SOUTH DAKOTA DOT 2020 DECENNIAL INTERSTATE CORRIDOR STUDY

Phase I Report

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EXECUTIVE SUMMARY

The South Dakota Department of Transportation (SDDOT) retained a consultant team to conduct an analysis of the Interstate System, including mainline and interchange facilities. The study will help guide SDDOT investments in the Interstate System for the next decade and beyond and incorporates a broad range of infrastructure performance measures to arrive at a list of needs and solutions.

The study focuses on the following performance objectives:

- Traffic Operations – Ensure a Level of Service (LOS) of C (urban) and B (rural) or better throughout the Interstate System.
- Road Design – Identify interchanges and mainline not in compliance with current Interstate design standards.
- Structures – Identify bridges in need of replacement before 2035.

In addition to addressing these objectives, the study examines traffic safety conditions, travel reliability, truck parking patterns, median cable barrier installation needs, and blowing snow. The study also evaluates the ability of interchange ramp terminal intersections to accommodate Long Combination Vehicles (LCVs) and provides standard diamond control of access drawings for most interchanges.

The study develops feasible solutions to address the portions of the Interstate System that fail to meet current design standards and/or current and future traffic LOS expectations.

ES.1 Study Process

The study is conducted in three phases. This report documents Phase 1, which is an assessment of the entire Interstate System looking at traffic operations, road design, and traffic safety. The additional evaluations are also addressed in this report. Phase 1 will identify 12 existing and 4 future interchange locations to be analyzed further in Phase 2. Phase 2 will include the development of detailed geometric layouts of these interchanges and a review of the projected traffic operations associated with the interchange design. Phase 3 will provide a prioritized plan for implementing the improvements.

Figure ES-1 illustrates the progression of three phases and depicts the Phase 1 process. The Phase 1 evaluation includes all 678 centerline miles of Interstate mainline in South Dakota, 151 existing interchanges, and two new interchanges that are funded and in project development. A statewide inventory and analysis revealed a need for improvements at 28 deficient interchanges, widening of 33 miles of Interstate triggered by traffic growth, and replacement of 13 structurally poor Interstate System bridges. The project team developed interchange solutions for consideration.

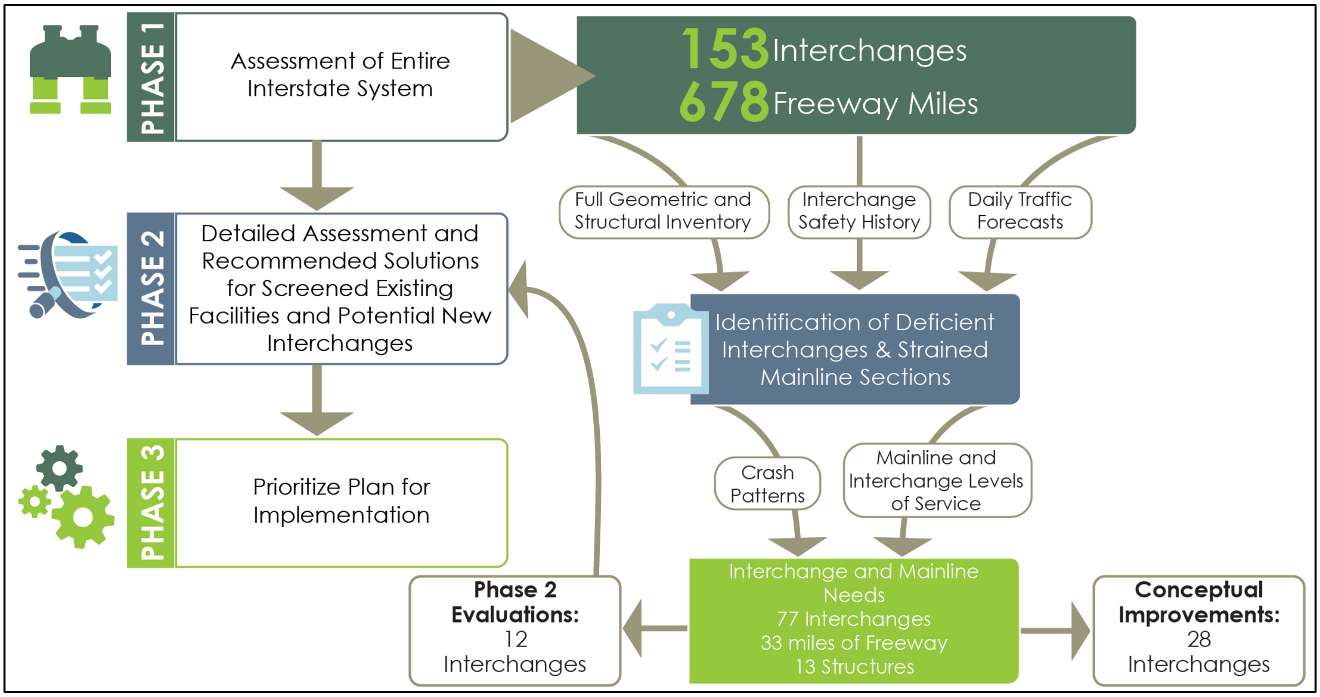


Figure ES-1. Phased Study Overview and Phase 1 Flow Diagram

The following information summarizes Phase 1 analyses and findings conducted for mainline, interchange, and systemwide components.

ES.2 Mainline Evaluations

The steps undertaken to evaluate the interstate mainline are outlined in **Table ES-1**.

Table ES-1. Mainline Phase 1 Analyses

Scope of Analysis	Area of Evaluation	Evaluation Actions	Outcome
678 centerline miles of mainline interstate	Road Design / Geometrics	Gather design information from design plans, field visits, and aerial imagery	Summary of mainline road design conditions relative to criteria with deficiencies noted
	Traffic Operations	• Traffic data collection • Segmentation of system • 2019 and 2050 AM/PM peak volumes • Basic freeway, merge / diverge and weaving section LOS analyses	Capacity improvement needs for 33 miles of interstate
	Traffic Safety	• Compilation of 5-year crash history • Development of Safety Performance Functions • Scoring of all mainline segments • Review of crash type patterns	List of segments with potential for crash reduction and associated crash patterns

Table ES-1. Mainline Phase I Analyses

Scope of Analysis	Area of Evaluation	Evaluation Actions	Outcome
	Median Cable Barrier (MCB) Needs	• Review of mainline crashes susceptible to mitigation using MCB • Development of criteria for consideration of MCB • Evaluation of system to identify needs and potential projects	Criteria for MCB installation, candidate project locations and benefit-cost calculations
	Travel Reliability	• Compile NPMRDS data for two years • Quantify travel reliability performance using simplified measures	Assessment of factors interrupting travel reliability, baseline for performance

Mainline Findings

Mainline road design deficiencies are scattered throughout the system but are rarely severe in nature. Within the paved surface, most lane and shoulder widths meet standards with the exception of some urbanized segments. Posted speeds have been increased along the interstate in recent years, causing some horizontal curves along I-29 and I-90 to exceed maximum degrees of curvature. Outside the paved surface, the most common deficiencies are steep inslopes and clear zones below minimum width. Mainline road design deficiencies typically do not warrant immediate correction but should be reviewed at the time of pavement replacement or other major mainline improvements.

Year 2019 and 2050 basic freeway, ramp merge / diverge, and weaving section LOS analyses indicate that approximately 96 percent of mainline sections meet SDDOT criteria through the Year 2050. Deficient urban segments are located in both Rapid City and Sioux Falls, and rural deficient segments are proximate to more developed areas.

More than 11,300 crashes occurred on mainline interstate segments between 2014 and 2018. This crash history was used to develop characteristic Safety Performance Functions for urban and rural interstate segments that allow a systemwide assessment of locations with a high crash reduction potential. Segment rankings incorporating accident frequency and severity indicate opportunities for improvement in urban and rural contexts. Rural opportunities include I-29 north of Sioux Falls and I-90 outside Sturgis. Segments of I-29 and I-229 in Sioux Falls top the urban list, followed by I-90 segments through Spearfish, Rapid City, and Sturgis.

An evaluation of median barrier warrants and related needs across the South Dakota Interstate System was performed. Rigid barriers are warranted in areas with high volumes and narrow medians, cable barriers are warranted in areas with medium volumes and median widths plus supporting crash history, and no median barriers are recommended in areas with low volumes and wide medians. Median cable barriers were recommended in various locations along I-29, I-90, and I-229, particularly in urban areas.

Blowing snow routinely causes safety concerns along the Interstate System. Needs have been reviewed based on SDDOT input and crash history. A total of 14 areas of concern along I-29 and I-90 have been identified as having a high potential for further consideration. These locations will be further evaluated to reach a shortlist of five locations for more detailed evaluation.

Travel reliability measures for South Dakota interstates have been extracted from the National Performance Management Research Data Set (NPMRDS). Travel reliability is a measure that captures the effects of non-recurring congestion on travel times. The Interstate System is shown to provide a high degree of travel time reliability, though interruptions occur due to weather, crashes, and work zone activity. The analysis indicates that 99.8 percent of interstate person miles traveled in South Dakota are reliable. Weather is the most significant contributor to travel time exceedances, followed by crashes.

ES.3 Interchange Evaluations

The steps undertaken to evaluate the interstate interchanges are outlined in **Table ES-2**.

Table ES-2. Interchange Phase I Analyses

Scope of Analysis	Area of Evaluation	Evaluation Actions	Outcome
151 Interchanges (153 in 2050)	Road Design / Geometrics	Gather design information from design plans, field visits, and aerial imagery	Tabulation of interchange design performance, identification of deficient conditions
	Intersection Traffic Operations	• Traffic volume data collection and volume estimation • Selection of interchanges for LOS analysis (87 locations exceeding 1,000 vehicles per day) • 2019 and 2050 AM / PM peak hour volumes • Intersection LOS analyses	Summary of LOS performance, noting locations not meeting SDDOT minimum LOS criteria, capacity improvements for 41 interchanges
	Traffic Safety	• Crash rates per traffic volume for all interchanges, weighted by severity • Assignment of score to each interchange accounting for types and locations • Ranking of interchange for safety review based on score	Detailed safety review of 31 higher-scoring interchanges and recommended improvements with potential to reduce crashes
	LCV Turning Movements	Approximate design assessment of ability of each interchange to accommodate turning LCVs	List of locations needing upgrades to accommodate LCVs
	Standard Control of Access	Apply SDDOT standard diamond footprint to all interchanges to assess control of access distances needed along crossroads	Drawings on aerials depicting control of access dimensions

Interchange Findings

Compliance with road design criteria varied from interchange to interchange. Within the paved surface of interchange ramps, the most common deficiency is related to pavement width, often evident from narrow right shoulder or lane widths. Outside the pavement, ramp inslope and clear zone minimums are not always met. Most geometric deficiencies do not warrant immediate correction and can be reviewed at the time of pavement replacement along ramps. Common cross street geometric deficiencies included crest vertical curvature, control of access, and intersection sight distance limitations, which can be addressed at the time of interchange reconstruction.

Intersection LOS analyses were performed for 87 interchanges currently exceeding or projected to exceed 1,000 vehicles per day along the cross street. Analyses of Year 2019 conditions indicate that at least one ramp terminal at 20 interchanges operates at a LOS below the SDDOT goal LOS values during either the AM or PM peak hour. By Year 2050, the number of interchanges where at least one ramp terminal operates below the SDDOT LOS goal is projected to increase to 41.

Compilation of five years of interchange crash history weighted by severity and organized by interchange type and location identified 31 interchanges showing elevated crash experience correlating to potential for crash reduction. Of these, 21 locations were advanced for further analyses. A range of potential safety treatments were identified for consideration, including traffic control modifications, pavement surfacing treatments, signing adjustments, and traffic calming measures.

The ability of interchange ramp terminals to accommodate LCVs was tested by assessing the wheel tracking of a Rocky Mountain Double (WB-28D [WB-92D]) vehicle through intersections. Several deficient interchanges were identified through this means, and those at junctions with official LCV-eligible routes are identified as interchange improvement needs. Deficiencies were noted at five out of the eight interstate interchanges with LCV routes.

A depiction of the control of access needed to accommodate a standard diamond at most interchanges was developed to provide the SDDOT with a tool for understanding the footprint area associated with each interchange. Drawings are provided in **Appendix F**.

The project team compiled the various technical analyses at each interchange to determine which interchanges have the greatest needs for further improvements. This effort included developing thresholds within each evaluation category and compiling those interchanges that met the thresholds into a systemwide list of needs. Interchanges were identified as having needs within the evaluation categories, and **Table ES-3** provides a summary of interchange needs.

Table ES-3. Interchange Needs

Exit	Location	Identified Needs
	I-29	
1	Dakota Dunes	Future Operations, Safety
2	North Sioux City	Existing and Future Operations
4	McCook Lake	Existing and Future Operations
15	Elk Point	Geometrics
26	Vermillion / Yankton	LCV Movements, Existing and Future Operations
38	Volin	Safety
47	Beresford / Irene	Future Operations
50	Centerville / Hudson	Geometrics
53	Viborg	Geometrics
56	Fairview	Geometrics
59	Davis	Bridge Clearance, Structural Condition
64	Worthing / Lennox	Future Operations
68	Lennox / Parker	Existing and Future Operations
71	Harrisburg/Tea	Future Operations
73	Tea	Future Operations
74	85th Street	Future Operations
77	41st Street	Existing and Future Operations, Safety
78	26th Street	Existing and Future Operations, Safety
79	12th Street	Safety
81	Russell Street	Safety
82	Benson Road	Future Operations
83	60th Street North	Safety
94	Baltic	Safety
98	Dell Rapids	Existing and Future Operations, Safety
109	Madison / Colman	Safety
133	Brookings / Huron	Future Operations, Safety
207	Summit / Aberdeen	Safety
	I-90	
10	North Avenue / Belle Fourche	Future Operations, LCV Movements, Safety
12	Jackson Boulevard	Geometrics, Future Operations
14	27th St / Spearfish Canyon	Future Operations
17	Lead / Deadwood	Future Operations
23	Whitewood	Future Operations
30	Lazelle Street / Deadwood-Lead	Geometrics
32	Junction Avenue	Future Operations

Table ES-3. Interchange Needs

Exit	Location	Identified Needs
44	Piedmont	Future Operations
46	Elk Creek Road	Existing and Future Operations
48	Stage Stop Canyon Road	Future Operations
52	Black Hawk / Peaceful Pines Road	Future Operations
55	Deadwood Avenue	Future Operations, Geometrics
57	I-190	Future Operations
58	Haines Avenue	Future Operations
59	Lacrosse Street	Geometrics, Future Operations, Safety
60	North Street	Future Operations
61	Elk Vale Road	Future Operations, Safety
63	Box Elder / Ellsworth AFB	Existing and Future Operations
67	Liberty Blvd / Ellsworth AFB	Existing and Future Operations
98	Wasta	Safety
112	Phillip / Pierre	Bridge Clearance, Structural condition
131	Interior / Badlands Loop	Bridge Clearance
191	Murdo	Bridge Clearance
296	White Lake	Safety
308	Plankinton	Structural condition
310	Stickney / Aberdeen	LCV Movements, Safety
319	Mount Vernon	Structure
330	Mitchell / Huron	Existing and Future Operations
332	Mitchell / Parkston	Safety
357	Bridgewater	Safety, Structural condition
364	Salem / Yankton	Safety
368	Canistota	Safety, Structural condition
374	Montrose	Safety
379	Humboldt / Madison	Safety
387	Hartford	Existing and Future Operations
390	SD38 / Hartford	Existing and Future Operations
395	Marion Road	Future Operations
399	Cliff Avenue	Future Operations
400	I-229	Future Operations
402	US Geological Survey / EROS	Future Operations
406	Brandon / Corson	Existing and Future Operations
410	Valley Springs / Garretson	Future Operations

Table ES-3. Interchange Needs

Exit	Location	Identified Needs
I-229		
1C	Louise Avenue	Future Operations, Safety
2	Western Avenue	Existing and Future Operations, Safety
3	Minnesota Avenue	Existing and Future Operations, Safety
4	Cliff Avenue	Existing and Future Operations, Safety
5	26th Street	Existing and Future Operations, Safety
6	10th Street	Existing and Future Operations, Safety
7	Rice Street	Future Operations, Safety
9	Benson Road	Existing and Future Operations

ES.4 Systemwide Evaluations

Several systemwide evaluations were also performed, as outlined in **Table ES-4**.

Table ES-4. Systemwide Phase I Analyses

Scope of Analysis	Area of Evaluation	Evaluation Actions	Outcome
Systemwide	Bridge Conditions	• List structures in poor condition • Note bridge clearance issues	List of structures in need of replacement or clearance improvement
	Truck Parking	• Document truck parking demand throughout system within ½ mile of interstate • Project future usage levels • Identify unauthorized use locations	Data showing parking sites and usage across the Interstate System and potential future truck parking enhancement needs
	Blowing Snow Analysis	• Identify candidate locations based on SDDOT input and safety analysis • Develop additional detail for select locations	List of candidate locations and additional design detail for five potential locations

The bridge evaluation examined the structures across the Interstate System. The current rating system classifies bridges as either Good, Fair, or Poor. Of the 604 bridges reviewed, 13 are classified as Poor, including structures on I-29, I-90, and I-229. Additionally, many bridges do not meet current geometric requirements, primarily vertical clearance requirements. Six structures that pass over the interstates are identified for future clearance improvements, reflecting two bridges along I-29 and four along I-90. Two structures (one along I-90 at Exit 112 and one along I-29 at Exit 59) are identified for both bridge condition and vertical clearance improvements.

A truck parking assessment has been performed to build the SDDOT's knowledge base of how large trucks are using available parking. This assessment will be provided in a separate report that is currently in progress.

ES.5 Summary of Improvements

The interchange needs outlined in **Table ES-4** were translated into potential solutions for the Interchange locations. **Table ES-5** lists the Phase 1 solutions depicted in more detail in **Appendix E**.

Table ES-5. Interchange Improvement Preliminary Solutions

Exit	Location	Proposed Solution(s)
		I-29
1	Dakota Dunes	1. Signalize southbound ramp terminal 2. Construct offset Single Point Urban Interchange on east side
2	North Sioux City	Signalize southbound ramp terminal
4	McCook Lake	Improve existing diamond interchange with wider structure
15	Elk Point	Shoulder and inslope improvements for all ramps
26	Vermillion / Yankton	Minor ramp widening and signalize northbound ramp terminal
38	Volin	Reconstruct interchange including new bridge
47	Beresford / Irene	Signalize southbound ramp terminal and add turn lanes
50	Centerville / Hudson	Reconstruct interchange including new bridge
53	Viborg	Reconstruct interchange including new bridge
56	Fairview	Reconstruct interchange including new bridge
59	Davis	Replace structure
78	26th Street	Add flashing yellow arrow with signal timing changes and improve signing & striping
81	Russell Street	Signal timing changes
109	Madison / Colman	Widen structure and improve lighting

Table ES-5. Interchange Improvement Preliminary Solutions

Exit	Location	Proposed Solution(s)
		I-90
10	North Avenue / Belle Fourche	1. Signalized diamond interchange with geometric improvements 2. Offset single point urban interchange
12	Jackson Boulevard	1. All-way stop at north ramp terminal intersection 2. Half diverging diamond interchange 3. Geometric improvements (only)
17	Lead / Deadwood	1. Signalized diamond interchange with added turn lanes 2. Diverging diamond interchange
30	Lazelle St / Deadwood-Lead	Reconstruct interchange including new bridge
55	Deadwood Avenue	Realign eastbound off-ramp; minor improvements for others
112	Philip / Pierre	1. Replace existing poor structure in kind 2. Consolidate movements to south structure; retain loop ramp 3. Consolidate movements to south structure; add left turn on ramp
296	White Lake	Reconstruct interchange including new bridge
308	Plankinton	Replace structure
310	Stickney / Aberdeen	Reconstruct interchange including new bridge
319	Mount Vernon	Replace structure
330	Mitchell / Huron	Signalize ramp terminals, add turn lanes, improve ramp geometry
357	Bridgewater	Reconstruct interchange including new bridge
368	Canistota	Reconstruct interchange including new bridge
374	Montrose	Reconstruct interchange including new bridge

ES.6 Phase 2 Evaluation

Phase 2 of the ICS is scoped to include a more detailed evaluation of improvements to 12 existing interchange locations and 4 potential new interchanges. The interchanges currently planned to be evaluated in Phase 2 are shown in **Table ES-6**. The selection process for Phase 2 interchanges considered several elements, including other study efforts, identified deficiencies and ratings from the Phase 1 effort, and identified potential new interchanges scoped for Phase 2 evaluation.

Table ES-6 Phase 2 Interchanges

Interchange	Reason for Inclusion in Phase 2
I-29	
I-29 Exit 1 – Dakota Dunes	Identified deficiencies
I-29 Exit 2 – North Sioux City	Identified deficiencies
I-29 Exit 4 – McCook Lake	Identified deficiencies
I-29 Exit 26 – Vermillion / Yankton	Identified deficiencies
I-29 Exit 59 – Davis	Identified deficiencies
I-29 Exit 86 – Renner / Crooks	Pressure from growth potential
I-90	
I-90 Exit 10 – North Avenue / Belle Fourche	Identified deficiencies
I-90 Exit 16 – Rainbow Road, Spearfish	Potential new interchange
I-90 Exit 17 – Lead / Deadwood	Identified deficiencies
I-90 Exit 48 – Stage Stop Canyon Road	Interstate corridor planning considerations
I-90 Exit 55 – Deadwood Avenue	Identified deficiencies
I-90 Exit 110 – Wall / Badlands Loop	Pressure from growth potential
I-90 Exit 112 – Philip / Pierre	Identified deficiencies
I-90 Exit 264 – Chamberlain	Potential new interchange
I-90 Exit 404 – Brandon	Potential new interchange
I-90 Exit 408 – Brandon	Potential new interchange

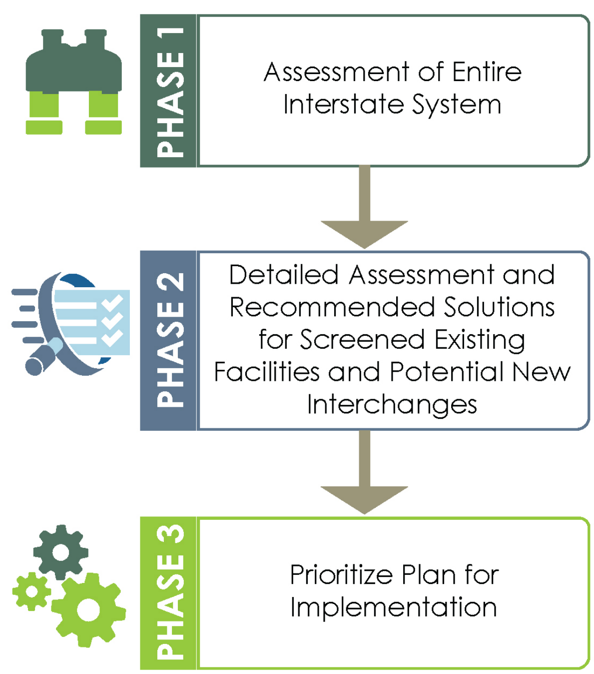
1. INTRODUCTION

The South Dakota Department of Transportation (SDDOT) and the Study Advisory Team (SAT) are conducting a study that focuses on ensuring a mainline Level of Service (LOS) of B or better throughout the rural Interstate System and LOS C or better throughout the urban Interstate System and identifying areas not in compliance with current Interstate design standards. The study is expected to:

- Complete a traffic LOS analysis for both existing and future conditions on the Interstate System mainline and interchanges.
- Identify locations on the Interstate System not in compliance with current design standards under both the current and predicted future traffic conditions.
- Identify bridges on the Interstate System that will need bridge replacement before 2035.
- Develop feasible solutions to address the portions of the Interstate System that fail to meet current design standards and/or traffic LOS expectations under both the current and predicted future traffic conditions.
- Create a final product for use by the SDDOT to guide the Department in the implementation of recommended improvements.

This report is the third Decennial Interstate Corridor Study (ICS) and builds on both the Year 2000 and the Year 2010 study efforts, in addition to incorporating several new evaluations.

1.1 Phase 1 Study Description



As in previous editions, the 2020 Decennial ICS will be conducted in three phases. Phase 1, which is summarized in this report, includes a review of the roadway geometrics, crash history, and traffic operations. In this edition, access management, the ability of interchanges to accommodate long combination vehicles (LCVs), and mainline operational reliability have been added to the Phase 1 evaluation. A screening process uses these categories to identify a shortened list of interchanges in need of improvements and/or reconstruction. Conceptual alternative sketches of these potential changes are included.

The result of Phase 1 will be a combination of 12 existing and 4 future interchange locations to be analyzed further in Phase 2. Phase 2 will include the development of detailed geometric layouts of these interchanges and a review of the projected traffic operations associated with the interchange design. The next phase will also include an assessment of the impact of those alternatives on the operating conditions of the mainline and connecting arterial streets. Phase 3 will provide a prioritized plan for implementing the improvements.

1.1.1 Early Interstate Corridor Studies

The initial statewide interstate study was completed in the Year 1989. The scope was limited to several key interchanges and interstate segments of concern across the state.

1.1.2 2000 SDDOT Interstate Corridor Study

The first formal Decennial ICS was completed in the Year 2000. The Phase 1 portion of that First Edition studied a grouping of 60 existing and 4 proposed interchanges and 148 miles of mainline freeway segments along Interstates 29, 90, and 229. The Phase 2 portion of the study provided a more detailed look at 22 existing interchanges and 4 new interchanges. Recommended improvements included items such as the number of lanes required, intersection channelization, and traffic control improvements. A capacity analysis to determine the LOS on the mainline, ramps, and connecting arterials was also conducted.

1.1.3 2010 SDDOT Interstate Corridor Study

The second Decennial ICS was completed in the Year 2010. The Phase 1 portion of the Second Edition studied a grouping of 126 existing and 4 proposed interchanges and all 678 centerline miles of mainline freeway segments along I-29, I-90, I-190, and I-229. The Phase 2 portion of the study provided a more detailed look at 10 existing interchanges and 5 new interchanges. Again, recommended improvements included items such as the number of lanes required, intersection channelization, and traffic control improvements. A capacity analysis to determine the LOS on the mainline, ramps, and connecting arterials was also conducted, and mainline improvements were presented in the Phase 1 report.

1.1.4 Scope of the 2020 SDDOT Interstate Corridor Study

This effort represents an expansion over both the first and second editions of the Decennial ICS. The Phase 1 portion of this 2020 Edition examines 153 interchanges and 4 proposed interchanges, plus all 678 centerline miles of mainline freeway along I-29, I-90, I-190, and I-229. It should be noted that there are 151 interstate interchanges today (2019). The I-29 Exit 74 interchange and the I-29 Exit 130 interchange are currently being designed, with plans for construction in the next two to three years. Since construction is eminent, both interchanges have been included as baseline interchanges in future analyses, resulting in a total of 153 interchanges in the future year.

The Phase 2 portion of the study is expected to evaluate 12 existing and 4 proposed interchanges. Like the Year 2000 and Year 2010 studies, this effort will reflect existing and future traffic operations through LOS in accordance with the Highway Capacity Manual[1] (HCM) and will compare mainline and interchange design with current SDDOT design guidance. It will consider interchange safety using weighted rates (as was done in the 2010 study) but will expand the mainline safety evaluation to use levels of service of safety (LOSS), in accordance with the Highway Safety Manual (HSM). Bridge condition and structural clearance will also be evaluated explicitly, instead of being a design consideration as was done in 2010. The 2020 study will also add evaluations to address the following questions:

- Long Combination Vehicles (LCVs) – Can interchanges (particularly on LCV routes) accommodate these vehicles?
- Reliability – What elements of the network affect mainline interstate travel reliability, and can changes be made to address identified concerns?
- Truck Parking – Where are trucks parking, and can unauthorized parking be better managed to keep trucks from parking on shoulders?
- Blowing Snow Analysis – Where is snow blowing and drifting across the interstates and causing safety concerns, and what mitigations can be applied?
- Median Cable Barrier Analysis – Where are median cable barriers (MCBs) appropriate across the interstates?

1.2 Improvements Constructed Since the 2010 Study

The inclusion of an interchange in the 2010 Phase 2 report did not automatically indicate that it was a high priority location for reconstruction. That report provided guidance and information to SDDOT and local governments for developing those priorities.

Since the time of the 2010 ICS, several existing interchanges have been reconstructed or are currently under construction:

- I-29 Exit 62 – Canton (2016)
- I-29 Exit 75 – I-229 (2017)
- I-29 Exit 98 – Dell Rapids (2018)
- I-90 Exit 14 – 27th Street / Spearfish Canyon (2018)
- I-90 Exit 44 – Piedmont (2019)
- I-90 Exit 399 – Cliff Avenue (2013)
- I-90 Exit 402 – Veterans Parkway (2019)
- I-190 Exit 1C – Silver Street (2017)
- I-229 Exit 5 – 26th Street (currently under construction)

[1] *Highway Capacity Manual*, 6th Edition, Transportation Research Board of the National Academies, Washington, DC, 2016.

1.3 Recent and Ongoing Interchange Studies

Since the completion of the 2010 Decennial ICS, several existing and proposed interchange locations have been studied in greater detail. Many of these studies led to the ultimate construction of new or reconfigured interchanges identified in the previous section, which are not included with this list. Other locations have much more recent or even current studies underway as a part of the planning and design process associated with future interstate access modifications. Since these detailed studies have been conducted or are underway, these existing and potential new interchange locations were not included in this Phase 1 or Phase 2 analysis.

1.3.1 Recent Interchange Studies

- I-29 Exit 62 (US 18 / Canton) – September 2014
- I-29 Exit 74 (85th Street, Sioux Falls / Tea) – October 2018
- I-29 Exit 75 / I-229 Exit 1A / 1B (System Interchange, Sioux Falls) – February 2014
- I-29 Exit 77 (41st Street, Sioux Falls) – October 2017
- I-29 Exit 83 Feasibility Study (60th Street N, Sioux Falls) – April 2017
- I-29 Exit 98 (Dell Rapids) – February 2015
- I-90 Exit 14 (27th Street / Spearfish Canyon) – October 2013
- I-90 Exit 37 (Pleasant Valley Road) – December 2019
- I-90 Exit 44 (Piedmont) – February 2014
- I-90 Exit 46 (Elk Creek Road) Interchange Study – April 2016
- I-90 Exit 59 (La Crosse Street, Rapid City) – April 2014
- I-90 Exit 399 (Cliff Street, Sioux Falls) – February 2011
- I-90 Exit 402 (US Geological Survey / EROS) – June 2014
- I-90 Exit 406 (Corson / Brandon) – September 2018
- I-190 Exit 1C (Silver Street, Rapid City) – December 2011
- I-229 Exit 5 (26th Street, Sioux Falls) – October 2014
- I-229 Exit 9 (Benson Road, Sioux Falls) – January 2019

1.3.2 Recent Corridor Studies

- I-29 Exit 62 to Exit 73 Corridor Study – July 2018
- I-29 Exit 73 to Exit 77 Corridor Study – December 2010
- I-29 Exit 77 Crossroad Corridor Study – June 2012
- US14A Corridor Study (Spearfish, including I-90 Exit 14) – March 2012
- I-90 Exit 32 to Exit 40 Corridor Study – October 2019

- I-90 Exit 61 to Exit 67 Corridor Study – December 2017
- I-190 Corridor / Silver Street Interchange Study, Rapid City – June 2012
- I-229 Major Investment Corridor Study – June 2017

1.3.3 Ongoing Studies

- I-29 Exit 130 (20th Street South, Brookings) Interchange Justification Report
- I-90 Exit 34 – Black Hills National Cemetery Interstate Modification Justification Report (IMJR)
- I-90 Exit 63 (Box Elder / Ellsworth AFB) Interchange Study
- I-90 Exit 387 (Hartford) Interchange Study (IMJR approved)
- I-229 Exit 3 (Minnesota Ave) and Exit 4 (Cliff Ave) Interchange Study
- I-229 Exit 6 (10th Street) IMJR
- I-229 Exit 9 (Benson Rd) Interchange Study (IMJR approved)

1.4 Phase 1 Study Process

As noted above, the 2020 Decennial ICS will evaluate South Dakota's Interstate System. The interstates are shown by region and Mileage Reference Marker (MRM) in **Table 1-1**.

