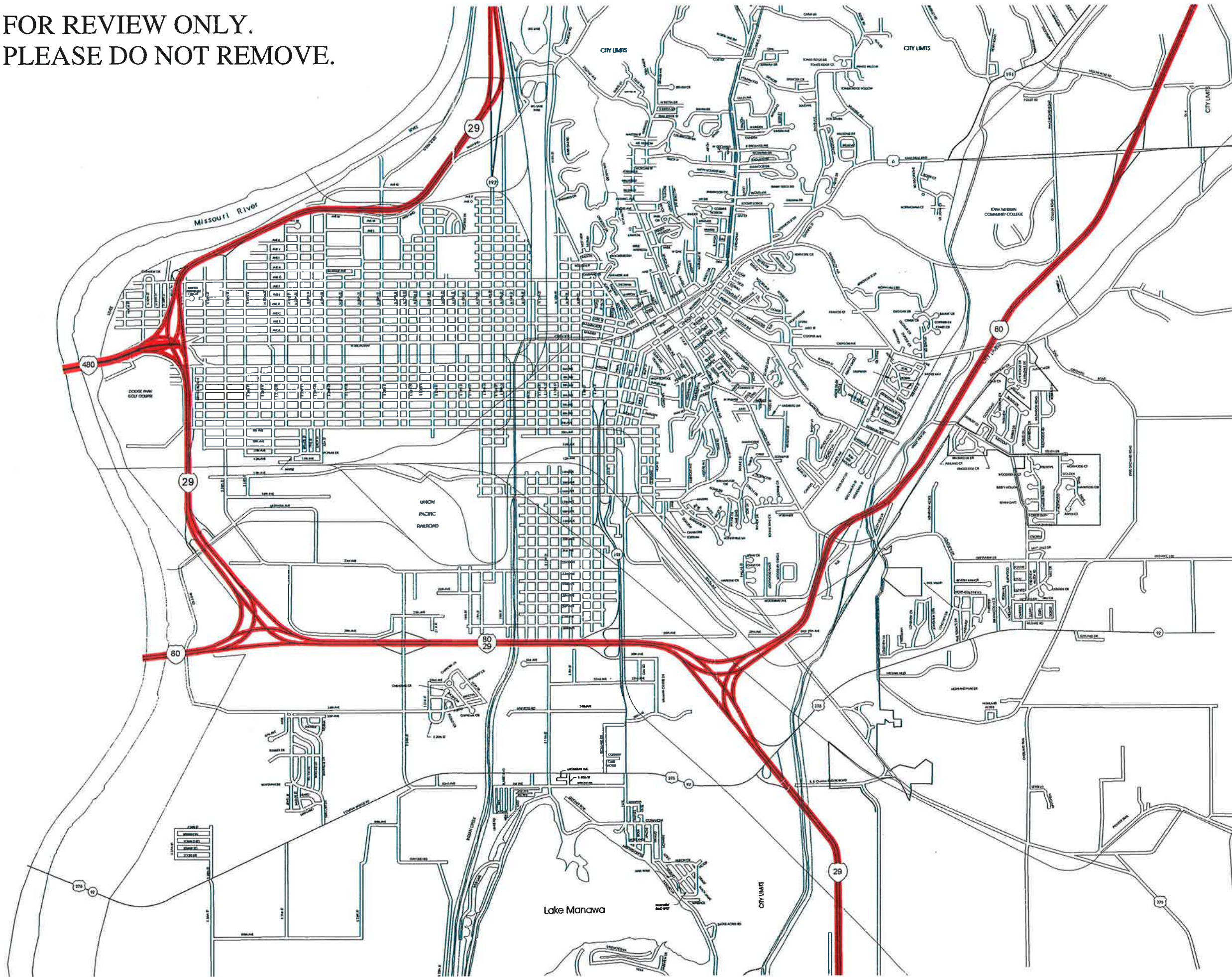


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**Council Bluffs  
Interstate System  
Needs Study**

**Council Bluffs, Iowa**



**Phase II Report  
Development of  
Improvement Alternatives**

**August 1998**



In Association with:



# **COUNCIL BLUFFS INTERSTATE SYSTEM NEEDS STUDY**

## **Phase II Report Development of Improvement Alternatives**

Prepared For

**Metropolitan Area Planning Agency**

By

**HDR Engineering, Inc**

in association with

**HGM Associates, Inc.**

**August 1998**

## TABLE OF CONTENTS

<b>CHAPTER 1:INTRODUCTION .....</b>	<b>1</b>
1.1 STUDY PURPOSE.....	1
1.2 STUDY APPROACH.....	1
1.3 PHASE I FINDINGS .....	1
1.4 PHASE II .....	1
1.5 REMAINDER OF THE REPORT .....	1
1.6 COMPANION REPORTS .....	1
<b>CHAPTER 2:FUTURE TRAFFIC VOLUMES .....</b>	<b>3</b>
2.1 MAPA REGIONAL TRAVEL DEMAND MODEL.....	3
2.2 ADJUSTMENT OF MODEL OUTPUT.....	3
2.3 DEVELOPMENT OF PEAK HOUR VOLUMES.....	3
2.4 ASSESSMENT OF ADDITIONAL ACCESS SCENARIOS.....	5
2.5 SELECT-LINK DATA .....	5
<b>CHAPTER 3:FUTURE NO-BUILD ASSESSMENT.....</b>	<b>6</b>
3.1 FREEWAY LEVEL OF SERVICE .....	6
3.2 WEAVING LEVEL OF SERVICE.....	7
3.3 RAMP JUNCTION LEVEL OF SERVICE.....	7
3.4 SIGNALIZED INTERSECTION LEVEL OF SERVICE.....	8
3.5 UNSIGNALIZED INTERSECTION LEVEL OF SERVICE.....	9
<b>CHAPTER 4:NEED FOR IMPROVEMENTS .....</b>	<b>11</b>
4.1 SUMMARY OF EXISTING DEFICIENCIES .....	11
4.2 SUMMARY OF FUTURE DEFICIENCIES .....	12
<b>CHAPTER 5:FRAMEWORK FOR PLAN DEVELOPMENT .....</b>	<b>14</b>
5.1 PLANNING PRINCIPLES .....	14
5.2 DESIGN CRITERIA.....	14
<b>CHAPTER 6:LONG-TERM ALTERNATIVES.....</b>	<b>17</b>
6.1 BASIC LANE NEEDS.....	17
6.2 BASIC LANE ALTERNATIVES.....	17
6.3 AUXILIARY LANE NEEDS .....	19
6.4 INTERCHANGE ALTERNATIVES.....	21
<b>US HIGHWAY 6 / I-80 INTERCHANGE.....</b>	<b>22</b>
<b>MCPHERSON AVENUE / I-80 INTERCHANGE.....</b>	<b>26</b>
<b>MADISON AVENUE / I-80 INTERCHANGE .....</b>	<b>36</b>
<b>US HIGHWAY 275 / I-29 INTERCHANGE.....</b>	<b>40</b>
<b>EAST I-80/I-29 SYSTEM INTERCHANGE.....</b>	<b>41</b>
<b>SOUTH EXPRESSWAY / I-80 / I-29 INTERCHANGE.....</b>	<b>53</b>
<b>SOUTH 24<sup>TH</sup> STREET / I-80 / I-29 INTERCHANGE .....</b>	<b>54</b>
<b>WEST I-80/I-29 SYSTEM INTERCHANGE.....</b>	<b>65</b>
<b>NEBRASKA AVENUE / I-29 INTERCHANGE .....</b>	<b>74</b>
<b>9<sup>TH</sup> AVENUE / I-29 INTERCHANGE.....</b>	<b>75</b>
<b>I-29/I-480/BROADWAY SYSTEM INTERCHANGE.....</b>	<b>82</b>
<b>G AVENUE /N. 35<sup>TH</sup> STREET / I-29 INTERCHANGE .....</b>	<b>92</b>
<b>NORTH 25<sup>TH</sup> STREET / I-29 INTERCHANGE .....</b>	<b>97</b>
<b>NORTH 16<sup>TH</sup> STREET / I-29 INTERCHANGE .....</b>	<b>101</b>
<b>EPPLEY AIRFIELD / I-29 INTERCHANGE .....</b>	<b>106</b>

**APPENDIX**

    FUTURE "NO-BUILD" PERFORMANCE MEASURE EXHIBITS

## LIST OF TABLES

TABLE 1 - FREEWAY SEGMENT LOS SUMMARY .....	6
TABLE 2 - WEAVING LOS SUMMARY .....	7
TABLE 3 - RAMP JUNCTION LOS SUMMARY .....	8
TABLE 4 - SIGNALIZED INTERSECTION LOS SUMMARY.....	9
TABLE 5 - UNSIGNALIZED INTERSECTION LOS SUMMARY .....	10
TABLE 6 - MAINLINE DESIGN CRITERIA .....	15
TABLE 7 - RAMP DESIGN CRITERIA .....	16
TABLE 8 - COMPARISON OF WIDENING ALTERNATIVES .....	19
TABLE 9 - CONCEPT SCREENING SUMMARY - US HIGHWAY 6 / I-80 INTERCHANGE.....	25
TABLE 10 - CONCEPT SCREENING SUMMARY - MCPHERSON AVENUE / I-80 INTERCHANGE.....	34
TABLE 10 - CONCEPT SCREENING SUMMARY - MCPHERSON AVENUE / I-80 INTERCHANGE (CONTINUED).....	35
TABLE 11 - CONCEPT SCREENING SUMMARY - MADISON AVENUE / I-80 INTERCHANGE.....	39
TABLE 12 - CONCEPT SCREENING SUMMARY - EAST I-80/I-29 SYSTEM INTERCHANGE.....	51
TABLE 12 - CONCEPT SCREENING SUMMARY - EAST I-80/I-29 SYSTEM INTERCHANGE (CONTINUED) .....	52
TABLE 13 - CONCEPT SCREENING SUMMARY - SOUTH 24 <sup>TH</sup> STREET/I-80/I-29 INTERCHANGE .....	63
TABLE 13 - CONCEPT SCREENING SUMMARY - SOUTH 24 <sup>TH</sup> STREET/I-80/I-29 INTERCHANGE (CONTINUED).....	64
TABLE 14 - CONCEPT SCREENING SUMMARY - WEST I-80/I-29 SYSTEM INTERCHANGE .....	72
TABLE 14 - CONCEPT SCREENING SUMMARY - WEST I-80/I-29 SYSTEM INTERCHANGE (CONTINUED) .....	73
TABLE 15 - CONCEPT SCREENING SUMMARY - 9 <sup>TH</sup> AVENUE/I-29 INTERCHANGE .....	81
TABLE 16 - CONCEPT SCREENING SUMMARY - I-29/I-480/BROADWAY SYSTEM INTERCHANGE .....	89
TABLE 16 - CONCEPT SCREENING SUMMARY - I-29/I-480/BROADWAY SYSTEM INTERCHANGE (CONTINUED).....	90
TABLE 16 - CONCEPT SCREENING SUMMARY - I-29/I-480/BROADWAY SYSTEM INTERCHANGE (CONTINUED).....	91
TABLE 17 - CONCEPT SCREENING SUMMARY - G AVENUE/N. 35 <sup>TH</sup> STREET/I-29 INTERCHANGE .....	96
TABLE 18 - CONCEPT SCREENING SUMMARY - NORTH 25 <sup>TH</sup> STREET/I-29 INTERCHANGE.....	100
TABLE 19 - CONCEPT SCREENING SUMMARY - NORTH 16 <sup>TH</sup> STREET/I-29 INTERCHANGE.....	105
TABLE 20 - CONCEPT SCREENING SUMMARY - EPPLEY AIRFIELD/I-29 INTERCHANGE.....	109

