protected/permitted head and phasing for northbound approach. » Three section left-turn permitted-only head and phasing for southbound, eastbound, and westbound approaches.			4	3

	Existing Items/Facilities	New Countdown Heads	New Push Buttons	New FYA	New No RTOR
	» Southbound No RTOR				
Central Avenue	» Pedestrian countdown heads and pushbuttons for all approaches. » Five section left-turn protected/permitted head and phasing for southbound approach.	2	2	1	3
2nd Avenue S	» Pedestrian countdown heads and pushbuttons for all approaches. All pushbuttons located on signal standards. Relocate one per corner. » Three section left-turn permitted-only head and for all approaches.		4	4	4
Burdick Expressway	» Pedestrian countdown heads and pushbuttons for all approaches. » Five section left-turn protected/permitted head and phasing for northbound and southbound approaches. » Three section left-turn protected-only head and phasing for eastbound and westbound approaches.			2	4
11th Avenue S	» Pedestrian countdown heads and pushbuttons for all approaches. All corners would benefit from aligning pedestrian heads with crossings. » Five section left-turn protected/permitted head and phasing for northbound and southbound approaches. » Three section left-turn permitted-only head and phasing for eastbound and westbound approaches	4	4	4	4
16th Avenue S	» Pedestrian countdown heads and pushbuttons for all approaches. » All approaches have one head far from the crossing and would be better to relocate. » Five section left-turn protected/permitted head and phasing for all approaches.	4	4	4	4
20th Avenue S*	» No pedestrian facilities. » Five section left-turn protected/permitted head and phasing for all approaches.	6	6	4	
US 2 North Ramps*	» No pedestrian facilities. » Three section left-turn permitted-only head and phasing for south approach.	4	4	2	
US 2 South Ramps*	» No pedestrian facilities. » No left turns.	2	2		
31st Avenue S*	» Pedestrian countdown heads and pushbuttons for North approach. » Five section left-turn protected/permitted head and phasing for northbound, southbound, and eastbound approaches.			2	1

	Existing Items/Facilities	New Countdown Heads	New Push Buttons	New FYA	New No RTOR
	» Three section left-turn permitted-only head and phasing for westbound approach.				
37th Avenue S*	» No pedestrian facilities. » Five section left-turn protected/permitted head and phasing for northbound and southbound approaches. » Three section left-turn protected-only head and phasing for eastbound and westbound approaches.			2	

**These specific locations do not have pedestrian or bicycle amenities currently. As facilities are planned and constructed, pedestrian crossing amenities (push buttons and countdown timers) in the signal system will be required. The City could elect to install and set to zero until that time or wait to incorporate in the pedestrian amenities construction projects.*

PUBLIC INPUT MEETING #2: WHAT WE HEARD

After the technical review of possible improvement solutions was completed, the projects Steering Committee meeting and public engagement was completed to review, refine, and prioritize the improvements across the Broadway corridor.

KEY STAKEHOLDER ENGAGEMENT

The Broadway Corridor Study is guided by a set of key stakeholders through the Study's Steering Committee. Members of the committee represent the City of Minot (Alderman, Engineering, Transit), the Minot Area Development Corporation, and the North Dakota Department of Transportation (Minot District and Local Government Division). As part of alternative review process, the committee was asked to rank each alternative, refining and discarding where appropriate. Below is a summary of each segment's alternative ranking and discussion.

South Segment

Five build alternatives were presented to the Steering Committee for the south segment (28th Avenue S to 41st Avenue S): widen only, median and backage roads, roundabout parkway, signalized parkway, and signalized frontage roads. The widen only and signalized frontage road alternatives were discarded due to poor operations and high cost. The Steering Committee preferred the signalized parkway, followed by the roundabout parkway and median and backage road concepts. The committee did acknowledge the frontage road changes may result in initial access challenges for businesses that would require owner communication and negotiations. Most of the committee (71 percent) believed improvements to this segment should be implemented as soon as feasible.

Figure 138: South Segment Steering Committee Alternative Ranking (1 is Best)

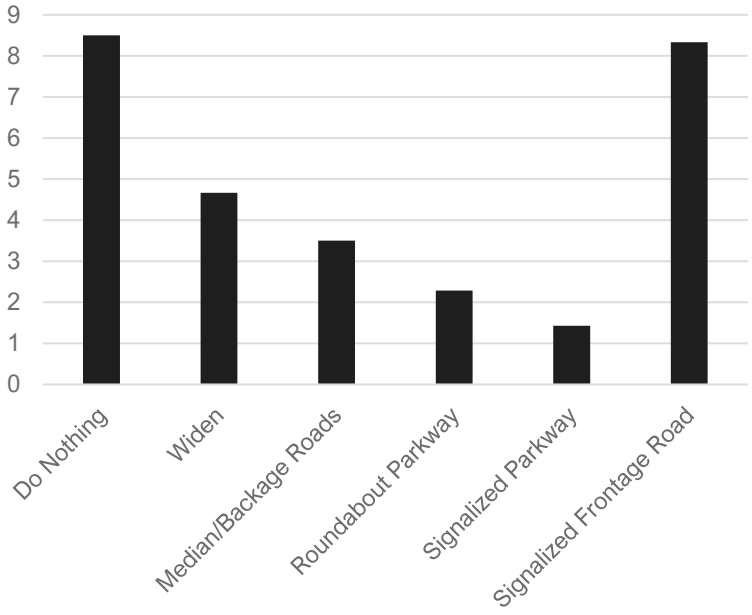
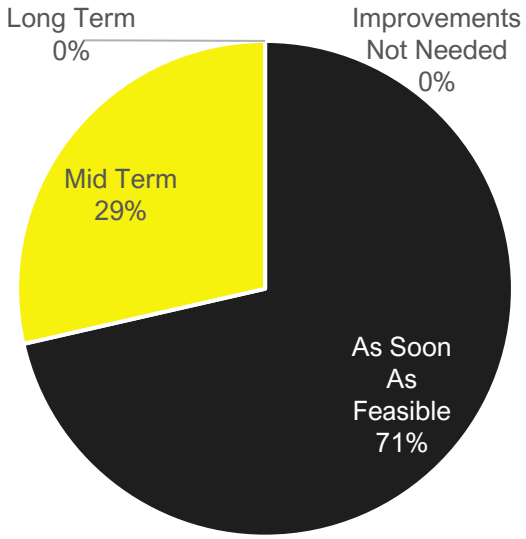


Figure 139: South Segment Steering Committee Implementation Priority



Interchange

Four build alternatives were presented to the Steering Committee for the interchange (20th Avenue S to 28th Avenue S): access and spot improvements with pedestrian tunnel, controlled loop ramps, access improvements with center median pedestrian path, and the continuous T interchange. The committee did not believe the center median pedestrian option was technically feasible due to winter maintenance challenges and uncomfortable for pedestrians, so was discarded from further consideration. The committee also had concerns regarding the cost and ADA grade compliance of pedestrian tunnels. Construction staging and implementation was also discussed as a challenge due to the cost of the south segment. Most committee members believed this project to be a mid term project.

Figure 140: Interchange Steering Committee Alternative Ranking (1 is Best)

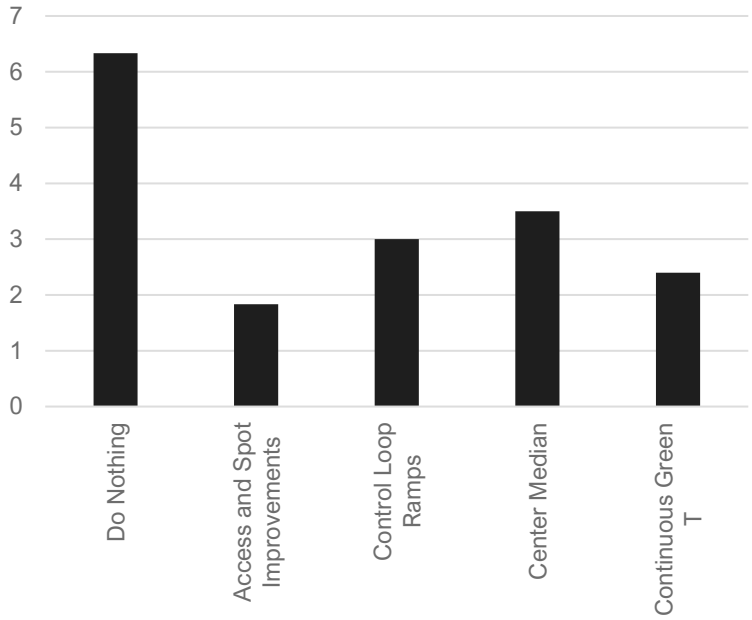
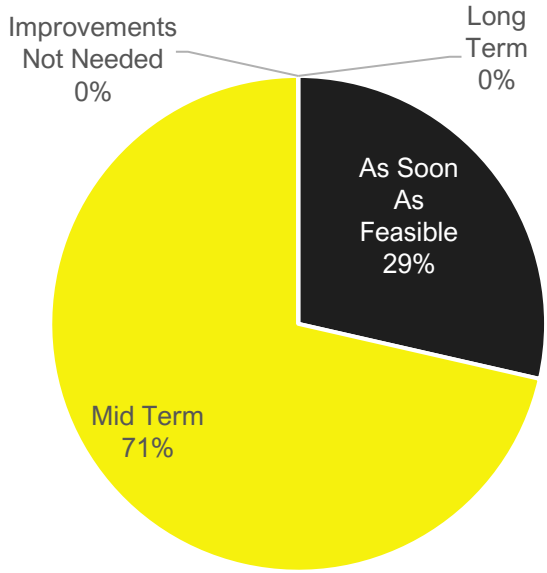


Figure 141: Interchange Steering Committee Implementation Priority



Commercial Segment

Three build alternatives were presented for the commercial segment (20th Avenue S to Burdick Expressway): low access management, moderate access management, and high access management. Members of the committee preferred the moderate and high access management alternatives because they included longer medians which are easier to maintain and felt that uncontrolled median openings of the low access management alternative would only lead to the same high crash rates and frustrating delays experienced along the corridor today. The low access management alternative was thus discarded. committee overwhelmingly believed this to be a mid term project.

