



Sunset Drive Corridor Study

Bismarck-Mandan Metropolitan
Planning Organization (or MPO)



Final Report | April 2023

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Executive Summary

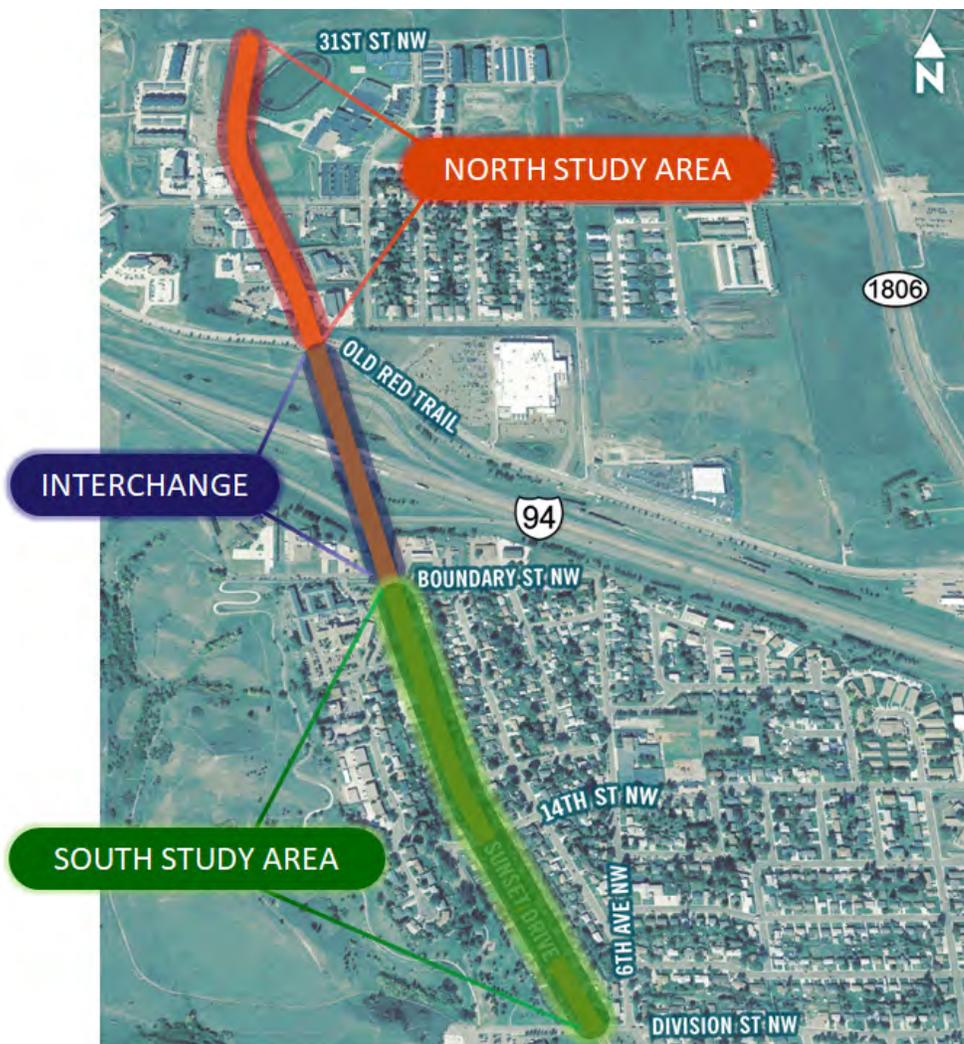
The Sunset Drive Corridor in Mandan, ND is a major transportation route between downtown Mandan to the south and Interstate 94 (I-94)/northwest Mandan to the north. The corridor study area extends along Sunset Drive from Division Street NW to 38th Street NW, intersecting major east/west functionally classified roadways including 27th Street NW, Old Red Trail, I-94, 14th Street NW and Division Street NW.

Strain has been placed on the region's public service costs and infrastructure from western North Dakota's unprecedented growth over the last decade and subsequent heightened level of growth that the Bismarck-Mandan community experienced. Notably, the region's transportation infrastructure and specifically for Mandan, the Sunset Drive corridor, have experienced heightened impacts. The future reconstruction and reconfiguration of Sunset Drive NW creates an opportunity to reallocate the right-of-way to better serve changing transportation needs, particularly by studying proper lane striping, parking policy, and pedestrian infrastructure. This study will also analyze intersection geometry and traffic operations for the purpose of evaluating the potential effect of corridor lane and/or roadway reconfiguration on neighboring streets and the surrounding roadways. The corridor study will take into consideration best practices for new development of the northward extension of the Sunset Drive corridor beyond 31st Street NW as northern Mandan develops.

Purpose and Need Statement

The purpose of the Sunset Drive corridor study is to address the expanding needs due to population growth and reassess the needs and uses of the aging infrastructure by producing planning alternatives to guide future development and redevelopment of the corridor to better serve the needs of all users (vehicular, bicycle, pedestrian, transit, etc.). Specifically, to assess opportunities to reallocate the right-of-way by studying appropriate lane striping, parking policy, and pedestrian infrastructure.

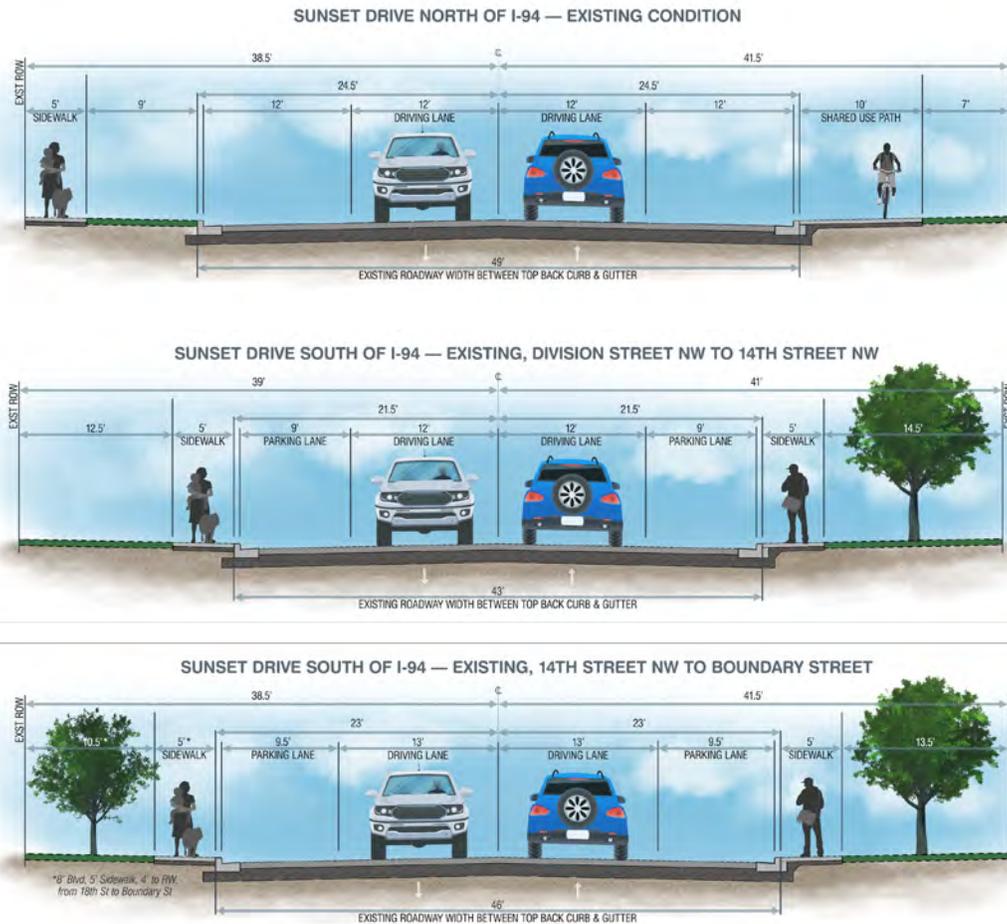
Figure 1. Sunset Drive Corridor



EXISTING CONDITIONS

The corridor has three functionally distinct subareas that have different recommendations and alternatives throughout the process of the corridor study. The first subarea is the south section from Division Street to Boundary Street which is predominantly residential in nature. The second Subarea is the I-94 interchange area from Boundary Street to Old Red Trail which serves as a transitional space between the south and north segments while connecting Sunset Drive to I-94. The north subarea is primarily commercial in nature immediately adjacent to the corridor with some residential land uses nearby. It is important to note that the I-94 ramp intersections between Boundary Street and Old Red Trail are within the corridor study area but are NOT considered study intersections. These intersections will be included in modeling and general discussion of the report, but recommendations will not be made.

Figure 2. Existing Conditions Typical Sections



Currently the corridor is an undivided two-lane facility with turn lanes only present at the I-94 ramps and Old Red Trail intersections with a posted speed limit of 25 mph. Sidewalks are present on both sides of Sunset Drive between Division Street and Boundary Street, and on the west side of the roadway from Old Red Trail to 27th Street. The south segment of the corridor from Division Street to Boundary Street has no parking restrictions with enough pavement to accommodate parking on both sides of the roadway. General observations have shown that parking is consistently used but under capacity. The north segment of the corridor from Old Red Trail to 31st Street NW is signed as “no parking any time,” however the width of the roadway contains space to accommodate parking on both sides of the street. Observations have been made that on-street parking occurs in this section of the corridor even though it is not marked.

There were 111 crashes reported in the study area (including the I-94 ramp intersections) for the five-year analysis period between 2017 and 2021. There were no traffic fatalities or serious injury crashes reported during the analysis period. There were no crashes involving bicyclists or pedestrian reported during the analysis period. The crash frequency was higher during the cold weather months from November through March. Of the 69 crashes that occurred during cold months, 39 of them (more than half) occurred with icy, snowy, slushy, or wet roadway surface conditions. Without crashes occurring with less-than-ideal surface conditions, the cold winter month crash frequency falls more in trend with the warmer month data. Rear end crashes are the most predominant crash type in

the corridor with fifty-two crashes (47% of the crash history). The most predominant locations and directions of the rear end crashes were at the I-94 eastbound ramp and Old Red Trail in the northbound and southbound directions. Angle crashes were the second most predominant crash type with thirty-four crashes in the crash history (31%). The angle crashes are generally spread out throughout the corridor and more concentrated around higher volume intersections. The parking crash trend indicates that creating a well-defined parking space that is predictable for moving vehicles in the corridor, would be beneficial.

There were 15 crashes reported along the Sunset Drive between Division Street and Boundary during the analysis period that do not include intersection crashes. The most predominant crash type was rear end crashes (6 of 15). Five of the six rear end crashes occurred in the northbound direction, and one occurred in the southbound direction. The second most predominant crash type in this segment was backing crashes (5 of 15). Six of the segment crashes involved a parked vehicle.

The corridor carries between 8,000 to 10,000 vehicles daily in the south subarea, 10,000 to 16,000 vehicles daily in the I-94 interchange area between Boundary Street and Old Red Trail, and drops off rapidly north of Old Red Trail from 7,000 daily vehicles to less than 500. The AM peak hour along the corridor occurs from 7:00 AM to 8:00 AM, while the PM peak occurs from 3:00 PM to 4:00 PM. The earlier PM peak hour is due to the adjacent schools to the corridor. Traffic volumes are generally split evenly in the northbound and southbound directions throughout the day. Based on this planning-level capacity approach, the Sunset Drive corridor operates between the level of service (LOS) A or LOS D range. Based on traffic modeling, Sunset Drive has existing peak hour traffic operations between LOS A and C for all locations within the AM and PM peak hour. Average travel times through the study corridor are approximately three and a half minutes to just over 4 minutes, plus or minus about 10 seconds. The average travel speeds equate to approximately 21 to 23 mph. Existing conditions traffic analysis did not show any capacity concerns.

Table 1. Existing (2022) Intersection Capacity Analysis

Sunset Dr Intersection	Traffic Control	AM Peak Hour	PM Peak Hour
Division St NW	SSS ¹	C (25 sec)	B (12 sec)
14 th St NW	SSS	B (14 sec)	A (8 sec)
Boundary Rd	SSS	C (23 sec)	C (21 sec)
Old Red Trail	Signal	B (17 sec)	B (17 sec)
27 th St NW	SSS	B (14 sec)	A (8 sec)
31 st St NW	SSS	A (1 sec)	A (1 sec)

1 – SSS = side street stop control

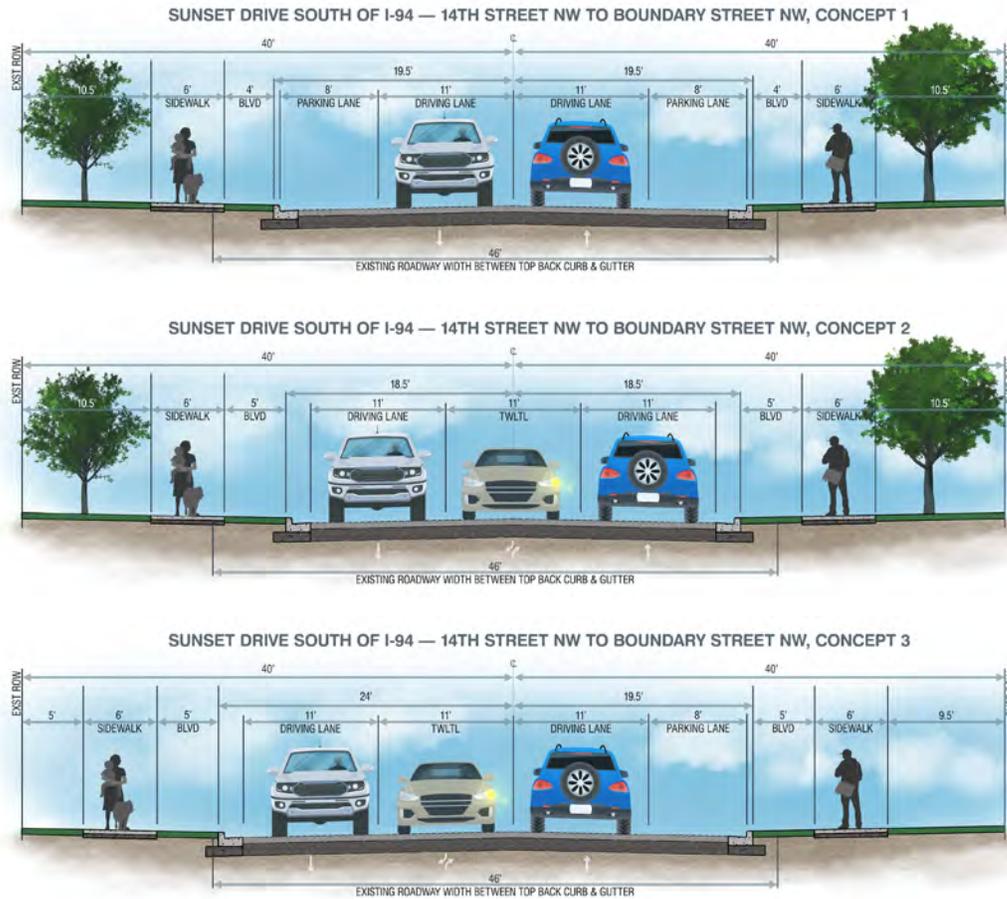
FUTURE CONDITIONS

Sunset Drive has seen significant historic growth in the past decade. 2022 volumes were 10–20% higher than predicted by the Advanced Traffic Analysis Center (ATAC) Travel Demand Model (developed in 2016). Traffic growth is expected to continue but at a slower pace than the last 5 to 10 years. Four growth scenarios were evaluated from the ATAC model which include, 2030 without Sunset Drive Extension (10% growth from existing), 2030 with Sunset Drive Extension (20% growth from existing), 2045 Base Growth (40% growth over existing) and 2045 Full Growth (50% growth over existing). 2045 growth scenarios include the Sunset Drive Extension. There is the potential for a large development to increase traffic on Sunset Drive that was not included in the ATAC model. One third of this traffic was added to the full buildout scenario for 2045 to create a sensitivity analysis. This added approximately 2,500 daily trips on Sunset Drive north of the Interchange area. In the future no-build scenario growth scenarios there were a few operational concerns at specific intersections. 27th Street and Boundary Street are expected to experience failing side street traffic operations by the year 2030 in the peak hours. Division Street and 14th Street show deteriorating traffic operations in 2045 with failing operations in the PM peak-hours of the sensitivity analysis. Aside from the intersections, the corridor itself showed no capacity concerns even in the sensitivity analysis. As such, a four-lane section was not explored in the alternatives analysis since it would not be necessary from a capacity standpoint. Additionally, in the south subarea there is dense residential driveway spacing less than 100 feet apart. With limited options to reduce access, a four-lane section would decrease safety on a corridor with dense access spacing.

The south segment alternatives focused on typical sections. The three alternatives developed, and their technical ranking results were:

- » Technical Ranking 1 – Three Lane with Parking on One Side (Concept 3)
- » Technical Ranking 2 – Three Lane with No Parking (Concept 2)
- » Technical Ranking 3 – Two Lane with Parking on Both Sides (Concept 1)

Figure 3. South Segment Alternative Concepts



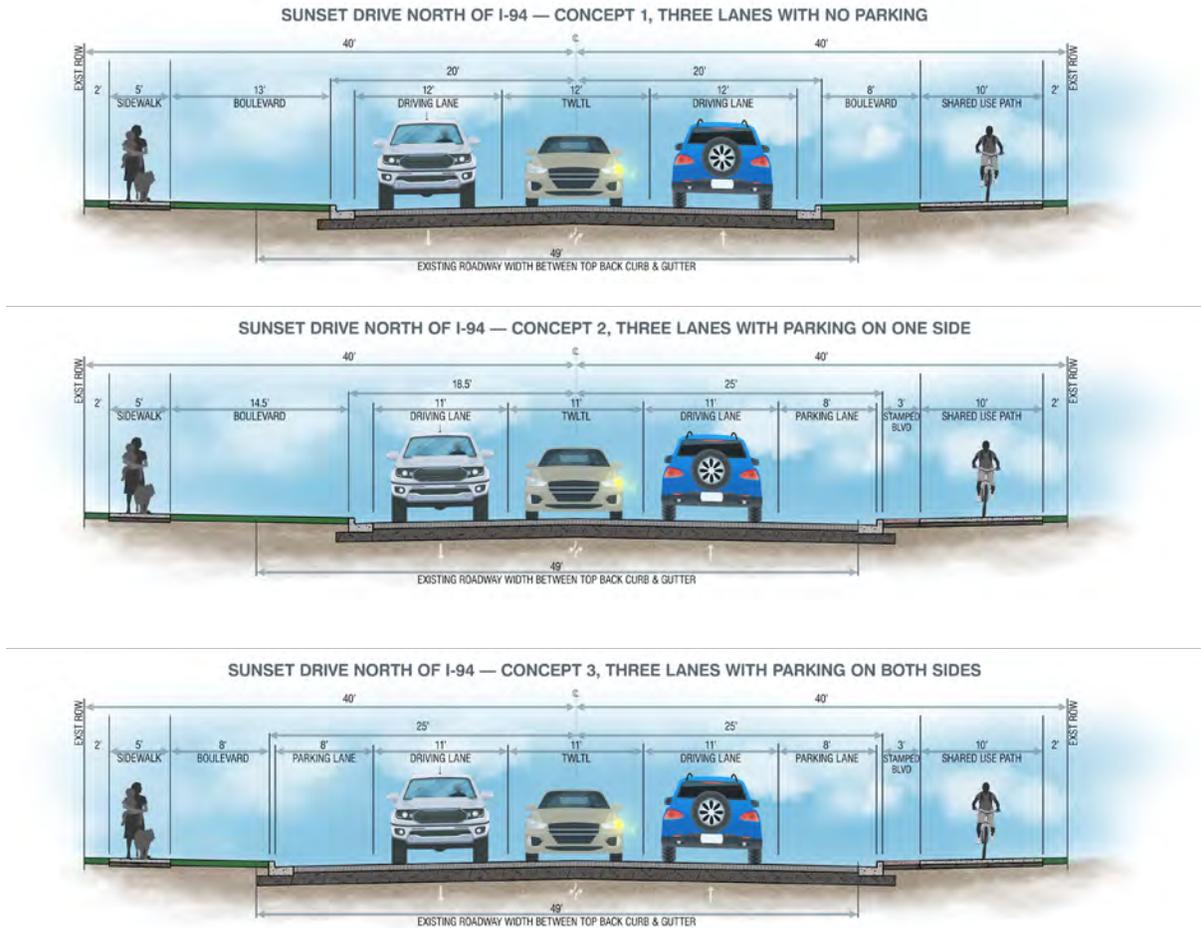
All typical section alternatives are expected to operate at an acceptable level of service, increase corridor safety, and improve bike/pedestrian safety and trip quality. The alternatives were ranked based on a three-lane section providing more mobility and better traffic operations, and parking capacity only being needed on one side of the street without any anticipation for increased parking needs in the future. In addition to the cross section alternatives, spot improvement considerations at 14th Street in this segment included a southbound left turn lane if a two-lane section is constructed to help with traffic capacity, parking restrictions near the intersection to improve sight lines, and an enhanced pedestrian crossing potentially using a refuge island on the south leg of the intersection in place of a northbound left turn lane with a Rectangular Rapid-Flashing Beacon (RRFB). Additionally, the recommendation was made to improve all pedestrian crossings at public intersections with color/imprinted concrete and to add a mid-block crossing between 15th Street and 18th Street with an RRFB.

As stated above the I-94 ramp intersections are not within the scope of this corridor study; however, four alternatives were considered to aid in understanding the impacts changes to the interchange would have on the rest of the corridor. These alternatives included roundabouts at the ramp terminals, a northwest loop, a Single Point Urban Interchange (SPUI), and a Diverging Diamond Interchange (DDI). Traffic operation analysis showed that the roundabout alternative would be expected to decrease traffic operation level of service. The northwest loop alternative showed little to no benefit over no build. Both the SPUI and DDI showed the potential for a traffic operation and safety benefit for the ramp terminals. The DDI was ranked the best technical solution in for the subarea based on high benefits for a lower cost and impacts compared to the SPUI alternative.

The north segment alternatives focused on typical sections. The three alternatives developed, and their technical ranking results were:

- » Technical Ranking 1– Three Lanes with Parking on One Side (Concept 2)
- » Technical Ranking 2 – Three Lane with Parking on Both Sides (Concept 3)
- » Technical Ranking 3 –Three Lane with No Parking (Concept 1)

Figure 4. North Segment Alternative Concepts



All typical section alternatives would be expected to operate at an acceptable level of service, increase corridor safety, and improve bike/pedestrian safety and trip quality. All three alternatives added multimodal facilities to the corridor as well, the major difference in the technical ranking was the parking. While some parking capacity was needed, it was also deemed beneficial to reduce the cross section and width of pavement for safety. This balance of parking need and narrower pavement width is why the three-lane with parking only on the East side scored best in the technical ranking. In addition to the cross-section alternatives, spot improvement considerations at 27th street included considering new intersection control when volumes warrant a traffic signal or a multi-lane (2X1) roundabout. As Sunset Drive is extended north past 31st Street, it is recommended that the City implement policies and practices related to access spacing, on-site business parking for new developments, and transit stops.

Figure 5. 27th Street Concepts

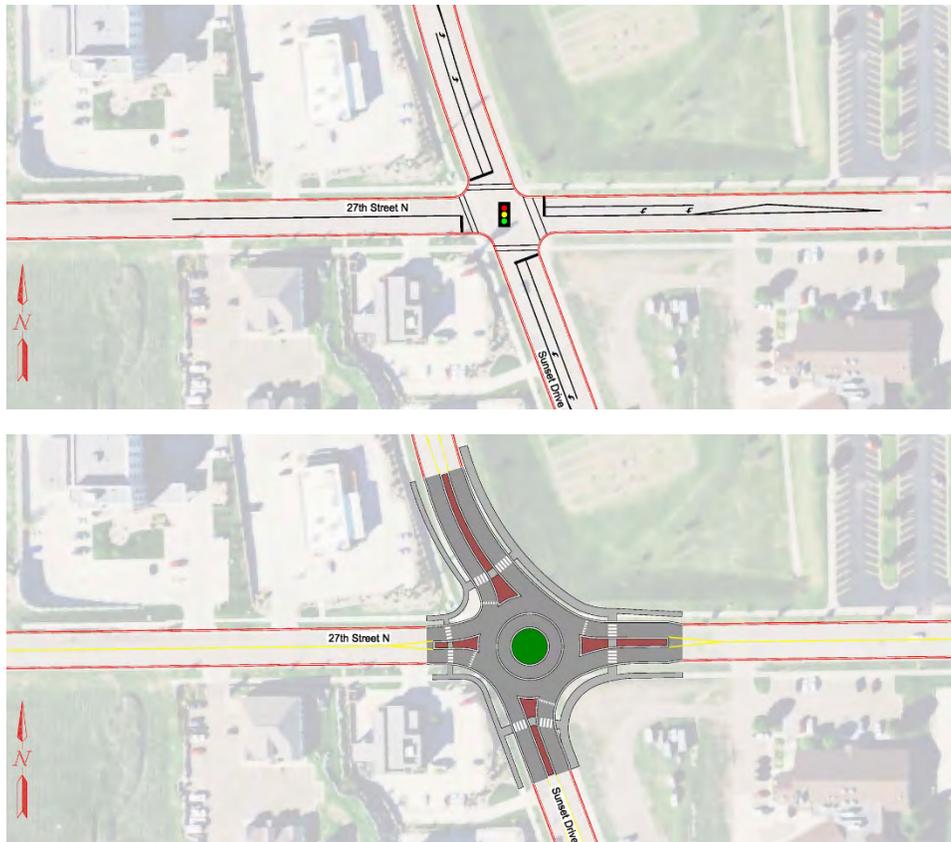


Table 2. Future No Build (2045) Sensitivity Analysis Growth Scenario Intersection Capacity Analysis

Sunset Dr Intersection	Traffic Control	Mainline Operations (PM)	Side Street Operations (PM)	Notes
Division St NW	SSS ¹	A (4 sec)	F (66 sec)	Side Street operations show as failing but are heavily dependent on the redevelopment of the Mandan High School Site. Intersection controls should be re-evaluated when the old Mandan Highschool site is redeveloped.
14 th St NW	SSS	A (9 sec)	F (98 sec)	A traffic signal and all-way stop control were evaluated but not warranted. Access consolidation could be considered but the existing infrastructure does not support re-routed trips. No mitigation is recommended.
Boundary St	SSS	B (12 sec)	F (100+ sec)	Intersection controls are anticipated to change with the I-94 interchange project the NDDOT is currently progressing. A traffic signal would bring traffic operations to an acceptable level.
Old Red Trail	Signal	D (40 sec) ²		Intersection design is anticipated to change with I-94 interchange project the NDDOT is currently progressing.
27 th St NW	SSS	A (5 sec)	F (100+ sec)	Either a traffic signal or roundabout would increase the LOS to C or better.
31 st St NW	SSS	A (3 sec)	B (11 sec)	No mitigation needed.

1 – SSS = side street stop control

2 – Signal operations are evaluated for the whole intersection

Public Engagement

The public engagement process was established to utilize public input as guiding principles in the development of corridor alternatives. The engagement was designed to share information with interested parties and to collect input to guide decision making. The public involvement goals for the project were as follows:

- » Provide information to the public in a timely, clear, and effective manner.
- » Engage stakeholders in meaningful and accessible ways.
- » Solicit early and continuous input from stakeholders.
- » Provide transparency during the recommendation development process.
- » Maintain and strengthen the relationship between Bismarck-Mandan Metropolitan Planning Organization (BMMPO), project partners, and key stakeholders.

A designated Steering Committee provided technical guidance and leadership throughout the study process. The Committee consisted of the following members:

Justin Froseth, Mandan City Engineer	Andrew Stromme, Mandan City Planning
Mitch Murray and Jarek Wigness, Mandan Assist. City Engineer	Mitch Bitz, Mandan Public Works
Ellen Huber and Madison Cermak, Business Development	Natalie Pierce, County Planner
Deidre Hughes, Bis-Man Transit	Kim Riepl, BMMPO Staff
Wayne Zacher, NDDOT Local Government	Dean Schloss, NDDOT Bismarck District
Kristen Sperry, FHWA- ND	Ranae Tunison, FTA- Region VIII

The project team held two separate stakeholder meetings and public input meetings (PIM) with the following strategies:

- » **Stakeholder and PIM #1**
Issues Identification and Needs Assessment
- » **Stakeholder and PIM #2**
Review Corridor Concepts and Alternatives

Along with in-person input opportunities, the public was able to provide ideas, feedback, and input online through the project website with the use of an interactive map and surveys. Additional outreach efforts included social media, flyers to area business, and direct mailers to a select group of residents.

See “Public Involvement Phase 1 Summary” and “Public Involvement Phase 2 Summary” reports for detailed survey results and comments received during the public involvement process.

Access Management and Setbacks

With the pending update of its Zoning and Land Development Code the City of Mandan will have the opportunity to establish more updated and modernized access management standards. Access management standards are typically applied based on a roadways functional class based on the approved functional map used by the BMMPO. For the Sunset Drive Corridor much of the access south of 27th Street is generally set in place. However, north of 27th Street through 31st Street and as part of future potential corridor extension to 38th Street, access and setback standards should be set at a typical collector standard which would be no more than one access per 660 feet or every 1/8-mile. Refer to **Figure 6**.

Figure 6. Access Points



The 27th Street intersection should reserve enough right-of-way to accommodate both traffic control options, specifically a roundabout since it requires the most. Per **Figure 5 on page 6** the roundabout could take advantage of the undeveloped land east of the intersection and place a centroid of the possible roundabout at 46° 51' 00.40" N, 100° 54' 34.30" E with a radius of 80 feet. See **Figure 7** for roundabout setbacks.