## LIST OF EXHIBITS

EXHIBIT 1 - STUDY AREA.....	2
EXHIBIT 2 – EXISTING AND FUTURE ANNUAL AVERAGE TRAFFIC VOLUMES .....	4
EXHIBIT 3 – SUMMARY OF EXISTING AND FUTURE DEFICIENCIES .....	13
EXHIBIT 7 – YEAR 2020 BASIC LANE REQUIREMENTS.....	18
EXHIBIT 8 – MAINLINE WIDENING ALTERNATIVES .....	20
EXHIBIT 9 – US HIGHWAY 6 / I-80 INTERCHANGE – ALTERNATIVE 1.....	23
EXHIBIT 10 – US HIGHWAY 6 / I-80 INTERCHANGE – ALTERNATIVE 2.....	24
EXHIBIT 11 – MCPHERSON AVENUE / I-80 INTERCHANGE – ALTERNATIVE 1.....	28
EXHIBIT 12 – MCPHERSON AVENUE / I-80 INTERCHANGE – ALTERNATIVE 2.....	29
EXHIBIT 13 – MCPHERSON AVENUE / I-80 INTERCHANGE – ALTERNATIVE 3.....	30
EXHIBIT 14 – MCPHERSON AVENUE / I-80 INTERCHANGE – ALTERNATIVE 4.....	31
EXHIBIT 15 – MCPHERSON AVENUE / I-80 INTERCHANGE – ALTERNATIVE 5.....	32
EXHIBIT 16 – MCPHERSON AVENUE / I-80 INTERCHANGE – ALTERNATIVE 6.....	33
EXHIBIT 17 – MADISON AVENUE / I-80 INTERCHANGE – ALTERNATIVE 1 .....	37
EXHIBIT 18 – MADISON AVENUE / I-80 INTERCHANGE – ALTERNATIVE 2 .....	38
EXHIBIT 19 – EAST I-80/I-29 SYSTEM INTERCHANGE – ALTERNATIVE 1 .....	43
EXHIBIT 20 – EAST I-80/I-29 SYSTEM INTERCHANGE – ALTERNATIVE 2 .....	44
EXHIBIT 21 – EAST I-80/I-29 SYSTEM INTERCHANGE – ALTERNATIVE 3 .....	45
EXHIBIT 22 – EAST I-80/I-29 SYSTEM INTERCHANGE – ALTERNATIVE 4 .....	46
EXHIBIT 23 – EAST I-80/I-29 SYSTEM INTERCHANGE – ALTERNATIVE 5 .....	47
EXHIBIT 24 – EAST I-80/I-29 SYSTEM INTERCHANGE – ALTERNATIVE 6 .....	48
EXHIBIT 25 – EAST I-80/I-29 SYSTEM INTERCHANGE – ALTERNATIVE 7 .....	49
EXHIBIT 26 – EAST I-80/I-29 SYSTEM INTERCHANGE – ALTERNATIVE 8 .....	50
EXHIBIT 27 – SOUTH 24 <sup>TH</sup> STREET/I-80/I-29 INTERCHANGE – ALTERNATIVE 1.....	56
EXHIBIT 28 – SOUTH 24 <sup>TH</sup> STREET/I-80/I-29 INTERCHANGE – ALTERNATIVE 2.....	57
EXHIBIT 29 – SOUTH 24 <sup>TH</sup> STREET/I-80/I-29 INTERCHANGE – ALTERNATIVE 3.....	58
EXHIBIT 30 – SOUTH 24 <sup>TH</sup> STREET/I-80/I-29 INTERCHANGE – ALTERNATIVE 4.....	59
EXHIBIT 31 – SOUTH 24 <sup>TH</sup> STREET/I-80/I-29 INTERCHANGE – ALTERNATIVE 5.....	60
EXHIBIT 32 – SOUTH 24 <sup>TH</sup> STREET/I-80/I-29 INTERCHANGE – ALTERNATIVE 6.....	61
EXHIBIT 33 – SOUTH 24 <sup>TH</sup> STREET/I-80/I-29 INTERCHANGE – ALTERNATIVE 7.....	62
EXHIBIT 34 – WEST I-80/I-29 SYSTEM INTERCHANGE – ALTERNATIVE 1 .....	67
EXHIBIT 35 – WEST I-80/I-29 SYSTEM INTERCHANGE – ALTERNATIVE 2 .....	68
EXHIBIT 36 – WEST I-80/I-29 SYSTEM INTERCHANGE – ALTERNATIVE 3 .....	69
EXHIBIT 37 – WEST I-80/I-29 SYSTEM INTERCHANGE – ALTERNATIVE 4 .....	70
EXHIBIT 38 – WEST I-80/I-29 SYSTEM INTERCHANGE – ALTERNATIVE 5 .....	71
EXHIBIT 39 – 9 <sup>TH</sup> AVENUE/I-29 INTERCHANGE – ALTERNATIVE 1.....	77
EXHIBIT 40 – 9 <sup>TH</sup> AVENUE/I-29 INTERCHANGE – ALTERNATIVE 2.....	78
EXHIBIT 41 – 9 <sup>TH</sup> AVENUE/I-29 INTERCHANGE – ALTERNATIVE 3.....	79
EXHIBIT 42 – 9 <sup>TH</sup> AVENUE/I-29 INTERCHANGE – ALTERNATIVE 4.....	80
EXHIBIT 43 – I-29/I-480/BROADWAY SYSTEM INTERCHANGE – ALTERNATIVE 1 .....	84
EXHIBIT 44 – I-29/I-480/BROADWAY SYSTEM INTERCHANGE – ALTERNATIVE 2 .....	85
EXHIBIT 45 – I-29/I-480/BROADWAY SYSTEM INTERCHANGE -- ALTERNATIVE 3 .....	86
EXHIBIT 46 – I-29/I-480/BROADWAY SYSTEM INTERCHANGE – ALTERNATIVE 4 .....	87
EXHIBIT 47 – I-29/I-480/BROADWAY SYSTEM INTERCHANGE – ALTERNATIVE 5 .....	88
EXHIBIT 48 – G AVENUE/N. 35 <sup>TH</sup> STREET/I-29 INTERCHANGE – ALTERNATIVE 1.....	93
EXHIBIT 49 – G AVENUE/N. 35 <sup>TH</sup> STREET/I-29 INTERCHANGE – ALTERNATIVE 2.....	94
EXHIBIT 50 – G AVENUE/N. 35 <sup>TH</sup> STREET/I-29 INTERCHANGE – ALTERNATIVE 3.....	95
EXHIBIT 51 – NORTH 25 <sup>TH</sup> STREET/I-29 INTERCHANGE – ALTERNATIVE 1 .....	98
EXHIBIT 52 – NORTH 25 <sup>TH</sup> STREET/I-29 INTERCHANGE – ALTERNATIVE 2 .....	99
EXHIBIT 53 – NORTH 16 <sup>TH</sup> STREET/I-29 INTERCHANGE – ALTERNATIVE 1 .....	102
EXHIBIT 54 – NORTH 16 <sup>TH</sup> STREET/I-29 INTERCHANGE – ALTERNATIVE 2 .....	103
EXHIBIT 55 – NORTH 16 <sup>TH</sup> STREET/I-29 INTERCHANGE – ALTERNATIVE 3 .....	104
EXHIBIT 56 – EPPLEY AIRFIELD/I-29 INTERCHANGE – ALTERNATIVE 1 .....	107
EXHIBIT 57 – EPPLEY AIRFIELD/I-29 INTERCHANGE – ALTERNATIVE 2 .....	108

## CHAPTER 1: INTRODUCTION

### 1.1 STUDY PURPOSE

The purpose of the Council Bluffs Interstate System Needs Study is to identify the needs of the system and recommend improvements to the structural condition, capacity and functionality of the system through a cost effective combination of rehabilitation and reconstruction. Successful attainment of these objectives will result in the preparation of a prioritized plan that the Metropolitan Area Planning Agency (MAPA), the Iowa Department of Transportation (IaDOT) and the City of Council Bluffs can use as a guide in the development of short term and long term improvements for the interstate system.

The study area is shown in Exhibit 1. The general boundaries of the study include:

- To the north: I-29, north of Iowa Highway 192 (N. 16th Street)
- To the south: I-29, south of US Highway 275/Iowa Highway 92
- To the east: I-80, east of US Highway 6 (Kanesville Boulevard)
- To the west: Missouri River crossings of I-80 and I-480

The study area includes 17 miles of mainline freeway and 14 interchanges. These interchanges include three system interchanges, seven full interchanges, and four partial interchanges.

### 1.2 STUDY APPROACH

The project approach being utilized on the Council Bluffs Interstate System Needs Study provides a process to answer the following key questions:

1. What are the current operational and safety problems on the freeway system?
2. What are the long term system needs? How can the freeway system be rehabilitated or reconstructed to address both current problems and long term needs?
3. What are the costs (construction, right of way, environmental, socioeconomic) of a program to rehabilitate/reconstruct the Council Bluffs Interstate System?
4. How can a long range program be implemented in stages to assure overall plan compatibility and reasonable operation during each stage?
5. Will individual improvements fit with each other or the system as a whole?

The study approach includes the following three phases:

- Phase I - Analysis and Evaluation of the Existing System (The focus of Report I)
- Phase II - Development of Improvement Alternatives (The focus of this report)
- Phase III - Development of a Recommended Plan

The outputs of each phase are intended to provide an incremental approach to decision-making and problem-solving throughout the entire project. In addition, each phase is designed to be a logical break-point prior to the beginning of the next phase. In this way, decision makers will have an understanding of the background data and analyses necessary to provide informed direction on the work to be completed in the subsequent phase of the project.

### 1.3 PHASE I FINDINGS

A brief summary of the findings of Phase I of the study is provided in Chapter 4 of this report.

### 1.4 PHASE II

The focus of this report is on the procedures and findings of Phase II. The purpose of this phase of the project was to assess future volume conditions and to identify alternative solutions to existing and future deficiencies within the interstate system. Phase II included the following tasks:

- Development of future conditions in the study area including future travel volumes, future land use, and future roadway development plans.
- Identification of future operational deficiencies.
- Establishment of design standards and operational criteria utilized in the development and assessment of improvement alternatives and, ultimately, the recommended plan.
- Development of conceptual-level improvement alternatives to address existing and future deficiencies.
- Screening of the improvement alternatives with respect to cost, traffic operations, route and lane continuity, environmental impacts, right-of-way impacts and constructability which will provide the basis for the identification of preferred alternatives and appropriate short-term improvements to be assessed in greater detail in Phase III of the study.

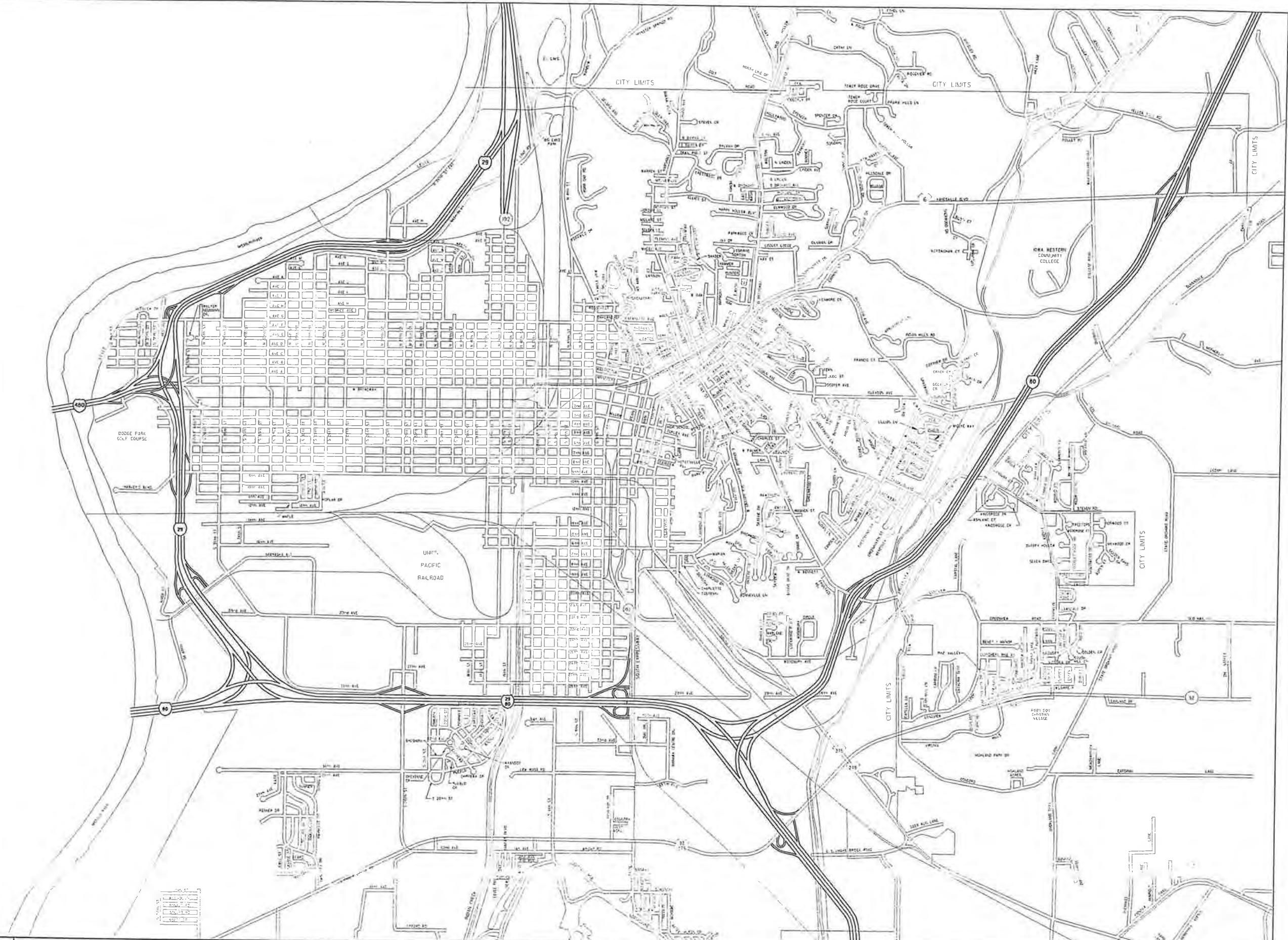
### 1.5 REMAINDER OF THE REPORT

The remainder of this report has been divided into the following chapters:

- Chapter 2: Future Traffic Volumes
- Chapter 3: Future No-Build Assessment
- Chapter 4: Need for Improvements
- Chapter 5: Framework for Plan Development
- Chapter 6: Long-Term Alternatives

### 1.6 COMPANION REPORTS

This is the second of three reports which document the procedures and findings of the Council Bluffs Interstate System Needs Study. The report for Phase I, entitled "Analysis of Existing Conditions", was published in September of 1997 and described the existing safety, operational and physical conditions of the study area. A Phase III report documenting the short-term and long-term recommendations of the study will be prepared at a later date.