Figure 142: Commercial Segment Steering Committee Alternative Ranking (1 is Best)

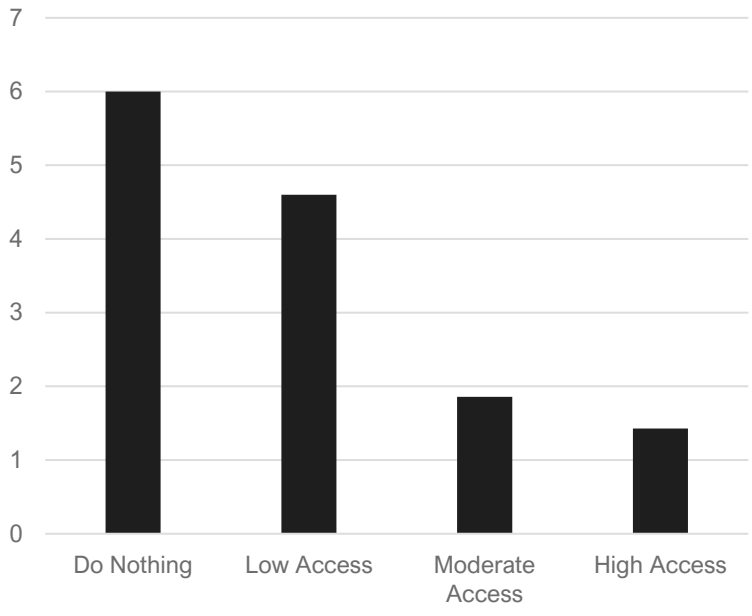
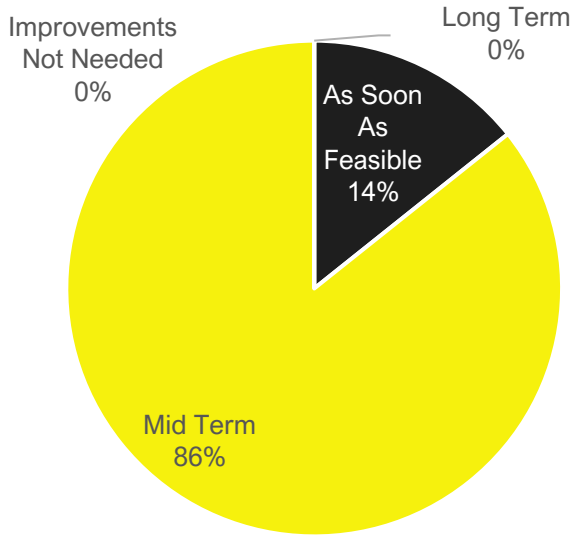


Figure 143: Commercial Segment Steering Committee Implementation Priority



Downtown Segment

Three build alternatives were presented for the downtown segment (Burdick Expressway to the Mouse River): low access management, moderate access management, and high access management. Members of the committee preferred the high access management alternative because it included longer medians which are easier to maintain. Modifications to the low access alternative were suggested and incorporated, including closing the 3rd Avenue and Western Avenue access points on the west side of Broadway. This provided similar safety benefits as the medians in the moderate access management alternative without the added cost. The moderate access management alternative was then discarded because the narrow medians were difficult to maintain during winter and several were designed in a manner that may not be as effective as intended. Much of the committee believed this to be a mid term project.

Figure 144: Downtown Segment Steering Committee Alternative Ranking (1 is Best)

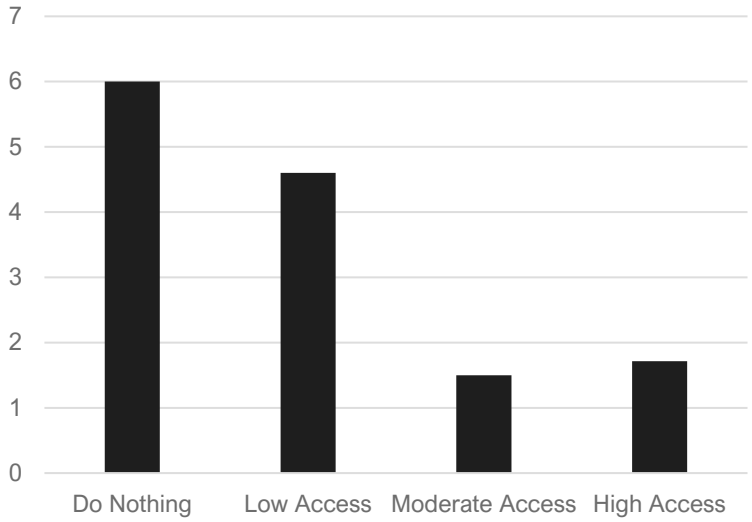
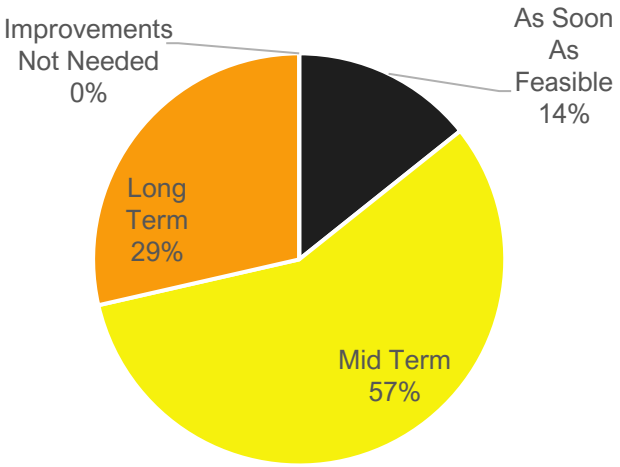


Figure 145: Downtown Segment Steering Committee Implementation Priority



Campus Segment

Two build alternatives were presented for the campus segment (Mouse River to 11th Avenue N): low access management and high access management. Members of the committee did not have a strong preference between the two alternatives and the committee was nearly split between this segment needing a mid term or long term project.

Figure 146: Campus Segment Steering Committee Alternative Ranking (1 is Best)

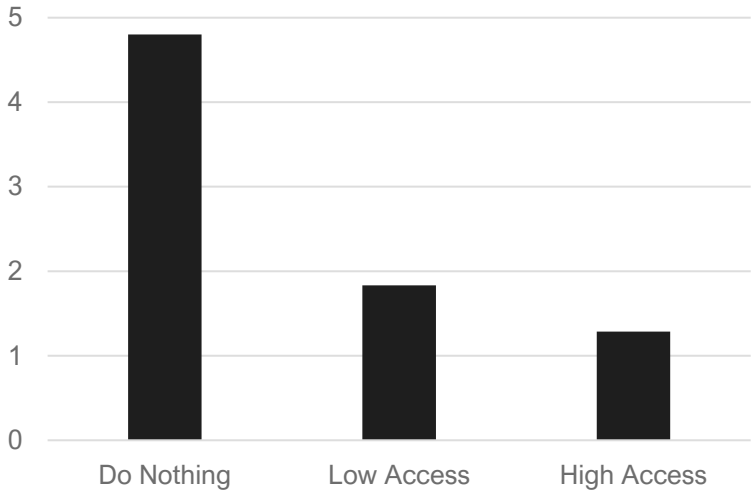
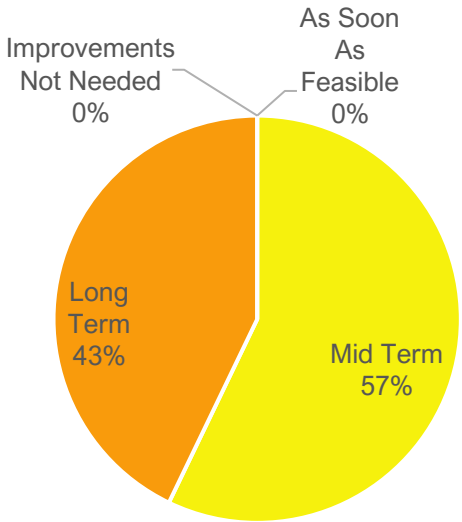


Figure 147: Campus Segment Steering Committee Implementation Priority



North Segment

Two build alternatives were presented for the north segment (11th Avenue N to 46th Avenue N): traffic signals and access control and roundabouts and restricted crossing U-turns. Members of the committee did not have a strong preference between the two alternatives, but the committee overwhelmingly believed this to be a long-term project.

Figure 148: Campus Segment Steering Committee Alternative Ranking (1 is Best)

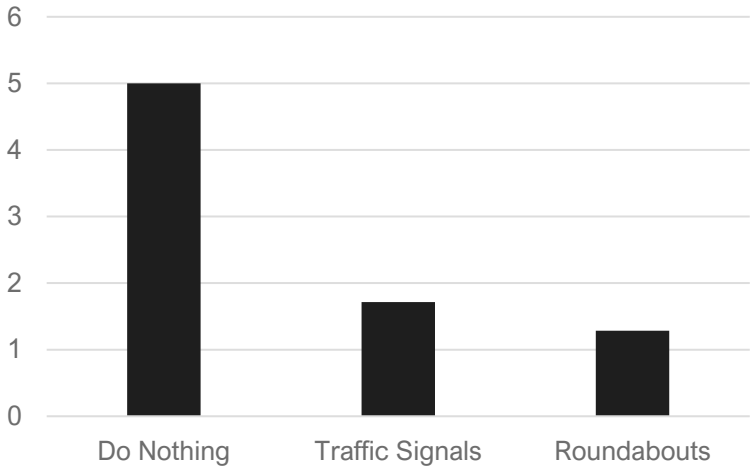
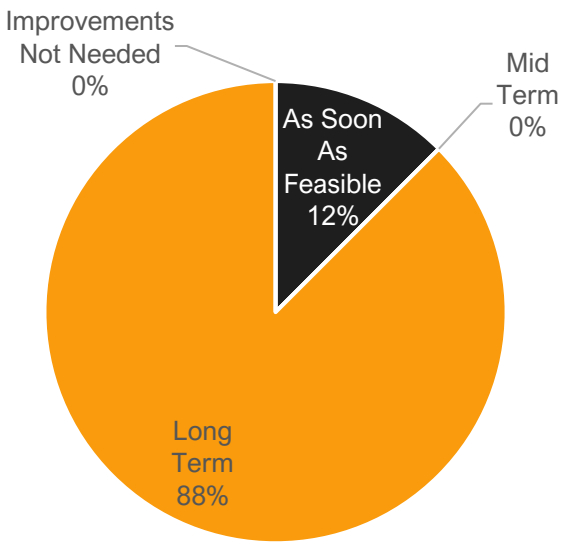


Figure 149: Campus Segment Steering Committee Implementation Priority



Public Engagement

The second public input meeting for the Broadway Corridor Study was entirely virtual on the project's website: www.movingbroadway.com. This virtual open house ran from April 19th to May 17th, 2021. On the website, the community could view alternatives summary videos, complete a survey, participate in a live Q&A, and provide written comments. Six focus groups were also held to gather feedback from specific key stakeholders.

The public input opportunity was marketed through a variety of means, relying heavily on the City of Minot's established communication channels:

- Postcards were sent to more than 5,000 properties within one-half mile of Broadway.
- A box ad was published in the Minot Daily News.
- A project newsletter was sent to key stakeholders and the City's email list.
- Multiple City of Minot Facebook posts between April 19th and May 17th, as well as an interview with the City's traffic engineer using Facebook Live and This Week Ahead video updates.
- A press release was published in the Minot Daily News as well as two additional articles on the input opportunities.
- Two updates to the Minot City Council
- A feature in Mayor Shaun Sipma's *Sincerely, City Hall* column

Figure 150: Rotating Digital Billboard

- Three rotating digital billboards near Hobby Lobby, Hardee's, and Minot Auto Center
- Minot Chamber of Commerce monthly newsletter

Ultimately, there were more than 900 unique users that visited the project website during the virtual open house. From these visitors, there were 288 views of the videos, 24 comments, and 133 completed surveys, 21 participants in the live Q&A, and 25 participants in the listening sessions. There are more details on the key elements of input opportunities provided below.

