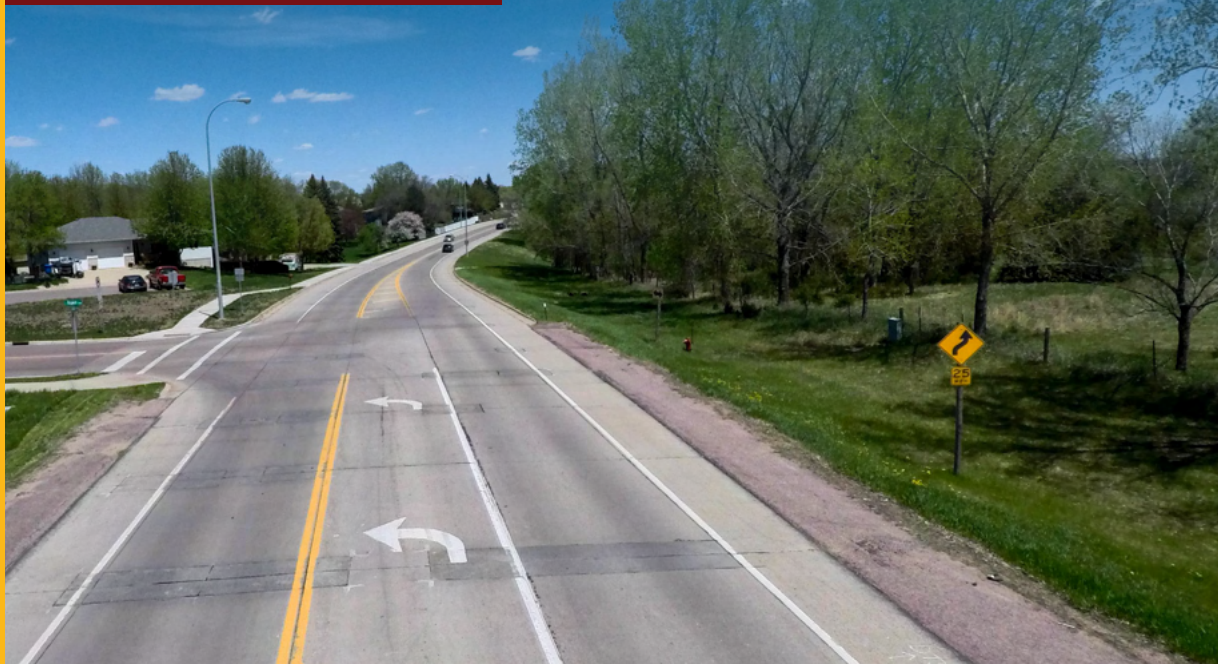
SD11 Corridor Study

SD42 to Redwood Boulevard

Project No: HP 5596(23)P

May 2022



Prepared for:

South Dakota Department of Transportation
700 East Broadway Avenue
Pierre, SD 57501

Prepared by:

Felsburg Holt & Ullevig

In Association with
SRF Consulting Group, Inc.
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LIST OF ACRONYMS AND ABBREVIATIONS

ADT	Average Daily Traffic
APE	Area of Potential Effect
AWS	Advanced Warning System
CMF	Crash Modification Factor
CR	County Road
CRF	Crash Reduction Factor
DOT	Department of Transportation
EJ	Environmental Justice
EPA	US Environmental Protection Agency
FFS	Free Flow Speed
FHU	Felsburg Holt & Ullevig
FHWA	Federal Highway Administration
GIS	Geographic Information System
HCM	Highway Capacity Manual
HSM	Highway Safety Manual
I-90	Interstate 90
ITS	Intelligent Transportation Systems
LOS	Level of Service
LWCF	Land and Water Conservation Fund
mph	miles per hour
MPO	Metropolitan Planning Organization
MRM	Mileage Reference Marker
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
NRHP	National Register of Historic Places
PFFS	Percent of Free-Flow Speed
PHF	Peak Hour Factor
PTSF	Percent Time-Spent Following
ROW	Right-of-Way
SAT	Study Advisory Team
SD	South Dakota
SDCL	South Dakota Codified Laws
SDDOT	South Dakota Department of Transportation
SDGFP	South Dakota Game Fish and Parks
STIP	Statewide Transportation Improvement Program
TSM&O	Transportation Systems Management and Operations
TWLTL	Two-way Left-Turn Lane
USFWS	United States Fish and Wildlife Service
UST	Underground Storage Tank

1.0 INTRODUCTION

The South Dakota Department of Transportation's (SDDOT) pavement management system has identified a segment of South Dakota Highway 11 (SD11), known locally as Splitrock Blvd, for a major rehabilitation or reconstruction project in the 2028-2030 timeframe. The purpose of this corridor study is to evaluate existing conditions and future operations to identify potential improvements to the segment of SD11 from the junction with South Dakota Highway 42 (SD42) through the intersection with Redwood Blvd.

This segment of SD11 in Minnehaha County provides an important connection to the City of Brandon, the City of Corson, and the eastern portion of the County, as well as to Interstate 90 (I-90). The context and character of this 5.7-mile corridor located east of Sioux Falls change considerably through the limits of the study area. A two-lane rural highway with shoulders and auxiliary turning lanes is provided on the south end of the corridor from the intersection with SD42 to the north intersection with Aspen Blvd. A five-lane urban section is provided on the northern end, from the intersection with East Aspen Blvd to Redwood Blvd. **Figure 1-1** shows the study corridor and vicinity map of the study area.

Key elements of the corridor study include an evaluation of the roadway segments with regard to safety, capacity, and access management. Travel forecasts helped to determine the appropriate lane configuration required along the corridor, and an analysis of the recent crash history identified problem locations that need to be addressed with the proposed improvements. Reconstructing the highway will provide opportunities to enhance aesthetic treatments within the community of Brandon and address shortcomings in multimodal transportation, including pedestrian, bicycle, and transit operations.

The goals and outcomes for this SD11 Corridor Study are as follows:

1. Determine potential intersection configurations for key intersections along the study corridor.
2. Determine the need for additional through, turning, and/or passing lanes along the SD11 mainline.
3. Develop an access management plan along the entire corridor.
4. Create environmental scan documentation for the entire SD11 corridor within the study limits.
5. Develop an overall corridor implementation plan.
6. Create final products for use by the City of Brandon, City of Sioux Falls, Minnehaha County, and the SDDOT that will provide guidance to implement recommended improvements for future construction.

NORTH

NOTE: Drawing Not to Scale

FELSBURG HOLT & ULLEVIG

FIGURE 1-1
Vicinity Map

1.1 PURPOSE AND NEED FOR THE PROJECT

National Environmental Policy Act (NEPA) and other environmental requirements rely on a decision-making process guided by the Purpose and Need for the study. The Purpose is a brief statement of the primary intended transportation objective and related goals to be achieved by a proposed transportation improvement. The Need is a condition sought to be relieved, or a statement of the problem in need of a solution. The Need proves that the problem exists based on existing data and information. The Need for the proposed improvements is the basis from which a range of alternatives are developed, compared, and evaluated, ultimately leading to a preferred alternative.

1.1.1 What is the Purpose of this Project?

The Purpose of the SD11 Corridor Study is to evaluate the corridor segments from the junction with SD42 through the intersection with Redwood Blvd to determine which segments may require safety and/or capacity improvements and address locations along the corridor with substandard roadway geometries and aging pavement conditions. The study also evaluated independent utility and determined future projects and prioritization of those projects.

1.1.2 What are the Goals and Objectives for the Corridor Study?

This section addresses goals and objectives that each improvement type is intended to address. These goals are important to the corridor, but they are not defined and measured to the same extent as a transportation need for the corridor. These goals and objectives may result in the selection of an alternative(s) when other needs are equal and one alternative addresses the goals and objectives better than other alternatives.

- Enhance multimodal access throughout the corridor and provide connectivity for pedestrian and bicycle movement within the City of Brandon.
- Provide lane widths and shoulders as needed to accommodate future traffic volumes and freight movements.

1.1.3 What is the Need for this Project?

Study “Needs” are conditions that require remedy. The “Need” statement proves that the problem exists, provides data to support the Purpose, and is used to guide decision-making throughout the project development process.

The transportation needs evaluated with this study include pavement condition, geometric deficiencies, transportation congestion, traffic operations, and safety:

- **Pavement Condition:** The segment of SD11 from Madison St to the north junction with East Aspen Blvd requires major rehabilitation or reconstruction due to poor pavement conditions. The pavement is nearing the end of its design life, and deficiencies in the existing conditions are characterized by joint spalling, joint seal damage, and cracking. These needs are supported by information from the SDDOT’s pavement management system and existing conditions analysis.
- **Geometric Deficiencies:** Geometric conditions along segments of the SD11 corridor have been identified as not meeting current design standards. Improvements and/or modifications to the roadway may be necessary to satisfy current design criteria, or possible mitigation measures may be introduced to address geometric deficiencies.

- **Congestion & Traffic Operations:** Intersection improvements may also be necessary due to the increase in development and urbanization along the corridor. Urban growth promotes an anticipated increase in traffic volumes, which can cause increased delay and congestion. Therefore, intersections along the corridor may need to be improved to ensure appropriate lane configurations are provided to accommodate the anticipated traffic volume increase for the duration of the rehabilitated or reconstructed pavement assets' service life. These improvements would also need to address intersection operations.
  - Traffic operations along segments and at intersections were evaluated and improvements were identified to meet the SDDOT operational goals of Level of Service (LOS) B for rural and LOS C for urban areas.
- **Safety:** Safety improvements may be necessary along corridor segments or at specific locations to address locations that have experienced higher than expected crash rates. An analysis of the most recent 5-year crash history along the SD11 corridor was completed to determine if any roadway segments or intersections have crash rates or conditions that may benefit from safety improvements.
  - For segments of the SD11 corridor, improvements were identified to bring the predicted crash rate below the published SDDOT statewide crash rate on highway segments for rural and urban areas.
  - For intersections, improvements were identified that would result in a reduced predicted crash rate based on application of crash modification factors in the Highway Safety Manual (HSM).

1.2 STAKEHOLDER INVOLVEMENT

Many stakeholders were involved in this SD11 Corridor Study. The stakeholders participated in project meetings, data collection, traffic projections, concept development, evaluation, and selection. Throughout the study process, information was collected from and disseminated to the stakeholder groups, which included:

- South Dakota Department of Transportation (SDDOT)
- Federal Highway Administration (FHWA)
- City of Brandon
- Sioux Falls Metropolitan Planning Organization (MPO)
- Minnehaha County
- City of Sioux Falls

1.3 STUDY ADVISORY TEAM

A Study Advisory Team (SAT), formed to guide the study through completion, includes representative parties of the SDDOT, Sioux Falls MPO, Minnehaha County, and FHWA. SAT members include:

Representative	Organization	Representative	Organization
Tami Jansma	City of Brandon	Mark Hoines	FHWA
Shannon Schultz	Minnehaha County	Jim Feeney	Sioux Falls MPO
Shannon Ausen	City of Sioux Falls	Andrea Kramer	SDDOT–Environmental
Steve Gramm	SDDOT–Project Development	Stacy DuChene	SDDOT–Roadway Design
Sarah Gilkerson	SDDOT–Project Development	Joanne Hight	SDDOT–Environmental
Zachary Nevitt	SDDOT–Project Development	Harry Johnston	SDDOT–Sioux Falls Area
Jeff Brosz	SDDOT–Transportation Inventory Mgmt.	Tom Strubel	SDDOT–Bridge

A series of SAT meetings were conducted throughout the study as listed below. **Appendix A** includes the following meeting minutes:

- Kickoff Meeting – November 12, 2020
- SAT Meeting – January 12, 2021
- SAT Meeting – April 21, 2021
- SAT Meeting – August 30, 2021
- Public Meeting #1 – September 27, 2021
- SAT Meeting – December 1, 2021
- Public Meeting #2 – January 25, 2022

1.4 STUDY PROCESS

This corridor study comprises three main elements: Needs and Solutions Analyses, Public Involvement, and Environmental Review. These work elements proceeded along parallel paths throughout the study, culminating in the final selection of solutions to meet the project needs.

1.4.1 Needs and Solutions Analyses

The needs and solutions analyses represent the technical core of the study. Needs were identified by first compiling a comprehensive dataset describing existing conditions throughout the study area. Data collection efforts included recording traffic volumes; reviewing relevant agency requirements; compiling available Geographic Information Systems (GIS) based mapping of boundaries, resources and land contours; reviewing pavement quality metrics; gathering a current inventory of intelligent transportation systems (ITS); and collecting a history of reported traffic crashes. The data were analyzed to rate current performance and to identify deficiencies. Future (2050) traffic forecasts were developed using several sources (including the Sioux Falls Regional Travel Demand Model) to test operational performance into the future, reveal any additional needs not known based on current conditions, and understand the impact of various potential future roadway network enhancements.

Having a good understanding of the needs, the study team worked to identify potential solutions along the SD11 corridor. Solutions included SD11 widening scenarios, addition of auxiliary turn-lanes, and intersection traffic control improvements. The potential concepts were evaluated to assess the ability of each to address the needs. Higher-performing feasible build scenarios were developed for consideration, refinement, and inclusion as study recommendations.

1.4.2 Public Involvement

Stakeholders identified for the public involvement effort consisted of travelers using the SD11 corridor, residential and business property owners adjacent to the highway and crossroads, and residents of Brandon, South Dakota. The Methods and Assumptions document outlined the following key public involvement elements:

- **Project website:** www.sd11corridorstudy.com was established as the repository of information on Existing and No-Build conditions, alternatives to address current and/or future needs, and technically feasible alternatives. The website was updated throughout the study period and was used to advertise the two public information meetings.
- **Public information meetings:** Two public information meetings were held for the study:
  - *Public Meeting 1*: Existing conditions, study process, and project goals.
  - *Public Meeting 2*: Range of alternatives for each intersection, the SD11 segments, and preliminary findings of the technical analysis.

- **Stakeholder/Landowner Meetings:** Property owners abutting the SD11 corridor and crossroads were invited to meet with SDDOT staff and the study team to discuss needs relative to their property use, how alternatives could affect their properties, and potential refinements to the concepts.
- **Study Advisory Team:** The project SAT made up of SDDOT staff from the region and central office, FHWA, Minnehaha County, City of Brandon, and City of Sioux Falls met several times throughout the study period, as described in **Section 1.3**.

Appendix A includes summaries from the two public information meetings.

A **Solutions Workshop** was held after the first public meeting and completion of the needs assessment. At the workshop, the SAT and additional agency representatives participated in a brainstorming session and identified priorities for the future of the study area. The Solutions Workshop allowed study team members to collaborate and broaden their understanding of issues. The workshop provided direction for the development of alternatives and evaluation parameters used throughout the study.

1.4.3 Environmental Review

The environmental work element was conducted in parallel with the needs and solution analyses throughout the project and provided information to assist with solution development.

1. GIS was used to compile the inventory of existing environmental resources and helped to inform the determination of feasibility of corridor and intersection solutions. This inventory, documented in **Chapter 3.0**, will assist in future steps toward implementation of projects.
2. The environmental overview conducted for the SD11 Corridor Study will serve as a bridge to future environmental documentation that would be required to clear projects for implementation. NEPA requires that, among other items, projects have a firm basis in a purpose and need statement, arise from appropriate consideration of alternatives, and include public involvement efforts. The study team identified these elements in the study and helped set the stage for more streamlined future completion of NEPA documents.

The environmental review included a desktop review of available resource information and a field review to confirm and supplement known information. SDDOT and FHWA participated in the review of information during the study process.

1.4.4 Study Oversight

The SDDOT Project Manager and SAT provided study oversight. Consistent with SDDOT practice for planning studies, the study team, in collaboration with SDDOT and FHWA authorities, developed a Methods and Assumptions document at the outset of the study. The Methods and Assumptions document ensured agency agreement on the fundamental methods to be used for completion of the study. **Appendix B** includes the Methods and Assumptions document.

1.5 PLANNING CONTEXT AND PREVIOUS STUDIES

Several previous plans and studies have included consideration of transportation needs within the SD11 Corridor Study area. The following documents served as references for the Corridor Study, and their findings were incorporated as appropriate:

- Go Sioux Falls 2045 – Sioux Falls MPO's Current Long-Range Plan
- Sioux Falls MPO Bicycle Plan
- Envision 2035 – Minnehaha County's Comprehensive Plan
- Red Rock Overlay District Plan
- Brandon Comprehensive Plan 2035
- Aspen Park Master Plan
- Strategic Highway Safety Plan
- Traffic Impact Studies from recent developments
- I-90 Exit 406 Interchange Modification Justification Report
- Maple Street / Park Street Corridor Study
- Go Sioux Falls 2045 -Sioux Falls MPO's Long Range Plan
- Rice Street / Holly Blvd Corridor Study
- Brandon Transportation Plan
- Brandon Bicycle & Pedestrian Plan
- Preliminary design plans for NH-P 0042(59)373 P, PCN 03TE (which includes the Intersection of SD11 & SD42).

2.0 EXISTING (2021) CONDITIONS

2.1 EXISTING FACILITY AND ROADWAY NETWORK

SD11, a state highway in southeast South Dakota, runs from the junction with South Dakota Highway 48 (SD48) in Union County and continues north through the Sioux Falls metropolitan area. The alignment jogs to the east on SD42 and continues north through the City of Brandon and I-90, terminating at the Minnesota State Line on the north end of Minnehaha County. The segment of SD11 within the study area has a northern terminus of Redwood Blvd and a southern terminus of SD42. In addition to studying the corridor itself, many intersections and access points were evaluated as a part of this study. The primary focus was the 12 major intersections within the study limits.

SD11 is a north-south corridor and split into two FHWA functional classes: (1) Urban Other Principal Arterial north of 264th St and (2) Rural Minor Arterial south of 264th St. The context of the highway changes considerably within the study limits. For the purposes of this study, the highway was divided into the following three sections:

- **South Section**: SD42 to Sioux Blvd
- **Middle Section**: Sioux Blvd to Aspen Blvd (East)
- **North Section**: Aspen Blvd (East) to Redwood Blvd

2.2 EXISTING LAND USE

The South Section of the corridor, which runs from SD42 to Sioux Blvd, is a two-lane undivided rural roadway with a two-way left-turn lane (TWLTL) between SD42 and 266th St. The speed limit is 45 miles per hour (mph). Split Rock Creek runs on the east side of the roadway until it crosses SD11 just north of 265th St. Additionally, the Big Sioux River runs along the west side of SD11 starting at Madison St and eventually joins with Split Rock Creek just north of 265th St. The surrounding land area is primarily agricultural except for residential homes between 266th St and SD42. Oakridge Nursery and Landscaping is located on the southwest corner of SD11 with Sioux Blvd. Their commercial entrance is provided off SD11 and their truck/freight entrance is located off Sioux Blvd.

The Middle Section, which runs from Sioux Blvd to the northern intersection of Aspen Blvd (East), is primarily a two-lane undivided urban roadway with auxiliary turn lanes at key intersections. The posted speed limit transitions from 55 mph to 45 mph approximately 2,100 feet north of Sioux Blvd and then from 45 mph to 30 mph approximately 600 feet south of Aspen Blvd (West). Split Rock Creek runs adjacent to the roadway along the east side. More than a dozen homes directly access SD11 along the west side of the roadway within this section. Huset's Speedway lies on the northeast corner of SD11 with Sioux Blvd, which creates significant event traffic throughout the summer months. The surrounding land uses are a mix of farmland and residential, with schools located along Sioux Blvd.

The North Section, which runs from the northern intersection of Aspen Blvd (east leg) to Redwood Blvd, is a five-lane undivided urban roadway with a TWLTL in the center. The speed limit is 30 mph. This section functions as Brandon's main artery and commercial district. Businesses and public buildings are the primary developments along this section. Brandon Valley High School sits on the west side of the roadway south of Holly Blvd. The surrounding land uses are primarily residential.

2.3 DESCRIPTION OF STUDY INTERSECTIONS

Twelve intersections along SD11 were identified for evaluation in this corridor study. They include the intersections of SD11 with:

1. **SD42** is an unsignalized two-way stop-controlled intersection with the stop signs provided for the northbound and southbound movements. Eastbound and westbound left-turn lanes are provided, as well as a channelized southbound right-turn lane. SD42 within the study area is a two-lane undivided roadway with a posted speed limit of 55 mph. To the west, SD42 and SD11 are on the same alignment.
2. **266th St (CR 146)** is an unsignalized two-way stop-controlled intersection with stop signs provided for the eastbound and westbound movements. Northbound and southbound left-turn lanes are provided, as well as a northbound right-turn lane. 266th St within the study area is a gravel road west of SD11 with a statutory speed limit of 25 mph and is a two-lane undivided roadway west of SD11 with a posted speed limit of 55 mph. To the east, 266th St is also designated as County Road 146 (CR 146).
3. **265th St** is an unsignalized two-way stop-controlled intersection with stop signs provided for the eastbound and westbound movements. 265th St within the study area is a gravel road to the east and west of SD11 with a posted speed limit of 35 mph.
4. **264th St** is an unsignalized two-way stop-controlled intersection with stop signs provided for the eastbound and westbound movements. A southbound left-turn lane is provided. 264th St within the study area is a gravel road east of SD11 with a posted speed limit of 35 mph.
5. **Madison St (CR 142)** is an unsignalized two-way stop-controlled intersection with a stop sign provided for the eastbound movement. A northbound left-turn lane is provided, as well as a southbound right-turn lane. Madison St within the study area is a two-lane undivided roadway west of SD11 with a posted speed limit of 50 mph. To the west of SD11, Madison St is also designated as County Road 142 (CR 142).
6. **Sioux Blvd** is an unsignalized two-way stop-controlled intersection with a stop sign provided for the eastbound movement. A northbound left-turn lane is provided. Sioux Blvd within the study area is a two-lane undivided roadway west of SD11 with a posted speed limit of 30 mph. The east leg of the intersection is a gravel driveway to a private residence. Immediately north of the intersection, two driveways to Huset's exist, approximately 100 feet and 300 feet, respectively. South of the intersection, approximately 150 feet, a driveway to Oakridge Nursery & Landscaping is provided.
7. **Park St (future)/North Huset's Dr** is an unsignalized stop-controlled tee intersection with the north driveway to Huset's Speedway, which is stop sign controlled. A southbound left-turn lane is provided. A future Park St extension would align with the north entrance/exit to Huset's Speedway on the east side of SD11.
8. **Aspen Blvd (West)** is an unsignalized two-way stop-controlled intersection with a stop sign provided for the eastbound movements. A northbound left-turn lane is provided. Aspen Blvd (West) within the study area is a two-lane undivided street west of SD11 with a posted speed limit of 30 mph.
9. **Aspen Blvd (East)** is an unsignalized two-way stop-controlled intersection. A southbound left-turn lane is provided, as well as a southbound right-turn lane and channelized northbound

right-turn lane that is yield controlled and a channelized westbound right-turn lane that transitions into its own northbound lane. Aspen Blvd (East) within the study area is a two-lane undivided street east of SD11 with a posted speed limit of 30 mph. The west leg of the intersection, Fleetwood Cr, is a residential cul-de-sac.

10. **Pedestrian Signal** at the Brandon Valley High School provides traffic control for pedestrian and bicycle crossings across SD11. It is located approximately 240 feet south of Rushmore Dr.
11. **Holly Blvd** is a signalized intersection with left-turn lanes provided on all approaches, as well as an eastbound and westbound right-turn lane. Holly Blvd within the study area is a three-lane undivided street with a TWLTL west of SD11 with a posted speed limit of 30 mph. The east leg of the intersection, Sylvan Cr, is a residential local access street.
12. **Redwood Blvd** is a signalized intersection with left-turn lanes provided on all approaches. Redwood Blvd within the study area is a three-lane undivided street with a TWLTL and a posted speed limit of 30 mph west of SD11. To the east of SD11, Redwood Blvd is two-lane undivided street with a 25 mph posted speed limit.

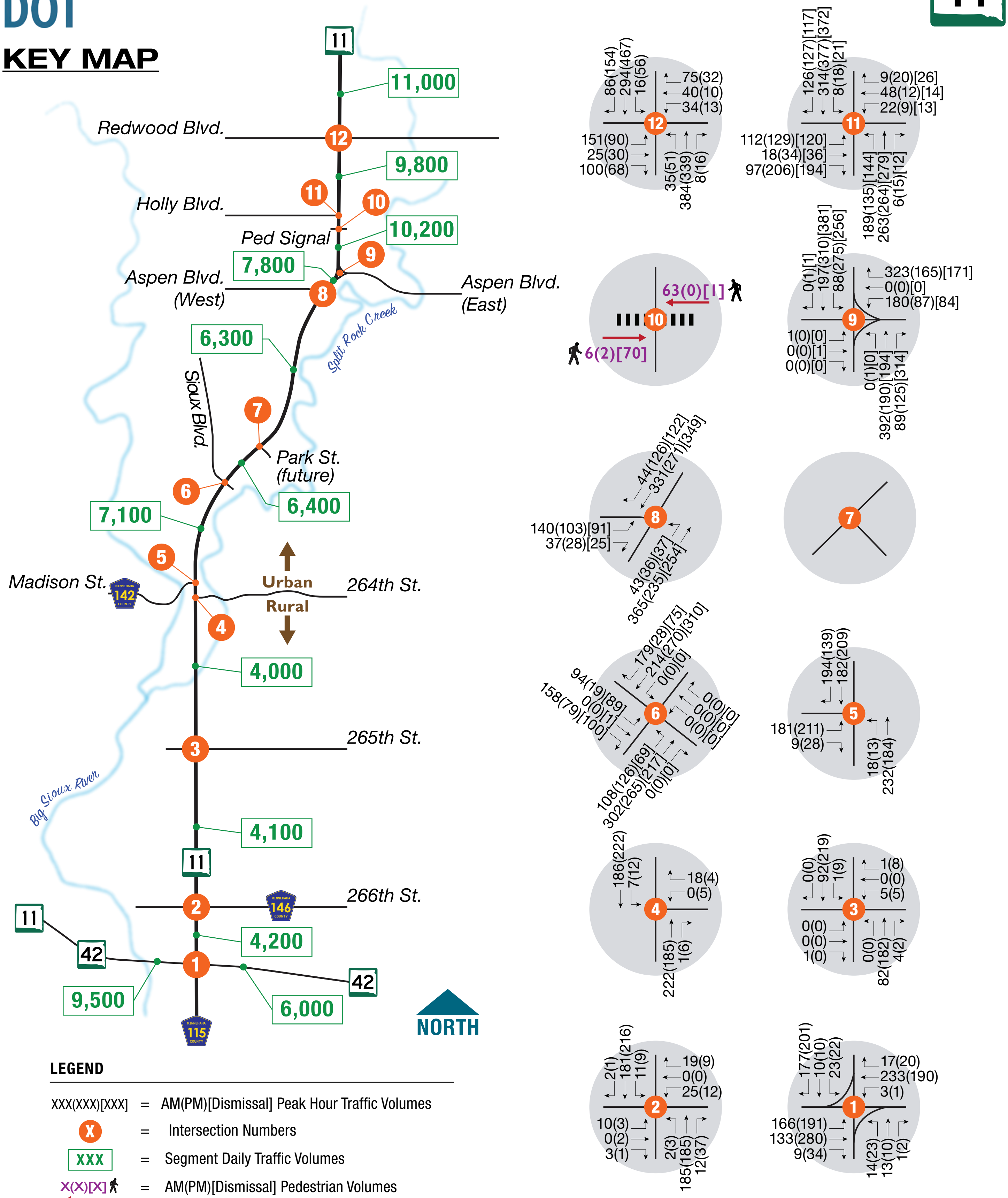
2.4 EXISTING (2021) TRAFFIC VOLUMES

Turning movement counts were compiled at the SD11 study intersections via video camera technology. **Figure 2-1** shows the resultant peak hour and average daily counts at the study intersections and along the corridor. **Appendix C** provides the count data. Counts were completed on a typical weekday (Tuesday – Thursday) during school hours, apart from Park St (North Huset's Dr) which was counted on a Sunday evening, which is the typical race day.

2.4.1 Daily Traffic and Truck Traffic

Both Felsburg Holt & Ullevig (FHU) and All Traffic Data conducted counts at study intersection locations. Average Daily Traffic (ADT) volumes along SD11 were estimated from the 13-hour counts based on a growth factor that was based on known 24-hour count numbers along the corridor. Truck percentages were calculated for all study intersections.

KEY MAP



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NOTE: Drawing Not to Scale

FIGURE 2-1
Existing (2021) Traffic Volumes

2.4.2 Peak Hours

Table 2-1 lists AM, PM, and the school dismissal peak hours and peak hour factors (PHF) at the 12 study intersections. The school dismissal peak hour was calculated only for the study intersections of Sioux Blvd to Holly Blvd due to the limited influence of school traffic. The counts were compiled, and the systemwide AM, PM and school dismissal peak hours were established as 7:15 to 8:15 AM, 4:45 to 5:45 PM, and 3:00 to 4:00 PM, respectively.

Table 2-1. Study Intersection Peak Hours

Intersection		AM Peak Hour		PM Peak Hour		Dismissal Peak Hour (PM)	
		Time Period	PHF	Time Period	PHF	Time Period	PHF
1	SD42	7:00 – 8:00	0.89	4:30 – 5:30	0.96	–	–
2	266th Street	7:00 – 8:00	0.82	4:45 – 5:45	0.93	–	–
3	265th Street	7:15 – 8:15	0.83	3:45 – 4:45	0.91	–	–
4	264th Street	7:15 – 8:15	0.80	4:45 – 5:45	0.87	–	–
5	Madison Street	7:15 – 8:15	0.80	4:45 – 5:45	0.93	–	–
6	Sioux Blvd	7:15 – 8:15	0.75	4:45 – 5:45	0.95	3:00 – 4:00	0.73
7	Park Street	–	–	–	–	–	–
8	Aspen Blvd (West)	7:15 – 8:15	0.77	4:30 – 5:30	0.97	3:00 – 4:00	0.72
9	Aspen Blvd (East)	7:15 – 8:15	0.78	4:45 – 5:45	0.92	3:00 – 4:00	0.62
10	Pedestrian Signal	7:15 – 8:15	0.83	4:30 – 5:30	0.89	3:00 – 4:00	0.83
11	Holly Blvd	7:15 – 8:15	0.84	4:30 – 5:30	0.90	3:15 – 4:15	0.87
12	Redwood Blvd	7:15 – 8:15	0.84	4:45 – 5:45	0.87	–	–
Global Peak		**7:15 – 8:15**	**0.81**	**4:45 – 5:45**	**0.92**	**3:00 – 4:00**	**0.75**

2.4.3 Huset's Speedway Traffic Counts

As previously stated, counts at Huset's Speedway were performed during a weekend race event on June 20, 2021 from 4:00 PM – 12:00 AM at both the North Huset's Drive and the South Huset's Drive access driveways. **Table 2-1** shows the count information at the two driveways.

Table 2-2. Huset's Speedway Count Information

	WBL	WBR	NBT	NBR	SBL	SBT	Total	PHF
Park Street (North Huset's Drive)								
Pre-Race Peak (6:00 – 7:00 PM)	4	5	186	72	264	263	794	0.89
Post-Race Peak (10:30 – 11:30 PM)	105	573	115	3	1	58	855	0.78
South Huset's Drive								
Pre-Race Peak (6:00 – 7:00 PM)	1	1	466	12	1	212	693	0.86
Post-Race Peak (10:30 – 11:30 PM)	30	5	39	1	1	618	694	0.79

2.5 EXISTING (2021) OPERATIONAL ANALYSIS

The existing year traffic operational analysis used 2021 traffic volumes, as approved by the study stakeholders in the Methods and Assumptions document provided in **Appendix B**.

2.5.1 Traffic Operations Criteria

The traffic operations analysis used procedures documented in the *Highway Capacity Manual, 6th Edition*. The analysis obtained a key measure or "level of service" (LOS) rating of the traffic operational condition. Levels of service are described by a letter designation of either A, B, C, D, E or F, with LOS A representing essentially uninterrupted flow, and LOS F representing a breakdown of traffic flow with noticeable congestion and delay.

Segments

For two-lane highways, like the section of SD11 south of Aspen Blvd (East), LOS is a qualitative assessment of traffic's percent time-spent-following (PTSF), average travel speed, as well as percent of free-flow speed (PFFS). PFFS represents the ability of vehicles to travel at or near the posted speed limit. **Table 2-4** shows the LOS criteria for two-lane highways.

Table 2-3. Two-lane Highway Level of Service Criteria

Level of Service	Class I Highways ATS (mi/h)	Class I Highways PTSF (%)	Class II Highways PTSF (%)	Class III Highways PFFS (%)
A	> 55	≤ 35	> 40	> 91.7
B	> 50 – 55	> 35 – 50	> 40 – 55	> 83.3 – 91.7
C	> 45 – 50	> 50 – 65	> 55 – 70	> 75.0 – 83.3
D	> 40 – 45	> 65 – 80	> 70 – 85	> 66.7 – 75.0
E	≤ 40	> 80	> 85	≤ 66.7
F	Demand exceeds capacity			

Source: *Highway Capacity Manual* (HCM) 6th Edition

For urban street segments, like the section of SD11 north of Aspen Blvd (East), LOS is a qualitative assessment of traffic operational conditions within a traffic stream in terms of the ratio of travel speed to the base free-flow speed. The travel speed reflects the factors that influence running time along the link and the delay incurred by through vehicles. Base free-flow speed is the average running speed of through vehicles traveling along a segment under low-volume conditions and not delayed by traffic control devices or other vehicles. **Table 2-4** shows the LOS criteria for urban street segments.

Table 2-4. Urban Street Segment Level of Service Criteria

Level of Service	Travel Speed Threshold by Base Free-Flow Speed (mi/h)							Volume-to-Capacity Ratio
	55	50	45	40	35	30	25	
A	> 44	> 40	> 36	> 32	> 28	> 24	> 20	≤ 1.0
B	> 37	> 34	> 30	> 27	> 23	> 20	> 17	
C	> 28	> 25	> 23	> 20	> 18	> 15	> 13	
D	> 22	> 20	> 18	> 16	> 14	> 12	> 10	
E	> 17	> 15	> 14	> 12	> 11	> 9	> 8	
F	≤ 17	≤ 15	≤ 14	≤ 12	≤ 11	≤ 9	≤ 8	
F	Any							> 1.0

Source: *Highway Capacity Manual* (HCM) 6th Edition

Intersections

For intersections, LOS qualitatively assesses traffic operational conditions within a traffic stream in terms of the average stopped delay per vehicle at a controlled intersection. Signalized intersection analysis results in an overall LOS representative of all movements through the intersection. Unsignalized, or stop sign controlled, intersection operational analysis produces LOS results for each movement that must yield to conflicting traffic at the intersection.

Table 2-5 summarizes LOS criteria for both signalized and unsignalized (stop sign controlled) intersections.

Table 2-5. Intersection Level of Service Criteria

Level of Service	Average Control Delay per Vehicle (sec/veh)	
	Signalized Intersections	Stop Sign Controlled Intersections
A	≤ 10	≤ 10
B	> 10 to 20	> 10 to 15
C	> 20 to 35	> 15 to 25
D	> 35 to 55	> 25 to 35
E	> 55 to 80	> 35 to 50
F	> 80	> 50

Source: HCM 6th Edition, Exhibit 19-8; Unsignalized Intersections, HCM 6th Edition, Exhibit 20-2 (TWSC) & Exhibit 21-8 (AWSC)

For this study, SDDOT, in concurrence with FHWA, specified goals for acceptable peak hour traffic operations at intersections were assumed to be LOS C in urban areas and LOS B in rural areas. All study stakeholders agreed to this LOS target as part of the Methods and Assumptions document. The current urban/rural boundary in the study area for SD11 is Madison St, with the intersection of SD11 with Madison St included in the urban area.

2.5.2 Segment Operations Analysis

The HCS7 software was used to analyze traffic operations at study segments. **Figure 2-2** shows the lane geometry, traffic control, and LOS for Existing (2021) study segments and intersections. The lane configurations along all study segments are based on existing geometrics. **Appendix D** includes capacity analysis worksheets for the Existing (2021) traffic conditions scenario.