Scale: 1" = 1/4 Mile  
North Arrow

**HDR**  
HDR Engineering, Inc.

**hgm**  
ASSOCIATED INC.

Metropolitan Area Planning Agency  
**COUNCIL BLUFFS INTERSTATE SYSTEM NEEDS STUDY**  
PHASE 2 REPORT  
AUGUST 1998

**STUDY AREA**

EXHIBIT  
**1**

## CHAPTER 2: FUTURE TRAFFIC VOLUMES

This chapter summarizes the development of traffic forecasts used in the identification of future operational deficiencies, in the assessment of access at each interchange in the study, and in the screening of the improvement alternatives.

### 2.1 MAPA REGIONAL TRAVEL DEMAND MODEL

The Metropolitan Area Planning Agency (MAPA) maintains a travel demand forecasting model for estimating future traffic volumes on the street network for the Omaha-Council Bluffs regional area. These traffic forecasts are used within the transportation planning process employed by MAPA to address the long-term transportation needs of the metropolitan area. Although travel demand models could, in theory, be developed to estimate traffic volumes for any given year, such models are generally only maintained for a base year (calibrated to actual traffic counts) and a horizon year. MAPA's base year model represents 1992 conditions while the horizon year model represents Year 2020.

These computer-based models utilize input data such as number of households, population, employment, auto ownership, etc. to estimate daily traffic volumes on links representing roadways. For future conditions, these variables are estimated based on land use plans, comprehensive plans and from specific site development plans. Using input provided by MAPA and the City of Council Bluffs, the Project Team performed a review of the Year 2020 model's assumption for land use. Based on the results of this assessment, several revisions were made to the model.

The roadway network of the Year 2020 model generally consists of all key existing roadways plus any projects that are included in MAPA's FY 1998-2003 Transportation Improvement Plan (TIP) or 2020 Long Range Transportation Plan (LRTP). Since the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) mandates that both of these plans be fiscally constrained, proposed projects that are included in the Year 2020 network generally represent the highest priorities for implementation and are relatively realistic in terms of probability of ultimate construction.

Although the Year 2020 network includes proposed improvements in other parts of the metropolitan area, it does not include improvements to the Council Bluffs interstate system. Rather, the roadway network in the model reflects a "Do-Nothing" or "No-Build" network for the Council Bluffs Interstate System.

For this study, the Project Team requested output from the Year 1992 base model and from the Year 2020 model. In recognition of a possible need for additional lanes in the highest-volume sections of the study area, the Project Team also requested that MAPA perform a Year 2020 model run with three lanes in each direction on I-80 between the Missouri River and the East I-80/I-29 System Interchange. Such output is of particular interest since it is possible that the provision of additional capacity on a facility will attract additional traffic. In the remainder of

this report, the two scenarios of the Year 2020 model are referred to as the No-Build model and the Build model.

### 2.2 ADJUSTMENT OF MODEL OUTPUT

Since the output from a regional travel demand model represents rough approximations of future traffic volumes, adjustments to the output are often necessary. The methodology employed by the Project Team is summarized below.

- Model assignments were obtained from the 1992 Base Year calibration model and from the Year 2020 No-Build and Build models.
- Relative and absolute correction factors were developed for each of the network links within the study area based on the deviation observed between the 1992 Base Year assignments and actual 1992 traffic volumes as reported on the 1992 traffic flow map prepared by MAPA.
- Both factors were then applied separately to the 2020 assignments in the study area for the 2020 No-Build and 2020 Build scenarios. A final 2020 forecast for each scenario was then developed by averaging the results obtained from applying the correction factors.
- The adjusted forecasts were then further adjusted, as necessary, for reasonableness.

Adjusted Year 2020 forecasts for the No-Build and Build scenarios are shown in Exhibit 2. Annual average traffic volumes for 1996 are also shown for comparison purposes.

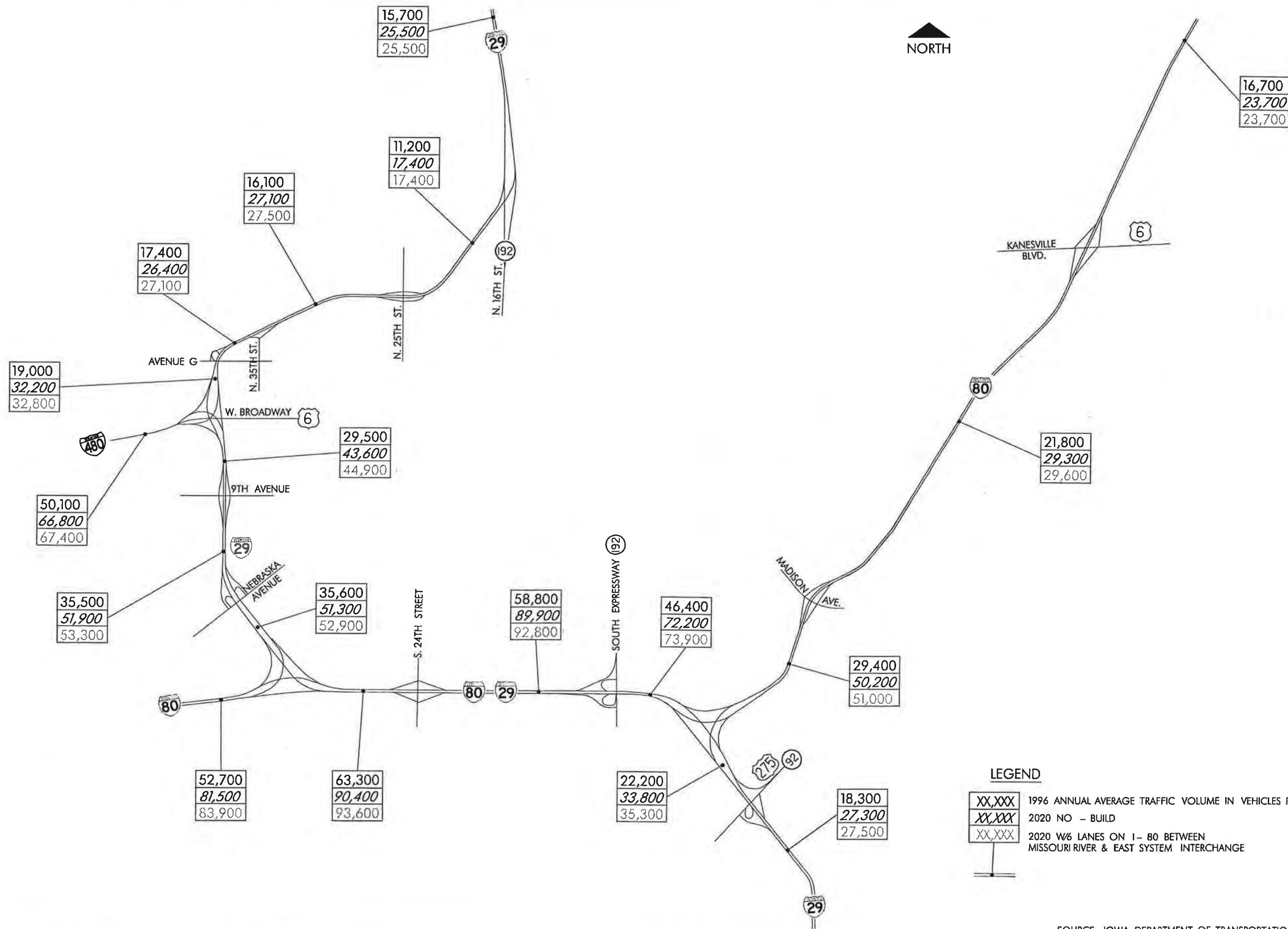
In general, the Year 2020 No-Build forecasts represent overall percentage increases ranging from 17 percent to 55 percent, and average annual percentage increases ranging from approximately 0.7 percent to 1.8 percent. In the six-lane section of the Build scenario, the forecasts are approximately two to four percent higher than the corresponding forecasts for the No-Build scenario. This indicates that the provision of additional capacity would not be expected to attract a significant amount of new traffic to the interstate.

### 2.3 DEVELOPMENT OF PEAK HOUR VOLUMES

Following the development of daily volume forecasts in the study area, the Project Team developed directional AM and PM peak hour volumes for all mainline segments, ramps and cross-streets including turning movement forecasts at each ramp terminal intersection.

The 2020 AM and PM peak hour volumes for the No-Build and Build scenarios were developed through the following procedure:

- Application of current peak hour percentages and directional splits.
- Application of current peak hour turning percentages at the terminal intersections.



SOURCE: IOWA DEPARTMENT OF TRANSPORTATION



- Making the appropriate adjustments based on changes in traffic between the current and 2020 period. These included adjustments to the peak hour percentage and directional splits to correct for changes in the type of development.

Year 2020 AM and PM peak hour traffic volumes for the No-Build scenario are shown graphically in Appendix A as part of the exhibits which summarize the performance measures from the analysis of the No-Build scenario. Year 2020 AM and PM peak hour traffic volumes for the Build scenario have not been included in this report since there is not a substantial difference between the two scenarios, particularly at locations away from the six-lane section. However, where notable differences were observed, the higher volumes from the Build scenario were utilized in the development and assessment of improvement alternatives.

In general, hourly traffic volumes on the ramps and mainlines have been balanced (i.e., mainline and ramp volumes can be added and subtracted to determine the volume at any other mainline or ramp location). This is not necessarily true of the relationship between ramp volumes and intersection turning movements. This is due to the fact that intersection turning movements reflect the peak hour of the intersection as a whole rather than the peak hour of any particular ramp approach or ramp departure.

#### 2.4 ASSESSMENT OF ADDITIONAL ACCESS SCENARIOS

Additional model runs were also requested from MAPA to assist the Project Team in the development and assessment of interchange alternatives, particularly at interchanges where only partial access is provided today. Output from the following five model runs was subsequently provided by MAPA. Each of these model runs was performed in conjunction with the Build network.

1. New full access interchange at McPherson Avenue including the extension of Valley View Drive eastward from McPherson Avenue to College Road.
2. Full access interchange at I-29/US 275, adding the movement from eastbound US 275 to northbound I-29 and from southbound I-29 to westbound US 275.
3. Full access interchange at I-480/I-29/West Broadway (i.e., ramps to/from West Broadway) with no revisions to the configuration of the G Avenue/I-29 and N. 35th Street/I-29 interchanges.
4. Full access interchange at I-480/I-29/West Broadway and removal of the G Avenue/I-29 and N. 35th Street/I-29 interchanges.
5. Full access interchange at N. 16th Street/I-29 interchange, adding ramps allowing movements between N.16<sup>th</sup> Street and I-29 to the south.

Hourly volumes for these network scenarios were not developed. Rather, daily volume output from these runs was evaluated at a qualitative level to estimate the impacts of the access revision on traffic volumes and traffic operations on ramps, cross streets and intersections in the vicinity of the specific change. The results of this assessment are summarized in later sections of this report for each location.

#### 2.5 SELECT-LINK DATA

Select-link output from the Build model run was also provided by MAPA to supplement field-collected origin-destination data. Together these data were utilized in the analysis of the weaving sections of interchange alternatives.

Select-link data can be obtained for any link in the network and provides a model-based estimate of where traffic is coming from or where traffic is destined. For weaving sections created by an on-ramp followed by an off-ramp, this data provides an estimate of the percentage of the on-ramp volume that is destined for the freeway and the percentage of the on-ramp volume that is destined for the off-ramp. Similarly, the data provides an estimate of the percentage of the off-ramp volume that originated on the upstream on-ramp and the percentage that originated on the freeway.

Select-link output was provided for all inbound and outbound freeway links to the three system interchanges. This resulted in a total of 18 links for which select-link data was provided. The detailed traffic analyses that were performed using this data are summarized in Chapter 5 of this report.

### CHAPTER 3: FUTURE NO-BUILD ASSESSMENT

This chapter summarizes the assessment of traffic operations for the Year 2020 No-Build scenario. The procedures and methodologies utilized in the assessment are identical to those utilized in the assessment of existing conditions and documented in the Phase I report. To a limited degree, these procedures and methodologies are also summarized in this report.