Next Steps and Implementation

SOUTH SEGMENT – DIVISION STREET TO BOUNDARY STREET

A range of three project alternatives were developed for the south segment of the corridor study from Boundary Street to Division Street. This corridor study ranked **Alternative 2 – Three-lane with parking on east side** as the most technically-feasible alternative. This also included a series of potential spot improvements to address issues regarding parking, turning movements and pedestrian accommodations. The City and the BMMPO should continue to monitor conditions along this stretch of corridor and determine the potential for the development of a locally or federally funded improvements through either Mandan’s Capital Improvement Program (CIP) of the BMMPO Transportation Implementation Plan (TIP). The highest technically ranked alternative(s) should be integrated for consideration into the ongoing BMMPO Master Transportation Plan (MTP) update.

INTERCHANGE AREA – BOUNDARY ROAD TO OLD RED TRAIL

Preliminary concepts were developed to a range of multimodal conditions along this stretch of corridor. NDDOT is currently studying this segment of the corridor in more detail over 2023 and into 2024. This corridor study ranked the development of the **diverging diamond interchange (DDI)** as the highest ranked alternative. Impacts from other improvements resulting from NDDOT’s interchange project north of Old Red Trail, such as a second northbound lane to 27th St NE, will be addressed as part of NDDOT’s interchange project. The City of Mandan and the BMMPO should stay engaged with the NDDOT through the required metropolitan planning process to ensure improvements are evaluated, prioritized, and integrated into the BMMPO MTP and TIP over the next 12 to 18 months.

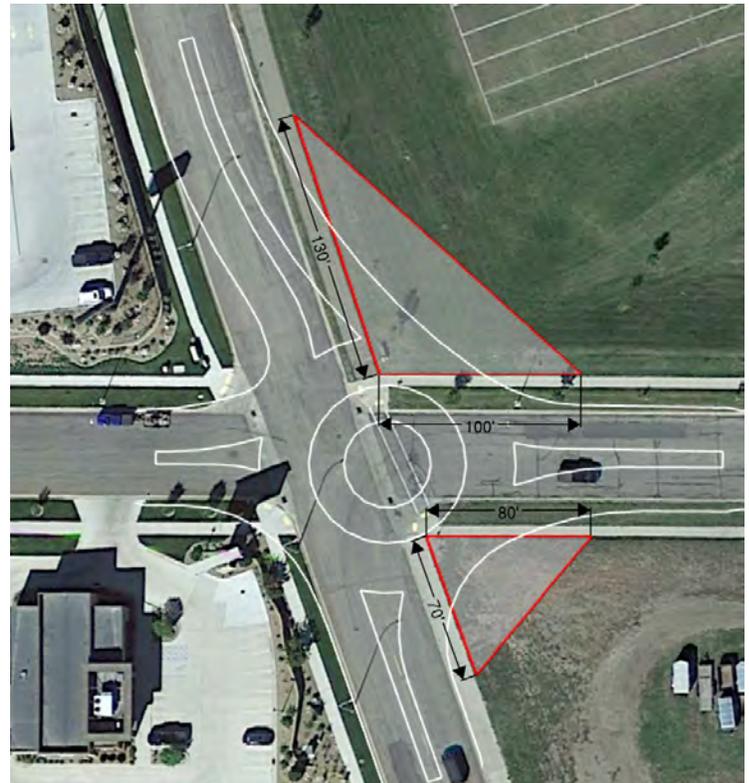
NORTH SEGMENT – OLD RED TRAIL TO 31ST STREET

A range of three project alternatives were developed for the north segment of the corridor study and two options for intersection improvements at the 27th Street Intersection. Each involves modifications to the existing roadway to address needed improvements to pedestrian accommodation, potential changes in parking along the corridor and needed intersection improvements. **Alternative 2 – Three-Lane with street parking on the east side and a roundabout at the 27th Street** were the highest technically ranked alternatives. The City and the BMMPO should continue to monitor conditions along this stretch of corridor and determine the potential for the development of locally or federally funded improvements through either Mandan’s CIP or the BMMPO TIP. The highest technically ranked alternative(s) should be integrated for consideration into the ongoing BMMPO MTP update.

SUNSET DRIVE EXTENSION – NORTH OF 31ST STREET

Depending on the pace of development, specifically the 550 acres of potential development evaluated north and west of the study area, an extension of Sunset Drive may be warranted by 2030. Again, this extension appears to be development driven. Currently classified as a collector to 27th Street, the extension past 31st Street to 38th Street should be planned as at least a collector roadway.

Figure 7. Roundabout Setbacks



Final Report Introduction

The goal of the corridor study is to address the expanding needs of population growth and aging transportation infrastructure by producing a set of planning alternatives that gives options for reconfiguring Sunset Drive to improve access, mobility, and safety. The objective of the final report is to document the Phase 1 and Phase 2 analysis, which includes the development process for the planning alternatives and the public involvement process.

Study Area

The Sunset Drive Corridor is a major transportation route between downtown Mandan to the south and I-94 and northwest Mandan to the north. The 1.3-mile corridor shown in **Figure 1** extends along Sunset Drive from Division Street NW to 38th Street NW. Key intersections were found based on existing daily traffic volumes. Intersections that were identified for analysis are listed below.

Division Street	Boundary Street	27th Street NW
14th Street NW	Old Red Trail	31st Street NW

It is important to note that the I-94 ramp intersections between Boundary Street and Old Red Trail are within the corridor study area but are NOT considered study intersections. These intersections will be included in modeling and general discussion of the report, but recommendations will not be made.

The corridor has three functionally distinct subareas that may have different recommendations and alternatives throughout the process of the corridor study. These include:

- » South Sunset Drive: Division Street to Boundary Street
- » I-94 Interchange Area: Boundary Street to Old Red Trail
- » North Sunset Drive: Old Red Trail to 31st Street NW

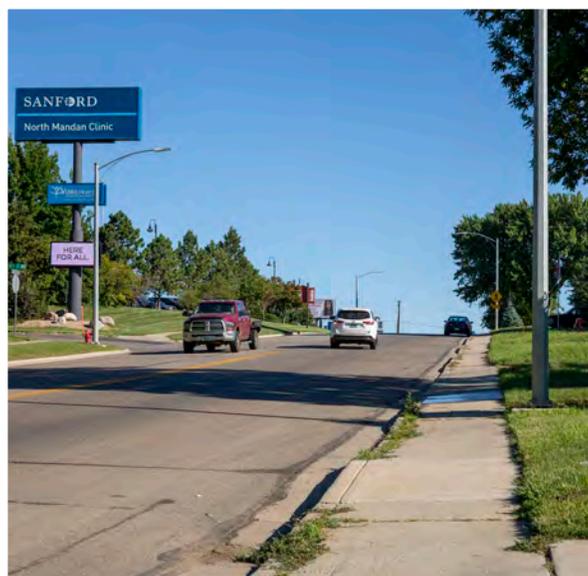


Figure 8. Study Area



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Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Source: ND DOT, Bismarck/Mandan MPO, NDGIS Hub, ESRI, KLJ, Aerial from 2020.

August 2022

Corridor Context

Sunset Drive is an especially important corridor for the city of Mandan, providing a direct route to the Mandan High School, Mandan Middle School, hospital services, and connects to the heart of the central business district on its south end. As such, there have been many previous planning efforts and studies completed in Mandan along the study segment. This section provides existing context for the corridor with summaries of earlier studies and identifies known issues and considerations, as well as planned projects.

PREVIOUS STUDIES

A review of previous studies from the past 10 years showed consensus for the challenges and potential of the study corridor. The following studies (listed below) were consulted along with field observations, meetings with the project study committee, and public engagement to compile a list of known issues and planned improvements prior to alternative development and existing conditions analysis.

- » **Arrive 2045 (2020)** is the long-range transportation plan (LRTP) for the BMMPO area, which includes the City of Bismarck, the City of Mandan, City of Lincoln, Burleigh County, and Morton County. The LRTP is a key first step in the overall regional transportation planning process with the goals of establishing a community vision, evaluating mobility, accessibility, and safety performance, addressing all modes of travel, developing, and evaluating a range of improvement strategies, and developing a prioritized financially constrained implementation plan. The plan is used to prioritize most of transportation spending throughout the 25 years from its publication.
- » **The BMMPO requested the *Bismarck-Mandan Corridor Improvement Study (2016)*** to evaluate the potential improvement of 20 corridors located in the cities of Mandan and Bismarck. The two primary objectives of the Corridor Improvement Project were to improve traffic operations along the corridors and to reduce crashes by applying low-cost alternative solutions. Sunset Drive/6th Avenue was a corridor within the scope of the study, extending from Main Street to Old Red Trail, which overlaps the project study area on the south end from Division Street to Old Red Trail.
- » **Envision 2040 (2015)** was the previous version of the LRTP, revised in 2020.
- » **The North Mandan Subarea (2013)** was completed to identify multimodal transportation improvements needed to support the current and proposed levels of development within and influencing North Mandan. The focus area of this study encompassed areas within and outside the city from north of I-94 to Square Butte Drive (north end of the Schlosser Addition), and from the Missouri River to approximately 47th Avenue NW. The Sunset Drive study corridor north of the I-94 ramps was in the south part of this study area, halfway between the east and west extents.

KNOWN ISSUES

The following lists known issues that were identified prior to existing conditions analysis.

I-94 Ramp Congestion

All the studies listed above identified the I-94 Ramp area as having substantial congestion issues with future traffic growth. While this corridor is impacted by congestion at the I-94 ramp, it is not within the scope of this project to make traffic control recommendations to alleviate the congestion. This corridor study will need to coordinate with a separate study conducted for the NDDOT that specifically relates to the congestion regarding the I-94 ramps. Recommendations and concepts completed for Sunset Drive corridor will need to be compatible and will integrate well with the improvements at the I-94 ramp intersections.

Parking

Parking has been identified as an issue in both the southern and northern subarea for varying reasons. The on-street parking in the southern area of the corridor serves residential land uses and has been observed to be underutilized. The concern with parking in this area is that it negatively impacts site lines for minor approach traffic as well as visibility of pedestrians. North of I-94, on-street parking is prohibited on Sunset Drive, but observations of drivers parking on the wide shoulder have been made. These observations have been more common during busy times for businesses in the area and during Mandan Middle School events.

Residential Driveways

South of Boundary Street there are residential driveways consistently spaced less than 100 feet apart to Division Street. This presents a unique challenge for the corridor given the projected volume growth and connectivity of Sunset Drive. More than 50 single family residential properties have driveway connections to Sunset Drive in the study corridor without alternative access options. Maintaining safe and effective access for these residential properties is an important consideration as alternatives are developed and evaluated to accommodate growing traffic volumes.

Speed

The posted speed limit along Sunset Drive in the corridor is 25 mph. There have been observations stating concerns of drivers exceeding the speed limit. Especially with the school land uses along the corridor, the goal of any recommendations made will align with attempting to calm traffic and reduce speeds.

Grade Changes

Division Street experiences a significant grade change at its intersection with Sunset Drive. The roadway is decreasing in elevation from the east to the west into the existing Mandan High School site. Significant grade changes create safety concerns especially in inclement weather where the approach has a stop condition like Division Street. Sunset Drive also has a significant decrease in grade as it continues out of the study area south towards downtown Mandan. These grade challenges may have an impact on the feasibility of recommendations made for intersection control at the intersection of Sunset Drive and Division Street.

Institutional Land Uses & Multimodal Concerns

Land use will be explored in more detail later in the report, but within the corridor there are many institutional land uses that affect how the corridor operates. Typically, schools tend to have more intense AM peak hours as opposed to the traditional heavier PM peak hours for corridors with more residential and commercial land uses. Institutional land uses also create additional concerns like young pedestrian activity near schools and emergency vehicle access near hospitals. With a variety of parks and school in the study area, many of the issues listed above combine and integrate with the high amount of multimodal and pedestrian traffic in the area. Roadway congestion, on-street parking blocking site lines, and speed are all issues that compound with high pedestrian traffic to create safety concerns. There is particular concern with a lack of pedestrian crossing infrastructure between Boundary Street and 14th Avenue.

FUTURE CONSIDERATIONS

The primary driving factors of this corridor study are the expanding needs of population growth and aging/outdated transportation infrastructure. More information about future conditions and growth projections will be addressed in the future conditions report. The following section offers a small amount of context related to expected traffic growth within the corridor. As growth occurs, many of the known issues will continue to worsen if new infrastructure is not implemented.

North Corridor Growth

According to the North Mandan Subarea study, in Mandan and Morton County approximately 60 percent of the anticipated urban residential development and 65 percent of the commercial increment of development anticipated through 2040 has been allocated to the North Mandan study area (north of I-94 to Square Butte Drive (north end of the Schlosser Addition) and from the Missouri River to approximately 47th Avenue NW). Traffic and land use forecasts from relevant studies include:

- » Land use surrounding the extension on Sunset Drive north of 31st Street is expected to have more than 500 new households and between 200 to 500 new jobs from 2015 to 2040 [Envision 2040].
- » Land use between the I-94 interchange ramps and the north end of the corridor is expected to have 100 to 500 new households from 2015 to 2040 and more than 1,000 new jobs [Envision 2040].
- » The trip generation growth is significantly higher than the household and job growth due to the retail commercial attributes of the land use growth type [North Area Mandan Subarea study].
- » From 2013 to 2040 the volume on Sunset Street is expected to grow from 1,500 vpd to 11,500 vehicles per day (vpd) north of 27th Street NW [North Area Mandan Subarea study].
- » Between 27th Street and the I-94 ramps, Sunset Drive is expected to grow average daily traffic (ADT) from 9,500 vpd to 26,500 vpd from 2013 to 2040 [North Area Mandan Subarea study].
- » The annual average daily traffic (AADT) count between the I-94 Ramp and Old Red Trail on Sunset Drive was observed to be 14,300 vpd in 2019 [NDDOT geographic information system (GIS) Interactive Mapping].

Site Redevelopment & South Corridor Growth

The existing Mandan High School Site in the southwest quadrant of Sunset Drive and Division Street will be partially demolished and redeveloped when the new High School site opens in the fall of 2024. The new Mandan High School site will be located north of I-94 to the east of Sunset Drive at the intersection of 8th Avenue and Old Red Trail. It is anticipated that Sunset Drive will still carry fifty percent of school related traffic to the new site when it opens. The existing site does not have specific redevelopment plans at the time of this report, but the aquatic center and sports arena are planned to remain in operation. This leaves approximately fifteen to twenty acres for redevelopment with the opportunity to expand site development to the west. Additionally, there is potential to extend Division Street and Boundary Street to the west to facilitate more growth in the southern area of the corridor. Traffic and land use forecasts from relevant studies include:

- » Land use to the west of Sunset Drive between Division Street and the I-94 ramps is expected to grow between 100 and 250 new households from 2015 to 2040 [Envision 2040].
- » South of the I-94 ramps, Sunset Drive AADT would grow from 8,000 vpd to 14,300 vpd by 2040 [North Area Mandan Subarea study].
- » The AADT count between the I-94 Ramp and Division Street on Sunset Drive was observed to be 10,000 vpd in 2019 [NDDOT GIS Interactive Mapping].

RECENT PROJECT

In 2013, a roadway improvement project was completed on Sunset Drive/6th Avenue NW from north of 7th Street NW to approximately 1701 Sunset Drive (north driveway of the Buehler-Larson Funeral Parlor). Improvements included the removal and replacement of existing curb, gutter, driveways, sidewalks, roadway surfacing, landscaping, roadway lighting, and needed reconstruction of municipal utilities (water, sewer, and storm sewer).

PLANNED IMPROVEMENTS

Based on a review of the documents stated above, the following transportation projects have been identified for infrastructure improvements within the vicinity or directly on the study corridor. The planned construction year listed is based on information from the Arrive 2045 document (2020 update to the LRTP).

Adjacent to the Study Corridor

- » **Old Red Trail from Sunset Drive to ND 1806** (east of the study corridor) will be restriped to a 3-lane urban section in the short term (2024–2031 planned construction).
- » **Division Street from Sunset Drive to ND 1806** (east of the study corridor) will be reconstructed in the short term (2024–2031 planned construction).
- » **Boundary Street from 32nd Avenue to Sunset Drive** (west of the study corridor) will be constructed as a 3-lane urban section in the mid-term (2032–2038 planned construction).

Within Study Corridor

- » **Sunset Drive from Mandan Middle School to 38th Street** will be a new roadway connection constructed as a 2-lane urban section in the mid-term. This project is north of the study corridor and will create a new connection and have a major impact on traffic in future conditions (2032–2038 planned construction).
- » **27th Street N and Sunset Drive** will have an intersection capacity improvement. This is one of the study intersections for this project (2032–2038 planned construction).
- » **Boundary Street and Sunset Drive** will be signalized and stiped with turn lanes on all approaches. This project occurs at one of the study intersections (2032–2038 planned construction).
- » **Sunset Drive and the I-94 ramps** will have an interchange reconstruction. This project does not occur at a study intersection but is within the project corridor and will influence the study intersections and corridor operations. NDDOT is completing an interchange study at the same time as this corridor study (2039–2045 planned construction). Additionally, the Envision 2040 document classified the I-94 bridges as functionally obsolete in 2013.

Existing Conditions

Roadway Characteristics

FUNCTIONAL CLASS

Most streets and highways have a predominant function: either to provide the user with access to neighboring land or to allow movement through an area. Functional classification is an important and widely accepted tool in planning highway system development, as well as fiscal planning. The functional classifications of the corridor and the cross streets are shown in **Figure 9**. Within the corridor study limits, Sunset Drive NW is functionally classified as a principal arterial roadway south of the I-94 interchange and a collector and local roadway north of the I-94 interchange.

LAND USE

Land use can have many implications on the demands of adjacent transportation networks. 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.

The section of Sunset Drive south of Boundary Street NW is predominantly residential in nature. Generally, the housing types in this segment are predominantly single family with pockets of medium and high density residential. Vibra Hospital is located at the south-west corner of the intersection of Sunset Drive and Boundary Street NW and is designated “mixed use–commercial/residential.” North of Old Red Trail the land use is primarily commercial in nature immediately adjacent to the corridor. Even though the north area is predominantly commercial there is a 4 square block section of single family residential one block east of Sunset Drive on 27th Street. There is also high density residential on both the east and west sides of Sunset Drive between 27th Street and 31st Street.

There are several relevant institutional lands uses throughout the corridor. These include the following:

- » **Lewis & Clark Elementary** on the corner of 14th Street NW and 6th Avenue NW east of the corridor.
- » **Mandan High School** south of Division Street. The high school is planned to relocate to a new facility north of Interstate 94 to the east of Sunset Drive at the intersection of 8th Avenue and Old Red Trail for the 2024/2025 school year.
- » **Mandan Middle School** in the northeast corner of Sunset Drive and 27th Street opened relatively recently in 2008
- » **HIT Inc.** provides a variety of services to people with disabilities in western North Dakota. The corridor has two HIT sites. The first is in the south area of the corridor on 18th Street NW and the second is in the north area between Old Red Trail and 27th Street.
- » **Mandan Community Center** is located north of the existing Mandan High School site west of the corridor south of Division Street. The community center features an aquatic center and multipurpose gymnasium/auditorium space.
- » **Sunset Park** located just north of the Mandan Community Center, is an 80-acre park between Division Street and Boundary Street. The park has rough terrain trail loops, an 18-hole Frisbee Golf course, and skate park.
- » **Old Red Trail Section One** is a paved multi-use pathway that runs parallel to Old Red Trail connecting Collins Avenue to Sunset Drive and beyond. The southeast corner of the intersection of Sunset Drive and Old Red Trail is a key multimodal junction between the Parks and Recreation trails of Old Red Trail Section 1 and Sunset Park Walking Trail, which connects Old Red Trail to the Sunset Park under the I-94 bridges.
- » **Vibra Hospital of the Central Dakotas** is located in the southwest corner of Sunset Drive and Boundary Street.

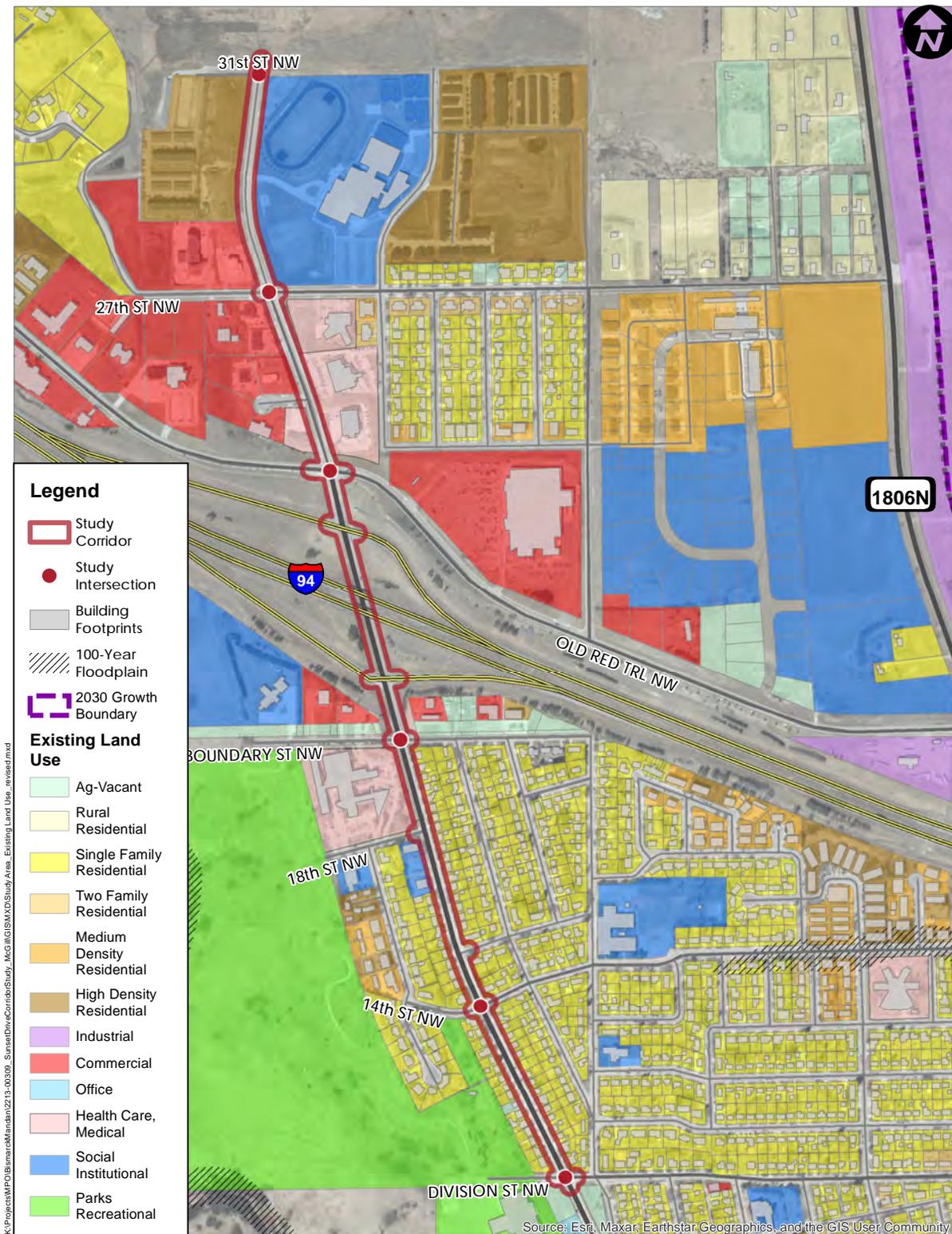
In addition to land use directly adjacent to the corridor it is also relevant to mention other land uses that are important to the corridor and rely on Sunset Drive for access. The first notable land use related to Sunset Drive is the central business district or “downtown” for the city of Mandan located along Main Street. Sunset Drive serves as an important north/south connection between downtown and the I-94 interchange for the west side of Mandan. Sunset Drive also serves as an important connection from I-94 to a variety of industrial land uses north of the I-94 ramps with Sunset Drive.

Figure 10 shows the existing land use along the Sunset Drive corridor.

Figure 9. Road Functional Classifications



Figure 10. Existing Land Use



CROSS SECTIONS

The corridor is a two-lane urban roadway from Division Street NW to the I-94 interchange, a three-lane urban section from the I-94 interchange to Old Red Trail NW, and a two-lane section from Old Red Trail to the north terminus. **Figure 11** and **Figure 12** show more detail of the existing cross sections south of I-94 and North of Old Red Trail.

Figure 11. Existing Cross-Section South of I-94

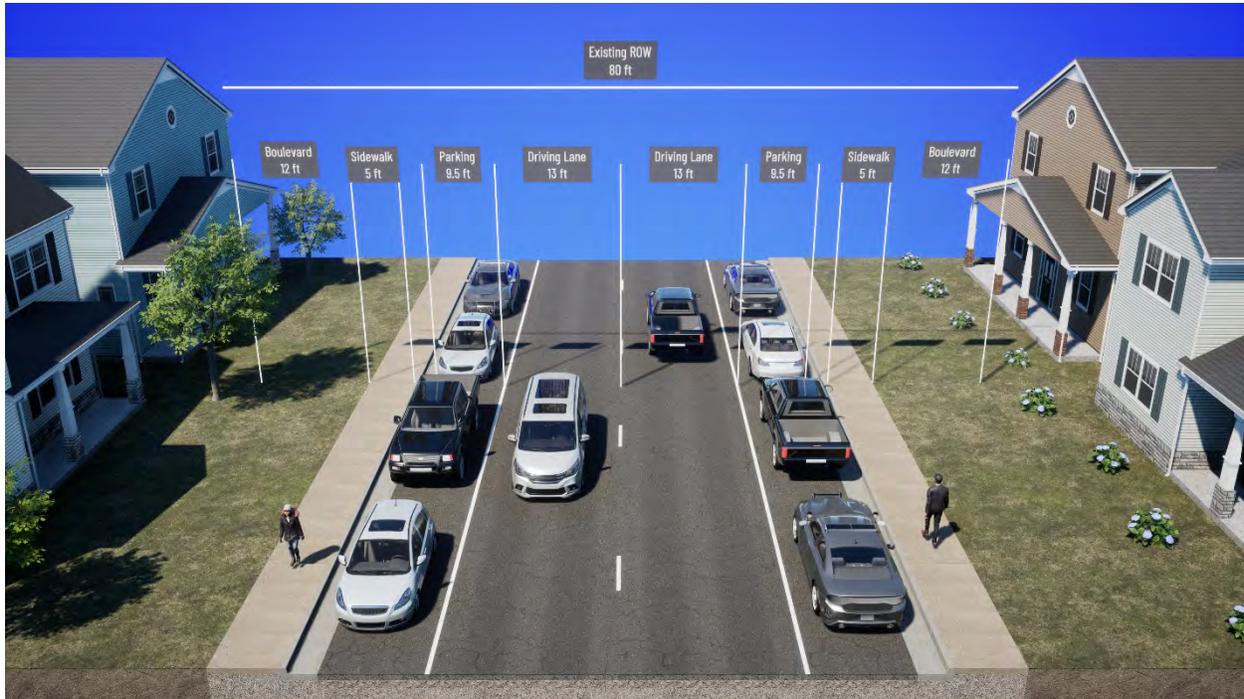
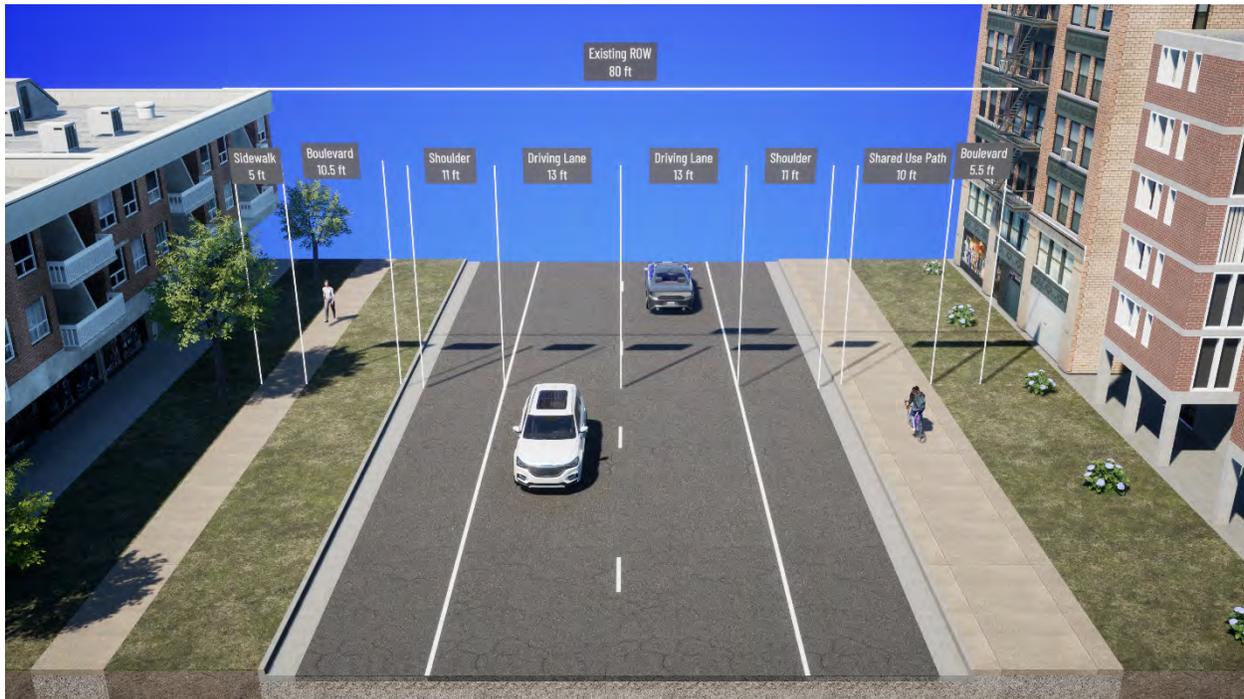


Figure 12. Existing Cross-Section North of Old Red Trail



SPEED

South of the I-94 interchange Sunset Drive has a posted speed limit of 25 mph, there are no speed limit signs near the interchange, and the posted speed limit reduces to 20 mph north of 27th Street. The speed limits along the roadways that are study intersections for the corridor include the following:

- » **Division Street** does not have a posted speed limit.
- » **14th Street** does not have a posted speed limit within one block of Sunset Drive. To the east past Monte Drive 14th Street has a 15-mph school zone speed limit when children are present.
- » **Boundary Street** has a posted speed limit of 25 mph.
- » **Old Red Trail** generally has a posted speed limit of 25 mph near the study corridor. Approximately 500 feet east of Sunset Drive the speed limit increases to 35 mph for eastbound traffic moving away from the study corridor. On the west side, the speed limit remains 25 mph moving away from the study corridor and there is a dynamic feedback message sign approximately 500 feet west of the Sunset Drive intersection for westbound traffic.
- » **27th Street** has a posted speed limit of 25 mph and near Mandan Middle School to the east of Sunset Drive there is a 20-mph school zone speed limit when children are present.
- » **31st Street** does not currently have a posted speed limit.