Table 1-1. South Dakota Interstate System(I

SDDOT Region	Interstate	Boundaries
Rapid City	I-90	MRM 0.00 to MRM 130.30
	I-190	MRM 0.00 to MRM 2.03
Pierre	I-90	MRM 130.30 to MRM 251.00
Mitchell	I-29	MRM 0.00 to MRM 124.00
	I-90	MRM 251.00 to MRM 412.52
	I-229	MRM 0.00 to MRM 10.83
Aberdeen	I-29	MRM 124.00 to MRM 252.65

As shown on **Figure 1-1**, the Phase 1 evaluation includes the entire interstate mainline (678 centerline miles), plus 153 interchanges. A statewide inventory was performed to document current geometric conditions, bridge conditions, traffic safety, and traffic volumes. These data were used to develop deficiency lists for existing conditions, including locations where improvements are supported due to design, LCV, bridge, and safety shortcomings. The traffic volumes were used to evaluate existing traffic operations, and forecasts were developed to allow the evaluation of future year (2050) operational deficiencies.

This deficiency screening effort led to the identification of needs throughout the system. The broad list of deficiencies in each evaluation category was narrowed to the most concerning issues, resulting in a total of 77 interchanges with needs. A detailed review of the mainline segments and interchanges that exhibited shortfalls in each category was performed, and locations that exhibited the potential for improvement were further evaluated. Based on this effort, 28 interchanges and 33 miles of mainline interstate have been identified for improvements. The project team has identified potential solutions for each of the 28 interchanges. The remaining Phase 1 report sections provide further details regarding this process.

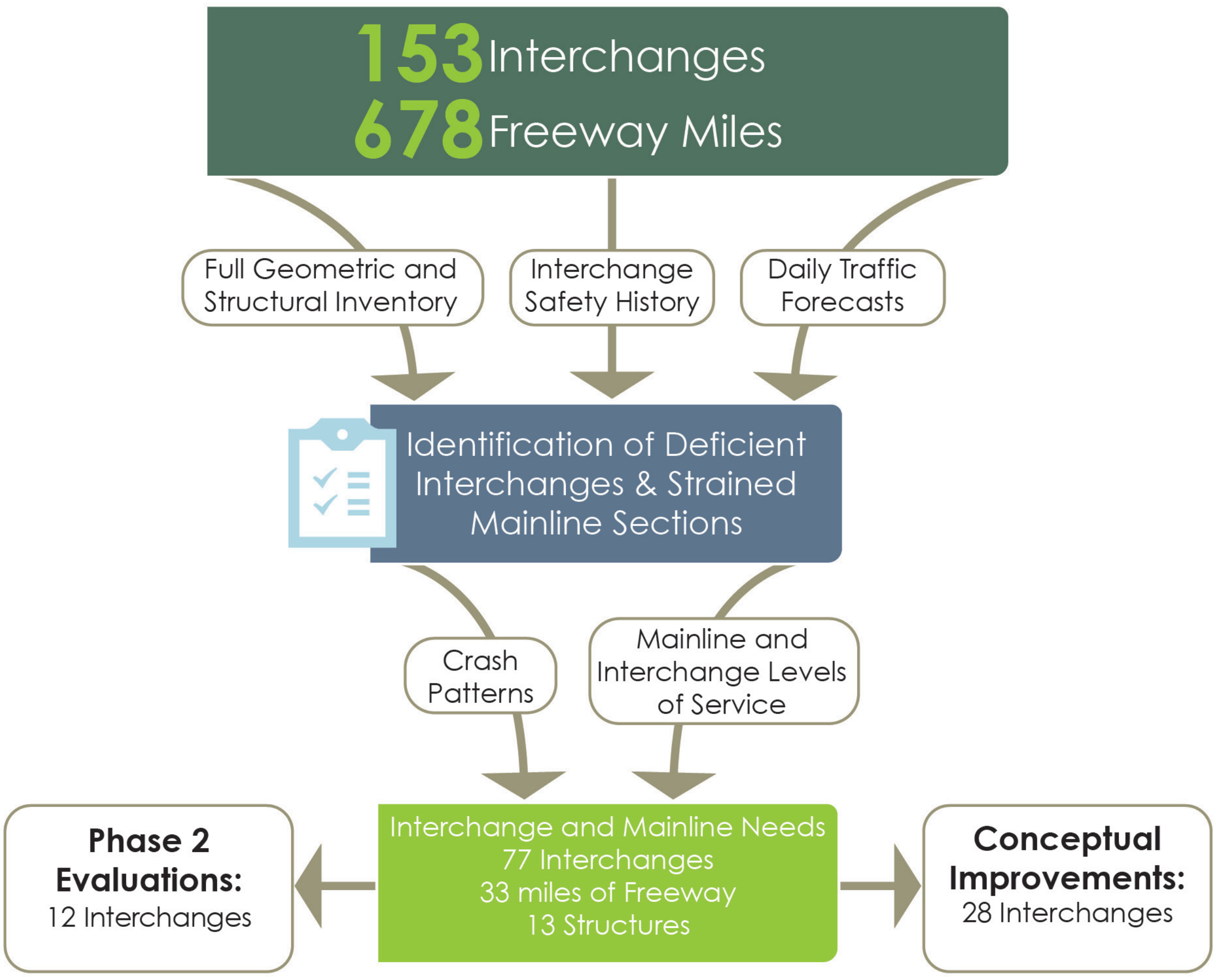


Figure 1-1. Study Process Flowchart

2. IDENTIFICATION OF DEFICIENCIES

The first step in the Phase 1 ICS study process is to identify the deficiencies. In the 2020 study, this consisted of geometric evaluations (mainline and interchange), an LCV evaluation (interchange only), bridge evaluations (mainline and interchanges), safety evaluations (mainline and interchange), and traffic operations (mainline and interchanges, plus reliability). Supplemental evaluations of truck parking (mainline and interchanges), median cable barrier needs (mainline), and blowing snow (mainline and interchanges) were also conducted and are documented here.

The framework above was defined in the project's Methods and Assumptions (M&A) document. The M&A document (required by SDDOT) lists assumptions for the study area, analysis methodologies, and other key study inputs. Approved by the Federal Highway Administration (FHWA) and the Study Advisory Team (SAT), it can be found in **Appendix A**.

2.1 Geometrics

The geometric evaluations examined the mainline freeways (I-29, I-90, I-190, and I-229) and each of the 153 interchanges (151 existing, plus I-29 Exit 74 and I-29 Exit 130). Generally, each criterion is based on the appropriate state or national standard for the facility type being evaluated. Most design criteria thresholds are based on the most recent SDDOT Design Guidelines. Details are provided below.

2.1.1 Interstate Mainline Geometric Conditions

The interstate mainline segments along I-29, I-90, I-190, and I-229 were reviewed using information collected in the 2010 South Dakota Decennial Interstate Corridor Study. The mainline analysis was grouped into the same segments as shown in the 2010 data. Several changes have occurred since 2010:

- Some interstate segments have been reconstructed since the previous study was conducted. It is assumed that these segments meet current design standards and as such were not included in this review.
- The posted speed limits on the interstate mainline have been increased since the 2010 study. The criteria checks were performed based on the higher speed limits and related design speeds.
- An evaluation of existing median widths was added to the 2020 process. In addition to identifying median width deficiencies, this analysis supports the Median Cable Barrier evaluation.

The analyses performed on the mainline are intended to be a high-level review of the mainline segments. Criteria checks are performed over larger sections of MRM ranges. It is possible an issue may occur at one location but likely does not indicate there is an issue for the entire MRM range. The geometric summary in **Table 2-1** identifies data sources, minimum design criteria, and observed trends the design team noted along the corridors.

Table 2-1. Interstate Mainline Geometric Guidance Summary

Geometric Category	Source of Data	Thresholds for Determining Need/Deficiency	Trends Found in the Evaluation
Traffic Lane Width	• 2010 Study Data • Interchange Plans	12’	MRM ranges analyzed meet minimum criteria on all Interstate Systems.
Number of Lanes	• 2010 Study Data • Google Earth	Not applicable for geometric analysis	Not applicable for geometric design criteria analysis.
Right Shoulder Width	• 2010 Study Data • Interchange Plans	10’	I-29/I-190: Substandard shoulder widths likely due to urban environment or older design criteria.
Left Shoulder Width	• 2010 Study Data • Interchange Plans	2 Lanes: 4’ 3 Lanes: 10’	I-29/I-190: Substandard shoulder widths likely due to urban environment.
Minimum Paved Section Width (per direction)	• 2010 Study Data • Interchange Plans	2 Lanes: 38’ 3 Lanes: 50’	I-29/I-190: Minimum paved section widths per direction are substandard in locations and the shoulder widths are substandard.
Minimum Median Width	• Google Earth • Interchange Plans	22’	I-90: Substandard median widths located at Missouri River. Concrete barrier in place. I-229/I-190: Substandard median widths likely due to urban environment.
Posted Speed (PS) Limit	SDDOT GIS Dataset	Not applicable for geometric analysis	Posted speed limits have increased since the 2010 study.
Design Speed (DS)	SDDOT GIS Dataset	PS 55mph: DS 60mph PS 65mph: DS 70mph PS 70mph: DS 75mph PS 75mph: DS 80mph PS 80mph: DS 80mph	Design speed assumptions have been increased to address current posted speeds.
Maximum Degree of Curve	• 2010 Study Data • Horizontal Design Speed SDDOT GIS Dataset	DS 65 mph: 3°27' DS 70 mph: 2°48' DS 75 mph: 2°17' DS 80 mph: 1°15'	I-29/I-90: Most curves meet updated design speeds, though some deficiencies are found due to increased posted limits. I-229: Substandard maximum degree of curvature likely due to urban environment.
Minimum Clear Zone from Edge of Travel Lane	• 2010 Study Data • Interchange Plans	30’	Generally, clear zone issues are on the outside of the roadway section at spot locations and do not indicate an issue for the entire MRM range.
Inslope	• 2010 Study Data • Interchange Plans	6:1	Slope ranges from 3:1 to 5:1 were substandard. Consider improvement with design upgrades.
Superelevation (e_{max})	• 2010 Study Data • Interchange Plans	6%	I-90: MRM 53-60 indicated substandard superelevation. All remaining MRM ranges meet standards.
Minimum Bridge Section Width	• 2010 Study Data • Interchange Plans	38’	Refer to additional structural substandard criteria.
Maximum Longitudinal Grade	• 2010 Study Data • Vertical Design Speed SDDOT GIS Dataset	3% Level Terrain 4% Rolling Terrain	I-90: Substandard MRM ranges are east of Missouri River bridge; likely required to gain clearance over the river. Other substandard section likely due to urban environment and proximity to Black Hills National Forest.

Table 2-1. Interstate Mainline Geometric Guidance Summary

Geometric Category	Source of Data	Thresholds for Determining Need/Deficiency	Trends Found in the Evaluation
Minimum Longitudinal Grade	• 2010 Study Data • Vertical Design Speed SDDOT GIS Dataset	0.30%	Additional analysis required to determine if grades flatter than 0.30% are causing any ponding issues.

This review of existing geometric features on the mainline indicated that the most common geometric element that does not meet standards for new construction on the interstate is the inslope. Typically, the inslope ranges from a slope of 3:1 to 5:1, versus the desirable slope of 6:1. These slopes likely correspond to design criteria at the time of construction and do not warrant immediate correction. However, additional analysis should be completed at the time of improvements to determine if slopes could be flattened.

Another common element is clear zones that are less than the desirable 30'. Often this geometric element can be found along several continuous segments of the interstate, likely corresponding with the design criteria at the time of construction. On I-29, the team noted that generally the clear zone issues are on the outside of the highway, not the median. A large percentage of major obstacles are protected by short runs of cable rail. However, there are still areas where slopes steeper than 6:1 exist and drop off to box culverts or pipes just shy of the 30-foot clear zone from edge of travelway. Most of I-90 is within rural areas, and clear zone issues are not as prevalent as on I-29. The clear zone issues generally appear on the outside of the highway and are a result of steep inslopes.

The 2010 study determined the longitudinal grade has minimal consequence to the Interstate System. This statement was verified in the 2020 ICS using vertical design speed Geographic Information System (GIS) data provided by SDDOT. The grades do not appear to create stopping sight distance issues. The minimum longitudinal grade is substandard in many locations, but due to the high-level nature of this review, it was not noted if these minimum grades have caused any ponding issues.

The high-speed nature of the Interstate System did not provide a safe environment to field measure lane widths, median widths, or shoulder widths. Therefore, these criteria relied heavily on the 2010 data and Google Earth desktop review.

Table 2-2 presents a summary of the mainline geometric deficiencies in each segment, along with deficiencies noted in the highlighted cells. Detailed information for each segment is presented in **Appendix B**. It should be noted that the geometric elements identified in **Table 2-2** do not typically warrant immediate correction but should be reviewed at the time of pavement replacement or other significant improvement projects on the interstate mainline.

Table 2-2. Mainline Geometric Conditions

Segment	Geometric Performance														Achieved?
	Lane Width	Right Shoulder Width	Left Shoulder Width	Minimum Paved Section Width	Minimum Median Width	Posted Speed Limit	Maximum Degree of Curve	Minimum Clear Zone	Inslope	Superelevation Rate	Minimum Bridge Section Width	Minimum Vertical Clearance	Maximum Longitudinal Grade	Minimum Longitudinal Grade	
I-29															
MRM 0–2	12'	10'	6'	40'	44'	65	3° 00'	< 30'	4:1		30'	16.17	1.38%	0.00%	Supports Impr.
MRM 2–4	12'	10'	6'	41'	44'	65	1° 00'	< 30'	4:1		41'	–	2.00%	0.25%	Supports Impr.
MRM 4–9	12'	8'	4'	36'	44'	80	0° 46'	< 30'	4:1	–	–	16.17	0.25%	0.00%	Supports Impr.
MRM 9–15	12'-13'	8'	4'	36'	44'	80	0° 26'	< 30'	4:1	–	–	16.25	0.20%	0.00%	Supports Impr.
MRM 15–18	12'	10'	4'	38'	50'	80	1° 30'	< 30'	4:1	–	–	16.58	0.87%	0.00%	Supports Impr.
MRM 18–26	12'	10'	6'	40'	50'	80	1° 30'	< 30'	4:1	–	40'	16.58	3.00%	0.00%	Supports Impr.
MRM 26–31	13'	10'	6'	42'	50'	80	1° 30'	< 30'	4:1	–	42'	16	1.33%	0.00%	Supports Impr.
MRM 31–38	12'	10'	6'	40'	50'	80	0° 03'	< 30'	4:1	–	–	16.42	3.00%	0.08%	Supports Impr.
MRM 38–42	12'	10'	6'	40'	50'	80	0° 06'	< 30'	4:1				1.34%	0.20%	Supports Impr.
MRM 42–47	12'	10'	6'	40'	50'	80	0° 06'	< 30'	4:1				1.96%	0.02%	Supports Impr.
MRM 47–50	12'	10'	6'	40'	50'	80	0° 10'	< 30'	4:1	–	–	17	2.68%	0.20%	Supports Impr.
MRM 50–53	12'	10'	6'	40'	44'	80	0° 15'	< 30'	4:1	–	–	15.75	0.81%	0.10%	Supports Impr.
MRM 53–56	12'	10'	6'	40'	44'	80	–	< 30'	4:1	–	–	18.08	1.92%	0.20%	Supports Impr.
MRM 56–59	12'	10'	6'	40'	44'	80	0° 01'	< 30'	4:1	–	40'	15.83	0.52%	0.02%	Supports Impr.
MRM 59–62	12'	10'	6'	40'	44'	80	0° 02'	< 30'	4:1	–	40'	15.67	0.60%	0.04%	Supports Impr.
MRM 62–64	12'	10'	6'	40'	44'	80	–	< 30'	4:1	–	-	14.75	0.59%	0.13%	Supports Impr.
MRM 64–68	12'	10'	6'	40'	44'	80	–	< 30'	4:1	–	30'	16.33	3.11%	0.00%	Supports Impr.
MRM 68–71	12'	10'	6'	40'	44'	80	0° 30'	< 30'	4:1	2.0%	–	16.5	1.15%	0.14%	Supports Impr.
MRM 71–73	12'	10'	6'	40'	44'	65	1° 00'	< 30'	4:1	2.8%	–	16.42	1.79%	0.09%	Supports Impr.

Table 2-2. Mainline Geometric Conditions

Segment	Geometric Performance: Lane Width	Right Shoulder Width	Left Shoulder Width	Minimum Paved Section Width	Minimum Median Width	Posted Speed Limit	Maximum Degree of Curve	Minimum Clear Zone	Inslope	Superelevation Rate	Minimum Bridge Section Width	Minimum Vertical Clearance	Maximum Longitudinal Grade	Minimum Longitudinal Grade	Achieved?
MRM 73–75	12'	10'	6'	40'	40'	65	1° 00'	< 30'	4:1	2.1%	–	16.92	2.58%	0.00%	Supports Impr.
MRM 75–77	12'	10'	6'	52'	40'	65	1° 30'	< 30'	4:1	4.2%	30'	16.25	3.00%	0.30%	Supports Impr.
MRM 77–78	12'	10'	6'	52'	40'	65	0° 15'	< 30'	4:1	-	-	16.33	0.35%	0.06%	Supports Impr.
MRM 78–79	12'	10'	10'	56'	38'	65	0° 15'	< 30'	6:1		68'		0.95%	0.05%	Supports Impr.
MRM 79–80	12'	10'	10'	56'	38'	65	0° 24'	< 30'	6:1		56'		2.55%	0.49%	Supports Impr.
MRM 80–81	12'	10'	10'	56'	44'	65	2° 00'	< 30'	6:1		56'		2.84%	0.76%	Supports Impr.
MRM 81–82	12'	10'	10'	56'	46'	65	2° 17'	< 30'	6:1	5.5%	56'		1.12%	0.50%	Supports Impr.
MRM 82–83	12'	10'	4'	52'	46'	65	0° 29'	< 30'	6:1	5.8%	56'		2.21%	0.89%	Supports Impr.
MRM 83–84	12'	10'	4'	52'	50'	65	0° 15'	< 30'	6:1	2.5%	38'		1.34%	0.12%	Supports Impr.
MRM 84–86	12'	10'	4'	38'	56'	65	0° 20'	< 30'	6:1		38'		2.71%	0.12%	Supports Impr.
MRM 86–94	12'	10'	4'	38'	56'	80	1° 00'	< 30'	4:1	2.8%	38'	15.67	2.83%	0.15%	Supports Impr.
MRM 94–98	12'	10'	4'	38'	56'	80	0° 06'	< 30'	4:1	–	38'	15.75	2.96%	0.21%	Supports Impr.
MRM 98–104	12'	10'	4'	38'	56'	80	1° 00'	< 30'	4:1	–	38'	15.67	2.60%	0.28%	Supports Impr.
MRM 104–109	12'	10'	4'	38'	56'	80	0° 12'	< 30'	4:1	–	30'	16.25	2.99%	0.12%	Supports Impr.
MRM 109–114	12'	10'	4'	38'	56'	80	0° 04'	< 30'	4:1	–	–	16.25	1.33%	0.05%	Supports Impr.
MRM 114–121	12'	10'	4'	38'	56'	80	0° 04'	< 30'	4:1	–	38'	16.92	1.54%	0.09%	Supports Impr.
MRM 121–127	12'	10'	4'	38'	56'	80	0° 14'	< 30'	4:1	–	30'	16.67	1.65%	0.15%	Supports Impr.
MRM 127–132	12'	10'	4'	38'	56'	80	0° 06'	< 30'	4:1	–	30'	15.92	1.85%	0.00%	Supports Impr.
MRM 132–133	12'	10'	4'	38'	56'	80	–	< 30'	4:1	–	30'	16.08	0.40%	0.20%	Supports Impr.
MRM 133–140	12'	10'	4'	38'	56'	80	–	< 30'	4:1	–	38'	15.75	1.27%	0.11%	Supports Impr.

Table 2-2. Mainline Geometric Conditions

Segment	Geometric Performance														Achieved?
	Lane Width	Right Shoulder Width	Left Shoulder Width	Minimum Paved Section Width	Minimum Median Width	Posted Speed Limit	Maximum Degree of Curve	Minimum Clear Zone	Inslope	Superelevation Rate	Minimum Bridge Section Width	Minimum Vertical Clearance	Maximum Longitudinal Grade	Minimum Longitudinal Grade	
MRM 140–150	12'	10'	4'	38'	56'	80	0° 30'	> 30	6:1	–	–	16.08	1.20%	0.09%	Supports Impr.
MRM 150–157	12'	10'	4'	38'	64'	80	1° 00'	> 30	6:1	2.1%			2.06%	0.10%	Supports Impr.
MRM 157–164	12'	10'	4'	38'	64'	80	0° 30'	> 30	6:1		38'		3.00%	0.20%	Supports Impr.
MRM 164–177	12'	10'	4'	38'	64'	80	–	> 30	6:1		38'		2.70%	0.10%	Supports Impr.
MRM 177–180	12'	10'	4'	38'	68'	80	–	> 30	6:1		38'		2.65%	0.17%	Supports Impr.
MRM 180–185	12'	10'	4'	38'	68'	80	–	> 30	6:1				2.15%	0.19%	Supports Impr.
MRM 185–193	12'	10'	4'	38'	68'	80	0° 03'	> 30	4:1		38'		1.89%	0.14%	Supports Impr.
MRM 193–201	12'	10'	4'	38'	70'	80	0° 30'	> 30	6:1		38'		2.16%	0.13%	Supports Impr.
MRM 201–207	12'	10'	4'	38'	72'	80	0° 04'	> 30	6:1		40'	15.25	1.75%	0.10%	Supports Impr.
MRM 207–213	12'	10'	4'	38'	72'	80	1° 00'	> 30	6:1	3.7%	–	17.25	2.18%	0.00%	Supports Impr.
MRM 213–224	12'	10'	4'	38'	72'	80	1° 00'	> 30	6:1	3.7%	40'	15.83	4.31%	0.10%	Supports Impr.
MRM 224–232	12'	10'	4'	38'	72'	80	0° 40'	> 30'	6:1	3.7%	–	16	1.50%	0.00%	Supports Impr.
MRM 232–242	12'	10'	4'	38'	72'	80	–	> 30	6:1	3.0%	–	15.83	1.39%	0.08%	Supports Impr.
MRM 242–246	12'	10'	4'	38'	72'	80	1° 00'	> 30'	6:1	3.5%	40'	–	1.00%	0.02%	Supports Impr.
MRM 246–ND	12'	10'	4'	38'	72'	80	1° 00'	> 30'	6:1	–	40'	16.08	2.00%	0.00%	Supports Impr.
I-90															
MRM 0–10	12'	10'	4'	38'	48'	75	3° 00'	> 30	6:1	5.7%	40'	–	2.07%	0.33%	Supports Impr.
MRM 10–14	12'	10'	4'	38'	48'	75	1° 30'	< 30	6:1	6.0%	38'	16	3.00%	0.30%	Supports Impr.
MRM 38–44	12'	10'	4'	38'	38'	75	1° 33'	> 30	6:1		–	17.33	4.85%	0.02%	Acceptable
MRM 44–53	12'	10'	4'	38'	36'	75	2° 15'	> 30	6:1	6.0%	–	15.83	4.00%	0.00%	Supports Impr.

Table 2-2. Mainline Geometric Conditions

Segment	Geometric Performance														Achieved?
	Lane Width	Right Shoulder Width	Left Shoulder Width	Minimum Paved Section Width	Minimum Median Width	Posted Speed Limit	Maximum Degree of Curve	Minimum Clear Zone	Inslope	Superelevation Rate	Minimum Bridge Section Width	Minimum Vertical Clearance	Maximum Longitudinal Grade	Minimum Longitudinal Grade	
MRM 53–64	12'	10'	6'	40'	44'	65	2° 30'	> 30	5:1	6.9%	30'	16.42	4.00%	0.00%	Acceptable
MRM 64–69	12'	10'	4'	38'	48'	65	0° 14'	> 30	5:1	6.0%	30'	16.5	2.43%	0.12%	Supports Impr.
MRM 69–76	12'	10'	4'	38'	48'	80	1° 30'	> 30	5:1		30'		3.00%	0.10%	Supports Impr.
MRM 76–95	12'	10'	6'	40'	48'	80	1° 30'	> 30	5:1	4.2%	30'	17.17	3.00%	0.31%	Supports Impr.
MRM 95–102	12'	10'	4'	38'	48'	80	1° 30'	> 30	5:1	5.0%	30'	18	4.00%	0.10%	Supports Impr.
MRM 102–112	12'	10'	4'	38'	56'	80	2° 15'	> 30	6:1	6.0%	38'	16	4.00%	0.10%	Supports Impr.
MRM 112–125	12'	10'	4'	38'	136'	80	2° 03'	> 30	6:1	5.7%	40'	17.08	1.80%	0.00%	Supports Impr.
MRM 125–133	12'	10'	4'	38'	36'	80	2° 00'	> 30	6:1		–	15.75	2.00%	0.00%	Supports Impr.
MRM 133–142	12'	10'	4'	38'	70'	80	–	> 30	6:1		38'		3.00%	0.15%	Acceptable
MRM 142–149	12'	10'	4'	38'	68'	80	–	> 30	5:1		-	–	3.00%	0.18%	Supports Impr.
MRM 149–159	12'	10'	4'	38'	54'	80	1° 00'	> 30	5:1		38'	16.58	2.97%	0.07%	Supports Impr.
MRM 159–165	12'	10'	4'	38'	58'	80	0° 30'	> 30	5:1	3.7%	38'	–	2.92%	0.00%	Supports Impr.
MRM 165–174	12'	10'	4'	38'	50'	80	0° 45'	> 30	5:1	2.7%	38'	–	2.54%	0.23%	Supports Impr.
MRM 174–182	12'	10'	4'	38'	56'	80	1° 00'	> 30	6:1	3.7%	38'	16.42	3.00%	0.10%	Supports Impr.
MRM 182–189	12'	10'	4'	38'	56'	80	0° 45'	> 30	6:1	3.0%	38'	–	3.00%	0.09%	Supports Impr.
MRM 189–198	12'	10'	4'	38'	72'	80	1° 00'	> 30	6:1	3.7%	-	15.5	3.00%	0.10%	Supports Impr.
MRM 198–206	12'	10'	4'	38'	68'	80	–	> 30	6:1	–	38'	–	2.21%	0.00%	Supports Impr.
MRM 206–213	12'	10'	4'	38'	68'	80	0° 06'	> 30	6:1		38'	17.17	3.00%	0.32%	Supports Impr.
MRM 213–219	12'	10'	4'	38'	68'	80	1° 00'	> 30	6:1	3.7%	38'	–	3.00%	0.10%	Supports Impr.
MRM 219–227	12'	10'	4'	38'	70'	80	1° 00'	> 30	6:1	3.7%	38'	–	2.11%	0.26%	Supports Impr.

Table 2-2. Mainline Geometric Conditions

Segment	Geometric Performance														Achieved?
	Lane Width	Right Shoulder Width	Left Shoulder Width	Minimum Paved Section Width	Minimum Median Width	Posted Speed Limit	Maximum Degree of Curve	Minimum Clear Zone	Inslope	Superelevation Rate	Minimum Bridge Section Width	Minimum Vertical Clearance	Maximum Longitudinal Grade	Minimum Longitudinal Grade	
MRM 227–236	12'	10'	4'	38'	66'	80	0° 45'	> 30	6:1	3.0%	38'	–	2.75%	0.00%	Supports Impr.
MRM 236–243	12'	10'	4'	38'	66'	80	0° 45'	> 30	6:1		38'	–	3.00%	0.67%	Acceptable
MRM 243–251	12'	10'	4'	38'	66'	80	1° 00'	> 30	6:1	3.1%	38'	–	1.00%	0.15%	Supports Impr.
MRM 251–260	12'	10'	4'	38'	68'	80	1° 00'	> 30	6:1		38'		3.95%	0.10%	Acceptable
MRM 260–263	12'	10'	4'	38'	10'	80	2° 00'	> 30	6:1	5.0%	38'	–	2.91%	0.10%	Supports Impr.
MRM 263–265	12'	10'	4'	38'	12'	80	1° 00'	> 30	6:1	3.7%	26'	15.92	5.50%	0.50%	Supports Impr.
MRM 265–272	12'	10'	4'	38'	48'	80	1° 00'	> 30	4:1	2.8%	–	16.17	1.15%	0.02%	Supports Impr.
MRM 272–284	12'	10'	4'	38'	48'	80	1° 00'	> 30	5:1	2.8%	30'	16.83	2.80%	0.11%	Supports Impr.
MRM 284–292	12'	10'	4'	38'	60'	80	0° 75'	< 30	3:1	-	38'	15.92	1.59%	0.14%	Supports Impr.
MRM 292–297	12'	10'	4'	38'	56'	80	1° 00'	> 30	4:1	2.8%	38'	15.92	1.05%	0.30%	Supports Impr.
MRM 297–306	12'	10'	4'	38'	56'	80	0° 45'	> 30	4:1		–		0.83%	0.00%	Supports Impr.
MRM 306–316	12'	10'	4'	38'	54'	80	1° 00'	> 30	4:1		–		0.45%	0.05%	Supports Impr.
MRM 316–325	12'	10'	4'	38'	50'	80	0° 14'	< 30	6:1	–	–	16	1.20%	0.00%	Supports Impr.
MRM 325–334	12'	10'	4'	38'	56'	80	0° 20'	< 30	3:1	–	30'	16.83	2.54%	0.15%	Supports Impr.
MRM 334–344	12'	10'	4'	38'	56'	80	0° 45'	> 30	4:1	–	38'	16.75	2.15%	0.00%	Supports Impr.
MRM 344–352	12'	10'	4'	38'	54'	80	0° 14'	> 30	4:1	–	38'	16.33	2.10%	0.02%	Supports Impr.
MRM 352–362	12'	10'	4'	38'	56'	80	0° 10'	< 30	3:1	–	38'	17.08	1.10%	0.02%	Supports Impr.
MRM 362–369	12'	10'	4'	38'	56'	80	0° 06'	< 30	3:1	4.0%	30'	16	1.68%	0.00%	Supports Impr.
MRM 369–377	12'	10'	4'	38'	56'	80	0° 06'	< 30	3:1	–	30'	15.75	3.00%	0.10%	Supports Impr.
MRM 377–389	12'	10'	4'	38'	56'	80	1° 30'	< 30	3:1	–	30'	15.92	1.72%	0.03%	Supports Impr.