Most segments in the study area operate at acceptable levels of service (LOS C or better on urban roadways and LOS B or better on rural roadways) in the peak hours in Existing (2021) traffic conditions. One study segment does not operate at an acceptable LOS:

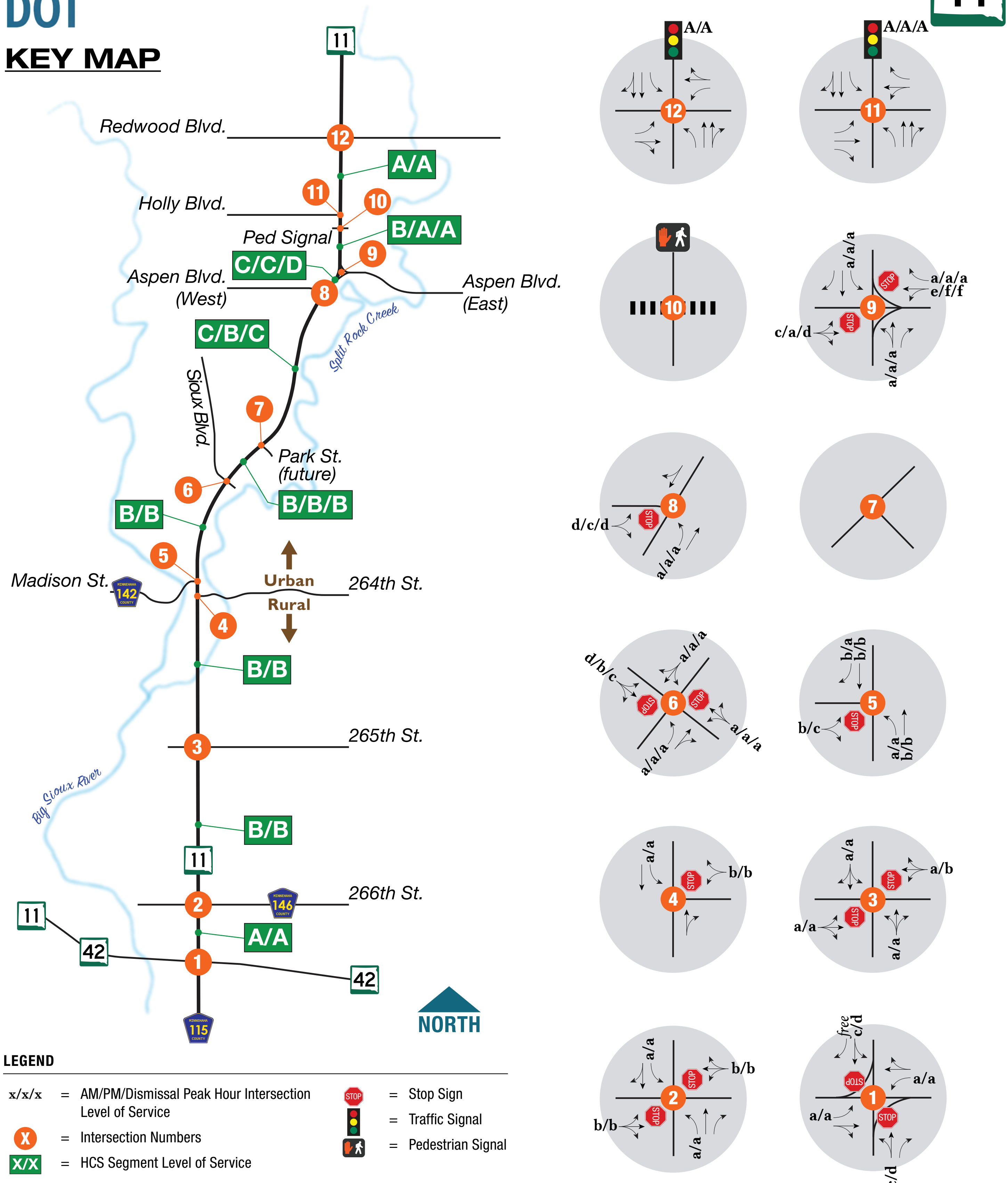
- The roadway segment between Aspen Blvd (West) and Aspen Blvd (East) operates at LOS D during the school dismissal peak period, but LOS C during the AM and PM peak periods.

2.5.3 Intersection Operations Analysis

Synchro 11 software was used to analyze traffic operations at the study intersections. **Figure 2-2** shows the lane geometry, traffic control, and LOS for Existing (2021) intersections. The lane configurations at all study intersections are based on existing geometrics. **Appendix D** includes capacity analysis worksheets for the Existing (2021) traffic conditions scenario.

Most intersections in the study area operate at acceptable levels of service (LOS C or better on urban roadways and LOS B or better on rural roadways) in the peak hours in Existing (2021) traffic conditions. Four study intersections do not operate at an acceptable LOS:

- SD42 (Int. #1) – The southbound and northbound thru-left movements operate at LOS C in the AM peak period and LOS D in the PM peak period.
- Sioux Blvd (Int. #6) – The eastbound shared left/right turn movement operates at LOS D in the AM peak period and LOS C during the school dismissal peak period.
- Aspen Blvd (West) (Int. #8) – The eastbound shared left/right turn movement operates at LOS D in the AM and school dismissal peak periods and LOS C in the PM.
- Aspen Blvd (East) (Int. #9) – The eastbound shared left/thru/right turn movement operates at LOS D during the school dismissal peak period, and the westbound shared left-thru movement operates at LOS E or F for all peak periods.



FELSBURG HOLT & ULLEVIG

NOTE: Drawing Not to Scale

FIGURE 2-2
Existing (2021) Traffic Operations

2.6 CRASH HISTORY AND SAFETY ANALYSIS

SDDOT currently maintains a GIS crash database designed to monitor crash trends. As part of this corridor study, crash data were compiled for a 5-year period to identify significant crash patterns within the study area. The crash history was analyzed for the period of January 1, 2015, through December 31, 2019, using crash data provided by the SDDOT. 2020 data was excluded from the analysis due to the start of the COVID-19 pandemic impacting traffic volumes, operations, and crash occurrences. The number, severity, type, and rate of collisions on the corridor are discussed in detail in this section.

Crash rates were developed for study area intersections and segments. In addition, a weighted crash rate was also calculated. To calculate this rate, weight factors, as shown in **Table 2-6**, were applied to specific crash types and crash severity. Crashes with higher severity are given a higher weight. This allows intersections and segments that may have a low number of crashes with high severity to be compared to locations with a high number of crashes but low severity.

Table 2-6. SDDOT Weighted Crash Factors

Crash Type	Weight Factor
Wild animal hit	1.00
No injury	1.00
Possible	3.00
Non-incapacitating	3.00
Incapacitating	3.00
Fatal injury	12.00

These records were compared with the average statewide weighted crash rates for the SDDOT State Highway System. **Table 2-7** shows these rates for both urban and rural segments.

Table 2-7. SDDOT State Highway System Weighted Crash Rates

Classification	Weighted Rate
Urban Principal Arterial	1.95
Rural Minor Arterial	1.76

Table 2-8 and **Table 2-9** present developed crash rates and weighted crash rates for the study area, for both intersections and segments, respectively. **Tables 2-10, 2-11** and **2-12** show the breakdown of intersection crashes by event, severity, and type. **Tables 2-13, 2-14** and **2-15** summarize the breakdown of crashes by event, severity, and type but for the study segments. It should be noted that SDDOT only provides standard crash rates for segments. All segment crash rates were below the SDDOT standard crash rates, as shown in **Table 2-9** and **Table 2-11**.

Additionally, **Figure 2-3** summarizes the crash history along the corridor for both the study area segments and intersections. The intersections/segments were categorized as either Low, Moderate, or Higher crash rates. Since all the corridor crash rates were below the statewide average and weighting was based on standard deviation of the segment or intersection crash rates from the study area average, respectively.

Table 2-8. Crash History for Intersections

Intersections (w/ SD 11)		SD 11; Intersection Crash Rates									
		2015	2016	2017	2018	2019	Total Crashes	5-Year (MEV)*	Crash Rate per MEV	Weighted Crash Rate	
12	Redwood Blvd	2	1	2	0	5	10	24.10	**0.41**	**0.66**	
11	Holly Blvd	2	1	2	2	3	10	25.02	**0.40**	**0.72**	
10	Ped Signal	1	0	0	0	0	1	18.63	**0.05**	**0.16**	
9	Aspen Blvd (East)	1	0	1	0	1	3	22.64	**0.13**	**0.13**	
8	Aspen Blvd (West)	0	0	1	0	2	3	15.34	**0.20**	**0.33**	
7	Park Street	0	2	0	1	0	3	11.69	**0.26**	**0.26**	
6	Sioux Blvd	2	2	2	0	0	6	15.16	**0.40**	**0.53**	
5	Madison Street	3	5	4	3	4	19	13.51	**1.41**	**1.85**	Urban
4	264th Street	0	2	1	0	1	4	7.67	**0.52**	**0.52**	Rural
3	265th Street	0	0	1	0	0	1	7.67	**0.13**	**0.39**	
2	266th Street	0	1	1	0	2	4	8.22	**0.49**	**0.97**	
1	SD 42	5	3	4	4	6	22	18.81	**1.17**	**1.92**	
Total / Average		16	17	19	10	24	**86**	**15.70**	**0.46**	**0.70**	

Table 2-9. Crash History for Segments

Segments (on SD 11)		SD 11; Segment Crash Rates									
		2015	2016	2017	2018	2019	Total Crashes	5-Year (MVMT)**	Crash Rate per MVMT	Weighted Crash Rate	
11 - 12	Holly Blvd - Redwood Blvd	3	1	2	1	1	8	9.02	**0.89**	**0.78**	
9 - 11	Aspen Blvd (East) - Holly Blvd	1	0	4	0	1	6	10.69	**0.56**	**0.33**	
8 - 9	Aspen Blvd (West) - Aspen Blvd (East)	1	0	1	0	0	2	2.75	**0.73**	**0.14**	
7 - 8	Park St - Aspen Blvd (West)	0	5	0	2	6	13	12.35	**1.05**	**1.21**	
6 - 7	Sioux Blvd - Park St	2	0	0	0	0	2	4.05	**0.49**	**0.17**	
5 - 6	Madison St - Sioux Blvd	0	2	0	2	2	6	11.71	**0.51**	**0.46**	Urban
3 - 4	265th St - 264th St	1	3	2	2	2	10	7.36	**1.36**	**1.36**	Rural
2 - 3	265th St - 266th St	1	2	0	0	2	5	7.56	**0.66**	**0.93**	
1 - 2	SD42 - 266th St	1	0	0	0	1	2	2.85	**0.70**	**0.26**	
Total / Average		10	13	9	7	15	**54**	**7.59**	**0.77**	**0.63**	

*ADT = Average Daily Traffic **MVMT = Million Vehicle Miles Traveled

Table 2-10. Intersection Crashes by Event

Intersections (w/ SD 11)		SD 11 Corridor Study; Intersection Crashes by Event					
		Animal - wild	Ran off Road	Motor Vehicle in Transport	Pedestrian	Pedalcycle	Total Crashes
12	Redwood Blvd	0	0	9	0	1	10
11	Holly Blvd	0	0	8	2	0	10
10	Ped Signal	0	1	0	0	0	1
9	Aspen Blvd (East)	0	1	2	0	0	3
8	Aspen Blvd (West)	0	0	3	0	0	3
7	Park Street	3	0	0	0	0	3
6	Sioux Blvd	2	0	4	0	0	6
5	Madison Street	7	0	12	0	0	19
4	264th Street	3	0	1	0	0	4
3	265th Street	0	1	0	0	0	1
2	266th Street	0	3	1	0	0	4
1	SD 42	4	4	14	0	0	22
Total		19	10	54	2	1	**86**

Urban
Rural

Table 2-11. Intersection Crashes by Severity

Intersections (w/ SD 11)		SD 11 Corridor Study; Intersection Crashes by Severity						
		No Injury	Wild Animal Hit	Non-incapacitating	Possible	Incapacitating	Total Crashes	Weighted Crash Rate
12	Redwood Blvd	7	0	1	2	0	10	0.66
11	Holly Blvd	6	0	2	2	0	10	0.72
10	Ped Signal	0	0	0	1	0	1	0.16
9	Aspen Blvd (East)	3	0	0	0	0	3	0.13
8	Aspen Blvd (West)	2	0	0	1	0	3	0.33
7	Park Street	0	3	0	0	0	3	0.26
6	Sioux Blvd	3	2	0	1	0	6	0.53
5	Madison Street	10	6	0	2	1	19	1.85
4	264th Street	1	3	0	0	0	4	0.52
3	265th Street	0	0	1	0	0	1	0.39
2	266th Street	2	0	1	1	0	4	0.97
1	SD 42	13	2	1	4	2	22	1.92
Total / Avg.		47	16	6	14	3	**86**	**0.70**

Urban
Rural

Table 2-12. Intersection Crashes by Type

Intersections (w/ SD 11)		SD 11 Corridor Study; Intersection Crashes by Type				
		Single-vehicle	Sideswipe, same direction	Angle	Rear-end (front to rear)	Total Crashes
12	Redwood Blvd	1	0	5	4	10
11	Holly Blvd	2	1	2	5	10
10	Ped Signal	1	0	0	0	1
9	Aspen Blvd (East)	1	0	2	0	3
8	Aspen Blvd (West)	0	0	2	1	3
7	Park Street	3	0	0	0	3
6	Sioux Blvd	2	0	2	2	6
5	Madison Street	7	1	10	1	19
4	264th Street	3	0	0	1	4
3	265th Street	1	0	0	0	1
2	266th Street	2	0	2	0	4
1	SD 42	8	1	8	5	22
Total		31	3	33	19	**86**

Urban
Rural

Table 2-13. Segment Crashes by Event

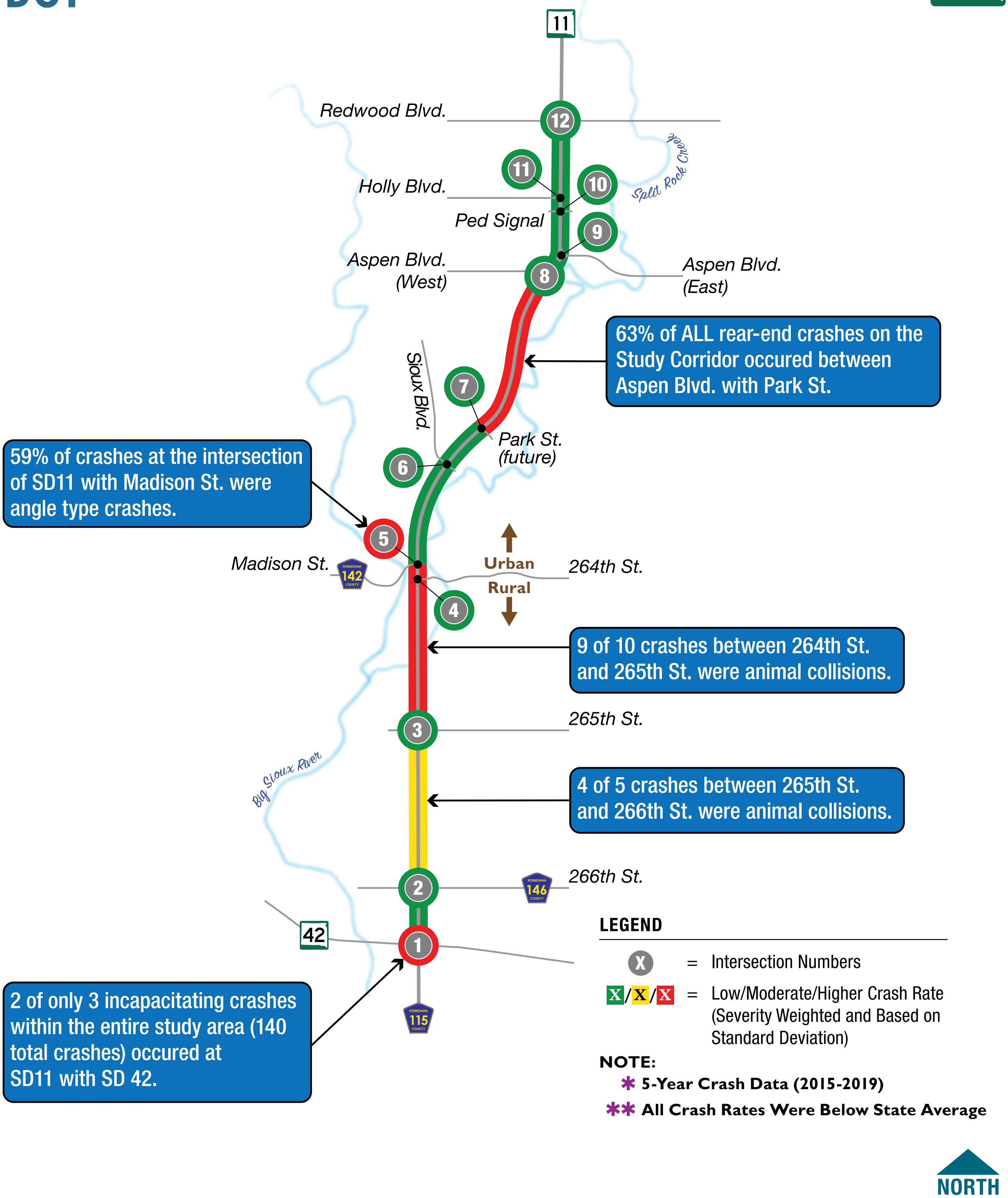
Segments (on SD 11)		SD 11 Corridor Study; Segment Crashes by Event						
		Animal - wild	Ran off Road	Motor Vehicle in Transport	Pedestrian	Pedalcycle	Total Crashes	
11 - 12	Holly Blvd - Redwood Blvd	0	0	7	0	1	8	
9 - 11	Aspen Blvd (East) - Holly Blvd	0	0	6	0	0	6	
8 - 9	Aspen Blvd (West) - Aspen Blvd (East)	0	1	1	0	0	2	
7 - 8	Park St - Aspen Blvd (West)	7	1	5	0	0	13	
6 - 7	Sioux Blvd - Park St	2	0	0	0	0	2	
5 - 6	Madison St - Sioux Blvd	3	3	0	0	0	6	Urban
3 - 4	265th St - 264th St	9	1	0	0	0	10	Rural
2 - 3	265th St - 266th St	4	1	0	0	0	5	
1 - 2	SD42 - 266th St	1	0	1	0	0	2	
Total		26	7	20	0	1	**54**	

Table 2-14. Segment Crashes by Severity

Segments (on SD 11)		SD 11 Corridor Study; Segment Crashes by Severity							
		No Injury	Wild Animal Hit	Non-incapacitating	Possible	Incapacitating	Total Crashes	Weighted Crash Rate	
11 - 12	Holly Blvd - Redwood Blvd	5	0	1	2	0	8	0.78	
9 - 11	Aspen Blvd (East) - Holly Blvd	6	0	0	0	0	6	0.33	
8 - 9	Aspen Blvd (West) - Aspen Blvd (East)	2	0	0	0	0	2	0.14	
7 - 8	Park St - Aspen Blvd (West)	5	7	1	0	0	13	1.21	
6 - 7	Sioux Blvd - Park St	0	2	0	0	0	2	0.17	
5 - 6	Madison St - Sioux Blvd	3	3	0	0	0	6	0.46	Urban
3 - 4	265th St - 264th St	2	8	0	0	0	10	1.36	Rural
2 - 3	265th St - 266th St	1	3	0	1	0	5	0.93	
1 - 2	SD42 - 266th St	1	1	0	0	0	2	0.26	
Total		25	24	2	3	0	**54**	**0.63**	

Table 2-15. Segment Crashes by Type

Segments (on SD 11)		SD 11 Corridor Study; Segment Crashes by Type					
		Single-vehicle	Sideswipe, same direction	Angle	Rear-end (front to rear)	Total Crashes	
11 - 12	Holly Blvd - Redwood Blvd	1	0	6	1	8	
9 - 11	Aspen Blvd (East) - Holly Blvd	0	0	6	0	6	
8 - 9	Aspen Blvd (West) - Aspen Blvd (East)	1	0	0	1	2	
7 - 8	Park St - Aspen Blvd (West)	8	0	0	5	13	
6 - 7	Sioux Blvd - Park St	2	0	0	0	2	
5 - 6	Madison St - Sioux Blvd	6	0	0	0	6	Urban
3 - 4	265th St - 264th St	10	0	0	0	10	Rural
2 - 3	265th St - 266th St	5	0	0	0	5	
1 - 2	SD42 - 266th St	1	0	0	1	2	
Total		34	0	12	8	**54**	



NOTE: Drawing Not to Scale

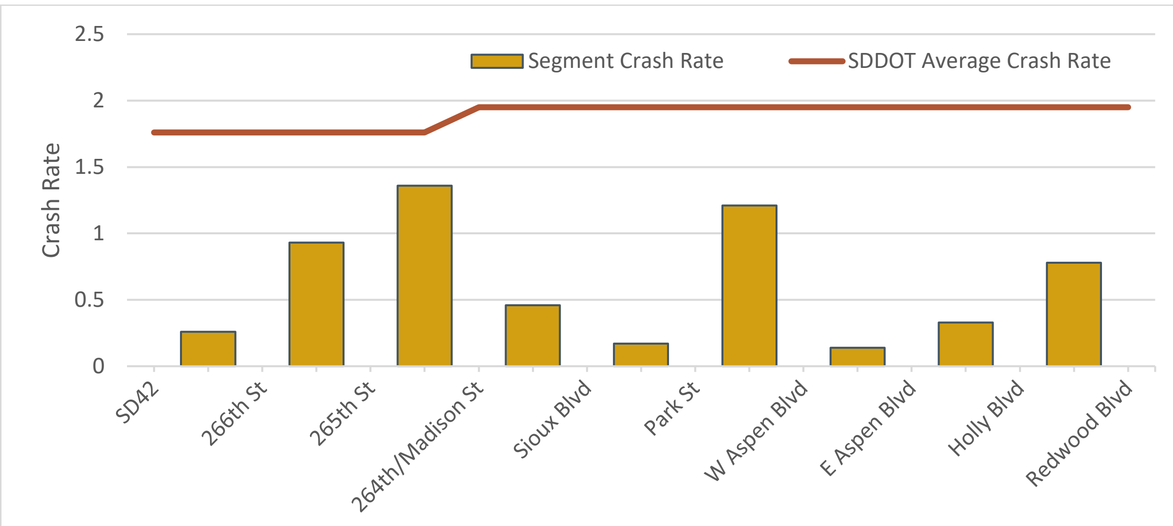
FIGURE 2-3
Corridor Crash Summary

2.6.1 SD11 Corridor Segments

Over the 5-year analysis period, from 1/1/2015 to 12/31/2019, 54 crashes occurred along the study segments. **Figure 2-3** displays the crash summary for the study segments in the study area. No segments along the SD11 corridor have higher weighted crash rates than the statewide average.

Figure 2-4 visually displays the breakdown of crash rates by segment on SD11 for the study area. **Figure 2-4** illustrates three things: location, segment crash rates, and statewide crash rates. The axis on the left of the bar graph identifies the crash rate on each segment during the five-year study period. The line on the graph represents the SDDOT state average rate for comparable facilities.

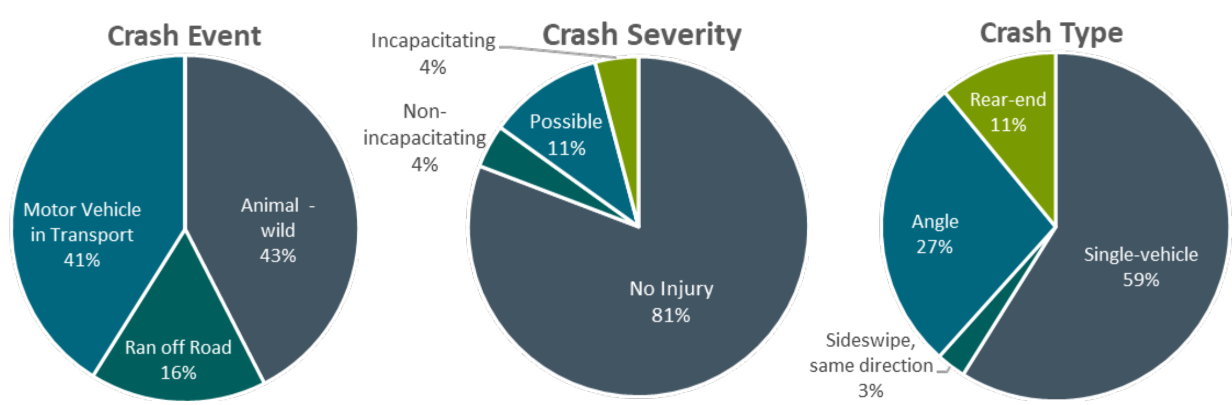
Figure 2-4. SD11 Segment Crash Rate Summary



2.6.2 South Section Crash Summary

The South Section extends from the SD42 intersection to the Sioux Blvd intersection along SD11. During the 5-year study period, 73 total crashes were reported, with 14 of the crashes resulting in injuries. The most common crash events within this section were Animal – wild and Motor Vehicle in Transport related crashes. No pedestrian or bicycle crashes were reported along the study corridor during the study period. The predominant crash types were single-vehicle crashes, with approximately 59 percent of the total crashes, and Angle crashes at 27 percent. **Figure 2-5** shows the pie charts for crashes by event, severity, and type.

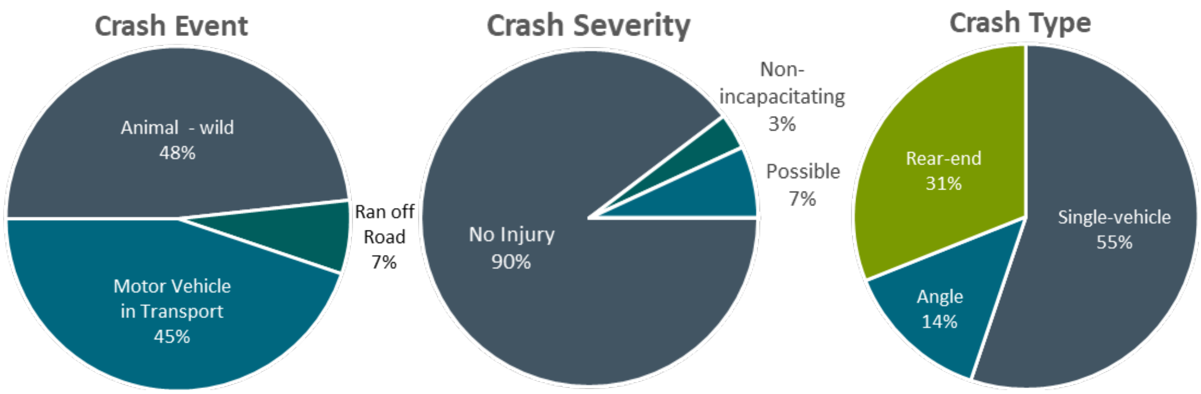
Figure 2-5. South Section of SD11 Crash Summary Charts



2.6.3 Middle Section Crash Summary

The Middle Section extends from the intersection of Sioux Blvd through the Aspen Blvd (West) intersection along SD11. There were 29 total crashes during the 5-year study period, with 3 of the crashes resulting in injuries. The most common crash events within this section were Animal – wild and Motor Vehicle in Transport crashes. No pedestrian or pedal cycle crashes occurred along the study corridor during the study period. The predominant crash types are single-vehicle crashes with approximately 55 percent of the total crashes and Rear-end crashes at 31 percent. **Figure 2-6** shows the pie charts for crashes by event, severity, and type.

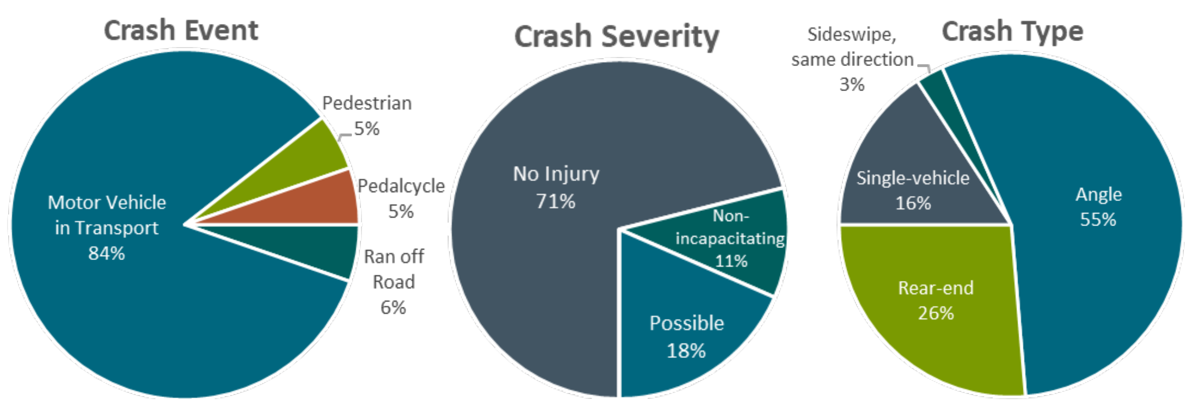
Figure 2-6. Middle Section of SD11 Crash Summary Charts



2.6.4 North Section Crash Summary

The North Section extends from the intersection of Aspen Blvd (East) through the Redwood Blvd intersection along SD11. During the 5-year study period, 38 total crashes were reported, with 11 of the crashes resulting in injuries. The most common crash events within this section were Motor Vehicle in Transport crashes. Two pedestrian and two bicycle crashes were reported along the study corridor during the 5-year study period. The predominant crash types were Angle crashes with approximately 55 percent of the total crashes and Rear-end crashes at 26 percent. **Figure 2-7** shows the pie charts for crashes by event, severity, and type.

Figure 2-7. North Section of SD11 Crash Summary Charts



2.7 INTELLIGENT TRANSPORTATION SYSTEMS

The SDDOT manages the planning, evaluation and implementation of intelligent transportation system (ITS) efforts through the Transportation Systems Management and Operations (TSM&O) Program Plan, which provides a framework for action. Using the TSM&O Plan, the SDDOT directly manages the causes of recurring and non-recurring congestion in real time and prepares individual action plans to respond to events that affect the operation of the transportation system. Through the individual corridor plans, a network of actions to ensure the roadway network is used to its optimal extent, ensuring trips are efficient, reliable and safe, and agency operations are cost-effective.

ITS recommendations are directly developed using the framework in the TMS&O Plan for three system areas:

- Traveler information systems
- Event traffic management
- Incident (safety) improvements

2.7.1 Traveler information Systems

For the SD11 corridor, traveler information needs focus on addressing travel time reliability through the corridor that may be influenced by severe weather, congestion connected with scheduled events at Huset's Speedway, peak hour traffic, or longer term flood events that have occurred in the corridor. Through the reliability analysis, few events outside the scheduled races at Huset's Speedway resulted in delay that warranted active management of the situation. Minor levels of daily recurring congestion can be effectively managed through upgrading intersection control when warrants are satisfied.

Consideration to monitor future flooding events of the Big Sioux River and Split Rock Creek is recommended to understand the frequency with which flooding to the extent observed in 2019 is occurring. Delay caused by flood events that impact the corridor for more than a few hours may warrant investment into automated message signs, remotely activated as a means of directing drivers to alternate routes before getting to flood influence areas.

2.7.2 Huset's Speedway Event Management

Huset's Speedway currently has a traffic management plan that is activated immediately before and after events. The owner has developed a plan to operate one access as the inbound access for patrons and one access as the outbound. This method has been observed to provide adequate management of the corridor to reduce delay for through vehicles. Thus, no action regarding ITS deployments is recommended.

2.7.3 Incident (Safety) Improvements

Through analysis of the latest five years of crash data at intersections and along corridor segments, no locations were identified that could be corrected through ITS applications. Thus, no application of ITS devices is recommended, with the exception of installation of an Advance Warning System (AWS) upstream from proposed signalized intersections in the segments outside Brandon. Locations to consider for this AWS are:

- Madison St
- South Sioux Blvd (or East Park St when constructed)
- SD42 (not a part of this project)

2.8 CORRIDOR TRAVEL TIME RELIABILITY ASSESSMENT

FHWA has established that meaningful congestion performance measures must be based on travel times because they are easily understood by practitioners and the public and are applicable from both the user and facility perspectives of performance. Average travel time through a corridor is used to represent typical conditions; however, it does not show the entire breadth of user experiences. Unexpected interruptions, including those caused by crashes, congestion, inclement weather, or special events cause deviations from average travel times.

Travel time reliability is reflective of the unique combination of corridor characteristics including auto drivers and passengers, transit riders, and freight haulers, who influence decisions about where, when, and how travel is made. Reliability benchmarks used in one area may not be appropriate in others as the mix of users and corridor conditions combine into unique conditions. Reliability measures include indices relative to free-flow travel speed and constant thresholds among others.

2.8.1 Methods and Data

The reliability assessment used a methodology of reviewing historical travel times and speeds along each corridor segment, both within Brandon and along rural segments in the county. Data for this analysis come from INRIX, a vendor that provides travel data from global positioning system devices such as vehicle navigation systems, fleet tracking equipment, and some mobile devices. The INRIX platform allows the user to select roadway segments on specific days and times over desired durations. Data on 24 directional segments were extracted at 5-minute intervals for the period from January 2019 through December 2019. The extracted dataset contains travel time and average speed on every segment and time interval.

For this corridor study, the year-long dataset for each segment was disaggregated into 5-minute periods, which were then compared to each other with the purpose of identifying “outliers” in either travel speed or travel time, or both. Periods with travel times and/or speeds substantially below the 25th percentile speed or time were defined as outliers to be reviewed relative to cause. In addition to identifying single, 5-minute events of unreliability, different durations of unreliable events have also been identified. Specifically, events lasting 15, 30, 60, and 120 minutes have been counted by day and segment.

As the INRIX dataset represents actual data collected at specific times of the data, the team was able to connect outlier travel times and speeds with other specific events that can be time stamped. For these assessments, events include weather-related conditions slowing travel speeds, incidents such as crashes that slow other travel, or congestion along segments or specific intersections.

2.8.2 Results and Discussion

To better understand the types of unreliability in the SD11 corridor, the number of unreliable events of specific durations have been counted. **Figure 2-7** and **Figure 2-8** show these counts for segments in the City of Brandon and outside of town, respectively. The distinction was made due to each set of segments having very different roadway characteristics, including signalized intersections, speed limits, and land use. Note the difference in vertical axis scales between the two figures. There are far fewer segments in town than out of town. There are also no instances of 120-minute unreliable periods in town and instances of 60-minute unreliable periods are limited to a few days. Conversely, **Figure 2-9** shows that instances of 120-minute periods of unreliability do happen along SD11 outside Brandon. The following sections will describe some of the likely causes of these events.

Figure 2-8. Instances of Unreliability in the City of Brandon

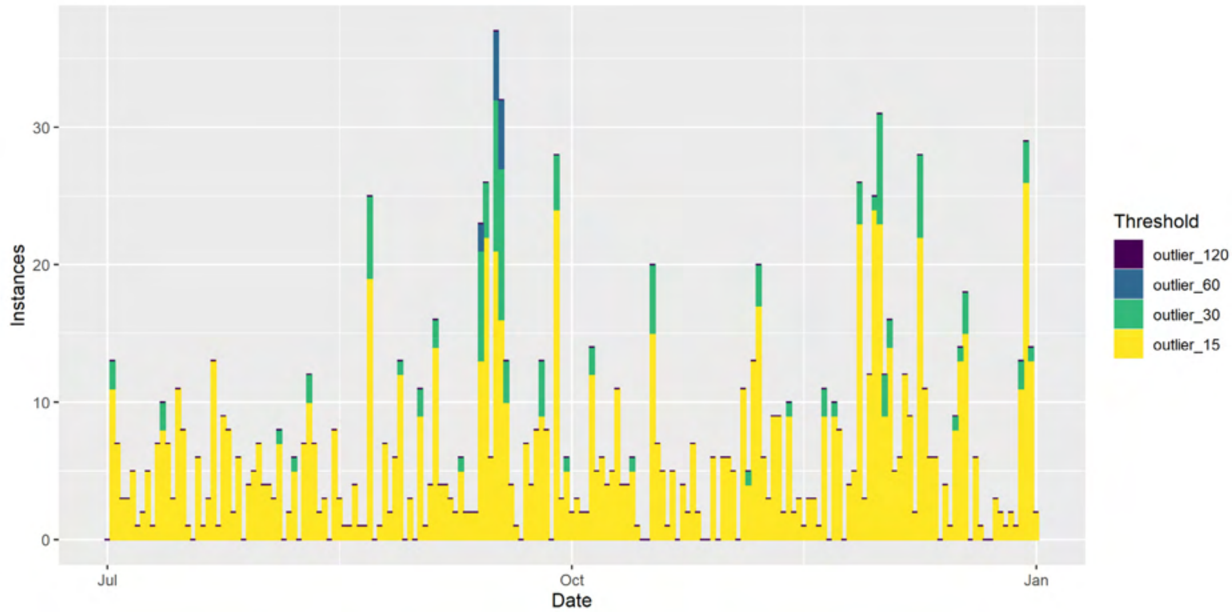
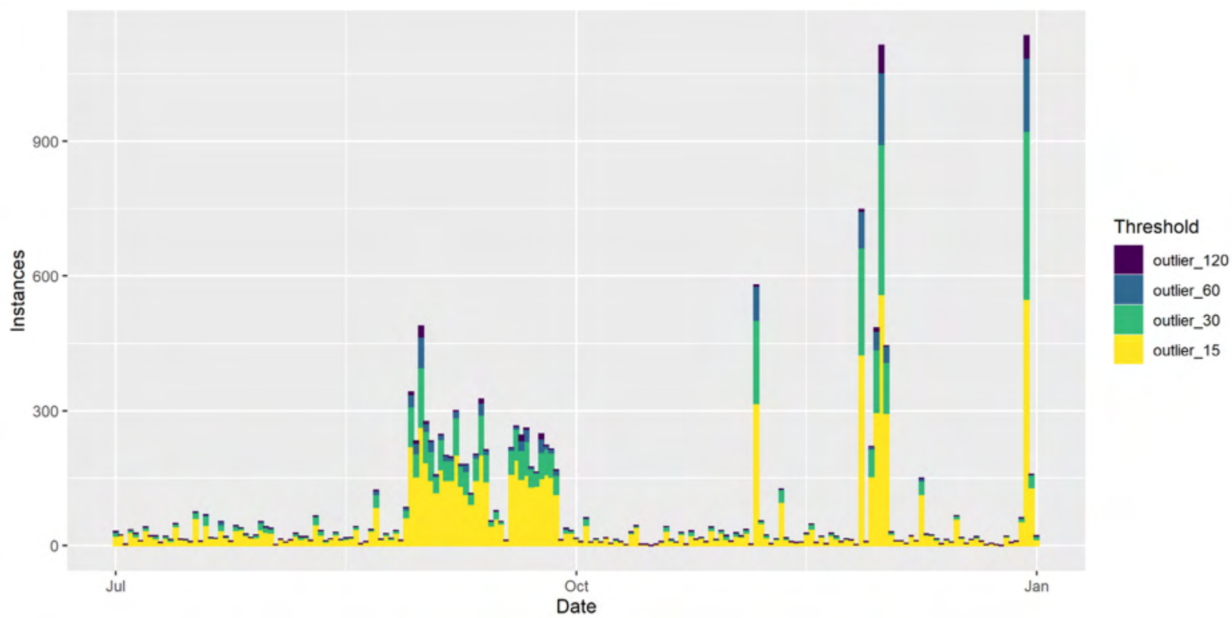


Figure 2-9. Instances of Unreliability Outside the City of Brandon



2.8.3 Weather Effects

Weather information was obtained from the National Oceanic and Atmospheric Administration (NOAA) for 2019. Through the NOAA data, heavy precipitation in September 2019 led to flooding of the Big Sioux River in early September 2019. The cluster of segments showing unreliability during September 2019 are adjacent to the Big Sioux River. Additionally, significant snowfalls occurred on December 1, 2019, and December 30, 2019, coinciding with 11 segments showing variability.

