South Dakota DOT
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South Dakota Decennial Interstate Corridor Study

PHASE THREE REPORT

November 2010

FELSBURG HOLT & ULLEVIG

SOUTH DAKOTA DOT
DECENNIAL INTERSTATE CORRIDOR STUDY

Phase 3 Report – Implementation Plan

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EXECUTIVE SUMMARY

Introduction

The South Dakota Department of Transportation (SDDOT) retained Felsburg Holt & Ullevig to conduct a statewide analysis of the Interstate system. The study is focused on:

- Ensuring a mainline Level of Service (LOS) of C or better throughout the Interstate System,
- Ensuring an interchange LOS of D or better for all interchanges throughout the Interstate System, and
- Identification of areas not in compliance with current Interstate design standards.

Phase 1 of the study was completed in March of 2010, providing an inventory of the statewide Interstate system, noting locations where geometric, safety or operational problems are occurring or are expected to occur in the 10 to 20 year future. The Phase 1 effort resulted in identification of ten existing interchanges in need of particular attention. These interchanges were then forwarded to Phase 2 for further analysis, along with five potential new interchanges.

Each interchange was examined in detail in the Phase 2 report, completed in August 2010. This phase of the study addressed questions raised by SDDOT staff during the Phase 1 analysis, and provided recommendations for future improvements. Technical information for each interchange included all or portions of the following:

- Traffic analyses (updated traffic counts, forecasts, and/or Levels of Service)
- Conceptual design drawings for Alternatives being considered
- Alternative performance evaluations that compare the alternatives across a range of categories and support the recommendation of a Most Feasible Alternative
- Probable costs for each alternative
- Review of environmental resource impacts for each alternative

The existing interchanges evaluated in the Phase 2 report were:

- I-29 Exit 2 – River Drive, North Sioux City
- I-29 Exit 71 – Tea/Harrisburg
- I-29 Exit 77 – 41st Street, Sioux Falls
- I-90 Exit 17 – US 85, Spearfish/Lead/Deadwood
- I-90 Exit 55 – Deadwood Avenue, Rapid City
- I-90 Exit 59 – LaCrosse Street, Rapid City
- I-90 Exit 63 – Ellsworth Air Force Base Commercial, Box Elder
- I-90 Exit 332 – SD 37/SD 90L, Mitchell/Parkston
- I-90 Exit 406 – SD11, Brandon/Corson
- I-229 Exit 5 – Sioux Falls, 26th Street

Potential new interchanges evaluated as a part of Phase 2 included:

- I-29 Exit 130 – 20th Street, Brookings
- I-29 Exit 175 – South Connector, Watertown
- I-90 Exit 69 – Box Elder
- I-90 Exit 393 – Ellis Road, Sioux Falls
- I-90 Exit 398 – Minnesota Avenue, Sioux Falls

Phase 3 Prioritization of Improvements

Projects indentified as the most feasible alternative in the Phase 2 analysis are prioritized in this Phase 3 report based on the following three general criteria, with the individual evaluation factors as listed below:

1. **Need**: Based on the Phase 1 effort, a measure of significance of the need based on:
    - existing geometric deficiencies
    - safety record
    - existing and future traffic operations performance
    - structure condition

2. **Performance**: Based on information from Phase 2, measure of effectiveness of the proposed solution based on:
    - property impacts
    - physical environment
    - traffic
    - geometric design
    - safety
    - construction

3. **Implementation**: Additional information regarding the proposed action, including:
    - construction cost
    - cost-effectiveness
    - regional significance
    - community support

Results of this Phase 3 evaluation identifies an implementation plan based on the Need, Performance, and Implementation evaluation for the selected existing interchanges followed by potential future interchanges. **Table S.1** identifies the recommended priority of implementation for the list of approximately $80.0 Million in interchange improvements. Improvements to existing interchanges total approximately $45.2 Million, with $34.4 Million estimated for construction of new interchanges.

Table S.1 Priorities for Implementation of Improvements

Interchange	Overall Ranking	Needs Ranking	Recommended Improvement	Probable Construction Cost
Near-Term Improvements				
I-29 Exit 77 41st Street Sioux Falls	70.5	32.5	Diverging Diamond Interchange	$3.08 Million
Mid-Range Improvements				
I-90 Exit 59 LaCrosse Street Rapid City	55.7	20.7	Diverging Diamond Interchange	$6.11 Million
I-229 Exit 5 Sioux Falls 26th Street	57.4	19.4	Crossroad and Ramp Improvements	$7.53 Million
I-90 Exit 55 Deadwood Avenue Rapid City	57.3	16.3	Interchange Improvements and Closed Access	$2.83 Million
I-90 Exit 406 SD11 Brandon/Corson	53.1	13.1	Crossroad and Bridge Improvements	$5.78 Million
I-29 Exit 2 River Drive North Sioux City	56.4	12.4	Signalization and Access Improvements	$0.86 Million
I-90 Exit 17 US 85 Spearfish/Lead/Deadwood	57.0	12.0	New Turn Lanes and Signals	$4.40 Million
I-29 Exit 71 County Hwy 110 Tea/Harrisburg	50.9	7.9	Widen Crossroad and Bridge to 3-lanes w/ Shoulders	$3.44 Million
I-90 Exit 332 SD 37/SD 90L Mitchell/Parkston	57.6	6.6	Signal Timing Enhancements	n/a
Long Range Improvements				
I-90 Exit 63 Ellsworth Base Comm. Box Elder	38.1	4.1	Diamond Interchange	$11.13 Million

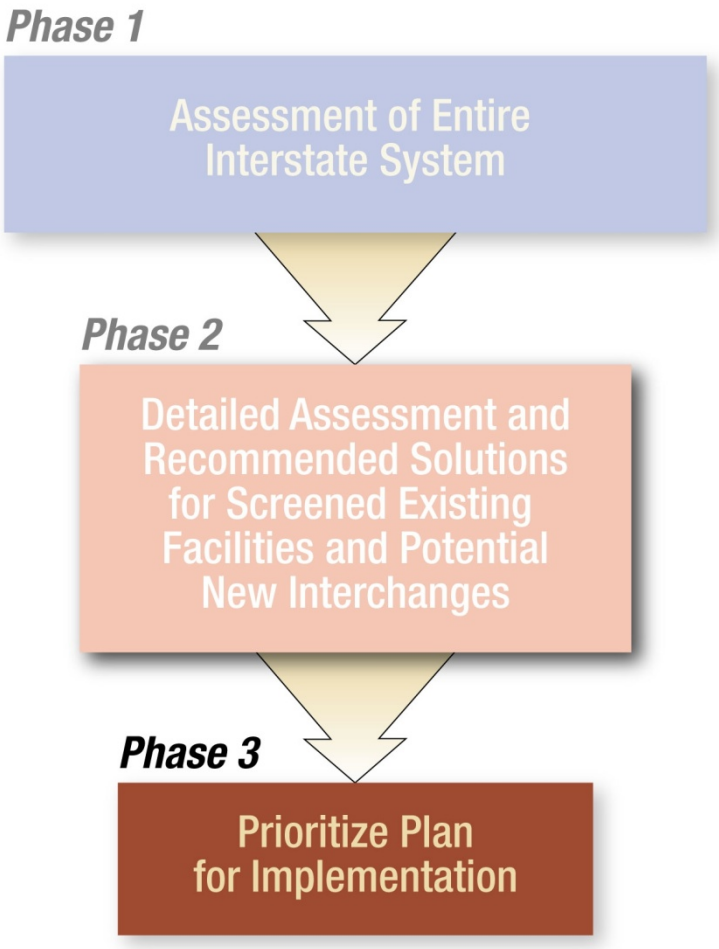
1.0 INTRODUCTION

The South Dakota Department of Transportation (SDDOT) retained Felsburg Holt & Ullevig to conduct a statewide analysis of the Interstate system. The study is focused on:

- Ensuring a mainline Level of Service (LOS) of C or better throughout the Interstate System,
- Ensuring an interchange LOS of D or better for all interchanges throughout the Interstate System, and
- Identification of areas not in compliance with current Interstate design standards.

1.1 *Study Process*

Phase 1 of the study was documented in a previous report, completed in March of 2010. The report reviewed the roadway geometrics, crash history and daily traffic volumes for all 678 centerline miles of Interstate mainline in South Dakota and 126 of the 152 total existing interchanges. The evaluation conducted in the Phase 1 report identified a combination of 15 existing and five potential new interchanges to be analyzed further in next phase of the study. Phase 2 provided a detailed assessment of these locations, addressed key questions that were raised about each location during the Phase 1 report, and recommended most feasible solutions. Phase 3, addressed in this report, provides a prioritized plan for implementing the most feasible solutions.



1.2 *Phase 2 Alternative Evaluation*

In Phase 2 of the study, which was completed in August of 2010, each interchange was examined in detail in order to provide recommendations for future improvements. Technical information for each interchange included all or portions of the following:

- Traffic analyses (updated traffic counts, forecasts, and/or Levels of Service)
- Conceptual design drawings for Alternatives considered
- Alternative performance evaluations that compare the alternatives across a range of categories and support the recommendation of a Most Feasible Alternative
- Probable costs for each alternative
- Review of environmental resource impacts for each alternative

At each location, alternative interchange configurations were further tested against each other based on a list of six evaluation factors. These factors included:

- Property Impacts
- Physical Environment
- Traffic
- Geometric Design
- Safety
- Construction

Each factor included a number of specific categories for evaluation. For example, the Physical Environment factor included hazardous sites, wetlands impacts and flood/drainage impacts. Alternatives were assigned ratings of 1, 2, or 3 within each category, 3 being the highest rating and 1 being lowest.

Table 1.1 identifies each of the existing interchanges and potential new interchanges evaluated in the Phase 2 report. The best-performing, or most feasible alternative based on the performance evaluation, is shown for each interchange along with the estimate of probable construction cost. Results of the Phase 2 evaluation identified a list of approximately $80 Million in interchange improvements at the selected existing interchanges and potential future interchanges.

Table 1.1 Most Feasible Alternative Selections

	Most Feasible Alternative	Probable Construction Cost	Comments
Existing Interchanges			
I-29 Exit 2 River Drive North Sioux City	Alternative 1 – Signalization and Access Improvements	$0.86 Million	Low cost and simplicity of design is primary advantage over other options
I-29 Exit 71 County Hwy 110 Tea/Harrisburg	Alternative 1 – Widen Crossroad and Bridge to 3-lanes w/ Shoulders	$3.44 Million	Low cost and simplicity of design; no other concepts were considered
I-29 Exit 77 41st Street Sioux Falls	Alternative 2 – Diverging Diamond	$3.08 Million	Operational advantages for lower cost. Uses existing bridge with minor modifications
I-90 Exit 17 US 85 Spearfish/Lead/Deadwood	Alternative 1 – New Turn Lanes and Signals	$4.4 Million	Low cost is primary advantage over Single Point option
I-90 Exit 55 Deadwood Avenue Rapid City	Alternative 3 – Interchange Improvements and Closed Access	$2.83 Million	Provides best access control, cost is same as other options
I-90 Exit 59 LaCrosse Street Rapid City	Alternative 3 – Diverging Diamond Interchange	$6.11 Million	Div. Diamond provides operational advantages for lower cost. Would require bridge widening.
I-90 Exit 63 Ellsworth Base Comm. Box Elder	Alternative 1 – Diamond Interchange	$11.13 Million	Cost, Right-of-way and property impacts eliminate Alternatives 1 and/or 3
I-90 Exit 332 SD 37/SD 90L Mitchell/Parkston	Alternative 1 – Signal Timing Enhancements	n/a	No capital improvements recommended
I-90 Exit 406 SD11 Brandon/Corson	Alternative 1 – Crossroad and Bridge Improvements	$5.78 Million	Low cost and less ROW and construction impacts
I-229 Exit 5 Sioux Falls 26th Street	Alternative 1 – Crossroad and Ramp Improvements	$7.53 Million	City of Sioux Falls concept; eliminates hook ramps
Potential New Interchanges			
I-29 Exit 130 20th Street Brookings	Alternative 1 – Folded Diamond Interchange	$10.97 Million	City supports this location; folded diamond avoids some properties
I-29 Exit 175 South Connector Watertown	Alternative 1 – Diamond Interchange	$11.34 Million	Area Transportation Plan proposes this location and simple diamond is adequate
I-90 Exit 393 Ellis Road Sioux Falls	Alternative 1 – Folded Diamond Interchange	$12.13 Million	Folded diamond avoids properties in NW and SE quadrants

2.0 PROJECT PRIORITIZATION – EXISTING INTERCHANGES

2.1 *Purpose and Objective*

The purpose of this Phase 3 report is to prioritize the interchange improvement projects identified in Phase 2 of the Interstate Corridor Study. It is basically a structured process using evaluation criteria coupled with a scoring system using points for each criterion, establishing the relative importance of each criterion.