Table 2-2. Mainline Geometric Conditions

Segment	Geometric Performance														Achieved?
	Lane Width	Right Shoulder Width	Left Shoulder Width	Minimum Paved Section Width	Minimum Median Width	Posted Speed Limit	Maximum Degree of Curve	Minimum Clear Zone	Inslope	Superelevation Rate	Minimum Bridge Section Width	Minimum Vertical Clearance	Maximum Longitudinal Grade	Minimum Longitudinal Grade	
MRM 389–395	12'	10'	4'	38'	48'	65	0° 30'	< 30	3:1	–	30'	16.25	3.00%	0.10%	Supports Impr.
MRM 395–399	12'	10'	4'	38'	48'	65	1° 00'	< 30	6:1			16.5	2.16%	0.00%	Supports Impr.
MRM 399–407	12'	10'	6'	40'	40'	65	1° 00'	> 30	4:1	2.4%	30'	15.17	3.06%	0.00%	Supports Impr.
MRM 407–MIN	12'	10'	6'	40'	44'	80	0° 20'	>30	4:1	1.0%	30'	16.67	3.00%	0.00%	Supports Impr.
I-190															
MRM 0–1	12'	8'	3'	35'	11'	55	1°36'	> 30	6:1	3.4%	34'		4.00%	0.34%	Supports Impr.
MRM 1–2	12'	8'	3'	35'	11'	55	1° 00'	> 30	6:1	2.0%	–	–	3.40%	2.20%	Supports Impr.
I-229															
MRM 1–2	12'	10'	6'	40'	48'	65	1° 00'	> 30'	6:1	–	30'	16.42	0.97%	0.47%	Supports Impr.
MRM 2–3	12'	10'	6'	40'	48'	65	–	> 30	6:1	–	–	16.25	2.00%	0.00%	Acceptable
MRM 3–4	12'	10'	6'	40'	48'	65	1° 00'	> 30	6:1	3.3%	–	17.17	2.93%	0.17%	Supports Impr.
MRM 4–5	12'	10'	6'	52'	48'	65	3° 00'	> 30	6:1	6.0%	–	17.33	2.90%	0.22%	Supports Impr.
MRM 5–6	12'	10'	6'	40'	12'	65	1° 45'	> 30	6:1	6.0%	40'	16.08	0.35%	0.22%	Supports Impr.
MRM 6–7	12'	10'	4'	50'	12'	65	4° 00'	> 30	6:1	–	48'	16.25	2.68%	0.34%	Supports Impr.
MRM 7–9	12'	10'	4'	50'	48'	65	0° 30'	> 30	6:1	1.0%	56'	17.5	3.04%	0.60%	Acceptable

2.1.2 Interchange Geometric Conditions

The review of existing geometrics for all interchanges on I-29, I-90, I-190, and I-229 was conducted using a combination of measurements taken in the field, site observations, and a review of the design plans provided by SDDOT.

Interchange Ramps

The geometric summary in **Table 2-3** identifies data sources, minimum design criteria, and any trends the design team noted along the corridor. A more detailed table summarizing the interchange geometric analysis is included in **Appendix B**. While each ramp per interchange was analyzed for design criteria compliance, **Table 2-3** identifies if any ramp is substandard. This evaluation process identified several design elements that do not meet current design criteria. Descriptions of the more common substandard geometric outcomes follow.

The most common substandard geometric element was associated with the width provided for the right shoulder. Many locations have a shoulder width ranging from 1 foot to 7.5 feet, compared to the minimum design criteria of 8 feet. Several interchange ramps were also noted with lane widths less than 15 feet and left shoulder widths less than 2 feet.

Inslopes ranged from 3:1 to 6:1 on the ramps. While 4:1 is within an acceptable range of allowable slopes, it does not meet the current design criteria of 6:1. Plans generally stated 3:1 maximum on the inslope, but it is not clear if those slopes were constructed flatter. This geometric element does not warrant immediate correction and can be reviewed at the time of pavement replacement along ramps.

Given the high-level nature of this review, exact dimensions were not collected to determine full compliance with Chapter 10 (pp. 10-4 to 10-5) of the design manual. Approximate types of objects were noted during the field review that appeared within 30 feet of the edge of travelway. Types of objects noted include, but are not limited to, retaining walls, trees, utility poles, and drainage pipes/box culverts. Most of the substandard clear zone obstructions appear on the outside edge of the ramp. It is important to note these clear zone deficiencies may exist at only a specific location and not for the entire ramp.

Table 2-3. Interchange Ramp Geometric Guidance Summary

Geometric Category	Source of Data	Thresholds for Determining Need/Deficiency	Trends Found in the Evaluation
Design Speed	• SDDOT Design Guideline	Standard 50 mph Loop 30 mph	Ramps do not typically have posted speed limits. Design speeds were assumed using SDDOT design criteria.
Number of Lanes	• 2010 Study Data • Field Review • Google Earth	Not applicable for geometric analysis	Not applicable for geometric design criteria analysis.
Lane Width with Auxiliary Lane	• 2010 Study Data • Field Review • Interchange Plans	Standard: 15' Loop: 19'	Substandard lane widths may be a result of approximate restriping or older interchanges where the standard was once a smaller lane width.
Lane Width Single	• 2010 Study Data • Field Review • Interchange Plans	12'	Substandard lane widths may be a result of approximate restriping or older interchanges where the standard was once a smaller lane width.
Right Shoulder Width	• 2010 Study Data • Field Review • Interchange Plans	8'	Substandard shoulder widths likely due to urban environment, approximate restriping, or older design criteria.
Left Shoulder Width	• 2010 Study Data • Field Review • Interchange Plans	2'	Substandard shoulder widths likely due to urban environment, approximate restriping, or older design criteria.
Superelevation (e_{max})	• 2010 Study Data • Interchange Plans	6%	I-29: Substandard superelevation rates exceed maximum criteria by 0.2%. Likely a result of overlays, construction tolerances, or meeting existing cross street grades. I-90: Substandard superelevation likely a result of tying into existing cross street grades. Two loop ramps exceed maximum criteria. Likely a design decision to tighten the radius of the curve to reduce right-of-way (ROW) footprint.
Minimum Horizontal Radius	• 2010 Study Data • Interchange Plans	Standard (50mph): 833' Loop (30mph): 231'	Substandard minimum horizontal radius likely due to urban environments or ROW constraints. If ramp designed to lower design speed, minimum radius might meet the intended criteria. However, design speeds would not meet minimum.
Maximum Degree of Curvature	• 2010 Study Data • Interchange Plans	50 mph: 6°53' 30 mph: 24°48'	Substandard maximum degree of curvature likely due to urban environments or ROW constraints. If ramp designed to lower design speed, maximum degree of curvature might meet the intended criteria but design speeds would not meet minimum.

Table 2-3. Interchange Ramp Geometric Guidance Summary

Geometric Category	Source of Data	Thresholds for Determining Need/Deficiency	Trends Found in the Evaluation
Minimum Clear Zone from Edge of Travel Lane	• 2010 Study Data • Field Review • Interchange Plans	30'	Generally, clear zone issues are on the outside of the ramp at spot locations and do not indicate an issue for the entire ramp.
Maximum Grade of Ramp (Ascending)	• 2010 Study Data • Interchange Plans	Standard: 3% to 5% Loop: 5% to 7%	The minimal ramps that are substandard and exceed this criterion are likely constrained by existing topography. Majority are within 1% of criteria. I-90 Exit 58 Ramp B grade exceeds by 2.5% but is constrained by existing topography and buildings.
Maximum Grade on Ramp (Descending)	• 2010 Study Data • Interchange Plans	Standard: -3% to -5% Loop: -5% to -7%	The minimal ramps that are substandard and exceed this criterion are likely constrained by existing topography. Majority are within 1% of criteria.
Inslope (#:1)	• 2010 Study Data • Interchange Plans	6:1	Inslopes range from 3:1 to 6:1. 3:1 slopes seem to be used in areas without a ditch. Most typical sections state 3:1 maximum, and it is not clear if they were constructed flatter in the field.
Minimum Off-Ramp Taper Rate (#:1)	• 2010 Study Data • Interchange Plans	20:1	Substandard taper rates are likely due to older design criteria at time of design.
Minimum On-Ramp Taper Rate (#:1)	• 2010 Study Data • Interchange Plans	50:1	Substandard taper rates are likely due to older design criteria at time of design.
Minimum K Crest Vertical Curve	• 2010 Study Data • Interchange Plans	• 50 mph: 84 • 30 mph: 19	Minimums are noted at the minimum curve location on the profile. A crest curve may be within the intersection to meet existing cross slopes resulting in a K value less than the minimum design criteria. In this case, the profile is controlled by the intersection design and 30 or 50 mph is too conservative.
Minimum K Sag Vertical Curve	• 2010 Study Data • Interchange Plans	• 50 mph: 96 • 30 mph: 37	Minimums are noted at the minimum curve location on the profile. A sag curve may be within the intersection to meet existing cross slopes resulting in a K value less than the minimum design criteria. In this case, the profile is controlled by the intersection design and 30 or 50 mph is too conservative.
Minimum Stopping Sight Distance	• 2010 Study Data • Field Review	• 50 mph: 425 • 30 mph: 200	Field crew visually noted any issues with stopping sight distance. Actual stopping sight distance was not calculated.

Design criteria thresholds are based on the most recent SDDOT Design Guidelines. Compliance with the remainder of the geometric features varied from interchange to interchange. Tables in **Appendix B** summarize the design features that do not meet the desirable design criteria.

Interchange Cross Street

The geometric summary in **Table 2-4** identifies data sources, minimum design criteria, and any trends the design team noted along the interchange cross streets. **Appendix B** includes a more detailed table summarizing the cross street geometric analysis. This evaluation process identified several design elements that do not meet current design criteria. Descriptions of the more common substandard geometric outcomes follow the table.

Table 2-4. Interchange Cross Street Geometric Guidance Summary

Geometric Category	Source of Data	Thresholds for Determining Need/Deficiency	Trends Found in the Evaluation
Minimum K Crest Vertical Curve	• 2010 Study Data • Interchange Plans	• 50mph: 84 • 30mph: 19	Substandard K values are likely due to older design criteria (i.e., minimum K value, maximum grades, minimum bridge clearances) or topographic constraints. Cross street crest curvature over the interstate is noted as a common deficiency.
Minimum K Sag Vertical Curve	• 2010 Study Data • Interchange Plans	• 50 mph: 96 • 30 mph: 37	Substandard K values are likely due to older design criteria (i.e., minimum K value, maximum grades, minimum bridge clearances) or topographic constraints.
Minimum Stopping Sight Distance	• 2010 Study Data • Interchange Plans	• 50 mph: 425 • 3 0mph: 200	2010 data was heavily used as the stopping sight distance was not calculated. If a value was not discernable from plans, a 0 was added. In locations where minimum K values are not met, the stopping sight distance usually fails.
Minimum Ramp Intersection Sight Distance	• 2010 Study Data • Interchange Plans	• 50 mph: 425 • 30 mph: 200	Field crew visually noted common issues with intersection sight distance. Some issues include bridge abutments and retaining walls.
Maximum Longitudinal Grade	• 2010 Study Data • Interchange Plans	7%	Substandard grades are likely due to ROW and topographic feature constraints.
Minimum Longitudinal Grade	• 2010 Study Data • Interchange Plans	0.50%	Some locations indicated 0% with other areas less than 0.5%. Additional analysis is required to determine if grades flatter than 0.50% are causing any ponding issues.
Minimum Control of Access from Interchange Ramp	• 2010 Study Data • Field Review • Interchange Plans • Google Earth	• Urban: 100' • Rural: 300'	Control of access was field verified by wheel or vehicle measurements. Substandard control of access was commonly observed.

Compliance with geometric features varied from interchange to interchange. Substandard elements not meeting criteria are likely due to different design criteria at the time of construction. Geometric elements identified as substandard do not appear to warrant immediate correction and can be reviewed at the time of pavement replacement along ramps. Tables in **Appendix B** summarize design features not meeting the desirable design criteria.

2.2 Long Combination Vehicles

The Interstate System provides the major corridors for truck-based freight traffic across the United States. To enhance efficiency of these movements, long combination vehicles (LCVs) are used for many trips. An LCV typically consists of a tractor and two long trailers (up to 48 feet each) or three short trailers (up to 28 feet each)[2]. LCV access between key truck origins / destinations and the Interstate System is provided by designated LCV routes. In South Dakota, these routes are defined in LCV regulations and generally consist of US or state highways that intersect the Interstate System[3]. LCVs must be broken down outside these routes.

Because these LCVs are longer than typical tractor-trailer combinations, accommodating their turning movements through interstate interchanges with LCV routes is important. The ability of interchange ramp terminals to accommodate LCVs was tested by assessing the wheel tracking of a Rocky Mountain Double (WB-28D [WB-92D]) vehicle through intersections. Several deficient interchanges were identified through this means, and those at junctions with official LCV-eligible routes are identified as interchange improvement needs. A summary of the LCV findings is presented in **Table 2-5**, and a detailed tabulation of these assessments is provided in **Appendix B.**

Table 2-5. Long Combination Vehicle Interchange Summary

Interchange		Route	Right Turn Accommodated?	Left Turn Accommodated?
I-29				
Exit 26	Vermillion / Yankton	SD50	No; supports improvements	No; supports improvements
Exit 133	Brookings / Huron	US14	No; supports improvements	No; supports improvements
Exit 207	Summit / Aberdeen	US12	Yes	Yes
I-90				
Exit 10	North Ave / Belle Fourche	US85	No; supports improvements	No; supports improvements
Exit 61	Elk Vale Road	US16	Yes	Yes
Exit 212	Pierre / Fort Pierre	US83	No; supports improvements	No; supports improvements
Exit 310	Stickney / Aberdeen	US281	No; supports improvements	No; supports improvements
Exit 330	Mitchell / Huron	SD37	Yes	Yes

2.3 Structures

The bridge evaluation examined the structures across the Interstate System. Generally, each interchange has one or two bridges separating the cross street from the freeway. Several interchanges have additional structures where there is another feature that crosses through the interchange or the interchange has a non-standard design. Structures at other locations include railroad underpasses,

[2] *South Dakota Commercial and Agricultural Vehicle Handbook*, South Dakota Department of Transportation, Pierre, SD, 2007, Chapter 5, Table 15, page 53.
[3] Ibid, Table 18, page 57.

waterway underpasses, and crossroad underpasses and overpasses. The national bridge rating system has been revamped since the 2010 study, and details of the new system are provided for information. This is followed by a summary of the bridge evaluation performed for the 2020 ICS.

2.3.1 Bridge Ratings – Then and Now

In January 2017, the FHWA issued the Pavement and Bridge Condition Performance Measures Final Rule, which establishes measures to assess the condition of bridges on the National Highway System (NHS). Before 2017, bridges not meeting criteria were classified using the familiar terms "Structurally Deficient" and "Functionally Obsolete." Structurally Deficient referred to bridges with structural elements experiencing severe degradation or damage. Functionally Obsolete referred to bridges whose geometric makeup (clearances, widths, etc.) no longer met current standards. The FHWA no longer recognizes these terms as official bridge classifications. Structurally Deficient may still be used as a general description or designation, but Functionally Obsolete has been removed completely from the FHWA lexicon.

Under the new guidelines, bridges are classified as either Good, Fair, or Poor. Bridges are classified based only on the structural condition ratings of the deck, superstructure, and substructure (or culvert). The structural condition rating is an assessment of the current physical state of the various elements and components that make up the bridge structure relative to their original (new) conditions. If the lowest condition rating of any of these bridge elements is less than or equal to 4 (on a scale from 0 to 9, with 9 being "excellent"), the bridge is classified as Poor. Previously, the bridge classification was based on both the condition rating and the appraisal rating, but this is no longer the case. The appraisal rating is an assessment of the bridge's overall compliance with current geometric standards (vertical and horizontal clearances, lane and shoulder widths, waterway openings, etc.).

Age is an important factor to consider during the repair/replacement evaluation process. However, it should not be used as the sole determining factor. Of the 604 bridges included here, 338 are more than 50 years old with ratings of Good or Fair.

Another tool available for assessing the need for replacement is the sufficiency rating. The sufficiency rating is a measure of a bridge's ability or suitability to remain in service. This rating is on a scale of 0 to 100, with 100 being "entirely sufficient." Before the 2017 Final Rule, the FHWA used the sufficiency rating to select candidate bridges for repair or replacement. Under the Final Rule, it has been replaced by the Good, Fair, Poor rating system. Like age, the sufficiency rating can be considered but should not be used as the sole determining factor.

2.3.2 Structural Findings

This study is limited to bridges directly on or over the four Interstate Systems within the State of South Dakota (I-29, I-90, I-190, and I-229). Excluded from the study are frontage road bridges paralleling the interstate and interchange ramp bridges (i.e., on- and off-ramps).

Poor Structures

Of the 604 bridges identified, 13 are classified as Poor according to the National Bridge Inspection Standards (NBIS) ratings. Bridges classified as Poor receive the highest priority in terms of replacement and repair funding. Also, many bridges do not meet current geometric requirements (formerly classified as Functionally Obsolete). Of these, the primary concern encompasses those with inadequate vertical clearances. Correcting inadequate vertical clearances should be considered a higher priority than widening bridges of inadequate width when no crash history is related to the inadequate width.

Table 2-6 summarizes the Interstate System Bridges in terms of ratings and minimum vertical clearances. A detailed list of all bridges can be found in **Appendix B**

Table 2-6. Interstate Bridge Ratings

Route	Good	Fair	Poor	Total
I-29	56	164	4	224
I-90	93	246	8	347
I-190	1	2	0	3
I-229	21	8	1	30
Total	**171**	**420**	**13**	**604**

The Poor bridges are listed by corridor:

- I-29:
  - 248th Street over I-29, MRM 96.5 near Dell Rapids
  - 281st Street over I-29, MRM 63.0 near Worthing
  - US18 over I-29, Exit 59 near Davis
  - 215th Street over I-29, MRM 129 near Brookings
- I-90:
  - EB I-90 over Box Elder Creek, MRM 53.9 near Black Hawk
  - US14 WB Off-Ramp over I-90, Exit 112 near Wall
  - 348th Avenue over I-90, MRM 270 near Chamberlain
  - SD258 over I-90, Exit 308 near Plankinton
  - 397th Avenue over I-90, Exit 319 near Mt. Vernon
  - 435th Avenue over I-90, Exit 357 near Spencer
  - 445th Avenue over I-90, Exit 368 near Salem
  - WB I-90 over SD19 Exit 379 near Humboldt
- I-229:
  - E. 60th Street North over I-229, MRM 10 near Sioux Falls

Substandard Clearance Structures

Bridge clearances across the Interstate System were also reviewed. SDDOT raised their minimum vertical clearance (MVC) guidance to 17'-0" (above and below the interstate), and many older structures do not meet this criterion. This criterion superseded the previous SDDOT MVC of 16'-6", and both values exceed the AASHTO and FHWA MVC of 16'-0". Many original interstate structures over other roadways fall below the 16'0" MVC. The available clearance data reflect 451 of the 604 interstate bridges. The remaining 153 structures cross railroads, waterways, and other features where roadway clearance is not a key measure. The roadway clearances are summarized in **Table 2-7**.

Table 2-7. Interstate Bridge Clearances

Route	Minimum Vertical Clearance (Mainline Passes Under / Mainline Passes Over)			
	MVC ≥ 17'-0"	17'-0" ≤ MVC < 16'-6"	16'-6" ≤ MVC < 16"0"	MVC < 16'-0"
I-29	9 / 28	38 / 3	21 / 12	2 / 49
I-90	20 / 54	32 / 8	25 / 18	4 / 104
I-190	1 / 1	0 / 0	0 / 0	0 / 0
I-229	6 / 4	5 / 0	3 / 4	0 / 0
Total	**36 / 87**	**75 / 11**	**49 / 34**	**6 / 153**

Vertical clearance data were not available for two structures that pass over interstates. A review of available street level photographs at these structures did not reflect bridge clearance signing, so these structures were assumed to have adequate clearance and are shown in the ≥17'-0" category. Locations where structures over the interstates do not meet the FHWA / AASHTO 16'-0" MVC were reviewed. The following six structures were identified in this category:

- I-29:
  - US18 over I-29 at Exit 59, near Davis (15.92')
  - 257th Street over I-29 at approximately MRM 87, near Crooks (15.92')
- I-90:
  - US14 WB over I-90 at Exit 112, near Wall (15.83')
  - SD240 over I-90 at Exit 131, near Interior (15.92')
  - SD248 over I-90 at Exit 191, near Murdo (15.66')
  - 478th Avenue over I-90 at Exit 402, near Sioux Falls (15.25')

Four of these structures are in interchanges, and vertical clearances should be addressed if interchange improvements are undertaken. The structure in the US14 / Wall interchange has been recommended for improvements as part of the ICS due to the poor structural condition of this bridge.

2.4 Traffic Safety

The traffic safety evaluation has also seen a significant change since the 2010 study. In the previous ICS, both the mainline and the interchanges were evaluated using a weighted crash rate. In the 2020 ICS, the interstate mainline has been evaluated using a Safety Performance Function (SPF)-based LOSS approach. This approach (documented further below) calculates an expected crash frequency and severity based on facility type, geometric conditions, and other underlying measures and then compares the safety performance of each segment to the expected crash experience. The interchange safety evaluation (also documented further below) has been completed using weighted crash rates, as was done in previous ICS efforts. It is SDDOT's objective to maximize crash reduction within the limitations of available budgets by making road safety improvements at locations where it does the most good or prevents the most severe crashes.

2.4.1 Interstate Mainline Safety Conditions

As noted above, the mainline safety evaluation has been expanded when compared to the previous version of the ICS. The new process and related results are presented below.

Crash History

The crash history for the period of January 1, 2014, through December 31, 2018, was examined across the Interstate System to locate crash clusters and identify crash causes. Over 11,000 crashes were reported in the 5-year period, with 9,533 Property Damage Only (PDO), 1,711 Injury, and 68 Fatals. **Table 2-8** summarizes the crash history over the 5-year analysis period by corridor, and **Table 2-9** presents the same data organized by urban and rural areas.

Table 2-8. Total Crashes by Type and Corridor

Route	PDO	Injury	Fatal	Total
I-29	3,492	695	20	4,207
I-90	5,367	912	44	6,323
I-190	26	9	0	35
I-229	648	95	4	747
Total	**9,533**	**1,711**	**68**	**11,312**

Table 2-9. Total Crashes by Setting

Setting	PDO	Injury	Fatal	Total
Urban	4,491	774	33	5,298
Rural	5,042	937	35	6,014
Total	**9,533**	**1,711**	**68**	**11,312**

Crash Pattern Recognition

To further inform potential future safety improvements, the entirety of the Interstate System was reviewed to identify locations where particular crash type patterns emerge as overrepresented. Each section of interstate was examined relative to systemwide norms for percentage of crash type. Four sets of norms were developed to statistically capture all segment types. **Table 2-10** provides a selection of norms by category, daily traffic level, and other crash attributes (road condition, weather, impaired driving etc.).

Table 2-10. Statistical Norm Percentages (Select Crash Types)

Crash Types		Crashes as a Percent of Total by Category and AADT			
		Urban		Rural	
		<20,000	>20,000	<10,000	>10,000
Severity	PDO	82.9%	82.6%	85.0%	85.0%
	Injury	16.7%	16.8%	14.4%	14.4%
	Fatal	0.4%	0.7%	0.6%	0.6%
Select Types	Wild Animal	34.8%	23.1%	46.6%	46.6%
	Fixed Object	29.2%	30.9%	15.2%	15.2%
Road Condition	Dry	64.5%	62.3%	66.7%	66.7%
	Other	35.5%	37.7%	33.3%	33.3%

Mainline Freeway Analysis Process

As noted previously, the primary intent of the 2020 Decennial ICS is to evaluate the South Dakota Interstate System, which consists of 678 centerline miles of freeways.

The analysis of mainline traffic safety conditions was developed using the following steps:

- Dataset preparation – Process of compiling the crash history, traffic exposure (AADT [Annual Average Daily Traffic]), and basic roadway characteristics needed to establish interstate segment safety performance.
- Safety Performance Model development – Creation of statistical models that relate frequency and severity of crashes to traffic exposure and establish thresholds for evaluating relative safety performance of individual portions of the interstates.
- Interstate Segment analysis – An evaluation of current and projected future safety performance by mile along the Interstates, including LOSS.
- Scoring of safety performance – A scoring system formulated and assigned to each interstate segment reflecting its potential for crash reduction.

- Crash pattern recognition – Identification of statistically significant elevated crash types and attributes along the interstates to identify where particular crash characteristics are overrepresented relative to peer locations.

The results of the mainline safety analysis provide a measure of the potential for total and severe crash reduction across the Interstate System and a list of top locations for further safety improvement consideration.

Dataset Preparation

The mainline freeway safety evaluation was performed using the SDDOT crash database. Crash history for each interstate facility was compiled over the 5-year period noted above. AADT for each freeway segment for each of the five years was entered into the same dataset; interchange-related intersection crashes, crashes on crossroads, and crashes on ramps were removed prior to the fitting of the model. The reason for removing ramp and crossroad crashes was to isolate mainline-only crashes required for the development of SPFs. **Figure 2-1** illustrates how freeway segment datasets were prepared.

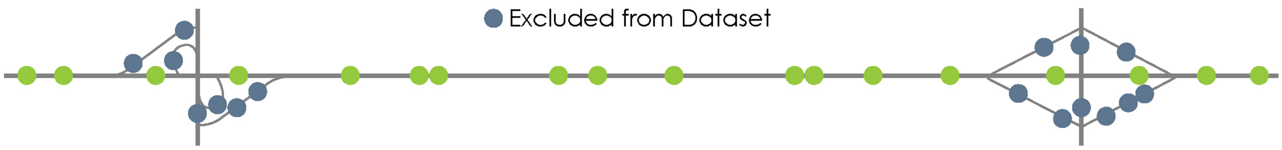


Figure 2-1. Freeway Dataset Preparation Diagram

Safety Performance Function Model Development

This project developed SPFs for the interstate freeway segments in South Dakota. SPFs are essentially crash prediction models that generally relate traffic exposure measured in AADT to safety measured in the number of crashes over a unit of time. The method used relies on substantive and comprehensive work in the area of crashes modeling done by Miaou and Lum[4], Hauer and Persaud[5], Hauer[6] and others. The following briefly describes the modeling methodology used in this project using Generalized Linear Models (GLM).

[4] Miaou S. & Lum H. (1993). Modeling Vehicle Accidents and Highway Geometric Design Relationships. Accident Analysis & Prevention 25(6):689-709.
[5] Hauer, E. & Persaud, B. Safety Analysis of Roadway Geometric and Ancillary Features. Transportation Association of Canada, 1997.
[6] Hauer, E. Art of Regression Modeling in Road Safety. Spring 2015.

Two kinds of SPFs were calibrated. The first one addressed the total number of crashes, and the second one looked only at crashes involving injury or death. It allowed the magnitude of the safety problem from both the frequency and the severity standpoints to be assessed. Frequency and severity SPFs were developed for Urban and Rural interstate segments, for a total of four SPFs.

SPF graphs are depicted on **Figure 2-2** through **Figure 2-5**. The central thicker line on each graph depicts the expected crash experience in Accidents Per Mile Per Year (APMPY) for given levels of AADT, and the upper (80th percentile) and lower (20th percentile) thin lines provide thresholds for assessing the potential for crash reduction as LOSS. These thresholds are further described in **Table 2-11**.

Table 2-11. LOSS Definitions

Crash Reduction Potential	Low	Low – Moderate	Moderate – High	High
LOSS Value	I	II	III	IV
Percentile Threshold	< 20th	20th to Mean	Mean to 80th	> 80th