2.8.4 Crash/Incident Effects

Crash incidents observed in the corridor over the 5-year period were not of a level that would result in elevated travel times for periods long enough and for vehicle numbers needed to create outlier travel times. Thus, no additional reliability analysis connected to crash events was warranted.

2.8.5 Traffic Operations Effects

Intersection and segment analysis of traffic operations documents that all intersections, with the exception of SD42, Sioux Blvd, Aspen Blvd (West) and Aspen Blvd (East), operate at LOS B in rural areas and LOS C in urban areas of the corridor. For the intersections noted, the legs where unacceptable operations were observed were either cross routes or the duration of poor operations was short enough to not measure noticeably in the observed speed and travel time data. Thus, no additional analysis of intersection or segment operations was warranted.

3.0 ENVIRONMENTAL REVIEW

An Environmental Scan Report, provided in **Appendix F,** was developed to identify environmental resources and environmentally sensitive areas for the SD11 corridor study. Its purpose is to identify resources early in the planning process to avoid fatal flaws and to consider sensitive environmental resources in the environmental study area. It also connects the long-range transportation planning and NEPA requirements so that planning decisions are carried forward into project development. This Environmental Scan aids in determining the most reasonable and feasible option(s) to be advanced into further environmental studies. Potential environmental resource impacts will be considered in the alternatives analysis to avoid and minimize impacts during subsequent study phases, while also developing alternatives that meet a project's purpose and need. The results of this Environmental Scan will be carried forward into NEPA.

3.1 ENVIRONMENTAL STUDY AREA

An overall environmental study area for this corridor study was defined as a 500-foot buffer around the existing SD11 corridor from SD42 to Redwood Blvd and included 0.5-mile east and west along the cross routes of each intersection. The overall environmental study area encompasses an area of sufficient size to address environmental matters on a broad scale for a wide range of potential transportation improvements. Figures 2A, 2B, and 2C in **Appendix F** provide an overview of the environmental study area.

The environmental overview focused on collecting readily available environmental resource information to assist SDDOT with planning level information for the SD11 corridor study. The intent of the overview was to collect, summarize, and provide the source of relevant existing data along the corridor to determine, with reasonable assurance, the major socioeconomic and environmental resources present (i.e., existing conditions) and whether there is a potential for impacts on resources from the likely improvements (i.e., conclusions). This overview is not an environmental findings document intended to comply with NEPA. However, the information presented will guide further evaluation and analysis during subsequent project development phases.

3.2 ENVIRONMENTAL DATA SOURCES AND RESOURCES

The review included a desktop analysis of the latest available data and a field survey of the environmental study area. The review specifically covers resources with the potential to delay or stop project development or make permitting project activities challenging, including those resources with specific regulatory drivers such as the Endangered Species Act and Clean Water Act. Environmental resources evaluated include:

- Air Quality
- Airports and Heliports
- Contaminated Materials
- Environmental Justice
- Farmlands
- Federal and Tribal Lands
- Floodplains
- Historic, Archeological and Cultural Resources
- Land Use
- Section 4(f) and Section 6(f)
- Social and Economic Resources
- Threatened and Endangered Species
- Migratory Birds, and Eagles
- Traffic Noise
- Vegetation and Wildlife
- Water Quality
- Waters of the United States & Wetlands

Based on the desktop analysis, the following resources were determined not to be present in the study vicinity and were, therefore, excluded from further review:

- Wild and Scenic Rivers
- Coastal Zone Management

3.3 KEY FINDINGS FROM ENVIRONMENTAL SCAN

Information provided in the following sections summarizes those environmental resources that are likely to be impacted by the proposed improvements, or that will likely require special attention during the next phase of environmental review and evaluation to avoid, minimize, or mitigate potential impacts. The detailed information regarding each of these environmental resources, as well as those listed in the previous section, can be found in **Appendix F**.

3.3.1 Contaminated Materials

Thirty-eight registered sites were identified within 0.1 mile of the project alignment. Several registered sites fall within the probable project limits of the proposed improvements, and some facilities are listed for multiple regulatory programs. Table 1 in **Appendix F** identifies registered environmental sites according to the US Environmental Protection Agency (EPA) Facility Registry Service database and the aboveground storage tank and underground storage tank locations according to the South Dakota Department of Agriculture and Natural Resources.

At the time this report was written, it was assumed that acquisition and/or easements from property rights were anticipated as part of the proposed projects; however, it is unknown where additional right-of-way (ROW) would be necessary. The property acquisition process may require additional assessments and field investigations. Specific materials management may be necessary during construction of the projects.

A more detailed Contaminated Materials Report, following SDDOT guidance, would be needed as part of any future project development. During the planning and design process, the environmental database records would be evaluated with respect to the status of the facility listing and its location within the study area boundaries. In addition to the environmental database review, an on-site visual inspection of the study area and surrounding areas should be completed by a qualified environmental professional, skilled and experienced in identifying hazardous materials and waste issues, to identify and evaluate present conditions.

3.3.2 Environmental Justice

The demographic and economic character of the environmental study area was compared with that of the City of Brandon, Minnehaha County. Census tract and census block group data were analyzed to determine if minority, low-income, or limited English proficiency) populations exist in the environmental study area, as presented in Table 2 in **Appendix F**. Environmental Justice (EJ) populations were identified in Census Tract 105.01, Block Group 2 and Census Tract 105.01, Block Group 3 because the percentages of low-income households in these block groups exceed both county and state percentages. There are minority populations identified within the block groups associated with the study area; however, the population percentages are below the percentages of the City of Brandon, Minnehaha County, and the State of South Dakota.

A detailed EJ analysis should be completed during the NEPA process to verify the projects resulting from this corridor study do not have a potential for disproportionately high or adverse impacts on EJ populations. The analysis should also identify ways to avoid and mitigate for any impacts.

3.3.3 Floodplains

Much of the environmental study area parallels the Big Sioux River and Split Rock Creek, and therefore, includes, or is directly adjacent to, the A/AE floodzones of the Big Sioux River and Split Rock Creek. The environmental study area also includes a portion of the Big Sioux River Regulated Floodway (Zone AE) near East Madison St. The north and south ends of the environmental study area increase in elevation and are outside any floodzone.

A floodplain analysis would need to be completed to determine whether potential floodway impacts are associated with transportation improvements throughout the corridor. If impacts are found, the level of these impacts will be identified, as well as measures to mitigate or avoid these impacts. Any activities located within Zone AE and Zone A floodplains, particularly activities that have the potential to raise the base flood elevation, would need to be coordinated and permitted by the Minnehaha County (South Dakota) floodplain administrator. Depending on the scope, hydraulic analyses may be required for permitting.

3.3.4 Historic, Archeological and Cultural Resources

A review of eligible or potentially eligible historic, archeological, and cultural resources present within the environmental study area was conducted and shown in Table 4 in **Appendix F.** Previously surveyed resources included buildings and structures that met the minimum age requirement of 50 years, based on 2021 as the study year. This analysis identified properties with buildings and structures that are 45 years and older (1976 and older) to provide a 5-year extension for design development and construction of the preferred alternative. Forty-six (46) properties located within the Area of Potential Effect (APE) were found to contain buildings meeting the 45-year threshold for National Register of Historic Places (NRHP) eligibility. These properties have not been formally surveyed in the past because they either were not within a previous survey area or did not meet the minimum age requirement for evaluation. One (1) additional potential resource was present within the APE, the Ellis and Eastern Railroad corridor, located approximately 0.5 miles south of Aspen Blvd. This resource was not identified in the South Dakota Archeological Research Center records search and will require formal survey and evaluation as the project moves through the formal Section 106 review process.

In summary, a review of known and potential historic and cultural resources within the SD11 Corridor Study APE determined that two (2) known NRHP eligible and/or listed resources, including the Eminija Mounds site and the Ellis and Eastern Railroad, are located within and adjacent to the proposed corridor study area. Impacts to these resources should be avoided at all costs. Additional properties meeting the minimum age for potential NRHP eligibility are also located adjacent to the SD11 roadway corridor and should be surveyed and evaluated for NRHP eligibility and coordinated with South Dakota State Historic Preservation Office. If the proposed project results in impacts outside the APE, the project has the potential to affect additional historic and cultural resources beyond what has been identified in this analysis.

3.3.5 Section 4(f) and Section 6(f)

Public parks, recreational resources, and cultural resources are protected under Section 4(f) of the US Department of Transportation (USDOT) Act of 1966, which prohibits the use of public park and recreation areas for federally funded projects unless there is no feasible or prudent alternative; all possible planning has been conducted to minimize harm to the property; there is only a *de minimis* impact; the project meets certain exceptions or requirements exempting 4(f) evaluation; and all coordination requirements have been met. Project activities that restrict access may also be considered a "use" under Section 4(f).

The environmental study area includes park and recreational facilities, as well as cultural resources listed on the NRHP. Multiple public-use properties and NRHP-eligible properties were also identified within the environmental study area.

During future project development processes, if proposed projects impact historic properties, publicly owned parks, trails, or open space that qualify for protection under Section 4(f), the next steps of the Section 4(f) process require further evaluation, documentation and agency coordination, including NEPA.

Recreational resources developed with federal funding through the Land and Water Conservation Fund (LWCF) are protected under Section 6(f) of the LWCF Act, which prohibits the conversion of these properties to anything other than public outdoor recreation uses. South Dakota Game Fish and Parks (SDGFP) verified the location of projects associated with LWCF funds in Minnehaha County within 1-mile of the project corridor. Two properties were verified as located within the environmental study area and in receipt of LWCF grant assistance for acquisition and/or development in the park area; therefore, the entire boundary of the park is encumbered under Section 6(f). Table 5 in **Appendix F** describes Section 4(f) and Section 6(f) properties.

Two public use properties were acquired or built using the LWCF and are subject to Section 6(f) of the USDOT Act. During the NEPA process, the Section 6(f) review would need to be verified to determine if there will be any impacts to Section 6(f) properties based on future project footprint(s) and/or activities. For Section 6(f) properties located in the areas of the improvements, alternatives should be designed to avoid a conversion of these properties and/or determine if improvements would be a benefit to the property. If a conversion of land cannot be avoided, efforts will need to be made to mitigate effects to these properties. SDDOT, in cooperation with the local government landowner, must identify replacement land of equal value, location, and usefulness before a transfer of property under Section 6(f) can occur. Additional evaluation and agency coordination will be necessary in future project development phases, including NEPA.

3.3.6 Threatened and Endangered Species, Migratory Birds, and Eagles

On May 4, 2021, FHU inspected the environmental study area to evaluate if suitable habitat for listed species, migratory birds, and eagles is potentially present in Minnehaha County. Four federally listed species and one state listed species were identified through the US Fish and Wildlife Service (USFWS) IPaC. Habitat is generally lacking for listed species along the west side of the corridor north of Sioux Blvd and along the east side of the corridor north of Aspen Blvd, due to the urban and residential nature of these areas. The remainder of the corridor is of rural nature with pockets of potential habitat suitable for listed species. Table 6 in **Appendix F** identifies federal and state listed species potentially located in Minnehaha County.

The SDGFP reviewed the corridor study, including a search of the SD Natural Heritage Database in June 2021, and USFWS completed their review in July 2021. Two federally listed species and one state listed species were documented as having potential to occur in Minnehaha County. Topeka shiner and lined snake occurrences have been recorded within the immediate vicinity of the environmental study area.

According to the IPaC resource report, six species on the USFWS birds of conservation concern list are likely to be present, in addition to more common migratory birds, within the environmental study area in areas of potentially suitable habitat such as trees, wetlands, grasslands, and bridge or culvert substructures. Bald eagles (*Haliaeetus leucocephalus*) require mature trees near large open bodies of water for nesting and winter roosting. Golden eagles (*Aquila chrysaetos*) generally nest on cliffs or escarpments.

FHU environmental scientists observed riparian forest, grasslands, wetlands, and bridge substructures between Mileage Reference Marker (MRM) 76.20 and MRM 79.48. Large cliffs and escarpments are lacking in the area adjacent to the project and the environmental study area is outside the golden eagle range. Therefore, potential nesting habitat for golden eagles is not present. Split Rock Creek and the Big Sioux River are present in the vicinity of the SD11 corridor, and bald eagle nesting and roosting habitat are present.

3.3.7 Waters of the United States and Wetlands

National Wetland Inventory wetlands are not prevalent in the SD11 corridor, except for the following areas:

- Riverine wetlands mapped along the Big Sioux River and Split Rock Creek
- Palustrine emergent wetlands mapped in a drainage path southeast of a SD11 bridge crossing Split Rock Creek, structure number S0270205 at approximately MRM 76.5
- Palustrine scrub/shrub wetlands mapped along Split Rock Creek east of SD11 near MRM 78.55

A review of aerial imagery and a windshield survey indicate potential wetness signatures and that additional wetland features are possible within the environmental study area, particularly southwest of the bridge crossing and in the roadside ditches between MRM 75.0 and MRM 76.0. Other water resources, mapped in the National Hydrography Dataset, within the environmental study area are the Big Sioux River near MRM 77.0 and Split Rock Creek near MRM 76.55 and running parallel to SD11 between MRM 77.0 and MRM 78.0, and also near MRMs 78.55, 78.85, and 79.50 (i.e., the north intersection of SD11 and East Aspen Blvd). Split Rock Creek flows into the Big Sioux River approximately 0.5 miles west of the SD11 bridge crossing Split Rock Creek. The Big Sioux River and Split Rock Creek fall into the tributary category of Waters of the US, as defined in the Navigable Waters Protection Rule (published April 21, 2020, in the Federal Register and effective June 22, 2020 [33 Code of Federal Regulations 328.3]).

A wetland delineation would be required during the NEPA phase of any future project(s) resulting from this corridor study to ensure that the areas preliminarily identified within the study area contain all three requirements of a wetland. When wetland impacts cannot be avoided through design, adequate time must be built into the project schedule to allow wetland permitting and mitigation.

4.0 FUTURE (2050) NO-BUILD TRAFFIC CONDITIONS

The study area is within the coverage of the Sioux Falls Metropolitan Planning Organization (MPO) regional travel model. Thus, daily and hourly traffic forecasting methods were used with the MPO regional model to develop one set of horizon year forecasts for the entire study area. Peak hour intersection turning movements and segment ADTs were derived through a process of applying currently observed factors calculated from data collected in the corridor and smoothing SD11 volumes, as required, through balancing intersection volumes using a methodology discussed and approved by the SDDOT and the MPO.

4.1 FUTURE (2050) DAILY TRAFFIC FORECASTING METHODOLOGY

General steps used in developing ADT forecasts for segments of the SD11 corridor in the study area include:

1. **Calculate annual traffic change from historical counts**. Past changes in traffic patterns can either provide good direction as to where volume levels may go in the future or at least be a source of back checking the logic of other sources. For the SD11 corridor, historic daily traffic counts were obtained from the SDDOT for the segments along the study corridor. This data was used to develop an annual trend change for each segment.
2. **Extract from the Sioux Falls MPO area regional travel demand model forecasted volume changes between Existing (2021) and Future (2050)**. Assignments from the model were used to derive an annual change in traffic trend to be applied to Existing (2021) count data to derive one scenario for Future (2050) forecasted daily traffic.
3. **Review the annual average volume change from each listed alternatives for consistency.** If the annual average change in traffic from each of the sources is similar across each segment, one of the sources would be used as the most appropriate. In the situation of conflicting/inconsistent rates, a process for defining the most logical rates would be implemented.
4. **Review forecasts developed for other projects near the SD11 corridor to ensure there is consistency between the future estimates of daily and peak hour traffic.** Relative to the study area, other studies were completed along SD11, north of Redwood Blvd and along SD42.
5. **The process of defining the most logical annual growth rates included reviewing**:
   - Forecasted levels along the study area segments with current volumes along adjacent roadways. The purpose of this sensitivity analysis was to assess the logic of a forecast relative to the anticipated development density in the study area travelshed relative to the current travelshed of other more urban links. If the increment of development in the study area would not result in a similar wider area development density, the increment of traffic growth would be questioned.
   - Historical traffic change versus development density. Forecasting future traffic level changes that differ greatly from historical levels will require a complementary change from historical development. If a complementary change in development patterns or density adjacent to the corridor are not observed, a change in traffic growth that deviates from the historical change would be questioned.
6. **Select from the alternate rates a unique rate or composite of the range to be used for each segment and intersection, then apply that rate to the Existing (2021) traffic data collected by the SDDOT as part of the study.**

4.2 FUTURE (2050) NO-BUILD OPERATIONAL ANALYSIS

Future (2050) traffic volumes, as depicted on **Figure 4-1**, were used for the Future (2050) No-Build operational analysis. Segment analyses used the Highway Capacity Software (HCS7), and intersection analysis used Synchro (Version 11) software with HCM methodology.

4.2.1 Segment Operations Analysis

The HCS7 software was used to analyze traffic operations along the study segments. **Figure 4-2** shows the lane geometry, traffic control, and LOS for Future (2050) No-Build study segments. The lane configurations for the study segments were based on existing geometrics. **Appendix D** includes capacity analysis worksheets for the Future (2050) traffic conditions scenario.

Most study area segments are expected to operate at acceptable levels of service (LOS C or better on urban roadways and LOS B or better on rural roadways) in the peak hours under Future (2050) traffic conditions. Two urban study segments are not expected to operate at an acceptable LOS:

- The segment between Park St and Aspen Blvd (West) is expected to operate at LOS D during the AM and school dismissal peak period, but LOS C during the AM and PM peak periods.
- The segment between Aspen Blvd (West) and Aspen Blvd (East) is expected to operate at LOS E during the AM and school dismissal peak period, and LOS D during the PM peak periods.

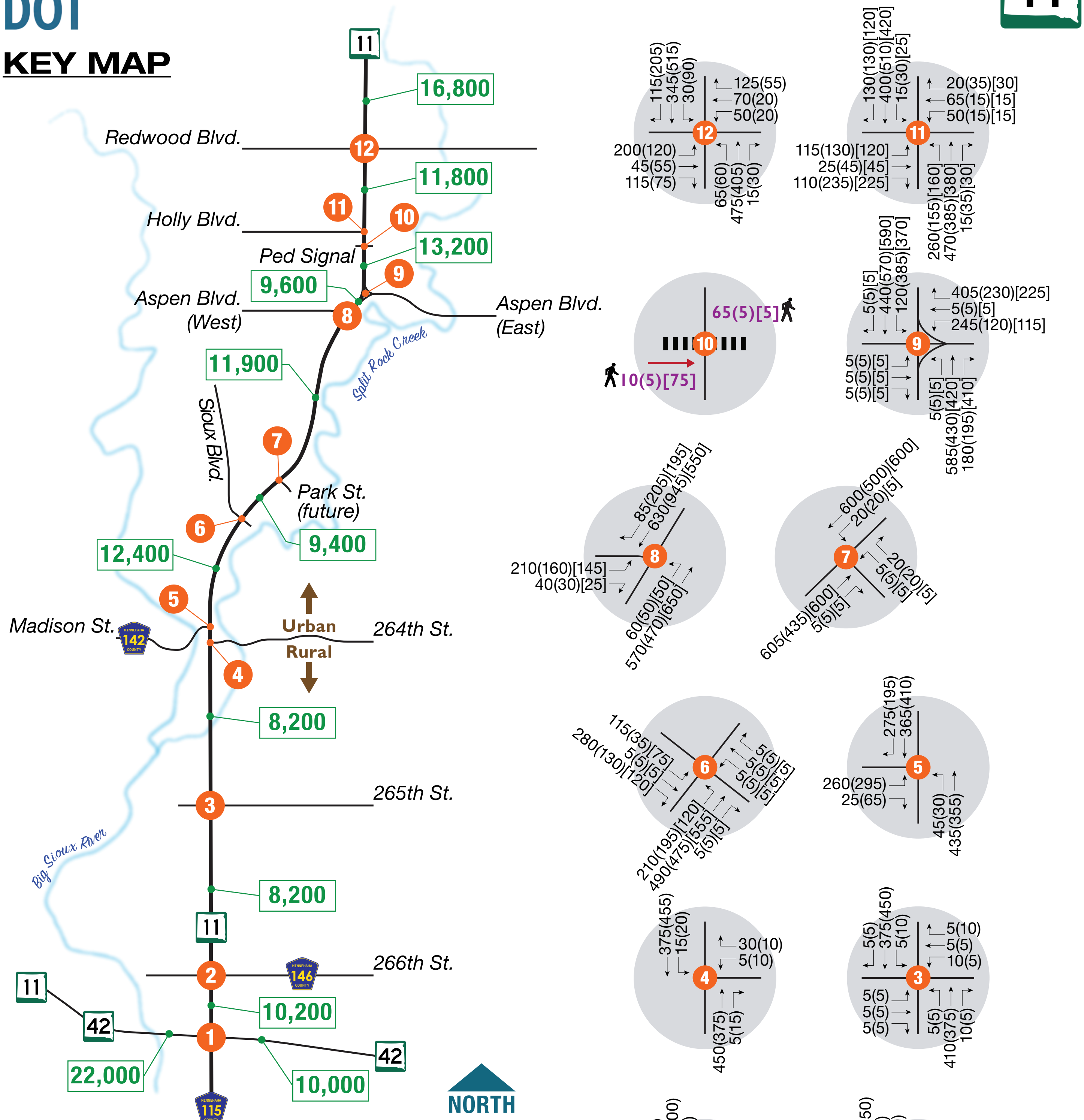
4.2.2 Intersection Operations Analysis

Synchro 11 software was used to analyze traffic operations at the study intersections using the HCM 6th Edition methodology. **Figure 4-2** shows the lane geometry, traffic control, and LOS for Future (2050) No-Build study intersections. The lane configurations for study intersections were based on existing geometrics. **Appendix D** contains analysis worksheets for the Future (2050) No-Build traffic conditions.

Most intersections in the rural section of the study area are expected to operate at acceptable levels of service (LOS C or better on urban roadways and LOS B or better on rural roadways) in the peak hours in Future (2050). None of the study intersections in the rural section of the corridor are expected to operate at acceptable levels of service in the peak hours in Future (2050) No-Build conditions. Four urban study intersections of note are projected to operate at an unacceptable LOS under Future (2050) No-Build traffic conditions:

- The stop-controlled intersection of SD11 with SD42 is expected to operate at LOS F on the northbound and southbound approaches. The eastbound and westbound left-turn movements are expected to operate at an acceptable LOS.
- The stop-controlled intersection of SD11 with Madison St is expected to operate at LOS F on the eastbound approach for all study peak hour periods.
- The stop-controlled intersection of SD11 with Sioux Blvd is expected to operate at an unacceptable LOS on both minor approaches (eastbound and westbound movements) during all study peak hour periods.
- The stop-controlled intersection of SD11 with Aspen Blvd (West) is expected to operate at LOS F on the eastbound approach for all study peak hour periods.
- The stop-controlled intersection of SD11 with Aspen Blvd (East) is expected to operate at LOS E or F on both eastbound and westbound approaches for all study peak hour periods.

KEY MAP



LEGEND

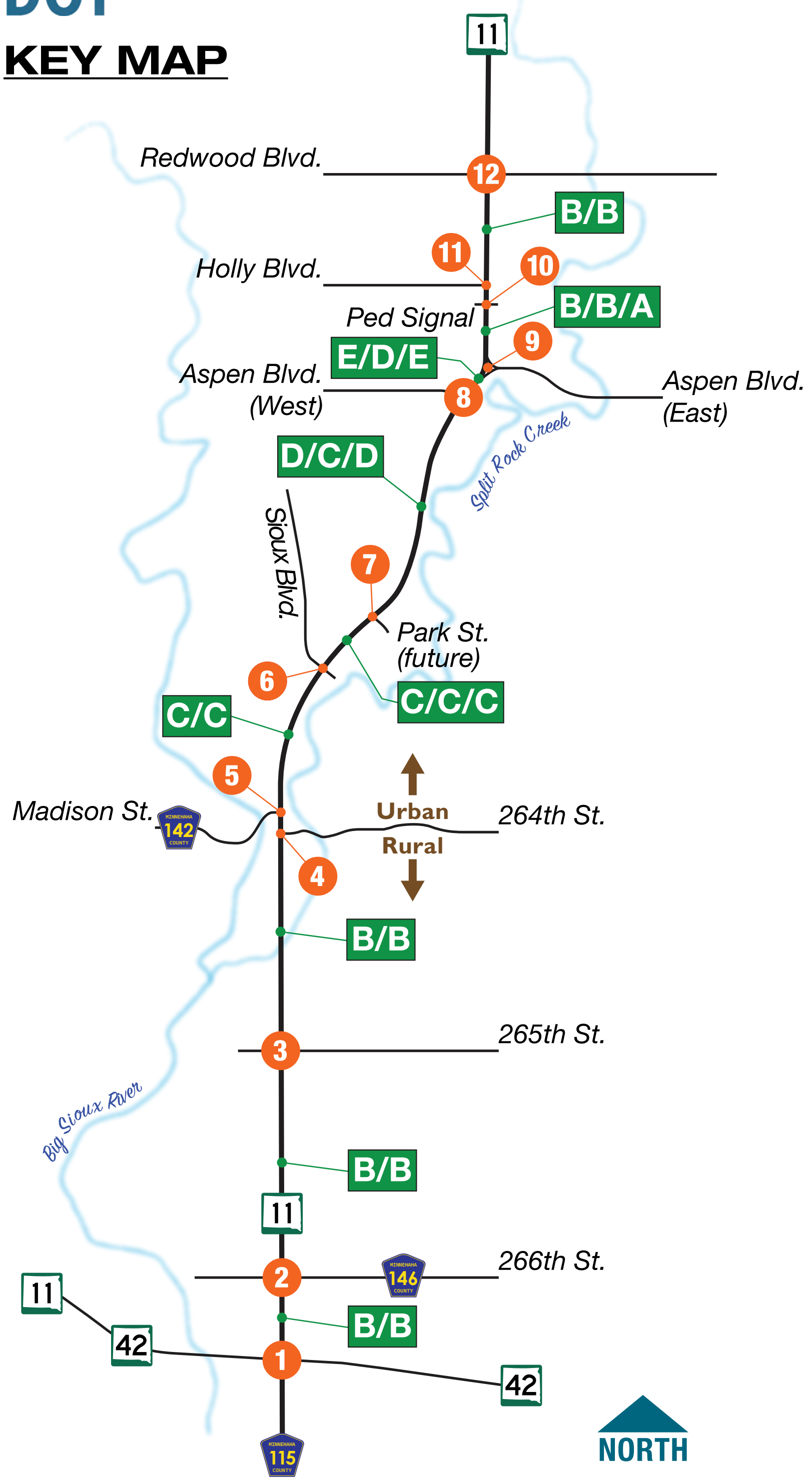
XXX(XXX)[XXX] = AM(PM)[Dismissal] Peak Hour Traffic Volumes
X = Intersection Numbers
XXX = Segment Daily Traffic Volumes
X(X)[X] = AM(PM)[Dismissal] Pedestrian Volumes

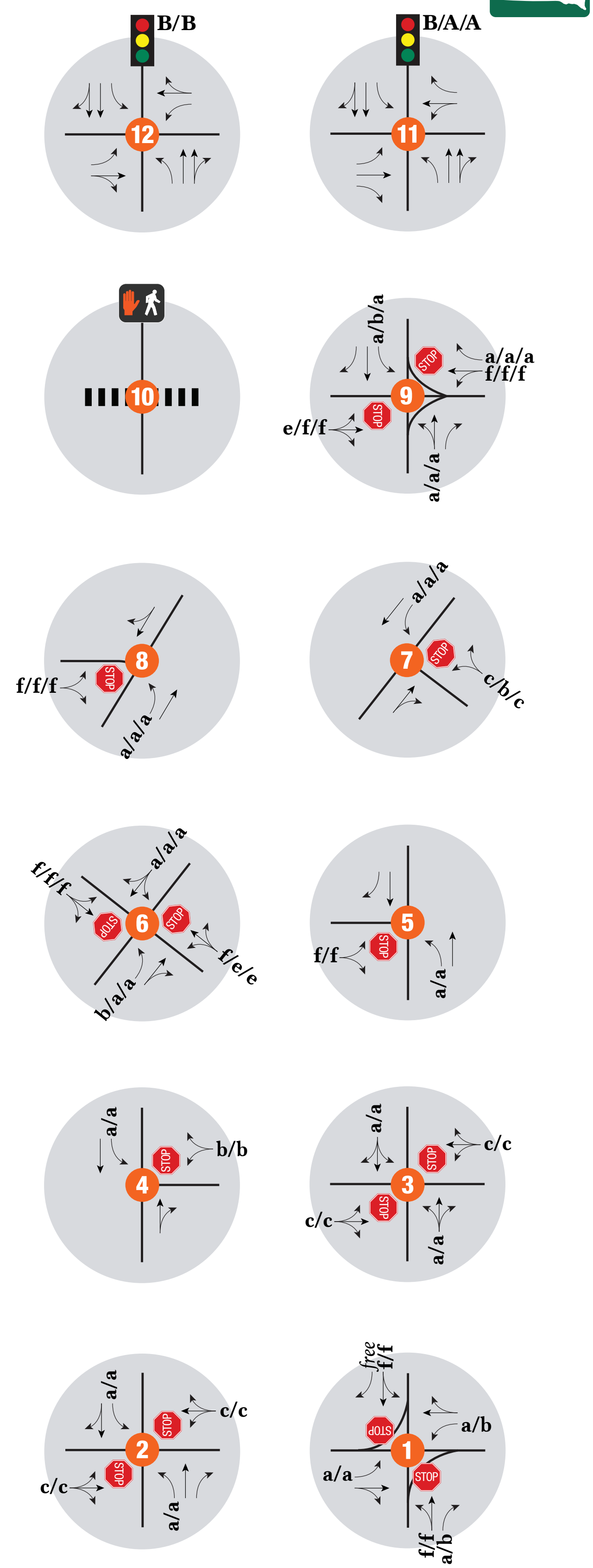
FELSBURG HOLT & ULLEVIG

NOTE: Drawing Not to Scale

FIGURE 4-1
Future (2050) Traffic Volumes

KEY MAP





LEGEND

x/x/x = AM/PM/Dismissal Peak Hour Intersection Level of Service

X = Intersection Numbers

X/X = HCS Segment Level of Service

STOP = Stop Sign

= Traffic Signal

= Pedestrian Signal

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NOTE: Drawing Not to Scale

FIGURE 4-2

Future (2050) No-Build Traffic Operations

5.0 ALTERNATIVES ANALYSIS

As part of this corridor study, two interim analysis years and a future year were analyzed to determine the year proposed improvements are anticipated to reach the operational goal thresholds, when warrants are expected to be met, and to inform the implementation phasing. This analysis is intended to assist SDDOT decision-makers in determining which, and when, segments and intersections along SD11 break down and when to program the necessary improvements. The interim analysis years were determined before the operational analysis to be Phase I (2028) and Phase II (2040), with the horizon year as Future (2050).

5.1 ANALYSIS METHODOLOGY

5.1.1 Volume Development

Straight line growth projections were used to determine the interim year volumes. The volumes were estimated for both the AM, PM, and school dismissal peak periods using the following formula:

$$Volume_{Interim\_Year} = Volume_{2021} + \left((Volume_{2050} - Volume_{2021}) * \left(\frac{Interim\_Year - 2021}{2050 - 2021} \right) \right)$$

All SD11 segments between study intersections throughout the study area were analyzed for the interim and future design years. Both the segment and intersection analyses looked at Existing and No-Build conditions, as well as alternative lane arrangements and traffic control, as guided by the study stakeholders and technical findings from the traffic control warrant and operational analyses.

5.1.2 Segment Operations Analysis

In the SD11 Corridor Study Methods and Assumptions document (**Appendix** B), study stakeholders identified traffic operations goals. The preferred traffic operations goals are LOS C or better on urban roadways and LOS B or better on rural roadways, which is consistent with the *AASHTO Green Book* and the *South Dakota DOT Road Design Manual (Table 15-9*).

Segment analyses were conducted using the Highway Capacity Software (HCS7). A few observations should be noted about the HCS7 analysis methodology:

1. HCS7 does not have a common method for analyzing three-lane cross-section roadways but only suggests minor adjustments be made to two-lane cross-section analysis. This leads to only minor capacity increases from a two-lane to three-lane cross-section analysis, whereas the SDDOT Road Design Manual assumes the capacity of a three-lane cross-section is double that of a three-lane roadway in their planning level traffic capacity thresholds.
2. HCS7 is highly influenced by the number of accesses on a roadway section, indiscriminate of the side of the roadway on which they are located when considering two-lane vs. three-lane cross-sections. This leads to inadequately accounting for the capacity of a continuous TWLTL with driveways primarily on one side of the road.
3. HCS7 can conflate LOS results for shorter segments. This happens when a shorter analysis segment has a series of driveways, no-passing zones, speed restriction areas, or other factors that overstate the density and the variables' effect on the overall corridor.

5.1.3 Intersection Operations Analysis

The project stakeholders identified traffic operations goals in the SD11 Corridor Study Methods and Assumptions Document (**Appendix B**). The preferred traffic operations goals are LOS C or better at urban intersections and LOS B or better at rural intersections, which is consistent with the *AASHTO Green Book* and the *South Dakota DOT Road Design Manual (Table 15-9*).

Intersection analyses were conducted using Synchro 11 using *HCM 6th Edition* methodology for all stop-controlled and signalized intersections. SIDRA traffic analysis software was used for roundabout analyses. SIDRA is a widely accepted analysis software for roundabouts and its methodology is based on the ratio of the volume of traffic observed making a particular movement compared to the maximum capacity for that movement.

5.2 SEGMENT ANALYSIS

The following sections discuss the alternatives developed and the technical findings from the analyses of segments within the South, Middle, and North sections of the study corridor. Geometric layouts for all the alternatives are included in **Exhibits A, B, and C**. The discussion and analysis in the following sections focus on the lane configurations and traffic control provided. The recommended improvements along the various segments will also incorporate pedestrian and bicycle accommodations.

5.2.1 South Section

Due to acceptable future traffic operations under Existing and No-Build conditions, minimal safety concerns, and discussion with the SAT, no alternative improvements were developed for the mainline segments within the South Section of the study area, from the junction with SD42 to the intersection with Madison St. The capacity provided by a two-lane highway with auxiliary lanes at key intersections is adequate to provide acceptable traffic operations through the Future (2050) No-Build condition. From Madison St to Sioux Blvd, alternatives considered included maintaining the existing two-lane configuration and a three-lane alternative with a center TWLTL.

The SD11 bridge over Split Rock Creek currently provides two-lanes and 2’ surfaced shoulders. The bridge is currently in good condition. Although the shoulder widths provided are substandard, the number of lanes is adequate to provide acceptable traffic operations through the Future (2050) condition.

It should be noted that recommended improvements to the Madison St intersection, described in **Section 5.4.1**, include the installation of a traffic signal at its intersection with SD11. In addition, the junction with SD42 is anticipated to be widened to a four-lane divided highway in 2025–2026, which includes some widening on the SD11 approach to the intersection.

Figure 5-1, **Figure 5-2**, and **Figure 5-3** show the lane geometry and associated LOS under Phase I (2028), Phase II (2040), and Future (2050) traffic conditions, respectively. **Appendix D** includes capacity analysis worksheets for all traffic condition scenarios. Conceptual layouts for the proposed improvements in this South Section can be found on pages **A-1** through **A-5** and part of **A-6** in **Exhibit A**.

No-Build

Under the No-Build scenario, LOS B is provided on the segment from SD42 to Madison St for all analysis periods. For the segment from Madison St to Sioux Blvd, LOS C is anticipated for the two-lane configuration under Phase II (2040) and Future (2050) traffic conditions, respectively. This meets the operational criteria since the current urban/rural boundary in the study area for SD11 is Madison St, with the intersection of SD11 with Madison St included in the urban area.

Alternative 1: 3-Lane Section
Alternative 1 would provide a three-lane section with a center TWLTL on the segment from Madison St to Sioux Blvd. The operational analysis indicates that this lane configuration would also operate at LOS C under Phase II (2040) and Future (2050) traffic conditions, respectively. Some additional ROW may be required along the west side of SD11 from the Oakridge Nursery and Landscaping property immediately south of the Sioux Blvd intersection. This will be evaluated during the next phase of the project development once topographic survey is available.

5.2.2 Middle Section

In the Middle Section of the study corridor, in addition to the No-Build, two alternative cross-sections were developed as part of the segment analysis. These alternatives were developed based on the Existing (2021) and Future (2050) No-Build traffic analysis, intersection warrants, future development patterns, safety analysis findings, and input from study stakeholders:

- Alternative 1: A three-lane cross-section along SD11 from Sioux Blvd north to Aspen Blvd (West) where the roadway would expand to five-lanes up to the intersection with Aspen Blvd (East).
- Alternative 2: A five-lane cross-section along SD11 from Sioux Blvd north to Aspen Blvd (East).

The primary concern identified in the analysis of the Middle Section was future traffic operations and safety. The HCS7 software was used to analyze traffic operations for the study segments. **Figure 5-1**, **Figure 5-2**, and **Figure 5-3** show the lane geometry and associated LOS under Phase I (2028), Phase II (2040), and Future (2050) traffic conditions, respectively. **Appendix D** includes capacity analysis worksheets for all traffic condition scenarios. Conceptual layouts for the proposed improvements in this Middle Section can be found on pages **B-1** through **B-4** in **Exhibit B**.

No-Build
Under the No-Build scenario, most study area segments are expected to operate at an acceptable LOS in the AM, PM, and school dismissal peak hours under the analysis years, apart from the segment along SD11 between Park St and Aspen Blvd (East), which is anticipated to operate at LOS D/E by Future (2050).

Alternative 1: 3-Lane Section Urban Section
Alternative 1 would address operational deficiencies along the roadway except for the segment between Park St and Aspen Blvd (West). The operational analysis along this segment suggests a three-lane cross-section would provide acceptable traffic operations through the Phase II (2040), but not for the Future (2050) conditions. The center TWLTL would help to mitigate the crash history of rear-end crashes reported along this segment.