Figure 151: Facebook Post

Live Q&A with the Study Team

Due to COVID-19, virtual Q&As were held with the study team to provide an opportunity for the community to ask questions of the technical team, including the City of Minot, North Dakota Department of Transportation, and the consultant team. Two sessions were held. The first, for the southern segment (20th Avenue S to southern city limits) was held on May 5th from 12 noon to 1 PM and the second, for the middle and northern segments (20th Avenue S to northern city limits) was held on May 6th from 12 noon to 1 PM.

Ten people requested to participate in the south segment Q&A and 11 in the north and middle segments Q&A. Generally, questions focused on impacts to the frontage roads, bicycle and pedestrian facilities, and funding and implementation. The comments were overwhelmingly in-favor of improvements to the corridor. The meeting minutes are included in Appendix A.

Listening Sessions

Six listening sessions were held with key stakeholders identified by the project's Steering Committee. Each session was organized around specific key stakeholders including one for local government staff and officials (six participants), one for advocacy groups (two participants), and four for local businesses (17 participants). In total, 25 people participated.

Local Government	Local Businesses #1	Local Businesses #2
» Ron Merritt, Minot Parks » Shaun Sipma, Mayor, City of Minot » Steven Shirley, Minot State University » Dan Jonasson, City of Minot » Jason Sorenson, City of Minot » Brian Billingsley, Community Development Commission » Harold Stewart, City of Minot	» Kevin Harmon, Minot State University » Randy Schwan, Trinity Health » Paul Kramer, Ackerman Estvold » Ellen Knutson, Gate City Bank	» Roscoe Streyle, United Community Bank » Mike Uran, Trinity Health » Emily Mackner, Slumberland (and associates) » Wendy Keller, Magic City Discovery Center
Local Businesses #3	**Local Businesses #4**	**Advocacy Organizations**
» Dani Reichenberger, Buffalo Wild Wings » Kristen Boen, Signal Realty » Stephanie Schoenrock, Visit Minot » George Withus, Minot Area Community Land Trust	» Carleton Borden, Tomahawk District, Boy Scouts of America » Tim Vallely, Vallely Marine » Phyllis Burckhard, Minot SBS » Taylor Wilson, Trinity Health » Tim Mihalick, First Western Bank	» Roger Reich, Minot Commission on Aging » Scott Burlingame, Independence Inc.

During each focus group, the participants viewed a brief presentation of the corridor's issues and the alternatives. They were then asked which alternatives they prefer, and their priorities. A generalized summary for each segment is provided below.

South and Interchange Segments

Generally, participants were highly supportive of all the alternatives.

- Participants noted the safety benefits, the elimination of red light running, and efficiency of roundabouts but had concerns regarding pedestrian crossing, public acceptance, winter maintenance, and impacts to the Air Force Base's missile convoy routes.
- Participants who preferred the median/backage road concept and/or the signalized parkway concept believed they were a more appropriate design for Broadway.
- Many participants commented on the challenging merging maneuvers for the continuous T-interchange.
- Participants representing Slumberland voiced concern with closing 22nd Avenue S. Desired improvements to their access at 4th Street and 20th Avenue S and 20th Avenue S and Broadway if it were to occur.
- Everyone was highly supportive of pedestrian and bicycle facilities on both sides of the roadway. Most participants did not believe the tunnel option to be cost-effective. A few participants preferred the tunnel option because there were no vehicle conflict locations but had concerns about its maintenance.

Middle Segments

Generally, participants were highly supportive of access management alternatives, however support ranged from "get rid of as many turns as possible" to "keep as many as possible".

- Many participants already noted the difficulty with making lefts onto Broadway. One participant even noted that she knows "every possible route that does not include Broadway" when making her way between office locations.
- Multiple participants noted the poor quality of the existing backage roads and expressed concern for increased traffic on them.
- Many participants voiced concern for the impacts on businesses and suggested more engagement will be necessary with them as well as a public safety awareness campaign, connecting the crash rates to the access points.
- With the installation of the medians, participants saw opportunities to incorporate beautification and greenery.
- All participants supported bicycle facilities but differed on which side. Support for the west side alternative generally focused on connecting Minot State University students with downtown to connect with a future campus location while support on the east side generally focused on connecting neighborhoods to downtowns, schools, and parks. Many noted the value of investing in bicycle facilities as a workforce attraction tool.

North Segment

On the north side, there was less consensus on the alternatives. Participants who liked the roundabout concept did not like the RCUT's, citing difficulty making the quick merge movements in high traffic. Participants discussed the multitude of changes expected in the next decade (Magic City Discovery Center, second High School, new athletic facility, and general North Hill development pressures). Most participants cited the driver speeds but also requested clarity on the posted speed, which changes three times in the north segment.

Survey Responses

Eight surveys were made available for the second public input opportunity, one for each segment (south, interchange, commercial, downtown, campus, north), off-Broadway bicycle alternatives, and Title VI demographics survey. Each survey had between 14 and 21 completed responses.

South Segment

Nineteen responses were collected for the south segment. The parkway concepts were most popular, with 42 percent supporting the roundabouts. Participants also saw the value of implementation as soon as feasible (44 percent) or the mid-term (50 percent). I n addition to the survey responses, three comments were collected. Two supported the roundabouts with some concerns for access and side street delay; one did not think improvements on Broadway was a good investment.

Figure 152: South Segment Alternative Responses

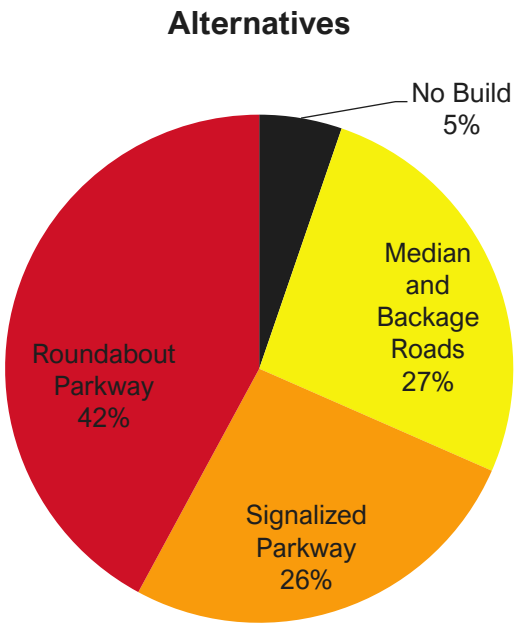
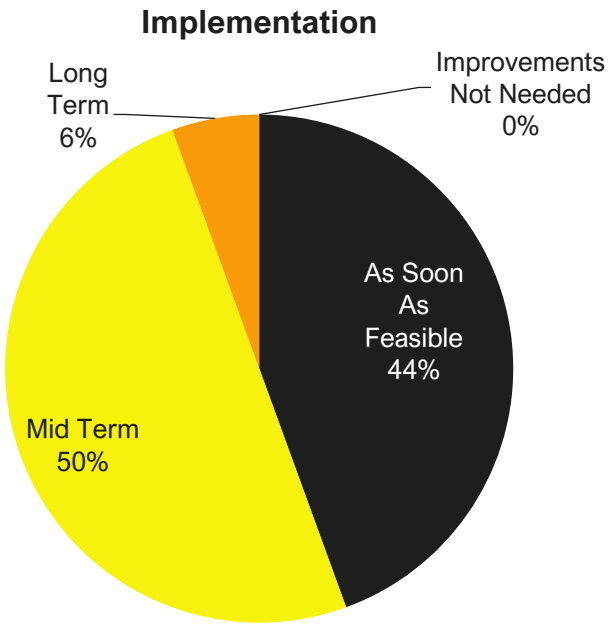


Figure 153: South Segment Implementation Responses



Interchange

Fourteen responses were collected for the interchange. The interchange improvements were split equally (Continuous T or Access Control), with more people preferring the at-grade options for pedestrians. Participants also saw the value of implementation as soon as feasible (46 percent) or the mid-term (46 percent). In addition to the survey responses, three comments were collected, noting support for pedestrian and bicycle improvements, and concern regarding the proposed closure of 22nd Avenue.

Figure 154: Interchange Alternative Responses

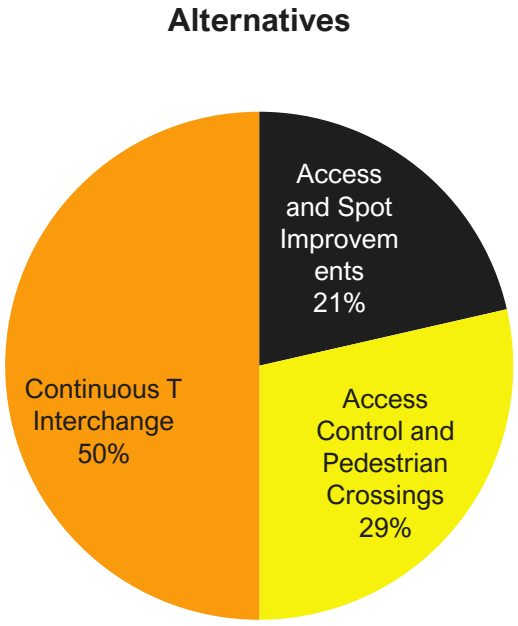
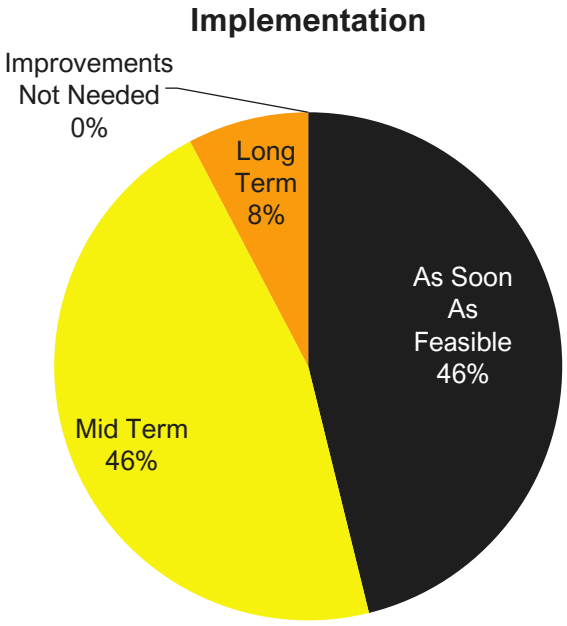


Figure 155: Interchange Implementation Responses



Commercial Segment

For the commercial segment, 21 responses were collected. All responses preferred a build alternative, with 52 percent preferring the moderate access management (3/4 access). Nearly 70 percent of respondents believed implementation should occur as soon as feasible. In addition to the survey responses, four comments were collected. Generally, these comments did not support adding additional traffic signals at 14th Avenue and 18th Avenue, concerns for the backage roads in their existing condition, and advocating for safer facilities for all modes of transportation.