PAVEMENT CONDITIONS

In August of 2020, the BMMPO retained consultant services to perform a pavement condition assessment of the functionally classified roadways within the BMMPO's jurisdiction. PAVERTM was the pavement maintenance management system used to document the Pavement Condition Index (PCI). The PCI provides an indication of both the structural integrity and surface operational condition of the roadway. PCI values range from 0 (a failed pavement) to 100 (a pavement in excellent condition). The BMMPO sorts the range of PCI scores into the following three categories:

- » **Adequate:** PCI score between 71 and 100 with pavement that only needs preventative maintenance like crack sealing and surface treatment
- » **Degraded:** PCI score between 56 and 70 that needs preventative maintenance as well as localized repairs like full depth patching and thin overlays
- » **Unsatisfactory:** PCI score between 0 and 50 for pavement that needs major rehabilitation or reconstruction.

The PCI ratings for the Sunset Drive Corridor within the study limits are shown in **Figure 13**. It is notable that in 2013 the section of roadway in the corridor from Division Street to approximately 1701 Sunset Drive (north driveway of the Buehler-Larson Funeral Parlor) was reconstructed and resurfaced.

TRAFFIC CONTROLS

The corridor mainly has two way stop controlled (TWSC) intersections, with three signalized intersections at the I-94 East-Bound (EB) Ramp, I-94 West-Bound (WB) Ramp, and Old Red Trail. Boundary Street will likely become signalized in the future based on planned improvements from the Long-Range Transportation Plans. A full detailed image with all intersection control is shown below in **Figure 14**.

Figure 13. 2021 Pavement Conditions Index

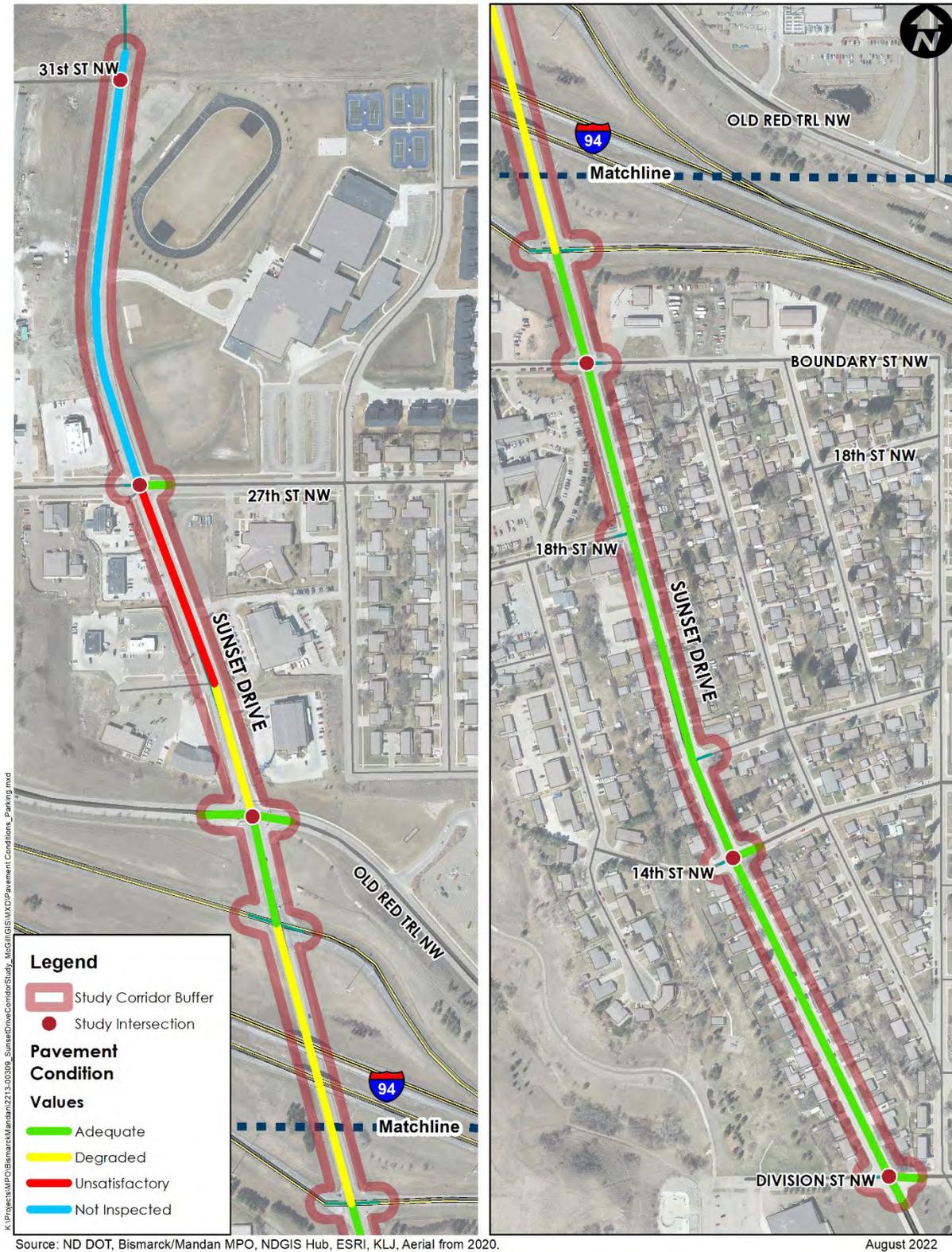


Figure 14. Traffic Control



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Source: ND DOT, Bismarck/Mandan MPO, NDGIS Hub, ESRI, KLJ, Aerial from 2020.

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PARKING

In general parking along Sunset Drive is not well defined with signage or pavement markings. Parking trends, concerns, and needs vary for the different segments of the corridor as follows:

- » The **south segment** of the corridor from Division Street to Boundary Street has no parking restrictions on Sunset drive with enough pavement to accommodate parking on both sides of the roadway. General observations have shown that parking is not fully utilized on both sides of Sunset Drive. The land adjacent to Sunset Drive for which parking demand is applicable is fully developed as single family residential and is not anticipated to change in the future.
- » The **middle segment** of the corridor from Boundary Street to Old Red Trail is not signed to restrict parking but the width of the roadway and nature of the land use near the I-94 interchange leads to no observations or need for on-street parking in this segment.
- » The **north segment** of the corridor from Old Red Trail to 31st Street NW is signed as “no parking any time,” however the width of the roadway contains space to accommodate parking on both sides of the street. One of the known issues for the corridor is parking in the north segment of the roadway. Many observations have been made that commercial business in the area do not have adequate on-site parking lots for peak hours and vehicles park on Sunset Drive. Additionally, observations have been made that parking occurs on-street for major events at the Mandan Middle School.

ACCESS MANAGEMENT

Access management is the process of balancing the competing needs of mobility 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.

NDDOT’s design manual states the minimum desirable spacing of access points in urban areas is 400 to 600 feet, which is approximately 8 to 13 per mile. North of Old Red Trail there are commercial driveways and public intersections with spacing ranging from 50 feet to 350 feet. South of Boundary Street the corridor has many residential driveway access points spaced less than 100 feet apart.

Figure 15 shows the existing access points along the corridor.

LIGHTING & UTILITIES

The lighting warrants used by NDDOT are primarily from American Association of State Highway Transportation Official’s (AASHTO’s) design guideline. Lighting of at-grade intersections are warranted if the geometric conditions mentioned in the *AASHTO Roadway Design Guide* exist, or if one or more conditions found in the *North Dakota Traffic Engineering Manual* exists. Intersection lighting is present at Old Red Trail, interchange lighting is present at the I-94 ramp intersections, and all unsignalized intersections are lit in conjunction with the continuous roadway lighting. Along the Sunset Drive corridor, the continuous roadway lighting has the following configuration:

- » From Division Street to 14th Street there are light poles on one side of the roadway spaced approximately 180 feet in the west edge of Sunset Drive.
- » From 14th Street to Boundary Street there are light poles on both side of the roadway spaced approximately 180 feet from each other in an alternating pattern on the west and east edge of Sunset Drive.
- » From Boundary Street to Old Red Trail the roadway is fully lit by interchange lighting at the I-94 ramps and intersection lighting at Old Red trail
- » From Old Red Trail to 31st Street there are light poles one side of the roadway spaced approximately 130 feet on the west edge of the roadway.

Underground utilities within the corridor are shown in **Figure 16**. In addition to the underground utilities, there is an overhead power-line that crosses the corridor running along the north edge of Boundary Street.

Figure 15. Access Locations

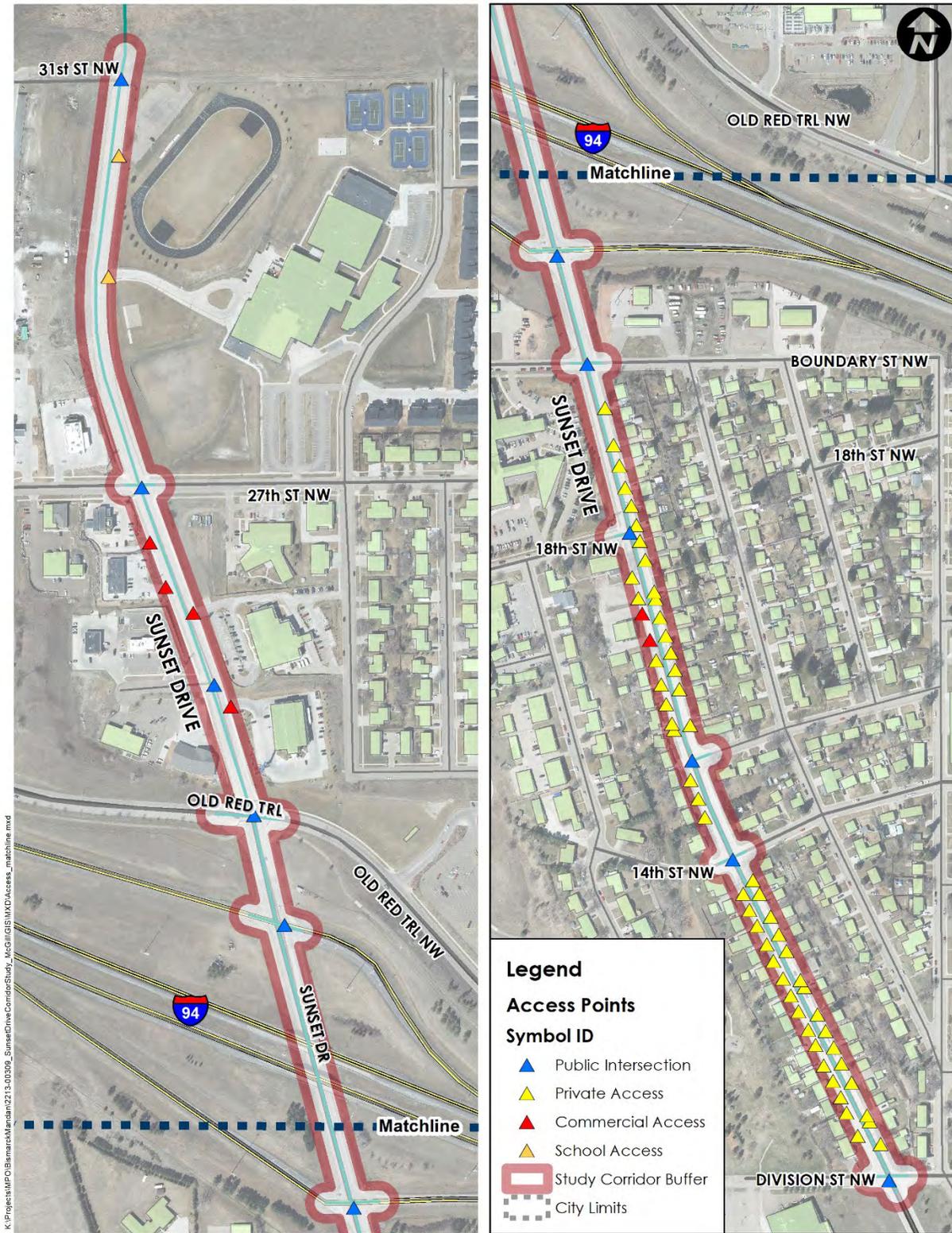
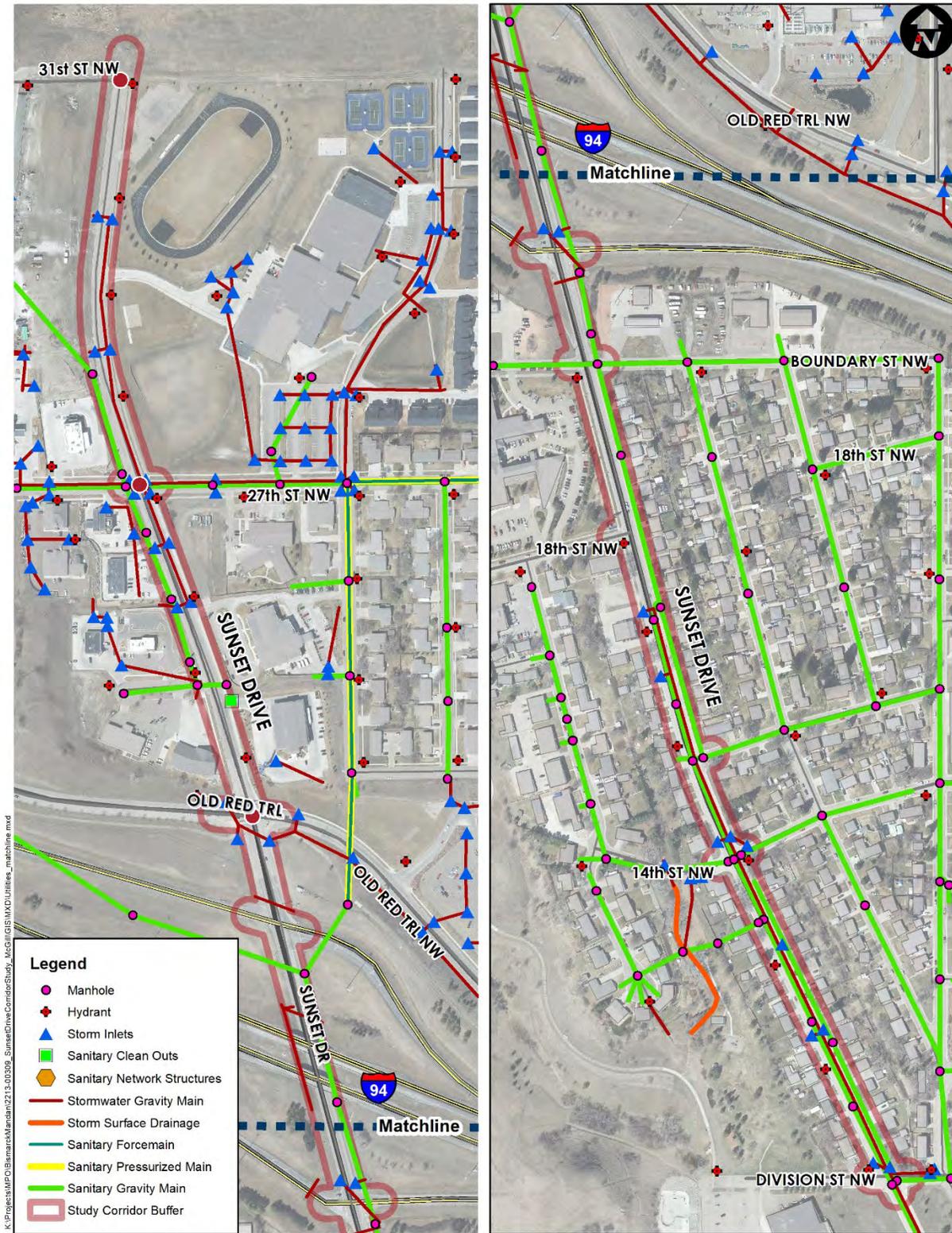


Figure 16. Underground Utilities



MULTIMODAL FACILITY

Of the 13 existing land use categories in the city of Mandan (**Figure 10**), the corridor is directly adjacent to seven of those land uses, which all produce and attract varying volumes of pedestrian and bicycle trips. To support these pedestrian and bicycle generators and destinations the corridor has many facilities to support the multimodal traffic, shown in **Figure 17**. The Bismarck-Mandan Bicycle +Pedestrian Plan completed in 2017, identified the top five prioritized multimodal routes and intersections in the city of Mandan. The analysis completed in this previous project included considerations for safety, accessibility, equity, mobility, and multimodal demand to identify where resources should be focused. Sunset Drive from 1st Street NW to Boundary Street was ranked the third most important route and the intersection of Sunset Drive and Old Red Trail was ranked the second most important intersection.

Currently along the corridor, there are the following existing multimodal facilities:

Sidewalks:

- » East/West sides of Sunset Drive between Division Street and Boundary Street NW
- » West side of the corridor from Old Red Trail to just north of 27th Street NW

A total of seven (7) marked crosswalk facilities at the intersections of:

- » 14th Street NW
- » Boundary Street NW
- » SE I-94 on-ramp
- » NE I-94 off-ramp
- » NW I-94 on-ramp
- » East side of corridor crossing 27th Street NW

Multi-Use Trails:

- » From Division Street (located west of the single-family residential area), north through park land to Boundary Street NW, then proceeding east, crossing Sunset Drive, and continuing north along the east side of the corridor and terminating at 31st Street NW.

TRANSIT

One of Bismarck-Mandan Public Transportation System's six (6) fixed routes runs along the corridor as shown in **Figure 11**. Capital Area Transit (CAT) Route 6 provides east-west service between Bismarck and Mandan. Route 6 serves the Bismarck State College as a major destination on the east side of the route and Mandan Aquatic Center, Skate Park and High School, as well as Vibra Hospital as major destinations on the west side. All Bismarck-Mandan Public Transportation fixed routes operate six days per week with no Sunday service. The routes generally run between 6:30 am to 7:00 pm on weekdays and 8:00 am to 7:00 pm on Saturdays. The system operates on a flag-stop system, where the bus can stop along the route to pick up passengers. The Mandan Community Center has a bus shelter located on Sunset Drive south of Division Street on the west side of Sunset Drive. According to the *Bis-Man Transit Development Plan* released in 2018, the purple line daily boardings averaged 50 on a weekday and 38 on Saturdays.

Data pulled specifically for the study from 1/1/2022 to 6/30/2022 showed there were 803 pick-ups around the Mandan Walmart and Mandan High School. This averages out approximately 4.5 boardings per day. As for the paratransit service, there were 752 pickups on Sunset Drive and 739 drop-offs in the month of June alone (2022). This equates to roughly 18% of total June paratransit ridership. Paratransit is significant within the corridor likely due to the hospital land use in the southwest corner of Boundary Street and Sunset Drive as well as HIIT Inc, which provides services to persons with disabilities and has two facilities within the study corridor.

Figure 17. Multimodal Facilities

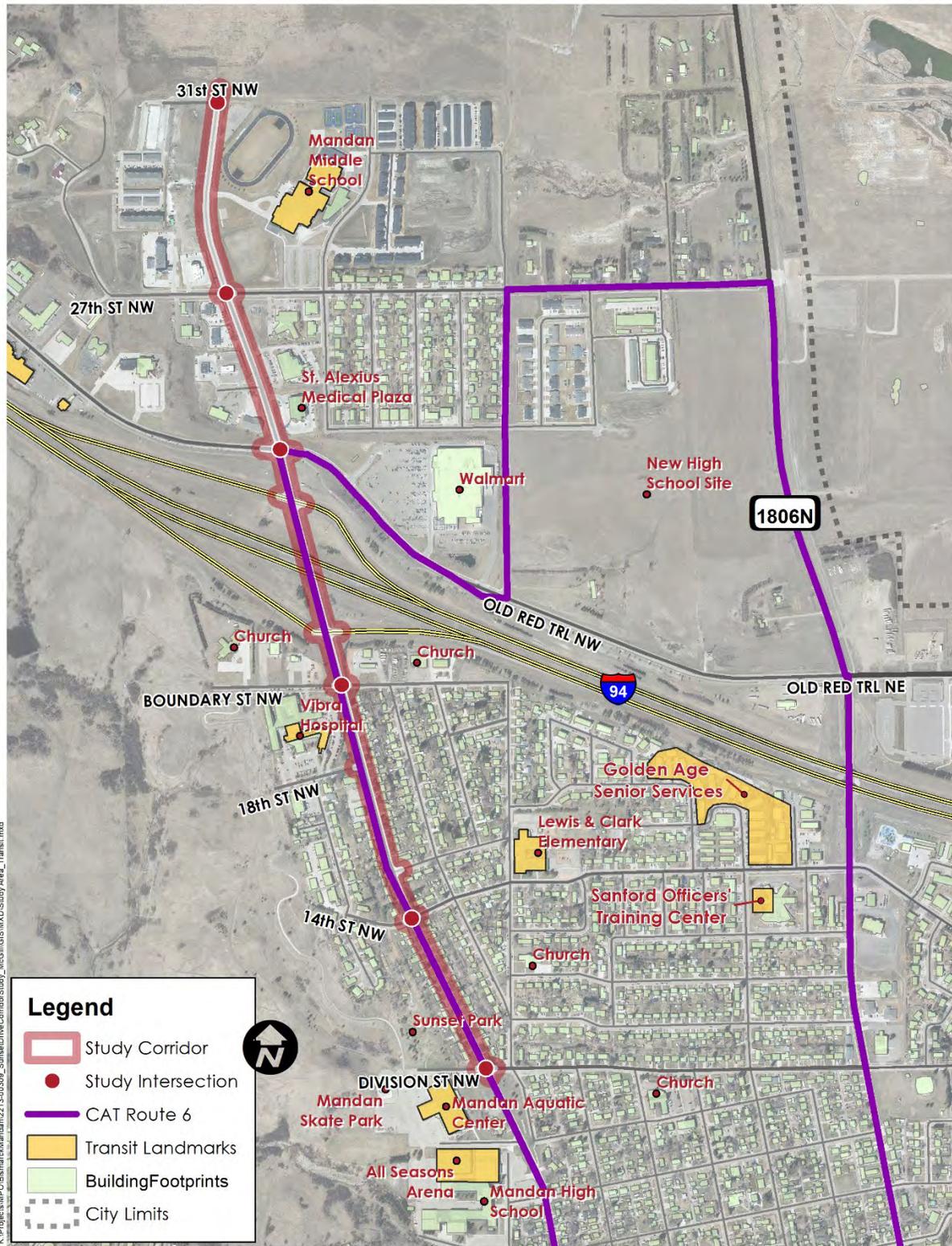


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Source: ND DOT, Bismarck/Mandan MPO, NDGIS Hub, ESRI, KLJ, Aerial from 2020.

May 2023

Figure 18. Transit Infrastructure



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Source: ND DOT, Bismarck/Mandan MPO, NDGIS Hub, ESRI, KLJ, Aerial from 2020.

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Crash Analysis

Reviewing historic crash information can help identify existing deficiencies that can be addressed through this study. Five years of crash records from January 1, 2017, through December 31, 2021, were requested from NDDOT. There were 111 crashes reported during this period in the study area (including the I-94 ramp intersections). This total corresponds to an average of 22 crashes per year with about 5.6 crashes per year resulting in an injury. There were no traffic fatalities or incapacitating/serious injury reported during the analysis period.

The 2018 FHWA's *Crash Costs for Highway Safety Analysis* methodology was used to estimate a crash cost of nearly \$229,560 per year associated with the Sunset Drive corridor. The five-year crash summary is shown in **Figure 19**. The number of crashes per year saw a peak in frequency in 2018 and have generally been declining in the past three years. Injury related crashes have remained consistent in frequency. Full detail crash reports are included in **the November 2022 Existing Conditions Report. Table 1** provides a summary of key findings of the analyzed crash data:

Figure 19. Five-Year Crash Summary (Year 2017–2021)

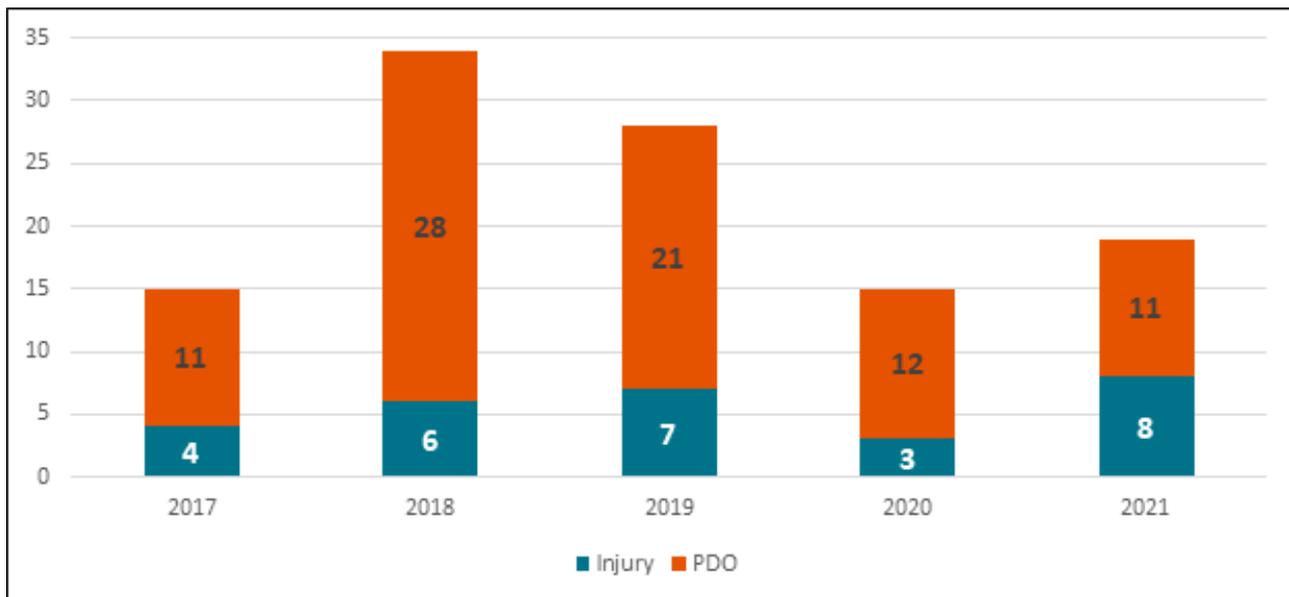
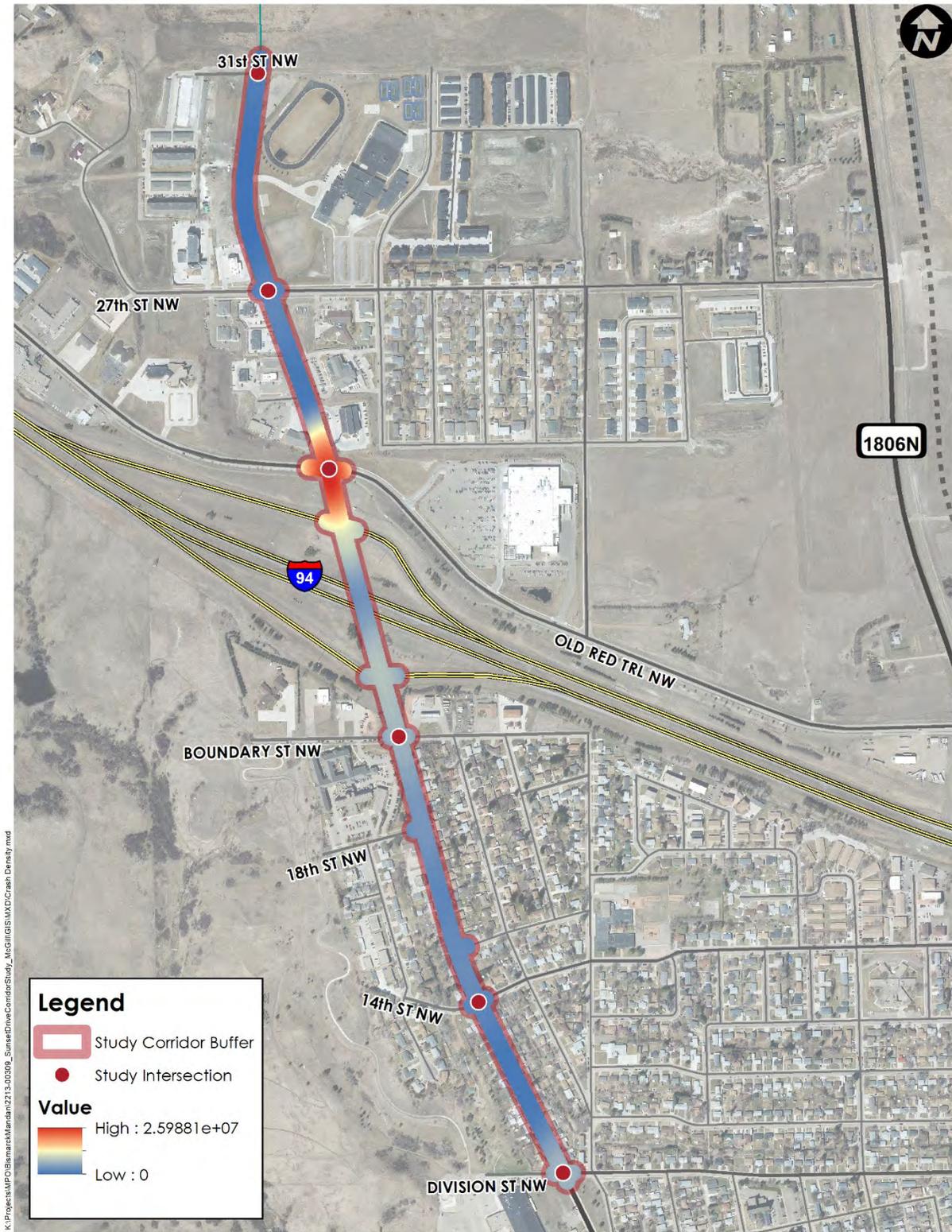


Table 3. High Level Crash Summary (Crashes from 2017–2021)

Total Crashes	111
Total crashes per year	22.2
Intersection Related	90 crashes or 81%
Roadway Related	21 crashes or 19%
Fatal or Serious Injury Crashes	None
Pedestrian/Bicycle related Crashes	None
Rear-End Crashes	52 crashes or 47%
Angle Crashes (Not Specific)	24 crashes or 22%
Angle Crashes (Left Turn)	10 crashes or 9%
Sideswipe Crashes	8 crashes or 7%
Single Vehicle Related Crashes	9 crashes or 8%
Backing	7 crashes or 6%
Other	1 crashes or 1%

The density of crashes along the corridor and the location of crash events are shown in **Figure 20**. The corridor experiences the highest crash density near the I-94 ramps and Old Red Trail intersection.