The objective of Phase 3 is to compare the most feasible alternatives at each location and to rank projects on a system-wide basis. Construction funds are limited, and this ranking will help direct resources toward the most cost-effective projects.

2.2 *Methodology Overview*

This process builds upon the methods used in Phases 1 and 2 to assess the needs of the overall interstate system and the alternative performance evaluation to arrive at the Most Feasible Alternatives indentified in Phase 2 for each location. Projects are prioritized based on the following three criteria, with individual evaluation factors listed:

Need: Based on the Phase 1 effort, a measure of significance of the need based on:

- existing geometric deficiencies
- safety record
- existing and future traffic operations performance
- structure condition

Performance: Based on information from Phase 2, measures of effectiveness of the proposed solutions based on:

- Property impacts
- Physical environment impacts
- Traffic flow improvement
- Geometric design improvement
- Safety enhancement
- Construction

Implementation: Additional information regarding the proposed action, including:

- Construction cost
- Cost-effectiveness
- Regional significance

With these principles in mind, the following scoring guidelines were used for each criterion.

2.3 *Need Criteria*

2.3.1 Geometrics

Based on the work in Phase I, five geometric elements have been identified as those which are among the most commonly found deficiencies and which are most critical to safe operations. To reflect the magnitude of the deficiencies, we have defined a point system which recognizes these levels. Table 2.1 summarizes the standards which define the appropriate point level for each geometric element.

Table 2.1 Geometric Needs

Deficiency Points	Control of Access (Feet)	Ramp Intersection Sight Distance (Feet)	Ramp Stopping Sight Distance (Feet)	On-Ramp Taper Rate	Cross-Road Stopping Sight Distance (Feet)
Severe-3	0-100	<200	<200	<15:1	<200
Moderate-2	100-200	200-275	200-275	15:1-30:1	200-275
Minimal-1	200-300	275-375	275-375	30:1-50:1	275-375
None-0	>300	>375	>375	>50:1	>375

Each interchange was evaluated for each geometric element, and the total points (when all five elements are considered) were scored for this criterion, with a maximum of 15 points. **Table 2.2** provides the values and ratings for each interchange.

Table 2.2 Ratings for Geometric Needs

Exit	Location	Geometric Feature					
		Control of Access (Feet)	Ramp Intersection Sight Distance (Feet)	Ramp Stopping Sight Distance (Feet)	On-Ramp Taper (Feet)	Cross-Road Stopping Sight Dist. (ft.)	Total Points
I-90							
Exit 17	Lead/Deadwood	200’	> 425	490	61	1039	**2**
Exit 55	Deadwood Avenue	330'	> 425	246		460	**2**
Exit 59	LaCrosse Street	150’	> 425	262			**4**
Exit 63	Box Elder/EAFB	n/a	n/a	414	58	n/a	**0**
Exit 332	Mitchell/Parkston	400’	> 425	539	60	949	**0**
Exit 406	Brandon/Corson	400’	> 425	427	29	871	**2**
I-29							
Exit 2	North Sioux City	70’	> 425	446	62	649	**3**
Exit 71	Harrisburg/Tea	150’	< 425	538	29	414	**5**
Exit 77	41st Street	200’	> 425	367	29	444	**5**
I-229							
Exit 5	26th Street	260’	-	257	-	-	**3**

2.3.2 Safety

Interchanges were scored on a scale of 0 to 13, based on their 3-year weighted crash rate. An upper value of 13 was selected to emphasize the importance of safety and to provide a round total of 100 for all of the criteria elements. Of all of the interchanges included in the study, the calculated crash rates ranged from a high of 4.22 weighted accidents/million entering vehicles to a low of 0.00. Thus, the 4.22 rate would be equated to 13.0 points and the remaining locations scored on a linear relationship by a factor of 3.08 (13.0 / 4.22 = 3.08). Table 2.3 summarizes safety ratings.

Table 2.3 Ratings for Safety Needs

Exit	Location	Number of Crashes By Type July 2006 - July 2009				Weighted 3-Year Crashes		
		Fatal	Injury	PDO	Total	Total	Rate (MEV)	Points (x 3.08)
I-90								
Exit 17	Lead/Deadwood	0	4	13	17	25	1.31	**4.03**
Exit 55	Deadwood Avenue	1	12	18	31	66	1.39	**4.28**
Exit 59	LaCrosse Street	0	31	54	85	147	2.49	**7.67**
Exit 63	Box Elder/Ellsworth AFB	1	9	15	25	54	1.33	**4.10**
Exit 332	Mitchell/Parkston	0	11	32	43	65	2.15	**6.62**
Exit 406	Brandon/Corson	1	3	12	16	33	1.02	**3.14**
I-29								
Exit 2	North Sioux City	0	5	12	17	27	0.78	**2.40**
Exit 71	Harrisburg/Tea	0	1	7	8	10	0.29	**0.89**
Exit 77	41st Street	0	71	103	174	316	3.72	**11.46**
I-229								
Exit 5	26th Street	0	35	68	103	173	2.41	**7.42**

2.3.3 Traffic Operations/ Capacity

The Levels of service were evaluated for ramp intersections and for mainline merge/diverge points, with points scored on the following basis:

Level of Service	Point Assignment
LOS F	3 Points
LOS E	2 Points
LOS D	1 Point
LOS C, B or A	0 Points

The worst level of service of any of these locations was the basis for scoring. This scoring was done for both existing conditions and future conditions. The total points for the four conditions

were the scores for the interchange with a maximum of 18 total points for an interchange. **Table 2.4** identifies capacity ratings.

Table 2.4 Ratings for Operational / Capacity Needs

Exit	Location	2009/2020/2030 Level of Service						Total Points
		EB/ NB Diverge	EB/ NB Merge	WB/SB Diverge	WB/ SB Merge	EB/ NB Ramp	WB/ SB Ramp	
I-90								
Exit 17	Lead/Deadwood	B/B/C	A/B/B	A/A/B	A/B/B	A/F/F	C/F/F	**6**
Exit 55	Deadwood Avenue	B/B/B	B/C/C	B/C/D	B/B/C	F/F/F	B/C/E	**10**
Exit 59	LaCrosse Street	B/C/C	B/B/C	B/B/B	B/B/B	E/E/E	D/D/E	**6**
Exit 63	Box Elder/Ellsworth AFB Commercial	B/B/B	-/-/-	-/-/-	B/B/B	B/B/C	B/B/B	**0**
Exit 332	Mitchell/Parkston	A/A/A	A/A/A	A/A/A	A/A/A	A/A/A	A/A/A	**0**
Exit 406	Brandon/Corson	A/B/B	A/B/B	A/A/A	A/B/B	C/E/F	C/D/F	**5**
I-29								
Exit 2	North Sioux City	A/A/A	B/B/B	A/B/B	A/A/B	B/B/B	C/D/F	**4**
Exit 71	Harrisburg/Tea	B/B/C	B/B/C	C/D/D	C/C/D	B/B/B	B/B/C	**2**
Exit 77	41st Street	C/E/F	C/D/F	C/E/F	D/F/F	F/F/F	F/F/F	**16**
I- 229								
Exit 5	26th Street	B/B/C	B/C/C	B/C/C	B/B/C	E/F/F	F/F/F	**9**

2.3.4 Structure Condition

The conditions of structures along the corridor were reviewed for deficiencies as part of Phase 1. Although none of the bridges at the interchanges were identified as functionally obsolete, three sets of mainline structures were identified as functionally obsolete within the area of impact of the study interchanges. These included:

- I-90 Bridges over North Maple Avenue at MRM 58.80 (Exit 59)
- I-90 Bridges over BNSF at MRM 406.12 (Exit 406)
- I-29 Bridges over River Drive at MRM 2.48 (Exit 2)

A total of 3 points was added to each of the interchanges adjacent to these structures, with the acknowledgement that if these adjacent structures require replacement, it may be advantageous to consider reconstruction of the interchange at the same time.

2.4 *Performance Criteria*

Using an adjusted version of the alternative evaluation process used in Phase 2, a series of 6 evaluation factors were used to quantify the performance of each of the Most Feasible

Alternatives. The performance of each alternative was evaluated within each category according to these measures and assigned a rating of good, fair, or poor. A good rating was assigned a value of 3 points, fair was 2, and poor was 1. A total rating was developed for each alternative as the sum of all of the individual ratings. These ratings slightly differ from the Phase 2 ratings as the Relative Construction Cost category is measured by comparing costs across different locations rather than focused on a single location. **Table 2.5** summarizes the performance criteria and methods of measurement, and **Table 2.6** the ratings by location.

Table 2.5 Performance Criteria

Evaluation Factors	Category	Good (3)	Fair (2)	Poor (1)
Property Impacts (9 points)	# of business properties taken and/or impacted	Relatively few impacts to property	Moderate property impacts	Multiple properties impacted
	# of residential properties taken and/or impacted			
	Amount of Right-of-way acquisition required			
Physical Environment (9 points)	Hazardous Sites, 4(f), 6(f)	Minimal environmental impacts	Moderate environmental impacts	Significant environmental impacts
	Wetlands Impacts			
	Flood and Drainage Impacts			
Traffic (9 points)	Traffic Operations	LOS B or better	LOS C conditions	LOS D or worse
	Development Access	Direct	Limited movements	No access
	Multimodal Compatibility	Continuous sidewalks, safe crossings, good bike/transit infrastructure	Reduced sidewalks, ltd. crossings., little bike/transit infrastructure	Little or no sidewalks, poor crossings., no bicycle infrastructure
Geometric Design (3 points)	Conformity to SDDOT design standards, including access management, roadway curvature, etc.	Addresses all current substandard geometrics	Addresses some current substandard geometrics	Addresses little or no current substandard geometrics
Safety (6 points)	Improvement of existing hazardous conditions	High potential for crash reduction	Little potential for crash reduction	No potential for crash reduction
	Interstate Incident Response / Emergency Response	Reduces response time	No change	Increases response time
Constructability (9 points)	Utility Impacts	Requires No relocations	Minimal relocations	Req. significant relocations
	Scheduling/Adaptability	Can be built in phases, shorter schedule with minor traffic impacts	Moderate traffic impacts and schedule with some phasing possible	Little or no phasing, time-consuming and impacts traffic
	Relative Construction Cost	Less than $3M	$3M to $5M	More than $5M

Table 2.6 Ratings for Performance

Exit	Location	Property Impacts	Environ.	Traffic	Geometric	Safety	Construct	Total Points
I-90								
Exit 17	Lead/Deadwood	9	9	7	2	4	7	**38**
Exit 55	Deadwood Avenue	7	6	6	3	4	7	**33**
Exit 59	LaCrosse Street	7	6	6	2	5	5	**31**
Exit 63	Box Elder/Ellsworth AFB Commercial	6	6	6	3	4	5	**30**
Exit 332	Mitchell/Parkston	9	9	7	2	6	9	**42**
Exit 406	Brandon/Corson	9	5	7	1	5	6	**33**
I-29								
Exit 2	North Sioux City	7	7	6	2	6	8	**36**
Exit 71	Harrisburg/Tea	9	8	8	2	6	4	**37**
Exit 77	41st Street	9	5	5	2	6	5	**32**
I- 229								
Exit 5	26th Street	9	5	8	2	6	4	**34**

2.5 *Implementation Criteria*

2.5.1 Construction Cost

The following scoring guidelines were used to reflect the relative ease or difficulty in implementing the feasible projects:

0 points - The project would cost more than $8 Million to construct

1 point - The project could be constructed for between $5 Million and $8 Million

2 points - The project could be constructed for between $3 Million and $5 Million

3 points - The project would cost less than $3 Million to construct

2.5.2 Cost-Effectiveness

The project would score between 0 and 3 points on the basis of the following matrix:

	Benefits		
Costs	**High**	**Moderate**	**Low**
Low	3	3	2
Moderate	3	2	1
High	2	1	0

DEFINITION OF BENEFITS:

High If the project demonstrates a high level of performance as evaluated in Phase 2 and would create a high level of benefit for at least a moderate number of persons.