#### 3.1 FREEWAY LEVEL OF SERVICE

Separate analyses were performed for basic freeway segments, ramp junctions and weaving sections. The basic freeway segment analysis is summarized in this section. The analysis of ramp junctions and weaving sections is summarized in subsequent sections.

##### Methodology/Definitions/Assumptions

Level of service (LOS) analyses were performed following Chapter 3 procedures (Basic Freeway Segments) of the Highway Capacity Manual (HCM). The Highway Capacity Software (HCS), a computerized analytical tool based on the HCM, was utilized to evaluate the operational characteristics of the freeway segments of the system. Geometric inputs from the existing conditions analysis were held constant. Volume inputs consisted of the AM and PM peak hour volumes for the Year 2020 No-Build scenario.

For freeway segments, level of service is defined in terms of traffic stream density over a certain distance. By definition, basic freeway segments are segments of the freeway that are not affected by merging or diverging movements at nearby ramps or by weaving movements. Given that freeway ramps have an influence distance of 1,500 feet upstream or downstream, and weaving sections have an influence distance of 2,500 feet, only freeway segments over 2,000 feet in length were evaluated as basic freeway segments.

##### Results

Table 1 summarizes the results of the analysis of basic freeway segments for the No-Build scenario. Level of service for the existing conditions is also shown for comparison purposes. Table 1 indicates that the level of service on the basic freeway segments will likely worsen by one level of service. As a result, additional segments will provide unacceptable operations (LOS E or worse) and several segments will approach the limits of acceptable operations (LOS D) when compared to existing conditions.

The most critical areas of the corridor will be along I-80/I-29 between the Missouri River and the East I-80/I-29 System Interchange. LOS F will occur in this area during the AM and PM peak hours of the day.

An overall assessment of freeway level of service for the Year 2020 No-Build scenario is provided graphically in Appendix A.

TABLE 1 - Freeway Segment LOS Summary

Freeway	Segment	Direction	Existing		2020 No-Build	
			AM	PM	AM	PM
I-29	North of Highway 192	NB	A	A	A	B
		SB	A	A	B	A
	Highway 192 to N. 25th Street	NB	A	A	A	A
		SB	A	A	A	A
	N. 25th Street to N. 35th Street	NB	A	A	A	B
		SB	A	A	B	A
	N. 35th Street to Avenue G	NB	A	A	A	B
		SB	A	A	B	A
	Avenue G to I-480	NB	A	A	A	B
		SB	See Weaving Analysis	See Weaving Analysis	See Weaving Analysis	See Weaving Analysis
	I-480 to 9th Avenue	NB	Not Analyzed	Not Analyzed	Not Analyzed	Not Analyzed
		SB	See Weaving Analysis	See Weaving Analysis	See Weaving Analysis	See Weaving Analysis
	9th Avenue to Nebraska Avenue	NB	B	B	C	C
		SB	B	B	C	C
	Nebraska Avenue to I-80	NB	B	B	C	C
		SB	See Weaving Analysis	See Weaving Analysis	See Weaving Analysis	See Weaving Analysis
	I-80 to Highway 275/92	NB	See Weaving Analysis	See Weaving Analysis	See Weaving Analysis	See Weaving Analysis
		SB	Not Analyzed	Not Analyzed	Not Analyzed	Not Analyzed
South of Highway 275/92	NB	A	A	A	A	
	SB	A	A	B	A	
I-80	West of I-29	EB	B	C	D	F
		WB	C	C	E	D
	I-29 to Madison Avenue	EB	A	B	B	D
		WB	B	B	C	B
	Madison Avenue to Highway 6	EB	A	B	B	C
		WB	B	A	B	B
North of Highway 6	EB	A	A	A	B	
	WB	A	A	B	A	
I-80/I-29	West System Interchange to S. 24th Street	EB	B	D	C	F
		WB	C	B	D	C
	S. 24th Street to S. Expressway	EB	B	D	C	F
		WB	D	C	F	D
	S. Expressway to East System Interchange	EB	See Weaving Analysis	See Weaving Analysis	See Weaving Analysis	See Weaving Analysis
		WB	See Weaving Analysis	See Weaving Analysis	See Weaving Analysis	See Weaving Analysis

Note: Freeway segments not analyzed are of insufficient length to be classified as basic freeway segments.

**3.2 WEAVING LEVEL OF SERVICE**

Weaving is defined as the crossing of two or more traffic streams traveling in the same general direction along a significant length of freeway, without the aid of traffic control devices. Six existing weaving areas were identified in the study area.

**Methodology/Definitions/Assumptions**

Consistent with Phase I of the study, Chapter 4 procedures (Weaving Areas) of the HCM were utilized to assess the level of service of weaving segments for the Year 2020 No-Build scenario. A more detailed analysis of weaving areas using a microscopic simulation model was utilized in the development of interchange alternatives and is documented in Section 5.3.

Note that not all lane-changing operations are categorized as weaving nor are they all suitable for weaving analysis. For instance, a freeway segment of two lanes with a right hand on ramp followed by a left hand off ramp (northbound I-29 between 9<sup>th</sup> Avenue and I-480) can easily be mistaken as type “C” weaving, while there is only one lane change taking place. In addition, at locations where the measured weaving length exceeded 2,500 feet, the segment was analyzed as a basic freeway segment. The analysis of freeway sections not meeting one of these requirements was performed as necessary during the development and assessment of improvement alternatives.

Level of service for weaving operations is expressed in terms of minimum average speed of weaving vehicles and non-weaving vehicles, respectively. The percentages for weaving and non-weaving vehicles were calculated for both merging traffic streams based on the proportion of traffic on the ramps and freeway mainline and supplemented with the select-link data.

**Results**

Table 2 summarizes the results of the analysis of weaving segments in the study area. Level of service for the existing conditions is also shown for comparison purposes. Similar to basic freeway level of service, Table 2 indicates that weaving sections will generally worsen by one level of service. As a result, the only weaving area expected to provide LOS C or better is the weaving area on northbound I-29 between the US 275 and the East System Interchange.

An overall assessment of weaving level of service for the Year 2020 No-Build scenario is provided graphically in Appendix A.

**TABLE 2 - Weaving LOS Summary**

Freeway	Segment	Direction	Existing		2020 No-Build	
			AM	PM	AM	PM
I-29	Avenue G to I-480	SB	E/D	B/B	F/D	C/C
	I-480 to 9th Avenue	SB	C/B	D/D	C/C	E/E
	Nebraska Avenue to I-80	SB	A/B	B/B	C/C	C/C
	I-80 to Highway 275/92	NB	C/C	B/B	D/C	B/B
I-80/I-29	S. Expressway to East System Interchange	EB	B/B	C/C	C/C	D/E
		WB	C/C	C/C	E/E	D/E

X/X - Weaving Vehicles/Non-Weaving Vehicles

**3.3 RAMP JUNCTION LEVEL OF SERVICE**

Ramp junctions refer to the merge and diverge areas created by the intersection of a freeway and a ramp. The ramp junctions of all system interchanges and service interchanges in the study area were analyzed, unless weaving analysis procedures were determined to be applicable. Ramp roadways which connect the freeway with another freeway or with a surface street (sometimes referred to as the ramp proper) were not analyzed.

**Methodology/Definitions/Assumptions**

Ramp junction areas were analyzed based on Chapter 5 procedures (Ramps and Ramp Junctions) of the HCM and performed using the HCS. By definition, the LOS for a typical ramp-freeway junction is primarily measured in vehicular density in the influence area of the ramp. The average speed of vehicles is used as a secondary parameter for the LOS.

The guidelines in the HCM for major merge and major diverge analysis were consulted and evaluated because the HCS does not provide readily available tools. A major merge is formed by two primary multiple-lane freeways merging into one freeway segment. A major diverge is the same but with reversed direction of travel.

The HCM suggests the analysis of major merge areas be limited to a capacity check, rather than a determination of level of service like that performed for other elements of the freeway system. The project team adopted a flexible approach using two unique methods. One method to approximate the LOS was to use HCS as one would for regular merges but to specify a two-lane on ramp at its full acceleration length. The “ramp” was assigned to the leg with lighter traffic, and the free flow speed of the ramp was indicated as that of the freeway. The other method was to regard the downstream area as a freeway segment, then compare the calculated LOS with the adjacent ramp influence areas for necessary adjustments. The application of the two methods depended primarily on the geometry and channelization of the ramps.

A simple formula for major diverge analysis is presented in the HCM. It was strictly applied to major diverge analysis in this study. The alternative methods for major merge analysis described above were also used for major diverge in the corresponding terms.

**Results**

Table 3 on the next page summarizes the results of the analysis of ramp junctions for the Year 2020 No-Build scenario. Level of service for the existing conditions is also shown for comparison purposes. Table 3 indicates additional ramps will begin to operate at unacceptable levels of service, particularly in the I-80/I-29 overlap section of the study area. Table 3 also indicates that most ramp junctions outside of the overlap will operate at LOS C even in the No-Build scenario. The exception is the eastbound I-80 off-ramp to Madison Avenue.

An overall assessment of ramp junction level of service for the Year 2020 No-Build scenario is provided graphically in Appendix A.

TABLE 3 - Ramp Junction LOS Summary

Interchange	Ramp	Existing		2020 No-Build	
		AM	PM	AM	PM
Highway 6 & I-80	EB Off Ramp	A	B	B	C
	EB On Ramp	A	A	B	B
	WB Off Ramp	A	A	B	A
Madison & I-80	EB On Ramp	B	A	B	B
	EB Off Ramp	A	C	B	D
	WB Off Ramp	A	B	B	C
Highway 275/92 & I-29	EB On Ramp	A	A	B	B
	WB Off Ramp	A	A	B	B
	EB On Ramp	B	B	C	C
East I-80/I-29 System Interchange	NB Off Ramp	A	A	B	A
	NB On Ramp	See Weaving	See Weaving	See Weaving	See Weaving
	SB Off Ramp	A	A	B	B
	SB On Ramp	A	A	A	A
	NB I-29/EB I-80 Diverge	See Weaving	See Weaving	See Weaving	See Weaving
S. Expressway & I-80/I-29	WB I-80/SB I-29 Merge	A	A	A	A
	WB I-80/SB I-29 Diverge	B	B	B	B
	NB I-29/EB I-80 Merge	A	B	B	C
	EB I-80/SB I-29 Diverge	See Weaving	See Weaving	See Weaving	See Weaving
	WB I-80/NB I-29 Merge	See Weaving	See Weaving	See Weaving	See Weaving
24th Street & I-80/I-29	EB Off Ramp	B	D	C	F
	EB On Ramp	See Weaving	See Weaving	See Weaving	See Weaving
	WB Off Ramp	See Weaving	See Weaving	See Weaving	See Weaving
	WB On Ramp	C	B	F	D
West I-80/I-29 System Interchange	EB On Ramp	B	D	C	F
	NB I-29/WB I-80 Diverge	B	B	D	C
	EB I-80/SB I-29 Merge	A	C	B	F
	EB I-80/NB I-29 Diverge	B	C	C	F
	SB I-29/WB I-80 Merge	B	B	D	C
	WB I-80/SB I-29 Diverge	See Weaving	See Weaving	See Weaving	See Weaving
Nebraska Avenue & I-29	EB I-80/NB I-29 Merge	B	B	C	B
	NB Off Ramp	B	B	C	C
	NB On Ramp	B	B	C	C
	SB Off Ramp	A	B	B	B
9th Avenue & I-29	SB On Ramp	See Weaving	See Weaving	See Weaving	See Weaving
	NB Off Ramp	B	B	C	C
	NB On Ramp	B	B	C	C
	SB Off Ramp	See Weaving	See Weaving	See Weaving	See Weaving
I-29/I-480 System Interchange	SB On Ramp	B	B	B	C
	NB I-29/WB I-480 Diverge	B	B	C	B
	SB I-29/EB I-480 Merge	See Weaving	See Weaving	See Weaving	See Weaving
	EB I-480/NB&SB I-29 Diverge	A	B	A	C
	WB I-480/NB&SB I-29 Merge	B	A	B	A
Avenue G & I-29	SB I-29/WB I-480 Diverge	See Weaving	See Weaving	See Weaving	See Weaving
	NB I-29/EB I-480 Merge	A	A	A	B
	SB Off Ramp	A	A	B	A
35th Street G & I-29	SB On Ramp	See Weaving	See Weaving	See Weaving	See Weaving
	NB Off Ramp	A	A	A	B
25th Street & I-29	NB On Ramp	A	A	A	B
	SB Off Ramp	A	A	A	A
	NB On Ramp	A	A	A	A
	SB On Ramp	A	A	B	A
	SB Off Ramp	A	A	B	A
Highway 192 & I-29	NB On Ramp	A	B	B	B

3.4 SIGNALIZED INTERSECTION LEVEL OF SERVICE

Level of service analyses were performed for each of the corresponding ramp-street junctions in the study area. Ramp-street junctions that are currently signalized are summarized in this section. Ramp-street junctions that are currently unsignalized are summarized in the next section.