Figure 20. Crash Density



Source: ND DOT, Bismarck/Mandan MPO, NDGIS Hub, ESRI, KLJ, Aerial from 2020.

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CRASH PATTERNS

The corridor crashes by hour of the day were analyzed for the crash records. The frequency of crashes by the hour of the day is shown in **Figure 21**. Frequency of crashes are generally prevalent throughout the day. Most crashes occurred during the school PM peak between 3PM and 4PM. The next most significant time frame is the AM Peak hour between 8AM and 9AM. The remaining hours of the day have evenly distributed crash frequency within the most traveled half of the day between 7AM and 8PM. Nighttime and early morning crashes between 8PM and 7AM are low as expected based on traffic volumes.

Figure 21. Crashes by Hour of the Day

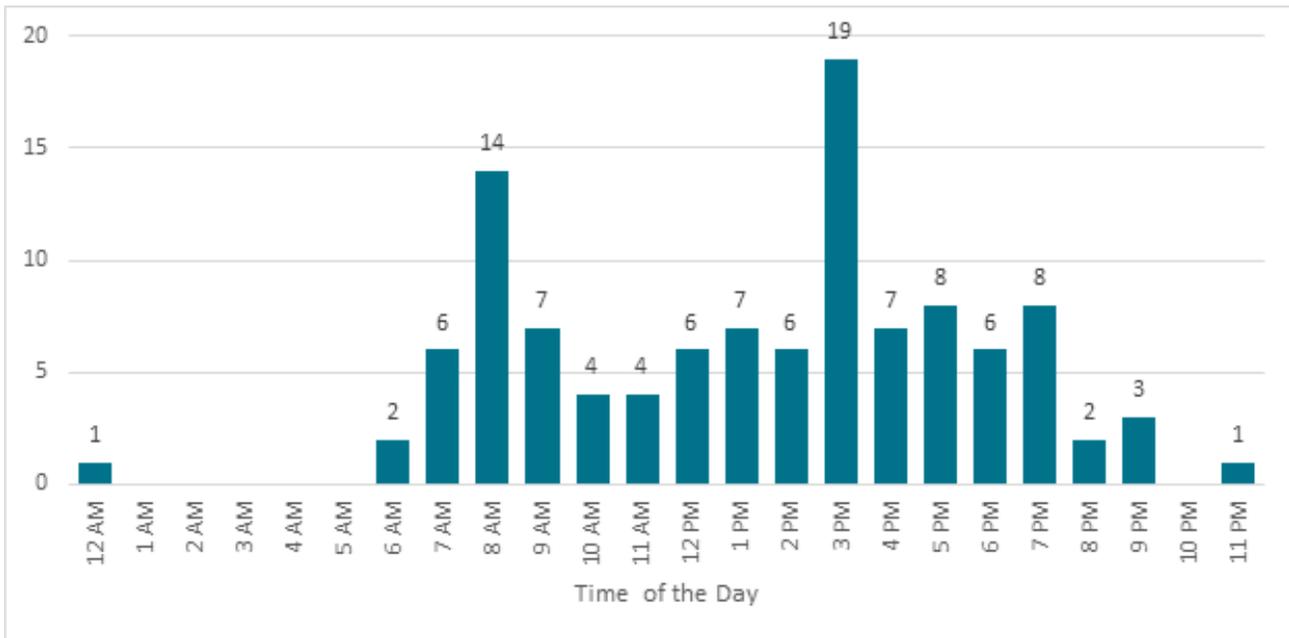
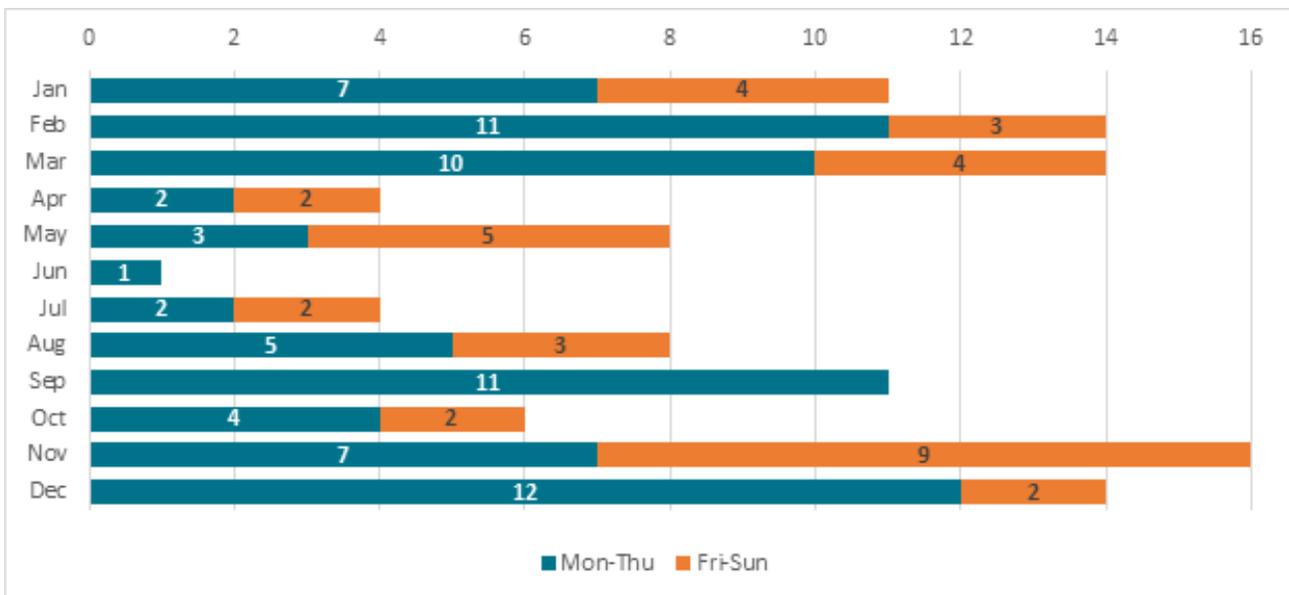


Figure 22 illustrates a peak in crashes during the colder months from November through March, followed by a lower crash frequency in the warmer months in the remainder of the year. Crash frequencies were generally much higher on weekdays, except for May and November.

Figure 22. Crashes by Month and Day of the Week



CRITICAL CRASH LOCATIONS

To identify overrepresented crash locations within the study intersections, the critical crash rate analysis method was used. Critical Crash Rate method is a suitable performance measure identified in the *Highway Safety Manual* (HSM). 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.

Critical Crash Rate is calculated using the following equation:

For Intersections:

For Segments:

$$CR_c = CR_A + \left[K \times \sqrt{\frac{CR_A}{MEV}} \right] + \left[\frac{1}{2 \times MEV} \right]$$

$$CR_c = CR_A + \left[K \times \sqrt{\frac{CR_A}{MEV}} \right] + \left[\frac{1}{2 \times MEV} \right]$$

Where

- CR_c = Critical Crash Rate for Intersection
- CR_A = Weighted average crash rate for the reference study
- MEV = Million Entering Vehicles. MEV is used as a scaling factor and is calculated by dividing the total number of vehicles per day per year by 1,000,000
- VMT = The measure of exposure is the total number of vehicles traveling on the road segment during the specified time period. This is called vehicle miles of travel (VMT). VMT is usually expressed as Million Vehicle Miles (MVM).
- K = P-value for the corresponding confidence level. A confidence level of 0.995 was used where $K = 2.576$

This method calculated crash rates and compared to a weighted average crash rate for the reference study. For intersections, the Bismarck/Mandan Intersection Study (completed in 2020) was consulted for local average crash rates for intersection of a similar type to those in the corridor. The average crash rate used for the signalized intersections 0.59 crashes per MEV and the average crash rate used for the TWSC intersections was 0.39 crashes per MEV. For roadway segments the average crash rate comes from the 2019 NDDOT Crash Summary Publication for the Vision Zero program. In this publication roadway crash rates were given on a county level. Morton County had a roadway crash rate of 1.49 crashes per million vehicle miles traveled (MVMT) which is slightly higher than the statewide crash rate of 1.44 crashes per MVMT. Since the county crash rate is higher than the statewide average, the statewide average will be used in the roadway comparison. The crash rates by intersection and segments are summarized in **Table 4** and **Table 5**, respectively.

Table 4. Intersection Crash Summary

Sunset Drive Intersection with	Traffic Control	MEV	# Crashes	Crash Rate		
				Observed	Average	Critical
Division Street	TWSC	17.4	8	0.46	0.39	0.80
14th Street	TWSC	18.0	3	0.17	0.39	0.8
15th Street	TWSC	16.4	1	0.06	0.39	0.82
18th Street	TWSC	18.5	1	0.05	0.39	0.79
Boundary Street	TWSC	21.7	8	0.37	0.39	0.76
I-94 EB	Signal	28.9	12	0.41	0.59	0.98
I-94WB	Signal	33.4	16	0.48	0.59	0.95
Old Red Trail	Signal	36.2	36	0.99	0.59	0.93
Overlook Lane	TWSC	12.2	1	0.08	0.39	0.89
27th Street	TWSC	10.4	2	0.19	0.39	0.94
31st Street	TWSC	1.1	2	1.87	0.39	2.41

Values Highlighted in **Red and White** represent intersections with crash rates greater than the benchmark

Old Red Trail is the only intersection that experienced a crash rate greater than the critical crash rate. Division Street and 31st Street are above the local average but below the critical crash rate.

Table 5. Segment Crash Summary

Segment from	Segment Type	VMT	# Crashes	Crash Rate		
				Observed	Average	Critical
Division Street to Boundary Street	2-lane Undivided	5.8	15	2.59	1.44	2.81
Boundary Street to Old Red Trail	2-lane Undivided	6.6	4	0.61	1.44	2.72
Old Red Trail to 31st Steet NW	2-lane Undivided	5.4	2	0.37	1.44	2.87

Values Highlighted in **Red and White** represent intersections with crash rates greater than benchmark rate for similar type of facility.

The segment from Division Street to Boundary Street experiences crash rates greater than the statewide average but less than the critical crash rate.

INJURY SEVERITY

There were no fatal or serious injury crashes reported during the analysis years. There were ten non-incapacitating and thirteen possible injury crashes throughout the corridor in five-year crash history. **Figure 23 on page 33** shows the crashes by injury severity in the corridor. There is no defined injury severity trend for the corridor.

CRASH TRENDS

Crash trends refer to statistically significant trends in crash attributes like location, time, contributing factors, manner of collision, vehicle direction, etc. Crash trends may represent a common crash type or attribute in the crash history or one that is overrepresented and not expected for a corridor of this type. The following lists the observed crash trends from the five-year history obtained for the study corridor. **Figure 24 on page 34** shows the crashes by collision type.

Cold Weather Surface Conditions

As stated above, the crash frequency was higher during the cold weather months from November through March. Of the 69 crashes that occurred during cold months, 39 of them (more than half) occurred with icy, snowy, slushy, or wet roadway surface conditions. Without crashes occurring with less-than-ideal surface conditions, the cold winter month crash frequency would fall more in trend with the warmer month data.

Rear End Crashes

Rear end crashes are the most predominant crash type in the corridor with 52 crashes (47% of the crash history). The most predominant locations and directions of the rear end crashes in the crash history were at the I-94 eastbound ramp and Old Red Trail. At the I-94

eastbound ramp there were ten rear end crashes in the southbound direction. At Old Red Trail there were nine rear end crashes in the eastbound direction and nine rear end crashes in the southbound direction. While these represent many rear end crashes, they are both signalized intersections near a major high volume highway ramp interchange, so the trend is common. In fact, 37 of the 52 rear end crashes occurred at the at the I-94 ramps and Old Red Trail signalized intersections.

Angle Crashes

Angle crashes were the second most predominant crash type with thirty-four crashes in the crash history (31%). Twenty-four of these crashes were not specified and likely occurred between two thru vehicles in opposing directions. Ten of the crashes occurred between a left turn and through vehicle. The angle crashes are generally spread out throughout the corridor and more concentrated around higher volume intersections

Backing Crashes

Within the corridor there were seven backing crashes. While this only makes up 6% of the crash history, backing crashes are an uncommon crash type to be repeated on a corridor in a short period of time. Two of the backing crashes occurred at intersections. The remaining five occurred along Sunset Drive in the south segment between Division Street and Boundary Street. Four of the seven crashes involved an eastbound or westbound vehicle backing out onto Sunset Drive and interacting with a vehicle traveling on the mainline. A high level of backing crashes indicated the need to consider parking and access as a high priority in the design and development of alternatives for the corridor.

Crashes with Parked Vehicles

There were seven crashes involving a parked vehicle in the corridor crash history. One crash involved a sideswipe of a parked vehicle in the segment north of Old Red Trail where parking is always prohibited. The remaining six crashes occurred in the south segment between Division Street and Boundary Street in a variety of collision types. There were two crashes where moving vehicle rear ended a parked vehicle, one crash where a moving vehicle backed into a parked vehicle, one sideswipe same direction, one sideswipe opposite direction, and one collision type other where a vehicle swerved to avoid rear ending a parked vehicle and hit a different parked vehicle in a driveway. The parking crash trend indicates that creating a well-defined parking space that is predictable for moving vehicles in the corridor, would be beneficial.

Crash Hotspots

Using the identified trends, additional analysis and evaluation was completed in the study area for the intersections and segments that experienced crash rates greater than the critical rate. This crash hotspot analysis is used to show specific combinations of crash type and direction to further understand the specific issues at the intersections and segment of the study corridor.

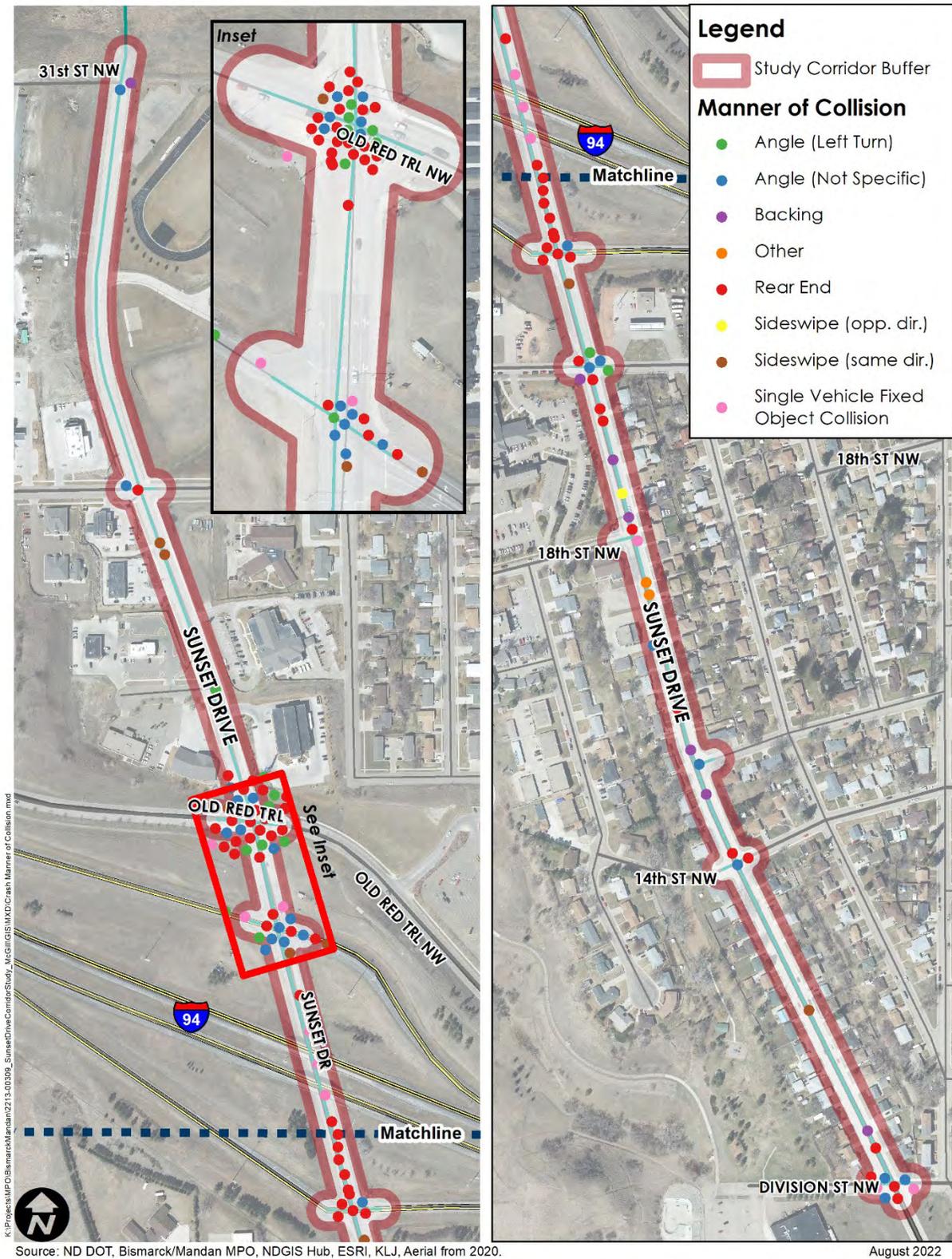
Old Red Trail. There were thirty-six crashes reported at the intersection of Old Red Trail during the analysis period. Rear end crashes were the predominant type of crashes (22 crashes or 61%) at the intersection. Most of the rear end crashes were along southbound (nine crashes) and eastbound approaches (nine crashes). A large portion of the rear end crashes (13) occurred in the dedicated southbound and eastbound right turn lanes. Rear end crashes at this location are likely due to congestion, especially unexpected congestion for right turns which drivers are not expecting stopping for. Angle crashes were the second most prominent type of crashes (12 crashes or 33%) at the intersection. This included 5 left turn crashes. The angle crashes are a variety of directions and the left turn crashes are split between minor and major left turn movements.

Sunset Drive from Division Street to Boundary Street. There were 15 crashes reported along the Sunset Drive between Division Street and Boundary during the analysis period that do not include intersection crashes at Division Street, 14th Street, 15th Street, 18th Street, or Boundary Street. The most predominant crash type was rear end crashes (6 of 15). Five of the six rear end crashes occurred in the northbound direction, and one occurred in the southbound direction. Two rear end crashes involved a parked vehicle, two involved a vehicle that was slowing or stopping to turn, and the remaining two involved both vehicles in motion. The second most predominant crash type in this segment was backing crashes. (5 of 15). The remaining four crashes include one angle crash, one type of other crash, one sideswipe same direction, and one sideswipe opposite direction crashes. Six of the segment crashes involved a parked vehicle.

Figure 23. Crash Injury Severity (Five Year Crashes from 2017-2021)



Figure 24. Collision Type (Five Year Crashes from 2017-2021)



Traffic Volumes

The data collection effort for this study looked at many different sources to quantify the traffic volumes on the Sunset Drive corridor. The source of intersection level Turning Movement Counts (TMCs) is shown described below. Raw traffic counts are included in the **November 2022 Existing Conditions Report**.

KLJ

- » KLJ collected TMCs on typical weekdays during September 2022.
- » Twenty four-hour traffic counts were collected for the following five intersections.
 - Division Street NW
 - 14th Street NW
 - Boundary Street
 - 27th Street NW
 - 31st Street NW

City of Mandan

- » TMCs for the following three intersections were provided to the consultant from data collected May 3rd, 2022.
 - I-94 East on/off ramp I-94 EB Ramp
 - I-94 West on/off ramp
 - Old Red Trail

AVERAGE DAILY TRAFFIC

The historic AADT was sourced from NDDOT’s Transportation Information Interactive Map to classify historic fluctuations. The most recent official NDDOT published AADTs are shown in **Figure 25**. From the traffic volumes collected for the traffic analysis, updated 2022 ADT values were created and are shown in **Figure 26**. The values in **Figure 26** are not annualized and are extrapolated from 13 hour counts for the locations where data was collected by KLJ.

Current ADT volumes along the corridor range from approximately 8,650 vpd on the south end of the corridor near Division Street, gradually increases to a maximum of 16,200 vpd between the I-94 ramps, decreases to 6,640 vpd north of Old Red Trail, then significantly drops off north of 27th Street to as low as 600 vpd near 31st Street. The existing AM and PM peak hour TMCs are presented in **Table 6** and **Table 7 on page 38**, respectively.

Table 6. Turning Movement Counts (AM Peak)

Sunset Dr Intersection	Control ¹	Northbound			Southbound			Eastbound			Westbound		
		L	T	R	L	T	R	L	T	R	L	T	R
Division St NW	SSS	24	461	9	8	428	148	17	13	19	21	2	3
14 th St NW	SSS	7	468	42	30	529	2	37	4	55	7	6	11
Boundary Rd	SSS	8	545	21	55	622	40	4	1	5	11	1	114
Old Red Trail	Signal	332	416	76	12	411	59	68	74	453	73	78	23
27 th St NW	SSS	45	51	374	5	55	1	2	8	55	356	15	8
31 st St NW	SSS	15	0	0	0	0	0	0	0	37	0	0	0
I-94 East on/off ramp	Signal	0	375	288	501	663	0	28	0	54	0	0	0
I-94 West on/off ramp	Signal	25	378	0	0	901	36	0	0	0	263	0	446

L – Left, T – Through, R – Right

1. SSS – side-street stop controlled.

Figure 25. Historic Annual Average Daily Traffic Volumes (AADT)



Figure 26. 2022 Average Daily Traffic Volumes (ADT)



Table 7. Turning Movement Counts (PM Peak)

Sunset Dr Intersection	Control ¹	Northbound			Southbound			Eastbound			Westbound		
		L	T	R	L	T	R	L	T	R	L	T	R
Division St NW	SSS	10	441	18	9	327	38	8	5	15	62	6	35
14 th St NW	SSS	8	470	43	33	330	4	32	2	50	2	3	7
Boundary Rd	SSS	13	551	21	42	411	22	30	2	8	5	2	77
Old Red Trail	Signal	250	307	227	45	286	30	37	87	312	143	74	53
27 th St NW	SSS	33	111	234	6	52	1	14	6	45	208	5	8
31 st St NW	SSS	21	0	0	0	0	0	0	0	14	0	0	0
I-94 East on/off ramp	Signal	0	429	229	369	455	0	31	0	20	0	0	0
I-94 West on/off ramp	Signal	25	435	0	0	685	56	0	0	0	139	0	349

L – Left, T – Through, R – Right

1. SSS – side-street stop controlled

TRAFFIC PATTERNS

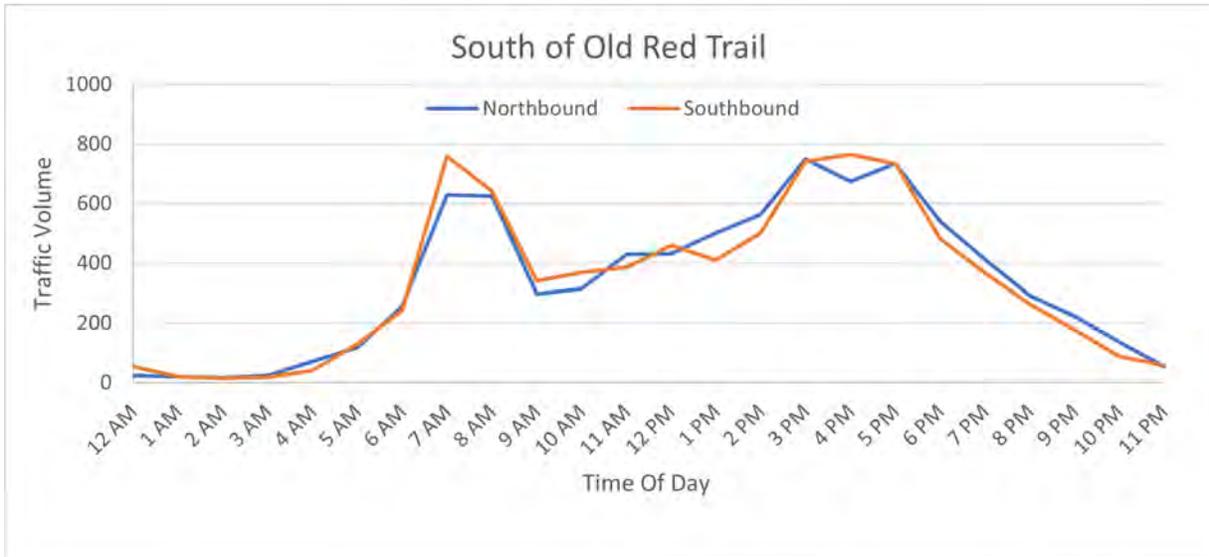
The existing daily hourly volume profile is shown in **Figure 27**. The Sunset Drive corridor has a lot of institutional land uses that it serves particularly the three nearby schools. As such the AM and PM peak hours experienced on the corridor are earlier than typical corridors in an urban setting. Based on the traffic data collected, the AM peak hour along the corridor occurs from 7:00 to 8:00 AM, while the PM peak occurs from 3:00 PM to 4:00 PM. Directional distribution is evenly split between northbound and southbound traffic throughout the day.

Figure 27. Traffic Hourly Volume Profile



(Continued)

(Continued)- Traffic Hourly Volume Profile



Capacity Analysis and Demand

The roadway capacity is defined as the maximum number of vehicles a street segment can accommodate. Existing traffic capacity and demands were analyzed along the corridor.

Planning Level Capacity Analysis

ADT volumes along Sunset Drive range from approximately 600 to 16,000 vpd. The corridor is an undivided two-lane facility with turn lanes only present at the I-94 ramps and Old Red Trail intersections. Typical planning level capacity thresholds by facility type are shown in **Table 8**.

Table 8. Planning Level Capacity Thresholds

Facility Type	LOS A	LOS B	LOS C	LOS D	LOS E	LOS F
Primary/Principal Arterial (5-lane)	< 11,400	< 18,200	< 29,100	< 32,600	< 36,300	< 36,300
Primary/Principal Arterial (4-lane)	< 7,600	< 12,100	< 19,400	< 23,300	< 27,600	< 27,600
Primary/Principal Arterial (3-lane)	< 4,900	< 7,900	< 12,700	< 17,000	< 21,100	< 21,100
Primary/Principal Arterial (2-lane)	< 3,100	< 5,000	< 8,000	< 12,000	< 15,900	< 15,900

SOURCE: FHWA, MnDOT and WSB & Associates

Based on this planning-level capacity approach, the Sunset Drive corridor operates between LOS D and LOS A, depending on the segment. A summary of the planning-level capacity analysis by segment is shown in **Table 9**.

Table 9. Planning Level Capacity Analysis

25 th Street Segment	Facility Type	ADT Volume	Planning-Level LOS
Division Street to Boundary Street	2-lane	8,650 to 9,610	LOS D
Old Red Trail to 27 th Street	2-lane	5,350 to 6,640	LOS C
27 th Street to 31 st Street	2-lane	600 to 1,290	LOS A

Intersection Capacity Analysis

Although the planning-level capacity can provide a good high-level measure of corridor operations, intersection operations often provide a clearer indication of corridor operations. Therefore, a detailed intersection capacity analysis was completed at the study intersections along Sunset Drive, to understand various performance metrics, including LOS, queuing, and travel time.

The intersection capacity analysis was completed using Synchro/SimTraffic Software (version 11), which incorporates methods outlined in the Highway Capacity Manual, 6th Edition. The software was used to develop calibrated models that simulate observed traffic operations and identify key metric such as intersection LOS and queues. These models incorporate collected traffic, pedestrian, and bicyclist volumes, traffic controls, and driver behavior factors. Existing signal timing provided by the city of Mandan was incorporated as well.

LOS quantifies how an intersection is operating. Intersections are graded from LOS A through LOS F, which corresponds to the average delay per vehicle value shown in **Table 10**. An overall intersection LOS A through LOS D is generally considered acceptable under North Dakota DOT standards. LOS A indicates the best traffic operation, while LOS F indicates an intersection where demand exceeds capacity.

LOS for TWSC intersection is undefined by Highway Capacity Manual (HCM). For TWSC intersections the through traffic on the major (uncontrolled) street generally experiences no delay at the intersection. Conversely, vehicles turning left or crossing the major street from the minor street, experience more delay than other movements, and at times can experience significant delay. Vehicles on the minor street, which are turning right, experience less delay than those turning left from the same approach. Due to these reasons, for side-street stop-controlled intersections, special emphasis is given to providing an estimate for the LOS of the side-street approach. It is typical of intersections with higher mainline traffic volumes to experience high-levels of delay (i.e., poor LOS) on the side-street approaches, but an acceptable overall intersection level of service during peak hour conditions.

