July 2018

I-29 - Exit 62 to Exit 73 Corridor Study

Project No: HP 5596 19

prepared for:

South Dakota Department of Transportation

700 East Broadway Avenue
Pierre, SD 57501

FELSBURG HOLT & ULLEVIG

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Lincoln County, SD

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ACS	American Community Survey
ACHP	Advisory Council on Historic Places
ADT	Average Daily Traffic
AFS	Air Facility System
APE	area of potential effect
ARC	Archeological Research Center
ARSD	Administrative Rule of South Dakota
AST	aboveground storage tank
BGPA	Bald and Golden Eagle Protection Act
BMP	best management practices
CCTV	Closed-Circuit Television
CFR	Code of Federal Regulations
CMF	Crash Modification Factor
CR	(Lincoln) County Road
CRGRID	Cultural Resource Geographic Research Information Display
CWA	Clean Water Act
DDI	diverging diamond interchange
DMS	dynamic message sign
DOT	Department of Transportation
EJ	Environmental Justice
EO	Executive Order
EPA	US Environmental Protection Agency
ESA	environmental study area
FEMA	Federal Emergency Management Agency
FFS	free flow speed
FHU	Felsburg Holt & Ullevig
FHWA	Federal Highway Administration

FIRM	Flood Insurance Rate Map
FPPA	Farmland Protection Policy Act
FRS	Facility Registry Service
GIS	Geographic Information System
HCM	Highway Capacity Manual
HSM	Highway Safety Manual
I-29	Interstate 29
ICIS	Integrated Compliance Information System
IER	Initial Environmental Review
IMJR	Interchange Modification Justification Report
ITS	Intelligent Transportation Systems
LOS	Level of Service
LUST	leaking underground storage tank
LWCF	Land and Water Conservation Fund
MBTA	Migratory Bird Treaty Act
MEV	million entering vehicles
MOE	measure of effectiveness
mph	miles per hour
MPO	Metropolitan Planning Organization
MRM	Mileage Reference Marker
MVM	million vehicle miles
NEPA	National Environmental Policy Act
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NWI	National Wetland Inventory
PHF	peak hour factor
RCRA	Resource Conservation and Recovery Act
ROW	right-of-way
RWIS	Road Weather Information Systems
SAT	Study Advisory Team
SD	South Dakota
SDCL	South Dakota Codified Laws
SDDENR	South Dakota Department of Environment and Natural Resources
SDDOT	South Dakota Department of Transportation
SDGFP	South Dakota Game, Fish, and Parks
SECOG	Southeastern Council of Governments
SGPA	State Game Production Area
SHPO	State Historic Preservation Office
SPI	single point interchange
SWPPP	Storm Water Pollution Prevention Plan
TDI	tight diamond interchange
THPO	Tribal Historic Preservation Officer
TRI	Toxic Release Inventory
USACE	United States Army Corps of Engineers
USDA	US Department of Agriculture (FPPA Regulations)
USFWS	United States Fish and Wildlife Service
UST	underground storage tank
V/C	volume to capacity
WOUS	Waters of the US

1.0 INTRODUCTION

1.1 PROJECT DESCRIPTION AND LOCATION

The South Dakota Department of Transportation (SDDOT) is responsible for developing and maintaining the interstate and highway system throughout the state. As part of their continuous monitoring and management analysis of their routes, the SDDOT has identified the section of I-29 from the Canton Interchange at Exit 62 (Mileage Reference Marker [MRM] 62.35) through the Tea interchange at Exit 73 (MRM 73.38) in Lincoln County, shown on **Figure 1-1**, as a corridor in need of a major rehabilitation or replacement within the next eight years. As such, the SDDOT commissioned this corridor study to determine the potential needs of the corridor in base year 2017 and future year 2045. Evaluation of potential needs in the I-29 corridor goes beyond the mainline pavement condition to include the critical cross routes that may bridge the mainline or have an interchange with I-29.

1.2 PROJECT BACKGROUND

Many structures crossing I-29 have been in place since the late 1950s and early 1960s and are nearing the end of their useful life, including the following crossroad and interchange structures:

- 281st Street Crossroad Structure
- Exit 64 Interchange (SD 44) Structure
- 278th Street Crossroad Structure
- Exit 71 Interchange (273rd Street) Structure

Proximity of this I-29 segment to the expanding Sioux Falls metro area enhances the desire to look at not only the current conditions, but the longer-term travel needs as economic and physical expansion of the Sioux Fall metro continues. The Lincoln County Comprehensive Plan and the future Land Use Plan for the area included in the 2040 Long-Range Transportation Plan both anticipate nodes of commercial growth occurring at the cross routes with access to I-29 and expansion of communities that will influence travel within the I-29 corridor and each cross route. Tea is anticipated to continue growing east to I-29, with a combination of residential and commercial uses. Harrisburg is farther from I-29 and its growth will likely influence the SD 115 corridor more directly than I-29; however, there is the expectation that east-west travel between I-29 and Harrisburg will increase as the community grows. Growth in these two communities, along with Worthing and Lennox to the south of the Sioux Falls metro, generates the need to include each cross route with structures and those that may warrant structures to provide regional connectivity in the future.

The SD 100 improvement is a planned four-lane arterial corridor from I-29 to SD 11, which then provides a north/south connection to I-90. This new arterial has the potential to influence the needs at not only the Exit 73 (Tea) Interchange but also routes to the south in the study area that are influenced by the SD 100 corridor concept. As the route is anticipated to be constructed before the 2045 I-29 Corridor Study horizon, these influences have been incorporated into the alternatives review.

Figure 1-1.   I-29 Corridor Study Area

1.3 PURPOSE AND NEED FOR THE PROJECT

National Environmental Policy Act (NEPA) and other environmental requirements rely on a project decision-making process guided by the purpose and need for a project. 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 is developed, compared, and evaluated, ultimately leading to a preferred alternative.

1.3.1 What is the Purpose of this Project?

The purpose of this Project is to:

- Preserve the transportation assets,
- Provide for the reliability and efficiency of the transportation system, and
- Support the mobility of the traveling public.

1.3.2 What is the Need for this Project?

The need for this project is based on information from the SDDOT's pavement management system, which has identified the segment of I-29 from Exit 62 to Exit 73 for either a major rehabilitation or a reconstruction project within the next 8 years.

Previous studies have indicated that this segment of I-29 may need capacity improvements sometime in the future. Most crossroad bridges in the corridor are also approaching the end of the design and/or service life and are coming due for either replacement or major rehabilitation. Interchanges within the corridor would also need to be brought up to current standards when the corresponding crossroad bridge is replaced and may also need to be reconfigured to accommodate anticipated future traffic.

To accommodate the forecasted traffic volumes for the service life, the appropriate typical section must be identified. The same is true for all the crossroad bridges and interchanges along the corridor.

1.4 STAKEHOLDER INVOLVEMENT

Many stakeholders were involved in this I-29 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 stakeholders group, which included:

- South Dakota Department of Transportation (SDDOT)
- Federal Highway Administration (FHWA)
- Lincoln County
- Sioux Falls Metropolitan Planning Organization (MPO)
- Southeastern Council of Governments (SECOG)
- City of Sioux Falls
- City of Tea
- Lincoln County Airport

1.5 STUDY ADVISORY TEAM

A Study Advisory Team (SAT), formed to guide the study through completion, includes representative parties of the SDDOT, Lincoln County, Sioux Falls MPO, and FHWA. Members of the SAT are shown below.

Representative	Organization
Jeff Brosz	SDDOT – Inventory Management
Toby Brown	Lincoln County – Planning & Zoning
Cary Cleland	SDDOT – Road Design
Dave Coley	SDDOT – Bridge Design
Sonia Downs	SDDOT – Project Development
Travis Dressen	SDDOT – Sioux Falls Area
Amber Gibson	Sioux Falls MPO
Steve Gramm	SDDOT - Project Development
Mark Hoines	FHWA
Dave Huft	SDDOT – Research
Paula Huizenga	SDDOT – Administration
Scott Jansen	SDDOT – Mitchell Region
Brad Remmich	SDDOT – Project Development

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

- Kickoff Meeting – May 11, 2017
- SAT Meeting – August 3, 2017
- Public Meeting #1 – October 24, 2017
- Solutions Workshop – October 25, 2017
- SAT Meeting – December 11, 2017
- SAT Meeting – February 8, 2018
- SAT Meeting / Public Meeting #2 – March 27, 2018

1.6 STUDY PROCESS

Figure 1-2 depicts the work plan graphically. The study comprises three main elements: Needs and Solutions Analyses, Public Involvement, and Environmental. These work elements proceeded along parallel paths throughout the project, culminating in the final selection of corridor-wide solutions.

1.6.1 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; gathering a current inventory of intelligent transportation systems (ITS); and collecting a history of reported traffic crashes. The data was analyzed to rate current performance and to identify deficiencies. Year 2045 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 project team worked to identify potential solutions along the I-29 corridor. Solutions included mainline I-29 widening scenarios, potential interchange reconstruction, and ITS improvements. The potential solutions 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.

1.6.2 Public Involvement

Stakeholders composed of travelers using the I-29 corridor, residential and business property owners adjacent to the interstate and crossroads, and travelers using crossroads with and without access to I-29 were incorporated into the project engagement plan. The Methods and Assumptions document outlined the following key plan elements:

- **Project website:** www.I29corridorstudy.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, focusing on:
    - Public Meeting 1: Existing conditions, study process, and project goals.
    - Public Meting 2: Range of alternatives for each interchange, the I-29 mainline, and crossroads of I-29 and preliminary findings of the technical analysis.
- **Stakeholder/Landowner Meetings:** Property owners abutting the I-29 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.
- **MPO Committee Meetings:** Presentations to the Sioux Falls MPO Citizens Advisory Committee, Technical Advisory Committee, and the Unified Development Commission were made. The study team provided information to SDDOT staff for presentation to the Sioux Falls MPO committees.
- **Study Advisory Team:** The project SAT made up of SDDOT staff from the region and central office, FHWA, Lincoln County, and SECOG met several times throughout the study period, as described in Section 1.6.

Appendix A includes summaries from the two public information meetings.

The **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 project 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.

1.6.3 Environmental

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 interchange solutions. This inventory, documented in **Chapter 3,** will assist in future steps toward implementation of projects.
2. The environmental overview conducted for the I-29 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 project 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.

1.6.4 Study Oversight

The SDDOT Project Manager and SAT provided study oversight. Consistent with SDDOT practice for planning studies, the project team, in collaboration with SDDOT and FHWA authorities, developed a Methods and Assumptions document at the outset of the project. 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.

1.7 PLANNING CONTEXT AND PREVIOUS STUDIES

Several previous plans and studies have included consideration of transportation needs within the I-29 Corridor study area. The following documents served as references for the Corridor Study, and their findings were incorporated as appropriate:

- **Decennial Interstate Corridor Study.** Completed by SDDOT in 2010, the statewide study included initial alternatives for the future of Exit 64 and Exit 71.
- **SDDOT Highway Needs Analysis Report***.* The SDDOT maintains a highway needs book for use in planning studies. The 2017 “Needs Book” was provided and used in this study in part to help determine pavement condition, crash rates, and traffic volumes (average daily traffic [ADT]) for I-29 mainline segments in the study area.
- I-29 Exit 62 Interchange Modification Justification Report (IMJR)
- I-29 Exit 73 IMJR
- I-29 Exit 75 IMJR (85th Street)
- I-29 / I-229 IMJR
- Lincoln County Comprehensive Plan
- 2030 City of Tea Comprehensive Plan
- 2030 City of Worthing Comprehensive Plan
- City of Sioux Falls 2040 Long Range Transportation Plan
- 2017 South Dakota Airport Directory

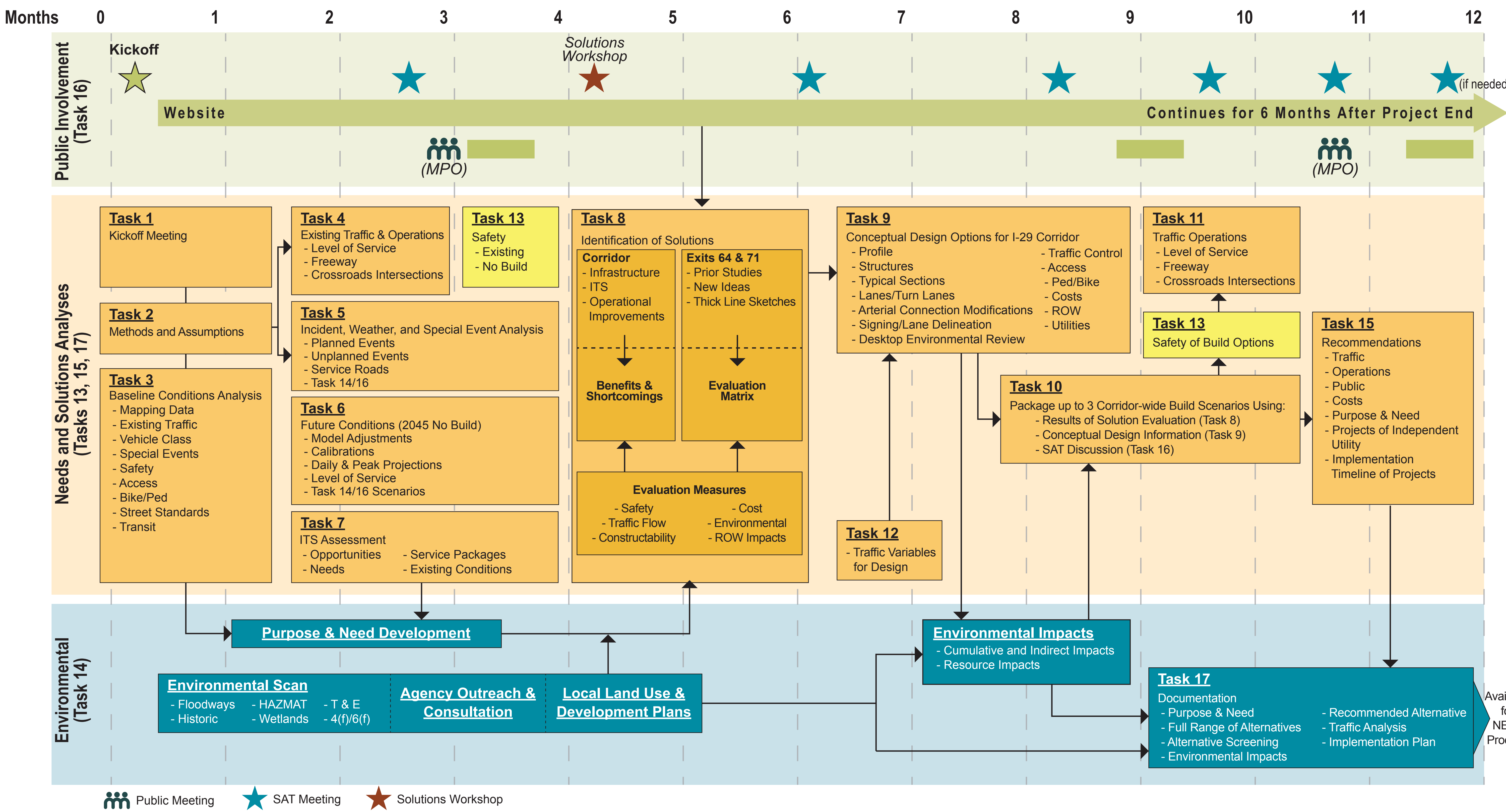


Figure I-2
I-29 Corridor Study Workplan

2.0 2017 EXISTING CONDITIONS

2.1 EXISTING FACILITY AND ROADWAY NETWORK

The existing roadway system in the study area, shown on **Figure 2-1,** includes the following primary facilities:

- **Interstate 29.** I-29 runs north-south through the study area and is currently a four-lane facility (two lanes in both directions). The posted speed limit along I-29 throughout the study area is 80 miles per hour (mph) but decreases to 65 mph north of the 271st Street interchange (north of MRM 72.00). The change in speed limit correlates with the Urban/Rural boundary limit.
- **US Highway 18 / 282nd Street / Lincoln County Road (CR) 128.** US Highway 18 (US 18) / 282nd Street / CR 128 runs east-west in the study area, providing access to I-29 from Canton. East of I-29 the roadway is designated as US 18 and is currently a two-lane undivided roadway with a posted speed of 65 mph. West of I-29, the two-lane undivided roadway is designated as 282nd Street / CR 128, and has a posted speed limit of 55 mph. At the interchange, a three-lane cross section is provided with a two-way left-turn lane, also referred to as TWLTL. The posted speed limit at the interchange is 40 mph. US 18 / 282nd Street / CR 128 is about 2 miles south of South Dakota Highway 44 (SD 44).
- **281st Street.** 281st Street runs east-west in the study area approximately 1 mile north of 282nd Street. 281st Street, a gravel roadway, provides local connectivity with a grade separation across I-29.
- **South Dakota Highway 44 / 280th Street / CR 124.** SD 44 / 280th Street / CR 124 runs east-west in the study area and is currently a two-lane undivided roadway, providing access to I-29 from Worthing and Lennox. The posted speed limit west of the I-29 interchange is 65 mph, while the posted speed limit east of the I-29 interchange is 55 mph. At the interchange, the speed limit is posted as 40 mph. SD 44 is located about 4 miles south of 276th Street.
- **278th Street.** 278th Street runs east-west in the study area approximately 2 miles north of 280th Street. 278th Street, a gravel roadway, provides local connectivity with a grade separation across I-29.
- **276th Street / CR 116.** 276th Street / CR 116 runs east-west in the study area and is currently a two-lane undivided roadway with a posted speed limit of 55 mph east of the I-29 interchange and 65 mph west of the I-29 interchange. 276th Street is about 3 miles south of 273rd Street.
- **273rd Street / CR 110.** 273rd Street / CR 110 runs east-west in the study area and is currently a two-lane undivided roadway, providing access to I-29 from Harrisburg and Tea. The posted speed limit east of the I-29 interchange is 45 mph, and the posted speed limit west of the I-29 interchange is 55 mph. The posted speed limit at the interchange is 25 mph. 273rd Street is about 2 miles south of 271st Street.
- **271st Street / CR 106.** 271st Street / CR 106 runs east-west in the study area and is currently a four-lane divided roadway with a speed limit of 45 mph. 271st Street serves as the primary route to I-29 from Tea, the Lincoln County Airport, and the surrounding developed area of Lincoln County. East of the I-29 interchange, 271st Street / CR 106 is a two-lane undivided roadway with a speed limit of 55 mph, while west of the I-29 interchange, 271st is a two-lane undivided roadway with a speed limit of 45 mph.

- **470th Avenue / Sundowner Avenue.** 470th Avenue / Sundowner Avenue runs north-south in the study area approximately 0.5 mile west of I-29. 470th Avenue is paved from 271st Street to 272nd Street through the industrial park, with a speed limit of 35 mph, and is a gravel roadway south of 272nd Street. 470th Avenue provides local connectivity west of I-29 between the various roadways in the study area.
- **471st Avenue / Tallgrass Avenue.** 471st Avenue / Tallgrass Avenue runs north-south in the study area approximately 0.5 mile east of I-29. 471st Avenue, a gravel roadway in the study area, provides local connectivity east of I-29 between the various roadways in the study area.

2.2 DESCRIPTION OF EXISTING INTERCHANGES

The five interchanges on I-29 within the study area are located from Exit 62 to Exit 73. The lane configurations for each intersection in the study area are as follows:

- **Exit 62 (US 18 / 282nd Street / CR 128).** The Exit 62 (Canton) interchange is a diamond configuration with stop signs at the northbound and southbound ramp terminals, which are located approximately 950 feet apart. On US 18, one through lane and a single left-turn lane at the ramp terminals are provided in both the eastbound and westbound directions. A right-turn lane is also provided at the northbound ramp terminal in the westbound direction. At both the northbound and southbound ramp terminal intersections, a single lane is provided for traffic exiting the interstate. The Exit 62 interchange was reconstructed in 2015, and the crossroad structure passes over I-29.
- **Exit 64 (SD 44 / 280th Street / CR 124).** The Exit 64 (Worthing) interchange is a diamond configuration with stop signs at the northbound and southbound ramp terminals, which are spaced about 550 feet apart. SD 44 travels over I-29 and has one through lane provided in both the eastbound and westbound direction. At both the northbound and southbound ramp terminal intersections, a single shared lane is provided for both left-turn and right-turn movements. The Exit 64 interchange and crossroad structure are original to the interstate system and were built in the late 1950s and no longer meet current geometric design standards.
- **Exit 68 (276th Street / CR 116).** The Exit 68 (Lennox / Parker) interchange is a diamond configuration with stops signs located at the ramp terminals. A single lane is provided at both the northbound and southbound ramp terminal intersections for traffic exiting the interstate. The 276th Street crossroad structure over I-29 has one through lane and a single left-turn lane provided in both directions. There is approximately 1,050 feet between the ramp terminal intersections. The Exit 68 interchange and crossroad structure were reconstructed in the 1990s.
- **Exit 71 (273rd Street / CR 110).** The Exit 71 (Harrisburg) interchange is a diamond configuration with stop signs located at both ramp terminals. 273rd Street has one through lane in both the eastbound and westbound direction that travels over I-29. The northbound and southbound ramp terminals are spaced approximately 575 feet apart and provide a single shared lane for left-turn and right-turn movements. The Exit 71 interchange and crossroad structure are original to the interstate system and were built in the late 1950s; they no longer meet current geometric design standards.
- **Exit 73 (271st Street / CR 106).** The Exit 73 (Tea) interchange is a single point with the crossroad provided under the mainline; I-29 spans the 271st Street / CR 106 with twin bridges. A single traffic signal is provided for both the northbound and southbound ramp terminals, which are

approximately 300 feet apart. On 271st Street, two through lanes and dual left-turn lanes at the ramp terminals are provided in both the eastbound and westbound directions. Right-turn movements are accommodated from the shared outside through lane at the ramp terminals for both the eastbound and westbound directions. At both the northbound and southbound ramp terminal intersections, an exclusive left-turn lane and right-turn lane are provided for traffic exiting the interstate. The 271st Street interchange was reconstructed in 2005.

2.3 EXISTING LAND USE

Existing land use in the project area includes a mixture of residential, agricultural, commercial, and light industrial. The potential for increased development in the area exists adjacent to I-29 and in the surrounding communities. **Appendix D** contains the 2017 Planning Map for Lincoln County illustrating county land use.

At the Exit 62 interchange, the southeast quadrant includes a gas station and RV park; the northeast quadrant has commercial development north of US 18, including the Sioux Falls Regional Livestock Exchange. A small repair shop is located in the southwest quadrant, and the SDDOT Canton Shop is located in the northwest quadrant. The rest of the area surrounding the interchange is a mixture of agricultural and undeveloped land.

At the Exit 64 interchange, commercial / light industrial development is located in the southwest quadrant. This area includes a pet supply store, a car dealership, and an agricultural implement dealership. In the northwest quadrant is the CHS Eastern Ethanol Plant. On the northeast quadrant, houses are located along SD 44, but the remainder of the land north of the houses is the Worthing State Game Production Area. The southwest quadrant of the interchange is agricultural land.

Around the Exit 68 interchange, most of the land is agricultural with an office for the Southeastern Electric Cooperative, Inc., in the southwest quadrant.

The land use surrounding the Exit 71 interchange includes a storage facility and a few residential houses in the southwest quadrant. The northwest quadrant includes agricultural land immediately west of I-29, as well as an auto shop and storage units farther west. A commercial / light industrial development is located on the northeast quadrant, including several businesses close to the ramp terminal intersection such as a concrete plant, office buildings, a fireworks store, an auto repair shop, and a trailer dealership. The southeast quadrant of the interchange is agricultural land.

At the Exit 73 interchange, the northeast and southeast quadrants are developed with a commercial / light industrial area, including a truck stop and various businesses. Located in the southwest quadrant are several commercial buildings and the Lincoln County Airport. The northwest quadrant was formerly agricultural land but as of 2018 has been graded for a commercial development. Additional commercial development is located to the west of 471st Avenue / Sundowner Avenue on both sides of 271st Street.

2.4 2017 EXISTING TRAFFIC VOLUMES

SDDOT compiled 2017 ADT count data along I-29 in the study area using automated count station data and supplemental counts conducted in May 2017. **Figure 2-1** shows the resultant 2017 daily traffic volumes. Peak period turning movement counts were also conducted by MNRG, LLC, and SRF Consulting, Inc., via video camera technology at the study area ramp terminals. Counts were conducted for both the AM and PM peak periods at nine intersections in May 2017. **Appendix C** provides the count data.

2.4.1 2017 Daily Traffic and Truck Traffic

MNRG provided comprehensive 2017 24-hour (daily) turning movement counts at the nine study area ramp terminals, as shown on **Figure 2-1**. Both SDDOT and MNRG conducted vehicle classification counts at several locations in the study area. SDDOT compiled the data and calculated the estimated truck percentages for all ramps and mainline segments. MNRG also provided raw truck turning movement counts at the nine ramp terminal intersections during the peak periods of the day. The distribution of truck trips at the ramp terminal intersections was applied to the daily truck volume estimates.

2.4.2 2017 AM and PM Peak Hours

MNRG and SRF conducted AM and PM peak hour turning movement counts at the nine ramp terminal intersections listed in **Table 2-1**. SDDOT provided AM and PM peak hour counts for I-29 mainline segments, on- and off-ramps, and in the study area. The counts were compiled, and the systemwide AM and PM peak hours were established as 7:00 to 8:00 AM and 4:30 to 5:30 PM, respectively.

Table 2-1. 2017 Intersection Peak Hours

Intersection	AM Peak Hour			PM Peak Hour		
	Individual Intersection Peak Hour		Systemwide Peak (7:00 – 8:00) Entering Volume	Individual Intersection Peak Hour		Systemwide Peak (4:30 – 5:30) Entering Volume
	Time	Entering Volume		Time	Entering Volume	
I-29 Exit 62 NB Ramp Terminal	7:00 – 8:00	387	387	4:45 – 5:45	390	375
I-29 Exit 62 SB Ramp Terminal	6:45 – 7:45	195	188	4:45 – 5:45	251	244
I-29 Exit 64 NB Ramp Terminal	7:15 – 8:15	313	312	4:30 – 5:30	259	259
I-29 Exit 64 SB Ramp Terminal	7:30 – 8:30	276	258	3:45 – 4:45	350	294
I-29 Exit 68 NB Ramp Terminal	6:45 – 7:45	430	428	4:15 – 5:15	297	295
I-29 Exit 68 SB Ramp Terminal	7:00 – 8:00	454	454	4:30 – 5:30	553	553
I-29 Exit 71 NB Ramp Terminal	7:00 – 8:00	661	661	4:45 – 5:45	597	595
I-29 Exit 71 SB Ramp Terminal	6:45 – 7:45	477	473	5:00 – 6:00	602	560
I-29 Exit 73 Single Point	7:15 – 8:15	2427	2403	4:45 – 5:45	2535	2522

Although these time periods represent the highest overall traffic volumes on the system, some study intersections have slightly different peak hours. **Table 2-1** shows the AM and PM peak hours (the four-highest consecutive 15-minute periods) and corresponding volumes for each study intersection, along with the systemwide peak hour volumes.

After establishing the systemwide AM and PM peak hours, the through volumes on the arterial streets were balanced to negate any discrepancies between intersections. **Figure 2-2** shows the resultant 2017 peak hour traffic volumes.

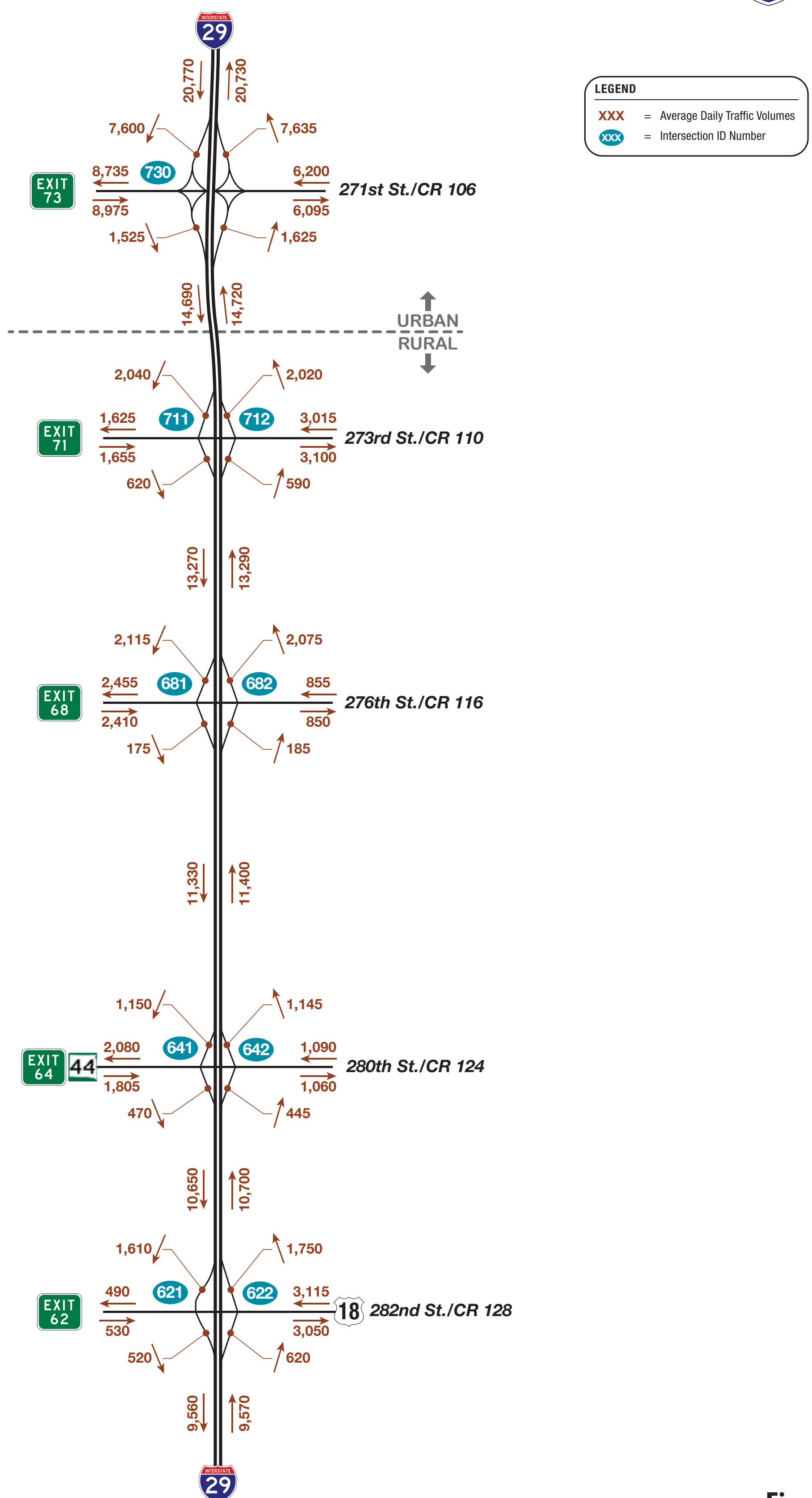


Figure 2-1

2017 Existing Average Daily Traffic Volumes

NOTE: Drawing Not to Scale

NORTH

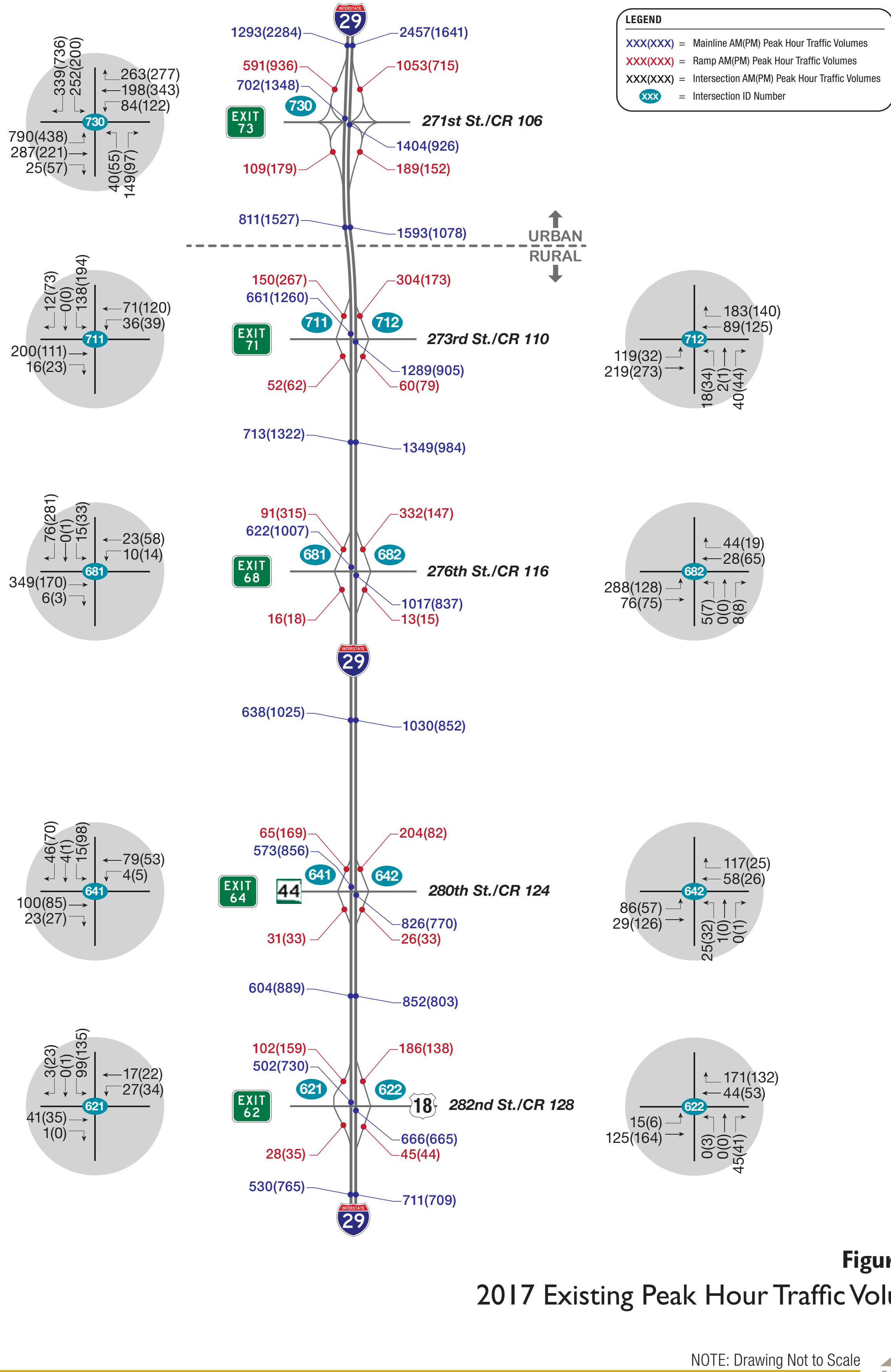


Figure 2-2
2017 Existing Peak Hour Traffic Volumes

2.5 2017 EXISTING OPERATIONAL ANALYSIS

The existing year operational analysis used 2017 traffic volumes, as approved by the project 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.

For freeways, LOS is a qualitative assessment of traffic operational conditions within a traffic stream in terms of the density for individual segments. **Table 2-2** shows the LOS criteria for basic freeway segments and for merge and diverge areas.

Table 2-2. Mainline Level of Service Criteria

Level of Service	Density (pc/mi/ln)	
	Basic Freeway Segments	Merge and Diverge Areas
A	≤ 11	≤ 10
B	> 11 to 18	> 10 to 20
C	> 18 to 26	> 20 to 28
D	> 26 to 35	> 28 to 35
E	> 35 to 45	> 35
F	> 45	Demand Exceeds Capacity

Source: Basic Freeway Segments, *Highway Capacity Manual* (HCM) 6th Edition, Exhibit 12-15; Merge and Diverge Areas, HCM 6th Edition, Exhibit 14-3

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 capacity analysis results in an overall LOS representative of all movements through the intersection. Unsignalized, or stop sign controlled, intersection capacity analysis produces LOS results for each movement that must yield to conflicting traffic at the intersection. **Table 2-3** summarizes LOS criteria for both signalized and unsignalized (stop sign controlled) intersections.

Table 2-3. 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: Signalized Intersections, 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 on freeways to be LOS C in urban areas and LOS B in rural areas. All project stakeholders agreed to this LOS target as part of the Methods and Assumptions document in **Appendix B**. The current urban/rural boundary in the study area is MRM 72.00, between Exits 71 and 73.

2.5.2 Mainline Operations Analysis

The mainline basic segment analysis used the Highway Capacity Software (HCS7). All the 2017 I-29 mainline basic segments in the study area currently meet the minimum operations goal of LOS B or better in rural areas and LOS C or better in urban areas. **Table 2-4** and **Figure 2-3** show the mainline LOS for 2017. **Appendix H** includes the HCS7 freeway analysis worksheets for the 2017 traffic conditions scenario.

Table 2-4. 2017 Mainline Basic Operations Analysis

Segment	Direction	Total Number of Lanes	AM Peak Hour		PM Peak Hour	
			Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS
I-29 – Exit 62	Northbound	2	6.4	A	6.1	A
	Southbound	2	5.1	A	6.2	A
I-29 – Between Exit 62 On- & Off-Ramps	Northbound	2	6.3	A	5.8	A
	Southbound	2	4.9	A	5.9	A
I-29 – Exit 62 to Exit 64	Northbound	2	7.1	A	5.5	A
	Southbound	2	4.8	A	7.5	A
I-29 – Between Exit 64 On- & Off-Ramps	Northbound	2	6.9	A	5.3	A
	Southbound	2	4.4	A	7.1	A
I-29 – Exit 64 to Exit 68	Northbound	2	8.5	A	6.9	A
	Southbound	2	4.9	A	7.9	A
I-29 – Between Exit 68 On- & Off-Ramps	Northbound	2	8.4	A	6.8	A
	Southbound	2	4.8	A	7.8	A
I-29 – Exit 68 to Exit 71	Northbound	2	11.1	B	8.1	A
	Southbound	2	5.2	A	11.3	B
I-29 – Between Exit 71 On- & Off-Ramps	Northbound	2	10.8	A	7.6	A
	Southbound	2	5.2	A	11.9	B
I-29 – Exit 71 to Exit 73	Northbound	2	13.0	B	8.7	A
	Southbound	2	7.0	A	12.5	B
I-29 – Between Exit 73 On- & Off-Ramps	Northbound	2	11.6	B	7.6	A
	Southbound	2	6.3	A	13.1	B
I-29 – North of Exit 73	Northbound	3	24.4	C	16.5	B
	Southbound	3	11.8	B	22.9	C

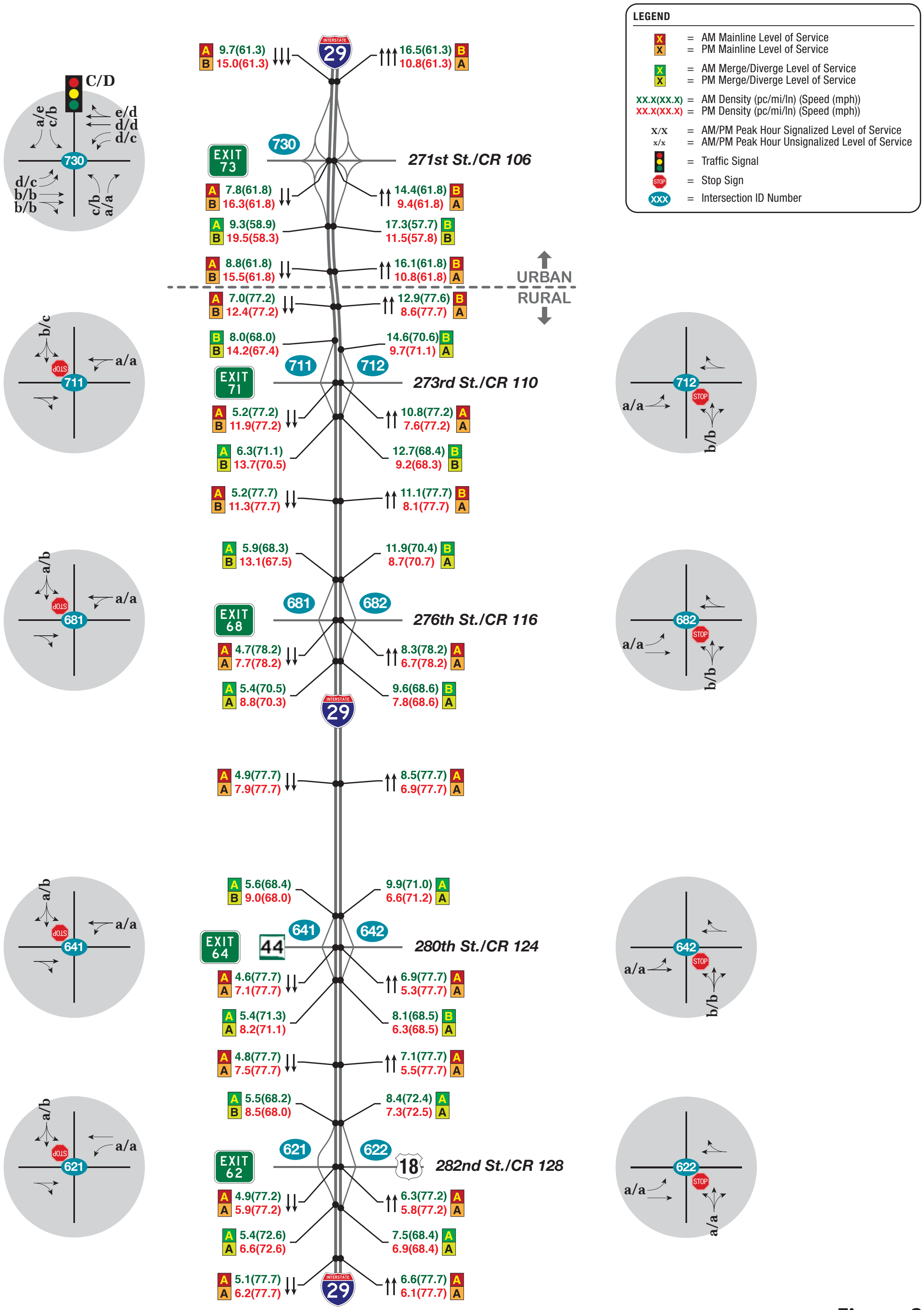


Figure 2-3

2017 Existing Traffic Conditions

NOTE: Drawing Not to Scale

NORTH

2.5.3 Merge/Diverge Analysis

The HCS7 software was also used in the merge/diverge analysis at the I-29 ramps. In both the AM and PM peak hours, all the I-29 ramps currently meet the minimum freeway operations goal. **Table 2-5** and **Figure 2-3** show the merge/diverge analysis results for 2017 conditions. **Appendix H** includes HCS7 ramp and ramp junction worksheets for the 2017 traffic conditions scenario.

Table 2-5. 2017 Merge/Diverge Analysis

Interchange	Ramp	Number of Lanes			AM Peak Hour		PM Peak Hour	
		Mainline	Ramp	Total	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS
Exit 62 (Diamond)	NB Off-Ramp	2	Decel	2	7.5	A	6.9	A
	NB On-Ramp	2	Accel	2	8.8	A	7.8	A
	SB Off-Ramp	2	Decel	2	5.5	A	8.5	A
	SB On-Ramp	2	Accel	2	5.7	A	6.9	A
Exit 64 (Diamond)	NB Off-Ramp	2	Decel	2	8.1	A	6.3	A
	NB On-Ramp	2	Accel	2	9.9	A	6.6	A
	SB Off-Ramp	2	Decel	2	5.6	A	9.0	A
	SB On-Ramp	2	Accel	2	5.4	A	8.2	A
Exit 68 (Diamond)	NB Off-Ramp	2	Decel	2	9.6	A	7.8	A
	NB On-Ramp	2	Accel	2	11.9	B	8.7	A
	SB Off-Ramp	2	Decel	2	5.9	A	13.1	B
	SB On-Ramp	2	Accel	2	5.4	A	8.8	A
Exit 71 (Diamond)	NB Off-Ramp	2	Decel	2	12.7	B	9.2	A
	NB On-Ramp	2	Accel	2	9.3	A	9.7	A
	SB Off-Ramp	2	Decel	2	8.0	A	14.2	B
	SB On-Ramp	2	Accel	2	6.3	A	13.7	B
Exit 73 (Single Point)	NB Off-Ramp	2	Decel	2	17.3	B	11.5	B
	NB On-Ramp	2	1	3	Add lane, no merge			
	SB Off-Ramp	2	1	3	Drop lane, no diverge			
	SB On-Ramp	2	Accel	2	7.9	A	16.6	B

2.5.4 Ramp Check Analysis

HCM 6th Edition, Exhibit 14-12 was used to analyze traffic operations on the study interchange ramps. Based on the ramps free flow speed (FFS) and the number of lanes on the ramp, an estimated capacity was obtained. All ramp volumes were converted to peak flow rates using the peak hour factor (PHF). The capacity of the ramp was then compared to the peak flow rate of the ramp to obtain a volume to capacity ratio (V/C ratio). If the V/C ratio is greater than 1.0, the ramp is determined to be over capacity based on the HCM ramp check methodologies. **Table 2-6** shows the V/C ratios for all study area ramps for the 2017 existing traffic conditions. All ramps in the study area currently operate under capacity during the 2017 existing peak hours.

Table 2-6. 2017 Existing Ramp Check Analysis

Ramp	No. of Lanes	Ramp FFS (mi/h)	AM Peak Hour				PM Peak Hour			
			Volume	Peak Flow Rate	Capacity	V/C Ratio	Volume	Peak Flow Rate	Capacity	V/C Ratio
NB I-29 Exit 62 Off-Ramp	1	45	45	52	2,100	0.02	44	52	2,100	0.02
NB I-29 Exit 62 On-Ramp	1	45	186	235	2,100	0.11	138	153	2,100	0.07
NB I-29 Exit 64 Off-Ramp	1	45	26	35	2,100	0.02	33	36	2,100	0.02
NB I-29 Exit 64 On-Ramp	1	45	204	314	2,100	0.15	82	109	2,100	0.05
NB I-29 Exit 68 Off-Ramp	1	45	13	24	2,100	0.01	15	16	2,100	0.01
NB I-29 Exit 68 On-Ramp	1	45	332	369	2,100	0.18	147	173	2,100	0.08
NB I-29 Exit 71 Off-Ramp	1	45	60	85	2,100	0.04	79	90	2,100	0.04
NB I-29 Exit 71 On-Ramp	1	45	304	371	2,100	0.18	173	194	2,100	0.09
NB I-29 Exit 73 Off-Ramp	1	45	189	220	2,100	0.10	152	173	2,100	0.08
NB I-29 Exit 73 On-Ramp	1	45	1053	1,284	2,100	0.61	715	831	2,100	0.40
SB I-29 Exit 73 Off-Ramp	1	45	591	687	2,100	0.33	936	1,029	2,100	0.49
SB I-29 Exit 73 On-Ramp	1	45	109	116	2,100	0.06	179	239	2,100	0.11
SB I-29 Exit 71 Off-Ramp	1	45	150	165	2,100	0.08	267	361	2,100	0.17
SB I-29 Exit 71 On-Ramp	1	45	52	72	2,100	0.03	62	93	2,100	0.04
SB I-29 Exit 68 Off-Ramp	1	45	91	103	2,100	0.05	315	354	2,100	0.17
SB I-29 Exit 68 On-Ramp	1	45	16	20	2,100	0.01	18	28	2,100	0.01
SB I-29 Exit 64 Off-Ramp	1	45	65	72	2,100	0.03	169	188	2,100	0.09
SB I-29 Exit 64 On-Ramp	1	45	31	40	2,100	0.02	33	42	2,100	0.02
SB I-29 Exit 62 Off-Ramp	1	45	102	121	2,100	0.06	159	189	2,100	0.09
SB I-29 Exit 62 On-Ramp	1	45	28	29	2,100	0.01	35	40	2,100	0.02

2.5.5 Intersection Operations Analysis

The HCS7 software was used to analyze traffic operations at the study intersections. **Figure 2-3** shows the lane geometry, traffic control, and LOS for 2017 traffic conditions. The lane configurations at all study intersections are based on existing geometrics. **Appendix H** includes capacity analysis worksheets for the 2017 existing traffic conditions scenario.

Most intersections in the study area operate at acceptable levels of service (LOS C or better on urban principal and minor arterial roadways and LOS B or better on rural principal and minor arterial roadways) in the peak hours in 2017. Two study intersections do not operate at acceptable LOS:

- The Single Point Interchange intersection of the I-29 Exit 73 ramp terminals with 271st Street / CR 106 operates at LOS D overall in the PM peak hour.
- The southbound approach at the intersection of the southbound I-29 Exit 71 ramp terminal with 273rd Street / CR 110 operates at LOS C in the PM peak hour.

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 was 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, 2012, through December 31, 2016, using crash data provided by the SDDOT. The number, severity, and rate of collisions on the mainline segments, ramps, and ramp intersections will be discussed in detail in this section.

Crash rates were developed for study area mainline segments, ramps, and ramp intersections. In addition, a weighted crash rate was also calculated. To calculate this rate, weight factors, as shown in **Table 2-7**, are applied to specific crash types and crash severity. Crashes with higher severity are given a higher weight. This allows for mainline segments, ramps, or ramp intersections that may have a low number of crashes, equaling a lower crash rate, but those crashes are of high severity be compared to locations with a high number of crashes, all with low severity.

Table 2-7. 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 2-8** shows these rates for both urban and rural segments. Tables throughout this section highlight in yellow those locations with weighted crash rates above the average statewide weighted crash rate.

Table 2-8. SDDOT State Highway System Weighted Crash Rates

Classification	Weighted Rate
Rural Interstate	0.9
Urban Interstate	1.09

Figure 2-4 presents developed crash rates and weighted crash rates for the study area.

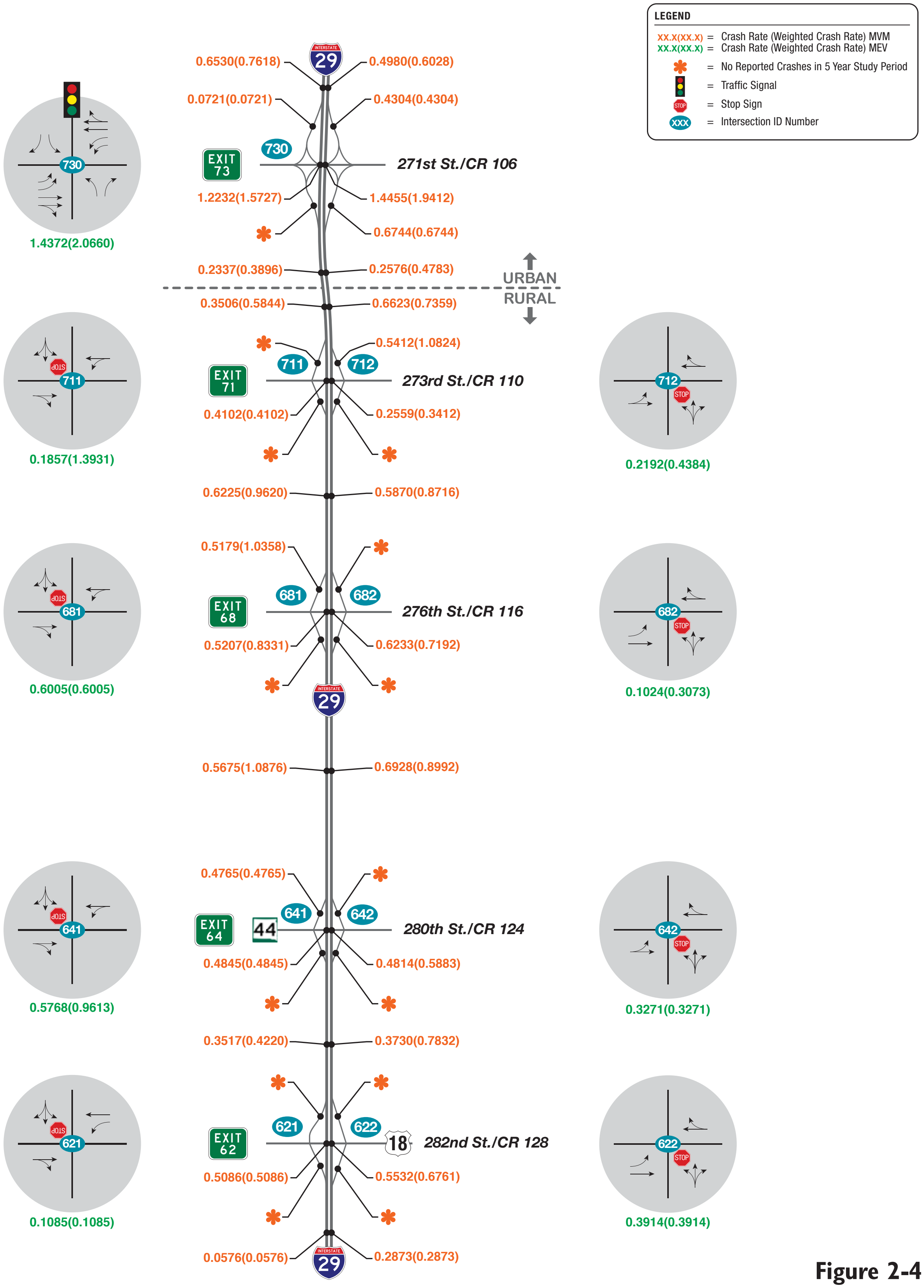


Figure 2-4
Crash History
2012 - 2016

NOTE: Drawing Not to Scale

NORTH

2.6.1 Interstate 29 Mainline Segments

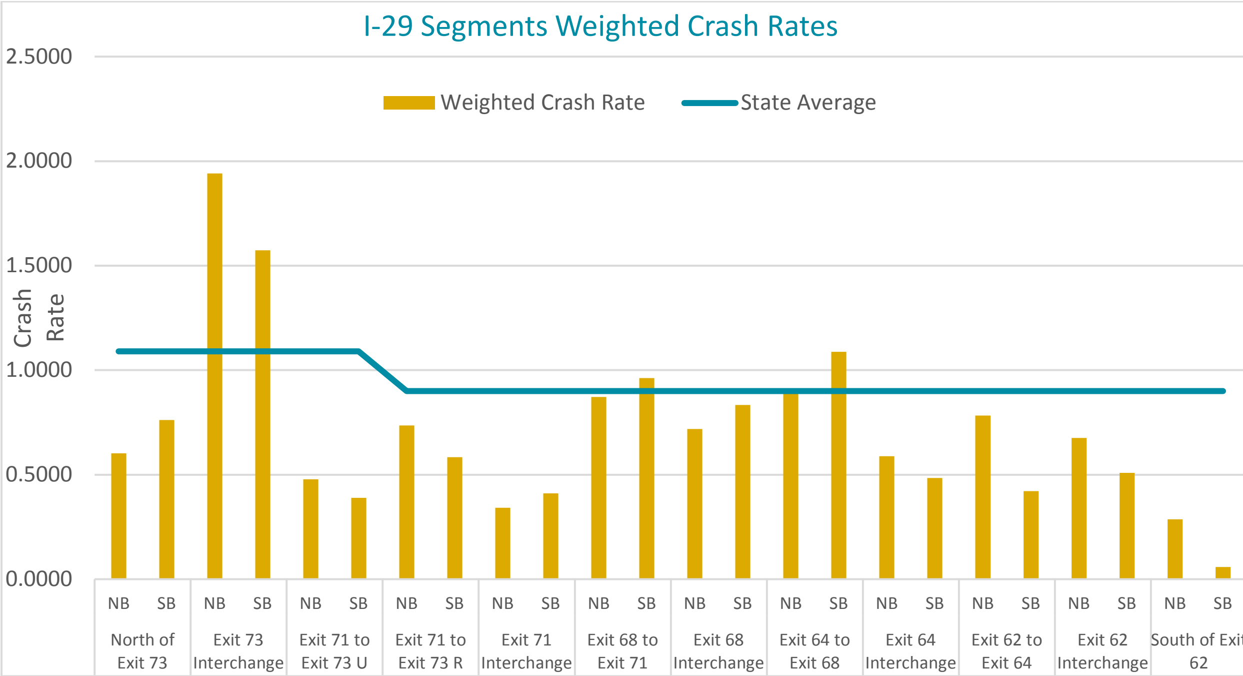
Over the 5-year analysis period, 395 crashes occurred along the mainline segments of I-29. **Table 2-9** displays the crash summary for the mainline segment in the study area. Two urban segments and two rural segments of I-29 have higher weighted crash rates than the statewide average. These four segments are highlighted in yellow and a more detailed analysis is provided for these locations.