Alternative 2: 5-Lane Section Urban Section
Alternative 2 would address all operational deficiencies along the corridor with a five-lane cross-section with a TWLTL from Sioux Blvd to Aspen Blvd (East) through the Future (2050) conditions. However, a five-lane cross-section in the less urban Middle Section may lead to concerns about speeding, particularly during the period when traffic volumes are lower. Using FHWA USLIMITS2, a tool for setting speed limits based on roadway geometry, operational data, and crash history, the advised speed limit for the section between Sioux Blvd and Aspen Blvd (East) along SD11 would be 50 mph. During stakeholder meetings, interest was expressed about lowering the current speed limit along this section, which is currently 45 mph.

5.2.3 North Section

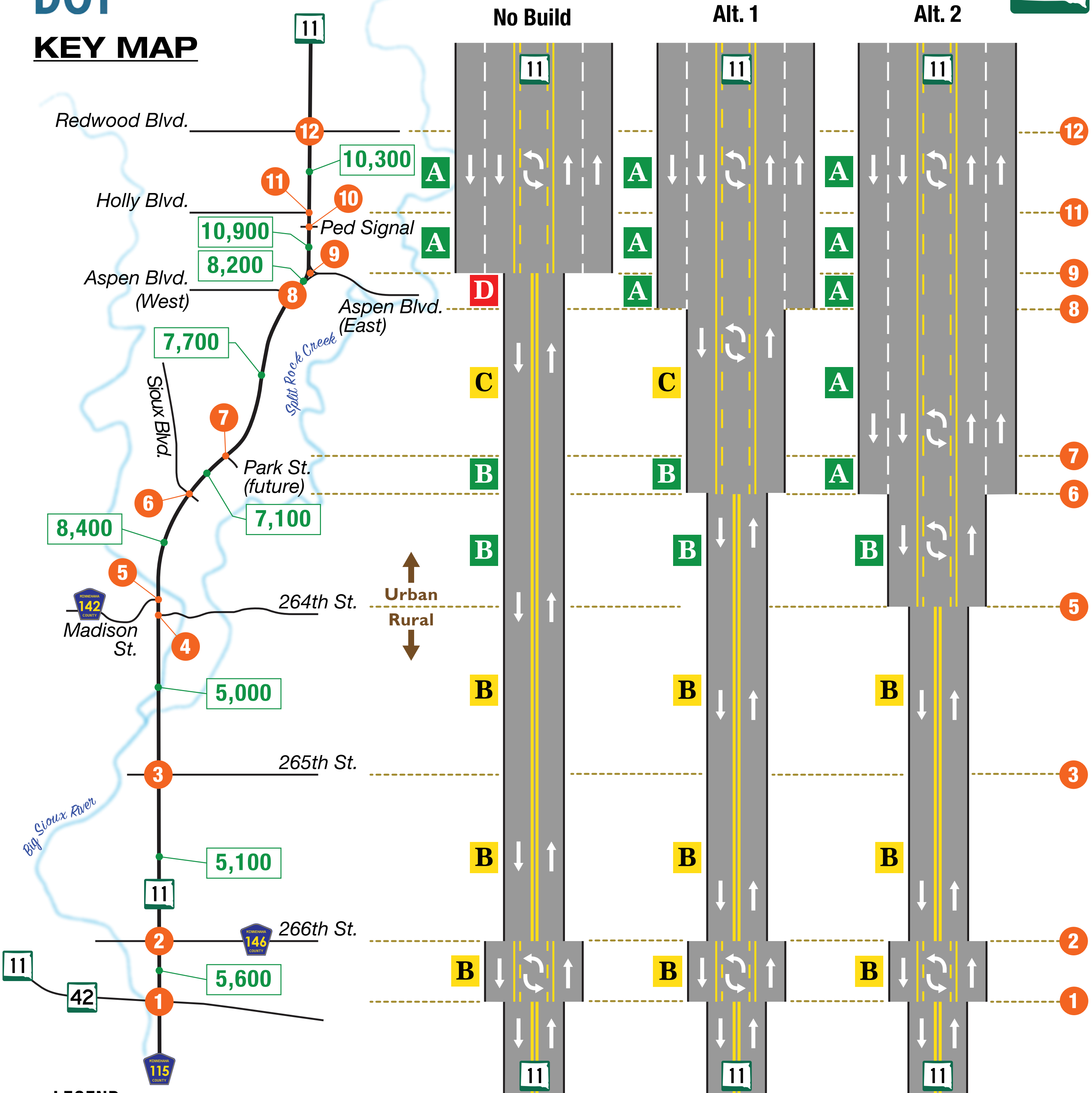
The North Section did not have any operational concerns in the Existing (2021) or Future (2050) No-Build traffic analysis. The primary concern along the segments within the North Section is access control. Therefore, alternatives were developed separately for this section that looked to address access management along this urban section.

Alternative N1: 5-lanes (No Median)
Alternative N1 would leave conditions as they currently exist, with no raised medians and a center TWLTL. There would be some consolidation and closing of driveways where possible.

Alternative N2: Partial Medians at Major Intersections
The Partial Medians option is a hybrid of the 5-lanes (No Median) and the Full Median options. This alternative proposes medians at the major intersections with Holly Blvd and Redwood Blvd, as well as medians along certain segments where access and safety conditions are of concern.

Alternative N3: Full Median for Entire Section
Alternative N3 proposes construction of medians throughout the length of the North Section with full movement access onto SD11 only at intersections and a few driveway locations. Alternative N3 also includes some driveway closing and consolidation where possible.

Operations along the existing five-lane cross-section are anticipated to meet SDDOT standards into Future (2050) traffic conditions. While there may be some safety concerns with the conflict points at the intersections and driveways, it should be noted that the 5-year crash rates are below the statewide average. Managing driveway access along the North Section of the study corridor is a concern as development continues and volumes increase. **Figure 5-1**, **Figure 5-2**, and **Figure 5-3** show the lane geometry and associated LOS under Phase I (2028), Phase II (2040), and Future (2050) traffic conditions, respectively. Layouts of each of the alternatives are included in **Exhibit C** and can be found on pages **C-1** through **C-12**.



LEGEND

X = Intersection Numbers

XXX = Segment Daily Traffic Volumes

X = Roadway Capacity Level of Service

X/X/X = Exceeds/Acceptable/Deficient Level of Service Goal

NOTE:
Roadway cross-sections do not show intersection turn-lanes

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NOTE: Drawing Not to Scale

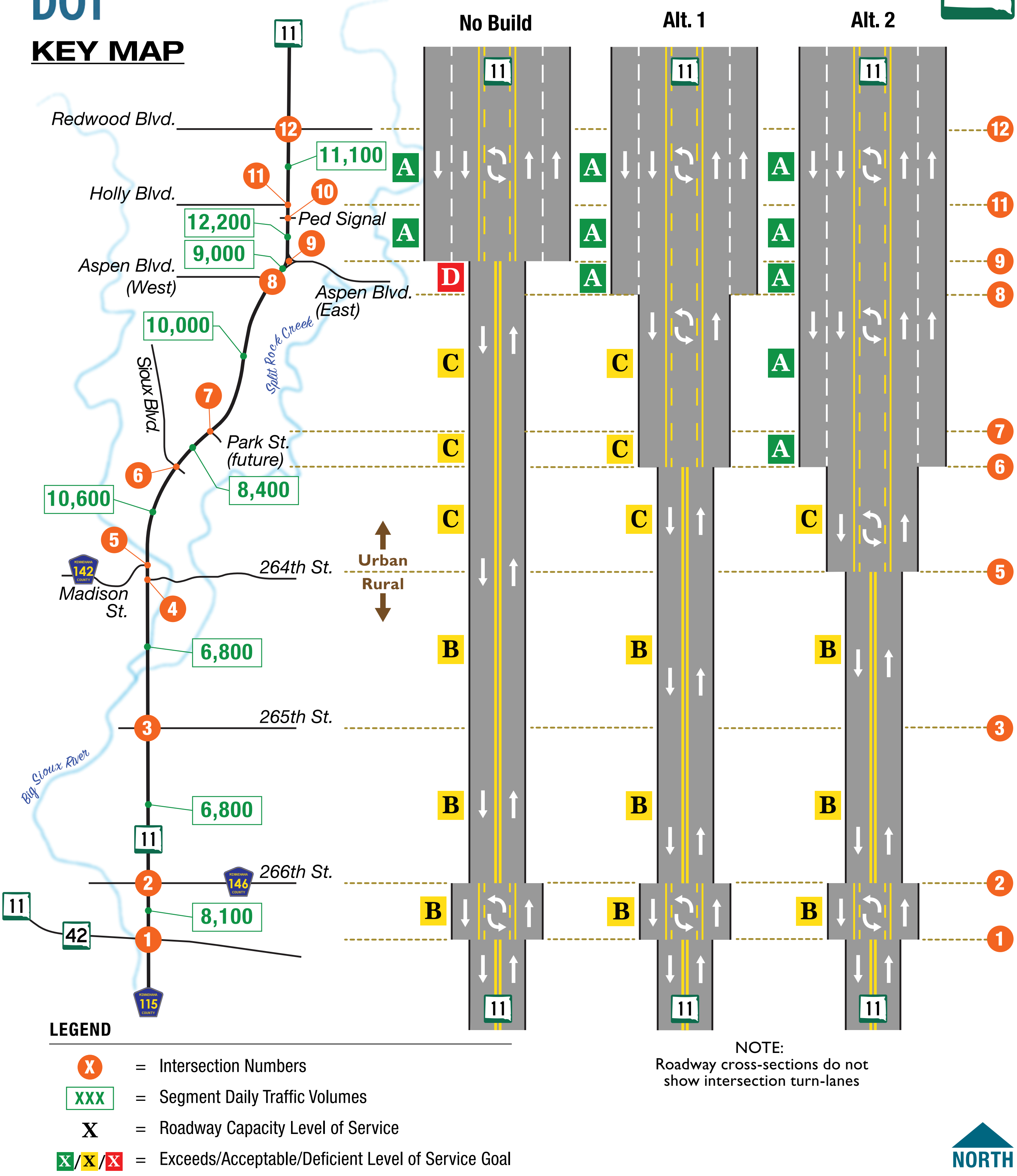
NORTH

FIGURE 5-1

Phase I (2028)

HCS Segment LOS

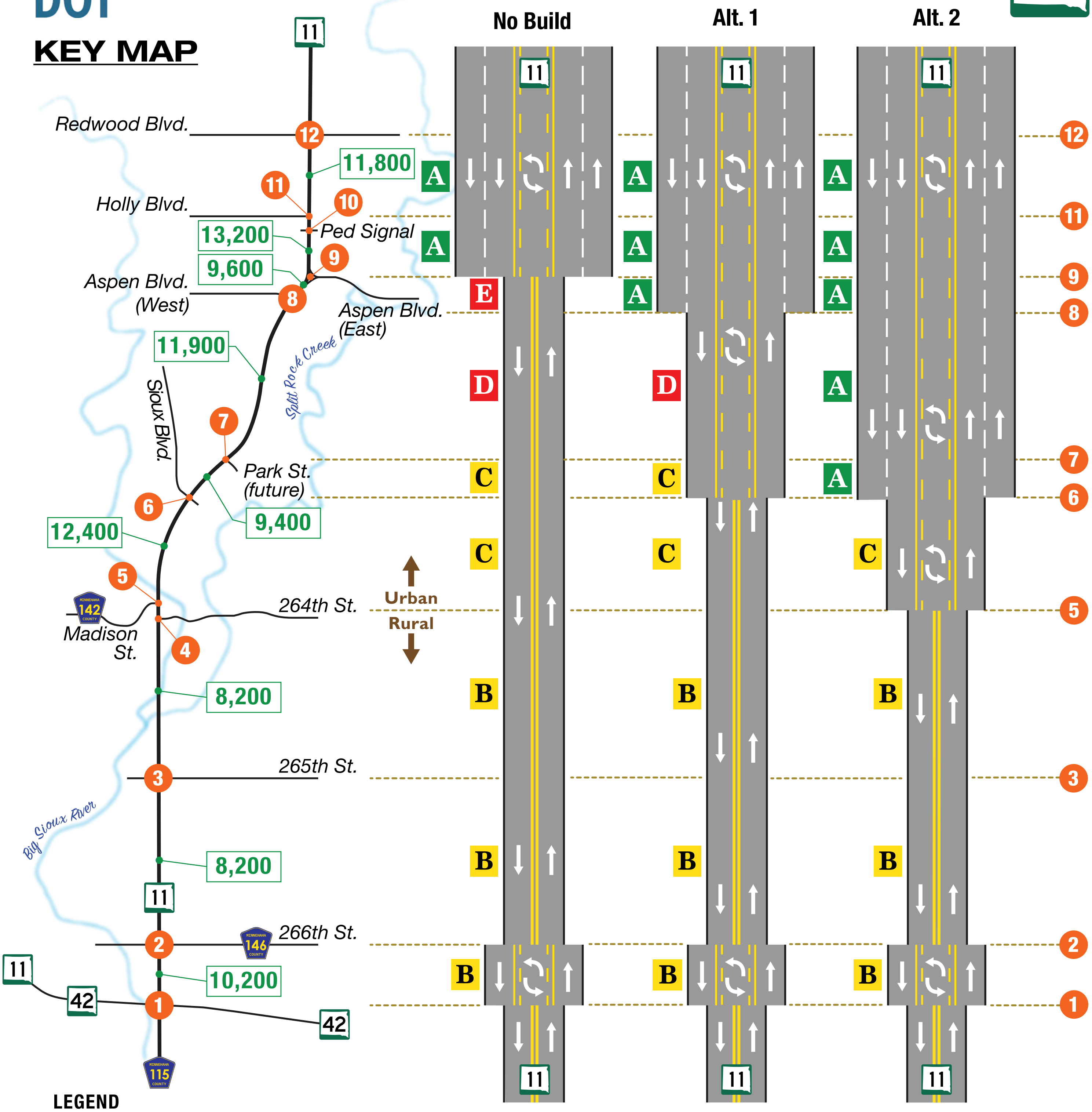
SDDOT - SD 11 Corridor Study 20-323-01 4/11/22



FELSBURG HOLT & ULLEVIG

NOTE: Drawing Not to Scale

FIGURE 5-2
Phase II (2040)
HCS Segment LOS



NOTE:
Roadway cross-sections do not show intersection turn-lanes

LEGEND

- X = Intersection Numbers
- XXX = Segment Daily Traffic Volumes
- X = Roadway Capacity Level of Service
- X/X/X = Exceeds/Acceptable/Deficient Level of Service Goal

NORTH

FELSBURG HOLT & ULLEVIG

NOTE: Drawing Not to Scale

FIGURE 5-3
Future (2050) HCS Segment LOS

5.3 INTERSECTION WARRANT ANALYSIS OF FUTURE CONDITIONS

As part of the alternatives analysis, both *Manual on Uniform Traffic Control Devices (MUTCD)* Signal Warrants and *National Cooperation Highway Research Program (NCHRP)* turn-lane warrants were examined at the study intersections. These warrants help guide operational improvements at the study intersections, taking into account traffic volumes, roadway characteristics, and safety data.

The following subsections analyze the AM, PM, and school dismissal peak hour volumes for Phase I (2028), Phase II (2040), and Future (2050) traffic conditions. If traffic signals or turn-lanes are warranted for any of the peak hours during an analysis year, the warrant is shown as "satisfied." This warrant analysis and its findings were used to help guide future analysis within the study and ultimately the study recommendations. It should be noted that for the Phase I (2028) and Phase II (2040) warrant analyses, Alternative 1 segment geometry was assumed, and for Future (2050) warrant analysis, Alternative 2 segment geometry was assumed.

5.3.1 MUTCD Signal Warrant Analysis

A review was performed to determine if *Manual on Uniform Traffic Control Devices (MUTCD) for Streets and Highways, 2009 Edition* traffic signal Warrant 1 (Eight-Hour Vehicular Volume) and/or Warrant 2 (Four-Hour Vehicular Volume) are satisfied for existing signalized and two-way stop-controlled study intersection(s) under Phase I (2028), Phase II (2040), and Future (2050) traffic conditions. Right-turn reductions were examined, and reductions were assumed based on *NCHRP Report 457* guidance. **Table 5-1** summarizes the results of the analysis, and graphical results of the MUTCD Warrant Analysis are included in **Appendix G**.

Table 5-1. MUTCD Signal Warrants

ID #	Intersection *(w/ SD11)*	Existing Traffic Control	Phase I (2028) Signal Warrants	Phase II (2040) Signal Warrants	Future (2050) Signal Warrants
12	**Redwood Blvd**	Signalized[4]	Satisfied[4]	Satisfied[4]	Satisfied[4]
11	**Holly Blvd**	Signalized[4]	Satisfied[4]	Satisfied[4]	Satisfied[4]
10	**Ped Signal**	Signalized[4]	Satisfied[4]	Satisfied[4]	Satisfied[4]
9	**Aspen Blvd (East)**	TWSC[1]	Satisfied[2]	Satisfied[2]	Satisfied[2]
8	**Aspen Blvd (West)**	TWSC[3]	No[4]	No[4]	Satisfied[4]
7	**Park Street** *(Sioux Blvd Closed)*	NA	Satisfied[4]	Satisfied[4]	Satisfied[4]
–	**Park Street** *(Sioux Blvd Open)*	NA	Satisfied[4]	Satisfied[4]	Satisfied[4]
6	**Sioux Blvd** *(No Park Street)*	TWSC[3]	Satisfied[4]	Satisfied[4]	Satisfied[4]
–	**Sioux Blvd** *(W/ Park Street)*	TWSC[3]	No[4]	No[4]	No[4]
5	**Madison Street**	TWSC[3]	Satisfied[3]	Satisfied[3]	Satisfied[3]
4	**264th Street**	TWSC[3]	No[3]	No[3]	No[3]
3	**265th Street**	TWSC[6]	No[6]	No[6]	No[6]
2	**266th Street**	TWSC[3]	No[3]	No[3]	No[3]
1	**SD42**	TWSC	Satisfied[5]	Satisfied[5]	Satisfied[5]

[1]Two-lane section to the south
[2]Five-lane section to the south
[3]Three-lane section or left turn lanes
[4]Five-lane section
[5]Future improvements on SD11
[6]Two-lane section

5.3.2 Auxiliary Right-Turn Lane Analysis

The NCHRP has developed guidance to determine if an auxiliary right-turn is warranted on the major road of a two-way stop-controlled intersection. These guidelines are published in *NCHRP Report 457: Evaluating Intersection Improvements*. The methodologies are based on an evaluation of the operating and collision costs associated with the turning maneuver relative to the cost of constructing a turn lane. In addition, for right-turn lanes, *NCHRP Report 457* guidelines are based on the following measures:

- Major road 85th percentile speed (posted speed can be used if data are unavailable)
- Major road peak hour approaching traffic volumes
- Right-turn traffic volumes

The AM, PM, and school dismissal peak hour volumes for Phase I (2028), Phase II (2040), and Future (2050) traffic conditions were examined at the stop-controlled intersections within the study area that do not currently have right-turn lanes and where signal warrants were not met. **Table 5-2** summarizes the results of the analysis, and graphical results of the analysis are included in **Appendix H**.

Table 5-2. NCHRP Auxiliary Right-turn Lane Warrants

ID #	Intersection *(w/ SD11)*	Approach Direction	Existing Turn Lane (ft)	Phase I (2028) Lane Warrant	Phase II (2040) Lane Warrant	Future (2050) Lane Warrant
8	**Aspen Blvd (West)**	–	–	–	–	*Sig. Warranted*
		Southbound	None	No	Satisfied	*Sig. Warranted*
6	**Sioux Blvd** *(Park St Connection)*	Northbound	None	No	No	No
		Southbound	None	Satisfied	Satisfied	Satisfied
4	**264th Street**	Northbound	None	No	No	No
		Southbound	–	–	–	–
3	**265th Street**	Northbound	None	No	No	No
		Southbound	None	No	No	No
2	**266th Street**	Northbound	200’	Satisfied	Satisfied	Satisfied
		Southbound	None	No	No	No

5.3.3 Auxiliary Left-turn Lane Analysis

NCHRP Report 457 also provides guidance for determining if an auxiliary left-turn is warranted on the major road of a two-way stop-controlled intersection. For left-turn lanes, *NCHRP Report 457* guidelines are based on the following measures:

- Major road 85th percentile speed (posted speed can be used if data are unavailable)
- Percent of left-turns in advancing volume
- Major road peak hour advancing and opposing traffic volumes

The AM, PM, and school dismissal peak hour volumes for Phase I (2028), Phase II (2040), and Future (2050) traffic conditions were examined at the stop-controlled intersection(s) within the study area that do not currently have left-turn lanes. **Table 5-3** summarizes the results of the analysis, and graphical results of the analysis are included in **Appendix H**.

Table 5-3. NCHRP Auxiliary Left-turn Lane Warrants

ID #	Intersection (w/ SD11)	Approach Direction	Existing Turn Lane (ft)	Phase I (2028) Lane Warrant	Phase II (2040) Lane Warrant	Future (2050) Lane Warrant
8	**Aspen Blvd (West)**	Northbound	80’	Satisfied	Satisfied	*Sig. Warranted*
		–	–	–	–	*Sig. Warranted*
6	**Sioux Blvd** *(Park St Connection)*	Northbound	370’	Satisfied	Satisfied	Satisfied
		Southbound	None	No	No	No
4	**264th Street**	–	–	–	–	–
		Southbound	115’	No	No	No
3	**265th Street**	Northbound	None	No	No	No
		Southbound	None	No	No	No
2	**266th Street**	Northbound	200’	No	No	No
		Southbound	360’	No	Satisfied	Satisfied

5.3.4 Minor Road Approach Analysis

NCHRP Report 457 provides guidance on when an additional approach lane on the minor leg of a two-way stop-controlled intersection is needed. It is based on the need to provide the side street with an acceptable LOS. To determine the approach geometry, *NCHRP Report 457* guidelines are based on the following measures:

- Major road peak hour traffic volumes (total of both directions)
- Minor road peak hour approaching traffic volumes
- Minor road right-turn traffic volumes
- Percentage of minor road right-turns

The AM, PM, and school dismissal peak hour volumes for Phase I (2028), Phase II (2040), and Future (2050) traffic conditions were examined at the stop-controlled intersection(s) within the study area that do not currently have two-lane approaches. **Table 5-4** summarizes the results of the analysis, and **Appendix H** includes graphical results of the analysis.

Table 5-4. NCHRP Minor Road Approach Analysis

ID #	Intersection (w/ SD11)	Approach Direction	Existing Approach	Phase I (2028) Two-lane Warrant	Phase II (2040) Two-lane Warrant	Future (2050) Two-lane Warrant
8	**Aspen Blvd (West)**	Eastbound	One-lane	Satisfied	Satisfied	*Sig. Warranted*
		–	–	–	–	*Sig. Warranted*
6	**Sioux Blvd** *(Park St Connection)*	Eastbound	One-lane	No	No	No
		Westbound	Priv. Drive	No	No	No
4	**264th Street**	–	–	–	–	–
		Westbound	One-lane	No	No	No
3	**265th Street**	Eastbound	One-lane	No	No	No
		Westbound	One-lane	No	No	No
2	**266th Street**	Eastbound	One-lane	No	No	No
		Westbound	One-lane	No	No	No

5.4 INTERSECTION ANALYSIS

Alternatives were developed for the study intersections based on input from study stakeholders, operational goals, safety analysis, and traffic signal/turn-lane warrant analysis results. The number of analyzed alternatives varied at each intersection and depended on the results from the variables. **Table 5-5** summarizes the intersection alternatives that were examined as part of this study.

Table 5-5. Intersection Alternatives

ID #	Intersection *(w/ SD11)*	No-Build	Alt. 1	Alt. 2	Alt. 3
12	**Redwood Blvd**	*Signalized*	–	–	–
11	**Holly Blvd**	*Signalized*	–	–	–
10	**Ped Signal**	*Ped. Signal*	–	–	–
9	**Aspen Blvd (East)**	*TWSC*	*Signalized*	*Roundabout*	–
8	**Aspen Blvd (West)**	*TWSC*	*TWSC (w/ EBR turn-lane)*	*Signalized*	–
7	**Park Street**	*TWSC*	*Signalized (Sioux Blvd Closed)*	*Signalized (Sioux Blvd Open)*	–
6	**Sioux Blvd**	*TWSC*	*Signalized (No Park Street Connection)*	*TWSC (w/ Park Street Connection)*	*TWSC (Sioux Blvd Closed)*
5	**Madison Street**	*TWSC*	*TWSC (w/ EBR turn-lane)*	*Signalized*	–
4	**264th Street**	*TWSC*	–	–	–
3	**265th Street**	*TWSC*	–	–	–
2	**266th Street**	*TWSC*	–	–	–
1	**SD42**	*TWSC*	*TWSC (SD42 w/ 4-lanes)*	*Signalized (SD42 w/ 4-lanes)*	–

5.4.1 South Section

Figure 5-4a, Figure 5-4b, and **Figure 5-4c** show the lane geometry, traffic control, and LOS for the proposed alternatives along the South Section of the SD11 study corridor under Phase I (2028), Phase II (2040), and Future (2050) traffic conditions, respectively. This section was assumed to provide the existing two-lane section with turn lanes at key intersections. Alternatives were proposed at two intersections within the South Section. A two-lane cross-section was assumed for the segments within the South Section, except for the segment between SD42 and 266th St, which is a three-lane cross-section with a TWLTL.

SD11 with SD42

Under No-Build conditions, the northbound and southbound operations are expected to deteriorate to LOS E by Phase I (2028) and further to LOS F by Phase II (2040). Signal warrants are met at this intersection by Phase I (2028). Additionally, the SDDOT has geometric improvements planned along SD42 that are anticipated to be constructed by Phase I (2028). Two alternatives were proposed at this intersection:

- Alternative 1: TWSC with Turn-lane Improvements
- Alternative 2: Traffic Signal with Turn-lane Improvements

Alternative 1 as a TWSC intersection, even with turn-lane improvements, is not expected to operate at an acceptable LOS by Phase I (2028). Further, as stated earlier, signal warrants are met by Phase I (2028).

Alternative 2 as a signalized intersection is anticipated to operate at LOS A through Future (2050). As a result, this is the recommended alternative for this intersection. The configuration evaluated for Alternative 2 matches the recommendations made by the previous study conducted along SD42 and the preliminary design plans provided by the SDDOT. Improvements on the SD11 leg of this intersection can be constructed within the existing ROW. No adverse effects to environmental resources are anticipated with the construction of this alternative. The concept for this intersection is shown on page **A-1** in **Exhibit A**.

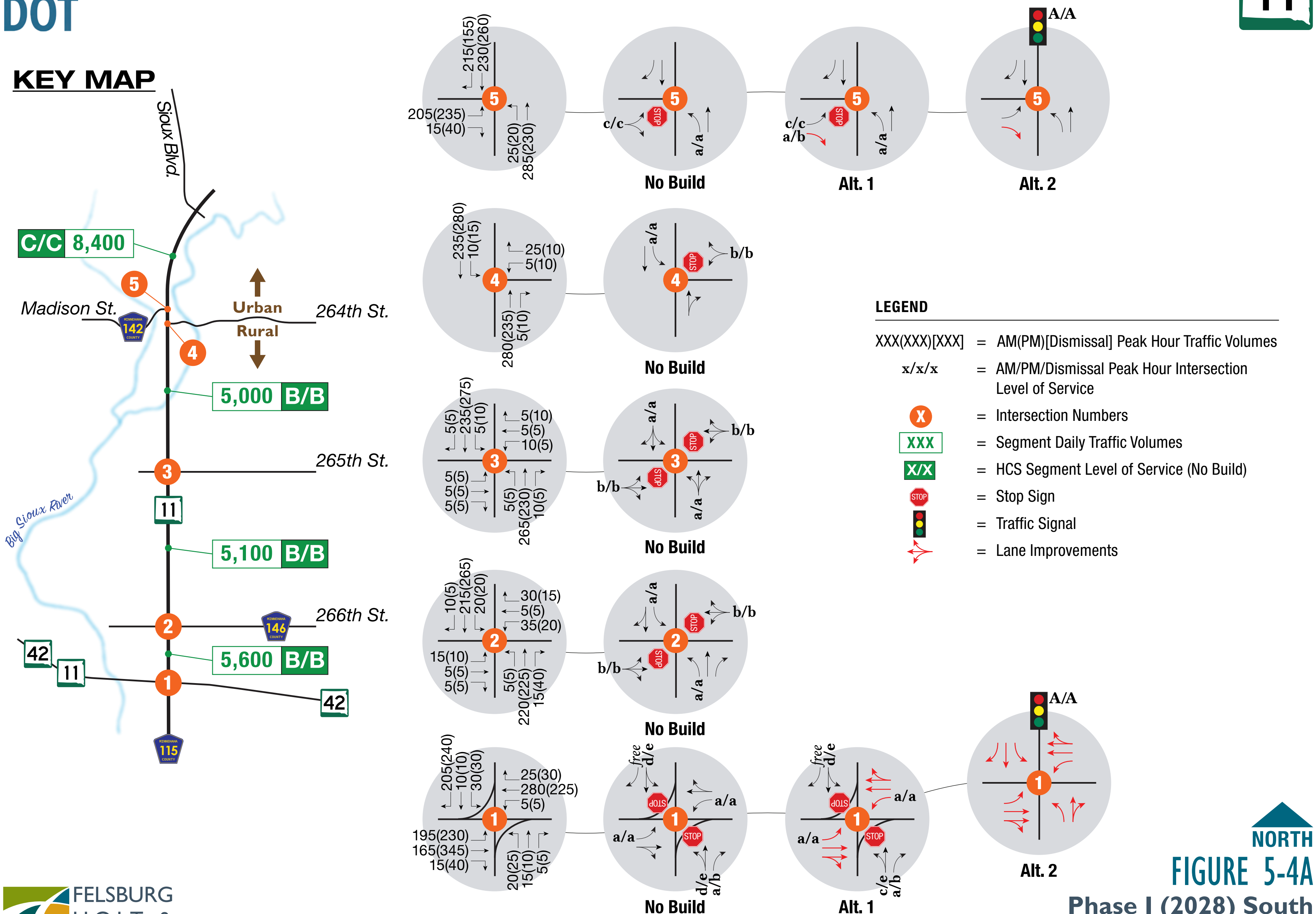
SD11 with Madison Street

Under No-Build conditions, the eastbound approach is anticipated to operate at LOS F by Phase II (2040). Signal warrants are met by Phase I (2028). Two alternatives were proposed at this intersection:

- Alternative 1: TWSC with Turn-lane Improvements
- Alternative 2: Traffic Signal with Turn-lane Improvements

Alternative 1, with Madison St as a TWSC intersection with turn-lane improvements, is anticipated to function at LOS C or better through Phase I (2028). By Phase II (2040) traffic conditions operations are anticipated to deteriorate to LOS F.

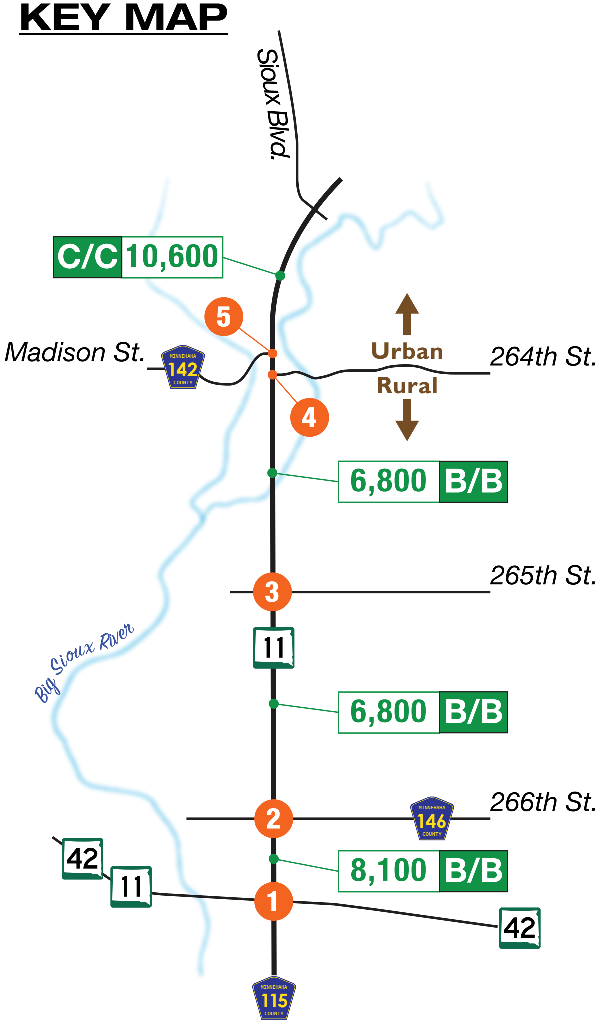
Alternative 2, Madison St as a signalized intersection with turn-lane improvements, is anticipated to operate at LOS A through Future (2050) traffic conditions. As a result, this is the recommended alternative for this intersection. The widening proposed for this segment of Madison St approaching the intersection with SD11 could be constructed within the existing ROW. No adverse effects to environmental resources are anticipated with the construction of this alternative.

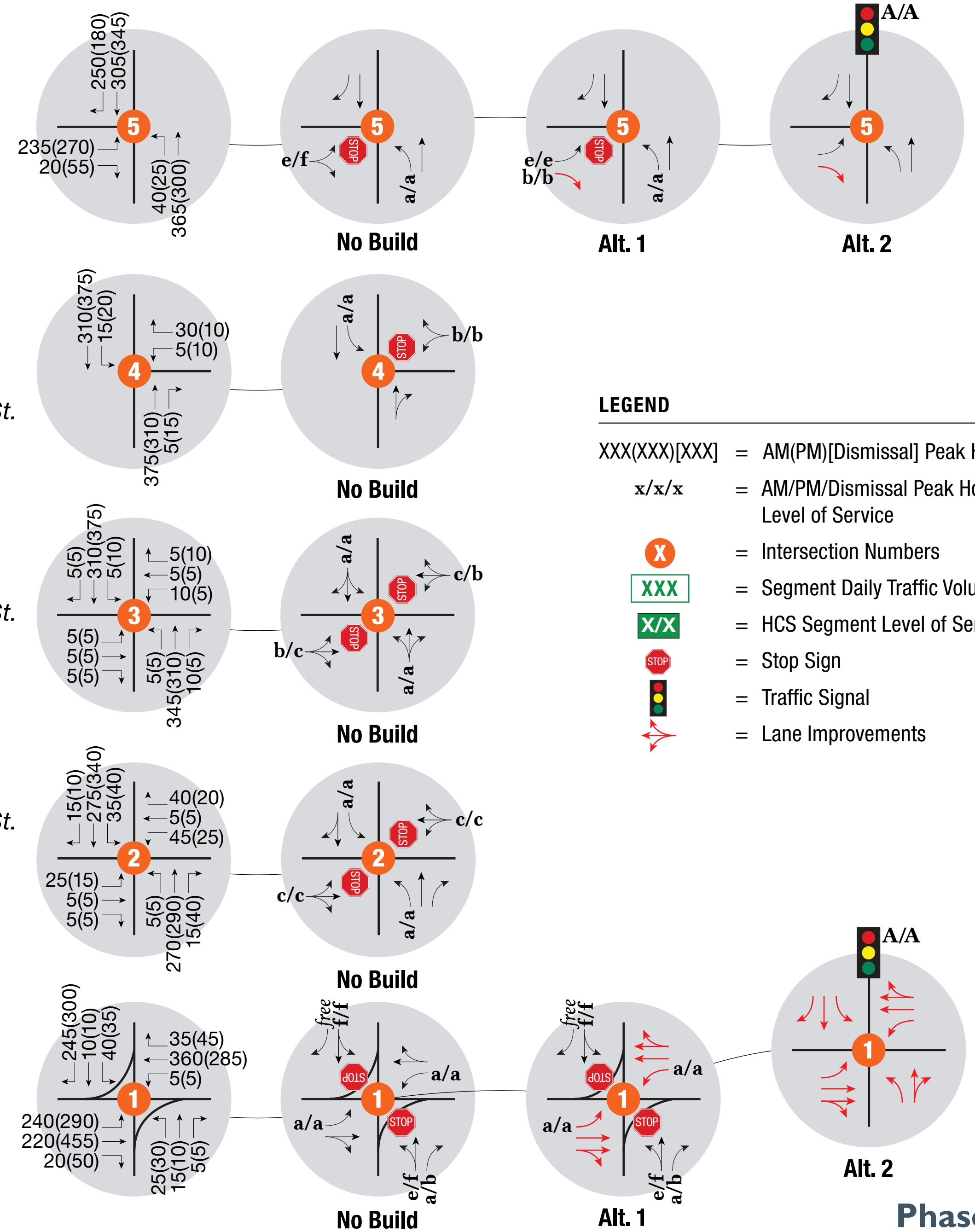


NOTE: Drawing Not to Scale

FIGURE 5-4A
Phase I (2028) South Traffic Conditions

KEY MAP





LEGEND

XXX(XXX)[XXX]	=	AM(PM)[Dismissal] Peak Hour Traffic Volumes
x/x/x	=	AM/PM/Dismissal Peak Hour Intersection Level of Service
X	=	Intersection Numbers
XXX	=	Segment Daily Traffic Volumes
X/X	=	HCS Segment Level of Service (No Build)
STOP	=	Stop Sign
	=	Traffic Signal
	=	Lane Improvements

NORTH

FIGURE 5-4B

Phase II (2040) South Traffic Conditions

NOTE: Drawing Not to Scale

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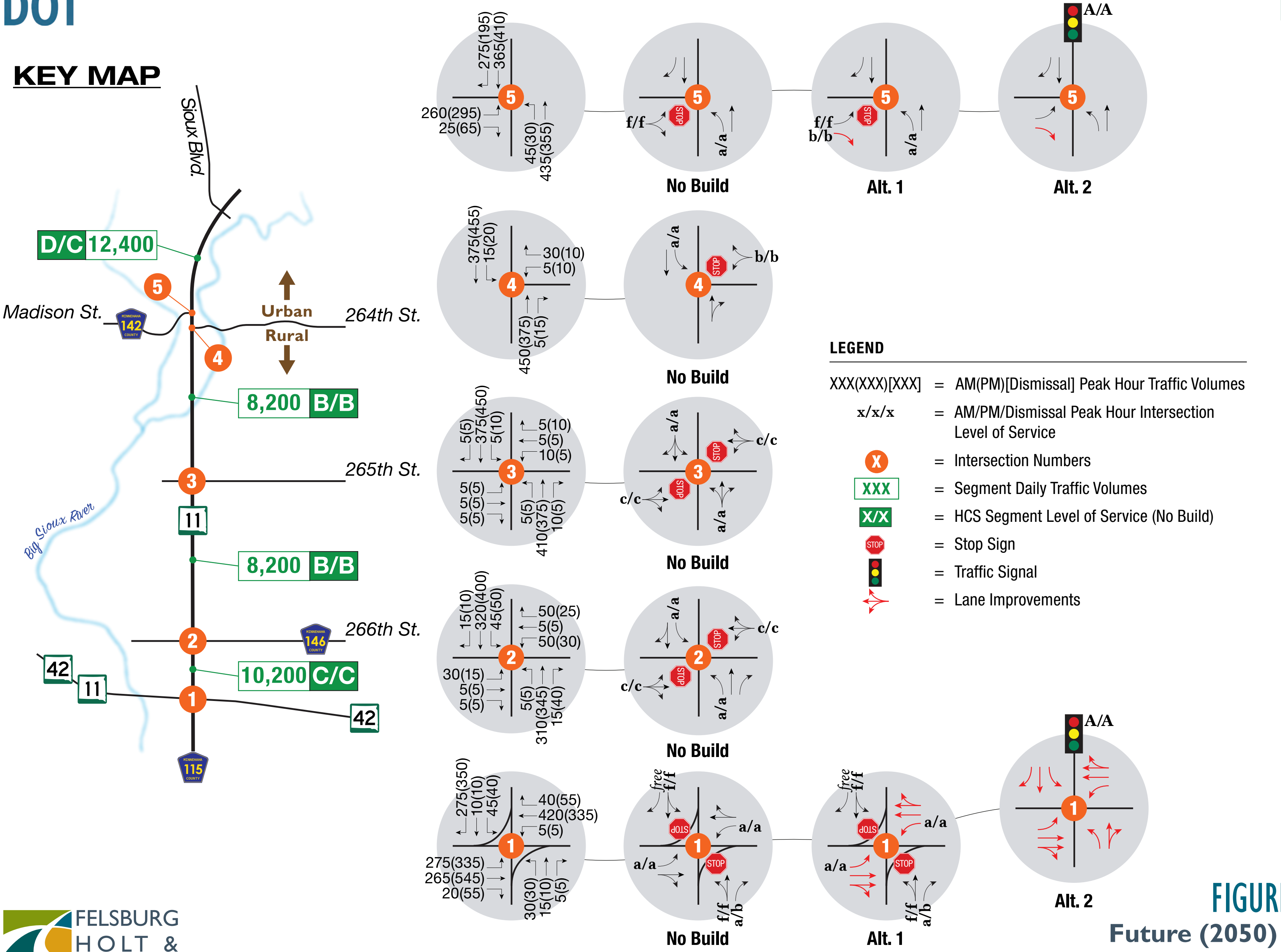

NOTE: Drawing Not to Scale

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FIGURE 5-4C

Future (2050) South Traffic Conditions

5.4.2 Middle Section

Figure 5-5a, Figure 5-5b, and **Figure 5-5c** show the lane geometry, traffic control, and LOS for the proposed alternatives along the Middle Section of the SD11 study corridor under Phase I (2028), Phase II (2040), and Future (2050) traffic conditions, respectively. Based on the segment analysis, a three-lane cross-section would be adequate to accommodate Phase I (2028) and Phase II (2040) traffic conditions. However, a five-lane cross-section would be necessary by Future (2050) traffic conditions on the Middle Section. These assumptions were carried through within the intersection analysis. Alternatives are proposed at three intersections within the Middle Section.