Figure 156: Commercial Segment Alternative Responses

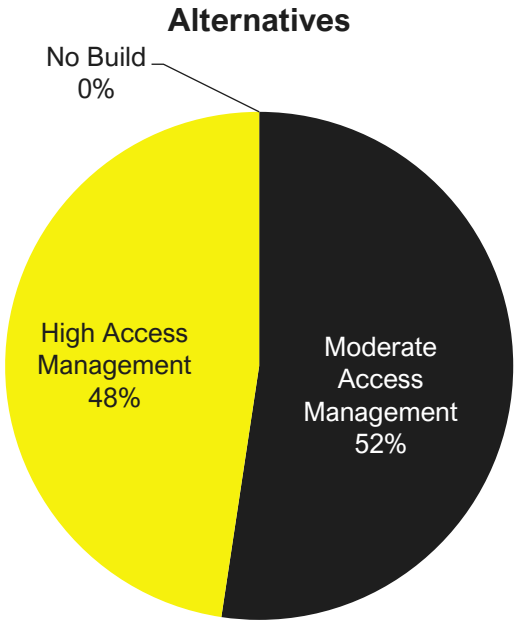
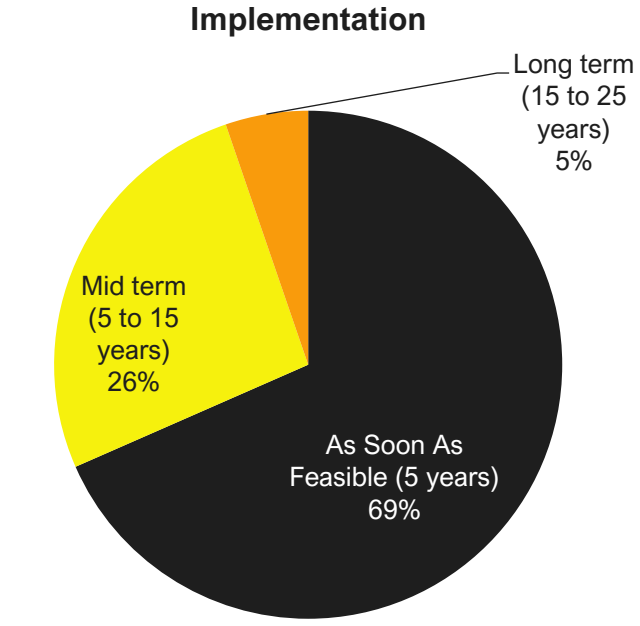


Figure 157: Commercial Segment Implementation Responses



Downtown Segment

or the downtown segment, 15 responses were collected. All responses preferred a build alternative, with 53 percent preferring the high access management (3/4 access). Sixty percent of respondents believed implementation should occur as soon as feasible. In addition to the survey responses, one comment was collected which including concern for the lack of left-turning off of Broadway in the alternatives.

Figure 158: Downtown Segment Alternative Responses

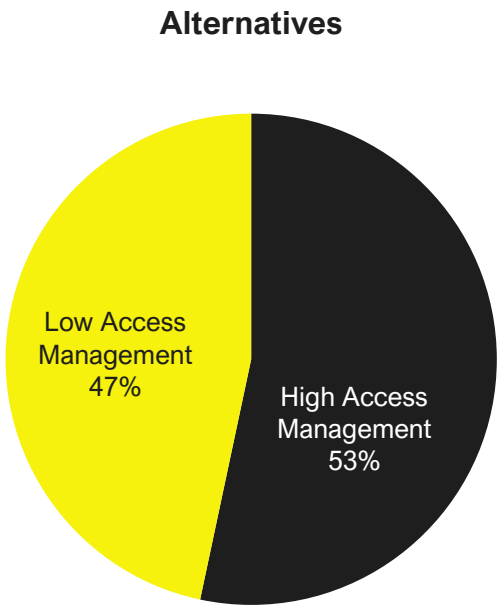
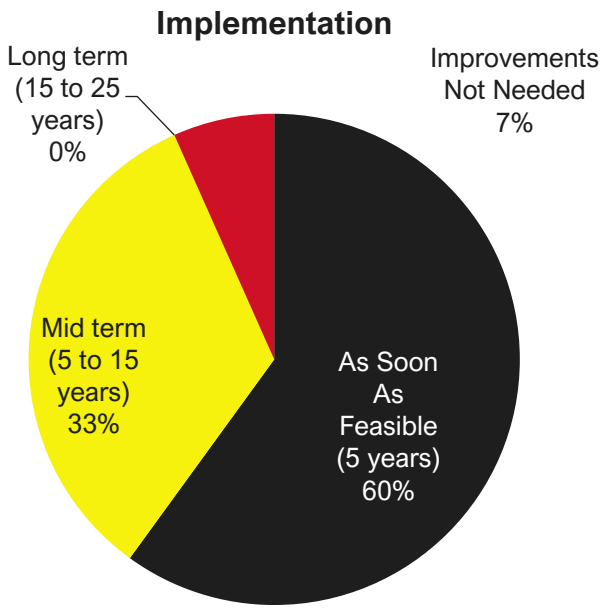


Figure 159: Downtown Segment Implementation Responses



Campus Segment

For the campus segment, 21 responses were collected. Most responses preferred some form of access management, with 67 percent supporting high access management and 19 percent supporting low access management. More than 40 percent of respondents believed implementation should occur as soon as feasible. In addition to the survey responses, four comments were collected, primarily advocating for safety improvements for all modes.

Figure 160: Campus Segment Alternative Responses

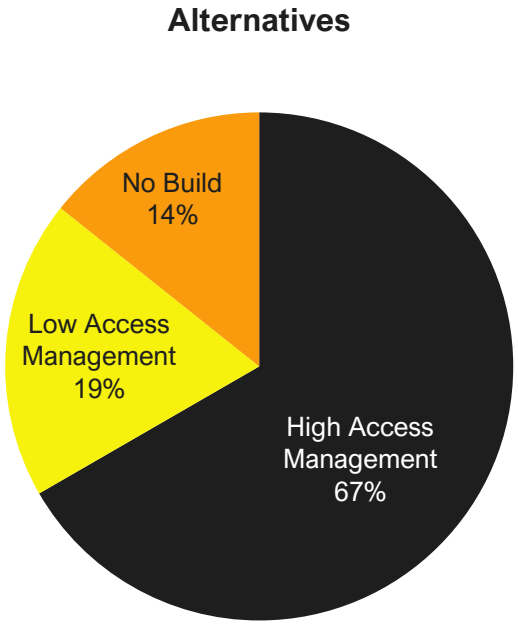
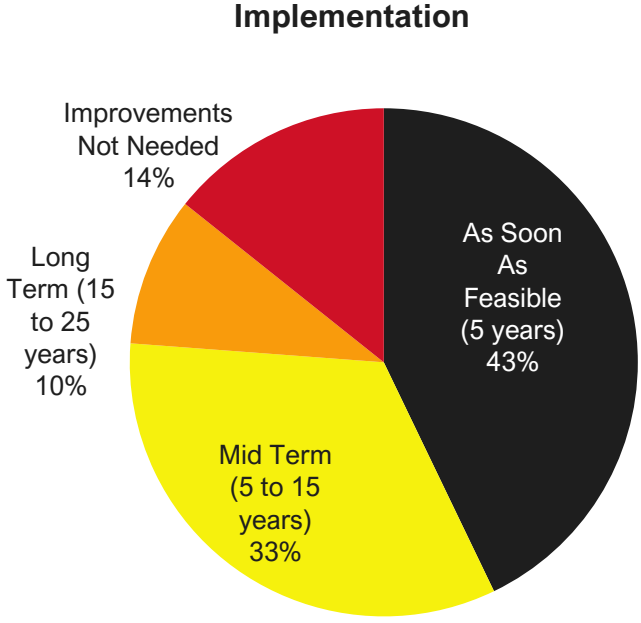


Figure 161: Campus Segment Implementation Responses



North Segment

For the north segment, 21 responses were collected. More than half of responses preferred the traffic signals and access revisions alternative. Nearly half of respondents believed implementation should occur in the mid-term. In addition to the survey responses, three comments were collected. One had concerns about the proposed roundabouts, one regarding traffic on the frontage roads, and one regarding speeding.

Figure 162: North Segment Alternative Responses

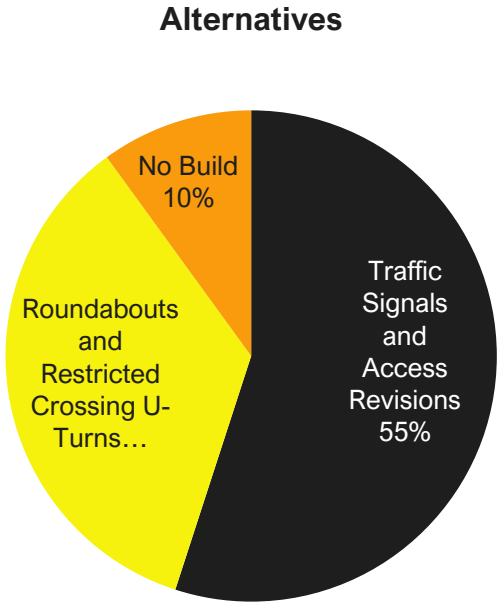
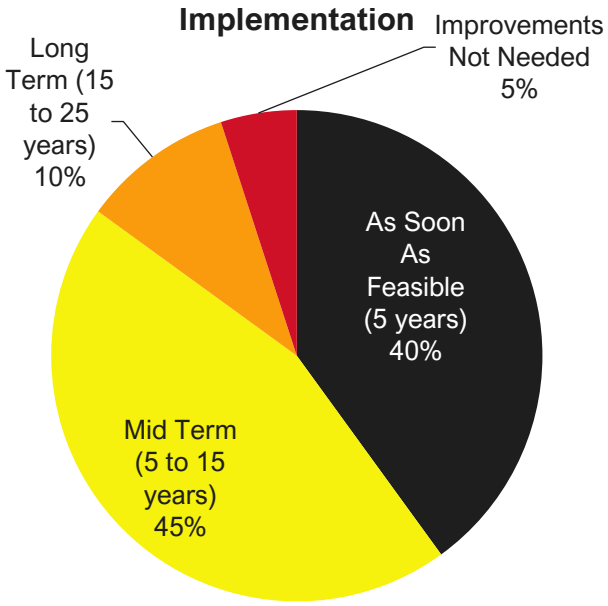


Figure 163: North Segment Implementation Responses



Bicycle Facilities

Sixteen responses were collected regarding the bicycle facilities. Respondents were highly supportive of building bicycle facilities, with 38 percent selecting facilities both east and west of Broadway, 25 percent selecting the east route, and 12 percent selecting the west route. More than half of respondents believed implementation should occur in the mid-term. In addition to the survey responses, three comments were collected. Three supported the bicycle facilities for various reasons, the other supporting the bicycle lanes but is concerned regarding the narrow streets and safely sharing the roadway with bicycles.