Table 10. Intersection Level of Service Thresholds

Level of Service	Average Delay / Vehicle	
	Stop, Yield, and Roundabout Intersections	Signalized Intersections
A	< 10 seconds	< 10 seconds
B	10 to 15 seconds	10 to 20 seconds
C	15 to 25 seconds	20 to 35 seconds
D	25 to 35 seconds	35 to 55 seconds
E	35 to 50 seconds	55 to 80 seconds
F	> 50 seconds	> 80 seconds

The existing intersection capacity analysis shown **Table 11** indicates that all study intersections currently operate at an overall LOS C or better during the AM and PM peak hours. For full detailed Synchro results, refer to the **November 2022 Existing Conditions Report**.

Table 11. Existing Intersection Capacity Analysis

Sunset Dr Intersection	Traffic Control	AM Peak Hour	PM Peak Hour
Division St NW	SSS	C (24.7 sec)	B (11.6 sec)
14 th St NW	SSS	B (13.9 sec)	A (7.7 sec)
Boundary Rd	SSS	C (23.4 sec)	C (21.0 sec)
Old Red Trail	Signal	B (17.1 sec)	B (17.4 sec)
27 th St NW	SSS	B (14.3 sec)	A (8.3 sec)
31 st St NW	SSS	A (0.5 sec)	A (0.5 sec)
I-94 East on/off ramp	Signal	A (9.9 sec)	A (7.7 sec)
I-94 West on/off ramp	Signal	B (15.1 sec)	B (10.5 sec)

SSS – side street stop RAB – Roundabout

Note: LOS for a SSS is undefined by HCM. For SSS intersections, the LOS (delay) shown is for the worst side-street approach.

Corridor Travel Time

Corridor travel times and average arterial speed data was obtained from the calibrated SimTraffic modeling results. As shown in **Table 12**, average travel times through the 1.3-mile study corridor are approximately. The average travel speeds equate to approximately 21 to 23 mph.

Table 12. Corridor Travel Time and Average Speed

Sunset Dr Direction	AM Peak Hour		PM Peak Hour	
	Travel Time	Arterial Speed	Travel Time	Arterial Speed
Northbound	4 min. 11 sec.	21 mph	4 min. 11 sec.	21 mph
Southbound	3 min. 40 sec.	21 mph	3 min. 30 sec.	23 mph

Existing Conditions Summary

Roadway Characteristics

- » Within the corridor study limits, Sunset Drive NW is functionally classified as a principal arterial roadway south of the I-94 interchange and a collector and local roadway north of the I-94 interchange.
- » Sunset Drive south of Boundary Street NW is predominantly residential. North of Old Red Trail the land use is primarily commercial.
- » There are several relevant institutional lands uses throughout the corridor including the Lewis & Clark Elementary School, Mandan High School, Mandan Middle School, HIT Inc, Mandan Community Center, Sunset Park, Old Red Trail, and Vibra Hospital of the Central Dakotas
- » The corridor is an undivided two-lane facility with turn lanes only present at the I-94 ramps and Old Red Trail intersections.
- » The *Bismarck-Mandan Bicycle +Pedestrian Plan* completed in 2017 identified Sunset Drive from 1st Street NW to Boundary Street was ranked the third most important route and the intersection of Sunset Drive and Old Red Trail was ranked the second most important intersection.
- » Sidewalks are present on both sides of Sunset Drive between Division Street and Boundary Street, and on the west side of the roadway from Old Red Trail to 27th Street.
- » There are a total of seven marked crosswalks
- » The entire section of Sunset Drive has a posted speed limit of 25 mph.
- » South of Boundary Street the corridor has dense residential driveway access spacing less than 100 feet apart.
- » The corridor is well illuminated throughout.
- » The south segment of the corridor from Division Street to Boundary Street has no parking restrictions with enough pavement to accommodate parking on both sides of the roadway. General observations have shown that parking is consistently used but under capacity.
- » The north segment of the corridor from Old Red Trail to 31st Street NW is signed as “no parking any time,” however the width of the roadway contains space to accommodate parking on both sides of the street Observations have been made that on-street parking occurs in this section of the corridor even though it is prohibited.
- » The CAT bus route 6 runs along the corridor and provides service to the Mandan Community Center, Mandan High School, and Vibra Hospital.

Safety

- » There were 111 crashes reported in the study area (including the I-94 ramp intersections) for the five-year analysis period between 2017 and 2021.
- » There were no traffic fatalities or serious injury crashes reported during the analysis period.
- » There were no crashes involving bicyclists or pedestrian reported during the analysis period.
- » Rear end (52 crashes or 47%) and angle (34 crashes or 31%) crashes were the most typical crash types at the study intersections.
- » The segment of Sunset Drive from Division Street to Boundary Street has a 5-year historic crash rate higher than the statewide average but less than the critical crash rate.
- » Old Red Trail is the only intersections that experienced a crash rate greater than the critical crash rate. Division Street and 31st Street have crash rates above the local average but below the critical crash rate.
- » Other trends included seven crashes involving a vehicle packing and seven collision involving parked vehicles.

Traffic Volumes

- » The corridor carries between 8,000 vehicles daily in the south to 10,00 vehicles daily south of Boundary Street.
- » The corridor carries between 10,000 vehicles daily in the south to 16,00 vehicles daily within the I-94 interchange area between Boundary Street and Old Red Trail.
- » The corridor carries between 500 vehicles daily in the south to 7,000 vehicles daily north of Old Red Trail.
- » The AM peak hour along the corridor occurs from 7:00 to 8:00 AM, while the PM peak occurs from 3:00 PM to 4:00 PM. The earlier PM Peak hour is due to the adjacent schools to the corridor.
- » Traffic volumes are generally split evenly in the northbound and southbound directions throughout the day.

Capacity Analysis

- » Based on this planning-level capacity approach, the Sunset Drive corridor operates between the LOS A or LOS D range.
- » Based on existing conditions peak hour traffic analysis, Sunset Drive has peak hour traffic operations between LOS A and C for all locations within the AM and PM peak hour.
- » Average travel times through the 1.3 study corridor are approximately three and a half minutes to just over 4 minutes, plus or minus about 10 seconds. The average travel speeds equate to approximately 21 to 23 mph.

Future Conditions and Alternatives Analysis

The future reconstruction and reconfiguration of Sunset Drive NW creates an opportunity to reallocate the right-of-way to better serve changing transportation needs, particularly by studying proper lane striping, parking policy, and pedestrian infrastructure. When making infrastructure decisions, understanding future conditions, issues, and needs are important to ensure a fiscally responsible plan is in place in anticipation of future traffic growth and corridor characteristics.

The goal of the entire corridor study is to address the expanding needs of population growth and aging transportation infrastructure by producing a set of planning alternatives that give options for reconfiguring Sunset Drive to improve access, mobility, and safety. The objective of this report is to evaluate the future no build conditions of the corridor, develop the planning alternatives, evaluate the alternatives, and provide recommendations.

The corridor has three functionally distinct subareas that may have different recommendations and alternatives throughout the process of the corridor study. These include:

- » South Sunset Drive: Division Street to Boundary Street
- » I-94 Interchange Area: Boundary Street to Old Red Trail
- » North Sunset Drive: Old Red Trail to 31st Street NW

Forecasting

As Mandan continues to grow and develop, vehicular traffic on the Sunset Drive corridor will continue to increase. Therefore, year 2030 and 2045 traffic forecasts were developed, with a goal of identifying long-term corridor and intersection capacity needs within the study area. The following information provides an overview of the methodology, assumptions, and traffic forecasts.

Historic Traffic Growth

Historic traffic volumes on Sunset Drive show that the area surrounding the corridor, or origins and destinations related to the corridor, have seen growth in the past decade. **Table 13** shows the historic growth on Sunset Drive which generally ranges from 1.5% to 5% annually. North of 27th Street has a large AADT growth due to business development directly adjacent to the corridor. It is also noteworthy that in 2008 Mandan Middle School relocated adjacent to the corridor in the northwest corner of the Sunset Drive and 27th Street intersection from the old school site south of the study corridor between Sunset Drive and Collins Avenue on 4th Street NW. Additionally the Wal-Mart Super Center east of the corridor, north of I-94, on Old Red Trail opened in 2013. These are just two of the many destinations that the corridor north of interstate 94 has seen development and increased traffic growth in the last decade.

Table 13. Historic Traffic AADTs

Sunset Drive Segment	2009 AADT	2014 AADT	2022 ADT	2009–2022 Annual Growth Rate	2014 Annual Growth Rate 2022
South of Division Street	5,405	N/A	8,640	3.7%	N/A
Division Street to 14 th Street	N/A	N/A	9,070	N/A	N/A
14 th Street to Boundary Street	N/A	6,960	9,610	N/A	2.6%
Boundary Street to EB-I94 ramps	7,355	9,575	11,200	3.3%	1.5%
EB-I94 ramps to WB I-94 ramps	8,620 ¹	10,600	13,100	3.0%	2.0%
WB I-94 ramps to Old Red Trail	8,170	12,850	16,200	5.4%	1.6%
Old Red Trail to 27 th Street	1,530	5,880	6,640	12.0%	4.8%
North of 27 th Street	N/A	N/A	1,290	N/A	N/A

1- Actual AADT count year for this location is 2008

Future Traffic Growth

The main tool used to predict future traffic growth for the corridor was the Bismarck-Mandan Metropolitan Organization 2030 and 2045 travel demand models. The travel demand models are used to develop traffic forecasts based on expected growth in jobs and households. The model was used to estimate the percent increase in daily intersection volumes with some manual adjustments based on historic traffic growth. The most recent travel demand models were completed in 2016 with the available data and knowledge at the time. Since 2016, the corridor has experienced growth beyond the expectations and data inputs of the model. **Table 14** and **Figure 28** show the expected 2022 ADT volumes from the model compared to the data collected for this corridor study. On average, the data collected was 20% higher along the Sunset Drive corridor than the 2016 Travel Demand Model projected for 2022.

Table 14. 2022 Expected Traffic Volume Versus 2022 Collected Traffic Volume

Sunset Drive Segment	2022 Travel Demand Model Expected ADT	2022 ADT	% Difference
South of Division Street	6,990	8,640	124%
Division Street to 14 th Street	6,942	9,070	131%
14 th Street to Boundary Street	7,681	9,610	125%
Boundary Street to EB-I94 ramps	10,289	11,120	108%
EB-I94 ramps to WB I-94 ramps	11,406	13,100	115%
WB I-94 ramps to Old Red Trail	13,464	16,200	120%
Old Red Trail to 27 th Street	4,834	6,640	137%
North of 27 th Street	N/A	1,290	N/A

Based on this information, the ADTs used to produce turning movement counts from the Travel Demand model were adjusted up 20% for the 2030 year, then the growth trend of the model was followed from 2030 to 2045. This methodology resulted in the peak-hour turning movement counts shown in **Tables 13–16**. Three of the four future growth scenarios include the extension of Sunset Drive from 31st Street to 38th Street shown in **Figure 29 on page 46**. The future ADTs are shown in **Figure 30 on page 49** for the following growth scenarios:

- » 2030: No Sunset Drive Extension
- » 2030: Sunset Drive Extension
- » 2045: Base Scenario (includes Sunset Drive Extension)
- » 2045: Full Buildout (includes Sunset Drive Extension)

The Sunset Drive Extension is shown in **Figure 29**.

Figure 28. 2022 ADT Increase compared to Travel Demand Model Existing (2016) Volumes



Figure 29. Sunset Drive Extension



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Table 15. 2030 – No Sunset Drive Extension Growth Scenario – Peak-Hour Turn Movement Counts

Sunset Dr Intersection	Northbound			Southbound			Eastbound			Westbound		
	L	T	R	L	T	R	L	T	R	L	T	R
AM Peak-Hour												
Division St NW	26	499	11	10	463	159	18	25	21	26	4	4
14 th St NW	7	500	45	35	565	2	41	5	56	8	8	13
Boundary St	8	611	22	65	698	47	5	1	5	11	1	134
I-94 East on/off ramp	0	437	305	520	773	0	33	0	67	0	0	0
I-94 West on/off ramp	29	421	0	0	1004	40	0	0	0	276	0	458
Old Red Trail	353	433	86	13	427	57	66	82	481	83	86	25
27 th St NW	50	58	410	5	63	1	2	8	61	390	16	9
31 st St NW	17	0	0	0	0	0	1	0	43	0	0	0
PM Peak-Hour												
Division St NW	11	477	22	11	354	41	9	9	16	77	11	43
14 th St NW	8	502	46	38	353	4	35	3	51	2	4	8
Boundary St	13	618	22	49	461	26	35	2	8	5	2	90
I-94 East on/off ramp	0	500	243	383	531	0	36	0	25	0	0	0
I-94 West on/off ramp	29	485	0	0	763	63	0	0	0	146	0	358
Old Red Trail	266	319	258	49	297	29	36	96	331	163	82	57
27 th St NW	37	127	256	7	60	1	16	6	50	228	5	9
31 st St NW	24	0	0	0	0	0	0	0	16	0	0	0

Table 16. 2030 – Sunset Drive Extension Scenario – Peak-Hour Turn Movement Counts

Sunset Dr Intersection	Northbound			Southbound			Eastbound			Westbound		
	L	T	R	L	T	R	L	T	R	L	T	R
AM Peak-Hour												
Division St NW	26	512	11	10	475	165	19	25	21	27	4	4
14 th St NW	7	519	47	36	587	2	42	5	58	8	8	13
Boundary St	9	635	23	67	725	49	5	1	5	12	1	138
I-94 East on/off ramp	0	471	328	584	832	0	36	0	68	0	0	0
I-94 West on/off ramp	32	464	0	0	1107	44	0	0	0	297	0	489
Old Red Trail	374	503	91	15	497	65	75	81	511	88	85	28
27 th St NW	65	85	500	7	92	2	3	8	79	476	15	11
31 st St NW	17	79	15	12	79	20	20	0	47	15	0	12
PM Peak-Hour												
Division St NW	11	490	23	11	363	42	9	10	17	78	12	45
14 th St NW	8	522	48	39	366	5	37	3	53	2	4	8
Boundary St	14	642	23	51	479	27	37	2	9	5	2	93
I-94 East on/off ramp	0	538	261	430	571	0	40	0	25	0	0	0
I-94 West on/off ramp	32	534	0	0	842	68	0	0	0	157	0	383
Old Red Trail	282	371	272	55	346	33	41	95	352	172	81	65
27 th St NW	47	185	313	8	87	2	23	6	65	278	5	11
31 st St NW	26	90	11	14	90	23	23	0	19	11	0	14

Table 17. 2045 – Base Growth Scenario – Peak-Hour Turn Movement Counts

Sunset Dr Intersection	Northbound			Southbound			Eastbound			Westbound		
	L	T	R	L	T	R	L	T	R	L	T	R
AM Peak-Hour												
Division St NW	30	592	12	11	550	191	22	18	24	27	3	4
14 th St NW	9	622	55	43	703	3	51	6	68	9	9	16
Boundary St	10	757	27	77	864	57	6	1	6	14	1	160
I-94 East on/off ramp	0	544	372	652	962	0	43	0	84	0	0	0
I-94 West on/off ramp	38	539	0	0	1284	53	0	0	0	341	0	574
Old Red Trail	441	594	110	18	587	77	89	98	601	105	104	35
27 th St NW	76	120	580	10	129	3	6	9	92	552	16	16
31 st St NW	17	121	35	32	121	20	20	0	47	35	0	32
PM Peak-Hour												
Division St NW	12	566	23	12	420	49	10	7	19	80	8	12
14 th St NW	10	625	56	48	439	6	44	3	62	3	4	10
Boundary St	17	765	27	59	571	31	43	2	10	6	2	17
I-94 East on/off ramp	0	623	296	481	660	0	47	0	31	0	0	0
I-94 West on/off ramp	38	620	0	0	976	83	0	0	0	180	0	38
Old Red Trail	332	438	328	68	408	39	48	116	414	207	98	332
27 th St NW	55	261	363	12	122	3	40	7	76	323	5	55
31 st St NW	26	138	32	36	138	22	22	0	19	32	0	26

Table 18. 2045 – Full Buildout Scenario – Peak-Hour Turn Movement Counts

Sunset Dr Intersection	Northbound			Southbound			Eastbound			Westbound		
	L	T	R	L	T	R	L	T	R	L	T	R
AM Peak-Hour												
Division St NW	31	631	12	12	585	204	23	20	25	29	3	4
14 th St NW	9	684	59	48	774	3	57	6	73	10	9	18
Boundary St	11	835	30	83	953	62	6	1	7	16	1	172
I-94 East on/off ramp	0	582	396	680	1029	0	45	0	90	0	0	0
I-94 West on/off ramp	40	565	0	0	1347	55	0	0	0	364	0	607
Old Red Trail	461	621	115	19	614	81	94	103	629	110	109	36
27 th St NW	79	128	601	11	138	3	6	9	97	572	16	17
31 st St NW	17	137	37	33	137	21	21	0	47	37	0	33
PM Peak-Hour												
Division St NW	13	603	25	13	447	52	11	8	20	86	9	51
14 th St NW	11	687	60	53	483	6	49	3	66	3	5	11
Boundary St	19	844	30	63	629	34	46	2	11	7	2	116
I-94 East on/off ramp	0	666	315	501	706	0	50	0	34	0	0	0
I-94 West on/off ramp	40	650	0	0	1024	86	0	0	0	192	0	475
Old Red Trail	347	458	342	71	427	41	51	121	433	215	103	84
27 th St NW	58	278	376	13	130	3	42	7	79	334	5	17
31 st St NW	26	157	36	38	157	24	24	0	19	36	0	38

Figure 30. Future Traffic Growth Scenario ADTs



Planned Infrastructure Improvements & Development

There is current interest to develop nearly 550 acres of land adjacent to the corridor north of 31st Street. **Figure 31** shows the proposed development plan of the area. Based on conversation with the steering committee for this project, it was assumed that approximately 1/3rd of development should be considered for the High Growth 2045 Sunset Drive Extension Scenario. Upon review of the data, it was determined that a sensitivity analysis would be completed by adding 2,500 ADT to Sunset Drive north of 31st Street to the High Growth 2045 Sunset Drive Extension Scenario. **Table 19** shows the expected daily volumes north of 31st street (Sunset Drive Extension) for the four growth scenarios with the addition of the Sensitivity Analysis growth scenario. **Table 20** shows the expected peak-hour turn movements for the Sensitivity Analysis growth scenario. It should be noted that only the PM peak-hour was evaluated for the Sensitivity Analysis. The additional development traffic of the Sensitivity Analysis assumed that 75% of the additional 2,500 daily trips would approach/exit the developed area via I-94 and 25% via Sunset Drive to the south towards downtown Mandan.

Figure 31. Sunset Drive Extension Potential Development Plan

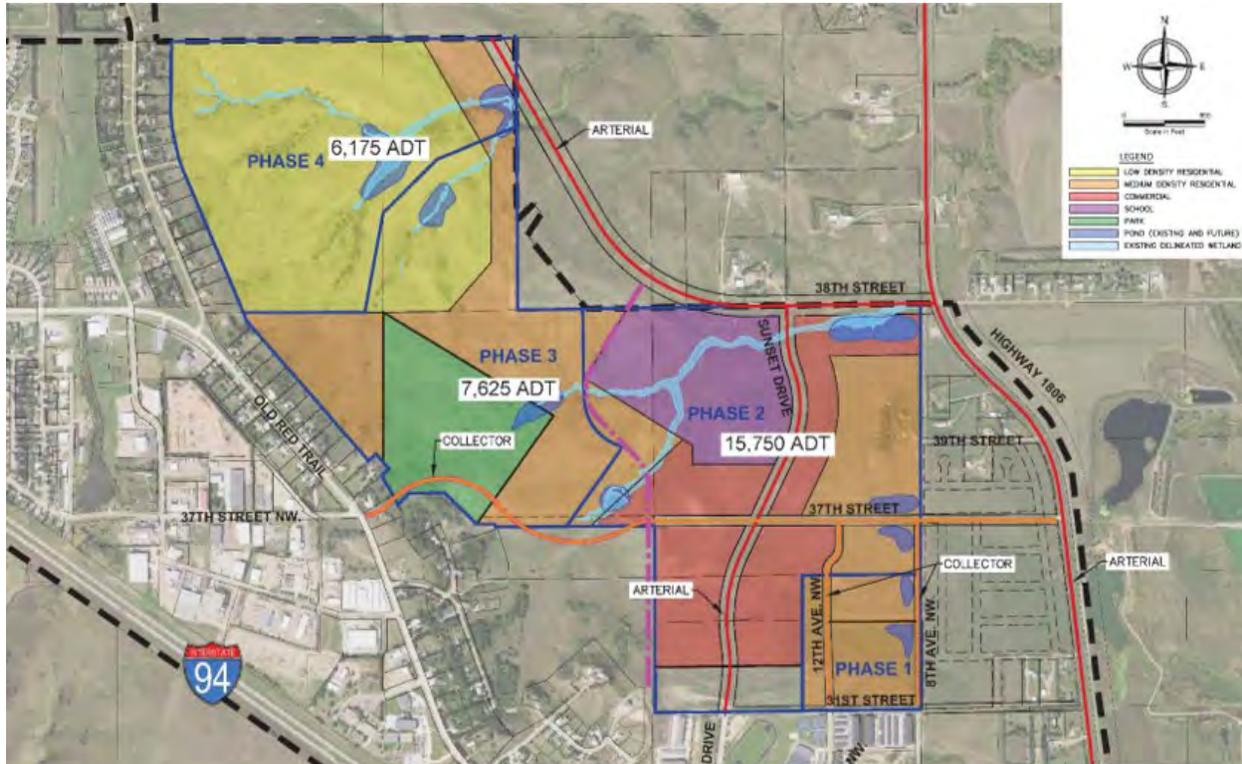


Table 19. Sunset Drive Extension Expected ADTs

Growth Scenario	Expected ADT on Sunset Drive North of 31 st Street
2030 – No Sunset Drive Extension	0
2030 – Sunset Drive Extension	2,550
2045 – Base Scenario	3,950
2045 – Full Buildout	4,500
2045 Sensitivity Analysis	7,000

Table 20. 2045 – Sensitivity Analysis Scenario Peak-Hour Turn Movement Counts

Sunset Dr Intersection	Northbound			Southbound			Eastbound			Westbound		
	L	T	R	L	T	R	L	T	R	L	T	R
PM Peak-Hour												
Division St NW	5	615	30	25	455	45	10	10	10	100	50	95
14 th St NW	5	705	50	100	550	10	60	50	20	2	5	20
Boundary St	10	815	15	60	715	30	40	0	5	5	0	95
I-94 East on/off ramp	0	670	280	465	750	0	90	0	55	0	0	0
I-94 West on/off ramp	70	690	0	0	1040	170	0	0	0	175	0	495
Old Red Trail	310	500	375	90	575	45	55	110	395	240	95	105
27 th St NW	30	385	245	30	445	5	40	0	35	255	0	35
31 st St NW	30	365	50	40	375	25	25	5	30	50	5	40

No Build Traffic Analysis

The intersection capacity analysis was completed using Synchro/SimTraffic Software (version 11), which incorporates methods outlined in the Highway Capacity Manual, 6th Edition. The software was used to develop calibrated models that simulate observed traffic operations and identify key metrics such as intersection LOS and queue lengths. These models incorporate collected traffic, traffic controls, and driver behavior factors. Existing signal timing provided by the City of Mandan was incorporated as well. LOS quantifies how an intersection is operating. Intersections are graded from LOS A through LOS F, which corresponds to the average delay per vehicle value shown in **Table 21**. An overall intersection LOS A through LOS D is generally considered acceptable under North Dakota DOT standards. LOS A indicates the best traffic operation, while LOS F indicates demand which exceeds capacity.

Table 21. Intersection Level of Service Thresholds

Level of Service	Average Delay / Vehicle	
	Stop, Yield, and Roundabout Intersections	Signalized Intersections
A	< 10 seconds	< 10 seconds
B	10 to 15 seconds	10 to 20 seconds
C	15 to 25 seconds	20 to 35 seconds
D	25 to 35 seconds	35 to 55 seconds
E	35 to 50 seconds	55 to 80 seconds
F	> 50 seconds	> 80 seconds

LOS for a two-way stop-controlled intersection is undefined by the HCM. For TWSC intersections the through traffic on the major (uncontrolled) street generally experiences no delay at the intersection. Conversely, vehicles turning left or crossing the major street from the minor street, experience more delay than other movements, and at times can experience significant delay. Due to these reasons, for side-street stop-controlled intersections, special emphasis is given to providing an estimate of the LOS for the side-street approach. Side-street stop-controlled intersection capacity is reported as the worst approach delay and LOS instead of an intersection average. **Table 22** shows the no-build results for the four growth scenarios and the PM peak-hour results for the Sensitivity Analysis.

Table 22. 2030 No-Build Intersection Capacity Analysis

2030 Year Scenarios					
Sunset Dr Intersection	Traffic Control	2030 – No Extension		2030 – Sunset Dr Extension	
		AM Peak-Hour	PM Peak-Hour	AM Peak-Hour	PM Peak-Hour
Division St NW	SSS	C (18 sec)	C (16 sec)	D (26 sec)	C (20 sec)
14 th St NW	SSS	B (15 sec)	B (10 sec)	C (16 sec)	B (12 sec)
Boundary St	SSS	F (63 sec)	C (25 sec)	F (100 + sec)	F (70 sec)
I-94 East on/off ramp	Signal	B (12 sec)	B (10 sec)	B (15 sec)	B (11 sec)
I-94 West on/off ramp	Signal	B (16 sec)	B (11 sec)	B (18 sec)	B (15 sec)
Old Red Trail	Signal	C (20 sec)	B (18 sec)	C (23 sec)	C (20 sec)
27 th St NW	SSS	C (16 sec)	B (10 sec)	F (61 sec)	B (16 sec)
31 st St NW	SSS	A (1 sec)	A (1 sec)	A (4 sec)	A (4 sec)

SSS - side street stop control

2045 Year Scenarios						
Sunset Dr Intersection	Traffic Control	2045 - Base Growth		2045 – Full Buildout		Sensitivity Analysis
		AM Peak-Hour	PM Peak-Hour	AM Peak-Hour	PM Peak-Hour	PM Peak-Hour
Division St NW	SSS	D (35 sec)	D (28 sec)	D (30 sec)	D (32 sec)	F (66 sec)
14 th St NW	SSS	D (25 sec)	D (19 sec)	E (36 sec)	D (30 sec)	F (98 sec)
Boundary St	SSS	F (100+ sec)	F (100+ sec)	F (100+ sec)	F (100+ sec)	F (100+ sec)
I-94 East on/off ramp	Signal	C (27 sec)	B (14sec)	C (30 sec)	B (19 sec)	B (16 sec)
I-94 West on/off ramp	Signal	C (24 sec)	C (25 sec)	C (25 sec)	C (29 sec)	D (43 sec)
Old Red Trail	Signal	D (46 sec)	C (24 sec)	D (49 sec)	C (29 sec)	D (40 sec)
27 th St NW	SSS	F (100+ sec)	F (83 sec)	F (100+ sec)	F (96 sec)	F (100+ sec)
31 st St NW	SSS	A (5 sec)	A (5 sec)	A (5 sec)	A (5 sec)	B (11 sec)

SSS - side street stop control

Alternatives Analysis

The no-build analysis was completed with the use of Sychro using Highway Capacity Software (HCS) methodology. For the alternatives analysis the traffic operations were evaluated using SimTraffic, which is a microsimulation add-on to the Synchro. SimTraffic models individual vehicle movements while tracking and compiling delay, queue, and travel time data for all traffic entering the simulation. SimTraffic is a more time intensive technique that can provide better data for less traditional intersection control and more complex traffic patterns, which is why it was used in the alternatives analysis to evaluate the segment of Sunset Drive near the I-94 interchange.

South Segment Alternatives

From Boundary Street to Division Street the alternatives focused on typical section details. It should be noted that all alternatives in the south segment include sidewalk and boulevards on both sides of Sunset Drive. Intersection control and configuration recommendations at the study intersections in the south segment will be discussed and recommended as spot improvements. Spot improvements were modeled separate from the main corridor Synchro/SimTraffic models (when present) to isolate the evaluation of the recommendation. The south segment alternatives include:

- » Alternative 1: One lane in each direction with North-Bound (NB) and South-Bound (SB) parking (**Figure 32**)
- » Alternative 2: Three-lanes with parking on the east side (**Figure 33**)
- » Alternative 3: Three-lanes without street parking (**Figure 34**)

Ultimately, all the alternatives would be expected to operate at an acceptable level of service, increase corridor safety, and improve bicycle/pedestrian safety and trip quality. **Table 23** discusses the key considerations of each concept.