SD11 with Sioux Blvd

Under the No-Build condition, the eastbound and westbound operations are expected to deteriorate to LOS F by Phase I (2028). The proposed alternatives at this intersection are each dependent on whether a Park St connection to SD11 is constructed. Signal warrants are met at this intersection without a Park St connection by Phase I (2028). With a Park St connection, signal warrants are not satisfied through Future (2050), but a southbound right-turn lane would be warranted at the intersection if it is two-way stop-controlled. Three alternatives were proposed at this intersection:

- Alternative 1: Traffic Signal with Turn-lane Improvements (No Park St Connection)
- Alternative 2: TWSC with a Southbound Right-turn Lane (w/ Park S Connection)
- Alternative 3: Eastbound Approach Removed (w/ Park St Connection)

Alternative 1 consists of a signalized intersection at Sioux Blvd and assumes the Park St connection to the north is not constructed. Under this scenario, signal warrants are met by Phase I (2028) and the intersection is anticipated to operate at LOS A through Future (2050). Left-turn lanes are recommended on all approaches under signalization.

Alternative 2 consists of a two-way stop-controlled intersection for Sioux Blvd and assumes the Park St connection is made. Signal warrants are not met under this scenario. With the Park St connection to the west, a significant amount of the traffic on SD11 from Sioux Blvd is anticipated to be rerouted to the new Park St intersection. The intersection of SD11 with Sioux Blvd under these conditions is expected to operate at LOS E on the eastbound minor approach by Phase I (2028) and LOS F on both minor approaches by Future (2050).

Alternative 3 proposes the removal of the eastbound approach of Sioux Blvd at the intersection with SD11 under the assumption that the Park St connection is made. The private drive on the east side of the roadway would remain open and function as stop controlled. Under this scenario, the three-leg intersection would operate at LOS C or better through Future (2050) traffic conditions. This recommended concept is shown on page **A-6** in **Exhibit A**.

SD11 with Park Street

Under the No-Build condition, with the northern Huset's Speedway driveway as the eastbound leg, the westbound approach is anticipated to operate at LOS C or better through Future (2050) traffic conditions. All future scenarios assume the Park St connection is constructed by that time. The proposed alternatives are dependent on whether Sioux Blvd remains open or is closed to traffic. However, signal warrants are met under both traffic conditions.

The two alternatives proposed at this intersection are:

- Alternative 1: Traffic Signal with Turn-lane Improvements (Sioux Blvd Closed)
- Alternative 2: Traffic Signal with Turn-lane Improvements (Sioux Blvd Open)

Both Alternative 1 and Alternative 2 meet signal warrants and, as signalized intersections, are anticipated to operate at LOS A through Future (2050) traffic conditions. If signalized, it is recommended that the eastbound approach be constructed with two lanes, the northbound approach constructed with a left-turn lane, and the construction of a separate westbound left-turn lane. This recommended concept is shown on page **B-1** in **Exhibit B**.

For the proposed improvements on SD11, it is anticipated that some additional ROW will be required from the parcel immediately north of the future Park St, on the west side of SD11. The Park St extension will be constructed under a separate project and will be a new roadway on new alignment. This study did not evaluate the potential environmental impacts associated with that construction.

SD11 with Aspen Blvd (West)

Under the No-Build condition, the eastbound operations are expected to deteriorate to LOS F by Phase I (2028). Signal warrants are met at this intersection by Future (2050). Two alternatives were proposed at this intersection:

- Alternative 1: TWSC with Turn-lane Improvements
- Alternative 2: Traffic Signal with Turn-lane Improvements

Alternative 1 consists of Aspen Blvd (West) as a TWSC intersection. Even with turn-lane improvements, the intersection would not operate at an acceptable LOS by Phase I (2028). As stated earlier, signal warrants would not be met until the Future (2050) conditions.

Alternative 2 consists of Aspen Blvd (West) as a signalized intersection. This alternative is anticipated to operate at LOS A through Future (2050). When signalized, it is recommended that the eastbound approach be constructed to provide separate right and left turn lanes. This recommended concept is shown on page **B-2** in **Exhibit B**.

The widening of the Aspen Blvd (West) approach to the intersection with SD11 can be constructed within the existing ROW. No adverse effects to environmental resources are anticipated with the construction of these alternatives.

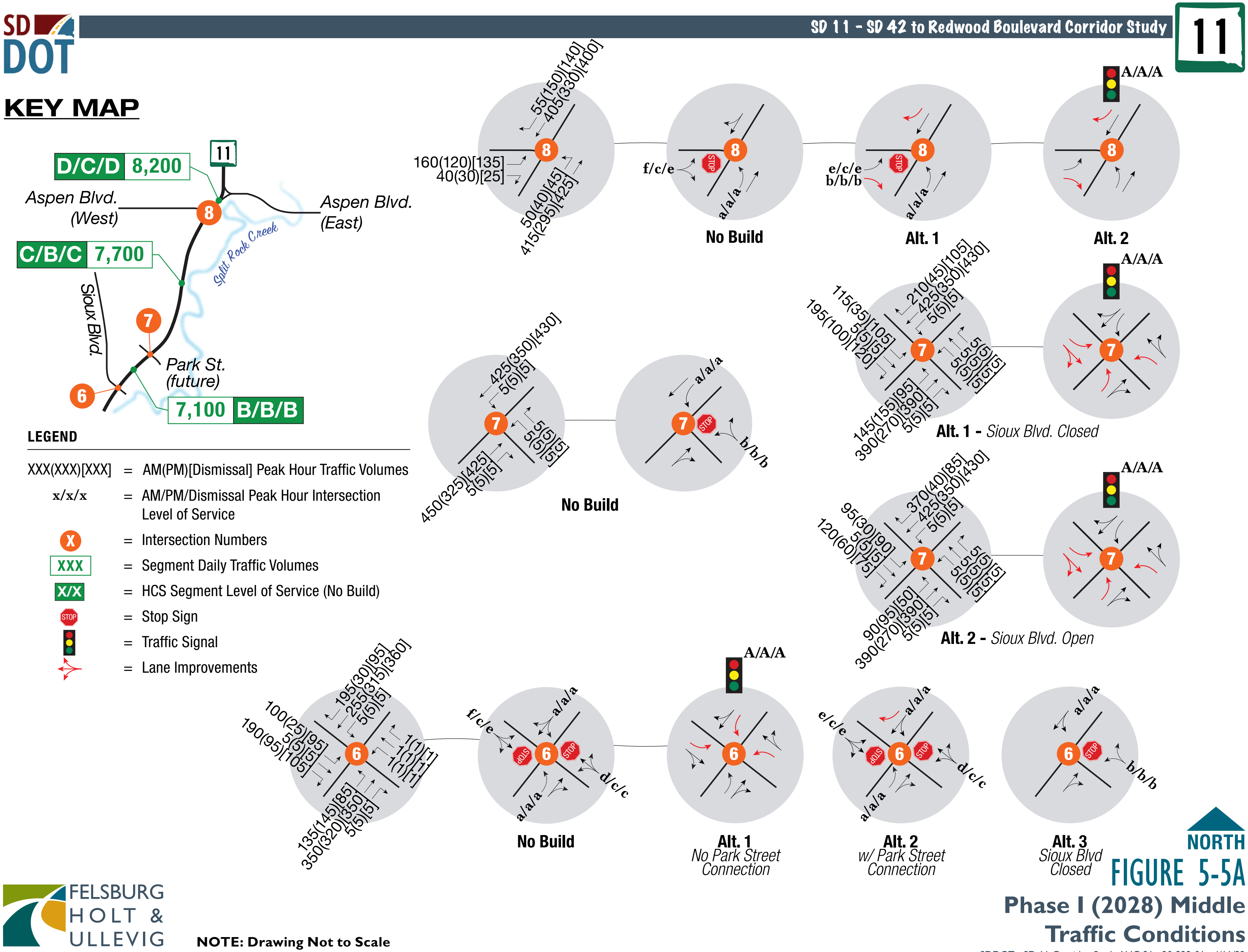
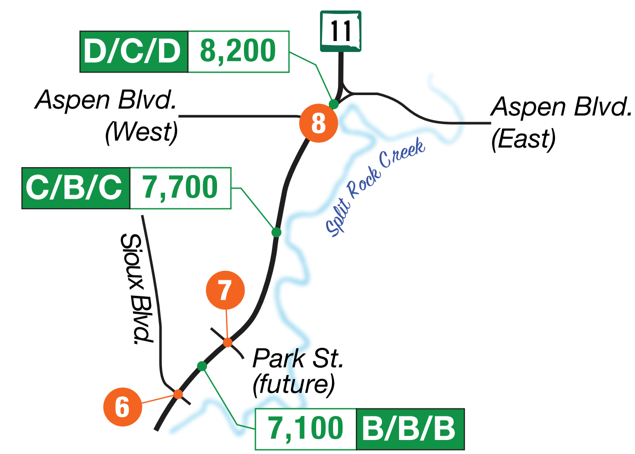


FIGURE 5-5A

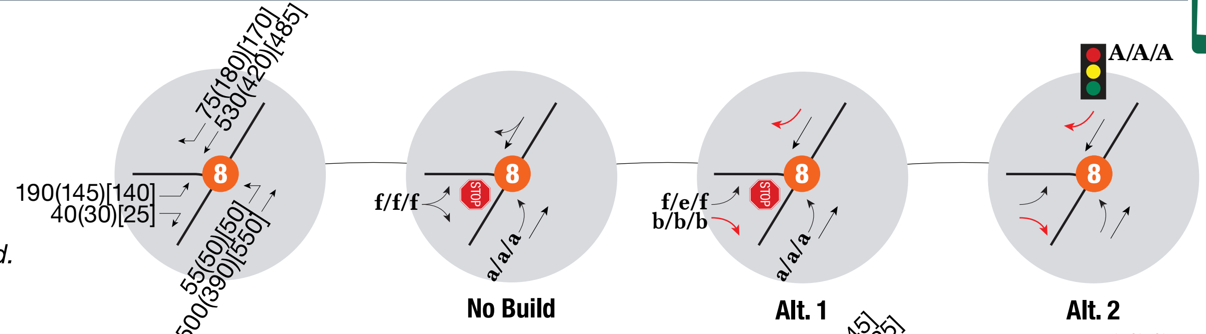
Phase I (2028) Middle Traffic Conditions

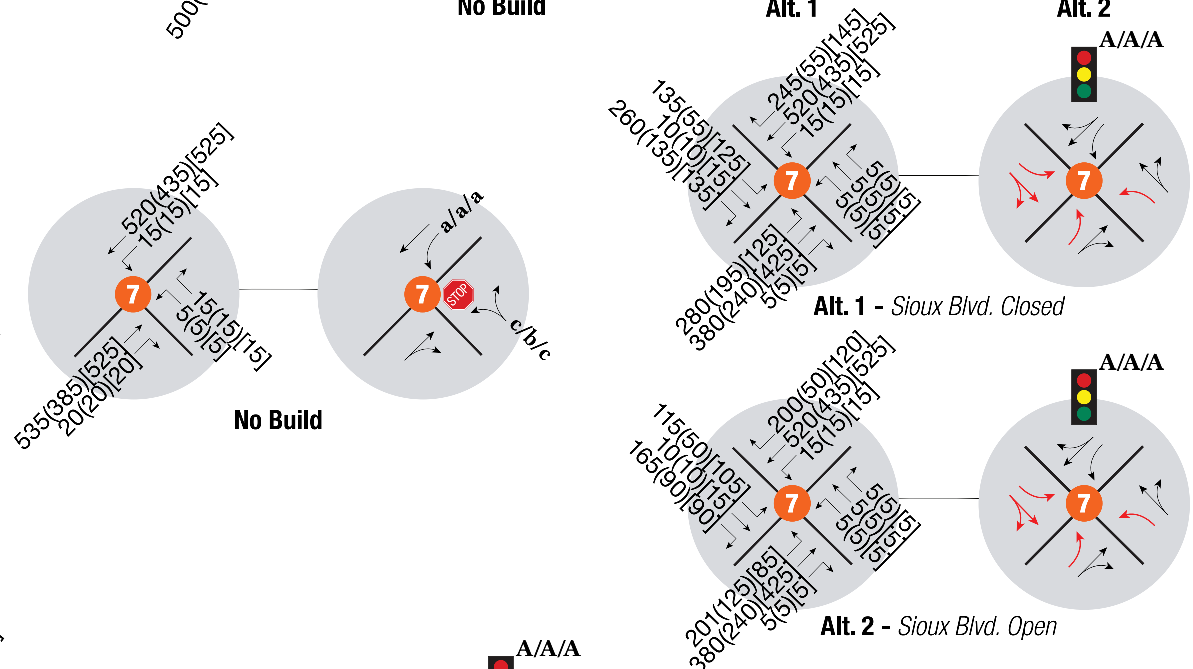
KEY MAP

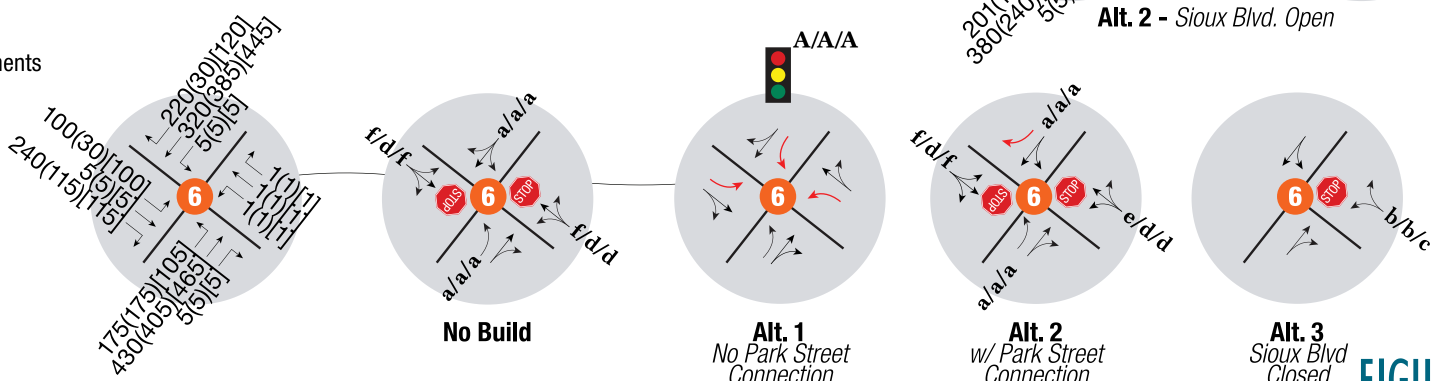


LEGEND

XXX(XXX)[XXX]	=	AM(PM)[Dismissal] Peak Hour Traffic Volumes
x/x/x	=	AM/PM/Dismissal Peak Hour Intersection Level of Service
X	=	Intersection Numbers
XXX	=	Segment Daily Traffic Volumes
X/X	=	HCS Segment Level of Service (No Build)
STOP	=	Stop Sign
	=	Traffic Signal
	=	Lane Improvements







NORTH

FIGURE 5-5B

Phase II (2040) Middle Traffic Conditions

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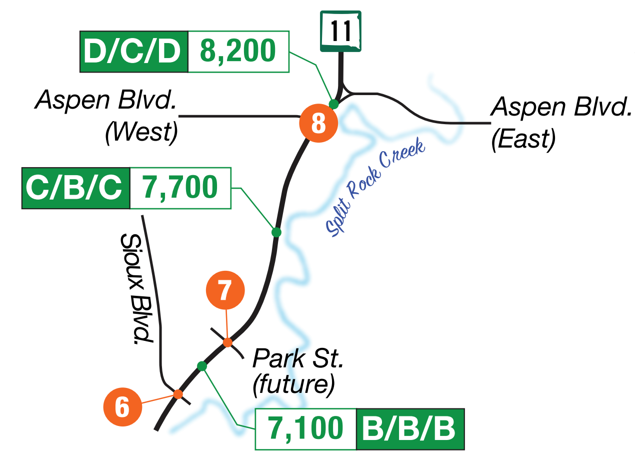
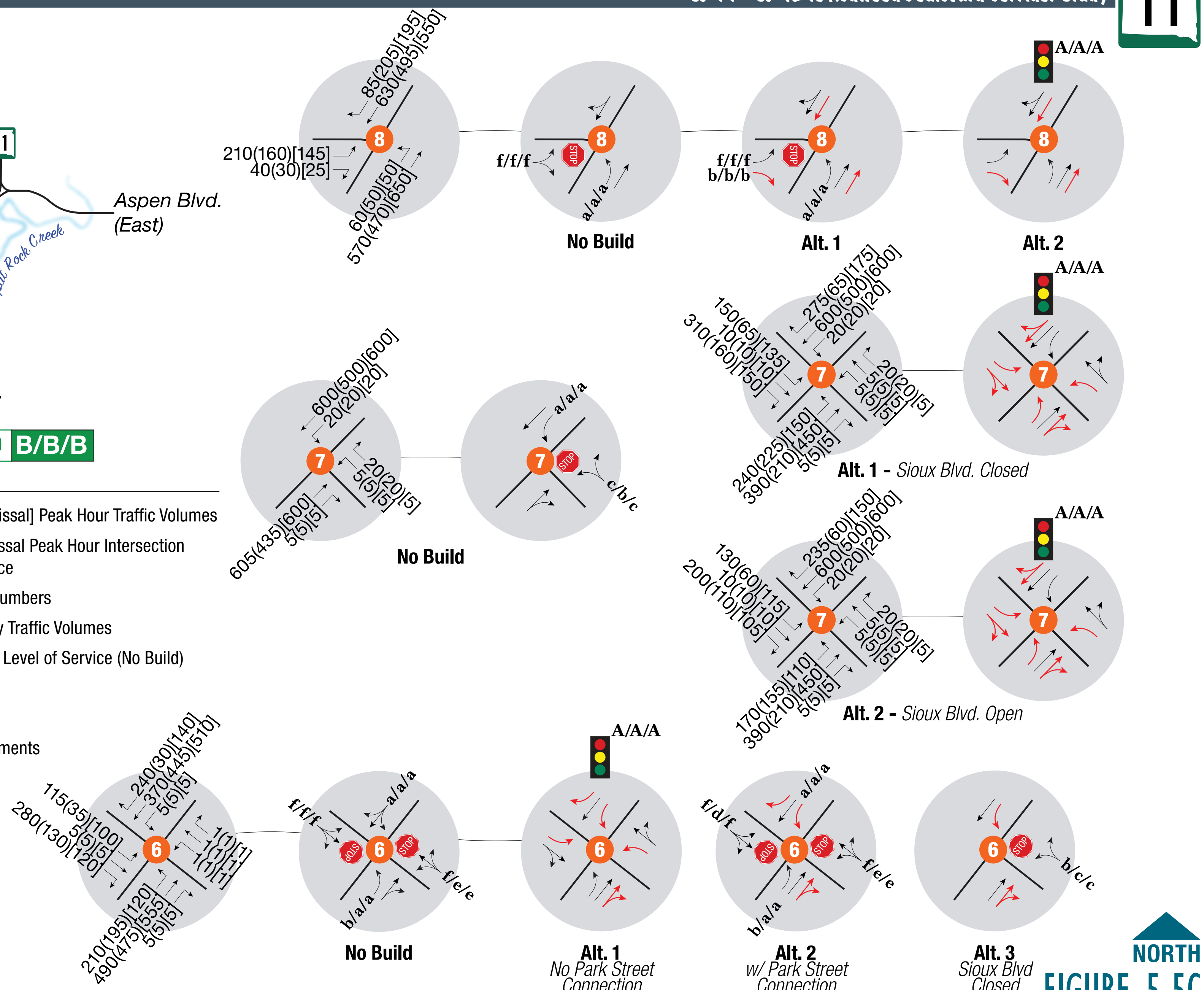
NOTE: Drawing Not to Scale

KEY MAP



LEGEND

XXX(XXX)[XXX] = AM(PM)[Dismissal] Peak Hour Traffic Volumes
x/x/x = AM/PM/Dismissal Peak Hour Intersection Level of Service
X = Intersection Numbers
XXX = Segment Daily Traffic Volumes
X/X = HCS Segment Level of Service (No Build)
STOP = Stop Sign
= Traffic Signal
= Lane Improvements



NOTE: Drawing Not to Scale

FIGURE 5-5C

Future (2050) Middle Traffic Conditions

5.4.3 North Section

Figure 5-6a, Figure 5-6b, and **Figure 5-6c** show the lane geometry, traffic control, and LOS for the proposed alternatives along the North Section of the SD11 study corridor under Phase I (2028), Phase II (2040), and Future (2050) traffic conditions, respectively. Alternatives are proposed at two intersections within the North Section.

SD11 with Aspen Blvd (East)

Under the No-Build condition, the westbound approach operations are expected to deteriorate to LOS F by Phase I (2028). Signal warrants are met at this intersection by Phase I (2028). Two alternatives were proposed at this intersection:

- Alternative 1: Traffic Signal with Lane Improvements
- Alternative 2: Multi-Lane Roundabout

Alternative 1 as a signalized intersection is anticipated to operate at LOS A through Future (2050) traffic conditions. Based on the segment alternative analysis previously discussed, a five-lane cross-section is warranted south of the intersection and additional northbound/southbound through lanes through the intersection would be provided.

It should be noted that for sight distance and safety, access locations should meet at, or nearly at, right angles. An intersection at acute angles can limit visibility on approaches and on intersecting roadways. Acute-angle intersections can also increase the exposure time of vehicles crossing the main traffic flow and may increase the risk for a crash. To provide a safe and an efficient intersection configuration, the south leg of the signalized Alternative 1, shown on page **C-1** in **Exhibit C**, was realigned to provide the necessary stopping sight distance to the intersection.

Alternative 2 as a multi-lane roundabout is anticipated to operate at LOS A through Future (2050) traffic conditions. As stated previously, a five-lane cross-section is warranted south of the intersection, necessitating a multi-lane roundabout versus a single lane roundabout to accommodate the lane arrangement and anticipated traffic volumes. The roundabout functions well operationally due to minimal traffic volume on the west leg (Fleetwood Cr), relatively equal volume splits between the other three legs, and a significant amount of westbound to northbound right-turning vehicles. This recommended concept is shown on page **C-2** in **Exhibit C**.

Additional benefits of a roundabout at this location include:

- According to the Institute for Highway Safety where stop sign or signalized intersections are replaced by roundabouts, all crashes were reduced by 37 percent, pedestrian crashes by 40 percent, and serious crashes by 75 percent, including a 90 percent reduction in fatalities.
- Increased intersection capacity and efficiency. Under many conditions, like at SD11 with Aspen Blvd (East), a roundabout can operate with less delay to users than a signal or an all-way stop controlled intersection. A roundabout does not require a complete stop by all entering vehicles.
- Roundabouts act as a traffic calming device. Vehicle traffic slows down when approaching and going through a roundabout, providing effective speed control along a corridor.

Based on this analysis, construction of a roundabout at this intersection is the recommended alternative. The location of the roundabout, as shown on **Exhibit C,** was shifted to the northeast to minimize impacts with the properties on the west side of SD11 and McHardy Park to the south and east. As a result, some additional ROW will be required from the undeveloped parcel in the northeast quadrant of the intersection. There may be some temporary impacts to McHardy Park during the construction of the roundabout. No other environmental impacts are anticipated with this alternative.

SD11 with Ped Signal

The pedestrian signal operations for the installation located on SD11 between Cedar St and Rushmore Dr were examined as a part of this analysis. It should be noted that LOS results are not reported for pedestrian signals. Pedestrian safety and vehicle compliance are of primary concern regarding the pedestrian signal's operation. The existing stop bars are placed directly at the crosswalk and the signal arms are located approximately 20 feet downstream of the crosswalk for each direction, respectively. Two alternatives for modification to the placement of the stop bars and signal arms are proposed:

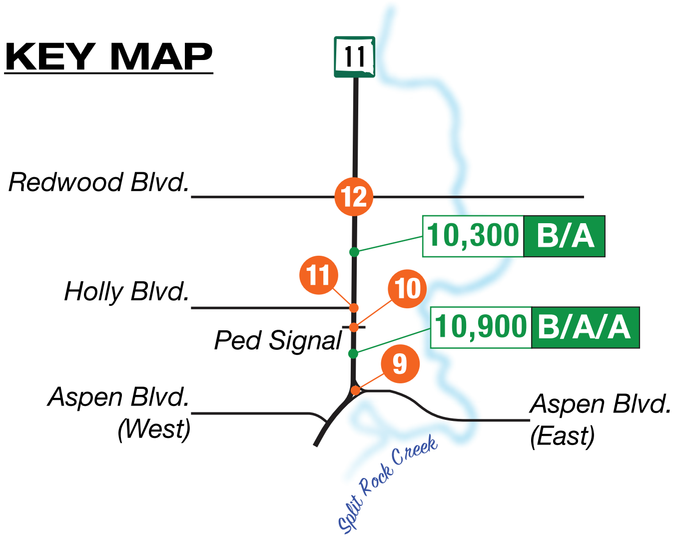
- Alternative 1: Move Stop-Bars to 20 Feet in Advance of Crosswalk
- Alternative 2: Move Stop-Bars to 20 Feet in Advance of Crosswalk & Relocate Signal Arms to be Directly Over Crosswalk

Alternative 1 proposes to move the stop-bars 20 feet in advance of the crosswalk to better separate vehicles and pedestrian traffic and to reduce the risk of pedestrians being struck by a non-yielding driver after being shadowed by a vehicle in an adjacent lane that is stopped very close (5 feet or less) to the crosswalk. This guidance is based on MUTCD recommendations and typical engineering judgment for multi-lane approaches at midblock locations. It is desirable to provide a stop bar that is 20 to 50 feet in advance of the crosswalk as recommended by MUTCD Section 3B.18 and Figure 3B-17, which is for yield lines at unsignalized midblock locations. Section 4C.06 of the MUTCD, which discusses pedestrian signals, does not discuss stop-bar placement; however, it provides the same safety benefits in this application.

Alternative 2 proposes the same improvements from Alternative 1 and realigns the signal arms to directly over the crosswalk. On new signals it is typical to locate the signal heads over the crosswalk, often on the same mast arm for both directions, to improve driver expectancy of pedestrian crossing location. This recommended concept is shown on page **C-4** in **Exhibit C**.

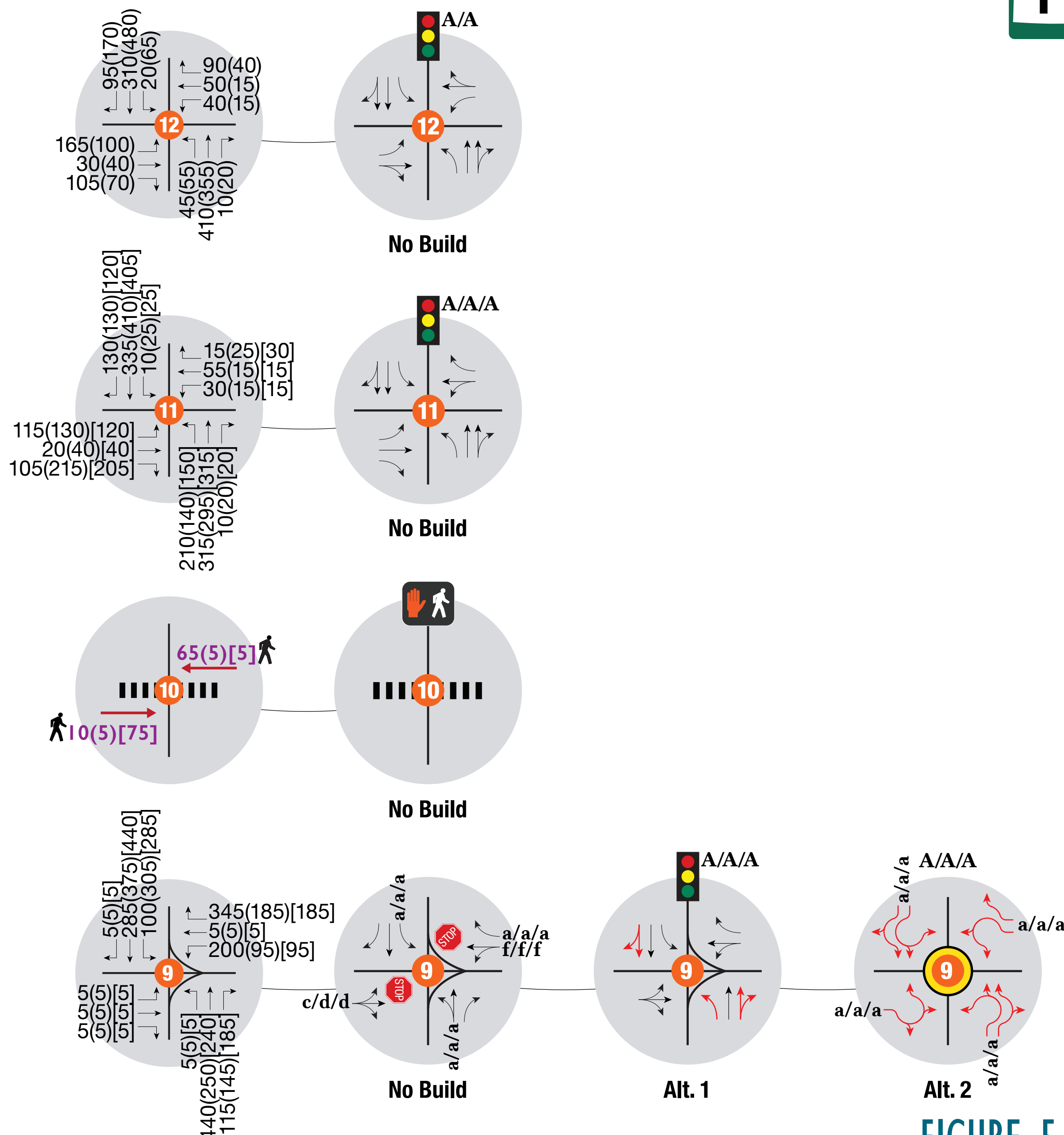
No adverse impacts to environmental resources are anticipated with the construction of these alternatives.

