I-229 Exit 4 (Cliff Avenue) Crossroad Corridor Study

I-229 Major Investment Corridor Study
Project PL 0100(87) 3616 P, PCN 044K

Sioux Falls, South Dakota
June 2017

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The preparation of this report has been financed in part through grant(s) from the Federal Highway Administration and Federal Transit Administration, U.S. Department of Transportation, under the State Planning and Research Program, Section 505 [or Metropolitan Planning Program, Section 104(f)] of Title 23, U.S. Code. The contents of this report do not necessarily reflect the official views or policy of the U.S. Department of Transportation.

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EXECUTIVE SUMMARY

The Interstate 229 (I-229) Corridor through the City of Sioux Falls is a critical traffic corridor that provides access to the expanding east side and allows access to downtown. The I-229 Major Investment Study (MIS) allows the City of Sioux Falls, the Sioux Falls Metropolitan Planning Organization, the South Dakota Department of Transportation, adjacent landowners, and area users to help determine the vision of the corridor. The I-229 Exit 4 (Cliff Avenue) Crossroad Corridor Study is a subset of the I-229 MIS.

This study assesses existing and future conditions at the I-229 interchange at Exit 4 (Cliff Avenue) and along Cliff Avenue from 33rd Street to 49th Street. The purpose of this study is to address the traffic operations and safety concerns for this corridor. The Cliff Avenue/I-229 southbound on-ramp intersection experiences congestion in the peak traffic hours. By year 2035, congestion is anticipated to increase at this intersection.

Preliminary concepts for the Cliff Avenue interchange to address the existing and year 2035 transportation deficiencies have been developed. No improvements were needed beyond the interchange area so no corridor options were analyzed. The preliminary concepts were screened to determine which interchange concepts should be selected for further development and assessment. There were three (3) alternative scenarios identified for further development. Each of the alternative scenarios was analyzed using established evaluation criteria. The analysis of the alternative scenarios was used to determine which alternative scenarios should be recommended to advance for future studies. The following are the recommended alternative scenarios to advance:

- ***Cliff-1.*** NB Cliff to SB I-229 Loop Ramp
- ***Cliff-6.*** SPUI, 41st Street Realigned
- ***Cliff-7.*** SPUI, SB I-229 Off-Ramp Thru & Rights at 41st Street

The public was involved throughout the study through public open houses, landowner meetings, and a project website. Public comments, provided in person, in writing, or electronically, were used in the development and refinement of improvement alternatives. The project's Study Advisory Team consisted of representatives from the Federal Highway Administration (FHWA), South Dakota Department of Transportation (SDDOT), Sioux Falls Metropolitan Planning Organization (MPO), City of Sioux Falls, and HDR.

CHAPTER 1 - INTRODUCTION

Section 1.1 - Introduction

The Interstate 229 (I-229) Corridor through the City of Sioux Falls carries commuters and tourism traffic, provides access to the expanding east side of this thriving community, and allows access to downtown. The I-229 Major Investment Study (MIS) allows the City of Sioux Falls, the Sioux Falls Metropolitan Planning Organization (MPO), the South Dakota Department of Transportation (SDDOT), adjacent landowners, and area users to help determine the vision of the corridor. The I-229 Exit 4 (Cliff Avenue) Corridor Study is a subset of the I-229 MIS.

An MIS provides a focused evaluation of transportation needs and issues within a corridor or sub-region. An MIS is designed to provide decision makers with information on the options available for addressing transportation challenges before making investment decisions. An MIS can lead to decisions on design concepts and scope of the investment.

The I-229 Major Investment Corridor Study (MIS) fulfills the following objectives:

1. Complete a traffic level of service analysis for both existing and future (2035) no-build conditions on the I-229 mainline, select interchanges and crossroads.
2. Complete a safety analysis of I-229 mainline, interchanges and crossroads.
3. Identify locations on I-229 not in compliance with current design standards under both the current and forecasted future traffic conditions.
4. Determine the effects of incidents on traffic operations within the I-229 corridor's area of influence.
5. Develop a long range plan consisting of feasible solutions to address the portions of the Interstate System that fail to meet current design standards, traffic level of service expectations, and/or have identifiable safety concerns under both the current and forecasted future traffic conditions.
6. Create final products for use by the SDDOT, the City of Sioux Falls and the Sioux Falls Metropolitan Planning Organization, which will guide the Department in the implementation of recommended improvements that will maximize the efficiency of the system.

The I-229 MIS has been separated into six individual sub-studies. The sub-studies include:

- *I-229 Corridor Study*
- *I-229 Exit 3 (Minnesota Avenue) Crossroad Corridor Study*
- *I-229 Exit 4 (Cliff Avenue) Crossroad Corridor Study*
- *I-229 Exit 6 (10th Street) Crossroad Corridor Study*
- *I-229 Exit 7 (Rice Street) Crossroad Corridor Study*
- *I-229 Exit 9 (Benson Road) Crossroad Corridor Study*

A map illustrating the study areas for each of the corridor studies is shown in ***FIGURE 1***.

The remainder of this document details the transportation efforts entailed in the I-229 Exit 4 (Cliff Avenue) Crossroad Corridor Study.

Section 1.2 - Project Description / Study Area

This study assesses existing and future conditions at the I-229 interchange at Exit 4 (Cliff Avenue) and along Cliff Avenue from 33rd Street to 49th Street. The I-229 Exit 4 interchange and adjacent Cliff Avenue corridor is located in the southeastern portion of the Sioux Falls metropolitan area, approximately 7 miles south of the I-229/I-90 system interchange. The I-229 mainline study limits include Exit 3 (Minnesota Avenue) through Exit 5 (26th Street). The Cliff Avenue study limits include 33rd Street through 49th Street.

An illustration of the study area is shown in ***FIGURE 2***. There are 5 study area intersections located on Cliff Avenue, including:

- 33rd Street
- I-229 southbound off-ramp/41st Street
- I-229 southbound on-ramp
- I-229 northbound ramp terminal
- 49th Street

Figure 1. I-229 MIS Study Area Map

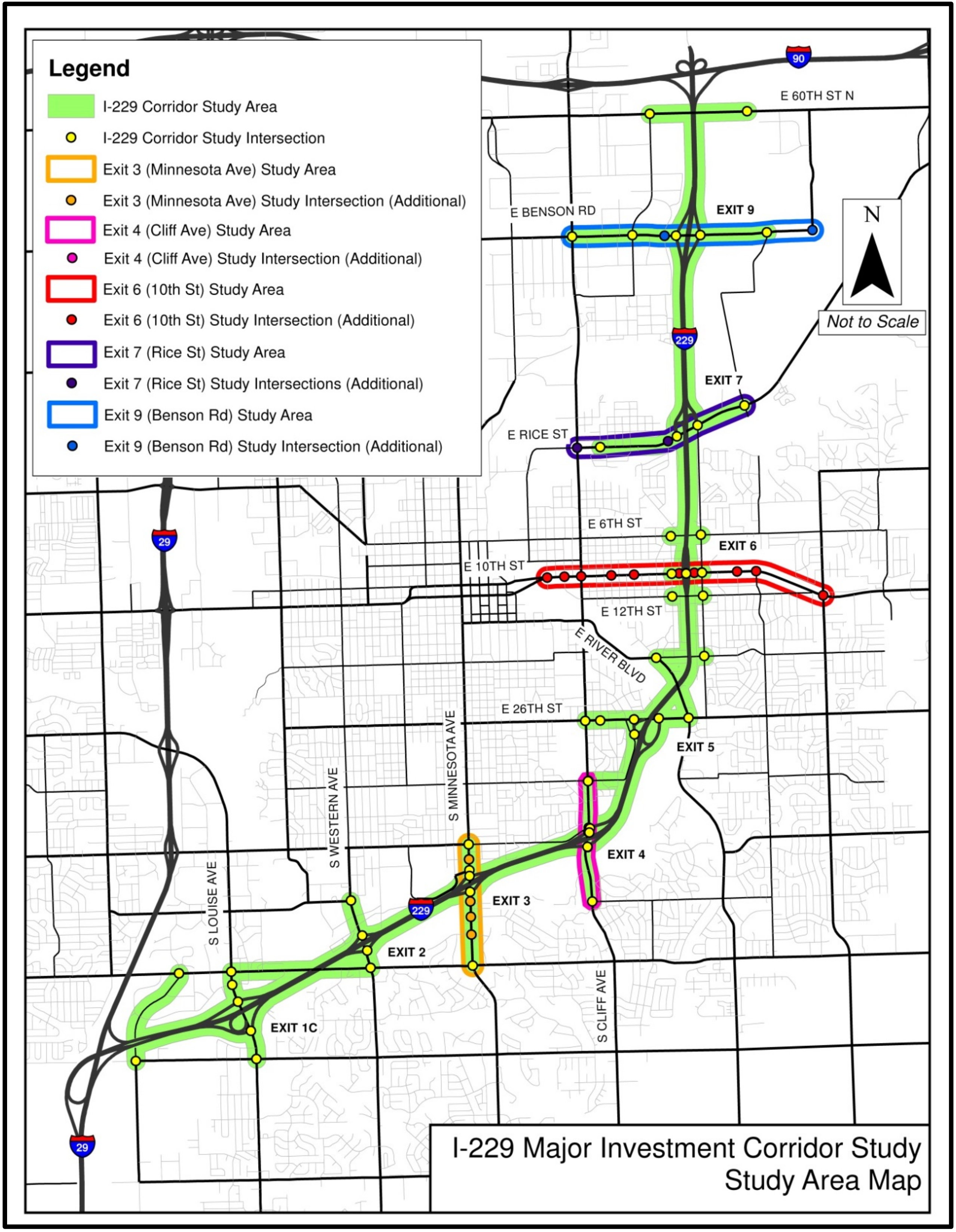
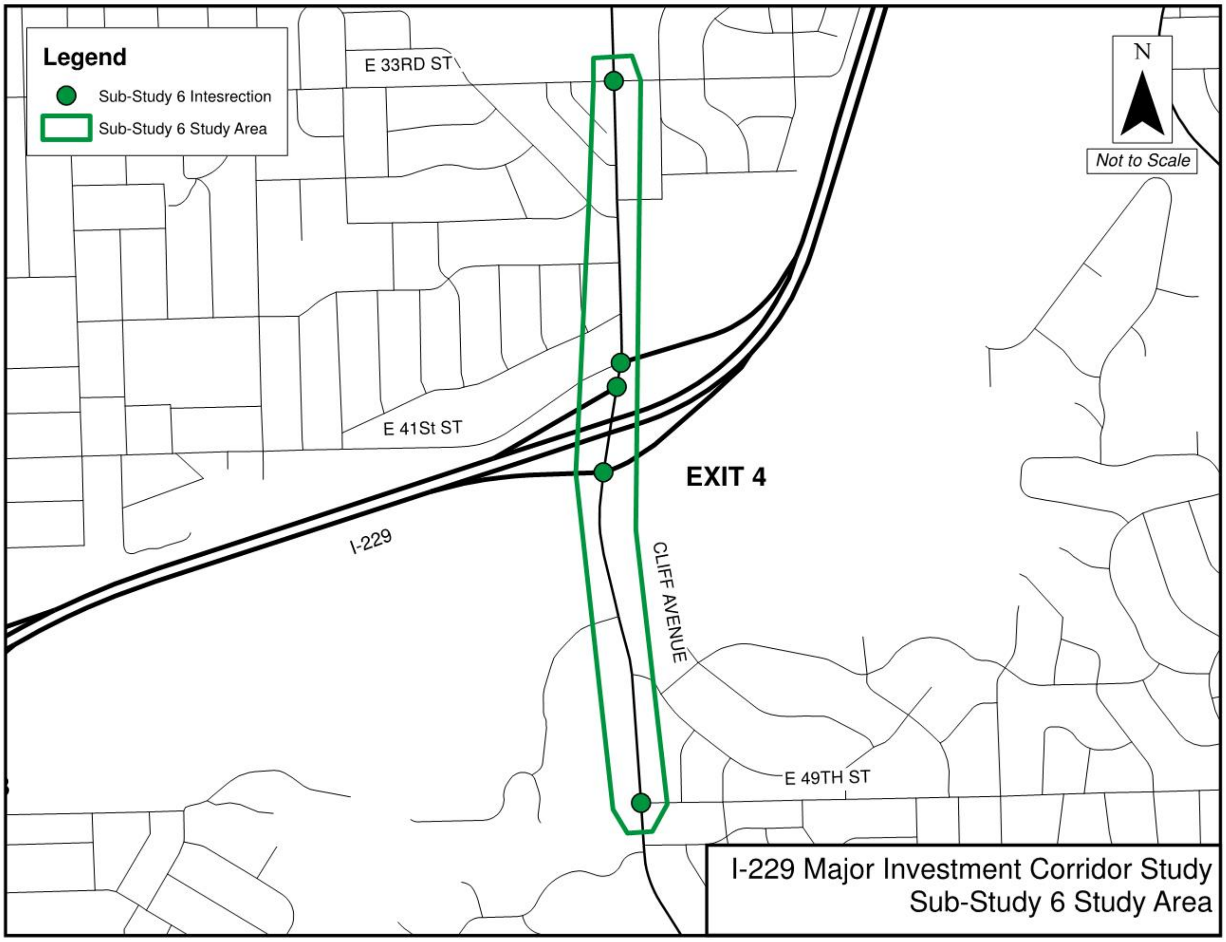


Figure 2. Exit 4 (Cliff Avenue) Study Area



Section 1.3 - Purpose

The purpose of this study is to address the traffic operations and safety concerns at the I-229/Exit 4 (Cliff Avenue) interchange and along the Cliff Avenue corridor which serves the growing east side of Sioux Falls, South Dakota. The following is a list of specific issues/needs that were identified for this study:

- Congestion at the Cliff Avenue / I-229 interchange
- Pedestrian / Multimodal safety in the vicinity of Lincoln High School and the Sioux Falls trail system
- Geographic constraints on corridor performance, including the Big Sioux River, Tuthill Park, and Spencer Park

The primary goal of this study is to develop feasible solutions to address the identified issues and needs. The solutions will follow current design standards and provide acceptable traffic level of service (LOS) and operations under both current and future traffic conditions.

Section 1.4 - Methods and Assumptions

The SDDOT provides a ***Methods and Assumptions*** template for SDDOT planning studies. This template guided the development of a specific document for the I-229 Exit 4 (Cliff Avenue) Crossroad Corridor Study. This Methods and Assumptions document is used to outline technical methodologies and key assumptions used in the course of the study. The Methods and Assumptions document can be found in ***APPENDIX A. METHODS AND ASSUMPTIONS FOR SUB-STUDY 3***.

CHAPTER 2 - EXISTING AND YEAR 2035 NO-BUILD CONDITIONS

Assessment of existing conditions and 2035 no-build conditions is based on traffic data collected and developed as part of the overall I-229 MIS. Traffic data applicable to Exit 4 (Cliff Avenue) includes base mapping, existing and 2035 no-build traffic volume data and crash data. The existing conditions analysis is representative of year 2012. Content in this chapter focuses on analysis of the Exit 4 (Cliff Avenue) interchange and corridor study area.

Section 2.1 - Traffic Capacity and Analysis Methodologies

Existing (year 2012) and 2035 no-build conditions operational analysis included the analysis of 4 signalized intersections, 1 unsignalized intersection, 2 basic freeway segments, and 2 weave segments. All locations were analyzed for the AM peak hour (7:15 – 8:15 AM) and PM peak hour (4:30 – 5:30 PM). The operational analysis results include:

- Ramp terminal intersections
- Arterial intersections
- Basic Freeway and Weave Areas

Analysis methodologies utilized for determining traffic capacities are outlined in ***APPENDIX B1. TRAFFIC CAPACITY ANALYSIS METHODOLOGIES***. Level of service (LOS) is based on procedures from the ***Highway Capacity Manual*** (***HCM 2010***).

Section 2.2 - Existing Conditions Operational Results

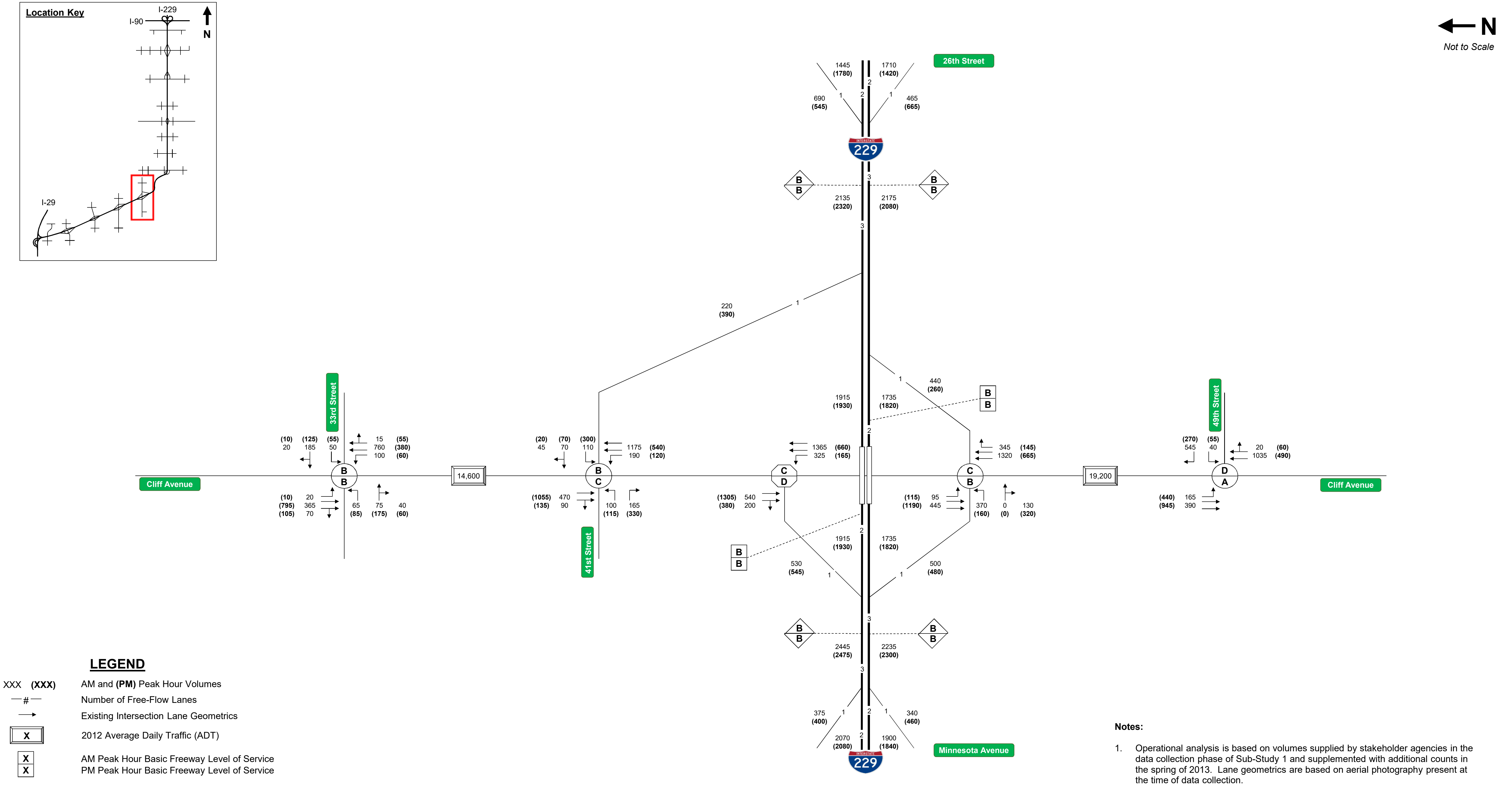
The existing conditions LOS results for all locations are depicted in ***FIGURE 3***.

This existing conditions analysis found that the freeway and ramps are operating at a desirable LOS of C or better throughout the study area. One ramp terminal intersection has degraded beyond the acceptable threshold of LOS C. All arterial intersections are operating at a desirable LOS of D or better. ***TABLE 1*** highlights the intersections that do not meet the project specific LOS thresholds. The existing traffic analysis reports can be found in ***APPENDIX B2. EXISTING HCS 2010 REPORTS***.

Table 1. Existing Conditions Deficient Locations Based on Operational Analysis

LOCATION	AM	PM
Cliff Avenue & I-229 SB On-Ramp – Worst stop-controlled movement LOS		LOS D

Note: Acceptable threshold is LOS D for arterial intersections and LOS C for freeway, ramps, and ramp terminal intersections.



LEGEND

XXX **(XXX)**	AM and **(PM)** Peak Hour Volumes
—#—	Number of Free-Flow Lanes
→	Existing Intersection Lane Geometrics
X	2012 Average Daily Traffic (ADT)
X X	AM Peak Hour Basic Freeway Level of Service PM Peak Hour Basic Freeway Level of Service
X X	AM Peak Hour Ramp Merge Level of Service PM Peak Hour Ramp Merge Level of Service
X X	AM Peak Hour Ramp Diverge Level of Service PM Peak Hour Ramp Diverge Level of Service
X X	AM Peak Hour Weaving Section Level of Service PM Peak Hour Weaving Section Level of Service
X X	AM Peak Hour Signalized Intersection Level of Service PM Peak Hour Signalized Intersection Level of Service
X X	AM Peak Hour Unsignalized Intersection Level of Service PM Peak Hour Unsignalized Intersection Level of Service

Notes:

1. Operational analysis is based on volumes supplied by stakeholder agencies in the data collection phase of Sub-Study 1 and supplemented with additional counts in the spring of 2013. Lane geometrics are based on aerial photography present at the time of data collection.
2. 7:15 - 8:15 AM Peak Hour; 4:30 - 5:30 PM Peak Hour
3. 2012 ADT's are based on traffic counts taken by the Sioux Falls Public Works Department and the South Dakota Department of Transportation
4. Worst case stop controlled movement Level of Service reported

Existing Conditions Traffic Operations Analysis

I-229 Major Investment Corridor Study: Sub-Study 6
Sioux Falls, South Dakota

Date
June 2017

Figure
3

Section 2.3 - Year 2035 No-Build Operational Results

Traffic forecasts for year 2035 for the No-Build condition were established as part of the overall I-229 MIS.

The balanced set of year 2035 No-Build volumes is included with the results of the Future No-Build analysis.

A detailed report of the future No-Build operations can be found in ***APPENDIX C. 2035 NO-BUILD AND BUILD OPERATIONAL ANALYSIS TECHNICAL MEMORANDUM***.

The year 2035 conditions analysis found that two ramp terminal intersections will degrade beyond the threshold of LOS C and one arterial intersection will degrade beyond the threshold of LOS D.

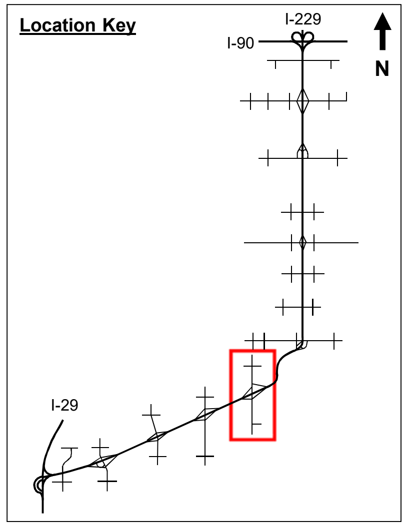
TABLE 2 highlights intersections that will not meet the project specific LOS thresholds.

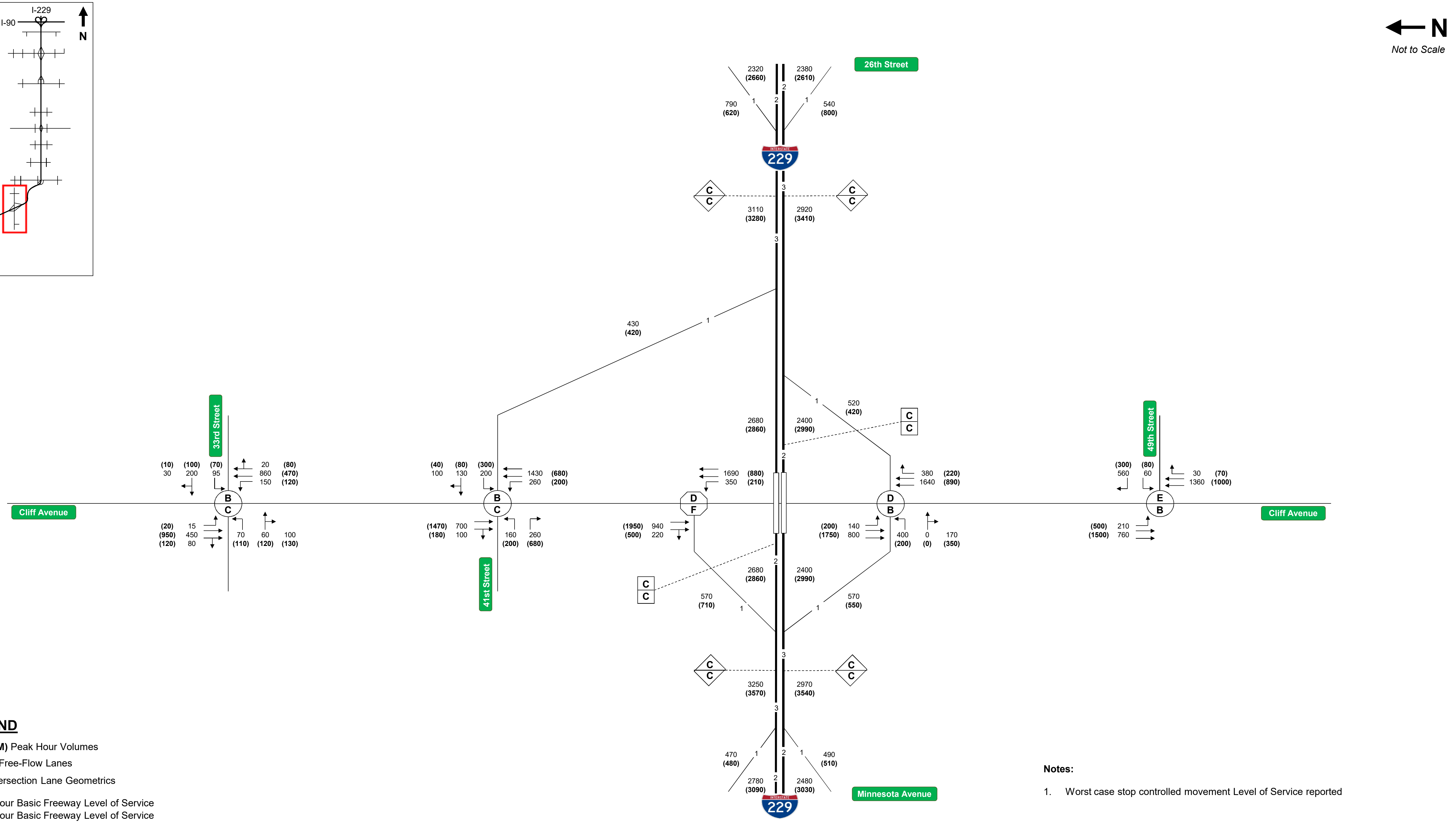
Final operational analysis LOS results for year 2035 No-Build AM and PM peak hour can be found in graphical format in ***FIGURE 4*** for study intersections, as well as basic freeway and weaving segments.

Table 2. 2035 No-Build Conditions Deficient Locations Based on Operational Analysis

LOCATION	AM	PM
Cliff Avenue & I-229 SB On-Ramp – Worst stop-controlled movement LOS	LOS D	LOS F
Cliff Avenue & I-229 NB Ramp Terminal	LOS D	
Cliff Avenue & 49th Street	LOS E	

Note: Acceptable threshold is LOS D for arterial intersections and LOS C for freeway, ramps, and ramp terminal intersections.





LEGEND

XXX **(XXX)**	AM and **(PM)** Peak Hour Volumes
—#—	Number of Free-Flow Lanes
→	Existing Intersection Lane Geometrics
X X	AM Peak Hour Basic Freeway Level of Service PM Peak Hour Basic Freeway Level of Service
X X	AM Peak Hour Ramp Merge Level of Service PM Peak Hour Ramp Merge Level of Service
X X	AM Peak Hour Ramp Diverge Level of Service PM Peak Hour Ramp Diverge Level of Service
X X	AM Peak Hour Weaving Section Level of Service PM Peak Hour Weaving Section Level of Service
X X	AM Peak Hour Signalized Intersection Level of Service PM Peak Hour Signalized Intersection Level of Service
X X	AM Peak Hour Unsignalized Intersection Level of Service PM Peak Hour Unsignalized Intersection Level of Service

Notes:

1. Worst case stop controlled movement Level of Service reported

2035 No-Build Conditions Traffic Operations Analysis

I-229 Major Investment Corridor Study: Sub-Study 6
Sioux Falls, South Dakota

Date
June 2017

Figure
4

CHAPTER 3 - CONCEPT DEVELOPMENT AND ANALYSIS

The transportation deficiencies identified in the Existing Conditions and 2035 No-Build Conditions analysis were taken into consideration along with input from the Study Advisory Team (SAT) in order to develop potential roadway improvement projects. A multi-step process was used to develop, analyze and refine potential concepts in order to identify the recommended concepts for future consideration.

Section 3.1 - Preliminary Concept Development

Prior to development of the preliminary concepts, a Public Open House was held October 30th, 2013 to introduce and receive feedback regarding the I-229 MIS. The Public Open House discussed the needs and goals for each individual corridor study and received feedback from the public. A summary of the public involvement process and meeting notes can be found in ***APPENDIX H. PUBLIC INVOLVEMENT.***

The first step in the concept development phase was to identify preliminary concepts to potentially address the deficiencies identified in the Existing Conditions and 2035 No-Build Conditions analysis.

These concepts were developed with SAT input during concept workshops in April and June of 2016. Preliminary concepts for the Exit 4 (Cliff Avenue) interchange included:

- ***Cliff-1.*** NB Cliff to SB I-229 Loop Ramp
- ***Cliff-2.*** NB/SB Cliff to SB I-229 Loop Ramp, Eliminate SB Diagonal Ramp
- ***Cliff-4.*** Diamond Interchange, 41st Street Realigned
- ***Cliff-6.*** SPUI, 41st Street Realigned
- ***Cliff-7.*** SPUI, SB I-229 Off-Ramp Thru & Rights at 41st Street
- ***Cliff-8.*** Tight Diamond Interchange, 41st Street Realigned

Preliminary Concept figures are shown in ***APPENDIX D1. PRELIMINARY CONCEPT FIGURES***.

Section 3.2 - Preliminary Concept Comparisons

The preliminary concepts were evaluated through a screening process in order to identify concepts to be carried forward in the study and further refined and analyzed. Each of the preliminary concepts was evaluated using criteria in four categories. The four category types evaluated for each preliminary concept identified for further consideration included Property Impacts, Traffic Operations, Environmental Review and Construction Costs as described in the next sections. Additional detail may be found in ***APPENDIX D2. PRELIMINARY CONCEPTS TECH MEMO***.

PROPERTY IMPACTS

An approximate footprint for each preliminary concept was developed by setting impact limits. The portion of each property parcel intersected by the impact limits that was inside of the impact limit was assumed to be an acquisition. If an acquisition impacted a structure, or rendered a parcel unusable in the opinion of the consultant (e.g. a large part of a parking lot was acquired), the entire structure or parcel was assumed to be an acquisition.

A unit price of $5 per square foot of acquisition area was applied to estimate the cost of property impacts. The total estimated cost of property impacts for a concept is the total impacted area multiplied by $5 per square foot plus the assessed value of structures impacted (from the Minnehaha County Assessor's website) multiplied by 1.5 (to estimate the fair market value of impacts).

Although not included in the assessment of property impacts for the concepts, the existing access control limits along I-229 at each of the corridor sub-study interchanges were researched at the request of the SAT and are depicted in a set of figures in ***APPENDIX I. EXISTING ACCESS CONTROL FIGURES***.

TRAFFIC OPERATIONS

The traffic operations assessment for each preliminary concept was developed using output from ***Highway Capacity Software 2010 (HCS 2010) version 6.50***. The 2035 No-Build condition was used as a baseline model to which output from each preliminary concept was compared.

For each concept, the Measures of Effectiveness (MOEs) were pulled for both AM and PM peaks and then averaged. The averaged MOEs from each concept run were compared to the No-Build MOEs and a percent change calculated between each concept and No-Build. The following MOEs were used to compare the concepts:

- Queues
- Delay
- Travel Time

The traffic operations results can be found in ***APPENDIX D2. PRELIMINARY CONCEPTS TECH MEMO***.

ENVIRONMENTAL REVIEW

A desktop review of available data was analyzed against the preliminary concepts. Items that could require further analysis at the time of future project initiation were identified for issues that separate project concepts. Later phases in potential project corridor planning will require environmental documentation if federal funds are used, and would require analysis of additional resources such as environmental justice and noise. The environmental review included the following elements:

- Archaeological and Historical Resources
- Wetlands and Waters
- Threatened and Endangered Species

- Section 4(f) and Section 6(f) Properties
- Floodplain
- Regulated Materials

APPENDIX D3. ENVIRONMENTAL CONSTRAINTS MAPS identify constraints in the study area such as schools, bike trails, rivers, wetlands, parks, and floodplain.

CONSTRUCTION COSTS

Pavement area costs are assumed to include curb, shoulder, median, sidewalk, and drainage items. For cost estimating purposes, all retaining walls were assumed to have a constant height of 12 feet over their entire estimated length. Relocation costs are not included in the ROW cost estimates.

The comparative assessment of the preliminary concepts is summarized in ***TABLE 3***.

PRELIMINARY CONCEPT COMPARISON

The preliminary concepts and the concept evaluation were presented to the business /land owners and public through a Stakeholders Meeting and Public Open House on June 22nd, 2016. A summary of the public involvement process and meeting notes can be found in ***APPENDIX H. PUBLIC INVOLVEMENT.***

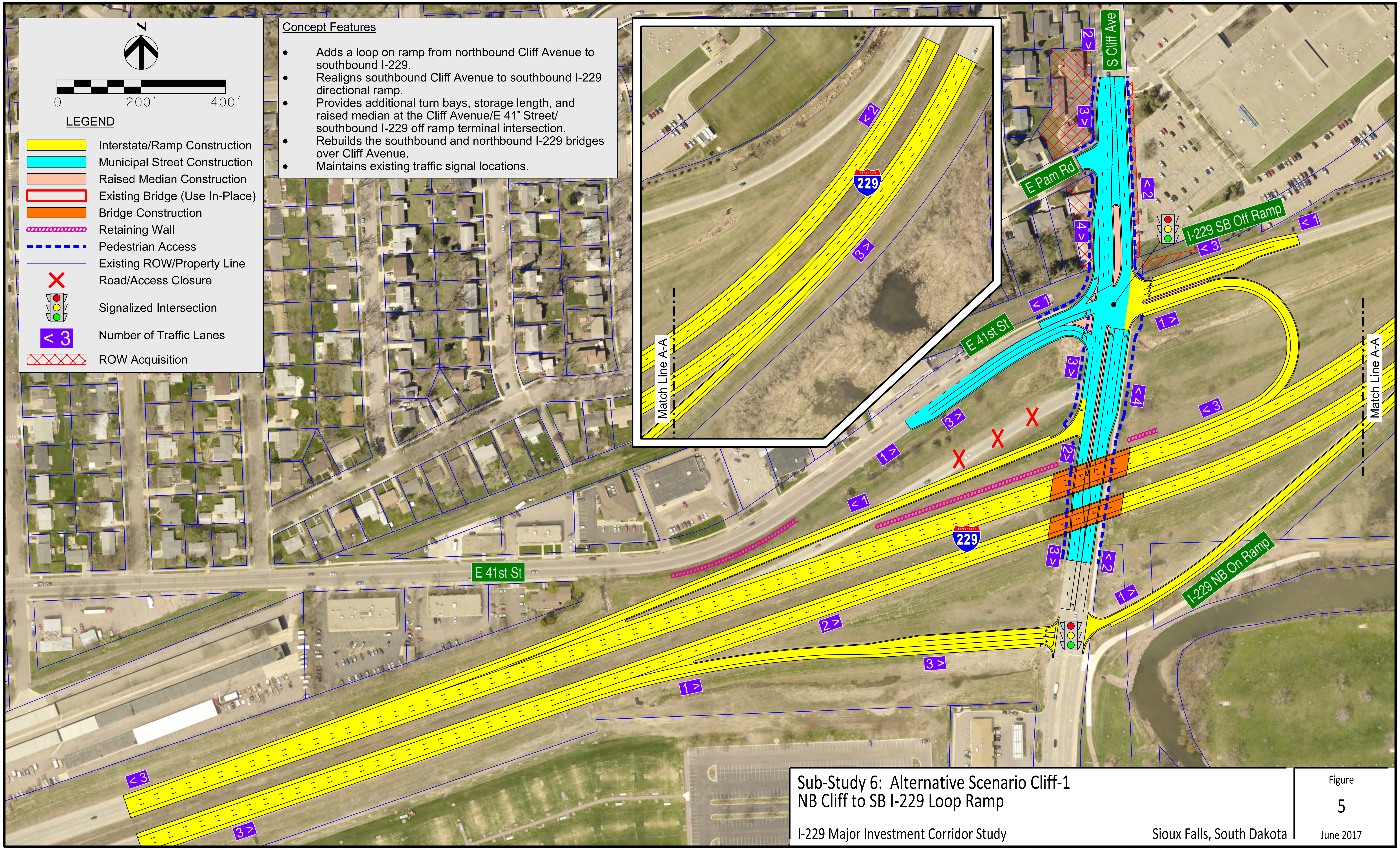
Based on the preliminary concept comparison and public feedback, the concepts were screened through a workshop with the SAT in June 2016 to determine which concepts should be selected as alternative scenarios for further development. The alternative scenarios selected for further development are as follows:

- ***Cliff-1.*** NB Cliff to SB I-229 Loop Ramp
- ***Cliff-6.*** SPUI, 41st Street Realigned
- ***Cliff-7.*** SPUI, SB I-229 Off-Ramp Thru & Rights at 41st Street

Alternative scenario figures are shown in ***FIGURES 5 THROUGH 7***.

Table 3. Preliminary Concepts Composite Comparative Assessment

Preliminary Concept		Traffic Assessment			Environmental Impacts	Cost	ROW (acre)
		Queues	Delay	Travel Time			
Cliff-1	NB Cliff to SB I-229 Loop Ramp Auxiliary Lane Add	Neutral	**Good**	Neutral	**Low**	$11,219,600	1.1
Cliff-2	NB/SB Cliff to SB I-229 Loop Ramp, Eliminate SB Diagonal Ramp	Neutral	Neutral	Neutral	**Low**	$7,490,000	1.1
Cliff-4	Diamond Interchange - 41st Street Realigned to High School	**Good**	**Very Good**	Neutral	**Low**	$7,850,000	1.8
Cliff-6	SPUI Interchange - 41st Street Realigned to Pam Road	**Good**	**Very Good**	Neutral	**Low**	$24,810,000	3.5
Cliff-7	SPUI Interchange - SB I-229 Off Ramp Thru & Right Turn Lanes at 41st Street Intersection	Neutral	**Good**	Neutral	**Low**	$19,850,000	0.4
Cliff-8	Tight Diamond Interchange - 41st Street Realigned to High School	**Good**	**Very Good**	Neutral	**Low**	$12,690,000	1.9



LEGEND

🟨	Interstate/Ramp Construction
🟦	Municipal Street Construction
🟫	Raised Median Construction
□	Existing Bridge (Use In-Place)
🟧	Bridge Construction
ooooooooooooooo	Retaining Wall
- - - -	Pedestrian Access
—	Existing ROW/Property Line
✕	Road/Access Closure
🚦	Signalized Intersection
< 3	Number of Traffic Lanes
▨	ROW Acquisition

Concept Features

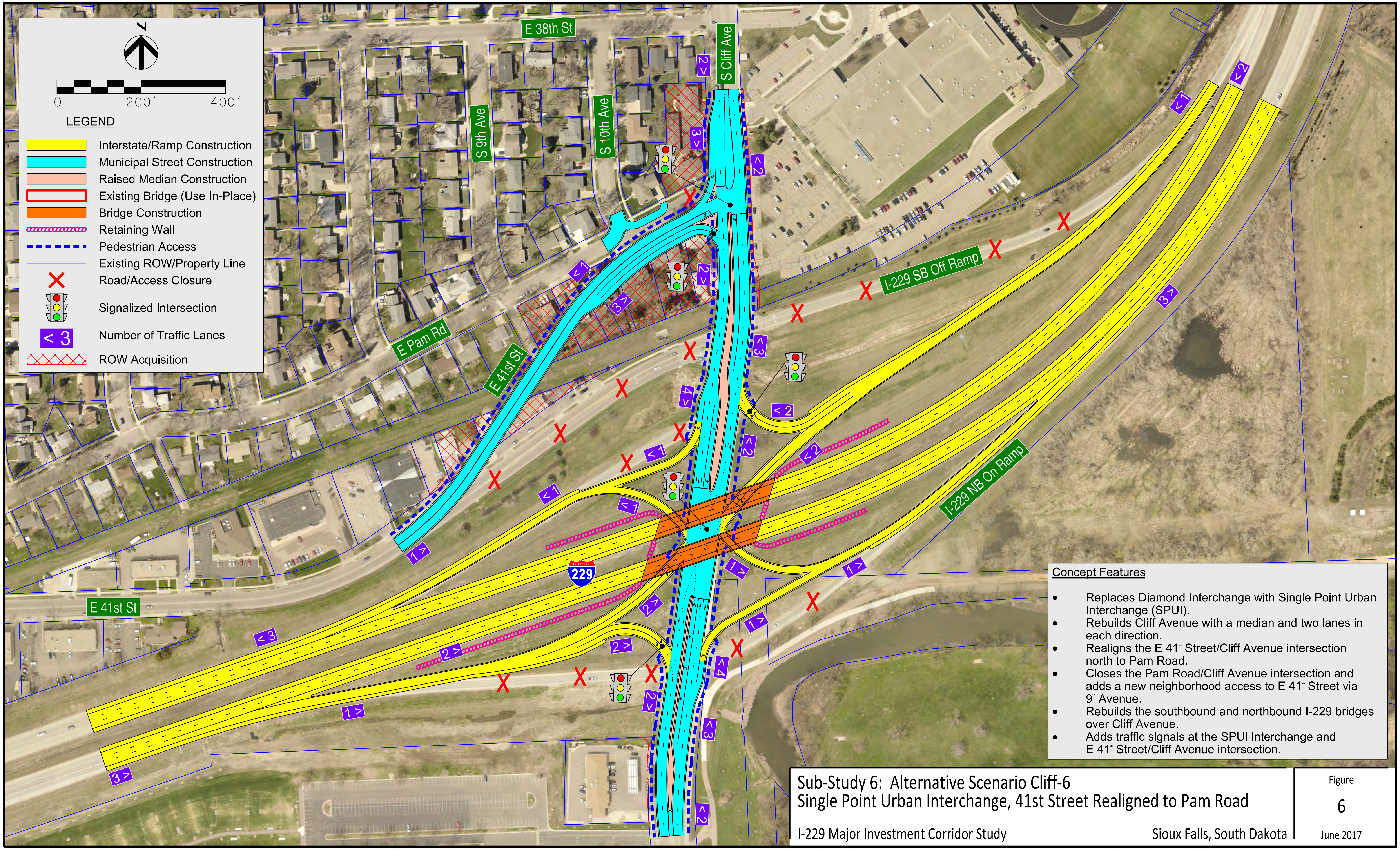
- Adds a loop on ramp from northbound Cliff Avenue to southbound I-229.
- Realigns southbound Cliff Avenue to southbound I-229 directional ramp.
- Provides additional turn bays, storage length, and raised median at the Cliff Avenue/E 41st Street/ southbound I-229 off ramp terminal intersection.
- Rebuilds the southbound and northbound I-229 bridges over Cliff Avenue.
- Maintains existing traffic signal locations.

Sub-Study 6: Alternative Scenario Cliff-1
NB Cliff to SB I-229 Loop Ramp

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure
5
June 2017



LEGEND

- 🟨 Interstate/Ramp Construction
- 🟦 Municipal Street Construction
- 🟧 Raised Median Construction
- ☐ Existing Bridge (Use In-Place)
- 🟧 Bridge Construction
- ∞∞∞∞ Retaining Wall
- - - - Pedestrian Access
- — Existing ROW/Property Line
- ✕ Road/Access Closure
- 🚦 Signalized Intersection
- < 3 Number of Traffic Lanes
- ▨ ROW Acquisition

Concept Features

- Replaces Diamond Interchange with Single Point Urban Interchange (SPUI).
- Rebuilds Cliff Avenue with a median and two lanes in each direction.
- Realigns the E 41st Street/Cliff Avenue intersection north to Pam Road.
- Closes the Pam Road/Cliff Avenue intersection and adds a new neighborhood access to E 41st Street via 9th Avenue.
- Rebuilds the southbound and northbound I-229 bridges over Cliff Avenue.
- Adds traffic signals at the SPUI interchange and E 41st Street/Cliff Avenue intersection.

Sub-Study 6: Alternative Scenario Cliff-6
Single Point Urban Interchange, 41st Street Realigned to Pam Road

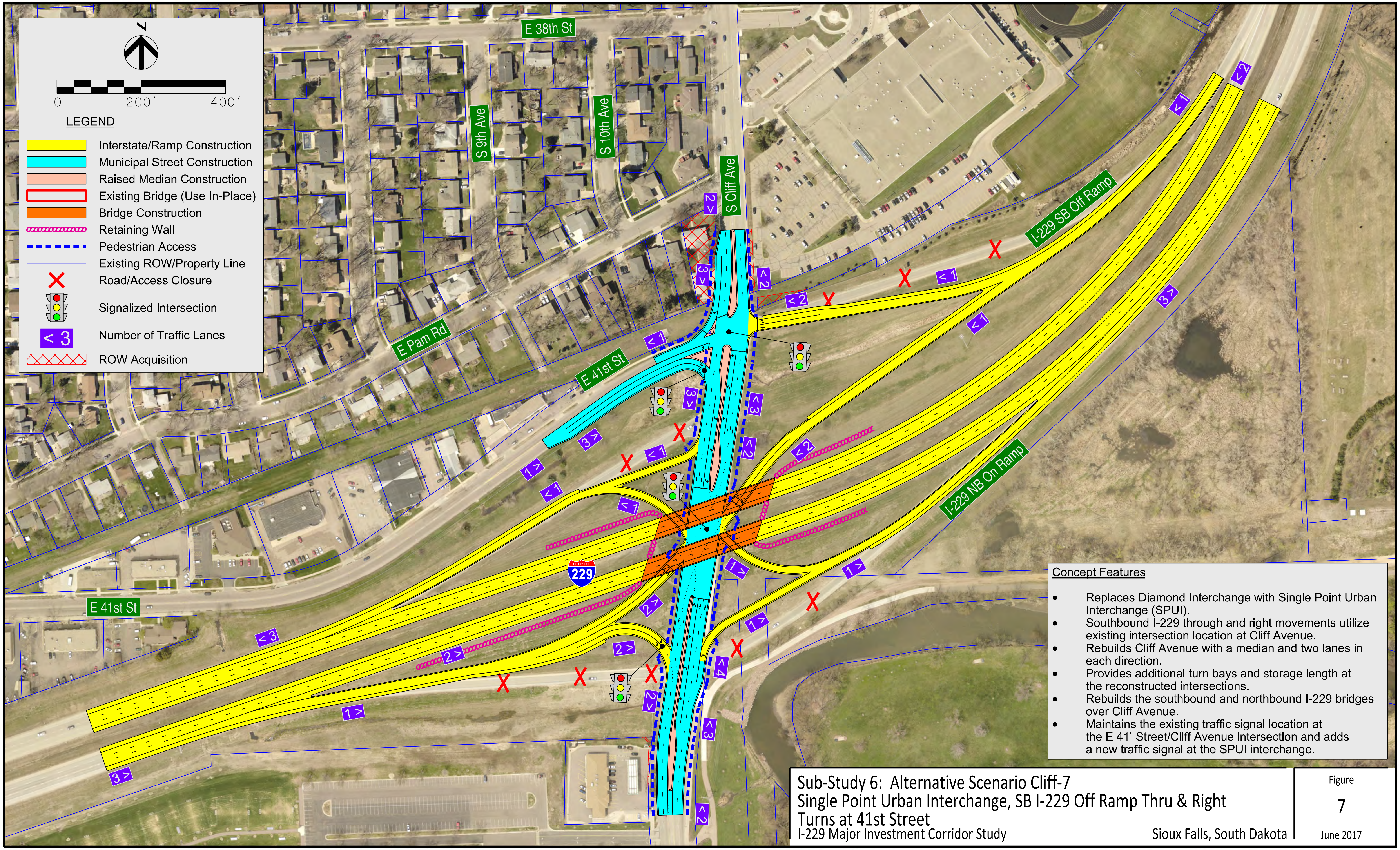
I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure

6

June 2017



LEGEND

- 🟨 Interstate/Ramp Construction
- 🟦 Municipal Street Construction
- ▭ Raised Median Construction
- ☐ Existing Bridge (Use In-Place)
- 🟧 Bridge Construction
- oooooooo Retaining Wall
- - - - Pedestrian Access
- — Existing ROW/Property Line
- ✕ Road/Access Closure
- 🚦 Signalized Intersection
- < 3 Number of Traffic Lanes
- ▨ ROW Acquisition

Concept Features

- Replaces Diamond Interchange with Single Point Urban Interchange (SPUI).
- Southbound I-229 through and right movements utilize existing intersection location at Cliff Avenue.
- Rebuilds Cliff Avenue with a median and two lanes in each direction.
- Provides additional turn lanes and storage length at the reconstructed intersections.
- Rebuilds the southbound and northbound I-229 bridges over Cliff Avenue.
- Maintains the existing traffic signal location at the E 41st Street/Cliff Avenue intersection and adds a new traffic signal at the SPUI interchange.

Sub-Study 6: Alternative Scenario Cliff-7
Single Point Urban Interchange, SB I-229 Off Ramp Thru & Right Turns at 41st Street

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure

7

June 2017

Section 3.3 - Analysis of Alternative Scenarios

The alternative scenarios were evaluated through a screening process in order to identify alternatives recommended to be considered in future studies. Each of the alternative scenarios were evaluated using additional evaluation criteria including:

- Predictive Crash
- Traffic Operations
- Year of Failure
- Noise
- Constructability

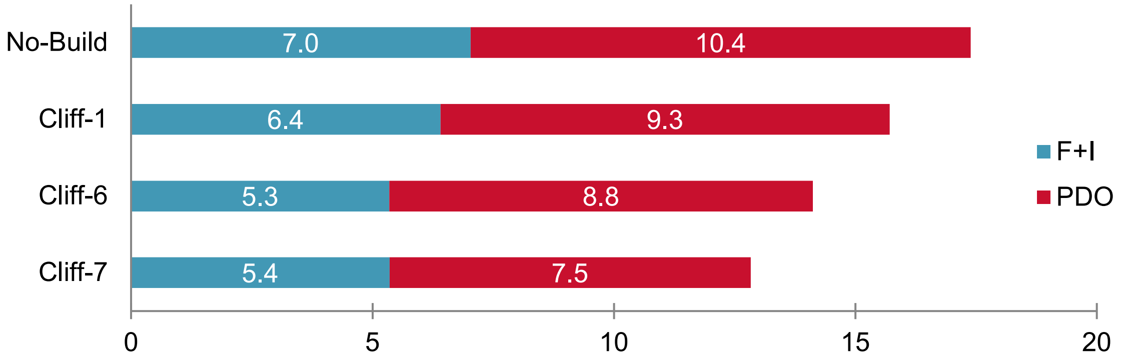
PREDICTIVE CRASH ANALYSIS

Predictive crash analysis was conducted for freeway ramps and the ramp terminal intersections. The predictive safety analysis was based on principles and methods of the ***Highway Safety Manual (HSM)***.

A comparative analysis of the predicted crashes anticipated between the Existing (Year 2012) condition and the Future No-Build (Year 2035) condition, as well as a comparative analysis between No-Build and Build alternatives for each sub-study was developed.

The predicted annual crash frequencies for the No-Build and Build alternatives (2012 to 2035) are presented in ***TABLE 4*** along with the breakdown of Fatal + Injury (F+I) and Property Damage Only (PDO) crashes.

Table 4. Cliff Avenue Corridor 2012-2035 Predicted Build and No-Build Annual Crashes



Planning horizon crash cost savings were calculated for the Build alternatives and are shown in ***TABLE 5***.

Table 5. Cliff Avenue Corridor Planning Horizon Crash Cost Savings

ALTERNATIVE	TOTAL USER COST[1]	USER COST SAVINGS[2]
No-Build	**$ 42,900,000**	**$ -**
Cliff-1	**$ 39,100,000**	**$ 3,800,000**
Cliff-6	**$ 32,900,000**	**$ 10,000,000**
Cliff-7	**$ 32,600,000**	**$ 10,300,000**

[1] Total User Cost – The discounted, monetized safety cost from the crashes totaled for all years in the period 2012-2035 (rounded to $100,000).

[2] User Cost Savings - The discounted, monetized safety benefit from the crashes reduced by a scenario (compared to a baseline of No-Build) totaled for all years in the period 2012-2035 (rounded to $100,000).

Additional detail from the Predictive Crash Analysis can be found in ***APPENDIX E. PREDICTIVE SAFETY ANALYSIS***.

TRAFFIC OPERATIONS ANALYSIS

Traffic operations were analyzed for each alternative scenario using HCS 2010. A detailed report of the alternative scenario operations can be found in ***APPENDIX C. 2035 NO-BUILD AND BUILD OPERATIONAL ANALYSIS TECHNICAL MEMORANDUM***.

For all alternative scenarios, the ramp terminals operate at an acceptable LOS of C or better and the signalized arterial intersections operate at an acceptable threshold of LOS of D or better.

YEAR OF FAILURE ANALYSIS

A year of failure analysis was conducted for the alternative scenarios' interchanges in order to identify the year beyond the Future / Design year (2035) when traffic operations fail to meet acceptable criteria. Projected traffic volumes beyond year 2035 were developed using straight line extrapolation between year 2012 adjusted peak hour volumes and year 2035 adjusted peak hour volumes. Potential years of failure were evaluated in 5-year increments up to the identified year of failure.

The resulting year of failure for the No-Build and Build alternatives is shown in ***TABLE 6***.

Table 6. Cliff Avenue Corridor Year of Failure

ALTERNATIVE	YEAR OF FAILURE
No-Build	Already Failing
Cliff-1	2050
Cliff-6	2055
Cliff-7	2045

Additional detail from the Year of Failure Analysis can be found in ***APPENDIX F. YEAR OF FAILURE ANALYSIS***.

NOISE ANALYSIS

A traffic noise analysis was conducted along the Cliff Avenue corridor's area of influence for the three alternative scenarios. The analysis included traffic noise monitoring and modeling. HDR used the ***FHWA Traffic Noise Model (TNM), Version 2.5***, to evaluate projected traffic noise levels under both existing conditions and "Build" alternatives. Basic model inputs are:

- Existing and Preliminary project concept and geometry
- 2012 and 2035 traffic volumes in the study area
- The operational speed for I-229: 65 miles per hour (mph); arterial streets: 30-45 mph

Traffic noise impacts were identified in accordance with SDDOT Noise Analysis and Abatement Guidance (July 13, 2011), which is intended to supplement FHWA traffic noise and abatement regulations and guidance. The Guidance provides procedures for noise studies and noise abatement measures to help protect the public health and welfare, to supply noise abatement criteria, and to establish requirements for traffic noise information to be given to those officials who have planning and zoning authority.

Noise abatement measures are considered when predicted traffic noise levels approach or exceed the Noise Abatement Criteria (NAC), or when the predicted traffic noise levels substantially exceed existing noise levels.

TABLE 7 shows the number of traffic noise impacts predicted under each alternative.

Table 7. Noise Impact Summary

ALTERNATIVE	APPROACH/ EXCEED NAC	SUBSTANTIALLY EXCEED	TOTAL RECEPTORS AFFECTED
Existing	1	0	1
Cliff-1	11	0	11
Cliff-6	19	0	19
Cliff-7	8	0	8

Potential noise abatement measures could be considered for all alternative scenarios. Further investigation into the feasibility and reasonability (noise reduction goal, cost-effectiveness, viewpoints of benefited receptors) would need to occur once a preferred alternative is selected.

A detailed technical memorandum describing the noise analysis can be found in *APPENDIX G. SUB-STUDY 3 NOISE STUDY TECHNICAL REPORT*. This memo includes a discussion of the conceptual feasibility of noise mitigation options in areas where future noise levels exceed state and federal criteria.

CONSTRUCTABILITY

A constructability analysis was conducted for the alternative scenarios in order to assess potential construction phasing, maintenance of traffic and general timeframe.

TABLE 8 shows construction analysis results predicted for each alternative.

Table 8. Constructability Analysis

ALTERNATIVE	MAINTENANCE OF TRAFFIC COMPLEXITY	ALLOWS FOR PHASED CONSTRUCTION	ESTIMATED CONSTRUCTION TIME FRAME (MONTHS)
Cliff-1	Low	Yes	8
Cliff-6	High	Yes	12
Cliff-7	Medium	Yes	12

It is anticipated that all of the alternative scenarios will allow for phased construction. Further construction analysis would need to occur during future studies and continue through the design process.

Section 3.4 - Recommendation of Alternatives for Future Consideration

The analysis of alternative scenarios along with other evaluation criteria were used to develop an evaluation matrix to compare the alternative scenarios. The alternative scenarios were compared using the following criteria categories:

- Driver/Public Perception
- Construction Impacts
- Traffic Operations & Safety
- Property Impacts
- Environmental
- Pedestrians
- Cost

The alternative scenarios evaluation matrix was reviewed with the SAT during a workshop in September 2016 to determine which alternative scenarios should be recommended to advance for future studies.

The evaluation matrix for the alternative scenarios is summarized in ***TABLE 9***.

Based on the evaluation, all three (3) alternative scenarios are recommended to advance for future studies along with No-Build. The alternative scenarios are as follows:

- ***Cliff-1.*** NB Cliff to SB I-229 Loop Ramp
- ***Cliff-6.*** SPUI, 41st Street Realigned
- ***Cliff-7.*** SPUI, SB I-229 Off-Ramp Thru & Rights at 41st Street

Table 9. Alternative Scenarios Evaluation Matrix
I-229/Cliff Interchange/Corridor Construction

Sub-Study 6

Option	Description	Driver/ Public Perception	Construction Impacts		Traffic Operations & Safety											Property Impacts				Environmental	Pedestrians	Cost	Recommendation
		Driver familiarity/ expectancy	Maintenance of Traffic Complexity During Construction	Allows for phased construction	2035 Total interchange delay (Average AM/PM Peak)	Year of Failure[1]	2035 Traffic operations at northbound ramp terminal intersection		2035 Traffic operations at southbound ramp terminal intersection		2035 Traffic operations at Cliff Ave. / 49th St.		2035 Traffic operations at Cliff Ave. / 33rd St.		Planning Horizon Crash Cost Savings[1,2]	Number of closed access points	Total residential acqusitions	Total business acquisitions	Total ROW Required (Acres)	Environmental Impacts	Pedestrian accomodations on both sides	Total cost (including ROW)	
					Sec/Veh	*Year*	*LOS AM / PM*	*Intersection Delay AM / PM (sec)*	*LOS AM / PM*	*Intersection Delay AM / PM (sec)*	*LOS AM / PM*	*Intersection Delay AM / PM (sec)*	*LOS AM / PM*	*Intersection Delay AM / PM (sec)*	*M $*							*M $*	
No-Build		Good	N/A	N/A	48.2	< 2035	D / B	38.1 / 15.9	B / C	19.7 / 27.4	E / B	62.2 / 12.2	B / C	17.7 / 21.9	-	N/A	N/A	N/A	N/A	Low	Yes	N/A	
Cliff-1	NB Cliff to SB I-229 Loop Ramp	Good	Low	Yes	39.5	2050	B / B	16.8 / 18.2	C / C	26.9 / 30.8	C / B	30.4 / 11.6	C / C	26.2 / 21.7	$3.8	0	2	0	1.1	Low	Yes	$11.6	**Advance**
Cliff-6	SPUI + 41st Realigned North	Fair	High	Yes	27.4	2055	C / C	28.5 / 26.4	N/A	N/A	C / B	32.1 / 10.6	B / C	18.7 / 21.3	$10.1	1	9	3	3.4	Low	Yes	$25.0	**Advance**
Cliff-7	SPUI + SB I-229 Off Ramp Thru & Right Turn Lanes at 41st St	Poor	Medium	Yes	38.8	2045	C / C	21.8 / 26.1	C / C	20.3 / 26.1	C / A	32.1 / 8.4	B / C	17.5 / 21.6	$10.4	0	1	0	0.4	Low	Yes	$20.3	**Advance**

[1] Year of Failure and Predictive Safety analysis include ramp terminal intersections and in general do not include non-ramp terminal intersections.

[2] Planning Horizon Cost Savings - The discounted, monetized safety benefit from the crashes reduced by a scenario (compared to a baseline of No-Build) totaled for all years in the period 2012-2035.

CHAPTER 4 - SUMMARY AND NEXT STEPS

The I-229 Exit 4 (Cliff Avenue) Crossroad Corridor Study:

- Identified existing and future traffic and safety issues and needs on the Study Area roadways.
- Developed reasonable improvement concept options and alternative scenarios to address the traffic and safety needs.
- Evaluated the benefits and drawbacks of each of the concept options and alternative scenarios.
- Identified alternative scenarios for further consideration in future studies. The alternative scenarios are as follows:
    - ***Cliff-1.*** NB Cliff to SB I-229 Loop Ramp
    - ***Cliff-6.*** SPUI, 41st Street Realigned
    - ***Cliff-7.*** SPUI, SB I-229 Off-Ramp Thru & Rights at 41st Street

These are the anticipated next steps for the projects associated with the I-229 Exit 4 (Cliff Avenue) Crossroad Corridor Study:

- Refine the implementation timeframe and funding responsibility. The I-229 Exit 4 (Cliff Avenue) Corridor was identified as a medium priority in the overall I-229 MIS.
- Add projects, as necessary, to the MPO fiscally constrained Long Range Transportation Plan.
- Fund individual projects in the State 8-year Improvement Program or City 5-year Improvement Program.
- Prepare an Interchange Modification Report for the I-229/Cliff Avenue interchange.
- Prepare an environmental document for each project in accordance with National Environmental Policy Act and other applicable federal and state regulations. This step includes further design refinement and in-depth analysis of each option. The No-Build option will be considered as well as all of the options identified in this Corridor Study.
- Select a preferred option for each project.
- Acquire right-of-way (where necessary).
- Complete final design plans.
- Construct project.

APPENDICES

APPENDIX A. METHODS AND ASSUMPTIONS FOR SUB-STUDY 6

APPENDIX B1. TRAFFIC CAPACITY ANALYSIS METHODOLOGIES

APPENDIX B2. EXISTING HCS 2010 REPORTS

APPENDIX C. 2035 NO-BUILD AND BUILD OPERATIONAL ANALYSIS TECHNICAL MEMORANDUM

APPENDIX D1. PRELIMINARY CONCEPT FIGURES

APPENDIX D2. PRELIMINARY CONCEPTS TECH MEMO

APPENDIX D3. ENVIRONMENTAL CONSTRAINTS MAPS

APPENDIX E. PREDICTIVE SAFETY ANALYSIS

APPENDIX F. YEAR OF FAILURE ANALYSIS

APPENDIX G. SUB-STUDY 6 NOISE STUDY TECHNICAL REPORT

APPENDIX H. PUBLIC INVOLVEMENT

APPENDIX I. EXISTING ACCESS CONTROL FIGURES

APPENDIX A -

METHODS AND ASSUMPTIONS DOCUMENT

- ORIGINAL M&A
- APPENDICES
  - MEETING MINUTES
  - HIGHWAY CAPACITY SOFTWARE ANALYSIS PROCEDURES FOR A DIVERGING DIAMOND INTERCHANGE (DDI)
  - CRASH PREDICTION ANALYSIS PROCEDURES FOR DIVERGING DIAMOND INTERCHANGE (DDI), SINGLE-POINT URBAN INTERCHANGE (SPUI), AND TWO-LANE LOOP RAMP

Methods & Assumptions Meeting Documentation

1. Methods and Assumptions Cover Page

I-229 Major Investment Corridor Study: Sub-Study #6- Cliff Avenue - Original

To:	Study Advisory Team (SDDOT, FHWA, City of Sioux Falls)		
From:	Dave Meier, HDR Brian Ray, HDR Courtney Sokol, HDR Jon Markt, HDR	Project:	I-229 Major Investment Corridor Study
CC:	File		
Date:	March 15, 2016	Job No:	207030

Methods and Assumptions Document

This Methods and Assumptions document was developed as a summation of the Methods and Assumptions Meeting held on March 7, 2016, with representatives from the South Dakota Department of Transportation (SDDOT), Federal Highway Administration (FHWA), City of Sioux Falls, Sioux Falls MPO, and HDR. This document is intended to serve as a historical record of the process, dates, and decisions made by the study team representatives for the ***I-229 Major Investment Corridor Study: Sub-Study #6- Cliff Avenue***.

2. Stakeholder Acceptance Page

The undersigned parties concur with the Methods and Assumptions for the **I-229 Major Investment Corridor Study: Sub-Study #6** as presented in this document.

SDDOT:	FHWA:
Signature	Signature
Title	Title
Date	Date

Notes:

(1) Participation on the Study Advisory Team and/or signing of this document does not constitute approval of the ***I-229 Major Investment Corridor Study: Sub-Study #6*** Final Report or conclusions.

(2) All members of the Study Advisory Team will accept this document as a guide and reference as the study progresses through the various stages of development. If there are any agreed upon changes to the assumptions in this document a revision will be created, endorsed and signed by all the signatories.

3. Introduction and Project Description

Project Background and Understanding

Sub-Study 6 will analyze existing and future conditions at the I-229 interchange at Exit 4 (Cliff Avenue) and along Cliff Avenue from 33rd Street to 49th Street. The study will conduct an interchange options study for the I-229 Exit 4 interchange.

Location

The I-229 Exit 4 interchange and adjacent Cliff Avenue corridor is located in the eastern portion of the Sioux Falls metropolitan area, approximately 7 miles south of the I-229/I-90 systems interchange. The mainline interstate study limits include Exit 3 (Minnesota Avenue) through Exit 5 (26th Street). The Cliff Avenue study limits include 33rd Street to 49th Street.

An illustration of the Sub-Study 6 study area is shown in Section 4 (Study Area) of this report.

Need for Study

The study team has determined the following needs for this specific study:

- Congestion at the Cliff Avenue / I-229 interchange.
- Pedestrian / Multimodal safety in the vicinity of Lincoln High School and the Sioux Falls trail system.
- Geographic constraints on corridor performance, including the Big Sioux River, Tuthill Park, and Spencer Park.

Study Schedule

Date	Task/Event
February 2016	Notice to Proceed
March- April 2016	Methods & Assumptions Documentation Preliminary Concepts Identification
May 2016	Conceptual Design of Reconfiguration Options for the I-229 Exit 4 Interchange Conceptual Design of Cliff Avenue Corridor Improvements
June 2016 – November 2016	**Stakeholder Meetings (July 2016)** **Public Meeting #2 (Cliff/ Rice Preliminary Concepts) July 2016)** **MPO Meeting (Scenario Building Presentation)** Determination of Interchange and Corridor Build Scenarios Traffic and Operations Analysis of Build Scenarios Predictive Crash Analysis of Build Scenarios Noise Analysis of Build Scenarios Constructability Analysis of Build Scenarios Recommendations
December 2016- February 2017	Sub-Study 6 Report Documentation **Public Meeting #3 (Draft Report Stage)** **MPO Meeting (Final Recommendations Presentation)**

Facilities Affected by the Study

Modifications to the I-229 Exit 4 (Cliff Avenue) interchange and adjacent Cliff Avenue corridor would have the potential to affect:

- The intersections on Cliff Avenue near I-229.
- The adjacent parallel corridor providing access to I-229 at Exit 3 (Minnesota Avenue).
- The adjacent parallel corridor providing access to I-229 at Exit 5 (26th Street).
- The adjacent perpendicular corridors of 41st and 49th Streets.

Previous Studies

The following previous studies will be reviewed during the course of this study:

- Direction 2035, Sioux Falls MPO Long-Range Transportation Plan (LRTP)
  - http://www.siouxfalls.org/~/media/Documents/planning/long-range/lrtp/2035_lrtp/adopted_lrtp_rev120210.pdf
- Sioux Falls Comprehensive Development Plan
  - http://www.siouxfalls.org/~/media/Documents/planning/shape_sf/chapters-maps/Chapter_1_r112111.pdf
- Sioux Falls Transit Development Plan 2011- 2015
  - http://www.siouxfalls.org/~/media/Documents/planning/long-range/2011_2015_Transit_Development_Plan.pdf
- 2007 Sioux Falls Bicycle Plan
  - http://www.siouxfalls.org/~/media/Documents/planning/transportation/bicycle/Bicycle_Plan_Final.pdf
- The Sioux Falls MPO Multi-Use Trail Study
- https://www.railstotrails.org/resourcehandler.ashx?id=4551
- Sioux Falls Major Street and Access Management Plan
  - http://www.siouxfalls.org/~/media/Documents/planning/transportation/long-range/majorstreetplanmediumfinal%20pdf.pdf
- 2010 Decennial Interstate Corridor Study and 2000 Decennial Interstate Study
- ITS Studies from City of Sioux Falls and SDDOT

Study Advisory Team Members
A Study Advisory Team has been formed to guide the study through completion. The Study Advisory Team is comprised of representative parties of the SDDOT, FHWA and City of Sioux Falls. Members of the Study Advisory Team are:

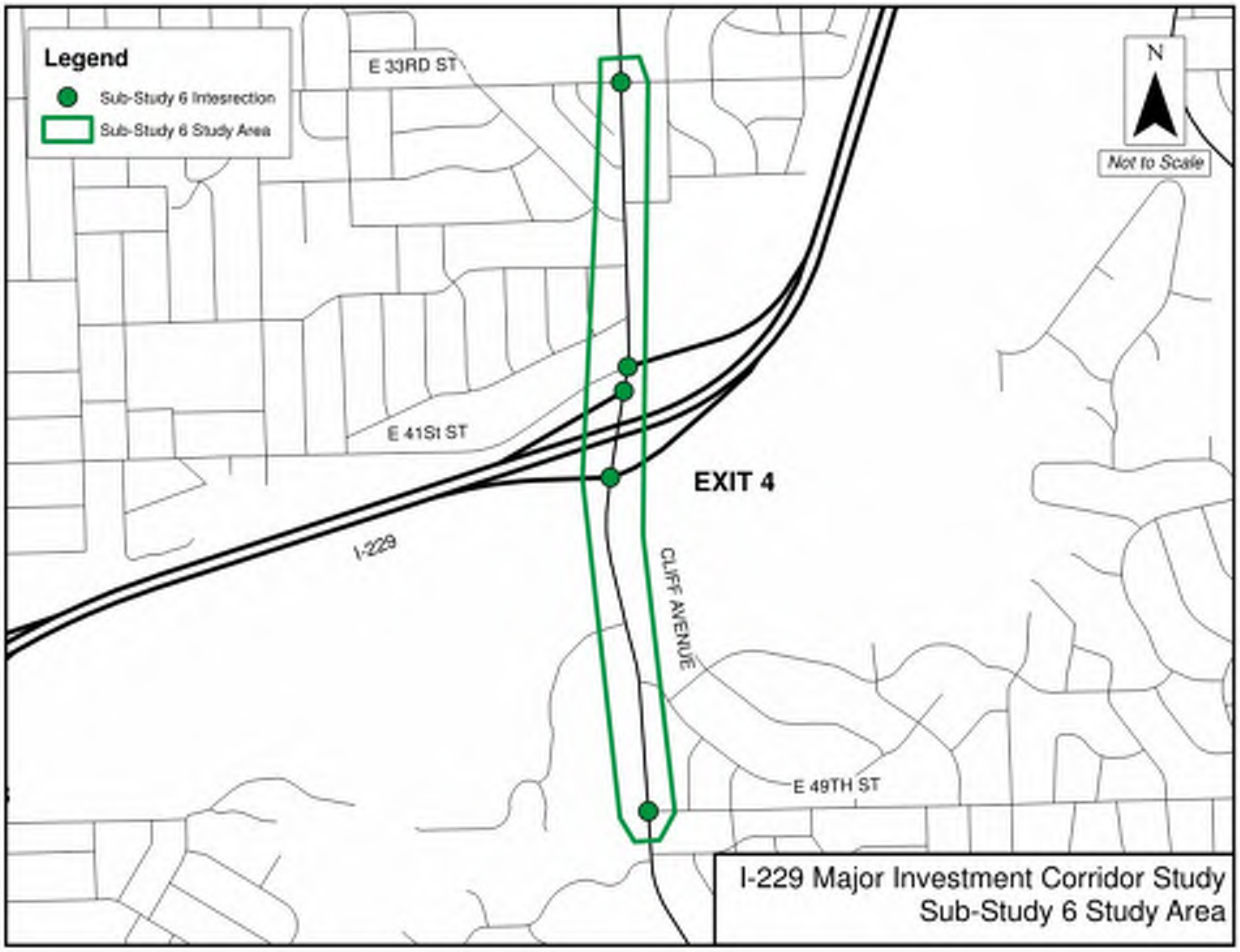
Shannon Ausen	City of Sioux Falls – Public Works
Mike Behm	SDDOT – Planning & Engineering
Christina Bennett	SDDOT – Operations Support
Jeff Brosz	SDDOT – Transportation Inventory Management
Andy Vandel	SDDOT – Project Development (Safety)
Joel Gengler	SDDOT – Right of Way
Amber Gibson	Sioux Falls MPO
Kevin Goeden	SDDOT – Bridge Design
Steve Gramm	SDDOT – Project Development (Planning)
Heath Hoftiezer	City of Sioux Falls – Public Works
Mark Hoines	FHWA
Dave Huft	SDDOT – Research
Bruce Hunt	FHWA
Scott Jansen	SDDOT – Mitchell Region
Lt. Jeff DeVaney	South Dakota Highway Patrol
Ryan Kerkvliet	Sioux Falls MPO – Citizens Advisory Committee
Tom Lehmkuhl	SDDOT – Administration/Environmental
Pete Longman	SDDOT – Road Design
Ron McMahon	FHWA
Paul Nikolas	SDDOT – Road Design
Brad Remmich	SDDOT – Project Development (Planning)
Craig Smith	SDDOT – Mitchell Region

Additional team members may be added as the study progresses.

4. Study Area

The study area for Sub-Study 6 was defined by the Study Advisory Team and is illustrated in this report for documentation. The study area contains Cliff Avenue from 33rd to 49th Street. Freeway operations will be conducted during Sub-Study 1 and will also be reported in Sub-Study 6 for freeway locations from Exit 3 (Minnesota Avenue) to Exit 5 (26th Street). The following graphic shows the study area and identifies each of the study intersections.

Sub-Study 6 Study Area



Cliff Avenue (Exit 4) Intersections:

- Cliff Avenue & 33rd Street
- Cliff Avenue & I-229 Southbound off-Ramp/ 41st Street
- Cliff Avenue & I-229 Southbound on-Ramp
- Cliff Avenue & I-229 Northbound Ramps
- Cliff Avenue & 49th Street

Study Basic Freeway Areas (*See also Note 1 below for designated analysis areas as potential Freeway Weave Areas for segments including auxiliary lanes*):

- I-229 Northbound between Minnesota Avenue (Exit 3) and Cliff Avenue (Exit 4) [1]
- I-229 Northbound between Cliff Avenue (Exit 4) and 26th Street (Exit 5) [1]
- I-229 Southbound between 26th Street (Exit 5) and Cliff Avenue (Exit 4) [1]
- I-229 Southbound between Cliff Avenue (Exit 4) and Minnesota Avenue (Exit 3) [1]

[1] *Segment will be evaluated using Highway Capacity Manual (HCM) 2010 procedures to determine if the segment meets the criteria for a weave*

segment. If the segment meets the weave segment criteria the segment will be analyzed as a Freeway Weave Area and not a Basic Freeway Area

Study Mainline Freeway Areas (Crash Prediction)

- I-229 Northbound & Southbound
    - Between mile marker 3 and mile marker 4.5

Study Service Interchange Areas (Crash Prediction)

- Cliff Avenue (Exit 4)

Study Intersections (Crash Prediction)

- Cliff Avenue & I-229 Southbound off-Ramp/ 41st Street
- Cliff Avenue & I-229 Southbound on-Ramp
- Cliff Avenue & I-229 Northbound Ramps / Cleveland Avenue

5. Analysis Years/Periods

This study will evaluate traffic during and for the following time periods:

Existing Conditions – Existing conditions analyses will be conducted for year 2012 volume conditions. Turning movement counts were collected at several study area intersections in 2012. Intersections that do not already have recent count data from 2012 will be counted by the City of Sioux Falls as part of this study as described in Section 6. For existing conditions the following time periods will be evaluated:

- Existing Conditions (Year 2012) – AM Peak Hour
- Existing Conditions (Year 2012) – PM Peak Hour

Future/ Design Conditions – Future/ Design conditions analyses will be conducted for year 2035 conditions. This horizon year matches the planning horizon of the current Sioux Falls LRTP. The Travel Demand Model was calibrated and updated in year 2009 for a base year 2008 and planning horizon of year 2035. Projected traffic volumes from the Sioux Falls MPO Travel Demand Model will be utilized to establish year 2035 volumes. For the design conditions the following time periods will be evaluated:

- Future/Design Conditions (Year 2035) – AM Peak Hour
- Future/Design Conditions (Year 2035) – PM Peak Hour

Interim Conditions – No interim conditions will be evaluated as part of this study.

Year of Failure Conditions Analysis

Year of failure analysis will be conducted (for denoted study area intersections) to identify the year beyond the Future / Design year (2035) when traffic operations fail to meet acceptable criteria. Projected traffic volumes beyond year 2035 will be developed using straight line extrapolation between year 2012 adjusted peak hour volumes and year 2035 adjusted peak hour volumes. Potential years of failure will be evaluated in 5-year increments up to the identified year of failure. Should traffic operations still meet acceptable criteria 30 years beyond the Future / Design year (2065), the year of failure will be identified as beyond 2065, but no additional traffic analysis will be conducted for years beyond 2065.

- Year of Failure Conditions (Year determined by analysis) – AM Peak Hour
- Year of Failure Conditions (Year determined by analysis) – PM Peak Hour

Volume data will be smoothed/balanced for the Existing and Future/Design Conditions using the Cube Voyager macroscopic model, with adjustments to raw model output based on post-processing techniques.

6. Data Collection

Data Collection is one of the most important items during any transportation planning study. The data collection efforts are documented below:

Existing Arterial Intersection Turning Movement Count Data
Turning movement counts define actual traffic at the study intersections during the course of a typical weekday. The most recent turning movement counts available by the City of Sioux Falls at Cliff Avenue study intersections were mostly conducted in year 2012. The City of Sioux Falls also collected traffic data for the linked movement at 41st St/Cliff Avenue in February 2015.

Existing Freeway Data
Automated Traffic Recorded (ATR) data was provided for SDDOT Station #610, which is located between Exit 2 (Western Avenue) and Exit 3 (Minnesota Avenue). The ATR included hourly directional mainline I-229 freeway volumes from Sept 2012 to February 2013. In addition, ATR at Station #610 was provided in 15-minute increments from March 6 to April 21, 2013.

SDDOT supplied hourly ramp volume data from year 2012. Study intersection turning movement counts will be used to determine existing AM and PM peak hour ramp volumes and then smoothed/balanced along the I-229 corridor.

Additional Data Supplied by SDDOT and/or City of Sioux Falls

- Vehicle Classification Samples on I-229 Interstate
  - Supplied by SDDOT
- Crash History Geodatabase
  - Supplied by SDDOT
  - Includes crash records dated January 2008 to December 2012 (5 years)
- Roadway Design Standards
  - available online at: http://www.sddot.com/business/design/forms/roaddesign/Default.aspx
- Construction Plans for I-229
  - Supplied by SDDOT
- GIS Base Mapping Data (parcels, parks, streets, rail, plats)
  - Supplied by City of Sioux Falls
- 2012 Aerial SID files
  - Supplied by City of Sioux Falls
- MPO Travel Demand Model Files in Cube Voyager (Existing and Future)

    - Supplied by City of Sioux Falls
- Average daily traffic counts
    - Supplied by City of Sioux Falls

Data Collection Techniques
All data was collected and will be collected using standard field practices which consist of using cameras, digital count boards or tube counters.

7. Traffic Operations Analysis

Traffic Operations Analysis (Existing and Future No-Build)

1. Software
    a. Signalized Intersections
        i. Highway Capacity Software (HCS) Release 6.7 (2010 HCM Methodology) Streets Module
            1. Ramp terminal intersections meeting the interchange types defined in HCM Chapter 22 (Interchange Ramp Terminals) will be analyzed with the Interchanges section of the Streets Module.
            2. Analysis of a Diverging Diamond Interchange will follow the methodology outlined in the ‘Highway Capacity Software Analysis Procedures for a Diverging Diamond Interchange (DDI)’ memorandum, found in the Appendix.
    b. Basic Freeway, Ramp Junctions and Weave Areas
        i. HCS Release 6.7 (2010 HCM Methodology)
2. Operational Analysis Results
    a. Level of Service (LOS)
        i. Signalized Ramp Terminal Intersections (SDDOT’s System)
            1. Intersections where geometry is modified because of project improvements
                a. Minimum allowable LOS – LOS ‘C’
                    i. Individual movements will be allowed to operate at LOS ‘D’ but the overall intersection LOS shall be ‘C’ or better
            2. Other intersections (intersections within the study area that are not modified by project improvements)
                a. Minimum allowable LOS – LOS ‘D’
                    i. Individual movements will be allowed to operate at LOS ‘E’ but the overall intersection LOS shall be ‘D’ or better
        ii. Signalized Non-Ramp Terminal Intersections (City of Sioux Fall’s System)
            1. Minimum allowable LOS – LOS ‘D’
        iii. Basic Freeway, Ramp Junctions and Weave Areas
            1. Minimum allowable LOS – LOS ‘C’
3. Variables
    a. Peak Hour Factor (PHF)
        i. Existing (year 2012) conditions analysis will use calculated PHFs from existing counts with a maximum value of 0.93.

 - ii. Design year (year 2035) conditions analysis will use existing PHFs rounded up to the nearest 0.05 with a maximum value of 0.93.
   1. The increase in the PHF is to account for traffic growth that is likely to be spread throughout the peak periods.

b. Saturation Flow Rate
 - i. SDDOT Design Manual (Page 24, Chapter 15) requires the use of 1,800 vph in Sioux Falls. This value will be used for the signalized intersections and freeway locations within the study area.

c. Traffic Signal Controllers
 - i. Operational analysis will allow for both actuated and coordinated controllers.

d. Left-Turn Phasing
 - i. Protected, Permitted / Protected or Split Phasing will be allowed at intersections.

e. Heaviest Lane Volume (Lane Utilization)
 - i. Default HCS Streets Values used for ramp terminal / arterial intersections.

f. Heavy Vehicle Percentage
 - i. Study Intersections
   1. Use existing turning movement counts that included truck counts to determine arterial truck percentages.
 - ii. Ramp Junctions and Weave Areas
   1. Use existing freeway counts that included truck counts to determine freeway truck percentages.

g. Phase Change Intervals
 - i. Existing (Year 2012) Conditions
   1. Existing signal timings will be used for phase change intervals during existing conditions.
 - ii. Future No-Build (Year 2035) Conditions
   1. Existing signal timings will be used for phase change intervals of phases that exist at intersections that have no geometric change from existing conditions.
   2. Phase change intervals will be calculated for the following locations:
      a. New phases added at an intersection where geometry is unchanged from existing conditions
      b. All phases at an intersection where geometry is changed from existing conditions

      The calculated values will be based on methodologies presented in the *Institution of Transportation Engineers (ITE) Traffic Engineering Handbook*. The methodologies presented in the handbook use vehicle length and speed and the distance needed to track through the intersection to calculate phase change intervals.

h. Speeds
 - i. Arterials – Use posted speeds
 - ii. Freeway – Use 85th percentile of collected spot speed data

i. Right Turn on Red Volume
 - i. Existing (Year 2012) Conditions

        1. The number of vehicles turning right on red will be assumed to be zero for all locations initially based on the guidance in the 2010 Highway Capacity Manual.
        2. Intersections reporting LOS E or worse potentially related to right turn on red volume will be identified and presented to the SAT to decide if a right turn on red count is necessary.
        3. If a right turn on red count is deemed necessary, video recordings of existing peak hour traffic at the locations of interest will be used to count the number of vehicles turning right on red and incorporated into the HCS analysis at these locations.
    - ii. Future No-Build (Year 2035) Conditions
        1. The number of vehicles turning right on red will be assumed to be zero for all locations that were not counted for right turn on red movements.
        2. For locations that were counted for right turn on red movements, the percentage of right turn on red volume of the total volume for the right turn movement in the existing condition will be multiplied by the future forecast right turn movement for each approach and incorporated into the HCS analysis at these locations.
        3. Intersections reporting LOS E or worse potentially related to right turn on red volume will be identified and presented to the SAT to decide if a right turn on red count is necessary.
        4. If a right turn on red count is deemed necessary, video recordings of existing peak hour traffic at the locations of interest will be used to count the number of vehicles turning right on red.
        5. Step 2 will be repeated for all locations where a right turn on red count was added by the SAT based on a projected future operating condition of LOS E or worse.
    - iii. Future Build (Year 2035) Conditions
        1. The number of vehicles turning right on red will be assumed to be zero for all locations that were not counted for right turn on red movements
        2. For locations that were counted for right turn on red movements, the same projected right turn on red volume for Future No-Build (Year 2035) Conditions will be used, assuming the Future Build (Year 2035) Condition geometry remain similar to the Future No-Build (Year 2035) Condition geometry.

8. Travel Forecast

1. The 2035 Sioux Falls MPO Travel Demand Model (Macro/Static Model) will be utilized for the basis of future year no-build volume development. The 2035 model will match the model specifications used in the Sub-Study 1 projections.

9. Safety Issues

Crash data will be reviewed for the study area based on the Crash Geodatabase which includes crashes between January 2008 and December 2012. SDDOT's database will be the only database used in the calculation of crash rates and critical crash rates. The following information will be provided as a result of the crash analysis:

- Segment and Intersection Crash Rates
- Segment and Intersection Critical Crash Rates (per Highway Safety Manual)
- Crash Trends
- Potential Mitigation Measures to Improve Locations Above Critical Crash Rates

Predictive crash analysis will be conducted for freeway segments, freeway ramps, ramp terminal intersections, and some arterial intersections with the limits described in the Sub-Study 1 & Sub-Study 6 Methods and Assumptions documents. Predictive crash analysis will be conducted using the following standard procedures / tools:

- All analysis types
    - For existing conditions:
        - Geometric information will be estimated from aerial photography using tools built in to Google Earth.
        - Average daily traffic counts, described in the data collection section of this document, will be utilized.
    - For build conditions:
        - Geometric information available from design files will be utilized. Geometric information not available at this level of design will be assumed to match existing conditions where practical.
        - Projected future daily volumes, described in the travel forecasting section of this document, will be utilized.
    - Calibration factors or South Dakota-specific Safety Performance Functions will not be used in place of default equations from the Enhanced Interchange Safety Analysis Tool (ISATe).
    - Existing crash data (2008 – 2012) will be used when forecasting expected crash frequency for the Existing and the Future No-Build Conditions using the Empirical Bayes method.
    - Existing crash data will not be used as a factor when predicting crash frequency for Future No-Build and Build Alternative Conditions for comparing these scenarios.
    - Computed crash prediction frequencies will be reported by crash type using default distributions included in the Highway Safety Manual where applicable.
- Freeway segments, freeway ramps, and traditional ramp terminal intersections
    - ISATe Build 06.10 will be used.
- Non-traditional ramps and ramp terminal intersections
    - Analysis will follow the methodology outlined in the ‘Crash Prediction Analysis Procedures for Diverging Diamond Interchange (DDI), Single-Point Urban Interchange (SPUI), and Two-Lane Loop Ramp’ memorandum, found in the Appendix of this document.
- Arterial intersections
    - Methods from Chapter 12 of the Highway Safety Manual will be used.

Predictive crash analysis will forecast crash frequencies for Existing (Year 2012, for comparison to actual crashes), Future No-Build (Year 2035) and Future Build Alternative (Year 2035) conditions.

10. Selection of Measures of Effectiveness (MOE)

The main goals of this study are as follows:

1. Conduct an interchange options study for Exit 4 (Cliff Avenue).
    a. Complete a traffic level of service analysis for both existing and future (2035) conditions along Cliff Avenue from 33rd Street to 49th Street.
    b. Complete a safety analysis of Cliff Avenue from 33rd Street to 49th Street.
    c. Complete a predictive safety analysis of interchange Exit 4 (Cliff Avenue) for both existing and future (2035) conditions.
    d. Determine and recommend improvement options that will improve mobility and safety along the Cliff Avenue corridor, including the I-229 Exit 4 interchange.
2. Create final products for use by the SDDOT and City of Sioux Falls which will guide them in the implementation of recommended improvements that will maximize the efficiency of the system.

To satisfy the study objectives, the following MOEs will be used to evaluate and compare the concepts:

- Cliff Avenue Intersections: **LEVEL OF SERVICE (LOS)** and **INDIVIDUAL MOVEMENT DELAY**
- Cliff Avenue Corridor: **LOS** and **TRAVEL SPEED**
- Ramp Terminal Intersections: **LOS** and **INDIVIDUAL MOVEMENT DELAY**
- Freeway Segments, Ramp Junctions and Weave Areas: **LOS** and **DENSITY**

These statements are made assuming that the geometric improvements identified meet all AASHTO, SDDOT, and City of Sioux Falls guidelines. It is understood that all traffic analysis reporting will be completed using HCM 2010 Methodology.

11. FHWA Interstate Access Modification Policy Points

An Interchange Modification Justification Report (IMJR) will not be developed for the I-229 Exit 4 (Cliff Avenue) interchange as part of this project.

12. Deviations/Justifications

No deviations from standards are currently known. If it is determined during the study that deviations are required, the methods and assumptions document will be amended prior to proceeding.

13. Conclusion

All sections contained in this document will guide the traffic data collection and traffic assessment for this study.

14. Appendices

The appendix includes the following:

- Methods and Assumptions Study Team Meeting Minutes (March 7, 2016)
- Analysis Procedures for Diverging Diamond Interchange (DDI)
- Crash Prediction Analysis Procedures for Diverging Diamond Interchange (DDI), Single-Point Urban Interchange (SPUI), and Two-Lane Loop Ramp

APPENDIX

Meeting Minutes

Project:	I-229 Major Investment Study (MIS)
Subject:	Study Advisory Team (SAT) Meeting # 15
Date:	Monday, March 7, 2016
Location:	Online Meeting

Attendees:

Scott Jansen - SDDOT	Amber Gibson – MPO
Jeff Brosz – SDDOT	Ron McMahon - FHWA
Kevin Goeden – SDDOT	Mark Hoines, FHWA
Pete Longman - SDDOT	Shannon Ausen – City of Sioux Falls
Andy Vandel – SDDOT	Heath Hoftiezzer – City of Sioux Falls
Paul Nikolas – SDDOT	Jason Kjenstad - HDR
Steve Gramm – SDDOT	Jon Markt - HDR
Brad Remmich – SDDOT	Dave Meier - HDR
Travis Dressen – SDDOT	Brian Ray – HDR
Tom Lemkuhl – SDDOT	Courtney Sokol – HDR
Dave Huft – SSDOT	Theo Weseman – HDR
Christina Bennett – SDDOT	Garret Menard – HDR
Joel Gangler – SDDOT	

	Action Items	***Responsibility***
1	Rice 3: Review access to third parcel south of Rice and west of existing Cleveland to ascertain whether a dedicated access to the property is feasible	HDR
2	Rice 3b: Reduce property impacts/takes from realigned Cleveland and implement a right-of-way corridor instead	HDR
3	Rice 3c, Rice 5, Rice 7: Review access options for Archery Outfitter's property or show as full take	HDR
4	Rice 3b, Rice 3c: Investigate sensitivity of 3rd EB lane on Rice Street	HDR
5	All Options: Review feasibility of purchasing the property north of the warehouse/shipping facility property located north of Rice and east of I-229 to connect to N Glenwood Cir for access from the north side of property. Include median break for ¾ access from Rice	HDR
6	Rice 5: Review NB entrance and SB exit ramps to assess if profile grade criteria would encourage lengthening the ramps	HDR
7	Schedule meeting with BNSF for feedback on concepts, particularly existing ditch encroachment and upgraded at-grade crossings	HDR
8	Rice C2: Add first feature bullet: "All on-street parking to be removed."	HDR
9	Review documents presented at SAT meeting #15 and follow up with questions/comments	SAT
10	Follow up with environmental lead about Environmental Justice impact details that can be reasonably added to the environmental review findings	HDR
11	Change 41st to 49th in SS 6 M&A document. Two locations on page 3	HDR
12	Strike bullet concerning access to lift station from "Need for Study" section in M&A document	HDR
13	Replace Captain Alan Welsh with Lieutenant Jeff DeVaney on page 6 of M&A document	HDR
14	Replace Mike Behm job title with SDDOT Planning & Engineering and Tom	HDR

	Lemkuhl job title with SDDOT Administration/Environmental on Page 6 of M&A document	
15	Add “Cliff Avenue” to the Sub-Study #6 title block on Page 1	HDR
16	Update minor comments on M&A document and reissue for signature	HDR
17	Check on facilities for June public & stakeholder meetings	City of Sioux Falls

1. Introductions/Agenda Overview

- Review Rice Street developed concepts
- Discuss upcoming public meeting
- Review Cliff Ave M&A document

2. Rice Street Developed Concepts Review

- HDR presented Rice St Concept Summary Table (Table 1 from Tech Memo). Changes, additions, and removals for each concept were discussed. There were no questions/comments.
- HDR presented each Rice St Concept Figure (exhibits from Tech Memo). HDR discussed traffic analysis advancement, updated geometrics, updated concepts, and added features from SAT Meeting #14.
- HDR discussed **Rice 1**. Additions included retaining wall added at the bridge abutments to avoid full bridge reconstruction and a splitter island added at the southbound ramp terminal intersection. Traffic operations are better than existing conditions but do not meet level of service (LOS) C criteria. This option is shown as LOS D in AM and PM
    - SDDOT inquired about the full take for the single family home south of Rice on the east side of Cleveland. HDR stated that widening Cleveland requires the use of the entire driveway. Since there would be no parking for the driveway, total acquisition of the parcel is anticipated.
- HDR discussed **Rice 2**. Additions included a full reconstruct for the I-229 bridges over Rice Street, a splitter island was added at the SB ramp intersection, Cleveland northbound was reduced to one through lane to match the one receiving lane on the I-229 northbound on ramp, and the dual right turn lanes on northbound Cleveland were reduced to a single lane.
    - There were no comments/questions.
- HDR discussed **Rice 3**. Additions included a retaining wall added at the I-229 bridge abutments, a splitter island at the SB ramp terminal, and a connection from realigned Cleveland to a segment of existing Cleveland to grant access to businesses and single family home. The right turn lanes on eastbound Rice to southbound Cleveland were reduced from two to one, and a raised median was added on Cleveland at its intersection with Rice.
    - SDDOT inquired about the access to the third parcel south of Rice and west of existing Cleveland. **HDR will review access options to the parcel to ascertain whether a dedicated access to the property is feasible.**
    - The City of Sioux Falls inquired whether the northernmost parcel east of Cleveland and south of Rice is part of a single business. HDR responded that it appears to be, even though it is shown as separate parcels. There is no take shown on the east side of Cleveland as the properties can be accessed and used.
- HDR discussed **Rice 3b**, a new concept developed at request of SAT at SAT #14. It includes a 4 lane divided corridor on Rice Street that includes a grade separated, realigned Cleveland Ave over the BNSF Railroad. It eliminates the Cleveland and Bahnson at-grade RR crossings. The connection to the business on southeast side of Bahnson and Rice is shown under the bridge at Rice.

  - SDDOT inquired about the stop-controlled condition on Bahnson and Cleveland. HDR responded that it is a two-way stop with Cleveland being the free movement.
  - The City of Sioux Falls asked about the need to take all property north of realigned Cleveland. The business could sell the remaining property for redevelopment. **HDR will reduce property impacts/takes and implement a right-of-way corridor instead.**

- HDR discussed **Rice 3c**, a new concept similar to Rice 3b, except that the ramps have been improved for I-229. The west ramp terminal was realigned to intersect Rice St at Lowell Ave and the loop horizontal curve improved to a 35 mph design. The east ramp terminal was realigned to be more perpendicular with Rice St and improved to a 30 mph design curve. The directional ramps included to north require bridge widening over the Big Sioux River. The intersection at Lowell is shown as upgraded to a signalized intersection. HDR pointed out that anywhere there is an intersection upgrade that includes improvements reaching an existing at-grade railroad crossing, it is anticipated that the crossing surface would be replaced, crossing gates installed, and the railroad signal system coordinated with the traffic signal (preemption).
  - HDR inquired about access on the west side of I-229 to the Archery Outfitter's property. The City of Sioux Falls responded that it is not a heavily traveled commercial business access road archery lessons and that rerouting access along the residential street would probably not be supported by residents. HDR does not believe there is enough room to extend an access to Rice Street. HDR recommended showing the property as an acquisition. City of Sioux Falls agreed that showing as an acquisition is the best way to start. **HDR will review access options for Archery Outfitter's property or show as full acquisition.**
    - ➢ **Post-Meeting Note: This property includes more land than originally understood during the meeting discussion of the access. A Full acquisition may not be desired.**
  - The City of Sioux Falls inquired about lane utilization assumptions and if the additional eastbound lane on Rice between existing Cleveland and Bahnson is needed. HDR responded that it is necessary based on the combined traffic volumes. **HDR will look into the LOS results if the lane is removed.**
    - ➢ **Post-Meeting Note: HDR verified that the 3rd EB lane is necessary based on traffic volume levels. A six-lane section all the way to Sycamore would further justify balanced lane utilization in this area.**
  - The City of Sioux Falls discussed how to access property east of I-229 and north of Rice St and noted that the strip of land to north of those parcels could be acquired and used for access. **HDR will review the feasibility of connecting this strip to N Glenwood Circle for access to properties.** This would include a median break on Rice St at N Glenwood and verifying that traffic operations at Bahnson Ave intersection would not be adversely impacted. The N Glenwood intersection could be shown as a ¾ access. This access could also provide access to the parcel to the north. If there was no access to this parcel, it would need to be shown as a full acquisition.

- HDR Discussed **Rice 4**; a modification of the original Rice 4. Its changes include a raised median as a physical barrier to prevent through and left turn movements and a raised median added on Cleveland Ave at Rice St. All through and left turn movements have been eliminated at the intersection, and traffic must use right turns and U-turns. The median U-turn lane was extended, a lane added near Lowell, and the bridges on I-229 over Rice will be full reconstruction.
  - SDDOT inquired if a median break for the access to properties between the northbound ramp terminal and U-turn supplementary intersection is intended. HDR responded that all driveway access between the ramp terminal and U-turn intersections need to be right in/right out.
  - The City of Sioux Falls inquired if the Rice St alignment was shifted north to keep separation from the RR. HDR responded yes, this option provides more separation from the RR.

  - o FHWA inquired if another U-turn provision at Bahnson Ave would help. HDR responded that not many people would use it as it is further away from Cleveland Ave. Also, a U-turn at Bahnson would not accommodate the level of design vehicle used elsewhere in the corridor. The City of Sioux Falls noted that this might cause an undesirable increase in traffic volumes on Bahnson, especially near the school and library, in an effort to avoid unconventional turns.
  - o SDDOT asked if the northbound lanes on Cleveland Ave at Rice St could be signed so that northbound Cleveland traffic headed for I-229 or westbound Rice St would use the left-hand, right turn lane on the approach at Rice St, eliminating the need to weave across a lane on Rice to reach the U-turn lane. HDR responded that the signage could probably be provided, however driver reaction to signs intended to guide them through linked turning movements is sometimes less than hoped for. Local drivers would probably quickly become familiar with the most efficient path through the combination of turning movements.
  - o SDDOT asked if there are any problems with vehicular safety if using a channelizing island. HDR responded that right-turning traffic was assumed to be controlled by a signal and not a yield sign. A channelizing island would function mostly as a pedestrian refuge island.
- HDR discussed **Rice 5**. The additions include showing a new bridge over I-229 at the SPUI ramp terminal intersection and a right turn lane added on Rice Street eastbound at Lowell, to provide storage for the railroad at-grade crossing on Lowell. The Rice and Lowell intersection was upgraded to a signalized intersection, which will require upgrades to existing at-grade railroad crossing just to the south. The northbound right turn lane along Cleveland Ave was removed.
  - o SDDOT requested that an access to the Archery Outfitter's property be investigated. An access would need to be at least 660feet away from the ramp terminal intersection radius. **HDR will review access options for the Archery Outfitter's property.**
  - o SDDOT asked if the northbound entrance ramp and the southbound exit ramp are long enough to allow reasonable grade profiles. **HDR will conduct a preliminary review of ramp grades for the offset SPUI and adjust ramp lengths if needed.**
- HDR discussed **Rice 7**; a new concept requested after SAT #14. It provides realigned I-229 ramps to increase the design speed on the northbound exit ramp to 45 mph and to 35 mph on the southbound entrance ramp. The southbound entrance ramp has been realigned with Lowell Ave and the intersection upgraded to a signalized intersection with an upgraded at-grade railroad crossing and signal. The connection point to I-229 has been pushed north and the bridges over the Big Sioux widened to accommodate.
    - ➢ **Post-Meeting Note: There were no FHWA comments about the Cleveland Ave intersection located between the ramp terminal intersections. Cleveland Ave and its intersection with Rice St will remain as shown.**
  - o The City of Sioux Falls asked why traffic operations weren't more improved. HDR responded that this concept included an additional signal so there was more travel time and stop time.
  - o The City of Sioux Falls commented that they need to understand what BNSF will require at the reconstructed at-grade railroad crossings. **HDR will set up a meeting with BNSF personnel for feedback on the concepts.**
    - ➢ **Post-Meeting Note: Contact was made with Kristopher Swanson of BNSF on March 11th. A meeting to review the Rice St concepts will be scheduled for either the week of April 11th or the week of April 25th when Mr. Swanson will be in South Dakota.**
- HDR discussed **Rice C2.** The Cliff Ave turn lanes have been lengthened which increase overall reconstruction limits. Retaining walls have been added due to urban constrains and tighter right-of-way limits and some full property acquisitions are shown.
  - o The City of Sioux Falls inquired if the total acquisitions were because buildings are so close to the corridor. HDR confirmed.

- o HDR asked if a section that is not median-divided should be looked at. The City of Sioux Falls responded that if Russell to Rice corridor is built, the median is necessary.
- o SDDOT inquired about a signal at Jessica and Rice. HDR responded that Jessica was not included in the study and traffic volume data is not available.
- o The City of Sioux Falls requested that a note be added to the concept features list: "On street parking will be removed with all concepts." **HDR will add first feature bullet.**
- o SDDOT discussed how large trucks would access I-229 from property north of Rice St and west of I-229. Several routes were discussed.

3. Ditch conditions between Rice & BNSF

- HDR discussed the impacts to the railroad. BNSF owns most of the green space between Rice St and the railroad. A majority of options will be widening Rice St and adding a sidewalk which are components of nearly all of the concepts will impact the existing ditch section along the railroad. HDR will discuss these impacts with BNSF at a meeting to be scheduled.
- The existing ditch section is variable so there is not yet a for potential drainage issues. If BNSF decides that there is to be no foreslope encroachment, Rice improvements as shown in the concepts to date will need to be shifted to the north.
- The City of Sioux Falls mentioned that they needed to get an easement just to put a traffic signal, so shifting all alignments north is a likely possibility.
- **Post-Meeting Note: If input from BNSF suggests the need to shift Rice St improvements to the north, additional concept layout and development will be needed.**

4. Rice St Summary Comparison Table

- HDR discussed the evaluations and environmental impacts that have been rolled into a table. The right-of-way costs are included in the cost estimate, and right-of-way acres are also included. The table will be adjusted per SAT comments recorded above, and Rice 3b and Rice 3c concept costs and acreage could go down.
- SDDOT inquired about environmental justice. HDR said that once the concepts are moved into NEPA, EJ would get more attention. **HDR will follow up with its environmental lead about Environmental Justice impact details that can be reasonably added to the environmental review findings at this stage.**

5. Cliff Ave M&A

- HDR discussed the M&A document for Sub-Study #6.
- **HDR will change 41st to 49th in the instances that it occurs.**
- City of Sioux Falls inquired if the existing access to the Tuthill Park sanitary sewer lift station could remain as a curb ramp on Cliff Ave.

  FHWA concurred, since it is not accessed very often and it looks more like a pedestrian access so there would not be issues with other people driving on it. **HDR will strike the fourth bullet from the "Need for Study" list.**
- **Captain Alan Welch has retired and HDR will replace with Lieutenant Jeff DeVaney on Page 6.**
- **HDR will replace Mike Behm's job title with SSDOT Planning & Engineering and Tom Lemkuhl's job title with SDDOT Administration/Environmental on Page 6.**

- The City of Sioux Falls asked if HDR could analyze the Lincoln High School pedestrian signal operation and access. HDR responded that they could not without more data collection. There was no further discussion on adding the Lincoln High School area to the list of study intersections.
- **HDR will update minor comments and reissue for signature.**
- **HDR will add "Cliff Avenue" to Sub Study 6 title block on page 1.**

6. Next Steps

- HDR discussed the possibility of June 22, 23, and 24 as a window for Rice St and Cliff Ave stakeholder & public meetings and a preliminary concept screening workshop in Sioux Falls. **The City of Sioux Falls will find a location to use.**
- The updated website was discussed. HDR will strive to have the web site content reflect upcoming Rice St and Cliff Ave study milestones.

7. Other Items

- HDR discussed the progress on Sub-Study 3 (10th Street) along with working through other concepts in modeling.
- The City of Sioux Falls will schedule a meeting with HR Green soon to review updated Minnesota Ave Build Scenarios.
- HDR has supplied SDDOT with comments responses on detour maps. SDDOT has circulated the responses to SAT for review. HDR can re-issue once concurrence is received from SAT.

HDR ONE COMPANY *Many Solutions*℠

To:	File		
From:	Mike Forsberg, P.E.	Project:	None
CC:			
Date:	July 18, 2013	Job No:	

RE: Highway Capacity Software Analysis Procedures for a Diverging Diamond Interchange (DDI)

Introduction

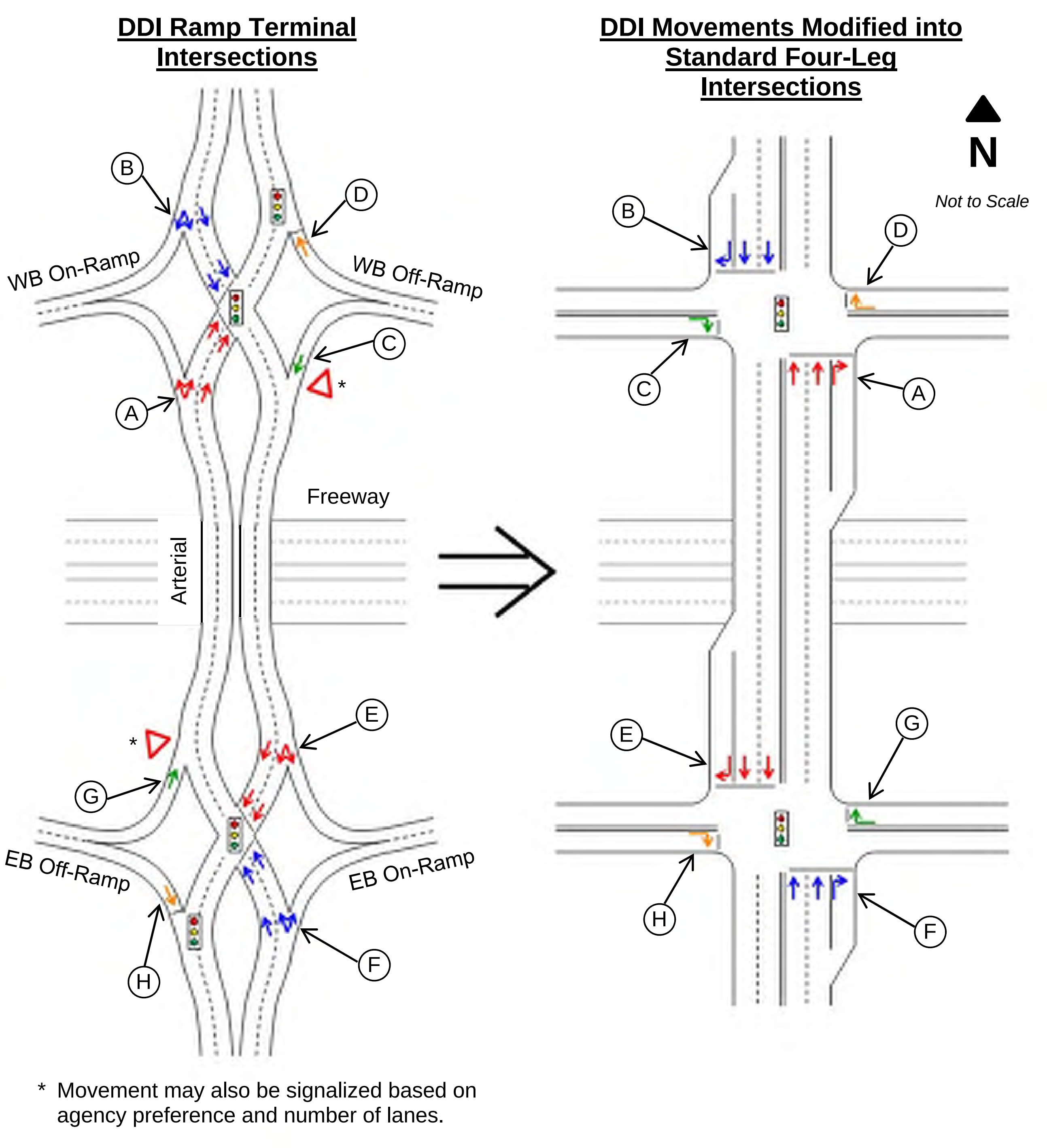
This document presents a proposed methodology for analyzing a Diverging Diamond Interchange (DDI) using Highway Capacity Software (HCS) 2010 Streets module. The Federal Highway Agency (FHWA) has indicated that HCS 2010 is the preferred traffic analysis tool for various projects within certain agencies. The procedures documented in this memorandum were developed in response to known challenges of analyzing DDIs in HCS 2010 based on discussions with the software developer, McTrans. HCS 2010 version 6.50 was utilized to develop this methodology.

Proposed DDI Analysis Methodology

The proposed analysis methodology for DDIs includes manipulation of the intersection movements at a DDI to analyze the ramp terminal intersections as standard four-leg intersections in HCS 2010. The proposed methodology involves manipulating the movements at the DDI ramp terminal intersections of the proposed DDI concept to conform to the analysis methodology of HCS 2010 while mimicking similar operational elements of the DDI ramp terminal intersection.

For simplification purposes, the methodology is presented for an arterial oriented north/south and freeway oriented east/west. The methodology for different orientations would be the same, but rotated accordingly. **Figure 1** expresses the proposed manipulation of the DDI ramp terminal movements into a format with standard four-leg intersections. The modified standard four-leg configuration shown in **Figure 1** would have split-phase operations for northbound and southbound traffic and allow for coordination of the ramp terminal intersections with signals north and south of the interchange.

Figure 1. Manipulation of DDI Movements into Standard Four-Leg Intersections



* Movement may also be signalized based on agency preference and number of lanes.

The following presents details of the proposed manipulation of intersection movements for the westbound ramp terminal intersection shown in **Figure 1** from the DDI configuration to a standard four-leg intersection configuration. Manipulation of intersection movements for the eastbound ramp terminal intersection would follow similar methodology.

- The DDI westbound ramp terminal intersection would operate as a two-phase signal. The northbound crossover movement (A) and westbound off-ramp left-turn movement (C) would travel through the intersection during the first phase (e.g., phase 2). The southbound crossover movement (B) and westbound off-ramp right-turn movement (D) would travel through the intersection during the second phase (e.g., phase 6).

- The two-phase operations of the DDI would be modified to two-phase operations with a four-leg intersection configuration. For example, at the westbound ramp terminal intersection:
    - The northbound crossover movement (A) of the DDI would be treated as a northbound through movement in the four-leg intersection configuration.
    - The northbound left-turn movement of the DDI in advance of the crossover would be treated as a northbound right-turn movement in the four-leg intersection configuration.
        - The value for right-turn-on-red (RTOR) for the northbound right turns would be set to zero. This assumes that all northbound right turns would only be able to turn during the northbound green signal indication. This assumption is conservative since these vehicles would be able to complete this turning maneuver during a northbound red signal indication in the DDI configuration, while the northbound queue of the crossover movement does not extend to the turning movement location. However, due to the unknown percentage of time that the northbound through movement would extend beyond the turning movement location, it is assumed that no vehicles would be able to turn right on red.
    - The southbound crossover movement (B) of the DDI would be treated as a southbound through movement in the four-leg intersection configuration.
    - The southbound right-turn movement of the DDI in advance of the crossover would be treated as a southbound right-turn movement in the four-leg intersection configuration.
        - The value for right-turn-on-red (RTOR) for the southbound right turns would be set to zero. This assumes that all southbound right turns would only be able to turn during the southbound green signal indication. This assumption is conservative since these vehicles would be able to complete this turning maneuver during a southbound red signal indication in the DDI configuration, while the southbound queue of the crossover movement does not extend to the turning movement location. However, due to the unknown percentage of time that the southbound through movement would extend beyond the turning movement location, it was assumed that no vehicles would be able to turn right on red.
    - The westbound off-ramp left-turn movement (C) of the DDI would be treated as an eastbound right-turn movement in the four-leg intersection configuration.
        - This movement would be treated as an eastbound right-turn movement at a signal with RTOR allowed. The value of RTOR would be based on the 'RTOR Reduction' factor shown in the HCM 2000 report obtained from Synchro traffic analysis software (Synchro would be used to code the modified four-leg configuration and obtain the RTOR value for this movement).
    - The westbound off-ramp right-turn movement (D) of the DDI would be treated as a westbound right-turn movement in the four-leg intersection configuration.

    - RTOR for the westbound right-turn movement would likely be restricted in the DDI configuration for safety purposes; therefore, the RTOR of the westbound right-turn movement four-leg configuration would be set to ‘0’. For locations where the controlling agency would operate the westbound off-ramp right-turn movement (D) of the DDI with RTOR allowed, the value of RTOR would be based on the ‘RTOR Reduction’ factor shown in the HCM 2000 report obtained from Synchro.
  - In the modified version of the four-leg intersection the northbound (A) and eastbound (C) movements would travel through the intersection during the same phase (e.g., phase 2). This would be consistent with the overlapping northbound crossover movement (A) and westbound off-ramp left-turn movement (C) of the DDI.
  - In the modified version of the four-leg intersection the southbound (B) and westbound (D) movements would travel through the intersection during the same phase (e.g., phase 6). This would be consistent with the overlapping southbound crossover movement (B) and westbound off-ramp right-turn movement (D) of the DDI.

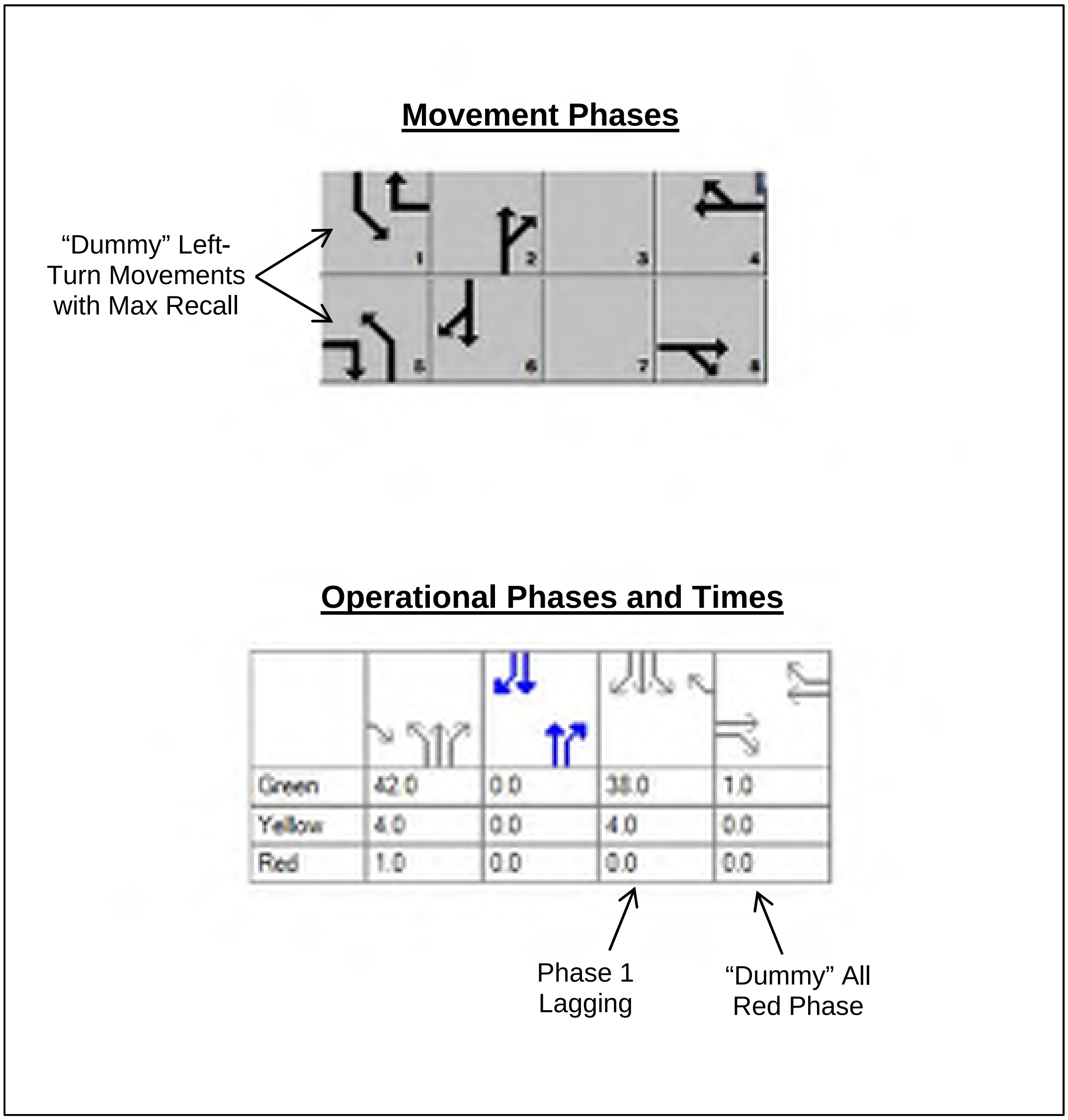
The following presents specific details of coding elements in HCS 2010 Streets to model the westbound ramp terminal intersection shown in **Figure 1** as a standard four-leg intersection of the DDI intersection. Manipulation of intersection movements for the eastbound ramp terminal intersection would follow similar methodology.

- To model split-phase operations for the arterial street (northbound and southbound movements) in HCS 2010 Streets, the following coding elements would be needed. Additionally, the diagrams shown in **Figure 2** supplement the coding elements listed below.
  - Artificial (“dummy”) northbound and southbound left-turn movements would be added with protected phasing. These movements would not serve any of the DDI traffic. The added left-turn phases would be phase 5 for the northbound left-turn movement and phase 1 for the southbound left-turn movement (based on the previously mentioned example phasing of phases 2 and 6 for the northbound and southbound through movements, respectively).
  - The eastbound and westbound right-turn movements would be overlapped with the northbound and southbound left-turn movements.
  - The southbound left-turn movement would be set to a lagging left-turn phase so that the northbound and southbound left-turn movements would not need to have a green signal indication simultaneously.
  - The Recall Mode for the northbound and southbound left-turn movements would be set to ‘Max’.
  - Eastbound and westbound phases (phases 8 and 4, respectively) would be required to be included to meet the criteria for signal timings in HCS 2010 Streets. This would include eastbound and westbound through movements with zero volume. These phases would have a green signal indication simultaneously for 1 second (the minimum time allowed for a phase). This effectively serves as the Red time for the previous split that serves southbound traffic. This 1 second phase for the eastbound and westbound approaches is labeled as “Dummy” All Red Phase in **Figure 2**. To counter the additional 1 second of green time given to the eastbound and westbound right-turn movements, each of these movements would be given an additional 0.5

seconds of “Start-Up Lost Time”. Each of these right-turn movements would experience the extra 0.5 seconds of “Start-Up Lost Time” during the “Dummy” All Red Phase and during their normal phase of operation (Phase 1 or 5), totaling 1 second of additional “Start-Up Lost Time” over the course of 1 signal cycle for the eastbound and westbound right-turn movements.

  - The Demand for the northbound and southbound left-turn movements would be set to ‘1’ in order for phases 1 and 5 to be given a green signal indication (otherwise, all of the time would be given to the phase where northbound and southbound traffic travel through the intersection simultaneously).

Figure 2. Sample HCS 2010 Streets Phasing for the Westbound Ramp Terminal Intersection



Green	42.0	0.0	38.0	1.0
Yellow	4.0	0.0	4.0	0.0
Red	1.0	0.0	0.0	0.0

- The following coding elements would also be included in HCS 2010 Streets to mimic the movements of the DDI.
  - The Arrival Type for the eastbound and westbound right-turn movements would be ‘3’, representing random arrivals from the freeway. The Arrival Type for the

northbound and southbound approaches would be ‘4’, representing coordination of signals. However, the arrival patterns of the northbound and southbound movements would be dictated by the signal timings at upstream intersections and the coded Arrival Type for the northbound and southbound approaches would not have any impact on the operations at these intersections.

- Phase 5 would operate with 4 seconds of yellow and 1 second of all red.
- Phase 1 would operate with 4 seconds of yellow and 0 seconds of all red (the all red time would be effectively given by the “Dummy” All Red Phase shown in **Figure 2**).
- The Phase Split time for the northbound left-turn movement (phases 5) would be set to the optimum phase split time for the northbound movement. The Phase Split time for the southbound left-turn movement (phases 5) would be set to the optimum phase split time for the northbound movement minus 1 second (to account for the 1 second “Dummy” All Red Phase). The combined split times for the northbound left-turn movement (phase 5), southbound left-turn movement (phase 1) and eastbound/westbound movements (phases 8/4) would equal the cycle length of the signal, leaving no remaining time for the overlapping phase where northbound and southbound through traffic would travel through the intersection simultaneously.
- The speed limit would be set to 25 mph to account for lower speeds through the crossover and channelized turn movements. The exception to this would be for the southbound approach that arrives from outside of the DDI and would be set to the speed limit of the Arterial Street.

As mentioned previously, the modified standard four-leg configuration would have split-phase operations at the ramp terminal intersections for northbound and southbound traffic and allow for coordination of the ramp terminal intersections with signals north and south of the interchange. The signal offset values at the ramp terminals would be based on the turn patterns at each intersection to maximize platooning of traffic through the two signals. Signal offsets at intersections adjacent to the ramp terminals would be based on the offsets established at the ramp terminal intersections.

Memo

Date: Wednesday, November 04, 2015

Project:

To: File

From: Rob Frazier, P.E.
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Subject: **RE: Crash Prediction Analysis Procedures for Diverging Diamond Interchange (DDI), Single-Point Urban Interchange (SPUI), and Two-Lane Loop Ramp**

Introduction

This document presents proposed methodologies for performing crash prediction for a Diverging Diamond Interchange (DDI), a Single-Point Urban Interchange (SPUI), and a two-lane loop ramp. The American Association of State Highway and Transportation Officials (AASHTO) Highway Safety Manual (HSM) provides a standard practice for safety analysis over a project's full life-cycle. The HSM can be faithfully implemented by a variety of tools including the Federal Highway Administration's (FHWA) Enhanced Interchange Safety Analysis Tool (ISATe). However, neither the HSM nor ISATe currently address the DDI, SPUI, or two-lane loop ramp configurations. In response to these shortcomings, a synthesis of recent and on-going research yielded these proposed methodologies to address crash prediction for the DDI, SPUI, and two-lane loop ramp.

Crash Prediction

Crash prediction is a method of assessing safety by applying a combination of Safety Performance Functions (SPFs) and Crash Modification Factors (CMFs) to a roadway facility to predict the number of crashes that are statistically likely to occur in an average year. Crash prediction relies on roadway and roadside geometry, traffic volumes, traffic control, and other safety related factors to forecast crash frequency. Crash prediction can be performed at the site level or at the project level. Site level crash prediction involves the use of SPFs or CMFs to predict crash frequency for an individual roadway segment or intersection. Project level crash prediction involves the use of a CMF to estimate the change in crash frequency for a group of sites that make up the project area. For example, consider the conversion of an at-grade intersection to a grade-separated interchange. The site level analysis would involve calculating crash frequency for the existing intersection and adjacent roadway segments and the calculation of crash frequency for the proposed roadway segments, ramps, and ramp terminal intersections related to the interchange. For a project level analysis of the same example, a single project level CMF would be used to estimate predicted crash frequency at the interchange, based on the existing crash frequency at the intersection.

In general, a project level assessment is more simple and easier to implement. Site level analyses provide greater detail and flexibility in both the analysis and presentation of the results.

The proposed methodology applies site level analysis where possible, using project level analysis only when necessary.

Diverging Diamond Interchange (DDI)

DDIs have only been in operation in North America since 2009. Considering that HSM methods rely on observed crash data for the development of SPFs and CMFs, the newness of the DDI has been a major factor in its absence from the HSM and consequently ISATe. Recently however, researchers have completed several in-depth safety evaluations of DDIs in Missouri. As an early adopter of DDIs, Missouri provides a good source for DDI crash data. The research has addressed both project level and site level analyses. Based on these studies, the proposed methodology is as follows:

1. Develop crash predictions for the freeway mainline for the No-Build and Build (DDI) conditions
2. Develop crash predictions for theoretical traditional diamond interchanges for the locations of the proposed DDI interchanges (predicted crashes for ramps and ramp terminals).
3. Develop site level crash predictions for the ramp and ramp terminals for the proposed DDI designs.
    a. Ramps – The ramp crash predictions will be based on the ramp geometry and will only be adjusted if specifically indicated by the research.
    b. Ramp Terminal Intersections – The ramp terminal crash predictions will be developed by applying CMFs from the research to the diamond ramp terminal predictions. Preliminary CMFs are:
        i. $CMF_{Fatal\&Injury} = 0.63$
        ii. $CMF_{PropertyDamageOnly} = 0.51$
4. As a check on the site level predictions, a project level analysis will also be prepared. This will use the project level research CMFs to modify the entire diamond interchange crash prediction to estimate the entire DDI interchange crash frequency. This value will be compared with the site level results before finalizing the crash predictions.

Crash type frequency will not be quantitatively predicted for the DDI ramp terminal intersections. A qualitative assessment will be provided for the trends in crash type associated with the DDI.

Single-Point Urban Interchange (SPUI)

The SPUI has a much longer history compared to the DDI, but a similarly limited research base pertaining to predictive safety. Research has begun on NCHRP Project 17-68 to develop SPFs and CMFs directly applicable to SPUIs, but the project is still on-going. The NCHRP Project 17-68 will have a significant crash data set (~100 intersections) to develop SPFs and CMFs. Investigations into other research concerning SPUIs and crash prediction have not produced any additional studies. However, some data concerning SPUIs has been made available by SDDOT (before and after study data for conversion from a traditional diamond interchange to a SPUI). Based on these studies, the proposed methodology is as follows:

1. Should NCHRP Project 17-68 results become available prior to March 2016

    a. Analyze the SPUI ramp terminal intersection based on methods / equations from NCHRP Project 17-68.
2. Should NCHRP Project 17-68 results not be available
    a. Perform crash prediction for a traditional diamond interchange with similar freeway mainline segment, freeway ramp segment, and ramp terminal interchange characteristics as the proposed SPUI.
    b. Combine site predicted crashes for the traditional diamond interchange to develop a project level estimate of crashes.
    c. Multiply the project level estimate of crashes for the traditional diamond by a project level CMF based on the available SDDOT data. The preliminary CMF is 0.63 for conversion of a traditional diamond interchange to a SPUI.

Should NCHRP Project 17-68 results not be available, crash type frequency will not be quantitatively predicted for the SPUI ramp terminal intersection. A qualitative assessment will be provided for the trends in crash type associated with the SPUI. Should NCHRP Project 17-68 results be available, recommendations from that project will be utilized to determine how to provide crash type frequency information.

Two-Lane Loop Ramp

Single-lane loop ramp safety is addressed at both the ramp segment and ramp terminal intersection level by the Highway Safety Manual, and most loop ramps are single-lane loop ramps. The previous reasoning may explain why developing SPFs and / or CMFs for two-lane loop ramps has not been a primary research direction based on our literature review. However, NCHRP Project 03-105 is on-going research and will attempt to improved roadway design guidance for single-lane and two-lane loop ramps. The project research plan was to collect safety data for single-lane and two-lane loop ramps, there may be an opportunity to use results of this project to address crash prediction for two-lane loop ramps. Based on this review of available research, the proposed methodology is as follows:

1. Should NCHRP Project 03-105 results become available prior to March 2016
    a. Analyze the two-lane loop ramp terminal intersection based on data, methods, equations, and findings from NCHRP Project 03-105.
2. Should NCHRP Project 03-105 results not be available
    a. Perform crash prediction for a two-lane ramp segment with tight curvature.
    b. Confirm that the crash prediction for a two-lane ramp segment with tight curvature produces reasonable crash prediction results. This will involve comparing the predicted number of single-vehicle and multi-vehicle crashes for the tight curvature ramp with a standard one-lane loop ramp. If comparison crash data is available for two-lane loop ramps that will also be considered.

APPENDIX B1. TRAFFIC CAPACITY ANALYSIS METHODOLOGIES

Traffic operational analysis involves the development of input parameters, the use of traffic flow models to determine measures of effectiveness based on the inputs, and the evaluation of those measures of effectiveness. The input development requires information on levels of traffic, vehicle classification, facility geometry, signal timing data, and speed data. Many of these input parameters were identified and collected as described as part of the data collection efforts, while some required assumptions or processed data to develop the best input parameters for traffic analysis.

LEVEL OF SERVICE

After identifying the proper input data, level of service (LOS) analyses for the existing conditions were performed for the basic freeway segments, weave segments, freeway merge and diverge segments, and key intersections (including ramp terminal intersections) using procedures from the ***Highway Capacity Manual*** (***HCM***). Highway Capacity Software 2010 (HCS 2010) version 6.50, a computerized analytical tool based on the ***HCM***, was utilized for the freeway segment and intersection operational analysis. HCS 2010 is representative of macroscopic models that describe traffic flow in the aggregate and is based on deterministic relationships developed through past research on traffic flow.

The following sections further describe the methodologies used and the types of HCS analyses applied.

Basic Freeway Segment Level of Service

LOS analyses for the basic freeway elements were performed following Chapter 11 procedures (Basic Freeway Segments) of the ***HCM***. For freeway segments, LOS is defined in terms of traffic stream density, as shown in ***TABLE 1***. By definition, basic freeway segments are segments of the freeway that are outside of the influence area of ramps or weaving sections. Per ***HCM*** definition, freeway ramps have an influence distance of 1,500 feet upstream or downstream of ramp junctions. The influence distance of a weaving section between ramp junctions varies based on geometry and volume. Only freeway segments outside of the influence area of ramp junctions and weaving sections were evaluated as basic freeway segments, unless noted otherwise.

Table 1. Freeway LOS Definitions

LOS	Density Range (pc/mi/ln*)
A	0-11
B	>11-18
C	>18-26
D	>26-35
E	>35-45
F	Demand exceeds capacity >45

** Passenger cars per mile per lane*

Weave Segment Level of Service

Weave segments were analyzed based on Chapter 12 procedures (Freeway Weaving Segments) of the ***HCM***. Weaving is defined as the crossing of two or more traffic streams traveling in the same direction. Weaving areas generally occur when a merge area is closely followed by a diverge area, or when an entrance ramp is closely followed by an exit ramp connected by an auxiliary lane. LOS for weaving operations is related to the average density of all vehicles in the section. For locations with weaving traffic, ramp-to-ramp flows were estimated based on the Sioux Falls travel demand model. Based on the assumed ramp-to-ramp flows, ramp-to-freeway, freeway-to-ramp, and freeway-to-freeway flows could be calculated using flow conservation from the balanced sub-area volume set. The density range for 'Freeway Weaving Segments' shown in ***TABLE 2*** was used when evaluating weaving segments bounded by entry/exit ramps.

Table 2. Weaving LOS Definitions

LOS	Density Range (pc/mi/ln[*])	
	Freeway Weaving Segments	Weaving Segments on Multilane Highways or C-D Roadways
A	≤10	≤12
B	>10-20	>12-24
C	>20-28	>24-32
D	>28-35	>32-36
E	>35	>36
F	Demand Exceeds Capacity	Demand Exceeds Capacity

[*] Passenger cars per mile per lane

Freeway Merge and Diverge Segment Level of Service

Freeway merge and diverge segments were analyzed based on ***HCM*** Chapter 13 procedures (Freeway Merge and Diverge Segments). Acceleration and deceleration length of a freeway merge or diverge segment is measured from the point at which the edges of the ramp and freeway lanes converge (gore) to the end of the taper segment connecting the ramp to the freeway. By definition, the LOS for a typical freeway merge or diverge segment is based on the average density of vehicles in the influence area (defined by the ***HCM*** as 1,500 feet upstream or downstream) of the ramp, as described in ***TABLE 3.***

Table 3. Freeway Merge and Diverge LOS Definitions

LOS	Density Range (pc/mi/ln[*])
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	Demand Exceeds Capacity

[*] Passenger cars per mile per lane

For this study, LOS C was determined to be the critical threshold for mainline and ramp locations.

Signalized Intersection Level of Service

Key signalized intersections were analyzed based on ***HCM*** Chapter 18 procedures (Signalized Intersections). LOS for signalized intersections is evaluated based on control delay per vehicle (in seconds per vehicle), shown in ***TABLE 4***. Control delay is the portion of the total delay attributed to traffic signal operation and includes initial deceleration delay, queue move-up time, stopped delay and final acceleration delay.

Table 4. Signalized Intersection LOS Definitions

Control Delay per Vehicle (s/veh*)	LOS by Volume-to-Capacity Ratio	
	v/c ≤ 1.0	v/c > 1.0
<u><</u>10	A	F
>10-20	B	F
>20-35	C	F
>35-55	D	F
>55-80	E	F
>80	F	F

** Seconds per vehicle*

Unsignalized Intersection Level of Service

Key unsignalized intersections were analyzed based on ***HCM*** Chapters 19 procedures (Two-Way Stop-Controlled Intersections). LOS for unsignalized intersections is evaluated based on control delay per vehicle (in seconds per vehicle), shown in ***TABLE 5***. For two-way stop-controlled intersections with stop control on the side-street, the LOS is measured separately for each individual movement. Results of the two-way stop controlled intersection analysis were reported as the worst-case stop-controlled approach.

Table 5. Unsignalized Intersection LOS Definitions

Control Delay per Vehicle (s/veh*)	LOS by Volume-to-Capacity Ratio	
	v/c ≤ 1.0	v/c > 1.0
<u><</u>10	A	F
>10-15	B	F
>15-25	C	F
>25-35	D	F
>35-50	E	F
>50	F	F

** Seconds per vehicle*

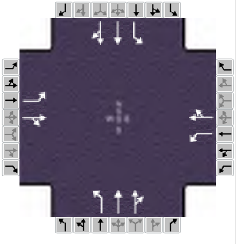
LOS ‘C’ is typically preferred for the average intersection operations during the peak period traffic conditions of a project horizon year (beyond 20 years from existing), though LOS ‘D’ has generally been considered acceptable. For this study, LOS ‘D’ was used as the worst allowable LOS for future year intersection operations when identifying proposed improvements.

APPENDIX B2 -

EXISTING HCS 2010 REPORTS

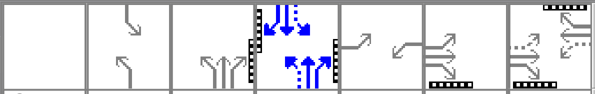
HCS 2010 Signalized Intersection Results Summary

General Information				**Intersection Information**	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	Cliff Ave & 33rd St	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_Cliff_AM.xus				
Project Description	Existing AM				

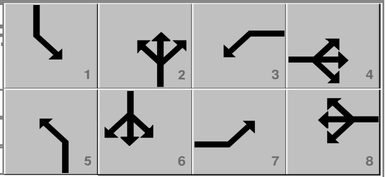


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	63	76	38	50	187	20	101	760	13	19	365	69

Signal Information			
Cycle, s	100.0	Reference Phase	2
Offset, s	26	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	1.9	3.5	51.9	4.2	1.0	17.7
Yellow	3.6	0.0	3.6	3.6	0.0	3.6
Red	1.0	0.0	1.9	1.0	0.0	1.5



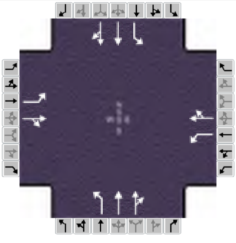
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	4.0	1.1	4.0	1.1	4.0	1.1	4.0
Phase Duration, s	9.8	23.8	8.8	22.8	10.1	60.9	6.5	57.4
Change Period, (Y+R_c), s	4.6	5.1	4.6	5.1	4.6	5.5	4.6	5.5
Max Allow Headway (MAH), s	4.2	4.2	4.2	4.2	4.2	0.0	4.2	0.0
Queue Clearance Time (g_s), s	5.8	9.6	5.0	16.6	5.4		2.7	
Green Extension Time (g_e), s	0.0	1.4	0.0	1.1	0.3	0.0	0.0	0.0
Phase Call Probability	0.89	1.00	0.82	1.00	0.97		0.48	
Max Out Probability	1.00	0.00	1.00	0.05	0.00		0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	79	143		63	259		126	485	482	24	277	265
Adjusted Saturation Flow Rate (s), veh/h/ln	1681	1665		1664	1718		1664	1748	1737	1664	1748	1651
Queue Service Time (g_s), s	3.8	7.6		3.0	14.6		3.4	9.7	9.6	0.7	6.2	6.3
Cycle Queue Clearance Time (g_c), s	3.8	7.6		3.0	14.6		3.4	9.7	9.6	0.7	6.2	6.3
Green Ratio (g/C)	0.23	0.19		0.22	0.18		0.58	0.55	0.55	0.54	0.52	0.52
Capacity (c), veh/h	194	311		253	304		551	968	962	355	906	856
Volume-to-Capacity Ratio (X)	0.407	0.458		0.247	0.851		0.229	0.501	0.501	0.067	0.306	0.310
Available Capacity (c_a), veh/h	248	468		323	466		757	968	962	620	906	856
Back of Queue (Q), veh/ln (95th percentile)	2.9	5.7		2.3	11.1		2.3	5.1	5.1	0.4	4.1	4.0
Queue Storage Ratio (RQ) (95th percentile)	0.37	0.14		0.46	0.29		0.59	0.06	0.06	0.11	0.11	0.10
Uniform Delay (d_1), s/veh	32.4	36.2		32.1	39.9		10.2	5.7	5.6	11.1	8.4	8.4
Incremental Delay (d_2), s/veh	1.4	1.1		0.5	9.0		0.1	1.3	1.3	0.1	0.9	0.9
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	33.7	37.2		32.6	48.9		10.3	7.0	6.9	11.2	9.3	9.3
Level of Service (LOS)	C	D		C	D		B	A	A	B	A	A
Approach Delay, s/veh / LOS	36.0	D		45.8	D		7.3	A		9.4	A	
Intersection Delay, s/veh / LOS	16.4						B					

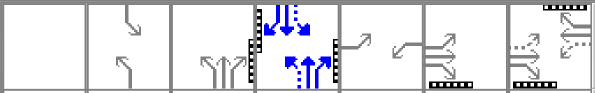
Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.8	C	2.2	B	2.3	B
Bicycle LOS Score / LOS	0.9	A	1.0	A	1.4	A	1.0	A

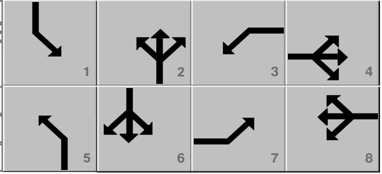
HCS 2010 Signalized Intersection Results Summary

General Information				**Intersection Information**	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Cliff Ave & 33rd St	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_Cliff_PM.xus				
Project Description	Existing PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	87	173	59	55	124	12	59	381	55	12	795	104





Signal Information										
Cycle, s	100.0	Reference Phase	2							
Offset, s	16	Reference Point	Begin	Green	1.2	2.1	55.4	4.0	2.1	15.3
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.6	0.0	3.6	3.6	0.0	3.6
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	0.0	1.9	1.0	0.0	1.5

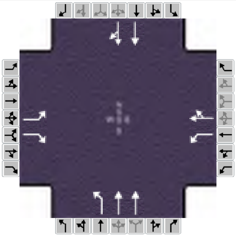
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	4.0	1.1	4.0	1.1	4.0	1.1	4.0
Phase Duration, s	10.8	22.6	8.6	20.4	7.9	63.0	5.8	60.9
Change Period, ($Y+R_c$), s	4.6	5.1	4.6	5.1	4.6	5.5	4.6	5.5
Max Allow Headway (*MAH*), s	4.2	4.2	4.2	4.2	4.2	0.0	4.2	0.0
Queue Clearance Time (g_s), s	6.6	16.3	5.0	9.9	3.6		2.3	
Green Extension Time (g_e), s	0.0	1.1	0.0	1.3	0.1	0.0	0.0	0.0
Phase Call Probability	0.93	1.00	0.81	1.00	0.83		0.30	
Max Out Probability	1.00	0.03	1.00	0.00	0.00		0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	94	249		59	146		63	238	231	13	493	473
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1687		1664	1720		1664	1748	1670	1664	1748	1676
Queue Service Time (g_s), s	4.6	14.3		3.0	7.9		1.6	6.0	5.7	0.3	11.8	11.8
Cycle Queue Clearance Time (g_c), s	4.6	14.3		3.0	7.9		1.6	6.0	5.7	0.3	11.8	11.8
Green Ratio (*g/C*)	0.21	0.17		0.19	0.15		0.59	0.57	0.57	0.57	0.55	0.55
Capacity (*c*), veh/h	268	295		152	264		377	1005	960	543	968	928
Volume-to-Capacity Ratio (*X*)	0.349	0.846		0.389	0.554		0.168	0.237	0.240	0.024	0.510	0.510
Available Capacity (c_a), veh/h	306	477		225	450		641	1005	960	843	968	928
Back of Queue (*Q*), veh/ln (95th percentile)	3.5	10.7		2.3	6.2		1.0	4.1	3.7	0.2	6.9	6.6
Queue Storage Ratio (*RQ*) (95th percentile)	0.44	0.27		0.46	0.16		0.27	0.05	0.05	0.06	0.18	0.17
Uniform Delay (d_1), s/veh	33.0	40.0		34.8	39.2		9.5	9.1	8.4	9.6	7.4	7.4
Incremental Delay (d_2), s/veh	0.8	7.6		1.6	1.8		0.2	0.5	0.6	0.0	1.9	2.0
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	33.7	47.6		36.4	41.0		9.7	9.6	9.0	9.6	9.3	9.4
Level of Service (LOS)	C	D		D	D		A	A	A	A	A	A
Approach Delay, s/veh / LOS	43.8	D		39.7	D		9.4	A		9.3	A	
Intersection Delay, s/veh / LOS	18.1						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.9	C	2.2	B	2.2	B
Bicycle LOS Score / LOS	1.1	A	0.8	A	0.9	A	1.3	A

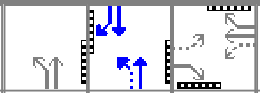
HCS 2010 Signalized Intersection Results Summary

General Information				**Intersection Information**	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	Cliff Ave & I-229 SB Off-rar	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_Cliff_AM.xus				
Project Description	Existing AM				

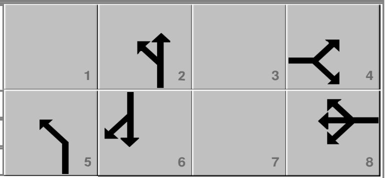


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	101		163	108	68	44	188	1176			471	89

Signal Information			
Cycle, s	100.0	Reference Phase	2
Offset, s	71	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	8.4	55.1	20.8	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	2.5	1.5	0.0	0.0	0.0



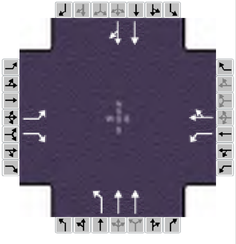
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2		6
Case Number		5.0		6.0	1.0	4.0		8.3
Phase Duration, s		25.9		25.9	13.0	74.1		61.2
Change Period, (*Y+R*$_c$), s		5.1		5.1	4.6	6.1		6.1
Max Allow Headway (*MAH*), s		4.2		4.2	4.2	0.0		0.0
Queue Clearance Time (*g*$_s$), s		20.1		9.8	8.2			
Green Extension Time (*g*$_e$), s		0.7		1.3	0.2	0.0		0.0
Phase Call Probability		1.00		1.00	1.00			
Max Out Probability		0.77		0.01	1.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14	3	8	18	5	2			6	16
Adjusted Flow Rate (*v*), veh/h	126		0	135	140		235	1470			359	341
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1188		1435	1593	1565		1622	1714			1711	1614
Queue Service Time (*g*$_s$), s	10.3		0.0	7.3	7.8		6.2	31.0			12.1	13.7
Cycle Queue Clearance Time (*g*$_c$), s	18.1		0.0	7.3	7.8		6.2	31.0			12.1	13.7
Green Ratio (*g/C*)	0.21		0.21	0.21	0.21		0.65	0.62			0.55	0.55
Capacity (*c*), veh/h	227		298	403	325		504	2130			942	889
Volume-to-Capacity Ratio (*X*)	0.557		0.000	0.335	0.431		0.466	0.690			0.381	0.384
Available Capacity (*c*$_a$), veh/h	276		357	469	390		539	2130			942	889
Back of Queue (*Q*), veh/ln (95th percentile)	5.7		0.0	5.1	5.3		2.8	14.7			9.0	9.2
Queue Storage Ratio (*RQ*) (95th percentile)	0.72		0.00	1.04	0.14		0.72	0.47			0.11	0.11
Uniform Delay (*d*$_1$), s/veh	42.3		0.0	34.3	34.5		8.3	13.7			14.6	15.6
Incremental Delay (*d*$_2$), s/veh	2.1		0.0	0.5	0.9		0.2	0.5			1.1	1.2
Initial Queue Delay (*d*$_3$), s/veh	0.0		0.0	0.0	0.0		0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh	44.5		0.0	34.8	35.4		8.5	14.2			15.7	16.9
Level of Service (LOS)	D			C	D		A	B			B	B
Approach Delay, s/veh / LOS	44.5	D		35.1	D		13.4	B		16.3	B	
Intersection Delay, s/veh / LOS	17.7						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.7	B	1.6	A	2.5	B
Bicycle LOS Score / LOS		F	0.9	A	1.9	A	1.1	A

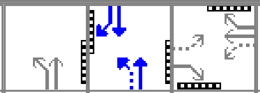
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Cliff Ave & I-229 SB Off-rar	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_Cliff_PM.xus				
Project Description	Existing PM				

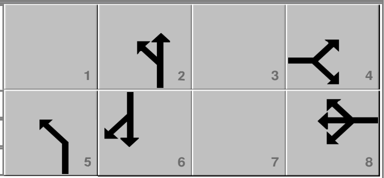


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	115		332	299	71	22	120	538			1056	135

Signal Information			
Cycle, s	100.0	Reference Phase	2
Offset, s	62	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	5.0	57.6	21.6	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	2.5	1.5	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2		6
Case Number		5.0		6.0	1.0	4.0		8.3
Phase Duration, s		26.7		26.7	9.6	73.3		63.7
Change Period, (Y+R_c), s		5.1		5.1	4.6	6.1		6.1
Max Allow Headway (MAH), s		4.1		4.1	4.2	0.0		0.0
Queue Clearance Time (g_s), s		16.4		20.8	5.0			
Green Extension Time (g_e), s		1.4		0.9	0.1	0.0		0.0
Phase Call Probability		1.00		1.00	0.97			
Max Out Probability		0.20		0.99	0.68			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14	3	8	18	5	2			6	16
Adjusted Flow Rate (v), veh/h	124		0	322	100		129	579			652	629
Adjusted Saturation Flow Rate (s), veh/h/ln	1220		1420	1664	1678		1591	1614			1780	1705
Queue Service Time (g_s), s	9.4		0.0	18.8	5.0		3.0	8.2			28.0	28.2
Cycle Queue Clearance Time (g_c), s	14.4		0.0	18.8	5.0		3.0	8.2			28.0	28.2
Green Ratio (g/C)	0.22		0.22	0.22	0.22		0.65	0.67			0.58	0.58
Capacity (c), veh/h	275		307	432	363		271	2168			1024	981
Volume-to-Capacity Ratio (X)	0.449		0.000	0.745	0.276		0.476	0.267			0.636	0.641
Available Capacity (c_a), veh/h	315		354	486	418		345	2168			1024	981
Back of Queue (Q), veh/ln (95th percentile)	5.2		0.0	12.6	3.6		2.2	4.9			17.2	17.2
Queue Storage Ratio (RQ) (95th percentile)	0.66		0.00	2.57	0.09		0.56	0.16			0.22	0.22
Uniform Delay (d_1), s/veh	38.6		0.0	38.1	32.7		14.4	7.8			18.2	19.0
Incremental Delay (d_2), s/veh	1.1		0.0	5.4	0.4		1.2	0.3			2.5	2.7
Initial Queue Delay (d_3), s/veh	0.0		0.0	0.0	0.0		0.0	0.0			0.0	0.0
Control Delay (d), s/veh	39.8		0.0	43.5	33.1		15.6	8.1			20.7	21.7
Level of Service (LOS)	D			D	C		B	A			C	C

Approach Delay, s/veh / LOS	39.8	D	41.0	D	9.4	A	21.2	C
Intersection Delay, s/veh / LOS	22.1				C			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.7	B	1.6	A	2.7	B
Bicycle LOS Score / LOS		F	1.2	A	1.1	A	1.5	A

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                 HCS+: Unsignalized Intersections Release 5.6

_______________________TWO-WAY STOP CONTROL SUMMARY___________________________

Analyst:              JKM
Agency/Co.:           HDR
Date Performed:       11/15/2013
Analysis Time Period: AM Peak
Intersection:         Cliff Ave & I-229 SB On-Ramp
Jurisdiction:         Sioux Falls, SD
Units: U. S. Customary
Analysis Year:        2013
Project ID:  I-229 MIS
East/West Street:     I-229 SB On-Ramp
North/South Street:   Cliff Ave
Intersection Orientation: NS                 Study period (hrs):  0.25

______________________Vehicle Volumes and Adjustments_________________________
Major Street:  Approach        Northbound              Southbound
               Movement     1      2      3     |  4      5      6
                            L      T      R     |  L      T      R
______________________________________________________________________________
Volume                      327    1364                   541    201
Peak-Hour Factor, PHF       0.80   0.80                   0.80   0.80
Hourly Flow Rate, HFR       408    1704                   676    251
Percent Heavy Vehicles      2      --     --              --     --
Median Type/Storage         TWLTL                 / 1
RT Channelized?
Lanes                          1   2                      2    0
Configuration                   L  T                      T   TR
Upstream Signal?                   Yes                    Yes
______________________________________________________________________________
Minor Street:  Approach        Westbound               Eastbound
               Movement     7      8      9     |  10     11     12
                            L      T      R     |  L      T      R
______________________________________________________________________________
Volume                                             0             0
Peak Hour Factor, PHF                              0.80          0.80
Hourly Flow Rate, HFR                              0             0
Percent Heavy Vehicles                             2             2
Percent Grade (%)                  0                      0
Flared Approach:  Exists?/Storage                /              No     /
Lanes                                                 0        0
Configuration                                             LR
______________________________________________________________________________

                  Delay, Queue Length, and Level of Service___________________
Approach             NB     SB        Westbound             Eastbound
Movement             1      4   |  7      8      9    |  10     11     12
Lane Config          L          |                     |         LR
______________________________________________________________________________
v (vph)              408                                        0
C(m) (vph)           759
v/c                  0.54
95% queue length     3.25
Control Delay        15.1
LOS                   C
Approach Delay
Approach LOS
______________________________________________________________________________
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                  HCS+: Unsignalized Intersections Release 5.6






Phone:                                        Fax:
E-Mail:

______________________TWO-WAY STOP CONTROL(TWSC) ANALYSIS_____________________

Analyst:              JKM
Agency/Co.:           HDR
Date Performed:       11/15/2013
Analysis Time Period: AM Peak
Intersection:         Cliff Ave & I-229 SB On-Ramp
Jurisdiction:         Sioux Falls, SD
Units: U. S. Customary
Analysis Year:        2013
Project ID:  I-229 MIS
East/West Street:     I-229 SB On-Ramp
North/South Street:   Cliff Ave
Intersection Orientation: NS                 Study period (hrs):  0.25

________________________Vehicle Volumes and Adjustments________________________
Major Street Movements      1      2      3      4      5      6
                            L      T      R      L      T      R

______________________________________________________________________________
Volume                     327    1364                 541    201
Peak-Hour Factor, PHF      0.80   0.80                 0.80   0.80
Peak-15 Minute Volume      102    426                  169    63
Hourly Flow Rate, HFR      408    1704                 676    251
Percent Heavy Vehicles     2      --     --            --     --
Median Type/Storage         TWLTL                /  1
RT Channelized?
Lanes                         1   2                    2    0
Configuration                  L  T                    T   TR
Upstream Signal?                  Yes                  Yes
______________________________________________________________________________
Minor Street Movements        7    8      9     10     11     12
                            L      T      R      L      T      R

______________________________________________________________________________
Volume                                          0             0
Peak Hour Factor, PHF                           0.80          0.80
Peak-15 Minute Volume                           0             0
Hourly Flow Rate, HFR                           0             0
Percent Heavy Vehicles                          2             2
Percent Grade (%)                 0                    0
Flared Approach:  Exists?/Storage               /              No     /
RT Channelized?
Lanes                                              0        0
Configuration                                          LR
______________________________________________________________________________

______________________Pedestrian Volumes and Adjustments______________________
Movements                    13     14     15     16
______________________________________________________________________________
Flow (ped/hr)                0      0      0      0
```

```
Lane Width (ft)              12.0   12.0   12.0   12.0
Walking Speed (ft/sec)       4.0    4.0    4.0    4.0
Percent Blockage             0      0      0      0
______________________________________________________________________________

_____________________________Upstream Signal Data_____________________________
                 Prog.    Sat   Arrival   Green  Cycle   Prog.   Distance
                 Flow     Flow   Type     Time   Length  Speed   to Signal
                 vph      vph             sec     sec     mph      feet
______________________________________________________________________________
S2  Left-Turn    0       1800     3       0       100     30       600
    Through      1320    1800     4       52      100     30       600
S5  Left-Turn    0       1800     3       0       100     30       200
    Through      471     1800     4       55      100     30       200
______________________________________________________________________________

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles
______________________________________________________________________________
                                           Movement 2     Movement 5
______________________________________________________________________________
Shared ln volume, major th vehicles:
Shared ln volume, major rt vehicles:
Sat flow rate, major th vehicles:
Sat flow rate, major rt vehicles:
Number of major street through lanes:
______________________________________________________________________________

Worksheet 4-Critical Gap and Follow-up Time Calculation
______________________________________________________________________________
Critical Gap Calculation
Movement          1      4      7      8      9     10     11     12
                  L      L      L      T      R      L      T      R
______________________________________________________________________________
t(c,base)        4.1                                7.5           6.2
t(c,hv)          2.00   2.00   2.00   2.00   2.00   2.00   2.00   2.00
P(hv)            2                                  2             2
t(c,g)                         0.20   0.20   0.10   0.20   0.20   0.10
Percent Grade                  0.00   0.00   0.00   0.00   0.00   0.00
t(3,lt)          0.00                               0.70          0.00
t(c,T):  1-stage 0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
         2-stage 0.00   0.00   1.00   1.00   0.00   1.00   1.00   0.00
t(c)     1-stage 4.1                                6.8           6.2
         2-stage 4.1                                5.8           6.2
______________________________________________________________________________
Follow-Up Time Calculations
Movement          1      4      7      8      9     10     11     12
                  L      L      L      T      R      L      T      R
______________________________________________________________________________
t(f,base)        2.20                               3.50          3.30
t(f,HV)          1.00   1.00   1.00   1.00   1.00   1.00   1.00   1.00
P(HV)            2                                  2             2
t(f)             2.2                                3.5           3.3
______________________________________________________________________________

Worksheet 5-Effect of Upstream Signals
______________________________________________________________________________
Computation 1-Queue Clearance Time at Upstream Signal
                                            Movement 2        Movement 5
                                         V(t)   V(l,prot)  V(t)   V(l,prot)
______________________________________________________________________________
V prog                                   1320     0        471      0
```

```
Total Saturation Flow Rate, s (vph)      3600     3600     3600     3600
Arrival Type                             4        3        4        3
Effective Green, g (sec)                 52       0        55       0
Cycle Length, C (sec)                    100      100      100      100
Rp (from Exhibit 16-11)                  1.333    1.000    1.333    1.000
Proportion vehicles arriving on green P  0.693    0.000    0.733    0.000
g(q1)                                    11.2     0.0      3.5      0.0
g(q2)                                    10.8     0.0      0.7      0.0
g(q)                                     22.0     0.0      4.2      0.0
_______________________________________________________________________________
Computation 2-Proportion of TWSC Intersection Time  blocked
                                            Movement 2        Movement 5
                                         V(t)   V(l,prot)  V(t)   V(l,prot)
_______________________________________________________________________________
alpha                                         0.350             0.350
beta                                          0.741             0.741
Travel time, t(a) (sec)                       13.605            4.535
Smoothing Factor, F                           0.221             0.460
Proportion of conflicting flow, f        1.000    1.000    1.000    1.000
Max platooned flow, V(c,max)             3585     0        3333     0
Min platooned flow, V(c,min)             2000     2000     2000     2000
Duration of blocked period, t(p)         26.9     0.0      4.0      0.0
Proportion time blocked, p                    0.269             0.040
_______________________________________________________________________________
Computation 3-Platoon Event Periods     Result
_______________________________________________________________________________
p(2)                                    0.269
p(5)                                    0.040
p(dom)                                  0.269
p(subo)                                 0.040
Constrained or unconstrained?             U
_______________________________________________________________________________
Proportion
unblocked                  (1)             (2)              (3)
for minor              Single-stage         Two-Stage Process
movements, p(x)          Process       Stage I         Stage II
_______________________________________________________________________________
p(1)                      0.960
p(4)
p(7)
p(8)
p(9)
p(10)                     0.711         0.960           0.731
p(11)
p(12)                     0.960
_______________________________________________________________________________
Computation 4 and 5
Single-Stage Process
Movement                1      4      7      8      9     10     11     12
                        L      L      L      T      R      L      T      R
_______________________________________________________________________________
V c,x                  927                                2470          464
s                      3000                               3000          3000
Px                     0.960                              0.711         0.960
V c,u,x                840                                2255          358
_______________________________________________________________________________
C r,x                  791                                35            685
C plat,x               759                                25            658
_______________________________________________________________________________
Two-Stage Process
                     7               8              10              11
```

```
              Stage1  Stage2  Stage1  Stage2  Stage1  Stage2  Stage1  Stage2

V(c,x)                                        802     1668
s                                             3000    3000
P(x)                                          0.960   0.731
V(c,u,x)                                      710     1178

C(r,x)                                        448     255
C(plat,x)                                     430     186


Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.                          9               12

Conflicting Flows                                                464
Potential Capacity                                               658
Pedestrian Impedance Factor                     1.00             1.00
Movement Capacity                                                658
Probability of Queue free St.                   1.00             1.00

Step 2: LT from Major St.                          4                1

Conflicting Flows                                                927
Potential Capacity                                               759
Pedestrian Impedance Factor                     1.00             1.00
Movement Capacity                                                759
Probability of Queue free St.                   1.00             0.46
Maj L-Shared Prob Q free St.

Step 3: TH from Minor St.                          8               11

Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor                     1.00             1.00
Cap. Adj. factor due to Impeding mvmnt          0.46             0.46
Movement Capacity
Probability of Queue free St.                   1.00             1.00

Step 4: LT from Minor St.                          7               10

Conflicting Flows                                                2470
Potential Capacity                                               25
Pedestrian Impedance Factor                     1.00             1.00
Maj. L, Min T Impedance factor                  0.46
Maj. L, Min T Adj. Imp Factor.                  0.58
Cap. Adj. factor due to Impeding mvmnt          0.58             0.46
Movement Capacity                                                12


Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.                          8               11

Part 1 - First Stage
Conflicting Flows
Potential Capacity                              51               422
Pedestrian Impedance Factor                     1.00             1.00
Cap. Adj. factor due to Impeding mvmnt          0.46             1.00
Movement Capacity                               24               422
Probability of Queue free St.                   1.00             1.00
```

```
------------------------------------------------------------------------------
Part 2 - Second Stage
Conflicting Flows
Potential Capacity                              369              51
Pedestrian Impedance Factor                     1.00             1.00
Cap. Adj. factor due to Impeding mvmnt          1.00             0.46
Movement Capacity                               369              24
------------------------------------------------------------------------------
Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor                     1.00             1.00
Cap. Adj. factor due to Impeding mvmnt          0.46             0.46
Movement Capacity
------------------------------------------------------------------------------
Result for 2 stage process:
a                                               0.91             0.91
y
C t
Probability of Queue free St.                   1.00             1.00
------------------------------------------------------------------------------
Step 4: LT from Minor St.                          7               10
------------------------------------------------------------------------------
Part 1 - First Stage
Conflicting Flows                                                802
Potential Capacity                              44               430
Pedestrian Impedance Factor                     1.00             1.00
Cap. Adj. factor due to Impeding mvmnt          0.46             1.00
Movement Capacity                               20               430
------------------------------------------------------------------------------
Part 2 - Second Stage
Conflicting Flows                                                1668
Potential Capacity                              763              186
Pedestrian Impedance Factor                     1.00             1.00
Cap. Adj. factor due to Impeding mvmnt          1.00             0.46
Movement Capacity                               763              86
------------------------------------------------------------------------------
Part 3 - Single Stage
Conflicting Flows                                                2470
Potential Capacity                                               25
Pedestrian Impedance Factor                     1.00             1.00
Maj. L, Min T Impedance factor                  0.46
Maj. L, Min T Adj. Imp Factor.                  0.58
Cap. Adj. factor due to Impeding mvmnt          0.58             0.46
Movement Capacity                                                12
------------------------------------------------------------------------------
Results for Two-stage process:
a                                               0.91             0.91
y                                                                5.65
C t                                                              68
------------------------------------------------------------------------------

Worksheet 8-Shared Lane Calculations
------------------------------------------------------------------------------
Movement                              7      8      9     10     11     12
                                      L      T      R      L      T      R
------------------------------------------------------------------------------
Volume (vph)                                              0             0
Movement Capacity (vph)                                   68            658
Shared Lane Capacity (vph)
------------------------------------------------------------------------------
```

```
Worksheet 9-Computation of Effect of Flared Minor Street Approaches
______________________________________________________________________________
Movement                              7      8      9     10     11     12
                                      L      T      R      L      T      R
______________________________________________________________________________
C sep                                                     68            658
Volume                                                    0             0
Delay
Q sep
Q sep +1
round (Qsep +1)
______________________________________________________________________________
n max
C sh
SUM C sep
n
C act
______________________________________________________________________________

Worksheet 10-Delay, Queue Length, and Level of Service
______________________________________________________________________________
Movement             1      4      7      8      9      10     11     12
Lane Config          L                                          LR
______________________________________________________________________________
v (vph)             408                                        0
C(m) (vph)          759
v/c                 0.54
95% queue length    3.25
Control Delay       15.1
LOS                  C
Approach Delay
Approach LOS
______________________________________________________________________________

Worksheet 11-Shared Major LT Impedance and Delay
______________________________________________________________________________
                                                 Movement 2     Movement 5
______________________________________________________________________________
p(oj)                                               0.46           1.00
v(il), Volume for stream 2 or 5
v(i2), Volume for stream 3 or 6
s(il), Saturation flow rate for stream 2 or 5
s(i2), Saturation flow rate for stream 3 or 6
P*(oj)
d(M,LT), Delay for stream 1 or 4                    15.1
N, Number of major street through lanes
d(rank,1) Delay for stream 2 or 5
______________________________________________________________________________
```

```
                 HCS+: Unsignalized Intersections Release 5.6

_______________________TWO-WAY STOP CONTROL SUMMARY___________________________

Analyst:              JKM
Agency/Co.:           HDR
Date Performed:       11/15/2013
Analysis Time Period: PM Peak
Intersection:         Cliff Ave & I-229 SB On-Ramp
Jurisdiction:         Sioux Falls, SD
Units: U. S. Customary
Analysis Year:        2013
Project ID:  I-229 MIS
East/West Street:     I-229 SB On-Ramp
North/South Street:   Cliff Ave
Intersection Orientation: NS                 Study period (hrs):  0.25

______________________Vehicle Volumes and Adjustments_________________________
Major Street:  Approach        Northbound             Southbound
               Movement     1      2      3     |  4      5      6
                            L      T      R     |  L      T      R
______________________________________________________________________________
Volume                      164    658                    1305   382
Peak-Hour Factor, PHF       0.93   0.93                   0.93   0.93
Hourly Flow Rate, HFR       176    707                    1403   410
Percent Heavy Vehicles      3      --     --              --     --
Median Type/Storage         TWLTL                 / 1
RT Channelized?
Lanes                          1   2                      2    0
Configuration                   L  T                      T   TR
Upstream Signal?                   Yes                    Yes
______________________________________________________________________________
Minor Street:  Approach        Westbound              Eastbound
               Movement     7      8      9     |  10     11     12
                            L      T      R     |  L      T      R
______________________________________________________________________________
Volume                                             0             0
Peak Hour Factor, PHF                              0.93          0.93
Hourly Flow Rate, HFR                              0             0
Percent Heavy Vehicles                             3             3
Percent Grade (%)                  0                      0
Flared Approach:  Exists?/Storage                /              No     /
Lanes                                                 0        0
Configuration                                             LR
______________________________________________________________________________

__________________Delay, Queue Length, and Level of Service___________________
Approach            NB     SB        Westbound             Eastbound
Movement            1      4   |  7      8      9    |  10     11     12
Lane Config         L          |                     |         LR
______________________________________________________________________________
v (vph)             176                                        0
C(m) (vph)          333
v/c                 0.53
95% queue length    2.93
Control Delay       27.3
LOS                  D
Approach Delay
Approach LOS
______________________________________________________________________________
```

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                  HCS+: Unsignalized Intersections Release 5.6




Phone:                                        Fax:
E-Mail:

______________________TWO-WAY STOP CONTROL(TWSC) ANALYSIS_____________________

Analyst:              JKM
Agency/Co.:           HDR
Date Performed:       11/15/2013
Analysis Time Period: PM Peak
Intersection:         Cliff Ave & I-229 SB On-Ramp
Jurisdiction:         Sioux Falls, SD
Units: U. S. Customary
Analysis Year:        2013
Project ID:  I-229 MIS
East/West Street:     I-229 SB On-Ramp
North/South Street:   Cliff Ave
Intersection Orientation: NS                 Study period (hrs):  0.25

________________________Vehicle Volumes and Adjustments_______________________
Major Street Movements      1      2      3      4      5      6
                            L      T      R      L      T      R
______________________________________________________________________________
Volume                     164    658                  1305   382
Peak-Hour Factor, PHF      0.93   0.93                 0.93   0.93
Peak-15 Minute Volume      44     177                  351    103
Hourly Flow Rate, HFR      176    707                  1403   410
Percent Heavy Vehicles     3      --     --            --     --
Median Type/Storage         TWLTL                 / 1
RT Channelized?
Lanes                         1   2                    2    0
Configuration                   L T                    T   TR
Upstream Signal?                  Yes                  Yes
______________________________________________________________________________
Minor Street Movements        7      8      9     10     11     12
                            L      T      R      L      T      R
______________________________________________________________________________
Volume                                          0             0
Peak Hour Factor, PHF                           0.93          0.93
Peak-15 Minute Volume                           0             0
Hourly Flow Rate, HFR                           0             0
Percent Heavy Vehicles                          3             3
Percent Grade (%)                 0                    0
Flared Approach:  Exists?/Storage                /              No     /
RT Channelized?
Lanes                                              0        0
Configuration                                          LR
______________________________________________________________________________

______________________Pedestrian Volumes and Adjustments______________________
Movements                    13     14     15     16
______________________________________________________________________________
Flow (ped/hr)                0      0      0      0
```

```
Lane Width (ft)              12.0   12.0   12.0   12.0
Walking Speed (ft/sec)       4.0    4.0    4.0    4.0
Percent Blockage             0      0      0      0
______________________________________________________________________________

_____________________________Upstream Signal Data_____________________________
                 Prog.    Sat   Arrival   Green  Cycle   Prog.   Distance
                 Flow     Flow   Type     Time   Length  Speed   to Signal
                 vph      vph             sec     sec     mph      feet
______________________________________________________________________________
S2  Left-Turn    0       1800      3      0       100     30       600
    Through      1056    1800      4      54      100     30       600
S5  Left-Turn    0       1800      3      0       100     30       200
    Through      664     1800      4      54      100     30       200
______________________________________________________________________________

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles
______________________________________________________________________________
                                           Movement 2     Movement 5
______________________________________________________________________________
Shared ln volume, major th vehicles:
Shared ln volume, major rt vehicles:
Sat flow rate, major th vehicles:
Sat flow rate, major rt vehicles:
Number of major street through lanes:
______________________________________________________________________________

Worksheet 4-Critical Gap and Follow-up Time Calculation
______________________________________________________________________________
Critical Gap Calculation
Movement          1      4      7      8      9      10     11     12
                  L      L      L      T      R      L      T      R
______________________________________________________________________________
t(c,base)        4.1                                 7.5           6.2
t(c,hv)          2.00   2.00   2.00   2.00   2.00   2.00   2.00   2.00
P(hv)            3                                   3             3
t(c,g)                         0.20   0.20   0.10   0.20   0.20   0.10
Percent Grade                  0.00   0.00   0.00   0.00   0.00   0.00
t(3,lt)          0.00                               0.70          0.00
t(c,T):  1-stage 0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
         2-stage 0.00   0.00   1.00   1.00   0.00   1.00   1.00   0.00
t(c)     1-stage 4.2                                6.9           6.3
         2-stage 4.2                                5.9           6.3
______________________________________________________________________________
Follow-Up Time Calculations
Movement          1      4      7      8      9      10     11     12
                  L      L      L      T      R      L      T      R
______________________________________________________________________________
t(f,base)        2.20                               3.50          3.30
t(f,HV)          1.00   1.00   1.00   1.00   1.00   1.00   1.00   1.00
P(HV)            3                                   3             3
t(f)             2.2                                3.5           3.3
______________________________________________________________________________

Worksheet 5-Effect of Upstream Signals
______________________________________________________________________________
Computation 1-Queue Clearance Time at Upstream Signal
                                            Movement 2        Movement 5
                                         V(t)   V(l,prot)  V(t)   V(l,prot)
______________________________________________________________________________
V prog                                   1056     0        664      0
```

```
Total Saturation Flow Rate, s (vph)      3600     3600     3600     3600
Arrival Type                             4        3        4        3
Effective Green, g (sec)                 54       0        54       0
Cycle Length, C (sec)                    100      100      100      100
Rp (from Exhibit 16-11)                  1.333    1.000    1.333    1.000
Proportion vehicles arriving on green P  0.720    0.000    0.720    0.000
g(q1)                                    8.2      0.0      5.2      0.0
g(q2)                                    5.3      0.0      1.7      0.0
g(q)                                     13.5     0.0      6.8      0.0
______________________________________________________________________________
Computation 2-Proportion of TWSC Intersection Time  blocked
                                            Movement 2        Movement 5
                                         V(t)   V(l,prot)  V(t)   V(l,prot)
______________________________________________________________________________
alpha                                         0.350             0.350
beta                                          0.741             0.741
Travel time, t(a) (sec)                       13.605            4.535
Smoothing Factor, F                           0.221             0.460
Proportion of conflicting flow, f        1.000    1.000    1.000    1.000
Max platooned flow, V(c,max)             3476     0        3547     0
Min platooned flow, V(c,min)             2000     2000     2000     2000
Duration of blocked period, t(p)         15.3     0.0      6.9      0.0
Proportion time blocked, p                    0.153             0.069
______________________________________________________________________________
Computation 3-Platoon Event Periods     Result
______________________________________________________________________________
p(2)                                    0.153
p(5)                                    0.069
p(dom)                                  0.153
p(subo)                                 0.069
Constrained or unconstrained?             U
______________________________________________________________________________
Proportion
unblocked                  (1)             (2)             (3)
for minor              Single-stage         Two-Stage Process
movements, p(x)          Process        Stage I         Stage II
______________________________________________________________________________
p(1)                      0.931
p(4)
p(7)
p(8)
p(9)
p(10)                     0.813         0.931           0.847
p(11)
p(12)                     0.931
______________________________________________________________________________
Computation 4 and 5
Single-Stage Process
Movement                1      4      7      8      9     10     11     12
                        L      L      L      T      R      L      T      R
______________________________________________________________________________
V c,x                  1813                               2313          906
s                      3000                               3000          3000
Px                     0.931                              0.813        0.931
V c,u,x                1724                               2155          750
______________________________________________________________________________
C r,x                  358                                40            407
C plat,x               333                                33            379
______________________________________________________________________________
Two-Stage Process
                     7               8              10              11
```

```
              Stage1  Stage2  Stage1  Stage2  Stage1  Stage2  Stage1  Stage2
------------------------------------------------------------------------------
V(c,x)                                        1608    705
s                                             3000    3000
P(x)                                          0.931   0.847
V(c,u,x)                                      1504    292
------------------------------------------------------------------------------
C(r,x)                                        169     729
C(plat,x)                                     157     618
------------------------------------------------------------------------------

Worksheet 6-Impedance and Capacity Equations
------------------------------------------------------------------------------
Step 1: RT from Minor St.                          9               12
------------------------------------------------------------------------------
Conflicting Flows                                                906
Potential Capacity                                               379
Pedestrian Impedance Factor                     1.00             1.00
Movement Capacity                                                379
Probability of Queue free St.                   1.00             1.00
------------------------------------------------------------------------------
Step 2: LT from Major St.                          4                1
------------------------------------------------------------------------------
Conflicting Flows                                                1813
Potential Capacity                                               333
Pedestrian Impedance Factor                     1.00             1.00
Movement Capacity                                                333
Probability of Queue free St.                   1.00             0.47
Maj L-Shared Prob Q free St.
------------------------------------------------------------------------------
Step 3: TH from Minor St.                          8               11
------------------------------------------------------------------------------
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor                     1.00             1.00
Cap. Adj. factor due to Impeding mvmnt          0.47             0.47
Movement Capacity
Probability of Queue free St.                   1.00             1.00
------------------------------------------------------------------------------
Step 4: LT from Minor St.                          7               10
------------------------------------------------------------------------------
Conflicting Flows                                                2313
Potential Capacity                                               33
Pedestrian Impedance Factor                     1.00             1.00
Maj. L, Min T Impedance factor                  0.47
Maj. L, Min T Adj. Imp Factor.                  0.58
Cap. Adj. factor due to Impeding mvmnt          0.58             0.47
Movement Capacity                                                16
------------------------------------------------------------------------------

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance
------------------------------------------------------------------------------
Step 3: TH from Minor St.                          8               11
------------------------------------------------------------------------------
Part 1 - First Stage
Conflicting Flows
Potential Capacity                              373              173
Pedestrian Impedance Factor                     1.00             1.00
Cap. Adj. factor due to Impeding mvmnt          0.47             1.00
Movement Capacity                               176              173
Probability of Queue free St.                   1.00             1.00
```

```
______________________________________________________________________________
Part 2 - Second Stage
Conflicting Flows
Potential Capacity                              135              373
Pedestrian Impedance Factor                     1.00             1.00
Cap. Adj. factor due to Impeding mvmnt          1.00             0.47
Movement Capacity                               135              176
______________________________________________________________________________
Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor                     1.00             1.00
Cap. Adj. factor due to Impeding mvmnt          0.47             0.47
Movement Capacity
______________________________________________________________________________
Result for 2 stage process:
a                                               0.91             0.91
y
C t
Probability of Queue free St.                   1.00             1.00
______________________________________________________________________________
Step 4: LT from Minor St.                          7               10
______________________________________________________________________________
Part 1 - First Stage
Conflicting Flows                                                1608
Potential Capacity                              385              157
Pedestrian Impedance Factor                     1.00             1.00
Cap. Adj. factor due to Impeding mvmnt          0.47             1.00
Movement Capacity                               182              157
______________________________________________________________________________
Part 2 - Second Stage
Conflicting Flows                                                705
Potential Capacity                              522              618
Pedestrian Impedance Factor                     1.00             1.00
Cap. Adj. factor due to Impeding mvmnt          1.00             0.47
Movement Capacity                               522              291
______________________________________________________________________________
Part 3 - Single Stage
Conflicting Flows                                                2313
Potential Capacity                                               33
Pedestrian Impedance Factor                     1.00             1.00
Maj. L, Min T Impedance factor                  0.47
Maj. L, Min T Adj. Imp Factor.                  0.58
Cap. Adj. factor due to Impeding mvmnt          0.58             0.47
Movement Capacity                                                16
______________________________________________________________________________
Results for Two-stage process:
a                                               0.91             0.91
y                                                                0.51
C t                                                              100
______________________________________________________________________________

Worksheet 8-Shared Lane Calculations
______________________________________________________________________________
Movement                              7      8      9     10     11     12
                                      L      T      R      L      T      R
______________________________________________________________________________
Volume (vph)                                              0             0
Movement Capacity (vph)                                   100           379
Shared Lane Capacity (vph)
______________________________________________________________________________
```

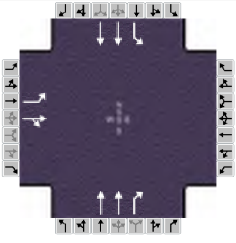
```
Worksheet 9-Computation of Effect of Flared Minor Street Approaches
------------------------------------------------------------------------------
Movement                              7      8      9     10     11     12
                                      L      T      R      L      T      R
------------------------------------------------------------------------------
C sep                                                     100           379
Volume                                                    0             0
Delay
Q sep
Q sep +1
round (Qsep +1)
------------------------------------------------------------------------------
n max
C sh
SUM C sep
n
C act
------------------------------------------------------------------------------

Worksheet 10-Delay, Queue Length, and Level of Service
------------------------------------------------------------------------------
Movement             1      4      7      8      9     10     11     12
Lane Config          L                                          LR
------------------------------------------------------------------------------
v (vph)             176                                        0
C(m) (vph)          333
v/c                 0.53
95% queue length    2.93
Control Delay       27.3
LOS                  D
Approach Delay
Approach LOS
------------------------------------------------------------------------------

Worksheet 11-Shared Major LT Impedance and Delay
------------------------------------------------------------------------------
                                                 Movement 2     Movement 5
------------------------------------------------------------------------------
p(oj)                                               0.47           1.00
v(il), Volume for stream 2 or 5
v(i2), Volume for stream 3 or 6
s(il), Saturation flow rate for stream 2 or 5
s(i2), Saturation flow rate for stream 3 or 6
P*(oj)
d(M,LT), Delay for stream 1 or 4                    27.3
N, Number of major street through lanes
d(rank,1) Delay for stream 2 or 5
------------------------------------------------------------------------------
```

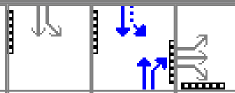
HCS 2010 Signalized Intersection Results Summary

General Information				**Intersection Information**	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	Cliff Ave & NB I-229 Ramps	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_Cliff_AM.xus				
Project Description	Existing AM				

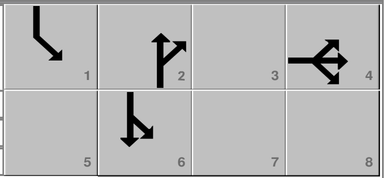


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	371	0	131					1320	346	95	446	

Signal Information			
Cycle, s	100.0	Reference Phase	6
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	5.2	52.1	27.9	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	1.5	1.5	0.0	0.0	0.0



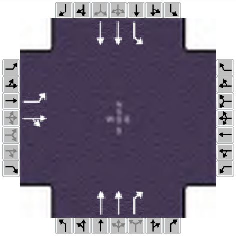
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2	1	6
Case Number		10.0				7.3	1.0	4.0
Phase Duration, s		33.0				57.2	9.8	67.0
Change Period, ($Y+R_c$), s		5.1				5.1	4.6	5.1
Max Allow Headway (MAH), s		4.1				0.0	4.2	0.0
Queue Clearance Time (g_s), s		29.2					5.3	
Green Extension Time (g_e), s		0.0				0.0	0.0	0.0
Phase Call Probability		1.00					0.96	
Max Out Probability		1.00					1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14					2	12	1	6	
Adjusted Flow Rate (v), veh/h	464	164						1650	433	119	558	
Adjusted Saturation Flow Rate (s), veh/h/ln	1692	1512						1735	1470	1588	1612	
Queue Service Time (g_s), s	27.2	8.8						43.4	20.0	3.3	5.0	
Cycle Queue Clearance Time (g_c), s	27.2	8.8						43.4	20.0	3.3	5.0	
Green Ratio (g/C)	0.28	0.28						0.52	0.52	0.59	0.62	
Capacity (c), veh/h	472	422						1810	766	170	1995	
Volume-to-Capacity Ratio (X)	0.982	0.388						0.912	0.564	0.697	0.279	
Available Capacity (c_a), veh/h	472	422						1810	766	190	1995	
Back of Queue (Q), veh/ln (95th percentile)	21.9	5.6						20.7	8.8	3.3	2.7	
Queue Storage Ratio (RQ) (95th percentile)	3.74	0.14						0.22	0.90	0.84	0.09	
Uniform Delay (d_1), s/veh	35.8	29.1						21.8	16.2	22.4	4.9	
Incremental Delay (d_2), s/veh	36.7	0.6						2.8	0.9	8.8	0.3	
Initial Queue Delay (d_3), s/veh	0.0	0.0						0.0	0.0	0.0	0.0	
Control Delay (d), s/veh	72.5	29.7						24.6	17.1	31.2	5.2	
Level of Service (LOS)	E	C						C	B	C	A	
Approach Delay, s/veh / LOS	61.3	E		0.0			23.0	C		9.8	A	
Intersection Delay, s/veh / LOS	27.5						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.9	C	1.9	A	1.7	A
Bicycle LOS Score / LOS	1.5	A			2.2	B	1.0	A

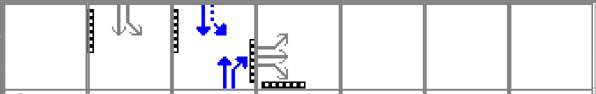
HCS 2010 Signalized Intersection Results Summary

General Information				**Intersection Information**	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Cliff Ave & NB I-229 Ramps	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_Cliff_PM.xus				
Project Description	Existing PM				

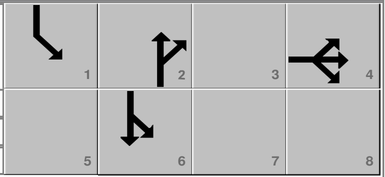


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	158	0	321					664	147	114	1191	

Signal Information			
Cycle, s	100.0	Reference Phase	6
Offset, s	48	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	5.1	54.3	25.9	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	1.5	1.5	0.0	0.0	0.0



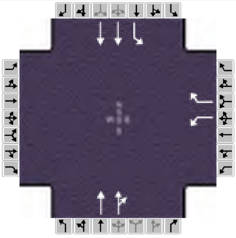
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2	1	6
Case Number		10.0				7.3	1.0	4.0
Phase Duration, s		31.0				59.4	9.7	69.0
Change Period, (*Y*+*Rc*), s		5.1				5.1	4.6	5.1
Max Allow Headway (*MAH*), s		4.2				0.0	4.2	0.0
Queue Clearance Time (*gs*), s		25.5					5.2	
Green Extension Time (*ge*), s		0.3				0.0	0.1	0.0
Phase Call Probability		1.00					0.97	
Max Out Probability		1.00					1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14					2	12	1	6	
Adjusted Flow Rate (*v*), veh/h	170	345						714	158	123	1281	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1603	1432						1628	1418	1589	1692	
Queue Service Time (*gs*), s	8.8	23.5						12.8	5.7	3.2	21.3	
Cycle Queue Clearance Time (*gc*), s	8.8	23.5						12.8	5.7	3.2	21.3	
Green Ratio (*g/C*)	0.26	0.26						0.54	0.54	0.61	0.64	
Capacity (*c*), veh/h	415	370						1767	769	400	2163	
Volume-to-Capacity Ratio (*X*)	0.410	0.932						0.404	0.205	0.306	0.592	
Available Capacity (*ca*), veh/h	431	385						1767	769	438	2163	
Back of Queue (*Q*), veh/ln (95th percentile)	6.0	16.2						7.9	3.3	2.0	10.9	
Queue Storage Ratio (*RQ*) (95th percentile)	1.03	0.41						0.08	0.34	0.51	0.35	
Uniform Delay (*d1*), s/veh	30.7	36.2						13.4	11.8	9.8	9.9	
Incremental Delay (*d2*), s/veh	0.6	28.7						0.6	0.5	0.3	0.8	
Initial Queue Delay (*d3*), s/veh	0.0	0.0						0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	31.4	64.9						14.0	12.3	10.1	10.7	
Level of Service (LOS)	C	E						B	B	B	B	
Approach Delay, s/veh / LOS	53.8	D		0.0			13.7	B		10.7	B	
Intersection Delay, s/veh / LOS	19.6						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.9	C	1.9	A	1.6	A
Bicycle LOS Score / LOS	1.3	A			1.2	A	1.6	A

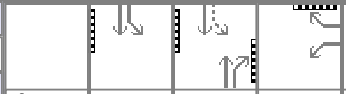
HCS 2010 Signalized Intersection Results Summary

General Information				**Intersection Information**	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	Cliff Ave & 49th St	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_Cliff_AM.xus				
Project Description	Existing AM				

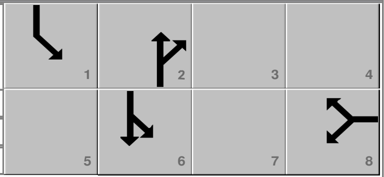


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				38		546		1037	19	164	390	

Signal Information			
Cycle, s	94.1	Reference Phase	6
Offset, s	0	Reference Point	Begin
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	7.4	37.9	34.0	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	1.5	1.5	0.0	0.0	0.0



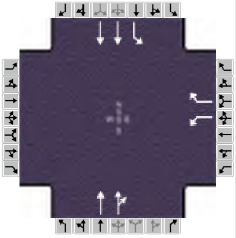
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8		2	1	6
Case Number				9.0		8.3	1.0	4.0
Phase Duration, s				39.1		43.0	12.0	55.0
Change Period, (*Y+R*c), s				5.1		5.1	4.6	5.1
Max Allow Headway (*MAH*), s				4.4		4.1	4.2	4.1
Queue Clearance Time (*g*s), s				32.4		39.9	9.2	9.6
Green Extension Time (*g*e), s				1.6		0.0	0.0	10.2
Phase Call Probability				1.00		1.00	1.00	1.00
Max Out Probability				0.39		1.00	1.00	0.06

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3		18		2	12	1	6	
Adjusted Flow Rate (*v*), veh/h				48		503		662	658	205	488	
Adjusted Saturation Flow Rate (*s*), veh/h/ln				1681		1496		1748	1736	1664	1664	
Queue Service Time (*g*s), s				1.7		30.4		37.9	34.3	7.2	7.6	
Cycle Queue Clearance Time (*g*c), s				1.7		30.4		37.9	34.3	7.2	7.6	
Green Ratio (*g/C*)				0.36		0.36		0.40	0.40	0.50	0.53	
Capacity (*c*), veh/h				607		540		704	699	208	1765	
Volume-to-Capacity Ratio (*X*)				0.078		0.930		0.940	0.941	0.988	0.276	
Available Capacity (*c*a), veh/h				713		634		704	699	208	1765	
Back of Queue (*Q*), veh/ln (95th percentile)				1.2		19.2		24.8	24.7	9.9	5.0	
Queue Storage Ratio (*RQ*) (95th percentile)				0.42		0.49		0.63	0.63	1.02	0.05	
Uniform Delay (*d*1), s/veh				19.8		28.9		27.0	27.0	24.4	12.2	
Incremental Delay (*d*2), s/veh				0.1		18.8		22.1	22.3	57.6	0.4	
Initial Queue Delay (*d*3), s/veh				0.0		0.0		0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh				19.8		47.7		49.1	49.3	82.1	12.5	
Level of Service (LOS)				B		D		D	D	F	B	
Approach Delay, s/veh / LOS	0.0			45.3		D	49.2		D	33.1		C
Intersection Delay, s/veh / LOS	44.0						D					

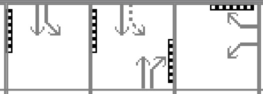
Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.7	B	2.9	C	2.5	B	0.7	A
Bicycle LOS Score / LOS				F	1.6	A	1.1	A

HCS 2010 Signalized Intersection Results Summary

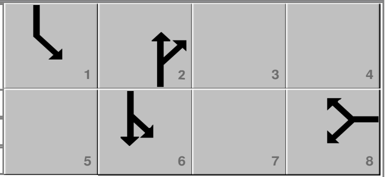
General Information				**Intersection Information**	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Cliff Ave & 49th St	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_Cliff_PM.xus				
Project Description	Existing PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h				55		272		490	59	441	947	



Signal Information										
Cycle, s	40.4	Reference Phase	6							
Offset, s	0	Reference Point	Begin	Green	9.2	13.1	3.3	0.0	0.0	0.0
Uncoordinated	Yes	Simult. Gap E/W	On	Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	1.5	1.5	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8		2	1	6
Case Number				9.0		8.3	1.0	4.0
Phase Duration, s				8.4		18.2	13.8	32.0
Change Period, $(Y+R_c)$, s				5.1		5.1	4.6	5.1
Max Allow Headway (*MAH*), s				4.3		4.1	4.2	4.1
Queue Clearance Time (g_s), s				4.0		9.1	8.7	4.3
Green Extension Time (g_e), s				0.2		1.3	0.6	7.6
Phase Call Probability				0.78		1.00	1.00	1.00
Max Out Probability				0.64		1.00	1.00	0.14

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3		18		2	12	1	6	
Adjusted Flow Rate (v), veh/h				59		76		294	286	474	1018	
Adjusted Saturation Flow Rate (s), veh/h/ln				1681		1496		1748	1691	1664	1664	
Queue Service Time (g_s), s				1.4		2.0		7.1	5.5	6.7	2.3	
Cycle Queue Clearance Time (g_c), s				1.4		2.0		7.1	5.5	6.7	2.3	
Green Ratio (g/C)				0.08		0.08		0.33	0.33	0.60	0.67	
Capacity (c), veh/h				135		121		568	550	680	2218	
Volume-to-Capacity Ratio (X)				0.437		0.634		0.517	0.520	0.698	0.459	
Available Capacity (c_a), veh/h				371		330		568	550	771	2218	
Back of Queue (Q), veh/ln (95th percentile)				1.0		1.4		3.9	3.9	2.1	0.6	
Queue Storage Ratio (*RQ*) (95th percentile)				0.33		0.04		0.10	0.10	0.22	0.01	
Uniform Delay (d_1), s/veh				17.7		18.0		11.0	11.1	5.8	0.9	
Incremental Delay (d_2), s/veh				2.2		5.4		3.3	3.5	1.7	0.5	
Initial Queue Delay (d_3), s/veh				0.0		0.0		0.0	0.0	0.0	0.0	
Control Delay (d), s/veh				19.9		23.4		14.4	14.5	7.5	1.4	
Level of Service (LOS)				B		C		B	B	A	A	
Approach Delay, s/veh / LOS	0.0			21.9	C		14.5	B		3.3	A	
Intersection Delay, s/veh / LOS	7.4						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.7	B	2.8	C	2.5	B	0.6	A
Bicycle LOS Score / LOS				F	1.0	A	1.7	A

FREEWAY WEAVING WORKSHEET

General Information

Analyst	JKM
Agency/Company	HDR
Date Performed	11/18/2013
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	Minnesota Ave to Cliff Ave
Analysis Year	2013

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	3130ft
Freeway free-flow speed, FFS	70 mph

Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	1460	0.80	6	0	1.5	1.2	0.971	1.00	1880
V_{RF}	275	0.80	3	0	1.5	1.2	0.985	1.00	349
V_{FR}	439	0.80	3	0	1.5	1.2	0.985	1.00	557
V_{RR}	63	0.80	3	0	1.5	1.2	0.985	1.00	80
V_{NW}	1960							V =	2783
V_W	906								
VR	0.316								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc

Minimum weaving lane changes, LC_{MIN}	906 lc/h
Weaving lane changes, LC_W	1231 lc/h
Non-weaving lane changes, LC_{NW}	1522 lc/h
Total lane changes, LC_{ALL}	2753 lc/h
Non-weaving vehicle index, I_{NW}	613

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2783 veh/h
Weaving segment capacity, c_w	6405 veh/h
Weaving segment v/c ratio	0.434
Weaving segment density, D	16.1 pc/mi/ln
Level of Service, LOS	B

Weaving intensity factor, W	0.204
Weaving segment speed, S	59.4 mph
Average weaving speed, S_W	60.7 mph
Average non-weaving speed, S_{NW}	58.9 mph
Maximum weaving length, L_{MAX}	5757 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".

b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst JKM
Agency/Company HDR
Date Performed 11/18/2013
Analysis Time Period PM Peak

Site Information

Freeway/Dir of Travel I-229 Northbound
Weaving Segment Location Minnesota Ave to Cliff Ave
Analysis Year 2013

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	3130ft
Freeway free-flow speed, FFS	70 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1381	0.93	6	0	1.5	1.2	0.971	1.00	1529
V_{RF}	440	0.93	3	0	1.5	1.2	0.985	1.00	480
V_{FR}	458	0.93	3	0	1.5	1.2	0.985	1.00	500
V_{RR}	21	0.93	3	0	1.5	1.2	0.985	1.00	23
V_{NW}	1552							V =	2459
V_W	980								
VR	0.387								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	980 lc/h
Weaving lane changes, LC_W	1305 lc/h
Non-weaving lane changes, LC_{NW}	1438 lc/h
Total lane changes, LC_{ALL}	2743 lc/h
Non-weaving vehicle index, I_{NW}	486

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2459 veh/h
Weaving segment capacity, c_w	6020 veh/h
Weaving segment v/c ratio	0.408
Weaving segment density, D	14.2 pc/mi/ln
Level of Service, LOS	B
Weaving intensity factor, W	0.204
Weaving segment speed, S	59.6 mph
Average weaving speed, S_W	60.7 mph
Average non-weaving speed, S_{NW}	58.9 mph
Maximum weaving length, L_{MAX}	6536 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information / Site Information

Analyst	*JKM*	Highway/Direction of Travel	*I-229 Northbound*
Agency or Company	*HDR*	From/To	*Cliff Off-Ramp to On-Ramp*
Date Performed	*11/19/2013*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*AM Peak*	Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1735*	veh/h	Peak-Hour Factor, PHF	*0.80*
AADT		veh/day	%Trucks and Buses, P_T	*5*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.976*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*69.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*69.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1111*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*15.9*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes

V - Hourly volume

v_p - Flow rate

LOS - Level of service

DDHV - Directional design hour volume

S - Speed

D - Density

FFS - Free-flow speed

BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12

E_T - Exhibits 11-10, 11-11, 11-13

f_p - Page 11-18

LOS, S, FFS, v_p - Exhibits 11-2, 11-3

f_{LW} - Exhibit 11-8

f_{LC} - Exhibit 11-9

TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JKM*	Highway/Direction of Travel	*I-229 Northbound*
Agency or Company	*HDR*	From/To	*Cliff Off-Ramp to On-Ramp*
Date Performed	*11/19/2013*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*PM Peak*	Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1821*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*5*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]	*0.976*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*69.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*69.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1004*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*14.3*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JKM
Agency/Company	HDR
Date Performed	11/18/2013
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	Cliff Ave to 26th St
Analysis Year	2013

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2750ft
Freeway free-flow speed, FFS	69 mph

Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	1280	0.80	9	0	1.5	1.2	0.957	1.00	1672
V_{RF}	431	0.80	3	0	1.5	1.2	0.985	1.00	547
V_{FR}	455	0.80	3	0	1.5	1.2	0.985	1.00	577
V_{RR}	10	0.80	3	0	1.5	1.2	0.985	1.00	13
V_{NW}	1685							V =	2689
V_W	1124								
VR	0.400								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc

Minimum weaving lane changes, LC_{MIN}	1124 lc/h
Weaving lane changes, LC_W	1426 lc/h
Non-weaving lane changes, LC_{NW}	1260 lc/h
Total lane changes, LC_{ALL}	2686 lc/h
Non-weaving vehicle index, I_{NW}	463

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2689 veh/h
Weaving segment capacity, c_w	5740 veh/h
Weaving segment v/c ratio	0.468
Weaving segment density, D	16.3 pc/mi/ln
Level of Service, LOS	B

Weaving intensity factor, W	0.222
Weaving segment speed, S	57.5 mph
Average weaving speed, S_W	59.2 mph
Average non-weaving speed, S_{NW}	56.4 mph
Maximum weaving length, L_{MAX}	6683 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JKM
Agency/Company	HDR
Date Performed	11/18/2013
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	Cliff Ave to 26th St
Analysis Year	2013

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2750ft
Freeway free-flow speed, FFS	69 mph

Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1168	0.93	9	0	1.5	1.2	0.957	1.00	1312
V_{RF}	251	0.93	3	0	1.5	1.2	0.985	1.00	274
V_{FR}	653	0.93	3	0	1.5	1.2	0.985	1.00	713
V_{RR}	10	0.93	3	0	1.5	1.2	0.985	1.00	11
V_{NW}	1323							V =	2211
V_W	987								
VR	0.427								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc

Minimum weaving lane changes, LC_{MIN}	987 lc/h
Weaving lane changes, LC_W	1289 lc/h
Non-weaving lane changes, LC_{NW}	1185 lc/h
Total lane changes, LC_{ALL}	2474 lc/h
Non-weaving vehicle index, I_{NW}	364

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2211 veh/h
Weaving segment capacity, c_w	5375 veh/h
Weaving segment v/c ratio	0.411
Weaving segment density, D	13.1 pc/mi/ln
Level of Service, LOS	B

Weaving intensity factor, W	0.208
Weaving segment speed, S	58.8 mph
Average weaving speed, S_W	59.7 mph
Average non-weaving speed, S_{NW}	58.2 mph
Maximum weaving length, L_{MAX}	6989 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JKM
Agency/Company	HDR
Date Performed	11/18/2013
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-229 Southbound
Weaving Segment Location	26th St to Cliff Ave
Analysis Year	2013

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2670ft
Freeway free-flow speed, FFS	69 mph

Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1234	0.80	9	0	1.5	1.2	0.957	1.00	1612
V_{RF}	682	0.80	3	0	1.5	1.2	0.985	1.00	865
V_{FR}	210	0.80	3	0	1.5	1.2	0.985	1.00	266
V_{RR}	10	0.80	3	0	1.5	1.2	0.985	1.00	13
V_{NW}	1625							V =	2638
V_W	1131								
VR	0.410								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc

Minimum weaving lane changes, LC_{MIN}	1131 lc/h
Weaving lane changes, LC_W	1429 lc/h
Non-weaving lane changes, LC_{NW}	1204 lc/h
Total lane changes, LC_{ALL}	2633 lc/h
Non-weaving vehicle index, I_{NW}	434

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2638 veh/h
Weaving segment capacity, c_w	5596 veh/h
Weaving segment v/c ratio	0.471
Weaving segment density, D	16.0 pc/mi/ln
Level of Service, LOS	B

Weaving intensity factor, W	0.224
Weaving segment speed, S	57.5 mph
Average weaving speed, S_W	59.1 mph
Average non-weaving speed, S_{NW}	56.4 mph
Maximum weaving length, L_{MAX}	6798 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".

b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JKM
Agency/Company	HDR
Date Performed	11/18/2013
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-229 Southbound
Weaving Segment Location	26th St to Cliff Ave
Analysis Year	2013

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2670ft
Freeway free-flow speed, FFS	69 mph

Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	1397	0.93	8	0	1.5	1.2	0.962	1.00	1562
V_{RF}	533	0.93	3	0	1.5	1.2	0.985	1.00	582
V_{FR}	382	0.93	3	0	1.5	1.2	0.985	1.00	417
V_{RR}	10	0.93	3	0	1.5	1.2	0.985	1.00	11
V_{NW}	1573							V =	2474
V_W	999								
VR	0.388								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc

Minimum weaving lane changes, LC_{MIN}	999 lc/h
Weaving lane changes, LC_W	1297 lc/h
Non-weaving lane changes, LC_{NW}	1193 lc/h
Total lane changes, LC_{ALL}	2490 lc/h
Non-weaving vehicle index, I_{NW}	420

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2474 veh/h
Weaving segment capacity, c_w	5941 veh/h
Weaving segment v/c ratio	0.416
Weaving segment density, D	14.7 pc/mi/ln
Level of Service, LOS	B

Weaving intensity factor, W	0.214
Weaving segment speed, S	58.4 mph
Average weaving speed, S_W	59.5 mph
Average non-weaving speed, S_{NW}	57.7 mph
Maximum weaving length, L_{MAX}	6552 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		***Site Information***	
Analyst	*JKM*	Highway/Direction of Travel	*I-229 Southbound*
Agency or Company	*HDR*	From/To	*Cliff Off-Ramp to On-Ramp*
Date Performed	*11/19/2013*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*AM Peak*	Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1916*	veh/h	Peak-Hour Factor, PHF	*0.80*
AADT		veh/day	%Trucks and Buses, P_T	*7*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*69.0*	mph	FFS	*69.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1239*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*70.0*	mph	S	mph
D = v_p / S	*17.7*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*B*		Required Number of Lanes, N	

Glossary

N - Number of lanes	S - Speed
V - Hourly volume	D - Density
v_p - Flow rate	FFS - Free-flow speed
LOS - Level of service	BFFS - Base free-flow speed
DDHV - Directional design hour volume	

Factor Location

E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
f_p - Page 11-18	TRD - Page 11-11
LOS, S, FFS, v_p - Exhibits 11-2, 11-3	

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JKM*	Highway/Direction of Travel	*I-229 Southbound*
Agency or Company	*HDR*	From/To	*Cliff Off-Ramp to On-Ramp*
Date Performed	*11/19/2013*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*PM Peak*	Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1930*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*7*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*69.0*	mph	FFS	*69.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1074*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*70.0*	mph	S	mph
D = v_p / S	*15.3*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*B*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JKM
Agency/Company	HDR
Date Performed	11/18/2013
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-229 Southbound
Weaving Segment Location	Cliff Ave to Minnesota Ave
Analysis Year	2013

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	3120ft
Freeway free-flow speed, FFS	67 mph

Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	1639	0.80	6	0	1.5	1.2	0.971	1.00	2110
V_{RF}	429	0.80	3	0	1.5	1.2	0.985	1.00	544
V_{FR}	277	0.80	3	0	1.5	1.2	0.985	1.00	351
V_{RR}	99	0.80	3	0	1.5	1.2	0.985	1.00	126
V_{NW}	2236							V =	3040
V_W	895								
VR	0.286								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc

Minimum weaving lane changes, LC_{MIN}	895 lc/h
Weaving lane changes, LC_W	1220 lc/h
Non-weaving lane changes, LC_{NW}	1574 lc/h
Total lane changes, LC_{ALL}	2794 lc/h
Non-weaving vehicle index, I_{NW}	698

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3040 veh/h
Weaving segment capacity, c_w	6329 veh/h
Weaving segment v/c ratio	0.480
Weaving segment density, D	18.6 pc/mi/ln
Level of Service, LOS	B

Weaving intensity factor, W	0.207
Weaving segment speed, S	56.2 mph
Average weaving speed, S_W	58.1 mph
Average non-weaving speed, S_{NW}	55.5 mph
Maximum weaving length, L_{MAX}	5433 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JKM
Agency/Company	HDR
Date Performed	11/18/2013
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-229 Southbound
Weaving Segment Location	Cliff Ave to Minnesota Ave
Analysis Year	2013

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	3120ft
Freeway free-flow speed, FFS	67 mph

Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1559	0.93	6	0	1.5	1.2	0.971	1.00	1727
V_{RF}	519	0.93	3	0	1.5	1.2	0.985	1.00	566
V_{FR}	371	0.93	3	0	1.5	1.2	0.985	1.00	405
V_{RR}	27	0.93	3	0	1.5	1.2	0.985	1.00	29
V_{NW}	1756							V =	2648
V_W	971								
VR	0.356								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc

Minimum weaving lane changes, LC_{MIN}	971 lc/h
Weaving lane changes, LC_W	1296 lc/h
Non-weaving lane changes, LC_{NW}	1475 lc/h
Total lane changes, LC_{ALL}	2771 lc/h
Non-weaving vehicle index, I_{NW}	548

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2648 veh/h
Weaving segment capacity, c_w	6160 veh/h
Weaving segment v/c ratio	0.430
Weaving segment density, D	16.1 pc/mi/ln
Level of Service, LOS	B

Weaving intensity factor, W	0.206
Weaving segment speed, S	56.5 mph
Average weaving speed, S_W	58.1 mph
Average non-weaving speed, S_{NW}	55.6 mph
Maximum weaving length, L_{MAX}	6193 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".

b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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APPENDIX C. 2035 NO-BUILD AND BUILD OPERATIONAL ANALYSIS TECHNICAL MEMORANDUM

Year 2035 Sub-Study 6 No Build conditions operational analysis included the analysis of 4 signalized intersections, 1 unsignalized intersection, 2 basic freeway segments, and 4 weave segments. All locations were analyzed for the AM peak hour and PM peak hour, based on traffic forecasting procedures utilizing output from the Sioux Falls MPO Sioux Falls travel demand model in Cube Voyager.