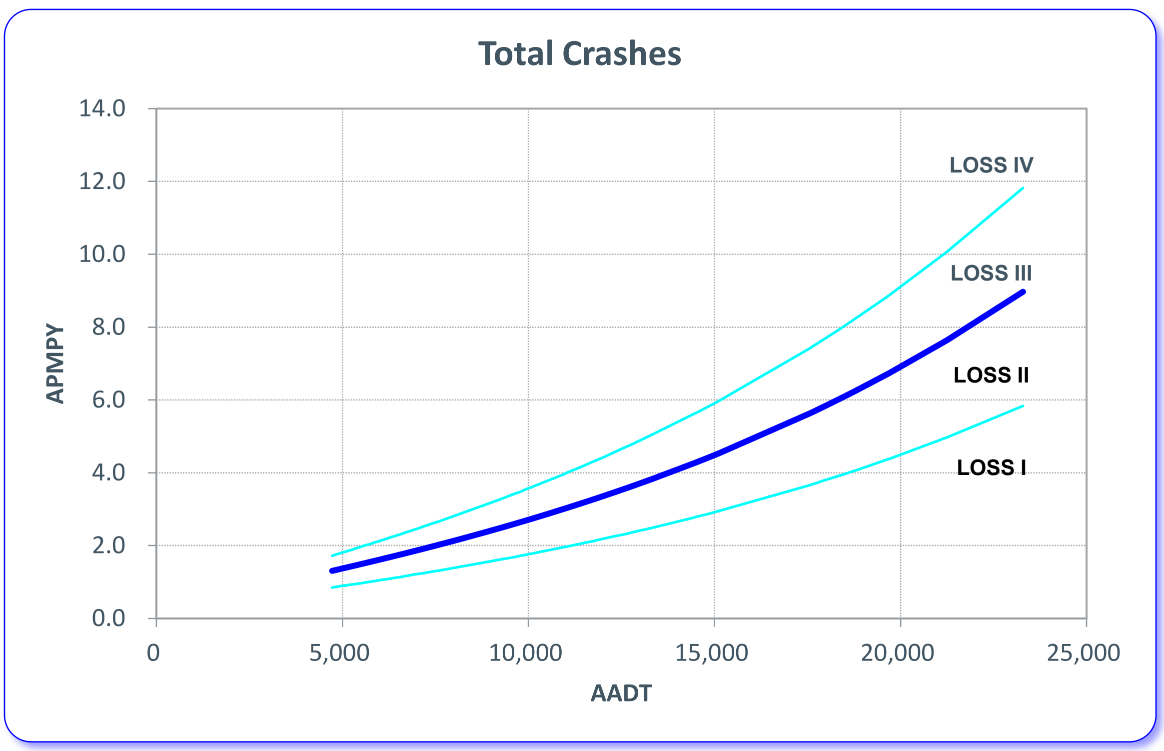


Figure 2-2. Rural 4-Lane Divided Freeway Frequency SPF

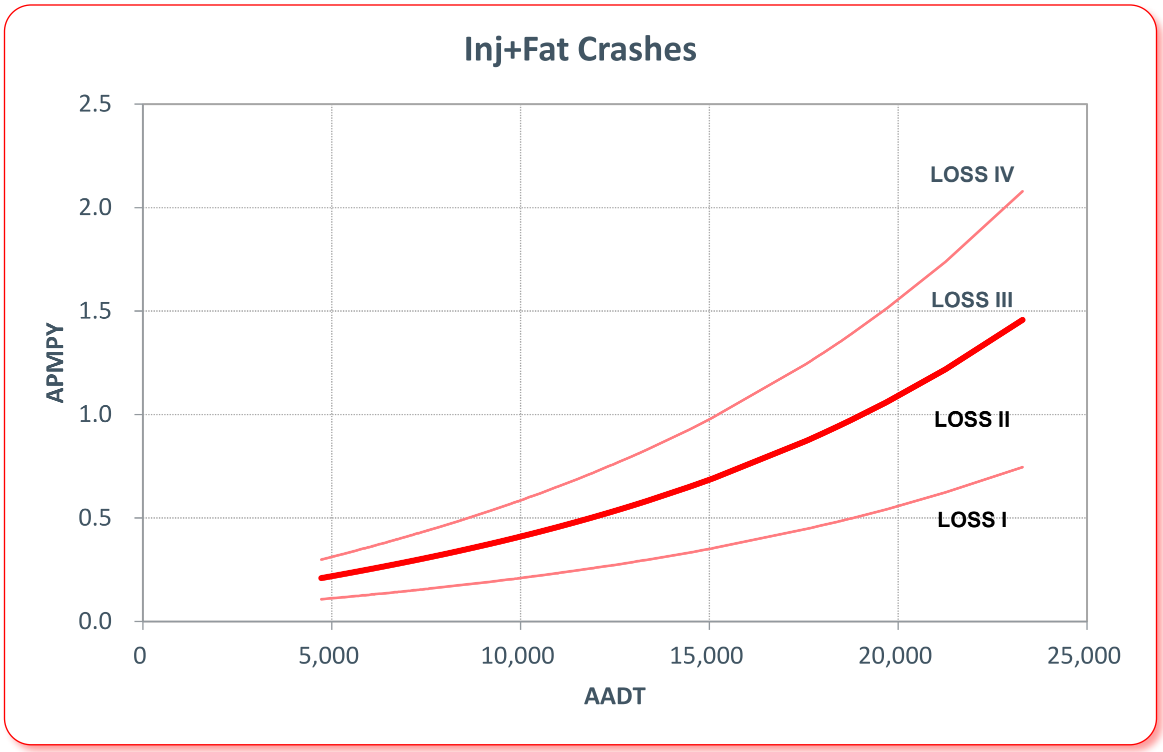


Figure 2-3. Rural 4-Lane Divided Freeway Severity SPF

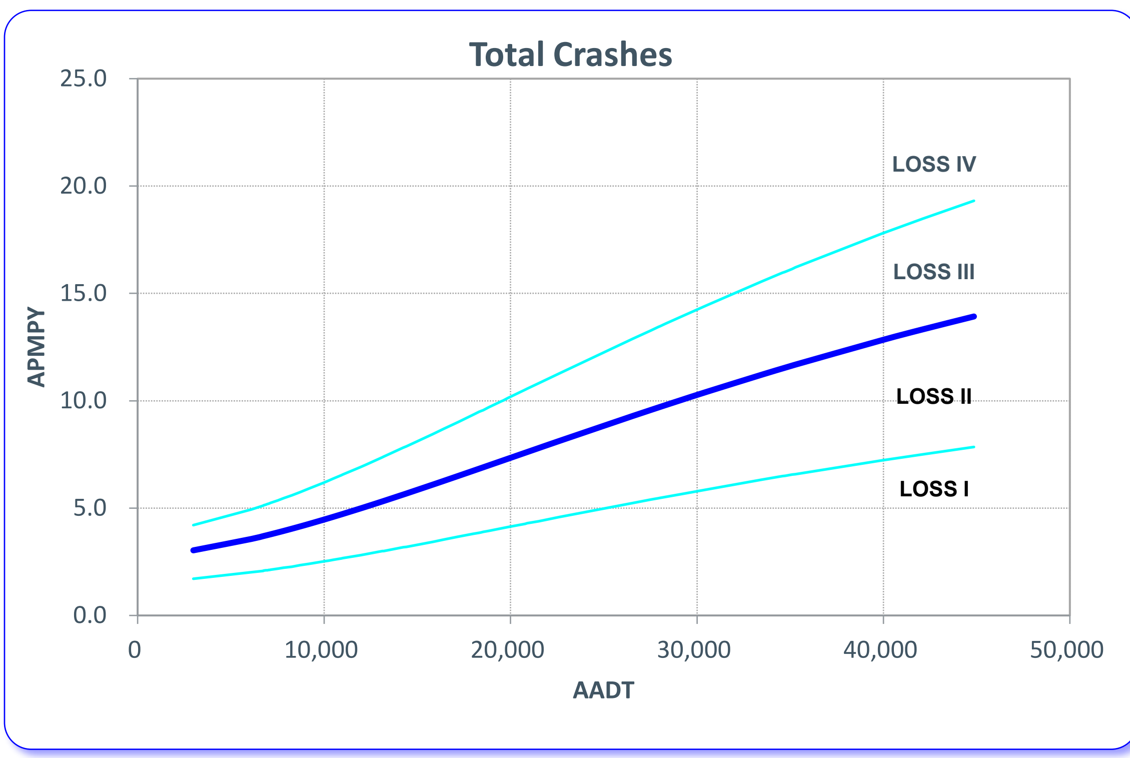


Figure 2-4. Urban 4-Lane Divided Freeway Frequency SPF

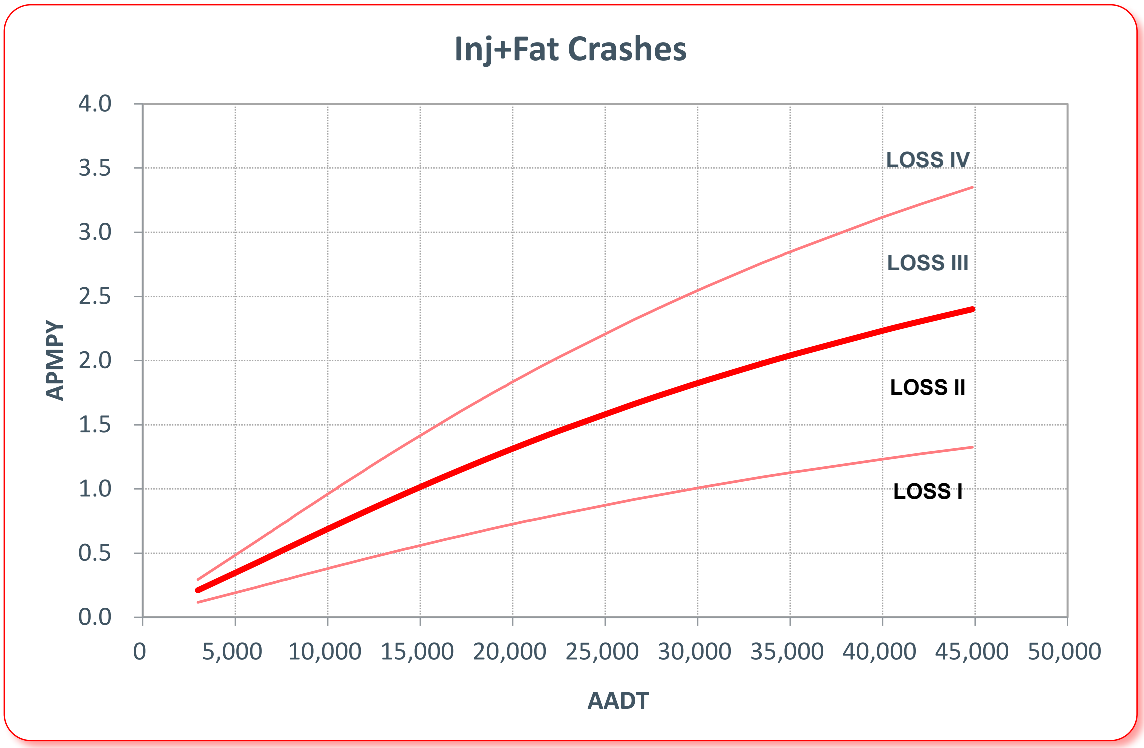


Figure 2-5. Urban 4-Lane Divided Freeway Severity SPF

Scoring of Safety Performance

Based on a study by Hauer[7], sites with the highest number of injuries are likely to lead to the most cost-effective projects. This finding has influenced the project team's approach to assigning the score for ranking freeway segments by their potential for crash reduction. The result is the assignment of higher scores to segments performing at LOSS-IV than to segments with the same number of crashes, but performing at LOSS III, II, or I. The ranking on the list of 1-mile freeway segments represents a preliminary reflection of the potential for crash reduction based on the application of South Dakota-specific predictive tools (SPFs); however, SDDOT will determine final suitability of each site to potential safety improvement projects through detailed examination and site visits. **Appendix B** provides the ranking of all segments.

The top 20 rural segments and 20 urban segments exhibiting the poorest safety performance based on the interstate SPFs are shown in **Table 2-12** (rural at the top of the table; urban at the bottom).

[7] Hauer, E, Allery, A, Kononov, J and Griffith, M. How Best to Rank Sites with Promise, In Transportation Research Record, Journal of Transportation Research Board, No 1897, Washington DC 2004, pp 48-54

Table 2-12. Interstate Segments with Elevated Crash Reduction Potential

Rank	Location				Current Annual Crashes	LOSS		2050 Predicted Crashes
	Route	Begin MRM	End MRM	Community		Overall	Injury + Fatal	
Rural								
1	I-29	93	94	Baltic	12.4	IV	IV	32.85
2	I-29	87	88	Crooks / Renner	8.6	IV	IV	23.66
3	I-90	33	34	Sturgis area	9.2	IV	IV	17.79
4	I-29	94	95	Baltic	10.4	IV	III	27.83
5	I-90	40	41	Tilford	11.4	IV	III	20.96
6	I-90	44	45	Piedmont	8.0	III	IV	22.32
7	I-29	88	89	Crooks / Renner	7.6	III	IV	21.26
8	I-90	23	24	Whitewood	11.4	IV	IV	14.46
9	I-90	37	38	Tilford	7.8	III	IV	14.99
10	I-90	38	39	Tilford	7.2	III	III	14.01
11	I-29	90	91	Baltic	8.6	IV	III	23.66
12	I-29	85	86	Crooks / Renner	9.6	III	II	29.68
13	I-29	86	87	Crooks / Renner	10.0	IV	II	28.31
14	I-29	42	43	Alcester	5.0	IV	IV	10.14
15	I-29	123	124	Nunda / Ward	6.8	IV	IV	8.00
16	I-29	115	116	Flandreau	6.6	IV	IV	7.92
17	I-90	36	37	Sturgis area	7.2	III	III	14.13
18	I-90	34	35	Sturgis area	8.4	IV	III	16.34
19	I-90	35	36	Sturgis area	5.8	II	III	11.79
20	I-90	26	27	Sturgis area	7.0	IV	IV	9.56
Urban								
1	I-29	79	80	Sioux Falls	21.2	IV	IV	27.63
2	I-29	78	79	Sioux Falls	23.6	IV	III	30.27
3	I-229	6	7	Sioux Falls	19.4	IV	IV	25.16
4	I-29	84	85	Sioux Falls	21.0	IV	IV	31.20
5	I-229	8	9	Sioux Falls	18.6	IV	III	24.55
6	I-229	2	3	Sioux Falls	14.4	III	III	18.67
7	I-90	13	14	Spearfish	10.4	IV	IV	15.75
8	I-90	61	62	Rapid City	8.2	II	IV	12.66
9	I-90	53	54	Rapid City	9.0	III	IV	13.97
10	I-90	58	59	Rapid City	11.8	III	III	17.21
11	I-90	48	49	Summerset	12.6	IV	III	19.17
12	I-29	73	74	Sioux Falls	12.6	III	III	18.20
13	I-229	3	4	Sioux Falls	16.2	III	II	20.50
14	I-229	7	8	Sioux Falls	18.6	IV	II	24.39
15	I-90	12	13	Spearfish	13.8	IV	III	20.24
16	I-90	57	58	Rapid City	9.4	II	III	14.20

Table 2-12. Interstate Segments with Elevated Crash Reduction Potential

Rank	Location				Current Annual Crashes	LOSS		2050 Predicted Crashes
	Route	Begin MRM	End MRM	Community		Overall	Injury + Fatal	
17	I-229	4	5	Sioux Falls	13.4	III	II	17.26
18	I-90	403	404	Brandon	14.4	IV	II	19.20
19	I-229	5	6	Sioux Falls	14.0	III	II	18.14
20	I-90	32	33	Sturgis area	8.2	III	III	11.26

The project team reviewed the top 20 rural and urban locations shown in **Table 2-12** to develop segments with similar crash patterns and adjacent geography. For each segment, the team compiled crash types and related information from other study efforts to determine crash causes. Based on the underlying causes and the national Crash Modification Factor (CMF) Clearinghouse[8], recommendations have been made for potential improvements. Each segment evaluation is described below, and the resulting recommendations are summarized in **Table 2-13**.

- I-29 between MRM 42 and MRM 43 (rural, Alcester) – This segment exhibited a significant number of sideswipe same collisions. The geometric evaluation identified clear zone and inslope issues. The CMF Clearinghouse indicates that shoulder rehabilitation can provide a reduction in sideswipe collisions along interstates in rural areas. Hence, shoulder improvements that address clear zones, inslopes, and condition are recommended.
- I-29 between MRM 73 and MRM 74 (urban, Sioux Falls) – This segment is planned to be modified with the construction of the new Exit 74 and was not evaluated further.
- I-29 between MRM 78 and MRM 80 (urban, Sioux Falls) – This segment experienced a significant number of fixed object collisions, and many collisions happened during inclement weather and/or on icy roads. The geometric evaluation identified clear zone issues, which should be addressed.
- I-29 between MRM 84 and MRM 89 (urban and rural, Sioux Falls, Crooks, Renner) – This 5-mile segment is along I-29 from the I-90 interchange north and represents the transition from rural interstate north of Sioux Falls to urban interstate within Sioux Falls. This segment experienced a significant number of PDO collisions (many with the cable rail), and wildlife collisions were prevalent in the northern portion of the segment. As noted in the MCB evaluation, fixed object collisions with the barrier can increase when cable barrier is used. However, these collisions are typically less severe than the potential collisions without the barrier. Hence, no change to the barrier is recommended. Several tributaries to the Big Sioux River cross under I-29 in the

[8] *Crash Modification Factors Clearinghouse*, Federal Highway Administration, Washington DC, http://www.cmfclearinghouse.org/index.cfm, accessed September 2020.

northern portion of this segment and may function as wildlife corridors. The addition of wildlife mitigation in these targeted areas could help reduce wildlife collisions.

- I-29 between MRM 90 to MRM 91 (rural, Crooks) – This segment exhibited a significant number of two-vehicle rear end collisions. The CMF Clearinghouse does not provide rear end countermeasures for rural interstates, and no congestion issues were identified in the ICS operational analyses. Hence, no improvements are recommended.
- I-29 between MRM 93 to MRM 95 (rural, Baltic) – This segment exhibited a significant number of multi-vehicle rear end collisions. The CMF Clearinghouse does not provide rear end countermeasures for rural interstates, and no congestion issues were identified in the ICS operational analyses. Hence, no improvements are recommended.
- I-29 between MRM 115 to MRM 116 (rural, Flandreau) – Many of the collisions in this segment were related to inclement weather and/or icy roads. The ICS Blowing Snow Analysis considered this location for potential future mitigation, ultimately recommending mitigation near MRM 100 prior to treatment at this location.
- I-29 between MRM 123 to MRM 124 (rural, Nunda / Ward) – Most collisions in this segment were single vehicle crashes related to inclement weather and/or icy roads. Wildlife was also a significant factor. The Big Sioux River crosses under I-29 in this segment, which may function as a wildlife corridor. The addition of wildlife mitigation in this targeted area could help mitigate wildlife collisions.
- I-90 between MRM 12 and MRM 14 (urban, Spearfish) – This segment was reconstructed during the 5-year safety evaluation period. Hence, it is likely that construction-related crashes are included in the dataset and deficiencies that existed prior to the construction project have been addressed. The segment should be monitored for future safety issues, but no further analysis is recommended at this time.
- I-90 between MRM 23 and MRM 24 (rural, Whitewood) – This segment is in the challenging topography of the Black Hills area. Most collisions in this segment were single vehicle crashes related to wildlife. Whitewood Creek crosses under I-90 in this segment and may function as a wildlife corridor. The addition of wildlife mitigation in this targeted area could help mitigate wildlife collisions.
- I-90 between MRM 26 and MRM 27 (rural, Sturgis) – This segment is in the challenging topography of the Black Hills area. Many collisions in this segment were single vehicle crashes related to wildlife. A drainageway crosses under I-90 in this segment and may function as a wildlife corridor. The addition of wildlife mitigation in this targeted area could help mitigate wildlife collisions.

- I-90 between MRM 32 and MRM 39 (urban and rural, Sturgis / Tilford) – This segment is in the challenging topography of the Black Hills area. Several collision types were prevalent, most of which were single vehicle crashes. In the center of the segment (MRM 34 to MRM 38), wildlife crashes were significant. Due to the length of this segment, wildlife fencing may not be feasible, but wildlife movements should be studied further for potential mitigation. In the eastern portion of the segment (MRM 36 to MRM 39), inclement weather and/or icy roads were significant. The ICS Blowing Snow Analysis has identified recommendations for this area.
- I-90 between MRM 40 and MRM 41 (rural, Tilford) – This segment is in the challenging topography of the Black Hills area. This segment experienced a significant number of PDO collisions with fixed objects (many with the cable rail). The segment was reconstructed during the crash analysis period, and the mainline geometric evaluation did not identify further correctable concerns. Hence, no further actions are recommended.
- I-90 between MRM 44 and MRM 45 (rural, Piedmont) – This segment is in the challenging topography of the Black Hills area. Because no significant patterns were observed, no mitigations are recommended.
- I-90 between MRM 48 and MRM 49 (urban, Summerset) – This segment is in the challenging topography of the Black Hills area and experienced a significant number of wildlife crashes. Due to the lack of identifiable wildlife corridors, wildlife movements should be studied further for potential mitigation.
- I-90 between MRM 53 and MRM 54 (urban, Rapid City) – This segment is in the challenging topography of the Black Hills area and represents the transition from the small urban and rural areas to the west into the urbanized Rapid City area. It also includes I-90's crossing of Box Elder Creek. There were a significant number of run-off-the-road crashes (including median-related crashes) that involved overturning and resulted in injuries. This segment was identified for a high-tension median cable barrier in the MCB analysis.
- I-90 between MRM 57 and MRM 59 (urban, Rapid City) – This segment experienced a significant number of off-road and fixed object crashes, many during inclement weather and/or on icy roads. Given the extended barriers in the Haines Avenue interchange (Exit 58 / MRM 58.3) and the Exit 59 Interchange study (2014), no further mitigations are recommended.
- I-90 between MRM 61 and MRM 62 (urban, Rapid City) – This segment exhibited a significant number of multi-vehicle crashes, many resulting in injuries. Fixed object collisions were also prevalent. This segment was evaluated in the I-90 Exit 61 to Exit 67 Corridor Study (2017). This segment is planned to be modified as part of the resulting I-90 Exit 63 IMJR and was not evaluated further.

- I-90 between MRM 403 and MRM 404 (urban, Brandon) – Many collisions in this segment were related to wildlife. The interstate parallels the Big Sioux River in this area. A tributary of the Big Sioux River crosses under the highway in a culvert at approximately MRM 403.5. The addition of wildlife mitigation in the targeted area around the tributary could help mitigate wildlife collisions.
- I-229 between MRM 2 and MRM 9 (urban, Sioux Falls) – This segment has been studied as part of the I-229 Major Corridor Investment Study (2017) and was not evaluated further.

Summary

Five years of mainline crash history have been evaluated, SPFs have been developed for the South Dakota Interstate System, and the system has been screened for locations with elevated potential for crash reduction reflected by LOSS III and IV and crash patterns. Based on this process, areas of crash concentrations presented in **Table 2-13** should be considered as future resurfacing and reconstruction projects are planned and executed.

Table 2-13. Mainline Interstate Safety Recommendations

Location			Recommendations
Route	Begin MRM	End MRM	
I-29	42	43	Provide shoulder improvements
I-29	78	80	Address clear zone concerns
I-29	84	89	Provide targeted wildlife mitigation
I-29	90	91	No mitigation measures identified
I-29	93	95	No mitigation measures identified
I-29	115	116	Consider future mitigation per the Blowing Snow Analysis
I-29	123	124	Provide targeted wildlife mitigation
I-90	23	24	Provide targeted wildlife mitigation
I-90	26	27	Provide targeted wildlife mitigation
I-90	32	39	Study potential wildlife mitigations Provide mitigations per the Blowing Snow Analysis
I-90	40	41	Recently reconstructed; no action
I-90	44	45	No patterns identified; no action
I-90	48	49	Potential for wildlife mitigation
I-90	53	54	Provide Median Cable Barrier
I-90	403	404	Provide targeted wildlife mitigation

2.4.2 Interchange Safety Conditions

The project team completed a crash analysis of each of the existing 151 interchanges. Crash information was compiled for the 5-year period between January 2014 and December 2018. The SDDOT provided historical crash information in its GIS database. The SDDOT also provided traffic volume data for the calculation of crash rates for each interchange.

The crash rate methodology was first developed for the SDDOT ICS completed in the Year 2000. The methodology is used to calculate a crash rate per million vehicle trips entering the interchange, like the measure typically used to calculate a surface street intersection crash rate. The number of collisions were weighted according to their severity, totaled for the 5-year time period, and then divided by the total number of vehicle-trips entering the interchange area.

Crash data were provided for each interchange with a categorization of fatal, injury, and PDO traffic crashes occurring within the interchange area during the 5-year study period. The crash analysis focused on the interchange ramps, ramp terminals, and crossroad. This analysis did not include mainline interstate crash data.

To determine the total number of vehicle-trips associated with a typical interchange, a boundary line was drawn 300 feet around each ramp terminal intersection, including the crossroad. The total traffic entering the interchange area was compiled as the sum of the middle crossroad ADT and all ramp traffic. The project team developed traffic volumes as part of the operations analyses. The total traffic was converted to a total number of Millions of Total Vehicles (MTV) for the 5-year time period.

A crash rate and a weighted crash rate were calculated for each interchange. For the weighted crash rates, a point rating system of 12 points for a fatal crash, 3 points for an injury crash, and 1 point for a PDO crash was applied to the data. Based on this point system, a 5-year weighted crash rate was established for each interchange.

To evaluate a variety of interchange types and locations, the study interchanges were ranked by several factors, including crash rate, severity rate, number of crashes, area type (urban and rural), and interchange type. For each category, the interchanges were ranked 1 through 4 based on the following percentiles:

- 1 point: 100th percentile – 80th percentile
- 2 points: 79th percentile – 50th percentile
- 3 points: 49th percentile – 30th / 20th percentile*
- 4 points: 29th / 19th percentile* – 0th percentile

* - varying percentiles were used in urban and rural settings

Additional breakdowns by interstate, interchange type, and area type are summarized in **Appendix B**.

Using the evaluation factors and percentile rating systems, a shortened list of interchanges was designated as high crash locations based on their history relative to the other interchanges. Several interchanges ranked in the top 20 are currently in the planning/design stages with future improvements anticipated or they have been reconstructed within the last three years. The top ranked interchanges are noted in **Table 2-14**. The 31 locations include the highest 20 crash rate interchanges and additional locations that were chosen based on their crash ranking, number of crashes, area type, and interchange type. Additional data were gathered to further evaluate these locations. The full decision matrix can be found in **Appendix B**.

Table 2-14. Elevated Crash Interchange Locations

Locations	AADT of Interchange Area	Area Type	Interchange Type	# of Crashes	Crash Rate 5-year (Crashes/MV)	Wtd. Crash Rate 5-year (Crashes/MV)
I-29 Exit 1	24,664	Urban	Other	27	0.60	0.91
I-29 Exit 38	754	Rural	Diamond – Unsignalized	2	1.45	4.36
I-29 Exit 77*	61,724	Urban	Diamond – Signalized	361	3.20	4.78
I-29 Exit 78	52,128	Urban	Diamond – Signalized	118	1.24	1.83
I-29 Exit 79	50,389	Urban	SPI	144	1.57	2.31
I-29 Exit 81	31,222	Urban	Other	95	1.67	2.23
I-29 Exit 83	21,646	Urban	Other	63	1.59	2.51
I-29 Exit 94	7,063	Rural	Diamond – Unsignalized	7	0.54	1.55
I-29 Exit 98*	6,850	Rural	Diamond – Unsignalized	8	0.64	1.12
I-29 Exit 109	8,465	Rural	Diamond – Unsignalized	19	1.23	1.88
I-29 Exit 133	9,220	Urban	Diamond – Unsignalized	10	0.59	0.71
I-29 Exit 207	7,620	Rural	Diamond – Unsignalized	27	1.94	3.24
I-90 Exit 10	18,254	Urban	Diamond – Unsignalized	56	1.68	2.58
I-90 Exit 59*	33,223	Urban	Diamond – Signalized	95	1.57	2.74
I-90 Exit 61	43,376	Urban	SPI	82	1.04	1.55
I-90 Exit 98	782	Rural	Other	3	2.10	2.10
I-90 Exit 296	1,128	Rural	Diamond – Unsignalized	1	0.49	5.83
I-90 Exit 310	4,858	Rural	Diamond – Unsignalized	15	1.69	2.59
I-90 Exit 332*	24,288	Urban	Diamond – Signalized	62	1.40	1.85
I-90 Exit 357	397	Rural	Diamond – Unsignalized	1	1.38	4.14
I-90 Exit 364	4,556	Rural	Diamond – Unsignalized	16	1.92	2.89
I-90 Exit 368	472	Rural	Diamond – Unsignalized	2	2.32	4.64
I-90 Exit 374	911	Rural	Diamond – Unsignalized	4	2.41	6.01
I-90 Exit 379	2,377	Rural	Diamond – Unsignalized	7	1.61	2.07
I-229 Exit 1C	49,356	Urban	Other	168	1.87	2.75
I-229 Exit 2*	36,495	Urban	Diamond – Signalized	102	1.53	2.37
I-229 Exit 3*	36,342	Urban	Diamond – Signalized	121	1.82	2.52
I-229 Exit 4*	39,089	Urban	Diamond – Signalized	119	1.67	2.43
I-229 Exit 5*	34,304	Urban	Other	139	2.22	3.37

Table 2-14. Elevated Crash Interchange Locations

Locations	AADT of Interchange Area	Area Type	Interchange Type	# of Crashes	Crash Rate 5-year (Crashes/MV)	Wtd. Crash Rate 5-year (Crashes/MV)
I-229 Exit 6*	39,985	Urban	SPI	156	2.14	3.07
I-229 Exit 7*	24,048	Urban	Other	71	1.62	2.35
Study Average	**10,167**	**–**	**–**	**19.9**	**0.65**	**1.03**

*Interchange already being studied or recently reconstructed.

A detailed investigation was completed for the 21 interchanges identified for further analysis. No additional investigation was completed for 10 interchanges that were recently reconstructed or are in the planning/design stage. The interchange ramps, ramp terminals, and crossroads were evaluated to identify crash patterns and crash causality. Countermeasures were developed to improve safety along the roadway or at the ramp terminals. These evaluations are based on engineering judgment and results of other ICS study efforts. **Table 2-15** displays the interchange safety recommendations.

Table 2-15. Summary of Interchange Safety Recommendations

Interchange	Safety Recommendation	Comments
I-29 Exit 1	Provide overhead signal head indications for each travel lane. Provide arrow signal indications for northbound (NB) off-ramp. Install No Right Turn on Red light emitting diode (LED) Blankout side for NB off-ramp. Relocate NB on-ramp away from signalized intersection. Provide striping for southbound (SB) off-ramp, including dividing lane line, left and right turn arrow pavement markings, and advanced lane assignment signing. Evaluate SB off-ramp terminal for signalization.	There was a pattern of rear-end type collisions.
I-29 Exit 38	Install shoulder rumble strips on SB off-ramp. Check intersection sight distance with bridge crest vertical curve.	There was a pattern of run-off-the-road crashes on the SB ramp terminal.
I-29 Exit 77	Reconstruct interchange to diverging diamond interchange (DDI).	http://www.41ststudy.com
I-29 Exit 78	Implement flashing yellow arrow (FYA) at both ramp terminals. Provide overhead signal head indications for each travel lane. Provide arrow signal indications for NB and SB off-ramp. Consider alternative interchanges such as DDI or single point interchange (SPI).	There was a pattern of rear-end and angle type collisions.

Table 2-15. Summary of Interchange Safety Recommendations

Interchange	Safety Recommendation	Comments
I-29 Exit 79	Provide additional near side supplementary signal head for left-turn lanes prior to entering the SPI. Currently, they are mounted to the bridge structure and may be obstructed on approach to the intersection. Signalized SB right-turn movement with no right turn on red (RTOR). Implement traffic calming countermeasures, such as speed enforcement, radar speeds signs on 12th Street, narrow lanes to 11 ft, zig-zag pavement markings.	There was a pattern of rear-end and angle type collisions. Pattern of vehicles noted as driving too fast for conditions (speed limit 35 mph).
I-29 Exit 81	Implement FYA at both ramp terminals. Provide a second signal head indication for the NB left-turn and restripe dashed line dividing dual NB left-turn to accommodate a larger radius. Pull back stop bar for eastbound (EB) traffic at the NB Ramp Terminal. Signalize NB right-turn movement with no RTOR.	There was a pattern of rear-end and angle type collisions.
I-29 Exit 83	Implement FYA at both ramp terminals. Provide a signal head indication for the NB left-turn. Provide a signal head indication for the EB left-turn and one over each through travel lane. With posted speed limit 50 mph or greater, install advanced warning beacon for dilemma zone protection.	There was a pattern of rear-end and angle type collisions.
I-29 Exit 94	No recommendation made.	No correctable pattern.
I-29 Exit 98	Interchange was reconstructed in 2017.	No correctable pattern.
I-29 Exit 109	Provide additional delineation on bridge rail and guardrail. Widen bridge to provide adequate shoulder or replace structure to provide adequate cross section and improve clearance over I-29. Light interchange ramp terminals.	There was a pattern of run-off road – fixed object (Bridge) type collisions occurring at dark.
I-29 Exit 133	No recommendation made.	No correctable pattern.
I-29 Exit 207	Upgrade to 36"x36" stop signs. Construct porkchop median at both ramp terminals for supplementary stop sign.	There was a pattern of rear-end, angle, and run-off-the-road type collisions.
I-90 Exit 10	Upgrade to 36"x36" stop signs. Evaluate intersection for signal warrants, or other intersection control type.	There was a pattern of angle and run-off the road type collisions.
I-90 Exit 59	Reconstruct interchange to DDI.	http://www.i90lacrosseddi.com/index.html

Table 2-15. Summary of Interchange Safety Recommendations

Interchange	Safety Recommendation	Comments
I-90 Exit 61	Provide 8” wide dotted white lane lines through the SPI for lane channelization. Signalize the EB right-turn movement with no RTOR.	There was a pattern of rear-end and sideswipe same direction type collisions.
I-90 Exit 98	No recommendation made.	No correctable pattern.
I-90 Exit 296	Relocate access south of interchange to 300 feet per Ch. 13 of SDDOT Road Design Manual (https://dotfiles.sd.gov/rd/rdmch13.pdf). Check intersection sight distance with bridge crest vertical curve.	No correctable pattern.
I-90 Exit 310	Provide shoulder rumble strips on US281 between ramp terminals. Provide additional delineation on bridge rail and guardrail. Widen bridge to provide adequate shoulder or replace structure to provide adequate cross section and improve clearance over I-90.	There was a pattern of run-off the road – fixed object (bridge rail) type collisions.
I-90 Exit 332	Interchange was reconstructed in 2018 and ramp terminal signalized.	No correctable pattern.
I-90 Exit 357	Check intersection sight distance with bridge crest vertical curve.	No correctable pattern.
I-90 Exit 364	Install shoulder rumble strips on EB off-ramp. Evaluate for turn lanes on US81 at the westbound (WB) ramp terminal.	South Ramp Terminal – Run-off Road. North Ramp Terminal – Rear-ends on US81.
I-90 Exit 368	Check intersection sight distance with bridge crest vertical curve.	No correctable pattern.
I-90 Exit 374	Check intersection sight distance with bridge crest vertical curve. Consider lowering speed limit through interchange. Install Rural Intersection Conflict Warning System (RICWS) at both ramp terminals.	No correctable pattern.
I-90 Exit 379	Relocated access south of interchange to 300 feet per Ch. 13 of SDDOT Road Design Manual (https://dotfiles.sd.gov/rd/rdmch13.pdf). Reduce speed on SD19 through the interchange from 65 mph to 45 mph starting 750 feet south of interchange.	No correctable pattern.
I-229 Exit 1C	Upgrade both ramp terminals traffic signals. Implement FYA. Evaluate for additional loop ramps. Reconfigure north ramp terminal.	There was a pattern of rear-end and angle type collisions.
I-229 Exit 2	Reconstruct interchange.	http://www.i229study.com/corridorstudy.html
I-229 Exit 3	Reconstruct interchange.	http://www.i229study.com/exit3.html
I-229 Exit 4	Reconstruct interchange.	http://www.i229study.com/exit4.html

Table 2-15. Summary of Interchange Safety Recommendations

Interchange	Safety Recommendation	Comments
I-229 Exit 5	Reconstruct interchange to folded diamond.	https://www.26thstreetcorridorstudy.com/project.html
I-229 Exit 6	Reconstruct interchange.	http://www.i229study.com/exit6.html
I-229 Exit 7	Reconstruct interchange.	http://www.i229study.com/exit7.html

2.5 Traffic Operations and Reliability

The traffic operations and reliability evaluations consisted of three elements. The mainline operational analysis consisted of LOS analysis for each freeway segment, merge, diverge, and weaving area on the freeway. These analyses were conducted for existing and future years in the AM and PM peak periods. The interchange operational analyses consisted of LOS analysis of the ramp terminal intersection(s) at each interchange. For locations where there are no ramp terminal intersections (directional interchanges and system-to-system interchange), the mainline LOS values were used as surrogate for interchange operations. These analyses were also conducted for existing and future years in the AM and PM peak periods. The reliability evaluation used aggregated traveler data to identify locations where incidents, weather, or construction created non-recurring delay. Summaries of each of these evaluations, along with the development methodology for the future year forecasts, are presented below.