Figure 164: Bicycle Facilities Alternative Responses

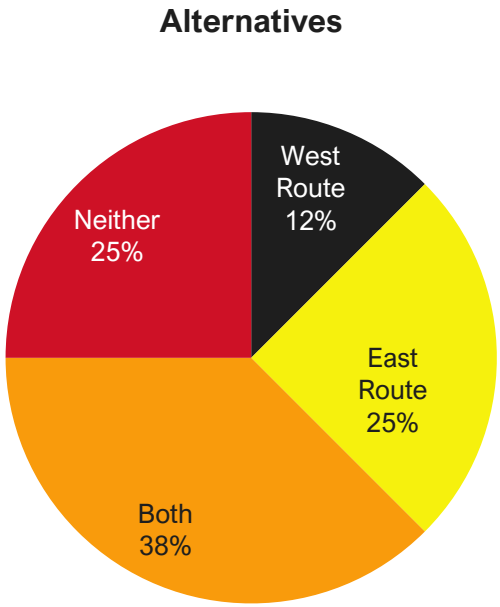
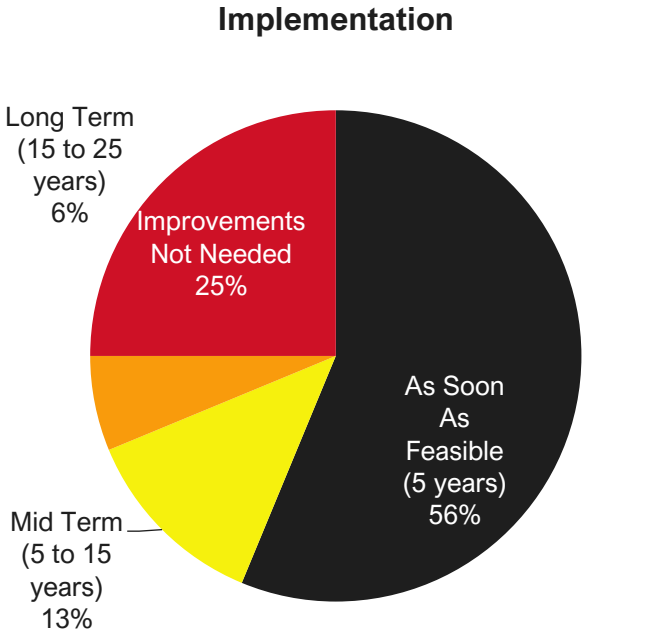


Figure 165: Bicycle Facilities Implementation Responses



Demographics Survey

The North Dakota Department of Transportation and its partners requests demographic information of public meeting participants to help inform its public engagement efforts and ensure compliance with Title VI/Non-discrimination requirements. Ten Title VI surveys were completed. Respondents nearly equally identified as male and female and were equally under 35 and over 35. All were white and all spoke English as their primary language. No respondents identified as having a disability or receiving public assistance.

Figure 166: Gender of Participants

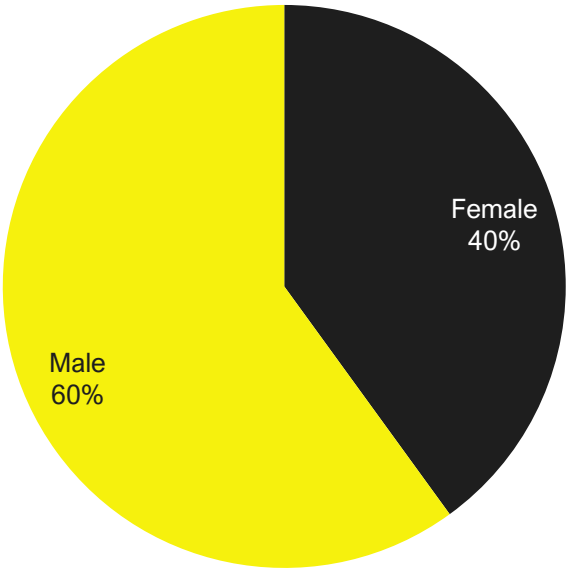
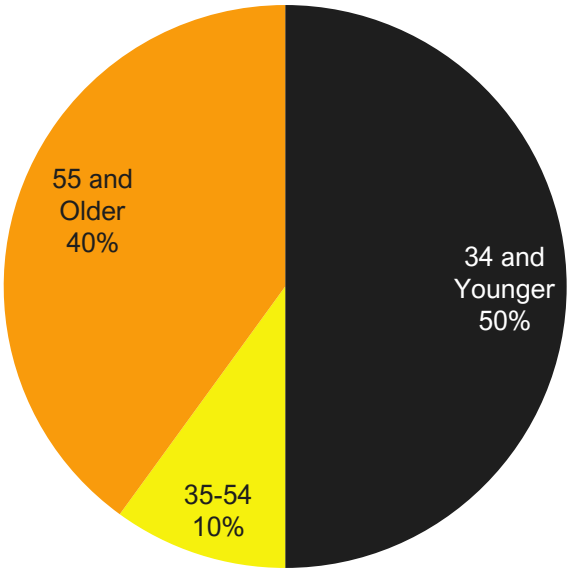


Figure 167: Age of Participants



Summary

Generally, the public was highly supportive of any alternative that improves the multimodal safety and traffic efficiency and would like to see most improvements done as soon as feasible. Depending on the alternatives that move forward, it will be imperative to develop key messaging highlighting the safety benefits for all users, driver education of new concepts (Continuous T or roundabouts), and constant communication with the business community throughout all phases of the projects so they can appropriately plan their activities and marketing.

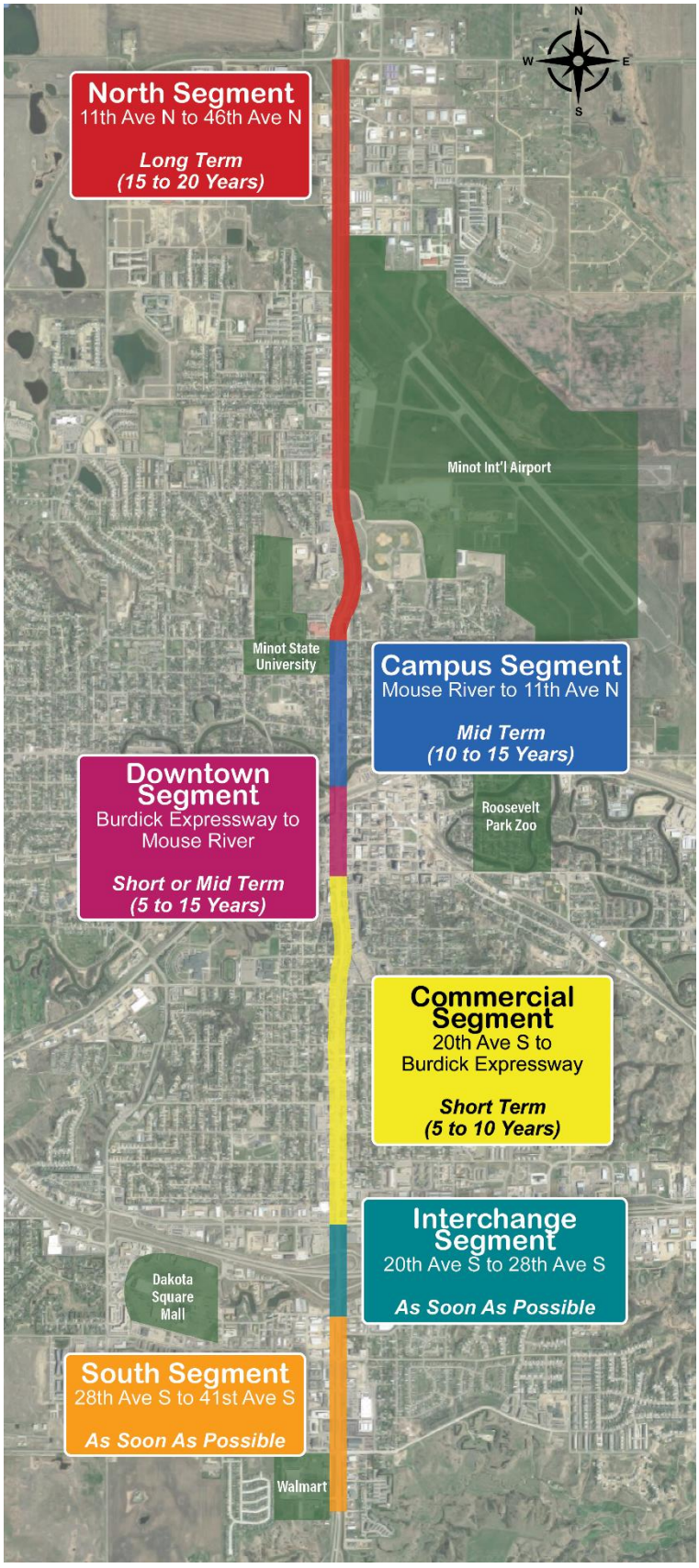
IMPLEMENTATION STRATEGY

Throughout the study process, the technical analysis and community feedback identified a significant number of needs along and parallel to the Broadway corridor. The alternatives analysis and community feedback then identified feasible and publicly supported alternatives. The significant number of needs comes with an equally significant level of funding required. The final element of the Broadway Corridor Study is developing an implementation strategy for the improvements identified for each segment of the corridor. For each segment, strategy summaries were developed, which include:

- The key issues for each segment.
- A summary of the alternative's technical performance, Steering Committee feedback, and public support.
- Timing (short, mid, and long term) needs, which considered the pavement conditions, safety needs, and available funding.
- Next steps to provide guidance to local and state agencies in advancing improvements from planning into project development.

Strategy summaries are provided on the next pages for the South Segment, Commercial Segment, Downtown Segment, Campus Segment, North Segment, bicycle facilities, and traffic signal improvements. The timing needs is summarized on Figure 168.

Figure 168: Implementation Timing Overview



BROADWAY CORRIDOR STUDY

SOUTH SEGMENT

28TH AVENUE S TO 41ST AVENUE S

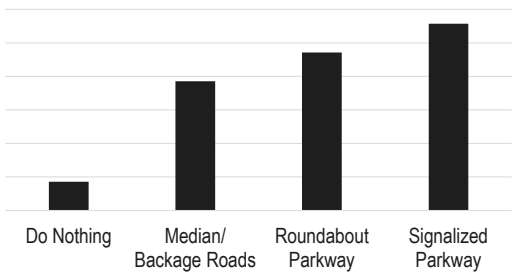
KEY ISSUES

Vehicles	Limited capacity at signalized intersections creates bottlenecks with deficient operations. Frontage road configurations provide limited queue storage, crash concerns, and access challenges.
Safety	High crash rates atat 31st Avenue S due to access management challenges and mainline queuing. High crash rates at 40th Avenue S due to challenges finding gaps in traffic.
Livability	No pedestrian or bicycle facilities on either side of Broadway. Limited transit service.
Other	Poor pavement conditions means a rehabilitation project is necessary in the short term.