Table 2-9. Interstate 29 Crash Data by Mainline Segment (2012–2016)

Segment	Direction	PDO		Injury			Fatal	Crash Rate Per MVM	Weighted Crash Rate	
		Wild Animal	No Injury	Possible	Non-incapacitating	Incapacitating				
North of Exit 73	NB	3	13	1	0	1	0	0.4980	0.6028	Urban
	SB	6	16	2	0	0	0	0.6530	0.7618	
Exit 73 Interchange	NB	2	27	3	3	0	0	1.4455	1.9412	
	SB	3	21	1	2	1	0	1.2232	1.5727	
Exit 71 to Exit 73 (Urban)	NB	3	1	0	2	1	0	0.2576	0.4783	
	SB	1	3	1	1	0	0	0.2337	0.3896	
Exit 71 to Exit 73 (Rural)	NB	10	7	1	0	0	0	0.6623	0.7359	Rural
	SB	2	3	2	1	0	0	0.3506	0.5844	
Exit 71 Interchange	NB	0	5	1	0	0	0	0.2559	0.3412	
	SB	5	4	0	0	0	0	0.4102	0.4102	
Exit 68 to Exit 71	NB	11	14	6	2	0	0	0.5870	0.8716	
	SB	10	14	4	2	3	0	0.6225	0.9620	
Exit 68 Interchange	NB	3	7	0	1	0	0	0.6233	0.7192	
	SB	2	5	2	0	1	0	0.5207	0.8331	
Exit 64 to Exit 68	NB	9	30	2	2	3	0	0.6928	0.8992	
	SB	9	15	9	2	0	0	0.5675	1.0876	
Exit 64 Interchange	NB	2	5	0	1	0	0	0.4814	0.5883	
	SB	4	5	0	0	0	0	0.4845	0.4845	
Exit 62 to Exit 64	NB	2	7	0	0	0	1	0.3730	0.7832	
	SB	4	5	0	1	0	0	0.3517	0.4220	
Exit 62 Interchange	NB	2	6	0	0	0	0	0.5532	0.6761	
	SB	4	5	0	0	0	0	0.5086	0.5086	
South of Exit 62	NB	2	3	0	0	0	0	0.2873	0.2873	
	SB	0	1	0	0	0	0	0.0576	0.0576	

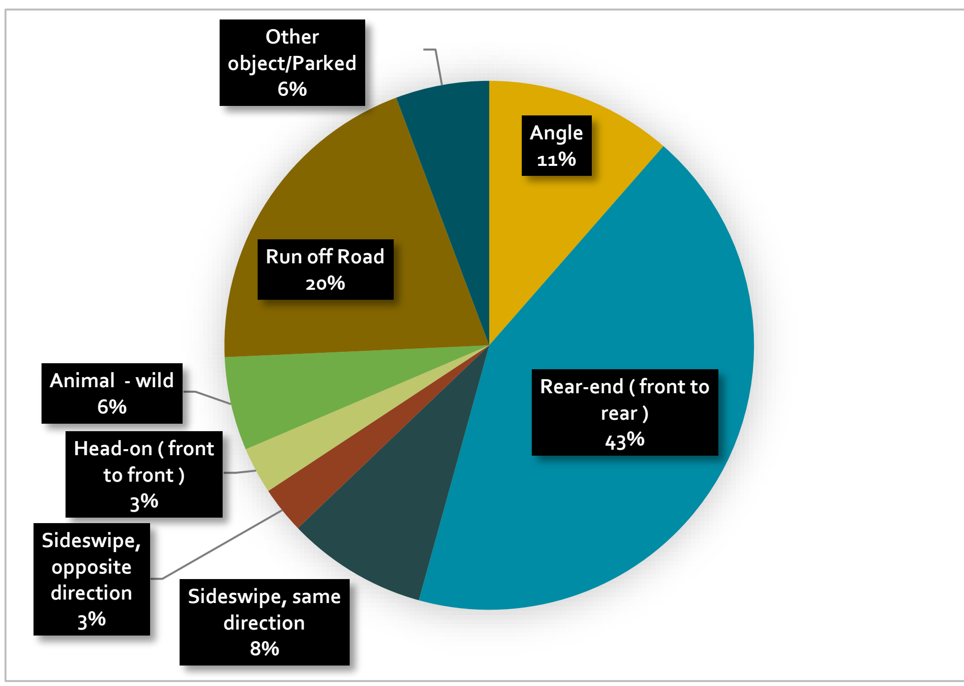
Figure 2-5 visually displays the breakdown of crash rates by segment on I-29 for the study area. The figure illustrates three things: location, segment crash rates, and statewide crash rates. The axis on the left of the bar graph identifies the number of crash rates on each segment during the five-year study period. The blue line on the graph represents the SDDOT state average rate for comparable facilities.

Figure 2-5. Crash Rate Summary



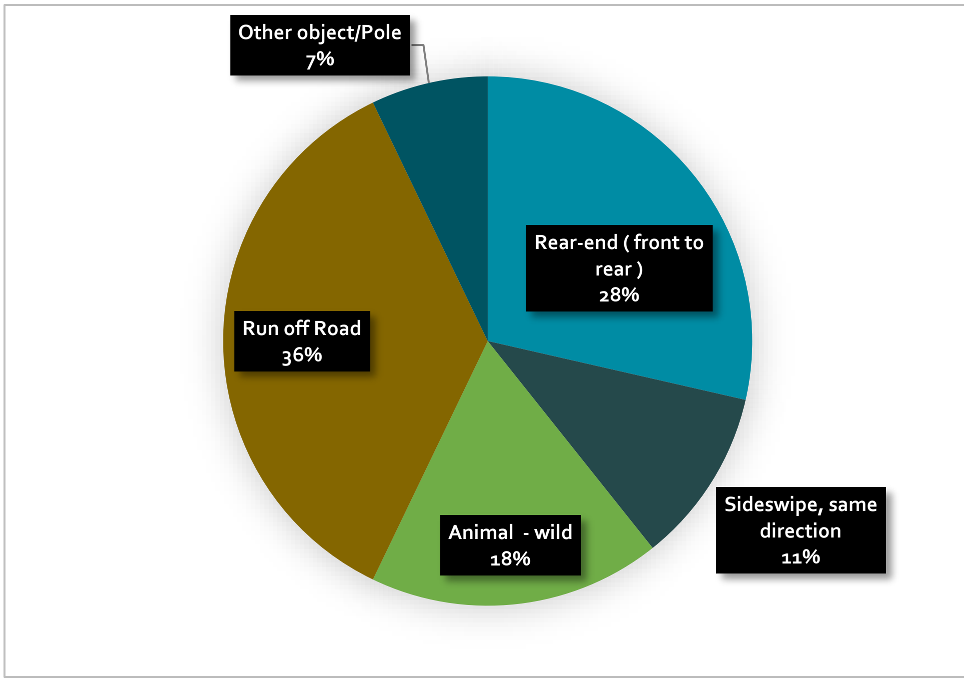
2.6.2 Northbound I-29 between Exit 73 Off-ramp and Exit 73 On-ramp

This segment extends from the Exit 73 off-ramp to the Exit 73 on-ramp along northbound I-29. As shown in **Table 2-9**, this section of I-29 had 35 total crashes during the 5-year study period with 6 of the crashes resulting in injuries. The pie chart to the right shows the breakdown of crashes by type. As shown, the predominant crash types are rear-ends with approximately 43 percent of the total crashes and run-off the road at 20 percent; however, none of the crash types were statistically significant in this segment of the I-29 corridor. The pattern of crashes could be contributed to queuing on I-29 during the construction of the I-29/I-229 interchange.



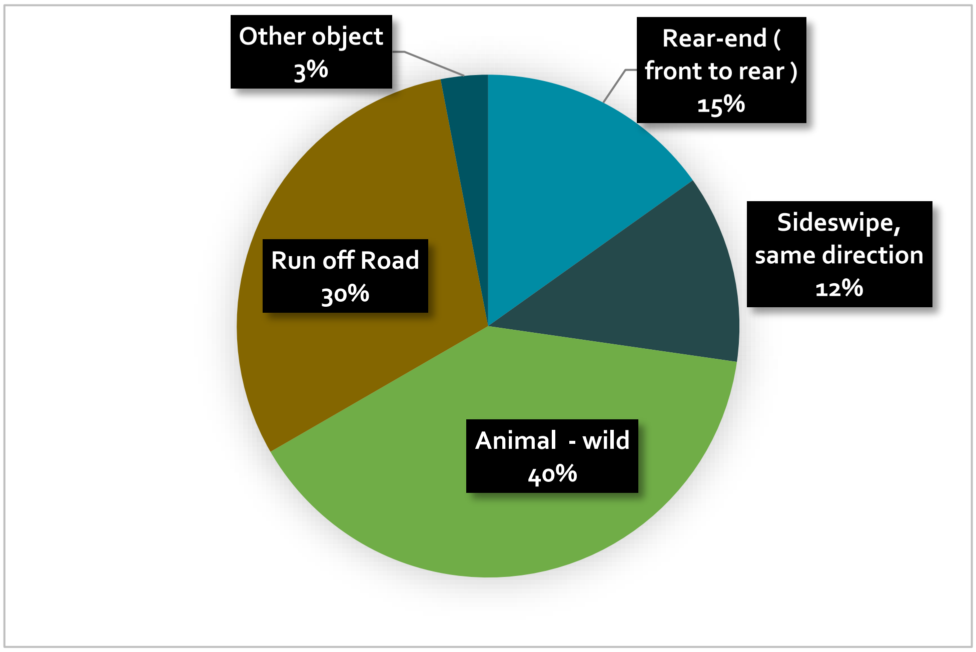
2.6.3 Southbound I-29 between Exit 73 Off-ramp and Exit 73 On-ramp

This segment extends from the Exit 73 off-ramp to the Exit 73 on-ramp along southbound I-29. As shown in **Table 2-9**, this section of I-29 had 28 total crashes during the 5-year study period with 4 of the crashes resulting in injuries. The pie chart to the right shows the breakdown of crashes by type. As shown, the predominant crash types are run-off the road with approximately 36 percent of the total crashes and rear-ends at 28 percent; however, none of the crash types were statistically significant in this segment of the I-29 corridor.



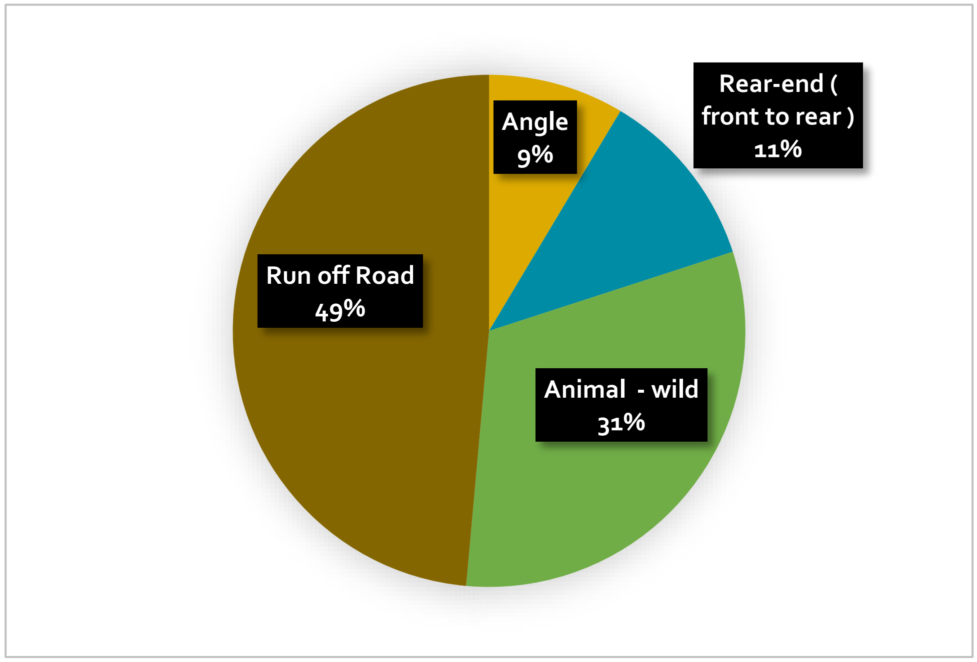
2.6.4 Southbound I-29 between Exit 71 On-ramp and Exit 68 Off-ramp

This segment extends from the Exit 71 on-ramp to the Exit 68 off--ramp along southbound I-29. As shown in **Table 2-9**, this section of I-29 had 33 total crashes during the 5-year study period with 9 of the crashes resulting in injuries. The pie chart to the right shows the breakdown of crashes by type. As shown, the predominant crash types are wild animal collisions with approximately 40 percent of the total crashes and run-off the road at 30 percent; however, none of the crash types were statistically significant in this segment of the I-29 corridor.



2.6.5 Southbound I-29 between Exit 68 On-ramp and Exit 64 Off-ramp

This segment extends from the Exit 68 on-ramp to the Exit 64 off-ramp along southbound I-29. As shown in **Table 2-9**, this section of I-29 had 35 total crashes during the 5-year study period with 11 of the crashes resulting in injuries. The pie chart to the right shows the breakdown of crashes by type. As shown, the predominant crash types are run-off the road with approximately 49 percent of the total crashes and wild animal collisions at 31 percent; however, none of the crash types were statistically significant in this segment of the I-29 corridor.



2.6.6 Interstate 29 Ramp Terminal Intersections

Over the 5-year analysis period, 81 crashes occurred at the interchange ramp terminals of I-29. **Table 2-10** displays the crash summary for the intersections in the study area. There is one urban intersection and two rural intersections with higher weighted crash rates per million entering vehicles (MEV) than the statewide average. These three segments are highlighted in yellow and a more detailed analysis is provided for these locations.

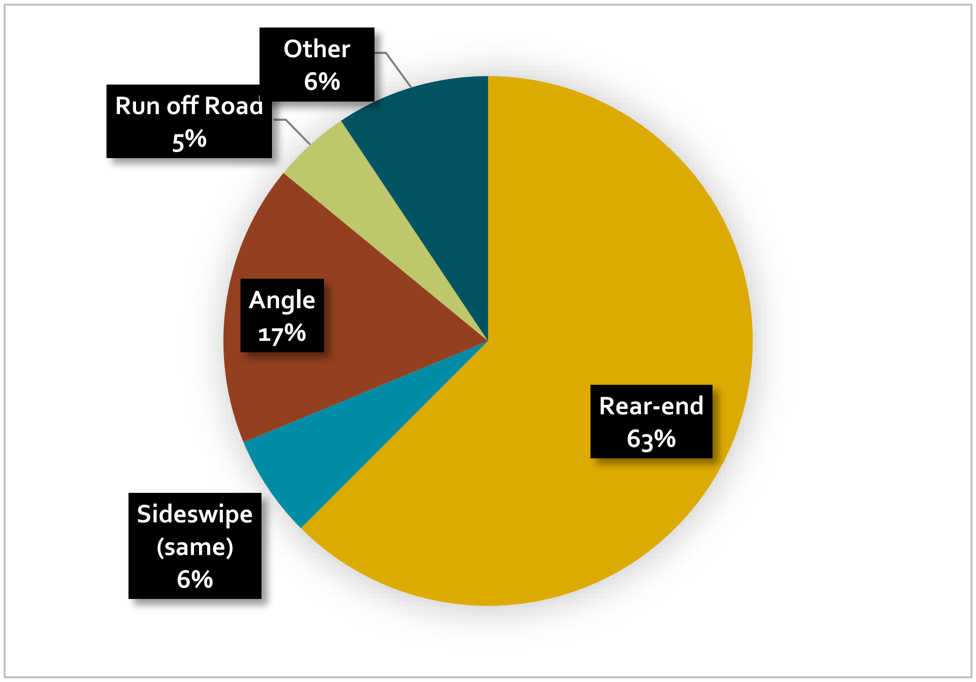
Table 2-10. Interstate 29 Crash Data by Ramp Intersection (2012–2016)

Ramp Intersection ID Number	PDO		Injury			Fatal	Crash Rate Per MEV	Weighted Crash Rate	
	Wild Animal	No Injury	Possible	Non-incapacitating	Incapacitating				
730*	0	50	13	1	0	0	1.4372	2.0660	Urban
712	0	1	1	0	0	0	0.2192	0.4384	Rural
711	0	0	1	0	0	1	0.1857	1.3931	
682	0	0	0	0	1	0	0.1024	0.3073	
681	0	4	0	0	0	0	0.6005	0.6005	
642	0	2	0	0	0	0	0.3271	0.3271	
641	0	2	1	0	0	0	0.5768	0.9613	
622	0	2	0	0	0	0	0.3914	0.3914	
621	0	1	0	0	0	0	0.1085	0.1085	

*Single Point Interchange (SPI)

2.6.7 Exit 73 – Single Point Interchange

As shown in **Table 2-10**, the SPI intersection at Exit 73 had 64 total crashes during the 5-year study period with 14 of the crashes resulting in injuries. The pie chart to the right shows the breakdown of crashes by type. As shown, the predominant crash types are rear-ends with approximately 63 percent of the total crashes; however, none of the crash types were statistically significant in this segment of the I-29 corridor. The pattern of crashes could be contributed to queuing on I-29 during the construction of the I-29/I-229 interchange



2.6.8 Exit 71 – Southbound Ramp Terminal

As shown in **Table 2-10**, the I-29 Exit 71 Southbound Ramp Terminal had two total crashes during the 5-year study period, with one of the crashes resulting in injury and the other being a fatality. With only two crashes at this intersection there is no identifiable crash pattern. The fatality was an angle collision involving a motorcycle and passenger car. The injury accident was also an angle type collision and occurred due to a vehicle sliding through a stop sign during snowy/icy conditions.

2.6.9 Exit 64 – Southbound Ramp Terminal

As shown in **Table 2-10**, the I-29 Exit 64 Southbound Ramp Terminal had three total crashes during the 5-year study period, with one of the crashes resulting in injury. All three crashes were angle type collisions; however, none of the crash types were statistically significant at this intersection.

2.6.10 Interstate 29 Ramps

Over the 5-year analysis period, 14 crashes occurred on the interchange ramps of I-29. Of the 20 ramps analyzed, crashes occurred on only 6 of them. **Table 2-11** displays the crash summary for the ramp segments in the study area. Two rural interchange ramps highlighted in yellow had a higher weighted crash rates per million vehicle miles (MVM) than the statewide average. A more detailed analysis is provided for these locations.

Table 2-11. Interstate 29 Crash Data by Ramp (2012–2016)

Ramp	PDO		Injury			Fatal	Crash Rate	Weighted Crash Rate	
	Wild Animal	No Injury	Possible	Non-incapacitating	Incapacitating		Per MVM		
Exit 73 NB On-Ramp	0	6	0	0	0	0	0.4304	0.4304	
Exit 73 SB Off-Ramp	0	1	0	0	0	0	0.0721	0.0721	
Exit 73 NB Off-Ramp	0	2	0	0	0	0	0.6744	0.6744	
Exit 73 SB On-Ramp	0	0	0	0	0	0	0	0	Urban
Exit 71 NB On-Ramp	0	1	0	1	0	0	0.5412	1.0824	Rural
Exit 71 SB Off-Ramp	0	0	0	0	0	0	0	0	
Exit 71 NB Off-Ramp	0	0	0	0	0	0	0	0	
Exit 71 SB On-Ramp	0	0	0	0	0	0	0	0	
Exit 68 NB On-Ramp	0	0	0	0	0	0	0	0	
Exit 68 SB Off-Ramp	0	1	0	0	1	0	0.5179	1.0358	
Exit 68 NB Off-Ramp	0	0	0	0	0	0	0	0	
Exit 68 SB On-Ramp	0	0	0	0	0	0	0	0	
Exit 64 NB On-Ramp	0	0	0	0	0	0	0	0	
Exit 64 SB Off-Ramp	0	1	0	0	0	0	0.4765	0.4765	
Exit 64 NB Off-Ramp	0	0	0	0	0	0	0	0	
Exit 64 SB On-Ramp	0	0	0	0	0	0	0	0	
Exit 62 NB On-Ramp	0	0	0	0	0	0	0	0	
Exit 62 SB Off-Ramp	0	0	0	0	0	0	0	0	
Exit 62 NB Off-Ramp	0	0	0	0	0	0	0	0	
Exit 62 SB On-Ramp	0	0	0	0	0	0	0	0	

2.6.11 Exit 71 – Northbound On-Ramp

As shown in **Table 2-11**, the I-29 Exit 71 northbound on-ramp had two total crashes during the 5-year study period with one of the crashes resulting in injury. Both crashes were angle type collisions. However, none of the other crash types were statistically significant at this location.

2.6.12 Exit 68 – Southbound Off-Ramp

As shown in **Table 2-11**, the I-29 Exit 68 southbound off-ramp had two total crashes during the 5-year study period with one of the crashes resulting in injury. Both crashes were angle type collisions. However, none of the crash types were statistically significant at this intersection.

Overall, the most frequently observed crash patterns at the existing ramp intersections, ramps, and mainline segments were no injury or wild animal types, representing approximately 61 percent and 21 percent of the collisions, respectively.

2.7 SAFETY HOT SPOT ANALYSIS

SDDOT provided the GIS data used to complete a hot spot analysis. The optimized hot spot analysis tool in ArcGIS function was used by evaluating the input crash data to obtain settings that will yield optimal hot spot results. The tools aggregate the incidents into weighted features. Using the distribution of the weighted features, the tools identify an appropriate scale of analysis. The statistical significance reported in the output features were automatically adjusted for multiple testing and spatial dependence using the False Discovery Rate correction method. The statistical equation for this technique is as follows:

$$G_i^*(d) = \frac{\sum_j w_{ij}(d)x_j - W_i^*\bar{x}^*}{s^*\{[(nS_{1i}^*) - W_i^{*2}]/(n-1)\}^{1/2}}, \quad \text{for all } j,\ x_j \neq 0$$

Based on the predominant crash types in the study corridor, the data was summarized in two categories: roadway departure and wildlife-vehicle crashes. **Figure 2-6** and **Figure 2-7** display roadway departure crash density and hot spots. **Figure 2-8** and **Figure 2-9** display wildlife-vehicle crash density and hot spots.

The confidence levels noted in the figures describe probability. For example, the “99% confidence level” means that there is a 1 in 100 chance that the observation location occurred naturally; i.e., what is observed is extremely unusual and is noted as a hot spot. It should be noted that the data points tended to be clustered at Mile Reference Marker points due to the method of reporting in the SDDOT system.

Upon analysis, the only segment of I-29 where statistically significant Roadway Departure hot spots were identified was north of Exit 73, between 271st Street/CR 106 and 85th Street. This segment of I-29 is on the extreme north end of the study area.

There were no segments of I-29 where Wildlife-Vehicle hot spots were identified as statistically significant.

Figure 2-6. Roadway Departure Crash Density

Figure 2-7. Roadway Departure Hot Spots

Figure 2-8. Wildlife-Vehicle Collision Crash Density

Figure 2-9. Wildlife-Vehicle Collision Hot Spots

2.8 INTELLIGENT TRANSPORTATION SYSTEMS

2.8.1 Intelligent Transportation System Service Packages

The services provided through implementing ITS projects are organized into service packages—a term used by FHWA and the National ITS Architecture to describe a category of ITS projects or services. Potential ITS service packages from the *National ITS Architecture 7.0* (a service package representing the collection of one or more ITS devices working together) appropriate for the study area include:

- **Traveler Information.** Traveler information is any trip-related information provided to a traveler or potential traveler. Information includes traffic conditions, availability and conditions of public transportation, and availability of parking. In its broadest sense, traveler information may include traditional road signage and maps; however, the focus is on information produced by advanced traveler information systems.
- **Traffic Management**. Encompasses the range of active devices to address, real-time traffic congestion and safety concerns across all travel modes.
- **Emergency Management**. Includes coordinated efforts of management plans and devices to reduce the congestion, potential for secondary crashes, and shorten clearance intervals.
- **Maintenance and Construction Management**. Plans and devices that focus on the shorter-term safety and congestion concerns associated with larger maintenance and reconstruction activities.

2.8.2 Existing Intelligent Transportation System Infrastructure

Within the current study area from Exit 61 to Exit 73, there are few existing ITS elements. **Table 2-12** documents the range of ITS infrastructure element deployed in the state and if they are implemented along this segment of I-29.

Table 2-12. Intelligent Transportation System Elements Deployed in South Dakota

Device	Description	Located in Study Limits
Dynamic Message Sign (DMS)	Pole mounted, single-sided Spread spectrum radio communication Roadway Management Announcements	No
Road Closure Gates/Signs	Manually operated No electronic monitoring	Yes – Exit 73
Road Weather Information System (RWIS)	Installation measures/records temperature, wind speed/direction, precipitation, pavement condition (temperature, wetness, chemical freezing point), subsurface conditions (temperature)	No – Located at MRM 59
Automatic Traffic Recorder	Continuously records traffic data, including speed and vehicle classification Communication via dial-up modem	No – Not in close proximity
Closed Circuit Television Camera (CCTV)	Dome style camera with pan, tilt, zoom capabilities mounted on a pole	No – MRM 59 (coordinated with RWIS)
Variable Speed Limit Signs	Displays a range of reduced speed limits based on travel and weather conditions recorded using RWIS and live observers	No – None deployed in state

Present in the I-29 corridor are road closure gates and signs at Exit 73 that are deployed manually when needed. Adjacent to the immediate corridor are a limited number of devices, including:

- **Dynamic Message Sign (DMS)**. Located on southbound I-29 approximately 775 feet south of the proposed 85th Street crossing.
- **Road Weather Information System (RWIS)**. Located on I-29 at MRM 59 (US 18 West). Included with the RWIS station is a closed circuit camera capable of looking northbound, southbound, and at the road surface.

2.9 INCIDENT, WEATHER, AND SPECIAL EVENT ANALYSIS

Traditionally, defining the need for network improvements and comparing alternatives from an operations perspective have relied on LOS assessments of the current conditions in the future without improvements and/or the potential change when any one of a range of alternatives is implemented. A more recent addition to the analysis and screening toolbox is the evaluation of travel time reliability experienced by highway users under a range of conditions. It involves reviewing a longer duration of travel time records – one year, for example – to understand the variability throughout that period. Reliability evaluation also aims to identify and quantify the causes of unreliable travel; common factors that contribute to this include weather, crashes, incidents, road work, and special events.

Addressing reliability is important because variation in travel time creates uncertainty in on-time arrival, which leads to travelers needing to adjust schedules in real time to ensure they get to where they want to be / need to be at a specific time. A congested but consistent commute is easier to plan for than a less congested but unreliable commute. The purpose of the reliability analysis for the I-29 Corridor Study is to understand factors that can contribute to unreliable travel time conditions and the potential impacts being observed today. Reliability results were developed using 2016 travel time, crash, and weather data and are presented in a memorandum as **Appendix E**.

2.9.1 Key Reliability Analysis Findings

Key findings of the I-29 Corridor reliability assessment include:

- Recurring congestion was not observed at any locations along the I-29 mainline.
- Most non-recurring events are weather related and did not result in significant levels of congestion or associated crashes. In 2016, there were three longer term (more than two hours) events when vehicle travel time ratios exceeded 1.5, and each was associated with a winter weather event.
- Areas north of the study area along both I-229 and I-29 were evaluated as surrogates for future conditions along I-29 in the current study area. A similar review of travel time indexes over the 2016 calendar year resulted in observation of little recurring congestion. Along the same sections that experience more traffic than I-29 today in the current study area experience only limited non-recurring congestion. Most periods of elevated travel time indexes were connected to a small number of severe winter events.
- The project study team observed traffic on the I-29 Corridor during the peak travel days before the 2017 Sturgis Motorcycle Rally on August 3-4, 2017. No significant congestion or concerns were noted related to increased motorcycle traffic in the I-29 Corridor Study area.

3.0 ENVIRONMENTAL REVIEW

This chapter specifically discusses environmental, social, and economic resources that could be impacted by proposed alternatives for the corridor.

3.1 INTRODUCTION

3.1.1 Environmental Study Area

An overall environmental study area (ESA) for this corridor study was defined as a 500-foot buffer around the I-29 alignment from Exit 62 to Exit 73 (**Figure 3-1**) and included 0.5 mile east and west along the cross routes of each interchange. The overall ESA encompasses an area of sufficient size to address environmental matters on a broad scale for a wide range of potential transportation improvements.

Separate reviews using an Initial Environmental Review (IER) data form were also completed for three areas of the corridor that may be constructed as separate phases of the project (**Appendix D**). The three areas evaluated separately are described in the following sections.

- **I-29 Mainline Improvements**. This proposed phase includes the same I-29 corridor as the overall study but does not include the reconstruction of any interchanges. The anticipated improvements considered for this phase include reconstructing northbound and southbound lanes and exit ramps; one additional freeway lane north and southbound constructed north of Exit 68 and continued to Exit 73; turn lane modifications at 271st Street (Exit 73) and 276th Street (Exit 68) for exit ramps; and ramp length modifications south of Exit 68, north and south of Exit 64, and north of Exit 62.
- **Exit 71 Improvements**. This proposed phase includes Exit 71 (approximately MRM 70.85 to MRM 71.85) and 273rd Street east and west of I-29. The western and eastern limits of the ESA on 273rd Street extend to the first section road. The anticipated improvements considered for this phase include interchange reconstruction; access drive closure west of I-29 on 273rd Street; and access drive modifications east of I-29 on 273rd Street.
- **Exit 64 Improvements**. This proposed phase includes Exit 64 (approximately MRM 63.75 to MRM 65.00), SD 44 west of I-29, and 280th Street east of I-29. The western limits on SD 44 and eastern limits on 280th Street of the ESA extend to the first section road. The anticipated improvements considered for this phase include interchange reconstruction; access drive modifications west of I-29 on SD 44, and access drive modifications east of I-29 on 280th Street.

3.1.2 Environmental Setting

The project corridor is in the Central Lowlands Physiographic Region of eastern South Dakota with the northern portion located in the Coteau de Prairies physical division and the remainder of the project located in the James River Lowland physical division. Most of the topographic features in these divisions are the result of glaciers. The elevation decreases from north to south and ranges from approximately 1,510 to 1,310 feet above sea level. The project corridor is located in the Northern Glaciated Plains Ecoregion of South Dakota, characterized by a flat to gently rolling landscape composed of glacial drift (i.e., Illinoian glacial sediments). The project corridor also occurs in the Prairie Pothole Region, consisting of a high concentration of temporary and seasonal wetlands. The historic tall and shortgrass prairies have largely been converted to row crop agriculture.

3.1.3 Methodology

The environmental overview focused on collecting readily available environmental resource information to assist SDDOT with planning level information for the I-29 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 would guide further evaluation and analysis during subsequent project development phases.

For this reason, recommendations are provided to address potential impacts or to identify when additional information is needed during project development. The overview does not include detailed quantitative information on environmental impacts due to the existing level of project scope information. The environmental overview does not include several environmental resources with regulatory drivers because they were either absent within the ESA or not applicable to the study. For example, Wild and Scenic Rivers are not present in the ESA, and Coastal Zone Management is not applicable to the study.

The environmental team completed a windshield survey of the ESA on June 30, 2017. The team collected GIS and other electronic data and coordinated with agencies to conduct the environmental overview.

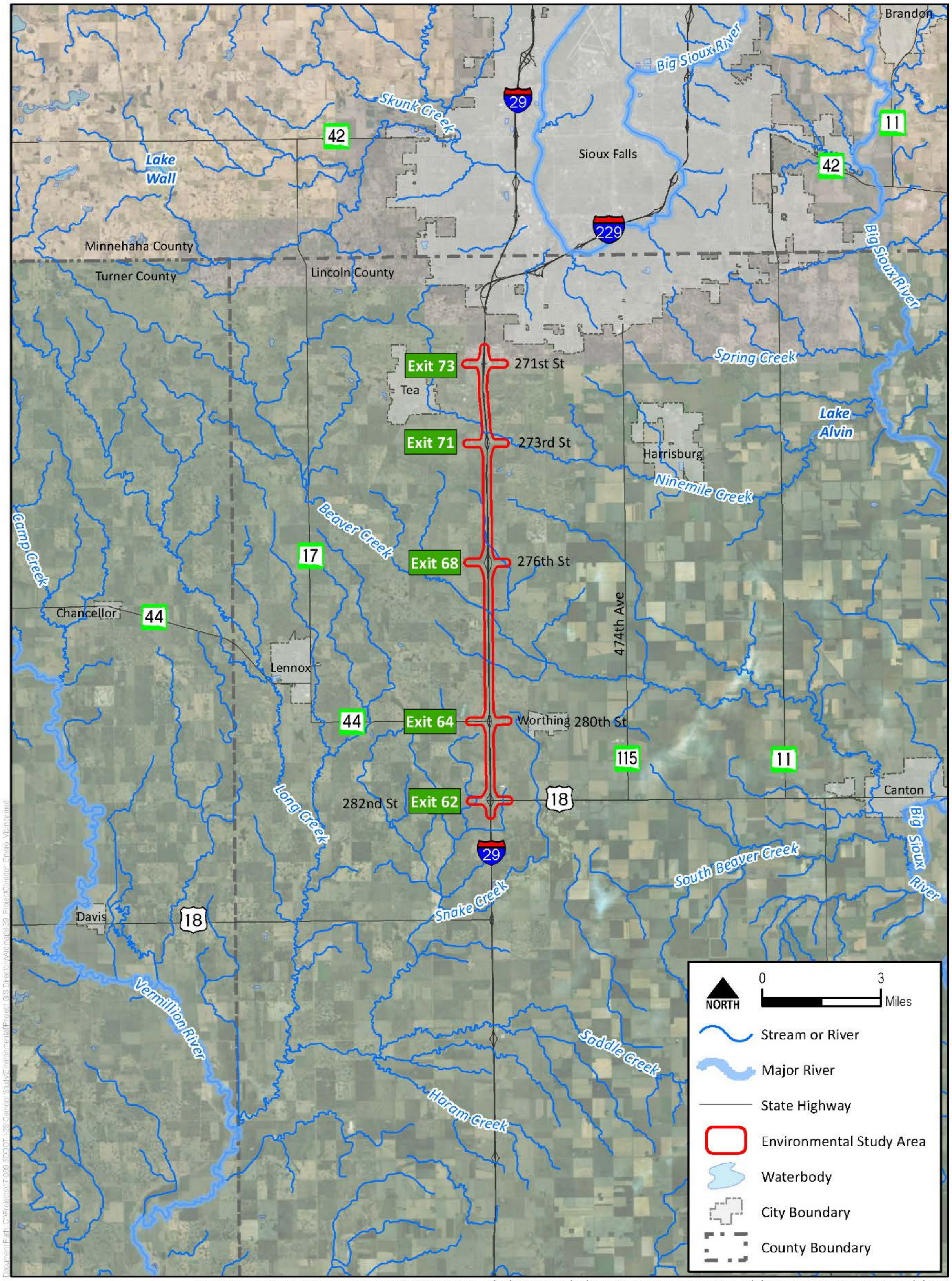
3.1.4 Environmental Data Sources and Resources

The following sources were used to evaluate the proposed project:

- South Dakota GIS web maps
- Parks, Recreational, & Open Space / Federal Lands (Section 4(f))
- Land and Water Conservation Fund (LWCF) project sites (Section (6f))
- Historic Sites Survey and Structures, Districts, and other Cultural Resources
- Reservations and Tribal Lands
- National Park Service / Native American Graves Protection & Repatriation Act
- National Association of Tribal Historical Preservation Office resources
- National Wetland Inventory
- Federal Emergency Management Agency (FEMA) Flood Hazard Zones
- US Fish and Wildlife Service (USFWS) Critical Habitat for Threatened and Endangered Species
- South Dakota Game, Fish, and Parks (SDGFP) wildlife interactive map
- South Dakota Department of Environment and Natural Resources (SDDENR) interactive maps
- US Environmental Protection Agency's (EPA) Facility Registry Service (FRS)
- Water Quality (impaired waters, wellhead protection, drinking water, stormwater) (SDDENR)
- Natural Resources Conservation Service (NRCS) Web Soil Survey (farmland classification)

The following sections summarize the existing conditions for the overall ESA for the evaluated resources. Potential impacts and/or recommended steps for later phases of project development are summarized for each resource, including a summary of differences, if any, between the potential phases of the project evaluated in the IERs.

Figure 3-1. Environmental Vicinity Map



Aerial Source: ESRI Aerial Imagery Service, 2018; DigitalGlobe, 3/10/2016 and 10/25/2015; Minnehaha County Orthos, 4/1/2017; and Sioux Falls Sanborn, 5/2/2017.

3.2 SOCIOECONOMIC CONSIDERATIONS AND ENVIRONMENTAL JUSTICE

3.2.1 Existing Conditions

Executive Order (EO) 12898, Federal Actions to Address Environmental Justice in Minority and Low-Income Populations, directs federal agencies to incorporate environmental justice in their decision-making process. Federal agencies are directed to identify and address, as appropriate, any disproportionately high and adverse effects their programs, policies, and activities have on minority or low-income populations. **Table 3-1** provides demographics data from the 2011–2015 American Community Survey (ACS) for the ESA, cities within the vicinity of the ESA, Lincoln County, and the State of South Dakota. ACS data includes projected demographics based on the 2010 Decennial Census conducted by the US Census Bureau.

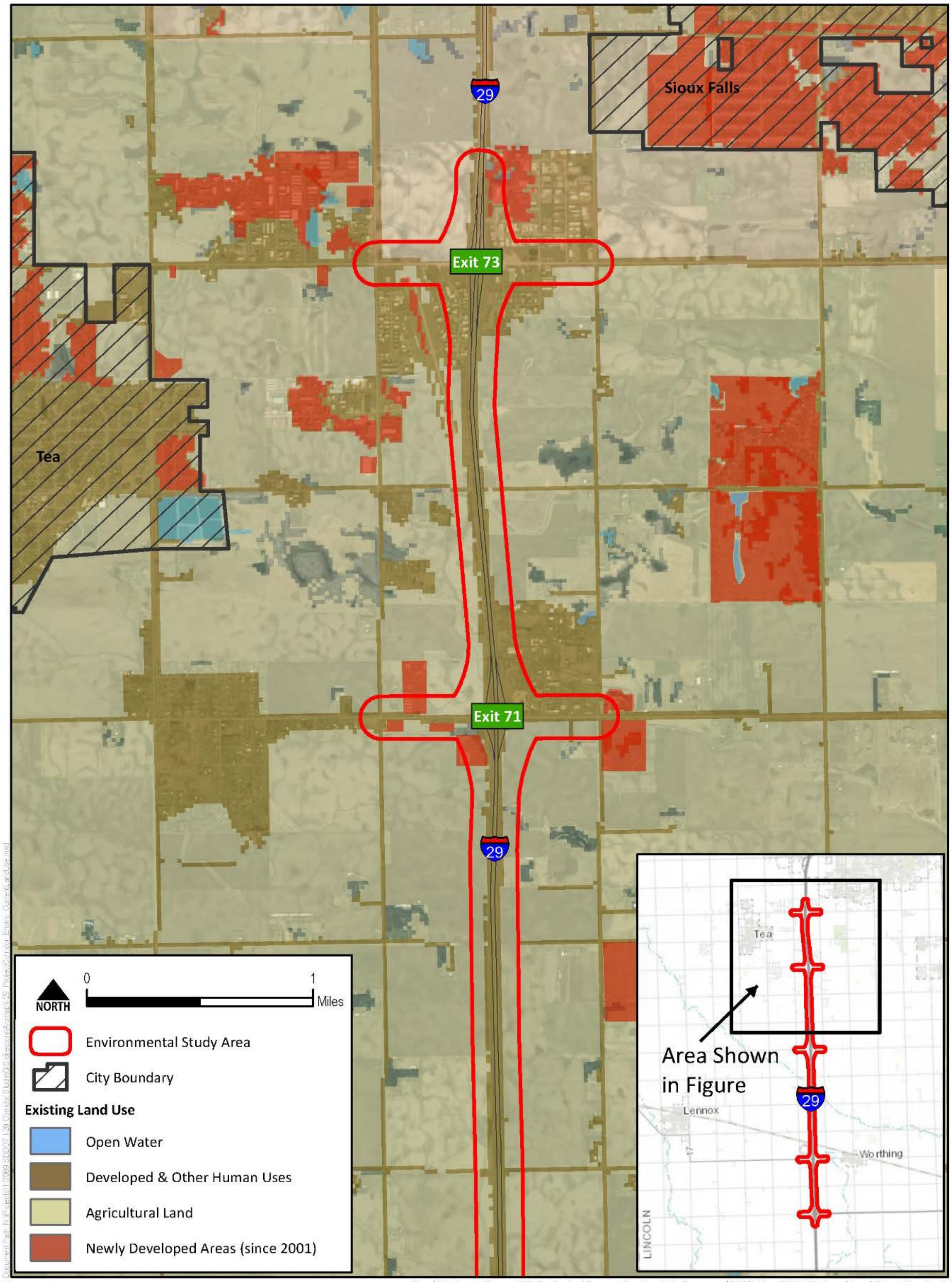
Other social considerations could include issues such as accessibility relative to school districts (i.e., their busing operations), emergency services, community cohesion, and travel patterns. Economic considerations that may affect the regional or local economy could include induced development, changes to employment opportunities, retail sales, or other impacts on businesses or residences, such as relocation or displacement. The following paragraphs summarize existing conditions relative to these socioeconomic considerations.

Chapter 2 discusses the existing conditions of I-29, related to accessibility and safety for busing operations, emergency services, community cohesion, and travel patterns. Most of the ESA is in the Lennox 41-4 school district but it also includes small portions of Tea 41-5 and Harrisburg 41-2 school districts.

According to the 2009 Revised Zoning Ordinance for Lincoln County, zoning districts located in the ESA are agricultural, commercial, rural residential, light industrial, and planned development (**Appendix D**). The commercial and light industrial zoning district areas within the ESA are located around the interchanges, whereas areas south of Exit 71 and between the interchanges are zoned as agriculture. Similarly, existing land use relative to site development characteristics (**Figure 3-2**) shows newly developed areas are concentrated around Exit 73 between Sioux Falls and Tea and Exit 71. A golf course and residential subdivision located east of the study corridor (between Exits 71 and 73) were also developed since 2001.

Agricultural uses dominate Lincoln County and areas of the ESA south of Exit 71; however, only 2.4 percent of the workforce in Lincoln County is employed in occupations categorized as agriculture, forestry, fishing, or mining **(Table 3-2**). According to the 2005 Lincoln County Comprehensive Plan, the number of rural residential structures (i.e., hobby farms and rural subdivisions) and the number of vacated farms with a dilapidated structure still standing have increased over the past 20 years. Occupations in educational services, healthcare, and social assistance have remained the highest percentage of the workforce in Lincoln County since 2010, whereas the percentage of occupations in retail and wholesale trade has increased relative to occupations in finance, insurance, and real estate.

Figure 3-2. Existing Land Use



Land Use Layer Source: US Geological Survey, Gap Analysis Program (GAP). May 2011. National Land Cover, Version 2.

Table 3-1. Demographics Data for the Environmental Study Area and Other Comparative Geographic Locations

Demographic Category	ESA	Worthing	Tea	Sioux Falls	Lincoln County	South Dakota
Total Population	345	930	4,201	162,728	49,874	843,190
Over 64	8%	7%	3%	12%	10%	15%
Low Income Population	12%	17%	16%	30%	15%	33%
Per Capita Income	$30,607	$25,781	$31,154	$29,000	$35,559	$26,747
Minority Population	6%	4%	5%	17%	6%	17%
Limited English Proficiency*	1%	0%	1%	3%	1%	1%
Employment Status (Population in Labor Force)	N/A	88.6%	88.4%	74%	77.4%	69%
Unemployed	N/A	1.0%	2.3%	3%	1.5%	3.1%
Commute to Work: Mean Travel Time	N/A	23.8 minutes	17.1 minutes	16.7 minutes	19.7 minutes	16.9 minutes

Source: US Census Bureau and the American Community Survey through American Fact Finder (www.factfinder.census.gov) and the EPA's Environmental Justice (EJ) Screen Tool (http://ejscreen.epa.gov/mapper/)
*Linguistic isolation is the percent of households in which no one age 18 and over speaks English "very well" or speaks English only (as a fraction of households).

Table 3-2. Occupation Demographics for the Civilian Employed Population 16 Years and Over in Lincoln County, South Dakota

Occupation Category	2016 (%)	2014 (%)	2012 (%)	2010 (%)
Agriculture, forestry, fishing, and mining	2.4	1.8	1.9	1.8
Arts, entertainment, and recreation, and accommodation and food services	4.8	4.3	4.4	4.6
Construction	8.3	8.2	7.7	7.3
Educational services, and health care and social assistance	27.9	28.4	28.7	24.9
Finance and insurance, and real estate and rental and leasing	13.0	12.1	11.3	13.9
Information	1.9	2.0	1.6	2.6
Manufacturing	8.2	8.2	9.8	9.6
Other services, except public administration	4.5	5.4	5.7	5.5
Professional, scientific, and management, and administrative and waste management services	7.7	7.9	8.5	8.1
Public administration	2.9	3.3	3.5	3.4
Retail and wholesale trade	14.4	11.2	10.5	10.8
Transportation and warehousing, and utilities	4.0	3.4	2.6	3.8

Source: American Community Survey through American Fact Finder (www.factfinder.census.gov)

3.2.2 Conclusions

A review of census data revealed no minority, low-income, or limited English proficiency populations in the ESA; therefore, the proposed project would not have a disproportionately high or adverse effect on low-income and minority populations.

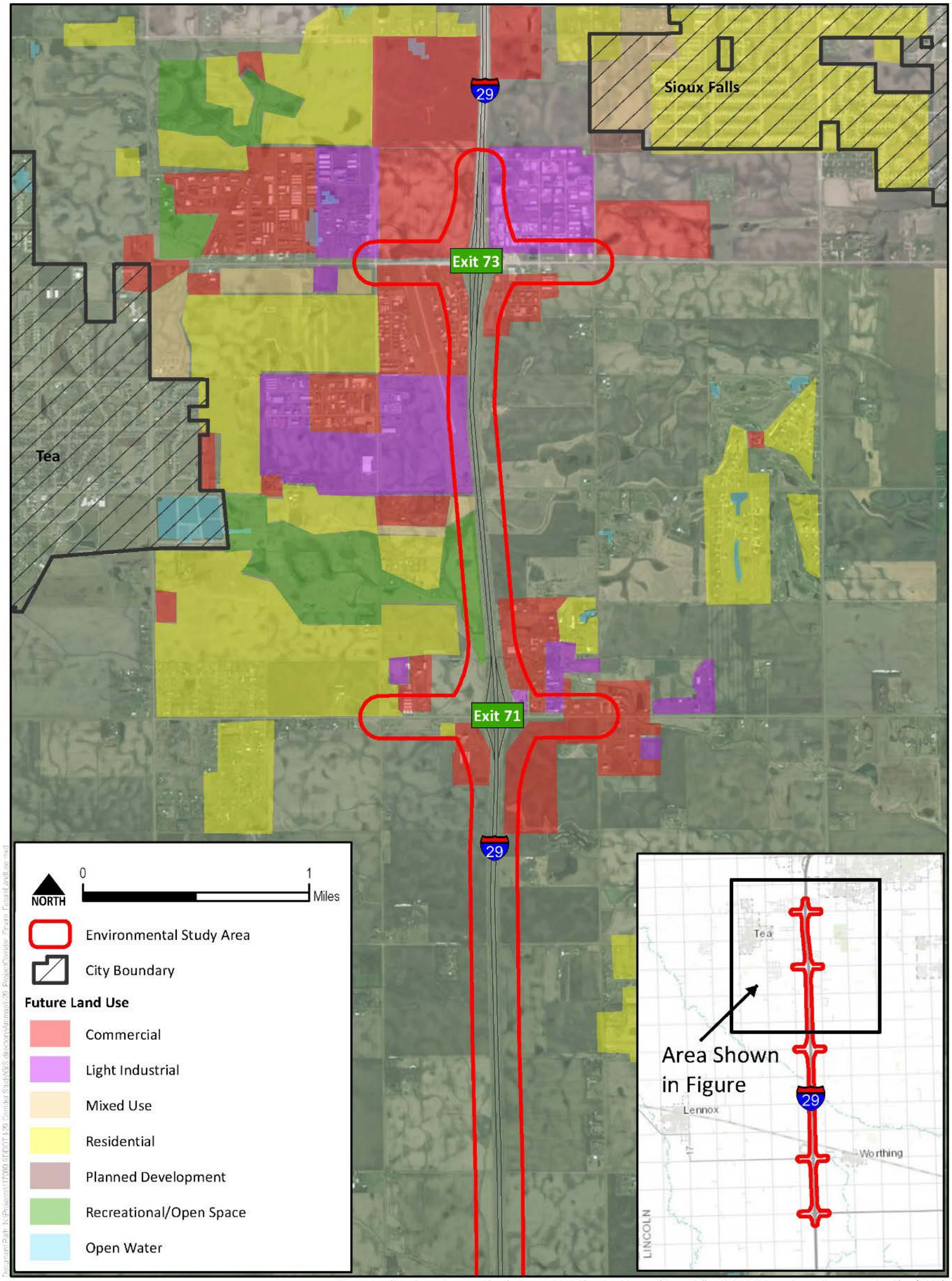
The population of Lincoln County grew from 24,131 in 2000 to 44,828 in 2010 (85.8 percent increase) based on the US Census, and to 49,874 in 2015 based on the ACS (**Table 3-1**). In the 2005 *Lincoln County Comprehensive Plan*, projections based on the 2000 US Census indicated the population would grow to as much as 48,986 by 2025, which has already been surpassed. The future population growth and development between Tea and Sioux Falls (i.e., north of and surrounding Exits 71 and 73) is expected to contribute to increased ADT on I-29, as discussed in **Section 4.2**. However, there would be beneficial impacts associated with the proposed improvements (all phases), such as increased traffic capacity and LOS, which would facilitate accessibility relative to school districts, emergency services, and community cohesion.

Population increases are expected to correlate with urban expansion and development between Tea and Sioux Falls. As indicated by the 2017 Lincoln County Planning Map and the Sioux Falls MPO 2040 Long-Range Transportation Plan (2015) (**Appendix D**), future land use includes increased residential, light industrial, and commercial areas north of and surrounding Exit 71 (**Figure 3-3**). Agricultural uses are generally expected to remain dominant in areas south of Exit 71 (**Appendix D**). The Lincoln County economy was historically driven by the agricultural industry with estimates of people employed in agricultural-related occupations as high as 26.8 percent in 1970; however, that percent has averaged around 2 percent of the workforce in recent estimates (**Table 3-2**).