The 2035 No-Build volumes are based on the MPO's future travel demand model, reflective of fiscally constrained planned projects included in the 2035 Long Range Transportation Plan (LRTP). The No-Build condition for this study also includes geometric modifications associated with the I-229 Exit 5 (26th Street) proposed improvements. The LRTP includes capacity-related roadway segment improvements at a high-level, and does not include intersection-level geometrics associated with the improvements. Thus, intersection-level geometrics were assumed for the No-Build condition where necessary in order to capture planned development in the study area.

No-Build "Worst Case" Analysis Results

During the 2035 no-build analysis, the Highway Capacity Software (HCS) 2010 identified capacity constraints at upstream intersections that limited traffic that would get to downstream intersections along a given corridor. In an effort to provide a conservative estimate of future no-build traffic operations, a procedure was devised to ensure that each study area intersection received the full projected demand. After meetings with the Study Advisory Team (SAT) and Federal Highway Administration (FHWA), it was decided that some of the no-build analysis results may indicate higher projected delays than will actually be realized because not all capacity constraints may be eliminated at upstream intersections as assumed in the analysis. For instance, a roadway may have a future demand that warrants additional capacity, but if the hurdles to adding that capacity are insurmountable, then the roadway would not be widened and continue to meter traffic to downstream intersections. As the no-build traffic analysis results potentially error on the side of higher traffic demand at all study area intersections, that analysis has been named the "Worst Case" scenario.

2010 Highway Capacity Software (HCS 2010) from McTrans was used to conduct no-build traffic operations analysis, in a similar fashion to the existing conditions traffic operations analysis. Common practice for no-build analysis dictates that the geometry of the subject intersection is analyzed under the future projected traffic demand without modifications to geometry such that any anticipated deficiencies in the no-build condition may be identified. One difficulty in maintaining this practice is the software's treatment of adjacent intersections in a connected manner, such that if an upstream intersection has a failing movement (movement demand / movement capacity > 1.0) then the demand beyond the capacity threshold is not perpetuated to the downstream intersections. While this operation in the programming of the HCS 2010 software has benefits when conducting a multi-period analysis, the software does not provide a built-in feature to bypass this part of the computations. This results in a situation where intersections downstream of intersections with failing movements only experience a portion of the projected demand. In order to allow each intersection to fully reach its projected demand, the project team developed a method for isolating the traffic operations for groups of intersections that could all be analyzed in a single HCS 2010 file while still receiving all projected demand. This method is as follows:

1. Develop a master file for the corridor of interest, including all study intersections along the corridor. Master street files were developed sequentially from South to North and West to East.
2. Starting at the southernmost or westernmost intersection, check to see if the southbound or westbound projected demand is fully received at the intersection.
3. If the full demand is not received, then separate the southernmost or westernmost intersection out as its own group (called “Group 1”) by making multiple copies of the master corridor file. All intersections not in “Group 1” are currently in “Group 2”.
4. Open the HCS file for “Group 1” and make necessary changes to non-“Group 1” intersections to get all projected demand to reach all “Group 1” intersections.
5. Report the LOS for the southernmost or westernmost intersection from the “Group 1” HCS file.
6. Open the HCS file for “Group 2”.
7. Check the first “Group 2” intersection (southernmost or westernmost intersection in the group) to see if both major approaches to the subject intersection receive all projected demand.
8. If all northbound or eastbound projected demand is not received at the first “Group 2” intersection, then make necessary changes to the “Group 1” intersection to allow all projected demand to reach the first “Group 2” intersection.
9. If all southbound or eastbound projected demand is not received at the first “Group 2” intersection, then call that intersection “Group 2” and all intersections to the north or east of the intersection as “Group 3”.
10. Both conditions from Step 8 and Step 9 may exist at any intersection internal to the corridor.
11. Repeat the process until a set number of groups is established (maximum number of groups is the number of intersections along the corridor) where each group only contains intersections that receive their full projected demand.
12. Report LOS results from the group file to which the intersection of interest belongs.

Upon applying the method to isolated groups of intersections, intersection LOS was reported for the condition where the no-build geometry at each intersection experienced the full projected demand from the 2035 AM and PM peak hour volume sets, even though adjacent intersections under no-build conditions may not have sufficient capacity to convey all projected demand.

This Year 2035 conditions analysis found that ramp terminal intersections and arterials show the LOS at a couple of key intersections has degraded beyond the acceptable threshold of LOS D.

TABLE 1 highlights intersections that do not meet the project specific LOS thresholds.

Table 1. 2035 No-Build Conditions "Worst Case" Deficient Intersections based on Operational Analysis Results

LOCATION	AM	PM
I-229 SB on-ramp & Cliff Avenue- Worst stop-controlled movement LOS		LOS F
49th Street & Cliff Avenue	LOS E	

Note: Acceptable Threshold is LOS D for intersections, and LOS C for freeway and ramps.

No-Build "Best Case" Analysis Results

In addition to the "Worst Case" scenario, the SAT and FHWA commissioned HDR to perform a variation of the no-build traffic analysis where no capacity constraints were removed from the study area. As this scenario may potentially error on the side of lower traffic demand, and thus lower delay, this new variation on the no-build traffic analysis has been named the "Best Case" scenario.

TABLE 2 shows the intersections that changed LOS between "Worst Case" and "Best Case" conditions.

Table 2. LOS Differences between 2035 No-Build "Worst Case" and "Best Case" Scenarios

LOCATION	AM Peak		PM Peak	
	"Worst Case" LOS	"Best Case" LOS	"Worst Case" LOS	"Best Case" LOS
Cliff & 33rd	C	B		
Cliff & 41st/I-229 SB Off-Ramp	C	B		

"Worst Case" and "Best Case" Conditions Operational Results

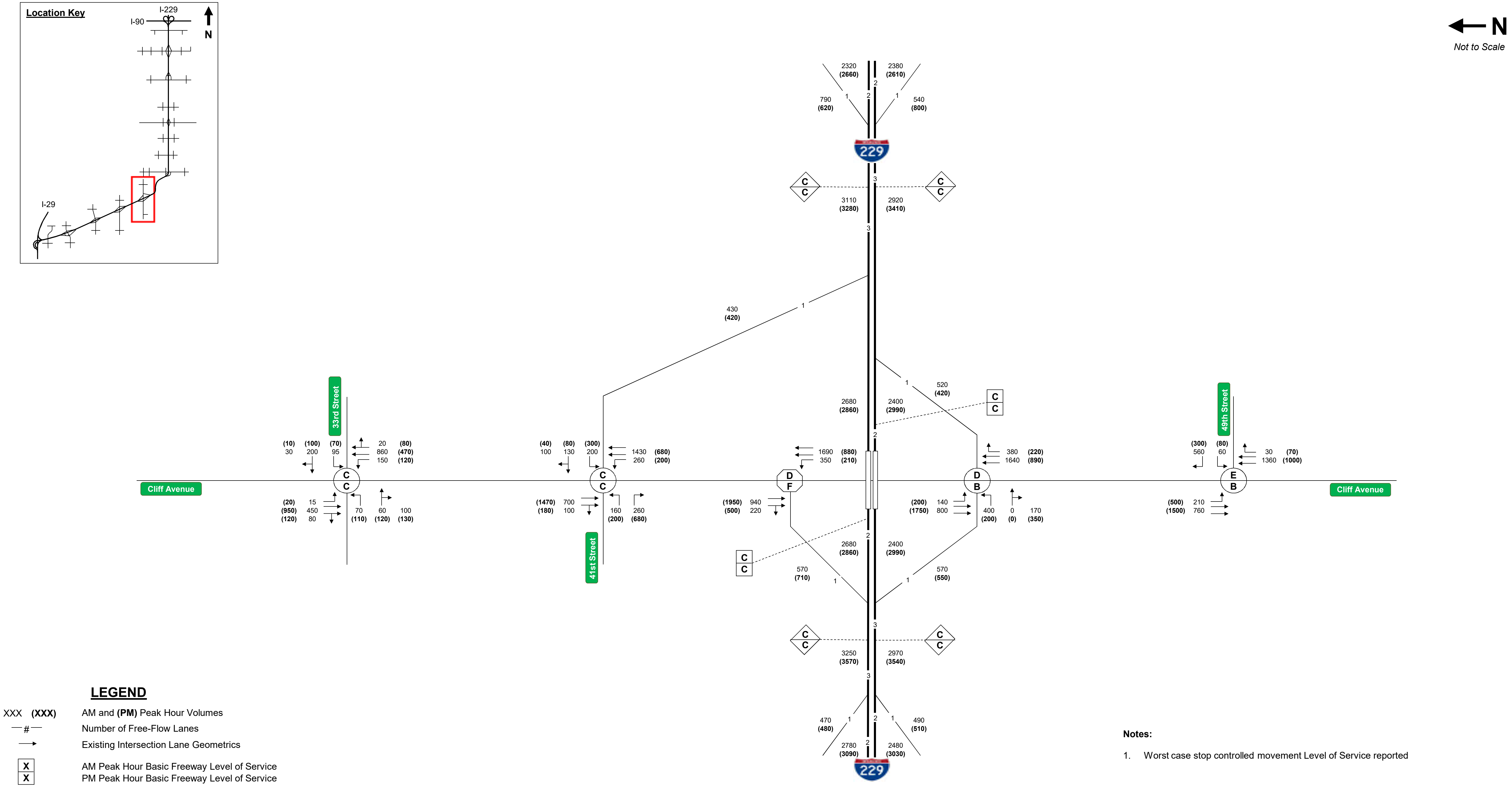
The 2035 no-build "Worst Case" lane geometrics and LOS results for all locations are shown in ***FIGURE 1***. The 2035 No-Build "Worst Case" HCS 2010 Reports can be found in the ***APPENDIX***.

The 2035 no-build "Best Case" lane geometrics and LOS results for all locations are shown in ***FIGURE 2***. The 2035 No-Build "Best Case" HCS 2010 Reports can be found in the ***APPENDIX***.

Build Conditions Analysis Results

The 2035 Build condition used the same volumes as the 2035 No-Build condition. The 2035 build alternative scenarios were analyzed using HCS 2010 for the AM and PM peak hours. The alternative scenarios analyzed are as follows:

- ***Cliff-1.*** NB Cliff to SB I-229 Loop Ramp
- ***Cliff-6.*** SPUI, 41st Street Realigned
- ***Cliff-7.*** SPUI, SB I-229 Off-Ramp Thru & Rights at 41st Street



Notes:

1. Worst case stop controlled movement Level of Service reported

LEGEND

XXX **(XXX)**	AM and **(PM)** Peak Hour Volumes
—#—	Number of Free-Flow Lanes
→	Existing Intersection Lane Geometrics
X X	AM Peak Hour Basic Freeway Level of Service PM Peak Hour Basic Freeway Level of Service
X X	AM Peak Hour Ramp Merge Level of Service PM Peak Hour Ramp Merge Level of Service
X X	AM Peak Hour Ramp Diverge Level of Service PM Peak Hour Ramp Diverge Level of Service
X X	AM Peak Hour Weaving Section Level of Service PM Peak Hour Weaving Section Level of Service
X X	AM Peak Hour Signalized Intersection Level of Service PM Peak Hour Signalized Intersection Level of Service
X X	AM Peak Hour Unsignalized Intersection Level of Service PM Peak Hour Unsignalized Intersection Level of Service

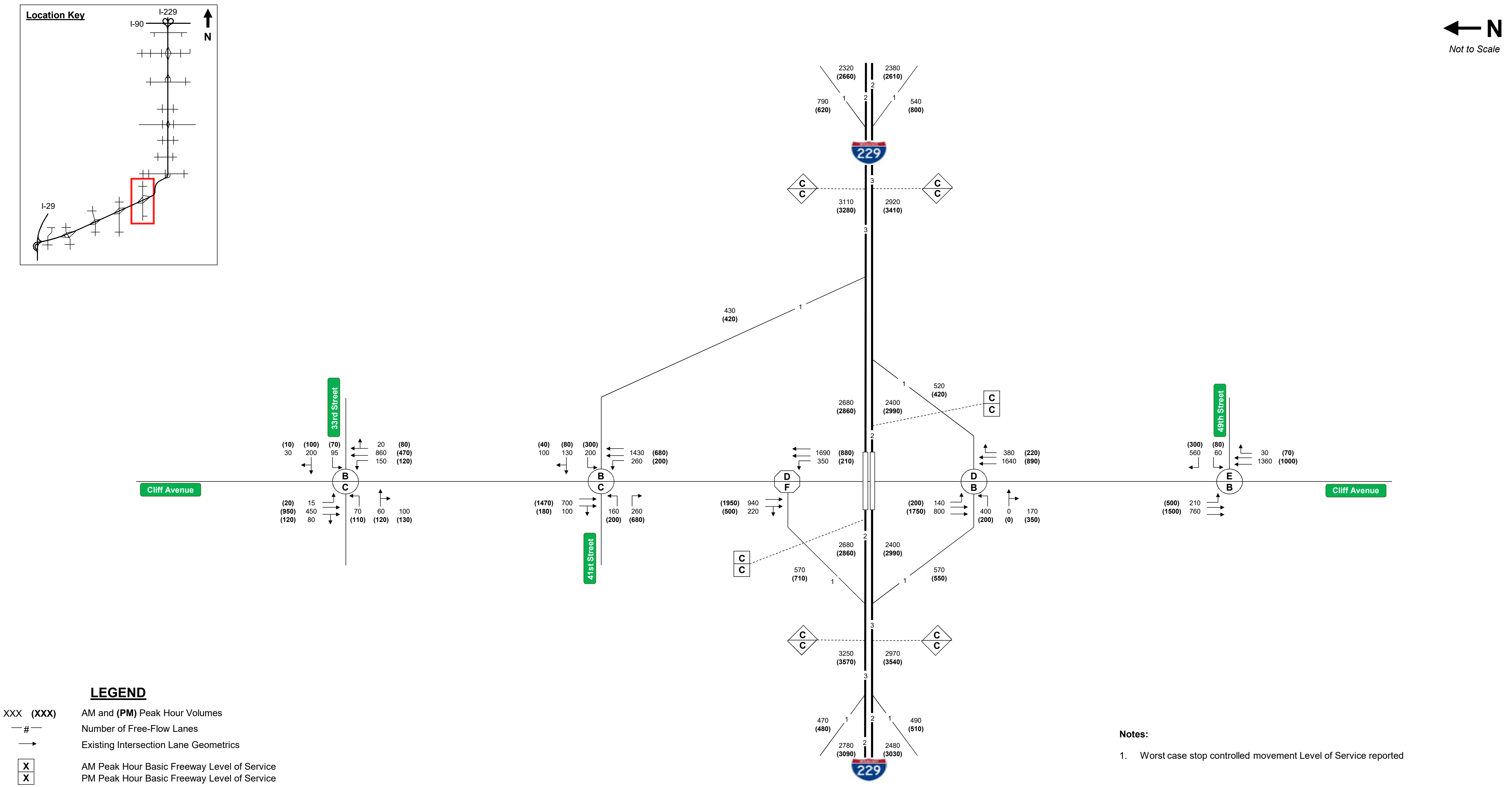
HDR

2035 No-Build "Worst Case" Conditions Traffic Operations Analysis

I-229 Major Investment Corridor Study: Sub-Study 6
Sioux Falls, South Dakota

Date
12/22/2016

Figure
1



LEGEND

XXX **(XXX)**	AM and **(PM)** Peak Hour Volumes
—#—	Number of Free-Flow Lanes
→	Existing Intersection Lane Geometrics
X X	AM Peak Hour Basic Freeway Level of Service PM Peak Hour Basic Freeway Level of Service
X X	AM Peak Hour Ramp Merge Level of Service PM Peak Hour Ramp Merge Level of Service
X X	AM Peak Hour Ramp Diverge Level of Service PM Peak Hour Ramp Diverge Level of Service
X X	AM Peak Hour Weaving Section Level of Service PM Peak Hour Weaving Section Level of Service
X X	AM Peak Hour Signalized Intersection Level of Service PM Peak Hour Signalized Intersection Level of Service
X X	AM Peak Hour Unsignalized Intersection Level of Service PM Peak Hour Unsignalized Intersection Level of Service

Notes:

1. Worst case stop controlled movement Level of Service reported

HDR

2035 No-Build "Best Case" Conditions Traffic Operations Analysis

I-229 Major Investment Corridor Study: Sub-Study 6
Sioux Falls, South Dakota

Date
12/22/2016

Figure
2

See ***TABLE 3*** for the 2035 Build LOS results for the alternative scenarios.

Table 3. 2035 Build LOS Results for Alternative Scenarios

Alternative Scenario	Intersection (AM LOS/PM LOS)			
	Cliff & 49th	Cliff & I-229 NB Ramps[1]	Cliff & I-229 SB Off-Ramp / 41st [2]	Cliff & 33rd
Cliff-1	C / B	B / B	C / C	C / C
Cliff-6	C / B	C / C	B / C	B / C
Cliff-7	C / A	C / C	C / C	B / C

[1] LOS reported for SPUI for the Cliff-6 and Cliff-7 scenarios.

[2] LOS reported for Cliff Avenue & 41st Street for the Cliff-6 scenario and Cliff Avenue & SB I-229 Off-Ramp Thru and Right Turn Lanes at 41st Street for the Cliff-7 scenario.

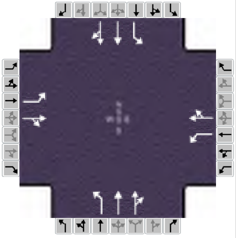
For all alternative scenarios, all intersections operate at an acceptable LOS of C or better. The 2035 Build HCS 2010 Reports can be found in the ***APPENDIX***.

APPENDIX -

2035 NO-BUILD "WORST CASE" HCS 2010 REPORTS

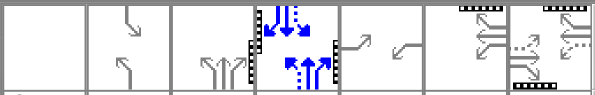
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Cliff Ave & 33rd St	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Cliff_AM_WorstCase.xus				
Project Description	2035 NB AM				

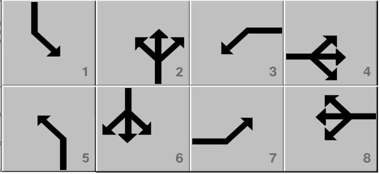


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	70	60	100	95	200	30	150	860	20	15	450	80

Signal Information			
Cycle, s	95.0	Reference Phase	2
Offset, s	68	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	1.5	1.0	44.7	5.1	2.0	16.2
Yellow	3.6	3.6	3.6	3.6	0.0	3.6
Red	1.0	1.0	1.9	1.0	0.0	1.5



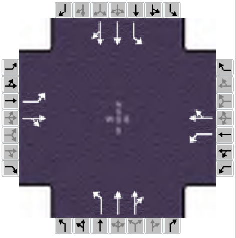
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	4.0	1.1	4.0	1.1	4.0	1.1	4.0
Phase Duration, s	9.7	21.3	11.7	23.3	11.7	55.9	6.1	50.2
Change Period, ($Y+R_c$), s	4.6	5.1	4.6	5.1	4.6	5.5	4.6	5.5
Max Allow Headway (*MAH*), s	4.2	4.2	4.2	4.2	4.2	0.0	4.2	0.0
Queue Clearance Time (g_s), s	5.8	12.6	7.2	16.5	6.6		2.5	
Green Extension Time (g_e), s	0.0	1.8	0.3	1.7	0.6	0.0	0.0	0.0
Phase Call Probability	0.89	1.00	0.95	1.00	0.99		0.37	
Max Out Probability	1.00	0.00	0.00	0.00	0.00		0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	82	188		112	271		169	498	494	18	319	304
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1586		1664	1707		1664	1748	1733	1664	1748	1655
Queue Service Time (g_s), s	3.8	10.6		5.2	14.5		4.6	11.3	11.1	0.5	8.5	8.6
Cycle Queue Clearance Time (g_c), s	3.8	10.6		5.2	14.5		4.6	11.3	11.1	0.5	8.5	8.6
Green Ratio (g/C)	0.22	0.17		0.25	0.19		0.57	0.53	0.53	0.49	0.47	0.47
Capacity (*c*), veh/h	189	271		270	327		498	926	919	318	822	779
Volume-to-Capacity Ratio (*X*)	0.437	0.695		0.414	0.827		0.340	0.538	0.538	0.056	0.388	0.391
Available Capacity (c_a), veh/h	193	687		713	776		1202	926	919	823	822	779
Back of Queue (*Q*), veh/ln (95th percentile)	2.9	7.7		3.8	10.6		3.1	5.4	5.3	0.4	5.7	5.5
Queue Storage Ratio (*RQ*) (95th percentile)	0.37	0.20		0.78	0.27		0.80	0.07	0.07	0.09	0.15	0.14
Uniform Delay (d_1), s/veh	31.2	37.1		29.6	36.9		11.4	6.9	6.8	13.0	11.0	11.0
Incremental Delay (d_2), s/veh	1.6	3.2		1.0	5.3		0.2	1.2	1.2	0.1	1.4	1.5
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	32.8	40.3		30.6	42.2		11.6	8.1	8.0	13.0	12.3	12.5
Level of Service (LOS)	C	D		C	D		B	A	A	B	B	B
Approach Delay, s/veh / LOS	38.0	D		38.8	D		8.6	A		12.4	B	
Intersection Delay, s/veh / LOS	17.5						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.8	C	2.3	B	2.3	B
Bicycle LOS Score / LOS	0.9	A	1.1	A	1.5	A	1.0	A

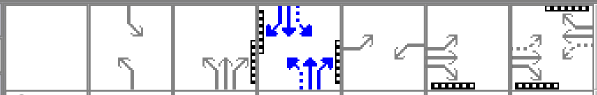
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Cliff Ave & 33rd St	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Cliff_PM_WorstCase.xus				
Project Description	2035 NB PM				

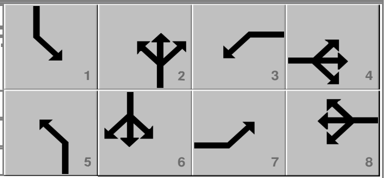


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	110	120	130	70	100	10	120	470	80	20	950	120

Signal Information			
Cycle, s	100.0	Reference Phase	2
Offset, s	16	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	1.8	3.9	50.3	5.0	2.4	16.7
Yellow	3.6	0.0	3.6	3.6	0.0	3.6
Red	1.0	0.0	1.9	1.0	0.0	1.5



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	4.0	1.1	4.0	1.1	4.0	1.1	4.0
Phase Duration, s	12.1	24.3	9.6	21.8	10.3	59.7	6.4	55.8
Change Period, (*Y*+*R*c), s	4.6	5.1	4.6	5.1	4.6	5.5	4.6	5.5
Max Allow Headway (*MAH*), s	4.2	4.2	4.2	4.2	4.2	0.0	4.2	0.0
Queue Clearance Time (*g*s), s	7.7	18.2	5.7	8.2	5.6		2.6	
Green Extension Time (*g*e), s	0.0	1.0	0.0	1.3	0.3	0.0	0.0	0.0
Phase Call Probability	0.96	1.00	0.88	1.00	0.97		0.45	
Max Out Probability	1.00	0.11	1.00	0.00	0.00		0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	118	269		75	118		129	302	289	22	586	564
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1614		1664	1719		1664	1748	1659	1664	1748	1678
Queue Service Time (*g*s), s	5.7	16.2		3.7	6.2		3.6	8.7	8.2	0.6	20.0	20.1
Cycle Queue Clearance Time (*g*c), s	5.7	16.2		3.7	6.2		3.6	8.7	8.2	0.6	20.0	20.1
Green Ratio (*g/C*)	0.24	0.19		0.22	0.17		0.57	0.54	0.54	0.52	0.50	0.50
Capacity (*c*), veh/h	332	309		167	288		312	947	899	454	878	844
Volume-to-Capacity Ratio (*X*)	0.356	0.869		0.450	0.411		0.414	0.319	0.322	0.047	0.668	0.669
Available Capacity (*c*a), veh/h	348	440		223	427		491	947	899	698	878	844
Back of Queue (*Q*), veh/ln (95th percentile)	4.3	11.8		2.8	4.8		2.3	6.1	5.3	0.4	10.8	10.6
Queue Storage Ratio (*RQ*) (95th percentile)	0.54	0.30		0.58	0.12		0.59	0.08	0.07	0.11	0.28	0.27
Uniform Delay (*d*1), s/veh	31.1	39.2		33.4	37.2		12.7	11.2	10.1	11.8	11.5	11.5
Incremental Delay (*d*2), s/veh	0.6	12.4		1.9	0.9		0.8	0.8	0.9	0.0	4.0	4.2
Initial Queue Delay (*d*3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	31.8	51.6		35.3	38.2		13.5	12.0	10.9	11.9	15.5	15.7
Level of Service (LOS)	C	D		D	D		B	B	B	B	B	B
Approach Delay, s/veh / LOS	45.6	D		37.0	D		11.8	B		15.5	B	
Intersection Delay, s/veh / LOS	20.8						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.8	C	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.1	A	0.8	A	1.1	A	1.5	A

```
                 HCS+: Unsignalized Intersections Release 5.6

_______________________TWO-WAY STOP CONTROL SUMMARY___________________________

Analyst:              GHM
Agency/Co.:           HDR
Date Performed:       10/09/2014
Analysis Time Period: AM Peak
Intersection:         Cliff Ave & I-229 SB On-Ramp
Jurisdiction:         Sioux Falls, SD
Units: U. S. Customary
Analysis Year:        2035
Project ID:  I-229 MIS
East/West Street:     I-229 SB On-Ramp
North/South Street:   Cliff Ave
Intersection Orientation: NS                 Study period (hrs):  0.25

______________________Vehicle Volumes and Adjustments_________________________
Major Street:  Approach        Northbound             Southbound
               Movement     1      2      3     |  4      5      6
                            L      T      R     |  L      T      R

______________________________________________________________________________
Volume                      350    1690                   940    220
Peak-Hour Factor, PHF       0.85   0.85                   0.85   0.85
Hourly Flow Rate, HFR       411    1988                   1105   258
Percent Heavy Vehicles      2      --     --              --     --
Median Type/Storage         TWLTL                 / 1
RT Channelized?
Lanes                          1   2                      2    0
Configuration                   L  T                      T   TR
Upstream Signal?                   Yes                    Yes

______________________________________________________________________________
Minor Street:  Approach        Westbound              Eastbound
               Movement     7      8      9     |  10     11     12
                            L      T      R     |  L      T      R

______________________________________________________________________________
Volume                                             0             0
Peak Hour Factor, PHF                              0.85          0.85
Hourly Flow Rate, HFR                              0             0
Percent Heavy Vehicles                             2             2
Percent Grade (%)                  0                      0
Flared Approach:  Exists?/Storage                /              No     /
Lanes                                                 0        0
Configuration                                             LR

______________________________________________________________________________

__________________Delay, Queue Length, and Level of Service___________________
Approach            NB     SB        Westbound             Eastbound
Movement            1      4   |  7      8      9    |  10     11     12
Lane Config         L          |                     |         LR

______________________________________________________________________________
v (vph)             411                                        0
C(m) (vph)          519
v/c                 0.79
95% queue length    7.38
Control Delay       33.4
LOS                  D
Approach Delay
Approach LOS

______________________________________________________________________________
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                  HCS+: Unsignalized Intersections Release 5.6





Phone:                                        Fax:
E-Mail:

______________________TWO-WAY STOP CONTROL(TWSC) ANALYSIS_____________________

Analyst:              GHM
Agency/Co.:           HDR
Date Performed:       10/09/2014
Analysis Time Period: AM Peak
Intersection:         Cliff Ave & I-229 SB On-Ramp
Jurisdiction:         Sioux Falls, SD
Units: U. S. Customary
Analysis Year:        2035
Project ID:  I-229 MIS
East/West Street:     I-229 SB On-Ramp
North/South Street:   Cliff Ave
Intersection Orientation: NS                 Study period (hrs):  0.25

________________________Vehicle Volumes and Adjustments_______________________
Major Street Movements      1      2      3      4      5      6
                            L      T      R      L      T      R

______________________________________________________________________________
Volume                     350    1690                 940    220
Peak-Hour Factor, PHF      0.85   0.85                 0.85   0.85
Peak-15 Minute Volume      103    497                  276    65
Hourly Flow Rate, HFR      411    1988                 1105   258
Percent Heavy Vehicles     2      --     --            --     --
Median Type/Storage         TWLTL                 / 1
RT Channelized?
Lanes                         1   2                    2    0
Configuration                  L  T                    T   TR
Upstream Signal?                  Yes                  Yes
______________________________________________________________________________
Minor Street Movements      7      8      9     10     11     12
                            L      T      R      L      T      R

______________________________________________________________________________
Volume                                          0             0
Peak Hour Factor, PHF                           0.85          0.85
Peak-15 Minute Volume                           0             0
Hourly Flow Rate, HFR                           0             0
Percent Heavy Vehicles                          2             2
Percent Grade (%)                 0                    0
Flared Approach:  Exists?/Storage                /              No     /
RT Channelized?
Lanes                                              0        0
Configuration                                          LR
______________________________________________________________________________

______________________Pedestrian Volumes and Adjustments______________________
Movements                    13     14     15     16
______________________________________________________________________________
Flow (ped/hr)                0      0      0      0
```

```
Lane Width (ft)              12.0   12.0   12.0   12.0
Walking Speed (ft/sec)       4.0    4.0    4.0    4.0
Percent Blockage             0      0      0      0
------------------------------------------------------------------------------

_____________________________Upstream Signal Data_____________________________
                 Prog.    Sat   Arrival   Green  Cycle   Prog.   Distance
                 Flow     Flow   Type     Time   Length  Speed   to Signal
                 vph      vph             sec     sec     mph      feet
------------------------------------------------------------------------------
S2  Left-Turn    0       1800     3       0       100     30       600
    Through      1640    1800     4       52      100     30       600
S5  Left-Turn    0       1800     3       0       100     30       200
    Through      700     1800     4       55      100     30       200
------------------------------------------------------------------------------

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles
------------------------------------------------------------------------------
                                           Movement 2     Movement 5
------------------------------------------------------------------------------
Shared ln volume, major th vehicles:
Shared ln volume, major rt vehicles:
Sat flow rate, major th vehicles:
Sat flow rate, major rt vehicles:
Number of major street through lanes:
------------------------------------------------------------------------------

Worksheet 4-Critical Gap and Follow-up Time Calculation
------------------------------------------------------------------------------
Critical Gap Calculation
Movement          1      4      7      8      9     10     11     12
                  L      L      L      T      R      L      T      R
------------------------------------------------------------------------------
t(c,base)        4.1                                7.5           6.2
t(c,hv)          2.00   2.00   2.00   2.00   2.00   2.00   2.00   2.00
P(hv)            2                                  2             2
t(c,g)                         0.20   0.20   0.10   0.20   0.20   0.10
Percent Grade                  0.00   0.00   0.00   0.00   0.00   0.00
t(3,lt)          0.00                               0.70          0.00
t(c,T):  1-stage 0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
         2-stage 0.00   0.00   1.00   1.00   0.00   1.00   1.00   0.00
t(c)     1-stage 4.1                                6.8           6.2
         2-stage 4.1                                5.8           6.2
------------------------------------------------------------------------------
Follow-Up Time Calculations
Movement          1      4      7      8      9     10     11     12
                  L      L      L      T      R      L      T      R
------------------------------------------------------------------------------
t(f,base)        2.20                               3.50          3.30
t(f,HV)          1.00   1.00   1.00   1.00   1.00   1.00   1.00   1.00
P(HV)            2                                  2             2
t(f)             2.2                                3.5           3.3
------------------------------------------------------------------------------

Worksheet 5-Effect of Upstream Signals
------------------------------------------------------------------------------
Computation 1-Queue Clearance Time at Upstream Signal
                                            Movement 2        Movement 5
                                         V(t)   V(l,prot)  V(t)   V(l,prot)
------------------------------------------------------------------------------
V prog                                   1640     0        700      0
```

```
Total Saturation Flow Rate, s (vph)      3600     3600     3600     3600
Arrival Type                             4        3        4        3
Effective Green, g (sec)                 52       0        55       0
Cycle Length, C (sec)                    100      100      100      100
Rp (from Exhibit 16-11)                  1.333    1.000    1.333    1.000
Proportion vehicles arriving on green P  0.693    0.000    0.733    0.000
g(q1)                                    14.0     0.0      5.2      0.0
g(q2)                                    21.6     0.0      1.8      0.0
g(q)                                     35.6     0.0      7.0      0.0
------------------------------------------------------------------------------
Computation 2-Proportion of TWSC Intersection Time  blocked
                                            Movement 2        Movement 5
                                         V(t)   V(l,prot)  V(t)   V(l,prot)
------------------------------------------------------------------------------
alpha                                         0.350             0.350
beta                                          0.741             0.741
Travel time, t(a) (sec)                       13.605            4.535
Smoothing Factor, F                           0.221             0.460
Proportion of conflicting flow, f        1.000    1.000    1.000    1.000
Max platooned flow, V(c,max)             3600     0        3552     0
Min platooned flow, V(c,min)             2000     2000     2000     2000
Duration of blocked period, t(p)         48.8     0.0      7.1      0.0
Proportion time blocked, p                    0.488             0.071
------------------------------------------------------------------------------
Computation 3-Platoon Event Periods     Result
------------------------------------------------------------------------------
p(2)                                    0.488
p(5)                                    0.071
p(dom)                                  0.488
p(subo)                                 0.071
Constrained or unconstrained?             U
------------------------------------------------------------------------------
Proportion
unblocked                  (1)             (2)             (3)
for minor              Single-stage         Two-Stage Process
movements, p(x)          Process        Stage I         Stage II
------------------------------------------------------------------------------
p(1)                      0.929
p(4)
p(7)
p(8)
p(9)
p(10)                     0.477         0.929           0.512
p(11)
p(12)                     0.929
------------------------------------------------------------------------------
Computation 4 and 5
Single-Stage Process
Movement                1      4      7      8      9     10     11     12
                        L      L      L      T      R      L      T      R
------------------------------------------------------------------------------
V c,x                  1363                                  3050          682
s                      3000                                  3000          3000
Px                     0.929                                 0.477         0.929
V c,u,x                1237                                  3105          504
------------------------------------------------------------------------------
C r,x                  559                                   9             566
C plat,x               519                                   4             526
------------------------------------------------------------------------------
Two-Stage Process
                     7               8              10              11
```

```
              Stage1  Stage2  Stage1  Stage2  Stage1  Stage2  Stage1  Stage2
______________________________________________________________________________
V(c,x)                                        1234    1816
s                                             3000    3000
P(x)                                          0.929   0.512
V(c,u,x)                                      1098    690
______________________________________________________________________________
C(r,x)                                        281     459
C(plat,x)                                     261     235
______________________________________________________________________________

Worksheet 6-Impedance and Capacity Equations
______________________________________________________________________________
Step 1: RT from Minor St.                          9               12
______________________________________________________________________________
Conflicting Flows                                                682
Potential Capacity                                               526
Pedestrian Impedance Factor                     1.00             1.00
Movement Capacity                                                526
Probability of Queue free St.                   1.00             1.00
______________________________________________________________________________
Step 2: LT from Major St.                          4                1
______________________________________________________________________________
Conflicting Flows                                                1363
Potential Capacity                                               519
Pedestrian Impedance Factor                     1.00             1.00
Movement Capacity                                                519
Probability of Queue free St.                   1.00             0.21
Maj L-Shared Prob Q free St.
______________________________________________________________________________
Step 3: TH from Minor St.                          8               11
______________________________________________________________________________
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor                     1.00             1.00
Cap. Adj. factor due to Impeding mvmnt          0.21             0.21
Movement Capacity
Probability of Queue free St.                   1.00             1.00
______________________________________________________________________________
Step 4: LT from Minor St.                          7               10
______________________________________________________________________________
Conflicting Flows                                                3050
Potential Capacity                                               4
Pedestrian Impedance Factor                     1.00             1.00
Maj. L, Min T Impedance factor                  0.21
Maj. L, Min T Adj. Imp Factor.                  0.34
Cap. Adj. factor due to Impeding mvmnt          0.34             0.21
Movement Capacity                                                1
______________________________________________________________________________

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance
______________________________________________________________________________
Step 3: TH from Minor St.                          8               11
______________________________________________________________________________
Part 1 - First Stage
Conflicting Flows
Potential Capacity                              26               270
Pedestrian Impedance Factor                     1.00             1.00
Cap. Adj. factor due to Impeding mvmnt          0.21             1.00
Movement Capacity                               5                270
Probability of Queue free St.                   1.00             1.00
```

```
______________________________________________________________________________
Part 2 - Second Stage
Conflicting Flows
Potential Capacity                              232              26
Pedestrian Impedance Factor                     1.00             1.00
Cap. Adj. factor due to Impeding mvmnt          1.00             0.21
Movement Capacity                               232              5
______________________________________________________________________________
Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor                     1.00             1.00
Cap. Adj. factor due to Impeding mvmnt          0.21             0.21
Movement Capacity
______________________________________________________________________________
Result for 2 stage process:
a                                               0.91             0.91
y
C t
Probability of Queue free St.                   1.00             1.00
______________________________________________________________________________
Step 4: LT from Minor St.                          7               10
______________________________________________________________________________
Part 1 - First Stage
Conflicting Flows                                                1234
Potential Capacity                              21               261
Pedestrian Impedance Factor                     1.00             1.00
Cap. Adj. factor due to Impeding mvmnt          0.21             1.00
Movement Capacity                               4                261
______________________________________________________________________________
Part 2 - Second Stage
Conflicting Flows                                                1816
Potential Capacity                              631              235
Pedestrian Impedance Factor                     1.00             1.00
Cap. Adj. factor due to Impeding mvmnt          1.00             0.21
Movement Capacity                               631              49
______________________________________________________________________________
Part 3 - Single Stage
Conflicting Flows                                                3050
Potential Capacity                                               4
Pedestrian Impedance Factor                     1.00             1.00
Maj. L, Min T Impedance factor                  0.21
Maj. L, Min T Adj. Imp Factor.                  0.34
Cap. Adj. factor due to Impeding mvmnt          0.34             0.21
Movement Capacity                                                1
______________________________________________________________________________
Results for Two-stage process:
a                                               0.91             0.91
y                                                                5.42
C t                                                              38
______________________________________________________________________________

Worksheet 8-Shared Lane Calculations
______________________________________________________________________________
Movement                              7      8      9     10     11     12
                                      L      T      R      L      T      R
______________________________________________________________________________
Volume (vph)                                              0             0
Movement Capacity (vph)                                   38            526
Shared Lane Capacity (vph)
______________________________________________________________________________
```

```
Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement                              7      8      9     10     11     12
                                      L      T      R      L      T      R

C sep                                                     38            526
Volume                                                    0             0
Delay
Q sep
Q sep +1
round (Qsep +1)

n max
C sh
SUM C sep
n
C act


Worksheet 10-Delay, Queue Length, and Level of Service

Movement             1      4      7      8      9     10     11     12
Lane Config          L                                          LR

v (vph)             411                                        0
C(m) (vph)          519
v/c                 0.79
95% queue length    7.38
Control Delay       33.4
LOS                  D
Approach Delay
Approach LOS


Worksheet 11-Shared Major LT Impedance and Delay

                                                 Movement 2     Movement 5

p(oj)                                               0.21           1.00
v(il), Volume for stream 2 or 5
v(i2), Volume for stream 3 or 6
s(il), Saturation flow rate for stream 2 or 5
s(i2), Saturation flow rate for stream 3 or 6
P*(oj)
d(M,LT), Delay for stream 1 or 4                    33.4
N, Number of major street through lanes
d(rank,1) Delay for stream 2 or 5
```

```
                 HCS+: Unsignalized Intersections Release 5.6

_______________________TWO-WAY STOP CONTROL SUMMARY___________________________

Analyst:              GHM
Agency/Co.:           HDR
Date Performed:       10/09/2014
Analysis Time Period: PM Peak
Intersection:         Cliff Ave & I-229 SB On-Ramp
Jurisdiction:         Sioux Falls, SD
Units: U. S. Customary
Analysis Year:        2035
Project ID:  I-229 MIS
East/West Street:     I-229 SB On-Ramp
North/South Street:   Cliff Ave
Intersection Orientation: NS                Study period (hrs):  0.25

______________________Vehicle Volumes and Adjustments_________________________
Major Street:  Approach        Northbound              Southbound
               Movement     1      2      3     |  4      5      6
                            L      T      R     |  L      T      R
______________________________________________________________________________
Volume                      210    880                    1950   500
Peak-Hour Factor, PHF       0.93   0.93                   0.93   0.93
Hourly Flow Rate, HFR       225    946                    2096   537
Percent Heavy Vehicles      3      --     --              --     --
Median Type/Storage         TWLTL                / 1
RT Channelized?
Lanes                          1   2                      2    0
Configuration                   L  T                      T   TR
Upstream Signal?                   Yes                    Yes
______________________________________________________________________________
Minor Street:  Approach        Westbound               Eastbound
               Movement     7      8      9     |  10     11     12
                            L      T      R     |  L      T      R
______________________________________________________________________________
Volume                                             0             0
Peak Hour Factor, PHF                              0.93          0.93
Hourly Flow Rate, HFR                              0             0
Percent Heavy Vehicles                             3             3
Percent Grade (%)                  0                      0
Flared Approach:  Exists?/Storage               /              No     /
Lanes                                                 0        0
Configuration                                             LR
______________________________________________________________________________

__________________Delay, Queue Length, and Level of Service___________________
Approach             NB     SB        Westbound             Eastbound
Movement             1      4   |  7      8      9    |  10     11     12
Lane Config          L          |                     |         LR
______________________________________________________________________________
v (vph)              225                                        0
C(m) (vph)           126
v/c                  1.79
95% queue length     17.26
Control Delay        443.2
LOS                   F
Approach Delay
Approach LOS
______________________________________________________________________________
```

```
                  HCS+: Unsignalized Intersections Release 5.6






Phone:                                        Fax:
E-Mail:

______________________TWO-WAY STOP CONTROL(TWSC) ANALYSIS_____________________

Analyst:              GHM
Agency/Co.:           HDR
Date Performed:       10/09/2014
Analysis Time Period: PM Peak
Intersection:         Cliff Ave & I-229 SB On-Ramp
Jurisdiction:         Sioux Falls, SD
Units: U. S. Customary
Analysis Year:        2035
Project ID:  I-229 MIS
East/West Street:     I-229 SB On-Ramp
North/South Street:   Cliff Ave
Intersection Orientation: NS                 Study period (hrs):  0.25

________________________Vehicle Volumes and Adjustments_______________________
Major Street Movements      1      2      3      4      5      6
                            L      T      R      L      T      R
______________________________________________________________________________
Volume                     210    880                  1950   500
Peak-Hour Factor, PHF      0.93   0.93                 0.93   0.93
Peak-15 Minute Volume      56     237                  524    134
Hourly Flow Rate, HFR      225    946                  2096   537
Percent Heavy Vehicles     3      --     --            --     --
Median Type/Storage         TWLTL                 / 1
RT Channelized?
Lanes                         1   2                    2    0
Configuration                  L  T                    T   TR
Upstream Signal?                  Yes                  Yes
______________________________________________________________________________
Minor Street Movements      7      8      9     10     11     12
                            L      T      R      L      T      R
______________________________________________________________________________
Volume                                          0             0
Peak Hour Factor, PHF                           0.93          0.93
Peak-15 Minute Volume                           0             0
Hourly Flow Rate, HFR                           0             0
Percent Heavy Vehicles                          3             3
Percent Grade (%)                 0                    0
Flared Approach:  Exists?/Storage              /              No     /
RT Channelized?
Lanes                                              0        0
Configuration                                          LR
______________________________________________________________________________


______________________Pedestrian Volumes and Adjustments______________________
Movements                    13     14     15     16
______________________________________________________________________________
Flow (ped/hr)                0      0      0      0
```

```
Lane Width (ft)              12.0   12.0   12.0   12.0
Walking Speed (ft/sec)       4.0    4.0    4.0    4.0
Percent Blockage             0      0      0      0
______________________________________________________________________________

_____________________________Upstream Signal Data_____________________________
                 Prog.    Sat   Arrival   Green  Cycle   Prog.   Distance
                 Flow     Flow   Type     Time   Length  Speed   to Signal
                 vph      vph             sec     sec     mph      feet
______________________________________________________________________________
S2  Left-Turn    0       1800     3       0       100     30       600
    Through      890     1800     4       54      100     30       600
S5  Left-Turn    0       1800     3       0       100     30       200
    Through      1470    1800     4       54      100     30       200
______________________________________________________________________________

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles
______________________________________________________________________________
                                           Movement 2     Movement 5
______________________________________________________________________________
Shared ln volume, major th vehicles:
Shared ln volume, major rt vehicles:
Sat flow rate, major th vehicles:
Sat flow rate, major rt vehicles:
Number of major street through lanes:
______________________________________________________________________________

Worksheet 4-Critical Gap and Follow-up Time Calculation
______________________________________________________________________________
Critical Gap Calculation
Movement          1      4      7      8      9     10     11     12
                  L      L      L      T      R      L      T      R
______________________________________________________________________________
t(c,base)        4.1                                7.5           6.2
t(c,hv)          2.00   2.00   2.00   2.00   2.00   2.00   2.00   2.00
P(hv)            3                                  3             3
t(c,g)                         0.20   0.20   0.10   0.20   0.20   0.10
Percent Grade                  0.00   0.00   0.00   0.00   0.00   0.00
t(3,lt)          0.00                               0.70          0.00
t(c,T):  1-stage 0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
         2-stage 0.00   0.00   1.00   1.00   0.00   1.00   1.00   0.00
t(c)     1-stage 4.2                                6.9           6.3
         2-stage 4.2                                5.9           6.3
______________________________________________________________________________
Follow-Up Time Calculations
Movement          1      4      7      8      9     10     11     12
                  L      L      L      T      R      L      T      R
______________________________________________________________________________
t(f,base)        2.20                               3.50          3.30
t(f,HV)          1.00   1.00   1.00   1.00   1.00   1.00   1.00   1.00
P(HV)            3                                  3             3
t(f)             2.2                                3.5           3.3
______________________________________________________________________________

Worksheet 5-Effect of Upstream Signals
______________________________________________________________________________
Computation 1-Queue Clearance Time at Upstream Signal
                                            Movement 2        Movement 5
                                         V(t)   V(l,prot)  V(t)   V(l,prot)
______________________________________________________________________________
V prog                                   890      0        1470     0
```

```
Total Saturation Flow Rate, s (vph)      3600     3600     3600     3600
Arrival Type                             4        3        4        3
Effective Green, g (sec)                 54       0        54       0
Cycle Length, C (sec)                    100      100      100      100
Rp (from Exhibit 16-11)                  1.333    1.000    1.333    1.000
Proportion vehicles arriving on green P  0.720    0.000    0.720    0.000
g(q1)                                    6.9      0.0      11.4     0.0
g(q2)                                    3.4      0.0      13.7     0.0
g(q)                                     10.3     0.0      25.1     0.0

------------------------------------------------------------------------------
Computation 2-Proportion of TWSC Intersection Time  blocked
                                            Movement 2        Movement 5
                                         V(t)   V(l,prot)  V(t)   V(l,prot)

------------------------------------------------------------------------------
alpha                                        0.350             0.350
beta                                         0.741             0.741
Travel time, t(a) (sec)                      13.605            4.535
Smoothing Factor, F                          0.221             0.460
Proportion of conflicting flow, f        1.000    1.000    1.000    1.000
Max platooned flow, V(c,max)             3326     0        3600     0
Min platooned flow, V(c,min)             2000     2000     2000     2000
Duration of blocked period, t(p)         11.0     0.0      29.8     0.0
Proportion time blocked, p                   0.110             0.298

------------------------------------------------------------------------------
Computation 3-Platoon Event Periods     Result

------------------------------------------------------------------------------
p(2)                                    0.110
p(5)                                    0.298
p(dom)                                  0.298
p(subo)                                 0.110
Constrained or unconstrained?             U

------------------------------------------------------------------------------
Proportion
unblocked                  (1)             (2)             (3)
for minor                Single-stage        Two-Stage Process
movements, p(x)            Process      Stage I         Stage II

------------------------------------------------------------------------------
p(1)                          0.702
p(4)
p(7)
p(8)
p(9)
p(10)                         0.647        0.702           0.890
p(11)
p(12)                         0.702

------------------------------------------------------------------------------
Computation 4 and 5
Single-Stage Process
Movement                 1      4      7      8      9     10      11     12
                         L      L      L      T      R      L      T      R

------------------------------------------------------------------------------
V c,x                   2633                                2287          1316
s                       3000                                3000          3000
Px                      0.702                               0.647         0.702
V c,u,x                 2477                                3444          601

------------------------------------------------------------------------------
C r,x                   180                                 5             496
C plat,x                126                                 3             348

------------------------------------------------------------------------------
Two-Stage Process
                      7               8              10              11
```

```
              Stage1  Stage2  Stage1  Stage2  Stage1  Stage2  Stage1  Stage2
------------------------------------------------------------------------------
V(c,x)                                        2364    923
s                                             3000    3000
P(x)                                          0.702   0.890
V(c,u,x)                                      2094    668

------------------------------------------------------------------------------
C(r,x)                                        79      469
C(plat,x)                                     55      418

------------------------------------------------------------------------------

Worksheet 6-Impedance and Capacity Equations
------------------------------------------------------------------------------
Step 1: RT from Minor St.                          9               12
------------------------------------------------------------------------------
Conflicting Flows                                                1316
Potential Capacity                                               348
Pedestrian Impedance Factor                      1.00            1.00
Movement Capacity                                                348
Probability of Queue free St.                    1.00            1.00
------------------------------------------------------------------------------
Step 2: LT from Major St.                          4                1
------------------------------------------------------------------------------
Conflicting Flows                                                2633
Potential Capacity                                               126
Pedestrian Impedance Factor                      1.00            1.00
Movement Capacity                                                126
Probability of Queue free St.                    1.00            0.00
Maj L-Shared Prob Q free St.
------------------------------------------------------------------------------
Step 3: TH from Minor St.                          8               11
------------------------------------------------------------------------------
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor                      1.00            1.00
Cap. Adj. factor due to Impeding mvmnt           0.00            0.00
Movement Capacity
Probability of Queue free St.                    1.00            1.00
------------------------------------------------------------------------------
Step 4: LT from Minor St.                          7               10
------------------------------------------------------------------------------
Conflicting Flows                                                3287
Potential Capacity                                               3
Pedestrian Impedance Factor                      1.00            1.00
Maj. L, Min T Impedance factor                   0.00
Maj. L, Min T Adj. Imp Factor.                   0.00
Cap. Adj. factor due to Impeding mvmnt           0.00            0.00
Movement Capacity                                                0
------------------------------------------------------------------------------

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance
------------------------------------------------------------------------------
Step 3: TH from Minor St.                          8               11
------------------------------------------------------------------------------
Part 1 - First Stage
Conflicting Flows
Potential Capacity                               232             67
Pedestrian Impedance Factor                      1.00            1.00
Cap. Adj. factor due to Impeding mvmnt           0.00            1.00
Movement Capacity                                0               67
Probability of Queue free St.                                    1.00
```

```
______________________________________________________________________________
Part 2 - Second Stage
Conflicting Flows
Potential Capacity                              42               232
Pedestrian Impedance Factor                     1.00             1.00
Cap. Adj. factor due to Impeding mvmnt          1.00             0.00
Movement Capacity                               42               0
______________________________________________________________________________
Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor                     1.00             1.00
Cap. Adj. factor due to Impeding mvmnt          0.00             0.00
Movement Capacity
______________________________________________________________________________
Result for 2 stage process:
a                                               0.91             0.91
y
C t
Probability of Queue free St.                   1.00             1.00
______________________________________________________________________________
Step 4: LT from Minor St.                          7                10
______________________________________________________________________________
Part 1 - First Stage
Conflicting Flows                                                2364
Potential Capacity                              224              55
Pedestrian Impedance Factor                     1.00             1.00
Cap. Adj. factor due to Impeding mvmnt          0.00             1.00
Movement Capacity                               0                55
______________________________________________________________________________
Part 2 - Second Stage
Conflicting Flows                                                923
Potential Capacity                              563              418
Pedestrian Impedance Factor                     1.00             1.00
Cap. Adj. factor due to Impeding mvmnt          1.00
Movement Capacity                               563
______________________________________________________________________________
Part 3 - Single Stage
Conflicting Flows                                                3287
Potential Capacity                                               3
Pedestrian Impedance Factor                     1.00             1.00
Maj. L, Min T Impedance factor                  0.00
Maj. L, Min T Adj. Imp Factor.                  0.00
Cap. Adj. factor due to Impeding mvmnt          0.00             0.00
Movement Capacity                                                0
______________________________________________________________________________
Results for Two-stage process:
a                                               0.91             0.91
y
C t
______________________________________________________________________________

Worksheet 8-Shared Lane Calculations
______________________________________________________________________________
Movement                              7      8      9     10     11     12
                                      L      T      R      L      T      R
______________________________________________________________________________
Volume (vph)                                              0             0
Movement Capacity (vph)                                                 348
Shared Lane Capacity (vph)
______________________________________________________________________________
```

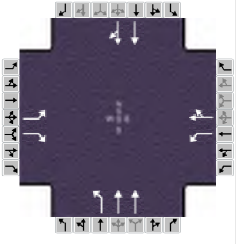
```
Worksheet 9-Computation of Effect of Flared Minor Street Approaches
______________________________________________________________________________
Movement                              7      8      9     10      11     12
                                      L      T      R      L       T      R
______________________________________________________________________________
C sep                                                                   348
Volume                                                    0             0
Delay
Q sep
Q sep +1
round (Qsep +1)
______________________________________________________________________________
n max
C sh
SUM C sep
n
C act
______________________________________________________________________________

Worksheet 10-Delay, Queue Length, and Level of Service
______________________________________________________________________________
Movement             1      4      7      8      9      10     11     12
Lane Config          L                                          LR
______________________________________________________________________________
v (vph)             225                                        0
C(m) (vph)          126
v/c                 1.79
95% queue length    17.26
Control Delay       443.2
LOS                  F
Approach Delay
Approach LOS
______________________________________________________________________________

Worksheet 11-Shared Major LT Impedance and Delay
______________________________________________________________________________
                                                 Movement 2     Movement 5
______________________________________________________________________________
p(oj)                                               0.00           1.00
v(il), Volume for stream 2 or 5
v(i2), Volume for stream 3 or 6
s(il), Saturation flow rate for stream 2 or 5
s(i2), Saturation flow rate for stream 3 or 6
P*(oj)
d(M,LT), Delay for stream 1 or 4                    443.2
N, Number of major street through lanes
d(rank,1) Delay for stream 2 or 5
______________________________________________________________________________
```

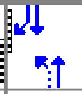
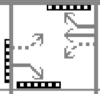
HCS 2010 Signalized Intersection Results Summary

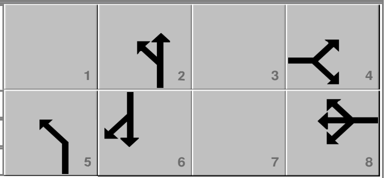
General Information				**Intersection Information**	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Cliff Ave & I-229 SB Off-rar	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Cliff_AM_WorstCase.xus				
Project Description	2035 NB AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	160		260	200	130	100	260	1430			700	100

Signal Information			
Cycle, s	95.0	Reference Phase	2
Offset, s	4	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

						
Green	8.6	41.9	28.7	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	2.5	1.5	0.0	0.0	0.0



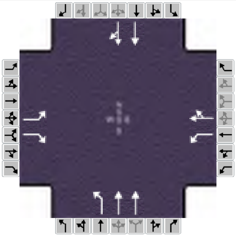
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2		6
Case Number		5.0		6.0	1.0	4.0		8.3
Phase Duration, s		33.8		33.8	13.2	61.2		48.0
Change Period, (*Y+R*$_c$), s		5.1		5.1	4.6	6.1		6.1
Max Allow Headway (*MAH*), s		4.3		4.3	4.2	0.0		0.0
Queue Clearance Time (*g*$_s$), s		27.8		13.3	10.7			
Green Extension Time (*g*$_e$), s		0.9		2.3	0.0	0.0		0.0
Phase Call Probability		1.00		1.00	1.00			
Max Out Probability		1.00		0.02	1.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14	3	8	18	5	2			6	16
Adjusted Flow Rate (*v*), veh/h	188		0	235	216		291	1600			474	455
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1119		1448	1618	1616		1634	1720			1732	1660
Queue Service Time (*g*$_s$), s	15.5		0.0	11.3	10.2		8.7	30.9			19.7	20.8
Cycle Queue Clearance Time (*g*$_c$), s	25.8		0.0	11.3	10.2		8.7	30.9			19.7	20.8
Green Ratio (*g/C*)	0.30		0.30	0.30	0.30		0.55	0.58			0.44	0.44
Capacity (*c*), veh/h	293		438	565	489		353	1993			762	730
Volume-to-Capacity Ratio (*X*)	0.643		0.000	0.417	0.442		0.824	0.803			0.622	0.624
Available Capacity (*c*$_a$), veh/h	318		471	601	526		353	1993			762	730
Back of Queue (*Q*), veh/ln (95th percentile)	7.9		0.0	7.6	6.9		3.9	10.3			13.3	13.3
Queue Storage Ratio (*RQ*) (95th percentile)	1.01		0.00	1.56	0.18		1.00	0.33			0.17	0.17
Uniform Delay (*d*$_1$), s/veh	37.1		0.0	27.1	26.7		18.3	11.2			21.2	22.0
Incremental Delay (*d*$_2$), s/veh	3.9		0.0	0.5	0.6		1.5	0.3			3.4	3.6
Initial Queue Delay (*d*$_3$), s/veh	0.0		0.0	0.0	0.0		0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh	41.0		0.0	27.6	27.3		19.8	11.5			24.7	25.6
Level of Service (LOS)	D			C	C		B	B			C	C
Approach Delay, s/veh / LOS	41.0		D	27.4		C	12.8		B	25.1		C
Intersection Delay, s/veh / LOS	19.5						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.7	B	1.7	A	2.6	B
Bicycle LOS Score / LOS		F	1.2	A	2.1	B	1.3	A

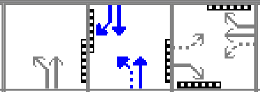
HCS 2010 Signalized Intersection Results Summary

General Information				**Intersection Information**	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Cliff Ave & I-229 SB Off-rar	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Cliff_PM_WorstCase.xus				
Project Description	2035 NB PM				

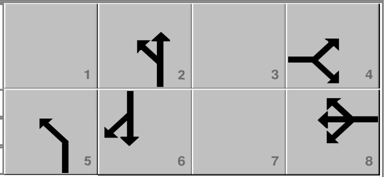


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	200		680	300	80	40	200	680			1470	180

Signal Information			
Cycle, s	100.0	Reference Phase	2
Offset, s	62	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	6.4	52.9	24.9	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	2.5	1.5	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2		6
Case Number		5.0		6.0	1.0	4.0		8.3
Phase Duration, s		30.0		30.0	11.0	70.0		59.0
Change Period, (*Y+R*$_c$), s		5.1		5.1	4.6	6.1		6.1
Max Allow Headway (*MAH*), s		4.2		4.2	4.2	0.0		0.0
Queue Clearance Time (*g*$_s$), s		24.9		20.1	8.4			
Green Extension Time (*g*$_e$), s		0.0		1.2	0.0	0.0		0.0
Phase Call Probability		1.00		1.00	1.00			
Max Out Probability		1.00		0.82	1.00			

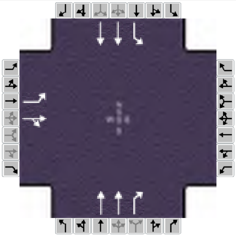
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14	3	8	18	5	2			6	16
Adjusted Flow Rate (*v*), veh/h	215		0	323	117		215	731			888	877
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1221		1444	1664	1670		1616	1630			1839	1771
Queue Service Time (*g*$_s$), s	17.3		0.0	18.1	5.7		6.4	11.0			49.6	47.2
Cycle Queue Clearance Time (*g*$_c$), s	22.9		0.0	18.1	5.7		6.4	11.0			49.6	47.2
Green Ratio (*g/C*)	0.25		0.25	0.25	0.25		0.61	0.64			0.53	0.53
Capacity (*c*), veh/h	307		360	486	416		184	2083			973	937
Volume-to-Capacity Ratio (*X*)	0.701		0.000	0.663	0.282		1.169	0.351			0.912	0.936
Available Capacity (*c*$_a$), veh/h	307		360	486	416		184	2083			973	937
Back of Queue (*Q*), veh/ln (95th percentile)	9.6		0.0	12.0	4.1		16.3	6.6			28.4	29.7
Queue Storage Ratio (*RQ*) (95th percentile)	1.23		0.00	2.43	0.10		4.18	0.21			0.35	0.37
Uniform Delay (*d*$_1$), s/veh	39.6		0.0	35.0	30.3		31.4	9.0			25.1	26.7
Incremental Delay (*d*$_2$), s/veh	6.9		0.0	3.4	0.4		113.1	0.4			10.4	13.1
Initial Queue Delay (*d*$_3$), s/veh	0.0		0.0	0.0	0.0		0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh	46.5		0.0	38.3	30.7		144.6	9.4			35.4	39.8
Level of Service (LOS)	D			D	C		F	A			D	D
Approach Delay, s/veh / LOS	46.5	D		36.3	D		40.1	D		37.6	D	
Intersection Delay, s/veh / LOS	38.7						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.7	B	1.7	A	3.2	C
Bicycle LOS Score / LOS		F	1.2	A	1.3	A	1.9	A

HCS 2010 Signalized Intersection Results Summary

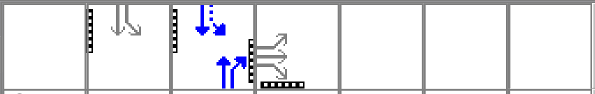
General Information			
Agency	HDR		
Analyst	GHM	Analysis Date	Feb 2, 2015
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak
Intersection	Cliff Ave & NB I-229 Ramps	Analysis Year	2035
File Name	2035_NB_Cliff_AM_WorstCase.xus		
Project Description	2035 NB AM		

Intersection Information	
Duration, h	0.25
Area Type	Other
PHF	0.85
Analysis Period	1> 7:15

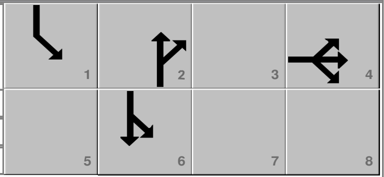


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	400	0	170					1640	380	140	800	

Signal Information			
Cycle, s	95.0	Reference Phase	6
Offset, s	51	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	6.4	53.9	19.9	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	1.5	1.5	0.0	0.0	0.0



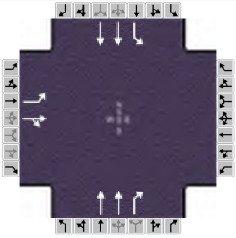
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2	1	6
Case Number		10.0				7.3	1.0	4.0
Phase Duration, s		25.0				59.0	11.0	70.0
Change Period, (*Y+Rc*), s		5.1				5.1	4.6	5.1
Max Allow Headway (*MAH*), s		4.1				0.0	4.2	0.0
Queue Clearance Time (*gs*), s		21.9					6.4	
Green Extension Time (*ge*), s		0.0				0.0	0.1	0.0
Phase Call Probability		1.00					0.99	
Max Out Probability		1.00					1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14					2	12	1	6	
Adjusted Flow Rate (*v*), veh/h	471	200						1929	447	165	941	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1687	1507						1758	1468	1599	1648	
Queue Service Time (*gs*), s	19.9	11.5						49.0	7.3	4.4	18.9	
Cycle Queue Clearance Time (*gc*), s	19.9	11.5						49.0	7.3	4.4	18.9	
Green Ratio (*g/C*)	0.21	0.21						0.57	0.57	0.66	0.48	
Capacity (*c*), veh/h	353	316						1998	834	190	1591	
Volume-to-Capacity Ratio (*X*)	1.332	0.633						0.966	0.536	0.865	0.591	
Available Capacity (*ca*), veh/h	353	316						1998	834	225	1591	
Back of Queue (*Q*), veh/ln (95th percentile)	37.1	7.8						22.1	2.8	5.5	10.7	
Queue Storage Ratio (*RQ*) (95th percentile)	6.33	0.20						0.23	0.29	1.40	0.34	
Uniform Delay (*d1*), s/veh	37.6	34.2						15.8	3.3	22.7	11.4	
Incremental Delay (*d2*), s/veh	167.5	4.1						7.5	1.1	20.7	1.3	
Initial Queue Delay (*d3*), s/veh	0.0	0.0						0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	205.1	38.3						23.3	4.4	43.4	12.7	
Level of Service (LOS)	F	D						C	A	D	B	
Approach Delay, s/veh / LOS	155.3	F		0.0			19.7	B		17.3	B	
Intersection Delay, s/veh / LOS	41.0						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.9	C	1.9	A	1.6	A
Bicycle LOS Score / LOS	1.6	A			2.4	B	1.4	A

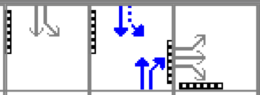
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Cliff Ave & NB I-229 Ramps	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Cliff_PM_WorstCase.xus				
Project Description	2035 NB PM				

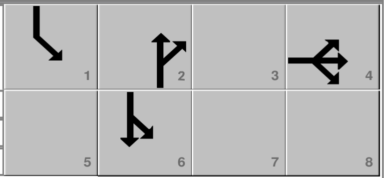


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	200	0	350					890	220	200	1750	

Signal Information			
Cycle, s	100.0	Reference Phase	6
Offset, s	48	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	6.4	51.9	26.9	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	1.5	1.5	0.0	0.0	0.0



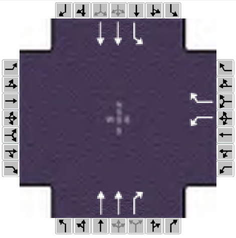
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2	1	6
Case Number		10.0				7.3	1.0	4.0
Phase Duration, s		32.0				57.0	11.0	68.0
Change Period, (*Y+R*c), s		5.1				5.1	4.6	5.1
Max Allow Headway (*MAH*), s		4.2				0.0	4.2	0.0
Queue Clearance Time (*g*s), s		27.8					7.8	
Green Extension Time (*g*e), s		0.0				0.0	0.0	0.0
Phase Call Probability		1.00					1.00	
Max Out Probability		1.00					1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14					2	12	1	6	
Adjusted Flow Rate (*v*), veh/h	215	376						957	237	215	1882	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1616	1444						1655	1432	1616	1764	
Queue Service Time (*g*s), s	11.2	25.8						13.7	4.7	5.8	44.1	
Cycle Queue Clearance Time (*g*c), s	11.2	25.8						13.7	4.7	5.8	44.1	
Green Ratio (*g/C*)	0.27	0.27						0.52	0.52	0.60	0.63	
Capacity (*c*), veh/h	435	388						1718	743	347	2219	
Volume-to-Capacity Ratio (*X*)	0.495	0.969						0.557	0.318	0.620	0.848	
Available Capacity (*c*a), veh/h	435	388						1718	743	347	2219	
Back of Queue (*Q*), veh/ln (95th percentile)	7.7	18.5						6.8	2.5	3.7	21.3	
Queue Storage Ratio (*RQ*) (95th percentile)	1.32	0.47						0.07	0.26	0.95	0.68	
Uniform Delay (*d*1), s/veh	30.8	36.1						8.9	5.6	12.0	17.1	
Incremental Delay (*d*2), s/veh	0.9	37.4						1.1	1.0	1.2	1.6	
Initial Queue Delay (*d*3), s/veh	0.0	0.0						0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	31.7	73.6						10.0	6.6	13.2	18.6	
Level of Service (LOS)	C	E						A	A	B	B	
Approach Delay, s/veh / LOS	58.3	E		0.0			9.3	A		18.1	B	
Intersection Delay, s/veh / LOS	21.5						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.9	C	1.9	A	1.6	A
Bicycle LOS Score / LOS	1.5	A			1.5	A	2.2	B

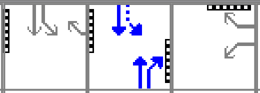
HCS 2010 Signalized Intersection Results Summary

General Information				**Intersection Information**	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Cliff Ave & 49th St	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Cliff_AM_WorstCase.xus				
Project Description	2035 NB AM				

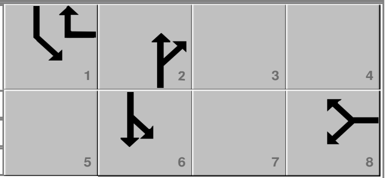


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				60		560		1360	30	210	760	

Signal Information			
Cycle, s	95.0	Reference Phase	6
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	11.7	48.7	19.9	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	1.5	1.5	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8		2	1	6
Case Number				9.0		7.3	1.0	4.0
Phase Duration, s				25.0		53.8	16.3	70.0
Change Period, (*Y+R*$_c$), s				5.1		5.1	4.6	5.1
Max Allow Headway (*MAH*), s				4.4		0.0	4.2	0.0
Queue Clearance Time (*g*$_s$), s				21.9			10.7	
Green Extension Time (*g*$_e$), s				0.0		0.0	0.9	0.0
Phase Call Probability				1.00			1.00	
Max Out Probability				1.00			0.00	

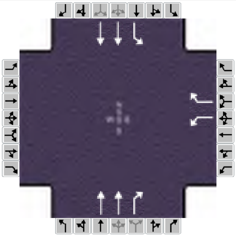
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3		18		2	12	1	6	
Adjusted Flow Rate (*v*), veh/h				71		485		1600	35	247	894	
Adjusted Saturation Flow Rate (*s*), veh/h/ln				1681		1496		1664	1481	1664	1664	
Queue Service Time (*g*$_s$), s				3.3		19.9		42.9	1.1	8.7	7.9	
Cycle Queue Clearance Time (*g*$_c$), s				3.3		19.9		42.9	1.1	8.7	7.9	
Green Ratio (*g/C*)				0.21		0.33		0.51	0.51	0.66	0.68	
Capacity (*c*), veh/h				352		497		1704	758	298	2273	
Volume-to-Capacity Ratio (*X*)				0.201		0.976		0.939	0.047	0.829	0.393	
Available Capacity (*c*$_a$), veh/h				352		497		1704	758	854	2273	
Back of Queue (*Q*), veh/ln (95th percentile)				2.4		21.7		25.1	0.7	10.4	3.8	
Queue Storage Ratio (*RQ*) (95th percentile)				0.82		0.55		0.64	0.07	1.07	0.04	
Uniform Delay (*d*$_1$), s/veh				31.0		31.3		21.8	11.6	31.6	4.1	
Incremental Delay (*d*$_2$), s/veh				0.3		34.0		11.5	0.1	4.6	0.4	
Initial Queue Delay (*d*$_3$), s/veh				0.0		0.0		0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh				31.3		65.3		33.3	11.7	36.2	4.5	
Level of Service (LOS)				C		E		C	B	D	A	

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	0.0		61.0	E	32.8	C	11.3	B
Intersection Delay, s/veh / LOS	30.2				C			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.9	C	2.5	B	0.7	A
Bicycle LOS Score / LOS				F	1.8	A	1.4	A

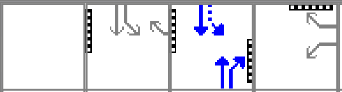
HCS 2010 Signalized Intersection Results Summary

General Information				**Intersection Information**	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Cliff Ave & 49th St	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Cliff_PM_WorstCase.xus				
Project Description	2035 NB PM				

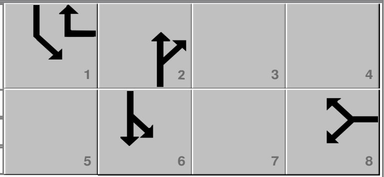


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				80		300		1000	70	500	1500	

Signal Information			
Cycle, s	100.0	Reference Phase	6
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	18.0	59.9	7.3	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	1.5	1.5	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8		2	1	6
Case Number				9.0		7.3	1.0	4.0
Phase Duration, s				12.4		65.0	22.6	87.6
Change Period, (*Y+R*c), s				5.1		5.1	4.6	5.1
Max Allow Headway (*MAH*), s				4.3		0.0	4.2	0.0
Queue Clearance Time (*g*s), s				7.0			16.7	
Green Extension Time (*g*e), s				0.3		0.0	1.3	0.0
Phase Call Probability				0.99			1.00	
Max Out Probability				0.08			0.48	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3		18		2	12	1	6	
Adjusted Flow Rate (*v*), veh/h				86		84		1075	63	538	1613	
Adjusted Saturation Flow Rate (*s*), veh/h/ln				1681		1496		1664	1481	1664	1664	
Queue Service Time (*g*s), s				5.0		4.4		19.1	1.8	14.7	11.1	
Cycle Queue Clearance Time (*g*c), s				5.0		4.4		19.1	1.8	14.7	11.1	
Green Ratio (*g/C*)				0.07		0.25		0.60	0.60	0.80	0.83	
Capacity (*c*), veh/h				122		378		1994	888	570	2746	
Volume-to-Capacity Ratio (*X*)				0.704		0.222		0.539	0.071	0.943	0.587	
Available Capacity (*c*a), veh/h				250		492		1994	888	653	2746	
Back of Queue (*Q*), veh/ln (95th percentile)				4.2		2.9		11.1	1.1	11.9	2.8	
Queue Storage Ratio (*RQ*) (95th percentile)				1.41		0.07		0.28	0.03	1.21	0.03	
Uniform Delay (*d*1), s/veh				45.3		29.6		11.9	8.4	15.9	1.6	
Incremental Delay (*d*2), s/veh				7.2		0.3		1.1	0.2	10.2	0.4	
Initial Queue Delay (*d*3), s/veh				0.0		0.0		0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh				52.5		29.9		12.9	8.5	26.2	1.9	
Level of Service (LOS)				D		C		B	A	C	A	

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	0.0		41.3	D	12.7	B	8.0	A
Intersection Delay, s/veh / LOS	11.2				B			

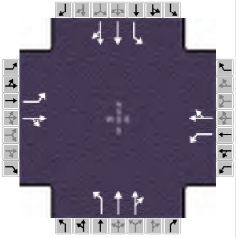
Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.9	C	2.6	B	0.6	A
Bicycle LOS Score / LOS				F	1.4	A	2.3	B

APPENDIX -

2035 NO-BUILD "BEST CASE" HCS 2010 REPORTS

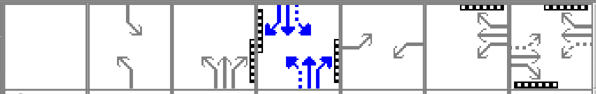
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Cliff Ave & 33rd St	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Cliff_AM_BestCase.xus				
Project Description	2035 NB AM				

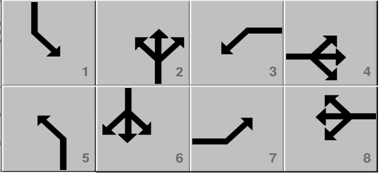


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	70	60	100	95	200	30	150	860	20	15	450	80

Signal Information			
Cycle, s	95.0	Reference Phase	2
Offset, s	68	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	1.5	0.7	45.1	5.1	2.0	16.2
Yellow	3.6	3.6	3.6	3.6	0.0	3.6
Red	1.0	1.0	1.9	1.0	0.0	1.5



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	4.0	1.1	4.0	1.1	4.0	1.1	4.0
Phase Duration, s	9.7	21.3	11.7	23.3	11.4	55.9	6.1	50.6
Change Period, (*Y+R$_c$*), s	4.6	5.1	4.6	5.1	4.6	5.5	4.6	5.5
Max Allow Headway (*MAH*), s	4.2	4.2	4.2	4.2	4.2	0.0	4.2	0.0
Queue Clearance Time (*g$_s$*), s	5.8	12.6	7.2	16.5	6.3		2.5	
Green Extension Time (*g$_e$*), s	0.0	1.8	0.3	1.7	0.6	0.0	0.0	0.0
Phase Call Probability	0.89	1.00	0.95	1.00	0.99		0.37	
Max Out Probability	1.00	0.00	0.00	0.00	0.00		0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	82	188		112	271		159	469	465	18	319	304
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1586		1664	1707		1664	1748	1733	1664	1748	1655
Queue Service Time (*g$_s$*), s	3.8	10.6		5.2	14.5		4.3	10.4	10.3	0.5	8.4	8.5
Cycle Queue Clearance Time (*g$_c$*), s	3.8	10.6		5.2	14.5		4.3	10.4	10.3	0.5	8.4	8.5
Green Ratio (*g/C*)	0.22	0.17		0.25	0.19		0.57	0.53	0.53	0.49	0.47	0.47
Capacity (*c*), veh/h	189	271		270	327		496	926	919	335	828	785
Volume-to-Capacity Ratio (*X*)	0.437	0.695		0.414	0.827		0.322	0.507	0.507	0.053	0.385	0.388
Available Capacity (*c$_a$*), veh/h	193	687		713	776		1205	926	919	840	828	785
Back of Queue (*Q*), veh/ln (95th percentile)	2.9	7.7		3.8	10.6		2.9	5.4	5.3	0.3	5.6	5.4
Queue Storage Ratio (*RQ*) (95th percentile)	0.37	0.20		0.78	0.27		0.74	0.07	0.07	0.09	0.14	0.14
Uniform Delay (*d$_1$*), s/veh	31.2	37.1		29.6	36.9		11.2	7.0	6.9	12.7	10.7	10.8
Incremental Delay (*d$_2$*), s/veh	1.6	3.2		1.0	5.3		0.2	1.2	1.2	0.1	1.4	1.4
Initial Queue Delay (*d$_3$*), s/veh	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	32.8	40.3		30.6	42.2		11.4	8.2	8.1	12.8	12.1	12.2
Level of Service (LOS)	C	D		C	D		B	A	A	B	B	B
Approach Delay, s/veh / LOS	38.0	D		38.8	D		8.6	A		12.2	B	
Intersection Delay, s/veh / LOS	17.7						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.8	C	2.3	B	2.3	B
Bicycle LOS Score / LOS	0.9	A	1.1	A	1.5	A	1.0	A

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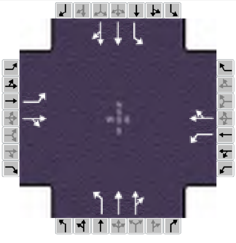
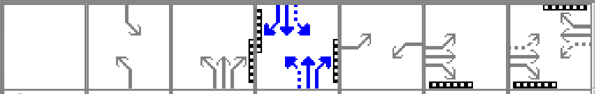
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Cliff Ave & 33rd St	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Cliff_PM_BestCase.xus				
Project Description	2035 NB PM				

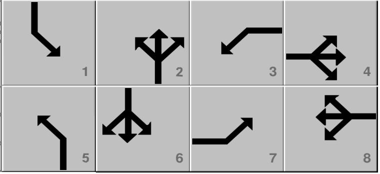


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	110	120	130	70	100	10	120	470	80	20	950	120

Signal Information			
Cycle, s	95.0	Reference Phase	2
Offset, s	93	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	1.7	3.9	46.4	4.8	1.6	16.8
Yellow	3.6	0.0	3.6	3.6	0.0	3.6
Red	1.0	0.0	1.9	1.0	0.0	1.5



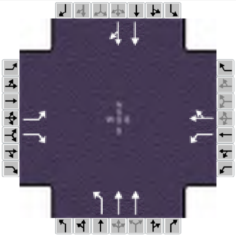
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	4.0	1.1	4.0	1.1	4.0	1.1	4.0
Phase Duration, s	11.0	23.5	9.4	21.9	10.2	55.8	6.3	51.9
Change Period, (Y+R_c), s	4.6	5.1	4.6	5.1	4.6	5.5	4.6	5.5
Max Allow Headway (MAH), s	4.2	4.2	4.2	4.2	4.2	0.0	4.2	0.0
Queue Clearance Time (g_s), s	7.4	17.3	5.5	7.8	5.5		2.6	
Green Extension Time (g_e), s	0.0	1.1	0.1	1.4	0.3	0.0	0.0	0.0
Phase Call Probability	0.96	1.00	0.86	1.00	0.97		0.43	
Max Out Probability	1.00	0.07	0.02	0.00	0.00		0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	118	269		75	118		129	302	289	22	586	564
Adjusted Saturation Flow Rate (s), veh/h/ln	1681	1614		1664	1719		1664	1748	1659	1664	1748	1678
Queue Service Time (g_s), s	5.4	15.3		3.5	5.8		3.5	11.1	11.1	0.6	20.2	20.2
Cycle Queue Clearance Time (g_c), s	5.4	15.3		3.5	5.8		3.5	11.1	11.1	0.6	20.2	20.2
Green Ratio (g/C)	0.24	0.19		0.23	0.18		0.56	0.53	0.53	0.51	0.49	0.49
Capacity (c), veh/h	337	312		173	304		306	925	878	424	853	819
Volume-to-Capacity Ratio (X)	0.351	0.861		0.436	0.389		0.422	0.327	0.330	0.051	0.688	0.689
Available Capacity (c_a), veh/h	337	467		323	469		531	925	878	647	853	819
Back of Queue (Q), veh/ln (95th percentile)	4.0	11.1		2.6	4.4		2.3	8.1	7.7	0.4	11.0	10.7
Queue Storage Ratio (RQ) (95th percentile)	0.51	0.28		0.54	0.11		0.58	0.10	0.10	0.10	0.28	0.28
Uniform Delay (d_1), s/veh	29.4	37.1		31.1	34.6		13.1	16.2	16.1	12.1	12.0	12.0
Incremental Delay (d_2), s/veh	0.6	10.3		1.7	0.8		0.8	0.8	0.9	0.0	4.5	4.7
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	30.0	47.3		32.8	35.4		13.9	17.0	16.9	12.2	16.5	16.7
Level of Service (LOS)	C	D		C	D		B	B	B	B	B	B
Approach Delay, s/veh / LOS	42.0	D		34.4	C		16.4	B		16.5	B	
Intersection Delay, s/veh / LOS	21.9						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.8	C	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.1	A	0.8	A	1.1	A	1.5	A

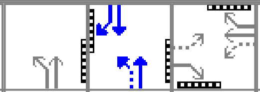
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Cliff Ave & I-229 SB Off-rar	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Cliff_AM_BestCase.xus				
Project Description	2035 NB AM				

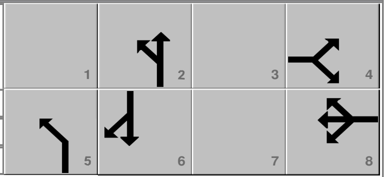


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	160		260	200	130	100	260	1430			700	100

Signal Information			
Cycle, s	95.0	Reference Phase	2
Offset, s	4	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	8.6	41.9	28.7	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	2.5	1.5	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2		6
Case Number		5.0		6.0	1.0	4.0		8.3
Phase Duration, s		33.8		33.8	13.2	61.2		48.0
Change Period, (*Y+R*c), s		5.1		5.1	4.6	6.1		6.1
Max Allow Headway (*MAH*), s		4.3		4.3	4.2	0.0		0.0
Queue Clearance Time (*g*s), s		27.8		13.3	10.7			
Green Extension Time (*g*e), s		0.9		2.3	0.0	0.0		0.0
Phase Call Probability		1.00		1.00	1.00			
Max Out Probability		1.00		0.02	1.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14	3	8	18	5	2			6	16
Adjusted Flow Rate (*v*), veh/h	188		0	235	216		271	1491			474	455
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1119		1448	1618	1616		1629	1707			1732	1660
Queue Service Time (*g*s), s	15.5		0.0	11.3	10.2		8.7	27.4			19.7	21.0
Cycle Queue Clearance Time (*g*c), s	25.8		0.0	11.3	10.2		8.7	27.4			19.7	21.0
Green Ratio (*g/C*)	0.30		0.30	0.30	0.30		0.55	0.58			0.44	0.44
Capacity (*c*), veh/h	293		438	565	489		352	1979			762	730
Volume-to-Capacity Ratio (*X*)	0.643		0.000	0.417	0.442		0.770	0.754			0.622	0.624
Available Capacity (*c*a), veh/h	318		471	601	526		352	1979			762	730
Back of Queue (*Q*), veh/ln (95th percentile)	7.9		0.0	7.6	6.9		3.8	9.6			13.6	13.5
Queue Storage Ratio (*RQ*) (95th percentile)	1.01		0.00	1.56	0.18		0.96	0.31			0.17	0.17
Uniform Delay (*d*1), s/veh	37.1		0.0	27.1	26.7		16.3	10.9			21.8	22.6
Incremental Delay (*d*2), s/veh	3.9		0.0	0.5	0.6		1.4	0.4			3.4	3.6
Initial Queue Delay (*d*3), s/veh	0.0		0.0	0.0	0.0		0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh	41.0		0.0	27.6	27.3		17.7	11.3			25.2	26.2
Level of Service (LOS)	D			C	C		B	B			C	C

Approach Delay, s/veh / LOS	41.0	D	27.4	C	12.3	B	25.7	C
Intersection Delay, s/veh / LOS	19.7				B			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.7	B	1.7	A	2.6	B
Bicycle LOS Score / LOS		F	1.2	A	2.1	B	1.3	A

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_______________________TWO-WAY STOP CONTROL SUMMARY___________________________

Analyst:              GHM
Agency/Co.:           HDR
Date Performed:       10/09/2014
Analysis Time Period: AM Peak
Intersection:         Cliff Ave & I-229 SB On-Ramp
Jurisdiction:         Sioux Falls, SD
Units: U. S. Customary
Analysis Year:        2035
Project ID:  I-229 MIS
East/West Street:     I-229 SB On-Ramp
North/South Street:   Cliff Ave
Intersection Orientation: NS                 Study period (hrs):  0.25

______________________Vehicle Volumes and Adjustments_________________________
Major Street:  Approach        Northbound              Southbound
               Movement     1      2      3     |  4      5      6
                            L      T      R     |  L      T      R
______________________________________________________________________________
Volume                      350    1690                   940    220
Peak-Hour Factor, PHF       0.85   0.85                   0.85   0.85
Hourly Flow Rate, HFR       411    1988                   1105   258
Percent Heavy Vehicles      2      --     --              --     --
Median Type/Storage         TWLTL                 / 1
RT Channelized?
Lanes                          1   2                      2    0
Configuration                   L  T                      T   TR
Upstream Signal?                   Yes                    Yes
______________________________________________________________________________
Minor Street:  Approach        Westbound               Eastbound
               Movement     7      8      9     |  10     11     12
                            L      T      R     |  L      T      R
______________________________________________________________________________
Volume                                             0             0
Peak Hour Factor, PHF                              0.85          0.85
Hourly Flow Rate, HFR                              0             0
Percent Heavy Vehicles                             2             2
Percent Grade (%)                  0                      0
Flared Approach:  Exists?/Storage                /              No     /
Lanes                                                 0        0
Configuration                                             LR
______________________________________________________________________________

__________________Delay, Queue Length, and Level of Service___________________
Approach            NB     SB         Westbound             Eastbound
Movement            1      4   |  7      8      9    |  10     11     12
Lane Config         L          |                     |         LR
______________________________________________________________________________
v (vph)             411                                        0
C(m) (vph)          519
v/c                 0.79
95% queue length    7.38
Control Delay       33.4
LOS                  D
Approach Delay
Approach LOS
______________________________________________________________________________
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                  HCS+: Unsignalized Intersections Release 5.6




Phone:                                        Fax:
E-Mail:

______________________TWO-WAY STOP CONTROL(TWSC) ANALYSIS_____________________

Analyst:              GHM
Agency/Co.:           HDR
Date Performed:       10/09/2014
Analysis Time Period: AM Peak
Intersection:         Cliff Ave & I-229 SB On-Ramp
Jurisdiction:         Sioux Falls, SD
Units: U. S. Customary
Analysis Year:        2035
Project ID:  I-229 MIS
East/West Street:     I-229 SB On-Ramp
North/South Street:   Cliff Ave
Intersection Orientation: NS                 Study period (hrs):  0.25

________________________Vehicle Volumes and Adjustments_______________________
Major Street Movements      1      2      3      4      5      6
                            L      T      R      L      T      R

______________________________________________________________________________
Volume                     350    1690                 940    220
Peak-Hour Factor, PHF      0.85   0.85                 0.85   0.85
Peak-15 Minute Volume      103    497                  276    65
Hourly Flow Rate, HFR      411    1988                 1105   258
Percent Heavy Vehicles     2      --     --            --     --
Median Type/Storage         TWLTL                 / 1
RT Channelized?
Lanes                         1   2                    2    0
Configuration                  L  T                    T   TR
Upstream Signal?                  Yes                  Yes
______________________________________________________________________________
Minor Street Movements        7    8      9     10     11     12
                            L      T      R      L      T      R

______________________________________________________________________________
Volume                                          0             0
Peak Hour Factor, PHF                           0.85          0.85
Peak-15 Minute Volume                           0             0
Hourly Flow Rate, HFR                           0             0
Percent Heavy Vehicles                          2             2
Percent Grade (%)                 0                    0
Flared Approach:  Exists?/Storage               /              No     /
RT Channelized?
Lanes                                              0        0
Configuration                                          LR
______________________________________________________________________________


______________________Pedestrian Volumes and Adjustments______________________
Movements                    13     14     15     16
______________________________________________________________________________
Flow (ped/hr)                0      0      0      0
```

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Lane Width (ft)              12.0   12.0   12.0   12.0
Walking Speed (ft/sec)       4.0    4.0    4.0    4.0
Percent Blockage             0      0      0      0
______________________________________________________________________________

_____________________________Upstream Signal Data_____________________________
                 Prog.    Sat   Arrival   Green  Cycle   Prog.   Distance
                 Flow     Flow   Type     Time   Length  Speed   to Signal
                 vph      vph             sec     sec     mph      feet
______________________________________________________________________________
S2  Left-Turn    0       1800     3       0       100     30       600
    Through      1640    1800     4       52      100     30       600
S5  Left-Turn    0       1800     3       0       100     30       200
    Through      700     1800     4       55      100     30       200
______________________________________________________________________________

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles
______________________________________________________________________________
                                           Movement 2     Movement 5
______________________________________________________________________________
Shared ln volume, major th vehicles:
Shared ln volume, major rt vehicles:
Sat flow rate, major th vehicles:
Sat flow rate, major rt vehicles:
Number of major street through lanes:
______________________________________________________________________________

Worksheet 4-Critical Gap and Follow-up Time Calculation
______________________________________________________________________________
Critical Gap Calculation
Movement          1      4      7      8      9     10     11     12
                  L      L      L      T      R      L      T      R
______________________________________________________________________________
t(c,base)        4.1                                7.5           6.2
t(c,hv)          2.00   2.00   2.00   2.00   2.00   2.00   2.00   2.00
P(hv)            2                                  2             2
t(c,g)                         0.20   0.20   0.10   0.20   0.20   0.10
Percent Grade                  0.00   0.00   0.00   0.00   0.00   0.00
t(3,lt)          0.00                               0.70          0.00
t(c,T):  1-stage 0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
         2-stage 0.00   0.00   1.00   1.00   0.00   1.00   1.00   0.00
t(c)     1-stage 4.1                                6.8           6.2
         2-stage 4.1                                5.8           6.2
______________________________________________________________________________
Follow-Up Time Calculations
Movement          1      4      7      8      9     10     11     12
                  L      L      L      T      R      L      T      R
______________________________________________________________________________
t(f,base)        2.20                               3.50          3.30
t(f,HV)          1.00   1.00   1.00   1.00   1.00   1.00   1.00   1.00
P(HV)            2                                  2             2
t(f)             2.2                                3.5           3.3
______________________________________________________________________________

Worksheet 5-Effect of Upstream Signals
______________________________________________________________________________
Computation 1-Queue Clearance Time at Upstream Signal
                                            Movement 2        Movement 5
                                         V(t)   V(l,prot)  V(t)   V(l,prot)
______________________________________________________________________________
V prog                                   1640     0        700      0
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Total Saturation Flow Rate, s (vph)      3600     3600     3600     3600
Arrival Type                             4        3        4        3
Effective Green, g (sec)                 52       0        55       0
Cycle Length, C (sec)                    100      100      100      100
Rp (from Exhibit 16-11)                  1.333    1.000    1.333    1.000
Proportion vehicles arriving on green P  0.693    0.000    0.733    0.000
g(q1)                                    14.0     0.0      5.2      0.0
g(q2)                                    21.6     0.0      1.8      0.0
g(q)                                     35.6     0.0      7.0      0.0
______________________________________________________________________________
Computation 2-Proportion of TWSC Intersection Time  blocked
                                            Movement 2        Movement 5
                                         V(t)   V(l,prot)  V(t)   V(l,prot)
______________________________________________________________________________
alpha                                         0.350             0.350
beta                                          0.741             0.741
Travel time, t(a) (sec)                       13.605            4.535
Smoothing Factor, F                           0.221             0.460
Proportion of conflicting flow, f        1.000    1.000    1.000    1.000
Max platooned flow, V(c,max)             3600     0        3552     0
Min platooned flow, V(c,min)             2000     2000     2000     2000
Duration of blocked period, t(p)         48.8     0.0      7.1      0.0
Proportion time blocked, p                    0.488             0.071
______________________________________________________________________________
Computation 3-Platoon Event Periods     Result
______________________________________________________________________________
p(2)                                    0.488
p(5)                                    0.071
p(dom)                                  0.488
p(subo)                                 0.071
Constrained or unconstrained?             U
______________________________________________________________________________
Proportion
unblocked                  (1)             (2)             (3)
for minor              Single-stage         Two-Stage Process
movements, p(x)          Process       Stage I         Stage II
______________________________________________________________________________
p(1)                      0.929
p(4)
p(7)
p(8)
p(9)
p(10)                     0.477         0.929           0.512
p(11)
p(12)                     0.929
______________________________________________________________________________
Computation 4 and 5
Single-Stage Process
Movement                1      4      7      8      9     10     11     12
                        L      L      L      T      R      L      T      R
______________________________________________________________________________
V c,x                  1363                                  3050          682
s                      3000                                  3000          3000
Px                     0.929                                 0.477         0.929
V c,u,x                1237                                  3105          504
______________________________________________________________________________
C r,x                  559                                   9             566
C plat,x               519                                   4             526
______________________________________________________________________________
Two-Stage Process
                     7               8              10              11
```

```
              Stage1  Stage2  Stage1  Stage2  Stage1  Stage2  Stage1  Stage2
______________________________________________________________________________
V(c,x)                                        1234    1816
s                                             3000    3000
P(x)                                          0.929   0.512
V(c,u,x)                                      1098    690

______________________________________________________________________________
C(r,x)                                        281     459
C(plat,x)                                     261     235

______________________________________________________________________________

Worksheet 6-Impedance and Capacity Equations
______________________________________________________________________________
Step 1: RT from Minor St.                          9               12
______________________________________________________________________________
Conflicting Flows                                               682
Potential Capacity                                              526
Pedestrian Impedance Factor                     1.00             1.00
Movement Capacity                                               526
Probability of Queue free St.                   1.00             1.00
______________________________________________________________________________
Step 2: LT from Major St.                          4                1
______________________________________________________________________________
Conflicting Flows                                               1363
Potential Capacity                                              519
Pedestrian Impedance Factor                     1.00             1.00
Movement Capacity                                               519
Probability of Queue free St.                   1.00             0.21
Maj L-Shared Prob Q free St.
______________________________________________________________________________
Step 3: TH from Minor St.                          8               11
______________________________________________________________________________
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor                     1.00             1.00
Cap. Adj. factor due to Impeding mvmnt          0.21             0.21
Movement Capacity
Probability of Queue free St.                   1.00             1.00
______________________________________________________________________________
Step 4: LT from Minor St.                          7               10
______________________________________________________________________________
Conflicting Flows                                               3050
Potential Capacity                                              4
Pedestrian Impedance Factor                     1.00             1.00
Maj. L, Min T Impedance factor                  0.21
Maj. L, Min T Adj. Imp Factor.                  0.34
Cap. Adj. factor due to Impeding mvmnt          0.34             0.21
Movement Capacity                                               1
______________________________________________________________________________

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance
______________________________________________________________________________
Step 3: TH from Minor St.                          8               11
______________________________________________________________________________
Part 1 - First Stage
Conflicting Flows
Potential Capacity                              26               270
Pedestrian Impedance Factor                     1.00             1.00
Cap. Adj. factor due to Impeding mvmnt          0.21             1.00
Movement Capacity                               5                270
Probability of Queue free St.                   1.00             1.00
```

```
______________________________________________________________________________
Part 2 - Second Stage
Conflicting Flows
Potential Capacity                              232               26
Pedestrian Impedance Factor                     1.00              1.00
Cap. Adj. factor due to Impeding mvmnt          1.00              0.21
Movement Capacity                               232               5
______________________________________________________________________________
Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor                     1.00              1.00
Cap. Adj. factor due to Impeding mvmnt          0.21              0.21
Movement Capacity
______________________________________________________________________________
Result for 2 stage process:
a                                               0.91              0.91
y
C t
Probability of Queue free St.                   1.00              1.00
______________________________________________________________________________
Step 4: LT from Minor St.                          7                10
______________________________________________________________________________
Part 1 - First Stage
Conflicting Flows                                                 1234
Potential Capacity                              21                261
Pedestrian Impedance Factor                     1.00              1.00
Cap. Adj. factor due to Impeding mvmnt          0.21              1.00
Movement Capacity                               4                 261
______________________________________________________________________________
Part 2 - Second Stage
Conflicting Flows                                                 1816
Potential Capacity                              631               235
Pedestrian Impedance Factor                     1.00              1.00
Cap. Adj. factor due to Impeding mvmnt          1.00              0.21
Movement Capacity                               631               49
______________________________________________________________________________
Part 3 - Single Stage
Conflicting Flows                                                 3050
Potential Capacity                                                4
Pedestrian Impedance Factor                     1.00              1.00
Maj. L, Min T Impedance factor                  0.21
Maj. L, Min T Adj. Imp Factor.                  0.34
Cap. Adj. factor due to Impeding mvmnt          0.34              0.21
Movement Capacity                                                 1
______________________________________________________________________________
Results for Two-stage process:
a                                               0.91              0.91
y                                                                 5.42
C t                                                               38
______________________________________________________________________________

Worksheet 8-Shared Lane Calculations
______________________________________________________________________________
Movement                               7      8      9     10     11     12
                                       L      T      R      L      T      R
______________________________________________________________________________
Volume (vph)                                               0             0
Movement Capacity (vph)                                    38            526
Shared Lane Capacity (vph)
______________________________________________________________________________
```

```
Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement                              7      8      9     10     11     12
                                      L      T      R      L      T      R

C sep                                                     38            526
Volume                                                    0             0
Delay
Q sep
Q sep +1
round (Qsep +1)

n max
C sh
SUM C sep
n
C act


Worksheet 10-Delay, Queue Length, and Level of Service

Movement             1      4      7      8      9      10     11     12
Lane Config          L                                          LR

v (vph)             411                                        0
C(m) (vph)          519
v/c                 0.79
95% queue length    7.38
Control Delay       33.4
LOS                  D
Approach Delay
Approach LOS

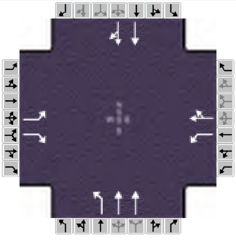

Worksheet 11-Shared Major LT Impedance and Delay

                                                 Movement 2     Movement 5

p(oj)                                               0.21           1.00
v(il), Volume for stream 2 or 5
v(i2), Volume for stream 3 or 6
s(il), Saturation flow rate for stream 2 or 5
s(i2), Saturation flow rate for stream 3 or 6
P*(oj)
d(M,LT), Delay for stream 1 or 4                    33.4
N, Number of major street through lanes
d(rank,1) Delay for stream 2 or 5
```

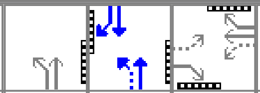
HCS 2010 Signalized Intersection Results Summary

General Information				**Intersection Information**	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Cliff Ave & I-229 SB Off-rar	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Cliff_PM_BestCase.xus				
Project Description	2035 NB PM				

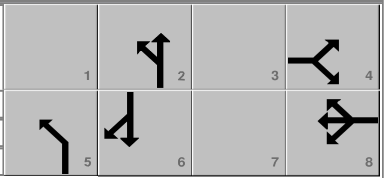


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	200		680	300	80	40	200	680			1470	180

Signal Information			
Cycle, s	95.0	Reference Phase	2
Offset, s	14	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	10.2	52.2	16.9	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	2.4	1.5	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2		6
Case Number		5.0		6.0	1.0	4.0		8.3
Phase Duration, s		22.0		22.0	14.8	73.0		58.2
Change Period, (*Y+R$_c$*), s		5.1		5.1	4.6	6.1		6.1
Max Allow Headway (*MAH*), s		4.2		4.2	4.2	0.0		0.0
Queue Clearance Time (*g$_s$*), s		18.9		18.9	9.5			
Green Extension Time (*g$_e$*), s		0.0		0.0	0.8	0.0		0.0
Phase Call Probability		1.00		1.00	1.00			
Max Out Probability		1.00		1.00	0.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14	3	8	18	5	2			6	16
Adjusted Flow Rate (*v*), veh/h	215		0	323	117		215	731			888	877
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1219		1441	1659	1665		1613	1626			1828	1760
Queue Service Time (*g$_s$*), s	11.0		0.0	16.9	5.9		7.5	7.8			94.8	38.1
Cycle Queue Clearance Time (*g$_c$*), s	16.9		0.0	16.9	5.9		7.5	7.8			94.8	38.1
Green Ratio (*g/C*)	0.18		0.18	0.18	0.18		0.68	0.64			0.55	0.55
Capacity (*c*), veh/h	217		256	371	296		250	2086			1001	965
Volume-to-Capacity Ratio (*X*)	0.992		0.000	0.870	0.396		0.861	0.351			0.886	0.909
Available Capacity (*c$_a$*), veh/h	217		256	371	296		1050	2086			1001	965
Back of Queue (*Q*), veh/ln (95th percentile)	13.4		0.0	14.4	4.3		7.7	4.2			17.3	15.9
Queue Storage Ratio (*RQ*) (95th percentile)	1.71		0.00	2.92	0.11		1.97	0.13			0.22	0.20
Uniform Delay (*d$_1$*), s/veh	43.9		0.0	39.8	34.5		24.1	4.9			12.3	11.1
Incremental Delay (*d$_2$*), s/veh	58.9		0.0	19.4	0.9		6.7	0.4			8.0	9.9
Initial Queue Delay (*d$_3$*), s/veh	0.0		0.0	0.0	0.0		0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh	102.8		0.0	59.1	35.4		30.7	5.2			20.3	21.0
Level of Service (LOS)	F			E	D		C	A			C	C

Approach Delay, s/veh / LOS	102.8	F	52.8	D	11.0	B	20.7	C
Intersection Delay, s/veh / LOS	27.4				C			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.7	B	1.6	A	3.2	C
Bicycle LOS Score / LOS		F	1.2	A	1.3	A	1.9	A

```
                 HCS+: Unsignalized Intersections Release 5.6

_______________________TWO-WAY STOP CONTROL SUMMARY___________________________

Analyst:                 GHM
Agency/Co.:              HDR
Date Performed:          10/09/2014
Analysis Time Period: PM Peak
Intersection:            Cliff Ave & I-229 SB On-Ramp
Jurisdiction:            Sioux Falls, SD
Units: U. S. Customary
Analysis Year:           2035
Project ID:  I-229 MIS
East/West Street:        I-229 SB On-Ramp
North/South Street:      Cliff Ave
Intersection Orientation: NS                 Study period (hrs):  0.25

______________________Vehicle Volumes and Adjustments_________________________
Major Street:  Approach        Northbound              Southbound
               Movement     1      2      3     |  4      5      6
                            L      T      R     |  L      T      R
______________________________________________________________________________
Volume                      210    880                    1950   500
Peak-Hour Factor, PHF       0.93   0.93                   0.93   0.93
Hourly Flow Rate, HFR       225    946                    2096   537
Percent Heavy Vehicles      3      --     --              --     --
Median Type/Storage         TWLTL                / 1
RT Channelized?
Lanes                          1   2                      2    0
Configuration                   L  T                      T   TR
Upstream Signal?                   Yes                    Yes
______________________________________________________________________________
Minor Street:  Approach        Westbound               Eastbound
               Movement     7      8      9     |  10     11     12
                            L      T      R     |  L      T      R
______________________________________________________________________________
Volume                                             0             0
Peak Hour Factor, PHF                              0.93          0.93
Hourly Flow Rate, HFR                              0             0
Percent Heavy Vehicles                             3             3
Percent Grade (%)                  0                      0
Flared Approach:  Exists?/Storage               /              No     /
Lanes                                                 0        0
Configuration                                             LR
______________________________________________________________________________

__________________Delay, Queue Length, and Level of Service___________________
Approach            NB     SB        Westbound             Eastbound
Movement            1      4   |  7      8      9    |  10     11     12
Lane Config         L          |                     |         LR
______________________________________________________________________________
v (vph)             225                                        0
C(m) (vph)          126
v/c                 1.79
95% queue length    17.26
Control Delay       443.2
LOS                  F
Approach Delay
Approach LOS
______________________________________________________________________________
```

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                  HCS+: Unsignalized Intersections Release 5.6




Phone:                                        Fax:
E-Mail:

______________________TWO-WAY STOP CONTROL(TWSC) ANALYSIS_____________________

Analyst:              GHM
Agency/Co.:           HDR
Date Performed:       10/09/2014
Analysis Time Period: PM Peak
Intersection:         Cliff Ave & I-229 SB On-Ramp
Jurisdiction:         Sioux Falls, SD
Units: U. S. Customary
Analysis Year:        2035
Project ID:  I-229 MIS
East/West Street:     I-229 SB On-Ramp
North/South Street:   Cliff Ave
Intersection Orientation: NS                 Study period (hrs):  0.25

________________________Vehicle Volumes and Adjustments_______________________
Major Street Movements      1      2      3      4      5      6
                            L      T      R      L      T      R

______________________________________________________________________________
Volume                     210    880                  1950   500
Peak-Hour Factor, PHF      0.93   0.93                 0.93   0.93
Peak-15 Minute Volume      56     237                  524    134
Hourly Flow Rate, HFR      225    946                  2096   537
Percent Heavy Vehicles     3      --     --            --     --
Median Type/Storage         TWLTL                / 1
RT Channelized?
Lanes                         1   2                    2    0
Configuration                  L  T                    T   TR
Upstream Signal?                  Yes                  Yes
______________________________________________________________________________
Minor Street Movements      7      8      9     10     11     12
                            L      T      R      L      T      R

______________________________________________________________________________
Volume                                          0             0
Peak Hour Factor, PHF                           0.93          0.93
Peak-15 Minute Volume                           0             0
Hourly Flow Rate, HFR                           0             0
Percent Heavy Vehicles                          3             3
Percent Grade (%)                 0                    0
Flared Approach:  Exists?/Storage               /              No     /
RT Channelized?
Lanes                                              0        0
Configuration                                          LR
______________________________________________________________________________

______________________Pedestrian Volumes and Adjustments______________________
Movements                    13     14     15     16
______________________________________________________________________________
Flow (ped/hr)                0      0      0      0
```

```
Lane Width (ft)              12.0   12.0   12.0   12.0
Walking Speed (ft/sec)       4.0    4.0    4.0    4.0
Percent Blockage             0      0      0      0
______________________________________________________________________________

_____________________________Upstream Signal Data_____________________________
                 Prog.    Sat   Arrival   Green  Cycle   Prog.   Distance
                 Flow     Flow   Type     Time   Length  Speed   to Signal
                 vph      vph             sec     sec     mph      feet
______________________________________________________________________________
S2  Left-Turn    0       1800      3      0       100     30       600
    Through      890     1800      4      54      100     30       600
S5  Left-Turn    0       1800      3      0       100     30       200
    Through      1470    1800      4      54      100     30       200
______________________________________________________________________________

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles
______________________________________________________________________________
                                           Movement 2     Movement 5
______________________________________________________________________________
Shared ln volume, major th vehicles:
Shared ln volume, major rt vehicles:
Sat flow rate, major th vehicles:
Sat flow rate, major rt vehicles:
Number of major street through lanes:
______________________________________________________________________________

Worksheet 4-Critical Gap and Follow-up Time Calculation
______________________________________________________________________________
Critical Gap Calculation
Movement          1      4      7      8      9      10     11     12
                  L      L      L      T      R       L      T      R
______________________________________________________________________________
t(c,base)        4.1                                 7.5           6.2
t(c,hv)          2.00   2.00   2.00   2.00   2.00   2.00   2.00   2.00
P(hv)            3                                   3             3
t(c,g)                         0.20   0.20   0.10   0.20   0.20   0.10
Percent Grade                  0.00   0.00   0.00   0.00   0.00   0.00
t(3,lt)          0.00                                0.70          0.00
t(c,T):  1-stage 0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
         2-stage 0.00   0.00   1.00   1.00   0.00   1.00   1.00   0.00
t(c)     1-stage 4.2                                 6.9           6.3
         2-stage 4.2                                 5.9           6.3
______________________________________________________________________________
Follow-Up Time Calculations
Movement          1      4      7      8      9      10     11     12
                  L      L      L      T      R       L      T      R
______________________________________________________________________________
t(f,base)        2.20                                3.50          3.30
t(f,HV)          1.00   1.00   1.00   1.00   1.00   1.00   1.00   1.00
P(HV)            3                                   3             3
t(f)             2.2                                 3.5           3.3
______________________________________________________________________________

Worksheet 5-Effect of Upstream Signals
______________________________________________________________________________
Computation 1-Queue Clearance Time at Upstream Signal
                                            Movement 2        Movement 5
                                         V(t)   V(l,prot)  V(t)   V(l,prot)
______________________________________________________________________________
V prog                                   890      0        1470     0
```

```
Total Saturation Flow Rate, s (vph)      3600     3600     3600     3600
Arrival Type                             4        3        4        3
Effective Green, g (sec)                 54       0        54       0
Cycle Length, C (sec)                    100      100      100      100
Rp (from Exhibit 16-11)                  1.333    1.000    1.333    1.000
Proportion vehicles arriving on green P  0.720    0.000    0.720    0.000
g(q1)                                    6.9      0.0      11.4     0.0
g(q2)                                    3.4      0.0      13.7     0.0
g(q)                                     10.3     0.0      25.1     0.0
______________________________________________________________________________
Computation 2-Proportion of TWSC Intersection Time  blocked
                                            Movement 2        Movement 5
                                         V(t)   V(l,prot)  V(t)   V(l,prot)
______________________________________________________________________________
alpha                                         0.350             0.350
beta                                          0.741             0.741
Travel time, t(a) (sec)                       13.605            4.535
Smoothing Factor, F                           0.221             0.460
Proportion of conflicting flow, f        1.000    1.000    1.000    1.000
Max platooned flow, V(c,max)             3326     0        3600     0
Min platooned flow, V(c,min)             2000     2000     2000     2000
Duration of blocked period, t(p)         11.0     0.0      29.8     0.0
Proportion time blocked, p                    0.110             0.298
______________________________________________________________________________
Computation 3-Platoon Event Periods     Result
______________________________________________________________________________
p(2)                                    0.110
p(5)                                    0.298
p(dom)                                  0.298
p(subo)                                 0.110
Constrained or unconstrained?             U
______________________________________________________________________________
Proportion
unblocked                  (1)             (2)             (3)
for minor              Single-stage         Two-Stage Process
movements, p(x)          Process        Stage I         Stage II
______________________________________________________________________________
p(1)                      0.702
p(4)
p(7)
p(8)
p(9)
p(10)                     0.647         0.702           0.890
p(11)
p(12)                     0.702
______________________________________________________________________________
Computation 4 and 5
Single-Stage Process
Movement                1      4      7      8      9     10     11     12
                        L      L      L      T      R      L      T      R
______________________________________________________________________________
V c,x                  2633                               3287          1316
s                      3000                               3000          3000
Px                     0.702                              0.647         0.702
V c,u,x                2477                               3444          601
______________________________________________________________________________
C r,x                  180                                5             496
C plat,x               126                                3             348
______________________________________________________________________________
Two-Stage Process
                     7               8              10              11
```

```
              Stage1  Stage2  Stage1  Stage2  Stage1  Stage2  Stage1  Stage2
------------------------------------------------------------------------------
V(c,x)                                        2364    923
s                                             3000    3000
P(x)                                          0.702   0.890
V(c,u,x)                                      2094    668
------------------------------------------------------------------------------
C(r,x)                                        79      469
C(plat,x)                                     55      418
------------------------------------------------------------------------------

Worksheet 6-Impedance and Capacity Equations
------------------------------------------------------------------------------
Step 1: RT from Minor St.                          9               12
------------------------------------------------------------------------------
Conflicting Flows                                                1316
Potential Capacity                                               348
Pedestrian Impedance Factor                     1.00             1.00
Movement Capacity                                                348
Probability of Queue free St.                   1.00             1.00
------------------------------------------------------------------------------
Step 2: LT from Major St.                          4                1
------------------------------------------------------------------------------
Conflicting Flows                                                2633
Potential Capacity                                               126
Pedestrian Impedance Factor                     1.00             1.00
Movement Capacity                                                126
Probability of Queue free St.                   1.00             0.00
Maj L-Shared Prob Q free St.
------------------------------------------------------------------------------
Step 3: TH from Minor St.                          8               11
------------------------------------------------------------------------------
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor                     1.00             1.00
Cap. Adj. factor due to Impeding mvmnt          0.00             0.00
Movement Capacity
Probability of Queue free St.                   1.00             1.00
------------------------------------------------------------------------------
Step 4: LT from Minor St.                          7               10
------------------------------------------------------------------------------
Conflicting Flows                                                3287
Potential Capacity                                               3
Pedestrian Impedance Factor                     1.00             1.00
Maj. L, Min T Impedance factor                  0.00
Maj. L, Min T Adj. Imp Factor.                  0.00
Cap. Adj. factor due to Impeding mvmnt          0.00             0.00
Movement Capacity                                                0
------------------------------------------------------------------------------

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance
------------------------------------------------------------------------------
Step 3: TH from Minor St.                          8               11
------------------------------------------------------------------------------
Part 1 - First Stage
Conflicting Flows
Potential Capacity                              232              67
Pedestrian Impedance Factor                     1.00             1.00
Cap. Adj. factor due to Impeding mvmnt          0.00             1.00
Movement Capacity                               0                67
Probability of Queue free St.                                    1.00
```

```
Part 2 - Second Stage
Conflicting Flows
Potential Capacity                              42               232
Pedestrian Impedance Factor                     1.00             1.00
Cap. Adj. factor due to Impeding mvmnt          1.00             0.00
Movement Capacity                               42               0

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor                     1.00             1.00
Cap. Adj. factor due to Impeding mvmnt          0.00             0.00
Movement Capacity

Result for 2 stage process:
a                                               0.91             0.91
y
C t
Probability of Queue free St.                   1.00             1.00

Step 4: LT from Minor St.                          7               10

Part 1 - First Stage
Conflicting Flows                                                2364
Potential Capacity                              224              55
Pedestrian Impedance Factor                     1.00             1.00
Cap. Adj. factor due to Impeding mvmnt          0.00             1.00
Movement Capacity                               0                55

Part 2 - Second Stage
Conflicting Flows                                                923
Potential Capacity                              563              418
Pedestrian Impedance Factor                     1.00             1.00
Cap. Adj. factor due to Impeding mvmnt          1.00
Movement Capacity                               563

Part 3 - Single Stage
Conflicting Flows                                                3287
Potential Capacity                                               3
Pedestrian Impedance Factor                     1.00             1.00
Maj. L, Min T Impedance factor                  0.00
Maj. L, Min T Adj. Imp Factor.                  0.00
Cap. Adj. factor due to Impeding mvmnt          0.00             0.00
Movement Capacity                                                0

Results for Two-stage process:
a                                               0.91             0.91
y
C t


Worksheet 8-Shared Lane Calculations

Movement                              7      8      9     10     11     12
                                      L      T      R      L      T      R

Volume (vph)                                              0             0
Movement Capacity (vph)                                                348
Shared Lane Capacity (vph)
```

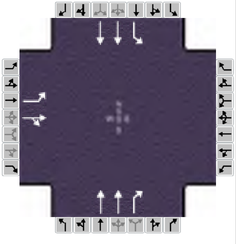
```
Worksheet 9-Computation of Effect of Flared Minor Street Approaches
_______________________________________________________________________________
Movement                              7      8      9     10     11     12
                                      L      T      R      L      T      R
_______________________________________________________________________________
C sep                                                                   348
Volume                                                    0             0
Delay
Q sep
Q sep +1
round (Qsep +1)
_______________________________________________________________________________
n max
C sh
SUM C sep
n
C act
_______________________________________________________________________________

Worksheet 10-Delay, Queue Length, and Level of Service
_______________________________________________________________________________
Movement             1      4      7      8      9      10     11     12
Lane Config          L                                          LR
_______________________________________________________________________________
v (vph)             225                                        0
C(m) (vph)          126
v/c                 1.79
95% queue length    17.26
Control Delay       443.2
LOS                  F
Approach Delay
Approach LOS
_______________________________________________________________________________