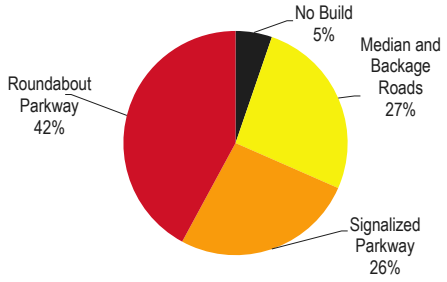
TECHNICAL SCORING

ALTERNATIVE	DO NOTHING	MEDIAN/ BACKAGE ROADS	ROUNDABOUT PARKWAY	SIGNALIZED PARKWAY
Vehicle Efficiency				
Safety				
Livability				
Cost & Impacts		$17.3 M	$14.4 M	$14.5 M
Overall Score				

COMMITTEE SUPPORT



PUBLIC SUPPORT



TIMING

Short Term

(Less than 5 Years)

Construction should occur as soon as funding is available. The combination of pavement needs, growth, safety, and multimodal needs move this to the top of the list.

NEXT STEPS

- Work with NDDOT to get project into the Statewide Transportation Improvement Program.
- Advance the Do Nothing, Signalized Parkway, and Roundabout Parkway concepts through the environmental documentation process.
- Advance and refine the aesthetics plan.
- Coordinate with businesses affected by frontage road changes.


Signalized Parkway
-20% peak hour daily
-23% in crash potential
Improved livability with shared use paths
Frontage road access points are relocated away from busy intersections to reduce conflict potential.
Expanded intersection capacity through new turn lanes improves traffic flow.


Roundabout Parkway
-5% corridor travel times
-8% in weighted conflicts
Improved livability with shared use paths and reduced speeds
Frontage road access points are relocated away from busy intersections to reduce conflict potential.
Roundabouts more easily facilitate u-turn maneuvers to/ from one-way frontage roads.

BROADWAY CORRIDOR STUDY

US 2 INTERCHANGE

20TH AVENUE S TO 28TH AVENUE S

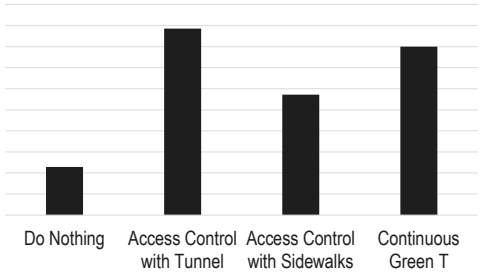
KEY ISSUES

Vehicles	Traffic operations are acceptable but closely spaced traffic signals can create friction.
Safety	High crash rates at 20th Avenue S. Access at 22nd Avenue creates conflicts and driver confusion.
Livability	No pedestrian or bicycle facilities on either side of Broadway. US 2 is a major multimodal barrier with few crossings throughout Minot. Limited transit service.
Other	Past efforts looked into adding additional lanes on the northeast off-ramp but concluded they could not be provided without property impacts.

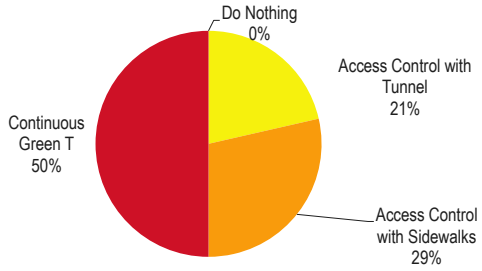
TECHNICAL SCORING

ALTERNATIVE	DO NOTHING	ACCESS CONTROL WITH TUNNEL	ACCESS CONTROL WITH SIDEWALKS	CONTINUOUS T INTERCHANGE
Vehicle Efficiency				
Safety				
Livability				
Cost & Impacts		$6.0 M	$4.9 M	$6.2 M
Overall Score				

COMMITTEE SUPPORT



PUBLIC SUPPORT



TIMING

Short Term

(Less than 5 Years)

Improvements to the interchange should be coordinated with the South segment to facilitate a continuous pedestrian/bicycle connection on Broadway.

NEXT STEPS

- Work with NDDOT to get project into the Statewide Transportation Improvement Program.
- Advance all concepts through the environmental documentation process.
- Continue to coordinate with Slumberland and other businesses impacted by the potential 22nd Avenue S closure.

BROADWAY CORRIDOR STUDY

COMMERCIAL SEGMENT

BURDICK EXPRESSWAY TO 20TH AVENUE S

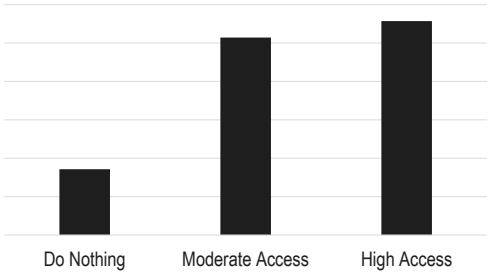
KEY ISSUES

Vehicles	Consistent traffic makes turning left on-to or off-of the corridor time-consuming, frustrating, and unsafe. Compounded signal delays increases perception of poor operations.
Safety	High crash rates due to uncontrolled driveways. Crash rate is 310% higher than other similar corridors.
Livability	Uncomfortable pedestrian facilities with ADA compliance issues. Challenging pedestrian crossings across the corridor. No dedicated bicycle facilities. Limited transit service.
Other	Right-of-way limitations and corridor goals moved bicycle improvements off of Broadway. Concepts are discussed later in chapter.

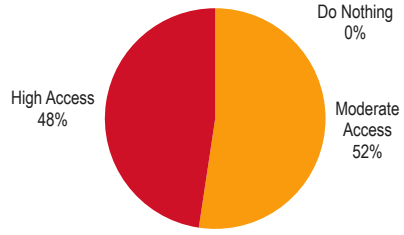
TECHNICAL SCORING

ALTERNATIVE	DO NOTHING	MODERATE ACCESS MANAGEMENT	HIGH ACCESS MANAGEMENT	
Vehicle Efficiency				
Safety				
Livability				
Cost & Impacts		$14.0 M	$13.4 M	
Overall Score				

COMMITTEE SUPPORT



PUBLIC SUPPORT



TIMING

Short Term

(5-10 Years)

Few corridors in the State have crash rates as high as this segment of Broadway. The available right-of-way means improvements can be constructed with limited impacts.

NEXT STEPS

- Review funding opportunities. Highway Safety Improvement Program or Transportation Alternatives funding may be available, but will not cover the full cost of improvements and are competitive applications.
- Advance concepts into project development activities as soon as funding is available.
- Maintain regular communication with businesses and property owners. Look for opportunities to remove/ consolidate accesses as redevelopment occurs.

Moderate Access Management

Pedestrian Crossing Improvements
Traffic signal timing and turn restriction enhancement, along with the pedestrian refuge island can reduce crash potential by 60-80%.

Parallel Bike Corridor
High quality bike facilities on quiet corridors just east and west of Broadway can facilitate access to the corridor while benefiting the entire community.

Traffic Signal Priority (TSP)
TSP adjusts signal timing to improve transit reliability. Studies have found up to a 50% reduction in overall delays.

-26% in daily delay

-66% in crash conflicts

New traffic signals and improved backage roads maintain business accessibility

Raised medians reduce high-severity and long-delay left-turn movements to/from driveways. Medians also provide aesthetic opportunities, improve pedestrian crossings, and a location for lighting.

High Access Management

Pedestrian Crossing Improvements
Traffic signal timing and turn restriction enhancement, along with the pedestrian refuge island can reduce crash potential by 60-80%.

Parallel Bike Corridor
High quality bike facilities on quiet corridors just east and west of Broadway can facilitate access to the corridor while benefiting the entire community.

Traffic Signal Priority (TSP)
TSP adjusts signal timing to improve transit reliability. Studies have found up to a 50% reduction in overall delays.

-23% in daily delay

-69% in crash conflicts

New traffic signals and improved backage roads maintain business accessibility

Raised medians reduce high-severity and long-delay left-turn movements to/from driveways. Medians also provide aesthetic opportunities, improve pedestrian crossings, and a location for lighting.

BROADWAY CORRIDOR STUDY

DOWNTOWN SEGMENT

MOUSE RIVER TO BURDICK EXPRESSWAY

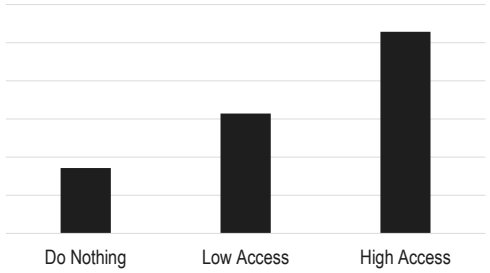
KEY ISSUES

Vehicles	Consistent traffic makes turning left on-to or off-of the corridor time-consuming, frustrating, and unsafe. Compounded signal delays increases perception of poor operations.
Safety	High crash rates due to uncontrolled driveways. Crash rate is 90% higher than other similar corridors.
Livability	Uncomfortable pedestrian facilities with ADA compliance issues. No dedicated bicycle facilities. Limited transit service.
Other	Right-of-way limitations and corridor goals moved bicycle improvements off of Broadway. Concepts are discussed later in chapter.

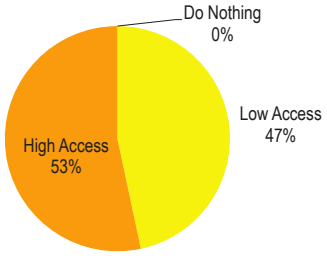
TECHNICAL SCORING

ALTERNATIVE	DO NOTHING	LOW ACCESS MANAGEMENT	HIGH ACCESS MANAGEMENT	
Vehicle Efficiency				
Safety				
Livability				
Cost & Impacts		$60 K	$905 K	
Overall Score				

COMMITTEE SUPPORT



PUBLIC SUPPORT



TIMING

Short or Mid Term

(5-15 Years)

This segment has fewer safety issues than others and improvements here are relatively simple. This segment may be connected to projects in the commercial or campus segments.

NEXT STEPS

- Determine whether improvements in this segment should be coordinated with the commercial or campus segments. The commercial segment provides connectivity for Broadway between the river and US 2 but the campus segment has a lower cost, so may be easier to expand the scope of that project.
- The Main Street Initiative grant program may be a source of funding for a standalone project.