KEY MAP



LEGEND

XXX(XXX)[XXX] = AM(PM)[Dismissal] Peak Hour Traffic Volumes
x/x/x = AM/PM/Dismissal Peak Hour Intersection Level of Service
X = Intersection Numbers
XXX = Segment Daily Traffic Volumes
X/X = HCS Segment Level of Service (No Build)
= Stop Sign
= Traffic Signal
= Pedestrian Signal
X = Pedestrian Volumes
= Roundabout
= Lane Improvements



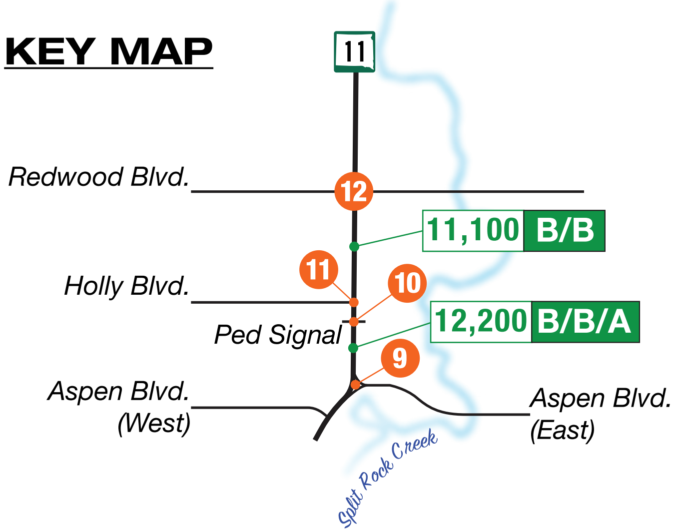
NORTH

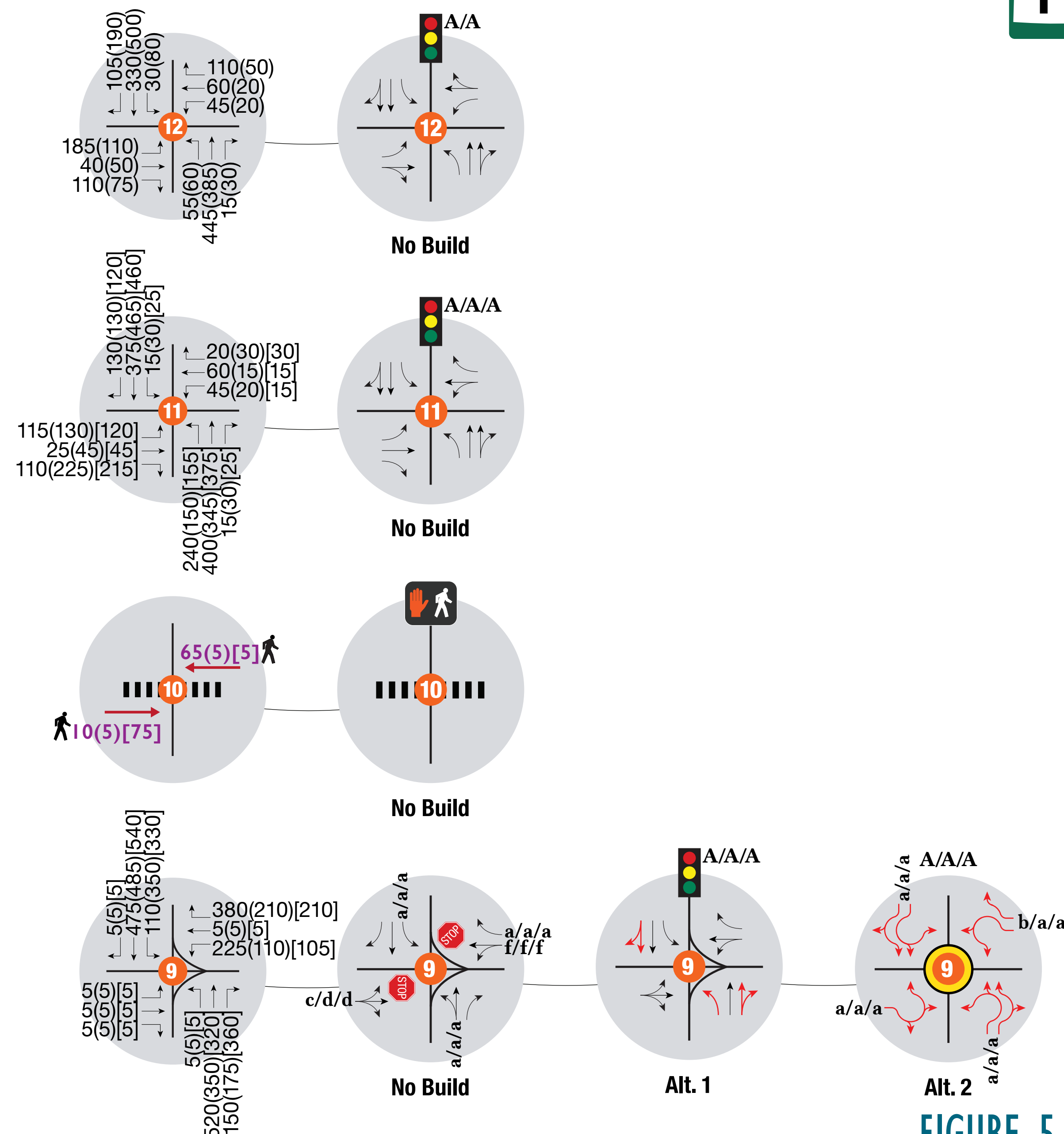
NOTE: Drawing Not to Scale

FIGURE 5-6A

Phase I (2028) North Traffic Conditions

KEY MAP





LEGEND

XXX(XXX)[XXX] = AM(PM)[Dismissal] Peak Hour Traffic Volumes

x/x/x = AM/PM/Dismissal Peak Hour Intersection Level of Service

X = Intersection Numbers

XXX = Segment Daily Traffic Volumes

X/X = HCS Segment Level of Service (No Build)

STOP = Stop Sign

= Traffic Signal

= Pedestrian Signal

X = Pedestrian Volumes

= Roundabout

= Lane Improvements

NORTH

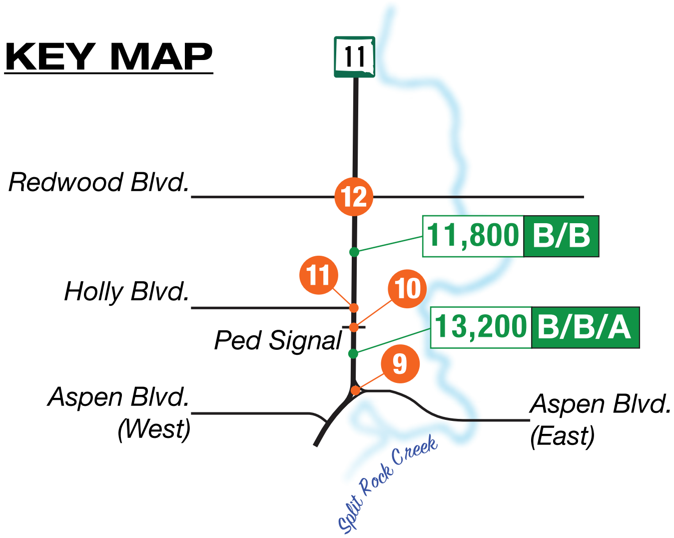
FELSBURG HOLT & ULLEVIG

NOTE: Drawing Not to Scale

FIGURE 5-6B

Phase II (2040) North Traffic Conditions

KEY MAP



LEGEND

- XXX(XXX)[XXX] = AM(PM)[Dismissal] Peak Hour Traffic Volumes
- x/x/x = AM/PM/Dismissal Peak Hour Intersection Level of Service
- X = Intersection Numbers
- XXX = Segment Daily Traffic Volumes
- X/X = HCS Segment Level of Service (No Build)
- STOP = Stop Sign
- = Traffic Signal
- = Pedestrian Signal
- X = Pedestrian Volumes
- = Roundabout
- = Lane Improvements

NORTH

NOTE: Drawing Not to Scale

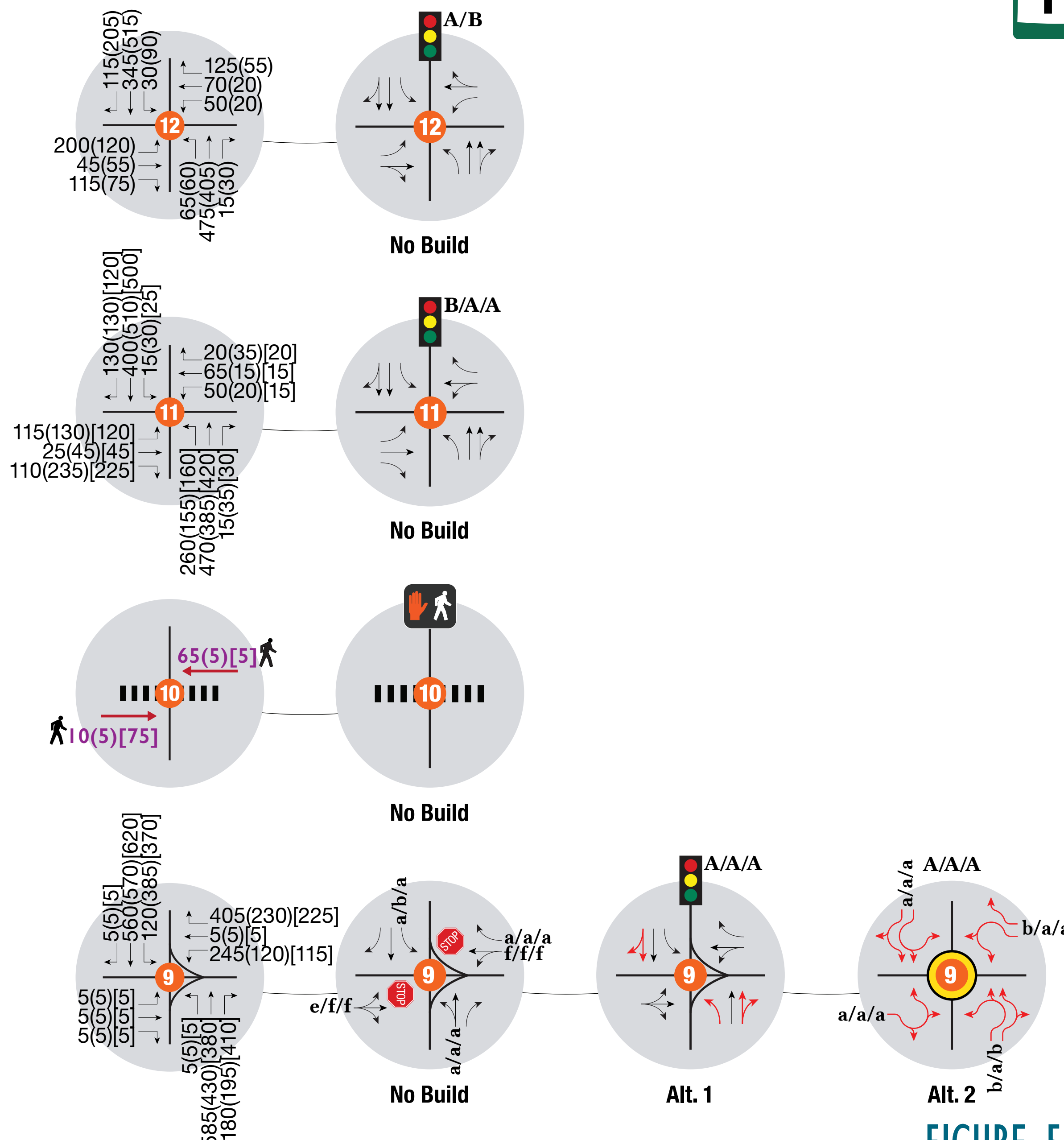


FIGURE 5-6C

Future (2050) North Traffic Conditions

5.5 CRASH PREDICTION ANALYSIS OF ALTERNATIVES

A crash prediction model was created for the proposed alternative segments and intersections. The crash reduction factors (CRF) were calibrated for area type (urban, rural, suburban, etc.) and specific geometry (cross-section, turn-lanes, etc.). The CRFs apply to all crash types and severities. CRFs are based on data from the CMF Clearinghouse and the HSM.

Almost all proposed alternatives are anticipated to reduce crashes along the study corridor, except those segments proposed to be widened from two-lanes to five-lanes. It is anticipated that crash rates along these segments will go up by 43.7 percent per year, compared with a No-Build scenario.

Table 5-6 summarizes the predicted crash rates for the segment alternatives, shows the existing lane geometry and historic average crash rate for the 5-year period, and lists the proposed alternatives with their respective CRFs and corresponding predicted crash rate. **Table 5-7** summarizes the same information for the intersection alternatives.

Table 5-6. Crash Prediction of Segment Alternatives

Segments (along SD11)		Existing Lane Geometry	Crash Rate per Year (over 5-years)	Alternative 1			Alternative 2			
				Proposed Geometry	CRF	Predicted Crash Rate	Proposed Geometry	CRF	Predicted Crash Rate	
11 - 12	Holly Blvd - Redwood Blvd	5-lanes w/ TWLTL	1.60	5-lanes w/ Partial Median	13.0%	1.39	5-lanes w/ Full Median	23.0%	1.23	
9 - 11	Aspen Blvd (East) - Holly Blvd	5-lanes w/ TWLTL	1.20	5-lanes w/ Partial Median	13.0%	1.04	5-lanes w/ Full Median	23.0%	0.92	
8 - 9	Aspen Blvd (West) - Aspen Blvd (East)	2-lanes	0.40	5-lanes	-43.7%	0.57	5-lanes	-43.7%	0.57	
7 - 8	Park St - Aspen Blvd (West)	2-lanes	2.60	3-lanes	14.3%	2.23	5-lanes	-43.7%	3.74	
6 - 7	Sioux Blvd - Park St	2-lanes	0.40	3-lanes	14.3%	0.34	5-lanes	-43.7%	0.57	
5 - 6	Madison St - Sioux Blvd	2-lanes	1.20	2-lanes	-	1.20	3-lanes	14.3%	1.03	Urban
3 - 4	265th St - 264th St	2-lanes	2.00	2-lanes	-	2.00	2-lanes	-	2.00	Rural
2 - 3	265th St - 266th St	2-lanes	1.00	2-lanes	-	1.00	2-lanes	-	1.00	
1 - 2	SD42 - 266th St	3-lanes	0.40	3-lanes	-	0.40	3-lanes	-	0.40	
Total Predicted Crashes per Year		-	10.80	-	-	10.18	-	-	11.47	

Table 5-7. Crash Prediction of Intersection Alternatives

Intersections (w/ SD11)		Existing Traf. Ctrl.	Crash Rate per Year (over 5-years)	Alternative 1			Alternative 2/3			
				Proposed Alternative	CRF	Predicted Crash Rate	Proposed Alternative	CRF	Predicted Crash Rate	
12	Redwood Blvd	Signal	2.00	-	-	2.00	-	-	2.00	
11	Holly Blvd	Signal	2.00	-	-	2.00	-	-	2.00	
10	Ped Signal	Ped. Signal	0.20	-	-	0.20	-	-	0.20	
9	Aspen Blvd (East)	TWSC	0.60	Signal	39.0%	0.37	Multi-lane Roundabout	5.0%	0.57	
8	Aspen Blvd (West)	TWSC	0.60	EB turn-lane	-	0.60	Signal	36.1%	0.38	
7	Park Street	TWSC	0.60	Signal	36.1%	0.38	-	-	0.60	
6	Sioux Blvd	TWSC	1.20	Signal	36.1%	0.77	TWSC	-	1.20	
5	Madison Street	TWSC	3.80	EB turn-lane	-	3.80	Signal	36.1%	2.43	Urban
4	264th Street	TWSC	0.80	-	-	0.80	-	-	0.80	Rural
3	265th Street	TWSC	0.20	-	-	0.20	-	-	0.20	
2	266th Street	TWSC	0.80	-	-	0.80	-	-	0.80	
1	SD 42	TWSC	4.40	Turn-lanes	-	4.40	Signal	44.0%	2.46	

6.0 ACCESS MANAGEMENT

The City of Brandon and SDDOT prepared an access plan for SD11/Splitrock Blvd in June 2003 to develop guidance to address the rapid growth in Brandon and to provide the advanced identification of access points to reduce the potential for crashes and to improve traffic flow. Considerable development and growth in traffic volumes have occurred over the 19 years since that access plan was developed. This chapter not only updates the information contained in that document but also extends recommendations through the entire study limits, from the junction with SD42 through the intersection with Redwood Blvd.

Access location criteria in South Dakota is determined by the access class of the highway. **Table 6-1** summarizes the access criteria for traffic signalization, median opening, and unsignalized access spacing. The *Sioux Falls Area Highway Access Classifications*, published in April 2002, identifies the entire section of SD11 included within the study area as Intermediate Urban. This access class is defined as a facility that serves through traffic while allowing moderate access density. Most access locations along SD11 are well established. Major intersections are well defined and serve a combination of regional and local access. Driveway locations have been provided to serve a variety of residences, schools, and businesses that have been present for several years.

Table 6-1. South Dakota Access Location Criteria

Access Class	Signal Spacing Distance (mile)	Median Opening Spacing (mile)	Minimum Unsignalized Access Spacing (feet)	Access Density	Denial of Direct Access When Other Available
Interstate	N/A	N/A	N/A	N/A	Yes
Expressway	½	½	2,640	at half-mile increments	Yes
Free Flow Urban	½	½ Full ¼ Directional	1,320	at quarter-mile increments	Yes
Intermediate Urban	½	½ Full ¼ Directional	660	at eighth-mile increments	Yes
Urban Developed	¼	¼	100	2 accesses/block face	Yes
Urban Fringe	¼	½ Full ¼ Directional	1,000	5 accesses/side/mile	Yes
Rural	N/A	N/A	1,000	5 accesses/side/mile	Yes

Chapter 17 of the *SDDOT Road Design Manual* addresses access management guidelines for all highways across the state. Sections of that chapter that are applicable to the roadway characteristics and recommended improvements along SD11 include:

- Non-traversable medians should be used as part of reconstruction in areas with ADT more than 24,000 to 28,000 vehicles per day (vpd) (TRB, page 411) and high driveway densities. The access criteria provided in the access management rules regulate median opening spacing.
- Continuous TWLTLs should be considered on roadways where numerous, closely spaced, low-volume access connections exist. Continuous TWLTLs can be used to improve traffic operations on highways carrying up to 24,000 vpd (TRB, page 410). Operating speeds for roadways being considered for TWLTLs should be between 25 and 45 mph.

- On roadways where there is an excessive number of closely spaced access connections on both sides of the roadway, directly aligning access connections on opposite sides of a roadway to create a single four-leg intersection will reduce conflicting movements and increase available storage distances. Where it is not possible to directly align driveways, sufficient positive offset distance between driveways should be provided to avoid problems with spillback and left turn head-to-head.

Table 6-2 summarizes the existing access management conditions and opportunities to manage future access by highway segment. This summary is based on maintaining the existing five-lane cross section of SD11 through Brandon, since that condition will exist until the pavement requires replacement, likely 10 to 15 years. The recommendations presented in this report should be used as the basis to identify future opportunities to incorporate access management strategies through future projects, development, and redevelopment. New access points should follow the SDDOT Access Location Criteria shown in **Table 6-1**.

Table 6-2. SD11 Access Management Summary

Highway Segment	SD11 Crossroad/Section	Access Management Considerations
SD42 to Madison Street	SD42 to 266th St. (CR 146) Segment length = 0.35 miles	• Maintain three-lane highway section with TWLTL • Maintain one commercial and six residential access points on the east side • Portage Street is the only access on the west side
	266th St. (CR 146) to 265th St. Segment length = 1.0 mile	• Maintain two-lane highway section • Maintain one field entrance and one residential access on the east side • Maintain two field entrances and four residential accesses on the west side
	265th St. to 264th St./Madison St. Segment length = 1.07 miles	• Maintain two-lane highway section • Maintain two field entrances on the east side • Maintain two field entrances and two residential accesses on the west side
Madison Street to East Aspen Boulevard	Madison St. to S. Sioux Blvd. Segment length = 0.70 miles	• Construct three-lane highway section with TWLTL • Maintain three residential accesses on the east side • Maintain one field entrance and three residential accesses on the west side • Relocate entrance to Oakridge Nursery to S. Sioux Blvd until E. Park St. is extended to SD11 • Once E. Park St. is constructed, sever the connection of S. Sioux Blvd to SD11 and reconstruct driveway access to the nursery from SD11 • Maintain residential drive across from current S. Sioux Blvd intersection
	E. Park Street Extension	• Construct E. Park Street Extension to align with north entrance to Huset's Speedway

Highway Segment	SD11 Crossroad/Section	Access Management Considerations
Madison Street to East Aspen Boulevard (continued)	S. Sioux Blvd to E. 5th St. Segment length = 1.15 miles	• Construct five-lane highway section with TWLTL • Eliminate the southernmost driveway to Huset's Speedway gravel parking • Reconstruct primary southern access to Huset's Speedway with 40-ft drive • Maintain two field entrances and two residential accesses on the east side • Maintain access to 14 residential properties on the west side • Look for opportunities to eliminate multiple access points to residential properties
	E. 5th St. to E. Aspen Blvd (west leg) Segment length = 0.28 miles	• Construct five-lane highway section with TWLTL • Maintain access to one residential property on the east side
	E. Aspen Blvd (west leg) to E. Aspen Blvd (east leg) Segment length = 0.20 miles	• Construct five-lane highway section with TWLTL • Maintain access to one residential property on the east side • Maintain access to one residential property on the west side
East Aspen Boulevard to Holly Boulevard	Beechnut Street	• Close Beechnut St. to SD11 and construct hammerhead turnaround
	Cedar Street	• Maintain full-movement access
	Cedar St. to Holly Blvd. Segment length = 0.28 miles	• Consider closing the shared driveway to the gas station and commercial strip mall on the east side • Consider closing south driveway to Brandon Valley School administration office on the east side • Maintain access drives to Brandon Valley High School • Maintain access drive to First National Bank on the west side
Holly Boulevard to Redwood Boulevard	Holly Blvd to Teakwood Dr. Segment length = 0.13 miles	• Maintain the two commercial driveways located on the west side
	Teakwood Dr. to Keystone Dr. Segment length = 0.20 miles	• Consider closing southern driveway to the Risen Savior Catholic Church
	Keystone Dr. to Redwood Blvd. Segment length = 0.17 miles	• Consider closing southern driveway to the gas station on the east side
Redwood Boulevard to Birch Street	Redwood Blvd to Birch St. Segment length = 0.13 miles	• If five-lane section with TWLTL is provided with construction of the I-90 interchange, maintain three commercial driveways on the east side and one commercial driveway on the west side

7.0 BRANDING, LANDSCAPING AND AESTHETICS

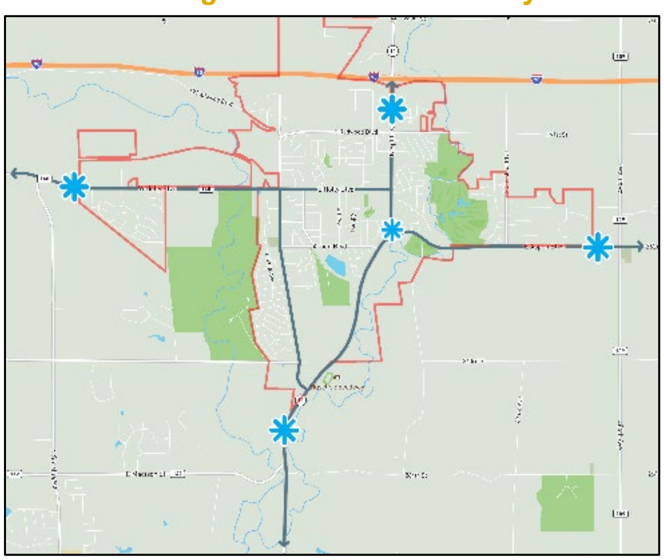
Potential improvements identified in this SD11 Corridor Study provide opportunities to integrate landscape and community branding into the streetscape through the City of Brandon. While the highway's proposed improvements are being designed with safety, vehicle capacity, and access management in mind, aesthetic treatments can also be provided. Landscape opportunities in the proposed roundabout and median concepts provide potential options for the corridor, designed with constraints, community input, and budget in mind. Landscape improvements must make the landscape as low-maintenance as possible while still providing an interesting and unique appearance, with constraints from the city of no trees and no irrigation. Within the proposed roundabout and medians are opportunities for community branding and wayfinding, in the form of signage, sculpture, or other iconic features unique to the SD11 corridor.

7.1 COMMUNITY BRANDING

Entry signs into Brandon are currently located on the north side of town on SD11, just off the I-90 exit, and on the west side of town on Holly Blvd (see photo to the right). The proposed roundabout intersection and the improvements to SD11 provide opportunities for additional community branding. Additional sign locations include south on SD11, near the intersection with Madison St, and to the east on Aspen Blvd. Along with the two existing locations, these signs would greet travelers from any direction approaching the city on these major streets as shown on **Figure 7-1**. One final location for branding could be integrated into the roundabout, whether it is signage incorporated onto a wall, into an art piece, or a community branding feature. A signage concept page is shown in **Appendix I**. This concept page illustrates three signage family ideas and examples from other cities showing materials and features.

Current Entry Signs for Brandon

Figure 7-1. Location of Existing and Potential Gateway Features



7.2 ROUNDABOUT LANDSCAPE OPTIONS

The recommendation to construct a roundabout at the intersection of SD11 and Aspen Blvd (East) provides the best opportunity to incorporate landscape and aesthetic features into the roadway improvements. These features can be developed to complement the gateway branding elements previously discussed. To illustrate variety of options available for aesthetic treatments to the roundabout, each of the three lane configuration options for the segment of SD11 north of Aspen Blvd contains a different version of how the roundabout could be landscaped.

7.3 SPLITROCK BLVD (SD11) FROM EAST ASPEN BLVD TO REDWOOD BLVD

This section describes potential landscape and signage features for the following options for the north segment of this corridor study. **Appendix I** includes the concept boards for each roadway and roundabout option with additional examples and layouts.

Five-Lane Option

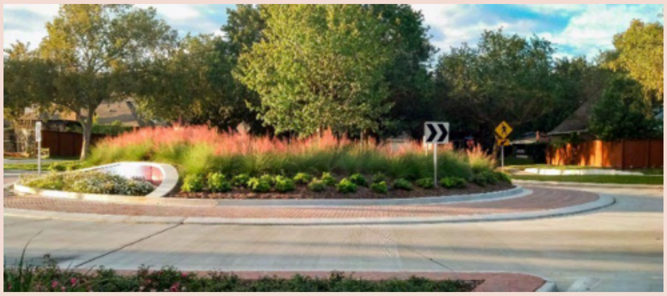
The five-lane alternative previously discussed consists of two lanes in both directions and a center turn lane, exactly as the road exists today. This improvement concept limits landscape opportunities to the central median in the proposed roundabout at the intersection with Aspen Blvd (East). The roundabout concept creates a center circle of landscaping opportunity with the road apron surrounding to fill the outer edges of the irregular shape of the median. In the center of the circle, there would be an opportunity to construct a continuous low wall, similar to the Aspen Park sign shown to the right. This wall could have metal lettering mounted on it to provide wayfinding or as a welcome gateway into the city. Inside the curve of the wall the ground level would be raised to provide area for plantings, and in the center of the landscape circle is space for an iconic feature, whether it is a sculpture, monument, or other installation piece that serves as an icon for Brandon.

A wall design similar to the Aspen Park sign could be incorporated into the roundabout.

Partial Median Option

The partial median option for this segment of Splitrock Blvd (SD11) includes a corridor with a few raised medians at major road intersections and a two-way center turn lane between the medians. In this option, the medians would have alternating stripes of plantings and pavement. In the planting areas are stone walls with stepped levels from low to high. On top of the largest of these walls in the medians could be placed a large planter that could be planted with annuals or decorated with the seasons.

The central median of the roundabout could contain areas of native grass plantings around the main feature wall. In the same style as the median walls, this angled feature wall steps up from low on the ends to high in the center, where a large planter could be placed as the photo below demonstrates. Lettering could be mounted on the face or top of the wall as needed as shown below. The landscape on the inside angle of the wall would slope upward, toward the top of the wall, to provide additional height to the landscape.



Optional roundabout central island plantings

Signage options for the roundabout median

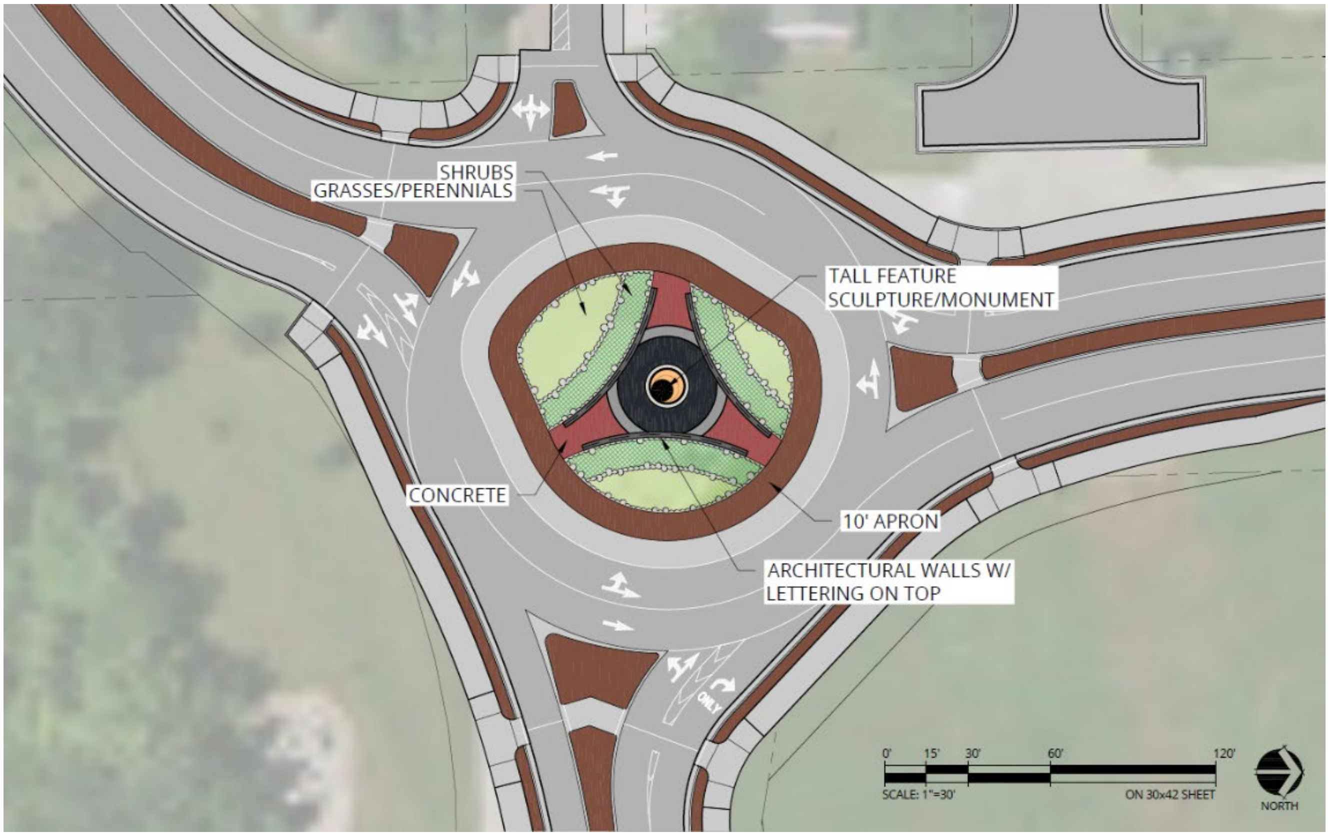
Full Median Option

The final option identified for this northern segment of the SD11 corridor would provide full medians through town with left turn lanes provided at major intersections. This option provides the most opportunities for landscape and iconic features. This concept shown to the right demonstrates the median landscape as swooping round shapes of alternating bands of colored concrete and planting areas. In the centers of the medians are proposed two low curved walls, which could feature interesting color or texture. A sculptural piece could be placed in the curve of these walls or integrated into them.

Landscaping concepts for the full median option through Brandon

For the roundabout in this concept shown in **Figure 7-7**, the center island contains three curved walls that could have lettering mounted to the top, welcoming drivers into Brandon. In front of the walls are areas for plantings, while in the center of the walls is a paved area with a central featured sculpture; something that could be a large iconic feature for the city.

Figure 7-2. Optional Roundabout Landscaping Concept



8.0 RECOMMENDATIONS

Recommended improvements to the SD11 Corridor incorporate a combination of the technical reviews of traffic, safety, access management, potential for adjacent property impacts, and input received through public and agency engagement completed throughout the study. As the corridor operating needs and physical condition vary throughout the length of the corridor, recommendations have been organized by segment as previously identified in this study.

8.1 SD11 SOUTH SEGMENT – SD42 TO SIOUX BOULEVARD

This segment of SD11 extends from the intersection with SD42 north, to just south of the intersection with Sioux Blvd. This segment includes the bridge over Split Rock Creek and the intersection with Madison St.

8.1.1 South Dakota 42 Junction

Recommended improvements for this intersection and the SD42 corridor were developed as part of an earlier South Dakota 42 Corridor Study covering the area from Six-Mile Road to the Iowa State Line. Improvements recommended from that study have been advanced through project development and are identified in the Statewide Transportation Improvement Program (STIP) for construction in 2025–2026. The following recommended improvements to the intersection area have been incorporated into the segment recommendations for SD11 north of the intersection:

- Widen SD42 to a four-lane divided section with a raised median
- Provide separate left turn lanes on the SD42 east and west approaches
- Reconstruct the north leg of the intersection on SD11 to provide separate southbound right and left turn lanes and one southbound through lane
- Reconstruct the south leg of the intersection on CR115 to provide a northbound left turn lane and a shared northbound through and right turn lane
- Install a traffic signal
- Construct a 10-foot multi-use trail on the north side of SD42

8.1.2 SD11 – SD42 to Split Rock Creek Bridge

The existing three-lane section on SD11 with a center TWLTL from SD42 through the intersection with 266th St (CR 146) would remain to accommodate turning traffic into rural residential properties and the intersections with Portage St and 266th St (CR 146). North of 266th St, the current two-lane section is anticipated to accommodate forecasted traffic through the 2050 horizon year. The section also meets current design guidelines for a rural highway section with a posted speed limit of 55 mph.

8.1.3 Split Rock Creek Bridge

The bridge over Split Rock Creek currently provides two-lanes and 2-foot surfaced shoulders. The most recent bridge inspection report indicates that the deck condition of the bridge is Satisfactory, the superstructure condition is Fair, and the substructure condition is Good. Comments received during the public meeting expressed the desire to provide full width shoulders to better accommodate wide farm implements traversing the bridge. Since the structural condition of the bridge is still sufficient, the recommended action to address the identified functional obsolescence is to expand the current 2-foot shoulders to 10 feet at the time the bridge has achieved its useful life, which will likely be beyond 2040. Scour has been identified as a concern for this bridge. There will be ongoing maintenance and repair activity to mitigate the impact caused by scour.

8.1.4 SD11 – Split Rock Creek Bridge to Madison Street

The existing cross-section consisting of two-lanes with 8-foot surfaced shoulders is adequate to accommodate the anticipated traffic volumes and speeds. No further improvements are recommended for this segment.

8.1.5 Madison Street Intersection

Geometric improvements to the intersection area focus on the Madison St approach from the west to SD11. The recommended improvements include widening the approach to provide separate eastbound right and left turn lanes from Madison St to SD11. The widening would begin at the east side of the approach to the bridge over the Big Sioux River. Additionally, the current intersection control of a stop sign on Madison St is recommended to be converted to traffic signal control when the warrants are met, which is anticipated to occur around 2028 based on forecasted traffic growth. It is recommended that the widening of Madison St and the installation of the traffic signal be implemented concurrently. No improvements are anticipated for the SD11 approaches to the intersection. A northbound left turn lane and a southbound right turn lane are currently provided. North of Madison St, SD11 will transition into the three-lane section described below.

8.1.6 SD11 – Madison Street to Sioux Boulevard

The segment of SD11 between Madison St and Sioux Blvd represents a transition between the two-lane rural highway section to the south and the five-lane urban section recommended to the north of S. Sioux Blvd. The *SDDOT Development Plan* currently indicates that the pavement on this segment of SD11 is programed for reconstruction in 2028. Since the distance of this segment is only 0.7 miles in length, the recommendation is to provide a three-lane section that begins south of the Madison St intersection and extends to just south of Sioux Blvd, where it will transition into the recommended five-lane section to the north. Construction of a three-lane section for this segment of SD11 will provide better lane continuity and eliminate the need to provide additional roadway tapers between Madison St and Sioux Blvd. In addition, there are several residential and farm access points along this segment, plus the historical marker area for the Eminija Mounds. Construction of a center TWLTL along this segment provides additional benefits for accessing these adjacent properties. It is recommended that a three-lane cross-section with a center turn lane and 8-foot surfaced shoulders be constructed on this segment.

A 10-foot multi-use trail is proposed for construction on the west side of SD11. This trail will provide an off-road option for cyclists currently using the shoulder along this segment. Future trail plans call for a multi-use trail along the north side of Madison St, heading west into the Sioux Falls area.

8.2 SD11 MIDDLE SEGMENT – SIOUX BLVD TO ASPEN BLVD (WEST)

The combination of traffic growth and the need to accommodate safe access to adjacent properties influences the recommendation to widen the SD11 section to a five-lane section consisting of two through lanes in each direction and a center TWLTL. The construction of a 10-foot multi-use trail on the west side of SD11 is also recommended for this entire segment.

8.2.1 SD11 – Sioux Blvd to Aspen Blvd (West)

Recommended improvements to SD11 through this section consist of widening the highway to a five-lane urban section, including two through lanes in each direction and a center TWLTL. The turn lane provides the capacity enhancement needed to maintain acceptable operations and improves safety by removing left turning vehicles from the through traffic stream. Throughout the segment, key improvement recommendations include:

- Driveway consolidation: During future design phases, it is recommended that locations where residential or other uses have multiple access points onto SD11 be discussed with property owners regarding the opportunity to consolidate drives. Eliminating duplicate function driveways creates opportunities to increase distances between access points, which reduces the potential for conflicts in the center TWLTL and with slow moving right turn vehicles.
- As need determines through future design phases, construct a retaining wall between SD11 and Split Rock Creek to reduce the potential for erosion of the shoulder and undercutting the roadway.
- Construction of a retaining wall will likely be required at the structure over the Ellis & Eastern Railroad to accommodate the highway widening and the construction of the multi-use trail on the west side of SD11.

8.2.2 Sioux Boulevard Intersection and Park Street Extension

Parcels immediately adjacent to Sioux Blvd and SD11 have been the focus of commercial development proposals that would influence the traffic volume forecasts and recommendations along this segment of the highway. The *Maple Street / Park Street Corridor Study*, completed in July 2019, recommended the following improvements:

- Extend Park St from its current intersection with Sioux Blvd easterly to intersect with SD11 approximately 1,800 feet north of Sioux Blvd, which lines up with the current north access to Huset's Speedway.
- Construct Park St as a three-lane section, with the approach to SD11 configured as a shared through-right lane and a left turn lane.
- Signalize the SD11 and Park St intersection when warrants are met.
- Eliminate the current Sioux Blvd segment between the service entrance to Oakridge Nursery and Landscaping and SD11. A turnaround to accommodate emergency access vehicles would be provided east of the service entrance.

Extending Park St to intersect with SD11 impacts traffic volumes and travel patterns along the SD11 mainline. Pavement conditions through the segment anticipate reconstruction of SD11 beginning in 2028. An implementation timetable for the commercial area included in the Park St area development plan and traffic analysis has not been established.

Since the extension of Park St may not occur before the reconstruction of SD11, it may be necessary to develop a phased implementation plan. There are two scenarios for improvements to the SD11 corridor along this segment:

- Scenario #1: No development north of Sioux Blvd on the west side of SD11 and no extension of Park St.
- Scenario #2: Development adjacent to SD11 occurs, and the Park St extension is constructed.

Implementation Scenario #1

If the extension of Park Street is not completed or under construction at the time of the proposed widening of SD11 to a five-lane urban section, it will be necessary to maintain the connection of Sioux Blvd with the highway. Under this condition, it is recommended that the access to Oakridge Nursery and Landscaping be closed at its current location approximately 140 feet south of the intersection with Sioux Blvd. A new access is recommended on Sioux Blvd approximately 270 feet west of the intersection with SD11. This location will provide direct access to the retail portion of the business and be set back far enough to minimize conflicts with southbound queues extending from the intersection with SD11.

Scenario #1 would be considered an interim condition until the Park St connection is constructed and the connection of Sioux Blvd to SD11 is eliminated. If property owners desire, this access point could also be developed to be a permanent driveway with the elimination of the connection to SD11 occurring to the east of this location.

Implementation Scenario #2

If the Park St extension is constructed or under construction by 2028, the recommendation identified in the *Maple Street / Park Street Corridor Study* to eliminate the connection of Sioux Blvd should be followed. The study recommended that a cul-de-sac be constructed just past the delivery driveway for the Oakridge Nursery and Landscaping business. As discussed above, there may be some value in having Sioux Blvd continue to a new driveway located to the front of the business and truncated at that point. There may also be an additional benefit to provide an access to the proposed commercial development on the north side of Sioux Blvd at that location.

Eliminating the Sioux Blvd intersection with SD11 would allow the opportunity to maintain the highway access for the Oakridge Nursery and Landscaping business. The driveway to the business and the adjacent home would be the only two driveways on the west side of SD11 for a distance of approximately one mile. During the design phase of the SD11 widening, alternative driveway configurations should be fully evaluated. The commercial driveway could remain in its current location, or even moved north to line up with the residential driveway located on the east side of the highway. This would also provide additional distance from the residential driveway to the south of the nursery.

There may also be an opportunity to eliminate the southernmost driveway to the rock parking lot for Huset’s Speedway and provide a 40-foot access drive at the paved entrance to the speedway.