Methodology/Definitions/Assumptions

Level of service analyses were performed following Chapter 9 procedures (Signalized Intersections) of the HCM, SYNCHRO 3.0, a computerized analytical tool based on the HCM, was utilized to evaluate the operational characteristics of signalized intersections.

Level of service for signalized intersections is defined in terms of average stopped delay per vehicle for a 15-minute analysis period. This delay is a measure of driver discomfort and frustration, fuel consumption, and lost travel time. LOS A through E are described below.

LOS	Average Stopped Delay Per Vehicle (sec)
A	≤ 5.0
B	> 5.0 and ≤ 15.0
C	> 15.0 and ≤ 25.0
D	> 25.0 and ≤ 40.0
E	> 40.0 and ≤ 60.0
F	> 60.0

Initially, the analysis was performed using the No-Build traffic volumes, existing intersection geometry and existing signal timing/phasing. As necessary, however, revisions to the signal timing/phasing were made to serve the traffic volumes. Revisions to the intersection geometry were not considered as part of the No-Build analysis.

Results

Table 4 on the next page summarizes the results of the analysis of signalized intersections for the Year 2020 No-Build scenario. Level of service for the existing conditions is also shown for comparison purposes. Table 4 indicates that half of the signalized intersections in the study area will operate overall at LOS D or worse or will have specific movements that operate at LOS D or worse. The worst operations will occur at the ramp terminal intersections of the Madison Avenue/I-80, South Expressway/I-80 and Nebraska Avenue/I-29 interchanges.

Based on observations of existing traffic operations, it is also reasonable to expect that unacceptable operations may occur in the Year 2020 at the 24<sup>th</sup> Street/I-80 interchange. The discrepancy between observed operations and analysis results is likely due to the inability of the HCM procedures to replicate the impacts of the high percentage of heavy trucks which utilize this interchange and the grades approaching the intersections.

An overall assessment of signalized intersection level of service for the Year 2020 No-Build scenario is provided graphically in Appendix A.

TABLE 4 - Signalized Intersection LOS Summary

Intersection			Existing				2020 No-Build			
			AM LOS	AM Delay	PM LOS	PM Delay	AM LOS	AM Delay	PM LOS	PM Delay
Madison Avenue & EB I-80 Off Ramp	NB Madison	Thru/Right	B	8.4	B	9.6	B	9.2	B	11.4
	SB Madison	Left	A	3.5	A	4.9	A	3.5	B	6.6
		Thru	A	3.8	B	6.3	A	3.9	B	7.7
	EB Off Ramp	Left	B	7.7	B	9.5	B	8.4	D	29.5
		Thru	B	7.7	B	9.5	B	8.4	D	29.3
		Right	B	7.3	B	8.7	B	7.6	B	14.3
	Intersection Total			B	7.3	B	8.4	B	7.9	C
South Expressway & EB I-80 / SB I-29 Off Ramp	NB Express.	Left	B	6.3	C	18.8	B	6.7	F	*
		Thru/Right	B	11.3	B	13.1	B	14.2	F	96.3
	SB Express.	Left	A	2.1	B	13.9	C	15.5	B	11.7
		Thru	B	5.1	D	31.6	D	29.4	F	*
	EB Off Ramp	Left/Thru	B	12.4	C	22.1	C	20.6	D	38.2
		Right	B	7.4	B	13.6	B	10.1	F	93.7
	Intersection Total			B	8.4	C	19.8	C	19.3	F
South Expressway & WB I-80 / SB I-29 Off Ramp	NB Express.	Left	B	12.6	D	26.2	C	19.2	F	78.7
		Thru/Right	A	4.1	A	2.2	A	4.7	B	5.3
	SB Express.	Thru	B	12.8	C	23.0	C	19.1	F	71.8
	EB Off Ramp	Left/Thru	B	9.7	C	22.7	C	21.1	D	31.2
	WB Frontage	Left/Thru/Rt.	B	9.1	C	21.3	C	19.2	D	27.3
	Intersection Total			B	8.9	B	14.4	B	12.9	E
24th Street & EB I-80 / SB I-29 Off Ramp	NB 24th	Thru/Right	B	7.4	B	10.1	B	10.8	B	12.3
	SB 24th	Left/Thru	A	2.8	B	5.6	A	5.7	B	6.6
	EB Off Ramp	Left	B	11.3	B	8.1	B	7.7	B	9.3
		Thru/Right	B	10.0	B	7.7	B	6.5	B	8.3
	Intersection Total			B	7.2	B	7.8	B	8.3	B
24th Street & WB I-80 / SB I-29 Off Ramp	NB 24th	Left/Thru	A	4.3	B	6.0	A	7.1	B	11.4
	SB 24th	Thru/Right	B	9.5	B	9.8	B	11.8	B	12.5
	WB Off Ramp	Left	B	9.4	B	9.2	B	8.2	B	10.0
		Thru/Right	B	10.9	B	10.1	B	11.3	B	12.1
	Intersection Total			B	7.3	B	8.1	B	9.5	B
Nebraska Avenue & NB I-29 Off Ramp	SB Off Ramp	Left	B	6.0	B	9.7	B	6.6	B	14.1
		Right	A	2.9	B	5.5	A	4.0	B	8.1
	EB Nebraska	Left	B	5.4	A	4.5	B	5.4	B	7.1
		Thru/Right	B	6.0	A	4.9	B	13.9	A	4.1
	WB Nebraska	Thru/Right	B	11.3	B	10.7	B	13.9	D	25.4
Intersection Total			B	6.8	B	7.8	B	8.4	B	14.1

TABLE 4 - Signalized Intersection LOS Summary (Continued)

Intersection			Existing				2020 No-Build			
			AM LOS	AM Delay	PM LOS	PM Delay	AM LOS	AM Delay	PM LOS	PM Delay
Nebraska Avenue & SB I-29 Off Ramp	NB River	Left	B	12.1	B	7.4	B	11.7	B	8.0
		Thru/Right	B	12.1	B	12.5	B	11.7	B	12.3
	SB Off Ramp	Left	B	8.5	B	8.5	B	9.6	B	13.6
		Thru	B	12.0	B	12.0	B	11.1	B	11.5
		Right	B	7.8	B	8.1	B	8.0	B	8.2
	EB Nebraska	Left	B	5.3	B	5.2	B	5.5	D	38.6
		Thru/Right	B	9.6	B	11.1	B	9.7	B	14.3
	WB Nebraska	Left	B	5.2	B	6.0	B	5.4	A	4.9
		Thru/Right	B	9.2	B	9.6	B	10.4	C	21.9
	Intersection Total			B	8.5	B	9.4	B	9.3	C
9th Avenue & NB I-29 Off Ramp	NB Off Ramp	Left	B	8.4	B	7.2	B	9.0	B	6.7
		Thru	B	8.5	B	7.3	B	9.1	B	6.9
		Right	B	9.6	B	10.4	B	11.4	C	20.0
	EB 9th	Left	A	3.5	B	6.1	A	3.3	B	7.5
		Thru	A	3.6	B	6.8	A	3.5	B	7.8
	WB 9th	Thru/Right	B	8.9	B	11.2	B	8.3	B	12.8
	Intersection Total			B	8.3	B	9.4	B	8.7	B
9th Avenue & SB I-29 Off Ramp	SB Off Ramp	Left	B	12.2	B	11.8	B	12.9	B	11.9
		Thru/Right	B	11.8	B	10.7	B	12.1	B	10.7
	EB 9th	Thru/Right	B	10.7	B	8.9	B	11.2	B	11.0
	WB 9th	Left/Thru	A	3.4	A	3.3	A	3.9	A	3.6
	Intersection Total			B	5.7	B	7.1	B	6.5	B

4.5 UNSIGNALIZED INTERSECTION LEVEL OF SERVICE

This section summarizes the level of service analyses that were performed for unsignalized ramp-street junctions in the study area.

Methodology/Definitions/Assumptions

Level of service analyses were analyzed based on Chapter 10 procedures (Unsignalized Intersections) of the HCM and performed using the HCS.

Level of service for unsignalized intersections is defined in terms of the average total delay per vehicle for a 15-minute analysis period. Total delay is defined as the total elapsed time from when a vehicle stops at the end of the queue until the vehicle departs from the stop line. The average total delay for any particular minor movement is a function of the service rate or capacity of the approach and the degree of saturation. LOS A through E are described on the next page.

LOS	Average Total Delay Per Vehicle (sec)
A	≤5.0
B	> 5.0 and ≤ 10.0
C	> 10.0 and ≤ 20.0
D	> 20.0 and ≤ 30.0
E	> 30.0 and ≤ 45.0
F	> 45.0

**Results**

Table 5 summarizes the results of the analysis of unsignalized intersections in the study area. Level of service for the existing conditions is also shown for comparison purposes. Table 5 indicates that the number of unsignalized intersections with specific movements that are currently operating at LOS D or worse will increase from two to five.

An overall assessment of unsignalized intersection level of service for the Year 2020 No-Build scenario is provided graphically in Appendix A.

A traffic signal warrant analysis was performed to assess the potential need for traffic signals at the intersections that are expected to have poor unsignalized movements. The analysis was performed using the warrants contained in the Manual on Uniform Traffic Control Devices (MUTCD). Typically these warrants are applied as part of a comprehensive evaluation of existing conditions at a site to determine if a traffic signal is warranted based on traffic volumes, pedestrians, accident experience, traffic progression, etc. Because this traffic study addresses future conditions, only Warrant 11 dealing with peak hour traffic volumes was applied.

The results are summarized below. All of the analyzed intersections except the N. 25<sup>th</sup> Street/SB I-29 Off-Ramp would be expected to meet Signal Warrant No. 11.

Intersection	Meet Warrant 11 for Year 2020 No-Build Volumes?
US Highway 6 / EB I-80 Off Ramp	Yes
US Highway 6 / WB I-80 Off Ramp	Yes
Madison Avenue / WB I-80 Off Ramp	Yes
US Highway 275 / NB I-29 Off Ramp	Yes
N. 25 <sup>th</sup> Street / SB I-29 Off Ramp	No

**TABLE 5 - Unsignalized Intersection LOS Summary**

Int./Approach/Movement			Existing				2020 No-Build			
			AM LOS	AM Delay	PM LOS	PM Delay	AM LOS	AM Delay	PM LOS	PM Delay
Highway 6 & EB I-80 Off Ramp	EB Hwy 6	Left	A	3.9	A	3.0	B	5.7	A	3.9
	NB Off Ramp	Left	C	13.9	C	18.2	F	80.0	F	232.2
		Right	A	2.8	A	3.4	A	2.9	A	3.9
	Intersection Total				3.6		5.9		16.6	
Highway 6 & WB I-80 Off Ramp	WB Hwy 6	Left	A	3.6	A	3.9	A	4.5	B	6.3
	SB Off Ramp	Left	C	13.1	C	11.9	D	25.4	D	27.9
		Right	A	3.7	A	3.5	A	4.5	A	4.0
	Intersection Total				1.4		0.6		1.8	
Madison Ave & WB I-80 Off Ramp	NB Madison	Left	B	6.4	B	8.7	C	19.2	F	47.3
	WB Off Rmp	Left	C	18.9	F	109.3	F	167.5	F	*
		Right	A	3.9	B	5.6	A	4.8	B	9.8
	Intersection Total				1.4		3.2		7.0	
Hwy 275/92 & NB I-29 Off Ramp	NB Off Ramp	Left	B	9.4	E	36.7	E	30.6	F	*
		Right	A	2.9	A	4.9	A	3.4	B	9.3
	Intersection Total				1.9		1.8		4.7	
Hwy 275/92 & SB I-29 On Ramp	WB 275/92	Left	A	2.5	B	5.3	A	2.8	B	9.6
	Intersection Total				0.1		0.1		0.1	
41st Street & EB I-480 Off Ramp	SB 41st	Left	A	2.2	A	2.2	A	2.3	A	2.3
	EB Off Ramp	Left	A	4.2	A	4.6	A	4.6	B	5.4
		Thru/Right	A	3.6	A	3.9	A	3.6	A	4.4
	WB S. 37th	Left	A	3.9	A	4.5	A	4.2	B	5.3
		Right	A	2.9	A	2.9	A	3.0	A	2.9
	Intersection Total				2.3	A	3.1		2.4	A
41st Street & WB I-480 On Ramp	SB Dodge Pk	Left	A	2.2	A	2.4	A	2.2	A	2.5
	WB Ave A	Left/Thru/Rt	A	4.4	A	4.2	A	4.7	B	5.1
	NB 41 <sup>st</sup>	Left	A	2.2	A	2.1	A	2.2	A	2.2
	Intersection Total				2.8		1.5		2.5	
Avenue G & SB I-29 Off Ramp	NB Benson	Left/Thru/Rt	A	4.5	A	3.8	B	6.2	A	4.5
	SB Off Ramp	Left/Thru/Rt	B	5.2	B	5.1	A	4.9	B	7.0
	EB Ave G	Left	A	3.1	A	3.0	A	4.2	A	3.3
	WB Ave G	Left	A	2.3	A	2.4	A	2.4	A	2.6
	Intersection Total				0.6		0.9		0.8	
25th Street & NB I-29 Off Ramp	EB Off Ramp	Left	C	10.5	B	6.1	C	17.6	B	8.5
		Right	A	3.3	B	6.1	A	3.6	C	13.7
	SB 25th	Left	A	4.5	A	3.2	B	6.2	A	3.9
	Intersection Total				1.0		3.8		1.3	
25th Street & SB I-29 Off Ramp	WB Off Rmp	Left	C	19.4	B	7.3	F	78.7	C	11.0
		Right	A	2.7	A	2.7	A	2.8	A	2.9
	NB 25 <sup>th</sup>	Left	A	3.5	A	2.7	B	5.1	A	3.1
	Intersection Total				4.6		2.6		9.8	

## CHAPTER 4: NEED FOR IMPROVEMENTS

This chapter summarizes the existing and future deficiencies within the Council Bluffs Interstate System. These deficiencies provide the framework for the improvement alternatives presented in the Chapter 6. Exhibit 3 highlights the primary deficiencies at each interchange in the system.