2.5.1 Forecasting Methodology

The forecasting methodology was developed using the approach in the M&A document. Three Metropolitan Planning Organizations (MPOs) serve the urbanized areas of South Dakota. The Rapid City Area MPO serves the Rapid City area, the Sioux Falls MPO serves the Sioux Falls area, and SIMPCO serves the tri-state Sioux City planning area. These agencies were created to oversee long-range transportation planning in their respective urbanized areas based on Federal guidelines. Each agency maintains a travel demand model that is used to develop long-range travel demands across the MPO's major roadway network (including the interstates). The current long-range forecast year for each MPO is 2045. For the ICS, year 2050 forecasts were developed by interpolating linear growth between the study's 2019 base year and the 2045 future year for each model to obtain year 2050 projections. These projections were reviewed for consistency with local studies, including those listed in previous sections of this report where appropriate.

For areas outside the MPOs, SDDOT maintains county-by-county growth rates based on historic traffic counts and local growth patterns. These growth rates were used to increase the volumes developed for the study's 2019 base year to obtain year 2050 projections. Again, these projections were reviewed for consistency with local studies, including those listed in previous sections of this report.

The future volumes obtained using each methodology were then compiled into one set of volumes across the network. Volumes at the county and MPO boundaries were reviewed for consistency, and adjustments were made where necessary based on engineering judgment. This effort resulted in a final set of year 2050 volumes for use in the subsequent analyses across the Interstate System.

2.5.2 Interstate Mainline Traffic Operations

Traffic operations along the interstate mainlines were evaluated using the uninterrupted flow methodologies in the HCM. For freeways, these methodologies are generally broken into three analysis types: basic freeway segments, merge / diverge segments, and weaving segments. LOS metrics for each analysis type are based on traffic density in the analysis segment, with lower densities indicating better operations.

For analysis purposes, the Interstate System was divided into facility segments, using guidance in the HCM. Each facility segment varies from about 10 to almost 20 miles in length and includes all of the interchanges within that portion of interstate. This approach is more robust than the one used in 2010 ICS, where a simple volume / capacity ratio was calculated. The segmentation and analysis methodologies were defined in the M&A document.

Input data for the analysis generally fall in two categories: geometry and volumes. Geometric data were extracted from the geometric condition evaluation previously described. Volumes were compiled across the entire Interstate System using available count data, previous studies, and other tools outlined in the M&A document. These data were combined in a spreadsheet to generate analysis input files and to summarize results.

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. Freeway LOSs are based on the traffic density in passenger cars per mile per lane, with higher densities relating to poorer performance and lower LOS. **Table 2-16** summarizes LOS criteria for signalized and unsignalized (stop sign controlled) intersections.

Table 2-16. Freeway LOS Criteria

LOS	Freeway Segment Density (pc/mi/ln)		
	Basic Freeway Segment[1]	Merge/Diverge Segment	Weaving Segment
A	≤ 11	≤ 10	≤ 10
B	> 11 – 18	> 10 – 20	> 10 – 20
C	> 18 – 26	> 20 – 28	> 20 – 28
D	> 26 – 35	> 28 – 35	> 28 – 35
E	> 35 – 45	> 35	> 35 – 43
F	> 45 OR v/c ratio[2] > 1.00	v/c ratio[2] > 1.00	> 43 OR v/c ratio[2] > 1.00

[1]LOS thresholds for basic freeway segments also apply to composite freeway LOS determinations.

[2]Also, demand-to-capacity ratio. When v/c > 1.00, traffic flow is characterized as congested with significant upstream queueing on mainline and ramp segments.

Existing Conditions

The existing conditions analysis network consisted of 594 basic freeway segments, 287 diverge segments, 283 merge segments, and 30 weaving segments, for a total of 1,194 analysis segments. Each segment was analyzed using both AM and PM peak hour volumes. The results are summarized on **Figure 2-6**.

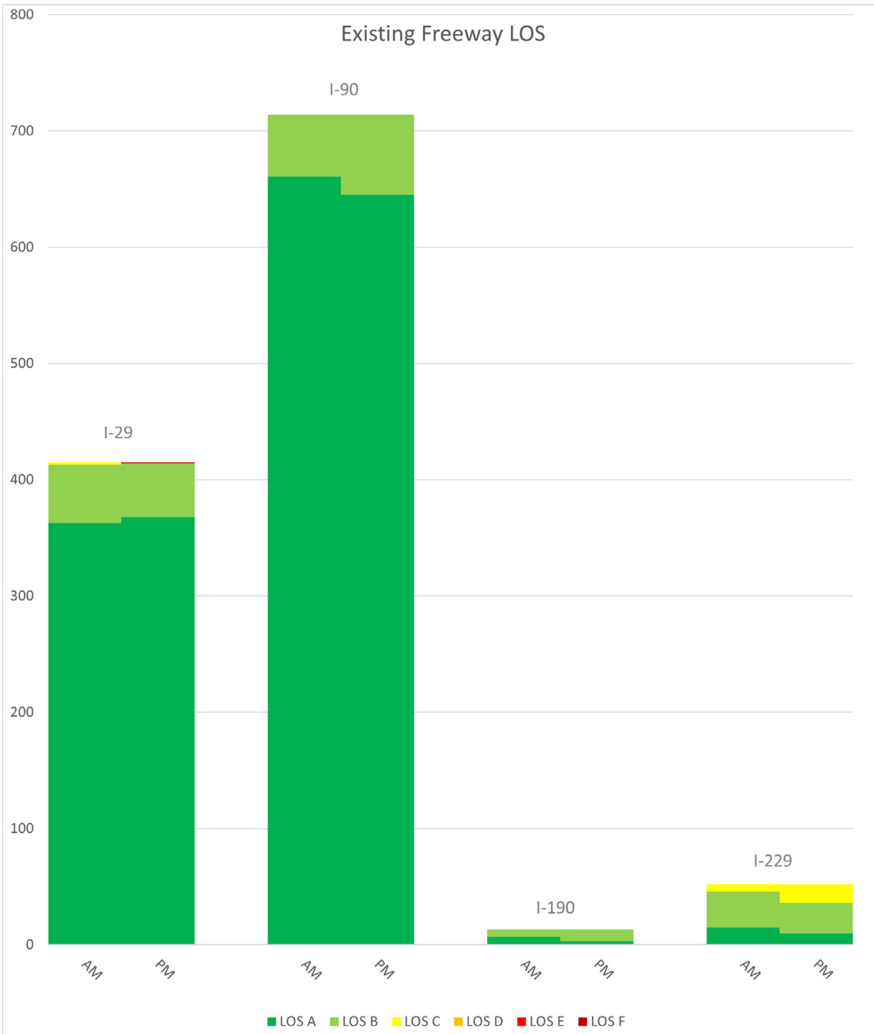


Figure 2-6. Existing Mainline LOS Summary

The SDDOT LOS criteria is LOS B for rural areas and LOS C for urban areas. As can be seen, the majority of the Interstate System (about 86 percent of segments) operates at LOS A under existing conditions. Most of the remaining segments (about 13 percent) operate at LOS B, and about 1 percent of segments typically operate at LOS C or worse. The following segments exceed the SDDOT LOS criteria:

- The NB I-29 off-ramp to Exit 68 operates at LOS C in the AM peak hour. This segment is just outside the Sioux Falls area and exceeds the SDDOT rural LOS criteria of LOS B.
- The SB I-29 weaving area between Exit 78 and Exit 79 operates at LOS F in the PM peak hour. This segment is in the Sioux Falls area and exceeds the SDDOT urban LOS criteria of LOS C. This result is based on a significant ramp volume within the weaving area that exceeds operational thresholds. The density-based LOS in this weaving area is B.

Future (2050) Conditions

The future conditions analysis network consisted of 601 basic freeway segments, 290 diverge segments, 286 merge segments, and 31 weaving segments, for a total of 1,208 analysis segments. The increase in number of segments over existing was due to the addition of Exit 74 on I-29 in the Sioux Falls area and I-29 Exit 130 in the Brookings area. Again, each segment was analyzed using both AM and PM peak hour volumes. The results are summarized on **Figure 2-7**.

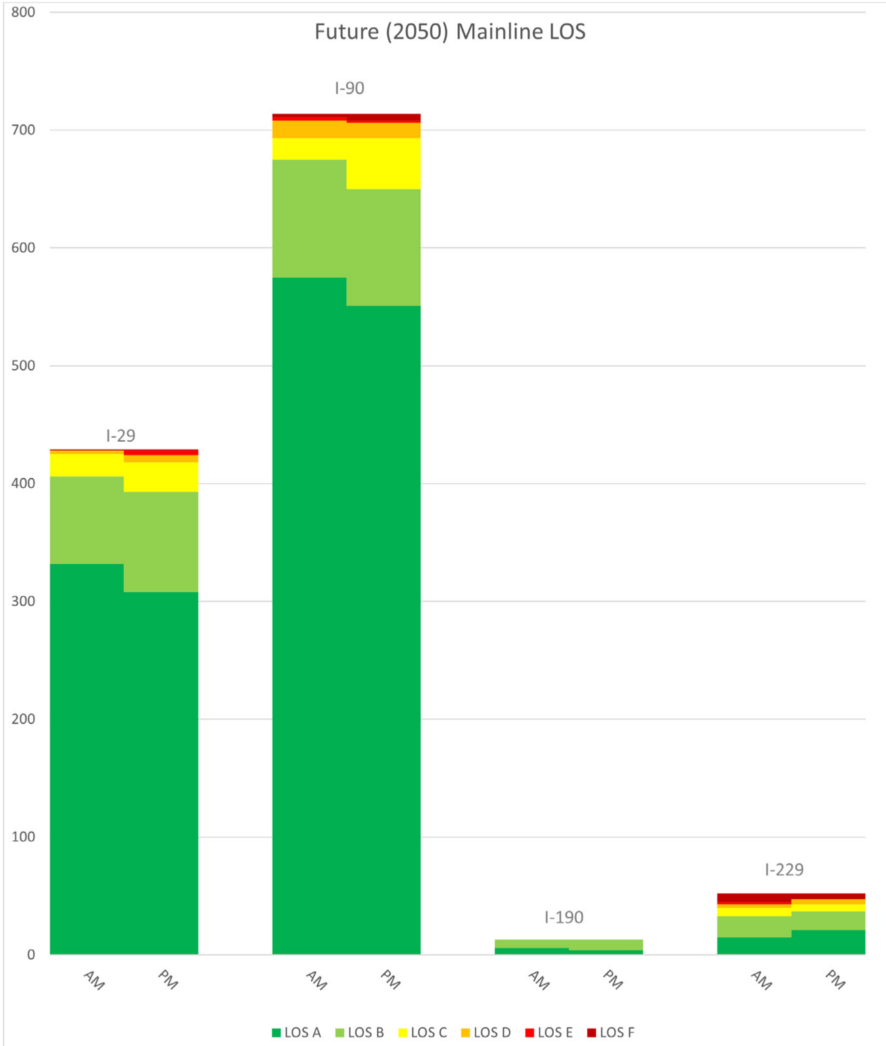


Figure 2-7. Future (2050) LOS Summary

Most the Interstate System (about 76 percent of segments) operates at LOS A under future traffic levels. Most remaining segments (about 17 percent) operate at LOS B, and about 7 percent of segments operate at LOS C or worse. The following segments exceed the SDDOT LOS criteria:

- Ramps on I-29 at the Exit 62, Exit 64, and Exit 68 (south of Sioux Falls) interchanges operate at LOS C in the AM and PM peak hours. The NB I-29 mainline between Exit 68 and Exit 71 operates at LOS C in the AM peak hour. These interchanges and segments were included in the I-29 Exit 62 to 73 Corridor Study and should be addressed in accordance with that effort.
- Several ramps at the I-29 Exit 71 and Exit 73 interchanges and the NB I-29 mainline between these interchanges operate at LOS D in the AM peak hour. One SB ramp operates at LOS D in the PM peak hour. This area has previously been studied and should be addressed in accordance with that effort.

- The NB weaving area along I-29 between Exit 74 and Exit 75 operates at LOS F in the AM and PM peak hours. The geometry for this weaving area was assumed based on the Exit 74 IMJR, and the project is currently under detailed design. It is anticipated that design updates will address this issue.
- Several weaving and mainline segments along I-29 SB between Exit 80 and Exit 77 operate at LOS D or LOS E in the PM peak hour. These segments should be the subject of future study and potential improvements.
- Various ramps and WB mainline segments along I-90 between Exit 44 and Exit 57 operate poorly (LOS D, LOS E, or LOS F) in the AM and PM peak hours. Several of these segments and ramps were evaluated as part of the ongoing I-90 Exit 46 IMJR and should be addressed in accordance with that effort. Other segments should be the subject of future study and potential improvements.
- Various ramps along I-90 between Exit 58 and Exit 63 operate poorly (LOS D, LOS E, or LOS F) in the PM peak hour. Several of these ramps will be evaluated as part of the ongoing I-90 Exit 63 IMJR and should be addressed in accordance with that effort. Other interchanges should be the subject of future study and potential improvements.
- Several ramps on I-90 between Exit 396 and Exit 399 operate at LOS D in the PM peak hour, as does the EB mainline between these interchanges. These interchanges and this segment should be the subject of future study and potential improvements.
- Various ramps and mainline segments along I-90 between Exit 400 and Exit 406 operate at LOS F in the PM peak hour. These interchanges may be affected by the proposed I-90 Exit 404 and Exit 408 interchanges being evaluated in Phase 2 of the ICS and should be the subject of future study and potential improvements.
- The EB ramps in I-90 Exit 410 operate at LOS C in the PM peak hour. This interchange may be affected by the proposed I-90 Exit 408 interchange being evaluated in Phase 2 of the ICS and should be the subject of future study and potential improvements.
- The weaving areas and NB mainline segments along I-229 between I-29 and Exit 3 operate poorly (LOS D, LOS E, or LOS F) in the AM and PM peak hours. These segments have been evaluated as part of the previous I-229 Major Investment Corridor Study and should be addressed in accordance with that effort. Some segments near I-29 may also be modified as part of the ongoing I-29 Exit 74 effort.
- Several weaving areas and mainline segments along I-229 between Exit 5 and Exit 7 operate at LOS F in the AM and PM peak hours. These segments have been evaluated as part of the previous I-229 Major Investment Corridor Study and should be addressed in accordance with that effort.

2.5.3 Interchange Traffic Operations

Traffic operations were analyzed for the study interchange ramp terminal intersections using Highway Capacity Software (HCS), which uses procedures documented in the HCM 6th Edition, Transportation Research Board, 2016. From the analyses, a key measure or "level of service" rating of the traffic operational condition was obtained. In general, LOS is a qualitative assessment of traffic operational conditions within a traffic stream in terms of the average stopped delay per vehicle at a controlled intersection.

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. Unsignalized, or stop sign controlled, intersection capacity analyses produce LOS results for each movement that must yield to conflicting traffic at the intersection, while signalized intersections produce LOS results for the overall intersection performance. **Table 2-17** summarizes LOS criteria for signalized and unsignalized (stop sign controlled) intersections.

Table 2-17. Level of Service (LOS) Criteria

Level of Service	Average Control Delay (seconds per vehicle)*	
	Signalized Intersections	Stop 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

* HCM 6th Edition, Exhibit 19-8 & Exhibit 20-2.

For analysis purposes, signalized intersection pairs at interchange ramp terminals were evaluated together, using guidance from HCM Chapter 23, as outlined in the M&A document. At unsignalized interchange ramp terminal intersections, each intersection was analyzed individually. The LOS grade reported for two-way stop controlled (TWSC) intersections represents the delay on the off-ramp at the ramp terminal intersection. LOS grades are reported for each direction. The SDDOT traffic operations goal is LOS B for rural areas and LOS C for urban areas.

Input data for the analyses generally fall into two categories: geometry and volumes. Most geometric data were collected during field visits. Volume data were compiled across the entire Interstate System using available count data, previous studies, and other tools outlined in the M&A document. The traffic counts conducted for the ICS are presented in **Appendix C**. The volume and geometric data were combined in a spreadsheet to generate analysis input files and to summarize results; the entirety is included in **Appendix B**.

This study encompassed the entire Interstate System within South Dakota. An initial vetting process was conducted to concentrate efforts on interchanges with at least 1,000 ADT (Average Daily Traffic) on the crossroad. It was deemed that interchanges where crossroads with ADT below this threshold would not pose a concern from an operational standpoint.

The traffic operations analyses consisted of 87 interchanges: 35 interchanges are located on I-29, 43 on I-90, 1 on I-190, and 8 on I-229. Of these 87 interchanges, 14 are signalized with two ramp terminal intersections (Signalized), 11 are single point interchanges (SPI), 57 are TWSC, and 5 interchanges have one intersection signalized and one with TWSC. Each interchange was analyzed using both AM and PM peak hour volumes with 2019 Existing and 2050 Future traffic volume scenarios. Detailed analysis results for each interchange are presented in **Appendix D**. For purposes of the analysis, TWSC interchanges were analyzed and reported as two separate intersections, while signalized and SPI intersections were reported as a combined interchange.

The results for 2019 and 2050 traffic operations are summarized in the bar charts on **Figure 2-8**.

Figure 2-8. 2019 Existing LOS of All Interchanges by Intersection Type

A large portion of the state's interchange ramp terminal intersections (about 49 percent of locations) operate at LOS A under 2019 existing conditions. Of the remaining interchanges, 27 percent operate at LOS B, 14 percent operate at LOS C, 5 percent operate at LOS D, 3 percent operate at LOS E, and 2 percent operate at LOS F. **Table 2-18** lists interchanges that exceed the SDDOT traffic operations goals (LOS B in rural areas and LOS C in urban areas).

Table 2-18. 2019 Interchanges That Exceed Traffic Operations Goals

Exit	Location	Int. Type	Direction	Urban/Rural	LOS (AM/PM)
			I-29		
2	North Sioux City	TWSC	SB	Urban	C / F
4	McCook Lake	TWSC	NB	Urban	D / B
26	Vermillion / Yankton	TWSC	NB	Rural	C / C
77	41st Street	Signal	Interchange	Urban	D / C
81	Russell Street	Signal	Interchange	Urban	D / B
98	Dell Rapids	TWSC	SB	Rural	C / B
			I-90		
46	Elk Creek Road	TWSC	WB	Urban	D / A
63	Box Elder / Ellsworth AFB	TWSC	EB	Urban	F / F
63	Box Elder / Ellsworth AFB	TWSC	WB	Urban	D / D
67	Liberty Blvd / Ellsworth AFB	TWSC	EB	Urban	E / B
330	Mitchell / Huron	TWSC	EB	Urban	E / E
330	Mitchell / Huron	TWSC	WB	Urban	C / D
387	Hartford	TWSC	EB	Rural	C / A
390	SD38 / Hartford	TWSC	EB	Rural	C / B
406	Brandon / Corson	TWSC	EB	Urban	D / F
406	Brandon / Corson	TWSC	WB	Urban	F / F
			I-229		
2	Western Avenue	Signal	Interchange	Urban	C / D
3	Minnesota Avenue	Signal	Interchange	Urban	D / D
4	Cliff Avenue	Signal	Interchange	Urban	D / D
5	26th Street	Signal	Interchange	Urban	C / D
6	10th Street	SPI	–	Urban	D / D
9	Benson Road	Signal	NB	Urban	F / A
9	Benson Road	TWSC	SB	Urban	F / A

In analysis Year 2019, 6 interchanges along I-29 did not satisfy traffic operations goals, 7 on I-90, 6 along I-229, and none on I-190. Of these 19 interchanges, 6 locations had a LOS of E or F during AM and/or PM peak hours.

Figure 2-9. 2050 LOS of All Interchanges by Intersection Type

As shown on **Figure 2-9**, the plurality of the state's interchange ramp terminal intersections (about 35 percent of locations) are projected to operate at LOS A under 2050 Future conditions. Of the remaining locations, 25 percent are projected to operate at LOS B, 13 percent at LOS C, 7 percent at LOS D, 5 percent at LOS E, and 15 percent at LOS F. are listed in **Table 2-19** lists Interchange ramp terminal intersections that exceed the SDDOT traffic operations goals (LOS B in rural areas and LOS C in urban areas).

Table 2-19. 2050 Interchanges That Exceed Traffic Operations Goals

Exit	Location	Int. Type	Direction	Urban/Rural	LOS (AM/PM)
			I-29		
1	Dakota Dunes	TWSC	SB	Urban	D / C
2	North Sioux City	TWSC	SB	Urban	D / F
4	McCook Lake	TWSC	NB	Urban	D / B
26	Vermillion / Yankton	TWSC	NB	Rural	E / F
26	Vermillion / Yankton	TWSC	SB	Rural	C / C
47	Beresford / Irene	TWSC	NB	Rural	B / C
47	Beresford / Irene	TWSC	SB	Rural	F / F
68	Lennox / Parker	TWSC	NB	Rural	C / B
71	Harrisburg / Tea	TWSC	NB	Urban	E / C
71	Harrisburg / Tea	TWSC	SB	Urban	F / C
73	Tea	SPI	–	Urban	C / D
77	41st Street	Signal	Interchange	Urban	F / F
82	Benson Road	SPI	–	Urban	E / F
98	Dell Rapids	TWSC	SB	Rural	E / C
133	Brookings / Huron	TWSC	NB	Urban	C / E
			I-90		
10	North Avenue / Belle Fourche	TWSC	EB	Urban	C / F
10	North Avenue / Belle Fourche	TWSC	WB	Urban	C / F
12	Jackson Blvd	TWSC	EB	Urban	C / B
12	Jackson Blvd	TWSC	WB	Urban	E / D
14	27th Street / Spearfish Canyon	SPI	–	Urban	B / D
17	Lead / Deadwood	TWSC	WB	Urban	D / D
23	Whitewood	TWSC	EB	Rural	D / C
23	Whitewood	TWSC	WB	Rural	D / C
32	Junction Avenue	TWSC	EB	Urban	F / F
46	Elk Creek Road	TWSC	WB	Urban	E / B
48	Stage Stop Canyon Road	TWSC	WB	Urban	B / F
52	Black Hawk / Peaceful Pines Rd	TWSC	EB	Urban	B / D
59	LaCrosse Street	Signal	Interchange	Urban	C / F
61	Elk Vale Road	SPI	–	Urban	F / E
63	Box Elder / Ellsworth AFB	TWSC	EB	Urban	F / F
63	Box Elder / Ellsworth AFB	TWSC	WB	Urban	F / F
67	Liberty Blvd / Ellsworth AFB	TWSC	EB	Urban	F / F
67	Liberty Blvd / Ellsworth AFB	TWSC	WB	Urban	F / C

Table 2-19. 2050 Interchanges That Exceed Traffic Operations Goals

Exit	Location	Int. Type	Direction	Urban/Rural	LOS (AM/PM)
330	Mitchell / Huron	TWSC	EB	Urban	F / F
330	Mitchell / Huron	TWSC	WB	Urban	D / F
387	Hartford	TWSC	EB	Rural	E / B
387	Hartford	TWSC	WB	Rural	B / F
390	SD38 / Hartford	TWSC	EB	Rural	D / C
390	SD38 / Hartford	TWSC	WB	Rural	A / C
395	Marion Road	TWSC	EB	Urban	C / F
395	Marion Road	TWSC	WB	Urban	B / F
402*	US Geological Survey / EROS	SPI	–	Urban	F / B
406	Brandon / Corson	TWSC	EB	Urban	F / F
406	Brandon / Corson	TWSC	WB	Urban	F / F
I-229					
1C	Louise Avenue	Signal	Interchange	Urban	B / D
2	Western Avenue	Signal	Interchange	Urban	C / D
3	Minnesota Avenue	Signal	Interchange	Urban	E / F
4	Cliff Avenue	Signal	Interchange	Urban	F / F
5	26th Street	Signal	Interchange	Urban	D / F
6	10th Street	SPI	–	Urban	E / E
7	Rice Street	Signal	Interchange	Urban	B / F
9	Benson Road	Signal	NB	Urban	F / F
9	Benson Road	TWSC	SB	Urban	F / D

* Exit 402 was evaluated as a stop-controlled diamond interchange under existing conditions. It has been evaluated as a SPI in the future year, reflecting SDDOT's recent interchange reconstruction.

In analysis Year 2050, 12 interchanges along I-29 did not meet traffic operations goals, 19 on I-90, 8 along I-229, and none on I-190. Most interchanges below the LOS criteria are TWSC, although 15 are signalized or SPI. Thirty-seven locations are projected to operate at LOS E or F during AM and/or PM peak hours.

2.5.4 System Reliability

Travel time reliability is a measure of how often travel on a given facility exceeds the typical or average travel time. These exceedances may be the result of weather, construction, incidents (crashes), and other events. The FHWA Office of Operations has obtained anonymized vehicle probe data and made them available to state and local agencies for use in assessing network reliability. This dataset is referred to as the National Performance Management Research Data Set or NPMRDS. For the 2020 ICS, the project team compiled two years of FHWA data to find locations and times where the 95th percentile travel time was exceeded along the Interstate System. These times and locations were then cross-referenced with weather, crash, and construction data to determine causes of non-recurring congestion.

After compiling the data, the following observations were made:

- Non-recurring congestion occurred across the Interstate System.
- Non-recurring congestion related to weather events occurred most frequently along I-29 between Watertown and Summit.
- Non-recurring congestion related to crashes did not show a discernable geographic pattern, but several of the crash hot spots matched weather hot spots.
- Construction projects (work zones) did cause non-recurring congestion. The locations coincided with work zones active each year across the network.

In the urbanized areas, the following observations were made:

- Non-recurring congestion was more likely in the outlying areas of the Rapid City MPO area, near Summerset and Box Elder. This may be because congestion within Rapid City is more common and is, therefore, considered recurring.
- Non-recurring congestion was also more likely in the outlying areas of the Sioux Falls MPO area but only to the west (Harford area) and south (Tea area). Again, the lack of non-recurring congestion in the urban core may be because congestion within Sioux Falls is more common.

Overall, the SDDOT has identified a target of 90 percent reliable person-miles traveled for South Dakota interstates, and they have benchmarked 2017 as being at 99.8 percent reliable. The ICS analyses show a systemwide reliability of 99.76 percent for both 2018 and 2019. Further details of the reliability analysis are provided in **Appendix G**.

2.6 Supplemental Analyses

The 2020 Decennial ICS also included several supplemental analyses. Each of these efforts is summarized in a separate technical memorandum. These memoranda are included as appendices to this report.

2.6.1 Truck Parking Evaluation

The truck parking evaluation examined a year of truck parking data along the ICS study corridors (I-29, I-90, I-190, and I-229). These data were used to find areas where trucks are parking, identify unauthorized parking locations, examine use of existing facilities, and make recommendations regarding potential future improvements. This effort builds on SDDOT's 2014 Rest Area Study and the 2018 Rest Area and Truck Pullout Truck Parking Analysis.

Data on truck parking were obtained from a vendor that collects anonymized truck movement data (time, speed, and location) across the country. Truck movement data were acquired in a 1-mile buffer (1/2 mile on either side) including and surrounding South Dakota's interstates. Trucks that were parked or moving slowly within the buffer were compiled to determine sites where trucks are parking. Almost 425 parking sites were identified, including 30 truck stops, 123 other private sites (gas stations, hotels, etc.), 43 DOT facilities (parking areas, rest stops, and ports of entry), and 226 unauthorized parking sites. Shipper sites (an additional 241 sites representing warehouses, factories, etc.) were excluded from the analysis as these sites are not available for truck parking, except for trucks specifically related to that shipper. Private sites (truck stops, gas stations, hotels, etc.) provide an average of 20 spaces per site, while unauthorized sites are typically much smaller, providing an average of about 3 spaces per site. Over 4,400 non-shipper spaces were identified along the Interstate System.

Once the sites were identified, parking utilization was evaluated. Expansion factors were developed to reflect the fact that the vendor's data reflect only a portion of trucks in the traffic stream. Data from the FHWA Freight Analysis Framework were used to develop future truck parking forecasts to reflect the 2050 ICS analysis year. Separate evaluations were conducted for public / private truck parking sites and for unauthorized parking sites.

The evaluation of public / private sites looked at 196 facilities. Both average and 90th percentile (peak) utilization were considered. The following observations were made during the future (2050) condition evaluation of the public / private truck parking sites:

- About 66 percent of the sites exhibited overcapacity conditions under average utilization, and about 81 percent of the sites exhibited overcapacity conditions under peak utilization.
- The top 10 most utilized sites were small facilities, with two truck parking spaces or less.

- Eight of the top 10 sites that were overcapacity were hotels and motels.
- Four of the top 10 sites that were overcapacity were in Sioux Falls, and another four were along I-90 between Spearfish and Rapid City.

The evaluation of public / private facilities identified improvements at 30 locations, including 9 locations for private investment and 21 locations for public investment. One identified private investment is already planned; SDDOT should encourage others as opportunities arise. The public investments include minor striping revisions within existing facilities, guide signing modifications, minor expansions within existing site footprints, and major site reconstructions. Nine of the public investments were identified in previous SDDOT studies. One full site reconstruction recommended in the previous studies has been implemented and the new facility is expected to open this fall.

The unauthorized truck parking evaluation considered over 200 unauthorized parking sites across the state. They consisted of on-street parking, parking lots where truck parking is prohibited, and interstate mainline / ramp shoulder parking. Since the on-street and shoulder parking sites were similar, they were evaluated together. The team examined how many times they were used over the course of the analysis year, size, and relationship to nearby public / private sites. Improvements were identified at 14 locations, including 11 sites for private investment and 3 locations for public investment. Unauthorized parking at parking lots was evaluated similarly to the public / private evaluation, looking at existing and future utilization. Improvements were identified at three locations, including one location for private investment and two locations for public investment.

Based on these efforts, the recommended improvements to address truck parking shortfalls are summarized in **Table 2-20**. Recommendations were made at 36 locations, including 12 sites for private investment and 24 locations for public investment. Public improvements are noted in the highlighted cells, while private investments are not highlighted. Further details can be found in the Truck Parking Assessment memorandum in **Appendix H**.

Table 2-20. Truck Parking Facility Recommendations

Location	Recommendation
I-29	
Exit 26 – Junction City	Private investment to replace lost capacity recommended if existing unauthorized parking lot is closed; otherwise no action.
Between Exit 38 and Exit 42	Construct new public facility northbound to complement existing SB facility. Available ROW may exist at approximately MRM 40.
Exit 47 – Beresford	Improve signing to redistribute truck parking demand.
Exit 77 – 41st Street, Sioux Falls	Support private investment in truck parking / detention lot northeast of the interchange.
Exit 83 – 60th Street North, Sioux Falls	Expand existing private facilities or construct additional private capacity along the W 60th Street N corridor between I-29 Exit 83 and I-90 Exit 399.
MRM 103 – Dell Rapids Truck Parking	Expand both NB and SB sites by 2 to 4 spaces.
MRM 121 – Ward Rest Area	Expand by 11 spaces.
Exit 132 – Brookings	Monitor existing vacant lot being used for truck parking. If lot is closed, support private investment for replacement capacity.
MRM 160 – Hidewood Truck Parking	Expand both NB and SB sites by 14 spaces each.
MRM 213 – Wilmot Information Center	Expand site by 6 spaces.
MRM 235 – Sisseton Port of Entry	Restripe parking area to gain 2 to 4 spaces.
MRM 250 – Glacial Lakes Rest Area	Expand site by 8 spaces.
I-90	
I-90 Exit 14 – Spearfish	Support private investment to address shortfalls at Exit 14 and Exit 17.
I-90 Exit 32 – Sturgis	Support private investment to address shortfalls at Exit 32 and at mainline facilities to the east and unauthorized parking at Exit 30.
MRM 41 – Tilford Truck Parking	Expand both EB and WB sites by 12 spaces each.
MRM 69 – Box Elder Truck Parking	Expand both EB and WB sites by 2 to 4 spaces to address shortfalls at each site and unauthorized parking at Exit 67.
MRM 99 – Wasta Truck Parking	Expand both EB and WB sites by 9 spaces.
Exit 110 – Wall	Support planned private investment that could relieve shortfalls to the west.
MRM 129 – Eastbound Cactus Flats Truck Parking	Expand EB site by 2 spaces.
MRM 138 – Westbound Cactus Flats Scenic Area	Expand WB scenic overlook by 12 spaces.
Exit 143 – Philip	Close existing unauthorized parking; provide signing to nearby facilities.

