

# South Dakota Interstate Corridor Study

## Phase I Summary Report

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## Introduction

The South Dakota Department of Transportation retained the services of Kirkham Michael Consulting Engineers and Felsburg, Holt & Ullevig to conduct an analysis of several segments of the interstate system located throughout the State of South Dakota. The study will be conducted in two phases. Phase I, summarized in this report, includes a review of the roadway geometrics, accident history, the forecasting of traffic volumes for the Years 2010 and 2020 and the evaluation of existing and future levels of service at the interchanges within the study corridors.

As a result of the findings from this Phase I report, a total of 26 interchanges were identified for further analysis. Phase II of the study will include the development of detailed geometric layouts of these interchanges, and a review of the projected traffic operations associated with the interchange design. In some cases, additional traffic counts will be obtained to evaluate traffic operations along the crossroad corridor through the interchange. Access management in the vicinity of the interchange will also be considered during Phase II.

It should be noted that the inclusion of an interchange in the Phase II portion of the analysis does not automatically indicate that it is one of the high priority locations for reconstruction. It simply means that there was a need for some additional design and/or analysis. In many cases, the information developed in Phase I was adequate to determine what improvements are required at that interchange.

Ten segments of the interstate system in South Dakota were evaluated as a part of this Phase I study, representing 148 miles, 60 existing interchanges and 4 proposed interchanges. The interstate segments evaluated include:

<b>Western South Dakota</b>	I-90	Milepost 8 to Milepost 48
<b>Rapid City</b>	I-90	Milepost 49 to Milepost 67
<b>Mitchell</b>	I-90	Milepost 330 to Milepost 333
<b>Southeastern South Dakota</b>	I-29	Milepost 0 to Milepost 10
<b>Sioux Falls</b>	I-29	Milepost 62 to Milepost 95
	I-229	Milepost 0 to Milepost 10.8
	I-90	Milepost 387 to Milepost 412
<b>Northeastern South Dakota</b>	I-29	Milepost 131 to Milepost 134
	I-29	Milepost 177 to Milepost 181
	I-29	Milepost 207

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## Geometric Analysis

The existing geometric features of the interstate mainline and interchanges within the study corridors identified above were reviewed to determine if they met current design criteria. These design features included such items as the travel lane width, shoulder widths, design speed, degree of curve, clear zone, inslope, superelevation, bridge width, vertical clearance, vertical curves and grades. At the interchanges, the analysis also included cross road features such as stopping sight distance, ramp intersection sight distance and access control. Desirable values for these roadway elements were based on the *South Dakota Department of Transportation Roadway Design Manual* and *A Policy on Geometric Design of Highways and Streets*, published by AASHTO.

## Mainline Geometric Summary

The interstate mainline segments along I-90, I-29 and I-229 identified above were reviewed using information available on the as-built plans from when the interstate was constructed. The interstate system consists of two lanes in each direction, with the exception of the segment of I-29 between Exits 83 and 84 in the Sioux Falls area, where three lanes are provided in each direction. Tables summarizing the mainline geometric analysis are included in the Appendix.

The most common geometric deficiency that occurs along most of the interstate segments is the inslope. Typically, it ranges from a slope of 4:1 to 5:1, versus the desirable slope of 6:1. Another very frequent deficiency is the locations with a longitudinal grade of less than 0.5%. Neither of these items warrants reconstruction of the interstate, and should be able to be addressed at the time of pavement reconstruction. Several of the interstate segments on I-90 in the Black Hills region, and one segment of I-29 near North Sioux City, contain horizontal curves that exceed a desirable 2° 15' curve. These curves range in size from 2° 30' to 4° 00'.

The most notable geometric feature on the interstate corridors evaluated is bridges with substandard widths. In many cases, these bridges are only 30' wide, and should be reconstructed to provide a 40' wide clear roadway. In addition, several bridges are classified as functionally obsolete or structurally deficient according to their sufficiency rating.

A statement of probable costs was prepared for the removal and reconstruction of these bridges along the study corridors. The quantities and costs shown in the following tables are based on conceptual design of the structures and do not include earthwork, mobilization, traffic control, concrete approach slab, or other incidental roadway costs. Bridges that have a structure width of 38' were not included in this cost estimate unless they were identified as functionally obsolete or structurally deficient.

A total of 77 bridges were identified in this analysis, with a total construction cost estimate of \$42.8 million. The breakdown of bridges with various roadway segments is shown in the

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following table. More detailed information regarding the location and size of each structure are provided in the Appendix.

**Table 1. Interstate Mainline Deficient Bridges**

<i>Interstate Segment</i>	<i>Number of Bridges</i>	<i>Construction Cost</i>
I-90: Milepost 8 to Milepost 67	21	\$9.6 million
I-90: Milepost 330 to Milepost 410	30	\$17.5 million
I-29: Milepost 0 to Milepost 207	22	\$12.0 million
I-229: Milepost to Milepost 10	4	\$3.7 million

## Interchange Geometric Summary

The review of the interchange geometrics identified several design elements that were consistently applied at the time of the majority of the interstate construction. Typically, the travel lane width on the ramps was constructed at 18', instead of the 19' desirable under today's criteria. Similarly, the majority of the right shoulders on the ramps were constructed at a width of 3' instead of 4'. In many cases, the superelevation rate on the ramps exceeds the desirable 4% cross slope. The inslopes on the ramps were typically constructed at a slope of 4:1, which is within the acceptable range of allowable slopes, however, it does not meet the current design criteria of 6:1 slopes.

Compliance with the remainder of the geometric features varied from interchange to interchange. The design features that do not meet the desirable design criteria are summarized in the tables provided in the Appendix. The actual geometric checklists for each interchange can be found in the analysis notebooks along with each interchange summary report.

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## Accident Analysis

In conjunction with the analysis of the Interstate 90, 29 and 229 corridors in South Dakota, a methodology was developed for calculating the accident rate at individual freeway interchanges using the traffic volume and accident information for each interchange which was provided by the South Dakota Department of Transportation (SDDOT).

The methodology consisted of calculating a weighted accident rate per million vehicles entering (MEV) the interchange. Accident data were provided by SDDOT in the form of a three-year (1997-1999) data summary sheet for each interchange. The data summary provided a categorization of fatal, injury, and property damage traffic accidents occurring within the interchange limits during the three-year period. The interchange limits include mainline, ramps, and crossroad segments between the ramp merge/diverge points and between the crossroad ramp intersections. A point rating system of 12 points for a fatal crash, 3 points for an injury crash, and 1 point for a property damage crash was applied to the data. Based on this point system, a 3-year weighted accident sum was established for each interchange. This methodology is described in detail in the Appendix.

By dividing the weighted accident sum by the MEV value, a 3-year crash rate was then calculated for each interchange. To re-emphasize, the accident history focused on the three-year period between 1997 and 1999. The crash rate calculations are summarized in Table 1 of the Appendix. The interchanges in the study area are ranked according to crash rate.

## High Accident Locations

After the calculation of each interchange crash rate, it was necessary to determine which interchanges could be considered high accident locations. The methodology identified in the *Manual of Transportation Engineering Studies*, published by the Institute of Transportation Engineers in 1994, was used to identify the high accident locations.

That methodology states that a high accident location is defined as those locations that have a 3-year weighted accident crash rate greater than the mean rate for all locations, plus a constant times the standard deviation for all locations. At the 90% confidence level, that constant is 1.282. The mean rate for all locations was calculated to be 1.23, and the standard deviation for all locations was calculated to be 0.69. With these values, the corresponding crash rate that determines high accident locations is 2.12 weighted accidents per million entering vehicles. Using these criteria, a total of 10 interchanges were identified as high accident locations. These interchanges are summarized in the following table.



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**Table 2. High Accident Interchanges**

Interchange	Number of Accidents by Type 1997 - 1999				Weighted 3-Year Accidents	Crash Rate 3-Year (Wtd. Acc./MEV)
	Fatal	Injury	PDO	Total		
I-29: 77	0	38	88	126	202	2.77
I-29: 207	1	4	5	10	29	2.74
I-90: 60	1	15	32	48	89	2.55
I-90: 58	0	30	52	82	142	2.46
I-29: 81	0	24	60	84	132	2.45
I-90: 30	1	11	34	46	79	2.39
I-29: 79	1	24	93	118	177	2.27
I-229: 6	0	18	56	74	110	2.19
I-90: 59	0	24	43	67	115	2.17
I-90: 400	1	7	25	33	58	2.13

## Detailed Interchange Accident Analysis

Individual accident records for each of these interchanges were then obtained from the SDDOT to identify accident locations and trends. Collision diagrams were developed for each interchange to aid in the process of evaluating accident types. A brief summary of each interchange is provided below.

### ***I-29: Exit 77 – 41<sup>st</sup> Street, Sioux Falls***

A detailed accident analysis was conducted at this interchange to determine if any accident trends are present that could be addressed by the development of alternative interchange concepts. The predominate accident types at this interchange are rear-end and left turn or right angle accidents. The most prominent location for rear-end accidents is on 41<sup>st</sup> Street. At the northbound off-ramp intersection, 26 rear-end accidents occurred in the eastbound direction during the three-year evaluation period. Another 8 rear-end accidents were recorded in the westbound direction. Nine additional rear-end accidents were recorded in the eastbound direction on 41<sup>st</sup> Street approaching the southbound ramp intersection.

The next predominate accident type at this interchange is the rear-end accidents on the off-ramps. A total of 29 rear-end accidents occurred during the three-year period, with 17 accidents on the southbound off-ramp, and 12 accidents on the northbound off-ramp.

The other major accident type observed included the left turn and right angle accidents at the intersections, as would be expected on a heavily traveled facility. Eight right angle accidents occurred at the southbound ramp intersection, and a total of 17 right angle and left turn accidents at the northbound ramp intersection.

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## ***I-29: Exit 207 – US 12, Summit***

The high accident rate at this interchange is due primarily to the low volume at the interchange and one fatal accident during the 3-year analysis period. A review of the detailed accident records showed that this fatality was associated with a snowmobile crossing the mainline of the interstate. The remaining accidents failed to indicate any trends associated with the geometric configuration of the interchange. Most of the accidents occurred during snow and ice conditions.

## ***I-90: Exit 60 – US 16B, Rapid City***

Most of the crashes at this interchange occurred during wet, icy, or snow-packed roadway conditions. Investigation of detailed accident reports indicated a large number of crashes on the eastbound I-90 bridge over US Highway 16B. The majority of these accidents occurred during slippery roadway conditions. Several crashes involved vehicles losing control during slippery roadway conditions at the westbound I-90 off ramp to US Highway 16B.

## ***I-90: Exit 58 – Haines Avenue, Rapid City***

This intersection was not evaluated since it was under construction in the summer of 2000.

## ***I-29: Exit 81 – Maple Street/Russell Street, Sioux Falls***

The predominate accident types at this interchange are rear-end and out of control accidents. The number of intersections and various turning movements required within the interchange area, along with the large volumes, appear to play a role in these types of accidents. The most prominent location of rear-end accidents is at the southbound off-ramp intersection with Maple Street and Russell Street. A total of 9 rear-end accidents occurred during the three-year evaluation period.

The other predominate accident type at this interchange is out of control vehicles. A total of 25 out of control vehicle accidents occurred during the three-year period. Eleven of these were on I-29 northbound, near the area where the northbound on-ramp from Russell Street merges with the mainline. These accidents may be associated with the 4E curve on the northbound mainline in this area. Eight more out of control vehicles were involved in accidents on or near the I-29 southbound exit to Russell Street. Most of these accidents occurred during inclement weather conditions, with snow or ice on the roadway. This analysis indicates that there may be some geometric features that contribute to these accidents

The remainder of the accident types observed included the left turn and right angle accidents at the intersections, as would be expected on a heavily traveled facility. One other observation was that a number of accidents at the merge point for the I-29 southbound on-ramp were sideswipes, with vehicles merging onto the interstate or from vehicles on the interstate changing lanes to avoid a vehicle entering from the on-ramp.

## ***I-90: Exit 30 – US 14A, Sturgis***

Based on a 3-year crash rate, this interchange ranks 6<sup>th</sup> of the 62 interchanges evaluated in the study. This is due in part to the one fatal crash that occurred during the study period. A significant number of crashes occurred during icy roadway conditions along the mainline I-90 Bridge over US Highway 14A. Vehicles negotiate a horizontal curve when crossing this bridge, and a total of 19 vehicles lost control and crashed along the mainline bridge during the study

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period. Adjustments to the geometric configuration of the interchange may be required to address this particular safety problem.

## ***I-229: Exit 79 – 12<sup>th</sup> Street, Sioux Falls***

The predominate accident types at this interchange are rear-end and left turn or right angle accidents. A total of 54 rear-end accidents occurred during the three-year evaluation period at the two ramp intersections. The largest number occurred on the northbound off-ramp, with 22 accidents during that time frame, compared to only 4 accidents on the southbound off-ramp. Westbound rear-end accidents at the west ramp intersection were also relatively high, with a total of 11 accidents.

The other predominate accident type at this interchange is associated with the turning movements at the ramp intersections. A total of 33 left turn and right angle accidents were reported during the three-year period. The northbound off-ramp contained 12 right angle accidents, while the southbound off-ramp experienced 7 right angle accidents. Six left turn accidents occurred with eastbound left turns at the northbound off-ramp, and 8 westbound left turn accidents at the southbound off-ramp intersection.

## ***I-229: Exit 6 – 10<sup>th</sup> Street, Sioux Falls***

There were two major accident types at this interchange present during the three-year analysis period. There were a total of 11 sideswipe accidents near the area where the southbound on-ramp merges with southbound I-229. The majority of these accidents appeared to be related to construction activity that restricted southbound I-229 to one lane. There may have been some visibility restrictions associated with the placement of construction signing and barricades that contributed to these accidents.

The other prominent accident type at this interchange is rear-end accidents. The northbound off-ramp experienced a total of 15 rear-end accidents during the three year study period. On 10<sup>th</sup> Street, 11 rear-end accidents were observed for westbound vehicles, and 8 rear-end accidents for eastbound vehicles. These types of accidents may be attributed to driver unfamiliarity with the traffic movements at a single point interchange. If a driver is inattentive, the right turn on yield may result in a vehicle stopping quickly to yield to a conflicting movement, resulting in a rear-end collision. The proximity of the adjacent access points on 10<sup>th</sup> Street may also contribute to these accidents, even though the access is limited to right-in/right-out movements. The location of the traffic signals at the interchange should also be reviewed to determine if the signal head placement could be modified slightly to improve visibility for drivers.

One other accident condition observed at this interchange is worthy of mention. There were several out of control accidents on I-229 underneath the single point interchange bridge. Icy conditions were cited in almost every case. The size of the bridge required to accommodate the turning movements at this single point interchange creates a large area under the structure that does not receive much direct sunlight. During inclement weather, this area is likely to be one of the first sections of interstate mainline to experience icing conditions. It is also likely to be one of the last to clear up, and is susceptible to freeze/thaw conditions. The area under the bridge

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should be monitored to determine if in fact there is a problem with icy conditions. If so, it merits special attention during inclement weather.

The accident rate at this interchange should continue to be monitored. It is anticipated that the accident rate will decline as drivers become more familiar with the traffic movements at a single point interchange. The construction related accidents appeared to have an impact on the accident rate as well. Removing the 11 sideswipe accidents at the southbound merge with I-229 reduces the accident rate enough to drop this interchange out of the high accident locations.

## ***I-90: Exit 59 – Lacrosse Street, Rapid City***

A review of the detailed accident records at this interchange revealed that 28 of the 67 crashes occurred at the eastbound ramp terminal intersection. This indicates that problems may exist with the geometric configuration of this intersection. In particular, the sight distance available to vehicles approaching the intersection may be deficient. The heightened accident count at this intersection warrants further investigation.

## ***I-90: Exit 400 – I-90/I-229 Interchange, Sioux Falls***

The predominate accident type at this interchange is out of control vehicle accidents that occurred during inclement weather. A total of 24 out of control vehicle accidents occurred during the three-year evaluation period, with 7 of those on the westbound to southbound loop ramp. This represents 73% of the total 33 accidents at this interchange. The weight associated with the fatal accident appears to have vaulted this interchange into the high accident group.

The only other accident type at this interchange that indicates any trend at all is rear-end accidents on the northbound to eastbound ramp. However, only 4 rear-end accidents were reported on this ramp during the three-year period.

Since most of the out of control accidents occurred during inclement weather conditions, with snow or ice on the roadway, there may be some correlation with the superelevation rates provided on the ramps. This interchange is the only one evaluated that contains superelevation rates as high as 7.0% on the direct ramps, and 8.0% on the loop ramps. The alternative concepts developed for this interchange should include reduced superelevation rates in line with current design criteria. In addition, this interchange should receive extra attention for snow removal and sand and gravel application during periods of inclement weather.

## **Capacity Analysis**

The Year 2010 and 2020 traffic projections for the interstate mainline, along with the existing volumes, are provided in the Appendix. The traffic projections for the interchange turning movements are provided with each interchange summary analysis.

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## Interstate Mainline Capacity Analysis

The design criteria for acceptable traffic operations on the interstate mainline is level of service LOS C. According to the *1997 Highway Capacity Manual (HCM)*, the determination of level of service is based on the maximum density of traffic on that freeway segment, defined as the number of passenger cars/mile/lane (pc/mi/ln) for a given free-flow speed. The level of service can also be determined by the minimum travel speed on a segment, the maximum service flow rate in passenger cars/hour/lane (pcphpl), and a maximum v/c ratio.

Since the areas of concern with regard to traffic volumes and capacity of the interstate system is limited to the urban areas within South Dakota, a free-flow speed of 55 mph was selected. Table 3-1 from the *1997 HCM* is shown below.

At LOS C, the maximum service flow rate on the interstate is 1,320 pcphpl, which calculates to 5,280 vehicles per hour (vph) for a basic four-lane interstate segment. In the urban areas, the volume of traffic that occurs during the PM peak hour was observed to range from approximately 8.5% to 9.5%. Applying this same percentage range to the maximum service flow rate, an average daily traffic (ADT) range of 55,600 vehicles per day (vpd) to 62,100 vpd for LOS C is calculated.

**Table 3. LOS Criteria for Basic Freeway Sections**

<i>Level of Service</i>	<i>Max. Density (pc/mi/ln)</i>	<i>Min. Speed (mph)</i>	<i>Max. Service Flow Rate (pcphpl)</i>	<i>Max. v/c Ratio</i>
<i>Free-Flow Speed = 55 mph</i>				
A	10.0	55.0	550	0.24
B	16.0	55.0	880	0.39
C	24.0	55.0	1,320	0.59
D	32.0	54.5	1,744	0.78
E	45.0	50.0	2,250	1.00
F	variable	variable	variable	variable

Source: 1997 Highway Capacity Manual, Table 3-1, p. 3-11.

The traffic volumes, v/c ratio and level of service for the interstate segments are shown in the Appendix. A review of the traffic volumes on the interstate mainline segments evaluated indicates that a four-lane section will provide level of service C or better through the Year 2010. However, by the Year 2020, there are a few segments of interstate that are projected to operate at LOS D, based on the traffic forecasts. These segments are summarized in the table below.

The portion of I-29 from Exit 75 (I-29/I-229) through Exit 81 (Maple/Russell) is projected to operate at LOS D in the Year 2020 with a four-lane interstate section. The next segment to the

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north, between Exit 81 and Exit 83 (SD 38) is projected to be very close to LOS D at that time as well.

There are a couple of segments on I-229 that are also projected to operate at LOS D based on a four-lane section. However, the current design-build project on I-229 will provide a third auxiliary lane from Exit 1 (Louise Avenue) to Exit 9 (Benson Road). It should be noted that the interstate from Exit 9 to the I-90 interchange is one of the segments that is projected to operate at LOS D in the Year 2020. Based on this analysis, it is recommended that when the I-90/I-229 interchange is reconstructed, a third lane in each direction of I-229 should be added at that time.

**Table 4. Interstate Mainline Traffic and Level of Service**

<i>Segment</i>	<i>Existing</i>			<i>Year 2010</i>			<i>Year 2020</i>		
	<i>ADT</i>	<i>v/c</i>	<i>LOS</i>	<i>ADT</i>	<i>v/c</i>	<i>LOS</i>	<i>ADT</i>	<i>v/c</i>	<i>LOS</i>
<i>Interstate 29</i>									
Exit 75 – Exit 77	24,800	0.26	B	37,600	0.40	C	57,900	0.61	D
Exit 77 – Exit 78	32,200	0.34	B	45,900	0.48	C	63,800	0.67	D
Exit 78 – Exit 79	36,100	0.38	B	54,100	0.57	C	68,700	0.73	D
Exit 79 – Exit 81	32,900	0.35	B	46,400	0.49	C	60,200	0.64	D
<i>Interstate 229</i>									
Exit 4 – Exit 5	26,800	0.28	B	43,600	0.46	C	57,500	0.61	D
Exit 9 – I-90	9,400	0.10	A	43,600	0.46	C	57,500	0.61	D

## Interchange Capacity Analysis

The capacity analysis performed on the interchanges was based on the assumption that existing lane configurations and traffic control would remain unchanged through the Year 2020. The results of these analyses, based on existing 2010 and 2020 traffic volumes are depicted in Tables 5, 6, and 7. This methodology provides an indication of those interchanges that will experience congestion and delay if improvements are not constructed. The analysis indicated only a few locations where existing or projected levels of service were determined to be at LOS D or worse.

**Table 5. Existing Traffic Capacity Analysis**

<i>Interchange</i>	<i>Maple/Russell</i>	<i>NB Off-Ramp w/ Stop</i>	<i>SB Off-Ramp</i>
I-29: Exit 81	C	F	F

Under existing traffic volumes, only the ramp intersections of Exit 81 at the Maple Street/Russell Street interchange are presently determined to be operating at unacceptable levels of service. Both of the off-ramp intersections at this interchange are presently unsignalized.

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For the Year 2010 traffic volumes, a few additional locations were projected to operate at LOS D or worse. It should be noted that for all cases, the mainline movements are at acceptable levels, and the ramp intersections are the movements that trigger identification as capacity problems. On I-29, the southbound off-ramp at Exit 2 in North Sioux City is projected to operate at LOS E. At Exit 132 in Brookings, the northbound off-ramp intersection is projected to operate at LOS F. The interchange at Exit 81 in Sioux Falls again shows up as a capacity concern, even with the addition of traffic signals at the northbound off-ramp intersection.

**Table 6. Year 2010 Interchange Capacity Analysis**

<i>Interchange</i>	<i>Interstate Mainline Movements</i>				<i>Intersection Movements</i>	
	<i>NB or EB Diverge</i>	<i>NB or EB Merge</i>	<i>SB or WB Diverge</i>	<i>SB or WB Merge</i>	<i>NB or EB Off-Ramp</i>	<i>SB or WB Off-Ramp</i>
I-29: Exit 2-North Sioux City	B	B	B	B	C	E
I-29: Exit 132-Brookings	A	A	A	A	F	C
I-90: Exit 55-Rapid City	B	B	B	B	F	C
I-90: Exit 61-Rapid City	C	B	B	B	F	F
I-229: Exit 5-Sioux Falls	-	B	B	-	F	D
	<i>Maple/Russell</i>		<i>NB Off-Ramp w/ Signal</i>		<i>SB Off-Ramp</i>	
I-29: Exit 81-Sioux Falls	F		B		F	

On I-90, two interchanges in the Rapid City area were projected to have unacceptable levels of service in the Year 2010. The EB off-ramp intersections at Exit 55 (Deadwood Avenue) and Exit 61 (Elk Vale Road) are both projected to operate at LOS F. In addition, the WB off-ramp intersection at Exit 61 is projected to operate at LOS F.

I-229 through Sioux Falls contains one interchange that is projected to operate at unacceptable levels in the Year 2010. The northbound off-ramp intersection at Exit 5 (26<sup>th</sup> Street) is projected to operate at LOS F.

For the Year 2020, traffic operations at the same interchanges listed above will continue to decline as traffic volumes grow. In addition, three new interchanges are projected to exceed capacity by the Year 2020.

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**Table 7. Year 2020 Interchange Capacity Analysis**

<i>Interchange</i>	<i>Interstate Mainline Movements</i>				<i>Intersection Movements</i>	
	<i>NB or EB Diverge</i>	<i>NB or EB Merge</i>	<i>SB or WB Diverge</i>	<i>SB or WB Merge</i>	<i>NB or EB Off-Ramp</i>	<i>SB or WB Off-Ramp</i>
I-29: Exit 2-North Sioux City	B	B	B	B	E	F
I-29: Exit 132-Brookings	A	A	A	A	F	E
I-29: Exit 177-Watertown	A	A	A	A	F	D
I-90: Exit 55-Rapid City	B	C	B	B	F	D
I-90: Exit 61-Rapid City	C	C	C	C	F	F
I-90: Exit 406-Brandon	B	B	B	B	D	F
I-229: Exit 2-Sioux Falls	-	-	-	-	C	E
I-229: Exit 5-Sioux Falls	-	B	C	-	F	E
	<i>Maple/Russell</i>		<i>NB Off-Ramp w/</i>		<i>SB Off-Ramp</i>	
I-29: Exit 81-Sioux Falls	F		F		F	

On I-29, the NB off-ramp at Exit 177 (US 212) in Watertown is projected to operate at LOS F. Exit 406 (SD 11) near Brandon will experience LOS F at the westbound off-ramp intersection. On I-229, the SB off-ramp intersection at Exit 2 (Western Avenue) in Sioux Falls will experience congestion and delay, with LOS E projected.



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## **Interchange Analysis Summaries**

Each interchange was evaluated to determine if improvements are required to address geometric deficiencies, accident frequency or capacity constraints. The information included in this section provides a brief summary of the analysis and recommendations from each interchange. More detailed discussion of the analysis for each interchange can be found in the separate Technical Appendix notebooks. Small scale drawings identifying the proposed improvements for each interchange are included at the end of this section.

### **Western South Dakota, I-90: Milepost 8 to Milepost 48**

#### ***I-90: Exit 8 - McGuigan Road, Spearfish***

The City of Spearfish is proposing that a diamond interchange be constructed at McGuigan Road and Interstate 90. The construction of an interchange at this location will provide an alternative access route for truck traffic presently utilizing the Exit 10 interchange for access to and from the City of Spearfish.

#### ***I-90: Exit 10 - US 85 North, Spearfish***

The interchange located at Exit 10 on I-90 does not require any significant improvements to accommodate the Year 2010 or Year 2020 traffic volume projections. However, significant accident history led to interchange improvement recommendations in the 1992 Interchange Justification Report prepared for the City of Spearfish. These recommendations are consistent with observations made during this analysis. The eastbound interchange ramps should be realigned to improve separation from the twin bridge structures over I-90 and improve approach grades to the intersection. Old US Highway 14, in turn, should be realigned to improve intersection separation with the ramp terminal intersection. Due to existing terrain constraints, such as Spearfish Creek, realigning Old US Highway 14 may not be practical. One alternative solution could be the construction of a cul-de-sac along Old U.S. Highway 14. This option, along with other alternatives, will be evaluated in greater detail in Phase II of this study.

#### ***I-90: Exit 12 - Jackson Boulevard, Spearfish***

The interchange located at Exit 12 on I-90 does not require any significant improvements to accommodate the Year 2010 or Year 2020 traffic volume projections. The geometric deficiencies are minor, and can be corrected at the time of pavement replacement. Currently, this interchange does not provide access to the north; the cross-road terminates at the interchange. If and when development occurs to the north, access and intersection spacing should be reviewed in more detail. The accident analysis indicates that there are no apparent safety improvements required.

#### ***I-90: Exit 14 – US Highway 14A, Spearfish***

This interchange does not require any significant improvements to accommodate the Year 2010 or Year 2020 traffic volume projections. The geometric deficiencies are minor, and can be corrected at some future date. The accident analysis indicates that there are no apparent safety improvements required.

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## ***I-90: Exit 17 - US 85 South, Deadwood***

This interchange I-90 does not require any significant improvements to accommodate the Year 2010 or Year 2020 traffic volume projections. The geometric deficiencies are minor, and can be corrected at the time of pavement reconstruction. The accident analysis indicates that there are no apparent safety improvements required. A planned unit development was recently proposed for the area that surrounds Exit 17; however, it did not win approval of the voters in a recent election. If development occurs to the north of the interchange, the existing intersection on the north side of the interchange should be relocated to achieve the minimum control of access.

## ***I-90: Exit 23 - SD 34, Whitewood***

The interchange located at Exit 23 on I-90 does not require any significant improvements to accommodate the Year 2010 or Year 2020 traffic volume projections. The geometric deficiencies are minor, and can be corrected at the time of pavement reconstruction. The accident analysis indicates that there are no apparent safety improvements required.

## ***I-90: Exit 30 - US 14A, Sturgis***

The interchange located at Exit 30 on I-90 does not require any significant improvements to accommodate the Year 2010 or Year 2020 traffic volume projections. The accident analysis indicates that some traffic safety improvements to the mainline are recommended. These improvements include increased mainline radii through the interchange with new bridges over the cross street. Improvements to Ramps A and B are recommended as well, including new bridges over the railroad tracks. These improvements will address deficient horizontal and vertical geometrics, and inadequate taper rates. Realignment of the service roads north and south of the interchange could be considered to increase intersection spacing. However, such a realignment would likely impact several buildings north of the interchange and require a railroad crossing south of the interchange.

## ***I-90: Exit 34 - Black Hills National Cemetery***

This interchange does not require any significant improvements to accommodate the Year 2010 or Year 2020 traffic volume projections. The accident analysis indicates that there are no apparent safety improvements required. Ramp geometric deficiencies are minor and could be addressed through a regular maintenance program or when pavement condition warrants replacement. In order to improve cross road geometric deficiencies (which are primarily related to close intersection spacing), the interchange would need to be replaced. Without the support of increased demand or a history of accidents, it is not recommended to replace the interchange at this time.

## ***I-90: Exit 37 – Pleasant Valley Road, Sturgis***

This interchange does not require any significant improvements to accommodate the Year 2010 or Year 2020 traffic volume projections. The accident analysis indicates that there are no apparent safety improvements required. Ramp geometric deficiencies are minor and could be addressed through a regular maintenance program or when

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pavement condition warrants replacement. In order to improve cross road geometric deficiencies and ramp vertical deficiencies, the interchange would need to be replaced. Without the support of increased demand or a history of accidents, it is not recommended to replace the interchange at this time.

## ***I-90: Exit 40 - Tilford Road, Tilford***

This interchange does not require any significant improvements to accommodate the Year 2010 or Year 2020 traffic volume projections. The geometric deficiencies are minor, and can be corrected at the time of pavement reconstruction. The accident analysis indicates that there are no apparent safety improvements required.

## ***I-90: Exit 44 - Bethlehem Road, Piedmont***

The interchange located at Exit 44 on I-90 does not require any significant improvements to accommodate the Year 2010 or Year 2020 traffic volume projections. The accident analysis indicates that there are no apparent safety improvements required. The geometric deficiencies are minor, and can be corrected at the time of pavement reconstruction. Separating the south frontage road from the ramps is a recommended improvement. This interchange will be evaluated in greater detail in Phase II of this study.

## ***I-90: Exit 46 - Elk Creek Road, Piedmont***

The interchange located at Exit 46 on I-90 does not require any significant improvements to accommodate the Year 2010 or Year 2020 traffic volume projections. The accident analysis indicates that there are no apparent safety improvements required. The geometric deficiencies are minor, and can be corrected at the time of pavement reconstruction. Separating the frontage roads from the ramps is a recommended improvement. The north side frontage road could be constructed to the north of the railroad and avoid at-grade crossings of the railroad. This interchange will be evaluated in greater detail in Phase II of this study.

## ***I-90: Exit 48 - Stagebarn Canyon, Piedmont***

This interchange does not require any significant improvements to accommodate the Year 2010 or Year 2020 traffic volume projections. The accident analysis indicates that there are no apparent safety improvements required. The geometric deficiencies are minor, and can be corrected at the time of pavement reconstruction. It is recommended that the frontage road in the northeast quadrant be realigned to separate it from the existing ramp/cross street intersection. This interchange will be evaluated in greater detail in Phase II of this study.

## **Rapid City, I-90: Milepost 51 to Milepost 67**

### ***I-90: Exit 51 - Black Hawk Road, Black Hawk***

The interchange located at Exit 51 on I-90 does not require improvements to accommodate the Year 2010 or Year 2020 traffic volume projections. The accident analysis indicates that there are no apparent accident patterns. Although the 1997-99 data does not reflect a significant crash pattern at Exit 51, observations made by the

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SDDOT regional office suggest that a history of severe accidents exists. Further research will be conducted in Phase II of this study to evaluate the traffic safety characteristics of the Exit 51 interchange. Most geometric deficiencies are minor, and can be corrected at the time of pavement reconstruction. The mainline I-90 horizontal curves are currently programmed for replacement, which will improve design speeds and potentially reduce the accident potential. The cross street approach from the ½ diamond to the at-grade railroad crossing is deficient and warrants improvement. A long-term plan of this connection could include a grade separated crossing of the railroad or reconfiguration of the interchange. A single point interchange may be a viable concept for this interchange. The accident history and capacity do not support this significant of an improvement at this time. The improvements to the horizontal and vertical alignment of the cross street as it approaches the railroad crossing are recommended. This interchange will be evaluated in greater detail in Phase II of this study

## ***I-90: Exit 55 - Deadwood Avenue, Rapid City***

Based on existing lane geometry and traffic control, the interchange ramp terminal intersections are projected to operate at LOS F and D by the Year 2020. Traffic signals at the interchange ramp terminals would improve intersection operations and are therefore recommended. The accident analysis indicates that there are no apparent safety improvements. Geometric deficiencies, including substandard lane widths, right shoulder widths, inslopes, and vertical K-values are pervasive on all interchange ramps. The approach and exit tapers are deficient for all ramps, and the vertical grades along the westbound ramps exceed the desirable maximum of five percent. It is recommended that they be reconstructed. Access control could be improved with a realignment of the frontage road on the east side. This interchange will be evaluated in greater detail in Phase II of this study.

## ***I-90: Exit 59 - LaCrosse Street, Rapid City***

The interchange located at Exit 59 (Lacrosse Street) on I-90 does not require any significant improvements to accommodate the Year 2010 or Year 2020 traffic volume projections. The geometric deficiencies are minor, and can be corrected at the time of pavement reconstruction. Multiple access points are present in close proximity to the interchange ramp terminals. The accident patterns suggest an incident history that may be related to these accesses. It is recommended that an access management plan be prepared for this interchange area that reviews opportunities to consolidate access or to limit these accesses. The access adjacent to the interchange will be evaluated in greater detail in Phase II of this study.

## ***I-90: Exit 60 - East North Street, Rapid City***

The interchange located at Exit 60 has been reviewed in greater detail with the "I-90/East North Street Interchange Reconstruction Concept Study" and the 1992 supplement as prepared by Kirkham Michael and Associates for the SDDOT. The study has recommended reconstruction of the interchange to provide safety improvements and to provide a north connection to the interchange. Two concepts were shortlisted with that

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study; and a third has been developed with this study. These interchange alternatives will be evaluated in greater detail in Phase II of this study. The feasibility of extending Eglin Street over to East North Street will also be reviewed in greater detail in Phase II.

## ***I-90: Exit 61 - Elk Vale Road, Rapid City***

Based on existing lane geometry and traffic control, the interchange ramp terminal intersections are both projected to operate at LOS F by the Year 2010. Traffic signals would improve intersection operations and are therefore recommended. Additional turning lanes will also be required at the intersections. There is limited sight distance available to westbound vehicles looking to the south from the north ramp terminal intersection. The sight distance is limited primarily by the narrow width of the cross-road bridge over mainline I-90. The widening of this structure to accommodate additional turning lanes and the installation of traffic signals at the ramp terminal intersections would likely improve this situation. The remaining geometric deficiencies are minor, and can be corrected at the time of pavement reconstruction. The accident analysis indicates that there are no apparent safety improvements required. This interchange would be the northern terminus of the Heartland Expressway when this regional roadway concept is implemented. At that time, the goal for more free-flow traffic patterns may justify reconfiguration of the interchange. This interchange will be evaluated in greater detail in Phase II of this study.

## ***I-90: Exit 63 - SD 230, Duster's Corner***

The interchange located at Exit 63 on I-90 does not require any significant improvements to accommodate the Year 2010 or Year 2020 traffic volume projections. There are no geometric deficiencies that warrant reconstruction. The accident analysis indicates that there are no apparent safety improvements required. The interchange provides only directional movements to/from the west. Should a full movement interchange become a desire of Box Elder or the SDDOT, as supported by land use planning and growth trends, a concept has been developed and attached for reference.

## ***I-90: Exit 66 - Ellsworth Road, Ellsworth AFB***

The interchange located at Exit 66 on I-90 was reviewed in great detail in numerous previous studies – the “Ellsworth Air Force Base Joint Land Use Study”, the “Box Elder Area Transportation Network Planning Study”, and the “Exit 67 / I90 Interchange Justification Study”. The results of these studies were to replace this interchange with a new interchange at exit 67, one mile to the east. Ramps and CR 223 would be removed at this location.

## ***I-90: Exit 67 - Spruce Street, Ellsworth AFB***

The proposed interchange located at Exit 67 on I-90 was reviewed in great detail in numerous previous studies – the “Ellsworth Air Force Base Joint Land Use Study”, the “Box Elder Area Transportation Network Planning Study”, and the “Exit 67 / I90 Interchange Justification Study”. The recommendation of these studies was to replace the Exit 66 interchange with a new interchange at exit 67, one mile to the east. The preferred interchange concept includes a partial cloverleaf with a loop ramp in the

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southeast quadrant to provide free flow movement to the large eastbound to northbound demand.