A goal of the project would be to accommodate continued agricultural practices at interchange crossroads, specifically south of Exit 73. Some residences and businesses are in the area close to the project right-of-way (ROW). Relocations and displacement of residences or businesses are not anticipated; however, additional property acquisitions and alteration of access would be necessary. Overall, the proposed improvements would likely induce development near the interchanges within the ESA and facilitate planned growth surrounding the Tea area (west of Exits 73 and 71), which would benefit the regional and local economy by providing additional employment opportunities, increasing retail sales, and maintaining access for agricultural practices.

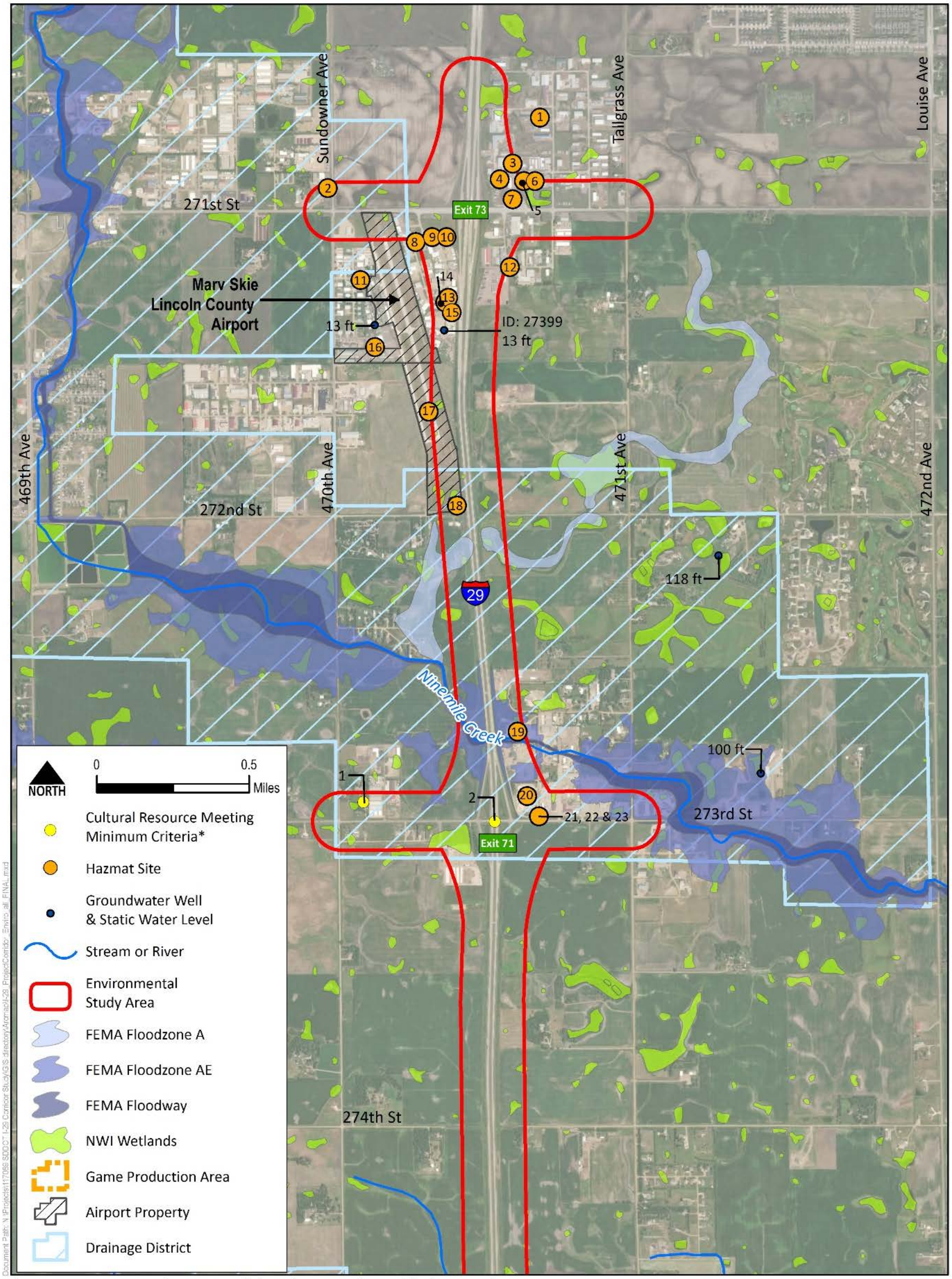
The proposed project (all phases) would have either no impact or beneficial impacts associated with socioeconomic considerations.

Figure 3-3. Future Land Use



Future Land Use Layer Sources: Lincoln County 2017 Planning Map and Sioux Falls MPO 2040 Long-Range Transportation Plan (2015).

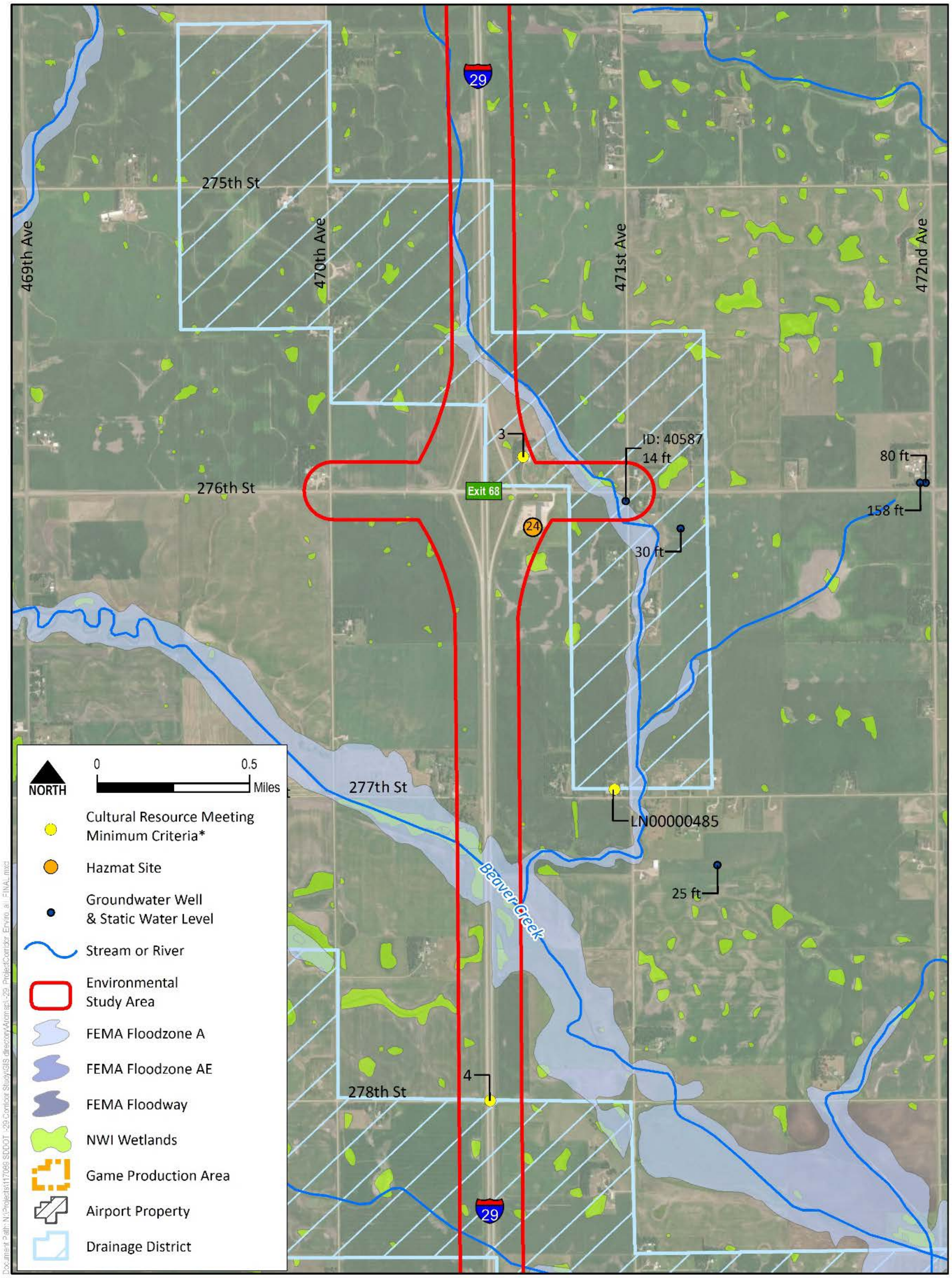
Figure 3-4. Environmental Resources Map – North



*Minimum survey criteria is at least 50 years old, physical integrity, and potential for historic significance.

Aerial Source: ESRI Aerial Imagery Service, 2018; DigitalGlobe, 7/25/2017.

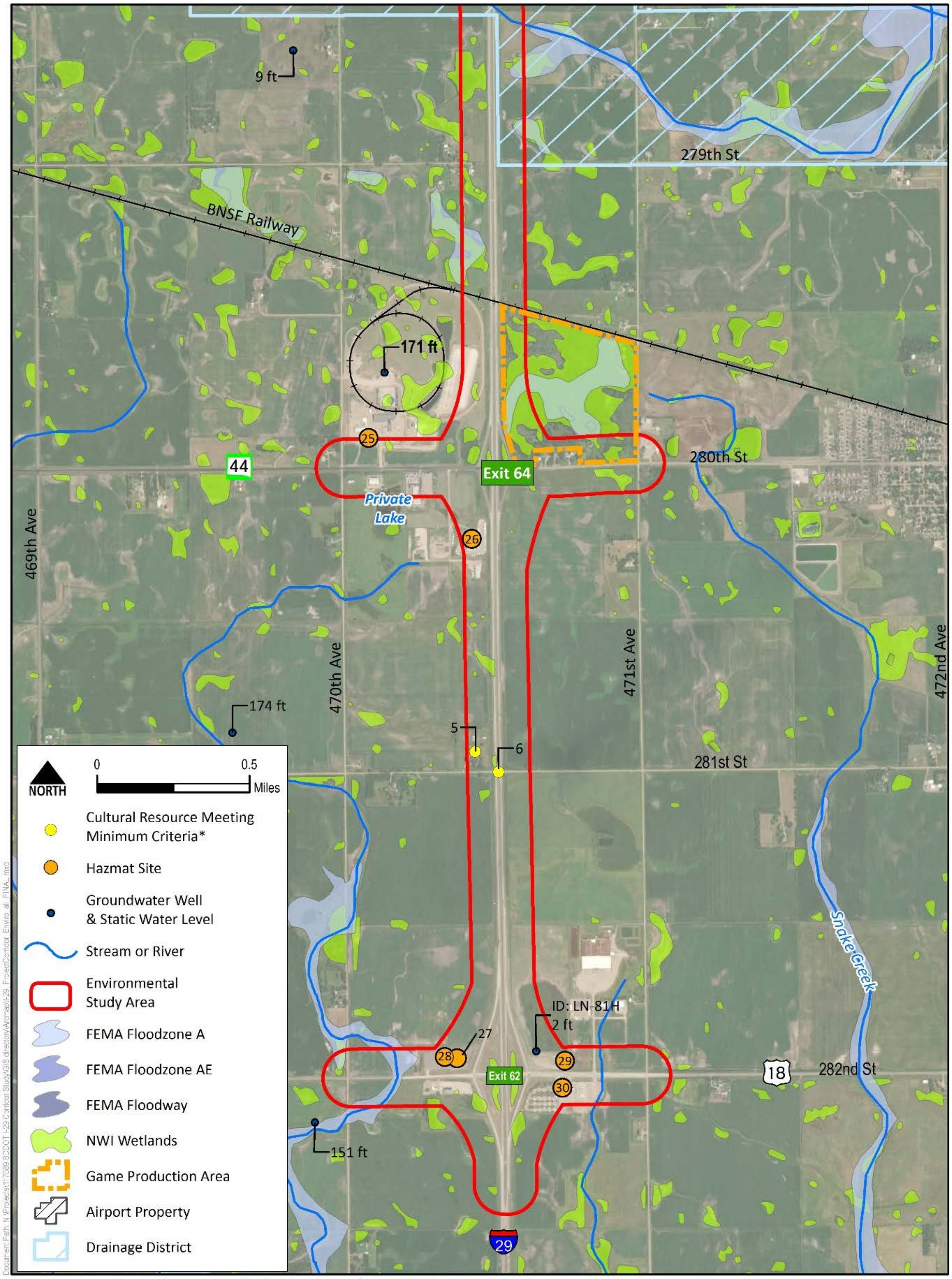
Figure 3-5. Environmental Resources Map – Central



*Minimum survey criteria is at least 50 years old, physical integrity, and potential for historic significance.

Aerial Source: ESRI Aerial Imagery Service, 2018; DigitalGlobe, 7/25/2017.

Figure 3-6. Environmental Resources Map – South



*Minimum survey criteria is at least 50 years old, physical integrity, and potential for historic significance.

Aerial Source: ESRI Aerial Imagery Service, 2018; DigitalGlobe, 7/25/2017.

3.3 WETLANDS, WATERS OF THE US, AND WATERS OF THE STATE

3.3.1 Existing Conditions

Wetlands are defined as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions" (33 Code of Federal Regulations 328). Wetland resources are afforded protection under the Clean Water Act (CWA) as amended, EO 11990 of 1977 (Protection of Wetlands), and Administrative Rule of South Dakota (ARSD) Chapter 74:51 for Waters of the State. Wetlands and riparian areas are important because they provide habitat for various plants, fish, and wildlife species; serve as groundwater recharge areas; provide storage areas for storm and flood waters; serve as natural water filtration areas; and provide protection from wave action, erosion, and storm damage.

National Wetland Inventory (NWI) wetlands are prevalent in the I-29 corridor between Exits 62 and 73 (**Figure 3-4, Figure 3-5,** and **Figure 3-6**). Several types of palustrine emergent wetlands are mapped in agricultural fields, ditches, interchange medians, stream floodplain and fringes of Beaver Creek, and other unnamed drainages. Mapped palustrine forested wetlands were located in the Worthing State Game Production Area (SGPA) northwest of I-29 Exit 64 and within the south floodplain of Beaver Creek, east of I-29 near MRM 67.00. A review of aerial imagery indicates potential wetness signatures and that additional wetland features are possible within the ESA. Several freshwater ponds are also mapped in NWI data.

Wetlands not included in the NWI data may have developed in ditches, drainages, depressions, or other areas with adequate hydrology throughout the ESA. Other water resources, mapped in the National Hydrography Dataset, within the ESA are two unnamed tributaries of Snake Creek west and east of Exit 62, Ditch No. 14 (canal) near MRM 65.80, Beaver Creek near MRM 67.10, an unnamed tributary of Beaver Creek near MRM 68.75, and Ninemile Creek near MRM 71.63. Beaver Creek flows into the Big Sioux River approximately 12.5 miles southeast of the ESA, whereas Ninemile Creek flows into the Big Sioux River approximately 10 miles east of the ESA. Snake Creek flows into Vermillion River tributaries approximately 10 miles southwest of the ESA. The Big Sioux River and Vermillion River flow into the Missouri River and both are Waters of the US (WOUS).

3.3.2 Conclusions

A windshield survey of the ESA confirmed there are wetlands present within the project corridor, particularly between I-29 Exit 64 and Exit 68 and along drainages. Within the overall ESA, I-29 crosses multiple WOUS, including Ditch No. 14, Beaver Creek, Ninemile Creek, and an unnamed tributary of Beaver Creek. West of I-29 Exit 62 interchange, 282nd Street crosses an unnamed tributary of Snake Creek.

Using Step 1A of the wetland process identified in the 2015 SDDOT *Environmental Procedures Manual*, field surveys would be necessary to delineate wetland boundaries during later project planning phases. If wetlands or streams are present and would be affected, a United States Army Corps of Engineers (USACE) Jurisdictional Determination may be necessary. Impacts on jurisdictional wetlands or WOUS would require a Section 404 permit from the USACE and may require mitigation.

Section 404 permitting for the I-29 Mainline Improvements Phase would include most of the potential wetland and WOUS impacts for the corridor. The Exit 71 Improvements Phase would potentially meet the requirements of a Section 404 nationwide permit because there are fewer wetlands present relative to Exit 64 or the entire corridor. The Exit 64 Improvements Phase has the potential to affect more than 0.5 acre of wetland or WOUS.

3.4 FLOODPLAIN MANAGEMENT

3.4.1 Existing Conditions

EO 11988 requires federally funded or assisted projects to evaluate and minimize the risk of flood loss. FEMA is the primary agency responsible for evaluating impacts on the 100-year floodplain and floodway, with the program administered by the local community's floodplain manager. Any work conducted within the floodplain requires a No-Rise certification and floodplain development permit.

Special Flood Hazard Areas (e.g., Flood Zone AE and A) are defined as areas that would be inundated by a flood event having a 1-percent chance of being equaled or exceeded in any given year. The 1-percent annual chance flood is also referred to as the base flood or 100-year flood. Zone AE areas have been determined by detailed methods and include Base Flood Elevations. Zone A areas have been determined using approximate methodologies and do not have Base Flood Elevations. The floodway consists of the channel plus any adjacent floodplain areas that must be kept free of encroachment to discharge the base flood without increasing flood heights.

The ESA crosses tributaries of the Big Sioux and Vermillion rivers. FEMA released several Flood Insurance Rate Maps (FIRMs) covering the ESA in 2008 (Map Numbers 46083C0250C, 46083C0141C, and 46083C0133C). In October 2017, an updated FIRM was released for a portion of the ESA surrounding I-29 Exit 68 (Map Number 46083C0150D).

Within the ESA, I-29 crosses three streams located in Lincoln County Drainage Districts: Ninemile Creek (District 11), Canal Ditch #14 (District 14), and an unnamed tributary to Beaver Creek north of Exit 68 (District 19).

A substantial portion of the ESA is mapped as Zone X, areas considered outside the 100-year floodplain. However, there are mapped areas of Flood Zone AE and A (Special Flood Hazard Areas) and Floodway (**Figure 3-4, Figure 3-5,** and **Figure 3-6**). The Zone AE and A areas are located primarily where I-29 or crossroads span the drainages identified in Section A.3 or in low areas capable of ponding during high water events. The Floodway is mapped along Ninemile Creek west and east of I-29 by MRM 71.60.

3.4.2 Conclusions

Based on the FEMA FIRM, areas of Zone AE and Zone A floodplain and floodway are present within the ESA, primarily located in the floodplain of Ditch No. 14, Beaver Creek, and Ninemile Creek. The USACE and the Lincoln County (South Dakota) floodplain administrator would need to coordinate and permit any project activities located within Zone AE and Zone A, particularly activities that have the potential to raise the base flood elevation. Depending on the scope, hydraulic analyses may be required for permitting. Drainage permits may be needed to remove sediment or vegetation from channels in drainage districts.

Floodplain permitting for the I-29 Mainline Improvements Phase would include most of the areas with potential impacts in FEMA Zones A, AE, and Floodway. The Exit 71 Improvements Phase would likely require floodplain and drainage permits if work is conducted in FEMA Zones A, AE, or Floodway, in addition to Lincoln County Drainage District 11 associated with Ninemile Creek. The Exit 64 Improvements Phase would likely require a floodplain permit if work is conducted in the FEMA Zone A located in stream floodplains and prairie pothole wetlands.

3.5 WATER QUALITY

3.5.1 Existing Conditions

The protection of water quality is important because of the need for a reliable drinking water supply, for swimming and recreating, for fish and shellfish consumption, for adequate agricultural production, for fish and wildlife habitat, and for other beneficial uses. Clean water is pivotal in the protection of human health and the environment.

Surface Water. SDDENR regulations are in place to address water quality, including post-construction stormwater management, stormwater best management practices (BMPs), and Stormwater Pollution Prevention Plans (SWPPP) for erosion and sediment control. These regulations were developed to minimize adverse effects of pollutants entering waterways from stormwater runoff associated with the continued development of hard surfaces, such as roads, parking lots, sidewalks, and trails.

Section 303(d) of the federal CWA also requires states, territories, and authorized tribes (states) to identify and establish a priority ranking for all waterbodies where technology-based effluent limitations required by Section 301 are not stringent enough to attain and maintain applicable water quality standards. Impaired waters are identified through assessment and monitoring programs administered by SDDENR and documented on the 303(d) List of Waters.

The 303(d) List of Waters, included in the 2016 *South Dakota Integrated Report for Surface Water Quality Assessment* generated by SDDENR and approved by EPA, was reviewed for this study. The assessment did not address drainages located in the ESA because of insufficient data. However, all streams in South Dakota are assigned the beneficial uses of “fish and wildlife propagation, recreation, and stocking waters” and “irrigation waters” unless otherwise stated in ARSD Chapter 74:51:03.

Groundwater. The United States Geological Survey topographic maps and SDDENR files for groundwater wells indicate that regional groundwater flow would generally be to the southeast toward Big Sioux River north of I-29 Exit 64 and south toward Saddle Creek. Local groundwater flow would generally follow surface topography and drainage patterns; however, the groundwater flow direction may be affected by water table elevations and may flow from areas with high water table elevations to areas with lower water table elevations, which may or may not be consistent with the direction of surface water flow.

The ESA was reviewed for potential impacts on groundwater and Wellhead Protection Areas, which are designated as Zone A of the Aquifer Protection District overlay (**Appendix D**). The ESA (including I-29 Mainline, Exit 71, and Exit 64 Improvement Phases) does not contain Zone A areas. However, the area in which Beaver Creek and part of the adjacent floodplain intersects with the I-29 mainline is designated as Zone B. Zone B is an aquifer secondary impact zone designated to protect the aquifer for current and future use for drinking water and could eventually be designated as Zone A.

A records review was conducted of the SDDENR Observation Well Network, a list of state-owned wells used to measure groundwater levels, and Water Well Completion Reports, a list of domestic water supply, irrigation, and monitoring wells. Within the ESA, there is one observation groundwater well (LN-81H) and two monitoring wells (Report IDs: 40587 and 27399) (**Figure 3-4, Figure 3-5,** and **Figure 3-6**). None of the wells are within a Wellhead Protection Area.

3.5.2 Conclusions

Surface water. Impaired streams or waterbodies were not identified within the ESA (including I-29 Mainline, Exit 71 and Exit 64 Improvement Phases) and project construction activities would not be anticipated to contribute to or exacerbate water quality downstream.

SDDOT applies for construction permits for all projects directly adjacent to water bodies, regardless of disturbed acreage. Permit applicants are required to develop a SWPPP detailing BMPs that will reduce or eliminate any possible water quality impacts due to erosion and sedimentation. The SDDENR had no objections to the project and provided preliminary comments, including conditions for SDDOT and/or contractors concerning water quality, which are described in **Appendix D**.

Groundwater. According to the updated 2009 Zoning Ordinance for Lincoln County, "The purpose of the [Aquifer Protection] district is to prohibit certain uses which pose the greatest threat to groundwater contamination and to impose reasonable and adequate safeguards on other uses which exhibit a potential to contaminate the groundwater." Most Zone B restrictions (located in the I-29 Mainline Improvement Phase) are for industrial, commercial, and agricultural uses and would not apply to the proposed corridor improvements. However, if any leaks or spills of materials contaminate groundwater, the Office of Planning and Zoning (Lincoln County) and SDDENR should be notified within 24 hours.

3.6 THREATENED AND ENDANGERED SPECIES AND OTHER PROTECTED WILDLIFE

3.6.1 Existing Conditions

Threatened and Endangered Species. The Endangered Species Act protects imperiled species and their habitat. Section 7 of the Endangered Species Act requires federal agencies to consult with the USFWS for any federal project or federally permitted project that may affect a species listed under the Endangered Species Act. The South Dakota Codified Laws (SDCL) also protects state listed threatened and endangered plants and wildlife (SDCL, Title 34A, Chapter 34A-8, Endangered and Threatened Species).

The ESA primarily consists of row-crop agricultural fields with commercial and industrial properties surrounding each interchange area, especially I-29 Exits 71 and 73. Some residential areas occur within the ESA. Most vegetated areas are mowed and maintained. Potential habitat for wildlife in the ESA consists of grassy roadside ditches, row-crop agricultural fields, woodland patches, and several wetland areas. Quality habitat for wildlife species, particularly threatened and endangered species, is limited to riparian corridors (e.g., Beaver Creek) and the Worthing SGPA northeast of I-29 Exit 64.

Northeast of I-29 Exit 64

Table 3-3 lists eight species that are either federally or state listed for Lincoln County and identifies the potential for suitable habitat for each species. The following paragraphs describe the potential for suitable habitat for the northern redbelly dace, Topeka shiner, northern long-eared bat, and northern river otter.

The northern redbelly dace occurs in tributaries of the Big Sioux River and prefers vegetated areas of quiet spring-fed streams, bogs, and beaver ponds. The SDGFP Wildlife Interactive Map indicates confirmed distribution for the northern redbelly dace in the Ninemile and Beaver Creek watersheds.

The Topeka shiner occurs in low order prairie streams of the James River, Big Sioux River, and Vermillion River watersheds. Stream habitat suitable for Topeka shiner consists of low bank slopes, pool and riffle areas, bottom substrate composed of coarse substrate overlain by silt, or off-channel pool areas. Habitat with suitable characteristics also needs to be near perennial reaches or pools. The nearest record of Topeka shiners in the South Dakota Natural Heritage Database is from Long Creek, which is indirectly connected to the small intermittent stream crossed by 282nd Street (west of I-29 Exit 62) approximately 9.5 miles upstream.

The northern long-eared bat has potential habitat within the ESA. During summer, northern long-eared bats roost underneath bark, in cavities, or in crevices of both live and dead trees. It may also roost in manmade structures located in rural or urban areas. Habitat within the ESA consists of wooded riparian areas, forested corridors, and other areas with mature trees that could provide roosting habitat. Bridges and large box culverts also have the potential to provide roosting habitat for bats.

Table 3-3. Federal and State Listed Species in Lincoln County, South Dakota

Group	Common Name	Scientific Name	Federal Status	State Status	Potential Habitat
Bird	Rufa red knot	*Calidris canutus rufa*	Threatened	–	No
Reptile	Lined snake	*Tropidoclonion lineatum*	–	Endangered	No
Fish	Northern redbelly dace	*Chrosomus eos*	–	Threatened	Possible
	Pallid sturgeon	*Scaphirhynchus albus*	Endangered	Endangered	No
	Topeka shiner	*Notropis topeka*	Endangered	Endangered	Possible
Mammal	Northern long-eared bat	*Myotis septentrionalis*	Threatened	Threatened	Possible
	Northern river otter	*Lontra canadensis*	–	Threatened	Possible
Plant	Western prairie fringed orchid	*Platanthera praeclara*	Threatened	–	No

The northern river otter occurs near rivers of eastern South Dakota and prefers slow-moving rivers or streams with deep pools, abundant riparian vegetation and fish, and limited human disturbance. The SDGFP Wildlife Interactive Map indicates a year-round presence throughout the project corridor for the northern river otter.

Migratory Birds and Eagles. Migratory birds are protected under the Migratory Bird Treaty Act (MBTA), and bald eagles are protected under the Bald and Golden Eagle Protection Act (BGPA). The USFWS administers both and prohibits the "taking" or possession of bald eagles and migratory birds or their parts, feathers, nests, or eggs. The BGPA also protects bald and golden eagles from disturbances that may interfere with their normal behavior or cause abandonment of nests.

Migratory bird habitat consists of grassland, wetland, stream, or woodland areas. According to the USFWS Information for Planning and Conservation website, over 17 species of MBTA species are likely to be present throughout the ESA in areas of potentially suitable habitat, such as trees, wetlands, riparian grasslands, and bridge or culvert substructures. Bald eagles use mature, forested riparian areas along large rivers and lakes throughout the state. Specifically, the Worthing SGPA northeast of I-29 Exit 64 and prairie pothole lakes within 1 mile between I-29 Exit 64 and Exit 68 provide suitable nesting trees and water resources for bald eagles and other migratory birds. The ESA is outside the golden eagle range.

3.6.2 Conclusions

Although a search of the South Dakota Natural Heritage Database (June 16, 2017) resulted in no documented threatened, endangered, or rare species in the immediate vicinity of the ESA for the three improvement phases, there could be undocumented presence of or habitat suitable for protected species (**Table 3-3**). For example, there is habitat potentially suitable for the northern redbelly dace in Ninemile Creek (Exit 71 Improvement Phase) and habitat potentially suitable for the northern long-eared bat and northern river otter in the Worthing SGPA (Exit 64 Improvement Phase). Therefore, further evaluation and coordination with USFWS and SDGFP should be completed during the NEPA process and later stages of the project planning.

The SDGFP had no objections to the project and provided preliminary comments, including recommendations that BMPs be implemented for Topeka shiners for all stream work (**Appendix D**). In 2008, the USFWS issued the current Programmatic Biological Opinion for the Stream Crossing Projects Administered/Funded by the FHWA and SDDOT to guide construction activities in stream crossings. If needed, the Biological Opinion further set forth terms and conditions for the implementation of Reasonable and Prudent Measures that are incorporated into Incidental Take Statements for the Topeka shiner to ensure compliance with the ESA.

This project is within the range of suitable habitat for the northern long-eared bat and project work should avoid conflicts with hibernacula or roosting habitat during the northern long-eared bat seasonal work restriction timeframe, April 1 to October 31, without approval from the SDDOT Environmental Office. Tree removal should occur between November 1 and March 31.

Under the MBTA, construction activities should be avoided in potential bird habitats or those areas with bridges or large culverts (e.g., habitat for swallow nests) that would otherwise result in the "taking" of migratory birds, eggs, young, and/or active nests. Although MBTA provisions are applicable year-round, most migratory bird nesting activity in South Dakota is from April 1 to July 15. Impacts should be avoided by either clearing vegetation outside the primary nesting season or surveying before construction activities in areas of potential nesting habitat. Work on bridges or large culverts should also occur outside the primary nesting season. Mowing before April 1 is also recommended to help limit use by nesting birds. A desktop and field review would be needed to identify potential bald eagle nests within 1 mile of the project improvements.

3.7 CULTURAL RESOURCES

3.7.1 Existing Conditions

Section 106 of the National Historic Preservation Act of 1966 requires the evaluation of the effects of federally funded projects on historic properties that are on, or eligible for, the National Register of Historic Places (NRHP). HRG, a historic preservation consulting firm whose professionals meet the Secretary of the Interior's Professional Qualifications Standards, conducted the cultural resource/historic property evaluation for this study.

The area of potential effect (APE) for Section 106 purposes is defined as the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. Because this is a preliminary study, the APE for this project is the same as the ESA of the project and was identified to consider the possible visual, as well as physical impacts of a project (**Figure 3-4, Figure 3-5,** and **Figure 3-6**).

The standing structure field survey for this project began with a search of existing survey and site files maintained by the South Dakota State Historic Preservation Officer (SHPO) via the Archeological Research Center (ARC). Websites were also consulted to assist in documenting construction dates, property history, and referencing NRHP nominations, if needed. Internet sites primarily used include the South Dakota SHPO's Cultural Resource Geographic Research Information Display (CRGRID) online mapper, various city/county resources, and the Lincoln County Assessor's website. A field assessment conducted in June 2017 identified those properties with architectural significance and physical integrity that may be potential historic resources for future study.

Previously identified historic properties for study purposes are identified as only those properties currently listed in or officially determined eligible for the NRHP or locally designated historic landmarks if appropriate. There are no NRHP listed or eligible standing structures within the ESA. However, there are seven properties with potential architectural significance and physical integrity within the ESA boundary. There are three bridges over I-29 (within the ESA) that have been previously surveyed and determined not eligible for the NHRP. One archeological site has been surveyed and recommended NRHP eligible. **Table 3-4** lists the properties identified in CRGRID and the ARC site file search.

Table 3-4. Properties and Structures Identified in CRGRID and ARC File Search

Site Number	Name	Address	Description	Status
39LN2007	N/A	Northwest of I-29 Exit 64	Archeological site	NRHP eligible
LN00000661	Bridge 42-064-093	I-29 over Beaver Creek between 277th Street and 278th Street	1958 Highway bridge	Not eligible
LN00000664	Bridge 42-065-120	SD 44, 280th Street bridge over I-29	1958 Highway bridge	Not eligible
LN00000665	Bridge 42-065-140	282nd Street (US 18 W) bridge over I-29	c. 1958 Highway bridge	Not eligible

3.7.2 Conclusions

Current project design recommendations, specifically the three improvement phases, do not show any work planned near the identified archeological site or cultural resource sites requiring further study (**Table 3-5**). The Mainline Improvement Phase would include six of the sites in **Table 3-5**and the Exit 71 Improvement Phase would include two sites, whereas the Exit 64 Improvement Phase does not include any of the sites. The APE for cultural resources (**Figure 3-4, Figure 3-5,** and **Figure 3-6**) may be further refined during later project planning phases and as information is received through public input. A Section 106 review and surveys would be required during the NEPA process for all proposed corridor improvements.

The South Dakota SHPO had no objections to the project and provided preliminary comments. Comments included the following statements:

- The APE has the potential to contain unrecorded historic properties (**Appendix D**).
- It is recommended that a qualified archeologist conduct a Level III Intensive Survey of any areas that may be affected by the project once plans for the corridor have been further developed.
- It was also recommended that a qualified professional visit the LaValley Presbyterian Church (LN00000485) to update the survey record form, which was initially completed in 1980 and has inadequate information.

Felsburg Holt & Ullevig team members revisited the location of the LaValley Presbyterian Church on October 24, 2017, to confirm the location and to verify its inclusion in the Cultural Resources Survey (**Table 3-5**).

Table 3-5. Field Surveyed Properties Requiring Further Study to Determine National Register of Historic Places Eligibility

Site Number	Address	Description
1	47008 273rd Street	1 ½ story house with outbuildings and c. 1910 construction date.
2	273rd Street crossroad structure (Bridge 42-065-050)	Bridge over I-29 at 273rd Street built in 1958.
3	47062 276th Street	Modern house and shed with historic granary and barn.
4	278th Street crossroad structure (Bridge 42-065-100)	Bridge over I-29 at 278th Street built in 1958.
5	47038 281st Street	1 ½ story farmhouse with standing seam steel roof and associated outbuildings. Assessor identifies a 1980 construction date.
6	281st Street crossroad structure (Bridge 42-065-130)	Bridge over I-29 at 281st Street built in 1958.
LN00000485	Near Junction of 277th Street and 471st Avenue	LaValley Presbyterian Church c. 1910.

3.8 PUBLIC USE PROPERTIES (SECTION 4(F) AND 6(F))

3.8.1 Existing Conditions

Public parks, recreational resources, and cultural resources are protected under Section 4(f) of the US Department of Transportation 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 ESA includes no park or trail facilities. Saint Edwards Cemetery is within the ESA approximately 0.5 mile east of I-29 at Exit 64 on 280th Street. Outside the ESA, but within 0.5 mile, there are two cemeteries: Faith LaValley Cemetery (on 471st Avenue, approximately 0.5 mile east of I-29 and north of 277th Street) and Tea Cemetery (on 470th Avenue, approximately 0.5 mile west of I-29 between 273rd and 274th streets). None of these cemeteries were identified as cultural sites or NRHP-eligible and would not be properties covered by Section 4(f).

One public use property and one NRHP-eligible property were identified within the ESA and are described below:

- Worthing SGPA (122 acres), northeast of I-29 Exit 64 (**Figure 3-6**)
- Archeological site, northwest of I-29 Exit 64

Recreational resources developed with federal funding through the 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. There were many properties associated with LWCF funds in Lincoln County; however, none are located within the ESA.

3.8.2 Conclusions

The Worthing SGPA northeast of I-29 Exit 64 is public land open for hunting, owned and managed by SDGFP, and would be subject to Section 4(f) of the US Department of Transportation Act. An archeological site northwest of I-29 Exit 64 may be a Section 4(f) property if it warrants preservation in place. The proposed phases for mainline and Exit 64 improvements include both of the above properties.

Section 4(f) would not apply to the archeological site if FHWA determines, after consultation with the SHPO/Tribal Historic Preservation Officer (THPO), federally recognized Indian tribes (as appropriate), and the Advisory Council on Historic Places (ACHP) (if participating), that the archeological resource is important chiefly because of what can be learned by data recovery and has minimal value for preservation in place, and the SHPO/THPO and ACHP (if participating) do not object to this determination. Additional historic sites may be identified within the ESA with further study and could potentially be subject to Section 4(f). The recommended process to identify other historic sites is discussed in **Section 3.7**.

Section 4(f) stipulates that FHWA and other DOT agencies cannot approve the use of land from publicly owned parks, recreational areas, wildlife and waterfowl refuges, or public and private historical sites unless all coordination requirements have been met. Section 4(f) requires demonstration that there is no prudent and feasible alternative to using the land, that project plans minimize harm to the resource, and there is mitigation to offset the impacts. In some cases, FHWA determines that the use of the property will have a *de minimis* impact (an impact that will not adversely affect the activities, features, or attributes of the property). A Section 4(f) evaluation would be required during the NEPA process.

No public use properties were acquired or built using the LWCF and are not subject to Section 6(f) of the Transportation Act.

3.9 CONTAMINATED MATERIALS REVIEW

3.9.1 Existing Conditions

The term contaminated materials is an all-inclusive term for materials regulated as solid waste, hazardous waste, and other wastes contaminated with hazardous substances, radioactive materials, petroleum fuels, toxic substances, and pollutants, as defined in the 2015 SDDOT *Environmental Procedures Manual*. A Contaminated Materials Review identifies and assesses the potential for encountering hazardous materials on properties adjacent to or within the ESA. This section provides a summary of properties with the potential or known (e.g., current and past) soil or groundwater contamination within the ESA and considered a potential risk to implementation of the proposed project.

Registered sites within the ESA have been identified through the use of the EPA FRS. The FRS houses the data submitted to EPA's Enviromapper website (internet-based mapping service) associated with the Envirofacts Warehouse, which locates all registered sites and identifies them as one of the following: discharges to water, superfund, hazardous waste, and toxic releases, air releases, other or multiple. These regulatory program databases are available at www.epa.gov.

The SDDENR maintains the groundwater quality program that contains the underground and aboveground storage tank (AST) database. This information is available at https://denr.sd.gov/data.

Thirty registered sites were identified within 0.1 mile of the project alignment (**Table 3-6**). Several registered sites fall within the probable project limits of the proposed improvements. **Figure 3-4, Figure 3-5,** and **Figure 3-6** identify all registered environmental sites according to the EPA and all the AST and underground storage tank (UST) locations according to the SDDENR.

3.9.2 Conclusions

The database report was evaluated regarding potential impacts on the proposed project or on the registered site from construction. Sites were evaluated based on regulatory status, topographic gradient, or distance from the proposed project. Twenty-four of the 30 registered sites within the ESA were identified as having the potential to affect transportation improvements (**Table 3-6**). Six sites were Integrate Compliance Information System (ICIS) or Air Facility System (AFS) and are considered to have no impact on transportation systems. No Superfund sites are within 1 mile of the project.

One leaking underground storage tank (LUST) site is within the ESA (Exit 62). Exit 62 also has an AST. The other registered sites are linked to operating USTs and/or the use and/or storage of petroleum products and hazardous substances. Registered UST or AST sites are also located near Exit 64, Exit 68, and Exit 73. In addition to an AST, there is one registered hazardous waste generator site (No. 26, **Table 3-6**) located near Exit 64.

Private industrial properties are located near I-29 Exit 71 and Exit 73. In general, these properties characteristically contain multiple structures, equipment storage, miscellaneous debris piles, 55-gallon drums, ASTs, propane tanks, and unknown hazardous materials handling, storage, or disposal practices. The associated activities with industrial properties include the use and storage of petroleum products, fueling equipment, and/or small quantities of on-site chemical storage.

The Mainline Improvement Phase would include 20 of the 30 registered sites consisting of a hazardous waste generator, ASTs, USTs, LUSTs, and toxic release inventory (chemical storage) sites. Registered sites within the ESA around the Exit 71 Improvement Phase include one registered hazardous waste generator site (No. 19, **Table 3-6**), a concrete ready-mix plant, and automotive maintenance and repair facilities.

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 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 review, following SDDOT guidance, would be needed as part of any future project development. A more detailed review will gather additional information needed to plan for known and potential contaminated materials concerns, including asbestos and lead-based paint in building materials that may require demolition. During the planning and design process, this information can be used to identify avoidance options, when possible, and, if necessary, to assist with the development of specific materials management or mitigation measures. If full acquisition of property rights might occur, and as mentioned above, further assessment such as individual Phase I environmental site assessments before the ROW acquisition process may also be required. SDDENR does not expect that any hazardous waste sites would be encountered during road construction in rural areas, but urban areas would require additional coordination with their Hazardous Waste - Waste Management Program (**Appendix D**).

Table 3-6. Contaminated Materials Sites

Figure ID No.	Facility	Address	Regulatory Database	Potential to Impact
1	Midwest Excavating	27073 Henry Place, Sioux Falls	AST[2]	Yes
2	Hawkins Water Treatment Group	27093 Sundowner Avenue, Sioux Falls	RCRA[1], ICIS[4]	Yes
3	Delta Enterprises	47060 98th Street, Sioux Falls	ICIS	No
4	Laboratory of Clinical Medicine	I-29 and Exit 73, Sioux Falls	UST[3] (removed)	Yes
5	Leyva Drywall and Insulation	47065 W. 98th Street, Sioux Falls	ICIS	No
6	Rogers Body Shop	47077 98th Street, Sioux Falls	RCRA	Yes
7	Roadway Travel Center	47058 271st Street, Sioux Falls	UST	Yes
8	T Motors	27117 Skylane Drive, Sioux Falls	RCRA	Yes
9	Larson Truck Sales Inc.	27115 South Parklane Drive, Sioux Falls	RCRA	Yes
10	Howard's Corvettes	I-29 Exit 73, Sioux Falls	UST (removed)	Yes
11	Great Planes Airport	I-29 and Exit 73, Sioux Falls	UST (removed)	Yes
12	Pivot Power Inc.	47063 104th Street, Sioux Falls	RCRA	Yes
13	FM Acoustical Tile	RR 3, Sioux Falls	UST (removed)	Yes
14	Diamond Mowers	27134 S. Parklane Drive, Sioux Falls	RCRA, TRI[5]	Yes
15	Sunbelt Rentals	27134 South Parkland Drive, Sioux Falls	AST	Yes
16	Legacy Aviation	47010 Great Planes Place, Sioux Falls	AST	Yes
17	Dakota Transportation Services	Exit 73 and I-29 South, Sioux Falls	RCRA	Yes
18	Northwestern Bell	Township Road and I-29, Sioux Falls	UST (removed)	Yes
19	RMS Roller Grinder	27271 Ironworks Avenue, Harrisburg	RCRA	Yes
20	United Concrete	27291 Ironworks Avenue, Harrisburg	AFS[6]	No
21	Nick's Garage	27294 Ironworks Avenue, Harrisburg	ICIS	No
22	Midwest Auto Sound and Power	27294 Ironworks Avenue, Harrisburg	ICIS	No
23	C&K Equipment Repair	27294 Ironworks Avenue, Harrisburg	ICIS	No
24	Sioux Falls Office	47077 276th Street, Lennox	UST	Yes
25	Eastern Farmers Coop	47014 SD Hwy 14, Worthing	AST	Yes
26	Agile Manufacturing	28026 Boondocks Avenue, Worthing	RCRA	Yes
27	SDDOT	47028 282nd Street, Canton	AST	Yes
28	SDDOT	47028 282nd Street, Canton	UST	Yes
29	S&A 66	I-28 and US Hwy 18, Canton	UST (removed)	Yes
30	Country Side Convenience	47073 US Hwy 18, Canton	LUST[7]	Yes

Notes:

1 RCRA = Resource Conservation and Recovery Act hazardous waste generator
2 AST = aboveground storage tank
3 UST = underground storage tank
4 ICIS = Integrated Compliance Information System
5 TRI = Toxic Release Inventory
6 AFS = Air Facility System
7 LUST = Leaking Underground Storage Tank

3.10 FARMLAND

3.10.1 Existing Conditions

The Farmland Protection Policy Act of 1981 (FPPA) outlines guidelines for federal agencies to account for any adverse effects on farmland and develop alternatives that would avoid or mitigate such adverse effects. Farmland is defined as "prime or unique farmlands" or "farmland of statewide or local importance," and includes land not currently used for farming. However, farmland does not include "land already in or committed to urban development or water storage."

According to the US Department of Agriculture (USDA) 2012 Census of Agriculture county profile for Lincoln County, there are 899 farms totaling 365,530 acres of farmland, which is over 98 percent of the county. The average farm size is about 407 acres. Of the total acres, 330,073.5 (90.3 percent) are characterized as cropland; 21,931.8 (6.0 percent) are characterized as pasture; and 13,890.1 (3.8 percent) are characterized as other uses.

Prime farmland was determined using the NRCS Soil Survey for Lincoln County and overlaying the ESA. For this evaluation, any land classified as prime farmland, farmland of statewide importance, prime farmland if drained, or prime farmland if irrigated was considered prime farmland. According to the NRCS Soil Survey for the ESA, several soil types occurring in the study area are considered prime farmland soils and total 2,096.1 acres. **Table 3-7** identifies the affected acres of prime farmland, farmland of statewide importance, and prime farmland if drained.

Table 3-7. Prime Farmland within ESA

Farmland Classification	Acres within ESA	Acres within Lincoln County
Prime Farmland	387.6	99,243.6
Farmland of Statewide Importance	426.4	57,395.5
Prime Farmland if Drained	1,277.8	164,240.0
Prime Farmland if Irrigated	4.3	4,766.2
Totals for all Classifications	**2,096.1**	**325,645.3**

3.10.2 Conclusions

The USDA FPPA guidelines require coordination with the NRCS if the land needed for development is purchased after August 6, 1984. Form CPA-106 (Farmland Conversion Impact Rating) for corridor type projects is used to score the relative value of the site. This assessment evaluates impact categories, considering the existing and future farming conditions, the types of surrounding land uses, the comparable size of the farm unit being converted, existing farm support services in the area, the number and value of farm investments, and the local or state protections provided for farming, among other considerations. For FPPA-regulated farmland, a threshold limit of 160 points determines if further action is necessary. Scores between 160 and 200 require further consideration of alternatives that would avoid this loss.

The total area of prime farmland within the ESA is less than 1 percent of the total acreage of prime farmland within the county. The overall project (I-29 Mainline, Exit 71 and Exit 64 Improvement Phases) would require only a portion of the total and would represent a negligible percentage relative to the total acreage of prime farmland within the county.

3.11 AIRPORTS AND HELIPORTS

3.11.1 Existing Conditions

Federal Aviation Administration and SDDOT – Aeronautics Commission have established height restrictions for temporary and permanent structures based on their proximity to public airport/heliport facilities and flightpaths (SDCL, Chapter 50-9: Air Navigation Hazards and Administrative Rules, Chapter 70:02:03: Structures Affecting Aviation). The airport's Height Restriction Zoning applies to the construction or alteration of structures greater than 200 feet in height above ground level or structures that exceed a 100:1 surface ratio from any point on the runway.

The Marv Skie-Lincoln County Airport is west of the ESA, southwest of I-29 Exit 73 (**Figure 3-4**). The airport is a publicly owned facility. No other public or privately owned facility has a restricted area crossing the ESA.

3.11.2 Conclusions

The ESA for this project, specifically improvement phases on the mainline and near Exit 71, is within 1 mile of the Marv Skie-Lincoln County Airport runway. The height of the roadway would not exceed 200 feet in height and would not obstruct the glidepath at a 100:1 slope from any point on the runway. It is anticipated that the proposed projects would comply with the airport's Height Restriction Zoning.

Because of the proximity to the Marv Skie-Lincoln County Airport, the height of any equipment used in the construction of the proposed projects (or any antennae installed on the equipment) shall not exceed the local airport's Height Restriction Zoning. Therefore, any Contractor involved in the project shall use the Notice Criteria Tool available at https://oeaaa.faa.gov/oeaaa/external/portal.jsp. If required, the Contractor shall file a 7460-1 Form with the Federal Aviation Administration. This includes any trucks or equipment used during the project construction.

The ESA for the proposed Exit 64 Improvement Phase is over 5 miles away from the Marv Skie-Lincoln County Airport or any other public airport or heliport.

4.0 2045 NO BUILD TRAFFIC CONDITIONS

The northern 4 miles of the proposed I-29 study area are within the coverage of the Sioux Falls MPO regional travel model, while the southern 7 miles are in rural Lincoln County outside the MPO model area. Thus, daily and hourly traffic forecasting methods used by the SDDOT in rural areas and the method used by the MPO within the regional model limits were coordinated to develop one set of horizon year forecasts for the entire study area.

Peak hour total, directional, and intersection turning movement 2045 forecasts were derived through a process of applying currently observed factors calculated from data collected in the corridor. I-29 mainline volumes were smoothed, as required, through balancing isolated intersections inbound and outbound volume using a methodology discussed and approved by the SDDOT and the MPO.

4.1 2045 DAILY TRAFFIC FORECASTING METHODOLOGY

Listed below are the general steps used in developing ADT forecasts for segments of the I-29 corridor in the study area:

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 I-29 corridor, daily traffic counts for the period from 2000 through 2016 were obtained from the SDDOT for each segment along the mainline. This data was used to develop an annual change trend for each segment.

2. **Extract from the Sioux Falls MPO area regional demand model forecasted volume changes between the base year 2013 and the horizon year of 2045**. Assignments from the model were used to derive an annual change in traffic trend to be applied to the current (2017) count data to derive one scenario for 2045 forecasted daily traffic.

3. **Obtain the SDDOT traffic growth factor for rural interstate routes applicable in Lincoln County.** SDDOT derives a unique/semi-unique traffic growth factor for urban and rural routes of various classifications for each county in the state. Factors are derived for five-year growth increments between 20- and 40-year periods. The factors can be converted to annual average growth and applied to current traffic volumes to estimate daily traffic levels in the applicable horizon year; in this case, 28 years into the future.

4. **Review the annual average volume change from each listed alternatives for consistency.** If the annual average change in traffic from each of the three 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.

5. **Review forecasts developed for other projects near the I-29 Corridor Study to ensure there is consistency between the future estimates of daily and peak hour traffic.** Relative to the study area, an interchange justification analysis is being completed at 85th Street, which, if constructed, would be Exit 75. The study assumptions for the I-29/85th Street interchange justification analysis were similar in that:

   - The horizon year is 2045.
   - Alternatives with and without portions of the proposed Highway 100 corridor were developed.

6. **The process of defining the most logical annual growth rates includes reviewing**:

   - Forecasted levels along the study area segments with current volume along segments in Sioux Falls. The purpose of this sensitivity analysis is 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. For example, if one or most of the trends result in a 2045 forecast of 80,000 vehicles per day, the logic test of reviewing the future adjacent area density to areas along I-29 between 26th Street and 12th Street would be reviewed. 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 relative to being defensible.
   - 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/level adjacent to the corridor are not observed, a change in traffic growth that deviates from the historical change would be questioned relative to being defensible.

7. **Select from the alternate rates a unique rate or composite of the range to be used for each segment and apply that rate to the current (2017) traffic data collected by the SDDOT as part of the study.**

4.2 ANNUAL CHANGE IN TRAFFIC – ALTERNATE SOURCES

Tables 4-1 and 4-2 contain the combination of historical traffic in the corridor and forecasted traffic from either the Sioux Falls regional travel model or from the SDDOT. Information in these tables provide the basis for developing a reasonable change in traffic rate to apply to the 2017 traffic count data for corridor mainline segments.

Table 4-1 contains historical count data for each segment for the period from 2000 through 2016 and the composite annual percent change for each corridor segment.

Table 4-1. Historical I-29 Segment Daily Traffic (2000– 2016) and Annual Change Percent

Year	I-29 Segment Between					
	Exit 59 -Exit 62	Exit 62 - Exit 64	Exit 64 - Exit 68	Exit 68 - Exit 71	Exit 71 - Exit 73	Exit 73 -Exit 75
2000	15,780	17,110	18,730	22,620	25,250	21,940
2001	17,390	17,910	19,420	21,260	26,760	25,290
2002	17,980	18,510	20,070	21,980	27,660	26,140
2003	17,140	17,640	19,200	21,040	26,470	28,200
2004	16,910	17,393	18,106	19,841	25,035	26,593
2005	17,000	17,230	17,310	20,290	25,590	27,180
2006	17,830	18,120	18,160	21,160	28,920	28,350
2007	17,470	17,760	17,800	22,750	31,090	31,000
2008	17,889	18,143	18,227	22,408	31,650	31,558
2009	18,780	19,230	19,400	23,750	33,550	33,300
2010	18,210	18,650	18,820	23,040	34,420	34,170
2011	18,480	18,920	19,100	23,070	34,040	33,790
2012	18,460	18,900	19,080	23,050	35,910	35,650
2013	18,440	18,880	19,060	24,340	37,920	37,650
2014	17,810	18,240	18,410	22,890	36,900	36,630
2015	17,400	17,840	18,010	22,390	33,430	33,170
2016	17,450	17,894	18,064	22,457	33,530	33,270
Annual Average Traffic Change	<1%	<1%	<1%	1.00%	2.00%	2.10%

Table 4-2 displays the 2013 Baseline and 2045 forecasted traffic for each segment from the Sioux Falls regional travel model. The network used in this base condition for 2045 includes 85th Street as an overpass of I-29 and does not include the Highway 100 corridor improvements.

The network for the 2045 period assumes:

- 85th Street is connected on either side of I-29 by an overpass.
- Highway 100 has not been constructed as a controlled access arterial between I-29 and I-90.