8.2.3 Trail Connections to Aspen Park

The Aspen Park Master Plan includes the concept of constructing two pedestrian trails to provide access from the park to the SD11 corridor. These trail connections, which would be built on existing public ROW between some of the residential properties, would tie into the proposed 10-foot multi-use trail to be constructed on the west side of SD11 when it is widened to a five-lane roadway section.

8.2.4 Aspen Blvd (West) Intersection

The analysis indicated that it is necessary to widen and restripe the Aspen Blvd (West) approach to SD11 to include a left and right turn lane from 8th Avenue to the highway. Widening by approximately 6 feet is proposed to be split between the north and south sides to reduce the potential for impacts to adjacent properties.

The operational analysis of future conditions indicated that traffic signal warrants will not be met by 2028 at the time of reconstruction of SD11. Careful consideration should be given to the traffic control required with the widening of Aspen Blvd (West) to provide a two-lane approach to the highway. Previous studies have shown a potential for restricted right turn sight distance when left turn vehicles are present on the approach. During the design phase of SD11 widening, the following implementation scenarios should be considered:

- Delay the widening of Aspen Blvd (West) until traffic signal warrants are met.
- Construct the widening of Aspen Blvd (West) with the SD11 improvements and operate the multi-lane approach under stop sign control. Install conduits and pull boxes for future traffic signal system.
- Construct the widening of Aspen Blvd (West) with the SD11 improvements and stripe out the left turn lane until traffic signal warrants are met.

8.2.5 SD11 – Aspen Blvd (West) to Aspen Blvd (East)

The recommendation is to continue the five-lane urban section with a TWLTL on SD11 north from Aspen Blvd (West) to the Aspen Blvd (East) intersection. The multi-use trail would continue on the west side of the highway.

8.3 SD11 NORTH SEGMENT – ASPEN BLVD (EAST) TO REDWOOD BLVD

The traffic operations analysis for this segment of SD11 indicated that the existing five-lane section would provide acceptable traffic operations beyond the analysis year of 2050. However, with the need to maintain two-lanes in each direction and separate left turn lanes, three options were identified for consideration.

1. Maintain existing five-lane undivided section
2. Construct raised medians on SD11 approaches to major intersections
3. Construct raised medians on entire segment of SD11, providing full movement access at key intersections

Construction would occur when the pavement on this segment of SD11 is ready for replacement. Currently, it’s anticipated that this would occur sometime after 2030. The construction of a 10-foot multi-use trail on the west side of SD11 is also recommended for this entire segment.

8.3.1 Aspen Blvd Intersection

Based on the analysis of this intersection with SD11, the construction of a multi-lane roundabout is the recommended improvement. The five-lane urban section from the north will allow two northbound and two southbound lanes through the roundabout. Splitter islands will be provided on each approach to the roundabout. On the north leg of SD11, the splitter island should be extended approximately 200 feet to would allow full movement access to the residential property on the west side of SD11, just south of Cedar St. The connection to Beechnut St should be closed due to the proximity to the roundabout. A hammerhead turnaround should be constructed at the east end of Beechnut St, west of the last residential driveway.

The Aspen Blvd (East) approach to the intersection will need to be widened to provide for the construction of the splitter island and to provide a two-lane approach to the roundabout. The outside lane would be a right turn only lane, and the inside lane would be a shared through/left turn lane.

Pedestrian crossings should be provided on each leg of the intersection. The 10-foot multi-use trail will continue on the west side of SD11. A sidewalk should be provided on both sides of Aspen Blvd. On the south side, the sidewalk should continue to the parking area, and on the north side, it should continue to tie into the existing sidewalk to the east.

8.3.2 SD11 Segment –Aspen Blvd to Redwood Blvd

Since the operational and safety analysis indicated that the current five-lane cross section provides acceptable traffic operations through the 2050 analysis horizon, it is recommended that the decision with regard to constructing medians on this segment of SD11 be fully evaluated during the next phase of project development. Conditions may change over time that would influence the selection of the desired cross-section. Maintaining the five-lane undivided section at this time is recommended over the full or partial median section for the following reasons:

- Current and forecasted/predicted future crash assessment associated with the center TWLTL do not show a need to replace the center TWLTL to reduce conflicts. Demonstrating crash conditions that could be mitigated with a median is a critical determinant for supporting the need to convert a five-lane corridor to a median divided corridor.
- Construction of the partial median alternative results in a series of discontinuous islands, requiring intermittent widening and narrowing of the width of the roadway while increasing maintenance costs. The partial median option would restrict movements at access points adjacent to the major intersections at Holly Blvd and Redwood Blvd. However, currently there would be little operational or crash mitigation benefit.
- Adding the full median alternative requires widening the corridor to accommodate the preferred median width of 16 feet for the entire length of this segment of SD11. While there would be a benefit in providing access management and reduction of conflict points along the corridor, the analysis of historical operations indicates that the benefit returned for the added impact and expense is minimal.
- The SDDOT *Road Design Manual*, in the Access Management chapter, states that non-traversable medians should be used as part of reconstruction in areas with ADT more than 24,000 to 28,000 vpd and high driveway densities. The 2050 forecast traffic volumes for this urban segment of SD11 are projected to range from 13,200 vpd south of Holly Blvd and 11,800 vpd north of Holly Blvd.

As this segment of the corridor carries the most traffic, has a higher number of private access points between public intersections, and will not likely be reconstructed for more than 10 to 15 years, it is prudent to incorporate into recommendations updates of the crash assessment and traffic operations analysis in future design phases. During future design phases of the project, if crash and/or operations analyses demonstrate the need for a median, current recommendations should be reconsidered.

8.3.3 Pedestrian and Bicycle Accommodations

Along this segment of the SD11 corridor, 6-foot sidewalks are present on the east side of the roadway. On the west side, the width of the sidewalk varies from 6-foot to 8-foot between Aspen Blvd and Teakwood St. From Teakwood St to the intersection of Redwood Blvd, no sidewalk is provided. With the delayed timing of the reconstruction of the SD11 mainline, consideration should be given to construction of this segment to provide continuity of pedestrian facilities in the near future instead of waiting for reconstruction of the roadway. At the time of full reconstruction, the recommendation is to provide a 10-foot multi-use trail for pedestrians and bicyclists on both the east and west sides of the roadway.

8.3.4 Signalized Pedestrian Crossing at Brandon Valley High School

Minor modifications are recommended at the signalized pedestrian crossing at Brandon Valley High School:

- Relocate stop bars between 20 and 25 feet from the crosswalk, increasing the separation between stopped vehicles and pedestrians crossing the roadway. Providing additional distance helps avoid pedestrians being shadowed by adjacent stopped vehicles. This modification can be implemented when roadway striping is refreshed.
- Relocate signals to be closer to the pedestrian crossing corridor, preferably directly over the crosswalk. At that time, stop bars should be relocated further from the crosswalk, providing approximately 40 feet separation, which will increase the visibility the combination of pedestrians using the crosswalk and the signals. It is recommended that this modification be implemented when the roadway is reconstructed.

8.3.5 Private Access Consolidation

Through future design phases, additional analysis and outreach focusing on identifying private access locations that can be eliminated and/or consolidated through the commercial corridor of this segment are recommended. Each access location must be evaluated independently, and access management assessment must account for all of the functions (customer access, deliveries, etc.) required of each driveway. Refer to **Table 6-2**, **SD11 Access Management Summary**, for a summary of access conditions along the corridor.

8.4 CRASH PREDICTION OF RECOMMENDED ALTERNATIVE

Predicted crash rates for an existing (No-Build) scenario can be compared to the proposed (Buildout) scenario based on the recommendations for the SD11 study segments and intersections. Under a No-Build scenario, it is anticipated that an average of 27.8 crashes would occur along the study corridor annually. Under the same base assumption for traffic volumes, but changing the traffic control, lane arrangement, and segment cross-sections to the recommended improvements, it is anticipated that crashes would be reduced to 20.6 crashes per year, a 26.0 percent reduction in total crashes. **Table 8-1** summarizes the results of this No-Build versus Buildout crash prediction model.

Table 8-1 Predicted Crashes (per Year) of No-Build vs. Proposed Alternative

Intersections & Segments (on SD11)		No Build			Proposed			
		Traf. Ctrl. / Geometry	CRF	Predicted Crashes per Year	Traf. Ctrl. / Geometry	CRF	Predicted Crashes per Year	
12	Redwood Blvd	Signal	-	2.00	Signal	-	2.00	
11 - 12	Holly Blvd - Redwood Blvd	5-lanes w/ TWLTL	-	1.60	5-lanes w/ TWLTL	-	1.60	
11	Holly Blvd	Signal	-	2.00	Signal	-	2.00	
9 - 11	Aspen Blvd (East) - Holly Blvd	5-lanes w/ TWLTL	-	1.20	5-lanes w/ TWLTL	-	1.20	
9	Aspen Blvd (East)	TWSC	-	0.60	Multi-lane Roundabout	5.0%	0.57	
8 - 9	Aspen Blvd (West) - Aspen Blvd (East)	2-lanes	-	0.40	5-lanes	-43.7%	0.57	
8	Aspen Blvd (West)	TWSC	-	0.60	Signal	36.1%	0.38	
7 - 8	Park St - Aspen Blvd (West)	2-lanes	-	2.60	5-lanes	-43.7%	3.74	
7	Park Street	TWSC	-	0.60	Signal	36.1%	0.38	
6 - 7	Sioux Blvd - Park St	2-lanes	-	0.40	5-lanes	-43.7%	0.57	
6	Sioux Blvd	TWSC	-	1.20	TWSC	-	1.20	
5 - 6	Madison St - Sioux Blvd	2-lanes	-	1.20	3-lanes	14.3%	1.03	
5	Madison Street	TWSC	-	3.80	Signal	44.0%	2.13	Urban
4	264th Street	TWSC	-	0.80	TWSC	-	0.80	Rural
3 - 4	265th St - 264th St	2-lanes	-	2.00	2-lanes	-	2.00	
3	265th Street	TWSC	-	0.20	TWSC	-	0.20	
2 - 3	265th St - 266th St	2-lanes	-	1.00	2-lanes	-	1.00	
2	266th Street	TWSC	-	0.80	TWSC	-	0.80	
1 - 2	SD42 - 266th St	3-lanes	-	0.40	3-lanes	-	0.40	
1	SD 42	TWSC	-	4.40	Signal	44.0%	2.46	
Total Predicted Crashes per Year		-	-	27.80	-	26.0%	20.58	

8.5 PROBABLE CONSTRUCTION COSTS

A determination of probable construction costs has been developed for the recommendations discussed in the previous section. **Table 8-2** identifies the project location, description, probable construction costs and the total project costs, which include engineering design, construction engineering and anticipated ROW costs. Summaries of the quantity and probable construction costs are shown in **Appendix J**.

For purposes of this estimate, the Madison St intersection improvements have been separated from the SD11 mainline improvements. Due to the timing of these projects, it is likely that they will be incorporated into the same design and construction package.

Table 8-2 Probable Construction Costs

Location	Improvement Description	Probable Construction and ROW Costs	Total Project Costs
Madison Street Intersection	Widen the Madison Street approach to SD11 to provide separate left and right turn lanes. Install traffic signal.	$1,300,000	$1,682,000
Madison Street to Sioux Blvd	Reconstruct SD11 pavement between Madison Street and Sioux Blvd to provide a 3-lane section. Construct 10' multi-use trail on the west side of SD11 between Madison Street and Sioux Blvd.	$8,300,000	$10,682,000
Sioux Blvd to Aspen Blvd (East)	Widen SD11 to a 5-lane undivided section from south of Sioux Blvd to the intersection with Aspen Blvd (East). Construct 10' multi-use trail on the west side of SD11 between Sioux Blvd and Aspen Blvd.	$33,200,000	$43,103,000
Aspen Blvd Roundabout	Construct a multi-lane roundabout at the intersection of Aspen Blvd and SD11. Construct sidewalks and multi-use trails through the intersection.	$9,400,000	$12,085,000
Aspen Boulevard to Redwood Boulevard			
5-Lane Option	Reconstruct pavement to provide a 5-lane undivided section.	$24,300,000	$28,626,000
Partial Median Option	Reconstruct pavement to provide a 5-lane undivided section with raised medians for the intersections with Rushmore Drive, Holly Blvd and Redwood Blvd.	$26,300,000	$34,131,000
Full Median Option	Reconstruct pavement to provide a four-lane divided section with a raised median from Aspen Blvd to Redwood Blvd, with median breaks at key intersections.	$28,700,000	$37,286,000

For the intersection of SD11 with Aspen Blvd (East), an estimate of probable construction costs was also developed for the traffic signal alternative. The SDDOT requires that the local jurisdiction pay for the cost difference between the preferred roundabout alternative and a traditional intersection with a traffic signal. Since the traffic signal option would require realignment of approximately 600 feet of SD11 south of the intersection, the quantities and cost estimate used the same beginning point for comparison purposes. The probable construction cost for the traffic signal alternative was estimated at $7.7 million, compared to the roundabout alternative estimate of $8.4 million. **Appendix J** contains the conceptual level opinion of probable costs for each intersection alternative.

9.0 IMPLEMENTATION PLAN

The implementation plan associated with the recommended improvements discussed in **Chapter 8.0** identifies the projects anticipated for construction along the study corridor, along with the timing of construction. **Figure 9-1** illustrates the three projects within the corridor limits that are either part of the 2022–2025 STIP or part of the SDDOT Developmental Program.

9.1 I-90/EXIT 406 INTERCHANGE IMPROVEMENTS

The first project within the study corridor limits will be the construction of a diverging diamond interchange at the junction of SD11 and I-90. This interchange project will also include reconstruction of a portion of SD11 from the interchange south to the intersection with Ash St. This project is currently programmed for construction in 2023–2024

9.2 HIGHWAY SD42 IMPROVEMENTS

The widening of Highway SD42 on the south end of the study corridor is currently programmed for construction in 2025–2026 in the current STIP. SD42 will be widened to a four-lane divided section but will also include the SD11 approaches to the intersection. The SD11 approach to the intersection will be widened to provide separate left, through and right turn lanes. Traffic signals will also be installed with the project.

9.3 SD11 – MADISON STREET TO ASPEN BOULEVARD (EAST)

The driving force behind this study of the SD11 corridor is the pavement condition of the highway, from Madison St to the northern Aspen Blvd (East) intersection. The recommendations include widening SD11 to three-lanes between Madison St and Sioux Blvd, and five-lanes from Sioux Blvd to Aspen Blvd (East). This pavement reconstruction project is currently in the *SDDOT Developmental Plan*, anticipated for construction in 2028–2030.

In addition to the mainline improvements, additional improvements are recommended on Madison St, on the southern Aspen Blvd (West) approach to the highway, and at the northern intersection with Aspen Blvd (East).

9.3.1 Madison Street

The operational analysis conducted at the intersection of Madison St with SD11 indicated that the widening of Madison St to provide separate right and left turn lanes and the installation of a traffic signal would be required by the Year 2028. It is recommended that this project be incorporated into the mainline pavement reconstruction project.

9.3.2 Park Street Extension

The extension of Park St from Sioux Blvd to SD11 is independent of the projects anticipated on the SD11 corridor. At this time, the funding for this extension has not been identified. If it is constructed prior to 2028 or is under construction concurrently with the SD11 mainline improvements, the connection with Sioux Blvd will be eliminated. If the construction of the extension is after the SD11 mainline improvements are complete, the connection of Sioux Blvd must remain in place.

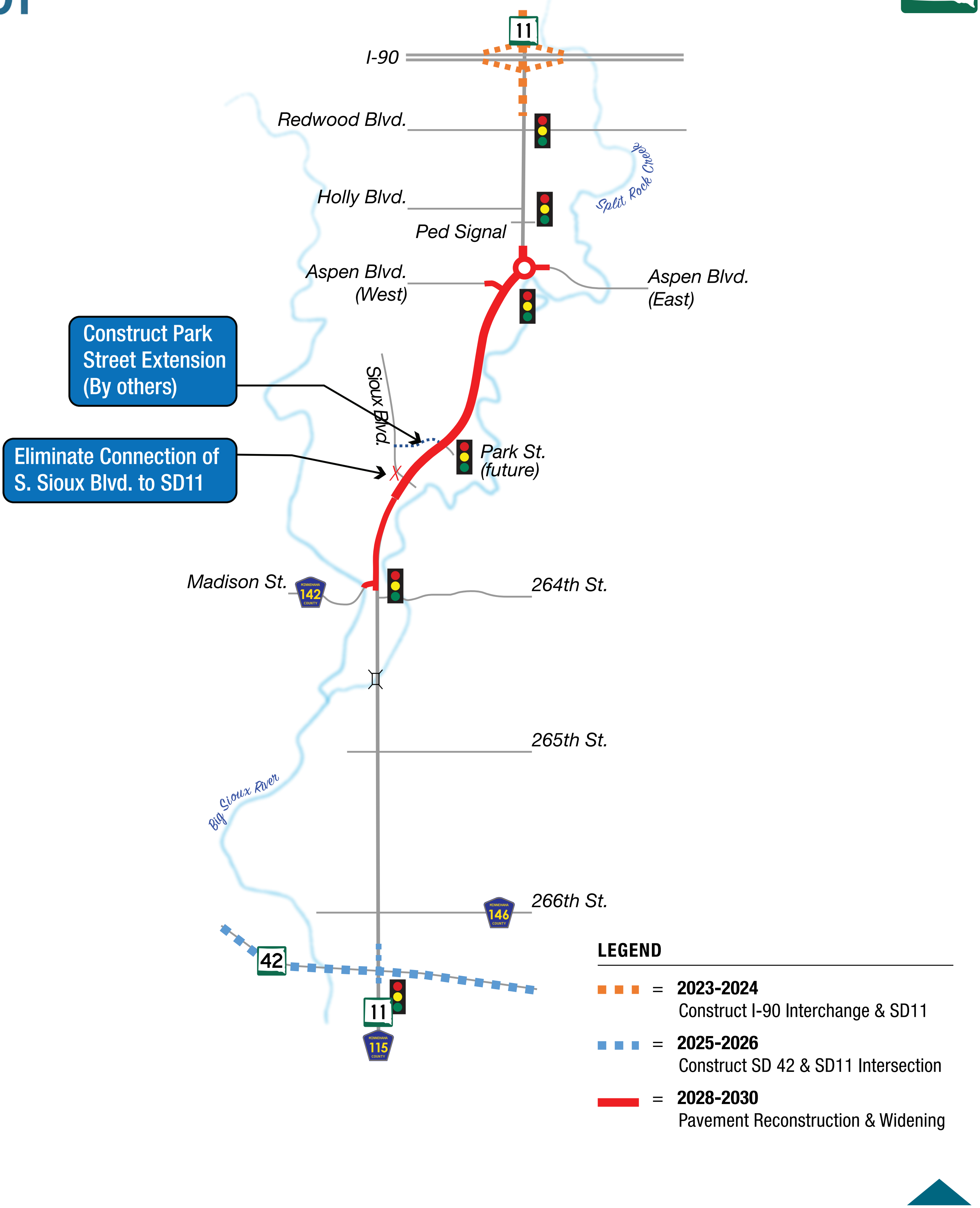
9.3.3 Aspen Blvd (West)

Improvements to the west leg of the Aspen Blvd (West) intersection with SD11 and the installation of a traffic signal were identified to provide acceptable traffic operations at this intersection. However, the analysis indicated that the traffic signal warrant would not be met by the 2028 construction on SD11. With that in mind, during the design phase of the SD11 widening, the following options should be considered:

- Delay the widening of Aspen Blvd until traffic signal warrants are met.
- Construct the widening of Aspen Blvd with the SD11 improvements and operate the multi-lane approach under stop sign control.
- Construct the widening of Aspen Blvd with the SD11 improvements and stripe out the left turn lane until traffic signal warrants are met.
- If the traffic signal is not constructed with the SD11 improvements, install conduits and pull boxes for future use.

9.3.4 Aspen Blvd (East)

Improvements at the northern intersection of Aspen Blvd (East) will be required by 2028 and should be incorporated into the pavement reconstruction project to the south. Construction of the roundabout will also require some improvements on the Aspen Blvd (East) approach and on the north leg of SD11.



NOTE: Drawing Not to Scale

FIGURE 9-1
Implementation Summary

EXHIBITS

Exhibit A. South Section Proposed Improvements

SOUTH SECTION
SD 42 TO S SIOUX BLVD

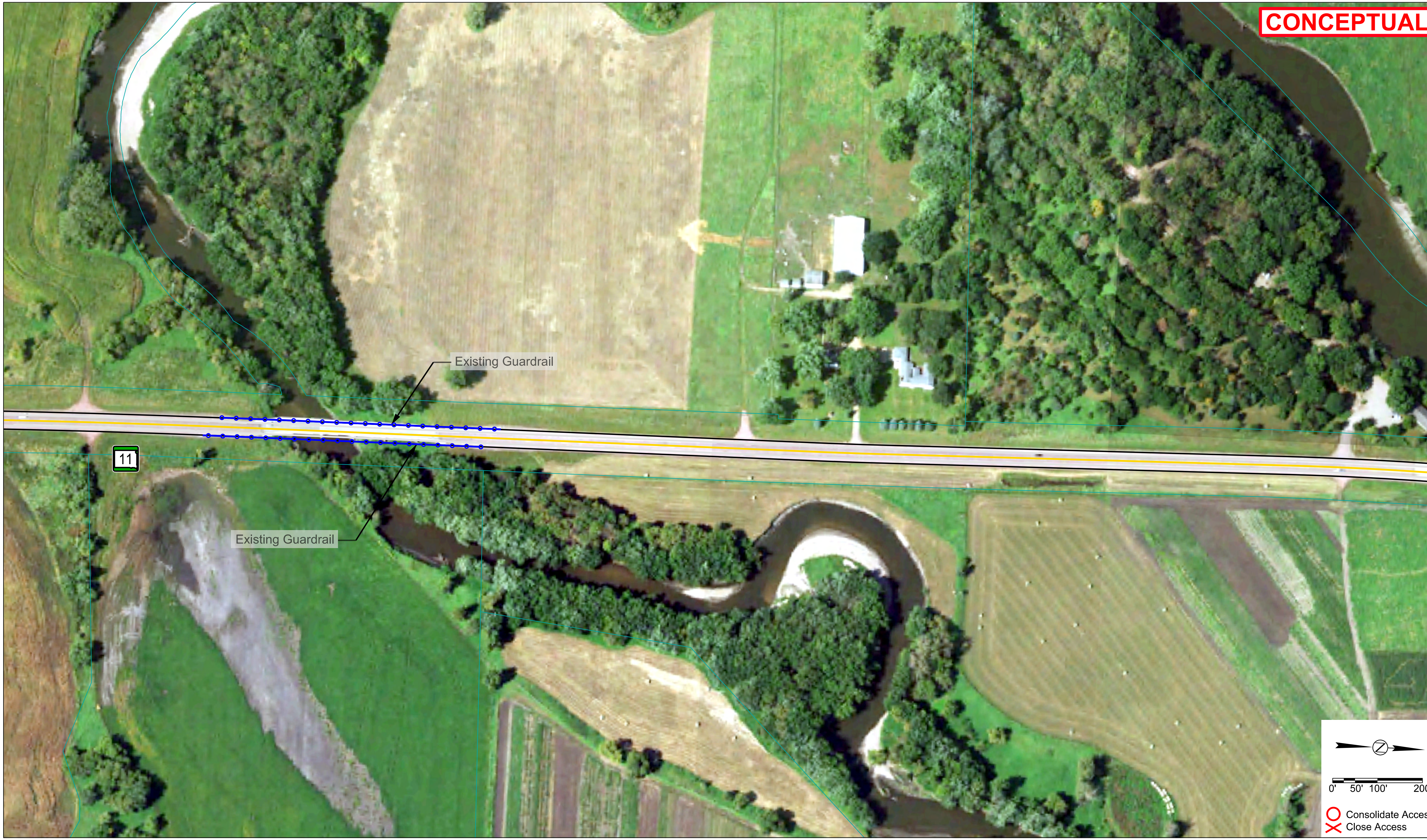
SOUTH DAKOTA 11 CORRIDOR STUDY

SOUTH SECTION
SD 42 TO S SIOUX BLVD

SOUTH DAKOTA 11 CORRIDOR STUDY

SOUTH DAKOTA 11 CORRIDOR STUDY

SOUTH SECTION
SD 42 TO S SIOUX BLVD

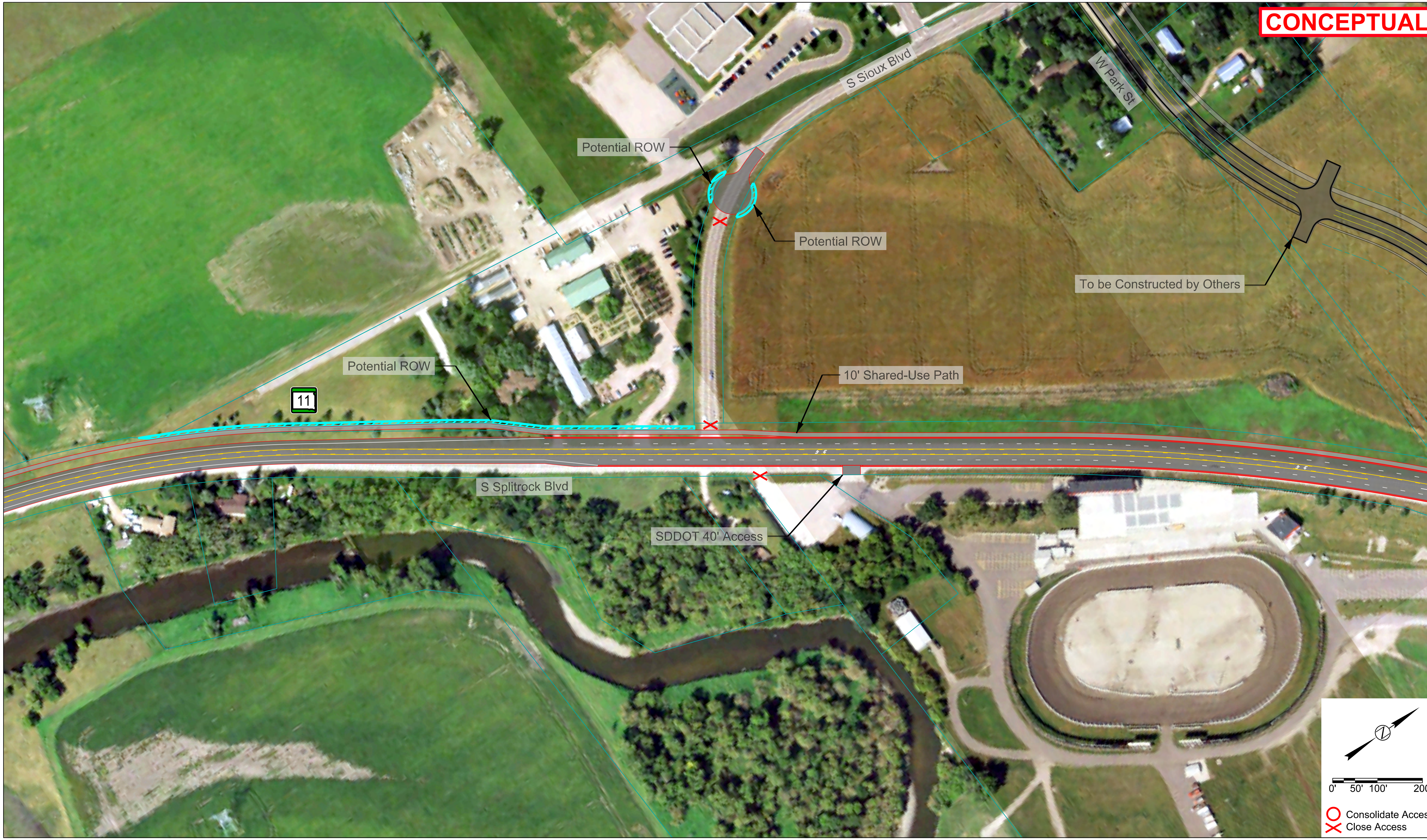


SOUTH SECTION
SD 42 TO S SIOUX BLVD

SOUTH DAKOTA 11 CORRIDOR STUDY

SOUTH SECTION
SD 42 TO S SIOUX BLVD

SOUTH DAKOTA 11 CORRIDOR STUDY



MIDDLE SECTION
S SIOUX BLVD TO E ASPEN BLVD

SOUTH DAKOTA 11 CORRIDOR STUDY

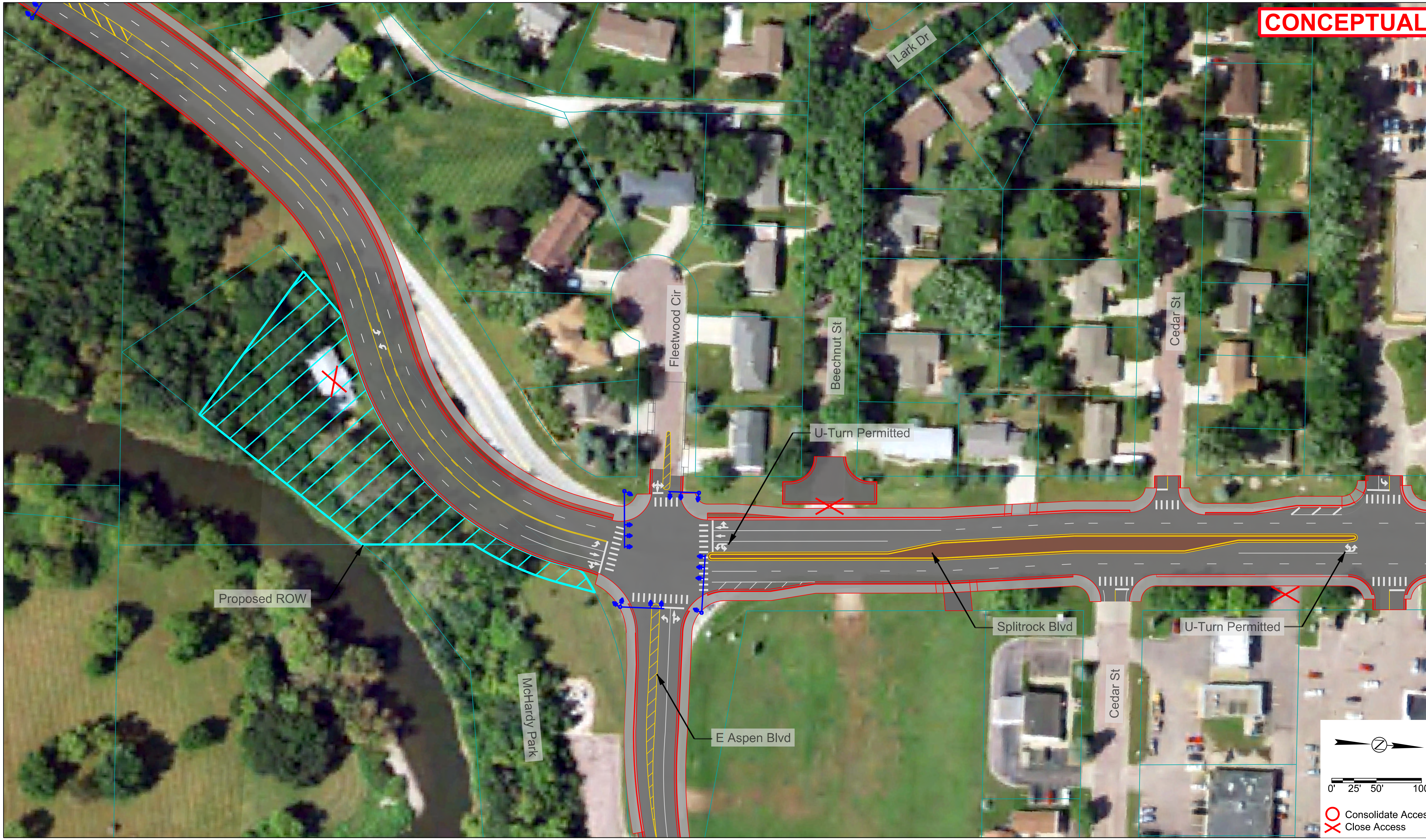
Exhibit B. Middle Section Proposed Improvements

MIDDLE SECTION
S SIOUX BLVD TO E ASPEN BLVD

SOUTH DAKOTA 11 CORRIDOR STUDY

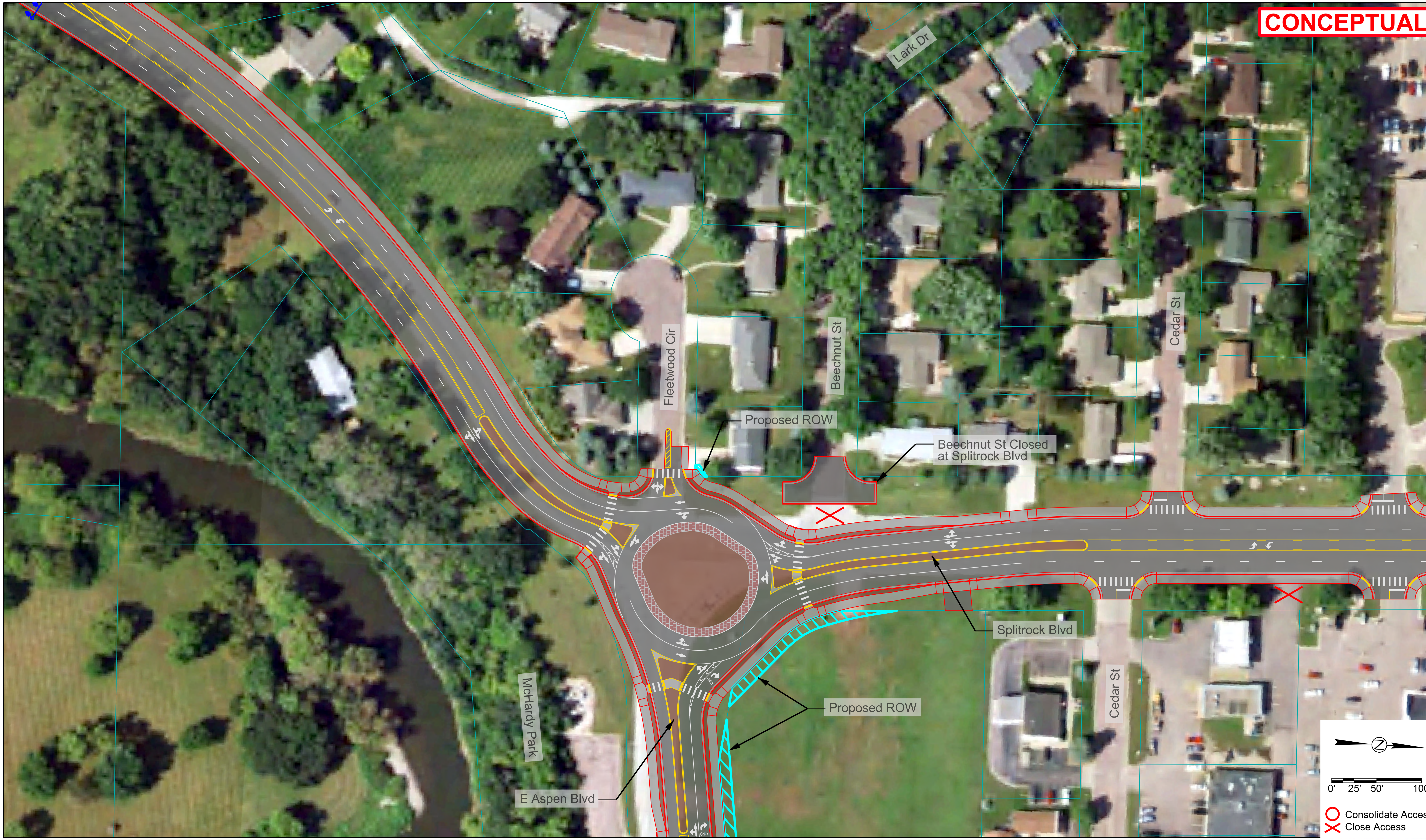
11 SOUTH DAKOTA 11 CORRIDOR STUDY

MIDDLE SECTION
S SIOUX BLVD TO E ASPEN BLVD



SOUTH DAKOTA 11 CORRIDOR STUDY

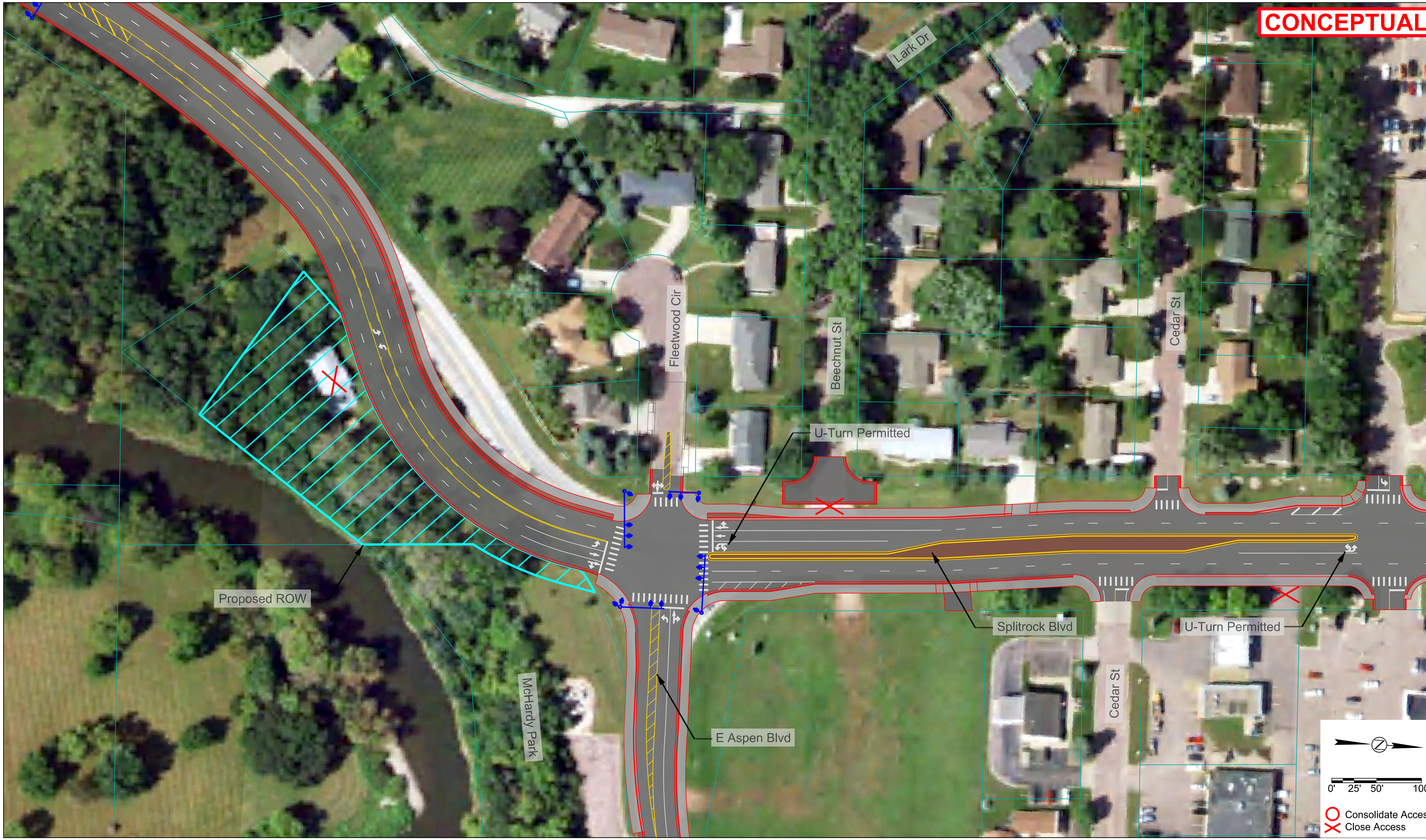
NORTH SECTION: E ASPEN BLVD TO I-90
INTERSECTION ALTERNATIVE: SIGNAL AT S SPLITROCK BLVD AND E ASPEN BLVD