Worksheet 11-Shared Major LT Impedance and Delay
_______________________________________________________________________________
                                                 Movement 2     Movement 5
_______________________________________________________________________________
p(oj)                                               0.00           1.00
v(il), Volume for stream 2 or 5
v(i2), Volume for stream 3 or 6
s(il), Saturation flow rate for stream 2 or 5
s(i2), Saturation flow rate for stream 3 or 6
P*(oj)
d(M,LT), Delay for stream 1 or 4                    443.2
N, Number of major street through lanes
d(rank,1) Delay for stream 2 or 5
_______________________________________________________________________________
```

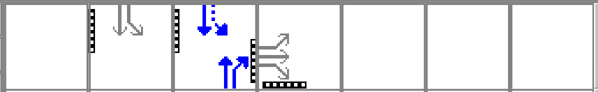
HCS 2010 Signalized Intersection Results Summary

General Information				**Intersection Information**	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Cliff Ave & NB I-229 Ramps	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Cliff_AM_BestCase.xus				
Project Description	2035 NB AM				

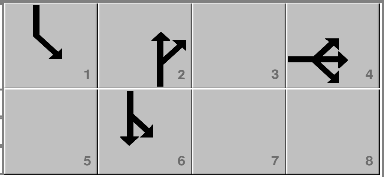


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	400	0	170					1640	380	140	800	

Signal Information			
Cycle, s	95.0	Reference Phase	6
Offset, s	51	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	6.0	54.3	19.9	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	1.5	1.5	0.0	0.0	0.0



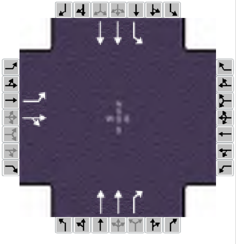
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2	1	6
Case Number		10.0				7.3	1.0	4.0
Phase Duration, s		25.0				59.4	10.6	70.0
Change Period, (*Y+R*c), s		5.1				5.1	4.6	5.1
Max Allow Headway (*MAH*), s		4.1				0.0	4.2	0.0
Queue Clearance Time (*g*s), s		21.9					6.0	
Green Extension Time (*g*e), s		0.0				0.0	0.1	0.0
Phase Call Probability		1.00					0.99	
Max Out Probability		1.00					1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14					2	12	1	6	
Adjusted Flow Rate (*v*), veh/h	471	200						1774	411	165	941	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1687	1507						1740	1462	1599	1648	
Queue Service Time (*g*s), s	19.9	11.5						40.9	6.2	4.0	18.8	
Cycle Queue Clearance Time (*g*c), s	19.9	11.5						40.9	6.2	4.0	18.8	
Green Ratio (*g/C*)	0.21	0.21						0.57	0.57	0.66	0.48	
Capacity (*c*), veh/h	353	316						1989	836	201	1591	
Volume-to-Capacity Ratio (*X*)	1.332	0.633						0.892	0.492	0.821	0.591	
Available Capacity (*c*a), veh/h	353	316						1989	836	241	1591	
Back of Queue (*Q*), veh/ln (95th percentile)	37.1	7.8						15.2	1.8	4.9	10.6	
Queue Storage Ratio (*RQ*) (95th percentile)	6.33	0.20						0.16	0.18	1.26	0.34	
Uniform Delay (*d*1), s/veh	37.6	34.2						15.0	3.1	20.5	11.2	
Incremental Delay (*d*2), s/veh	167.5	4.1						0.7	0.2	13.9	1.3	
Initial Queue Delay (*d*3), s/veh	0.0	0.0						0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	205.1	38.3						15.7	3.3	34.4	12.5	
Level of Service (LOS)	F	D						B	A	C	B	
Approach Delay, s/veh / LOS	155.3		F	0.0			13.4		B	15.8		B
Intersection Delay, s/veh / LOS	38.1						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.9	C	1.9	A	1.6	A
Bicycle LOS Score / LOS	1.6	A			2.4	B	1.4	A

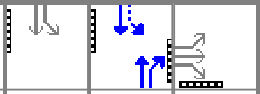
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Cliff Ave & NB I-229 Ramps	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Cliff_PM_BestCase.xus				
Project Description	2035 NB PM				

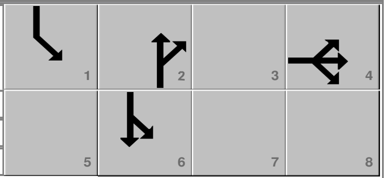


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	200	0	350					890	220	200	1750	

Signal Information			
Cycle, s	95.0	Reference Phase	6
Offset, s	80	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	9.2	43.1	28.0	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	1.5	1.5	0.0	0.0	0.0



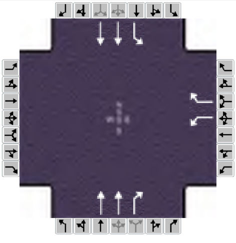
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2	1	6
Case Number		10.0				7.3	1.0	4.0
Phase Duration, s		33.1				48.2	13.8	61.9
Change Period, (*Y+R*c), s		5.1				5.1	4.6	5.1
Max Allow Headway (*MAH*), s		4.2				0.0	4.2	0.0
Queue Clearance Time (*g*s), s		25.7					8.5	
Green Extension Time (*g*e), s		2.3				0.0	0.7	0.0
Phase Call Probability		1.00					1.00	
Max Out Probability		0.00					0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14					2	12	1	6	
Adjusted Flow Rate (*v*), veh/h	215	376						957	237	215	1882	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1613	1441						1649	1430	1613	1752	
Queue Service Time (*g*s), s	10.3	23.7						16.2	5.3	6.5	39.5	
Cycle Queue Clearance Time (*g*c), s	10.3	23.7						16.2	5.3	6.5	39.5	
Green Ratio (*g/C*)	0.29	0.29						0.45	0.45	0.57	0.60	
Capacity (*c*), veh/h	475	425						1496	648	358	2096	
Volume-to-Capacity Ratio (*X*)	0.453	0.887						0.640	0.365	0.600	0.898	
Available Capacity (*c*a), veh/h	796	711						1496	648	667	2096	
Back of Queue (*Q*), veh/ln (95th percentile)	7.0	13.5						7.6	2.8	3.3	12.9	
Queue Storage Ratio (*RQ*) (95th percentile)	1.19	0.35						0.08	0.29	0.84	0.41	
Uniform Delay (*d*1), s/veh	27.3	32.0						11.5	7.0	12.3	10.1	
Incremental Delay (*d*2), s/veh	0.7	7.5						1.7	1.3	0.5	2.4	
Initial Queue Delay (*d*3), s/veh	0.0	0.0						0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	27.9	39.5						13.2	8.3	12.8	12.5	
Level of Service (LOS)	C	D						B	A	B	B	
Approach Delay, s/veh / LOS	35.3		D	0.0			12.2		B	12.5		B
Intersection Delay, s/veh / LOS	15.9						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.9	C	1.9	A	1.7	A
Bicycle LOS Score / LOS	1.5	A			1.5	A	2.2	B

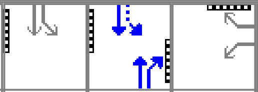
HCS 2010 Signalized Intersection Results Summary

General Information				**Intersection Information**	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Cliff Ave & 49th St	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Cliff_AM_BestCase.xus				
Project Description	2035 NB AM				

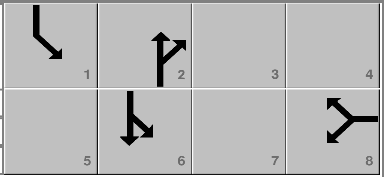


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				60		560		1360	30	210	760	

Signal Information			
Cycle, s	95.0	Reference Phase	6
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	12.6	42.7	24.9	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	1.5	1.5	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8		2	1	6
Case Number				9.0		7.3	1.0	4.0
Phase Duration, s				30.0		47.8	17.2	65.0
Change Period, (*Y*+*R*c), s				5.1		5.1	4.6	5.1
Max Allow Headway (*MAH*), s				4.4		0.0	4.2	0.0
Queue Clearance Time (*g*s), s				26.9			11.7	
Green Extension Time (*g*e), s				0.0		0.0	0.9	0.0
Phase Call Probability				1.00			1.00	
Max Out Probability				1.00			0.00	

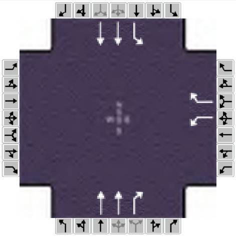
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3		18		2	12	1	6	
Adjusted Flow Rate (*v*), veh/h				71		485		1600	35	247	894	
Adjusted Saturation Flow Rate (*s*), veh/h/ln				1681		1496		1664	1525	1664	1664	
Queue Service Time (*g*s), s				3.1		24.9		42.8	1.2	9.7	9.4	
Cycle Queue Clearance Time (*g*c), s				3.1		24.9		42.8	1.2	9.7	9.4	
Green Ratio (*g/C*)				0.26		0.26		0.45	0.45	0.60	0.63	
Capacity (*c*), veh/h				441		392		1498	687	296	2098	
Volume-to-Capacity Ratio (*X*)				0.160		1.237		1.068	0.051	0.836	0.426	
Available Capacity (*c*a), veh/h				441		392		1498	687	837	2098	
Back of Queue (*Q*), veh/ln (95th percentile)				2.2		34.1		34.8	0.8	10.6	4.8	
Queue Storage Ratio (*RQ*) (95th percentile)				0.76		0.87		0.89	0.08	1.08	0.05	
Uniform Delay (*d*1), s/veh				27.0		35.1		26.1	14.7	32.8	5.6	
Incremental Delay (*d*2), s/veh				0.2		126.6		43.7	0.1	4.8	0.5	
Initial Queue Delay (*d*3), s/veh				0.0		0.0		0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh				27.2		161.7		69.8	14.8	37.6	6.0	
Level of Service (LOS)				C		F		F	B	D	A	

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	0.0		144.6	F	68.6	E	12.9	B
Intersection Delay, s/veh / LOS	62.2				E			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.9	C	2.5	B	0.7	A
Bicycle LOS Score / LOS				F	1.8	A	1.4	A

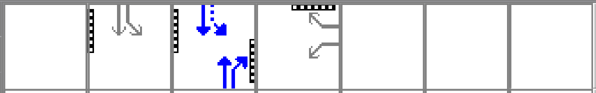
HCS 2010 Signalized Intersection Results Summary

General Information				**Intersection Information**	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Cliff Ave & 49th St	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Cliff_PM_BestCase.xus				
Project Description	2035 NB PM				

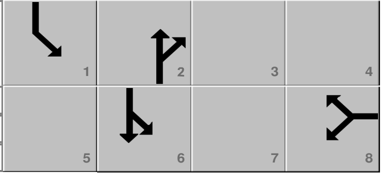


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				80		300		1000	70	500	1500	

Signal Information			
Cycle, s	95.0	Reference Phase	6
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	20.3	52.6	7.3	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	1.5	1.5	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8		2	1	6
Case Number				9.0		7.3	1.0	4.0
Phase Duration, s				12.4		57.7	24.9	82.6
Change Period, (*Y*+*R*c), s				5.1		5.1	4.6	5.1
Max Allow Headway (*MAH*), s				4.3		0.0	4.2	0.0
Queue Clearance Time (*g*s), s				7.2			18.0	
Green Extension Time (*g*e), s				0.1		0.0	2.3	0.0
Phase Call Probability				0.99			1.00	
Max Out Probability				1.00			0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3		18		2	12	1	6	
Adjusted Flow Rate (*v*), veh/h				86		84		1075	63	538	1613	
Adjusted Saturation Flow Rate (*s*), veh/h/ln				1681		1496		1664	1525	1664	1664	
Queue Service Time (*g*s), s				4.7		5.2		20.2	1.8	16.0	12.2	
Cycle Queue Clearance Time (*g*c), s				4.7		5.2		20.2	1.8	16.0	12.2	
Green Ratio (*g/C*)				0.08		0.08		0.55	0.55	0.79	0.82	
Capacity (*c*), veh/h				129		114		1845	846	598	2715	
Volume-to-Capacity Ratio (*X*)				0.669		0.733		0.583	0.075	0.899	0.594	
Available Capacity (*c*a), veh/h				175		156		1845	846	1032	2715	
Back of Queue (*Q*), veh/ln (95th percentile)				3.9		4.1		11.9	1.1	16.5	3.0	
Queue Storage Ratio (*RQ*) (95th percentile)				1.32		0.10		0.30	0.03	1.69	0.03	
Uniform Delay (*d*1), s/veh				42.7		42.9		13.9	9.8	22.1	1.9	
Incremental Delay (*d*2), s/veh				5.9		10.9		1.4	0.2	2.1	0.3	
Initial Queue Delay (*d*3), s/veh				0.0		0.0		0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh				48.6		53.8		15.3	10.0	24.2	2.2	
Level of Service (LOS)				D		D		B	B	C	A	
Approach Delay, s/veh / LOS	0.0			51.2		D	15.0		B	7.7		A
Intersection Delay, s/veh / LOS	12.2						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.9	C	2.6	B	0.6	A
Bicycle LOS Score / LOS				F	1.4	A	2.3	B

APPENDIX -

2035 NO-BUILD FREEWAY HCS 2010 REPORTS

FREEWAY WEAVING WORKSHEET

General Information

Analyst	GHM
Agency/Company	HDR
Date Performed	11/3/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	Minnesota Ave to Cliff Ave
Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	3130ft
Freeway free-flow speed, FFS	70 mph

Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	1989	0.85	6	0	1.5	1.2	0.971	1.00	2410
V_{RF}	411	0.85	3	0	1.5	1.2	0.985	1.00	491
V_{FR}	491	0.85	3	0	1.5	1.2	0.985	1.00	586
V_{RR}	79	0.85	3	0	1.5	1.2	0.985	1.00	94
V_{NW}	2504							V =	3477
V_W	1077								
VR	0.301								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc

Minimum weaving lane changes, LC_{MIN}	1077 lc/h
Weaving lane changes, LC_W	1402 lc/h
Non-weaving lane changes, LC_{NW}	1634 lc/h
Total lane changes, LC_{ALL}	3036 lc/h
Non-weaving vehicle index, I_{NW}	784

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3477 veh/h
Weaving segment capacity, c_w	6443 veh/h
Weaving segment v/c ratio	0.540
Weaving segment density, D	20.7 pc/mi/ln
Level of Service, LOS	C

Weaving intensity factor, W	0.221
Weaving segment speed, S	57.5 mph
Average weaving speed, S_W	60.1 mph
Average non-weaving speed, S_{NW}	56.5 mph
Maximum weaving length, L_{MAX}	5592 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

HCS 2010^{TM} Version 6.50 Generated: 1/10/2017 1:29 PM

FREEWAY WEAVING WORKSHEET

General Information

Analyst	GHM
Agency/Company	HDR
Date Performed	11/3/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	Minnesota Ave to Cliff Ave
Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	3130ft
Freeway free-flow speed, FFS	70 mph

Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	2504	0.93	6	0	1.5	1.2	0.971	1.00	2773
V_{RF}	486	0.93	3	0	1.5	1.2	0.985	1.00	530
V_{FR}	526	0.93	3	0	1.5	1.2	0.985	1.00	574
V_{RR}	24	0.93	3	0	1.5	1.2	0.985	1.00	26
V_{NW}	2799							V =	3790
V_W	1104								
VR	0.283								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc

Minimum weaving lane changes, LC_{MIN}	1104 lc/h
Weaving lane changes, LC_W	1429 lc/h
Non-weaving lane changes, LC_{NW}	1695 lc/h
Total lane changes, LC_{ALL}	3124 lc/h
Non-weaving vehicle index, I_{NW}	876

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3790 veh/h
Weaving segment capacity, c_w	6483 veh/h
Weaving segment v/c ratio	0.585
Weaving segment density, D	22.9 pc/mi/ln
Level of Service, LOS	C

Weaving intensity factor, W	0.226
Weaving segment speed, S	56.9 mph
Average weaving speed, S_W	59.9 mph
Average non-weaving speed, S_{NW}	55.8 mph
Maximum weaving length, L_{MAX}	5401 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".

b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*GHM*
Agency or Company	*HDR*
Date Performed	*11/3/2014*
Analysis Time Period	*AM Peak*

Site Information

Highway/Direction of Travel	*I-229 Northbound*
From/To	*Cliff Off-Ramp to On-Ramp*
Jurisdiction	*Sioux Falls*
Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2400*	veh/h	Peak-Hour Factor, PHF	*0.85*
AADT		veh/day	%Trucks and Buses, P_T	*5*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.976*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*69.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*69.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1447*	pc/h/ln
S	*69.3*	mph
D = v_p / S	*20.9*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information / Site Information

Analyst	GHM	Highway/Direction of Travel	I-229 Northbound
Agency or Company	HDR	From/To	Cliff Off-Ramp to On-Ramp
Date Performed	11/3/2014	Jurisdiction	Sioux Falls
Analysis Time Period	PM Peak	Analysis Year	2035 No Build

Project Description I-229 MIS

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	2990	veh/h	Peak-Hour Factor, PHF	0.93
AADT		veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K			%RVs, P_R	0
Peak-Hr Direction Prop, D			General Terrain:	Level
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	mi

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.976

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	2	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	69.0	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	69.0	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1648	pc/h/ln
S	67.7	mph
D = v_p / S	24.4	pc/mi/ln
LOS	C	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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FREEWAY WEAVING WORKSHEET

General Information

Analyst GHM
Agency/Company HDR
Date Performed 11/3/2014
Analysis Time Period AM Peak

Site Information

Freeway/Dir of Travel I-229 Northbound
Weaving Segment Location Cliff Ave to 26th St
Analysis Year 2035 No Build

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2750ft
Freeway free-flow speed, FFS	69 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	1870	0.85	8	0	1.5	1.2	0.962	1.00	2288
V_{RF}	510	0.85	3	0	1.5	1.2	0.985	1.00	609
V_{FR}	530	0.85	3	0	1.5	1.2	0.985	1.00	633
V_{RR}	10	0.85	3	0	1.5	1.2	0.985	1.00	12
V_{NW}	2300							V =	3406
V_W	1242								
VR	0.351								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1242 lc/h
Weaving lane changes, LC_W	1544 lc/h
Non-weaving lane changes, LC_{NW}	1387 lc/h
Total lane changes, LC_{ALL}	2931 lc/h
Non-weaving vehicle index, I_{NW}	633

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3406 veh/h
Weaving segment capacity, c_w	6176 veh/h
Weaving segment v/c ratio	0.551
Weaving segment density, D	21.2 pc/mi/ln
Level of Service, LOS	C
Weaving intensity factor, W	0.238
Weaving segment speed, S	55.8 mph
Average weaving speed, S_W	58.6 mph
Average non-weaving speed, S_{NW}	54.4 mph
Maximum weaving length, L_{MAX}	6134 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	GHM
Agency/Company	HDR
Date Performed	11/3/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	Cliff Ave to 26th St
Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2750ft
Freeway free-flow speed, FFS	69 mph

Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	2200	0.93	8	0	1.5	1.2	0.962	1.00	2460
V_{RF}	410	0.93	3	0	1.5	1.2	0.985	1.00	447
V_{FR}	790	0.93	3	0	1.5	1.2	0.985	1.00	862
V_{RR}	10	0.93	3	0	1.5	1.2	0.985	1.00	11
V_{NW}	2471							V =	3635
V_W	1309								
VR	0.346								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc

Minimum weaving lane changes, LC_{MIN}	1309 lc/h
Weaving lane changes, LC_W	1611 lc/h
Non-weaving lane changes, LC_{NW}	1422 lc/h
Total lane changes, LC_{ALL}	3033 lc/h
Non-weaving vehicle index, I_{NW}	680

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3635 veh/h
Weaving segment capacity, c_w	6188 veh/h
Weaving segment v/c ratio	0.587
Weaving segment density, D	22.9 pc/mi/ln
Level of Service, LOS	C

Weaving intensity factor, W	0.244
Weaving segment speed, S	55.1 mph
Average weaving speed, S_W	58.4 mph
Average non-weaving speed, S_{NW}	53.5 mph
Maximum weaving length, L_{MAX}	6086 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".

b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	GHM
Agency/Company	HDR
Date Performed	11/3/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-229 Southbound
Weaving Segment Location	26th St to Cliff Ave
Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2670ft
Freeway free-flow speed, FFS	69 mph

Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1900	0.85	8	0	1.5	1.2	0.962	1.00	2325
V_{RF}	780	0.85	3	0	1.5	1.2	0.985	1.00	931
V_{FR}	420	0.85	3	0	1.5	1.2	0.985	1.00	502
V_{RR}	10	0.85	3	0	1.5	1.2	0.985	1.00	12
V_{NW}	2337							V =	3625
V_W	1433								
VR	0.380								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc

Minimum weaving lane changes, LC_{MIN}	1433 lc/h
Weaving lane changes, LC_W	1731 lc/h
Non-weaving lane changes, LC_{NW}	1351 lc/h
Total lane changes, LC_{ALL}	3082 lc/h
Non-weaving vehicle index, I_{NW}	624

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3625 veh/h
Weaving segment capacity, c_w	6071 veh/h
Weaving segment v/c ratio	0.597
Weaving segment density, D	23.0 pc/mi/ln
Level of Service, LOS	C

Weaving intensity factor, W	0.253
Weaving segment speed, S	54.6 mph
Average weaving speed, S_W	58.1 mph
Average non-weaving speed, S_{NW}	52.7 mph
Maximum weaving length, L_{MAX}	6459 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	GHM
Agency/Company	HDR
Date Performed	11/3/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-229 Southbound
Weaving Segment Location	26th St to Cliff Ave
Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2670ft
Freeway free-flow speed, FFS	69 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	2250	0.93	8	0	1.5	1.2	0.962	1.00	2516
V_{RF}	610	0.93	3	0	1.5	1.2	0.985	1.00	666
V_{FR}	410	0.93	3	0	1.5	1.2	0.985	1.00	447
V_{RR}	10	0.93	3	0	1.5	1.2	0.985	1.00	11
V_{NW}	2527							V =	3500
V_W	1113								
VR	0.306								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1113 lc/h
Weaving lane changes, LC_W	1411 lc/h
Non-weaving lane changes, LC_{NW}	1390 lc/h
Total lane changes, LC_{ALL}	2801 lc/h
Non-weaving vehicle index, I_{NW}	675

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3500 veh/h
Weaving segment capacity, c_w	6265 veh/h
Weaving segment v/c ratio	0.559
Weaving segment density, D	21.6 pc/mi/ln
Level of Service, LOS	C
Weaving intensity factor, W	0.235
Weaving segment speed, S	56.2 mph
Average weaving speed, S_W	58.7 mph
Average non-weaving speed, S_{NW}	55.2 mph
Maximum weaving length, L_{MAX}	5646 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information / Site Information

Analyst	*GHM*	Highway/Direction of Travel	*I-229 Southbound*
Agency or Company	*HDR*	From/To	*Cliff Off-Ramp to On-Ramp*
Date Performed	*11/3/2014*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*AM Peak*	Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2680*	veh/h	Peak-Hour Factor, PHF	*0.85*
AADT		veh/day	%Trucks and Buses, P_T	*7*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*69.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*69.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1632*	pc/h/ln
S	*67.8*	mph
D = v_p / S	*24.1*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes

V - Hourly volume

v_p - Flow rate

LOS - Level of service

DDHV - Directional design hour volume

S - Speed

D - Density

FFS - Free-flow speed

BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12

E_T - Exhibits 11-10, 11-11, 11-13

f_p - Page 11-18

LOS, S, FFS, v_p - Exhibits 11-2, 11-3

f_{LW} - Exhibit 11-8

f_{LC} - Exhibit 11-9

TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		**Site Information**	
Analyst	*GHM*	Highway/Direction of Travel	*I-229 Southbound*
Agency or Company	*HDR*	From/To	*Cliff Off-Ramp to On-Ramp*
Date Performed	*11/3/2014*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*PM Peak*	Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2860*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*7*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]	*0.966*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*69.0*	mph	FFS	*69.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1591*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*68.2*	mph	S	mph
D = v_p / S	*23.3*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

Glossary		**Factor Location**	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	GHM
Agency/Company	HDR
Date Performed	11/3/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-229 Southbound
Weaving Segment Location	Cliff Ave to Minnesota Ave
Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	3120ft
Freeway free-flow speed, FFS	67 mph

Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	2325	0.85	6	0	1.5	1.2	0.971	1.00	2817
V_{RF}	455	0.85	3	0	1.5	1.2	0.985	1.00	543
V_{FR}	355	0.85	3	0	1.5	1.2	0.985	1.00	424
V_{RR}	115	0.85	3	0	1.5	1.2	0.985	1.00	137
V_{NW}	2954							V =	3807
V_W	967								
VR	0.247								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc

Minimum weaving lane changes, LC_{MIN}	967 lc/h
Weaving lane changes, LC_W	1292 lc/h
Non-weaving lane changes, LC_{NW}	1722 lc/h
Total lane changes, LC_{ALL}	3014 lc/h
Non-weaving vehicle index, I_{NW}	922

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3807 veh/h
Weaving segment capacity, c_w	6422 veh/h
Weaving segment v/c ratio	0.593
Weaving segment density, D	23.9 pc/mi/ln
Level of Service, LOS	C

Weaving intensity factor, W	0.220
Weaving segment speed, S	54.7 mph
Average weaving speed, S_W	57.6 mph
Average non-weaving speed, S_{NW}	53.8 mph
Maximum weaving length, L_{MAX}	5018 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".

b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	GHM
Agency/Company	HDR
Date Performed	11/3/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-229 Southbound
Weaving Segment Location	Cliff Ave to Minnesota Ave
Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	3120ft
Freeway free-flow speed, FFS	67 mph

Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	2414	0.93	6	0	1.5	1.2	0.971	1.00	2674
V_{RF}	676	0.93	3	0	1.5	1.2	0.985	1.00	738
V_{FR}	446	0.93	3	0	1.5	1.2	0.985	1.00	487
V_{RR}	34	0.93	3	0	1.5	1.2	0.985	1.00	37
V_{NW}	2711							V =	3822
V_W	1225								
VR	0.311								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1225 lc/h
Interchange density, ID	1.0 int/mi	Weaving lane changes, LC_W	1550 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	1672 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	3222 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	846

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3822 veh/h	Weaving intensity factor, W	0.232
Weaving segment capacity, c_w	6268 veh/h	Weaving segment speed, S	53.4 mph
Weaving segment v/c ratio	0.610	Average weaving speed, S_W	57.2 mph
Weaving segment density, D	24.6 pc/mi/ln	Average non-weaving speed, S_{NW}	51.9 mph
Level of Service, LOS	C	Maximum weaving length, L_{MAX}	5705 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".

b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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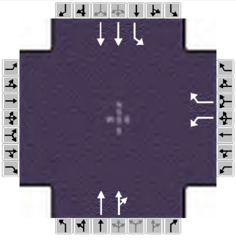
APPENDIX -

YEAR 2035 BUILD HCS 2010 REPORTS

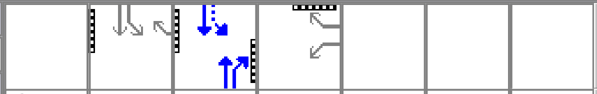
HCS 2010 Signalized Intersection Results Summary

General Information				**Intersection Information**	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Cliff Ave & 49th St	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_Cliff_Cliff1_AM.xus				
Project Description					

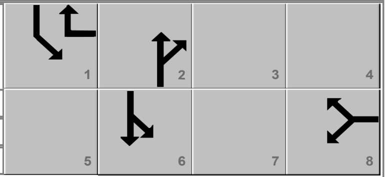


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				60		560		1360	30	210	760	

Signal Information			
Cycle, s	125.0	Reference Phase	6
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	13.0	67.3	29.9	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	1.5	1.5	0.0	0.0	0.0



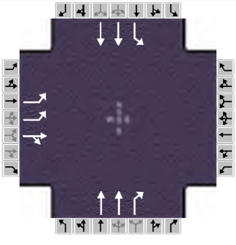
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8		2	1	6
Case Number				9.0		8.3	1.0	4.0
Phase Duration, s				35.0		72.4	17.6	90.0
Change Period, (Y+R_c), s				5.1		5.1	4.6	5.1
Max Allow Headway (*MAH*), s				4.4		0.0	4.2	0.0
Queue Clearance Time (g_s), s				31.9			13.0	
Green Extension Time (g_e), s				0.0		0.0	0.0	0.0
Phase Call Probability				1.00			1.00	
Max Out Probability				1.00			1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3		18		2	12	1	6	
Adjusted Flow Rate (*v*), veh/h				71		485		819	816	247	894	
Adjusted Saturation Flow Rate (*s*), veh/h/ln				1681		1496		1748	1734	1664	1664	
Queue Service Time (g_s), s				4.2		29.9		51.4	44.5	11.0	15.8	
Cycle Queue Clearance Time (g_c), s				4.2		29.9		51.4	44.5	11.0	15.8	
Green Ratio (*g/C*)				0.24		0.34		0.54	0.54	0.66	0.68	
Capacity (*c*), veh/h				402		513		941	934	269	2260	
Volume-to-Capacity Ratio (*X*)				0.176		0.945		0.870	0.873	0.919	0.396	
Available Capacity (c_a), veh/h				402		513		941	934	275	2260	
Back of Queue (*Q*), veh/ln (95th percentile)				3.2		25.0		22.3	22.4	14.5	9.5	
Queue Storage Ratio (*RQ*) (95th percentile)				0.54		0.64		0.57	0.57	0.74	0.10	
Uniform Delay (d_1), s/veh				37.8		39.9		14.3	14.4	33.8	9.8	
Incremental Delay (d_2), s/veh				0.2		26.6		10.8	11.1	30.7	0.5	
Initial Queue Delay (d_3), s/veh				0.0		0.0		0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh				38.0		66.5		25.2	25.5	64.5	10.2	
Level of Service (LOS)				D		E		C	C	E	B	
Approach Delay, s/veh / LOS	0.0			62.9		E	25.3		C	22.0		C
Intersection Delay, s/veh / LOS	30.4						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.9	C	2.5	B	0.7	A
Bicycle LOS Score / LOS				F	1.8	A	1.4	A

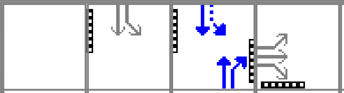
HCS 2010 Signalized Intersection Results Summary

General Information				**Intersection Information**	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Cliff Ave & NB I-229 Ramps	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_Cliff_Cliff1_AM.xus				
Project Description					

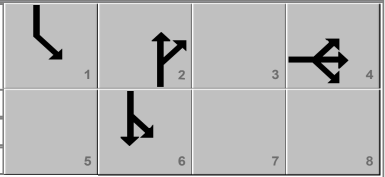


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	400	0	170					1640	380	140	800	

Signal Information			
Cycle, s	125.0	Reference Phase	6
Offset, s	73	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	7.1	81.0	22.1	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	1.5	1.5	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2	1	6
Case Number		10.0				7.3	1.0	4.0
Phase Duration, s		27.2				86.1	11.7	97.8
Change Period, (*Y*+*R*c), s		5.1				5.1	4.6	5.1
Max Allow Headway (*MAH*), s		4.1				0.0	4.2	0.0
Queue Clearance Time (*g*s), s		19.8					6.6	
Green Extension Time (*g*e), s		2.3				0.0	0.4	0.0
Phase Call Probability		1.00					1.00	
Max Out Probability		0.08					0.00	

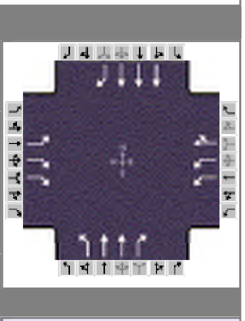
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14					2	12	1	6	
Adjusted Flow Rate (*v*), veh/h	471	200						1929	447	165	941	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1592	1465						1800	1495	1613	1679	
Queue Service Time (*g*s), s	17.8	16.3						42.4	10.1	4.6	7.8	
Cycle Queue Clearance Time (*g*c), s	17.8	16.3						42.4	10.1	4.6	7.8	
Green Ratio (*g/C*)	0.18	0.18						0.65	0.65	0.72	0.71	
Capacity (*c*), veh/h	564	260						2329	967	193	2384	
Volume-to-Capacity Ratio (*X*)	0.834	0.771						0.829	0.462	0.855	0.395	
Available Capacity (*c*a), veh/h	813	374						2329	967	360	2384	
Back of Queue (*Q*), veh/ln (95th percentile)	11.8	10.4						15.8	3.9	6.4	3.9	
Queue Storage Ratio (*RQ*) (95th percentile)	0.93	0.63						0.16	0.40	0.82	0.12	
Uniform Delay (*d*1), s/veh	49.7	49.0						9.9	4.5	28.0	3.0	
Incremental Delay (*d*2), s/veh	5.1	6.0						1.3	0.5	8.4	0.4	
Initial Queue Delay (*d*3), s/veh	0.0	0.0						0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	54.8	55.0						11.1	5.0	36.4	3.4	
Level of Service (LOS)	D	D						B	A	D	A	

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	54.8	D	0.0		10.0	A	8.3	A
Intersection Delay, s/veh / LOS	16.8				B			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.9	C	1.9	A	1.9	A
Bicycle LOS Score / LOS	1.6	A			2.4	B	1.4	A

HCS 2010 Signalized Intersection Results Summary

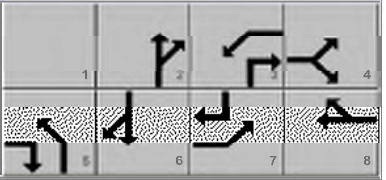
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Cliff Ave & I-229 SB Off-rar	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_Cliff_Cliff1_AM.xus				
Project Description					



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	160		260	200	130	100	260	1430	350		700	100

Signal Information			
Cycle, s	125.0	Reference Phase	2
Offset, s	123	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	26.0	44.3	10.5	3.5	20.5	0.0
Yellow	3.6	3.6	3.5	0.0	3.6	0.0
Red	1.0	2.4	1.0	0.0	1.5	0.0



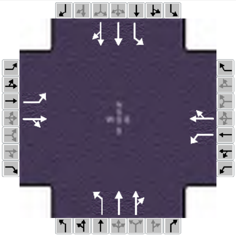
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2		6
Case Number	1.1	3.0	2.0	4.0	2.0	3.0		7.3
Phase Duration, s	15.0	25.6	18.5	29.1	30.6	80.9		50.3
Change Period, (*Y*+*R*c), s	4.5	5.1	4.5	5.1	4.6	6.1		6.1
Max Allow Headway (*MAH*), s	3.2	4.3	3.1	4.3	4.2	0.0		0.0
Queue Clearance Time (*g*s), s	12.5	12.8	11.1	17.7	23.8			
Green Extension Time (*g*e), s	0.0	1.5	0.5	1.4	0.4	0.0		0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00			
Max Out Probability	1.00	0.21	0.00	0.34	1.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14	3	8	18	5	2	12		6	16
Adjusted Flow Rate (*v*), veh/h	188		306	235	216		306	1682	412		824	106
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1622		1260	1550	1608		1667	1793	1486		1550	1413
Queue Service Time (*g*s), s	10.5		10.8	9.1	15.7		21.8	37.5	11.4		17.8	5.6
Cycle Queue Clearance Time (*g*c), s	10.5		10.8	9.1	15.7		21.8	37.5	11.4		17.8	5.6
Green Ratio (*g/C*)	0.25		0.37	0.11	0.19		0.21	0.60	0.71		0.35	0.44
Capacity (*c*), veh/h	250		937	348	309		347	2146	1056		1645	619
Volume-to-Capacity Ratio (*X*)	0.754		0.327	0.677	0.702		0.882	0.784	0.390		0.501	0.171
Available Capacity (*c*a), veh/h	250		955	682	320		364	2146	1056		1645	619
Back of Queue (*Q*), veh/ln (95th percentile)	3.4		6.0	6.4	11.0		12.8	16.2	7.3		11.0	4.5
Queue Storage Ratio (*RQ*) (95th percentile)	0.19		0.36	0.72	0.94		0.94	0.52	0.94		0.67	0.77
Uniform Delay (*d*1), s/veh	43.0		28.1	53.3	47.2		42.3	12.1	5.3		33.1	21.0
Incremental Delay (*d*2), s/veh	11.0		0.2	0.9	6.4		10.8	1.3	0.5		1.0	0.5
Initial Queue Delay (*d*3), s/veh	0.0		0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0
Control Delay (*d*), s/veh	54.0		28.3	54.2	53.6		53.2	13.5	5.8		34.1	21.6
Level of Service (LOS)	D		C	D	D		D	B	A		C	C
Approach Delay, s/veh / LOS	38.1		D	53.9		D	17.2		B	32.6		C
Intersection Delay, s/veh / LOS	26.9						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.3	C	3.0	C	2.5	B	2.4	B
Bicycle LOS Score / LOS		F	1.2	A	2.5	B	1.0	A

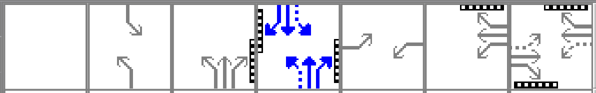
HCS 2010 Signalized Intersection Results Summary

General Information				**Intersection Information**	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Cliff Ave & 33rd St	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_Cliff_Cliff1_AM.xus				
Project Description					

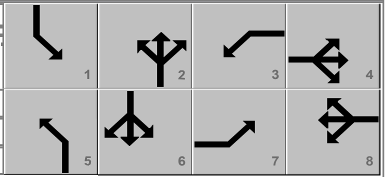


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	70	60	100	95	200	30	150	860	20	15	450	80

Signal Information			
Cycle, s	125.0	Reference Phase	2
Offset, s	93	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	1.8	1.9	67.4	6.7	2.1	20.7
Yellow	3.6	3.6	3.6	3.6	0.0	3.6
Red	1.0	1.0	1.9	1.0	0.0	1.5



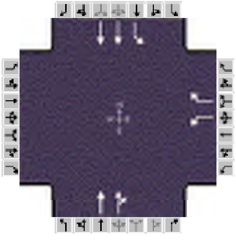
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	4.0	1.1	4.0	1.1	4.0	1.1	4.0
Phase Duration, s	11.3	25.8	13.3	27.9	12.9	79.4	6.4	72.9
Change Period, (*Y+R*c), s	4.6	5.1	4.6	5.1	4.6	5.5	4.6	5.5
Max Allow Headway (*MAH*), s	4.2	4.2	4.2	4.2	4.2	0.0	4.2	0.0
Queue Clearance Time (*g*s), s	7.0	16.0	8.9	21.2	7.8		2.6	
Green Extension Time (*g*e), s	0.1	1.6	0.0	1.5	0.5	0.0	0.0	0.0
Phase Call Probability	0.94	1.00	0.98	1.00	1.00		0.46	
Max Out Probability	1.00	0.00	1.00	0.01	0.00		0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	82	188		112	271		176	520	516	18	319	304
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1586		1664	1707		1664	1748	1733	1664	1748	1655
Queue Service Time (*g*s), s	5.0	14.0		6.9	19.2		5.8	26.3	26.4	0.6	8.5	8.5
Cycle Queue Clearance Time (*g*c), s	5.0	14.0		6.9	19.2		5.8	26.3	26.4	0.6	8.5	8.5
Green Ratio (*g/C*)	0.22	0.17		0.24	0.18		0.62	0.59	0.59	0.55	0.54	0.54
Capacity (*c*), veh/h	162	263		238	311		539	1033	1025	277	943	893
Volume-to-Capacity Ratio (*X*)	0.509	0.715		0.470	0.869		0.327	0.503	0.503	0.064	0.339	0.341
Available Capacity (*c*a), veh/h	212	439		260	500		738	1033	1025	509	943	893
Back of Queue (*Q*), veh/ln (95th percentile)	4.0	9.8		5.3	13.9		3.5	15.7	15.6	0.4	5.6	5.4
Queue Storage Ratio (*RQ*) (95th percentile)	0.50	0.25		0.90	0.36		0.59	0.20	0.19	0.11	0.14	0.14
Uniform Delay (*d*1), s/veh	41.6	49.3		40.0	49.7		10.1	21.2	21.3	14.5	9.3	9.3
Incremental Delay (*d*2), s/veh	2.5	3.6		1.4	9.3		0.2	0.9	0.9	0.1	1.0	1.0
Initial Queue Delay (*d*3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	44.1	53.0		41.4	59.0		10.3	22.1	22.2	14.6	10.2	10.3
Level of Service (LOS)	D	D		D	E		B	C	C	B	B	B
Approach Delay, s/veh / LOS	50.3		D	53.8		D	20.4		C	10.4		B
Intersection Delay, s/veh / LOS	26.2						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.9	C	2.3	B	2.3	B
Bicycle LOS Score / LOS	0.9	A	1.1	A	1.5	A	1.0	A

HCS 2010 Signalized Intersection Results Summary

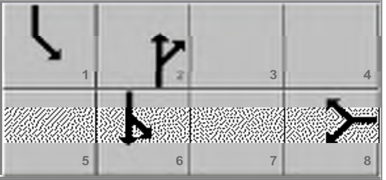
General Information				**Intersection Information**	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Cliff Ave & 49th St	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_Cliff_Cliff1_PM.xus				
Project Description					



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				80		300		1000	70	500	1500	

Signal Information			
Cycle, s	105.0	Reference Phase	6
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	18.4	63.8	8.0	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	1.5	1.5	0.0	0.0	0.0



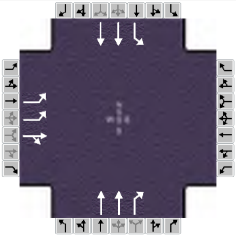
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8		2	1	6
Case Number				9.0		8.3	1.0	4.0
Phase Duration, s				13.1		68.9	23.0	91.9
Change Period, (*Y*+*R*c), s				5.1		5.1	4.6	5.1
Max Allow Headway (*MAH*), s				4.3		0.0	4.2	0.0
Queue Clearance Time (*g*s), s				7.8			16.9	
Green Extension Time (*g*e), s				0.3		0.0	1.5	0.0
Phase Call Probability				0.99			1.00	
Max Out Probability				0.27			0.10	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3		18		2	12	1	6	
Adjusted Flow Rate (*v*), veh/h				86		84		575	564	494	1482	
Adjusted Saturation Flow Rate (*s*), veh/h/ln				1681		1496		1748	1713	1664	1664	
Queue Service Time (*g*s), s				5.2		5.8		24.5	11.7	14.9	14.5	
Cycle Queue Clearance Time (*g*c), s				5.2		5.8		24.5	11.7	14.9	14.5	
Green Ratio (*g/C*)				0.08		0.08		0.61	0.61	0.80	0.83	
Capacity (*c*), veh/h				128		114		1062	1041	542	2751	
Volume-to-Capacity Ratio (*X*)				0.673		0.737		0.541	0.542	0.911	0.539	
Available Capacity (*c*a), veh/h				222		198		1062	1041	683	2751	
Back of Queue (*Q*), veh/ln (95th percentile)				4.3		4.4		6.1	6.0	18.9	4.9	
Queue Storage Ratio (*RQ*) (95th percentile)				0.73		0.11		0.16	0.15	0.97	0.05	
Uniform Delay (*d*1), s/veh				47.2		47.5		5.0	5.0	25.0	2.8	
Incremental Delay (*d*2), s/veh				6.0		8.9		2.0	2.0	7.7	0.4	
Initial Queue Delay (*d*3), s/veh				0.0		0.0		0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh				53.2		56.4		7.0	7.0	32.7	3.2	
Level of Service (LOS)				D		E		A	A	C	A	
Approach Delay, s/veh / LOS	0.0			54.8		D	7.0		A	10.5		B
Intersection Delay, s/veh / LOS	11.6						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.9	C	2.6	B	0.6	A
Bicycle LOS Score / LOS				F	1.4	A	2.3	B

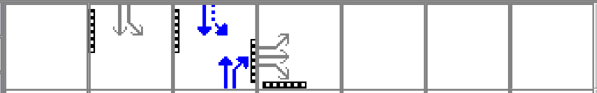
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Cliff Ave & NB I-229 Ramps	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_Cliff_Cliff1_PM.xus				
Project Description					

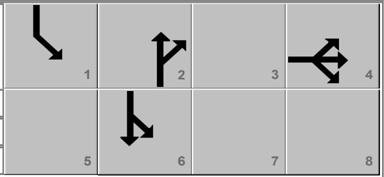


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	200	0	350					890	220	200	1750	

Signal Information			
Cycle, s	105.0	Reference Phase	6
Offset, s	103	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	8.5	50.9	30.8	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	1.5	1.5	0.0	0.0	0.0



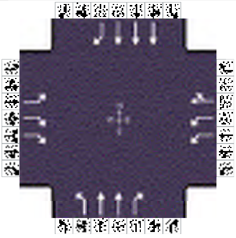
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2	1	6
Case Number		10.0				7.3	1.0	4.0
Phase Duration, s		35.9				56.0	13.1	69.1
Change Period, (*Y*+*R*c), s		5.1				5.1	4.6	5.1
Max Allow Headway (*MAH*), s		4.2				0.0	4.2	0.0
Queue Clearance Time (*g*s), s		28.8					8.3	
Green Extension Time (*g*e), s		1.9				0.0	0.3	0.0
Phase Call Probability		1.00					1.00	
Max Out Probability		0.10					0.23	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14					2	12	1	6	
Adjusted Flow Rate (*v*), veh/h	215	376						957	237	194	1698	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1541	1418						1660	1435	1613	1752	
Queue Service Time (*g*s), s	5.6	26.8						23.9	13.0	6.3	24.3	
Cycle Queue Clearance Time (*g*c), s	5.6	26.8						23.9	13.0	6.3	24.3	
Green Ratio (*g/C*)	0.29	0.29						0.48	0.48	0.59	0.61	
Capacity (*c*), veh/h	903	415						1609	695	315	2137	
Volume-to-Capacity Ratio (*X*)	0.238	0.906						0.595	0.340	0.616	0.795	
Available Capacity (*c*a), veh/h	1171	539						1609	695	407	2137	
Back of Queue (*Q*), veh/ln (95th percentile)	3.6	16.1						14.5	8.2	2.5	4.7	
Queue Storage Ratio (*RQ*) (95th percentile)	0.29	0.97						0.15	0.84	0.32	0.15	
Uniform Delay (*d*1), s/veh	28.2	35.7						23.4	22.2	14.4	5.1	
Incremental Delay (*d*2), s/veh	0.1	16.0						1.4	1.1	0.2	0.3	
Initial Queue Delay (*d*3), s/veh	0.0	0.0						0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	28.3	51.7						24.8	23.3	14.6	5.4	
Level of Service (LOS)	C	D						C	C	B	A	
Approach Delay, s/veh / LOS	43.2	D		0.0			24.5	C		6.4	A	
Intersection Delay, s/veh / LOS	18.2						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.9	C	1.9	A	1.9	A
Bicycle LOS Score / LOS	1.5	A			1.5	A	2.2	B

HCS 2010 Signalized Intersection Results Summary

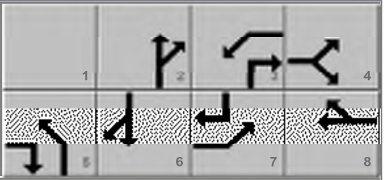
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Cliff Ave & I-229 SB Off-rar	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_Cliff_Cliff1_PM.xus				
Project Description					



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	200		680	300	80	40	200	680	210		1470	180

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	40	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	20.0	39.5	12.5	0.4	12.4	0.0
Yellow	3.6	3.6	3.5	0.0	3.6	0.0
Red	1.0	2.4	1.0	0.0	1.5	0.0



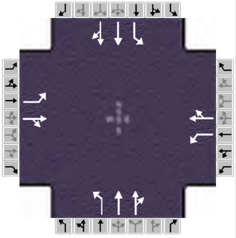
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2		6
Case Number	1.1	3.0	2.0	4.0	2.0	3.0		7.3
Phase Duration, s	17.0	17.5	17.4	18.0	24.6	70.0		45.5
Change Period, (*Y*+*R*c), s	4.5	5.1	4.5	5.1	4.6	6.1		6.1
Max Allow Headway (*MAH*), s	3.2	4.4	3.1	4.4	4.2	0.0		0.0
Queue Clearance Time (*g*s), s	14.3	14.4	12.6	9.4	14.1			
Green Extension Time (*g*e), s	0.0	0.0	0.3	1.5	0.4	0.0		0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00			
Max Out Probability	1.00	1.00	0.49	1.00	0.24			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14	3	8	18	5	2	12		6	16
Adjusted Flow Rate (*v*), veh/h	215		731	323	117		215	731	226		1581	184
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1619		1292	1556	1585		1619	1634	1432		1594	1424
Queue Service Time (*g*s), s	12.3		12.4	10.6	7.4		12.1	7.2	3.9		31.5	6.6
Cycle Queue Clearance Time (*g*c), s	12.3		12.4	10.6	7.4		12.1	7.2	3.9		31.5	6.6
Green Ratio (*g/C*)	0.24		0.31	0.12	0.12		0.19	0.61	0.73		0.37	0.49
Capacity (*c*), veh/h	301		797	384	194		308	1990	1049		1794	704
Volume-to-Capacity Ratio (*X*)	0.715		0.917	0.841	0.604		0.699	0.367	0.215		0.881	0.261
Available Capacity (*c*a), veh/h	301		798	489	195		316	1990	1049		1794	704
Back of Queue (*Q*), veh/ln (95th percentile)	9.1		15.8	7.9	5.6		7.7	3.8	2.0		16.3	3.7
Queue Storage Ratio (*RQ*) (95th percentile)	0.52		0.95	0.90	0.48		0.56	0.12	0.26		0.98	0.64
Uniform Delay (*d*1), s/veh	35.7		35.0	45.0	43.7		32.0	5.2	3.1		26.1	12.1
Incremental Delay (*d*2), s/veh	6.8		15.4	8.3	5.2		5.4	0.4	0.4		4.8	0.6
Initial Queue Delay (*d*3), s/veh	0.0		0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0
Control Delay (*d*), s/veh	42.4		50.4	53.3	48.8		37.4	5.7	3.5		30.9	12.7
Level of Service (LOS)	D		D	D	D		D	A	A		C	B
Approach Delay, s/veh / LOS	48.6	D		52.1	D		11.1	B		29.0	C	
Intersection Delay, s/veh / LOS	30.8						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.3	C	3.0	C	2.4	B	2.4	B
Bicycle LOS Score / LOS		F	1.2	A	1.5	A	1.5	A

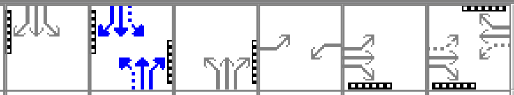
HCS 2010 Signalized Intersection Results Summary

General Information				**Intersection Information**	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Cliff Ave & 33rd St	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_Cliff_Cliff1_PM.xus				
Project Description					

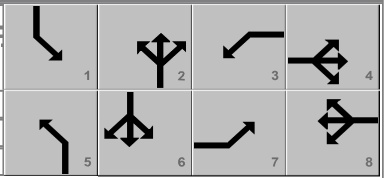


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	110	120	130	70	100	10	120	470	80	20	950	120

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	62	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	1.9	48.7	4.8	5.3	2.1	17.8
Yellow	3.6	3.6	3.6	3.6	0.0	3.6
Red	1.0	1.9	1.0	1.0	0.0	1.5



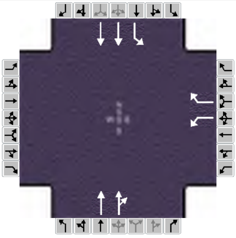
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	4.0	1.1	4.0	1.3	4.0	1.2	4.0
Phase Duration, s	12.0	25.0	9.9	22.9	9.4	63.6	6.5	60.7
Change Period, (*Y*+*R*c), s	4.6	5.1	4.6	5.1	5.5	5.5	4.6	5.5
Max Allow Headway (*MAH*), s	4.2	4.2	4.2	4.2	4.2	0.0	4.2	0.0
Queue Clearance Time (*g*s), s	8.0	19.0	5.9	8.4	2.0		2.7	
Green Extension Time (*g*e), s	0.0	0.9	0.0	1.3	0.7	0.0	0.0	0.0
Phase Call Probability	0.97	1.00	0.89	1.00	0.98		0.47	
Max Out Probability	1.00	0.18	1.00	0.00	1.00		0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	118	269		75	118		129	302	289	22	586	564
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1614		1664	1719		1664	1748	1659	1664	1748	1678
Queue Service Time (*g*s), s	6.0	17.0		3.9	6.4		0.0	8.8	8.9	0.7	19.1	19.1
Cycle Queue Clearance Time (*g*c), s	6.0	17.0		3.9	6.4		0.0	8.8	8.9	0.7	19.1	19.1
Green Ratio (*g/C*)	0.24	0.19		0.22	0.17		0.48	0.55	0.55	0.50	0.53	0.53
Capacity (*c*), veh/h	325	306		162	292		286	967	918	400	918	882
Volume-to-Capacity Ratio (*X*)	0.364	0.877		0.464	0.405		0.451	0.312	0.315	0.054	0.639	0.640
Available Capacity (*c*a), veh/h	325	415		228	408		287	967	918	568	918	882
Back of Queue (*Q*), veh/ln (95th percentile)	4.5	12.6		3.0	5.0		5.1	6.1	5.9	0.5	10.1	9.8
Queue Storage Ratio (*RQ*) (95th percentile)	0.57	0.32		0.61	0.13		0.87	0.08	0.07	0.12	0.26	0.25
Uniform Delay (*d*1), s/veh	32.8	41.3		34.9	38.9		29.2	11.0	11.0	13.9	10.3	10.3
Incremental Delay (*d*2), s/veh	0.7	14.8		2.1	0.9		1.0	0.8	0.8	0.1	3.4	3.5
Initial Queue Delay (*d*3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	33.5	56.1		37.0	39.8		30.2	11.8	11.8	13.9	13.7	13.9
Level of Service (LOS)	C	E		D	D		C	B	B	B	B	B
Approach Delay, s/veh / LOS	49.2	D		38.7	D		15.1	B		13.8	B	
Intersection Delay, s/veh / LOS	21.7						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.9	C	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.1	A	0.8	A	1.1	A	1.5	A

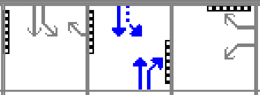
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Cliff Ave & 49th St	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_Cliff_Cliff-6_AM.xus				
Project Description	Cliff-SPUI 2035 AM				

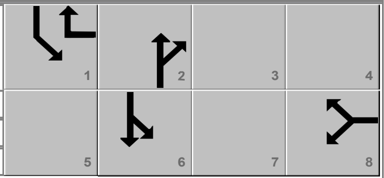


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h				60		560		1360	30	210	760	

Signal Information			
Cycle, s	90.0	Reference Phase	6
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	11.2	44.1	19.9	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	1.5	1.5	0.0	0.0	0.0



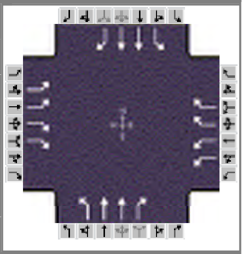
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8		2	1	6
Case Number				9.0		8.3	1.0	4.0
Phase Duration, s				25.0		49.2	15.8	65.0
Change Period, $(Y+R_c)$, s				5.1		5.1	4.6	5.1
Max Allow Headway (*MAH*), s				4.4		0.0	4.2	0.0
Queue Clearance Time (g_s), s				21.9			10.6	
Green Extension Time (g_e), s				0.0		0.0	0.6	0.0
Phase Call Probability				1.00			1.00	
Max Out Probability				1.00			0.03	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3		18		2	12	1	6	
Adjusted Flow Rate (v), veh/h				71		485		819	816	247	894	
Adjusted Saturation Flow Rate (s), veh/h/ln				1681		1496		1748	1734	1664	1664	
Queue Service Time (g_s), s				3.1		19.9		48.8	39.4	8.6	14.9	
Cycle Queue Clearance Time (g_c), s				3.1		19.9		48.8	39.4	8.6	14.9	
Green Ratio (g/C)				0.22		0.35		0.49	0.49	0.64	0.67	
Capacity (c), veh/h				372		517		857	850	287	2215	
Volume-to-Capacity Ratio (X)				0.190		0.938		0.957	0.960	0.861	0.404	
Available Capacity (c_a), veh/h				372		517		857	850	457	2215	
Back of Queue (Q), veh/ln (95th percentile)				2.2		19.2		22.2	22.4	9.2	9.2	
Queue Storage Ratio (RQ) (95th percentile)				0.57		0.49		0.57	0.57	0.72	0.09	
Uniform Delay (d_1), s/veh				28.5		28.5		14.7	14.8	25.8	11.0	
Incremental Delay (d_2), s/veh				0.2		25.1		21.9	22.6	7.6	0.4	
Initial Queue Delay (d_3), s/veh				0.0		0.0		0.0	0.0	0.0	0.0	
Control Delay (d), s/veh				28.7		53.6		36.6	37.3	33.4	11.4	
Level of Service (LOS)				C		D		D	D	C	B	
Approach Delay, s/veh / LOS	0.0			50.5		D	37.0		D	16.2		B
Intersection Delay, s/veh / LOS	32.1						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.7	B	2.9	C	2.5	B	0.7	A
Bicycle LOS Score / LOS				F	1.8	A	1.4	A

HCS 2010 Signalized Intersection Results Summary

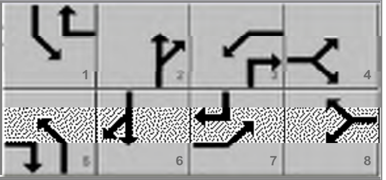
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Cliff Ave & I-229 SPUI	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_Cliff_Cliff-6_AM.xus				
Project Description	Cliff-SPUI 2035 AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	400		170	200		230	350	1290	380	140	600	220

Signal Information			
Cycle, s	90.0	Reference Phase	6
Offset, s	18	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	23.5	8.7	14.8	8.8	2.2	1.0
Yellow	4.0	4.0	4.0	4.0	0.0	0.0
Red	4.0	4.0	4.0	3.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	3.0	1.1	3.0	2.0	3.0	2.0	3.0
Phase Duration, s	18.0	3.2	15.8	1.0	31.5	48.2	22.8	39.5
Change Period, (*Y+R*$_c$), s	7.0	0.0	7.0	0.0	8.0	8.0	8.0	8.0
Max Allow Headway (*MAH*), s	4.1	4.3	4.1	4.3	4.2	0.0	4.2	0.0
Queue Clearance Time (*g*$_s$), s	13.0	5.2	8.6	3.0	23.4		11.0	
Green Extension Time (*g*$_e$), s	0.0	0.0	0.2	0.0	0.1	0.0	1.9	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00		0.98	
Max Out Probability	1.00	1.00	1.00	1.00	1.00		1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14	3		18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	471		200	235		271	412	1518	447	165	706	259
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1568		1244	1539		1249	1663	1701	1464	1597	1620	1432
Queue Service Time (*g*$_s$), s	11.0		3.2	6.6		1.0	21.4	40.0	12.5	9.0	13.8	11.9
Cycle Queue Clearance Time (*g*$_c$), s	11.0		3.2	6.6		1.0	21.4	40.0	12.5	9.0	13.8	11.9
Green Ratio (*g/C*)	0.13		0.30	0.11		0.18	0.26	0.45	0.55	0.16	0.35	0.47
Capacity (*c*), veh/h	567		739	486		437	435	1521	798	262	1132	675
Volume-to-Capacity Ratio (*X*)	0.830		0.271	0.484		0.619	0.947	0.997	0.560	0.629	0.623	0.383
Available Capacity (*c*$_a$), veh/h	567		739	561		437	443	1521	798	266	1132	675
Back of Queue (*Q*), veh/ln (95th percentile)	9.9		2.8	4.4		2.8	10.8	19.3	1.8	7.1	7.7	7.9
Queue Storage Ratio (*RQ*) (95th percentile)	0.92		0.32	0.65		0.26	0.79	0.18	0.26	0.91	0.26	0.73
Uniform Delay (*d*$_1$), s/veh	39.7		24.2	38.7		3.9	25.1	20.6	4.8	39.1	17.1	19.5
Incremental Delay (*d*$_2$), s/veh	10.1		0.2	0.7		2.6	13.0	12.2	0.9	4.1	2.3	1.5
Initial Queue Delay (*d*$_3$), s/veh	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	49.7		24.4	39.4		6.5	38.1	32.8	5.7	43.2	19.4	21.0
Level of Service (LOS)	D		C	D		A	D	C	A	D	B	C

Approach Delay, s/veh / LOS	42.2	D	21.8	C	28.6	C	23.2	C
Intersection Delay, s/veh / LOS	28.5				C			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.0	C	3.0	C	2.6	B	2.6	B
Bicycle LOS Score / LOS		F		F	2.4	B	1.4	A

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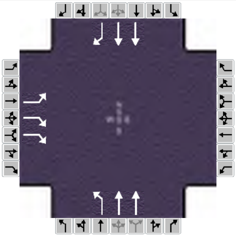
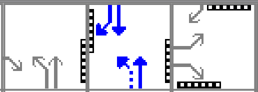
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Cliff Ave & 41st St	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_Cliff_Cliff-6_AM.xus				
Project Description	Cliff-SPUI 2035 AM				

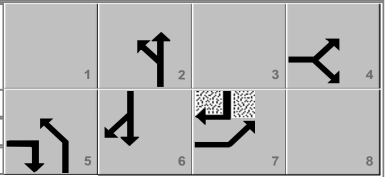


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	160		260				260	1430			700	100

Signal Information			
Cycle, s	90.0	Reference Phase	2
Offset, s	31	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	10.9	50.5	12.8	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	2.5	1.5	0.0	0.0	0.0



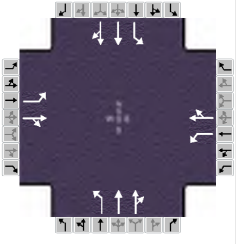
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4			5	2		6
Case Number		9.0			1.0	4.0		7.3
Phase Duration, s		17.9			15.5	72.1		56.6
Change Period, (*Y*+*R*c), s		5.1			4.6	6.1		6.1
Max Allow Headway (*MAH*), s		4.3			4.2	0.0		0.0
Queue Clearance Time (*g*s), s		11.7			10.4			
Green Extension Time (*g*e), s		1.0			0.5	0.0		0.0
Phase Call Probability		1.00			1.00			
Max Out Probability		0.73			1.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14				5	2			6	16
Adjusted Flow Rate (*v*), veh/h	188		306				347	1907			824	106
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681		1324				1664	1664			1664	1481
Queue Service Time (*g*s), s	9.7		8.7				8.4	39.9			14.4	3.0
Cycle Queue Clearance Time (*g*c), s	9.7		8.7				8.4	39.9			14.4	3.0
Green Ratio (*g/C*)	0.14		0.26				0.70	0.73			0.56	0.70
Capacity (*c*), veh/h	239		697				520	2440			1867	1041
Volume-to-Capacity Ratio (*X*)	0.788		0.439				0.666	0.781			0.441	0.102
Available Capacity (*c*a), veh/h	316		818				587	2440			1867	1041
Back of Queue (*Q*), veh/ln (95th percentile)	8.1		4.9				2.5	17.3			9.1	4.2
Queue Storage Ratio (*RQ*) (95th percentile)	0.82		0.38				0.17	0.59			0.13	0.72
Uniform Delay (*d*1), s/veh	37.3		27.6				6.8	13.7			13.6	6.7
Incremental Delay (*d*2), s/veh	9.4		0.4				0.4	0.5			0.7	0.2
Initial Queue Delay (*d*3), s/veh	0.0		0.0				0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh	46.7		28.0				7.3	14.1			14.2	6.9
Level of Service (LOS)	D		C				A	B			B	A
Approach Delay, s/veh / LOS	35.1	D		0.0			13.1	B		13.4	B	
Intersection Delay, s/veh / LOS	16.1						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.9	C	0.6	A	2.4	B
Bicycle LOS Score / LOS		F			2.1	B	1.3	A

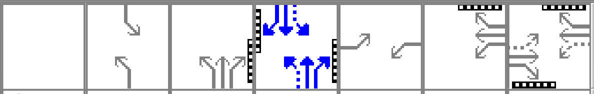
HCS 2010 Signalized Intersection Results Summary

General Information				**Intersection Information**	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Cliff Ave & 33rd St	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_Cliff_Cliff-6_AM.xus				
Project Description	Cliff-SPUI 2035 AM				

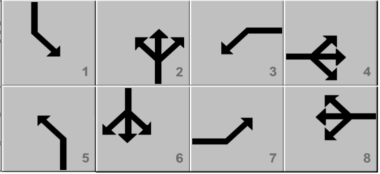


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	70	60	100	95	200	30	150	860	20	15	450	80

Signal Information			
Cycle, s	90.0	Reference Phase	2
Offset, s	76	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	1.4	1.1	41.7	4.9	1.6	14.9
Yellow	3.6	3.6	3.6	3.6	0.0	3.6
Red	1.0	1.0	1.9	1.0	0.0	1.5



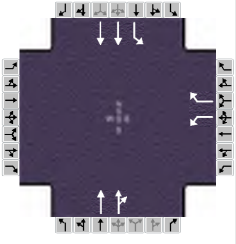
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	4.0	1.1	4.0	1.1	4.0	1.1	4.0
Phase Duration, s	9.5	20.0	11.1	21.6	11.7	52.9	6.0	47.2
Change Period, ($Y+R_c$), s	4.6	5.1	4.6	5.1	4.6	5.5	4.6	5.5
Max Allow Headway (*MAH*), s	4.2	4.2	4.2	4.2	4.2	0.0	4.2	0.0
Queue Clearance Time (g_s), s	5.6	12.1	6.9	15.8	6.9		2.5	
Green Extension Time (g_e), s	0.0	0.9	0.0	0.6	0.3	0.0	0.0	0.0
Phase Call Probability	0.87	1.00	0.94	1.00	0.99		0.36	
Max Out Probability	1.00	0.56	1.00	1.00	0.20		0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	82	188		112	271		186	548	543	18	319	304
Adjusted Saturation Flow Rate (s), veh/h/ln	1681	1586		1664	1707		1664	1748	1733	1664	1748	1655
Queue Service Time (g_s), s	3.6	10.1		4.9	13.8		4.9	13.7	13.7	0.5	8.3	8.4
Cycle Queue Clearance Time (g_c), s	3.6	10.1		4.9	13.8		4.9	13.7	13.7	0.5	8.3	8.4
Green Ratio (g/C)	0.22	0.17		0.24	0.18		0.56	0.53	0.53	0.48	0.46	0.46
Capacity (c), veh/h	180	262		263	313		503	919	912	285	809	767
Volume-to-Capacity Ratio (X)	0.458	0.717		0.424	0.865		0.370	0.596	0.596	0.062	0.394	0.397
Available Capacity (c_a), veh/h	226	313		279	367		617	919	912	504	809	767
Back of Queue (Q), veh/ln (95th percentile)	2.7	7.7		3.6	11.5		3.2	6.3	6.2	0.3	5.5	5.3
Queue Storage Ratio (RQ) (95th percentile)	0.35	0.20		0.74	0.29		0.65	0.09	0.09	0.09	0.14	0.14
Uniform Delay (d_1), s/veh	30.0	35.6		28.6	35.7		10.7	7.8	7.8	12.9	10.8	10.9
Incremental Delay (d_2), s/veh	1.8	6.2		1.1	17.0		0.2	1.5	1.5	0.1	1.4	1.5
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	31.8	41.8		29.7	52.6		11.0	9.3	9.3	13.0	12.3	12.4
Level of Service (LOS)	C	D		C	D		B	A	A	B	B	B
Approach Delay, s/veh / LOS	38.7	D		45.9	D		9.6	A		12.3	B	
Intersection Delay, s/veh / LOS	18.7						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.8	C	2.2	B	2.3	B
Bicycle LOS Score / LOS	0.9	A	1.1	A	1.5	A	1.0	A

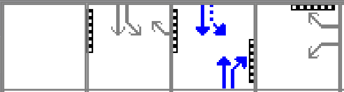
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Cliff Ave & 49th St	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_Cliff_Cliff-6_PM.xus				
Project Description	Cliff-SPUI 2035 PM				

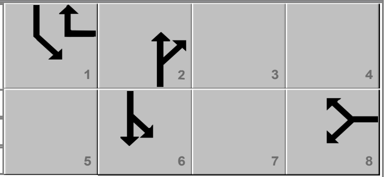


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				80		300		1000	70	500	1500	

Signal Information			
Cycle, s	90.0	Reference Phase	6
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	16.5	52.1	6.6	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	1.5	1.5	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8		2	1	6
Case Number				9.0		8.3	1.0	4.0
Phase Duration, s				11.7		57.2	21.1	78.3
Change Period, (Y+R_c), s				5.1		5.1	4.6	5.1
Max Allow Headway (*MAH*), s				4.3		0.0	4.2	0.0
Queue Clearance Time (g_s), s				6.5			16.2	
Green Extension Time (g_e), s				0.2		0.0	0.4	0.0
Phase Call Probability				0.99			1.00	
Max Out Probability				0.94			1.00	

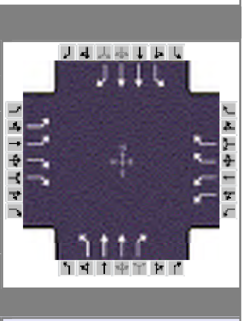
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3		18		2	12	1	6	
Adjusted Flow Rate (*v*), veh/h				86		84		575	564	526	1577	
Adjusted Saturation Flow Rate (*s*), veh/h/ln				1681		1496		1748	1713	1664	1664	
Queue Service Time (g_s), s				4.5		4.0		19.2	12.0	14.2	16.0	
Cycle Queue Clearance Time (g_c), s				4.5		4.0		19.2	12.0	14.2	16.0	
Green Ratio (*g/C*)				0.07		0.26		0.58	0.58	0.79	0.81	
Capacity (*c*), veh/h				124		382		1013	993	563	2706	
Volume-to-Capacity Ratio (*X*)				0.696		0.219		0.567	0.568	0.934	0.583	
Available Capacity (c_a), veh/h				204		454		1013	993	587	2706	
Back of Queue (*Q*), veh/ln (95th percentile)				3.7		2.6		6.4	6.3	16.3	4.4	
Queue Storage Ratio (*RQ*) (95th percentile)				0.95		0.07		0.16	0.16	0.88	0.04	
Uniform Delay (d_1), s/veh				40.7		26.4		5.6	5.6	22.7	3.3	
Incremental Delay (d_2), s/veh				6.9		0.3		2.3	2.4	6.3	0.2	
Initial Queue Delay (d_3), s/veh				0.0		0.0		0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh				47.6		26.7		7.9	8.0	29.0	3.5	
Level of Service (LOS)				D		C		A	A	C	A	

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	0.0		37.3	D	8.0	A	9.8	A
Intersection Delay, s/veh / LOS	10.6				B			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.9	C	2.6	B	0.6	A
Bicycle LOS Score / LOS				F	1.4	A	2.3	B

HCS 2010 Signalized Intersection Results Summary

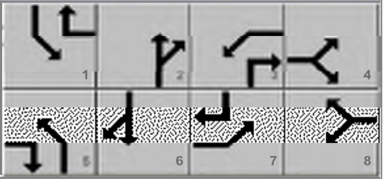
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Cliff Ave & I-229 SPUI	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_Cliff_Cliff-6_PM.xus				
Project Description	Cliff-SPUI 2035 PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	200		350	300		120	210	680	220	200	1450	500

Signal Information			
Cycle, s	90.0	Reference Phase	6
Offset, s	80	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	14.9	20.4	13.7	8.1	0.9	1.0
Yellow	4.0	4.0	4.0	4.0	0.0	0.0
Red	4.0	4.0	4.0	3.0	0.0	0.0



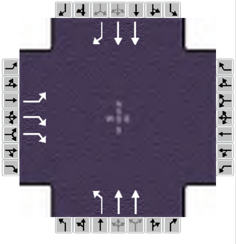
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	3.0	1.1	3.0	2.0	3.0	2.0	3.0
Phase Duration, s	15.1	1.0	16.0	1.9	22.9	51.3	21.7	50.1
Change Period, (*Y+R*$_c$), s	7.0	0.0	7.0	0.0	8.0	8.0	8.0	8.0
Max Allow Headway (*MAH*), s	4.1	4.3	4.1	4.3	4.2	0.0	4.2	0.0
Queue Clearance Time (*g*$_s$), s	8.1	3.0	11.0	3.9	14.5		13.7	
Green Extension Time (*g*$_e$), s	0.1	0.0	0.0	0.0	0.5	0.0	0.0	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00		1.00	
Max Out Probability	1.00	1.00	1.00	1.00	0.12		1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14	3		18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	215		376	323		129	226	731	237	214	1549	534
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1536		1257	1549		1239	1613	1622	1428	1609	1705	1479
Queue Service Time (*g*$_s$), s	6.1		1.0	9.0		1.9	12.5	14.4	7.6	11.7	39.7	18.5
Cycle Queue Clearance Time (*g*$_c$), s	6.1		1.0	9.0		1.9	12.5	14.4	7.6	11.7	39.7	18.5
Green Ratio (*g/C*)	0.10		0.18	0.11		0.17	0.17	0.48	0.58	0.15	0.47	0.56
Capacity (*c*), veh/h	437		445	491		428	268	1562	830	244	1593	825
Volume-to-Capacity Ratio (*X*)	0.492		0.845	0.657		0.301	0.843	0.468	0.285	0.874	0.972	0.648
Available Capacity (*c*$_a$), veh/h	467		445	491		428	394	1562	830	245	1593	825
Back of Queue (*Q*), veh/ln (95th percentile)	4.1		8.2	6.5		1.3	9.9	8.9	5.7	6.1	16.5	3.7
Queue Storage Ratio (*RQ*) (95th percentile)	0.38		0.94	0.95		0.12	0.72	0.08	0.84	0.78	0.56	0.35
Uniform Delay (*d*$_1$), s/veh	39.1		35.8	39.7		2.8	42.6	17.2	7.9	38.3	21.0	8.0
Incremental Delay (*d*$_2$), s/veh	0.9		13.9	3.2		0.4	8.8	0.8	0.7	3.9	3.2	0.4
Initial Queue Delay (*d*$_3$), s/veh	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	39.9		49.7	42.9		3.2	51.4	18.1	8.6	42.2	24.2	8.5
Level of Service (LOS)	D		D	D		A	D	B	A	D	C	A
Approach Delay, s/veh / LOS	46.2		D	31.5		C	22.5		C	22.2		C
Intersection Delay, s/veh / LOS	26.4						C					

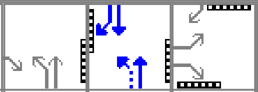
Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.0	C	3.0	C	2.6	B	2.6	B
Bicycle LOS Score / LOS		F		F	1.5	A	2.4	B

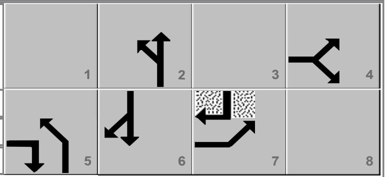
HCS 2010 Signalized Intersection Results Summary

General Information				**Intersection Information**	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Cliff Ave & 41st St	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_Cliff_Cliff-6_PM.xus				
Project Description	Cliff-SPUI 2035 PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	200		680				280	720			1470	180





Signal Information										
Cycle, s	90.0	Reference Phase	2							
Offset, s	24	Reference Point	Begin	Green	13.8	43.6	16.9	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	2.4	1.5	0.0	0.0	0.0

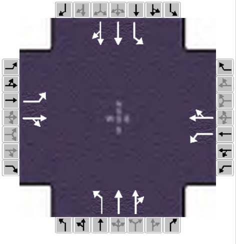
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4			5	2		6
Case Number		9.0			1.0	4.0		7.3
Phase Duration, s		22.0			18.4	68.0		49.6
Change Period, (*Y*+*R*c), s		5.1			4.6	6.1		6.1
Max Allow Headway (*MAH*), s		4.4			4.2	0.0		0.0
Queue Clearance Time (*g*s), s		18.9			13.7			
Green Extension Time (*g*e), s		0.0			0.2	0.0		0.0
Phase Call Probability		1.00			1.00			
Max Out Probability		1.00			1.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14				5	2			6	16
Adjusted Flow Rate (*v*), veh/h	215		731				301	774			1581	184
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1664		1311				1664	1664			1664	1481
Queue Service Time (*g*s), s	10.8		16.9				11.7	5.0			41.8	2.7
Cycle Queue Clearance Time (*g*c), s	10.8		16.9				11.7	5.0			41.8	2.7
Green Ratio (*g/C*)	0.19		0.34				0.66	0.69			0.48	0.67
Capacity (*c*), veh/h	313		895				341	2288			1607	993
Volume-to-Capacity Ratio (*X*)	0.688		0.817				0.883	0.338			0.984	0.185
Available Capacity (*c*a), veh/h	313		895				370	2288			1607	993
Back of Queue (*Q*), veh/ln (95th percentile)	8.5		12.2				13.9	2.3			21.7	1.3
Queue Storage Ratio (*RQ*) (95th percentile)	0.87		0.96				0.95	0.08			0.31	0.22
Uniform Delay (*d*1), s/veh	34.1		27.1				33.4	2.8			18.9	3.3
Incremental Delay (*d*2), s/veh	6.2		6.0				18.2	0.3			14.6	0.3
Initial Queue Delay (*d*3), s/veh	0.0		0.0				0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh	40.3		33.0				51.6	3.2			33.4	3.6
Level of Service (LOS)	D		C				D	A			C	A
Approach Delay, s/veh / LOS	34.7	C		0.0			16.7	B		30.3	C	
Intersection Delay, s/veh / LOS	27.6						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.9	C	0.7	A	2.4	B
Bicycle LOS Score / LOS		F		A	1.4	A	1.9	A

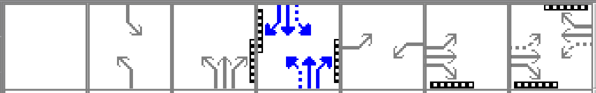
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Cliff Ave & 33rd St	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_Cliff_Cliff-6_PM.xus				
Project Description	Cliff-SPUI 2035 PM				

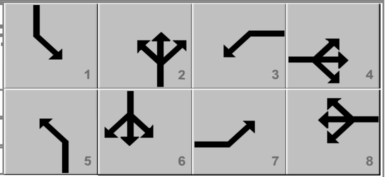


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	110	120	130	70	100	10	120	470	80	20	950	120

Signal Information			
Cycle, s	90.0	Reference Phase	2
Offset, s	28	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	1.7	3.7	43.2	4.5	0.9	16.2
Yellow	3.6	0.0	3.6	3.6	0.0	3.6
Red	1.0	0.0	1.9	1.0	0.0	1.5



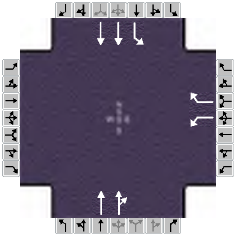
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	4.0	1.1	4.0	1.1	4.0	1.1	4.0
Phase Duration, s	10.0	22.3	9.1	21.3	10.0	52.4	6.3	48.7
Change Period, (*Y*+*R*c), s	4.6	5.1	4.6	5.1	4.6	5.5	4.6	5.5
Max Allow Headway (*MAH*), s	4.2	4.2	4.2	4.2	4.2	0.0	4.2	0.0
Queue Clearance Time (*g*s), s	7.2	16.6	5.3	7.4	5.5		2.6	
Green Extension Time (*g*e), s	0.0	0.6	0.0	1.2	0.1	0.0	0.0	0.0
Phase Call Probability	0.95	1.00	0.85	1.00	0.96		0.42	
Max Out Probability	1.00	0.98	1.00	0.02	1.00		0.03	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	118	269		75	118		131	306	293	22	586	564
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1614		1664	1719		1664	1748	1659	1664	1748	1678
Queue Service Time (*g*s), s	5.2	14.6		3.3	5.4		3.5	8.4	8.9	0.6	19.7	19.7
Cycle Queue Clearance Time (*g*c), s	5.2	14.6		3.3	5.4		3.5	8.4	8.9	0.6	19.7	19.7
Green Ratio (*g/C*)	0.24	0.19		0.23	0.18		0.55	0.52	0.52	0.50	0.48	0.48
Capacity (*c*), veh/h	333	308		171	310		304	910	864	434	839	806
Volume-to-Capacity Ratio (*X*)	0.355	0.873		0.441	0.381		0.429	0.336	0.339	0.050	0.699	0.700
Available Capacity (*c*a), veh/h	333	373		188	380		373	910	864	570	839	806
Back of Queue (*Q*), veh/ln (95th percentile)	3.8	11.4		2.5	4.1		2.2	5.8	5.9	0.4	10.8	10.6
Queue Storage Ratio (*RQ*) (95th percentile)	0.48	0.29		0.51	0.11		0.45	0.08	0.08	0.10	0.28	0.27
Uniform Delay (*d*1), s/veh	28.1	35.4		29.4	32.5		12.9	11.2	11.9	11.7	12.0	12.0
Incremental Delay (*d*2), s/veh	0.6	17.3		1.8	0.8		0.9	0.9	1.0	0.0	4.8	5.0
Initial Queue Delay (*d*3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	28.7	52.7		31.1	33.2		13.8	12.1	12.8	11.7	16.8	17.0
Level of Service (LOS)	C	D		C	C		B	B	B	B	B	B
Approach Delay, s/veh / LOS	45.4	D		32.4	C		12.7	B		16.8	B	
Intersection Delay, s/veh / LOS	21.3						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.8	C	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.1	A	0.8	A	1.1	A	1.5	A

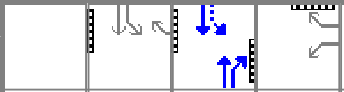
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Cliff Ave & 49th St	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_Cliff_Cliff-7_AM.xus				
Project Description	Cliff-SPUI 2035 AM				

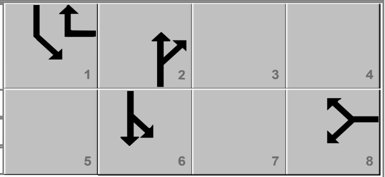


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				60		560		1360	30	210	760	

Signal Information			
Cycle, s	90.0	Reference Phase	6
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	11.2	44.1	19.9	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	1.5	1.5	0.0	0.0	0.0



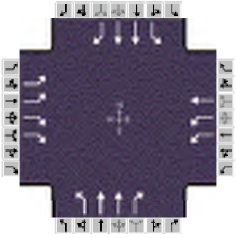
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8		2	1	6
Case Number				9.0		8.3	1.0	4.0
Phase Duration, s				25.0		49.2	15.8	65.0
Change Period, (*Y*+*R*$_c$), s				5.1		5.1	4.6	5.1
Max Allow Headway (*MAH*), s				4.4		0.0	4.2	0.0
Queue Clearance Time (*g*$_s$), s				21.9			10.8	
Green Extension Time (*g*$_e$), s				0.0		0.0	0.4	0.0
Phase Call Probability				1.00			1.00	
Max Out Probability				1.00			0.80	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3		18		2	12	1	6	
Adjusted Flow Rate (*v*), veh/h				71		485		819	816	247	894	
Adjusted Saturation Flow Rate (*s*), veh/h/ln				1681		1496		1748	1734	1664	1664	
Queue Service Time (*g*$_s$), s				3.1		19.9		44.4	39.3	8.8	13.1	
Cycle Queue Clearance Time (*g*$_c$), s				3.1		19.9		44.4	39.3	8.8	13.1	
Green Ratio (*g/C*)				0.22		0.35		0.49	0.49	0.64	0.67	
Capacity (*c*), veh/h				372		516		857	850	286	2215	
Volume-to-Capacity Ratio (*X*)				0.190		0.939		0.956	0.959	0.863	0.404	
Available Capacity (*c*$_a$), veh/h				372		516		857	850	365	2215	
Back of Queue (*Q*), veh/ln (95th percentile)				2.2		19.3		22.2	22.3	10.3	7.8	
Queue Storage Ratio (*RQ*) (95th percentile)				0.57		0.49		0.57	0.57	0.96	0.07	
Uniform Delay (*d*$_1$), s/veh				28.5		28.6		14.7	14.7	28.8	8.9	
Incremental Delay (*d*$_2$), s/veh				0.2		25.3		21.7	22.4	12.8	0.4	
Initial Queue Delay (*d*$_3$), s/veh				0.0		0.0		0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh				28.7		53.9		36.4	37.2	41.6	9.4	
Level of Service (LOS)				C		D		D	D	D	A	
Approach Delay, s/veh / LOS	0.0			50.7		D	36.8		D	16.3		B
Intersection Delay, s/veh / LOS	32.1						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.7	B	2.9	C	2.5	B	0.7	A
Bicycle LOS Score / LOS				F	1.8	A	1.4	A

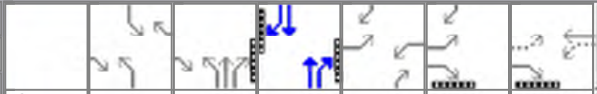
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Cliff Ave & I-229 SPUI	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_Cliff_Cliff-7_AM.xus				
Project Description	Cliff-SPUI 2035 AM				

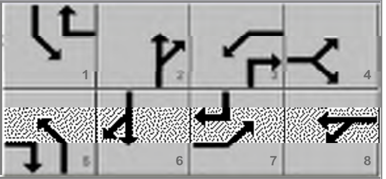


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	400		170	200	0		350	1290	380	140	600	220

Signal Information			
Cycle, s	90.0	Reference Phase	6
Offset, s	5	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	11.1	7.3	31.9	9.3	1.4	1.0
Yellow	4.0	4.0	4.0	4.0	4.0	0.0
Red	2.0	2.0	2.0	1.0	1.0	0.0



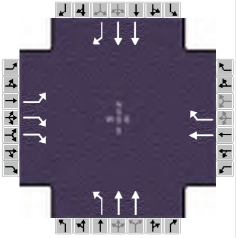
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	3.0	1.1	4.0	2.0	3.0	2.0	3.0
Phase Duration, s	20.7	7.5	14.3	1.0	30.4	51.2	17.1	37.9
Change Period, (*Y+R*c), s	5.0	0.0	5.0	0.0	6.0	6.0	6.0	6.0
Max Allow Headway (*MAH*), s	4.1	4.3	4.1	0.0	4.2	0.0	4.2	0.0
Queue Clearance Time (*g*s), s	14.6	7.1	8.6		23.5		11.0	
Green Extension Time (*g*e), s	1.1	0.4	0.7	0.0	0.8	0.0	0.3	0.0
Phase Call Probability	1.00	1.00	1.00		1.00		0.98	
Max Out Probability	0.35	0.39	0.00		0.52		0.10	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14	3	8		5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	471		200	235	0		412	1518	447	165	706	259
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1568		1244	1539	1633		1663	1701	1464	1597	1620	1432
Queue Service Time (*g*s), s	12.6		5.1	6.6	0.0		21.5	34.2	10.3	9.0	12.5	9.6
Cycle Queue Clearance Time (*g*c), s	12.6		5.1	6.6	0.0		21.5	34.2	10.3	9.0	12.5	9.6
Green Ratio (*g/C*)	0.21		0.35	0.11	0.01		0.27	0.50	0.61	0.12	0.35	0.53
Capacity (*c*), veh/h	737		880	502	19		450	1709	886	197	1148	757
Volume-to-Capacity Ratio (*X*)	0.638		0.227	0.469	0.000		0.914	0.888	0.505	0.838	0.615	0.342
Available Capacity (*c*a), veh/h	922		1025	903	114		541	1709	886	324	1148	757
Back of Queue (*Q*), veh/ln (95th percentile)	8.2		2.5	4.4	0.0		11.5	13.7	3.1	6.6	6.7	7.5
Queue Storage Ratio (*RQ*) (95th percentile)	0.84		0.29	0.56	0.00		0.98	0.13	0.28	0.76	0.34	0.96
Uniform Delay (*d*1), s/veh	33.2		20.4	38.2	0.0		31.1	15.6	4.7	36.2	14.3	12.8
Incremental Delay (*d*2), s/veh	1.0		0.1	0.7	0.0		5.9	2.1	0.5	8.4	2.1	1.1
Initial Queue Delay (*d*3), s/veh	0.0		0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	34.2		20.6	38.9	0.0		37.0	17.6	5.2	44.6	16.5	13.9
Level of Service (LOS)	C		C	D			D	B	A	D	B	B
Approach Delay, s/veh / LOS	30.2		C	38.9		D	18.7		B	20.0		B
Intersection Delay, s/veh / LOS	21.8						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.0	C	3.0	C	2.4	B	2.6	B
Bicycle LOS Score / LOS		F	0.9	A	2.4	B	1.4	A

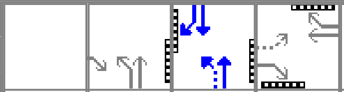
HCS 2010 Signalized Intersection Results Summary

General Information				**Intersection Information**	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Cliff Ave & 41st St	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_Cliff_Cliff-7_AM.xus				
Project Description	Cliff-SPUI 2035 AM				

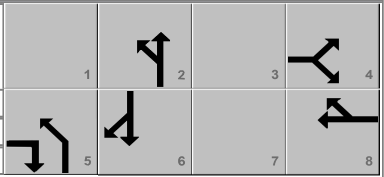


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	160		260		130	100	260	1430			700	100

Signal Information			
Cycle, s	90.0	Reference Phase	2
Offset, s	28	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	11.1	40.3	22.8	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	2.5	1.5	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2		6
Case Number		5.0		7.0	1.0	4.0		7.3
Phase Duration, s		27.9		27.9	15.7	62.1		46.4
Change Period, ($Y+R_c$), s		5.1		5.1	4.6	6.1		6.1
Max Allow Headway (*MAH*), s		4.4		4.4	4.2	0.0		0.0
Queue Clearance Time (g_s), s		22.7		8.4	10.9			
Green Extension Time (g_e), s		0.1		2.8	0.2	0.0		0.0
Phase Call Probability		1.00		1.00	1.00			
Max Out Probability		1.00		0.07	1.00			

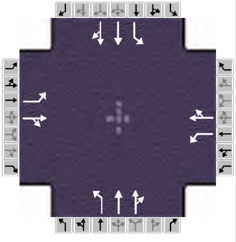
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14		8	18	5	2			6	16
Adjusted Flow Rate (*v*), veh/h	188		306		153	64	306	1682			824	106
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1160		1324		1748	1481	1664	1664			1664	1481
Queue Service Time (g_s), s	14.3		7.3		6.4	3.0	8.9	37.5			17.0	3.9
Cycle Queue Clearance Time (g_c), s	20.7		7.3		6.4	3.0	8.9	37.5			17.0	3.9
Green Ratio (*g/C*)	0.25		0.38		0.25	0.25	0.59	0.62			0.45	0.45
Capacity (*c*), veh/h	291		997		442	375	440	2071			1490	663
Volume-to-Capacity Ratio (*X*)	0.648		0.307		0.346	0.169	0.696	0.812			0.553	0.160
Available Capacity (c_a), veh/h	292		1001		445	377	465	2071			1490	663
Back of Queue (*Q*), veh/ln (95th percentile)	7.8		4.0		4.7	1.9	4.3	18.3			10.7	2.5
Queue Storage Ratio (*RQ*) (95th percentile)	0.53		0.27		0.20	0.32	0.55	0.94			0.13	0.42
Uniform Delay (d_1), s/veh	36.0		19.8		27.5	26.2	11.4	16.7			19.6	15.2
Incremental Delay (d_2), s/veh	4.9		0.2		0.5	0.2	1.9	1.7			1.3	0.5
Initial Queue Delay (d_3), s/veh	0.0		0.0		0.0	0.0	0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh	40.9		19.9		28.0	26.4	13.3	18.4			20.9	15.7
Level of Service (LOS)	D		B		C	C	B	B			C	B

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	27.9	C	27.5	C	17.6	B	20.3	C
Intersection Delay, s/veh / LOS	20.3				C			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.8	C	1.7	A	2.4	B
Bicycle LOS Score / LOS		F	0.8	A	2.1	B	1.3	A

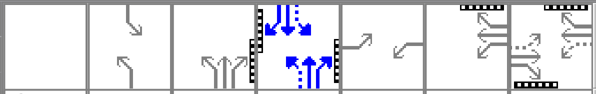
HCS 2010 Signalized Intersection Results Summary

General Information				**Intersection Information**	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Cliff Ave & 33rd St	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_Cliff_Cliff-7_AM.xus				
Project Description	Cliff-SPUI 2035 AM				

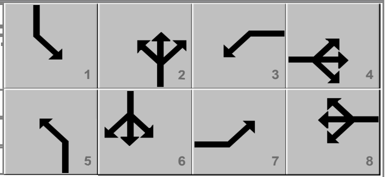


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	70	60	100	95	200	30	150	860	20	15	450	80

Signal Information			
Cycle, s	90.0	Reference Phase	2
Offset, s	87	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	1.4	1.0	41.4	4.8	0.6	16.4
Yellow	3.6	3.6	3.6	3.6	0.0	3.6
Red	1.0	1.0	1.9	1.0	0.0	1.5



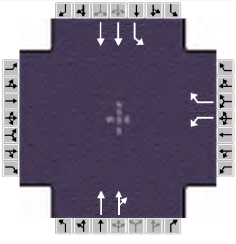
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	4.0	1.1	4.0	1.1	4.0	1.1	4.0
Phase Duration, s	9.4	21.5	10.0	22.1	11.6	52.4	6.0	46.9
Change Period, (*Y+R_c*), s	4.6	5.1	4.6	5.1	4.6	5.5	4.6	5.5
Max Allow Headway (*MAH*), s	4.2	4.2	4.2	4.2	4.2	0.0	4.2	0.0
Queue Clearance Time (*g_s*), s	5.5	11.9	6.9	15.7	6.8		2.5	
Green Extension Time (*g_e*), s	0.0	1.4	0.0	1.3	0.3	0.0	0.0	0.0
Phase Call Probability	0.87	1.00	0.94	1.00	0.99		0.36	
Max Out Probability	1.00	0.03	1.00	0.11	0.12		0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	82	188		112	271		176	520	516	18	319	304
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1586		1664	1707		1664	1748	1733	1664	1748	1655
Queue Service Time (*g_s*), s	3.5	9.9		4.9	13.7		4.8	12.8	12.7	0.5	8.4	8.5
Cycle Queue Clearance Time (*g_c*), s	3.5	9.9		4.9	13.7		4.8	12.8	12.7	0.5	8.4	8.5
Green Ratio (*g/C*)	0.24	0.18		0.24	0.19		0.56	0.52	0.52	0.48	0.46	0.46
Capacity (*c*), veh/h	187	290		266	323		497	911	904	297	803	761
Volume-to-Capacity Ratio (*X*)	0.441	0.649		0.420	0.838		0.355	0.570	0.571	0.059	0.397	0.400
Available Capacity (*c_a*), veh/h	197	439		266	483		624	911	904	527	803	761
Back of Queue (*Q*), veh/ln (95th percentile)	2.7	7.1		3.6	10.4		2.8	6.1	6.0	0.3	5.6	5.4
Queue Storage Ratio (*RQ*) (95th percentile)	0.34	0.18		0.74	0.27		0.72	0.08	0.07	0.09	0.14	0.14
Uniform Delay (*d₁*), s/veh	29.0	34.1		28.3	35.2		10.2	7.9	7.8	13.0	11.1	11.1
Incremental Delay (*d₂*), s/veh	1.6	2.4		1.1	8.1		0.2	1.4	1.4	0.1	1.5	1.6
Initial Queue Delay (*d₃*), s/veh	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	30.6	36.6		29.3	43.2		10.4	9.3	9.2	13.0	12.5	12.6
Level of Service (LOS)	C	D		C	D		B	A	A	B	B	B
Approach Delay, s/veh / LOS	34.7	C		39.2	D		9.4	A		12.6	B	
Intersection Delay, s/veh / LOS	17.5						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.8	C	2.3	B	2.3	B
Bicycle LOS Score / LOS	0.9	A	1.1	A	1.5	A	1.0	A

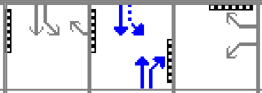
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Cliff Ave & 49th St	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_Cliff_Cliff-7_PM.xus				
Project Description	Cliff-SPUI 2035 PM				

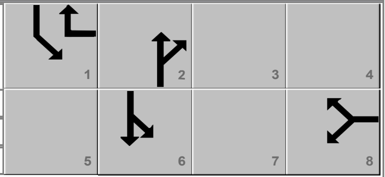


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				80		300		1000	70	500	1500	

Signal Information			
Cycle, s	90.0	Reference Phase	6
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	15.2	53.4	6.7	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	1.5	1.5	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8		2	1	6
Case Number				9.0		8.3	1.0	4.0
Phase Duration, s				11.8		58.5	19.8	78.2
Change Period, (*Y*+*R*c), s				5.1		5.1	4.6	5.1
Max Allow Headway (*MAH*), s				4.3		0.0	4.2	0.0
Queue Clearance Time (*g*s), s				6.5			13.8	
Green Extension Time (*g*e), s				0.3		0.0	1.4	0.0
Phase Call Probability				0.99			1.00	
Max Out Probability				0.22			0.27	

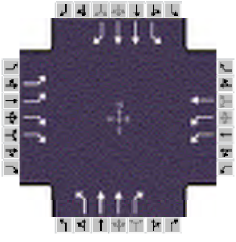
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3		18		2	12	1	6	
Adjusted Flow Rate (*v*), veh/h				86		84		575	564	508	1523	
Adjusted Saturation Flow Rate (*s*), veh/h/ln				1681		1496		1748	1713	1664	1664	
Queue Service Time (*g*s), s				4.5		4.0		21.1	11.1	11.8	10.4	
Cycle Queue Clearance Time (*g*c), s				4.5		4.0		21.1	11.1	11.8	10.4	
Green Ratio (*g/C*)				0.07		0.24		0.59	0.59	0.78	0.81	
Capacity (*c*), veh/h				125		363		1036	1015	535	2703	
Volume-to-Capacity Ratio (*X*)				0.689		0.231		0.555	0.555	0.950	0.564	
Available Capacity (*c*a), veh/h				241		467		1036	1015	654	2703	
Back of Queue (*Q*), veh/ln (95th percentile)				3.7		2.6		5.8	5.7	8.9	2.6	
Queue Storage Ratio (*RQ*) (95th percentile)				0.94		0.07		0.15	0.15	0.91	0.02	
Uniform Delay (*d*1), s/veh				40.6		27.3		5.0	5.0	11.4	1.7	
Incremental Delay (*d*2), s/veh				6.6		0.3		2.1	2.2	9.0	0.3	
Initial Queue Delay (*d*3), s/veh				0.0		0.0		0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh				47.2		27.6		7.2	7.2	20.5	2.0	
Level of Service (LOS)				D		C		A	A	C	A	

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	0.0		37.6	D	7.2	A	6.6	A
Intersection Delay, s/veh / LOS	8.4				A			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.9	C	2.6	B	0.6	A
Bicycle LOS Score / LOS				F	1.4	A	2.3	B

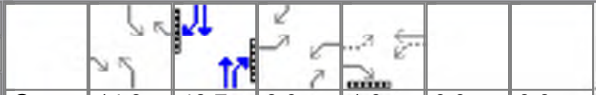
HCS 2010 Signalized Intersection Results Summary

General Information				**Intersection Information**	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Cliff Ave & I-229 SPUI	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_Cliff_Cliff-7_PM.xus				