Table 2-20. Truck Parking Facility Recommendations

Location	Recommendation
MRM 166 – Belvidere Rest Area	Redesign and expand both EB and WB sites by 3 to 12 spaces.
MRM 188 – Okaton Truck Parking	Reconfigure existing facilities to expand capacity by 2 to 4 spaces in both directions.
Exit 191 / Exit 192 – Murdo	Support private investment to address shortfalls in Murdo, at adjacent SDDOT truck parking areas, and unauthorized on-street parking. Close unauthorized parking lots once private investment is available.
MRM 194 – Murdo Truck Parking	Expand existing facilities to increase capacity by 2 to 4 spaces in both directions.
MRM 218 / MRM 221 – Presho Rest Area	Expand existing facility to increase capacity by 7 spaces EB and 10 spaces WB.
Exit 251 – Gregory / Winner	Close existing unauthorized parking lot and provide signing regarding facilities at adjacent interchanges.
MRM 264 – Chamberlain Rest Area	Expand existing facility to increase capacity by 14 spaces.
MRM 301 – White Lake Rest Area	Expand existing facility to increase capacity by 6 spaces in each direction.
MRM 337 – Mitchell Truck Parking	Expand both EB and WB sites by 2 spaces; improve signing related to nearby facilities for WB truckers.
Exit 344 – Alexandria	Support private investment to address shortfalls in Alexandria and Spencer, at adjacent DOT truck parking areas, and to address unauthorized parking at Exit 350.
MRM 362 – Salem Rest Area	Expand existing facilities to increase capacity by 10 spaces in each direction.
Exit 387 – Hartford	Support private investment to address shortfalls in Humboldt and Hartford and to provide supplemental capacity at the edge of Sioux Falls.
Exit 399 – Cliff Avenue, Sioux Falls	Expand existing private facilities or construct additional private capacity along the W 60th Street N corridor between I-29 Exit 83 and I-90 Exit 399. Also addresses unauthorized on-street parking at Exit 395 and Exit 399.
Exit 406 – Brandon	Expand current private detention facility to address unauthorized on-street parking.
I-90 MRM 412 – Eastbound Valley Springs Rest Area	Expand existing EB facility to increase capacity by 10 spaces.

2.6.2 Median Cable Barrier Evaluation

The MCB evaluation consisted of two steps. First, criteria for MCBs along the Interstate System were developed based on national experience. Then, those criteria were applied to the ICS network to determine where MCBs could be appropriate. These efforts are documented in the Median Cable Barrier memorandum in **Appendix I**.

Median Cable Barrier Warrants

MCB warrants along South Dakota interstates were developed based on local conditions and national practice. The process began with the information in the SDDOT Road Design Manual and recommends that the process for interstates be expanded and formalized to reflect volume, median width, and crash history. Based on this effort, the warrant matrix on **Figure 2-10** was developed. For interstates in South Dakota, median barriers are recommended when the average daily volume exceeds 30,000 ADT and the median is less than 50' wide, with the type of barrier varying based on median width. At lower volumes or for wider medians, barriers should be considered when an average of 0.5 or more correctable injury / fatal crash per mile occurs based on the most recent 5-year crash history.

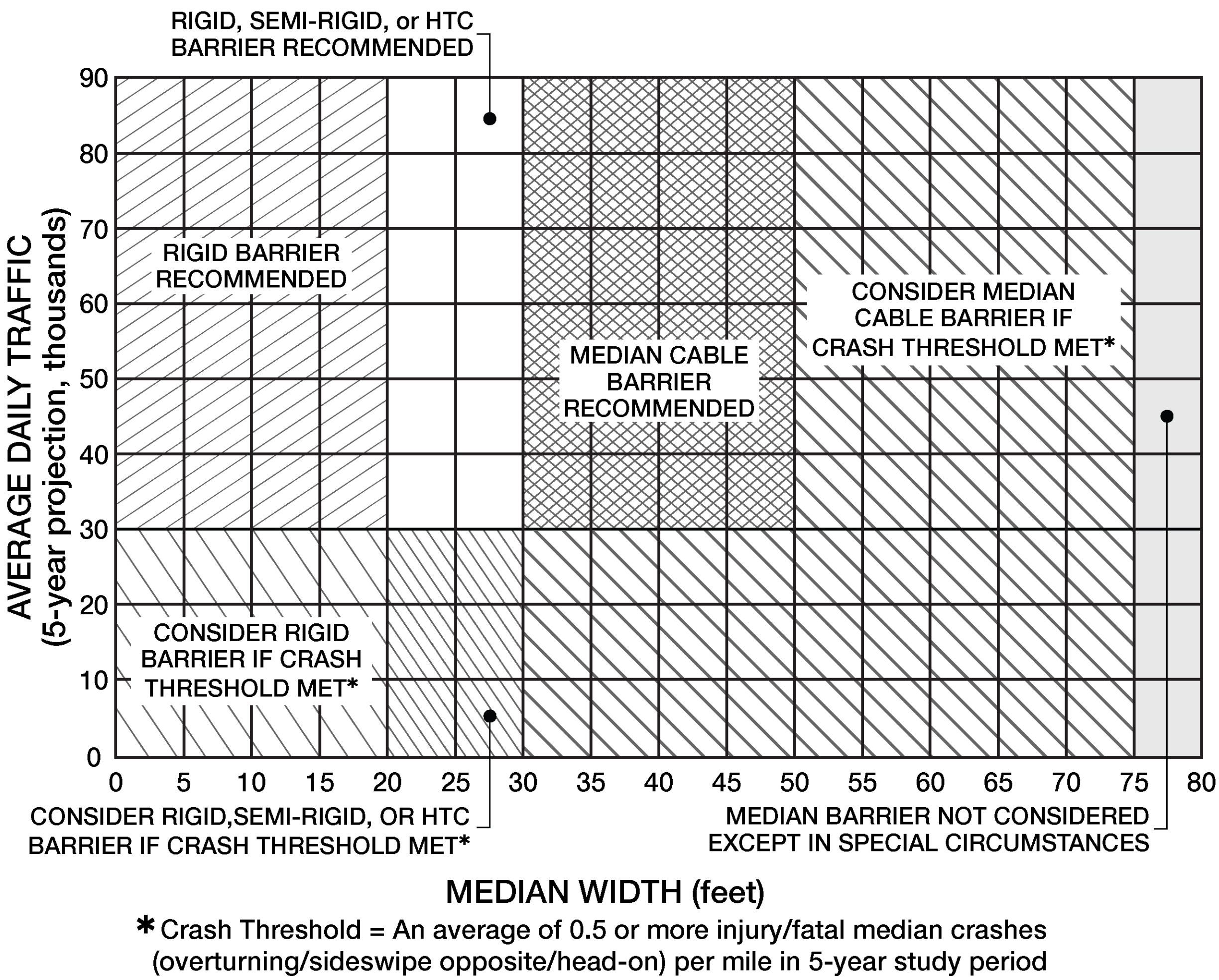


Figure 2-10. Median Barrier Warrants

The warrant memorandum also provides basic information about the design and implementation of MCBs, including median placement, cross slope considerations, truck and motorcycle considerations, and cable runs / median openings.

Median Cable Barrier Needs

The warrants above were applied across the ICS freeway network using the geometric, volume, and safety data compiled for other tasks. Based on this effort, locations for MCBs were identified. The recommendations from the analysis memorandum are summarized in **Table 2-21**.

Table 2-21. Recommended Median Barrier Locations

Location	Recommended Median Barrier*	Length*
	I-29	
MRM 17 to MRM 18	Install high-tension MCB between Exit 15 and Exit 18	3 miles
MRM 53 to MRM 54	Install high-tension MCB in interchange as part of interchange project	1 mile
MRM 67 to MRM 69	Install high-tension MCB from Beaver Creek to north side of Exit 68 (MRM 69)	2 miles
MRM 72 to MRM 73	Install high-tension MCB between Exit 71 and Exit 73 as part of the interstate project	2 miles
Exit 77 to Exit 80	Install high-tension MCB between these interchanges	3 miles
Exit 75 to Exit 77	Extend high-tension MCB in Exit 77 to Exit 80 project south to Exit 75	2 miles
Exit 80 to Exit 83	Extend high-tension MCB in Exit 77 to Exit 80 project north to Exit 83	3 miles
MRM 102 to MRM 103	Install high-tension MCB between MRM 101.8 (243rd Street) and MRM 103.8 (241st Street) as part of truck parking project	2 miles
MRM 110 to MRM 111, MRM 113 to MRM 114	Install high-tension MCB between Exit 109 and Exit 114	5 miles
MRM 147 to MRM 148	Install high-tension MCB from MRM 147.5 to MRM 148	½ mile
	I-90	
MRM 12 to MRM 14	Monitor for future MCB installation	(none)
MRM 36 to MRM 37, MRM 38 to MRM 39, MRM 40 to MRM 41	Install high-tension MCB between MRM 36 and MRM 41	5 miles
MRM 48 to MRM 49	Install high-tension MCB from ½ mile west of Exit 48 to ½ mile east of Exit 48	1 mile
MRM 52 to MRM 53, MRM 54 to MRM 55, MRM 56 to MRM 57	Install high-tension MCB between MRM 52 and MRM 57; possibly combined with interchange and mainline projects identified elsewhere in the ICS	5 miles
MRM 59 to MRM 60	Install high-tension MCB between the Lacrosse Street overpass and MRM 59.75 as part of planned Exit 59 interchange project	½ mile
MRM 63 to MRM 64	Install high-tension MCB between the existing crossover at MRM 62.8 and the Highway 1416 overpass as part of planned Exit 63 interchange project	1 mile
MRM 183 to MRM 184	Monitor for future MCB installation	(none)
MRM 303 to MRM 304	Install high-tension MCB between 380th Avenue (MRM 302.8) and MRM 304	1¼ miles
MRM 344 to MRM 345, MRM 346 to MRM 348	Install high-tension MCB between Exit 344 (MRM 344.5) and MRM 348	3½ miles

Table 2-21. Recommended Median Barrier Locations

Location	Recommended Median Barrier*	Length*
MRM 369 to MRM 370	Install high-tension MCB between MRM 369 and MRM 370 (447th Avenue overpass)	1 mile
MRM 396 to MRM 397	Install high-tension MCB through interchange (from MRM 396 to MRM 397), replacing and consolidating existing MCB as appropriate	1 mile
MRM 401 to MRM 402	Install high-tension MCB between the existing crossover at MRM 401.2 and the existing crossover at MRM 402	¾ mile
I-229		
MRM 2 to MRM 4	Install high-tension MCB between Exit 2 and Exit 4 as part of the projects stemming from the I-229 Major Investment Study	2 miles
MRM 5 to MRM 7	Install new high-tenon MCB between MRM 5 and the Big Sioux River as part of the projects stemming from I-229 Major Investment Study. Retain existing median barriers between the Big Sioux River and MRM 7.1	¾ mile
MRM 8 to MRM 9	Install high-tension MCB between Exit 7 and Exit 9 as part of the projects stemming from the I-229 Major Investment Study	2 miles

* Exact placement to be determined based on detailed project definitions. Distances shown are approximate.

2.6.3 Blowing Snow Analysis

Snow routinely drifts on portions of the Interstate System, exacerbating winter traffic safety concerns. An evaluation was performed to identify the locations where blowing snow is contributing to safety concerns, to reach a shortlist of five candidate locations, and to develop potential improvements for the five locations. This report summarizes the analysis process and the hierarchy of problem areas. Additional detailed study and conceptual layout information is provided in **Appendix J**.

Determination of Problem Areas

The following sources of information were used to identify blowing and drifting snow problem areas:

- SDDOT Initial Stakeholder Survey and Workshop – The project team circulated a survey to SDDOT staff to gather input regarding recurring blowing snow problem areas in early 2020. As a follow-up to the survey, a workshop among consultant and SDDOT staff from across the state was held on January 30, 2020. Information from completed surveys and from the meeting discussion was used to create an initial list of problem areas. The SDDOT input includes areas routinely noted by engineering and maintenance staff as blowing snow collection areas. Some of these collection areas show elevated wintry crash frequency. However, many of the locations do not show elevated wintry crash frequency, likely because the blowing snow causes the roadway to close to traffic.
- Wintry Crash History by 2-mile segment – The history of reported crashes that occurred on mainline interstate segments between 2014 and 2018 with a coincident snowy, slushy, or icy

roadway condition was compiled into 2-mile segments across the system. Segments were ranked based on frequency and severity of crashes. Crash locations were also scanned to determine whether any concentrations could be found within sections shorter than 2 miles in length.

- SDDOT Second Workshop – A second workshop was held in September 2020 to share the wintry crash history findings and to refine the list of top locations for further consideration. The meeting and added follow-up analyses resulted in the selection of top locations for more detailed evaluation.

The results of the problem area identification effort are tabulated in **Table 2-22**.

Table 2-22. Blowing Snow Problem Areas for Initial Consideration

Begin MRM	End MRM	Source[1]	Detailed MRM Location (if available)	Ranking based on Wintry Crashes		Potential for Further Consideration
				Total	Severe	
			I-29			
14	16	SI	15–16	131	87	Moderate
18	20	SI	19.6-20	121	111	Moderate
25	27	SI	25–25.5	150	157	Moderate
34	36	SI	34.1-36.4	90	75	Moderate
35	37	SI	34.1–36.4	51	45	Moderate
42	44	SI	42-43.1	65	29	Moderate
55	57	WCH	55.5–57	45	27	Moderate
70	72	SI, WCH	70–73	57	28	Low
71	73	SI, WCH	70–73	35	40	Low
72	74	WCH		9	21	Low
97	99	SI	98	72	140	Moderate
99	101	WCH	99.4–100.4	13	58	High
102	104	WCH		50	16	Low
103	105	WCH		28	11	Low
114	116	WCH		23	4	Low
115	117	WCH		17	7	Low
118	120	SI	118.9–119.1	52	46	Low
122	124	WCH		49	5	Low
123	125	WCH		27	8	Low
163	165	WCH	164-165	29	12	Moderate

Table 2-22. Blowing Snow Problem Areas for Initial Consideration

Begin MRM	End MRM	Source[1]	Detailed MRM Location (if available)	Ranking based on Wintry Crashes		Potential for Further Consideration
				Total	Severe	
164	166	WCH	164.5–165.1	56	17	Moderate
I-90						
15	17	SI		72	138	High
20	22	SI		84	140	Moderate
37	39	SI, WCH		7	6	High
62	64	WCH	62.7–64	15	33	Low
73	75	SI		173	112	High
79	81	SI	79.7–80.3	398	398	High
80	82	SI	80.9–81.2	232	194	Low
88	90	SI	89–90	112	262	High
112	114	SI	112.2–112.5	174	113	Low
170	173	SI, WCH	170.5–173	41	17	High
195	197	SI	195.9–197	70	84	High
224	226	SI	224.25–224.5	314	129	Moderate
239	243	SI		139	110	High
378	380	WCH	378.6–380	39	5	High

☐ = Location for more detailed evaluation

[1]SI = SDDOT Input; WCH = Wintry Crash History

As shown in **Table 2-22**, a total of 10 areas of concern along I-29 and I-90 were identified as having a high potential for further consideration. Those areas shown boxed in **Table 2-22** represent the five areas selected for more detailed evaluation. Criteria for creating the shortlist of locations included:

- SDDOT personnel input
- Crash severity and frequency
- Feasibility of blowing snow mitigation treatment(s)

Further analyses and preliminary design recommendations were developed for each of the five locations. **Appendix J** provides a full report including this information.

2.7 Conclusions

This chapter presents the evaluation of mainline and interchange geometrics, LCV movements through interchanges, bridge conditions and clearances, mainline and interchange safety, and mainline and interchange traffic operations. It also provides summaries of three systemwide evaluations: truck parking, MCBs, and blowing snow. Although shortcomings were identified in each category, the overall system is in reasonable condition.

The deficiencies identified in this chapter can be used in two ways:

- SDDOT staff can address smaller deficiencies during overlay, bridge rehabilitation, and other maintenance projects.
- The larger deficiencies have been compiled by location. The remainder of this report describes these larger needs. These subsequent efforts provide a guide for future capital investments across the South Dakota Interstate System.

3. SUMMARY OF INTERCHANGE NEEDS

The interchange deficiencies identified during the technical analyses described in **Chapter 2** have been compiled in **Table 3-1**. This table summarizes those components that do not meet individual criteria within each category. The evaluation categories presented include:

- Geometric Performance – These deficiencies are spread across 16 measures related to horizontal and vertical curves, sight distances, and other measures.
- Crashes – These deficiencies reflect locations with higher-than-average crash occurrences, including weighting for severity.
- Level of Service – These deficiencies reflect poor traffic operations at both ramp terminal intersections and at merge / diverge areas at the freeway ramps for each interchange. Results for both 2019 and 2050 are presented.

Highlighted cells in **Table 3-1** indicate locations where deficiencies have been identified.

Table 3-1. Interchange Conditions

Route and Exit	Geometric Performance: Max. Superelevation Rates	Minimum Radius	Maximum Degree of Curve	Clear Zone	Maximum Grade on Ramp	Minimum Lane Width	Minimum Right / Left Shoulder Width	Inslope	Minimum Off-Ramp / On-Ramp Taper	Minimum Ramp K Values	Minimum Ramp Stopping Sight Distance	Minimum Ramp Intersection Sight Distance	Minimum Crossroad k Values	Minimum Crossroad Stopping Sight Distance	Cross Road Grade (<0.5% or >7.0%)	Nearest Access (<100')	Crashes: Fatality / Injury / PDO	Weighted Total	Weighted Rate	State Rank by Rate	Level of Service (2019 / 2050): EB or NB Diverge	EB or NB Merge	WB or SB Diverge	WB or SB Merge	Interchange Type	EB or NB Ramp Terminal	WB or SB Ramp Terminal	Route and Exit
I-29																												
Exit 1	4.0%	330	SupImp	>30	4.0%	OK	2 / 2	4	20 / 50	39	228	OK	OK	571	0.25%	400	0 / 7 / 20	41	0.91	59	B / B	B / A	B / B	B / B	Signal/TWSC	C / B	C / D	Exit 1
Exit 2	-	1432	OK	>30	2.1%	OK	2 / 1	4	35 / 50	74	446	OK	OK	649	0.00%	150	0 / 2 / 16	22	0.79	65	A / A	B / B	B / B	A / B	Signal/TWSC	A / A	F / F	Exit 2
Exit 4	-	955	OK	<30	3.2%	OK	2 / 2	4	41 / 62	105	488	SupImp	OK	356	0.00%	310	0 / 0 / 2	2	0.14	120	B / B	B / B	A / B	B / B	TWSC	D / D	C / C	Exit 4
Exit 9	-	955	OK	>30	3.5%	OK	1 / 2	3	20 / 50	74	350	SupImp	OK	356	0.00%	525	0 / 1 / 0	3	0.64	76	A / B	A / B	A / A	A / A	TWSC	-	-	Exit 9
Exit 15	-	1432	OK	<30	3.0%	OK	4 / 1.5	3	24 / 29	72	349	SupImp	OK	349	0.00%	300	0 / 0 / 2	2	0.21	115	A / A	A / A	A / B	A / A	TWSC	A / A	B / B	Exit 15
Exit 18	n/a	n/a	n/a	n/a	1.1%	OK	3 / 2	3	21 / 25	18	26	OK	n/a	n/a	0.22%	60	0 / 0 / 0	0	0.00	122	A / A	A / A	A / A	A / A	TWSC	A / A	A / A	Exit 18
Exit 26	-	235	SupImp	<30	3.1%	OK	2 / 2	4	20 / 50	55	299	OK	OK	478	4.00%	440	0 / 1 / 11	14	0.51	91	A / A	A / A	A / A	A / A	TWSC	C / F	C / C	Exit 26
Exit 31	6.0%	1910	OK	<30	1.2%	OK	2 / 3	3	42 / 63	124	-	OK	OK	521	3.20%	372	0 / 1 / 0	3	0.56	85	A / B	A / A	A / B	A / B	TWSC	<1000 ADT		Exit 31
Exit 38	6.0%	1910	OK	<30	0.5%	OK	6 / 2	4	42 / 50	122	-	SupImp	-	421	4.96%	220	0 / 2 / 0	6	4.36	5	A / B	A / A	A / B	A / B	TWSC	<1000 ADT		Exit 38
Exit 42	6.0%	1910	OK	>30	1.6%	OK	5 / 1	4	35 / 50	54	290	OK	OK	500	0.40%	590	0 / 0 / 0	0	0.00	122	A / B	A / A	A / B	A / B	TWSC	<1000 ADT		Exit 42
Exit 47	6.2%	1432	OK	<30	3.8%	OK	7 / 2	3	42 / 63	89	439	OK	OK	569	3.14%	425	0 / 3 / 6	15	0.73	70	B / B	A / B	A / B	A / A	TWSC	A / C	B / F	Exit 47
Exit 50	6.2%	1432	OK	<30	2.9%	OK	4 / 2	3	42 / 63	50	368	OK	SupImp	356	4.25%	340	0 / 0 / 1	1	0.29	109	A / B	A / B	A / B	A / B	TWSC	<1000 ADT		Exit 50
Exit 53	6.2%	1432	OK	>30	3.8%	SupImp	5 / 2	3	42 / 63	64	333	SupImp	OK	415	3.14%	435	0 / 1 / 0	3	0.95	56	A / B	A / B	A / B	A / B	TWSC	<1000 ADT		Exit 53
Exit 56	6.2%	1432	OK	>30	1.1%	SupImp	4 / 2	3	29 / 42	182	-	SupImp	SupImp	334	0.27%	375	0 / 0 / 1	1	0.44	95	A / B	A / B	A / B	A / B	TWSC	<1000 ADT		Exit 56
Exit 59	6.2%	1432	OK	>30	3.1%	SupImp	4 / 2	3	29 / 42	106	577	OK	OK	569	3.00%	500	0 / 0 / 1	1	0.21	113	A / B	A / B	A / B	A / B	TWSC	A / B	A / A	Exit 59
Exit 62	4.0%	2300	OK	>30	3.0%	OK	8 / 1	6	21 / 29	110	366	OK	OK	561'	0.00%	100	0 / 0 / 5	5	0.44	97	A / B	A / B	B / C	A / B	TWSC	A / B	B / B	Exit 62
Exit 64	-	1432	OK	>30	2.9%	OK	2 / 3	4	29 / 29	59	330	OK	OK	434	3.00%	385	0 / 2 / 4	10	1.09	48	B / C	B / B	B / C	A / C	TWSC	B / B	A / B	Exit 64
Exit 68	-	1432	OK	>30	4.1%	OK	4 / 3	4	29 / 29	71	-	OK	SupImp	356	0.00%	330	0 / 1 / 7	10	0.77	66	C / C	B / C	B / C	B / C	TWSC	B / C	A / B	Exit 68
Exit 71	-	955	OK	>30	2.2%	OK	3 / 3	4	29 / 29	79	-	SupImp	SupImp	414	4.00%	140	1 / 1 / 4	19	1.08	49	B / D	B / C	B / E	A / C	TWSC	A / F	C / F	Exit 71
Exit 73	-	-	OK	n/a	-	OK	- / -	-	- / -	-	-	n/a	OK	n/a	0.03%	270	0 / 14 / 75	117	1.75	35	C / D	C / D	A / C	A / D	SPI	C / D		Exit 73
Exit 74	n/a	n/a	n/a	n/a	n/a	n/a	n/a / n/a	n/a	n/a / n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	- / E	- / E	- / C	- / C	Signal	- / C		Exit 74
Exit 75	6.0%	768	SupImp	n/a	1.0%	SupImp	- / 2	5	- / -	-	-	n/a	n/a	n/a	0.00%	>660	0 / 0 / 15	15	0.13	121	B / C	B / B	B / B	B / C	System	-		Exit 75
Exit 77	-	1145.9	OK	>30	4.0%	OK	2 / 2	2	52 / 15	80	-	OK	-	>425'	0.00%	200	0 / 89 / 272	539	4.78	3	B / B	*weave*	*weave*	A / C	Signal	D / F		Exit 77
Exit 78	n/a	572.96	SupImp	n/a	n/a	OK	3 / 2	-	- / -	-	-	OK	n/a	n/a	0.00%	>660	0 / 28 / 90	174	1.83	34	*weave*	*weave*	*weave*	*weave*	Signal	C / C		Exit 78
Exit 79	-	-	SupImp	-	-	OK	- / -	-	- / -	-	n/a	OK	SupImp	n/a	0.40%	225	0 / 34 / 110	212	2.31	21	*weave*	*weave*	*weave*	*weave*	SPI	B / C		Exit 79

Table 3-1. Interchange Conditions

Route and Exit	Geometric Performance: Max. Superelevation Rates	Minimum Radius	Maximum Degree of Curve	Clear Zone	Maximum Grade on Ramp	Minimum Lane Width	Minimum Right / Left Shoulder Width	Inslope	Minimum Off-Ramp / On-Ramp Taper	Minimum Ramp K Values	Minimum Ramp Stopping Sight Distance	Minimum Ramp Intersection Sight Distance	Minimum Crossroad k Values	Minimum Crossroad Stopping Sight Distance	Cross Road Grade (<0.5% or >7.0%)	Nearest Access (<100')	Crashes: Fatality / Injury / PDO	Weighted Total	Weighted Rate	State Rank by Rate	Level of Service (2019 / 2050): EB or NB Diverge	EB or NB Merge	WB or SB Diverge	WB or SB Merge	Interchange Type	EB or NB Ramp Terminal	WB or SB Ramp Terminal	Route and Exit
Exit 80	-	-	SupImp	-	-	SupImp	1 / 1	-	- / -	-	n/a	OK	SupImp	n/a	2.70%	580	0 / 3 / 35	44	1.60	36	*weave*	B / E	*weave*	*weave*	SPI	B / B		Exit 80
Exit 81	6.0%	286.48	SupImp	n/a	3.1%	SupImp	0.5 / 2	4	- / -	-	-	OK	n/a	n/a	3.50%	106	0 / 16 / 79	127	2.23	22	*weave*	A / A	*weave*	*weave*	Signal	D / C		Exit 81
Exit 82	-	-	SupImp	n/a	-	OK	N/A / 2	-	- / -	-	-	OK	-	n/a	0.30%	230	0 / 4 / 14	26	1.02	53	A / A	*weave*	*weave*	*weave*	SPI	C / F		Exit 82
Exit 83	6.0%	306.87	SupImp	n/a	2.6%	OK	2 / 2	4	- / -	-	-	OK	n/a	n/a	0.00%	330	0 / 18 / 45	99	2.51	16	*weave*	B / B	B / B	*weave*	Signal	B / C		Exit 83
Exit 84	n/a	n/a	n/a	n/a	n/a	n/a	n/a / n/a	n/a	n/a / n/a	n/a	n/a	OK	n/a	n/a	0.00%	330	-	-	-	-	B / B	A / A	A / B	B / B	System	-		Exit 84
Exit 86	5.0%	1910	OK	>30	3.6%	OK	6 / 3	3	41 / 62	117	547	OK	-	551	2.96%	151	0 / 2 / 6	12	0.81	64	A / A	A / A	B / B	A / B	TWSC	A / B	A / B	Exit 86
Exit 94	4.2%	1910	OK	>30	2.5%	SupImp	8 / 2	4	40 / 61	53	-	OK	-	1004	0.20%	360	1 / 1 / 5	20	1.55	38	A / B	B / B	A / A	A / A	TWSC	A / B	A / B	Exit 94
Exit 98	4.0%	2300	OK	>30	3.4%	OK	8 / 2	6	20 / 42	185	-	OK	OK	689	0.30%	405	0 / 3 / 5	14	1.12	47	A / B	A / B	A / A	B / A	TWSC	A / A	C / E	Exit 98
Exit 104	5.0%	1910	OK	>30	3.0%	OK	6 / 3	4	40 / 61	101	-	SupImp	OK	637	0.07%	500	0 / 0 / 1	1	0.23	112	A / B	A / B	A / A	A / A	TWSC	<1000 ADT		Exit 104
Exit 109	5.0%	1910	OK	>30	2.8%	OK	4 / 4	4	40 / 61	118	-	OK	OK	877	0.20%	512	0 / 5 / 14	29	1.88	31	A / A	A / A	A / A	A / A	TWSC	B / B	A / A	Exit 109
Exit 114	4.2%	1910	OK	>30	4.0%	OK	6 / 2	4	25 / 50	89	-	OK	OK	596	3.00%	365	0 / 1 / 4	7	1.29	41	A / A	A / A	A / A	A / A	TWSC	A / A	A / A	Exit 114
Exit 121	5.0%	1910	OK	>30	2.7%	OK	1 / 1	4	40 / 50	63	-	OK	OK	625	2.31%	340	0 / 0 / 2	2	0.48	94	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 121
Exit 127	5.0%	1910	OK	>30	1.1%	SupImp	5 / 4	4	20 / 50	254	-	OK	OK	608	0.48%	490	0 / 1 / 5	8	0.88	61	A / A	A / A	B / A	A / A	TWSC	B / B	B / B	Exit 127
Exit 130	n/a	n/a	n/a	n/a	n/a	n/a	n/a / n/a	n/a	n/a / n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	- / A	- / A	- / A	- / A	Signal	- / A	- / A	Exit 130
Exit 132	5.0%	1909	OK	>30	2.3%	OK	3 / 3	4	20 / 61	169	-	OK	-	792	0.28%	490	0 / 14 / 28	70	1.84	33	A / A	*weave*	*weave*	A / A	Signal/TWSC	A / B	B / C	Exit 132
Exit 133	5.0%	333	SupImp	>30	1.7%	OK	7 / 2	4	25 / 50	197	-	OK	OK	786	2.05%	530	0 / 1 / 9	12	0.71	71	*weave*	A / A	A / A	*weave*	TWSC	C / E	B / B	Exit 133
Exit 140	4.4%	1910	OK	>30	1.8%	OK	4 / 3	6	40 / 50	90	434	OK	OK	736	3.18%	625	0 / 1 / 3	6	1.23	44	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 140
Exit 150	5.0%	1910	OK	>30	2.0%	OK	2 / 2	6	- / -	-	-	OK	OK	865	0.10%	325	0 / 2 / 3	9	1.14	46	A / A	A / A	A / A	A / A	TWSC	A / A	A / A	Exit 150
Exit 157	5.0%	1910	OK	>30	2.0%	OK	3 / 2	6	40 / 61	107	478	OK	-	2060	0.30%	310	0 / 0 / 0	0	0.00	122	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 157
Exit 164	5.0%	1910	OK	>30	3.0%	OK	2 / 1	6	40 / 61	71	335	OK	OK	917	2.25%	320	0 / 0 / 3	3	0.50	93	A / A	A / A	A / A	A / A	TWSC	A / A	A / A	Exit 164
Exit 177	6.0%	1910	OK	>30	2.3%	OK	3 / 2	6	39 / 50	161	-	OK	-	>425'	-	370	0 / 6 / 28	46	1.27	42	A / A	A / A	A / A	A / A	Signal/TWSC	A / B	A / B	Exit 177
Exit 180	5.0%	1910	OK	>30	2.0%	OK	4 / 3	6	40 / 61	206	891	SupImp	OK	414	2.77%	535	0 / 0 / 3	3	0.53	88	A / A	A / A	A / A	A / A	TWSC	A / B	A / A	Exit 180
Exit 185	5.0%	1910	OK	>30	1.2%	OK	4 / 2	6	38 / 50	163	-	OK	-	-	2.77%	515	0 / 1 / 1	4	1.92	29	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 185
Exit 193	5.0%	1910	OK	>30	4.2%	OK	6 / 3	6	38 / 49	96	496	OK	OK	1155	2.15%	485	0 / 0 / 2	2	0.62	79	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 193
Exit 201	5.0%	1910	OK	>30	2.0%	SupImp	4 / 3	6	20 / 49	127	538	OK	-	823	0.12%	250	0 / 0 / 0	0	0.00	122	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 201
Exit 207	6.0%	1146	OK	>30	2.8%	SupImp	8 / 1	4	50 / 141	85	386	OK	-	>425'	0.17%	>660	0 / 9 / 18	45	3.24	8	A / A	A / A	A / A	A / A	TWSC	A / A	A / A	Exit 207