Low If the project will create only a small benefit (regardless of how many people will be affected); or if the project will affect only a few persons (regardless of how great the improvement).

DEFINITION OF COSTS:
A measure of the capital costs of this particular project relative to the same costs for other projects of this type. A high cost is more than $5 Million, a moderate cost is $3M to $5M, and a low cost is less than $3M.

2.5.3 Regional Significance

The following scoring guidelines were used:

3 Points - The crossroad at the interchange is on the State Highway System.

2 Points - The crossroad is a local street, but provides for longer, regional continuity in the system.

1 Point - The crossroad is a local street providing access to only a limited area.

Overall Implementation ratings are included in **Table 2.7**.

Table 2.7 Ratings for Implementation Criteria

Exit	Location	Construction Cost	Cost / Effectiveness	Regional Significance	Total Points
I-90					
Exit 17	Lead/Deadwood	2	2	3	**7**
Exit 55	Deadwood Avenue	3	3	2	**8**
Exit 59	LaCrosse Street	1	1	2	**4**
Exit 63	Box Elder/Ellsworth AFB Commercial	0	1	3	**4**
Exit 332	Mitchell/Parkston	3	3	3	**9**
Exit 406	Brandon/Corson	1	2	3	**6**
I-29					
Exit 2	North Sioux City	3	3	2	**8**
Exit 71	Harrisburg/Tea	2	2	2	**6**
Exit 77	41st Street	2	2	2	**6**
I- 229					
Exit 5	26th Street	1	1	2	**4**

2.6 *Summary of All Criteria for Existing Interchanges*

The overall ratings based on the combined criteria of Need, Performance, and Implementation are reflected in **Table 2.8.** The maximum total points that any location could receive based on the best rating in each category would be 100 points.

Results of this prioritization approach yielded some interesting results. As shown in Table 2.8, there is a clear distinction of the top interchange project and of the bottom interchange project. The construction of a diverging diamond interchange at Exit 77 on I-29 emerged as the top priority, with a total score of 70.5 out of 100 possible points. Reconstruction of the interchange at Exit 63 on I-90 clearly emerged as the bottom priority out of these 10 interchange locations, with a score of only 38.1.

The remaining eight interchange locations evaluated were fairly tightly grouped, with rankings ranging from 50.9 to 57.6. This tight range of results prompted a closer look at what considerations should carry more weight in making decisions with regard to prioritizing improvements. Based upon all of the factors considered in this evaluation methodology, the decision to construct the improvements at an interchange are primarily driven by the needs, which include such factors as geometric deficiencies, safety and traffic operations.

A closer evaluation of the point totals associated with the need criterion, indicates that there are some natural groupings within these eight interchange locations that occur. Beginning with the lowest range, two interchanges with needs rankings of 6.6 and 7.9 are clearly below the others (this is in addition to the lowest ranked interchange at Exit 63, discussed above). Next, there are four interchanges that are grouped between 12.0 and 16.3. Finally, there are two interchanges that are grouped higher, with values of 19.4 and 20.7.

Table 2.8 Ranking of Most Feasible Projects at Existing Interchanges

Criterion	I-90 Exit 17 Alternative 1- New Turn Lanes and Signals	I-90 Exit 55 Alternative 3- Int. Impvmts. & Closed Access	I-90 Exit 59 Alternative 3- Diverging Diamond Interchange	I-90 Exit 63 Alternative 1- Diamond Interchange	I-90 Exit 332 Alternative 1- Signal Timing Enhancmnts.	I-90 Exit 406 Alternative 1- Crossroad and Bridge Improvements	I-29 Exit 2 Alternative 1- Signalization & Access Improvements	I-29 Exit 71 Alternative 1- Signalization and Access Improvements	I-29 Exit 77 Alternative 2- Diverging Diamond Interchange	I-229 Exit 5 Alternative 1- Crossroad and Ramp Improvements
NEED (49 points)										
Geometrics (15)	2	2	4	0	0	2	3	5	5	3
Safety (Wt. Rate x 2.37 = 13)	4.0	4.3	7.7	4.1	6.6	3.1	2.4	0.9	11.5	7.4
Traffic Operations (18)	6	10	6	0	0	5	4	2	16	9
Structures Condition (3)	0	0	3	0	0	3	3	0	0	0
Need Totals	12.0	16.3	20.7	4.1	6.6	13.1	12.4	7.9	32.5	19.4
PERFORMANCE (42 points)										
Minimizes Property Impacts	9	7	7	6	9	9	7	9	9	9
Avoids Impacts to Environment	9	6	6	6	9	5	7	8	5	5
Improves Traffic Flow	7	6	6	6	7	7	6	8	5	8
Improves Geometric Design	2	3	2	3	2	1	2	2	2	2
Improves Safety	4	4	5	4	6	5	6	6	6	6
Constructability	7	7	5	5	9	6	8	4	5	4
Performance Totals	38	33	31	30	42	33	36	37	32	34
IMPLEMENTATION (9 points)										
Construction Cost	2	3	1	0	3	1	3	2	2	1
Cost Effectiveness	2	3	1	1	3	2	3	2	2	1
Regional Significance	3	2	2	3	3	3	2	2	2	2
Implementation Totals	7	8	4	4	9	6	8	6	6	4
TOTAL (100 points)	57.0	57.3	55.7	38.1	57.6	52.1	56.4	50.9	70.5	57.4
Priority Ranking	**5**	**4**	**7**	**10**	**2**	**8**	**6**	**9**	**1**	**3**

Near Term Improvements
Mid Range Improvements
Long Range Improvements

2.7 *Existing Interchange Recommendations*

Based upon the prioritization of the ten existing interchanges included in the Phase 2 analysis, the recommended implementation of improvements have been separated into three categories; Near Term, Mid-Range and Long Range projects. Reconstruction of the interchange at Exit 77 on I-29 emerged as the lone Near Term project, and reconstructing the Exit 63 interchange on I-90 is the lone Long Range project. The remaining eight interchanges, grouped in the Mid-Range category, have been further refined based upon their rankings within the Needs criteria. The rankings and categorization for each recommended improvement are shown in **Table 2.9**, along with probable construction costs. Chapter 4 describes the improvements.

Table 2.9 Implementation Recommendations

Interchange	Overall Ranking	Needs Ranking	Recommended Improvement	Probable Construction Cost
Near-Term Improvements				
I-29 Exit 77 41st Street Sioux Falls	70.5	32.5	Diverging Diamond Interchange	$3.08 Million
Mid-Range Improvements				
I-90 Exit 59 LaCrosse Street Rapid City	55.7	20.7	Diverging Diamond Interchange	$6.11 Million
I-229 Exit 5 Sioux Falls 26th Street	57.4	19.4	Crossroad and Ramp Improvements	$7.53 Million
I-90 Exit 55 Deadwood Avenue Rapid City	57.3	16.3	Interchange Improvements and Closed Access	$2.83 Million
I-90 Exit 406 SD11 Brandon/Corson	53.1	13.1	Crossroad and Bridge Improvements	$5.78 Million
I-29 Exit 2 River Drive North Sioux City	56.4	12.4	Signalization and Access Improvements	$0.86 Million
I-90 Exit 17 US 85 Spearfish/Lead/Deadwood	57.0	12.0	New Turn Lanes and Signals	$4.40 Million
I-29 Exit 71 County Hwy 110 Tea/Harrisburg	50.9	7.9	Widen Crossroad and Bridge to 3-lanes w/ Shoulders	$3.44 Million
I-90 Exit 332 SD 37/SD 90L Mitchell/Parkston	57.6	6.6	Signal Timing Enhancements	n/a
Long Range Improvements				
I-90 Exit 63 Ellsworth Base Comm. Box Elder	38.1	4.1	Diamond Interchange	$11.13 Million

3.0 PROJECT PRIORITIZATION – NEW INTERCHANGES

There were three potential new interchanges where the most feasible alternative from Phase 2 included a build option:

- I-29 Exit 130 – 20th Street, Brookings - Folded Diamond Interchange
- I-29 Exit 175 – South Connector, Watertown - Diamond Interchange
- I-90 Exit 393 – Ellis Road, Sioux Falls - Folded Diamond Interchange

The Federal Highway Administration (FHWA) has retained approval rights for the control of access to the interstate system. Approval by FHWA is required when access on the interstate system is added or modified. To obtain approval, a request for access must be submitted to FHWA through the South Dakota Department of Transportation in conformance with the eight FHWA Interstate Access Request policy points paraphrased below:

POLICY #1
The existing interchanges and/ or local roads and streets in the corridor can neither provide the necessary access nor be improved to satisfactorily accommodate the design-year traffic demands.

POLICY #2
All reasonable alternatives for the design options, locations and transportation system management type improvements (such as ramp metering, mass transit, and HOV facilities) have been assessed.

POLICY #3
The proposed access point does not have a significant adverse impact on the safety and operation of the Interstate facility based on an analysis of current and future traffic.

POLICY #4
The proposed access connects to a public road only and will provide for all traffic movements.

POLICY #5
The proposal considers and is consistent with local and regional land use plans.

POLICY #6
In areas where the potential exists for future multiple interchange additions, all requests for new or revised access are supported by a comprehensive Interstate network study.

POLICY #7
The request for a new or revised access generated by new or expanded development demonstrates appropriate coordination between the development and related or otherwise required transportation system improvements.

POLICY #8
The request for new or revised access contains information relative to the planning requirements and the status of the environmental processing of the proposal.

The performance of each of the feasible new Interchanges was evaluated within each category according to these measures and assigned a rating of 1, 2 or 3 points. A total rating was developed for each interchange as the sum of all of the individual ratings, with a maximum score possible of 24. The ratings were compiled to provide a tool for determining if any of the locations would have a higher priority than the others. The two new interchanges where the No Build Alternative was determined to be the Most Feasible were not evaluated. **Tables 3.1** and **3.2** outline the basis for ratings and the ratings.

Table 3.1 Alternative Evaluation Factors New Interchanges

Evaluation Factors	Category	Points Awarded		
		(3)	(2)	(1)
Policy 1 Existing Access Inadequate	Alternate Interchanges Overloaded	LOS F	LOS E	LOS D
Policy 2 Alternatives Assessed	Reasonable Alternatives Assessed Including Design & TSM	None Available	Environmental	Costly
Policy 3 Impacts to Interstate	Impacts to Mainline Capacity and Operations	No Impacts	Minimal Impacts	Moderate Impacts
Policy 4 Full Movement Access	Interstate Access	All directions from Public Road	Some Limited Movements	Access One Direction
Policy 5 Consistent With Local Plans	Conformity to Local & Regional Transportation Plans.	In Conformance with Current Plans	Some Modifications Required to Conform	Not in Current Plans
Policy 6 Conforms to Interstate Plan	Spacing with Existing & Future Interchanges	>3 Miles	2-3 Miles	1-2 Miles
Policy 7 Adjacent Development	Right-of-way and Access Issues	Minimal Impacts	Moderate Right-of-Way Required and / or Access	Little or no phasing, time-consuming and impacts traffic
Policy 8 Environment	Environmental Study Status	Nearing Completion	Underway	Scoping Only

Table 3.2 Evaluation of New Interchanges

Evaluation Factors	Category	Points Awarded		
		I-29 Exit 130	I-29 Exit 175	I-90 Exit 393
Policy 1 Existing Access Inadequate	Alternate Interchanges Overloaded	3	2	1
Policy 2 Alternatives Assessed	Reasonable Alternatives Assessed Including Design & TSM	2	2	2
Policy 3 Impacts to Interstate	Impacts to Mainline Capacity and Operations	3	2	3
Policy 4 Full Movement Access	Interstate Access	3	3	3
Policy 5 Consistent With Local Plans	Conformity to Local & Regional Transportation Plans.	3	3	2
Policy 6 Conforms to Interstate Plan	Spacing with Existing & Future Interchanges	2	1	2
Policy 7 Adjacent Development	Right-of-way and Access Issues	1	3	1
Policy 8 Environment	Environmental Study Status	0	1	1
Total Points		**17**	**17**	**15**

Based upon this methodology, each of the three interchanges are tightly grouped, with the proposed interchanges at Exit 130 and Exit 175, both on I-29, having the highest score of 17 out of 24 possible points. Exit 393 on I-90 was ranked only slightly behind, with a score of 15. One element that was excluded from the prioritization process is local development pressure and political interest in a new interchange. With the technical rankings of these three locations so tightly grouped, it is likely that these external factors will play a large part in which location moves forward. Descriptions of each of the proposed interchanges are provided in Chapter 5.