Project Description	Cliff-SPUI 2035 PM				

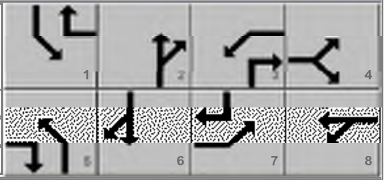


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	200		350	300	0		210	680	220	200	1450	500

Signal Information			
Cycle, s	90.0	Reference Phase	6
Offset, s	30	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	14.3	48.7	8.0	1.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Red	2.0	2.0	2.0	0.0	0.0	0.0



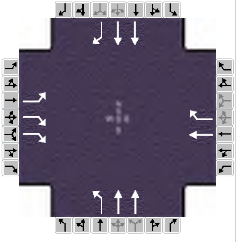
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	3.0	1.1	4.0	2.0	3.0	2.0	3.0
Phase Duration, s	14.0	1.0	14.0	1.0	20.3	54.7	20.3	54.7
Change Period, (*Y*+*R*c), s	6.0	0.0	6.0	0.0	6.0	6.0	6.0	6.0
Max Allow Headway (*MAH*), s	4.1	4.3	4.1	0.0	4.2	0.0	4.2	0.0
Queue Clearance Time (*g*s), s	8.1	3.0	10.0		14.1		13.7	
Green Extension Time (*g*e), s	0.0	0.0	0.0	0.0	0.3	0.0	0.6	0.0
Phase Call Probability	1.00	1.00	1.00		1.00		0.99	
Max Out Probability	1.00	1.00	1.00		1.00		0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14	3	8		5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	215		376	323	0		226	731	237	211	1530	527
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1536		1257	1549	1633		1613	1622	1428	1609	1703	1478
Queue Service Time (*g*s), s	6.1		1.0	8.0	0.0		12.1	15.4	9.4	11.7	34.6	9.7
Cycle Queue Clearance Time (*g*c), s	6.1		1.0	8.0	0.0		12.1	15.4	9.4	11.7	34.6	9.7
Green Ratio (*g/C*)	0.10		0.17	0.10	0.01		0.16	0.54	0.63	0.16	0.54	0.63
Capacity (*c*), veh/h	433		428	435	18		257	1756	900	256	1841	931
Volume-to-Capacity Ratio (*X*)	0.497		0.879	0.741	0.000		0.879	0.416	0.263	0.825	0.831	0.567
Available Capacity (*c*a), veh/h	433		428	435	18		323	1756	900	518	1841	931
Back of Queue (*Q*), veh/ln (95th percentile)	4.1		8.6	7.0	0.0		8.9	10.1	9.8	6.8	15.7	2.2
Queue Storage Ratio (*RQ*) (95th percentile)	0.42		0.98	0.90	0.00		0.76	0.09	0.91	0.78	0.80	0.28
Uniform Delay (*d*1), s/veh	39.2		36.4	40.7	0.0		32.9	18.4	12.3	42.3	19.0	3.0
Incremental Delay (*d*2), s/veh	0.9		18.4	6.6	0.0		17.1	0.6	0.6	1.3	0.9	0.5
Initial Queue Delay (*d*3), s/veh	0.0		0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	40.1		54.8	47.4	0.0		50.0	19.0	12.9	43.6	19.9	3.4
Level of Service (LOS)	D		D	D			D	B	B	D	B	A
Approach Delay, s/veh / LOS	49.5		D	47.4		D	23.7		C	18.3		B
Intersection Delay, s/veh / LOS	26.1						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.0	C	3.0	C	2.4	B	2.5	B
Bicycle LOS Score / LOS		F	1.0	A	1.5	A	2.4	B

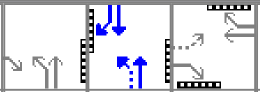
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Cliff Ave & 41st St	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_Cliff_Cliff-7_PM.xus				
Project Description	Cliff-SPUI 2035 PM				

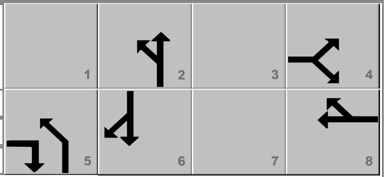


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	200		680		80	40	200	680			1470	180

Signal Information			
Cycle, s	90.0	Reference Phase	2
Offset, s	88	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	7.4	47.0	19.9	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	2.4	1.5	0.0	0.0	0.0



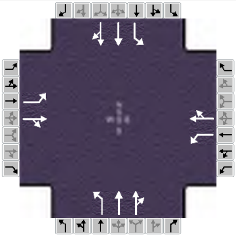
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2		6
Case Number		5.0		7.0	1.0	4.0		7.3
Phase Duration, s		25.0		25.0	12.0	65.0		53.0
Change Period, (*Y*+*R*c), s		5.1		5.1	4.6	6.1		6.1
Max Allow Headway (*MAH*), s		4.4		4.4	4.2	0.0		0.0
Queue Clearance Time (*g*s), s		21.9		5.6	7.9			
Green Extension Time (*g*e), s		0.0		4.6	0.0	0.0		0.0
Phase Call Probability		1.00		1.00	1.00			
Max Out Probability		1.00		0.19	1.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14		8	18	5	2			6	16
Adjusted Flow Rate (*v*), veh/h	215		731		86	31	215	731			1581	184
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1257		1311		1748	1481	1664	1664			1664	1481
Queue Service Time (*g*s), s	15.2		19.9		3.6	1.5	5.9	4.9			38.2	4.8
Cycle Queue Clearance Time (*g*c), s	18.8		19.9		3.6	1.5	5.9	4.9			38.2	4.8
Green Ratio (*g/C*)	0.22		0.30		0.22	0.22	0.63	0.65			0.52	0.52
Capacity (*c*), veh/h	307		795		386	327	243	2178			1734	772
Volume-to-Capacity Ratio (*X*)	0.700		0.920		0.223	0.095	0.885	0.336			0.912	0.238
Available Capacity (*c*a), veh/h	307		795		386	327	243	2178			1734	772
Back of Queue (*Q*), veh/ln (95th percentile)	8.9		14.1		2.7	0.9	7.6	2.4			18.6	2.7
Queue Storage Ratio (*RQ*) (95th percentile)	0.61		0.96		0.11	0.16	0.97	0.12			0.23	0.47
Uniform Delay (*d*1), s/veh	36.4		30.3		28.7	27.9	24.9	3.2			17.2	8.8
Incremental Delay (*d*2), s/veh	6.9		15.8		0.3	0.1	27.6	0.4			6.0	0.5
Initial Queue Delay (*d*3), s/veh	0.0		0.0		0.0	0.0	0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh	43.3		46.1		29.0	28.0	52.5	3.6			23.2	9.3
Level of Service (LOS)	D		D		C	C	D	A			C	A
Approach Delay, s/veh / LOS	45.4		D	28.7		C	14.7		B	21.8		C
Intersection Delay, s/veh / LOS	26.1						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.9	C	1.7	A	2.4	B
Bicycle LOS Score / LOS		F	0.7	A	1.3	A	1.9	A

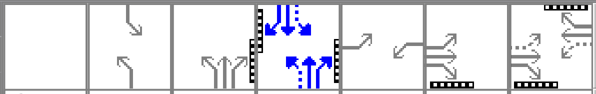
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Cliff Ave & 33rd St	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_Cliff_Cliff-7_PM.xus				
Project Description	Cliff-SPUI 2035 PM				

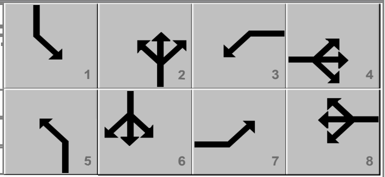


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	110	120	130	70	100	10	120	470	80	20	950	120

Signal Information			
Cycle, s	90.0	Reference Phase	2
Offset, s	89	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	1.7	3.6	43.2	4.5	0.9	16.2
Yellow	3.6	0.0	3.6	3.6	0.0	3.6
Red	1.0	0.0	1.9	1.0	0.0	1.5



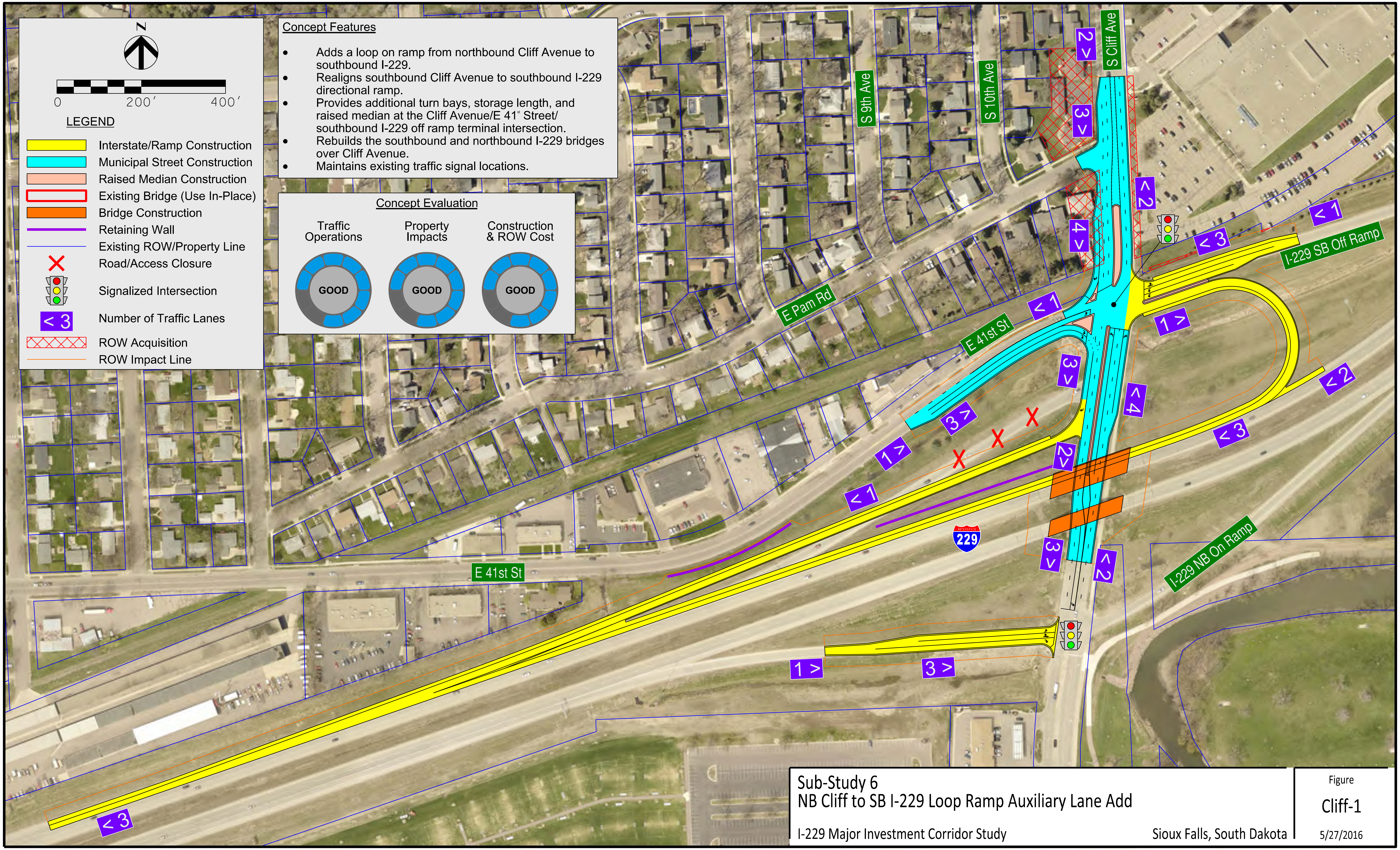
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	4.0	1.1	4.0	1.1	4.0	1.1	4.0
Phase Duration, s	10.0	22.3	9.1	21.3	9.9	52.4	6.3	48.7
Change Period, (*Y+R*c), s	4.6	5.1	4.6	5.1	4.6	5.5	4.6	5.5
Max Allow Headway (*MAH*), s	4.2	4.2	4.2	4.2	4.2	0.0	4.2	0.0
Queue Clearance Time (*g*s), s	7.2	16.6	5.3	7.4	5.4		2.6	
Green Extension Time (*g*e), s	0.0	0.6	0.0	1.2	0.1	0.0	0.0	0.0
Phase Call Probability	0.95	1.00	0.85	1.00	0.96		0.42	
Max Out Probability	1.00	0.98	1.00	0.02	1.00		0.03	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	118	269		75	118		129	302	289	22	586	564
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1614		1664	1719		1664	1748	1659	1664	1748	1678
Queue Service Time (*g*s), s	5.2	14.6		3.3	5.4		3.4	9.1	9.6	0.6	19.6	19.7
Cycle Queue Clearance Time (*g*c), s	5.2	14.6		3.3	5.4		3.4	9.1	9.6	0.6	19.6	19.7
Green Ratio (*g/C*)	0.24	0.19		0.23	0.18		0.55	0.52	0.52	0.50	0.48	0.48
Capacity (*c*), veh/h	333	308		171	310		304	910	864	430	840	806
Volume-to-Capacity Ratio (*X*)	0.355	0.873		0.441	0.381		0.424	0.332	0.335	0.050	0.699	0.699
Available Capacity (*c*a), veh/h	333	373		188	380		373	910	864	566	840	806
Back of Queue (*Q*), veh/ln (95th percentile)	3.8	11.4		2.5	4.1		2.2	6.5	6.6	0.4	10.8	10.5
Queue Storage Ratio (*RQ*) (95th percentile)	0.48	0.29		0.51	0.11		0.56	0.08	0.08	0.10	0.28	0.27
Uniform Delay (*d*1), s/veh	28.1	35.4		29.4	32.5		12.8	12.6	13.4	11.7	11.9	11.9
Incremental Delay (*d*2), s/veh	0.6	17.3		1.8	0.8		0.9	0.9	1.0	0.0	4.8	5.0
Initial Queue Delay (*d*3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	28.7	52.7		31.1	33.2		13.7	13.5	14.4	11.8	16.7	17.0
Level of Service (LOS)	C	D		C	C		B	B	B	B	B	B
Approach Delay, s/veh / LOS	45.4		D	32.4		C	13.9		B	16.7		B
Intersection Delay, s/veh / LOS	21.6						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.8	C	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.1	A	0.8	A	1.1	A	1.5	A

APPENDIX D1 -

PRELIMINARY CONCEPT FIGURES



LEGEND

🟨 Interstate/Ramp Construction
🟦 Municipal Street Construction
▭ Raised Median Construction
☐ Existing Bridge (Use In-Place)
🟧 Bridge Construction
— Retaining Wall
— Existing ROW/Property Line
✕ Road/Access Closure
🚦 Signalized Intersection
< 3 Number of Traffic Lanes
▨ ROW Acquisition
— ROW Impact Line

Concept Features

- Adds a loop on ramp from northbound Cliff Avenue to southbound I-229.
- Realigns southbound Cliff Avenue to southbound I-229 directional ramp.
- Provides additional turn bays, storage length, and raised median at the Cliff Avenue/E 41st Street/ southbound I-229 off ramp terminal intersection.
- Rebuilds the southbound and northbound I-229 bridges over Cliff Avenue.
- Maintains existing traffic signal locations.

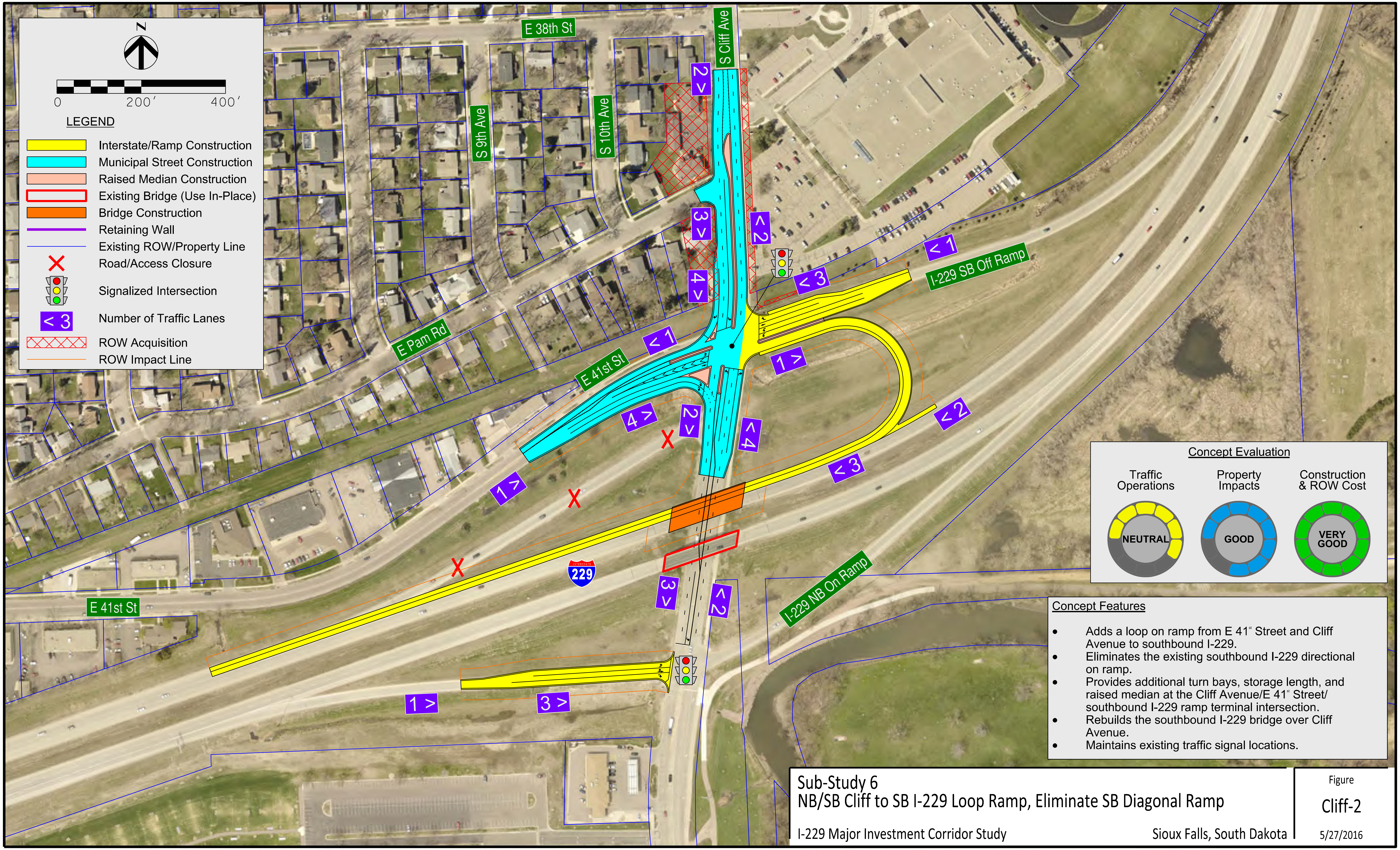
Concept Evaluation

Traffic Operations	Property Impacts	Construction & ROW Cost
GOOD	GOOD	GOOD

Sub-Study 6
NB Cliff to SB I-229 Loop Ramp Auxiliary Lane Add

I-229 Major Investment Corridor Study
Sioux Falls, South Dakota

Figure
Cliff-1
5/27/2016



Concept Evaluation

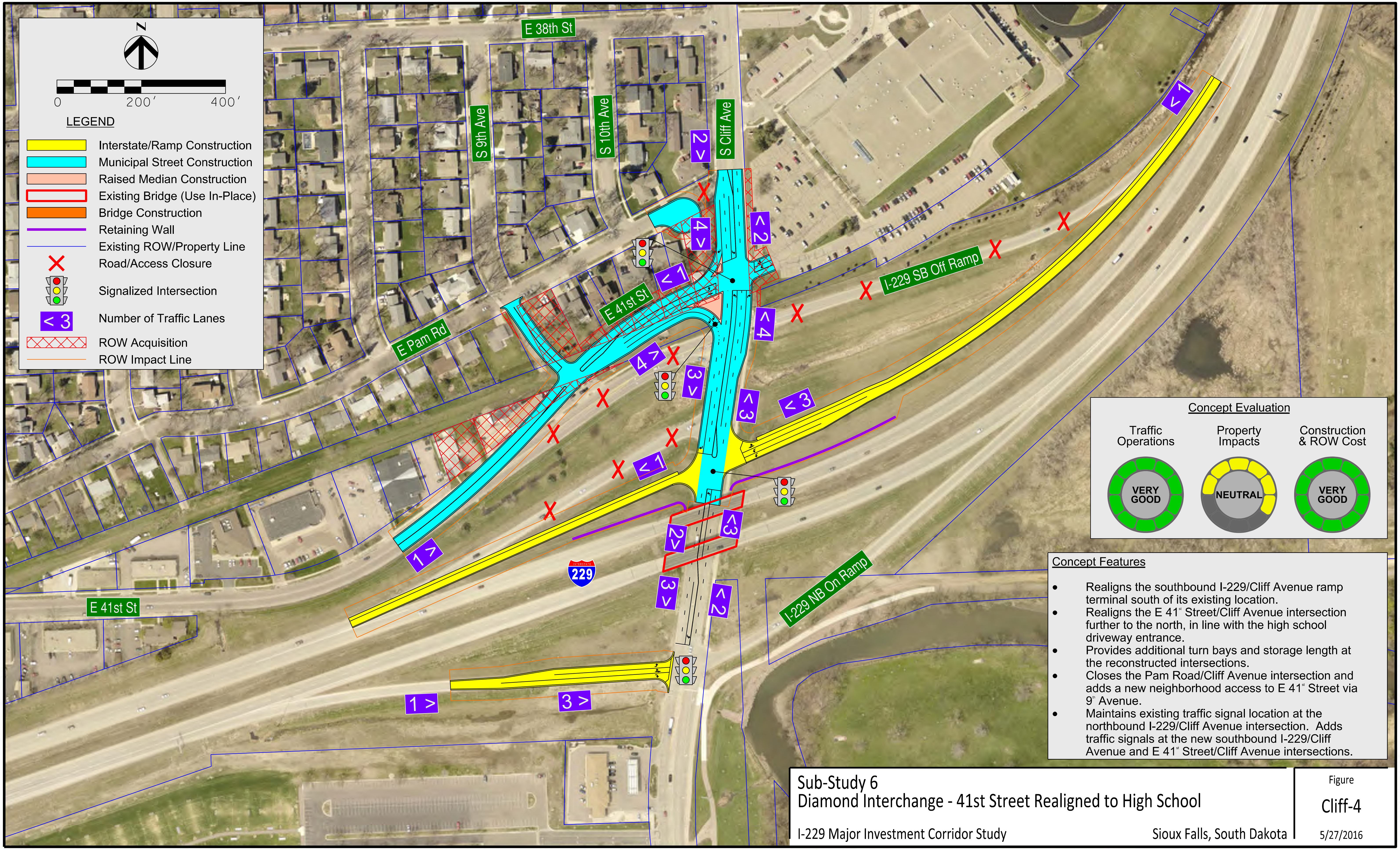
Traffic Operations	Property Impacts	Construction & ROW Cost
NEUTRAL	GOOD	VERY GOOD

Concept Features

- Adds a loop on ramp from E 41st Street and Cliff Avenue to southbound I-229.
- Eliminates the existing southbound I-229 directional on ramp.
- Provides additional turn bays, storage length, and raised median at the Cliff Avenue/E 41st Street/ southbound I-229 ramp terminal intersection.
- Rebuilds the southbound I-229 bridge over Cliff Avenue.
- Maintains existing traffic signal locations.

Sub-Study 6
NB/SB Cliff to SB I-229 Loop Ramp, Eliminate SB Diagonal Ramp
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota

Figure
Cliff-2
5/27/2016



Concept Evaluation

Traffic Operations	Property Impacts	Construction & ROW Cost
VERY GOOD	NEUTRAL	VERY GOOD

Concept Features

- Realigns the southbound I-229/Cliff Avenue ramp terminal south of its existing location.
- Realigns the E 41st Street/Cliff Avenue intersection further to the north, in line with the high school driveway entrance.
- Provides additional turn bays and storage length at the reconstructed intersections.
- Closes the Pam Road/Cliff Avenue intersection and adds a new neighborhood access to E 41st Street via 9th Avenue.
- Maintains existing traffic signal location at the northbound I-229/Cliff Avenue intersection. Adds traffic signals at the new southbound I-229/Cliff Avenue and E 41st Street/Cliff Avenue intersections.

Sub-Study 6
Diamond Interchange - 41st Street Realigned to High School

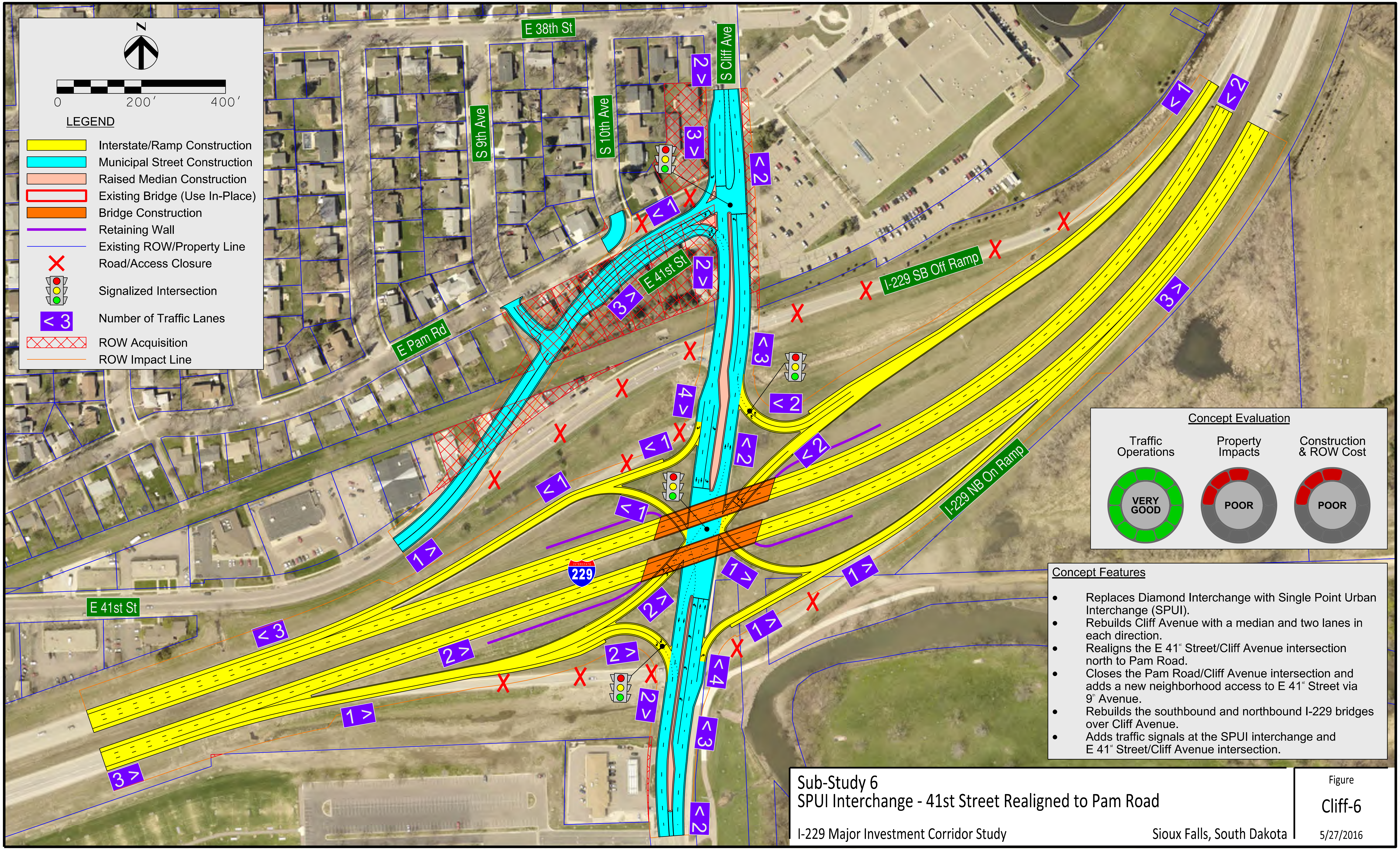
I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure

Cliff-4

5/27/2016



LEGEND

🟨 Interstate/Ramp Construction
🟦 Municipal Street Construction
🟧 Raised Median Construction
▭ Existing Bridge (Use In-Place)
🟧 Bridge Construction
— Retaining Wall
— Existing ROW/Property Line
✕ Road/Access Closure
🚦 Signalized Intersection
< 3 Number of Traffic Lanes
▨ ROW Acquisition
— ROW Impact Line

Concept Evaluation

Traffic Operations	Property Impacts	Construction & ROW Cost
VERY GOOD	POOR	POOR

Concept Features

- Replaces Diamond Interchange with Single Point Urban Interchange (SPUI).
- Rebuilds Cliff Avenue with a median and two lanes in each direction.
- Realigns the E 41st Street/Cliff Avenue intersection north to Pam Road.
- Closes the Pam Road/Cliff Avenue intersection and adds a new neighborhood access to E 41st Street via 9th Avenue.
- Rebuilds the southbound and northbound I-229 bridges over Cliff Avenue.
- Adds traffic signals at the SPUI interchange and E 41st Street/Cliff Avenue intersection.

Sub-Study 6
SPUI Interchange - 41st Street Realigned to Pam Road

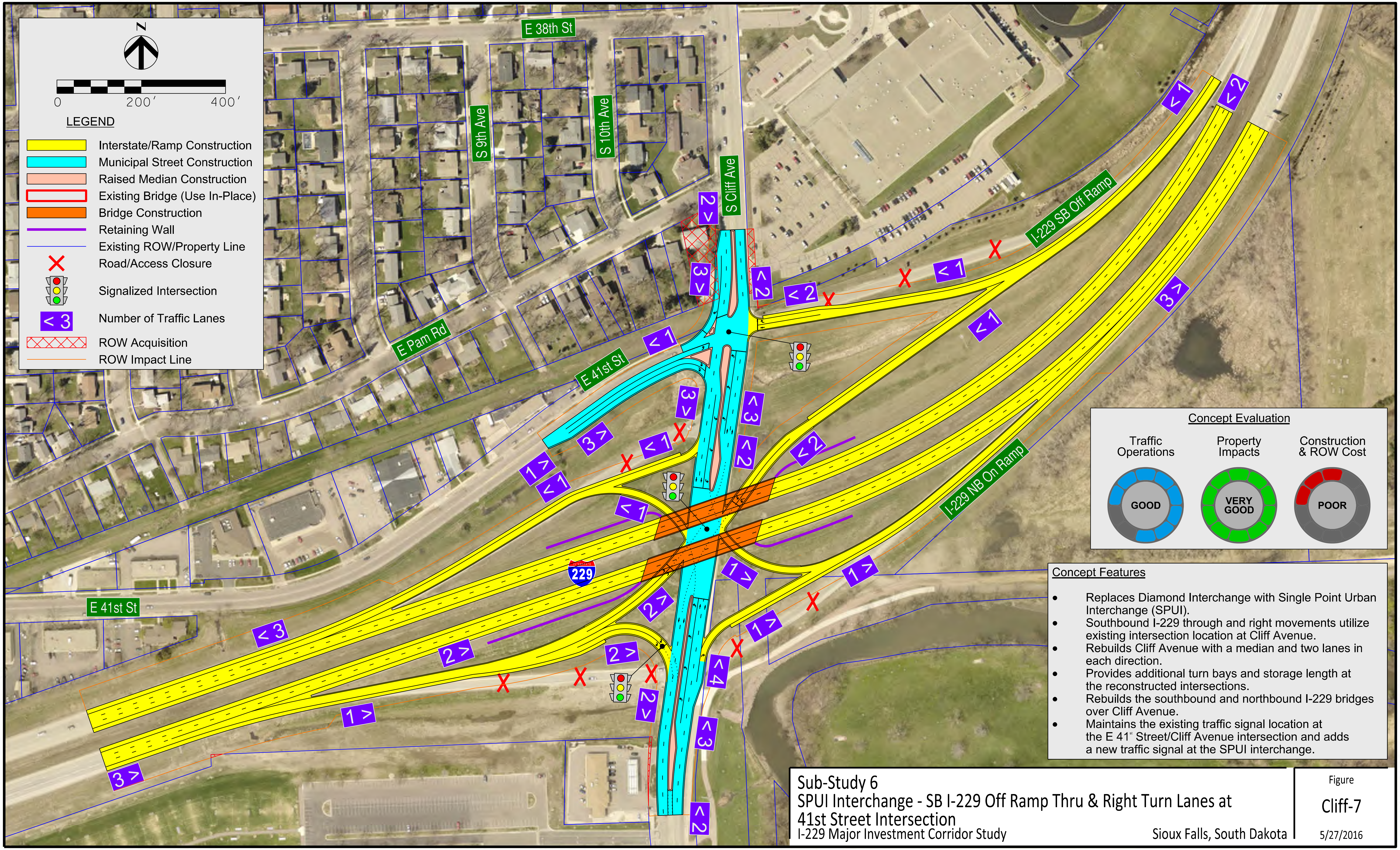
I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure

Cliff-6

5/27/2016



Concept Evaluation

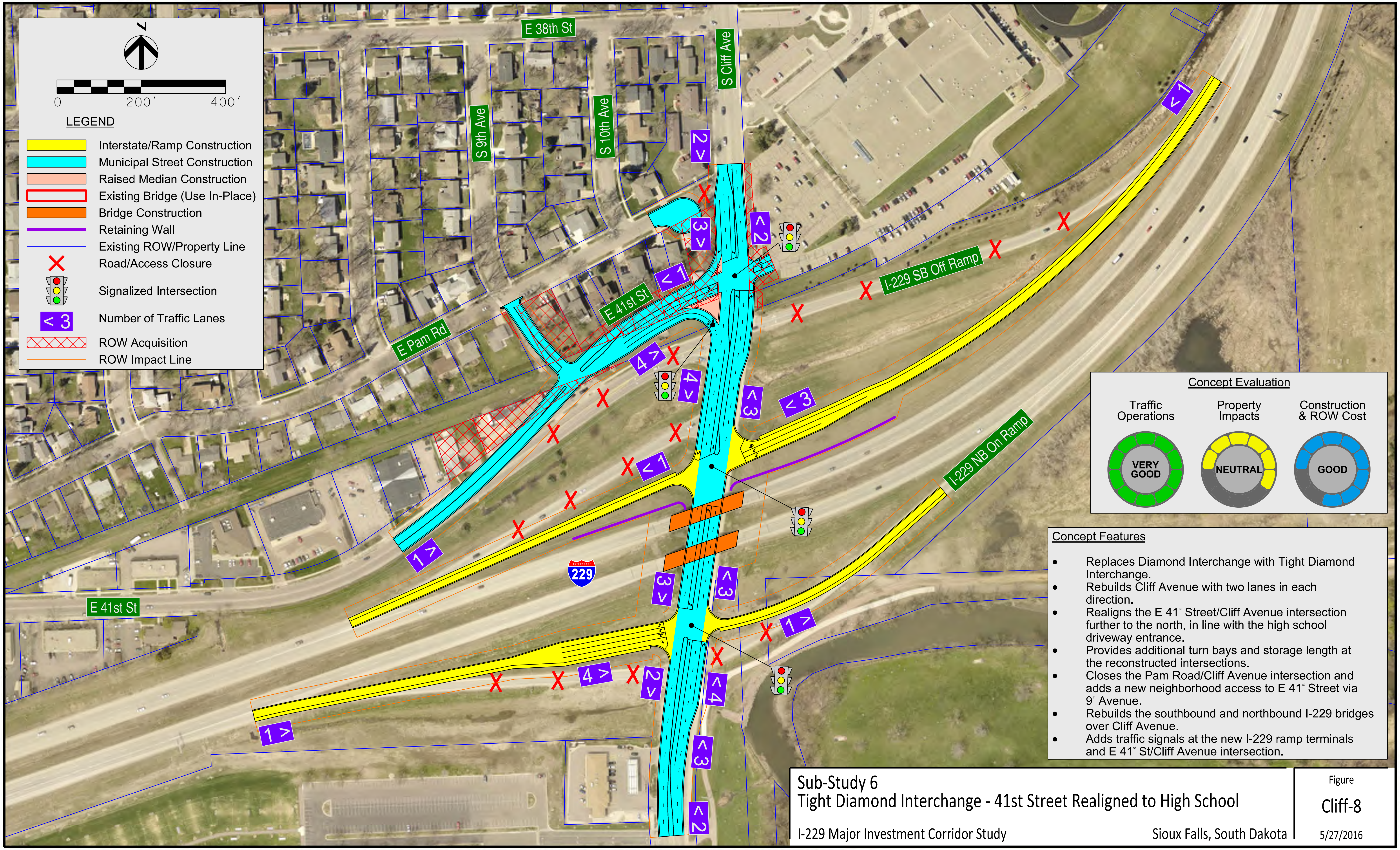
Traffic Operations	Property Impacts	Construction & ROW Cost
GOOD	VERY GOOD	POOR

Concept Features

- Replaces Diamond Interchange with Single Point Urban Interchange (SPUI).
- Southbound I-229 through and right movements utilize existing intersection location at Cliff Avenue.
- Rebuilds Cliff Avenue with a median and two lanes in each direction.
- Provides additional turn bays and storage length at the reconstructed intersections.
- Rebuilds the southbound and northbound I-229 bridges over Cliff Avenue.
- Maintains the existing traffic signal location at the E 41st Street/Cliff Avenue intersection and adds a new traffic signal at the SPUI interchange.

Sub-Study 6
SPUI Interchange - SB I-229 Off Ramp Thru & Right Turn Lanes at
41st Street Intersection
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota

Figure
Cliff-7
5/27/2016



LEGEND

🟨	Interstate/Ramp Construction
🟦	Municipal Street Construction
▭	Raised Median Construction
▭	Existing Bridge (Use In-Place)
🟧	Bridge Construction
—	Retaining Wall
—	Existing ROW/Property Line
✕	Road/Access Closure
🚦	Signalized Intersection
< 3	Number of Traffic Lanes
▨	ROW Acquisition
—	ROW Impact Line

Concept Evaluation

Traffic Operations	Property Impacts	Construction & ROW Cost
VERY GOOD	NEUTRAL	GOOD

Concept Features

- Replaces Diamond Interchange with Tight Diamond Interchange.
- Rebuilds Cliff Avenue with two lanes in each direction.
- Realigns the E 41st Street/Cliff Avenue intersection further to the north, in line with the high school driveway entrance.
- Provides additional turn bays and storage length at the reconstructed intersections.
- Closes the Pam Road/Cliff Avenue intersection and adds a new neighborhood access to E 41st Street via 9th Avenue.
- Rebuilds the southbound and northbound I-229 bridges over Cliff Avenue.
- Adds traffic signals at the new I-229 ramp terminals and E 41st St/Cliff Avenue intersection.

Sub-Study 6
Tight Diamond Interchange - 41st Street Realigned to High School

I-229 Major Investment Corridor Study
Sioux Falls, South Dakota

Figure
Cliff-8
5/27/2016

Appendix D2. Preliminary Concepts Tech Memo

Preliminary Concepts – Cliff Avenue Corridor and Interchanges

The Cliff Avenue Corridor portion of the Preliminary Concept Matrix was developed following the April 2016 Concept Web Meeting to document Study Advisory Team (SAT) decisions and serves as a road map for the development of concepts identified during the meeting. A comments column has been added to allow notes regarding evolution of the concepts from the meeting to be explained. The Preliminary Concept Matrix is shown in ***TABLE 1***.

The concepts depicted in ***APPENDIX D1- PRELIMINARY CONCEPT FIGURES*** following this memorandum have had one or the other of the following actions determined by the SAT, as documented in the Concept Matrix:

- Develop comparative data for preliminary concept screening
- Eliminate from further development due to anticipated impacts, but will be shown at the second public meeting to note that the concept was identified and received initial consideration.

Table 1. Preliminary Concept Matrix

Type
SPUI = Single Point
TD = Tight Diamond
DDI = Diverging Diamond
Par = Parclo
TSD = Tight Split Diamond
FD = Folded Diamond
CFI = Continuous Flow Intersection

Concept Workshop Decision
Develop = Develop for public meeting
Show = Show public / No further development
Eliminate = Do not show public / No further development

Concept ID	Type / Details Description	Web Meeting Decision	Development Items		Comments
			Traffic Assessment	ROW/Environ /Cost	
Cliff Avenue Interchange					
Cliff-1	NB Cliff to SB I-229 Loop Ramp Auxiliary Lane Add	Develop	X	X	
Cliff-2	NB/SB Cliff to SB I-229 Loop Ramp, Eliminate SB Diagonal Ramp	Develop	X	X	
Cliff-3	NB/SB Cliff to SB I-229 Loop Ramp, Relocate 41st South	Eliminate (1)			
Cliff-4	Diamond Interchange - 41st Street Realigned to High School	Develop	X	X	
Cliff-5	Diamond Interchange - 41st Street Realigned to Pam Road	Eliminate			
Cliff-6	SPUI Interchange - 41st Street Realigned to Pam Road	Develop	X	X	
Cliff-7	SPUI Interchange - SB I-229 Off Ramp Thru & Right Turn Lanes at 41st Street Intersection	Develop	X	X	Renamed From SPUI Interchange - WBT/WBR on Existing Ramp
Cliff-8	Tight Diamond Interchange - 41st Street Realigned to High School	Develop	X	X	Renamed From Tight Diamond Interchange - 41st Street Realigned to Pam Road

Footnotes
(1) Concept will not be developed further based on Synchro traffic analysis.

Preliminary Concepts - Development

The preliminary concepts shown in Table 1 were developed in response to traffic operational needs. Traffic analyses were conducted for all concepts in HCS 2010 to verify that the concepts provided the required standard of traffic operations of level of service (LOS) ‘C’ set for this study. Concept Cliff-3 met the LOS standard based on the HCS 2010 analysis, but the analysis results were affected by a limitation in the software related to closely-spaced traffic signals operating under a single traffic controller. To verify the HCS 2010 results, Synchro software was used as a tool capable of analyzing traffic operations under complex traffic signal phasing conditions. The Synchro analysis showed excessive queuing related to the close spacing of intersections in concept Cliff-3. Cliff-3 was therefore eliminated from further consideration due to potential for traffic and safety concerns.

Another situation that arose during the preliminary concept development stage was the potential impact of the concept limits on Lincoln High School. Traffic counts were conducted for pedestrian and vehicle traffic at all major driveways on a typical school day to assess the level of high school traffic and school traffic patterns. A high level review of the driveway volumes identified a potential future need within the study horizon for a traffic signal at the Cliff Avenue / E. 38th Street / Lincoln High School driveway intersection; no formal traffic analysis was conducted at this location. Implementation of a traffic signal at this location would require a traffic study to verify that the signal is warranted based on the requirements set in the Manual on Uniform Traffic Control Devices (MUTCD). This location should be monitored to determine the appropriate timing of conducting a future traffic volume study.

If a traffic signal is warranted and constructed, the pedestrian signal on Cliff Avenue just north of E. 38th Street would need to be removed and pedestrians would use the new traffic signal to cross Cliff Avenue. A potential signal at E. 38th Street / LHS driveway could create a tight traffic signal spacing depending on which Cliff Avenue concept is preferred. No preliminary concepts were eliminated based on the potential for tight signal spacing, but it is recommended that, if developed, the future traffic signal at E. 38th Street / LHS driveway be coordinated with the traffic signals proposed in the Cliff Avenue concepts.

Traffic operation analysis of the school’s driveways was limited to the southernmost driveway with direct access to Cliff Avenue based on the potential change in access for this driveway between concepts. The preliminary Cliff Avenue concepts range from providing right-in / right-out only access to aligning 41st Street with the driveway at a proposed traffic signal. Traffic operations for the southernmost driveway show acceptable LOS for either the right-in / right-out or signalized conditions. Impacts of the driveway traffic operations were included in the section entitled Traffic Operations Assessment.

Preliminary Concepts Comparative Data

The I-229 Major Investment Study scope identified the following four types of data to be developed for each preliminary concept identified for further consideration:

- Property Impacts
- Traffic Operations
- Environmental Review
- Construction and Property Impact Costs

This comparative data will be used in combination with public input to screen the concepts and identify “Build Scenarios” for further refinement. The remainder of this memorandum will describe the approach applied to preparing the comparative data and will document the comparative data for each concept.

Property Impacts

An approximate footprint for each preliminary concept was developed by setting impact limits based on the following criteria:

- 15 feet behind the back of curb
- 25-foot offset from ramp pavement (from back of curb or edge of shoulder)
- 100 feet from edge of I-229 shoulder pavement
- 5 feet behind retaining walls

The criteria that resulted in the greatest offset from a given roadway set the impact limit for that roadway.

The portion of each property parcel intersected by the impact limits that was inside of the impact limit was assumed to be an acquisition. If an acquisition impacted a structure, or rendered a parcel unusable in the opinion of the consultant (i.e. a large part of a parking lot was acquired), the entire structure or parcel was assumed to be an acquisition.

A unit price of $5 per square foot of acquisition area was applied to estimate the cost of property impacts. The total estimated cost of property impacts for a concept is the total impacted area times $5 per square foot plus the assessed value of structures impacted (from the Minnehaha County Assessor’s website) times 1.5 (to estimate the fair market value of impacts).

The estimated property impact areas (in acres) and costs are included in the tabulation of estimated construction costs later in this memorandum.

Traffic Operations Assessment

The traffic operations assessment for each preliminary concept was developed using output from Highway Capacity Software 2010 (HCS 2010) similarly to Sub-Study 5, which differs from the DTA model-based Measures of Effectiveness (MOEs) for Sub-Studies 1-4. The HCS 2010 output provides MOEs that address three key performance indicators used in Sub-Studies 1-4: Queues, Delay, and Travel Times. The MOEs used to address these key performance indicators are listed below, and are generally consistent with the MOEs previously derived from the DTA model. Any noteworthy differences between Sub-Studies 1-4 and Sub-Study 6 are included as sub-bullets in the following list.

- Total queues in the interchange area
    - The definition of interchange area for Sub-Study 6 is only inclusive of the Cliff Avenue ramp terminals, which is smaller than the previous DTA interchange areas.
- Delay in the interchange area
    - The definition of interchange area for Sub-Study 6 is only inclusive of the Cliff Avenue ramp terminals, which is smaller than the previous DTA interchange areas.
- Delay in the subarea
    - The definition of subarea for Sub-Study 6 is only inclusive of Cliff Avenue between 49th Street to 33rd Street, which is much smaller than the previous DTA subareas.
- Travel times for select Origin-Destination pairs
    - The only travel times studied for Sub-Study 6 were for through trips on Cliff Avenue from 49th Street to 33rd Street.
- Queue-to-ramp-length ratio
    - This measure was introduced as an improvement to Sub-Studies 1-4, which used Travel Time on I-229 to discover excessive ramp queuing.

For each concept, the MOEs were pulled for both AM and PM peaks and then averaged. The averaged MOEs from each concept were compared to the No-Build MOEs and a percent change calculated between each concept and No-Build. A subjective classification was then applied to each concept based on the areas of Queues, Delay, and Travel Time. The subjective classifications are Very Good, Good, Neutral, and Poor. Sub-Study 6 comparative traffic operations evaluations are shown on the following pages.

Queues

Interchange Area Total Queue Length		Queues	Subjective
Concept ID	Description	AM & PM	Classification
Cliff-1	NB Cliff to SB I-229 Loop Ramp Auxiliary Lane Add	24%	Poor
Cliff-2	NB/SB Cliff to SB I-229 Loop Ramp, Eliminate SB Diagonal Ramp	40%	Poor
Cliff-4	Diamond Interchange - 41st Street Realigned to High School	-18%	Good
Cliff-6	SPUI Interchange - 41st Street Realigned to Pam Road	-32%	Good
Cliff-7	SPUI Interchange - SB I-229 Off Ramp Thru & Right Turn Lanes at 41st Street Intersection	14%	Neutral
Cliff-8	Tight Diamond Interchange - 41st Street Realigned to High School	-35%	Good

Queue-to-ramp-length ratio		Queue Ratio	Subjective
Concept ID	Description	AM & PM	Classification
Cliff-1	NB Cliff to SB I-229 Loop Ramp Auxiliary Lane Add	-48%	Very Good
Cliff-2	NB/SB Cliff to SB I-229 Loop Ramp, Eliminate SB Diagonal Ramp	-48%	Very Good
Cliff-4	Diamond Interchange - 41st Street Realigned to High School	-56%	Very Good
Cliff-6	SPUI Interchange - 41st Street Realigned to Pam Road	-64%	Very Good
Cliff-7	SPUI Interchange - SB I-229 Off Ramp Thru & Right Turn Lanes at 41st Street Intersection	-64%	Very Good
Cliff-8	Tight Diamond Interchange - 41st Street Realigned to High School	-65%	Very Good

Delay

Interchange Area Delay (veh-min)		Delay, veh-min	Subjective
Concept ID	Description	AM & PM	Classification
Cliff-1	NB Cliff to SB I-229 Loop Ramp Auxiliary Lane Add	-19%	Good
Cliff-2	NB/SB Cliff to SB I-229 Loop Ramp, Eliminate SB Diagonal Ramp	-7%	Neutral
Cliff-4	Diamond Interchange - 41st Street Realigned to High School	-48%	Very Good
Cliff-6	SPUI Interchange - 41st Street Realigned to Pam Road	-48%	Very Good
Cliff-7	SPUI Interchange - SB I-229 Off Ramp Thru & Right Turn Lanes at 41st Street Intersection	-21%	Good
Cliff-8	Tight Diamond Interchange - 41st Street Realigned to High School	-58%	Very Good

Overall Subarea Delay (min)		Delay, min	Subjective
Concept ID	Description	AM & PM	Classification
Cliff-1	NB Cliff to SB I-229 Loop Ramp Auxiliary Lane Add	-24%	Good
Cliff-2	NB/SB Cliff to SB I-229 Loop Ramp, Eliminate SB Diagonal Ramp	-15%	Good
Cliff-4	Diamond Interchange - 41st Street Realigned to High School	-17%	Good
Cliff-6	SPUI Interchange - 41st Street Realigned to Pam Road	-22%	Good
Cliff-7	SPUI Interchange - SB I-229 Off Ramp Thru & Right Turn Lanes at 41st Street Intersection	-27%	Good
Cliff-8	Tight Diamond Interchange - 41st Street Realigned to High School	-22%	Good

Travel Time

Travel Time- Cliff Avenue Corridor Concept ID	 Description	Travel Time AM & PM	Subjective Classification
Cliff-1	NB Cliff to SB I-229 Loop Ramp Auxiliary Lane Add	**4%**	**Neutral**
Cliff-2	NB/SB Cliff to SB I-229 Loop Ramp, Eliminate SB Diagonal Ramp	**15%**	**Neutral**
Cliff-4	Diamond Interchange - 41st Street Realigned to High School	**11%**	**Neutral**
Cliff-6	SPUI Interchange - 41st Street Realigned to Pam Road	**7%**	**Neutral**
Cliff-7	SPUI Interchange - SB I-229 Off Ramp Thru & Right Turn Lanes at 41st Street Intersection	**4%**	**Neutral**
Cliff-8	Tight Diamond Interchange - 41st Street Realigned to High School	**8%**	**Neutral**

As evident from the preceding tables, all interchange options compare similarly to the No-Build condition when looking at the queue-to-ramp-length ratio, overall subarea delay, and travel time. Of these three, the travel time along Cliff Avenue is the only metric where the Build concepts do not show considerable improvement over the No-Build condition. The increase in corridor travel time apparent in all concepts is strongly influenced by additional stopped time for northbound and southbound through travelers to more adequately address traffic turning onto and off of I-229 and 41st Street. Though through travelers will experience more travel time, other trips that only use portions of the corridor should experience shorter travel times based on the major reductions in vehicle delay, though these perceived shorter travel times are not reflected in the performance metric.

Conversely, the interchange area total queue length and interchange area delay show more operational differences in the concepts. Looking at the interchange queue lengths, there are some concepts that show poor benefits, which means that the interchange ramp terminals will have longer queues than in the No-Build scenario. However, all of the Build concepts have interchange queue storage ratios less than one, which is not the case for the No-Build scenario. Therefore, the Build concepts represent a safety and operational benefit over the No-Build even though the metric of queue length does not show favorably for certain Build concepts.

Overall, the interchange area delay proves to be the best metric for assessing the operational benefits of the concepts. Using the interchange area delay as a guide, the following overall subjective classifications are recommended.

Overall

Overall Subjective Classification

Concept ID	Description	Subjective Classification
Cliff-1	NB Cliff to SB I-229 Loop Ramp Auxiliary Lane Add	**Good**
Cliff-2	NB/SB Cliff to SB I-229 Loop Ramp, Eliminate SB Diagonal Ramp	**Neutral**
Cliff-4	Diamond Interchange - 41st Street Realigned to High School	**Very Good**
Cliff-6	SPUI Interchange - 41st Street Realigned to Pam Road	**Very Good**
Cliff-7	SPUI Interchange - SB I-229 Off Ramp Thru & Right Turn Lanes at 41st Street Intersection	**Good**
Cliff-8	Tight Diamond Interchange - 41st Street Realigned to High School	**Very Good**

Environmental Review

To analyze potential resources within the Study Area, a desktop review of available data was analyzed against the project concepts, in addition to review of aerial imagery of the I-229 corridor. Items that could require further analysis at the time of future project initiation were identified for issues which separate project concepts. Later phases in potential project corridor planning will require environmental documentation if federal funds are used, and would require analysis of additional resources such as environmental justice, noise, etc.

Archaeological and Historical Resources

APPROACH

A record search was completed by the SD Archaeological Research Center. The area which encompasses a particular preliminary roadway concept was reviewed for potential historic and cultural resources. Historic and cultural resources are regulated under Section 106 of the National Historic Preservation Act, and may require consultation with the South Dakota Department of Transportation (SDDOT) and the South Dakota State Historic Preservation Office (SHPO).

The record search identified record sites and cultural surveys that were completed within the study area. Known sites that were listed as eligible for the National Register of Historic Places (NRHP) include three bridges and two railroad beds. Additionally, one unevaluated Native American stone circle is located within the study area. Shapefiles of these sites were imported into ArcGIS and compared against preliminary concepts to determine the potential for impacts to cultural resources. The known sites are not located within the area potentially affected by Sub-Study 6.

LIMITATIONS

Early in project planning, the City of Sioux Falls (City) should work with SDDOT to coordinate its intent to proceed with a particular roadway improvement project, and request that the SDDOT advise the City on the applicability of Section 106, the need to identify consulting parties, and for a Class I cultural resource literature search. When appropriate, the City should anticipate that a Class III identification effort will be conducted, including identification of archaeological, architectural, and traditional cultural properties subject to the effects of the project. When historic properties are identified, the City should anticipate that avoidance or mitigation of adverse effects to such properties may be required.

Wetlands and Waters of the U.S.

APPROACH

The National Wetlands Inventory (NWI) and aerial imagery were reviewed within the study area to determine potential project impacts. The Big Sioux River and its tributaries are located within the study area and cross the I-229 corridor three times. There are also several wetlands located adjacent to the I-229 corridor. Because the NWI provides an estimate of wetlands based on soil type and aerial photography, these boundaries are utilized as guidance for identifying wetland areas and delineation would be required for each project.

LIMITATIONS

Wetlands and other waters of the US will need to be considered for each project as the State and City want to move the project from planning stages to construction. Early in project planning, an onsite wetland delineation of the study area is recommended to confirm the boundaries of wetlands and other waters of the U.S. within the study area and to coordinate with USACE to determine jurisdiction.

Threatened and Endangered Species

APPROACH

Fish and wildlife species listed under the Federal Endangered Species Act (ESA) would need to be considered for each project. The list of species identified for Minnehaha was identified from US Fish and Wildlife Service (USFWS) information. Four threatened, endangered, or proposed species exist in Minnehaha County. These include the rufa red knot (threatened); Topeka shiner (endangered); western prairie fringed orchid (threatened); and northern long-eared bat (proposed endangered).

To identify the potential for threatened and endangered species to be present in an area, aerial imagery was used to identify potential habitat located within the project corridor. The study area is highly developed with commercial, industrial, and residential activities. Undeveloped areas are generally limited to areas associated with the Big Sioux River. Additionally, there is some cropland in the northern portion of the corridor. Habitat for the western prairie fringed orchid is not believed to occur within most of the study area due to lack of native habitat. Habitat for the Topeka shiner is found within the Big Sioux River and its tributaries, and the I-229 corridor crosses the river in multiple places. Typically within the City, the USFWS has noted for previous projects that the Topeka shiner is not anticipated to occur within these stretches of the Big Sioux River. Habitat for the rufa red knot is limited to sandy or gravel shorelines associated with the Big Sioux River. Potential habitat associated with the northern long-eared bat in the Study Area includes riparian areas and bridges along the Big Sioux River.

LIMITATIONS

Consultation with USFWS would be required to determine which ESA-listed species have the potential to occur within each Study Area. Coordination with SD Game, Fish, and Parks would be recommended regarding impacts to state-listed sensitive species.

Section 4(f) and Section 6(f) Properties

APPROACH

The Department of Transportation Act (DOT Act) of 1966 included a special provision – Section 4(f) – which is intended to protect publicly owned parks, recreational areas, wildlife and waterfowl refuges, or public and private historical sites. Similarly, Section 6(f) protects state and locally sponsored projects that were funded as part of the Land and Water Conservation Fund (LWCF).

The LWCF website was reviewed to identify the use of Section 6(f) grants in the Study Area. Publicly owned parks and recreation areas are present within the Study Area. Public spaces within the City of Sioux Falls that have received LWCF grant money are subject to Section 6(f) regulations. The Big Sioux Trail, a recreational trail, also received LWCF grant money for portions of the trail. Additionally, if the projects proposed in these alternatives receive Federal Highway Administration (FHWA) funds, the projects will be subject to Section 4(f) consultation.

LIMITATIONS

There have been several grants received at a variety of the City parks. Areas within the Project corridor that could impact City parks or recreational trails would need to be further reviewed to determine potential for a Section 6(f) impact. Due to the use of LWCF grants, it is recommended that consultation occur early with each project to determine the location of improvements to determine whether the park area impacted will be subject to Section 6(f) regulations.

Floodplain

APPROACH

The City has been a participating member of the Federal Emergency Management Agency (FEMA) Flood Insurance Program since 1979. The current Minnehaha County Flood Insurance Study (FIS) that includes the City and incorporated areas is dated September 2, 2009. The project area contains FEMA-designated zones for the Big Sioux River.

LIMITATIONS

If any projects would involve areas associated with the Big Sioux River, a floodplain permit may be required if the floodplain would be encroached upon. A Floodplain Development Application would be completed for the project and the City would obtain a Floodplain Development Permit.

Regulated Materials

APPROACH

The SD Department of National Resources (SDDENR) Environmental Events Database website was reviewed for the Project Area to identify any areas that could be of concern for project concepts.

LIMITATIONS

Information for hazardous material should be reviewed at the time of a proposed project to identify any potential new hazards that may have occurred from the time of the study to a project.

The environmental review findings for the I-229 corridor and interchange concepts are summarized in ***TABLE 2***.

Environmental constraints for the I-229 corridor are shown in ***APPENDIX D3- ENVIRONMENTAL CONSTRAINTS MAPS***.

Note, a noise assessment will be included at a later stage of the study.

Table 2. Preliminary Concepts Environmental Review

Concept ID	Description	Environmental Comparative Data					Environmental Summary	
		Wetlands	T&E	4(f) and 6(f) Properties	Cultural	Other	Anticipated Impact Level	Comments
Cliff-1	NB Cliff to SB I-229 Loop Ramp Auxiliary Lane Added	Impacts to ditch wetlands	Bridge work could require analysis to determine if bridge is considered potential northern long-eared bat habitat. However, in accordance with the final rule on northern long-eared bats, take is not prohibited.	No known Section 4(f)/6(f) properties are present.	Any buildings to be removed should be reviewed for potential eligibility. It is not anticipated any of the buildings would be eligible.	Some property acquisition; approximately 5 buildings.	Low	Potential wetland impacts. Potential northern long-eared bat impacts if trees are impacted, but take of the bats is not prohibited under the final rule. Property acquisition impacts.
Cliff-2	NB/SB Cliff to SB I-229 Ramp, Eliminate SB Diagonal Ramp	Impacts to ditch wetlands	Bridge work could require analysis to determine if bridge is considered potential northern long-eared bat habitat. However, in accordance with the final rule on northern long-eared bats, take is not prohibited.	No known Section 4(f)/6(f) properties are present.	Any buildings to be removed should be reviewed for potential eligibility. It is not anticipated any of the buildings would be eligible.	Some property acquisition; approximately 5 buildings.	Low	Potential wetland impacts. Potential northern long-eared bat impacts if trees are impacted, but take of the bats is not prohibited under the final rule. Property acquisition impacts.
Cliff-4	Diamond Interchange - 41st Street Realigned to High School	Potential ditch wetlands. Less potential impacts than Cliff-1 and Cliff-2	No impacts to threatened or endangered species are anticipated.	No known Section 4(f)/6(f) properties are present.	Any buildings to be removed should be reviewed for potential eligibility. It is not anticipated any of the buildings would be eligible.	Increased property acquisition when compared to Cliff 1 and 2. Approximately 7 buildings impacted. Would close the Pam Road/Cliff Avenue intersection and add a new neighborhood access to E 41st Street via 9th Avenue.	Low	May have wetland impacts, but would be minimal. Increased property acquisition required, along with new neighborhood access to E 41st Street.
Cliff-6	SPUI Interchange - 41st Street Realigned to Pam Road	Impacts to ditch wetlands. Potential for impacts is similar to Cliff-4.	Bridge work could require analysis to determine if bridge is considered potential northern long-eared bat habitat. However, in accordance with the final rule on northern long-eared bats, take is not prohibited.	No known Section 4(f)/6(f) properties are present.	Any buildings to be removed should be reviewed for potential eligibility. It is not anticipated any of the buildings would be eligible.	More property impacts than Cliff-4. Approximately 11 buildings impacted. Would close the Pam Road/Cliff Avenue intersection and add a new neighborhood access to E 41st Street via 9th Avenue.	Low	May have wetland impacts, but would be minimal. Would reuqire the most property acquisition of these concept alternatives, along with new neighborhood access to E 41st Street.
Cliff-7	SPUI Interchange - WBT/WBR on Existing Ramp	Impacts to ditch wetlands. Potential for impacts is similar to Cliff-4.	Bridge work could require analysis to determine if bridge is considered potential northern long-eared bat habitat. However, in accordance with the final rule on northern long-eared bats, take is not prohibited.	No known Section 4(f)/6(f) properties are present.	Any buildings to be removed should be reviewed for potential eligibility. It is not anticipated any of the buildings would be eligible.	Minimal property acquisition. Approximately 2 buildings impacted.	Low	May have wetland impacts, but would be minimal. Potential northern long-eared bat impacts if trees are impacted, but take of the bats is not prohibited under the final rule. Property acquisition impacts.
Cliff-8	Tight Diamond Interchange - 41st Street Realigned to Pam Road	Impacts to ditch wetlands. Potential for impacts is similar to Cliff-4.	Bridge work could require analysis to determine if bridge is considered potential northern long-eared bat habitat. However, in accordance with the final rule on northern long-eared bats, take is not prohibited.	No known Section 4(f)/6(f) properties are present.	Any buildings to be removed should be reviewed for potential eligibility. It is not anticipated any of the buildings would be eligible.	Some property acquisition; approximately 5 buildings. Would close the Pam Road/Cliff Avenue intersection and add a new neighborhood access to E 41st Street via 9th Avenue.	Low	May have wetland impacts, but would be minimal. Potential northern long-eared bat impacts if trees are impacted, but take of the bats is not prohibited under the final rule. Property acquisition impacts.

Construction Costs

In preparing estimates of construction costs for the preliminary concepts, quantities were developed for the following items and the unit costs shown in parenthesis were applied to the quantities:

- Bridge deck area ($180 or $270/SF tangent or curved bridge)
- Municipal Retaining wall length ($100/LF)
- Interstate Retaining wall length ($600/LF)
- Interstate / ramp / street pavement area ($20/SF)

Pavement area costs are assumed to include curb, shoulder, median, sidewalk, and drainage items. For cost estimating purposes, all retaining walls were assumed to have a constant height of 12 feet over their entire estimated length.

The pavement unit costs applied were developed from unit prices computed from the following awarded local projects:

• 57th/Western (2013)	$5.3 million total, $21.81/SF
• Russell Street (2013)	$15 million total, $18.94/SF
• I-90/Cliff Ave Interchange (2013)	$15.8 million total, $25.61/SF (includes bridge costs)
• Cliff Ave, 61st to 85th (2015)	$8.9 million total, $16.91/SF

Estimated construction costs and property impacts costs for the preliminary concepts are shown in ***Table 3***.

Relocation costs are not included in the ROW cost estimates.

Preliminary Concepts Composite Comparative Assessment

The four types of data compiled for the Preliminary Concepts is shown in ***Table 4***, along with the qualitative classification for each measure.

Table 3. Preliminary Concepts Estimated Costs

Concept ID	Description	Bridge		Retaining Wall (Municipal)		Retaining Wall (Interstate)		Interstate & Ramps		Municipal Street		Contingency		Property Impacts		Total Cost
		Area (ft^2)	Cost	Length (ft)	Cost	Length (ft)	Cost	Area (ft^2)	Cost	Area (ft^2)	Cost	%	Cost	Area (acre)	Cost	
Cliff-1	NB Cliff to SB I-229 Loop Ramp Auxiliary Lane Add	16,719	$3,100,000	321	$33,000	458	$300,000	166,536	$3,400,000	106,183	$2,200,000	20%	$1,186,600	1.1	$1,000,000	$11,219,600
Cliff-2	NB/SB Cliff to SB I-229 Loop Ramp, Eliminate SB Diagonal Ramp	9,892	$1,800,000	0	$0	0	$0	93,103	$1,900,000	99,652	$2,000,000	20%	$780,000	1.1	$1,010,000	$7,490,000
Cliff-4	Diamond Interchange - 41st Street Realigned to High School	0	$0	0	$0	726	$500,000	94,621	$1,900,000	126,150	$2,600,000	20%	$1,000,000	1.8	$1,850,000	$7,850,000
Cliff-6	SPUI Interchange - 41st Street Realigned to Pam Road	27,523	$5,000,000	0	$0	1208	$800,000	438,580	$8,800,000	186,417	$3,800,000	20%	$2,680,000	3.5	$3,730,000	$24,810,000
Cliff-7	SPUI Interchange - SB I-229 Off Ramp Thru & Right Turn Lanes at 41st Street Intersection	27,523	$5,000,000	0	$0	1141	$700,000	445,536	$9,000,000	115,446	$2,400,000	20%	$2,420,000	0.4	$330,000	$19,850,000
Cliff-8	Tight Diamond Interchange - 41st Street Realigned to High School	12,621	$2,300,000	0	$0	726	$500,000	131,669	$2,700,000	194,393	$3,900,000	20%	$1,420,000	1.9	$1,870,000	$12,690,000

Table 4. Preliminary Concepts Composite Comparative Assessment

Preliminary Concept		Traffic Assessment			Environmental Impacts	Cost	ROW (acre)
		Queues	Delay	Travel Time			
Cliff-1	NB Cliff to SB I-229 Loop Ramp Auxiliary Lane Add	Neutral	Good	Neutral	Low	$11,219,600	1.1
Cliff-2	NB/SB Cliff to SB I-229 Loop Ramp, Eliminate SB Diagonal Ramp	Neutral	Neutral	Neutral	Low	$7,490,000	1.1
Cliff-4	Diamond Interchange - 41st Street Realigned to High School	Good	Very Good	Neutral	Low	$7,850,000	1.8
Cliff-6	SPUI Interchange - 41st Street Realigned to Pam Road	Good	Very Good	Neutral	Low	$24,810,000	3.5
Cliff-7	SPUI Interchange - SB I-229 Off Ramp Thru & Right Turn Lanes at 41st Street Intersection	Neutral	Good	Neutral	Low	$19,850,000	0.4
Cliff-8	Tight Diamond Interchange - 41st Street Realigned to High School	Good	Very Good	Neutral	Low	$12,690,000	1.9

APPENDIX D3 -

ENVIRONMENTAL CONSTRAINTS MAPS

HDR

I-229 MIS CORRIDOR STUDY
I-229 CORRIDOR STUDY
MAP OVERVIEW

DATE 7/8/2015
FIGURE A.1

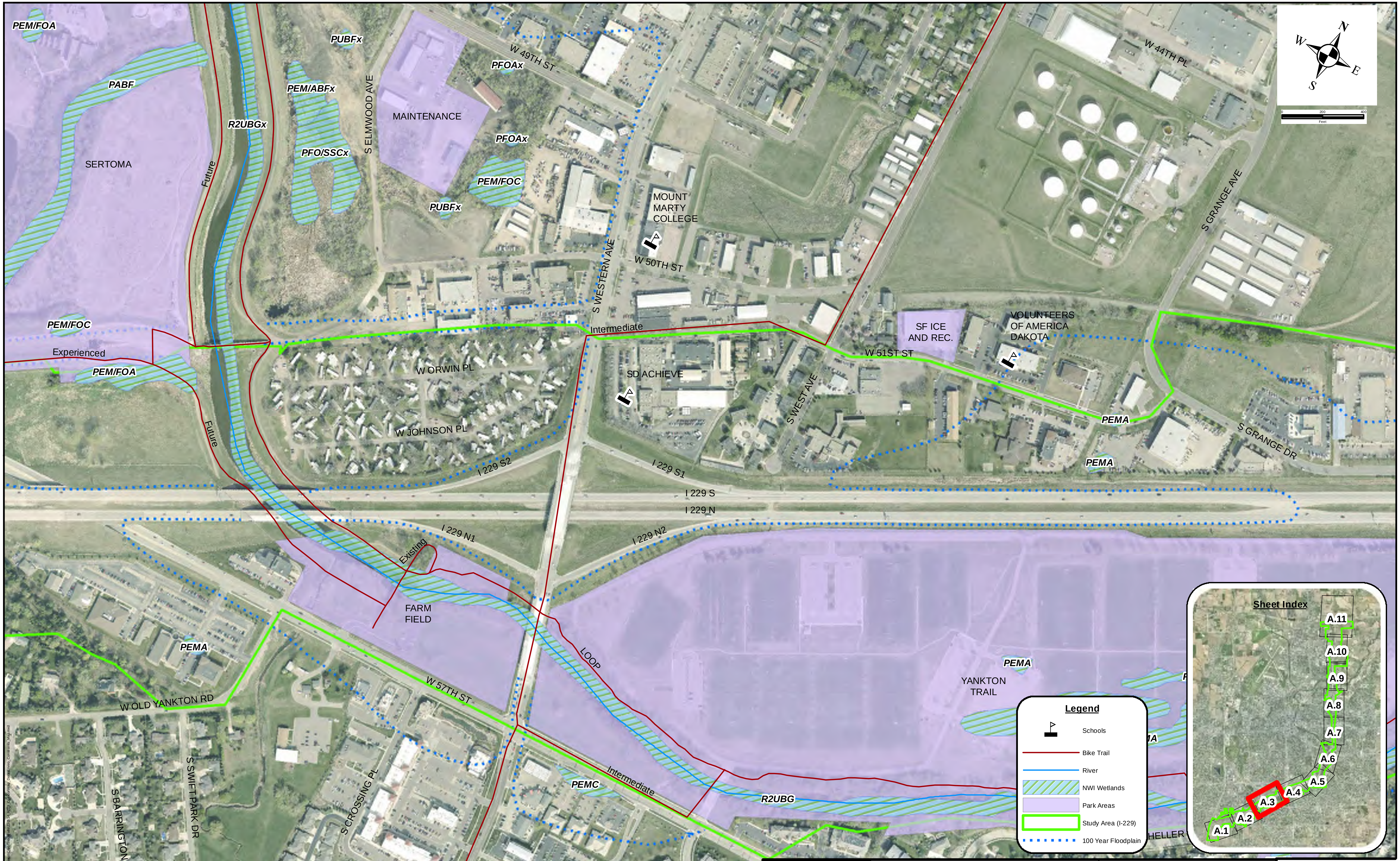
HDR

I-229 MIS CORRIDOR STUDY

I-229 CORRIDOR STUDY
MAP OVERVIEW

DATE 7/8/2015

FIGURE A.2

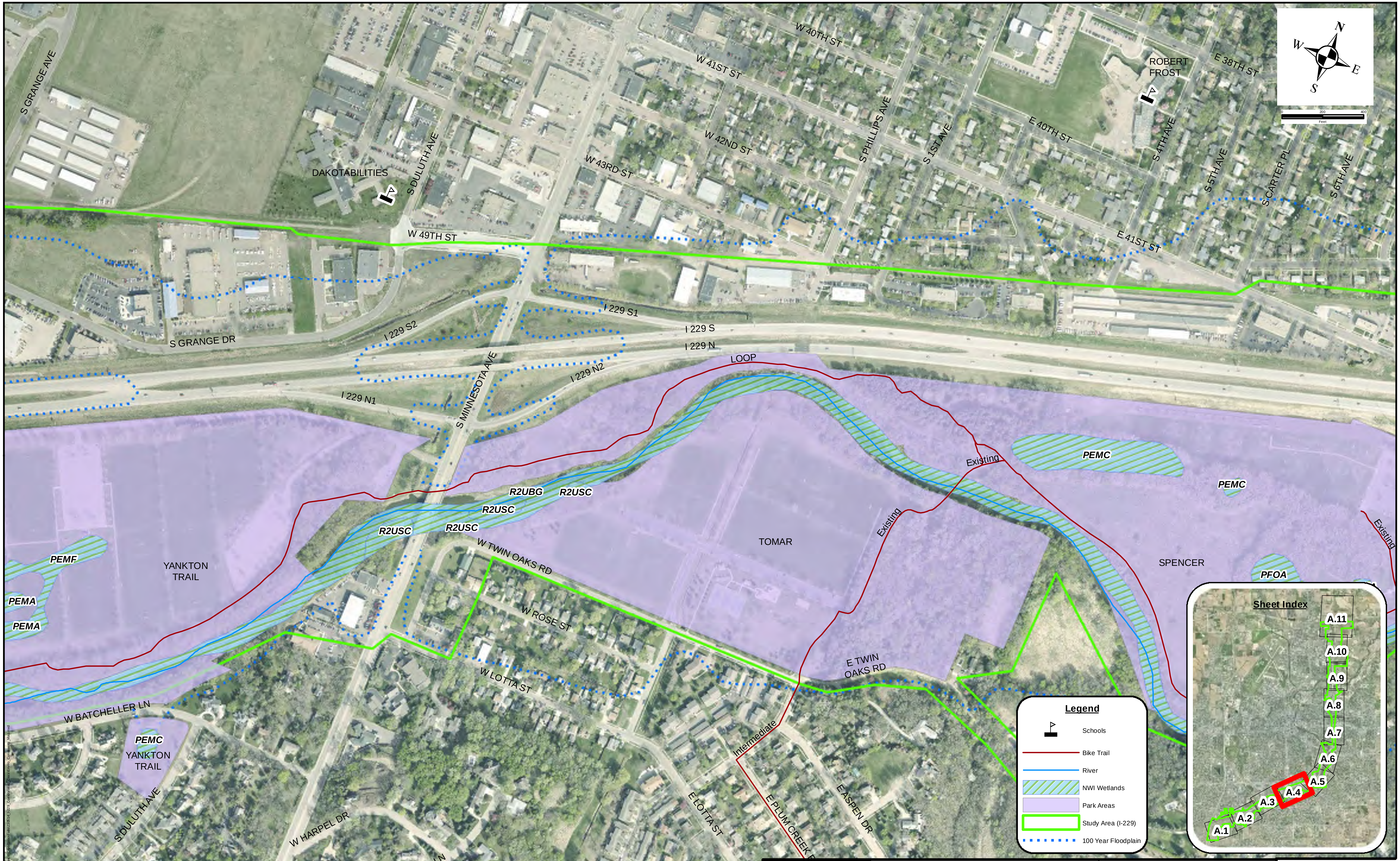


I-229 MIS CORRIDOR STUDY

I-229 CORRIDOR STUDY
MAP OVERVIEW

DATE 7/8/2015

FIGURE A.3



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Plot Date: 7/8/2015 kvandeka

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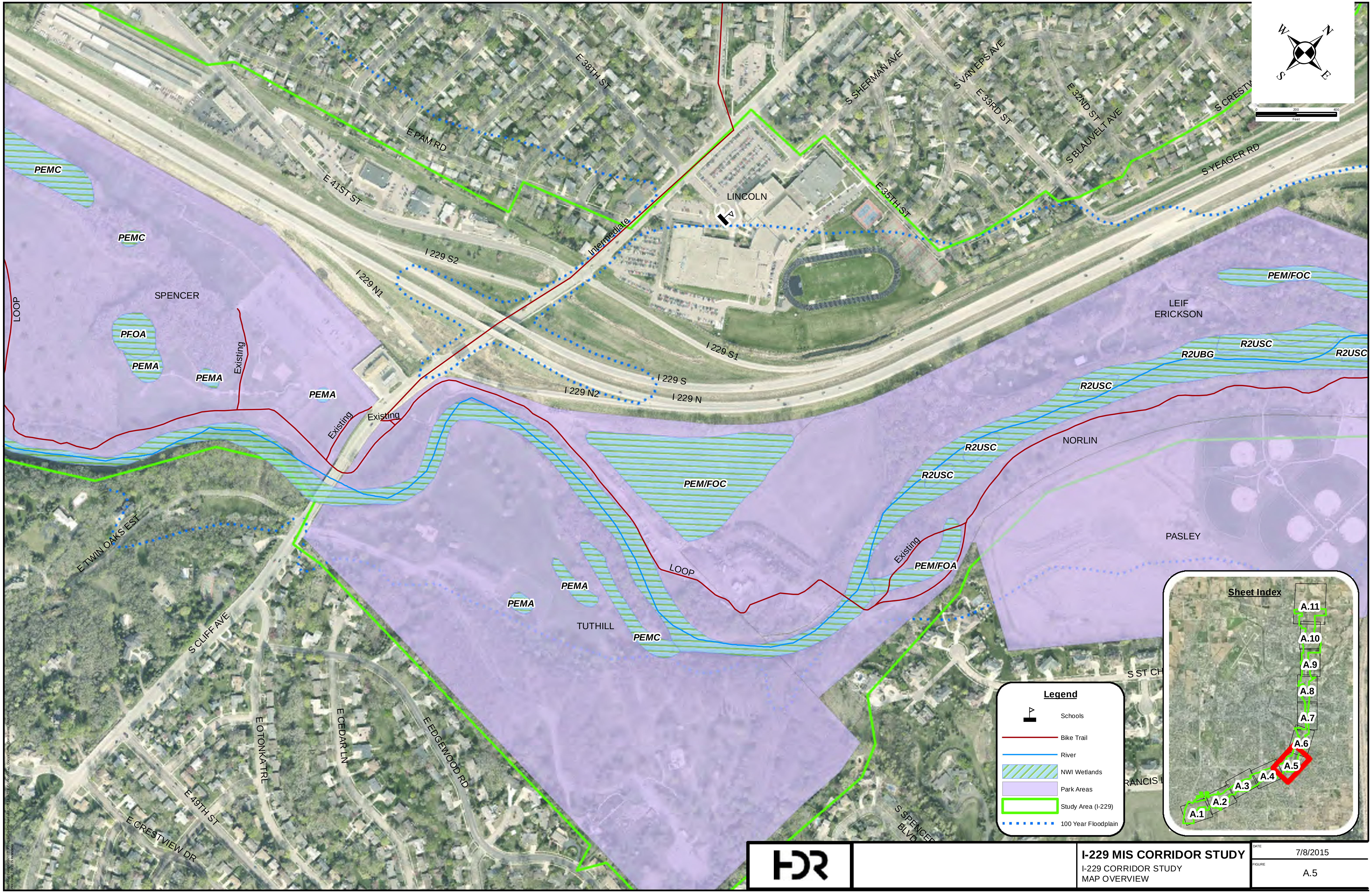
I-229 MIS CORRIDOR STUDY

I-229 CORRIDOR STUDY
MAP OVERVIEW

DATE 7/8/2015

FIGURE A.4



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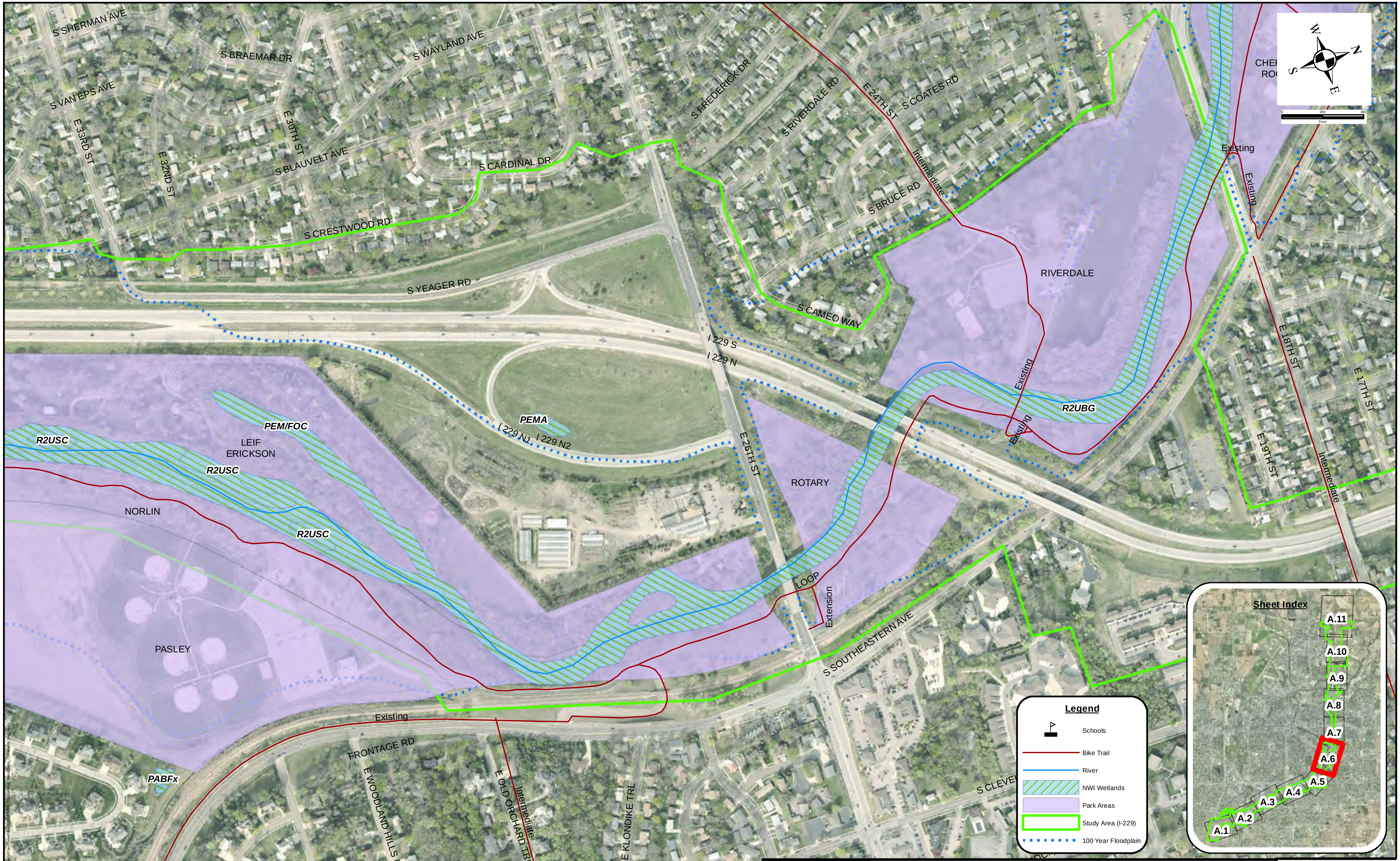
I-229 MIS CORRIDOR STUDY

I-229 CORRIDOR STUDY
MAP OVERVIEW

DATE
7/8/2015

FIGURE
A.5



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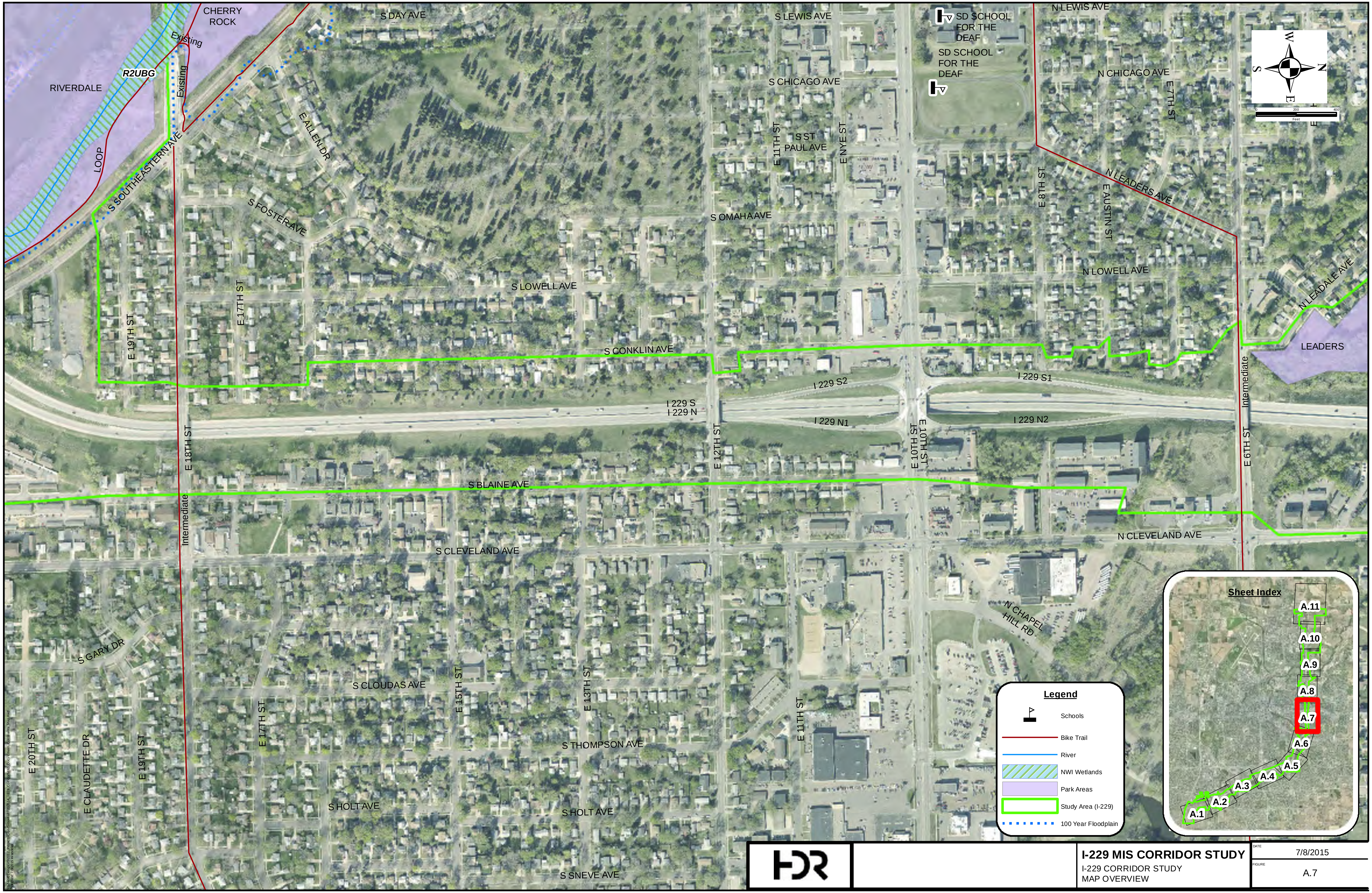
I-229 MIS CORRIDOR STUDY

I-229 CORRIDOR STUDY
MAP OVERVIEW

DATE 7/8/2015

FIGURE A.6



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Plot Date: 7/8/2015 kvandeka

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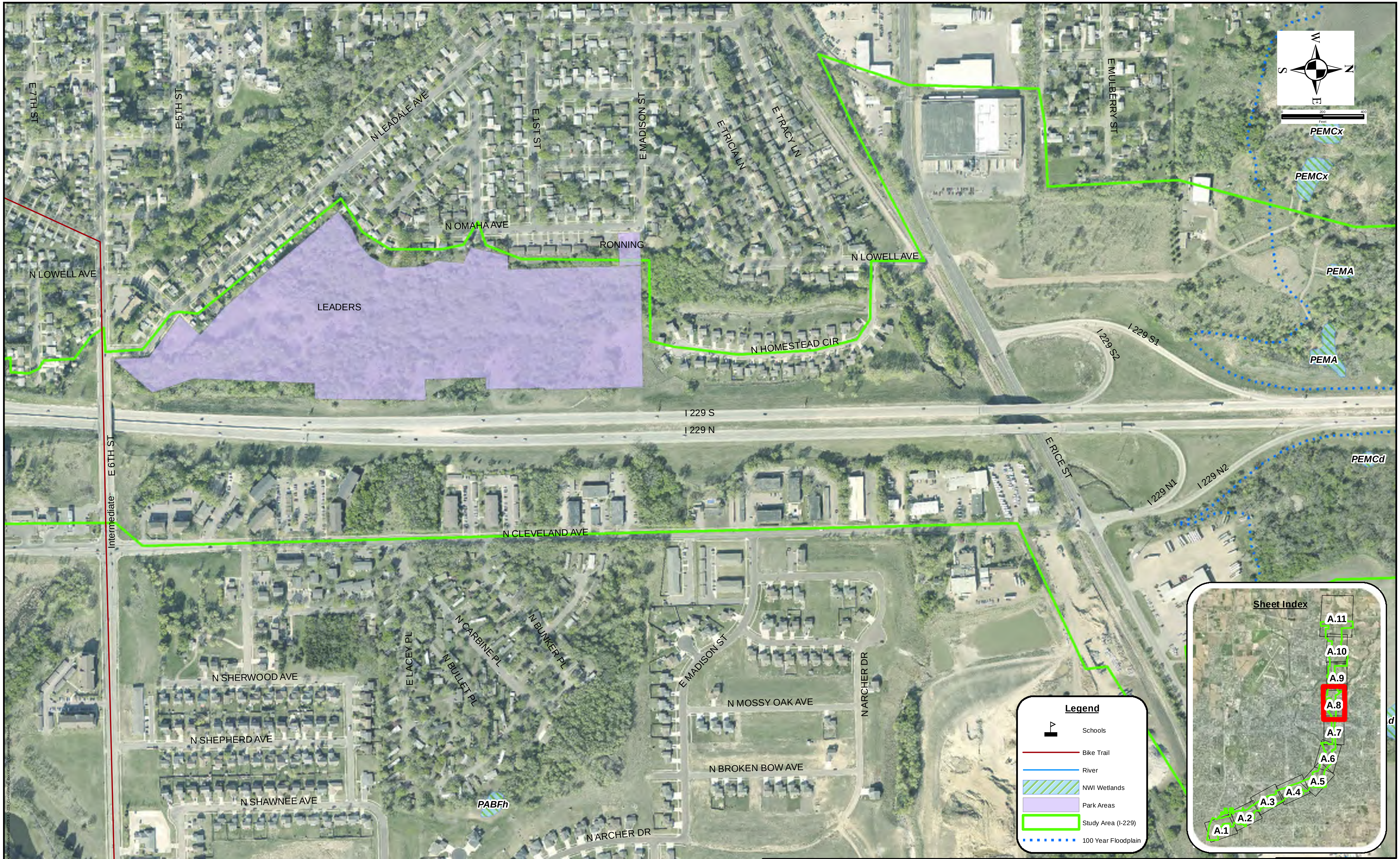
I-229 MIS CORRIDOR STUDY

I-229 CORRIDOR STUDY
MAP OVERVIEW

DATE 7/8/2015

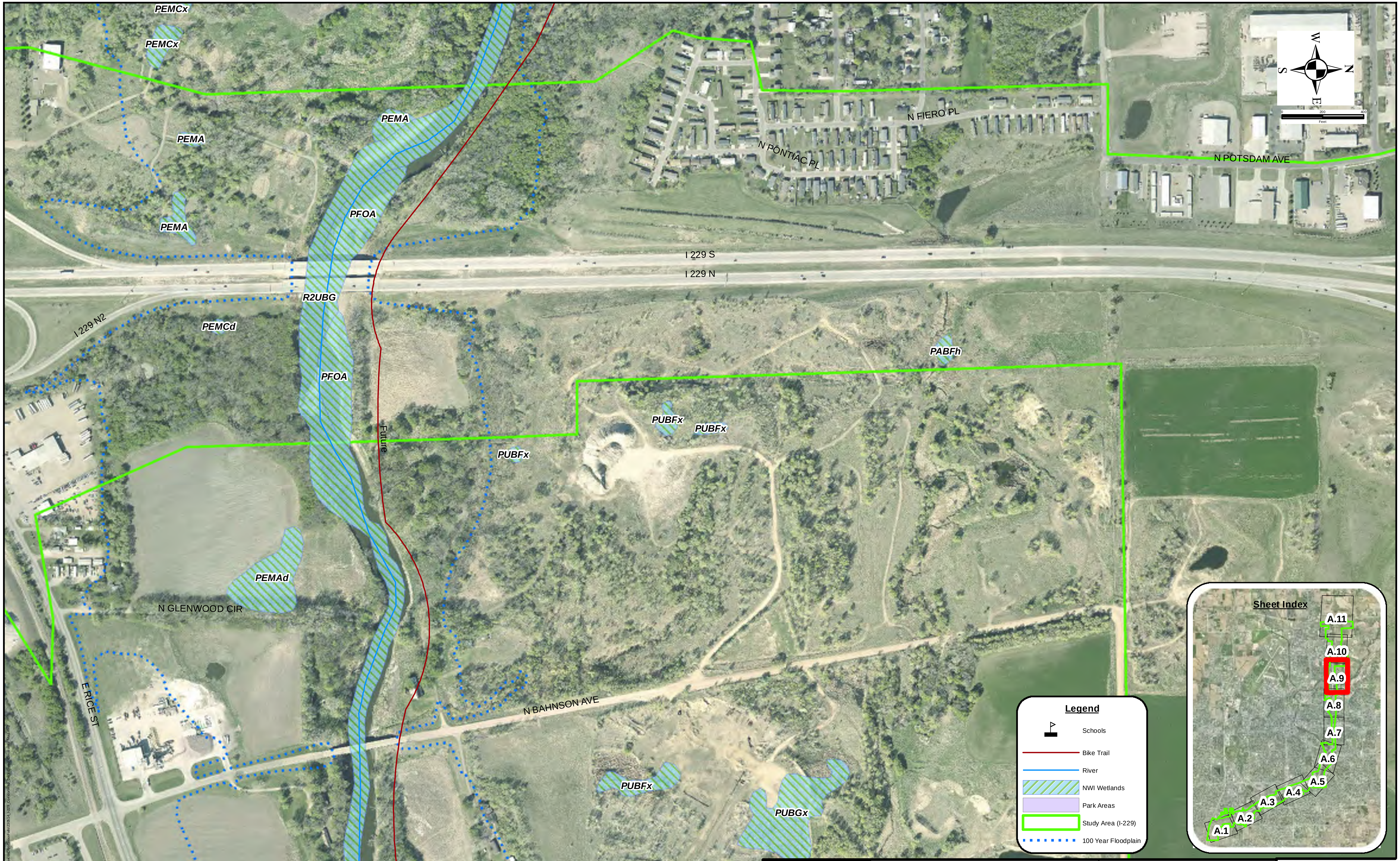
FIGURE A.7



I-229 MIS CORRIDOR STUDY

I-229 CORRIDOR STUDY
MAP OVERVIEW

DATE	7/8/2015
FIGURE	A.8



I-229 MIS CORRIDOR STUDY

I-229 CORRIDOR STUDY
MAP OVERVIEW

DATE 7/8/2015

FIGURE A.9

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I-229 MIS CORRIDOR STUDY

I-229 CORRIDOR STUDY
MAP OVERVIEW

DATE
7/8/2015

FIGURE
A.10

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I-229 MIS CORRIDOR STUDY

I-229 CORRIDOR STUDY
MAP OVERVIEW

DATE
7/8/2015

FIGURE
A.11

Appendix E. Predictive Safety Analysis

This memorandum presents a summary of the methodology and findings for the predicted safety performance analysis for the Existing, No-Build and Build conditions for the I-229 MIS.

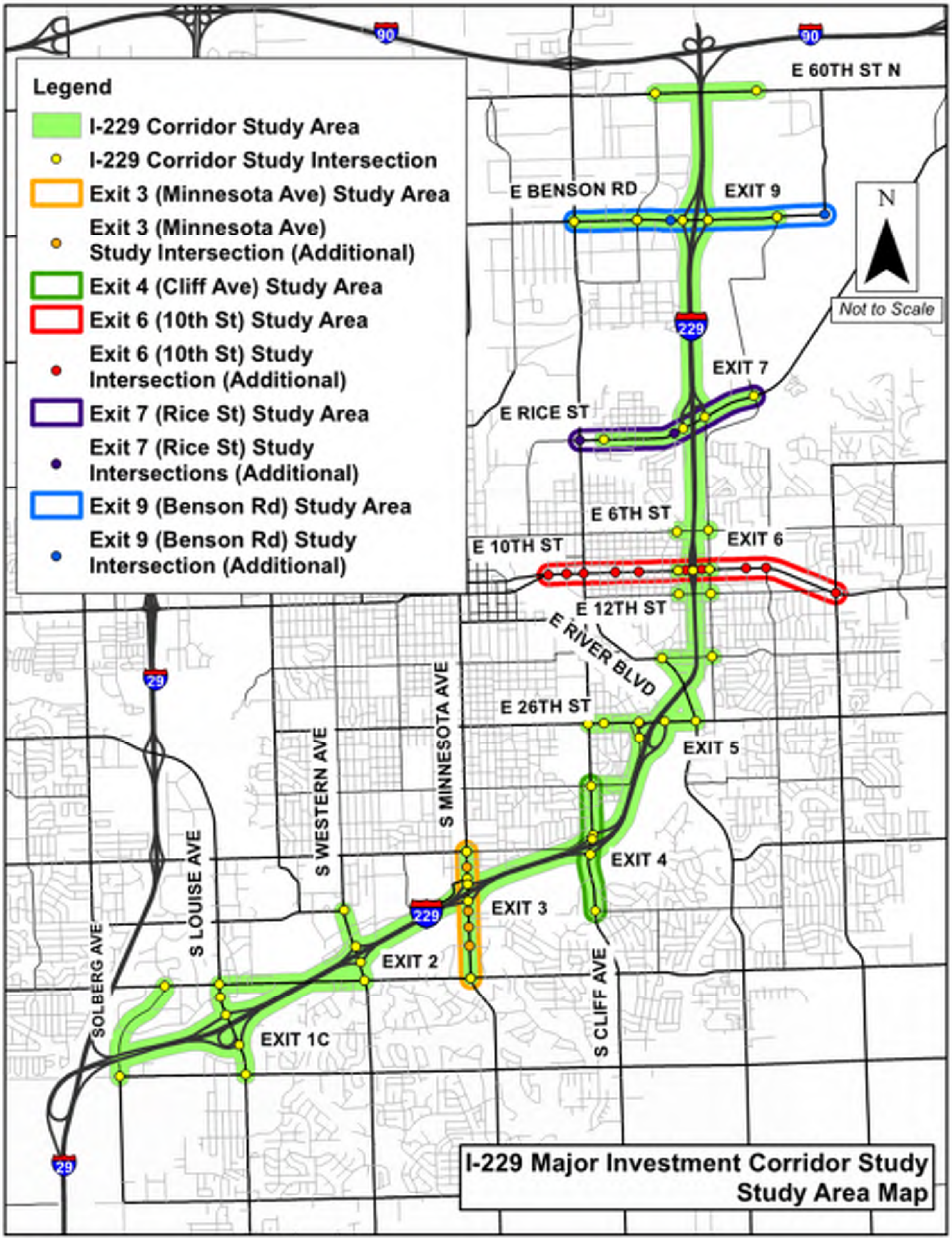
The I-229 MIS has been separated into individual sub-studies. The sub-studies include:

- I-229 Corridor Study
- Minnesota Avenue Corridor Study (Exit 3)
- 10th Street Corridor Study (Exit 6)
- Benson Road Corridor Study (Exit 9)
- Rice Street Corridor Study (Exit 7)
- Cliff Avenue Corridor Study (Exit 4)

A map illustrating the overall study areas for each of the sub-studies is shown in ***Figure 1***. The study limits for the predictive safety analysis differ slightly. In general, the predictive safety analysis limits for the I-229 Corridor Study are focused on the freeway area impacted by the corridor concepts (26th Street to 10th Street) and the remaining sub-studies focus on their respective ramps and ramp terminals. The analysis limits for each sub-study will be detailed later in this memorandum.

The predictive safety analysis presented in this memorandum is based on the principles and methods of the Highway Safety Manual (HSM) as discussed in detail below. It presents a comparative analysis of the predicted crashes anticipated between the Existing (Year 2012) condition and the Future No-Build (Year 2035) condition, as well as a comparative analysis between No-Build and Build alternatives for each sub-study. The Build alternatives to be analyzed for this study will be described later in this memorandum. The results are intended to help guide the selection of the alternatives moving forward to the alternatives analysis stage of planning.

Figure 1. I-229 MIS Study Area Map



Methodology

Predictive safety analysis was completed using the American Association of State Highway and Transportation Officials (AASHTO) HSM methods, including the National Cooperative Highway Research Program (NCHRP) Report 17-45 methods for evaluating freeways and interchanges (now part of the HSM as a supplemental volume published in 2014). FHWA supports, and in many cases now requires, the use of HSM methods for the evaluation of proposed freeway facility improvements, including new or modified Interstate access. According to the HSM preface:

“The focus of the HSM is to provide quantitative information for decision making. The HSM assembles currently available information and methodologies on measuring, estimating, and evaluating roadways in terms of crash frequency (number of crashes per year) and crash severity (level of injures due to crashes). The HSM presents tools and methodologies for consideration of ‘safety’ across the range of highway activities …”

The HSM goes on to describe a primary benefit of the predictive method, “The predictive method provides a quantitative measure of expected crash frequency under both existing conditions and conditions which have not yet occurred. This allows proposed roadway conditions to be quantitatively assessed …” (HSM, 2010)

HSM-based crash predictions are developed using safety performance functions (SPFs) for specific facility types. The SPFs predict crash frequency for a variety of freeway types with direct consideration of factors of crash risk exposure (e.g. daily traffic volumes and segment lengths). However, crash prediction by SPF alone is limited to facilities with geometric and traffic control features that match a theoretical base condition for that facility type. To overcome this limitation to SPF applicability, crash modification factors (CMFs) are used to make adjustments to the initial SPF results to account for differences between the actual geometric and traffic control conditions and the theoretical base condition. CMFs are multiplicative factors. Thus, if a CMF greater than 1 is combined with an SPF the resulting number of predicted crashes will increase over the original SPF-based crash prediction. Conversely, a CMF less than 1 it will decrease the number of predicted crashes. For example, if an outside shoulder width is less than the assumed 10-foot base condition, then a CMF of greater than 1 is applied to adjust the SPF results for the segment.

The HSM methodology has been in development for many years and is rapidly advancing; however, there are still many limitations where the available tools do not yet offer SPFs and/or CMFs for certain conditions. Where this is the case, recent research and crash data were also considered to overcome analysis limitations. Crash prediction methods beyond the scope of the HSM that were deemed necessary for the I-229 MIS study were agreed upon in the project Methods and Assumptions document and are described later in this section.

Facilities, Segmentation and Data Inputs

The HSM allows for crash prediction to be conducted at the project level or site-specific level. A site-specific analysis parses the project study area into individual homogenous elements, such as, freeway segments, ramp segments, and ramp terminal intersections. The I-229 MIS crash prediction area was segmented into 38 mainline freeway segments, 24 ramp segments, 11 ramp terminal intersections, and 4 arterial intersections. The segmentation will be provided as a digital appendix.

Crash prediction requires geometric and operational inputs to accurately compute the SPFs and apply the correct CMFs. These inputs include information such as segment length, daily traffic volume, ramp locations, merge distances, and horizontal curvature. The geometric inputs were primarily obtained from the conceptual design files and aerial photography. The traffic volume data was based on traffic counts provided by SDDOT and design year volume forecasts from the 2035 Sioux Falls Travel Demand Model.

I-229 Mainline Segments, Entrance and Exit Ramps, and Ramp Terminals

The I-229 mainline segments, entrance and exit ramps, and ramp terminals were evaluated using HSM methods implemented using the Enhanced Interchange Safety Analysis Tools (ISATe) version j software provided by FHWA. The ISATe analysis files are provided as a digital appendix for all freeway, ramp, and ramp terminal intersection sites that were reviewed.

The ISATe does have limitations however. Specifically, the ISATe ramp terminal method does not address Single-Point Urban Interchanges (SPUIs) or Diverging Diamond Interchanges (DDIs). It only predicts crashes for a variety of more typical diamond and partial cloverleaf interchange ramp terminals. Therefore, it was necessary to develop an estimate for an “operationally-similar” diamond interchange design and then use CMFs from HDR’s “Crash Prediction Analysis Procedures for Diverging Diamond Interchange (DDI), Single-Point Urban Interchange (SPUI), and Two-Lane Loop Ramp” memo dated November 4th, 2015 to modify the results to estimate the predictions for a SPUI and DDI design. Based on available SDDOT data, the preliminary CMF for conversion of a traditional diamond interchange to a SPUI is 0.63 for ramp terminal intersection crashes. Based on research done in Missouri on safety evaluations of DDIs, the preliminary CMF for conversion of a traditional diamond interchange to a DDI is 0.37 for Fatal + Injury (F+I) crashes at ramp terminal intersections and 0.49 for Property Damage Only (PDO) crashes at ramp terminal intersections.

Cross Street Segments

Crashes within an interchange’s functional area can be almost entirely predicted by evaluating the crashes from the freeway, freeway ramps, and ramp terminal intersections. However, some crashes near the interchange may be due to roadway segment characteristics of the arterial cross street. If these segment-related crashes are to be included, then HSM methods for urban and suburban arterials need to be applied. In this study, the primary area for crash prediction evaluation was focused on the interchange, and no arterial segment crashes were evaluated between scenarios.

Arterial Intersections

Some arterial intersections were included when the sub-study concepts involved realigning ramps to arterial intersections. Therefore, to make a fair comparison, the predictive safety analysis included the impacted arterial intersection for all sub-study concepts, including

No-Build. Methods from Chapter 12 of the HSM were used for analyzing arterial intersections. The analysis files for the 4 arterial intersections analyzed are provided as a digital appendix.

Calibration Factors

According to the HSM, “the predictive models were developed from the most complete and consistent data sets available.” However, the report also recommends that the equations be calibrated for each jurisdiction because “the general level of crash frequencies may vary substantially from one jurisdiction to another.” However, SDDOT has not yet conducted the extensive analyses required to develop a complete set of HSM related calibration factors. Therefore, using the national HSM equations is proposed as the best approach for this current analysis.

Empirical Bayes Approach: Considering Historical Crash Data

The HSM method includes an optional step called the Empirical Bayes (EB) approach, which combines “the estimate from a predictive model with observed crash data to obtain a more reliable estimate of the expected average crash frequency.” (HSM, 2010) Essentially, the historical crash data is used to adjust the future crash prediction. Typically, the EB method is only used when it can be applied equally to all of the alternatives under consideration. Thus the improvements being considered must be moderate, so that the historical crash data is reasonable to consider for the conditions being compared. When major alignment or traffic control changes are proposed (such as the proposed SPUI’s or DDI’s), it is not used because “there is typically a small difference in the results obtained from the predictive method when it is used with and without the EB Method.” Therefore, “if the EB Method is not applied consistently, such differences will likely introduce a small bias in the comparison of expected crash frequency among alternatives.” (HSM Supplement, 2014) Therefore, the results are presented with the EB method adjustment when comparing Existing to No-Build conditions and without the EB method adjustment when comparing No-Build to the Build alternatives.

Planning Horizon Cost Savings

Planning horizon cost savings were calculated for the Build alternatives. The planning horizon cost savings is the discounted, monetized safety benefit from the crashes reduced by a scenario (compared to a baseline of No-Build) totaled for all years in the period 2012-2035. This shows how much money is saved (or loss) from a safety standpoint for each alternative.

Analysis Results

The predicted number of crashes were compared for the Existing (Year 2012) and No-Build (Year 2035) conditions to see the effect on safety of the unimproved I-229 corridor with increased traffic volumes. This comparison of Existing and No-Build conditions comprises the entire crash prediction area for all six sub-studies, allowing adjacent interchanges to be compared for differences in predicted future crash frequency.

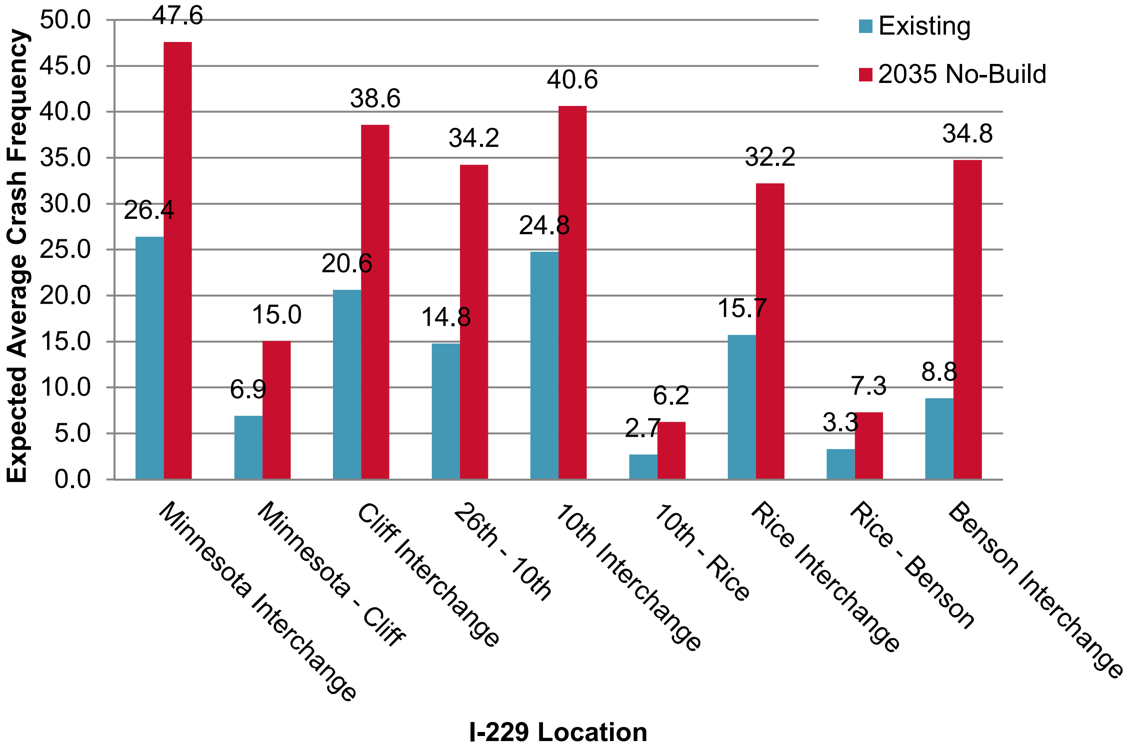
In a similar fashion, Build alternatives for each sub-study were evaluated and the predicted number of crashes was established for the 2012 to 2035 analysis period. The Build alternative crash predictions were then compared to the No-Build crash prediction for subject interchange. Hence, the results of the crash predictions for Build alternatives are presented by sub-study.

Existing vs. No-Build

The first stage of the crash prediction analysis was to compare the safety impact of anticipated traffic volume growth over the study horizon. The predicted annual crash frequencies for the Existing (Year 2012) and No-Build (Year 2035) conditions are presented in ***Table 1***. For the comparison of the Existing and No-Build conditions, historical crash data was applied using the EB method adjustment.

As expected, crashes predicted for each location along I-229 increase because of the increase in traffic volume. Notably, the I-229 interchange areas experience higher levels of existing crashes than the connecting freeway segments. By 2035, those interchange areas all have nearly doubled in annual crashes. Particularly, the Benson Road interchange shows the highest increase in annual predicted crashes at 26 additional crashes per year.

Table 1: Expected Average Crash Frequency – Existing vs. 2035 No-Build



No-Build vs. Build Alternatives

I-229 Corridor Study

STUDY AREA

The ISATe analysis limits for the I-229 Corridor Study focus on the I-229 freeway portion from 26th Street to 10th Street. The analysis limits for the I-229 Corridor Study are shown in ***Figure 2***.

Figure 2: I-229 Corridor ISATe Analysis Limits

Source: Google Earth, December 2016

ALTERNATIVES

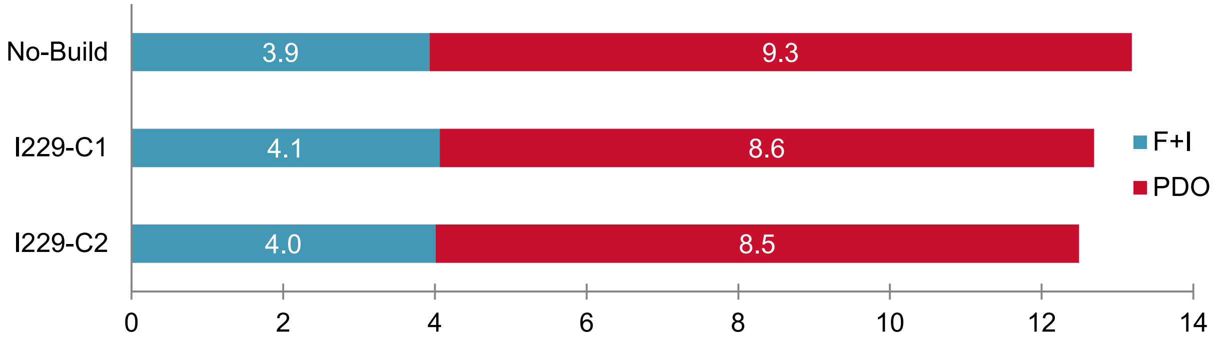
The alternatives to be analyzed for the I-229 Corridor Study are:

- I229-NB
    - No-Build
- I229-C1
    - 6-Lanes, From 26th St to 10th St
- I229-C2
    - 6-Lanes, From 26th St to 10th St
    - 65 MPH Improved Horizontal Curves

BUILD AND NO-BUILD CRASH FREQUENCY COMPARISON

The predicted annual crash frequencies for the No-Build and Build alternatives (2012 to 2035) are presented in ***Table 2*** along with the breakdown of Fatal + Injury (F+I) and Property Damage Only (PDO) crashes.

Table 2: I-229 Corridor 2012-2035 Predicted Build and No-Build Annual Crashes



The resulting total number of annual predicted crashes is slightly lower for both Build alternatives The Build alternatives result in a 4-5% decrease in total crashes and a 7-8% decrease in PDO crashes, but a 2-3% increase in F+I crashes. The cost for an F+I crash is high so this results in a negative cost savings, which is shown below in ***Table 3***.

Planning horizon crash cost savings were calculated for the Build alternatives and are shown in ***Table 3***.

Table 3: I-229 Corridor Planning Horizon Crash Cost Savings

Alternative	Total User Cost[1]	User Cost Savings[2]
No-Build	$ 24,600,000	$ -
I229-C1	$ 25,200,000	$ (600,000)
I229-C2	$ 24,900,000	$ (300,000)

[1] Total User Cost – The discounted, monetized safety benefit from the crashes totaled for all years in the period 2012-2035 (rounded to $100,000).
[2] User Cost Savings - The discounted, monetized safety benefit from the crashes reduced by a scenario (compared to a baseline of No-Build) totaled for all years in the period 2012-2035 (rounded to $100,000).

Minnesota Avenue Corridor Study

STUDY AREA

The ISATe analysis limits for the Minnesota Avenue Corridor Study focus on the I-229 ramps, the ramp terminals, and the arterial intersection of Minnesota Avenue and 49th Street. The arterial intersection was included in the analysis because some of the Build alternatives involve realigning the I-229 westbound off-ramp to 49th Street. The analysis limits for the Minnesota Avenue Corridor Study are shown in ***Figure 3***.

Figure 3: Minnesota Avenue Corridor ISATe Analysis Limits

Source: Google Earth, December 2016

ALTERNATIVES

The alternatives to be analyzed for the Minnesota Avenue Corridor Study are:

- Minn-NB
    - No-Build Interchange Configuration and Corridor Configuration
- Minn-2C
    - Realigns SB exit ramp with 49th Street; full access with signal-control.
    - Constructs loop ramp for NB Minnesota Ave to SB I-229.
    - Provides dual left-turn lanes for all signalized entrance and exit ramps.

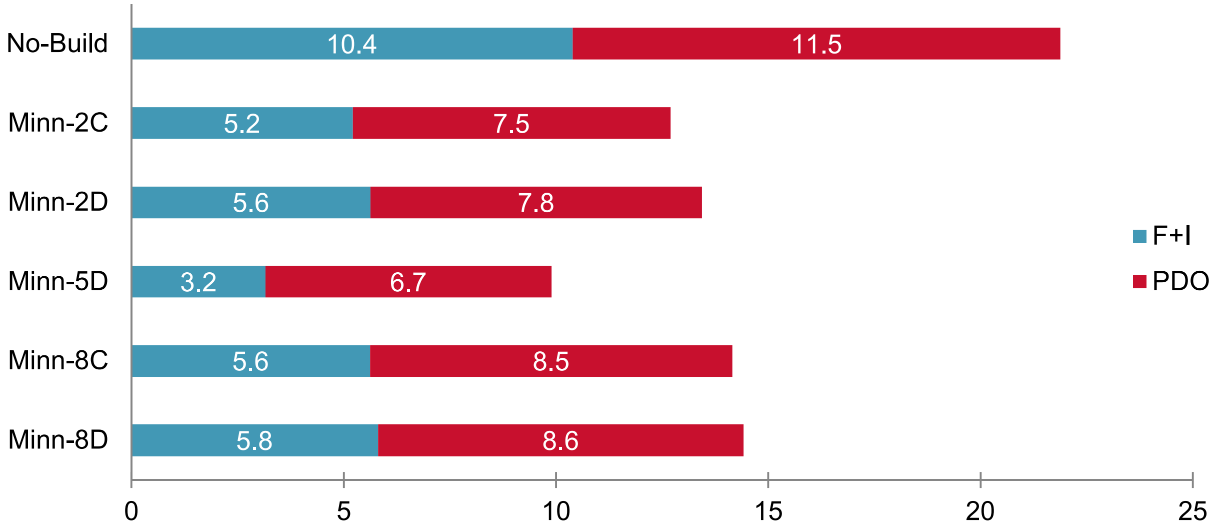
    - Increases separation between ramp terminal / 49th Street intersections.
    - Rebuilds Minnesota Avenue with a median and two lanes in each direction.
    - Third southbound lane added through 49th Street intersection.
- Minn-2D
    - Same as Minn-2C except rebuilds Minnesota Avenue with a median and three lanes in each direction.
- Minn-5D
    - Replaces Diamond Interchange with Diverging Diamond Interchange (DDI) configuration.
- Minn-8C
    - Replaces Diamond Interchange with Single Point Urban Interchange (SPUI) centered at existing interchange.
    - Provides dual-left turn lanes for all signalized entrance and exit ramps.
    - Incorporates full, signal-controlled access at 49th Street intersection.
    - Rebuilds Minnesota Avenue with a median and two lanes in each direction.
    - Third southbound lane added through 49th Street intersection.
- Minn-8D
    - Same as Minn-8C except rebuilds Minnesota Avenue with a median and three lanes in each direction.
- Minn-9D (Qualitative Analysis Only)
    - Same as Minn-8D except SB I-229 through and right-turn movements are provided direct connection to 49th Street.

BUILD AND NO-BUILD CRASH FREQUENCY COMPARISON

The predicted annual crash frequencies for the No-Build and Build alternatives (2012 to 2035) are presented in ***Table 4*** along with the breakdown of Fatal + Injury (F+I) and Property Damage Only (PDO) crashes.

The resulting total number of annual predicted crashes is lower for all the Build alternatives when compared to No-Build, with the DDI alternative expecting the least amount of crashes. The alternatives result in a 34-55% decrease in total crashes, with a 44-70% decrease in F+I crashes and 26-41% decrease in PDO crashes. Minn-9D is an alternative that was originally screened out prior to the concept refinement stage. As concept refinement progressed, Minn-9D was reconsidered and reinstated as a Build alternative. Shortly following the reinstatement of Minn-9D, the overall I-229 MIS entered into the final reporting stage of the project. The project team determined that a full crash prediction analysis of Minn-9D would not provide additional value to study recommendations. The project team's qualitative assessment of Minn-9D is that the concept would likely result in slightly fewer predicted crashes than Minn-8C and Minn-8D. That qualitative assessment is based on quantitative evaluation of very similar concepts at the Cliff Avenue interchange (Cliff-6 and Cliff-7).

Table 4: Minnesota Ave Corridor 2012-2035 Predicted Build and No-Build Annual Crashes



Planning horizon crash cost savings were calculated for the Build alternatives and are shown in ***Table 5***.

Table 5: Minnesota Avenue Corridor Planning Horizon Crash Cost Savings

Alternative	Total User Cost[1]	User Cost Savings[2]
No-Build	$ 64,600,000	$ -
Minn-2C	$ 32,000,000	$ 32,600,000
Minn-2D	$ 34,400,000	$ 30,100,000
Minn-5D	$ 20,000,000	$ 44,600,000
Minn-8C	$ 34,500,000	$ 30,100,000
Minn-8D	$ 35,600,000	$ 29,000,000

[1] Total User Cost – The discounted, monetized safety benefit from the crashes totaled for all years in the period 2012-2035 (rounded to $100,000).

[2] User Cost Savings - The discounted, monetized safety benefit from the crashes reduced by a scenario (compared to a baseline of No-Build) totaled for all years in the period 2012-2035 (rounded to $100,000).

10th Street Corridor Study

STUDY AREA

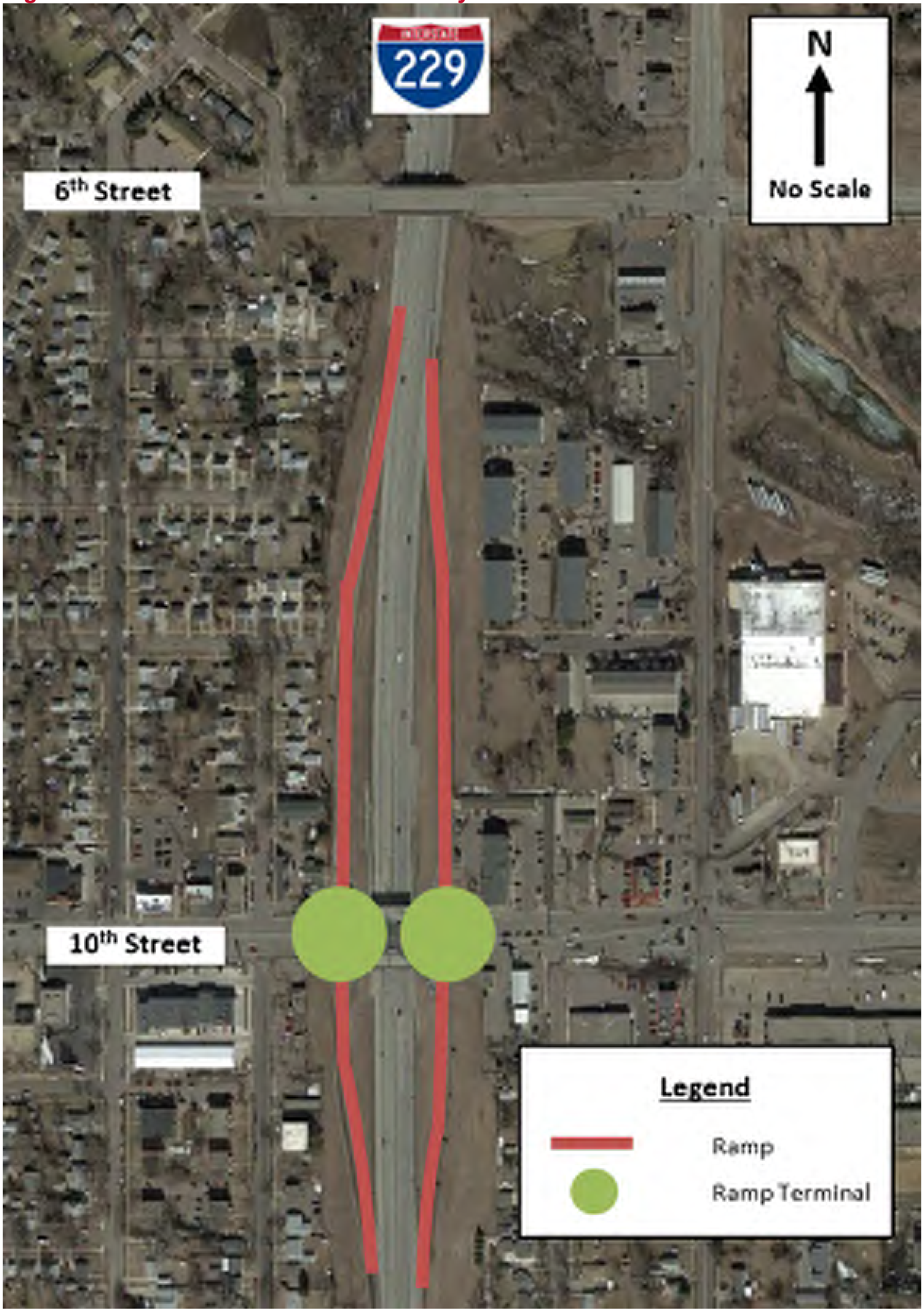
The ISATe analysis limits for the 10th Street Corridor Study focus on the I-229 ramps and the ramp terminals. For the Tight Split Diamond alternative, the proposed 6th Street ramp terminals were also included in the analysis. Because they are new intersections, no arterial intersection was included for the other alternatives. The analysis limits for the 10th Street Corridor Study are shown in ***Figure 4***.

ALTERNATIVES

The alternatives to be analyzed for the 10th Street Corridor Study are:

- 10th-NB
    - No-Build Interchange Configuration and Corridor Configuration

Figure 4: 10th Street Corridor ISATe Analysis Limits



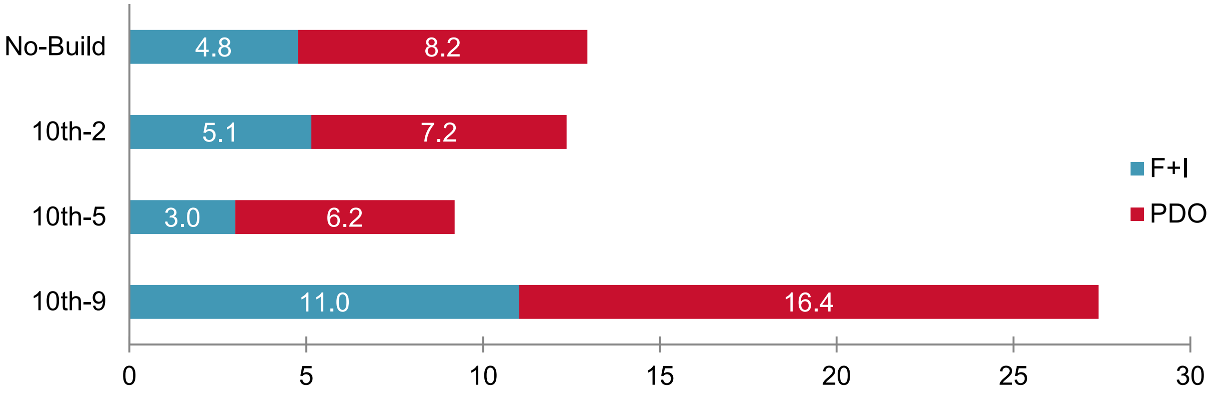
Source: Google Earth, December 2016

- 10th-2
    - Perpetuates Single Point Urban Interchange (SPUI) configuration.
    - Provides dual left-turn lanes for all entrance and exit ramps.
    - Rebuilds 10th Street with a median and three lanes in each direction through the interchange.
- 10th-5
    - Replaces Single Point Urban Interchange (SPUI) configuration with Diverging Diamond Interchange (DDI) configuration.
    - Eliminates left-turn movements on 10th Street by crossing 10th Street traffic to the left side between the ramp terminal intersections.
    - Rebuilds 10th Street with a median and three lanes in each direction through the interchange.
- 10th-9
    - Replaces Single Point Urban Interchange (SPUI) configuration with Tight Split Diamond Interchange (TSD) configuration with I-229 ramp connections to both 10th Street and 6th Street.
    - Provides dual left-turn lanes for all entrance and exit ramps except the NB entrance ramp.
    - Adds traffic signals at new ramp intersections with 6th Street.
- 10th-Var (Qualitative Analysis Only)
    - Unconstrained SB Entrance & NB Exit Ramps

BUILD AND NO-BUILD CRASH FREQUENCY COMPARISON

The predicted annual crash frequencies for the No-Build and Build alternatives (2012 to 2035) are presented in ***Table 6*** along with the breakdown of Fatal + Injury (F+I) and Property Damage Only (PDO) crashes.

Table 6: 10th Street Corridor 2012-2035 Predicted Build and No-Build Annual Crashes



The resulting total number of annual predicted crashes is 5% less for the SPUI alternative, 29% less for the DDI alternative, and 131% more for TSD alternative. Even though the total number of crashes is less for the SPUI alternative, the F+I crashes is slightly higher. The cost for an F+I crash is high so this results in a negative cost savings, which is shown below in ***Table 7***. 10th-9 results in a significant increase in crashes because the Tight Split Diamond alternative adds more exposure and conflict points from the addition of two new ramp terminals at 6th Street and two new collector-distributor roads between 10th Street and 6th Street. The 10th-Var concept would add a minor amount of crashes to 10th-2 and 10th-5 mainly due to added exposure from additional ramp length.

Planning horizon crash cost savings were calculated for the Build alternatives and are shown in ***Table 7***.

Table 7: 10th Street Corridor Planning Horizon Crash Cost Savings

Alternative	Total User Cost[1]	User Cost Savings[2]
No-Build	$ 30,000,000	$ -
10th-2	$ 31,900,000	$ (2,000,000)
10th-5	$ 19,100,000	$ 10,900,000
10th-9	$ 67,800,000	$ (37,900,000)

[1] Total User Cost – The discounted, monetized safety benefit from the crashes totaled for all years in the period 2012-2035 (rounded to $100,000).

[2] User Cost Savings - The discounted, monetized safety benefit from the crashes reduced by a scenario (compared to a baseline of No-Build) totaled for all years in the period 2012-2035 (rounded to $100,000).

Benson Road Corridor Study

STUDY AREA

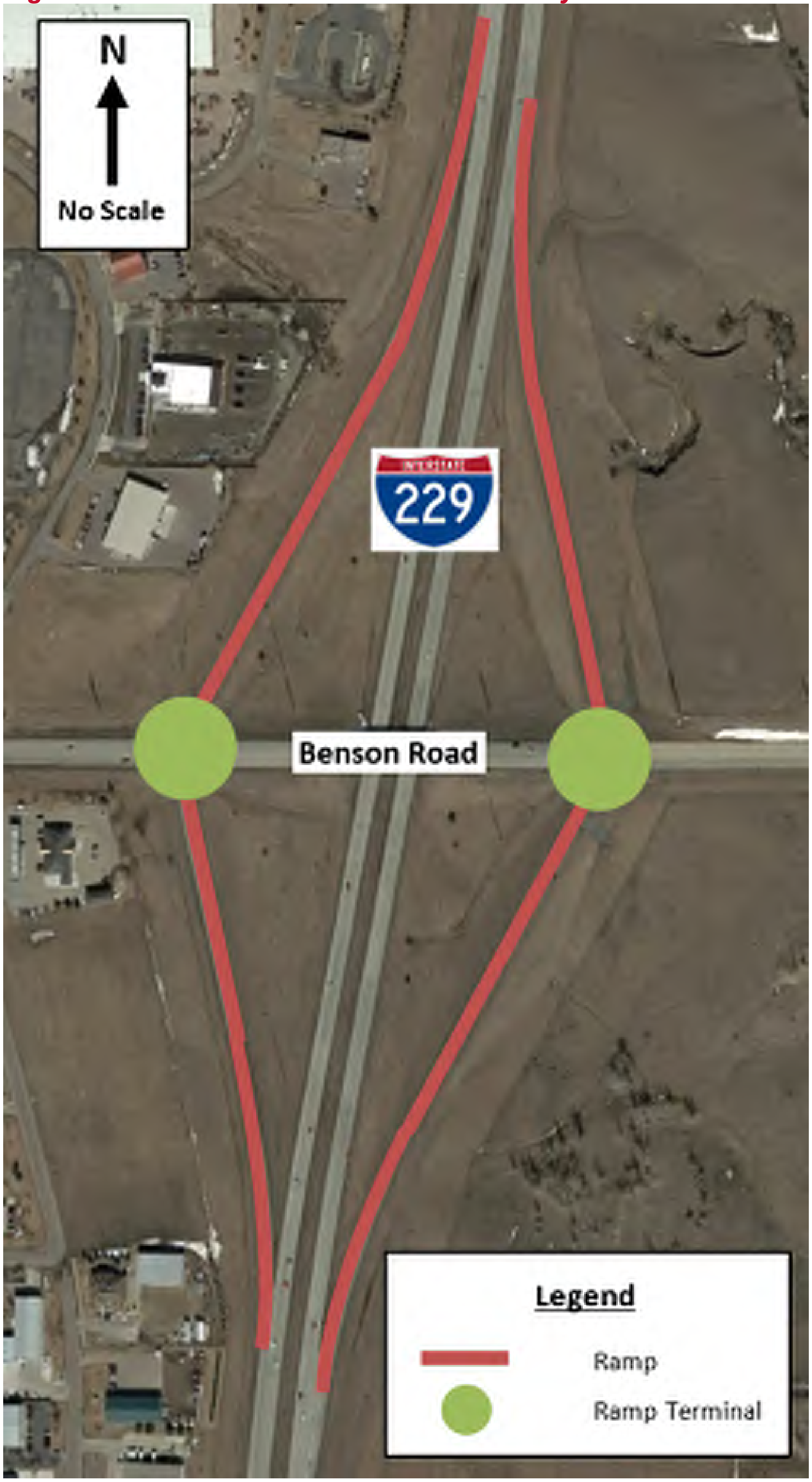
The ISATe analysis limits for the Benson Road Corridor Study focus on the I-229 ramps and the ramp terminals. The analysis limits for the Benson Road Corridor Study are shown in ***Figure 5***.

ALTERNATIVES

The alternatives to be analyzed for the Benson Road Corridor Study are:

- Benson-NB
  - No-Build Interchange Configuration and Corridor Configuration
- Benson-1A
  - 30 MPH 2-lane loop for NB I-229 to WB Benson Road.
  - Realign I-229 NB off ramp.
  - Dual right-turn lane and free right-turn movement for EB Benson Road to SB I-229.
  - Raised median on Benson Road with left-turn lanes.
- Benson-1B
  - Same as Benson-1A except single (instead of dual) right-turn lane and free right-turn movement for EB Benson Road to SB I-229.

Figure 5: Benson Road Corridor ISATe Analysis Limits



Source: Google Earth, December 2016

- Benson-4
    - Diverging Diamond Interchange (DDI) configuration.
    - Realign W I-229 ramps to maximize separation distance to Potsdam Avenue.
    - Right-turn lane and 2-lane free right-turn movement for EB Benson Road to SB I-229.

BUILD AND NO-BUILD CRASH FREQUENCY COMPARISON

The predicted annual crash frequencies for the No-Build and Build alternatives (2012 to 2035) are presented in ***Table 8*** along with the breakdown of Fatal + Injury (F+I) and Property Damage Only (PDO) crashes.

Table 8: Benson Road Corridor 2012-2035 Predicted Build and No-Build Annual Crashes

The resulting total number of annual predicted crashes is 8-9% less for the loop ramp alternatives and 45% less for the DDI alternative. The resulting annual PDO crashes is 5-6% less for the loop ramp alternatives and 33% less for the DDI alternative. The biggest safety benefit is in the F+I crashes, which is 12-13% less for the loop ramp alternatives and 60% less for the DDI alternative.

Planning horizon crash cost savings were calculated for the Build alternatives and are shown in ***Table 9***.

Table 9: Benson Road Corridor Planning Horizon Crash Cost Savings

Alternative	Total User Cost[1]	User Cost Savings[2]
No-Build	$ 47,400,000	$ -
Benson-1A	$ 41,600,000	$ 5,800,000
Benson-1B	$ 41,000,000	$ 6,300,000
Benson-4	$ 19,500,000	$ 27,800,000

[1] Total User Cost – The discounted, monetized safety benefit from the crashes totaled for all years in the period 2012-2035 (rounded to $100,000).

[2] User Cost Savings - The discounted, monetized safety benefit from the crashes reduced by a scenario (compared to a baseline of No-Build) totaled for all years in the period 2012-2035 (rounded to $100,000).

Rice Street Corridor Study

STUDY AREA

The ISATe analysis limits for the Rice Street Corridor Study focus on the I-229 ramps, the ramp terminals, and the arterial intersections of Rice Street/Bahnson Avenue and Rice Street/Lowell Avenue. The arterial intersections were included in the analysis because Rice-3C involves realigning Cleveland Avenue to Bahnson Avenue and the I-229 SB Ramps to Lowell Avenue. The analysis limits for the Rice Street Corridor Study are shown in ***Figure 6***.

Figure 6: Rice Street Corridor ISATe Analysis Limits

Source: Google Earth, December 2016

ALTERNATIVES

The alternatives to be analyzed for the Rice Street Corridor Study are:

- Rice-NB
  - No-Build Interchange Configuration and Corridor Configuration
- Rice-2
  - Perpetuates Folded Diamond Interchange configuration.

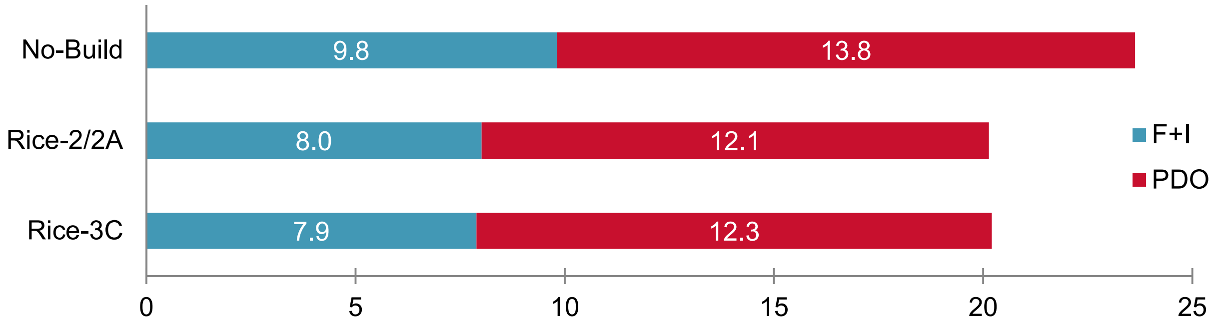
  - Rebuilds Rice Street with a median and three lanes in each direction through the interchange.
  - Provides additional turn bays and storage length at the Rice Street/Cleveland Avenue/NB I-229 off ramp and Rice Street/Bahnson Avenue intersections.
- Rice-2A
  - Same as Rice-2 except shifts and rebuilds Rice Street north of its current alignment to avoid impacts to BNSF Railroad Right-of-Way.
- Rice-3C
  - Replaces Folded Diamond Interchange with an improved geometrics Folded Diamond Interchange configuration.
  - Aligns SB I-229 ramps with Lowell Avenue and improves geometrics at NB I-229 ramps.
  - Rebuilds Rice Street with a median and three lanes in each direction through the interchange.
  - Separates conflicting traffic movements at Cleveland Avenue and the NB I-229 ramp terminal intersection by realigning Cleveland Avenue on a shifted alignment with a two-way left-turn lane and two lanes in each direction.
  - Provides a grade separated crossing of Cleveland Avenue over the BNSF Railroad.
  - Provides additional turn bays and storage length at the Rice Street/NB I-229 off ramp and Rice Street/Bahnson Avenue/Cleveland Avenue intersections.

Rice-2 and Rice-2A are treated the same for the predictive safety analysis because they comprise of the same cross section. The only difference between the two alternatives is that Rice-2A is shifted to the north.

BUILD AND NO-BUILD CRASH FREQUENCY COMPARISON

The predicted annual crash frequencies for the No-Build and Build alternatives (2012 to 2035) are presented in ***Table 10*** along with the breakdown of Fatal + Injury (F+I) and Property Damage Only (PDO) crashes.

Table 10: Rice Street Corridor 2012-2035 Predicted Build and No-Build Annual Crashes



The resulting total number of annual predicted crashes is lower for all the Build alternatives. The Build alternatives result in a 14-15% decrease in total crashes, an 11-12% decrease in PDO crashes, and an 18-20% decrease in F+I crashes. It should be noted that the results for Rice-3C do not take into effect the safety benefit of removing two railroad at-grade crossings that result from realigning Cleveland Avenue to Bahnson Avenue. Analysis of the Rice-3C option also does not include an estimate of the change in crashes on Rice Street and Cleveland Avenue due to the significant increase in travel distance between Cleveland Avenue and the Northbound I-229 ramps.

Planning horizon crash cost savings were calculated for the Build alternatives and are shown in ***Table 11***.

Table 11: Rice Street Corridor Planning Horizon Crash Cost Savings

Alternative	Total User Cost[1]	User Cost Savings[2]