Table 3-1. Interchange Conditions

Route and Exit	Geometric Performance																Crashes				Level of Service (2019 / 2050)							Route and Exit
	Max. Superelevation Rates	Minimum Radius	Maximum Degree of Curve	Clear Zone	Maximum Grade on Ramp	Minimum Lane Width	Minimum Right / Left Shoulder Width	Inslope	Minimum Off-Ramp / On-Ramp Taper	Minimum Ramp K Values	Minimum Ramp Stopping Sight Distance	Minimum Ramp Intersection Sight Distance	Minimum Crossroad k Values	Minimum Crossroad Stopping Sight Distance	Cross Road Grade (<0.5% or >7.0%)	Nearest Access (<100')	Fatality / Injury / PDO	Weighted Total	Weighted Rate	State Rank by Rate	EB or NB Diverge	EB or NB Merge	WB or SB Diverge	WB or SB Merge	Interchange Type	EB or NB Ramp Terminal	WB or SB Ramp Terminal	
Exit 213	4.8%	1910	OK	>30	6.6%	OK	3 / 3	6	20 / 55	71	338	OK	OK	500	2.88%	375	0 / 0 / 1	1	0.42	98	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 213
Exit 224	4.4%	1910	OK	>30	2.4%	OK	2 / 3	6	20 / 50	152	660	OK	-	>425'	0.08%	300	0 / 0 / 0	0	0.00	122	A / A	A / A	A / A	A / A	TWSC	A / A	A / A	Exit 224
Exit 232	6.0%	1910	OK	>30	3.4%	SupImp	3 / 3	4	- / -	-	-	OK	-	813	3.17%	420	0 / 2 / 5	11	0.76	67	A / A	A / A	A / A	A / A	TWSC	B / B	A / A	Exit 232
Exit 242	5.0%	1910	OK	>30	2.2%	OK	4 / 2	5	20 / 50	141	647	OK	-	>425'	-	300	0 / 0 / 0	0	0.00	122	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 242
Exit 246	N/A	1910	OK	>30	2.3%	OK	3 / 3	5	20 / 50	205	670	OK	-	-	0.15%	390	0 / 0 / 0	0	0.00	122	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 246
I-90																												
Exit 2	4.2%	1909.86	OK	>30	3.4%	OK	4 / 2	6	20 / 26	248	898	OK	-	-	2.18%	200	0 / 0 / 0	0	0.00	122	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 2
Exit 8	2.0%	1909.86	OK	>30	3.4%	OK	8 / 2	6	28 / 26	199	-	OK	n/a	n/a	0.00%	200	0 / 0 / 3	3	0.17	118	A / A	A / A	A / A	A / A	TWSC	A / B	A / C	Exit 8
Exit 10	-	n/a	OK	n/a	-	OK	6 / 4	4	20 / 46	22	-	OK	n/a	n/a	0.00%	100	0 / 15 / 41	86	2.58	14	A / A	A / A	B / B	A / A	TWSC	C / D	B / F	Exit 10
Exit 12	5.4%	1909.86	OK	>30	5.0%	OK	6 / 4	4	20 / 50	22	276	OK	OK	520	6.00%	500	0 / 3 / 9	18	0.55	87	B / B	B / B	A / A	B / B	TWSC	B / C	B / E	Exit 12
Exit 14	-	-	SupImp	-	-	OK	8 / -	-	- / -	-	-	OK	OK	462.43	3.40%	200	0 / 3 / 14	23	0.70	72	B / B	B / B	B / B	B / B	SPI	C / D		Exit 14
Exit 16	n/a	n/a	n/a	n/a	n/a	n/a	n/a / n/a	n/a	n/a / n/a	n/a	n/a	OK	OK	462.43	3.40%	200	-	-	-	-	A / A	A / A	A / A	A / A	-	-	-	Exit 16
Exit 17	5.9%	954.93	OK	>30	3.0%	OK	6 / 4	4	12 / 50	75	490	OK	-	1039	4.50%	90	0 / 4 / 7	19	0.94	57	B / B	A / A	B / B	B / B	TWSC	A / B	C / D	Exit 17
Exit 23	5.0%	1910	OK	>30	4.1%	SupImp	4 / 2	4	39 / 61	104	479	SupImp	OK	238	2.76%	310	0 / 1 / 5	8	0.33	106	A / B	A / B	A / A	A / B	TWSC	B / D	B / D	Exit 23
Exit 30	7.7%	573	SupImp	>30	4.1%	OK	1 / 2	4	20 / 49	46	317	OK	OK	497	-	150	0 / 13 / 9	48	1.39	39	A / B	A / A	A / A	A / B	Signal	B / B		Exit 30
Exit 32	5.9%	300	SupImp	n/a	4.4%	OK	4 / 2	4	20 / 34	17	-	OK	OK	n/a	3.60%	300	0 / 3 / 6	15	0.52	90	A / B	A / B	A / B	A / B	TWSC	C / F	B / C	Exit 32
Exit 34	-	2865	OK	>30	3.3%	SupImp	6 / 4	4	37 / 37	100	509	SupImp	SupImp	188	-	15	0 / 0 / 0	0	0.00	122	A / B	A / B	B / B	A / B	TWSC	A / A	A / A	Exit 34
Exit 37	5.0%	1432	OK	>30	5.6%	SupImp	6 / 4	4	26 / 50	70	-	OK	OK	178	-	>660	0 / 1 / 1	4	1.02	52	A / B	B / B	B / B	A / B	TWSC	A / A	A / A	Exit 37
Exit 40	5.0%	230	SupImp	>30	1.5%	OK	6 / 2	4	20 / 50	198	-	OK	OK	288	6.00%	50	0 / 0 / 2	2	0.69	73	A / B	A / B	A / B	A / B	TWSC	<1000 ADT		Exit 40
Exit 44	3.8%	1080	OK	>30	1.8%	OK	10 / 2	6	17 / 21	35	318	OK	-	165	0.35%	200	0 / 0 / 0	0	0.00	122	B / B	A / B	B / D	B / B	TWSC	A / A	A / A	Exit 44
Exit 46	n/a	310	n/a	>30	1.5%	OK	2 / 2	3	17 / 21	n/a	n/a	SupImp	n/a	n/a	0.00%	25	0 / 2 / 13	19	1.21	45	A / B	B / B	B / D	A / B	TWSC	C / C	D / E	Exit 46
Exit 48	n/a	310	n/a	>30	2.5%	OK	4 / 4	3	17 / 21	110	-	OK	SupImp	393	0.00%	50	0 / 1 / 3	6	0.41	99	B / B	B / B	B / D	B / B	TWSC	B / B	C / F	Exit 48
Exit 52	n/a	n/a	n/a	n/a	n/a	n/a	n/a / n/a	n/a	n/a / n/a	n/a	n/a	OK	SupImp	393	0.00%	50	0 / 2 / 11	17	0.76	68	B / C	B / B	B / E	B / C	TWSC	C / D	B / B	Exit 52
Exit 55	2.0%	n/a	n/a	>30	5.0%	SupImp	2 / 2	4	n/a / n/a	n/a	246	OK	SupImp	460	0.00%	50	0 / 10 / 11	41	0.76	69	B / B	B / B	B / F	B / B	Signal	B / B		Exit 55
Exit 57	n/a	n/a	n/a	n/a	n/a	n/a	n/a / n/a	n/a	n/a / n/a	n/a	n/a	n/a	n/a	n/a	0.00%	>660	0 / 7 / 30	51	0.53	89	B / E	weave	weave	B / E	System	-		Exit 57
Exit 58	-	-	OK	-	-	SupImp	- / -	-	- / -	-	-	OK	OK	N/A	0.41%	200	0 / 16 / 50	98	2.12	24	weave	B / D	B / D	weave	SPI	C / C		Exit 58

Table 3-1. Interchange Conditions

Route and Exit	Geometric Performance															Crashes				Level of Service (2019 / 2050)							Route and Exit
	Max. Superelevation Rates	Minimum Radius	Maximum Degree of Curve	Clear Zone	Maximum Grade on Ramp	Minimum Lane Width	Minimum Right / Left Shoulder Width	Inslope	Minimum Off-Ramp / On-Ramp Taper	Minimum Ramp K Values	Minimum Ramp Stopping Sight Distance	Minimum Ramp Intersection Sight Distance	Minimum Crossroad k Values	Minimum Crossroad Stopping Sight Distance	Cross Road Grade (<0.5% or >7.0%)	Nearest Access (<100')	Fatality / Injury / PDO	Weighted Total	Weighted Rate	State Rank by Rate	EB or NB Diverge	EB or NB Merge	WB or SB Diverge	WB or SB Merge	Interchange Type	EB or NB Ramp Terminal	WB or SB Ramp Terminal	
Exit 59	2.0%	n/a	n/a	>30	3.1%	OK	1 / 1	4	n/a / n/a	n/a	-	OK	n/a	-	0.00%	100	1 / 30 / 64	166	2.74	12	B / D	B / C	B / C	B / D	Signal	C / F		Exit 59
Exit 60	-	-	OK	n/a	-	OK	- / -	-	- / -	-	-	OK	n/a	n/a	0.00%	500	0 / 16 / 30	78	2.01	27	B / D	B / D	B / C	B / D	SPI	B / B		Exit 60
Exit 61	-	-	OK	n/a	-	OK	- / -	-	- / -	-	-	OK	n/a	n/a	4.22%	250	1 / 15 / 66	123	1.55	37	B / D	B / C	B / C	B / D	SPI	B / F		Exit 61
Exit 63	n/a	n/a	n/a	n/a	n/a	n/a	n/a / n/a	n/a	n/a / n/a	n/a	n/a	-	-	-	-	-	0 / 8 / 25	49	1.37	40	B / D	- / -	- / -	B / D	TWSC	F / F	D / F	Exit 63
Exit 67	6.0%	358	SupImp	n/a	5.8%	SupImp	8 / 2	4	19 / 51	22	-	OK	OK	n/a	5.35%	600	1 / 1 / 6	21	0.96	55	A / B	A / A	A / B	A / B	TWSC	E / F	B / F	Exit 67
Exit 78	n/a	1432	n/a	>30	4.3%	SupImp	4 / 2	4	29 / 29	61	310	OK	OK	514	0.25%	>660	0 / 0 / 2	2	0.34	102	A / A	A / A	A / A	A / A	TWSC	A / A	A / A	Exit 78
Exit 84	n/a	1432	n/a	>30	4.0%	SupImp	4 / 2	4	29 / 29	65	318	OK	OK	400	4.00%	500	0 / 0 / 0	0	0.00	122	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 84
Exit 88	n/a	n/a	n/a	n/a	n/a	n/a	n/a / n/a	n/a	n/a / n/a	n/a	n/a	OK	OK	550	4.00%	480	0 / 0 / 0	0	0.00	122	A / A	- / -	- / -	A / A	TWSC	<1000 ADT		Exit 88
Exit 90	n/a	1432	n/a	>30	4.9%	OK	6 / 4	4	29 / 29	106	628	OK	-	655	2.33%	> 660	0 / 0 / 0	0	0.00	122	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 90
Exit 98	n/a	n/a	n/a	n/a	n/a	n/a	n/a / n/a	n/a	n/a / n/a	n/a	n/a	OK	OK	1017	0.00%	50	0 / 0 / 3	3	2.10	25	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 98
Exit 101	n/a	n/a	n/a	n/a	n/a	n/a	n/a / n/a	n/a	n/a / n/a	n/a	n/a	OK	-	470	6.00%	100	0 / 0 / 0	0	0.00	122	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 101
Exit 107	6.0%	819	SupImp	>30	1.5%	OK	4 / 4	6	40 / 61	98	-	OK	OK	603	4.00%	>660	0 / 0 / 0	0	0.00	122	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 107
Exit 109	4.4%	1910	OK	>30	2.4%	OK	6 / 2	6	- / -	-	449	OK	OK	399	3.00%	85	0 / 0 / 1	1	0.33	105	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 109
Exit 110	5.9%	955	OK	>30	2.4%	OK	4 / 2	6	- / -	-	443	OK	SupImp	350	0.12%	100	0 / 0 / 4	4	0.61	80	A / A	A / A	A / A	A / A	TWSC	A / A	A / A	Exit 110
Exit 112	6.0%	200	SupImp	>30	2.6%	SupImp	6 / 2	6	32 / 52	294	597	-	-	-	-	>660	0 / 0 / 1	1	0.30	108	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 112
Exit 116	5.0%	1910	OK	>30	3.3%	OK	8 / 2	6	20 / 40	149	603	OK	-	1793	0.25%	300	0 / 0 / 0	0	0.00	122	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 116
Exit 121	6.0%	1910	OK	>30	2.6%	OK	8 / 2	6	20 / 52	149	579	OK	OK	811	0.32%	>660	0 / 0 / 0	0	0.00	122	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 121
Exit 127	5.4%	1910	OK	>30	2.8%	OK	4 / 2	6	20 / 53	138	-	OK	OK	1267	3.00%	>660	0 / 0 / 0	0	0.00	122	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 127
Exit 131	5.4%	1910	OK	>30	-	OK	4 / 2	6	- / -	-	-	OK	n/a	n/a	0.00%	364	0 / 0 / 1	1	0.23	111	A / A	A / A	A / A	A / A	TWSC	A / A	A / A	Exit 131
Exit 143	4.4%	1910	OK	>30	3.2%	OK	2 / 2	3	40 / 61	143	666	OK	-	879	0.04%	200	0 / 0 / 1	1	0.25	110	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 143
Exit 150	3.0%	1910	OK	>30	2.8%	OK	2 / 2	5	40 / 61	163	-	OK	OK	819	0.30%	250	0 / 0 / 1	1	0.17	117	A / A	A / A	A / A	A / A	TWSC	A / A	A / A	Exit 150
Exit 152	3.0%	1910	OK	>30	1.7%	OK	2 / 1	5	40 / 61	134	561	OK	-	-	0.44%	125	0 / 0 / 1	1	0.31	107	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 152
Exit 163	5.0%	1910	OK	>30	2.5%	OK	2 / 2	5	20 / 54	159	729	OK	-	1339	0.28%	225	0 / 0 / 1	1	0.62	78	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 163
Exit 170	4.2%	1910	OK	>30	3.3%	SupImp	2 / 1	5	40 / 61	242	799	OK	-	-	-	225	0 / 0 / 2	2	0.85	62	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 170
Exit 172	4.2%	1910	OK	>30	2.3%	OK	2 / 2	5	32 / 60	127	528	OK	OK	538	4.10%	50	0 / 0 / 0	0	0.00	122	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 172
Exit 177	5.4%	1910	OK	>30	3.0%	OK	4 / 2	5	20 / 50	134	574	OK	N/A	N/A	0.00%	475	0 / 0 / 0	0	0.00	122	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 177

Table 3-1. Interchange Conditions

Route and Exit	Geometric Performance																Crashes				Level of Service (2019 / 2050)							Route and Exit
	Max. Superelevation Rates	Minimum Radius	Maximum Degree of Curve	Clear Zone	Maximum Grade on Ramp	Minimum Lane Width	Minimum Right / Left Shoulder Width	Inslope	Minimum Off-Ramp / On-Ramp Taper	Minimum Ramp K Values	Minimum Ramp Stopping Sight Distance	Minimum Ramp Intersection Sight Distance	Minimum Crossroad k Values	Minimum Crossroad Stopping Sight Distance	Cross Road Grade (<0.5% or >7.0%)	Nearest Access (<100')	Fatality / Injury / PDO	Weighted Total	Weighted Rate	State Rank by Rate	EB or NB Diverge	EB or NB Merge	WB or SB Diverge	WB or SB Merge	Interchange Type	EB or NB Ramp Terminal	WB or SB Ramp Terminal	
Exit 183	4.4%	1910	OK	>30	2.4%	OK	6 / 2	5	20 / 50	80	439	OK	-	366	0.07%	150	0 / 0 / 0	0	0.00	122	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 183
Exit 191	4.6%	1910	OK	>30	3.4%	OK	10 / 4	5	20 / 50	148	-	SupImp	OK	592	0.35%	>660	0 / 0 / 0	0	0.00	122	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 191
Exit 192	4.4%	1910	OK	>30	3.0%	OK	2 / 2	6	20 / 52	94	420	OK	OK	819	0.48%	250	0 / 1 / 5	8	0.83	63	A / A	A / A	A / A	A / A	TWSC	A / B	A / A	Exit 192
Exit 201	5.0%	1910	OK	>30	2.4%	OK	2 / 2	6	40 / 61	112	503	OK	-	-	1.25%	250	0 / 0 / 0	0	0.00	122	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 201
Exit 208	4.4%	1910	OK	>30	1.4%	OK	2 / 1	6	n/a / n/a	n/a	568	OK	-	797	0.30%	> 660	0 / 0 / 0	0	0.00	122	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 208
Exit 212	5.6%	1910	OK	>30	3.0%	OK	3 / 4	6	40 / 61	131	576	OK	-	>425	0.10%	300	0 / 1 / 2	5	0.59	81	A / A	A / A	A / A	A / A	TWSC	B / B	A / A	Exit 212
Exit 214	4.4%	1910	OK	>30	4.5%	OK	4 / 1	6	40 / 61	111	-	OK	OK	791	5.52%	262	0 / 0 / 0	0	0.00	122	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 214
Exit 220	5.0%	1910	OK	>30	3.5%	OK	4 / 2	6	40 / 61	98	464	OK	OK	598	0.00%	100	0 / 0 / 0	0	0.00	122	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 220
Exit 225	5.0%	1910	OK	>30	4.4%	OK	4 / 2	6	40 / 61	134	537	OK	-	14215	0.25%	400	0 / 0 / 1	1	0.97	54	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 225
Exit 226	n/a	1910	OK	>30	n/a	OK	2 / 2	6	40 / 61	n/a	n/a	OK	n/a	n/a	0.00%	250	0 / 0 / 1	1	0.40	100	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 226
Exit 235	5.0%	1910	OK	>30	4.7%	SupImp	8 / 2	6	40 / 61	90	442	OK	OK	500	0.00%	100	0 / 2 / 2	8	2.44	17	A / A	A / A	A / A	A / A	TWSC	A / A	A / A	Exit 235
Exit 241	n/a	1910	OK	>30	n/a	OK	2 / 1	6	40 / 61	0	n/a	OK	-	>425	0.28%	>660	0 / 0 / 0	0	0.00	122	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 241
Exit 248	4.2%	n/a	n/a	>30	n/a	OK	2 / 2	6	n/a / n/a	n/a	n/a	OK	OK	1246	0.08%	48	0 / 0 / 0	0	0.00	122	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 248
Exit 251	4.2%	n/a	N/A	>30	2.9%	OK	4 / N/A	6	40 / 58	77	427	OK	-	-	0.65%	200	0 / 0 / 0	0	0.00	122	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 251
Exit 260	-	1910	OK	>30	4.4%	OK	8 / 2	6	20 / 63	118	-	SupImp	-	349	4.75%	250	0 / 0 / 2	2	0.21	114	A / A	A / A	A / A	A / A	TWSC	A / A	A / A	Exit 260
Exit 263	6.0%	236	SupImp	>30	4.0%	SupImp	2 / 3	6	- / -	-	303	OK	-	> 425'	-	75	0 / 0 / 0	0	0.00	122	A / A	A / A	A / A	A / A	TWSC	A / A	A / A	Exit 263
Exit 264	n/a	n/a	n/a	n/a	n/a	n/a	n/a / n/a	n/a	n/a / n/a	n/a	n/a	OK	-	> 425'	-	75	-	-	-	-	-	-	-	-	-	-	-	Exit 264
Exit 265	4.2%	1910	OK	>30	1.0%	OK	4 / 2	4	40 / 61	91	588	OK	OK	600	3.00%	280	0 / 0 / 2	2	0.18	116	A / A	A / A	A / A	A / A	TWSC	B / B	A / A	Exit 265
Exit 272	-	1910	OK	>30	3.4%	OK	5 / 2	4	40 / 61	96	-	SupImp	OK	899	3.01%	460	0 / 0 / 1	1	0.67	75	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 272
Exit 284	3.5%	2865	OK	>30	2.4%	OK	3 / 3	4	39 / 58	115	550	OK	-	> 425	-	215	0 / 2 / 1	7	0.92	58	A / A	A / A	A / A	A / A	TWSC	A / A	A / A	Exit 284
Exit 289	5.0%	1910	OK	>30	1.7%	SupImp	5 / 2	4	40 / 61	131	805	SupImp	OK	471	3.00%	>300'	0 / 0 / 1	1	0.33	103	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 289
Exit 296	4.2%	1910	OK	>30	1.7%	OK	5 / 2	4	40 / 61	196	856	SupImp	OK	600	3.00%	160	1 / 0 / 0	12	5.83	2	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 296
Exit 308	4.2%	1910	OK	>30	1.1%	OK	6 / 2	4	20 / 50	144	1483	SupImp	OK	496	4.00%	340	0 / 0 / 1	1	0.40	100	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 308
Exit 310	4.2%	1910	OK	>30	1.6%	SupImp	7 / 2	3	34 / 31	139	-	OK	OK	759	3.00%	355	0 / 4 / 11	23	2.59	13	A / A	A / A	A / A	A / A	TWSC	A / A	A / A	Exit 310
Exit 319	4.2%	1910	OK	>30	1.7%	SupImp	8 / 2	4	- / -	-	819	OK	-	600	-	385	0 / 0 / 2	2	1.06	50	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 319
Exit 325	4.0%	1910	OK	>30	1.9%	SupImp	8 / 3	4	20 / 50	104	560	SupImp	OK	618	3.75%	>300'	0 / 0 / 1	1	0.44	95	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 325

Table 3-1. Interchange Conditions

Route and Exit	Geometric Performance																Crashes				Level of Service (2019 / 2050)							Route and Exit
	Max. Superelevation Rates	Minimum Radius	Maximum Degree of Curve	Clear Zone	Maximum Grade on Ramp	Minimum Lane Width	Minimum Right / Left Shoulder Width	Inslope	Minimum Off-Ramp / On-Ramp Taper	Minimum Ramp K Values	Minimum Ramp Stopping Sight Distance	Minimum Ramp Intersection Sight Distance	Minimum Crossroad k Values	Minimum Crossroad Stopping Sight Distance	Cross Road Grade (<0.5% or >7.0%)	Nearest Access (<100')	Fatality / Injury / PDO	Weighted Total	Weighted Rate	State Rank by Rate	EB or NB Diverge	EB or NB Merge	WB or SB Diverge	WB or SB Merge	Interchange Type	EB or NB Ramp Terminal	WB or SB Ramp Terminal	
Exit 330	5.0%	1910	OK	>30	2.3%	OK	6 / 2	4	20 / 50	79	-	OK	OK	754	0.02%	410	0 / 2 / 9	15	0.55	86	A / A	A / A	A / A	A / A	TWSC	E / F	D / F	Exit 330
Exit 332	6.0%	1146	OK	>30	3.7%	OK	5 / 2	4	20 / 50	79	539	OK	-	949	0.20%	290	0 / 10 / 52	82	1.85	32	A / A	A / A	A / A	A / A	Signal	B / B		Exit 332
Exit 335	4.0%	1910	OK	>30	2.3%	OK	4 / 4	4	40 / 55	104	560	OK	-	960	0.29%	320	0 / 0 / 3	3	0.56	84	A / A	A / A	A / A	A / A	TWSC	A / A	A / A	Exit 335
Exit 344	4.0%	1910	OK	>30	2.2%	OK	5 / 2	4	40 / 53	224	1118	SupImp	OK	749	0.14%	265	0 / 1 / 2	5	1.98	28	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 344
Exit 350	4.0%	1910	OK	>30	2.0%	OK	7 / 2	4	40 / 61	212	913	OK	OK	754	0.49%	265	0 / 1 / 0	3	2.14	23	A / B	A / A	A / A	A / B	TWSC	<1000 ADT		Exit 350
Exit 353	5.0%	1910	OK	>30	2.2%	OK	5 / 2	4	41 / 61	125	-	SupImp	OK	665	2.60%	95	0 / 0 / 1	1	0.51	92	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 353
Exit 357	5.0%	1910	OK	>30	2.7%	OK	4 / 3	4	41 / 61	128	-	SupImp	OK	545	4.00%	200	0 / 1 / 0	3	4.14	6	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 357
Exit 364	5.0%	1910	OK	>30	3.8%	OK	6 / 3	4	40 / 61	128	-	OK	OK	759	0.14%	640	0 / 4 / 12	24	2.89	10	A / A	A / A	A / A	A / A	TWSC	A / A	A / A	Exit 364
Exit 368	5.0%	1910	OK	>30	3.0%	SupImp	7 / 3	4	39 / 61	179	-	SupImp	OK	608	3.80%	>300	0 / 1 / 1	4	4.64	4	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 368
Exit 374	-	1910	OK	>30	1.9%	OK	6 / 3	4	40 / 61	169	-	SupImp	OK	376	3.70%	340	0 / 3 / 1	10	6.01	1	A / A	A / A	A / A	A / A	TWSC	<1000 ADT		Exit 374
Exit 379	5.2%	1910	OK	>30	2.2%	SupImp	3 / 3	4	39 / 61	131	820	OK	-	807	-	200	0 / 1 / 6	9	2.07	26	A / A	A / A	A / A	A / A	TWSC	A / A	A / A	Exit 379
Exit 387	4.2%	1910	OK	>30	1.4%	OK	5 / 3	4	38 / 61	191	-	OK	-	569	-	300	0 / 3 / 8	17	0.90	60	A / A	A / B	A / C	A / A	TWSC	C / E	B / F	Exit 387
Exit 390	6.0%	252	OK	>30	3.5%	SupImp	4 / 9	4	41 / 61	72	380	OK	-	-	-	400	0 / 2 / 3	9	0.69	74	B / B	B / B	B / C	B / B	TWSC	C / D	B / C	Exit 390
Exit 395	n/a	n/a	n/a	n/a	n/a	n/a	n/a / n/a	n/a	n/a / n/a	n/a	n/a	OK	n/a	n/a	0.00%	>660	0 / 1 / 2	5	0.62	77	B / B	A / B	A / C	B / B	TWSC	A / F	A / F	Exit 395
Exit 396	n/a	n/a	n/a	n/a	n/a	SupImp	2 / 3	-	- / -	-	-	n/a	n/a	n/a	0.00%	>660	0 / 2 / 17	23	0.33	104	A / B	B / C	B / D	A / B	System	-		Exit 396
Exit 399	-	-	OK	n/a	-	OK	2 / 2	-	- / -	-	-	OK	OK	n/a	0.30%	92	0 / 8 / 21	45	1.25	43	B / D	*weave*	A / B	B / D	SPI	B / B		Exit 399
Exit 400	n/a	n/a	n/a	n/a	n/a	n/a	n/a / n/a	n/a	n/a / n/a	n/a	n/a	n/a	n/a	n/a	0.00%	>660	0 / 1 / 5	8	0.15	119	*weave*	B / F	B / F	B / F	System	-		Exit 400
Exit 402	4.0%	250	SupImp	n/a	1.9%	SupImp	8 / 2	4	- / -	-	-	OK	n/a	n/a	0.00%	138	0 / 1 / 1	4	0.56	83	B / F	B / F	A / C	B / F	SPI	F / B		Exit 402
Exit 404	n/a	n/a	n/a	n/a	n/a	n/a	n/a / n/a	n/a	n/a / n/a	n/a	n/a	OK	n/a	n/a	0.00%	138	-	-	-	-	A / B	A / B	A / B	A / B	-	-	-	Exit 404
Exit 406	6.0%	1432	OK	>30	6.0%	OK	4 / n/a	3	27 / 29	96	427	OK	-	871	-	140	1 / 7 / 28	61	1.88	30	B / F	B / B	A / B	B / F	TWSC	F / F	F / F	Exit 406
Exit 408	n/a	n/a	n/a	n/a	n/a	n/a	n/a / n/a	n/a	n/a / n/a	n/a	n/a	OK	-	871	-	140	-	-	-	-	A / A	A / A	A / A	A / A	-	-	-	Exit 408
Exit 410	-	1432	OK	>30	4.6%	OK	3 / 2	4	27 / 29	67	-	SupImp	OK	465	1.90%	280	0 / 0 / 2	2	0.58	82	B / C	B / C	A / B	B / C	TWSC	<1000 ADT		Exit 410
I-190																												
Exit 0	n/a	n/a	n/a	n/a	n/a	n/a	n/a / n/a	n/a	n/a / n/a	n/a	n/a	n/a	SupImp	n/a	4.00%	350	-	-	-	-	-	-	-	-	-	-	-	Exit 0
Exit 1C	-	-	SupImp	n/a	-	OK	10 / 2	-	- / -	-	-	n/a	SupImp	n/a	4.00%	350	0 / 0 / 0	0	0.00	122	B / B	B / B	A / A	A / B	SPI	B / B		Exit 1C
Exit 1A	n/a	n/a	n/a	n/a	n/a	n/a	n/a / n/a	n/a	n/a / n/a	n/a	n/a	n/a	SupImp	n/a	4.00%	350	-	-	-	-	B / B	B / B	B / B	B / B	-	-	-	Exit 1A

South Dakota DOT 2020 Decennial ICS

Table 3-1. Interchange Conditions

Route and Exit	Geometric Performance																Crashes				Level of Service (2019 / 2050)							Route and Exit
	Max. Superelevation Rates	Minimum Radius	Maximum Degree of Curve	Clear Zone	Maximum Grade on Ramp	Minimum Lane Width	Minimum Right / Left Shoulder Width	Inslope	Minimum Off-Ramp / On-Ramp Taper	Minimum Ramp K Values	Minimum Ramp Stopping Sight Distance	Minimum Ramp Intersection Sight Distance	Minimum Crossroad k Values	Minimum Crossroad Stopping Sight Distance	Cross Road Grade (<0.5% or >7.0%)	Nearest Access (<100')	Fatality / Injury / PDO	Weighted Total	Weighted Rate	State Rank by Rate	EB or NB Diverge	EB or NB Merge	WB or SB Diverge	WB or SB Merge	Interchange Type	EB or NB Ramp Terminal	WB or SB Ramp Terminal	
I-229																												
Exit 1A	n/a	n/a	n/a	n/a	n/a	n/a	n/a / n/a	n/a	n/a / n/a	n/a	n/a	OK	-	859	2.29%	335	-	-	-	-	A / A	A / A	A / A	A / A	-	-	-	Exit 1A
Exit 1C	5.8%	337.03	SupImp	n/a	-	OK	n/a / n/a	6	14 / 25	-	-	SupImp	N/A	N/A	0.44%	416	0 / 40 / 128	248	2.75	11	B / A	B / A	*weave*	B / A	Signal	C / D		Exit 1C
Exit 2	-	716	SupImp	>30	4.4%	OK	2 / 2	4	- / -	-	298	OK	OK	344	3.56%	350	0 / 28 / 74	158	2.37	19	B / C	*weave*	*weave*	*weave*	Signal	D / D		Exit 2
Exit 3	-	1637	OK	>30	3.5%	OK	3 / 1	4	- / -	-	487	OK	-	-	-	50	0 / 23 / 98	167	2.52	15	*weave*	*weave*	*weave*	*weave*	Signal	D / F		Exit 3
Exit 4	-	1848	OK	>30	3.3%	SupImp	1 / 2	3	- / -	-	-	OK	-	-	-	60	0 / 27 / 92	173	2.43	18	*weave*	*weave*	*weave*	*weave*	Signal	D / F		Exit 4
Exit 5	5.6%	200.49	SupImp	>30	5.0%	SupImp	8 / 2	6	- / -	-	257	OK	SupImp	-	5.68%	140	0 / 36 / 103	211	3.37	7	*weave*	B / B	B / B	*weave*	Signal	D / F		Exit 5
Exit 6	-	-	SupImp	N/A	-	OK	- / -	-	- / -	-	-	OK	n/a	N/A	5.12%	50	0 / 34 / 122	224	3.07	9	B / F	*weave*	*weave*	B / F	SPI	D / E		Exit 6
Exit 7	6.0%	160	SupImp	>30	5.3%	OK	1 / 2	4	- / -	-	257	OK	-	-	-	225	0 / 16 / 55	103	2.35	20	*weave*	*weave*	*weave*	*weave*	Signal	C / F		Exit 7
Exit 9	4.0%	2291	OK	>30	3.3%	SupImp	- / -	6	- / -	-	446	OK	-	859	2.29%	335	1 / 6 / 30	60	1.06	51	*weave*	B / A	B / B	*weave*	Signal/TWSC	F / F	F / F	Exit 9
Exit 10	n/a	n/a	n/a	n/a	n/a	n/a	n/a / n/a	n/a	n/a / n/a	n/a	n/a	OK	-	859	2.29%	335	-	-	-	-	A / A	A / A	B / B	B / B	-	-	-	Exit 10

The project team compiled the various technical analyses at each interchange to determine which interchanges have the greatest needs for further improvements. This effort included developing thresholds within each evaluation category and compiling those interchanges that met the thresholds into a systemwide list of needs. Interchanges were identified as having needs within the five evaluation categories described in **Chapter 2**. The needs thresholds for each category are shown described below:

- Geometrics – Geometric deficiencies exist at most interchanges throughout the system, as described in **Section 2.1**. Interchanges were assumed to have a geometric-based need if greater than 30 percent of the geometric parameters evaluated were found to be deficient. In addition, two interchanges were included as having geometric needs because improvements identified in the 2010 ICS have not yet been addressed (I-90 Exit 12 and I-90 Exit 30).
- Long Combination Vehicles – Interchanges located at a junction with a designated LCV route that cannot accommodate LCVs without modifications to an interchange ramp terminal are typically shown by a need to off-track on the roadway shoulder. Refer to **Section 2.2**.
- Structures – Interchanges having one or more "Poor" rated structures are included as needs, along with interchanges that include a mainline under-crossing bridge with substandard vertical clearance. Refer to **Section 2.3**.
- Traffic Safety – Based on the interchange crash analysis and ranking presented in **Section 2.4**, the 21 locations with interchange safety recommendations were included as needs.
- Traffic Operations – Interchanges demonstrating a substandard peak hour LOS (below LOS B for rural interchanges and below LOS C for urban interchanges) were included as needs. This includes substandard peak hour Year 2050 LOS in the following scenarios, as described in **Section 2.5**:
  - Any individual movement at an unsignalized ramp terminal intersection, typically the stop-controlled ramp approach
  - Any overall signalized ramp terminal intersection or signalized intersection pair
  - Any ramp merge/diverge section along the freeway

Based on the evaluations presented in **Table 3-1** and the structural and LCV technical evaluations (documented in **Appendix B**), a list of interchanges with needs has been compiled and is provided in **Table 3-2**. As shown, a total of 77 interchanges demonstrate at least one area of need. These interchanges are spread across the South Dakota Interstate System, including 27 interchanges on I-29, 42 interchanges on I-90, and 8 interchanges on I-229.