SOUTH DAKOTA 11 CORRIDOR STUDY

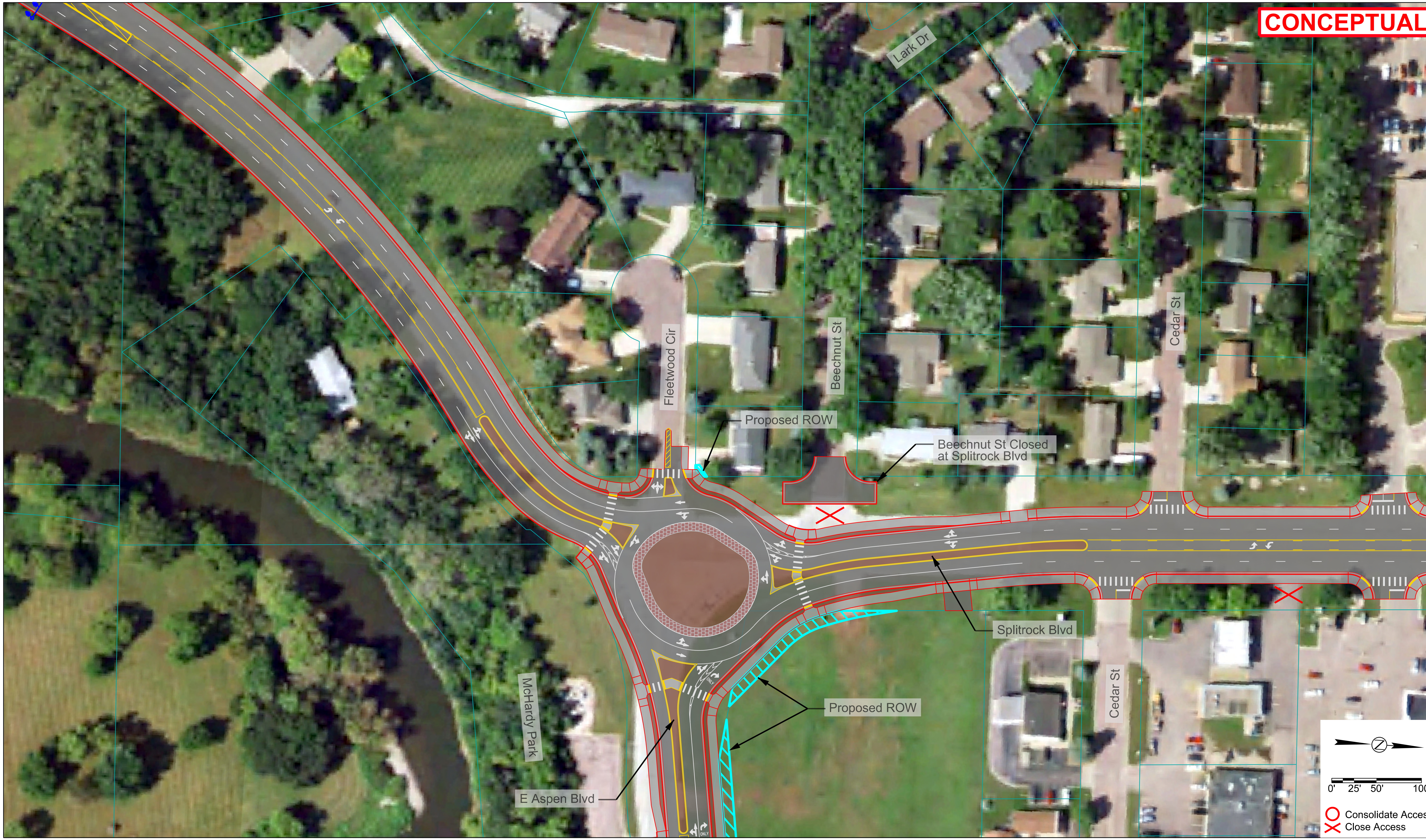
NORTH SECTION: E ASPEN BLVD TO I-90
INTERSECTION ALTERNATIVE: ROUNDABOUT AT S SPLITROCK BLVD AND E ASPEN BLVD

Exhibit C. North Section Proposed Improvements



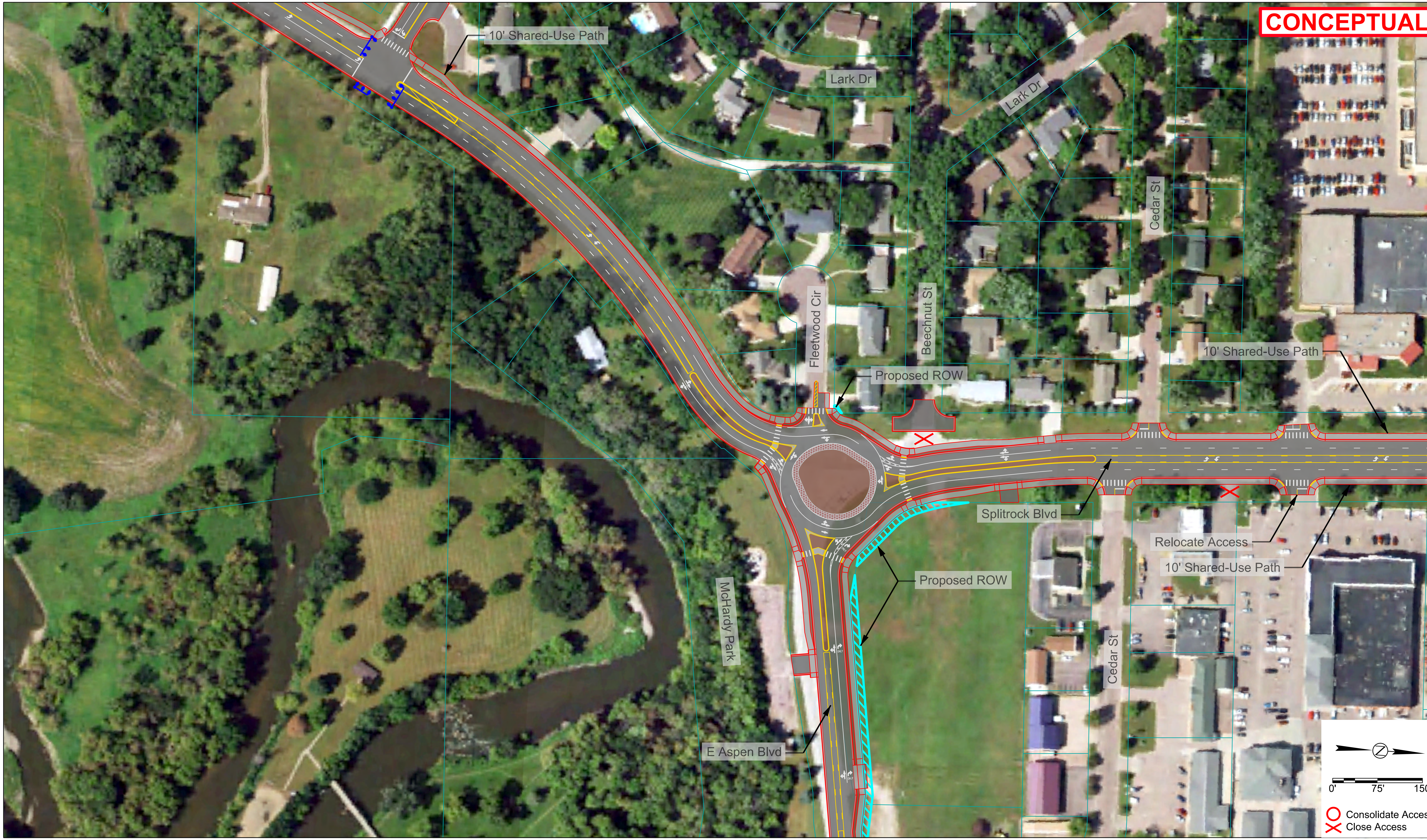
SOUTH DAKOTA 11 CORRIDOR STUDY

NORTH SECTION: E ASPEN BLVD TO I-90
INTERSECTION ALTERNATIVE: SIGNAL AT S SPLITROCK BLVD AND E ASPEN BLVD



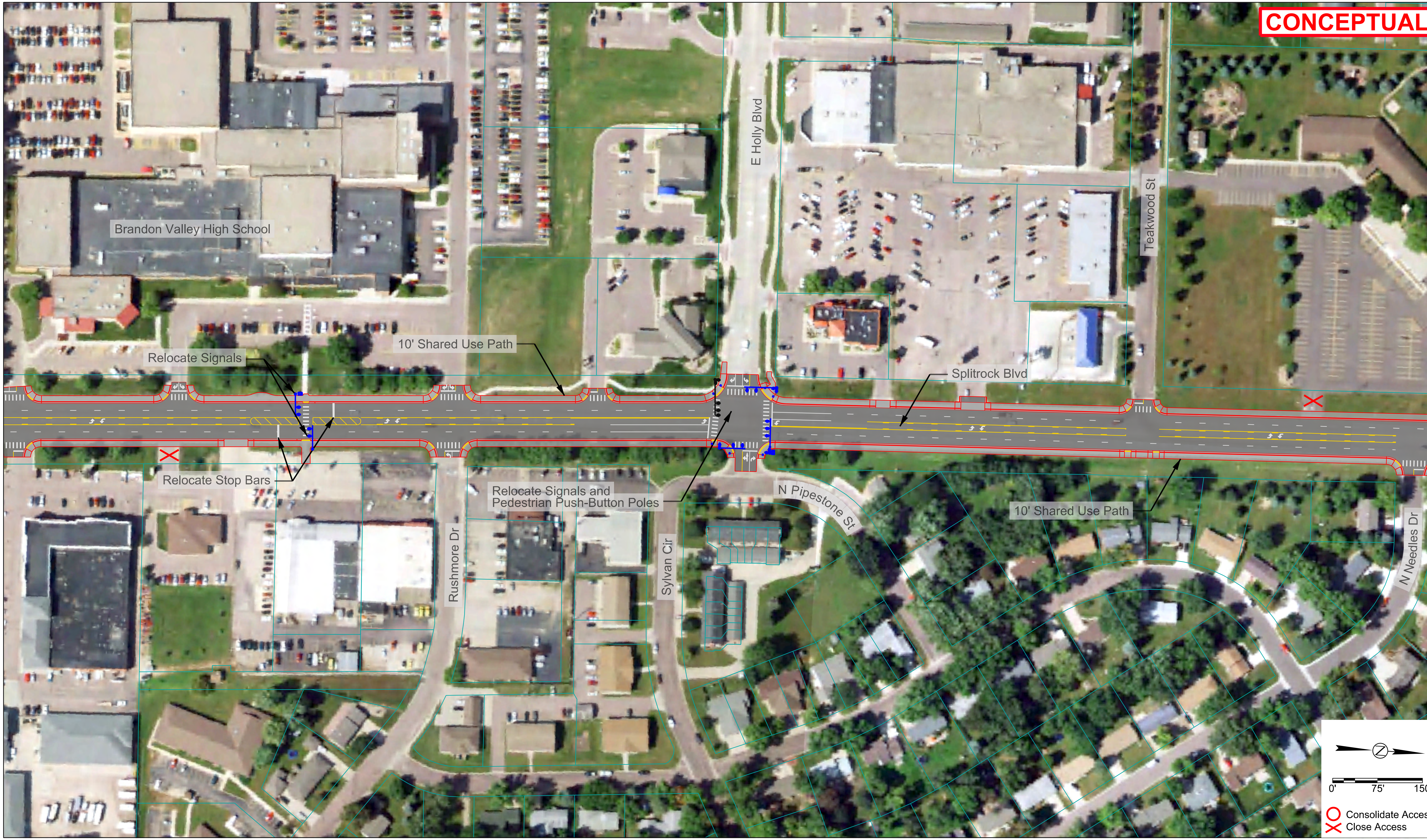
SOUTH DAKOTA 11 CORRIDOR STUDY

NORTH SECTION: E ASPEN BLVD TO I-90
INTERSECTION ALTERNATIVE: ROUNDABOUT AT S SPLITROCK BLVD AND E ASPEN BLVD



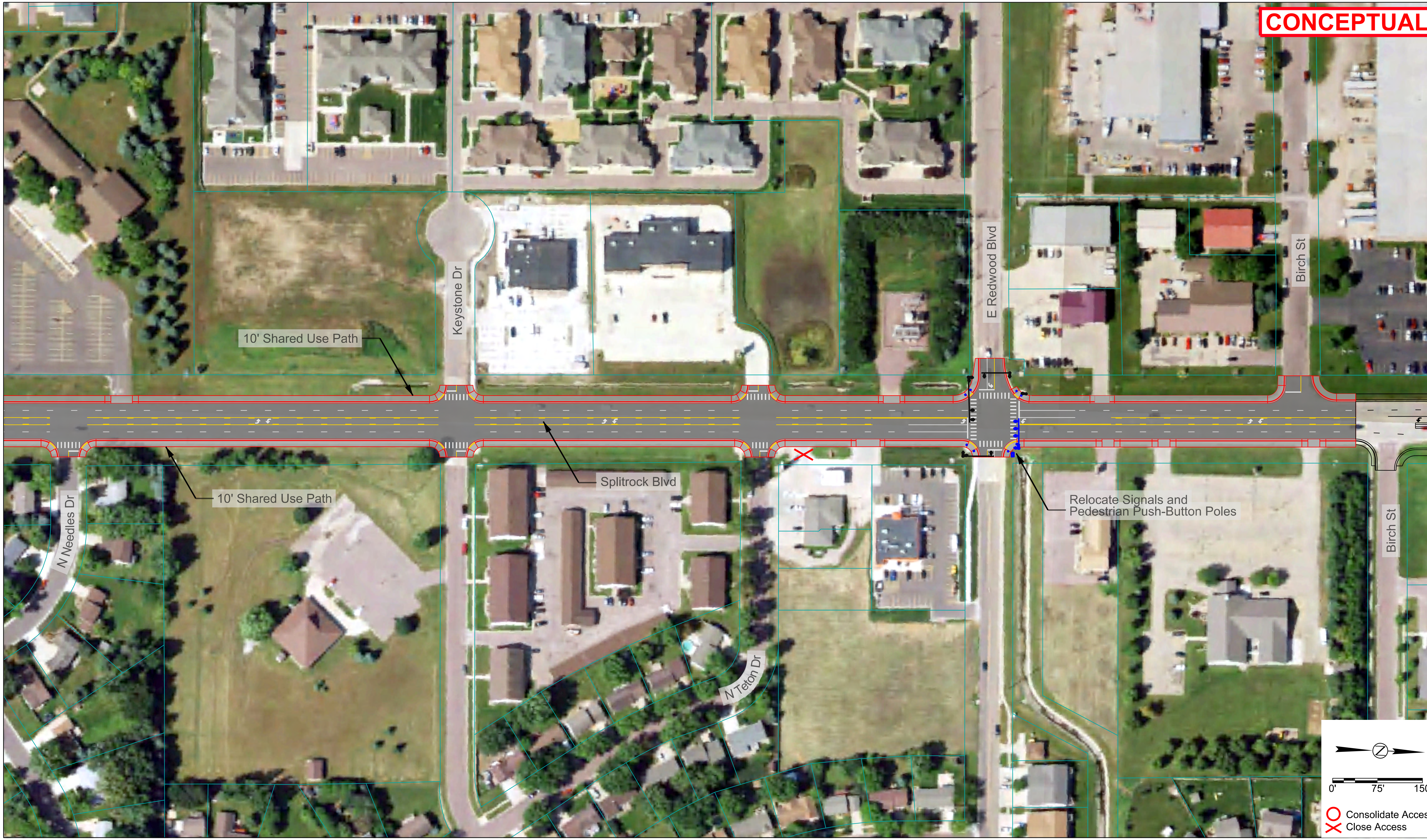
SOUTH DAKOTA 11
CORRIDOR
STUDY

NORTH SECTION: E ASPEN BLVD TO I-90
ALTERNATIVE N1: FIVE-LANE SECTION



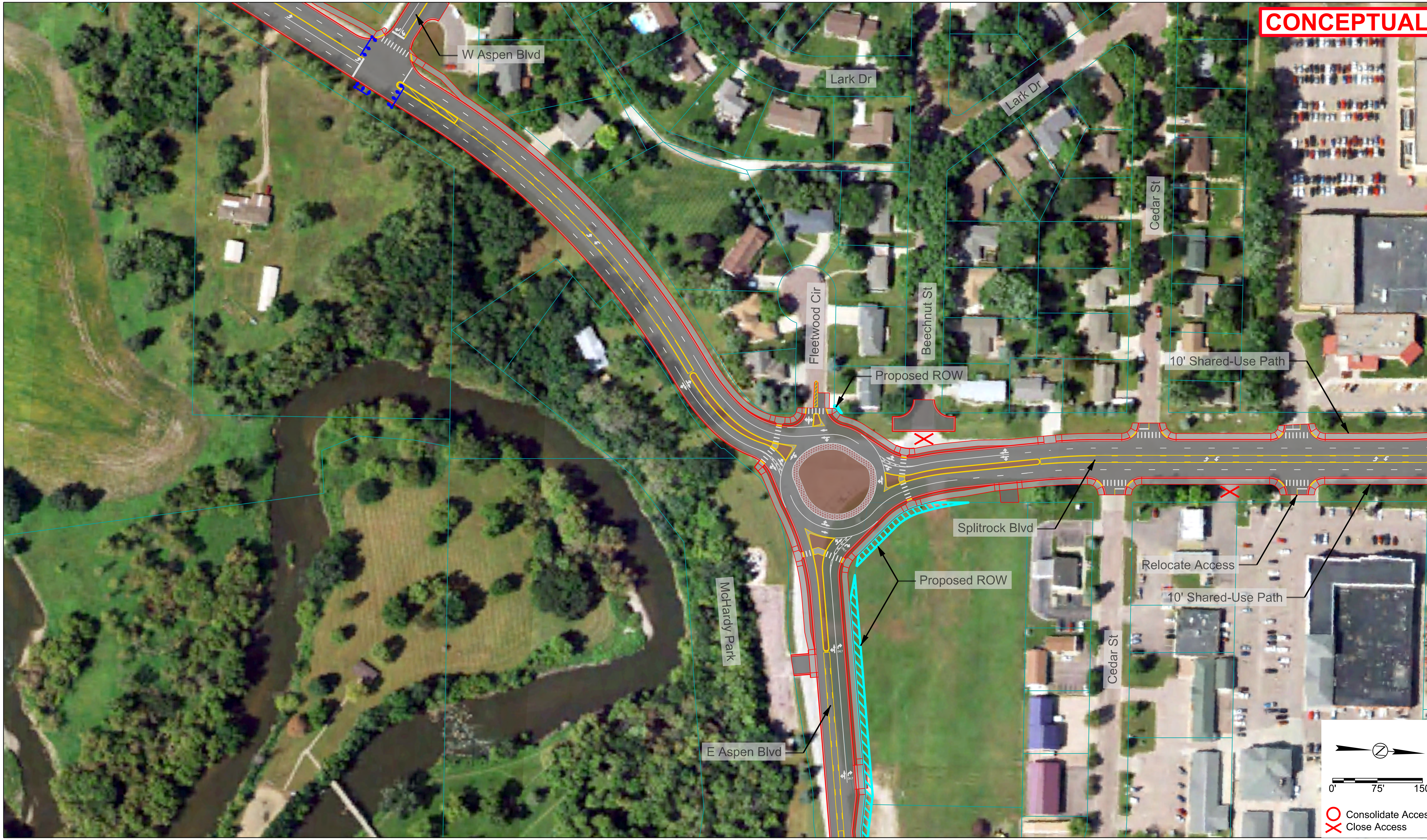
NORTH SECTION: E ASPEN BLVD TO I-90
ALTERNATIVE N1: FIVE-LANE SECTION

SOUTH DAKOTA 11 CORRIDOR STUDY



NORTH SECTION: E ASPEN BLVD TO I-90
ALTERNATIVE N1: FIVE-LANE SECTION

SOUTH DAKOTA 11 CORRIDOR STUDY

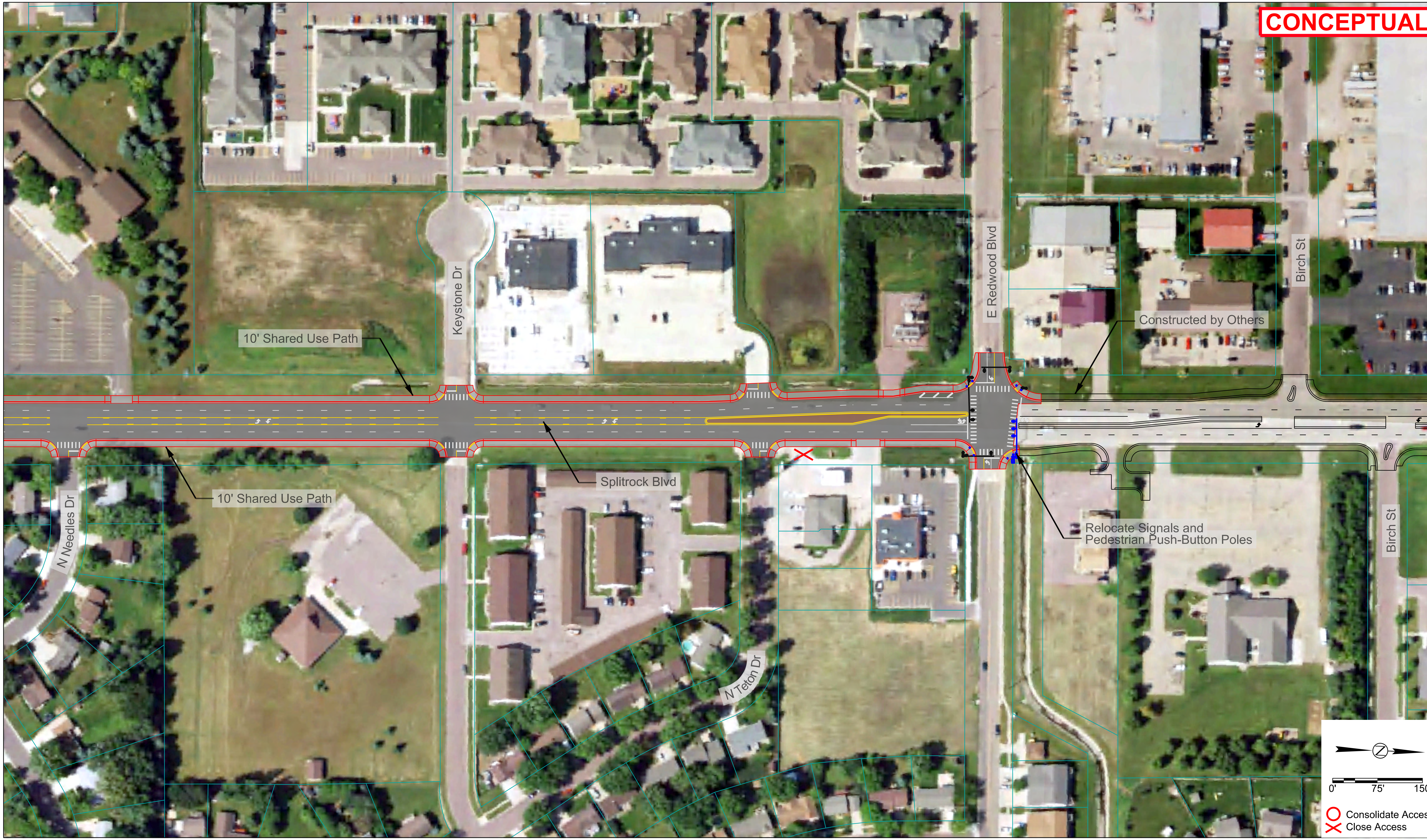


SOUTH DAKOTA 11 CORRIDOR STUDY

NORTH SECTION: E ASPEN BLVD TO I-90
ALTERNATIVE N2: FIVE-LANE SECTION WITH PARTIAL RAISED MEDIANS

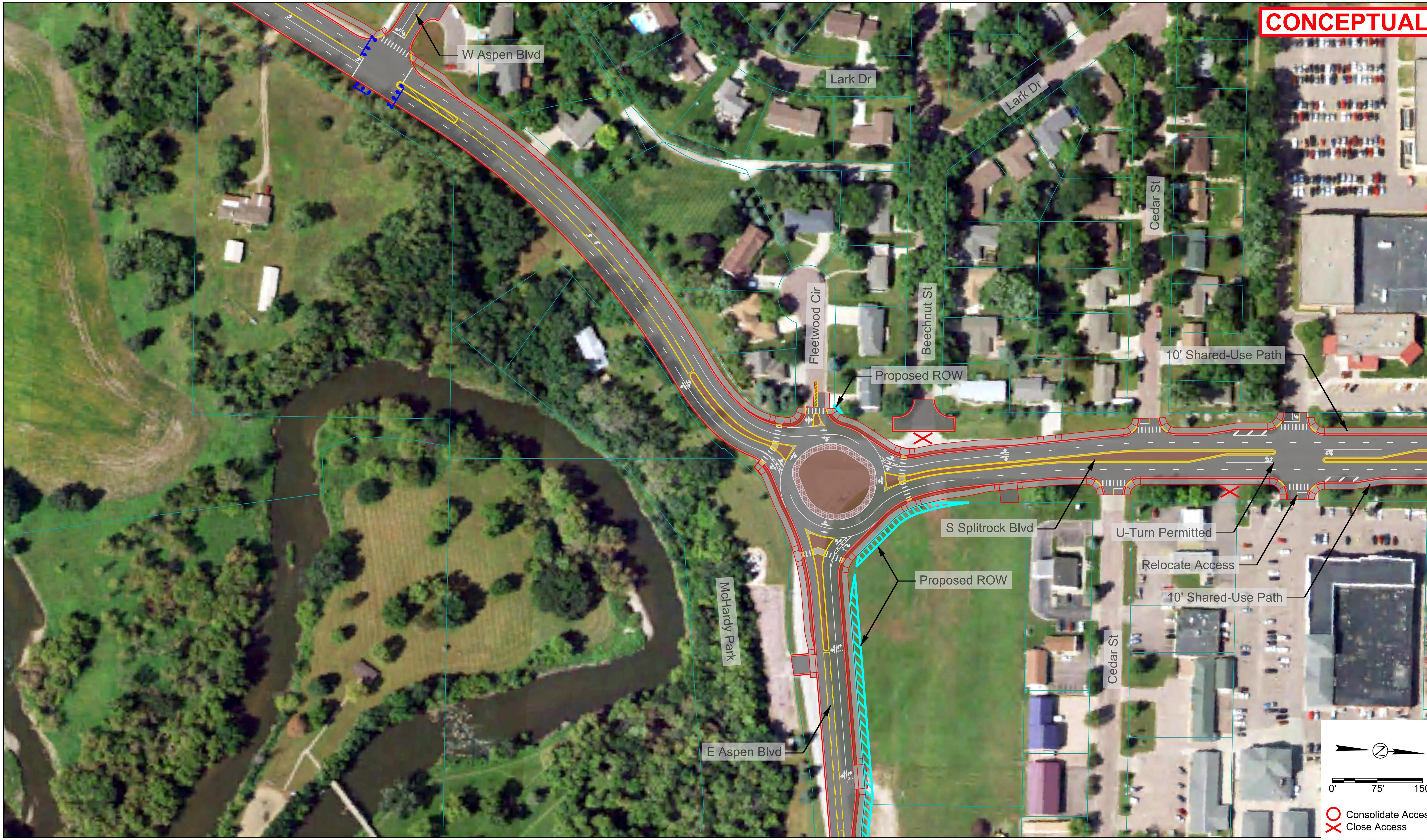
SOUTH DAKOTA 11 CORRIDOR STUDY

NORTH SECTION: E ASPEN BLVD TO I-90
ALTERNATIVE N2: FIVE-LANE SECTION WITH PARTIAL RAISED MEDIANS



SOUTH DAKOTA 11 CORRIDOR STUDY

NORTH SECTION: E ASPEN BLVD TO I-90
ALTERNATIVE N2: FIVE-LANE SECTION WITH PARTIAL RAISED MEDIANS

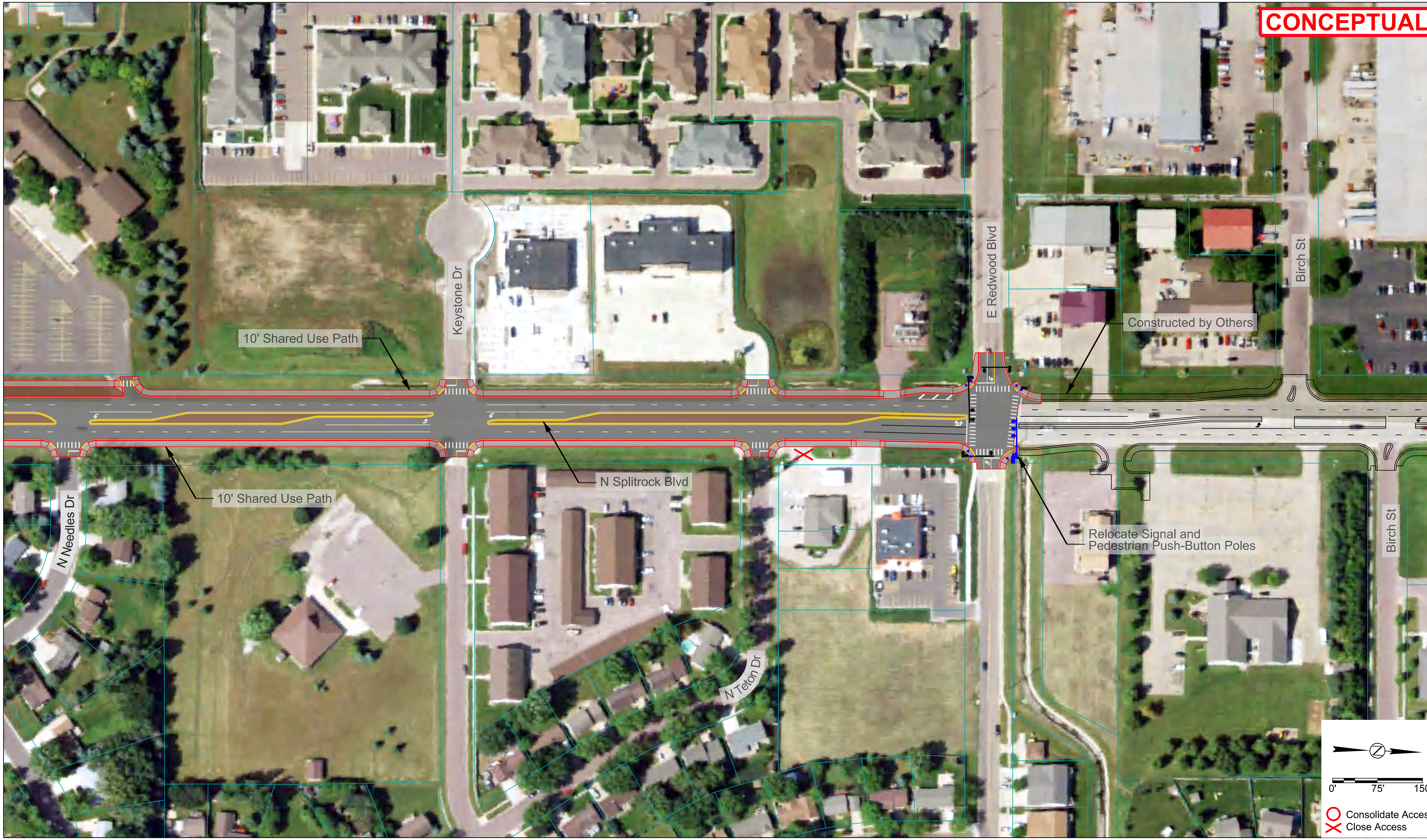


SOUTH DAKOTA 11 CORRIDOR STUDY

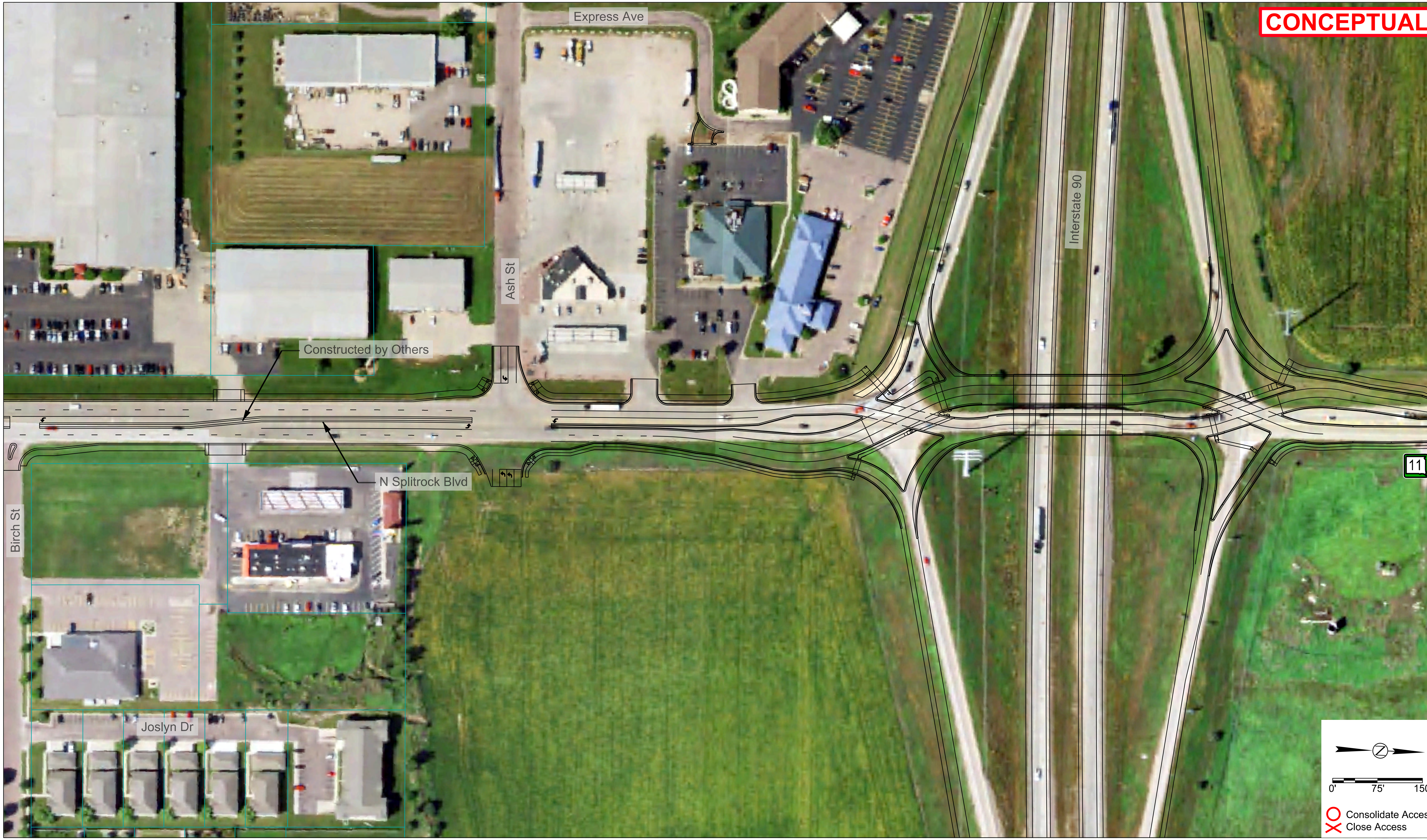
NORTH SECTION: E ASPEN BLVD TO I-90
ALTERNATIVE N3: FOUR-LANE SECTION WITH FULL MEDIANS

SOUTH DAKOTA 11 CORRIDOR STUDY

NORTH SECTION: E ASPEN BLVD TO I-90
ALTERNATIVE N3: FOUR-LANE SECTION WITH FULL MEDIANS



NORTH SECTION: E ASPEN BLVD TO I-90
ALTERNATIVE N3: FOUR-LANE SECTION WITH FULL MEDIANS



NORTH SECTION: E ASPEN BLVD TO I-90
ALTERNATIVE N3: FOUR-LANE SECTION WITH FULL MEDIANS

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