No-Build	$ 58,700,000	$ -
Rice-2/2A	$ 48,300,000	$ 10,400,000
Rice-3c	$ 47,900,000	$ 10,800,000

[1] Total User Cost – The discounted, monetized safety benefit from the crashes totaled for all years in the period 2012-2035 (rounded to $100,000).

[2] User Cost Savings - The discounted, monetized safety benefit from the crashes reduced by a scenario (compared to a baseline of No-Build) totaled for all years in the period 2012-2035 (rounded to $100,000).

Cliff Avenue Corridor Study

STUDY AREA

The ISATe analysis limits for the Cliff Avenue Corridor Study focus on the I-229 ramps, the ramp terminals, and the arterial intersection of Cliff Avenue and 41st Street. 41st Street is aligned with the I-229 southbound off-ramp for all the alternatives except Cliff-6. 41st Street is realigned to Pam Road in Cliff-6 so Cliff Avenue and 41st Street is analyzed as an arterial intersection. For the other alternatives, 41st Street is analyzed in ISATe as a non-ramp public street leg that is present at the north ramp terminal. The intersection of Cliff Avenue and Pam Road was not analyzed because the existing number of crashes is very low. Therefore, the predicted crashes for this intersection would be negligible. The analysis limits for the Cliff Avenue Corridor Study are shown in ***Figure 7***.

ALTERNATIVES

The alternatives to be analyzed for the Cliff Avenue Corridor Study are:

- Cliff-NB
  - No-Build Interchange Configuration and Corridor Configuration
- Cliff-1
  - Adds a loop on ramp from NB Cliff Avenue to SB I-229.
  - Realigns SB Cliff Avenue to SB I-229 directional ramp.
  - Provides additional turn bays, storage length, and raised median at the Cliff Avenue/E 41st Street/SB I-229 off ramp terminal intersection.

Figure 7: Cliff Avenue Corridor ISATe Analysis Limits

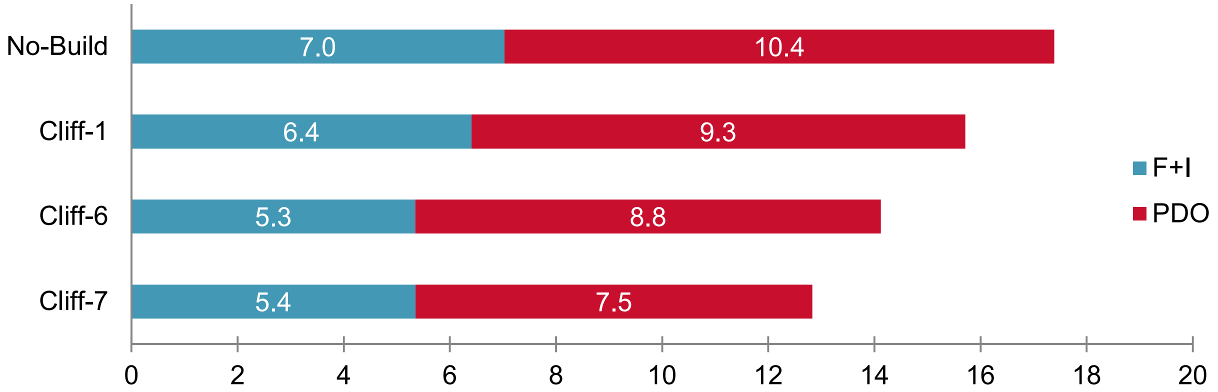
Source: Google Earth, December 2016

- Cliff-6
  - Replaces Diamond Interchange with Single Point Urban Interchange (SPUI)
  - Rebuilds Cliff Avenue with a median and two lanes in each direction.
  - Realigns the E 41st Street/Cliff Avenue intersection north to Pam Road.
- Cliff-7
  - Same as Cliff-6 except SB I-229 through and right movements utilize existing intersection location at Cliff Avenue.

BUILD AND NO-BUILD CRASH FREQUENCY COMPARISON

The predicted annual crash frequencies for the No-Build and Build alternatives (2012 to 2035) are presented in *Table 12* along with the breakdown of Fatal + Injury (F+I) and Property Damage Only (PDO) crashes.

Table 12: Cliff Avenue Corridor 2012-2035 Predicted Build and No-Build Annual Crashes



The resulting total number of annual predicted crashes is lower for all the Build alternatives, with Cliff-7 showing the least amount of crashes. The Build alternatives result in a 10-26% decrease in total crashes, a 10-28% decrease in PDO crashes, and a 9-24% decrease in F+I crashes.

Planning horizon crash cost savings were calculated for the Build alternatives and are shown in ***Table 13***.

Table 13: Cliff Avenue Corridor Planning Horizon Crash Cost Savings

Alternative	Total User Cost[1]	User Cost Savings[2]
No-Build	$ 42,900,000	$ -
Cliff-1	$ 39,100,000	$ 3,800,000
Cliff-6	$ 32,900,000	$ 10,100,000
Cliff-7	$ 32,600,000	$ 10,400,000

[1] Total User Cost – The discounted, monetized safety benefit from the crashes totaled for all years in the period 2012-2035 (rounded to $100,000).

[2] User Cost Savings - The discounted, monetized safety benefit from the crashes reduced by a scenario (compared to a baseline of No-Build) totaled for all years in the period 2012-2035 (rounded to $100,000).

Conclusions

Based on the preceding HSM analysis, the following conclusions can be drawn for the entire I-229 MIS study:

- Crashes predicted for each location along I-229 increase for the No-Build (Year 2035) condition compared to the Existing (Year 2012) condition because of the increase in traffic volume. Notably, the I-229 interchange areas experience higher levels of existing crashes than the connecting freeway segments.
- For the I-229 Corridor Study, both Build alternatives decrease the total number of crashes. However, the fatal and injury crashes increase slightly so there is an increase in user cost.
- For the 10th Street Corridor Study, the SPUI and DDI alternatives decrease the total number of crashes. However, the fatal and injury crashes increase slightly for the SPUI alternative so there is an increase in user cost. The Tight Split

Diamond alternative increases the total number of crashes 131% because it adds two new ramp terminals at 6th Street and two new collector-distributor roads between 10th Street and 6th Street.

- For the remaining corridor studies (Minnesota Avenue, Benson Road, Rice Street, Cliff Avenue), all Build alternatives decrease crashes compared to their respective No-Build alternatives.
- If the alternatives with the highest safety benefit for all sub-studies were chosen, the entire I-229 corridor would see approximately $104 million in user cost savings.

The safety evaluation, along with traffic operations, environmental impacts, property impacts, and construction and right-of-way cost, helped select alternatives and prioritize the phasing of each sub-study.

Appendix F. Year of Failure Analysis

This technical memorandum documents the Year of Failure analysis for the I-229 Major Investment Study (MIS), serving as part of the overall documentation for the I-229 MIS project. The content provided in ***Appendix B1. Traffic Capacity Analysis Methodologies*** *should be referenced to supplement the content in this memorandum.*

The purpose of the I-229 MIS is to develop a comprehensive plan for improvements needed along I-229, its interchanges, and its cross streets through a horizon year of 2035. While proposed improvement projects recommended by the study were designed to meet operational and design criteria by 2035, elements of existing and proposed corridor infrastructure have service lives beyond 20-30 years after initial construction. The year of failure analysis is one type of analysis that considers conditions beyond the horizon year.

A year of failure analysis helps decision makers roughly assess how long after the design or horizon year a proposed interchange design will operate acceptably. The longer the interchange operates sufficiently, the longer down the road the interchange will have prior to additional investments to deal with future capacity constraints.

This memorandum presents a summary of the methodology and findings for the year of failure analysis for the No-Build and Build alternatives for the I-229 MIS. The Build alternatives to be analyzed for this study will be described later in this memorandum. The results are intended to help guide the selection of the alternatives moving forward to the alternatives analysis stage of planning.

Study Area

The I-229 MIS has been separated into individual sub-studies. The sub-studies include:

- I-229 Corridor Study
- Minnesota Avenue Corridor Study (Exit 3)
- 10th Street Corridor Study (Exit 6)
- Benson Road Corridor Study (Exit 9)
- Rice Street Corridor Study (Exit 7)
- Cliff Avenue Corridor Study (Exit 4)

A map illustrating the overall study areas for each of the sub-studies is shown in ***Figure 1***. For the year of failure analysis, the area of study was reduced to the interchanges. For the I-229 Corridor Study, the year of failure analysis limits focus on two interchanges that do not have their own sub-study: Louise Avenue and Western Avenue. The remaining sub-studies, focus on their respective interchanges. The analysis does not include identifying year of failure for I-229 freeway segments. The first signalized intersection beyond each interchange ramp terminal was also included to model the arrival flow profile approaching the ramp terminal intersections.

Methodology

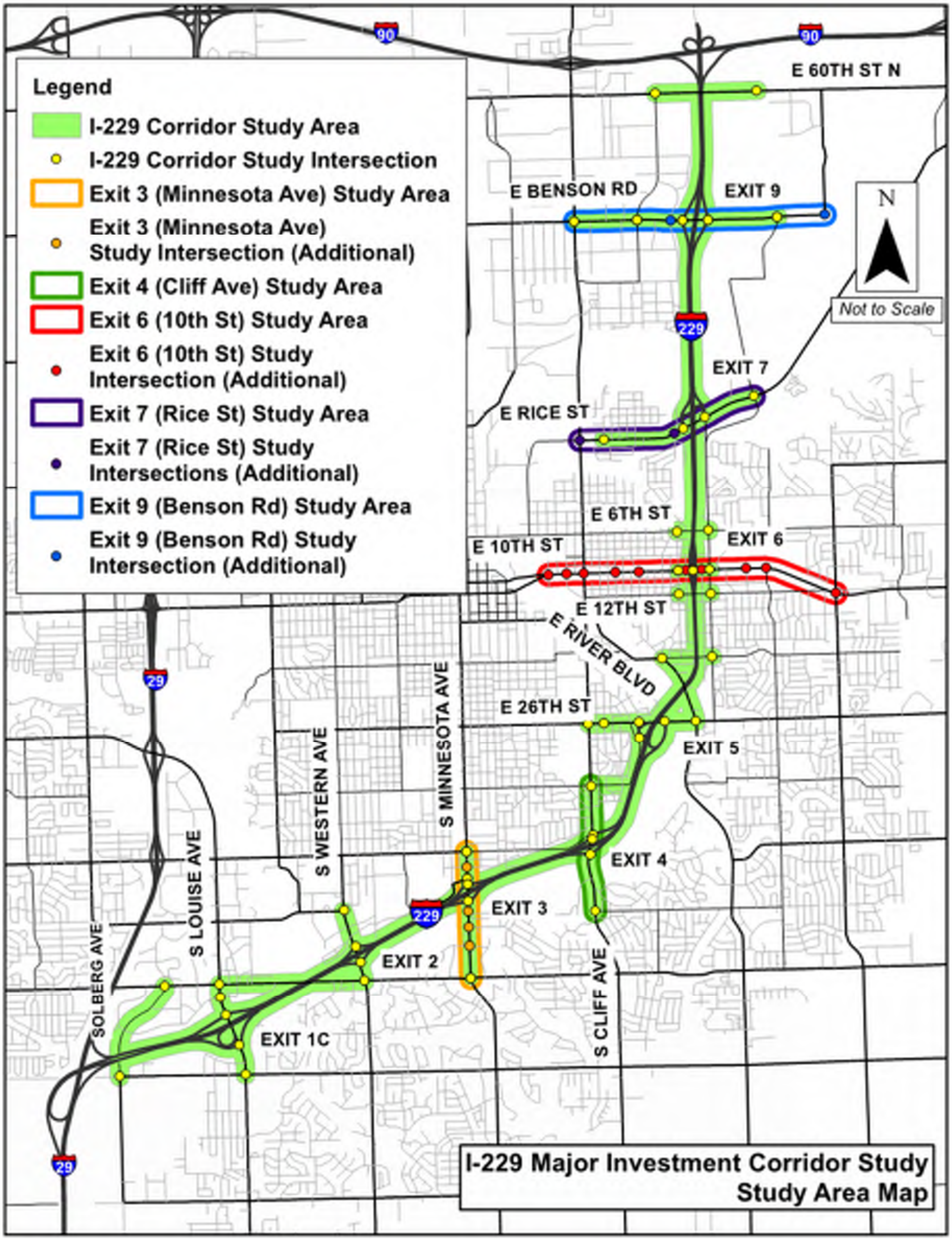
Volume Development

Traffic volumes were developed for the AM and PM peak hours on each cross street and each intersection within the study area until year of failure was identified. Volumes were developed for up to 30 years beyond the project future/design year (Year 2035) and at 5-year increments. The volumes beyond 2035 were linearly extrapolated using existing year (Year 2012) and future year (Year 2035) volumes. The traffic volume data was based on traffic counts provided by SDDOT and design year volume forecasts from the 2035 Sioux Falls Travel Demand Model.

Year of Failure Criteria

For the year of failure analysis, LOS ‘D’ was used as the worst allowable LOS for future year ramp terminal intersection operations. The interchange alternatives were considered failing when one of the ramp terminals was projected to operate at an average intersection LOS ‘E’ or ‘F’ or an intersection turning movement was projected to operate at LOS ‘F’.

Figure 1. I-229 MIS Study Area Map



Analysis Results

I-229 Corridor Study

Alternatives

The alternatives to be analyzed for the I-229 Corridor Study are:

- Louise-NB
    - Louise No-Build Interchange
- Western-NB
    - Western No-Build Interchange

Year of Failure Results

The resulting year of failure for the I-229 Corridor Study alternatives is shown in ***Table 1***.

Table 1 – I-229 Corridor Year of Failure

Alternative	Year of Failure
Louise-NB	Beyond 2065
Western-NB	2040

Minnesota Avenue Corridor Study

Alternatives

The alternatives to be analyzed for the Minnesota Avenue Corridor Study are:

- Minn-NB
    - No-Build Interchange Configuration and Corridor Configuration
- Minn-2C
    - Realigns SB exit ramp with 49th Street; full access with signal-control.
    - Constructs loop ramp for NB Minnesota Ave to SB I-229.
    - Provides dual left-turn lanes for all signalized entrance and exit ramps.
    - Increases separation between ramp terminal / 49th Street intersections.
    - Rebuilds Minnesota Avenue with a median and two lanes in each direction.
    - Third southbound lane added through 49th Street intersection.
- Minn-2D
    - Same as Minn-2C except rebuilds Minnesota Avenue with a median and three lanes in each direction.
- Minn-5D
    - Replaces Diamond Interchange with Diverging Diamond Interchange (DDI) configuration.

- Minn-8C
    - Replaces Diamond Interchange with Single Point Urban Interchange (SPUI) centered at existing interchange.
    - Provides dual-left turn lanes for all signalized entrance and exit ramps.
    - Incorporates full, signal-controlled access at 49th Street intersection.
    - Rebuilds Minnesota Avenue with a median and two lanes in each direction.
    - Third southbound lane added through 49th Street intersection.
- Minn-8D
    - Same as Minn-8C except rebuilds Minnesota Avenue with a median and three lanes in each direction.
- Minn-9D (Qualitative Analysis Only)
    - Same as Minn-8D except SB I-229 through and right-turn movements are provided direct connection to 49th Street.

Year of Failure Results

The resulting year of failure for the No-Build and Build alternatives is shown in ***Table 2***. Minn-9D is an alternative that was originally screened out prior to the concept refinement stage. As the concept refinement progressed, Minn-9D was reconsidered and reinstated as a Build alternative. The project team's qualitative assessment of Minn-9D is that the concept would likely result in a year of failure beyond the year of failure for Minn-8D. That qualitative assessment is based on quantitative evaluation of very similar concepts at the Cliff Avenue interchange (Cliff-6 and Cliff-7).

Table 2 – Minnesota Avenue Corridor Year of Failure

Alternative	Year of Failure
Minn-NB	Earlier than 2035
Minn-2C	2045
Minn-2D	2045
Minn-5D	2060
Minn-8C	2040
Minn-8D	2060
Minn-9D	Beyond 2060 (Estimation)

10th Street Corridor Study

Alternatives

The alternatives to be analyzed for the 10th Street Corridor Study are:

- 10th-NB
    - No-Build Interchange Configuration and Corridor Configuration

- 10th-2
    - Perpetuates Single Point Urban Interchange (SPUI) configuration.
    - Provides dual left-turn lanes for all entrance and exit ramps.
    - Rebuilds 10th Street with a median and three lanes in each direction through the interchange.
- 10th-5
    - Replaces Single Point Urban Interchange (SPUI) configuration with Diverging Diamond Interchange (DDI) configuration.
    - Eliminates left-turn movements on 10th Street by crossing 10th Street traffic to the left side between the ramp terminal intersections.
    - Rebuilds 10th Street with a median and three lanes in each direction through the interchange.
- 10th-9
    - Replaces Single Point Urban Interchange (SPUI) configuration with Tight Split Diamond Interchange (TSD) configuration with I-229 ramp connections to both 10th Street and 6th Street.
    - Provides dual left-turn lanes for all entrance and exit ramps except the NB entrance ramp.
    - Adds traffic signals at new ramp intersections with 6th Street.

Year of Failure Results

The resulting year of failure for the No-Build and Build alternatives is shown in ***Table 3***.

Table 3 – 10th Street Corridor Year of Failure

Alternative	Year of Failure
10th-NB	Earlier than 2035
10th-2	Beyond 2065
10th-5	Beyond 2065
10th-9	Beyond 2065

Benson Road Corridor Study

Alternatives

The alternatives to be analyzed for the Benson Road Corridor Study are:

- Benson-NB
    - No-Build Interchange Configuration and Corridor Configuration
- Benson-1A
    - 30 MPH 2-lane loop for NB I-229 to WB Benson Road.
    - Realign I-229 NB off ramp.

    - Dual right-turn lane and free right-turn movement for EB Benson Road to SB I-229.
    - Raised median on Benson Road with left-turn lanes.
- Benson-1B
    - Same as Benson-1A except single (instead of dual) right-turn lane and free right-turn movement for EB Benson Road to SB I-229.
- Benson-4
    - Diverging Diamond Interchange (DDI) configuration.
    - Realign W I-229 ramps to maximize separation distance to Potsdam Avenue.
    - Right-turn lane and 2-lane free right-turn movement for EB Benson Road to SB I-229.

Year of Failure Results

The resulting year of failure for the No-Build and Build alternatives is shown in ***Table 4***.

Table 4 – Benson Road Corridor Year of Failure

Alternative	Year of Failure
Benson-NB	Earlier than 2035
Benson-1A	2050
Benson-1B	2050
Benson-4	2045

Rice Street Corridor Study

Alternatives

The alternatives to be analyzed for the Rice Street Corridor Study are:

- Rice-NB
    - No-Build Interchange Configuration and Corridor Configuration
- Rice-2
    - Perpetuates Folded Diamond Interchange configuration.
    - Rebuilds Rice Street with a median and three lanes in each direction through the interchange.
    - Provides additional turn bays and storage length at the Rice Street/Cleveland Avenue/NB I-229 off ramp and Rice Street/Bahnson Avenue intersections.
- Rice-2A
    - Same as Rice-2 except shifts and rebuilds Rice Street north of its current alignment to avoid impacts to BNSF Railroad Right-of-Way.
- Rice-3C

  - Replaces Folded Diamond Interchange with an improved geometrics Folded Diamond Interchange configuration.
  - Aligns SB I-229 ramps with Lowell Avenue and improves geometrics at NB I-229 ramps.
  - Rebuilds Rice Street with a median and three lanes in each direction through the interchange.
  - Separates conflicting traffic movements at Cleveland Avenue and the NB I-229 ramp terminal intersection by realigning Cleveland Avenue on a shifted alignment with a two-way left-turn lane and two lanes in each direction.
  - Provides a grade separated crossing of Cleveland Avenue over the BNSF Railroad.
  - Provides additional turn bays and storage length at the Rice Street/NB I-229 off ramp and Rice Street/Bahnson Avenue/Cleveland Avenue intersections.

Year of Failure Results

The resulting year of failure for the No-Build and Build alternatives is shown in ***Table 5***.

Table 5 – Rice Street Corridor Year of Failure

Alternative	Year of Failure
Rice-NB	Earlier than 2035
Rice-2	2045
Rice-2A	2045
Rice-3C	2045

Cliff Avenue Corridor Study

Alternatives

The alternatives to be analyzed for the Cliff Avenue Corridor Study are:

- Cliff-NB
  - No-Build Interchange Configuration and Corridor Configuration
- Cliff-1
  - Adds a loop on ramp from NB Cliff Avenue to SB I-229.
  - Realigns SB Cliff Avenue to SB I-229 directional ramp.
  - Provides additional turn bays, storage length, and raised median at the Cliff Avenue/E 41st Street/SB I-229 off ramp terminal intersection.
- Cliff-6
  - Replaces Diamond Interchange with Single Point Urban Interchange (SPUI)
  - Rebuilds Cliff Avenue with a median and two lanes in each direction.

    - Realigns the E 41st Street/Cliff Avenue intersection north to Pam Road.
- Cliff-7
    - Same as Cliff-6 except SB I-229 through and right movements utilize existing intersection location at Cliff Avenue.

Year of Failure Results

The resulting year of failure for the No-Build and Build alternatives is shown in ***Table 6***.

Table 6 – Cliff Avenue Corridor Year of Failure

Alternative	Year of Failure
Cliff-NB	Earlier than 2035
Cliff-1	2050
Cliff-6	2055
Cliff-7	2045

Conclusion

The year of failure analysis, along with safety impacts, environmental impacts, property impacts, construction and right-of-way cost, and other traffic operations, helped screen alternatives and prioritize the phasing of each sub-study. Between the two interchanges in the I-229 Corridor Study (Louise Avenue and Western Avenue), Western Avenue is the next interchange after 2035 that will need to be addressed for operational issues.

APPENDIX G -

SUB-STUDY 6 NOISE STUDY TECHNICAL REPORT

Noise Study Technical Report

I-229 Major Investment Corridor Study

Sub-Study #6

Sioux Falls, South Dakota

HDR Project Number: 207030

December 2016

I-229 Major Investment Corridor Study (Sub-Study #6)

NOISE STUDY TECHNICAL REPORT

EXECUTIVE SUMMARY

The South Dakota Department of Transportation (SDDOT) initiated this study in order to address the current and future transportation needs along the entire I-229 corridor. Sub-Study #6 assesses existing and future conditions along the Cliff Avenue Corridor, which includes a combination of interchange concepts and corridor concepts (the Project). Three (3) Build Alternatives were evaluated as part of Sub-Study #6 (Cliff-1, Cliff-6 and Cliff-7).

On behalf of SDDOT, and as part of the environmental documentation, HDR Engineering, Inc. (HDR) performed a traffic noise analysis along the Cliff Avenue corridor's area of influence for the proposed improvements. The analysis included traffic noise monitoring and modeling. HDR used the FHWA Traffic Noise Model (TNM), Version 2.5, to evaluate projected traffic noise levels under the "Build" alternatives. If applicable, traffic noise impacts were identified in accordance with SDDOT Noise Analysis and Abatement Guidance (July 13, 2011). In areas where future noise levels exceed state and federal criteria, the conceptual feasibility of noise mitigation options is discussed if warranted.

Traffic noise levels were evaluated for the existing conditions and future Build Alternatives Cliff-1, Cliff-6 and Cliff-7 at 80 receptors in the Project area. There is 1 traffic noise impact predicted under the Existing Alternative; 11 impacts predicted under Future Build Alternative Cliff-1, 19 impacts predicted under Future Build Alternative Cliff-6 and 8 impacts predicted under Future Build Alternative Cliff-7.

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1. Introduction

The South Dakota Department of Transportation (SDDOT) initiated this study in order to address the current and future transportation needs along the entire I-229 corridor. Sub-Study #6 assesses existing and future conditions along the Cliff Avenue Corridor, which includes a combination of interchange concepts and corridor concepts (the Project). Three (3) Build Alternatives were evaluated as part of Sub-Study #6 (Cliff-1, Cliff-6 and Cliff-7). Figure 1 shows the project area.

The study fulfills the following objectives:

1. Complete a traffic level of service analysis for both existing and future (2035) conditions on the I-229 mainline, select interchanges and crossroads.
2. Complete a safety analysis of I-229 mainline, interchanges and crossroads.
3. Identify locations on I-229 not in compliance with current design standards under both the current and forecasted future traffic conditions.
4. Determine the effects of incidents on traffic operations within the I-229 corridor's area of influence.
5. Develop a long range plan consisting of feasible solutions to address the portions of the Interstate System that fail to meet current design standards, traffic level of service expectations, and/or have identifiable safety concerns under both the current and forecasted future traffic conditions.
6. Create final products for use by the SDDOT which will guide the Department in the implementation of recommended improvements that will maximize the efficiency of the system.

Three (3) Build Alternatives were evaluated as part of Sub-Study #6.

1. **Cliff-1:** Adds a loop on-ramp from northbound Cliff Avenue to southbound I-229; realigns southbound Cliff Avenue to southbound I-229 directional ramp; provides additional turn bays, storage length, and raised median at the Cliff Avenue/E 41st Street/southbound I-229 off-ramp terminal intersection; rebuilds the southbound and northbound I-229 bridges over Cliff Avenue; maintains existing traffic signal locations.
2. **Cliff-6:** Replaces Diamond Interchange with Single Point Urban Interchange (SPUI); rebuilds Cliff Avenue with a median and two lanes in each direction; realigns the E 41st Street/Cliff Avenue Intersections north to Pam Road; Closes the Pam Road/Cliff Avenue Intersection and adds a new neighborhood access to E 41st Street via 9th Avenue; rebuilds the southbound and northbound I-229 bridges over Cliff Avenue; adds traffic signals at the SPUI Interchange and E 41st Street/Cliff Avenue Intersection.
3. **Cliff-7:** Replaces Diamond Interchange with a SPUI; Southbound I-229 through and right movements utilize existing Intersection location at Cliff Avenue; rebuilds Cliff Avenue with a median and two lanes in each direction; provides additional turn bays and storage length at the reconstructed Intersections; rebuilds the southbound and northbound bridges over Cliff Avenue; maintains the existing traffic signal location at the E 41st Street/Cliff Avenue Intersection and adds a new traffic signal at the SPUI Interchange.

HDR Engineering, Inc. (HDR) performed a highway traffic noise analysis for SDDOT in support of the Project, as part of the environmental documentation. The analysis is based on the SDDOT Noise Analysis and Abatement Guidance (July 13, 2011). Results of the analysis are presented in this report.

2. Nature of Noise

Noise is defined as unwanted or excessive sound. Sound becomes unwanted when it interferes with normal activities, such as sleep, work, speech, or recreation. Vehicle noise is a combination of the noise produced by the engine, exhaust, and tires. Noise levels from highway traffic are affected by three factors: (1) the volume of the traffic, (2) the speed of the traffic, and (3) the number of trucks in the flow of traffic. Generally, traffic noise increases commensurate with these three factors.

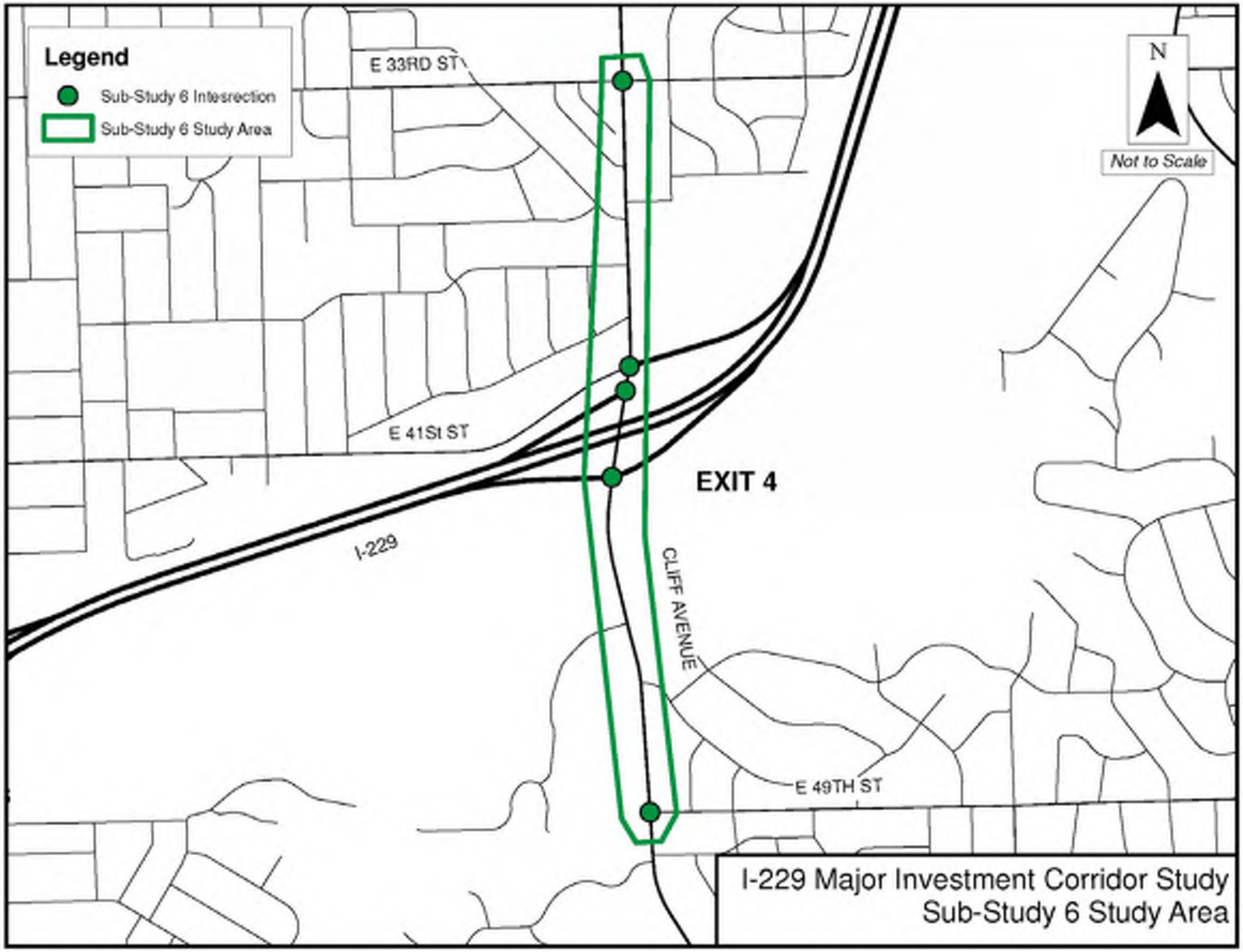
Noise is measured in decibels (dB) – a logarithmic scale. Because human hearing is not equally sensitive to all frequencies of sound, certain frequencies are given more "weight." The A-weighted scale corresponds to the sensitivity range for human hearing. Therefore, noise levels are measured in dBA, the A-weighted sound level in decibels. When noise levels change 3-dBA, the change is considered barely perceptible to human hearing. However, a 5-dBA change in noise level is clearly noticeable. A 10-dBA change in noise levels is perceived as a doubling or halving of noise loudness, while a 20-dBA change is considered a dramatic change in loudness. Table 1 shows noise levels associated with common, everyday sources and helps the reader more fully understand the magnitude of noise levels discussed in this report.

Table 1: Common Noise Sources and Levels

Sound Pressure Level (dB)	Typical Sources
120	Jet aircraft takeoff at 100 feet
110	Same aircraft at 400 feet
90	Motorcycle at 400 feet
80	Garbage disposal
70	City street corner
60	Conversational speech
50	Typical office
40	Living room (without TV)
30	Quiet bedroom at night

Source: Environmental Impact Assessment Handbook, ed. by Rau and Wooten, 1980

Figure 1: Project Location



3.SDDOT Noise Analysis and Abatement Guidance

The updated (July 13, 2011) SDDOT Noise Analysis and Abatement Guidance (Guidance), upon which this analysis is based, is intended to supplement FHWA traffic noise and abatement regulations and guidance. The Guidance provides procedures for noise studies and noise abatement measures to help protect the public health and welfare, to supply noise abatement criteria, and to establish requirements for traffic noise information to be given to those officials who have planning and zoning authority.

The Guidance contains noise abatement criteria that are based on the Leq(h), which is used to analyze traffic noise levels and identify noise impacts. The Leq is defined as the equivalent, steady-state sound level that, in a stated period of time, contains the same acoustic energy as the time-varying sound level during the same period. Therefore, for the purposes of this analysis, Leq can be considered the average sound level and Leq(h) can be considered the average sound level occurring over a one-hour time period. It is representative of the overall (average) traffic-generated noise level expressed on an hourly basis.

Land uses are assigned to an activity category based on the type of activities occurring in each area (i.e. picnic areas, churches, commercial land, and undeveloped land). Activity Categories are then ordered based on their sensitivity to traffic noise levels. NAC are assigned to each Activity Category. These NAC represent the maximum traffic noise levels that allow uninterrupted land use within each Activity Category. Table 2 summarizes noise abatement criteria corresponding to various land use activity categories. Activity categories and related traffic noise impacts are determined based on the actual land use in a given area.

Table 2: Noise Abatement Criteria

23 CFR 772 Noise Abatement Criteria [Hourly A-Weighted Sound Level, decibels (dBA)]			
Activity Category	**Leq(h)**	**Evaluation Location**	**Activity Description**
A	57	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve as an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67	Exterior	Residential
C	67	Exterior	Active sports areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools television studios, trails and trail crossings
D	52	Interior	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recordings studios, schools, and television studios.
E	72	Exterior	Hotels, motels, office, restaurant/bars, and other developed lands, properties or activities not included in A-D or F.
F	--	--	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical) and warehousing
G	--	--	Undeveloped lands that are not permitted

Highway traffic noise impacts occur when the predicted traffic noise levels for the design year approach (reach 1 decibel less than) or equal/exceed the NAC contained in 23 CFR 772 (Table 2), or when the predicted traffic noise levels substantially exceed the existing noise levels by 15 dBA, even though the predicted levels may not exceed the NAC.

4. Noise Prediction Method

Traffic noise levels were determined by using the FHWA Traffic Noise Model (TNM), Version 2.5. Basic model inputs are:

- Preliminary project concept and geometry
- 2035 traffic volumes in the Project Area (Appendix A)
- The operational speed for I-229: 65 miles per hour (mph); arterial streets: 30-45 mph

The traffic volume used for this analysis is the AM Peak Hourly Volume (PHV) traffic. Traffic was provided in a February 2015 HDR Technical Memo. Traffic volumes for the future “Build” condition were assumed to be the same as the future “No-Build” volumes.

5. Adjacent Land Use

Eighty (80) receptors were identified in the project area. The I-229 Cliff Avenue corridor is located east of I-29 in the Sioux Falls metropolitan area. The Cliff Avenue Corridor study limits include an approximately 0.36 mile section of Cliff Avenue from approximately Park Road to approximately E 38th Street.

Land use immediately adjacent to this Project is a combination of commercial/industrial, residential, a church and a recreational area. If no exterior areas of frequent human use are present at the commercial/retail locations, no further noise analysis is required. Figures located in Appendix B provide an aerial view of the project area.

6. Model Validation

Existing traffic noise levels were measured in the field and then compared against computer modeling results to verify the accuracy of the computer model. When modeled and measured levels are within + or – 3 dBA of one another, this indicates that the model is within the accepted level of accuracy.

6.1. Field Testing Procedure

On November 2, 2015, HDR staff measured traffic noise levels at representative sites throughout the project corridor. Traffic noise measurements were conducted in accordance with the FHWA-PD-96-046 Measurement of Highway Related Noise (May 1996). The average meteorological conditions were reported as shown in Table 3 below.

Table 3: Meteorological Conditions

Temperature	≅ 61 °F
Humidity	≅ 62%
Wind	< 12 mph
Conditions	Partly Cloudy
Barometric Pressure	≅ 29.81 inches

6.2. Instrumentation

Traffic noise monitoring was conducted using a Larson Davis 824 Sound Level Meter (SLM). Table 4 summarizes the instruments used to measure existing traffic noise levels for this noise analysis report.

Table 4: Noise Analysis Instrumentation Summary

Instrument	Make	Model	Serial Number
Sound Analyzer 1	Larson Davis	824	824A2636
Calibrator	Larson Davis	CAL200	3722

6.3. Field Measurement Methods

The SLM was programmed to compute the Leq(h). The following procedures were used for noise monitoring:

- The duration of the Leq(h) measurements was 15 minutes.
- The SLM was calibrated before and after monitoring. No significant calibration drifts were detected.
- The microphone was mounted on a tripod 5 feet above the ground.
- The microphone was covered with a windscreen.

6.4. Field Measurement Locations

Table 5 describes the location of the validation site in the project corridor.

Table 5: Noise Validation Location

Measurement Location	Description
K	≈ 35’ of S Cliff Ave

The validation location is shown in Appendix B, and is within 35 feet of the nearest roadway outside lane.

6.5. Model Validation Results

The measured and modeled noise levels for each of the monitoring sites selected along the project corridor are presented in Table 6. Each set of predicted and measured data was found to be within the acceptable + or – 3 dBA tolerance; therefore, the model is considered to be validated.

Table 6: Model Validation Results

Measurement Location	Leq(h)(dBA)		
	Measured	Modeled	Difference
K	66.2	63.6	-2.6

7. Traffic Noise Prediction

HDR used the FHWA TNM, Version 2.5, to evaluate future traffic noise levels at noise sensitive receptors within the limits of the Project. The TNM model accounts for the elevation differences and the proposed roadway alignment in relation to the noise-sensitive sites. Table 7 lists the NAC, existing Leq(h), and the future (2035) modeled Leq(h) for both the “Existing” and “Build” alternatives. Noise receptor locations are shown in Appendix B.

Table 7: Predicted Noise Levels at Receptors

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA						
			2012 Existing	2035 Build			Difference between Existing/Build		
				Cliff-1	Cliff-6	Cliff-7	Cliff-1	Cliff-6	Cliff-7
Shaded cells indicate noise levels that exceed the NAC									
373	B	66	58.9	64.8	64.7	64.7	5.9	5.8	5.8
374	B	66	59.7	65.3	65.1	65.1	5.6	5.4	5.4
375	B	66	59.8	65.0	64.8	64.7	5.2	5.0	4.9
376	B	66	59.6	64.5	64.3	64.3	4.9	4.7	4.7
377	B	66	59.6	64.1	63.8	63.8	4.5	4.2	4.2
378	B	66	59.4	64.5	64.2	64.2	5.1	4.8	4.8
379	B	66	59.3	64.5	64.2	64.2	5.2	4.9	4.9
380	B	66	59.2	64.5	64.1	64.1	5.3	4.9	4.9
381	B	66	59.4	64.8	64.4	64.4	5.4	5.0	5.0
382	B	66	59.4	64.5	64.0	64.0	5.1	4.6	4.6
383	B	66	59.1	64.2	63.8	63.8	5.1	4.7	4.7
384	B	66	59.2	64.3	63.9	63.9	5.1	4.7	4.7
385	B	66	59.6	64.8	64.4	64.4	5.2	4.8	4.8
386	B	66	59.5	64.7	64.3	64.3	5.2	4.8	4.8
387	B	66	59.9	64.9	64.6	64.6	5.0	4.7	4.7
388	B	66	60.1	65.3	65.0	65.0	5.2	4.9	4.9
389	B	66	60.2	64.9	64.8	64.7	4.7	4.6	4.5
390	B	66	60.3	64.7	64.6	64.6	4.4	4.3	4.3
391	B	66	60.2	64.5	64.4	64.4	4.3	4.2	4.2
392	B	66	60.1	64.2	64.1	64.1	4.1	4.0	4.0
393	B	66	60.1	64.1	63.9	64.0	4.0	3.8	3.9
394	B	66	60.3	64.1	64.1	64.0	3.8	3.8	3.7
395	B	66	67.5	68.3	*Note 1*	*Note 1*	0.8	N/A	N/A
396	B	66	65.8	66.6	*Note 1*	66.2	0.8	N/A	0.4
397	B	66	65.1	66.1	*Note 1*	65.6	1.0	N/A	0.5
398	B	66	64.1	65.5	*Note 1*	64.8	1.4	N/A	0.7
399	B	66	63.1	65.3	*Note 1*	64.6	2.2	N/A	1.5
400	B	66	62.7	65.2	*Note 1*	64.5	2.5	N/A	1.8
401	B	66	62.3	65.2	*Note 1*	64.6	2.9	N/A	2.3
402	B	66	61.5	64.7	*Note 1*	64.2	3.2	N/A	2.7
403	B	66	60.9	64.4	64.9	64.0	3.5	4.0	3.1
404	B	66	60.5	64.2	64.2	63.8	3.7	3.7	3.3
405	D	51	44.2	48.0	47.9	47.9	3.8	3.7	3.7
406	C	66	62.8	63.8	62.9	62.9	1.0	0.1	0.1
407	C	66	63.2	64.3	63.6	63.6	1.1	0.4	0.4
408	C	66	63.4	64.5	64.3	64.3	1.1	0.9	0.9

Receptor ID	Land Use	NAC dB(A)	2012 Existing	Hourly Leq(h) dBA					
				2035 Build			Difference between Existing/Build		
				Cliff-1	Cliff-6	Cliff-7	Cliff-1	Cliff-6	Cliff-7
Shaded cells indicate noise levels that exceed the NAC									
409	C	66	63.4	64.7	64.5	64.5	1.3	1.1	1.1
410	C	66	65.0	66.2	65.1	65.1	1.2	0.1	0.1
411	C	66	65.8	67.0	66.5	66.5	1.2	0.7	0.7
412	C	66	64.8	66.1	65.9	65.9	1.3	1.1	1.1
413	C	66	64.8	66.3	66.1	66.1	1.5	1.3	1.3
414	C	66	65.1	66.4	66.3	66.3	1.3	1.2	1.2
415	C	66	64.9	66.2	66.1	66.1	1.3	1.2	1.2
416	C	66	65.2	66.4	66.4	66.4	1.2	1.2	1.2
417	C	66	65.2	66.4	66.4	66.4	1.2	1.2	1.2
530	B	66	57.2	60.2	60.4	59.9	3.0	3.2	2.7
531	B	66	57.8	60.9	61.0	60.6	3.1	3.2	2.8
532	B	66	58.1	61.4	61.3	61.0	3.3	3.2	2.9
533	B	66	58.8	62.1	62.0	61.8	3.3	3.2	3.0
534	B	66	59.7	63.1	63.0	62.7	3.4	3.3	3.0
535	B	66	60.2	63.1	63.2	62.6	2.9	3.0	2.4
537	B	66	58.9	61.1	61.7	60.9	2.2	2.8	2.0
538	B	66	59.4	61.6	62.1	61.4	2.2	2.7	2.0
539	B	66	59.5	61.8	62.2	61.5	2.3	2.7	2.0
540	B	66	60.0	62.3	62.6	61.9	2.3	2.6	1.9
541	B	66	61.1	63.3	63.9	62.7	2.2	2.8	1.6
544	B	66	61.9	63.1	64.5	62.7	1.2	2.6	0.8
545	B	66	62.0	63.1	64.6	62.7	1.1	2.6	0.7
546	B	66	62.2	63.3	64.8	62.9	1.1	2.6	0.7
547	B	66	63.1	64.0	66.1	63.6	0.9	3.0	0.5
549	B	66	63.4	64.3	*Note 1*	64.0	0.9	N/A	0.6
550	B	66	63.6	64.3	*Note 1*	64.1	0.7	N/A	0.5
551	B	66	64.8	65.5	*Note 1*	65.1	0.7	N/A	0.3
552	B	66	64.2	64.8	*Note 1*	64.5	0.6	N/A	0.3
6000	B	66	58.2	63.0	62.7	62.7	4.8	4.5	4.5
6001	B	66	58.2	62.9	62.7	62.7	4.7	4.5	4.5
6002	B	66	58.3	62.8	62.6	62.6	4.5	4.3	4.3
6003	B	66	58.5	62.8	62.6	62.5	4.3	4.1	4.0
6004	B	66	58.6	62.6	62.4	62.3	4.0	3.8	3.7
6005	B	66	58.8	62.7	62.6	62.5	3.9	3.8	3.7
6006	B	66	59.0	62.9	62.6	62.5	3.9	3.6	3.5
6007	B	66	57.6	61.9	61.6	61.6	4.3	4.0	4.0
6008	B	66	57.0	61.2	60.9	60.9	4.2	3.9	3.9

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA						
			2012 Existing	2035 Build			Difference between Existing/Build		
				Cliff-1	Cliff-6	Cliff-7	Cliff-1	Cliff-6	Cliff-7
Shaded cells indicate noise levels that exceed the NAC									
6009	B	66	58.0	61.9	61.6	61.6	3.9	3.6	3.6
6010	B	66	57.8	61.7	61.4	61.3	3.9	3.6	3.5
6011	B	66	57.4	61.2	61.0	60.8	3.8	3.6	3.4
6012	B	66	56.9	60.7	60.5	60.3	3.8	3.6	3.4
6013	B	66	56.3	60.1	60.0	59.7	3.8	3.7	3.4
6014	B	66	57.4	62.0	61.7	61.7	4.6	4.3	4.3
6015	B	66	56.6	60.9	60.5	60.4	4.3	3.9	3.8

Note 1: This receptor will be acquired as part of the proposed project.

8.Noise Impact Analysis

Noise abatement measures are considered when predicted traffic noise levels approach or exceed the NAC, or when the predicted traffic noise levels substantially exceed existing noise levels. As shown in Table 8, there are 15 traffic noise impacts predicted under the Existing Alternative; 42 impacts predicted under Future Build Alternatives 2-C2 and 2A-C2, and; 29 impacts predicted under Future Build Alternative 3C-C2.

Table 8: Impact Summary

Alternative	Approach/ Exceed NAC	Substantially Exceed	Total Receptors Affected
Existing	1	0	1
Build – Cliff-1	11	0	11
Build – Cliff-6	19	0	19
Build – Cliff-7	8	0	8

8.1. Impacts

8.1.1. Alternative Cliff-1

The difference between the existing 2012 and the predicted 2035 Build noise levels range from +0.6 to +5.9 dBA. The difference in noise levels can be accounted for by the increase in traffic between the existing and build alternatives as well as any changes in geometry. Results of this analysis indicate that 11 traffic noise impacts are predicted to occur as a result of Alternative Cliff-1.

8.1.2. Alternative Cliff-6

The difference between the existing 2012 and the predicted 2035 Build noise levels range from +0.1 to +5.8 dBA. The difference in noise levels can be accounted for by the increase in traffic between the existing and build alternatives as well as any changes in geometry. Results of this analysis indicate that 19 traffic noise impacts are predicted to occur as a result of Alternative Cliff-6.

8.1.3. Alternative Cliff-7

The difference between the existing 2012 and the predicted 2035 Build noise levels range from +0.1 to +5.8 dBA. The difference in noise levels can be accounted for by the increase in traffic between the existing and build alternatives as well as any changes in geometry. Results of this analysis indicate that 8 traffic noise impacts are predicted to occur as a result of Alternative Cliff-7.

9.Noise Abatement Measures

Per the scope for this sub-study, "in areas where future noise levels exceed state and federal criteria (23 CFR, Part 772 and the SDDOT noise policy), noise mitigation options will be identified and the conceptual feasibility of those options will be described. A detailed analysis of the cost reasonability of noise mitigation options will not be conducted at the corridor study phase. In addition, this task excludes specific public involvement for noise mitigation features such as providing ballots to owners and tenants of impacted properties."

Impacts are predicted as a result of all of the Build alternatives. Potential traffic noise abatement measures that could be considered for Build Alternatives Cliff-1, Cliff-6 and Cliff-7 are listed below, along with reasons why some are considered infeasible.

1. Modifying the proposed horizontal and/or vertical alignments of the roadway
    - *Several different alignments are under investigation*
2. Traffic management measures (e.g. modify speed limits and restrict truck traffic)
    - *Impractical given the type of road in question*
3. Construction of noise barriers along or within the ROW
    - *Potentially possible; to be discussed further in Section 9.1.*
4. Acquisition of property rights for construction of noise barriers
    - *Potentially possible; would be investigated further in final design.*
5. Acquisition of property to serve as a buffer zone
    - *Prohibitively expensive*

9.1. Discussion of Feasibility of Noise Barriers (based on SDDOT Guidance)

All of the following conditions must be met in order for noise abatement to be considered feasible. Failure to achieve any single element of feasibility will result in the noise abatement measure being deemed not feasible. Further investigation into feasibility and reasonability (noise reduction goal, cost-effectiveness, viewpoints of benefited receptors) would need to occur once a preferred alternative is selected.

Feasibility

When a traffic noise impact is identified on a project, noise abatement will be considered and evaluated for engineering and acoustical feasibility.

- **Engineering feasibility:**
  - Safety: An abatement measure will be deemed not feasible if it causes an excessive restriction of sight distance, continuous shadow resulting in icing or snow accumulation on driving lanes, or severe drainage problems associated either with the barrier or flood-prone areas.
  - Barrier height: The design of each proposed barrier will be considered on an individual basis when determining barrier height. The designed height of any proposed barrier may be adjusted based on feasibility and reasonableness considerations. Due to safety concerns, SDDOT will generally not construct barriers higher than 20 feet.
  - Topography: If the topography is such that an abatement measure cannot be built, then it will be deemed not feasible.
  - Drainage and utilities: A noise abatement measure is not feasible if access to drainage and utilities cannot be maintained.
  - Maintenance of the abatement measure, maintenance access to adjacent properties, and access to adjacent properties: A noise abatement measure is not feasible if access to the abatement measure, side streets, driveways, ramps, etc., cannot be maintained.

- **Acoustic Feasibility:** A noise abatement measure is considered acoustically feasible when a minimum of 60 percent of front-row receptors directly behind the noise wall (noise wall must extend entirely across receptor's property line) achieve a 5 dBA noise reduction.

To be most effective, a noise barrier must be long and continuous to prevent sounds from passing around the ends in a manner that reduces or compromises the noise reduction provided by the noise barrier. It must also be solid, with few, if any, holes, cracks or openings. The majority of the impacts with each proposed alternative occur along I-229. There is sufficient right-of-way for noise barriers that are continuously long-enough with no breaks or openings to be designed. Noise barriers shielding many of the impacted receptors along I-229 are potentially feasible. Further detailed analysis would need to be performed when a preferred alternative has been chosen to further examine individual noise barrier feasibility and reasonableness.

Noise barriers shielding the impacted receptors along the crossroads are unlikely to be feasible as a lack of sufficient right-of-way to construct many of the noise barriers is available and lack of access control would create too many openings in the noise barrier to allow access to driveways and cross-streets.

10. Construction Noise and Vibration

Construction of the Project would result in temporary noise and vibration increases within the Project area. The evaluation and control of construction noise and vibration must be considered along with traffic noise. This Project is bordered by commercial and residential receptors for which impacts from construction noise and vibration are a concern.

The following are basic categories for mitigation measures for construction noise. Due to the interrelatedness of construction noise and vibration, some of these measures will also apply for vibration resulting from construction activities.

Design Considerations: Design considerations include measures in the plans and specifications to minimize or eliminate adverse impacts. The proposed changes and their proximity to noise sensitive receptors were considered during design.

Community Awareness: It is important for people to be made aware of the possible inconvenience construction can cause, and to know its approximate duration so they can plan their activities accordingly. It is SDDOT's policy to submit such Project information to all local news media.

Source Control: Source control involves reducing noise impacts from construction by controlling the noise emissions at their source. This can be accomplished by specifying proper muffler systems, either as a requirement in the plans and specifications on this Project or through an established local noise ordinance requiring mufflers. Contractors generally maintain proper muffler systems on their equipment to ensure efficient operation and to minimize noise for the benefit of their own personnel as well as the adjacent receptors.

Site Control: Site control involves the specification of certain areas where extra precautions should be taken to minimize construction noise. One way to reduce construction noise impacts at sensitive receptors is to operate stationary equipment, such as air compressors or generators, as far away from the sensitive receptors as possible. Another method might be placing a temporary noise barrier in front of the equipment. As a general rule, good coordination between the project engineer, the contractor and the affected receptors is less confusing, less likely to increase the cost of the project ,and provides a more personal approach to work out ways to minimize construction noise impacts in the more noise-sensitive areas.

Time and Activity Constraints: Limiting working hours on a construction site can be very beneficial during the hours of sleep or on Sundays and holidays. However, most construction activities do not occur at night and usually not on Sundays. Exceptions due to weather, schedule, and time-related phases of construction could occur. Enforcement of such constraints could be handled through a general city or county ordinance, either listing the exceptions or granting them on a case-by-case basis.

11. Information for Local Officials

Local officials will be provided with information on noise compatible planning techniques that can be used to prevent future highway traffic noise impacts. To assist local officials within whose jurisdiction a Type I highway project is located, SDDOT will provide information on future noise levels for each Activity Category located along the project. This is accomplished by providing a copy of the noise analysis report to the local official. The local official will also be provided with an estimation of future noise levels at various distances from the highway (Appendix B Noise Contours).

12. Conclusion

Traffic noise levels were evaluated for the existing conditions and future Build Alternatives Cliff-1, Cliff-6 and Cliff-7 at 80 receptors in the Project area. There is 1 traffic noise impact predicted under the Existing Alternative; 11 impacts predicted under Future Build Alternative Cliff-1, 19 impacts predicted under Future Build Alternative Cliff-6 and 8 impacts predicted under Future Build Alternative Cliff-7.

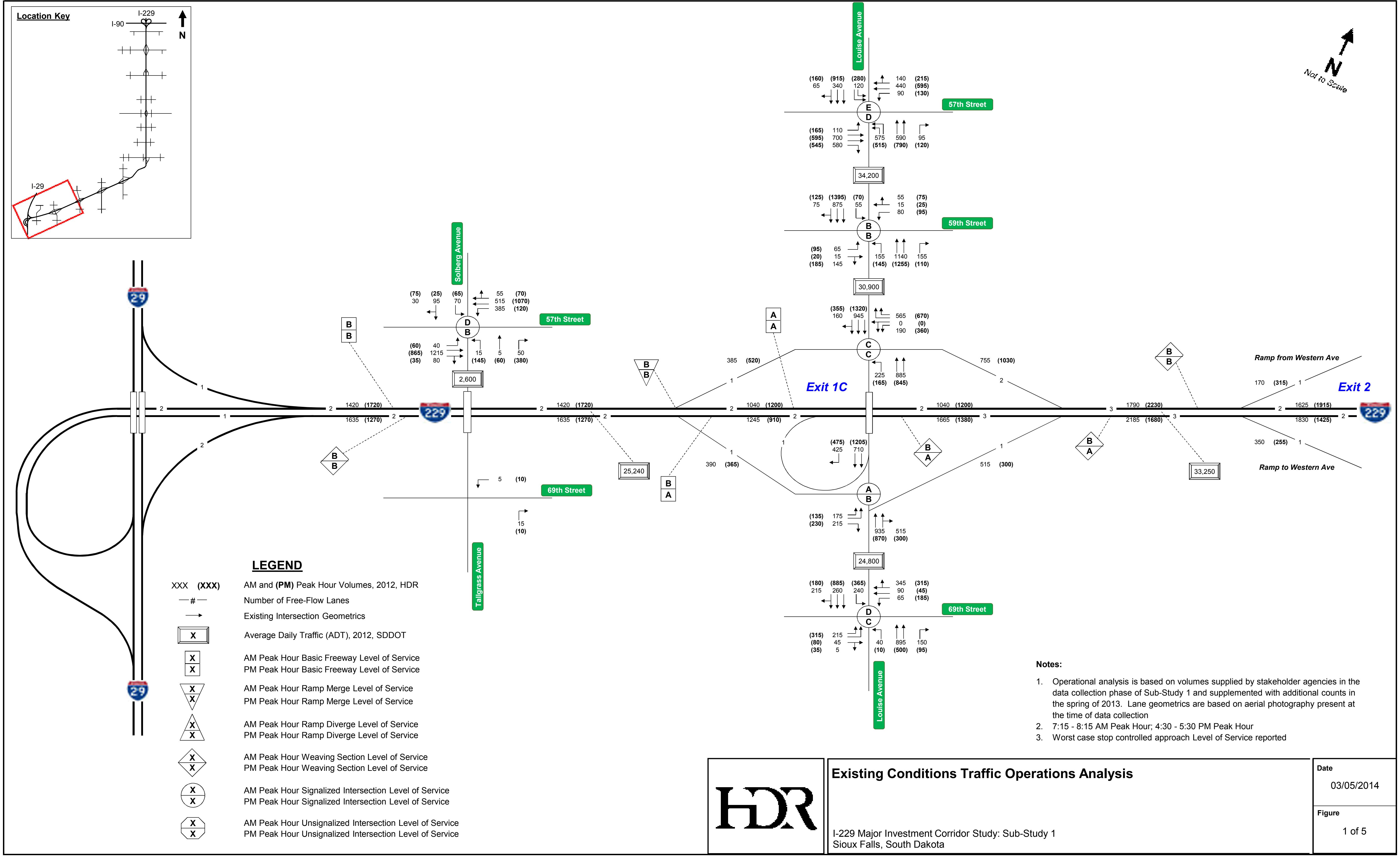
13. References

South Dakota Department of Transportation, “Noise Analysis and Abatement Guidance,” July 13, 2011.

Federal Highway Administration (FHWA), “Procedures for Abatement of Highway Traffic Noise and Construction Noise,” July 13, 2011.

Methods for evaluation and control of construction noise were taken from the FHWA Special Report – “Highway Construction Noise: Measurement, Prediction and Mitigation.”

Appendix A
Traffic Volumes



Notes:

1. Operational analysis is based on volumes supplied by stakeholder agencies in the data collection phase of Sub-Study 1 and supplemented with additional counts in the spring of 2013. Lane geometrics are based on aerial photography present at the time of data collection
2. 7:15 - 8:15 AM Peak Hour; 4:30 - 5:30 PM Peak Hour
3. Worst case stop controlled approach Level of Service reported

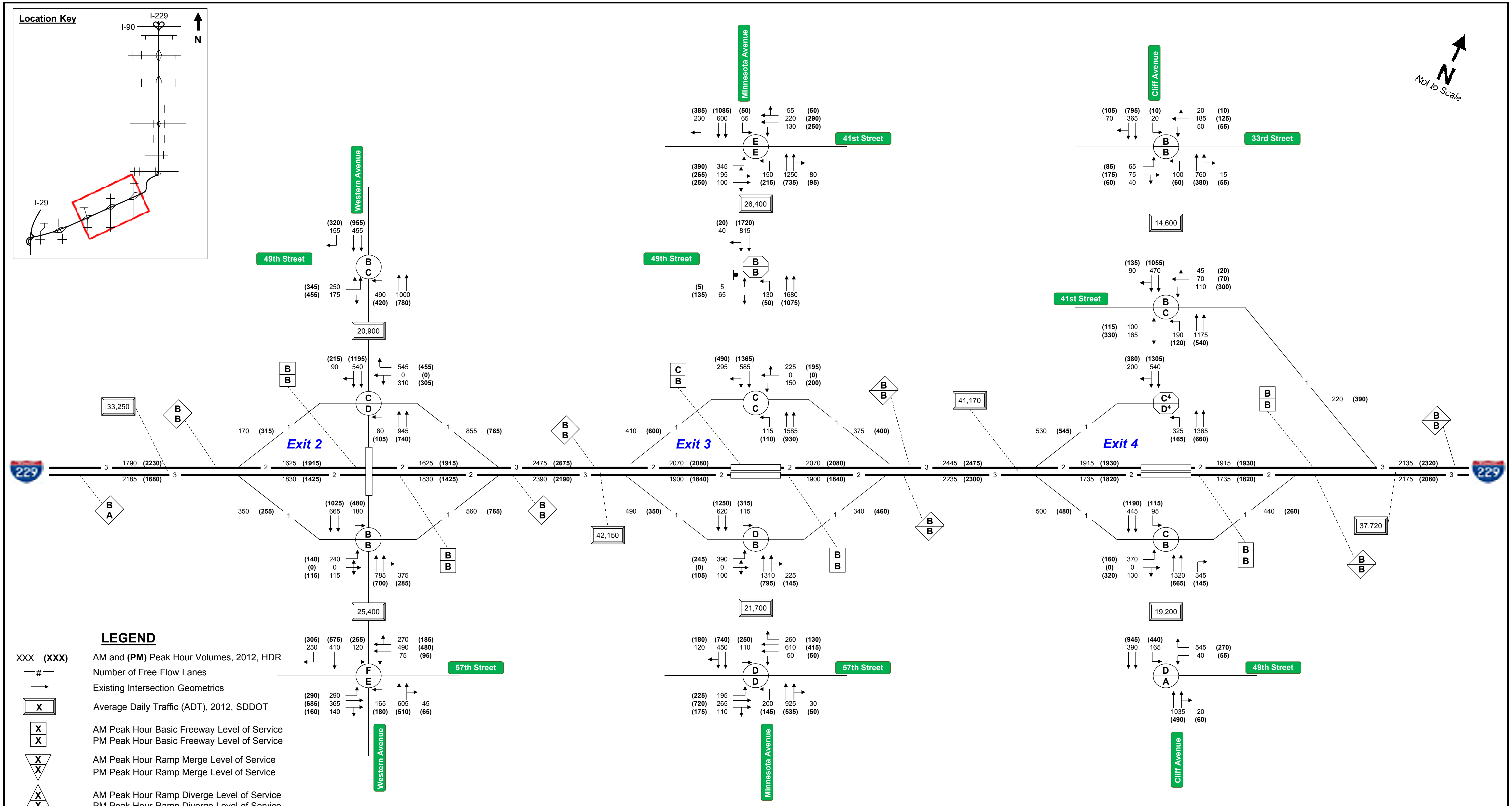
HDR

Existing Conditions Traffic Operations Analysis

I-229 Major Investment Corridor Study: Sub-Study 1
Sioux Falls, South Dakota

Date
03/05/2014

Figure
1 of 5



LEGEND

XXX (XXX)	AM and **(PM)** Peak Hour Volumes, 2012, HDR
—#—	Number of Free-Flow Lanes
→	Existing Intersection Geometrics
X	Average Daily Traffic (ADT), 2012, SDDOT
X X	AM Peak Hour Basic Freeway Level of Service PM Peak Hour Basic Freeway Level of Service
X X	AM Peak Hour Ramp Merge Level of Service PM Peak Hour Ramp Merge Level of Service
X X	AM Peak Hour Ramp Diverge Level of Service PM Peak Hour Ramp Diverge Level of Service
X X	AM Peak Hour Weaving Section Level of Service PM Peak Hour Weaving Section Level of Service
X X	AM Peak Hour Signalized Intersection Level of Service PM Peak Hour Signalized Intersection Level of Service
X X	AM Peak Hour Unsignalized Intersection Level of Service PM Peak Hour Unsignalized Intersection Level of Service

Notes:

1. Operational analysis is based on volumes supplied by stakeholder agencies in the data collection phase of Sub-Study 1 and supplemented with additional counts in the spring of 2013. Lane geometrics are based on aerial photography present at the time of data collection
2. 7:15 - 8:15 AM Peak Hour; 4:30 - 5:30 PM Peak Hour
3. Worst case stop controlled approach Level of Service reported

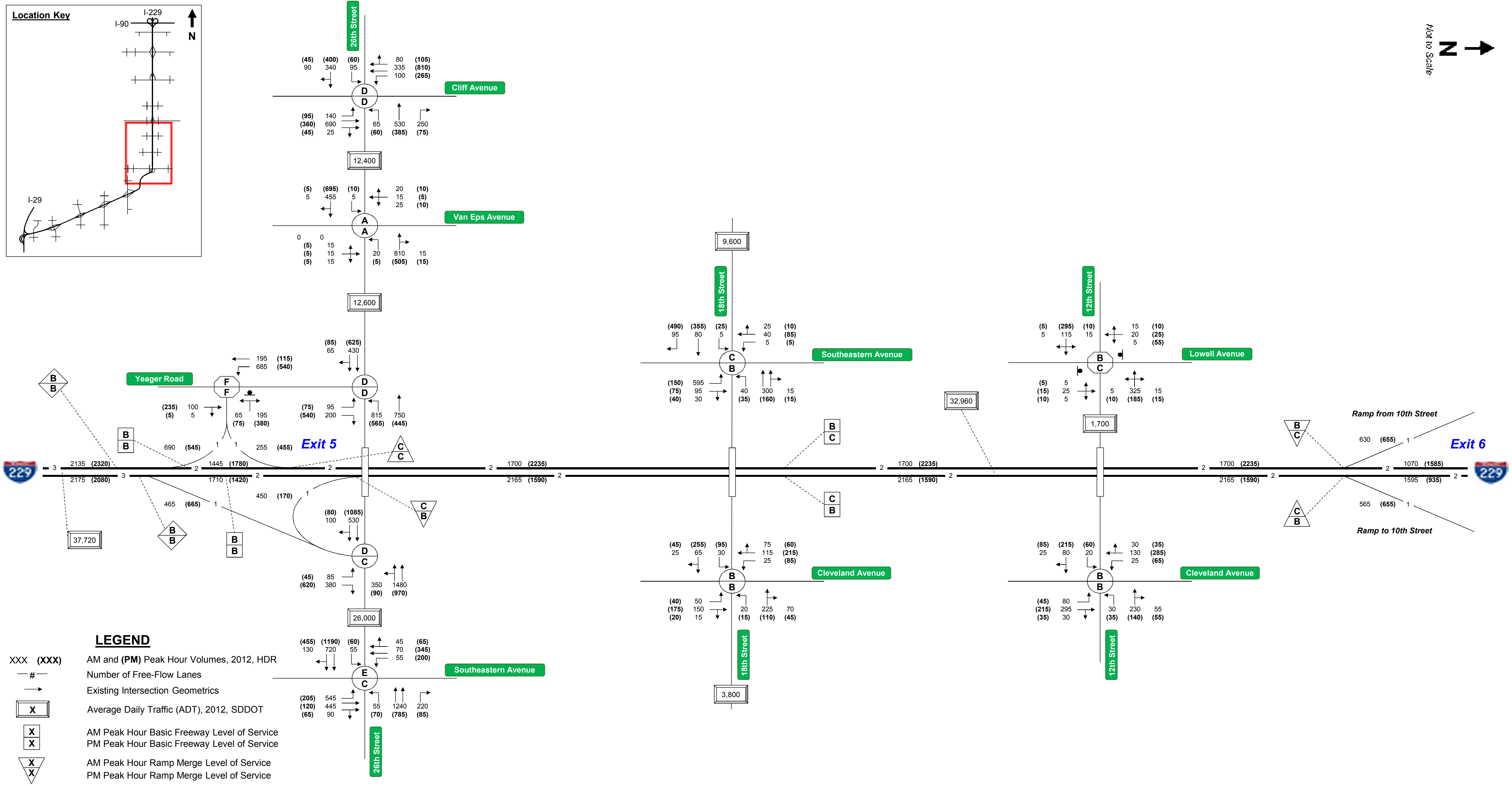
HDR

Existing Conditions Traffic Operations Analysis

I-229 Major Investment Corridor Study: Sub-Study 1
Sioux Falls, South Dakota

Date
03/05/2014

Figure
2 of 5



LEGEND

XXX **(XXX)**	AM and **(PM)** Peak Hour Volumes, 2012, HDR
—#—	Number of Free-Flow Lanes
→	Existing Intersection Geometrics
X	Average Daily Traffic (ADT), 2012, SDDOT
X X	AM Peak Hour Basic Freeway Level of Service PM Peak Hour Basic Freeway Level of Service
X X	AM Peak Hour Ramp Merge Level of Service PM Peak Hour Ramp Merge Level of Service
X X	AM Peak Hour Ramp Diverge Level of Service PM Peak Hour Ramp Diverge Level of Service
X X	AM Peak Hour Weaving Section Level of Service PM Peak Hour Weaving Section Level of Service
X X	AM Peak Hour Signalized Intersection Level of Service PM Peak Hour Signalized Intersection Level of Service
X X	AM Peak Hour Unsignalized Intersection Level of Service PM Peak Hour Unsignalized Intersection Level of Service

Notes:

1. Operational analysis is based on volumes supplied by stakeholder agencies in the data collection phase of Sub-Study 1 and supplemented with additional counts in the spring of 2013. Lane geometrics are based on aerial photography present at the time of data collection
2. 7:15 - 8:15 AM Peak Hour; 4:30 - 5:30 PM Peak Hour
3. Worst case stop controlled approach Level of Service reported

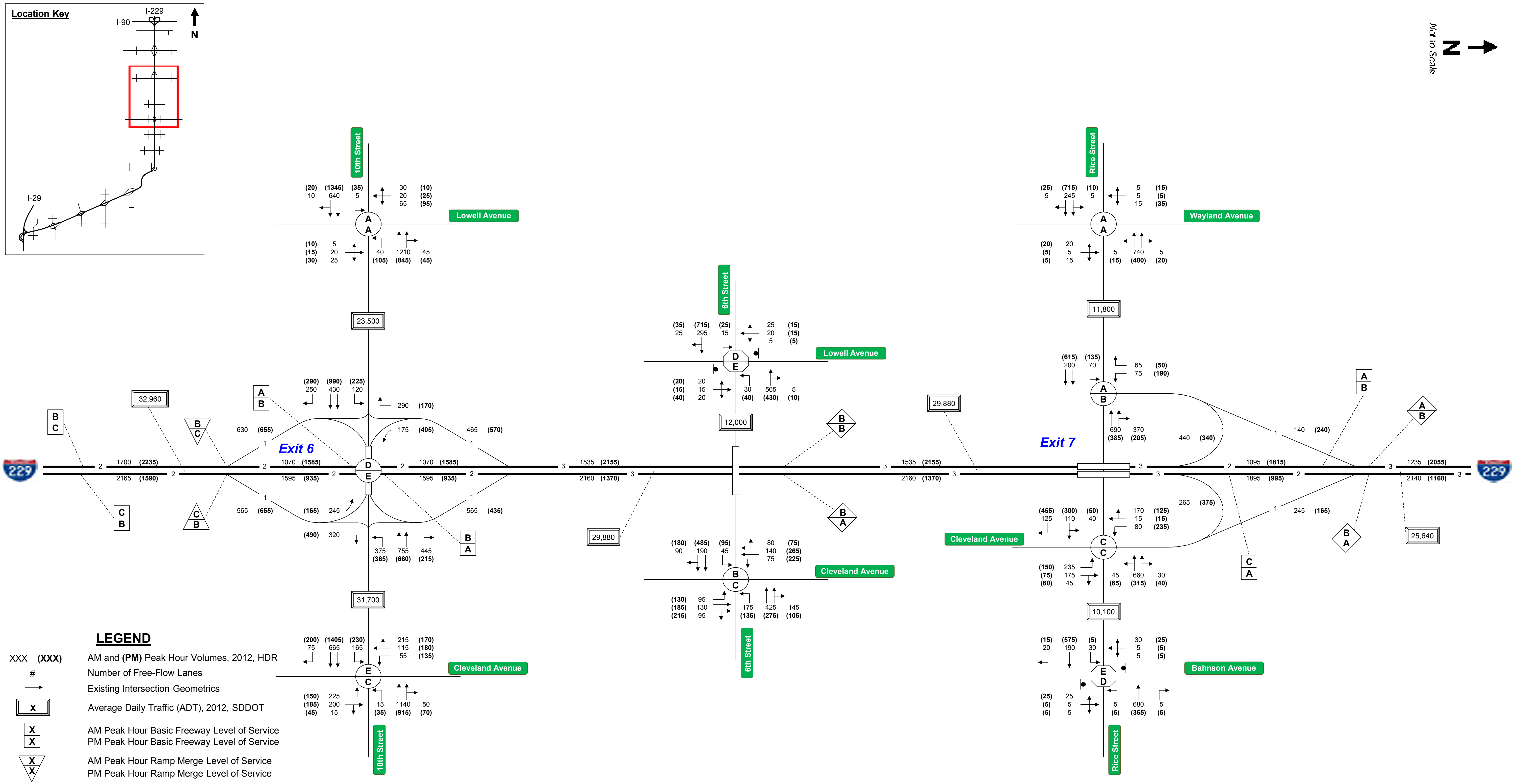
HDR

Existing Conditions Traffic Operations Analysis

I-229 Major Investment Corridor Study: Sub-Study 1
Sioux Falls, South Dakota

Date
03/05/2014

Figure
3 of 5



LEGEND

XXX **(XXX)**	AM and **(PM)** Peak Hour Volumes, 2012, HDR
—#—	Number of Free-Flow Lanes
→	Existing Intersection Geometrics
X	Average Daily Traffic (ADT), 2012, SDDOT
X X	AM Peak Hour Basic Freeway Level of Service PM Peak Hour Basic Freeway Level of Service
X X	AM Peak Hour Ramp Merge Level of Service PM Peak Hour Ramp Merge Level of Service
X X	AM Peak Hour Ramp Diverge Level of Service PM Peak Hour Ramp Diverge Level of Service
X X	AM Peak Hour Weaving Section Level of Service PM Peak Hour Weaving Section Level of Service
X X	AM Peak Hour Signalized Intersection Level of Service PM Peak Hour Signalized Intersection Level of Service
X X	AM Peak Hour Unsignalized Intersection Level of Service PM Peak Hour Unsignalized Intersection Level of Service

Notes:

1. Operational analysis is based on volumes supplied by stakeholder agencies in the data collection phase of Sub-Study 1 and supplemented with additional counts in the spring of 2013. Lane geometrics are based on aerial photography present at the time of data collection
2. 7:15 - 8:15 AM Peak Hour; 4:30 - 5:30 PM Peak Hour
3. Worst case stop controlled approach Level of Service reported

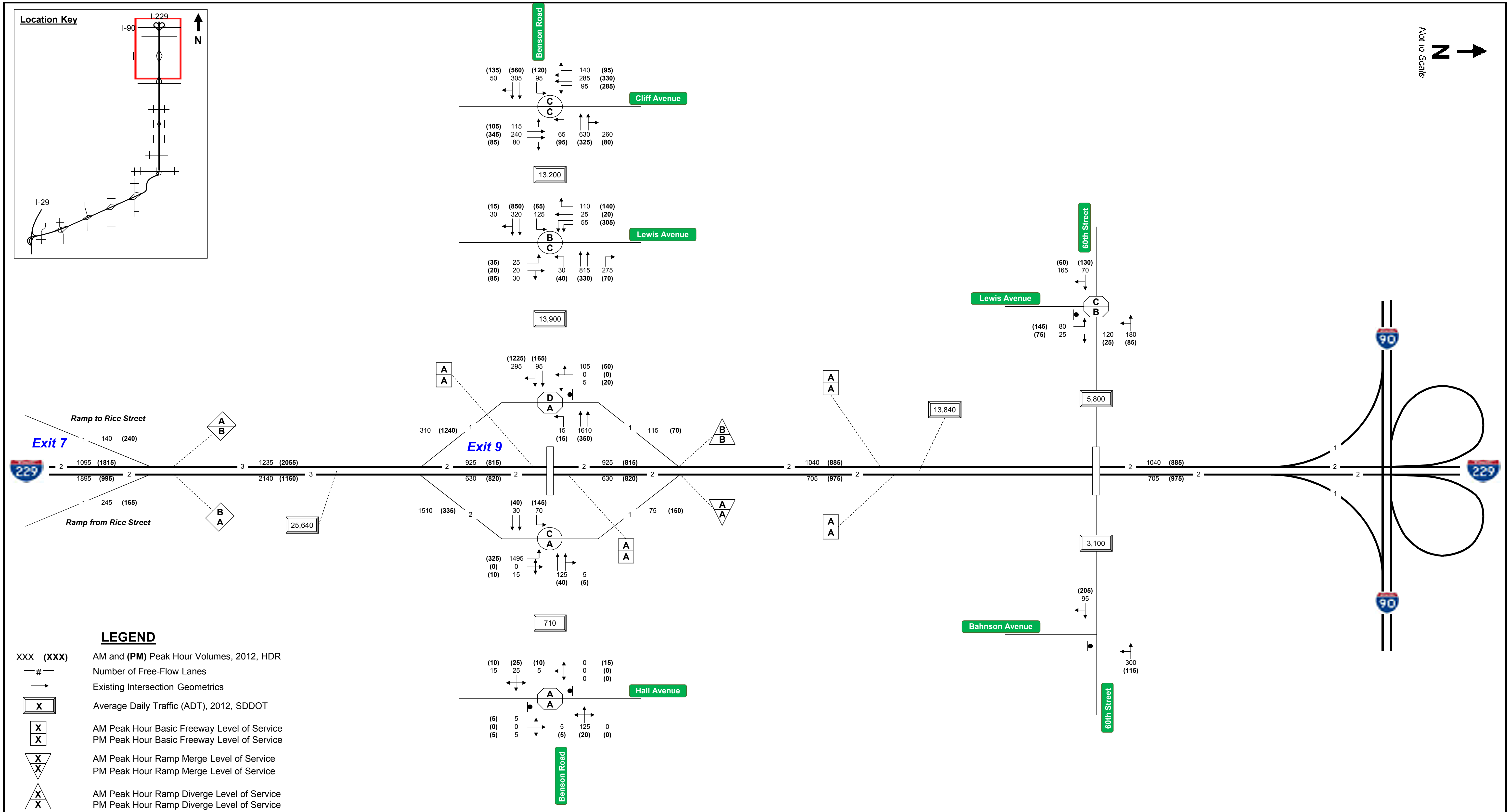
HDR

Existing Conditions Traffic Operations Analysis

I-229 Major Investment Corridor Study: Sub-Study 1
Sioux Falls, South Dakota

Date
03/05/2014

Figure
4 of 5



LEGEND

XXX **(XXX)**	AM and **(PM)** Peak Hour Volumes, 2012, HDR
—#—	Number of Free-Flow Lanes
→	Existing Intersection Geometrics
X	Average Daily Traffic (ADT), 2012, SDDOT
X X	AM Peak Hour Basic Freeway Level of Service PM Peak Hour Basic Freeway Level of Service
X X	AM Peak Hour Ramp Merge Level of Service PM Peak Hour Ramp Merge Level of Service
X X	AM Peak Hour Ramp Diverge Level of Service PM Peak Hour Ramp Diverge Level of Service
X X	AM Peak Hour Weaving Section Level of Service PM Peak Hour Weaving Section Level of Service
X X	AM Peak Hour Signalized Intersection Level of Service PM Peak Hour Signalized Intersection Level of Service
X X	AM Peak Hour Unsignalized Intersection Level of Service PM Peak Hour Unsignalized Intersection Level of Service

Notes:

1. Operational analysis is based on volumes supplied by stakeholder agencies in the data collection phase of Sub-Study 1 and supplemented with additional counts in the spring of 2013. Lane geometrics are based on aerial photography present at the time of data collection
2. 7:15 - 8:15 AM Peak Hour; 4:30 - 5:30 PM Peak Hour
3. Worst case stop controlled approach Level of Service reported

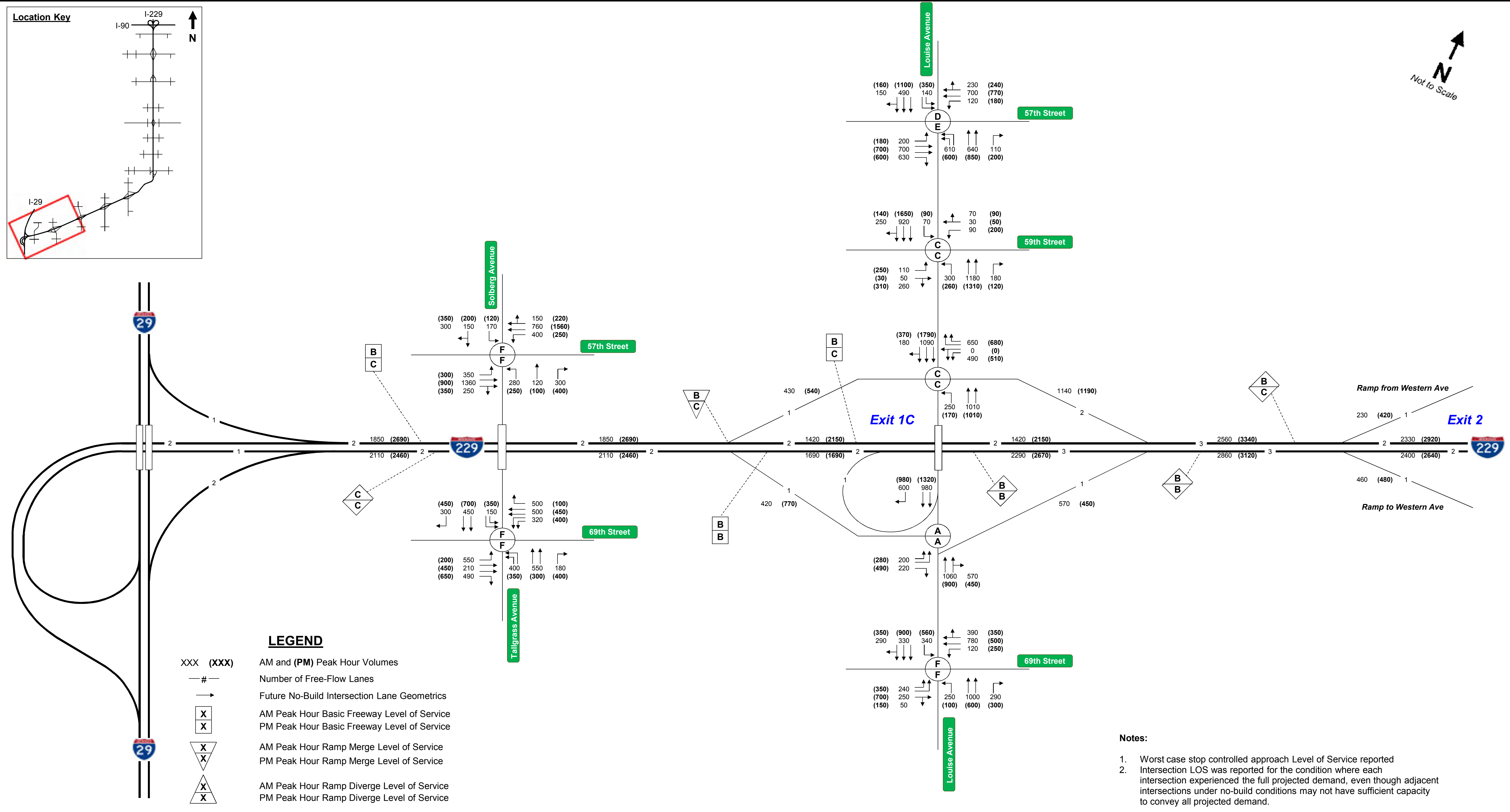
HDR

Existing Conditions Traffic Operations Analysis

I-229 Major Investment Corridor Study: Sub-Study 1
Sioux Falls, South Dakota

Date
03/05/2014

Figure
5 of 5



LEGEND

XXX **(XXX)**	AM and **(PM)** Peak Hour Volumes
—#—	Number of Free-Flow Lanes
→	Future No-Build Intersection Lane Geometrics
X X	AM Peak Hour Basic Freeway Level of Service PM Peak Hour Basic Freeway Level of Service
X X	AM Peak Hour Ramp Merge Level of Service PM Peak Hour Ramp Merge Level of Service
X X	AM Peak Hour Ramp Diverge Level of Service PM Peak Hour Ramp Diverge Level of Service
X X	AM Peak Hour Weaving Section Level of Service PM Peak Hour Weaving Section Level of Service
X X	AM Peak Hour Signalized Intersection Level of Service PM Peak Hour Signalized Intersection Level of Service
X X	AM Peak Hour Unsignalized Intersection Level of Service PM Peak Hour Unsignalized Intersection Level of Service

Notes:

1. Worst case stop controlled approach Level of Service reported
2. Intersection LOS was reported for the condition where each intersection experienced the full projected demand, even though adjacent intersections under no-build conditions may not have sufficient capacity to convey all projected demand.

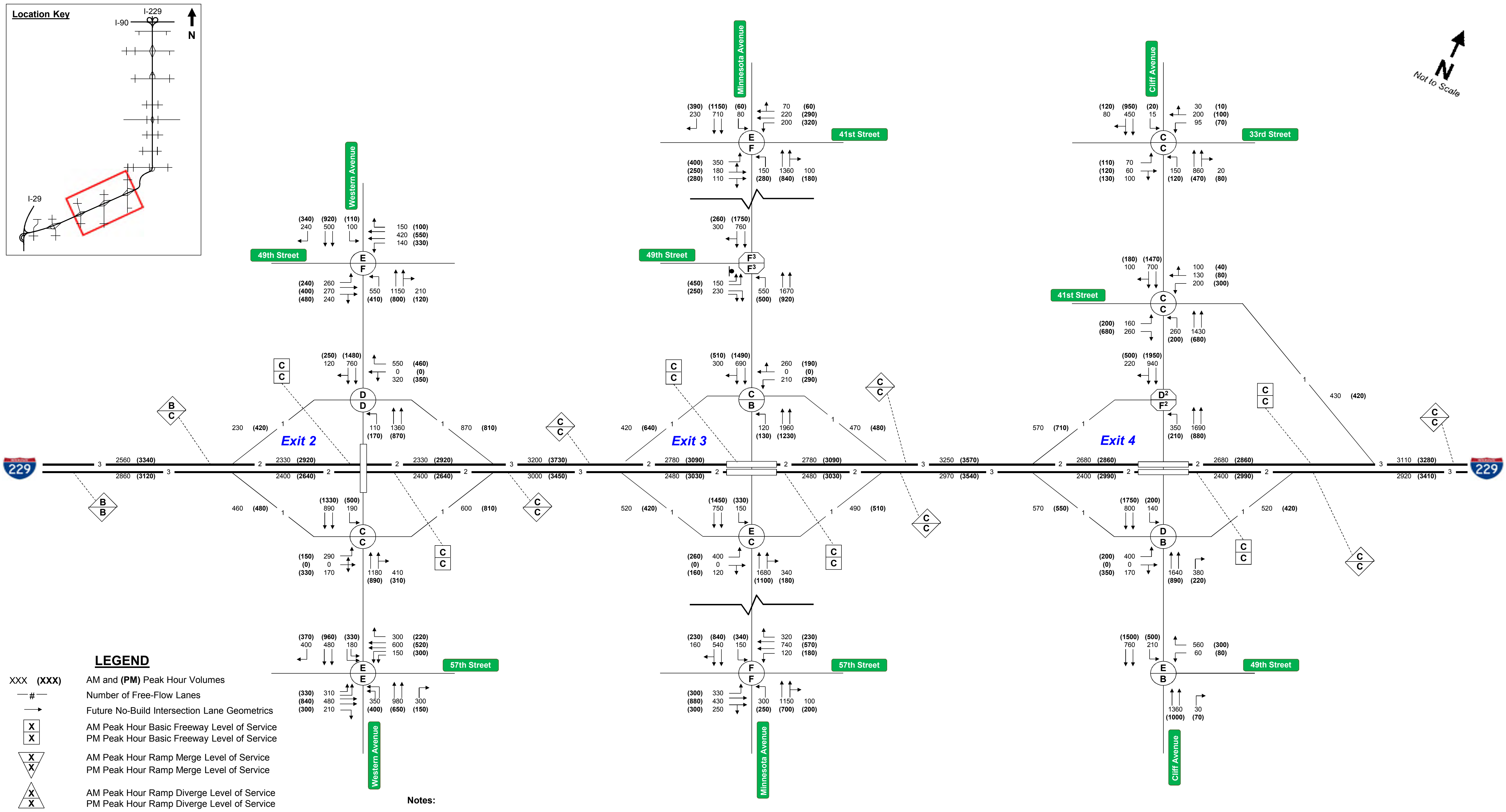
HDR

2035 No-Build "Worst Case" Conditions Traffic Operations Analysis

I-229 Major Investment Corridor Study: Sub-Study 1
I-229 Corridor Study
Sioux Falls, South Dakota

Date
11/5/2014

Figure
1



LEGEND

XXX (XXX)	AM and (PM) Peak Hour Volumes
—#—	Number of Free-Flow Lanes
→	Future No-Build Intersection Lane Geometrics
X X	AM Peak Hour Basic Freeway Level of Service PM Peak Hour Basic Freeway Level of Service
X X	AM Peak Hour Ramp Merge Level of Service PM Peak Hour Ramp Merge Level of Service
X X	AM Peak Hour Ramp Diverge Level of Service PM Peak Hour Ramp Diverge Level of Service
X X	AM Peak Hour Weaving Section Level of Service PM Peak Hour Weaving Section Level of Service
X X	AM Peak Hour Signalized Intersection Level of Service PM Peak Hour Signalized Intersection Level of Service
X X	AM Peak Hour Unsignalized Intersection Level of Service PM Peak Hour Unsignalized Intersection Level of Service

Notes:

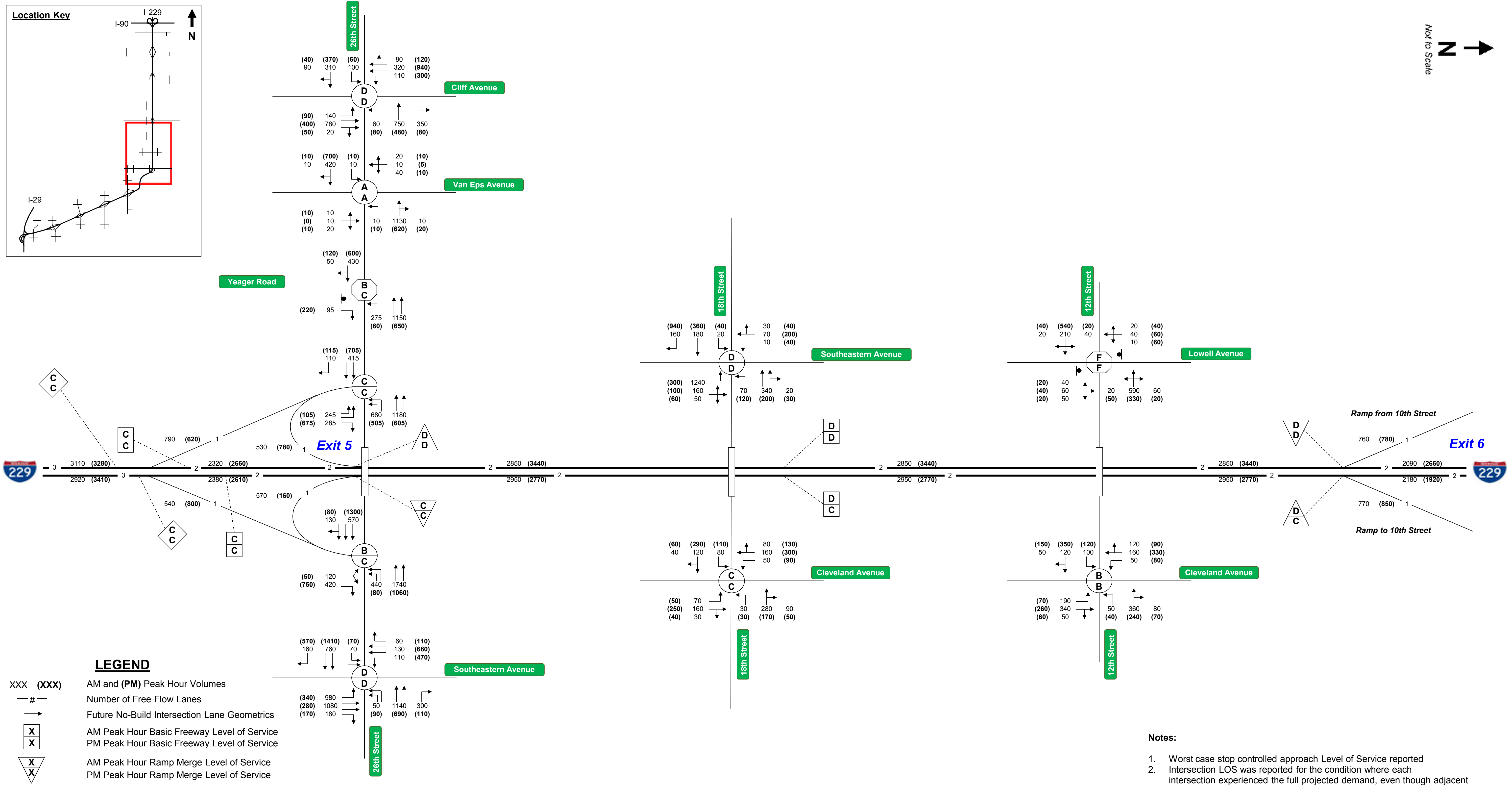
1. Worst case stop controlled approach Level of Service reported
2. Worst case stop controlled movement Level of Service reported
3. Level of Service reported from HCS 2010 analysis using a single left-turn lane and a single right-turn lane due to limitations of HCS 2010 software.
4. Intersection LOS was reported for the condition where each intersection experienced the full projected demand, even though adjacent intersections under no-build conditions may not have sufficient capacity

2035 No-Build "Worst Case" Conditions Traffic Operations Analysis

I-229 Major Investment Corridor Study: Sub-Study 1
I-229 Corridor Study
Sioux Falls, South Dakota

Date
11/5/2014

Figure
2



LEGEND

XXX (XXX) AM and **(PM)** Peak Hour Volumes

—#— Number of Free-Flow Lanes

→ Future No-Build Intersection Lane Geometrics

X / X AM Peak Hour Basic Freeway Level of Service
PM Peak Hour Basic Freeway Level of Service

X / X AM Peak Hour Ramp Merge Level of Service
PM Peak Hour Ramp Merge Level of Service

X / X AM Peak Hour Ramp Diverge Level of Service
PM Peak Hour Ramp Diverge Level of Service

X / X AM Peak Hour Weaving Section Level of Service
PM Peak Hour Weaving Section Level of Service

X / X AM Peak Hour Signalized Intersection Level of Service
PM Peak Hour Signalized Intersection Level of Service

X / X AM Peak Hour Unsignalized Intersection Level of Service
PM Peak Hour Unsignalized Intersection Level of Service

Notes:

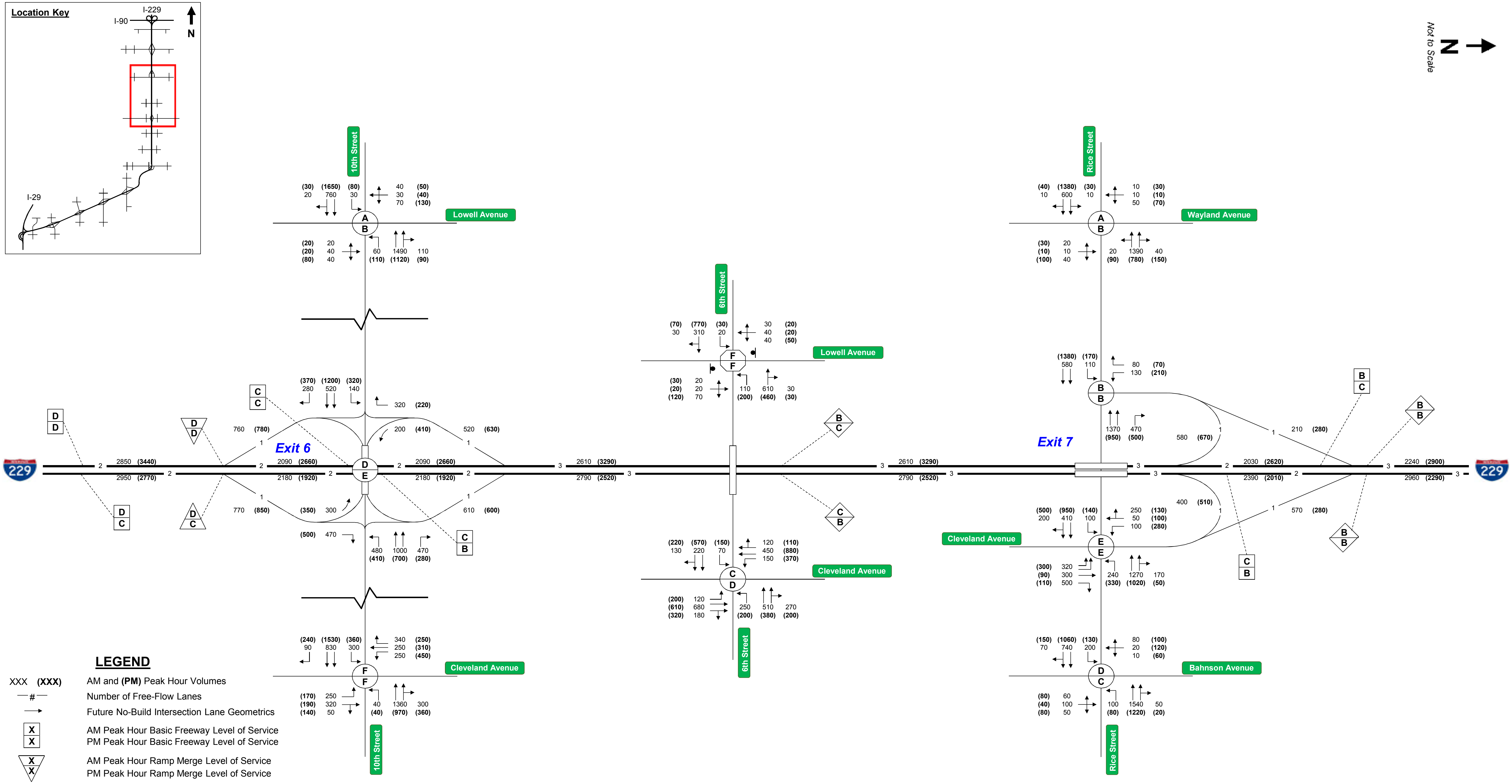
1. Worst case stop controlled approach Level of Service reported
2. Intersection LOS was reported for the condition where each intersection experienced the full projected demand, even though adjacent intersections under no-build conditions may not have sufficient capacity to convey all projected demand.

2035 No-Build "Worst Case" Conditions Traffic Operations Analysis

I-229 Major Investment Corridor Study: Sub-Study 1
I-229 Corridor Study
Sioux Falls, South Dakota

Date
11/5/2014

Figure
3



LEGEND

XXX **(XXX)**	AM and **(PM)** Peak Hour Volumes
—#—	Number of Free-Flow Lanes
→	Future No-Build Intersection Lane Geometrics
X X	AM Peak Hour Basic Freeway Level of Service PM Peak Hour Basic Freeway Level of Service
X X	AM Peak Hour Ramp Merge Level of Service PM Peak Hour Ramp Merge Level of Service
X X	AM Peak Hour Ramp Diverge Level of Service PM Peak Hour Ramp Diverge Level of Service
X X	AM Peak Hour Weaving Section Level of Service PM Peak Hour Weaving Section Level of Service
X X	AM Peak Hour Signalized Intersection Level of Service PM Peak Hour Signalized Intersection Level of Service
X X	AM Peak Hour Unsignalized Intersection Level of Service PM Peak Hour Unsignalized Intersection Level of Service

Notes:

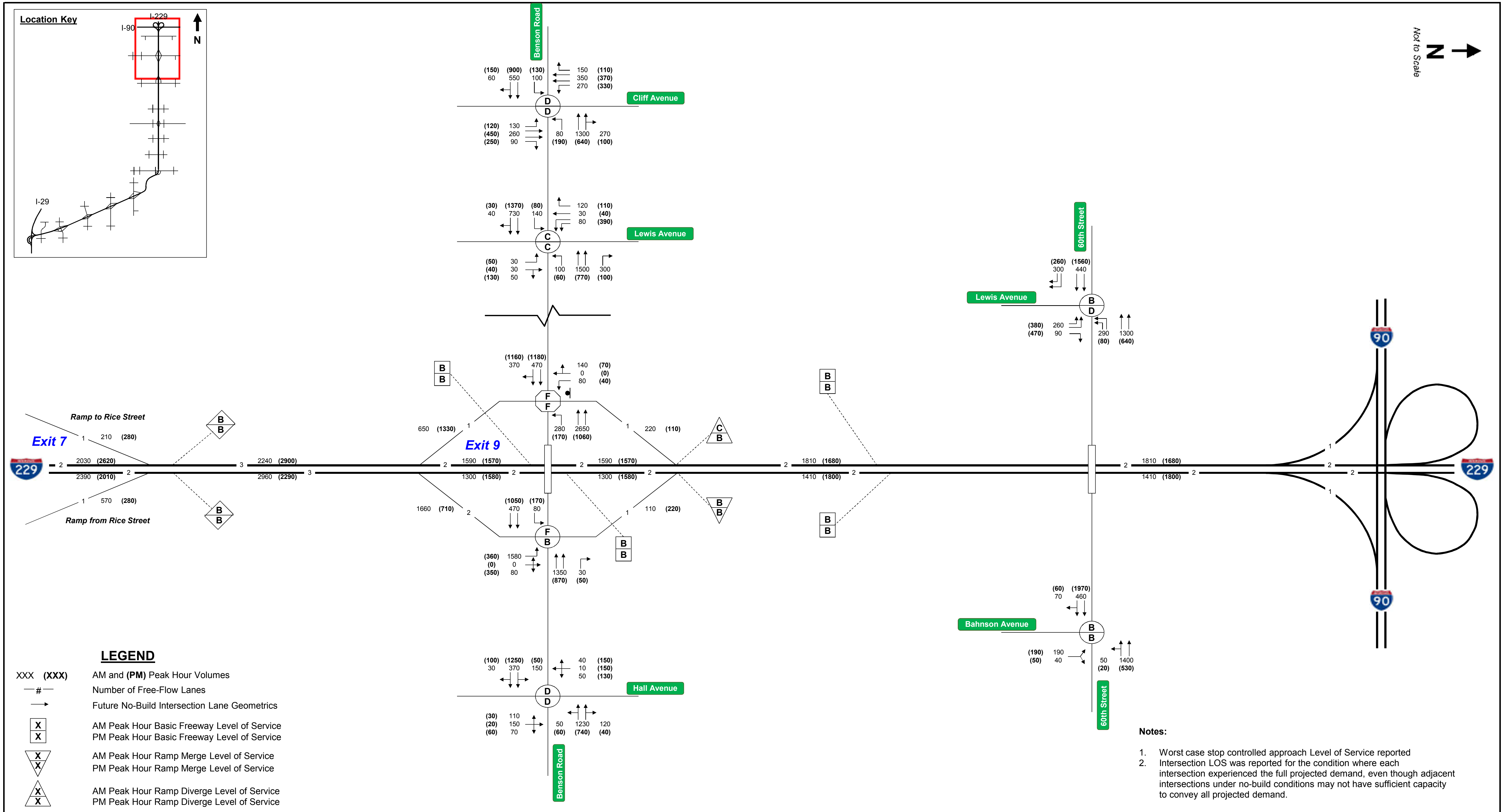
1. Worst case stop controlled approach Level of Service reported
2. Intersection LOS was reported for the condition where each intersection experienced the full projected demand, even though adjacent intersections under no-build conditions may not have sufficient capacity to convey all projected demand.

2035 No-Build "Worst Case" Conditions Traffic Operations Analysis

I-229 Major Investment Corridor Study: Sub-Study 1
I-229 Corridor Study
Sioux Falls, South Dakota

Date
11/5/2014

Figure
4



LEGEND

XXX **(XXX)**	AM and **(PM)** Peak Hour Volumes
—#—	Number of Free-Flow Lanes
→	Future No-Build Intersection Lane Geometrics
X X	AM Peak Hour Basic Freeway Level of Service PM Peak Hour Basic Freeway Level of Service
X X	AM Peak Hour Ramp Merge Level of Service PM Peak Hour Ramp Merge Level of Service
X X	AM Peak Hour Ramp Diverge Level of Service PM Peak Hour Ramp Diverge Level of Service
X X	AM Peak Hour Weaving Section Level of Service PM Peak Hour Weaving Section Level of Service
X X	AM Peak Hour Signalized Intersection Level of Service PM Peak Hour Signalized Intersection Level of Service
X X	AM Peak Hour Unsignalized Intersection Level of Service PM Peak Hour Unsignalized Intersection Level of Service

Notes:

1. Worst case stop controlled approach Level of Service reported
2. Intersection LOS was reported for the condition where each intersection experienced the full projected demand, even though adjacent intersections under no-build conditions may not have sufficient capacity to convey all projected demand.

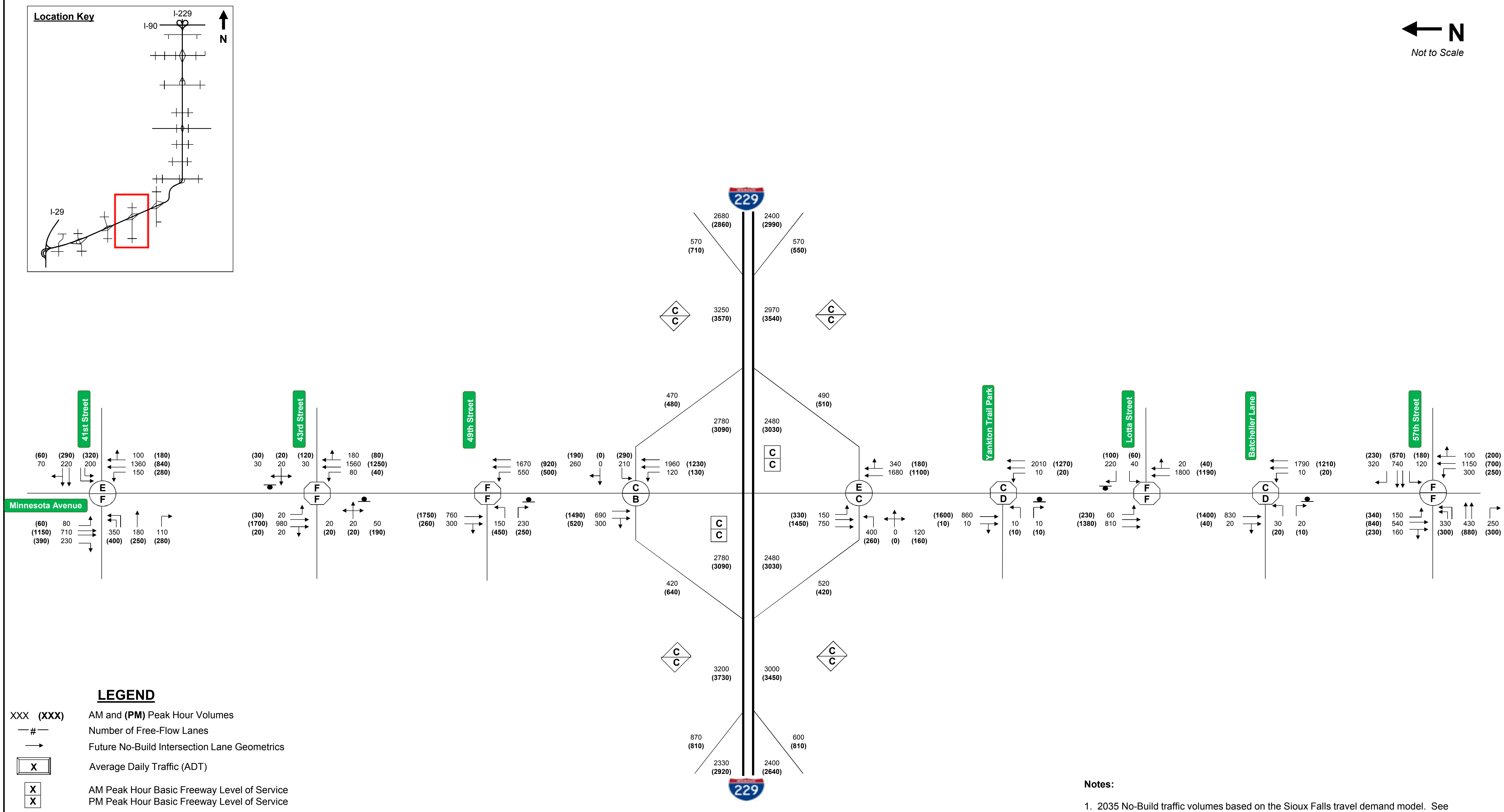
HDR

2035 No-Build "Worst Case" Conditions Traffic Operations Analysis

I-229 Major Investment Corridor Study: Sub-Study 1
I-229 Corridor Study
Sioux Falls, South Dakota

Date
11/5/2014

Figure
5



LEGEND

XXX (XXX) AM and (PM) Peak Hour Volumes
—#— Number of Free-Flow Lanes
→ Future No-Build Intersection Lane Geometrics
X Average Daily Traffic (ADT)
X X AM Peak Hour Basic Freeway Level of Service / PM Peak Hour Basic Freeway Level of Service
X X AM Peak Hour Ramp Merge Level of Service / PM Peak Hour Ramp Merge Level of Service
X X AM Peak Hour Ramp Diverge Level of Service / PM Peak Hour Ramp Diverge Level of Service
X X AM Peak Hour Weaving Section Level of Service / PM Peak Hour Weaving Section Level of Service
X X AM Peak Hour Signalized Intersection Level of Service / PM Peak Hour Signalized Intersection Level of Service
X X AM Peak Hour Unsignalized Intersection Level of Service / PM Peak Hour Unsignalized Intersection Level of Service

Notes:

1. 2035 No-Build traffic volumes based on the Sioux Falls travel demand model. See report text for additional information on volume development.
2. Worst case stop controlled approach Level of Service reported

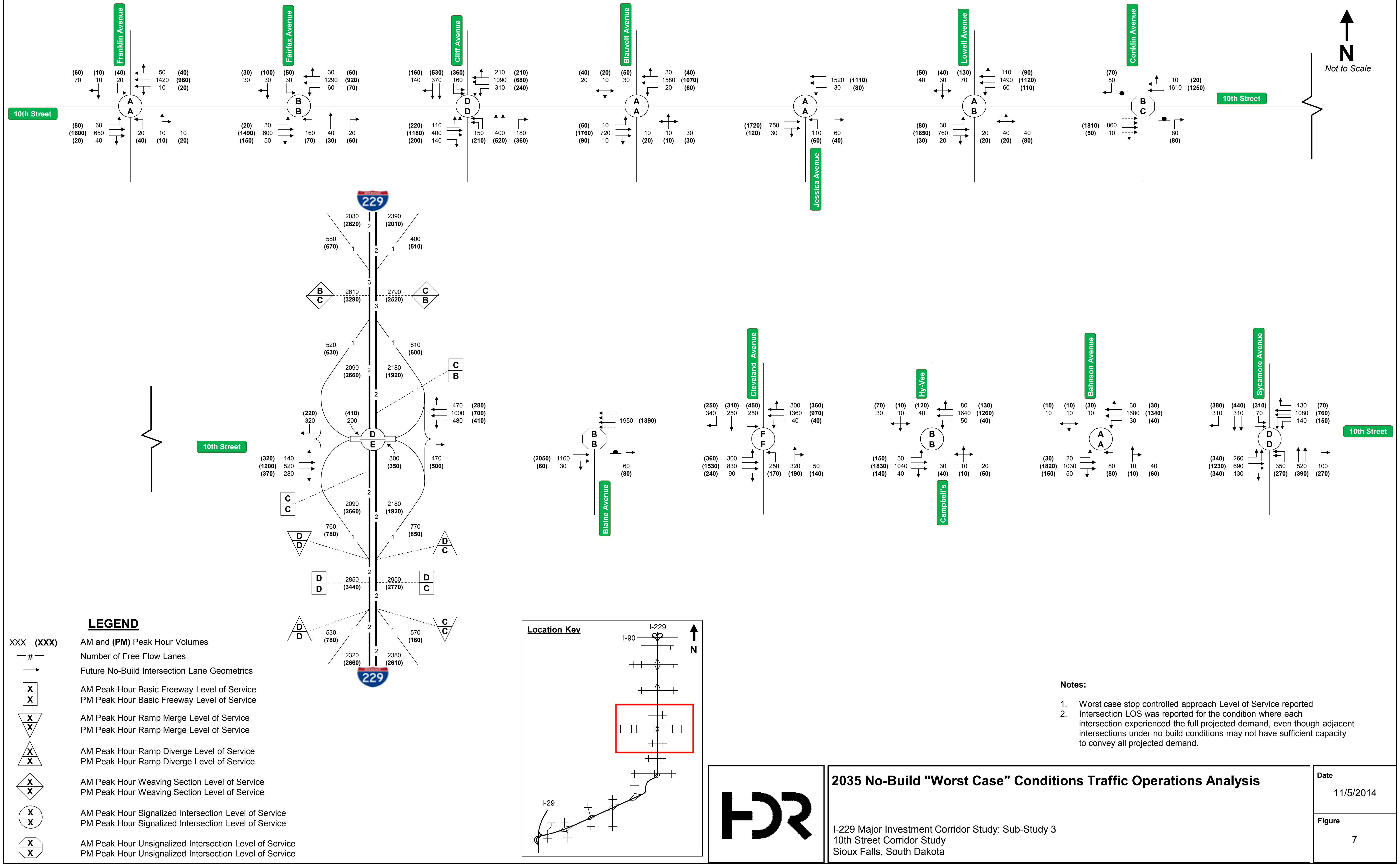
HRGreen

2035 No-Build "Worst Case" Conditions Traffic Operations Analysis

I-229 Major Investment Corridor Study: Sub-Study 2
Minnesota Avenue Corridor Study
Sioux Falls, South Dakota

Date
11/5/2014

Figure
6



LEGEND

XXX **(XXX)**	AM and **(PM)** Peak Hour Volumes
—#—	Number of Free-Flow Lanes
→	Future No-Build Intersection Lane Geometrics
X X	AM Peak Hour Basic Freeway Level of Service PM Peak Hour Basic Freeway Level of Service
X X	AM Peak Hour Ramp Merge Level of Service PM Peak Hour Ramp Merge Level of Service
X X	AM Peak Hour Ramp Diverge Level of Service PM Peak Hour Ramp Diverge Level of Service
X X	AM Peak Hour Weaving Section Level of Service PM Peak Hour Weaving Section Level of Service
X X	AM Peak Hour Signalized Intersection Level of Service PM Peak Hour Signalized Intersection Level of Service
X X	AM Peak Hour Unsignalized Intersection Level of Service PM Peak Hour Unsignalized Intersection Level of Service

Notes:

1. Worst case stop controlled approach Level of Service reported
2. Intersection LOS was reported for the condition where each intersection experienced the full projected demand, even though adjacent intersections under no-build conditions may not have sufficient capacity to convey all projected demand.

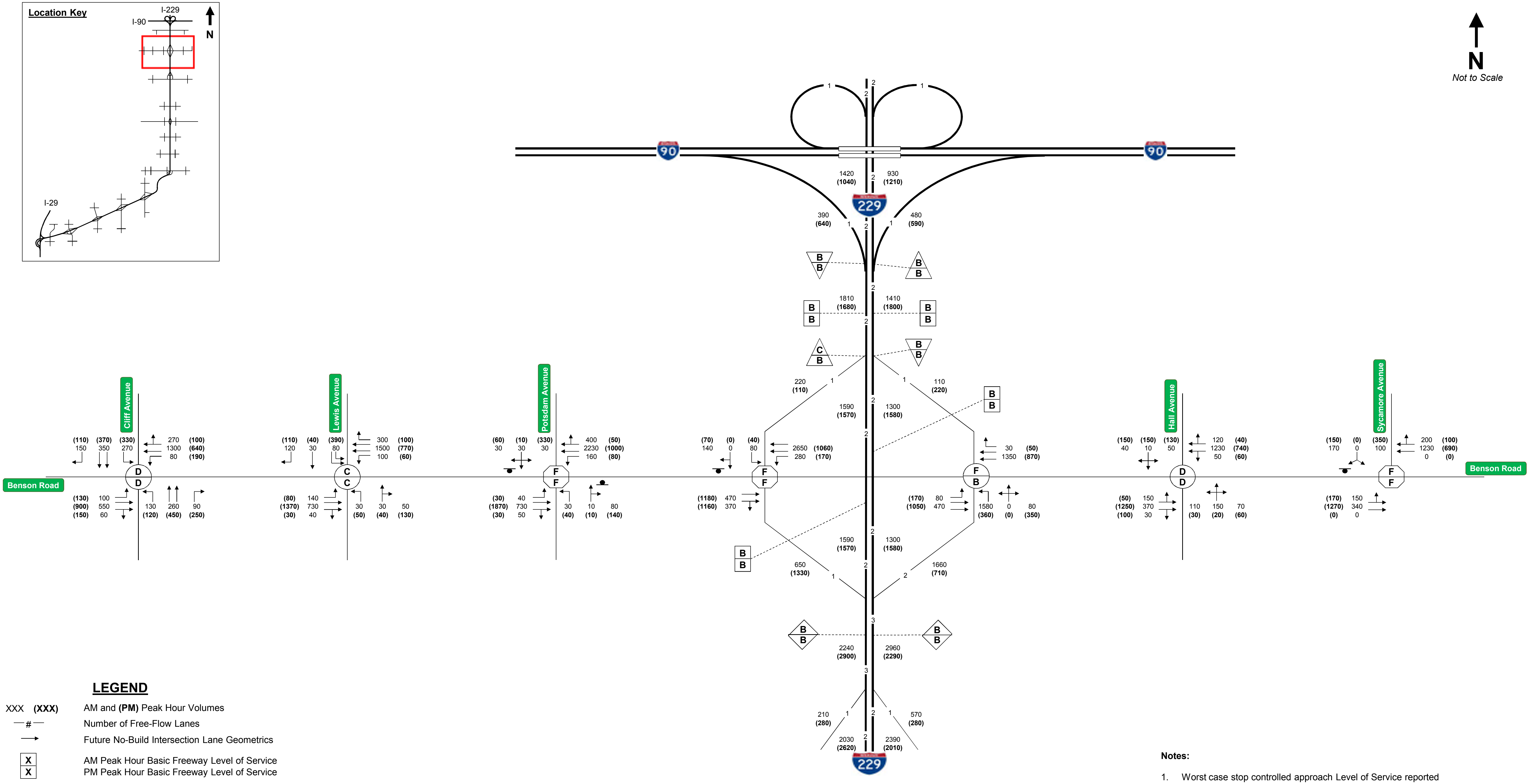
HDR

2035 No-Build "Worst Case" Conditions Traffic Operations Analysis

I-229 Major Investment Corridor Study: Sub-Study 3
10th Street Corridor Study
Sioux Falls, South Dakota

Date
11/5/2014

Figure
7



LEGEND

XXX **(XXX)**	AM and **(PM)** Peak Hour Volumes
—#—	Number of Free-Flow Lanes
→	Future No-Build Intersection Lane Geometrics
X X	AM Peak Hour Basic Freeway Level of Service PM Peak Hour Basic Freeway Level of Service
X X	AM Peak Hour Ramp Merge Level of Service PM Peak Hour Ramp Merge Level of Service
X X	AM Peak Hour Ramp Diverge Level of Service PM Peak Hour Ramp Diverge Level of Service
X X	AM Peak Hour Weaving Section Level of Service PM Peak Hour Weaving Section Level of Service
X X	AM Peak Hour Signalized Intersection Level of Service PM Peak Hour Signalized Intersection Level of Service
X X	AM Peak Hour Unsignalized Intersection Level of Service PM Peak Hour Unsignalized Intersection Level of Service

Notes:

1. Worst case stop controlled approach Level of Service reported
2. Intersection LOS was reported for the condition where each intersection experienced the full projected demand, even though adjacent intersections under no-build conditions may not have sufficient capacity to convey all projected demand.

HDR

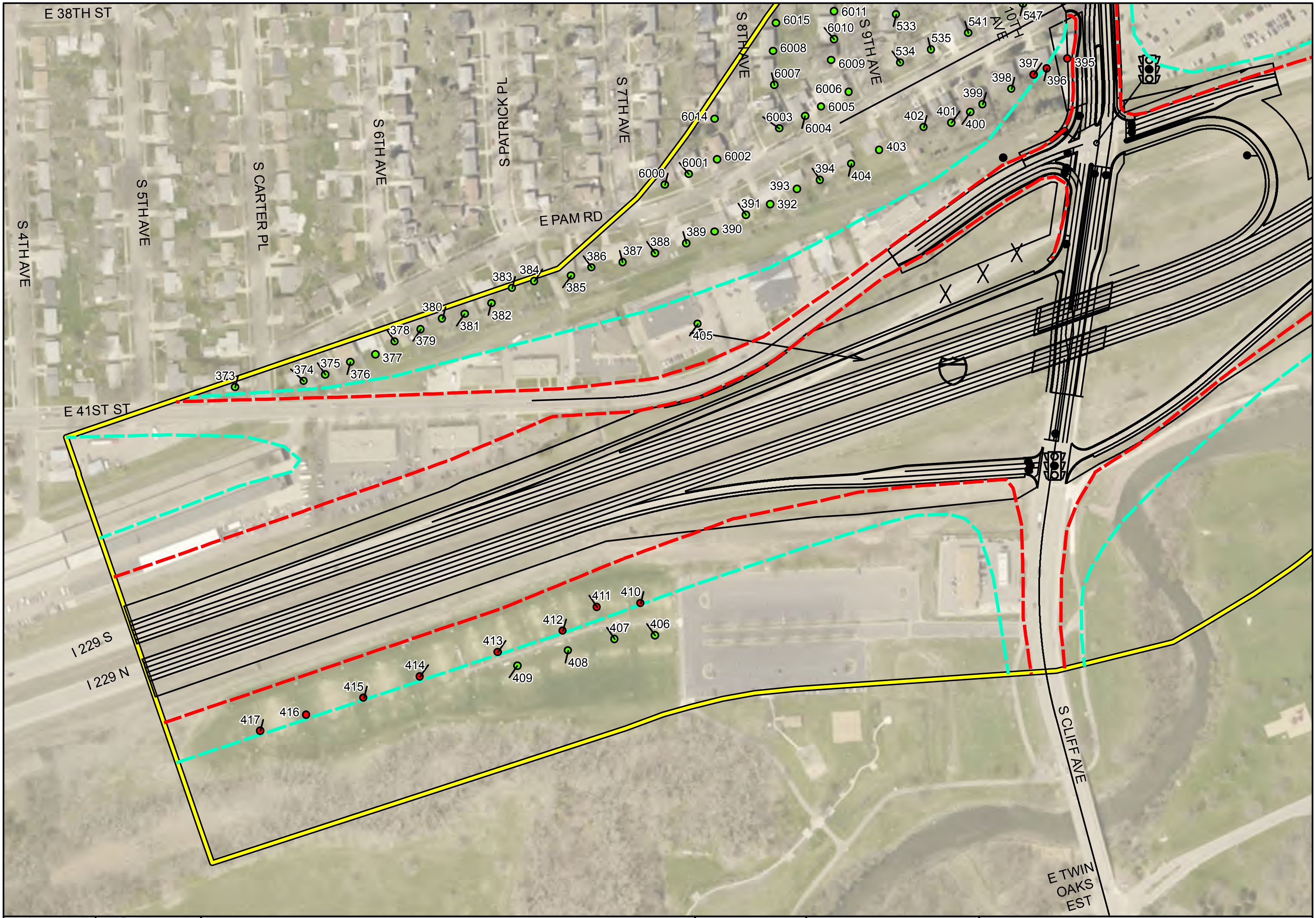
2035 No-Build "Worst Case" Conditions Traffic Operations Analysis

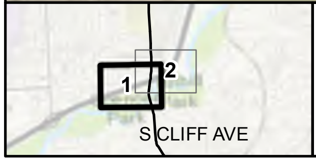
I-229 Major Investment Corridor Study: Sub-Study 4
Benson Road Corridor Study
Sioux Falls, South Dakota

Date
11/5/2014

Figure
8

Appendix B
Figures

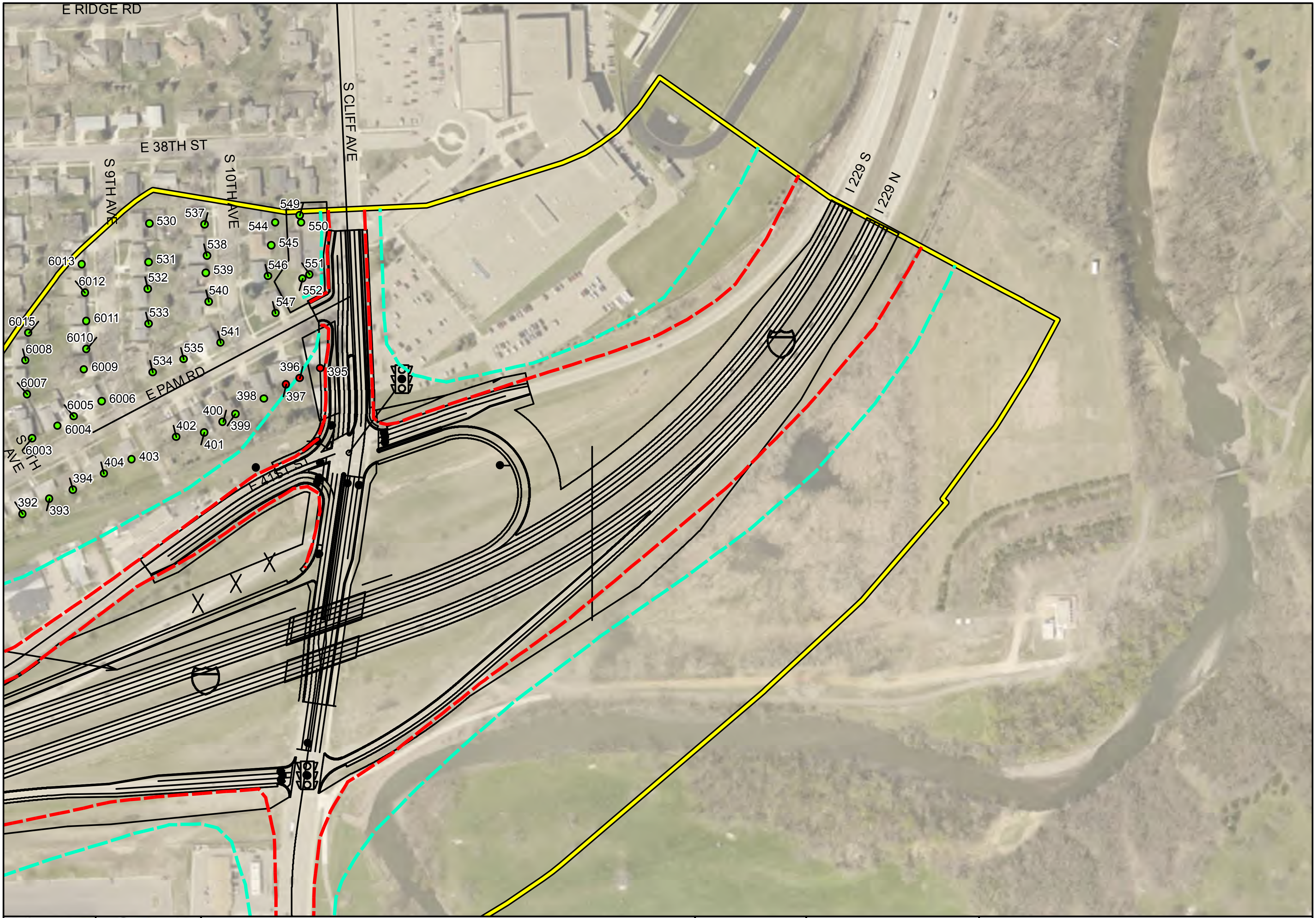


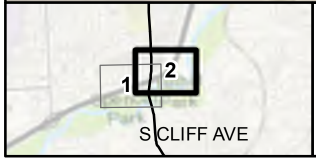


Legend

- 🟢 Non-Impacted Receptor
- 🔴 Impacted Receptor
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study Area
- Sub-Study 6 Concept Linework Alternative Cliff-1

I-229 Major Investment Corridor Study
Sub-Study #6
Noise Contour Figures
Proposed Alternative Cliff-1

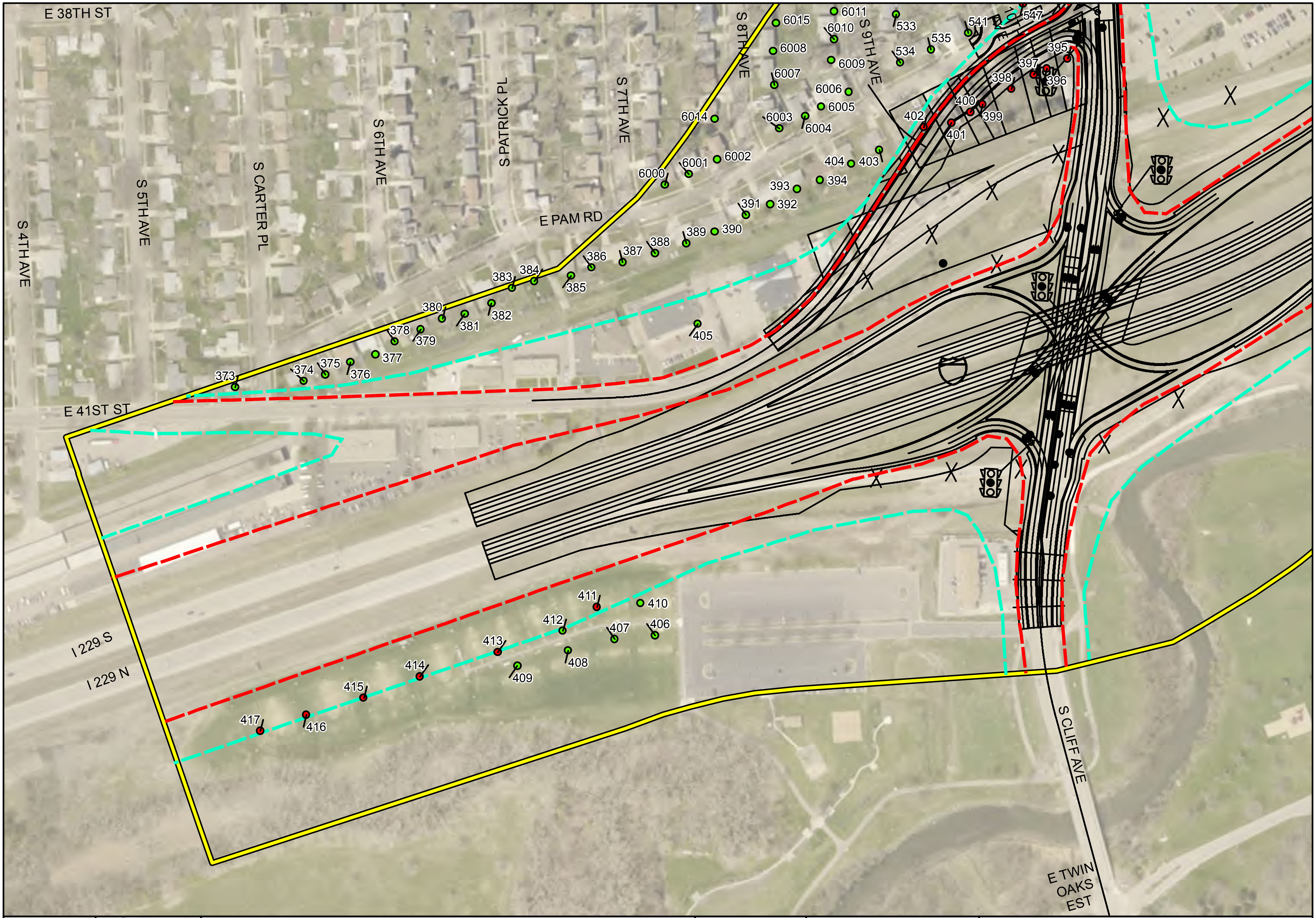


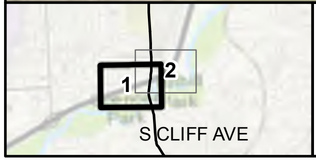


Legend

- ● Non-Impacted Receptor
- ● Impacted Receptor
- 66 dBA Contour Line
- 71 dBA Contour Line
- ☐ Noise Study Area
- Sub-Study 6 Concept Linework Alternative Cliff-1

I-229 Major Investment Corridor Study
Sub-Study #6
Noise Contour Figures
Proposed Alternative Cliff-1





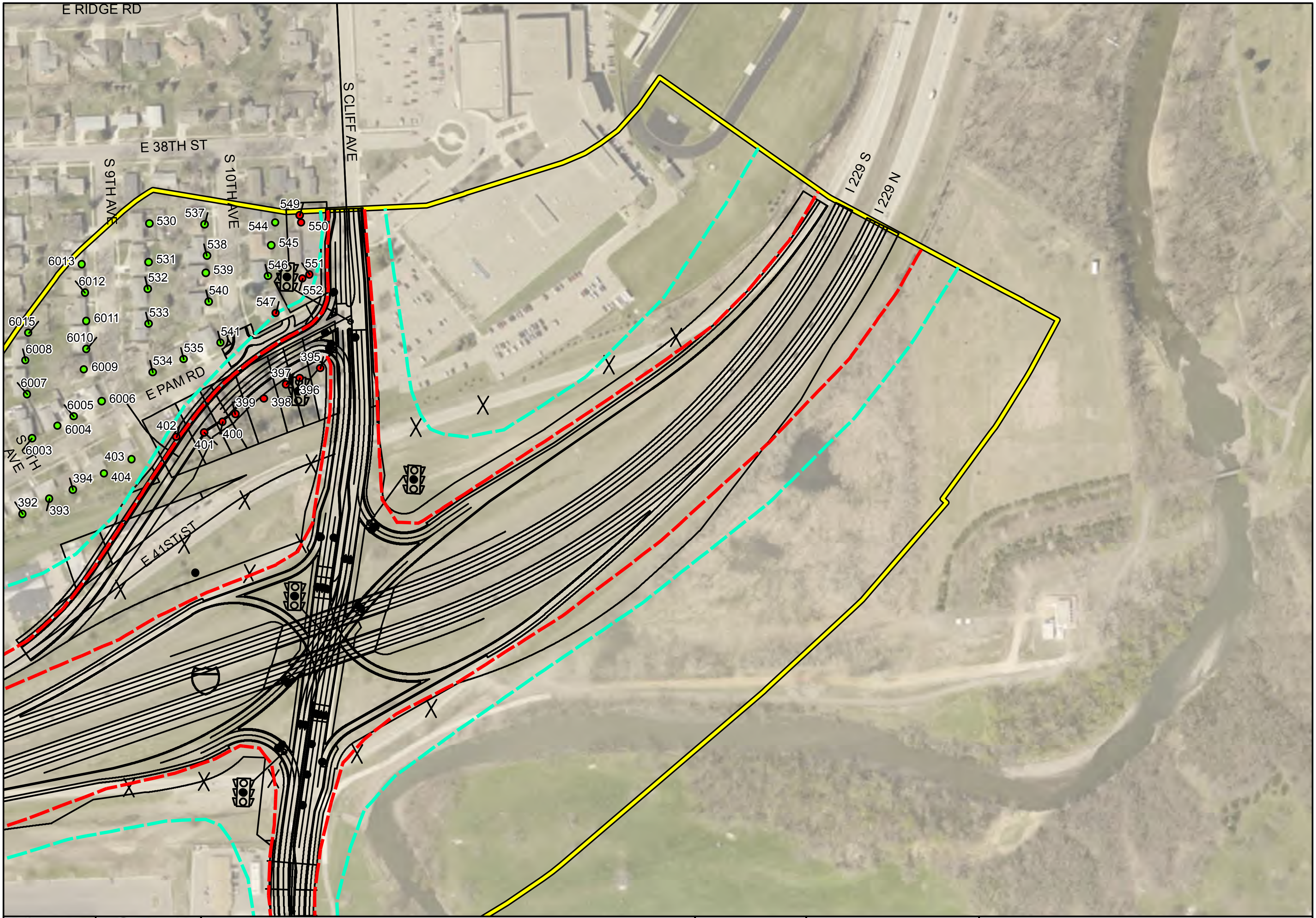
Legend

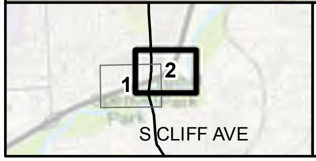
- ● Non-Impacted Receptor
- ● Impacted Receptor
- 66 dBA Contour Line
- 71 dBA Contour Line
- ▭ Noise Study Area
- Sub-Study 6 Concept Linework Alternative Cliff-6

N

HDR

I-229 Major Investment Corridor Study
Sub-Study #6
Noise Contour Figures
Proposed Alternative Cliff-6



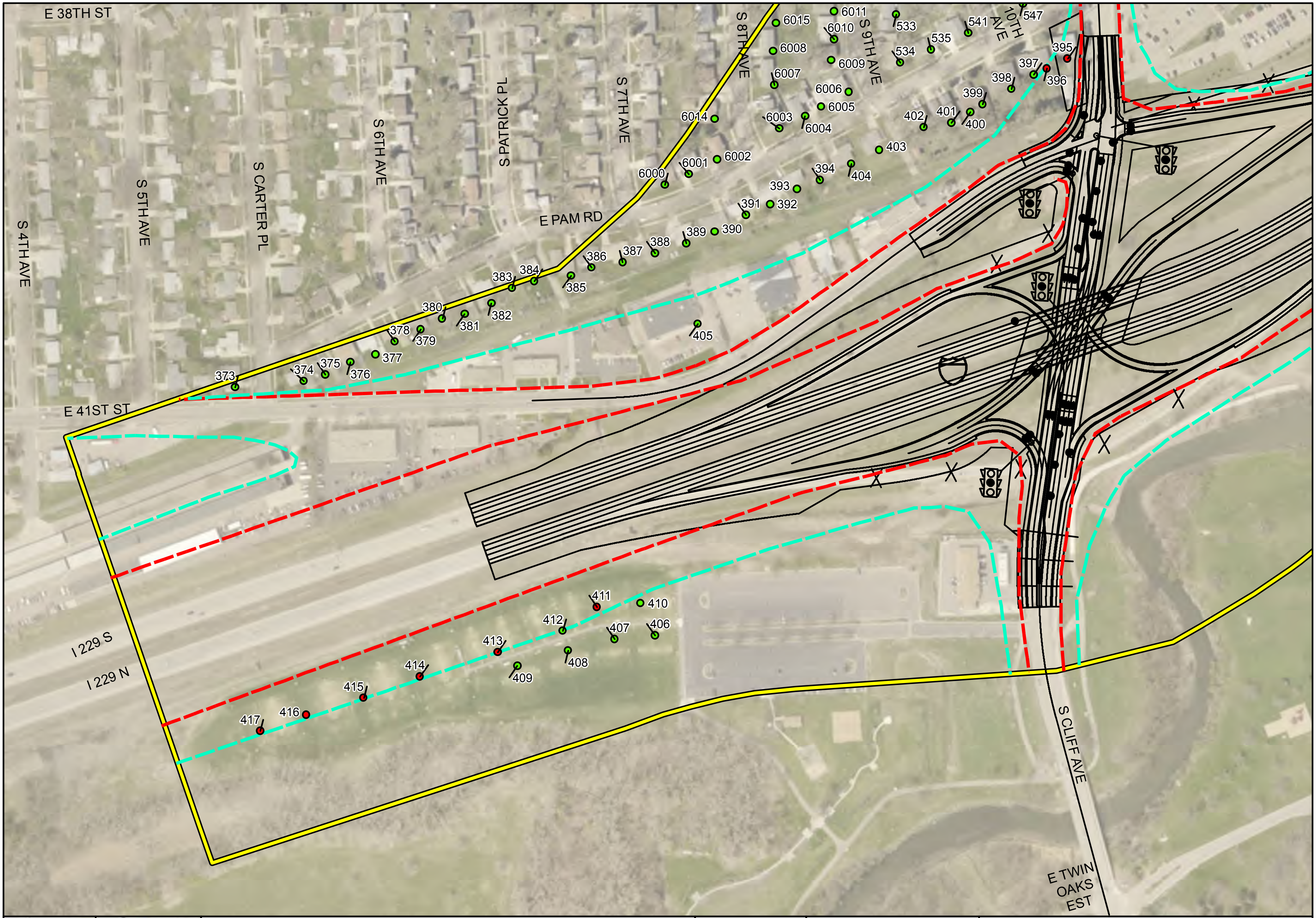


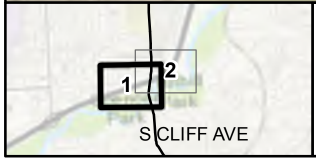
Legend

● Non-Impacted Receptor	● Impacted Receptor
66 dBA Contour Line	71 dBA Contour Line
▭ Noise Study Area	Sub-Study 6 Concept Linework Alternative Cliff-6

HDR

I-229 Major Investment Corridor Study
Sub-Study #6
Noise Contour Figures
Proposed Alternative Cliff-6





Legend

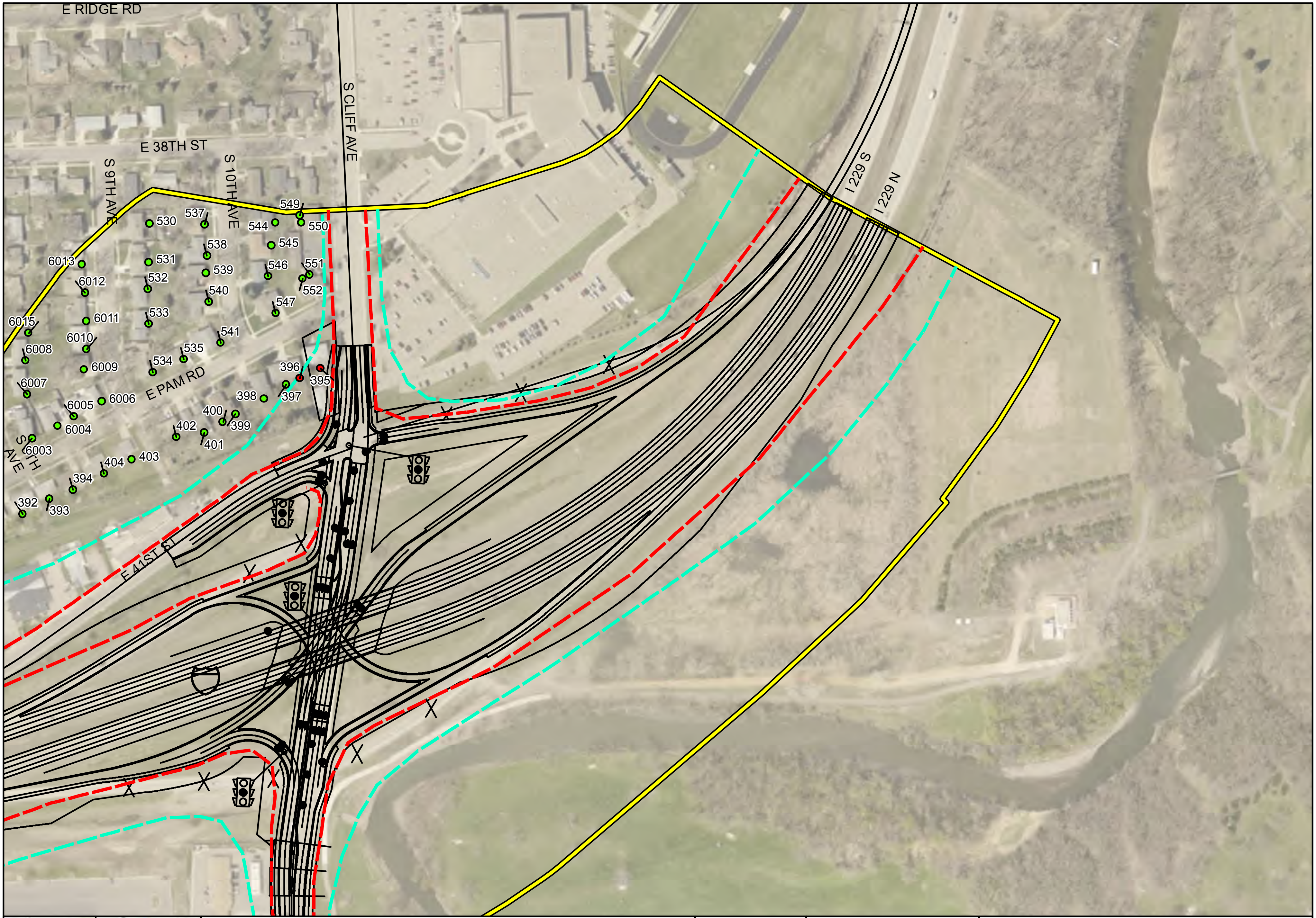
- ● Non-Impacted Receptor
- ● Impacted Receptor
- 66 dBA Contour Line
- 71 dBA Contour Line
- ☐ Noise Study Area
- Sub-Study 6 Concept Linework Alternative Cliff-7

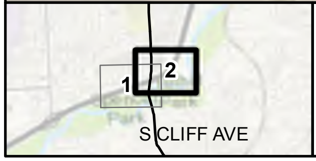
I-229 Major Investment Corridor Study

Sub-Study #6

Noise Contour Figures

Proposed Alternative Cliff-7





Legend

- ● Non-Impacted Receptor
- ● Impacted Receptor
- 66 dBA Contour Line
- 71 dBA Contour Line
- ▭ Noise Study Area
- Sub-Study 6 Concept Linework Alternative Cliff-7

I-229 Major Investment Corridor Study
Sub-Study #6
Noise Contour Figures
Proposed Alternative Cliff-7

Appendix H. Public Involvement

The general public and public agencies were involved throughout the study process, with public meetings, landowner meetings, a website, and other techniques.

Public meetings

Public Meeting #1

The first Public Open House was held on October 30th, 2013. This meeting included an overview presentation describing the drivers of the I-229 Major Investment Corridor Study, types of findings the study will eventually result in, how to get/stay involved in the study, schedule, and next steps. Meeting notes, sign-in sheets, public comments, and PowerPoint slides from this open house can be found in the ***APPENDIX***.

Public Meeting #2

The second Public Open House meetings were held on June 1st and 2nd, 2015. A presentation at the meeting provided a summary of study efforts to date, including the 2035 No-Build peak hour level of service results, conceptual ideas for I-229 mainline and interchange improvements and next steps in the study. Meeting notes, sign-in sheets, public comments, and PowerPoint slides from this open house can be found in the ***APPENDIX***.

Cliff Avenue and Rice Street Public Meetings

The Cliff Avenue and Rice Street crossroad corridors were originally a part of the I-229 Corridor Study. During the development of the analysis of the potential concepts, it was determined to separate these corridors into their own sub-studies. The first Public Open House for these two corridors was held on June 22nd, 2016. A presentation at the meeting provided a summary of study efforts to date, including the 2035 No-Build peak hour level of service results, conceptual ideas for I-229 mainline and interchange improvements and next steps in the study. Meeting notes, sign-in sheets, public comments, and PowerPoint slides from this open house can be found in the ***APPENDIX***.

Public Meeting #3

The third Public Open House (and second for the Cliff Avenue and Rice Street crossroad corridors) was held on December 6th, 2016. A presentation at the meeting provided a summary of study efforts to date, including the alternative scenario evaluation results, alternative scenarios recommended for further consideration. Meeting notes, sign-in sheets, public comments, and PowerPoint slides from this open house can be found in the ***APPENDIX***.

Business/Landowner Group Meetings

Business/landowner group meetings were held on the following dates for the following sub-studies:

- I-229 Exit 3 (Minnesota Avenue) Crossroad Corridor Study
    - Stakeholder Meeting #1 – December 16th, 2014

    - Stakeholder Meeting #2 – December 6th, 2016
- I-229 Exit 4 (Cliff Avenue) Crossroad Corridor Study
    - Stakeholder Meeting #1 – June 22nd, 2016
    - Stakeholder Meeting #2 – December 5th, 2016
- I-229 Exit 6 (10th Street) Crossroad Corridor Study
    - Stakeholder Meeting #1 – December 16th, 2014
    - Stakeholder Meeting #2 – December 5th, 2016
- I-229 Exit 7 (Rice Street) Crossroad Corridor Study
    - Stakeholder Meeting #1 – June 22nd, 2016
    - Stakeholder Meeting #2 – December 6th, 2016
- I-229 Exit 9 (Benson Road) Crossroad Corridor Study
    - Stakeholder Meeting #1 – December 15th, 2014
    - Stakeholder Meeting #2 – December 5th, 2016

All of the meetings were designed to allow landowners within the study area to discuss specific issues regarding their properties with study staff. In addition, several meetings were held with individual landowners where specific improvement options, and the associated impacts of those options, were discussed. Meeting notes, sign-in sheets, public comments, and PowerPoint slides from all the meetings can be found in the ***APPENDIX***.

Study Advisory Team

The Study Advisory Team, comprised of representatives of the Federal Highway Administration, South Dakota Department of Transportation, City of Sioux Falls, and the Sioux Falls Metropolitan Planning Organization, met periodically during the study to guide the study process and provide agency input. Members of the Study Advisory Team are shown in ***TABLE 1***.

Table 1. Study Advisory Team Members

NAME	AGENCY
Shannon Ausen	City of Sioux Falls – Public Works
Mike Behm	SDDOT – Project Development
Christina Bennett	SDDOT – Operations Support
Jeff Brosz	SDDOT – Transportation Inventory Management
Andy Vandel	SDDOT – Project Development (Safety)
Joel Gengler	SDDOT – Right of Way
Amber Gibson	Sioux Falls MPO
Kevin Goeden	SDDOT – Bridge Design
Steve Gramm	SDDOT – Project Development (Planning)
Heath Hoftiezer	City of Sioux Falls – Public Works
Mark Hoines	FHWA

Dave Huft	SDDOT – Research
Bruce Hunt	FHWA
Scott Jansen	SDDOT – Mitchell Region
Captain Alan Welsh	South Dakota Highway Patrol
Ryan Kerkvliet	Sioux Falls MPO – Citizens Advisory Committee
Tom Lehmkuhl	SDDOT – Project Development (Environmental)
Pete Longman	SDDOT – Road Design
Ron McMahon	FHWA
Paul Nikolas	SDDOT – Road Design
Brad Remmich	SDDOT – Project Development (Planning)
Craig Smith	SDDOT – Mitchell Region

Website

A study provided easy access to information and documents prepared as part of the study. The website address was: WWW.I229STUDY.COM

Upcoming Events

Public Meeting / Open House #1
Date: October 30th, 2013
Time: 5:30 PM – 7:00 PM
Place: Sioux Falls Convention Center
1101 N. West Avenue
Sioux Falls, SD

The Interstate 229 (I-229) Corridor through the City of Sioux Falls carries commuters and tourism traffic, provides access to the ever expanding east side of this thriving community, and allows direct access to downtown. The I-229 Major Investment Study will allow the City of Sioux Falls, the Sioux Falls Metropolitan Planning Organization, the South Dakota Department of Transportation, adjacent landowners, and area users to help determine the vision of the corridor. The I-229 Corridor Study Team will be using technology on this project that will allow us to distribute traffic in a manner that

The website provided project updates throughout the course of the study.

The “***Get Involved***” page provided opportunity for website visitors to submit a project comment or question.

Get Involved

Have a comment or question for the I-229 Major Investment Corridor Study Project Team? We want and need your input. Please become involved with these studies by leaving a comment below.

Name
Organization
Address
City, State, Zip
Phone
Email
*Select the Study you are interested in: General Questions
(please select one to make sure it gets delivered to the appropriate Study personnel)
Comment or Question:

Upcoming Events

Public Meeting / Open House #1
Date: October 30th, 2013
Time: 5:30 PM – 7:00 PM
Place: Sioux Falls Convention Center
1101 N. West Avenue
Sioux Falls, SD

The “***Resources***” page included links to relevant ongoing transportation studies in the area, as well as previously written documents referred to as part of the I-229 MIS.

On-Going Study: 26th Street Corridor Study

I-229 Exit 5 (26th Street) Crossroad Corridor Study Website

Additional Documents and Studies

The following previously written documents will be reviewed during the course of this study:

- 2010 Decennial Interstate Corridor Study Phases 1, 2, & 3
- Direction 2035, Sioux Falls Metropolitan Planning Organization Long Range Plan (LRTP)
- Current Statewide Long Range Transportation Plan
- SD 100 Corridor Preservation
- Northeast Transportation Study
- BNSF Rail Studies (07-02-02 Benefits Study, 03-08-02 Conceptual Phasing Plan, 05-10-01 Feasibility Study)
- Sioux Falls Comprehensive Development Plan
- Sioux Falls Transit Development Plan 2011-2015
- Sioux Falls Trail Masterplan
- 2007 Sioux Falls Bicycle Plan
- The Sioux Falls MPO Multi-Use Trail Study
- 60th Street North Planning and Feasibility Study
- Sioux Falls Major Street and Access Management Plan

MPO Meetings

The study team met with the Sioux Falls MPO in November 2013 and May 2015. The meetings on November 13th and 14th, 2013 followed Public Meeting #1, and the meetings on May 20th and 21st, 2015 followed Public Meeting #2. The formal presentations given at these MPO meetings were the same meeting materials as discussed at the public meetings.

APPENDIX -

PUBLIC MEETING #1 – OCTOBER 30TH, 2013

- MEETING NOTES
- SIGN-IN SHEETS
- COMMENTS
- POWERPOINT SLIDES

HDR | ONE COMPANY *Many Solutions*℠

Meeting Notes

Subject: I229 MIS Public Open House #1

Client: SDDOT

Project: I229 Corridor Study Project No: 207030

Meeting Date: October 30th, 2013 Meeting Location: Sioux Falls Convention Center

Notes by: HDR

Debrief Record: The following notes were provided by study participants to members of the study team during the meeting while reviewing the various open house displays.

1.) Many comments around providing better crossings for ped's and bike's along the I229 corridor. They find it very hard to get from one side to the other since most interchanges only have sidewalk on one side. Connections directly to the bike trail would be great.
2.) Several comments on how poor the 26th Street Interchange is and that the SB off/on ramp is so short it causes accidents and many people slide off of the road due to the tight SB on ramp curve.
3.) A few members heard a desire to finish the 49th Street extension as they believe it is long overdue.
4.) Interstate users believe that aux. lanes from 10th Street to 26th Street should be implemented soon.
5.) The interchange at 10th Street and the proximity of Cleveland Avenue is not good; this area doesn't work because one intersection backs up the other. Need to figure out something different at Cleveland.
6.) Many believe the I229 corridor needs to be 3 lanes in each direction to handle the traffic that we will see in the future.
7.) A few noted that placing a half interchange at 60th Street north would dramatically improve access to the industrial park and would reduce congestion at Benson Road.
8.) Folks from the SF Bike Club indicated that they would not use 10th Street as a bike route due to the driveway access. Rather have a route on 6th Street or 12th Street or both.
9.) Encourage the industrial park businesses to stagger shifts to reduce peaks in the traffic along the interstate.
10.) Maintain Access to businesses along Minnesota; don't place a median that will take away half of my traffic.
11.) Build the bridge over the BSR east of Hwy 11 on the 57th Street alignment so everyone doesn't have to enter the east side of the City on SD 42 which will reduce congestion on 10th Street.