Figure 32. South Segment Typical Section Alternative 1: One Lane in Each Direction with NB & SB Parking

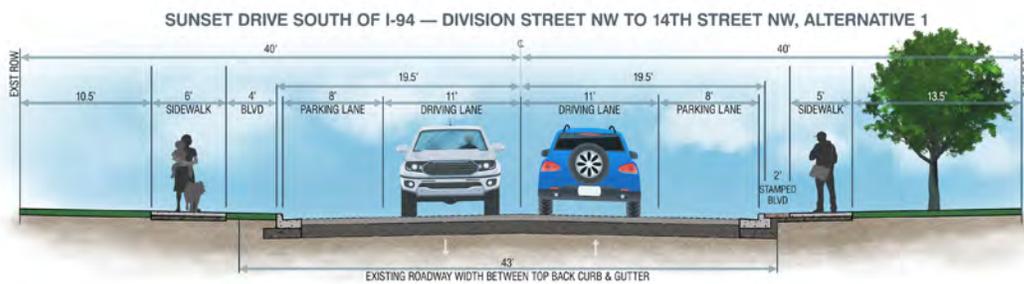


Figure 33. South Segment Typical Section Alternative 2: Three-Lane with Parking on East Side

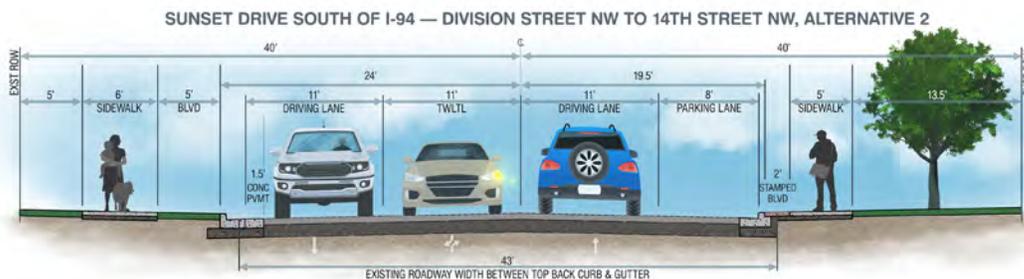


Figure 34. South Segment Typical Section Alternative 3: Three Lane without Street Parking

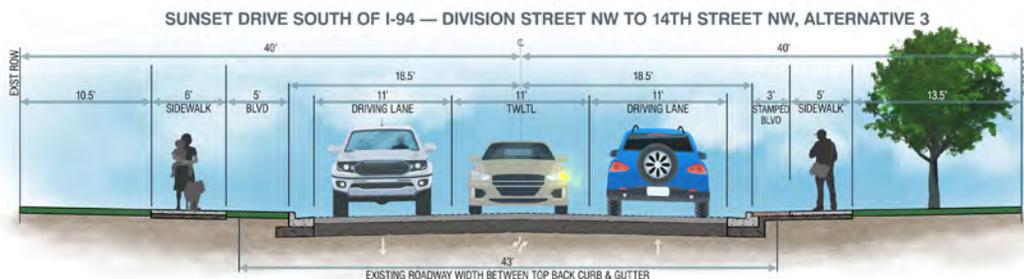


Table 23. South Segment Typical Section Alternatives Comparison

Sunset Drive Segment	Parking	Two-Way Left Turn Lane	Sidewalk and Boulevard	Traffic Capacity	Safety	Technical Ranking (1 = best)
Alternative 1: One Lane in Each Direction with NB & SB Parking	Keeps current parking capacity. Parking is underutilized in existing conditions	Does not provide a two-way left-turn lane.	Provides a 4-ft boulevard from the sidewalks to roadway and 10.5-ft of separation from sidewalk to residential properties.	Adequately supports traffic growth in all scenarios	Vehicle safety consistent with existing conditions. Improved multimodal safety with upgraded facilities.	3 of 3
Alternative 2: Three-Lane with Parking on East Side	Reduces current parking capacity by half. The land adjacent to the corridor is built out and not expected to increase in trip generation in the foreseeable future.	Provides a two-way left turn lane to help with dense residential access spacing.	Provides a 5-ft boulevard from the sidewalks to roadway and 10.5-ft of separation from sidewalk to residential properties.	Adequately supports traffic growth in all scenarios.	Vehicle safety improved with two-way left-turn lane by reducing rear end crash risk. Removal of parking on one side of the street improves sight distance. Improved multimodal safety with upgraded facilities.	1 of 3
Alternative 3: Three Lane without Street Parking	Completely removes on-street parking.	Provides a two-way left turn lane to help with dense residential access spacing.	Provides a 5-ft boulevard from the sidewalks to roadway and 5 ft(west)/9.5-ft (east) of separation from sidewalk to residential properties.	Adequately supports traffic growth in all scenarios.	Vehicle safety improved with two-way left-turn lane by reducing rear end crash risk. Removal of parking on both sides of the street greatly improves sight distance. Improved multimodal safety with upgraded facilities.	2 of 3

SOUTH SEGMENT SPOT IMPROVEMENTS¹

In addition to these typical section alternatives, the following items were evaluated as stand-alone spot improvements that can be implemented independently of each other and with any of the typical section alternatives. All spot improvements considered would be expected to benefit the corridor; however, some are more beneficial than others and easier to implement. The spot improvements for the south corridor segment include:

- » 14th Street Parking Restriction/Bump Outs
 - Parking should be restricted within 100 feet of the intersection to improve sight distance for minor approach left turn vehicles to improve safety and selection of appropriate traffic gaps. Another option would be to install curb bump outs to achieve an added multimodal benefit. The side street approaches at this intersection are expected to have failing operations as side street stop controlled in the sensitivity analysis but not in the other future scenarios and. A $\frac{3}{4}$ access intersection was considered but there are not acceptable diversion routes for the potential 60 eastbound left turns in the PM peak hour
- » Southbound left turn lane 14th Street (Alternative 1: One Lane in Each Direction with NB and SB Parking only)
 - If a two-way left-turn lane is not installed on Sunset Drive in the south segment, a southbound left turn lane should be installed at 14th Street to improve traffic operations. The southbound left turn movement could be expected to reach 100 vehicles per hour in the PM peak-hour. The traffic model did not show unacceptable traffic operations for this movement, however, with a daily left-turn volume of more than 250 expected, and a mainline two-way ADT of more than 14,000 vehicles per day expected in 2045, NDDOT's Traffic Engineering Manual suggests that a left-turn lane would be warranted.
- » 14th Street Pedestrian Crossing
 - Pedestrian crossing enhancements should be considered in the vicinity of the 14th Street intersection. This includes the installation of a RRFB, appropriate/Americans with Disabilities Act (ADA) compliant signing and striping, and color/imprinted concrete.
 - If a two-lane section is installed, then curb bump outs and enhanced signing and striping should be considered.
 - If a three-lane section is installed, then enhanced signing and striping should be considered in addition to curb bump outs and dynamic speed feedback signs.
 - A pedestrian refuge island could be considered on the south leg of the intersection to help with crossing. It is recommended that the northbound left turn does not receive a dedicated turn lane in order to make the refuge island larger and safer. This refuge island is recommended to be mountable curb.
- » Midblock Pedestrian Crossing (between 15th Street and 18th Street)
 - A midblock crossing between 15th Street and 18th Street should be considered with the installation of a RRFB, appropriate/ADA compliant signing and striping, and color/imprinted concrete.
- » All pedestrian crossings at public intersections should be improved with color/imprinted concrete.

1 Use mountable curbs for any island or bump outs incorporated, unless approved otherwise by the City of Mandan

I-94 Interchange Area Alternatives

As stated in the existing conditions section of the report the I-94 ramp intersections are not technically within the scope of this corridor study; however, four alternatives were considered to aid in understanding what the area of the corridor could look like and how it would tie into the rest of the Sunset Drive Corridor. The four intersections included in this area are Boundary Street, I-94 eastbound ramps, I-94 westbound ramps, and Old Red Trail. The I-94 Interchange Area alternatives include:

- » **Alternative 1: Roundabouts (no figure)**
 - All four intersections in the area would become multi-lane roundabouts.
- » **Alternative 2: Northwest Loop (Figure 35)**
 - All four intersections in the area would be signal controlled (Boundary Street intersection control changes from side-street-stop-controlled to signalized). This alternative would add a northwest loop ramp for vehicles westbound on I-94 to exit onto Sunset Drive southbound with a free right turn at the I-94 westbound ramps intersection. Additionally, the channelized eastbound right-turn at Old Red Trail would be removed in order to create more space for the northwest loop ramp and remove conflict between the EB ramp and WB lane movements at Old Red Trail.
- » **Alternative 3: SPUI (Figure 36)**
 - The I-94 ramp terminals would be combined into one central intersection with highly channelized right turn lanes. The centralized intersection would be signalized as well as Boundary Street and Old Red Trail.
- » **Alternative 4: DDI (Figure 37)**
 - A DDI directs traffic to cross to the other side of the roadway between freeway ramps. The crossing allows for vehicles to turn left on and off freeway ramps without stopping and crossing opposing lanes of traffic. Right turns on and off the freeway ramps occur either before or after the crossover intersection, when traffic is on the normal side of the roadway. All four intersections in the area would be signal controlled (Boundary Street intersection control changes from side-street-stop-controlled to signalized).

Table 24 on page 58 shows the traffic analysis results. **Table 25 on page 59** discusses the key considerations of each concept.

Figure 35. Interchange Alternative 2: Northwest Loop

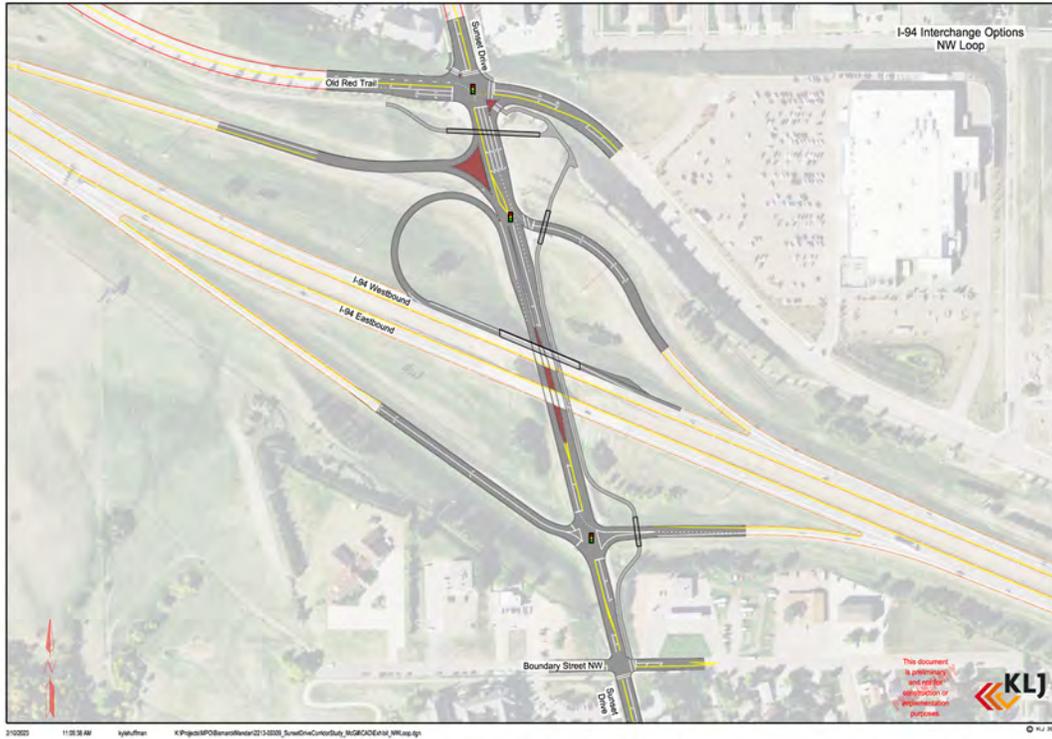


Figure 36. Interchange Alternative 3: Single Point Urban Interchange (SPUI)

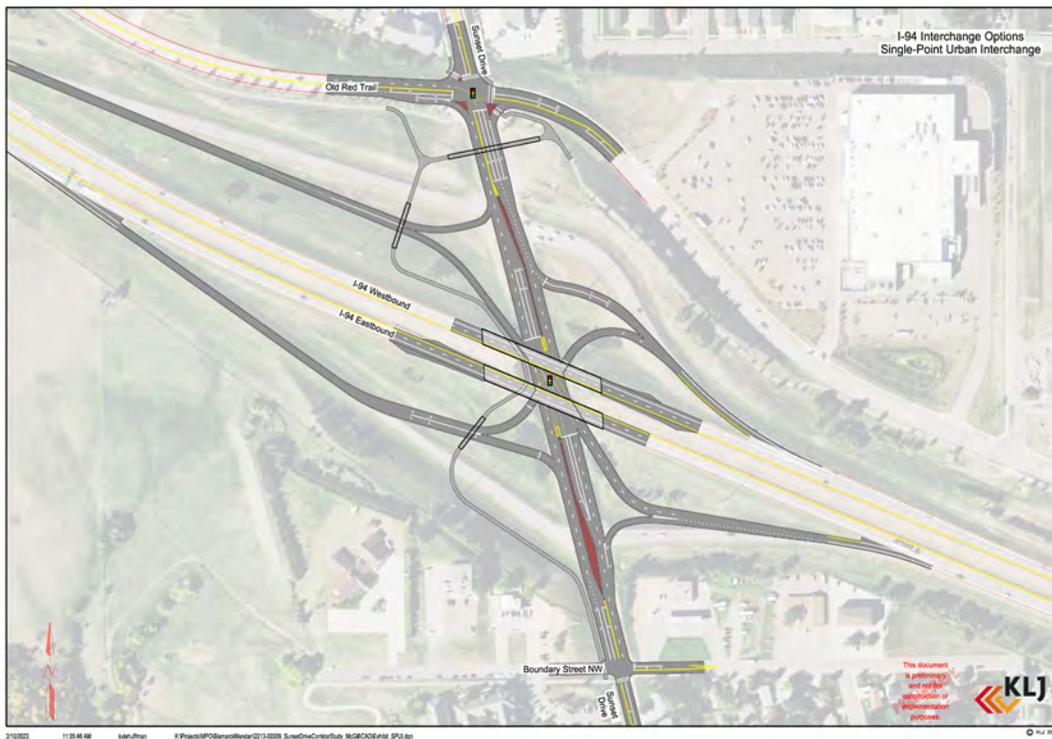


Figure 37. Interchange Alternative 4: Diverging Diamond Interchange (DDI)



Table 24. I-94 Interchange Area Alternatives Traffic Analysis

2045 Sensitivity Analysis Growth Scenario PM Peak-Hour					
Sunset Dr Intersection	No Build	Roundabout Intersection Control	Signalized Intersection Control		
		Multi-Lane Roundabout Alternative	Northwest Loop	Single Point Urban Interchange (SPUI)	Diverging Diamond Interchange (DDI)
Boundary St	F (100+ sec)	F (100+ sec)	D (48 Sec)	C (26 sec)	C (28 sec)
I-94 East on/off ramp	B (16 sec)	C (24 sec)	C (21 sec)	C (25 sec)	C (24 Sec)
I-94 West on/off ramp	D (43 sec)	C (20 sec)	C (30 sec)		C (22 sec)
Old Red Trail	D (40 sec)	F (100+ sec)	D (48 sec)	C (22 sec)	C (27 sec)

Table 25. I-94 Interchange Alternatives Comparison

Sunset Drive Segment	Traffic Capacity	Driver Familiarity	Safety	Technical Ranking (1 = best)
Alternative 1: Roundabouts	Expected failing operations at Boundary Street and Old Red Trail in the PM peak-hour sensitivity analysis.	Roundabouts have become more common in the U.S. in the past decade with more than 8,800 nationwide, more than 50 in North Dakota, and 8 on North Dakota Highways.	The net result of lower speeds and reduced conflicts at roundabouts is an environment where crashes that cause injury or fatality are substantially reduced. Up to 40% reduction in all crashes (CMF ID: 11132) and up to 65% reduction in injury crashes (CMF ID: 11130)	4 of 4
Alternative 2: Northwest Loop	All intersections expected to operate at LOS D or better in the PM peak-hour sensitivity analysis.	Intersection type would be a standard traffic signal.	Expected safety benefit from converting a left-turn to a right-turn at the eastbound ramp intersection and converting crossing conflicts to merging conflicts. Up to 20% reduction in all crashes (CMF ID: 351)	3 of 4
Alternative 3: SPUI	All intersections expected to operate at LOS D or better in the PM peak-hour sensitivity analysis.	Intersection type would be feel similar to a standard signal for drivers.	Expected conflict reduction since paths of opposing left turns do not intersect and the right-turns do not pass through the central intersection. Existing research is not conclusive on the quantitative crash reduction expected from this intersection control.	2 of 4
Alternative 4: DDI	All intersections expected to operate at LOS C in the PM peak-hour sensitivity analysis.	DDIs present some concern with driver familiarity and potential for wrong-way maneuvers at the crossovers. Since 2009, the US has opened more than 100 locations to date, which is expected to reach over 200 locations by 2025. There are currently no DDIs in North Dakota.	Design geometry has traffic-calming features, reduces speeds and has reduces conflict points. This may result in fewer and less severe crashes. 14% reduction in all crashes (CMF ID: 10761) and 44% reduction in injury crashes (CMF ID: 10762).	1 of 4

North Segment Alternatives

From Old Red Trail to 31st Street, and in the future for the extension of Sunset Drive through 38th Street, the alternatives focused on typical section details. It should be noted that all alternatives in the north segment include a 10-foot shared use path on the east side of Sunset Drive. Intersection control and configuration recommendations at the study intersection in the north segment will be discussed and recommended as spot improvements. Spot improvements were modeled separate from the main corridor Synchro/SimTraffic models (if needed) to isolate the evaluation of the recommendation. The south segment alternatives include:

- » Alternative 1: Three-lane without street parking (**Figure 38**)
- » Alternative 2: Three-lane with street parking on east side (**Figure 39**)
- » Alternative 3: Three-lane with NB and SB parking (**Figure 40**)

Ultimately, all the alternatives would be expected to operate at an acceptable level of service, increase corridor safety, and improve bike/pedestrian safety and trip quality. **Table 26** discusses the key considerations of each concept.

Figure 38. Three-Lane without Street Parking

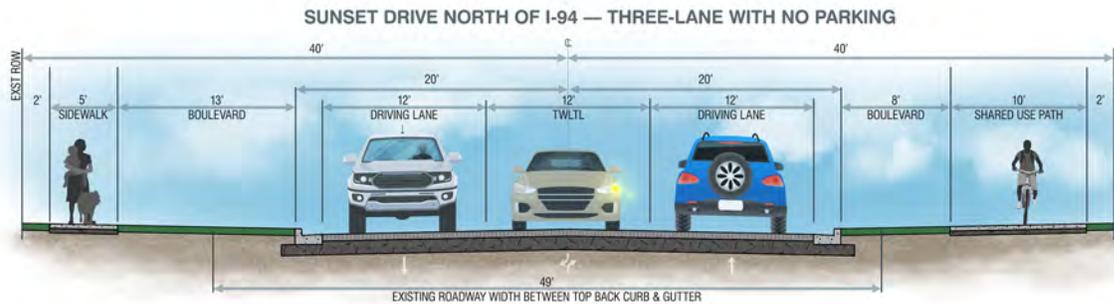


Figure 39. Three-Lane with Street Parking on East Side

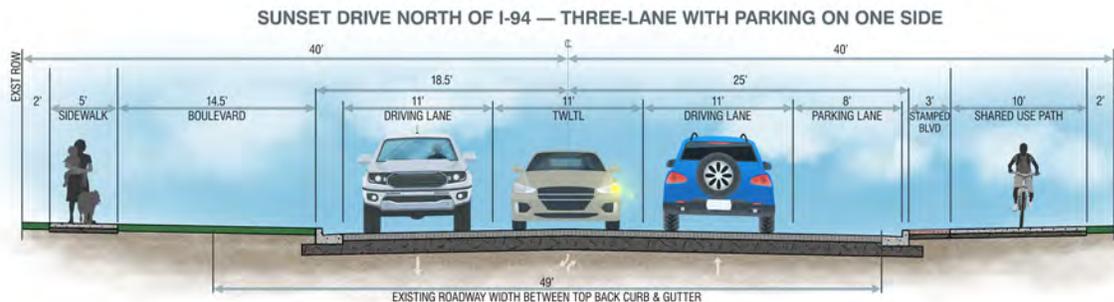


Figure 40. Three-Lane with NB & SB Parking

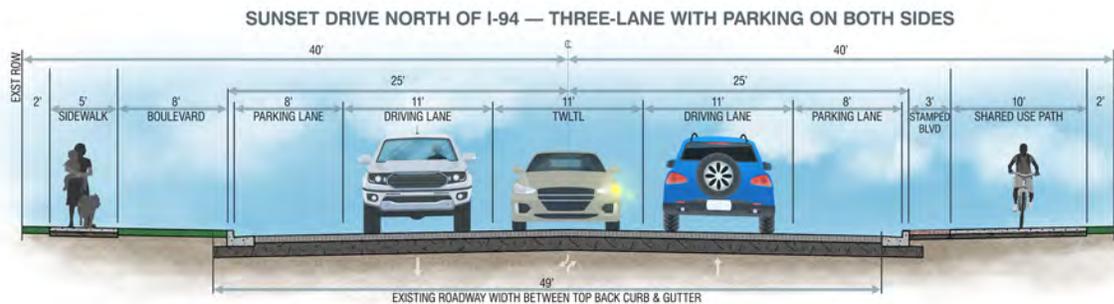


Table 26. North Segment Typical Section Alternatives Comparison

Sunset Drive Segment	Parking	Two-Way Left Turn Lane	Share Use Path & Sidewalk	Traffic Capacity	Safety	Technical Ranking (1 = best)
Alternative 1: Three-Lane without Street Parking	Completely removes space and ability for on-street parking. Street parking currently occurs even though it is not officially marked.	Provides a two-way left-turn lane to help with high volume business driveways and future development.	Provides a 10-foot shared use path on the east side of the roadway with a boulevard 10-foot to the roadway and a 5-foot sidewalk on the west side with a 13-foot boulevard to the roadway.	Adequately supports traffic growth in all scenarios	Vehicle safety improved with two-way left-turn lane by reducing rear end crash risk. Removal of wide shoulder on both sides of the street greatly improves sight distance. Improved multimodal safety with new facilities.	3 of 3
Alternative 2: Three-Lane with Street Parking on East Side	Reduces current parking potential by half. Parking will clearly be marked on the east side of the roadway. Parking would be restricted on the west side.	Provides a two-way left-turn lane to help with high volume business driveways and future development.	Provides a 10-foot shared use path on the east side of the roadway with 3-foot stamped boulevard to the roadway and a 5-foot sidewalk on the west side with a 14.5-foot boulevard to the roadway	Adequately supports traffic growth in all scenarios.	Vehicle safety improved with two-way left-turn lane by reducing rear end crash risk. Removal of parking on one side of the street improves sight distance. Improved multimodal safety with new facilities.	1 of 3
Alternative 3: Three-Lane with NB & SB Parking	Clearly marks parking on both sides of the roadway. Signing and marking will improve the quality of the parking and keep parking away from intersections.	Provides a two-way left-turn lane to help with high volume business driveways and future development.	Provides a 10-foot shared use path on the east side of the roadway with 3-foot stamped boulevard to the roadway and a 5-foot sidewalk on the west side with an 8-foot boulevard to the roadway	Adequately supports traffic growth in all scenarios.	Vehicle safety improved with two-way left-turn lane by reducing rear end crash risk. Defining parking space improves safety and prevents parking within intersection influence area with signing. Improved multimodal safety with new facilities.	2 of 3

NORTH SEGMENT SPOT IMPROVEMENTS

In addition to these typical section alternatives, the following items were evaluated as standalone spot improvements that can be implanted independently of each other and with any of the typical section alternatives. All spot improvements considered would be expected to benefit the corridor; however, some are more beneficial than others and easier to implement. The spot improvements for the south corridor segment include:

- » 27th Street Intersection Control
 - Under existing intersection control, 27th Street is expected to have failing side street operations in the PM peak-hour sensitivity analysis for no-build and all interchange concepts. It is recommended to reconstruct this intersection with the intention of signalization in the future when traffic volumes warrant the installation of a traffic signal. With 100-foot left-turn lanes for the northbound, southbound, and westbound approaches, this intersection would improve from failing operations to LOS C or better for all approaches in the PM peak-hour sensitivity analysis.
 - Another alternative to traffic signal control for this location is 2X1 roundabout. For the PM peak-hour sensitivity analysis, this intersection control is expected to improve failing operations to LOS C or better for all approaches.
- » Sunset Drive Extension
 - During the process of extending Sunset Drive north of 31st Street the City of Mandan should consider the following planning and policy items.
 - Access spacing along Sunset Drive north extension should be no less than 300 feet considering the two-way left-turn lane typical section.
 - New business development should plan and assume all parking to be on-site with no roadway parallel parking.
 - Additional transit stops should be considered to connect residential and business to the high school as Sunset Drive is extended north.

Future Conditions and Alternatives Summary

Future Conditions

- » Sunset Drive has seen significant historic growth in the past decade. Volumes for 2022 were 10–20% higher than predicted by the ATAC Travel Demand Model.
- » Traffic growth is expected to continue but at a slower pace than the last 5 to 10 years.
- » There is a proposed extension of Sunset Drive north of 31st Street to 38th Street and the potential for a large development to increase traffic on Sunset Drive. One third of this traffic was added to the full buildout scenario for 2045 to create a sensitivity analysis. This added approximately 2,500 daily trips on Sunset Drive north of the Interchange area.
- » 27th Street and Boundary Street are expected to experience failing side street traffic operations by the year 2030 in the peak-hours.
- » Division Street and 14th Street show deteriorating traffic operations in 2045 with failing operations in the PM peak-hours of the sensitivity analysis.

South Segment²

All typical section alternatives are expected to operate at an acceptable level of service, increase corridor safety, and improve bike/pedestrian safety and trip quality. The technical ranking of the alternatives from best to worst is Alternative 2: Three-Lane with Parking on East Side, Alternative 3: Three Lane without Street Parking, and Alternative 1: One Lane in Each Direction with NB and SB Parking, respectively. Spot improvement considerations in this segment include the following:

- » 14th Street
 - If a two-lane typical section is constructed, then a southbound left-turn lane should be installed at 14th Street.
 - $\frac{3}{4}$ intersection access should be considered at 14th Street and 18th Street with the consideration of a roundabout at Division Street.
 - In the near term, parking should be restricted near the Division Street intersection and any other design features that improve sight distance should be considered.

2 Use mountable curbs for any island or bump outs incorporated, unless approved otherwise by the City of Mandan

» Pedestrian crossings

- Pedestrian crossing enhancements should be considered in the vicinity of the 14th Street intersection. This includes the installation of a RRFB, appropriate/ADA compliant signing and striping, and color/imprinted concrete. A pedestrian refuge island could be considered on the south leg of the intersection to help with crossing. It is recommended that the northbound left turn does not receive a dedicated turn lane to make the refuge island larger and safer. This refuge island is recommended to be mountable curb.
- A midblock crossing between 15th Street and 18th Street should be considered with the installation of a RRFB, appropriate/ADA compliant signing and striping, and color/imprinted concrete.
- All pedestrian crossings at public intersections should be improved with color/imprinted concrete.

I-94 Interchange Area

As stated in the existing conditions section of the report, the I-94 ramp intersections are not technically within the scope of this corridor study; however, four alternatives were considered to aid in understanding what the area of the corridor could look like and how it would tie into the rest of the Sunset Drive Corridor.

Alternative 1: Roundabouts and Alternative 2: Northwest Loop did not show traffic operation improvements in the alternatives analysis and were technically ranked fourth and third, respectively. Alternative 3: SPUI and Alternative 4: DDI ranked second and first in the technical ranking, respectively, showing a lot of potential for traffic operations benefit.

North Segment

All typical section alternatives would be expected to operate at an acceptable level of service, increase corridor safety, and improve bike/pedestrian safety and trip quality. The technical ranking of the alternatives from best to worst is Alternative 2: Three Lane with Street Parking on East Side, Alternative 3: Three Lane with NB and SB Parking, and Alternative 1: Three Lane without Street Parking, respectively. Spot improvement considerations in this segment include the following:

» 27th Street

- When volumes warrant a signal, a traffic signal should be installed with at least 100 ft left turn lanes for the northbound, southbound, and westbound approaches.
- A 2X 1 roundabout may also be considered at this location and will also provide adequate traffic operations.

» Sunset Drive Extension

- As Sunset Drive is constructed north of 31st Street, policies and practices should be considered related to access spacing, on-site business parking for new developments, and transit stops.

Public Engagement Summary

Public involvement was designed with the goal to engage, inform, and gather input from all stakeholders who live, work, and play along the corridor. This engagement was on-going throughout both Corridor Study phases to provide general guidance on the study process and to allow business owners, residents, and users of the corridor to provide comments, address concerns, make suggestions.

Phase 1 Engagement

Several elements were done to ensure successful public involvement including project social pinpoint site with an interactive map and online survey, stakeholder session, public input open house, targeted social media marketing, mailers to residents along the corridor, and hanging project flyers throughout the corridor.

Phase 2 Engagement

The second phase of stakeholder and public involvement consisted of a review of alternatives developed for the north and south segments of Sunset Drive. Residents along the corridor, business owners, and the many people who travel the corridor were able to view cross section options of the alternatives that were developed for the corridor. The project website on the Social Pinpoint platform was the primary tool used to gather the public's opinion of corridor concepts, with a survey which allows users to rank (on a scale from 1 to 5) the various roadway alternatives.

The Social Pinpoint site coupled with in-person stakeholder and public input meeting opportunities resulted in a successful public engagement round. The team used social media, postcards, flyers to area business, newspaper, and traditional media to inform Mandan residents of the virtual and in-person input opportunities for this phase of the project.

Stakeholder Open House

One session was held during each phase of the study to visit with stakeholders including area businesses, city representatives, county representatives, and other interested parties. Email and postal mail invitations were sent out to for this resulting in eight people attending the in person open-house. Other comments were provided online for those who could not attend in person. The Phase 1 meeting was held on Wednesday, September 21, 2022 from 11 AM to 1 PM at HIT Inc, located on Sunset Drive. The Phase 2 meeting was held Thursday, March 9, 2023 from 11 AM to 1 PM at HIT, Inc, located on Sunset Drive. A formal presentation was also given; 11 people attended the stakeholder meeting. Refer to the **Public Involvement Phase 2 Report** for a specific stakeholder list and meeting attendees.

Key items shared during the stakeholder sessions included:

- » The intersection of Old Red Trail and Sunset was discussed in length and included traffic light timing, turning movements, lane configurations, lack of signage for lane configurations, and poor pedestrian crossings.
- » The westbound on/off ramp intersection with Sunset Drive was discussed including lane configuration that is not intuitive, signals are in close proximate from Old Red Trail and not timed properly, and traffic gets backed up onto the interstate (WB off ramp) posing a safety risk.
- » The Boundary Street/Sunset Drive intersection was discussed with concerns raised about pedestrian safety as it is difficult for pedestrians to cross east/west.
- » 18th Street was identified with difficulty seeing oncoming traffic.
- » The 14th Street intersection was identified as an area where traffic gets backed up along Sunset Drive due to southbound left turning traffic heading to Lewis & Clark Elementary School. Possibility of a turn lane at that location was discussed.
- » Other items brought up include parking on the west side of the roadway was not utilized as much as the east side, so to possibly eliminate parking on west. No bike facility on Sunset, but rather encourage bikes to utilize path west of Sunset.