4.0 SUMMARY OF PROJECTS

4.1 *I-29 Exit 77 – Sioux Falls 41st Street*

4.1.1 Review of Findings

The analysis of this interchange identified a combination of operational and safety issues. As a result, several safety improvements were identified to reduce the number of crashes at the interchange. Geometric deficiencies related to the ramp taper rate and intersection spacing were also identified, which should be addressed in the proposed interchange concept.

The interchange currently operates at LOS E in the AM peak period and LOS F in the PM peak at both ramp terminals. It was determined that both the northbound and southbound ramp terminal intersections are expected to operate at LOS F in both the AM and PM peak periods by 2030. Limited ROW at the interchange prevents the addition of loop ramps to eliminate left-turn movements.

The full access intersection of 41st Street with Carolyn Avenue is located approximately 200 feet east of the northbound ramp terminals. The close proximity of these two intersections raises traffic operational and safety concerns, particularly for westbound 41st Street traffic to northbound I-29. This intersection is proposed to be modified to provide right-in/right-out access only.

4.1.2 *Most Feasible Interchange Concept*

Alternative 2 – Diverging Diamond Interchange

The diverging diamond concept was ranked as the preferred configuration. This concept provides acceptable traffic operations in the design year, and can be constructed with minimal right-of-way impacts and for considerably less cost than the SPUI configuration. With conversion of the interchange to a diverging diamond, both ramp terminal intersections would be expected to operate at LOS D or better in both the AM peak period and LOS C or better in the PM peak period. The intersections with Terry Avenue and the Mall Entrance would both be expected to operate at LOS D or better in both the AM and PM peak periods. At Carolyn Avenue, the intersection would be converted to right in-right out access, controlled by a median. It would be expected to operate at LOS B or better in both the AM and PM peak periods.

With the diverging diamond concept, pedestrians would need to cross multiple lanes of traffic at each ramp, requiring pedestrian signals. There are different options available to accommodate pedestrians through the interchange. Sidewalks can be provided in the center median between the crossovers, or along the side of the road. This decision can be made during preliminary design of the interchange, as there are advantages and disadvantages of each. The concept drawing of this improvement option is shown in **Figure 4.1**.

Construction costs for this concept are estimated at $3,080,000. This concept would retain the existing bridge and modifications would be made to the crossroad and ramps.

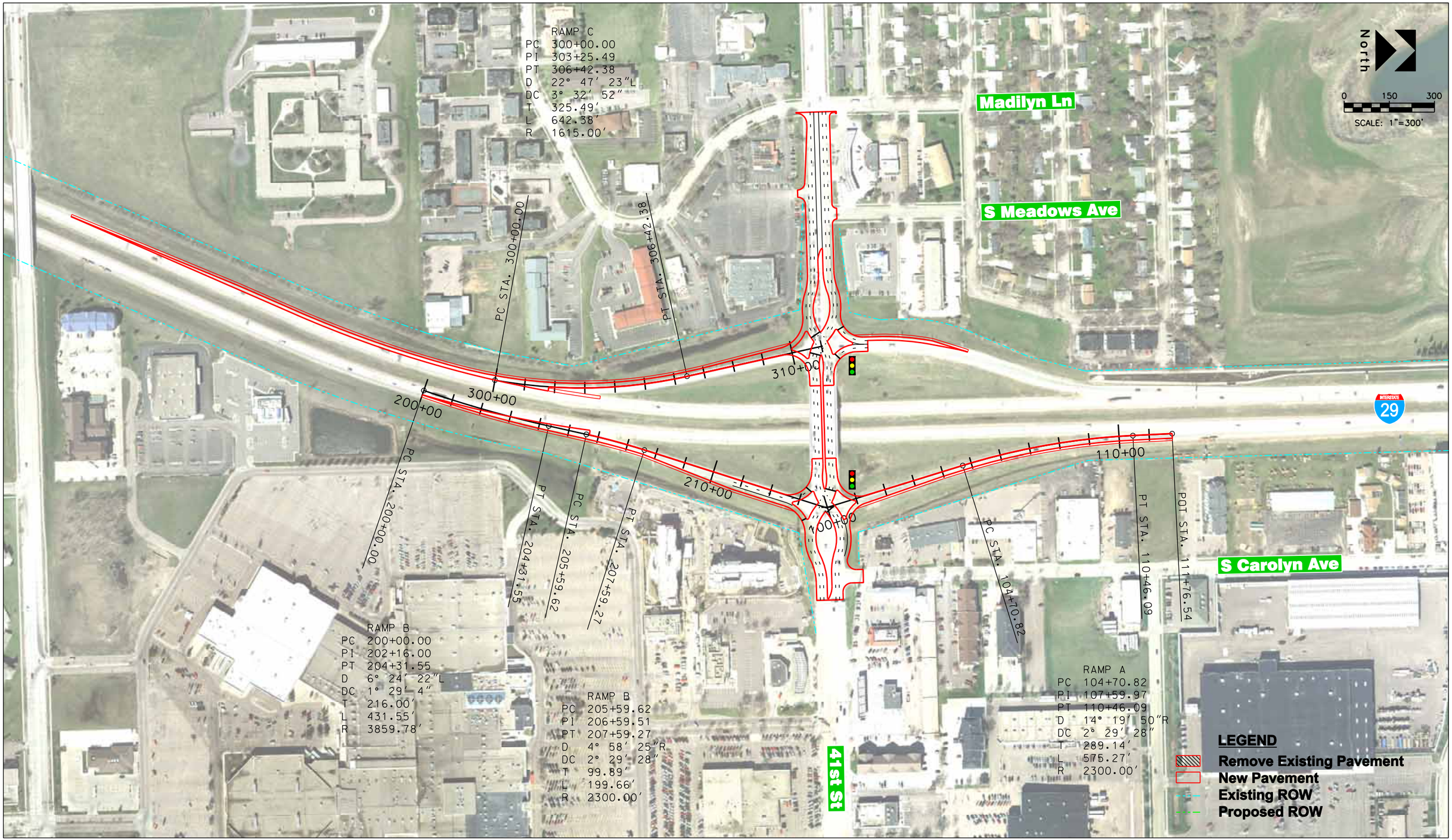


Figure 4.1
I-29 Exit 77 - 41st Street
Alternative 2
Diverging Diamond interchange

FELSBURG HOLT & ULLEVIG

CONCEPTUAL DESIGN

4.2 *I-90 Exit 59 – LaCrosse Street, Rapid City*

4.2.1 Review of Findings

The LaCrosse Street interchange serves the growing northeast edge of Rapid City. Recent years have seen this interchange become increasingly congested. The signalized ramp terminal intersections currently operate at LOS D and E during the PM peak period.

The interchange also demonstrates elevated crash rates, ranking 5th of the 126 interchanges evaluated based on weighted crash rates. It is likely that the high number of rear-end crashes is related to congestion in the vicinity of the interchange so there may be little that can be done to reduce the occurrence of this crash type. Some crash types can be reduced with changes to the signal phasing (i.e. protected lefts) or changes to the clearance interval length.

The westbound interchange ramps demonstrate mildly substandard vertical curvature. Adjacent accesses to LaCrosse Street lie as close as 150 feet away from the ramp termini, well below the minimum of 300 feet away from ramp termini. Growth is also hastening the need for improvements to this interchange.

Some potential environmental issues identified include:

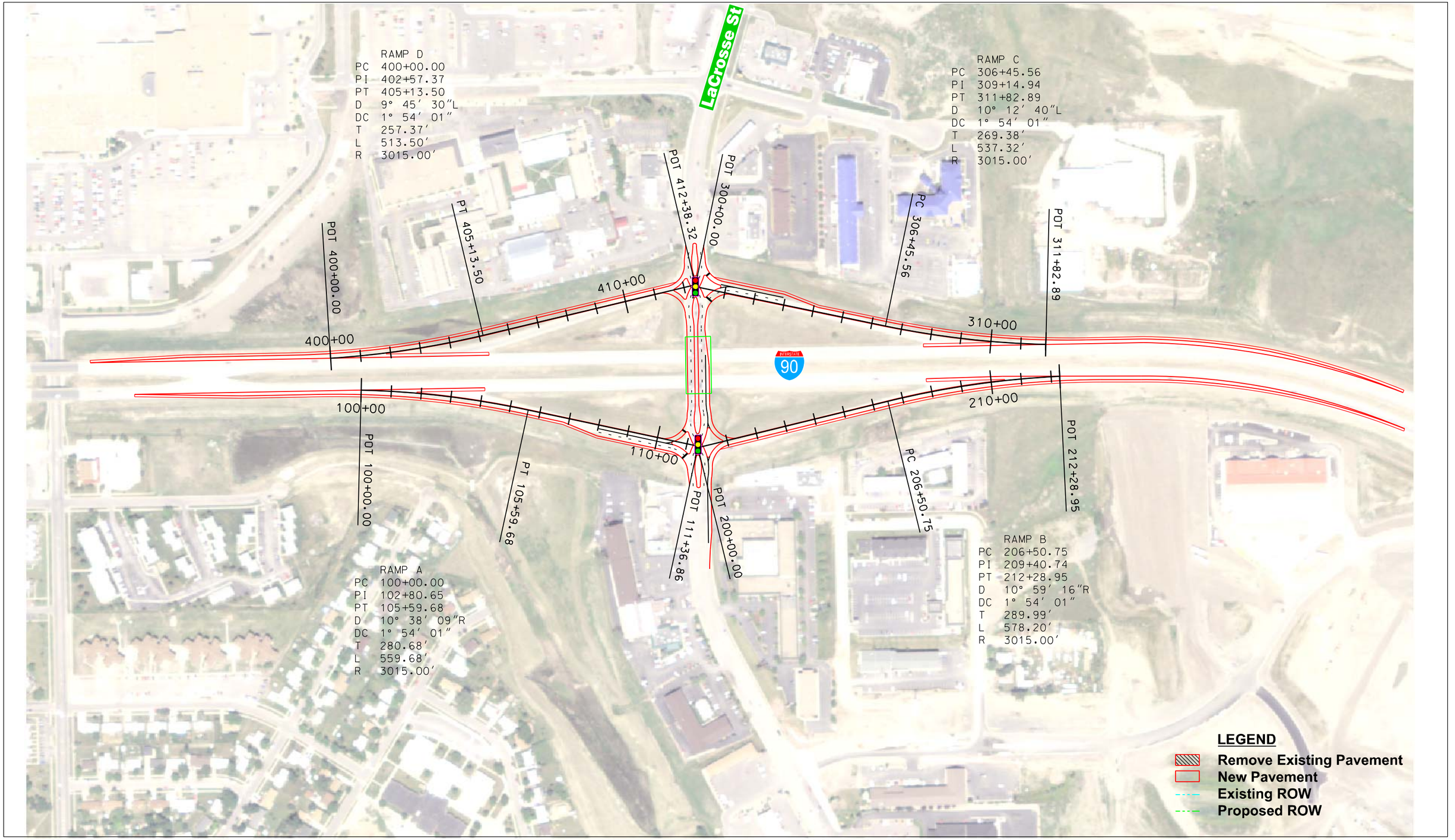
- A gasoline filling station is located adjacent to the proposed improvements in the southwest quadrant of the interchange, which could present some hazardous materials issues.
- Potential wetlands are present in the northwest and southwest quadrants of the interchange.
- What appears to be a light industrial property is located in the northeast quadrant of the interchange. This property has the potential to present some hazardous materials issues.

4.2.2 Most Feasible Interchange Concept

Alternative 3 – Diverging Diamond Interchange

Figure 4.2 depicts Alternative 3, a diverging diamond configuration. Analyses of forecast Year 2030 traffic conditions indicates that the crossover ramp termini would operate at Level of Service C or better. The interchange would require widening of the existing bridge to accommodate the southbound left turn lane approaching the south ramp terminal, and spot widening of LaCrosse Street would be required north and south of the interchange to accommodate the transition to the diverging diamond. However, no significant widening of southbound LaCrosse Street is needed, as no continuous right-turn lane is necessary to achieve acceptable traffic operations.

The estimated probable construction cost of this alternative is approximately $6.11 Million.