## **Mitchell, I-90: Milepost 330 to Milepost 332**

### ***I-90: Exit 330 – South Ohlman Street, Mitchell***

The cross road (South Ohlman Street) of the interchange located at Exit 330 on I-90 is programmed for reconstruction to a five-lane section within the next few years. The other geometric deficiencies of the remaining ramps are relatively minor, and can be corrected at the time of pavement reconstruction for the ramps. There are not any apparent safety issues identified in the accident analysis.

### ***I-90: Exit 332 – SD 37, Mitchell***

Traffic volumes at this interchange are projected to increase significantly due to the Spring 2000 opening of the Cabela's retail store, located in the southwest quadrant of the interchange. In addition to Cabela's, other major commercial development along SD 37 are planned, including a Wal-Mart Superstore to the south of I-90. To accommodate the traffic volumes, temporary traffic signals were installed in the spring of 2000.

The analysis indicated that with the addition of traffic signals at the ramp intersections, the interchange will provide acceptable levels of service through the Year 2020. However, as traffic volumes on SD 37 grow, additional traffic signals may be required along the corridor. Consideration should be given to reconstructing the interchange with a single point configuration, which would increase the signal spacing from approximately 450' between the northern ramps and the next major intersection, to approximately 800'. Current traffic counts along SD 37 and at the interchange will be conducted during Phase II of this study to fully evaluate traffic operations in the area.

The geometric deficiencies of the interchange ramps are relatively minor, and could be corrected at the time of pavement reconstruction for the ramps, if the diamond interchange configuration is maintained. There are not any apparent safety issues identified in the accident analysis.

## **Southeastern South Dakota, I-29: Milepost 0 to Milepost 10**

### ***I-29: Exit 1 - Dakota Dunes, North Sioux City***

This interchange was recently constructed to provide access to I-29 for the Dakota Dunes development. The geometric features of the interchange were designed in accordance with current standards. The capacity analysis of the interchange indicates that the existing configuration will accommodate the projected turning movements. Traffic signals will be installed in the near future at the northbound off-ramp intersection with the crossroad. It appears that this will be the only improvement required at the interchange to accommodate the projected traffic volumes.

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## ***I-29: Exit 2 - North Sioux City***

The interchange located at Exit 2 on I-29 is a tight diamond configuration. Improvements were recently constructed at this interchange, including the installation of traffic signals at the ramp intersections and the construction of dual right turn lanes for the northbound off-ramp. The reconstruction of this interchange will be capacity driven with the southbound ramps exceeding capacity by 2010 and the northbound ramp by 2020. The pavement is relatively new and the structures on I-29 have good life remaining. Due to the tight diamond configuration and development adjacent to the interchange, ultimately, it is recommended that this interchange be reconstructed as a single point interchange to improve the geometric deficiencies and to accommodate the growth in traffic volumes.

## ***I-29: Exit 4 - McCook Lake, North Sioux City***

The interchange located at Exit 4 is likely to be reconstructed approximately 1,400' north to align with a future dike road. As I-29 continues to the north, the alignment converges with Military Road on the east, as well as the railroad that parallels the roadway. The analysis indicates that a diamond interchange configuration will accommodate the projected traffic volumes. The diamond interchange concept also allows the future dike road to maintain its proposed alignment. Grade separation of the railroad and Military Road is necessary due to the proximity of I-29. A single point interchange concept was also developed for this location. However, due to the grades involved and the need for the cross road to travel over the interstate, the construction costs for the single point interchange are considerably higher.

This interchange is ready to proceed into preliminary design. The improvements are programmed for the Year 2004. The concepts evaluated in this analysis are intended to provide alternatives for further detailed design, either in Phase II of this study or as a separate project, moving into preliminary design.

## ***I-29: Exit 9 – SD 105, Jefferson***

The interchange at Exit 9 on I-29 is a tight diamond configuration, with the crossroad skewed to the interstate mainline. The geometric deficiencies at this interchange are relatively minor, and should not require reconstruction of the interchange in the near future. In addition, the capacity analysis indicates that the diamond interchange configuration with stop sign control on the off-ramps will operate acceptably through the Year 2020. A diamond interchange concept was developed that satisfies current design criteria. In addition to the reconstruction of the interchange ramps, the crossroad bridge over I-29 should also be reconstructed at that time to increase the vertical curve length and to provide full width shoulders. There is a proposal for a future bypass, which would travel north from Jefferson, through this Exit 9 interchange, and continue to the east to tie in with US 75. If this alignment is selected, the traffic forecasts and recommended improvements at this interchange must be reviewed at that time.

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## **Sioux Falls, I-29: Milepost 62 to Milepost 94**

### ***I-29: Exit 62 – US 81, Canton***

The interchange located at Exit 62 on I-29 contains a loop in the northwest quadrant to accommodate the westbound to southbound turning movements. This loop ramp provides less than a 30 mph design speed and should be removed. Based on the capacity analysis, it appears that the loop is not required to provide adequate capacity. A standard diamond configuration will provide adequate capacity through the Year 2020. The twin bridges on US 18 over the interstate are listed as functionally obsolete, and should be replaced in the near future. They also provide substandard clearance for the I-29 mainline. At the time of reconstruction, the bridges should be widened to provide 4' left and 8' right shoulders. The other geometric deficiencies of the remaining ramps are relatively minor, and can be corrected at the time of pavement reconstruction. There are not any apparent safety issues identified in the accident analysis.

### ***I-29: Exit 64 – SD 44, Worthing/Lennox***

The interchange located at Exit 64 on I-29 does not require any significant improvements to accommodate the Year 2010 or Year 2020 traffic volume projections. The geometric deficiencies of the ramps are minor, and can be corrected at the time of pavement reconstruction. Reconstruction to a standard diamond interchange meeting current design criteria is not necessary. The geometric analysis indicates that the bridge over I-29 should be widened to provide full width shoulders to improve the ramp intersection sight distance. It is recommended that the bridge be widened when it is time to redeck the bridge.

### ***I-29: Exit 68 – C.R. 116, Lennox/Parker***

The interchange located at Exit 68 on I-29 does not require any significant improvements to accommodate the Year 2010 or Year 2020 traffic volume projections. The interchange was recently reconstructed and meets all current design criteria. There are not any apparent safety issues identified in the accident analysis.

### ***I-29: Exit 71 – C.R. 100, Tea/Harrisburg***

The interchange located at Exit 71 on I-29 does not require any significant improvements to accommodate the Year 2010 or Year 2020 traffic volume projections. The geometric deficiencies of the ramps are minor and can be corrected at the time of pavement reconstruction, with the exception of the ramp intersection sight distance. The existing bridge over I-29 is only 24' wide, which means that shoulders are not provided. Right of way has been secured for the construction of a diamond interchange that will satisfy current design criteria.

### ***I-29: Exit 73 – C.R. 106, Tea***

The interchange located at Exit 73 on I-29 is programmed for reconstruction in 2003. A single point interchange design was developed by TranSystems Corporation in October 1999 to be constructed at this location.



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## ***I-29: Exit 75 – I-229, Sioux Falls***

The interchange located at Exit 75 on I-29 is the system interchange with I-229. It is programmed for some maintenance and repair work in 2003. A full cloverleaf interchange concept was developed by TranSystems Corporation in October 1999. The concept provides access to the west of I-29. Collector-distributor (CD) roads are shown along I-229 through the interchange. The bridges on I-29 over I-229 will require reconstruction to accommodate the CD roads.

The concept was developed to permit construction of a partial cloverleaf interchange, with the ability to add the movements to and from the west at a future date, if desired. The *41st Street Corridor Study*, conducted for the City of Sioux Falls, indicates that the construction of a full movement interchange with extended access to the west would divert traffic from 41st Street, thereby improving traffic operations on that corridor.

## ***I-29: Exit 77 – 41st Street, Sioux Falls***

The interchange located at Exit 77 is the highest rated accident location of the 62 interchanges evaluated as a part of this study. In addition, the capacity analysis indicates that by the Year 2020, traffic operations at the southbound off-ramp will be at level of service E. There are several geometric deficiencies present at this interchange, however, they are mostly minor in nature, and should not contribute to the high accident rate. The geometric features will be corrected at the time a new interchange is constructed.

Several options for improving traffic operations at the interchange of I-29 and 41st Street have been explored in the *41st Street Corridor Study, Phase I Report*, completed in December 1999 for the City of Sioux Falls. In the draft *Phase II Report*, completed in May 2000, two concepts were carried forward from the Phase I Report. The first concept consists of a split diamond interchange with a new bridge over I-29 at 43rd Street, and a frontage road system connecting 41st and 43rd Streets.

The second option consists of the construction of a half diamond interchange at 49th Street, which is unlikely to be approved by either FHWA or SDDOT, but was

allowed for further study. The ramps would be constructed on the south side of 49th Street, providing a northbound off-ramp and a southbound on-ramp. The report indicates that this concept would reduce some traffic on 41st Street and provide alternate access to the Empire Mall.

Two concepts were evaluated as a part of this study. The first is a modification of the design provided in the draft *41st Street Corridor Study, Phase II Report*. It consists of split diamond interchanges at 49th and 41st Street, connected by one-way frontage roads on each side of I-29. This concept provides acceptable traffic operations through the Year 2020, and results in some diversion of traffic from 41st Street as a result of the new access provided at 49th Street. The right of way impacts associated with the construction of this concept are considerable, due to the proximity of development along

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the interstate corridor, and specifically in the southwest quadrant of the 49th Street interchange.

The second concept considered is a single point interchange. This concept was developed due to the limited amount of right of way available, the heavy turning movements at the interchange and the large volume of through traffic on 41st Street. This concept was also determined to provide acceptable traffic operations through the Year 2020.

The decision on which concept to construct will be based on the determination of the overall network needs for the area. The single point interchange maintains current traffic patterns, while the addition of the ramps south of 49th Street will create some diversion in trips as a result of the new connection.

## ***I-29: Exit 79 – 12<sup>th</sup> Street, Sioux Falls***

The interchange located at Exit 79 on I-29 is programmed for reconstruction in the Year 2004. The segment of 12<sup>th</sup> Street, from I-29 to Marion Road is also programmed for widening to a six-lane section in the Year 2004. I-29 will be widened to three lanes in each direction from 41<sup>st</sup> Street (Exit 77) to SD 38 (Exit 83) at that time as well.

The recommended concept for reconstruction of this interchange is a single point interchange. Due to the proximity of adjacent development, particularly on the west side of the interstate, and the projected traffic volumes, it was determined that a single point interchange would have the least impact on adjacent development and still provide adequate capacity to accommodate the heavy turning movements. The need to provide dual left turn lanes on 12<sup>th</sup> Street will require that 12<sup>th</sup> Street be widened to six lanes through the interchange area. The proximity of the active railroad located north of 12<sup>th</sup> Street requires the existing bridges to be widened to provide acceptable taper lengths.

A new interchange on I-29 at Madison Street (1 mile north) is proposed for construction. The interchange justification study for the new interchange will be completed in the fall of 2000. If approved, this interchange will provide an alternate route to divert traffic from 12<sup>th</sup> Street and reduce congestion on the 12<sup>th</sup> Street corridor.

## ***I-29: Exit 80 – Madison Street, Sioux Falls***

The proposed interchange located at Exit 80 on I-29 will be studied in greater detail in an interchange justification study, which will be conducted concurrently with Phase II of this study. The justification study will be completed in October 2000. Two concepts were developed for this location, a partial cloverleaf interchange with the loop ramp provided in the northwest quadrant, and a single point interchange.

The lake created by the quarry in the northeast quadrant may limit the ability to construct a direct northbound on-ramp. In addition, the depth of the quarry in the southwest quadrant may impact the feasibility of the construction of the northbound off ramp. A single point interchange concept was also developed for evaluation. The single point

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interchange concept does not impact the two quarries, and minimizes the impact to the farmstead in the southwest quadrant.

## ***I-29: Exit 81 – Maple/Russell Street, Sioux Falls***

The Maple Street/Russell Street interchange with I-29 has been considered for reconstruction since the time of the *Sioux Falls I-29/I-229/I-90 Corridor Study*, completed in August 1989. Several concepts were developed for consideration as a part of that study. However, those concepts did not consider the realignment of the Maple Street/Russell Street connection to provide a direct movement. Based on a review of the existing and projected traffic movements through this area, it appears that there is considerable demand for this to be the through movement. As a result, there is an opportunity to construct a much more conventional interchange type that is more in line with driver expectations and that can accommodate the heavy turning movements that are present at this interchange.

Three concepts were evaluated for this interchange. The first is a partial cloverleaf interchange with loop ramps provided in the northwest and southeast quadrants. The second is also a partial cloverleaf interchange, with the loop ramp provided only in the northwest quadrant. The final concept evaluated is a single point interchange.

All three of these concepts were determined to provide acceptable traffic operations through the Year 2020 traffic forecasts. It is recommended that this interchange be evaluated in more detail during Phase II of this study. Consideration should be given to such issues as progression and traffic operations along the arterial roadway with the various signalized intersection locations. In addition, right of way impacts should be evaluated in greater detail. The amount of right of way required for the partial cloverleaf concepts is considerably more than that for the single point interchange.

## ***I-29: Exit 82 – Benson Road, Sioux Falls***

A proposed interchange located at Exit 82 on I-29 will be studied in greater detail in an interchange justification study, which will be conducted concurrently with Phase II of this Study.

## ***I-29: Exit 83 – SD 38, Sioux Falls***

The interchange located at Exit 83 on I-29 will have traffic signals installed in the summer of 2000. The capacity analysis indicates that the only improvement required at this interchange beyond the installation of traffic signals is the construction of a separate right turn lane on the northbound off-ramp. The geometric deficiencies of the ramps are very minor, and can be corrected at the time of pavement reconstruction. The frontage roads located approximately 300' to the east and west of the ramp intersections will be removed in the near future.

## ***I-29: Exit 86 – C.R. 130, Renner/Crooks***

The interchange located at Exit 86 on I-29 does not require any significant improvements to accommodate the Year 2010 or Year 2020 traffic volume projections. The ramp

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pavement was recently reconstructed, which addressed the geometric deficiencies. The accident analysis indicates that there are no apparent safety improvements required.

## ***I-29: Exit 94 – C.R. 114, Baltic***

The interchange located at Exit 94 on I-29 does not require any significant improvements to accommodate the Year 2010 or Year 2020 traffic volume projections. The geometric deficiencies are minor, and can be corrected at the time of pavement reconstruction. The accident analysis indicates that there are no apparent safety improvements required. A standard diamond interchange was developed for this location to identify the potential impacts.

## **Sioux Falls, I-229: Milepost 1 to Milepost 9**

### ***I-229: Exit 1 – Louise Avenue, Sioux Falls***

The interchange located at Exit 1 on I-229 does not require any significant improvements to accommodate the Year 2010 or Year 2020 traffic volume projections. The major modification recommended is the elimination of the southbound left turn from Louise Avenue to northbound I-229 by the construction of a raised median. This left turn volume is currently approximately 500 vehicles per hour, and is projected to grow even larger. The loop ramp located in the southwest quadrant can accommodate this heavy turning movement, which will greatly improve traffic operations at the signalized intersection with the northbound ramps.

An analysis was also conducted to determine the impact of eliminating the westbound free right turn from the southbound off-ramp to northbound Louise Avenue. The high volume of traffic making this right turn indicates that dual right turn lanes should be considered. With dual right turns, which allow turns only during a protected phase, the intersection is projected to operate at LOS B and C in the Years 2010 and 2020, respectively.

### ***I-229: Exit 2 – Western Avenue, Sioux Falls***

The interchange located at Exit 2 on I-229 will require some minor improvements to provide the capacity to accommodate the Year 2020 traffic volume projections. The geometric deficiencies of the ramps are minor, with the exception of the K values and the stopping sight distance provided, and can be corrected at the time of pavement reconstruction. The ramp profiles should be improved at that time as well.

A very heavy right turn movement is present from the I-229 southbound off-ramp onto northbound Western Avenue. It is recommended that dual right turn lanes be constructed to accommodate this heavy turning movement by the Year 2020. In addition, the construction of a southbound right turn lane from Western Avenue onto the I-229 southbound on-ramp will also help to improve traffic operations.

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## ***I-229: Exit 3 – Minnesota Avenue, Sioux Falls***

The interchange located at Exit 3 on I-229 does not require any significant improvements to accommodate the Year 2010 or Year 2020 traffic volume projections. The geometric deficiencies of the ramps are minor, and can be corrected at the time of pavement reconstruction.

A single point interchange concept was developed for this location to determine if the configuration would work well as a replacement for the existing diamond interchange. A single point interchange provides additional distance from the left turn movements at the interchange to the service road and driveways located north of the interstate. However, access control on Minnesota Avenue is still a key issue.

The *41<sup>st</sup> Street Corridor Study – Phase II Report*, completed in May 2000, indicates that three options are under consideration for relocation of the intersection of South Grange Drive with Minnesota Avenue further to the north. The connection of South Grange Drive to 43<sup>rd</sup> Street would provide the most separation and would result in improved traffic operations in the vicinity of the interchange. If a median is constructed on Minnesota Avenue, the existing intersection could be left in place to provide right-in/right-out access.

Traffic operations should be monitored at the access to the Yankton Trail Park and soccer fields south of the interstate. If necessary, the construction of a median on Minnesota Avenue would restrict this access to right-in/right-out. Left turning vehicles would have to divert to the access located on 57<sup>th</sup> Street, which provides a crossing of the Big Sioux River.

## ***I-229: Exit 4 – Cliff Avenue, Sioux Falls***

The interchange located at Exit 4 on I-229 does not require any significant improvements to accommodate the Year 2010 or Year 2020 traffic volume projections. The geometric deficiencies of the ramps are minor, and can be corrected at the time of pavement reconstruction. Access control along Cliff Avenue is an important element with respect to traffic operations through the interchange. Several access points are located immediately north of the intersection with the southbound off-ramp. To the south of the interchange, primary access to the soccer fields on the west side of Cliff Avenue is provided. During soccer events, the volume of traffic using this access point significantly impacts traffic operations on Cliff Avenue.

Recently, a request was made for consideration of modifying the bicycle trail access located immediately south of the interchange to allow access to a camp. The proximity of this access point to the signalized ramp intersection would create driver confusion, disrupt traffic flow on Cliff Avenue, and create additional conflict points at this intersection. Access control should be maintained as much as possible within 300' of the ramp intersections.

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## ***I-229: Exit 5 – 26<sup>th</sup> Street, Sioux Falls***

The interchange located at Exit 5 on I-229 contains some significant geometric deficiencies. Primarily, the radius provided on Ramps C, G and F are considerably below the 35 mph design criteria. Three concepts were developed to eliminate these features. The first concept consists of replacing the southbound on and off ramps with direct connections to 26<sup>th</sup> Street, similar to one half of a diamond interchange. The southbound off-ramp should be kept as close to the mainline as possible due to the proximity of the residential neighborhood in the northwest quadrant. The northbound ramps would remain in their present configuration in this concept. The second concept is the same as the first, with the addition of a direct northbound on-ramp to replace the loop ramp. The final concept developed is a single point interchange with 26<sup>th</sup> Street. The skew angle between 26<sup>th</sup> Street and I-229 makes the design of a single point interchange a bit more difficult than normal.

While the capacity analysis indicates that all of the concepts will provide acceptable traffic operations through the Year 2020, with traffic signals on the ramp terminals, the single point interchange is preferred since it requires only one signal at the interchange. The impacts to adjacent properties in the northwest quadrant and environmental considerations in the northeast quadrant are similar for the second concept and the single point interchange. The life span of the bridges over the Big Sioux River and the ability to widen these structures will be investigated in Phase II of this study.

## ***I-229: Exit 6 – 10<sup>th</sup> Street, Sioux Falls***

The interchange located at Exit 6 on I-229 was reconstructed as a single point interchange in 1995. As a result, all of the geometrics at the interchange satisfy current design criteria. The capacity analysis indicates that this configuration will provide acceptable levels of service through the Year 2020. The accident analysis identified this interchange as one of the high accident locations in the state. An evaluation of the individual accident records indicates that a number of the accidents were associated with construction and lane restrictions on I-229 through the interchange area and rear-end accidents on 10<sup>th</sup> Street and the northbound off-ramp. These rear-end accidents are likely associated with driver unfamiliarity with this interchange configuration. Accident history at this interchange should continue to be monitored to determine if the accident rate is decreasing over time.

## ***I-229: Exit 7 – Rice Street, Sioux Falls***

The loop ramps on the interchange located at Exit 7 on I-229 have a radius of 160', which is below a 30 mph design speed. The location of the railroad immediately south of Rice Street limits the options for alternative interchange concepts. Current traffic counts were not available for both of the ramp intersections with Rice Street at the time of the Phase I analysis. Traffic counts will be obtained at these frontage road intersections during Phase II of this study in order develop Year 2010 and 2020 traffic forecasts and to analyze traffic operations and progression at the interchange and along Rice Street

# SDDOT Interstate Corridor Study: Phase I

through the interchange area. Only minor improvements to the interchange will be evaluated.

## ***I-229: Exit 9 – Benson Road, Sioux Falls***

The interchange located at Exit 9 on I-229 does not require any significant improvements to accommodate the Year 2010 or Year 2020 traffic volume projections. The interchange geometrics satisfy current design criteria and the accident analysis indicates that this is a relatively low accident location.

## **Sioux Falls, I-90: Milepost 387 to Milepost 410**

### ***I-90: Exit 387 – C.R. 151, Hartford West***

The interchange located at Exit 387 on I-90 does not require any significant improvements to accommodate the Year 2010 or Year 2020 traffic volume projections. The geometric deficiencies of the ramps are minor, and can be corrected at the time of pavement reconstruction. There are not any apparent safety issues identified in the accident analysis.

### ***I-90: Exit 390 - SD 38, Hartford East***

This interchange is adequate to accommodate the future traffic volumes. However, the radii of the two loop ramps provide a design speed of less than 30 mph. A new partial cloverleaf interchange was developed, with a radius of 330' provided for the loop ramps. The interstate mainline will be reconstructed in 2004. The concept will be reviewed at that time.

### ***I-90: Exit 395 – Marion Road, Sioux Falls***

A new interchange is proposed for the Marion Road crossing of I-90, located approximately one mile west of I-29. The City of Sioux Falls completed the *Interstate 90 and Marion Road Interchange Justification Study* in December 1999. The study recommends a typical diamond interchange. The proposed typical section on Marion Road through the interchange is a five-lane section, with a center two-way left turn lane. Traffic signals will be required at the north ramp intersection by the Year 2010. However, with the lane configuration indicated in the justification study, the projected level of service in the Year 2020 is LOS E. It may be necessary to provide dual left turn lanes on either the northbound or westbound direction. Consideration will be given to providing loop ramps on the north half of the interchange to accommodate the heavy left turn movements. This concept will be explored in Phase II of this study.

### ***I-90: Exit 396 – I-29, Sioux Falls***

Exit 396 on I-90 is the full cloverleaf system interchange with I-29. The capacity analysis indicates that it does not require any significant improvements to accommodate the Year 2010 or Year 2020 traffic volume projections. However, the radii provided on the loop ramps are only 205', which is well below a 30 mph design speed. In addition, the weaving distance provided between the loop ramps does not meet current design criteria. The other geometric deficiencies are relatively minor, and can be corrected at the time of reconstruction. In an effort to address the geometric issues, a full cloverleaf

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interchange that meets current design criteria was developed for this system interchange. The capacity analysis indicates that this concept will accommodate the future traffic volumes. The accident analysis ranked this interchange 12<sup>th</sup> of the 62 interchanges evaluated. Since it did not meet the criteria of a high accident location, the individual accident records at this interchange were not reviewed.

## ***I-90: Exit 399 – Cliff Avenue, Sioux Falls***

The capacity analysis conducted for the interchange located at Exit 399 (Cliff Avenue) on I-90 does not require any significant improvements to accommodate the Year 2010 or Year 2020 traffic volume projections. However, the westbound off-ramp currently backs up onto the mainline during certain periods. As traffic volumes grow, even though the signalized intersections are projected to provide acceptable traffic operations, the queuing problem will continue. It may be desirable to construct a separate right turn lane on the westbound off-ramp to increase the capacity and storage length available on the ramp.

Ultimately, it may be necessary to construct a single point interchange at this location to address these deficiencies, to reduce the number of signals along Cliff Avenue and to provide improved traffic operations and progression. Access control along Cliff Avenue should also be addressed at the time of improvements. Current traffic counts will be obtained at the adjacent intersections during Phase II of this study in order to analyze traffic operations and turning movements along Cliff Avenue.

## ***I-90 Exit 400 – I-229, Sioux Falls***

The system interchange of I-90 and I-229 will accommodate the projected traffic volumes through the Year 2020. The two key issues at this interchange are providing access to the north and addressing the geometric deficiencies of the ramps. This interchange was identified as one of the high accident locations, due primarily to the number of out of control accidents during inclement weather and one fatal accident. A full cloverleaf interchange was developed that will provide access to and from the north. The concept also provides larger, constant radius loop ramps. The superelevation rates on all of the ramps can be reduced, which may help reduce the number of out of control accidents. The proposed full cloverleaf interchange could be constructed in phases, with the ramps for movements to and from the north added at a later time as warranted by growth and development.

## ***I-90 Exit 402 – Powder House Road, Sioux Falls***

The interchange located at Exit 402 on I-90 may be the northern terminus of an East Side corridor. The *East Side Corridor Study Report*, completed in March 1999 depicted that the cross road will be improved to a four-lane divided section with a raised median, separate left and right turn lanes at the ramp intersections, and traffic signalization. A standard diamond interchange with ramps that satisfy current design criteria was developed, along with the proposed typical cross road section. Based on this concept, the interchange will provide acceptable traffic operations through the Year 2020.



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## ***I-90: Exit 406 – SD 11, Brandon***

The interchange located at Exit 406 on I-90 does not require any significant improvements to accommodate the Year 2010 or Year 2020 traffic volume projections. However, there are a few geometric deficiencies that should be considered along with reconstruction of the interchange. Due to the proximity of the farmstead located in the northeast quadrant of the interchange, a partial cloverleaf interchange that satisfies current design criteria was developed for this location. A standard diamond interchange was also developed as an alternative. Five-lane sections are currently provided on each side of I-90 on SD 11 (Powder House Road). The section of SD 11 between the ramps should be widened to match the five-lane section. A potential new access point on I-90 has been discussed in the proximity of mile reference marker 404. If this interchange is constructed, some diversion of traffic from Exit 406 would be anticipated. The eastbound off-ramp capacity analysis shows that a traffic signal would be needed to improve intersection operations by the Year 2020.

## ***I-90: Exit 410 – C.R. 105, Valley Springs***

The interchange located at Exit 410 on I-90 does not require any significant improvements to accommodate the Year 2010 or Year 2020 traffic volume projections. The vertical curve on the bridge over I-90 does not meet current design standards, and provides limited sight distance at the ramp intersections. The speed limit across the interstate has been reduced to 25 mph due to the limited sight distance. While this may not drive reconstruction of the interchange, it should be corrected at the time of reconstruction of the ramps. A diamond interchange that satisfies current design criteria was developed for this location.

## **Northeastern South Dakota, I-29: Milepost 129 to Milepost 207**

### ***I-29: Exit 129 – C.R. 26, Brookings***

The City of Brookings is proposing that an interchange be constructed at the cross road located 3 miles south of U.S. 14 (Exit 132). There is a considerable amount of growth to the southern portions of the City, which is anticipated to continue over the next 20 years. The major concern is protecting the right of way necessary to construct the interchange. The construction of an interchange at this location will not only serve the development on the south side of Brookings, it will also divert some of the traffic from Exit 132 by providing an alternative route that is less congested.

### ***I-29: Exit 132 – US 14, Brookings***

The interchange located at Exit 132 on I-29 does not require any significant improvements to accommodate the Year 2010 or Year 2020 traffic volume projections. The geometric deficiencies of the ramps are minor, and can be corrected at the time of pavement reconstruction. The projected turning volumes at the ramp intersections indicate, from the capacity analysis, that the installation of traffic signals will be warranted prior to the Year 2010. With the installation of traffic signals, the interchange

# *SDDOT Interstate Corridor Study: Phase I*

is projected to operate at acceptable levels of service. In addition to the traffic signalization, it is recommended that the southbound right turn lane on Ramp D be constructed to provide 200' of storage. There is also concern about pedestrian access across I-29, once the new ice rink and the new events facility are constructed on the east side of the interstate.

## ***I-29: Exit 133 – US 14 Bypass, Brookings***

The interchange located at Exit 133 on I-29 does not require any significant improvements to accommodate the Year 2010 or Year 2020 traffic volume projections. The geometric deficiencies of the ramps are minor, and can be corrected at the time of pavement reconstruction. There are not any apparent safety issues identified in the accident analysis. Control at access should be extended to limit future access points near the interchange.

## ***I-29: Exit 177 – US 212, Watertown***

The interchange located at Exit 177 on I-29 does not require any significant improvements to accommodate the Year 2010 or Year 2020 traffic volume projections. From the capacity analysis, traffic signalization at the northbound ramp intersection will be required prior to the Year 2010. The geometric deficiencies of the ramps are minor, and can be corrected at the time of pavement reconstruction. Ultimately, it may be necessary to construct a single point interchange at this location to reduce the number of signals along US 212, and to provide signal spacing that will better accommodate traffic operations and progression along the highway. Current traffic counts will be obtained at these frontage road intersections during Phase II of this study in order to analyze traffic operations and progression along US 212 through the interchange area. Pedestrian traffic through the interchange was also identified as an important issue.

## ***I-29: Exit 180 – US 81, Watertown***

The interchange located at Exit 180 on I-29 does not require any significant improvements to accommodate the Year 2010 or Year 2020 traffic volume projections. The geometric deficiencies of the ramps are minor, and can be corrected at the time of pavement reconstruction. There are not any apparent safety issues identified in the accident analysis.

## ***I-29: Exit 207 – US 12, Summit***

The interchange located at Exit 207 on I-29 does not require any significant improvements to accommodate the Year 2010 or Year 2020 traffic volume projections. The geometric deficiencies are minor, and can be corrected at the time of pavement reconstruction. A new diamond interchange designed to meet current standards is proposed for this location at the time the old interchange has served its useful life.

Although the accident analysis of this interchange indicates that it is one of the high accident locations, a detailed review of the accident records revealed that the fatal accident at this interchange was due to a snow mobile crossing the mainline of the interstate. The low volumes at this interchange vaulted it into the high accident location category.

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## **Summary of Probable Construction Costs**

For each interchange improvement identified in Phase I, a statement of probable construction costs was developed. This information is included with the detailed analysis of each interchange in the separate Technical Appendix notebooks. The table below summarizes those probable construction costs. The costs shown are based on conceptual design for budgetary purposes. More detailed costs will be developed in the next phase of design. Right of way and relocation costs are not reflected with this estimate. They would be in addition to the costs shown in the following tables.

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**Table 8. I-90 Summary of Probable Construction Costs**

<i>Interchange</i>	<i>Proposed Improvement</i>	<i>Probable Construction Cost</i>
Interstate 90		
Exit 8	New diamond interchange	\$2,600,000
Exit 10	Various interchange modifications	\$2,600,000
Exit 30	Reconstruct diamond interchange	\$6,110,000
Exit 44	Frontage road realignment	\$600,000
Exit 46	Frontage road realignment	\$2,000,000
Exit 48	Frontage road realignment	\$1,000,000
Exit 51	Foothills Road reconstruction	\$200,000
Exit 55	Reconstruct diamond interchange	\$4,600,000
Exit 59	Access control	\$30,000
Exit 60	Construct diamond interchange	\$7,700,000
	Construct partial cloverleaf interchange	\$9,600,000
	Construct single point interchange	\$9,200,000
Exit 61	Crossroad improvements and signalization	\$3,100,000
Exit 67	New partial cloverleaf interchange	\$8,100,000
Exit 332	Crossroad improvements and signalization	\$404,000
	Construct single point interchange	\$5,467,000
Exit 390	Construct partial cloverleaf interchange	\$3,851,000
Exit 396	Construct full cloverleaf interchange	\$11,351,000
Exit 399	Construct single point interchange	\$4,852,000
Exit 400	Construct full cloverleaf interchange	\$11,244,000
Exit 402	Reconstruct diamond interchange	\$6,962,000
Exit 406	Construct partial cloverleaf interchange	\$4,465,000
	Reconstruct diamond interchange	\$4,282,000
Exit 410	Reconstruct diamond interchange	\$3,829,000

# SDDOT Interstate Corridor Study: Phase I

**Table 9. I-29 Summary of Probable Construction Costs**

<i>Interchange</i>	<i>Proposed Improvement</i>	<i>Probable Construction Cost</i>
Interstate 29		
Exit 2	Construct single point interchange	\$4,374,000
Exit 4	Reconstruct diamond interchange	\$6,240,000
	Construct single point interchange	\$9,382,000
Exit 9	Reconstruct diamond interchange	\$6,126,000
Exit 62	Various interchange modifications	\$417,000
	Reconstruction of bridges	\$2,564,000
Exit 64	Various bridge improvements	\$1,209,000
Exit 71	Reconstruct diamond interchange	\$4,208,000
Exit 73	Construct single point interchange	\$7,328,000
Exit 75	Construct partial cloverleaf interchange	\$12,970,000
	Construct full cloverleaf interchange	\$18,270,000
Exit 77	Construct split diamond interchange	\$10,033,000
	Construct single point interchange	\$9,337,000
Exit 79	Construct single point interchange	\$9,689,000
Exit 80	Construct single point interchange	\$8,519,000
Exit 81	Construct partial cloverleaf interchange 2/loops	\$10,040,000
	Construct partial cloverleaf interchange 1/loop	\$9,675,000
	Construct single point interchange	\$12,308,000
	Construct signalized intersection	\$1,194,000
Exit 83	Construct right turning lane	\$30,000
Exit 129	Construct partial cloverleaf interchange	\$6,144,000
Exit 132	Installation of traffic signal and turn lane	\$365,000
	Construct loop ramp	\$7,018,000
Exit 177	Installation of traffic signal and turn lanes	\$380,000
	Construct single point interchange	\$5,057,000
Exit 207	Reconstruct diamond interchange	\$2,730,000

# *SDDOT Interstate Corridor Study: Phase I*

**Table 10. I-229 Summary of Probable Construction Costs**

<i>Interchange</i>	<i>Proposed Improvement</i>	<i>Probable Construction Cost</i>
Interstate 229		
Exit 1	Construct raised median and turn lanes	\$118,000
Exit 2	Construct turn lanes	\$141,000
Exit 3	Construct single point interchange	\$5,564,000
Exit 5	Construct two ramps	\$6,800,000
	Construct three ramps	\$8,512,000
	Construct single point interchange	\$7,595,000

# Appendices

Appendix A	Alternative Interchange Concepts
Appendix B	Glossary of Terms
Appendix C	Existing Mainline Geometric Condition Analysis
Appendix D	Deficient Mainline Structure Summary
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# Appendix A