12.) Lower the speed limit on I229 to 55 mph.
13.) Interested in the placement of variable speed limits on I229, have seen these in other locations and area easy to follow.
14.) SB on Ramp at 10th does not work well due to the structure in such close proximity.
15.) Summer mowing practices may need to be modified to insure grass is kept shorter to improve sight from ramp to interstate as vehicle merges with mainline from the on-ramp.
16.) Horizontal curves between 10th and 26th can be a problem during winter events.
17.) Conflicting comments heard regarding noise walls, some folks say they are needed and believe they need to be built soon and others felt that it would make their home "feel like a prison" to have a noise wall in their backyard and that the noise isn't that bad.
18.) An auxiliary lane is needed along SB I-229 between Louise Avenue and the I-29 NB ramp.
19.) On I-29, there needs to be a third lane / auxiliary lane between I-229 and 57th Street (Outside of Study Area).

20.) Need an interchange on I-29 @ 85th Street to allow for southern Sioux Falls to continue growing. (Outside of Study Area).
21.) Would like a crossing of I-229 for 33rd Street.
22.) Removing Yeager Road would be bad for 26th Street between I-229 and Cliff Avenue.
23.) There was concern over the elevation for the future 26th Street. There's also a "dip" in 26th Street at the old railroad bridge that they hope will be fixed with the new interchange.

South Dakota DOT
Connecting South Dakota and the Nation

CITY OF SIOUX FALLS
PUBLIC WORKS
Providing a Better Quality of Life for You!

HDR

SIGN IN SHEET

Subject: I-229 Major Investment Corridor Study – Public Open House #1
Client: City of Sioux Falls / South Dakota Department of Transportation
Project: PL 0100(87) 3616P, PCN 044K
Project No: 207030
Meeting Date: Wednesday, Oct 30th, 2013 5:30 – 7:00 PM
Meeting Location: Sioux Falls Convention Center

Please print clearly. Thank you.

	NAME/REPRESENTING	ADDRESS	BEST CONTACT PHONE	E-MAIL
1	Chad Huwe / CityofSF		367-8601	chuwe@siouxfalls.org
2	Manny Steele Dist 12		335-7036	barbmanny78@gmail.com
3	Nick mentele		770-8856	nickmentele@yahoo
4	Jim Entenman			
5	Stacy DuChene		221-2647	sduchene@hrgreen.com
6	Trent Swanson	100 N Phillips #901 SF SD 57104-6725	335-4962	trents@cutlerlawfirm.com
7	Stephanie Logue	6300 S. Old Village Pl St	977-8104	Stephanie.logue@hdrinc.com
8	Allen Bindert	47120 85Th SF	605-368-2114	
9	Jack Mallek	4705 Yellowstone	335-5596	
10	Gail Brown	6500 TALLGRASS	357 4780	
11	Craig Lloyd	6904 S Westfield Tr	376-5834	Craig@LloydCompanies.com
12	Marv Schlechter	809 Day Ave	336-6874	
13	Mike Kuno	724 W Cascade St	413.5874	
14	Rodney McClure	1800 W 22nd St	332-7290	
15				
16				
17				
18				
19				

SIGN IN SHEET

Subject:	I-229 Major Investment Corridor Study – Public Open House #1
Client:	City of Sioux Falls / South Dakota Department of Transportation
Project:	PL 0100(87) 3616P, PCN 044K
Project No:	207030
Meeting Date:	Wednesday, Oct 30th, 2013 5:30 – 7:00 PM
Meeting Location:	Sioux Falls Convention Center

Please print clearly. Thank you.

	NAME/REPRESENTING	ADDRESS	BEST CONTACT PHONE	E-MAIL
1	Rich Schwanke VFW	3601 S Minnesota SF		Jmbliss688@aol.com
2	Butch Haugen VFW	3601 S. Minn. SFSD	605-553-5518	bhaugen@gmail.com
3	Mike Behm SDDOT	700 E Broadway Pierre SD	605 773 4423	Michael.Behm@state.sd.us
4	Brad Remmich SDDot	" "	605-773-3093	bradley.remmich@state.sd.us
5	Thomas Hein	6100 E Hein Place SF	605-361-8400	
6	Christina Bennett	Pierre, SD 700 E Broadway Ave	605-773-4759	christina.bennett@state.sd.us
7	Ross Harris	5525 Merle Hay Rd STE 200	515-278-2913	rharris@hrgreen.com
8	Steve Hoff	6300 S. Old Village Sioux Falls, SD	605-977-7740	steve.hoff@hdrinc.com
9	Kent Scribner	2505 S. Kiwanis, # 244 SF, SD 57105	605-338-0966	akscrib@yahoo.com
10	Brad Hicks	604 S. Conklin SF SD 57103		
11	Bill & Carol Kollis	3217 W. Zephyr Pl S.F. SD.		
12	Larry Karsten	2504 E. 19th	338-4760	
13	Chris Parsley	7001 W 66th	319-389-1507	CMPARSLEY@GMAIL.com
14	Brent Hamilton	1301 S. Majestic View	605-553-3868	
15	Jerry & Jackie Nash	2105 Tricia Lane	605-388-1870	
16	Julie Christianson	1705 S Riverdale	605-338-3260	bigkahuna@sio.midco.net
17	Robert Leonhardt	2001 S. Cardinal Dr	605-331-5074	
18	Mark Miller	3905 S Jolly SF 57103		
19	Mark Hoines	116 E. Dakot		

South Dakota DOT
Connecting South Dakota and the Nation

CITY OF SIOUX FALLS
PUBLIC WORKS
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HDR

SIGN IN SHEET

Subject: **I-229 Major Investment Corridor Study – Public Open House #1**

Client: City of Sioux Falls / South Dakota Department of Transportation

Project: PL 0100(87) 3616P, PCN 044K

Project No: 207030

Meeting Date: Wednesday, Oct 30th, 2013 5:30 – 7:00 PM

Meeting Location: Sioux Falls Convention Center

Please print clearly. Thank you.

	NAME/REPRESENTING	ADDRESS	BEST CONTACT PHONE	E-MAIL
1	Steve Gramm	700 E Broadway Ave Pierre	605-773-6641	Steve.gramm@state.sd.us
2	Jim Stalzer	5909 W Bristol Dr	605-366-5874	rep.stalzer@state.sd.us
3	Ruth Smith Gordon Smith	3500 E 60th St N 57104	605-940-4943	——
4	Amber Gibson SECOG	500 N Western Ave. Ste 100 SFSD 57104	605-367-5390	amber@secog.org
5	Mike Holm	1309 E NorthStar		mholm@cibinc.net
6	Joan Storer	3900 W Avera Dr	605 322-4573	joan.storer@avera.org
7	Dennis Woeldreyer	5510 ShadowWood PL.	605-351 0219	dwoeldreyer@lincolncountysd.org
8	Josh Larson	2208 S Sheffield	605-205-0016	joshuadavid@hotmail.com
9	GEORGE HAHN	647 S. Main	360-6639	S F SD 57104
10	ARLIE WULF	1600 S GrayGoose	335-1897	AMWULF@SVTV.com
11	Glenda Breed	944 S. Holt Ave	940-6380	cribstein@sio.midco.net
12	Phil Gundvaldson	1800 E. Arrowhead Pkwy	929-8190	philg@infrastructuredg.com.
13	Bob Bohm	3600 S Duluth Ave	334 4220	robert.bohm@dakotabilities.org
14	Mike Murphy / SF YMCA	2411 S. Carter Pl.	360-7414	camp@siouxfallsymca.org
15	Duane A.			duane@hass.com
16	Brian Ray	8404 Indian Hills Drive Omaha NE	402 399 1000	brian.ray@hdrinc.com
17				
18				
19				

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Providing a Better Quality of Life for You!

HDR

SIGN IN SHEET

Subject: I-229 Major Investment Corridor Study – Public Open House #1

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Please print clearly. Thank you.

	NAME/REPRESENTING	ADDRESS	BEST CONTACT PHONE	E-MAIL
1	Joel W Gengler SDDOT	700 E Broadway Ave, Pierre SD	605-773-3746	—
2	Pete Longman SDDOT	700 E Broadway Ave Pierre	605-773-6488	-
3	Vicki Melrose	[illegible] S. [illegible] Ave. SF SD 57[illegible]		
4	Rex Rolfing	SF SD		
5	Gerald Teunissen	SF, SD		
6	James Unruh	HDR SF, SD		
7	Sam Trebilcock	City Of SF	367-8890	
8	Heath Hoftiezer	City of SF		
9	Jon Wiegand	HR Green		
10	Bill Moran	HR Green		
11	Cheryl Rath	SFSD		
12	Clint Kolda	7605 W. Regina St SF		dakotacyclist@gmail.com
13	Steven [illegible]	5000 Sunnymede Cir SF		
14	Rick Kiley	1108 N. West Aves Sioux Falls	605-361-7785	kiley@southdakotasafety.org
15	Senator Ernie Otten	46787 273rd [illegible].		
16	Tom Sweetman	PO Box 2320 SFSD 57101	605 366 5746	thomasrsweetman@ gmail.com
17	Greg Boris	5915 S. Westwind	321-5514	
18		616 E. Wiswell Pl.	376.4056	
19	Marshall Lavin	1710 S. Southeastern Ave	334-7979	glavins@sio.midco.net

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Please print clearly. Thank you.

	NAME/REPRESENTING	ADDRESS	BEST CONTACT PHONE	E-MAIL
1	Mary & Jack Mortenson	2116 S. Crestwood Rd	605.321.0509	mary@sparklight.org
2				
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I-229 Major Investment Corridor Study

PL 0100 (87) 3616P, PCN 044K

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WE WANT TO KNOW WHAT YOU THINK! What are your concerns? What issues does the study team need to overcome with this project? What problems do you foresee? Please submit your comments before Nov 8th, 2013 to:

Mail: *HDR Engineering, Inc.*
ATTN: Jason Kjenstad
6300 S. Old Village Place, Suite 100
Sioux Falls, SD 57108-2102

E-mail: *Jason.Kjenstad@hdrinc.com*

Fax: *605-977-7747*

Very informational when asked questions while looking at the boards. Excited to See the progress take place

(optional)
Name: ______________________
Address: ______________________
Phone: ______________________
Email: ______________________

South Dakota
DOT
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I-229 Major Investment Corridor Study

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Sioux Falls, SD 57108-2102

E-mail: *Jason.Kjenstad@hdrinc.com*

Fax: *605-977-7747*

(optional)
Name: Jim Stalzer

Phone: 605-366-5874

Address: 5909 W Bristol Dr 57106

Email: jim.stalzer@gmail.com

I-229 Major Investment Corridor Study

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E-mail: *Jason.Kjenstad@hdrinc.com*

Fax: *605-977-7747*

Very informational when asked questions while looking at the boards. Excited to See the progress take place

(optional)

Name: ______________________ Address: ______________________

Phone: ______________________ Email: ______________________

From: BlueMail@bluehost.com
Sent: Wednesday, October 16, 2013 3:05 PM
To: email@i229study.com
Subject: Message from BlueMail

Your BlueMail form has been completed, following are the results:

Field	**Value**
Name	Chris Parsley
Org	Falls Area Bicyclists, President
Address2	7001 W 66th St
CSZ	Sioux Falls, SD 57106
Phone2	319-389-1507
Email2	cmparsley@gmail.com
Study2	I-229 Corridor Study
Comments	According to item 2, consider that bicycles operate as vehicles and make sure that the I229 crossings are safe for bicyclists. I would also ask that a pedestrian crossing be considered from South Phillips over I229 and connecting to the multi use path on the other side.
redirect2	http://www.i229study.com/thank-you.html

From: Chris Parsley <cmparsley@gmail.com>
Sent: Wednesday, October 30, 2013 5:33 PM
To: Kjenstad, Jason
Subject: I229 MIS

Some of my concerns involve getting pedestrians and bicyclists over I229 safely. I have not seen anything in the plan that addresses this issue.

Kjenstad, Jason

From: BlueMail@bluehost.com
Sent: Sunday, October 27, 2013 7:23 PM
To: email@i229study.com
Subject: Message from BlueMail

Your BlueMail form has been completed, following are the results:

Field	**Value**
Name	Jonathan Keill
Org	N/A
Address2	1515 S Glendale Ave
CSZ	Sioux Falls, SD 57105-1417
Phone2	(605) 321-2517
Email2	jjkeill@hotmail.com
Study2	I-229 Corridor Study
Comments	I've lived in Sioux Falls my whole life and am planning in the near future to relocate to the Twin Cities to attend a graduate program at the University of Minnesota in urban planning and design. After reviewing this study (as well as having seen the city and its traffic grow by leaps and bounds in the 25 years I've lived here), I have several ideas as to how we can possibly create new or reconfigure existing exits along the I-229 corridor. A few of these would require "hybrid" exits so-to-speak...but seeing how well the freeway systems work in the Twin Cities, I believe we would be able to maximize efficiency in traffic flow along the corridor for decades to come (not to mention a couple of ideas for the stretch of I-29 from I-229 to 41st St). These would provide increased access to the Empire/Empire East and the Interstate Crossing Business Park. I don't have professional software or anything with which I can already provide detailed plans...however, I would enjoy being able to meet with or talk to someone about my ideas and see if there is a plausibility aspect to them. Granted, I also am not very privy to things like costs or right-of-way, but having an analytical and mathematical mind, I feel I am able to see how things could be improved in a number of ways. I'd love to hear back from someone just to offer some proposals. Thank you for your time!
redirect2	http://www.i229study.com/thank-you.html

- Jason met w/ Jon Keill - Shared ideas for on/off ramps to 57th near I229 Underpass
  - wants a connection for 69th to I29
  - nothing really new between Western and Rice
  - Interested in Benson - 60th - I229/I90 Junction

From: Thomas Hein <theinmail@gmail.com>
Sent: Monday, November 04, 2013 9:38 AM
To: Kjenstad, Jason
Cc: Jeff R. Mindt; Shally Rogen; Brian Sather (gdentltd@hotmail.com); Eric & Mary Stormo (estormo@uswest.net)
Subject: I-229 Major Investment Corridor Study

Jason,
This email is in regards to your meeting on October 30th, 2013.
Please be advised that I own, with four other partners, the property call Minnesota Crossing located on the corner of 43rd and Minnesota Ave.
I am extremely concerned that you and your planning group are going to attempt to take our accesses away from the building located at 3508 S Minnesota Ave., just north of the Taylor Oil building.

I am hoping, with advance notice, your engineering team can design an appropriate exit on I-229 and Minnesota Ave so that you will be able to keep and maintain the integrity of my real estate access points. This real estate truly enhances its value because of the customers traveling south and approaching my strip mall as well as those customers coming from the South traveling North.
Lets make sure that we work toward the common goal of keeping both those access directions open from both north and south and not try to consider a median in the middle of the road way to eliminate 1/2 of our customer base.

Please be sure to forward all design concepts that you are discussing or considering so that we may include our input to find a win win solution.
I will watch for your reply and acknowledgement that you will provide me with all concept drawings that you are considering.

Thanks for your help in advance.
Tom Hein

Kjenstad, Jason

From: BlueMail@bluehost.com
Sent: Wednesday, November 06, 2013 5:06 PM
To: email@i229study.com
Subject: Message from BlueMail

Your BlueMail form has been completed, following are the results:

Field	**Value**
Name	Robin Solberg-Versluys
Org	
Address2	1205 S Gordon Dr
CSZ	Sioux Falls SD 57110
Phone2	605-331-5015
Email2	robin.versluys@gmail.com
Study2	I-229 Exit 9 (Benson Rd) Study
Comments	I work in the Industrial Park area and have noticed how bad the traffic is on East Benson getting on I229 South. I take E54th St N to Lewis Avenue then south to Benson. There are two lanes that turn left (east) on to Benson Rd off Lewis. However, there is approximately 1/2 mile for everyone from the two lanes to merge together into one lane to get onto I229 south. If someone is nice enough to let you in to the lane, you need to be very careful as the people in front of you are usually stopping for others that need to be let in. I can only imagine how many accidents or close calls there have been in this area. The second part of the problem is there is a street closer to the exit (Potsdam Ave) in which you have other people trying to get onto Benson. I think it would be more beneficial if there were two lanes to turn south onto I229 and merge prior to entering I229 (similar to the exit on the Benson and I29, and 12th and I29), and possibly a stop light on Potsdam to help those travelers get onto Benson. There are two lanes getting off of I229 onto Benson and i think the traffic would flow a lot better if the other side (south bound exit) would have two lanes also. Thank you, Robin Solberg-Versluys
redirect2	http://www.i229study.com/thank-you.html

From: Mark Miller <mark.miller@sio.midco.net>
Sent: Sunday, November 17, 2013 9:56 AM
To: Kjenstad, Jason
Subject: I-229 Corridor Study

I live in south Sioux Falls and work by Sanford Research in northern Sioux Falls. I know the traffic well on 229. Traffic is solid during peak commute times. People are becoming more impatient and careless with their driving habits. I notice cars weaving between traffic, cutting off other drivers while jockeying for a better position for the Benson Road exit. That exit is overwhelmed during rush hours. Last week there was a accident on the ramp, causing traffic to backup in the 2 outside lanes of 229 all the way down to the Rice Street exit. The other problem is traffic merging on Benson to go south on 229. Again, impatient drivers and dangerous driving decisions.

Here are my suggestions:
- put in a half-diamond interchange at 229 and 60th Street N. This will alleviate the load on Benson tremendously. Without question this would be my first choice. It would be the most cost effective development to address the traffic congestion at Benson.
- widen 229 to four lanes. The reality is that traffic is bad now and is going to get worse as the north industrial parks continue to develop. Completing Hwy 100 is a long ways out and will not provide relief in time.

From: BlueMail@bluehost.com
Sent: Sunday, December 01, 2013 7:52 PM
To: email@i229study.com
Subject: Message from BlueMail

Your BlueMail form has been completed, following are the results:

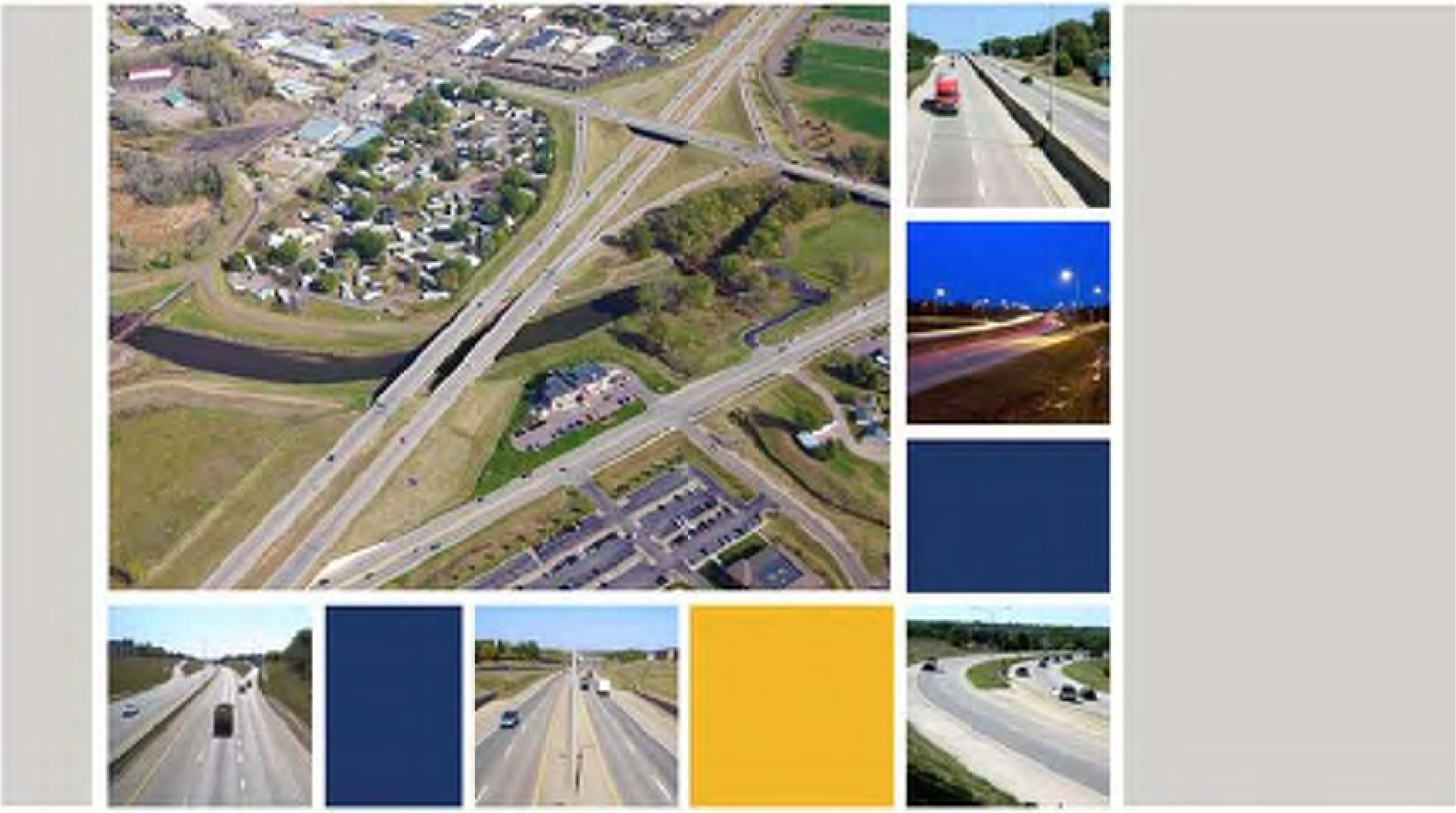
Field	**Value**
Name	Michael Christensen
Org	
Address2	1813 S Purdue Ave
CSZ	Sioux Falls, SD, 57106
Phone2	605-929-8923
Email2	mytzpyk@gmail.com
Study2	I-229 Corridor Study
Comments	Please include Cliff Ave in the study: because the Cliff Ave interchange is so similar to the Minnesota Ave interchange I am surprised that it is not being included in this study. I understand there may be vehicular factors that logically cause its exclusion, however the issues faced by pedestrians and bicyclists are the same as Minnesota Ave interchange. Consider bike & pedestrian crash data in your analysis, please. Minnesota Ave & Cliff Ave proximity to bike trail: please recognize and plan to include better movement or access from north of I-229 to the bike trail south of I-229. I-229 blocks a major path of desire for non-motorized access to the city's best and more frequently used park feature. Fix it. Add width to the outside lanes on Minnesota Ave. Add better sidewalk visibility and controls. Bridges: add pedestrian bridges over I-229 south from West Ave, south from Phillips Ave, and east from 35th St. Itâ€™s hard for me to believe justification exists for the pedestrian bridge west from Teem Drive over I-29 that doesnâ€™t exists for any of these three possibilities.
redirect2	http://www.i229study.com/thank-you.html

From:	BlueMail@bluehost.com
Sent:	Monday, December 02, 2013 8:08 PM
To:	email@i229study.com
Subject:	Message from BlueMail

Your BlueMail form has been completed, following are the results:

Field	**Value**
Name	Art Holden
Org	
Address2	705 W Victory Ln
CSZ	Sioux Falls
Phone2	6053713928
Email2	art@thundergeeks.com
Study2	I-229 Corridor Study
Comments	Please take active transportation options seriously in this study. Investments in pedestrian and cycling infrastructure have been proven to increase property values, spur economic growth, and enhance public health. I think a pedestrian bridge on South Phillips toward Tomar park would connect a large portion of central Sioux Falls to the trail and park system. I believe this would be heavily used and very valuable to the citizens of Sioux Falls. Thank you for the opportunity to voice my opinions.
redirect2	http://www.i229study.com/thank-you.html

U.S. Department of Transportation
Federal Highway Administration



I-229 Major Investment Corridor Study
Public Open House
October 30th, 2013 – 5:30 pm to 7:00 pm

HDR

HRGreen

Study Advisory Partners

Advisory Agencies

South Dakota Department of Transportation (SDDOT)

South Dakota Highway Patrol

City of Sioux Falls

Sioux Falls Metropolitan Planning Organization (MPO)

Federal Highway Administration (FHWA)

Consultant Team

HDR Engineering, Inc.

HR Green, Inc.

CITILABS

airsage

The power of where and when

Primary Contacts

SDDOT Project Manager
Steve Gramm, PE
Project Development, Data Analysis Engineer
Steve.gramm@state.sd.us
Phone: 605-773-6641

City of Sioux Falls Project Manager
Shannon Ausen, PE
Traffic Engineering Division
sausen@siouxfalls.org
Phone: 605-367-8607

CONSULTANT - Public Involvement Lead
Jason Kjenstad, PE
HDR Engineering, Sioux Falls
Jason.Kjenstad@hdrinc.com
Phone: 605-977-7740

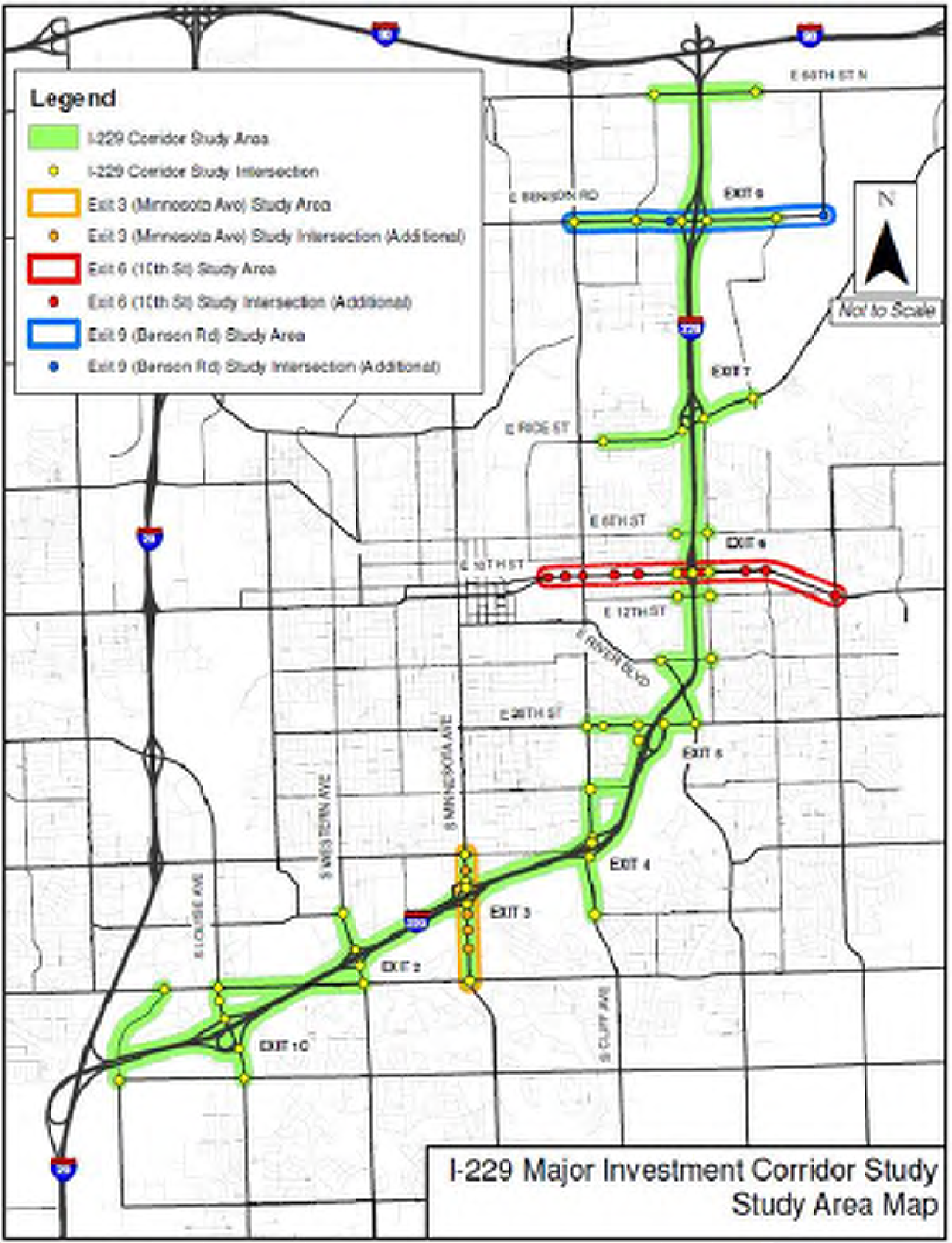
Study Area Map

I-229 Corridor Study

Solberg Avenue Overpass
to
60th Street N. Overpass

Additional Studies

Exit 3 – Minnesota Ave
Exit 6 – 10th Street
Exit 9 – Benson Road



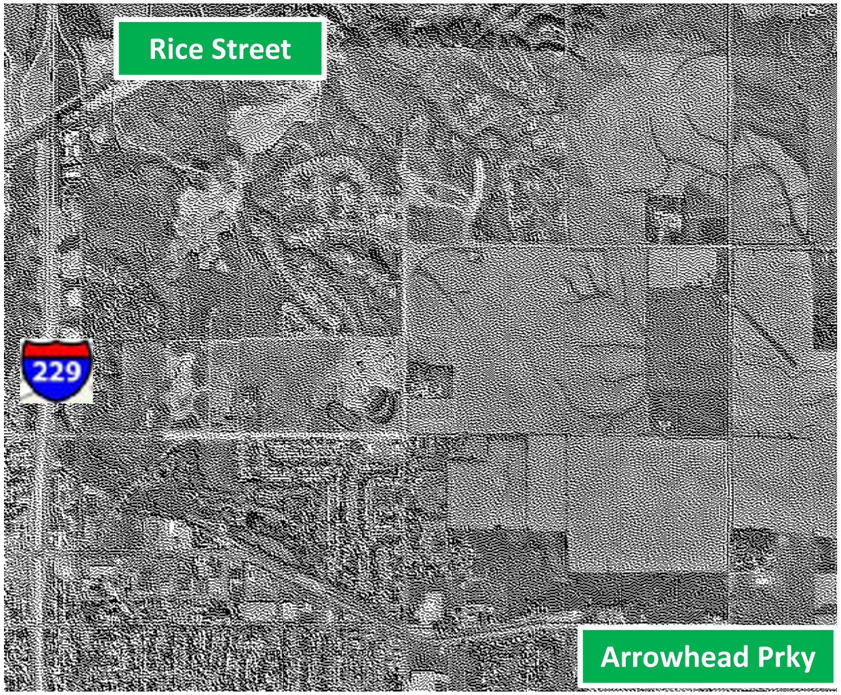
What is Driving this Study?

Louise Avenue Area – 1990’s

Louise Avenue Area – 2010’s

What is Driving this Study?

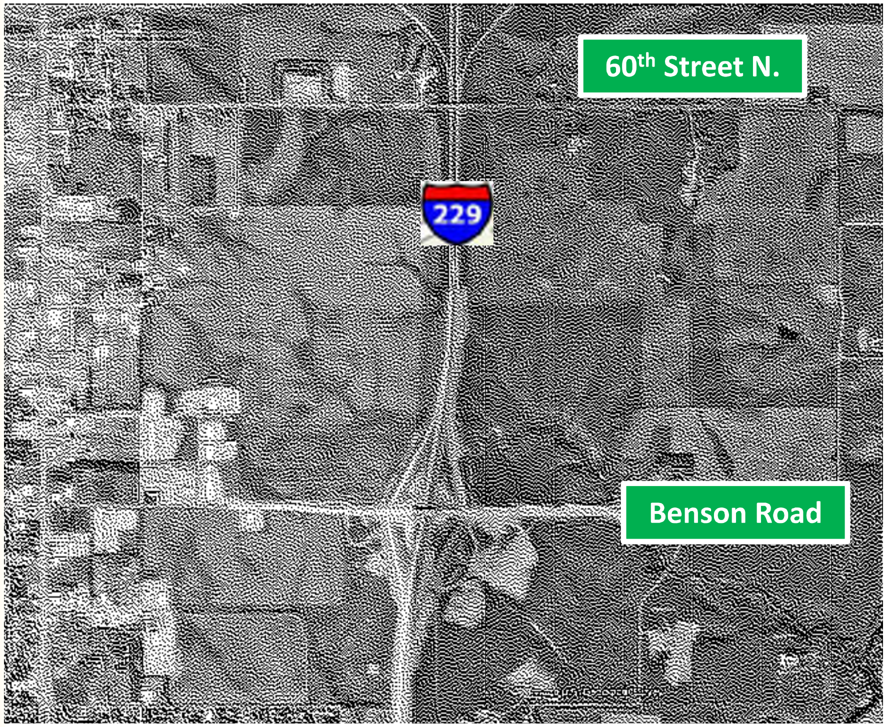
10th Street Area – 1990's



10th Street Area – 2010's

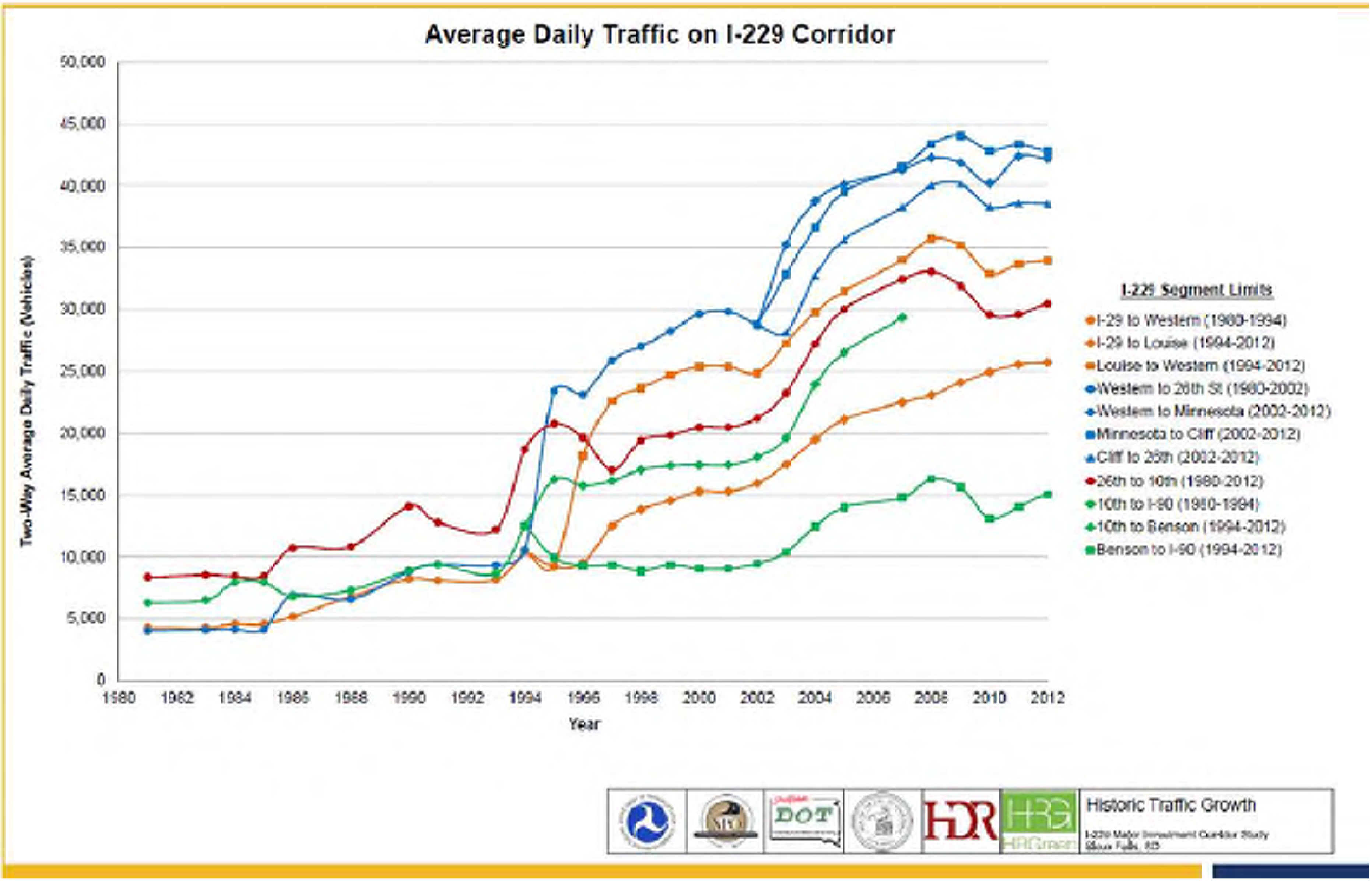
What is Driving this Study?

Benson Rd Street Area – 1990's



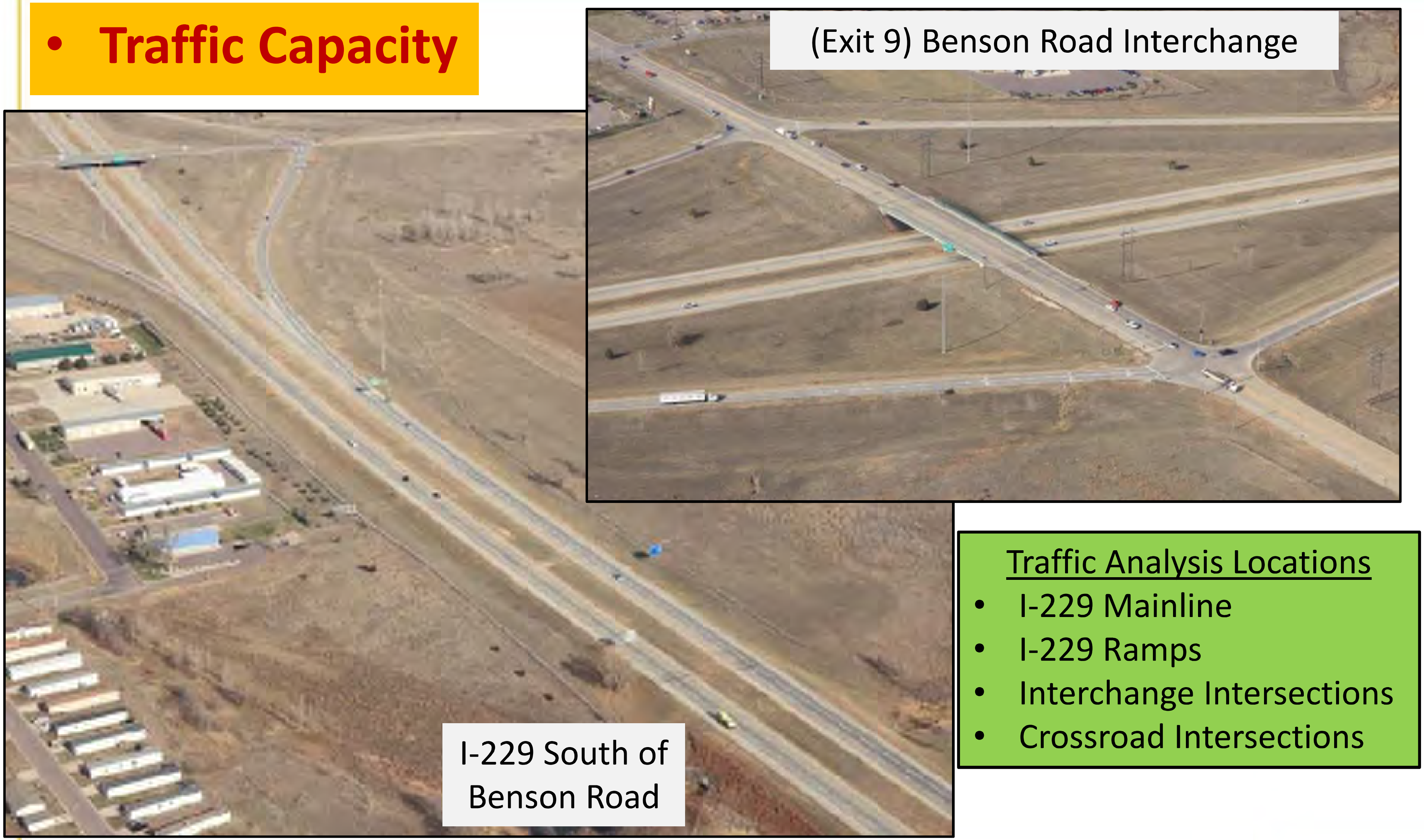
Benson Rd Street Area – 2010's

What is Driving this Study?



What Should the Study Tell Us?

- **Traffic Capacity**



(Exit 9) Benson Road Interchange

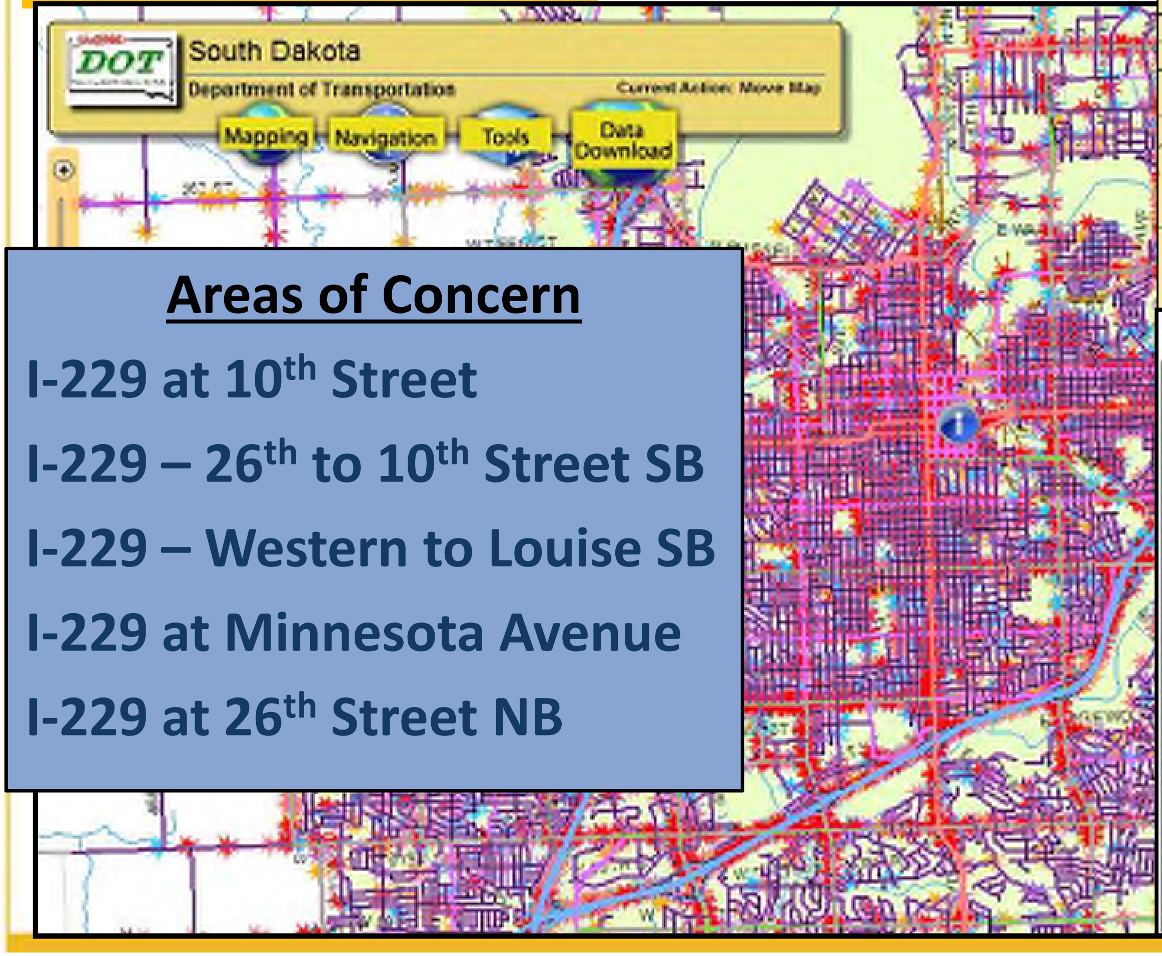
I-229 South of Benson Road

Traffic Analysis Locations

- I-229 Mainline
- I-229 Ramps
- Interchange Intersections
- Crossroad Intersections

What Should the Study Tell Us?

- Traffic Capacity
- **Traffic Safety**



Areas of Concern

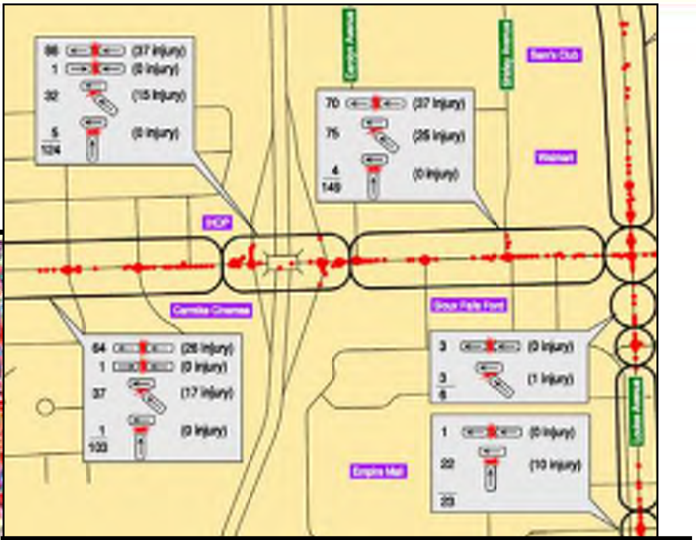
I-229 at 10th Street

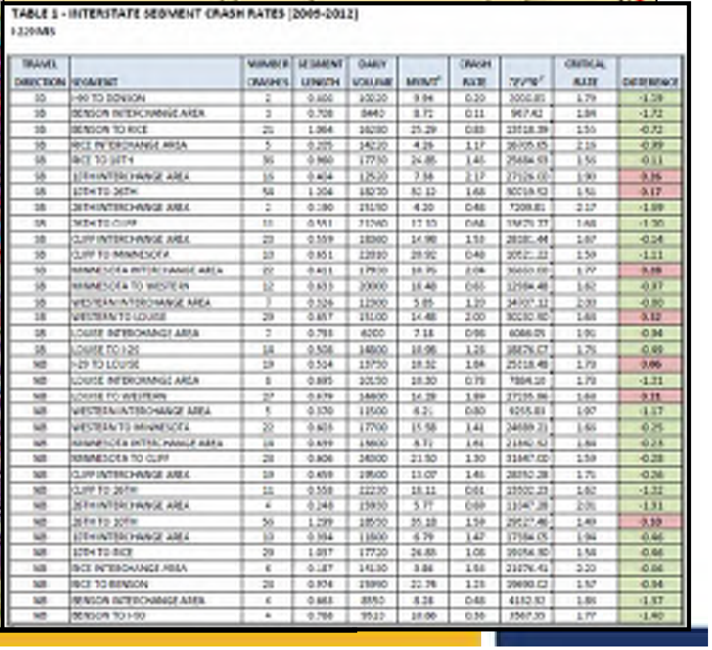
I-229 – 26th to 10th Street SB

I-229 – Western to Louise SB

I-229 at Minnesota Avenue

I-229 at 26th Street NB





What Should the Study Tell Us?

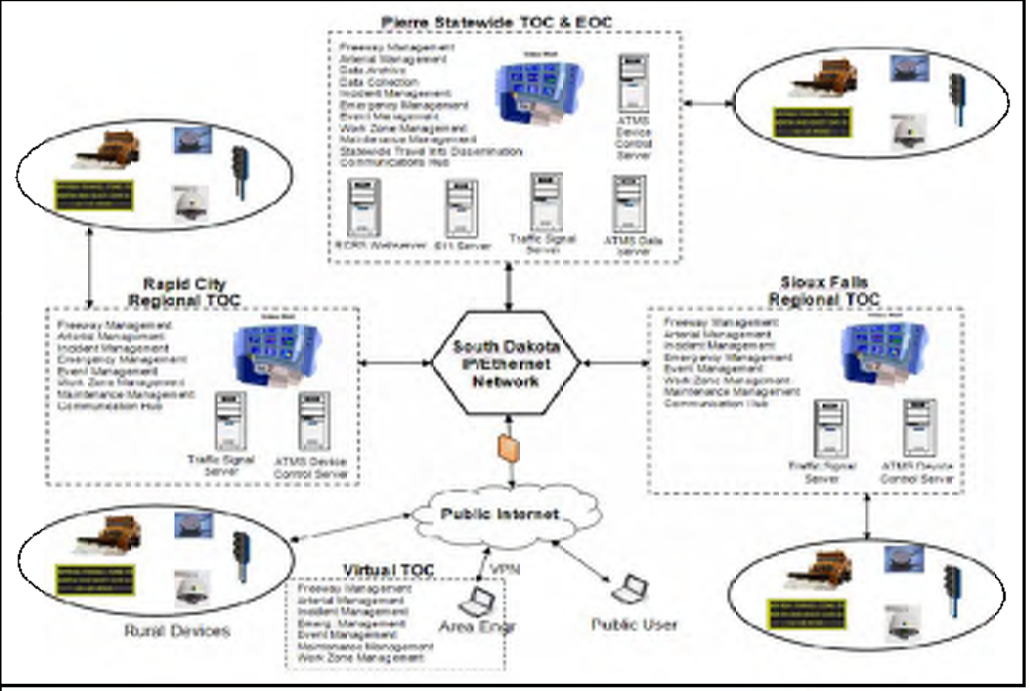
- Traffic Capacity
- Traffic Safety
- **Incident Management**

Incident Management Study Goals

- Development of Base Mapping for Detours along I-229
- Begin discussions on Communication Activities

Traffic Incident Management Partners

- Law Enforcement
- Fire and Rescue
- Medical Services
- Public Safety Communications
- Traffic Information Media
- SDDOT, City of Sioux Falls, and others



What Should the Study Tell Us?

- Traffic Capacity
- Traffic Safety
- Incident Management
- **Short & Long Term Planning**

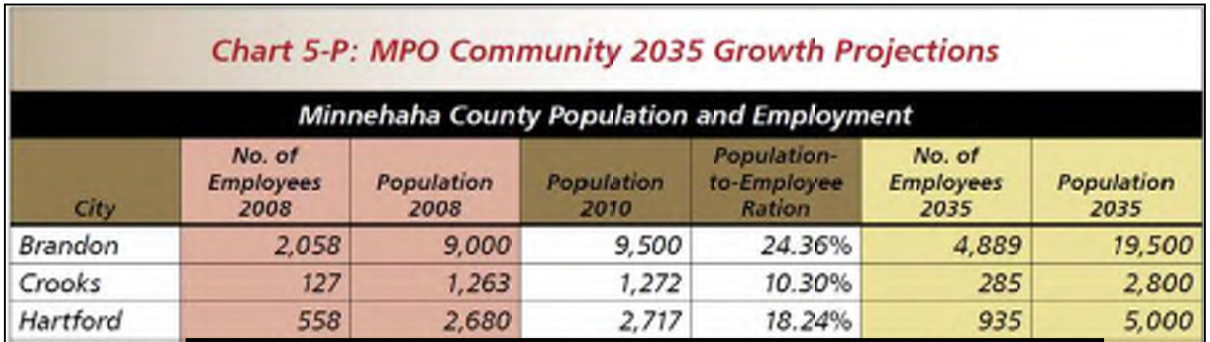
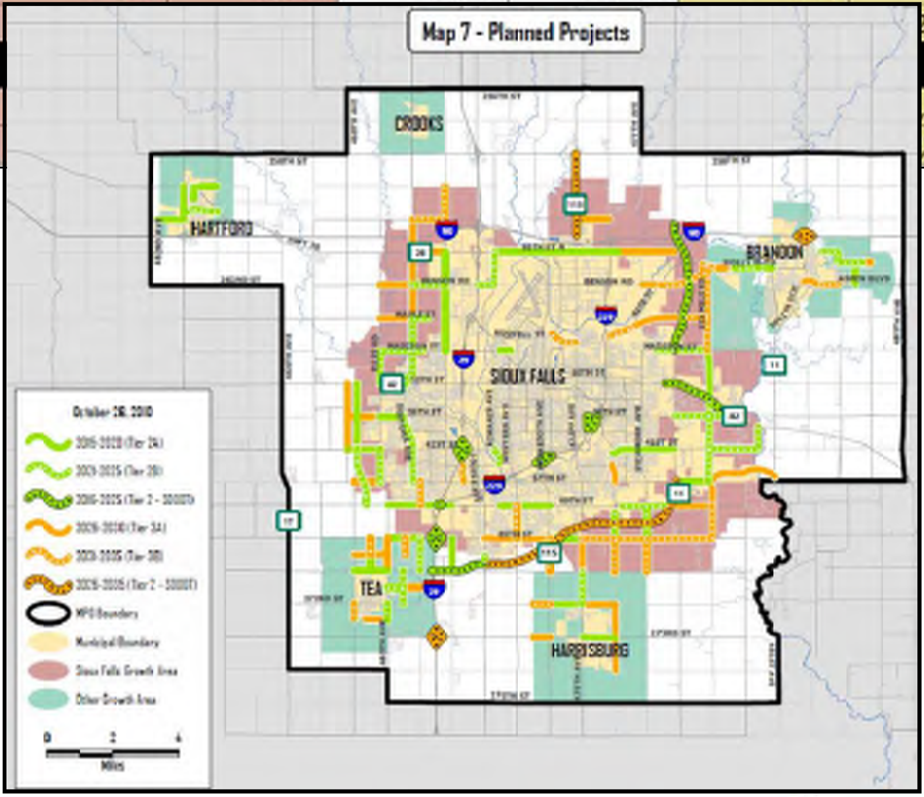


Chart 5-P: MPO Community 2035 Growth Projections

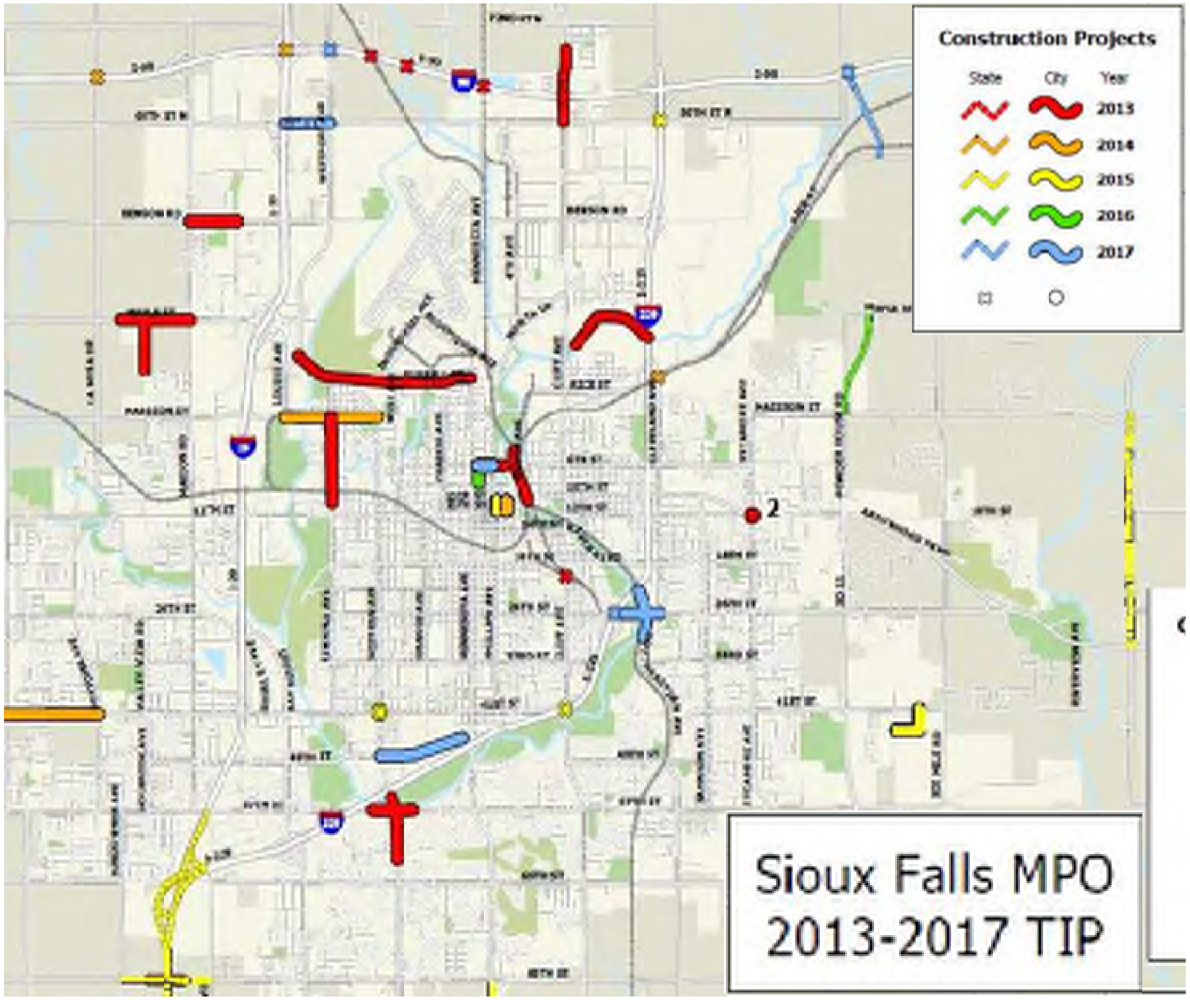
Minnehaha County Population and Employment

City	No. of Employees 2008	Population 2008	Population 2010	Population-to-Employee Ration	No. of Employees 2035	Population 2035
Brandon	2,058	9,000	9,500	24.36%	4,889	19,500
Crooks	127	1,263	1,272	10.30%	285	2,800
Hartford	558	2,680	2,717	18.24%	935	5,000
Sioux Falls						70,000
Tea						,200
Harrisburg						,800



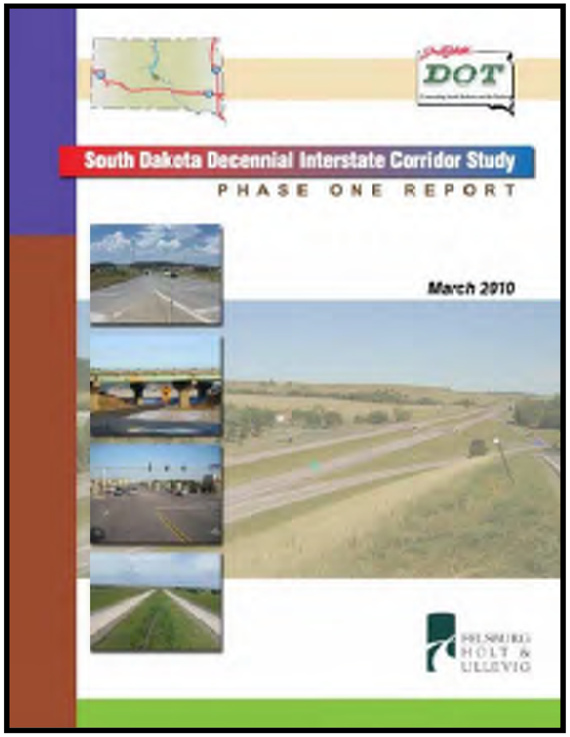
What Should the Study Tell Us?

- Traffic Capacity
- Traffic Safety
- Incident Management
- Short & Long Term Planning
- **Coordinated Implementation**



Why Additional Studies?

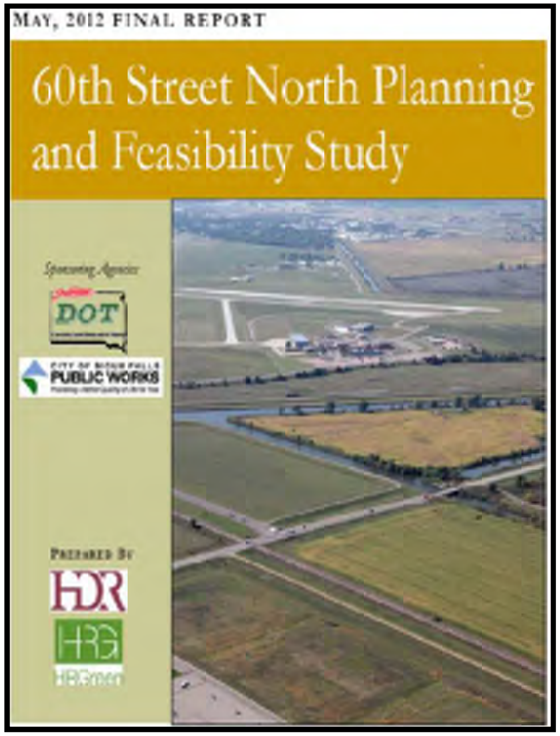
- Previous Planning Studies have indicated that Exit 3 (Minnesota Avenue), Exit 6 (10th Street), and Exit 9 (Benson Road) will need improvements along with possible crossroad corridor improvements.



South Dakota Decennial Interstate Corridor Study

PHASE ONE REPORT

March 2010

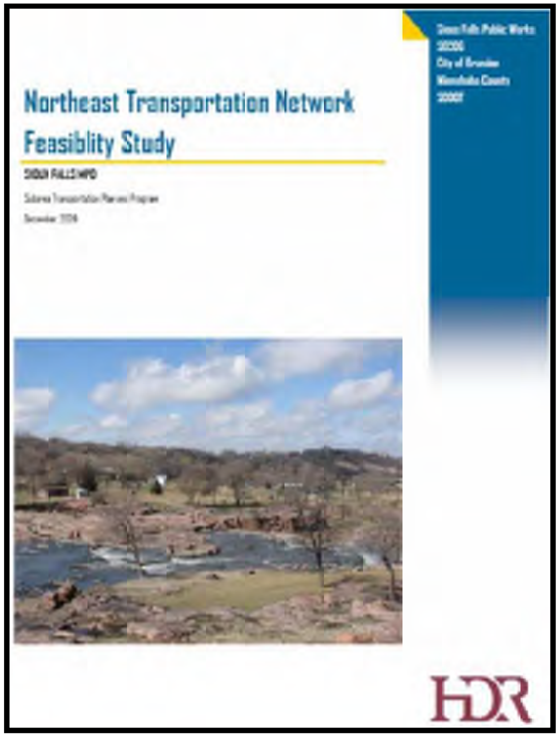


MAY, 2012 FINAL REPORT

60th Street North Planning and Feasibility Study

Sponsoring Agencies

PREPARED BY



Northeast Transportation Network Feasiblity Study

SIOUX FALLS MPO

Exit 3 (Minnesota Avenue)

Crossroad Study Goals

- Reduce traffic congestion
- Evaluate interchange options
- Integrate plans for the 49th Street Extension with the interchange options developed
- Improve pedestrian and bike access to the Big Sioux River Pathway
- Improve safety for corridor users
- Improve vehicle safety to Yankton Trail Park

Exit 6 (10th Street)

Crossroad Study Goals

- Reduce traffic congestion
- Develop Corridor Growth Plan to meet traffic demands but minimizing impacts to developed properties
- Improve pedestrian mobility
- Improve safety for corridor users
- Identify improvements to the interchange as well as the 10th Street and Cleveland Ave intersection

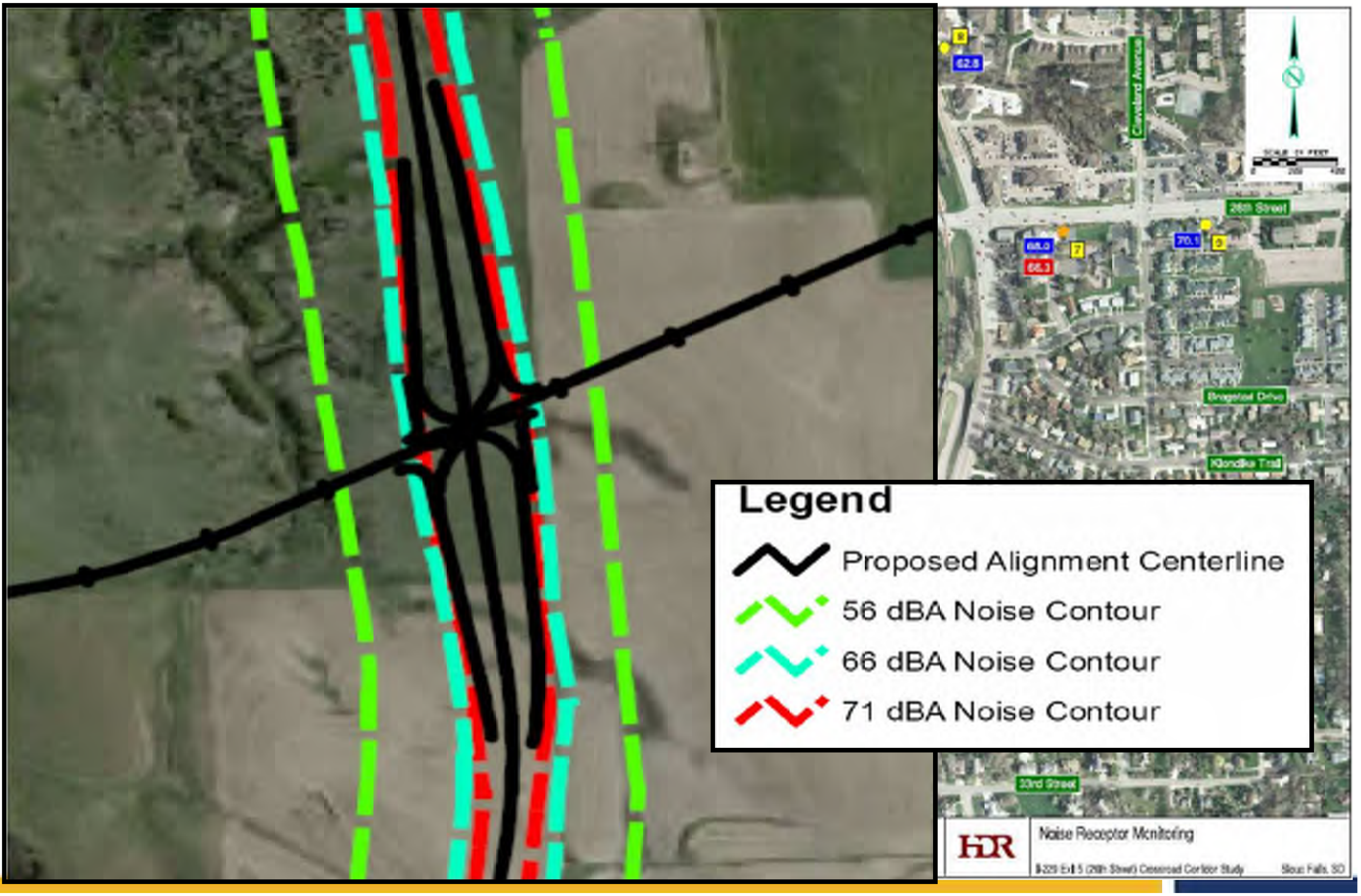
Exit 9 (Benson Road)

Crossroad Study Goals

- Reduce traffic congestion at NB on/off interchange ramp terminal
- Develop Corridor Growth Plan to meet traffic demands from development taking place east of I-229
- Improve pedestrian mobility
- Make recommendations to improve corridor intersections
- Develop interchange alternatives to meet future traffic demands

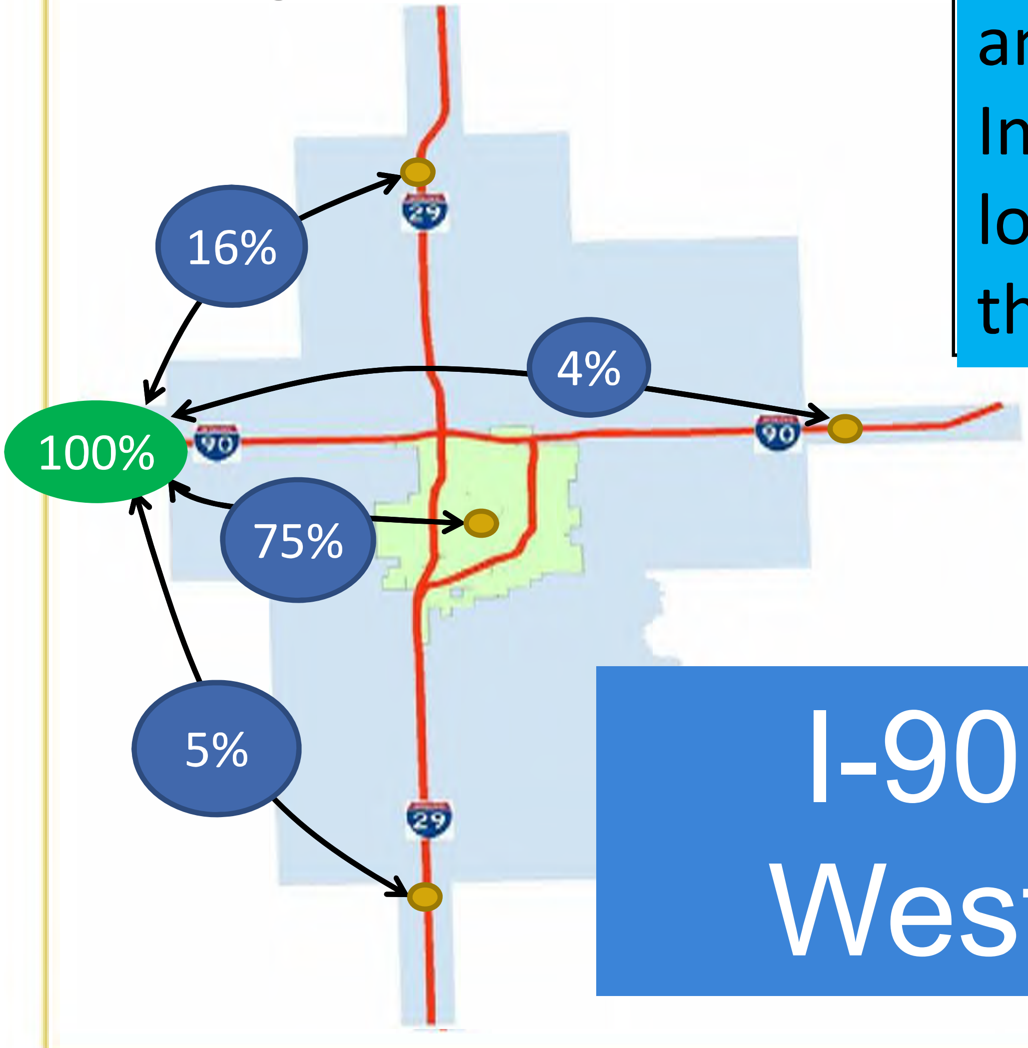
Other Study Activities?

- **Noise Data Collection**



Other Study Activities?

- **Origin-Destination Study**



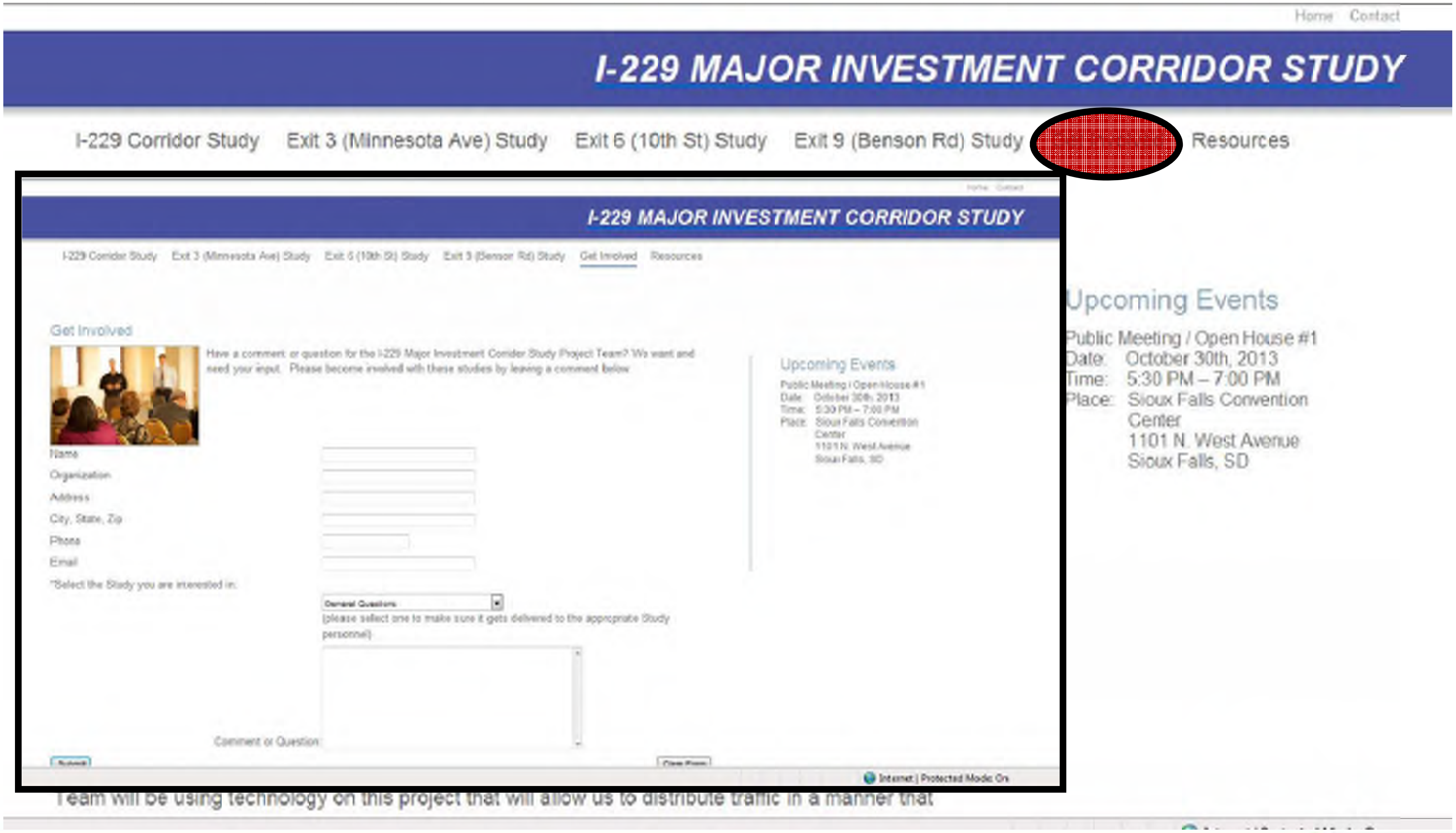
What is the amount of state and regional traffic on the Interstate system versus local traffic in and around the study area?

I-90 West

Methodology:
1.) Airsage collects signaling data from cell phone towers as your smartphone constantly communicates.
2.) This cell phone technology can locate a phone spatially at a given time of day.
3.) This data is being recorded 24 hours a day – 7 days a week.
4.) This "Technology" allows for anonymous and aggregated data meaning it only that knows that it is a phone, nothing more.
5.) Data sets are provided indicating time and location for us to determine travel demand *(keep in mind this is only a sample size of the overall population but allows us to estimate travel patterns better)*

Project Website

WWW.I229STUDY.COM



Get Involved

Have a comment or question for the I-229 Major Investment Corridor Study Project Team? We want and need your input. Please become involved with these studies by leaving a comment below.

(please select one to make sure it gets delivered to the appropriate Study personnel)

Upcoming Events

Public Meeting / Open House #1
Date: October 30th, 2013
Time: 5:30 PM – 7:00 PM
Place: Sioux Falls Convention Center
1101 N. West Avenue
Sioux Falls, SD

Team will be using technology on this project that will allow us to distribute traffic in a manner that

Project Schedule

TIMELINE OF EVENTS

YEAR 2013

April 2013 – Study Began

May / October 2013 – Data Collection & Traffic Model Building

October 30th, 2013 – ***Public Open House #1***

November 2013 / March 2014 – Complete Traffic Assessment and Develop Alternatives for Improvements

YEAR 2014

March / April 2014 - ***Public / Stakeholder Meetings***

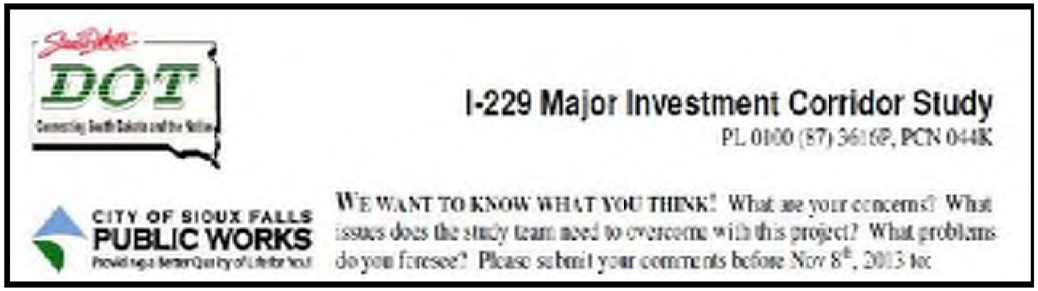
April / July 2014 – Refine Alternatives & Produce Draft Reports

August 2014 – ***Public Meeting (Final)***

October 2014 – Complete Study

Next Steps

(1.) Take public comments on concerns you have regarding I-229 Study Areas



DOT

CITY OF SIOUX FALLS
PUBLIC WORKS

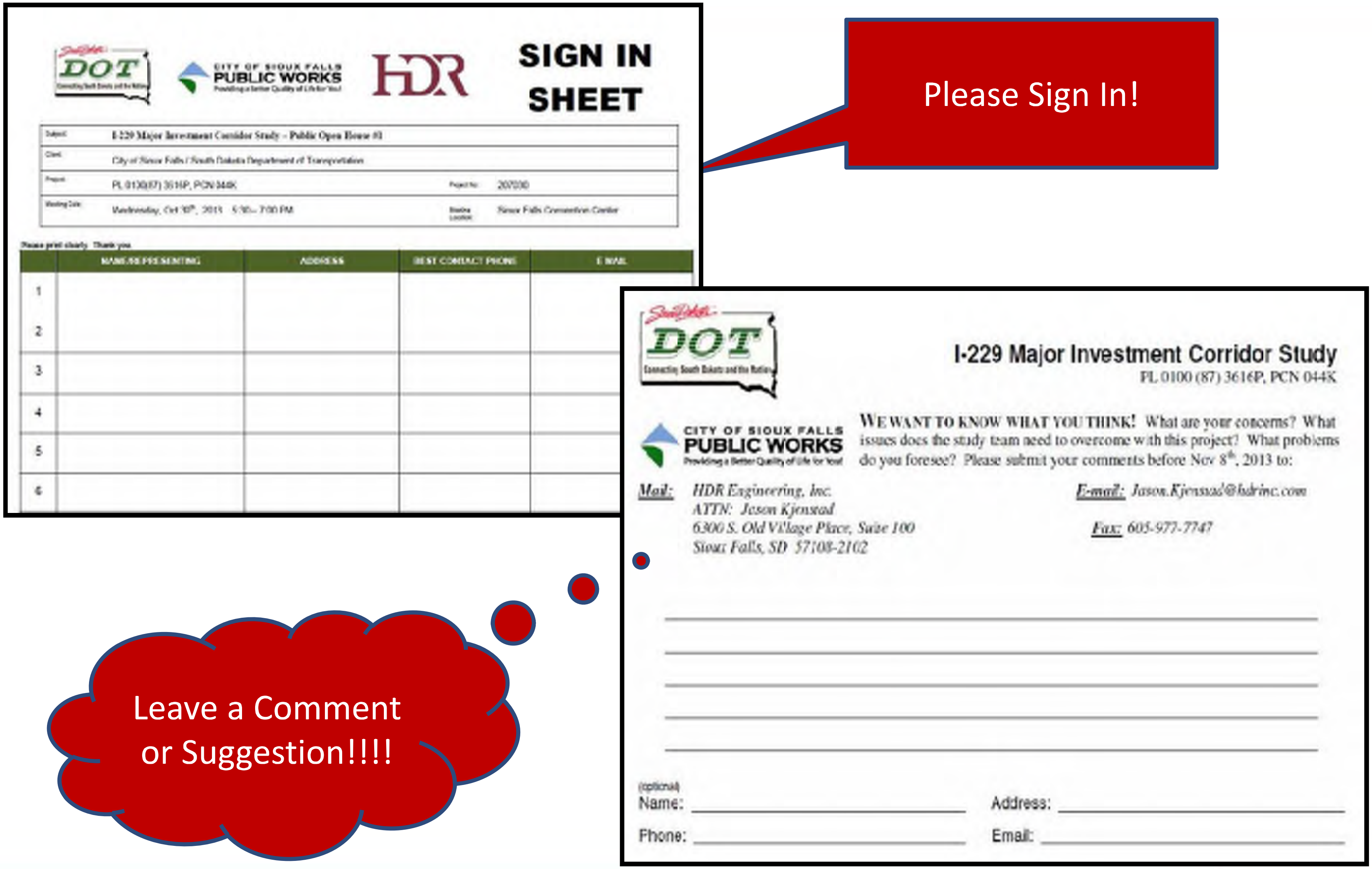
I-229 Major Investment Corridor Study
PL 0100 (87) 3616P, PCN 044K

WE WANT TO KNOW WHAT YOU THINK! What are your concerns? What issues does the study team need to overcome with this project? What problems do you foresee? Please submit your comments before Nov 8th, 2013 to:

(2.) Complete Traffic Assessment and begin to develop base alternatives to mitigate the capacity issues identified

(3.) Begin noise monitoring along corridor this fall

Before You Leave Please…



Please Sign In!

SIGN IN SHEET

Subject	I-229 Major Investment Corridor Study – Public Open House #1
Client	City of Sioux Falls / South Dakota Department of Transportation
Project	PL 0100(87) 3616P, PCN 044K
Project No.	207030
Meeting Date	Wednesday, Oct 30th, 2013 5:30 – 7:00 PM
Meeting Location	Sioux Falls Convention Center

Please print clearly. Thank you.

	NAME/REPRESENTING	ADDRESS	BEST CONTACT PHONE	E-MAIL
1				
2				
3				
4				
5				
6				

I-229 Major Investment Corridor Study

PL 0100 (87) 3616P, PCN 044K

WE WANT TO KNOW WHAT YOU THINK! What are your concerns? What issues does the study team need to overcome with this project? What problems do you foresee? Please submit your comments before Nov 8th, 2013 to:

Mail:
HDR Engineering, Inc.
ATTN: Jason Kjenstad
6300 S. Old Village Place, Suite 100
Sioux Falls, SD 57108-2102

E-mail: *Jason.Kjenstad@hdrinc.com*

Fax: *605-977-7747*

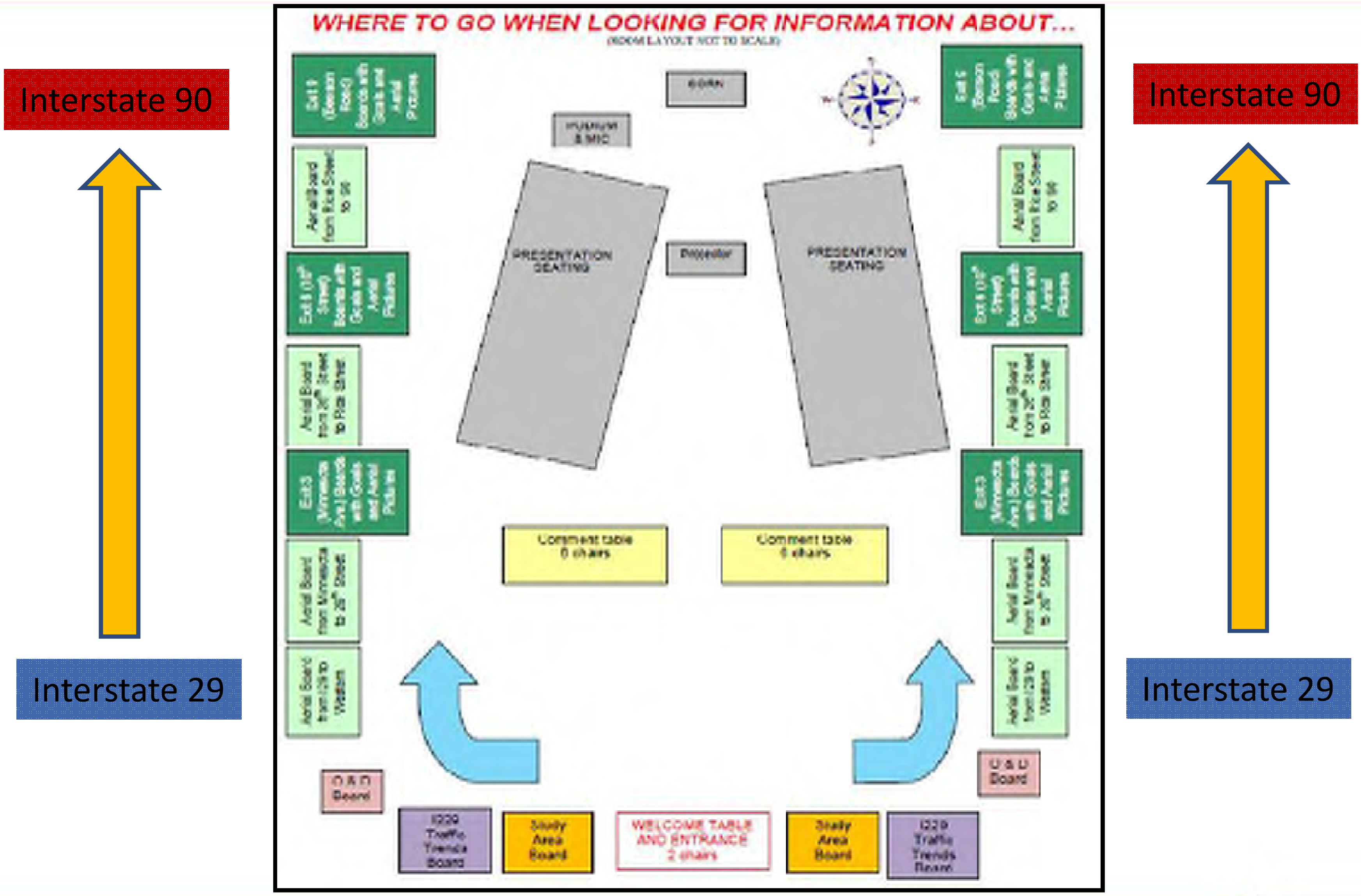
(optional)

Name: ____________________ Address: ____________________

Phone: ____________________ Email: ____________________

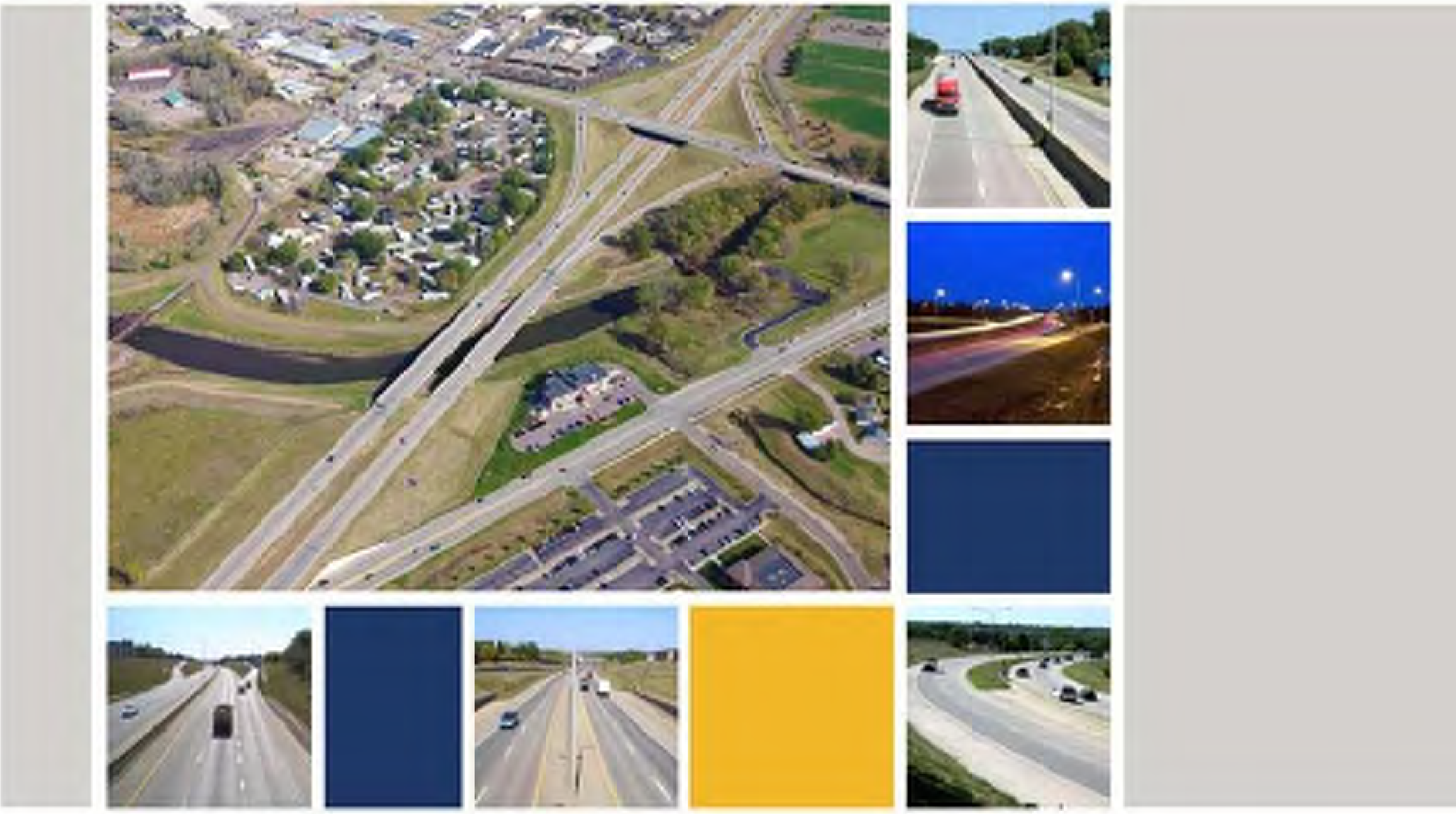
Leave a Comment or Suggestion!!!!

Room Layout



Interstate 90
Interstate 29
WHERE TO GO WHEN LOOKING FOR INFORMATION ABOUT…
(ROOM LAYOUT NOT TO SCALE)
PODIUM & MIC
Projector
PRESENTATION SEATING
PRESENTATION SEATING
Comment table 6 chairs
Comment table 6 chairs
O & D Board
O & D Board
I229 Traffic Trends Board
Study Area Board
WELCOME TABLE AND ENTRANCE 2 chairs
Study Area Board
I229 Traffic Trends Board
Interstate 90
Interstate 29

U.S. Department of Transportation
Federal Highway Administration



Thanks for Attending!

WWW.I229STUDY.COM

HDR

HRGreen

APPENDIX -

PUBLIC MEETINGS #2 – JUNE 1ST & 2ND, 2015

MINNESOTA AVENUE

JUNE 1ST, 2015

- SIGN-IN SHEETS
- POWERPOINT SLIDES
- MEETING NOTES (SEE END OF PUBLIC MEETINGS #2 APPENDIX)
- COMMENTS (SEE END OF PUBLIC MEETINGS #2 APPENDIX)

Note: actual attendance count was 53 people (including 15 women)

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Informational Meeting for Minnesota Avenue Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3516P, PCN 044K **Project No.:** 207030

Meeting Date Monday June 1st, 2015 5:00 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Ray Kirlin	3209 S. Lincoln	334-2411	kirlin.r@bd-zero.com
2	Pam + Steve [illegible]	3000 S. Sunnymede	332-6509	
3	Ron McMahon	116 E Dakota Ave, Pierre	776-1009	ron.mcmahon@dot.gov
4	John Shelso	2800 W 23rd St. SF, SD	605-951-2970	jhshelso@earthlink.net
5	[illegible]	1301 W [illegible] Dr		
6	Art Holden	705 W Victory Ln SF 57108	605-371-3828	artholden67@gmail.com
7	Bruce Danielson	[illegible] SF 57101		
8	Bob Bohm	3600 S Duluth	334-4220	robert.bohm@dakotabuilders.org
9	Greg Boris	5415 S. Westwood	321-5514	gboris@aol.com
10	David Heinold	205 S. Menlo Ave.	219-363-5768	d-heinold@gmail.com
11	Kevin Nyberg	330 W. 41st, 57105	605-331-4088	knyberg@nybergsace.com
12	Susan [illegible]	606 E 21st St	332-5319	sah @ [illegible].net
13	Gerald Teunissen	808 Jane Lane SF-SD	366-1979	gerald@benderco.com
14	Kurt [illegible]	605 E 21st 57105	3326035	KJG-321@yahoo.com
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CITY OF SIOUX FALLS
PUBLIC WORKS

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Informational Meeting for Minnesota Avenue Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(67) 3616P, PCN 044K **Project No.:** 207030

Meeting Date Monday, June 1st, 2015 5:00 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Brad Remmich	SDDOT		
2	Craig Smith	SDDOT	995-3300	craig.smith@state.sd.us
3	Steve Gramm	SDDOT	773-6641	Steve.gramm@state.sd.us
4	[illegible] Kelly		605-521-9281	Travis.Kelly@Sanfordhealth.org
5	Dave Rowe	Empire Bldg Cat	321-9823	DaveinSiouxFalls@msn.com
6	Sara Bertsch	Argus Leader	605-291-0831	
7	Jon Wiegand	HR Green		jwiegand@hrgreen.com
8	Amber Gibson	SECOG	367-5390	amber@secog.org
9	Kevin Kriese	Boen & Associates	336-0425	KevinK@BoenAssociates.com
10	James Unruh	HDR	977-7766	james.unruh@hdrinc.com
11	Trevor Pierson	5700 S Chucker Drive		Trevorhockey@sio.midco.net
12	Gregg Johnson	6801 E. Split Rock Cr	332-8166	grjohnson@sio.midco.net
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Sign In Sheet

Subject I-229 Major Investment Corridor Study – Informational Meeting for Minnesota Avenue Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3615P, PCN 044K **Project No.:** 207030

Meeting Date Monday, June 1st, 2015 5:00 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Jo Wahle			
2	Stan + Donna Schmidt	3214 W Zephen Pl. #1		stan@goingbeyondwords.com
3	Kay Gollesch	LifeScape		kay.gollesch@lifescapesd.org
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Sign In Sheet

Subject I-229 Major Investment Corridor Study – Informational Meeting for Minnesota Avenue Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3816P, PCN 044K **Project No.:** 207030

Meeting Date Monday, June 1st, 2015 5:00 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Pete Longman	SDDOT	773-6488	pete.longman@state.sd.us
2	Jason Kjenstad	HDR	605-977-7755	jason.kjenstad@hdrinc.com
3	Christina Bennett	SDDOT	(605)773-4759	Christina.Bennett@state.sd.us
4	Paul Nikolas	SDDOT	60-367-5680	Paul.Nikolas@state.sd.us
5	Al Schoeneman	1801 W 50th St SF 57105	605 376 1189	al.schoeneman@schoenemans.com
6	Thomas Hein	6100 E Hein Place SF SD 57110	605-361-8490	Theinmail@gmail.com
7	Travis Dressen	SDDOT - SF Area	605-367-5680	travis.dressen@state.sd.us
8	Ross Harris	HR Green 5525 Merle Hay Rd. Johnston, IA 50131	515-657-5263	rharris@hrgreen.com
9	Michael [illegible]	1813 S Prairie Ave	605 929 8723	[illegible]@ gmail.com
10	Audrey James	27002 Split Creek Ct	605.939-7594	audreyjames@borderstates.net
11	Joe James	27002 Split Creek Ct S Falls	605-366-5328	jjames@borderstates.net
12	Chris Paisley	7001 W 66th St SF SD	319-389-1507	Cmpaisley@Gmail.com
13	Lori Buschene	3710 S Southeastern Ave #A Sioux Falls SD	507.360.5554	buschene@midco.net
14	West Valley Dale Froehlich	6 So Le Chateau SF, SD 57105	605-201-9810	dalefroehlich@gmail.com
15	Nancy Preston	5700 S. Chuck Drive		
16	Alex Conaty	1510 W. 57th St	231-7620	alex.conaty@siouxfallsschools.com
17	Kathy + Jerry Phillips	5100 S. Swift Park Dr	940-2448	kzphil12@yahoo.com
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Interstate 229 Major Investment Study Exit 3 – Minnesota Avenue Sub-study

Informational Meeting
June 1st, 2015
5:00 pm to 7:00 pm

HDR

HRGreen

Study Area Map

I-229 Corridor Study

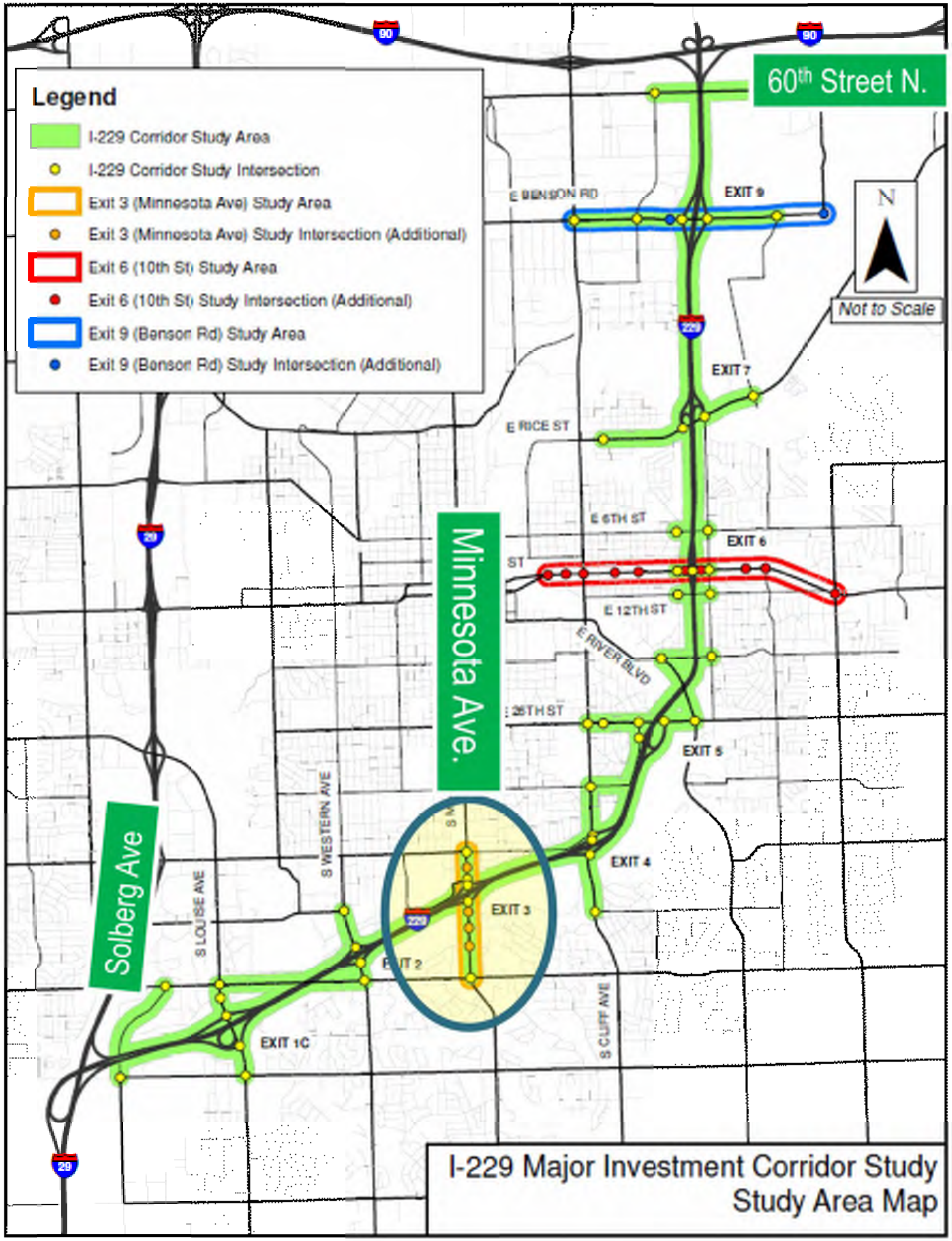
Solberg Avenue Overpass

to

60th Street N. Overpass

Meeting will focus on:

Exit 3 – Minnesota Ave



Study Advisory Partners

South Dakota Department of Transportation (SDDOT)

South Dakota Highway Patrol

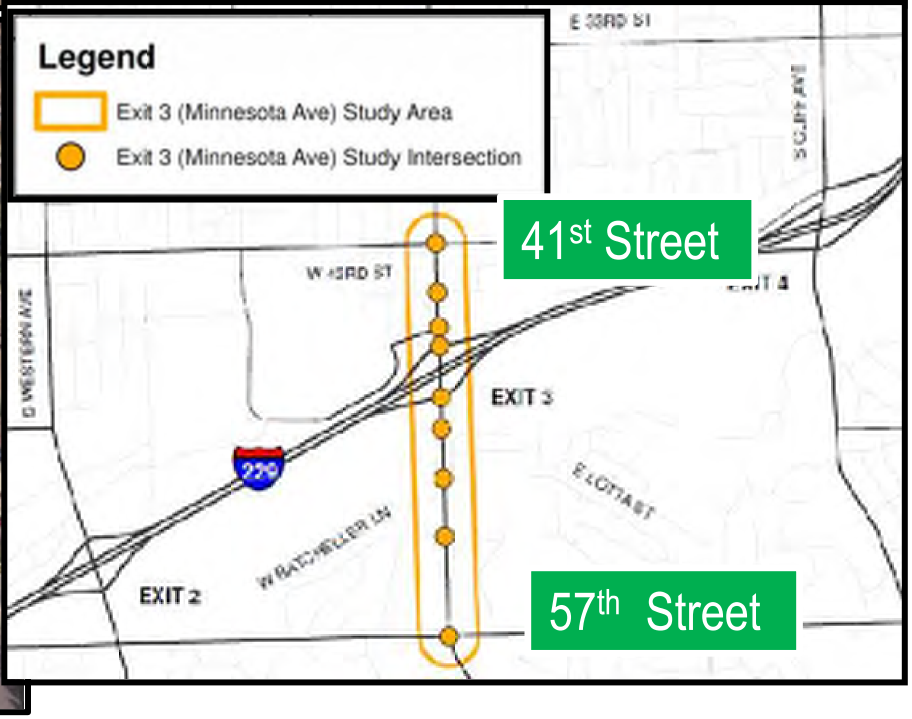
City of Sioux Falls

Sioux Falls Metropolitan Planning Organization (MPO)

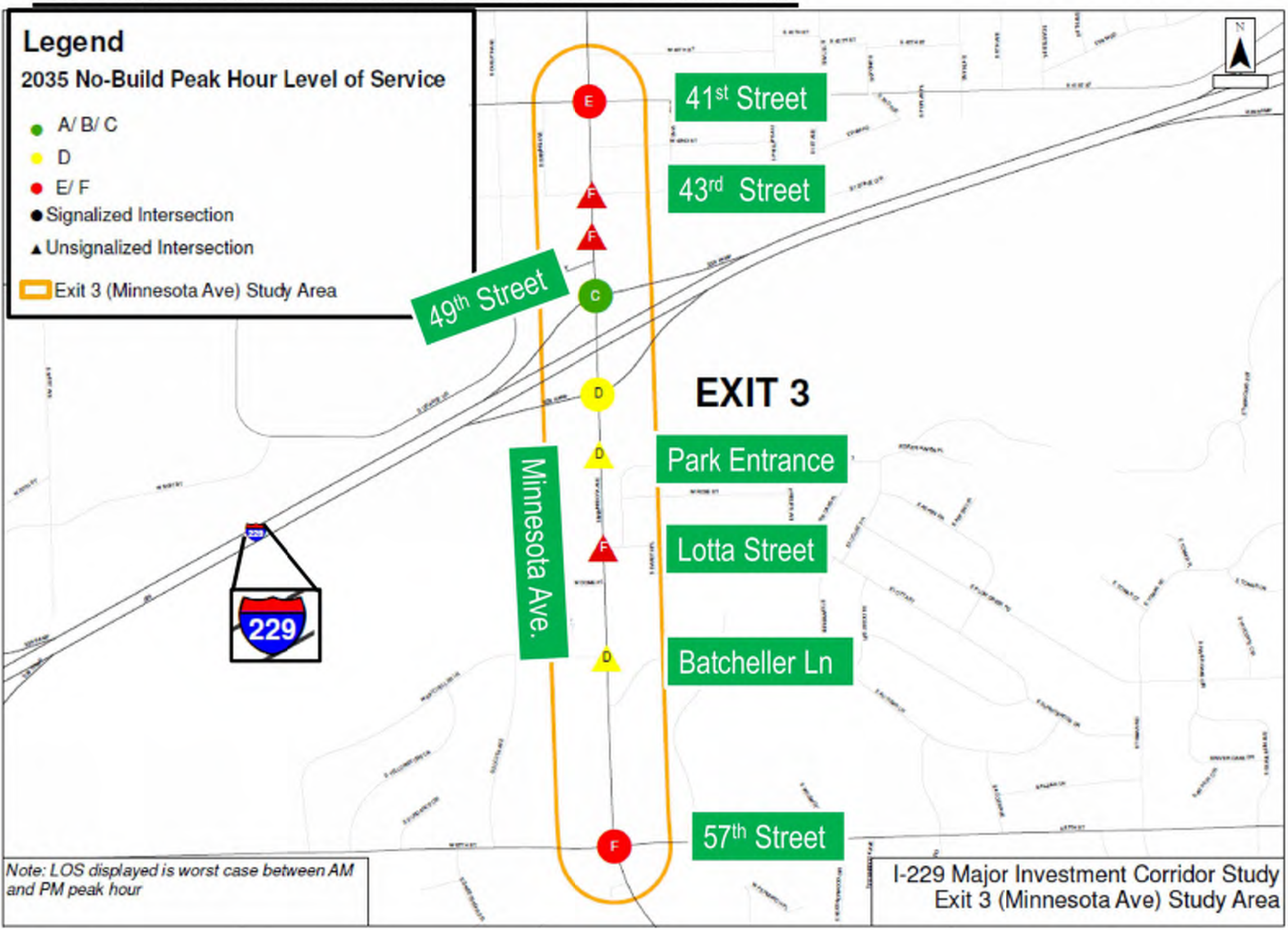
Federal Highway Administration (FHWA)

Exit 3 (Minnesota Avenue) Crossroad Study Goals

- Reduce traffic congestion
- Evaluate interchange options
- Integrate plans for the 49th Street Extension with the interchange options developed
- Improve pedestrian and bike access to the Big Sioux River Pathway
- Improve safety for corridor users
- Improve vehicle safety to Yankton Trail Park



Minnesota Avenue Corridor Overview



Note: LOS displayed is worst case between AM and PM peak hour

I-229 Major Investment Corridor Study
Exit 3 (Minnesota Ave) Study Area

Minnesota Avenue Corridor Overview

Intersection congestion in the peak hours, additional capacity needed.

43 Crashes in 4 year period (rear end and angle crashes)

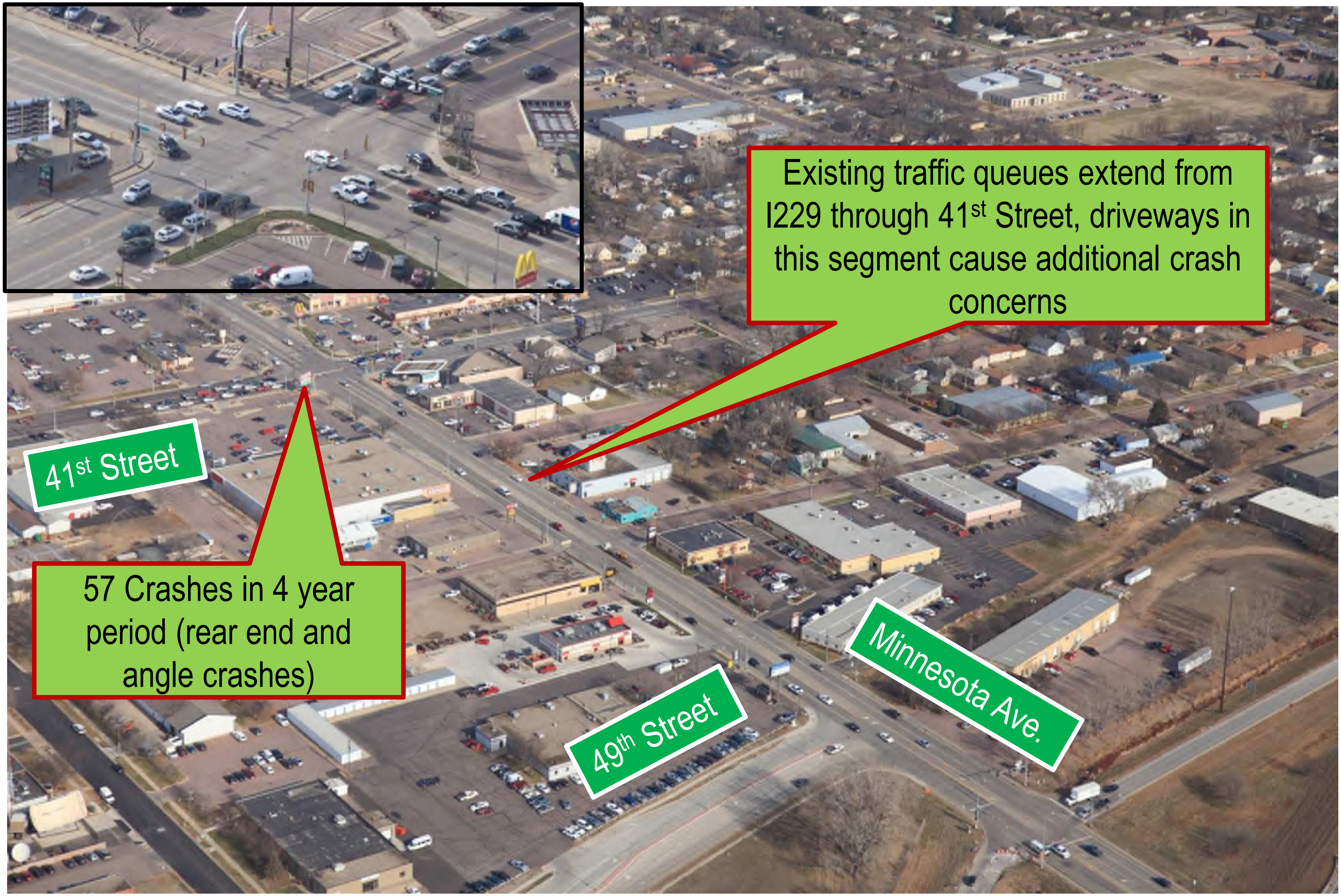
Minnesota Avenue Corridor Overview

49th Street Extension connection to Minnesota Avenue to be evaluated with interchange concepts

Park Entrance difficult to enter/exit during peak hours (mostly related to soccer season)

6 Crashes in 4 year period (rear end crashes near gore area)

Minnesota Avenue Corridor Overview



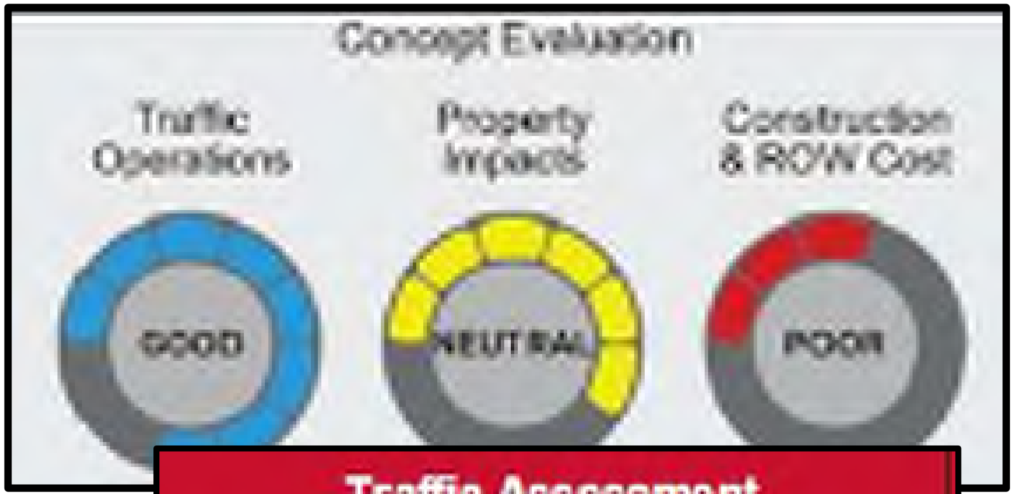
Existing traffic queues extend from I229 through 41st Street, driveways in this segment cause additional crash concerns

57 Crashes in 4 year period (rear end and angle crashes)

Conceptual Ideas for Minnesota Avenue

What you will be able to see tonight:

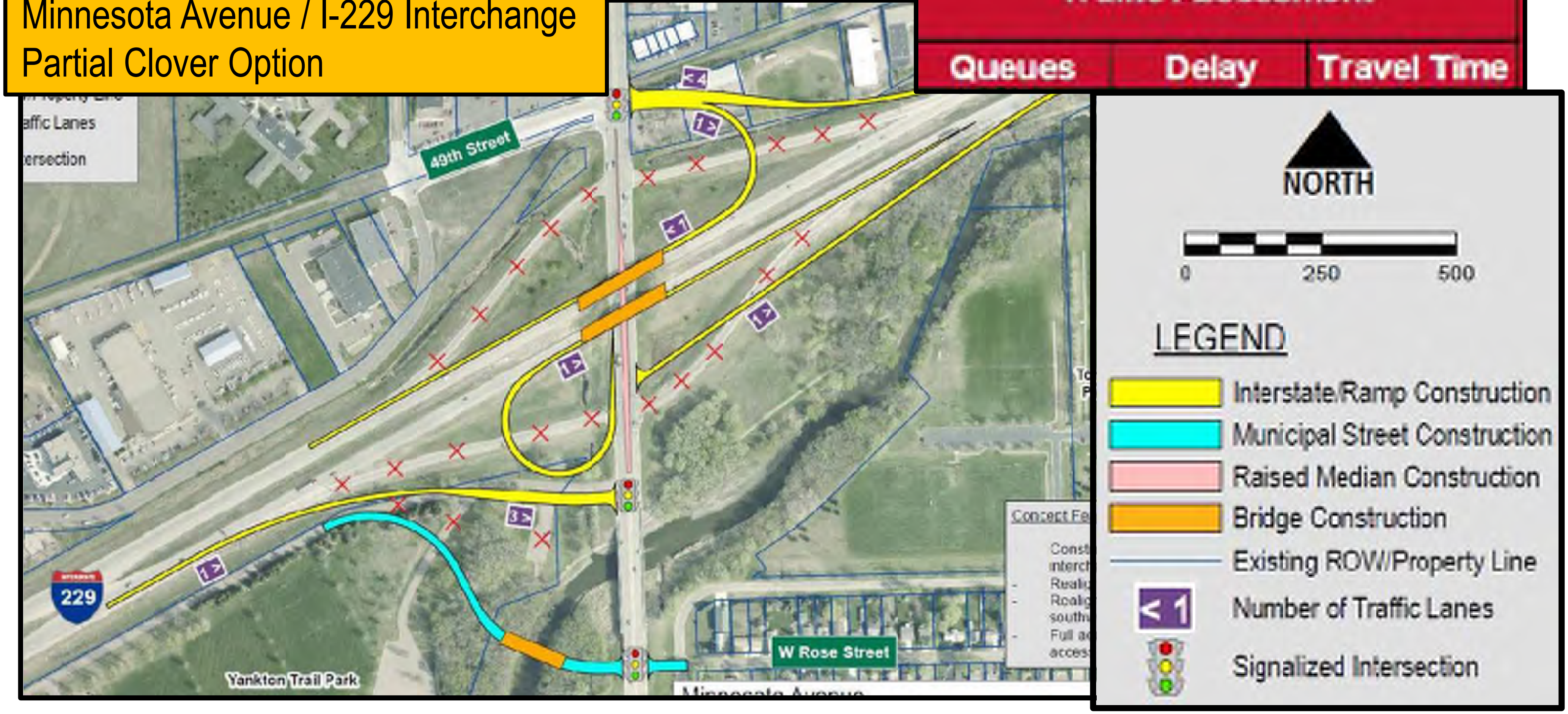
- 13 Interchange Conceptual Options
- 4 Corridor Options
- Access Changes to Yankton Trail Park
- Conceptual Options to improve safety



Minnesota Avenue / I-229 Interchange
Partial Clover Option

Traffic Assessment

Queues	Delay	Travel Time



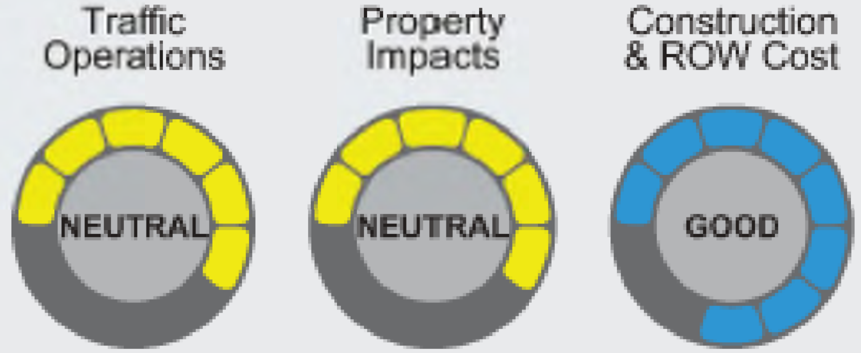
Conceptual Ideas for Minnesota Avenue

What you will be able to see tonight:

- 13 Interchange Conceptual Options
- 4 Corridor Options
- Access Changes to Yankton Trail Park
- Conceptual Options to improve safety

Minnesota Avenue – Raised Median with ¾ Movements when possible

Concept Evaluation



LEGEND

🟨	Interstate/Ramp Construction
🟦	Municipal Street Construction
🟥	Raised Median Construction
🟧	Bridge Construction
—	Existing ROW/Property Line
< 1	Number of Traffic Lanes
🚦	Signalized Intersection

Next Steps for Minnesota Avenue

- **Finalize Composite Comparison Matrix**
  - Traffic Assessment
  - Environmental Screening
  - ROW Impacts
  - Overall Costs
  - Public Involvement Support

- **Complete additional Traffic Operations analysis on a reduced number of options based on the screening activities**

- **Develop Priority Phasing Plan for I-229 Corridor and Sub-Study Corridor**

- **Schedule and Conduct next public meeting**

PROJECT CONTACTS:

Jason Kjenstad – HDR Engineering, Inc.
605-977-7740 or jason.kjenstad@hdrinc.com

Ross Harris– HR Green, Inc.
515-657-5263 or rharris@hrgreen.com

Shannon Ausen – City of Sioux Falls
605-367-8607 or sausen@siouxfalls.org

Steve Gramm – SDDOT Project Development
605-773-6641 or steve.gramm@state.sd.us

Interstate 229 Major Investment Study Exit 3 – Minnesota Avenue Sub-Study

Thanks for Attending!!!!!

10TH STREET

JUNE 1ST, 2015

- SIGN-IN SHEETS
- POWERPOINT SLIDES
- MEETING NOTES (SEE END OF PUBLIC MEETINGS #2 APPENDIX)
- COMMENTS (SEE END OF PUBLIC MEETINGS #2 APPENDIX)

CITY OF SIOUX FALLS PUBLIC WORKS

Note: actual attendance count was 31 people (including 8 women)

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Informational Meeting for 10th Street Sub-Study
Client City of Sioux Falls/South Dakota Department of Transportation
Project PL 0100(87) 3616P, PCN 044K **Project No.:** 207030
Meeting Date Monday, June 1st, 2015 7:30 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Amber Gibson	SECOG	605 367 5390	amber@secog.org
2	Brad Remmich	SDDOT		
3	Greg Boer	5415 S Western SF		
4	Travis Dressen	SDDOT - SF Area	605 367 5680	travis.dressen@state.sd.us
5	Chuck Gustafson	705 E Ridge Rd SF SD	332-1000	cgustafson@mac.com
6	Hemil Patel	5610 [illegible] Street	721 776 1476	gm@super8siouxfalls.com
7	Bob Bohm	3600 S Duluth Ave	605 334 4726	robert.bohm@dakotabilities.org
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CITY OF SIOUX FALLS
PUBLIC WORKS

Sign In Sheet

Subject I-229 Major Investment Corridor Study -- Informational Meeting for 10th Street Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3816P, PCN 044K **Project No.:** 207030

Meeting Date Monday, June 1st, 2015 7:30 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	PETE LONGMAN	SDDOT	773-6488	pete.longman@state.sd.us
2	Steve Gramm	SDDOT	773-6641	Steve.gramm@state.sd.us
3	Paul Nikolas	SDDOT	367-5680	Paul.Nikolas@state.sd.us
4	COLLIN MORIARTY	GAGE BROS	336.118	cmoriarty@gagebrothers.com
5		840 S. DAY	338-6900	—
6	Lodermeier Family LLC Barbara Anderson	840 S. Day SF 57103	338-6900	amandad840@aol.com
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CITY OF SIOUX FALLS
PUBLIC WORKS

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Informational Meeting for 10th Street Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3816P, PCN 044K **Project No.:** 207030

Meeting Date Monday, June 1st, 2015 7:30 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Tom Kelley	GAGE BROTHERS	6 605 376 8150	
2	Dave Nelson	3413 Southern Cir.	366-7708	
3	Jason Kjenstad	HDR	605-977-7740	jason.kjenstad@hdrinc.com
4	Mark Elneson	101 S Cleveland	605-338-6231	MElneson@sio.midco.net
5	Ron McMahon	116 E Dakota Ave Suite A Pierre	605-776-1009	mmcmahon@dot.gov
6	Christina Bennett	SDDOT	605-773-4759	Christina.Bennett@state.sd.us
7	Gary Busselman	7201 E Madison ST SF SD 57110	605-351-5001	gary@garybuss.com
8	Edith Smith	Gage Brothers	603336 1180	esmith@gagebrothers.com
9	Sharon Fix	101 S. Cleveland Ave	(605)338-8151	fixdds@midconetwork.com
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Interstate 229 Major Investment Study
Exit 6 – 10th Street Sub-Study

Informational Meeting
June 1st, 2015
7:30 pm to 9:00 pm

Study Area Map

I-229 Corridor Study

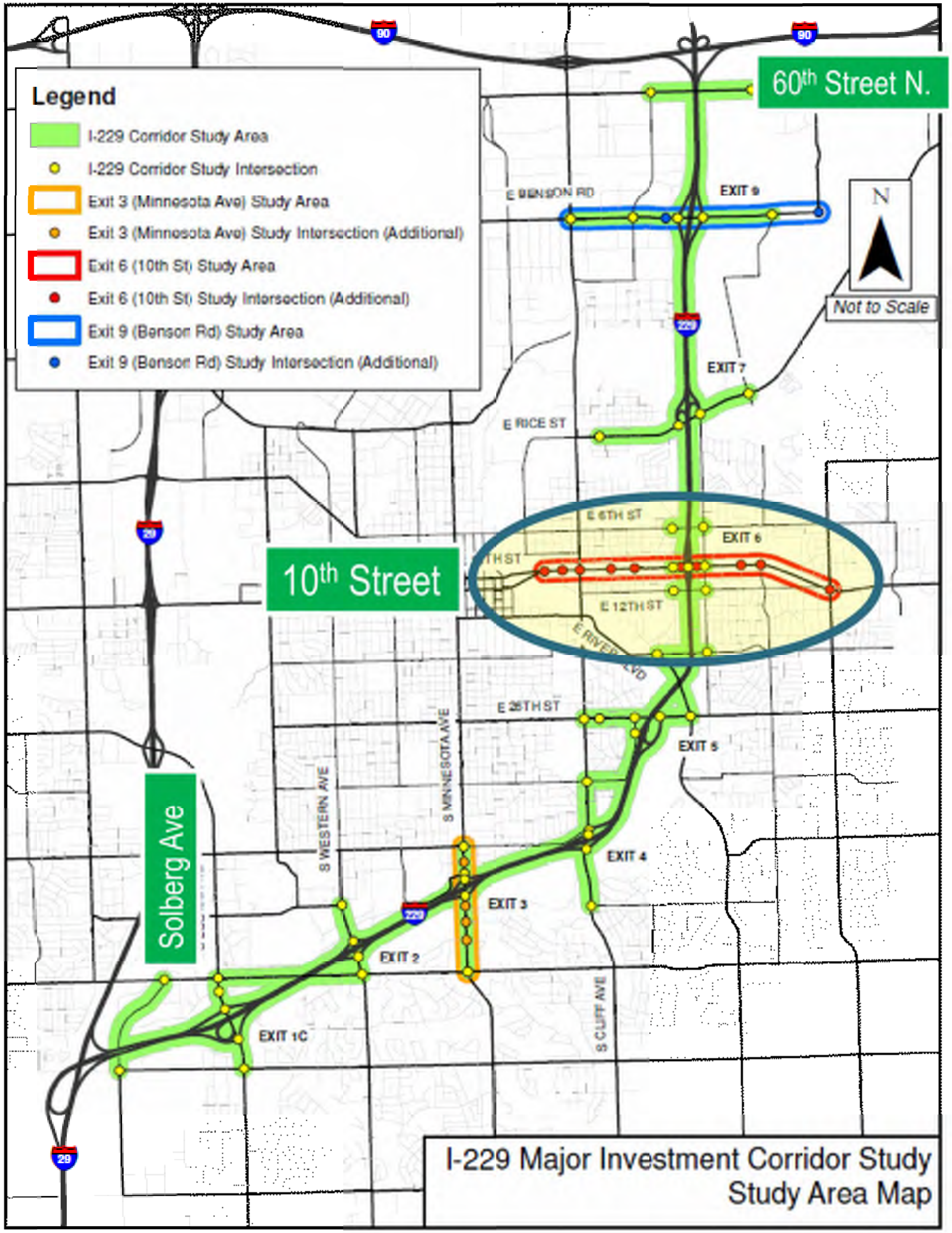
Solberg Avenue Overpass

to

60th Street N. Overpass

Meeting will focus on:

Exit 6 – 10th Street



Study Advisory Partners

South Dakota Department of Transportation (SDDOT)

South Dakota Highway Patrol

City of Sioux Falls

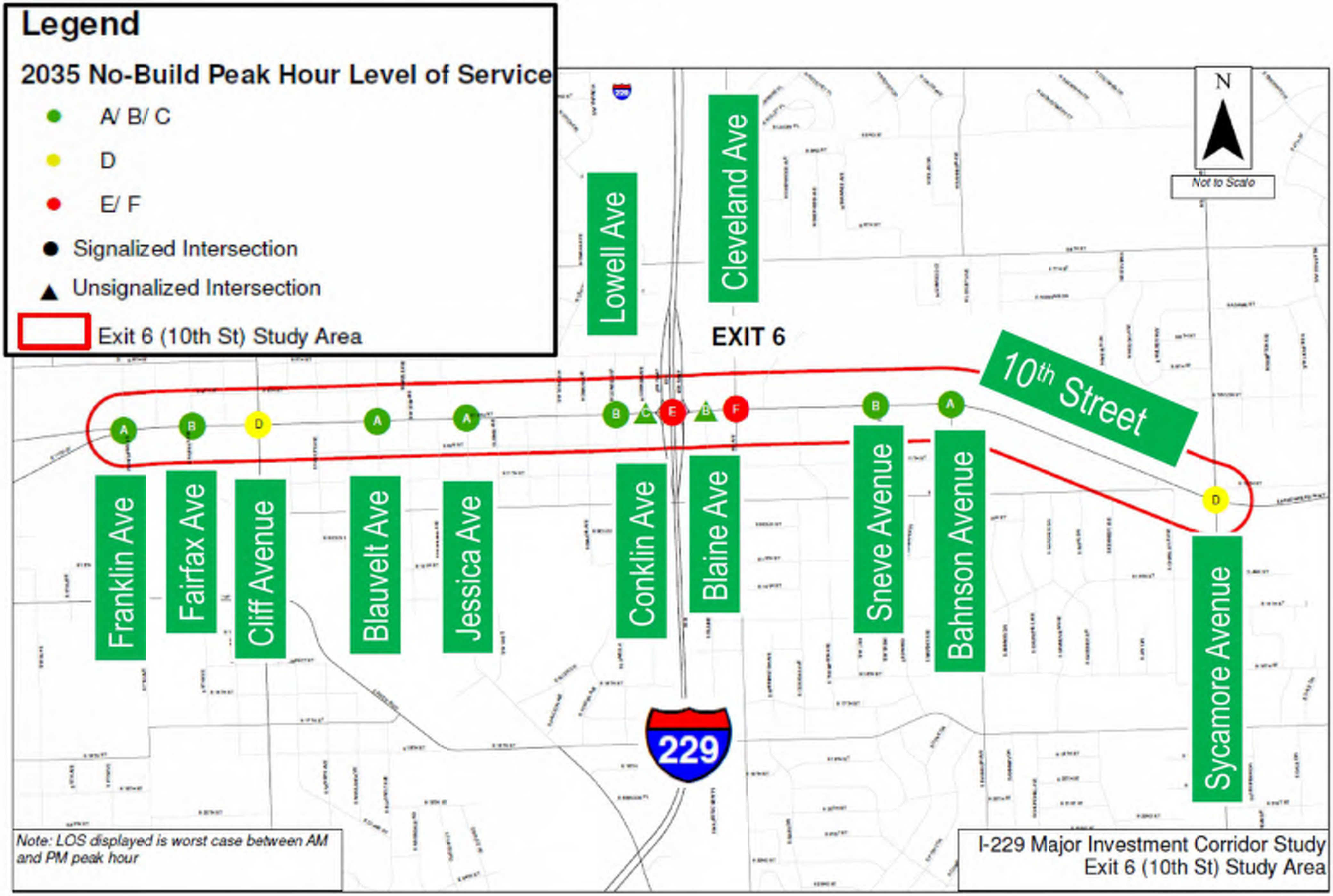
Sioux Falls Metropolitan Planning Organization (MPO)

Federal Highway Administration (FHWA)

Exit 6 (10th Street) Crossroad Study Goals

- Reduce traffic congestion
- Develop Corridor Growth Plan to meet traffic demands but minimizing impacts to developed properties
- Improve pedestrian mobility
- Improve safety for corridor users
- Identify improvements to the interchange as well as the 10th Street and Cleveland Ave intersection

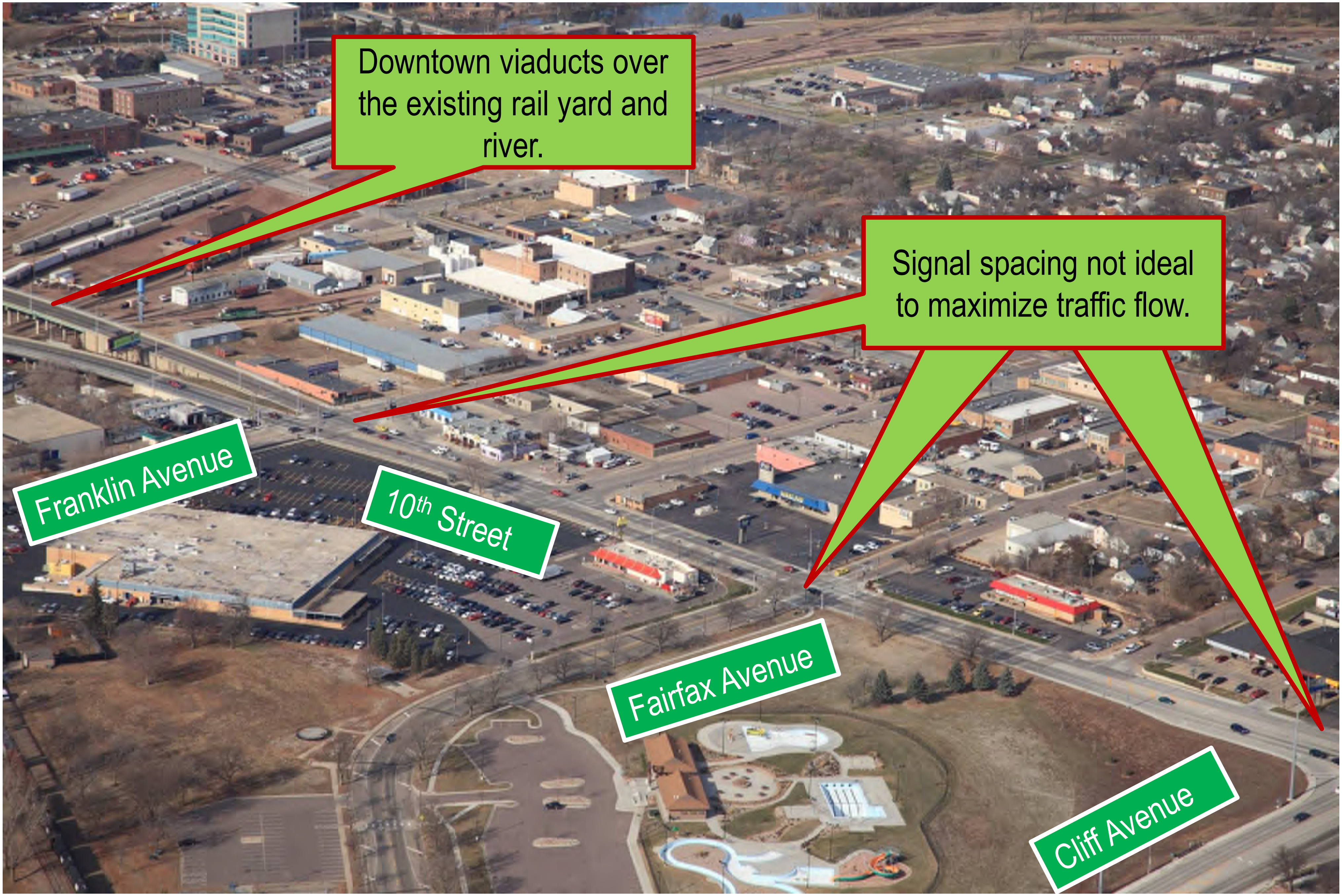
10th Street Corridor Overview



Note: LOS displayed is worst case between AM and PM peak hour

I-229 Major Investment Corridor Study
Exit 6 (10th St) Study Area

10th Street Corridor Overview

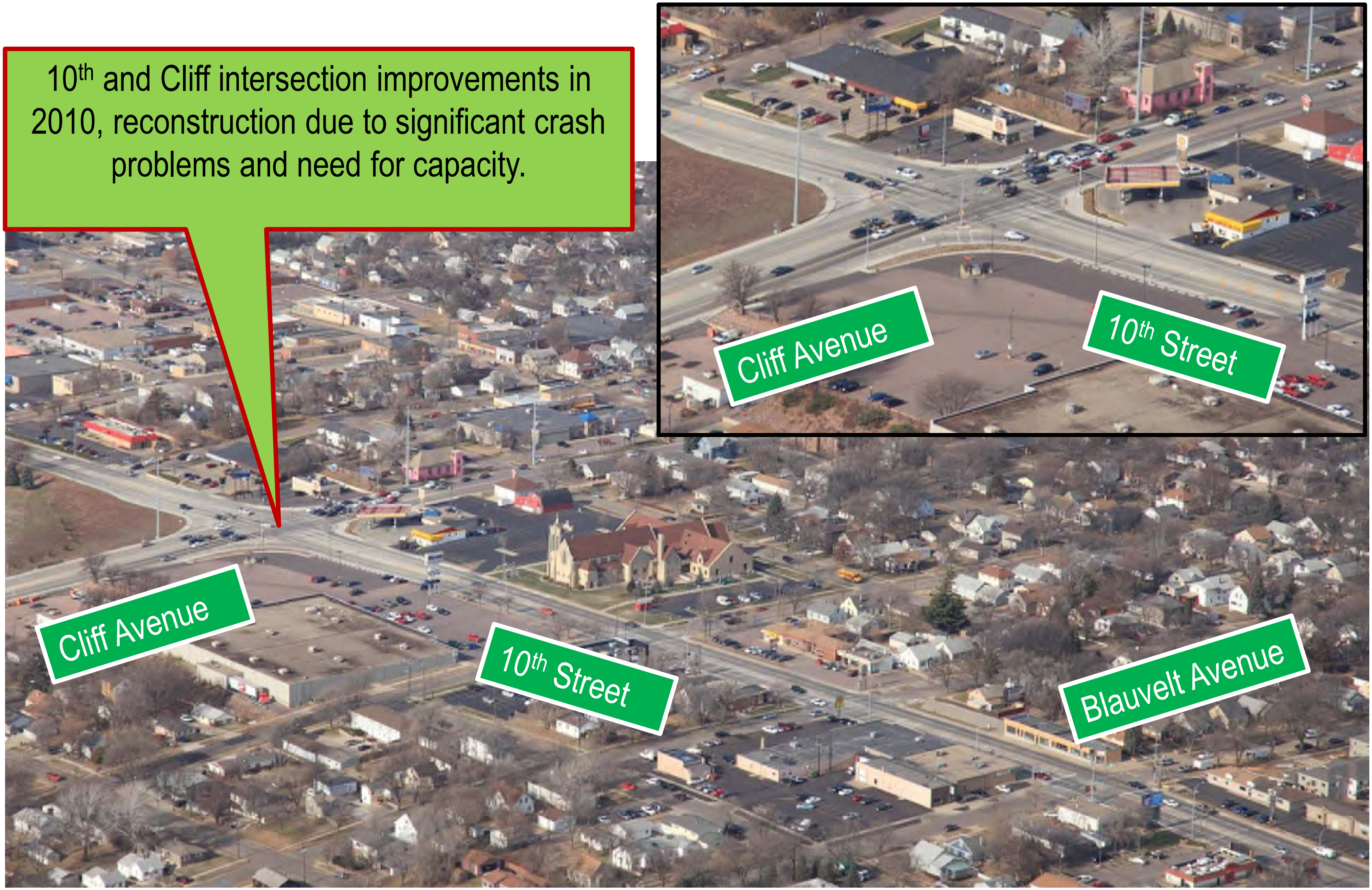


Downtown viaducts over the existing rail yard and river.

Signal spacing not ideal to maximize traffic flow.

10th Street Corridor Overview

10th and Cliff intersection improvements in 2010, reconstruction due to significant crash problems and need for capacity.



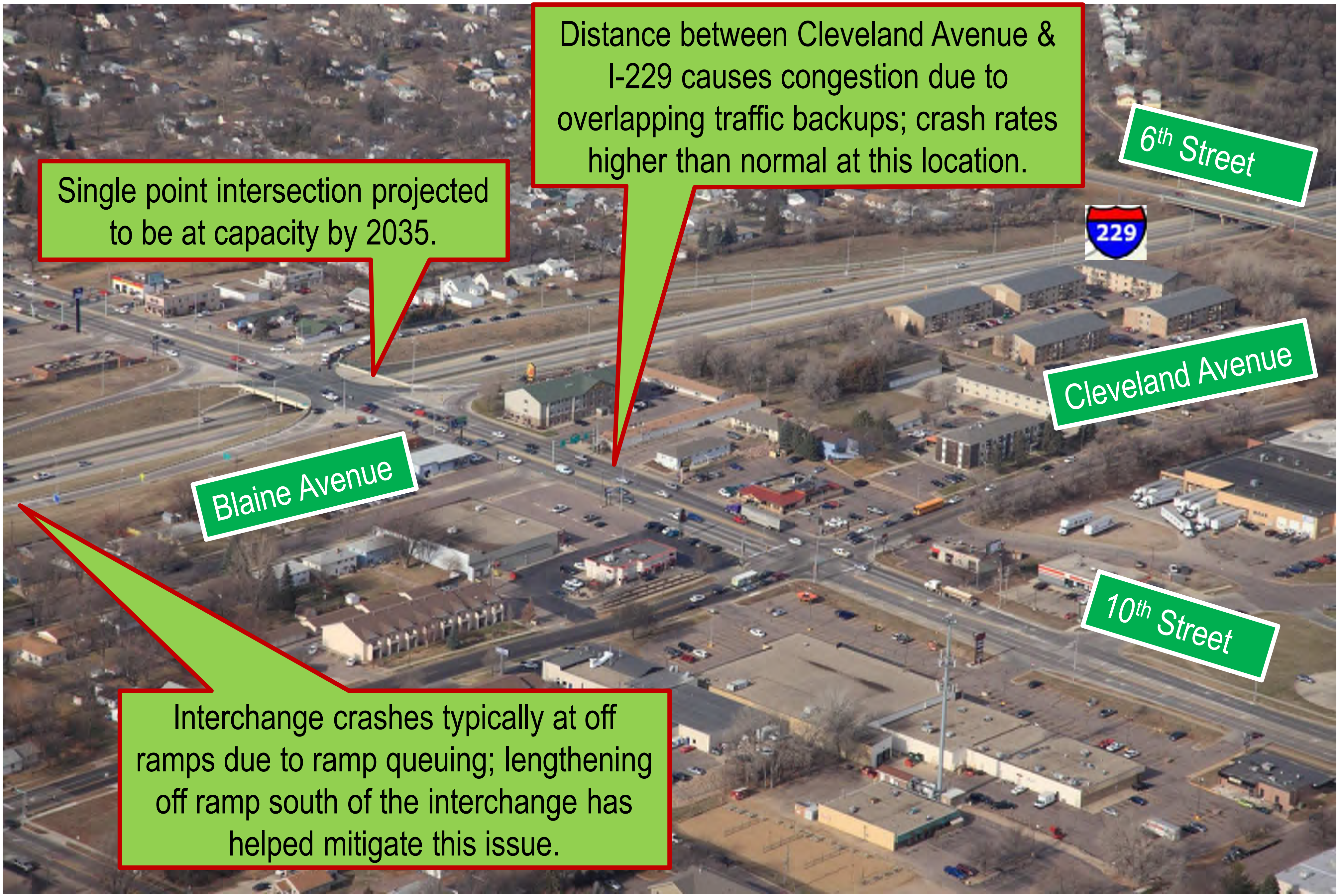
10th Street Corridor Overview

Multiple driveways and side streets affect corridor progression.

10th Street Corridor Overview

Access from side streets difficult and impedes travel speeds along Corridor

10th Street Corridor Overview

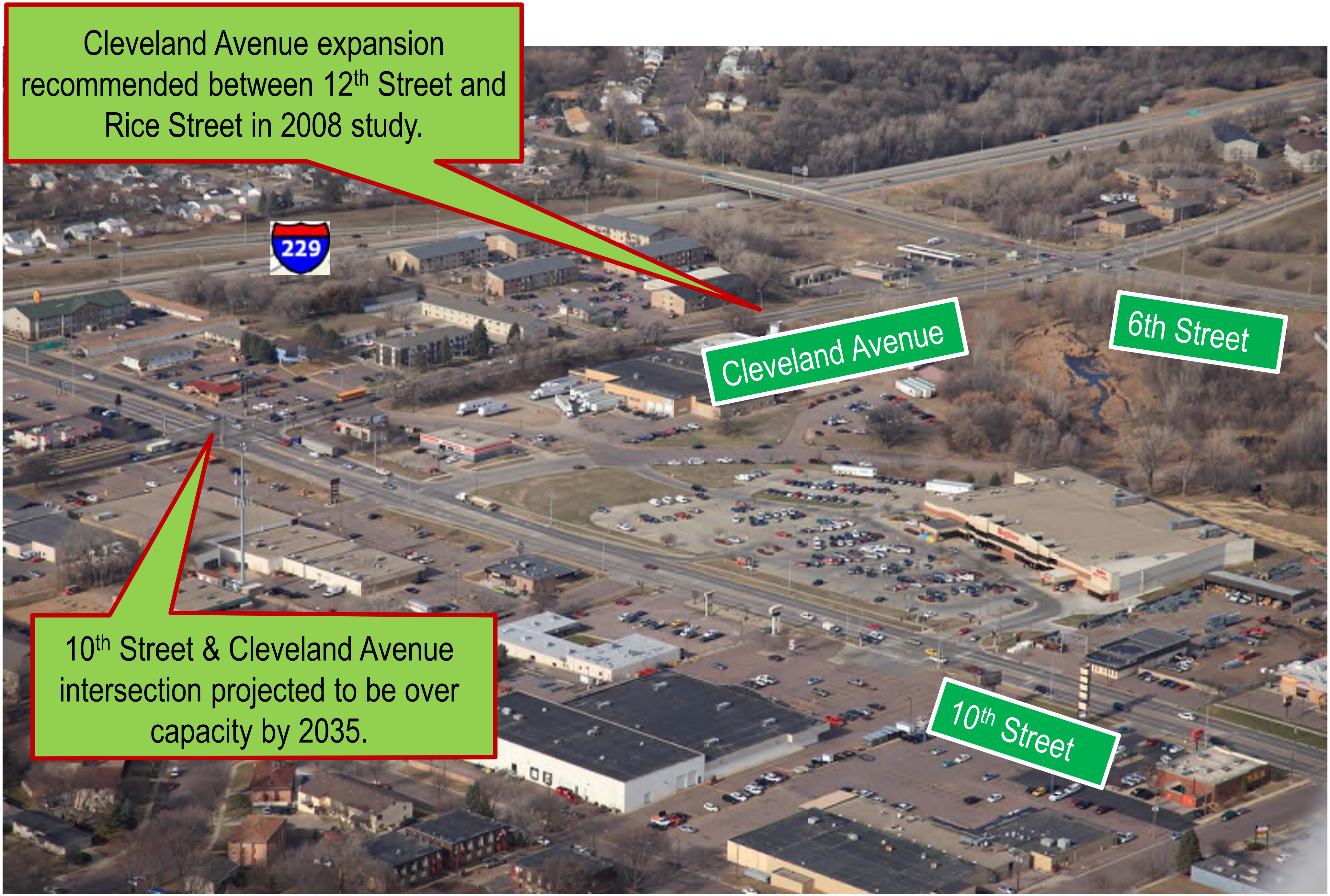


Distance between Cleveland Avenue & I-229 causes congestion due to overlapping traffic backups; crash rates higher than normal at this location.

Single point intersection projected to be at capacity by 2035.

Interchange crashes typically at off ramps due to ramp queuing; lengthening off ramp south of the interchange has helped mitigate this issue.

10th Street Corridor Overview



Cleveland Avenue expansion recommended between 12th Street and Rice Street in 2008 study.

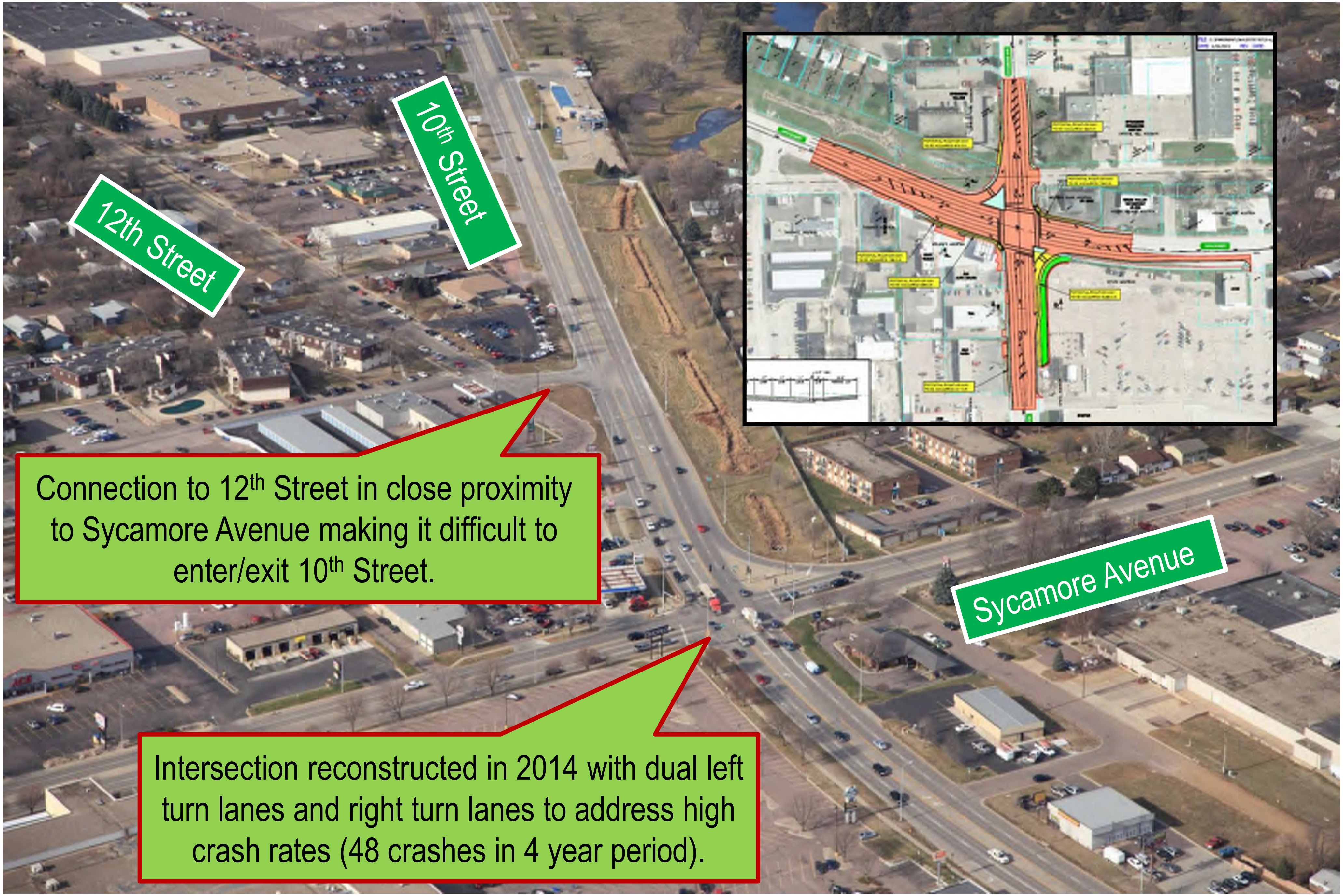
10th Street & Cleveland Avenue intersection projected to be over capacity by 2035.

10th Street Corridor Overview

Adding lanes to 10th Street would be difficult due to adjacent businesses.

Numerous driveways along 10th Street impacts traffic flow and increases potential for conflicts.

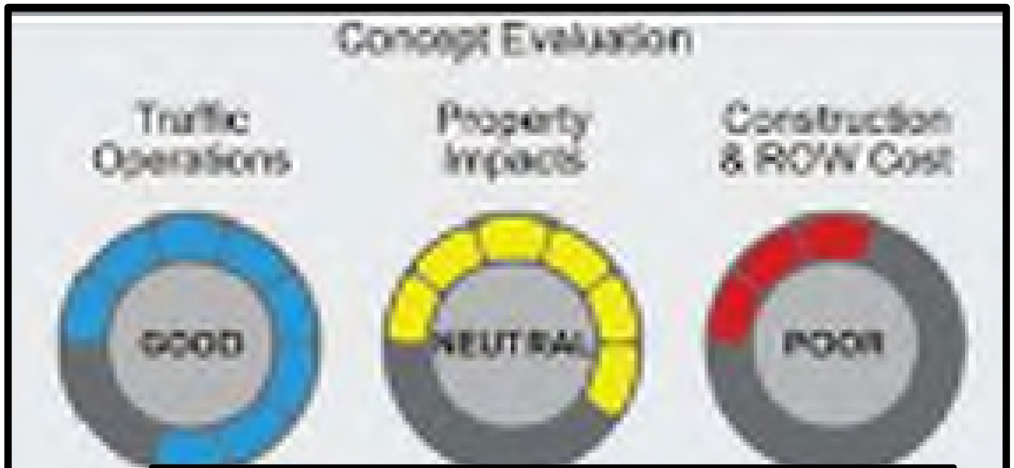
10th Street Corridor Overview



Connection to 12th Street in close proximity to Sycamore Avenue making it difficult to enter/exit 10th Street.

Intersection reconstructed in 2014 with dual left turn lanes and right turn lanes to address high crash rates (48 crashes in 4 year period).

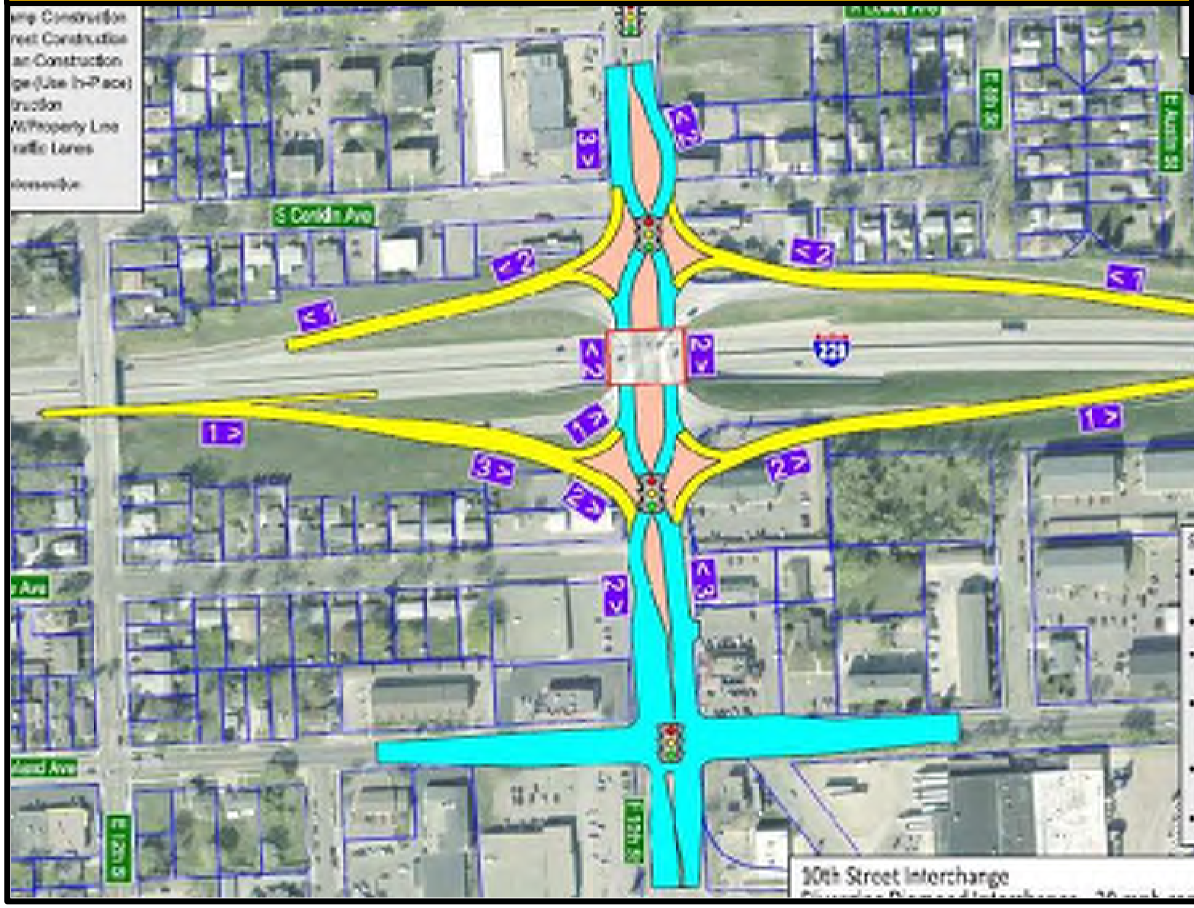
Conceptual Ideas for 10th Street Corridor



What you will be able to see tonight:

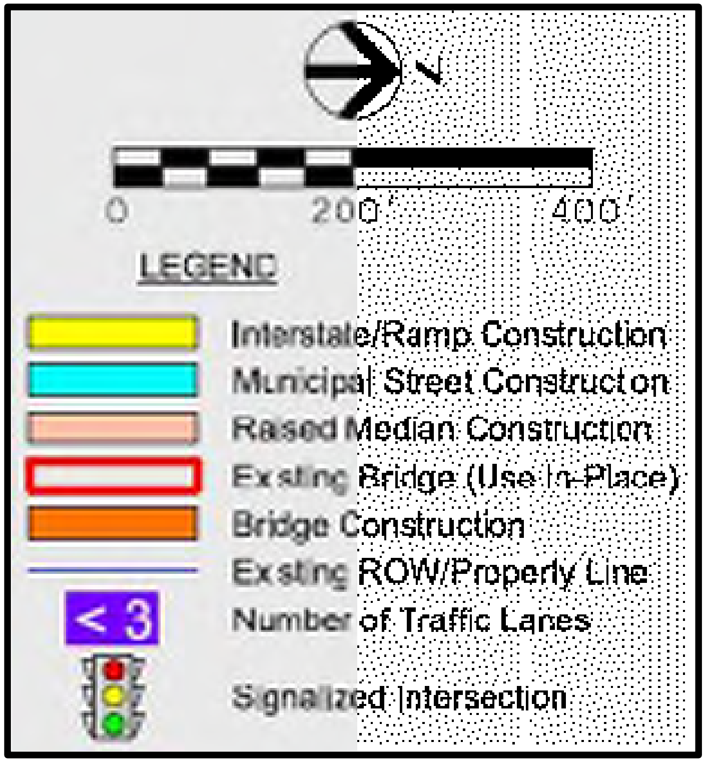
- 8 Interchange Conceptual Options
- 4 Corridor Options
- Median Changes or Driveway Closures to Improve Safety

10th Street / I-229 Interchange Diverging Diamond Option



Traffic Assessment

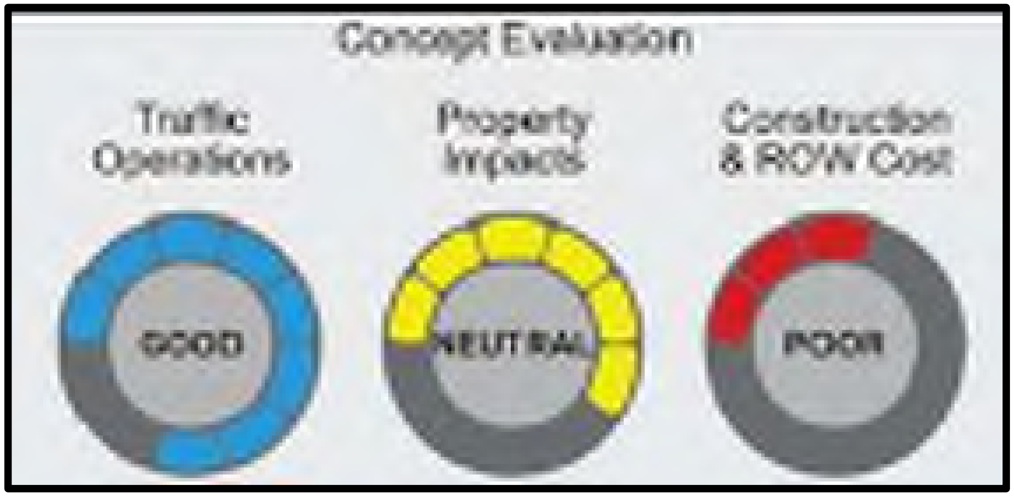
Queues | **Delay** | **Travel Time**

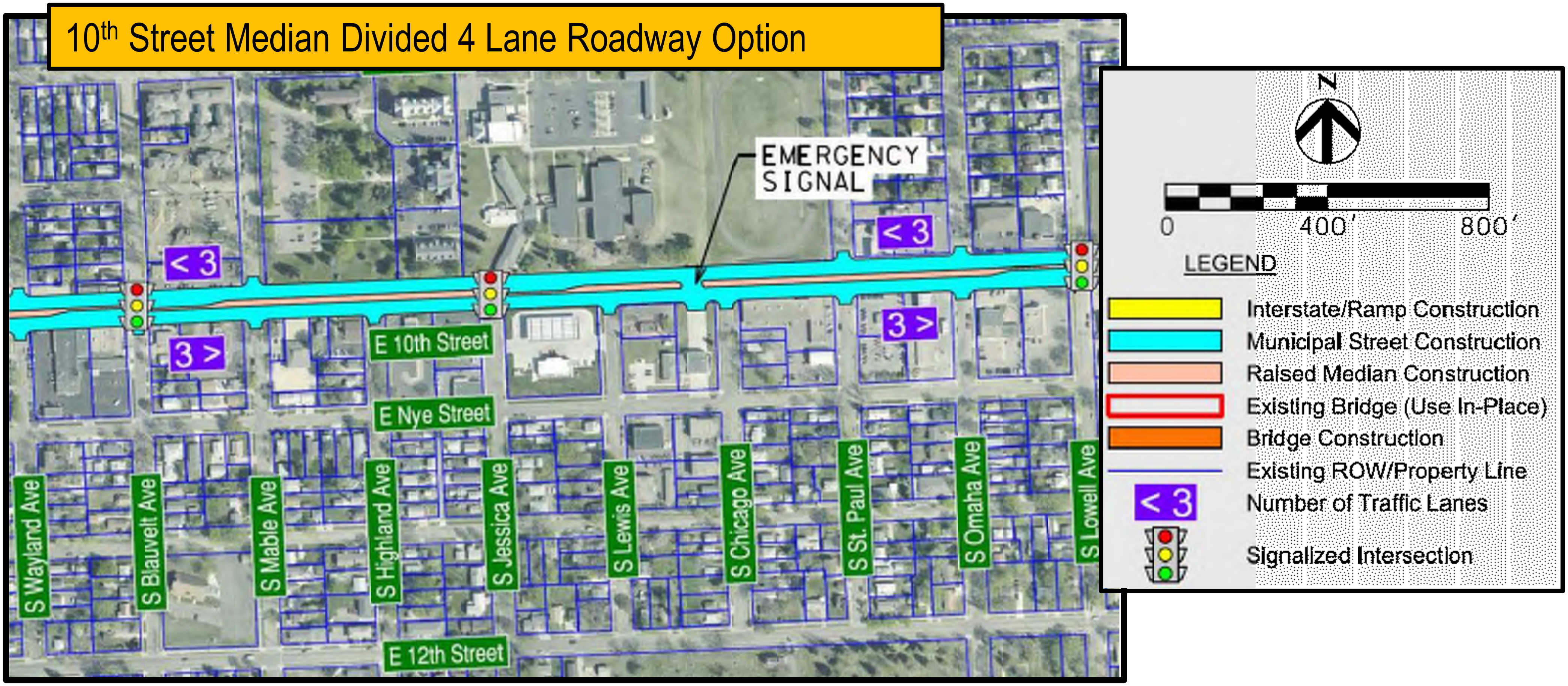


Conceptual Ideas for 10th Street Corridor

What you will be able to see tonight:

- 8 Interchange Conceptual Options
- 4 Corridor Options
- Median Changes or Driveway Closures to Improve Safety




10th Street Median Divided 4 Lane Roadway Option

Next Steps for 10th Street

- Finalize Composite Comparison Matrix
    - Traffic Assessment
    - Environmental Screening
    - ROW Impacts
    - Overall Costs
    - Public Involvement Support
- Complete additional Traffic Operations analysis on a reduced number of options based on the screening activities
- Develop Priority Phasing Plan for I-229 Corridor and Sub-Study Corridor
- Schedule and Conduct next public meeting

PROJECT CONTACTS:

Jason Kjenstad – HDR Engineering, Inc.
605-977-7740 or jason.kjenstad@hdrinc.com

Chris Malmberg – HDR Engineering, Inc.
402-399-4959 or chris.malmberg@hdrinc.com

Shannon Ausen – City of Sioux Falls
605-367-8607 or sausen@siouxfalls.org

Steve Gramm – SDDOT Project Development
605-773-6641 or steve.gramm@state.sd.us

Interstate 229 Major Investment Study
Exit 6 – 10th Street Sub-Study

Thanks for Attending!!!!!

HDR

HRGreen

BENSON ROAD

JUNE 2ND, 2015

- SIGN-IN SHEETS
- POWERPOINT SLIDES
- MEETING NOTES (SEE END OF PUBLIC MEETINGS #2 APPENDIX)
- COMMENTS (SEE END OF PUBLIC MEETINGS #2 APPENDIX)

Note: Actual attendance count was 20 people (including 6 women)

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Informational Meeting for Benson Road Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3618P, PCN 044K **Project No.:** 207030

Meeting Date Tuesday, June 2nd, 2015 5:00 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Pete Longman	SD DOT	773-6488	pete.longman@state.sd.us
2	Ron McMahon	FHWA	776-1009	ron.mcmahon@dot.gov
3	Sara Bertsch	Argus Leader		sbertsch@argusleader.com
4	Kay Gallesch	LifeScape	[illegible]	kay.gallesch@lifescapesd.org
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Sign In Sheet

Subject I-229 Major Investment Corridor Study – Informational Meeting for Benson Road Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(57) 3616P, PCN 044K **Project No.:** 207030

Meeting Date Tuesday, June 2nd, 2015 5:00 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Amber Gibson	SECOG	605-367-5390	amber@secog.org
2	Doug Brockhouse	Bender Commercial	605-728-5800	dbrock@bendercre.com
3	Travis Dressen	SDDOT - SF Area	605-367-5680	travis.dressen@state.sd.us
4	Kurt Griffin	600 E 21st 57105	312 6035	1496-34 @yahoo.com
5	Rick Kovala	Sioux Falls	521-6076	
6	Jason Kjerstad	HDR	605-977-7740	jason.kjerstad@hdrinc.com
7	Rush Smith	3500 E 60th St N	605-940-4443	
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Sign In Sheet

Subject I-229 Major Investment Corridor Study – Informational Meeting for Benson Road Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(67) 3010P, PCN 044K **Project No.:** 207030

Meeting Date Tuesday, June 2nd, 2015 5:00 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Christina Bennett	SDDOT	605-773-4759	Christina.Bennett@state.sd.us
2	Chad Hartman	Sioux Falls	605-334-3204	Chad.hartman@myrl androyspaving.com
3	Rick Vander Haar	3408 N Potsdam Ave	605-366-1111	eoale@midconetwork.com
4	Steve Gramm	SDDOT	773-6641	Steve.gramm@state.sd.us
5	Shannon Schultz	Minnehaha County H.D.	367-4316	sschultz@minnehahacounty.org
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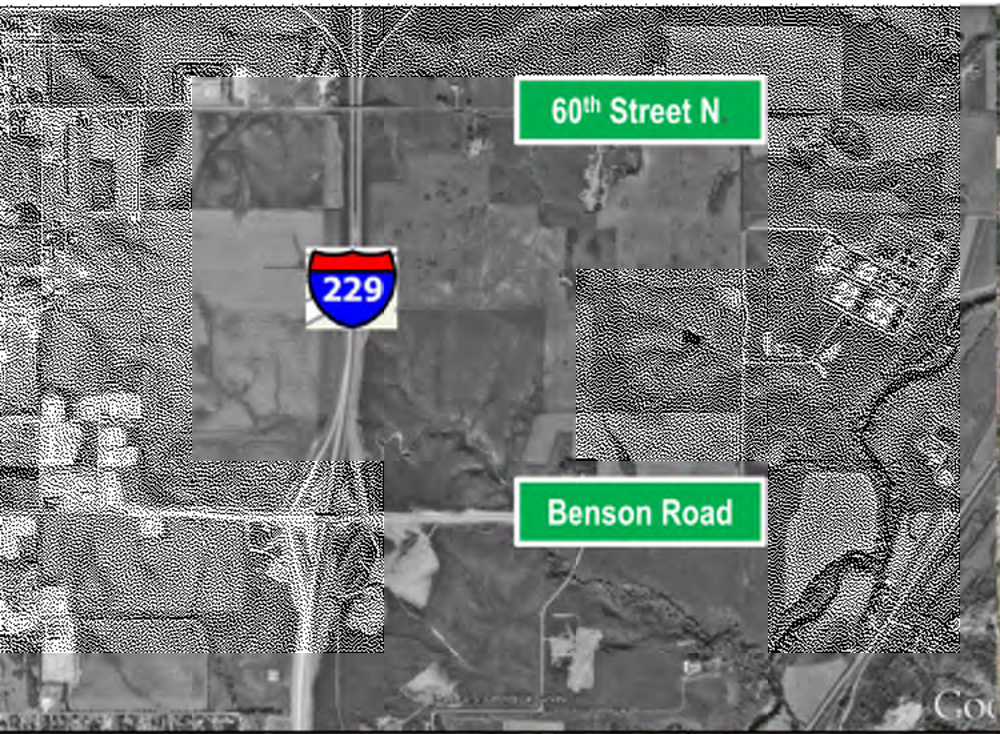


Interstate 229 Major Investment Study

Exit 9 – Benson Rd Sub-Study

Informational Meeting
June 2nd, 2015
5:00 pm to 6:30 pm

HDR

HRGreen

Study Area Map

I-229 Corridor Study

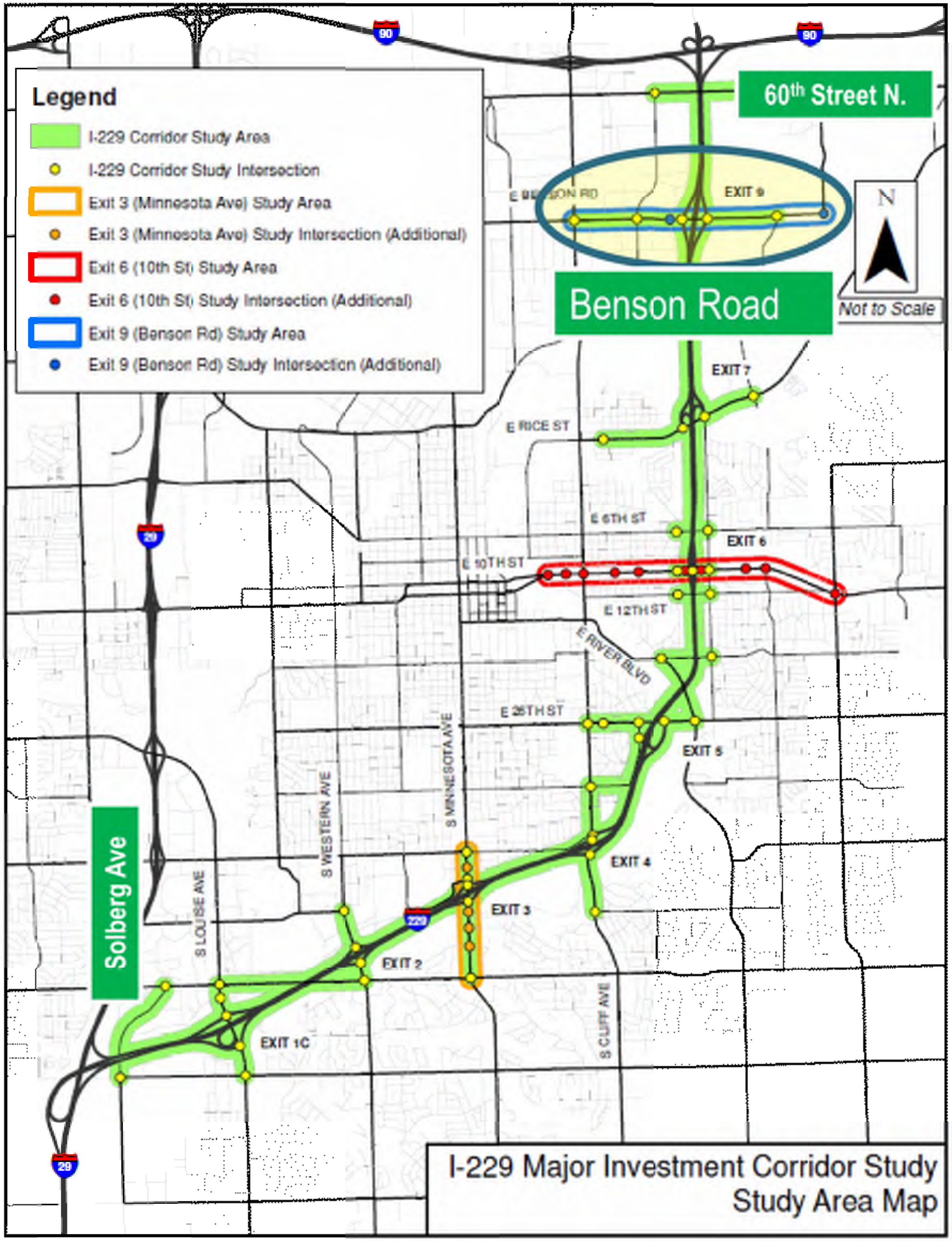
Solberg Avenue Overpass

to

60th Street N. Overpass

Meeting will focus on:

Exit 9 – Benson Road



Study Advisory Partners

South Dakota Department of Transportation (SDDOT)

South Dakota Highway Patrol

City of Sioux Falls

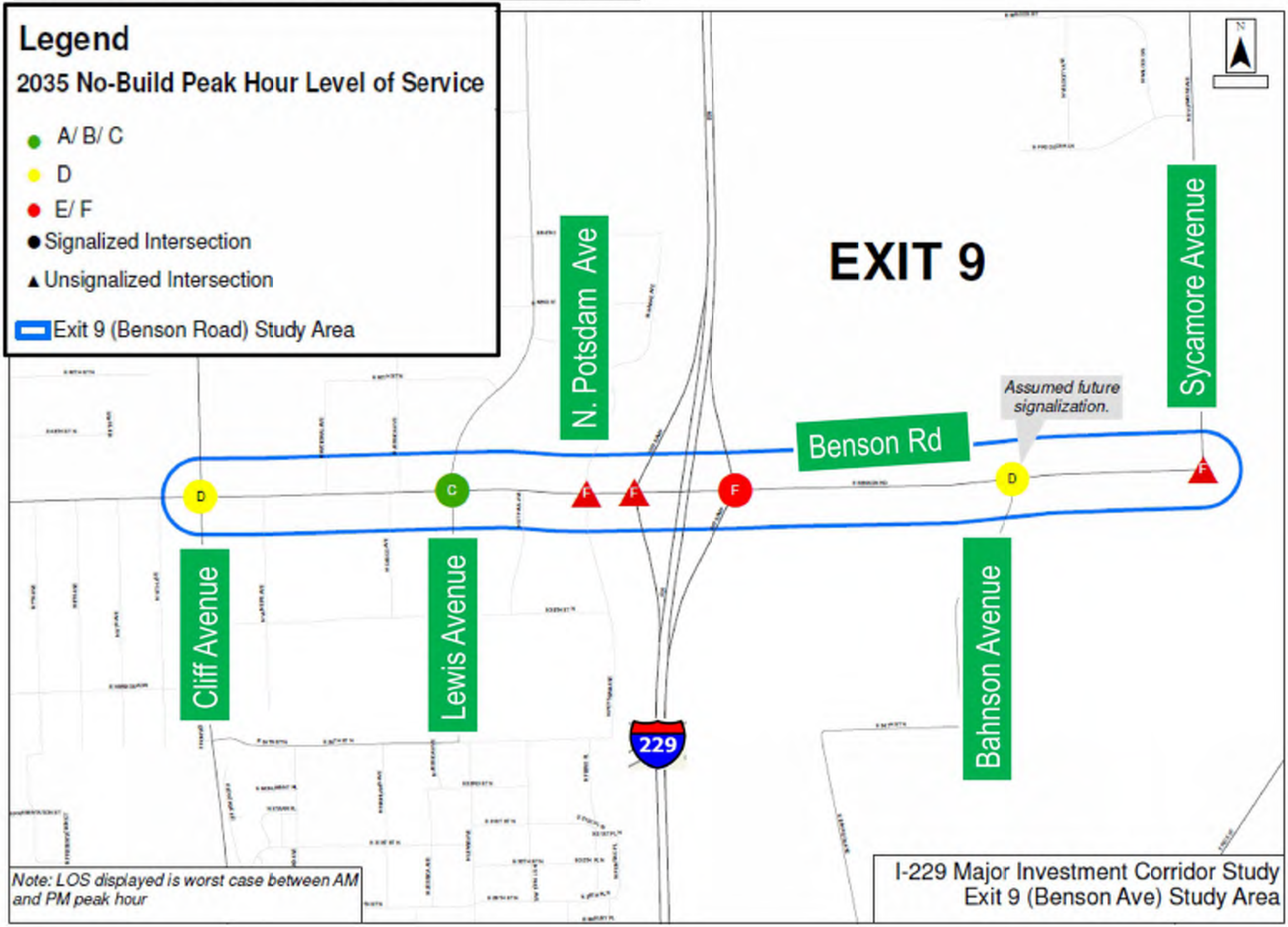
Sioux Falls Metropolitan Planning Organization (MPO)

Federal Highway Administration (FHWA)

Exit 9 (Benson Road) Crossroad Study Goals

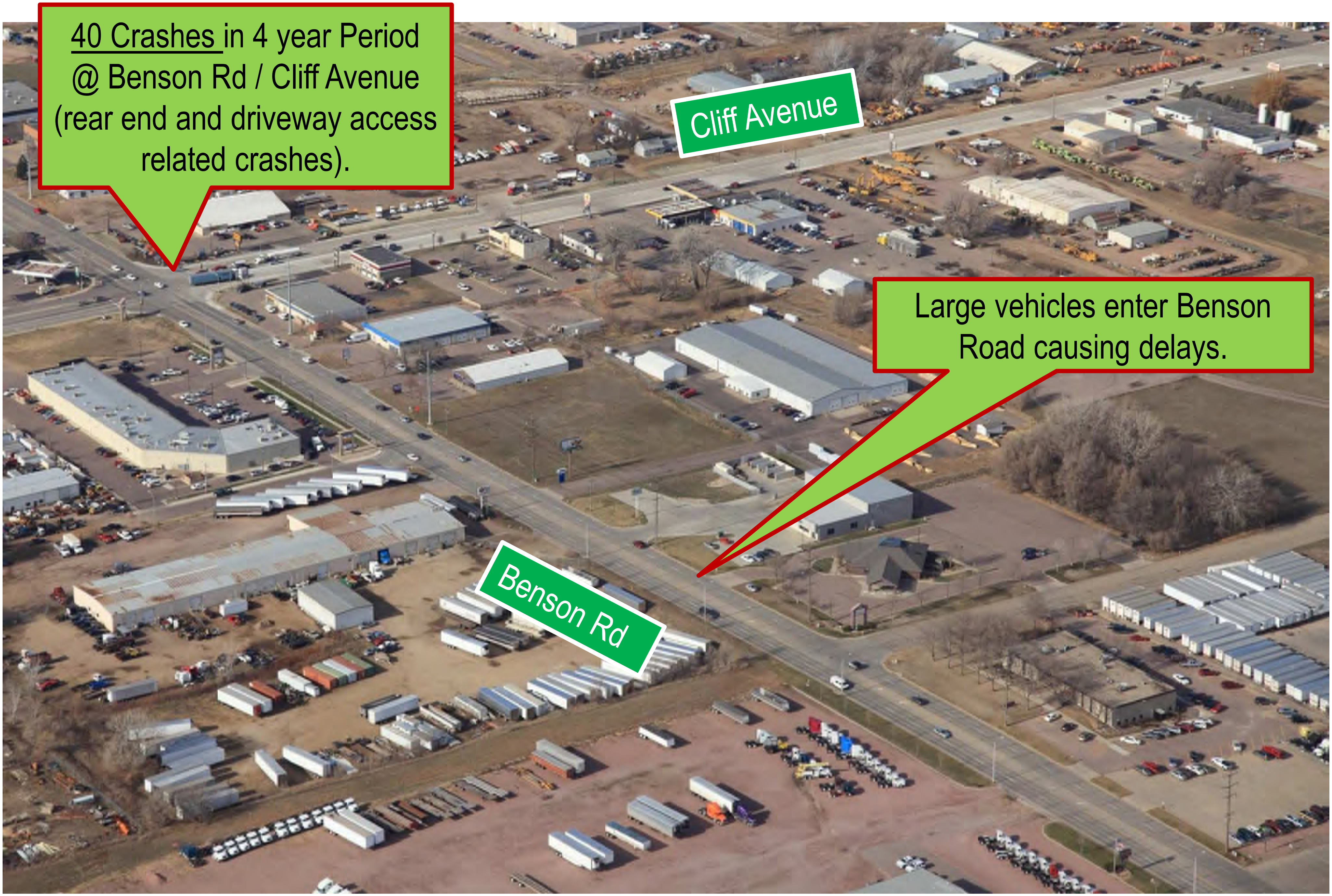
- Reduce traffic congestion at NB on/off interchange ramp terminal
- Develop Corridor Growth Plan to meet traffic demands from development taking place east of I-229
- Improve pedestrian mobility
- Make recommendations to improve corridor intersections
- Develop interchange alternatives to meet future traffic demands

Benson Rd Corridor Overview



Note: LOS displayed is worst case between AM and PM peak hour

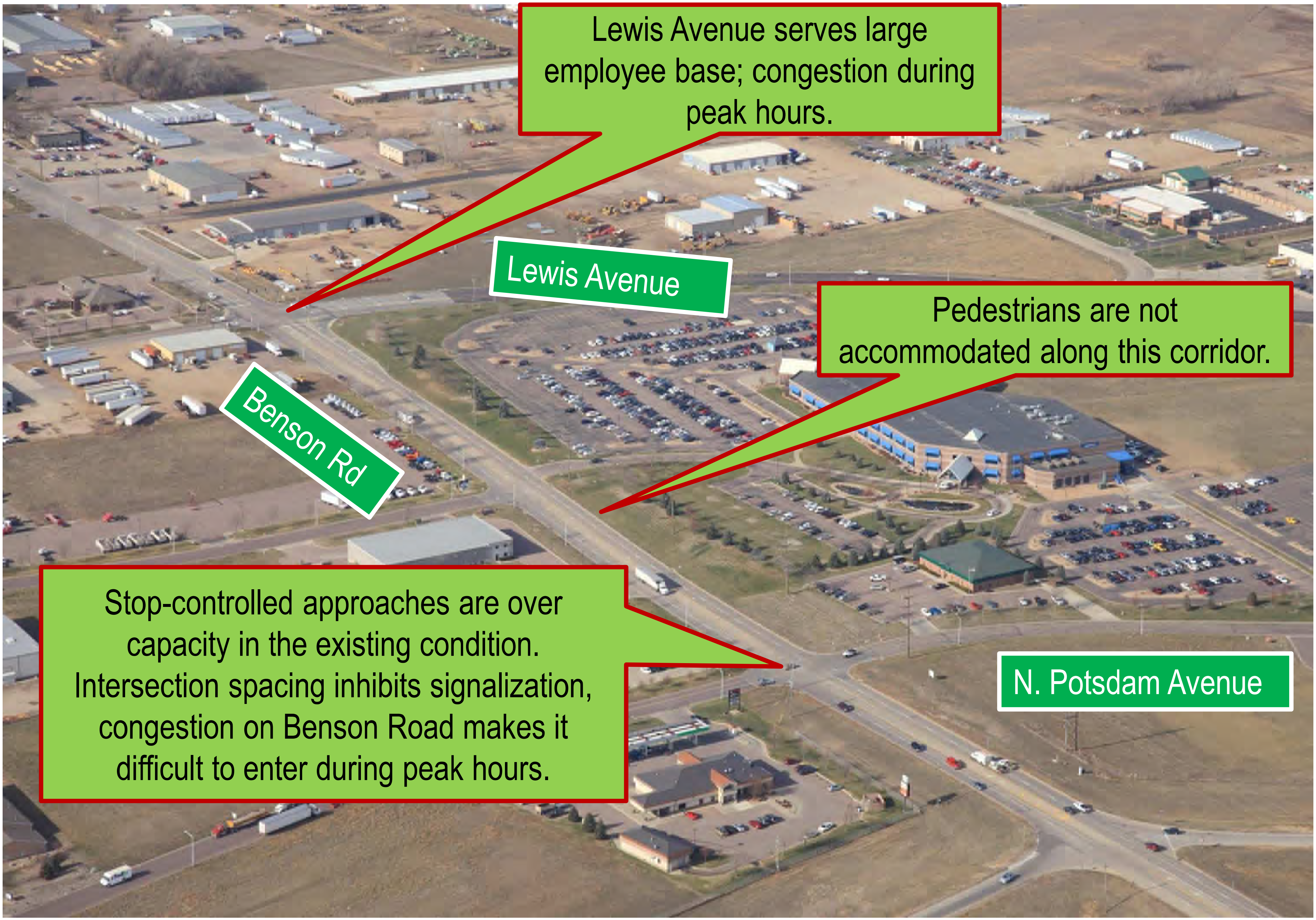
Benson Rd Corridor Overview



40 Crashes in 4 year Period @ Benson Rd / Cliff Avenue (rear end and driveway access related crashes).

Large vehicles enter Benson Road causing delays.

Benson Rd Corridor Overview

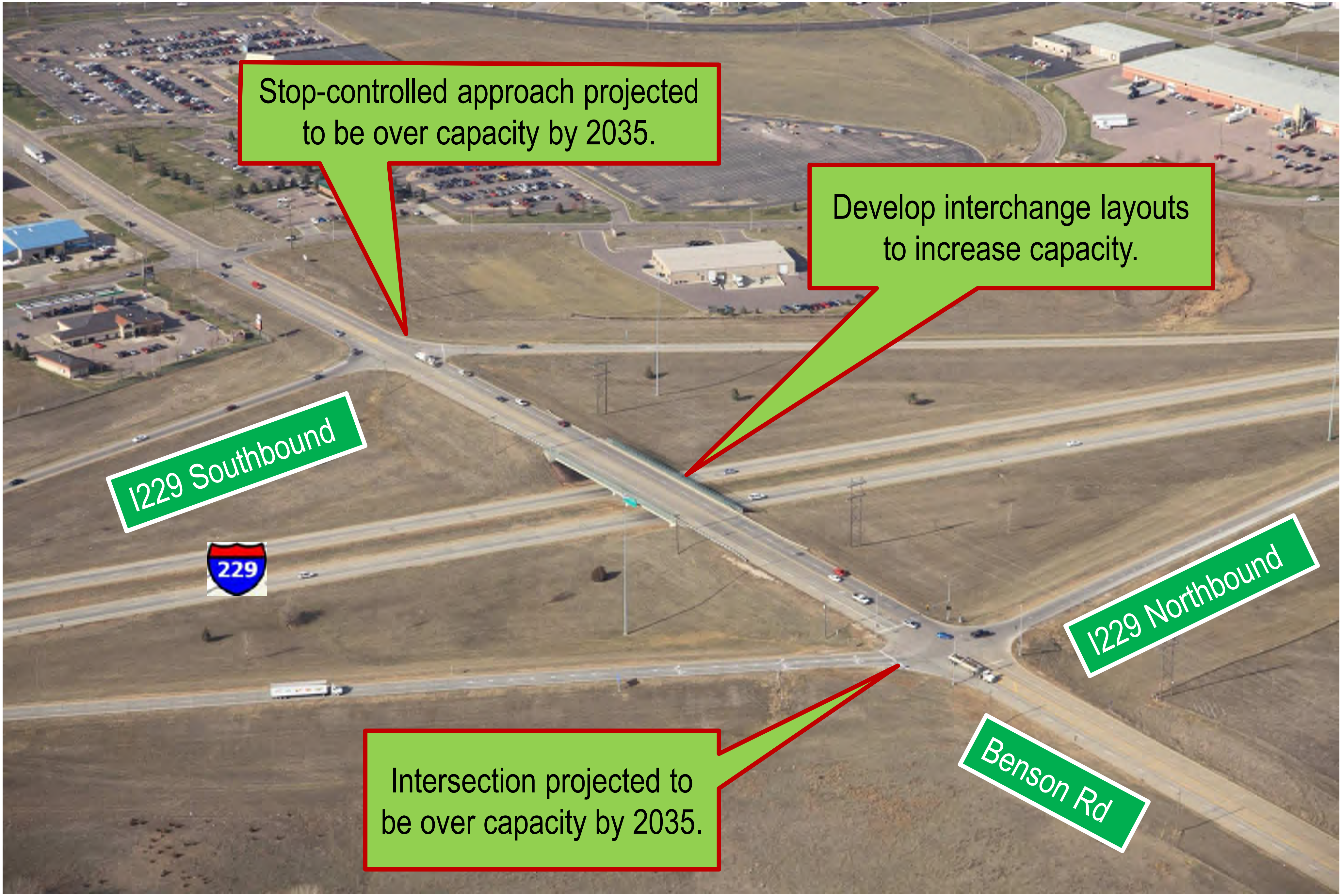


Lewis Avenue serves large employee base; congestion during peak hours.

Pedestrians are not accommodated along this corridor.

Stop-controlled approaches are over capacity in the existing condition. Intersection spacing inhibits signalization, congestion on Benson Road makes it difficult to enter during peak hours.

Benson Rd Corridor Overview

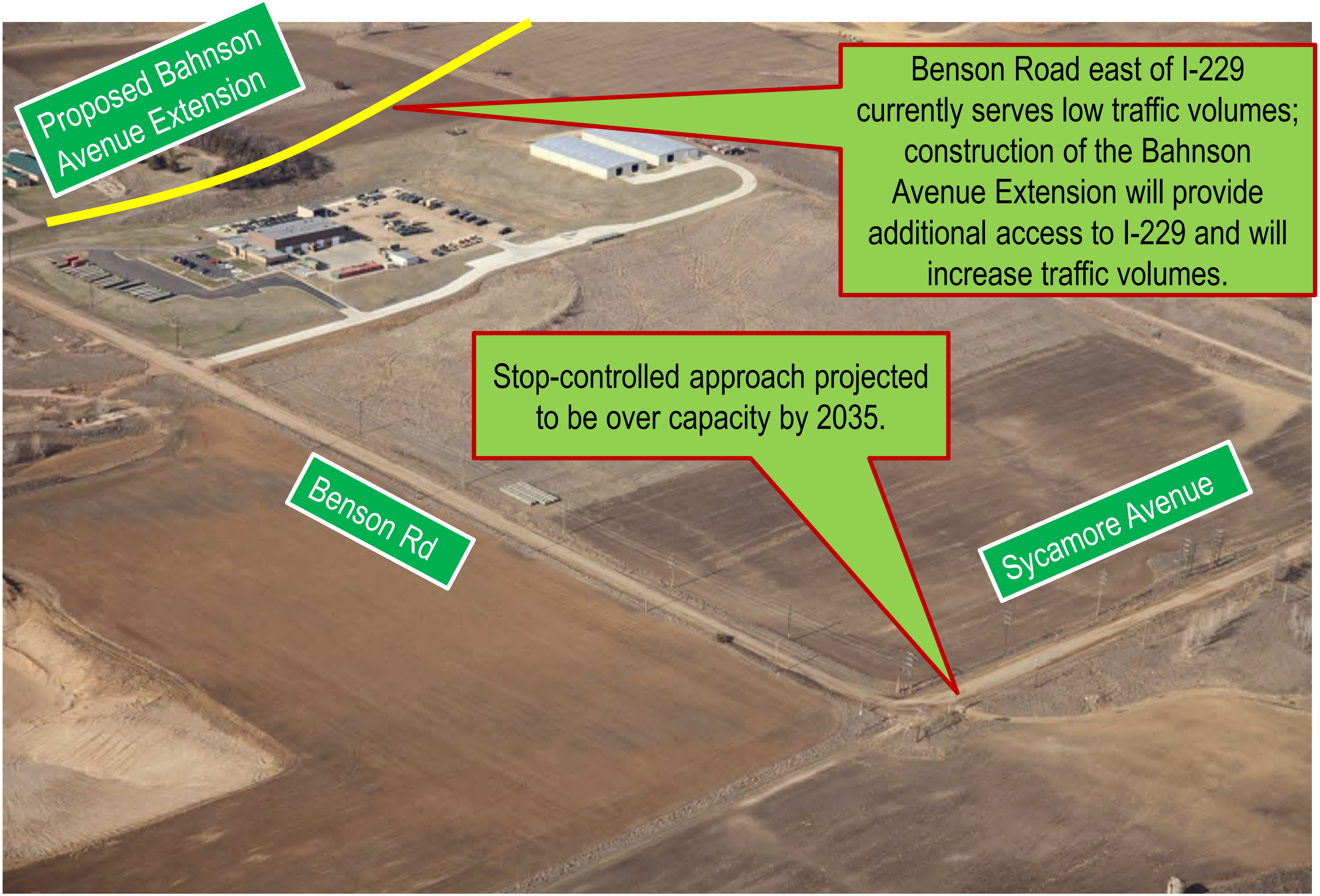


Stop-controlled approach projected to be over capacity by 2035.

Develop interchange layouts to increase capacity.

Intersection projected to be over capacity by 2035.

Benson Rd Corridor Overview



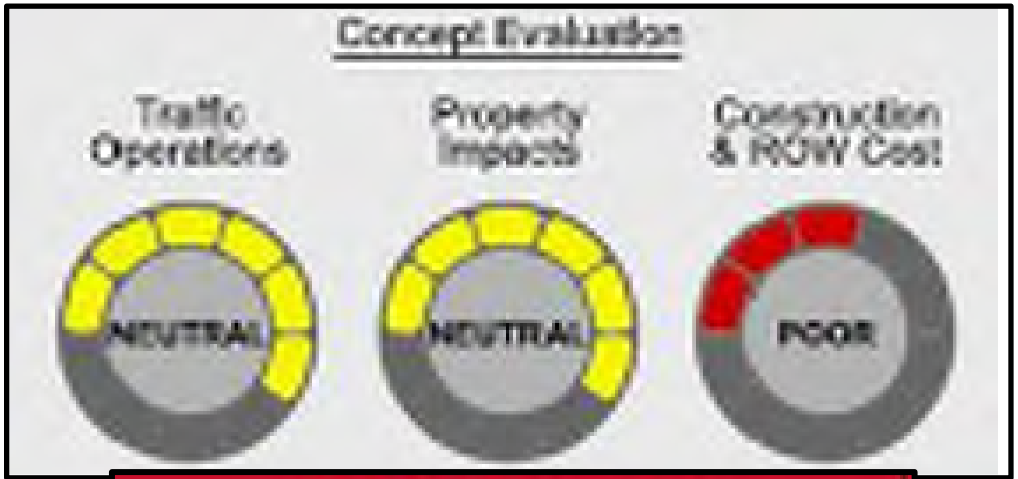
Benson Road east of I-229 currently serves low traffic volumes; construction of the Bahnson Avenue Extension will provide additional access to I-229 and will increase traffic volumes.

Stop-controlled approach projected to be over capacity by 2035.

Conceptual Ideas for Benson Road

What you will be able to see tonight:

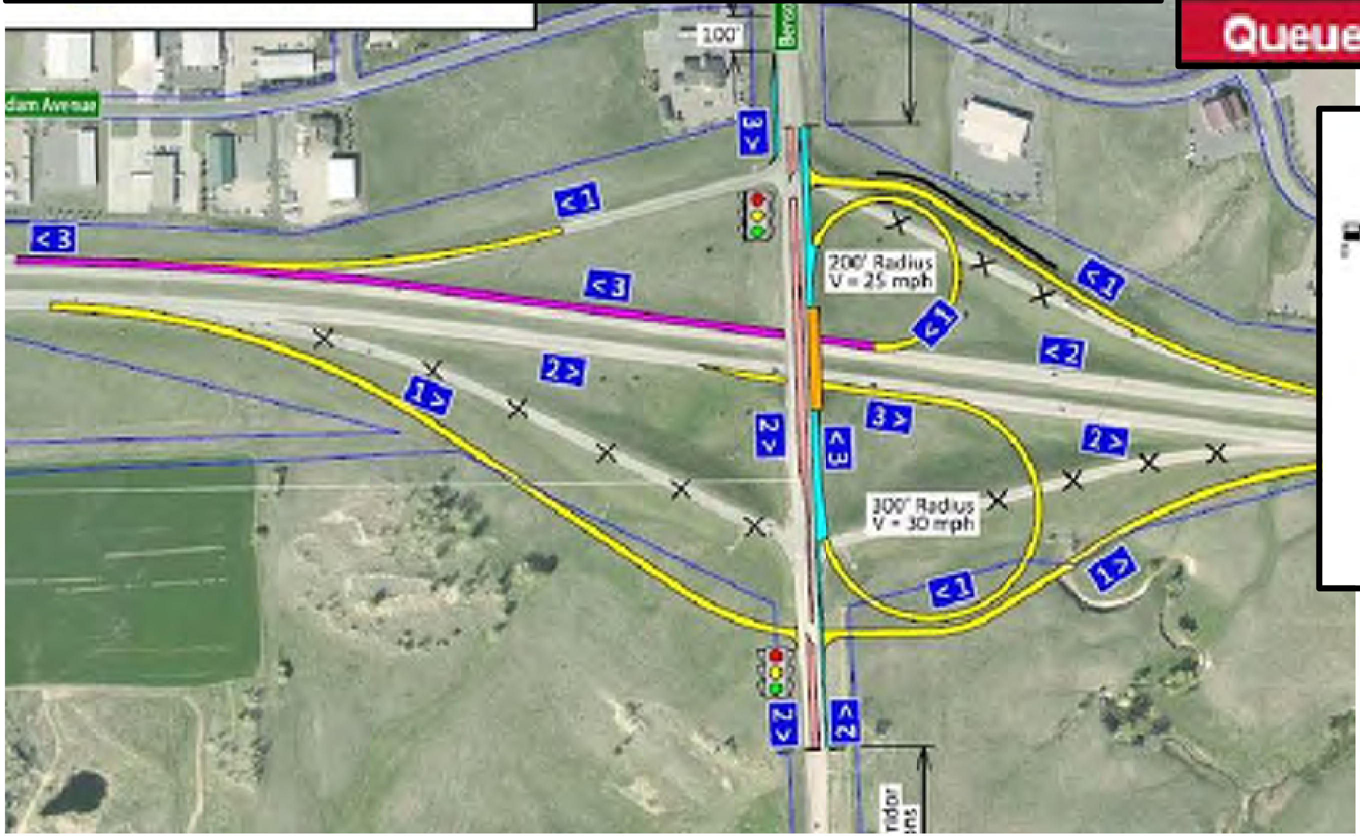
- 4 Interchange Conceptual Options
- 1 Corridor Option



Traffic Assessment

Queues	Delay	Travel Time

Benson Road / I-229 Interchange Folded Diamond Option



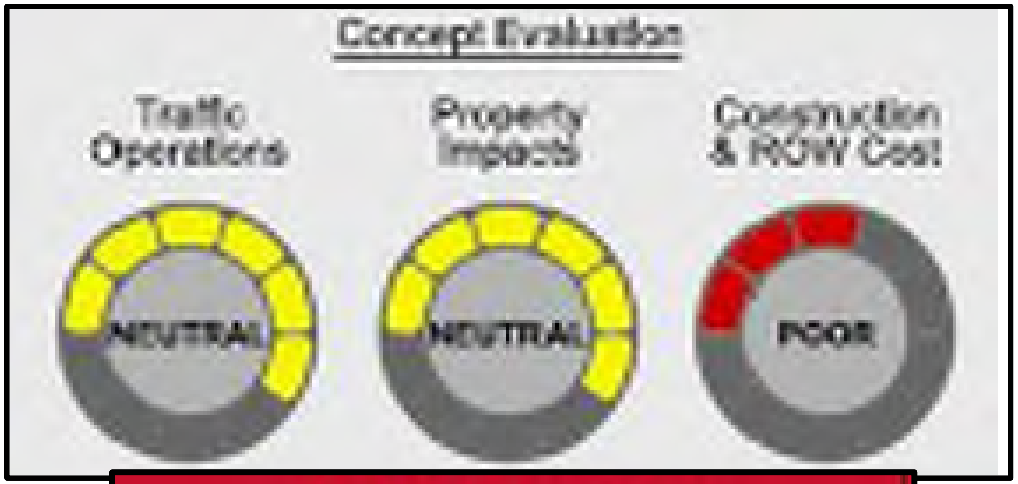
Scale in Feet
0 200 400

Legend
- 🟨 Interchange/Ramp/Loop Construction
- 🟦 Benson Road Construction
- 🟥 Raised Median Construction
- 🟧 Bridge Construction
- 🟪 Auxiliary Lane Construction
- — Existing ROW / Property Line
- X Road Closure
- 🚦 Signalized Intersection
- 🛑 Stop Condition Intersection
- < 3 Number of Traffic Lanes

Conceptual Ideas for Benson Road

What you will be able to see tonight:

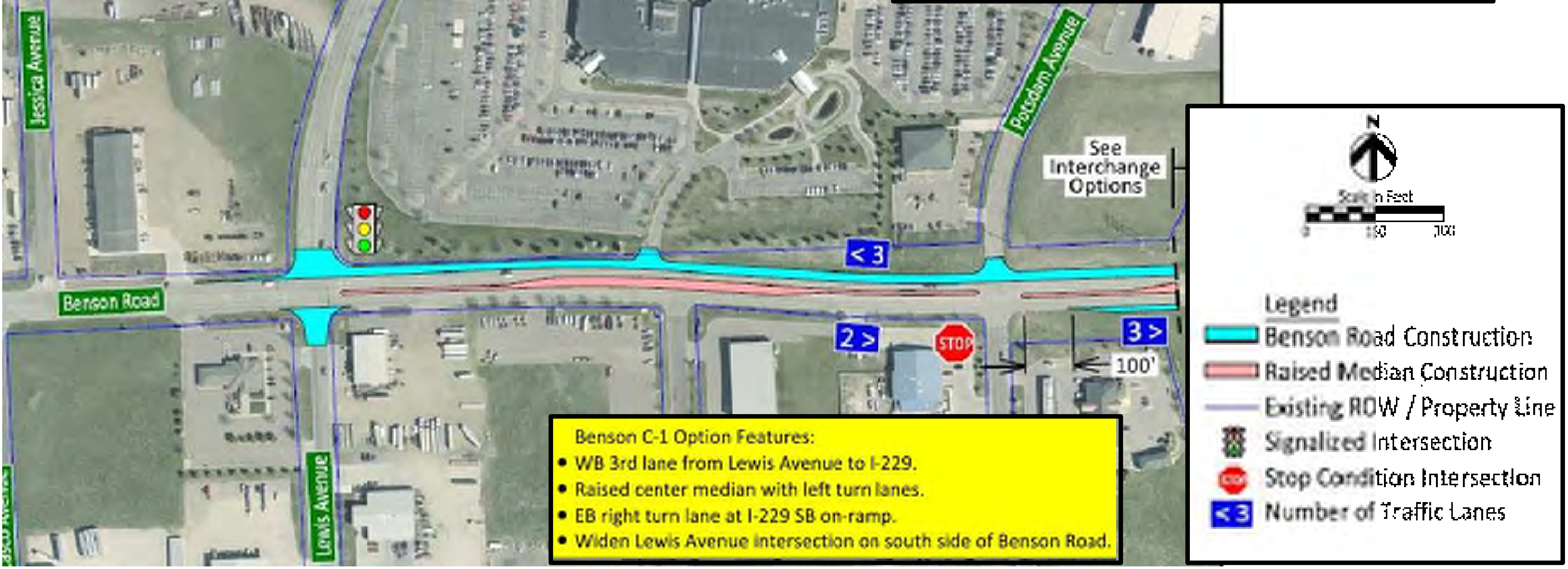
- 4 Interchange Conceptual Options
- 1 Corridor Option



Traffic Assessment

Queues	Delay	Travel Time

Benson Road Median Divided Section from Lewis to I-229

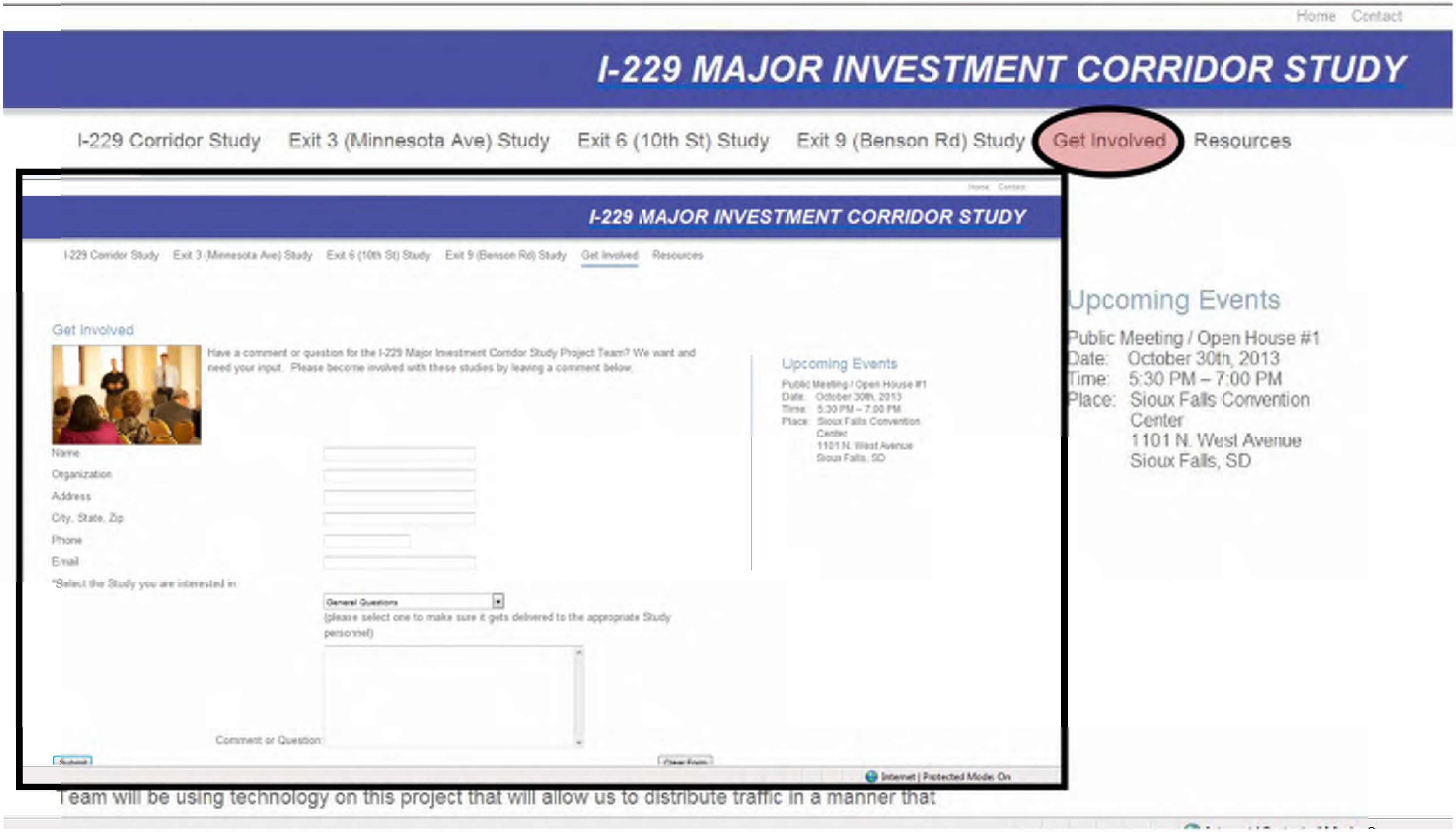


Benson C-1 Option Features:
- WB 3rd lane from Lewis Avenue to I-229.
- Raised center median with left turn lanes.
- EB right turn lane at I-229 SB on-ramp.
- Widen Lewis Avenue intersection on south side of Benson Road.

Next Steps for Benson Rd

- **Finalize Composite Comparison Matrix**
  - Traffic Assessment
  - Environmental Screening
  - ROW Impacts
  - Overall Costs
  - Public Involvement Support
- **Complete additional Traffic Operations analysis on a reduced number of options based on the screening activities**
- **Develop Priority Phasing Plan for I-229 Corridor and Sub-Study Corridor**
- **Schedule and Conduct next public meeting**

WWW.I229STUDY.COM



Get Involved

Have a comment or question for the I-229 Major Investment Corridor Study Project Team? We want and need your input. Please become involved with these studies by leaving a comment below.

Name

Organization

Address

City, State, Zip

Phone

Email

*Select the Study you are interested in:

General Questions

(please select one to make sure it gets delivered to the appropriate Study personnel)

Comment or Question:

Upcoming Events

Public Meeting / Open House #1
Date: October 30th, 2013
Time: 5:30 PM – 7:00 PM
Place: Sioux Falls Convention Center
1101 N. West Avenue
Sioux Falls, SD

Upcoming Events

Public Meeting / Open House #1
Date: October 30th, 2013
Time: 5:30 PM – 7:00 PM
Place: Sioux Falls Convention Center
1101 N. West Avenue
Sioux Falls, SD

Team will be using technology on this project that will allow us to distribute traffic in a manner that

PROJECT CONTACTS:

Jason Kjenstad – HDR Engineering, Inc.
605-977-7740 or jason.kjenstad@hdrinc.com

James Unruh – HDR Engineering, Inc.
605-977-7740 or james.unruh@hdrinc.com

Shannon Ausen – City of Sioux Falls
605-367-8607 or sausen@siouxfalls.org

Steve Gramm – SDDOT Project Development
605-773-6641 or steve.gramm@state.sd.us

Interstate 229 Major Investment Study
Exit 9 – Benson Rd Sub-Study

Thanks for Attending!!!!!

I-229 MAINLINE

JUNE 2ND, 2015

- SIGN-IN SHEETS
- POWERPOINT SLIDES
- MEETING NOTES (SEE END OF PUBLIC MEETINGS #2 APPENDIX)
- COMMENTS (SEE END OF PUBLIC MEETINGS #2 APPENDIX)

DOT

CITY OF SIOUX FALLS
PUBLIC WORKS

Note: Actual Attendance count was 18 people (including 7 women)

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Informational Meeting for I-229 Mainline Sub-Study 1

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3615P PCN 044K **Project No.:** 207030

Meeting Date Tuesday, June 2nd, 2015 7.00 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Steve Gramm	SDDOT 700 E. Broadway	773-6641	steve.gramm@state.sd.us
2	Amber Gibson	SECOG	367-3890	amber@secog.org
3	Jo Wahle			
4	Jason Kjenstad	HDR	605-977-7740	
5	James Unruh	HDR		
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Sign In Sheet

Subject I-229 Major Investment Corridor Study – Informational Meeting for I-229 Mainline Sub Study 1

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3616P, PCN 044K **Project No.:** 207030

Meeting Date Tuesday, June 2nd, 2015 7:00 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Ron McMahon	FHWA	776-1009	ron.mcmahon@dot.gov
2	PETE Longman	SD DOT	773-6488	pete.longman@state.sd.us
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Interstate 229 Major Investment Study

Mainline I-229 Sub-Study 1

Informational Meeting
June 2nd, 2015
7:00 pm to 8:30 pm

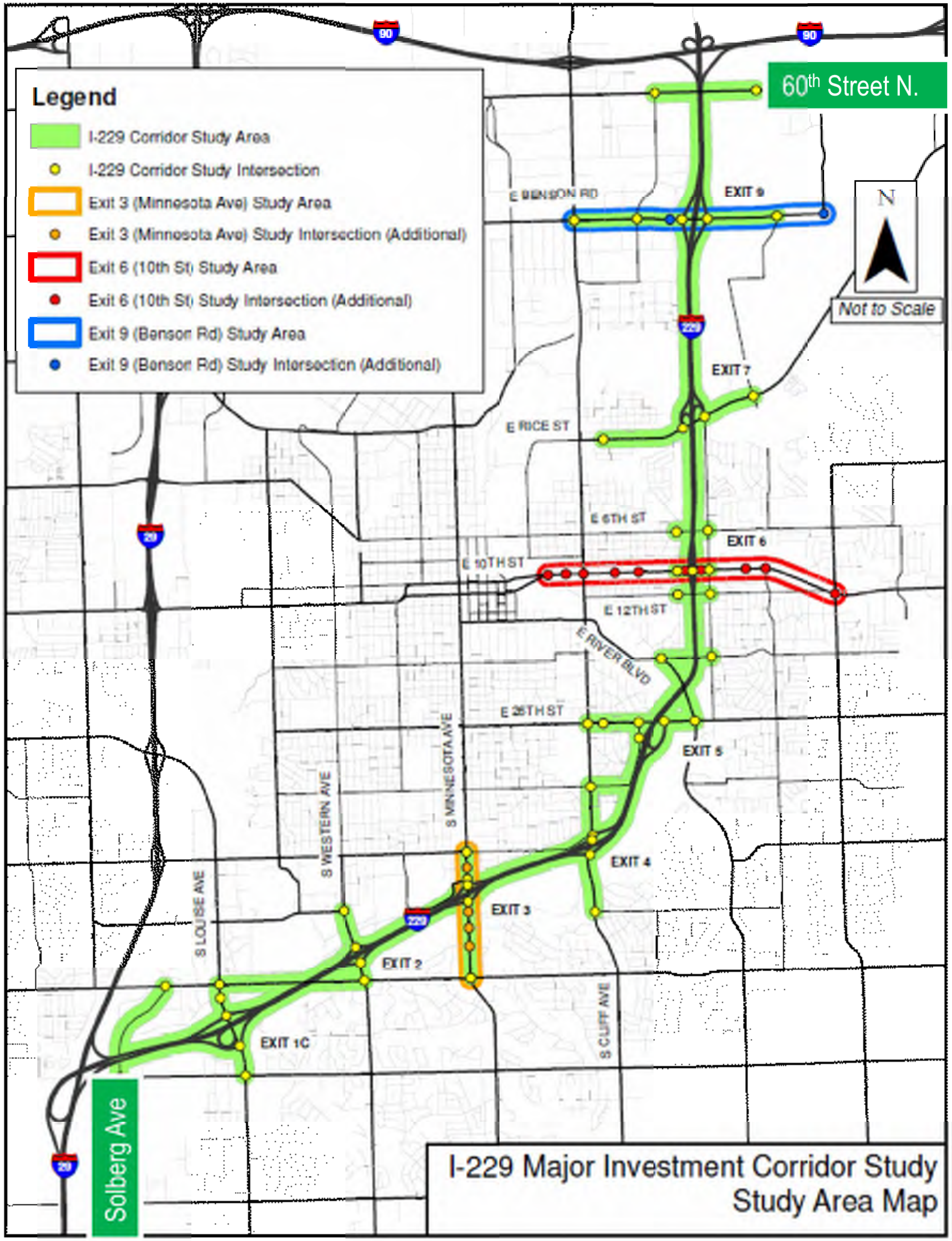
Study Area Map

I-229 Corridor Study

Solberg Avenue Overpass

to

60th Street N. Overpass



Study Advisory Partners

South Dakota Department of Transportation (SDDOT)

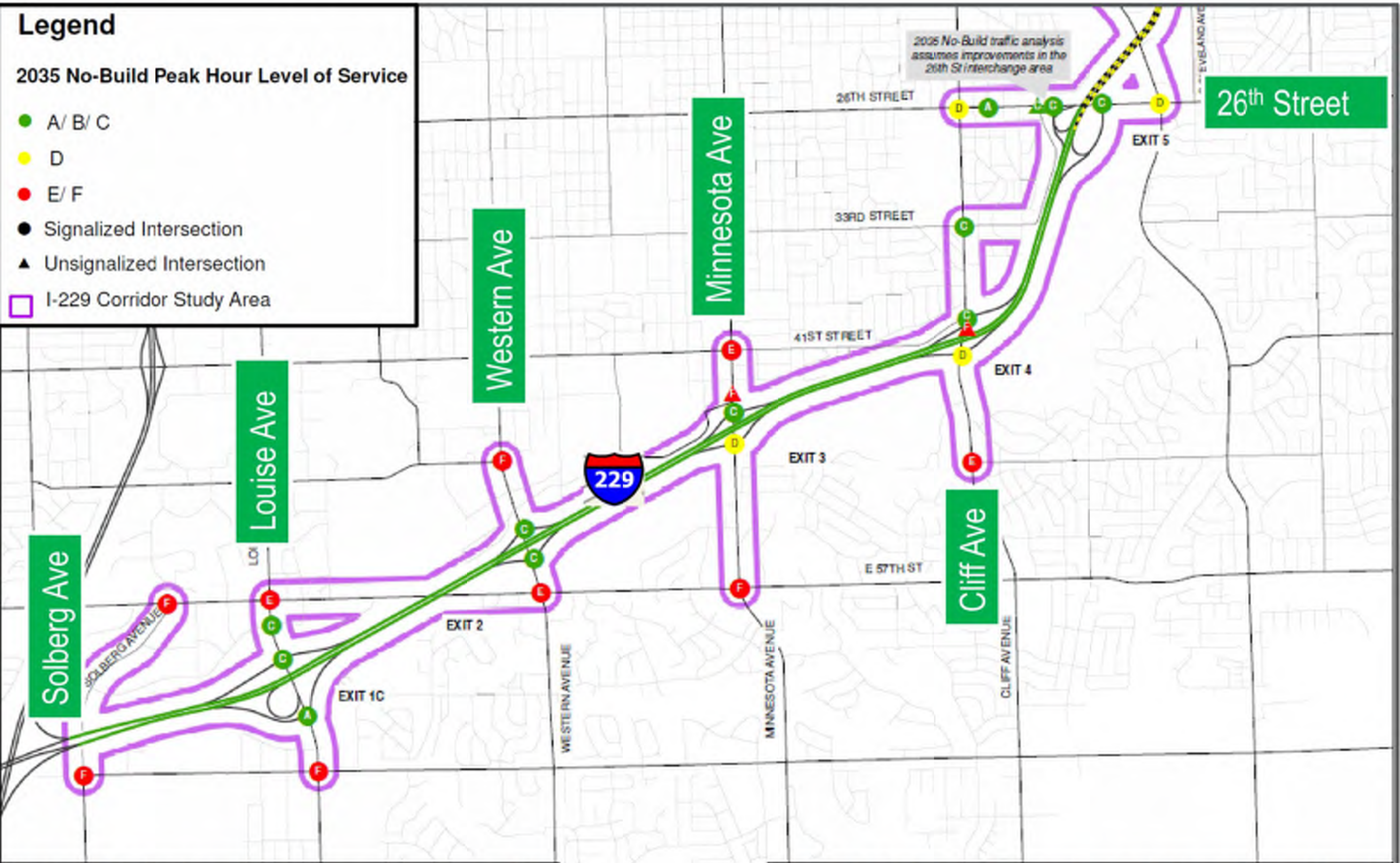
South Dakota Highway Patrol

City of Sioux Falls

Sioux Falls Metropolitan Planning Organization (MPO)

Federal Highway Administration (FHWA)

I-229 Corridor Overview

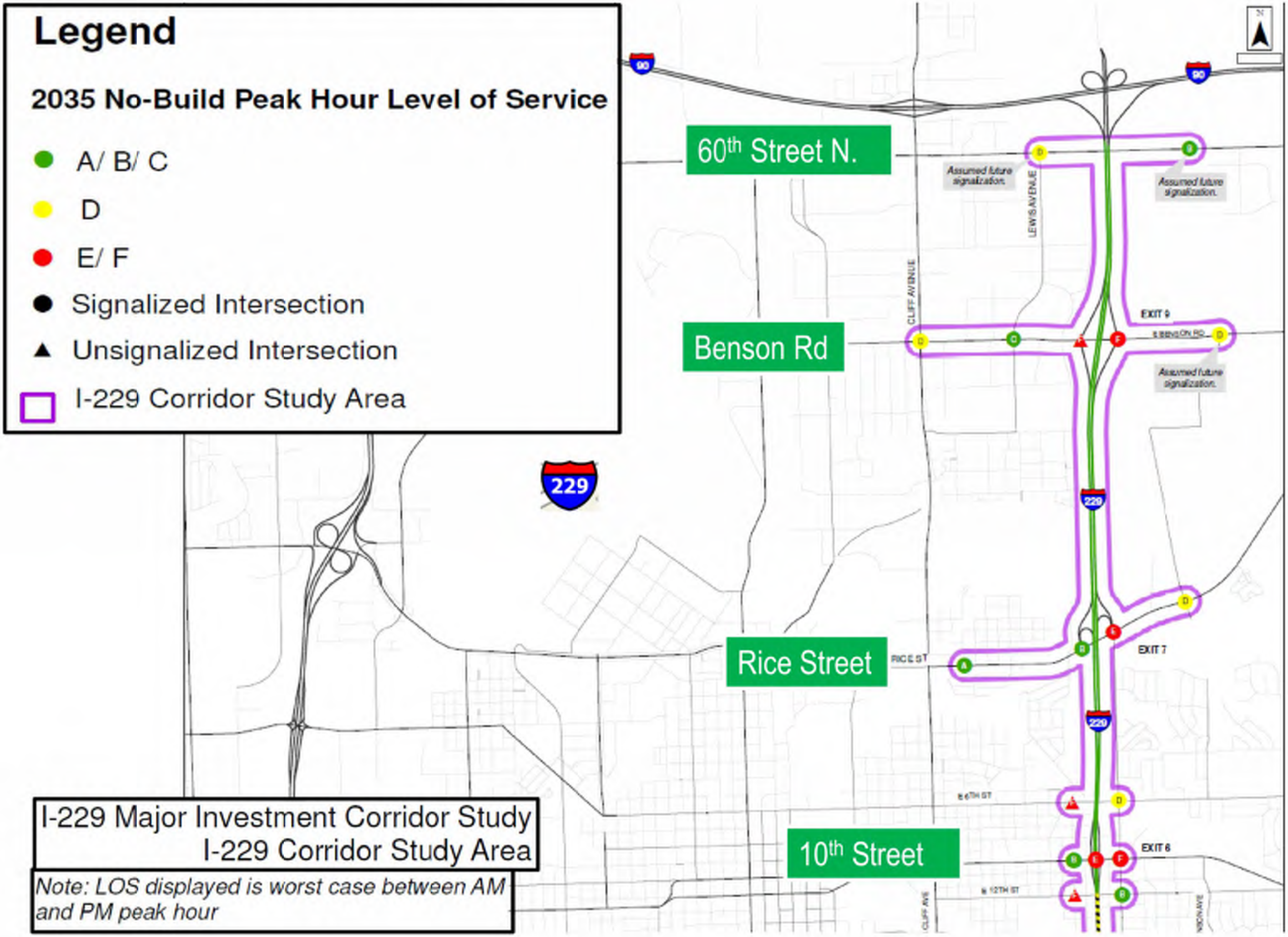


2035 No-Build traffic analysis assumes improvements in the 26th St interchange area

Note: LOS displayed is worst case between AM and PM peak hour

I-229 Major Investment Corridor Study
I-229 Corridor Study Area

I-229 Corridor Overview



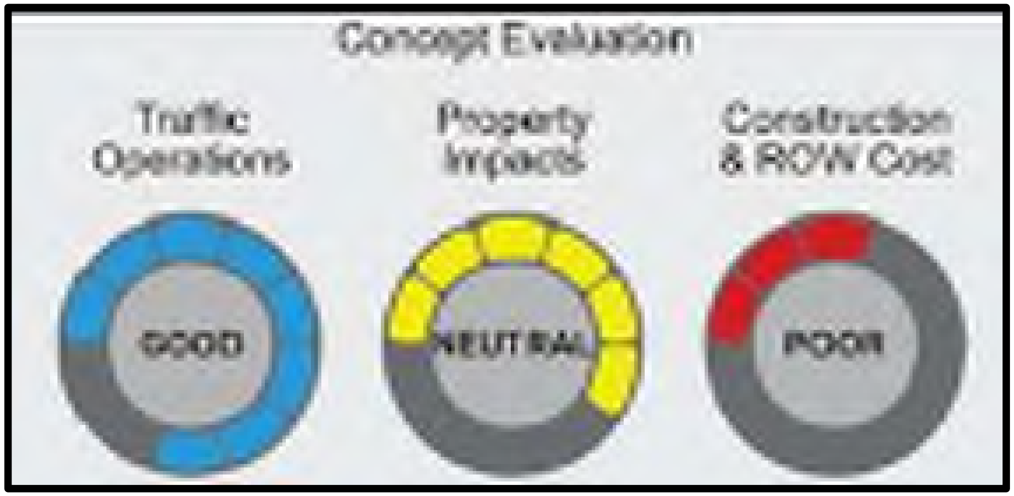
I-229 Major Investment Corridor Study
I-229 Corridor Study Area

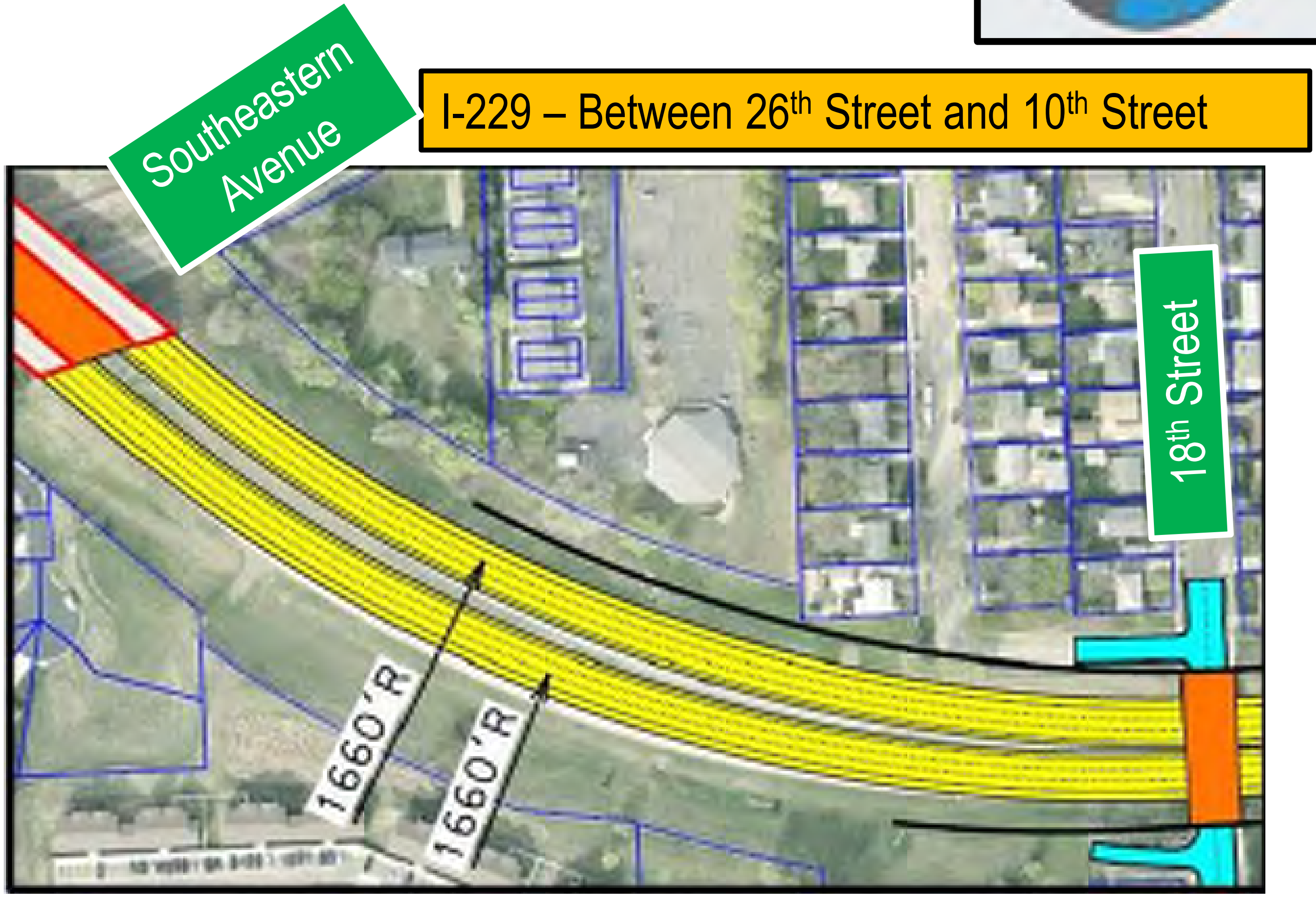
Note: LOS displayed is worst case between AM and PM peak hour

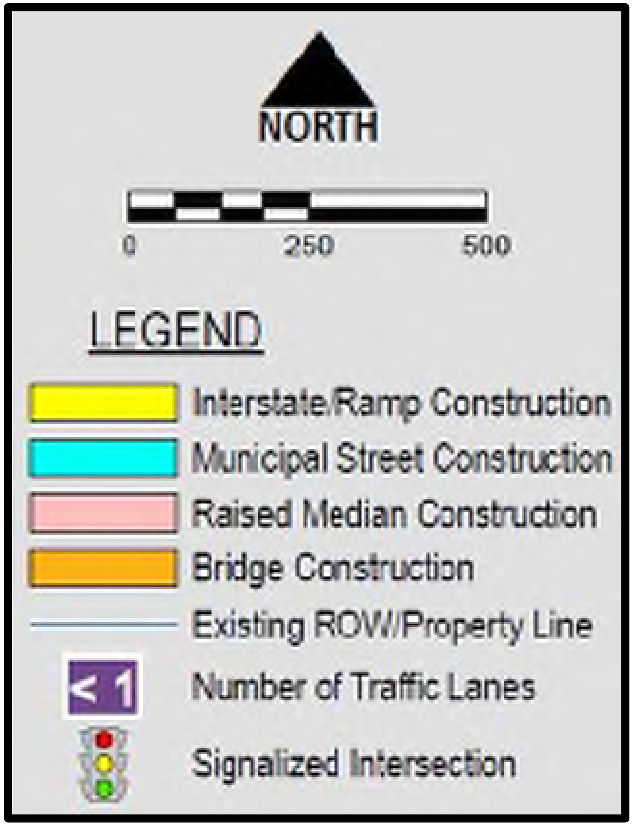
Conceptual Ideas for I-229 Mainline

What you will be able to see tonight:

- Additional 3rd Lane between 26th Street and 10th Street
- Modify design radius to allow for 65 mph design speed



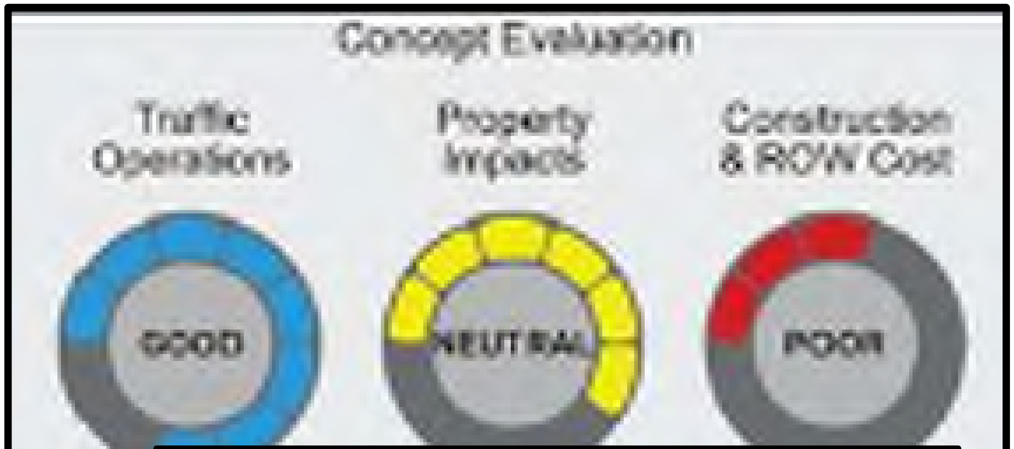

I-229 – Between 26th Street and 10th Street



Conceptual Ideas for Minnesota Avenue

What you will be able to see tonight:

- 13 Interchange Conceptual Options
- 4 Corridor Options
- Access Changes to Yankton Trail Park
- Conceptual Options to improve safety



Traffic Assessment

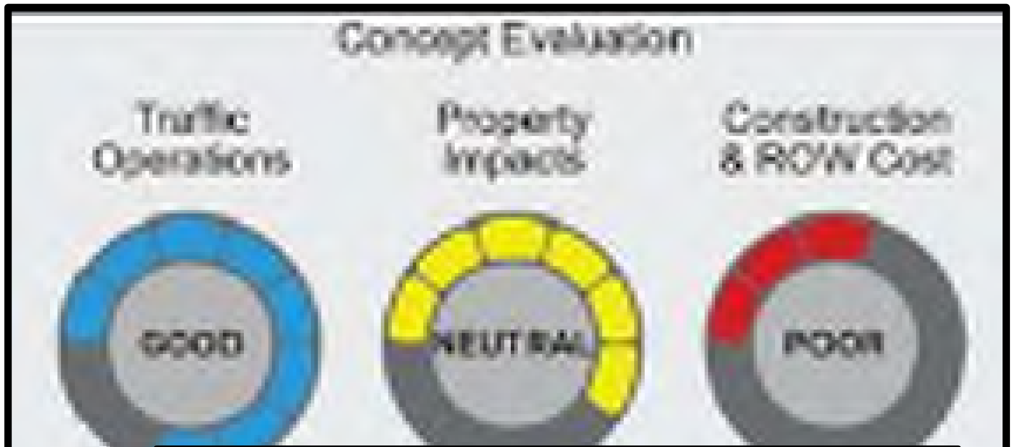
Queues	Delay	Travel Time

Minnesota Avenue / I-229 Interchange
Partial Clover Option

Conceptual Ideas for Cliff Avenue

What you will be able to see tonight:

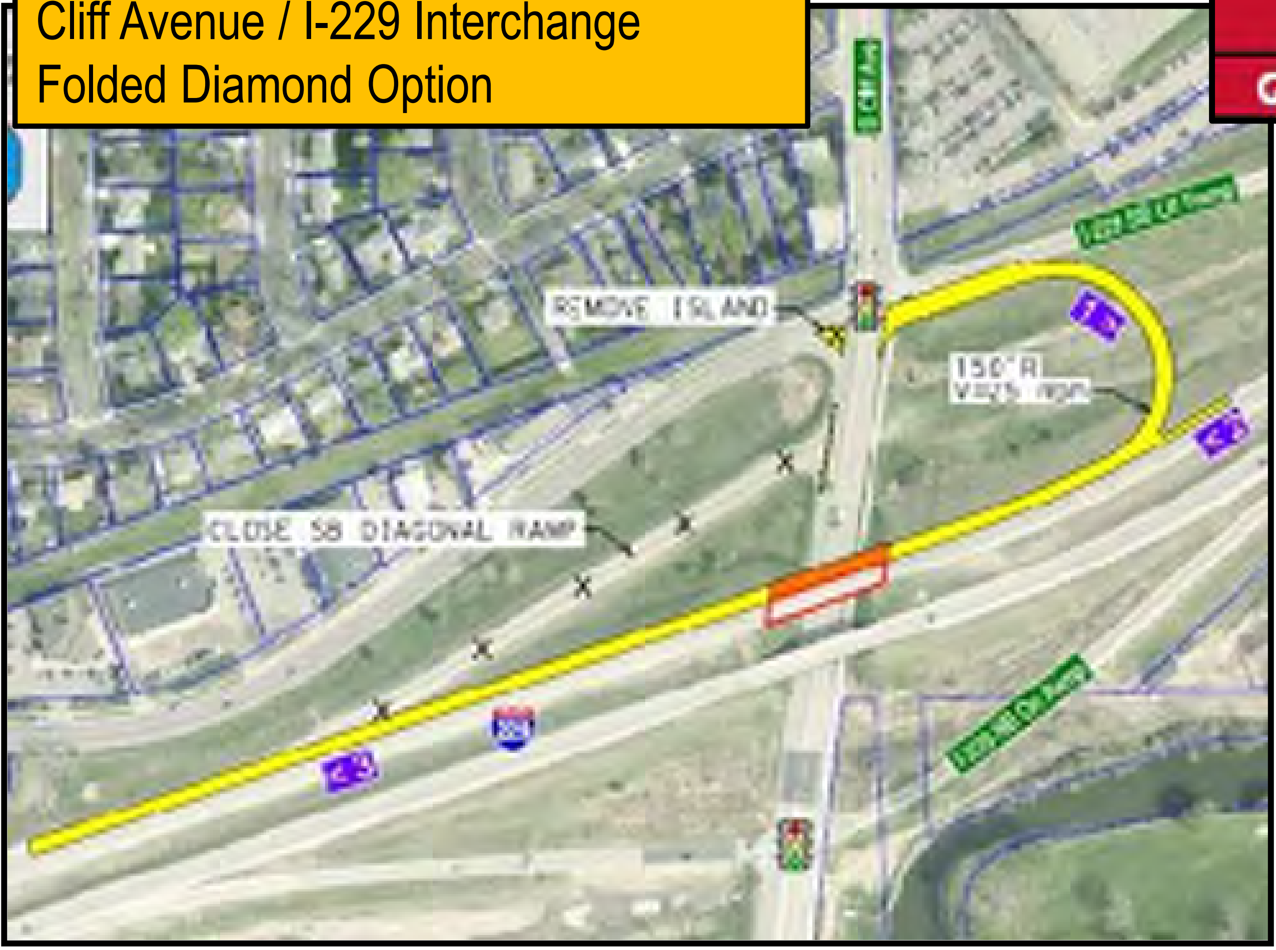
- 3 Interchange Conceptual Options



Traffic Assessment

Queues	Delay	Travel Time

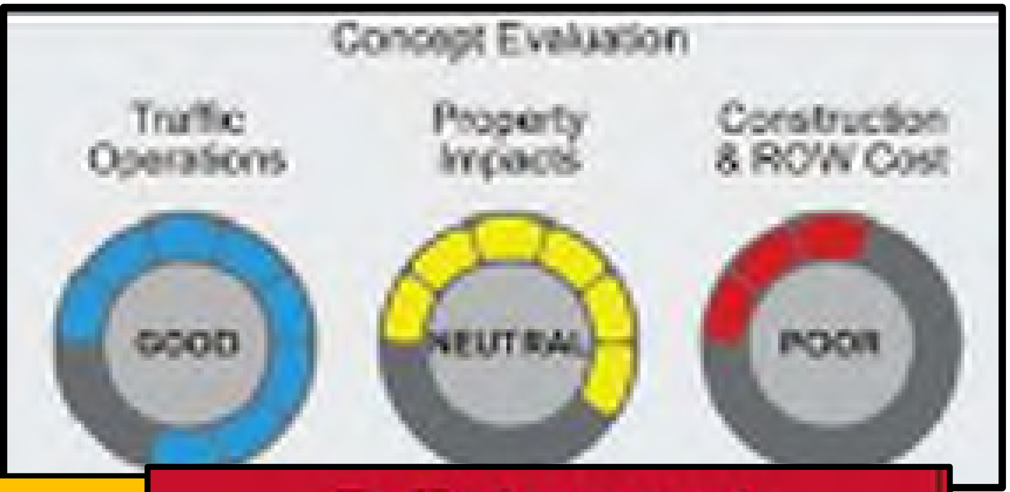
Cliff Avenue / I-229 Interchange
Folded Diamond Option



LEGEND

🟨	Interstate/Ramp Construction
🟦	Municipal Street Construction
🟥	Raised Median Construction
🟧	Bridge Construction
—	Existing ROW/Property Line
< 1	Number of Traffic Lanes
🚦	Signalized Intersection

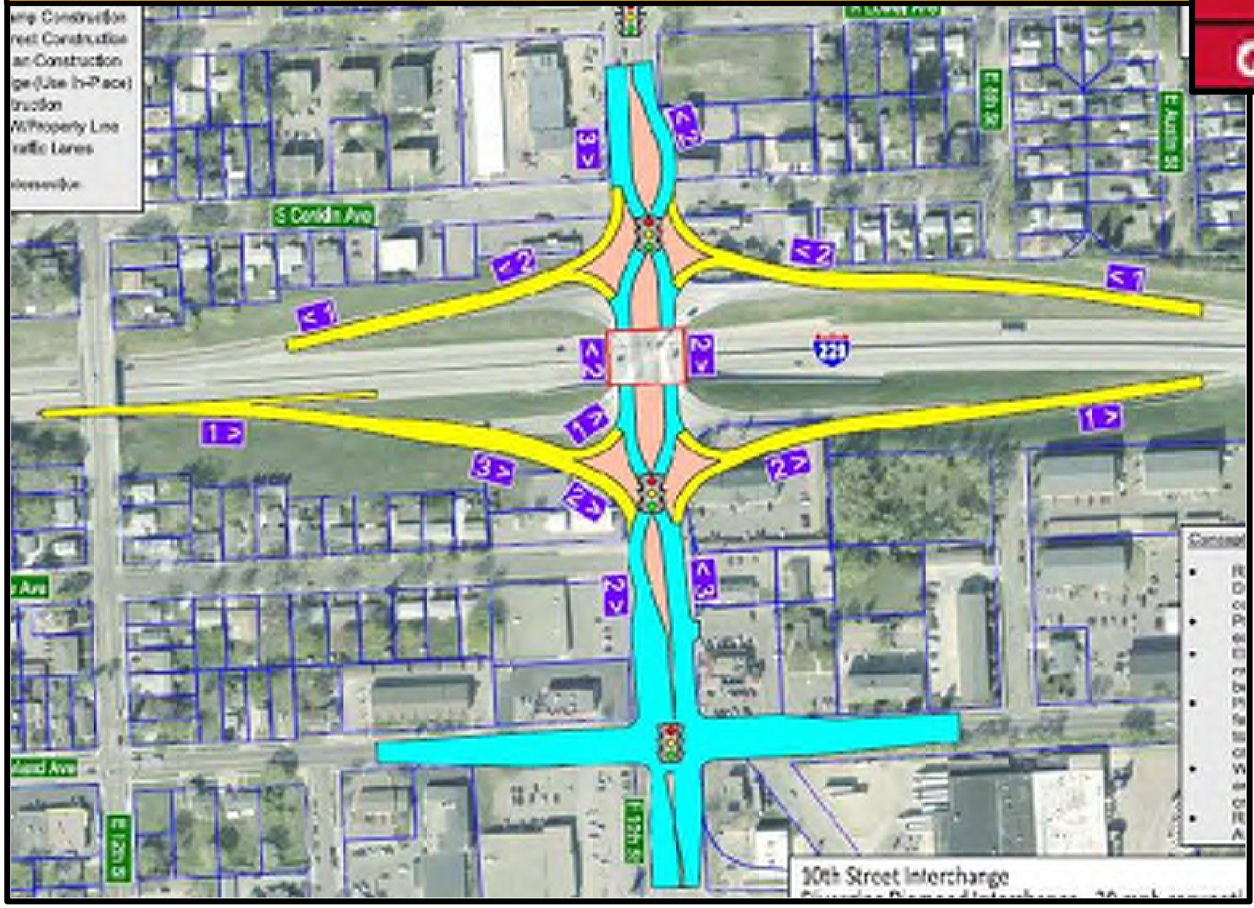
Conceptual Ideas for 10th Street Corridor



What you will be able to see tonight:

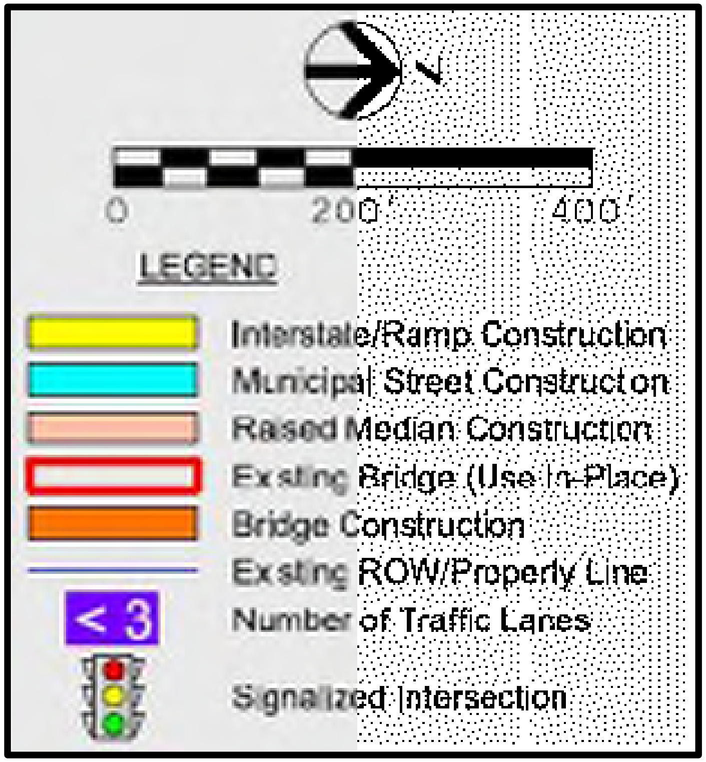
- 8 Interchange Conceptual Options
- 4 Corridor Options
- Median Changes or Driveway Closures to Improve Safety

10th Street / I-229 Interchange Diverging Diamond Option



Traffic Assessment

Queues | **Delay** | **Travel Time**



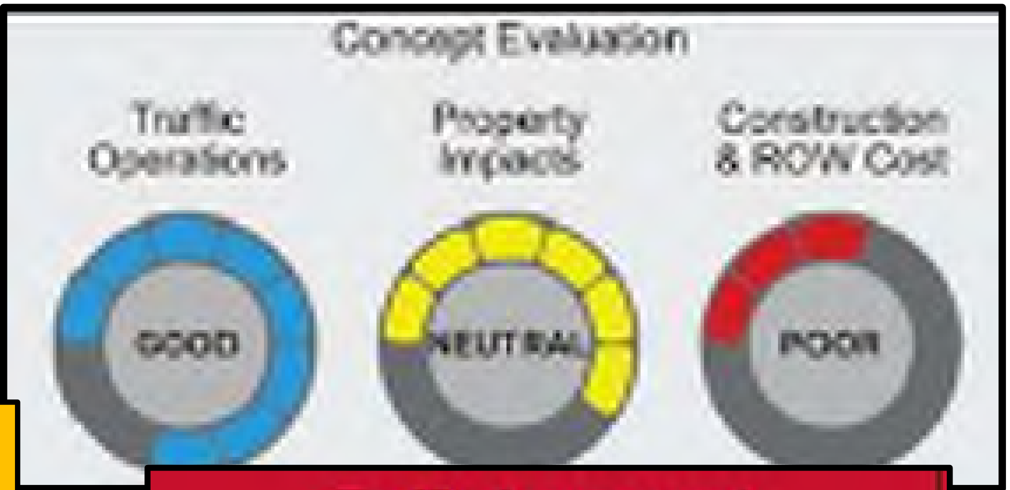
LEGEND

- 🟨 Interstate/Ramp Construction
- 🟦 Municipal Street Construction
- ▨ Raised Median Construction
- 🟥 Existing Bridge (Use In-Place)
- 🟧 Bridge Construction
- — Existing ROW/Property Line
- < 3 Number of Traffic Lanes
- 🚦 Signalized Intersection

Conceptual Ideas for Rice Street Interchange

What you will be able to see tonight:

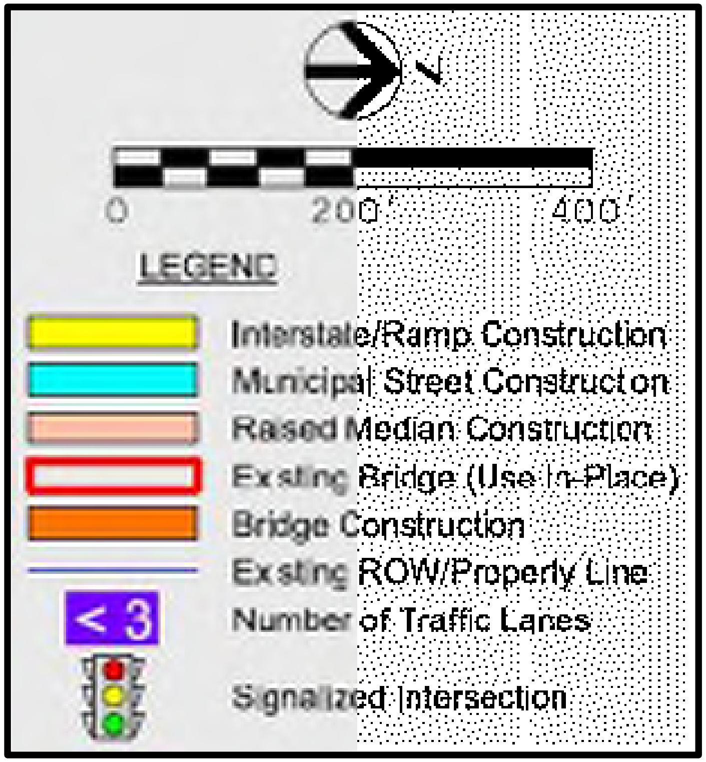
- 1 Interchange Conceptual Options



Traffic Assessment

Queues | **Delay** | **Travel Time**

Rice Street / I-229 Interchange Folded Diamond Improvements



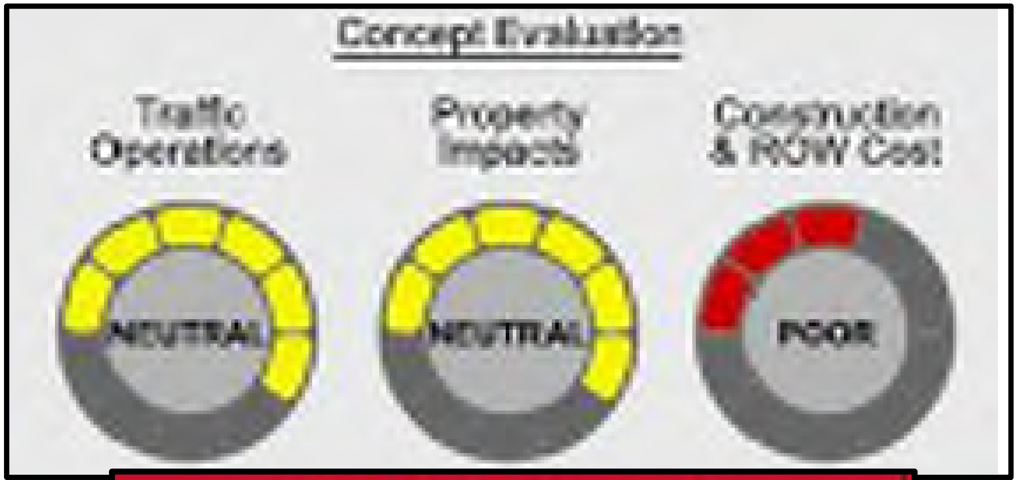
LEGEND

- 🟨 Interstate/Ramp Construction
- 🟦 Municipal Street Construction
- ▭ Raised Median Construction
- ▭ Existing Bridge (Use In-Place)
- 🟧 Bridge Construction
- — Existing ROW/Property Line
- < 3 Number of Traffic Lanes
- 🚦 Signalized Intersection

Conceptual Ideas for Benson Road

What you will be able to see tonight:

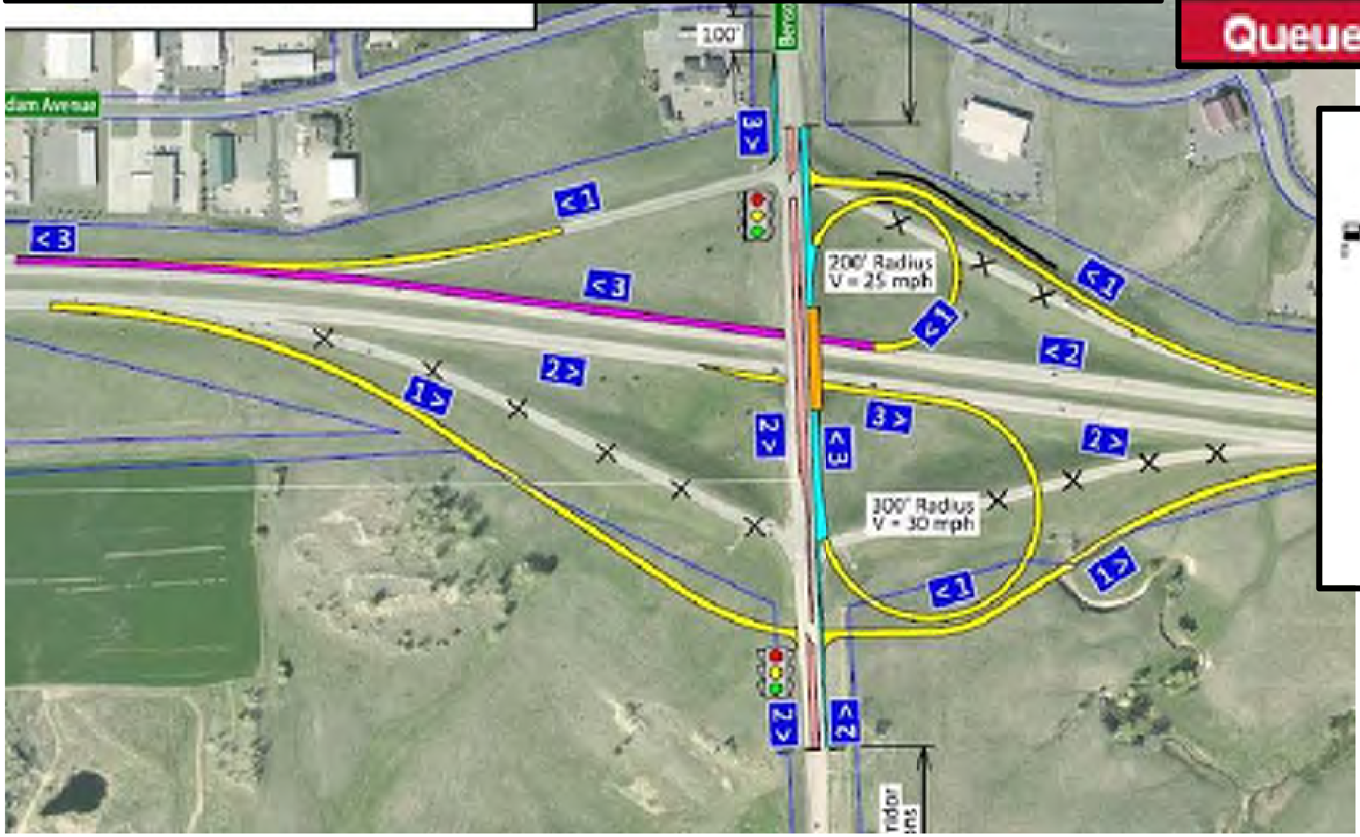
- 4 Interchange Conceptual Options
- 1 Corridor Option



Traffic Assessment

Queues	Delay	Travel Time

Benson Road / I-229 Interchange Folded Diamond Option

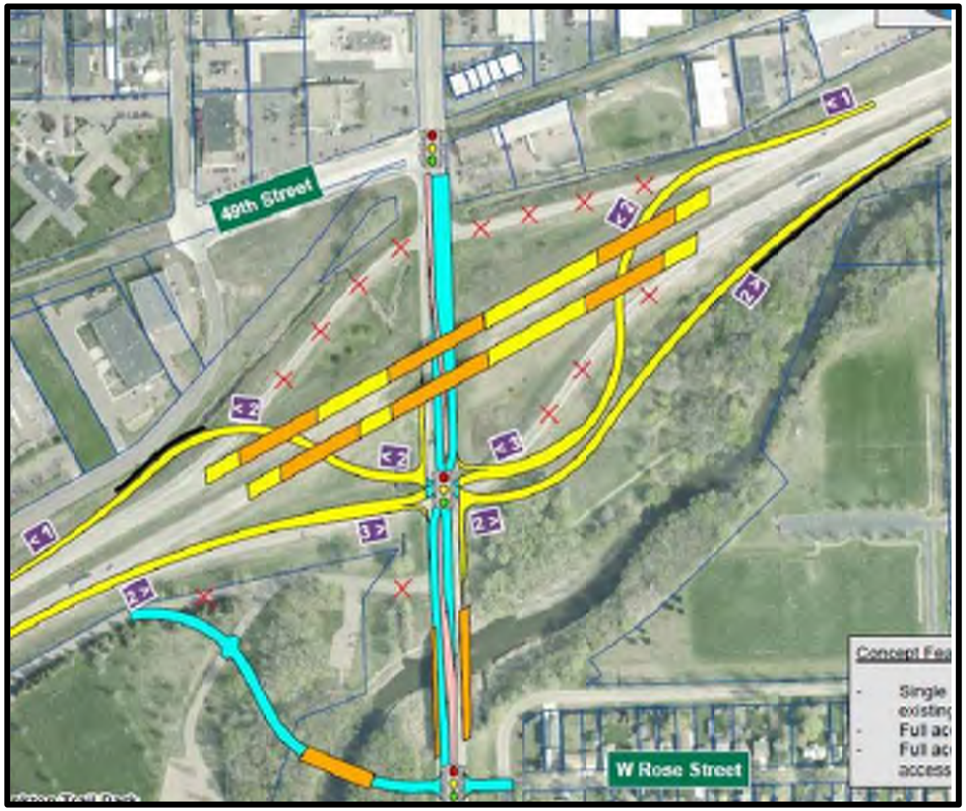


Scale in Feet 0 200 400

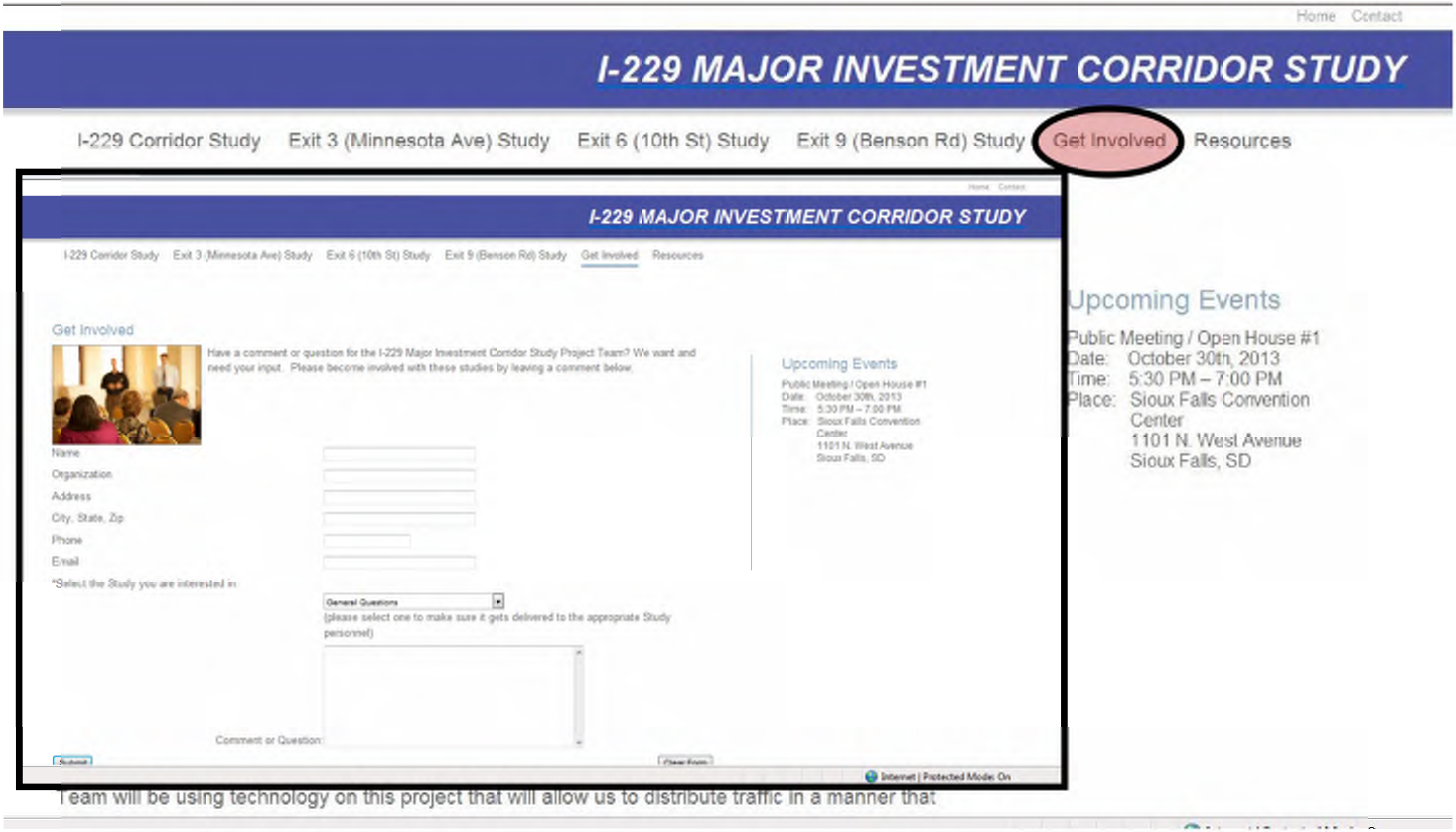
Legend
- 🟨 Interchange/Ramp/Loop Construction
- 🟦 Benson Road Construction
- 🟥 Raised Median Construction
- 🟧 Bridge Construction
- 🟪 Auxiliary Lane Construction
- — Existing ROW / Property Line
- ✕ Road Closure
- 🚦 Signalized Intersection
- 🛑 Stop Condition Intersection
- < 3 Number of Traffic Lanes

Next Steps for I-229

- Finalize Conceptual Options for all Sub-Studies
- Review Public Comments
- Complete additional Traffic Operations analysis on a reduced number of options based on the screening activities
- Develop Priority Phasing Plan for I-229 Corridor and Sub-Study Corridor
- Determine what "ITS" applications could improve the I-229 corridor safety
- Schedule and Conduct next public meeting



WWW.I229STUDY.COM



Get Involved

Have a comment or question for the I-229 Major Investment Corridor Study Project Team? We want and need your input. Please become involved with these studies by leaving a comment below.

Name

Organization

Address

City, State, Zip

Phone

Email

*Select the Study you are interested in: General Questions

(please select one to make sure it gets delivered to the appropriate Study personnel)

Comment or Question:

Upcoming Events

Public Meeting / Open House #1
Date: October 30th, 2013
Time: 5:30 PM – 7:00 PM
Place: Sioux Falls Convention Center
1101 N. West Avenue
Sioux Falls, SD

Upcoming Events

Public Meeting / Open House #1
Date: October 30th, 2013
Time: 5:30 PM – 7:00 PM
Place: Sioux Falls Convention Center
1101 N. West Avenue
Sioux Falls, SD

Team will be using technology on this project that will allow us to distribute traffic in a manner that

PROJECT CONTACTS:

Jason Kjenstad – HDR Engineering, Inc.
605-977-7740 or jason.kjenstad@hdrinc.com

Dave Meier – HDR Engineering, Inc.
402-399-1068 or dave.meier@hdrinc.com

Shannon Ausen – City of Sioux Falls
605-367-8607 or sausen@siouxfalls.org

Steve Gramm – SDDOT Project Development
605-773-6641 or steve.gramm@state.sd.us

Interstate 229 Major Investment Study
Mainline I-229 Sub-Study 1

Thanks for Attending!!!!!

MEETING NOTES

Memo

Date: Tuesday, June 02, 2015

Project: I229 MIS Public Meeting Debriefing Summary

To: Project Study Advisory Team (SAT)

From: HDR

Subject: ***Debriefing Summary / Meeting Comments***

Sub-Study 1 - I-229 Corridor:

- Mixture of interchange types confuses drivers. Should apply consistency in upgrading existing interchanges.
- Re ITS – Whatever advance information that can be provided to drivers via ITS features is a good thing.
- Concern about pavement noise. The I-229 pavement seems to generate a lot of noise.

Sub-Study 2 - Minnesota Ave:

- Prefer concepts with NO median on Minnesota north of 49th St.
- Don't see anything in the concepts shown that will improve operations on Minnesota outside the interchange area, particularly at 41st St and 57th St.
- Need to look at the sources of traffic congestion beyond the study limits.
- There were no operations problems on Minnesota until the traffic signals were added at the I-229 interchange ramps.
- Additional bicycle access across the I-229 corridor would be better if NOT on Minnesota.
- What about offsetting the school start time to avoid the morning peak period?
- Prefer interchange concepts without the traffic signals at the ramp terminals.
- Keep pedestrian and bike access separate from Minnesota Ave (off-alignment). Possibly aligned with Phillips or maybe with Duluth, Center or Spring. An overpass is preferred to an underpass.
- Improve bicycle/pedestrian access across I-229 on Minnesota and provide connection to Phillips corridor north of I-229.
- Like Minn-9 best. OK with right-turning traffic yield to pedestrians.
- Like the relocated Yankton Trails Park access concept with full access. Right-in/right-out for park access would not be good. Rose St connection to east as shown will not work – too steep a grade.
- Southbound ramp terminal intersection offset from 49th St is better – worried about ramp to/from 49th traffic speeding if the approaches are lined up.
- Post No Right Turn on Red for right turns onto of from ramp terminals to enhance safety of bike/pedestrian crossings.
- Significant population living northwest of 49th and Duluth that would benefit from improved pedestrian access.
- Believe there are issues with the railroad ROW easements that place limitations on use.
- Railroad ROW is not wide enough for street width shown on the Minn-C2 concept.
- 49th St should be perpendicular to Minnesota Ave. A horizontal curve to set up a 90-degree intersection would limit speeds on 49th and the ramps. Also have concern for angle of turn for trucks from eastbound 49th to southbound Minnesota.

- Like Minn-9 concept best except for park entrance right-in/out. Relocate the park access, but connect it to the existing trail parking lot to minimize impacts on forested area of park along river. Use the pavement from the existing drive from Minnesota for replacement trail parking.
- Relocated park access impacts Frisbee's drive.
- Need to provide pedestrian/bicycle connectivity between Minnesota Ave, Yankton Trail Park and Tomar Park.
- One person suggested studying a roundabout at Phillips with the 49th extension east alternative.
- One person commented that they preferred the loop ramps that remove left turns from Minnesota.

Sub-Study 3 - 10th Street:

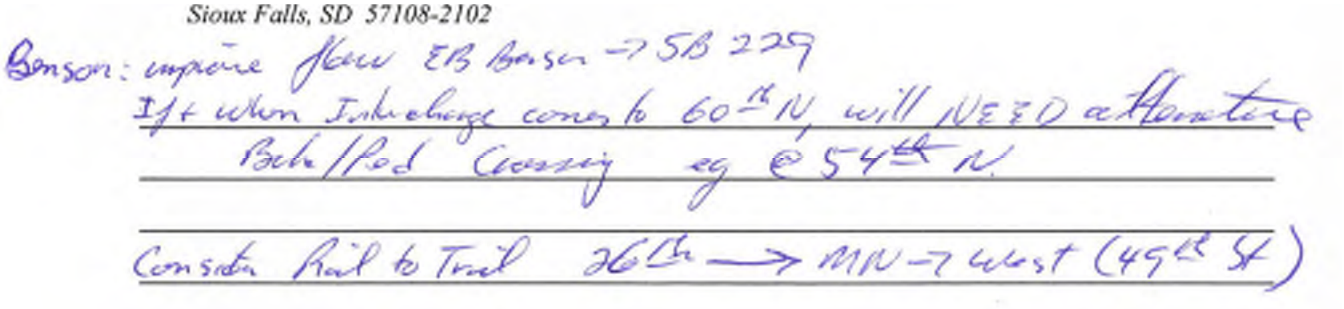
- Potential noise issues with split diamond concepts due to added one way ramp connectors.

Sub-Study 4 – Benson Road:

- Need only one set of ramps (half interchange) at 60th St N.
- SPUI interchange at 10th St and elsewhere have worked well. Is it a potential concept at Benson Rd?
- During peak periods traffic on Benson Rd typically lets traffic from Potsdam onto Benson Rd.
- If concrete casting plant (Gage Bros. Concrete) relocates to the Benson Rd area, beams up to 120 feet long may be transported onto I-229 at the Benson Rd interchange. Plant relocation could involve up to 60 trailers/day for all products shipped and materials received. Intrigued by DDI concept.
- Concern that none of concepts shown have features to address strong eastbound to southbound right turns onto I-229 entrance ramp. Dual right turn with two-lane ramp for some distance may be needed.
- Prefer that Benson Rd interchange get big capacity increase and do nothing at 60th St N. 60th St N has good I-229 trail crossing potential if there are no interchange ramps.
- 54th St N would be a good new I-229 trail crossing corridor.
- Minimal pedestrian use is expected along the Benson Road corridor due to the commercial and industrial land use in the area.

COMMENTS

Comment 01

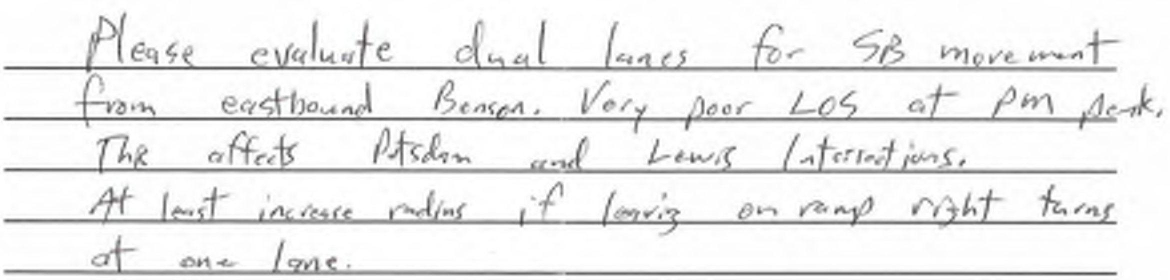


Sioux Falls, SD 57108-2102

Benson: improve flow EB Benson → SB 229
If + when Interchange comes to 60th N, will NEED alternative
Bike/Ped Crossing eg @ 54th N.

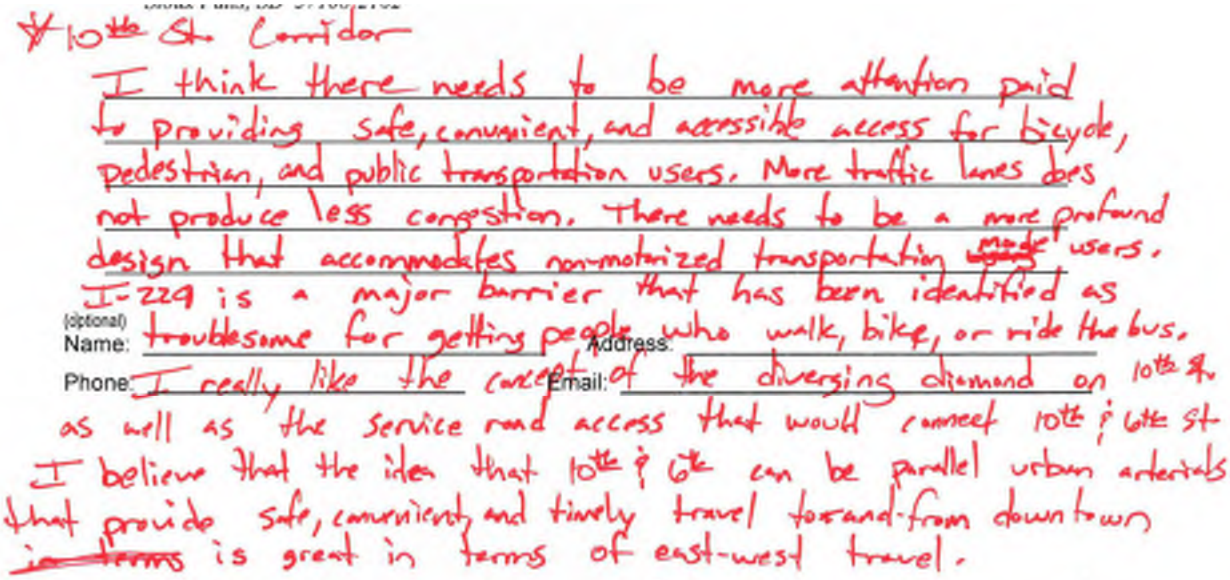
Consider Rail to Trail 26th → MN → West (49th St)

Comment 02



Please evaluate dual lanes for SB movement from eastbound Benson. Very poor LOS at PM peak. This affects Potsdam and Lewis Intersections. At least increase radius if leaving on ramp right turns at one lane.

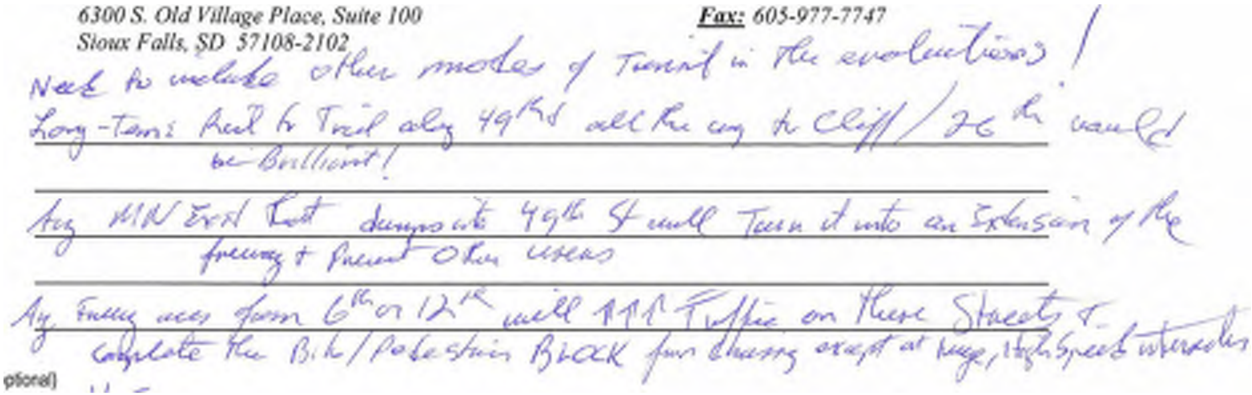
Comment 03



*10th St. Corridor
I think there needs to be more attention paid to providing safe, convenient, and accessible access for bicycle, pedestrian, and public transportation users. More traffic lanes does not produce less congestion. There needs to be a more profound design that accommodates non-motorized transportation ~~mode~~ users. I-229 is a major barrier that has been identified as troublesome for getting people who walk, bike, or ride the bus. I really like the concept of the diverging diamond on 10th St. as well as the service road access that would connect 10th & 6th St. I believe that the idea that 10th & 6th can be parallel urban arterials that provide safe, convenient, and timely travel to-and-from downtown ~~in terms~~ is great in terms of east-west travel.

(optional)
Name:
Address:
Phone:
Email:

Comment 04



6300 S. Old Village Place, Suite 100
Sioux Falls, SD 57108-2102
Fax: 605-977-7747

Need to include other modes of Transit in the evaluations!

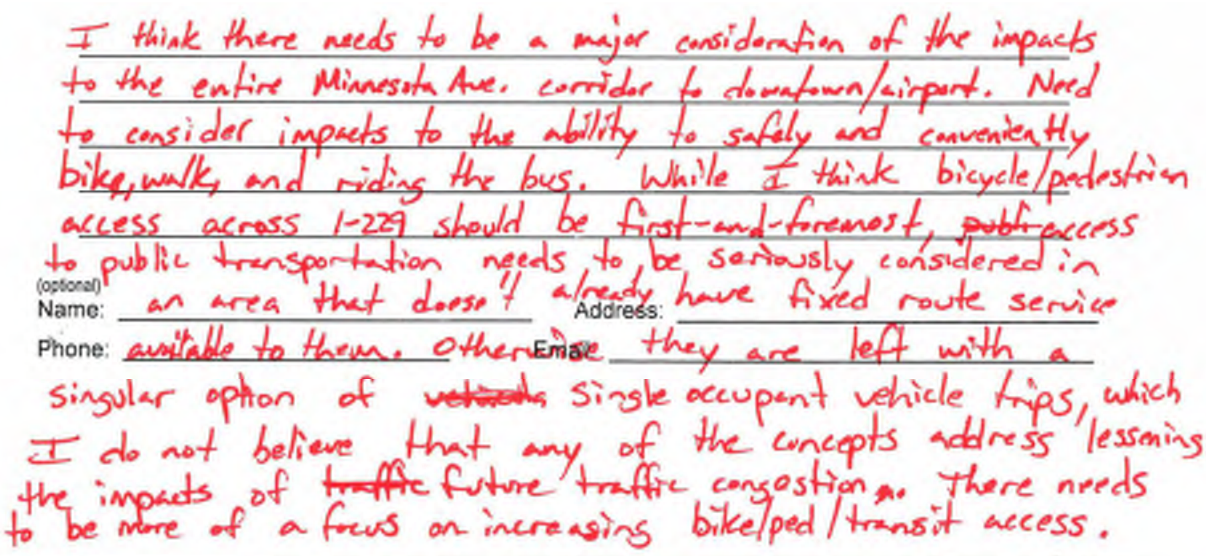
Long-Term: Rail to Trail along 49th all the way to Cliff/26th would be Brilliant!

Any MN Exit that dumps into 49th St will Turn it into an Extension of the freeway + Prevent Other users

Any Freeway access from 6th or 12th will ↑↑↑ Traffic on these Streets & complete the Bike/Pedestrian BLOCK from crossing except at large, High Speed intersections

ptional)

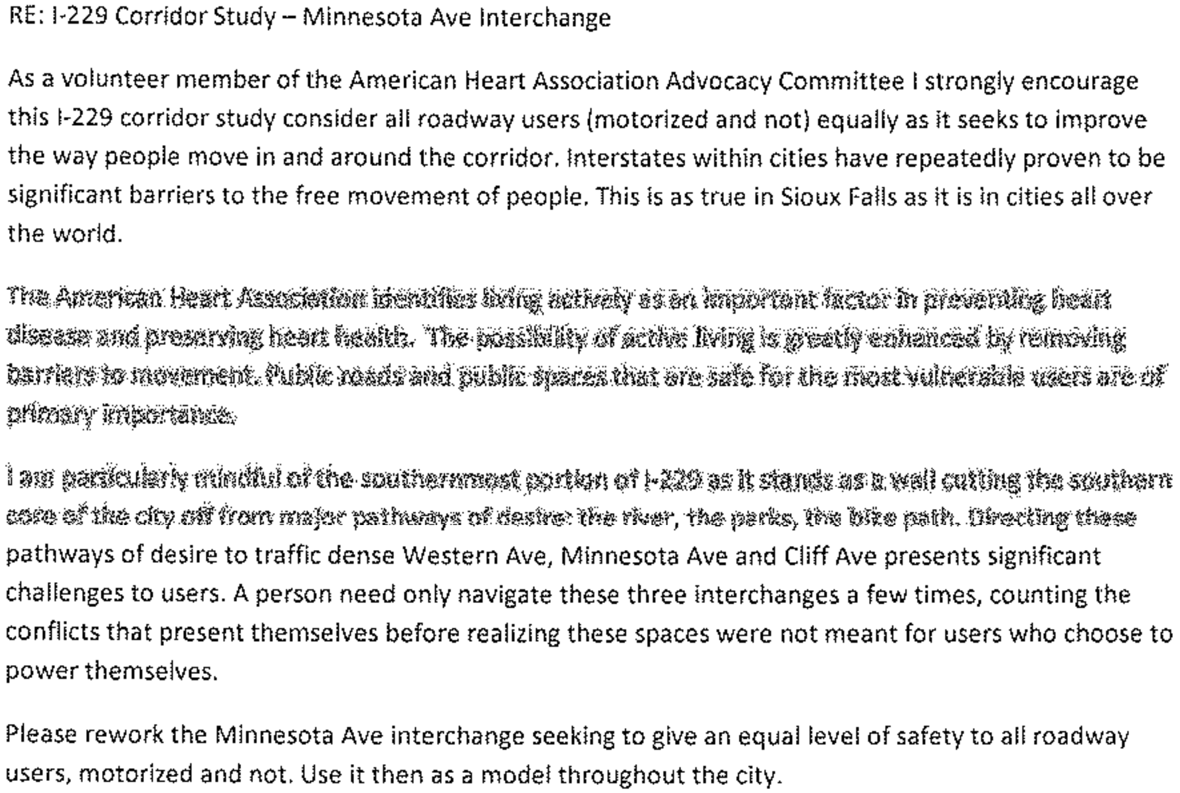
Comment 05



I think there needs to be a major consideration of the impacts to the entire Minnesota Ave. corridor to downtown/airport. Need to consider impacts to the ability to safely and conveniently bike, walk, and riding the bus. While I think bicycle/pedestrian access across I-229 should be first-and-foremost, ~~publ~~ access to public transportation needs to be seriously considered in

(optional)
Name: an area that doesn't already Address: have fixed route service
Phone: available to them. Otherwise Email: they are left with a singular option of ~~vehicles~~ single occupant vehicle trips, which I do not believe that any of the concepts address lessening the impacts of ~~traffic~~ future traffic congestion. There needs to be more of a focus on increasing bike/ped/transit access.

Comment 06



RE: I-229 Corridor Study – Minnesota Ave Interchange

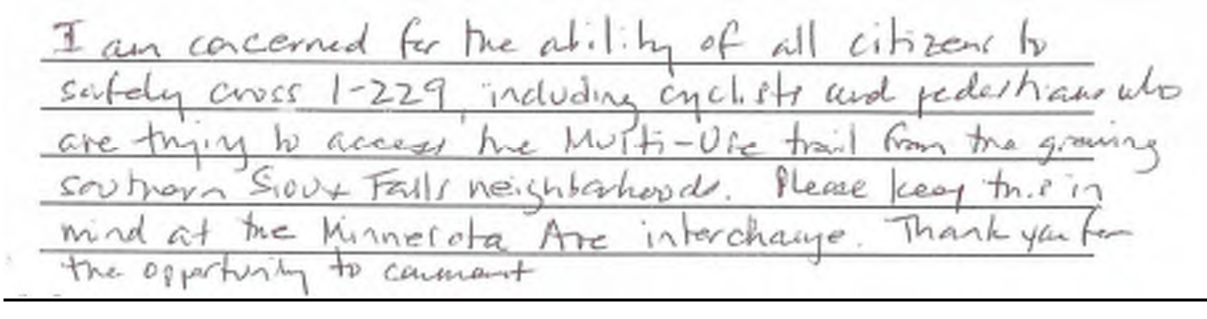
As a volunteer member of the American Heart Association Advocacy Committee I strongly encourage this I-229 corridor study consider all roadway users (motorized and not) equally as it seeks to improve the way people move in and around the corridor. Interstates within cities have repeatedly proven to be significant barriers to the free movement of people. This is as true in Sioux Falls as it is in cities all over the world.

The American Heart Association identifies living actively as an important factor in preventing heart disease and preserving heart health. The possibility of active living is greatly enhanced by removing barriers to movement. Public roads and public spaces that are safe for the most vulnerable users are of primary importance.

I am particularly mindful of the southernmost portion of I-229 as it stands as a wall cutting the southern core of the city off from major pathways of desire: the river, the parks, the bike path. Directing these pathways of desire to traffic dense Western Ave, Minnesota Ave and Cliff Ave presents significant challenges to users. A person need only navigate these three interchanges a few times, counting the conflicts that present themselves before realizing these spaces were not meant for users who choose to power themselves.

Please rework the Minnesota Ave interchange seeking to give an equal level of safety to all roadway users, motorized and not. Use it then as a model throughout the city.

Comment 07



I am concerned for the ability of all citizens to safely cross I-229, including cyclists and pedestrians who are trying to access the Multi-Use trail from the growing southern Sioux Falls neighborhoods. Please keep this in mind at the Minnesota Ave interchange. Thank you for the opportunity to comment

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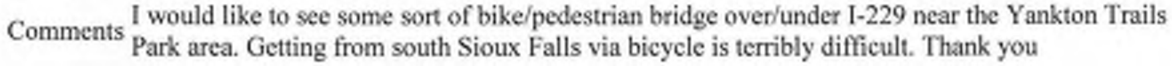
Comment 08



Comments I would like to see some sort of bike/pedestrian bridge over/under I-229 near the Yankton Trails Park area. Getting from south Sioux Falls via bicycle is terribly difficult. Thank you

Comment 09

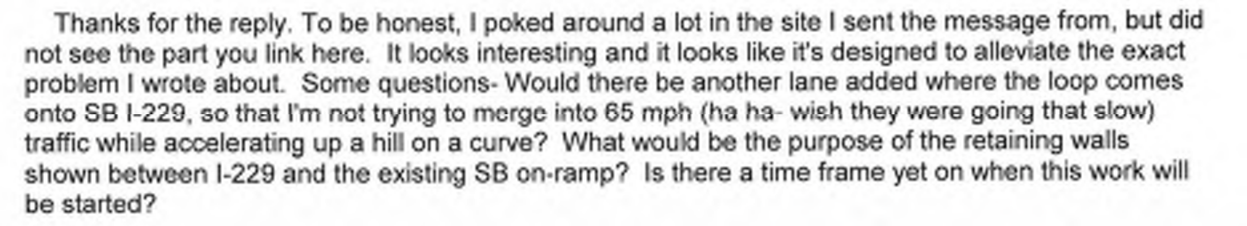
Comments

Please include me in any future planning around 10th Street. I am a commercial property owner around 10th and Cleveland, so I am particularly interested in any future plans. I appreciate your making this public and inclusive.

Comment 10

Something that I feel needs to be addressed concerning the I-229 corridor is the unsafe traffic conditions at Cliff Avenue on the north side of I-229. The current traffic light set-up forces northbound drivers to risk their lives to get on westbound I-229. The main problem for this is the amount of traffic going southbound, and the timing of the lights. The traffic heading south through the intersection is going downhill and generally driving rather faster than the speed limit. The traffic coming off I-229 and turning south on Cliff Avenue is usually going pretty fast too, as the green light is short, and no one wants to wait. Additionally, eastbound traffic on 41st street turning south on Cliff Avenue faces only a yield sign. Knowing that the southbound traffic is heavy and fast when southbound Cliff Avenue or westbound 41st Street have a green light, the eastbound 41st Street traffic turning south has a brief window to gun it and head south on Cliff Avenue. Sitting in the northbound Cliff Avenue turning lane, waiting to turn west onto the westbound I-229 on ramp becomes a crap-shoot. It's unsafe to turn across the two lanes of southbound Cliff Avenue when Cliff Avenue has a south green light, or when westbound traffic off I-229 has a green light, or when both those lanes have a red light, and the southbound traffic coming off 41st Street speeds south during the brief window of time when only northbound Cliff Avenue has the green light. When it's busy, especially before and after school, and after 5:00, there is no safe time to turn left from Cliff Avenue onto the I-229 on-ramp.Consequently, every car taking that route has to gun it, and hope the southbound traffic hits the brakes. This situation is clearly unsafe now. As traffic grows, it will get worse. A simple fix, for now, would be to time the lights a little different, or at least a little longer, and add a red light in place of the yield controlling southbound Cliff Avenue traffic from 41st Street. When all southbound and westbound traffic has a red light, those cars headed for southbound I-229 would have a safe, clear path. Time the light long enough to allow 6 cars to get through. Another, simple way to improve the traffic situation would be to widen the lane where traffic turns south onto Cliff Avenue from 41st Street. If that lane were twice as wide, 41st Street traffic trying to get on the on-ramp for I-229 south could do so without having to pull into the right lane of southbound Cliff Avenue. That lane should still have the traffic light in place of the yield sign. It wouldn't take much of a traffic study to see the issues at that intersection. Spending a half hour observing at 7:30 a.m. on a school day would tell you all you need to know.

<u>Comment 11</u>



Thanks for the reply. To be honest, I poked around a lot in the site I sent the message from, but did not see the part you link here. It looks interesting and it looks like it's designed to alleviate the exact problem I wrote about. Some questions- Would there be another lane added where the loop comes onto SB I-229, so that I'm not trying to merge into 65 mph (ha ha- wish they were going that slow) traffic while accelerating up a hill on a curve? What would be the purpose of the retaining walls shown between I-229 and the existing SB on-ramp? Is there a time frame yet on when this work will be started?

APPENDIX -

CLIFF AVENUE AND RICE STREET PUBLIC MEETINGS – JUNE 22ND, 2016

RICE STREET

JUNE 22ND, 2016

- MEETING NOTES
- SIGN-IN SHEETS
- COMMENTS
- POWERPOINT SLIDES

Meeting Minutes

Project:	I-229 Major Investment Corridor Study, PL 0100(87) 3616P, PCN 044K
Subject:	Stakeholder Meeting – Sub-study 5 – Rice Street Exit 7
Date:	Wednesday, June 22, 2016
Location:	Sioux Falls Convention Center Conference Room 6
Attendees:	See Attached Sign In Sheet – 8 Participants

Comments & responses noted:

1. Trucking firm on North side Rice, east of I-229 (Kunkel Truck Lines)
    - Concern for Eastbound truck ingress to property.
    - What is the purpose of the proposed median? Response: Median is the preferred treatment for arterials carrying more than 20,000 veh/day (City)
    - Are the proposed corridor improvements similar to W 12th Street near I-29? Response: Yes (City)
    - Will the railroad have one track or two? Response: BNSF has not indicated how many tracks there may be in the future. They have not ruled out the potential for expansion.
    - Business owns both existing drives on the north side of Rice St. An adjacent business to the east (Eastgate Towing) also has access to Rice St via the eastern of the two drives.
    - The proposed backage road would require 15-20 feet of embankment.
    - Existing security at the drives is provided by security cameras only. The business intends to add gates. Proposed widening on Rice St will make it more difficult for the business to position the gates.

2. Business southeast corner of Bahnson Ave (Myrl & Roy's Paving)
    - Recommend that project planners expect more railroad traffic.
    - Recommend consideration of eastbound in-bound trucks queueing when trains are in the crossing. Response: It is expected that the number of unit trains/day will remain about the same but local trains could increase to 3-4 per day (City).
    - The Cleveland realignment option is a step backward because it inhibits direct access to I-229.

3. Gravel Company – East side of Cleveland
    - When the railroad crossing is blocked, there will be no way out of our business if a median is built on Cleveland.

4. Proposed improvements on Rice St will increase speeds on Rice and create more problems with slow turning trucks. Response: Satisfying both commuter and industrial traffic is a challenge.

5. Between 4:00 – 4:30 pm, trucks waiting for a gap in Rice St traffic to turn out block the railroad crossing.

6. A railroad grade separation is needed.

7. What is the timeline for construction of Rice St improvements? Response: the I-229 study will include recommendations to prioritize improvements over a time span of more than 20 years. Widening Cleveland Ave to a 5-lane roadway is anticipated to be a near term project (City).

8. Eastbound right turn lane has been considered to allow westbound left lane to be added, but it is needed to hold traffic when railroad crossing is blocked.

9. Why is that more important than queuing traffic waiting for left turn traffic in the morning?

10. The railroad track should be realigned south to its original alignment farther south of Rice St.

11. The mine pit south of Rice St is now used mostly for recycling and has an indefinite remaining life.

12. Not opposed to realignment of Cleveland Ave if it can be shifted farther west or south toward the residential development.

13. When will SD-100 be constructed to Rice Street? Response: In about two years.

14. Why do the I-229 bridges need to be redone before improvements along Rice St?

15. On Concept Rice-5, would a roundabout be located where the ramps intersect Rice St? Response: A signalized intersection similar to the one at I-229 and 10th St would be located at the ramp terminals.

16. What is the benefit of the proposed median? Response: Vehicle crash mitigation and reduction of turning movement conflicts.