LaCrosse St
RAMP D
PC 400+00.00
PI 402+57.37
PT 405+13.50
D 9° 45′ 30″L
DC 1° 54′ 01″
T 257.37′
L 513.50′
R 3015.00′
RAMP C
PC 306+45.56
PI 309+14.94
PT 311+82.89
D 10° 12′ 40″L
DC 1° 54′ 01″
T 269.38′
L 537.32′
R 3015.00′
POT 400+00.00
PT 405+13.50
POT 412+38.32
POT 300+00.00
PC 306+45.56
POT 311+82.89
400+00
410+00
310+00
210+00
100+00
110+00
INTERSTATE
90
POT 100+00.00
PT 105+59.68
POT 111+36.86
POT 200+00.00
PC 206+50.75
POT 212+28.95
RAMP A
PC 100+00.00
PI 102+80.65
PT 105+59.68
D 10° 38′ 09″R
DC 1° 54′ 01″
T 280.68′
L 559.68′
R 3015.00′
RAMP B
PC 206+50.75
PI 209+40.74
PT 212+28.95
D 10° 59′ 16″R
DC 1° 54′ 01″
T 289.99′
L 578.20′
R 3015.00′
LEGEND
Remove Existing Pavement
New Pavement
Existing ROW
Proposed ROW

4.3 *I-229 Exit 5 – 26th Street, Sioux Falls*

4.3.1 Review of Findings

A number of safety improvements were identified to reduce the number of crashes at this interchange. Geometric deficiencies related to the ramp taper rate, loop ramp curve radii, k-value calculations and stopping sight distance were also identified, which would be addressed in the proposed interchange concept.

The northbound ramp terminal intersection currently operates at LOS E in the AM peak period and the southbound ramp terminal intersection operates at LOS E in the PM peak period. It was determined that both the northbound and southbound ramp terminal intersections are expected to operate at LOS F in both the AM and PM peak periods by 2030.

A suggestion was also made that a more detailed I-229 corridor study should be conducted in conjunction with the City and MPO to determine the scope of improvements to the arterial street network.

Land use in the general area of the interchange consists primarily of residential properties. However, there is one commercial property, Cliff Avenue Greenhouse and Garden Center, which is located on adjoining property south of the interchange which may present hazardous material issues.

4.3.2 Most Feasible Interchange Concept

Alternative 1 – Crossroad and Ramp Improvements

The City of Sioux Falls has previously investigated reconstruction of the southbound ramps in a folded diamond configuration. In this concept, the existing hook ramps and connection to Yeager Road would be removed to accommodate the new ramps. With conversion of the interchange to a folded diamond, both ramp terminal intersections would be expected to operate at LOS C or better in both the AM and PM peak periods in 2030. The concept drawing of this improvement option is shown in **Figure 4.3**.

The elimination of the segment of Yeager Road, between 26th Street and 33rd Street would result in modifications to travel patterns in the area. Additional traffic is anticipated to travel through the intersection of 26th Street and Cliff Avenue as a result of the elimination of Yeager Road. Also, the proposed closure of Yeager Road would impact access to the neighborhood.

Construction costs for this concept are estimated at $7,530,000 not including Right-of-Way acquisitions. Inclusion of Right-of-Way would considerably increase project costs. The relatively high cost of this concept is due to the need to remove and replace the bridge over the Interstate, reconstruct 26th Street through both ramp terminal intersections, and reconstruct the southbound ramps to meet current design standards.

FELSBURG HOLT & ULLEVIG

CONCEPTUAL DESIGN

Figure 4.3
I-229 Exit 5 - 26th Street
Alternative 1
Crossroad and Ramp Improvements

4.4 *I-90 Exit 55 – Deadwood Avenue, Rapid City*

4.4.1 Review of Findings

The Deadwood Avenue interchange serves the west edge of Rapid City, and traffic operations at the ramp terminal intersections are shown to deteriorate to LOS E/F by the year 2030. The south ramp terminal, currently unsignalized with a temporary signal during peak motorcycle rally season, would need to be signalized and widened to provide acceptable operations. Deadwood Avenue across I-90 would need to be widened to 4 lanes, necessitating a significant bridge widening project to provide acceptable future traffic operations.

In addition to anticipated future traffic congestion at the Exit 55 ramp terminal intersections, there is a full movement truck stop access located approximately 330 feet south of the interchange. This distance meets minimum spacing criteria but does not meet the desired spacing distance of 660 feet. SDDOT staff has noted operational problems created by this close spacing. Trucks currently use the access to exit the fuel pump area and reach the interchange quickly. Passenger cars also make use of the access to reach the car fuel pump area and the restaurant, which is located within the north portion of the site. Movements at the adjacent south truck stop access should be limited to improve traffic safety and operations.

Potential environmental issues included:

- Potential wetlands could be present in the northwest, southwest, and southeast quadrants of the interchange.
- The truck stop and gasoline filling station located adjacent to the proposed improvements in the southwest quadrant of the interchange, has the potential to present hazardous materials issues. Hazardous materials issues could also be present due to the number of light industrial facilities surrounding the interchange.

Alternative 3 – Interchange Improvements, Closed Access

Alternative 3 is the Most Feasible Alternative because of its ability to provide standard access spacing along Deadwood Avenue by closing the existing Truck Stop / Restaurant access. **Figure 4.4** depicts Alternative 3, which would fully close the truck stop/restaurant access. This action would further reduce congestion and potential crashes along Deadwood Avenue by eliminating vehicular conflicts at the access intersection and channeling all traffic to the Universal Drive connection to Deadwood Avenue.

The probable construction cost of this alternative is approximately $2.83 Million, excluding Right-of-Way. Inclusion of Right-of-Way acquisitions would considerably increase cost.

FELSBURG HOLT & ULLEVIG

CONCEPTUAL DESIGN

Figure 4.4
I-90 Exit 55 - Deadwood Avenue, Rapid City
Alternative 3
Interchange Improvements - Closed Access

4.5 *I-90 Exit 406 – SD 11, Brandon/Corson*

4.5.1 Review of Findings

In the assessment phase the study, it was determined that both of the ramp terminal intersections are expected to operate at LOS F in both the AM and PM peak periods by 2030. The SDDOT requested detailed analysis of this interchange due to inquiries/complaints regarding the two lane bridge with a connection to the four lane roadway to the south.

The existing two lane bridge has a number of design deficiencies that support improvements, including inadequate shoulder width, clear zone, ramp grades, and ramp taper rate. A new bridge design that accommodates a three lane roadway cross section was developed to address these deficiencies.

Land use in the general area of the interchange consists primarily of commercial and agricultural land. What appears to be an ethanol plant is located northwest of the interchange and a filling station is located south of the interchange, both of which may present hazardous materials issues. Split Rock Creek is located to the east of the interchange and transects the Interstate at Bridge Number 406.99. Wetlands may be of concern in this area, as well as floodplain issues.

4.5.2 Most Feasible Interchange Concept

Alternative 1 – Traffic Signalization and Reconstruct Interchange with 3-Lane Bridge

In order to provide adequate traffic operations, the interchange should be reconstructed to provide a three lane cross section on SD Highway 11 with left-turn lanes at the ramp terminal intersections. The addition of a southbound right-turn lane at the westbound ramp terminal is also recommended. Traffic signals should be provided at both ramp terminals. With these improvements, all critical movements at both the ramp terminal intersections would be expected to operate at LOS B or better in the AM and PM peak periods in 2030. The concept drawing of this improvement option is shown in **Figure 4.5**.

Construction costs for this concept are estimated at $4,150,000, not including Right-of-Way acquisitions. Inclusion of Right-of-Way will considerably increase project costs.

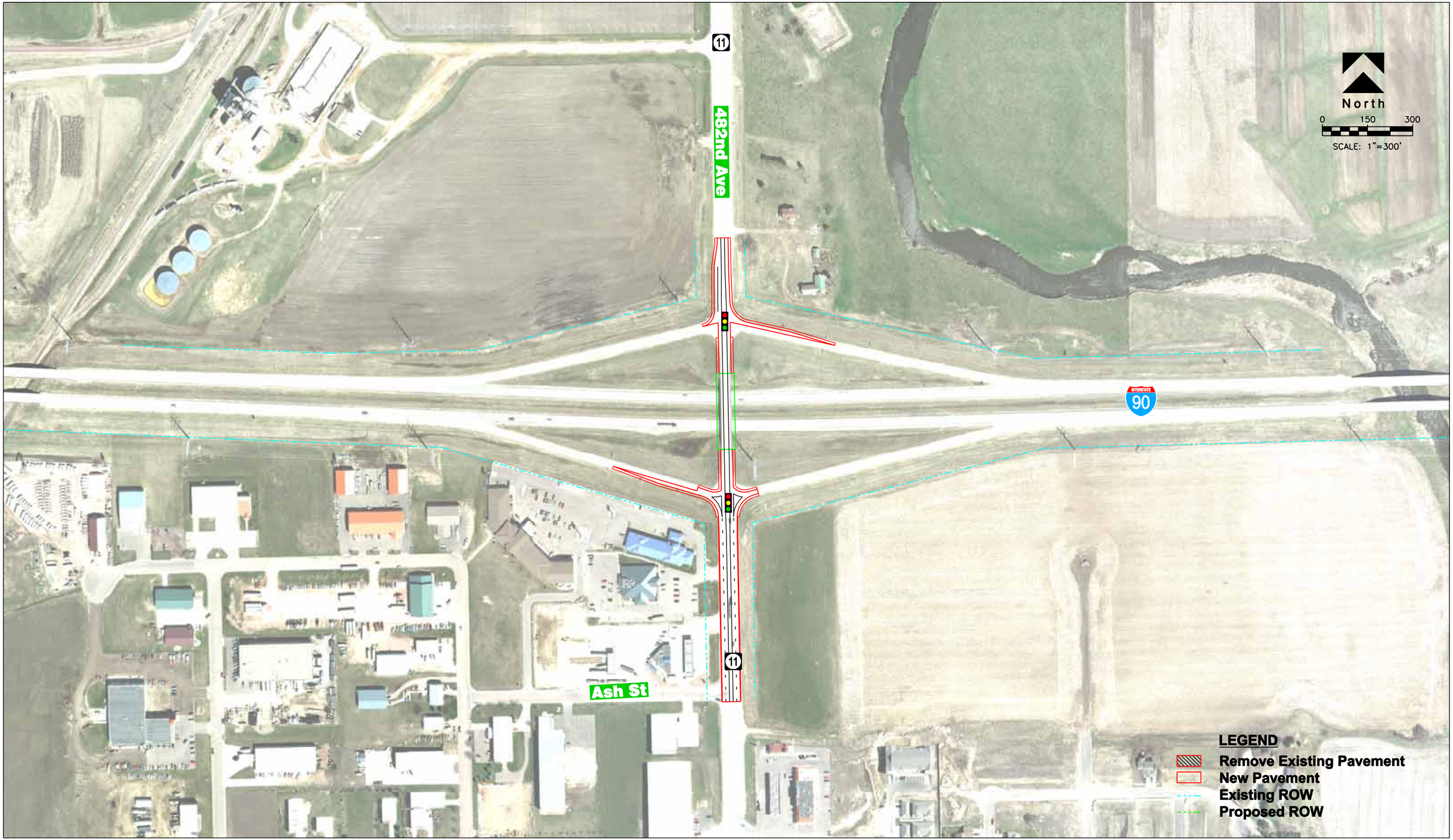


Figure 4.5
I-90 Exit 406 - Brandon
Alternative 1
Crossroad and Bridge Improvements

FELSBURG HOLT & ULLEVIG

CONCEPTUAL DESIGN

4.6 *I-29 Exit 2 – North Sioux City*

4.6.1 Review of Findings

In the initial assessment phase of the study, it was determined that the southbound ramp terminal intersection is expected to operate at LOS F in both the AM and PM peak periods by 2030.

The full access intersection of River Drive with Streeter Drive / Sioux Point Road is located approximately 250 feet west of the southbound ramp terminals. In the most feasible concept, this intersection is proposed to be closed, and connections to the development west of the interchange are provided off of Sadroc Drive.

A review of the potential impacts to pedestrian travel was also a consideration. Pedestrians are currently accommodated with a sidewalk along the north side of River Drive through the interchange area.