## Alternative Interchange Concepts



# Alternative Interchange Concepts

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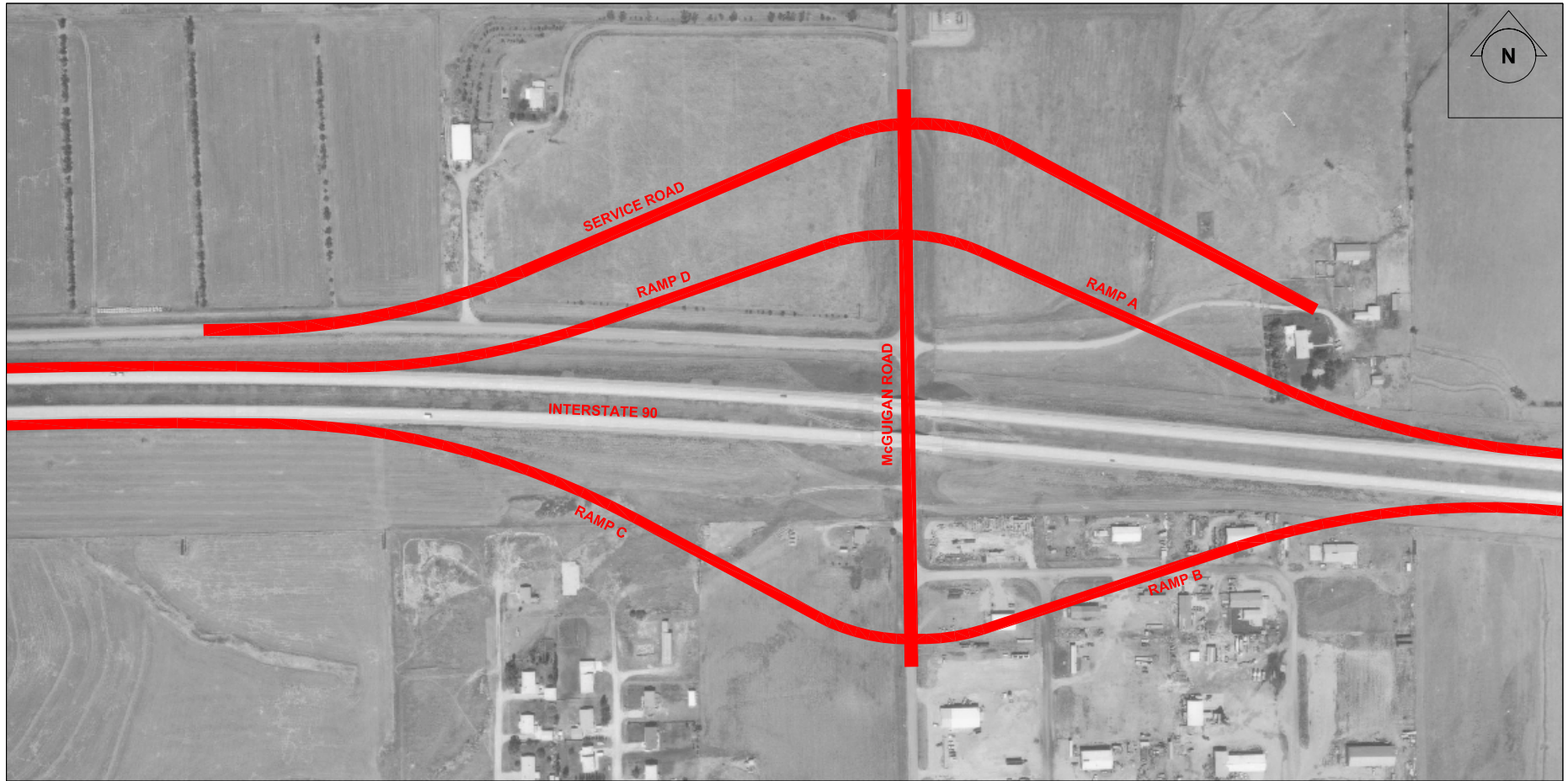
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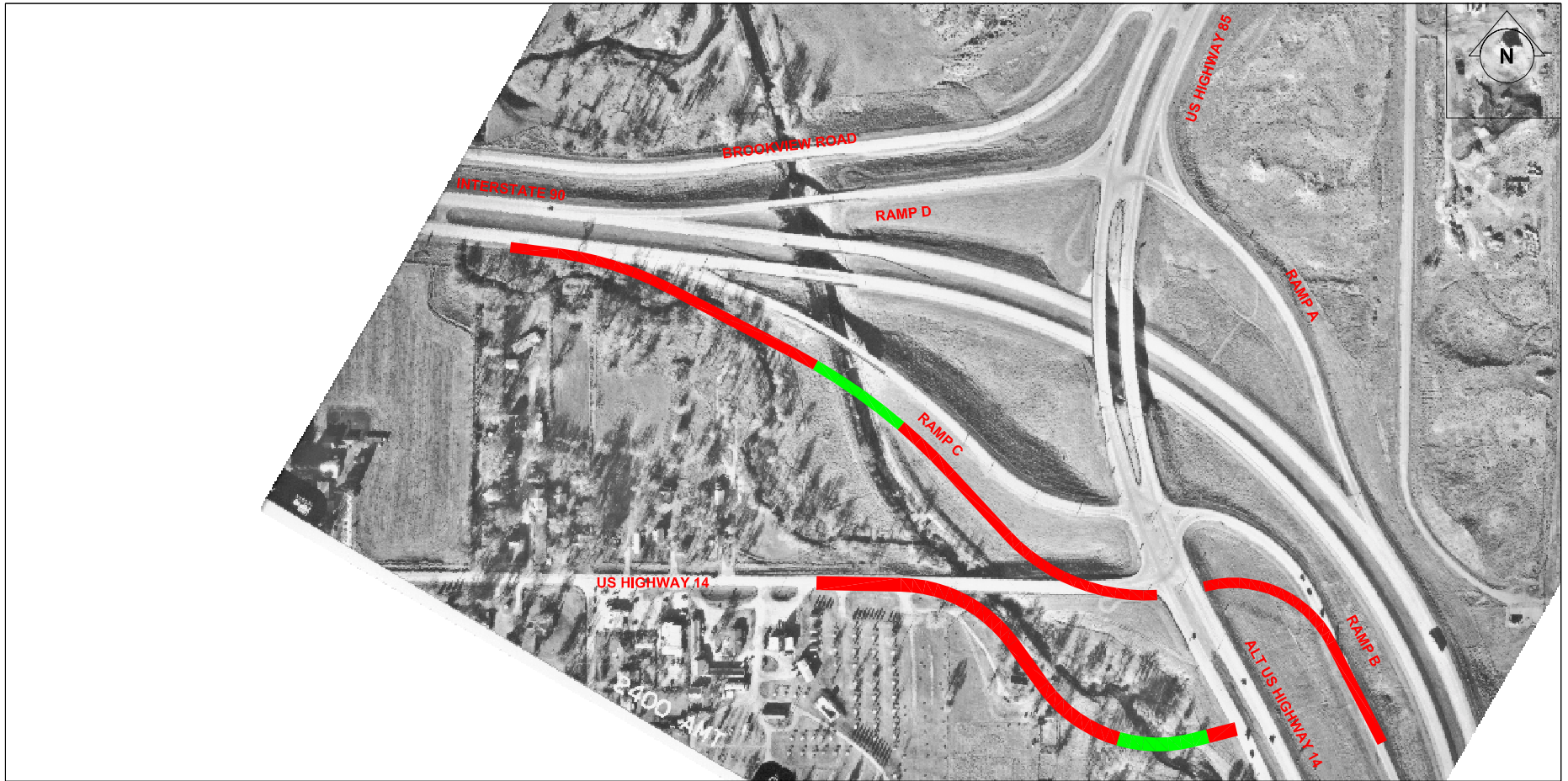


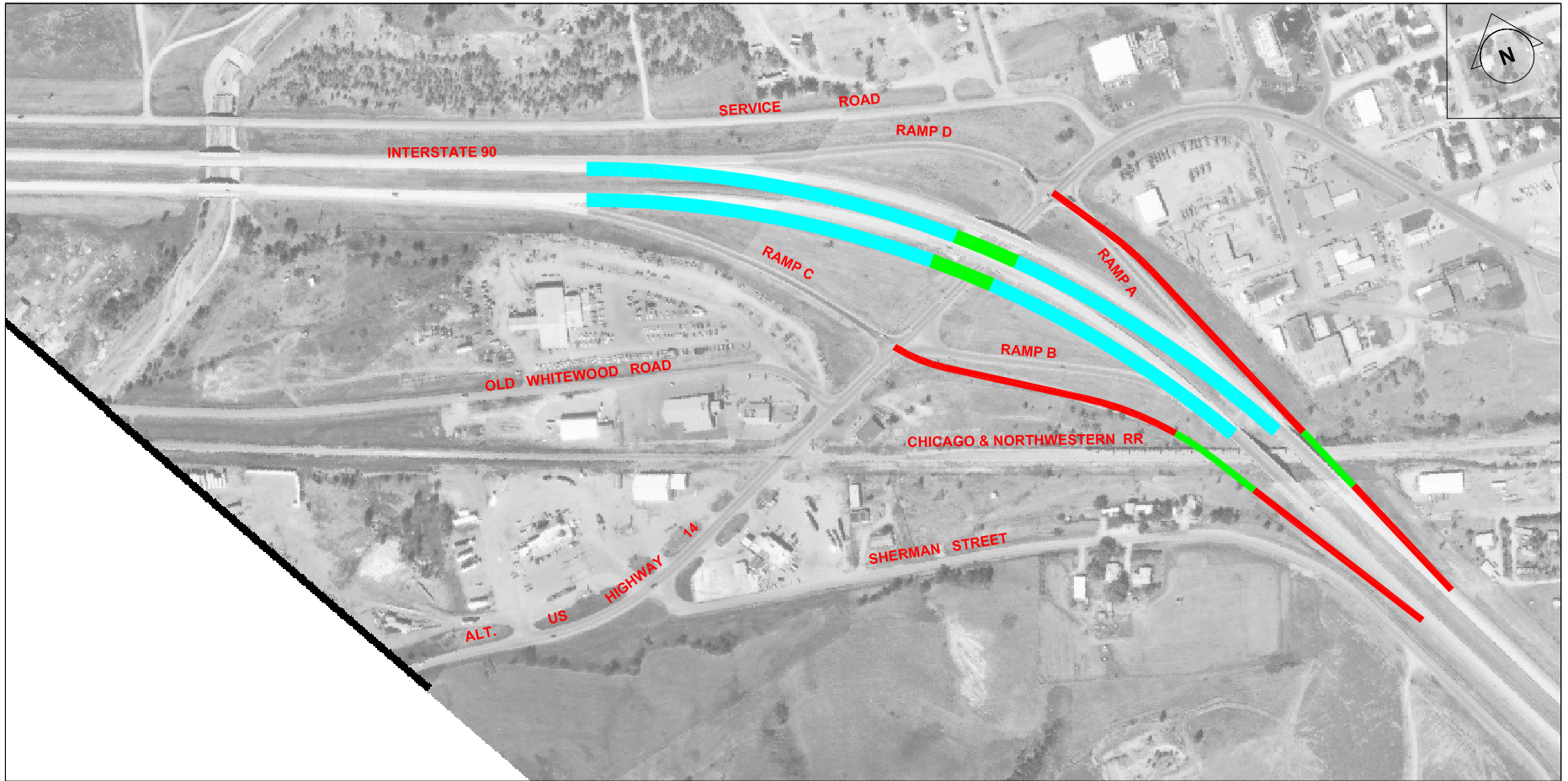
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CONSULTING ENGINEERS

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McGuigan Road, Spearfish  
Diamond Interchange

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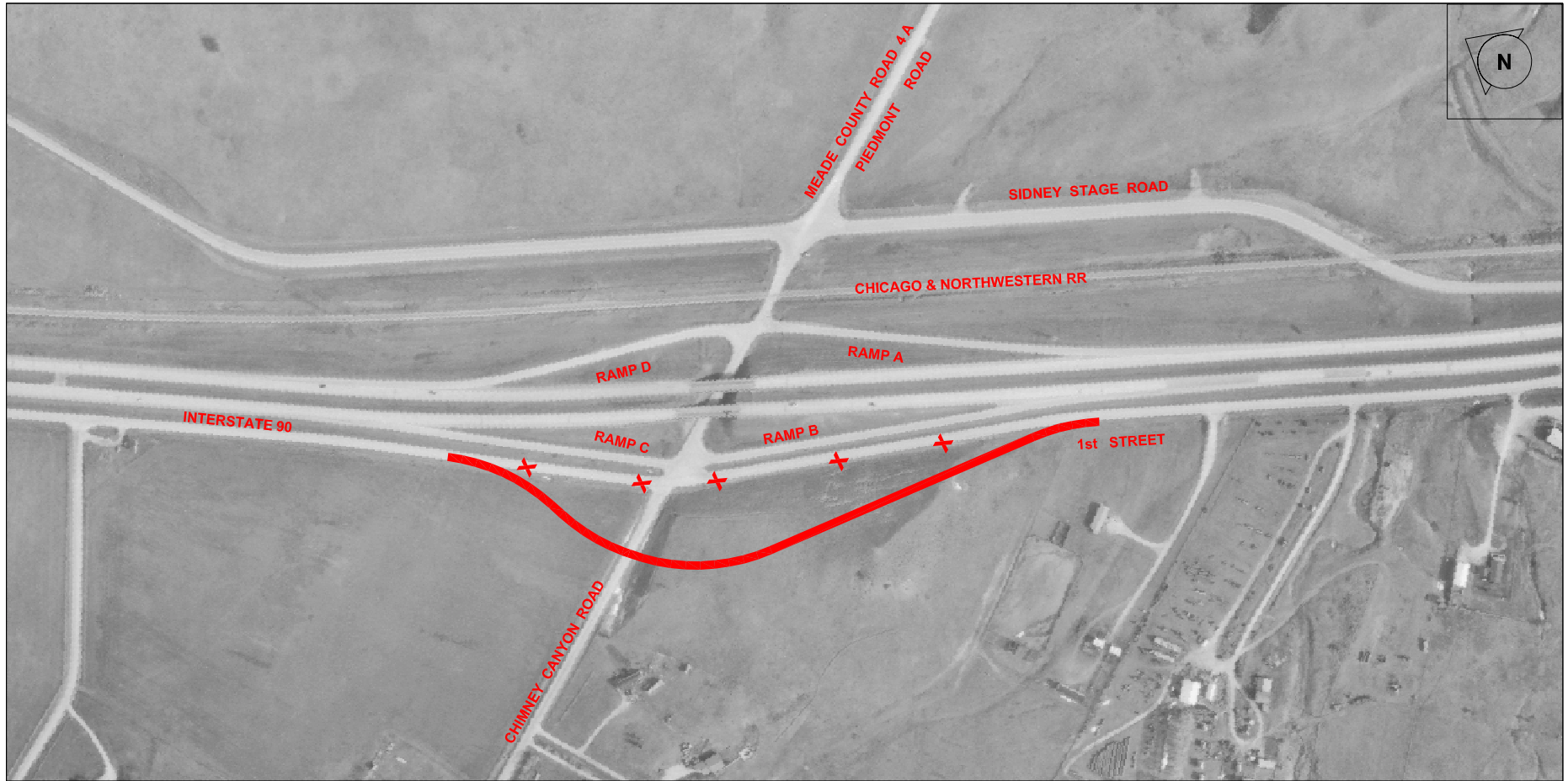


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US 14A, Sturgis  
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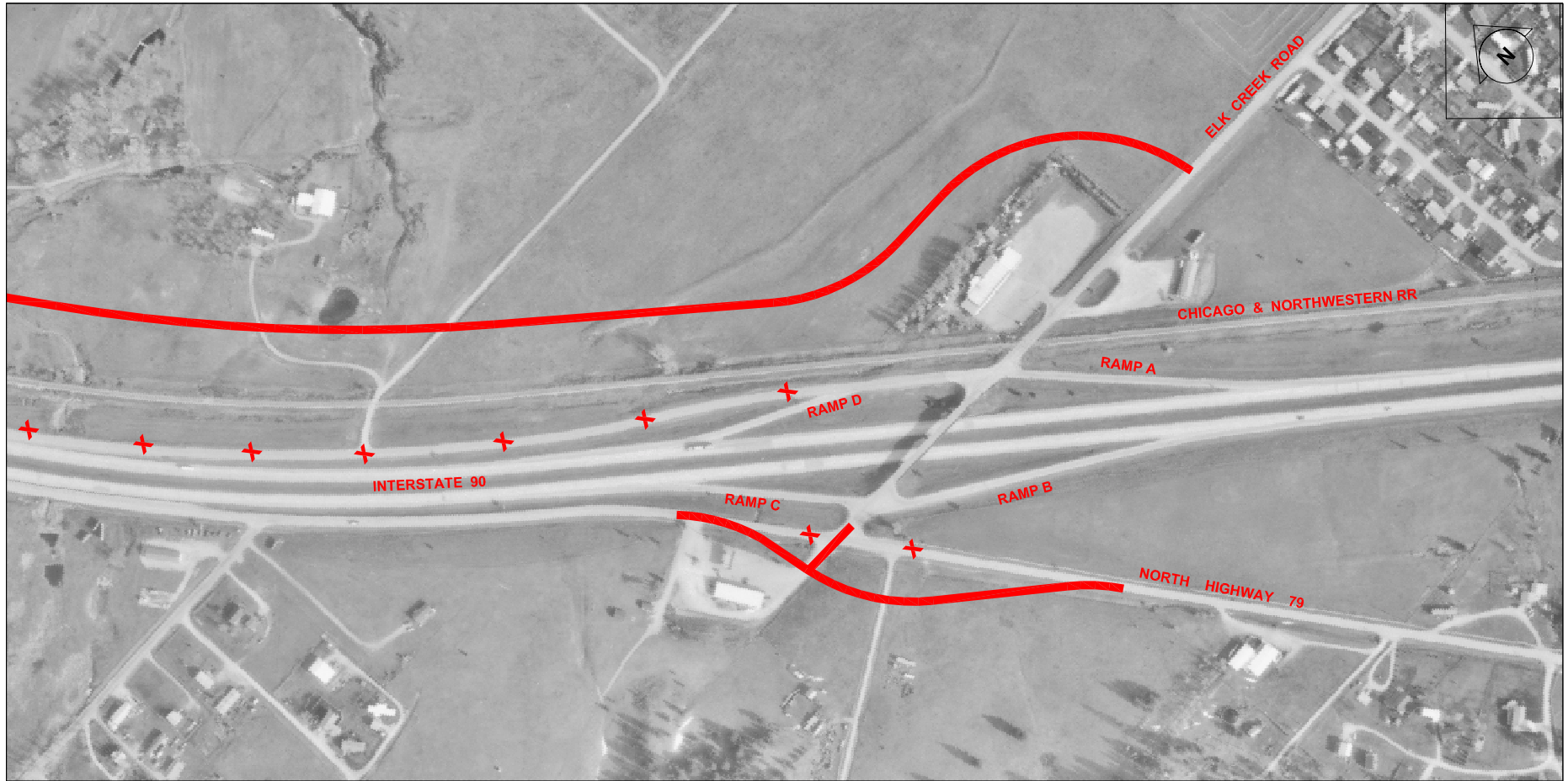


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Bethlehem Road, Piedmont  
Diamond Interchange

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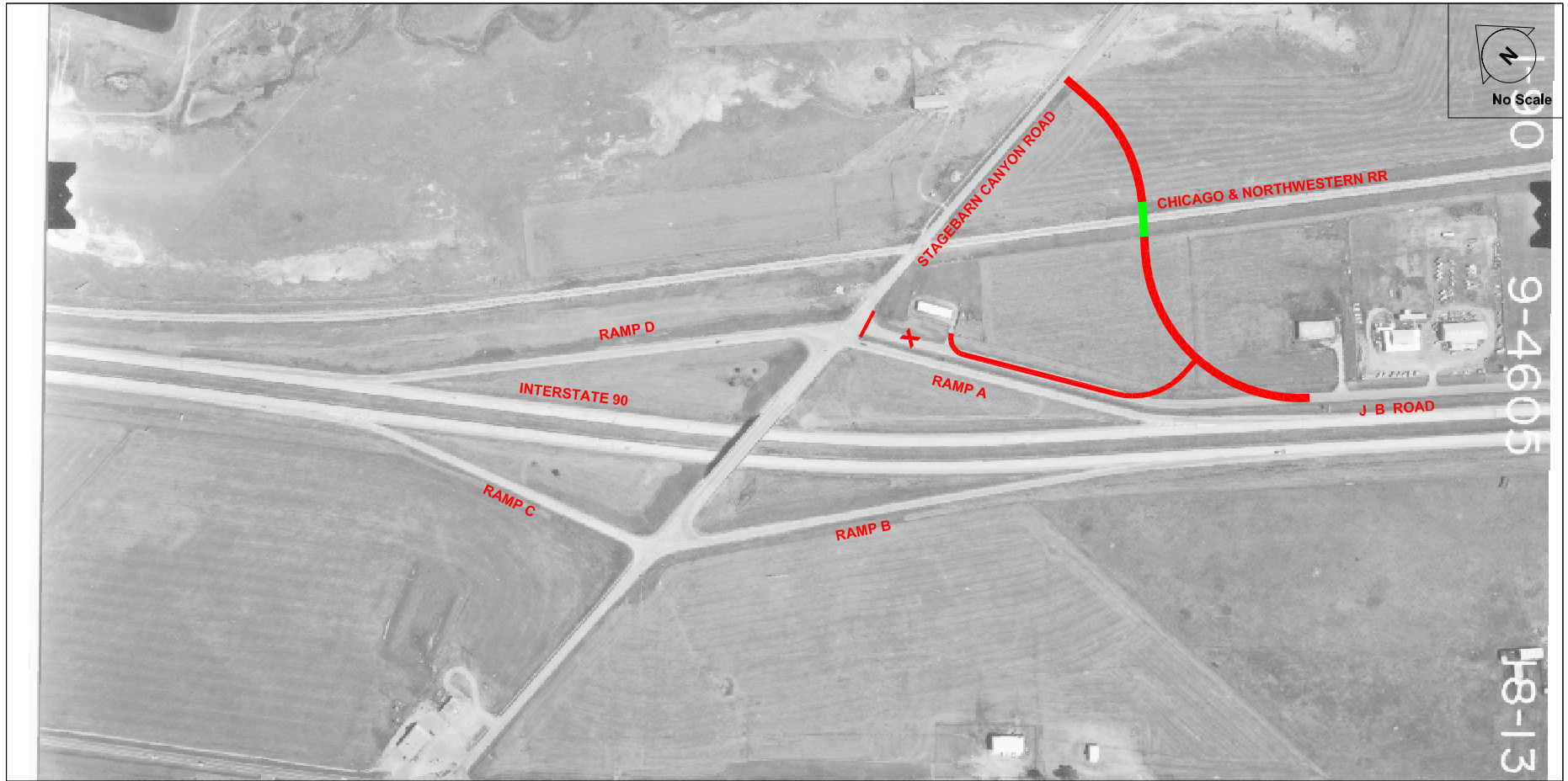


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I-90 Exit 46  
Elk Creek Road, Piedmont  
Diamond Interchange

South Dakota Interstate Corridor Study



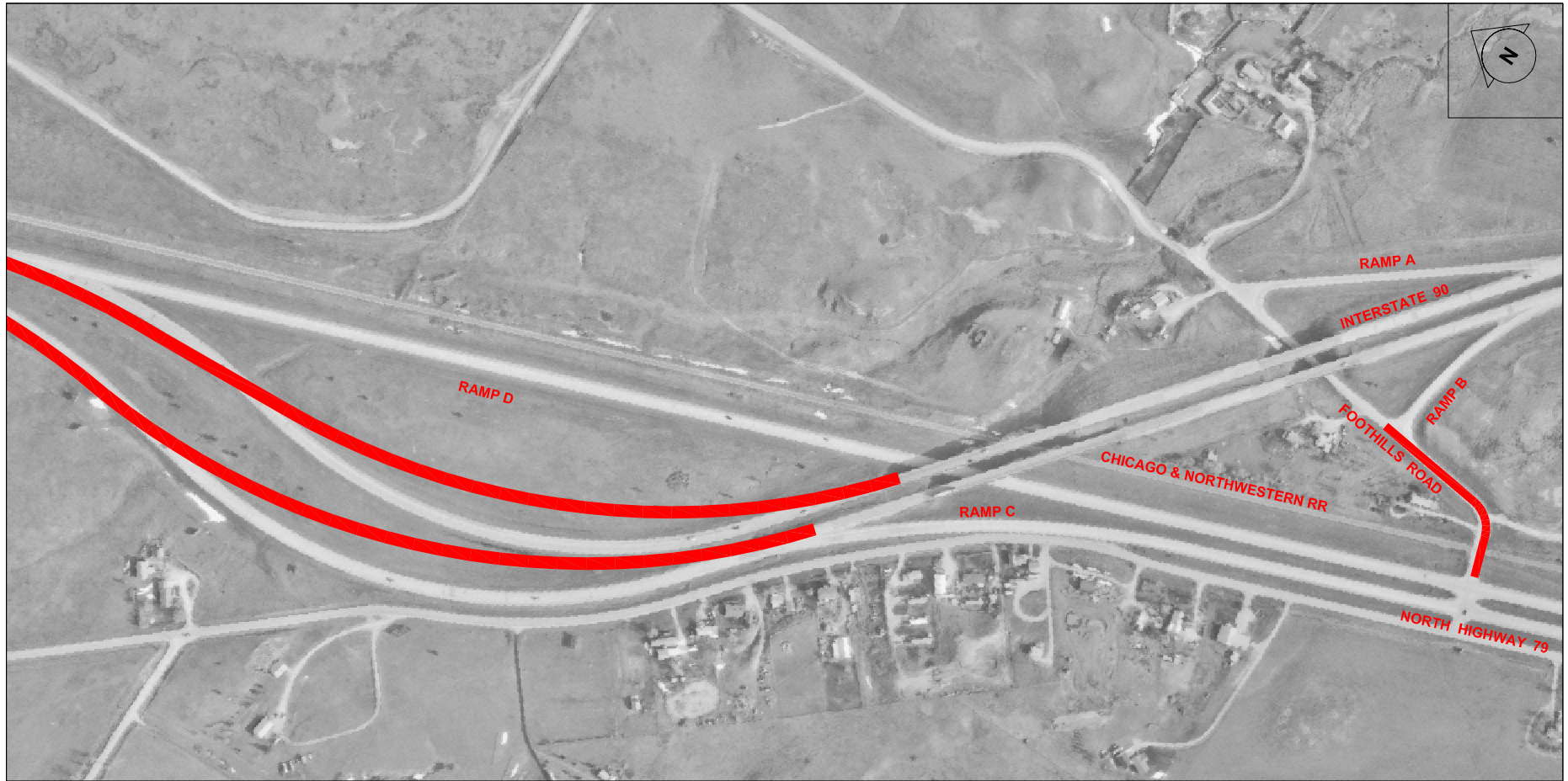
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I-90 Exit 48  
Stagebarn Canyon, Piedmont  
Diamond Interchange

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ULLEVIG

I-90 Exit 51  
Black Hawk Road, Black Hawk  
Diamond Interchange

South Dakota Interstate Corridor Study

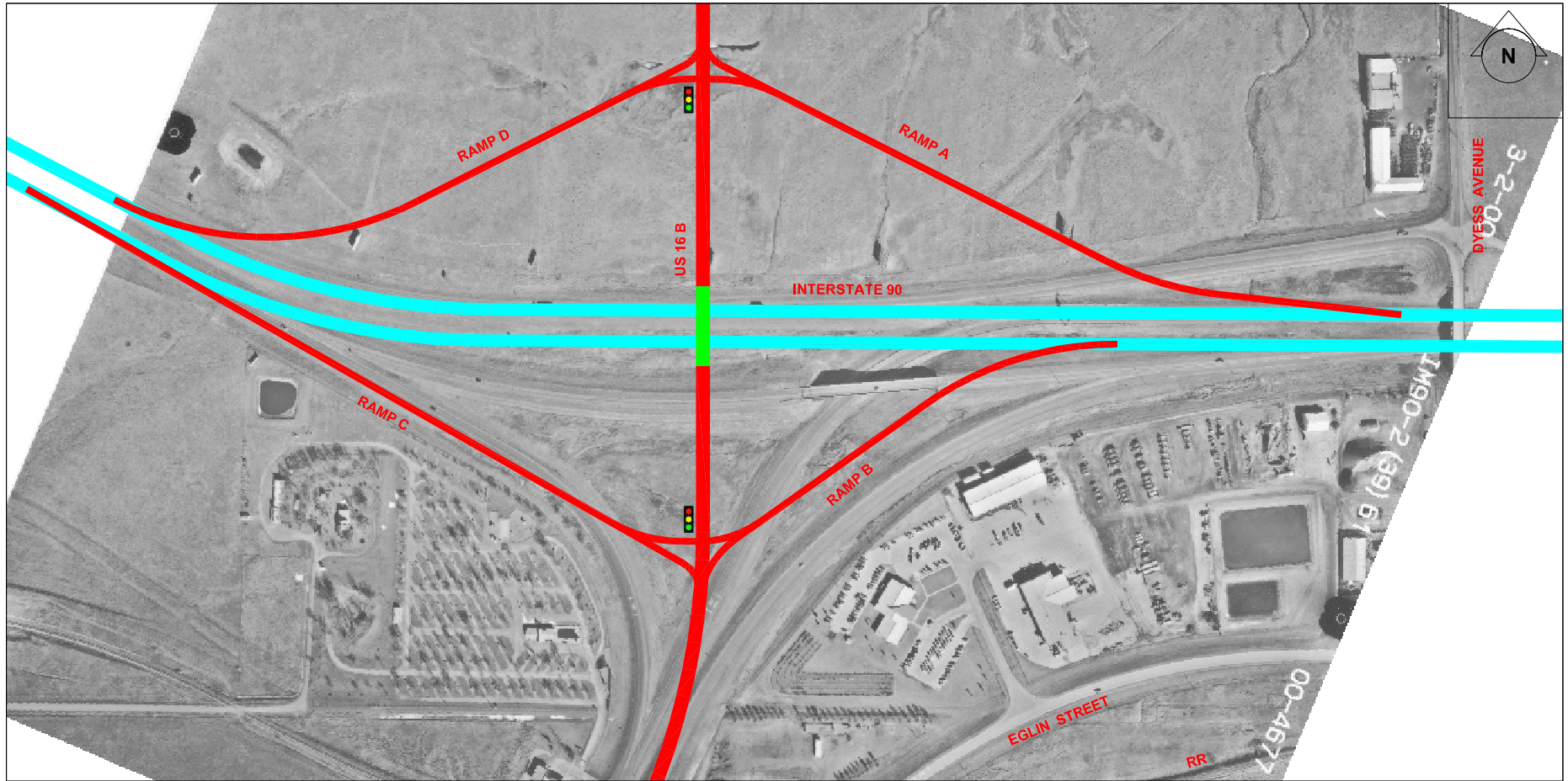


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ULLEVIG

I-90 Exit 55  
Deadwood Avenue, Rapid City  
Diamond Interchange

South Dakota Interstate Corridor Study

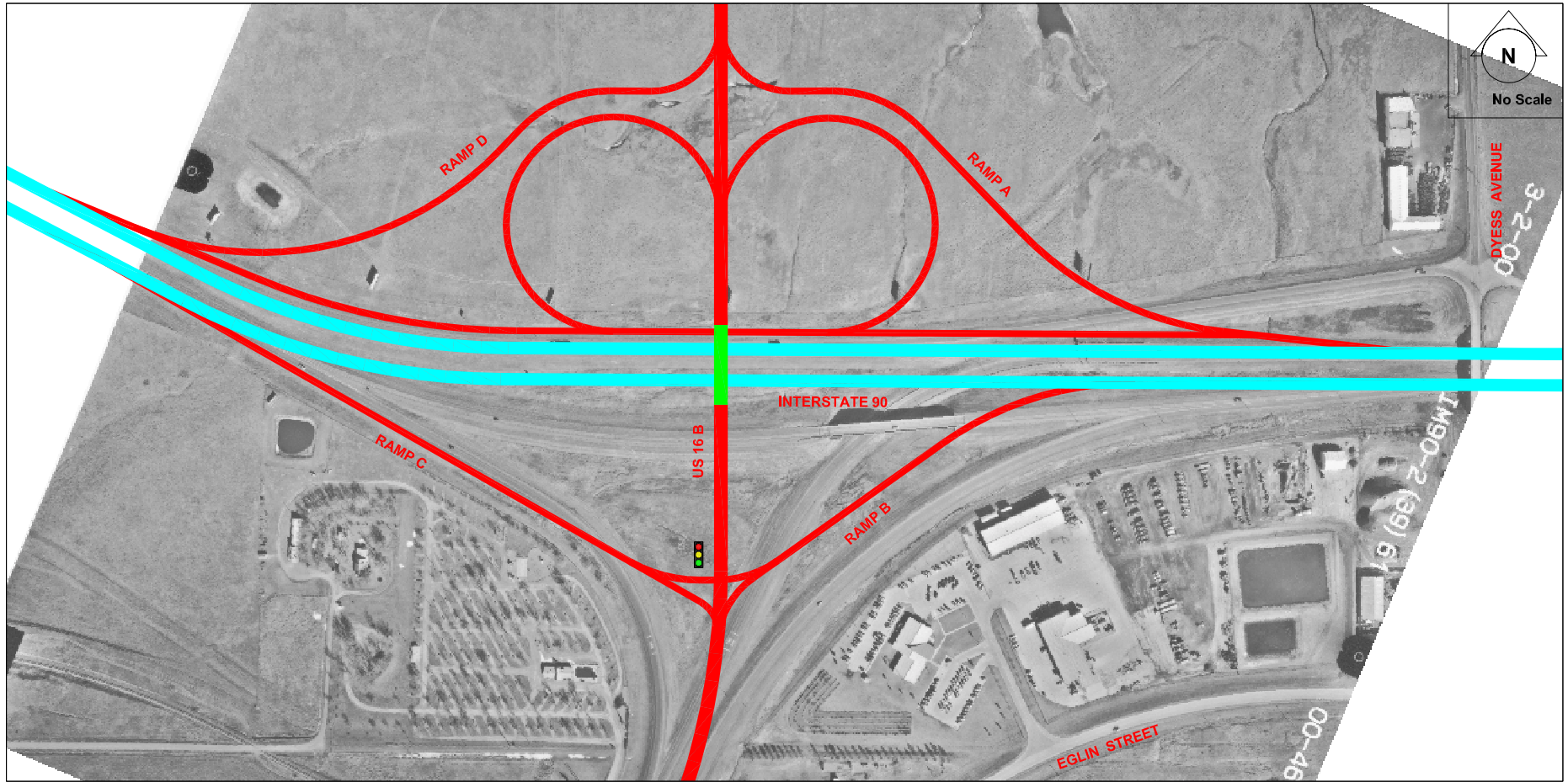


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HOLT &  
ULLEVIG

I-90 Exit 60  
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Alt 1-Diamond Interchange

South Dakota Interstate Corridor Study

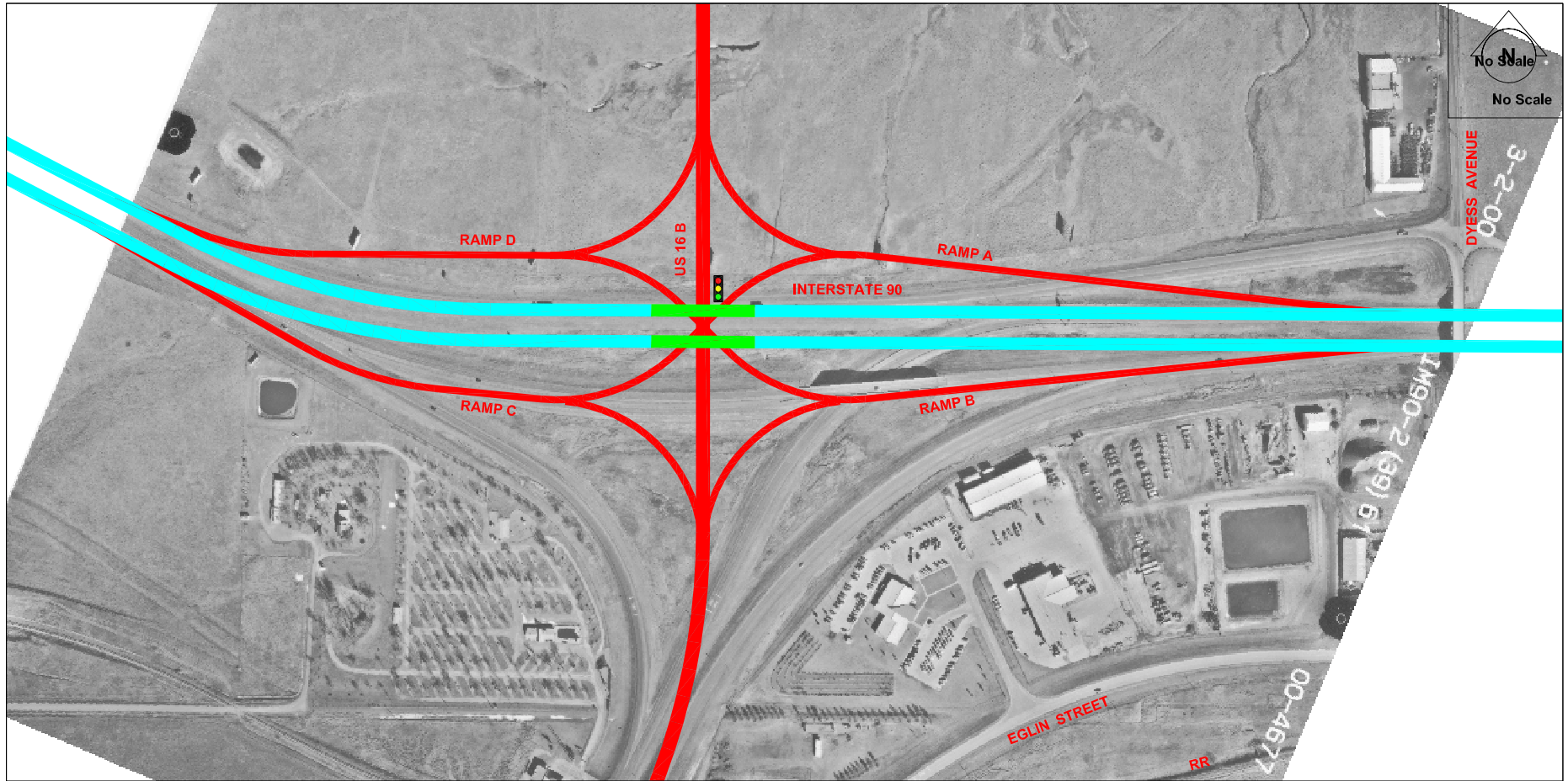


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South Dakota Interstate Corridor Study