BROADWAY CORRIDOR STUDY

CAMPUS SEGMENT

11TH AVENUE N TO MOUSE RIVER

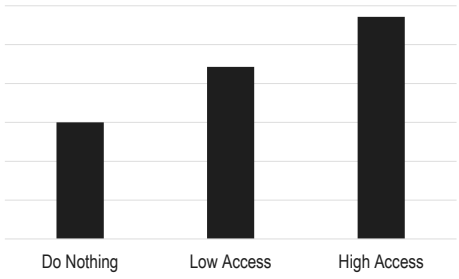
KEY ISSUES

Vehicles	Consistent traffic makes turning left on-to or off-of the corridor time-consuming, frustrating, and unsafe.
Safety	High crash rates due to uncontrolled driveways. Crash rate is 120% higher than other similar corridors.
Livability	Uncomfortable pedestrian facilities with ADA compliance issues. Challenging pedestrian crossings across the corridor. No dedicated bicycle facilities. Limited transit service.
Other	Right-of-way limitations and corridor goals moved bicycle improvements off of Broadway. Concepts are discussed later in chapter.

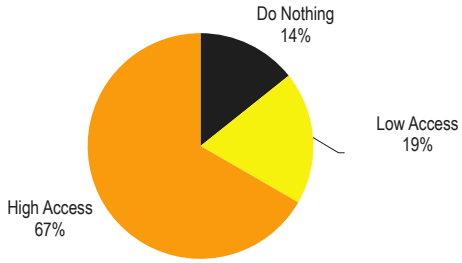
TECHNICAL SCORING

ALTERNATIVE	DO NOTHING	LOW ACCESS MANAGEMENT	HIGH ACCESS MANAGEMENT	
Vehicle Efficiency				
Safety				
Livability				
Cost & Impacts		$3.0 M	$3.6 M	
Overall Score				

COMMITTEE SUPPORT



PUBLIC SUPPORT



TIMING

Mid Term

(10-15 Years)

This segment should follow improvements on the South and Commercial segments. This segment has lower traffic volumes but crash rates are higher than expected due to uncontrolled access. There is no identified funding for this segment.

NEXT STEPS

- Highway Safety Improvement Program and Transportation Alternatives funding programs may be available, but are competitive applications.
- Advance concepts to project development after the Commercial Segment is financed or once roadway repairs are needed.
- Maintain regular communication with businesses and property owners. Look for opportunities to resolve/ consolidate accesses as redevelopment occurs.

BROADWAY CORRIDOR STUDY

NORTH SEGMENT

46TH AVENUE N TO 11TH AVENUE

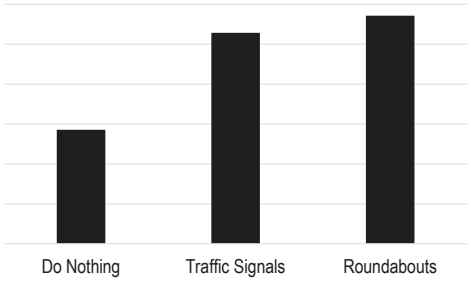
KEY ISSUES

Vehicles	Two-way stop-controlled intersections operate deficiently. High speeds make turning on- and off- Broadway challenging.
Safety	Much of the segment and intersections see critical crash rates. High severity crash rates due to speeds 10 to 15 MPH above the speed limit.
Livability	No off-street bicycle or pedestrian facilities north of 21st Avenue N. High traffic speeds can make crossing the corridor challenging.
Other	Some design options are limited by the airport's area of influence.

TECHNICAL SCORING

ALTERNATIVE	DO NOTHING	SIGNALS AND ACCESS CONTROL	ROUNDABOUTS AND RCUTS	
Vehicle Efficiency				
Safety				
Livability				
Cost & Impacts		$8.1 M	$11.1 M	
Overall Score				

COMMITTEE SUPPORT



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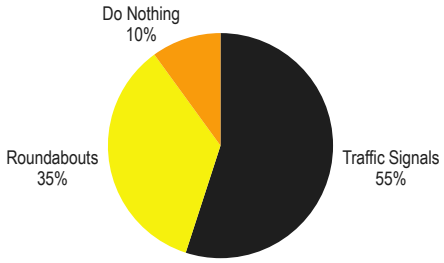


TIMING

Long Term

(15-20 Years)

There is no identified funding for Broadway north of US 2. This segment has lower traffic volumes, crash rates, and access density than others. The City should prioritize the Commercial Segment before other corridor segments.

NEXT STEPS

- Monitor growth to determine needs byintersection. Use proposed improvement plan to systematically implement improvemeents.
- Review opportunities for speed management. While overall re-design of the corridor is likely necessary, Dynamic Speed Display signs can help reduce speeds until changes to the corridor can be funded and implemented.

BICYCLE FACILITIES

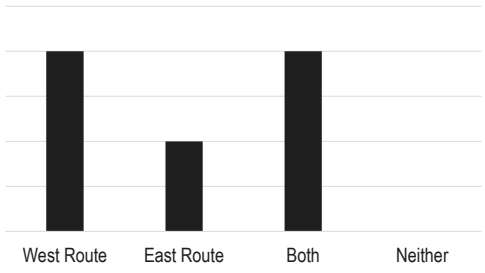
CITY-WIDE

KEY ISSUES

Accommodating bicycle facilities on Broadway is challenging north of 20th Avenue S, where vehicular traffic is high, access density is extreme, and right-of-way is limited. For these reasons, two alternative routing options were considered: west of Broadway and East of Broadway.

	WEST SIDE ROUTING	EAST SIDE ROUTING
Cost	✓ $585,000	✓ $560,000
Comfort	✓ Combination of shared lanes and bike lanes.	Combination of bike lanes and shared use paths on one side of the road.
Parking Impacts	70 blocks of on-street parking potentially impacted.	✓ 41 blocks of on-street parking potentially impacted.
Barriers	Must cross 4th Street/Burdick Expressway and 16th Avenue S, railroad underpass, and limited ROW south of 11th Avenue NW	✓ Must cross Burdick Expressway and 16th Avenue S, Mouse River bridge
Regional Benefits	Between Broadway and planned facilities on 16th Street, connects Minot State University	✓ No planned facilities to the east, connects to the heart of downtown

COMMITTEE SUPPORT



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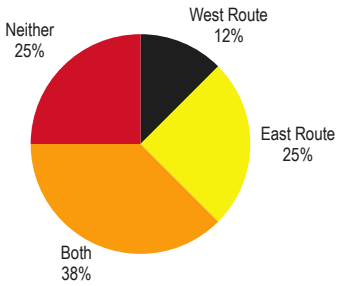


TIMING

Varied

There are several aspects of the bicycle improvements that can advance like on-street facilities and shared-use paths. However, major investments like the barriers at the railroad and bridge crossings will be costly and cannot be implemented in the short-term.

NEXT STEPS

- This study laid the groundwork for two possible and very beneficial routes. These concepts need further planning and public engagement.
- Complete a detailed review of feasibility and design.
- Construction would be eligible for Transportation Alternatives program funding, which is a competitive program and would need to be balanced against other community priorities.

BROADWAY CORRIDOR STUDY

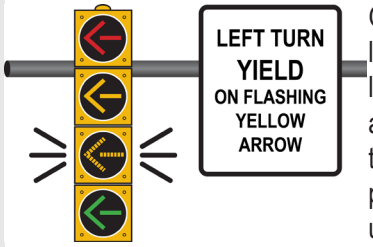
SIGNAL IMPROVEMENTS

CITY-WIDE

KEY ISSUES

The City of Minot is currently in process of upgrading signal controllers, communications, signal timing, and management and operations systems. Additional signal improvements that should be considered as signal replacements and upgrades are discussed below. Accommodating these features will likely cost around $65,000 per intersection, depending on existing signal hardware.

FLASHING YELLOW ARROW

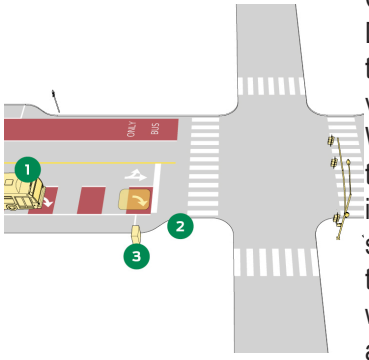


Green ball indications are no longer permitted over left turn lanes. Using flashing yellow arrow (FYA) has been found to reduce all crashes up to 25 percent and left turn crashes up to 37 percent.

PEDESTRIAN IMPROVEMENTS

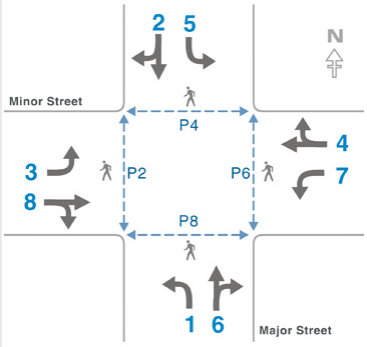
Pedestrian improvements, including countdown heads, pushbuttons, lead pedestrian interval, no right-turn on red, pedestrian omit on FYA should be programmed for pedestrian actuation (only when a pedestrian pushes the button) and located system wide. Proven to reduce pedestrian crashes up to 60%.

PREEMPTION AND PRIORITY



Currently, only the Fire Department's water tanker trucks use emergency vehicle preemption (EVP). With the City upgrading to a central signal system in 2022, the existing EVP system should be expanded to include police and transit, with a proper heirarchy, fire above police above transit.

SIGNAL TIMING



The City is currently undertaking signal timing upgrades. This work should be continued, along with regular maintenance plans to ensure signal timing remains current and appropriate for vehicle traffic trends and patterns.

TIMING

Short Term

The City is currently working on system-wide signal improvements. The signal improvements are low cost with high benefits, especially for traffic flow and cyclist and pedestrian safety. This improvement makes a logical short term investment.

NEXT STEPS

» Low cost improvements can be made by the city and without environmental clearance. Work through typical city budgeting process to advance improvements.

Aesthetics Improvement Plan

Aesthetic improvements bring life to functional transportation spaces and create a sense of place. Through the engagement process, multiple comments were received that Broadway creates a "concrete jungle" that is not conducive to walking and biking and detracts from the community spaces Minot is working to create, especially in the middle segments (Commercial, Downtown, and Campus). With redevelopment and revised cross sections, incorporating aesthetic improvements can accomplish several goals:

- Create a positive first impression while entering Minot and traveling through the commercial corridor
- Serve functional purposes in conjunction with visual appeal
- Attract and stimulate private property owner investment
- Create corridor context to aid in reducing speeding and better identify pedestrian crossings

Aesthetic Options

Minor and relatively inexpensive enhancements are easy to imagine and can significantly add vibrancy to Broadway. Features such as benches, trash receptacles, light fixtures, planting boxes, and community graphics should be designed under the same theme to maintain a consistent character. Aesthetics plans were developed for the two build alternatives on South Broadway from 20th Avenue S to 41st Avenue S shown in Figure 170 and Figure 171 with additional corridor options on the other segments, shown in Figure 172. Aesthetic practices for the Broadway Corridor are described below.