All comments collected from the stakeholder meetings were incorporated onto the social pinpoint site with either a new pin, a reply to an existing similar comment, or an upvote to an existing comment.

Public Input Meetings

The Phase 1 public input meeting was held in the format of an open-house; the Phase 2 meeting included a formal presentation. The Phase 1 meeting was held on Wednesday, September 21, from 5 PM to 7 PM at the Mandan Middle School cafeteria; 12 people signed the sign-up sheet with an estimated 20 people in attendance. The Phase 2 meeting was held on Thursday, March 9, from 5–7 PM at the Mandan High School with a formal presentation at 5:30 PM; 23 people were in attendance at the public input meeting.

Key items shared during the public sessions included:

- » Parking along the corridor
- » Intersection of Old Red Trail/Sunset
- » Signal timing
- » Lane configurations and lack of signage
- » Speeding traffic
- » Poor pedestrian access, no areas to cross the road safely
- » Traffic congestion during peak times

All comments collected from the public open house were incorporated onto the social pinpoint site with either a new pin, a reply to an existing similar comment, or an upvote to an existing comment.

Additional comments received included:

- » Weight/size of vehicles on Sunset Drive
- » Speed of traffic too fast
- » Poor visibility turning left from westbound 27th to southbound Sunset.
- » Traffic patterns make it difficult to get out of driveway
- » Concern of out-of-control vehicles safety of her residence (bollards/landscaping would be supported solutions)
- » Curb in front of her house reconstructed in 2000s in poor shape (crumbling curb, not level causing water to puddle/freeze)
- » Drainage from parking lot at church and Buehler Larson NW across Sunset puddles in front yard and contains sediments.

Social Media

PHASE 1

Two sets of paid social media ads ran; one to market the in-person public meeting, the other to encourage people to take the survey and provide feedback on the interactive map.



KLJ KLJ Sponsored · 🌐

We're seeking your input for Mandan's Sunset Drive Corridor Study. Share your thoughts and provide your feedback!

Give us your feedback.
Take the short survey now!



bit.ly/sunsetcorridor
Sunset Drive Corridor Study [Learn more](#)

👍 Like 💬 Comment ➦ Share

Ad #1

- » Run dates: Sept. 14–Sept. 30
- » Purpose: Share feedback by taking survey/providing comments on interactive map
- » Targeted to all 58554 zip code (Mandan residents)
- » Cost: \$75
- » Reached 11,729 people with 19,142 impressions (the number of times the ad was seen) with 37 link clicks to the social pinpoint site.

Ad #2

- » Run dates: Sept. 13–Sept. 21
- » Purpose: Invite people to public open house
- » Targeted to all 58554 zip code (Mandan residents)
- » Cost: \$75
- » Reached 14,928 people with 18,047 impressions (number of times the ad was seen) with 34 link clicks to the social pinpoint site.



KLJ KLJ Sponsored · 🌐

Please join us for a Public Open House to share feedback on Mandan's Sunset Drive! Wednesday, Sept. 21 from 5-7 p.m. at the Mandan Middle School Cafetorium.

You're invited
to share your feedback

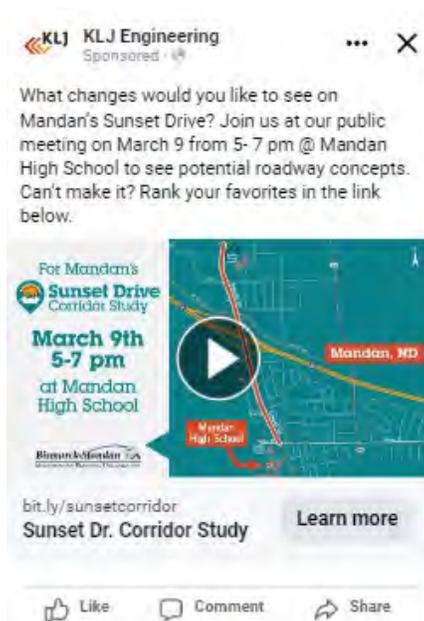


kij.mysocialpinpoint.com
Sunset Drive Corridor Study [Learn more](#)

👍 Like 💬 Comment ➦ Share

PHASE 2

Two sets of paid social media ads ran in conjunction with this round of public involvement. The first ad's purpose was to inform about the public input meeting, while also directing people to the project Social Pinpoint site. The second ad ran after the public input meeting was completed and it encouraged participation in the online survey on the corridor concepts.



Ad #1

- » Run dates: March 1–9
- » Purpose: Inform about public input meeting and direct to survey
- » Targeted to all Mandan residents (and surrounding area)
- » Cost: \$75
- » Results: Reached 3,590 people with 9,865 impressions

Ad #2

- » Run dates: March 10–23
- » Purpose: Direct to survey for feedback on corridor concepts
- » Targeted to all Mandan residents (and surrounding area)
- » Cost \$75
- » Results: Reached 3,858 people with 13,633 impressions



Mailers

For both Phases, postcards were mailed to 62 area residents who live on the Sunset Drive corridor inviting them to the public meeting, or to leave comments/feedback on the project site.



Newspaper

Additionally, for Phase 2, a newspaper ad was placed in the Bismarck Tribune and the Mandan Finder. The Bismarck Tribune ad ran Monday, February 20, 2023. The Mandan Finder ad ran Friday, February 24, 2023.

The BMMPO also issued a press release to local media on February 24, 2023.

(Refer to the **Public Involvement Phase 2 Report** for additional information regarding media coverage.)



**Your input
is needed!**

Your input is needed as part of an ongoing corridor study to determine potential traffic and safety improvements along Mandan's Sunset Drive from Division Street (Brave Center) to 38th Street (past Mandan Middle School).

Your input will guide the Bismarck-Mandan Metropolitan Planning Organization and the City of Mandan in determining the best alternatives for this vital corridor.

**View improvement alternatives
and give your feedback:**

Public Meeting

March 9, 5-7 p.
Presentation at 5:30 pm
Mandan High School Auditorium
905 8th Ave. NW, Mandan, ND
(side and enter through Door #20)

OR

Project website:
bit.ly/SunsetCorridor



Written comments can be submitted through the project website or by email to Adam McGill, Project Manager, adam.mcgill@kljeng.com. For accommodations for disabilities and/or language assistance, contact Title VI/ADA at 1-355-1332, MPO@bismarcknd.gov, TTY 711 or 1-800-366-6888 at least 48 hours in advance of the meeting.

Mandan Newsletter

Digital and printed newsletters are available for Mandan residents and information about the project was included in those publications during Phase 2.

Digital newsletter was available on March 1, 2023; the printed (black and white) newsletter was issued the week of March 13, 2023.



Input opportunity!



PUBLIC INPUT MEETING
for



**Sunset Drive
Corridor Study**

Thursday, March 9, 5-7 pm
Mandan High School Auditorium
905 8th Ave. NW, Mandan, ND

**Your feedback
is needed!**



ON POTENTIAL IMPROVEMENT OPTIONS
AS PART OF THE ONGOING



**Sunset Drive
Corridor Study**

View alternatives
and give your
feedback:



bit.ly/SunsetCorridor

Flyers

Flyers were distributed to business along the corridor with information on the project and QR code to the social pinpoint site.

- » Tracking for Phase 1 indicated 43 QR codes were scanned (between postcards and flyers).

Social Pinpoint/Project Website

bit.ly/SunsetCorridor

- » 2,077 total visits were made to the social pinpoint site in Phase 1
- » The Phase 1 interactive map allowed users to drop a pin on specific areas of the map under the categories of Traffic Safety, Bike/Pedestrian, Transit, Traffic/Congestion, Access, Other. In total 89 comments were collected with an additional 80 upvotes and 5 downvotes on the pins throughout the corridor.
- » In Phase 2, a total of 2,292 people visited the Social Pinpoint site and 112 people took the survey.

Online Survey

Participants could fill out a project survey which consisted of 12 multiple choice questions, with one open ended question. The survey was open from Sept. 7 through October 5 (advertised comment period was Sept. 30) and consisted of questions on how people utilized the corridor and highest level of concerns related to safety, traffic congestion, access, parking, transit, and more. In total 72 individuals submitted survey responses.

Digital Engagement Results

PHASE 1 ONLINE SURVEY RESULTS

The survey questions are listed below:

1. How frequently do you use the project corridor?
2. Where do you live?
3. How do you use Sunset Drive (Select all that apply)
4. What are your trips for? (Select all that apply)
5. Please prioritize each issue with respect to the Sunset Drive corridor
6. Traffic congestion in the corridor is acceptable (rate)
7. Sunset Drive feels like a safe place to drive (rate)
8. Sunset Drive feels like a safe place to walk/cross the street (rate)
9. Sunset Drive feels like a safe place to bike (rate)
10. Have you ever been involved in a traffic crash, or near miss, while driving on Sunset Drive?
11. If you were involved in a traffic crash or near miss, while driving on Sunset Drive, how did it occur?
12. What type of traffic control at roadway intersections do you prefer?
13. Are there any additional issues concerning the Sunset Drive corridor that should be considered in this study?



Project Background:

Serving as a major route to schools, restaurants, hotels, shopping, and other businesses, Sunset Drive is vital to the growth and expansion of northwest Mandan. To meet the safety and transportation needs of area residents and businesses, the Bismarck-Mandan Metropolitan Planning Organization (MPO) along with the City of Mandan are gathering input to help guide potential improvement options in this developing area of the city.

The area being studied extends along Sunset Drive from Division Street (Brave Center) through 38th Street (Mandan Middle School).



Share your thoughts!

- What are the critical issues along the corridor?
- What needs are not currently being met?
- What safety concerns do you have?

Leave your comments on the interactive map and take the short survey to give your input on the corridor.



bit.ly/SunsetCorridor

Stay connected:

Adam McGill, Project Manager
Adem.mcgill@cityjeng.com

Bismarck-Mandan
METROPOLITAN PLANNING ORGANIZATION



Project Background:

Your input is needed as part of an ongoing corridor study to determine potential traffic and safety improvements along Mandan's Sunset Drive from Division Street (Brave Center) to 38th Street (past Mandan Middle School).



Check out potential corridor improvement options and give your feedback!

Your input will guide the Bismarck-Mandan Metropolitan Planning Organization and the City of Mandan in determining the best alternatives for this vital corridor.



bit.ly/SunsetCorridor

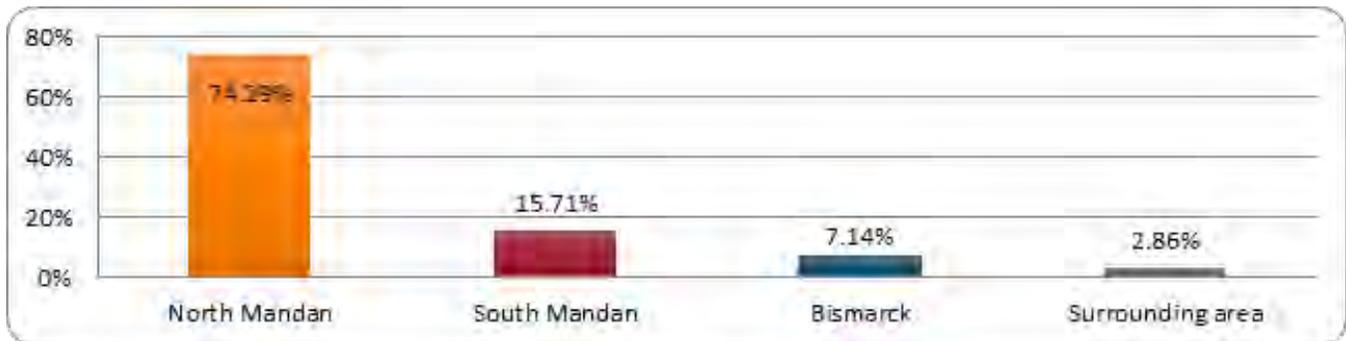
Bismarck-Mandan
METROPOLITAN PLANNING ORGANIZATION

A summary of responses to each question follows:

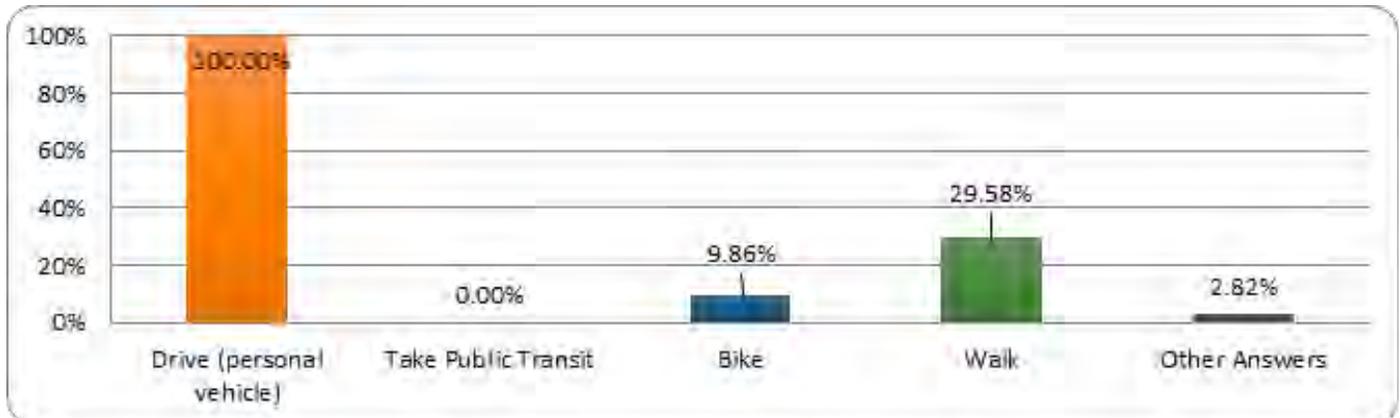
Question 1: How frequently do you use the project corridor?



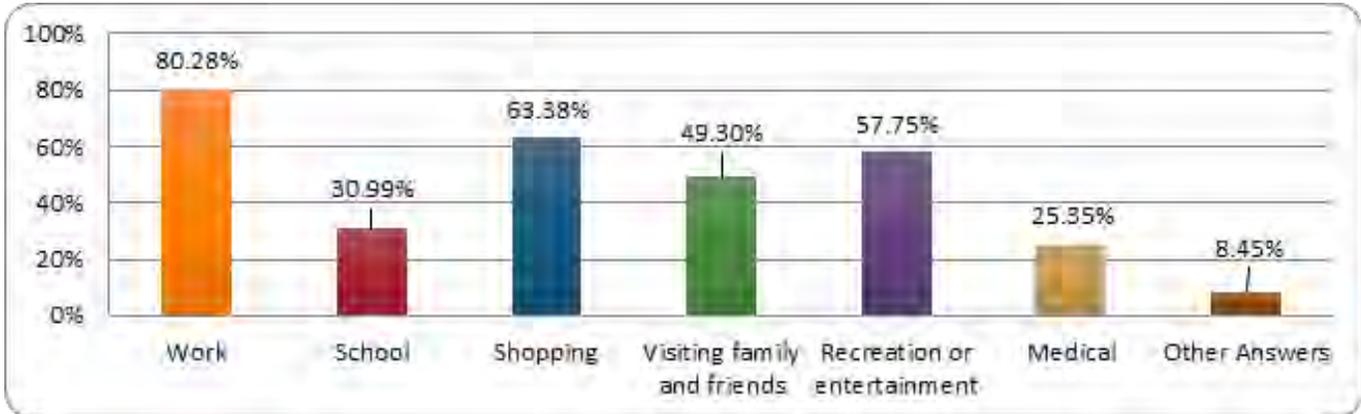
Question 2: Where do you live?



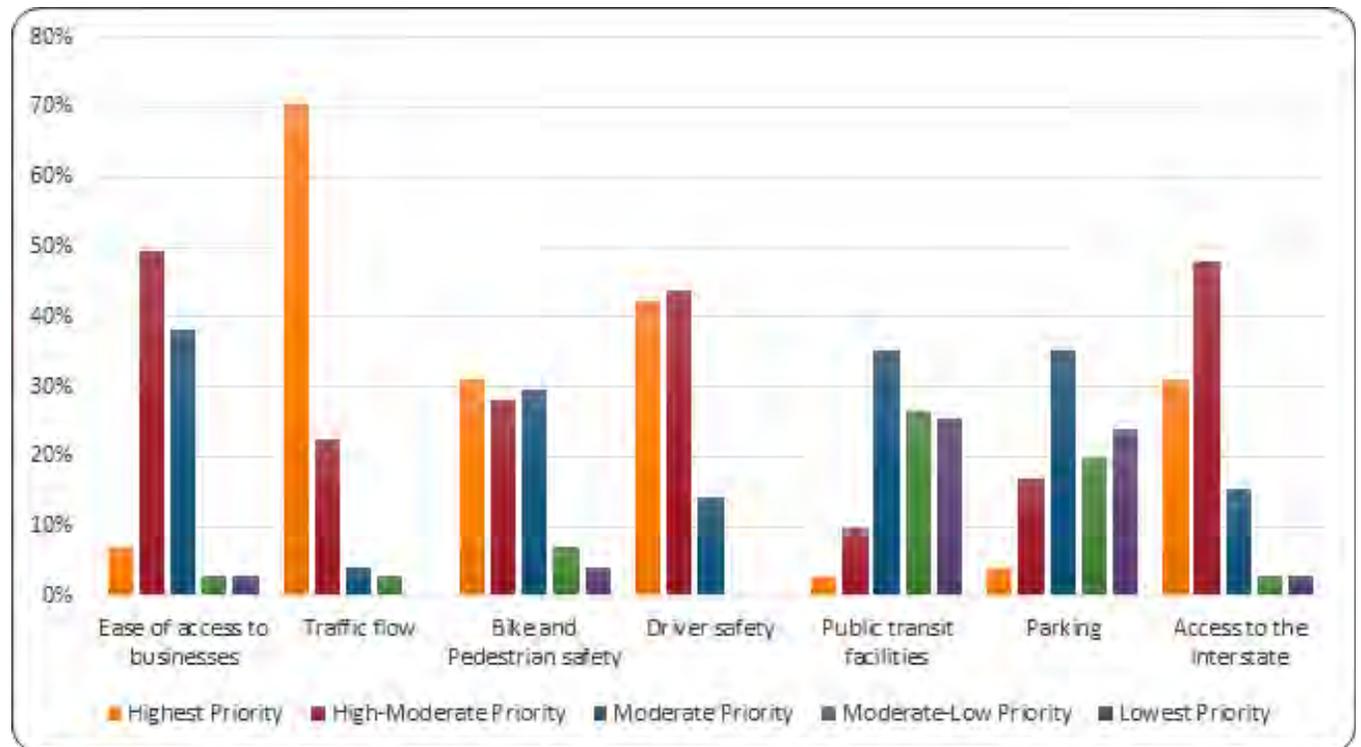
Question 3: How do you use Sunset Drive (Select all that apply)



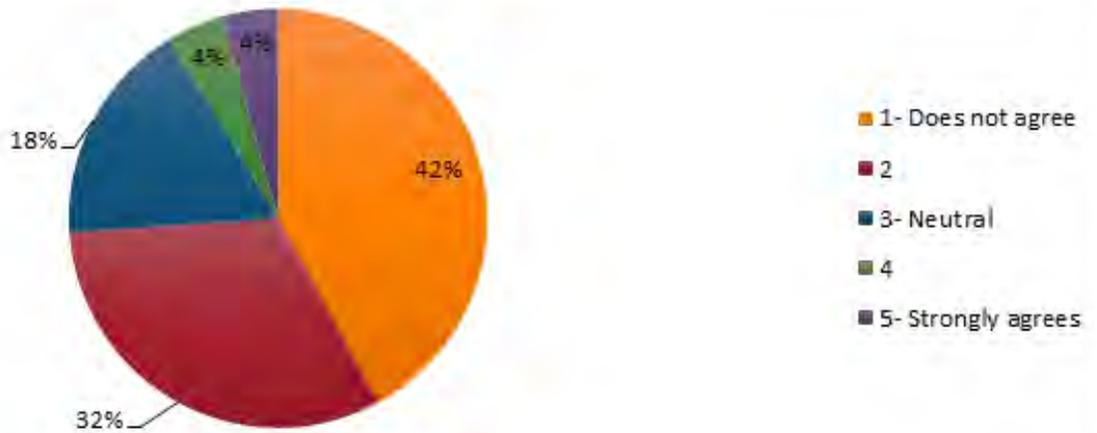
Question 4: What are your trips for? (Select all that apply)



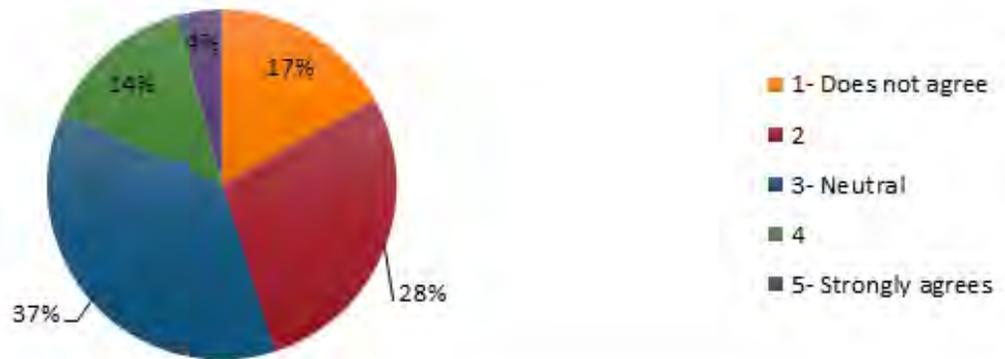
Question 5: Please prioritize each issue with respect to the Sunset Drive corridor:



Question 6: Traffic congestion in the corridor is acceptable. (Rating: 1= does not agree with the statement, 5= strongly agree)



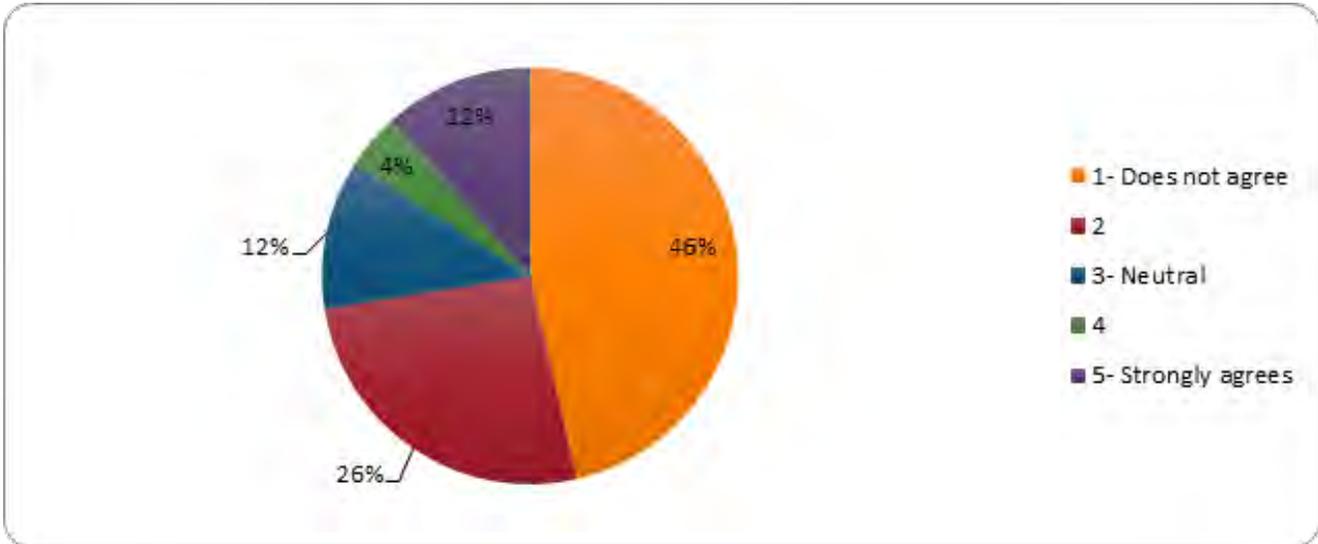
Question 7: Sunset Drive feels like a safe place to drive. (Rating: 1= does not agree with the statement, 5= strongly agree)



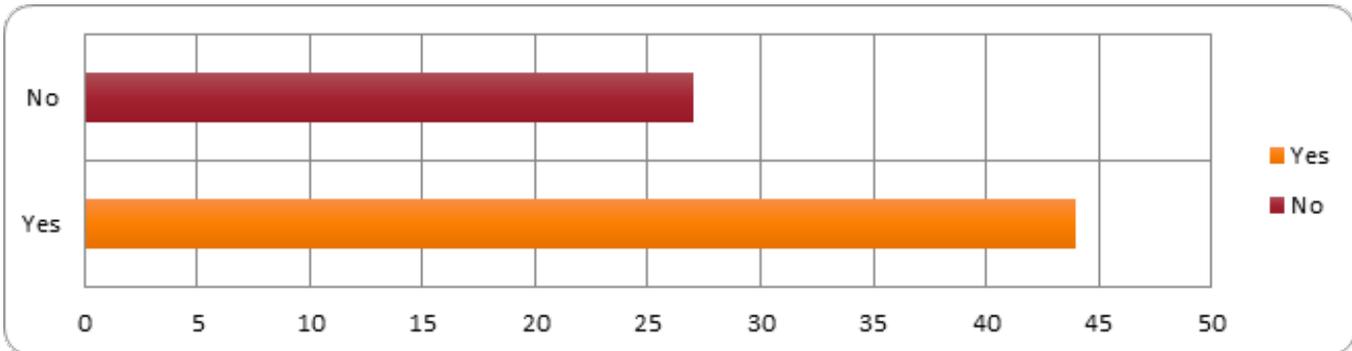
Question 8: Sunset Drive feels like a safe place to walk/cross the street. (Rating: 1= does not agree with the statement, 5= strongly agree)



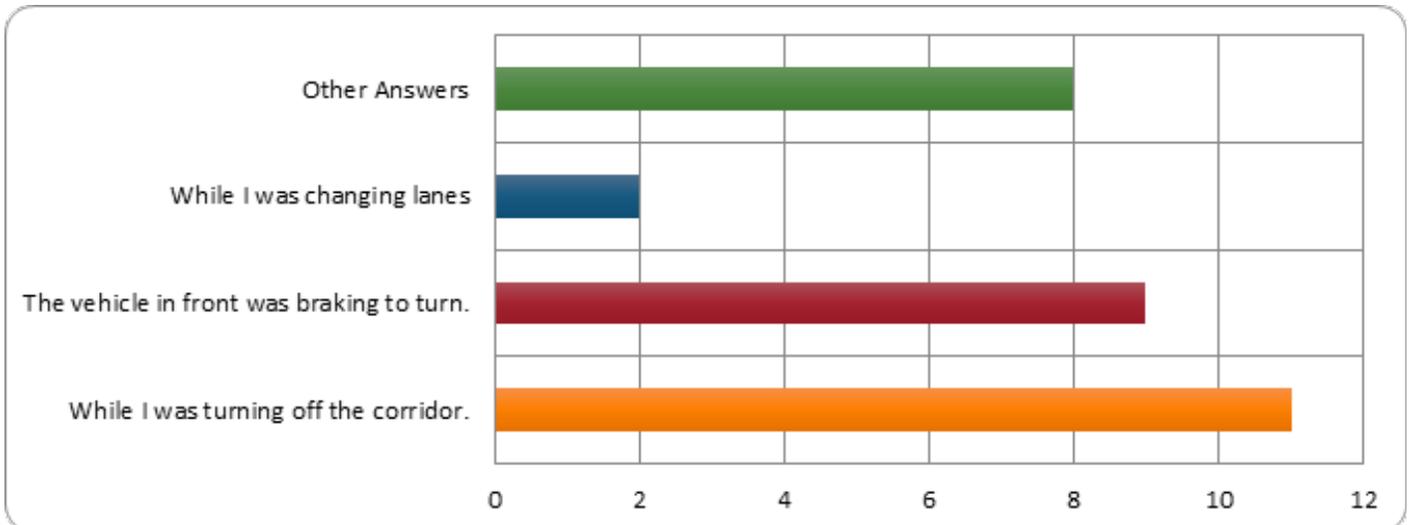
Question 9: Sunset Drive feels like a safe place to bike. (Rating: 1= does not agree with the statement, 5= strongly agree)



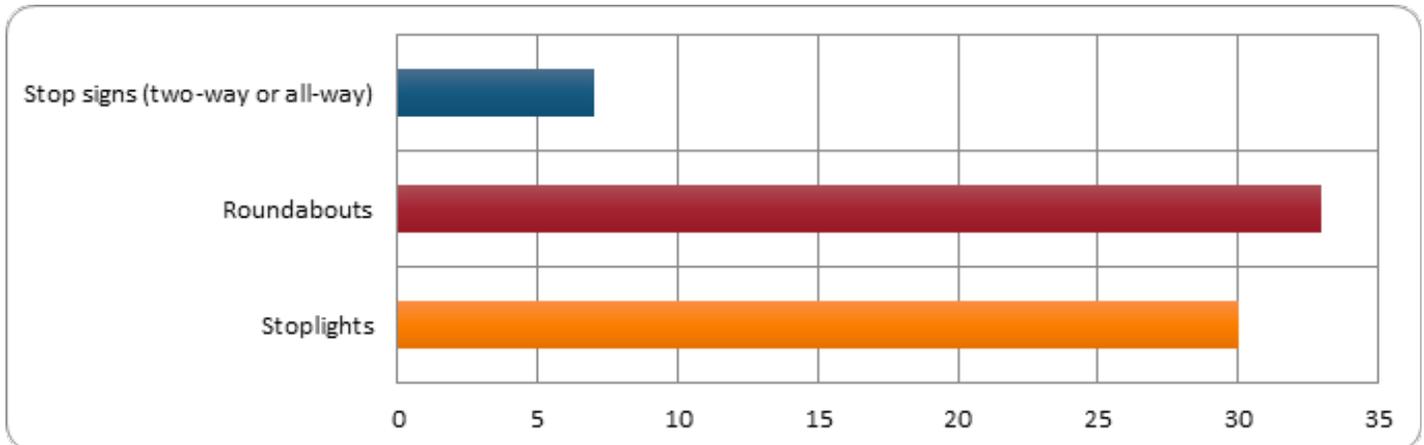
Question 10: Have you ever been involved in a traffic crash, or near miss, while driving on Sunset Drive?