17. Have studies been conducted regarding the safety of U-turns? Response: 57th & Southeastern project has been the source of some complaints about u-turns. 12th Street is working OK. A 30% reduction in crashes has been determined by analysis of previous median construction projects (City).

18. Senior driver comment – Medians cause confusion because drivers often cannot exit an adjacent property the same way they entered it.

19. Do not see a lot of semi-trailer trucks on Rice St west of I-229.

20. Business West Side of Cleveland South of Rice
    - Have been operating since 1991. Have only 70 employees, who may go on-site to service customers.
    - There are truck operations in and out of the site.
    - The site contains 50 storage spaces for customer RV's and campers storage.
    - Customers like that the storage spaces are close to I-229 access ramps.

DOT CITY OF SIOUX FALLS PUBLIC WORKS HDR

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Public Meeting for Rice Street Sub-Study
Client City of Sioux Falls/South Dakota Department of Transportation
Project PL 0100(87) 3616P, PCN 044K **Project No.:** 207030
Meeting Date Wednesday, June 22, 2016 5:00 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Brad Remmich	PIERRE	773-3093	bradley.remmich@state.sd.us
2	Brigitte Fawcett	1208 N Lowell ave	605-310-793	
3	Steve Gramm	700 E. Broadway Ave	773-6641	steve.gramm@state.sd.us
4	Jason Kjenstad	6300 S. Old Village Pl	977-7740	jason.kjenstad@hdrinc.com
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Sign In Sheet

Subject I-229 Major Investment Corridor Study – Public Meeting for Rice Street Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3616P, PCN 044K **Project No.:** 207030

Meeting Date Wednesday, June 22, 2016 5:00 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Andy Vandel	Pierre	773-4421	andy.vandel@state.sd.us
2	Jason Kjerstad	HDR	605-977-7740	jason.kjerstad@hdrinc.com
3	Josh Callahan	1501 N. Cleveland Ave Sioux Falls	605-521-6586	josh.callahan@smpsecurity.com
4	TROY MILLER	SIOUX FALLS	605-553-8729	TMILLER@SIOUXFALLS.ORG
5	Colleen Adler	1301 N. Lowell Ave SF 57103	339-2630	ca47dakota@gmail.com
6	Jackie Nash	2105 Tricia Lane 57103	338-1870	jackie830n@yahoo.com
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Sign In Sheet

Subject I-229 Major Investment Corridor Study – Public Meeting for Rice Street Sub-Study
Client City of Sioux Falls/South Dakota Department of Transportation
Project PL 0100(87) 3616P, PCN 044K **Project No.:** 207030
Meeting Date Wednesday, June 22, 2016 5:00 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	PETE LONGMAN	700 EAST Broadway – PIERRE	773-6488	pete.longman@state.sd.us
2	Christina Bennett	700 E Broadway-Pierre	773-4759	Christina.Bennett@state.sd.us
3	Tom Lehmkuhl	700 E. Broadway	773.3721	tom.lehmkuhl@state.sd.us
4	DEAN DELASHMUTT	1207 N VIOLET PL	496 1108	
5	Dhan Khapangi	1000 N BROKEN BOW AVE	605 360 3544	
6	Jesse Callahan	1501 N Cleveland Ave	334 9357	info@smpsecurity.co
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R3B
LOOKS good
FOR CLEVELAND

Comment Card

I-229 Major Investment Corridor Study – Rice Street Sub-Study

Public Open House

PL 0100(87) 3616P, PCN 044K

June 22, 2016

FUTURE: 4 LANES – HMMM?

Comments:

RICE ST - C2

MEDIAN BETWEEN JESSICA & WAYLAND: (AND TO SAVE MONEY),

REDO DRAINAGE ON JESSICA – REMOVE MERIDIAN

RICE ST - 1 TRUCKING FIRM RATHER INCONVIENCED FOR TRIPS

NORTH BOUND. SOUTH BOUND IS "DO-ABLE" BACK ACCESS ACCESSABLE TO I-229?

Name: DEAN DELASHMUTT Address: 1207 N. VIOLET PL

Phone: 605 496 1108 E-mail:

For your comments to be considered, please return by July 7, 2016.
Comments can also be e-mailed to: sausen@siouxfalls.org

Interstate 229 Major Investment Study
Exit 7 – Rice Street

Public Meeting
June 22nd, 2016
5:00 pm to 6:30 pm

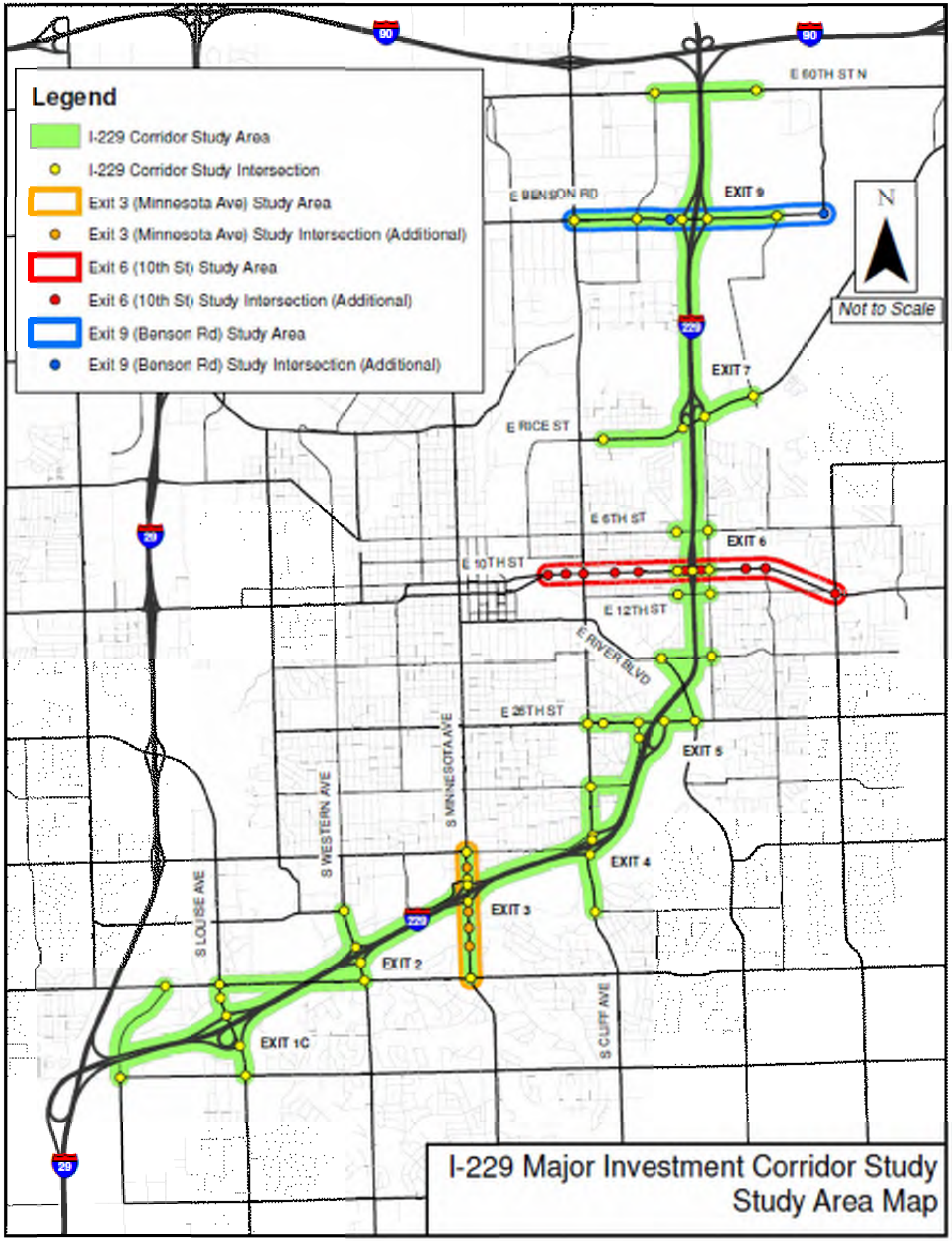
Study Area Map

I-229 Corridor Study

Solberg Avenue Overpass
to
60th Street N. Overpass

Additional Studies

Exit 3 – Minnesota Ave
Exit 6 – 10th Street
Exit 9 – Benson Road
Added Exit 4 – Cliff Avenue
Added Exit 7 – Rice Street



Study Advisory Partners

South Dakota Department of Transportation (SDDOT)

South Dakota Highway Patrol

City of Sioux Falls

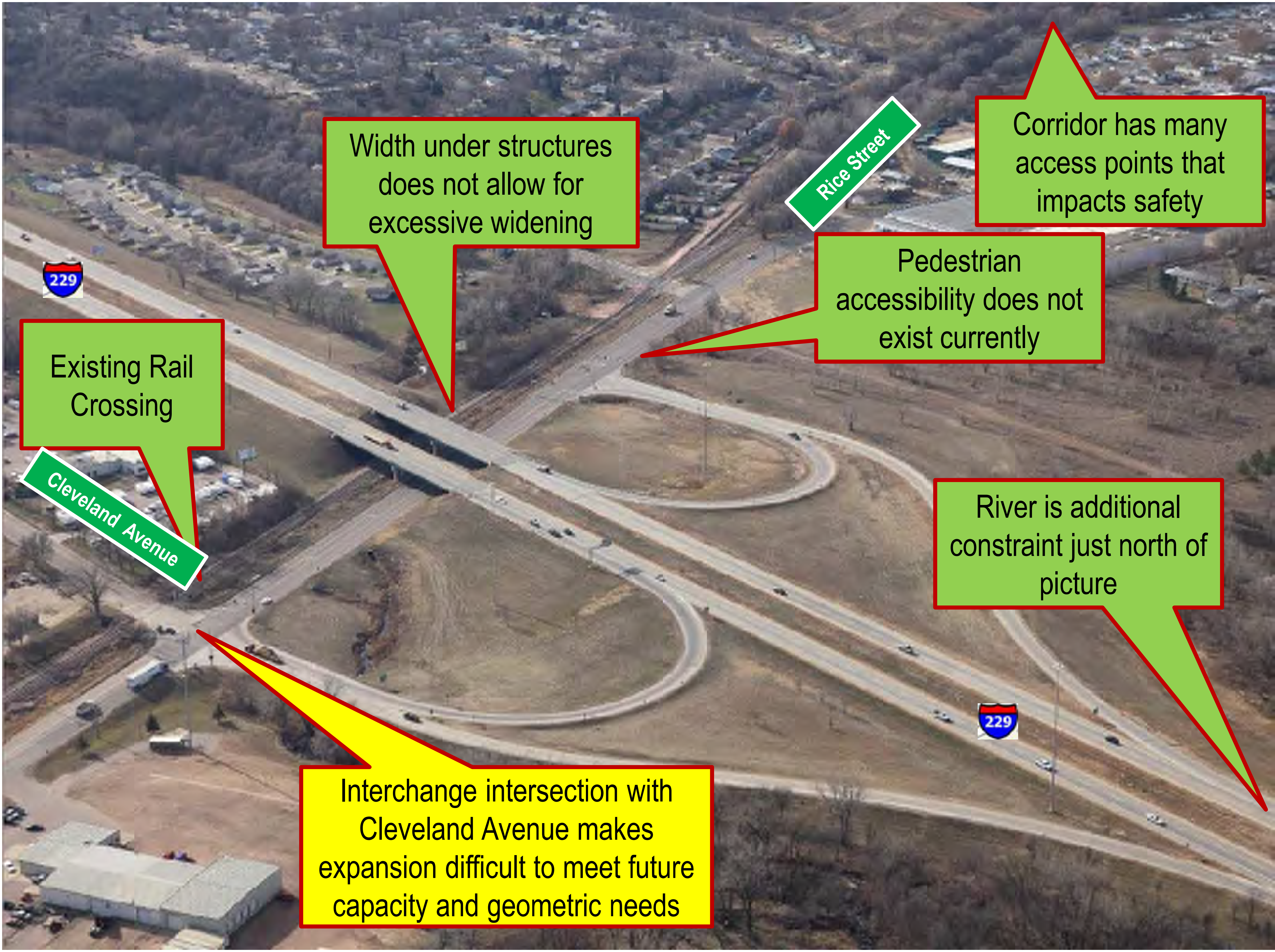
Sioux Falls Metropolitan Planning Organization (MPO)

Federal Highway Administration (FHWA)

Exit 7 (Rice Street) Crossroad Study Goals

- Reduce traffic congestion
- Provide and Interchange that will meet the future capacity requirements
- Improve pedestrian mobility
- Improve safety for corridor users

I-229 Major Investment Corridor Study
Sub-Study 5 Study Area



Width under structures does not allow for excessive widening

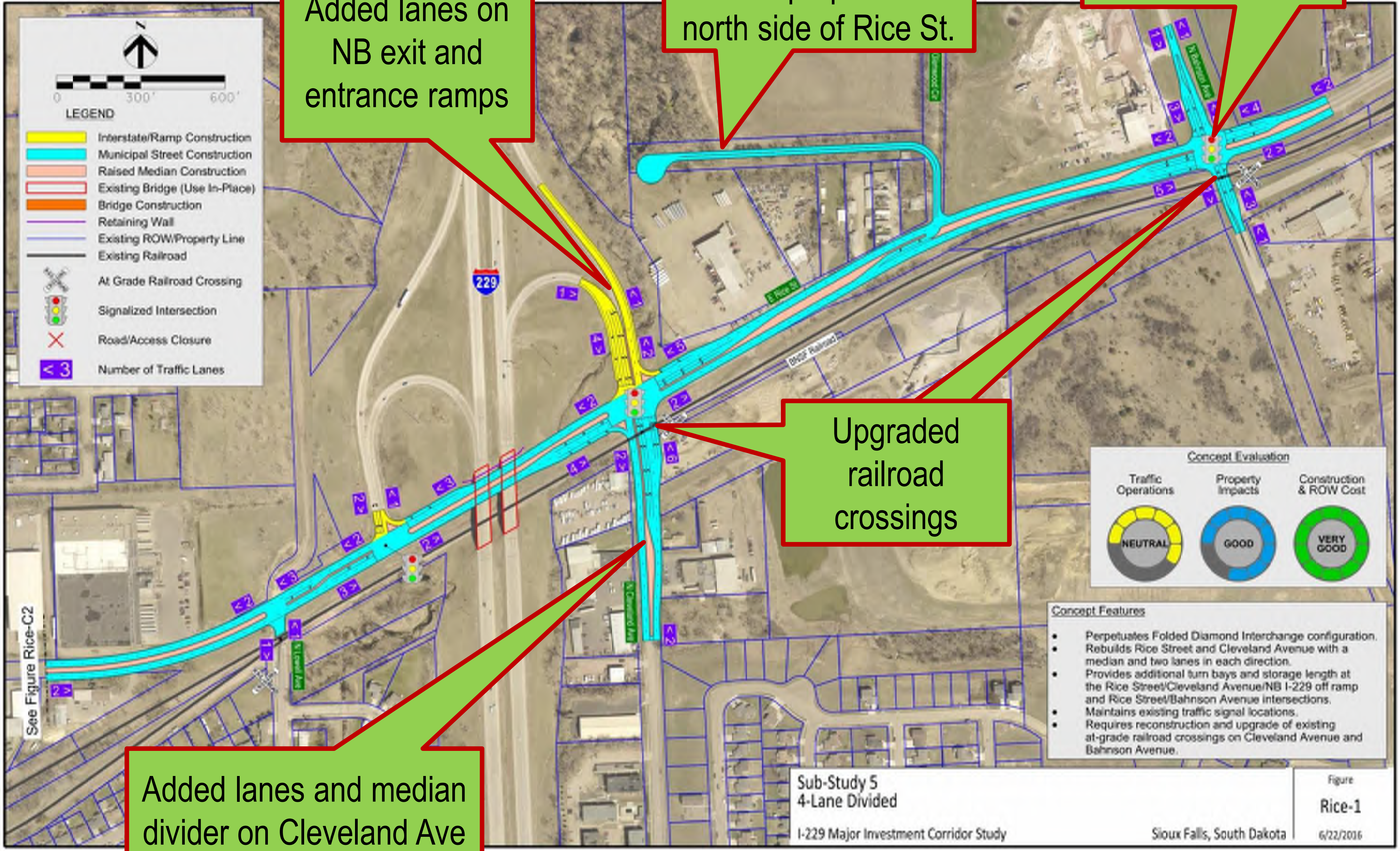
Corridor has many access points that impacts safety

Pedestrian accessibility does not exist currently

Existing Rail Crossing

River is additional constraint just north of picture

Interchange intersection with Cleveland Avenue makes expansion difficult to meet future capacity and geometric needs



Added lanes on NB exit and entrance ramps

New back access road for properties on north side of Rice St.

Turn lanes added at Bahnson Ave

Upgraded railroad crossings

Added lanes and median divider on Cleveland Ave

Concept Features

- Perpetuates Folded Diamond Interchange configuration.
- Rebuilds Rice Street and Cleveland Avenue with a median and two lanes in each direction.
- Provides additional turn bays and storage length at the Rice Street/Cleveland Avenue/NB I-229 off ramp and Rice Street/Bahnson Avenue intersections.
- Maintains existing traffic signal locations.
- Requires reconstruction and upgrade of existing at-grade railroad crossings on Cleveland Avenue and Bahnson Avenue.

Sub-Study 5
4-Lane Divided

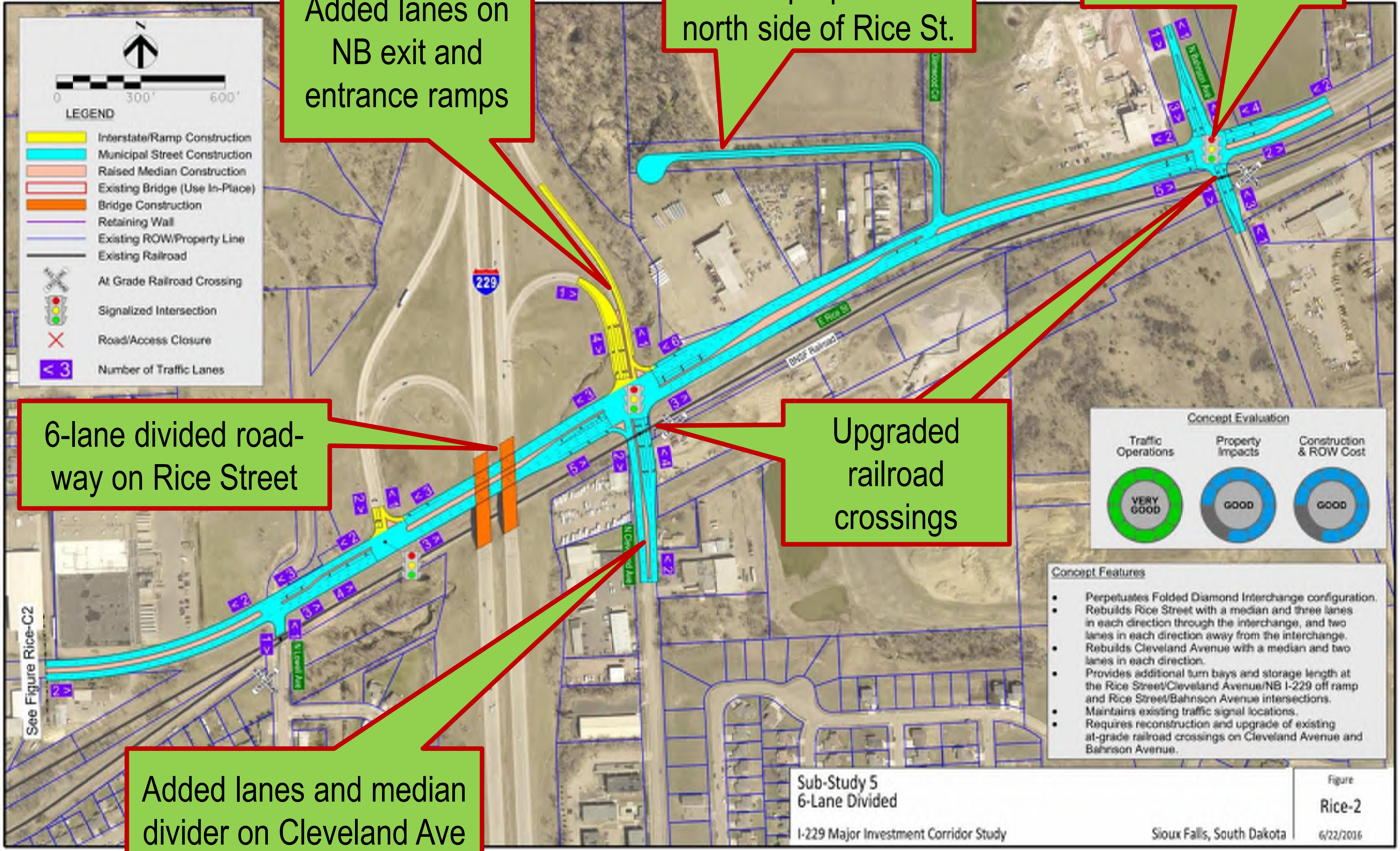
I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure

Rice-1

6/22/2016



Added lanes on NB exit and entrance ramps

New back access road for properties on north side of Rice St.

Turn lanes added at Bahnson Ave

6-lane divided roadway on Rice Street

Upgraded railroad crossings

Added lanes and median divider on Cleveland Ave

Concept Features

- Perpetuates Folded Diamond Interchange configuration.
- Rebuilds Rice Street with a median and three lanes in each direction through the interchange, and two lanes in each direction away from the interchange.
- Rebuilds Cleveland Avenue with a median and two lanes in each direction.
- Provides additional turn bays and storage length at the Rice Street/Cleveland Avenue/NB I-229 off ramp and Rice Street/Bahnson Avenue intersections.
- Maintains existing traffic signal locations.
- Requires reconstruction and upgrade of existing at-grade railroad crossings on Cleveland Avenue and Bahnson Avenue.

Sub-Study 5
6-Lane Divided

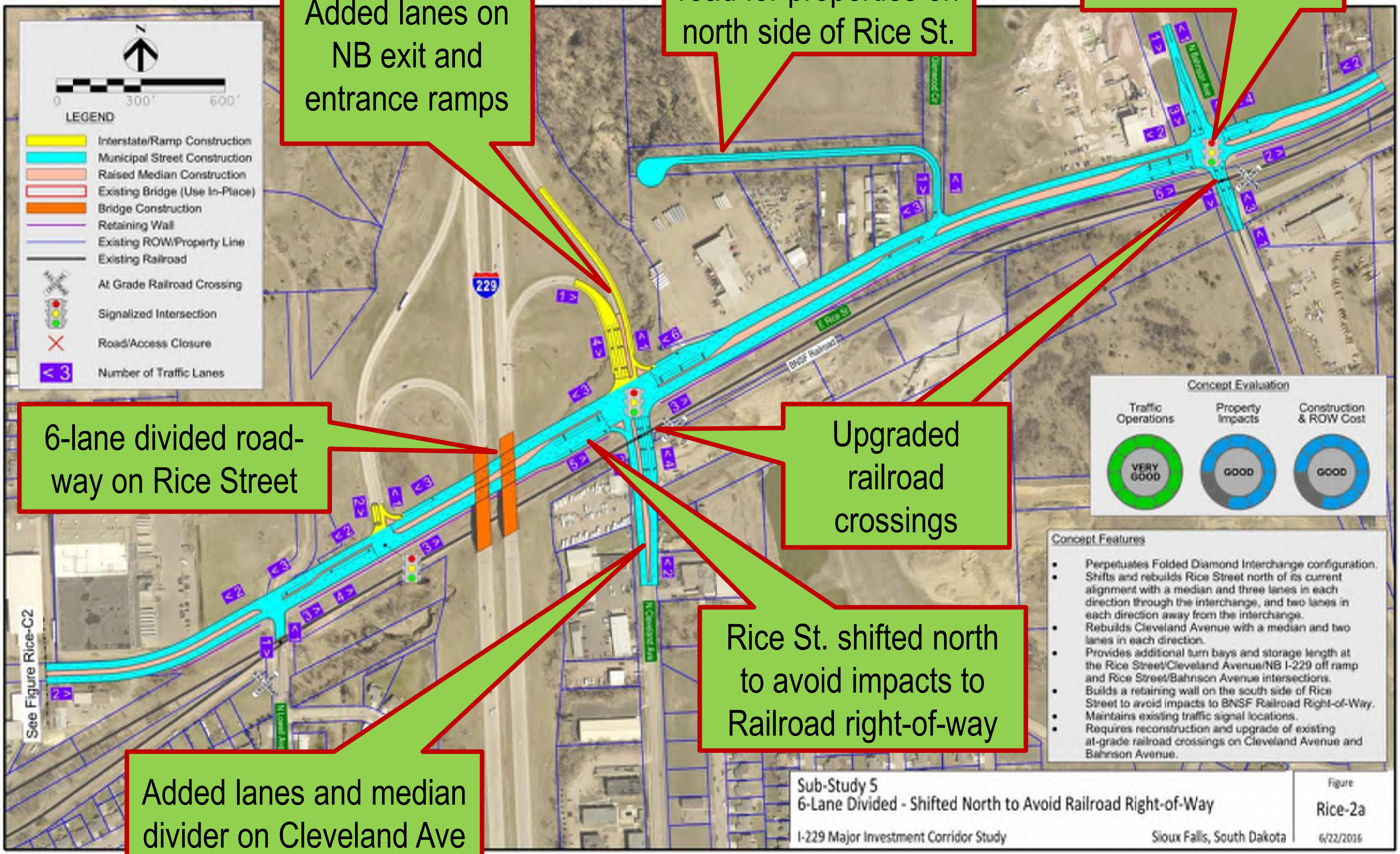
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota

Figure
Rice-2
6/22/2016

Added lanes on NB exit and entrance ramps

New back access road for properties on north side of Rice St.

Turn lanes added at Bahnson Ave



6-lane divided roadway on Rice Street

Upgraded railroad crossings

Rice St. shifted north to avoid impacts to Railroad right-of-way

Added lanes and median divider on Cleveland Ave

Concept Features

- Perpetuates Folded Diamond Interchange configuration.
- Shifts and rebuilds Rice Street north of its current alignment with a median and three lanes in each direction through the interchange, and two lanes in each direction away from the interchange.
- Rebuilds Cleveland Avenue with a median and two lanes in each direction.
- Provides additional turn bays and storage length at the Rice Street/Cleveland Avenue/NB I-229 off ramp and Rice Street/Bahnson Avenue intersections.
- Builds a retaining wall on the south side of Rice Street to avoid impacts to BNSF Railroad Right-of-Way.
- Maintains existing traffic signal locations.
- Requires reconstruction and upgrade of existing at-grade railroad crossings on Cleveland Avenue and Bahnson Avenue.

Sub-Study 5
6-Lane Divided - Shifted North to Avoid Railroad Right-of-Way

I-229 Major Investment Corridor Study
Sioux Falls, South Dakota

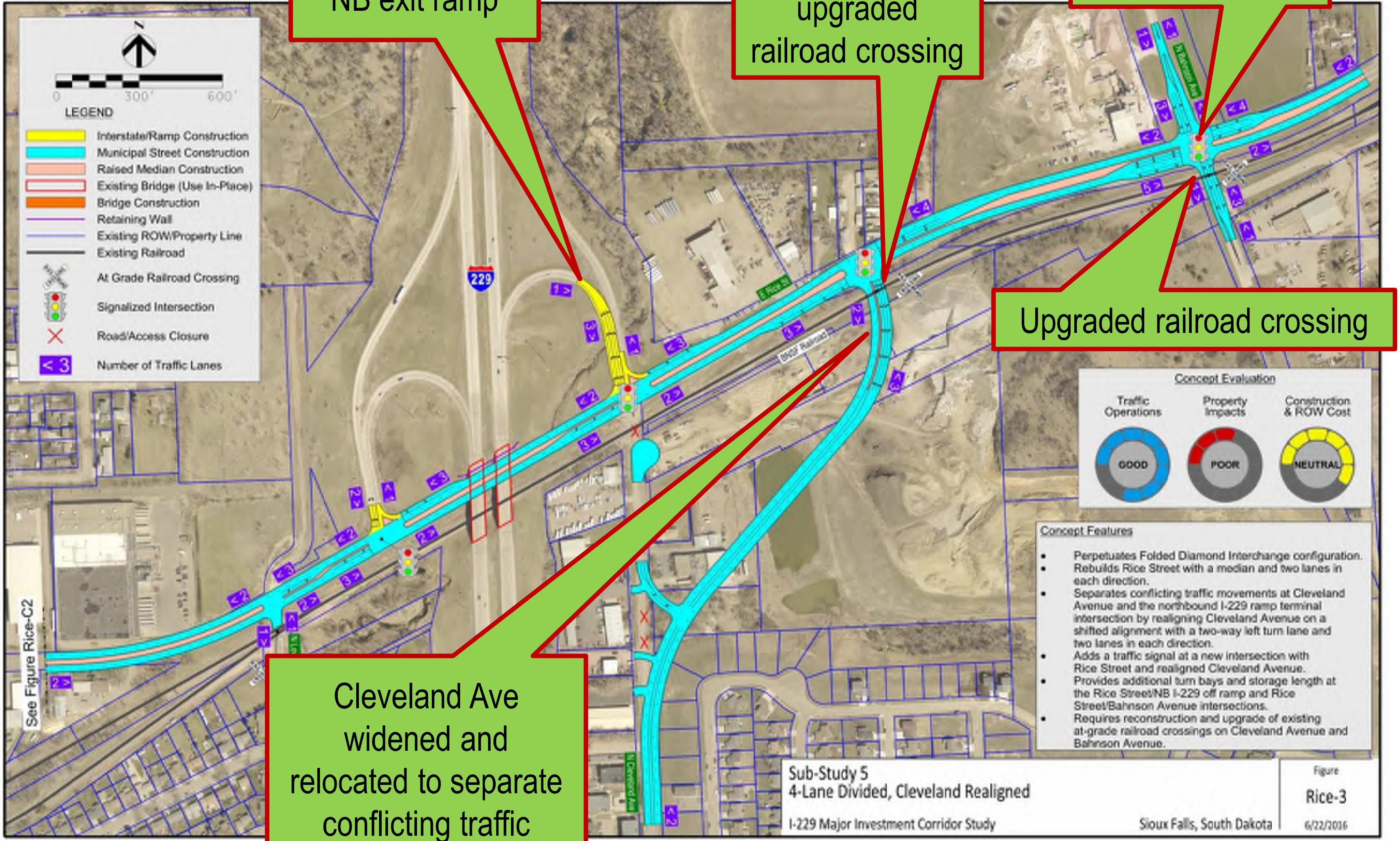
Figure
Rice-2a
6/22/2016

Added lane on NB exit ramp

Relocated and upgraded railroad crossing

Turn lanes added at Bahnson Ave

Upgraded railroad crossing



Concept Features

- Perpetuates Folded Diamond Interchange configuration.
- Rebuilds Rice Street with a median and two lanes in each direction.
- Separates conflicting traffic movements at Cleveland Avenue and the northbound I-229 ramp terminal intersection by realigning Cleveland Avenue on a shifted alignment with a two-way left turn lane and two lanes in each direction.
- Adds a traffic signal at a new intersection with Rice Street and realigned Cleveland Avenue.
- Provides additional turn bays and storage length at the Rice Street/NB I-229 off ramp and Rice Street/Bahnson Avenue intersections.
- Requires reconstruction and upgrade of existing at-grade railroad crossings on Cleveland Avenue and Bahnson Avenue.

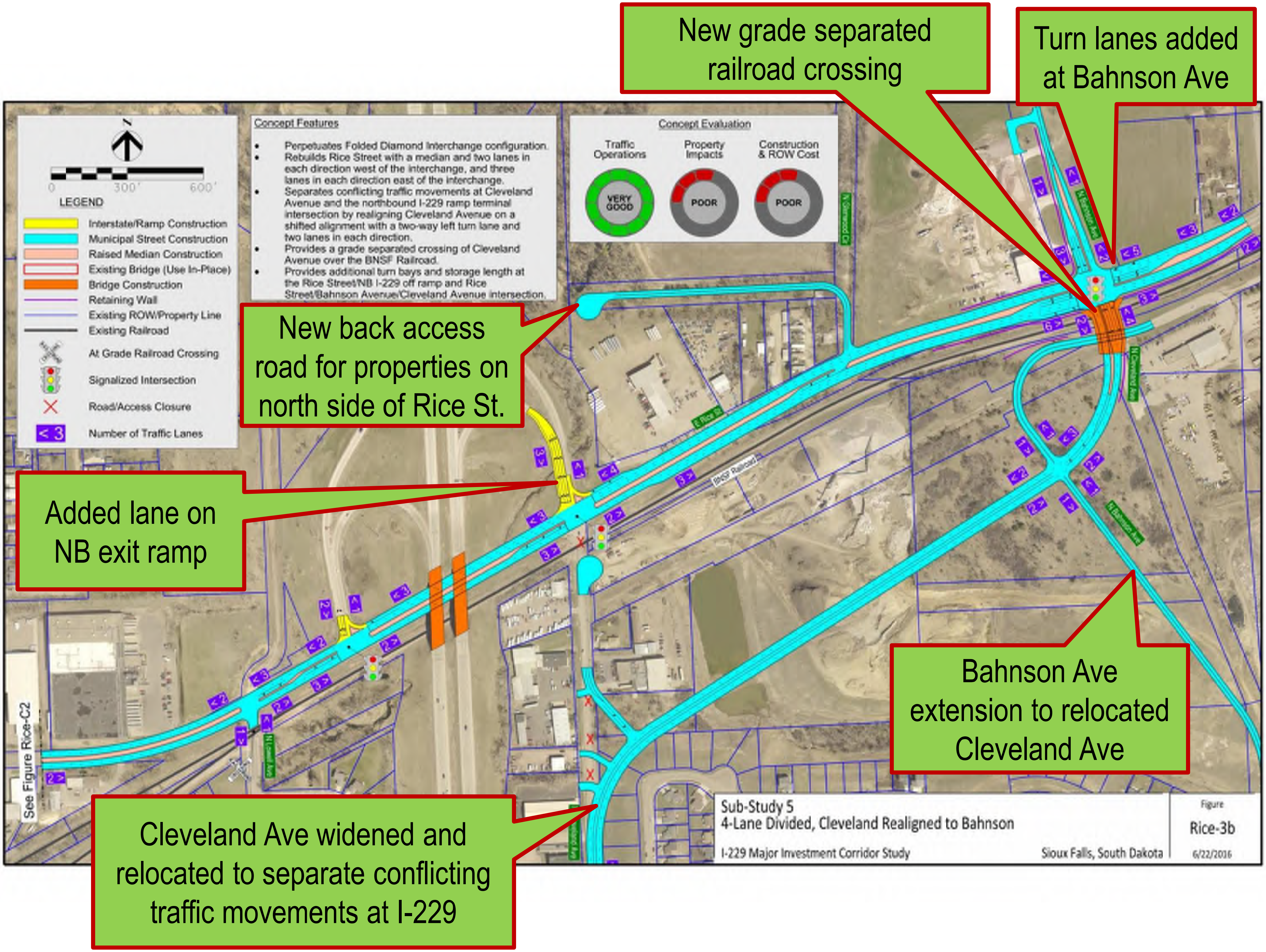
Sub-Study 5
4-Lane Divided, Cleveland Realigned

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure
Rice-3
6/22/2016

Cleveland Ave widened and relocated to separate conflicting traffic movements at I-229



Concept Features

- Perpetuates Folded Diamond Interchange configuration.
- Rebuilds Rice Street with a median and two lanes in each direction west of the interchange, and three lanes in each direction east of the interchange.
- Separates conflicting traffic movements at Cleveland Avenue and the northbound I-229 ramp terminal intersection by realigning Cleveland Avenue on a shifted alignment with a two-way left turn lane and two lanes in each direction.
- Provides a grade separated crossing of Cleveland Avenue over the BNSF Railroad.
- Provides additional turn bays and storage length at the Rice Street/NB I-229 off ramp and Rice Street/Bahnson Avenue/Cleveland Avenue intersection.

New grade separated railroad crossing

Turn lanes added at Bahnson Ave

New back access road for properties on north side of Rice St.

Added lane on NB exit ramp

Bahnson Ave extension to relocated Cleveland Ave

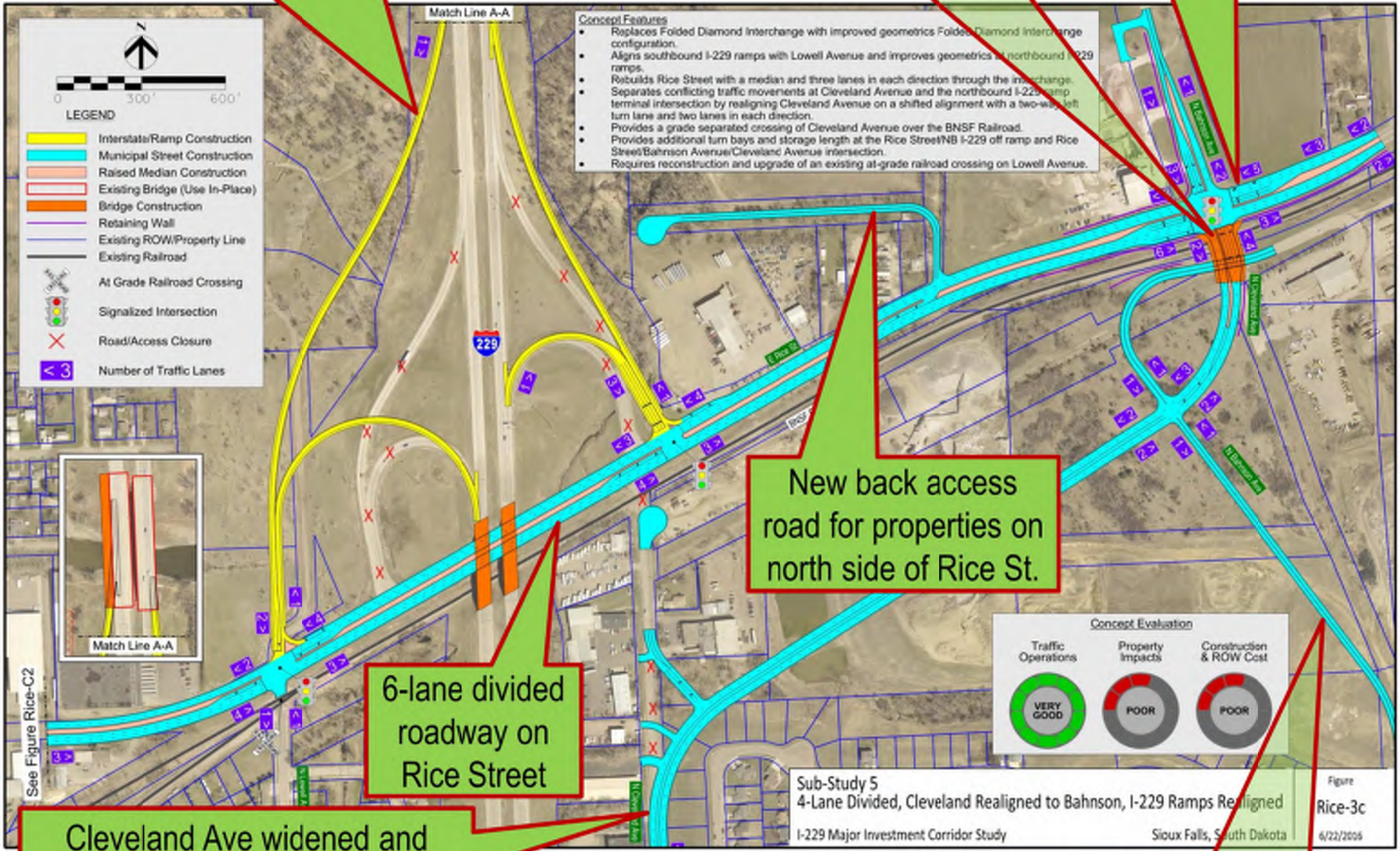
Cleveland Ave widened and relocated to separate conflicting traffic movements at I-229

Sub-Study 5
4-Lane Divided, Cleveland Realigned to Bahnson
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota

I-229 interchange reconstructed to improve ramp alignments

New grade separated railroad crossing

Turn lanes added at Bahnson Ave



Concept Features

- Replaces Folded Diamond Interchange with improved geometrics Folded Diamond Interchange configuration.
- Aligns southbound I-229 ramps with Lowell Avenue and improves geometrics at northbound I-229 ramps.
- Rebuilds Rice Street with a median and three lanes in each direction through the interchange.
- Separates conflicting traffic movements at Cleveland Avenue and the northbound I-229 ramp terminal intersection by realigning Cleveland Avenue on a shifted alignment with a two-way left turn lane and two lanes in each direction.
- Provides a grade separated crossing of Cleveland Avenue over the BNSF Railroad.
- Provides additional turn bays and storage length at the Rice Street/NB I-229 off ramp and Rice Street/Bahnson Avenue/Cleveland Avenue intersection.
- Requires reconstruction and upgrade of an existing at-grade railroad crossing on Lowell Avenue.

New back access road for properties on north side of Rice St.

6-lane divided roadway on Rice Street

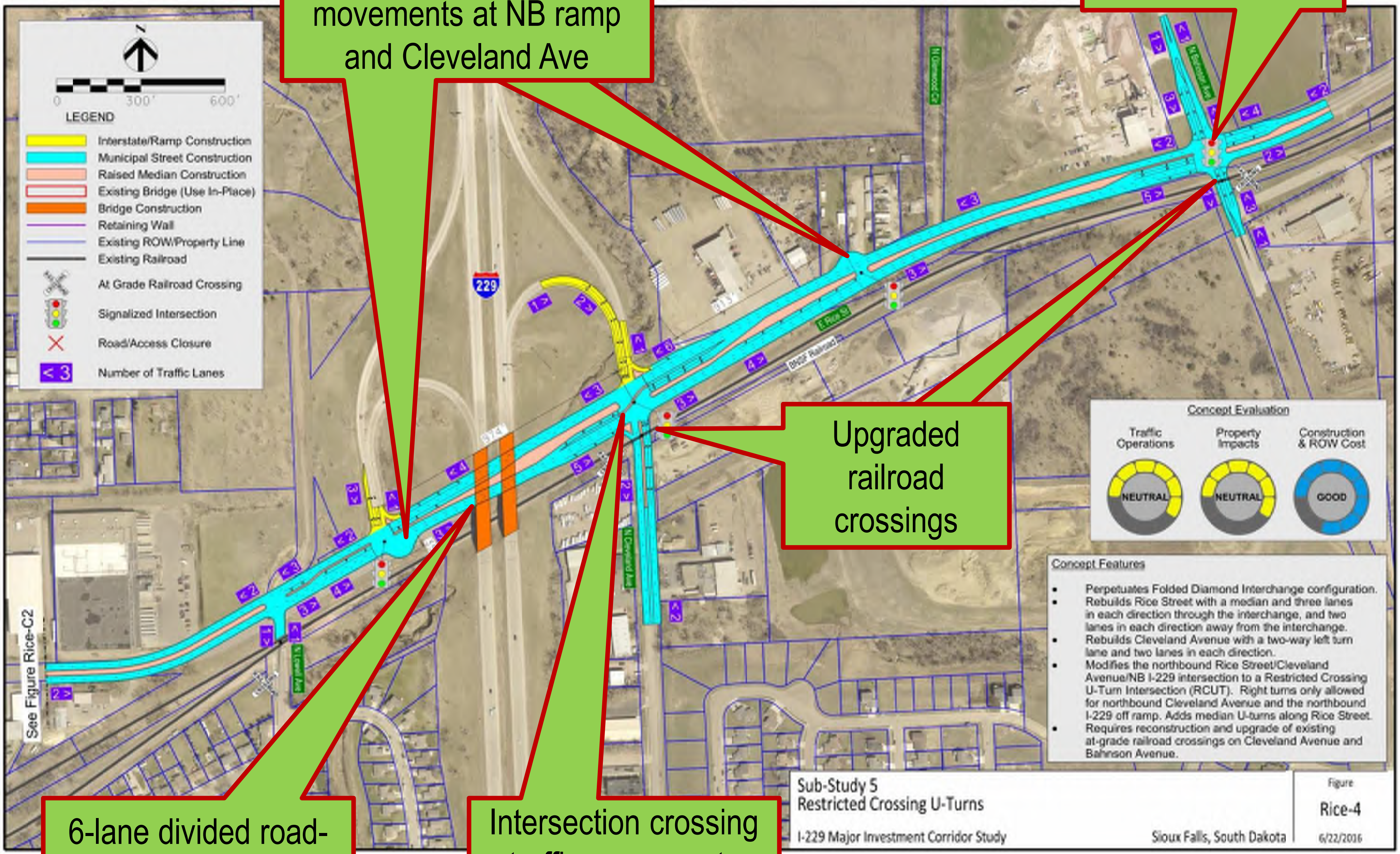
Sub-Study 5
4-Lane Divided, Cleveland Realigned to Bahnson, I-229 Ramps Realigned
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota

Cleveland Ave widened and relocated to separate conflicting traffic movements at I-229

Bahnson Ave extension to relocated Cleveland Ave

Median U-turns provided to replace crossing movements at NB ramp and Cleveland Ave

Turn lanes added at Bahnson Ave



Concept Features

- Perpetuates Folded Diamond Interchange configuration.
- Rebuilds Rice Street with a median and three lanes in each direction through the interchange, and two lanes in each direction away from the interchange.
- Rebuilds Cleveland Avenue with a two-way left turn lane and two lanes in each direction.
- Modifies the northbound Rice Street/Cleveland Avenue/NB I-229 intersection to a Restricted Crossing U-Turn Intersection (RCUT). Right turns only allowed for northbound Cleveland Avenue and the northbound I-229 off ramp. Adds median U-turns along Rice Street.
- Requires reconstruction and upgrade of existing at-grade railroad crossings on Cleveland Avenue and Bahnson Avenue.

Sub-Study 5
Restricted Crossing U-Turns
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota

Figure
Rice-4
6/22/2016

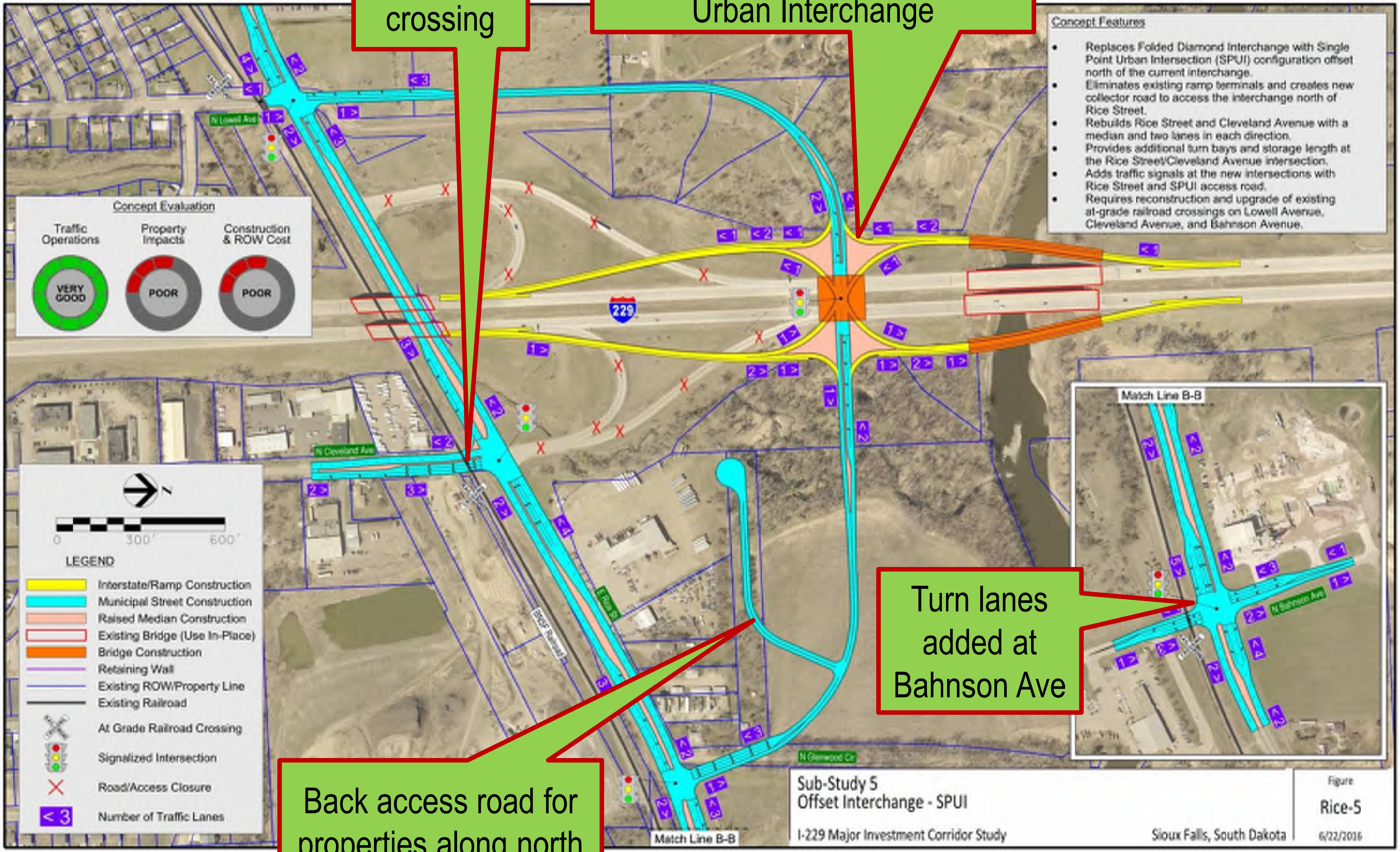
Upgraded railroad crossings

6-lane divided roadway on Rice Street

Intersection crossing traffic movements restricted

Upgraded railroad crossing

Relocated Rice St. interchange constructed as Single Point Urban Interchange



Concept Features

- Replaces Folded Diamond Interchange with Single Point Urban Intersection (SPUI) configuration offset north of the current interchange.
- Eliminates existing ramp terminals and creates new collector road to access the interchange north of Rice Street.
- Rebuilds Rice Street and Cleveland Avenue with a median and two lanes in each direction.
- Provides additional turn bays and storage length at the Rice Street/Cleveland Avenue intersection.
- Adds traffic signals at the new intersections with Rice Street and SPUI access road.
- Requires reconstruction and upgrade of existing at-grade railroad crossings on Lowell Avenue, Cleveland Avenue, and Bahnson Avenue.

Turn lanes added at Bahnson Ave

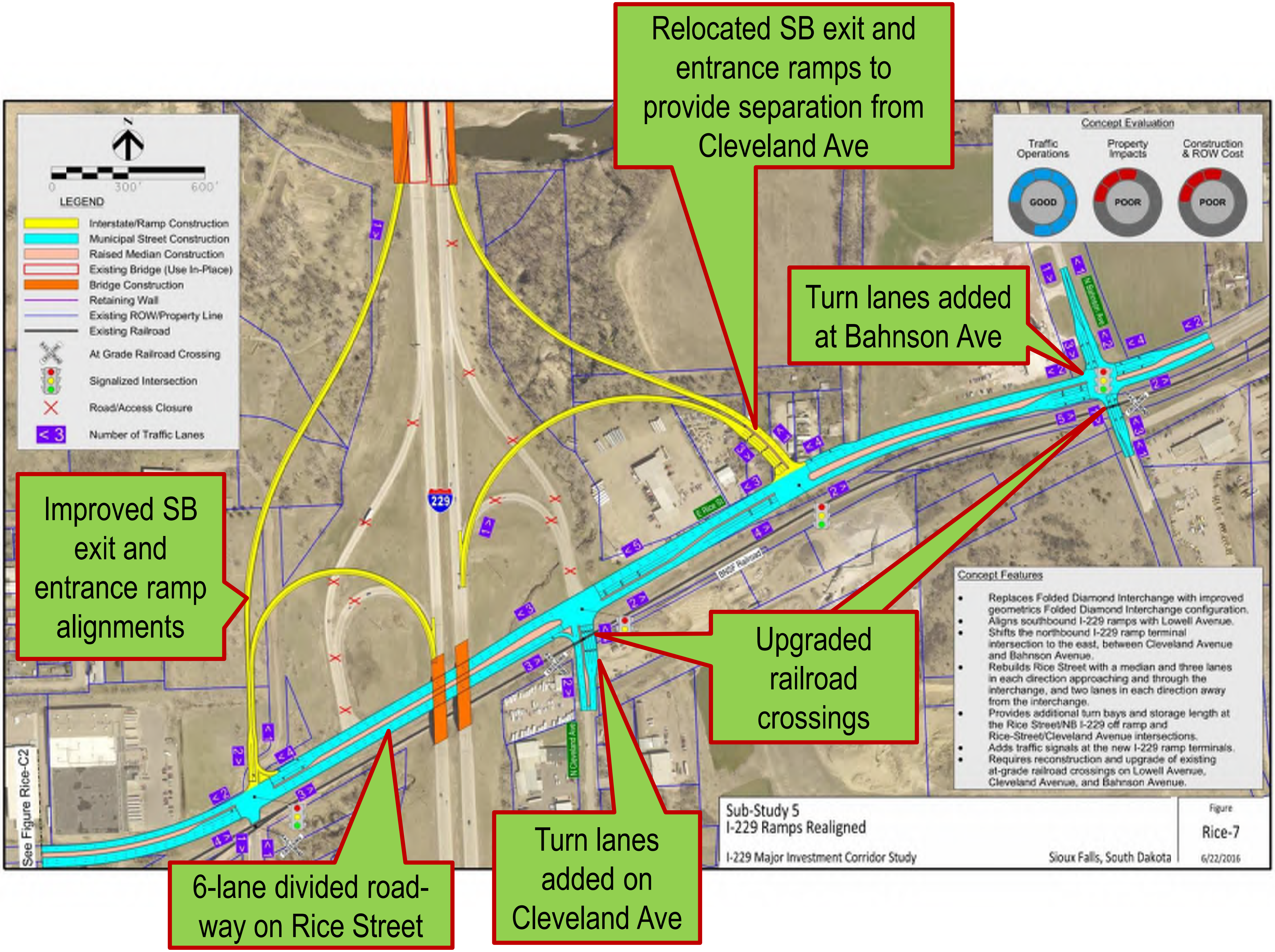
Back access road for properties along north side of Rice St.

Sub-Study 5
Offset Interchange - SPUI

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure
Rice-5
6/22/2016



Relocated SB exit and entrance ramps to provide separation from Cleveland Ave

Turn lanes added at Bahnson Ave

Improved SB exit and entrance ramp alignments

Upgraded railroad crossings

6-lane divided roadway on Rice Street

Turn lanes added on Cleveland Ave

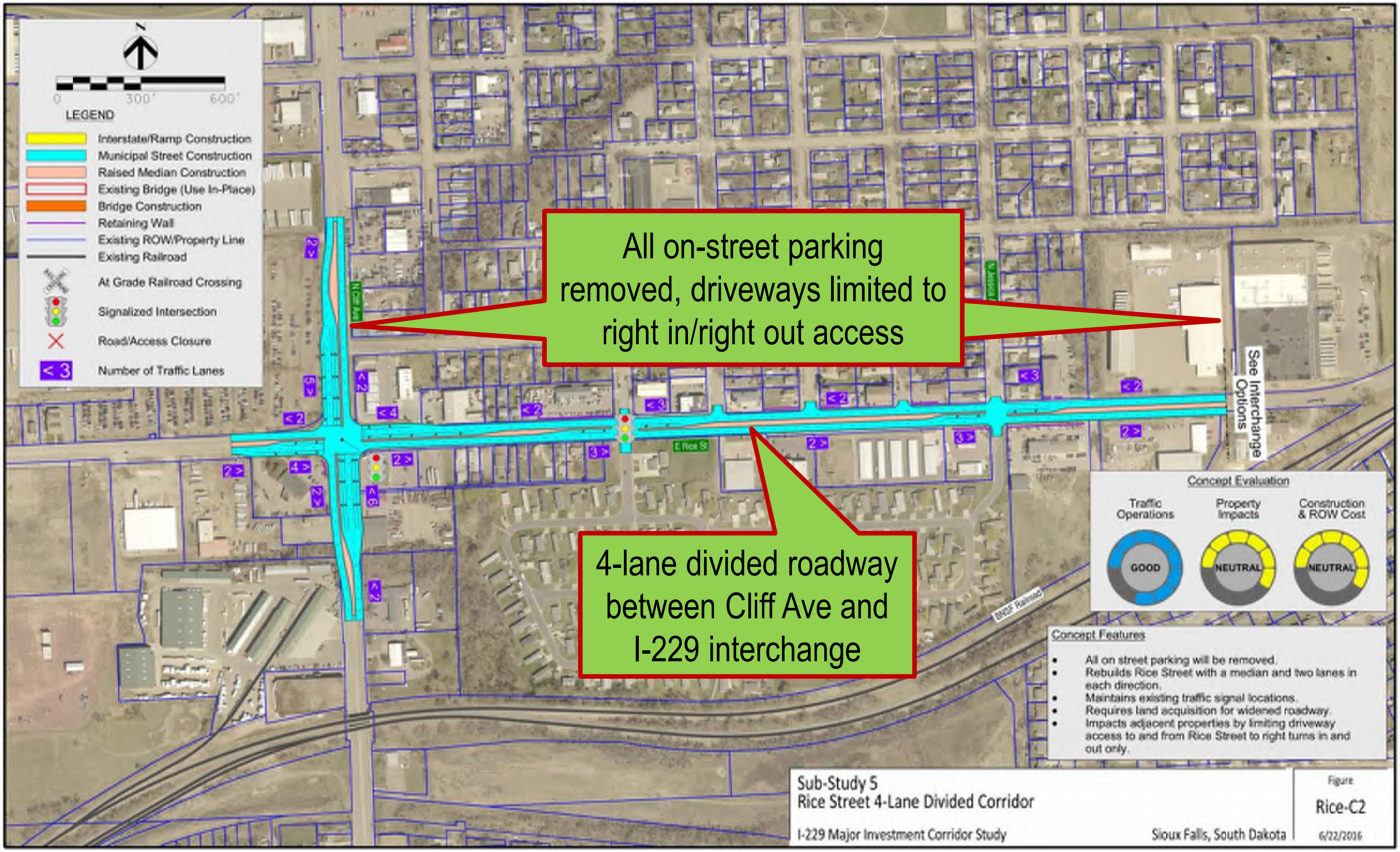
Concept Features

- Replaces Folded Diamond Interchange with improved geometrics Folded Diamond Interchange configuration.
- Aligns southbound I-229 ramps with Lowell Avenue.
- Shifts the northbound I-229 ramp terminal intersection to the east, between Cleveland Avenue and Bahnson Avenue.
- Rebuilds Rice Street with a median and three lanes in each direction approaching and through the interchange, and two lanes in each direction away from the interchange.
- Provides additional turn bays and storage length at the Rice Street/NB I-229 off ramp and Rice-Street/Cleveland Avenue intersections.
- Adds traffic signals at the new I-229 ramp terminals.
- Requires reconstruction and upgrade of existing at-grade railroad crossings on Lowell Avenue, Cleveland Avenue, and Bahnson Avenue.

Sub-Study 5
I-229 Ramps Realigned

I-229 Major Investment Corridor Study
Sioux Falls, South Dakota

Figure
Rice-7
6/22/2016



All on-street parking removed, driveways limited to right in/right out access

4-lane divided roadway between Cliff Ave and I-229 interchange

Concept Features

- All on street parking will be removed.
- Rebuilds Rice Street with a median and two lanes in each direction.
- Maintains existing traffic signal locations.
- Requires land acquisition for widened roadway.
- Impacts adjacent properties by limiting driveway access to and from Rice Street to right turns in and out only.

PROJECT CONTACTS:

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605-977-7740 or jason.kjenstad@hdrinc.com

Dave Meier – HDR Engineering, Inc.
402-399-1068 or Dave.Meier@hdrinc.com

Shannon Ausen – City of Sioux Falls
605-367-8607 or sausen@siouxfalls.org

Steve Gramm – SDDOT Project Development
605-773-6641 or steve.gramm@state.sd.us

Interstate 229 Major Investment Study
Exit 7 – Rice Street

Thanks for Attending!!!!!

CLIFF AVENUE

JUNE 22ND, 2016

- MEETING NOTES
- SIGN-IN SHEETS
- COMMENTS
- POWERPOINT SLIDES

Meeting Minutes

Project:	I-229 Major Investment Corridor Study, PL 0100(87) 3616P, PCN 044K
Subject:	Stakeholder Meeting and Public Meeting– Sub-study 6 – Cliff Avenue Exit 4
Date:	Wednesday, June 22, 2016
Location:	Sioux Falls Convention Center Conference Room 6
Attendees:	See Attached Sign In Sheet – 8 Participants

Follow-up discussion items included:

1. What about pedestrian access along Cliff Ave? Response: Providing pedestrian access along both sides of Cliff Ave is being proposed.

2. For Concept Cliff-4, why are property impacts shown described as “neutral”? The impacts look severe along Pam Rd.

3. Resident on Pam Rd – Proposed concepts will add noise to neighborhood.

4. Lincoln High School – Like Concepts Cliff-4 and Cliff-8 that include the 41st St relocation aligned with an entrance to the high school and signalized access to Cliff Ave. About half of the high school related traffic is to and from the south.

5. South 10th/38th St Resident – Parents can’t get in to Lincoln High School to pick up children. They park in the neighborhood west of Cliff Ave and the students cross Cliff Ave at random locations.

6. Lincoln High School – Adding a median on Cliff Ave will force school traffic into the school driveway loop. The school bus stop location was moved to 38th & S 10th from its previous location on Cliff Ave in recent years to help direct students to the designated pedestrian crossing on Cliff Ave.

7. Lincoln High School was asked if the existing Cliff Ave pedestrian crossing functions acceptably. The high school responded that some confusion has been noted. Operations are better in the morning peak period than the afternoon peak. It was noted that nearby residents hear vehicle screeching tires at night when the pedestrian crossing is activated. A comment was made that relocating the crossing to 38th St would help. The City noted that Lincoln High School and the City did discuss locating the crossing at the 38th St intersection before the existing midblock location was selected.

8. Will widening Cliff Ave bring more traffic? Response: Traffic volumes on Cliff Ave are approximately 15,000 vehicles/day north of I-229 and about 20,000 vehicles/day between the I-229 ramp terminal intersections. Traffic volumes have been consistent over the last five years.

9. Will it be possible to reduce truck traffic on Cliff Ave? Response: Cliff Ave is a designated truck route and that designation is unlikely to be removed.

10. What is the timeline for completion of the I-229 study? Response: Stakeholder and public comments will be reviewed followed by screening and some refinement of the concepts. A priority plan for potential projects will be the final study step. The study should wrap up in late 2016.

11. Lincoln High School – The high school prefers Concept Cliff-4, but would prefer that the proposed 41st St realignment be modified to stay south of the high school property line.

12. A right turn lane for southbound traffic at the park entrance south of the Cliff Ave bridge over the Big Sioux River is needed.

13. Although Cliff Ave has two southbound through lanes to the East 49th St intersection, drivers treat Cliff Ave as single lane going southbound up the hill toward East 49th. Response: Plans exist to extend a four lane section on Cliff Ave south of East 49th St.

14. Who owns the old railroad right of way? Response: The City owns the former railroad property.

15. Why is the connection from Pam Rd to South 10th Ave shown on Concept Cliff-6? Response: The purpose of the proposed connection is local street continuity and access to properties unaffected by the proposed realignment of East 41st St.

16. Consider using the old railroad right of way for street improvements instead of widening on 41st St. Response: Widening on 41st St is proposed to add lane capacity near Cliff Ave because the existing right of way along 41st St is wider than the former railroad right of way.

DOT

CITY OF SIOUX FALLS
PUBLIC WORKS
Providing a Better Quality of Life for You!

HDR

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Public Meeting for Cliff Avenue Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3616P, PCN 044K **Project No.:** 207030

Meeting Date Wednesday, June 22, 2016 7:00 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Christina Bennett	700 E Broadway Ave Pierre	773-4757	Christina.Bennett@state.sd.us
2	Andy Vandel	Pierre	773-4421	andy.vandel@state.sd.us
3	Pete Longman	PIERRE	773-6488	pete.longman@state.sd.us
4	DEAN DELASHMUTT	1207 N VIOLET PL SIOUX FALLS		
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DOT

CITY OF SIOUX FALLS PUBLIC WORKS

HDR

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Public Meeting for Cliff Avenue Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3616P, PCN 044K

Project No.: 207030

Meeting Date Wednesday, June 22, 2016 7:00 PM

Meeting Location: Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Steve Gramm	700 E. Broadway Ave	773-6641	steve.gramm@state.sd.us
2	Jason Kjerstad	6700 S. Old Village Pl, SF, SD	977-7740	jason.kjerstad@hdrinc.com
3	Paul Nikolas	5316 W 60th St. N SF, SD	367-5680	paul.nikolas@state.sd.us
4	Rob Leonhardt	2001 Cardinal Dr	231-5074	
5	Courtney & Jerry Helke	3709 S. Slater Park Dr.	376-8286	Helkes@sio.midco.net
6	Evelyn Stalheim	905 E. Ram Rd	605-376-2022	evs@sio.midco.net
7	Jud Peterson	1109 S Lance		
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Comment Card

I-229 Major Investment Corridor Study – Cliff Avenue Sub-Study

Public Open House

PL 0100(87) 3616P, PCN 044K

June 22, 2016

Comments:

CLIFF 8 has The Best Concept Because TRAFFIC STREAM is DRAWN FURTHER AWAY FROM LINCOLN H.S. The Signal AT The School is A very good idea.

Cancel → Suggestion use OLD RR, meeting 41ST, STRAIGHTEN 41ST To ABOUT 9th.

Name: Dean DeLashmutt

Address: 1207 N Violet PL 57103

Phone: 605 496 1108

E-mail:

For your comments to be considered, please return by July 7, 2016.
Comments can also be e-mailed to: sausen@siouxfalls.org

Comment Card

I-229 Major Investment Corridor Study – Cliff Avenue Sub-Study

Public Open House

PL 0100(87) 3616P, PCN 044K

June 22, 2016

Comments:

CLIFF 8 has The Best Concept Because TRAffic STREAM IS DRAWN FURTHER AWAY FROM LINCOLN H.S. The SIGNAL AT THE School is A VERY good IDEA.

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Name: Dean DeLASHMUTT

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E-mail:

For your comments to be considered, please return by July 7, 2016.
Comments can also be e-mailed to: sausen@siouxfalls.org

Interstate 229 Major Investment Study
Exit 4 – Cliff Avenue

Public Meeting
June 22nd, 2016
7:00 pm to 8:30 pm

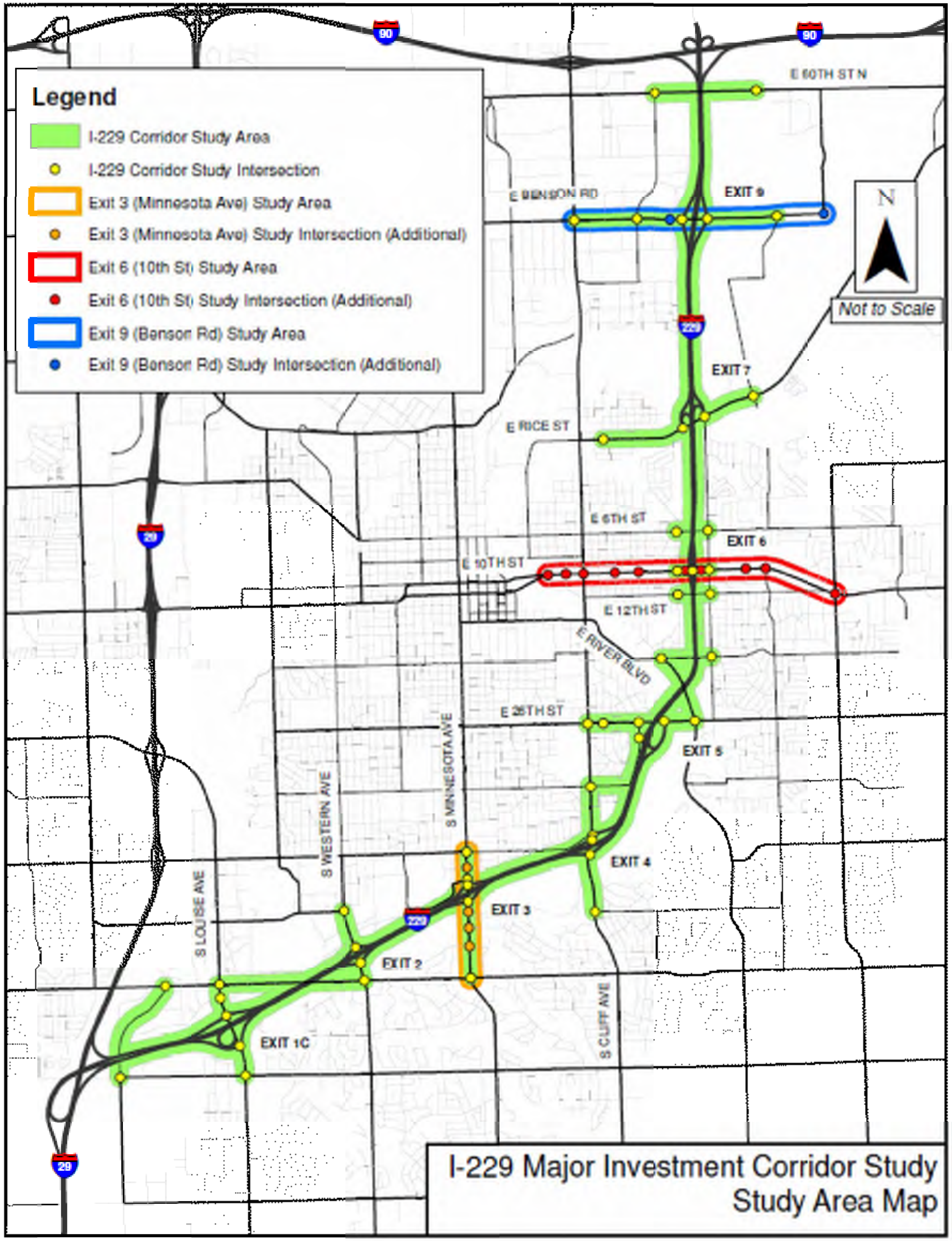
Study Area Map

I-229 Corridor Study

Solberg Avenue Overpass
to
60th Street N. Overpass

Additional Studies

Exit 3 – Minnesota Ave
Exit 6 – 10th Street
Exit 9 – Benson Road
Added Exit 4 – Cliff Avenue
Added Exit 7 – Rice Street



Study Advisory Partners

South Dakota Department of Transportation (SDDOT)

South Dakota Highway Patrol

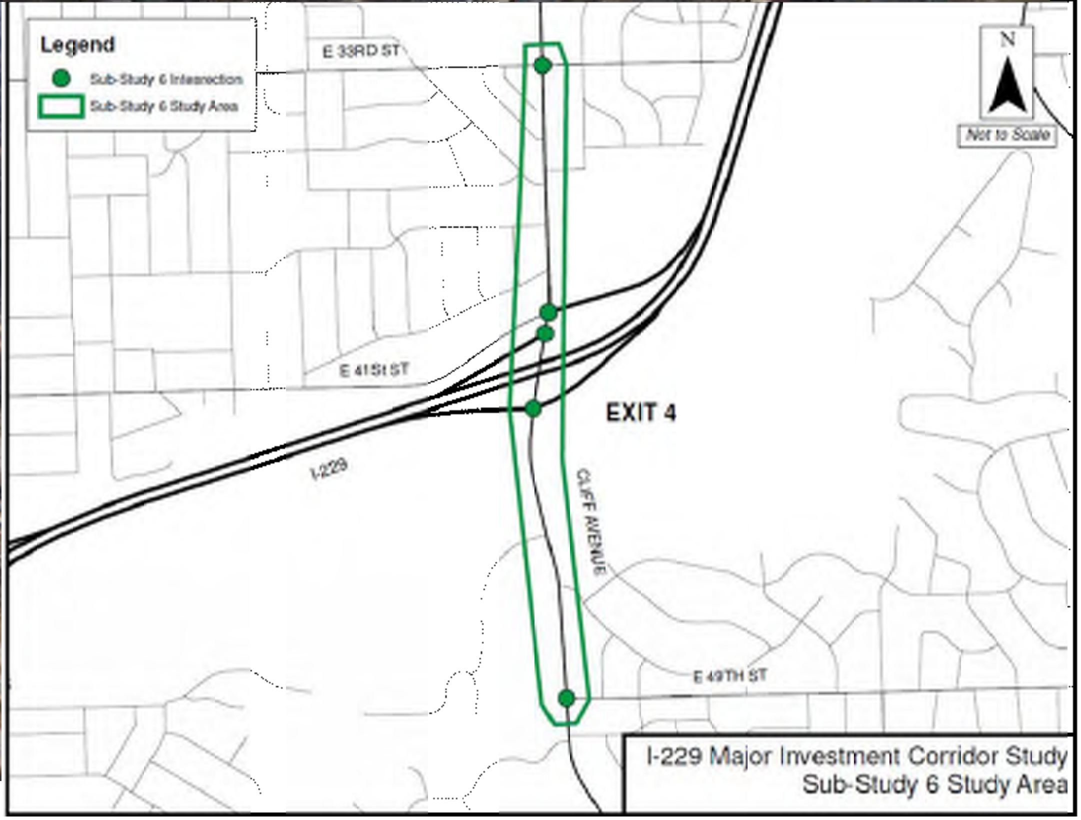
City of Sioux Falls

Sioux Falls Metropolitan Planning Organization (MPO)

Federal Highway Administration (FHWA)

Exit 4 (Cliff Avenue)
Sub - Study Goals

- Reduce traffic congestion
- Develop new geometrics to improve capacity at 41st Street and Interchange
- Improve pedestrian mobility
- Improve safety for corridor users



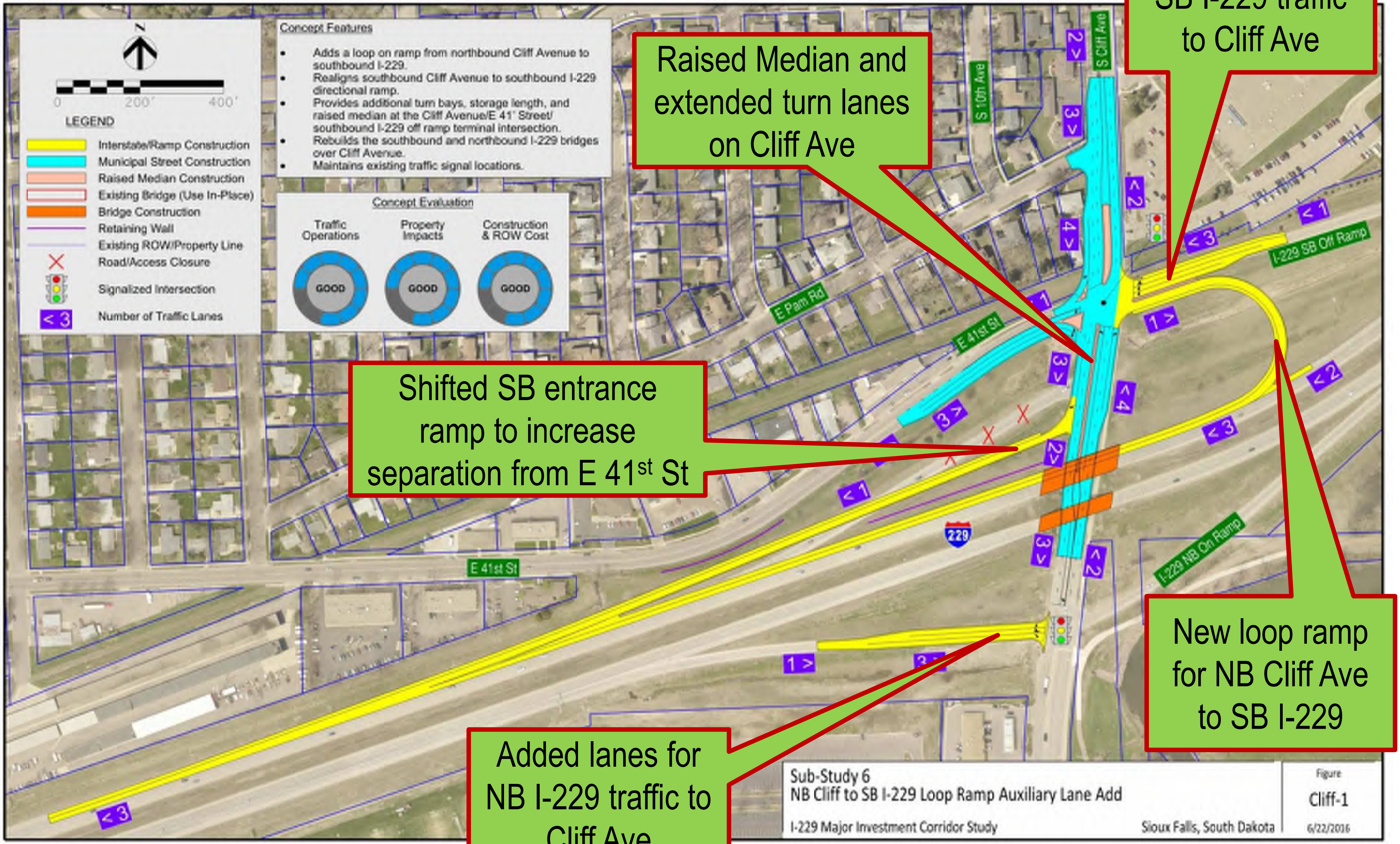
I-229 Major Investment Corridor Study
Sub-Study 6 Study Area

Access to Park close to interchange makes it difficult to exit during peak hour periods

Turn Lane short and few gaps exist to complete left turn movement

Congestion due to close proximity of 41st Street to I229 SB ON Ramp

High Right Turn Volume in the PM Peak Hour



Concept Features

- Adds a loop on ramp from northbound Cliff Avenue to southbound I-229.
- Realigns southbound Cliff Avenue to southbound I-229 directional ramp.
- Provides additional turn bays, storage length, and raised median at the Cliff Avenue/E 41' Street/ southbound I-229 off ramp terminal intersection.
- Rebuilds the southbound and northbound I-229 bridges over Cliff Avenue.
- Maintains existing traffic signal locations.

Sub-Study 6
NB Cliff to SB I-229 Loop Ramp Auxiliary Lane Add
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota

Figure
Cliff-1
6/22/2016

Added lanes for SB I-229 traffic to Cliff Ave

Raised Median and extended turn lanes on Cliff Ave

Shifted SB entrance ramp to increase separation from E 41st St

New loop ramp for NB Cliff Ave to SB I-229

Added lanes for NB I-229 traffic to Cliff Ave

Raised Median and extended turn lanes on Cliff Ave

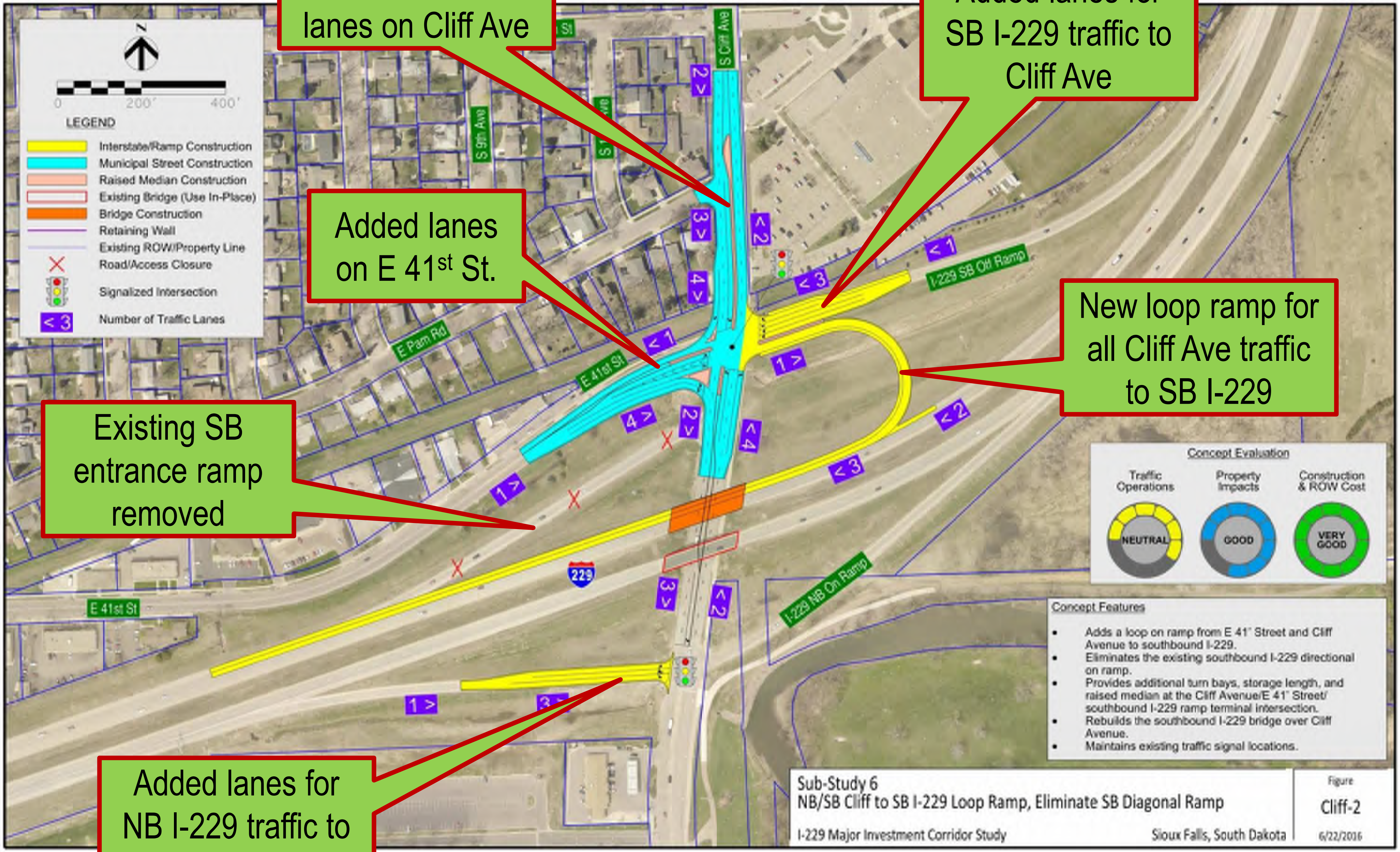
Added lanes for SB I-229 traffic to Cliff Ave

Added lanes on E 41st St.

New loop ramp for all Cliff Ave traffic to SB I-229

Existing SB entrance ramp removed

Added lanes for NB I-229 traffic to Cliff Ave



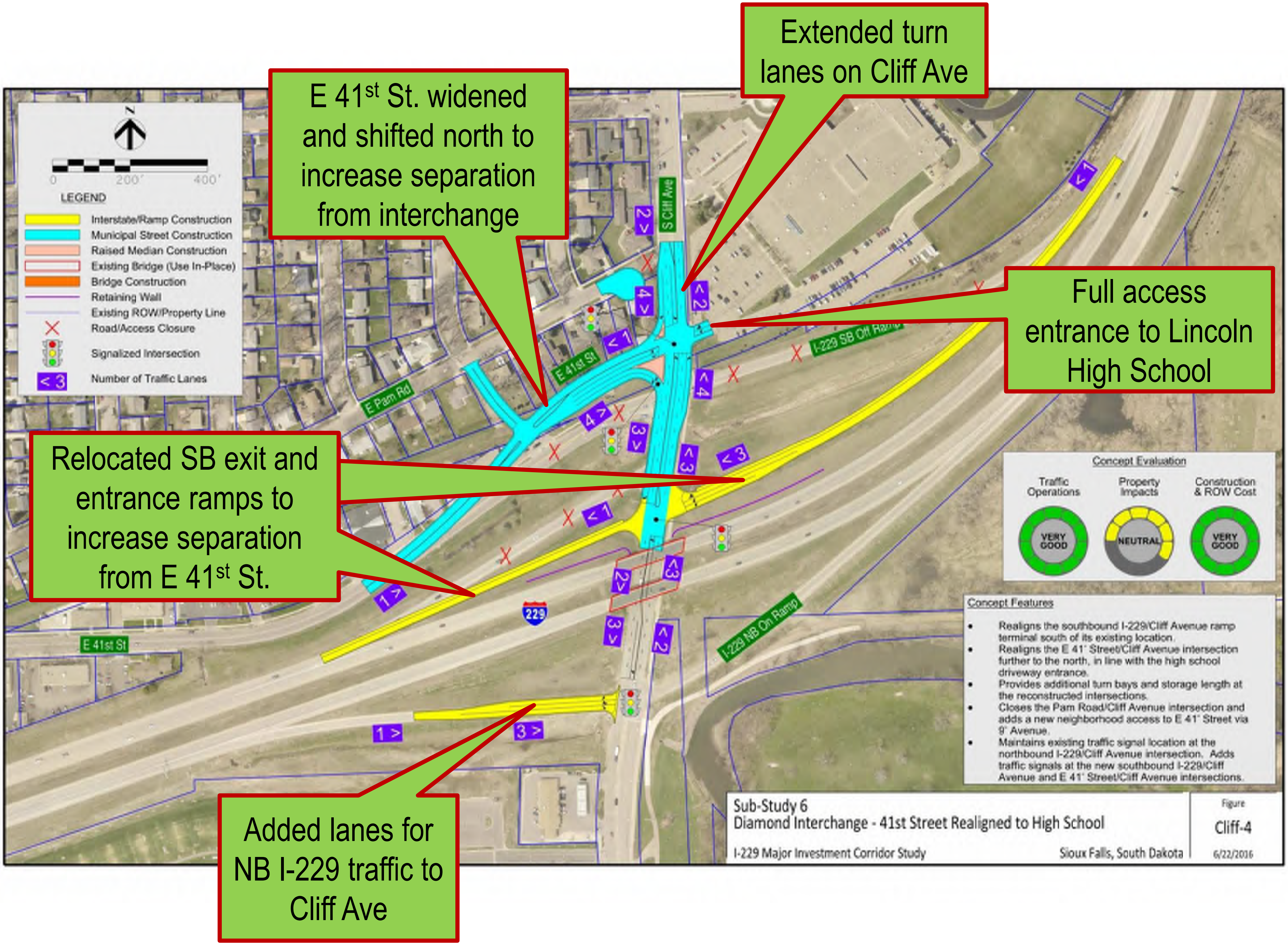
Concept Features

- Adds a loop on ramp from E 41st Street and Cliff Avenue to southbound I-229.
- Eliminates the existing southbound I-229 directional on ramp.
- Provides additional turn bays, storage length, and raised median at the Cliff Avenue/E 41st Street/ southbound I-229 ramp terminal intersection.
- Rebuilds the southbound I-229 bridge over Cliff Avenue.
- Maintains existing traffic signal locations.

Sub-Study 6
NB/SB Cliff to SB I-229 Loop Ramp, Eliminate SB Diagonal Ramp

I-229 Major Investment Corridor Study
Sioux Falls, South Dakota

Figure
Cliff-2
6/22/2016



E 41st St. widened and shifted north to increase separation from interchange

Extended turn lanes on Cliff Ave

Full access entrance to Lincoln High School

Relocated SB exit and entrance ramps to increase separation from E 41st St.

Added lanes for NB I-229 traffic to Cliff Ave

Concept Features

- Realigns the southbound I-229/Cliff Avenue ramp terminal south of its existing location.
- Realigns the E 41st Street/Cliff Avenue intersection further to the north, in line with the high school driveway entrance.
- Provides additional turn bays and storage length at the reconstructed intersections.
- Closes the Pam Road/Cliff Avenue intersection and adds a new neighborhood access to E 41st Street via 9th Avenue.
- Maintains existing traffic signal location at the northbound I-229/Cliff Avenue intersection. Adds traffic signals at the new southbound I-229/Cliff Avenue and E 41st Street/Cliff Avenue intersections.

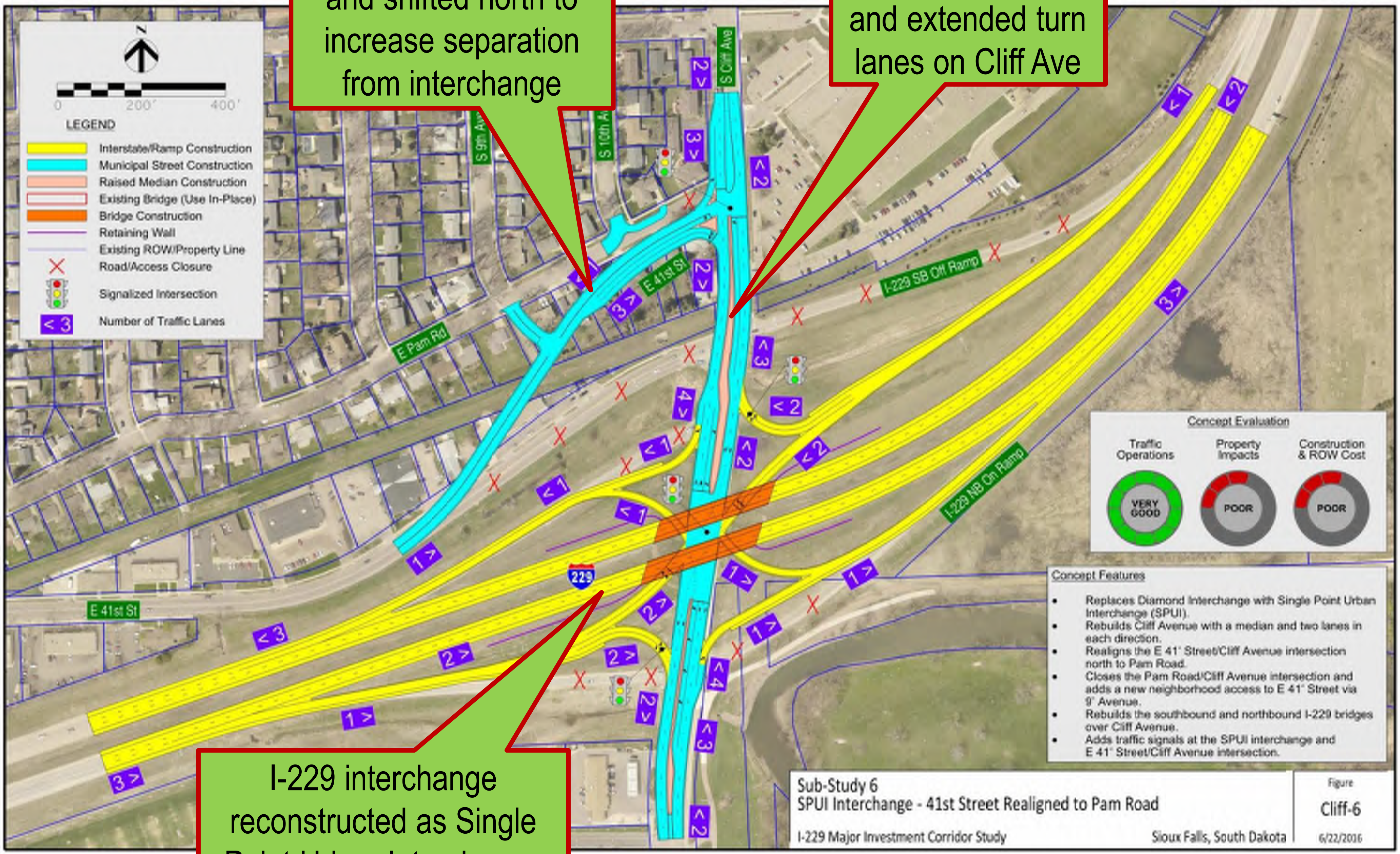
Sub-Study 6
Diamond Interchange - 41st Street Realigned to High School

I-229 Major Investment Corridor Study
Sioux Falls, South Dakota

Figure
Cliff-4
6/22/2016

E 41st St. widened and shifted north to increase separation from interchange

Raised Median and extended turn lanes on Cliff Ave



Concept Features

- Replaces Diamond Interchange with Single Point Urban Interchange (SPUI).
- Rebuilds Cliff Avenue with a median and two lanes in each direction.
- Realigns the E 41st Street/Cliff Avenue intersection north to Pam Road.
- Closes the Pam Road/Cliff Avenue intersection and adds a new neighborhood access to E 41st Street via 9th Avenue.
- Rebuilds the southbound and northbound I-229 bridges over Cliff Avenue.
- Adds traffic signals at the SPUI interchange and E 41st Street/Cliff Avenue intersection.

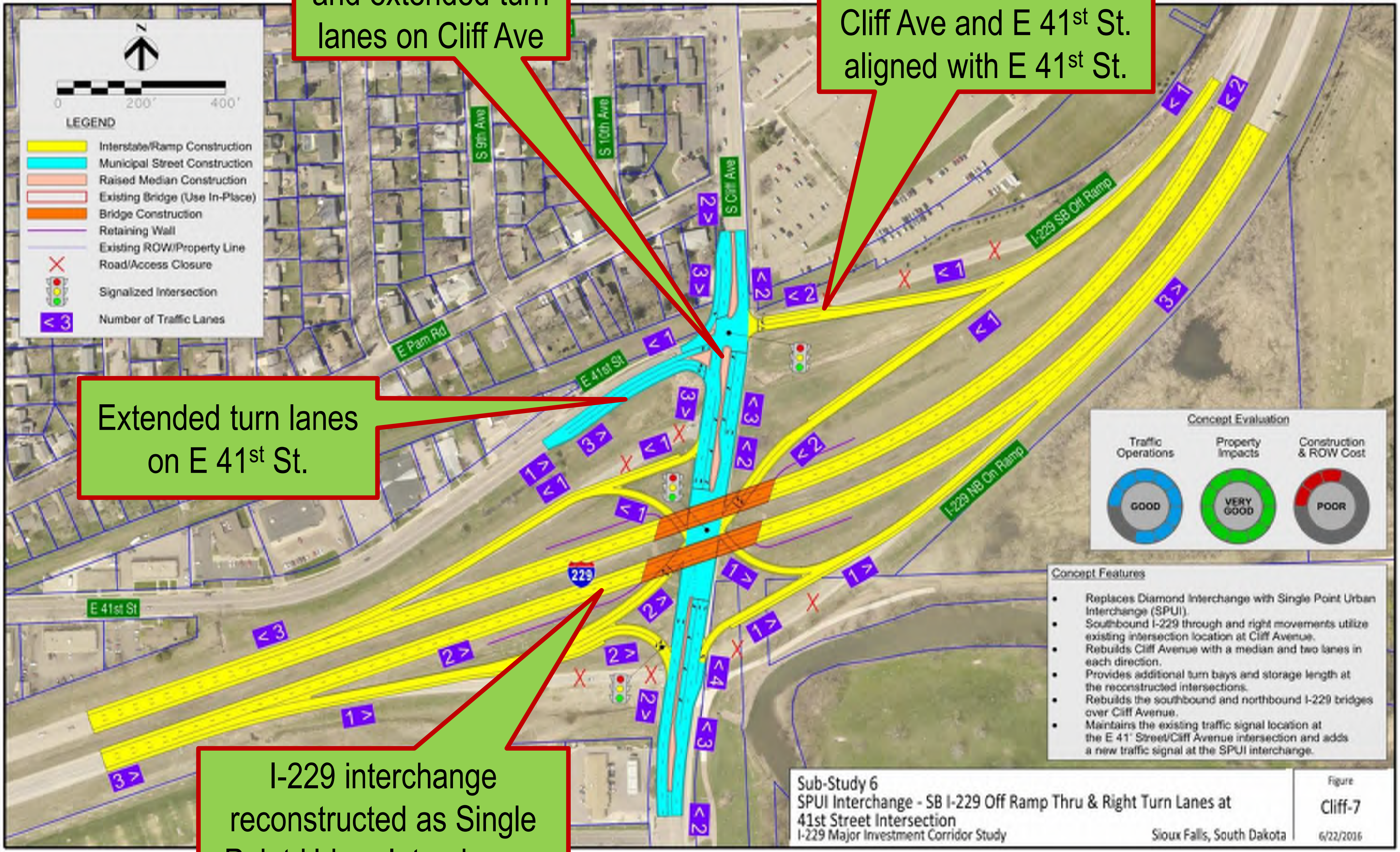
Sub-Study 6
SPUI Interchange - 41st Street Realigned to Pam Road
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota

Figure
Cliff-6
6/22/2016

I-229 interchange reconstructed as Single Point Urban Interchange for added capacity

Raised Median and extended turn lanes on Cliff Ave

SB exit lanes to NB Cliff Ave and E 41st St. aligned with E 41st St.



Extended turn lanes on E 41st St.

I-229 interchange reconstructed as Single Point Urban Interchange for added capacity

Concept Features

- Replaces Diamond Interchange with Single Point Urban Interchange (SPUI).
- Southbound I-229 through and right movements utilize existing intersection location at Cliff Avenue.
- Rebuilds Cliff Avenue with a median and two lanes in each direction.
- Provides additional turn bays and storage length at the reconstructed intersections.
- Rebuilds the southbound and northbound I-229 bridges over Cliff Avenue.
- Maintains the existing traffic signal location at the E 41st Street/Cliff Avenue intersection and adds a new traffic signal at the SPUI interchange.

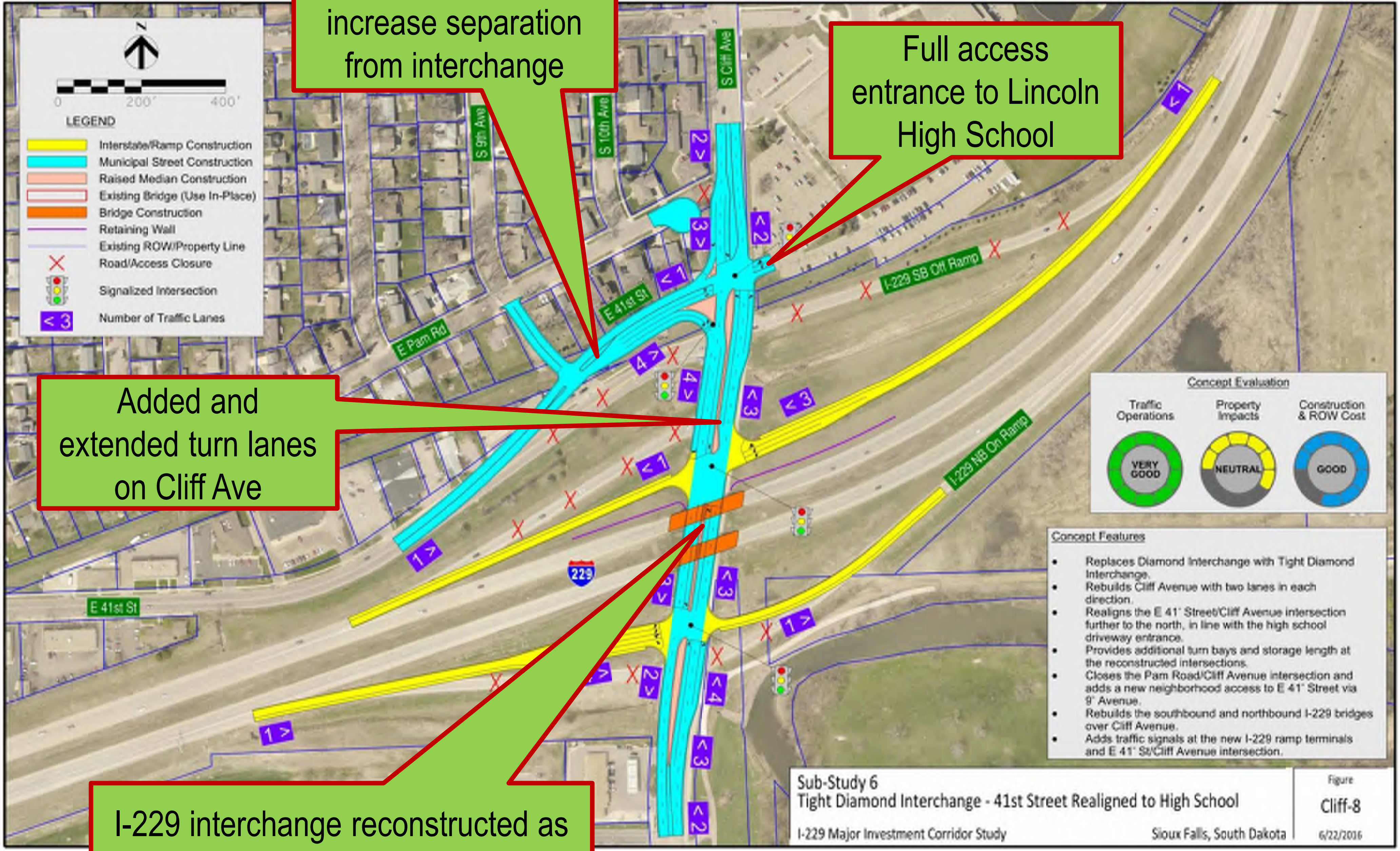
Sub-Study 6
SPUI Interchange - SB I-229 Off Ramp Thru & Right Turn Lanes at 41st Street Intersection
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota

Figure
Cliff-7
6/22/2016

E 41st St. widened and shifted north to increase separation from interchange

Full access entrance to Lincoln High School

Added and extended turn lanes on Cliff Ave



Concept Features

- Replaces Diamond Interchange with Tight Diamond Interchange.
- Rebuilds Cliff Avenue with two lanes in each direction.
- Realigns the E 41st Street/Cliff Avenue intersection further to the north, in line with the high school driveway entrance.
- Provides additional turn bays and storage length at the reconstructed intersections.
- Closes the Pam Road/Cliff Avenue intersection and adds a new neighborhood access to E 41st Street via 9th Avenue.
- Rebuilds the southbound and northbound I-229 bridges over Cliff Avenue.
- Adds traffic signals at the new I-229 ramp terminals and E 41st St/Cliff Avenue intersection.

Sub-Study 6
Tight Diamond Interchange - 41st Street Realigned to High School

I-229 Major Investment Corridor Study
Sioux Falls, South Dakota

Figure
Cliff-8
6/22/2016

I-229 interchange reconstructed as Tight Diamond for added capacity

PROJECT CONTACTS:

Jason Kjenstad – HDR Engineering, Inc.
605-977-7740 or jason.kjenstad@hdrinc.com

Brian Ray– HDR Engineering, Inc.
402-548-5066 or Brian.Ray@hdrinc.com

Shannon Ausen – City of Sioux Falls
605-367-8607 or sausen@siouxfalls.org

Steve Gramm – SDDOT Project Development
605-773-6641 or steve.gramm@state.sd.us

Interstate 229 Major Investment Study

Exit 4 – Cliff Avenue

Thanks for Attending!!!!!

APPENDIX -

PUBLIC MEETING #3 – DECEMBER 6TH, 2016

- SIGN-IN SHEETS
- COMMENTS
- POWERPOINT SLIDES
- MEETING NOTES (SEE STAKEHOLDER MEETINGS #2 APPENDIX)

DOT

CITY OF SIOUX FALLS
PUBLIC WORKS
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Sign In Sheet

Subject I-229 Major Investment Corridor Study – Public Meeting
Client City of Sioux Falls/South Dakota Department of Transportation
Project PL 0100(87) 3616P, PCN 044K
Project No.: 207030
Meeting Date Tuesday, December 6th, 2016 6:00 PM
Meeting Location: Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Bruce Wichers	3226 S SERENITY TR	605-254-4375	
2	Lee Miller	905 E. 34th St.	605-310-9642	
3	Mark Ellison	101 S Cleveland	605-338-6221	
4	Pete Longman	SDDOT Pierre	773-6488	
5	Joe Boyt	2533 E HARRIET LEA	206-484-2698	
6	Jo Wahle		605-351-0658	
7	Luke Henriksen	2200 S Shaw Ave S 57106	605321-5040	
8	Riley Hosman	Brandon, SD	951-5391	rhos1205@gmail.com
9	Bob Bohm	1116 S 4th Ave	605334 4220	
10	Gerald Teunissen	808 Jana Lane	605-366-1979	gerald@benderco.com
11	Judy Mickalowski		605-521-0345	
12	Carsen Bower	25225 474th Ave Garretson SD	605-594-6431	
13	Joe Ponte	3512 S Alpine SF		
14	Mark Meyer	1504 W. Mosby ST SF	605 275 2667	
15	Travis Krebs	2405 S Glendale Trl	605 254 8650	
16	Sharon Fix	301 N. Marquette Ave. 57110	605-338-6001	
17	Jon Smith	941 S. Grandview 57103	334-5869	jdsmith@sio.midco.net
18	Allan Kostboth	1205 E. 38th St. 57105	940-2721	kostboth@sio.midco.net
19	Dennis Olsen	2608 E Winston Cir 57108	978-3980	dennis.olsen@medvantx.com
20	DALE Froehlich	West Valley Chateau 6 So Le SF, SD 57105	201-9810	

DOT

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Project No.: 207030
Meeting Date Tuesday, December 6th, 2016 6:00 PM
Meeting Location: Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Steve Gramm	700 E. Broadway Ave.	773-6641	steve.gramm@state.sd.us
2	Dean DeLasamutt	1207 N Violet Pl	4961108	
3	Paul Nikolas	5316 W 60th St. N.	367-5680	Paul.Nikolas@state.sd.us
4	Brad Remmich	SDDot – Pierre	773-3093	bradley.remmich@state.sd.us
5	Sarah Schafer	117 E Twin Oaks Pl #53	338-5741	–
6	gary busselman	72016 Madison ST Sioux Falls SD 57110	605 334 5692	gary@garybuss;com
7	Bruce Card	4815 E Haven Hill Dr S F SD 57110	605-261-1624	bcard@amengtest.com
8	Amber Gibson	500 N Western Ave Ste 100 SFSD 57104	605-367-5390	amber@secog.org
9	Bart Brost	48005 Oak Trail Pl SF, SD 57108	605-310-8628	brostbart@showplacewood.com
10	Lanny Bleam	6300 E 26th SF SD 57110	605 332-7391	
11	Kim Blackburn	2708 S 10	940-7908	[illegible]@hotmail.c
12	Mark Skadsen	25952 476th Ave	351-9512	
13	Jason Kjenstad	6300 S. Old Village Pl Suite 100	977-7740	jason.kjenstad@hdrinc.com
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SD DOT

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Project PL 0100(87) 3616P, PCN 044K
Project No.: 207030
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Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Shannon Ausen	224 W 9th St SF SD	367-8607	sausen@siouxfalls.o
2	Jason Kjenstad	6300 S. Old Village Pl Suite 100 SF SD	977-7740	jason.kjenstad@hdrinc.com
3	Mark Hoines	116 E. Dakota Ave Pierre, SD	776-1010	mark.hoines@dot.gov
4	Steve Painter	4101 S. Western	359-8525	
5	Andy Vandel	SDDOT Pierre	773-4421	andy.vandel@state.sd.us
6	Jeff Hanssen	3101 W. Auburn Hills Ct	310-6280	jeff.hanssen@kneipgroup.com
7	Charlie Kneip	3066 W. [illegible] Sioux Falls	359-9451	charles.kneip@kneipgroup.com
8	Mitch Brandner	830 E 41st St, SF SD.	605-366-2404	mitch.brandner@gmail.com
9	Josh Larson	2208 S Sheffield SF SD	605-271-1609	joshuadavid@hotmail.com
10	Debi Schafer	2300 S Jefferson SF SD	605 310 2698	—
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I-229 Major Investment Corridor Study

PL 0100 (87) 3616P, PCN 044K

WE WANT TO KNOW WHAT YOU THINK! What are your concerns? What issues does the study team need to overcome with this project? What problems do you foresee? Please submit your comments before December 22, 2016 to:

Mail: *HDR Engineering, Inc.*
ATTN: Jason Kjenstad
6300 S. Old Village Place, Suite 100
Sioux Falls, SD 57108-2102

E-mail: *Jason.Kjenstad@hdrinc.com*

Fax: *605-977-7747*

Very much like improved pedestrian/bike access on all options. Of the 3 current options, Cliff 1 + 7 have less property owner impact (good). Cliff 7 appears to have less impact on affordable housing. Cliff 6 would feed Lincoln H.S. traffic right onto 41st - probably not a good idea. Intersection of Cliff + 41st at LHS would be a real mess 7:30-9 AM + 3-4:15 pm (current LHS busiest times. It's already not a favorite time/place for bus + paratransit drivers + commuters.

(optional)
Name: Wendy Butler-Boyesen
Address: 1104 E. Pam Rd.
Phone: 605-906-1203
Email: wbutlerboyesen@gmail.com

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E-mail: *Jason.Kjenstad@hdrinc.com*

Fax: *605-977-7747*

Website very useful → advertise on marquee sign please!

Thanks for making considerations for cyclists!

(optional)
Name: Riley Hosmon
Address: 1205 Parkview blvd, Brandon
Phone: 951-5391
Email: rhos1205@gmail.com

South Dakota DOT
Connecting South Dakota and the Nation

I-229 Major Investment Corridor Study

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E-mail: *Jason.Kjenstad@hdrinc.com*

Fax: *605-977-7747*

DONT INSTALL A DIVIDED Median ON Benson Prevents Left turns FROM the SOUTH

(optional) Name: CHRIS RANS
Address: 3412 N. POTSDAM
Phone: 338-9110
Email: CHRIS@SUNKOTA CONSTRUCTION.com

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Sioux Falls, SD 57108-2102

E-mail: *Jason.Kjenstad@hdrinc.com*

Fax: *605-977-7747*

Divider (median) along Minn from 41st south makes no sense. Will not improve safety. Will negatively impact retail business. How will access be maintained during construction and long term. NO GOOD ACCESS TO STAPLES / Dollar Tree

(optional) Name: Dave McElroy
Address: 3310 S Minn Ave
Phone: 605-338-9519
Email: mcelroy.dave@gmail.com

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PL 0100 (87) 3616P, PCN 044K

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Sioux Falls, SD 57108-2102

E-mail: *Jason.Kjenstad@hdrinc.com*

Fax: *605-977-7747*

DO NOT INSTALL A RAISED Median ON BENSON
to ELIMINATE LEFT Turns From the SOUTH

(optional)
Name: CHRIS RAWS

Address: 3412 N. POTSDAM AVE.

Phone: 338-9110

Email: CHRIS@ SUNKOTA CONSTRUCTION AVE.

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Sioux Falls, SD 57108-2102

E-mail: *Jason.Kjenstad@hdrinc.com*

Fax: *605-977-7747*

Like Mn Ave 2D
" 10 st 2 B/C
" Benson 1A — Suggest doing Southbound Ramp prior to worrying about NB Ramp
" Rice 3C — no need to move SB 229 Ramp
" Cliff 1

(optional)
Name: Lanny Bogan

Address: 6300 E 26th SF

Phone: 332-7391

Email: SQDA8 @ SiouxMidco.net

From: Gary Busselman <gary@garybuss.com>
Sent: Wednesday, December 07, 2016 5:27 PM
To: Kjenstad, Jason
Cc: Nancy Busselman
Subject: I-229 E 10th St Exit COMMENT

I-229 Major Investment Corridor Study
HDR Engineering Inc
ATT: Jason Kjenstad
6300 S. Old Village Place, Suite 100
Sioux Falls SD 57108-2102

Jason.Kjenstad@hdrinc.com

Fax: 605-977-7747

December 7, 2016

RE: 2700 & 2704 E 10th St
Loss of either of the two approaches or the front parking/pass through will amount to a virtual condemnation and will likely result in an inverse condemnation action. Either buy my property or don't damage it so I can't use it as is or sell it to somebody else.

Gary Busselman
STEM LLC
7201 E Madison St
Sioux Falls, SD 57110
605-334-5692
gary@garybuss.com

DOT
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ATTN: Jason Kjenstad
6300 S. Old Village Place, Suite 100
Sioux Falls, SD 57108-2102

E-mail: *Jason.Kjenstad@hdrinc.com*

Fax: *605-977-7747*

I have a tenant in 3508 S. Minesota Ave.
Access off of Minesota Ave & being able to turn
onto 43rd St. when heading S. on Minesota Ave to
access the business is important to the rentability
f these businesses and customer access.

: Jeff Mindt
: 360-6108

Address: 801 E. 38th St. SF, SD 57105
Email: jmindt68@gmail.com

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Mail: *HDR Engineering, Inc.*
ATTN: Jason Kjenstad
6300 S. Old Village Place, Suite 100
Sioux Falls, SD 57108-2102

E-mail: *Jason.Kjenstad@hdrinc.com*

Fax: *605-977-7747*

No Build -
Keep 43rd Street open to Minnesota Ave for N + S Bound traffic
No median

(optional) Name: Tom Hein
Address:
Phone: 361-8400
Email: theinmail@gmail.com

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I-229 Major Investment Corridor Study

PL 0100 (87) 3616P, PCN 044K

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Mail: *HDR Engineering, Inc.*
ATTN: Jason Kjenstad
6300 S. Old Village Place, Suite 100
Sioux Falls, SD 57108-2102

E-mail: *Jason.Kjenstad@hdrinc.com*

Fax: *605-977-7747*

No Build
Keep 43rd Street open to Minnesota Ave for N + S Bound Traffic
No Median.

(optional)
Name: MARY HEIN
Address:
Phone: 361-8400
Email: theinmail@gmail.com

DOT
Connecting South Dakota and the Nation

I-229 Major Investment Corridor Study

PL 0100 (87) 3616P, PCN 044K

www.i229study.com

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6300 S. Old Village Place, Suite 100
Sioux Falls, SD 57108-2102

E-mail: *Jason.Kjenstad@hdrinc.com*

Fax: *605-977-7747*

December 7, 2016

RE: 2700 & 2704 E 10th St

Loss of either of the two approaches or the front parking/pass through will amount to a virtual condemnation and will likely result in an inverse condemnation action. Either buy my property or don't damage it so I can't use it as is or sell it to somebody else.

(optional) Name: Gary Busselman
STEM LLC

Address: 7201 E Madison St
Sioux Falls, SD 57110

Phone:

Email: 605-334-5692
gary@garybuss.com

I-229 Major Investment Corridor Study

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Mail:
HDR Engineering, Inc.
ATTN: Jason Kjenstad
6300 S. Old Village Place, Suite 100
Sioux Falls, SD 57108-2102

E-mail: *Jason.Kjenstad@hdrinc.com*

Fax: *605-977-7747*

I think your design which hooks up with 49th ST going west makes most sense.

(optional)

Name: 
Mary Montoya
4809 S Twin Ridge Rd
Sioux Falls, SD 57108

Address:

Phone:

Email: mary.montoya@sio.midco.net

From:	Robert Reitz <tooferguy007@gmail.com>
Sent:	Monday, December 19, 2016 9:39 AM
To:	Tom Hein; Kjenstad, Jason
Cc:	Shally Rogen; Jeff R. Mindt; Eric & Mary Stormo; Brian Sather
Subject:	Re: I229 and Minnesota Layouts

Please consider access to Minnesota Crossing {3508 S Minnesota Ave} for southbound traffic on Minnesota Ave by narrowing the island to permit a left turn lane for entry to the middle access on the above mentioned property. Otherwise we strongly suggest NO BUILD!

On Tue, Dec 13, 2016 at 8:25 AM, Tom Hein <theinmail@gmail.com> wrote:

Please review DOT options below for destroying our property and access. Be sure to complete the I-229 Major Investment Corridor Study 'We want to know what you think" card and return it to HDR Engineering or Jason.Kjenstad@hdrinc.com with your thoughts. I highly encourage to have a **"No Build"** option which leaves our access points and does not provide a median to prevent our south bound customers from getting into our property.

Please reply.

Thanks,

Tom

---------- Forwarded message ----------

From: **Kjenstad, Jason** <Jason.Kjenstad@hdrinc.com>

Date: Fri, Dec 9, 2016 at 6:04 AM

Subject: Fwd: I229 and Minnesota Layouts

To: Thomas Hein <theinmail@gmail.com>

FYI Tom

Jason Kjenstad 605 360 6595

Begin forwarded message:

> **From:** "Kjenstad, Jason" <Jason.Kjenstad@hdrinc.com>
> **To:** "jmbliss628@aol.com" <jmbliss628@aol.com>
> **Cc:** "Kjenstad, Jason" <Jason.Kjenstad@hdrinc.com>
> **Subject: I229 and Minnesota Layouts**
>
> FYI Rich
>
> **Jason Kjenstad,** PE, LSIT
>
> *Vice President – Dakota's & Wyoming Transportation Operations Manager*
>
> **HDR**
>
> 6300 South Old Village Place
> Suite 100

I-229 Major Investment Corridor Study
HDR Engineering Inc
ATT: Jason Kjenstad
6300 S. Old Village Place, Suite 100
Sioux Falls SD 57108-2102

Jason.Kjenstad@hdrinc.com

Fax: 605-977-7747

December 7, 2016

RE: 2700 & 2704 E 10th St
Loss of either of the two approaches or the front parking/pass through will amount to a virtual condemnation and will likely result in an inverse condemnation action. Either buy my property or don't damage it so I can't use it as is or sell it to somebody else.

Gary Busselman

Gary Busselman
STEM LLC
7201 E Madison St
Sioux Falls, SD 57110
605-334-5692
gary@garybuss.com

Kjenstad, Jason

From: Brian Sather <gdentltd@hotmail.com>
Sent: Monday, December 19, 2016 2:00 PM
To: Kjenstad, Jason; Jeff R. Mindt; Tom Hein; Shally Rogen; Eric & Mary Stormo; Bob Reitz
Subject: I-229 Major Investment Corridor Study

As one of the owners of property at 3508 S. Minnesota Ave.(#108), I recommend a left turn from a turning lane for southbound traffic into the only remaining access opening on the north side. Also, there is no adequate access in these plans to the south of the building for delivery vehicles, trash haulers, and employees. If these concerns can not be corrected, I recommend a "No Build" as the option.

Brian Sather
gdentltd@hotmail.com

Kjenstad, Jason

From: Malmberg, Chris
Sent: Thursday, December 22, 2016 7:40 AM
To: Meier, Dave; Kjenstad, Jason
Subject: FW: Fryn' Pan Family Restaurant

Didn't know if this made it to you.

Chris Malmberg, PE, ENV SP
D 402.399.4959 **M** 402.212.8136

hdrinc.com/follow-us

From: Stan Mitzel [mailto:smitzel@frynpan.net]
Sent: Wednesday, December 21, 2016 3:50 PM
To: sausen@siouxfalls.org; steve.gramm@state.sd.us; Malmberg, Chris
Cc: Dave Stukel; Rick Weisser
Subject: Fryn' Pan Family Restaurant

Shannon,

I was just looking at the proposed project of the 10 th street corridor as it affects my business at 10th and Cleveland; If we are forced to move because the improvements are causing detrimental effects, I think a good relocation for us would be to take over the old Godfathers building along with the bank lot to the east. This would provide enough parking for us and a suitable location to make our business viable. It seems these lots have been continually vacant the last few years. Just thought I would share my thoughts as this project is very concerning to myself and partners and we would like to know where we stand sooner rather than later.

Thanks for your time,

Stan Mitzel
Fryn' Pan Family Restaurant
3215 S. Carolyn Ave
Sioux Falls, SD 57106
Office: 605.361.7804
Cell: 605.201.5141
Fax: 605.361.7921
smitzel@frynpan.net

Fryn' Pan
Family Restaurant

INTERSTATE 229 MAJOR INVESTMENT STUDY

Informational Meeting

December 6th, 2016
6:00 pm to 8:00 pm

HDR HRGreen

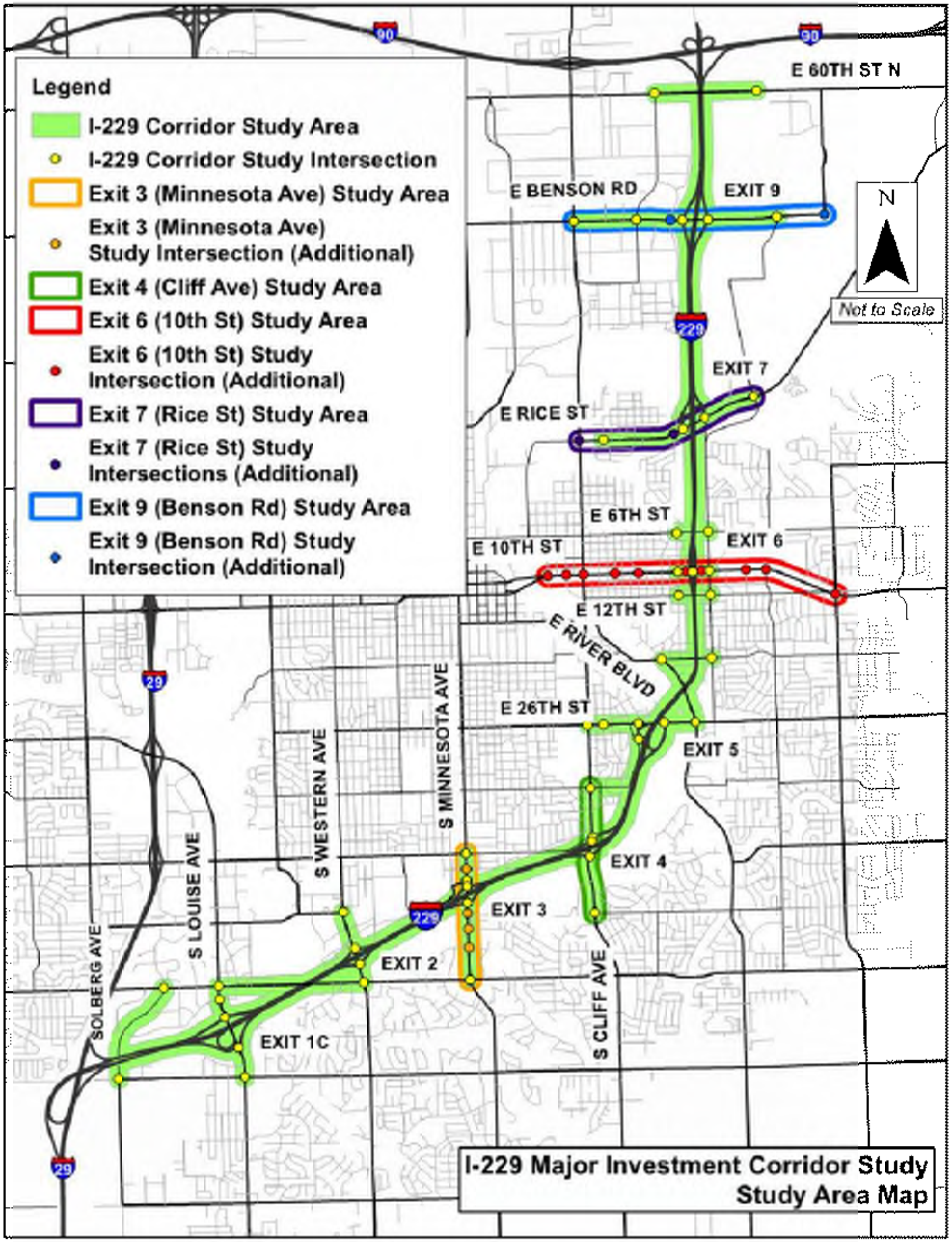
STUDY AREA MAP

I-229 Corridor Study

Solberg Avenue Overpass to 60th Street N Overpass

Meeting will focus on:

- Minnesota Avenue
- Cliff Avenue
- 10th Street
- Rice Street
- Benson Road



STUDY ADVISORY PARTNERS

South Dakota Department of Transportation (SDDOT)

South Dakota Highway Patrol

City of Sioux Falls

Sioux Falls Metropolitan Planning Organization (MPO)

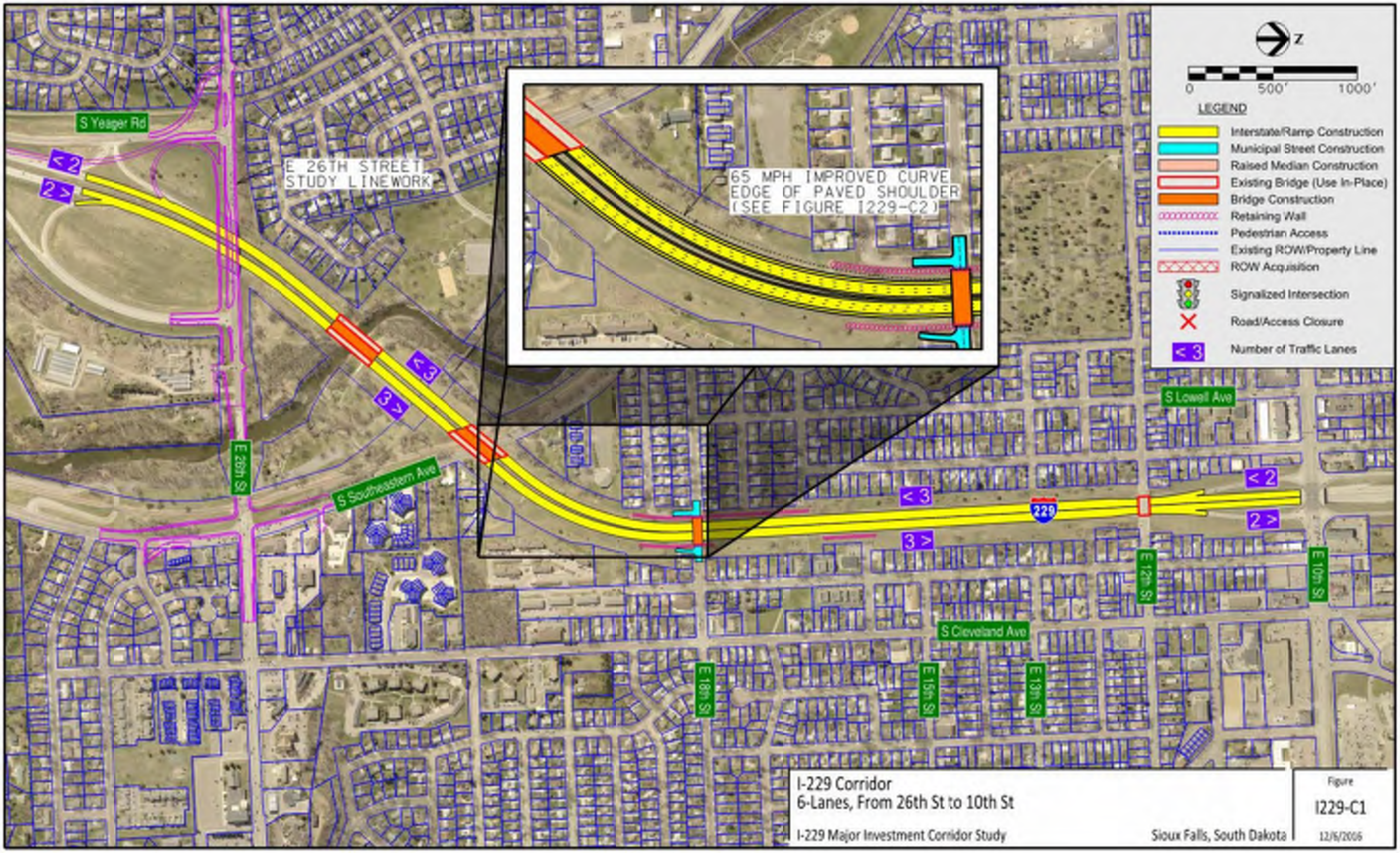
Federal Highway Administration (FHWA)

PRESENTATION AGENDA

- Recommended I-229 Corridor Improvement Concepts
- Interchange/Cross Road Sub-studies
  - Concept Evaluation Process
  - Concept Evaluation Results
  - Concepts Recommended for Further Consideration in Future Phases
- Next Steps

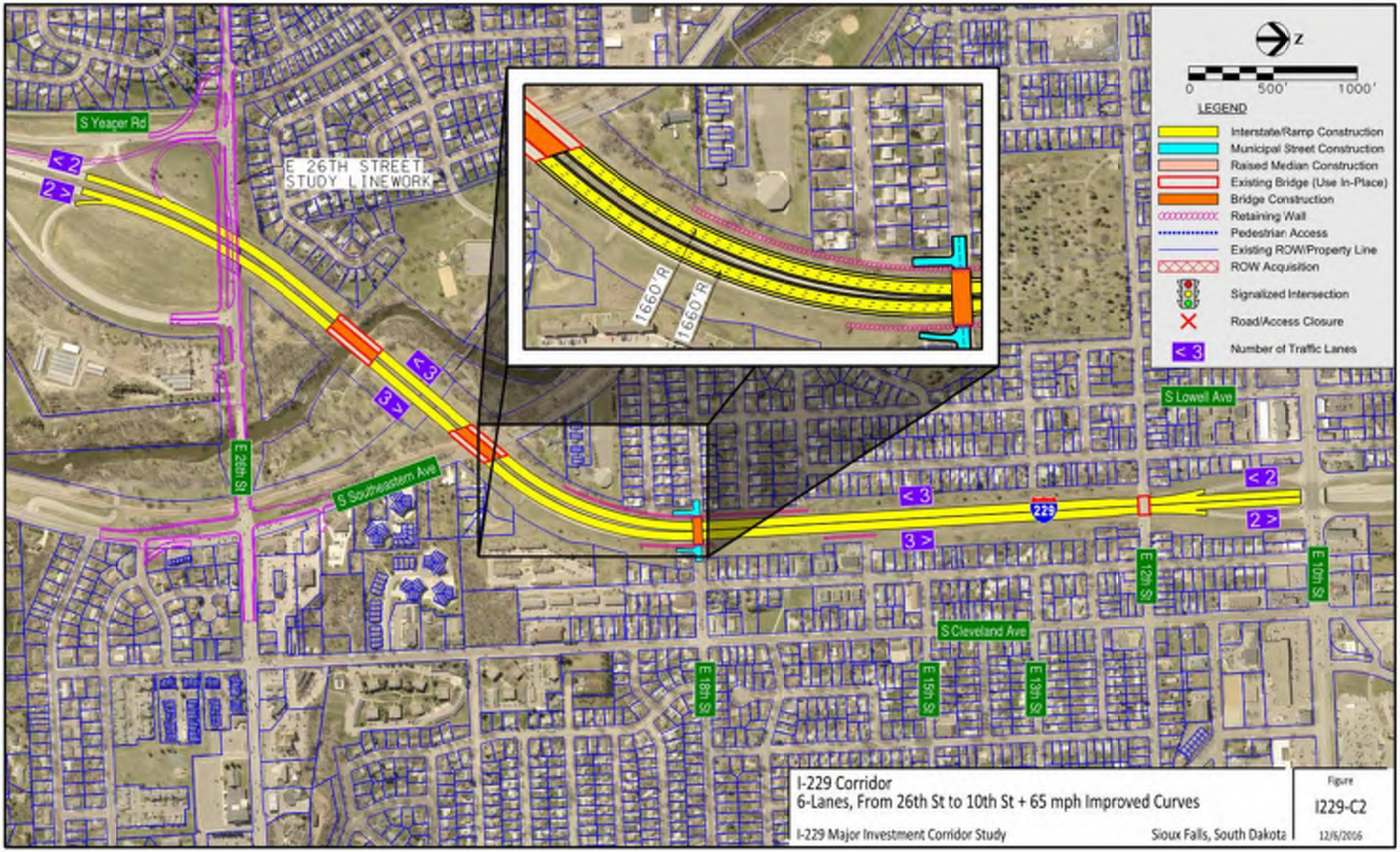
I-229 CORRIDOR IMPROVEMENTS

ADD 3RD LANE EACH DIRECTION
BETWEEN 26TH STREET AND 10TH STREET



I-229 CORRIDOR IMPROVEMENTS

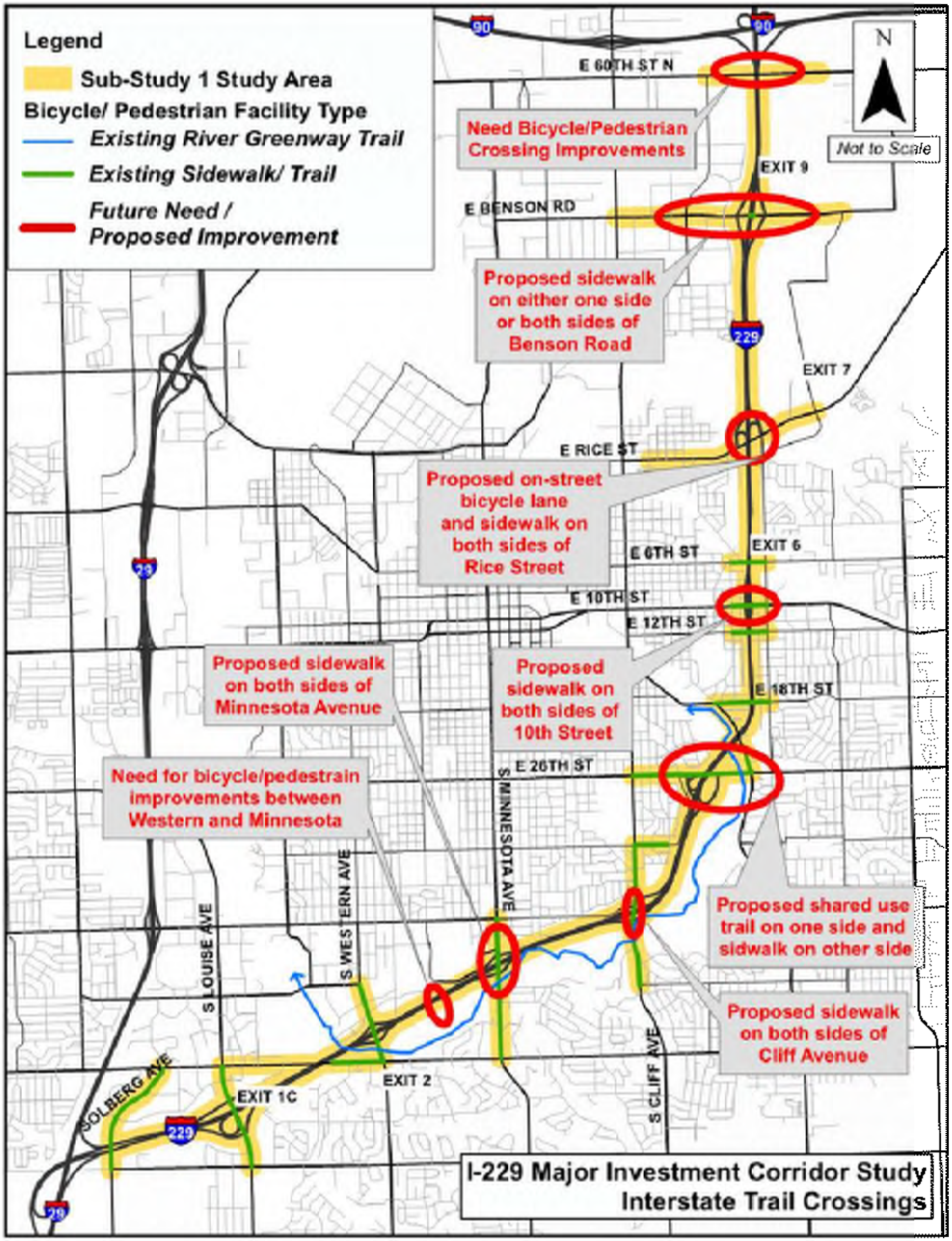
MODIFY CURVE RADIUS BETWEEN SOUTHEASTERN AVE & 18TH ST TO ALLOW 65 MPH DESIGN SPEED



I-229 CORRIDOR IMPROVEMENTS

PEDESTRIAN / BICYCLE CROSSING NEEDS & IMPROVEMENTS

- Sub-study Proposed Improvements
  - Minnesota Avenue
  - Cliff Avenue
  - 10th Street
  - Rice Street
  - Benson Road
- Other Need Locations



Need Bicycle/Pedestrian Crossing Improvements

Proposed sidewalk on either one side or both sides of Benson Road

Proposed on-street bicycle lane and sidewalk on both sides of Rice Street

Proposed sidewalk on both sides of Minnesota Avenue

Proposed sidewalk on both sides of 10th Street

Need for bicycle/pedestrain improvements between Western and Minnesota

Proposed shared use trail on one side and sidwalk on other side

Proposed sidewalk on both sides of Cliff Avenue

I-229 Major Investment Corridor Study
Interstate Trail Crossings

I-229 CORRIDOR IMPROVEMENTS

INTELLIGENT TRANSPORTATION SYSTEMS (ITS) CONCEPTS

- Adaptive Signal Control Technologies
- CCTV Cameras
- Dynamic Message Signs
- Dynamic Road Warning Signs
- Traffic Detectors

Dynamic Message Board to be placed along northbound I-29 south of Tea interchange (Exit 73)

I-229 Major Investment Corridor Study
Potential Placement of ITS Devices

INTERCHANGE AND CROSS ROAD SUB-STUDIES

- Concept Evaluation Process
- Concept Evaluation Results
- Concepts for Further Consideration in Future Phases

CONCEPT EVALUATION PROCESS

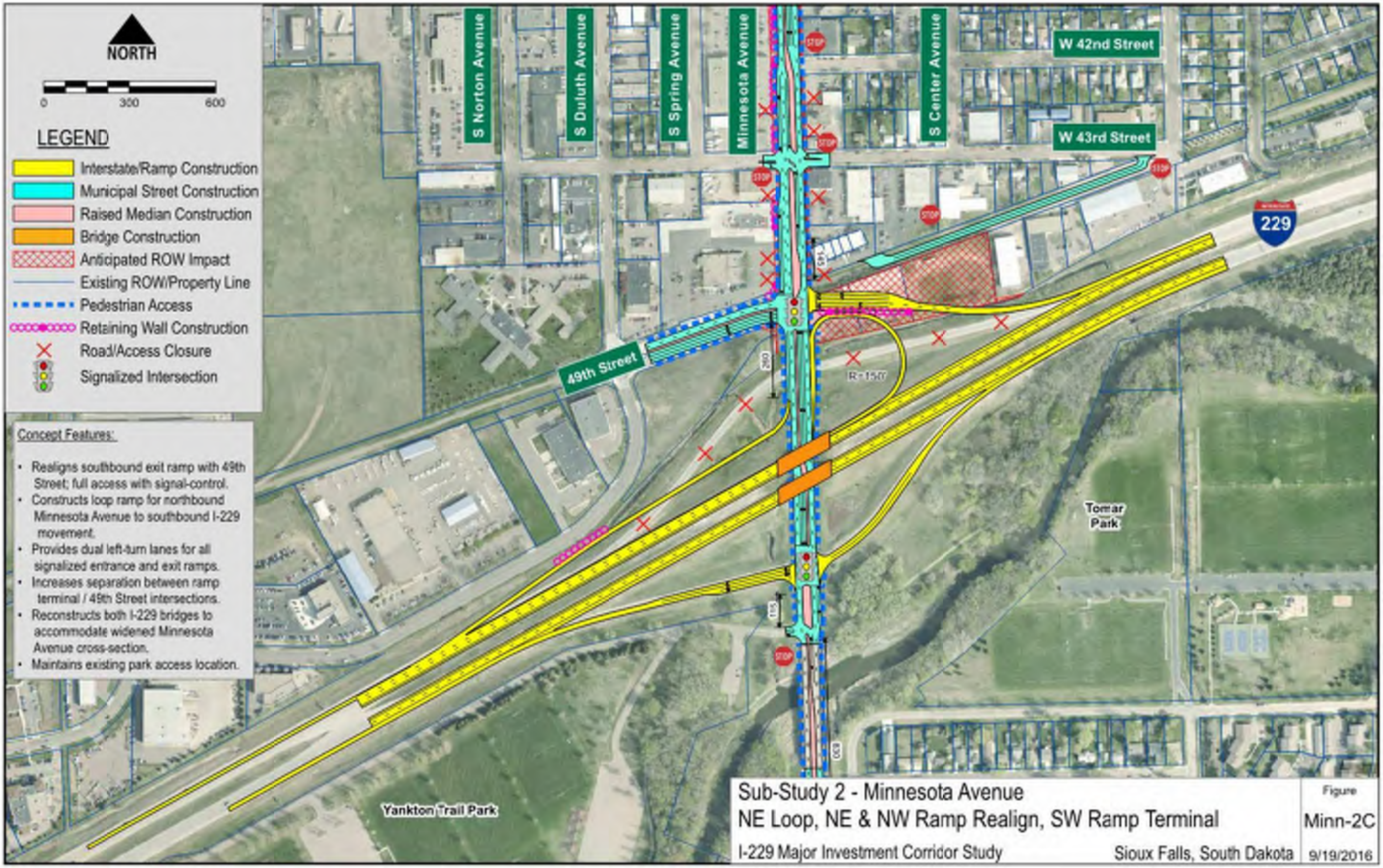
- Evaluation Factors:

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
Concept ID	Interchange and Corridor Type	•Traffic Delay •Level of Service •Interchange Year of Failure	Predicted Crash Reduction during 2012-2035	Potential impact to wetlands, historical resources, threatened and endangered species, public lands, and floodplains	Total Right of Way (ROW) Required and Acquisitions	Total Constuction Cost (including ROW)	**Advance** **or** **Eliminate**

- Recommended Action

CONCEPTS FOR FURTHER CONSIDERATION

MINNESOTA AVENUE – 2C



LEGEND

- 🟨 Interstate/Ramp Construction
- 🟦 Municipal Street Construction
- 🟥 Raised Median Construction
- 🟧 Bridge Construction
- ▨ Anticipated ROW Impact
- — Existing ROW/Property Line
- ┅ Pedestrian Access
- ○○○●○○○ Retaining Wall Construction
- ✕ Road/Access Closure
- 🚦 Signalized Intersection

Concept Features:

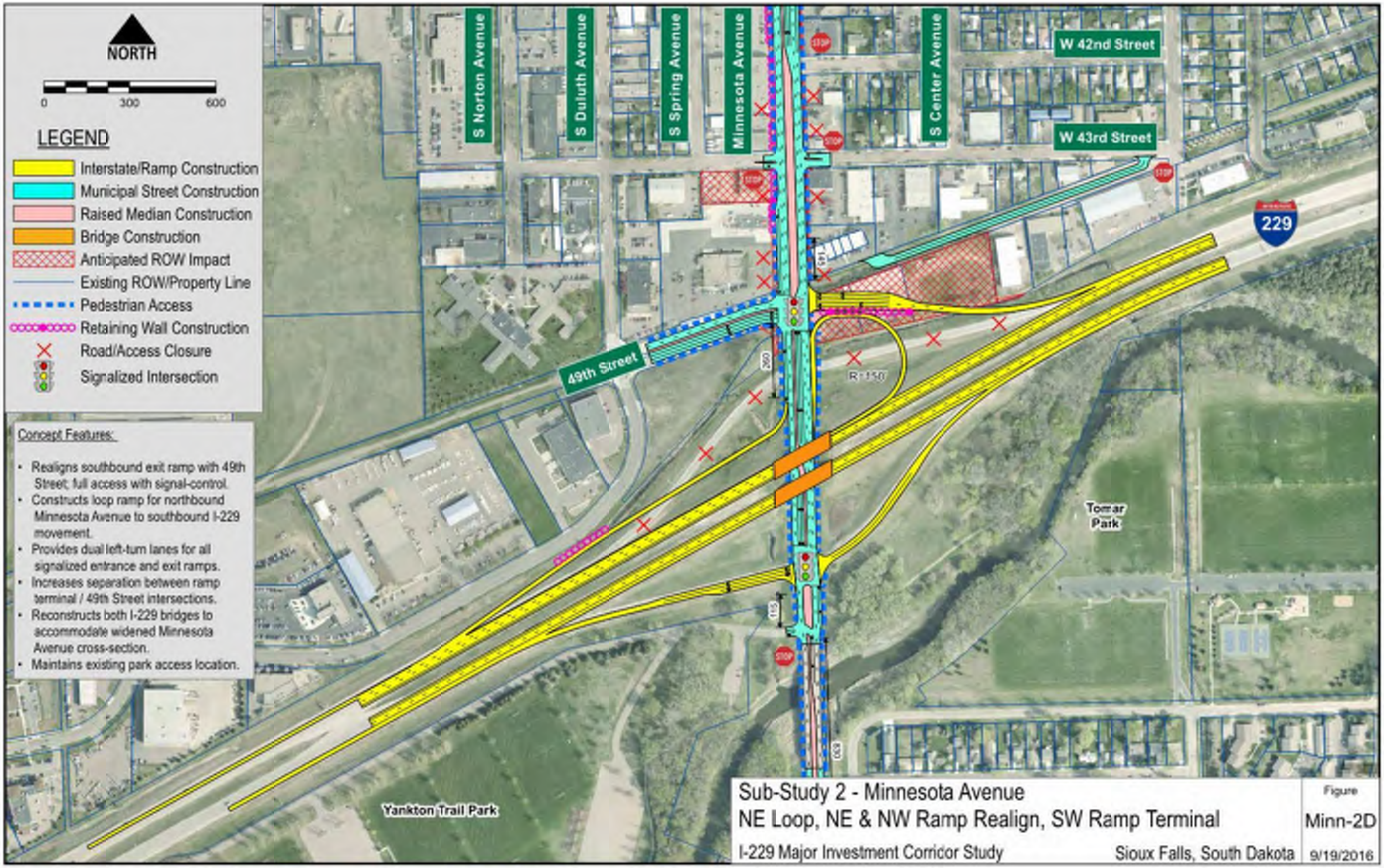
- Realigns southbound exit ramp with 49th Street; full access with signal-control.
- Constructs loop ramp for northbound Minnesota Avenue to southbound I-229 movement.
- Provides dual left-turn lanes for all signalized entrance and exit ramps.
- Increases separation between ramp terminal / 49th Street intersections.
- Reconstructs both I-229 bridges to accommodate widened Minnesota Avenue cross-section.
- Maintains existing park access location.

Sub-Study 2 - Minnesota Avenue
NE Loop, NE & NW Ramp Realign, SW Ramp Terminal
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota

Figure
Minn-2C
9/19/2016

CONCEPTS FOR FURTHER CONSIDERATION

MINNESOTA AVENUE – 2D



Concept Features:

- Realigns southbound exit ramp with 49th Street; full access with signal-control.
- Constructs loop ramp for northbound Minnesota Avenue to southbound I-229 movement.
- Provides dual left-turn lanes for all signalized entrance and exit ramps.
- Increases separation between ramp terminal / 49th Street intersections.
- Reconstructs both I-229 bridges to accommodate widened Minnesota Avenue cross-section.
- Maintains existing park access location.

Sub-Study 2 - Minnesota Avenue
NE Loop, NE & NW Ramp Realign, SW Ramp Terminal
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota

Figure
Minn-2D
9/19/2016

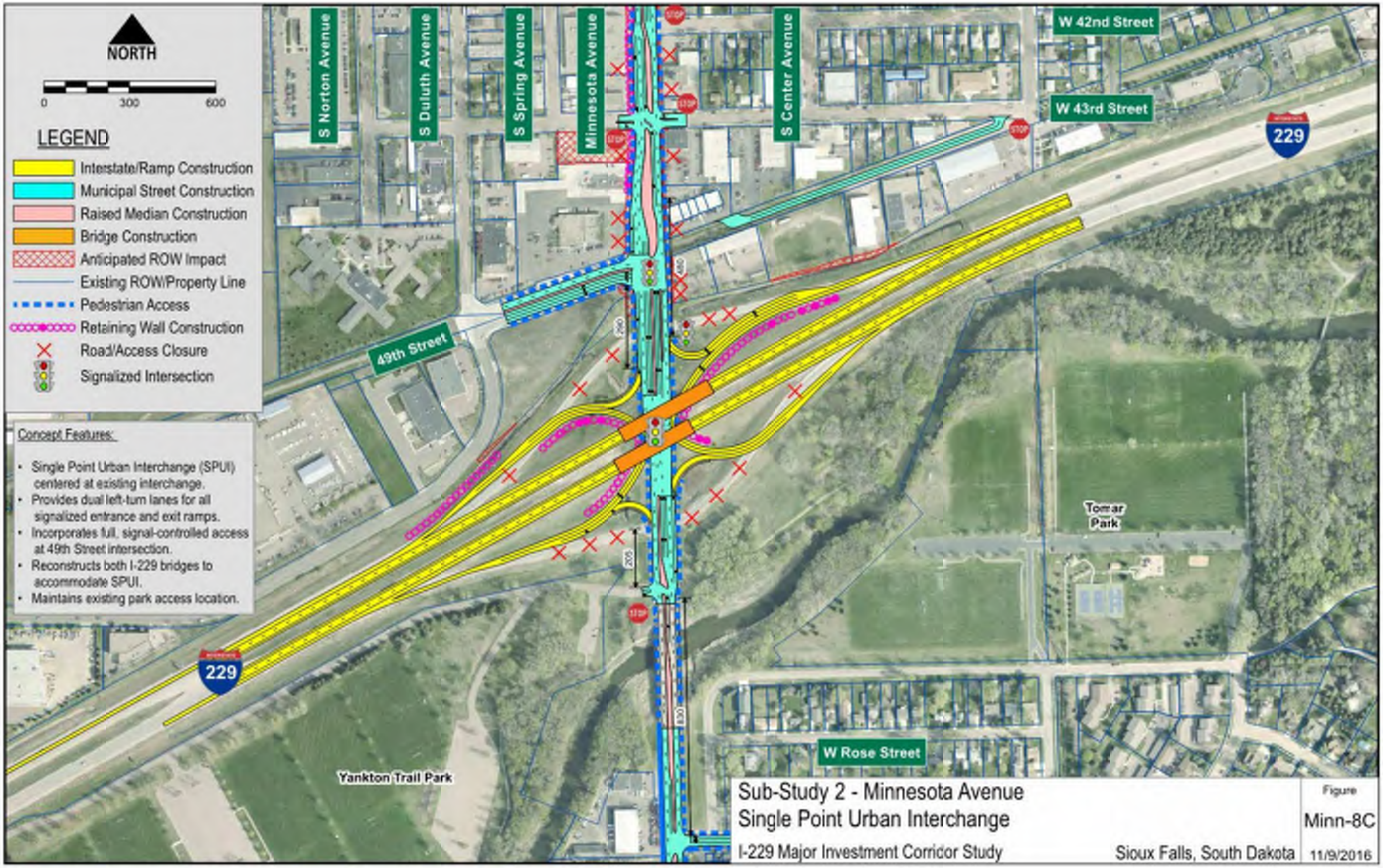
CONCEPT EVALUATION RESULTS

MINNESOTA AVENUE

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
No-Build	No-Build	POOR	NEUTRAL	N/A	N/A	N/A	**Advance**
Minn-2C	Diamond with Loop, Direct Connect to 49th St, 5-Lane Big Sioux River to 41st St	NEUTRAL	GOOD	NEUTRAL	NEUTRAL	GOOD	**Advance**
Minn-2D	Diamond with Loop, Direct Connect to 49th St, 6-Lane Big Sioux River to 41st St	NEUTRAL	GOOD	NEUTRAL	NEUTRAL	GOOD	**Advance**
Minn-5D	Diverging Diamond Interchange, 6-Lane Big Sioux River to 41st St, 49th St Right-In Right-Out	GOOD	VERY GOOD	NEUTRAL	GOOD	GOOD	**Eliminate** Closure of 49th Street Access

CONCEPTS FOR FURTHER CONSIDERATION

MINNESOTA AVENUE – 8C



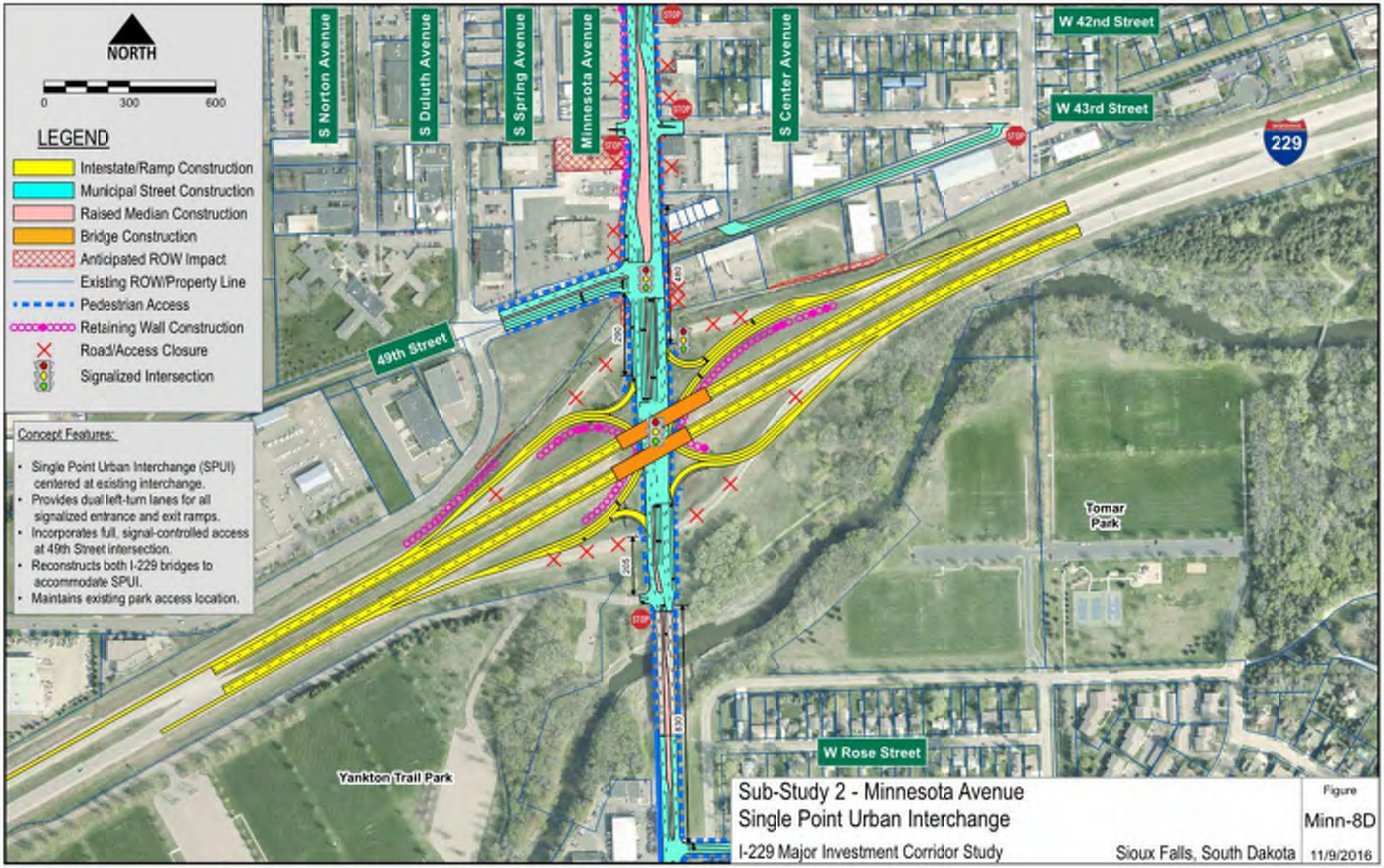
Concept Features:

- Single Point Urban Interchange (SPUI) centered at existing interchange.
- Provides dual left-turn lanes for all signalized entrance and exit ramps.
- Incorporates full, signal-controlled access at 49th Street intersection.
- Reconstructs both I-229 bridges to accommodate SPUI.
- Maintains existing park access location.

Sub-Study 2 - Minnesota Avenue
Single Point Urban Interchange
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Minn-8C
11/9/2016

CONCEPTS FOR FURTHER CONSIDERATION

MINNESOTA AVENUE – 8D



Concept Features:

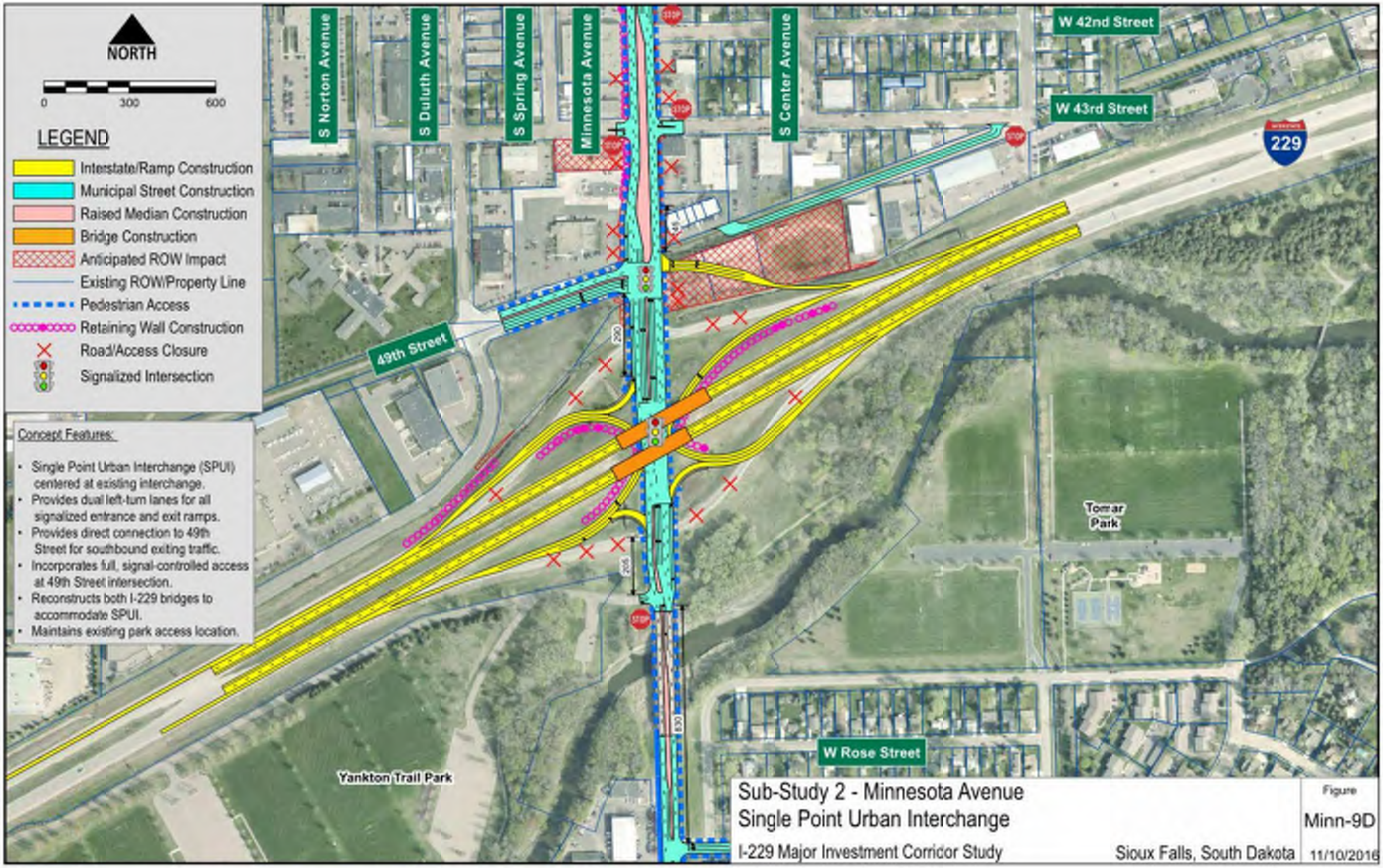
- Single Point Urban Interchange (SPUI) centered at existing interchange.
- Provides dual left-turn lanes for all signalized entrance and exit ramps.
- Incorporates full, signal-controlled access at 49th Street intersection.
- Reconstructs both I-229 bridges to accommodate SPUI.
- Maintains existing park access location.

Sub-Study 2 - Minnesota Avenue
Single Point Urban Interchange
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota

Figure
Minn-8D
11/9/2016

CONCEPTS FOR FURTHER CONSIDERATION

MINNESOTA AVENUE – 9D



Concept Features:

- Single Point Urban Interchange (SPUI) centered at existing interchange.
- Provides dual left-turn lanes for all signalized entrance and exit ramps.
- Provides direct connection to 49th Street for southbound exiting traffic.
- Incorporates full, signal-controlled access at 49th Street intersection.
- Reconstructs both I-229 bridges to accommodate SPUI.
- Maintains existing park access location.

Sub-Study 2 - Minnesota Avenue
Single Point Urban Interchange
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota

Figure
Minn-9D
11/10/2016

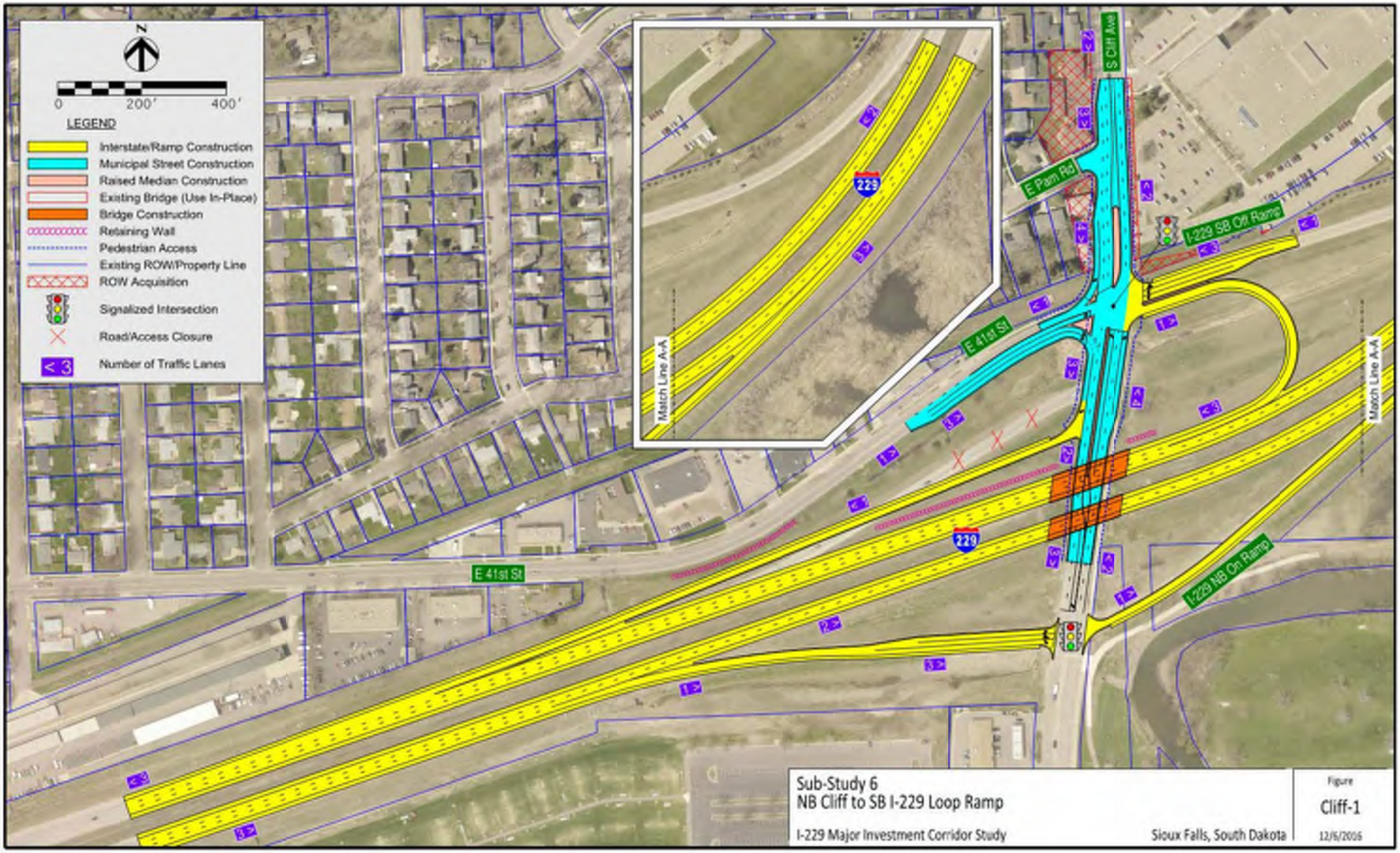
CONCEPT EVALUATION RESULTS

MINNESOTA AVENUE (cont.)

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
Minn-8C	Single Point Urban Interchange, 5-Lane Big Sioux River to 41st St, 49th St Full Access	GOOD	GOOD	NEUTRAL	GOOD	NEUTRAL	Advance
Minn-8D	Single Point Urban Interchange, 6-Lane Big Sioux River to 41st St, 49th St Full Access	GOOD	GOOD	NEUTRAL	GOOD	NEUTRAL	Advance
Minn-9	Single Point Urban Interchange, Exit Ramp Connection to 49th St, 5-Lane Big Sioux River to 41st St	NEUTRAL	GOOD	NEUTRAL	NEUTRAL	NEUTRAL	Advance

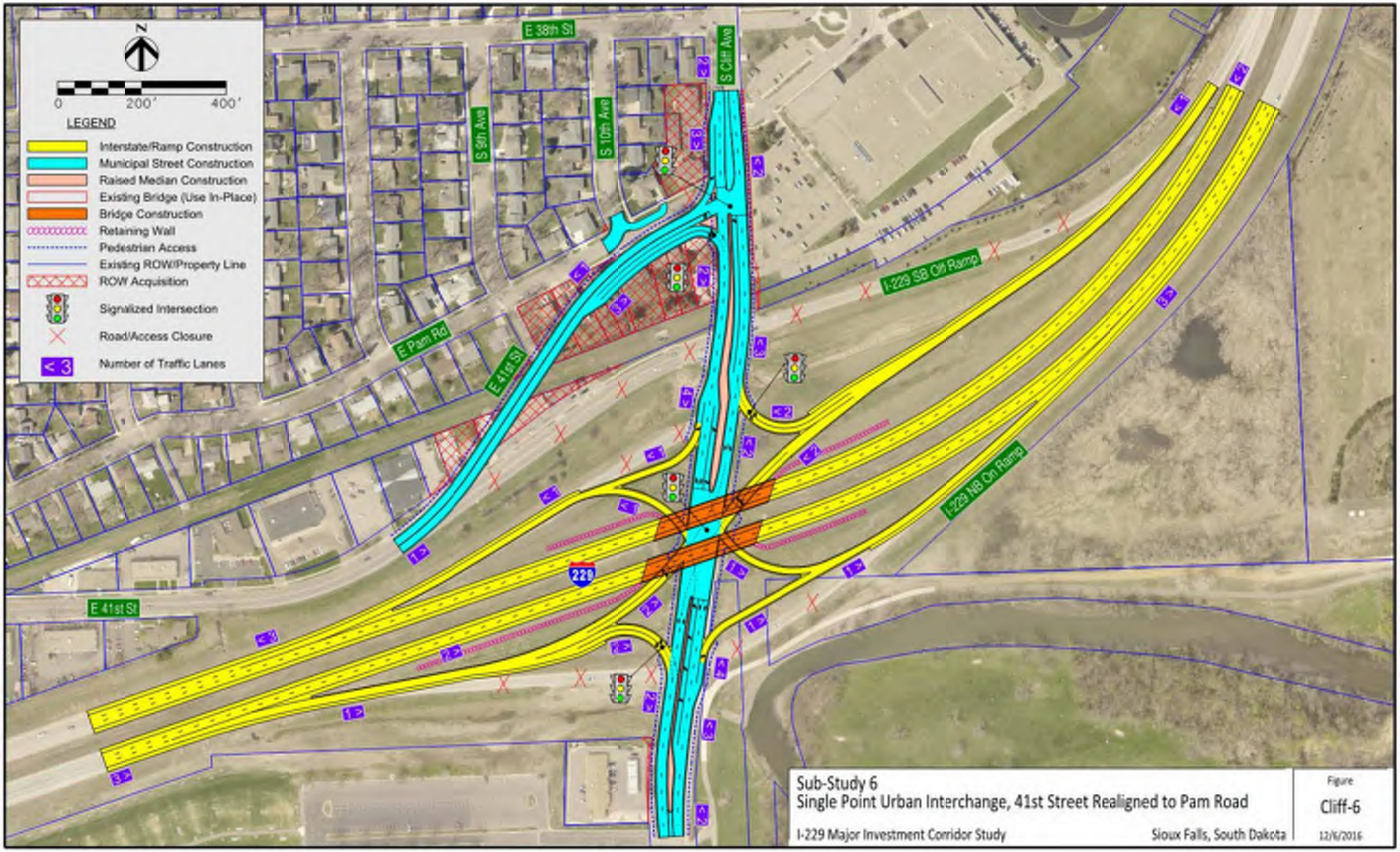
CONCEPTS FOR FURTHER CONSIDERATION

CLIFF AVENUE – 1



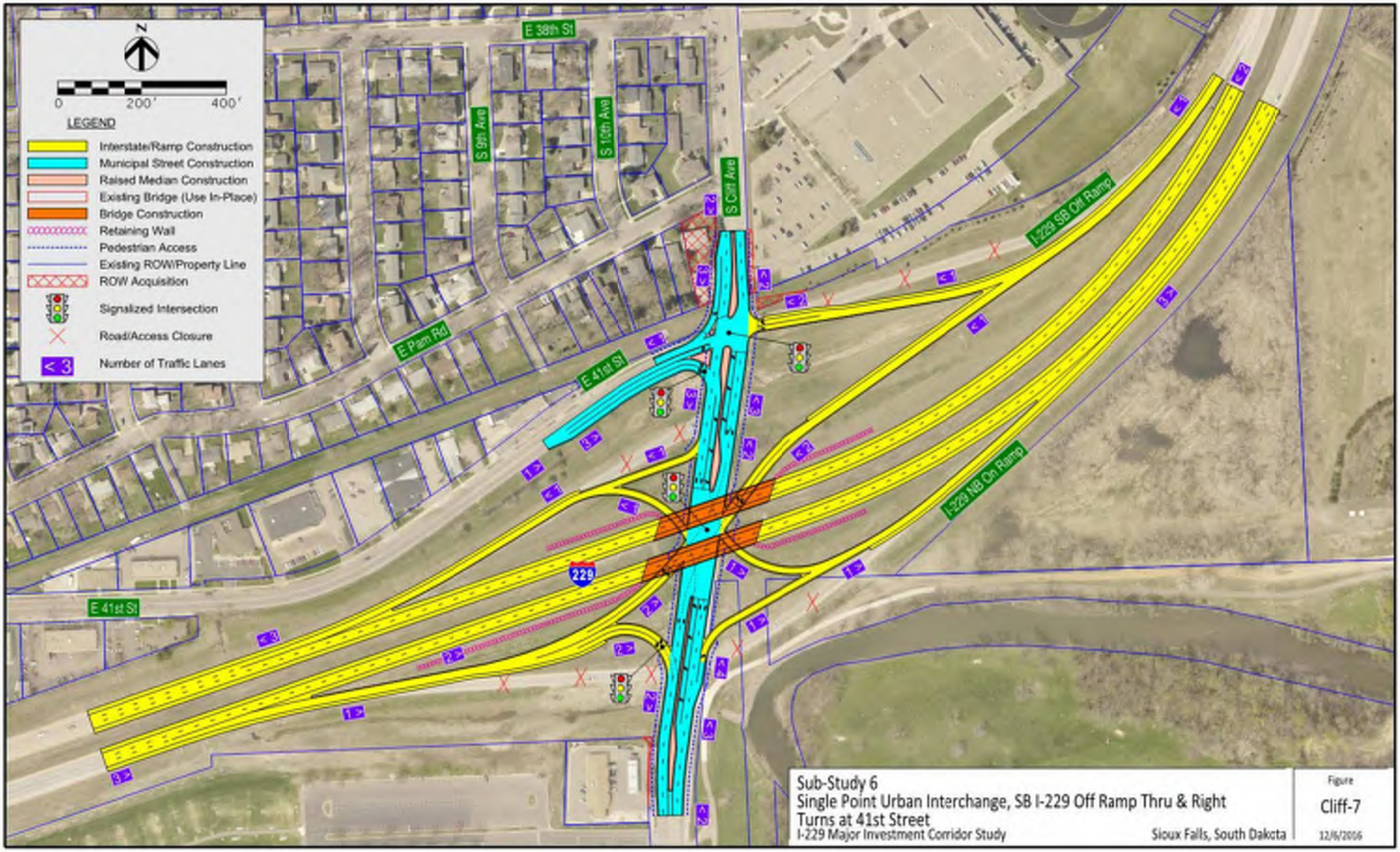
CONCEPTS FOR FURTHER CONSIDERATION

CLIFF AVENUE – 6



CONCEPTS FOR FURTHER CONSIDERATION

CLIFF AVENUE – 7



Sub-Study 6
Single Point Urban Interchange, SB I-229 Off Ramp Thru & Right Turns at 41st Street
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota

Figure
Cliff-7
12/6/2016

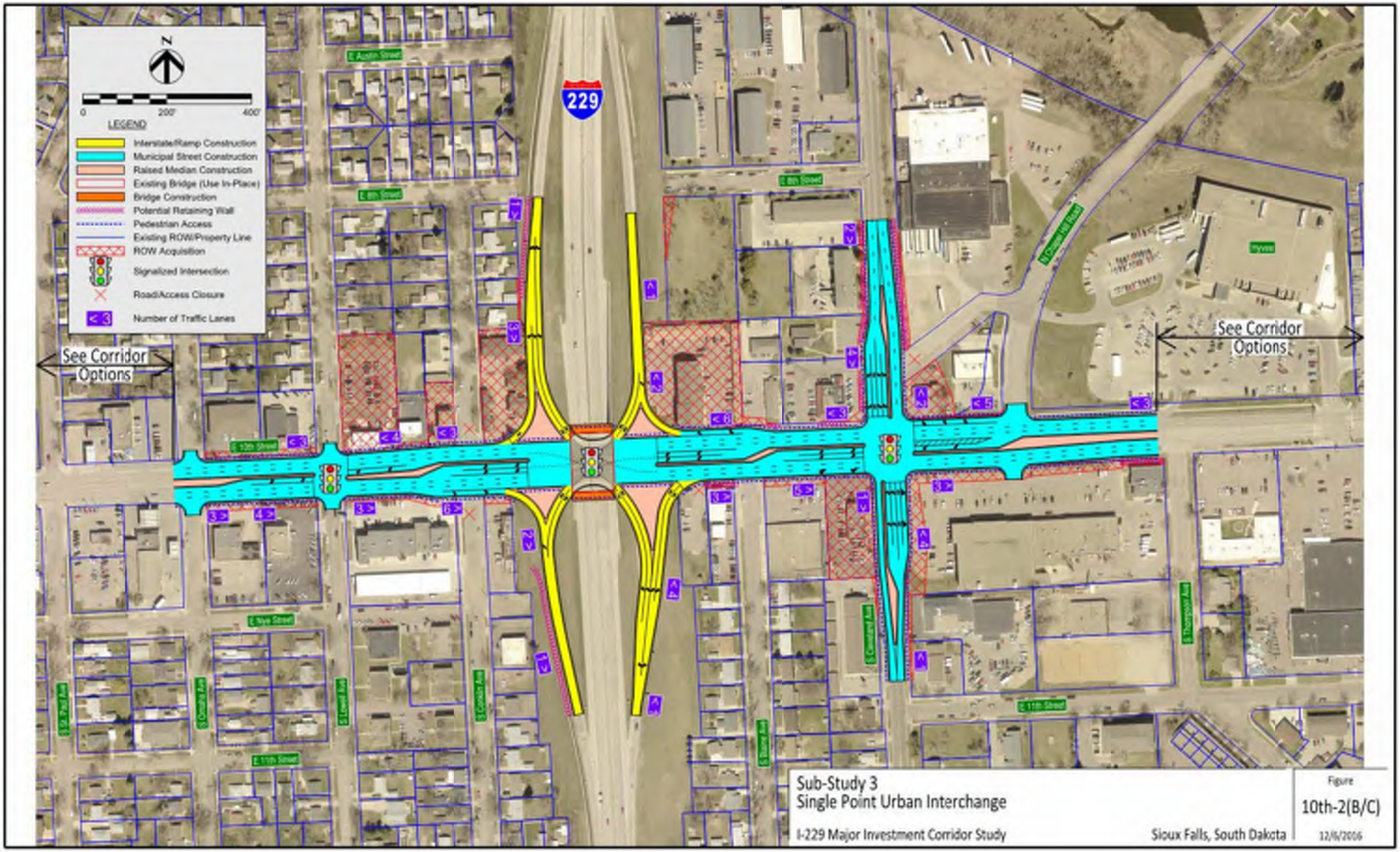
CONCEPT EVALUATION RESULTS

CLIFF AVENUE

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
No-Build	No-Build	POOR	NEUTRAL	N/A	N/A	N/A	**Advance**
Cliff-1	NB Cliff to SB I-229 Loop Ramp	GOOD	NEUTRAL	GOOD	GOOD	GOOD	**Advance**
Cliff-6	Single Point Urban Interchange, 41st St Realigned to Pam Rd	VERY GOOD	GOOD	GOOD	POOR	POOR	**Advance**
Cliff-7	Single Point Urban Interchange, SB I-229 Off-Ramp Thru & Right Turns at 41st St	GOOD	GOOD	GOOD	VERY GOOD	POOR	**Advance**

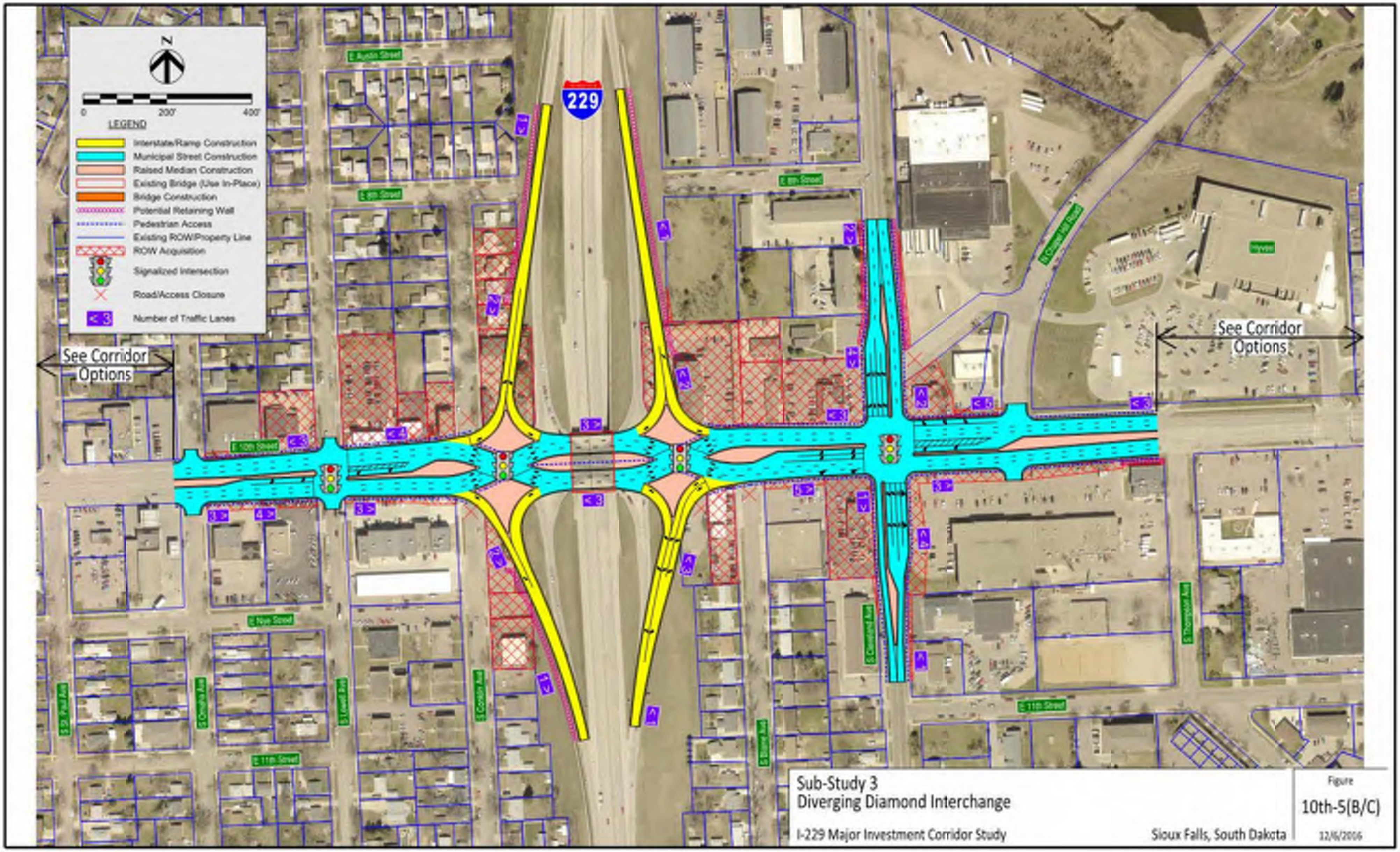
CONCEPTS FOR FURTHER CONSIDERATION

10TH STREET – 2 (B/C)



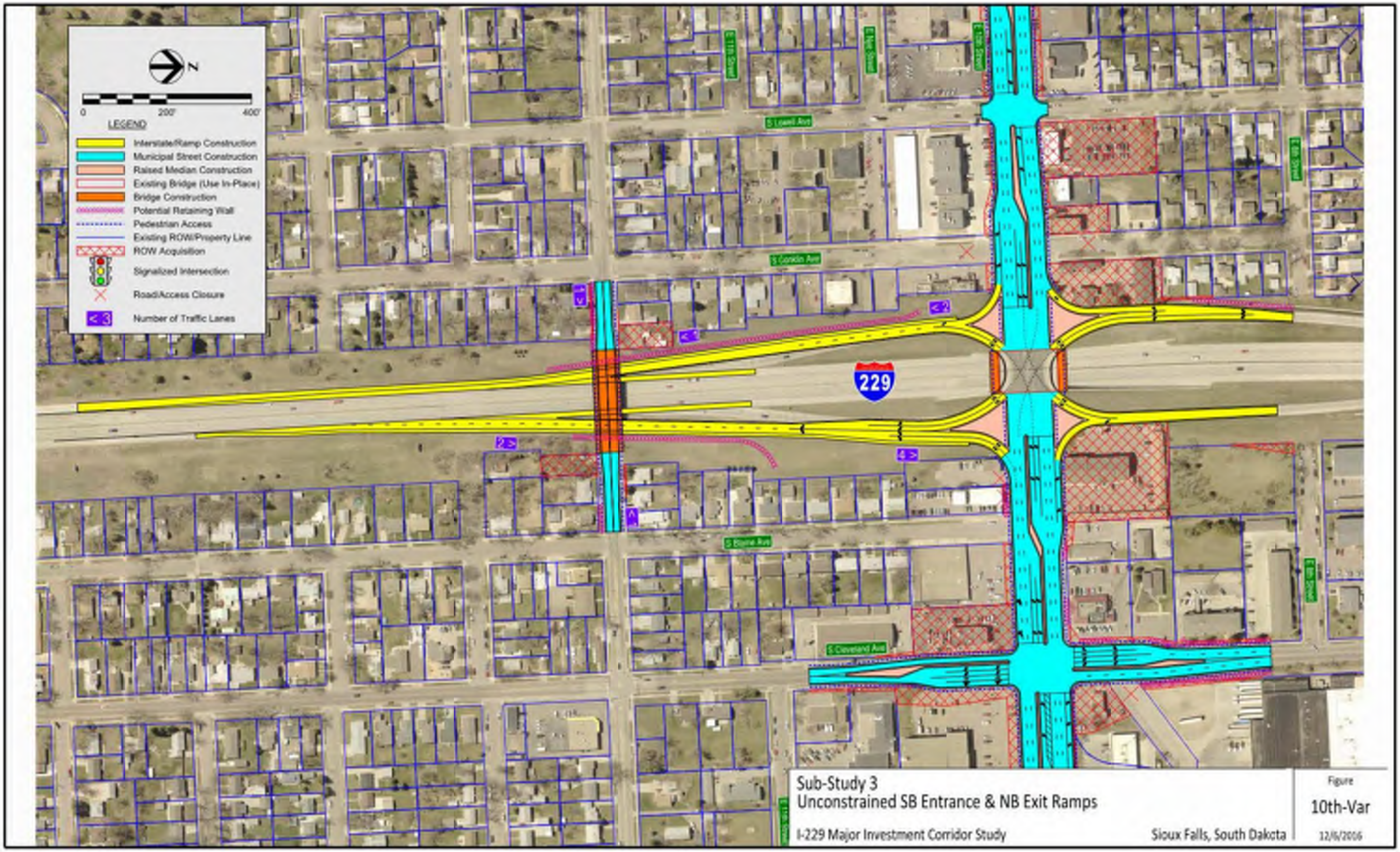
CONCEPTS FOR FURTHER CONSIDERATION

10^{TH} STREET – 5 (B/C)



CONCEPTS FOR FURTHER CONSIDERATION

10TH STREET – VAR



Sub-Study 3
Unconstrained SB Entrance & NB Exit Ramps

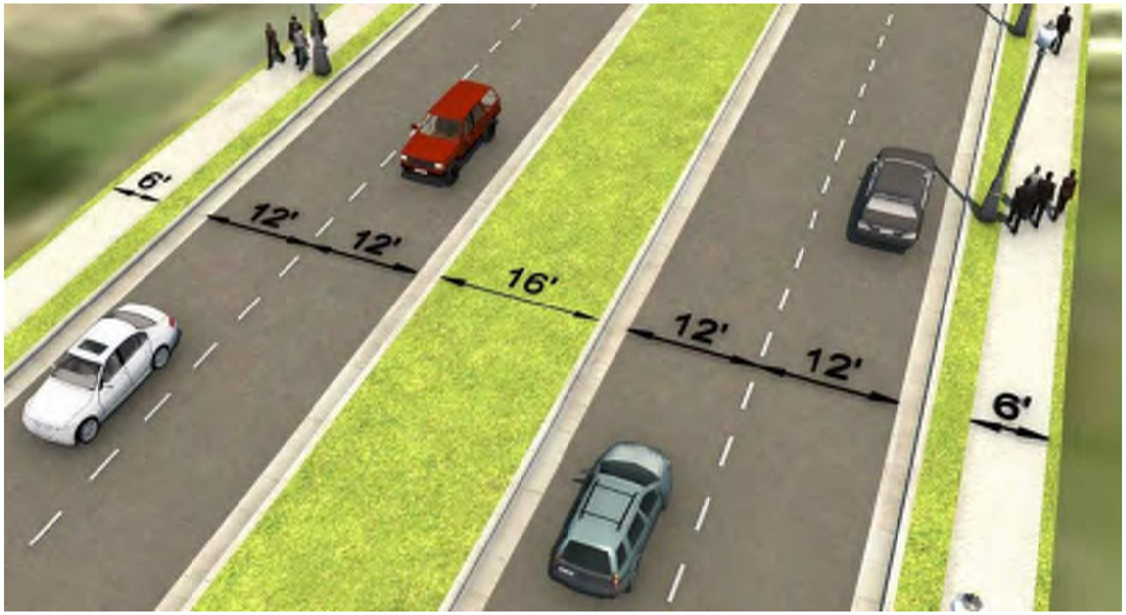
I-229 Major Investment Corridor Study

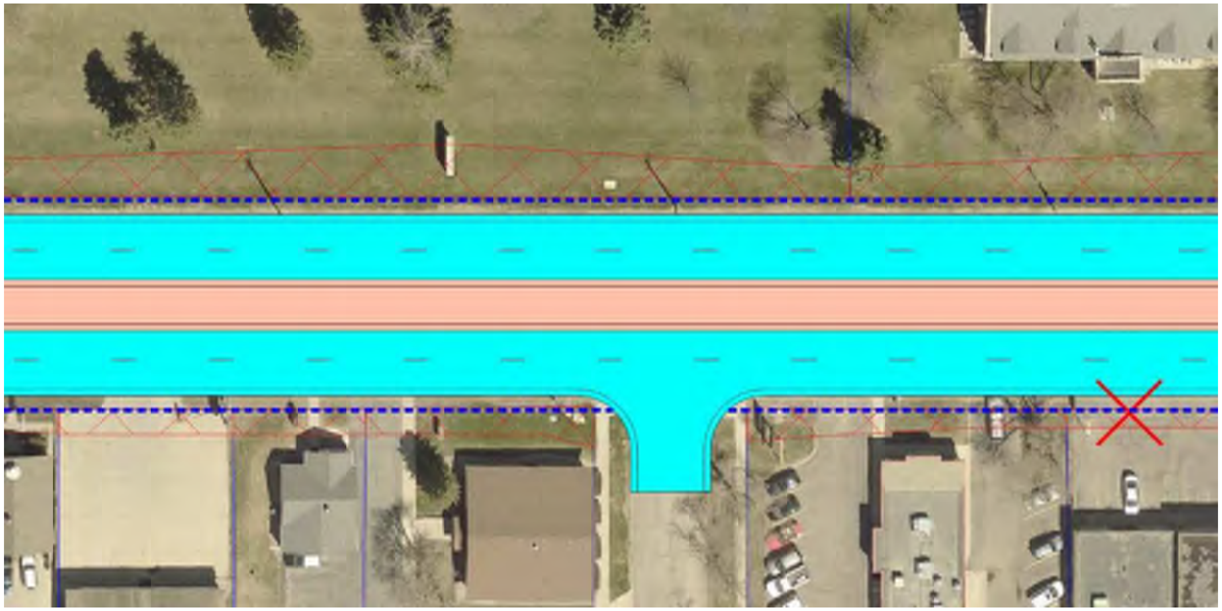
Sioux Falls, South Dakota

10th-Var

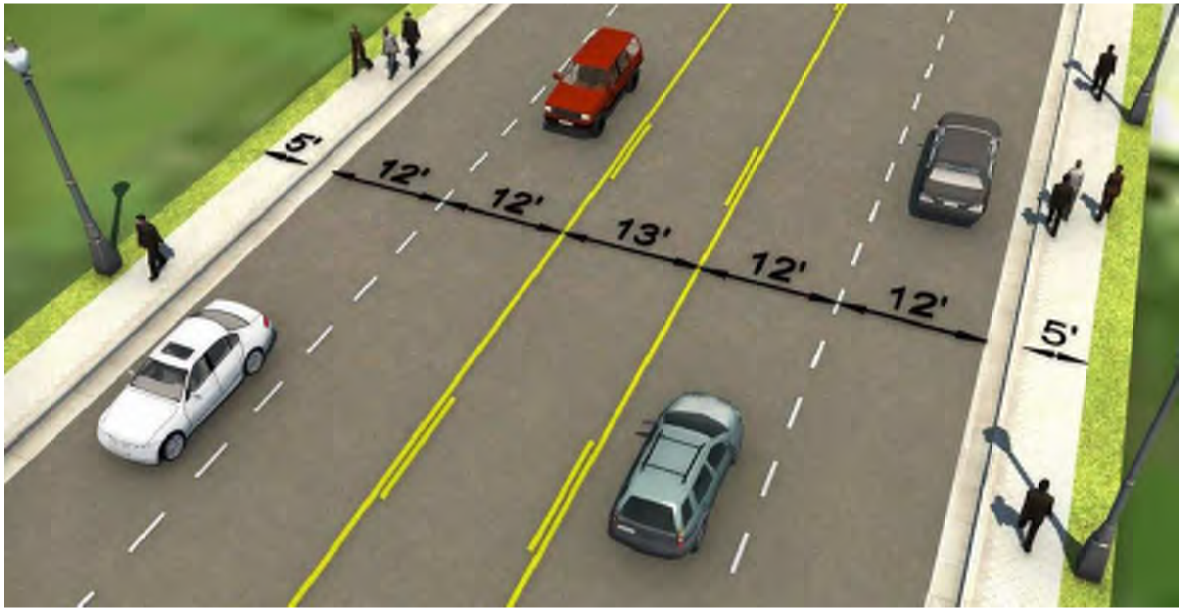
12/6/2016

4-Lane Divided Corridor





5-Lane Undivided Corridor



CONCEPT EVALUATION RESULTS

10TH STREET

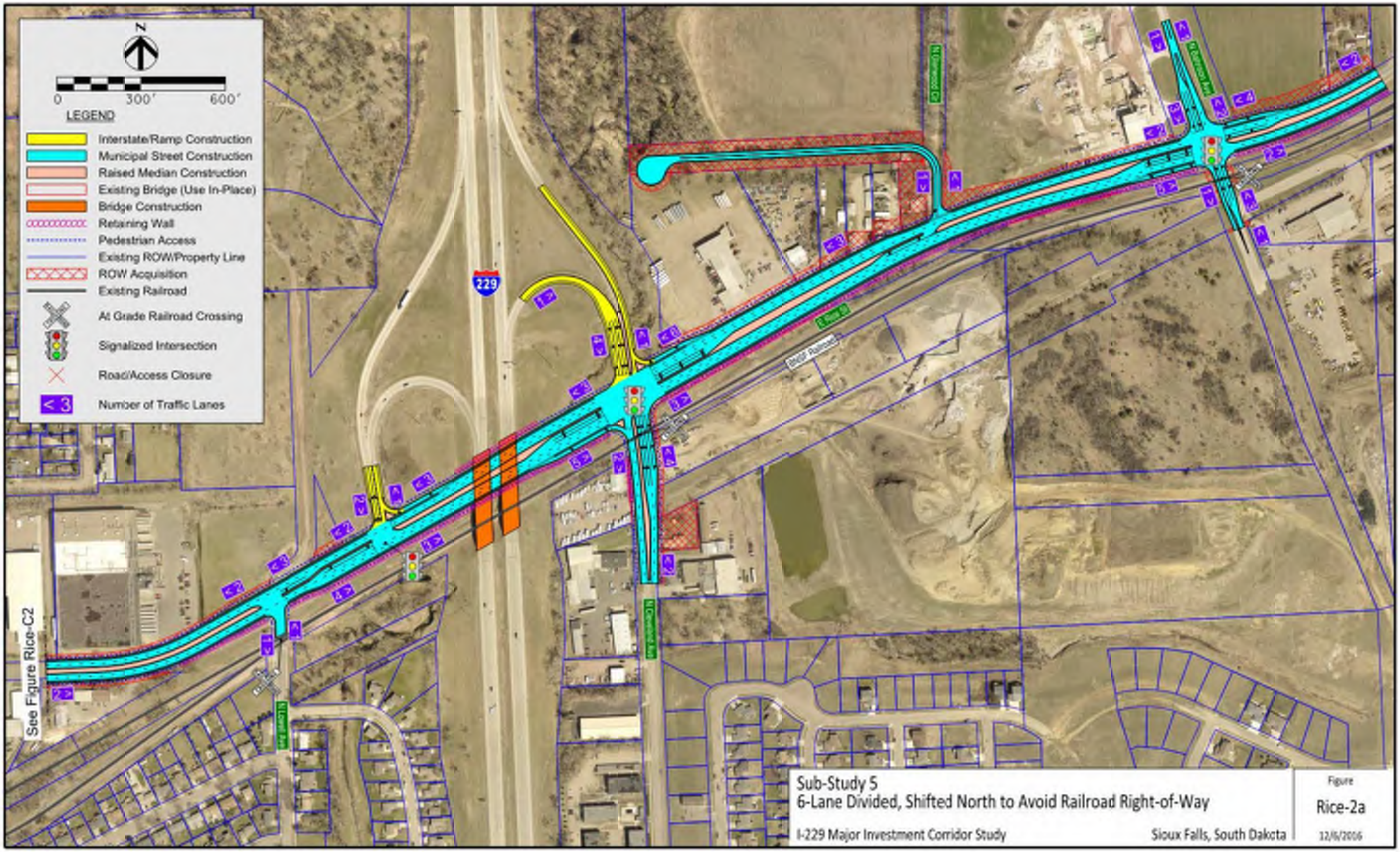
Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
No-Build	No-Build	POOR	NEUTRAL	N/A	N/A	N/A	**Advance**
10th-2A	Single Point Urban Interchange, 6-Lane Divided Corridor	VERY GOOD	NEUTRAL	NEUTRAL	POOR	POOR	**Eliminate** Property impacts, environmental impacts, and cost
10th-2B	Single Point Urban Interchange, 4-Lane Divided Corridor	GOOD	NEUTRAL	NEUTRAL	NEUTRAL	NEUTRAL	**Advance**
10th-2C	Single Point Urban Interchange, 5-Lane Undivided Corridor	GOOD	NEUTRAL	NEUTRAL	GOOD	GOOD	**Advance**

CONCEPT EVALUATION RESULTS 10TH STREET (cont.)

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
10th-5A	Diverging Diamond Interchange, 6-Lane Divided Corridor	VERY GOOD	GOOD	NEUTRAL	POOR	POOR	**Eliminate** Property impacts, environmental impacts, and cost
10th-5B	Diverging Diamond Interchange, 4-Lane Divided Corridor	GOOD	GOOD	NEUTRAL	NEUTRAL	NEUTRAL	**Advance**
10th-5C	Diverging Diamond Interchange, 5-Lane Undivided Corridor	GOOD	GOOD	NEUTRAL	GOOD	GOOD	**Advance**
10th-9A	Tight Split Diamond, 6th St/10th St with 4-Lane Divided Corridor	NEUTRAL	POOR	POOR	NEUTRAL	POOR	**Eliminate** Environmental impacts, cost, and lower traffic & safety benefits
10th-9B	Tight Split Diamond, 6th St/10th St with 5-Lane Undivided Corridor	NEUTRAL	POOR	POOR	GOOD	NEUTRAL	**Eliminate** Environmental impacts and lower traffic & safety benefits
10th-Var							**Advance**

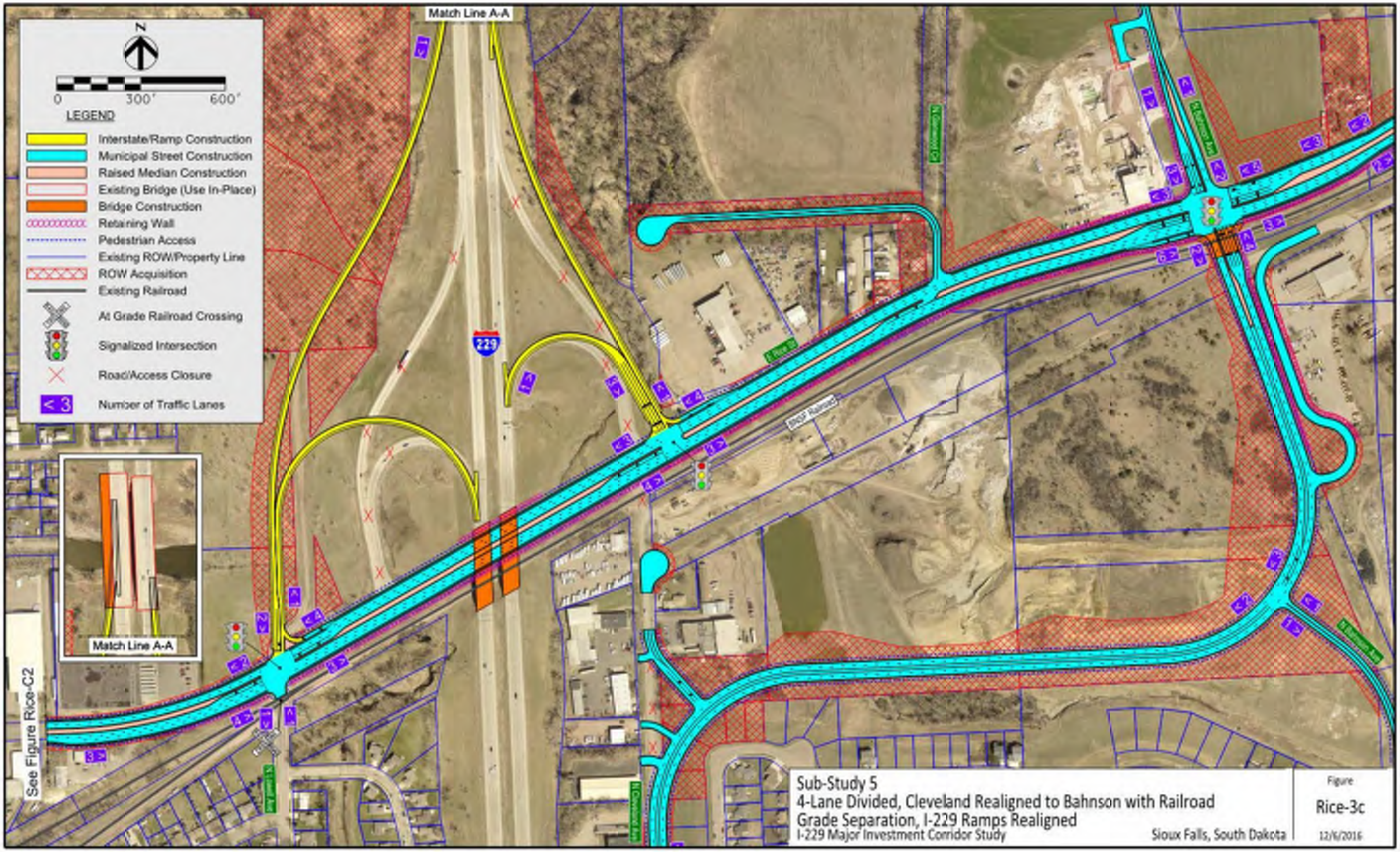
CONCEPTS FOR FURTHER CONSIDERATION

RICE STREET – 2A



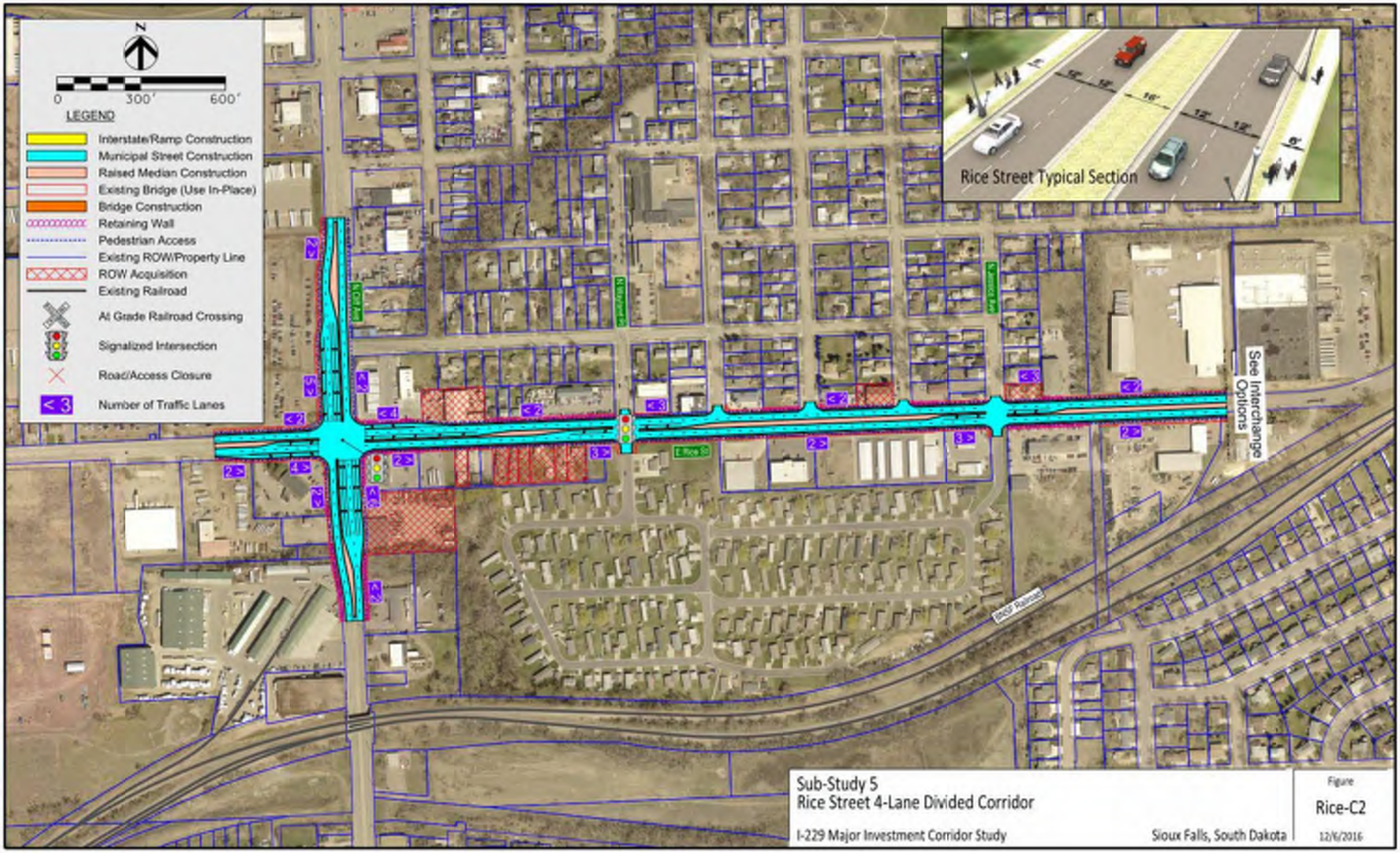
CONCEPTS FOR FURTHER CONSIDERATION

RICE STREET – 3C



CONCEPTS FOR FURTHER CONSIDERATION

RICE STREET – C2



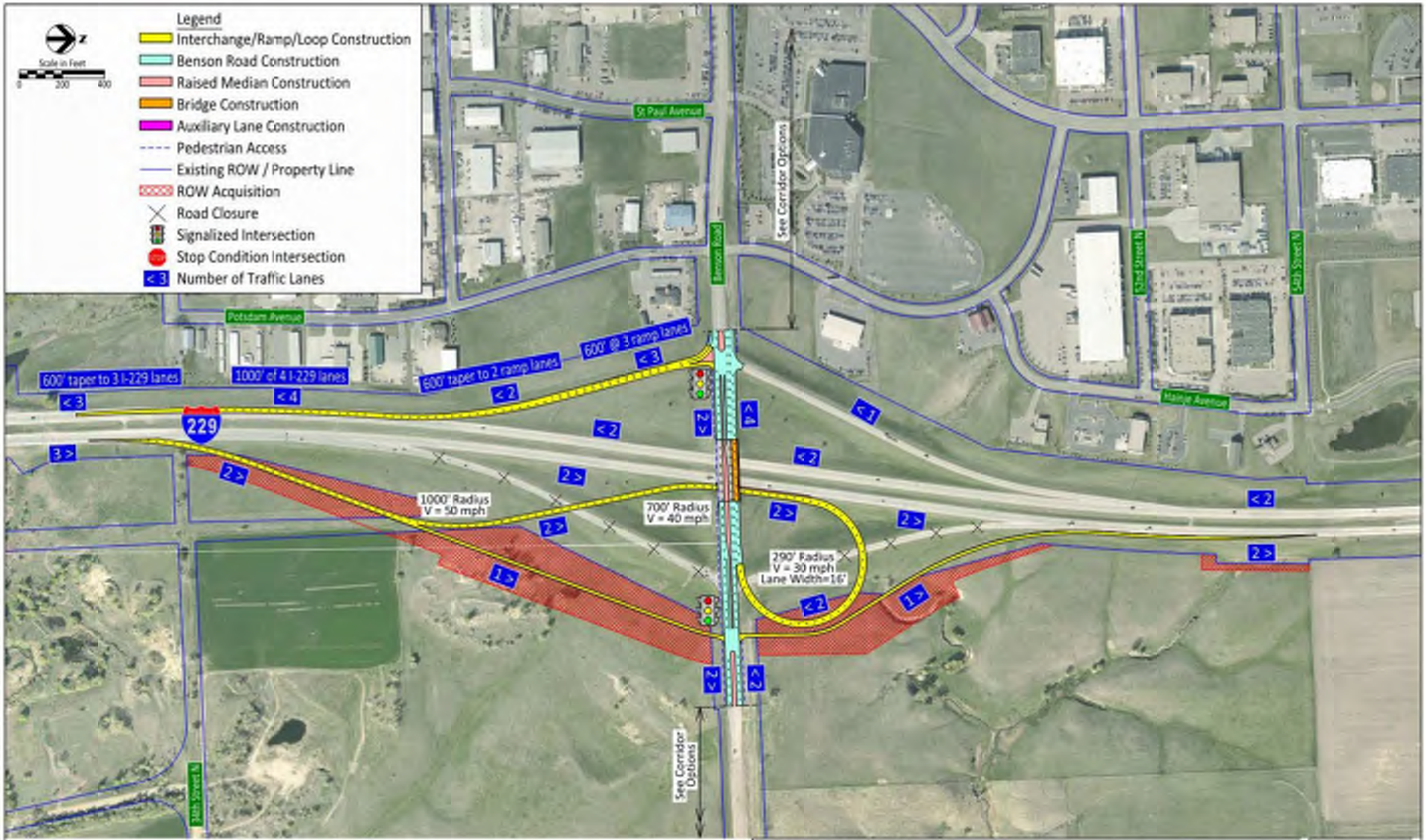
CONCEPT EVALUATION RESULTS

RICE STREET

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
No-Build	No-Build	POOR	NEUTRAL	N/A	N/A	N/A	**Advance**
Rice-2	6-Lane Divided	VERY GOOD	GOOD	NEUTRAL	GOOD	GOOD	**Advance**
Rice-2A	6-Lane Divided, Shifted North to Avoid Railroad Right-of-Way	VERY GOOD	GOOD	NEUTRAL	GOOD	GOOD	**Advance**
Rice-3C	4-Lane Divided, Cleveland Realigned to Bahnson with Railroad Grade Separation, I-229 Ramps Realigned	VERY GOOD	VERY GOOD	POOR	POOR	POOR	**Advance**

CONCEPTS FOR FURTHER CONSIDERATION

BENSON ROAD – 1A



Benson Road Corridor
2-Lane Northeast Quadrant Loop with 3-Lane SB On-Ramp

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

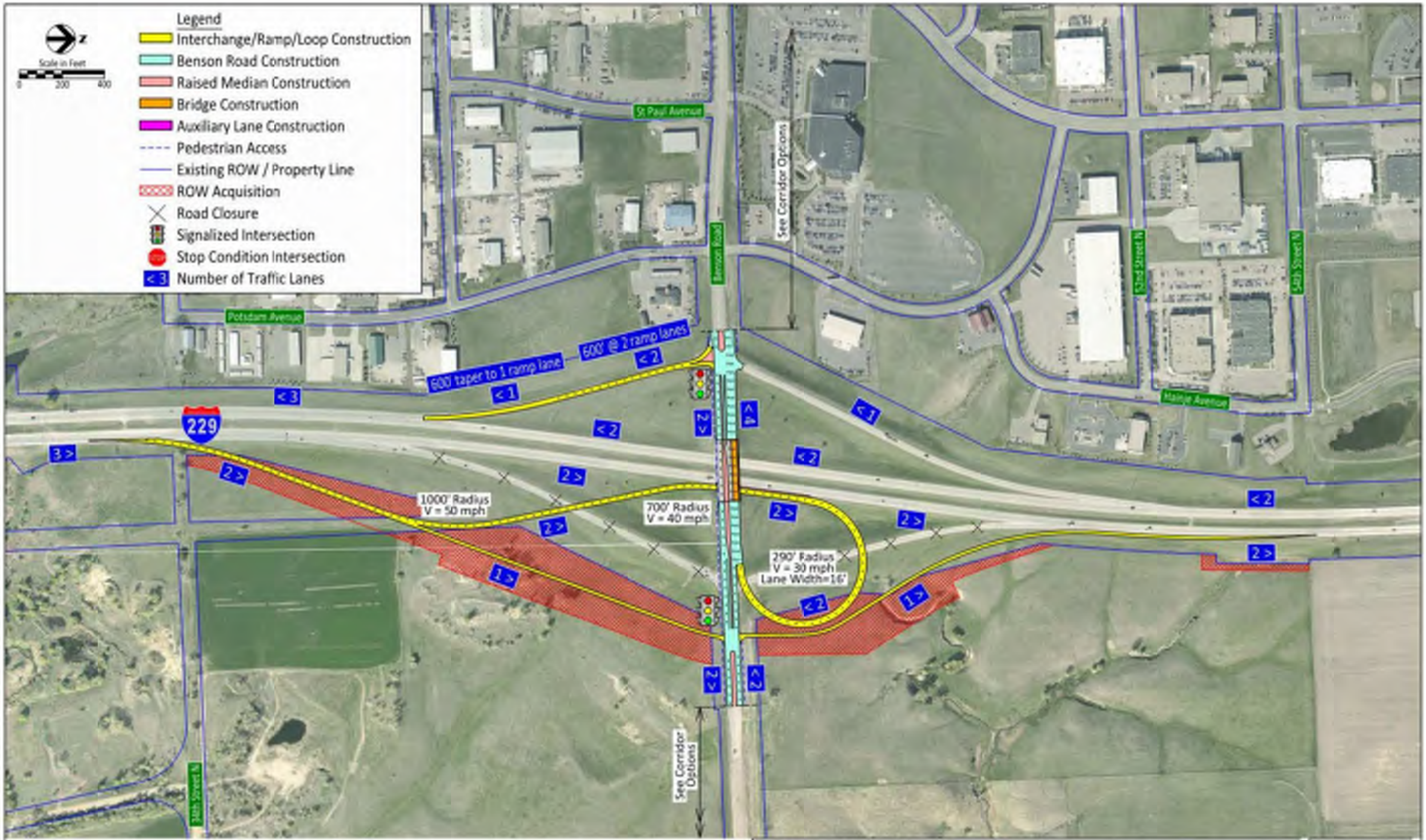
Figure

Benson-1a

12/6/2016

CONCEPTS FOR FURTHER CONSIDERATION

BENSON ROAD – 1B



Benson Road Corridor
2-Lane Northeast Quadrant Loop with 2-Lane SB On-Ramp

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

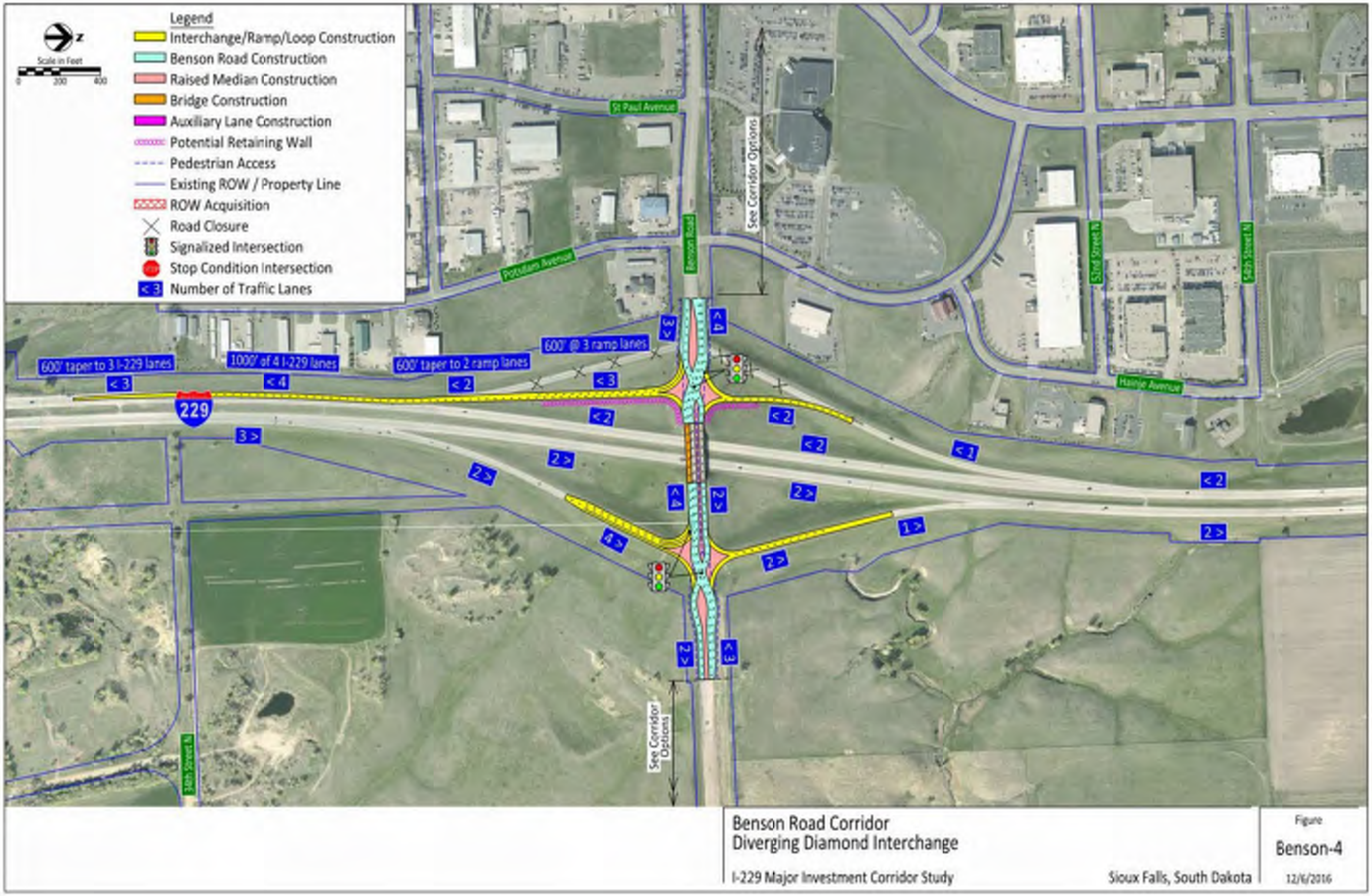
Figure

Benson-1b

12/6/2016

CONCEPTS FOR FURTHER CONSIDERATION

BENSON ROAD – 4



Benson Road Corridor
Diverging Diamond Interchange

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure
Benson-4
12/6/2016

CONCEPT EVALUATION RESULTS

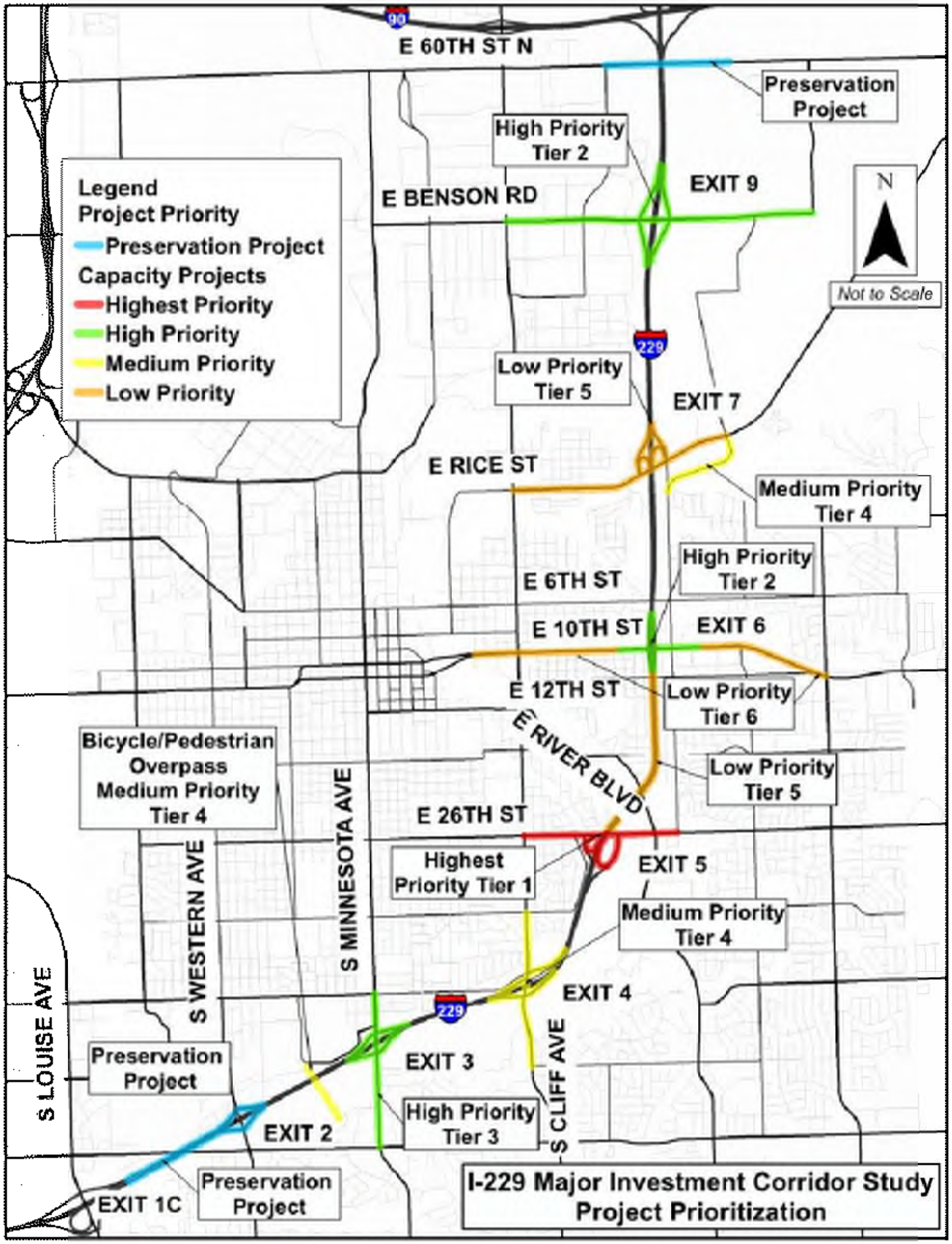
BENSON ROAD

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
No-Build	No-Build	POOR	NEUTRAL	N/A	N/A	N/A	**Advance**
Benson-1A	2-Lane Northeast Quadrant Loop with 3-Lane SB On-Ramp	VERY GOOD	GOOD	NEUTRAL	NEUTRAL	NEUTRAL	**Advance**
Benson-1B	2-Lane Northeast Quadrant Loop with 2-Lane SB On-Ramp	VERY GOOD	GOOD	NEUTRAL	NEUTRAL	NEUTRAL	**Advance**
Benson-4	Diverging Diamond Interchange	NEUTRAL	VERY GOOD	GOOD	VERY GOOD	NEUTRAL	**Advance**

FUTURE I-229 CORRIDOR PROJECTS

PRELIMINARY PRIORITIZATION

- Minnesota Avenue
- Cliff Avenue
- 10th Street
- Rice Street
- Benson Road
- Other projects list



NEXT STEPS

- Assemble Stakeholder and Public Comments
- SDDOT / City Finalize Project Priorities
- Complete Study Reports
- SDDOT / City Program Projects
- Project Development Process = 5-6 year timeline when initiated by SDDOT & City
    - Prepare Interchange Modification Justification Report and Environmental Document
    - Develop Project Design
    - Acquire Right of Way
    - Construction

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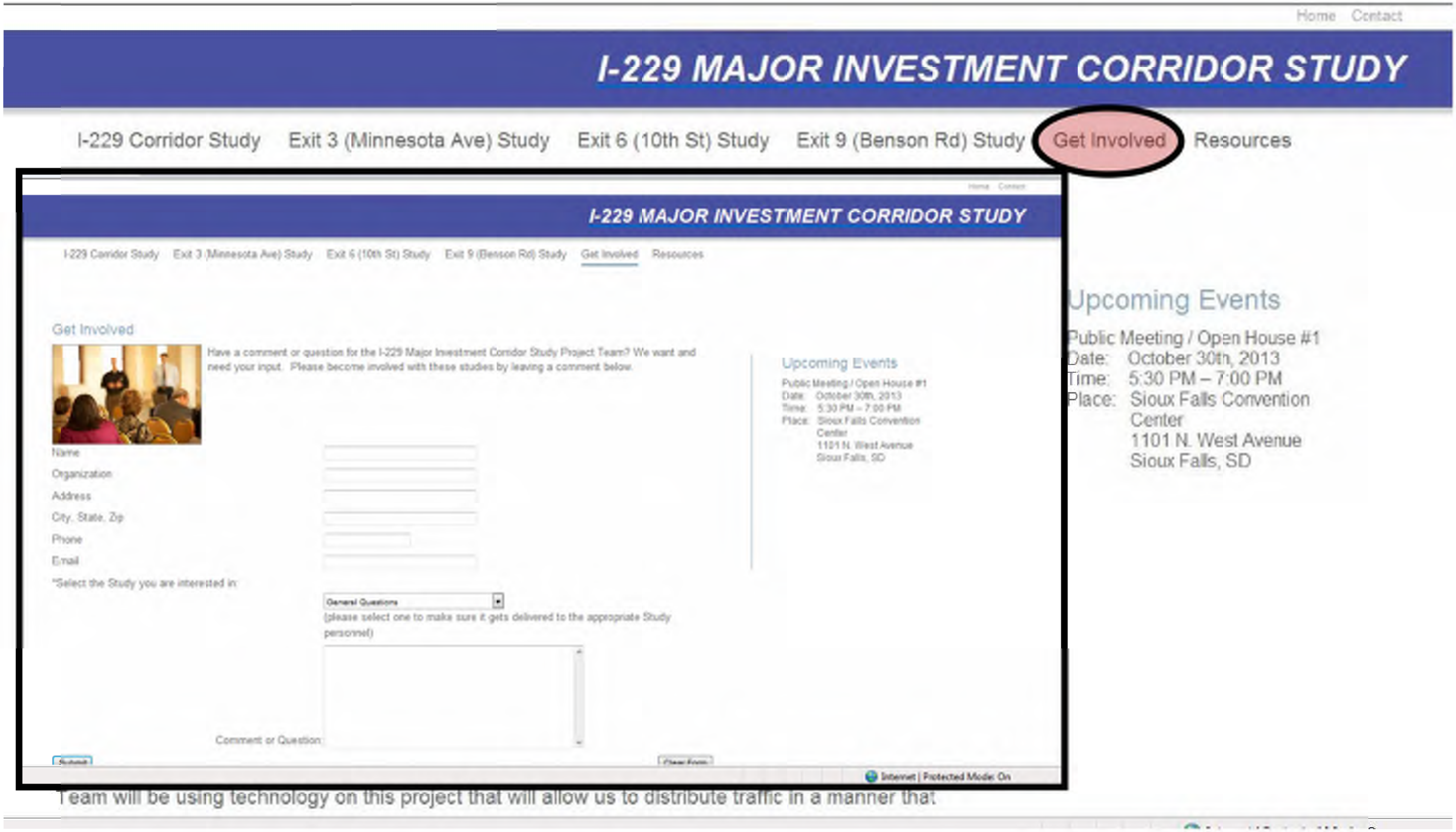

I-229 MAJOR INVESTMENT CORRIDOR STUDY

Get Involved

Have a comment or question for the I-229 Major Investment Corridor Study Project Team? We want and need your input. Please become involved with these studies by leaving a comment below.

*Select the Study you are interested in:

General Questions

(please select one to make sure it gets delivered to the appropriate Study personnel)

Comment or Question:

Upcoming Events

Public Meeting / Open House #1
Date: October 30th, 2013
Time: 5:30 PM – 7:00 PM
Place: Sioux Falls Convention Center
1101 N. West Avenue
Sioux Falls, SD

Team will be using technology on this project that will allow us to distribute traffic in a manner that

PROJECT CONTACTS:

Jason Kjenstad – HDR Engineering, Inc.
605-977-7740 or jason.kjenstad@hdrinc.com

Dave Meier – HDR Engineering, Inc.
402-399-1068 or dave.meier@hdrinc.com

Shannon Ausen – City of Sioux Falls
605-367-8607 or sausen@siouxfalls.org

Steve Gramm – SDDOT Project Development
605-773-6641 or steve.gramm@state.sd.us

INTERSTATE 229 MAJOR INVESTMENT STUDY

Thanks for attending!

APPENDIX -

STAKEHOLDER MEETINGS #1 –

DECEMBER 15TH & 16TH, 2014

JUNE 22ND, 2016 (CLIFF AVENUE & RICE STREET)

BENSON ROAD

DECEMBER 15TH, 2014

- MEETING NOTES
- SIGN-IN SHEETS
- POWERPOINT SLIDES

Meeting Minutes

Project:	I-229 Major Investment Corridor Study; PL 0100(87) 3616P, PCN 044K
Subject:	Stakeholder Meeting – Sub-study 4 (Benson Road from Cliff Avenue to Sycamore Avenue)
Date:	Monday, December 15, 2014
Location:	Sioux Falls Convention Center Conference Room 6
Attendees:	Paul Nikolas, Travis Dressen (SDDOT) Heath Hoftiezer, (City of Sioux Falls) Russ Robers (First National Bank) Jason Kjenstad, James Unruh (HDR)

Jason Kjenstad covered the PowerPoint slides (attached to meeting notes).

Follow-up discussion items included:

1. Existing Benson Road traffic observations:
    1.1 A.M. peak hour – Westbound traffic on Benson Road west of I-229 is heavy and limits access from the I-229 SB off-ramp and from driveways along Benson Road.
    1.2 P.M. peak hour – Eastbound traffic is heavy but flows reasonably well under normal traffic conditions (if there is no traffic diverted from other areas).
        - The EB to SB movement at the I-229 SB on-ramp is at capacity.
        - There is a high volume of left turning traffic from Potsdam Avenue to Benson Road. It is difficult for this traffic to find gaps in the Benson Road traffic.
    1.3 Off-peak periods – The Lewis Avenue/Benson Road intersection is busy but not congested.
2. Existing I-229 traffic observations
    2.1 Traffic coming from the on-ramps tends to merge into I-229 traffic before getting up to adequate speeds rather than staying in the auxiliary lane. The worst location for this is the 26th Street SB on-ramp where the ramp traffic speeds are slow due to the tight ramp curve. It was noted that the preferred 26th Street interchange configuration will improve this condition.
    2.2 At 10th Street, the trucks turning from the SB off-ramp to EB 10th Street make the turn through the single point intersection slowly and cause the SB off-ramp traffic to back up to I-229 during peak hour traffic. Hoftiezer noted that this is partly due to how the loop detectors sense the truck traffic.
3. Existing geometric constraints
    3.1 The south leg of the Lewis Avenue intersection is too narrow for the trucks that turn onto and off of Benson Road.
4. Benson Road improvement considerations
    4.1 If a 3rd WB lane is added from I-229 to Lewis Avenue, the Potsdam Avenue intersection may need to be right-in/right-out or a ¾ access condition with restriction of left-out movements. Potsdam traffic would re-route to Lewis Avenue. A signalized intersection along Lewis Avenue would be required to accommodate this traffic. Rob suggested that a signal may be most effective at 54th Street.
    4.2 A 3rd EB lane may be necessary from Lewis Avenue to I-229 with free-flow conditions for the SB on-ramp movement. Dual right turns at the SB on-ramp would require signalization and may reduce capacity in comparison to an unrestricted movement.

    - 4.3 The forecast traffic volumes for the MIS project assume that Benson Road will be extended to the east from Sycamore Avenue across the Big Sioux River. The timeframe for this is not known.

5. I-229 improvement considerations
    - 5.1 60th Street access to/from I-229 would help divert traffic from Benson Road. It was noted the Federal Highway Administration limits the type of access at 60th Street due to the close proximity to I-90 to the north.
    - 5.2 Benson Road/I-229 ramp terminals will likely need to be signalized.
    - 5.3 Various interchange configurations are being considered for Benson Road. The configurations will be presented at the next public meeting.

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Stakeholder Meetings for Benson Road Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3516P, PCN 044K

Project No.: 207030

Meeting Date Monday, December 15, 2014 5:30 PM

Meeting Location: Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	James Unruh	HDR, Inc. 6300 S. Old Village Pl	605-977-7766	james.unruh@hdrinc.com
2	Jason Kjenstad			
3	Heath Hoftiezer	City of Sioux Falls		
4	Paul Nikolas	SDDOT		
5	Travis Dressen	SDDOT		
6	Russ Robers First Nat'l Bank	1901 E. Benson Rd SF SD 57104	605-782-5801	rcrobers@fnbsf.com
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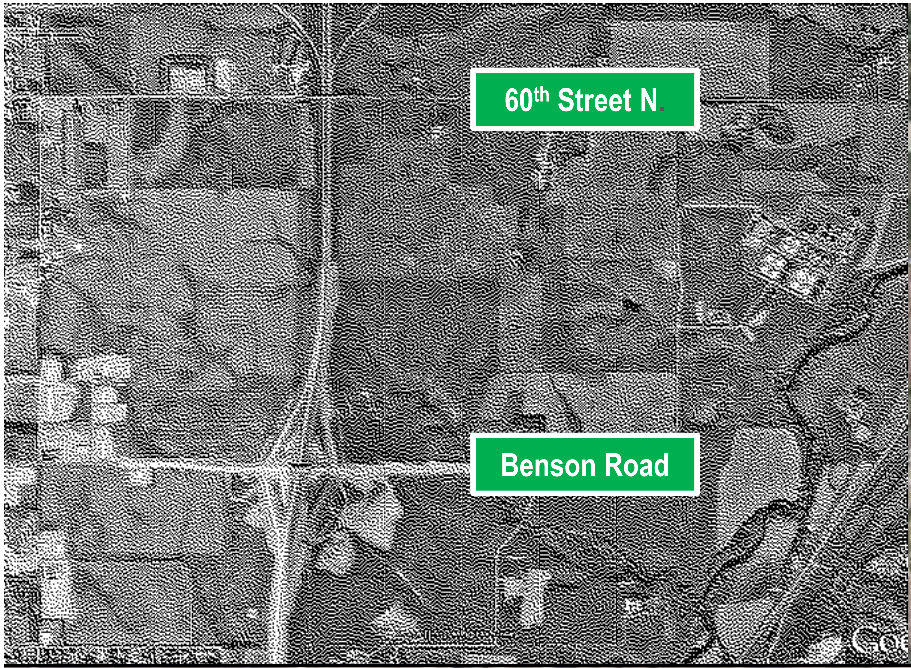


Interstate 229 Major Investment Study
Exit 9 – Benson Rd

Stakeholder Meeting
December 15th, 2014
5:30 pm to 6:30 pm

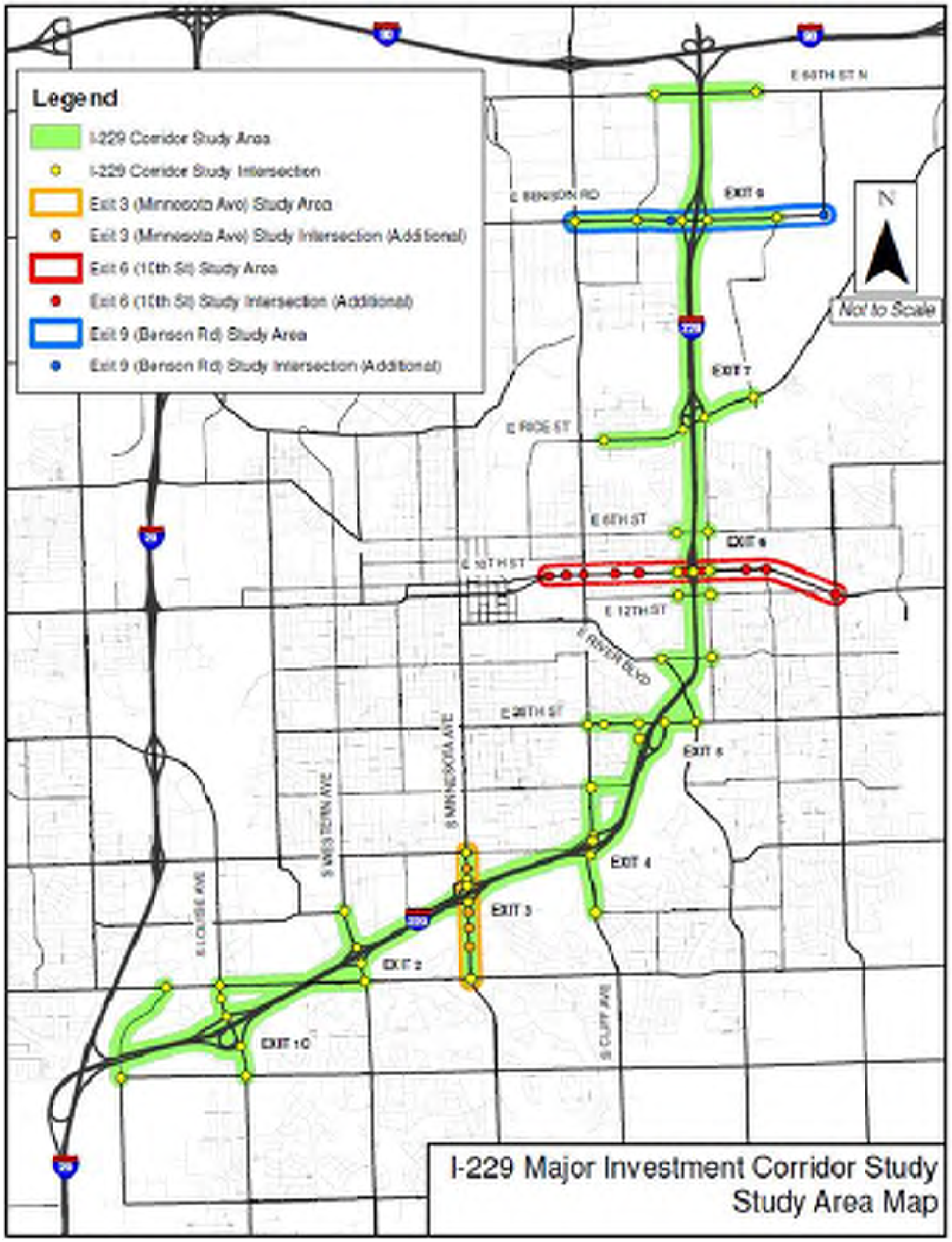
Study Area Map

I-229 Corridor Study

Solberg Avenue Overpass
to
60th Street N. Overpass

Additional Studies

Exit 3 – Minnesota Ave
Exit 6 – 10th Street
Exit 9 – Benson Road



Study Advisory Partners

South Dakota Department of Transportation (SDDOT)

South Dakota Highway Patrol

City of Sioux Falls

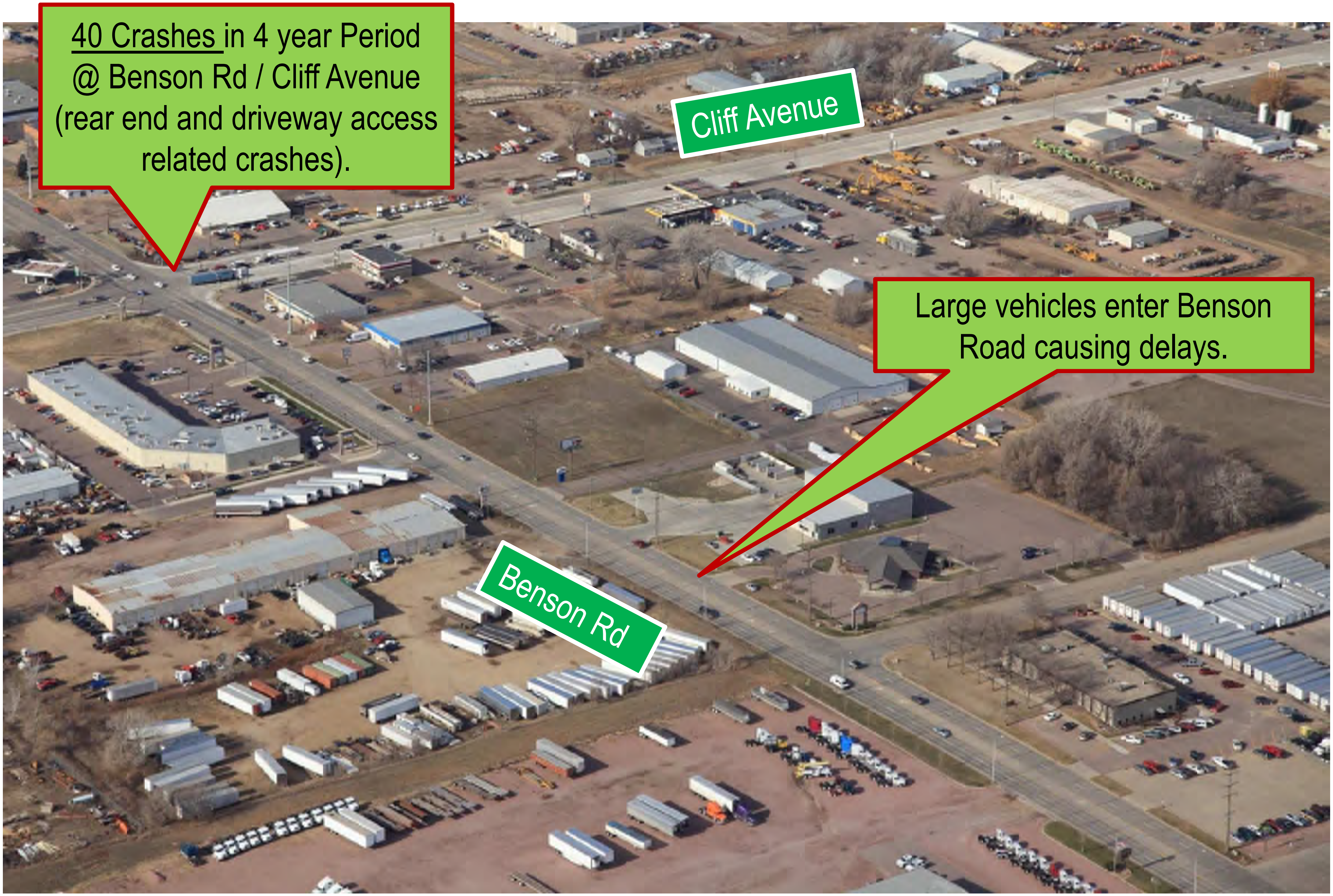
Sioux Falls Metropolitan Planning Organization (MPO)

Federal Highway Administration (FHWA)

Exit 9 (Benson Road) Crossroad Study Goals

- Reduce traffic congestion at NB on/off interchange ramp terminal
- Develop Corridor Growth Plan to meet traffic demands from development taking place east of I-229
- Improve pedestrian mobility
- Make recommendations to improve corridor intersections
- Develop interchange alternatives to meet future traffic demands

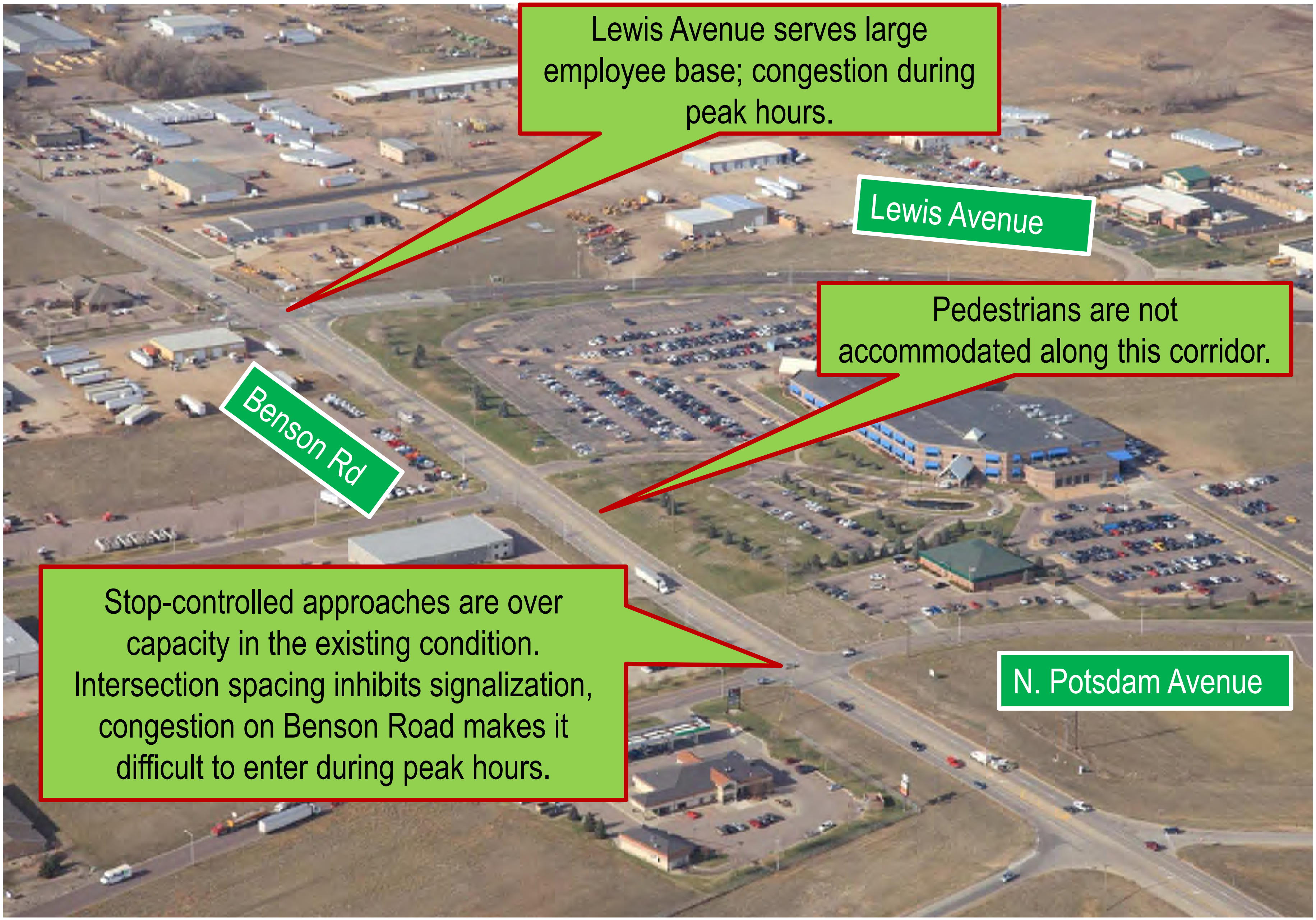
Benson Rd Corridor Overview



40 Crashes in 4 year Period @ Benson Rd / Cliff Avenue (rear end and driveway access related crashes).

Large vehicles enter Benson Road causing delays.

Benson Rd Corridor Overview

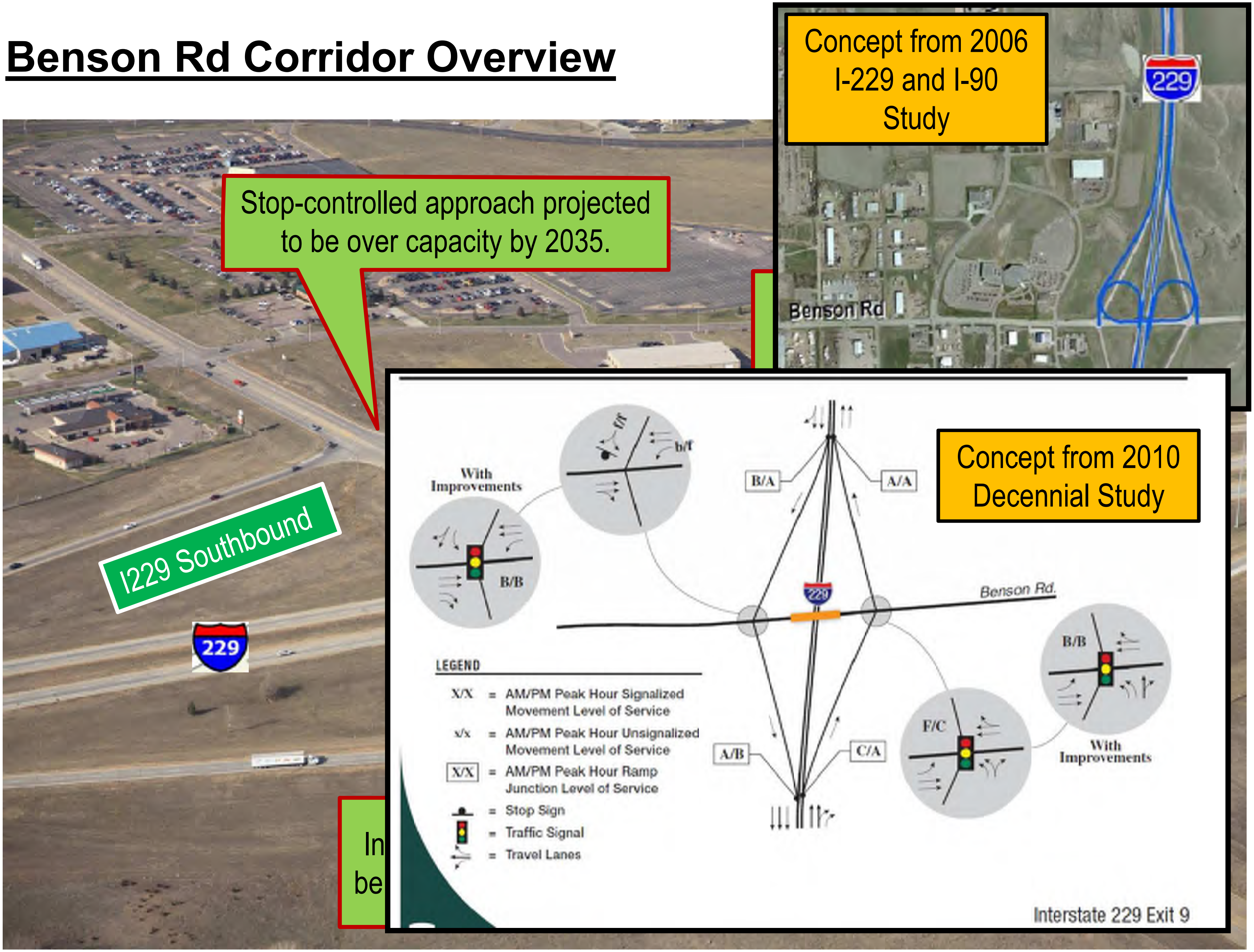


Lewis Avenue serves large employee base; congestion during peak hours.

Pedestrians are not accommodated along this corridor.

Stop-controlled approaches are over capacity in the existing condition. Intersection spacing inhibits signalization, congestion on Benson Road makes it difficult to enter during peak hours.

Benson Rd Corridor Overview



Stop-controlled approach projected to be over capacity by 2035.

I229 Southbound

In

be

Concept from 2006 I-229 and I-90 Study

Concept from 2010 Decennial Study

LEGEND

X/X = AM/PM Peak Hour Signalized Movement Level of Service

x/x = AM/PM Peak Hour Unsignalized Movement Level of Service

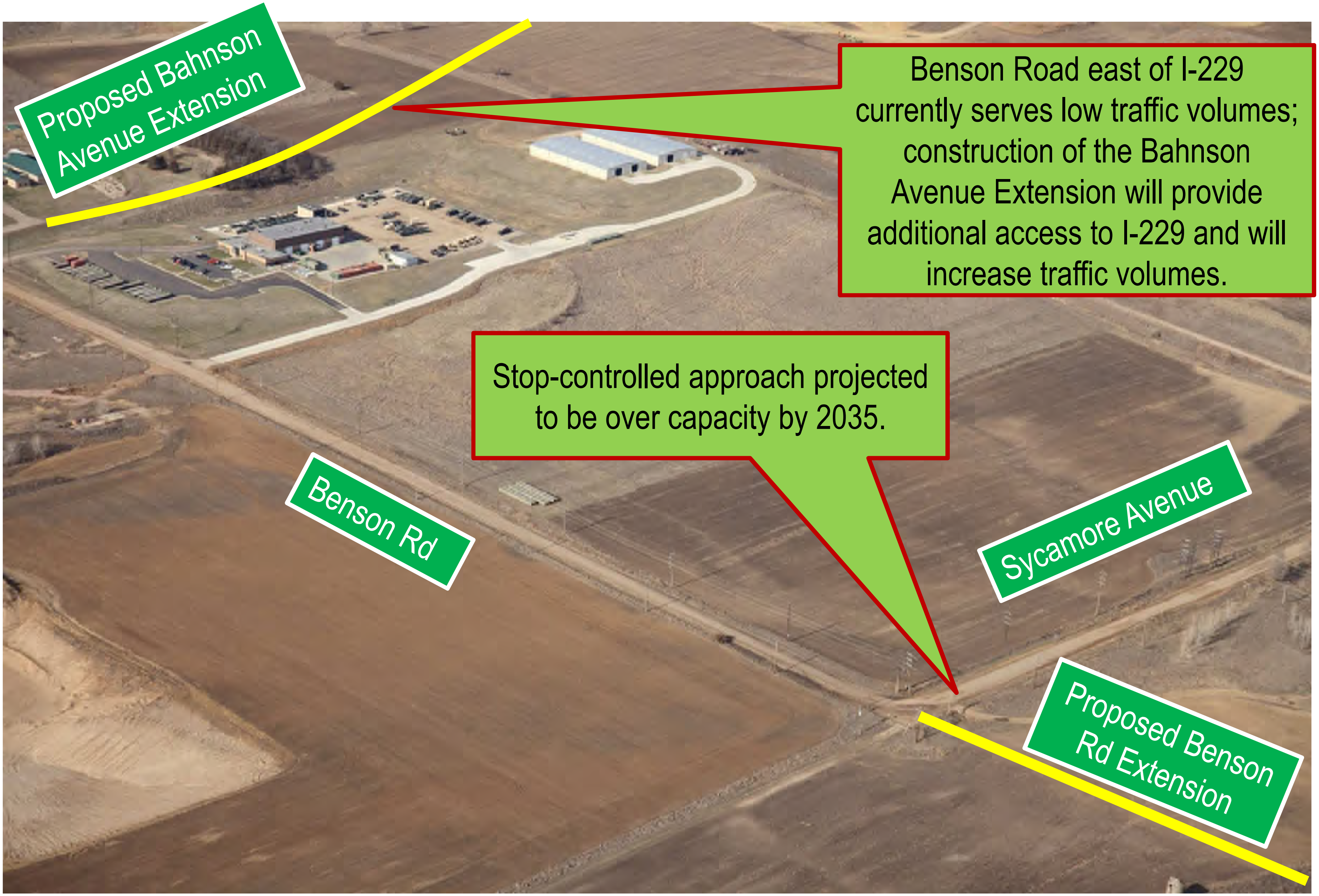
X/X = AM/PM Peak Hour Ramp Junction Level of Service

= Stop Sign

= Traffic Signal

= Travel Lanes

Benson Rd Corridor Overview



Benson Road east of I-229 currently serves low traffic volumes; construction of the Bahnson Avenue Extension will provide additional access to I-229 and will increase traffic volumes.

Stop-controlled approach projected to be over capacity by 2035.

PROJECT CONTACTS:

Jason Kjenstad – HDR Engineering, Inc.
605-977-7740 or jason.kjenstad@hdrinc.com

James Unruh – HDR Engineering, Inc.
605-977-7740 or james.unruh@hdrinc.com

Shannon Ausen – City of Sioux Falls
605-367-8607 or sausen@siouxfalls.org

Steve Gramm – SDDOT Project Development
605-773-6641 or steve.gramm@state.sd.us

Interstate 229 Major Investment Study
Exit 9 – Benson Rd

Thanks for Attending!!!!!

10TH STREET

DECEMBER 16TH, 2014

- MEETING NOTES
- SIGN-IN SHEETS
- POWERPOINT SLIDES

Meeting Minutes

Project:	I-229 Major Investment Corridor Study; PL 0100(87) 3616P, PCN 044K
Subject:	Stakeholder Meeting – Sub-study 3 (10th Street from Downtown Viaducts to Sycamore Avenue)
Date:	Tuesday, December 16, 2014
Location:	Sioux Falls Convention Center Conference Room 6
Attendees:	See attached Sign In sheets

Jason Kjenstad covered the PowerPoint slides (attached to meeting notes).

Follow-up discussion items included:

1. Existing 10th Street traffic observations:
    - 1.1 A.M. peak hour – Congestion on 10th Street in vicinity of interchange, WB through traffic queues can be obsessive from Cleveland to Hy-Vee.
    - 1.2 P.M. peak hour – Congestion on 10th Street in vicinity of interchange, WB & EB through traffic queues can be obsessive near I-229. High demand for turning traffic at 10th and Cleveland causes signal coordination issues with the I-229 interchange. Traffic queues on the interchange ramps are a concern.
2. Existing I-229 traffic observations
    - 2.1 Interchange congestion is noticed during the AM and PM peak hours.
    - 2.2 Crashes on the NB off ramp at 10th Street a problem, has been better since SDDOT lengthened ramps onto the mainline.
3. Existing geometric constraints
    - 3.1 The 10th Street and I-229 Single Point Urban Interchange is restricted to single lefts in lieu of dual lefts which is a capacity limitation and leads to additional single lane queuing.
    - 3.2 Proper queue lengths are not provided at 10th Street and Cleveland causing overlaps with I-229 and 10th Street.
    - 3.3 10th and Sycamore was a high crash intersection due to the horizontal curvature, 2014 the intersection was reconstructed that changed all the lefts to dual movements that are protected movements. This will remove the crash trends.
4. 10th Street improvement considerations
    - 4.1 Place a raised median to improve traffic flow by removing conflict locations
    - 4.2 Possibility widen to 6 lanes to increase capacity
    - 4.3 Develop interchange alternatives that improve traffic flow a ¼ mile either side of I-229
    - 4.4 Restrict turning movements at specific intersections to improve traffic flow
5. I-229 improvement considerations
    - 5.1 Various interchange configurations are being considered for Minnesota Avenue. The configurations will be presented at the next public meeting.
    - 5.2 Add an additional lane from 26th Street to 10th Street on I-229 to provide increased capacity.

The following notes were gathered during the discussion with the adjacent landowners and business owners. The statements below are questions asked by the meeting attendees for us to consider as we develop options:

- Biggest problems with 10th St traffic operations are during morning and afternoon peak hours.
- Need to get commuters to use 6th St, 12th St and 18th St to access downtown to relieve 10th St.
- Would raising the posted speed limit on 10th St help traffic flow?
- Why was the traffic signal installed at Lowell?
- 10th St should be widened only at the I-229 interchange.
- Constructing medians slow businesses down.
- If there were ramps from I-229 to 6th and 12th those streets would be viable alternatives to 10th for downtown access. More exists on I-229 would be a cheaper investment than elevated lanes on 10th.
- At Cleveland, traffic from the north is the problem.
- Widening on Cleveland should be done on the east side.
- Relocate Old Home (from the east side of Cleveland).
- A median on Cleveland is not the answer.
- Improvements made at 10th and Sycamore was a good project.
- Relocate the Pizza Hut.
- I-229 should be connected to River Blvd with ramps.
- 6th St should be used instead of 12th St for a split diamond interchange with 10th St.
- Westbound to southbound left turns from 10th St to Cleveland are difficult to make.

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Stakeholder Meetings for 10th Street Sub-Study
Client City of Sioux Falls/South Dakota Department of Transportation
Project PL 0100(87) 3616P, PCN 044K
Project No.: 207030
Meeting Date Tuesday, December 16, 2014 3:30 PM
Meeting Location: Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	HERSIL PATEL	2616 E 10TH STREET SIOUX FALLS SD 57103	605 338 8881	gm@super8siouxfalls.com
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Sign In Sheet

Subject I-229 Major Investment Corridor Study – Stakeholder Meetings for 10th Street Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3616P, PCN 044K **Project No.:** 207030

Meeting Date Tuesday, December 16, 2014 3:30 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Tami Johnson	Casey's General Store - 1901 East 10th St.	515 371-7184	jajrtp63@gmail.com
2	Mark Elisson	101 S. Cleveland Ave	605-338-8151	melisson@sio.midco.net
3	Mike Bruns	2310 E 10th	605-728-1570	mike@buildersmw.com
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Sign In Sheet

Subject I-229 Major Investment Corridor Study – Stakeholder Meetings for 10th Street Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 361NP, PCN 044K **Project No.:** 207030

Meeting Date Tuesday, December 16, 2014 3:30 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Gary Busselman	SF SD 57110 7201 E Madison ST	605 334 5692	gary@garybuss.com
2	CHUCK GUSTAFSON	705 E. RIDGE RD SFSD 57105	332-1000	CGUSTAFSON@mac.com
3	Travis Dressen	SF Area DOT	367-5680	travis.dressen@state.sd.us
4	Lynne Beatty	2520 W. 8th St SF SD 57104	339-1053	lynne.[illegible]@[illegible]
5	Shannon Ausen	224 [illegible] St	367-8607	sausen@siouxfalls.org
6	Gayle Nelson	2901 57103 S Bahnson	366-5782	DEKDAD@AOL.com
7	Layton [illegible]	301 S. Blaine	338-2206	
8	Quality Efficiencies Linda Hart	3503 S Norton Ave Sioux Falls, SD 57105	339-3382	[illegible].com
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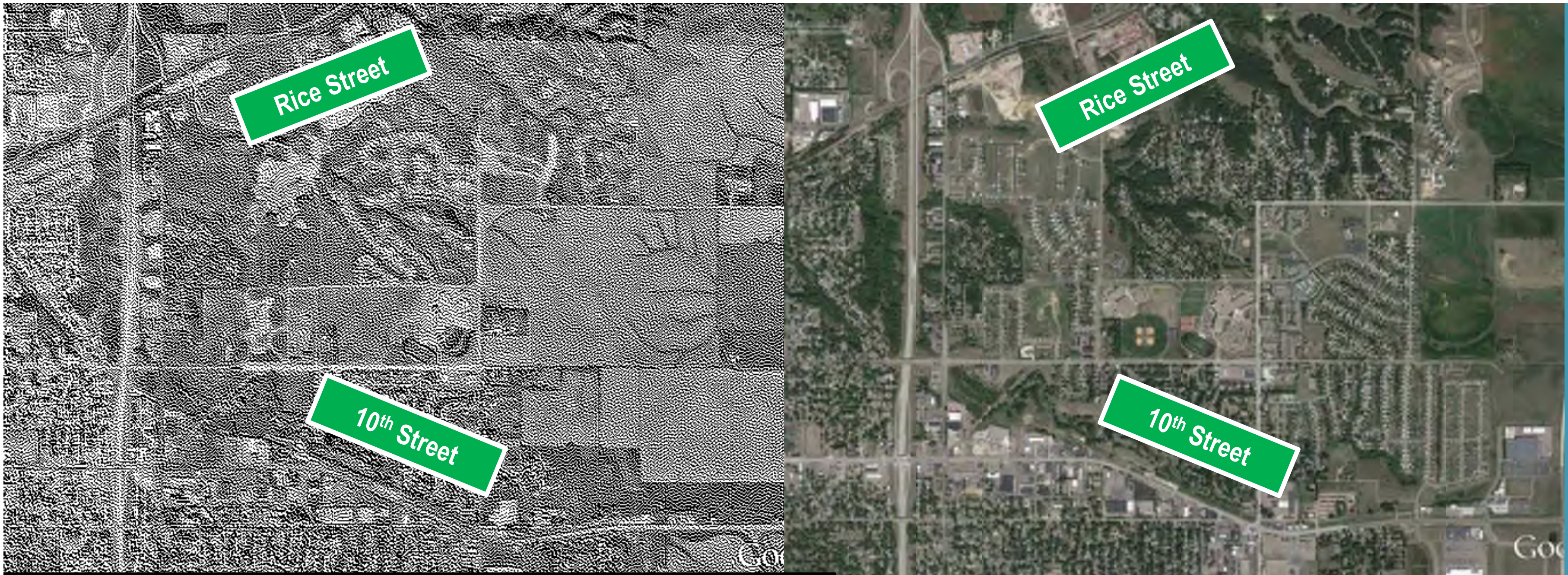


Interstate 229 Major Investment Study

Exit 6 – 10th Street

Stakeholder Meeting
December 16th, 2014
3:30 pm to 4:30 pm

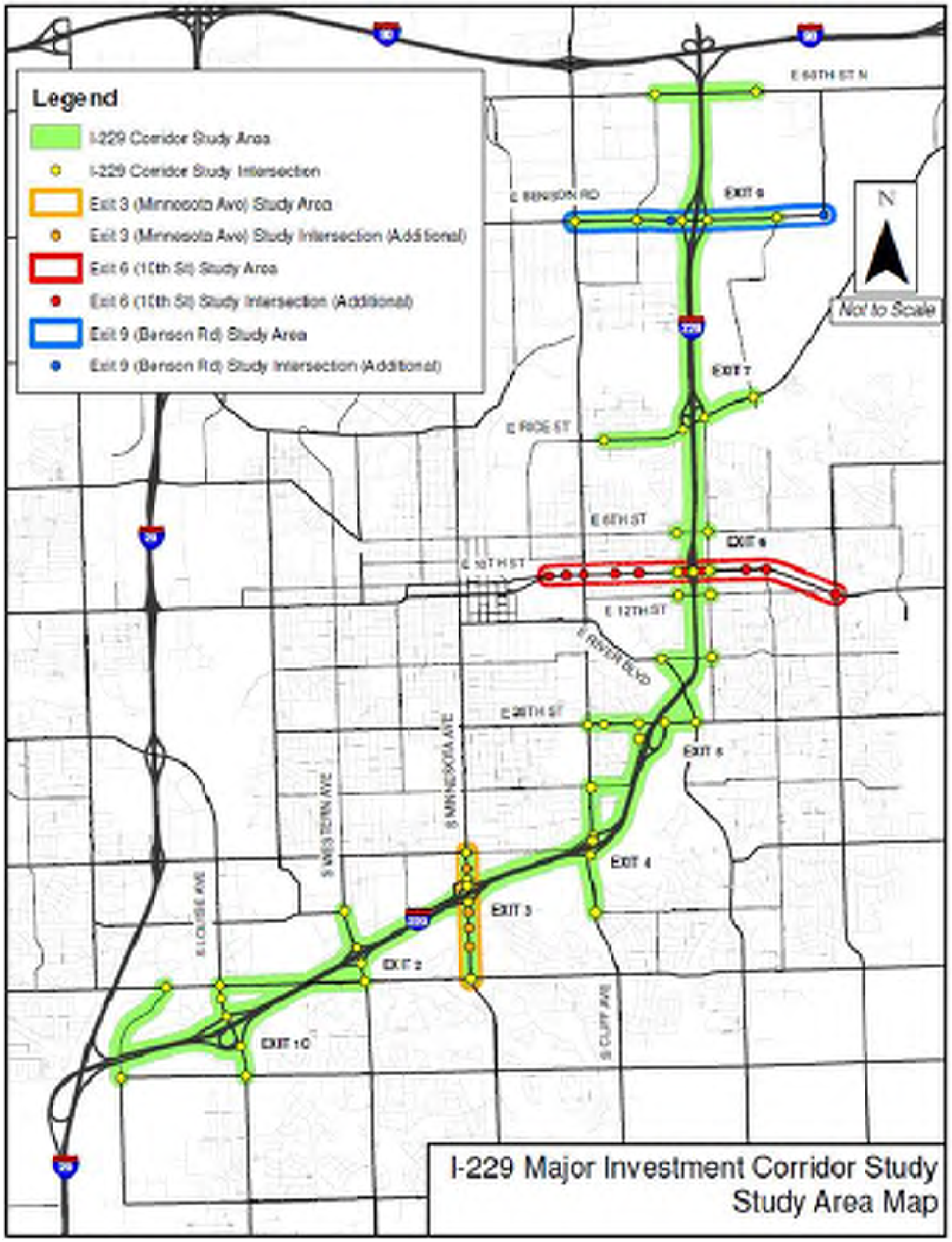
Study Area Map

I-229 Corridor Study

Solberg Avenue Overpass
to
60th Street N. Overpass

Additional Studies

Exit 3 – Minnesota Ave
Exit 6 – 10th Street
Exit 9 – Benson Road



Study Advisory Partners

South Dakota Department of Transportation (SDDOT)

South Dakota Highway Patrol

City of Sioux Falls

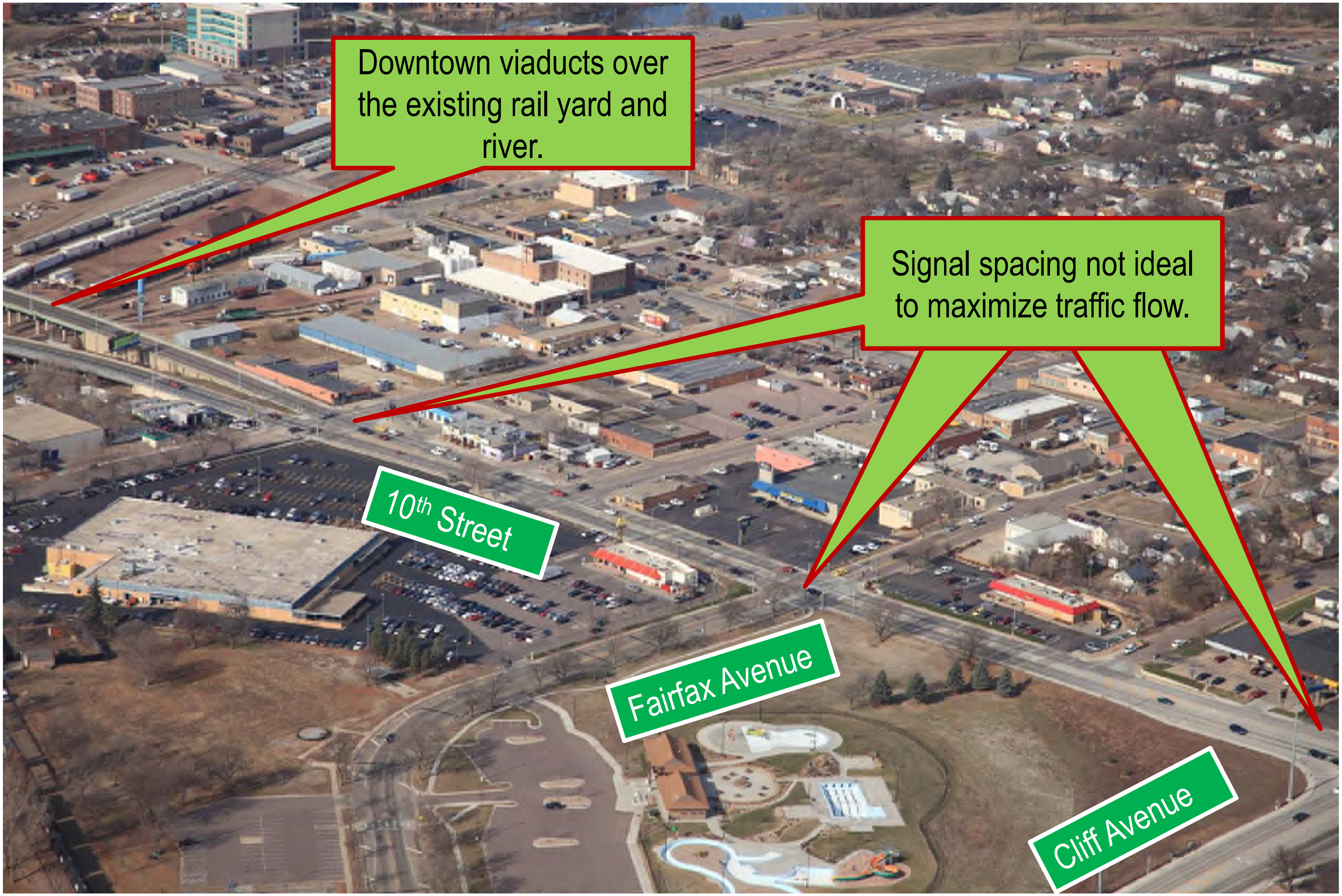
Sioux Falls Metropolitan Planning Organization (MPO)

Federal Highway Administration (FHWA)

Exit 6 (10th Street) Crossroad Study Goals

- Reduce traffic congestion
- Develop Corridor Growth Plan to meet traffic demands but minimizing impacts to developed properties
- Improve pedestrian mobility
- Improve safety for corridor users
- Identify improvements to the interchange as well as the 10th Street and Cleveland Ave intersection

10th Street Corridor Overview

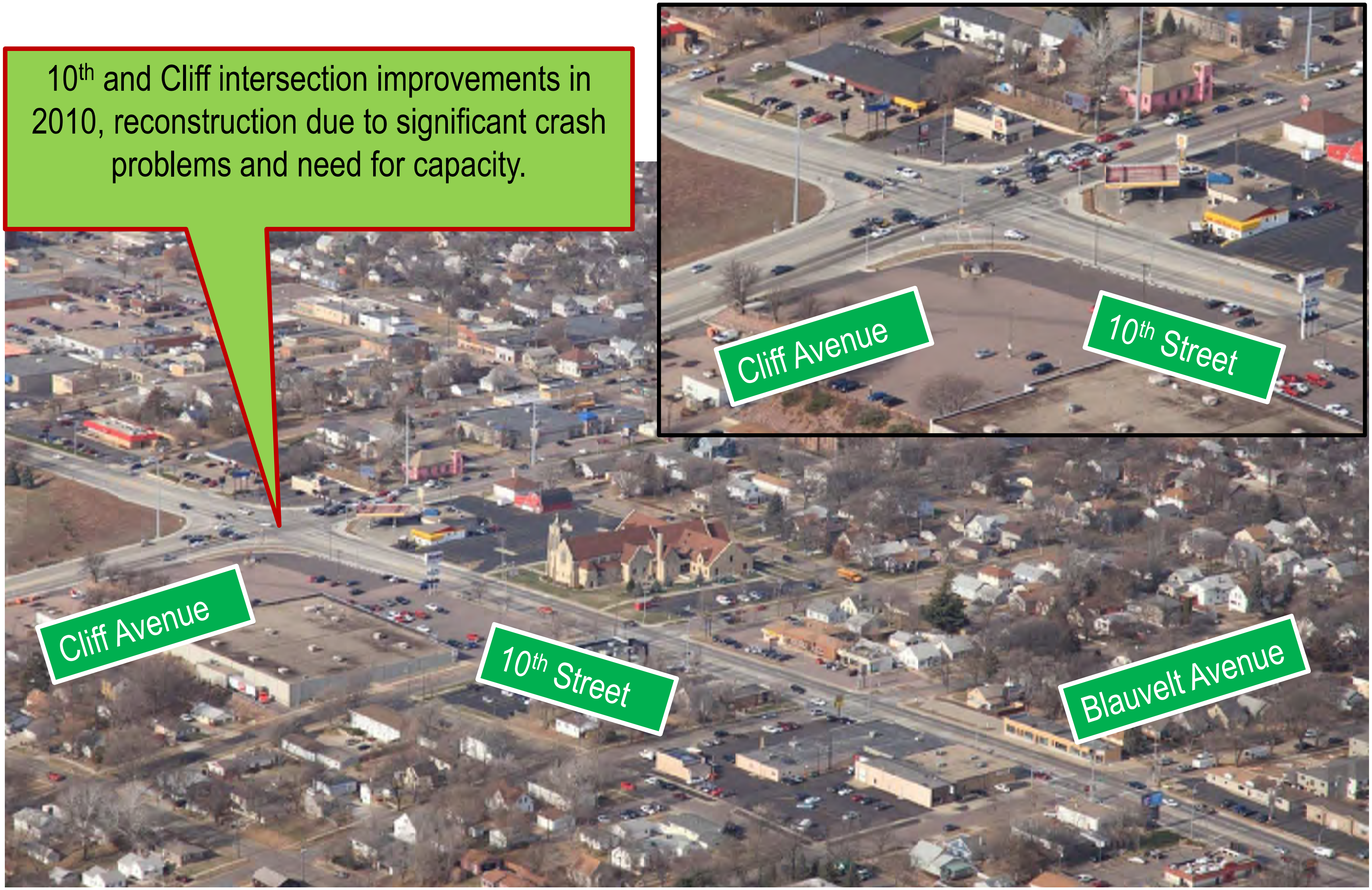


Downtown viaducts over the existing rail yard and river.

Signal spacing not ideal to maximize traffic flow.

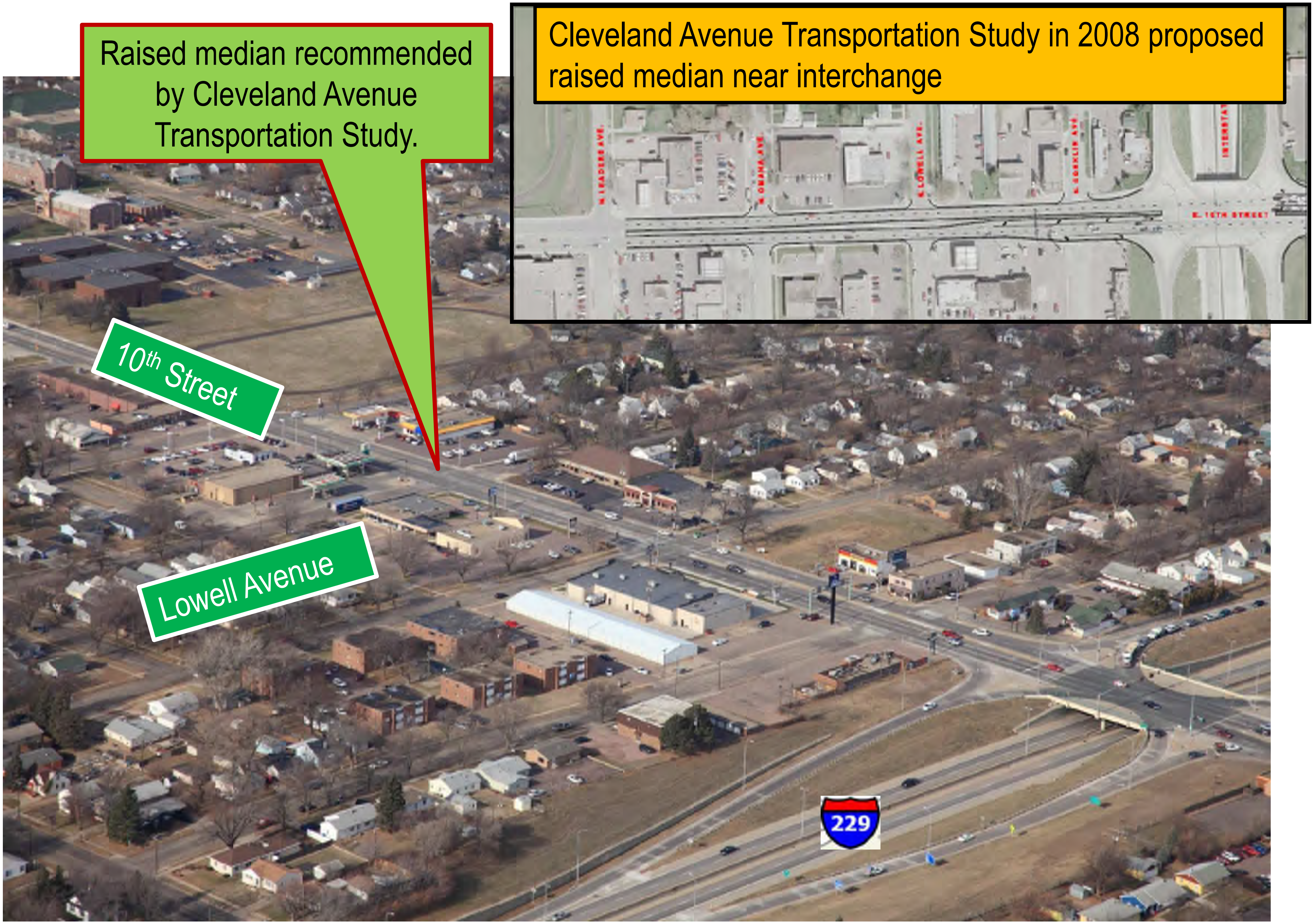
10th Street Corridor Overview

10th and Cliff intersection improvements in 2010, reconstruction due to significant crash problems and need for capacity.



10th Street Corridor Overview

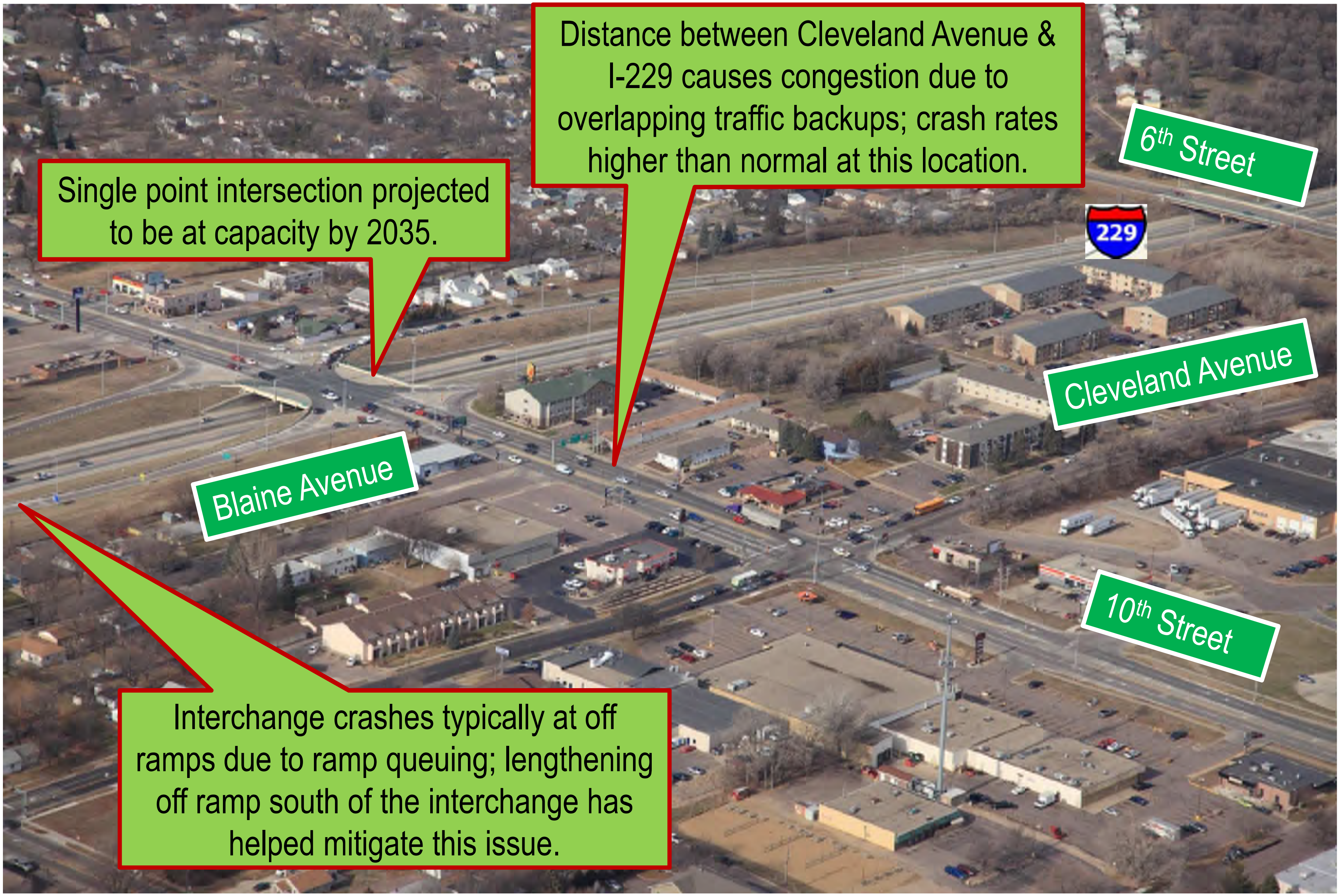
10th Street Corridor Overview



Raised median recommended by Cleveland Avenue Transportation Study.

Cleveland Avenue Transportation Study in 2008 proposed raised median near interchange

10th Street Corridor Overview

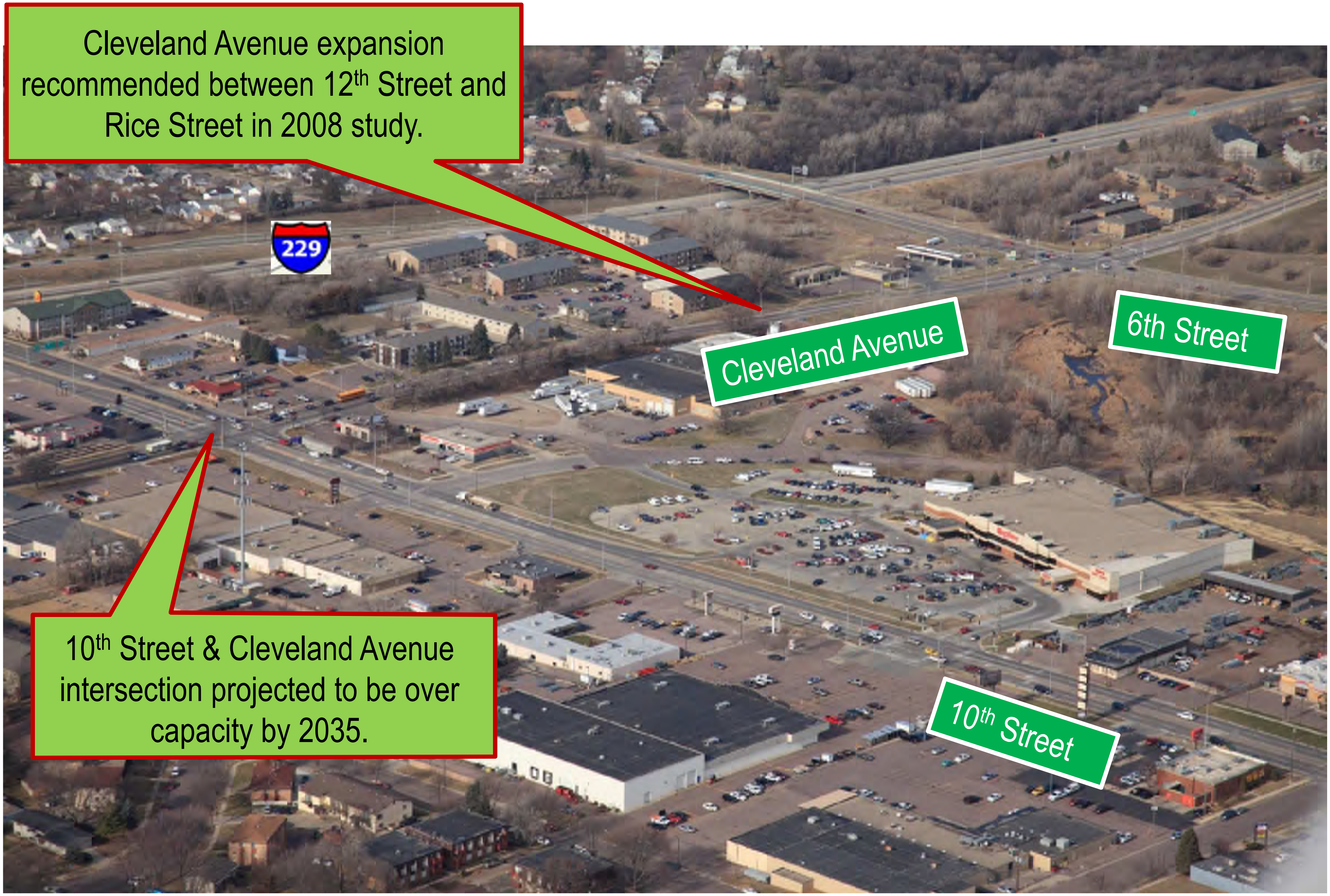


Distance between Cleveland Avenue & I-229 causes congestion due to overlapping traffic backups; crash rates higher than normal at this location.

Single point intersection projected to be at capacity by 2035.

Interchange crashes typically at off ramps due to ramp queuing; lengthening off ramp south of the interchange has helped mitigate this issue.

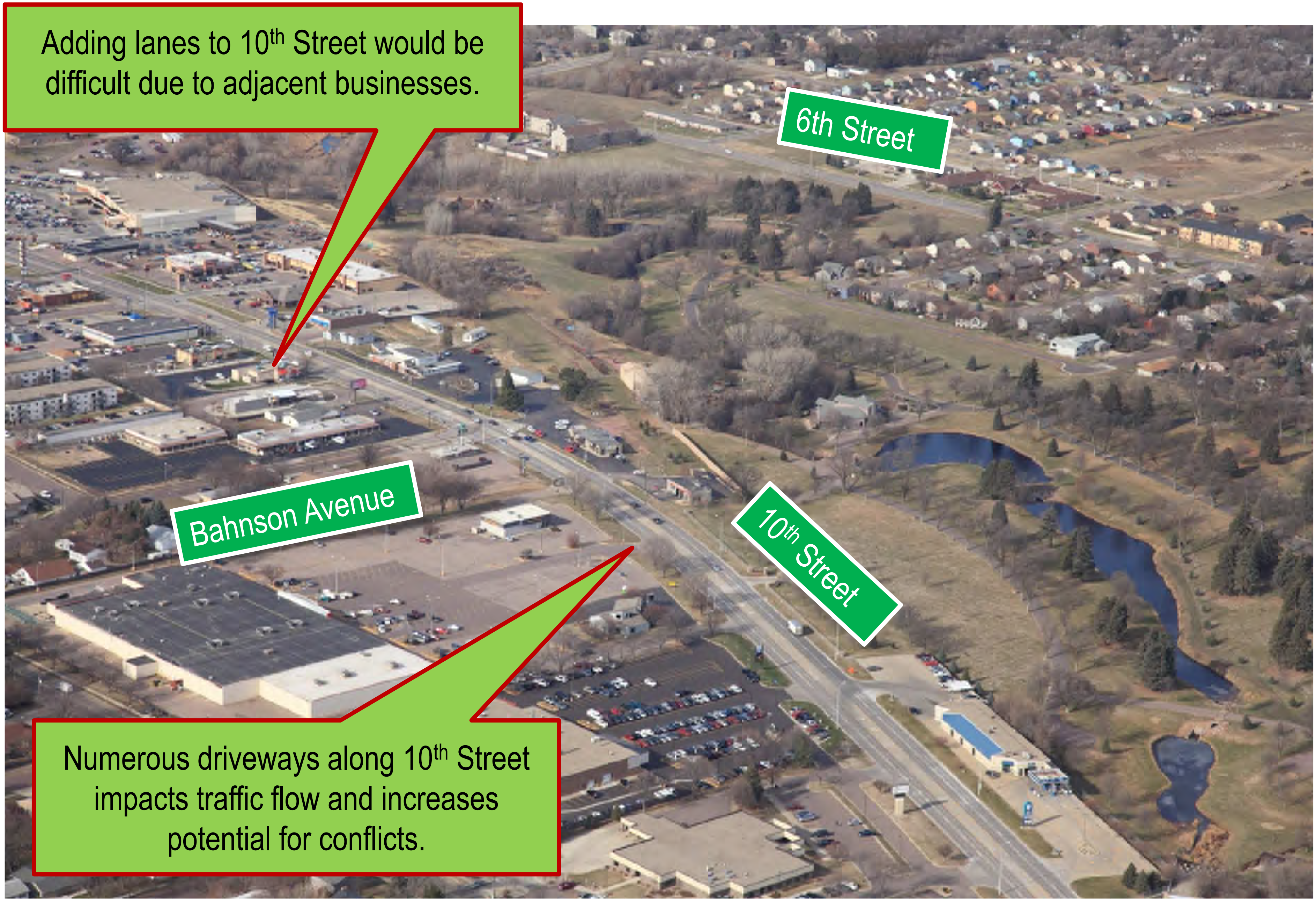
10th Street Corridor Overview



Cleveland Avenue expansion recommended between 12th Street and Rice Street in 2008 study.

10th Street & Cleveland Avenue intersection projected to be over capacity by 2035.

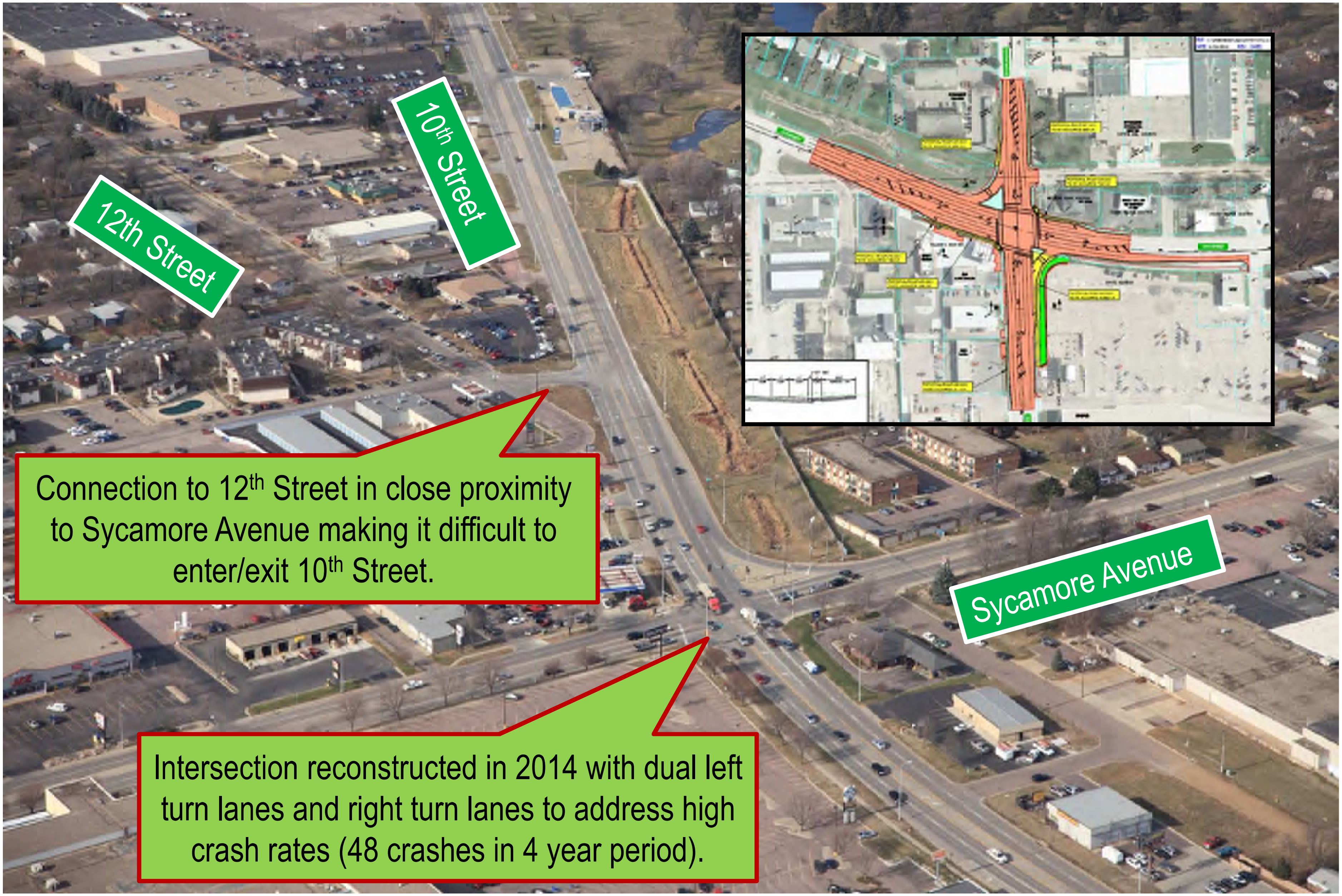
10th Street Corridor Overview



Adding lanes to 10th Street would be difficult due to adjacent businesses.

Numerous driveways along 10th Street impacts traffic flow and increases potential for conflicts.

10th Street Corridor Overview

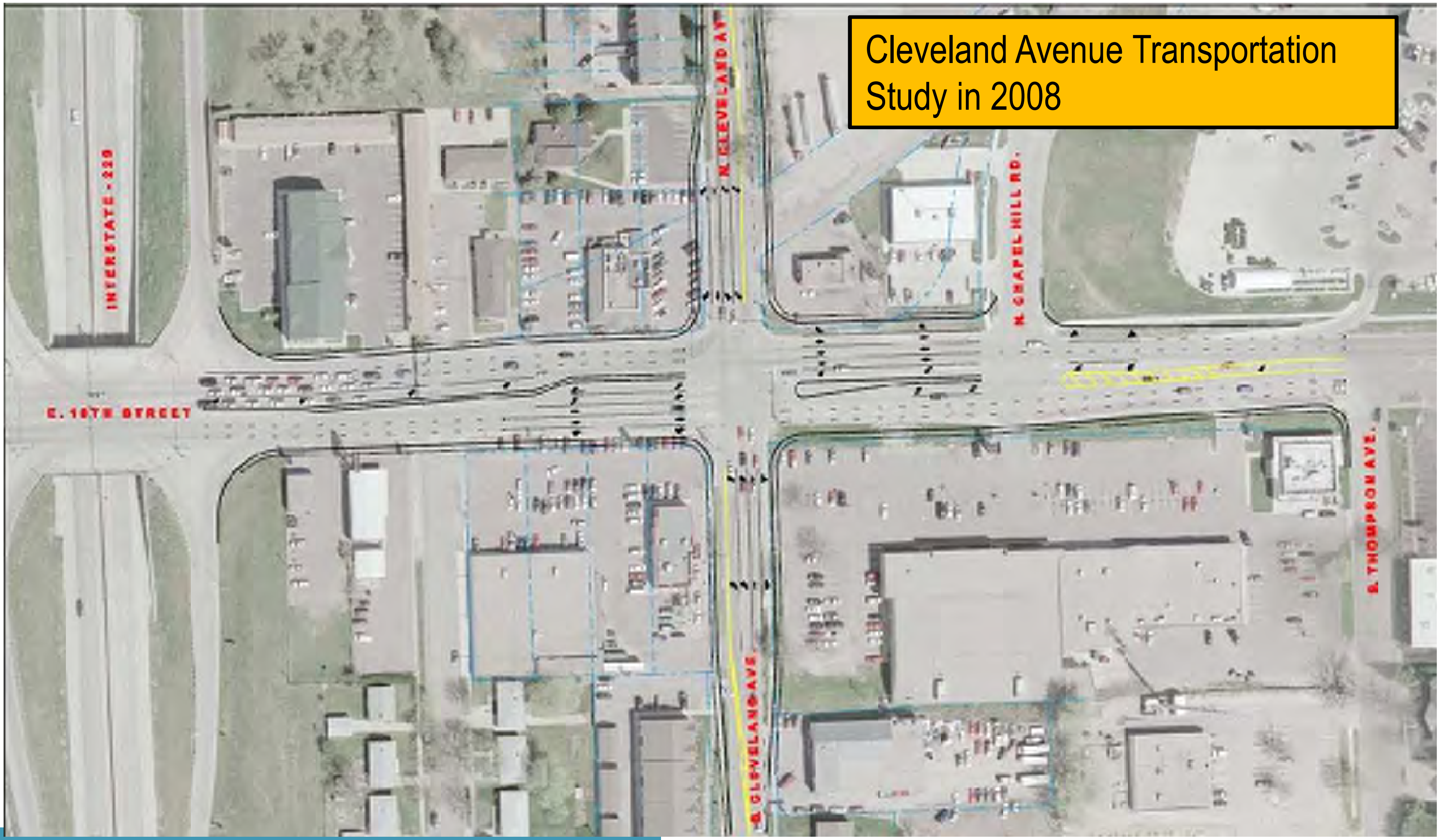


Connection to 12th Street in close proximity to Sycamore Avenue making it difficult to enter/exit 10th Street.

Intersection reconstructed in 2014 with dual left turn lanes and right turn lanes to address high crash rates (48 crashes in 4 year period).

Previous Study Ideas for 10th Street Corridor

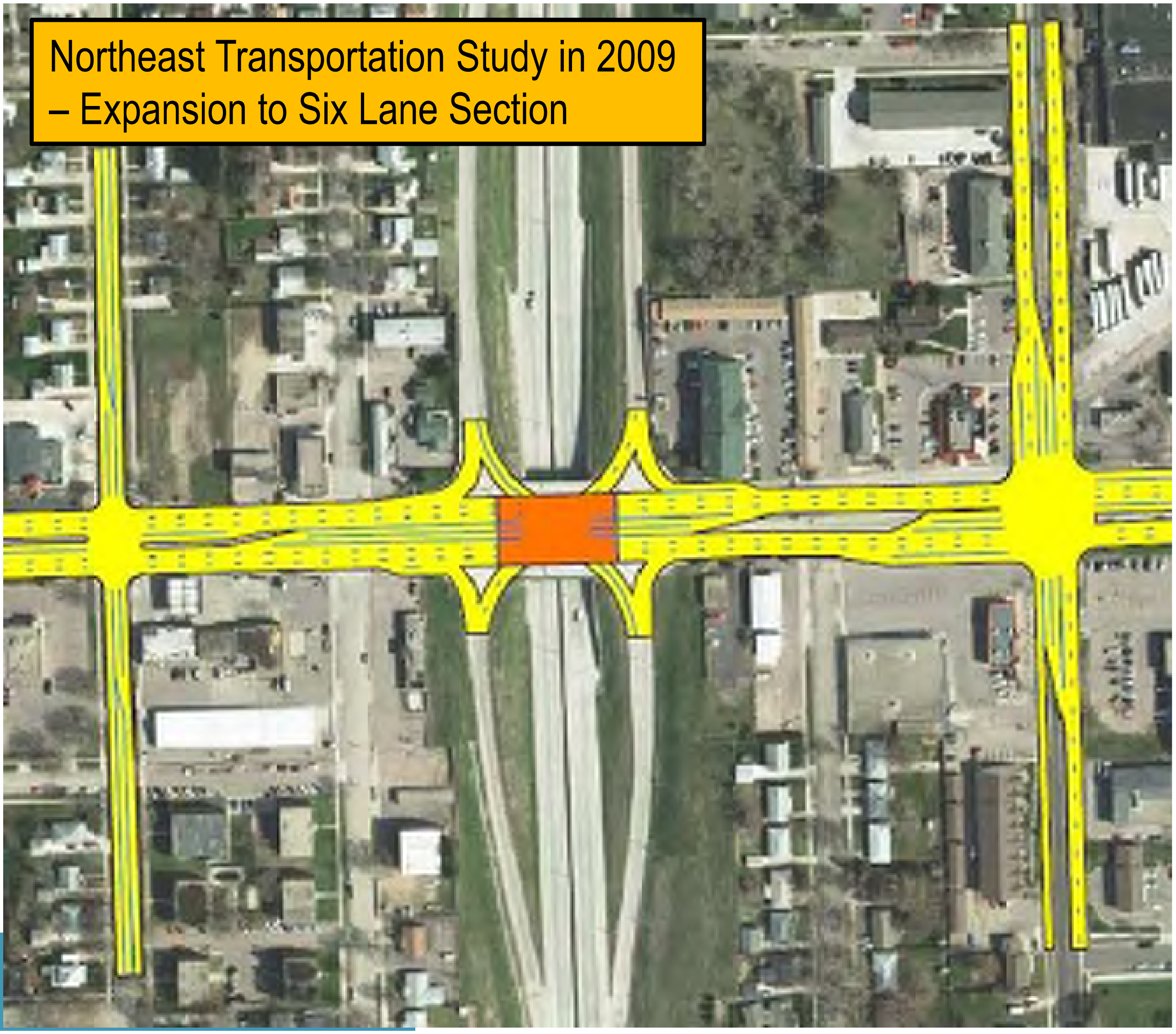
- **Cleveland Ave. Transportation Study**



Cleveland Avenue Transportation Study in 2008

Previous Study Ideas for 10th Street Corridor

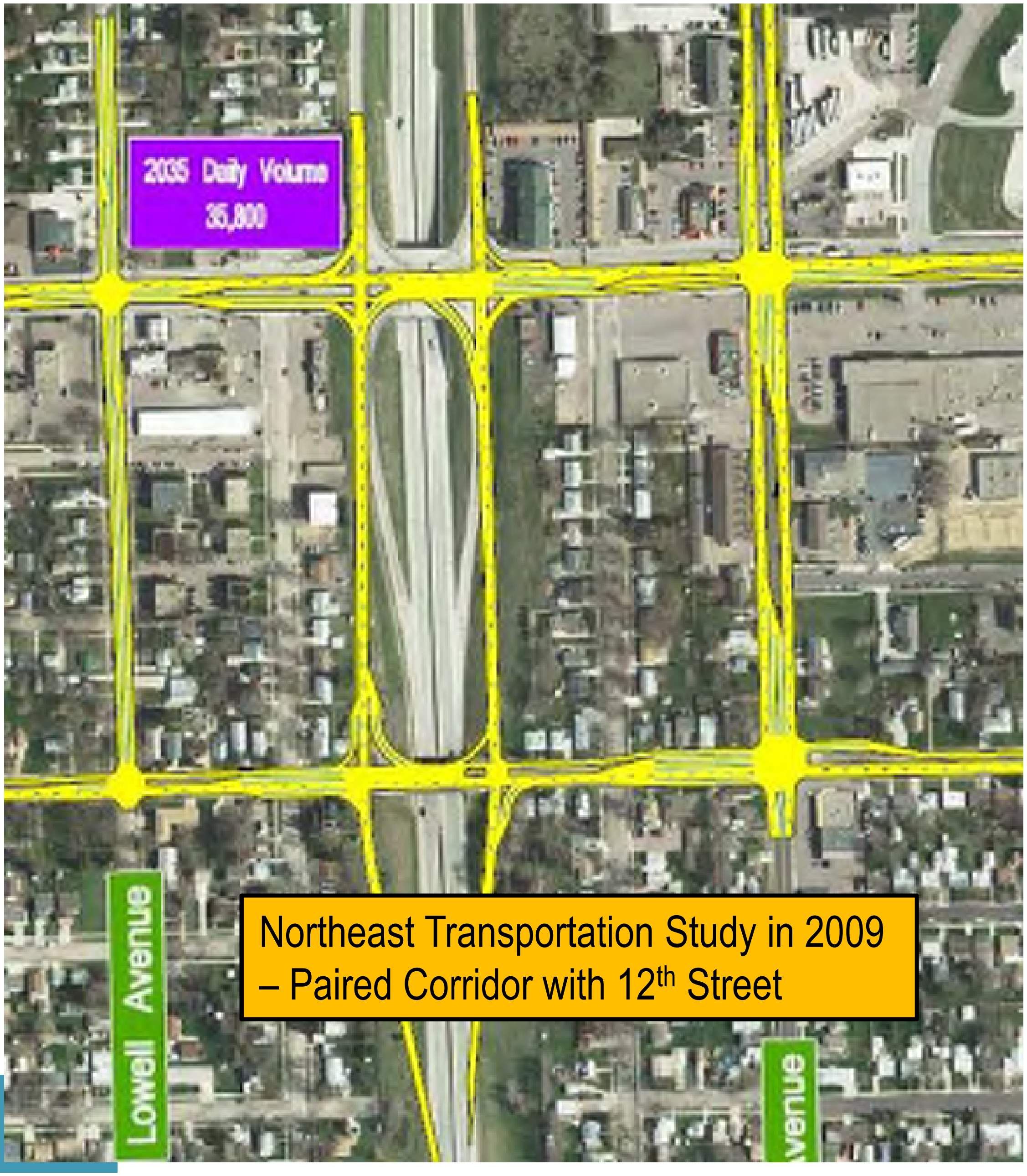
- **Northeast Transportation Study**



Northeast Transportation Study in 2009 – Expansion to Six Lane Section

Previous Study Ideas for 10th Street Corridor

- **Northeast Transportation Study**



Northeast Transportation Study in 2009 – Paired Corridor with 12th Street

PROJECT CONTACTS:

Jason Kjenstad – HDR Engineering, Inc.
605-977-7740 or jason.kjenstad@hdrinc.com

Chris Malmberg – HDR Engineering, Inc.
402-399-4959 or chris.malmberg@hdrinc.com

Shannon Ausen – City of Sioux Falls
605-367-8607 or sausen@siouxfalls.org