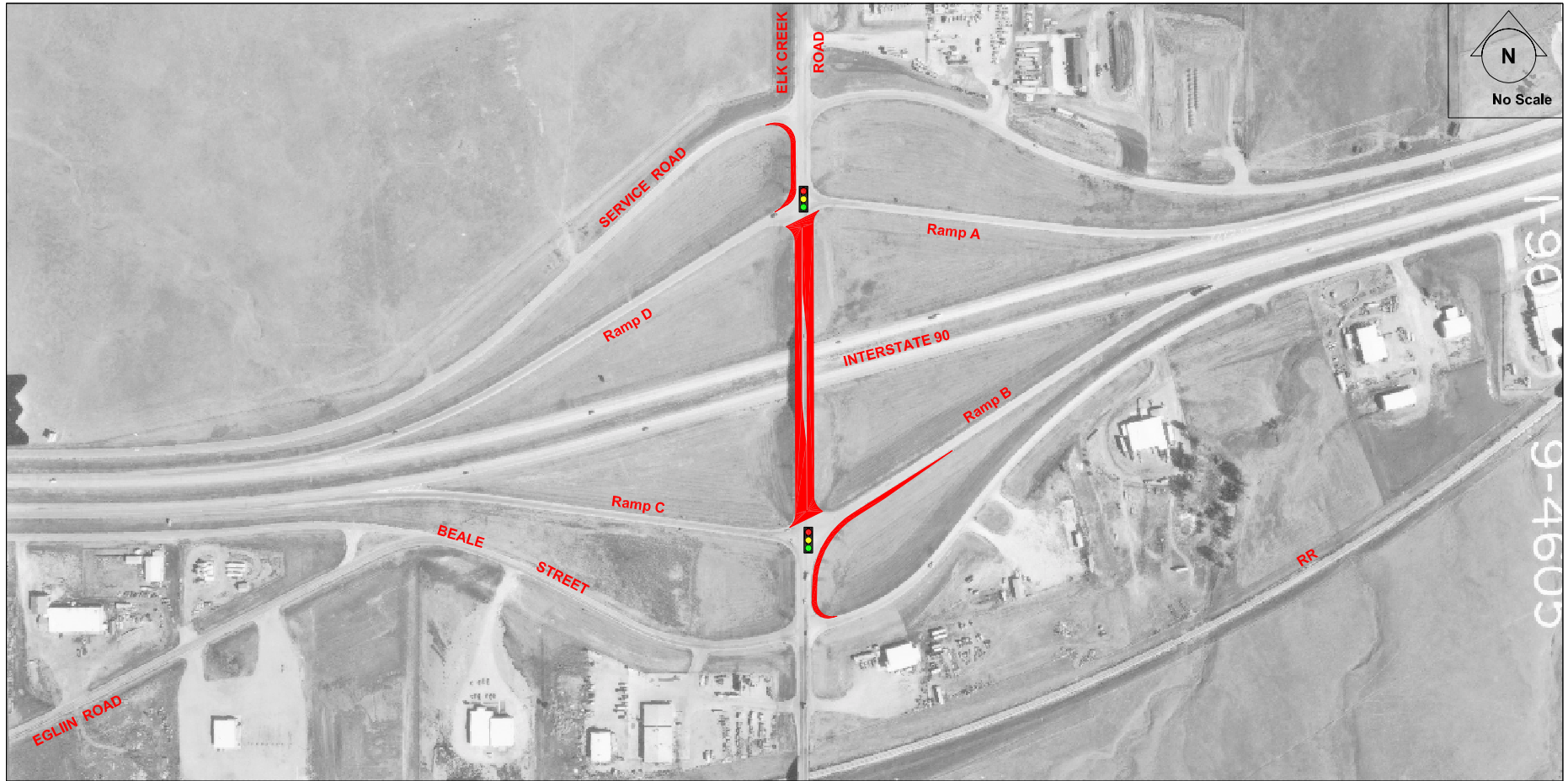


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South Dakota Interstate Corridor Study

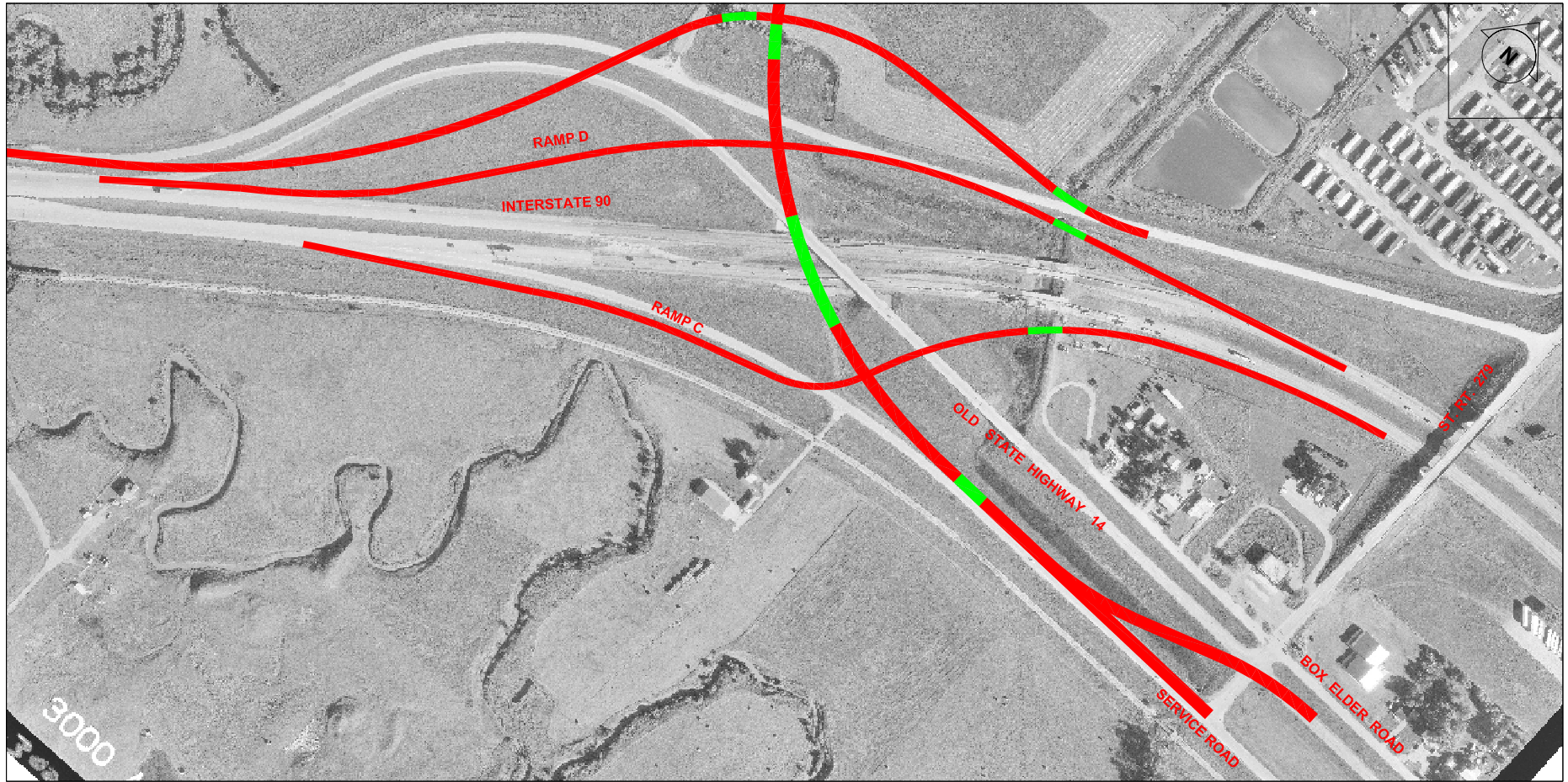


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I-90 Exit 61  
Elk Vale Road, Rapid City  
Diamond Interchange

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SH 230, Duster's Corner  
Diamond Interchange

South Dakota Interstate Corridor Study



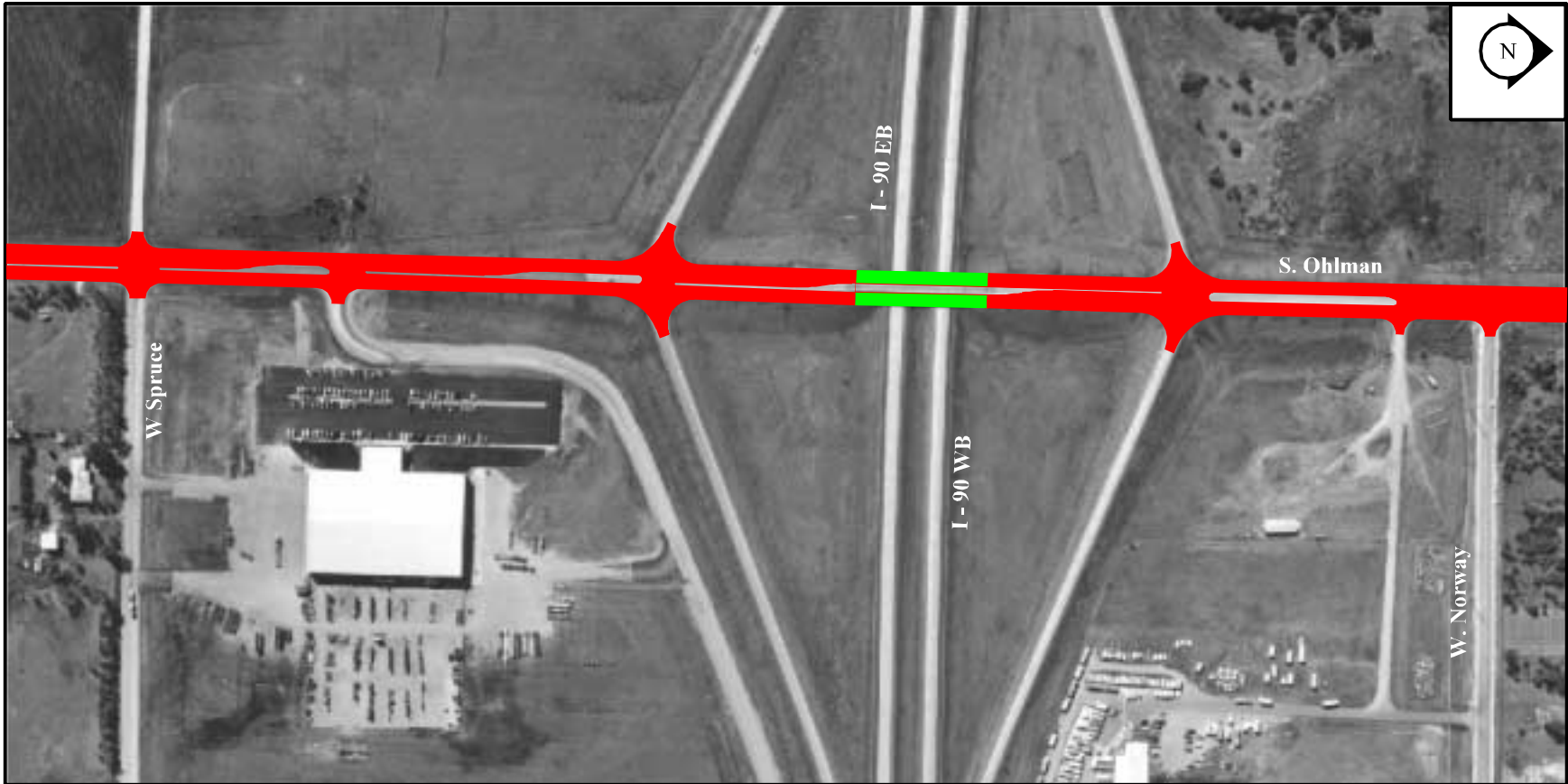
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Diamond Interchange

South Dakota Interstate Corridor Study

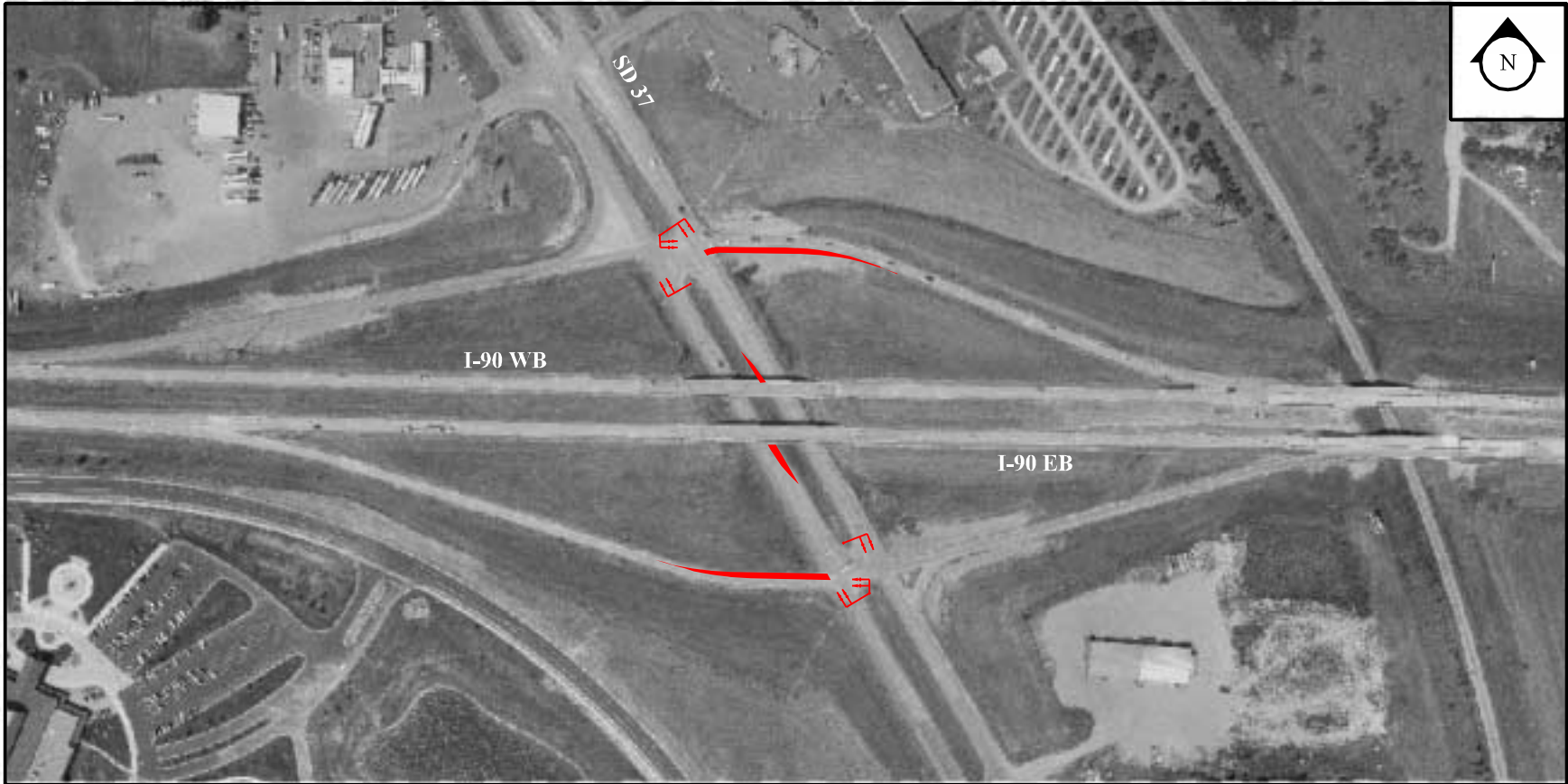




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I-90 Exit 330  
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Five - Lane Crossroad

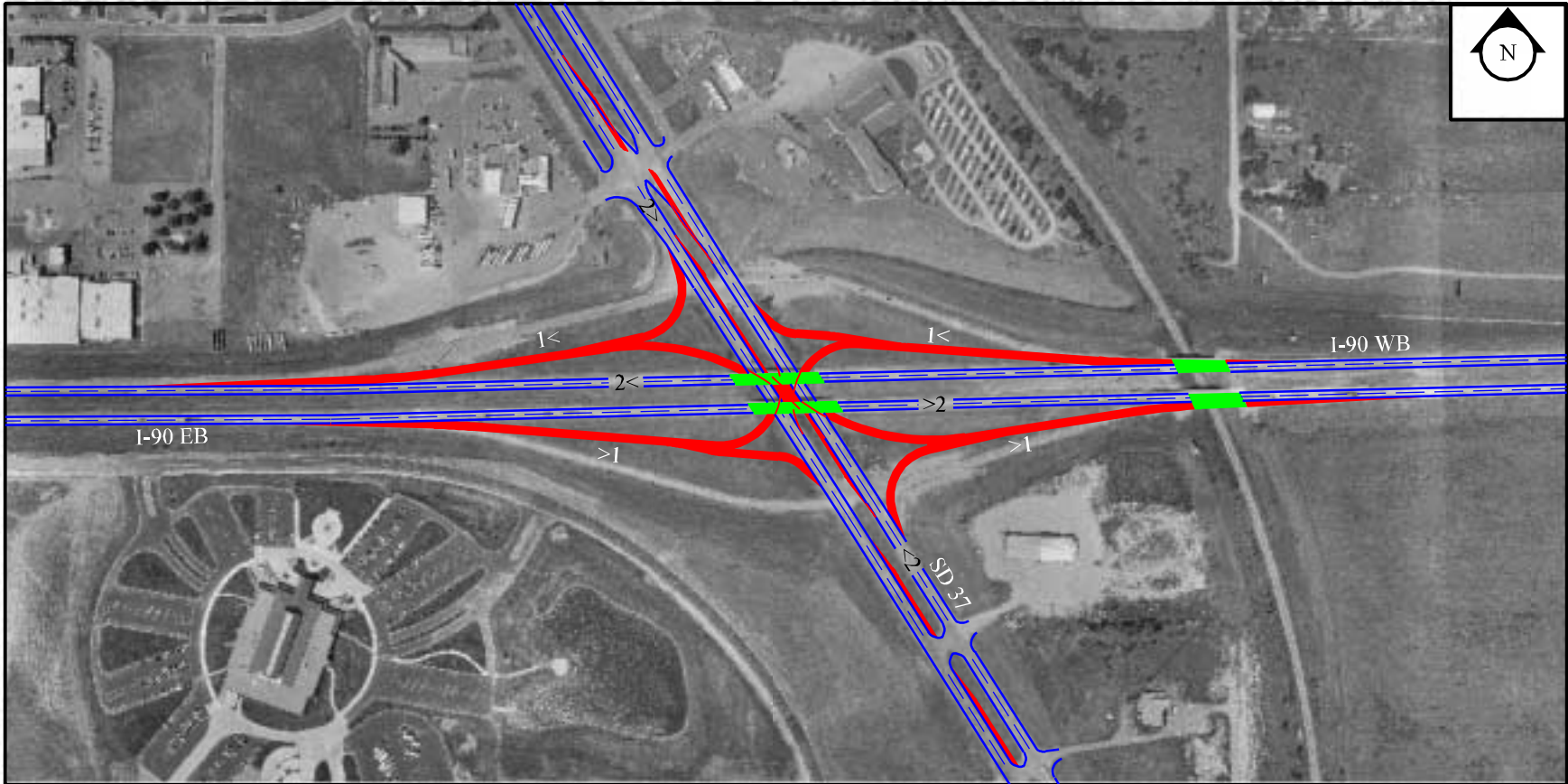


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ULLEVIG**

I-90 Exit 332  
SD 37, Mitchell  
Traffic Signalization

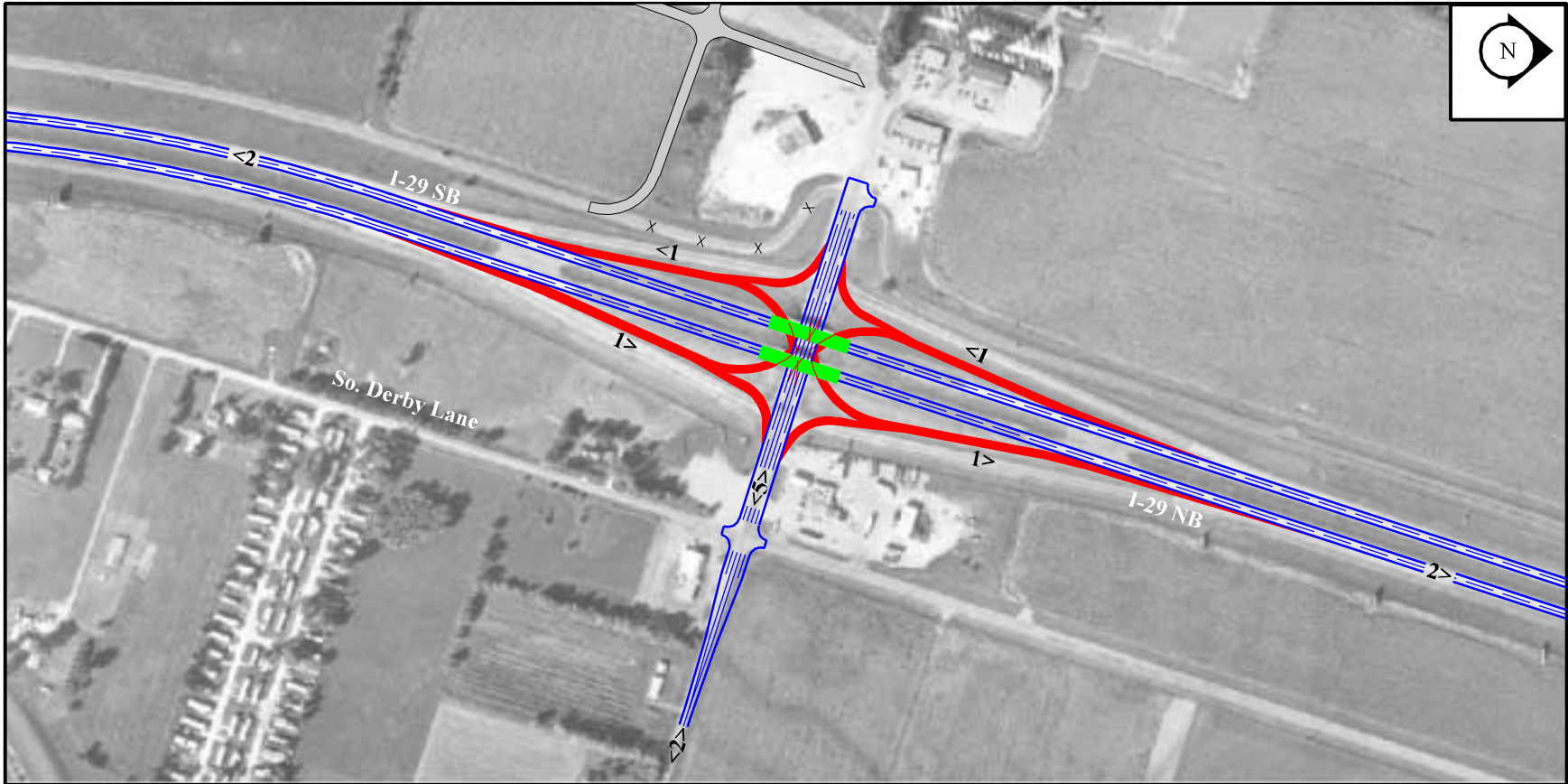
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I-90 Exit 332  
SD 37, Mitchell  
Single Point Interchange



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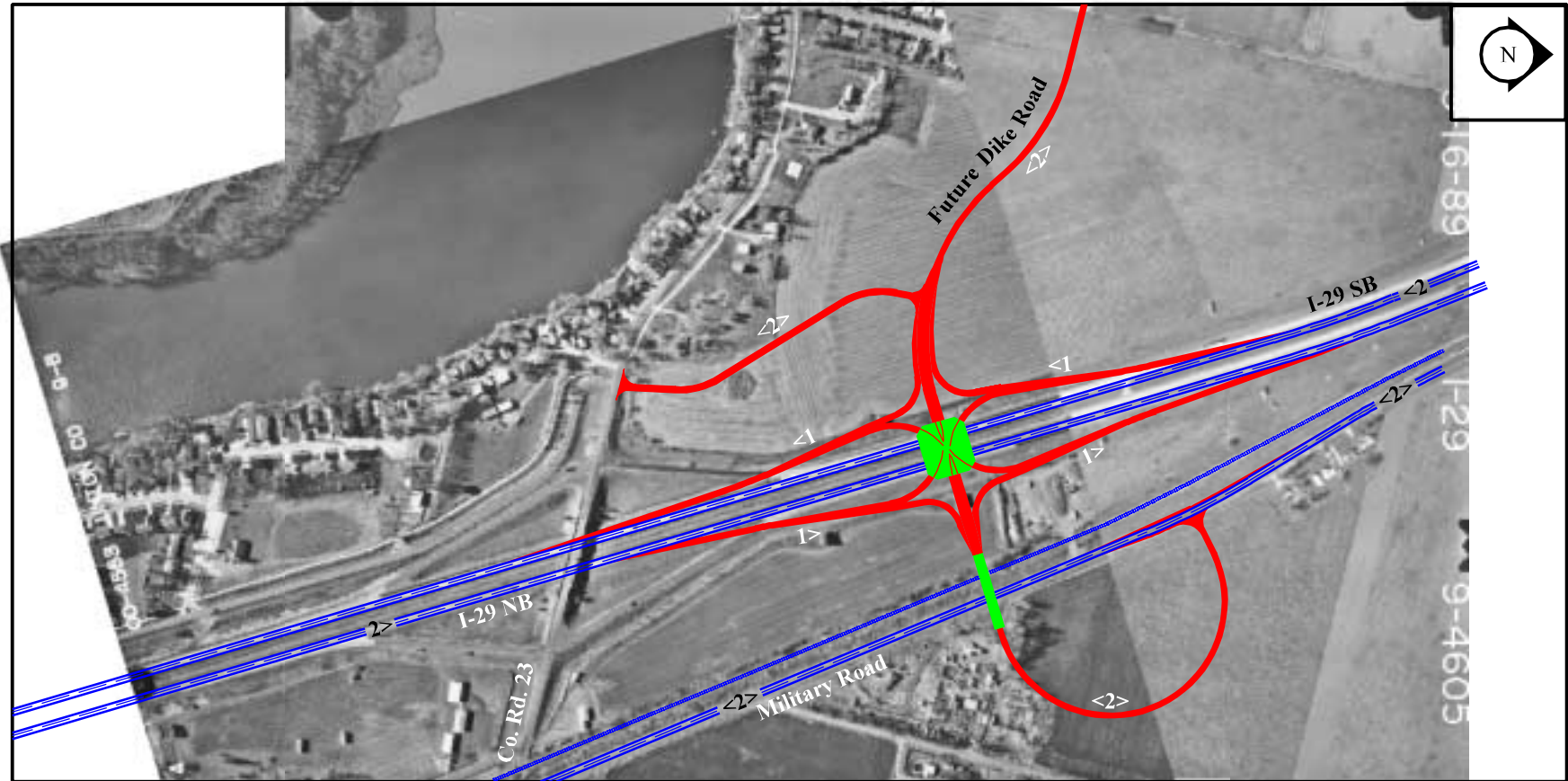
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No. Sioux City  
Single Point Interchange



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ULLEVIG**

I-29 Exit 4  
McCook Lake, No. Sioux City  
Diamond Interchange



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ULLEVIG**

I-29 Exit 4  
McCook Lake, No. Sioux City  
Single Point Interchange

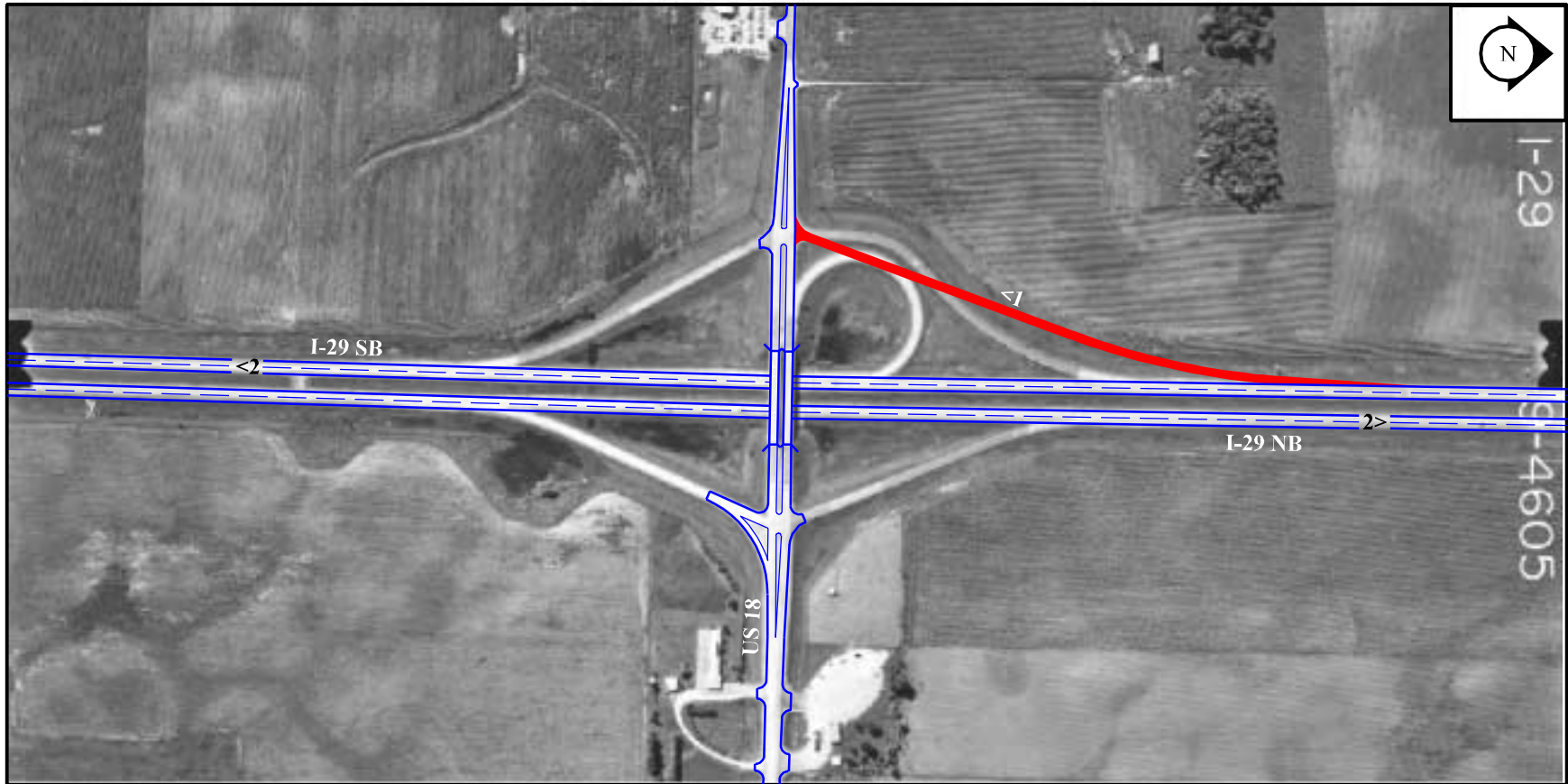
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I-29 Exit 9  
SD 105, Jefferson  
Diamond Interchange



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I-29 Exit 62  
US 81, Canton  
NW Loop Ramp Removal

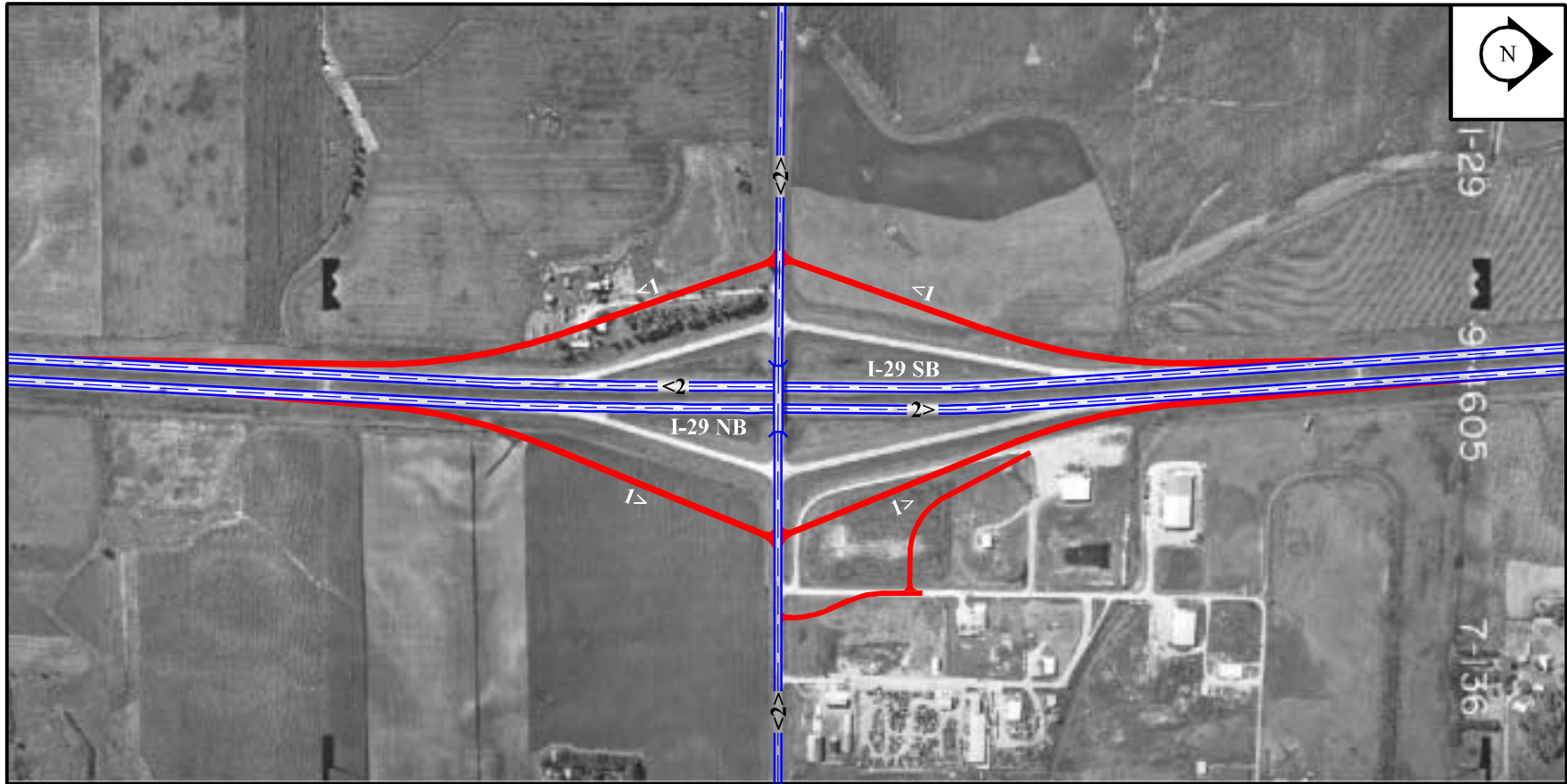




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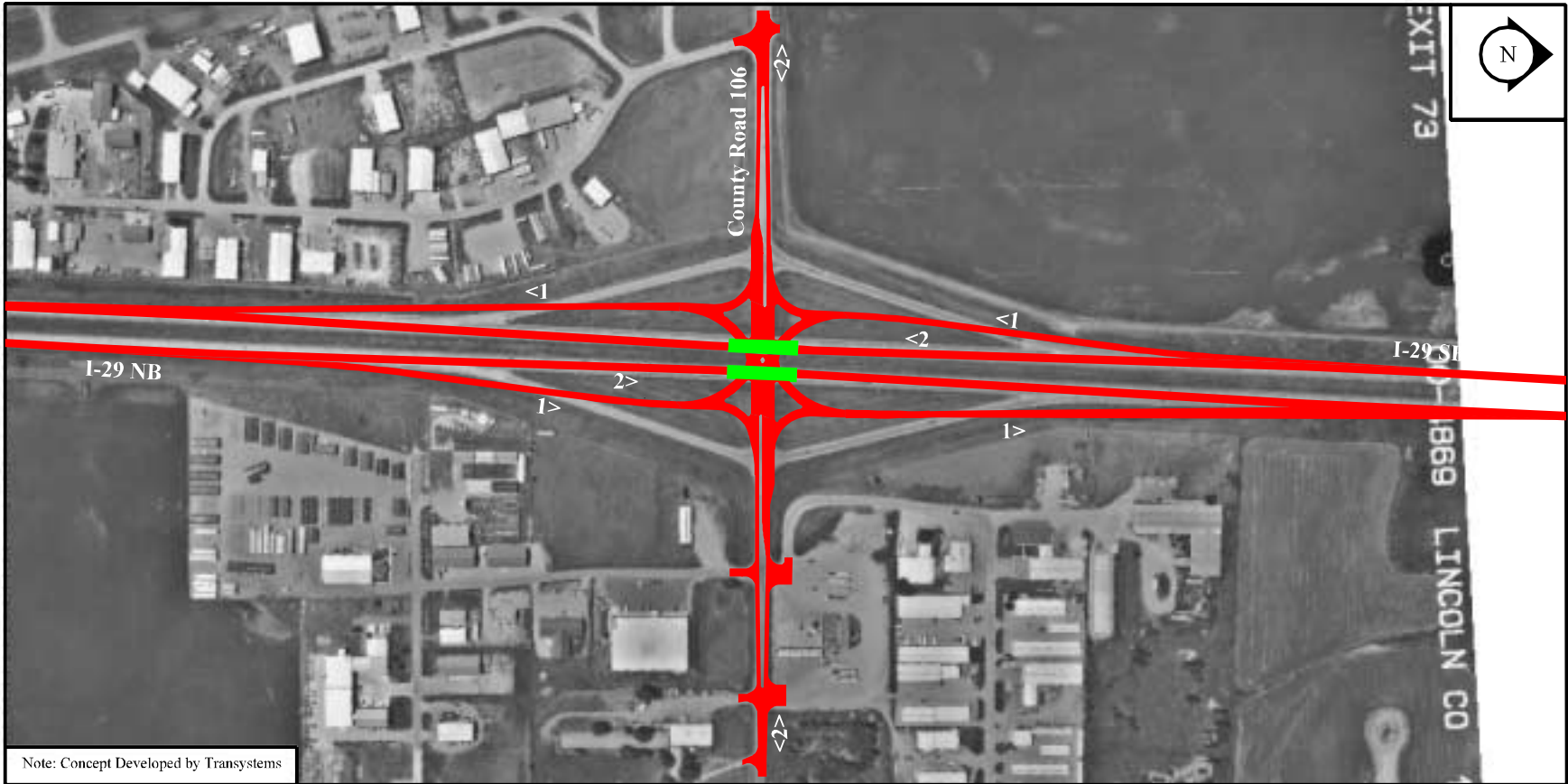
I-29 Exit 64  
SD 44, Worthing/Lennox  
New Bridge Over I-29