### 4.1 SUMMARY OF EXISTING DEFICIENCIES

Existing deficiencies as determined in Phase I of the study are summarized below for each of the criteria that were considered. Additional detail is provided in the Phase I report.

#### Pavement

The assessment of the existing pavement in the study area indicated that most of interstate pavement is in fair to poor condition. Pavement on I-80 from the Missouri River Bridge to the East I-80/I-29 System Interchange, and on I-29 from I-80 north to 9th Avenue was rated poor. The remainder of the system was rated fair except for I-29 from N. 25th Street to the north city limits, which was rated good.

#### Highway Structures

The existing condition of highway structures is relatively good. Of the 45 structures reviewed a total of 8 were rated poor.

#### Horizontal alignment

A majority of the horizontal curves in the study area meet or exceed the criteria to achieve a design speed of 70 mph, except at the three system interchanges where about half of the horizontal curves received a rating of either fair or poor. Good ratings were assigned to all other horizontal curves in the study area except for the following two areas:

- The northbound lanes of I-29 near the Highway 192 on ramp were rated fair
- The northbound and southbound lanes of I-29 north of Avenue G were rated poor.

#### Vertical alignment

The entire mainline vertical alignment received a rating of good, based on grade. When combined with the effects of the length of grade, eastbound I-80, east of McPherson Avenue, received a rating of poor. This section results in a speed reduction for trucks of over 15 mph.

#### Stopping sight distance

The analysis of stopping sight distance was based on AASHTO criteria established for a 70 mph design speed and revealed the following:

- Of the 45 crest vertical curves, 18 were rated good, 10 were rated fair, and 17 were rated poor.
- 14 of the crest curves that were rated poor are located at or near the I-29/I-480 interchange.

#### Cross section

Overall, the existing interstate cross-section in the study area rated good based on the lane, shoulder and median width. Several sections of I-29 and I-80 were rated as fair based on foreslope criteria.

#### Decision sight distance

Decision sight distance is adequate at a majority of the critical locations evaluated along the interstate system. Overall, 33 locations along the study area were analyzed for adequate decision sight distance, of which 28 received a rating of good, three received a rating of fair, and two received a rating of poor. All of the areas analyzed on I-80 received a good rating.

#### Exit and entrance ramp design

The design of exit ramps along the interstate mainline, excluding cloverleaf types, are adequate. All loop and cloverleaf ramps in the study area do not have the adequate acceleration or deceleration lengths required to merge to/from the design speed of the interstate. A majority of the entrance ramps, based on both taper length and/or acceleration length, are inadequately designed.

#### Basic number of lanes

There are no violations of the principles of basic number of lanes within the study area. Two basic lanes are provided in each direction throughout the study area. Auxiliary lanes are also provided in some segments of the study area.

#### Lane and route continuity

In general, relatively good route continuity is provided for each directional path. Exceptions include the major merge and diverge points at the East and West I-80/I-29 System Interchanges where vehicles must make a lane change to continue on their designated path.

#### Lane balance

Overall, lane balance is generally maintained throughout the Council Bluffs interstate system. Exceptions to this include the westbound I-80/I-29 off ramp to the South Expressway, the eastbound I-80 off ramp to northbound I-29 at the West I-80/I-29 System Interchange, the southbound I-29 off ramp to 9th Avenue, the eastbound I-480 split between West Broadway and northbound/southbound I-29, and the southbound I-29 off ramp to westbound I-480.

#### Ramp sequence and spacing

Of the 46 ramp pairs that were evaluated, eight pairs were found to have spacing less than the AASHTO minimum.

#### Guide signing

The review of guide signs in the study area found that most of the signs are properly designed and provide the information necessary for unfamiliar drivers to make informed decisions.

**Safety**

The I-29/I-80 corridor has an accident rate mostly in the fair category. The areas that were rated as "good" tend to be more rural in nature. Accident rate tends to increase at the system interchanges. I-480 is currently experiencing the highest mainline accident rate in the system.

**Freeway level of service**

Most freeway segments in the study area are operating at LOS C or better. The exceptions to this are located in the overlap section of I-80 and I-29.

**Weaving level of service**

The weaving segment on southbound I-29 between Avenue G and the I-29/I-480 System Interchange is operating at LOS E in the AM peak hour. The weaving segment on southbound I-29 between 9th Avenue and the I-29/I-480 System Interchange is operating at LOS D in the PM peak hour. All other weaving segments are currently operating at LOS C or better.

**Ramp junction level of service**

Most ramp junctions are operating at LOS C or better during the morning and afternoon peak hours. The exceptions to this are located in the overlap section of I-80 and I-29.

**Signalized intersection level of service**

Most signalized intersections in the study area are operating at LOS C or better during the AM and PM peak hours. The ramp terminal intersections at the South Expressway interchange are operating at LOS D.

**Unsignalized intersection level of service**

Most unsignalized intersections in the study area are operating at LOS C or better during the AM and PM peak hours.

**4.2 SUMMARY OF FUTURE DEFICIENCIES**

Although many of the criteria evaluated as part of the existing conditions analysis would be expected to deteriorate or worsen over time and as traffic volumes increase, the assessment of future deficiencies focused on traffic operations only. This assessment is documented in Chapter 3 of this report and summarized below. Note that the future deficiencies represent Year 2020 No-Build conditions.

**Freeway level of service**

Level of service on the basic freeway segments will likely worsen by one level. As a result, additional segments will provide unacceptable operations (LOS E or worse) and several segments will begin to approach the limit of acceptable operations (LOS D) when compared to existing conditions. The worst locations are located in the overlap section of I-80 and I-29.

**Weaving level of service**

In general, weaving level of service will also worsen by one level of service. As a result, the only weaving area providing LOS C or better for both peak hours is the weaving area on northbound I-29 between the US 275 interchange and the East I-80/I-29 System Interchange.

**Ramp junction level of service**

Additional ramps will begin to operate at unacceptable levels of service, particularly in the I-80/I-29 overlap section of the study area. Most ramp junctions outside of the overlap will operate at LOS C or better even in the No-Build scenario.

**Signalized intersection level of service**

Half of the signalized intersections in the study area will operate overall at LOS D or worse or will have specific movements that operate at LOS D. The worst operations will occur at the ramp terminal intersections of the Madison Avenue/I-80, South Expressway/I-80, S. 24<sup>th</sup> Street/I-80 and Nebraska Avenue/I-29 interchanges.

**Unsignalized intersection level of service**

The number of unsignalized intersections with specific movements operating at LOS D or worse will increase from two to five. A preliminary traffic signal warrant analysis was performed at these locations to assess the potential need for traffic signals. This analysis showed that most of unsignalized intersections with future operational problems would be expected to meet the warrant for peak hour volumes.





**N. 35TH STREET**

- PARTIAL ACCESS ONLY

**HIGHWAY 192**

- PARTIAL ACCESS ONLY
- LEFT SIDE EXIT RAMP
- POOR STOPPING / SIGHT DISTANCE

**US 6**

- RURAL CONFIGURATION
- POOR UNSIGNALIZED INTERSECTION LOS
- SIGNAL WARRANTS MET IN 2020

**AVENUE G**

- PARTIAL ACCESS ONLY
- SUBSTANDARD HORIZONTAL ALIGNMENT
- POOR DECISION / STOPPING SIGHT DISTANCE

**I-29 / I-480 SYSTEM INTERCHANGE**

- POOR SAFETY RATING
- LEFT SIDE EXIT RAMP AND ENTRANCE RAMP
- POOR WEAVING LOS AT MULTIPLE LOCATIONS
- POOR LANE AND ROUTE CONTINUITY
- NO ACCESS TO BROADWAY

**N. 25TH STREET**

- POOR DECISION / STOPPING SIGHT DISTANCE
- POOR UNSIGNALIZED INTERSECTION LOS
- PROXIMITY OF SIGNAL AT NASH

**9TH AVENUE**

- SUBSTANDARD ON-RAMP TAPERS
- POOR DECISION / STOPPING SIGHT DISTANCE
- POOR LANE BALANCE

**WEST I-80 / I-29 SYSTEM INTERCHANGE**

- LEFT SIDE EXIT RAMP AND ENTRANCE RAMP
- POOR LANE AND ROUTE CONTINUITY
- POOR LANE BALANCE

**MADISON AVENUE**

- POOR SAFETY RATING
- SUBSTANDARD ON-RAMP TAPERS
- INADEQUATE LANES ON MADISON
- PROXIMITY OF SIGNAL AT WOODBURY

**EAST I-80 / I-29 SYSTEM INTERCHANGE**

- POOR SAFETY RATING
- LEFT SIDE EXIT RAMP AND ENTRANCE RAMP
- POOR WEAVING LOS AT MULTIPLE LOCATIONS
- POOR LANE AND ROUTE CONTINUITY

**NEBRASKA AVENUE**

- SUBSTANDARD LOOP RAMP RADIUS / ON-RAMP TAPER

**US 275**

- PARTIAL ACCESS ONLY
- SUBSTANDARD ON-RAMP TAPERS
- POOR UNSIGNALIZED INTERSECTION LOS

**S. 24TH STREET**

- POOR RAMP JUNCTION LOS
- HIGH TRUCK PERCENTAGE

**SOUTH EXPRESSWAY**

- POOR LANE BALANCE
- SUBSTANDARD LOOP RAMP RADIUS / ON-RAMP TAPER
- POOR SIGNALIZED INTERSECTION LOS
- POOR RAMP JUNCTION LOS

**SYSTEM DEFICIENCIES**

- POOR PAVEMENT CONDITIONS
- POOR BRIDGE RATINGS
- POOR FREEWAY LOS BETWEEN MISSOURI RIVER AND EAST SYSTEM INTERCHANGE

## CHAPTER 5: FRAMEWORK FOR PLAN DEVELOPMENT

This chapter summarizes the criteria utilized in the development and assessment of improvement alternatives for the Council Bluffs Interstate System.

### 5.1 PLANNING PRINCIPLES

From the alternative concepts that are presented in this report, an overall improvement plan for the Council Bluffs Interstate System will be developed. As such, an understanding of the objectives, constraints and guiding principles of the overall improvement plan is critical even during the development and assessment of the alternatives. Some of these considerations are presented below.

**Long Range Plan.** When complete, the overall plan will represent a long range solution to existing and future deficiencies in the Council Bluffs Interstate System. It must be recognized that implementation of the plan will occur over an extended period of time, requiring that the plan be phased based on prioritized needs, available funding, etc. It is also desirable for short-term improvements to be consistent with the long-term improvements to minimize throw-away costs.

**Budget Constraints.** Although the plan will be implemented with consideration of funding availability, existing budget constraints should not be allowed to drive the development of the plan. However, care must be exercised so that the overall plan is not jeopardized by considering alternatives which may be cost-prohibitive.

**Flexibility.** The overall plan must be flexible to accommodate a range of traffic volumes as the land use, population, employment, and needs of the Council Bluffs metropolitan area change over time.

**Sensitivity.** The overall plan should be sensitive to local community values and concerns with respect to quality of service, safety, the environment, and costs as these too change over time.

**Compatibility.** The plan should be compatible with other elements of the transportation network. Overbuilding or underbuilding of the system should be avoided.

**Design Level of Service.** The design level of service for Council Bluffs Interstate System is LOS D. This will provide the users of the system with a relatively high level of traffic operations and while avoiding the impacts and costs that would accompany facilities providing a higher level of service.

**Operational Principles.** The overall plan should be compatible with current operational principles such as basic number of lanes, lane balance, lane and route continuity and ramp spacing.