Annual increases in traffic observed along the study area segments range from 1.58 percent per year on the north end (which carries the highest base year volume) to approximately 2.0 percent per year at the southern limits.

Table 4-2. Sioux Falls Regional Travel Model Forecasts/Assignments

Location/Segment	Model Loaded 2013		2045 Model No-build Base		Model Annual Growth Rate (2013-2045)		Average of NB/SB
	Northbound	Southbound	Northbound	Southbound	Northbound	Southbound	
North of 85th St.	24,760	20,618	38,546	36,026	1.39%	1.76%	1.58%
85th St. - Exit 73	24,760	20,618	38,546	36,026	1.39%	1.76%	1.58%
Exit 73 – Exit 71	20,553	15,858	32,333	26,550	1.43%	1.62%	1.52%
Exit 71 - Exit 68	17,014	15,386	27,036	25,609	1.46%	1.60%	1.53%
Exit 68 - Exit 64	14,685	13,919	24,110	23,743	1.56%	1.68%	1.62%
Exit 64 – Exit 62	11,816	11,491	20,453	20,563	1.73%	1.84%	1.78%
South of Exit 62	10,274	10,093	19,261	19,100	1.98%	2.01%	2.00%

Locations and increments of household and employment growth in the region are key influencers of where and by how much travel will likely change. Thus, understanding where new residential and employment growth is anticipated is key to understanding forecasted changes in traffic. **Figure 4-1** displays the increment of household growth by traffic analysis zone in the southern portion of the Sioux Falls metropolitan area. **Figure 4-2** displays locations and increments of employment growth in the region. For both key socioeconomic descriptors, large portions of the immediate study area are not anticipated to experience growth before 2045.

SDDOT reports growth factors for each county, facility type, and location (urban versus rural). The 30-year growth factor for rural interstate routes in Lincoln County is 2.25, which translates to a 2.75 percent per year average over the 30-year period. For the I-29 Corridor Study analysis, the factor was applied to two alternate base year traffic values to derive a 2045 forecasted volume. The base year alternates are:

- 2016 ADT volume reported by SDDOT.
- 2017 daily counts collected as part of the I-29 Corridor Study.

For most segments (roadway sections between interchanges), volumes collected in 2017 were higher than the reported 2016 ADT.

Figure 4-1. Change in Households by Traffic Analysis Zone – 2013 to 2045

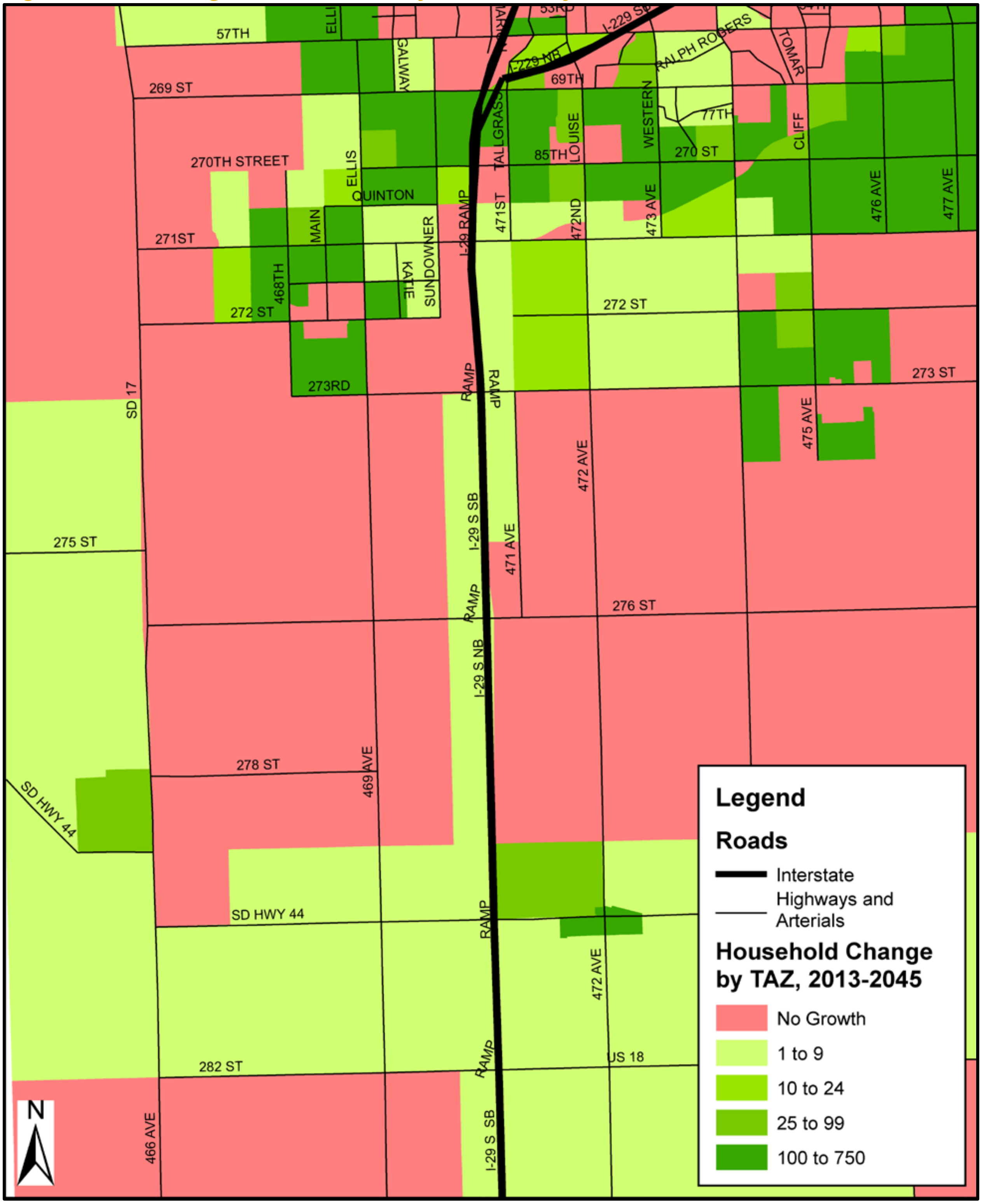
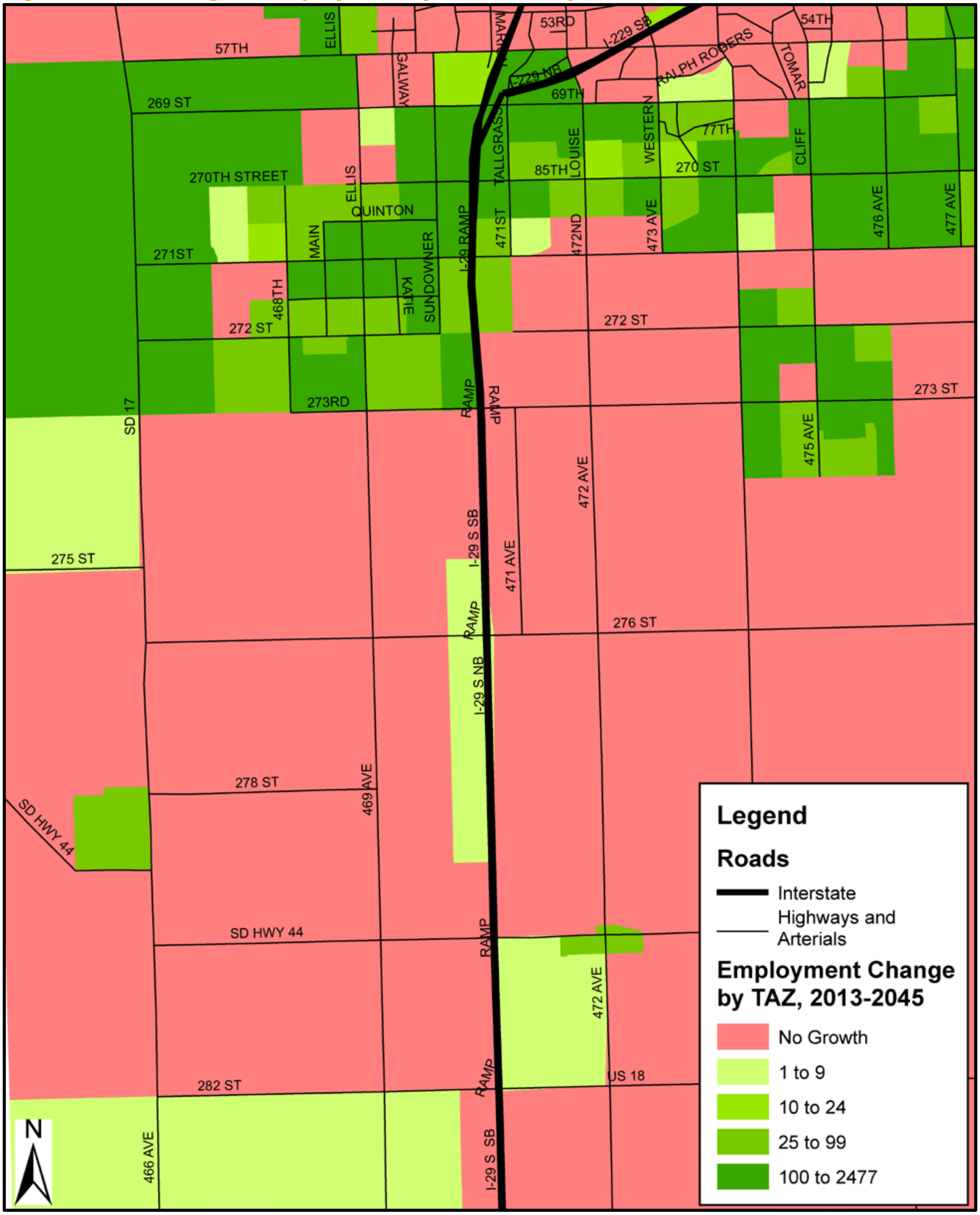


Figure 4-2. Change in Employment by Traffic Analysis Zone – 2013 to 2045



4.3 I-29/85TH STREET INTERCHANGE JUSTIFICATION REPORT TRAFFIC

Direction received from SDDOT staff during development and review of I-29 forecasts specified that forecasts derived for the I-29 Corridor Study and for the I-29/85th Street Interchange Justification Report need to be consistent at the project match points. For the forecasting process, the match point is the I-29/85th Street interchange. This match point was unique to the forecasting process because the operations analysis for the I-29 Corridor Study was limited to Exit 73 and areas to the south. Logic behind including the influences of the possible interchange included:

- Adding access to/from I-29 at 85th Street is close enough to Exit 73 (1 mile) to affect both through traffic on the cross route and the amount of traffic getting on and/or off the interstate at the Tea interchange.
- Anticipated improvements to the Highway 100 corridor proposed to extend east from I-29 to I-90 would also influence the amount of traffic using Exit 73 (Tea) and the level of cross route through traffic on 271st Avenue/Highway 106.

Forecasts derived for the I-29/85th Street Interchange Justification Report included alternatives with an I-29 overpass and with an interchange. Each alternative was incorporated into the I-29 Corridor Study forecasting process.

4.4 COMPOSITE 2045 DAILY TRAFFIC

Figure 4-3 displays updated ADT forecasts for the range of data source and network alternatives outlined in this section. Forecasts include the possible network improvements outlined below:

- **2045 Baseline**. Roadway network modifications with and adjacent to the study area are:
  - 85th Street – Constructed across I-29 connecting Sundowner Avenue to Tallgrass Avenue.
  - 69th Street – Constructed as a continuous corridor across I-29 connecting Sundowner to Tallgrass/Solberg Avenue.
- **Highway 100.** A planned four-lane divided arterial constructed from I-29 to SD 11, with the assumption that the corridor would be extended north along SD 11 to I-90 at a future time.
- **I-29/85th Street Interchange**. The interchange concept as outlined in the I-29/85th Street Interchange Justification Report would be completed by 2045.

Table 4-3 documents forecasts for cross routes reflective of the range of network improvement at 85th Street and with/without Highway 100 improvements. For each network alternative, **Table 4-3** includes:

- Annual percentage traffic growth rates applied to the current counts to obtain one option for future daily traffic.
- Increment of absolute change in traffic added to the current counts to create one option for future daily traffic.
- Average daily traffic. The average of the results of applying the absolute and annual percent growth rates, which represent the recommended 2045 daily traffic for the mainline and cross routes.

Figure 4-3. Current and 2045 Forecasted Daily Traffic

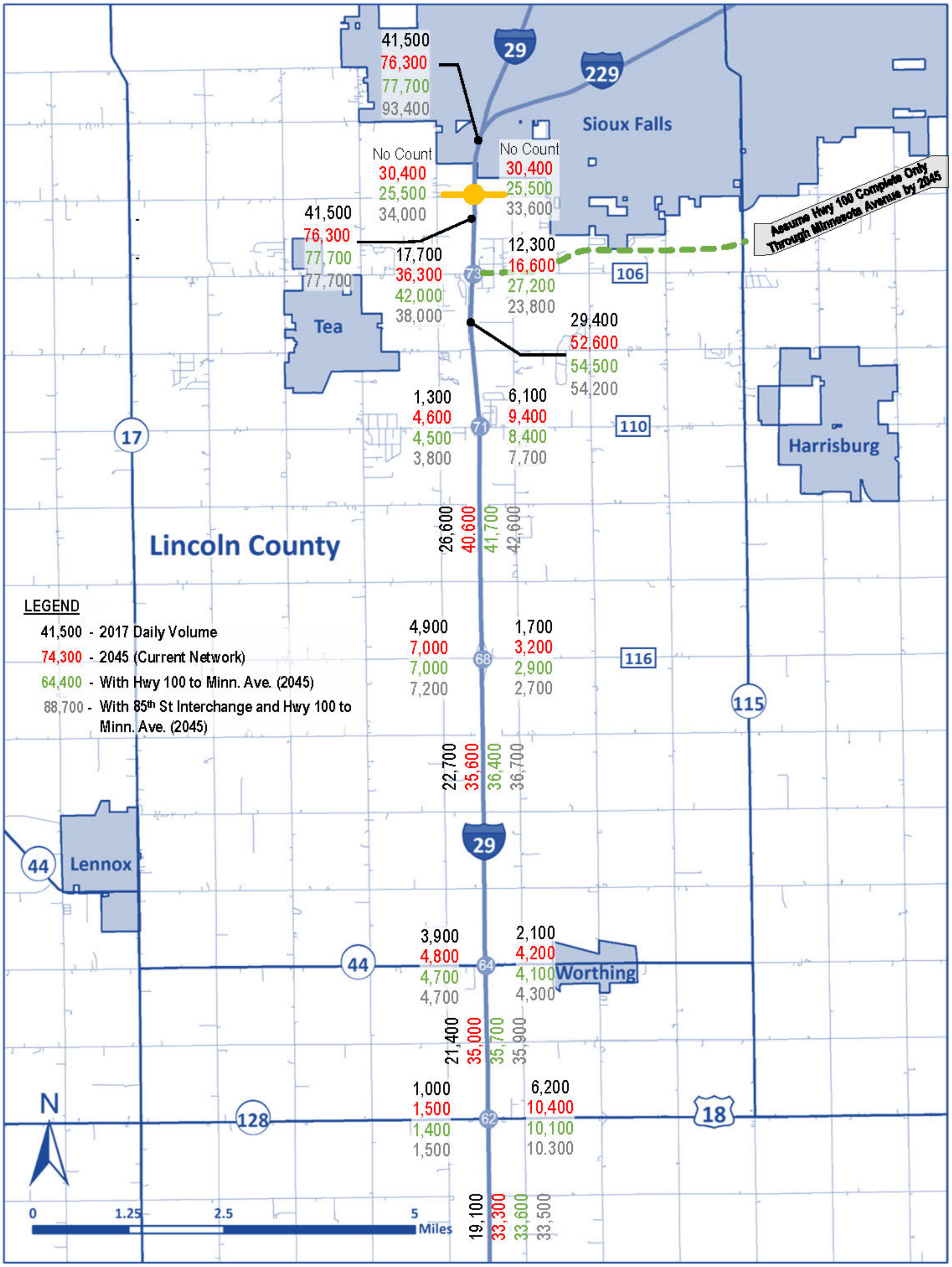


Table 4-3. Crossroad Daily Traffic Forecasts by Growth Method

Scenario and Location Relative to I-29

2045 BASELINE	2017		2045 85th Overpass (Percent Change)				2024 85th Overpass (Abs. Change)				2045 85th Overpass (Average)			
					Change From 2017				Change From 2017				Change From 2017	
Crossroad Volumes	East	West	East	West	East	West	East	West	East	West	East	West	East	West
85th St. Sioux Falls	0	0	30,400	30,400	30,400	30,400	30,400	30,400	30,400	30,400	30,400	30,400	30,400	30,400
Lincoln Co. Road 106, Exit 73	12,295	17,710	16,500	37,400	4,205	19,690	16,700	35,200	4,400	17,500	16,600	36,300	4,305	18,590
Lincoln Co. Road 110, Exit 71	6,115	3,280	9,700	4,300	3,585	1,020	9,100	4,900	3,000	1,600	9,400	4,600	3,285	1,320
Lincoln Co. Road 116, Exit 68	1,705	4,865	3,100	7,000	1,395	2,135	3,300	7,000	1,600	2,100	3,200	7,000	1,495	2,135
SD Hwy. 44, Exit 64	2,150	3,885	3,900	4,700	1,750	815	4,400	4,900	2,200	1,000	4,200	4,800	2,050	915
US Hwy 18, Exit 62	6,165	1,020	11,000	1,500	4,835	480	9,800	1,400	3,600	400	10,400	1,500	4,235	480

Scenario and Location Relative to I-29

2045 W/ HIGHWAY 100	2017		2045 - Based on Percent Change				2045 - Based on Absolute Change				2045 Average of Percent and Absolute			
(I-29 to Minnesota Ave)					Change From 2017				Change From 2017				Change From 2017	
Crossroad Volumes	East	West	East	West	East	West	East	West	East	West	East	West	East	West
85th St. Sioux Falls	0	0	25,500	25,500	25,500	25,500	25,500	25,500	25,500	25,500	25,500	25,500	25,500	25,500
Lincoln Co. Road 106, Exit 73	12,295	17,710	26,500	43,200	14,205	25,490	27,900	40,700	15,605	22,990	27,200	42,000	14,905	24,290
Lincoln Co. Road 110, Exit 71	6,115	3,280	8,600	4,200	2,485	920	8,200	4,700	2,085	1,420	8,400	4,500	2,285	1,220
Lincoln Co. Road 116, Exit 68	1,705	4,865	2,800	7,000	1,095	2,135	2,900	6,900	1,195	2,035	2,900	7,000	1,195	2,135
SD Hwy. 44, Exit 64	2,150	3,885	3,900	4,600	1,750	715	4,300	4,800	2,150	915	4,100	4,700	1,950	815
US Hwy 18, Exit 62	6,165	1,020	10,600	1,400	4,435	380	9,500	1,300	3,335	280	10,100	1,400	3,935	380

Scenario and Location Relative to I-29

2045 W/ 85th ST INTERCHANGE And HIGHWAY 100	2017		2045 - Based on Percent Change				2045 - Based on Absolute Change				2045 Average of Percent and Absolute			
(I-29 to Minnesota Ave)					Change From 2017				Change From 2017				Change From 2017	
Crossroad Volumes	East	West	East	West	East	West	East	West	East	West	East	West	East	West
85th St. Sioux Falls	0	0	33,600	34,000	33,600	34,000	33,600	34,000	33,600	34,000	33,600	34,000	33,600	34,000
Lincoln Co. Road 106, Exit 73	12,295	17,710	23,300	39,100	11,005	21,390	24,300	36,800	12,005	19,090	23,800	38,000	11,505	20,290
Lincoln Co. Road 110, Exit 71	6,115	3,280	7,800	3,600	1,685	320	7,500	3,900	1,385	620	7,700	3,800	1,585	520
Lincoln Co. Road 116, Exit 68	1,705	4,865	2,600	7,200	895	2,335	2,700	7,100	995	2,235	2,700	7,200	995	2,335
SD Hwy. 44, Exit 64	2,150	3,885	4,000	4,600	1,850	715	4,500	4,800	2,350	915	4,300	4,700	2,150	815
US Hwy 18, Exit 62	6,165	1,020	10,800	1,500	4,635	480	9,700	1,400	3,535	380	10,300	1,500	4,135	480

4.5 2045 PEAK HOUR TRAFFIC FORECASTS

Daily traffic forecasts for 2045 with an interchange at 85th Street, with and without Highway 100, were factored to AM and PM peak period forecasts by applying the following steps:

1. Apply current condition AM and PM peak period percentages of daily traffic observed in the peak hours to forecasted 2045 daily traffic. The product of this step is two-way peak hour traffic on the I-29 mainline and cross routes.
2. Apply current conditions AM and PM peak hour directional splits to the forecasted 2045 AM and PM peak two-way traffic to provide directional flows into and out of each intersection.
3. Using an iterative distribution model that incorporates current turning movements as seed values for 2045, develop AM and PM peak hour intersection turning movements for use in the traffic operations and predictive crash analyses.

4.5.1 Summary of 2045 Transportation Network Improvements

SDDOT/Lincoln Count /Sioux Falls MPO are currently planning the following transportation network improvements by 2045, which have been included in the 2045 traffic scenarios:

- 85th Street (Exit 75) Interchange with I-29
- Construct 85th Street across I-29 connecting Sundowner Avenue to Tallgrass Avenue
- Construct 69th Street as a continuous corridor across I-29 connecting Sundowner Avenue to Tallgrass/Solberg Avenue
- Construct Highway 100 as a four-lane divided arterial from I-29 through Minnesota Avenue (scenarios were run with and without Highway 100)
- Move the urban/rural boundary in the study area south approximately 3 miles from MRM 72.00 to MRM 69.00, between Exits 68 and 71

4.5.2 2045 Traffic Volume Scenarios

Two 2045 traffic volume scenarios were developed, with and without the future Highway 100 Corridor improvements immediately to the east of the project area on 271st Street / CR 106:

- 2045 No Build
- 2045 No Build with Highway 100

Generally only volumes on I-29 at Exit 73, including those along 271st Street / CR 106, are expected to change with the construction of Highway 100. For study purposes, traffic volumes south of Exit 73 on I-29 and various crossroads were assumed to be the same with or without Highway 100 Corridor improvements.

Figure 4-4 and **Figure 4-5** show the results of applying the traffic forecasting methodology.

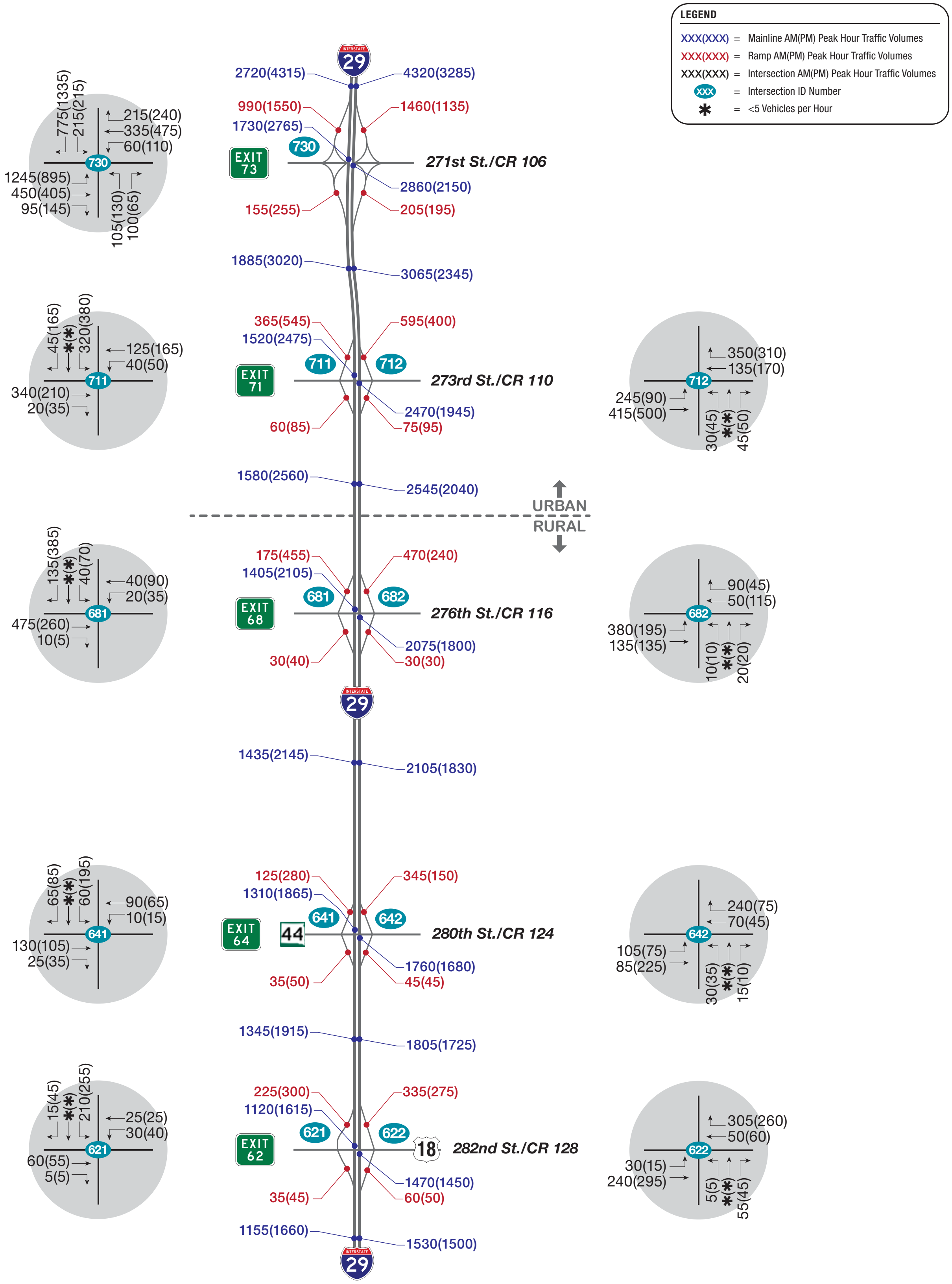


Figure 4-4

2045 No Build Peak Hour Traffic Volumes

NOTE: Drawing Not to Scale

NORTH

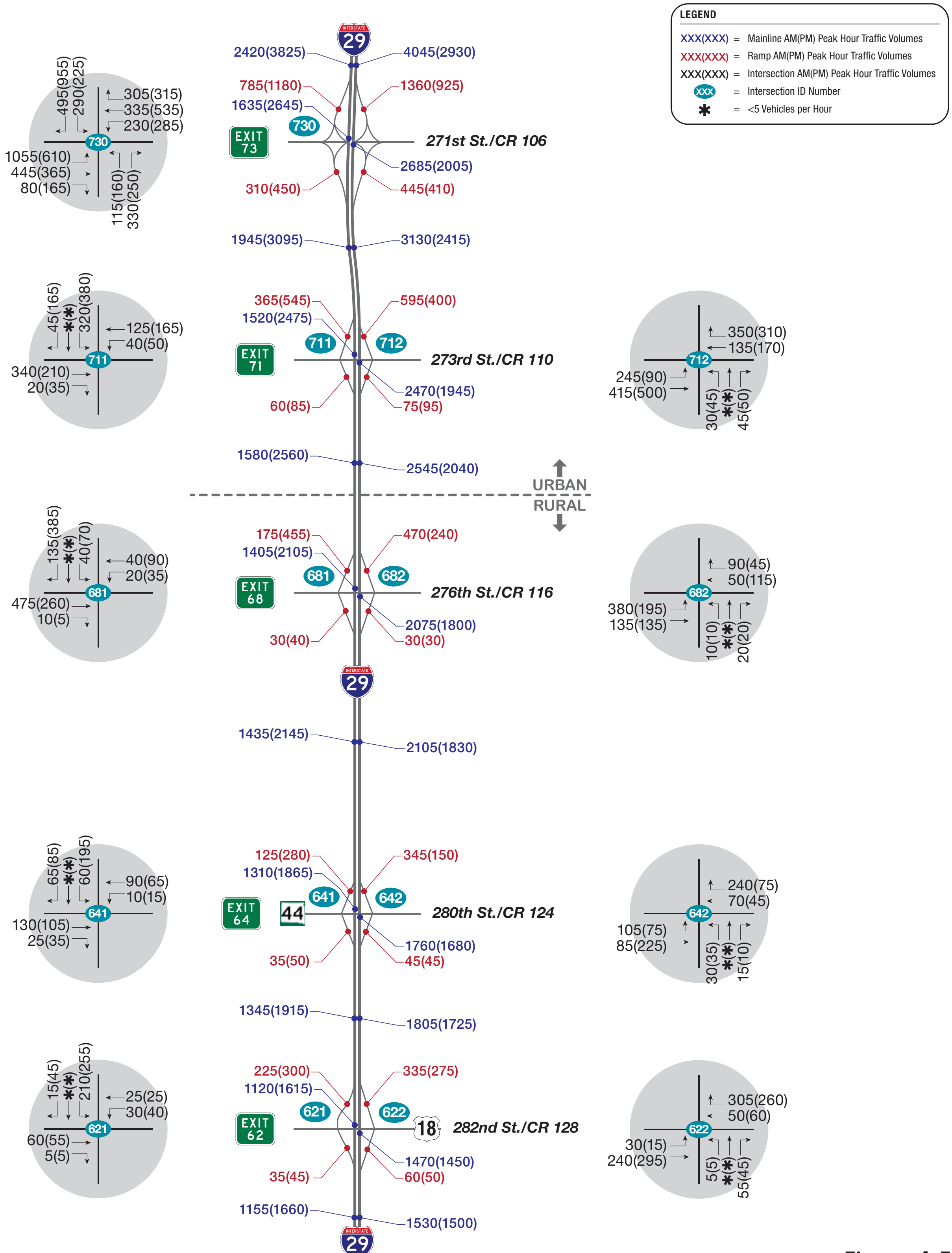


Figure 4-5

2045 No Build with Highway 100
Peak Hour Traffic Volumes

NOTE: Drawing Not to Scale

NORTH

4.6 2045 NO-BUILD OPERATIONAL ANALYSIS

2045 No-Build traffic volumes, as depicted in **Figure 4-4**, were used for the 2045 No-Build operational analysis. Mainline, Merge/Diverge, and Intersection analyses were conducted using the Highway Capacity Software (HCS7).

4.6.1 2045 No-Build Mainline Operations Analysis

The mainline basic segment analysis used HCS7. 2045 No-Build I-29 mainline basic segments in the study area not expected to meet the minimum operations goals are highlighted in yellow. **Table 4-4** and **Figure 4-6** show the mainline LOS for 2045. **Appendix H** includes HCS7 freeway analysis worksheets for the 2045 No-Build traffic scenario.

Table 4-4. 2045 No-Build Mainline Basic Operations Analysis

Segment	Direction	Total Number of Lanes	AM Peak Hour		PM Peak Hour	
			Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS
I-29 – Exit 62	Northbound	2	14.4	B	15.0	B
	Southbound	2	10.3	A	14.0	B
I-29 – Between Exit 62 On & Off Ramps	Northbound	2	12.1	B	12.7	B
	Southbound	2	10.0	A	13.7	B
I-29 – Exit 62 to Exit 64	Northbound	2	13.8	B	13.1	B
	Southbound	2	11.8	B	15.8	B
I-29 – Between Exit 64 On & Off Ramps	Northbound	2	13.0	B	12.7	B
	Southbound	2	11.5	B	15.2	B
I-29 – Exit 64 to Exit 68	Northbound	2	17.4	B	15.9	B
	Southbound	2	12.3	B	18.1	C
I-29 – Between Exit 68 On & Off Ramps	Northbound	2	17.0	B	15.5	B
	Southbound	2	11.9	B	17.7	B
I-29 – Exit 68 to Exit 71 Urban/Rural	Northbound	2	24.1/21.7	C/C	20.2/17.5	C/B
	Southbound	2	14.6/12.4	B/B	23.1/20.5	C/C
I-29 – Between Exit 71 On & Off Ramps	Northbound	2	23.9	C	19.4	C
	Southbound	2	14.0	B	22.7	C
I-29 – Exit 71 to Exit 73	Northbound	2	30.1	D	23.7	C
	Southbound	2	20.6	C	32.4	D
I-29 – Between Exit 73 On & Off Ramps	Northbound	2	27.1	D	21.9	C
	Southbound	2	19.3	C	30.1	D
I-29 – North of Exit 73	Northbound	3	28.3	D	21.5	C
	Southbound	3	18.5	C	28.3	D

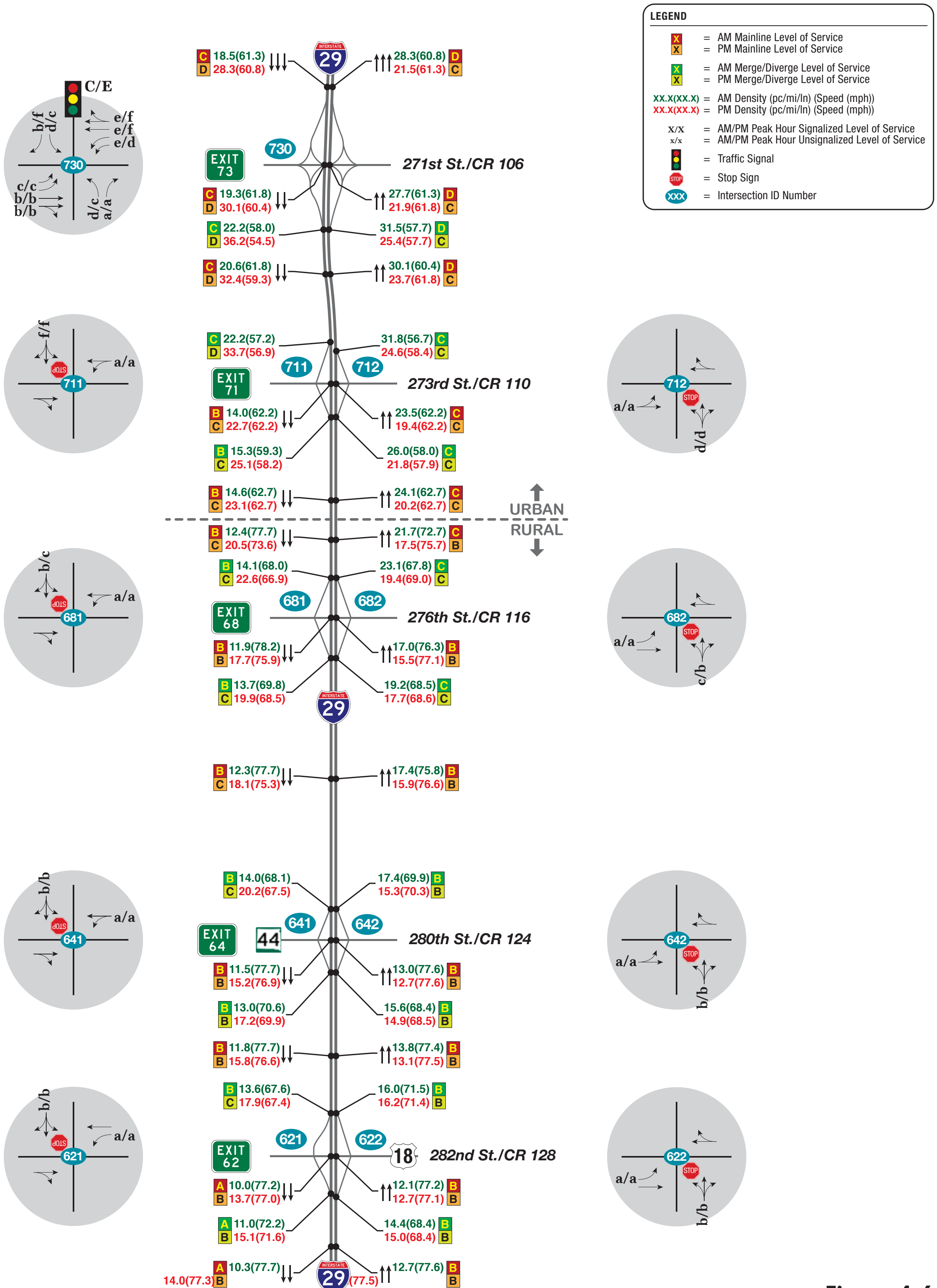


Figure 4-6

2045 No Build Levels of Service

NOTE: Drawing Not to Scale

NORTH

4.6.2 Merge/Diverge Analysis

The HCS7 software was also used to conduct the merge/diverge analysis at the I-29 ramps. I-29 ramps not expected to meet the minimum freeway operations goals are highlighted in yellow. **Table 4-5** and **Figure 4-6** show the merge/diverge analysis results for 2045 No-Build conditions. **Appendix H** includes HCS7 ramp and ramp junction worksheets for the 2045 No-Build traffic conditions scenario.

Table 4-5. 2045 No-Build Merge/Diverge Analysis

Interchange	Ramp	Number of Lanes			AM Peak Hour		PM Peak Hour	
		Mainline	Ramp	Total	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS
Exit 62 (Diamond)	NB Off-Ramp	2	Decel	2	14.4	B	15.0	B
	NB On-Ramp	2	Accel	2	16.0	B	16.2	B
	SB Off-Ramp	2	Decel	2	13.6	B	17.9	C
	SB On-Ramp	2	Accel	2	11.0	A	15.1	B
Exit 64 (Diamond)	NB Off-Ramp	2	Decel	2	15.6	B	14.9	B
	NB On-Ramp	2	Accel	2	17.4	B	15.3	B
	SB Off-Ramp	2	Decel	2	14.0	B	20.2	C
	SB On-Ramp	2	Accel	2	13.0	B	17.2	B
Exit 68 (Diamond)	NB Off-Ramp	2	Decel	2	19.2	C	17.7	B
	NB On-Ramp	2	Accel	2	23.1	C	19.4	C
	SB Off-Ramp	2	Decel	2	14.1	B	22.6	C
	SB On-Ramp	2	Accel	2	13.7	B	19.9	C
Exit 71 (Diamond)	NB Off-Ramp	2	Decel	2	26.0	C	21.8	C
	NB On-Ramp	2	Accel	2	31.8	C	24.6	C
	SB Off-Ramp	2	Decel	2	22.2	C	33.7	D
	SB On-Ramp	2	Accel	2	15.3	B	25.1	C
Exit 73 (Single Point)	NB Off-Ramp	2	Decel	2	31.5	D	25.4	C
	NB On-Ramp	2	1	3	Add lane, no merge			
	SB Off-Ramp	2	1	3	Drop lane, no diverge			
	SB On-Ramp	2	Accel	2	22.2	C	36.2	D

4.6.3 Ramp Check Analysis

The *HCM 6th Edition, Exhibit 14-12* was used to analyze traffic operations on the study interchange ramps. Based on the ramp's FFS and number of lanes on the ramp, an estimated capacity was obtained. All ramp volumes were converted to peak flow rates using the PHF. The capacity of the ramp was then compared to the peak flow rate of the ramp to obtain a V/C ratio. If the V/C ratio is greater than 1.0, the ramp is determined to be over capacity based on the HCM ramp check methodologies. **Table 4-6** shows the V/C ratios for all study area ramps for the 2045 No-Build traffic volume scenario. All ramps in the study area currently operate under capacity (V/C = 1.0) during the 2045 No-Build peak hours.

Table 4-6. 2045 No-Build Ramp Check Analysis

Ramp	No. of Lanes	Ramp FFS (mi/h)	AM Peak Hour				PM Peak Hour			
			Volume	Peak Flow Rate	Capacity	V/C Ratio	Volume	Peak Flow Rate	Capacity	V/C Ratio
NB I-29 Exit 62 Off-Ramp	1	45	60	68	2,100	0.03	50	57	2,100	0.03
NB I-29 Exit 62 On-Ramp	1	45	335	381	2,100	0.18	275	313	2,100	0.15
NB I-29 Exit 64 Off-Ramp	1	45	45	51	2,100	0.02	45	51	2,100	0.02
NB I-29 Exit 64 On-Ramp	1	45	345	392	2,100	0.19	150	170	2,100	0.08
NB I-29 Exit 68 Off-Ramp	1	45	30	34	2,100	0.02	30	34	2,100	0.02
NB I-29 Exit 68 On-Ramp	1	45	470	534	2,100	0.25	240	273	2,100	0.13
NB I-29 Exit 71 Off-Ramp	1	45	75	82	2,100	0.04	95	103	2,100	0.05
NB I-29 Exit 71 On-Ramp	1	45	595	647	2,100	0.31	400	435	2,100	0.21
NB I-29 Exit 73 Off-Ramp	1	45	205	223	2,100	0.11	195	212	2,100	0.10
NB I-29 Exit 73 On-Ramp	1	45	1460	1,587	2,100	0.76	1135	1,234	2,100	0.59
SB I-29 Exit 73 Off-Ramp	1	45	990	1,076	2,100	0.51	1550	1,685	2,100	0.80
SB I-29 Exit 73 On-Ramp	1	45	155	168	2,100	0.08	255	277	2,100	0.13
SB I-29 Exit 71 Off-Ramp	1	45	365	397	2,100	0.19	545	592	2,100	0.28
SB I-29 Exit 71 On-Ramp	1	45	60	65	2,100	0.03	85	92	2,100	0.04
SB I-29 Exit 68 Off-Ramp	1	45	175	199	2,100	0.09	455	517	2,100	0.25
SB I-29 Exit 68 On-Ramp	1	45	30	34	2,100	0.02	40	45	2,100	0.02
SB I-29 Exit 64 Off-Ramp	1	45	125	142	2,100	0.07	280	318	2,100	0.15
SB I-29 Exit 64 On-Ramp	1	45	35	40	2,100	0.02	50	57	2,100	0.03
SB I-29 Exit 62 Off-Ramp	1	45	225	256	2,100	0.12	300	341	2,100	0.16
SB I-29 Exit 62 On-Ramp	1	45	35	40	2,100	0.02	45	51	2,100	0.02

4.6.4 Intersection Operations Analysis

The HCS7 software was used to analyze traffic operations at the study intersections. **Figure 4-6** shows the lane geometry, traffic control, and LOS for 2045 No-Build traffic conditions. The lane configurations at all study intersections are based on existing geometrics. **Appendix H** includes capacity analysis worksheets for the 2045 No-Build traffic conditions scenario.

Most intersections in the rural section of the study area operate at acceptable levels of service (LOS B or better on rural principal and minor arterial roadways) in the peak hours in 2045. Two rural study intersections do not operate at acceptable LOS for the 2045 No-Build scenario:

- At the I-29 Exit 68 ramp terminals with 276th Street / CR 116, the northbound approach at the northbound ramp terminal is expected to operate at LOS C in the AM peak hour. In the PM peak hour, the southbound approach at the southbound ramp terminal is expected to operate at LOS C in the PM peak hour.

None of the intersections in the urban section of the study area are expected to operate at acceptable levels of service (LOS C or better on urban principal and minor arterial roadways) in the peak hours in 2045:

- At the I-29 Exit 71 ramp terminals with 273rd Street / CR 110, the northbound approach at the northbound ramp terminal is expected to operate at LOS D in both the AM and PM peak hours. The southbound approach at the southbound ramp terminal is expected to operate at LOS F in both the AM and PM peak hours.
- The Single Point Interchange intersection of the I-29 Exit 73 ramp terminals with 271st Street / CR 106 is expected to operate at LOS E overall in the PM peak hour.

4.7 2045 NO-BUILD WITH HIGHWAY 100 OPERATIONAL ANALYSIS

2045 No-Build with Highway 100 traffic volumes as depicted on **Figure 4-5** were used for the operational analysis. Mainline, Merge/Diverge, and Intersection analyses used HCS7.

4.7.1 Mainline Operations Analysis

The mainline basic segment analysis used HCS7. 2045 No-Build with Highway 100 I-29 mainline basic segments in the study area not expected to meet the minimum operations goals are highlighted in yellow. **Table 4-7** and

Figure 4-7 show the mainline LOS for 2045. **Appendix H** includes HCS7 freeway analysis worksheets for the 2045 No-Build traffic scenario.

Table 4-7. 2045 No-Build with Highway 100 Mainline Basic Operations Analysis

Segment	Direction	Total Number of Lanes	AM Peak Hour		PM Peak Hour	
			Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS
I-29 – Exit 62	Northbound	2	14.4	B	15.0	B
	Southbound	2	10.3	A	14.0	B
I-29 – Between Exit 62 On- & Off-Ramps	Northbound	2	12.1	B	12.7	B
	Southbound	2	10.0	A	13.7	B
I-29 – Exit 62 to Exit 64	Northbound	2	13.8	B	13.1	B
	Southbound	2	11.8	B	15.8	B
I-29 – Between Exit 64 On- & Off-Ramps	Northbound	2	13.0	B	12.7	B
	Southbound	2	11.5	B	15.2	B
I-29 – Exit 64 to Exit 68	Northbound	2	17.4	B	15.9	B
	Southbound	2	12.3	B	18.1	C
I-29 – Between Exit 68 On- & Off-Ramps	Northbound	2	17.0	B	15.5	B
	Southbound	2	11.9	B	17.7	B
I-29 – Exit 68 to Exit 71 Urban/Rural	Northbound	2	24.1/21.7	C/C	20.2/17.5	C/B
	Southbound	2	14.6/12.4	B/B	23.1/20.5	C/C
I-29 – Between Exit 71 On- & Off-Ramps	Northbound	2	23.9	C	19.4	C
	Southbound	2	14.0	B	22.7	C
I-29 – Exit 71 to Exit 73	Northbound	2	30.9	D	24.4	C
	Southbound	2	18.3	C	28.5	D
I-29 – Between Exit 73 On- & Off-Ramps	Northbound	2	25.8	C	20.5	C
	Southbound	2	21.2	C	33.6	D
I-29 – North of Exit 73	Northbound	3	26.3	D	19.2	C
	Southbound	3	16.4	C	24.9	D

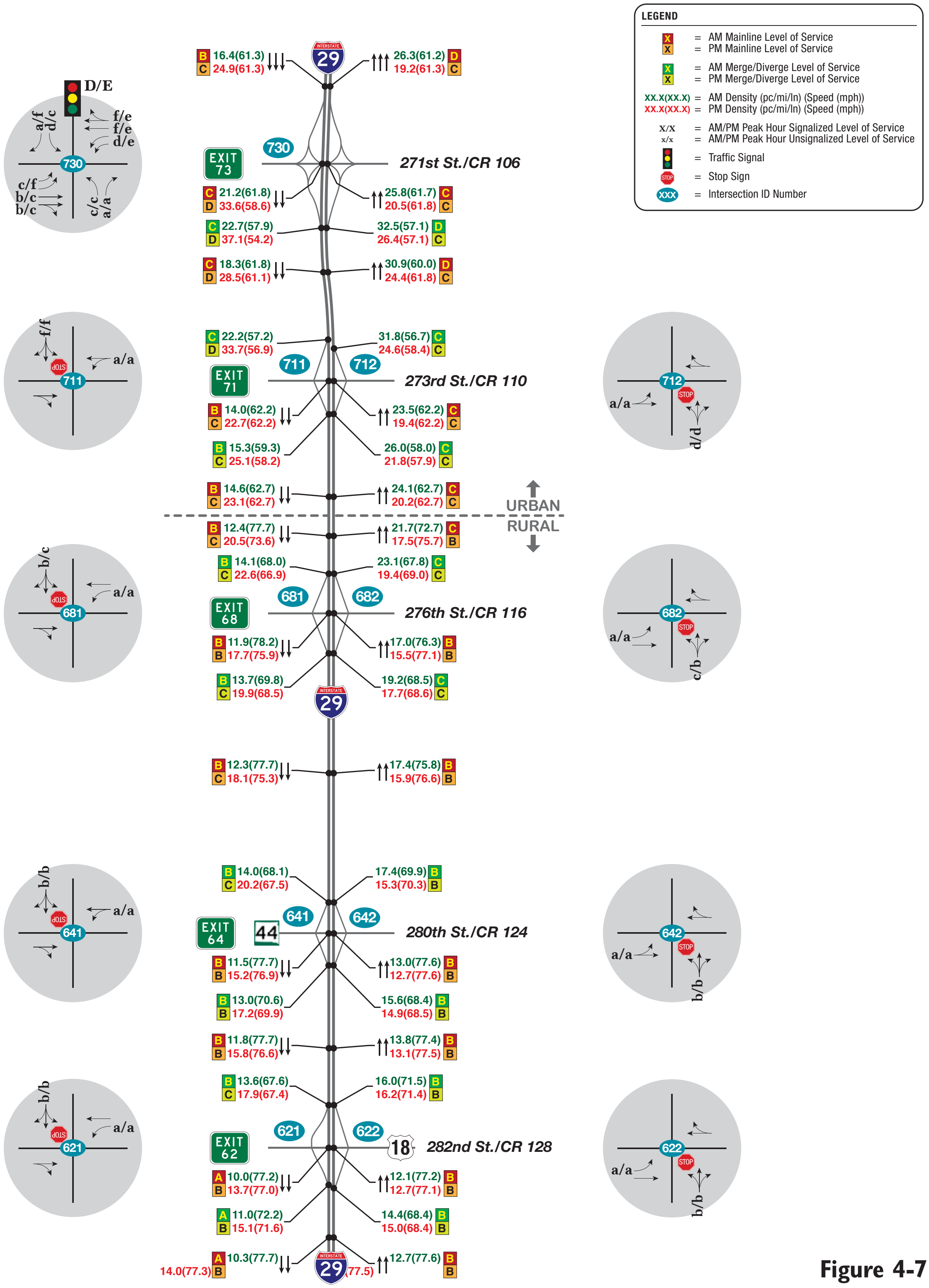


Figure 4-7

2045 No Build with Highway 100 Levels of Service

NOTE: Drawing Not to Scale

NORTH

4.7.2 Merge/Diverge Analysis

The HCS7 software was also used to conduct the merge/diverge analysis at the I-29 ramps. I-29 ramps not expected to meet the minimum freeway operations goals are highlighted in yellow. **Table 4-8** and

Figure 4-7 show the merge/diverge analysis results for 2045 No-Build with Highway 100 traffic. **Appendix H** includes HCS7 ramp and ramp junction worksheets for the 2045 No-Build with Highway 100 scenario.

Table 4-8. 2045 No-Build with Highway 100 Merge/Diverge Analysis

Interchange	Ramp	Number of Lanes			AM Peak Hour		PM Peak Hour	
		Mainline	Ramp	Total	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS
Exit 62 (Diamond)	NB Off-Ramp	2	Decel	2	14.4	B	15.0	B
	NB On-Ramp	2	Accel	2	16.0	B	16.2	B
	SB Off-Ramp	2	Decel	2	13.6	B	17.9	C
	SB On-Ramp	2	Accel	2	11.0	A	15.1	B
Exit 64 (Diamond)	NB Off-Ramp	2	Decel	2	15.6	B	14.9	B
	NB On-Ramp	2	Accel	2	17.4	B	15.3	B
	SB Off-Ramp	2	Decel	2	14.0	B	20.2	C
	SB On-Ramp	2	Accel	2	13.0	B	17.2	B
Exit 68 (Diamond)	NB Off-Ramp	2	Decel	2	19.2	C	17.7	B
	NB On-Ramp	2	Accel	2	23.1	C	19.4	C
	SB Off-Ramp	2	Decel	2	14.1	B	22.6	C
	SB On-Ramp	2	Accel	2	13.7	B	19.9	C
Exit 71 (Diamond)	NB Off-Ramp	2	Decel	2	26.0	C	21.8	C
	NB On-Ramp	2	Accel	2	31.8	C	24.6	C
	SB Off-Ramp	2	Decel	2	22.2	C	33.7	D
	SB On-Ramp	2	Accel	2	15.3	B	25.1	C
Exit 73 (Single Point)	NB Off-Ramp	2	Decel	2	30.9	D	24.4	C
	NB On-Ramp	2	1	3	Add lane, no merge			
	SB Off-Ramp	2	1	3	Drop lane, no diverge			
	SB On-Ramp	2	Accel	2	18.3	C	28.5	D

4.7.3 Ramp Check Analysis

The *HCM 6th Edition, Exhibit 14-12* was used to analyze traffic operations on the study interchange ramps. Based on the ramp's FFS and number of lanes on the ramp, an estimated capacity was obtained. All ramp volumes were converted to peak flow rates using the PHF. The capacity of the ramp was then compared to the peak flow rate of the ramp to obtain a V/C ratio. If the V/C ratio is greater than 1.0, the ramp is determined to be over capacity based on the HCM ramp check methodologies. **Table 4-9** shows the V/C ratios for all study area ramps for the 2045 No Build with Highway 100 traffic volume scenario. All ramps in the study area are expected to operate under capacity during the 2045 No-Build peak hours.