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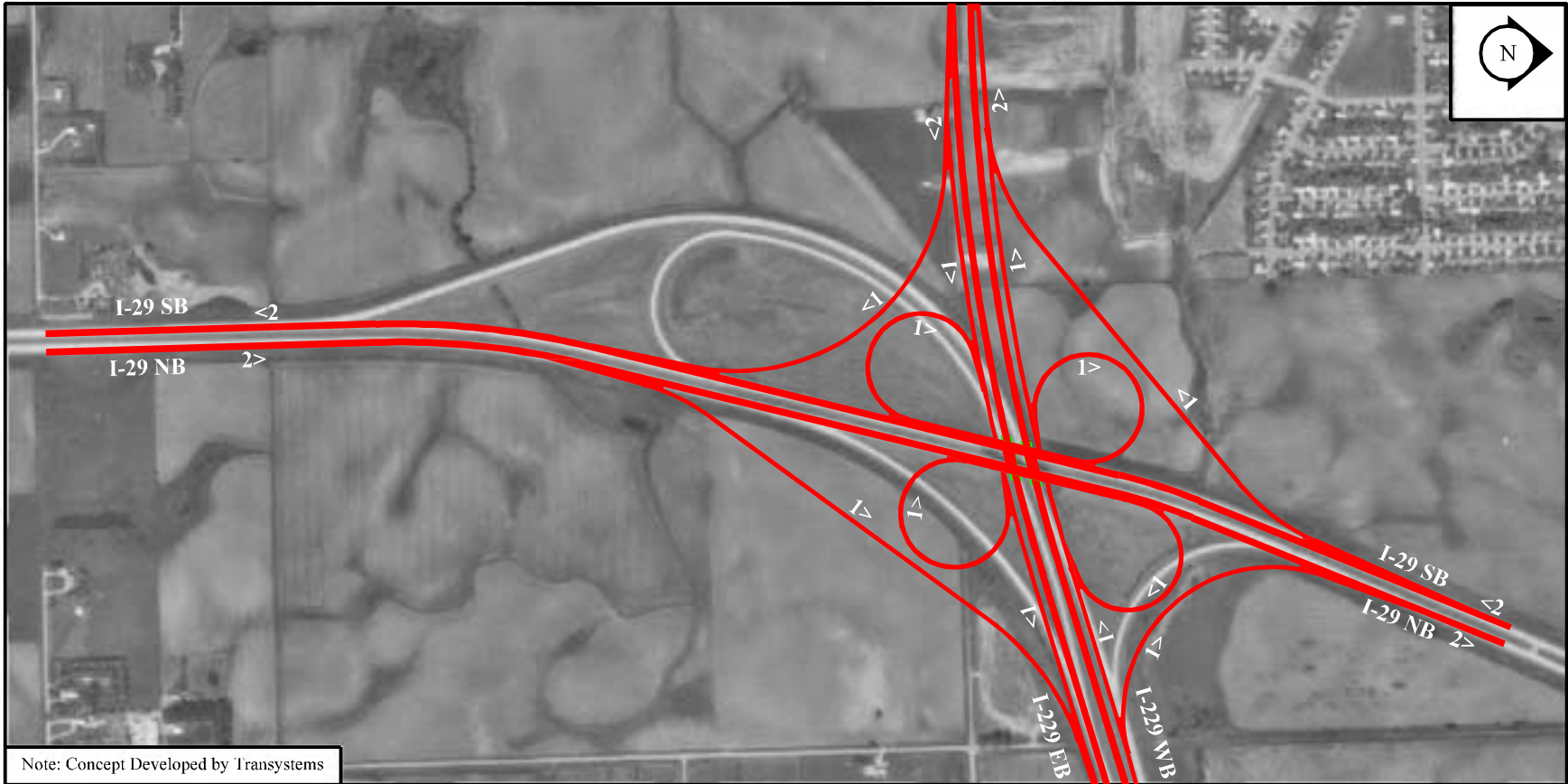
I-29 Exit 71  
C.R. 100 Tea/Harrisburg  
Diamond Interchange



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ULLEVIG**

I-29 Exit 73  
C.R. 106, Tea  
Single Point Interchange



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ULLEVIG**

I-29 Exit 75  
I-229, Sioux Falls  
Clover Leaf Interchange

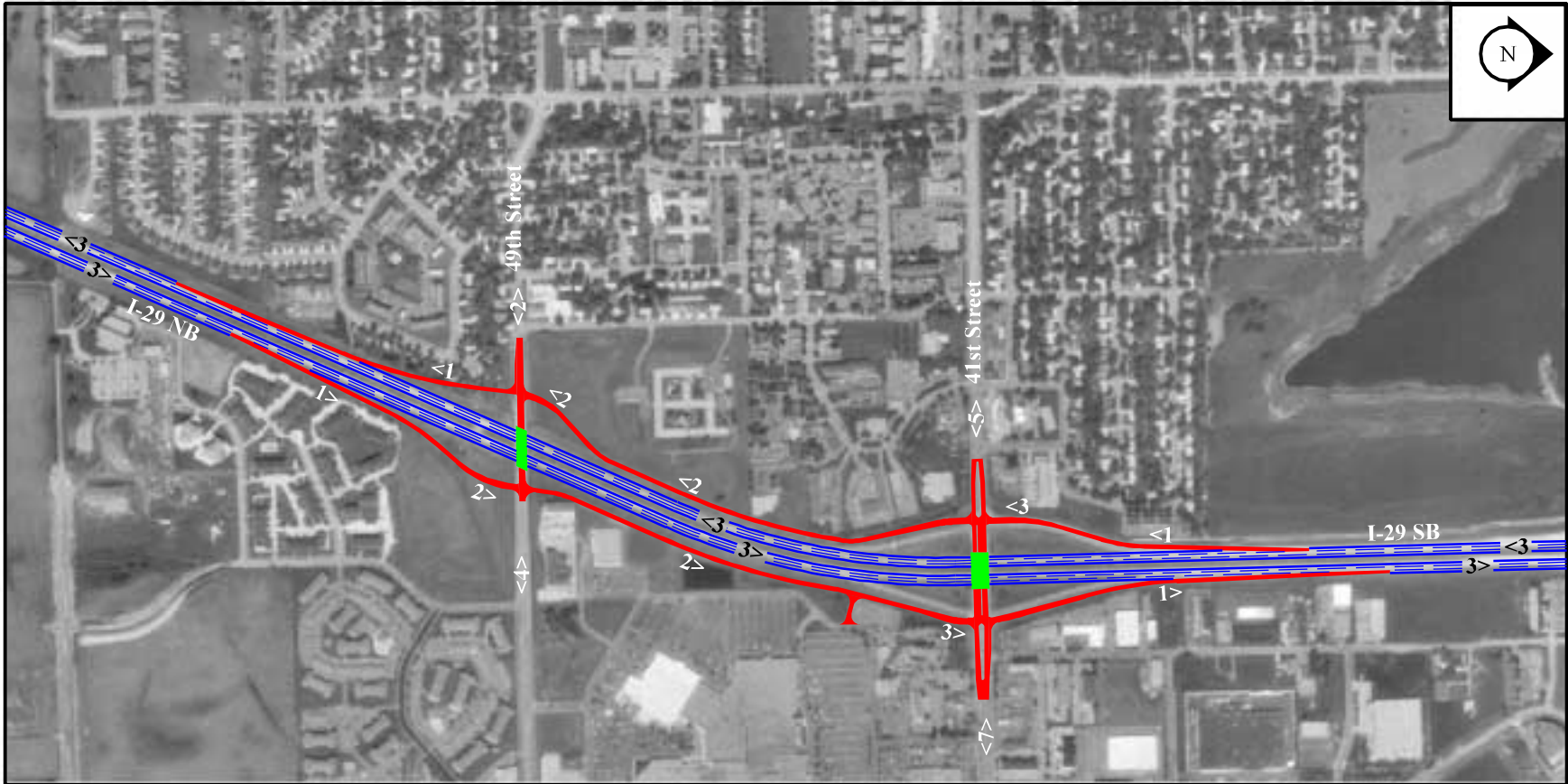


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ULLEVIG**

I-29 Exit 77  
Half Diamond at 49th Street  
41st Street, Sioux Falls  
Split Diamond With Frontage Roads

South Dakota Interstate Corridor Study

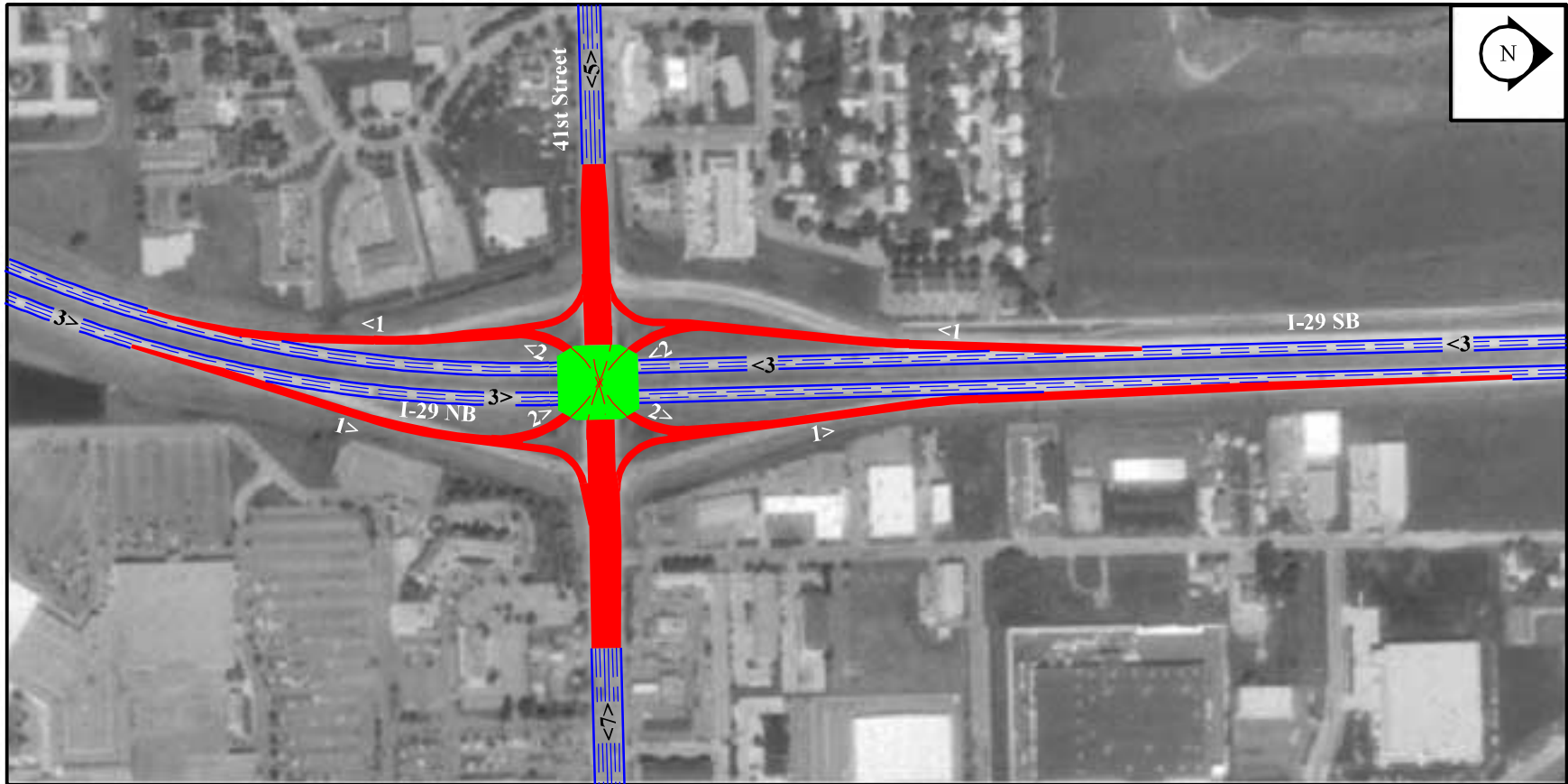


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HOLT &  
ULLEVIG**

I-29 Exit 77  
41st Street, Sioux Falls  
Split Diamond With Frontage Roads

South Dakota Interstate Corridor Study





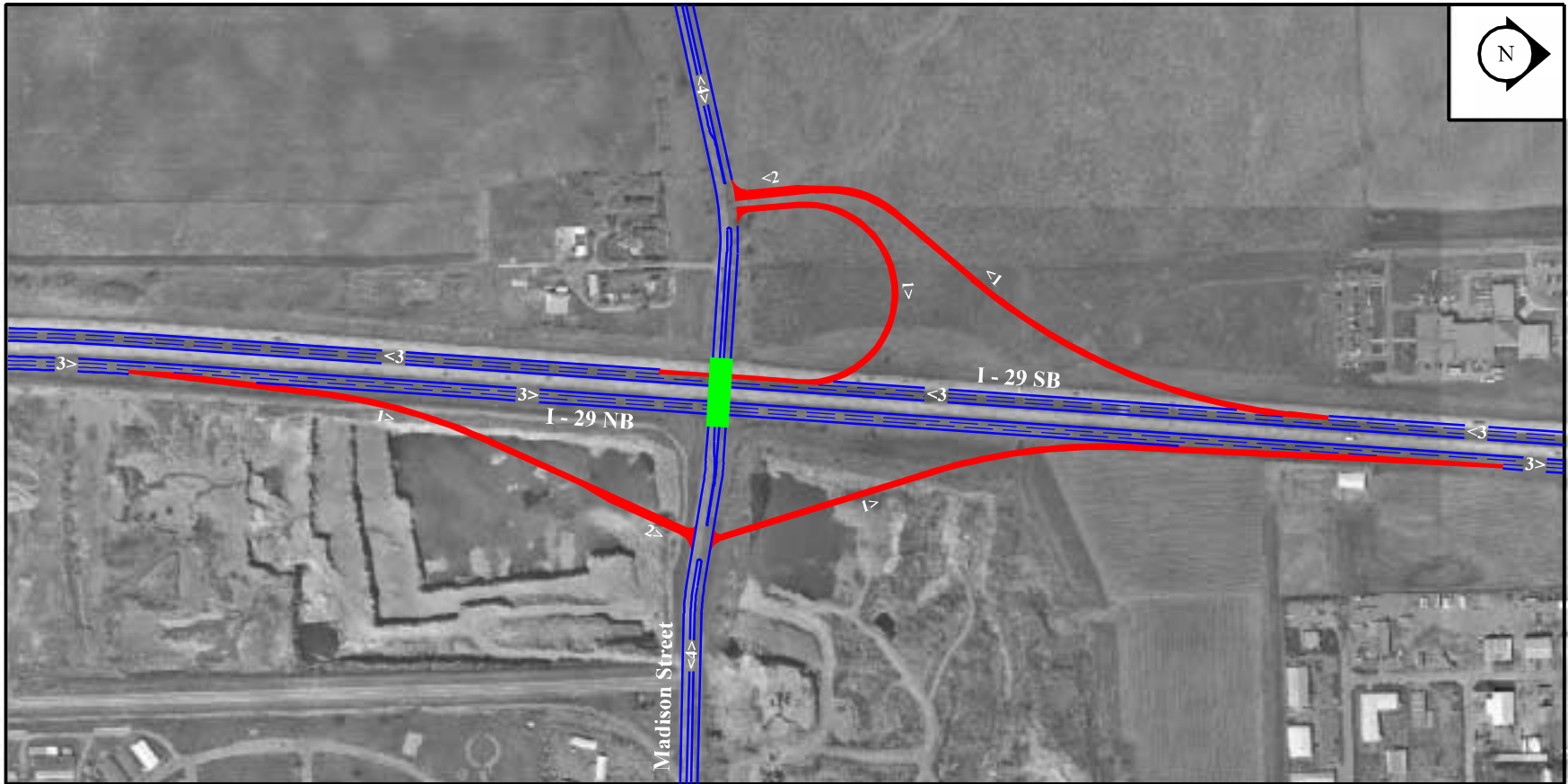
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HOLT &  
ULLEVIG**

I-29 Exit 79  
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Single Point Interchange

South Dakota Interstate Corridor Study

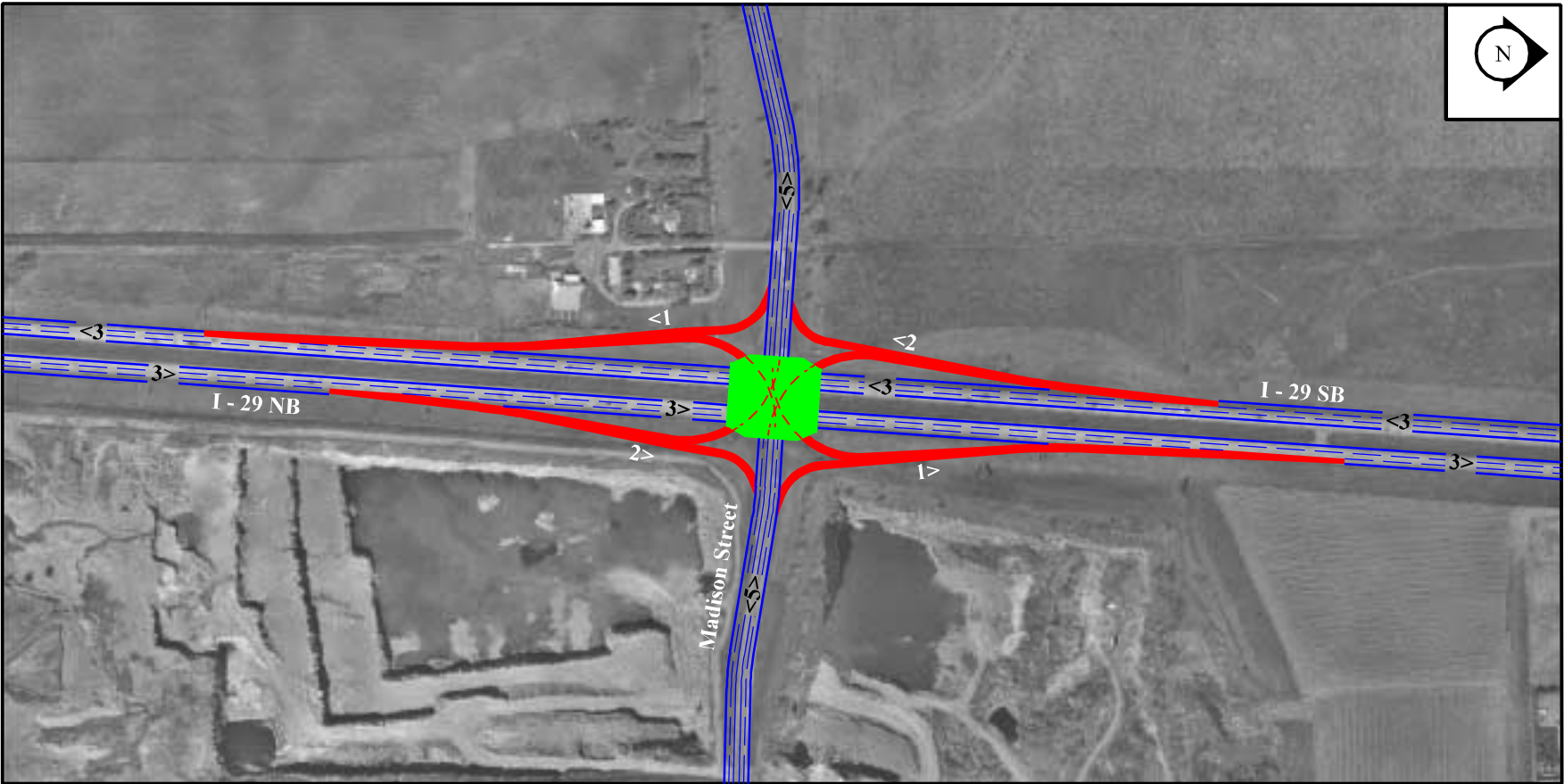




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**HOLT &**  
**ULLEVIG**

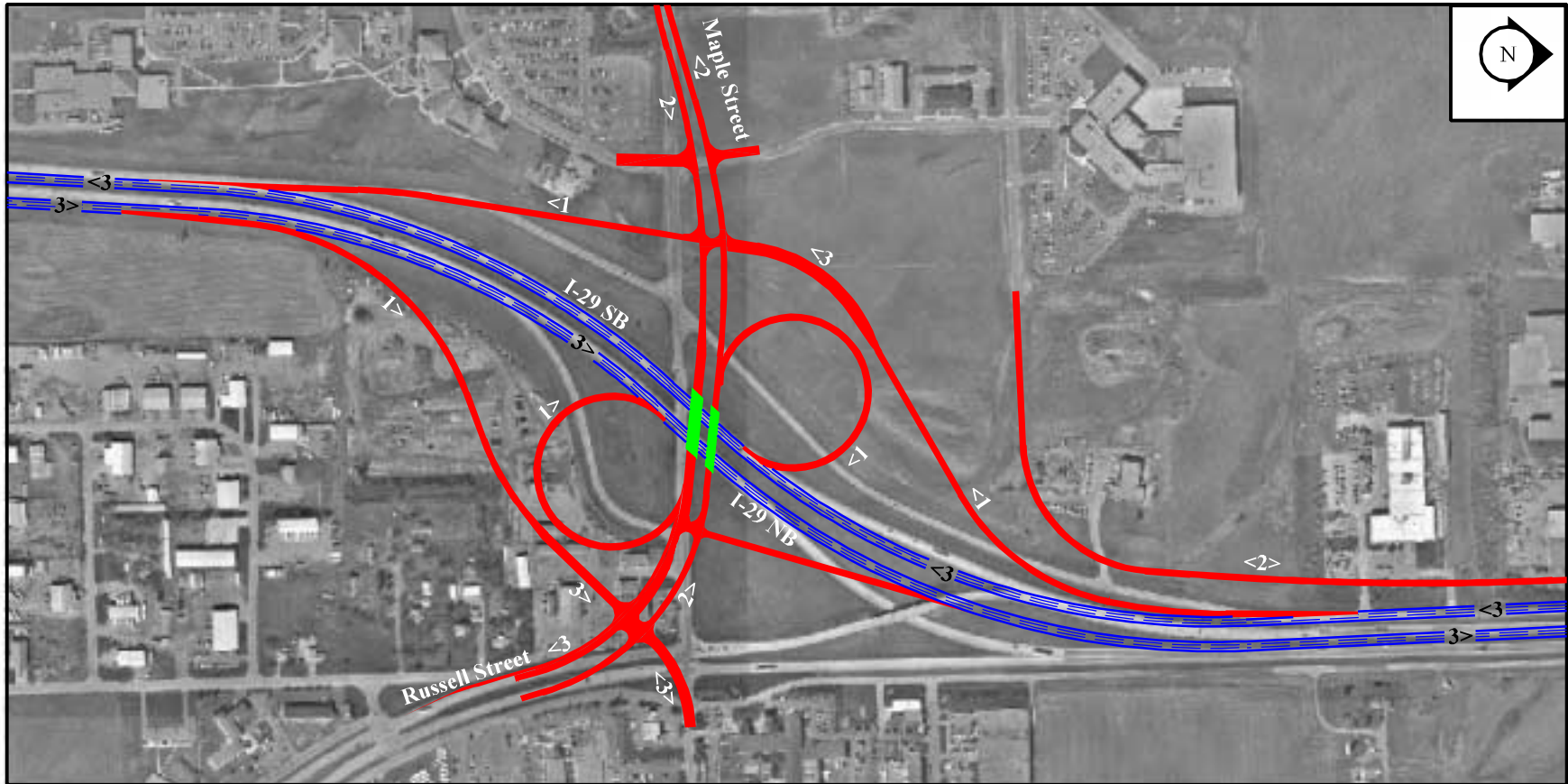
I-29 Exit 80  
Madison Street, Sioux Falls  
Partial Cloverleaf Interchange



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ULLEVIG**

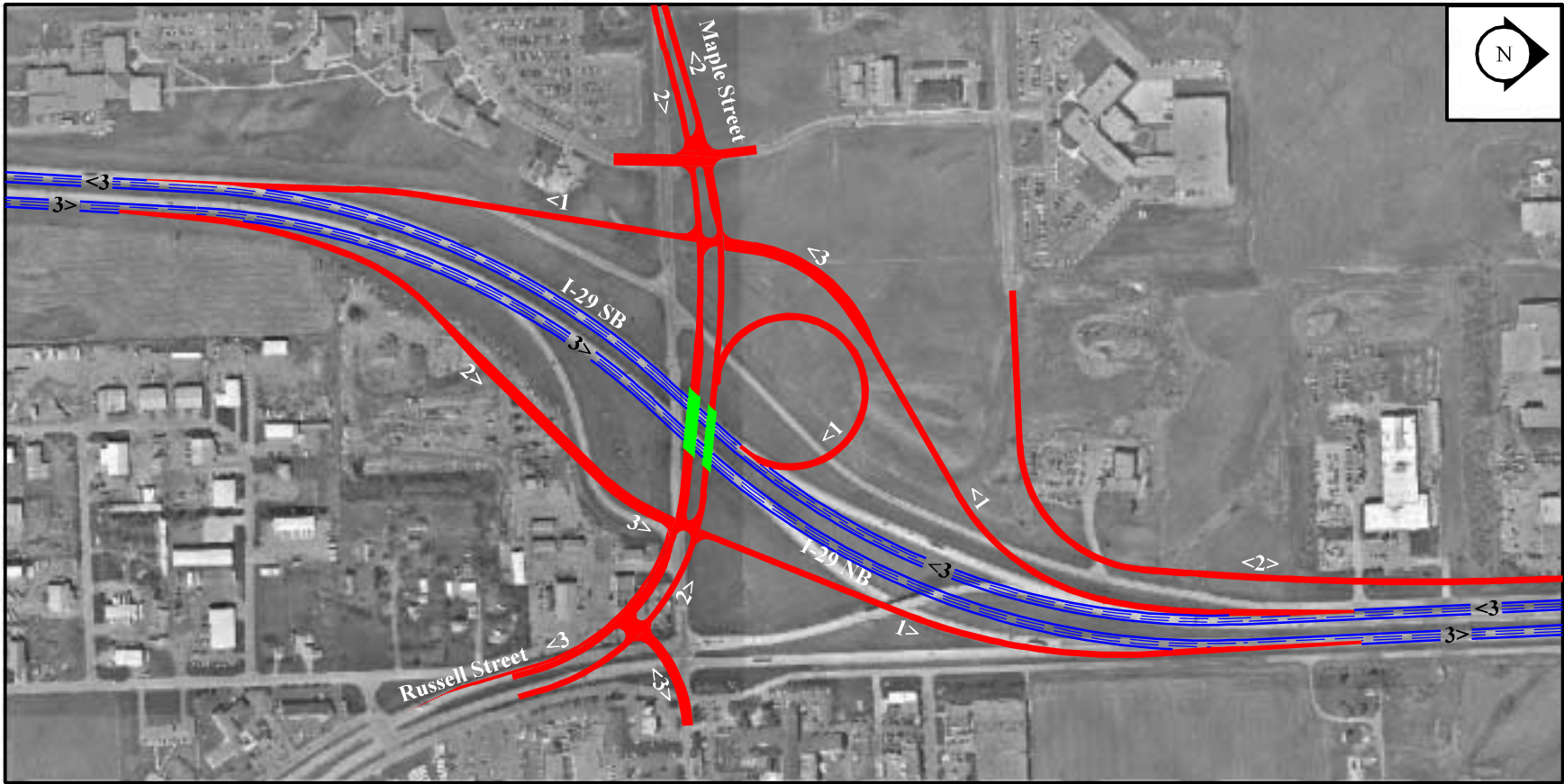
I-29 Exit 80  
Madison Street, Sioux Falls  
Single Point Interchange



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ULLEVIG**

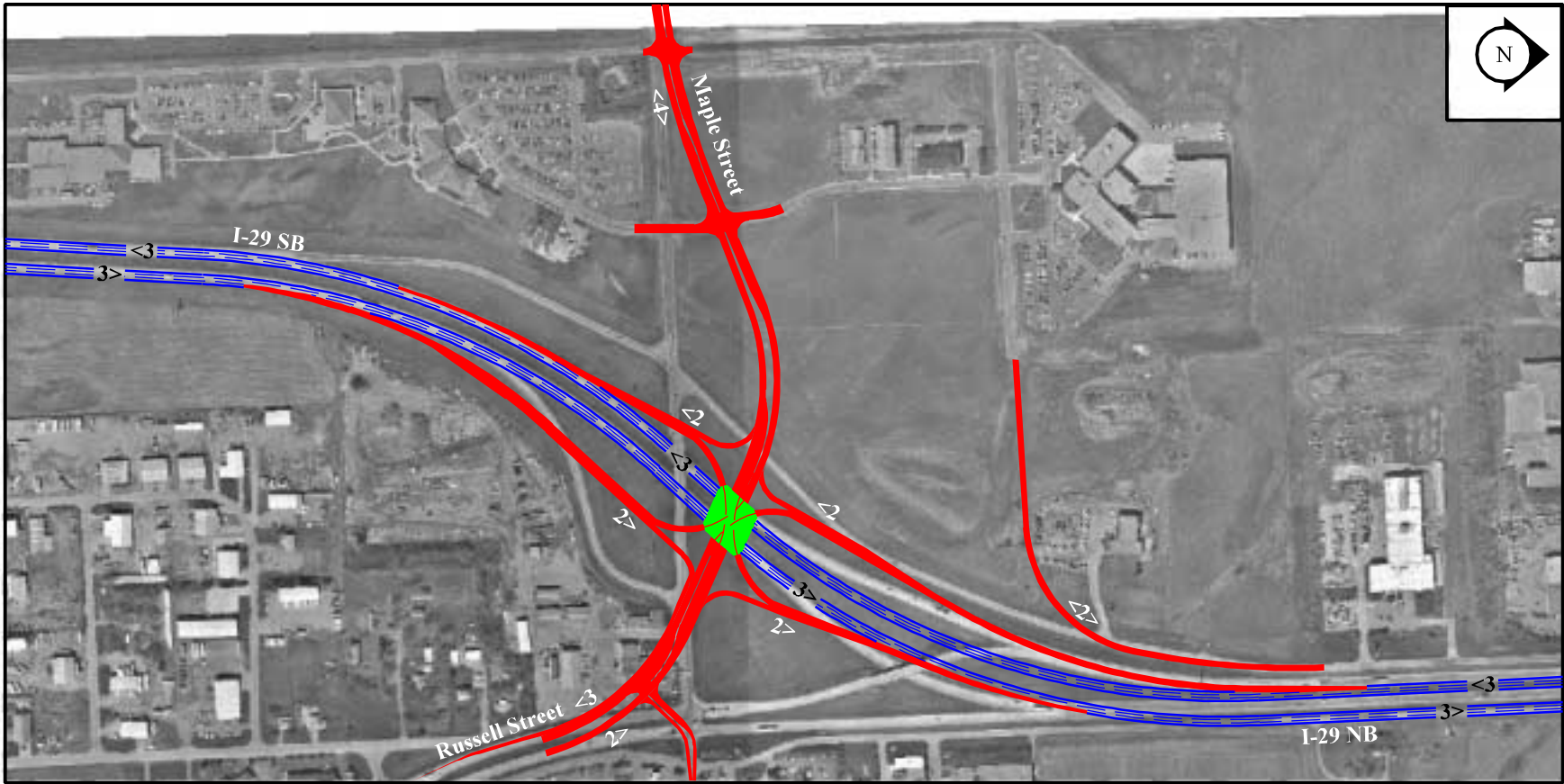
I-29 Exit 81  
Maple/Russell, Sioux Falls  
Partial Cloverleaf Interchange w/ 2 Loop Ramps



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I-29 Exit 81  
Maple/Russell, Sioux Falls  
Partial Cloverleaf Interchange w/ 1 Loop Ramp



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**FELSBURG  
HOLT &  
ULLEVIG**

I-29 Exit 81  
Maple/Russell, Sioux Falls  
Single Point Interchange

South Dakota Interstate Corridor Study

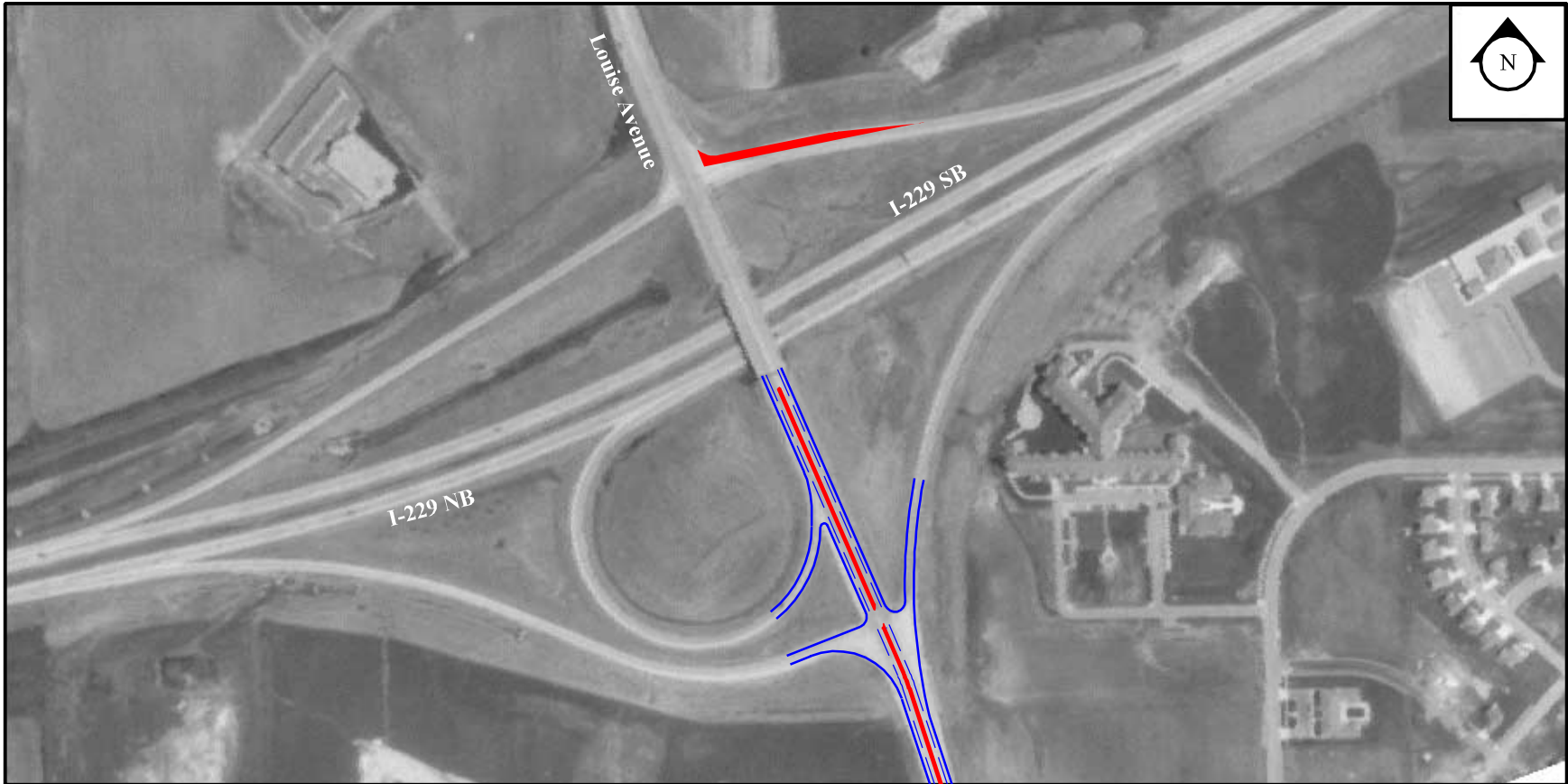


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I-29 Exit 94  
C.R. 114, Baltic  
Diamond Interchange

South Dakota Interstate Corridor Study



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ULLEVIG**

I-229 Exit 1  
Louise Avenue, Sioux Falls  
Raised Median SB Dual Right Turn Lane

South Dakota Interstate Corridor Study

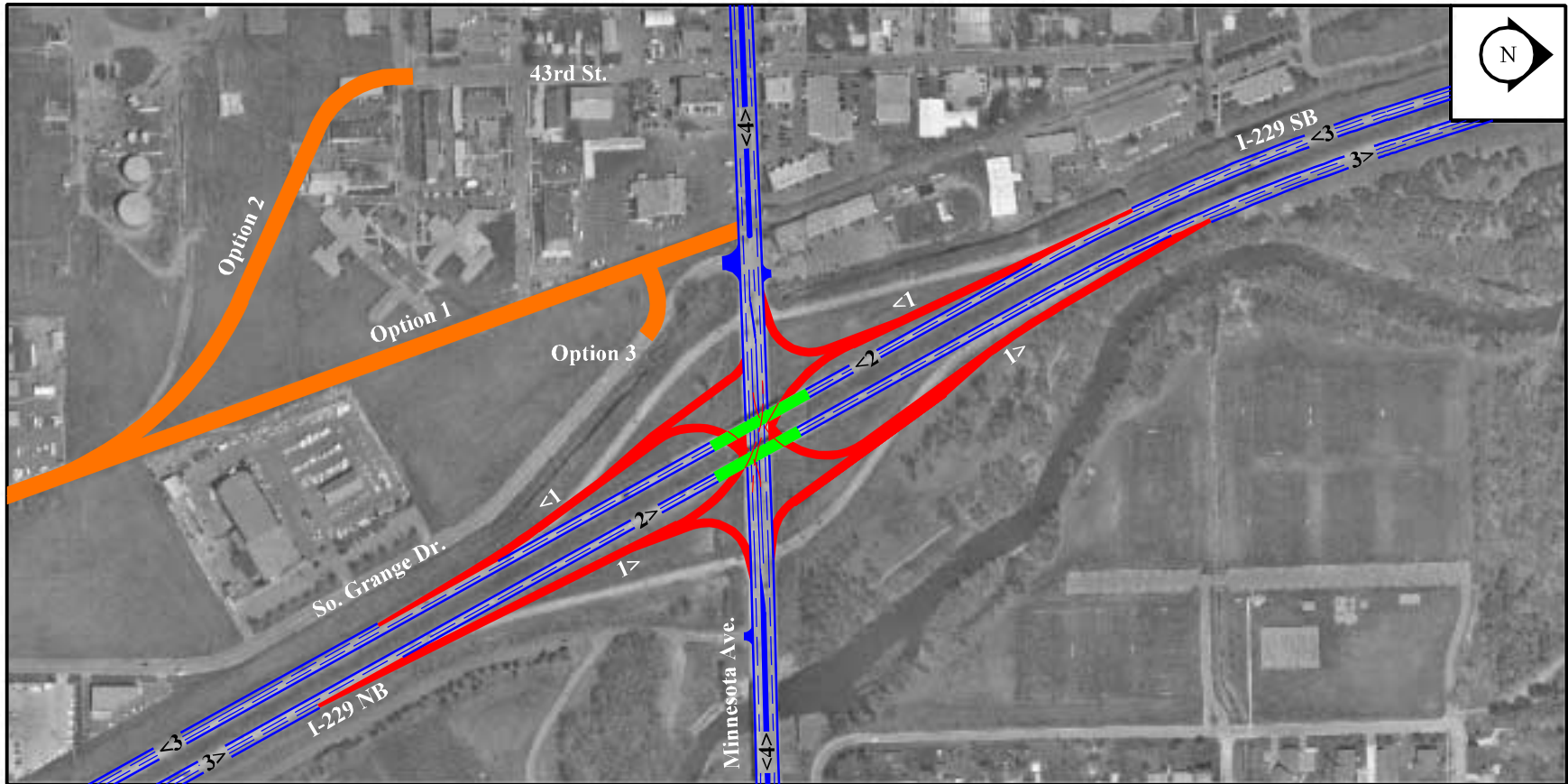


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ULLEVIG**

I-229 Exit 2  
Western Avenue, Sioux Falls  
Dual Right Turn Lane on SB Off-Ramp  
SB Right Turn Lane on Western Ave.