**Design criteria.** The plan should also comply with all physical and geometric design standards and criteria that are applicable. Design criteria applied during the development and assessment of improvement alternatives are summarized in the next section.

### 5.2 DESIGN CRITERIA

Criteria and standards applied during the development and assessment of improvement alternatives are summarized in Tables 6 and 7, for the mainline elements and ramp elements of the system, respectively.

The criteria/standards are based on the 1990 AASHTO Policy on Geometric Design of Highways and Streets, the 1994 Highway Capacity Manual, various Iowa Department of Transportation design manuals and policies and other widely accepted published standards and guidelines on highway design and traffic operations.

The criteria/standards for the Council Bluffs Interstate Study refer to "full" and "basic" criteria rather than "desirable" and "minimum". With terms such as "desirable" and "minimum" there is an implication that some elements of the system will be designed to "undesirable" standards. In contrast, the terms "full" and "basic" imply that the standards are appropriate and will produce a high quality of design. Definitions are provided below:

*Full Standard* - Representative of a value or dimension designated to provide for a high degree of safety and operational efficiency.

*Basic Standard* - Representative of a value or dimension designated to adequately provide for safety and operational efficiency.

The report for Phase I, entitled "Analysis of Existing Conditions", included an assessment of the physical conditions, geometric features, operational features and performance measures of the interstate system. For many of these measures, ratings of "good", "fair" or "poor" were applied as a means of describing the quality of the measure. These ratings were developed prior to and independently from the criteria/standards summarized in Tables 6 and 7. In general, however, a "good" rating from Phase I corresponds to the "full" standard of Phase II, while the "fair" rating corresponds to the "basic" standard. The exceptions are generally limited to a few geometric features for which the "full" standard provides a higher degree of design than a "good" rating. For example, a stopping sight distance greater than 625 feet resulted in a "good" rating in Phase I while a stopping sight distance greater than 850 feet was required to meet the "full" criteria in Phase II.

Given the study objective of developing a long-range functional plan for the interstate system, the criteria/standards do not specifically address details of final design. Such details will be addressed in the preparation of construction plans Phase III of the study. In addition, the criteria/standards are intended to reflect a high-type design wherever possible. This offers the following advantages:

- Use of high standards provides a cushion of safety and flexibility if compromises are required later in the development of the plan.
- Use of high standards will result in the greatest costs and impacts, assuring that no surprises will be encountered later in the development of the plan.
- Use of high standards reduces the likelihood that future changes in AASHTO Policies will result in a substandard plan or force major geometric revisions.

TABLE 6 – Mainline Design Criteria

Criteria	Full Standard <sup>1</sup>	Basic Standard <sup>2</sup>
DESIGN SPEED	70 mph	60 mph
SIGHT DISTANCE		
Stopping <sup>3</sup>	850 ft.	650 ft.
Decision <sup>4</sup>	1,450 ft.	1,275 ft.
HORIZONTAL ALIGNMENT		
Maximum Curvature	2°45'	4°15'
Maximum Superelevation	0.06 ft./ft.	
Transitional Curvature	AASHTO Spiral	
Lane Drop Taper <sup>5</sup>	70:1	50:1
VERTICAL ALIGNMENT		
Minimum Grade	0.50%	
Maximum Grade	3%	
Maximum Speed Reduction for Trucks <sup>6</sup>	10 mph	15 mph
Vertical Curve Length <sup>7</sup>	L = 3 X Design Speed or L = K X Algebraic Grade Diff. (whichever is greater)	
Crest	K = 540	K = 310
Sag	K = 220	K = 160
Minimum Clearance		
Above Roadways <sup>8</sup>	16.5 ft.	
Over Railroad Tracks	23.5 ft.	
Minimum Roadway Elevation <sup>9</sup>	3 ft. above 100 year flood	
CROSS SECTION		
Lane Width	12 ft.	
Shoulder Width <sup>10</sup>		
4-Lane Freeway		
Left	6 ft.	
Right	10 ft.	
6-Lane Freeway		
Left	12 ft.	
Right	12 ft.	10 ft.
8-Lanes or more		
Left	12 ft.	
Right	10 ft.	
Normal Cross Slope		
Lanes	2-3%	
Shoulders	4%	
Maximum Cross Slope Break	7%	8%
Foreslope	6:1 / 3:1 Barn Roof	
Backslope	2.5:1	

TABLE 6 – Mainline Design Criteria (Continued)

Criteria	Full Standard <sup>1</sup>	Basic Standard <sup>2</sup>
RAMP SEQUENCE AND SPACING <sup>11</sup>		
Entrance - Entrance	1,000 ft. - 800 ft.	
Exit - Exit	1,000 ft. - 800 ft.	
Exit - Entrance	500 ft. - 400 ft.	
Entrance - Exit		
System to Service Interchange	2,000 ft. - 1,600 ft.	
Service to Service Interchange	1,600 ft. - 1,000 ft.	
INTERCHANGE DESIGN		
Ramp Location	All right-hand ramps	Existing left-hand ramps permissible <sup>12</sup>
DESIGN YEAR LEVEL OF SERVICE		
Peak Hour	C	D
RAMP TERMINALS <sup>13</sup>		
Taper Angle		
Entrance (Merge)	50:1	
Exit (Diverge)	15:1	

Notes

1. Full Standard represents a value or dimension designated to provide for a high degree of safety and operational efficiency.
2. Basic Standard represents a value or dimension designated to adequately provide for safety and operational efficiency.
3. AASHTO stopping sight distance based on assumed Design Speed.
4. AASHTO decision sight distance for Avoidance Maneuver E (speed/path/direction change on urban road) based on assumed Design Speed.
5. Based on Length of Taper = Speed (mph) X Width (per IaDOT Road Design Memorandum No. 183).
6. Based on AASHTO typical heavy vehicle (WT/HP = 300); see p. 262, Figure III-30, AASHTO Policy.
7. K values represent upper range for design speed based on stopping sight distance.
8. Based on 16.5 ft. clearance including 6-inch margin for future pavement overlays.
9. Based on 100 year flood elevation.
10. Measured from edge line of outside travel lane.
11. Higher value is for ramps on a freeway. Lower value is for ramps on a collector-distributor road.
12. Left hand ramps permissible only as existing ramps and only where removal and/or replacement is not feasible or cost-effective.
13. Standards for mainline ramp terminals.

TABLE 7 – Ramp Design Criteria

Criteria	Full Standard <sup>1</sup>	Basic Standard <sup>2</sup>
<b>DESIGN SPEED</b>		
System Interchange Ramp	70 mph <sup>d</sup>	60 mph <sup>4</sup>
Direct Ramp (Service Interchange) <sup>b</sup>	60 mph	50 mph
Loop Ramp (Service Interchange)	30 mph	25 mph
<b>RAMP TERMINALS <sup>b</sup></b>		
Taper Angle		
Entrance (Merge)		50:1
Exit (Diverge)		15:1
<b>HORIZONTAL ALIGNMENT</b>		
Maximum Curvature		
System Ramp	2° 45'	4° 15'
Direct Ramp	4° 15'	6° 45'
Loop Ramp	R = 231 ft.	R = 165 ft.
Maximum Superelevation		
System Ramp		0.06 ft./ft/
Direct Ramp		0.06 ft./ft/
Loop Ramp		0.06 ft./ft/
Transition Curvature		No spirals required
Lane Drop Taper	70:1	50:1
Maximum Angle at Ramp Intersection		60°
<b>VERTICAL ALIGNMENT</b>		
Minimum Grade	0.50%	
Maximum Grade	5%	6%
Maximum Speed Reduction for Trucks <sup>f</sup>	10 mph	15 mph
Vertical Curve Length <sup>b</sup>	L = 3 X Design Speed or L = K X Algebraic Grade Diff. (whichever is greater)	
Crest (Direct Ramp)	K = 310	K = 160
Sag (Direct Ramp)	K = 160	K = 110
Minimum Clearance		
Above Roadways <sup>g</sup>		16.5 ft.
Over Railroad Tracks		23.5 ft.
Minimum Roadway Elevation		3 ft. above 100 year flood
<b>CROSS SECTION</b>		
Lane Width		
1 Lane Ramp		
Direct Ramp		16 ft.
Loop Ramp		18 ft.
2 Lane Ramp		
Exit		24 ft.
Entrance		24 ft.

TABLE 7 – Ramp Design Criteria (Continued)

Criteria	Full Standard <sup>1</sup>	Basic Standard <sup>2</sup>
Shoulder Width		
1 Lane Ramp		Left = 4' Right = 6'
2 Lane Ramp		Left = 6' Right = 10'
Normal Cross Slope		
Lanes	2%	
Shoulders	4%	
Maximum Cross Slope Break	7%	8%
Foreslope		6:1 / 3:1 Barn Roof
Backslope		2.5:1

Notes

1. Full Standard represents a value or dimension designated to provide for a high degree of safety and operational efficiency.
2. Basic Standard represents a value or dimension designated to adequately provide for safety and operational efficiency.
3. 70 mph minimum for “thru” ramps (i.e., ramps serving the continuation of an interstate route).
4. 60 mph minimum for “non-thru” ramps (i.e., ramps serving traffic from one route to another).
5. Design Speed for mainline entrance/exit tapers to be 60 mph.
6. Standards for ramp splits, ramp-to-ramp merges, etc.
7. Applies only to interstate-to-interstate movements.
8. K values represent upper range for design speed based on stopping sight distance.
9. Based on 16.5 ft. clearance including 6-inch margin for future pavement overlays.

## CHAPTER 6: LONG-TERM ALTERNATIVES

This chapter summarizes the development and assessment of improvement alternatives for the Council Bluffs Interstate System. These alternatives were developed for the basic lane needs of the overall system and for each interchange.

### 6.1 BASIC LANE NEEDS

Basic freeway lanes serve as the backbone of any interstate system. The basic number of lanes of a freeway is defined as a minimum number of lanes designated or maintained over a significant length of a route irrespective of localized changes in traffic volume and irrespective of the requirements for lane balance. At least two lanes should be provided in each direction of a freeway, exclusive of auxiliary lanes. Where traffic volumes justify additional lanes, it is desirable to provide a constant number of lanes over significant lengths of freeway.

An increase in the basic number of lanes is required where traffic builds sufficiently to justify an extra lane and where such a lane is justified for a significant length. To accommodate localized variations in traffic volumes, auxiliary lanes should be provided (See Section 6.3). The basic number of lanes may be decreased where traffic is reduced sufficiently to drop a basic lane, provided there does not exist a need to again add the basic lane downstream.

The results of the basic freeway segment analysis of Year 2020 AM and PM peak hour volumes for the No-Build and Build Scenarios were used to determine the basic lanes needs of the system. Where the No-Build analysis indicated an unacceptable level of service, one additional basic lane was added in each direction. As a check, these six-lane sections were then analyzed with Build volumes to assess whether the six-lane section could accommodate a higher traffic volume level that might result following the provision of additional capacity.

#### Recommendation

Exhibit 7 documents the results of the analysis. One additional basic lane (providing a six-lane section) is recommended on I-80 between the Missouri River and the East I-80/I-29 System Interchange. For the remainder of I-29 and I-80 in the study area, the four basic lanes that are currently provided will provide acceptable traffic operations through the Year 2020. The existing eight lanes of traffic on the I-480 bridge (six basic lanes and two auxiliary lanes) will provide adequate mainline capacity for the Year 2020.

### 6.2 BASIC LANE ALTERNATIVES

Alternatives for providing six basic lanes on I-80 between the Missouri River and the East I-80/I-29 System Interchange were assessed. This section of road can be divided into two distinct subsections with each subsection presenting unique opportunities and constraints for providing six lanes. The first subsection consists of the Missouri River bridge and the mainline approaches to the bridge on the Nebraska side. The second subsection consists of the remainder of the section. Separate discussions of these subsections are provided below.

#### 6.2.1 Missouri River Bridge

The need for six lanes on the I-80 bridge over the Missouri River requires consideration of how the six lane section will match with the proposed cross section of I-80 on the Omaha side. Currently, six lanes are provided west of 13<sup>th</sup> Street and four lanes are provided east of 13<sup>th</sup> Street. MAPA's Long Range Transportation Plan does not include further widening of I-80 between 13<sup>th</sup> Street and the Missouri River. However, with the recent reconstruction of I-80 in this area, the 13<sup>th</sup> Street and the 10<sup>th</sup> Street bridges over I-80 were reconstructed with spans of sufficient length to allow widening of I-80 to six lanes. The Riverview Boulevard bridge over I-80 may be reconstructed in the future. Therefore, it has been assumed that the provision of six lanes on the I-80 bridge would ultimately match a six-lane cross section on the Omaha side.

The existing I-80 bridge over the Missouri River has two lanes in each direction and shoulders. The left and right shoulders are estimated to be 4 feet and 10 feet, respectively, from available as-built construction plans and from a field review.