Table 4-9. 2045 N- Build with Highway 100 Ramp Check Analysis

Ramp	No. of Lanes	Ramp FFS (mi/h)	AM Peak Hour				PM Peak Hour			
			Volume	Peak Flow Rate	Capacity	V/C Ratio	Volume	Peak Flow Rate	Capacity	V/C Ratio
NB I-29 Exit 62 Off-Ramp	1	45	60	68	2,100	0.03	50	57	2,100	0.03
NB I-29 Exit 62 On-Ramp	1	45	335	381	2,100	0.18	275	313	2,100	0.15
NB I-29 Exit 64 Off-Ramp	1	45	45	51	2,100	0.02	45	51	2,100	0.02
NB I-29 Exit 64 On-Ramp	1	45	345	392	2,100	0.19	150	170	2,100	0.08
NB I-29 Exit 68 Off-Ramp	1	45	30	34	2,100	0.02	30	34	2,100	0.02
NB I-29 Exit 68 On-Ramp	1	45	470	534	2,100	0.25	240	273	2,100	0.13
NB I-29 Exit 71 Off-Ramp	1	45	75	82	2,100	0.04	95	103	2,100	0.05
NB I-29 Exit 71 On-Ramp	1	45	595	647	2,100	0.31	400	435	2,100	0.21
NB I-29 Exit 73 Off-Ramp	1	45	445	484	2,100	0.23	410	446	2,100	0.21
NB I-29 Exit 73 On-Ramp	1	45	1,360	1,478	2,100	0.70	925	1,005	2,100	0.48
SB I-29 Exit 73 Off-Ramp	1	45	785	853	2,100	0.41	1,180	1,283	2,100	0.61
SB I-29 Exit 73 On-Ramp	1	45	310	337	2,100	0.16	450	489	2,100	0.23
SB I-29 Exit 71 Off-Ramp	1	45	365	397	2,100	0.19	545	592	2,100	0.28
SB I-29 Exit 71 On-Ramp	1	45	60	65	2,100	0.03	85	92	2,100	0.04
SB I-29 Exit 68 Off-Ramp	1	45	175	199	2,100	0.09	455	517	2,100	0.25
SB I-29 Exit 68 On-Ramp	1	45	30	34	2,100	0.02	40	45	2,100	0.02
SB I-29 Exit 64 Off-Ramp	1	45	125	142	2,100	0.07	280	318	2,100	0.15
SB I-29 Exit 64 On-Ramp	1	45	35	40	2,100	0.02	50	57	2,100	0.03
SB I-29 Exit 62 Off-Ramp	1	45	225	256	2,100	0.12	300	341	2,100	0.16
SB I-29 Exit 62 On-Ramp	1	45	35	40	2,100	0.02	45	51	2,100	0.02

4.7.4 Intersection Operations Analysis

The HCS7 software was used to analyze traffic operations at the study intersections.

Figure 4-7 shows the lane geometry, traffic control, and LOS for 2045 No-Build with Highway 100 traffic conditions. The lane configurations at all study intersections are based on existing geometrics. **Appendix H** includes capacity analysis worksheets for the 2045 No-Build with Highway 100 traffic scenario.

Most intersections in the rural section of the study area operate at acceptable levels of service (LOS B or better on rural principal and minor arterial roadways) in the peak hours in 2045. Two rural study intersections do not operate at acceptable LOS for the 2045 No-Build scenario:

- At the I-29 Exit 68 ramp terminals with 276th Street / CR 116, the northbound approach at the northbound ramp terminal is expected to operate at LOS C in the AM peak hour. In the PM peak hour, the southbound approach at the southbound ramp terminal is expected to operate at LOS C in the PM peak hour.

None of the intersections in the urban section of the study area are expected to operate at acceptable levels of service (LOS C or better on urban principal and minor arterial roadways) in the peak hours in 2045:

- At the I-29 Exit 71 ramp terminals with 273rd Street / CR 110, the northbound approach at the northbound ramp terminal is expected to operate at LOS D in both the AM and PM peak hours. The southbound approach at the southbound ramp terminal is expected to operate at LOS F in both the AM and PM peak hours.
- The Single Point Interchange intersection of the I-29 Exit 73 ramp terminals with 271st Street / CR 106 is expected to operate at LOS D overall in the AM peak hour and at LOS E overall in the PM peak hour.

4.8 2017 EXISTING / 2045 NO-BUILD WORST CASE SUMMARY

Traffic operations for the 2017 Existing, 2045 No-Build, and 2045 No-Build with Highway 100 scenarios were compared and the “worst case” LOS (irrespective of AM or PM) for each year was summarized on **Figure 4-8**. The Mainline, Merge/Diverge, and Intersection analyses are represented with a color-coded bubble. Generally, the AM peak hour is the critical time period for northbound segments, and the PM peak hour is the critical time period for southbound segments.

For unsignalized ramp terminal intersections, the worst performing approach was identified; for the Exit 73 Single Point traffic signal, overall traffic operations were identified. Locations that meet the traffic operations goal of LOS B (rural) and LOS C (urban) are coded in green; other colors (yellow, orange, and red) indicate that the operations goal is not achieved with the No-Build geometry.

4.8.1 2017 Existing Operations Summary

For 2017 Existing traffic, acceptable traffic operations are provided for all I-29 Mainline segments and Merge/Diverge areas. Acceptable intersection operations are provided at all ramp terminals with one exception. The Exit 73 Single Point traffic signal currently operates at LOS D.

4.8.2 2045 No-Build Operations Summary

For 2045 No-Build and 2045 No-Build with Highway 100 traffic, acceptable traffic operations are expected to be provided for all I-29 Mainline segments south of Exit 64. North of Exit 64, several mainline segments are projected to operate at LOS C or D with existing geometry by 2045. Many Merge/Diverge areas in the study area are expected to exceed the traffic operations goal by 2045; modifications to increase ramp taper lengths or the addition of mainline lanes may be required. Acceptable intersection operations are provided only at the ramp terminal intersections at Exits 62 and 64. All ramp terminal intersections at Exits 68, 71, and 73 are expected to require geometric modifications by 2045.

Chapter 5 describes an interim analysis that was conducted to determine the years in which the stakeholder's traffic operations goals were exceeded at each location.

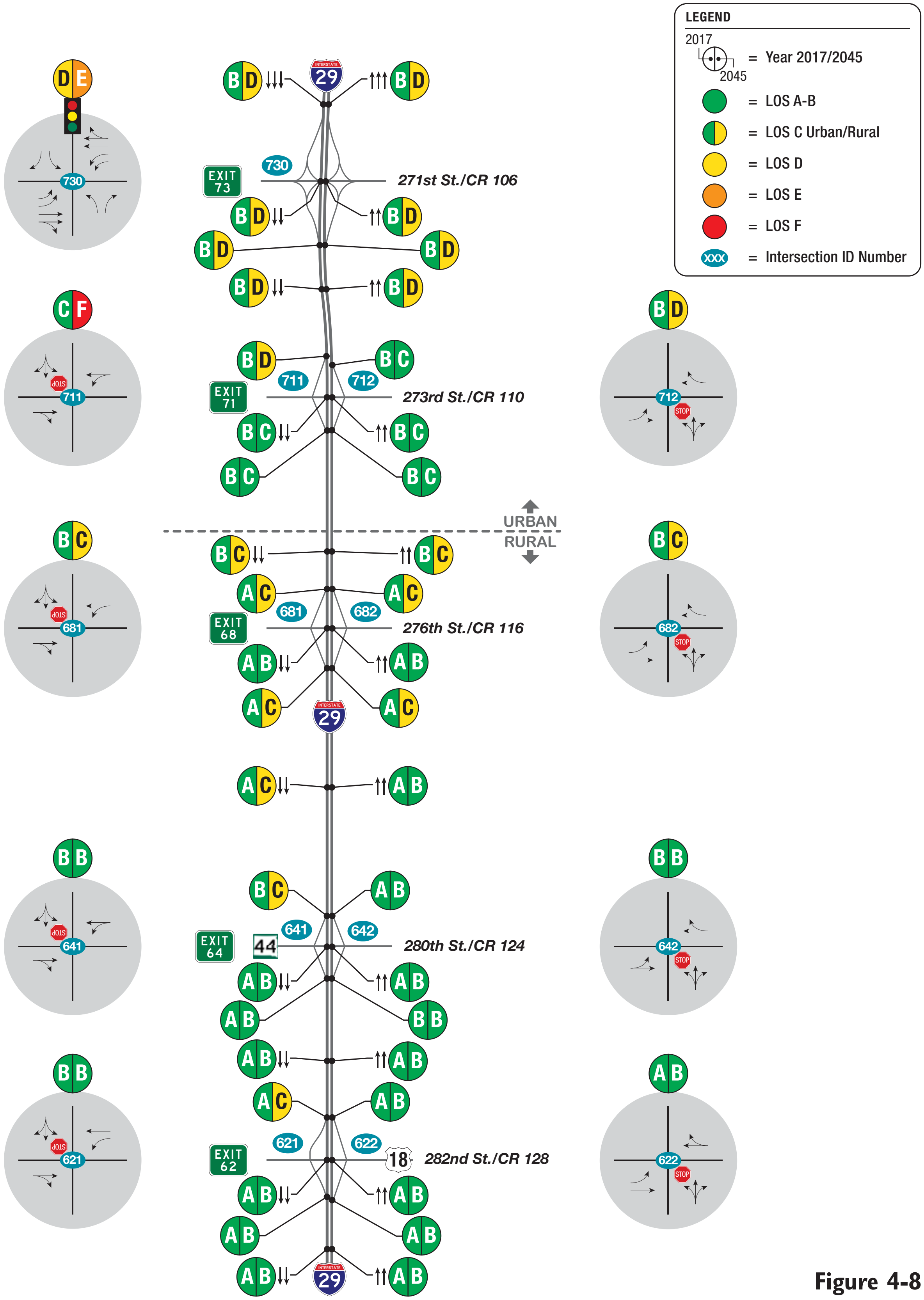


Figure 4-8
2017/2045 No Build
Worst Case Level of Service Summary

5.0 INTERIM ANALYSIS

5.1 INTRODUCTION

In the I-29 Corridor Study Methods and Assumptions Document, the project stakeholders identified traffic operations goals. The preferred traffic operations goals within the study roadways within the urban service boundary are LOS C for Principal and Minor Arterials, and LOS C minimum for Freeways, Interstates, and Expressways, which is consistent with the *AASHTO Green Book* and the *South Dakota DOT Road Design Manual (Table 15-9*). For rural classified roadways, the preferred traffic operations goals are LOS B for Principal and Minor Arterials, and LOS B for Freeways, Interstates, and Expressways.

As part of this study, an interim year analysis was performed to determine what year the proposed improvements are anticipated to reach the operations goal thresholds. This analysis is intended to assist SDDOT decision makers in determining which segments of I-29 break down the soonest and when to program the necessary improvements. The interim analysis year for each Mainline segment, Merge/Diverge area, or Intersection was defined as the year the following minimum operations thresholds were reached:

- Urban: LOS C/D
- Rural: LOS B/C

As described in **Chapter 4**, 2045 traffic volumes were developed for two scenarios: No-Build and No-Build with Highway 100 improvements. For segments north of Exit 71, the 2045 No-Build scenario was found to have failure years before the 2045 No-Build with Highway 100 scenario. Turning movement diagrams in **Chapter 4** report on 2045 No-Build and 2045 No-Build with Highway 100 traffic volumes. **Chapter 2** reports on 2017 Existing traffic volumes.

5.2 INTERIM ANALYSIS METHODOLOGY

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

$$Volume_{Interim\_Year} = Volume_{2017} + \left(\left(Volume_{2045} - Volume_{2017} \right) * \left(\frac{Interim\_Year - 2017}{2045 - 2017} \right) \right)$$

The interim analysis used procedures in the *HCM 6th Edition* for the interchange ramps and the HCS7 for mainline operations. All I-29 Mainline segments, Merge/Diverge areas, and ramp terminal intersections throughout the study area were analyzed for the interim analysis. The analysis assumed existing geometry for the entire roadway network, although it was assumed that the urbanized area boundary would be relocated south between Exit 68 and Exit 71.

5.3 INTERIM ANALYSIS RESULTS

Table 5-1 summarizes the results of the analysis for I-29 mainline, **Table 5-2** for merge/diverge areas, and **Table 5-3** for ramp terminal intersections.

Figure 5-1 displays the analysis results graphically for 2045 No-Build and **Figure 5-2** for 2045 No-Build with Highway 100. For unsignalized ramp terminal intersections, the worst performing approach was identified; for the Exit 73 Single Point traffic signal, overall traffic operations were identified. The interim years in which the LOS threshold is met were split into four groups:

1. 2018–2035 is depicted in red.
2. 2036–2040 is depicted in yellow.
3. 2041–2045 is depicted in green.
4. Beyond 2045 is depicted in blue.

Table 5-1. I-29 Mainline Segments Interim Analysis Summary

Segment	Direction	Interim Year	
		Actual	Grouped
I-29 – South of Exit 62	Northbound	2045+	Beyond 2045
	Southbound	2045+	Beyond 2045
I-29 – Between Exit 62 On- & Off-Ramps	Northbound	2045+	Beyond 2045
	Southbound	2045+	Beyond 2045
I-29 – Exit 62 to Exit 64	Northbound	2045+	Beyond 2045
	Southbound	2045+	Beyond 2045
I-29 – Between Exit 64 On- & Off-Ramps	Northbound	2045+	Beyond 2045
	Southbound	2045+	Beyond 2045
I-29 – Exit 64 to Exit 68	Northbound	2045+	Beyond 2045
	Southbound	2045	2041-2045
I-29 – Between Exit 68 On- & Off-Ramps	Northbound	2045+	Beyond 2045
	Southbound	2045+	Beyond 2045
I-29 – Exit 68 to Exit 71	Northbound	2036	2036-2040
	Southbound	2040	2036-2040
I-29 – Between Exit 71 On- & Off-Ramps	Northbound	2045+	Beyond 2045
	Southbound	2045+	Beyond 2045
I-29 – Exit 71 to Exit 73 No-Build	Northbound	2039	2036-2040
	Southbound	2036	2036-2040
I-29 – Exit 71 to Exit 73 No Build with Hwy 100	Northbound	2038	2036-2040
	Southbound	2035	2018-2035
I-29 – Between Exit 73 On- & Off-Ramps No Build	Northbound	2043	2041-2045
	Southbound	2039	2036-2040
I-29 – Between Exit 73 On- & Off-Ramps No-Build with Hwy 100	Northbound	2045+	Beyond 2045
	Southbound	2041	2041-2045
I-29 – North of Exit 73 No-Build	Northbound	2041	2041-2045
	Southbound	2041	2041-2045
I-29 – North of Exit 73 No-Build with Hwy 100	Northbound	2045	2041-2045
	Southbound	2045+	Beyond 2045

Table 5-2. I-29 Merge/Diverge Areas Interim Analysis Summary

Interchange	Ramp	Interim Year	
		Actual	Grouped
Exit 62 (Diamond)	NB Off-Ramp	2045+	Beyond 2045
	NB On-Ramp	2045+	Beyond 2045
	SB Off-Ramp	2040	2036-2040
	SB On-Ramp	2045+	Beyond 2045
Exit 64 (Diamond)	NB Off-Ramp	2045+	Beyond 2045
	NB On-Ramp	2045+	Beyond 2045
	SB Off-Ramp	2036	2036-2040
	SB On-Ramp	2045+	Beyond 2045
Exit 68 (Diamond)	NB Off-Ramp	2038	2036-2040
	NB On-Ramp	2037	2036-2040
	SB Off-Ramp	2030	2018-2035
	SB On-Ramp	2042	2041-2045
Exit 71 (Diamond)	NB Off-Ramp	2036	2036-2040
	NB On-Ramp	2045+	Beyond 2045
	SB Off-Ramp	2035	2018-2035
	SB On-Ramp	2045+	Beyond 2045
Exit 73 (Single Point) No-Build	NB Off-Ramp	2040	2036-2040
	NB On-Ramp	2041	2041-2045
	SB Off-Ramp	2041	2041-2045
	SB On-Ramp	2039	2036-2040
Exit 73 (Single Point) No-Build with Hwy 100	NB Off-Ramp	2039	2036-2040
	NB On-Ramp	2045	2041-2045
	SB Off-Ramp	2045+	Beyond 2045
	SB On-Ramp	2038	2036-2040

Table 5-3. I-29 Ramp Terminal Intersections Interim Analysis Summary

Interchange	Ramp Terminal	Interim Year	
		Actual	Grouped
Exit 62 (Diamond)	Northbound ID # 622	2045+	Beyond 2045
	Southbound ID # 621	2045+	Beyond 2045
Exit 64 (Diamond)	Northbound ID # 642	2045+	Beyond 2045
	Southbound ID # 641	2045+	Beyond 2045
Exit 68 (Diamond)	Northbound ID # 682	2036	2036-2040
	Southbound ID # 681	2040	2036-2040
Exit 71 (Diamond)	Northbound ID # 712	2042	2041-2045
	Southbound ID # 711	2030	2018-2035
Exit 73 (Single Point) No-Build	Single Point ID # 730	2017	2018-2035
Exit 73 (Single Point) No-Build with Hwy 100	Single Point ID # 730	2035	2018-2035

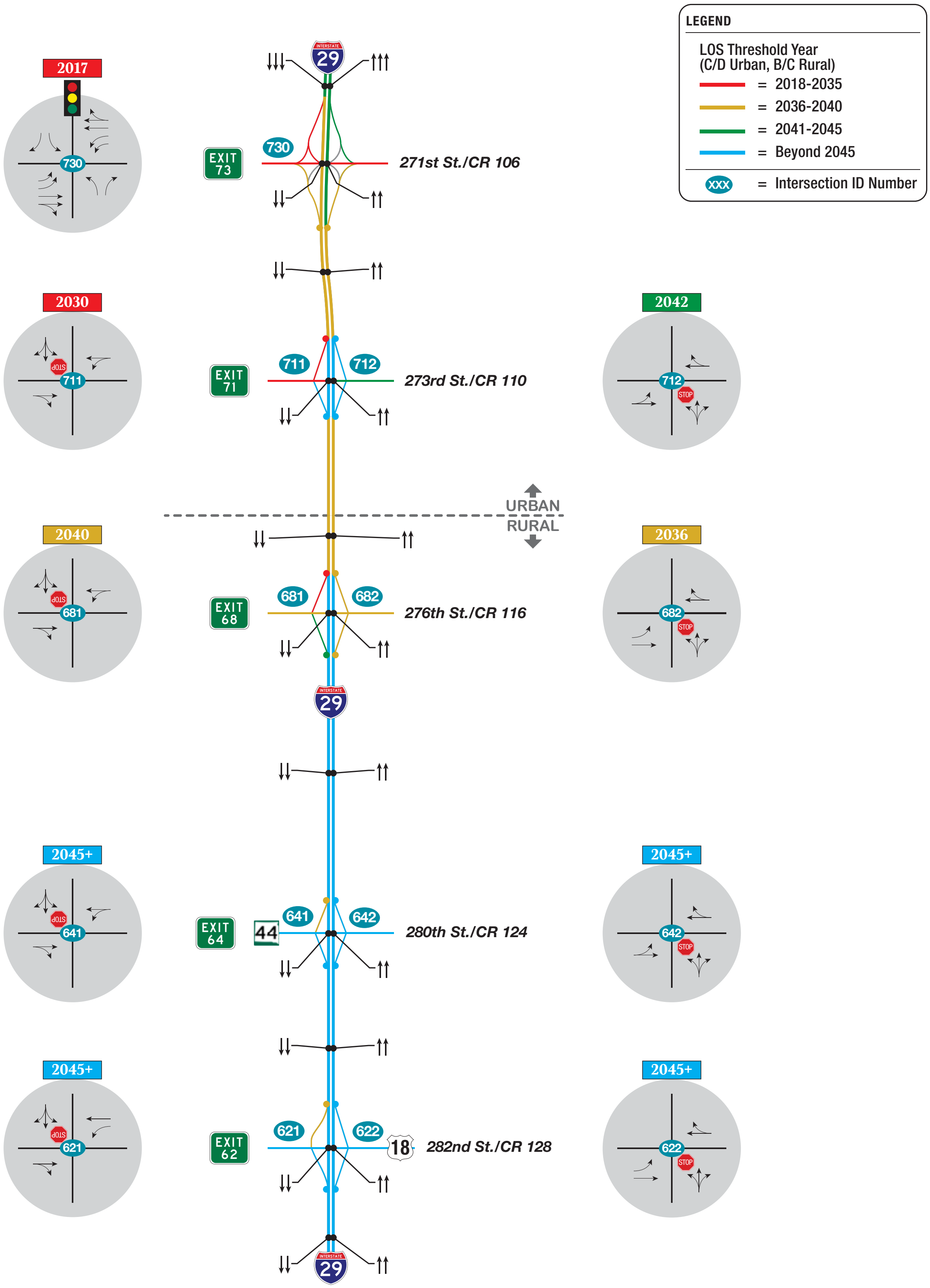


Figure 5-1

No Build Interim Analysis - LOS Threshold Years

NOTE: Drawing Not to Scale

NORTH

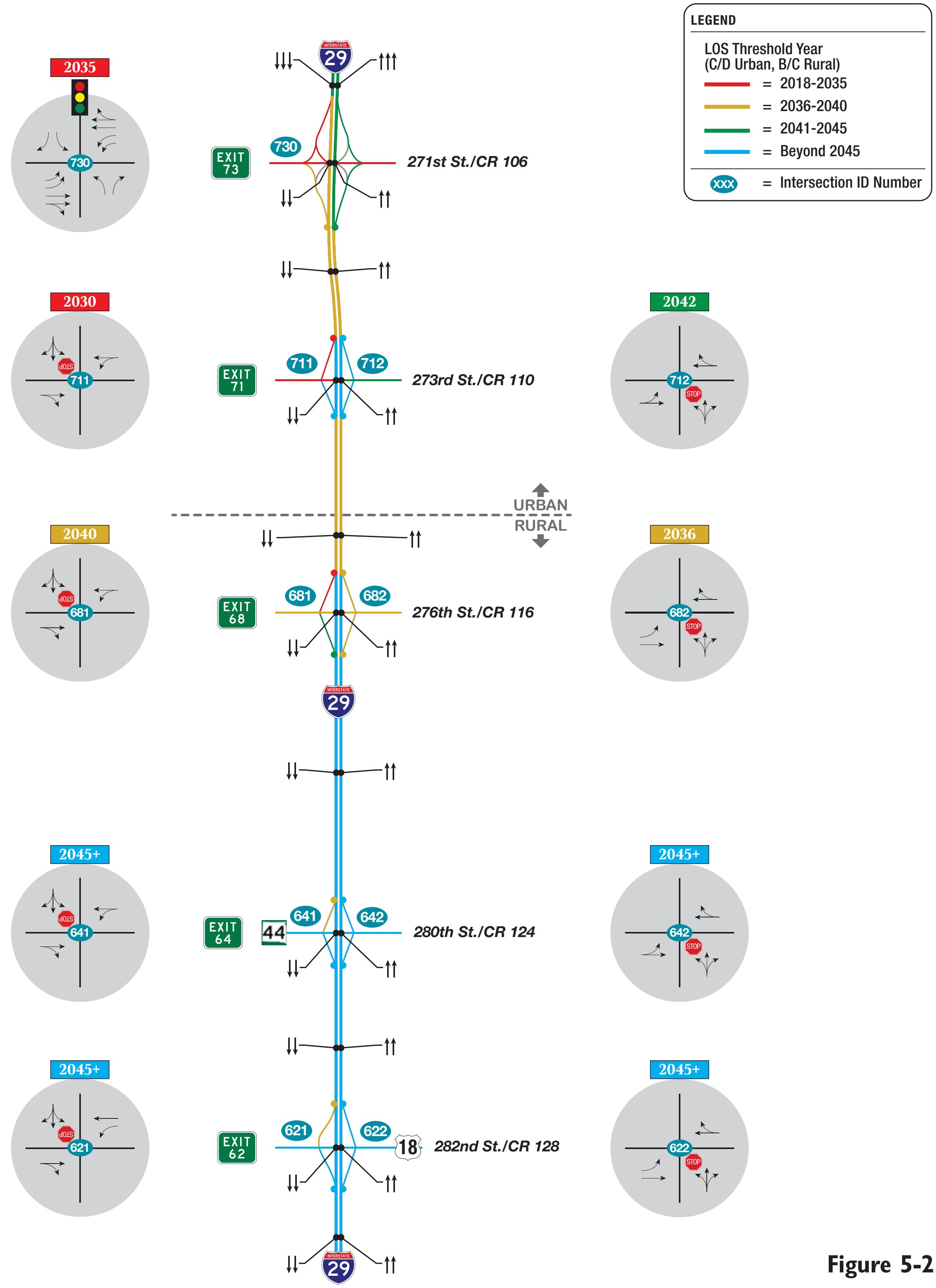


Figure 5-2
with Highway 100 Interim Analysis - Levels of Service Threshold Years

NOTE: Drawing Not to Scale
NORTH

6.0 I-29 MAINLINE SOLUTIONS

6.1 IDENTIFICATION OF SOLUTIONS

SDDOT plans to rebuild the pavement of I-29 between Exit 62 and Exit 73 in the next 10 years. Since this improvement is expected to have a life-span of many decades, the planned pavement rebuild should be constructed to accommodate:

- Potential interchange improvements at Exit 64 and Exit 71
- Interchange ramp modifications at Exits 62, 68, and 73
- The potential need to widen I-29 to six lanes, particularly as the urban boundary of metropolitan Sioux Falls moves south into Lincoln County
- Potential need to remove I-29 crossroad structures at 278th Street and 281st Street

6.1.1 Summary of 2045 Transportation Network Improvements

SDDOT / Lincoln County / Sioux Falls MPO are currently planning the following transportation network improvements by 2045, which have been included in the 2045 traffic scenarios:

- 85th Street (Exit 75) Interchange with I-29
- 85th Street constructed across I-29 connecting Sundowner Avenue to Tallgrass Avenue
- 69th Street constructed as a continuous corridor across I-29 connecting Sundowner Avenue to Tallgrass / Solberg Avenue
- Construction of Highway 100 as a planned four-lane divided arterial from I-29 to SD 11 (scenarios were run with and without Highway 100)
- The urban / rural boundary in the study area is assumed to move south approximately 3 miles from MRM 72.00 to MRM 69.00, between Exits 68 and 71

6.1.2 2045 Build Traffic Volume Scenarios

As described in **Chapter 4**, two 2045 traffic volume scenarios were developed for this study, with and without the future Highway 100 Corridor improvements immediately to the east of the project area on 271st Street / CR 106. **Chapter 4** reports on the No-Build traffic operations along I-29 with existing geometry and 2045 traffic volumes. For the 2045 Build scenario, two similar scenarios were developed to analyze 2045 traffic operations, including capacity and geometric improvements:

- 2045 Build (without Highway 100)
- 2045 Build with Highway 100

Generally only volumes on I-29 at Exit 73, including those along 271st Street / CR 106, are expected to change with the construction of Highway 100. For study purposes, traffic volumes south of Exit 73 on I-29 and various crossroads were assumed to be the same with or without Highway 100 Corridor improvements.

6.1.3 2045 Build Traffic Analysis Methodology

The preferred traffic operations goals within the study roadways within the urban service boundary are LOS C for Principal and Minor Arterials, and LOS C minimum for Freeways, Interstates and Expressways, which is consistent with the *AASHTO Green Book* and the *South Dakota DOT Road Design Manual*

(Table 15-9). For rural classified roadways, the preferred traffic operations goals are LOS B for Principal and Minor Arterials, and LOS B for Freeways, Interstates and Expressways. Geometric improvements were identified to meet the minimum operations goals for each 2045 traffic volume scenario.

6.2 ROADWAY DESIGN CRITERIA

Table 6-1 provides a partial summary of design criteria for the I-29 Mainline determined during discussions with SDDOT. **Appendix G** contains a more detailed description of design criteria.

Table 6-1. I-29 Mainline Design Criteria

Design Element	Criteria
General	
Roadway Classification	Interstate
Design Speed Rural/Urban (MPH)	80 / 80
Posted Speed Limit Rural/Urban (MPH)	80 / 65
Design Vehicle	WB-67
Horizontal Alignment Criteria	
Curve Radius min. (Ft.)	3050’
Curve Length min. (Ft.)	500’
Superelevation (e_{max})	6%
Stopping Sight Distance	910’
Clear Zone	30’
Vertical Alignment Criteria	
Maximum Grade	3%
Minimum Grade	0.5%
Vertical Clearance (over/under I-29)	17’
Assumed Structure Depth (Ft.)	7’

The design speed for I-29 is 80 mph, with a posted speed limit of 80 mph in the rural four-lane section, and a speed limit of 65 mph in the urban six-lane section. A maximum grade of 3 percent was used on I-29, with a vertical clearance of 17 feet and an assumed structure depth of 7 feet for the bridge structures. These design criteria are intended to follow typical standards for the interstate system in South Dakota.

6.3 2045 BUILD OPERATIONAL ANALYSIS

2045 traffic volumes, as depicted on **Figure 4-4,** were used for the 2045 Build operational analysis. Mainline, Merge/Diverge, and Intersection analyses were conducted using Highway Capacity Software (HCS7).

6.3.1 Mainline Operations Analysis

The mainline basic segment analysis was conducted using Highway Capacity Software (HCS7). **Table 6-2** and **Figure 6-1** show the mainline LOS for 2045. **Appendix H** includes HCS7 freeway analysis worksheets for the 2045 Build traffic scenario.

Table 6-2. 2045 Build Mainline Basic Operations Analysis

Segment	Direction	Total Number of Lanes	AM Peak Hour		PM Peak Hour	
			Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS
I-29 – South of Exit 62	Northbound	2	12.7	B	13.2	B
	Southbound	2	10.3	A	14.0	A
I-29 – Between Exit 62 On & Off Ramps	Northbound	2	12.1	B	12.7	B
	Southbound	2	10.0	A	13.7	B
I-29 – Exit 62 to Exit 64	Northbound	2	13.8	B	13.1	B
	Southbound	2	11.8	B	15.8	B
I-29 – Between Exit 64 On & Off Ramps	Northbound	2	13.0	B	12.7	B
	Southbound	2	11.5	B	15.2	B
I-29 – Exit 64 to Exit 68	Northbound	2	17.4	B	15.9	B
	Southbound	2	12.3	B	18.1	C
I-29 – Between Exit 68 On & Off Ramps	Northbound	2	17.0	B	15.5	B
	Southbound	2	11.9	B	17.7	B
I-29 – Exit 68 to Exit 71 Urban/Rural	Northbound	3	16.0/13.6	B/B	13.4/11.3	B/B
	Southbound	3	9.8/8.2	A/A	15.4/13.0	B/B
I-29 – Between Exit 71 On & Off Ramps	Northbound	3	15.7	B	12.9	B
	Southbound	3	9.3	A	15.1	B
I-29 – Exit 71 to Exit 73	Northbound	3	19.6	C	15.8	B
	Southbound	3	13.7	B	20.7	C
I-29 – Between Exit 73 On & Off Ramps	Northbound	3	18.3	C	14.6	B
	Southbound	3	12.9	B	19.6	C
I-29 – North of Exit 73	Northbound	4	21.1	D	16.2	B
	Southbound	4	13.9	B	21.0	C

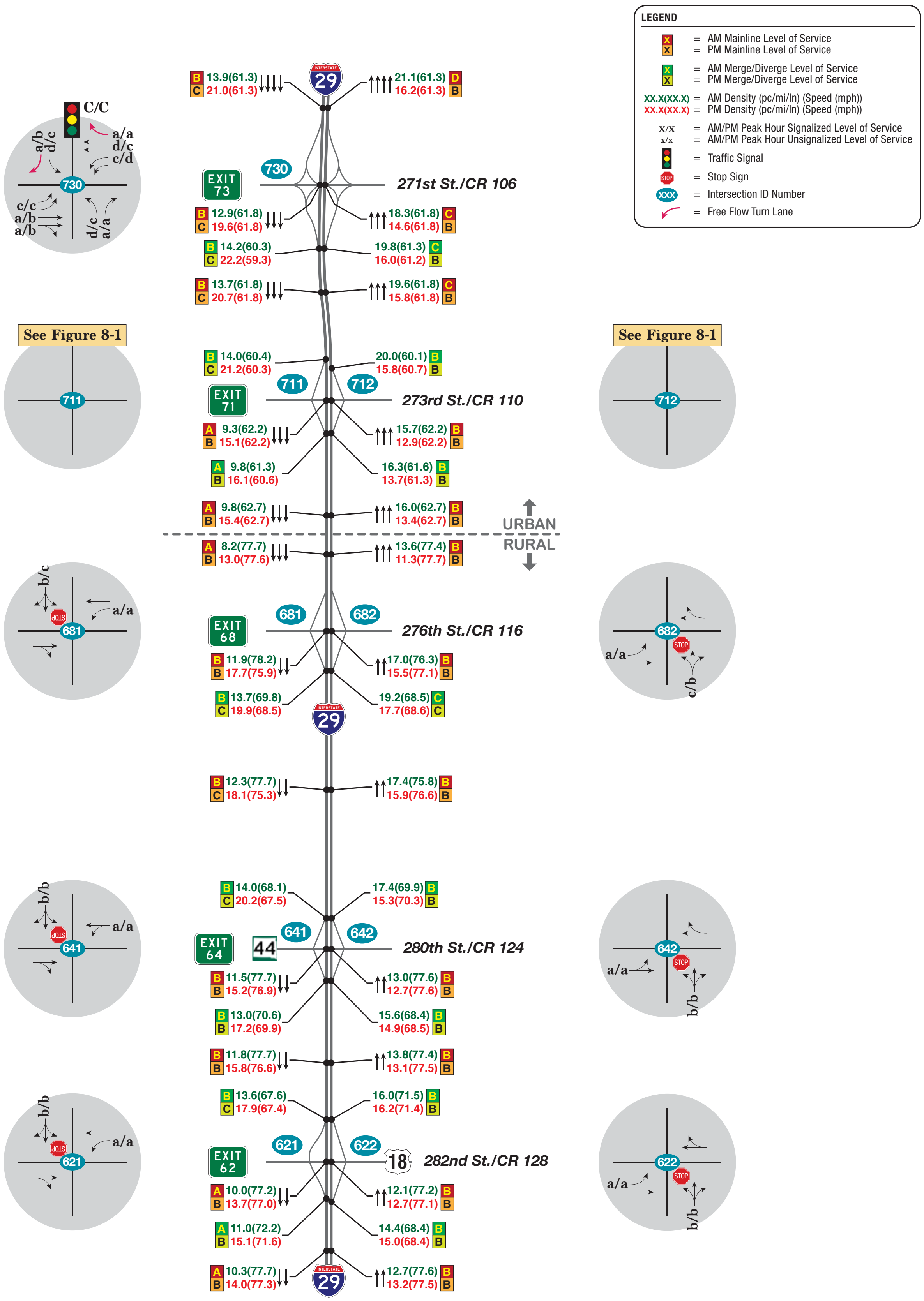


Figure 6-1

2045 Build without Highway 100 Levels of Service

NOTE: Drawing Not to Scale

NORTH

6.3.2 Merge/Diverge Analysis

The HCS7 software was also used to conduct the merge/diverge analysis at the I-29 ramps. **Table 6-3** and **Table 6-1** show the merge/diverge analysis results for 2045 Build conditions. **Appendix H** includes HCS7 ramp and ramp junction worksheets for the 2045 Build traffic conditions scenario.

Table 6-3. 2045 Build Merge/Diverge Analysis

Interchange	Ramp	Number of Lanes			AM Peak Hour		PM Peak Hour	
		Mainline	Ramp	Total	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS
Exit 62 (Diamond)	NB Off-Ramp	2	Decel	2	14.4	B	15.0	B
	NB On-Ramp	2	Accel	2	16.0	B	16.2	B
	SB Off-Ramp	2	Decel	2	13.6	B	17.9	C
	SB On-Ramp	2	Accel	2	11.0	A	15.1	B
Exit 64 (Diamond)	NB Off-Ramp	2	Decel	2	15.6	B	14.9	B
	NB On-Ramp	2	Accel	2	17.4	B	15.3	B
	SB Off-Ramp	2	Decel	2	14.0	B	20.2	C
	SB On-Ramp	2	Accel	2	13.0	B	17.2	B
Exit 68 (Diamond)	NB Off-Ramp	2	Decel	2	19.2	C	17.7	C
	NB On-Ramp	2	1	3	Add lane, no merge			
	SB Off-Ramp	2	1	3	Drop lane, no diverge			
	SB On-Ramp	2	Accel	2	13.7	B	19.9	C
Exit 71 (Diamond)	NB Off-Ramp	3	Decel	3	15.7	B	12.9	B
	NB On-Ramp	3	Accel	3	20.0	B	15.8	B
	SB Off-Ramp	3	Decel	3	14.0	B	21.2	C
	SB On-Ramp	3	Accel	3	9.8	A	16.1	B
Exit 73 (Single Point)	NB Off-Ramp	3	Decel	3	19.8	C	16.0	B
	NB On-Ramp	3	1	4	Add lane, no merge			
	SB Off-Ramp	3	1	4	Drop lane, no diverge			
	SB On-Ramp	3	Accel	3	14.2	B	22.2	C

6.3.3 Ramp Check Analysis

The *HCM 6th Edition, Exhibit 14-12* was used to analyze traffic operations on the study interchange ramps. Based on the ramp's FFS and number of lanes on the ramp, an estimated capacity was obtained. All ramp volumes were converted to peak flow rates using the PHF. The capacity of the ramp was then compared to the peak flow rate of the ramp to obtain a V/C ratio. If the V/C ratio is greater than 1.0, the ramp is determined to be over capacity based on the HCM ramp check methodologies. **Table 6-4** shows the V/C ratios for all study area ramps for the 2045 Build traffic volume scenario. All ramps in the study area currently operate under capacity during the 2045 No-Build peak hours.

Table 6-4. 2045 Build Ramp Check Analysis

Ramp	No. of Lanes	Ramp FFS (mi/h)	AM Peak Hour				PM Peak Hour			
			Volume	Peak Flow Rate	Capacity	V/C Ratio	Volume	Peak Flow Rate	Capacity	V/C Ratio
NB I-29 Exit 62 Off-Ramp	1	45	60	68	2,100	0.03	50	57	2,100	0.03
NB I-29 Exit 62 On-Ramp	1	45	335	381	2,100	0.18	275	313	2,100	0.15
NB I-29 Exit 64 Off-Ramp	1	45	45	51	2,100	0.02	45	51	2,100	0.02
NB I-29 Exit 64 On-Ramp	1	45	345	392	2,100	0.19	150	170	2,100	0.08
NB I-29 Exit 68 Off-Ramp	1	45	30	34	2,100	0.02	30	34	2,100	0.02
NB I-29 Exit 68 On-Ramp	1	45	470	534	2,100	0.25	240	273	2,100	0.13
NB I-29 Exit 71 Off-Ramp	1	45	75	82	2,100	0.04	95	103	2,100	0.05
NB I-29 Exit 71 On-Ramp	1	45	595	647	2,100	0.31	400	435	2,100	0.21
NB I-29 Exit 73 Off-Ramp	1	45	205	223	2,100	0.11	195	212	2,100	0.10
NB I-29 Exit 73 On-Ramp	1	45	1460	1,587	2,100	0.76	1135	1,234	2,100	0.59
SB I-29 Exit 73 Off-Ramp	1	45	990	1,076	2,100	0.51	1550	1,685	2,100	0.80
SB I-29 Exit 73 On-Ramp	1	45	155	168	2,100	0.08	255	277	2,100	0.13
SB I-29 Exit 71 Off-Ramp	1	45	365	397	2,100	0.19	545	592	2,100	0.28
SB I-29 Exit 71 On-Ramp	1	45	60	65	2,100	0.03	85	92	2,100	0.04
SB I-29 Exit 68 Off-Ramp	1	45	175	199	2,100	0.09	455	517	2,100	0.25
SB I-29 Exit 68 On-Ramp	1	45	30	34	2,100	0.02	40	45	2,100	0.02
SB I-29 Exit 64 Off-Ramp	1	45	125	142	2,100	0.07	280	318	2,100	0.15
SB I-29 Exit 64 On-Ramp	1	45	35	40	2,100	0.02	50	57	2,100	0.03
SB I-29 Exit 62 Off-Ramp	1	45	225	256	2,100	0.12	300	341	2,100	0.16
SB I-29 Exit 62 On-Ramp	1	45	35	40	2,100	0.02	45	51	2,100	0.02

6.3.4 Intersection Operations Analysis

The HCS7 software was used to analyze traffic operations at the study area ramp terminal intersections at Exit 62 and Exit 68. The ramp terminal intersections at Exit 64, Exit 71, and Exit 73 are reported in **Chapter 7**, **Chapter 8**, and **Chapter 9,** respectively. **Figure 6-2** shows the lane geometry, traffic control, and LOS for 2045 Build traffic conditions. 2045 Build and 2045 Build with Highway 100 traffic conditions are the same for the ramp terminals at Exit 62 and Exit 68. The lane configurations at the study intersections are based on geometrics need to achieve the traffic operations goals.

- At the Diamond Interchange at I-29 Exit 62, the off-ramp approaches to the ramp terminals with US 18 / 282nd Street / CR 128 are expected to operate at LOS B in both the AM and PM peak hour. No improvements are recommended at the Exit 62 ramp terminal intersections.
- At the Diamond Interchange at I-29 Exit 68, the northbound ramp terminal off-ramp approach is expected to operate at LOS C in AM peak hour. The southbound ramp terminal off-ramp approach is expected to operate at LOS C in PM peak hour. Although these movements technically do not meet the stakeholders' traffic operations goal of LOS B for rural arterials, the V/C ratios are under 0.65, and queues are not expected to exceed five vehicles in the critical time periods. As such, no improvements are recommended at the Exit 68 ramp terminal intersections.

Appendix H includes capacity analysis worksheets for Exit 62 and Exit 68 ramp terminal intersections for the 2045 Build traffic conditions scenario.

6.4 2045 BUILD WITH HIGHWAY 100 OPERATIONAL ANALYSIS

2045 traffic volumes with Highway 100, as depicted on **Figure 4-5,** were used for the 2045 Build with Highway 100 operational analysis. Mainline, Merge/Diverge, and Intersection analyses were conducted using HCS7.

6.4.1 Mainline Operations Analysis

The mainline basic segment analysis used HCS7. **Table 6-5** and **Figure 6-2** show the mainline LOS for 2045 Build with Highway 100. **Appendix H** includes HCS7 freeway analysis worksheets for the 2045 Build with Highway 100 traffic scenario**.**

Table 6-5. 2045 Build with Highway 100 Mainline Basic Operations Analysis

Segment	Direction	Total Number of Lanes	AM Peak Hour		PM Peak Hour	
			Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS
I-29 – South of Exit 62	Northbound	2	12.7	B	13.2	B
	Southbound	2	10.3	A	14.0	A
I-29 – Between Exit 62 On- & Off-Ramps	Northbound	2	12.1	B	12.7	B
	Southbound	2	10.0	A	13.7	B
I-29 – Exit 62 to Exit 64	Northbound	2	13.8	B	13.1	B
	Southbound	2	11.8	B	15.8	B
I-29 – Between Exit 64 On- & Off-Ramps	Northbound	2	13.0	B	12.7	B
	Southbound	2	11.5	B	15.2	B
I-29 – Exit 64 to Exit 68	Northbound	2	17.4	B	15.9	B
	Southbound	2	12.3	B	18.1	C
I-29 – Between Exit 68 On- & Off-Ramps	Northbound	2	17.0	B	15.5	B
	Southbound	2	11.9	B	17.7	B
I-29 – Exit 68 to Exit 71 Urban/Rural	Northbound	3	16.0/13.6	B/B	13.4/11.3	B/B
	Southbound	3	9.8/8.2	A/A	15.4/13.0	B/B
I-29 – Between Exit 71 On- & Off-Ramps	Northbound	3	15.7	B	12.9	B
	Southbound	3	9.3	A	15.1	B
I-29 – Exit 71 to Exit 73	Northbound	3	20.0	C	16.3	B
	Southbound	3	14.1	B	21.2	C
I-29 – Between Exit 73 On- & Off-Ramps	Northbound	3	17.2	B	13.6	B
	Southbound	3	12.2	B	18.8	C
I-29 – North of Exit 73	Northbound	4	19.7	C	14.4	B
	Southbound	4	12.3	B	18.7	C

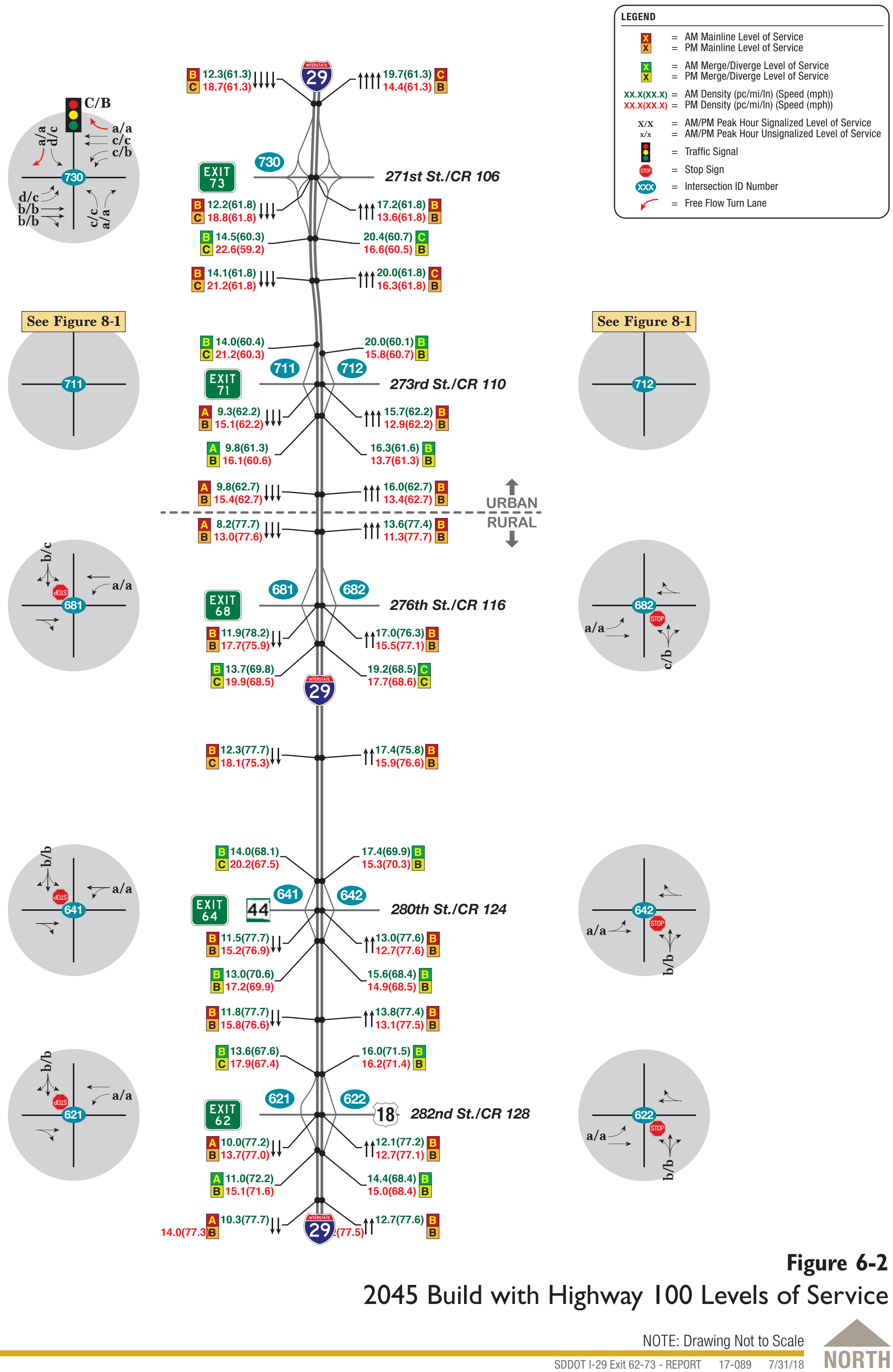


Figure 6-2

2045 Build with Highway 100 Levels of Service

6.4.2 Merge/Diverge Analysis

The HCS7 software was also used to conduct the merge/diverge analysis at the I-29 ramps. **Table 6-6** and **Figure 6-2** show the merge/diverge analysis results for 2045 Build with Highway 100 traffic. **Appendix H** includes HCS7 ramp and ramp junction worksheets for the 2045 Build with Highway 100 scenario.

Table 6-6. 2045 Build with Highway 100 Merge/Diverge Analysis

Interchange	Ramp	Number of Lanes			AM Peak Hour		PM Peak Hour	
		Mainline	Ramp	Total	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS
Exit 62 (Diamond)	NB Off-Ramp	2	Decel	2	14.4	B	15.0	B
	NB On-Ramp	2	Accel	2	16.0	B	16.2	B
	SB Off-Ramp	2	Decel	2	13.6	B	17.9	C
	SB On-Ramp	2	Accel	2	11.0	A	15.1	B
Exit 64 (Diamond)	NB Off-Ramp	2	Decel	2	15.6	B	14.9	B
	NB On-Ramp	2	Accel	2	17.4	B	15.3	B
	SB Off-Ramp	2	Decel	2	14.0	B	20.2	C
	SB On-Ramp	2	Accel	2	13.0	B	17.2	B
Exit 68 (Diamond)	NB Off-Ramp	2	Decel	2	19.2	C	17.7	B
	NB On-Ramp	2	1	3	Add lane, no merge			
	SB Off-Ramp	2	1	3	Drop lane, no diverge			
	SB On-Ramp	2	Accel	2	13.7	B	19.9	C
Exit 71 (Diamond)	NB Off-Ramp	3	Decel	3	15.7	B	12.9	B
	NB On-Ramp	3	Accel	3	20.0	B	15.8	B
	SB Off-Ramp	3	Decel	3	14.0	B	21.2	C
	SB On-Ramp	3	Accel	3	9.8	A	16.1	B
Exit 73 (Single Point)	NB Off-Ramp	3	Decel	3	20.4	C	16.6	B
	NB On-Ramp	3	1	4	Add lane, no merge			
	SB Off-Ramp	3	1	4	Drop lane, no diverge			
	SB On-Ramp	3	Accel	3	14.5	B	22.6	C

6.4.3 Ramp Check Analysis

The *HCM 6th Edition, Exhibit 14-12* was used to analyze traffic operations on the study interchange ramps. Based on the ramp's FFS and number of lanes on the ramp, an estimated capacity was obtained. All ramp volumes were converted to peak flow rates using the PHF. The capacity of the ramp was then compared to the peak flow rate of the ramp to obtain a V/C ratio. If the V/C ratio is greater than 1.0, the ramp is determined to be over capacity based on the HCM ramp check methodologies. **Table 6-7** shows the V/C ratios for all study area ramps for the 2045 Build with Highway 100 traffic volume scenario.

Table 6-7. 2045 Build with Highway 100 Ramp Check Analysis

Ramp	No. of Lanes	Ramp FFS (mi/h)	AM Peak Hour				PM Peak Hour			
			Volume	Peak Flow Rate	Capacity	V/C Ratio	Volume	Peak Flow Rate	Capacity	V/C Ratio
NB I-29 Exit 62 Off-Ramp	1	45	60	68	2,100	0.03	50	57	2,100	0.03
NB I-29 Exit 62 On-Ramp	1	45	335	381	2,100	0.18	275	313	2,100	0.15
NB I-29 Exit 64 Off-Ramp	1	45	45	51	2,100	0.02	45	51	2,100	0.02
NB I-29 Exit 64 On-Ramp	1	45	345	392	2,100	0.19	150	170	2,100	0.08
NB I-29 Exit 68 Off-Ramp	1	45	30	34	2,100	0.02	30	34	2,100	0.02
NB I-29 Exit 68 On-Ramp	1	45	470	534	2,100	0.25	240	273	2,100	0.13
NB I-29 Exit 71 Off-Ramp	1	45	75	82	2,100	0.04	95	103	2,100	0.05
NB I-29 Exit 71 On-Ramp	1	45	595	647	2,100	0.31	400	435	2,100	0.21
NB I-29 Exit 73 Off-Ramp	1	45	445	484	2,100	0.23	410	446	2,100	0.21
NB I-29 Exit 73 On-Ramp	1	45	1360	1,478	2,100	0.70	925	1,005	2,100	0.48
SB I-29 Exit 73 Off-Ramp	1	45	785	853	2,100	0.41	1180	1,283	2,100	0.61
SB I-29 Exit 73 On-Ramp	1	45	310	337	2,100	0.16	450	489	2,100	0.23
SB I-29 Exit 71 Off-Ramp	1	45	365	397	2,100	0.19	545	592	2,100	0.28
SB I-29 Exit 71 On-Ramp	1	45	60	65	2,100	0.03	85	92	2,100	0.04
SB I-29 Exit 68 Off-Ramp	1	45	175	199	2,100	0.09	455	517	2,100	0.25
SB I-29 Exit 68 On-Ramp	1	45	30	34	2,100	0.02	40	45	2,100	0.02
SB I-29 Exit 64 Off-Ramp	1	45	125	142	2,100	0.07	280	318	2,100	0.15
SB I-29 Exit 64 On-Ramp	1	45	35	40	2,100	0.02	50	57	2,100	0.03
SB I-29 Exit 62 Off-Ramp	1	45	225	256	2,100	0.12	300	341	2,100	0.16
SB I-29 Exit 62 On-Ramp	1	45	35	40	2,100	0.02	45	51	2,100	0.02

6.5 TYPICAL CROSS SECTIONS

The SAT considered several I-29 widening options between Exit 68 and Exit 73 (and continuing north). Options considered were:

- Widening to the outside of I-29
- Widening to the inside of I-29
- Transitioning from widening outside to inside I-29 somewhere between Exit 68 and Exit 71

In evaluating these options and from conversations with the SAT, it was evident that corridor conditions and constraints prevented a single approach to the widening effort. These conditions and constraints are described below:

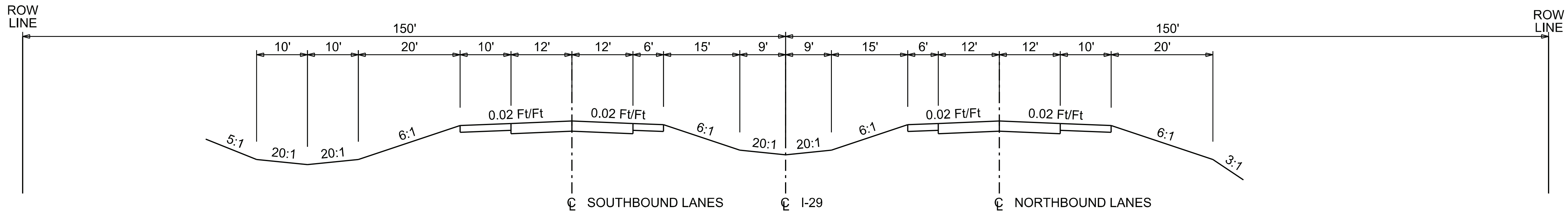
- The widening needed to match the existing lane alignment and transition with lane adds and lane drops to the outside at Exit 68.
- The widening needed to modify the existing Exit 73 interchange bridges and widen to the inside.
- North of Exit 73, the widening needed to match the future planned widening / improvements for the 85th Street interchange.
- North of Exit 73, the widening needed to consider the future planned I-229 / I-29 system interchange improvements.