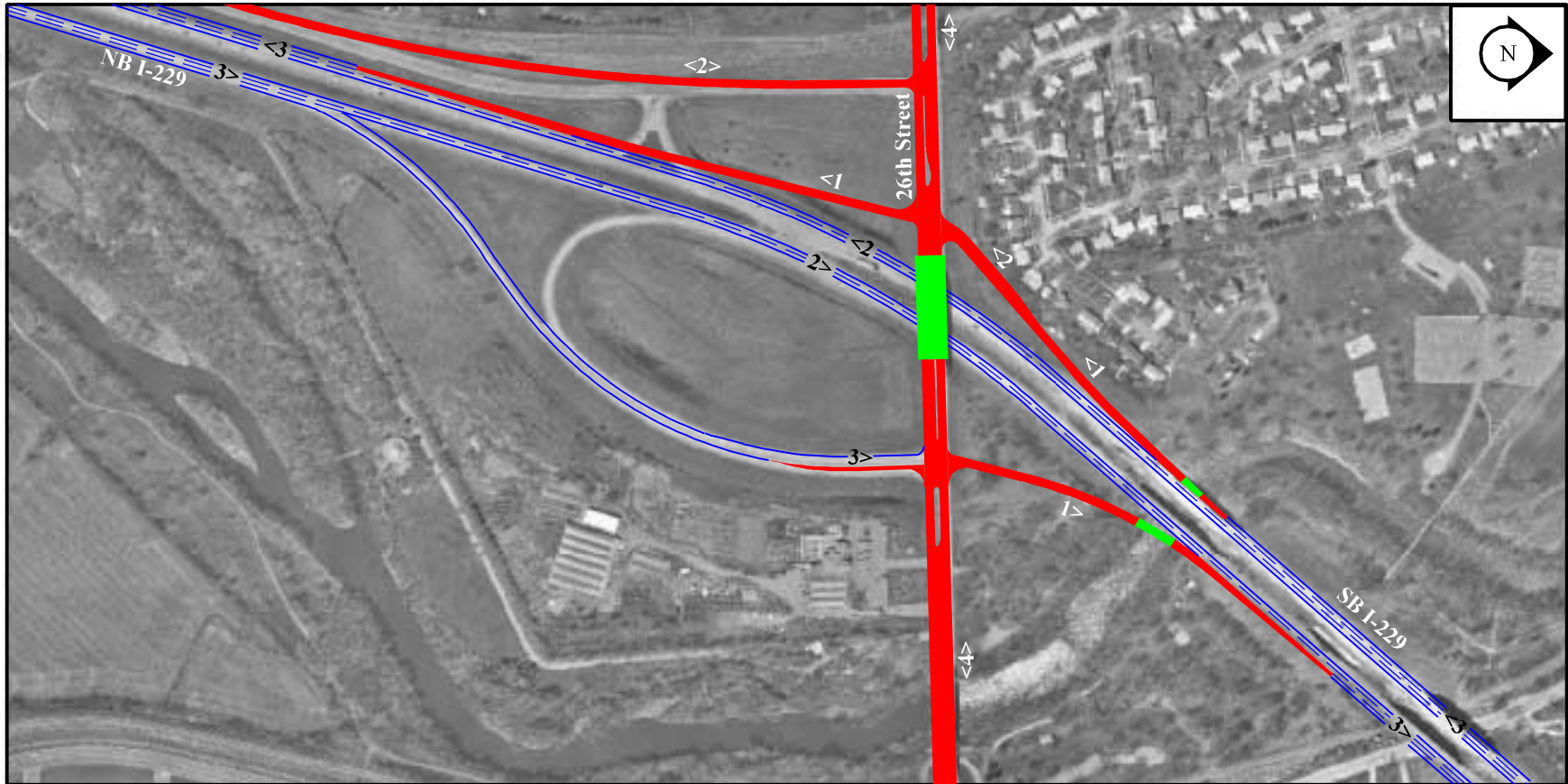




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ULLEVIG**

I-229 Exit 5  
26th Street, Sioux Falls  
Southbound Ramp Improvements



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ULLEVIG**

I-229 Exit 5  
26th Street, Sioux Falls  
SB Ramps With Direct NB Ramp

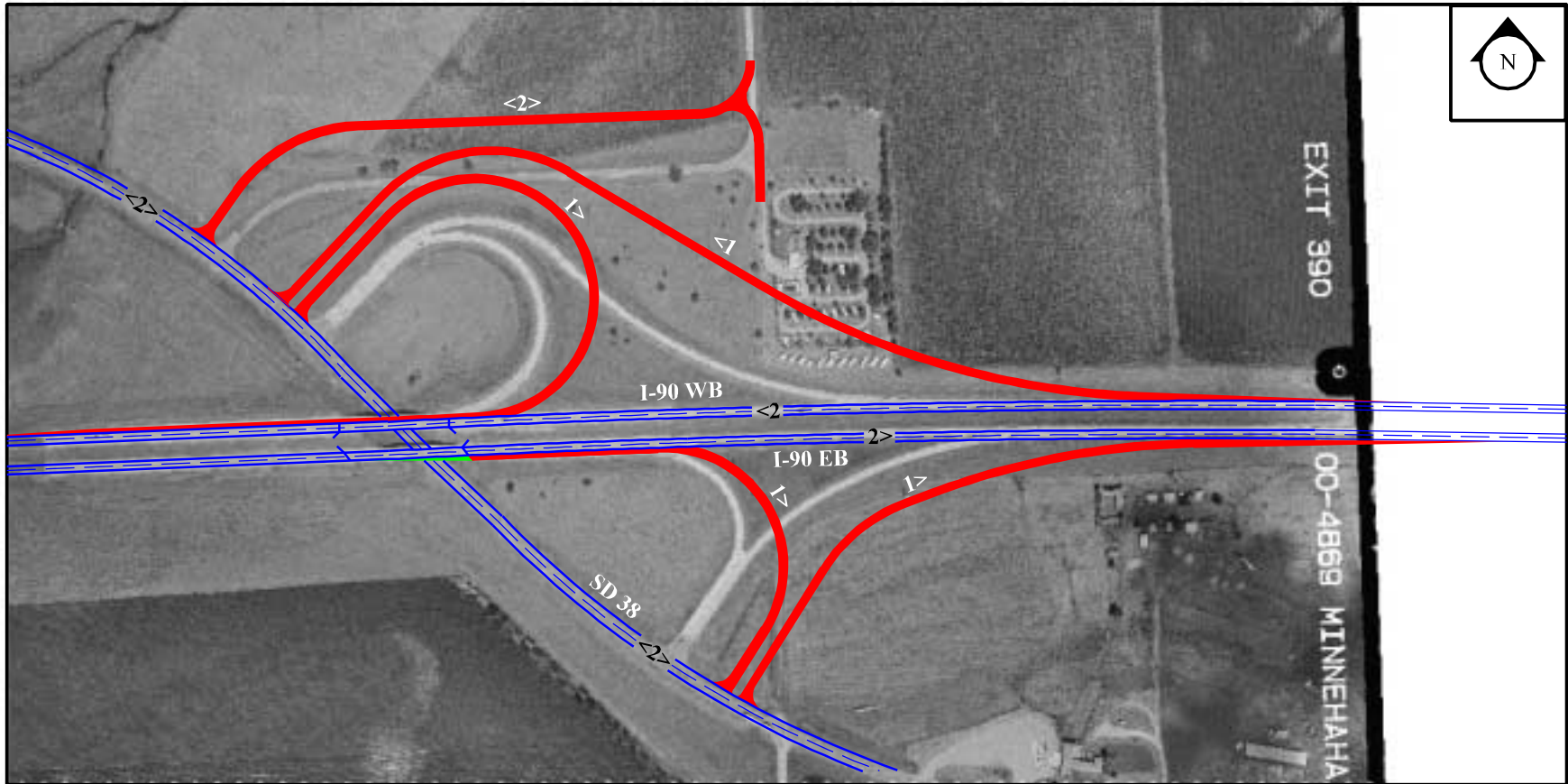
South Dakota Interstate Corridor Study



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I-229 Exit 5  
26th Street, Sioux Falls  
Single Point Interchange



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ULLEVIG**

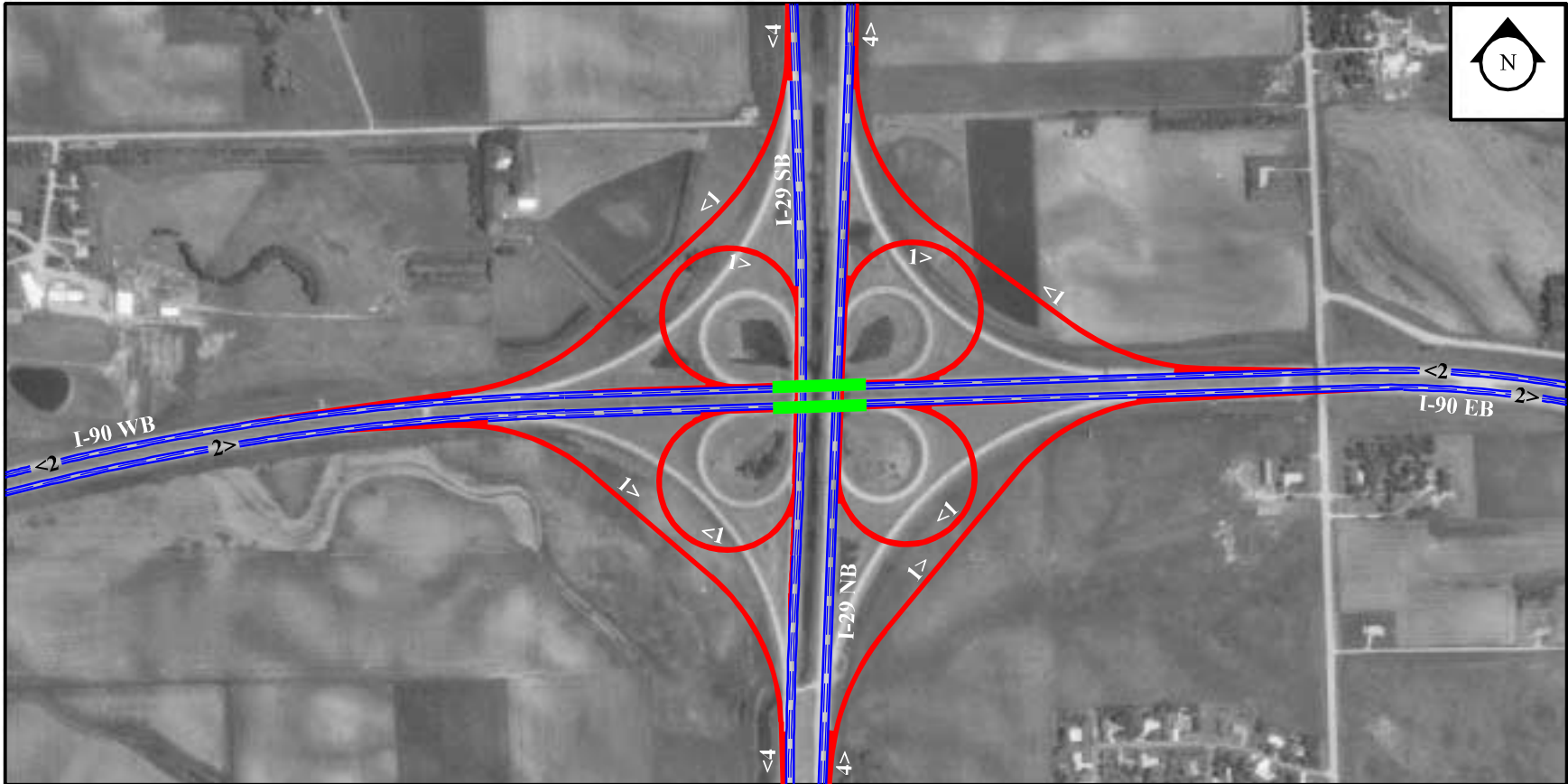
I-90 Exit 390  
SD 38, Hartford E  
Partial Cloverleaf Interchange



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HOLT &  
ULLEVIG**

I-90 Exit 395  
Marion Road, Sioux Falls  
Diamond Interchange

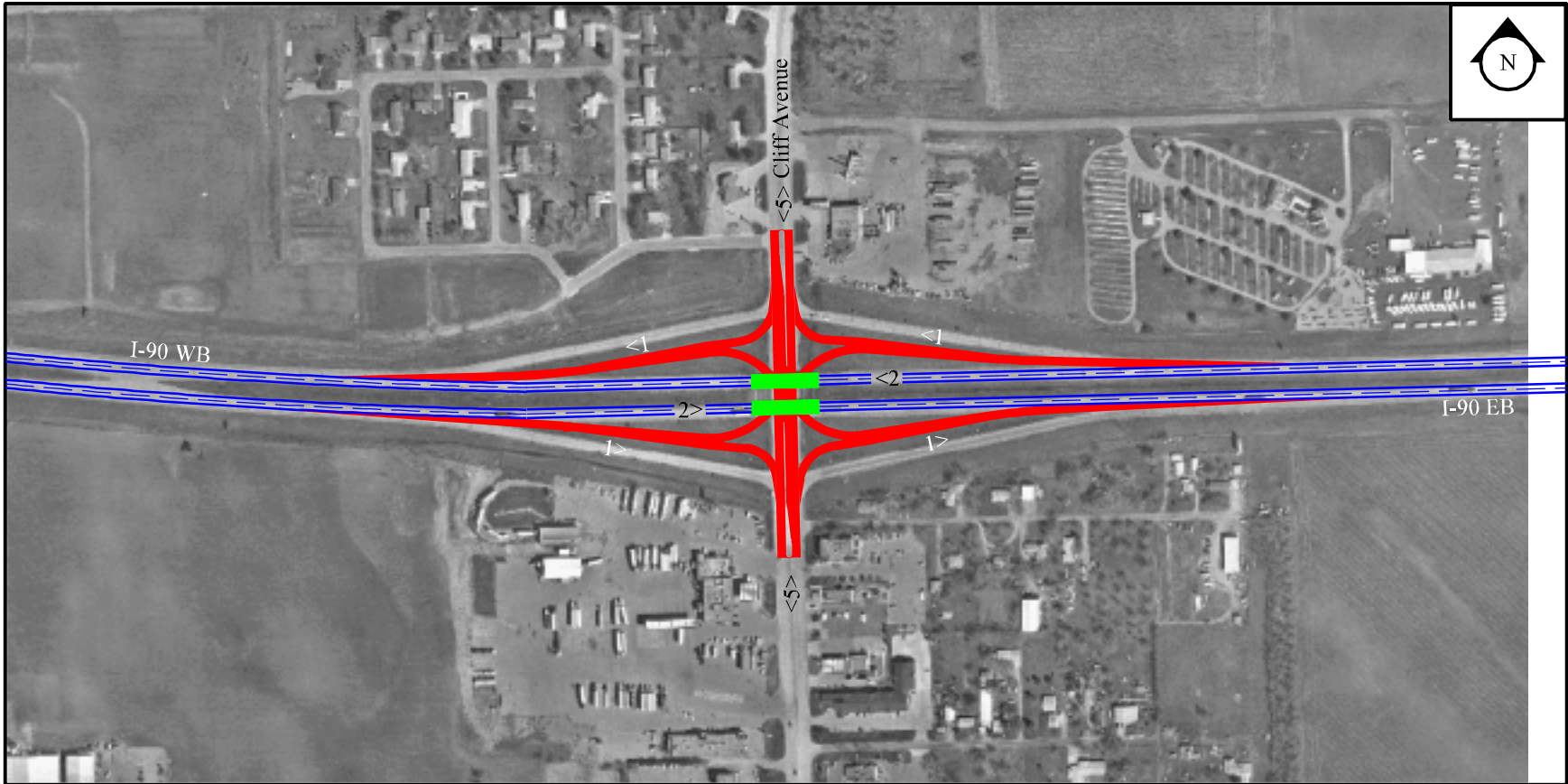


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HOLT &  
ULLEVIG**

I-90 Exit 396  
I-29/I-90, Sioux Falls  
Full Cloverleaf Interchange

South Dakota Interstate Corridor Study

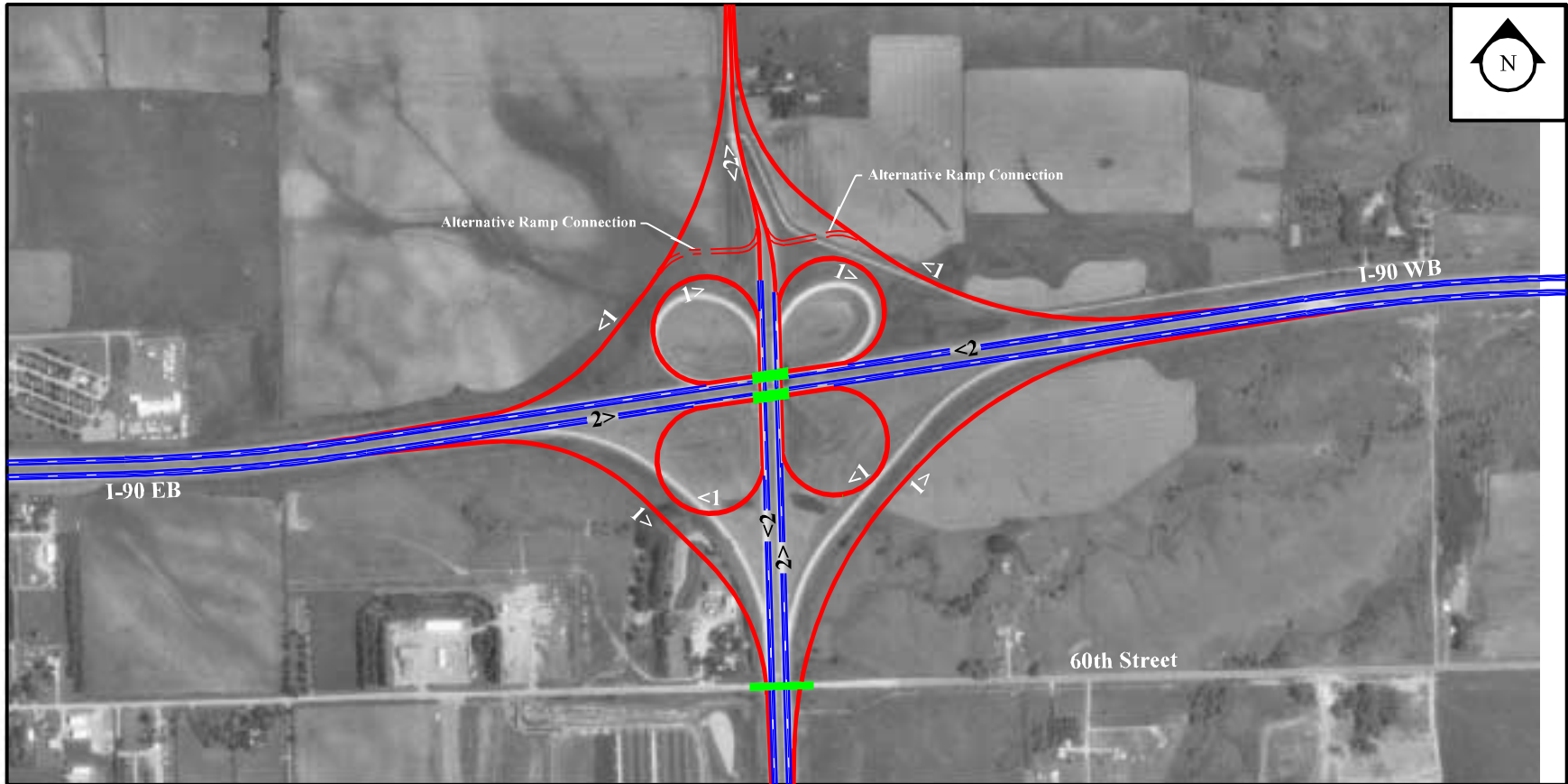


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HOLT &  
ULLEVIG**

I-90 Exit 399  
Cliff Avenue, Sioux Falls  
Single Point Interchange



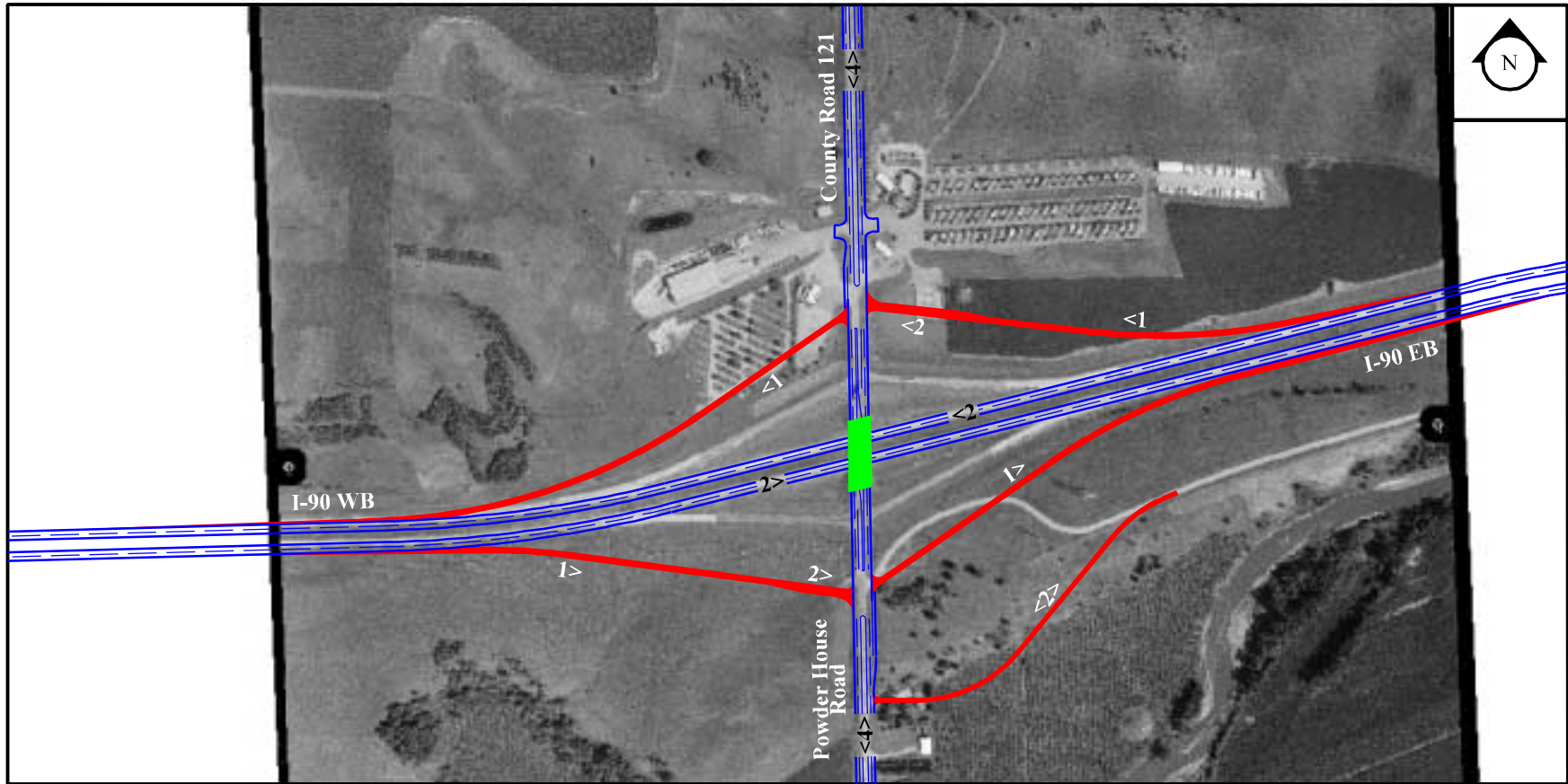


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HOLT &  
ULLEVIG**

I-90 Exit 400  
I-229, Sioux Falls  
Clover Leaf Interchange

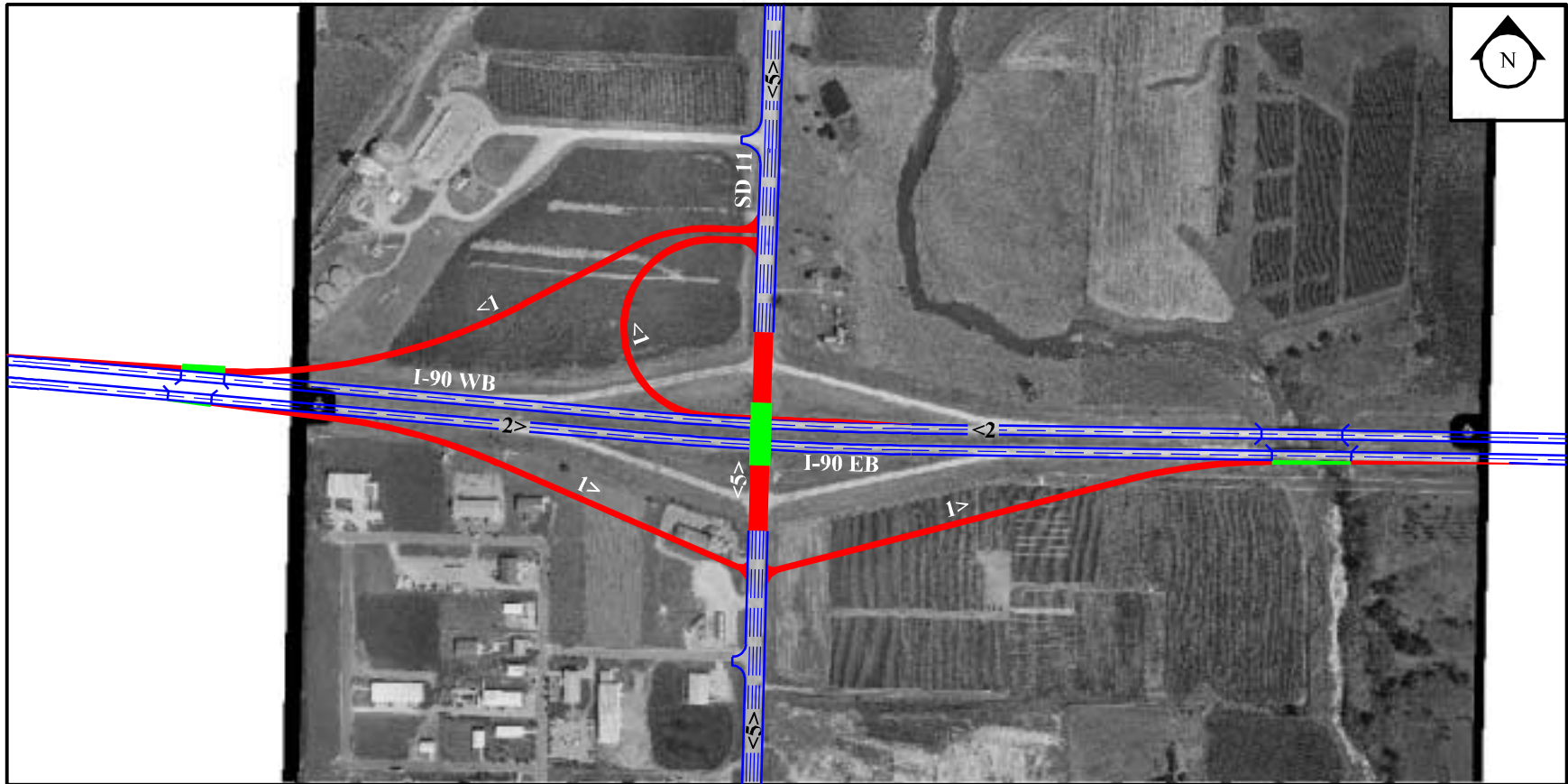
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HOLT &  
ULLEVIG**

I-90 Exit 402  
Powder House Road, Sioux Falls  
Diamond Interchange

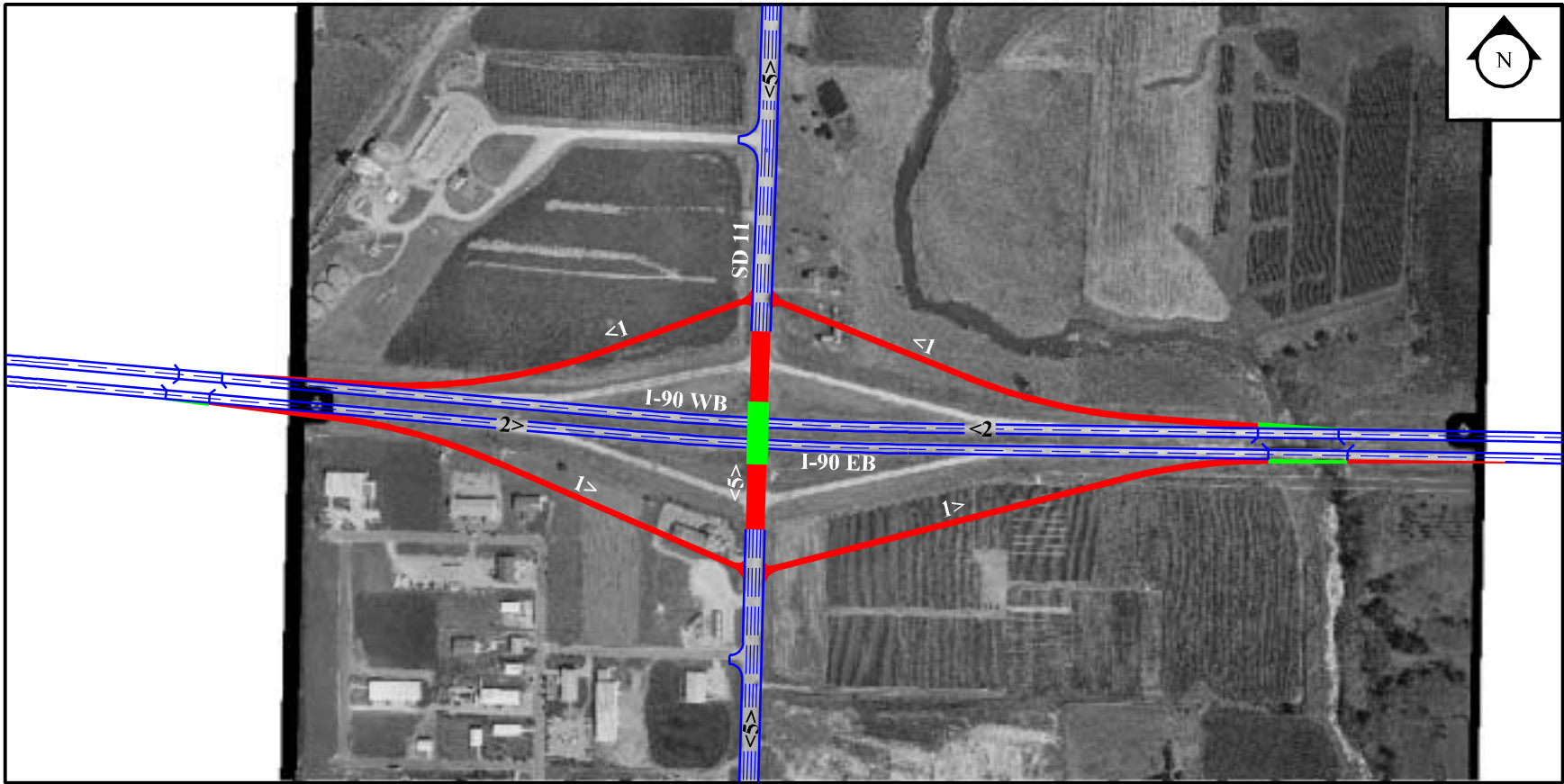


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I-90 Exit 406  
SD 11, Brandon  
Partial Cloverleaf Interchange

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ULLEVIG**

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SD 11, Brandon  
Diamond Interchange

South Dakota Interstate Corridor Study



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ULLEVIG**

I-90 Exit 410  
C.R. 105, Valley Springs  
Diamond Interchange

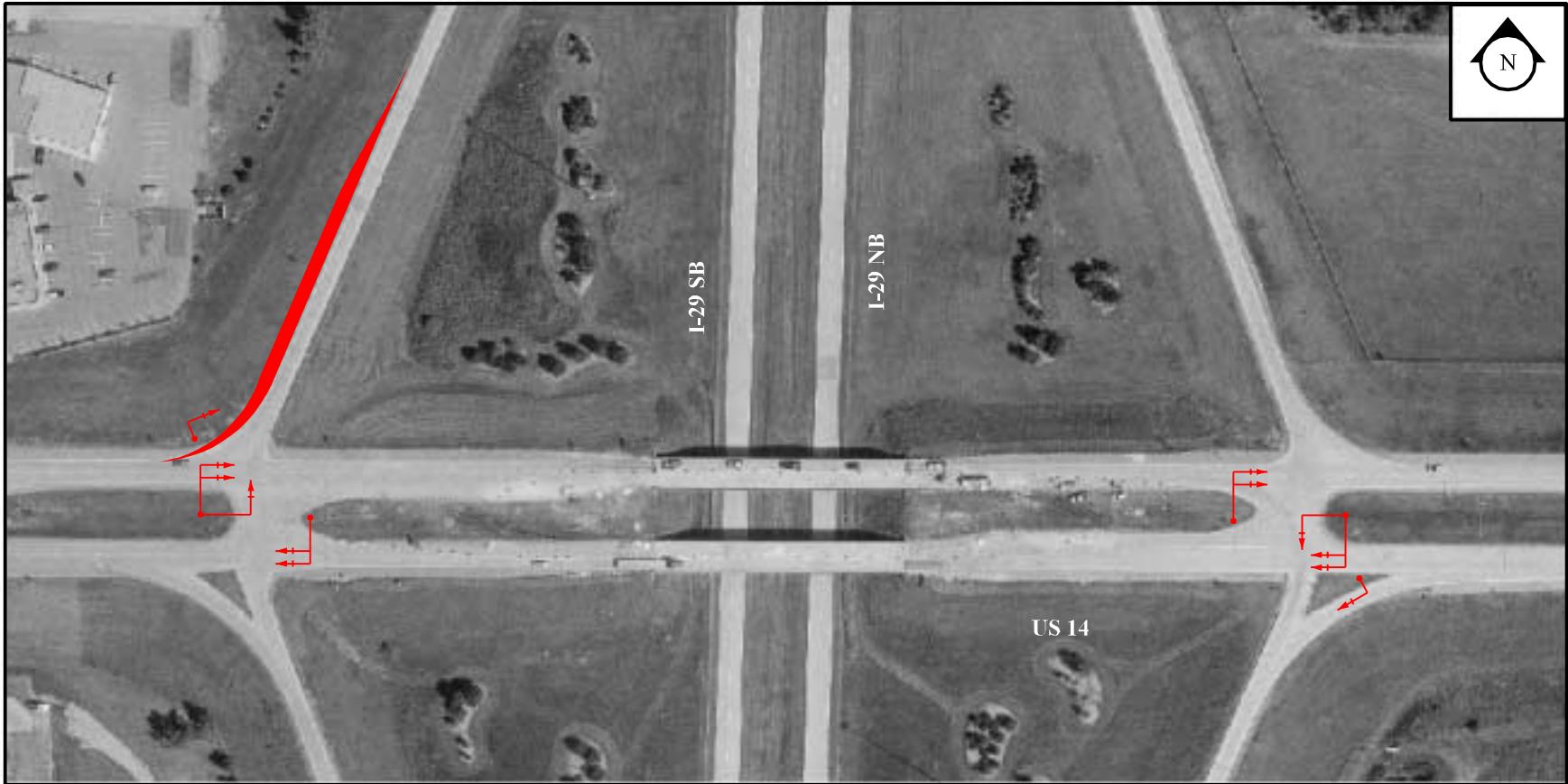
South Dakota Interstate Corridor Study



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CONSULTING ENGINEERS

**FELSBURG  
HOLT &  
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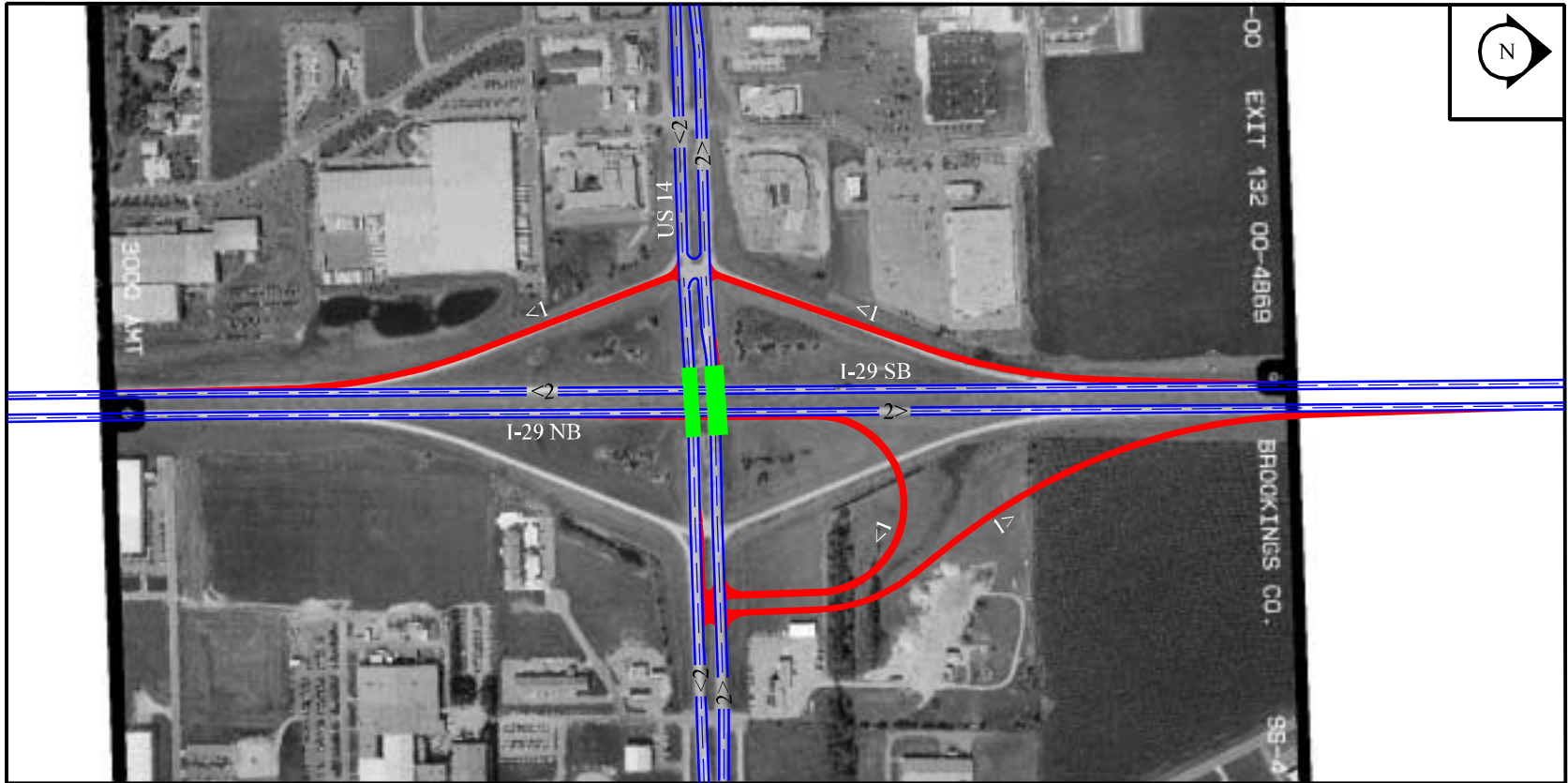
I-29 Exit 129  
C.R. 26, Brookings  
Partial Cloverleaf Interchange