Steve Gramm – SDDOT Project Development
605-773-6641 or steve.gramm@state.sd.us

Interstate 229 Major Investment Study
Exit 6 – 10th Street

Thanks for Attending!!!!!

HRGreen

MINNESOTA AVENUE

DECEMBER 16TH, 2014

- MEETING NOTES
- SIGN-IN SHEETS
- POWERPOINT SLIDES

Meeting Minutes

Project:	I-229 Major Investment Corridor Study; PL 0100(87) 3616P, PCN 044K
Subject:	Stakeholder Meeting – Sub-study 2 (Minnesota Ave from 57th Street to 41st Street)
Date:	Tuesday, December 16, 2014
Location:	Sioux Falls Convention Center Conference Room 6
Attendees:	See attached Sign In sheets

Jason Kjenstad covered the PowerPoint slides (attached to meeting notes).

Follow-up discussion items included:

1. Existing Minnesota Avenue traffic observations:
    - 1.1 A.M. peak hour – NB traffic on Minnesota Queues at I-229 and 41st Street. 57th Street traffic queues on East approach (WB) at Minnesota Avenue.
    - 1.2 P.M. peak hour – SB traffic on Minnesota is extremely congested between 41st Street and I-229. The 49th Street extension is blocked due to this.
2. Existing I-229 traffic observations
    - 2.1 Traffic queues at the NB off ramp in both AM and PM peak hours and SB off ramp in the AM peak hour.
    - 2.2 Travel Time runs on I-229 indicate capacity is good on the mainline.
    - 2.3 Crashes are highly noticed along the NB off ramp.
3. Existing geometric constraints
    - 3.1 Driveway from Yankton trail park is a concern in relationship to the I-229 ramps
    - 3.2 Proximity of 49th Street extension in relation to interchange.
4. Minnesota Avenue improvement considerations
    - 4.1 Place a raised median to improve traffic flow by removing conflict locations
    - 4.2 Possibility widen to 6 lanes to increase capacity
    - 4.3 Develop interchange alternatives that work with the 49th Street extension location on Minnesota Avenue
    - 4.4 Possibility relocate Yankton Trail Park entrance further south
5. I-229 improvement considerations
    - 5.1 Various interchange configurations are being considered for Minnesota Avenue. The configurations will be presented at the next public meeting.

The following notes were gathered during the discussion with the adjacent landowners and business owners.

- ❖ <u>57th Street and Minnesota:</u> Commenters noted that the angle of the curve in the intersection and the topographic changes create safety concerns – can’t see when vehicles are in turning lanes. It was explained that a break in the section line (platting) was the original issue that caused the current misalignment and that it is being slowly corrected each time improvements are made. Angle crashes at the intersection and speed limit changes at the intersection approach were also discussed.

- Lotta Street concerns: (multiple mentions, compiled below) – also see handout provided by Aspen Condominiums representative (attached).
    - Left turning movement safety from Lotta Street at Minnesota Avenue (driver delay and speed of approaching vehicles)
    - Speed on Minnesota Avenue at Lotta Street, particularly northbound (picking up speed heading down the hill)
    - Safety (turning gaps, speed, driveways and pedestrians/bicyclists)
    - Offset drives can lead to some confusion on turning movements
    - Residents at Aspen Condominiums are largely retired and many are elderly.
- Discussion on legal access: Southern building, east of the 49th Street intersection, has separate ownership than the others within the development. If they lose their access to Minnesota Avenue, they would lose their legal access to the property.
- Traffic volumes on 49th: Comment that there has been much more traffic on 49th over last couple years due to new construction and operation of Costco and a new apartment complex.
- Truck Parking West of Minnesota Avenue: A comment was made that Midco trucks park on- streets, creating safety concerns. It was noted that Midco is planning to build a separate facility with off-street parking in the near future, which could potentially alleviate this issue.
- Plans for 49th Street: It was noted the City plans to construct 49th Street beginning in 2017, starting on the west end. Multiple phases will over next several years. The final phase that ties into the existing 49th Street segment would be last, and will be dependent on the committed Minnesota Avenue interchange design.
- New Development Traffic (Walmart, Costco, and Apartments): It was noted that each of these new developments have been accounted for in the travel demand model.
- Safe Access to Minnesota Avenue: A property owner of building immediately adjacent to southbound exit ramp mentioned it was very difficult to turn left out of the property onto Minnesota Avenue.
- Interior cross parcel access: One commenter noted that motorists cut across parking lots west of Minnesota Avenue (North of 49th Street) via cross easements or interior driveways to avoid Minnesota Avenue.

- Center Median Proposed: City of Sioux Falls staff noted that they have begun to look at a median along Minnesota Avenue, starting near the airport and heading south along Minnesota Avenue.

- Bicyclist Safety: A commenter noted that there is a safety issue at the park access driveway with the number/frequency of bicyclists/pedestrians traveling north-south along Minnesota Avenue, across the park driveway. City staff noted they will continue with this study, at bike/ped bridges or overpasses for crossings of I-229.

- Adaptive Traffic Signal Control: City staff noted they plan to implement an adaptive traffic signal control system along Minnesota (from 18th to the southern ramp terminal intersection).

- 41st and Minnesota: City staff mentioned the intent to construct a new eastbound lane at 41st Street, for approximately one to three blocks. This will create an EBL, EBL, EBT, and EBR lane configuration at the Minnesota intersection. Looking at construction as early as 2016. The City plans to replace the existing 5-section heads at Minnesota to remove the Dallas phasing, thereby replacing it with the flashing yellow signal head.

DOT CITY OF SIOUX FALLS PUBLIC WORKS HDR

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Stakeholder Meetings for Minnesota Avenue Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3516P, PCN 044K **Project No.:** 207030

Meeting Date Tuesday, December 16, 2014 1:30 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Shannon Auser	224 W. 9th ST SF SD	367-8607	sauser@siouxfalls.org
2	Bob Bahm	3600 S Duluth Ave	334-4220	robert.bahm@dakotabilities.org
3	Pam Taylor	5000 S. Sunnymede Cir Sioux Falls	332-6509	Pam.Jansa@gmail.com
4	Steve Sherman	3800 S. Grange	359-7857	ssherman@jackhenry.com
5	Cindy Shrewsbury	4300 S. Pine Cone Place	3678871	Caberon@AOL.com
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Sign In Sheet

Subject I-229 Major Investment Corridor Study – Stakeholder Meetings for Minnesota Avenue Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(37) 3616P, PCN 044K **Project No.:** 207030

Meeting Date Tuesday, December 16, 2014 1:30 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Dianne Metli	4304 S. Minn Ave.	339-2864	metli@sio.midco.net
2	Thomas Hein	6100 E. Hein Place SF 57110	361-8400	Theinmail@gmail.COM
3	Paul Nikolas	5316 W. 60th St. N.	367-5680	Paul.Nikolas@state.sd.us
4	Ann Kelly	4601 S. Minn Ave.	334-2838	
5	Normandie Haai	4600 W. 12th.	605-366-3233	normdehaai@billionauto.com
6	BRIAN SATHER	3388 S. Sullivan, #708 57105 6000 E AUTUMN LN	338-3205	gdentted@hotmail.com
7	John Hart	1309 W. 51st	444-6320	j.hart@voa-dakotas.org
8	MARK KOZEL	4040 S. GRANGE AVE	336.0860	mkozel@lampertyards.com
9	Richard Elmen	3501 S. Minnesota	366 0252	relmen@rentall-inc.com
10	Kelly Vis	409 S. Grange Ave	336-6860	kvis@lampertlumber.com
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Interstate 229 Major Investment Study
Exit 3 – Minnesota Avenue

Stakeholder Meeting
December 16th, 2014
1:30 pm to 2:30 pm

HDR

HRGreen

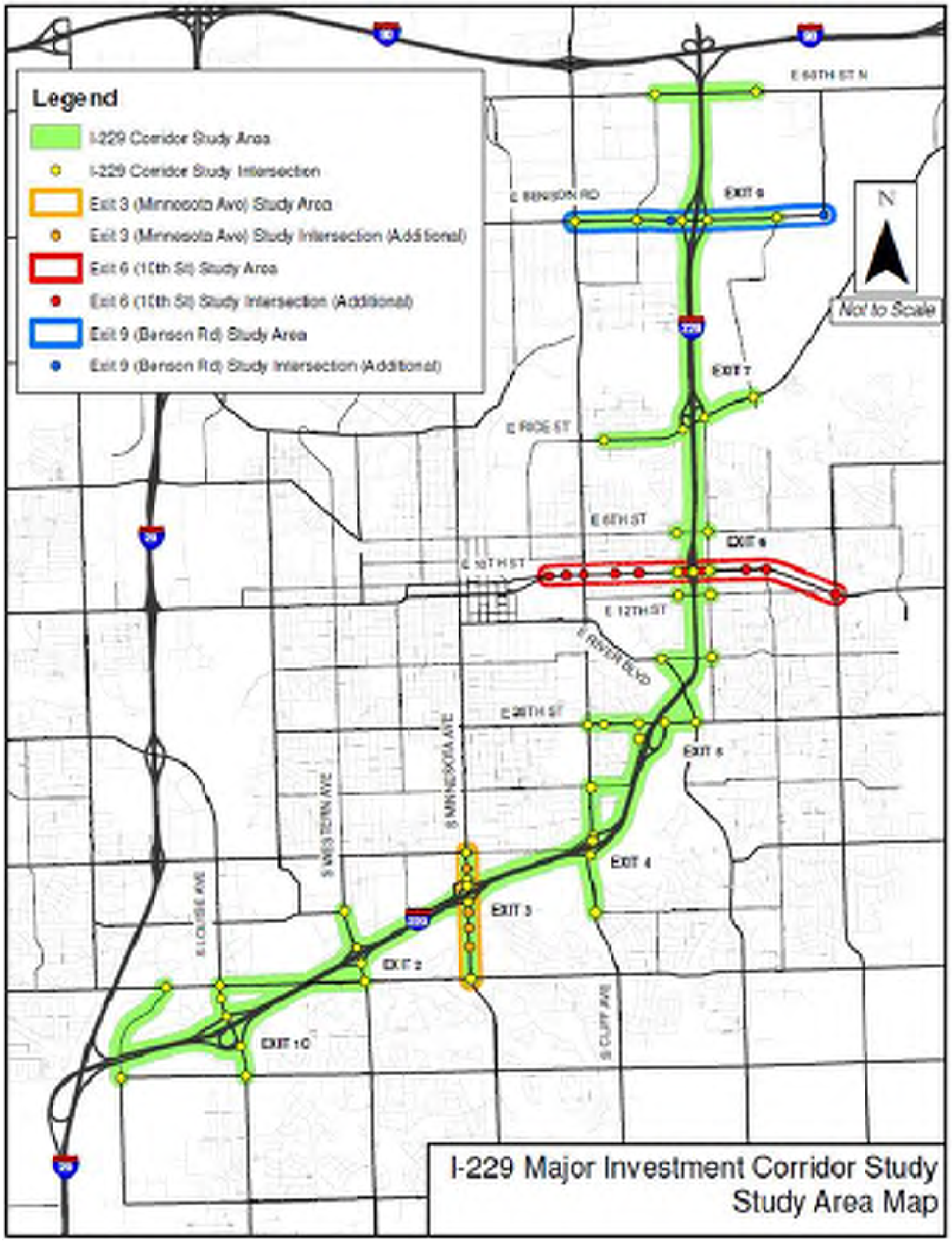
Study Area Map

I-229 Corridor Study

Solberg Avenue Overpass
to
60th Street N. Overpass

Additional Studies

Exit 3 – Minnesota Ave
Exit 6 – 10th Street
Exit 9 – Benson Road



I-229 Major Investment Corridor Study
Study Area Map

Study Advisory Partners

South Dakota Department of Transportation (SDDOT)

South Dakota Highway Patrol

City of Sioux Falls

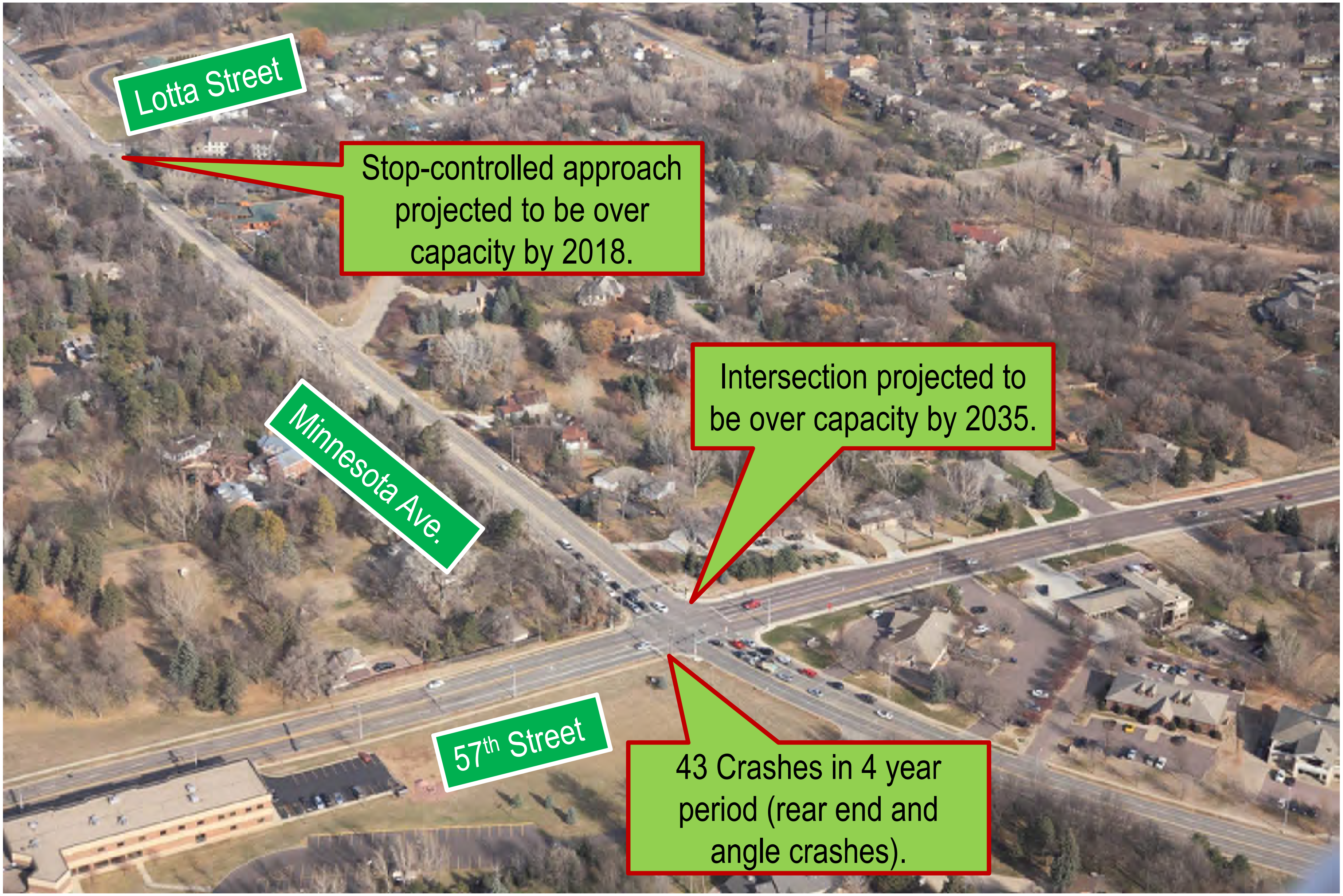
Sioux Falls Metropolitan Planning Organization (MPO)

Federal Highway Administration (FHWA)

Exit 3 (Minnesota Avenue) Crossroad Study Goals

- Reduce traffic congestion
- Evaluate interchange options
- Integrate plans for the 49th Street Extension with the interchange options developed
- Improve pedestrian and bike access to the Big Sioux River Pathway
- Improve safety for corridor users
- Improve vehicle safety to Yankton Trail Park

Minnesota Avenue Corridor Overview

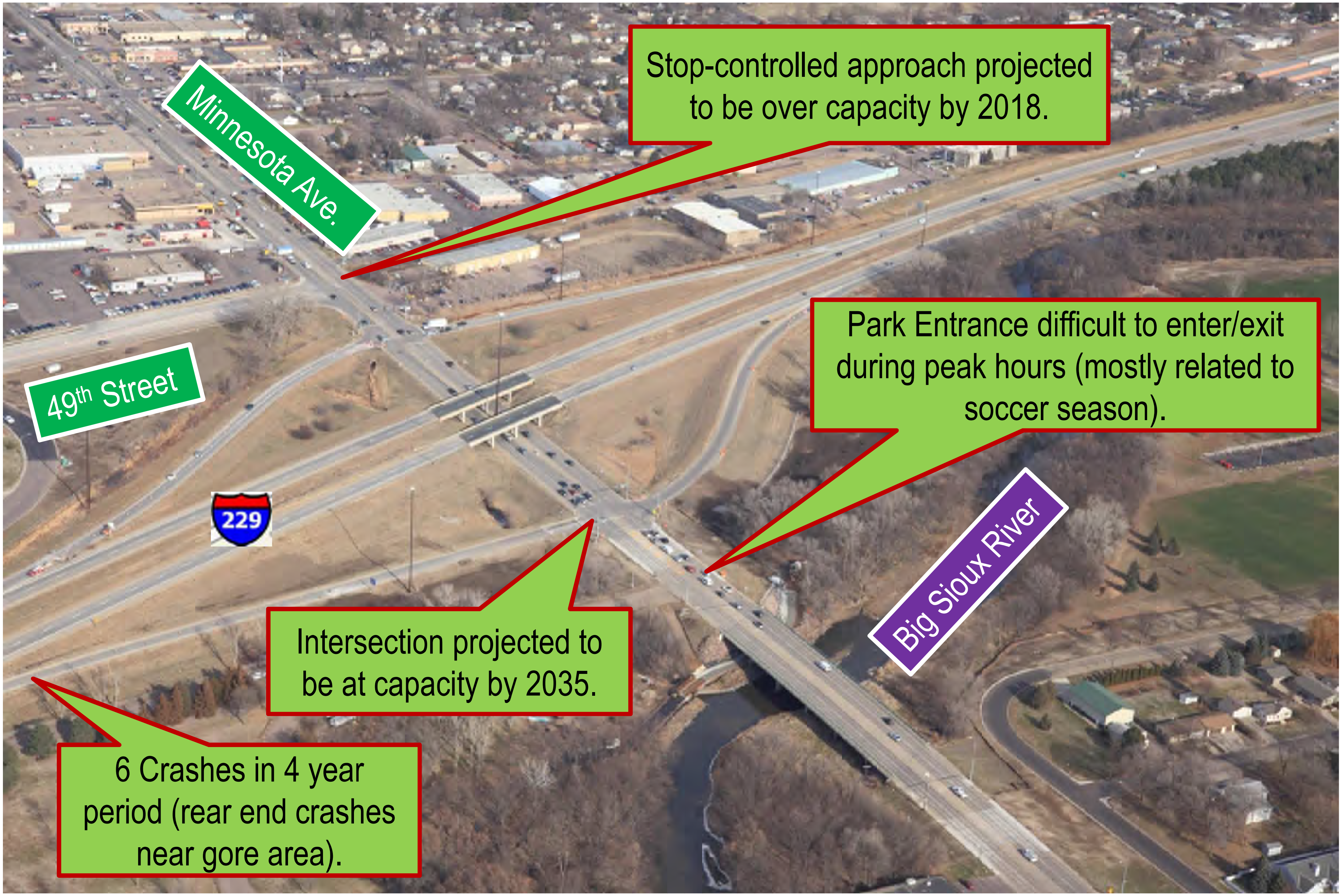


Stop-controlled approach projected to be over capacity by 2018.

Intersection projected to be over capacity by 2035.

43 Crashes in 4 year period (rear end and angle crashes).

Minnesota Avenue Corridor Overview



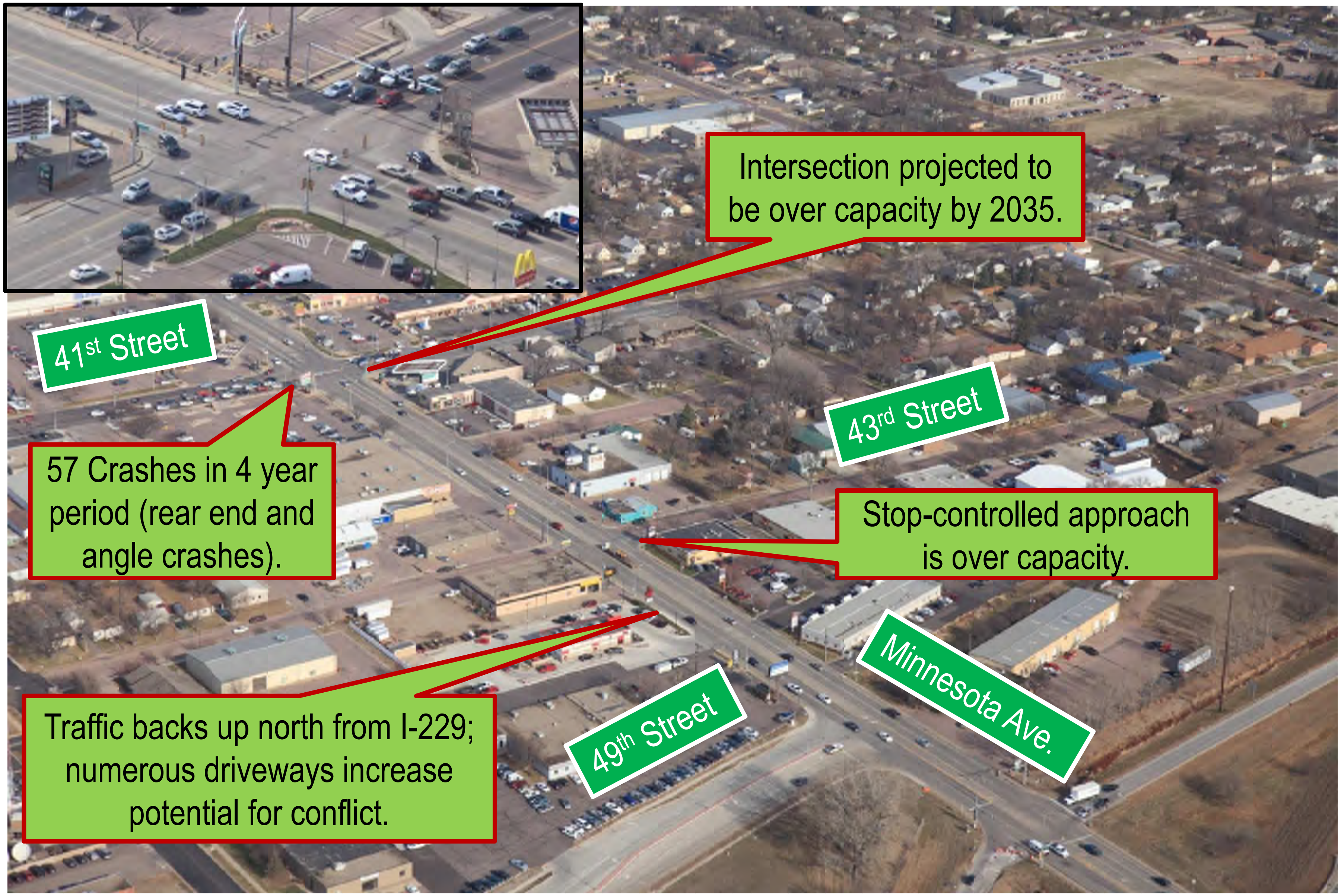
Stop-controlled approach projected to be over capacity by 2018.

Park Entrance difficult to enter/exit during peak hours (mostly related to soccer season).

Intersection projected to be at capacity by 2035.

6 Crashes in 4 year period (rear end crashes near gore area).

Minnesota Avenue Corridor Overview



Relevant Previous Studies

Preliminary local street extensions, interchange concepts, and traffic impact analyses in the vicinity of I-229 & Minnesota Avenue were identified in the following studies:

- 41st Street Corridor Study
- Sioux Falls Major Street and Access Management Plan
- 2000 and 2010 Decennial Interstate Corridor Studies
- 49th Street Extension Study
- Traffic Impact Studies – Costco, Scheels, and Walmart

PROJECT CONTACTS:

Jason Kjenstad – HDR Engineering, Inc.
605-977-7740 or jason.kjenstad@hdrinc.com

Ross Harris– HR Green, Inc.
515-657-5263 or rharris@hrgreen.com

Shannon Ausen – City of Sioux Falls
605-367-8607 or sausen@siouxfalls.org

Steve Gramm – SDDOT Project Development
605-773-6641 or steve.gramm@state.sd.us

Interstate 229 Major Investment Study
Exit 3 – Minnesota Avenue

Thanks for Attending!!!!!

HDR

HRGreen

RICE STREET

JUNE 22ND, 2016

- SIGN-IN SHEETS
- POWERPOINT SLIDES
- MEETING NOTES (SEE CLIFF AVENUE AND RICE STREET PUBLIC MEETINGS APPENDIX)
- COMMENTS (SEE CLIFF AVENUE AND RICE STREET PUBLIC MEETINGS APPENDIX)

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Stakeholder Meetings for Rice Street Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3616P, PCN 044K **Project No.:** 207030

Meeting Date Wednesday, June 22, 2016 1:00 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Patty Nohr Myr le Roy's Paving	1300 N. Bannson Ave	334-3204	Patty.n@marpaving.com
2	Darrel Hoyer	1300 N Bannison Ave SFSD	334-3204	darrel.hoyer@myrland roysPaving.com
3	Milt Nussbaum	2900 East Rice St SFSD	605-338.0053	milt@[illegible].com
4	Dan Kearney	47046 259 St SFSD	351-5705	PinBallFixer@Aol.com
5	Harold Dode	1509 E 39 St N	366 3139	
6	James St Clair	1409/1413 E Rice	605 359-0005	jensenport@ hotmail.com
7	Peggy Jensen	" "	605 310-0740	"
8	Jason Kjerstad	6300 S. Old Village Pl	605-977-7740	jason.kjerstad@hdrinc.com
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Interstate 229 Major Investment Study
Exit 7 – Rice Street

Stakeholder Meeting
June 22nd, 2016
1:00 pm to 2:00 pm

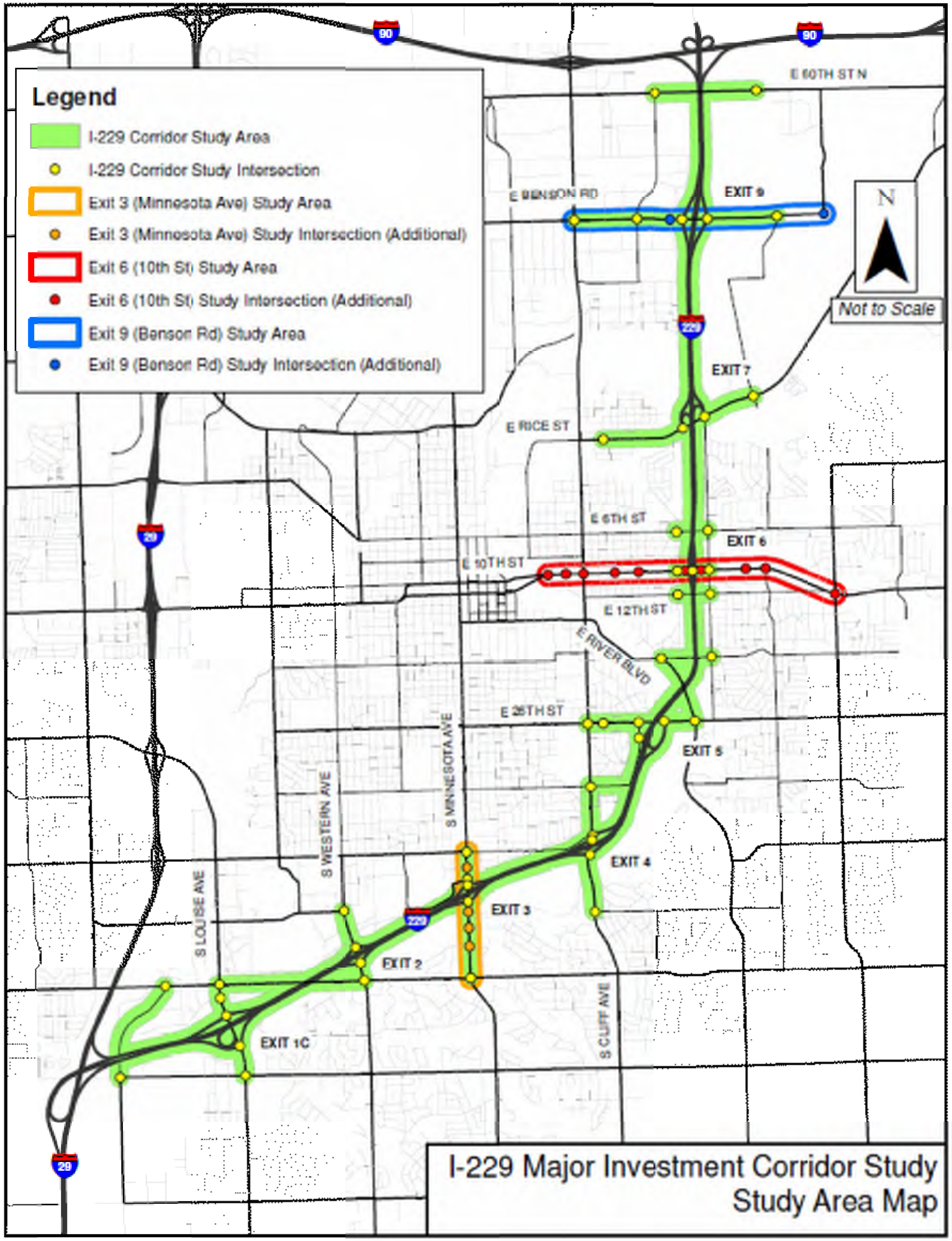
Study Area Map

I-229 Corridor Study

Solberg Avenue Overpass
to
60th Street N. Overpass

Additional Studies

Exit 3 – Minnesota Ave
Exit 6 – 10th Street
Exit 9 – Benson Road
Added Exit 4 – Cliff Avenue
Added Exit 7 – Rice Street



I-229 Major Investment Corridor Study
Study Area Map

Study Advisory Partners

South Dakota Department of Transportation (SDDOT)

South Dakota Highway Patrol

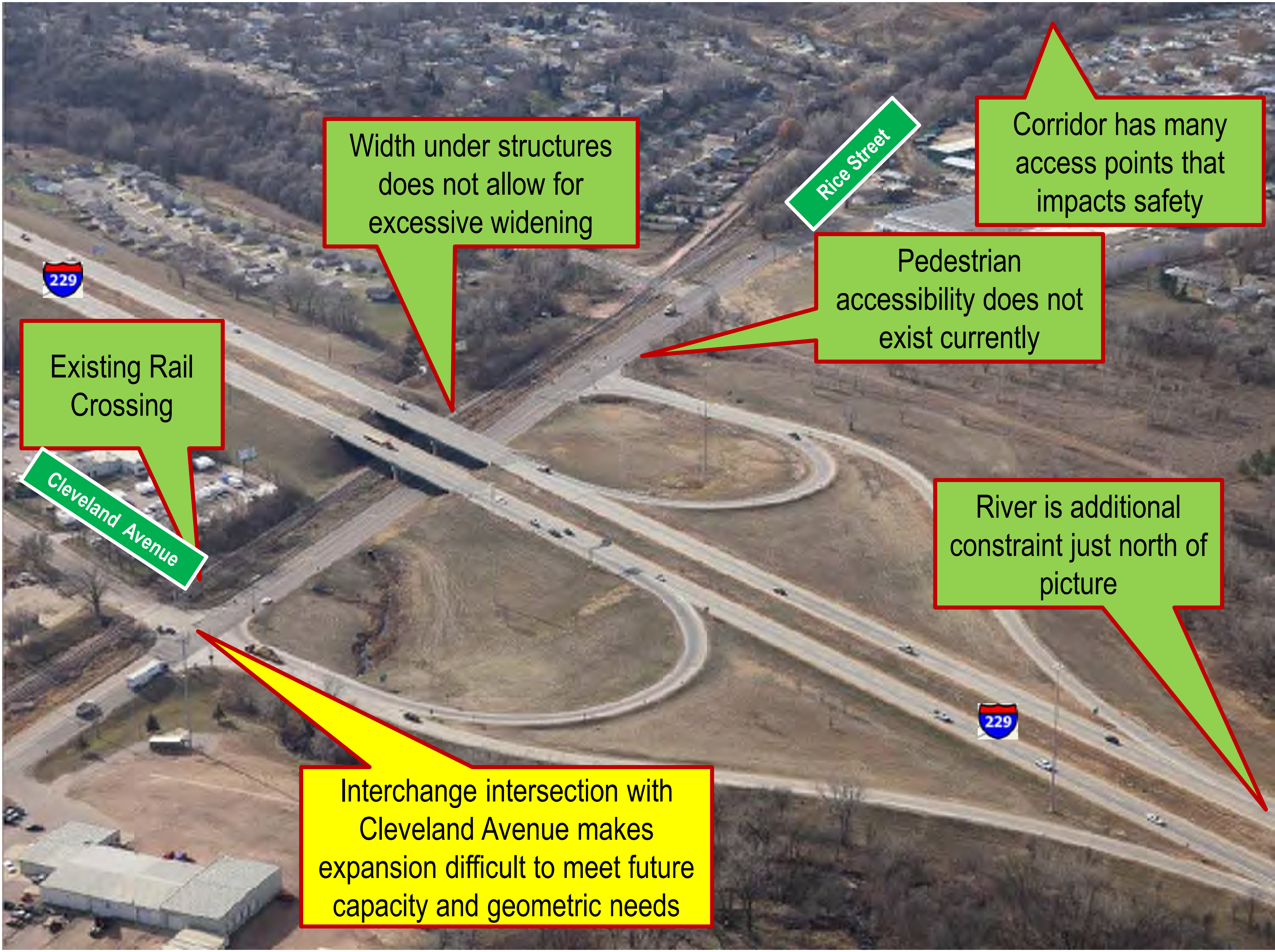
City of Sioux Falls

Sioux Falls Metropolitan Planning Organization (MPO)

Federal Highway Administration (FHWA)

Exit 7 (Rice Street) Crossroad Study Goals

- Reduce traffic congestion
- Provide and Interchange that will meet the future capacity requirements
- Improve pedestrian mobility
- Improve safety for corridor users



Width under structures does not allow for excessive widening

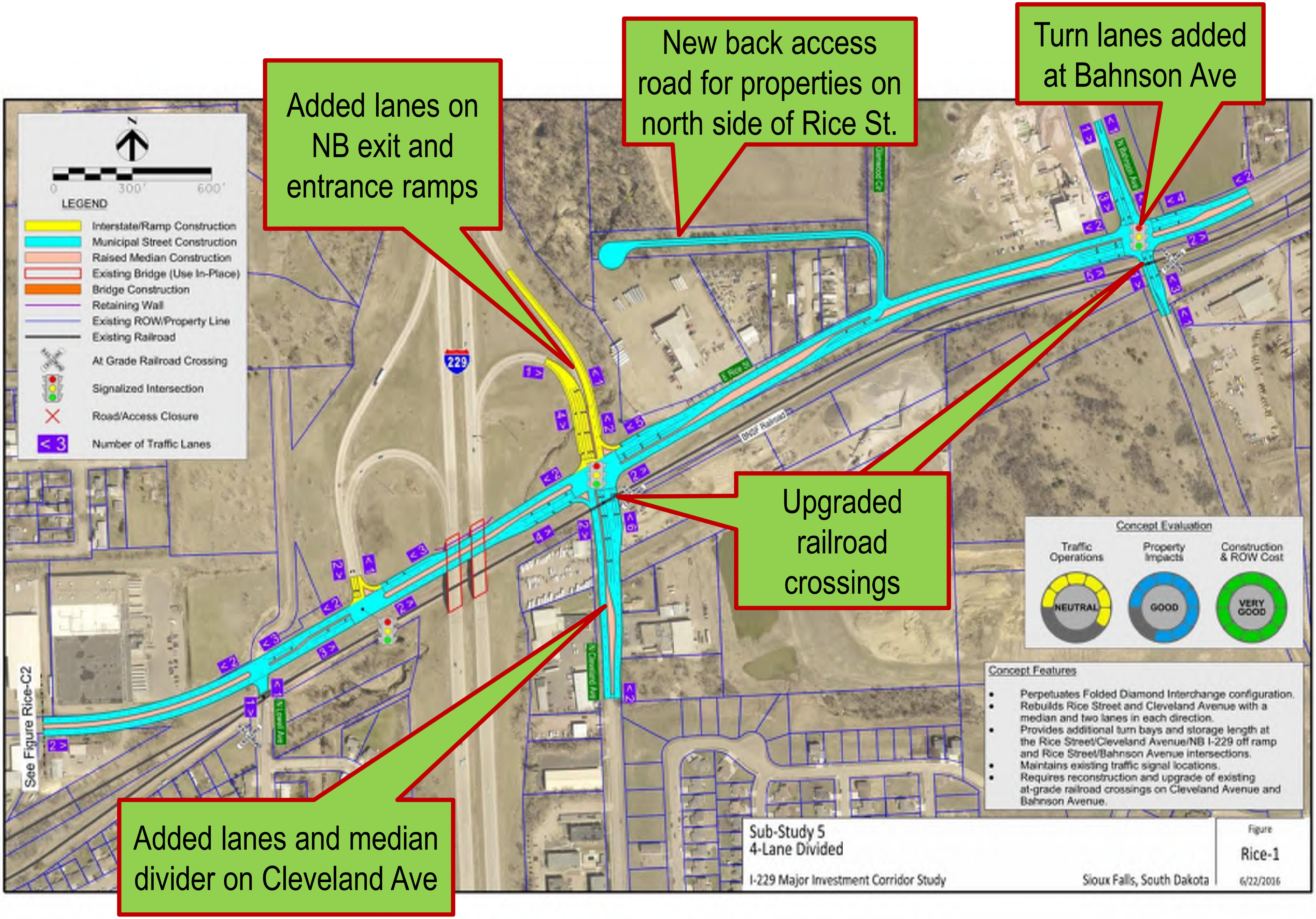
Corridor has many access points that impacts safety

Pedestrian accessibility does not exist currently

Existing Rail Crossing

River is additional constraint just north of picture

Interchange intersection with Cleveland Avenue makes expansion difficult to meet future capacity and geometric needs



Added lanes on NB exit and entrance ramps

New back access road for properties on north side of Rice St.

Turn lanes added at Bahnson Ave

Upgraded railroad crossings

Added lanes and median divider on Cleveland Ave

Concept Features

- Perpetuates Folded Diamond Interchange configuration.
- Rebuilds Rice Street and Cleveland Avenue with a median and two lanes in each direction.
- Provides additional turn bays and storage length at the Rice Street/Cleveland Avenue/NB I-229 off ramp and Rice Street/Bahnson Avenue intersections.
- Maintains existing traffic signal locations.
- Requires reconstruction and upgrade of existing at-grade railroad crossings on Cleveland Avenue and Bahnson Avenue.

Sub-Study 5
4-Lane Divided

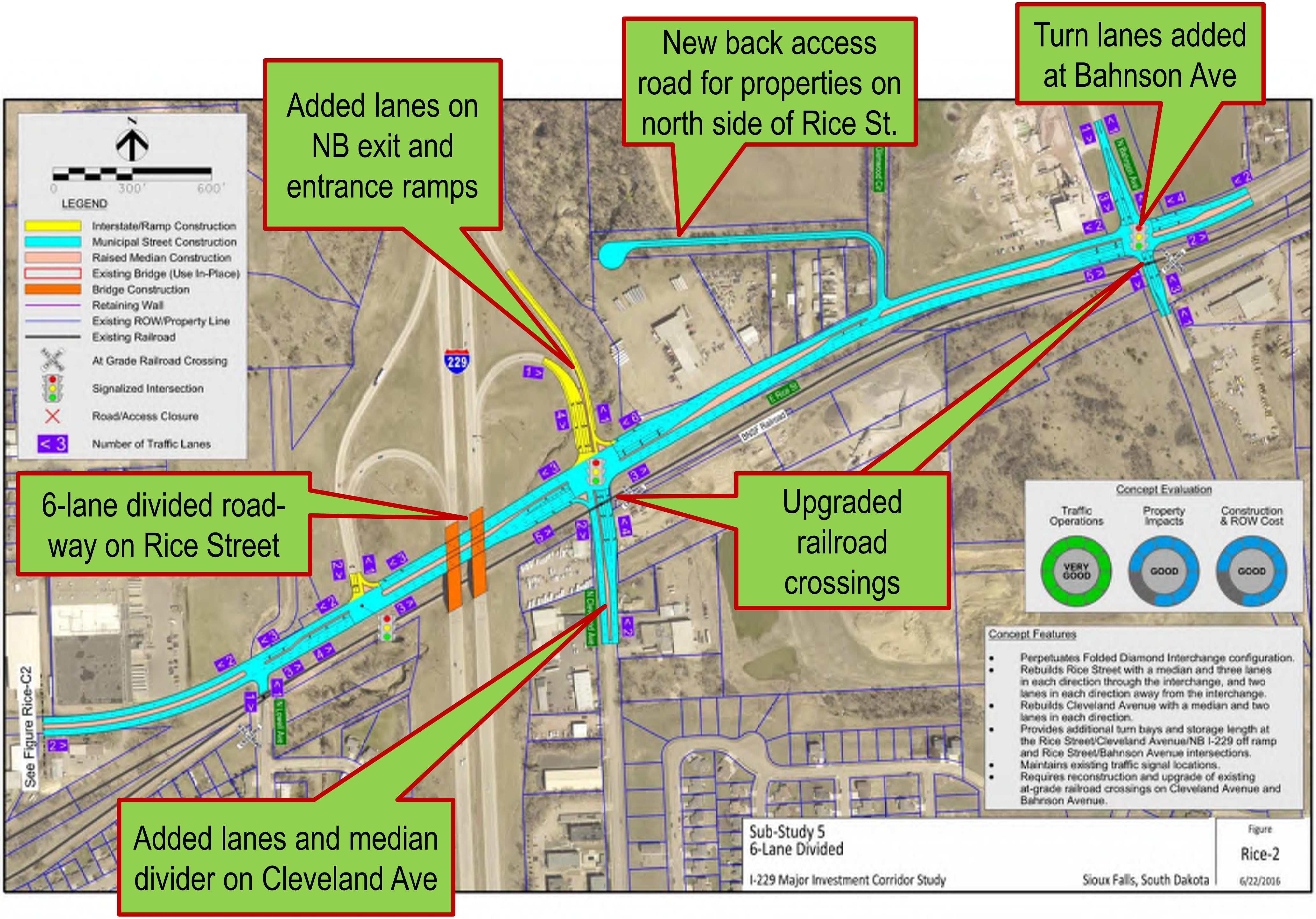
I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure

Rice-1

6/22/2016



Added lanes on NB exit and entrance ramps

New back access road for properties on north side of Rice St.

Turn lanes added at Bahnson Ave

6-lane divided roadway on Rice Street

Upgraded railroad crossings

Added lanes and median divider on Cleveland Ave

Concept Features

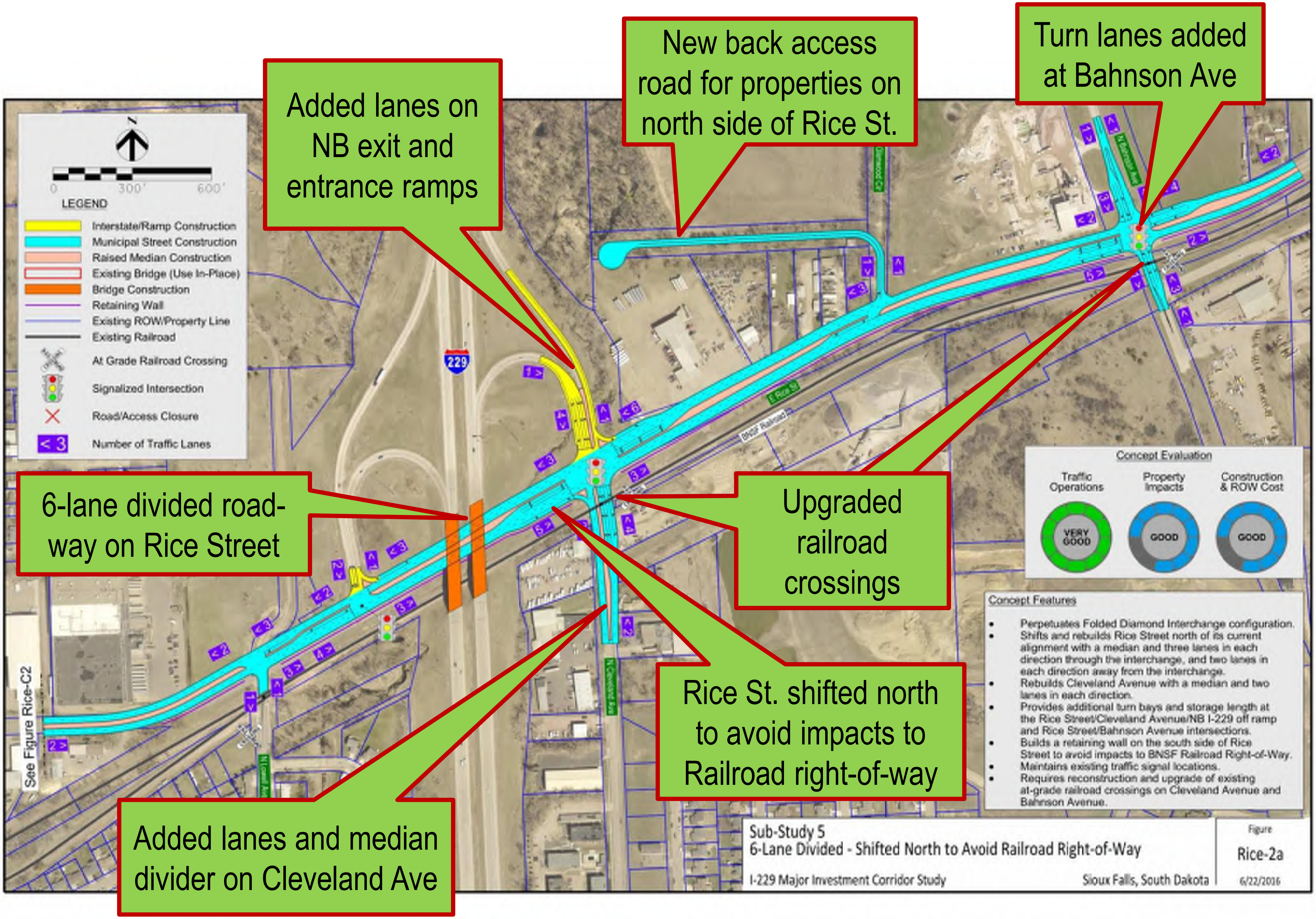
- Perpetuates Folded Diamond Interchange configuration.
- Rebuilds Rice Street with a median and three lanes in each direction through the interchange, and two lanes in each direction away from the interchange.
- Rebuilds Cleveland Avenue with a median and two lanes in each direction.
- Provides additional turn bays and storage length at the Rice Street/Cleveland Avenue/NB I-229 off ramp and Rice Street/Bahnson Avenue intersections.
- Maintains existing traffic signal locations.
- Requires reconstruction and upgrade of existing at-grade railroad crossings on Cleveland Avenue and Bahnson Avenue.

Sub-Study 5
6-Lane Divided

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure
Rice-2
6/22/2016



Added lanes on NB exit and entrance ramps

New back access road for properties on north side of Rice St.

Turn lanes added at Bahnson Ave

6-lane divided road-way on Rice Street

Upgraded railroad crossings

Rice St. shifted north to avoid impacts to Railroad right-of-way

Added lanes and median divider on Cleveland Ave

Concept Features

- Perpetuates Folded Diamond Interchange configuration.
- Shifts and rebuilds Rice Street north of its current alignment with a median and three lanes in each direction through the interchange, and two lanes in each direction away from the interchange.
- Rebuilds Cleveland Avenue with a median and two lanes in each direction.
- Provides additional turn bays and storage length at the Rice Street/Cleveland Avenue/NB I-229 off ramp and Rice Street/Bahnson Avenue intersections.
- Builds a retaining wall on the south side of Rice Street to avoid impacts to BNSF Railroad Right-of-Way.
- Maintains existing traffic signal locations.
- Requires reconstruction and upgrade of existing at-grade railroad crossings on Cleveland Avenue and Bahnson Avenue.

Sub-Study 5
6-Lane Divided - Shifted North to Avoid Railroad Right-of-Way

I-229 Major Investment Corridor Study
Sioux Falls, South Dakota

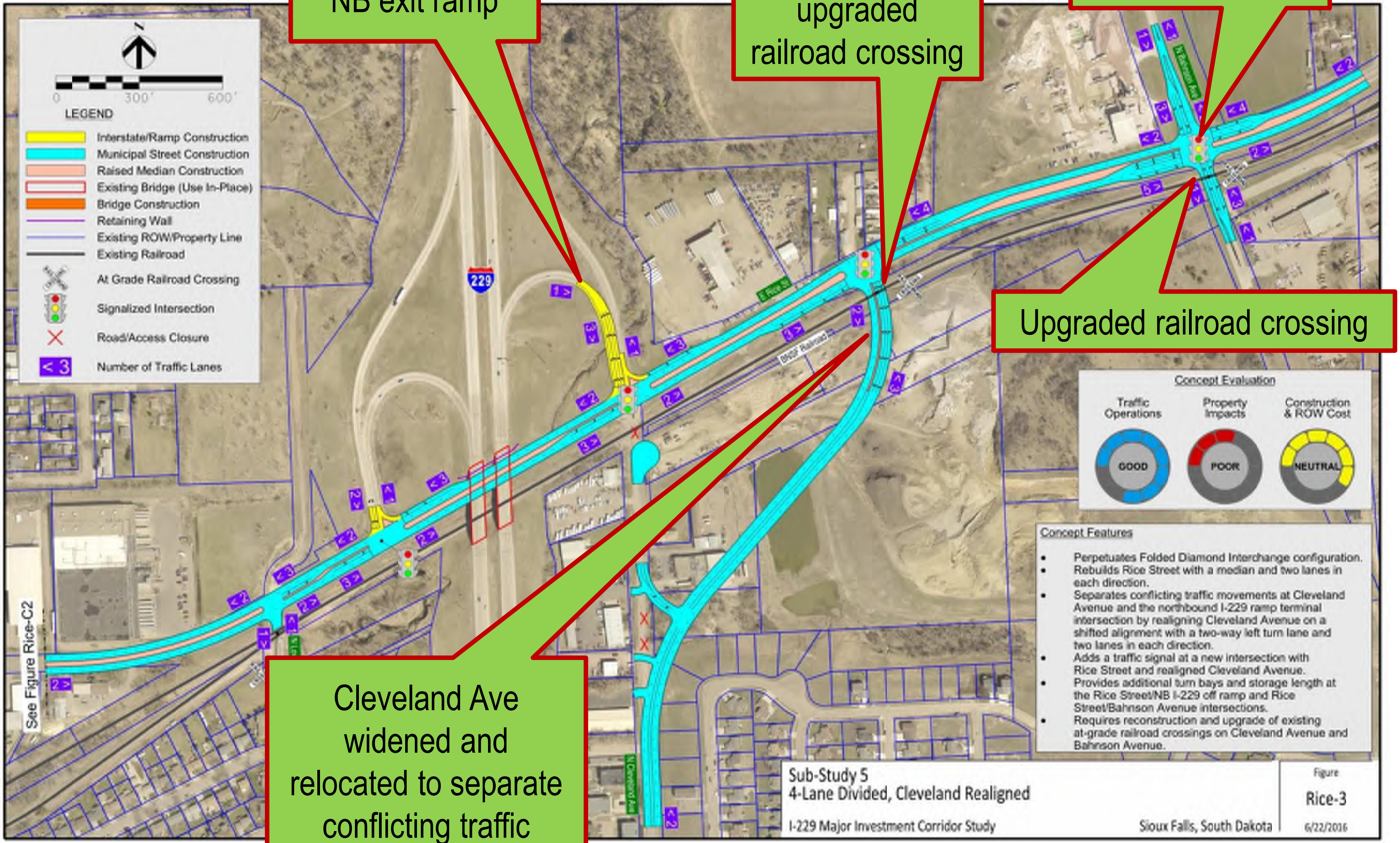
Figure
Rice-2a
6/22/2016

Added lane on NB exit ramp

Relocated and upgraded railroad crossing

Turn lanes added at Bahnson Ave

Upgraded railroad crossing



Cleveland Ave widened and relocated to separate conflicting traffic movements at I-229

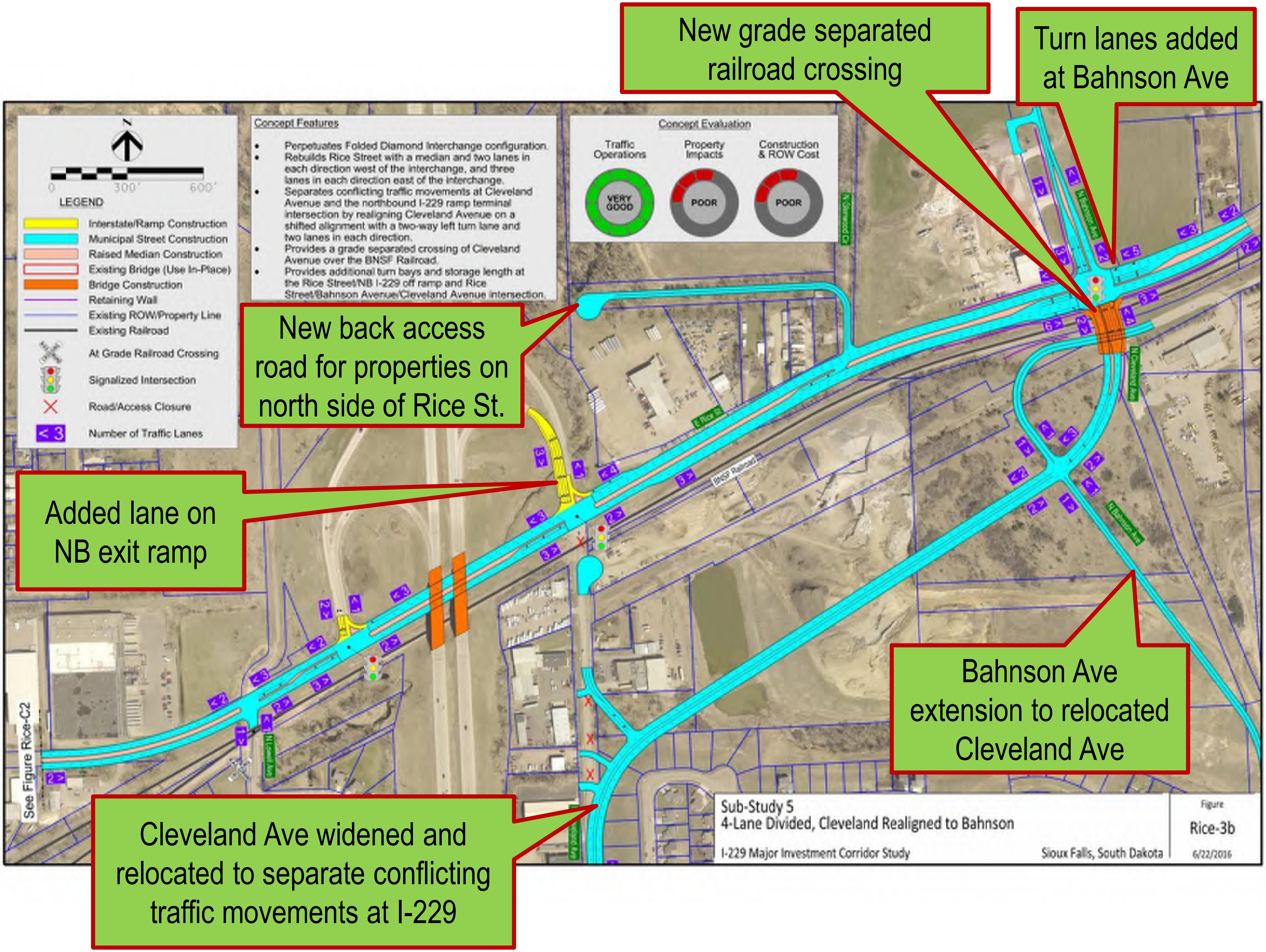
Concept Features

- Perpetuates Folded Diamond Interchange configuration.
- Rebuilds Rice Street with a median and two lanes in each direction.
- Separates conflicting traffic movements at Cleveland Avenue and the northbound I-229 ramp terminal intersection by realigning Cleveland Avenue on a shifted alignment with a two-way left turn lane and two lanes in each direction.
- Adds a traffic signal at a new intersection with Rice Street and realigned Cleveland Avenue.
- Provides additional turn bays and storage length at the Rice Street/NB I-229 off ramp and Rice Street/Bahnson Avenue intersections.
- Requires reconstruction and upgrade of existing at-grade railroad crossings on Cleveland Avenue and Bahnson Avenue.

Sub-Study 5
4-Lane Divided, Cleveland Realigned

I-229 Major Investment Corridor Study
Sioux Falls, South Dakota

Figure
Rice-3
6/22/2016



Concept Features

- Perpetuates Folded Diamond Interchange configuration.
- Rebuilds Rice Street with a median and two lanes in each direction west of the interchange, and three lanes in each direction east of the interchange.
- Separates conflicting traffic movements at Cleveland Avenue and the northbound I-229 ramp terminal intersection by realigning Cleveland Avenue on a shifted alignment with a two-way left turn lane and two lanes in each direction.
- Provides a grade separated crossing of Cleveland Avenue over the BNSF Railroad.
- Provides additional turn bays and storage length at the Rice Street/NB I-229 off ramp and Rice Street/Bahnson Avenue/Cleveland Avenue intersection.

Sub-Study 5
4-Lane Divided, Cleveland Realigned to Bahnson

I-229 Major Investment Corridor Study

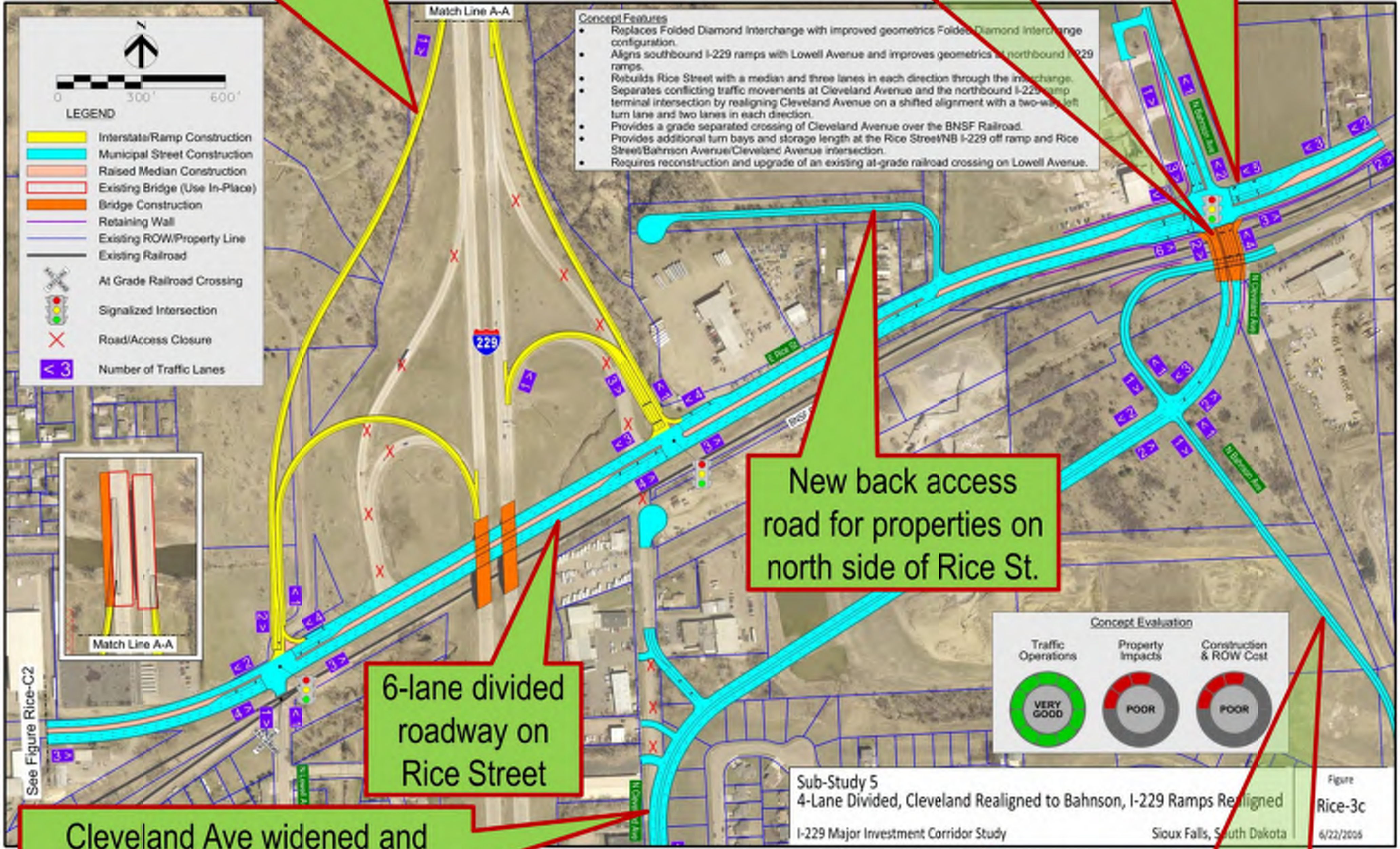
Sioux Falls, South Dakota

Figure
Rice-3b
6/22/2016

I-229 interchange reconstructed to improve ramp alignments

New grade separated railroad crossing

Turn lanes added at Bahnson Ave



Concept Features

- Replaces Folded Diamond Interchange with improved geometrics Folded Diamond Interchange configuration.
- Aligns southbound I-229 ramps with Lowell Avenue and improves geometrics at northbound I-229 ramps.
- Rebuilds Rice Street with a median and three lanes in each direction through the interchange.
- Separates conflicting traffic movements at Cleveland Avenue and the northbound I-229 ramp terminal intersection by realigning Cleveland Avenue on a shifted alignment with a two-way left turn lane and two lanes in each direction.
- Provides a grade separated crossing of Cleveland Avenue over the BNSF Railroad.
- Provides additional turn bays and storage length at the Rice Street/NB I-229 off ramp and Rice Street/Bahnson Avenue/Cleveland Avenue intersection.
- Requires reconstruction and upgrade of an existing at-grade railroad crossing on Lowell Avenue.

New back access road for properties on north side of Rice St.

6-lane divided roadway on Rice Street

Concept Evaluation

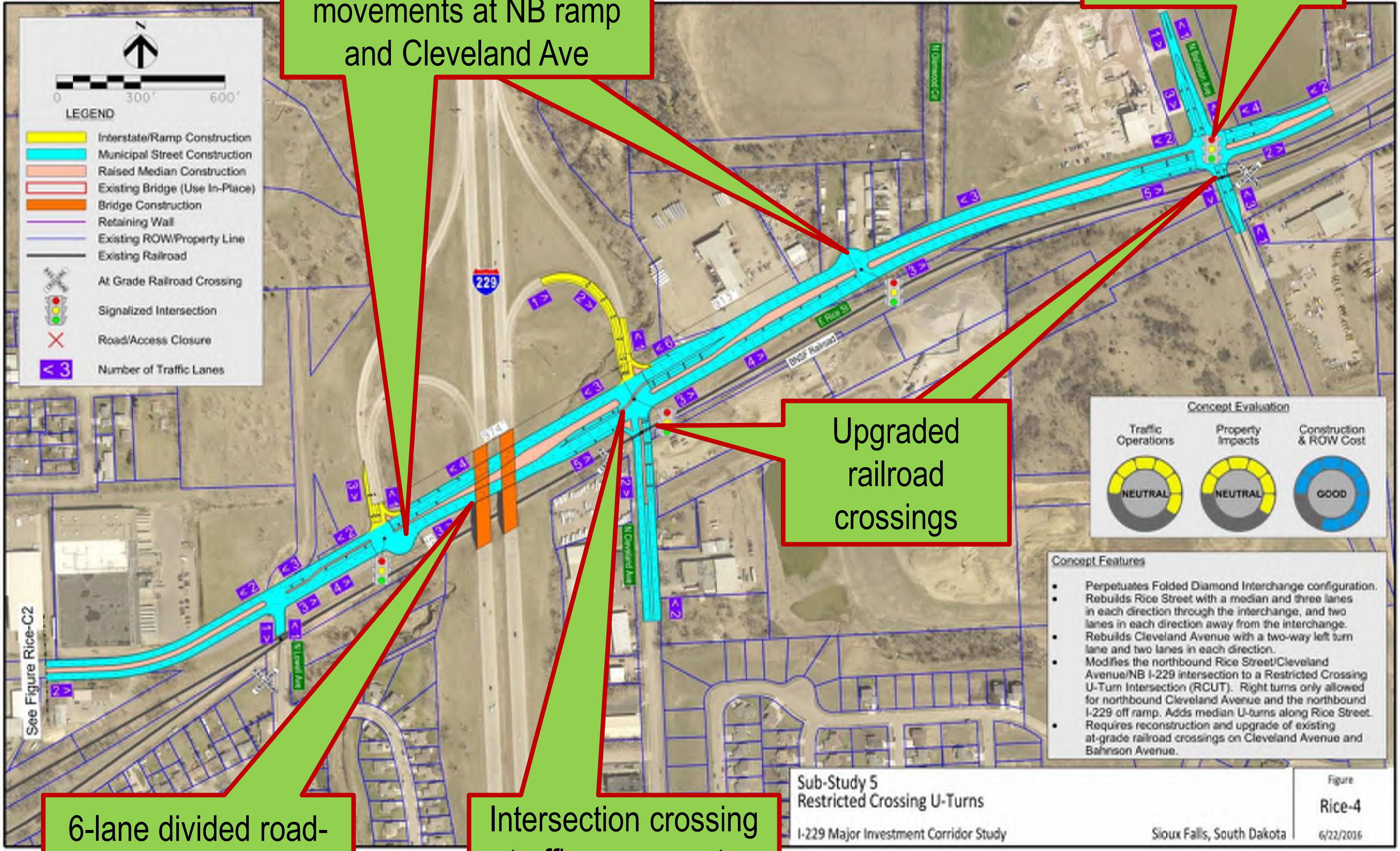
Traffic Operations	Property Impacts	Construction & ROW Cost
VERY GOOD	POOR	POOR

Sub-Study 5
4-Lane Divided, Cleveland Realigned to Bahnson, I-229 Ramps Realigned
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota

Figure
Rice-3c
6/22/2016

Cleveland Ave widened and relocated to separate conflicting traffic movements at I-229

Bahnson Ave extension to relocated Cleveland Ave



Median U-turns provided to replace crossing movements at NB ramp and Cleveland Ave

Turn lanes added at Bahnson Ave

Upgraded railroad crossings

6-lane divided roadway on Rice Street

Intersection crossing traffic movements restricted

Concept Evaluation

Traffic Operations	Property Impacts	Construction & ROW Cost
NEUTRAL	NEUTRAL	GOOD

Concept Features

- Perpetuates Folded Diamond Interchange configuration.
- Rebuilds Rice Street with a median and three lanes in each direction through the interchange, and two lanes in each direction away from the interchange.
- Rebuilds Cleveland Avenue with a two-way left turn lane and two lanes in each direction.
- Modifies the northbound Rice Street/Cleveland Avenue/NB I-229 intersection to a Restricted Crossing U-Turn Intersection (RCUT). Right turns only allowed for northbound Cleveland Avenue and the northbound I-229 off ramp. Adds median U-turns along Rice Street.
- Requires reconstruction and upgrade of existing at-grade railroad crossings on Cleveland Avenue and Bahnson Avenue.

Sub-Study 5
Restricted Crossing U-Turns

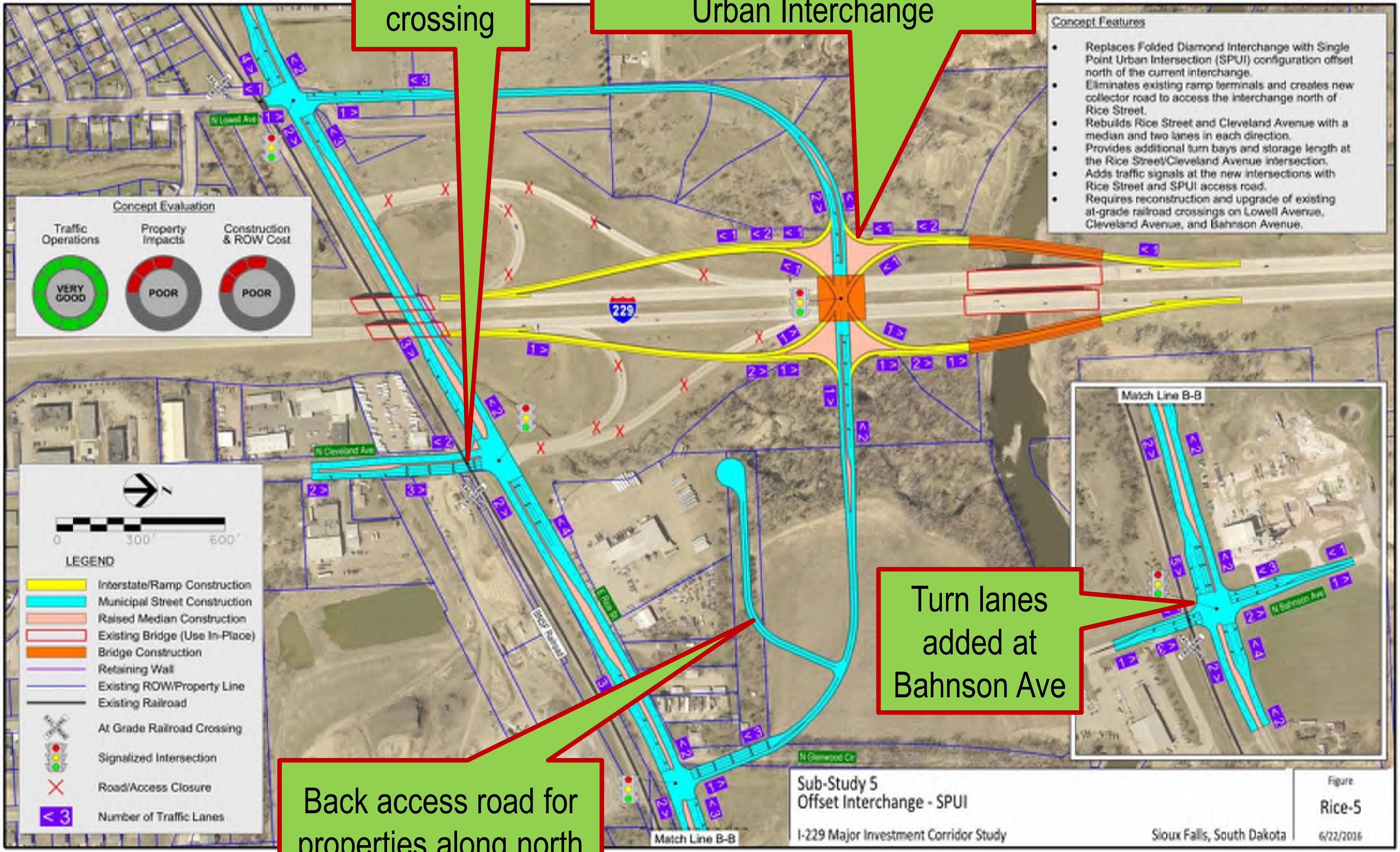
I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure
Rice-4
6/22/2016

Upgraded railroad crossing

Relocated Rice St. interchange constructed as Single Point Urban Interchange



Concept Features

- Replaces Folded Diamond Interchange with Single Point Urban Intersection (SPUI) configuration offset north of the current interchange.
- Eliminates existing ramp terminals and creates new collector road to access the interchange north of Rice Street.
- Rebuilds Rice Street and Cleveland Avenue with a median and two lanes in each direction.
- Provides additional turn bays and storage length at the Rice Street/Cleveland Avenue intersection.
- Adds traffic signals at the new intersections with Rice Street and SPUI access road.
- Requires reconstruction and upgrade of existing at-grade railroad crossings on Lowell Avenue, Cleveland Avenue, and Bahnson Avenue.

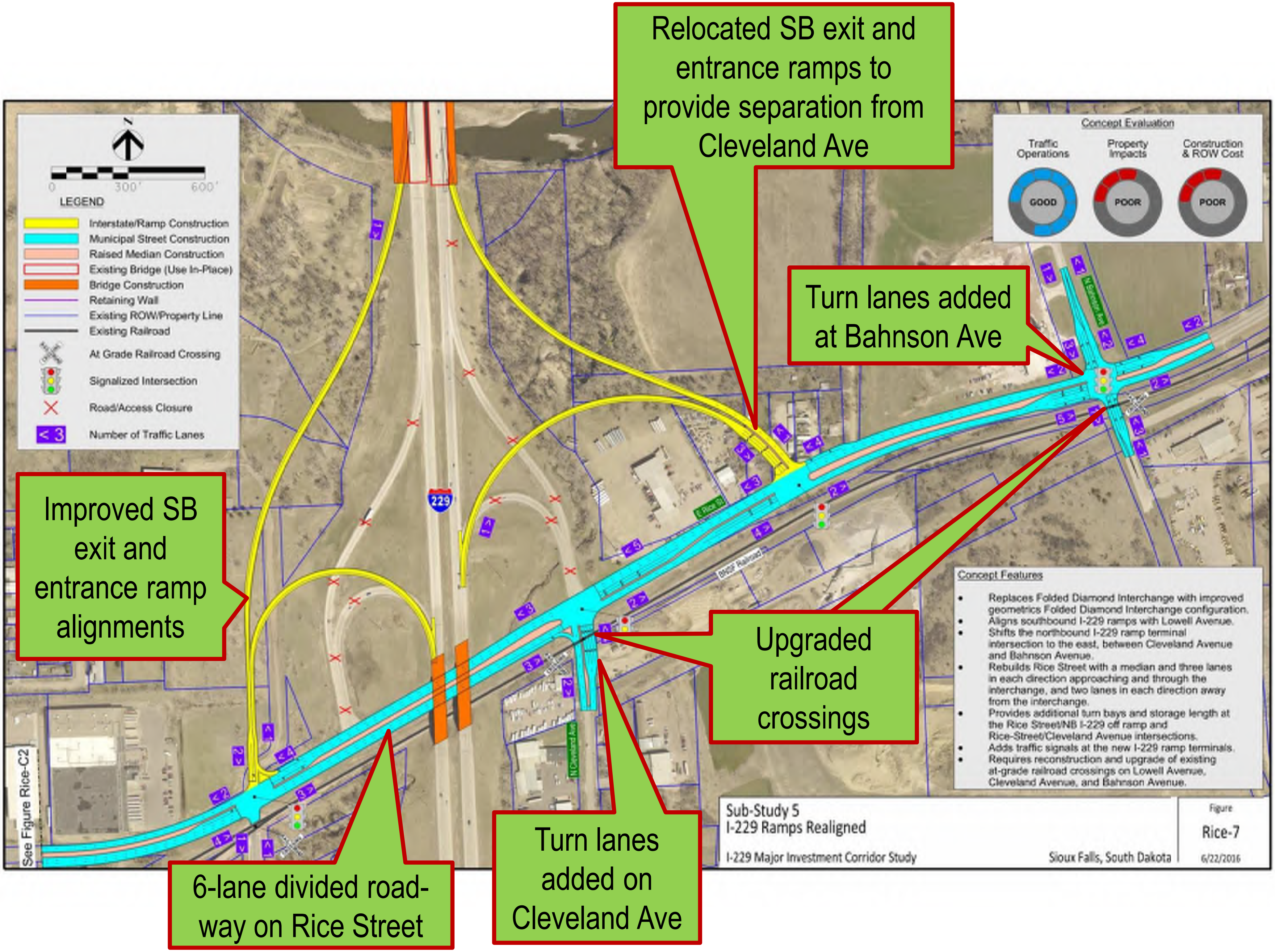
Turn lanes added at Bahnson Ave

Sub-Study 5
Offset Interchange - SPUI

I-229 Major Investment Corridor Study
Sioux Falls, South Dakota

Figure
Rice-5
6/22/2016

Back access road for properties along north side of Rice St.



Relocated SB exit and entrance ramps to provide separation from Cleveland Ave

Turn lanes added at Bahnson Ave

Improved SB exit and entrance ramp alignments

Upgraded railroad crossings

6-lane divided roadway on Rice Street

Turn lanes added on Cleveland Ave

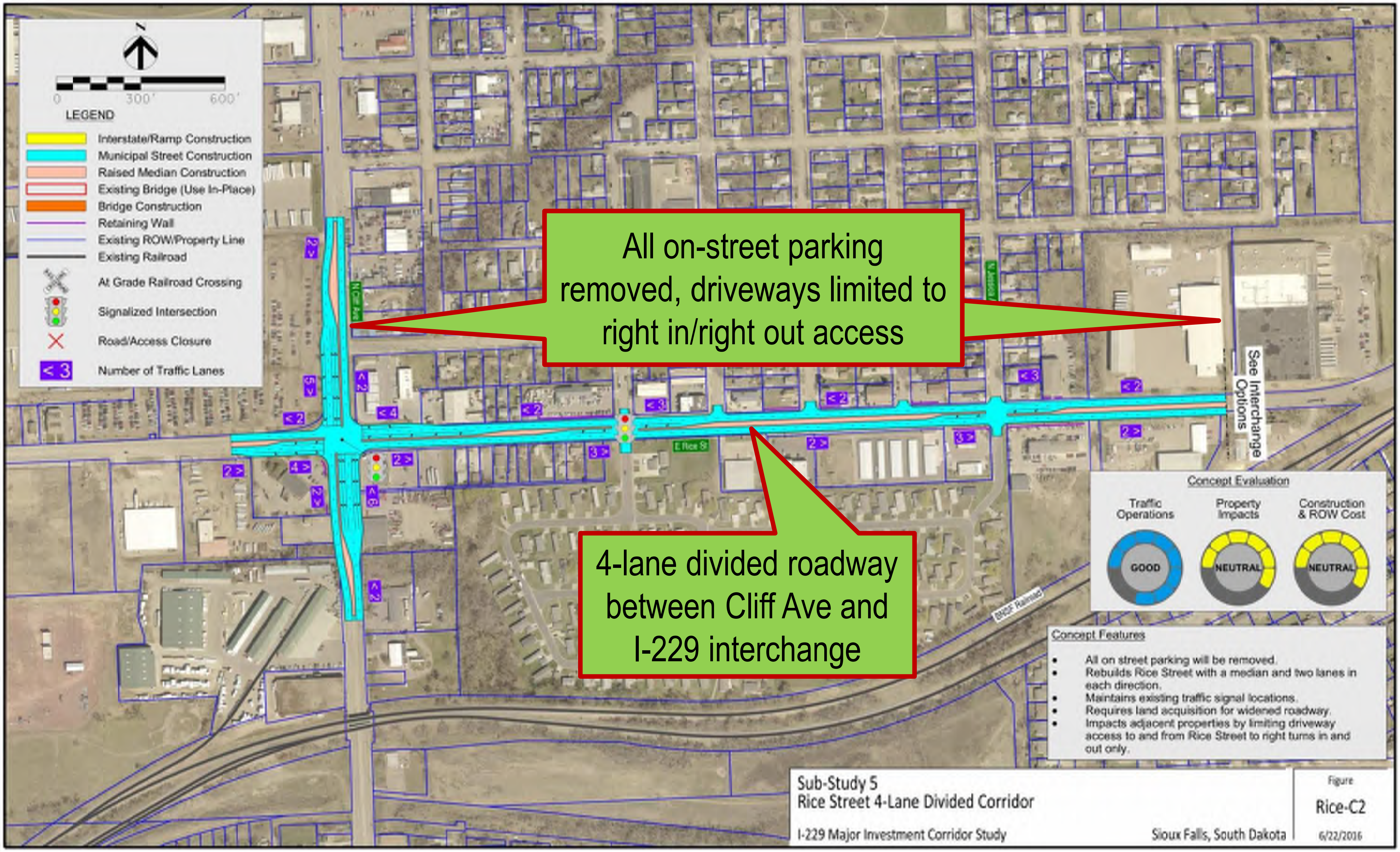
Concept Features

- Replaces Folded Diamond Interchange with improved geometrics Folded Diamond Interchange configuration.
- Aligns southbound I-229 ramps with Lowell Avenue.
- Shifts the northbound I-229 ramp terminal intersection to the east, between Cleveland Avenue and Bahnson Avenue.
- Rebuilds Rice Street with a median and three lanes in each direction approaching and through the interchange, and two lanes in each direction away from the interchange.
- Provides additional turn bays and storage length at the Rice Street/NB I-229 off ramp and Rice-Street/Cleveland Avenue intersections.
- Adds traffic signals at the new I-229 ramp terminals.
- Requires reconstruction and upgrade of existing at-grade railroad crossings on Lowell Avenue, Cleveland Avenue, and Bahnson Avenue.

Sub-Study 5
I-229 Ramps Realigned

I-229 Major Investment Corridor Study
Sioux Falls, South Dakota

Figure
Rice-7
6/22/2016



All on-street parking removed, driveways limited to right in/right out access

4-lane divided roadway between Cliff Ave and I-229 interchange

Concept Features

- All on street parking will be removed.
- Rebuilds Rice Street with a median and two lanes in each direction.
- Maintains existing traffic signal locations.
- Requires land acquisition for widened roadway.
- Impacts adjacent properties by limiting driveway access to and from Rice Street to right turns in and out only.

Sub-Study 5
Rice Street 4-Lane Divided Corridor

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure
Rice-C2
6/22/2016

PROJECT CONTACTS:

Jason Kjenstad – HDR Engineering, Inc.
605-977-7740 or jason.kjenstad@hdrinc.com

Dave Meier – HDR Engineering, Inc.
402-399-1068 or Dave.Meier@hdrinc.com

Shannon Ausen – City of Sioux Falls
605-367-8607 or sausen@siouxfalls.org

Steve Gramm – SDDOT Project Development
605-773-6641 or steve.gramm@state.sd.us

Interstate 229 Major Investment Study
Exit 7 – Rice Street

Thanks for Attending!!!!!

HDR

CLIFF AVENUE

JUNE 22ND, 2016

- SIGN-IN SHEETS
- POWERPOINT SLIDES
- MEETING NOTES (SEE CLIFF AVENUE AND RICE STREET PUBLIC MEETINGS APPENDIX)
- COMMENTS (SEE CLIFF AVENUE AND RICE STREET PUBLIC MEETINGS APPENDIX)

DOT

CITY OF SIOUX FALLS PUBLIC WORKS

HDR

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Stakeholder Meetings for Cliff Avenue Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3616P, PCN 044K

Project No.: 207030

Meeting Date Wednesday, June 22, 2016 2:30 PM

Meeting Location: Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Linda Mickelson Graham	4001 S Cliff Ave	605 940-4186	lindamlcaol.com
2	Jason Kjerstad	6300 S. Old Village Pl	977-7740	jason kjerstad@hdrinc.com
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Sign In Sheet

Subject I-229 Major Investment Corridor Study – Stakeholder Meetings for Cliff Avenue Sub Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3616P, PCN 044K **Project No.:** 207030

Meeting Date Wednesday, June 22, 2016 2:30 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Gene Napier	1109 + 1111 E. Pam Rd	375-0377	napier10@sio.midco.net
2	Jim Becker for E.J. King	2507 S. Big Timber Pl 2611 S. Big Timber Pl	334-7091	jrbecker25@hotmail.com
3	Dwight Smidt	3216 S. Phillips	201-1299	PUHRAH1340@s.o.midco.net
4	JEFF KREITER	1101 N. WESTERN AVE	367-7965	JEFFREY.KREITER@KR.SD.US
5	Marsha Biggar	3000 S. 10th Ave	929-7637	MDB3000@sio.midco.net
6	Minnehaha Properties Phil Johnson	100 S Phillips Ave	782-4011	pfjohnson@fnbsf.com
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Interstate 229 Major Investment Study
Exit 4 – Cliff Avenue

Stakeholder Meeting
June 22nd, 2016
2:30 pm to 3:30 pm

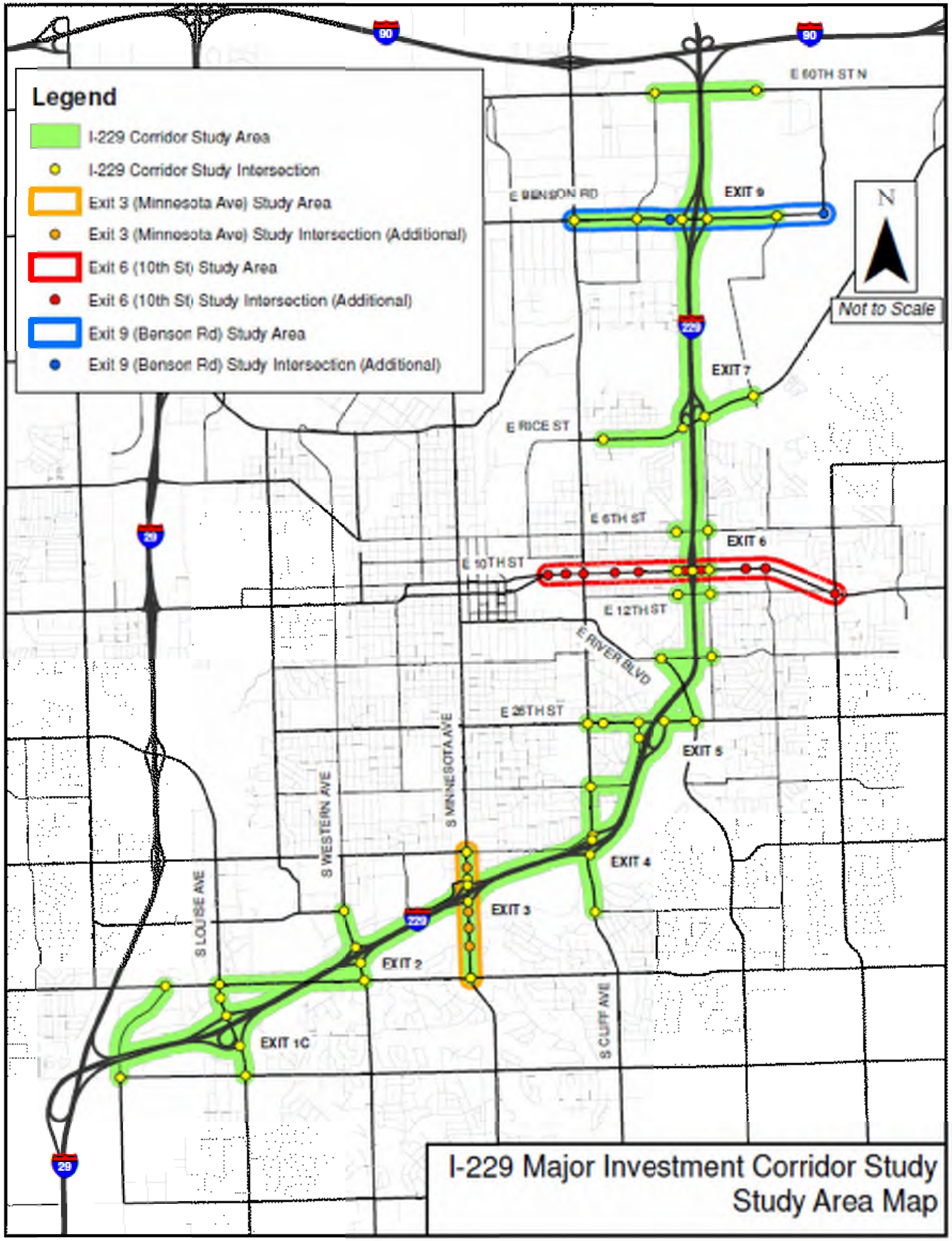
Study Area Map

I-229 Corridor Study

Solberg Avenue Overpass
to
60th Street N. Overpass

Additional Studies

Exit 3 – Minnesota Ave
Exit 6 – 10th Street
Exit 9 – Benson Road
Added Exit 4 – Cliff Avenue
Added Exit 7 – Rice Street



Study Advisory Partners

South Dakota Department of Transportation (SDDOT)

South Dakota Highway Patrol

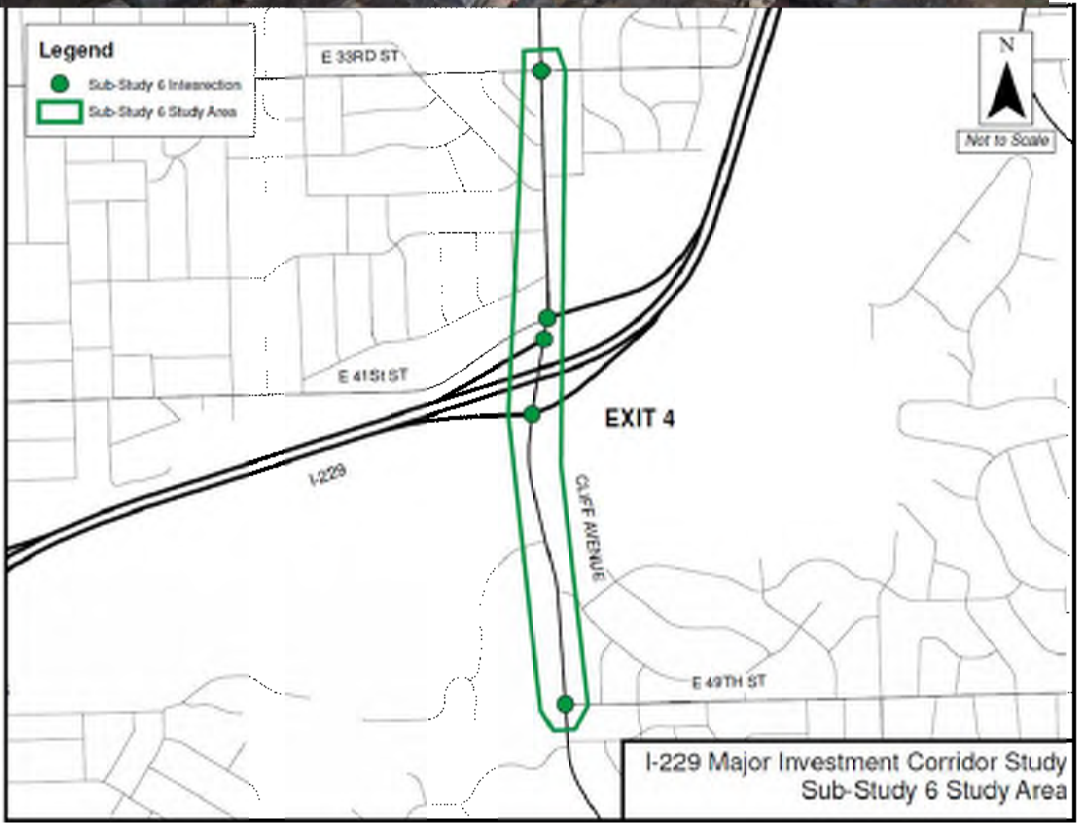
City of Sioux Falls

Sioux Falls Metropolitan Planning Organization (MPO)

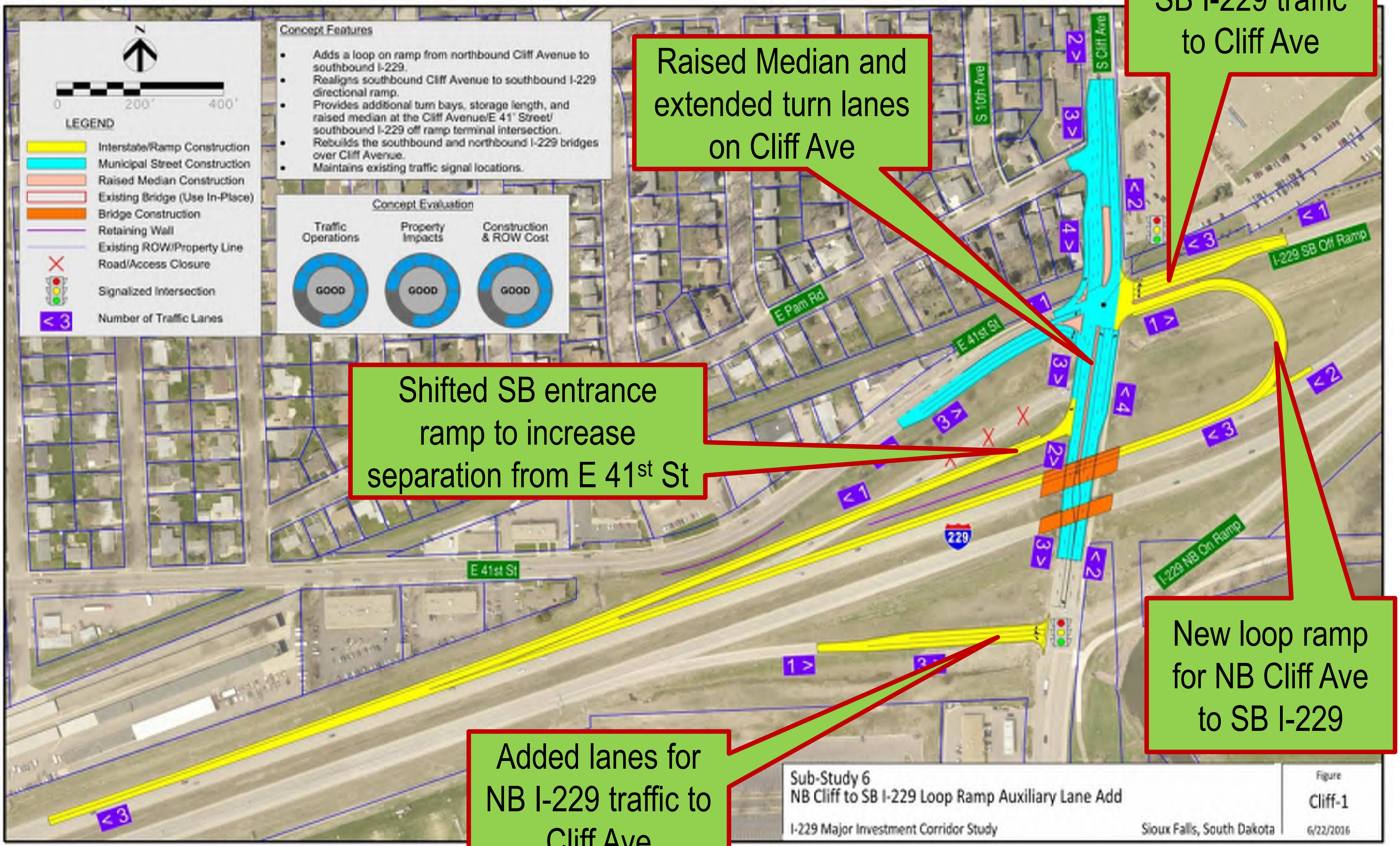
Federal Highway Administration (FHWA)

Exit 4 (Cliff Avenue)
Sub - Study Goals

- Reduce traffic congestion
- Develop new geometrics to improve capacity at 41st Street and Interchange
- Improve pedestrian mobility
- Improve safety for corridor users




Access to Park close to interchange makes it difficult to exit during peak hour periods
Cliff Avenue
Turn Lane short and few gaps exist to complete left turn movement
229
Cliff Avenue
High Right Turn Volume in the PM Peak Hour
Congestion due to close proximity of 41st Street to I229 SB ON Ramp



Concept Features

- Adds a loop on ramp from northbound Cliff Avenue to southbound I-229.
- Realigns southbound Cliff Avenue to southbound I-229 directional ramp.
- Provides additional turn bays, storage length, and raised median at the Cliff Avenue/E 41' Street/ southbound I-229 off ramp terminal intersection.
- Rebuilds the southbound and northbound I-229 bridges over Cliff Avenue.
- Maintains existing traffic signal locations.

Sub-Study 6
NB Cliff to SB I-229 Loop Ramp Auxiliary Lane Add
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota

Figure
Cliff-1
6/22/2016

Added lanes for SB I-229 traffic to Cliff Ave

Raised Median and extended turn lanes on Cliff Ave

Shifted SB entrance ramp to increase separation from E 41st St

New loop ramp for NB Cliff Ave to SB I-229

Added lanes for NB I-229 traffic to Cliff Ave

Raised Median and extended turn lanes on Cliff Ave

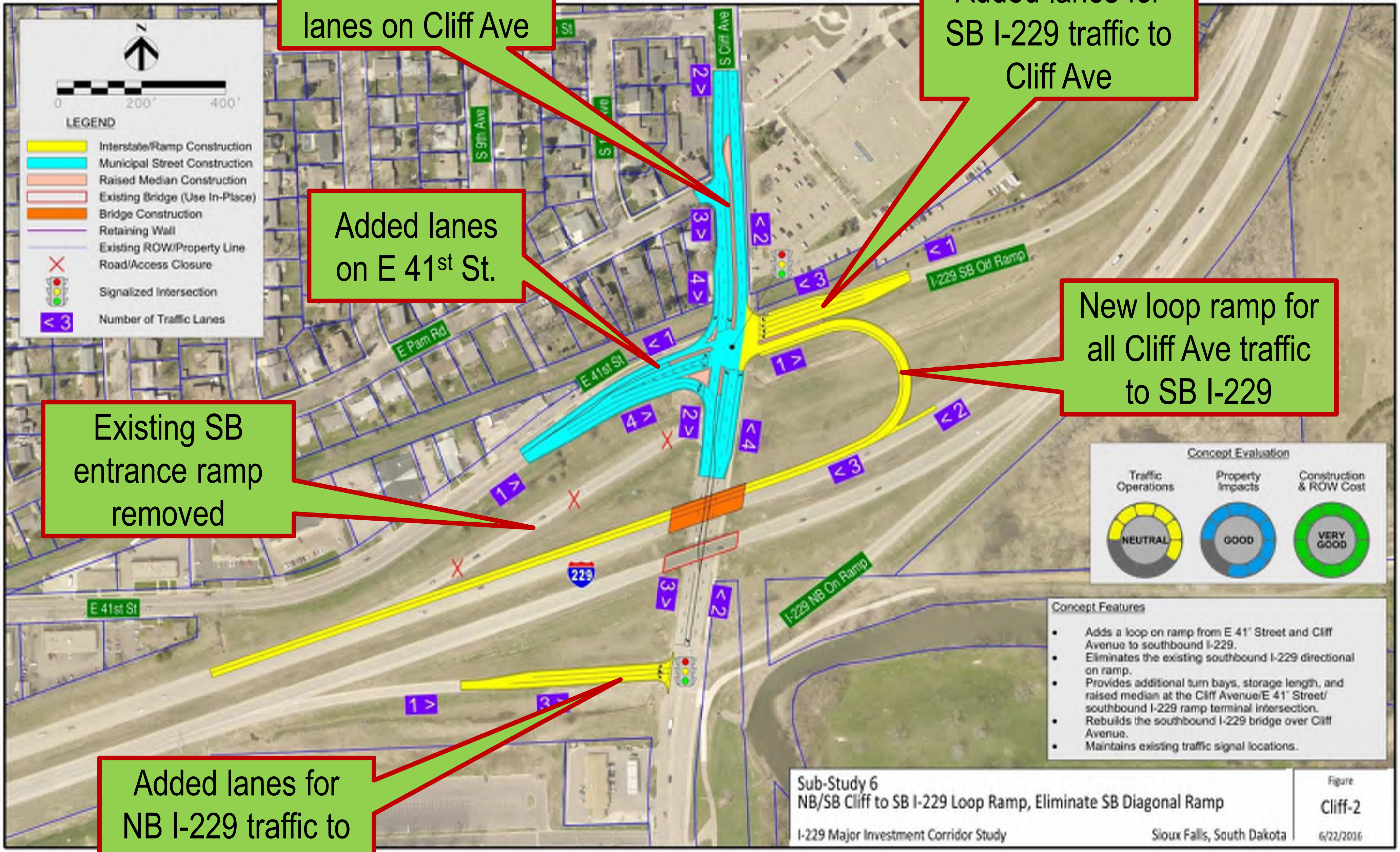
Added lanes for SB I-229 traffic to Cliff Ave

Added lanes on E 41st St.

New loop ramp for all Cliff Ave traffic to SB I-229

Existing SB entrance ramp removed

Added lanes for NB I-229 traffic to Cliff Ave



Concept Features

- Adds a loop on ramp from E 41st Street and Cliff Avenue to southbound I-229.
- Eliminates the existing southbound I-229 directional on ramp.
- Provides additional turn bays, storage length, and raised median at the Cliff Avenue/E 41st Street/ southbound I-229 ramp terminal intersection.
- Rebuilds the southbound I-229 bridge over Cliff Avenue.
- Maintains existing traffic signal locations.

Sub-Study 6
NB/SB Cliff to SB I-229 Loop Ramp, Eliminate SB Diagonal Ramp
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota

Figure
Cliff-2
6/22/2016

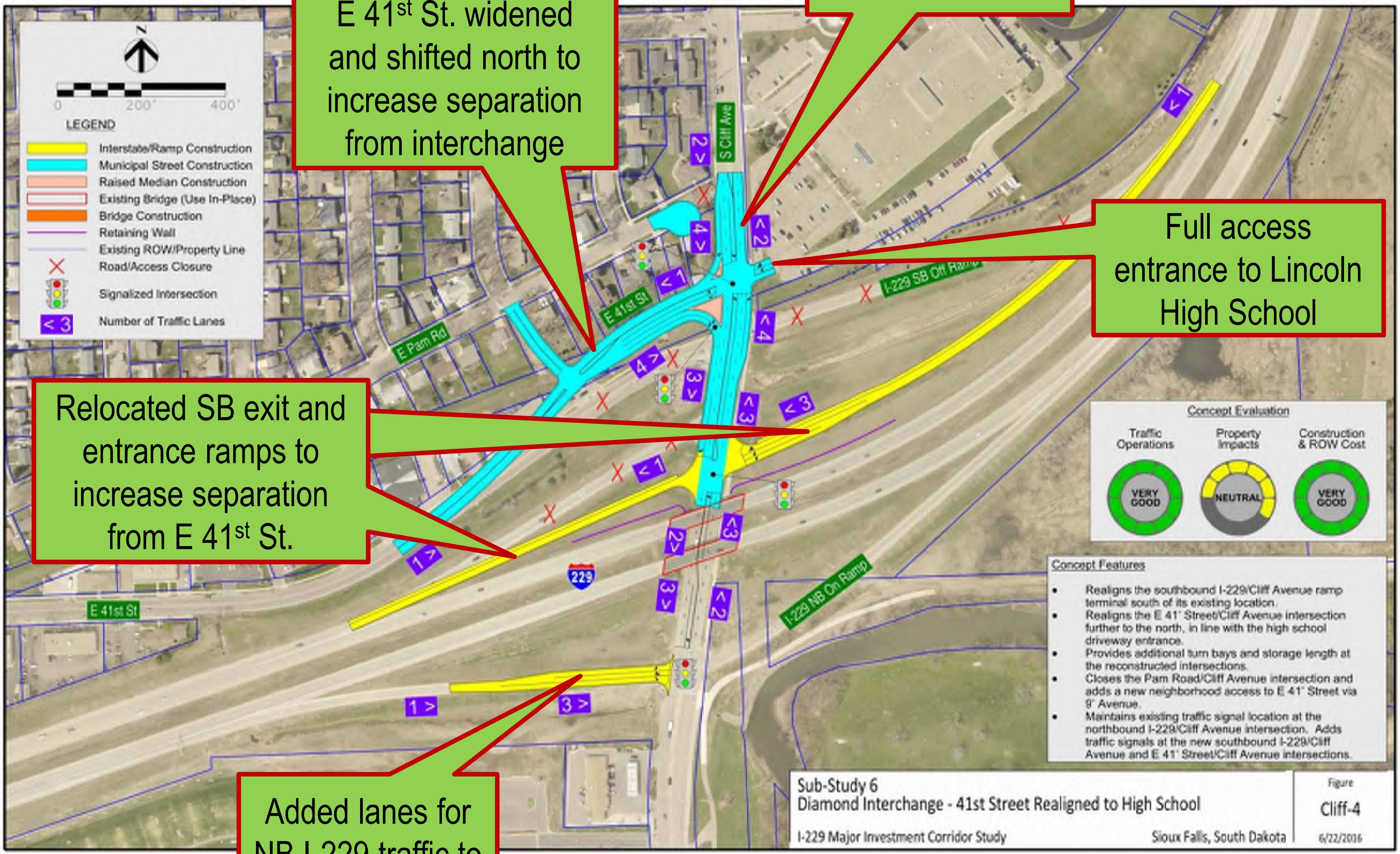
Extended turn lanes on Cliff Ave

E 41st St. widened and shifted north to increase separation from interchange

Full access entrance to Lincoln High School

Relocated SB exit and entrance ramps to increase separation from E 41st St.

Added lanes for NB I-229 traffic to Cliff Ave



Concept Features

- Realigns the southbound I-229/Cliff Avenue ramp terminal south of its existing location.
- Realigns the E 41st Street/Cliff Avenue intersection further to the north, in line with the high school driveway entrance.
- Provides additional turn bays and storage length at the reconstructed intersections.
- Closes the Pam Road/Cliff Avenue intersection and adds a new neighborhood access to E 41st Street via 9th Avenue.
- Maintains existing traffic signal location at the northbound I-229/Cliff Avenue intersection. Adds traffic signals at the new southbound I-229/Cliff Avenue and E 41st Street/Cliff Avenue intersections.

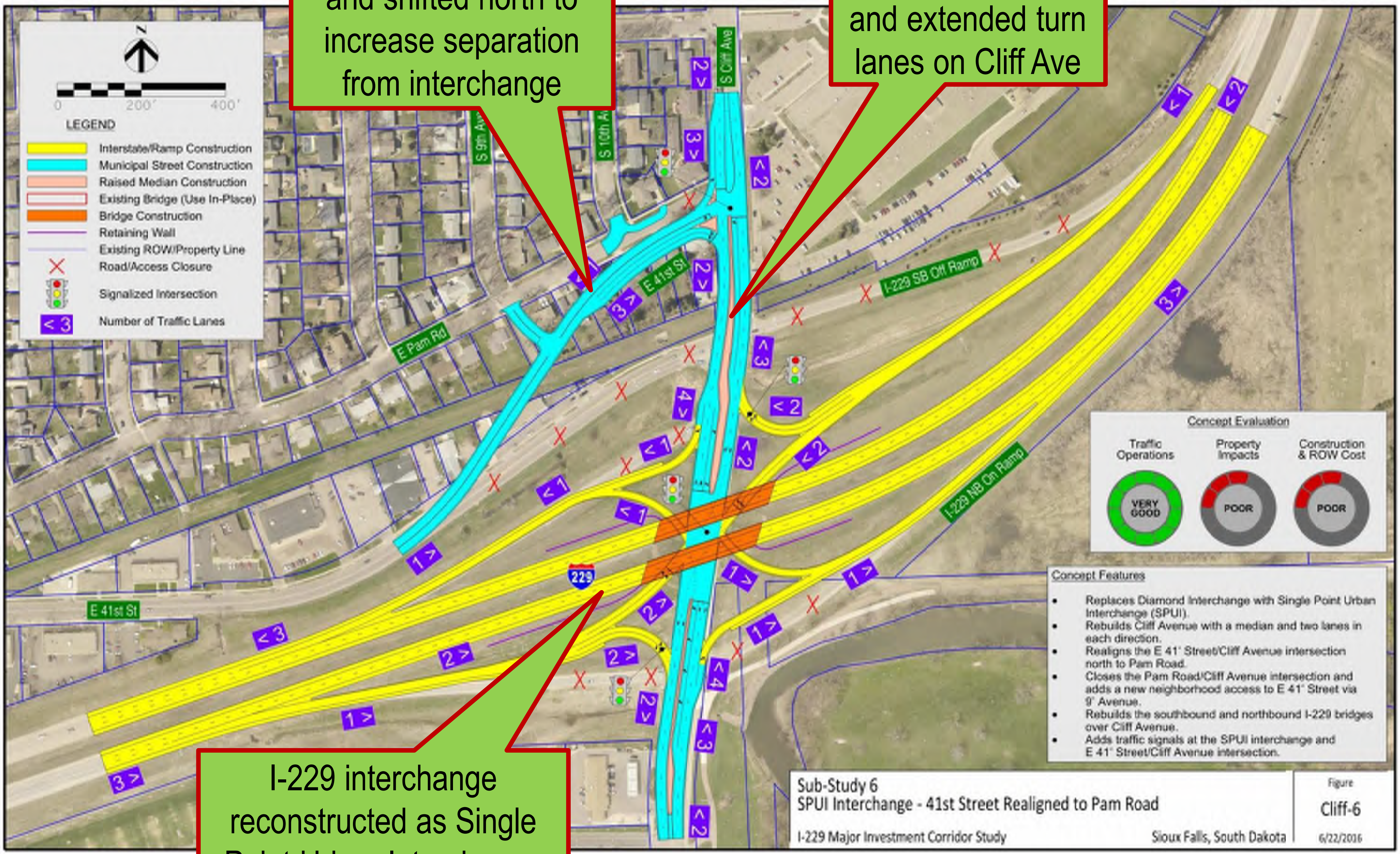
Sub-Study 6
Diamond Interchange - 41st Street Realigned to High School

I-229 Major Investment Corridor Study
Sioux Falls, South Dakota

Figure
Cliff-4
6/22/2016

E 41st St. widened and shifted north to increase separation from interchange

Raised Median and extended turn lanes on Cliff Ave



Concept Features

- Replaces Diamond Interchange with Single Point Urban Interchange (SPUI).
- Rebuilds Cliff Avenue with a median and two lanes in each direction.
- Realigns the E 41st Street/Cliff Avenue intersection north to Pam Road.
- Closes the Pam Road/Cliff Avenue intersection and adds a new neighborhood access to E 41st Street via 9th Avenue.
- Rebuilds the southbound and northbound I-229 bridges over Cliff Avenue.
- Adds traffic signals at the SPUI interchange and E 41st Street/Cliff Avenue intersection.

Sub-Study 6
SPUI Interchange - 41st Street Realigned to Pam Road
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota

Figure
Cliff-6
6/22/2016

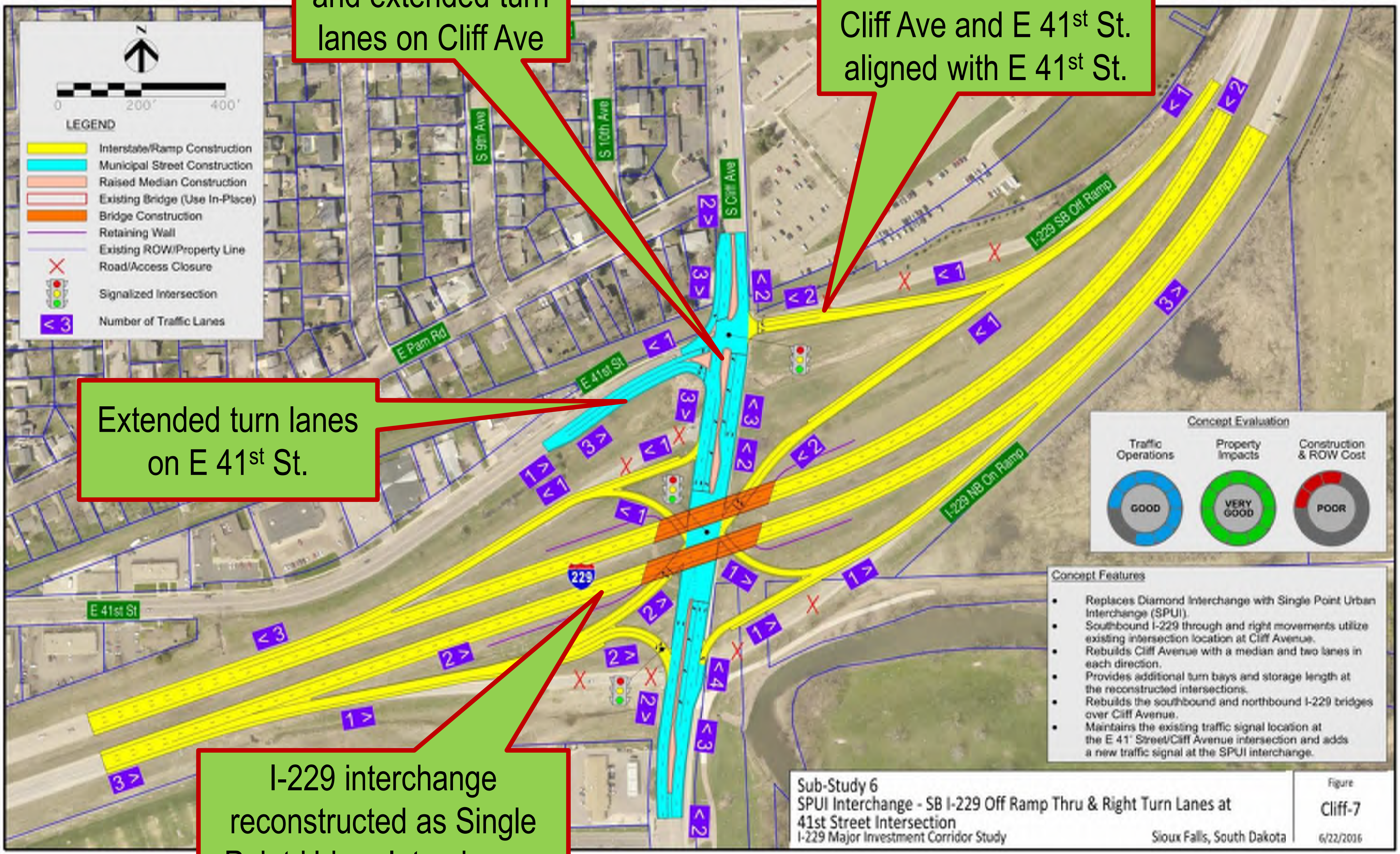
I-229 interchange reconstructed as Single Point Urban Interchange for added capacity

Raised Median and extended turn lanes on Cliff Ave

SB exit lanes to NB Cliff Ave and E 41st St. aligned with E 41st St.

Extended turn lanes on E 41st St.

I-229 interchange reconstructed as Single Point Urban Interchange for added capacity



Concept Features

- Replaces Diamond Interchange with Single Point Urban Interchange (SPUI).
- Southbound I-229 through and right movements utilize existing intersection location at Cliff Avenue.
- Rebuilds Cliff Avenue with a median and two lanes in each direction.
- Provides additional turn bays and storage length at the reconstructed intersections.
- Rebuilds the southbound and northbound I-229 bridges over Cliff Avenue.
- Maintains the existing traffic signal location at the E 41' Street/Cliff Avenue intersection and adds a new traffic signal at the SPUI interchange.

Sub-Study 6
SPUI Interchange - SB I-229 Off Ramp Thru & Right Turn Lanes at
41st Street Intersection
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota

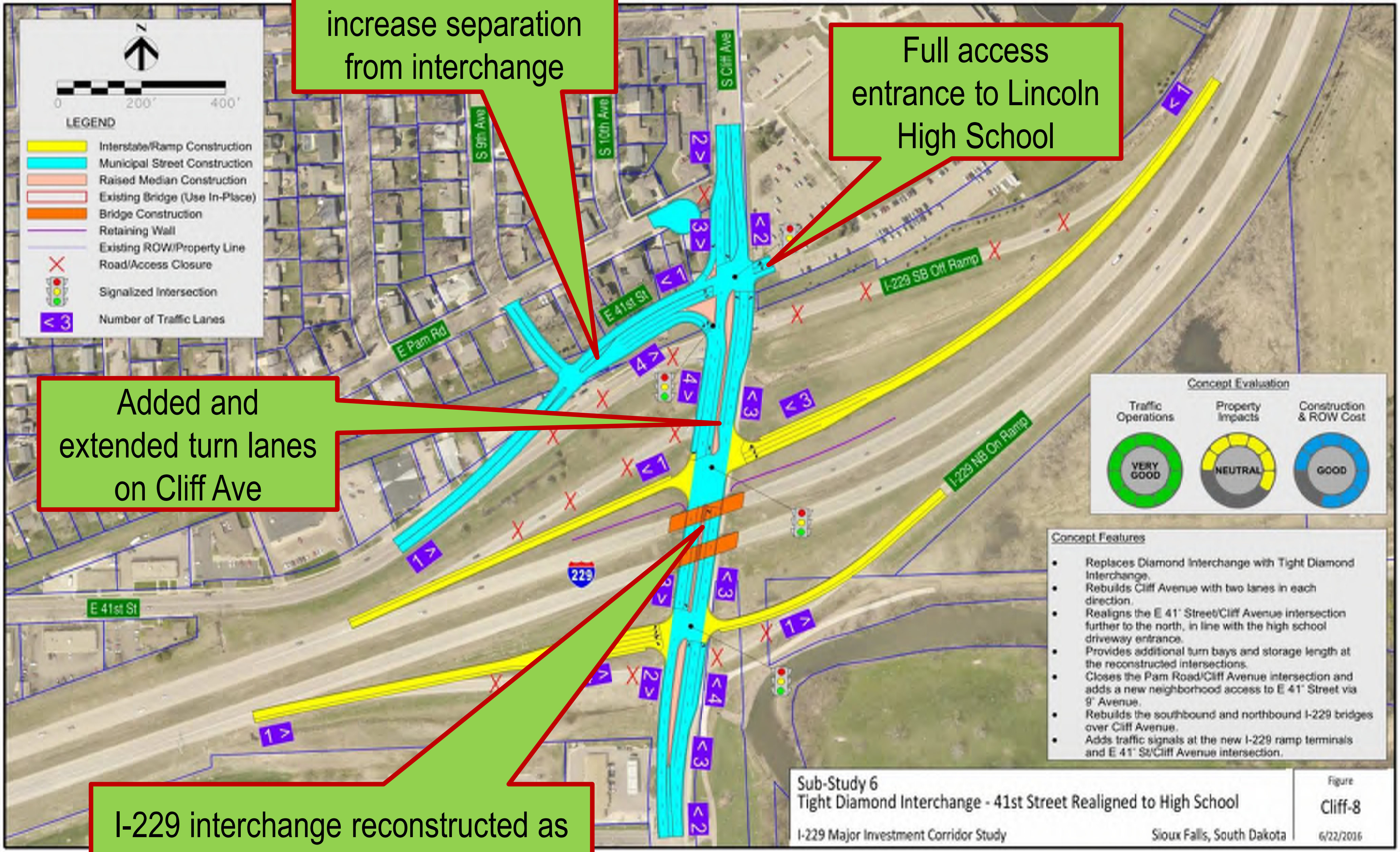
Figure
Cliff-7
6/22/2016

E 41st St. widened and shifted north to increase separation from interchange

Full access entrance to Lincoln High School

Added and extended turn lanes on Cliff Ave

I-229 interchange reconstructed as Tight Diamond for added capacity



Concept Features

- Replaces Diamond Interchange with Tight Diamond Interchange.
- Rebuilds Cliff Avenue with two lanes in each direction.
- Realigns the E 41st Street/Cliff Avenue intersection further to the north, in line with the high school driveway entrance.
- Provides additional turn bays and storage length at the reconstructed intersections.
- Closes the Pam Road/Cliff Avenue intersection and adds a new neighborhood access to E 41st Street via 9th Avenue.
- Rebuilds the southbound and northbound I-229 bridges over Cliff Avenue.
- Adds traffic signals at the new I-229 ramp terminals and E 41st St/Cliff Avenue intersection.

Sub-Study 6
Tight Diamond Interchange - 41st Street Realigned to High School
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota

Figure
Cliff-8
6/22/2016

PROJECT CONTACTS:

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Brian Ray– HDR Engineering, Inc.
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Shannon Ausen – City of Sioux Falls
605-367-8607 or sausen@siouxfalls.org

Steve Gramm – SDDOT Project Development
605-773-6641 or steve.gramm@state.sd.us

Interstate 229 Major Investment Study
Exit 4 – Cliff Avenue

Thanks for Attending!!!!!

APPENDIX -

STAKEHOLDER MEETINGS #2 – DECEMBER 5TH & 6TH, 2016

BENSON ROAD

DECEMBER 5TH, 2016

- MEETING NOTES
- SIGN-IN SHEETS
- POWERPOINT SLIDES
- COMMENTS (SEE PUBLIC MEETING #3 APPENDIX)

Meeting Minutes

Project:	I-229 Major Investment Corridor Study, PL 0100(87) 3616P, PCN 044K
Subject:	Stakeholder Meeting – Sub-study 4 – Benson Road Exit 9
Date:	Monday, December 05, 2016
Location:	Sioux Falls Convention Center Conference Room 6
Attendees:	See Attached Sign In Sheet – 5 Participants

Stakeholder comments and questions noted:

1. Stakeholders representing Boyer Trucks (West side of St Paul Ave, south of Benson Rd) – The proposed concept will prevent westbound traffic on Benson Rd from turning left at St Paul Ave to go south. Concern noted in particular for westbound semi-trailer truck traffic headed for businesses along St Paul Ave. That traffic would have to turn onto Potsdam Ave or Lewis Ave and find their way to St Paul Ave via 39th St N. Truck drivers headed for businesses along St Paul Ave may get lost along the way. The routing is too inconvenient. Boyer Truck has no access to Lewis Ave.

2. At least half of the businesses located south of Benson Rd and west of I-229 are trucking-related.

3. Opposed to proposed median treatment on Benson Rd at Potsdam Avenue.

4. Stakeholder opinion - Crashes on Benson Road at intersections are due to speed on Benson Road (the existing posted speed limit is 40 mph).

5. Will Concept Benson-4 impact the property to the northeast of the northbound I-229 entrance ramp at Benson Rd? Response: At this stage of concept development, it appears that property impacts along the northbound entrance ramp would be very limited.

6. Will right of way acquisition be needed for proposed widening at Benson Rd and Lewis Ave? Response: Probably.

7. How many years in the future will the proposed improvements be constructed? Response: At least six years.

Meeting Minutes

Project:	I-229 MIS; PL 0100 (87) 3616P, PCN 044K
Subject:	Sub-study 4 (Benson Road) Stakeholder Meeting Notes
Date:	Monday, December 05, 2016
Location:	SF Convention Center
Attendees:	See sign in sheets

1. Presentation by Jason Kjenstad. I229 MIS Set 2 Stakeholder Mtg_Benson Rd
2. Stakeholder questions/comments and *responses* during and after presentation:
    - Trucking company on south side of St. Paul Avenue is concerned about loss of access from the proposed raised center median on Benson Road. *Kjenstad response was that center median is needed for safety benefits; City design standards call for raised center median for roadways with 3 through lanes in each direction.*
    - With the proposed raised median at Benson Road/St. Paul Avenue intersection, trucks will be forced to use Lewis Avenue/Potsdam Avenue/39th Street combination to get to the trucking businesses along St. Paul Avenue. These streets do not now accommodate the widths and intersection radii required for truck movements. *Kjenstad response was that alternative access routes would have to be reviewed for truck traffic and potential improvements would need to be considered.*
    - Recommend speed control/reduction methods on Benson Road to address traffic speeds in excess of posted speed limits. *Kjenstad response was that besides speed limit enforcement, for arterial streets like Benson Road, the City typically does not incorporate speed control/reduction methods.*
    - South-side landowners were assessed for 2016 installation of sidewalk along the south side of Benson Road. Would landowners get assessed again for future sidewalk improvements associated with Benson Road reconstruction/widening? *City response was that there would not be additional assessments to landowners for sidewalk work.*
    - Recommended adding a traffic signal at Benson Road/St. Paul Avenue intersection. *Kjenstad response was that signals are spaced to facilitate traffic movements and a signal at the Benson Road/St. Paul Avenue intersection would not meet City or SDDOT signal spacing criteria.*
    - What is the timeframe for proposed Benson Road improvements? *Kjenstad response was 7 to 10 years from now before any construction begins.*
    - SF Development owns the property in the northeast quadrant of the I-29/Benson Road interchange. They are concerned about the additional roadway right-of-way needed for the interchange loop options. *Kjenstad response was that the City will work with the landowner throughout the development plan process.*
    - Benson Road traffic is not bad during off-peak hours; why is widening required? *Kjenstad response was that peak period traffic is the basis for design and 3 through traffic lanes in each direction are needed to accommodate predicted peak period traffic to meet City and SDDOT level of service criteria.*
    - What is the cost difference between the interchange options? *Response by Unruh was that DDI option is about $4M less that the loop options ($40M estimated cost for options with loops; $36M estimated cost for DDI option).*

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Stakeholder Meeting for Benson Road Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3616P, PCN 044K **Project No.:** 207030

Meeting Date Monday, December 5th, 2016 3:00 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Shannon Ausen	224 W 9th St SFSD	367-8607	sausen@ siouxfalls.org
2	James Unruh	HDR 6300 S. Old Village Pl. SFSD	605-977-7740	james.unruh@hdrinc.com
3	Jason Kjenstad	HDR 6300 S. Old Village Pl SF	605-977-7740	jason.kjenstad@hdrinc.com
4	Steve Gramm	700 E. Broadway Ave Pierre	605-773-6641	steve.gramm@state.sd.us
5	Bruce Mutschler	2101 E. Benson Rd	605-336-6100	bmutschler@beyertrucks.com
6	Lon Clemenson	SFDF 200 N. Phillips Ave	605-339-0703	bnc@siouxfalls.com
7	CHRIS RANS	3412 N POTSDAM AVE.	(605)338-9110	CHRIS@SUNKOTACONSTRUCTION.COM
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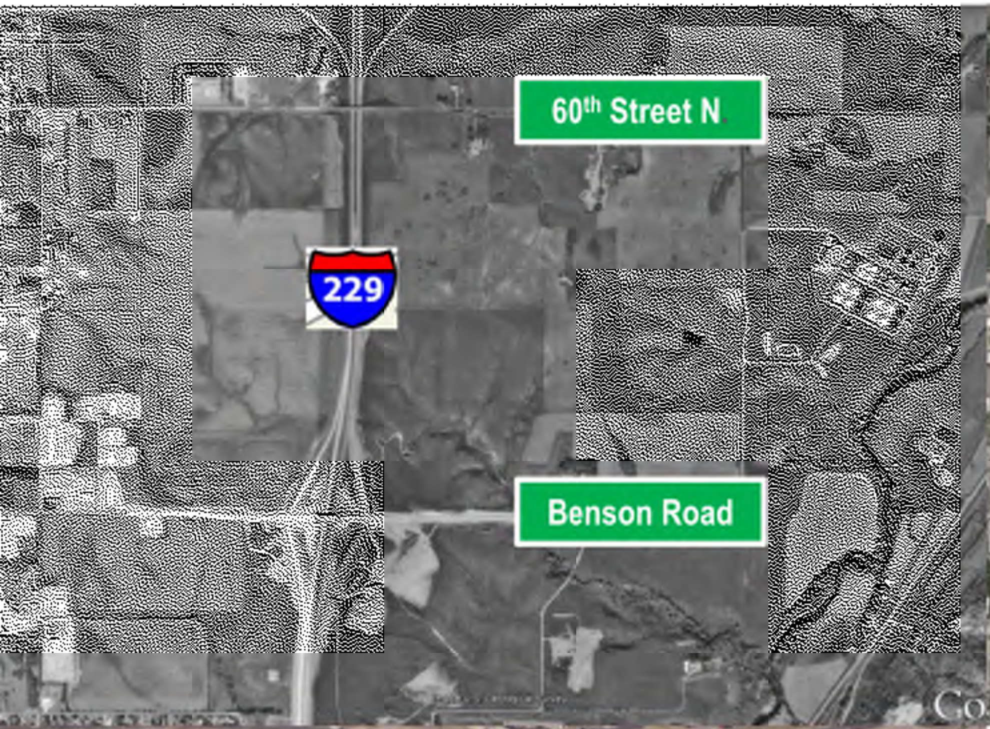


INTERSTATE 229 MAJOR INVESTMENT STUDY

Exit 9 – Benson Rd Sub-Study

Stakeholder Meeting

December 5th, 2016
3:00 pm to 4:00 pm

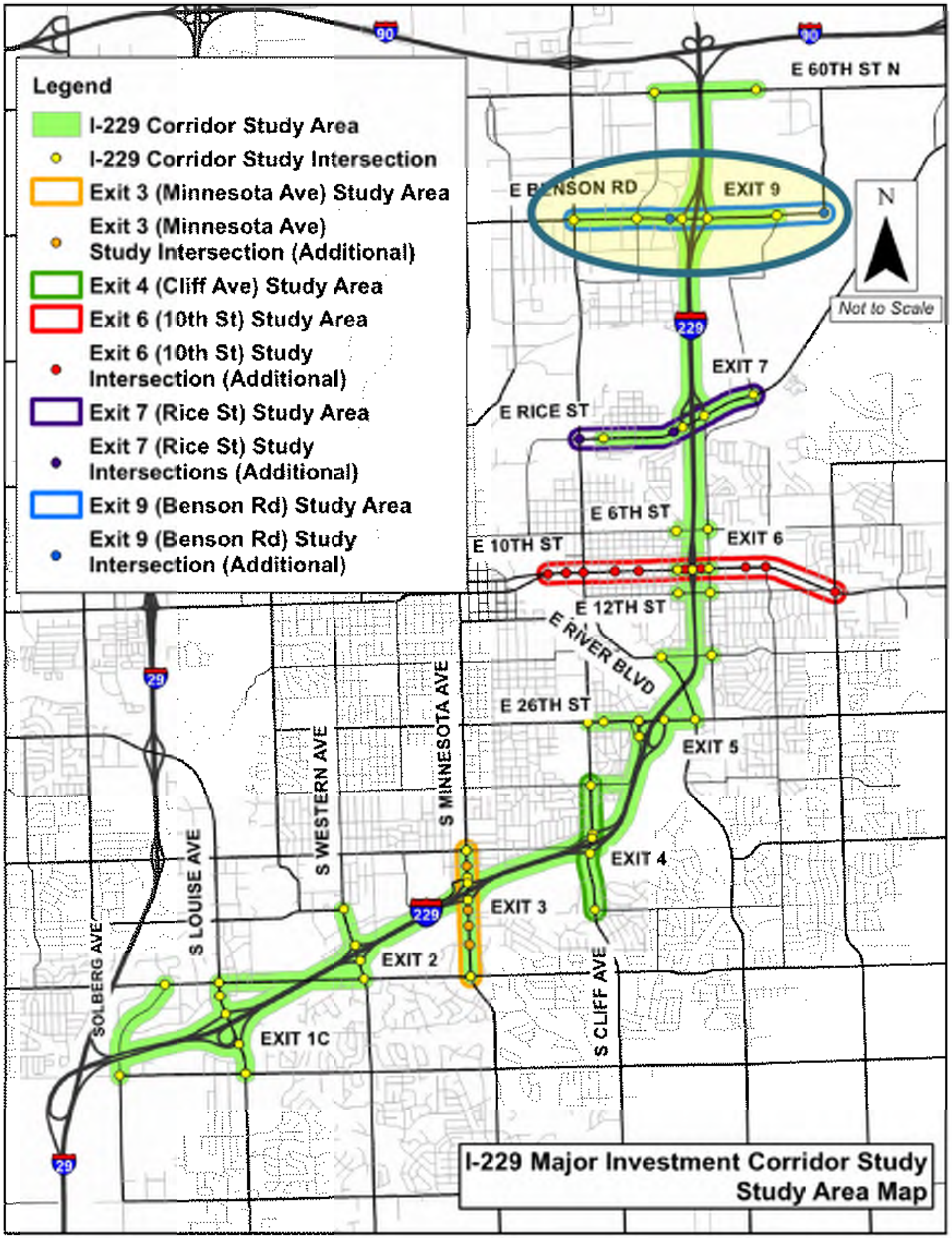
STUDY AREA MAP

I-229 Corridor Study

Solberg Avenue Overpass to 60th Street N Overpass

Meeting will focus on:

Exit 9 – Benson Road



STUDY ADVISORY PARTNERS

South Dakota Department of Transportation (SDDOT)

South Dakota Highway Patrol

City of Sioux Falls

Sioux Falls Metropolitan Planning Organization (MPO)

Federal Highway Administration (FHWA)

PRESENTATION AGENDA

- Concept Evaluation Process
- Concept Evaluation Results
- Concepts Recommended for Further Consideration in Future Phases (Interchange & Corridor Improvements)
- Next Steps

CONCEPT EVALUATION PROCESS

- Evaluation Factors:

Option	**Description**	**Traffic Operations**	**Safety**	**Environmental**	**Property Impacts**	**Construction & ROW Cost**	**DRAFT Recommendation**
Concept ID	Interchange and Corridor Type	•Traffic Delay •Level of Service •Interchange Year of Failure	Predicted Crash Reduction during 2012-2035	Potential impact to wetlands, historical resources, threatened and endangered species, public lands, and floodplains	Total Right of Way (ROW) Required and Acquisitions	Total Constuction Cost (including ROW)	**Advance** **or** **Eliminate**

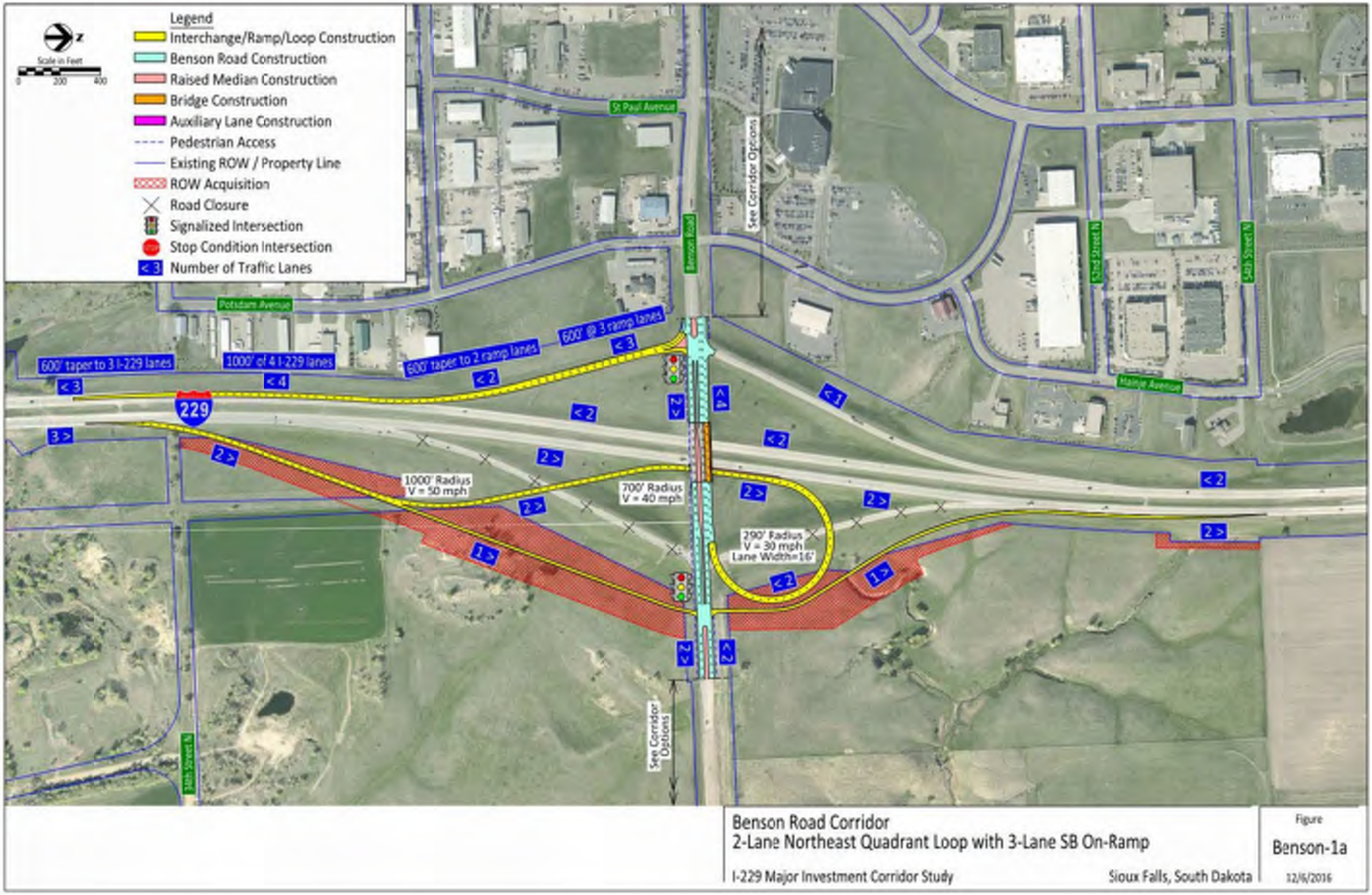
- Evaluation Matrix to Compare Concepts
- Recommended Action

CONCEPT EVALUATION RESULTS

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
No-Build	No-Build	POOR	NEUTRAL	N/A	N/A	N/A	**Advance**
Benson-1A	2-Lane Northeast Quadrant Loop with 3-Lane SB On-Ramp	VERY GOOD	GOOD	NEUTRAL	NEUTRAL	NEUTRAL	**Advance**
Benson-1B	2-Lane Northeast Quadrant Loop with 2-Lane SB On-Ramp	VERY GOOD	GOOD	NEUTRAL	NEUTRAL	NEUTRAL	**Advance**
Benson-4	Diverging Diamond Interchange	NEUTRAL	VERY GOOD	GOOD	VERY GOOD	NEUTRAL	**Advance**

CONCEPTS FOR FURTHER CONSIDERATION

BENSON-1A



Benson Road Corridor
2-Lane Northeast Quadrant Loop with 3-Lane SB On-Ramp

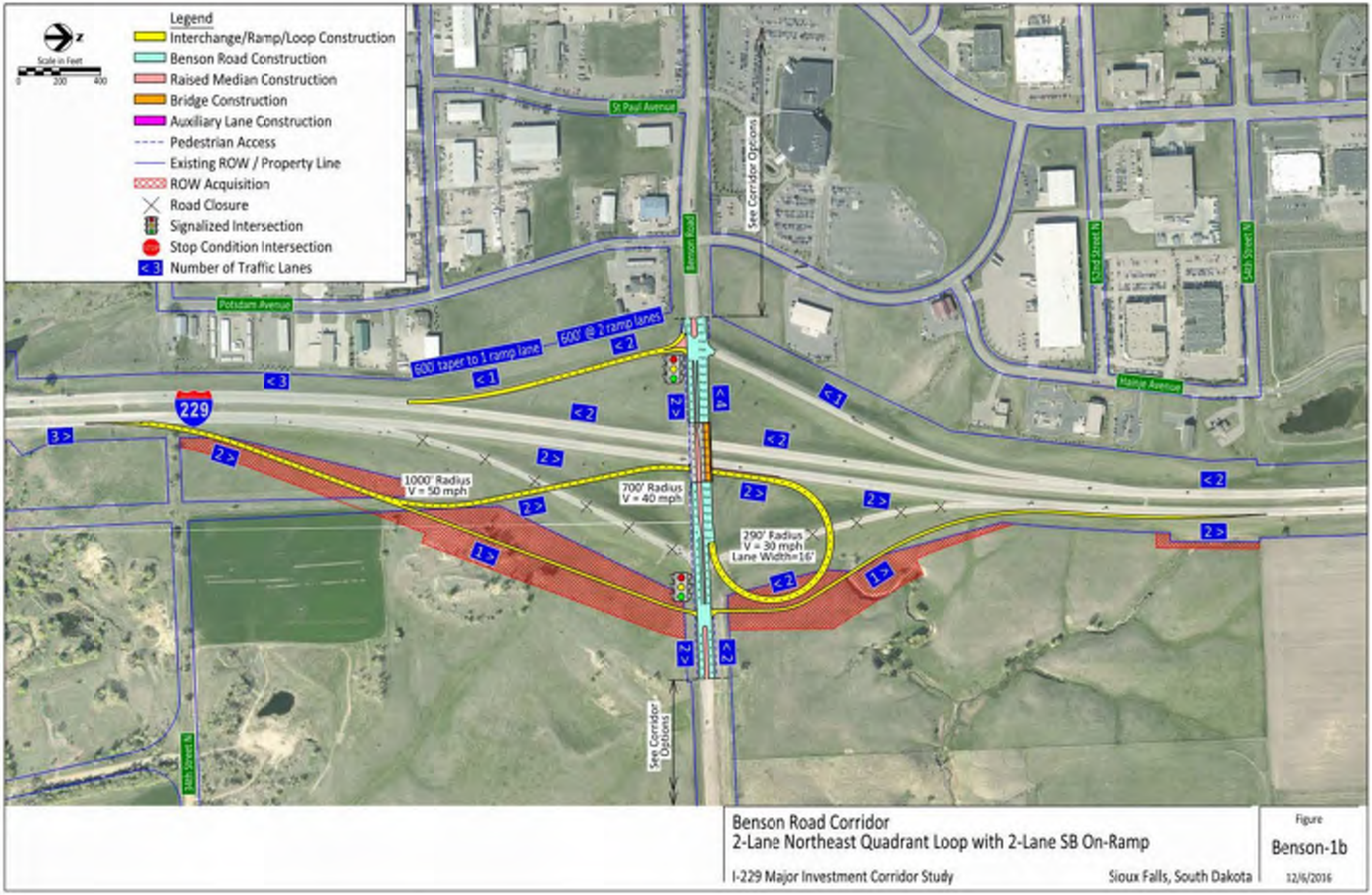
I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure
Benson-1a
12/6/2016

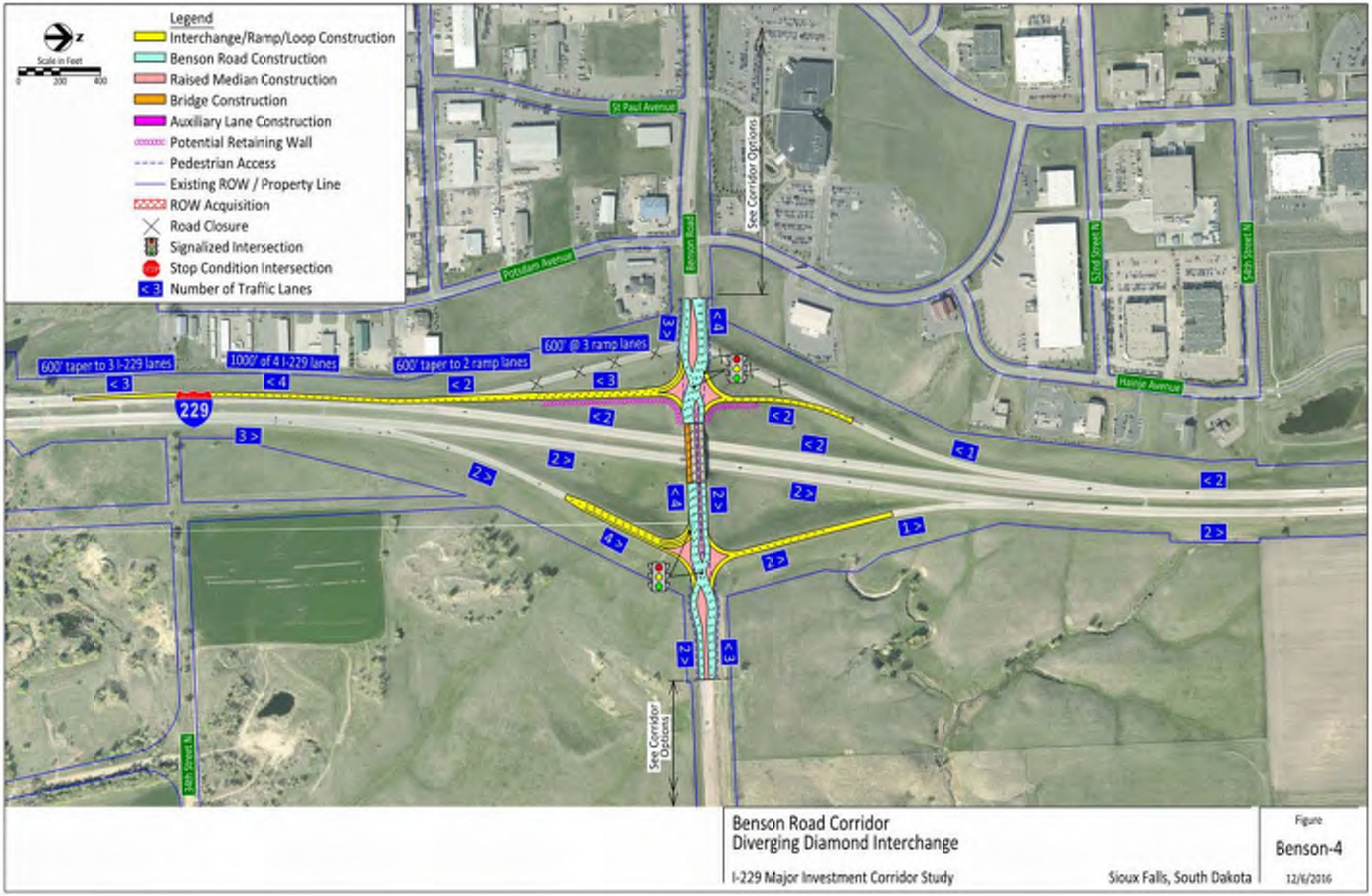
CONCEPTS FOR FURTHER CONSIDERATION

BENSON-1B



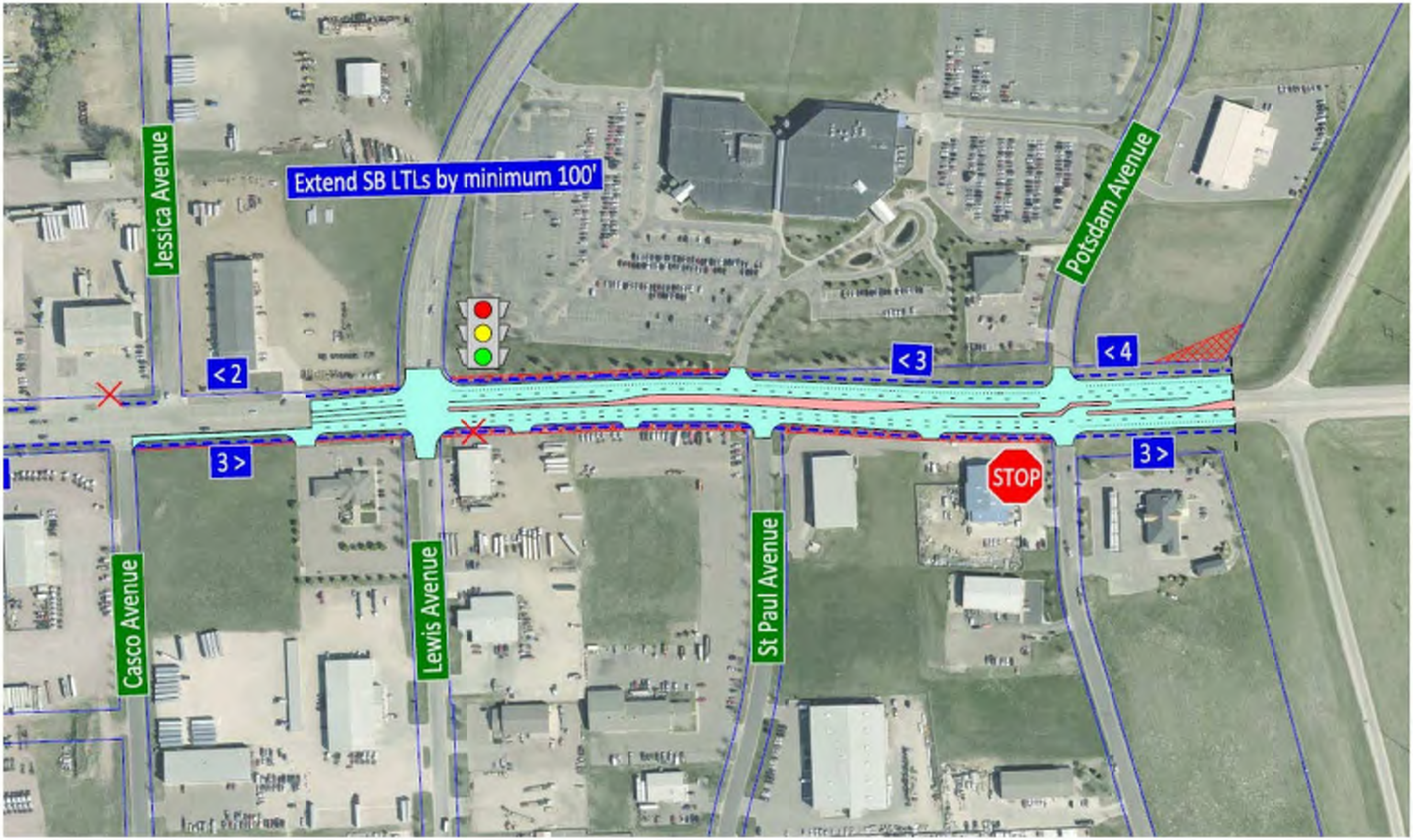
CONCEPTS FOR FURTHER CONSIDERATION

BENSON-4



CONCEPTS FOR FURTHER CONSIDERATION

BENSON IMPROVEMENTS



BENSON ROAD
PRELIMINARY PROJECT PRIORITY

- Priority recommendation based on existing and anticipated need and level of improvement and impacts associated with remaining concept options
- Benson Road Interchange and Corridor improvements = High Priority
- See exhibit board for additional information

NEXT STEPS

- Assemble Stakeholder and Public Comments
- Complete Study Report
- Project Development Process = 5-6 year timeline when initiated by SDDOT & City
  - Prepare Interchange Modification Justification Report and Environmental Document
  - Develop Project Design
  - Acquire Right of Way
  - Construction

PROJECT CONTACTS:

Jason Kjenstad – HDR Engineering, Inc.
605-977-7740 or jason.kjenstad@hdrinc.com

James Unruh – HDR Engineering, Inc.
605-977-7740 or james.unruh@hdrinc.com

Shannon Ausen – City of Sioux Falls
605-367-8607 or sausen@siouxfalls.org

Steve Gramm – SDDOT Project Development
605-773-6641 or steve.gramm@state.sd.us

INTERSTATE 229 MAJOR INVESTMENT STUDY

Exit 9 – Benson Rd Sub-Study

Thanks for attending!

10TH STREET

DECEMBER 5TH, 2016

- MEETING NOTES
- SIGN-IN SHEETS
- POWERPOINT SLIDES
- COMMENTS (SEE PUBLIC MEETING #3 APPENDIX)

Meeting Minutes

Project:	I-229 Major Investment Corridor Study, PL 0100(87) 3616P, PCN 044K
Subject:	Stakeholder Meeting – Sub-study 3 - Exit 6 (10th Street) Sub-Study
Date:	Monday, December 05, 2016
Location:	Sioux Falls Convention Center Conference Room 6
Attendees:	See Attached Sign In Sheet – 5 Participants

Stakeholder comments and questions noted:

1. Question from stakeholder associated with Fry'in Pan Restaurant (Northwest corner 10th & Cleveland) - Is a median proposed on Cleveland Avenue both north and south of 10th Street? Response: The alternatives include a median on Cleveland Avenue both north and south of 10th Street and dual left turn lanes are proposed on each Cleveland Ave approach to serve anticipated traffic.

The stakeholder noted that Cleveland Ave is only busy after school is dismissed, for about 45 minutes per day, so dual left turn lanes are not needed.

He stated that he does not support the proposed medians on Cleveland because he perceives that similar medians on 12th St "ruined" businesses there.

2. How will parking impacts will be addressed? Response: Replacement parking would be sought, but if replacement parking could not be identified, acquisition of the property would be considered.

3. What happens to the Super 8 Hotel on the northeast corner of I-229/10th Street? Response: It was noted that all of the alternatives impact the hotel similarly.

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Stakeholder Meeting for 10th Street Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3616P, PCN 044K **Project No.:** 207030

Meeting Date Monday, December 5th, 2016 4:30 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	gary busselman	7201 E Madison ST Sioux Falls SD 57110	605 334 5692	gary@garybuss.com
2	HERSIL PATEL	2616 E 10TH ST Sioux Falls SD 57103	727 776 1476 605 358 8881	hersil@yogimgt.com.
3	CHUCK GUSTAFSON	705 E RIDGE RD SFSD 57165	332-1000	CGUSTAFSON@MAC.COM
4	STAN MITZEL	2708 East 10th SF SD 57103	605-361-7804	Smitzel@FrynPan.net
5	JAMES NORD			
6	RYAN TYSON	LLOYD COMPANIES	376-0127	RYAN@LLOYDCOMPANIES.com
7	Jason Kjenstad	HDR 6300 S. Old Village Pl	977-7740	jason.kjenstad@hdrinc.com
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INTERSTATE 229 MAJOR INVESTMENT STUDY

Exit 6 – 10th Street Sub-Study

Stakeholder Meeting

December 5th, 2016
4:30 pm to 5:30 pm

HDR

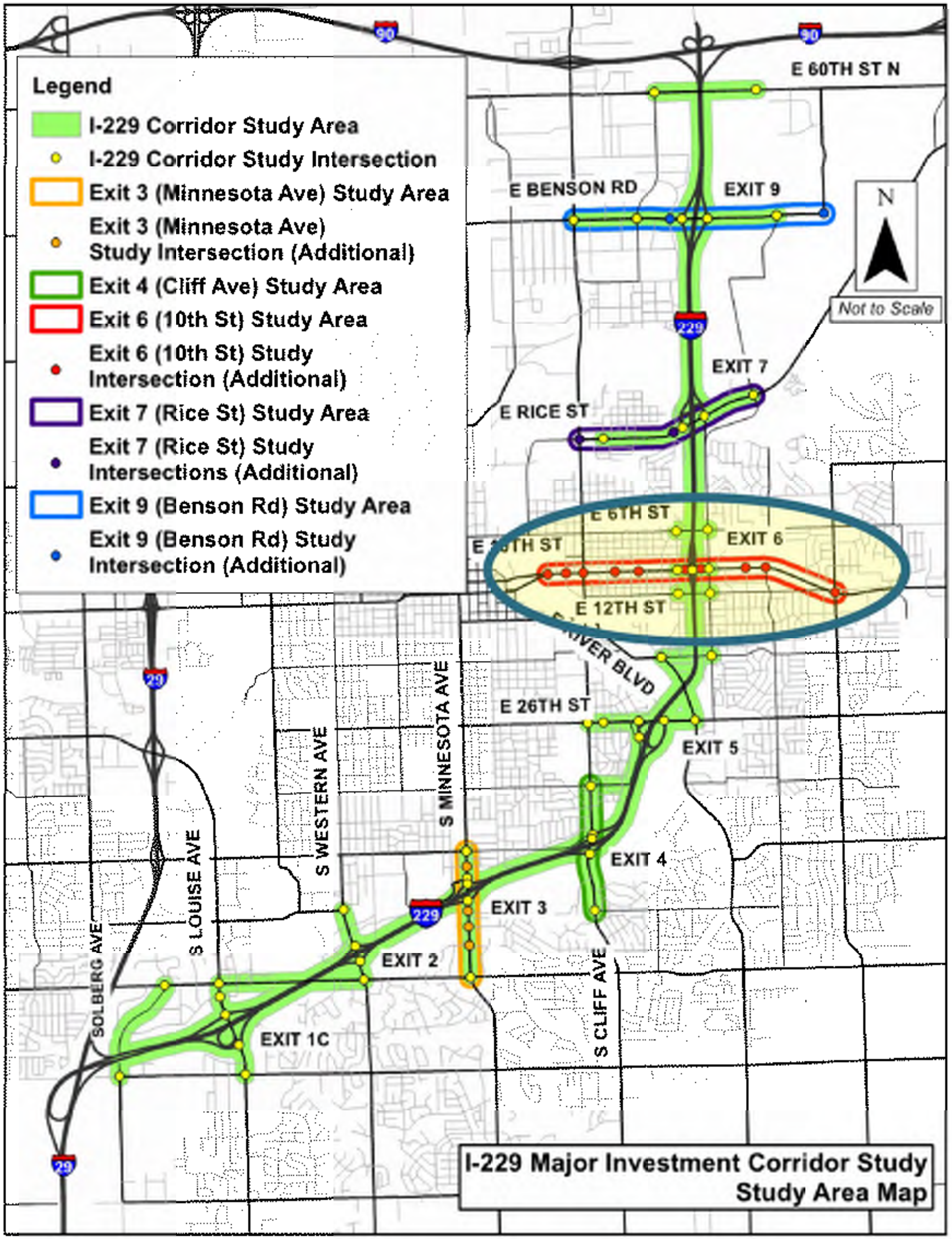
STUDY AREA MAP

I-229 Corridor Study

Solberg Avenue Overpass to 60th Street N Overpass

Meeting will focus on:

Exit 6 – 10th Street



STUDY ADVISORY PARTNERS

South Dakota Department of Transportation (SDDOT)

South Dakota Highway Patrol

City of Sioux Falls

Sioux Falls Metropolitan Planning Organization (MPO)

Federal Highway Administration (FHWA)

PRESENTATION AGENDA

- Concept Evaluation Process
- Concept Evaluation Results
- Concepts Recommended for Further Consideration in Future Phases (Interchange & Corridor Improvements)
- Next Steps

CONCEPT EVALUATION PROCESS

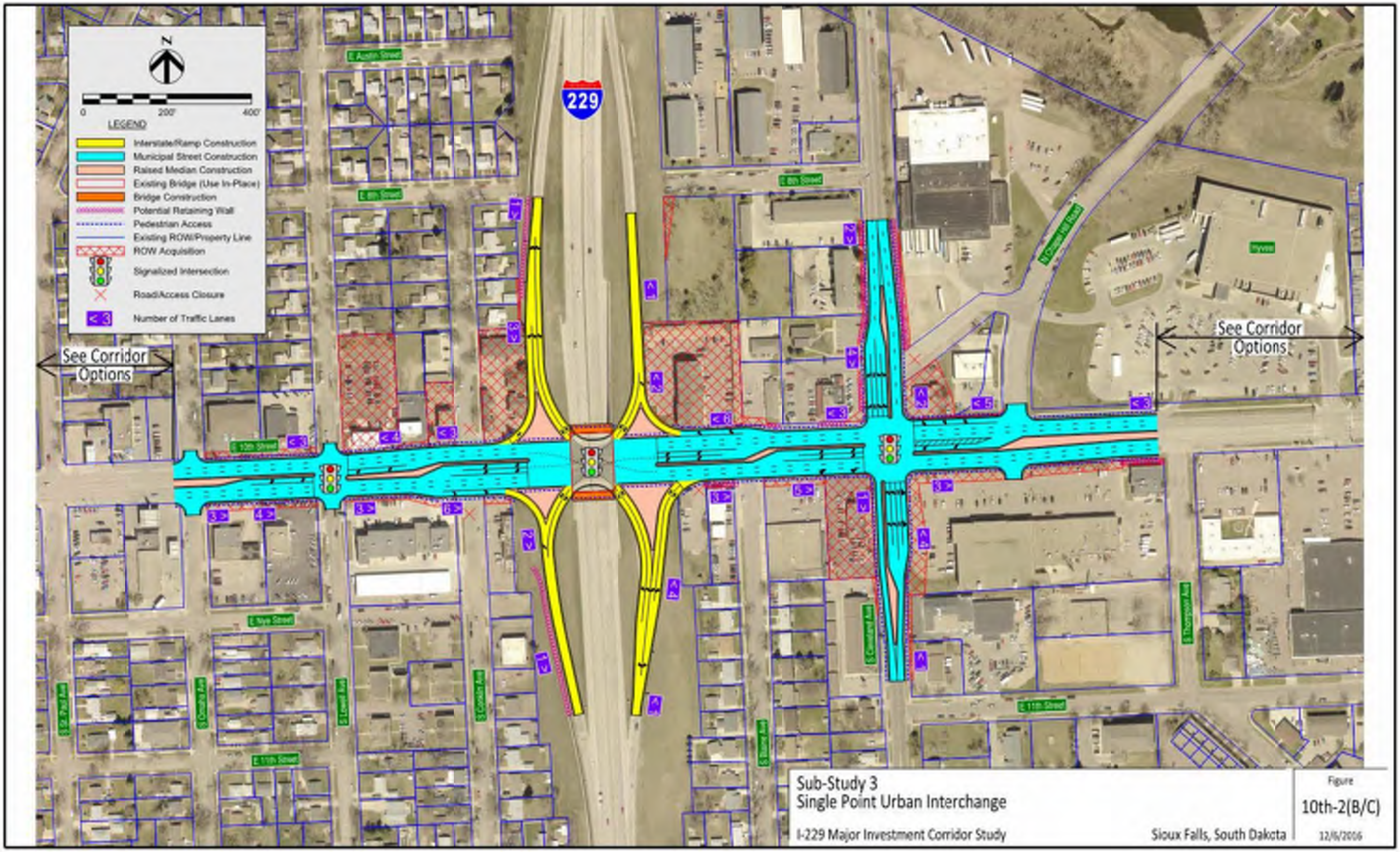
- Evaluation Factors:

Option	**Description**	**Traffic Operations**	**Safety**	**Environmental**	**Property Impacts**	**Construction & ROW Cost**	**DRAFT Recommendation**
Concept ID	Interchange and Corridor Type	•Traffic Delay •Level of Service •Interchange Year of Failure	Predicted Crash Reduction during 2012-2035	Potential impact to wetlands, historical resources, threatened and endangered species, public lands, and floodplains	Total Right of Way (ROW) Required and Acquisitions	Total Constuction Cost (including ROW)	**Advance** **or** **Eliminate**

- Evaluation Matrix to Compare Concepts
- Recommended Action

CONCEPTS FOR FURTHER CONSIDERATION

10TH-2 (B/C)



Sub-Study 3
Single Point Urban Interchange

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

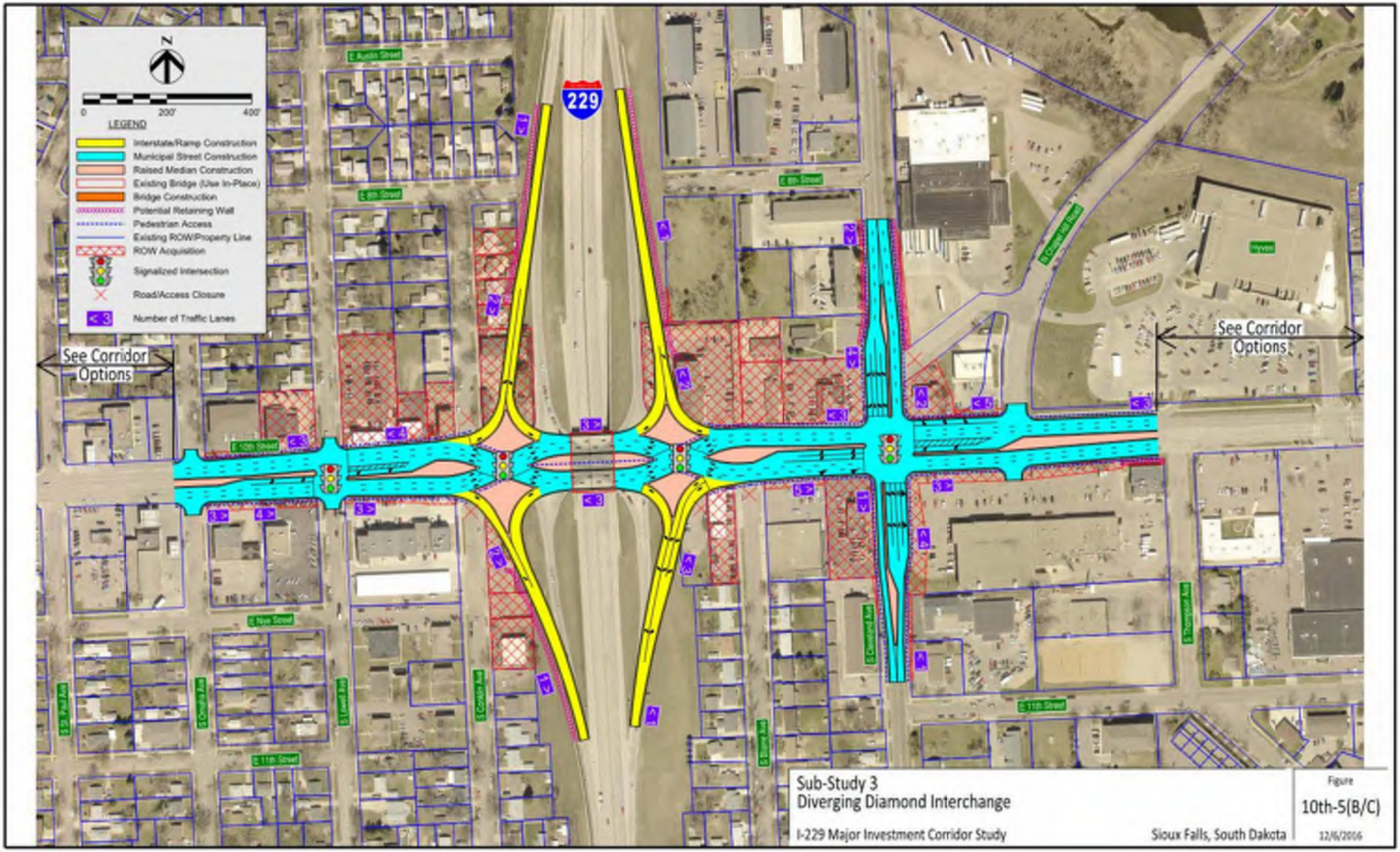
Figure
10th-2(B/C)
12/6/2016

CONCEPT EVALUATION RESULTS

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
No-Build	No-Build	POOR	NEUTRAL	N/A	N/A	N/A	**Advance**
10th-2A	Single Point Urban Interchange, 6-Lane Divided Corridor	VERY GOOD	NEUTRAL	NEUTRAL	POOR	POOR	**Eliminate** Property impacts, environmental impacts, and cost
10th-2B	Single Point Urban Interchange, 4-Lane Divided Corridor	GOOD	NEUTRAL	NEUTRAL	NEUTRAL	NEUTRAL	**Advance**
10th-2C	Single Point Urban Interchange, 5-Lane Undivided Corridor	GOOD	NEUTRAL	NEUTRAL	GOOD	GOOD	**Advance**

CONCEPTS FOR FURTHER CONSIDERATION

10^{TH}-5 (B/C)

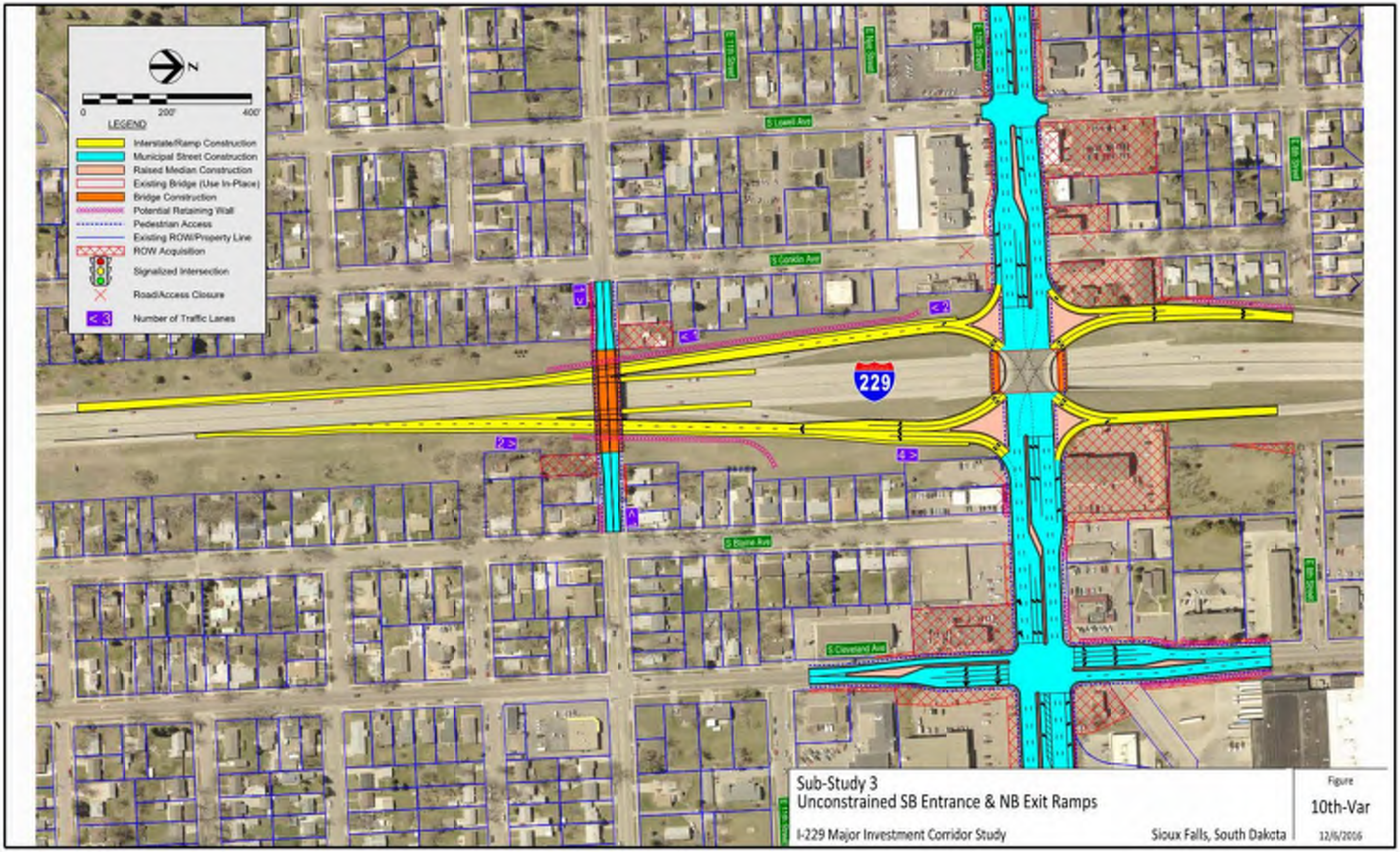


CONCEPT EVALUATION RESULTS (cont.)

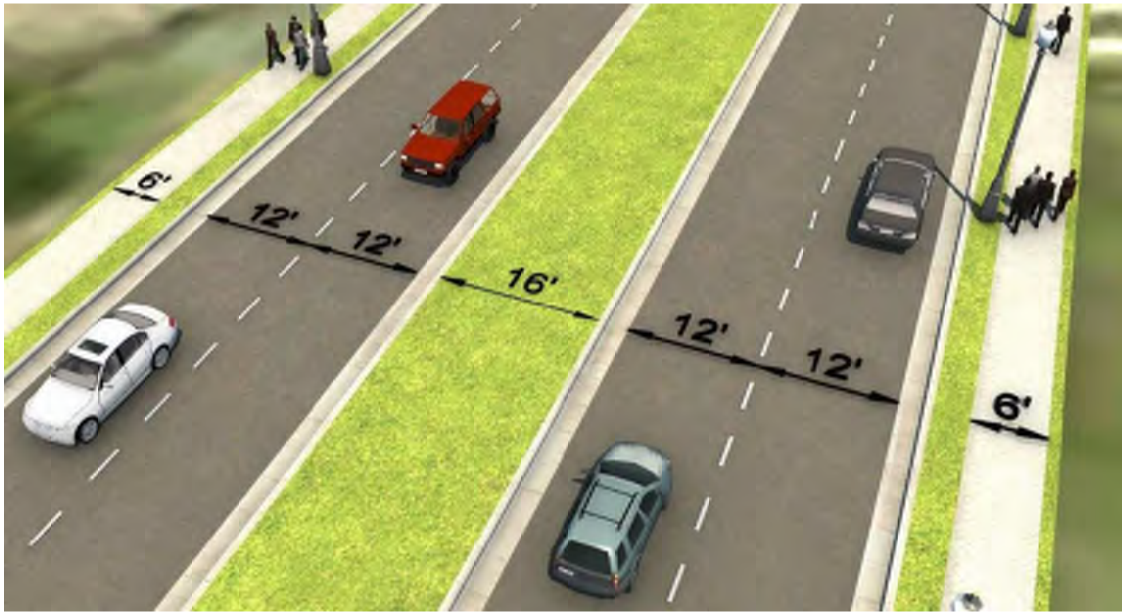
Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
10th-5A	Diverging Diamond Interchange, 6-Lane Divided Corridor	VERY GOOD	GOOD	NEUTRAL	POOR	POOR	**Eliminate** Property impacts, environmental impacts, and cost
10th-5B	Diverging Diamond Interchange, 4-Lane Divided Corridor	GOOD	GOOD	NEUTRAL	NEUTRAL	NEUTRAL	**Advance**
10th-5C	Diverging Diamond Interchange, 5-Lane Undivided Corridor	GOOD	GOOD	NEUTRAL	GOOD	GOOD	**Advance**
10th-9A	Tight Split Diamond, 6th St/10th St with 4-Lane Divided Corridor	NEUTRAL	POOR	POOR	NEUTRAL	POOR	**Eliminate** Environmental impacts, cost, and lower traffic & safety benefits
10th-9B	Tight Split Diamond, 6th St/10th St with 5-Lane Undivided Corridor	NEUTRAL	POOR	POOR	GOOD	NEUTRAL	**Eliminate** Environmental impacts and lower traffic & safety benefits
10th-Var							**Advance**

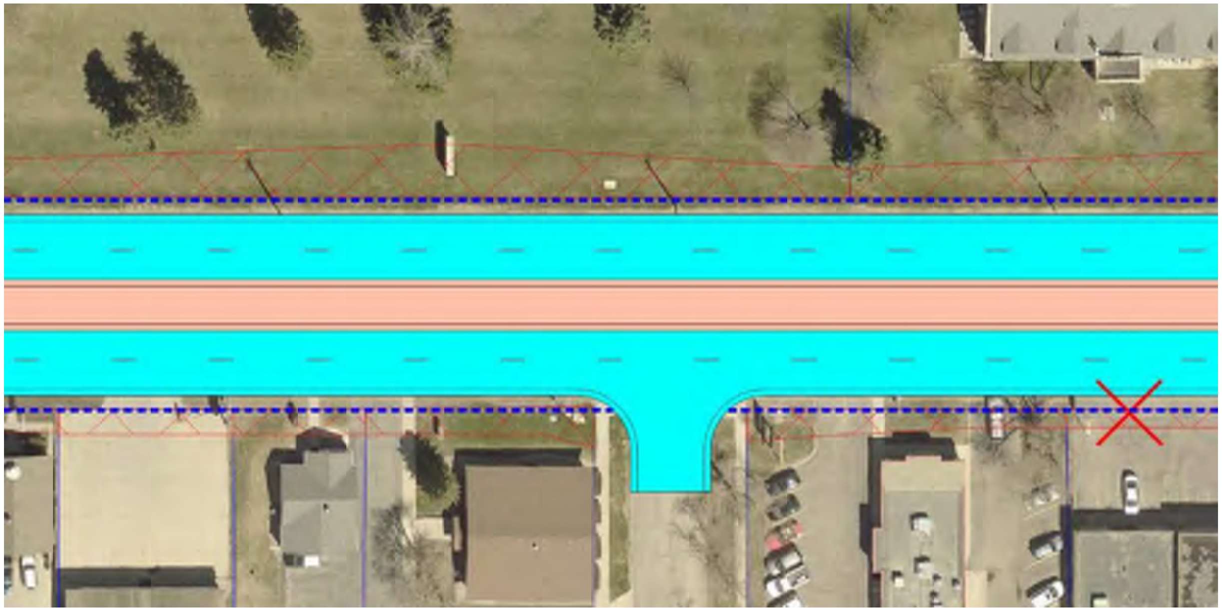
CONCEPTS FOR FURTHER CONSIDERATION

10TH-Var

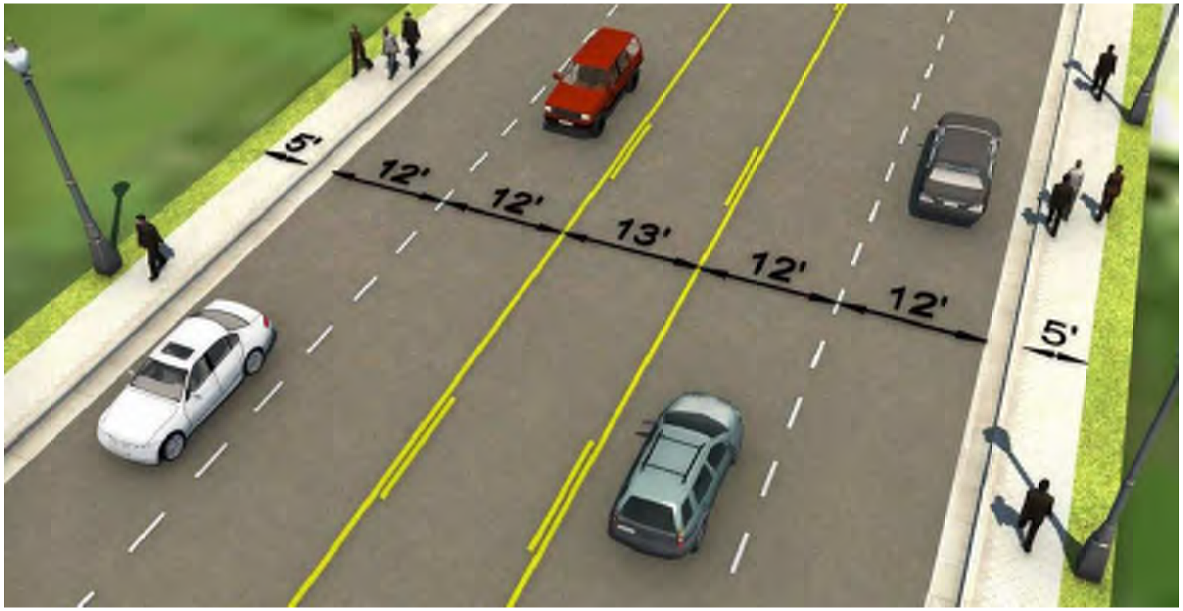


4-Lane Divided Corridor





5-Lane Undivided Corridor



10TH STREET
PRELIMINARY PROJECT PRIORITY

- Priority recommendation based on existing and anticipated need and level of improvement and impacts associated with remaining concept options
- 10th Street Interchange = High Priority
- 10th Street Corridor improvements = Low Priority
- See exhibit board for additional information

NEXT STEPS

- Assemble Stakeholder and Public Comments
- Complete Study Report
- Project Development Process = 5-6 year timeline when initiated by SDDOT & City
  - Prepare Interchange Modification Justification Report and Environmental Document
  - Develop Project Design
  - Acquire Right of Way
  - Construction

PROJECT CONTACTS:

Jason Kjenstad – HDR Engineering, Inc.
605-977-7740 or jason.kjenstad@hdrinc.com

Chris Malmberg – HDR Engineering, Inc.
402-399-4959 or chris.malmberg@hdrinc.com

Shannon Ausen – City of Sioux Falls
605-367-8607 or sausen@siouxfalls.org

Steve Gramm – SDDOT Project Development
605-773-6641 or steve.gramm@state.sd.us

INTERSTATE 229 MAJOR INVESTMENT STUDY

Exit 6 – 10th Street Sub-Study

Thanks for attending!

HDR

CLIFF AVENUE

DECEMBER 5TH, 2016

- MEETING NOTES
- SIGN-IN SHEETS
- POWERPOINT SLIDES
- COMMENTS (SEE PUBLIC MEETING #3 APPENDIX)

Meeting Minutes

Project:	I-229 Major Investment Corridor Study, PL 0100(87) 3616P, PCN 044K
Subject:	Stakeholder Meeting – Sub-study 6 – Cliff Avenue Exit 4
Date:	Monday, December 05, 2016
Location:	Sioux Falls Convention Center Conference Room 6
Attendees:	See Attached Sign In Sheet – 10 Participants

Stakeholder comments and questions noted:

1. Are the crashes recorded within the Minnesota Ave study limits car crashes only? Response: A range of types of crashes involving a variety of vehicle types has been recorded in the Minnesota corridor.

2. Does the environmental impact assessment process consider loss of affordable housing? Development is taking affordable houses in the central city and the lost housing is replaced with higher cost housing on the metropolitan area periphery.

SD DOT

CITY OF SIOUX FALLS PUBLIC WORKS
Providing a Better Quality of Life for You!

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Stakeholder Meeting for Cliff Avenue Sub-Study
Client City of Sioux Falls/South Dakota Department of Transportation
Project PL 0100(87) 3616P, PCN 044K **Project No.:** 207030
Meeting Date Monday, December 5th, 2016 6:00 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	JAMES NORD	904 E 38th	605 254 2480	jnord@sio.midco.net
2	Shannon Ausen	224 W. 9th St SFSD 57104	605-367-8607	Sausen@~~[illegible]~~ siouxfalls.org
3	Marlys Roskens	3105 S. 9th Ave	605-336-6226	marlys@sio.midco.net
4	PAUL HARTMAN	1201 OTONKA	605-929-9768	HARTZHART @SIO.MIDCO.NET
5	JEFF KOSHTE			
6	Gene Napier	1109 E. Pam Rd	605-373-0377	napier10@sio.midco.net
7	Jeff Roskens	3105 S. 9th Ave	605 557 2762	jroskens@sio.midco.net
8	Barbara Richards	1112 East 38th St.	605-338-2387	brichards@sio.midco.net
9	Lois Merritt	3004 S. 10th Ave.	(605)224-9498	
10	Wendy Butler-Boyer	1104 E. Pam Rd.	605-906-1223	wbutlerboyer@gmail.com
11	Jason Kjerstad	6300 S. Old Village Pl Suite 100 SF SD 57108	605-977-7741	jason.kjerstad@hdrinc.com
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INTERSTATE 229 MAJOR INVESTMENT STUDY

Exit 4 – Cliff Avenue Sub-Study

Stakeholder Meeting

December 5th, 2016
6:00 pm to 7:00 pm

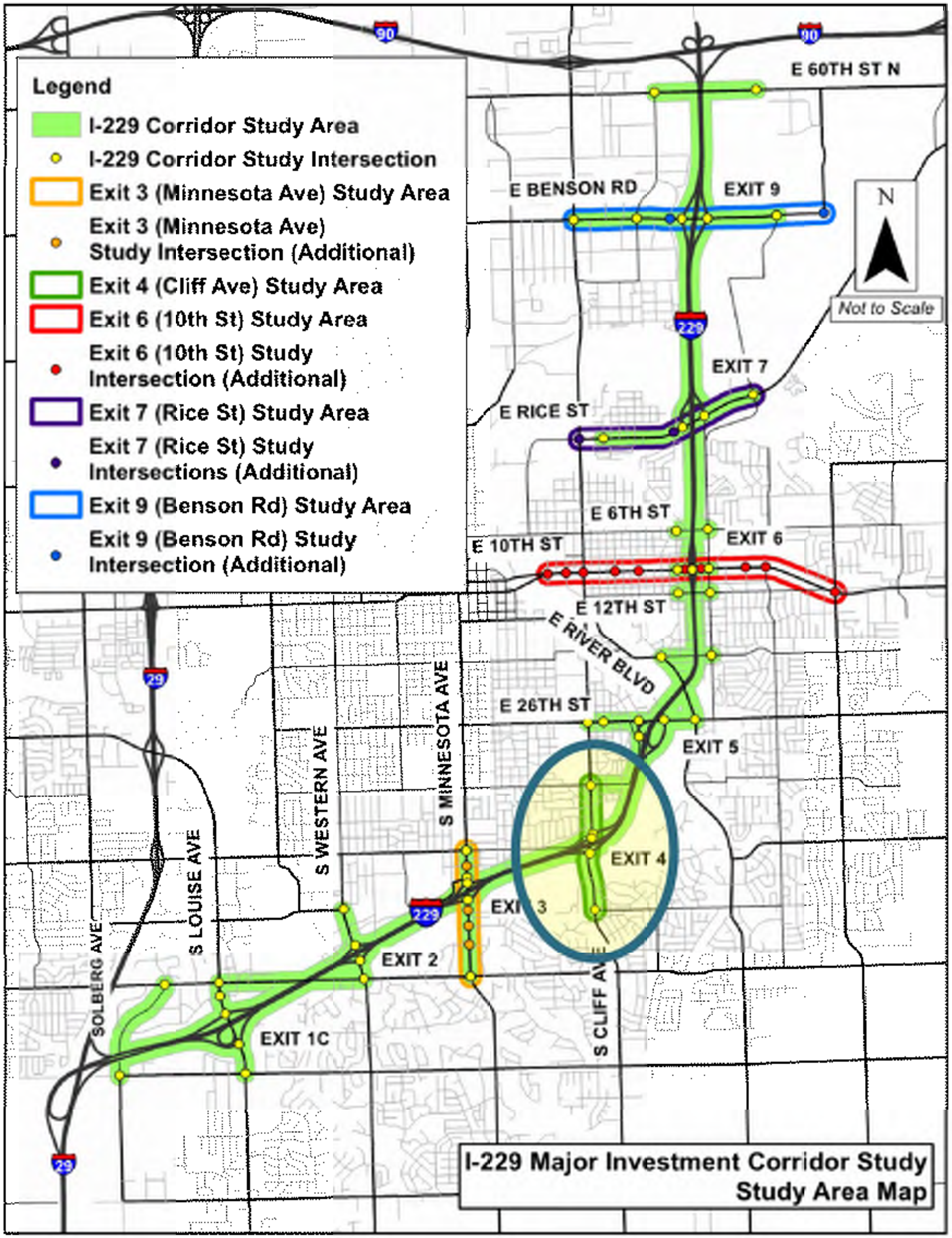
STUDY AREA MAP

I-229 Corridor Study

Solberg Avenue Overpass to 60th Street N Overpass

Meeting will focus on:

Exit 4 – Cliff Avenue



STUDY ADVISORY PARTNERS

South Dakota Department of Transportation (SDDOT)

South Dakota Highway Patrol

City of Sioux Falls

Sioux Falls Metropolitan Planning Organization (MPO)

Federal Highway Administration (FHWA)

PRESENTATION AGENDA

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- Concept Evaluation Results
- Concepts Recommended for Further Consideration in Future Phases (Interchange & Corridor Improvements)
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CONCEPT EVALUATION PROCESS

- Evaluation Factors:

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
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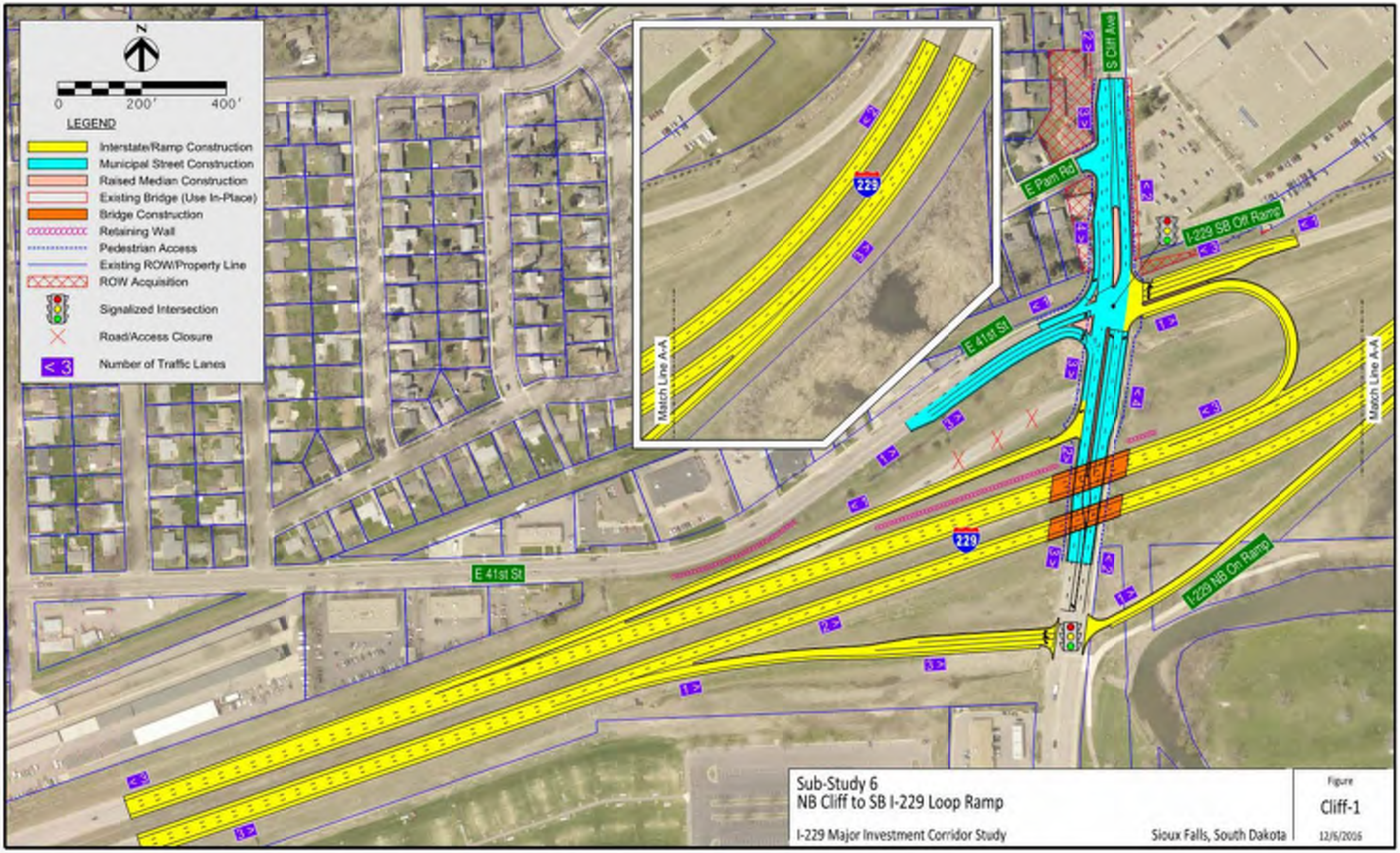
- Evaluation Matrix to Compare Concepts
- Recommended Action

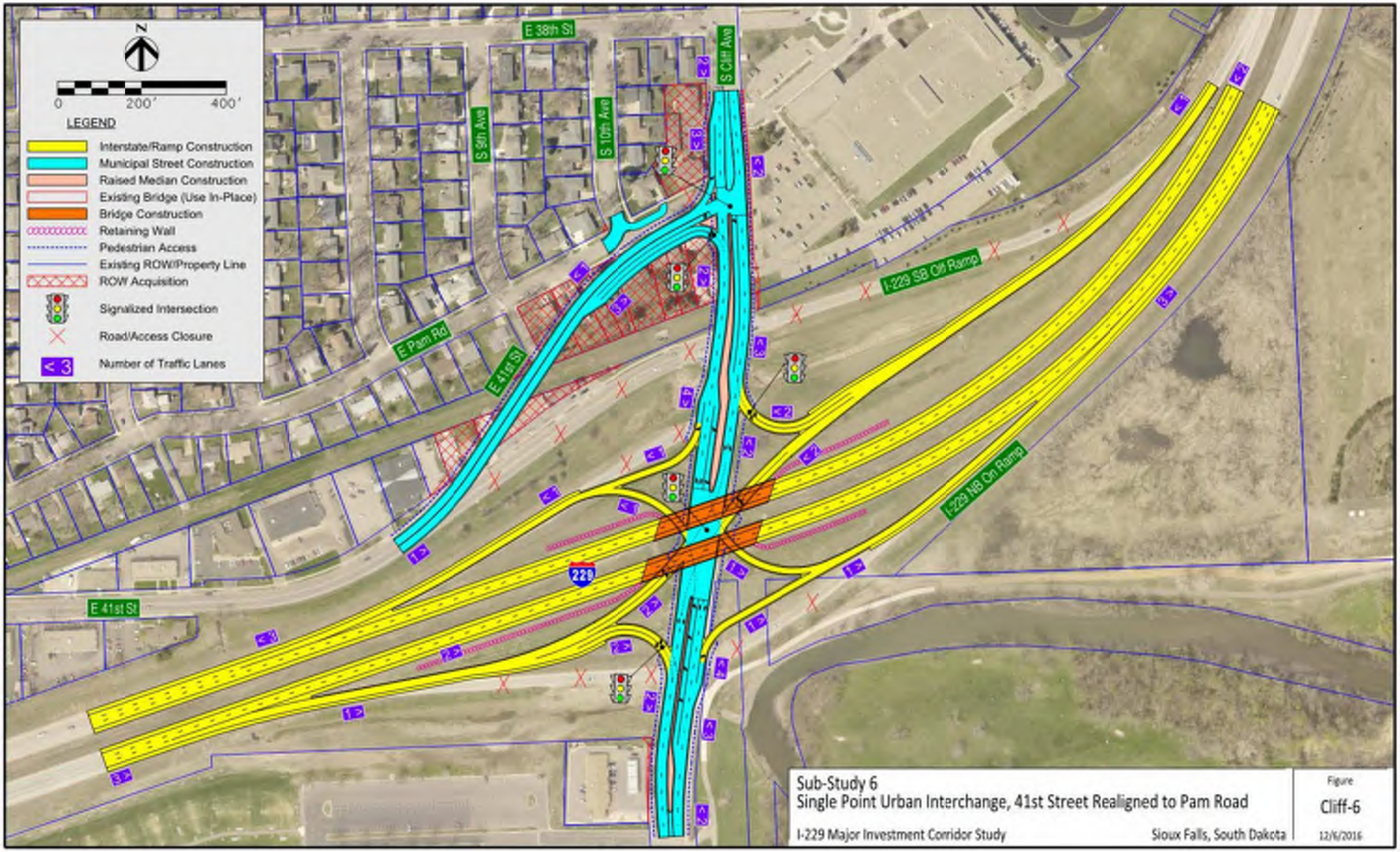
CONCEPTS FOR FURTHER CONSIDERATION

CLIFF-1



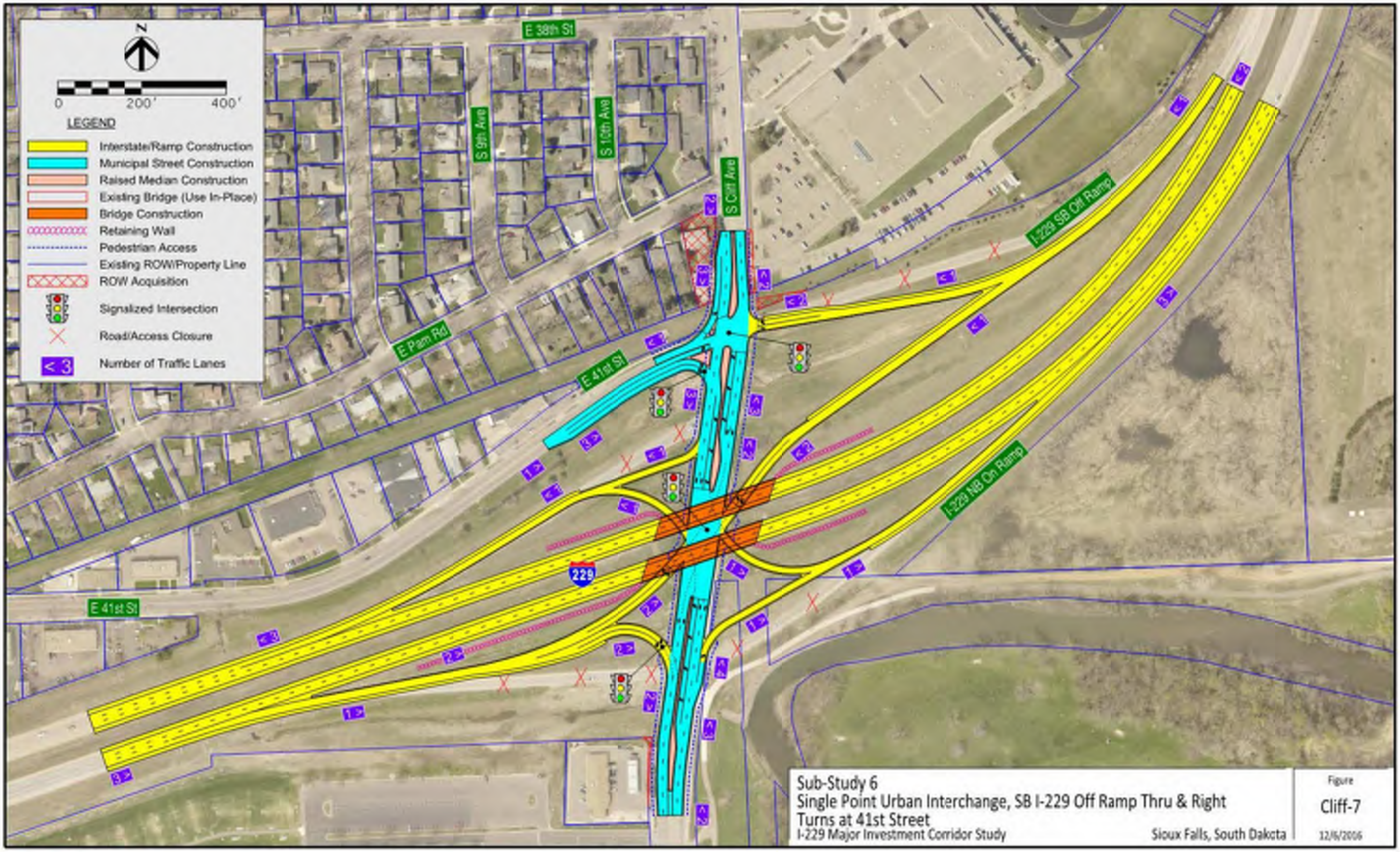
CONCEPTS FOR FURTHER CONSIDERATION

CLIFF- 6



CONCEPTS FOR FURTHER CONSIDERATION

CLIFF - 7



CONCEPT EVALUATION RESULTS

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
No-Build	No-Build	POOR	NEUTRAL	N/A	N/A	N/A	**Advance**
Cliff-1	NB Cliff to SB I-229 Loop Ramp	GOOD	NEUTRAL	GOOD	GOOD	GOOD	**Advance**
Cliff-6	Single Point Urban Interchange, 41st St Realigned to Pam Rd	VERY GOOD	GOOD	GOOD	POOR	POOR	**Advance**
Cliff-7	Single Point Urban Interchange, SB I-229 Off-Ramp Thru & Right Turns at 41st St	GOOD	GOOD	GOOD	VERY GOOD	POOR	**Advance**

CLIFF AVENUE
PRELIMINARY PROJECT PRIORITY

- Priority recommendation based on existing and anticipated need and level of improvement and impacts associated with remaining concept options
- Cliff Avenue Interchange = Medium Priority
- See exhibit board for additional information

NEXT STEPS

- Assemble Stakeholder and Public Comments
- Complete Study Report
- Project Development Process = 5-6 year timeline when initiated by SDDOT & City
    - Prepare Interchange Modification Justification Report and Environmental Document
    - Develop Project Design
    - Acquire Right of Way
    - Construction

PROJECT CONTACTS:

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Brian Ray– HDR Engineering, Inc.
402-548-5066 or Brian.Ray@hdrinc.com

Shannon Ausen – City of Sioux Falls
605-367-8607 or sausen@siouxfalls.org

Steve Gramm – SDDOT Project Development
605-773-6641 or steve.gramm@state.sd.us

INTERSTATE 229 MAJOR INVESTMENT STUDY

Exit 4 – Cliff Avenue

Thanks for attending!

HDR

RICE STREET

DECEMBER 6TH, 2016

- MEETING NOTES
- SIGN-IN SHEETS
- POWERPOINT SLIDES
- COMMENTS (SEE PUBLIC MEETING #3 APPENDIX)

Meeting Minutes

Project:	I-229 Major Investment Corridor Study, PL 0100(87) 3616P, PCN 044K
Subject:	Stakeholder Meeting – Sub-study 5 – Rice Street Exit 7
Date:	Tuesday, December 06, 2016
Location:	Sioux Falls Convention Center Conference Room 6
Attendees:	See Attached Sign In Sheet – 21 Participants

Stakeholder comments and questions noted:

1. Railroad spur crossing ties up traffic on Rice Street to the east. Response (City): There are 3 to 5 unit trains per day using the spur line, with no projected increase indicated by BNSF Railroad. Growth is anticipated in the number of daily local trains, however.

2. The amount of additional right of way acquired from businesses along the north side of Rice St to avoid the need for an easement from BNSF along the south side of Rice St could create problems for those businesses in complying with City code requirements for customer and employee parking.

3. How would the residential property east of Eastgate Towing get access from Rice St? Response: Access to each of the properties on the north side of Rice St and between the I-229 interchange and N Glenwood Cir would be via the proposed back access road on the north side of the properties.

4. Public access along the proposed back access road poses a security concern for properties on the north side of Rice St. Response: The back access road would be lighted as a City street, but would not be designated an emergency snow route.

5. The contract that Eastgate Towing has with the City Police Dept requires towing operation in all weather. Eastgate Towing would need to use the back access road during and immediately after snow events.

6. Do the Rice St concepts assume that the proposed SD-100 project will be constructed? Response: Yes.

7. City – Would like to begin environmental impact assessment process sooner, if it is believed that Concept Rice-3C is the locally preferred option.

8. Will Concept Rice-3C slow down traffic on Cleveland Ave compared to existing conditions?

9. On Concept Rice-3C, how would access to the recycling pit be provided from realigned Cleveland Ave? There is no other access street shown.

10. Would storm sewers along Rice St be constructed as part of the proposed improvements? Response: Yes, storm sewers would be part of the Rice St improvements.

11. Will sidewalks along Rice St be constructed as part of the proposed improvements? Response: Yes, sidewalks on both sides of Rice St are proposed as part of the Rice St improvements. However, first time sidewalk construction costs will be assessed to adjacent property owners.

12. Will the proposed Rice St improvements with pedestrian or trail access along Rice St result in elimination of the existing trail along the Big Sioux River? Response: No. The river trail would not be impacted by proposed improvements along Rice St.

13. Is the Bahnson Ave extension to Benson Rd included in the proposed Rice St improvements? Response: No, construction of the Bahnson Ave extension would be tied to development need.

CITY OF SIOUX FALLS PUBLIC WORKS

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Stakeholder Meeting for Rice Street Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3616P, PCN 044K **Project No.:** 207030

Meeting Date Monday, December 5th, 2016 2:00 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Pete Longman	SDDOT- PIERRE	773-6488	pete.longman@state.sd.us
2	Steve Gramm	700 E. Broadway Ave.	773-6641	steve.gramm@state.sd.us
3	[illegible]	2904 E Rice St. SF, SD	334-3160	beth.eastsidetowing@midconetwork.com
4	Kim Meester	1811 W Lovell Ave	367-9871	ArcheryOutfitter@Live.com
5	Myrl + Roys Paving Chad Hartman	1300 N Bahnson	334-3204	Chad.h@marpaving.com
6	Myrl + Roys Paving Luke Klein	" "	334-3201	luke.k@marpaving.com
7	DAN KEARNEY	47646 255 St SF	351-5705	DK5L5489@Aol.com
8	Jason Kjerstad	6300 S. Old Village Place Suite 100 SF SD	977-7740	jason.kjerstad@[illegible].com
9	[illegible]	1500 N Sweetman Pl. SF, SD	605-728-2966	bschmidt@cmcsd.com
10	Clark Meyer	~~1500~~ ' ''	605-336-5763	cmeyer@cmcsd.com
11	Shawn Aussen	224 W. 9th ST SF SD	605-367-8607	saussen@siouxfalls.org
12	Judy Hartman	2908 E. Rice SFSD	605-728-2459	
13	Patty Nohr	1300 N. Bahnson Ave	334-3204	Patty.n@marpaving.com
14	STU HORSTED	4001 E. Rice St	231-1763	shorsted@cmcsd.com
15	Eva Sadat	1410 E Rice St	605-271-1099	gsauto sales@midco network.com
16	Oscar Sadat	"	"	"
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DOT

CITY OF SIOUX FALLS
PUBLIC WORKS
Providing a Better Quality of Life for You!

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Stakeholder Meeting for Rice Street Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3616P, PCN 044K **Project No.:** 207030

Meeting Date Monday, December 5th, 2016 2:00 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Rodney Hartman	2908 E. Rice St	605-728-1667	RMS011@Net2000.net
2	Greg Rubin	2200 N. Bahnson	605-940-8501	GAJRUBIN@YAHOO.COM
3	Tammy Meland	1205 N. Caleb Ave	605-408-6763	
4	Harold Decker	3501 River Bluff Rd	605 366 3179	
5	Gary Harr	3408 Sycamore A	376 7328	
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INTERSTATE 229 MAJOR INVESTMENT STUDY

Exit 7 – Rice Street Sub-Study

Stakeholder Meeting

December 6th, 2016
2:00 pm to 3:00 pm

HDR

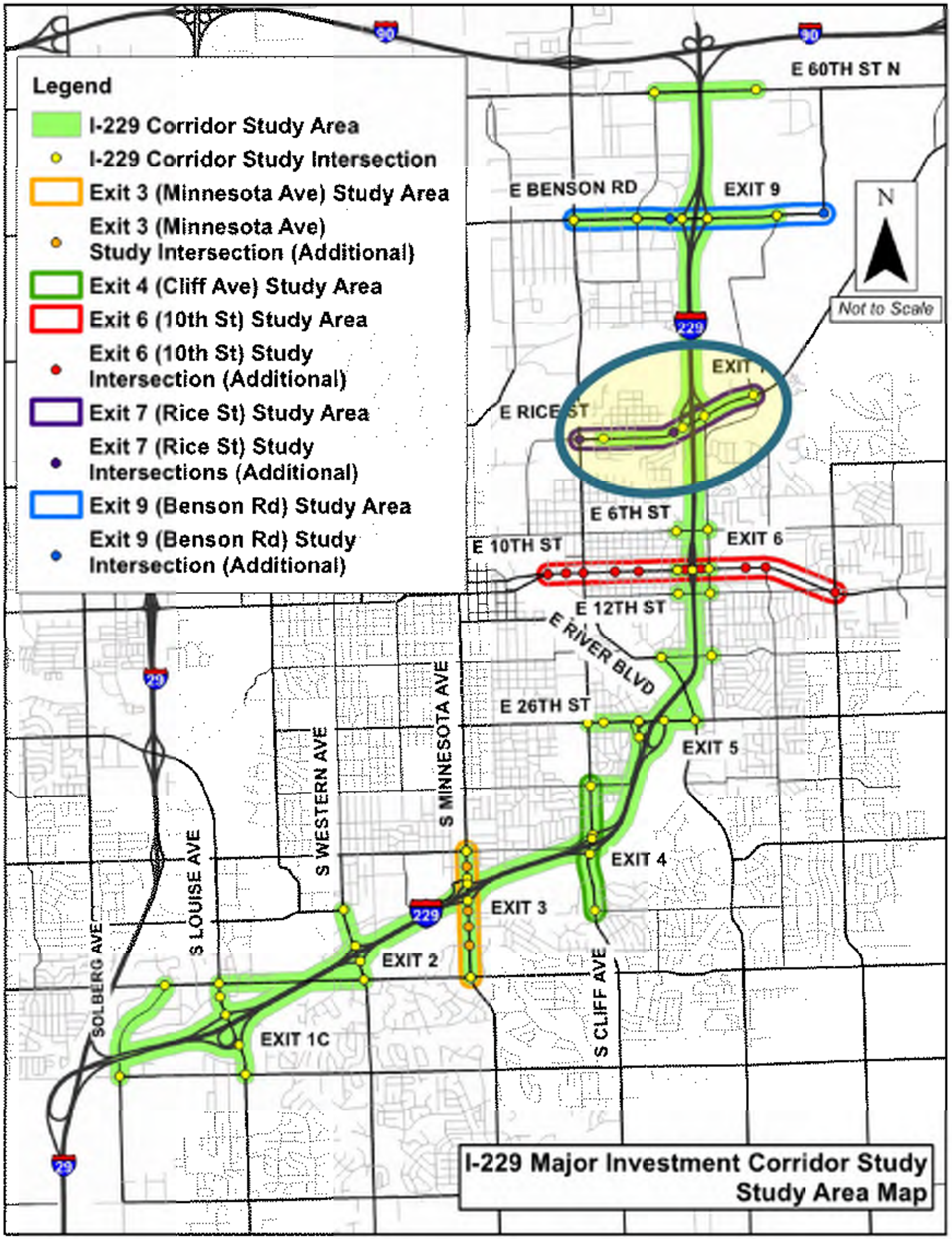
STUDY AREA MAP

I-229 Corridor Study

Solberg Avenue Overpass to 60th Street N Overpass

Meeting will focus on:

Exit 7 – Rice Street



I-229 Major Investment Corridor Study
Study Area Map

STUDY ADVISORY PARTNERS

South Dakota Department of Transportation (SDDOT)

South Dakota Highway Patrol

City of Sioux Falls

Sioux Falls Metropolitan Planning Organization (MPO)

Federal Highway Administration (FHWA)

PRESENTATION AGENDA

- Concept Evaluation Process
- Concept Evaluation Results
- Concepts Recommended for Further Consideration in Future Phases (Interchange & Corridor Improvements)
- Next Steps

CONCEPT EVALUATION PROCESS

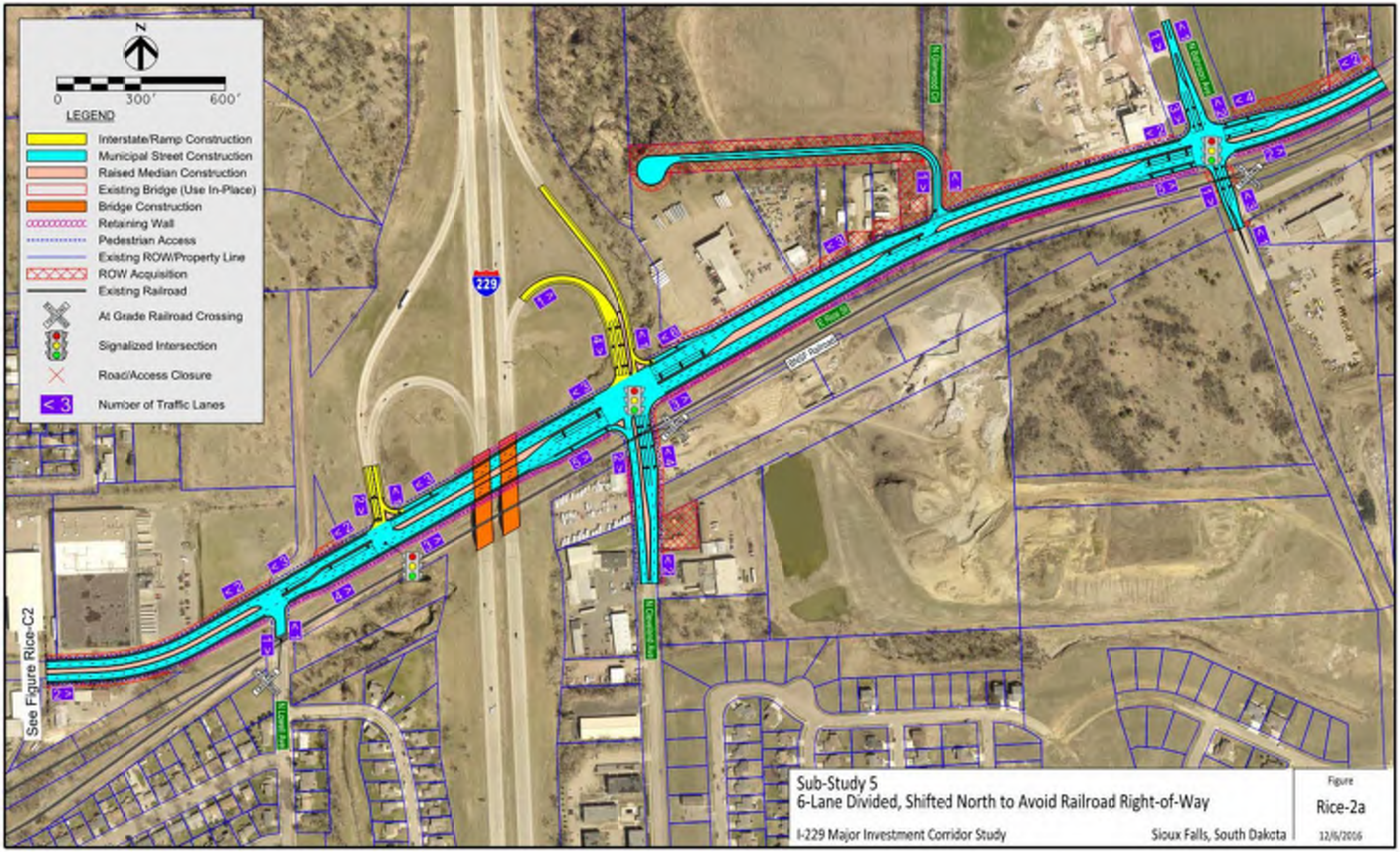
- Evaluation Factors:

Option	**Description**	**Traffic Operations**	**Safety**	**Environmental**	**Property Impacts**	**Construction & ROW Cost**	**DRAFT Recommendation**
Concept ID	Interchange and Corridor Type	•Traffic Delay •Level of Service •Interchange Year of Failure	Predicted Crash Reduction during 2012-2035	Potential impact to wetlands, historical resources, threatened and endangered species, public lands, and floodplains	Total Right of Way (ROW) Required and Acquisitions	Total Constuction Cost (including ROW)	**Advance** **or** **Eliminate**

- Evaluation Matrix to Compare Concepts
- Recommended Action

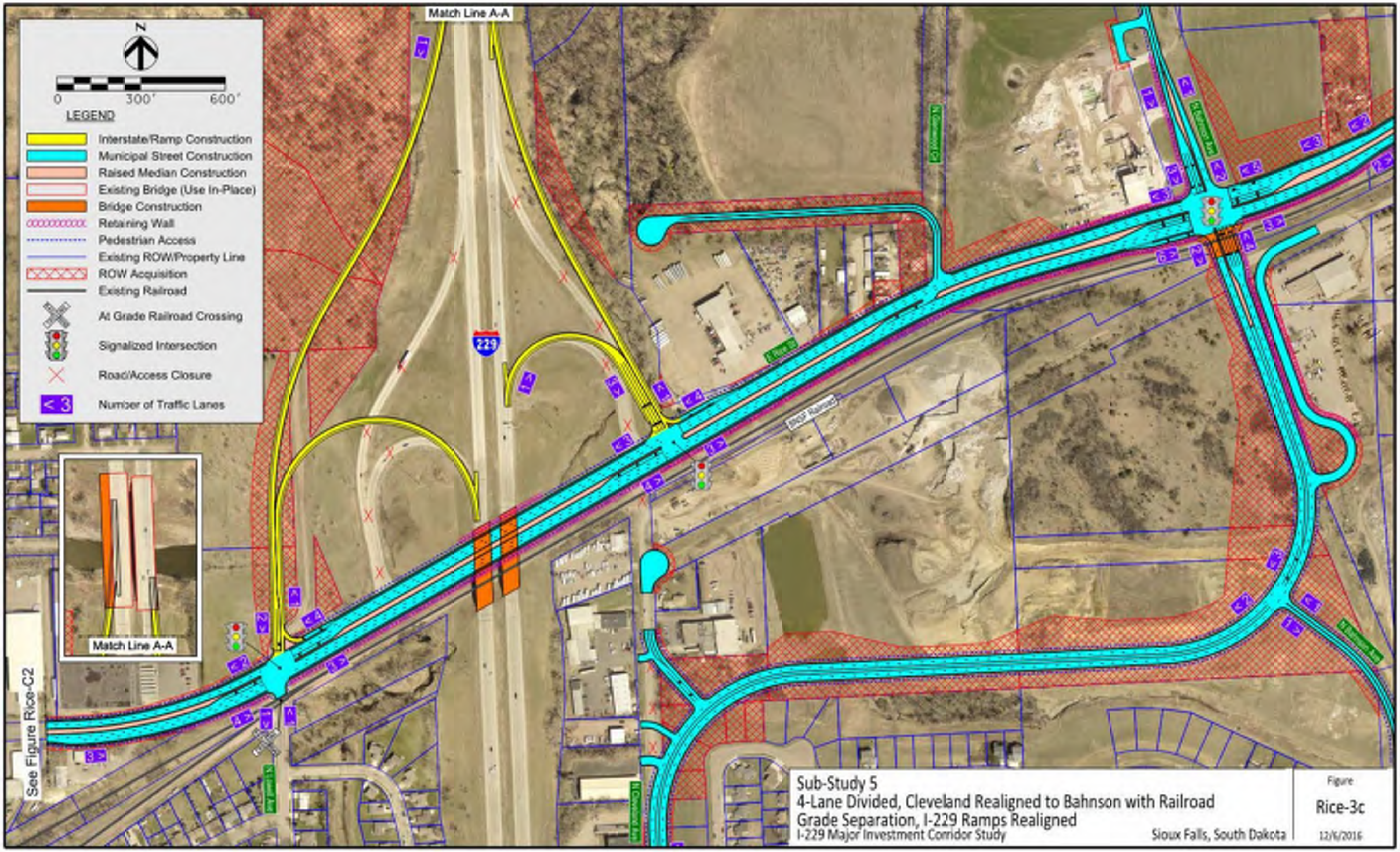
CONCEPTS FOR FURTHER CONSIDERATION

RICE-2A



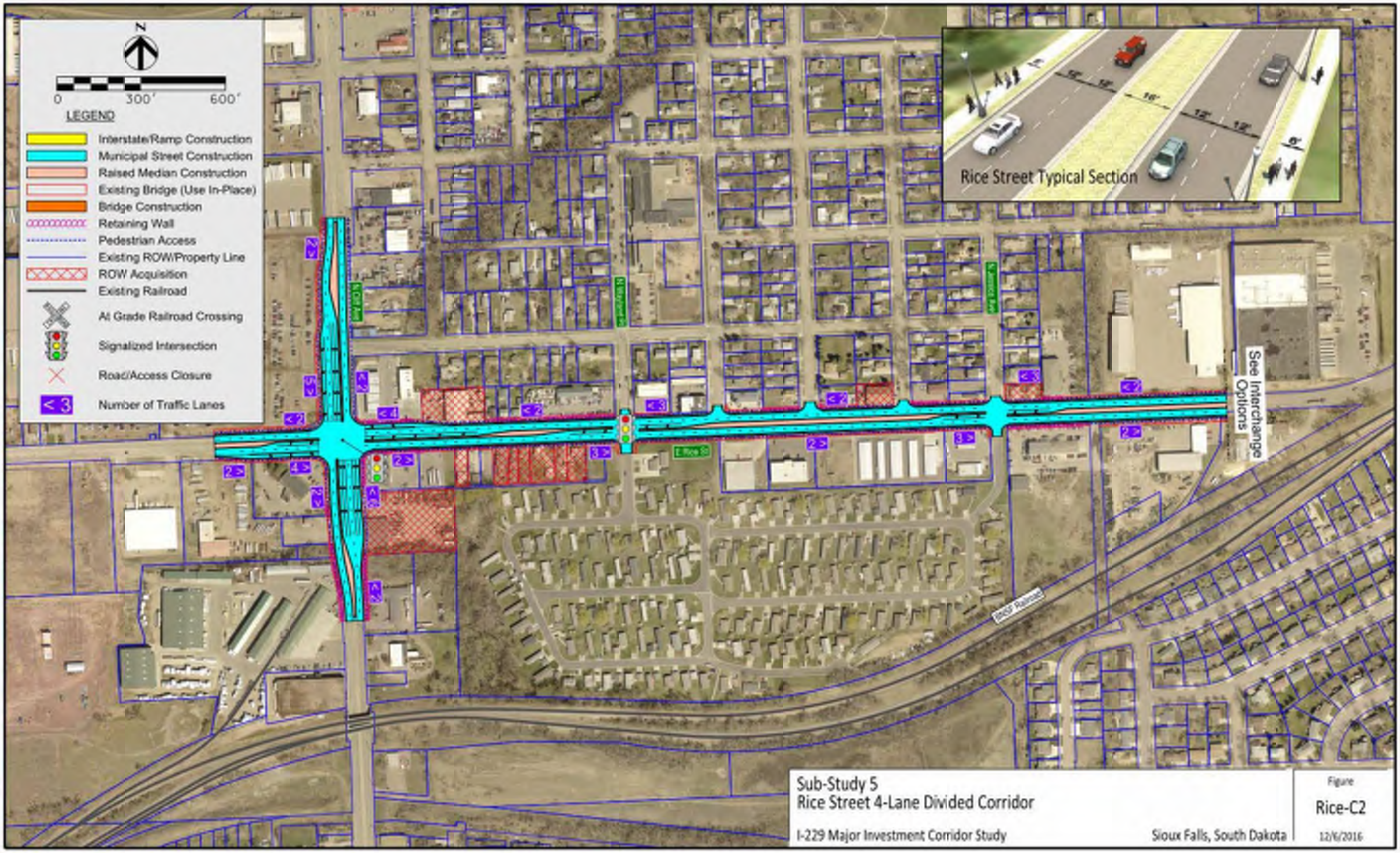
CONCEPTS FOR FURTHER CONSIDERATION

RICE-3C



CONCEPTS FOR FURTHER CONSIDERATION

RICE-C2



CONCEPT EVALUATION RESULTS

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
No-Build	No-Build	POOR	NEUTRAL	N/A	N/A	N/A	**Advance**
Rice-2	6-Lane Divided	VERY GOOD	GOOD	NEUTRAL	GOOD	GOOD	**Advance**
Rice-2A	6-Lane Divided, Shifted North to Avoid Railroad Right-of-Way	VERY GOOD	GOOD	NEUTRAL	GOOD	GOOD	**Advance**
Rice-3C	4-Lane Divided, Cleveland Realigned to Bahnson with Railroad Grade Separation, I-229 Ramps Realigned	VERY GOOD	VERY GOOD	POOR	POOR	POOR	**Advance**

RICE STREET
PRELIMINARY PROJECT PRIORITY

- Priority recommendation based on existing and anticipated need and level of improvement and impacts associated with remaining concept options
- Rice Street (Cleveland Avenue Realignment) = Medium Priority
- Rice Street Interchange = Low Priority
- See exhibit board for additional information

NEXT STEPS

- Assemble Stakeholder and Public Comments
- Complete Study Report
- Project Development Process = 5-6 year timeline when initiated by SDDOT & City
    - Prepare Interchange Modification Justification Report and Environmental Document
    - Develop Project Design
    - Acquire Right of Way
    - Construction

PROJECT CONTACTS:

Jason Kjenstad – HDR Engineering, Inc.
605-977-7740 or jason.kjenstad@hdrinc.com

Theo Weseman – HDR Engineering, Inc.
402-399-4801 or Theo.Weseman@hdrinc.com

Shannon Ausen – City of Sioux Falls
605-367-8607 or sausen@siouxfalls.org

Steve Gramm – SDDOT Project Development
605-773-6641 or steve.gramm@state.sd.us

INTERSTATE 229 MAJOR INVESTMENT STUDY

Exit 7 – Rice Street Sub-Study

Thanks for attending!

MINNESOTA AVENUE

DECEMBER 6TH, 2016

- MEETING NOTES
- SIGN-IN SHEETS
- POWERPOINT SLIDES
- COMMENTS (SEE PUBLIC MEETING #3 APPENDIX)

Meeting Minutes

Project:	I-229 Major Investment Corridor Study, PL 0100(87) 3616P, PCN 044K
Subject:	Stakeholder Meeting – Sub-study 2 – Minnesota Avenue Exit 3
Date:	Tuesday, December 06, 2016
Location:	Sioux Falls Convention Center Conference Room 6
Attendees:	See Attached Sign In Sheet – 19 Participants

Stakeholder comments and questions noted:

1. When might proposed improvements on Minnesota Ave and at the I-229 interchange be constructed? Response: At least 12 to 15 years in the future.

2. What is the status of proposed improvements along 49th St to the west? Response: Not all of the right of way for widening 49th St to the west has been acquired. The widening is not currently programmed. When construction begins, it will start at the west end.

3. Access to businesses along Minnesota Ave from the back would kill the businesses.

4. Is a right turn in/out a possibility where driveway closures are shown on the concepts? Response: Yes.

5. Eliminate the proposed medians and build service roads.

6. If the southbound I-229 exist ramp terminal is shifted north to 49th St as shown on Concept Minn-9D, traffic queues on Minnesota Ave would be pushed northward to 41st St. Response: Proposed added lanes on Minnesota Ave would manage traffic queues.

7. There are no concept options that do not include a proposed median.

8. Do the I-229 bridges over Minnesota Ave need replacement? Response: The replacement of the bridges is driven by a need to widen Minnesota Ave.

9. Minnesota Ave should be widened to a six-lane section with a two-way left turn lane.

10. Existing speed on Minnesota Ave is a problem between 41st and 57th St.

11. Owner of vacant property at I-229 and Minnesota Ave (east side) – Delay in implementing proposed project discourages property improvements.

12. Property owner commented that his property has already been held hostage for ten years or more due to uncertainty about improvements and impacts along Minnesota Ave.

13. Estimated costs of implementing the proposed concepts should be made available to the public.

14. Concern about ruining businesses due to poor access or very limited access.

15. Can the proposed median be eliminated? Also discussion regarding impacts due to corridor width.

16. Can the green light be extended at 41st and Minnesota? Comments regarding timing at the interchange ramp signals and how frequently are those updated.

17. Issues turning left from Lotta St onto Minnesota Ave. Support expressed for proposed traffic signal.

18. A lot of focus on the properties east of 49th Street intersection (on either side of abandoned railroad line). Impacts from access closures/restrictions, alternate routes, changes to traffic patterns, U-turns, and control of access were all topics of discussion.

19. In favor of improved pedestrian and bike crossings of I-229. Glad this was looked at in the study.

20. Was a diverging diamond type interchange considered for Minnesota Ave? Response: Yes.

CITY OF SIOUX FALLS
PUBLIC WORKS

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Stakeholder Meeting for Minnesota Avenue Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3616P, PCN 044K **Project No.:** 207030

Meeting Date Tuesday, December 6th, 2016 3:30 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Pete Longman	SDDOT – Pierre SD	773-6488	pete.longman@state.sd.us
2	Brad Remmick	SDDOT - PIERRE	773-3093	bradley.remmick@state.sd.u
3	Andy Vandel	SDDOT - Pierre	773-4421	andy.vandel@state.sd.us
4	Pat Walz	4230 S Minn	6053343815	bPwalz@sio.midco.neT
5	Mary Stone		605-376-6554	mstrom@ g.com
6	Shelly Roger	48274 258 St Brandon SD 57005	321-3806	drogm3061@aol.com
7	Brian Frisbee	4101 S. Minnesota	338-6321	info@frisbeesinc.com
8	Lee Lewis	309 W 43rd St Ste 105	335-8805	LAL1966@basec.net
9	Mike Von Bockern	5800 S Remington Pl #100	361 8211	Mike@VBClink.com
10	Kevin R Nyberg	330 W. 41st, SF	336-6474 ~~[illegible]~~	knyberg@nybergsace.com
11	Heather Taylor	3300 S Minn. Ave.	201-2841	heather@gsfw.com
12		465 Chapel Dr.	321-5606	grant@alvine weidenaar.com
13	Mary Montoya		332-0147	mary.montoya@sio.midco.neT
14	Jason Kjenstad	6300 S. Old Village suite 100 SF SD	977-7740	jason.kjenstad@hdrinc.com
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DOT

CITY OF SIOUX FALLS
PUBLIC WORKS
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Sign In Sheet

Subject I-229 Major Investment Corridor Study – Stakeholder Meeting for Minnesota Avenue Sub-Study

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Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Frank Howe	Brandon	5538484	franke prairiesons.com
2	Carol Tweedt	4302 S Minnesota Ave SF SD 57105	940-0756	CarolTweedt@sio.midco.net
3	Alex Connelly	1510 W. 57th SF, SD 57105	336-2165	alex.connelly@[illegible].com
4	Dave McElroy	3310 S Minn Ave SF SD 57105	338-9519	mcelroy.dave@gmail.com
5	Erik Nyberg	330 W 41st Street	728-5553	eriknecutlerlawfirm.com
6	Pam Taylor	3600 S. Minn	332-6509	
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Sign In Sheet

Subject I-229 Major Investment Corridor Study – Stakeholder Meeting for Minnesota Avenue Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3616P, PCN 044K **Project No.:** 207030

Meeting Date Tuesday, December 6th, 2016 3:30 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Frisbees, Inc Berry Howe	4101 S. Minnesota Ave.	605-338-6321	berryh@frisbeesinc.com
2	Dianne Noth	4204 S. Minnesota Ave SF, SD 57105	605-339-2864	nethi@sio.midco.net
3	Kevin Kroeze	Boen & Associates 309 W. 41st 57105	605-336-0485	KevinK@BoenAssociates.com
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INTERSTATE 229 MAJOR INVESTMENT STUDY

Exit 3 – Minnesota Avenue Sub-Study

Stakeholder Meeting

December 6th, 2016
3:30 pm to 4:30 pm

HDR HRGreen

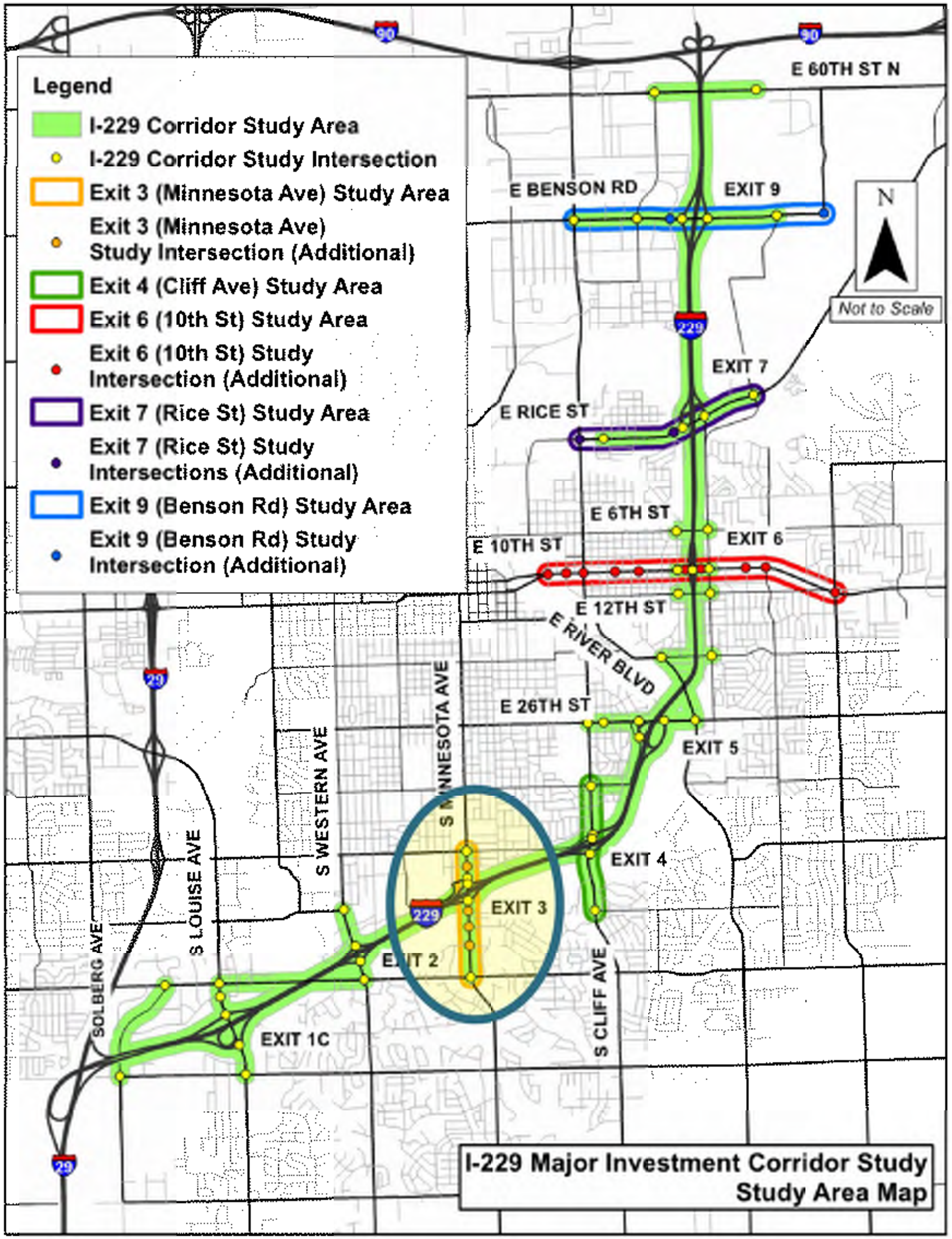
STUDY AREA MAP

I-229 Corridor Study

Solberg Avenue Overpass to 60th Street N Overpass

Meeting will focus on:

Exit 3 – Minnesota Avenue



STUDY ADVISORY PARTNERS

South Dakota Department of Transportation (SDDOT)

South Dakota Highway Patrol

City of Sioux Falls

Sioux Falls Metropolitan Planning Organization (MPO)

Federal Highway Administration (FHWA)

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- Concept Evaluation Process
- Concept Evaluation Results
- Concepts Recommended for Further Consideration in Future Phases (Interchange & Corridor Improvements)
- Next Steps

CONCEPT EVALUATION PROCESS

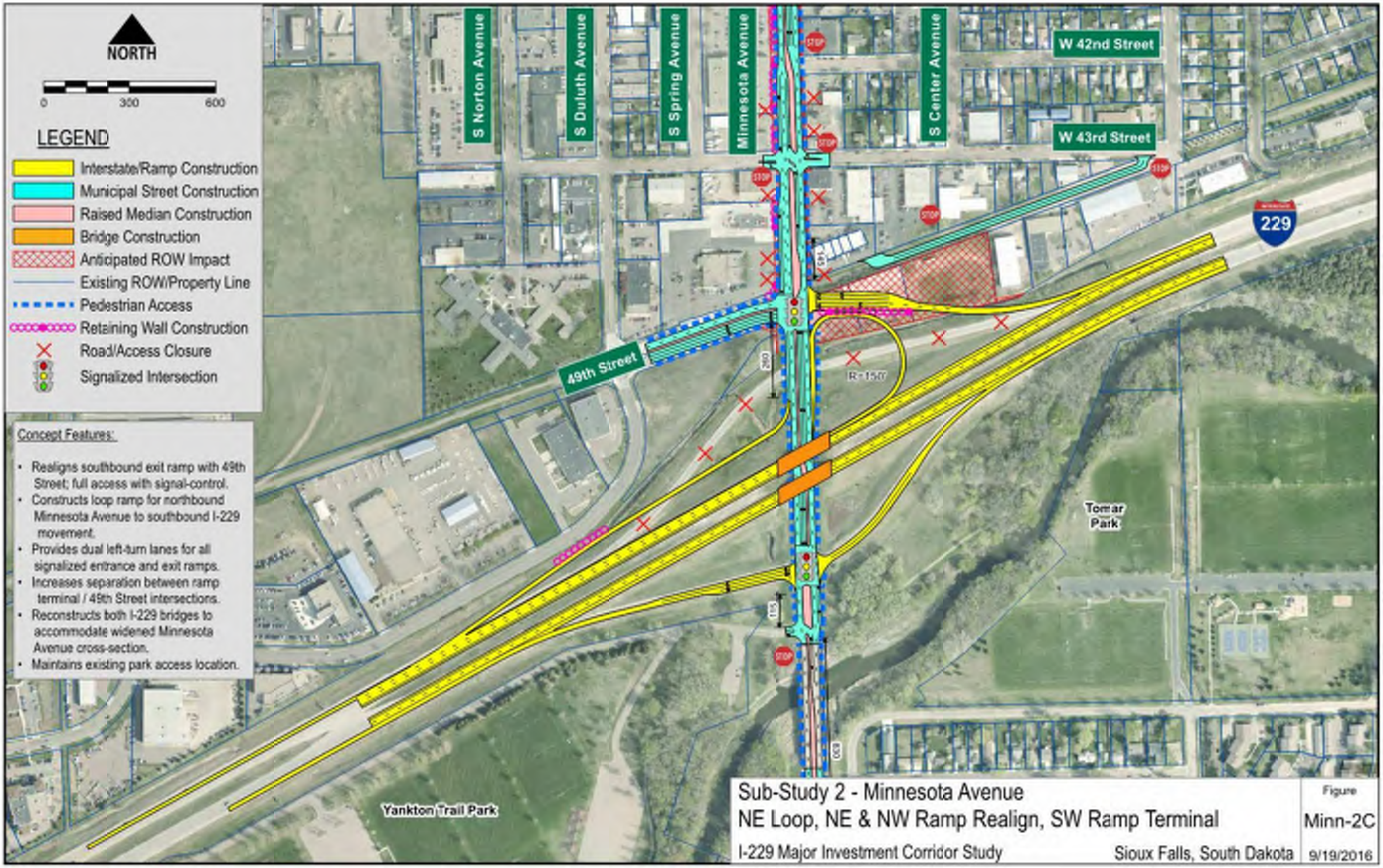
- Evaluation Factors:

Option	**Description**	**Traffic Operations**	**Safety**	**Environmental**	**Property Impacts**	**Construction & ROW Cost**	**DRAFT Recommendation**
Concept ID	Interchange and Corridor Type	•Traffic Delay •Level of Service •Interchange Year of Failure	Predicted Crash Reduction during 2012-2035	Potential impact to wetlands, historical resources, threatened and endangered species, public lands, and floodplains	Total Right of Way (ROW) Required and Acquisitions	Total Constuction Cost (including ROW)	**Advance** **or** **Eliminate**

- Evaluation Matrix to Compare Concepts
- Recommended Action

CONCEPTS FOR FURTHER CONSIDERATION

MINN-2C



Concept Features:

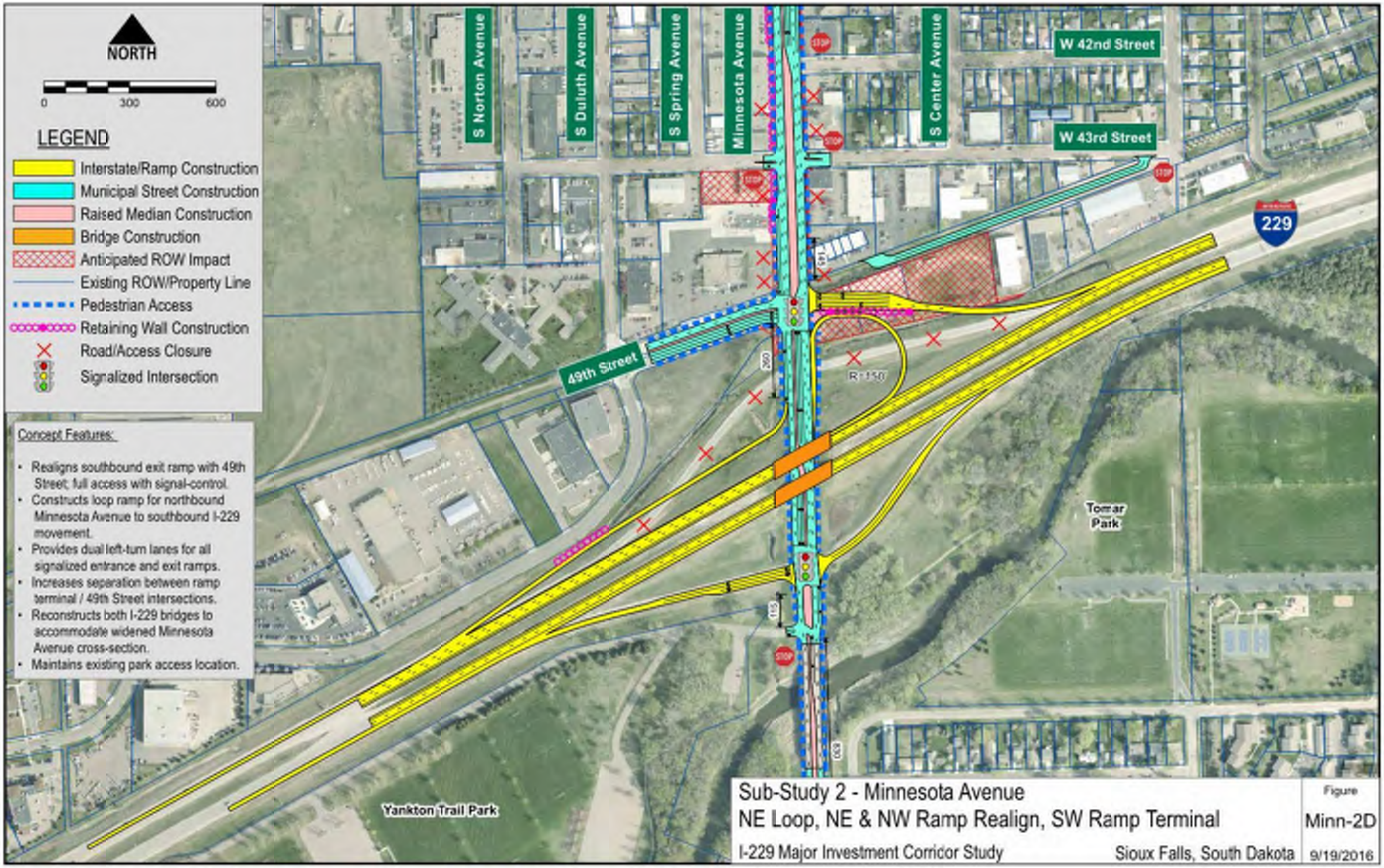
- Realigns southbound exit ramp with 49th Street; full access with signal-control.
- Constructs loop ramp for northbound Minnesota Avenue to southbound I-229 movement.
- Provides dual left-turn lanes for all signalized entrance and exit ramps.
- Increases separation between ramp terminal / 49th Street intersections.
- Reconstructs both I-229 bridges to accommodate widened Minnesota Avenue cross-section.
- Maintains existing park access location.

Sub-Study 2 - Minnesota Avenue
NE Loop, NE & NW Ramp Realign, SW Ramp Terminal
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota

Figure
Minn-2C
9/19/2016

CONCEPTS FOR FURTHER CONSIDERATION

MINN-2D



Concept Features:

- Realigns southbound exit ramp with 49th Street; full access with signal-control.
- Constructs loop ramp for northbound Minnesota Avenue to southbound I-229 movement.
- Provides dual left-turn lanes for all signalized entrance and exit ramps.
- Increases separation between ramp terminal / 49th Street intersections.
- Reconstructs both I-229 bridges to accommodate widened Minnesota Avenue cross-section.
- Maintains existing park access location.

Sub-Study 2 - Minnesota Avenue
NE Loop, NE & NW Ramp Realign, SW Ramp Terminal
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota

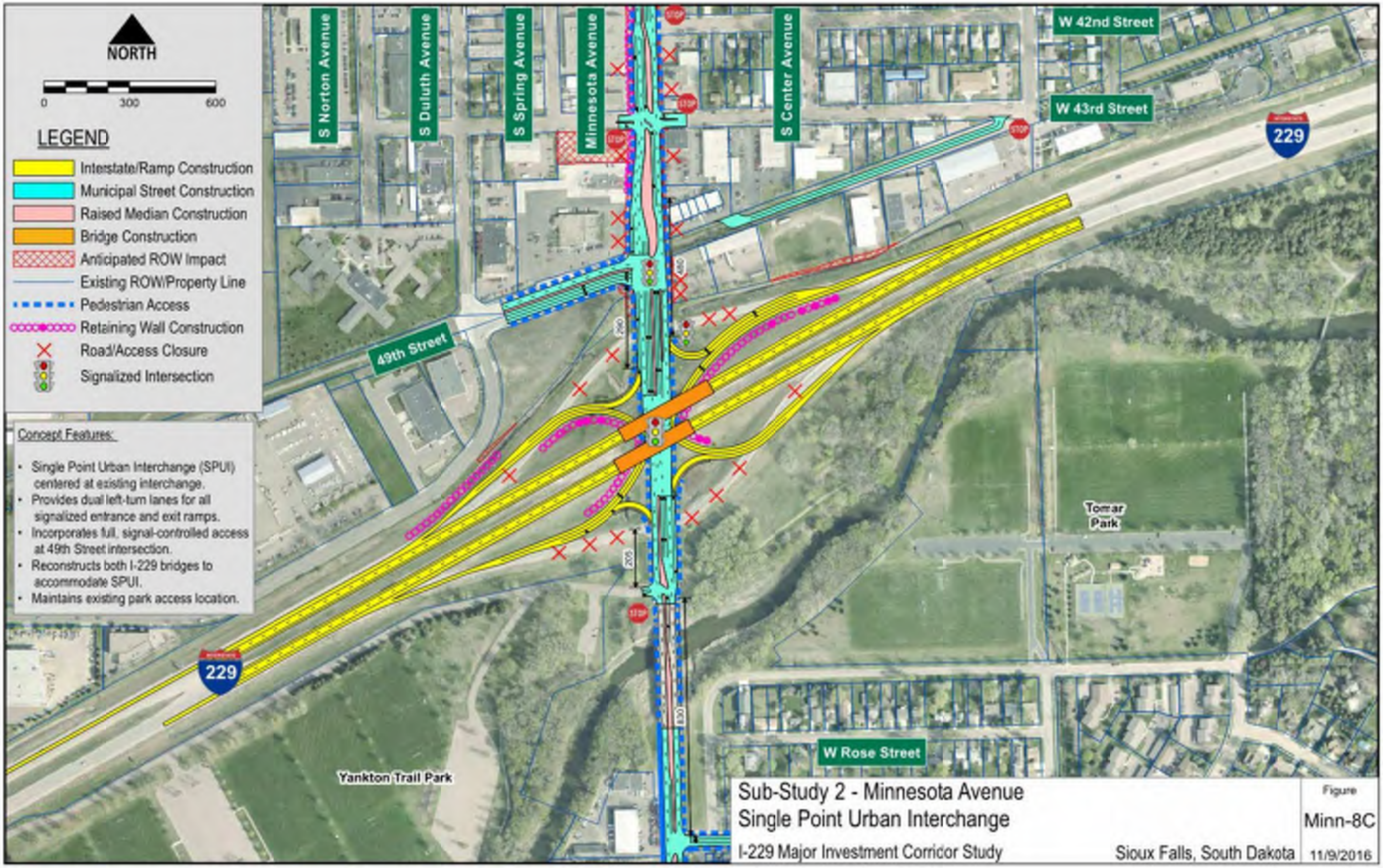
Figure
Minn-2D
9/19/2016

CONCEPT EVALUATION RESULTS

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
No-Build	No-Build	POOR	NEUTRAL	N/A	N/A	N/A	**Advance**
Minn-2C	Diamond with Loop, Direct Connect to 49th St, 5-Lane Big Sioux River to 41st St	NEUTRAL	GOOD	NEUTRAL	NEUTRAL	GOOD	**Advance**
Minn-2D	Diamond with Loop, Direct Connect to 49th St, 6-Lane Big Sioux River to 41st St	NEUTRAL	GOOD	NEUTRAL	NEUTRAL	GOOD	**Advance**
Minn-5D	Diverging Diamond Interchange, 6-Lane Big Sioux River to 41st St, 49th St Right-In Right-Out	GOOD	VERY GOOD	NEUTRAL	GOOD	GOOD	**Eliminate** Closure of 49th Street Access

CONCEPTS FOR FURTHER CONSIDERATION

MINN-8C



Concept Features:

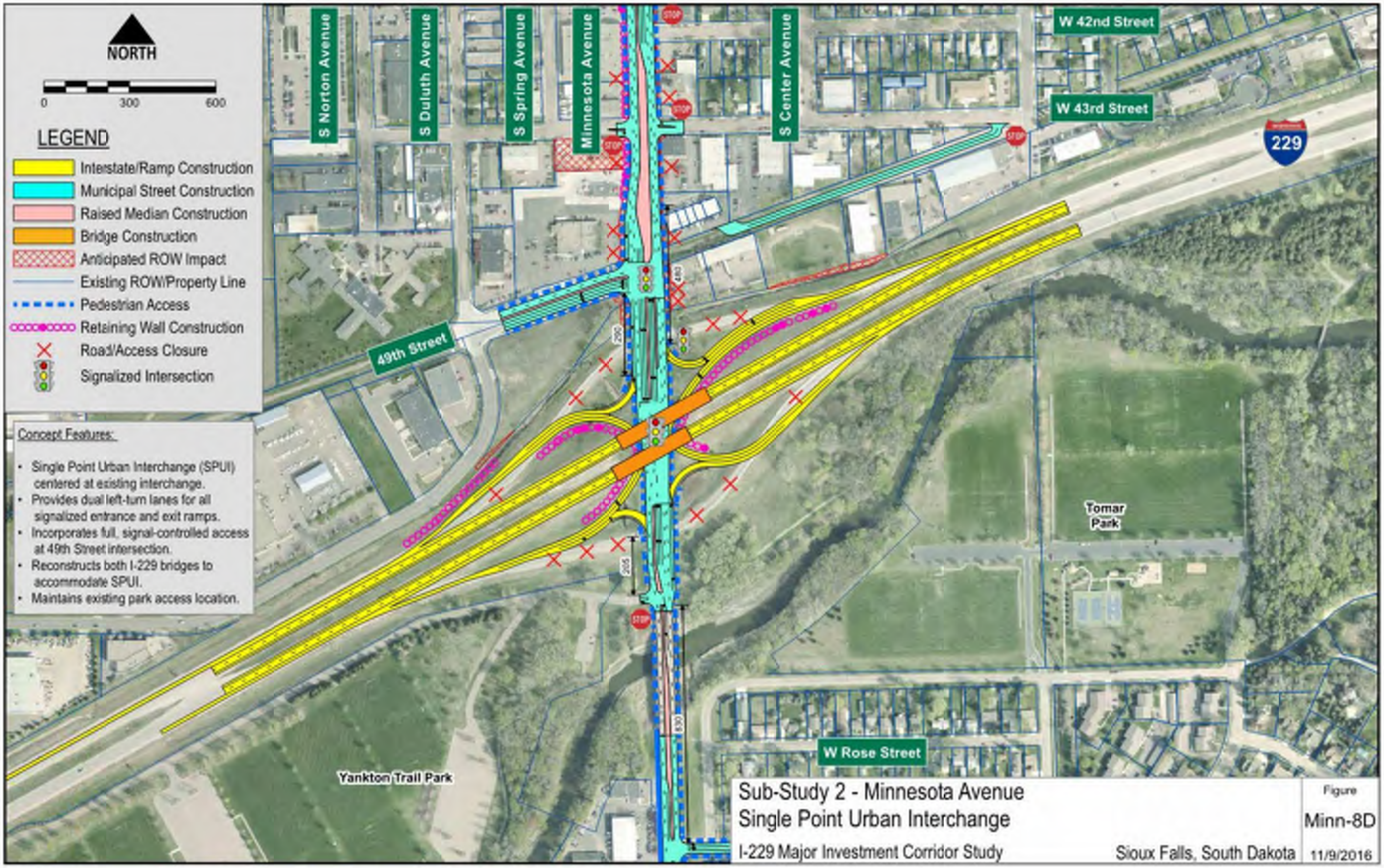
- Single Point Urban Interchange (SPUI) centered at existing interchange.
- Provides dual left-turn lanes for all signalized entrance and exit ramps.
- Incorporates full, signal-controlled access at 49th Street intersection.
- Reconstructs both I-229 bridges to accommodate SPUI.
- Maintains existing park access location.

Sub-Study 2 - Minnesota Avenue
Single Point Urban Interchange
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota

Figure
Minn-8C
11/9/2016

CONCEPTS FOR FURTHER CONSIDERATION

MINN-8D



Concept Features:

- Single Point Urban Interchange (SPUI) centered at existing interchange.
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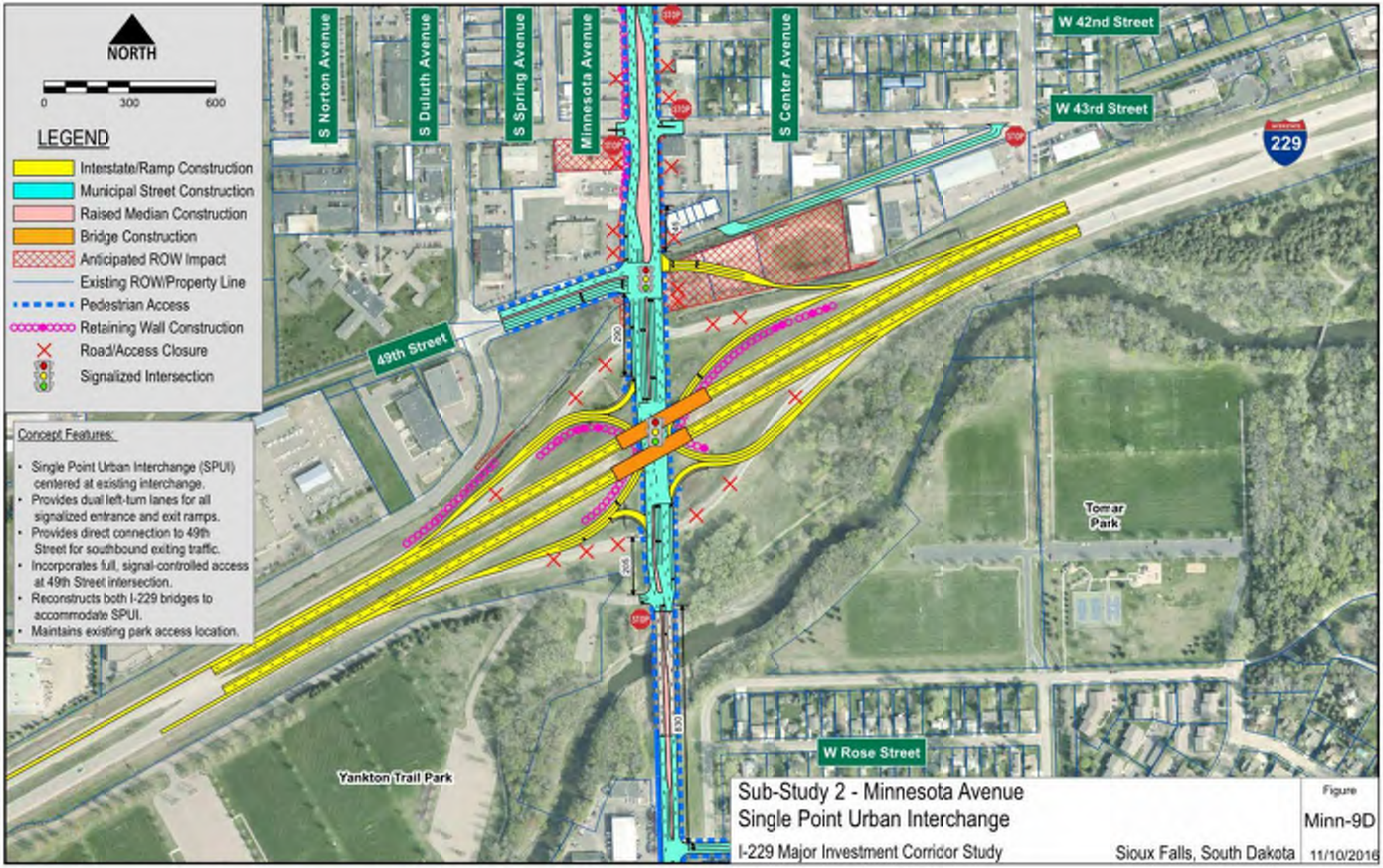
- Incorporates full, signal-controlled access at 49th Street intersection.
- Reconstructs both I-229 bridges to accommodate SPUI.
- Maintains existing park access location.

Sub-Study 2 - Minnesota Avenue
Single Point Urban Interchange
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota

Figure
Minn-8D
11/9/2016

CONCEPTS FOR FURTHER CONSIDERATION

MINN-9D



Concept Features:

- Single Point Urban Interchange (SPUI) centered at existing interchange.
- Provides dual left-turn lanes for all signalized entrance and exit ramps.
- Provides direct connection to 49th Street for southbound exiting traffic.
- Incorporates full, signal-controlled access at 49th Street intersection.
- Reconstructs both I-229 bridges to accommodate SPUI.
- Maintains existing park access location.

Sub-Study 2 - Minnesota Avenue
Single Point Urban Interchange
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota

Figure
Minn-9D
11/10/2016

CONCEPT EVALUATION RESULTS (cont.)

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
Minn-8C	Single Point Urban Interchange, 5-Lane Big Sioux River to 41st St, 49th St Full Access	GOOD	GOOD	NEUTRAL	GOOD	NEUTRAL	Advance
Minn-8D	Single Point Urban Interchange, 6-Lane Big Sioux River to 41st St, 49th St Full Access	GOOD	GOOD	NEUTRAL	GOOD	NEUTRAL	Advance
Minn-9D	Single Point Urban Interchange, Exit Ramp Connection to 49th St, 5-Lane Big Sioux River to 41st St	NEUTRAL	GOOD	NEUTRAL	NEUTRAL	NEUTRAL	Advance

MINNESOTA AVENUE
PRELIMINARY PROJECT PRIORITY

- Priority recommendation based on existing and anticipated need and level of improvement and impacts associated with remaining concept options
- Minnesota Avenue Interchange and Corridor improvements = High Priority
- See exhibit board for additional information

NEXT STEPS

- Assemble Stakeholder and Public Comments
- Complete Study Report
- Project Development Process = 5-6 year timeline when initiated by SDDOT & City
  - Prepare Interchange Modification Justification Report and Environmental Document
  - Develop Project Design
  - Acquire Right of Way
  - Construction

PROJECT CONTACTS:

Jason Kjenstad – HDR Engineering, Inc.
605-977-7740 or jason.kjenstad@hdrinc.com

Jon Wiegand– HR Green, Inc.
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Shannon Ausen – City of Sioux Falls
605-367-8607 or sausen@siouxfalls.org

Steve Gramm – SDDOT Project Development
605-773-6641 or steve.gramm@state.sd.us

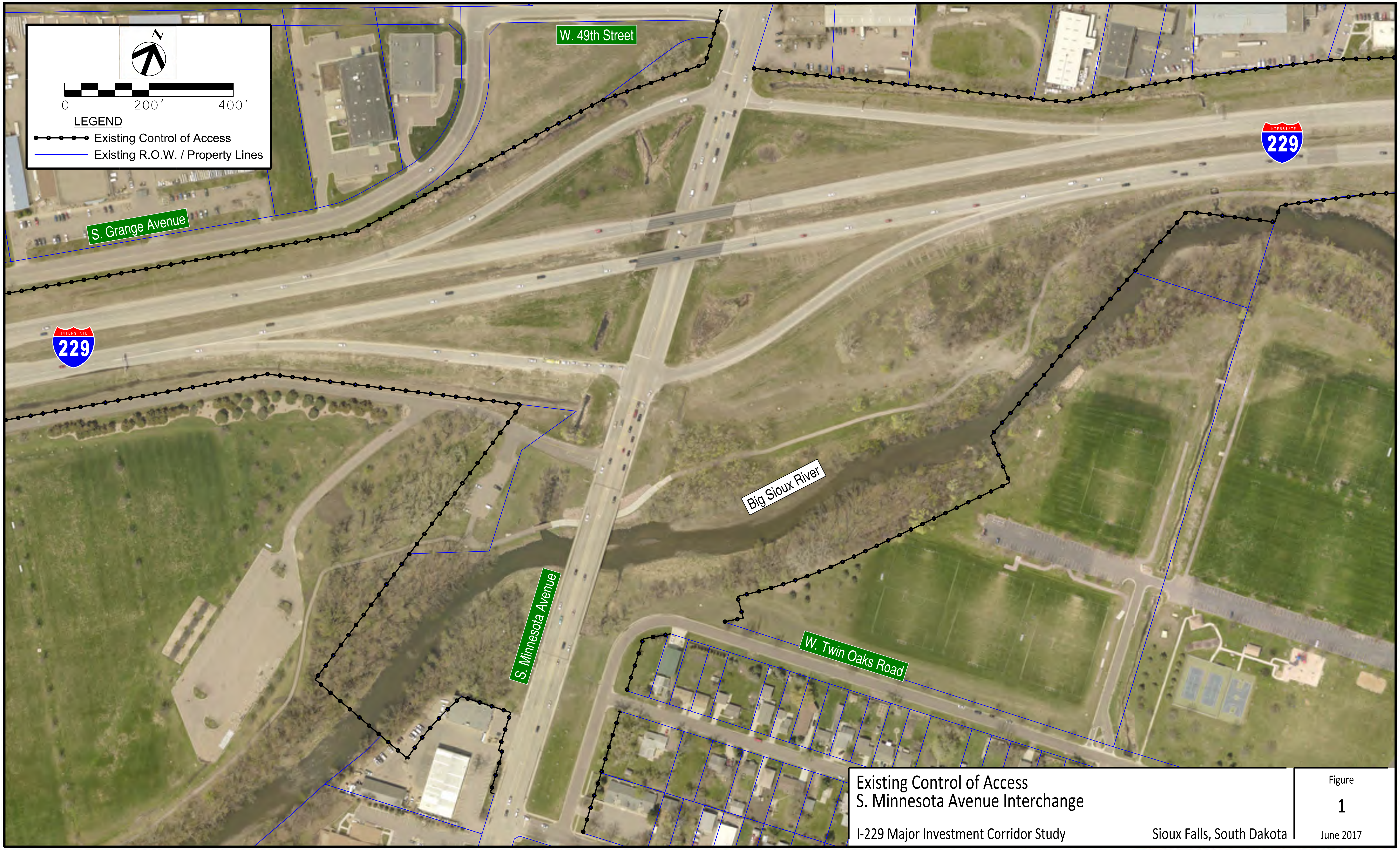
INTERSTATE 229 MAJOR INVESTMENT STUDY

Exit 3 – Minnesota Avenue Sub-Study

Thanks for attending!

APPENDIX I -

EXISTING ACCESS CONTROL FIGURES



Existing Control of Access
S. Minnesota Avenue Interchange

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure
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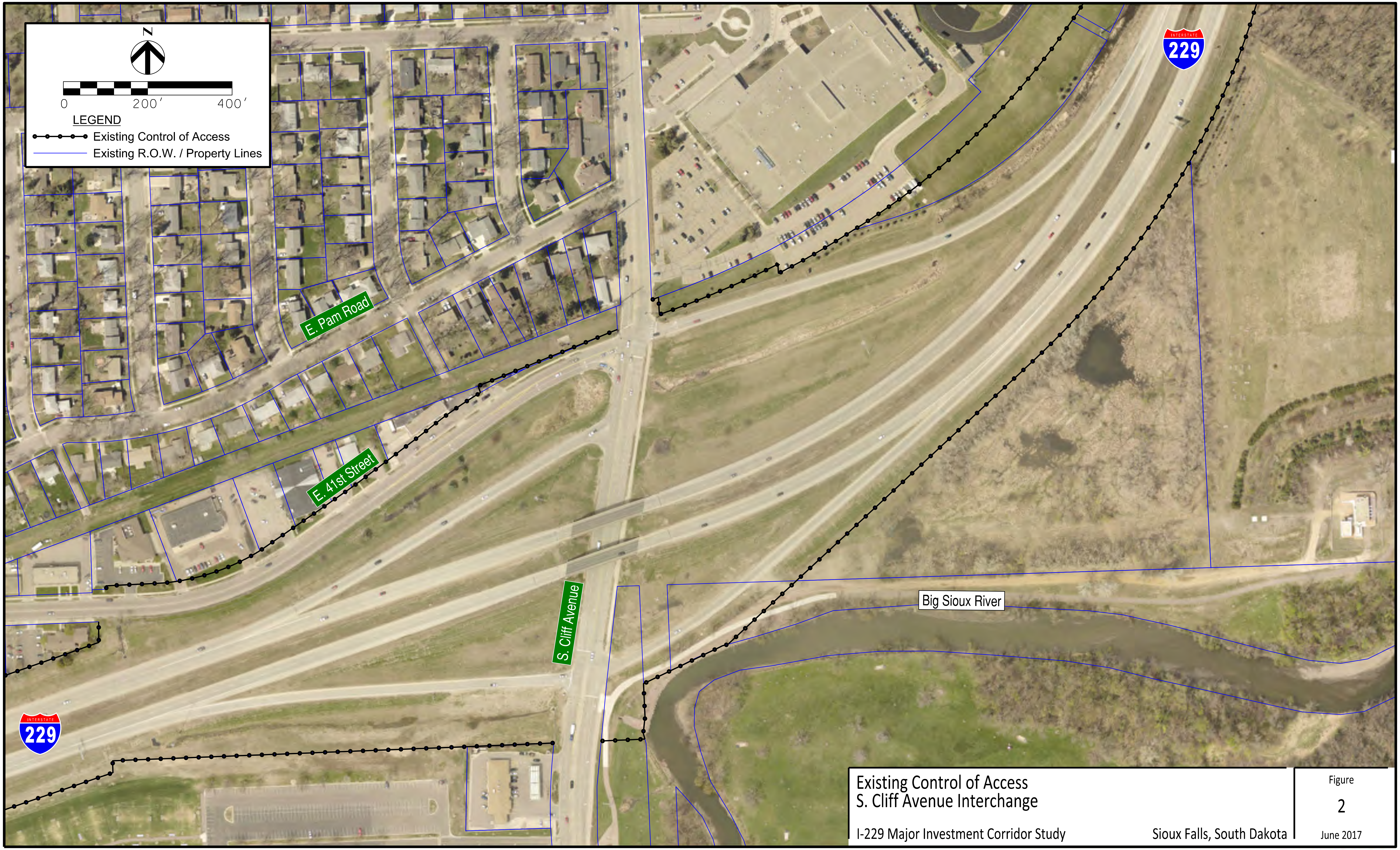
June 2017

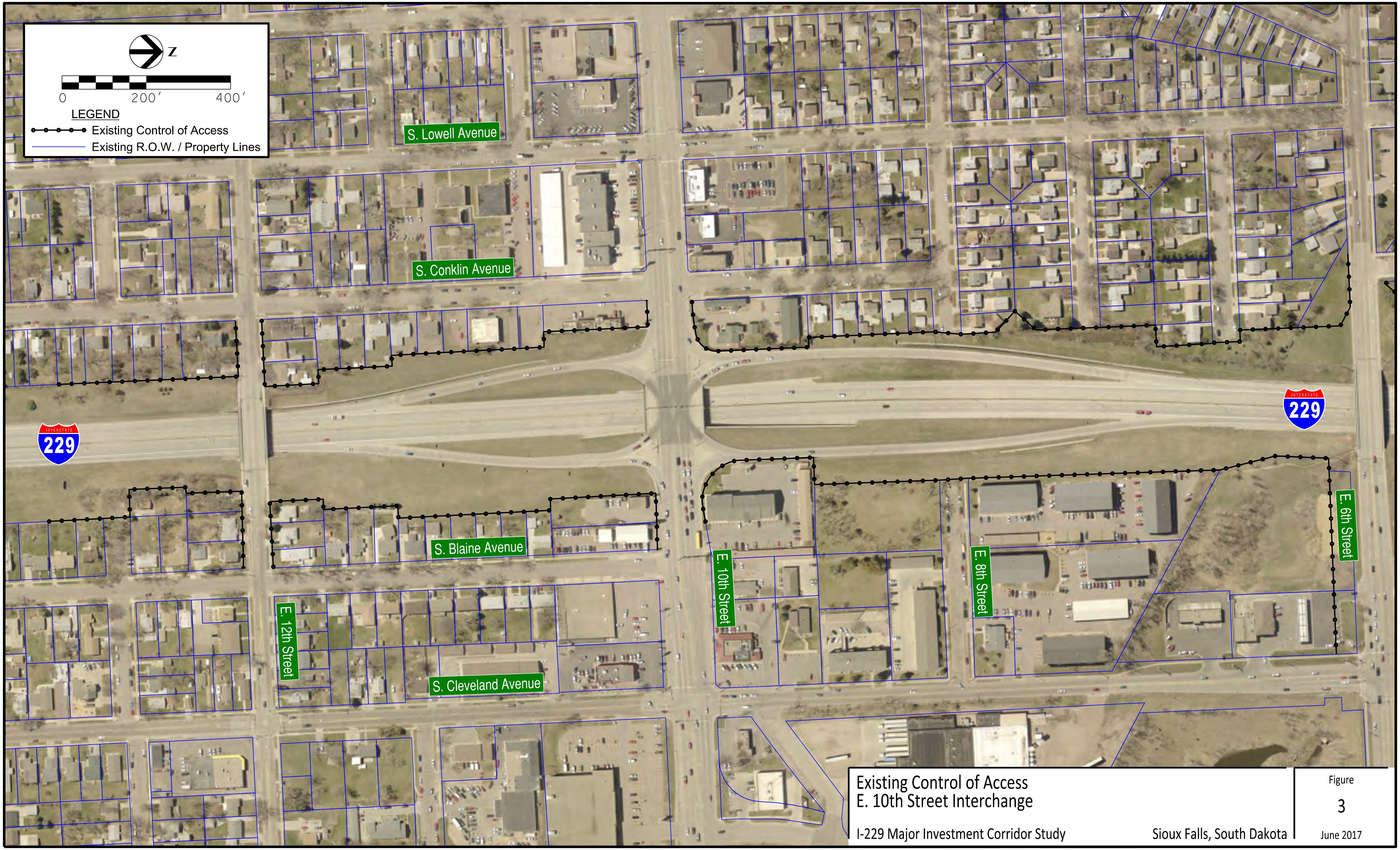


Existing Control of Access
S. Cliff Avenue Interchange

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure
2
June 2017

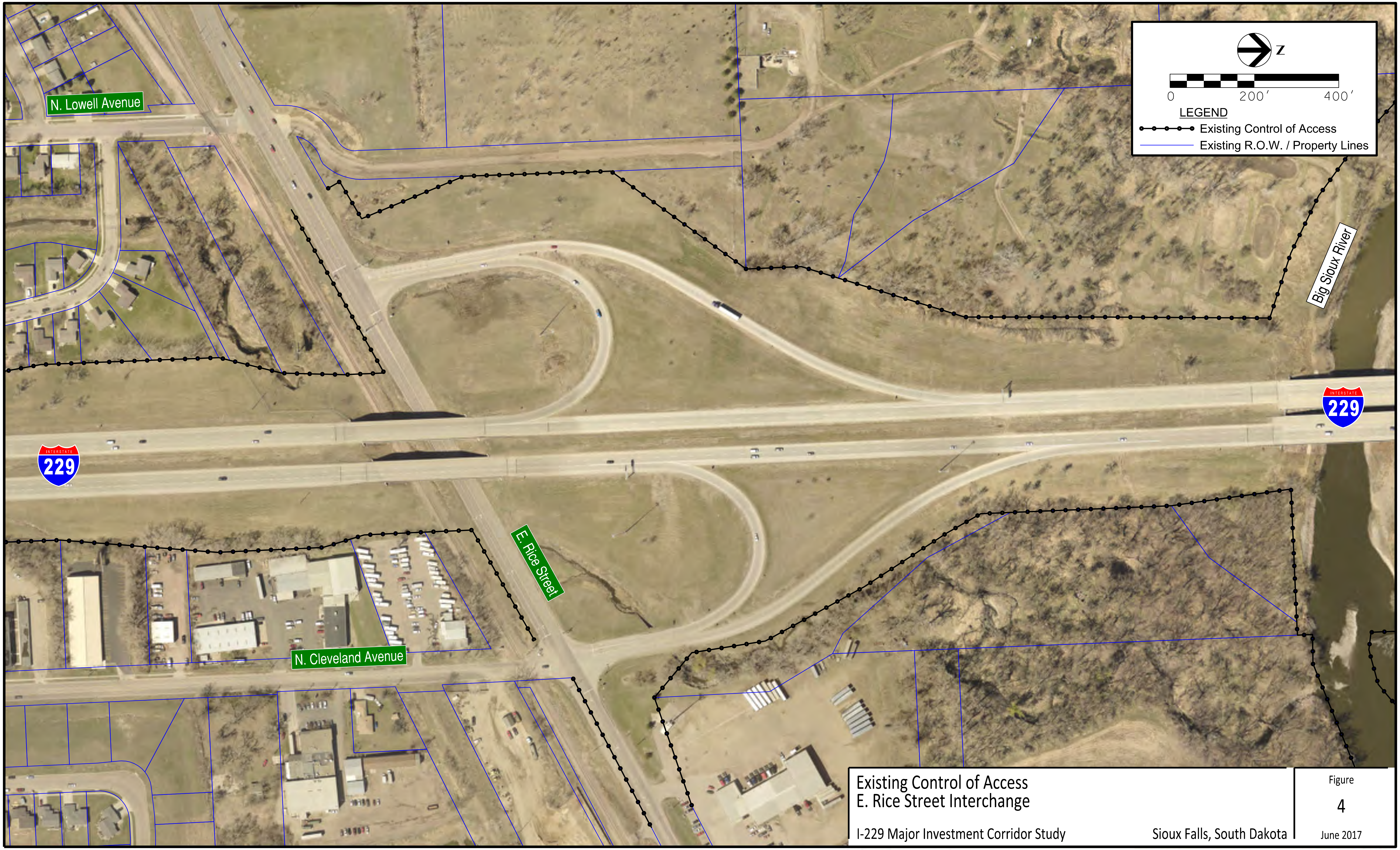


Existing Control of Access
E. 10th Street Interchange

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure
3
June 2017

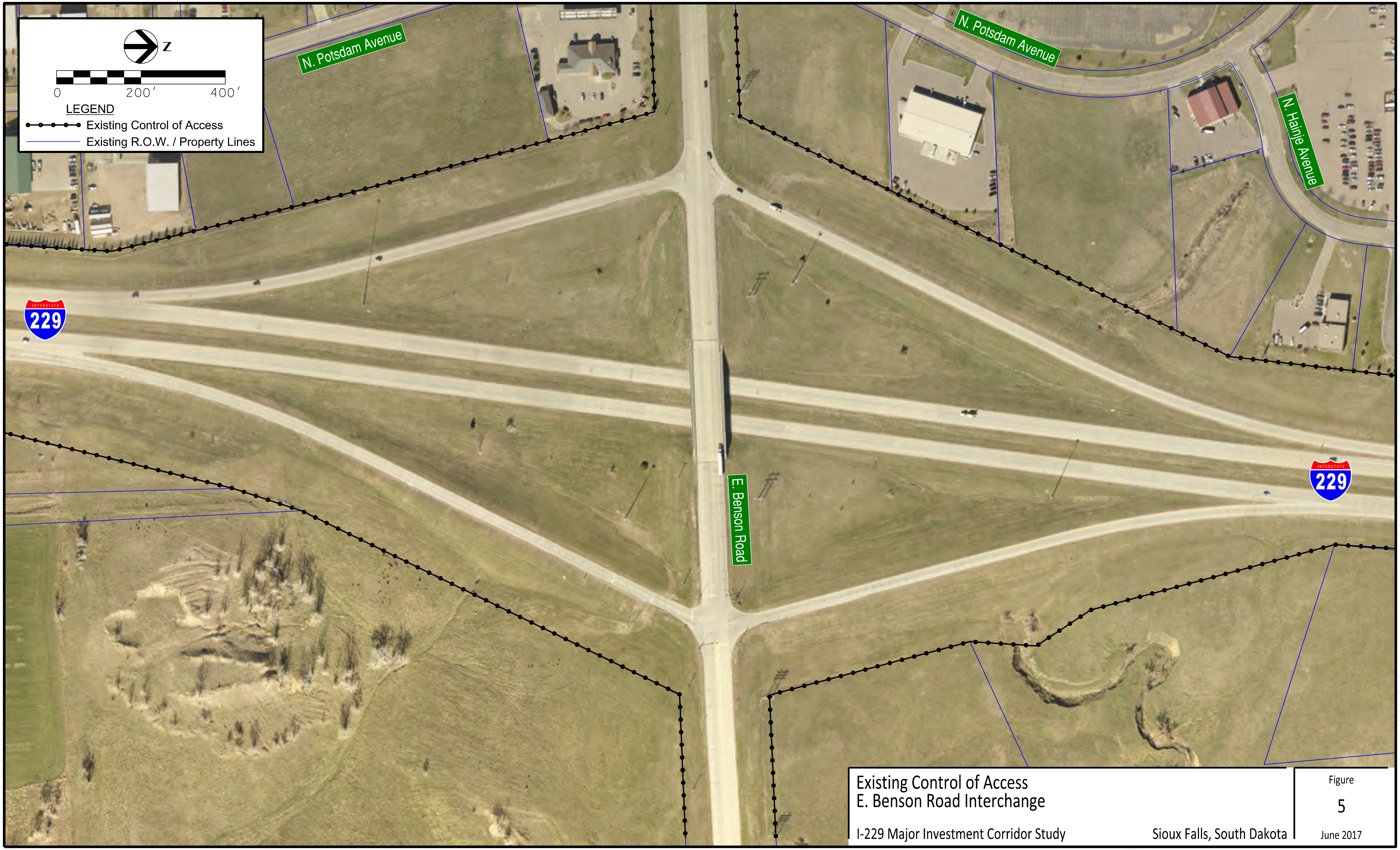


Existing Control of Access
E. Rice Street Interchange

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure
4
June 2017



Existing Control of Access
E. Benson Road Interchange

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure

5

June 2017