Question 11: If you were involved in a traffic crash or near miss, while driving on Sunset Drive, how did it occur?



Question 12: What type of traffic control at roadway intersections do you prefer?



Question 13: Are there any additional issues concerning the Sunset Drive corridor that should be considered in this study?

The word cloud below represents the most commonly used words or themes throughout the responses. The full responses can be found in the **Public Involvement Phase 1 Summary Report**.



Online Interactive Mapping Tool

The Phase 1 mapping tool allowed users to explore the study area, add location specific comments, and react (upvote/down-vote) comments left by others. A total of 89 comments were collected with an additional 80 upvotes and 5 downvotes on the pins throughout the corridor. Comments were collected in five categories including Traffic/Congestion, Bike/Pedestrian, Driver Safety, Transit, and Other. Comments by category are displayed in the pie chart.

Comments were fairly evenly distributed among the categories, with Driver Safety representing the majority of comments (34%).

The following heat maps shows the concentration levels of comments by location. As displayed, the concentration of comments are located at the intersection of Sunset Drive and Old Red Trail.

Comments by category

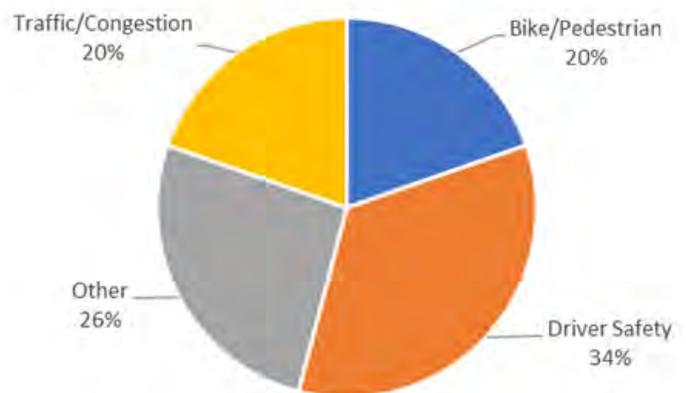


Figure 41. Heat Map of Comments Received for North Sunset Drive

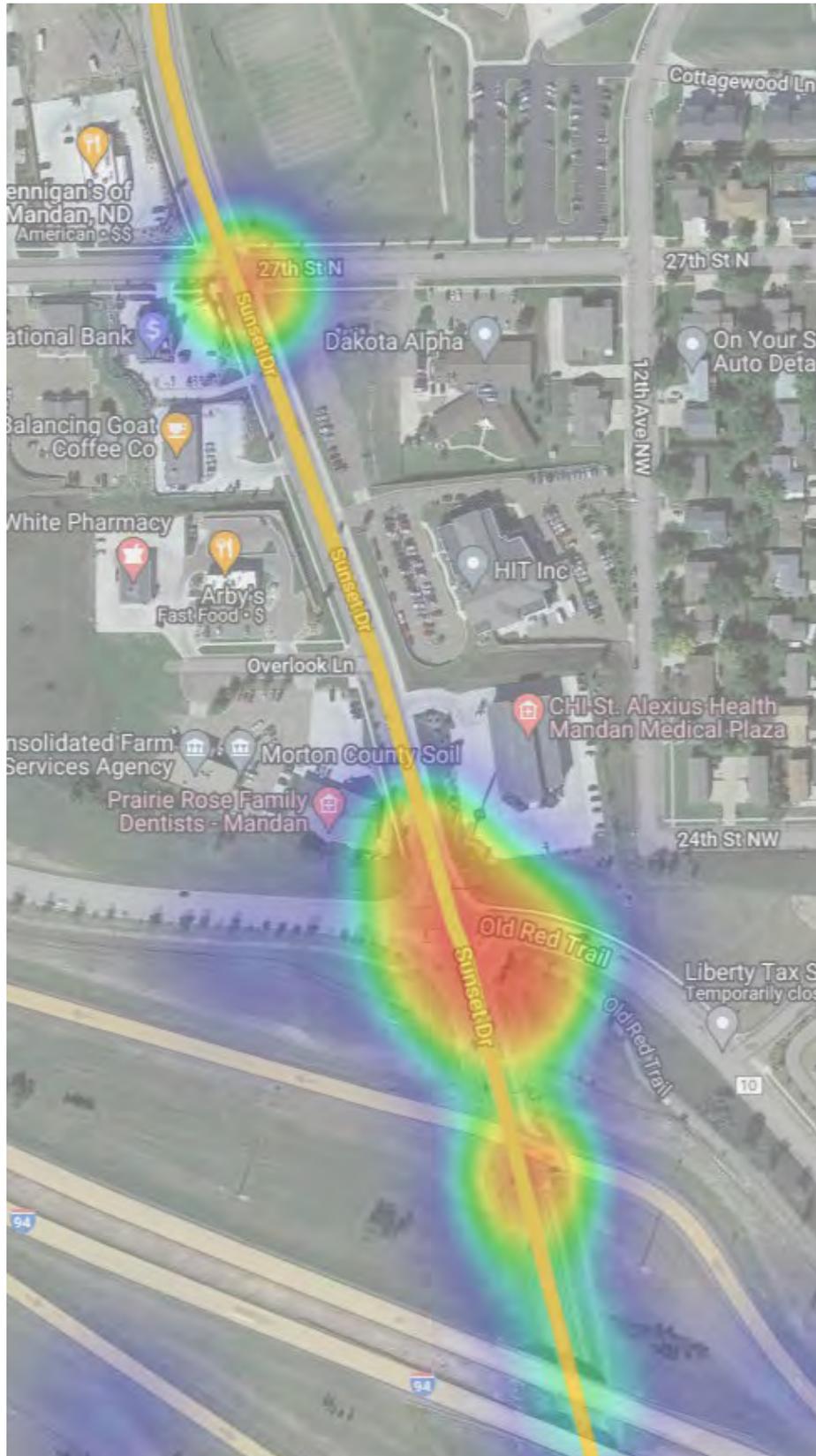


Figure 42. Heat Map of Comments Received for Central Sunset Drive

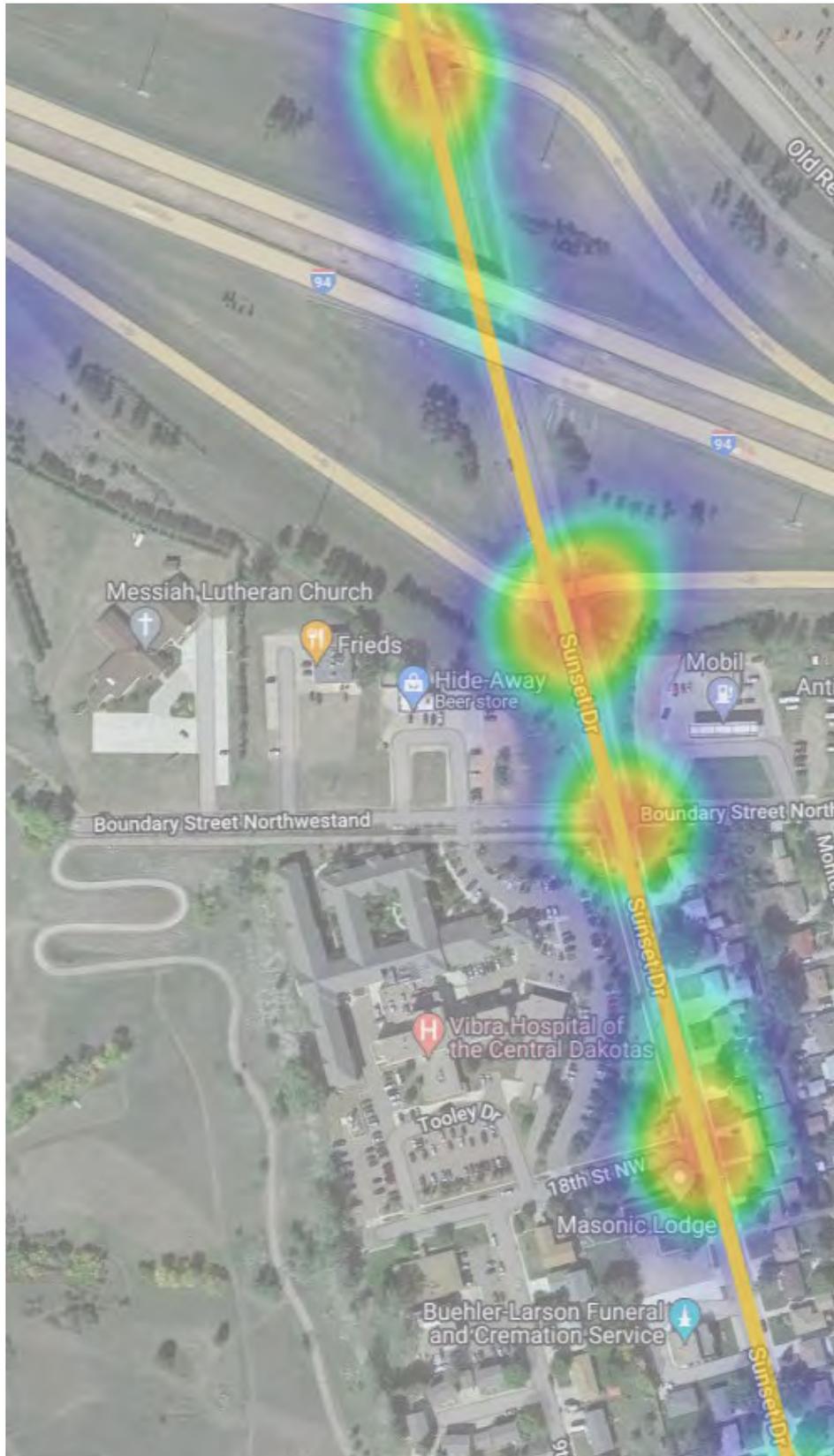


Figure 43. Heat Map of Comments Received for South Sunset Drive



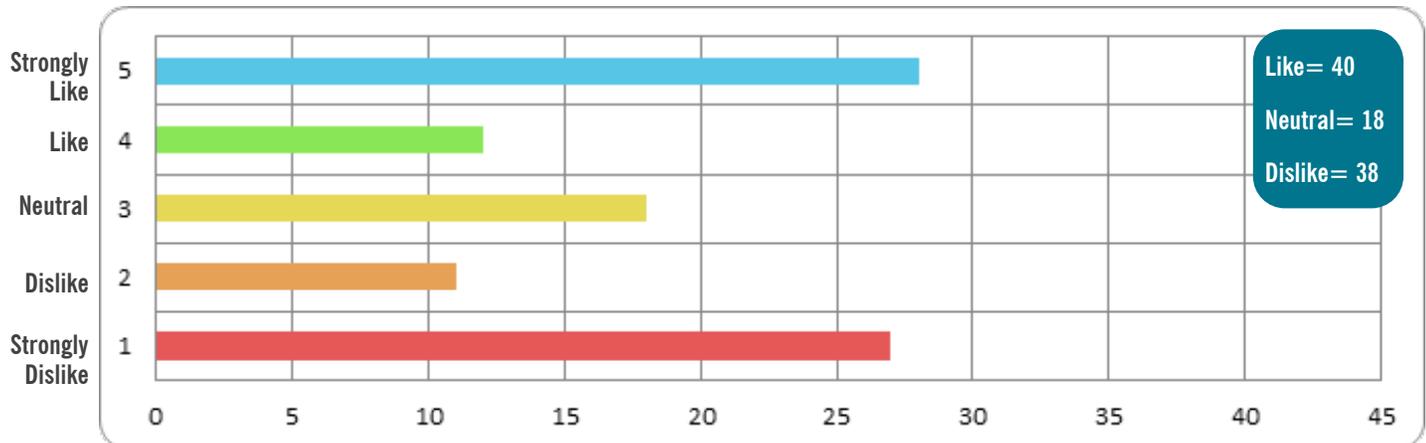
PHASE 2 ONLINE SURVEY RESULTS

During this round of engagement, the public was able to view corridor concepts and rank their favorite of three options for both the north and south segments of the roadway, along with an intersection option for the 27th Street intersection by the middle school. The interchange area was not included in the public input.

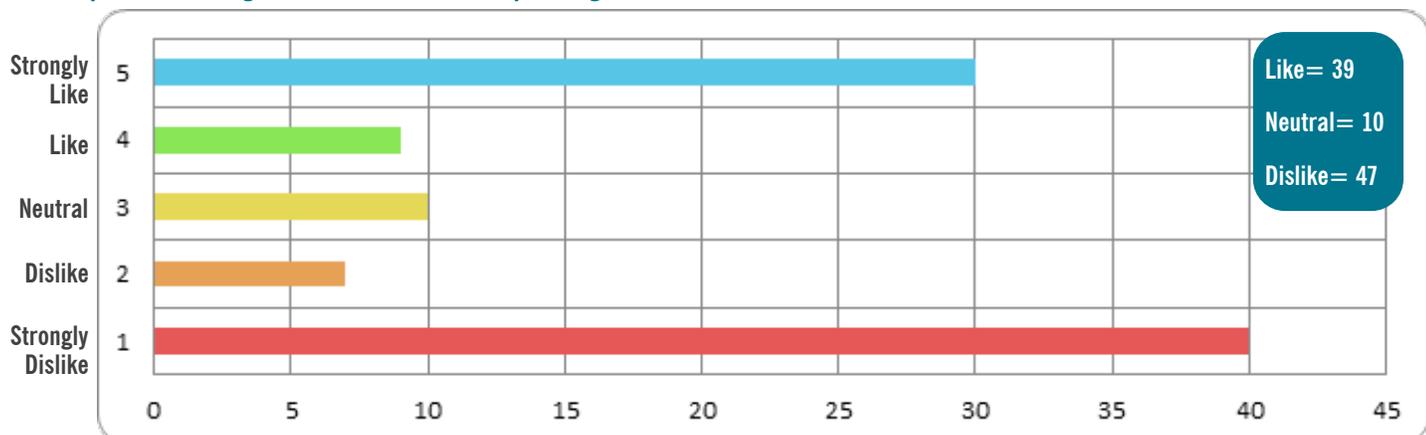
Respondents were able to view and rate roadway concepts on a scale of 1–5 (1 strongly dislike – 5 strongly like) and provide comments on each concept.

Results from the ratings are as follows; refer to the **Public Involvement Phase 2 Report** for a specific listing of comments.

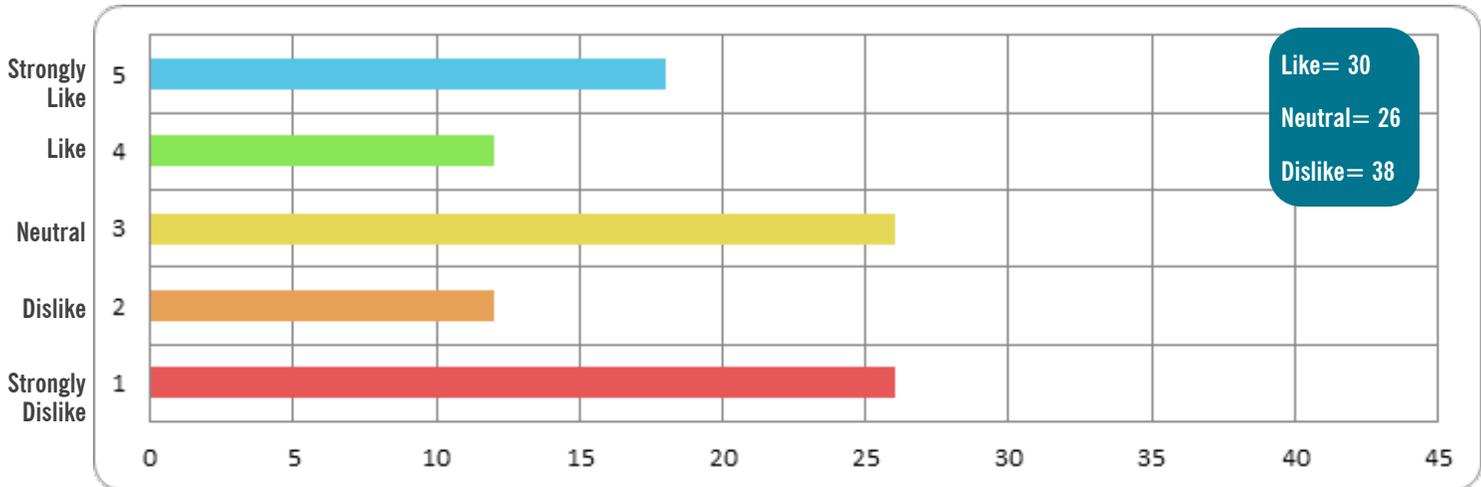
Concept 1 South Segment: Parking on both sides



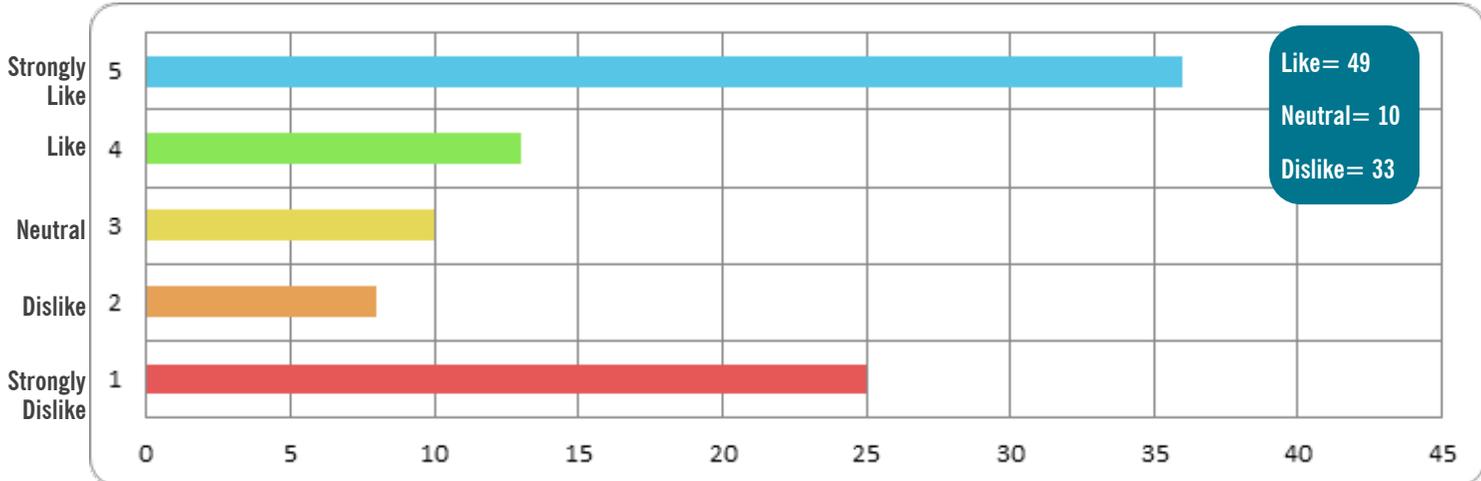
Concept 2 South Segment: Three lanes, no parking



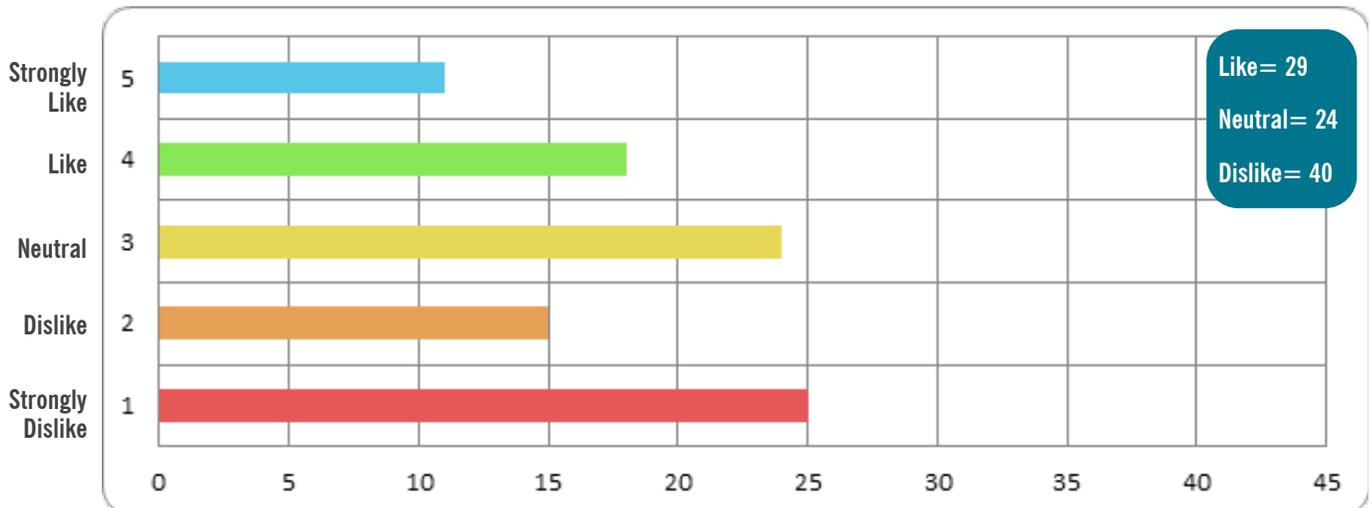
Concept 3 South Segment: Three lanes with park on east side



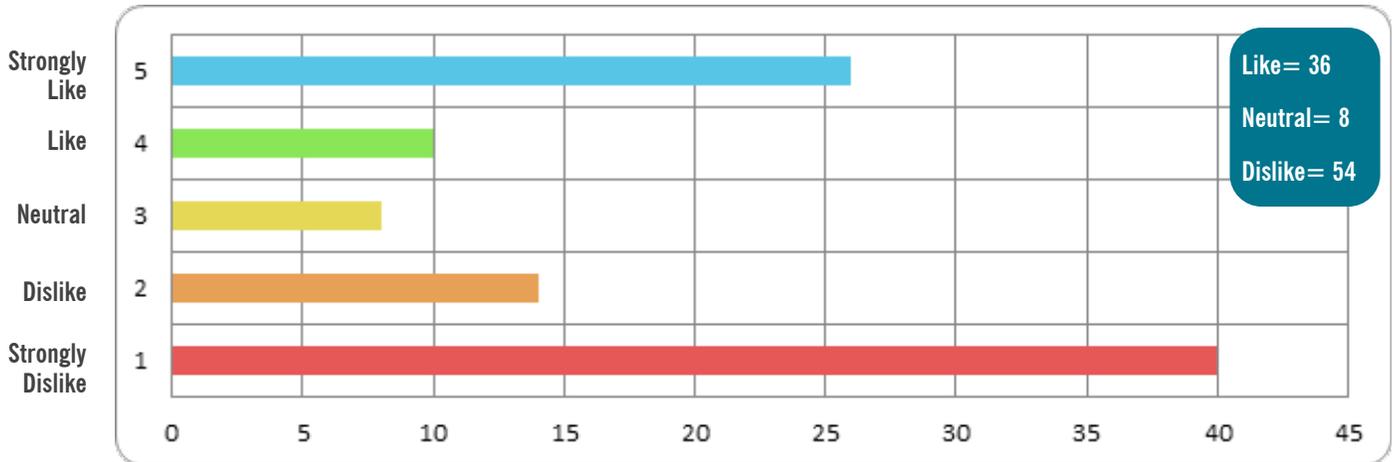
Concept 1 North Segment: Three lanes no parking



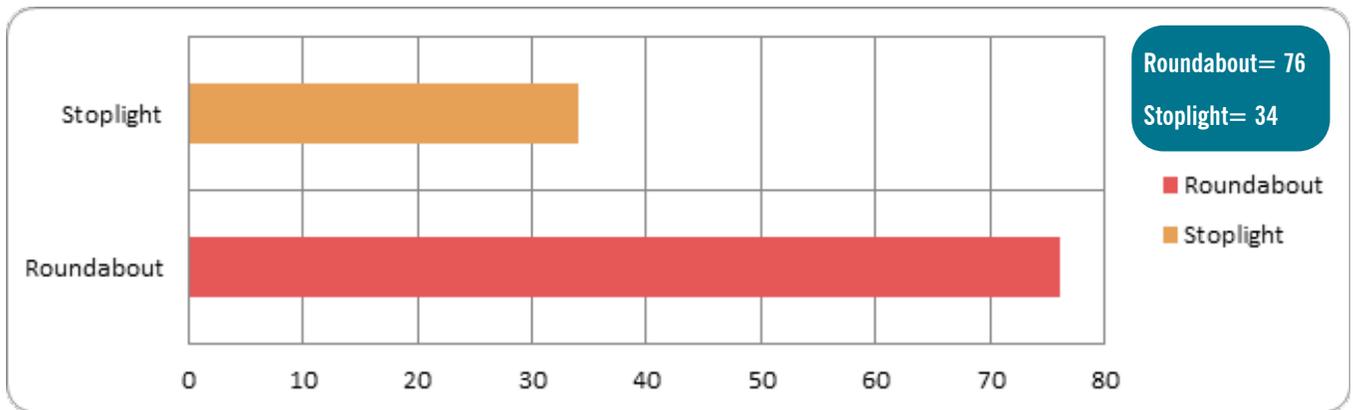
Concept 2 North Segment: Three lanes, parking on east side



Concept 3 North Segment: Three lanes, parking on both sides



27th Street Intersection:



Next Steps and Implementation

South Segment – Division Street to Boundary Street

A range of three project alternatives were developed for the south segment of the corridor study from Boundary Street to Division Street. This corridor study ranked **Alternative 2 – Three-lane with parking on east side** as the most technically-feasible alternative. This also included a series of potential spot improvements to address issues regarding parking, turning movements and pedestrian accommodations. The City and the BMMPO should continue to monitor conditions along this stretch of corridor and determine the potential for the development of a locally or federally funded improvements through either Mandan’s CIP of the BMMPO TIP. The highest technically ranked alternative(s) should be integrated for consideration into the ongoing BMMPO MTP update.

Interchange Area – Boundary Road to Old Red Trail

Preliminary concepts were developed to a range of multimodal conditions along this stretch of corridor. NDDOT is currently studying this segment of the corridor in more detail over 2023 and into 2024. This corridor study ranked the development of the **DDI** as the highest ranked alternative. The City of Mandan and the BMMPO should stay engaged with the NDDOT through the required metropolitan planning process to ensure improvements are evaluated, prioritized, and integrated into the BMMPO MTP and TIP over the next 12 to 18 months.

North Segment – Old Red Trail to 31st Street

A range of three project alternatives were developed for the north segment of the corridor study and two options for intersection improvements at the 27th Street Intersection. Each involves modifications to the existing roadway to address needed improvements to pedestrian accommodation, potential changes in parking along the corridor and needed intersection improvements. **Alternative 2 – Three-Lane with street parking on the east side and a roundabout at the 27th Street** were the highest technically ranked alternatives. The City and the BMMPO should continue to monitor conditions along this stretch of corridor and determine the potential for the development of locally or federally funded improvements through either Mandan’s CIP or the BMMPO TIP. The highest technically ranked alternative(s) should be integrated for consideration into the ongoing BMMPO MTP update.

Sunset Drive Extension – North of 31st Street

Depending on the pace of development, specifically the 550 acres of potential development evaluated north and west of the study area, an extension of Sunset Drive may be warranted by 2030. Again, this extension appears to be development driven. Currently classified as a collector to 27th Street, the extension past 31st Street to 38th Street should be planned as at least a collector roadway.

Glossary

A

- AADT (annual average daily traffic) [12](#)
- AASHTO (American Association of State Highway Transportation Officials) [21](#)
- ADA (Americans with Disabilities Act) [55](#)
- ADT (average daily traffic) [12](#)
- ATAC (Advanced Traffic Analysis Center) [3](#)

B

- BMMPO (Bismarck-Mandan Metropolitan Planning Organization) [7](#)

C

- CAT (Capital Area Transit) [24](#)
- CIP (Capital Improvement Program) [8](#)

D

- DDI (Diverging Diamond Interchange) [4](#)

E

- EB (East-Bound) [18](#)

F

- FHWA (Federal Highway Administration) [7](#)
- FTA (Federal Transit Administration) [7](#)

G

- GIS (geographic information system) [12](#)

H

- HCM (Highway Capacity Manual) [40](#)
- HCS (Highway Capacity Software) [53](#)
- HSM (Highway Safety Manual) [30](#)

I

- I-94 (Interstate 94) [1](#)

L

- LOS (level of service) [3](#)
- LRTP (long-range transportation plan) [11](#)

M

- MEV (Million Entering Vehicles) [30](#)
- mph (miles per hour) [12](#)
- MTP (Master Transportation Plan) [8](#)
- MVM (Million Vehicle Miles) [30](#)
- MVMT (million vehicle miles traveled) [30](#)

N

- NB (North-Bound) [53](#)
- NDDOT (ND Department of Transportation) [7](#)

P

- PCI (Pavement Condition Index) [18](#)
- PIM (public input meeting) [7](#)

R

- RRFB (Rectangular Rapid-Flashing Beacon) [4](#)

S

- SB (South-Bound) [53](#)
- SPUI (Single Point Urban Interchange) [4](#)
- SSS (side street stop control) [3](#)

T

- TIP (Transportation Implementation Plan) [8](#)
- TMCs (Turning Movement Counts) [35](#)
- TWLTL (two-way left turn lane) [4](#)
- TWSC (two way stop controlled) [18](#)

V

- VMT (vehicle miles of travel) [30](#)
- vpd (vehicles per day) [12](#)

W

- WB (West-Bound) [18](#)