Table 3-2. Interchange Needs

Exit	Location	Identified Needs
	I-29	
1	Dakota Dunes	Future Operations, Safety
2	North Sioux City	Existing and Future Operations
4	McCook Lake	Existing and Future Operations
15	Elk Point	Geometrics
26	Vermillion / Yankton	LCV Movements, Existing and Future Operations
38	Volin	Safety
47	Beresford / Irene	Future Operations
50	Centerville / Hudson	Geometrics
53	Viborg	Geometrics
56	Fairview	Geometrics
59	Davis	Bridge Clearance, Structural Condition
64	Worthing / Lennox	Future Operations
68	Lennox / Parker	Existing and Future Operations
71	Harrisburg / Tea	Future Operations
73	Tea	Future Operations
74	85th Street	Future Operations
77	41st Street	Existing and Future Operations, Safety
78	26th Street	Existing and Future Operations, Safety
79	12th Street	Safety
81	Russell Street	Safety
82	Benson Road	Future Operations
83	60th Street North	Safety
94	Baltic	Safety
98	Dell Rapids	Existing and Future Operations, Safety
109	Madison / Colman	Safety
133	Brookings / Huron	Future Operations, Safety
207	Summit / Aberdeen	Safety
	I-90	
10	North Avenue / Belle Fourche	Future Operations, LCV Movements, Safety
12	Jackson Boulevard	Geometrics, Future Operations
14	27th St / Spearfish Canyon	Future Operations
17	Lead / Deadwood	Future Operations
23	Whitewood	Future Operations
30	Lazelle Street / Deadwood-Lead	Geometrics
32	Junction Avenue	Future Operations

Table 3-2. Interchange Needs

Exit	Location	Identified Needs
44	Piedmont	Future Operations
46	Elk Creek Road	Existing and Future Operations
48	Stage Stop Canyon Road	Future Operations
52	Black Hawk / Peaceful Pines Road	Future Operations
55	Deadwood Avenue	Future Operations, Geometrics
57	I-190	Future Operations
58	Haines Avenue	Future Operations
59	Lacrosse Street	Geometrics, Future Operations, Safety
60	North Street	Future Operations
61	Elk Vale Road	Future Operations, Safety
63	Box Elder / Ellsworth AFB	Existing and Future Operations
67	Liberty Blvd / Ellsworth AFB	Existing and Future Operations
98	Wasta	Safety
112	Phillip / Pierre	Bridge Clearance, Structural condition
131	Interior / Badlands Loop	Bridge Clearance
191	Murdo	Bridge Clearance
296	White Lake	Safety
308	Plankinton	Structural condition
310	Stickney / Aberdeen	LCV Movements, Safety
319	Mount Vernon	Structure
330	Mitchell / Huron	Existing and Future Operations
332	Mitchell / Parkston	Safety
357	Bridgewater	Safety, Structural condition
364	Salem / Yankton	Safety
368	Canistota	Safety, Structural condition
374	Montrose	Safety
379	Humboldt / Madison	Safety
387	Hartford	Existing and Future Operations
390	SD38 / Hartford	Existing and Future Operations
395	Marion Road	Future Operations
399	Cliff Avenue	Future Operations
400	I-229	Future Operations
402	US Geological Survey / EROS	Future Operations
406	Brandon / Corson	Existing and Future Operations
410	Valley Springs / Garretson	Future Operations

Table 3-2. Interchange Needs

Exit	Location	Identified Needs
	I-229	
1C	Louise Avenue	Future Operations, Safety
2	Western Avenue	Existing and Future Operations, Safety
3	Minnesota Avenue	Existing and Future Operations, Safety
4	Cliff Avenue	Existing and Future Operations, Safety
5	26th Street	Existing and Future Operations, Safety
6	10th Street	Existing and Future Operations, Safety
7	Rice Street	Future Operations, Safety
9	Benson Road	Existing and Future Operations

It should be noted that several of the interchanges in **Table 3-2** have recently been studied, are currently under study, or are expected to be studied in the next few years. The recent and ongoing studies are listed in **Chapter 1** of this report. The identified studies provide a more detailed evaluation of issues and potential interchange improvements. Therefore, these locations have not been evaluated further in the ICS.

4. INTERCHANGE IMPROVEMENT IDENTIFICATION

As discussed in **Chapter 1**, the focus of 2020 Decennial ICS is to:

- Ensure appropriate mainline and interchange LOS (LOS B in rural areas; LOS C in urban areas) or better throughout the Interstate System
- Identify areas not in compliance with current Interstate design standards
- Identify mainline and interchange safety concerns
- Identify long combination vehicle (LCV) issues at interchanges

The evaluation of geometric, safety, and operational conditions throughout the South Dakota Interstate System resulted in a list of mainline freeway sections and interchanges where improvements are needed to reach compliance with the study goals. This section compiles that list based on identified deficiencies and conceptualizes the improvements needed.

4.1 Phase 1 Mainline Interstate Improvements

As discussed in **Chapter 2**, several mainline interstate segments would need to be widened in the future to accommodate traffic growth. These segments are generally in the urbanized areas of Rapid City and Sioux Falls. **Table 4-1** outlines the recommended mainline widening efforts through the Year 2050.

Table 4-1. Mainline Interstate Improvements

Interstate	Boundaries	Freeway Lanes		Notes
		Existing	Future	
I-29	Exit 71 to Exit 73	2	2 + auxiliaries	Widen in accordance with the 2018 I-29 Exit 62 to Exit 73 Corridor Study
	Exit 77 to Exit 80	3 + auxiliaries	4 + auxiliaries	Detailed study required
I-90	Exit 44 to Exit 57	2	2 + auxiliaries	Detailed study required; Exit 46 IMJR currently in process
	Exit 58 to Exit 63	2	2 + auxiliaries	Detailed study required; Exit 63 IMJR currently in process
	Exit 400 to Exit 406	2	2 + auxiliaries	Detailed study required; potential Exit 404 interchange may affect results
I-190	*(none)*	*(none)*	*(none)*	Exit 1C has been reconstructed since the 2010 ICS
I-229	Exit 1 to Exit 3	2 + auxiliaries	3 + auxiliaries	Widen in accordance with the 2017 Major Investment Corridor Study
	Exit 5 to Exit 6	2	3 + auxiliaries	Widen in accordance with the 2017 Major Investment Corridor Study

4.2 Phase I Interchange Improvements

Interchanges demonstrating substandard geometric, safety, and operating characteristics were identified in **Chapter 2**. Interchange solutions were identified for a subset of the 77 interchanges with needs. Improvements were identified for interchanges where:

- The interchange demonstrates multiple operational needs and more significant infrastructure actions are needed to bring the interchange into conformity with SDDOT LOS requirements.
- Broader reconfiguration of the interchange is appropriate to address multiple areas of need, such as geometrics and operations.
- The project's SAT input highlighted the need for Phase I solutions.
- Project opportunities show the ability to reduce crashes.
- A bridge in poor condition or with substandard clearance needs replacement.
- Improvements can be made to fix significant geometric or LCV needs.

Phase I solutions have not been identified for interchanges that are already being addressed in a parallel, previous, or upcoming study efforts. **Table 4-2** summarizes the 28 interchanges demonstrating geometric, safety, or operational issues that were translated into proposed solutions.

Table 4-2. Interchange Improvement Preliminary Solutions

Exit	Location	Proposed Solution(s)
		I-29
1	Dakota Dunes	1. Signalize southbound ramp terminal 2. Construct offset Single Point Urban Interchange on east side
2	North Sioux City	Signalize southbound ramp terminal
4	McCook Lake	Improve existing diamond interchange with wider structure
15	Elk Point	Shoulder and inslope improvements for all ramps
26	Vermillion / Yankton	Minor ramp widening and signalize northbound ramp terminal
38	Volin	Reconstruct interchange including new bridge
47	Beresford / Irene	Signalize southbound ramp terminal and add turn lanes
50	Centerville / Hudson	1. New bridge with safety, geometric, LCV and sight distance improvements 2. New diamond interchange with geometric improvements
53	Viborg	Reconstruct interchange including new bridge
56	Fairview	Reconstruct interchange including new bridge
59	Davis	Replace structure
78	26th Street	Add flashing yellow arrow with signal timing changes and improve signing & striping
81	Russell Street	Signal timing changes
109	Madison / Colman	Widen structure and improve lighting

Table 4-2. Interchange Improvement Preliminary Solutions

Exit	Location	Proposed Solution(s)
		I-90
10	North Avenue / Belle Fourche	1. Signalized diamond interchange with geometric improvements 2. Offset single point urban interchange
12	Jackson Boulevard	1. Modify interchange – safety and LCV improvements 2. New DDI – safety, geometric and operations improvements
17	Lead / Deadwood	1. Signalized diamond interchange with added turn lanes 2. Diverging diamond interchange
30	Lazelle St / Deadwood-Lead	Reconstruct interchange including new bridge
55	Deadwood Avenue	Realign eastbound off-ramp; minor improvements for others
112	Philip / Pierre	1. Modify interchange – safety and geometric improvements 2. New ramp – safety and geometric improvements
296	White Lake	Reconstruct interchange including new bridge
308	Plankinton	Replace structure
310	Stickney / Aberdeen	Reconstruct interchange including new bridge
319	Mount Vernon	Replace structure
330	Mitchell / Huron	Signalize ramp terminals, add turn lanes, improve ramp geometry
357	Bridgewater	Reconstruct interchange including new bridge
368	Canistota	Reconstruct interchange including new bridge
374	Montrose	Reconstruct interchange including new bridge

Multiple proposed solutions are provided at several of the interchanges. A brief description to the recommendations at each interchange is provided below. A more detailed list of benefits and shortcomings, concept drawings, and related information are provided in **Appendix E**.

4.3 I-29 Corridor

Fourteen interchanges have been identified with improvement needs along I-29. A summary of each follows.

4.3.1 Exit 1: Dakota Dunes

The Dakota Dunes interchange is a partial cloverleaf interchange, signalized at the NB ramp terminal intersection and stop-controlled at the SB ramps. The SB ramp terminal is expected to operate at LOS D by 2050 in the PM peak period. Signalization of the SB ramp terminal is a solution to address operations. Another solution is to construct an offset SPI centered on the NB ramp terminal intersection.

During the 5-year study period, 27 total crashes occurred, with 20 PDO and 7 injury crashes. This interchange ranked 59 out of 151 in statewide crash rate. Signing and striping can be implemented to help reduce the occurrence of rear-end type crashes at the NB and SB ramp terminal intersections.

4.3.2 Exit 2: North Sioux City

The North Sioux City interchange is a diamond interchange, signalized at the NB ramps and stop-controlled at the SB ramps. The SB ramp terminal operates at LOS F in the 2019 PM peak hour. By 2050, the SB ramp terminal intersection is expected to operate at LOS D and F in the AM and PM peak periods, respectively. Signalization of the SB ramp terminal is a solution to address operations. In addition to signalization, the Streeter Drive intersection with River Drive should be closed to provide access control to the west of the SB ramp terminal. If the Streeter Drive/River Drive intersection is closed, connections should be constructed to connect Streeter Drive to Sodrac Drive north and south of the interchange.

4.3.3 Exit 4: McCook Lake

The McCook Lake interchange is a stop-controlled diamond interchange and operates at LOS D at the NB ramp terminal in the 2019 PM peak hour. By 2050, the NB ramp terminal intersection is expected to operate at LOS D in the PM peak period. It is proposed to reconstruct the crossroad bridge and provide better alignment of Ramp B and Ramp D with the ramp terminal intersections to improve operations.

4.3.4 Exit 15: Elk Point

There are a few geometric deficiencies at the Elk Point interchange. It is recommended to reconstruct each of the ramps (A, B, C, D) to widen the right shoulder and improve inslope to 6:1.

4.3.5 Exit 26: Vermillion / Yankton

The Vermillion / Yankton interchange is a stop-controlled diamond interchange that operated at LOS C at the NB ramp terminal in 2019. By the 2050 PM peak period, the NB ramp terminal is expected to operate at LOS F and the SB ramp terminal is expected to operate at LOS C. Signalization of the NB ramp terminal is a solution to address operations.

The Vermillion / Yankton interchange is on a designated LCV route (SD50); as such, improvements are recommended to each ramp (A, B, C, D) to provide standard acceleration and deceleration rates. Pavement should be added to accommodate truck overtracking on ramps A, B, and C. In addition, the right shoulder should be improved on ramps B and C, and the inslope should be improved to 6:1 on ramps B, C, and D.

4.3.6 Exit 38: Volin

Two total crashes occurred at the Volin interchange during the 5-year study period, but it was ranked 5 out of 151 in statewide crash rate. Both crashes were injury crashes. Shoulder rumble strips can be implemented to help reduce the occurrence of run-off-the-road type crashes at the SB ramp terminal intersection. In addition, the vertical profile of the crossroad bridge is inadequate, and a 30-mph speed limit is signed through the interchange. Reconstruction of the crossroad bridge would allow wider shoulders and provide adequate intersection and stopping sight distance.

4.3.7 Exit 47: Beresford / Irene

The Beresford / Irene interchange is a stop-controlled diamond interchange. By the 2050 PM peak period, the NB ramp terminal is expected to operate at LOS C, and the SB ramp terminal is expected to operate at LOS F. Signalization of the SB ramp terminal and construction of a raised island to provide free-flow NB right-turns at the NB ramp terminal are proposed solutions to address operations.

4.3.8 Exit 50: Centerville / Hudson

The Centerville / Hudson interchange is a stop-controlled diamond interchange with some geometric deficiencies. Improvements are recommended to each ramp (A, B, C, D) to provide standard acceleration and deceleration rates. On each ramp (A, B, C, D), pavement should be added to accommodate truck overtracking, the right shoulder should be improved, and the inslope should be improved to 6:1. Reconstruction of the crossroad bridge would provide adequate intersection and stopping sight distance.

4.3.9 Exit 53: Viborg

The Viborg interchange is a stop-controlled diamond interchange with some geometric deficiencies. On each ramp (A, B, C, D), improvements are recommended to provide standard acceleration and deceleration rates, pavement should be added to accommodate truck overtracking, and the inslope should be improved to 6:1. Reconstruction of the crossroad bridge would provide adequate intersection and stopping sight distance.

4.3.10 Exit 56: Fairview

The Fairview interchange is a stop-controlled diamond interchange with some geometric deficiencies. On each ramp (A, B, C, D), improvements are recommended to provide standard acceleration and deceleration rates, pavement should be added to accommodate truck overtracking, and the inslope should be improved to 6:1. Reconstruction of the crossroad bridge would provide adequate intersection and stopping sight distance.

4.3.11 Exit 59: Davis

The Davis interchange is a stop-controlled diamond interchange with some geometric deficiencies related to ramp widths, shoulders, and inslopes. The existing structure (built in 1960) has a poor bridge condition rating with a sufficiency rating of 52.3 and provides a vertical clearance of 15.92’ over I-29. Given the poor bridge condition rating and bridge clearance, the structure is recommended to be replaced. This would allow the vertical clearance over I-29 to be addressed either through a thinner structure depth or by adjusting the crossroad profile. If the crossroad profile is modified, it may require changes to the ramp terminal intersections and the ramps. In this scenario, ramp widths, shoulders, and inslopes could be addressed.

4.3.12 Exit 78: 26th Street

The 26th Street interchange in Sioux Falls is a signalized diamond interchange and is expected to operate at LOS C at both ramp terminals in 2050. Traffic signal timing improvements are recommended, including implementation of flashing yellow arrow.

During the 5-year study period, 118 total crashes occurred, with 90 PDO and 28 injury crashes. This interchange ranked 34 out of 151 in statewide crash rate. Flashing yellow arrow and signal timing can be implemented to help reduce the occurrence of rear-end and angle type crashes at the NB and SB ramp terminal intersections.

4.3.13 Exit 81: Russell Street

The Russell Street interchange is a signalized partial cloverleaf interchange and operates at LOS D in 2019 during the AM peak period. With signal timing improvements, LOS C operations are expected in 2019 and 2050.

During the 5-year study period, 95 total crashes occurred, with 79 PDO and 16 injury crashes. This interchange ranked 22 out of 151 in statewide crash rate. Flashing yellow arrow and signal timing can be implemented to help reduce the occurrence of rear-end and angle type crashes at the NB and SB ramp terminal intersections.

4.3.14 Exit 109: Madison / Colman

At the Madison / Colman diamond interchange, 19 total crashes occurred during the 5-year study period, with 14 PDO and 5 injury crashes. This interchange ranked 31 out of 151 in statewide crash rate. There was a pattern of run-off-road – fixed object (Bridge) type collisions occurring at dark. Widening the crossroad bridge and providing overhead lighting of ramp terminal intersections are solutions to address the observed crash pattern.

4.4 I-90 Corridor

Fourteen interchanges have been identified with improvements needed along I-90. A summary of each follows.

4.4.1 Exit 10: North Avenue / Belle Fourche

The North Avenue / Belle Fourche interchange is a stop-controlled diamond interchange and is expected to operate at LOS D at the EB ramp terminal and LOS F at the WB ramp terminal by the 2050 PM peak period. Signalization of both the EB and WB ramp terminals is a solution to address operations. Another solution is to construct an offset single point interchange centered on the WB ramp terminal intersection.

The interchange is on a designated LCV route (US85); as such, improvements are recommended to ramps A, B, and C to add pavement to accommodate truck overtracking, and the inslope should be improved to 6:1. In addition, the right shoulder should be improved on ramps B and C.

During the 5-year study period, 56 total crashes occurred, with 41 PDO and 15 injury crashes. This interchange ranked 14 out of 151 in statewide crash rate. There was a pattern of right-angle and run-off-the-road type collisions. The intersection of US85 with Old US14 is close to the EB ramp terminal, which contributes to the angle crash pattern. Upgrades to 36” stop signs, signalization of the ramp terminal intersections, and closure of the Old US14 intersection are solutions to address the observed crash pattern.

4.4.2 Exit 12: Jackson Boulevard

The Jackson Boulevard interchange is a stop-controlled diamond interchange with some geometric deficiencies. On each of the ramps (A, B, C, D), improvements are recommended to widen the right shoulder and improve inslope to 6:1. At ramp C, standard deceleration rates should be provided.

By the 2050 AM peak period, the interchange is expected to operate at LOS C at the EB ramp terminal and LOS E at the WB ramp terminal. Conversion to a diverging diamond (using the existing crossroad bridge) is a potential solution to address operations.

4.4.3 Exit 17: Lead / Deadwood

The Lead / Deadwood interchange is a stop-controlled diamond interchange and is expected to operate at LOS C at the WB ramp terminal in 2019 during both peak hours. By 2050, the WB ramp terminal intersection is expected to operate at LOS D in both peak periods. Signalization of the EB and WB ramp terminals is a solution to address operations. Conversion to a diverging diamond (using the existing crossroad bridges) is a potential solution to address operations.

4.4.4 Exit 30: Lazelle Street / Deadwood-Lead

The Lazelle Street / Deadwood-Lead interchange is a signalized diamond interchange with some geometric deficiencies. On each of the ramps (A, B, C, D), the inslope should be improved to 6:1. Improvements are recommended on ramps A, B, and D to widen the right shoulder, ramp B should be reconstructed to provide the minimum design curve radius, and ramp C should be reconstructed to provide the minimum design curve radius and standard acceleration length.

4.4.5 Exit 55: Deadwood Avenue

The Deadwood Avenue interchange is a signalized diamond interchange with some geometric deficiencies. On each of the ramps (A, B, C, D), the inslope should be improved to 6:1. Improvements are recommended on ramps B and D to widen the right shoulder, and ramp C should be reconstructed to provide the minimum design curve radius and standard acceleration length.

4.4.6 Exit 112: Philip / Pierre

The Philip / Pierre interchange is a fully directional trumpet interchange with some structural deficiencies on the north structure (WB US14 to EB I-90) over mainline I-90. The existing structure (built in 1974) has a poor bridge condition rating with a sufficiency rating of 88.0 and provides a vertical clearance of 15.83' over I-90. Given the poor bridge condition rating and vertical clearance, the structure is recommended to be replaced. Several solutions are presented to address the deficient structure, including replacement of the bridge in place and reconstruction of the ramp G loop to provide a larger radius. Another solution is to remove the deficient north bridge and move head to head traffic onto the south bridge; this would also include removal of the ramp G loop and replacement with a direct on-ramp to EB I-90 and a signalized intersection.

4.4.7 Exit 296: White Lake

The White Lake interchange is a stop-controlled diamond interchange with some geometric deficiencies. During the 5-year study period, one fatal crash occurred, but it was ranked 1 out of 151 in statewide crash rate due to low volume. The vertical profile of the crossroad bridge is inadequate, and reconstruction of the crossroad bridge would allow wider shoulders and provide adequate intersection and stopping sight distance.

4.4.8 Exit 308: Plankinton

The Plankinton interchange is a stop-controlled diamond interchange with some geometric deficiencies related to clear zones, shoulders, and inslopes. The existing structure (built in 1965) has a poor bridge condition rating with a sufficiency rating of 88.0 and provides a vertical clearance of 16.5' over I-90. Given the poor bridge condition rating, the structure is recommended to be replaced. This would allow for the vertical clearance over I-90 to be addressed either through a thinner structure depth or by adjusting the crossroad profile. If the crossroad profile is modified, it may require changes to the ramp terminal intersections and the ramps. In this scenario, clear zones, shoulders, and inslopes could be addressed.

4.4.9 Exit 310: Stickney / Aberdeen

The Stickney / Aberdeen interchange is on a designated LCV route (US281); as such, improvements are recommended to each ramp (A, B, C, D) to provide standard acceleration and deceleration rates. Improvements are also recommended to ramps A, B, C and D to add pavement to accommodate truck overtracking, and the inslope should be improved to 6:1. The crossroad bridge has inadequate width and reconstruction of the crossroad bridge would allow wider shoulders to accommodate LCV loads.

4.4.10 Exit 319: Mount Vernon

The Mount Vernon interchange is a stop-controlled diamond interchange with some geometric deficiencies related to clear zones, shoulders, and inslopes. The existing structure (built in 1965) has a poor bridge condition rating with a sufficiency rating of 83.1 and provides a vertical clearance of 16.5' over I-90. Given the poor bridge condition rating, the structure is recommended to be replaced. This would allow the vertical clearance over I-90 to be addressed either through a thinner structure depth or by adjusting the crossroad profile. If the crossroad profile is modified, it may require changes to the ramp terminal intersections and the ramps. In this scenario, clear zones, shoulders, and inslopes could be addressed.

4.4.11 Exit 330: Mitchell / Huron

The Mitchell / Huron interchange is a stop-controlled diamond interchange and operates in 2019 at LOS E at the EB ramp terminal during both peak hours and LOS D at the WB ramp terminal during the PM peak hour. By 2050, both the EB and WB ramp terminal intersections are expected to operate at LOS F in one or both peak periods. Signalization of both the EB and WB ramp terminals is a solution to address operations.

Improvements are recommended to each ramp (A, B, C, D) to provide standard acceleration and deceleration rates. Improvements are also recommended to ramps A, B, C, and D to improve the inslope to 6:1. On ramps A and C, additional lanes should be provided on the ramps to include dual approach lanes.

4.4.12 Exit 357: Bridgewater

The Bridgewater interchange is a stop-controlled diamond interchange with some geometric deficiencies. During the 5-year study period, one injury crash occurred at the interchange, but it was ranked 6 out of 151 in statewide crash rate due to low volume. The existing structure (built in 1964) has a poor bridge condition rating with a sufficiency rating of 82.1 and provides a vertical clearance of 17.33' over I-90. Given the poor bridge condition rating, the structure is recommended to be replaced. The vertical profile of the crossroad bridge is inadequate, and reconstruction of the crossroad bridge would allow wider shoulders and provide adequate intersection and stopping sight distance. Each of the ramps (A, B, C, D) would also be regraded to match the grade of the proposed crossroad profile.

4.4.13 Exit 368: Canistota

The Canistota interchange is a stop-controlled diamond interchange with some geometric deficiencies. During the 5-year study period, two total crashes (one injury crash and one PDO crash) occurred at the interchange, but it was ranked 4 out of 151 in statewide crash rate due to low volume. The existing structure (built in 1964) has a poor bridge condition rating with a sufficiency rating of 82.1 and provides a vertical clearance of 17.25’ over I-90. Given the poor bridge condition rating, the structure is recommended to be replaced. The vertical profile of the crossroad bridge is inadequate, and reconstruction of the crossroad bridge would allow wider shoulders and provide adequate intersection and stopping sight distance. Each of the ramps (A, B, C, D) would also be regraded to match the grade of the proposed crossroad profile.

4.4.14 Exit 374: Montrose

The Montrose interchange is a stop-controlled diamond interchange with some geometric deficiencies. During the 5-year study period, four total crashes (three injury crashes and one PDO crash) occurred at the interchange, but it was ranked 1 out of 151 in statewide crash rate due to low volume. The vertical profile of the crossroad bridge is inadequate, and reconstruction of the crossroad bridge would allow for wider shoulders and provide adequate intersection and stopping sight distance. Each of the ramps (A, B, C, D) would also be regraded to match the grade of the proposed crossroad profile.

4.5 I-190 Corridor

No interchanges were identified for improvements on the I-190 corridor.

4.6 I-229 Corridor

No interchanges were identified for improvements on the I-229 corridor as it was previously studied.

5. PHASE 2 INTERCHANGE SELECTION

Phase 2 of the ICS is scoped to include a more detailed evaluation of improvements to 12 existing interchange locations and 4 potential new interchanges. The interchanges currently planned to be evaluated in Phase 2 are shown in **Table 5-1**.

Table 5-1. Phase 2 Interchanges

Interchange	Reason for Inclusion in Phase 2
I-29	
I-29 Exit 1 – Dakota Dunes	Identified deficiencies
I-29 Exit 2 – North Sioux City	Identified deficiencies
I-29 Exit 4 – McCook Lake	Identified deficiencies
I-29 Exit 26 – Vermillion / Yankton	Identified deficiencies
I-29 Exit 59 – Davis	Identified deficiencies
I-29 Exit 86 – Renner / Crooks	Pressure from growth potential
I-90	
I-90 Exit 10 – North Avenue / Belle Fourche	Identified deficiencies
I-90 Exit 16 – Rainbow Road, Spearfish	Potential new interchange
I-90 Exit 17 – Lead / Deadwood	Identified deficiencies
I-90 Exit 48 – Stage Stop Canyon Road	Interstate corridor planning considerations
I-90 Exit 55 – Deadwood Avenue	Identified deficiencies
I-90 Exit 110 – Wall / Badlands Loop	Pressure from growth potential
I-90 Exit 112 – Philip / Pierre	Identified deficiencies
I-90 Exit 264 – Chamberlain	Potential new interchange
I-90 Exit 404 – Brandon	Potential new interchange
I-90 Exit 408 – Brandon	Potential new interchange

The selection process for Phase 2 interchanges considered several elements:

- Existing interchanges being addressed in a parallel, previous, or upcoming study effort were not considered for advancement to Phase 2.
- The 12 existing interchanges for inclusion in Phase 2 were selected based on aggregate rating of interchange performance across the range of evaluation categories and considering Phase 2 advancement input received from the SAT. The aggregate rating-based selection of interchanges for advancement to Phase 2 is not the same as the selection of 28 interchanges for Phase 1 solution development. Several interchanges demonstrated only moderate levels of need across the range of categories in the Phase 1 deficiency screening exercise. Therefore, they are not included in the Phase 1 solutions development effort but are included in Phase 2 based on

aggregate ratings. Issues that contributed to the advancement of these interchanges that will be investigated further in Phase 2 are noted in **Table 5-1**.

- In accordance with the scope, four potential new interchange locations along I-90 (with approximate exit number based on MRM location) have been included in the list of Phase 2 interchanges. These interchanges are also shown in **Table 5-1**.