4.6.2 Most Feasible Interchange Concept

Alternative 1 – Signalization and Access Improvements

With traffic signalization and the addition of a southbound right turn lane at the southbound ramp terminal, both intersections would be expected to operate at LOS C or better in the AM and PM peak periods. Pedestrians at the southbound ramp terminal intersection would be required to cross an additional lane with the proposed improvements. The traffic signal should include pedestrian signals, similar to those provided at the northbound ramp terminal intersection. The concept drawing of this improvement option is shown in **Figure 4.6**.

Construction costs for this concept are estimated at $860,000. It should be noted that this estimate includes the construction costs associated with the new connections between Streeter Drive and Sadroc Drive.

Figure 4.6
I-29 Exit 2 - North Sioux City
Alternative 1
Signalization and Access Improvements

FELSBURG HOLT & ULLEVIG

CONCEPTUAL DESIGN

4.7 *I-90 Exit 17 – US Highway 85 to Lead-Deadwood*

4.7.1 Review of Findings

In the assessment portion of the study, the stop controlled approaches at both ramp terminals were projected to operate at LOS F by 2030 due to the expected increases in traffic related to the Elkhorn Ridge Development. Also, in addition to the Elkhorn Ridge Development, which includes several different kinds of retail, office and residential uses, the Regional Hospital System has acquired land to the south of the interchange for a new hospital. Two improvement options were proposed which include the following:

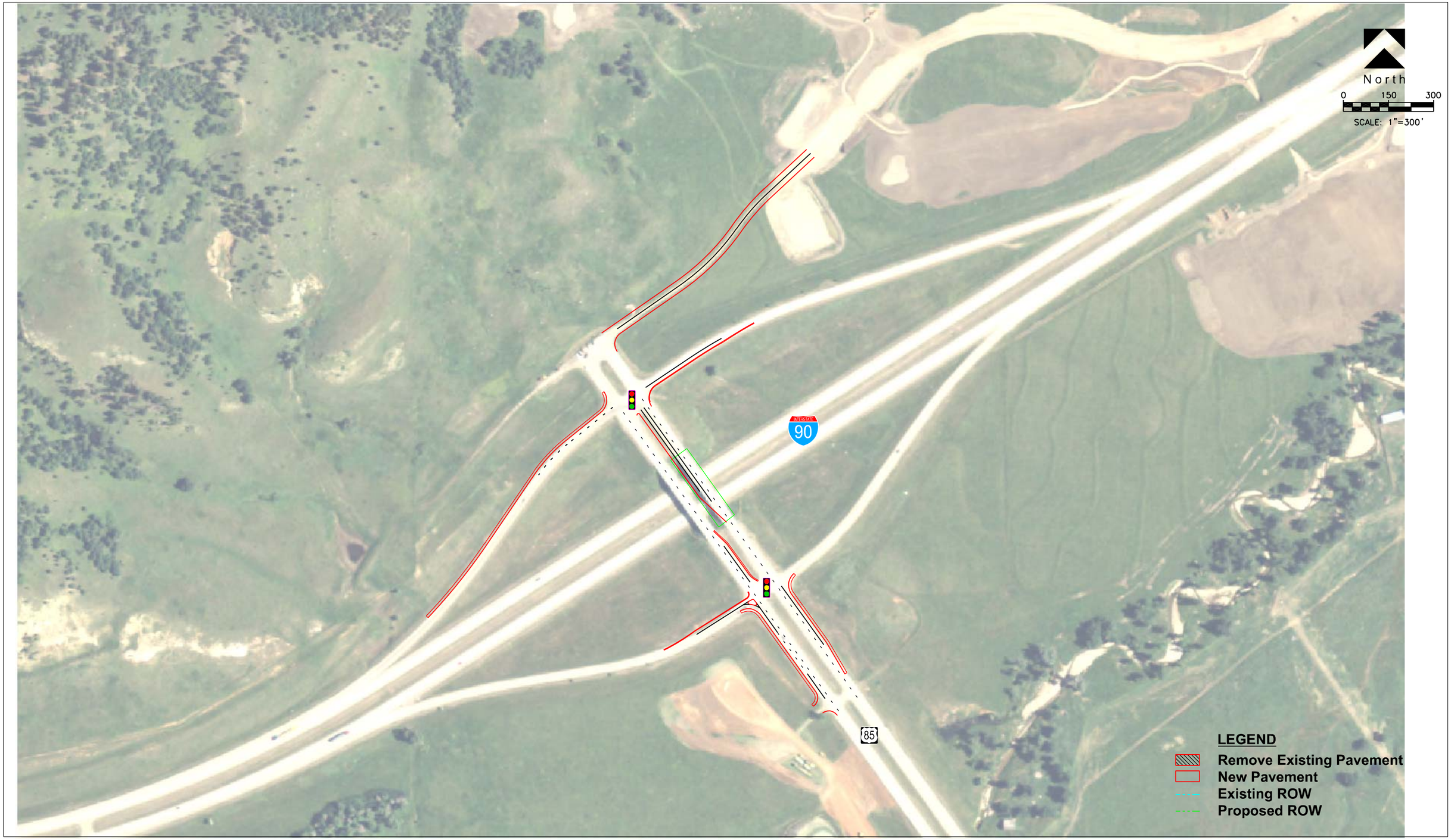
- Signalization and auxiliary lane improvements at both ramp terminals (may involve widening of existing bridges)
- Convert interchange to a Single Point Urban Interchange (SPUI)

4.7.2 Most Feasible Interchange Concept

Alternative 1 – New Turn Lanes and Signals

Alternative 1 includes signalization as well as auxiliary lane improvements at both ramp terminals. The auxiliary lane improvements at the westbound I-90 ramp terminal include a new westbound left turn lane and northbound dual left turn lanes. These new lanes may result in the need for the existing bridge over I-90 to be widened. At the eastbound I-90 ramp terminal the auxiliary lane improvements include new eastbound and southbound left turn lanes as well as a new northbound right turn lane. The proposed interchange conceptual improvements can be seen on **Figure 4.7**.

These new traffic signals and auxiliary lanes are estimated to cost approximately $4.4 million. With these improvements in place the ramp terminals are expected to operate at LOS B or better through 2030.



FELSBURG HOLT & ULLEVIG

CONCEPTUAL DESIGN

Figure 4.7
I-90 Exit 17 - Lead/Deadwood
Alternative 1
New Turn Lanes & Signals

4.8 *I-29 Exit 71 – County Hwy 110, Tea/Harrisburg*

4.8.1 Review of Findings

In the assessment phase of the study, it was determined that both of the ramp terminal intersections are expected to operate at LOS D in both the AM and PM peak periods by 2030. Minor improvements to the southbound ramp acceleration and deceleration lanes were also recommended. It was also determined that the interchange would be a candidate for sight distance improvements based upon field observations, k-value calculations, and stopping sight distance calculations.

The SDDOT requested detailed analysis of this interchange due to inquiries by developers and concerns that future development was not taken into account in the traffic forecasts. SDDOT has also received some complaints of inadequate sight distance at the ramp terminal intersections. Calculations and field observations indicated that sight distance is not adequate at the interchange.

A review of the sight distance calculations indicated that the k-value and stopping sight distance on County Highway 110 were inadequate. Field observations indicated that the intersection sight distance at the ramp terminals is limited by the guardrails on the bridge. A new bridge design that accommodates a three lane roadway cross section was developed to address these deficiencies.

4.8.2 Most Feasible Interchange Concept

Alternative 1 – Widen Crossroad and Bridge to 3-Lanes w/ Shoulders

In order to provide adequate sight distance at the interchange ramp terminal intersections, the interchange should be reconstructed to provide a three lane cross section on County Highway 110. The addition of a southbound right turn lane at the southbound ramp terminal is also recommended. With these improvements and maintaining stop sign control, all critical movements at both the ramp terminal intersections would be expected to operate at LOS C or better in the AM and PM peak periods for the Year 2030. The concept drawing of this improvement option is shown in **Figure 4.8.**

Construction costs for this concept are estimated at $3,440,000, not including Right-of-Way acquisition cost.

Figure 4.8
I-29 Exit 71 - Harrisburg/Tea
Alternative 1
Widen Cross Road and Bridge to 3-Lanes w/ Shoulders

FELSBURG HOLT & ULLEVIG

CONCEPTUAL DESIGN

4.9 *I-90 Exit 332 – SD 37/SD 90L, Mitchell Parkston*

4.9.1 Review of Findings

In the assessment portion of the study, it was determined that the southbound ramp terminal intersection is expected to operate at LOS A in both the AM and PM peak periods by 2030. No geometric improvements were recommended, although signal timing changes were mentioned to correct observed crash patterns.

A more detailed analysis of traffic operations was conducted in Phase 2 of the study since there are some perceived congestion problems at the interchange. With 2030 traffic volumes, the interchange ramp terminals would be expected to operate at LOS A in both the AM and PM peak periods. An iterative process of traffic projections and analyses was conducted to determine when each ramp terminal intersection reached the LOS E threshold. A multiplier was applied to 2009 traffic volumes at each intersection, and operational analyses were performed to determine the LOS results. It was determined that a multiplier of 5.1 in the AM peak period would be required before the interchange would be expected to operate at LOS E. In the PM peak period, the multiplier was 3.6. In other words, 3.6 times as many vehicles would need to travel through the interchange in the PM peak period before traffic operations would reach unacceptable levels. This growth is the equivalent to an annual growth rate in traffic volumes of 6.3% for the next 21 years. This exercise indicates that there is considerable excess capacity available through the interchange for the foreseeable future.

A truck stop and filling station, which may present hazardous materials issues, is located in the northwest quadrant and the Mitchell Visitor's Center and campgrounds are located in the northeast quadrant of the interchange. A hotel is located in the southeast quadrant and a Cabela's Outfitter retail store is located in the southwest quadrant. Railroad tracks transect the Interstate at the eastern end of the interchange which may present hazardous materials issues. A drainage way parallels the northeastern quadrant of the interchange and drains easterly into a nearby creek which eventually flows into the James River.

4.9.2 Most Feasible Interchange Concept

Alternative 1 – Traffic Signal Timing

Traffic operational analyses were performed with the assumption that the traffic signals at the interchange were timed and coordinated properly for optimum performance. Traffic congestion and safety problems observed at the interchange may be the result of improper timing and/or traffic signal equipment malfunctions. It is recommended that the traffic signal timing and coordination at the interchange be reviewed and field adjusted. Each traffic signal should also be inspected to ensure that all detectors and controllers are operating properly.

4.10 *I-90 Exit 63 – Old Highway 14/16, Box Elder*

4.10.1 Review of Findings

In the assessment phase of this study, the stop controlled approaches at both ramp termini are expected to operate at LOS C or better through 2030. However, since this interchange is currently only a partial diamond, there is a desire to construct a full diamond interchange at this location. The SDDOT requested that follow up analyses be completed for this interchange to better understand the impact a reconfigured interchange will have to traffic volumes along Highway 14/16.

The analysis of projected traffic volumes for 2030 showed that a large portion of the volumes that currently use this interchange are destined eastbound or westbound on Highway 14/16. Based on this travel pattern, the traffic volumes on Highway 14/16 are expected to remain about the same. This is primarily because Exit 63 is the best and most convenient option for any vehicles desiring to enter westbound I-90 or exit eastbound I-90. The next exit, at Exit 67, would be out of the way for a vehicle either coming from or heading to the west on I-90 that is currently traveling on Old Highway 14/16.