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I-29 Exit 132  
U.S. 14, Brookings  
Traffic Signalization and SB Right Turn Lane

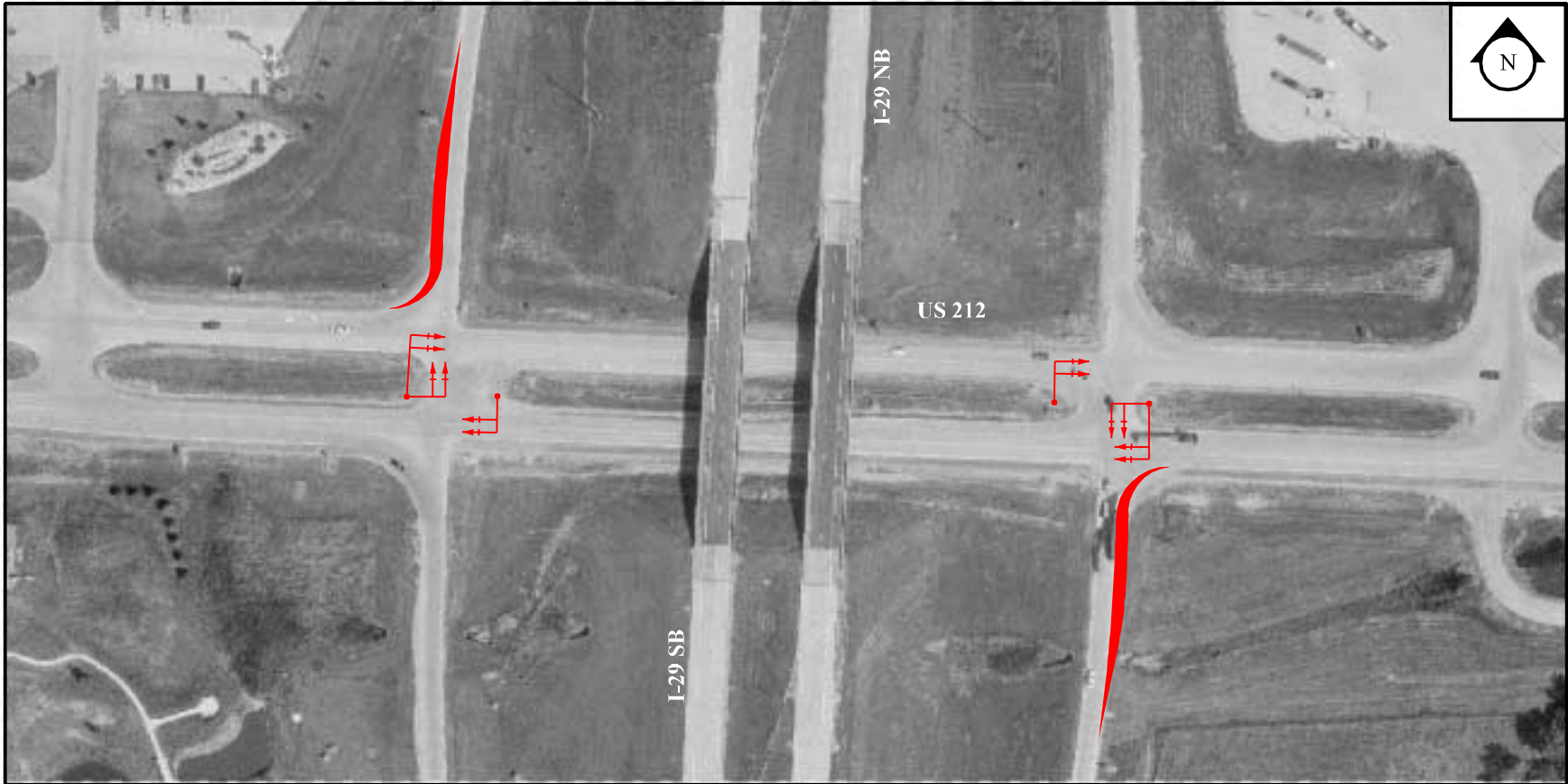


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I-29 Exit 132  
U.S. 14, Brookings  
Partial Cloverleaf - NE Quadrant

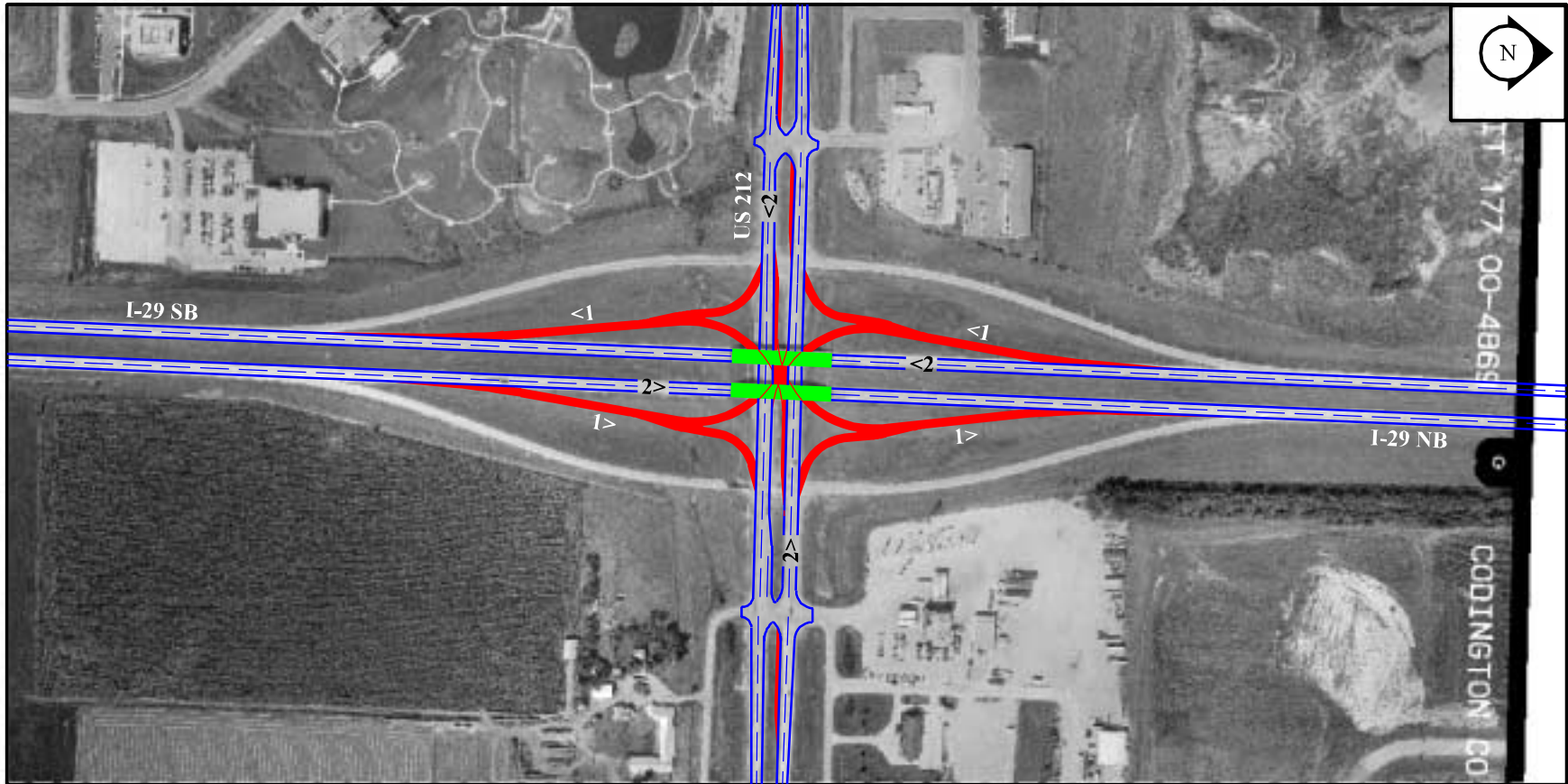




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I-29 Exit 177  
U.S. 212, Watertown  
Traffic Signalization,  
NB and SB Right Turn Lanes



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I-29 Exit 177  
U.S. 212, Watertown  
Single Point Interchange

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I-29 Exit 207  
U.S. 12, Summit  
Diamond Interchange

# Appendix B

## Glossary of Terms

## Glossary of Terms

**Access** – Openings in the right-of-way line along a highway which serve abutting land ownerships.

**ADT** – Average Daily Traffic Volumes, in units of Vehicles per day

**Approach** – A section of roadway directly upstream of an intersection. Denoted by a direction. For example, the northbound approach to a particular intersection refers to the section of roadway that carries northbound vehicles as they approach the intersection.

**Area of Influence** – The section of a freeway affected by traffic merging or diverging at an interchange ramp junction. Also referred to as the ramp influence area.

**Capacity** – The maximum rate of flow at which vehicles can be reasonably expected to traverse a point or uniform segment of a lane or roadway during a specified time period. Usually expressed as vehicles per hour (vph).

**Channelized** – A designation of a lane as restricted to a specific turn movement at an intersection. For example, a channelized left-turn lane is an exclusive left-turn lane at an intersection.

**Crest Vertical Curve** – A vertical roadway curve that connects a positive grade with a negative grade.

**Delay** – Additional travel time experienced by a driver, passenger, or pedestrian beyond what would reasonably be desired for a given trip.

**Density** – The number of vehicles occupying a given length of lane or roadway averaged over time, usually expressed as vehicles per mile or vehicles per mile per lane.

**Design Speed** – The maximum safe speed that can be maintained over a specified section of highway given the design features of the highway.

**DHV** – Design Hour Volume. The rate of traffic flow in vehicles per hour during the peak single hour of a typical day.

**Diverge** – The separation of a single traffic stream into two traffic streams. Associated with a freeway off-ramp.

**Geometric configuration** – The vertical and horizontal dimensions of a roadway or intersection facility.

**Grade** – The increase or decrease in roadway elevation divided by the horizontal length over which the increase or decrease occurs. A decreasing elevation along the direction of travel is a negative curve, while an increasing elevation along the direction of travel is a positive curve.

**Inslopes** – The grade from the edge of the roadway to the bottom of the ditch adjacent to the roadway.

**K value** – A constant value for a vertical curve, which is dependent on the length of the vertical curve and the difference in grades defining the vertical curve. The K-value is a proxy for the “sharpness” of a vertical curve.

**Level of Service** – A qualitative measure describing operational conditions within a traffic stream, generally described in terms of such factors as speed and travel time, freedom to maneuver, traffic interruptions, comfort and convenience, and safety. Evaluated based on conditions described in the Highway Capacity Manual. The result of such an evaluation is a level-of-service (LOS) rating, which is a qualitative assessment of the traffic flow based on the total delay per vehicle at a controlled intersection. Level of service is described by a letter designation ranging from “A” to “F,” with LOS A representing essentially uninterrupted flow, and LOS F representing a breakdown of traffic flow with excessive congestion and delay. For a signalized analysis, a LOS rating is calculated for an intersection as a whole. For an unsignalized analysis, a LOS rating is calculated for individual turning movements.

**Mainline** – A section of grade separated, divided freeway.

**Merge** – The combining of two separate traffic streams to form a single traffic stream without the aid of signals or other right-of-way controls. Associated with a freeway on-ramp.

**MEV** – Millions of Entering Vehicles. A measure (in millions of vehicles) referring to the total number of vehicles entering an intersection or interchange during a single year.

**PDO** – Property Damage Only. A term used to characterize traffic accidents that result in property damage only without injuries or fatalities.

**Peak Hour Factor (PHF)** – The hourly traffic volume (vph) during the maximum volume hour of the day divided by the peak 15-minute rate of flow within the peak hour multiplied by four; a measure of traffic demand fluctuation within the peak hour.

**Profile** – The vertical alignment of a roadway. A series of straight lines connected by vertical parabolic curves. Properly designed, should provide adequate sight distance, safety, comfortable driving, good drainage, and pleasing appearance.

**Queue** – An accumulation of vehicles waiting to be served by the system in which the rate of flow from the front of the queue determines the average speed within the queue.

**Sag Vertical Curve** – A vertical curve that connects a negative grade with a positive grade.

**Service Flow Rate** – The maximum hourly rate at which vehicles can be reasonably expected to traverse a point of uniform section of a lane or roadway during a given time period (usually 15 minutes) under prevailing roadway, traffic, and control conditions while maintaining a designated level of service, expressed as vehicles per hour or vehicles per hour per lane.

**Sight Distance** – The length of highway visible ahead to the driver of a vehicle.

**Storage Length** – Roadway length that accommodates vehicles waiting to be served by the system; i.e. vehicles in a queue.

**Taper** – A roadway section that accommodates the gradual realignment, narrowing, or widening of the roadway. The transition is governed by a “Taper ratio” which determines the horizontal distance over which the realignment, narrowing, or widening is to occur.

**Terminal** – The downstream end of a freeway ramp. The “Ramp Terminal intersection” refers to the intersection of a freeway ramp with the surface street.

**Volume** – The number of vehicles passing a point on a lane, roadway, or other trafficway during some time interval, often taken to be 1 hour, expressed in vph.

**VPH** – Vehicles Per Hour – A reference for the number of vehicles traversing a roadway section during 1 hour.

**Weighted Accident Rate** – The total number of accidents occurring at a given interchange weighted according to severity divided by the MEV of the interchange.

# Appendix C

## Existing Mainline Geometric Condition Analysis



## I-90 Existing Mainline Geometric Condition Analysis (◆ Denotes Deficiency)

Segment	Lane Width	Right Shldr. Width	Left Shldr. Width	Design Speed	Max. Degree of Curve	Clear Zone	Inslope	Superelevation Rate	Paved Section Width	Bridge Section Width	Vertical Clearance	Maximum Grade	Minimum Grade
MRM 10 to 12					◆		◆			◆			◆
MRM 12 to 14							◆			◆			◆
MRM 14 to 15							◆						◆
MRM 15 to 17							◆			◆			◆
MRM 17 to 20										◆			◆
MRM 20 to 23							◆			◆			
MRM 23 to 27							◆			◆			
MRM 27 to 30					◆		◆						◆
MRM 30 to 32							◆			◆			◆
MRM 32 to 34							◆						◆
MRM 34 to 37							◆						◆
MRM 37 to 40							◆						◆
MRM 40 to 44							◆						
MRM 44 to 46							◆						◆
MRM 46 to 48							◆						◆
MRM 48 to 51				◆	◆		◆						◆
MRM 51 to 55					◆		◆			◆			◆
MRM 55 to 57					◆		◆			◆		◆	◆
MRM 57 to 58							◆						
MRM 58 to 60					◆		◆			◆			◆
MRM 60 to 61							◆						◆
MRM 61 to 63							◆			◆			◆
MRM 63 to 66							◆			◆	◆		◆
MRM 66 to 67							◆						
MRM 330 to 332							◆			◆			◆
MRM 332 to 333							◆			◆			◆
MRM 326 to 330						◆							◆
MRM 377 to 389							◆						◆
MRM 389 to 395							◆			◆	◆		◆
MRM 395 to 399							◆			◆			◆
MRM 399 to 407							◆			◆			◆
MRM 407 to 412							◆			◆	◆		◆

## I-29 Existing Mainline Geometric Condition Analysis (◆ Denotes Deficiency)

Segment	Lane Width	Right Shldr. Width	Left Shldr. Width	Design Speed	Max. Degree of Curve	Clear Zone	Inslope	Superelevation Rate	Paved Section Width	Bridge Section Width	Vertical Clearance	Maximum Grade	Minimum Grade
MRM 1 to 15					◆		◆						◆
MRM 62 to 75							◆			◆			◆
MRM 77 to 81							◆			◆			◆
MRM 81 to 83				◆			◆						◆
MRM 84 to 87				◆			◆			◆			◆
MRM 87 to 95				◆			◆			◆			◆
MRM 131 to 133										◆			◆
MRM 177 to 178													◆
MRM 178 to 181										◆			
MRM 181 to 186													◆
MRM 206 to 207													◆

## I-229 Existing Mainline Geometric Condition Analysis

Segment	Lane Width	Right Shldr. Width	Left Shldr. Width	Design Speed	Max. Degree of Curve	Clear Zone	Inslope	Superelevation Rate	Paved Section Width	Bridge Section Width	Vertical Clearance	Maximum Grade	Minimum Grade
MRM 3 to 6										◆			◆
MRM 6 to 7			◆			◆			◆	◆			

# Appendix D

## Deficient Mainline Structure Summary

## Deficient Mainline Structure Summary I-90 Milepost 8 to Milepost 67

<i>Location</i>	<i>Number of Bridges</i>	<i>Length (ft)</i>	<i>Existing Width (ft)</i>	<i>Removal Cost</i>	<i>Proposed Width (ft)</i>	<i>New Bridge Cost</i>	<i>Total Project Cost</i>
Hwy 34 at MRM 30.28	2	182	30	\$109,200	40	\$946,400	\$1,055,600
County Road/Dak Minn & E Railroad at MRM 32.27	–	Will be removed and replaced as part of Project No. P-IM 90-1(85)32					
SD079 at MRM 32.41	–	Will be removed and replaced as part of Project No. P-IM 90-1(85)32					
I-90/BH National Cemetary Road at MRM 34.81	1	119	40	\$47,600	40	\$309,400	\$357,000
Elk Creek at MRM 42.81	2	130	30	\$78,000	40	\$676,000	\$754,000
Little Elk Creek at MRM 44.10	2	60	30	\$36,000	40	\$312,000	\$348,000
Chimney Canyon Road at MRM 44.66	2	130	30	\$78,000	40	\$676,000	\$754,000
County Road at Exit 51 at MRM 51.63	2	210	30	\$126,000	40	\$1,092,000	\$1,218,000
Interstate 190 at MRM 57.79	–	Will be removed and replaced as part of a Project 2001					
North Haines Avenue at MRM 58.30	–	Will be removed and replaced as part of a Project 2001					
North Maple Avenue at MRM 58.80	2	119	40	\$95,200	40	\$618,800	\$714,000
Eastbound I-90 over US Highway 16	1	365	30	\$109,500	40	\$949,000	\$1,058,500
Boxelder Creek at MRM 63.96	2	83	38	\$63,080	40	\$431,600	\$494,680
Ellsworth Air Force Base access road	2	244	30	\$146,400	40	\$1,268,800	\$1,415,200
Ellsworth Air Force Base railroad spur at MRM 65.76	2	165	30	\$99,000	40	\$858,000	\$957,000
Eastbound I-90 over Lemay Boulevard at MRM 66.17	1	142	42	\$59,640	42	\$387,660	\$447,300

- 1 Bridges that have a structure width of 38 feet were not included in this cost estimate unless they were functionally obsolete or structurally deficient.
- 2 Removal costs were estimated at \$10/SF
- 3 Construction costs were estimated at \$65/SF

## Deficient Mainline Structure Summary I-90 Milepost 330 to Milepost 410

<i>Location</i>	<i>Number of Bridges</i>	<i>Length (ft)</i>	<i>Existing Width (ft)</i>	<i>Removal Cost</i>	<i>Proposed Width (ft)</i>	<i>New Bridge Cost</i>	<i>Total Project Cost</i>
South Rowley Street at MRM 331.43 (Functionally Obsolete)	2	119	38	\$90,440	40	\$618,800	\$709,240
Twin Structures at MRM 332.15	2	269	30	\$161,400	40	\$1,398,800	\$1,560,200
Twin Structures at MRM 332.40 (Variable width structures)	2	158	40	\$126,400	44	\$903,760	\$1,030,160
Twin Structures at MRM 389.89 (Functionally Obsolete)	2	163	30	\$97,800	40	\$847,600	\$945,400
Twin structures at MRM 391.04	2	232	30	\$139,200	40	\$1,206,400	\$1,345,600
County Road at MRM 392.47 (Functionally Obsolete)	2	164	30	\$98,400	40	\$852,800	\$951,200
Big Sioux River at MRM 397.09	2	336	30	\$201,600	40	\$1,747,200	\$1,948,800
Silver Creek at MRM 397.72	2	170	30	\$102,000	40	\$884,000	\$986,000
Twin Structure over RR at MRM 397.94	2	170	30	\$102,000	40	\$884,000	\$986,000
SD 115 (Cliff Avenue) at MRM 399.56 (Functionally Obsolete)	2	182	30	\$109,200	40	\$946,400	\$1,055,600
Twin Structures over Creek at MRM 401.60	2	170	30	\$102,000	40	\$884,000	\$986,000
Twin Structures over Creek at MRM 405.14	2	186	30	\$111,600	40	\$967,200	\$1,078,800
Burlington Northern RR at MRM 406.12 (Functionally Obsolete)	2	184	30	\$110,400	40	\$956,800	\$1,067,200
Twin Structures at MRM 406.98	2	330	30	\$198,000	40	\$198,000	\$1,914,000
Twin Structures over Creek at MRM 411.41	2	170	30	\$102,000	40	\$102,000	\$986,000

- 1 Bridges that have a structure width of 38 feet were not included in this cost estimate unless they were functionally obsolete or structurally deficient.
- 2 Removal costs were estimated at \$10/SF
- 3 Construction costs were estimated at \$65/SF

## Deficient Mainline Structure Summary I-29 Milepost 0 to Milepost 207

<i>Location</i>	<i>Number of Bridges</i>	<i>Length (ft)</i>	<i>Existing Width (ft)</i>	<i>Removal Cost</i>	<i>Proposed Width (ft)</i>	<i>New Bridge Cost</i>	<i>Total Project Cost</i>
River Drive at MRM 2.48 (Functionally Obsolete)	2	126	38	\$95,760	40	\$655,200	\$750,960
US 18 at MRM 62.35 (Functionally Obsolete)	2	293	34	\$199,444	40	\$1,525,160	\$1,724,604
Twin Structures over RR at MRM 64.91 (Structurally Deficient)	2	171	30	\$102,600	40	\$889,200	\$991,800
Twin Structures over Creek at MRM 67.13 (Functionally Obsolete)	2	192	30	\$115,200	40	\$998,400	\$1,113,600
FAS County Road over I-29 at MRM 73.38 (Functionally Obsolete)	1	254	30	\$76,200	40	\$660,400	\$736,600
Twin Structures over RR at MRM 75.48	2	365	30	\$219,000	40	\$1,898,000	\$2,117,000
Ellis and Eastern RR at MRM 79.54 (Functionally Obsolete)	2	171	30	\$102,600	40	\$889,200	\$991,800
I-29 South over Drainage Ditch at MRM 83.86 (Structurally Deficient)	1	59	38	\$22,306	40	\$152,620	\$174,926
Burlington Northern RR at MRM 84.92 (I-29 SB Structurally Deficient)	2	165	30	\$98,880	40	\$856,960	\$955,840
County Road at MRM 90.49 (Functionally Obsolete)	2	119	38	\$90,440	40	\$618,800	\$709,240
Private Road and RR at MRM 131.89	2	153	30	\$91,860	40	\$796,120	\$887,980
Twin Structures over Creek at MRM 136.73	2	152	30	\$90,900	40	\$787,800	\$878,700

- 1 Bridges that have a structure width of 38 feet were not included in this cost estimate unless they were functionally obsolete or structurally deficient.
- 2 Removal costs were estimated at \$10/SF
- 3 Construction costs were estimated at \$65/SF

**Deficient Mainline Structure Summary  
I-229 Milepost 0 to Milepost 10**

<i>Location</i>	<i>Number of Bridges</i>	<i>Length (ft)</i>	<i>Existing Width (ft)</i>	<i>Removal Cost</i>	<i>Proposed Width (ft)</i>	<i>New Bridge Cost</i>	<i>Total Project Cost</i>
Cliff Avenue at MRM 4.16 (Functionally Obsolete)	2	183	38	\$139,232	40	\$952,640	\$1,091,872
Big Sioux River at MRM 8.28	2	436	38	\$331,360	40	\$2,267,200	\$2,598,560

- 1 Bridges that have a structure width of 38 feet were not included in this cost estimate unless they were functionally obsolete or structurally deficient.
- 2 Removal costs were estimated at \$10/SF
- 3 Construction costs were estimated at \$65/SF

# Appendix E

## Existing Interchange Geometric Condition Analysis



# I-90 Existing Interchange Geometric Condition Analysis (◆ Denotes Deficiency)

<b>I-90</b>	Superelevation Rate	Minimum Radius	Grade on Ramps	Lane Width	Right Shldr. Width	Left Shldr. Width	Inslope	Off-Ramp Taper	On Ramp Taper	Ramp K Values	Ramp Stopping Sight Distance	Cross Road K Values	Cross Road Sight Distance	Ramp Intersection Sight Distance	Cross Road Grade	Control of Access
Exit 10			◆	◆	◆		◆			◆	◆					◆
Exit 12			◆	◆	◆		◆			◆	◆			◆		
Exit 14				◆	◆		◆					◆	◆			◆
Exit 17				◆	◆		◆									◆
Exit 23				◆	◆		◆		◆							
Exit 30		◆	◆	◆	◆		◆			◆	◆				◆	◆
Exit 34				◆	◆		◆			◆	◆	◆	◆		◆	◆
Exit 37	◆		◆	◆	◆		◆			◆	◆	◆	◆	◆	◆	
Exit 40				◆	◆		◆					◆	◆			◆
Exit 44				◆	◆		◆		◆	◆	◆	◆			◆	◆
Exit 46				◆	◆		◆		◆	◆	◆					
Exit 48				◆	◆		◆	◆	◆			◆	◆	◆	◆	◆
Exit 51				◆	◆		◆	◆		◆	◆	◆	◆			◆
Exit 55			◆	◆	◆		◆	◆	◆	◆	◆			◆	◆	◆
Exit 59			◆	◆	◆		◆		◆	◆	◆	◆	◆	◆		◆
Exit 60		◆					◆	◆	◆	◆	◆				◆	
Exit 61	◆			◆	◆		◆	◆		◆					◆	◆
Exit 63	◆				◆											◆
Exit 66	◆	◆	◆	◆	◆				◆	◆	◆				◆	◆
Exit 67																
Exit 330	◆			◆	◆		◆									
Exit 332	◆			◆	◆		◆			◆						
Exit 387				◆	◆		◆									
Exit 390	◆	◆	◆	◆	◆		◆			◆	◆					
Exit 396	◆	◆		◆	◆		◆		◆							
Exit 399	◆			◆	◆		◆		◆							◆
Exit 400	◆	◆		◆			◆		◆							
Exit 402	◆		◆	◆	◆		◆	◆	◆	◆						
Exit 406	N/A		◆	◆	◆		◆	◆	◆	◆	◆	◆		◆		
Exit 410	N/A			◆	◆		◆		◆	◆	◆	◆		◆		

## I-29 Existing Interchange Geometric Condition Analysis (◆ Denotes Deficiency)

I-29	Superelevation Rate	Minimum Radius	Grade on Ramps	Lane Width	Right Shldr. Width	Left Shldr. Width	Inslope	Off-Ramp Taper	On Ramp Taper	Ramp K Values	Ramp Stopping Sight Distance	Cross Road K Values	Cross Road Sight Distance	Ramp Intersection Sight Distance	Cross Road Grade	Control of Access
Exit 1		◆								◆	◆					
Exit 2	N/A			◆	◆		◆			◆	◆		◆			
Exit 4	N/A			◆	◆		◆					◆	◆	◆		◆
Exit 9	N/A			◆	◆		◆			◆	◆	◆	◆	◆		
Exit 62	◆	◆		◆	◆		◆		◆	◆						
Exit 64	N/A			◆	◆		◆		◆	◆	◆			◆		
Exit 68	N/A															
Exit 71	N/A			◆	◆		◆		◆	◆		◆	◆	◆		
Exit 73	N/A			◆	◆		◆		◆	◆	◆	◆	◆	◆		
Exit 75	◆				◆		◆	◆								
Exit 77	N/A			◆	◆		◆		◆	◆		◆	◆	◆		◆
Exit 79	N/A			◆	◆		◆		◆	◆	◆	◆		◆		◆
Exit 81				◆	◆		◆			◆	◆					◆
Exit 83	◆			◆	◆		◆									
Exit 86	◆			◆	◆		◆									
Exit 94				◆			◆									
Exit 132	◆			◆	◆		◆									
Exit 133	◆			◆	◆		◆									
Exit 177	◆			◆	◆											
Exit 180	◆			◆												
Exit 207	◆			◆	◆		◆			◆						

**I-229 Existing Interchange Geometric Condition Analysis (◆ Denotes Deficiency)**

**I-229**

Superelevation Rate  
 Minimum Radius  
 Grade on Ramps  
 Lane Width  
 Right Shldr. Width  
 Left Shldr. Width  
 Inslope  
 Off-Ramp Taper  
 On Ramp Taper  
 Ramp K Values  
 Ramp Stopping Sight Distance  
 Cross Road K Values  
 Cross Road Sight Distance  
 Ramp Intersection Sight Distance  
 Cross Road Grade  
 Control of Access

Exit 1																	
Exit 2	N/A	N/A	N/A	◆	◆		◆			◆	◆						
Exit 3	N/A			◆	◆		◆		◆	◆	◆						◆
Exit 4	N/A			◆	◆		◆		◆	◆							
Exit 5	◆	◆		◆	◆				◆								
Exit 6																	◆
Exit 7	◆	◆		◆	◆		◆		◆	◆	◆						

# Appendix F

## Accident Analysis

## Accident Analysis

To measure the occurrence of traffic accidents along South Dakota roadways, the SDDOT currently utilizes a measure known as a weighted accident rate. To calculate the rate, accidents occurring along a section of highway are weighted according to their severity. The overall accident severity within a roadway section is then divided by the total vehicle-miles traveled along the section to calculate a weighted accident rate per million vehicle-miles of travel.

The typical SDDOT approach of calculating an accident rate per million vehicle-miles is appropriate for roadway sections. This approach, however, is less applicable to the calculation of interchange accident rates because interchanges are smaller in dimension and often include surface street intersections. An appropriate methodology for determining interchange accident rates is to calculate an accident rate per million vehicles entering the interchange, similar to the measure typically used to calculate a surface street intersection accident rate. The approach used to determine the total number of vehicle-trips associated with a typical I-90 interchange is summarized in the following steps:

1. The traffic volume data available for a typical diamond interchange are shown in Figure 1A. Mainline I-90 traffic volumes are represented by the numbers 1 - 4 and the numbers 5 - 8 represent interchange ramp traffic volumes. The number 9 on Figure 1A represents the total cross-street traffic flow within the ramp termini.
2. To determine the total number of vehicle trips associated with the interchange, a cordon line was drawn around the interchange roadways as shown in Figure 1A. The cordon line is consistent with the limits of the area for which accident data were provided. The interchange vehicle-trips were calculated as the total number of vehicles entering the cordoned area during a 24-hour period.
3. Traffic volumes entering the cordon from the interstate mainline were calculated based on balanced freeway volumes. Again referring to Figure 1A, directional freeway ADT volumes 1, 2, 3, and 4 were provided by SDDOT. These freeway counts were balanced by isolating the side of the interchange showing the greatest volumes and balancing the opposite side to this standard. Using the westbound direction in Figure 1A as an example, if the quantity  $1 - 6 + 5$  exceeded 1, the freeway volumes were balanced to reflect 1. Conversely, if the quantity  $4 - 5 + 6$  exceeded 1, the freeway volumes were balanced to reflect 4. The same procedure was used to balance the eastbound direction on the interstate.
4. The total traffic volume entering the interchange from the cross street was calculated by adding together movement 9 in Figure 1A and one half of the total interchange ramp volumes. One half of the ramp traffic is added to movement 9 because the other half of ramp traffic is included in the mainline traffic volumes.