- **Wayfinding**. Signs directing motorists, pedestrians, and bicyclists to key destinations can help integrate the corridor and surrounding community. Examples warranting wayfinding may include the Scandinavian Heritage Park, Minot State University, and Trinity Health Hospital.
- **Intersection Treatments**. Whether a roundabout or traffic signal is chosen as the preferred intersection control, elements of each can help create a distinctive feel along the corridor. High visibility pedestrian crosswalk markings will encourage vehicles to yield and will attract non-motorized traffic to the corridor. Wayfinding can be integrated into traffic signals by placing signs on signal posts. In the center of roundabouts, landscaping and sculptures can give each intersection a unique feel.
- **Corridor Lighting and Banners**. The Broadway Corridor acts as a gateway to Minot. Lighting and banners provide the city an opportunity to share the character of the community with visitors through creative branding.
- **Boulevard Trees, Landscaping, and Pavement**. Planting trees along the corridor can add a sense of enclosure desirable for pedestrians and cyclists. According to *North Dakota Tree Handbook,* many small and medium tree species are appropriate for boulevards, including the Ironwood, Mongolian Oak, and Flowering Crabtree. These trees are shown in Figure 169. Consistent landscaping can also help the corridor feel cohesive from end to end. This includes a median with grass, native grass, loose aggregate/wood chips, or stamped/colored concrete to add to the visual appeal of the roadway.

Figure 169: Boulevard Tree Options

Ironwood

Mongolian Oak

Flowering Crabapple

Corridor Character

Broadway serves a range of land uses and functions. Therefore, aesthetic improvements should be varied depending on the character of the surrounding community. Five unique segments were identified to capture the nuances of the corridor as it changes from South to North.

- **South (20th Avenue S to 41st Avenue S):** The south segment is adjacent to several hotels and shopping centers. For visitors arriving in Minot from the south, Broadway is a gateway so banners with city branding and wayfinding signs pointing to attractions and destinations are appropriate aesthetic elements for this segment.
- **Commercial (Burdick Expressway to 20th Avenue S):** This segment serves many businesses located on the corridor and large residential communities both to the east and west. Two elementary schools, a middle school, and a high school are located within a half-mile of this segment. Pedestrians and cyclists can benefit from aesthetic elements such as pavement markings and high-visibility crossings at intersections.
- **Downtown (Mouse River to Burdick Expressway):** This section is central to Minot and serves both local traffic into downtown and through traffic crossing the Mouse River. Aesthetic features such as benches, trash receptacles, and planting boxes can help establish this segment as a unique destination.
- **Campus (11th Avenue N to Mouse River)**: Minot State University has several pedestrian access points on Broadway and a welcome sign with landscaping north of the University Avenue intersection. Aesthetics on this segment of the Broadway Corridor should match these features.
- **North (46th Avenue N to 11th Avenue N):** For visitors arriving in Minot from the north, Broadway is a gateway similar to the south segment. A “Welcome to Minot” sign, banners with city branding, decorative medians, and wayfinding signs pointing to downtown attractions are appropriate aesthetic elements for this segment.

Figure 170: South Segment Signalized Parkway Aesthetics Options

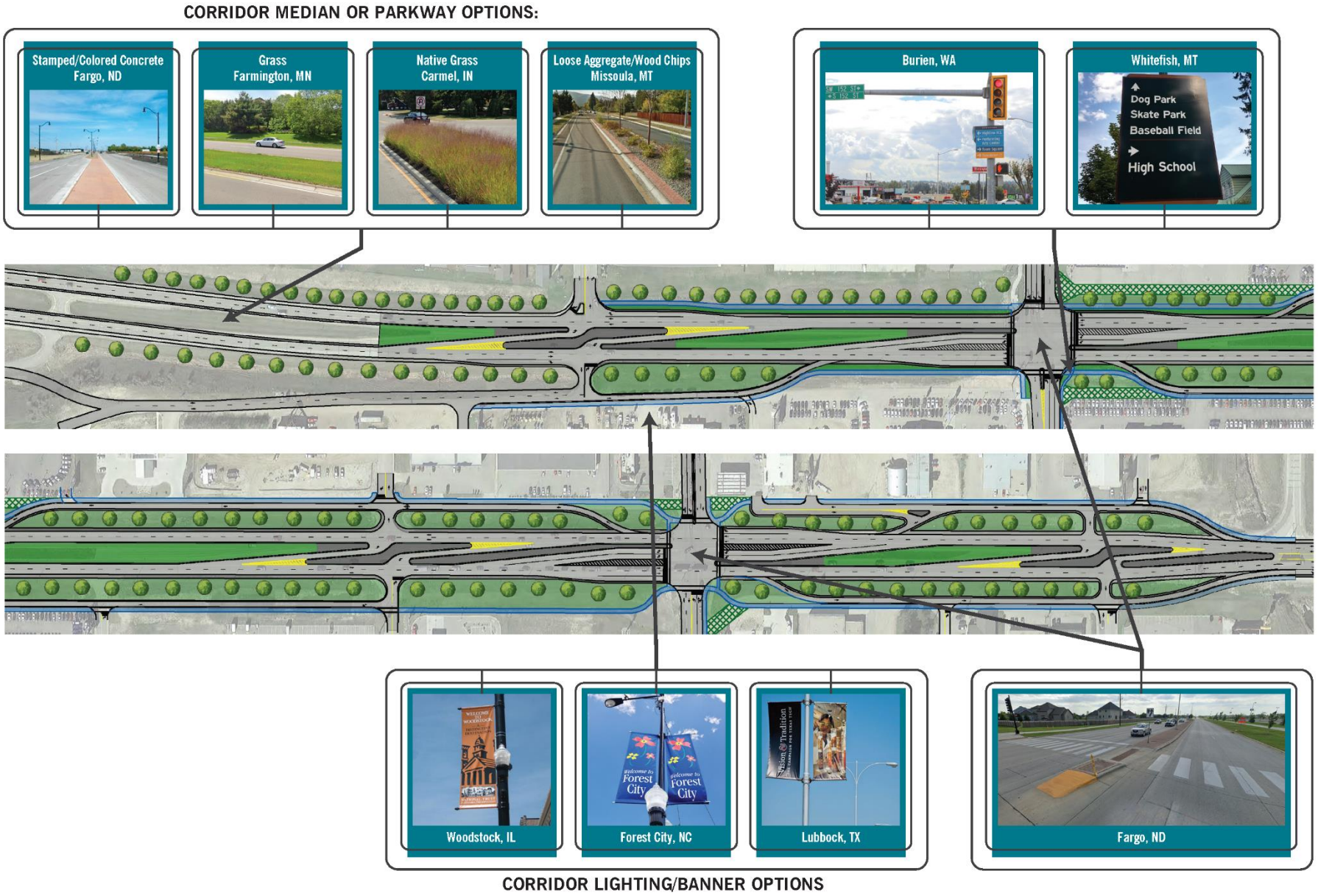


Figure 171: South Segment Roundabout Parkway Aesthetics Options

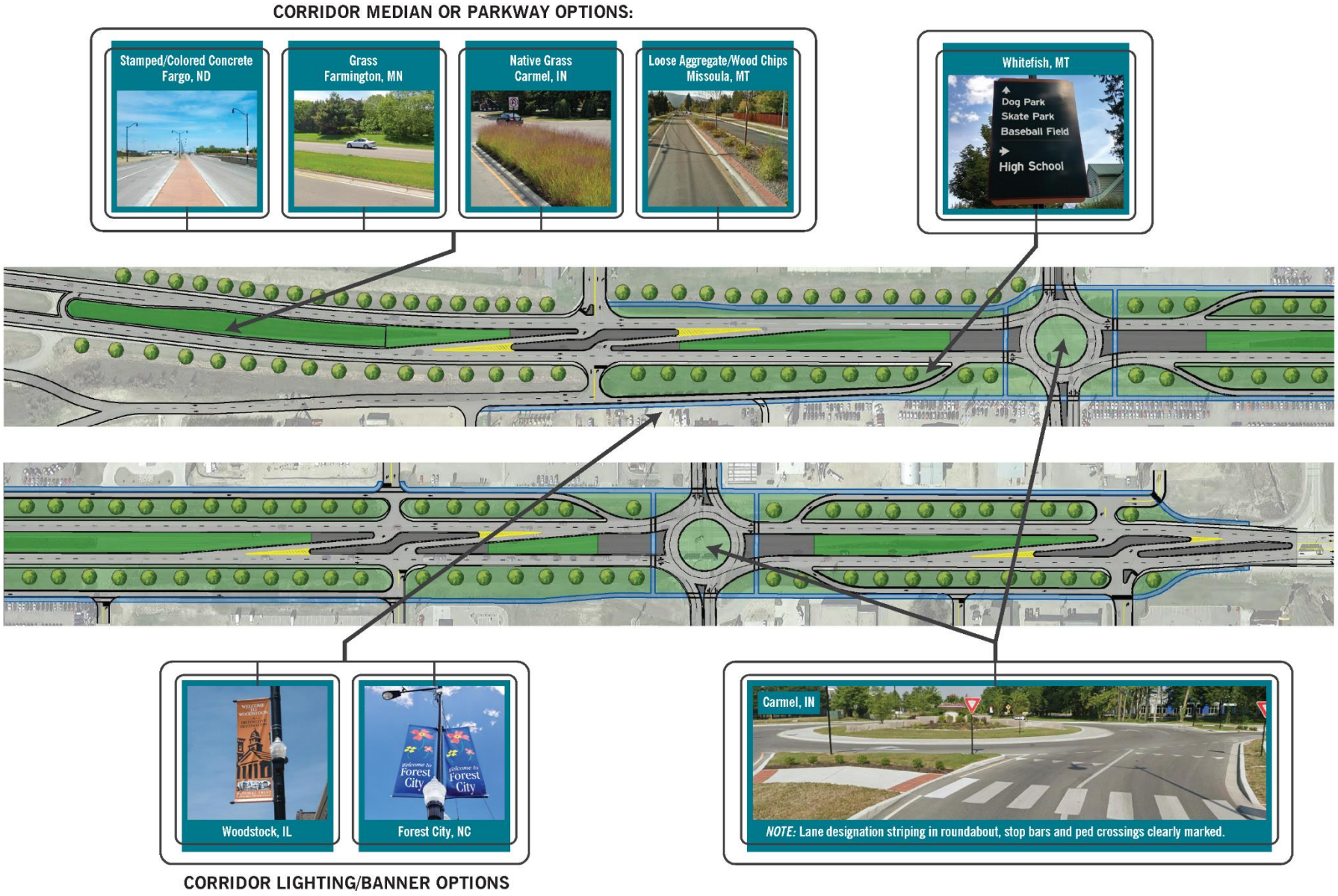


Figure 172: Other Corridor Area Aesthetic Opportunities

BROADWAY
CORRIDOR STUDY