Figure 6-3 depicts the proposed I-29 typical sections from Exit 62 to Exit 68, Exit 68 to MRM 72.30, and MRM 72.30 to Exit 73. As shown, the widening from Exit 68 to MRM 72.30 would add a lane to the outside of I-29. From MRM 72.30 to Exit 73, the lane would be added to the inside of I-29. The outside lane in both directions is the proposed auxiliary lane.

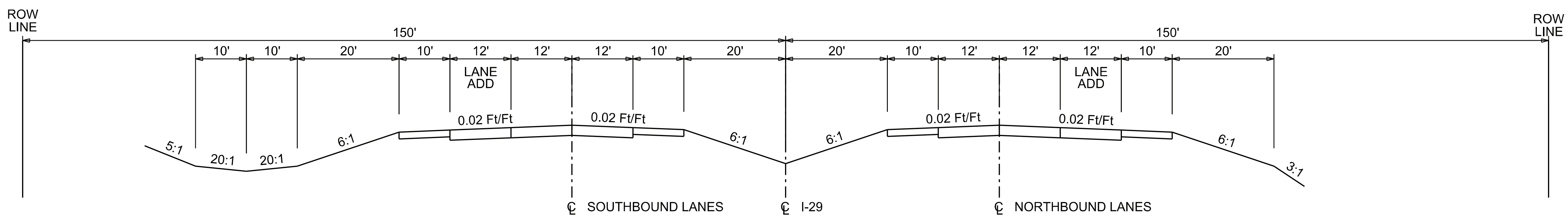
Figure 6-4 depicts the proposed I-29 typical sections across the Exit 73 Bridge and from Exit 73 to MRM 74.00. As shown, the widening from Exit 68 to MRM 72.30 would add a lane to the inside of I-29. Across Exit 73, a jersey barrier would be constructed in the median. **Figure 6-4** also depicts the typical cross section for the Exit 68 and Exit 71 crossroads with a Diamond Interchange configuration.

Figure 6-5 depicts the typical cross section for the Exit 73 crossroad (273rd Street) with both a SPI and a Diverging Diamond Interchange (DDI).

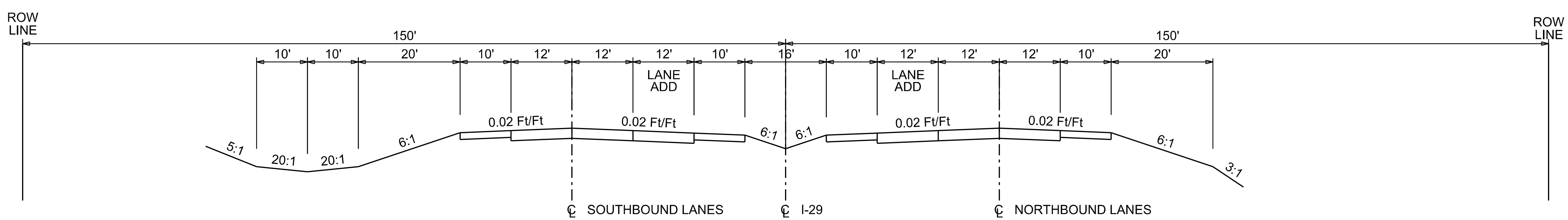
Figure 6-3
Typical Sections



I-29 TYPICAL SECTION
FROM EXIT 62 TO EXIT 68



I-29 TYPICAL SECTION
FROM EXIT 68 TO MRM 72.3

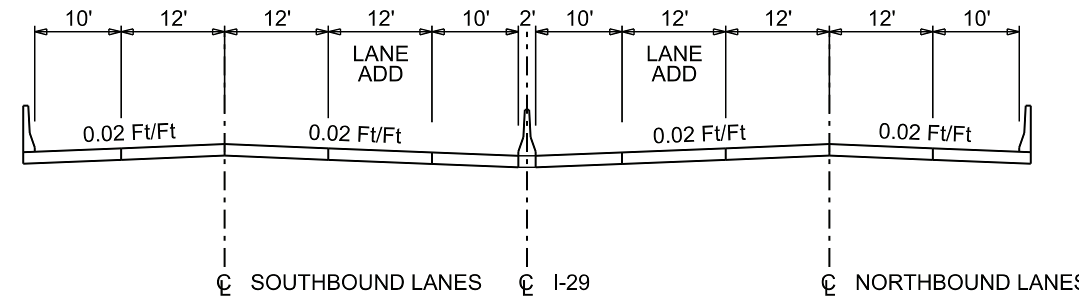


I-29 TYPICAL SECTION
FROM MRM 72.3 TO EXIT 73

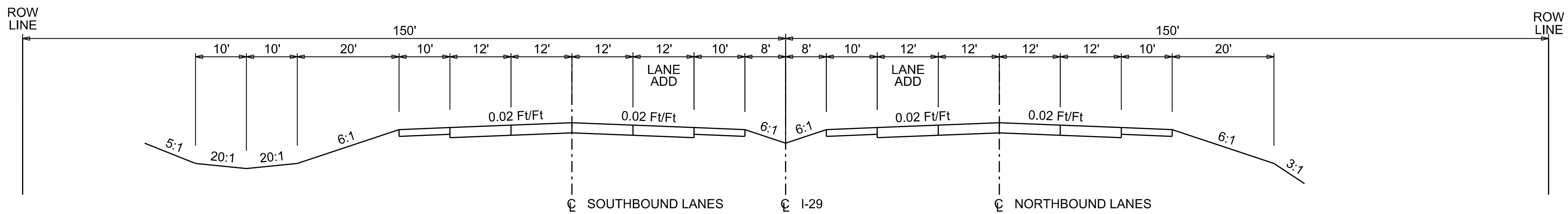
1 OF 3

NOTE: Drawing Not to Scale

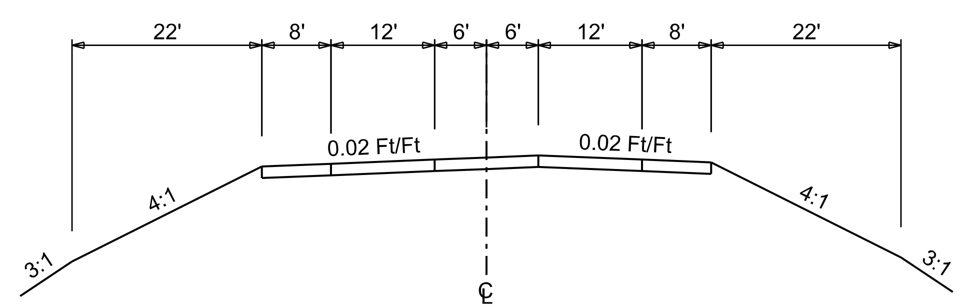
Figure 6-4
Typical Sections



I-29 TYPICAL SECTION
EXIT 73 BRIDGE



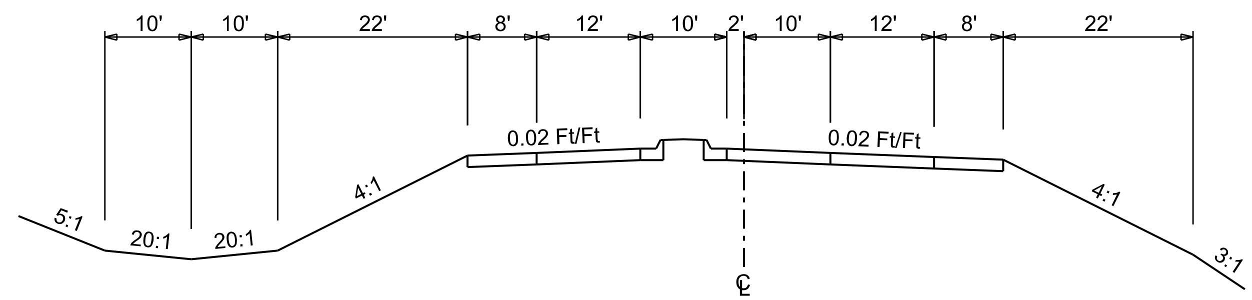
I-29 TYPICAL SECTION
FROM EXIT 73 TO MRM 74



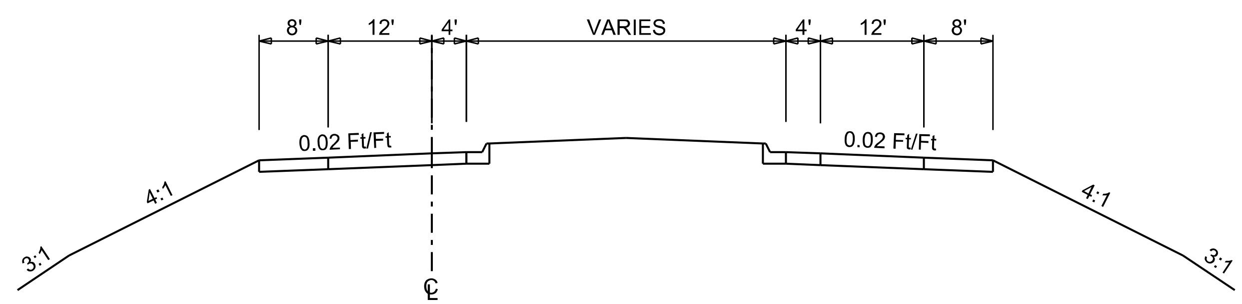
HWY. 44 / 280TH ST. & 273RD ST. TYPICAL SECTION
EXIT 68 & EXIT 71 DIAMOND INTERCHANGE

NOTE: Drawing Not to Scale

Figure 6-5
Typical Sections



273RD ST. TYPICAL SECTION
EXIT 73 SPI



273RD ST. TYPICAL SECTION
EXIT 71 DDI INTERCHANGE

3 OF 3

NOTE: Drawing Not to Scale

6.6 PAVEMENT REPLACEMENT NEEDS

Based on the interim analysis results presented in **Chapter 5**, the year of geometric improvements based on traffic operations was identified for each I-29 mainline segment, merge/diverge area, and ramp terminal intersection. SDDOT Pavement Management has also identified pavement replacement years for mainline segments of I-29 in the study area.

The SDDOT 2017 Needs Book identifies an "Optimized Year" for pavement replacement based on a number of factors, including funding availability. SDDOT Pavement Management also conducted inspections in November 2017 for inclusion in the 2018 Needs Book. SDDOT has provided the results of that inspection and best benefit calculations. **Table 6-8** summarizes the SDDOT pavement replacement needs in the study area for I-29 mainline.

Table 6-8. I-29 Mainline Segments Pavement Replacement Needs

Segment	Direction	2017 Needs Book	2017 Fall Inspection		Recommended Replacement Period
		Optimized	Optimized	Best Benefit	
I-29 – MRM 72.00 to 73.78	Northbound	2036	2023	2027	2018–2035
I-29 – MRM 65.00 to 72.00	Northbound	2032	2033	2032	2018–2035
I-29 – MRM 64.57 to 65.00	Northbound	2034	2024	2022	2018–2035
I-29 – MRM 61.00 to 64.57	Northbound	2032	2032	2032	2018–2035
I-29 – MRM 73.66 to 72.00	Southbound	2034	2027	2027	2018–2035
I-29 – MRM 72.00 to 61.00	Southbound	2031	2025	2031	2018–2035

Figure 6-6 combines the pavement replacement years from **Table 6-7** and the operational needs years (as developed in **Chapter 5** and displayed on **Figure 5-1**).

Similar to the interim years grouping, pavement replacement years were split into four groups:

1. 2018–2035 is depicted in red.
2. 2036–2040 is depicted in yellow.
3. 2041–2045 is depicted in green.
4. Beyond 2045 is depicted in blue.

Based on the composite graphic on **Figure 6-3**, the pavement replacement needs occur before I-29 mainline segment capacity improvement needs in all cases.

6.7 SUMMARY OF MAINLINE AND RAMP NEEDS

Several improvements have been identified on the I-29 Corridor between Exit 62 and Exit 73 to accommodate expected 2045 traffic volumes. The improvements include pavement replacement, geometric improvements, and capacity upgrades. The following subsections identify the mainline and ramp needs on I-29.

6.7.1 Mainline I-29 Improvements

- Replace pavement for the entire study area from Exit 62 to Exit 73.
- Add lanes to the mainline segment between Exit 68 and Exit 73 to provide three lanes in each direction.
- Add one lane to the mainline segment north of Exit 73 to provide four lanes in each direction. This improvement will need to be coordinated with future projects at the I-29/85th Street Service Interchange and the I-29/I-229 System Interchange.

6.7.2 Exit 62 Ramp Improvements

- Construct a 680-foot ramp deceleration lane and taper at the southbound off-ramp.
- No other ramp improvements are proposed at the Exit 62 interchange; the existing mainline and ramp geometrics are expected to operate at acceptable LOS.

6.7.3 Exit 64 Ramp Improvements

- Construct a 680-foot ramp deceleration lane and taper at the northbound off-ramp.
- Construct a 1,580-foot ramp acceleration lane and taper at the northbound on-ramp.
- Construct an 860-foot ramp deceleration lane and taper at the southbound off-ramp.
- Construct a 1,580-foot ramp acceleration lane and taper at the southbound on-ramp.
- Interchange reconstruction is expected; see **Chapter 7** for details.

6.7.4 Exit 68 Ramp Improvements

- Construct a 760-foot ramp deceleration lane and taper at the northbound off-ramp.
- Modify the northbound on-ramp to transition onto the mainline as an additional continuous freeway lane on the outside (no merge).
- Modify the southbound off-ramp so that the outside freeway lane transitions from the mainline to the off-ramp (lane drop).
- Construct a 1,580-foot ramp acceleration lane and taper at the southbound on-ramp.

6.7.5 Exit 71 Ramp Improvements

- Construct a 1,580-foot (minimum) ramp deceleration lane and taper at the northbound off-ramp.
- Construct a 1,580-foot (minimum) ramp acceleration lane and taper at the northbound on-ramp.
- Construct a 1,580-foot (minimum) ramp deceleration lane and taper at the southbound off-ramp.

- Construct a 1,580-foot (minimum) ramp acceleration lane and taper at the southbound on-ramp.
- Interchange reconstruction is expected; see **Chapter 8** for details.

6.7.6 Exit 73 Ramp Improvements

- Construct a 1,580-foot (minimum) ramp deceleration lane and taper at the northbound off-ramp.
- The northbound freeway segment north of the interchange is proposed to be at least four lanes wide. The northbound on-ramp should be reconstructed to provide a 1,580-foot (minimum) ramp acceleration lane and taper at the northbound on-ramp.
- The southbound freeway segment north of the interchange is proposed to be at least four lanes wide. The southbound off-ramp should be reconstructed with a 1,580-foot (minimum) ramp deceleration lane and taper at the southbound off-ramp.
- Downstream the southbound off-ramp should be reconfigured to provide a free-flow right-turn lane with an exclusive receiving lane to the west on 271st Street/CR 106.; see **Chapter 9** for details.
- Construct a 1,580-foot (minimum) ramp acceleration lane and taper at the southbound on-ramp.

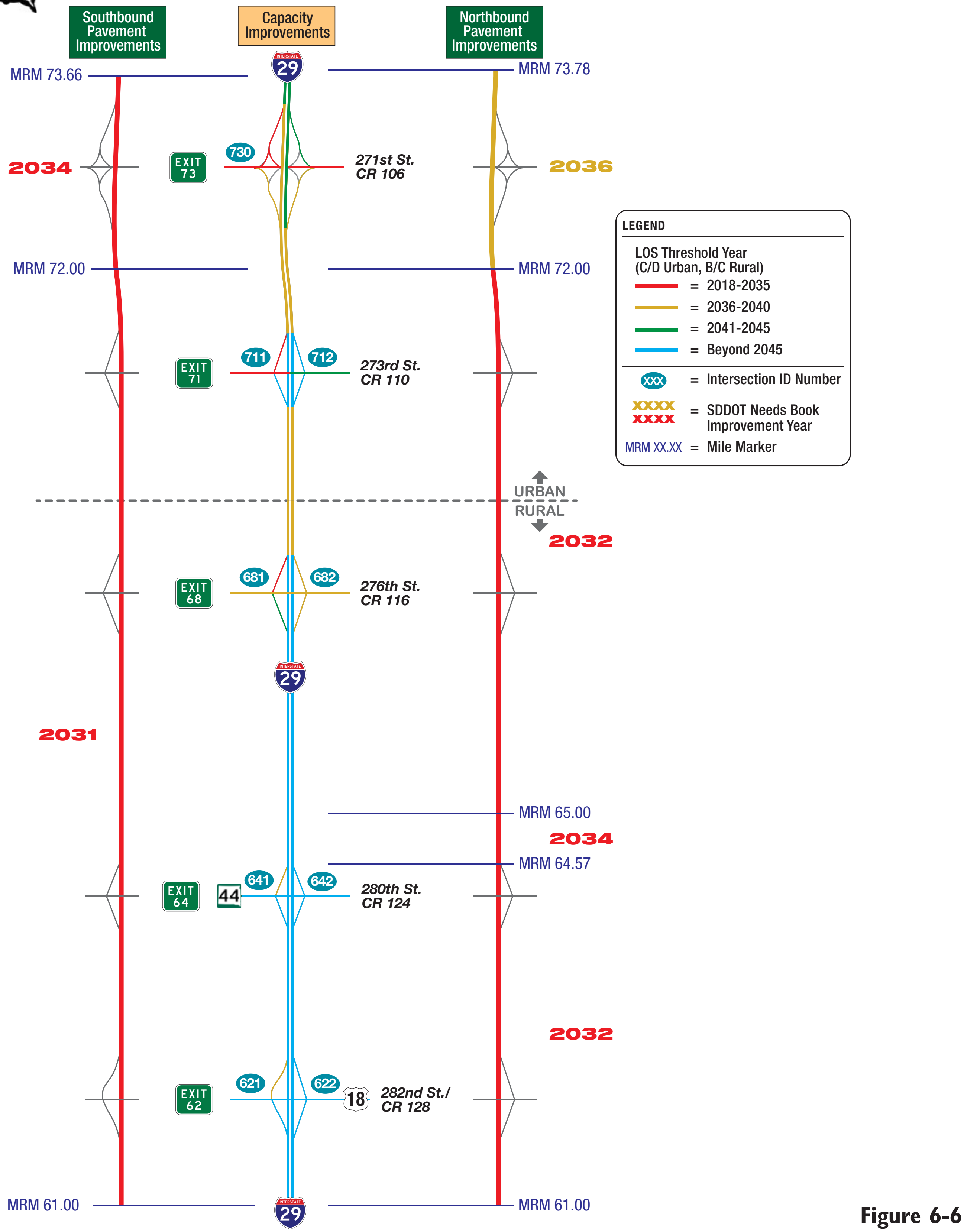


Figure 6-6
I-29 Improvement Needs Summary

NOTE: Drawing Not to Scale

6.8 POTENTIAL INTELLIGENT TRANSPORTATION SYSTEMS SOLUTIONS

6.8.1 Summary of Intelligent Transportation Systems Solutions

ITS solutions (sub-elements of a service package) appropriate for consideration in the I-29 corridor include:

- CCTV Cameras – Mainline and Interchanges
- Traffic Detectors – Mainline
- Dynamic Message Signs – Mainline
- 511/Advanced Traveler Information System – Regional
- Variable Speed Limit Signs – Mainline
- Road Weather Information Systems – Regional
- Roadway Service Patrol Vehicles – Mainline

6.8.2 Intelligent Transportation Systems Solutions Priorities

ITS solutions priorities in the I-29 corridor are:

- Higher Priority – Implement with Roadway/Interchange Improvements
  - **Infrastructure for Fiber Optic Cable.** Define potential connections to Sioux Falls network (likely in either I-29 and I-229). Including conduit and cable. Very low cost.
  - **Variable Speed Limit Installation.** Supports incident management and weather conditions and is associated with all ITS service packages associated infrastructure:
    - Signs between each interchange
    - Fiber optic cable
    - Traffic Detection – Upstream-Downstream-Within Corridor
  - **Dynamic Message Signs**. Mainline entering the urban area. Primary function has been notification of closures. This information can be integrated with incident management. Within the study area, incidents/delay have not been and are not expected to be significant. The recommended location for a northbound DMS in the study area is south Exit 73 to provide messages about traffic conditions as users enter the Sioux Falls area.
  - **Automated Gates.** Existing gates are manually controlled, requiring a person to lower/raise the gate and activate the beacon during a weather event or an incident, thus, exposing a person to potentially hazardous conditions. Automated control eliminates the requirement for manual activation. Since the Sioux Falls urban limits are anticipated to continue to expand, it is also recommended that the gates located at Exit 73 be moved south to Exit 71, whether they are automated or manually operated.
  - Encourage more centralized command and control through development and implementation of an Advanced Traffic Management System that would identify roles, responsibilities, and communication protocols.
- Lower Priority – Incorporate as appropriate as SDDOT develops a system plan
  - CCTV Cameras – Mainline and Interchanges
  - Highway Advisory Radio – Regional/Corridor-wide
  - 511/Advanced Traveler Information System – Regional
  - Road Weather Information Systems – Regional
  - Roadway Service Patrol Vehicles – Mainline

6.9 PREDICTIVE METHOD CRASH PREDICTION

Highway Safety Manual (HSM) predictive methodologies were used to predict the relative safety of the I-29 mainline improvement alternatives. Existing Observed and Existing Predicted crashes for the study period 2012–2016 were calculated. Future Predicted crashes for a period of similar length (five years) were calculated from 2045–2049.

The relative change in crashes from Existing Predicated to Future Predicted was then developed. Note that the number of crashes in the future is higher than existing due to the increase in volume from 2017 to 2045.

Table 6-9 summarizes the predictive safety analysis for I-29 mainline segments. **Appendix F** contains a memorandum with a more detailed description of the analysis.

Table 6-9. I-29 Mainline Segments Predictive Crash Analysis

SD I-29 Segments/Interchanges	Existing Observed Crashes (2012–2016)(1)	Calibrated Predicted Crashes		Change in Crashes (+/-)
		Existing Predicted Crashes (2012–2016)	Future Predicted Crashes (2045–2049)	
Segments				
North of Exit 73	33	24.9	43.1 (44.1) (3)	+ 18.2 (+ 19.2) (3)
Exit 73 to Exit 71	30	26.2	64.2 (66.5) (3)	+ 38.0 (+ 40.3) (3)
Exit 71 to Exit 68	33	36.1	80.5	+ 44.3
Exit 68 to Exit 64	59	48.9	111.3	+ 62.4
Exit 64 to Exit 62	13	15.3	35.0	+ 19.7
South of Exit 62	3	1.5	3.5	+ 2.1
Subtotal	***171***	***152.9***	***337.6***	***+ 184.7***
Interchanges				
Exit 73 (2)	60	35.0	61.0 (61.9) (3)	+ 26.0 (+ 26.9) (3)
Exit 71	22	21.8	48.7	+ 26.9
Exit 68	24	22.1	46.7	+ 24.6
Exit 64	16	15.3	31.6	+ 16.3
Exit 62	14	15.4	29.5	+ 14.1
Subtotal	***136***	***109.6***	***217.5***	***+ 107.9***

(1) The animal hit crashes on the SD I-29 corridor were omitted from crash prediction analysis.

(2) Ramp terminal intersection crashes and crash prediction are not included due to predictive method limitations for evaluating the ramp terminals of SPI's.

(3) Future predicted crashes in parentheses represent the future predicted crashes with the 85th Street interchange improvements.

6.10 CONSTRUCTION COST ESTIMATE

Total project costs associated with the construction of the proposed I-29 mainline improvements were broken into two sections:

- Rural four-lane divided section (from Exit 62 to Exit 68)
- Urban six-lane divided section (From Exit 68 to Exit 73)

The improvements were calculated on a per-mile basis and include both northbound and southbound directions. Estimates do not include work associated with major bridge structures. Total construction costs, contingencies, engineering services, construction services, and ROW were also calculated.

For the Rural four-lane divided section, the construction cost was estimated at $5.2 million per mile. The Urban six-lane divided section construction cost was estimated at $7.7 million per mile. **Table 6-10** summarizes the major cost items. **Appendix G** provides a more detailed quantity breakdown**.**

Table 6-10. Cost Estimate Summary – I-29 Mainline

Item	Rural Four-Lane Divided Section	Urban Four-Lane Divided Section
Construction Costs	$3,948,318	$5,442,618
Contingencies (10%/20%)	$394,832	$1,088,524
Engineering Services (12%/10%)	$521,178	$653,114
Construction Engineering (8%)	$347,452	$522,491
ROW (Ag/Residential)	$0	$0
ROW (Commercial/Industrial)	$0	$0
Total Project Costs per Mile(1)	**$5,211,780**	**$7,706,746**

(1) Estimates do not include work associated with major bridge structures.

7.0 EXIT 64 INTERCHANGE SOLUTIONS

7.1 IDENTIFICATION OF SOLUTIONS

With the pavement replacement on I-29 between Exit 62 and Exit 73, a complete reconstruction of the I-29 interchange at Exit 64 is expected. Constructed in the 1960s, the Exit 64 interchange is original to the interstate system and no longer meets current design standards.

Three interchange alternative concepts were identified for consideration at the Exit 64 Interchange in addition to the No-Build. Guidance from SDDOT, FHWA, and other sources was used to identify the initial alternatives for consideration, which included the following concepts:

- No Build
- Standard Diamond
- Compressed Diamond
- Tight Diamond

7.2 ROADWAY DESIGN CRITERIA

Design criteria for the proposed interchange alternatives were determined during discussions with SDDOT. **Table 7-1** provides a partial summary of criteria. **Appendix G** provides a more detailed description of design criteria.

Table 7-1. Exit 64 Interchange Design Criteria

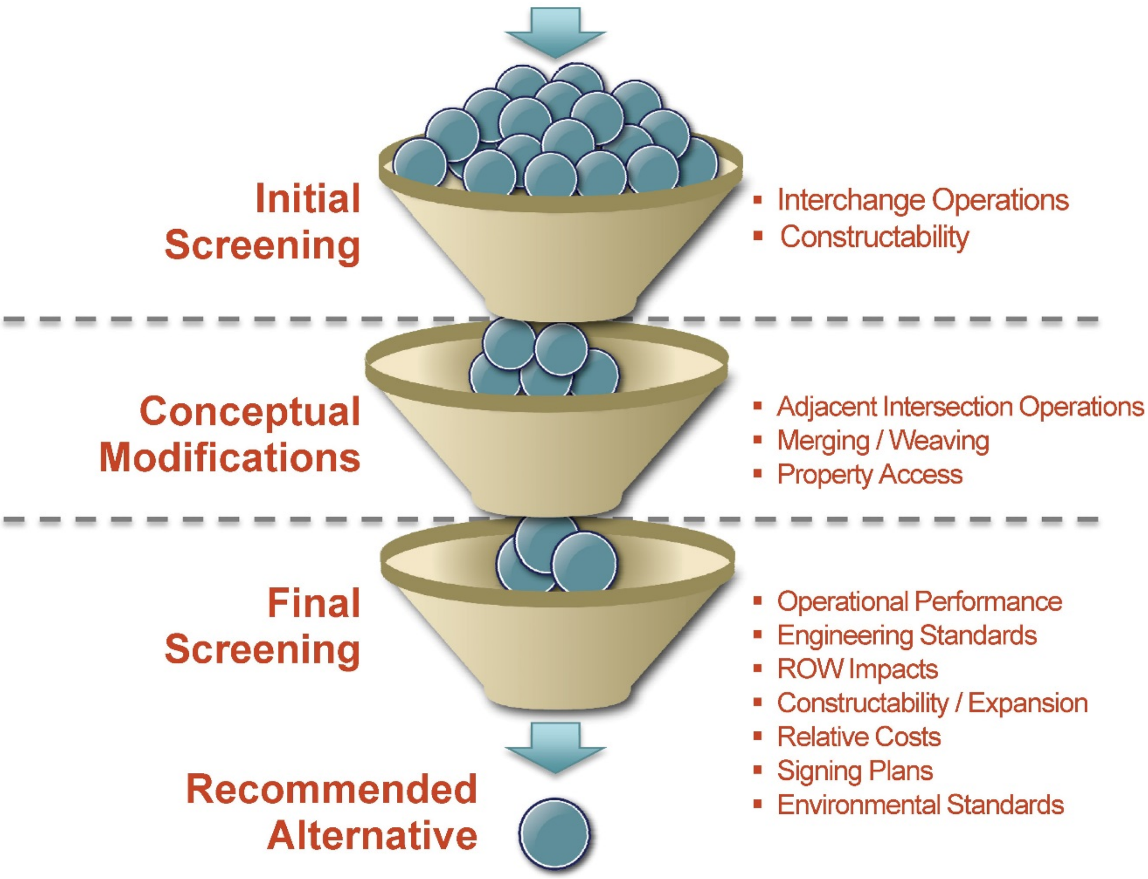
Design Element	Criteria
General	
Roadway Classification	Interstate
Design Speed (MPH)	80
Posted Speed Limit (MPH)	80
Design Vehicle	WB-67
Ramp Geometrics	
Ramp Design Speed (MPH)	50
Curve Radius for Ramp min. (Ft.)	2300’
Superelevation (e_{max})	6%
On-Ramp Taper Rate (Parallel)	50:1
Off-Ramp Taper Rate (Taper)	20:1
Vertical Alignment Criteria	
Maximum Grade (Ascending/Descending)	3%/5%
Minimum Grade	0.5%
Vertical Clearance (over/under I-29)	17’
Assumed Structure Depth (Ft.)	7’

The design speed for SD 44/280th Street is 60 mph, with a posted speed limit of 55 mph. Currently, the posted speed limit is 65 mph on the west leg, 40 mph at the interchange, and 55 mph on the east leg. A maximum grade of 5 percent was used on SD 44/280th Street, with a vertical clearance of 17 feet and an assumed structure depth of 7 feet for the bridge structures. The interchange ramps have a 50 mph design speed on tangent sections. These design criteria are typical for the interstate system in South Dakota.

7.3 ALTERNATIVES SCREENING PROCESS

Alternative interchange concepts for the Exit 64 interchange were developed and screened using an iterative process. This report is structured to document each step of that process. **Figure 7-1** illustrates the interchange alternatives screening process.

Figure 7-1. Alternative Screening Process



7.3.1 Initial Alternatives Screening

The three Exit 64 alternative interchange concepts, in addition to the No-Build alternative, were initially analyzed for traffic operations with 2045 Build traffic volumes. Each alternative concept met the 2045 traffic operations goal of LOS B (for rural areas) and was advanced for further review by the SAT for constructability. It was determined that all the alternatives should be advanced, except the Tight Diamond alternative, which was modified and replaced with the Compressed Diamond alternative (which achieved the desired goal of a similar footprint to the existing interchange and minimized impacts on the game protection area).

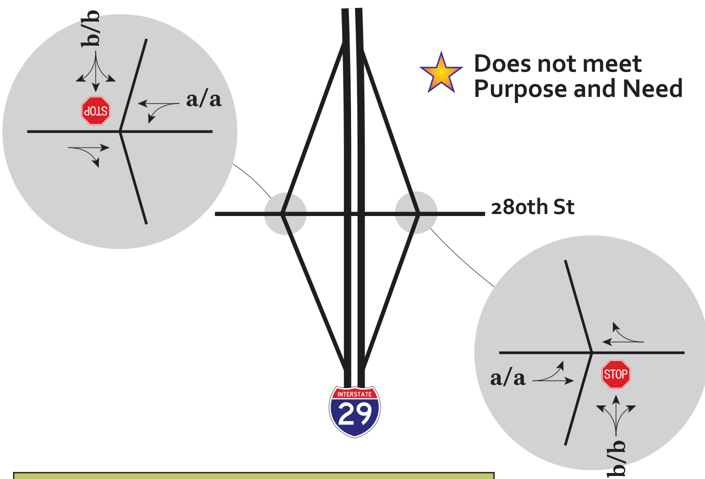
The two advanced alternatives were subsequently modified per stakeholder comments resulting in final alternative interchange concepts. A comparative evaluation of the benefits and impacts associated with each interchange alternative was conducted to determine recommended alternatives. **Figure 7-2** summarizes each alternative interchange concept at I-29 Exit 64.

7.3.2 No-Build Alternative

The No-Build alternative represents the existing geometrics at the interchange and adjacent intersections. The existing diamond interchange has stop control on the ramp terminal approaches, which are spaced about 575 feet apart. SD 44/280th Street goes over I-29; a single shared lane is provided for all approaches to the ramp terminals. Left-turn and right-turn movements at the ramp terminals originate from a shared lane.

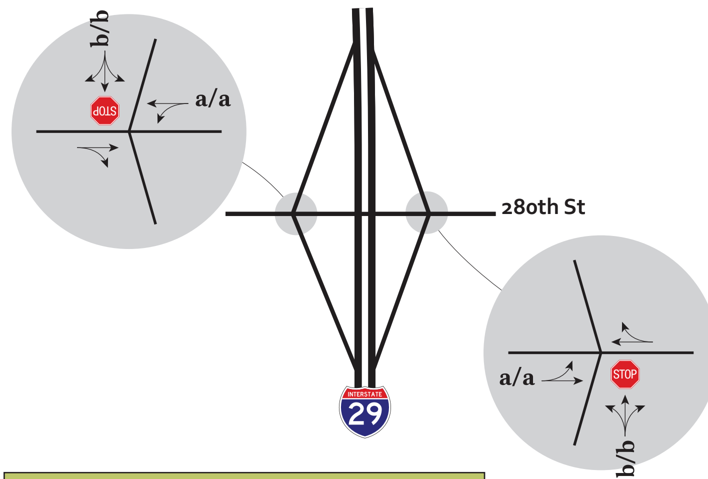
At the northbound ramp terminal intersection, northbound dual left-turn lanes are provided with a single exclusive right-turn lane. At the southbound ramp terminal intersection, a single exclusive lane is provided for each left- and right-turn movement. **Figure 7-2** shows the lane configurations for the No-Build alternative.

No Build



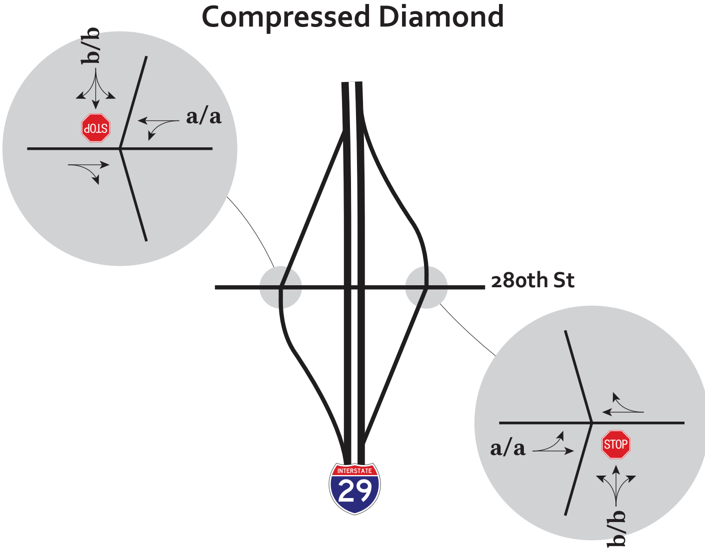
Design: **Undesirable (short ramps)**
Construction Cost: **$0**
ROW Impacts: **0 Acres**
Access: **Unchanged**

Standard Diamond



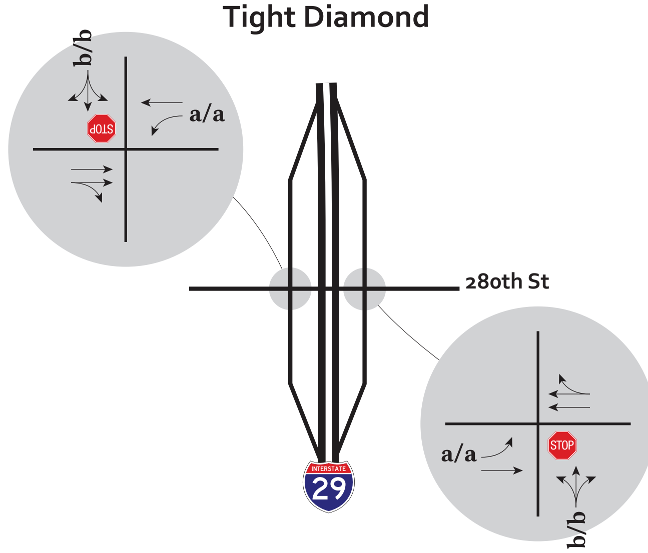
Design: **Standard**
Construction Cost: **$17.75 million**
ROW Impacts: **14.88 Acres**
Access: **Realigned or changed to west**

Compressed Diamond



Design: **Standard**
Construction Cost: **$15.09 million**
ROW Impacts: **14.25 Acres**
Access: **Realigned or changed to west**

Tight Diamond



Design: **Non-Standard**
Construction Cost: **Not Advanced**
ROW Impacts: **0.26 Acres**
Access: **Unchanged**

LEGEND

X/X = AM/PM Peak Hour Signalized Level of Service
x/x = AM/PM Peak Hour Unsignalized Level of Service
STOP = Stop Sign

Figure 7-2
Exit 64 Interchange Alternatives
2045 Traffic Operations

NOTE: Drawing Not to Scale

NORTH

7.4 INTERCHANGE ALTERNATIVES DESCRIPTIONS

7.4.1 Standard Diamond

In the Standard Diamond alternative, the two ramp terminal intersections have been moved apart to a distance of about 1,100 feet. The Standard Diamond provides additional lanes at the ramp terminal intersections. On SD 44/280th Street, exclusive left-turn lanes are provided at both ramp terminals. Right-turn movements onto the ramp terminals still originate from a shared lane.

At the northbound and southbound ramp terminal intersections, left-turn and right-turn movements originate from a shared lane. **Figure 7-3** shows the conceptual design for the Standard Diamond alternative.

7.4.2 Compressed Diamond

The Compressed Diamond alternative was developed as a variant of the Standard Diamond to achieve a smaller footprint. In the Compressed Diamond alternative, the two ramp terminal intersections are slightly farther apart than the existing interchange footprint, a distance of about 607 feet. With this spacing, back-to-back left-turn lanes would be provided on SD 44/280th Street at both ramp terminals. Right-turn movements onto the ramp terminals still originate from a shared lane.

At the northbound and southbound ramp terminal intersections, left-turn and right-turn movements originate from a shared lane. **Figure 7-4** shows the conceptual design for the Compressed Diamond alternative.

7.4.3 Tight Diamond Interchange

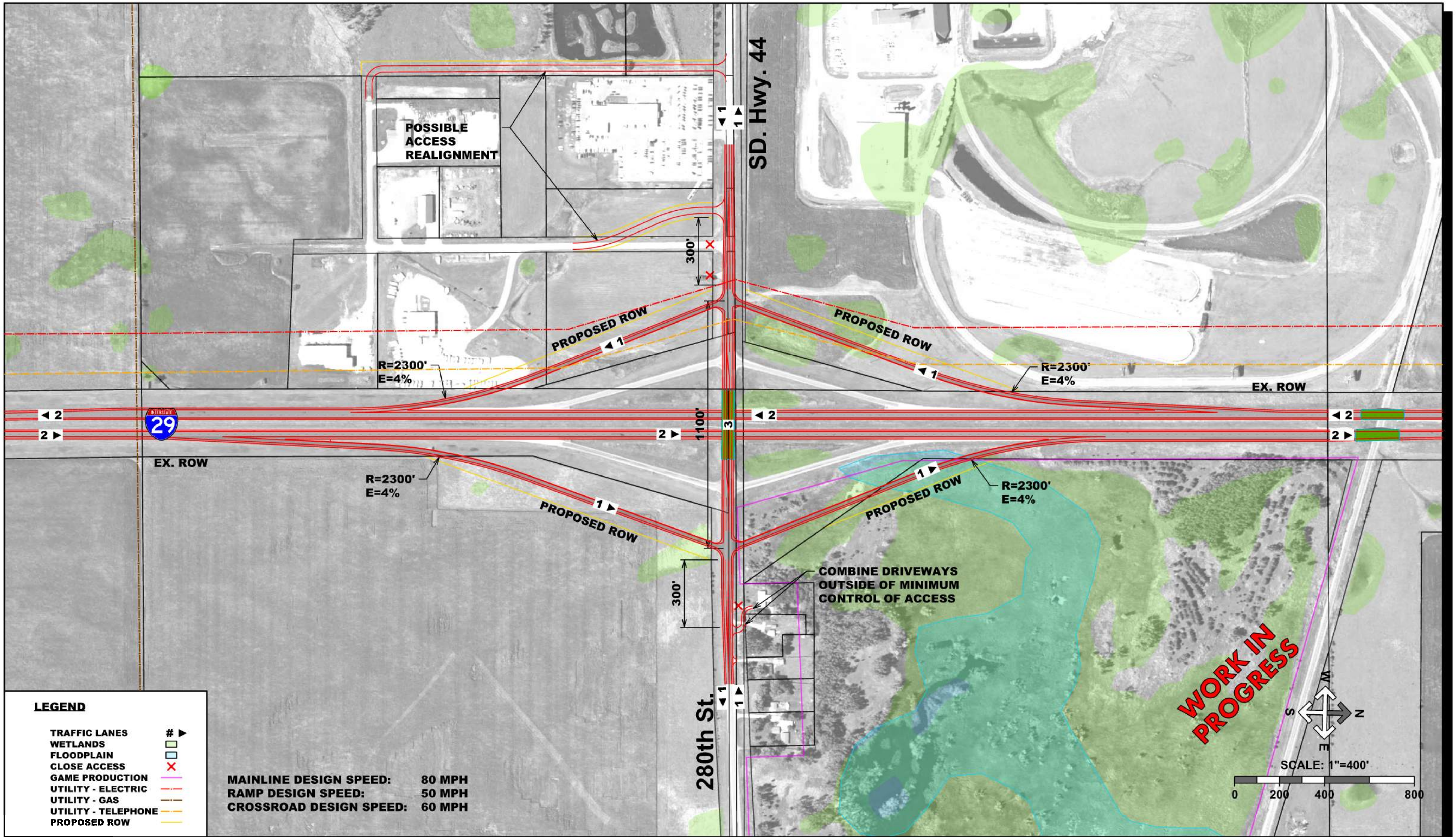
In the Tight Diamond alternative, the two ramp terminal intersections have been moved together to a distance of about 350 feet. With this close spacing, the two traffic signals would operate on a single controller. On SD 44/280th Street, single exclusive left-turn lanes are provided at both ramp terminals; these turn lanes are side by side on the crossroad bridge. Right-turn movements onto the ramp terminals originate from the shared through lane. To accommodate the turning movements and traffic volumes, the required cross section on SD 44/280th Street should be four lanes wide.

At the northbound and southbound ramp terminal intersections, left-turn and right-turn movements originate from a shared lane. **Figure 7-5** shows the conceptual design for the Tight Diamond alternative.

7.4.4 SD 44/280th Street Vertical Profile

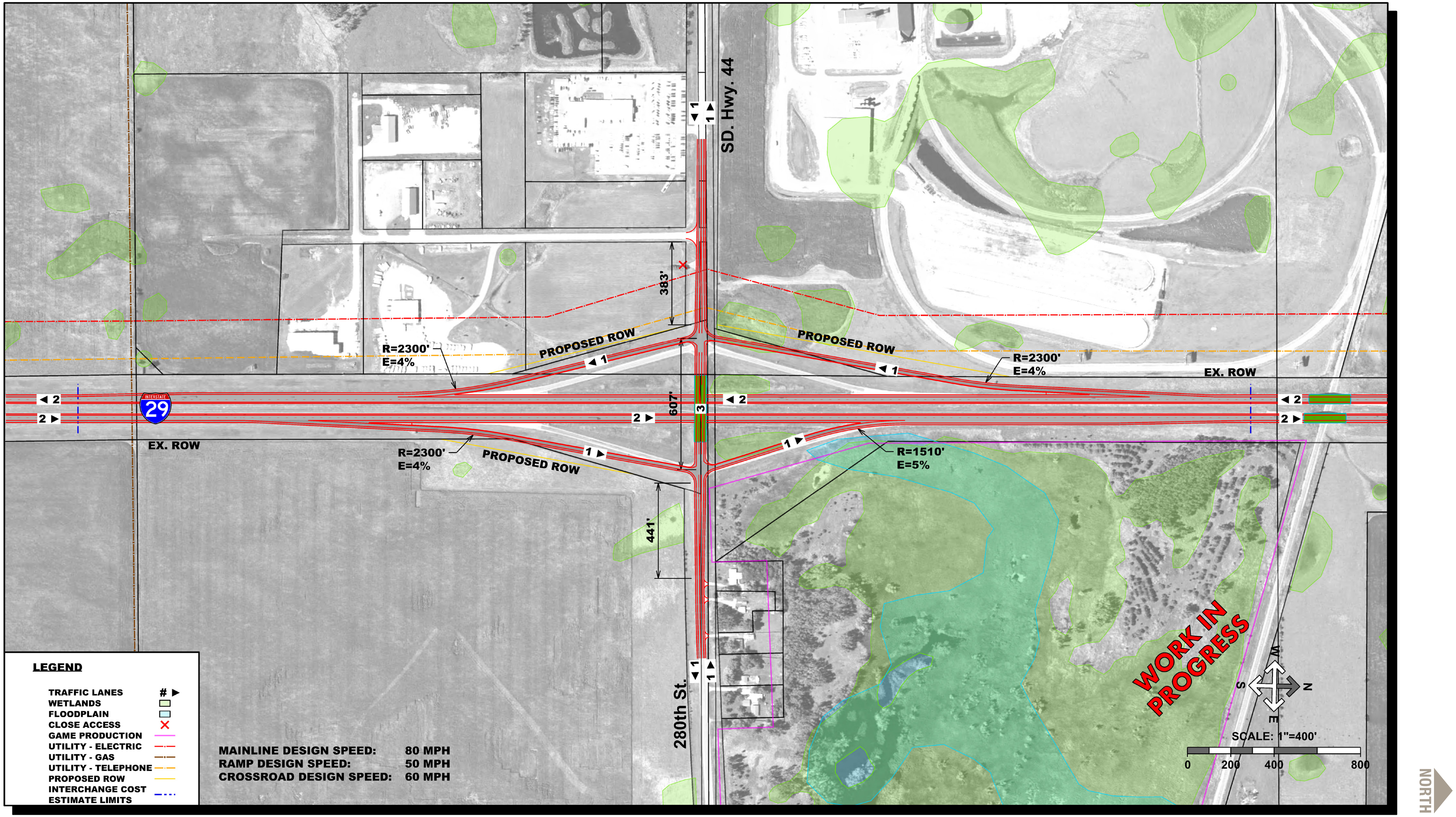
A standard vertical profile was developed for the alternatives. The profile is based on guidance from *Chapter 6 – Vertical Alignment* and *Chapter 13 – Interchanges* of the *SDDOT Road Design Manual.* This guidance was used to determine construction limits, ROW impacts, and construction costs. **Figure 7-6** shows the proposed vertical profile for Exit 64.

Figure 7-3
Exit 64 Standard Diamond Interchange



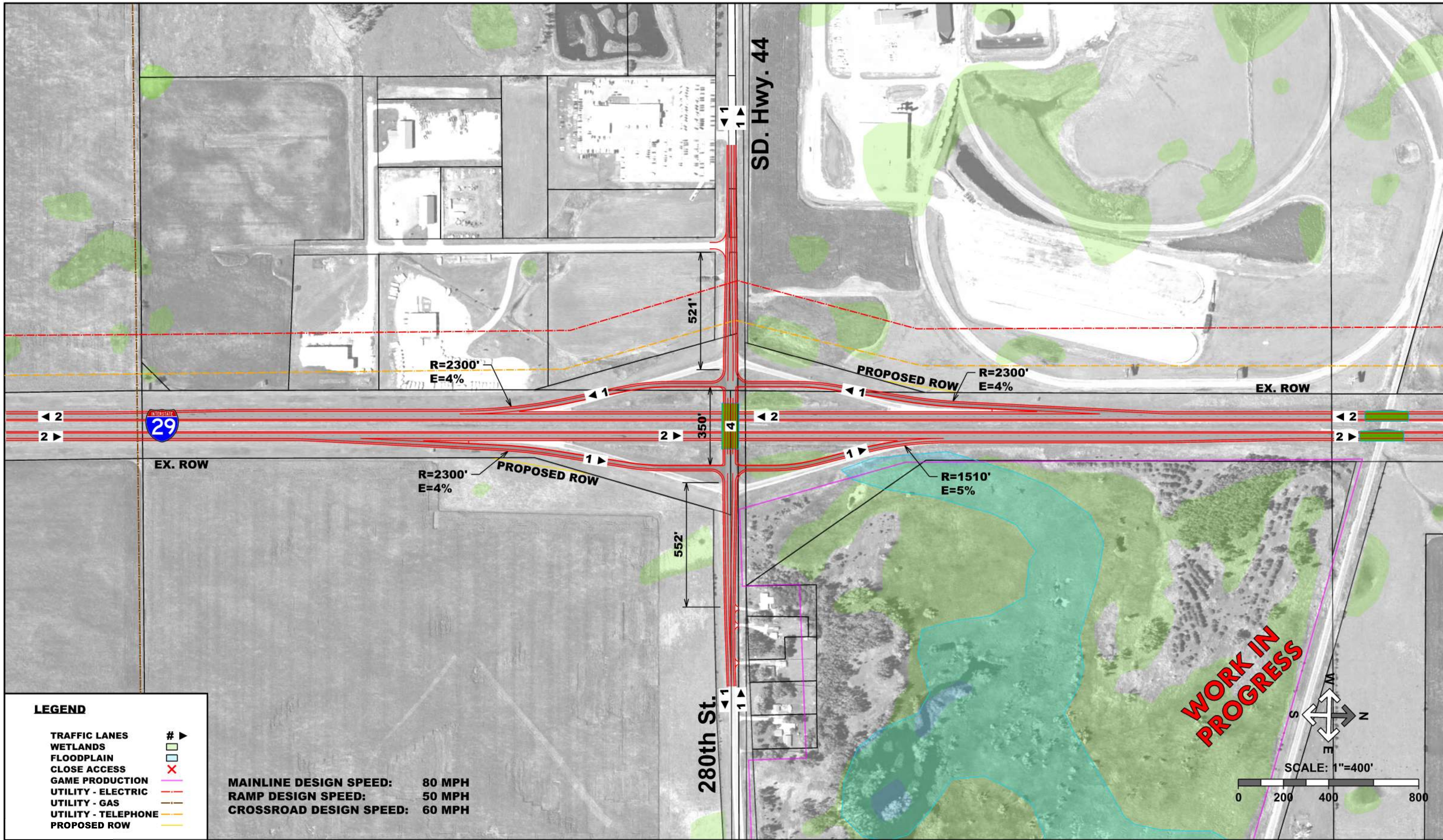
NOTE: Drawing Not to Scale

Figure 7-4
Exit 64 Compressed Diamond Interchange



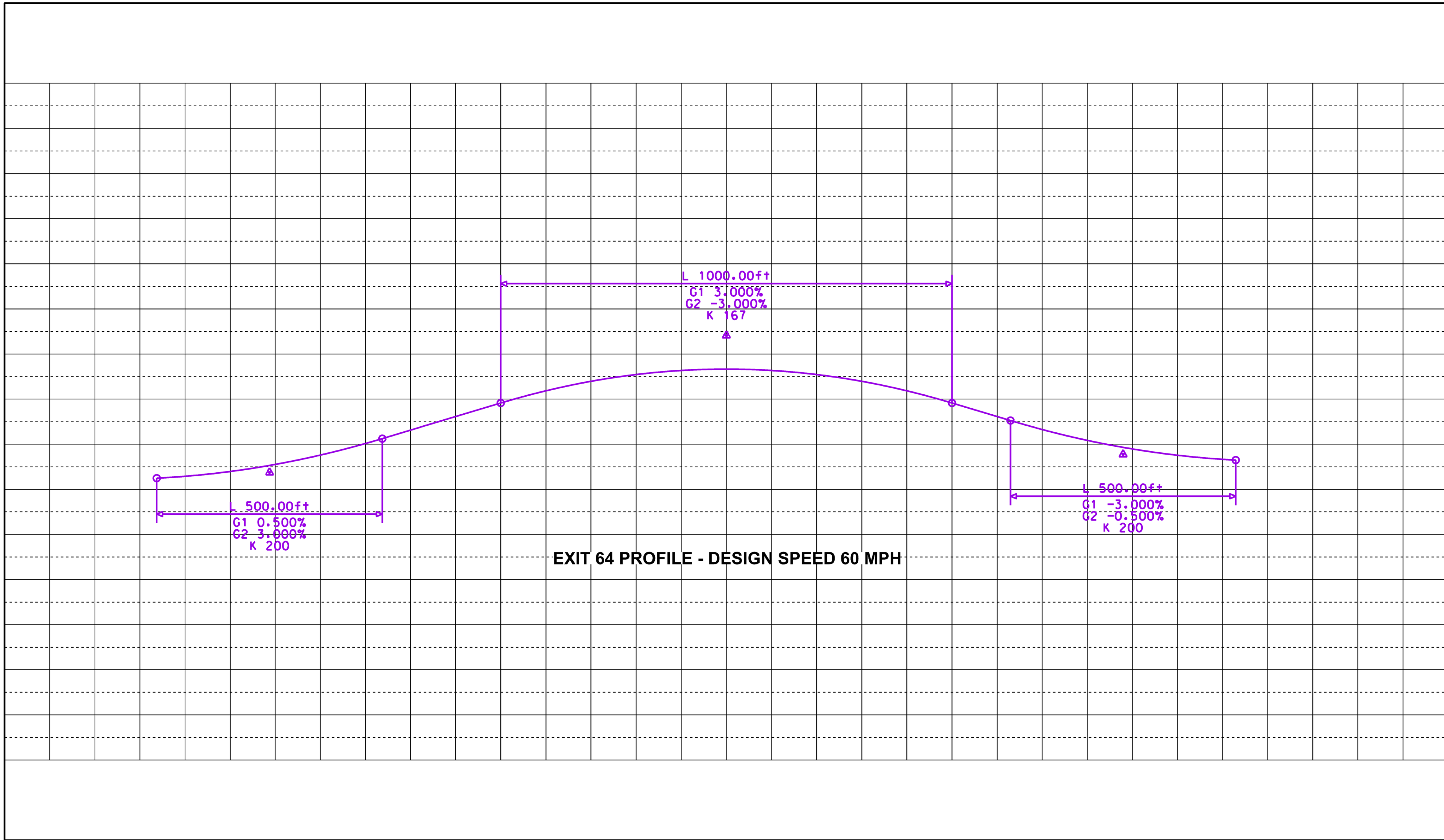
NOTE: Drawing Not to Scale

Figure 7-5
Exit 64 Tight Diamond Interchange



NOTE: Drawing Not to Scale

Figure 7-6
Exit 64 - Typical Vertical Profile



NOTE: Drawing Not to Scale

7.5 2045 BUILD ALTERNATIVES ANALYSIS

The interchange alternatives were evaluated using several developed criteria, which will be discussed in more detail in this section. The lane configurations at all study intersections are based on the geometrics as shown in the conceptual designs and in **Figure 7-2**.