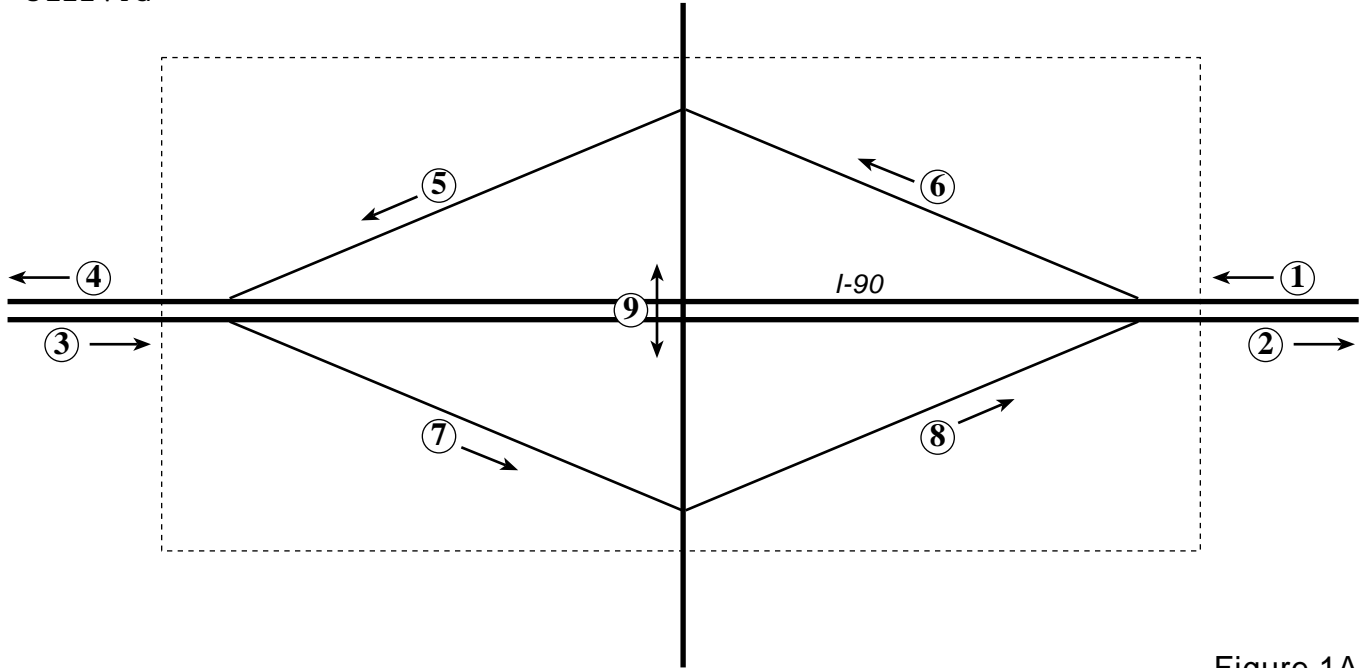


Figure 1A  
Available Traffic Volume Data for  
Typical I-90 Diamond Interchange

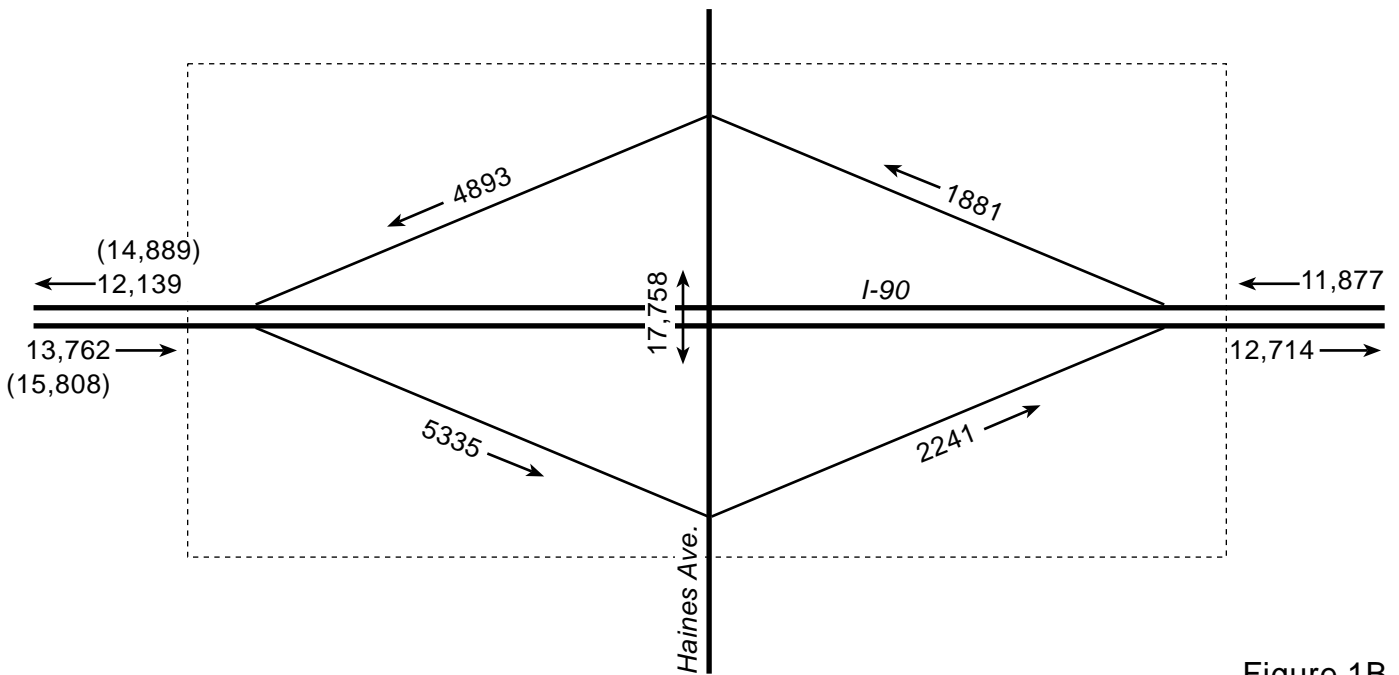


Figure 1B  
Sample ADT Calculation  
Exit 58 at Haines Avenue

LEGEND

(XXXX) = Balanced Mainline Traffic Volumes



North

5. The total number of vehicle trips entering the interchange was calculated by adding the quantity calculated in step 3 to the quantity calculated in step 4. This total was multiplied by the number of days in 3 years (at 365 days/year) to estimate the total traffic flow entering the interchange over a 3-year period. By dividing by 1 million, this total was converted to a Millions of Entering Vehicles (MEV) total.

A sample vehicle-trip calculation is depicted in Figure 1B for the interchange of I-90 and Haines Avenue in the Rapid City area. The traffic count data for this interchange showed higher freeway volumes on the east side of the interchange. Therefore, I-90 counts west of the interchange were balanced to reflect the east side data. The procedure enumerated above yielded a daily vehicle-trip estimate of approximately 53,000 vehicles per day for the I-90 / Haines Avenue interchange, translating to 57.6 MEV over three years.

Accident data were made available by SDDOT in the form of a three-year (1997-1999) data summary sheet for each interchange. The data summary provided a categorization of fatal, injury, and property damage traffic accidents occurring within the interchange area during the three year period. A point rating system of 12 points for a fatal crash, 3 points for an injury crash, and 1 point for a property damage crash was applied to the data. Based on this point system, a 3-year weighted accident sum was established for each interchange.

By dividing the weighted accident sum by the MEV value, a 3-year crash rate was then calculated for each interchange. The crash rate calculations are summarized in the attached Table 1. The interchanges in the study area are ranked according to the three year crash rate.

## **High Accident Locations**

After the calculation of each interchange crash rate, it was necessary to determine which interchanges could be considered high accident locations. The methodology identified in the *Manual of Transportation Engineering Studies*, published by the Institute of Transportation Engineers in 1994, was used to identify the high accident locations.

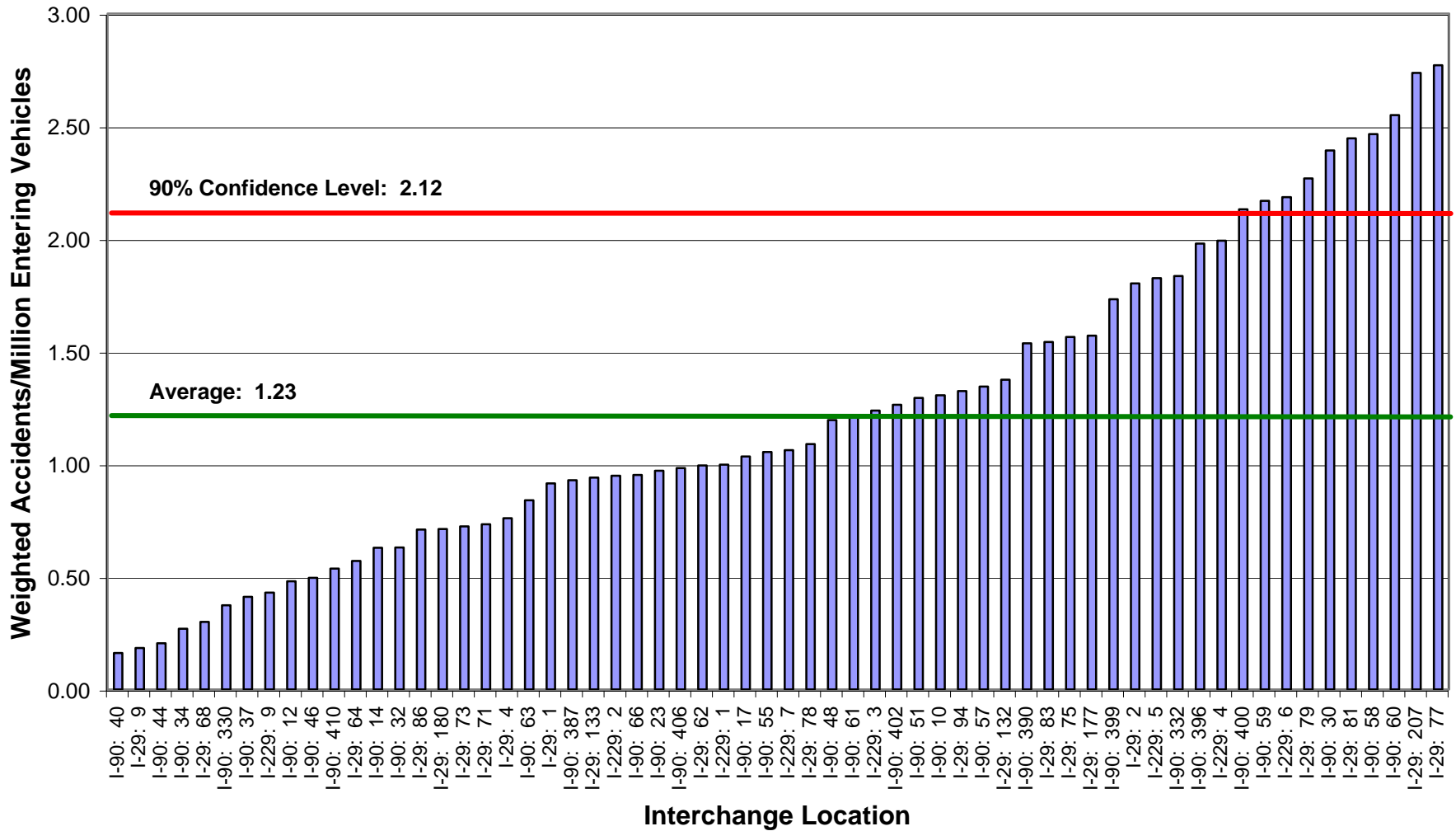
That methodology states that a high accident location is defined as those locations that have a 3-year weighted accident crash rate greater than the mean rate for all locations, plus a constant times the standard deviation for all locations. At the 90% confidence level, that constant is 1.282. The mean rate for all locations was calculated to be 1.23, and the standard deviation for all locations was calculated to be 0.69. With these values, the corresponding crash rate that determines high accident locations is 2.12 weighted accidents per million entering vehicles. Using this methodology, a total of 10 interchanges were identified as high accident locations.

## Summary of Average Daily Traffic Volumes and Accidents by Interchange

Rank	Interstate	Int. No.	Interchange Location	Average Daily Traffic	Average Annual Traffic	Number of Accidents by type			Weighted	Crash Rate	
				Interchange Area (Vehicles Per Day)	Interchange Area (Vehicles Per Year)	1997 - 1999			3-year Accidents*	3-year (Wtd Acc. / MEV**)	
				Fatal	Injury	Prop.	Total				
1	I-29	77	41st Street - Sioux Falls	66,595	24,307,175	0	38	88	126	202	2.77
2	I-29	207	US 12	9,680	3,533,200	1	4	5	10	29	2.74
3	I-90	60	US16B	31,880	11,636,200	1	15	32	48	89	2.55
4	I-90	58	Haines Ave	52,618	19,205,570	0	30	52	82	142	2.46
5	I-29	81	Maple St./Russell St. - S.F.	49,287	17,989,755	0	24	60	84	132	2.45
6	I-90	30	Sturgis US14A	30,151	11,005,115	1	11	34	46	79	2.39
7	I-29	79	12th Street - Sioux Falls	71,255	26,008,075	1	24	93	118	177	2.27
8	I-229	6	SD 42	45,965	16,777,225	0	18	56	74	110	2.19
9	I-90	59	Lacrosse St.	48,418	17,672,570	0	24	43	67	115	2.17
10	I-90	400	Sioux Falls I-229	24,860	9,073,718	1	7	25	33	58	2.13
11	I-229	4	Cliff Ave.	49,515	18,072,975	0	23	39	62	108	1.99
12	I-90	396	Sioux Falls I-29	30,460	11,117,900	0	14	24	38	66	1.98
13	I-90	332	Mitchell SD 37	22,402	8,176,730	0	7	24	31	45	1.83
14	I-229	5	26th Street	51,538	18,811,370	0	17	52	69	103	1.83
15	I-29	2	SD 105	31,414	11,466,110	0	11	29	40	62	1.80
16	I-90	399	Sioux Falls SD 115 Cliff Ave.	35,327	12,894,355	0	15	22	37	67	1.73
17	I-29	177	US 212 Watertown	18,025	6,579,125	0	6	13	19	31	1.57
18	I-29	75	I-229	33,847	12,354,155	0	11	25	36	58	1.56
19	I-29	83	SD 38 West	39,688	14,486,120	0	14	25	39	67	1.54
20	I-90	390	SD 38	16,640	6,073,600	0	8	4	12	28	1.54
21	I-29	132	US 14 Brookings	23,257	8,488,805	0	6	17	23	35	1.37
22	I-90	57	I-190	39,404	14,382,460	0	13	19	32	58	1.34
23	I-29	94	Baltic	15,858	5,788,170	0	6	5	11	23	1.32
24	I-90	10	US85 North	20,290	7,405,850	0	3	20	23	29	1.31
25	I-90	51	Blackhawk	21,873	7,983,645	0	6	13	19	31	1.29
26	I-90	402	Co. Road 121	17,340	6,328,918	0	5	9	14	24	1.26
27	I-229	3	SD 115 Minnesota Ave.	58,291	21,276,215	0	14	37	51	79	1.24
28	I-90	61	Elk Vale Rd.	36,316	13,255,340	0	10	18	28	48	1.21
29	I-90	48	Stagebarn Canyon Rd.	23,673	8,640,645	0	7	10	17	31	1.20
30	I-29	78	26th Street - Sioux Falls	53,652	19,582,980	0	13	25	38	64	1.09
31	I-229	7	Rice Street	29,226	10,667,490	0	3	25	28	34	1.06
32	I-90	55	Deadwood Ave.	38,136	13,919,640	0	8	20	28	44	1.05
33	I-90	17	US85 South	23,851	8,705,615	0	6	9	15	27	1.03
34	I-229	1	Louise Ave.	41,179	15,030,153	0	8	21	29	45	1.00
35	I-29	62	US 18 Canton	19,301	7,044,865	0	4	9	13	21	0.99
36	I-90	406	Brandon SD 11	21,373	7,801,145	0	4	11	15	23	0.98
37	I-90	23	SH34	22,581	8,242,065	0	5	9	14	24	0.97
38	I-90	66	EAFB	29,753	10,859,845	0	3	22	25	31	0.95
39	I-229	2	Western Ave.	51,965	18,967,225	0	11	21	32	54	0.95
40	I-29	133	US 14B Brookings	12,624	4,607,760	0	3	4	7	13	0.94
41	I-90	387	Hartford	12,786	4,666,890	0	1	10	11	13	0.93
42	I-29	1	Dakota Dunes	30,950	11,296,750	0	5	16	21	31	0.91
43	I-90	63	SH230	28,266	10,317,090	1	2	8	11	26	0.84
44	I-29	4	McCook	18,013	6,574,745	0	4	3	7	15	0.76
45	I-29	71	Tea/Harrisburg	23,656	8,634,440	0	5	4	9	19	0.73
46	I-29	73	Tea	32,835	11,984,775	0	2	20	22	26	0.72
47	I-29	180	US 81 West	7,701	2,810,865	0	0	6	6	6	0.71
48	I-29	86	Renner	16,737	6,109,005	0	1	10	11	13	0.71
49	I-90	32	SH79	21,764	7,943,860	0	3	6	9	15	0.63
50	I-90	14	Spearfish US14A	26,130	9,537,450	0	4	6	10	18	0.63
51	I-29	64	SD 44 Worthing	17,611	6,428,015	0	2	5	7	11	0.57
52	I-90	410	Garretson/Valley Springs	11,929	4,354,085	0	1	4	5	7	0.54
53	I-90	46	Elk Creek Rd.	20,281	7,402,565	0	3	2	5	11	0.50
54	I-90	12	Spearfish	20,938	7,642,370	0	0	11	11	11	0.48
55	I-229	9	Benson Road	27,654	10,093,710	0	2	7	9	13	0.43
56	I-90	37	Pleasant Valley Rd.	15,567	5,681,955	0	1	4	5	7	0.41
57	I-90	330	Mitchell 90L	14,673	5,355,463	0	1	3	4	6	0.37
58	I-29	68	Lennox/Parker	21,357	7,795,305	0	0	7	7	7	0.30
59	I-90	34	Cemetery Rd.	16,964	6,191,860	0	1	2	3	5	0.27
60	I-90	44	Piedmont Rd.	17,823	6,505,395	0	0	4	4	4	0.20
61	I-29	9	SD 105 Jefferson	14,890	5,434,850	0	0	3	3	3	0.18
62	I-90	40	Tilford	16,940	6,183,100	0	0	3	3	3	0.16
Weighting points				Totals		6	497	1213	1716	2776	76.06
Fatal = 12				Average		0.10	8.02	19.56	27.68	44.77	1.23
Injury = 3				Median		0	5.5	13	19	30	1.06
Property = 1				Std. Dev.		0.30	8.06	19.34	26.81	43.01	0.69
High Accident Ranking Analysis				Manual of Transportation Engineering Studies, ITE, 1994, page 204							
Classic Statistical Method:				OB = XA + (K * S)							
				OB = accident frequency or rate at location		2.12		High Accident Locations w/ Weighted Accidents/MEV > 2.12			
				XA = mean frequency or rate for all locations		1.23		(assuming 90% level of confidence)			
				K = constant corresponding to level of confidence (90%)		1.282					
				S = sample standard deviation for all locations		0.69					



## South Dakota Interstate Corridor Study Accident Summary (1997-1999)



# Appendix G

## Capacity Analysis

## Capacity Analysis

### I-90 Mainline Traffic and Level of Service

Segment	Existing			Year 2010			Year 2020		
	ADT	v/c	LOS	ADT	v/c	LOS	ADT	v/c	LOS
Exit 8 – Exit 10	9,000	0.10	A	17,800	0.19	A	25,400	0.27	B
Exit 10 – Exit 12	11,200	0.12	A	19,700	0.21	A	27,900	0.29	B
Exit 12 – Exit 14	11,200	0.12	A	27,000	0.29	B	37,700	0.40	C
Exit 14 – Exit 17	18,400	0.19	A	23,800	0.25	B	33,200	0.35	B
Exit 17 – Exit 23	16,900	0.18	A	22,600	0.24	A	32,400	0.34	B
Exit 23 – Exit 30	18,900	0.20	A	24,500	0.26	B	34,900	0.37	B
Exit 30 – Exit 34	15,100	0.16	A	23,300	0.25	B	33,200	0.35	B
Exit 34 – Exit 37	15,200	0.16	A	22,300	0.24	A	32,100	0.34	B
Exit 37 – Exit 40	14,200	0.15	A	21,600	0.23	A	31,000	0.33	B
Exit 40 – Exit 44	16,600	0.18	A	22,700	0.24	A	32,700	0.35	B
Exit 44 – Exit 46	15,600	0.16	A	22,000	0.23	A	31,600	0.33	B
Exit 46 – Exit 48	17,600	0.19	A	27,200	0.29	B	38,500	0.41	C
Exit 48 – Exit 51	18,100	0.19	A	22,900	0.24	B	32,100	0.34	B
Exit 51 – Exit 55	19,000	0.20	A	21,400	0.23	A	30,100	0.32	B
Exit 55 – Exit 57	26,000	0.27	B	29,500	0.31	B	39,600	0.42	C
Exit 57 – Exit 58	26,000	0.27	B	37,800	0.40	C	49,500	0.52	C
Exit 58 – Exit 59	24,700	0.26	B	33,800	0.36	B	45,000	0.48	C
Exit 59 – Exit 60	22,000	0.23	A	31,200	0.33	B	42,000	0.44	C
Exit 60 – Exit 61	23,800	0.25	B	35,700	0.38	B	47,100	0.50	C
Exit 61 – Exit 63	21,800	0.23	A	40,800	0.43	C	53,100	0.56	C
Exit 63 – Exit 66	21,800	0.23	A	34,600	0.37	B	46,100	0.49	C
Exit 325 – Exit 330	8,700	0.09	A	12,800	0.14	A	17,600	0.19	A
Exit 330 – Exit 332	8,600	0.09	A	17,600	0.19	A	22,000	0.23	A
Exit 387 – Exit 390	10,200	0.11	A	13,600	0.14	A	17,300	0.18	A
Exit 390 – Exit 396	12,000	0.13	A	22,900	0.24	B	41,900	0.44	C
Exit 396 – Exit 399	14,500	0.15	A	19,600	0.21	A	25,300	0.27	B
Exit 399 – Exit 400	15,700	0.17	A	29,600	0.31	B	41,700	0.44	C
Exit 400 – Exit 402	14,300	0.15	A	29,400	0.31	B	48,000	0.51	C
Exit 402 – Exit 406	12,600	0.13	A	17,600	0.19	A	24,900	0.26	B
Exit 406 – Exit 410	12,000	0.13	A	16,200	0.17	A	23,000	0.24	B

## I-29 Mainline Traffic and Level of Service

Segment	Existing			Year 2010			Year 2020		
	ADT	v/c	LOS	ADT	v/c	LOS	ADT	v/c	LOS
State Line – Exit 1	26,000	0.27	B	33,600	0.35	B	46,000	0.49	C
Exit 1 – Exit 2	19,000	0.20	A	27,000	0.29	B	37,000	0.39	C
Exit 2 – Exit 4	14,700	0.16	A	22,200	0.23	A	32,500	0.34	B
Exit 4 – Exit 9	13,200	0.14	A	15,800	0.17	A	19,700	0.21	A
Exit 9 – Exit 15	9,900	0.10	A	15,700	0.17	A	19,600	0.21	A
Exit 62 – Exit 64	15,600	0.16	A	23,800	0.25	B	35,200	0.37	B
Exit 64 – Exit 68	16,900	0.18	A	23,500	0.25	B	31,500	0.33	B
Exit 68 – Exit 71	18,500	0.20	A	28,700	0.30	B	39,600	0.42	C
Exit 71 – Exit 73	21,700	0.23	A	35,200	0.37	B	53,000	0.56	C
Exit 73 – Exit 75	24,200	0.26	B	38,200	0.40	C	52,800	0.56	C
Exit 75 – Exit 77	24,800	0.26	B	37,600	0.40	C	57,900	0.61	D
Exit 77 – Exit 78	32,200	0.34	B	45,900	0.48	C	63,800	0.67	D
Exit 78 – Exit 79	36,100	0.38	B	54,100	0.57	C	68,700	0.73	D
Exit 79 – Exit 81	32,900	0.35	B	46,400	0.49	C	60,200	0.64	D
Exit 81 – Exit 83	28,500	0.30	B	44,100	0.47	C	55,100	0.58	C
Exit 83 – Exit 84	23,500	0.25	B	31,800	0.34	B	44,300	0.47	C
Exit 84 – Exit 86	13,900	0.15	A	21,100	0.22	A	26,600	0.28	B
Exit 86 – Exit 94	11,500	0.12	A	16,900	0.18	A	23,800	0.25	B
Exit 127 – Exit 132	9,500	0.10	A	16,600	0.18	A	23,300	0.25	B
Exit 132 – Exit 133	8,100	0.09	A	14,300	0.15	A	18,400	0.19	A
Exit 177 – Exit 180	5,500	0.06	A	9,300	0.10	A	10,900	0.12	A
Exit 180 – Exit 185	5,500	0.06	A	10,700	0.11	A	17,300	0.18	A
Exit 201 – Exit 207	4,500	0.05	A	6,600	0.07	A	9,000	0.10	A
Exit 207 – Exit 210	4,200	0.04	A	5,400	0.06	A	7,200	0.08	A

## I-229 Mainline Traffic and Level of Service

Segment	Existing			Year 2010			Year 2020		
	ADT	v/c	LOS	ADT	v/c	LOS	ADT	v/c	LOS
I-29 – Exit 1	15,300	0.16	A	19,000	0.20	A	22,700	0.24	A
Exit 1 – Exit 2	25,400	0.27	B	31,400	0.33	B	37,600	0.40	C
Exit 2 – Exit 3	32,900	0.35	B	35,400	0.37	B	39,400	0.42	C
Exit 3 – Exit 4	31,400	0.33	B	40,000	0.42	C	47,600	0.50	C
Exit 4 – Exit 5	26,800	0.28	B	43,600	0.46	C	57,500	0.61	D
Exit 5 – Exit 6	20,700	0.22	A	32,800	0.35	B	48,200	0.51	C
Exit 6 – Exit 7	18,500	0.20	A	31,700	0.33	B	50,700	0.54	C
Exit 7 – Exit 9	15,900	0.17	A	28,200	0.30	B	47,400	0.50	C
Exit 9 – I-90	9,400	0.10	A	43,600	0.46	C	57,500	0.61	D

## Existing Interchange Capacity Analysis

Interstate 90	Interstate Mainline Movements				Intersection Movements	
	EB Diverge	EB Merge	WB Diverge	WB Merge	WB Off-Ramp	EB Off-Ramp
Exit 8	N/A	N/A	N/A	N/A	N/A	N/A
Exit 10	A	A	A	A	B	B
Exit 12	A	B	B	A	B	B
Exit 14	B	B	B	B	B	A
Exit 17	B	B	B	B	B	A
Exit 23	B	B	B	B	A	A
Exit 30	B	B	B	B	A	A
Exit 34	B	B	B	B	A	A
Exit 37	B	B	B	B	A	A
Exit 40	B	B	B	B	A	A
Exit 44	B	B	B	B	A	A
Exit 46	B	B	B	B	A	A
Exit 48	A	A	A	A	A	A
Exit 51	B	B	B	B	A	A
Exit 55	B	B	B	B	C	B
Exit 59	A	A	A	A	A	A
Exit 60	A	A	A	A	A	N/A
Exit 61	B	B	B	B	C	C
Exit 63	B	N/A	N/A	B	A	A
Exit 66	A	A	A	A	B	A
Exit 67	A	A	A	A	B	B
Exit 330	A	A	A	A	A	B
Exit 332	A	A	A	A	B	B
Exit 387	A	A	A	A	A	A
Exit 390	A	A	A	A	A	B
Exit 396	See Below					
Exit 399	A	B	A	A	A	A
Exit 400	See Below					
Exit 402	A	B	A	A	A	A
Exit 406	A	A	A	A	B	B
Exit 410	A	A	A	A	A	A
	<i>NB Diverge</i>	<i>NB Weave</i>	<i>NB Merge</i>	<i>SB Diverge</i>	<i>SB Weave</i>	<i>SB Merge</i>
Exit 396 (I-29)	B	A	A	A	A	A
	<i>EB Diverge</i>	<i>EB Weave</i>	<i>EB Merge</i>	<i>WB Diverge</i>	<i>WB Weave</i>	<i>WB Merge</i>
Exit 396 (I-90)	A	A	A	A	A	A
	<i>EB Diverge</i>	<i>EB Merge</i>	<i>NB Diverge</i>	<i>SB Diverge</i>	<i>WB Weave</i>	
Exit 400	A	B	A / A	A / A	A	

## Year 2010 Traffic Capacity Analysis

<b>Interstate 90</b>	<i>Interstate Mainline Movements</i>				<i>Intersection Movements</i>	
	<i>EB Diverge</i>	<i>EB Merge</i>	<i>WB Diverge</i>	<i>WB Merge</i>	<i>WB Off-Ramp</i>	<i>EB Off-Ramp</i>
Exit 8	A	B	B	B	A	A
Exit 10	B	B	B	B	C	C
Exit 12	B	B	B	B	B	B
Exit 14	B	B	B	B	B	B
Exit 17	B	B	B	B	C	A
Exit 23	B	B	B	B	B	B
Exit 30	B	B	B	B	A	B
Exit 34	B	B	B	B	A	A
Exit 37	B	B	B	B	A	A
Exit 40	B	B	B	B	A	A
Exit 44	B	B	B	B	A	A
Exit 46	B	B	B	B	A	A
Exit 48	B	B	B	B	A	B
Exit 51	B	B	B	B	A	B
Exit 55	B	B	B	B	F	C
Exit 59	A	A	A	A	B	B
Exit 60	B	B	B	B	B	N/A
Exit 61	C	B	B	B	F	F
Exit 63	B	N/A	N/A	B	B	A
Exit 66	B	B	B	B	B	B
Exit 67	B	B	B	B	B	B
Exit 330	A	A	A	A	A	B
Exit 332	A	A	A	A	-	-
Exit 387	A	A	A	A	A	A
Exit 390	A	A	B	B	B	B
Exit 396	See Below					
Exit 399	B	B	B	B	B	A
Exit 400	See Below					
Exit 402	B	B	B	B	B	C
Exit 406	A	B	A	B	C	C
Exit 410	A	A	A	A	A	A
	<i>NB Diverge</i>	<i>NB Weave</i>	<i>NB Merge</i>	<i>SB Diverge</i>	<i>SB Weave</i>	<i>SB Merge</i>
Exit 396 (I-29)	B	A	A	A	A	B
	<i>EB Diverge</i>	<i>EB Weave</i>	<i>EB Merge</i>	<i>WB Diverge</i>	<i>WB Weave</i>	<i>WB Merge</i>
Exit 396 (I-90)	B	A	B	B	A	B
	<i>EB Diverge</i>	<i>EB Merge</i>	<i>NB Diverge</i>	<i>SB Diverge</i>	<i>WB Weave</i>	
Exit 400	B	B	A / A	A / B	B	

## Year 2020 Traffic Capacity Analysis

<b>Interstate 90</b>	<i>Interstate Mainline Movements</i>				<i>Intersection Movements</i>	
	<i>EB Diverge</i>	<i>EB Merge</i>	<i>WB Diverge</i>	<i>WB Merge</i>	<i>WB Off-Ramp</i>	<i>EB Off-Ramp</i>
Exit 8	B	B	B	B	B	A
Exit 10	B	B	B	B	D	D
Exit 12	B	B	C	B	B	B
Exit 14	B	B	B	C	B	B
Exit 17	B	B	B	B	D	A
Exit 23	B	B	B	B	B	B
Exit 30	B	B	B	B	A	B
Exit 34	B	B	B	B	A	A
Exit 37	B	B	B	B	A	A
Exit 40	B	B	B	B	A	A
Exit 44	B	B	B	B	A	A
Exit 46	B	B	B	B	A	A
Exit 48	B	B	B	B	A	B
Exit 51	B	B	B	B	A	B
Exit 55	B	C	B	B	F	D
Exit 59	A	A	A	A	B	B
Exit 60	C	B	C	B	B	N/A
Exit 61	C	C	C	C	F	F
Exit 63	C	N/A	N/A	C	B	A
Exit 66	B	B	B	B	B	B
Exit 67	B	B	B	B	B	B
Exit 330	A	A	A	A	A	B
Exit 332	A	A	A	A	-	-
Exit 387	A	A	A	A	A	B
Exit 390	B	B	C	C	C	C
Exit 396	See Below					
Exit 399	B	C	C	C	C	B
Exit 400						
Exit 402	B	B	C	C	E	B
Exit 406	B	B	B	B	D	F
Exit 410	A	A	A	A	A	A
	<i>NB Diverge</i>	<i>NB Weave</i>	<i>NB Merge</i>	<i>SB Diverge</i>	<i>SB Weave</i>	<i>SB Merge</i>
Exit 396 (I-29)	C	A	B	A	A	B
	<i>EB Diverge</i>	<i>EB Weave</i>	<i>EB Merge</i>	<i>WB Diverge</i>	<i>WB Weave</i>	<i>WB Merge</i>
Exit 396 (I-90)	B	A	B	C	B	B
	<i>EB Diverge</i>	<i>EB Merge</i>	<i>NB Diverge</i>	<i>SB Diverge</i>	<i>WB Weave</i>	
Exit 400	B	B	B / B	B / B	C	



## Existing Traffic Capacity Analysis

<b>Interstate 29</b>	<i>Interstate Mainline Movements</i>				<i>Intersection Movements</i>	
	<i>NB Diverge</i>	<i>NB Merge</i>	<i>SB Diverge</i>	<i>SB Merge</i>	<i>NB Off-Ramp</i>	<i>SB Off-Ramp</i>
Exit 1	A	B	A	A	A	A
Exit 2	A	A	A	B	C	C
Exit 4	A	A	A	A	A	A
Exit 9	A	A	A	A	A	A
Exit 62	A	A	A	A	A	A
Exit 64	A	A	A	A	A	A
Exit 68	A	A	A	A	A	A
Exit 71	B	A	B	A	A	A
Exit 73	A	A	B	A	A	
Exit 75	Previous Study					
Exit 77	A	B	B	B	B	C
Exit 79	B	B	B	C	D	B
Exit 80	-	-	-	-	-	-
Exit 81	A	B	B	B	See Below	
Exit 83	A	A	A	A	A	A
Exit 86	A	A	A	A	A	A
Exit 94	A	A	A	A	A	A
Exit 129	-	-	-	-	-	-
Exit 132	A	A	A	A	C	C
Exit 133	A	A	A	A	B	A
Exit 177	A	A	A	A	B	B
Exit 180	A	A	A	A	A	A
Exit 207	A	A	A	A	A	A
	<i>Intersection Movements</i>					
	<i>Maple/Russell</i>		<i>NB Off-Ramp</i>		<i>SB Off-Ramp</i>	
Exit 81	C		F		F	

## Year 2010 Traffic Capacity Analysis

<b>Interstate 29</b>	<i>Interstate Mainline Movements</i>				<i>Intersection Movements</i>	
	<i>NB Diverge</i>	<i>NB Merge</i>	<i>SB Diverge</i>	<i>SB Merge</i>	<i>NB Off-Ramp</i>	<i>SB Off-Ramp</i>
Exit 1	A	B	A	B	B	B
Exit 2	B	B	B	B	C	E
Exit 4	A	B	A	B	B	A
Exit 9	A	A	A	A	A	A
Exit 62	A	B	A	B	B	A
Exit 64	B	A	B	A	A	A
Exit 68	A	B	A	B	B	A
Exit 71	B	B	B	B	A	A
Exit 73	A	B	B	A	B	
Exit 75	Previous Study					
Exit 77	B	C	B	B	B	D
Exit 79	C	C	C	C	D	C
Exit 80	B	B	C	B	A	A
Exit 81	A	A	A	A	See Below	
Exit 83	A	A	A	A	B	A
Exit 86	A	A	A	A	A	B
Exit 94	A	A	A	A	A	A
Exit 129	A	A	A	A	C	A
Exit 132	A	A	A	A	F	C
Exit 133	A	A	A	A	B	B
Exit 177	A	A	A	A	D	C
Exit 180	A	A	A	A	A	A
Exit 207	A	A	A	A	B	B
	<i>Intersection Movements</i>					
	<i>Maple/Russell</i>		<i>NB Off-Ramp</i>		<i>SB Off-Ramp</i>	
Exit 81	F		B		F	

## Year 2020 Traffic Capacity Analysis

<b>Interstate 29</b>	<i>Interstate Mainline Movements</i>				<i>Intersection Movements</i>	
	<i>NB Diverge</i>	<i>NB Merge</i>	<i>SB Diverge</i>	<i>SB Merge</i>	<i>NB Off-Ramp</i>	<i>SB Off-Ramp</i>
Exit 1	B	C	A	B	B	B
Exit 2	B	B	B	B	E	F
Exit 4	B	B	B	B	B	B
Exit 9	A	A	B	A	A	A
Exit 62	B	B	B	B	B	B
Exit 64	B	A	B	B	A	A
Exit 68	B	B	B	B	B	B
Exit 71	C	B	C	C	B	B
Exit 73	B	B	C	B	B	
Exit 75	Previous Study					
Exit 77	D	D	C	B	C	E
Exit 79	D	D	C	D	F	D
Exit 80	C	B	D	C	A	A
Exit 81	B	B	C	C	See below	
Exit 83	A	A	A	A	F	B
Exit 86	B	B	A	A	B	B
Exit 94	B	A	A	A	B	B
Exit 129	A	A	A	A	C	B
Exit 132	A	A	A	A	F	E
Exit 133	A	A	A	A	B	C
Exit 177	A	A	A	A	F	D
Exit 180	A	A	A	A	A	A
Exit 207	A	A	A	A	B	B
	<i>Intersection Movements</i>					
	<i>Maple/Russell</i>		<i>NB Off-Ramp</i>		<i>SB Off-Ramp</i>	
Exit 81	F		F		F	

## Existing Traffic Capacity Analysis

<b>Interstate 229</b>	<i>Interstate Mainline Movements</i>				<i>Intersection Movements</i>	
	<i>NB Diverge</i>	<i>NB Merge</i>	<i>SB Diverge</i>	<i>SB Merge</i>	<i>NB Off-Ramp</i>	<i>SB Off-Ramp</i>
Exit 1	A	A/B	B	A	A	A
Exit 2	B	B	B	B	B	A
Exit 3	B	B	A	A	A	A
Exit 4	B	B	B	B	B	B
Exit 5	B	A	B	B	D	C
Exit 6	A	A	B	B	C	
Exit 9	A	A	A	B	A	A

## Year 2010 Traffic Capacity Analysis

<b>Interstate 229</b>	<i>Interstate Mainline Movements</i>				<i>Intersection Movements</i>	
	<i>NB Diverge</i>	<i>NB Merge</i>	<i>SB Diverge</i>	<i>SB Merge</i>	<i>NB Off-Ramp</i>	<i>SB Off-Ramp</i>
Exit 1	A	- /B	-	B	A	A
Exit 2	-	-	-	-	B	C
Exit 3	-	-	-	-	A	A
Exit 4	-	-	-	-	B	C
Exit 5	-	B	B	-	F	D
Exit 6	B	-	-	B	C	
Exit 9	-	A	B	-	A	A

## Year 2020 Traffic Capacity Analysis

<b>Interstate 229</b>	<i>Interstate Mainline Movements</i>				<i>Intersection Movements</i>	
	<i>NB Diverge</i>	<i>NB Merge</i>	<i>SB Diverge</i>	<i>SB Merge</i>	<i>NB Off-Ramp</i>	<i>SB Off-Ramp</i>
Exit 1	B	- /B	-	B	A	A
Exit 2	-	-	-	-	C	E
Exit 3	-	-	-	-	B	A
Exit 4	-	-	-	-	C	C
Exit 5	-	B	C	-	F	E
Exit 6	B	-	-	C	D	
Exit 9	-	A	C	-	A	A