The potential environmental issues identified include:

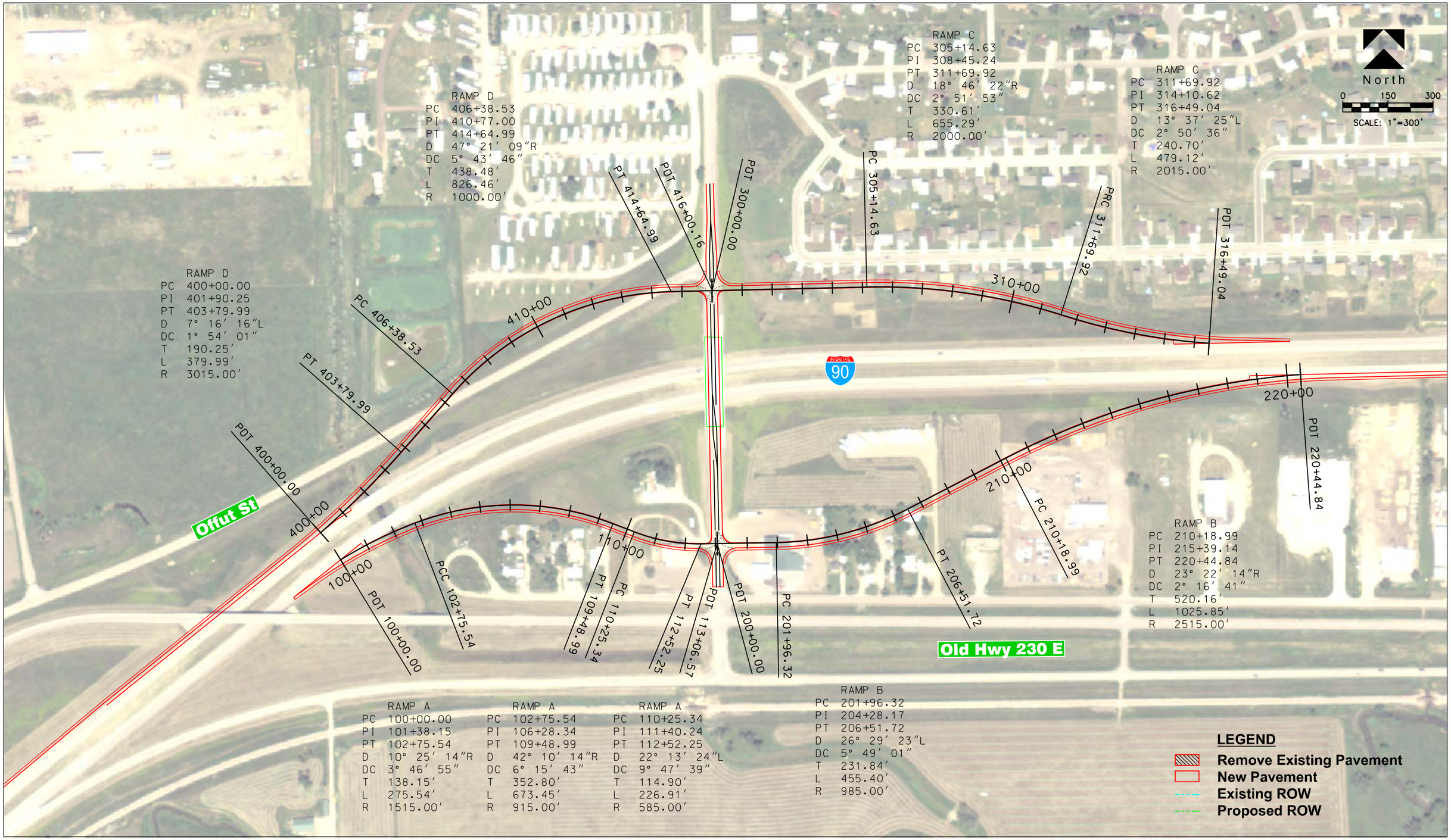
- A drainage ditch crosses I-90 to the east of the interchange. This feature could potentially be historic. Also, potential wetlands could be associated with the ditch.
- There are potential wetlands associated with an un-named tributary to Boxelder Creek. The tributary is located west of the ditch and north of the proposed westbound on-ramp to I-90.
- There are a number of potential residential acquisitions associated with this alternative. The potential residential acquisitions are located along Stealth Lane north of I-90. There are also a number of potential residential acquisitions south of I-90.
- A mobile home park is located off of Boxelder Road West. Although Alternative 1 does not appear to acquire any of the homes within the community, the proximity of the community to the interchange could be an environmental justice issue.
- The age of the structures that would potentially be acquired is unknown; however, some of these structures could potentially be historic.

4.10.2 Most Feasible Interchange Concept

Alternative 1 – Diamond Interchange

This alternative would place both ramp termini on West Gate Road just north of Old Highway 14/16 as well as provide ramps to and from the east on I-90. The stop controlled approaches at the ramp termini would be expected to operate at LOS B or better through 2030. A conceptual layout can be seen on **Figure 4.9**.

This alternative is estimated to cost about $11.1 million to construct not including Right-of-Way. Inclusion of Right-of-Way will considerably increase project costs.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100+00
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D 26° 29′ 23″L
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T 231.84′
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LEGEND
Remove Existing Pavement
New Pavement
Existing ROW
Proposed ROW

5.0 POTENTIAL NEW INTERCHANGES

5.1 *I-29 Exit 130 – 20th Street, Brookings*

5.1.1 Background

An additional interchange at 20th Street has been considered to provide additional Interstate access to the south portion of Brookings. This new interchange would be located 3.0 miles north of SD 324 (Exit 127) and two miles south of US 14 (Exit 132). The purpose of the new interchange would be to relieve traffic on US 14 by providing a more direct connection between the residential development in the southwest portion of Brookings to the commercial and industrial development located on the east side of I-29, and to provide an alternate access from I-29 to the industrial park.

The City and County of Brookings cosponsored a study in 2009 to address the paving of 34th Avenue, from US 14 south to 32nd Street (a distance of approximately 5 miles) and to construct an extension of 20th Street, from 22nd Avenue to 34th Avenue (a distance of 2 miles), including a new interchange with I-29. The purpose of these two projects is to complete the transportation "loop" around the southeastern portion of the community. A projected timeline was established to phase the construction of the improvements.

The assessment phase of the study evaluated the current and future traffic operations at the US 14 (Exit 132) interchange. That evaluation indicated that the off-ramp movements at the existing interchange are currently operating at poor levels of service. The recommended improvements of traffic signalization and the construction of separate right and left turn lanes on both the northbound and southbound off-ramps, would provide acceptable levels of service through the Year 2030. It is anticipated that the construction of a new interchange at the 20th Street alignment would provide further congestion relief to the US 14 interchange.

The City of Brookings, in conjunction with the South Dakota Department of Transportation will be conducting the ***Brookings Area Master Transportation Plan***, which will include the development of traffic forecasts for the entire community. It is anticipated that this transportation plan will provide daily traffic volumes for a future roadway network, which could include the construction of a new interchange at 20th Street as one of the concepts to provide additional Interstate access.

5.1.2 Most Feasible Interchange Concept

Alternative 1 – Folded Diamond Interchange

For the concept developed at this location, the ramp terminal intersections would be reconfigured to provide a folded diamond configuration due to conflicts on the north side of 20th Street. The Edgebrook Golf Course is located in the northwest quadrant of the interchange, and a lake is located in the northeast quadrant. A three-lane section across I-29 is recommended to provide separate left turn lanes from 20th Street onto the interchange ramps. The concept drawing of this improvement option is shown in **Figure 5.1.**

The construction costs for this concept are estimated at $10,190,000, not including Right-of-Way. Project costs will be considerably higher once required Right-of-Way acquisition costs are incorporated into the final cost estimate. The cost of this concept includes a new bridge over the Interstate as well as construction of ramps and ramp terminal intersections.

Land use in the general area of the proposed interchange consists primarily of agricultural and residential properties. The Edgebrook Golf Course is located in the northwest quadrant of the interchange and an operational sand and gravel dredging pit is located in the northeast quadrant of the interchange. A mobile home park is located in the southwest quadrant of the interchange; however it will not be impacted by the proposed interchange alignment. A pond is also located in the southwest quadrant of the interchange. In order to construct the southbound ramps, this pond would have to be reconfigured.

In October 2008, HDR prepared a Technical Memorandum for the Brookings Industrial Park TIA that summarized the environmental resources in the project vicinity and the potential impacts to those resources. It should be noted that the potential impacts discussed in the Technical Memorandum include the improvements to 34th Avenue as well. A brief summary of the findings identified in that Technical Memorandum are as follows:

- **Section 4(f) and 6(f) Resources** – The extension of 20th Street between 22nd Avenue and I-29 runs along the southern border of the Edgebrook Golf Course. The golf course received Land and Water Conservation Funds to develop the original nine holes. The roadway extension should be designed to avoid land acquisition from the golf course, although there may be temporary impacts during construction.
- **Wetlands and Waters of the U.S.** – A desktop analysis was conducted to identify areas that have been previously mapped as National Wetland Inventory (NWI) wetlands. A total of 0.93 acres of potential jurisdictional wetlands were identified along the 20th Street alignment that may be impacted by the proposed improvements.
- **Archeological and Historic Resources** – The wood building located in the northeast quadrant of I-29 and 20th Street has been documented by previous cultural surveys, but further analysis is needed to determine if it is eligible for the NRHP.

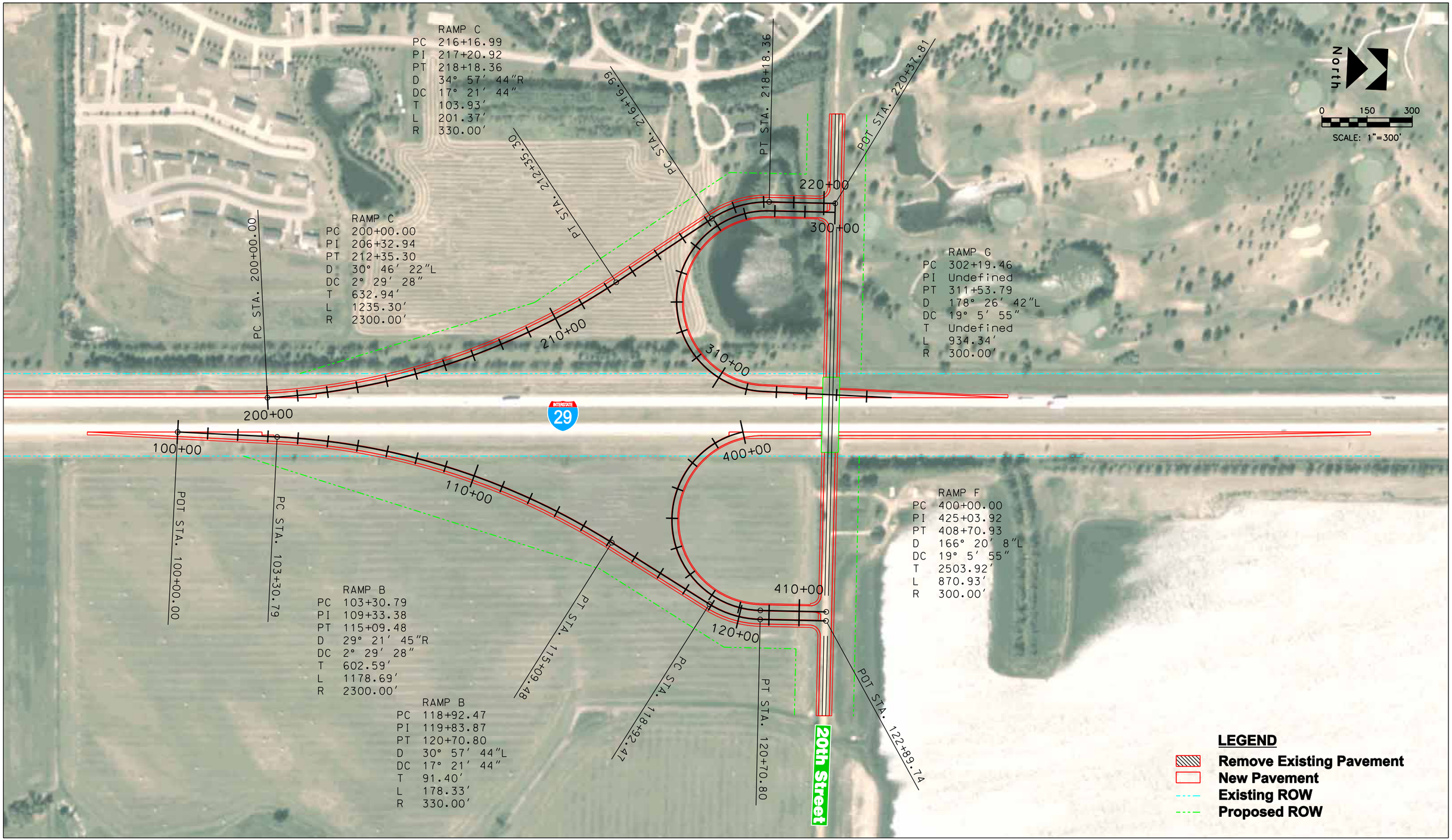


Figure 5.1
I-29 Exit 130 - Brookings - 20th Street
Alternative 1
Folded Diamond Interchange

FELSBURG HOLT & ULLEVIG

CONCEPTUAL DESIGN

5.2 *I-29 Exit 175 – South Connector, Watertown*

5.2.1 Background

An additional interchange at 20th Avenue SE has been considered to provide additional Interstate access to the south portion of Watertown. This new interchange would be located approximately one mile south of US 212 (Exit 177). The additional access point would primarily service a proposed industrial development area in the vicinity of I-29, but also provide a southern connection to US 81 and the rest of the community. It is anticipated that this proposed interchange would also relieve traffic at the I-29 interchange with US 212.