7.5.1 Measures of Effectiveness Evaluation

Each advanced alternative was evaluated in respect to MOEs. Property stakeholders selected MOEs, which include property impacts, environmental resources, traffic operations, access control, safety/geometry, constructability, expandability, and cost.

The SAT representatives reviewed the traffic operations analysis results and the constructability of each alternative at the SAT meeting on December 11, 2017. The analysis results are presented below, along with a summary of comments received at the SAT meeting.

Two major points of concern raised at the SAT meeting for the Exit 64 interchange were property impacts on the southwest and northeast quadrants of the interchange:

- Access to the commercial properties in the southwest quadrant of the southbound ramp terminal intersection would be affected. Two possible access realignment options were developed and are depicted in the interchange alternative concept sketches.
- The Worthing State Game Production Area is located in the northeast quadrant of the northbound ramp terminal intersection. This area contains both wetlands and floodplain features, and as such, the interchange alternatives were modified to avoid them.

The following sections describe how the interchange alternatives performed for the MOE's. **Table 7-4** provides an evaluation matrix for Exit 64 summarizing the MOEs for each alternative.

7.5.2 Property Impacts

ROW required for the three alternatives was compared based on the footprint needed to construct each alternatives

- **Standard Diamond (Signalized).** The Standard Diamond Interchange is expected to require 14.88 acres of additional ROW to construct. This additional ROW is necessary to construct the interchange ramps.
- **Compressed Diamond (Signalized)**. The Compressed Diamond Interchange is expected to require 14.25 acres of additional ROW to construct. This additional ROW is necessary to construct the southbound on- and off ramps and the northbound off ramp.
- **Tight Diamond.** The TDI is expected to require 0.26 acre of additional ROW to construct. This additional ROW is necessary to construct the interchange off-ramps.

7.5.3 Control of Access

Access management principles were reviewed and incorporated into the alternative concepts when feasible. *Chapter 13 – Interchanges* and *Chapter 17 – Access Management* from the *SDDOT Road Design Manual* provided guidelines for commercial access requirements onto highways and county roads. SDDOT designates the Exit 64 interchange as Interstate Access Classification. SD 44/280th Street has a Rural Access Classification.

Per SDDOT policy, the minimum control of access for a reconstructed or existing interchange is 300 feet from the edge of the nearest through lane of the roadway. This is the minimum distance that driveways should be located from the interchange ramp terminals. For developed areas with multiple drives, consolidation of drives is recommended.

Along SD 44/280th Street, there are currently no locations where an access point to the roadway is located closer to the interchange ramp terminals than recommended by SDDOT policy; however, with the design alternatives, other locations that may be affected include Boondock Avenue along the south side of SD 44/280th Street, 515 feet west of the southbound ramp terminal. To the east of the interchange, approximately 525 feet east of the southbound ramp terminal, is the first of four residential driveways along the north side of SD 44/280th Street. This type of access spacing degrades progression on the street and introduces conflict points, thereby increasing the potential for crashes.

Access management variations (or options) for each alternative were developed throughout the study process and were discussed with the project stakeholders. The following access management modifications are the result of stakeholders' participation and are recommended to promote safety and improve traffic operations. For any alternatives, access management principles should be followed including:

- Close access points that are within 300 feet spacing from ramp terminals. This may include the following locations:
    - SD 44/280th Street with Boondock Avenue
    - SD 44/280th Street with Residential Driveways
- Realign access to Boondock Avenue to 300 feet from ramp terminal.
- Consolidate Residential Driveway access within 300 feet of ramp terminal into one location.

For each alternative, **Figure 7-3** through **Figure 7-5** identify locations where access should be closed, consolidated, or realigned. Below describes the recommended access control for each alternative.

- **No Build.** Maintain existing access locations.
- **Standard Diamond.** Realign access to Boondock Avenue 300 feet west of the southbound ramp terminal. Consolidate the first two Residential Driveways and provide a shared access point 300 feet east of the northbound ramp terminal.
- **Compressed Diamond.** Maintain existing access locations.
- **Tight Diamond**. Maintain existing access locations.

7.5.4 Traffic Operations

Figure 7-2 shows the lane geometry, traffic control, and LOS for 2045 traffic conditions for all design alternatives for Exit 64.

- **No-Build.** Under the current interchange configuration, the stop-controlled southbound and northbound approaches of the ramp terminals are anticipated to operate at LOS B in both the AM and PM peak hours under 2045 traffic conditions. All other yielding movements are anticipated to operate at LOS A during both peak periods in 2045.
- **Standard Diamond.** The stop-controlled approach of the southbound ramp terminal is expected to operate at LOS B in both the AM and PM peak hour in 2045. The stop-controlled northbound ramp terminal approach is expected to operate at LOS B in both the AM and PM peak hours. All other yielding movements are anticipated to operate at LOS A during both peak periods under 2045 traffic conditions.
- **Compressed Diamond.** The stop-controlled approach of the southbound ramp terminal is expected to operate at LOS B in both the AM and PM peak hour in 2045. The stop-controlled northbound ramp terminal approach is expected to operate at LOS B in both the AM and PM peak hours. All other yielding movements are anticipated to operate at LOS A during both peak periods under 2045 traffic conditions.
- **Tight Diamond.** The stop-controlled approach of the southbound ramp terminal is expected to operate at LOS B in both the AM and PM peak hour in 2045. The stop-controlled northbound ramp terminal approach is expected to operate at LOS B in both the AM and PM peak hours. All other yielding movements are anticipated to operate at LOS A during both peak periods under 2045 traffic conditions.

7.5.5 Safety/Geometry

The HSM predictive method was used to predict the number of crashes anticipated for the Advanced Interchange Alternatives, including the No-Build. The No-Build Option model was used as a baseline for the existing configuration and compared to the other design alternatives. **Table 8-2** summarizes the results of the predictive crash analysis completed for each alternative. **Appendix F** contains a memorandum with a more detailed description of the analysis.

Table 7-2. Crash Prediction Summary – Exit 64

Exit 64 Interchange Alternatives	Future Predicted Crashes (2045-2049)	Change in Crashes (+/-)
No Build (1)	31.6	-
Standard Diamond (1)	30.0	-1.6
Compressed Diamond (1)(2)	29.3	-2.3

(1) Ramp terminal intersections analyzed as unsignalized intersections.
(2) A Crash Modification Factor (CMF) of 0.69 was applied to Modified Diamond entrance speed change crashes to account for the increase in acceleration distance in these alternatives. This CMF depends on the acceleration distance and is consistent with HSM 15-6.
(3) A CMF of 0.63 was applied to the 2045 existing traditional diamond ramp terminal intersection crashes. This CMF is consistent with HDR's *I-29 Exit 77 (41st Street) Interchange Modification Justification Report*.
(4) A CMF of 0.52 was applied to the 2045 existing traditional diamond ramp terminal intersection crashes. This CMF is based on MoDOT's "Safety Evaluation of Diverging Diamond Interchanges in Missouri."

- **No Build.** With the current interchange configuration, it is estimated that over the 5-year future period, 31.6 crashes would be anticipated.
- **Standard Diamond**. With the Standard Diamond Interchange configuration, it is estimated that over the 5-year future period, 30.0 crashes would be anticipated. This is a reduction of 1.6 crashes over the analysis period compared to the No-Build.
- **Compressed Diamond.** With the Compressed Diamond Interchange configuration, it is estimated that over the 5-year future period, 29.3 crashes would be anticipated. This is a reduction of 2.3 crashes over the analysis period compared to the No-Build.
- **Tight Diamond.** The TDI was not advanced for crash prediction analysis.

7.5.6 Constructability

Construction phasing associated with the proposed alternatives is an important consideration in the evaluation process. With limited crossings of I-29, the ability to keep SD 44/280th Street open during construction is critical to the community, agriculture, and area businesses. In addition, access to I-29 via the interchange ramps is also critical to accommodate traffic at this location.

- **No-Build.** Use existing structure until end of serviceable life.
- **Standard Diamond.** The Standard Diamond Interchange bridge will have a three-lane cross-section and could be constructed off-alignment to the south of the existing bridge. This would allow maintaining access across I-29 during construction using the existing structure.
- **Compressed Diamond.** The Compressed Diamond Interchange bridge will have a three-lane cross section and could be constructed off-alignment to the south of the existing bridge. This would allow maintaining access across I-29 during construction using the existing structure.
- **Tight Diamond**. The TDI bridge would be a larger structure with a four-lane cross section required. Due to the size of the structure, constructing off alignment may be difficult and may require closure of the crossing with the initial larger structure.

7.5.7 Expandability

The base assumption for Exit 64 was that one through lane would be provided in both the eastbound and westbound directions on the crossroad (SD 44/280th Street) to accommodate 2045 traffic volumes. Because the Exit 64 Interchange is in an area of potential future growth in Lincoln County, an expandability analysis was conducted to determine how far into the future the interchange could operate until the LOS B/C threshold was met. The expandability analysis revealed that the northbound ramp terminal intersection was the critical of the two at the interchange.

- **No-Build.** The current interchange configuration is expected to operate at LOS B beyond 2045. The existing interchange has substandard sight distance at the ramp terminal intersections (looking toward the crossroad structure) and has necessitated a 25 mph speed limit. The crossroad structure was built in the late 1950s and has reached the end of its service life. The current interchange and bridge needs to be reconstructed.
- **Standard Diamond.** The Standard Diamond Interchange configuration could be expanded to meet future traffic growth by adding lanes to the outside of a crossroad structure. The expandability analysis revealed that the northbound ramp terminal intersection would reach the LOS B/C threshold between 2065 and 2070.

- **Compressed Diamond.** The Compressed Diamond Interchange configuration could be expanded to meet future traffic growth by adding lanes to the outside of a crossroad structure. The expandability analysis revealed that the northbound ramp terminal intersection would reach the LOS B/C threshold between 2065 and 2070.
- **Tight Diamond**. The TDI was not advanced for expandability analysis.

7.5.8 Construction Cost

The total project costs associated with the construction of the proposed Exit 64 interchange improvements are estimated to range from $15.09 million for the Compressed Diamond Alternative to $17.75 million for the Standard Diamond Alternative. **Table 7-3** summarizes the major cost items for each alternative. These amounts consist of the reconstruction of the Exit 64 interchange and ramps and reflect all items shown on the concept sketches in **Figure 7-3** and **Figure 7-4**. **Appendix G** provides detailed quantity breakdowns.

Table 7-3. Cost Estimate Summary – Exit 64

Item	Standard Diamond	Compressed Diamond
Construction Costs	$11,207,900	$10,379,198
Contingencies (20%)	$2,241,580	$2,075,840
Engineering Services (10%)	$1,344,948	$1,245,504
Construction Engineering (8%)	$1,075,958	$996,403
ROW (Ag/Residential)	$382,500	$42,000
ROW (Commercial/Industrial)	$1,500,000	$356,000
Total Project Costs	**$17,752,886**	**$15,094,945**

7.6 RECOMMENDED ALTERNATIVES

Based on the results of the alternatives analysis and discussions with the SAT, the following alternative is recommended to be advanced forward once SDDOT initiates the IMJR and Environmental Study for Exit 64:

- Compressed Diamond

It was agreed at the concept review meeting that the alternative may need some refinement in the IMJR/NEPA study.

7.6.1 Compressed Diamond

The Compressed Diamond would perform with operations similar to those of the Standard Diamond Interchange, with the benefit of a footprint that is similar to the existing interchange, requiring less new ROW to construct and minimizing impacts on the game production area on the northeast quadrant of the interchange. The stop-controlled southbound and northbound ramp terminals are expected to operate at LOS B or better in both the AM and PM peak hours in 2045. A reduction of 2.3 crashes over the analysis period compared to the No-Build is expected. The Compressed Diamond alternative's estimated construction cost is $15.09 million.

Table 7-4. Exit 64 Interchange Alternatives Evaluation Matrix

Evaluation Factors	No-Build	Standard Diamond	Compressed Diamond	Tight Diamond
Property Impacts				
Right-of-Way Acquisition (Acres)	-	14.88	14.25	0.26
Environmental Resources				
Address Purpose and Need	No	Yes	Yes	Yes
HazMat Sites	-	NW quadrant	NW quadrant	None
Floodzone	-	NE quadrant	NE quadrant	NE quadrant - grading only
Wetlands / WOUS	-	NE, NW, SE quadrants	NE, NW, SE quadrants	NE, NW quadrants
Section 4(f)	-	NE quadrant - 4.17 AC	NE quadrant - 3.18 AC	NE quadrant - minor grading
Traffic Operations				
Traffic Operations - 2045 Volumes	LOS B	LOS B or Better	LOS B or Better	LOS B or Better
Breakdown Year - LOS D or worse	<2045	<2045	<2045	<2070
Farm Equipment / Implements	allows for access	allows for access	allows for access	allows for access
Control of Access				
Access to Properties	-	Access realigned or closed to west	Access realigned or closed to west	Access Maintained
Safety/Geometry				
Estimated Crashes Per Year	31.6	30.0	29.3	29.3
Driver Expectancy	Undesirable - short ramps	Desirable	Desirable	Desirable
Maintenance / Winter Operations	I-29 under	I-29 under	I-29 under	I-29 under
Geometric Design	Substandard	80 MPH Mainline Design	80 MPH Mainline Design	80 MPH Mainline Design
Constructability				
Maintain Crossroad During Construction	-	Able to construct bridge off-alignment	Able to construct bridge off-alignment	May require closure with initial larger structure
Construction Cost	-	$17,752,886	$15,094,945	-
Expandability				
Ability to Meet Traffic Growth Over Time	No	Expandable	Expandable	May require initial larger structure

8.0 EXIT 71 INTERCHANGE SOLUTIONS

8.1 IDENTIFICATION OF SOLUTIONS

With the pavement replacement on I-29 between Exit 62 and Exit 73 and the widening of I-29 to six lanes from Exit 68 to Exit 73, a complete reconstruction of the I-29 interchange at Exit 71 is also recommended. The Exit 71 interchange is original to the interstate system and was constructed in the 1960s. It no longer meets current design standards. The outside bridge piers would need to be moved to accommodate the I-29 mainline widening, and traffic operations at the interchange ramp terminals are projected to perform at LOS F in 2045 (not meeting the traffic operations goal of LOS C for urban areas). The interim analysis in **Chapter 5** indicated that the LOS C criteria would be exceeded at the Exit 71 southbound ramp terminal intersection as soon as 2030.

Seven interchange alternative concepts were identified for consideration at the Exit 71 Interchange in addition to the No-Build. Guidance from SDDOT, FHWA, and other sources was used to identify the initial alternatives for consideration, which included the following concepts:

- No-Build (stop-controlled diamond)
- Standard Diamond (signalized)
- Compressed Diamond (signalized)
- Folded Diamond Interchange
- Single Point Interchange (SPI) I-29 Under
- Single Point Interchange (SPI) I-29 Over
- Diverging Diamond Interchange (DDI)
- Tight Diamond Interchange (TDI)

8.2 ROADWAY DESIGN CRITERIA

Design criteria for the proposed interchange alternatives were determined during discussions with SDDOT. **Table 8-1** includes a partial summary of criteria. **Appendix G** provides a more detailed description of design criteria.

Table 8-1. Exit 71 Interchange Design Criteria

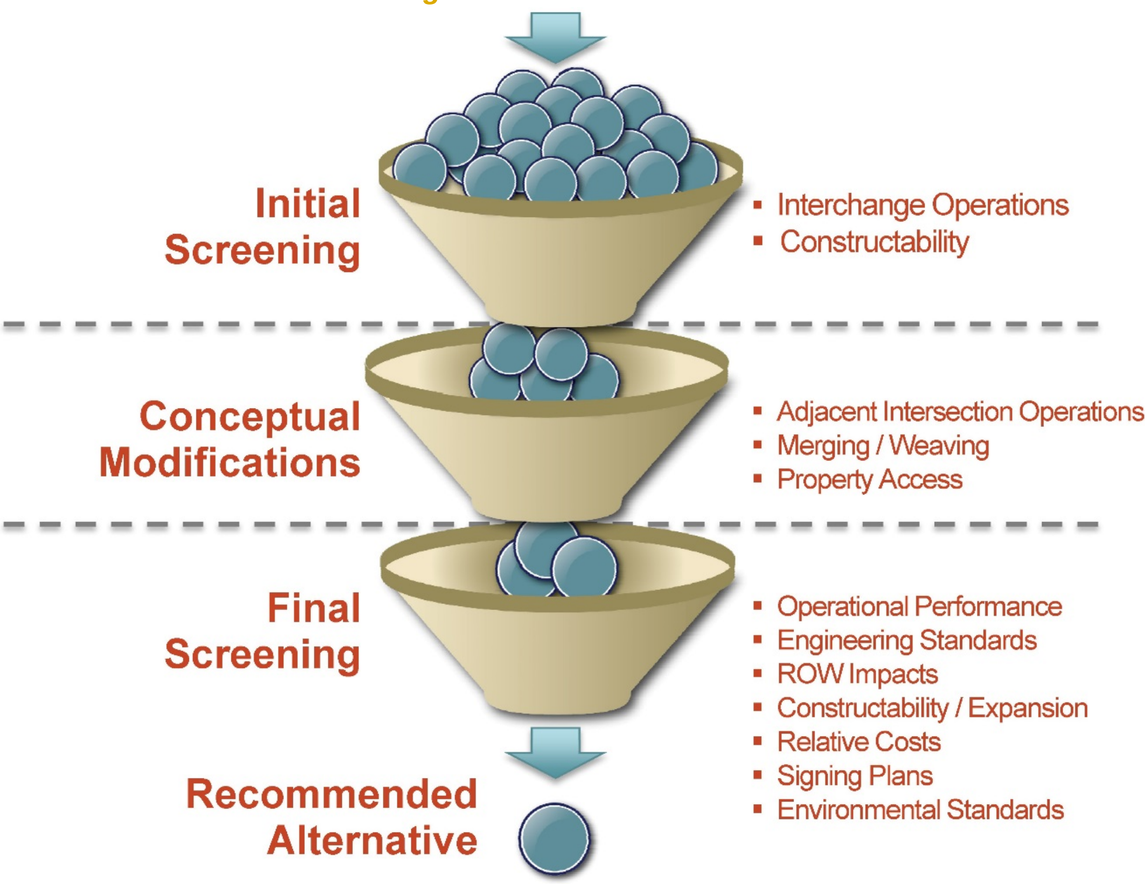
Design Element	Criteria
General	
Roadway Classification	Interstate
Design Speed (MPH)	80
Posted Speed Limit (MPH)	65
Design Vehicle	WB-67
Ramp Geometrics	
Ramp Design Speed (MPH)	50
Curve Radius for Ramp min. (Ft.)	2300'
Superelevation (e_{max})	6%
On-Ramp Taper Rate (Parallel)	50:1
Off-Ramp Taper Rate (Taper)	20:1
Vertical Alignment Criteria	
Maximum Grade (Ascending/Descending)	3%/5%
Minimum Grade	0.5%
Vertical Clearance (over/under I-29)	17'
Assumed Structure Depth (Ft.)	7'

The design speed for 273rd Street is 50 mph with a posted speed limit of 45 mph. The current posted speed limit is 55 mph on the west leg, 25 mph at the interchange, and 45 mph on the east leg. A maximum grade of 5 percent was used on 273rd Street with a vertical clearance of 17 feet and an assumed structure depth of 7 feet for the Diamond alternatives and the SPI alternative. The interchange ramps have a 50 mph design speed on tangent sections. These design criteria are typical for the interstate system in South Dakota.

8.3 ALTERNATIVES SCREENING PROCESS

An iterative process was used to develop and screen alternative interchange concepts for the Exit 71 interchange; this report documents each step. **Figure 8-1** illustrates the interchange alternatives screening process.

Figure 8-1. Alternative Screening Process



8.3.1 Initial Alternatives Screening

The seven Exit 71 alternative interchange concepts, in addition to the No-Build alternative, were initially analyzed for traffic operations with 2045 Build traffic volumes. Each alternative concept met the 2045 traffic operations' goal of LOS C (for urban areas) and was advanced for further review by the SAT for constructability. It was determined that all the alternatives should be advanced, except the Tight Diamond alternative, which was modified and replaced with the Compressed Diamond alternative (which achieved the desired goal of a similar footprint to the existing interchange with no need for new ROW to construct).

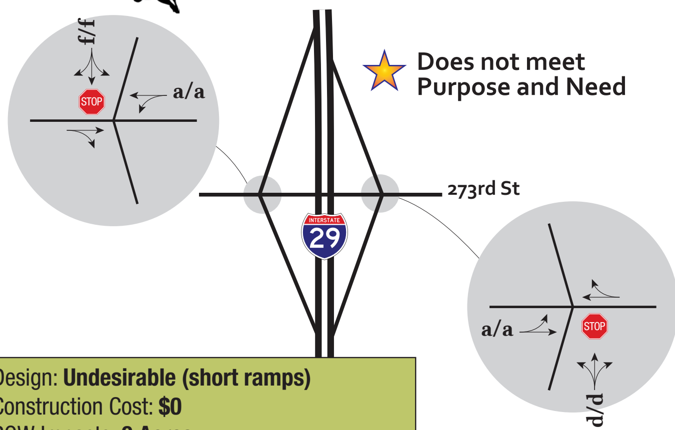
The six advanced alternatives were subsequently modified per stakeholder comments resulting in final alternative interchange concepts. A comparative evaluation of the benefits and impacts associated with each interchange alternative was conducted to determine recommended alternatives. **Figure 8-2** summarizes each of the alternative interchange concepts at I-29 Exit 71.

8.3.2 No Build Alternative

The No Build alternative represents the existing geometrics at the interchange and adjacent intersections. The existing diamond interchange has stop control on the ramp terminal approaches, spaced about 575 feet apart. 273rd Street/CR 110 goes over I-29; a single shared lane is provided for all approaches to the ramp terminals. Left-turn and right-turn movements at the ramp terminals originate from a shared lane.

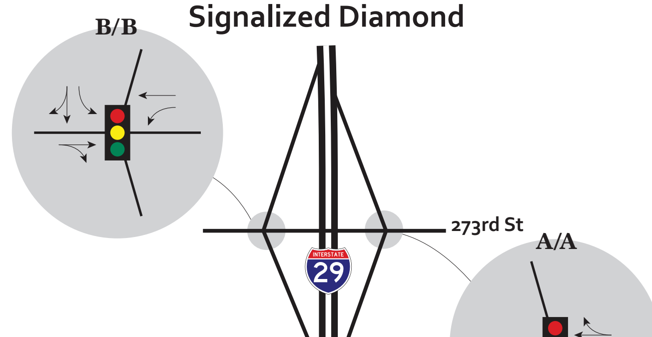
At the northbound ramp terminal intersection, northbound dual left-turn lanes are provided with a single exclusive right-turn lane. At the southbound ramp terminal intersection, a single exclusive lane is provided for each left- and right-turn movement. **Figure 8-2** shows the lane configurations for the No-Build alternative.

No Build



Design: **Undesirable (short ramps)**
Construction Cost: **$0**
ROW Impacts: **0 Acres**
Access: **Unchanged**

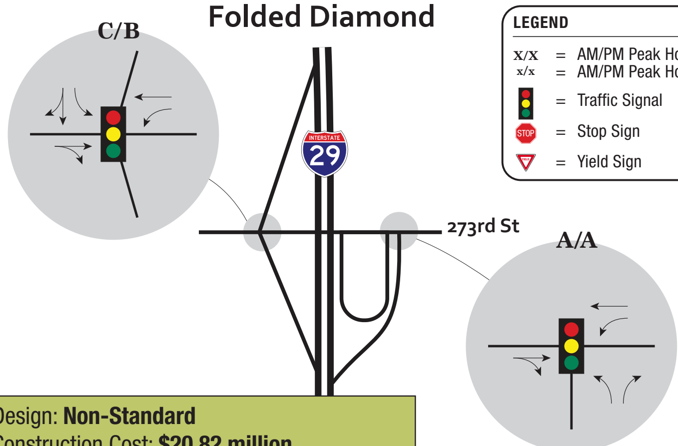
Signalized Diamond



Standard Diamond/
Compressed Diamond

Design: **Standard**
Construction Cost: **$19.85 million / $18.96 million**
ROW Impacts: **6.41 Acres / 0 Acres**
Access: **Drive closed to the east**

Folded Diamond

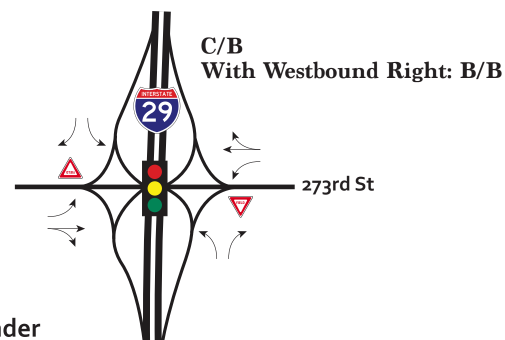


Design: **Non-Standard**
Construction Cost: **$20.82 million**
ROW Impacts: **10.53 Acres**
Access: **Unchanged**

LEGEND

- X/X = AM/PM Peak Hour Signalized Level of Service
- x/x = AM/PM Peak Hour Unsignalized Level of Service
- Traffic Signal
- STOP = Stop Sign
- Yield Sign

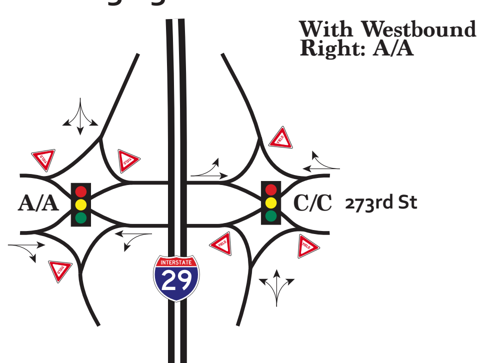
Single Point



I-29 Over/I-29 Under

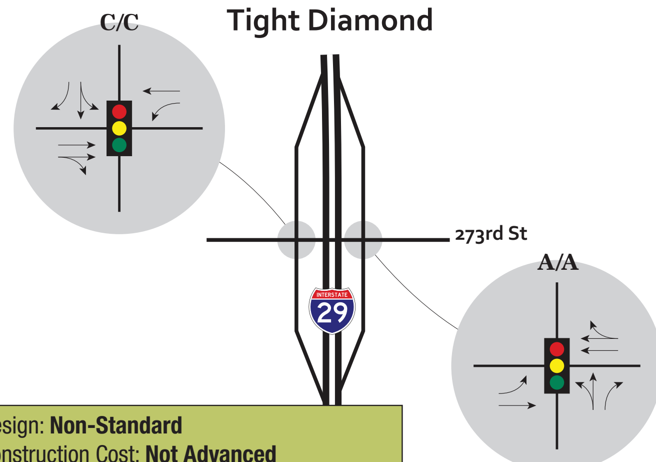
Design: **Standard / Not preferred**
Construction Cost: **$27.33 million / $24.13 million**
ROW Impacts: **0 Acres**
Access: **Unchanged**

Diverging Diamond



Design: **New in South Dakota**
Construction Cost: **$21.40 million**
ROW Impacts: **0.77 Acres**
Access: **Drive closed to the east**

Tight Diamond



Design: **Non-Standard**
Construction Cost: **Not Advanced**
ROW Impacts: **0 Acres**
Access: **Unchanged**

Figure 8-2

Exit 71 Interchange Alternatives
2045 Traffic Operations

NOTE: Drawing Not to Scale

NORTH

8.4 INTERCHANGE ALTERNATIVES DESCRIPTIONS

8.4.1 Standard Diamond (Signalized)

In the Standard Diamond alternative, the two ramp terminal intersections have been designed to a distance of about 1,100 feet apart. The Standard Diamond provides additional lanes at the ramp terminal intersections. On 273rd Street/CR 110, exclusive left-turn lanes are provided at both ramp terminals. Right-turn movements onto the ramp terminals still originate from a shared lane.

At the northbound and southbound ramp terminal intersections, exclusive left-turn lanes are provided. **Figure 8-3** shows the conceptual design for the Standard Diamond alternative.

8.4.2 Compressed Diamond (Signalized)

The Compressed Diamond alternative was developed as a variant of the Standard Diamond to achieve a smaller footprint. In the Compressed Diamond alternative, the two ramp terminal intersections are slightly farther apart than the existing interchange footprint, a distance of about 670 feet. With this spacing, back-to-back left-turn lanes would be provided on 273rd Street/CR 110 at both ramp terminals. Right-turn movements onto the ramp terminals still originate from a shared lane.

At the northbound and southbound ramp terminal intersections, exclusive left-turn lanes are provided. **Figure 8-4** shows the conceptual design for the Compressed Diamond alternative.

8.4.3 Folded Diamond

The Folded Diamond alternative consolidates the northbound ramp terminals in the southeast quadrant of the interchange. A loop ramp is provided for the northbound on-ramp. On 273rd Street/CR 110, exclusive left-turn lanes are provided at both ramp terminals. Right-turn movements onto the ramp terminals still originate from a shared lane.

At the northbound and southbound ramp terminal intersections, exclusive left-turn lanes are provided. **Figure 8-5** shows the conceptual design for the Folded Diamond alternative.

8.4.4 Single Point Interchange (I-29 Under)

The SPI I-29 Under alternative consolidates the northbound and southbound ramp terminals into a single signalized intersection. On 273rd Street/CR 110, single shared through/right-turn lanes and single left-turn lanes at the ramp terminals are provided in both directions. 273rd Street would be constructed on structure over I-29 as it currently is today.

Single exclusive left-turn lanes are provided from both the northbound and southbound ramp approaches for traffic turning onto 273rd Street. On the northbound and southbound approaches, a single right-turn lane is provided that must yield to 273rd Street traffic. **Figure 8-6** shows the conceptual design for the SPI I-29 Under alternative.

8.4.5 Single Point Interchange (I-29 Over)

The SPI I-29 Over alternative consolidates the northbound and southbound ramp terminals into a single signalized intersection. On 273rd Street/CR 110, single shared through/right-turn lanes and single left-turn lanes at the ramp terminals are provided in both directions. I-29 would be constructed on structure (likely twin bridges); 273rd Street would run under the interchange. This configuration would require extensive grading on mainline I-29 as the existing interchange is constructed with I-29 Under.

Single exclusive left-turn lanes are provided from both the northbound and southbound ramp approaches for traffic turning onto 273rd Street. On the northbound and southbound approaches, a single right-turn lane is provided that must yield to 273rd Street traffic. **Figure 8-7** shows the conceptual design for the SPI I-29 Over alternative.

8.4.6 Diverging Diamond Interchange

The DDI alternative shifts eastbound and westbound traffic lanes to the opposite side of the crossroad under I-29; the shifts would occur at the ramp terminal intersections, both of which would be signalized. On 273rd Street/CR 110, single shared through/right-turn lanes at the ramp terminals are provided in both directions. 273rd Street would be constructed on structure over I-29.

Single exclusive left-turn and right-turn lanes are provided from both the northbound and southbound ramp approaches for traffic turning that must yield to 273rd Street traffic. **Figure 8-8** shows the conceptual design for the Diverging Diamond alternative.

8.4.7 Tight Diamond Interchange

In the Tight Diamond alternative, the two ramp terminal intersections have been moved together to a distance of about 350 feet. With this close spacing, the two traffic signals would operate on a single controller. On 273rd Street/CR 110, single exclusive left-turn lanes are provided at both ramp terminals; these turn lanes are side by side on the crossroad bridge. Right-turn movements onto the ramp terminals originate from the shared through lane. To accommodate the turning movements and traffic volumes, the required cross section on 273rd Street/CR 110must be four lanes wide.

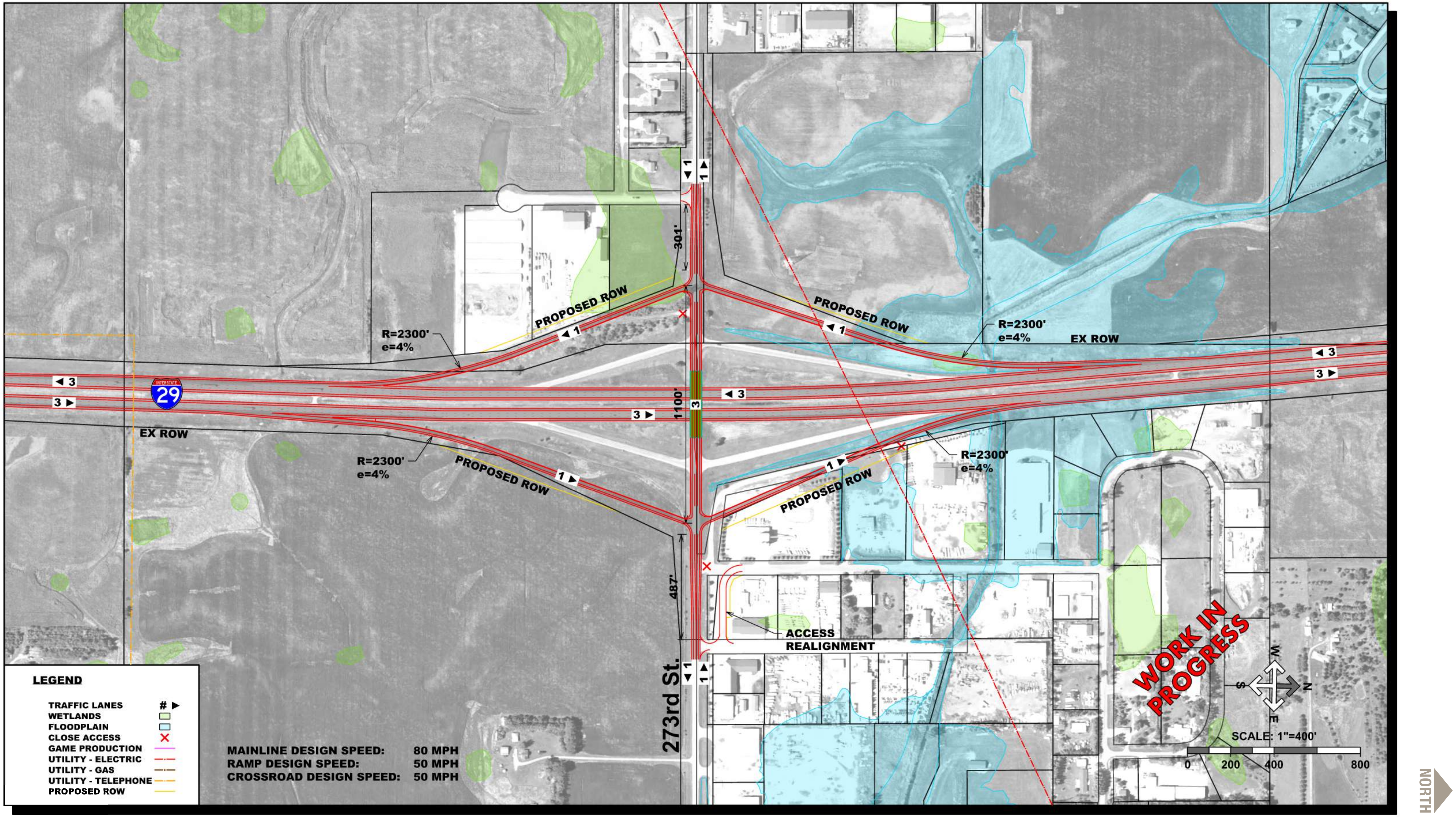
At the northbound and southbound ramp terminal intersections, exclusive left-turn lanes are provided. **Figure 8-9** shows the conceptual design for the Tight Diamond alternative.

8.4.8 273rd Street/CR 110 Vertical Profile

A standard vertical profile was developed for the alternatives. The profile is based on guidance from *Chapter 6 – Vertical Alignment* and *Chapter 13 – Interchanges* of the *SDDOT Road Design Manual,* which was used to determine construction limits, ROW impacts, and construction costs. **Figure 8-10** shows the proposed vertical profile for Exit 73.

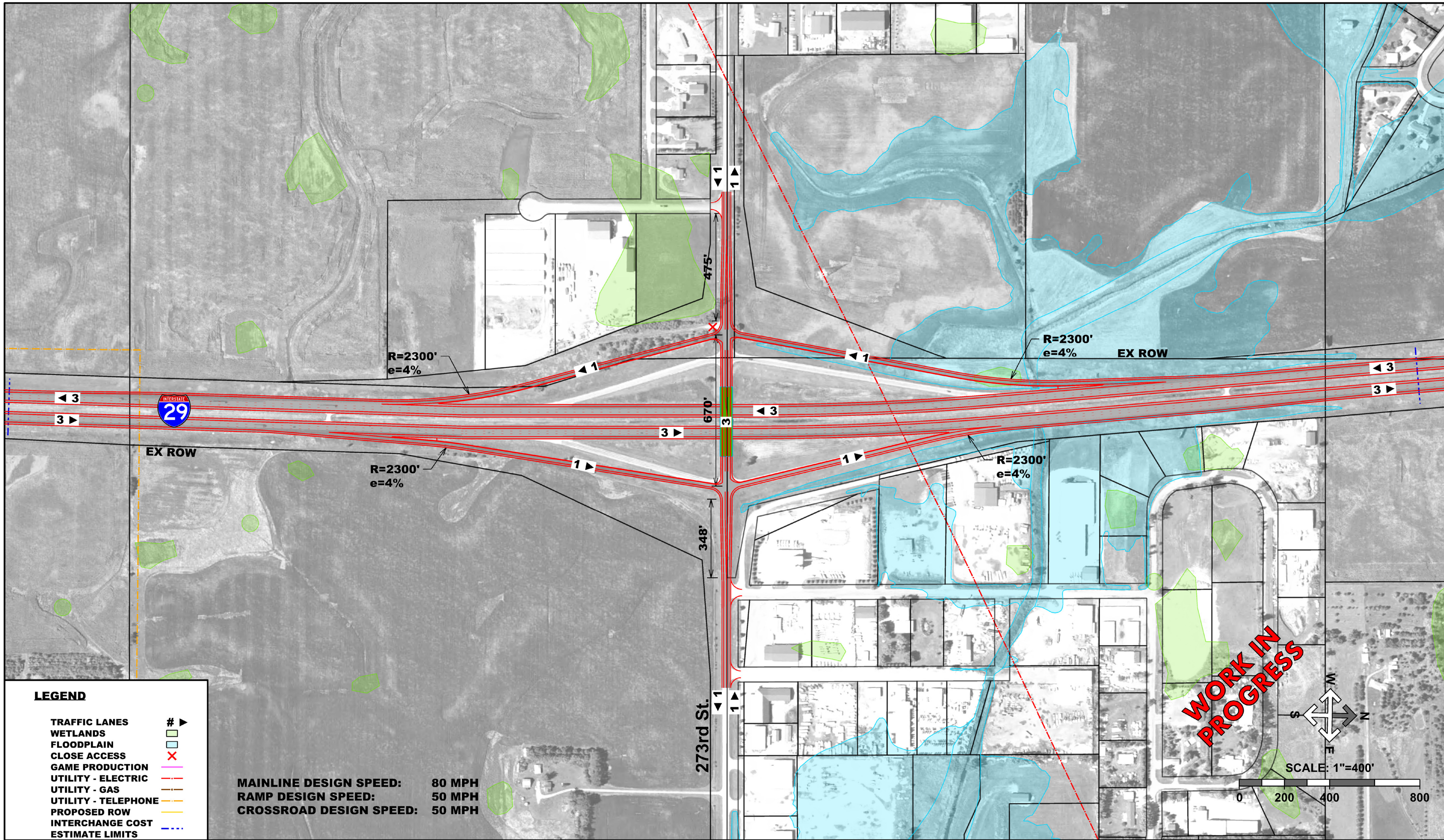
Figure 8-3

Exit 71 Standard Diamond Interchange



NOTE: Drawing Not to Scale

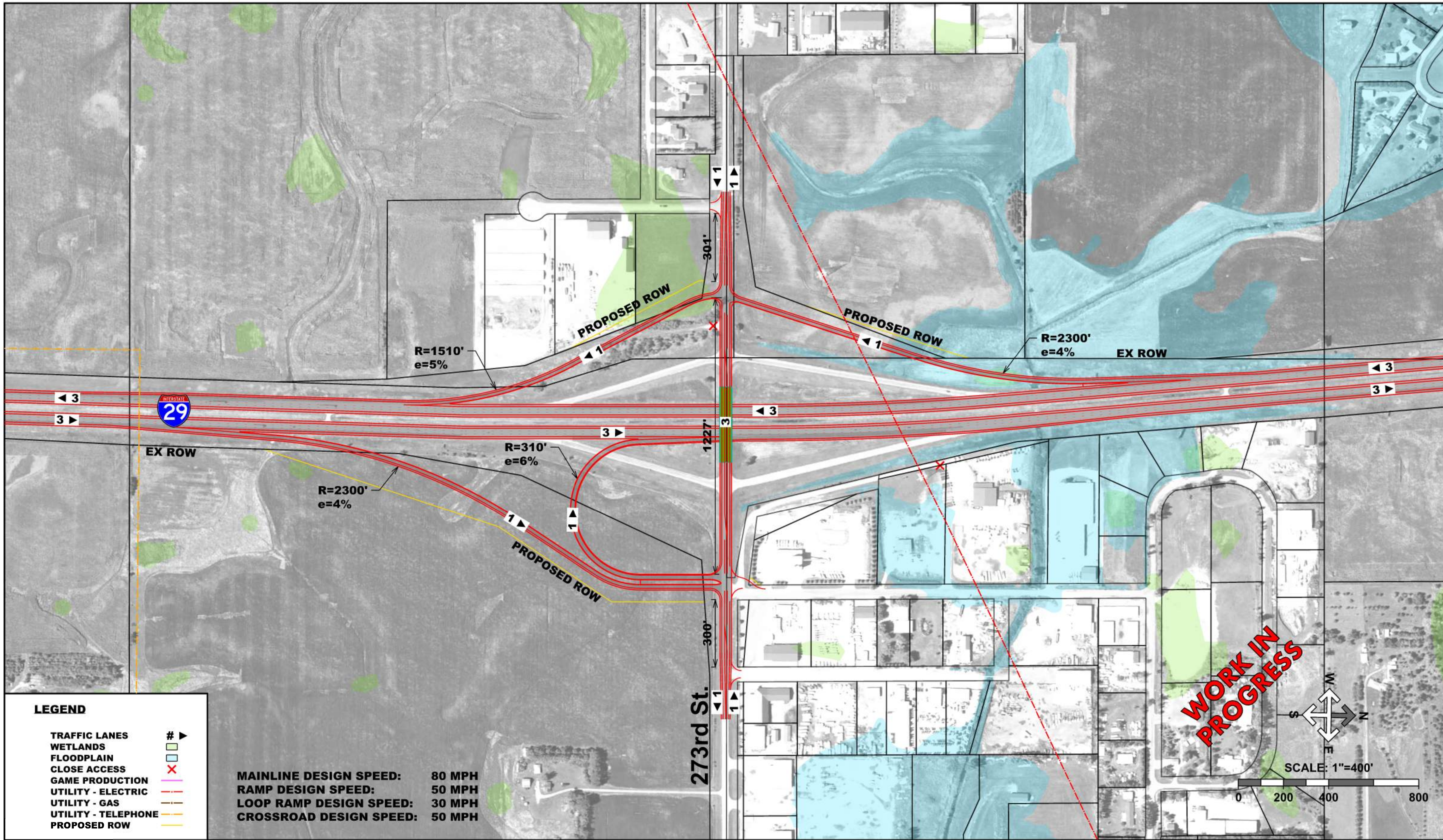
Figure 8-4
Exit 71 Compressed Diamond Interchange



NOTE: Drawing Not to Scale

Figure 8-5

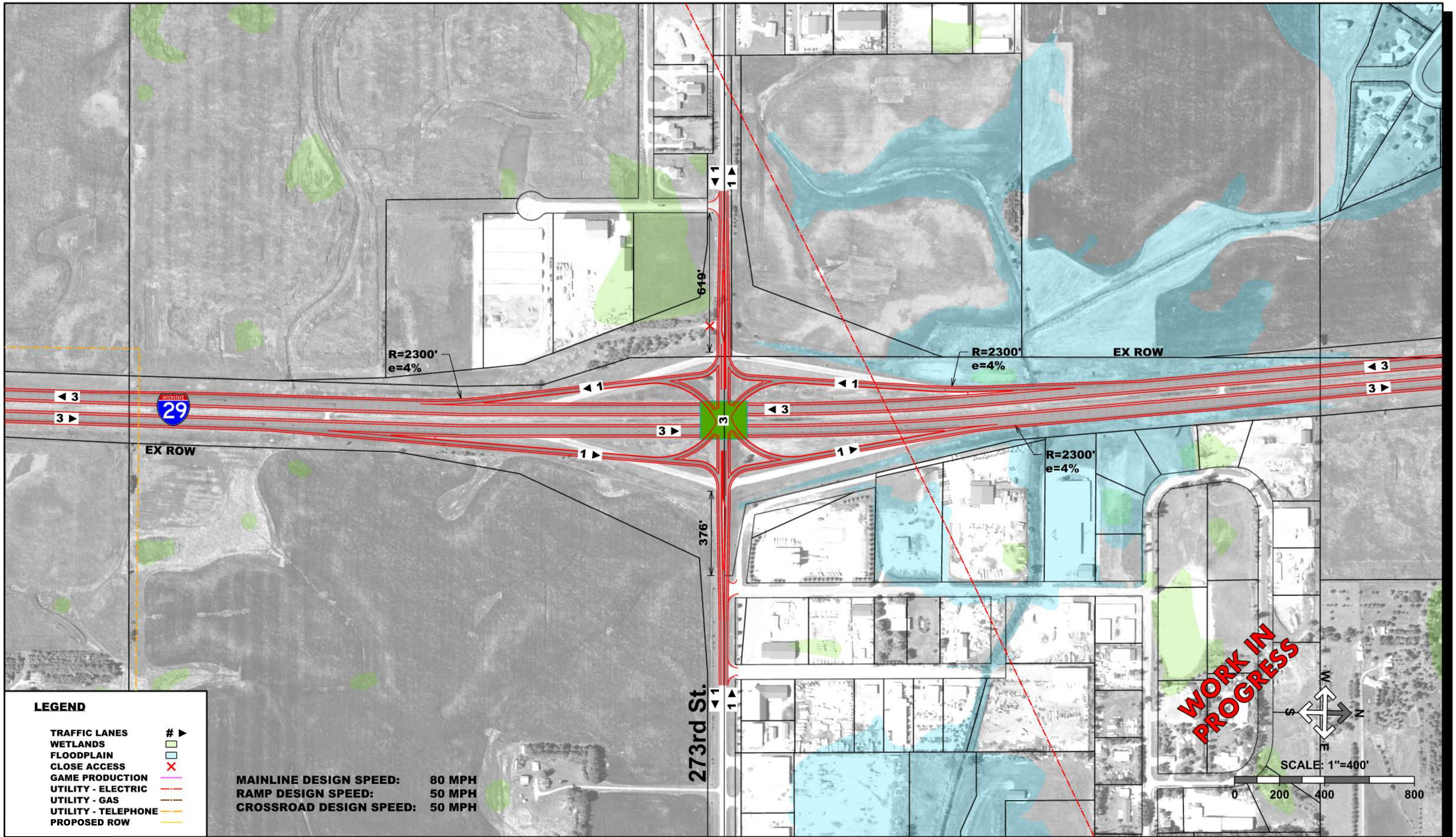
Exit 71 Folded Diamond Interchange



NOTE: Drawing Not to Scale

Figure 8-6

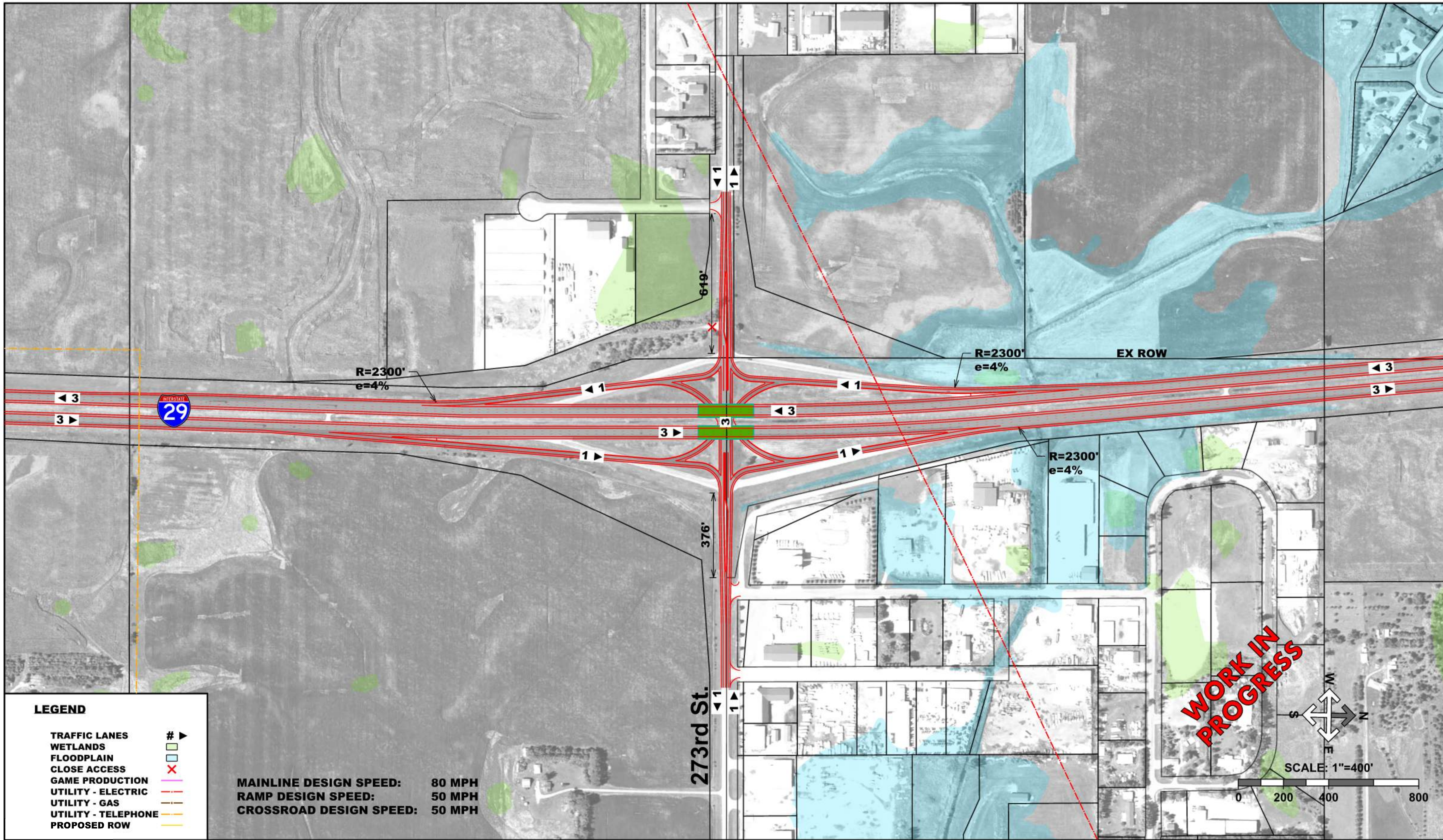
Exit 71 Single Point Interchange I-29 Under



NOTE: Drawing Not to Scale

Figure 8-7

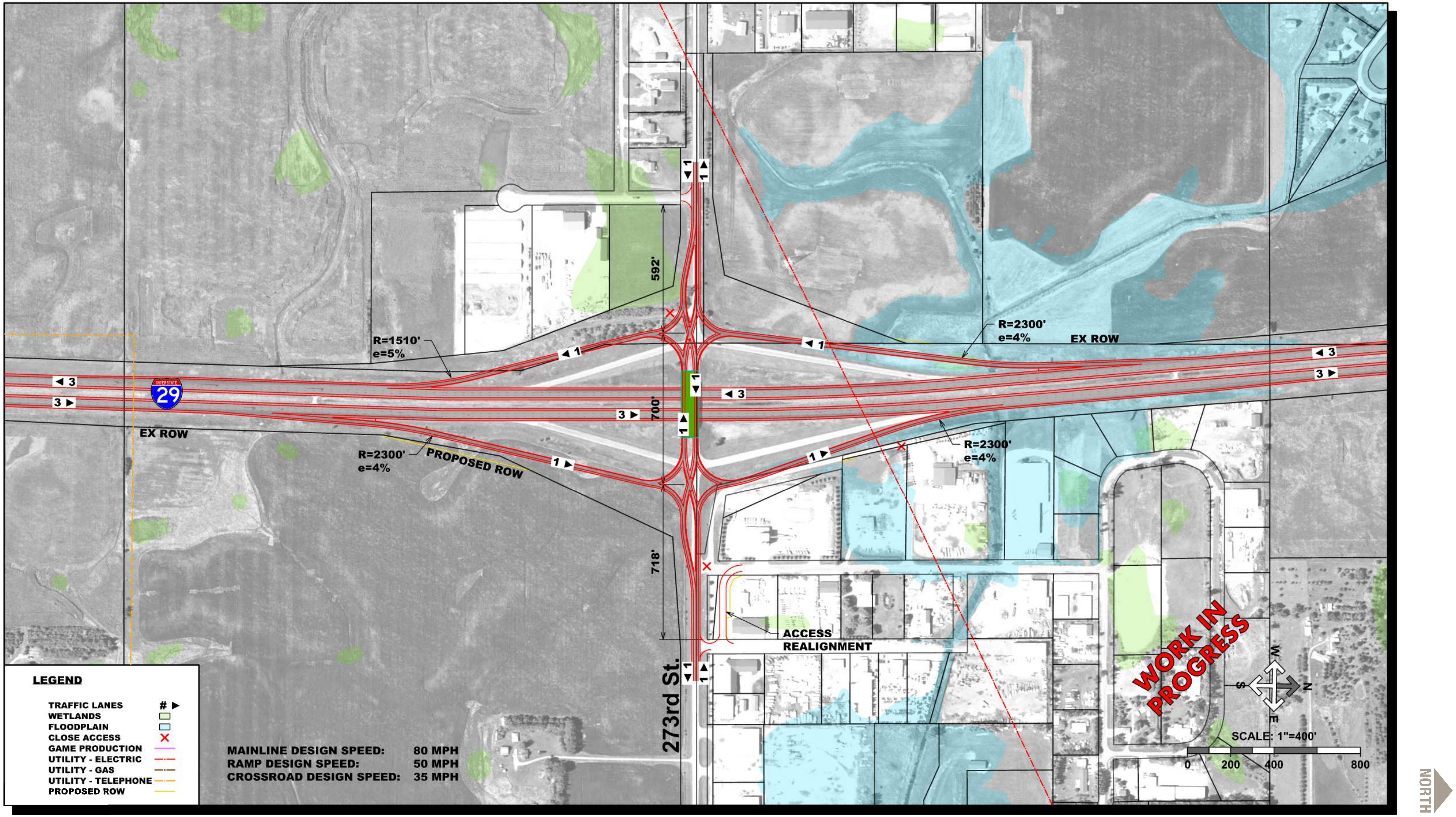
Exit 71 Single Point Interchange I-29 Over



NOTE: Drawing Not to Scale

Figure 8-8

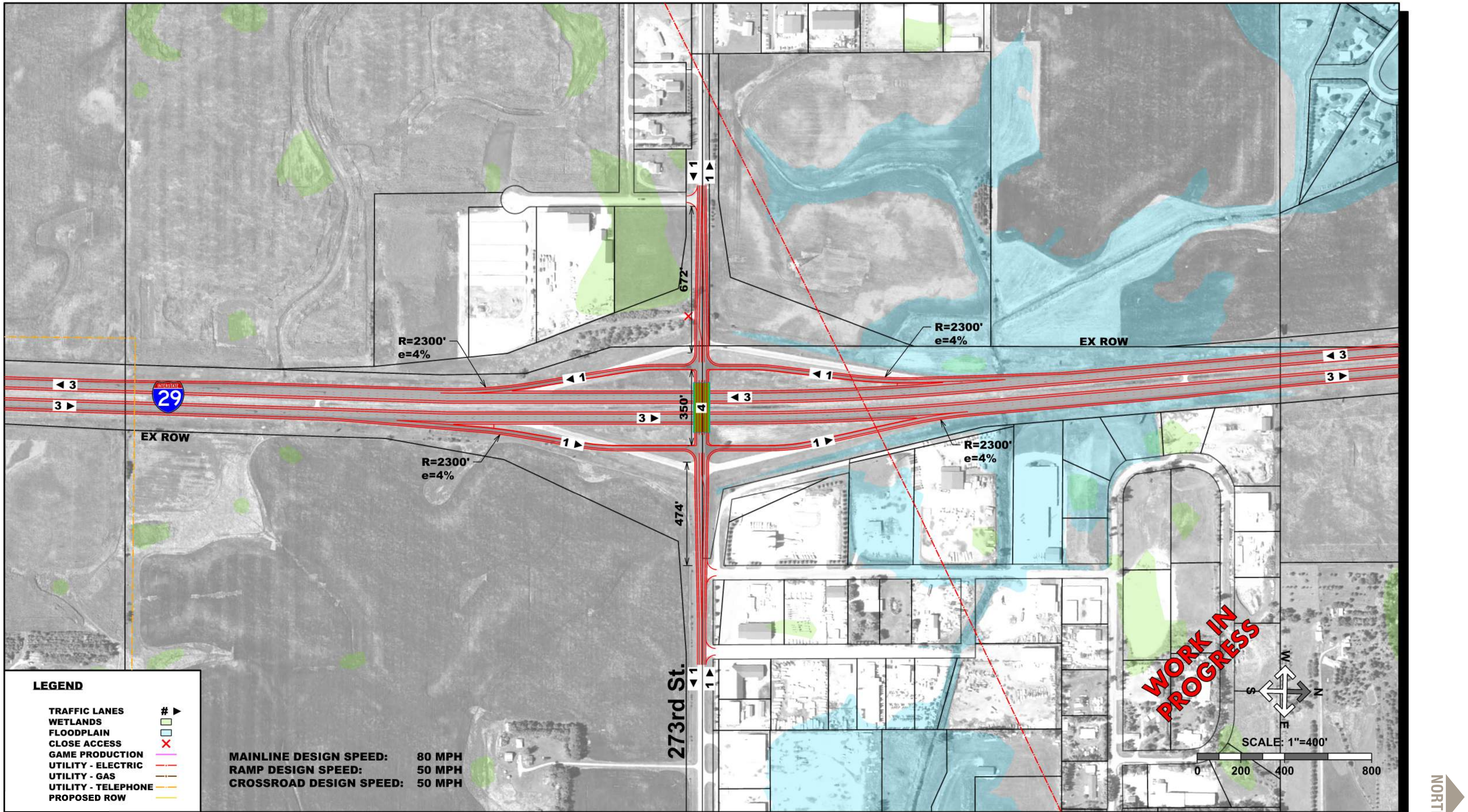
Exit 71 Diverging Diamond Interchange



NOTE: Drawing Not to Scale

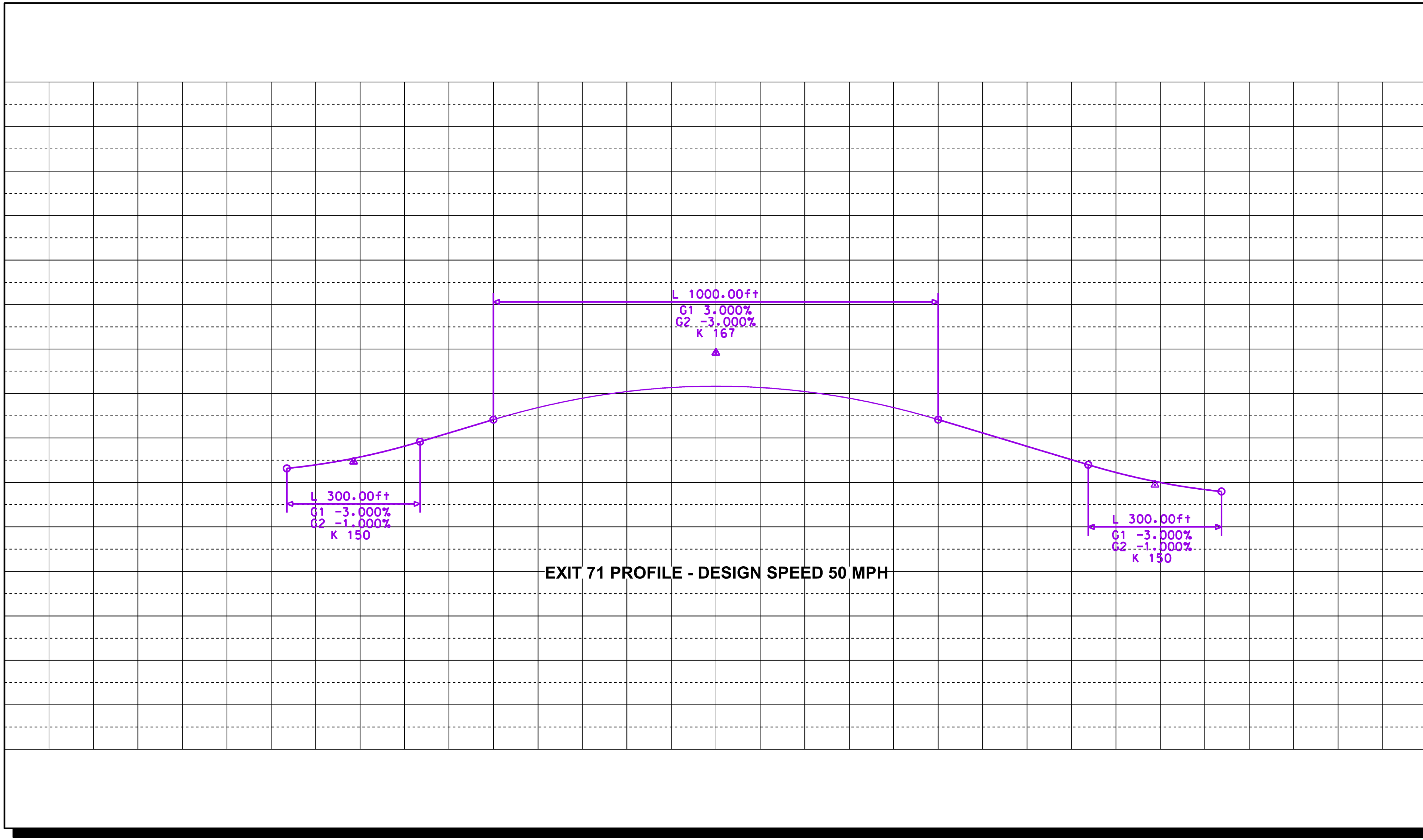
Figure 8-9

Exit 71 Tight Diamond Interchange



NOTE: Drawing Not to Scale

Figure 8-10
Exit 71 - Typical Vertical Profile



NOTE: Drawing Not to Scale

8.5 2045 BUILD ALTERNATIVES ANALYSIS

Several criteria were developed to evaluate the interchange alternatives discussed in more detail below. The lane configurations at all study intersections are based on the geometrics as shown in the conceptual designs and on **Figure 8-2**.

8.5.1 Measures of Effectiveness Evaluation

Each advanced alternative was evaluated in respect to various MOEs. Project stakeholders selected the MOEs, which include property impacts, environmental resources, traffic operations, access control, safety/geometry, constructability, expandability, and cost.

The SAT representatives reviewed the traffic operations analysis results and constructability of each alternatives at the SAT meeting on December 11, 2017. Analysis results are presented below, along with a summary of comments received at the SAT meeting.

The SAT meeting raised two major points of concern for the Exit 71 interchange: property impacts at the northbound ramp terminal intersection and heavy vehicle operations. With the initial alternative concepts, access to several properties in the northeast quadrant of the northbound ramp terminal intersection would be affected. It was also stated that the Folded Diamond concept was undesirable for heavy vehicle operations, and several area businesses use Exit 71 with semi-trucks and trailers daily.

The following sections describe how the interchange alternatives performed for the MOEs. **Table 8-4** presents an evaluation matrix for Exit 71 summarizing the MOEs for each alternative.

8.5.2 Property Impacts

ROW required for the seven alternatives was compared based on the footprint needed to construct each alternative.

- **Standard Diamond (Signalized).** The Standard Diamond Interchange is expected to require 6.41 acres of additional ROW to construct. This additional ROW is necessary to construct the interchange ramps.
- **Compressed Diamond (Signalized).** The Compressed Diamond Interchange is expected to have no ROW impacts to construct.
- **Folded Diamond (Signalized)**. The Folded Diamond Interchange is expected to require 10.53 acres of additional ROW to construct. Most ROW impacts are in the southeast quadrant of the interchange of the I-29 northbound loop on-ramp. Other additional ROW is necessary to construct the southbound I-29 off- and on-ramps.
- **Single Point (I-29 Under/I-29 Over).** Both Single Point Interchanges (I-29 Under and I-29 over) are expected to have no ROW impacts to construct.
- **Diverging Diamond.** The DDI is expected to require 0.77 acre of additional ROW to construct. The additional ROW is necessary to construct the northbound I-29 off-ramp.
- **Tight Diamond.** The TDI is expected to have no ROW impacts to construct.

8.5.3 Control of Access

Access management principles have been reviewed and incorporated into the alternative concepts when feasible. *Chapter 13 – Interchanges* and *Chapter 17 – Access Management* from the *SDDOT Road*

Design Manual provided guidelines for commercial access requirements onto highways and county roads. SDDOT designates the Exit 71 interchange as Interstate Access Classification. 273rd Street has a Rural Access Classification.

Per SDDOT policy, the minimum control of access for a reconstructed or an existing interchange is 300 feet from the edge of the nearest through lane of the roadway. This is the minimum distance that driveways should be located from the interchange ramp terminals. For developed areas with multiple drives, consolidation of drives is recommended.

Along 273rd Street/CR 110, there is currently one area where an access point to the roadway is located closer to the interchange ramp terminals than recommended by SDDOT policy. This location is on the south side of 273rd Street/CR 110 at Parkland Drive approximately 120 feet west of the southbound ramp terminal. Other locations that may be affected by the alternatives include Ironworks Avenue and Kenworth Place along the north side of 273rd Street/CR 110 east of the northbound ramp terminal. Access points are located approximately 480 feet and 820 feet east of the current interchange, respectively. This type of access spacing degrades progression on the street and introduces conflict points, thereby increasing the potential for crashes.

Access management variations (or options) for each alternative were developed throughout the study process and were discussed with the project stakeholders. The following access management modifications are the result of stakeholder participation and are recommended to promote safety and improve traffic operations. For any of the alternatives, access management principles should be followed, including:

- Close access points that are within 300 feet spacing from ramp terminals, including the following locations:
    - 273rd Street/CR 110 with Parkland Drive
    - 273rd Street/CR 110 with Ironworks Avenue
- Consolidate Ironworks Avenue and Kenworth Place access into one location and realign access to Ironworks Avenue.

Figure 8-3 through **Figure 8-8** for each alterative identify locations where access should be closed and where access points should be consolidated. Recommended access control for each alternative is as follows:

- **No Build.** Maintain existing access locations.
- **Standard Diamond (Signalized).** Close access to Parkland Drive and Ironworks Avenue. Realign and consolidate access for Ironworks Avenue with Kenworth Place.
- **Compressed Diamond (Signalized).** Close access to Parkland Drive.
- **Folded Diamond (Signalized).** Close access to Parkland Drive and consolidate Ironworks Avenue with the southbound ramp terminal.
- **Single Point (I-29 Under/I-29 Over).** Close access to Parkland Drive.
- **Diverging Diamond.** Close access to Parkland Drive and Ironworks Avenue. Realign and consolidate access for Ironworks Avenue with Kenworth Place.
- **Tight Diamond**. Close access to Parkland Drive.

8.5.4 Traffic Operations

Figure 8-2 shows the lane geometry, traffic control, and LOS for 2045 traffic conditions for all design alternatives for Exit 71.

- **No-Build.** With the current interchange configuration, the stop-controlled southbound approach of the southbound ramp terminal is anticipated to operate at LOS F in both the AM and PM peak hours under 2045 traffic conditions. The stop-controlled northbound approach of the northbound ramp terminal is anticipated to operate at LOS D in both the AM and PM peak hours under 2045 traffic conditions.
- **Standard Diamond (Signalized)**. With signalization and the addition of auxiliary left-turn lanes at both ramp terminals, acceptable traffic operations (LOS C or better) are achieved under 2045 traffic conditions. The southbound ramp terminal is expected to operate at LOS B in both the AM and PM peak hours in 2045. The northbound ramp terminal is expected to operate at LOS A in both the AM and PM peak hours.
- **Compressed Diamond (Signalized).** Operations similar to those of the Standard Diamond Interchange are anticipated. The signalized southbound ramp terminal is expected to operate at LOS B in both the AM and PM peak hours in 2045. The northbound ramp terminal is expected to operate at LOS A in both the AM and PM peak hours.
- **Folded Diamond (Signalized)**. The signalized southbound ramp terminal is expected to operate at LOS C in the AM peak hour and LOS B in the PM peak hour in 2045. The northbound ramp terminal is expected to operate at LOS A in both the AM and PM peak hours.
- **Single Point (I-29 Under/I-29 Over).** Both Single Point Interchanges (I-29 Under and I-29 over) are expected to have similar traffic operations. The single signalized intersection is anticipated to operate at LOS C in the AM peak hour and LOS B in the PM peak hour. With the addition of a westbound auxiliary right-turn lane, operations are improved to LOS B in both peak periods under 2045 traffic conditions.
- **Diverging Diamond**. The signalized southbound ramp terminal is anticipated to operate at LOS A in both the AM and PM peak hours. The signalized northbound ramp terminal is anticipated to operate at LOS C in both the AM and PM peak hours in 2045. With the addition of a westbound auxiliary right-turn lane at the northbound ramp terminal, operations are improved to LOS A in both peak periods under 2045 traffic conditions.
- **Tight Diamond.** With signalization and the addition of auxiliary left-turn lanes at both ramps terminals, acceptable traffic operations (LOS C or better) are achieved under 2045 traffic conditions. The southbound ramp terminal is expected to operate at LOS C in both the AM and PM peak hours in 2045. The northbound ramp terminal is expected to operate at LOS A in both the AM and PM peak hours.

8.5.5 Safety/Geometry

The HSM predictive method was used to anticipate the number of crashes for the Advanced interchange alternatives, including the No-Build alternative. The No-Build Option model was used as a baseline for the existing configuration and compared to the other design alternatives. **Table 8-2** summarizes the results of the predictive crash analysis completed for each alternative. **Appendix F** provides a memorandum with a more detailed description of the analysis.

Table 8-2. Crash Prediction Summary – Exit 71

Exit 71 Interchange Alternatives	Future Predicted Crashes (2045-2049)	Change in Crashes (+/-)
No Build (1)	48.7	-
Standard Diamond (1)	45.7	-3.0
Compressed Diamond (1)(2)	44.3	-4.4
Folded Diamond (1)	47.5	-1.2
Single Point (3)	40.8	-7.9
Diverging Diamond (4)	37.0	-11.7

(1) Ramp terminal intersections analyzed as unsignalized intersections.
(2) A Crash Modification Factor (CMF) of 0.69 was applied to Modified Diamond entrance speed change crashes to account for the increase in acceleration distance in these alternatives. This CMF depends on the acceleration distance and is consistent with HSM 15-6.
(3) A CMF of 0.63 was applied to the 2045 existing traditional diamond ramp terminal intersection crashes. This CMF is consistent with HDR's *I-29 Exit 77 (41st Street) Interchange Modification Justification Report*.
(4) A CMF of 0.52 was applied to the 2045 existing traditional diamond ramp terminal intersection crashes. This CMF is based on MoDOT's "Safety Evaluation of Diverging Diamond Interchanges in Missouri."

- **No Build.** With the current interchange configuration, it is estimated that over the 5-year future period 48.7 crashes would be anticipated.
- **Standard Diamond (Signalized).** With the Standard Diamond Interchange configuration, it is estimated that over the 5-year future period 45.7 crashes would be anticipated. This is a reduction of 3.0 crashes over the analysis period compared to the No-Build.
- **Compressed Diamond (Signalized)**. With the Compressed Diamond Interchange configuration, it is estimated that over the 5-year future period 44.3 crashes would be anticipated. This is a reduction of 4.4 crashes over the analysis period compared to the No-Build.
- **Folded Diamond (Signalized).** With the Folded Diamond Interchange configuration, it is estimated that over the 5-year future period 47.5 crashes would be anticipated. This is a reduction of 1.2 crashes over the analysis period compared to the No-Build.
- **Single Point (I-29 Under/I-29 Over).** With both Single Point Interchange configurations (I-29 Under and I-29 Over), it is estimated that over the 5-year future period 40.8 crashes would be anticipated. This is a reduction of 7.9 crashes over the analysis period compared to the No-Build.
- **Diverging Diamond.** With the DDI configuration, it is estimated that over the 5-year future period 37.0 crashes would be anticipated. This is a reduction of 11.7 crashes over the analysis period compared to the No-Build.
- **Tight Diamond.** The TDI was not advanced for crash prediction analysis.

8.5.6 Constructability

Construction phasing associated with the proposed alternatives is an important consideration in the evaluation process. With limited crossings of I-29, the ability to keep 273rd Street/CR 110 open during construction is critical to the community, agriculture, and area businesses. In addition, access to I-29 via the interchange ramps is also critical to accommodate the heavy traffic at this location.

- **No Build.** Use existing structure until the end of its serviceable life.

- **Standard Diamond (Signalized).** The Standard Diamond Interchange bridge will have a three-lane cross section and could be constructed off-alignment to the south of the existing bridge. This would maintain access across I-29 during construction using the existing structure.
- **Compressed Diamond (Signalized).** The Compressed Diamond Interchange bridge will have three-lane cross section and could be constructed off-alignment to the south of the existing bridge. This would maintain access across I-29 during construction using the existing structure.
- **Folded Diamond (Signalized).** The Folded Diamond Interchange bridge will have a three-lane cross section and could be constructed off-alignment to the south of the existing bridge. This would maintain access across I-29 during construction using the existing structure.
- **Single Point (I-29 Under/I-29 Over).** The Single Point Interchange (I-29 Under) bridge would be a large structure with a three-lane cross section, plus medians and an additional area for the interchange ramps. Due to the size of the structure and the interchange configuration, construction off-alignment would not be feasible and would require the closure of the 273rd Street/CR 110 crossing during construction.

  The **Single Point Interchange (I-29 Over)** would require two new structures, one for northbound and one for southbound I-29 mainline. Due to the size of the structures and the impacts on the grades on I-29, constructing off-alignment may be difficult and may require closure with the initial larger structures. This may also require lane closures and crossovers on I-29 during construction.

- **Diverging Diamond.** The DDI bridge will have a two-lane cross section with a center median and could be constructed off-alignment to the south of the existing bridge. This would maintain access across I-29 during construction using the existing structure.
- **Tight Diamond.** The TDI bridge would be a larger structure with a required four-lane cross section. Due to the size of the structure, constructing off alignment may be difficult and may require closure of the crossing with the initial larger structure.

8.5.7 Expandability

The base assumption for Exit 71 was that one through lane would be provided in both the eastbound and westbound directions on the crossroad (273rd Street / CR 110) to accommodate 2045 traffic volumes. Because the Exit 71 interchange is on the fringe of the Sioux Falls metropolitan area, an expandability analysis was conducted to determine how far into the future the interchange could operate until the LOS C/D threshold was met. The expandability analysis revealed that the northbound ramp terminal intersection was the critical of the two at the interchange.

- **No Build.** The current interchange configuration is expected to operate at LOS F by 2030. The existing interchange has substandard sight distance at the ramp terminal intersections (looking toward the crossroad structure) and has necessitated a 25 mph speed limit. The crossroad structure was built in the late 1950s and has reached the end of its service life. The current interchange and bridge need to be reconstructed.
- **Standard Diamond (Signalized).** The Standard Diamond Interchange configuration could be expanded to meet future traffic growth by adding lanes outside of the crossroad structure. The expandability analysis revealed that the northbound ramp terminal intersection would reach the LOS C/D threshold between 2085 and 2090.

- **Compressed Diamond (Signalized).** The Compressed Diamond Interchange configuration could be expanded to meet future traffic growth by adding lanes outside of the crossroad structure. The expandability analysis revealed that the northbound ramp terminal intersection would reach the LOS C/D threshold between 2085 and 2090.
- **Folded Diamond (Signalized).** The Folded Diamond Interchange configuration could be expanded to meet future traffic growth by adding lanes outside the crossroad structure. The expandability analysis revealed that the northbound ramp terminal intersection would reach the LOS C/D threshold between 2060 and 2065.
- **Single Point (I-29 Under/I-29 Over)**. Both Single Point Interchange configurations (I-29 Under and I-29 Over) would require a larger structure at the time of initial construction to meet future traffic growth. The expandability analysis revealed that the northbound ramp terminal intersection would reach the LOS C/D threshold between 2055 and 2060. Adding a westbound right-turn lane would extend the life of this configuration to between the years of 2085 and 2090.
- **Diverging Diamond.** The DDI configuration would require a larger structure at the time of initial construction to meet future traffic growth. The expandability analysis revealed that the northbound ramp terminal intersection would reach the LOS C/D threshold between 2055 and 2060. Adding a westbound right-turn lane would extend the life of this configuration to between the years of 2085 and 2090.
- **Tight Diamond.** The TDI was not advanced for the expandability analysis.

8.5.8 Construction Cost

Total project costs associated with the construction of the proposed Exit 71 interchange improvements are estimated to range from $18.96 million for the Compressed Diamond alternative to $27.33 million for the Single Point (I-29 Over) alternative. **Table 8-3** summarizes the major cost items for each alternative. These amounts consist of the reconstruction of the Exit 71 interchange and ramps and reflect all items shown on the concept sketches in **Figure 8-3** through **Figure 8-8**. **Appendix G** contains detailed quantity breakdowns.

Table 8-3. Cost Estimate Summary – Exit 71

Item	Standard Diamond (Signalized)	Compressed Diamond (Signalized)	Folded Diamond (Signalized)
Construction Costs	$13,707,223	$13,168,808	$14,171,751
Contingencies (20%)	$2,741,445	$2,633,762	$2,834,350
Engineering Services (12%/10%)	$1,644,867	$1,896,308	$1,700,610
Construction Engineering (8%)	$1,315,893	$1,264,206	$1,360,488
ROW (Ag/Residential)	$55,500	-	$649,500
ROW (Commercial/Industrial)	$384,000	-	$108,000
Total Project Costs	**$19,848,928**	**$18,963,084**	**$20,824,699**
Item	**Single Point with I-29 Under**	**Single Point with I-29 Over**	**Diverging Diamond**
Construction Costs	$17,037,815	$19,299,235	$15,039,897
Contingencies (20%)	$3,407,563	$3,859,847	$3,007,979
Engineering Services (12%/10%)	$2,044,538	$2,315,908	$1,804,788
Construction Engineering (8%)	$1,635,630	$1,852,727	$1,443,830
ROW (Ag/Residential)	-	-	$21,000
ROW (Commercial/Industrial)	-	-	$80,000
Total Project Costs	**$24,125,546**	**$27,327,717**	**$21,397,494**

Table 8-4. Exit 71 Interchange Alternatives Evaluation Matrix

Evaluation Factors	No-Build	Standard Diamond	Compressed Diamond	Folded Diamond	Single Point I-29 Under	Single Point I-29 Over	Diverging Diamond	Tight Diamond
Property Impacts								
Right-of-Way Acquisition (Acres)	-	6.41	0.00	10.53	0.00	0.00	0.77	0.00
Environmental Resources								
Address Purpose and Need	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
HazMat Sites	-	NE quadrant	None	None	None	None	NE quadrant	None
Floodzone	-	NE & NW quadrants	NE & NW quadrants	NW quadrant	Minimal – NW quadrant	Minimal – NW quadrant	NW & SW quadrants	Minimal – NW quadrant
Wetlands / WOUS	-	SW quadrant	SW quadrant	SW quadrant	Minor	Minor	SW quadrant	Minor
Traffic Operations								
Traffic Operations – 2045 Volumes	LOS F	LOS B or Better	LOS B or Better	LOS C or Better	LOS C or Better	LOS C or Better	LOS C or Better	LOS C or Better
Breakdown Year – LOS D or worse	2030	<2090*	<2090*	<2065	<2090*	<2090*	<2090*	<2080
Farm Equipment / Implements	Allows access	Allows access	Allows access	Allows access	Allows access	Allows access	Geometry not conducive	Allows access
Control of Access								
Access to Properties	-	Access closed to east	Access maintained	Access maintained	Access maintained	Access maintained	Access closed to east	Access maintained
Safety/Geometry								
Estimated Crashes Per Year	48.7	45.7	44.3	47.5	40.8	40.8	37.0	-
Driver Expectancy	Undesirable – short ramps	Desirable	Desirable	Undesirable – trucks	Desirable	Not preferred	New in SD	Desirable
Maintenance / Winter Operations	I-29 Under	I-29 Under	I-29 Under	I-29 Under	I-29 Over	Intersection on structure – potential for icing on I-29	I-29 Under	I-29 Under
Geometric Design	Substandard	80 MPH mainline design	80 MPH mainline design	80 MPH mainline design	80 MPH mainline design	80 MPH mainline design	80 MPH mainline design	80 MPH mainline design
Constructability								
Maintain Crossroad During Construction	-	Able to construct bridge off-alignment	Able to construct bridge off-alignment	Able to construct bridge off-alignment	Crossroad would need to be closed	May require closure with initial larger structure	Able to construct bridge off-alignment	May require closure with initial larger structure
Construction Cost	-	$16,448,668	$15,802,570	$17,006,101	$23,159,082	$20,445,378	$18,047,876	-
Expandability								
Ability to Meet Traffic Growth Over Time	No	Expandable	Expandable	Expandable	May require initial larger structure	May require initial larger structure	May require initial larger structure	May require initial larger structure

8.6 RECOMMENDED ALTERNATIVES

Based on the alternatives analysis results and discussions with the SAT, the following alternatives are recommended to be advanced forward once SDDOT initiates the IMJR and Environmental Study for Exit 71:

- Compressed Diamond
- Single Point Interchange (I-29 Under)
- Single Point Interchange (I-29 Over)

It was agreed at the concept review meeting that the alternatives may need some refinements in the IMJR / NEPA study.

8.6.1 Compressed Diamond (Signalized)

The Compressed Diamond would perform with operations similar to those of the Standard Diamond Interchange, with the benefit of a footprint that is similar to that of the existing interchange, requiring no new ROW to construct. The signalized southbound ramp terminal is expected to operate at LOS B in both the AM and PM peak hours in 2045. The northbound ramp terminal is expected to operate at LOS A in both the AM and PM peak hours and may not need signalization until after 2045. A reduction of 4.4 crashes over the analysis period compared to the No-Build is expected. The estimated construction cost of the Compressed Diamond alternative is $18.96 million.

8.6.2 Single Point (I-29 Under/I-29 Over)

The Single Point interchange would not require any new ROW to construct. The Single Point signalized intersection is anticipated to operate at LOS C in the AM peak hour and LOS B in the PM peak hour in 2045. With the addition of a westbound auxiliary right-turn lane, operations are improved to LOS B in both peak periods under 2045 traffic conditions. A reduction of 7.9 crashes over the analysis period compared to the No-Build is expected.

The estimated construction cost of the Single Point I-29 Under alternative is $24.12 million. The Single Point I-29 Over alternative is more expensive at $27.33 million (due to extensive grading on the I-29 mainline) to achieve SDDOT's preferred configuration with the signalized intersection at the lower level of the interchange.

9.0 EXIT 73 INTERCHANGE SOLUTIONS

9.1 IDENTIFICATION OF SOLUTIONS

The Exit 73 interchange was recently reconstructed from a Standard Diamond Interchange to a SPI in 2005. This study did not investigate the complete reconstruction of this interchange.

Figure 9-1 shows the lane geometry, traffic control, and LOS for 2045 traffic conditions for the No-Build alternative. Under 2045 Build without Highway 100 traffic conditions, the existing SPI configuration is anticipated to operate at LOS C in the AM peak hour and LOS E in the PM peak hour. With Highway 100 constructed, the existing SPI configuration is anticipated to operate at LOS D in the AM peak hour and LOS E in the PM peak hour. Under both traffic scenarios, acceptable traffic operations (LOS C or better in Urban areas) are not achieved.

At Exit 73, the analysis focuses on extending the life of the SPI with intersection improvements that achieve acceptable traffic operation under 2045 Build and 2045 Build with Highway 100 traffic conditions.

9.2 INTERSECTION IMPROVEMENTS DESCRIPTIONS

Two potential intersection improvement alternatives were developed to achieve acceptable traffic operations (LOS C or better) under 2045 Build and 2045 Build with Highway 100 traffic conditions.

9.2.1 Dual Southbound Right/Exclusive Westbound Right

The Dual Southbound Right/Exclusive Westbound Right alternative would include constructing an additional southbound right-turn lane to provide dual southbound right turns. This would require signalization of the dual turn lanes. In addition, an exclusive westbound right-turn lane is recommended. The taper for the turn lane should begin at Independence Avenue and extend west to the northbound I-29 on-ramp. The right-turn lane will yield at the on-ramp.

Figure 9-1 shows the lane geometry, traffic control, and LOS for 2045 traffic conditions for the Dual Southbound Right/Exclusive Westbound Right alternative. Under 2045 Build traffic conditions, with the dual southbound right-turn lanes and exclusive westbound right-turn lane, the SPI intersection is anticipated to operate at LOS C in both the AM and PM peak hours. With Highway 100 constructed, the improved intersection is anticipated to operate at LOS C in both the AM and PM peak hours.

9.2.2 Free-Flow Southbound Right with Receiving Lane/Exclusive Westbound Right

The Free-Flow Southbound Right with Receiving Lane/Exclusive Westbound Right alternative would include modifying the existing southbound right-turn lane to become a free-flow turn lane. This would require an additional westbound receiving lane on 273rd Street that would extend approximately 800 feet to a future access point on the north side of the roadway. In addition, an exclusive westbound right-turn lane is recommended. The taper for the turn lane should begin at Independence Avenue and extend west to the northbound I-29 on-ramp. The right-turn lane will yield at the on-ramp. **Figure 9-2** shows the conceptual design for the Free-Flow Southbound Right with Receiving Lane/Exclusive Westbound Right.

Figure 9-1 shows the lane geometry, traffic control, and LOS for 2045 traffic conditions for the Free-Flow Southbound Right with Receiving Lane/Exclusive Westbound Right alternative. Under 2045 Build without Highway 100 traffic conditions, with the free-flow southbound right-turn lane and exclusive westbound right turn lane, the SPI intersection is anticipated to operate at LOS C in both the AM and PM peak hours. With Highway 100 constructed, the improved intersection is anticipated to operate at LOS C in both the AM and PM peak hours.

9.3 RECOMMENDED INTERSECTION IMPROVMENTS

9.3.1 2045 Build Traffic Conditions

Converting the southbound right-turn lane into a free-flow lane with a receiving lane is projected to reduce the overall intersection delay to a LOS C for the PM peak hour during the future year 2045. This configuration is projected to break down to LOS D during the PM peak hour before the year 2050.

Adding a second southbound right-turn lane, without adding any free-flow lanes, and adding an exclusive westbound right-turn lane is projected to reduce the overall intersection delay to only LOS D for the PM peak hour in future year 2045; however, adding a southbound right turn phase, that takes time from the lighter northbound left turn movement, would improve operations to a projected LOS C in future year 2045. This configuration is also projected to break down to LOS D during the PM peak hour before the year 2050.

9.3.2 2045 Build with Highway 100 Traffic Conditions

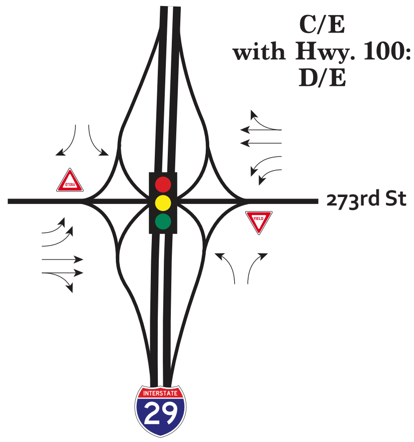
The interchange is projected to operate at LOS E during the PM peak and LOS D during the AM peak by 2045 with Highway 100 open. Converting the southbound right-turn lane into a free-flow lane with a receiving lane is projected to reduce the overall intersection delay to a LOS C for the AM and PM peak hours during the future year 2045. This configuration is projected to break down to LOS D during the AM peak hour before the year 2050.

Adding a second southbound right-turn lane, without adding any free-flow lanes, and adding an exclusive westbound right-turn lane is also projected to reduce the overall intersection delay to LOS C for the AM and PM peak hours in future year 2045. This configuration is projected to break down to LOS D during the PM peak hour before the year 2050.

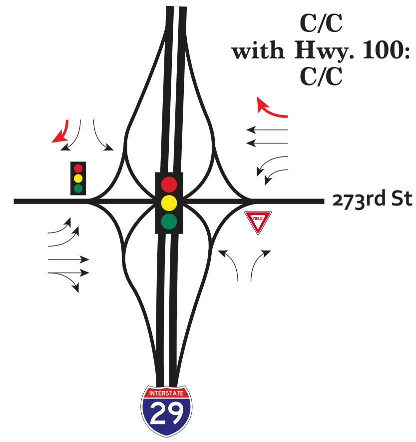
9.3.3 Recommendation

Due to safety concerns with dual right-turn lanes, SDDOT indicated a preference for the free-flow right-urn lane option. It is recommended that the intersection improvements in the Free-Flow Southbound Right with Receiving Lane/Exclusive Westbound Right alternative be implemented. Traffic operations at the Exit 73 SPI intersection should be monitored to determine when these improvements should be constructed.

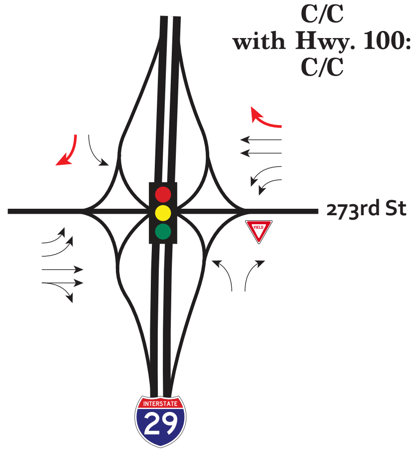
No Build



Dual Southbound Right
Exclusive Westbound Right



Free-Flow Southbound Right
with Receiving Lane
Exclusive Westbound Right



LEGEND

- X/X = AM/PM Peak Hour Signalized Level of Service
- x/x = AM/PM Peak Hour Unsignalized Level of Service
- = Traffic Signal
- STOP = Stop Sign
- = Yield Sign
- = Added Lane

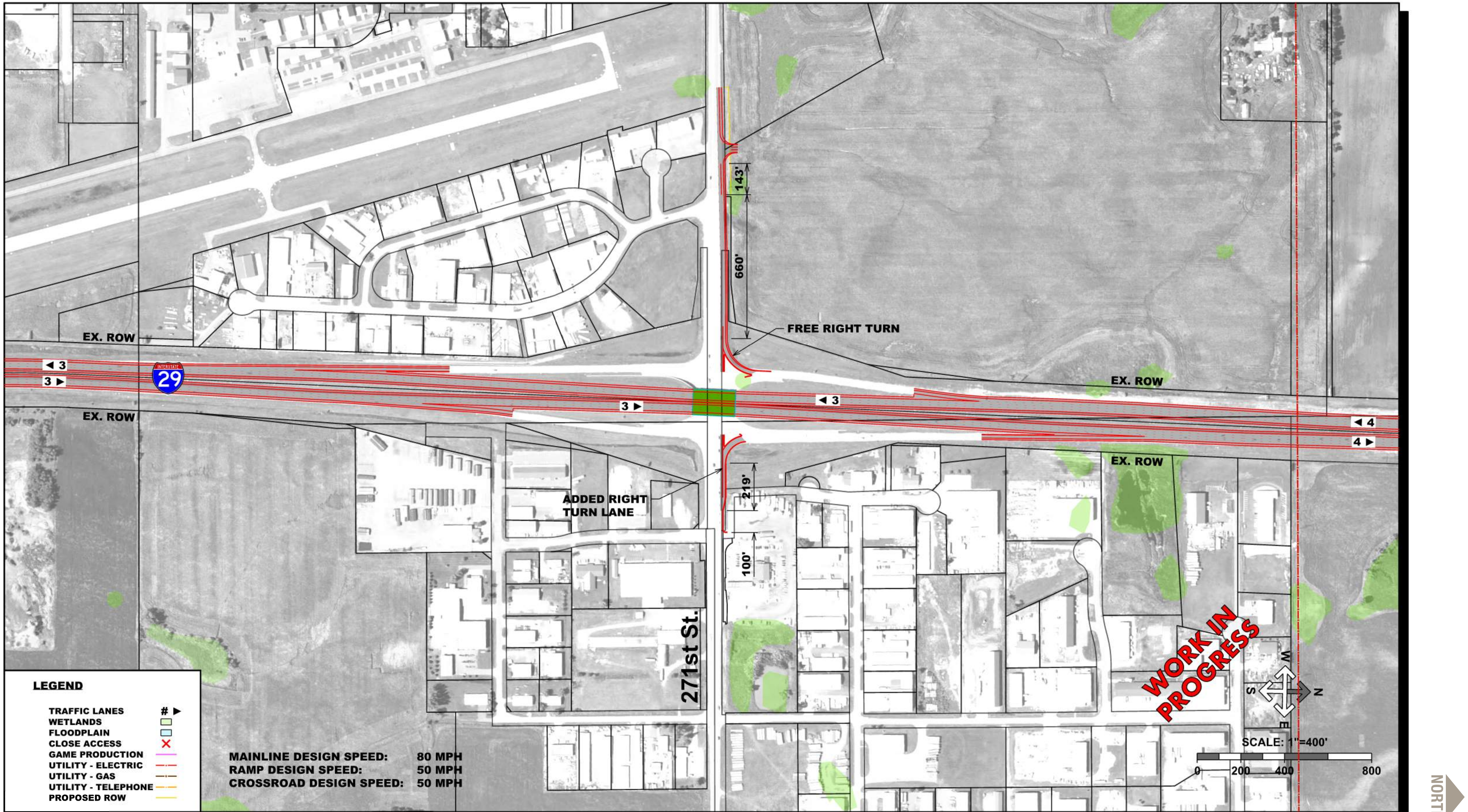
NORTH

Figure 9-1
Exit 73 Interchange Alternatives
2045 Traffic Operations

NOTE: Drawing Not to Scale

Figure 9-2

Exit 73 Right Turn Lanes



NOTE: Drawing Not to Scale

10.0 IMPLEMENTATION PLAN

10.1 RECOMMENDED IMPROVEMENTS

SDDOT plans a pavement replacement project on the I-29 Corridor between Exit 62 and Exit 73 in the next 10 years. The planning horizon year for the pavement replacement project is 2045. In this corridor study, several improvements have been identified on I-29 to accommodate 2045 traffic growth and include the pavement replacement, geometric improvements, and capacity upgrades.

10.1.1 I-29 Mainline and Merge/Diverge Area Improvements

Mainline and ramp needs on I-29 include:

- Mainline pavement replacement for the entire study area
- I-29 widening to six-lane urban section from Exit 68 to Exit 73
- I-29 widening to eight-lane urban section north of Exit 73
- Interchange ramp modifications at Exits 62, 68, and 73
- Complete interchange reconstruction at Exit 64 and Exit 71 (described in more detail in **Chapter 7** and **Chapter 8**)
- Potential need to remove I-29 crossroad structures at 278th Street and 281st Street

10.1.2 Exit 64 Interchange

The Exit 64 interchange should be completely reconstructed with the Compressed Diamond as the recommended interchange alternative.

The Compressed Diamond would perform with operations similar to those of the Standard Diamond Interchange, with the benefit of a footprint that is similar to that of the existing interchange, requiring less new ROW to construct and minimizing impacts on the game production area on the northeast quadrant of the interchange. The stop-controlled southbound and northbound ramp terminals are expected to operate at LOS B or better in both the AM and PM peak hours in 2045. A reduction of 2.3 crashes over the analysis period compared to the No-Build is expected. The estimated construction cost of the Compressed Diamond alternative is $15.09 million.

10.1.3 Exit 71 Interchange

The Exit 71 interchange should be completely reconstructed with either a Compressed Diamond or a Single Point as the recommended interchange alternative.

The Compressed Diamond would perform with operations similar to those of the Standard Diamond Interchange, with the benefit of a footprint that is similar to that of the existing interchange, requiring no new ROW to construct. The signalized southbound ramp terminal is expected to operate at LOS B in both the AM and PM peak hours in 2045. The northbound ramp terminal is expected to operate at LOS A in both the AM and PM peak hours and may not need signalization until after 2045. A reduction of 4.4 crashes over the analysis period compared to the No-Build is expected. The estimated construction cost of the Compressed Diamond alternative is $18.96 million.

The Single Point interchange would not require any new ROW to construct. The Single Point signalized intersection is anticipated to operate at LOS C in the AM peak hour and LOS B in the PM peak hour in 2045. With the addition of a westbound auxiliary right-turn lane, operations are improved to LOS B in both peak periods under 2045 traffic conditions. A reduction of 7.9 crashes over the analysis period compared to the No-Build is expected.

The estimated construction cost of the Single Point I-29 Under alternative is $24.12 million. The cost to construct the Single Point I-29 Over alternative is more expensive at $27.33 million (due to extensive grading on the I-29 mainline) to achieve SDDOT's preferred configuration with the interchange at grade.

10.1.4 Exit 73 Interchange

The Exit 73 interchange should be modified to provide:

- At the southbound off-ramp, a southbound free-flow right-turn lane with a receiving lane on 271st Street / CR 106. The receiving lane should extend from I-29 west to 471st Avenue / Sundowner Avenue.
- At the northbound on-ramp, a westbound exclusive right-turn lane should be provided on 271st Street / CR 106. The westbound right-turn lane would yield to oncoming traffic.
- Update traffic signal timing plans as needed.

10.2 IMPLEMENTATION PLAN

Figure 10-1 graphically identifies the proposed improvements on the I-29 Corridor from Exit 62 to Exit 73. A proposed implementation plan that identifies a series of steps for individual project construction is outlined below.

10.2.1 Step 1: by Year 2020

- Construct ramp improvements at Exit 73.
- Update traffic signal timing plans.

10.2.2 Step 2: Year 2030

- Complete reconstruction of the Exit 71 Interchange.
  - Recommended interchange type is either Single Point or Compressed Diamond. Exit 71 interchange reconstruction effort should be identified approximately 5 to 10 years before construction, at which time the NEPA environmental evaluation and IMJR process would formalize a preferred alternative and provide the basis for agency clearance, upon which the design and construction process would proceed.
  - **Implementation Strategy*:*** Build 273rd Street / CR 110 crossroad structure off-alignment to the south to maintain traffic during construction.
  - **Implementation Strategy:** Build 273rd Street / CR 110 crossroad structure one year before Mainline I-29 and temporary ramp closure during construction.

10.2.3 Step 3: Year 2031

- Construct Southbound Mainline I-29 from Exit 73 to Exit 62.
  - I-29 widening to eight-lane urban section north of Exit 73; match lanes from 85th Street Interchange.
  - I-29 widening to six-lane urban section from Exit 73 to Exit 68.
  - I-29 Mainline pavement replacement to four-lane rural section from Exit 68 to Exit 62.
- Removal or reconstruction of I-29 crossroad structure at 281st Street.

- Removal or reconstruction of I-29 crossroad structure at 278th Street.

10.2.4 Step 4: 2032

- Construct Northbound Mainline I-29 from Exit 62 to Exit 73.
  - I-29 widening to eight-lane urban section north of Exit 73; carry lanes to 85th Street Interchange
  - I-29 widening to six-lane urban section from Exit 73 to Exit 68
  - I-29 Mainline pavement replacement to four-lane rural section from Exit 68 to Exit 62

10.2.5 Step 5: by 2045

- Complete reconstruction of Exit 64 Interchange.
  - Compressed Diamond is recommended configuration. Exit 71 interchange reconstruction effort should be identified approximately 5 to 10 years before construction, at which time the NEPA environmental evaluation and IMJR process would formalize a preferred alternative and provide a basis for agency clearance, upon which the design and construction process would proceed.
  - **Implementation Strategy*:*** Build 273rd Street / CR 110 crossroad structure off-alignment to the south to maintain traffic during construction.

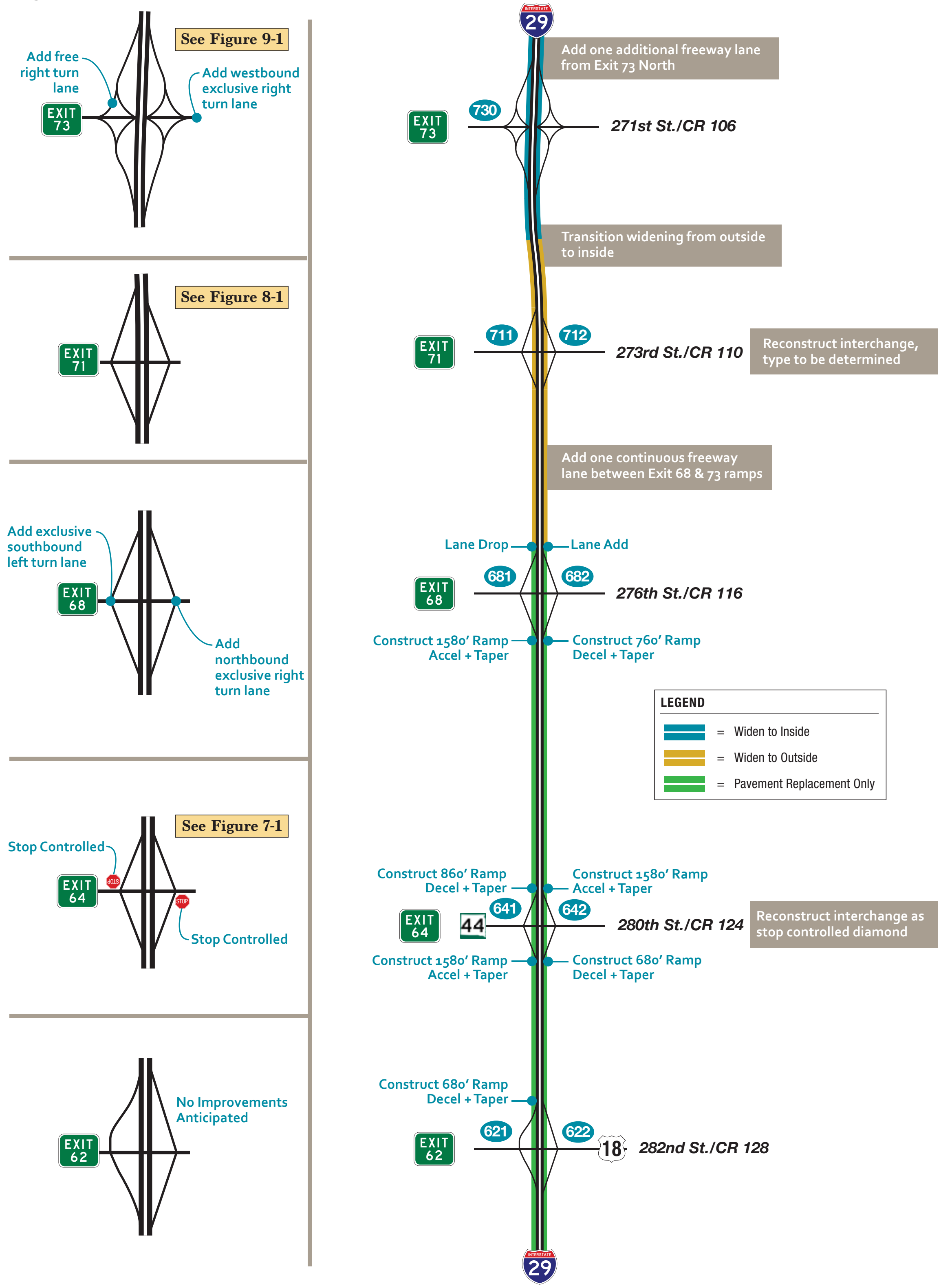


Figure 10-1

Implementation Summary

NOTE: Drawing Not to Scale

NORTH

APPENDICES

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