The assessment phase of the study evaluated the current and future traffic operations at the US 212 (Exit 177) interchange. That evaluation indicated that the northbound off-ramp movements at the existing interchange is projected to operate at a poor level of service in the Year 2020 and 2030, without improvements. The recommended improvements of traffic signalization and the construction of a separate right turn lane on the northbound off-ramps would provide acceptable levels of service through the Year 2030. It is anticipated that the construction of a new interchange at the 20th Avenue SE alignment would provide further congestion relief to the US 212 interchange.

The future traffic analysis conducted in the ***Watertown Area Transportation Plan*** indicated that approximately 4,000 to 5,000 vpd would divert from the US 212 interchange to a proposed interchange with 41st Street SE. The transportation plan also forecast that up to 9,000 vpd are anticipated between I-29 and US 81. With daily traffic volumes in this range, and with a three-lane section through the interchange, it is anticipated that acceptable traffic operations can be provided at the interchange ramp terminals. The initial construction could include stop sign control, with signalization provided once warrants are met.

5.2.2 Most Feasible Interchange Concept

Alternative 1 – Diamond Interchange

Based upon the terrain in the vicinity of the 20th Avenue SE alignment, it appears that a standard diamond interchange configuration would be the most economical concept and would be expected to accommodate the traffic volumes anticipated for the new interchange. The extension of 20th Avenue SE would include a new structure over I-29, and a three lane concept, at least through the ramp terminal intersections. The concept drawing of this improvement option is shown in **Figure 5.2**.

Construction costs for this concept are estimated at $10,560,000, not including Right-of-Way. The cost of this concept includes a new bridge over the Interstate as well as construction of ramps and ramp terminal intersections. The extension of 20th Avenue SE, between 29th Street SE and 41st Street SE are not included in this estimate. Project costs will be considerably higher once required Right-of-Way acquisition costs are incorporated into the final cost estimate.

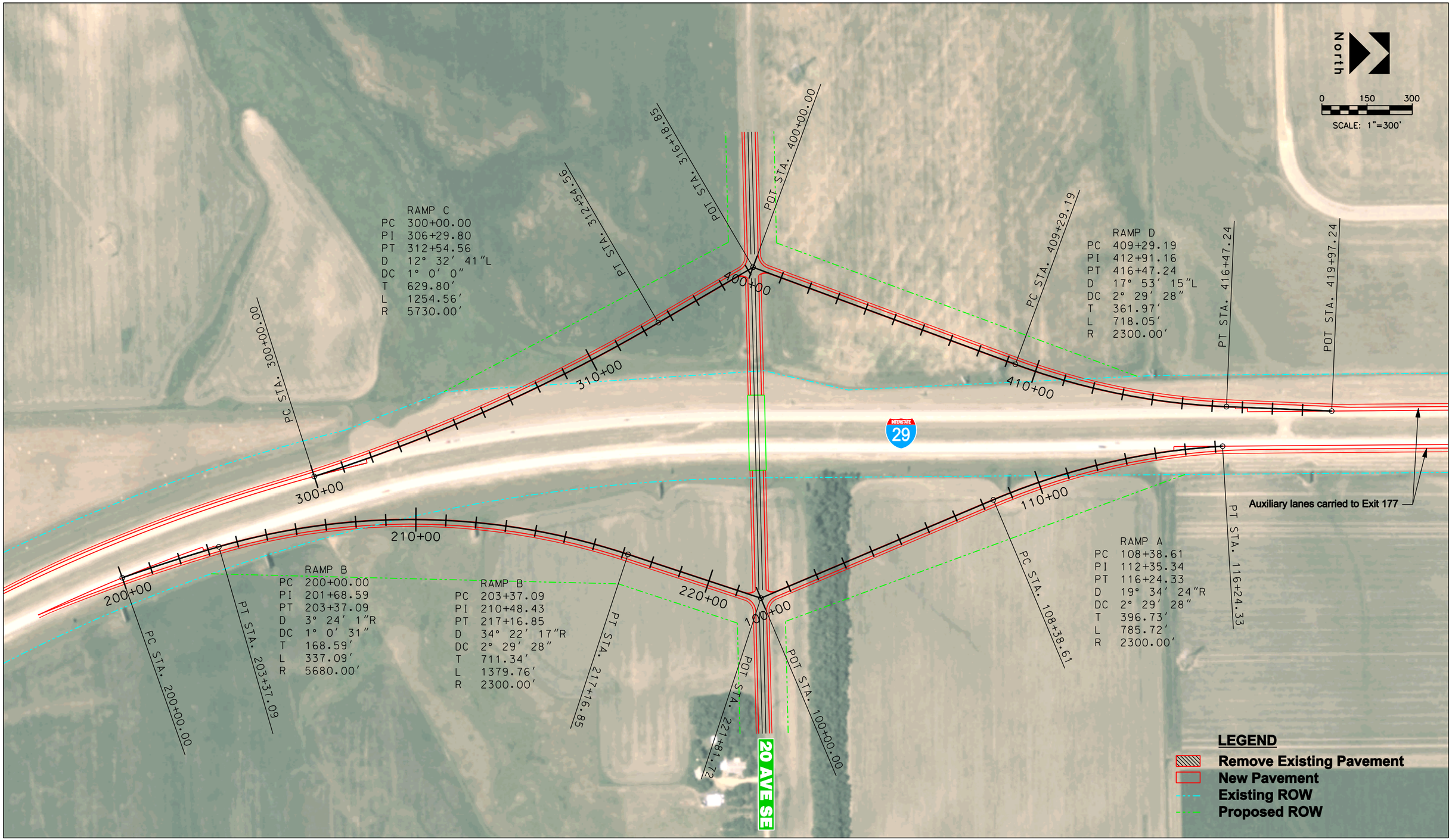


Figure 5.2
I-29 Exit 175 - Watertown
Alternative 1
Diamond Interchange

FELSBURG HOLT & ULLEVIG

CONCEPTUAL DESIGN

5.3 *I-90 Exit 393 – Ellis Road, Sioux Falls*

5.3.1 Background

An additional interchange on I-90 at Ellis Road has been considered to provide additional access to the west side of Sioux Falls. Ellis Road does not currently extend up to I-90, however, the Ellis Road alignment is located approximately three miles west of the I-29/I-90 systems interchange.

The Sioux Falls Metropolitan Planning Organization commissioned HDR to conduct a study to plan for a potential roadway on the western edge of the City. The ***West Side Corridor Study***, completed in 2004, evaluated the benefits and impacts of several alternative roadway locations and connections to I-90. The emerging idea since that study is that the existing Ellis Road corridor best provides the I-90 access for this alternative.

A new interchange is currently under construction at Marion Road, located approximately one mile west of the systems interchange. Concern was expressed about the interchange spacing with the potential La Mesa Drive location. If the proposed interchange is constructed at the Ellis Road alignment, two mile spacing would be provided from both the future Marion Road and three miles from the existing SD 38 interchange.

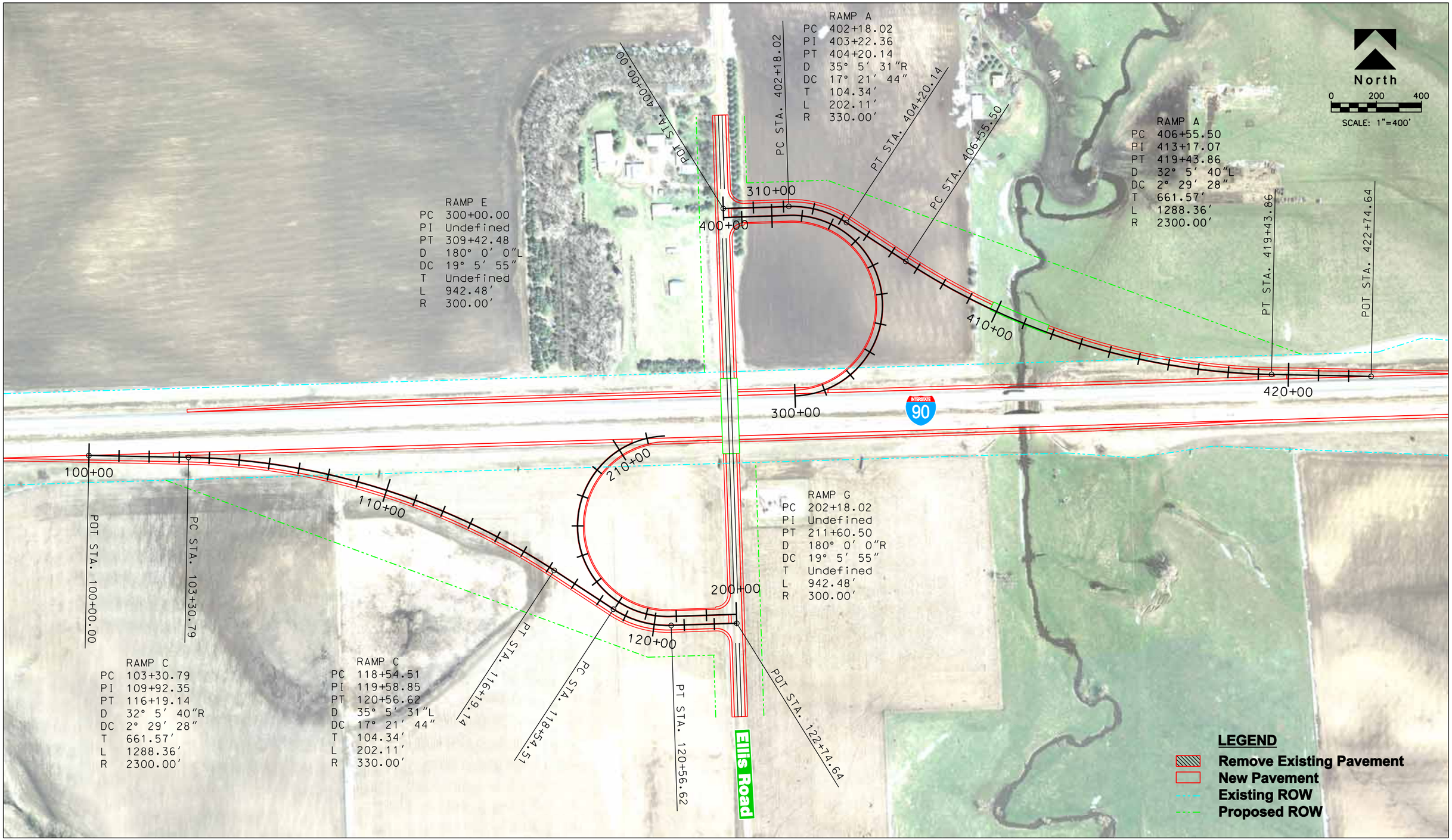
There appears to be a potential wetland in the southwest quadrant of the interchange, immediately adjacent to the eastbound off-ramp. Most of the eastern portion of South Dakota is within the Prairie Pothole Region and the occurrence of wetlands is likely. Other water resources in the area include Willow Creek and its associated floodplain.

5.3.2 Most Feasible Interchange Concept

Alternative 1 – Folded Diamond (Parclo A) Interchange

Due to the presence of a farmstead located in the northwest quadrant of the proposed interchange and an electrical substation in the southeast quadrant, a concept was developed to minimize impacts to both of these properties. A folded diamond configuration, with the loops provided in the northeast and southwest quadrants, was developed and is shown in **Figure 5.3**. The concept includes the construction of a new bridge over I-90 and the construction of a three lane road through the interchange ramp terminals. It is assumed that the extension of Ellis Road, north of 60th Street would be constructed.

Construction costs for this concept are estimated at $11,300,000, not including Right-of-Way. The cost of this concept includes a new bridge over the Interstate as well as construction of ramps and ramp terminal intersections. The estimated Right-of-Way required to construct this interchange is approximately 36 acres costs which would increase project costs when Right-of-Way acquisition costs are incorporated into the final cost estimate.



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CONCEPTUAL DESIGN

Figure 5.3
I-90 Exit 393 - Ellis Road
Alternative 1
Folded Diamond Interchange

engineering paths to transportation solutions

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