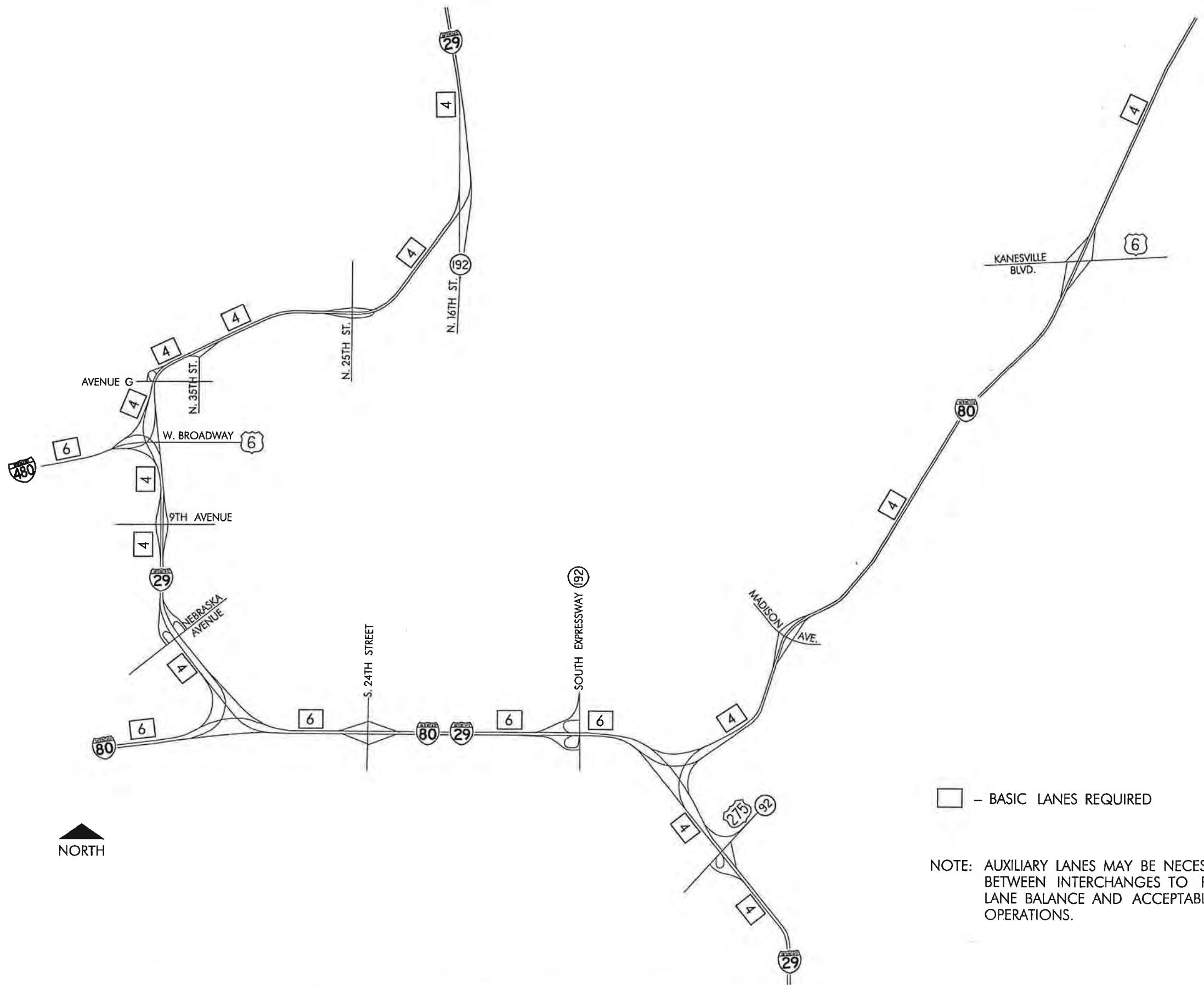
In general, three alternatives exist for providing 6 lanes on the I-80 bridge over the Missouri River. These include 1) restriping the bridge decks to provide minimal shy distances (approximately 2.5 feet) and provide three narrow lanes (approximately 11 feet) in each direction, 2) widening of the existing bridge by at least one lane in each direction, and 3) construction of a new bridge.

Restriping of the existing bridge to provide narrow lanes would be relatively inexpensive and could be implemented in a relatively short period of time once six lanes are provided on each approach to the bridge. Recent research has confirmed that shoulders and narrow lanes can be used effectively to increase capacity in congested urban corridors. A difference in lane width (12 to 11 feet) by itself has been shown to have no significant impact on capacity, speed or safety.

However, the findings of past studies also indicate that in many instances there may be measurable negative impacts to the overall safety performance of the corridor when other variables are introduced. These variables include physical features such as shoulders or lateral obstacles (e.g., barriers) and operational variables such as high truck percentages. Other issues to be considered include the impacts to maintenance, law enforcement and incident response. For these reasons, restriping of the bridge is not recommended as a long-term solution.

Widening by cantilevering from the existing bridge has been studied at a preliminary level in the past by the Iowa Department of Transportation and found to be impractical. These studies have concluded that additional piers will be necessary to support a wider bridge deck.

With construction of a new bridge, it is possible that the existing bridge could remain in place to serve traffic in one direction. Removal of the existing median barrier of the bridge and provision for drainage would allow the deck to provide at least three directional lanes and full shoulders plus an auxiliary lane. A new bridge would then serve the other direction of traffic. The Nebraska Department of Roads has indicated that the existing bridge is in good condition and is not scheduled for major rehabilitation in the near future.



☐ - BASIC LANES REQUIRED

NOTE: AUXILIARY LANES MAY BE NECESSARY BETWEEN INTERCHANGES TO PROVIDE LANE BALANCE AND ACCEPTABLE TRAFFIC OPERATIONS.

**Recommendation**

Restriping will serve as an acceptable short-term improvement until a long-term solution is implemented. The preferred long-term solution is to construct a second bridge to serve traffic in the westbound direction and retain the existing bridge to serve traffic in the eastbound direction. Mainline widening on the Omaha side will likely occur on the north side of the existing mainline to minimize impacts to the Henry Doorly Zoo. A new bridge is preferred for the following reasons:

- Past research has shown that narrow lanes may result in measurable negative impacts to the overall safety performance of a corridor when other variables such as barriers and/or trucks are introduced.
- Other issues to be considered include the impacts to maintenance, law enforcement and incident response.
- Widening by cantilevering from the existing bridge has been studied at preliminary level in the past and found to be impractical. These studies have concluded that additional piers will be necessary to support a wider bridge deck.
- The existing bridge is in good condition and is not scheduled for replacement in the near future.
- With construction of a new bridge, the median barrier on the existing bridge would be removed to provide sufficient width for three travel lanes, full shoulders plus an auxiliary lane in each direction.

**6.2.2 Missouri River to East I-80/I-29 System Interchange**

The existing cross section of I-80 between the Missouri River and the East I-80/I-29 System Interchange is shown schematically in Exhibit 8. In general, the cross section includes a 50-foot median. Exhibit 8 also illustrates two alternatives for providing six basic freeway lanes on I-80.

Alternative 1 would be to widen to the inside and provide an urban section. With a median barrier, 6 feet is needed between opposing inside shoulders for drainage purposes. Thus, with 12-foot inside shoulders this option would require that the existing travel lanes be moved 2 feet further out from the centerline. Since it is anticipated that all mainline pavement and cross street bridge structures will be reconstructed as part of plan implementation, this shifting of the mainline is not considered a negative impact.

Alternative 2 would retain a rural section by retaining the depressed center median. It would add the additional mainline lane to the outside and provide 12-foot inside and outside shoulders. Although this alternative has been shown in Exhibit 8 without the 2-foot shift shown for Alternative 1, this shift would be necessary to allow further widening to the inside in the future. Design considerations and the operational and safety attributes of each alternative are presented in Table 8.

**Recommendation**

Alternative 1 (Urban Section) is recommended. This alternative is preferred for the following reasons:

- Widening to the inside will have the fewest right-of-way impacts and will reduce the need for retaining walls.
- Widening to the inside will provide positive separation between opposing traffic flows (i.e., a median barrier).
- With auxiliary lanes, some sections of the mainline will have five freeway lanes in each direction. Saving the median for further widening in the future is not cost-effective or practical.

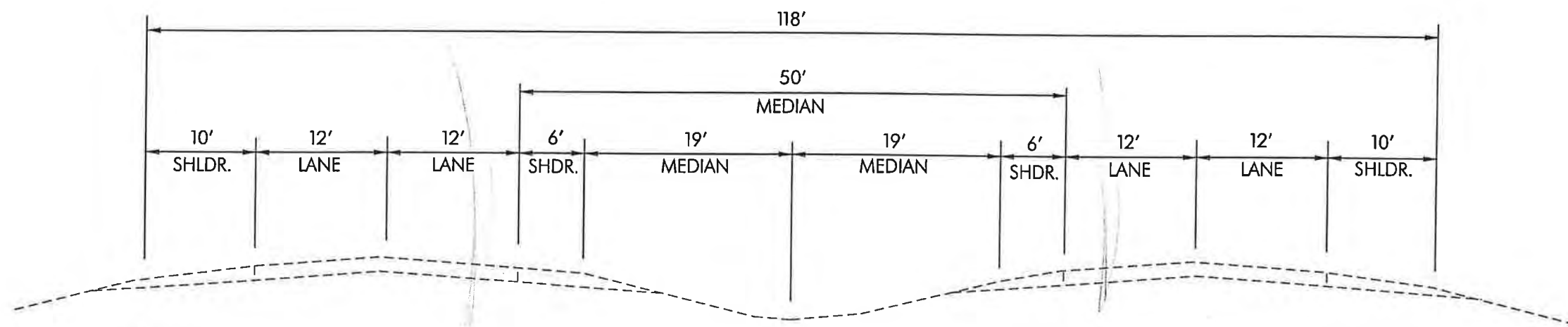
*TABLE 8 – Comparison of Widening Alternatives*

Alternative	Design and Construction Considerations	Operational and Safety Attributes
Alternative 1 - Urban Section (Widen to the Inside)	<ul style="list-style-type: none"> <li>• Requires 2-foot shift of all travel lanes for median construction.</li> <li>• Widening does not require major interchange ramp reconstruction</li> <li>• Sufficient median width for bridge piers, lighting, sign trusses, etc.</li> <li>• Maintains existing centerline</li> <li>• Requires closed drainage</li> </ul>	<ul style="list-style-type: none"> <li>• Full 12-foot left shoulders</li> <li>• Special design needed for full horizontal sight distance</li> <li>• Median barrier provided</li> </ul>
Alternative 2 - Rural Section (Widen to the Outside)	<ul style="list-style-type: none"> <li>• Maintains existing median width</li> <li>• Requires 2-foot shift of all travel lanes for future widening to the inside.</li> <li>• Flexibility of drainage (open or closed)</li> <li>• Median width provided for lighting, sign trusses, etc.</li> <li>• Requires total reconstruction of all ramp terminals</li> <li>• Greatest right-of-way requirements</li> <li>• Greatest retaining wall and structural requirements</li> </ul>	<ul style="list-style-type: none"> <li>• Full 12-foot left shoulders</li> <li>• Median provides full horizontal sight distance</li> <li>• 30-foot clear zone provided</li> </ul>

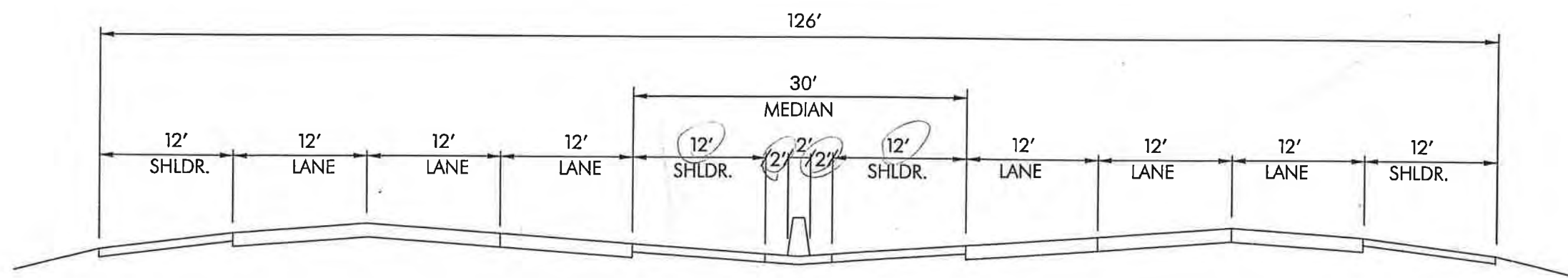
- Widening to the inside does not require major interchange ramp reconstruction. However, most ramps will be reconstructed as part of corridor rehabilitation.
- Although it is anticipated that most cross street bridge structures will be reconstructed as part of plan implementation, a preliminary assessment indicates that the location of the center piers of existing bridges would not significantly impact Alternative 1.

**6.3 AUXILIARY LANE NEEDS**

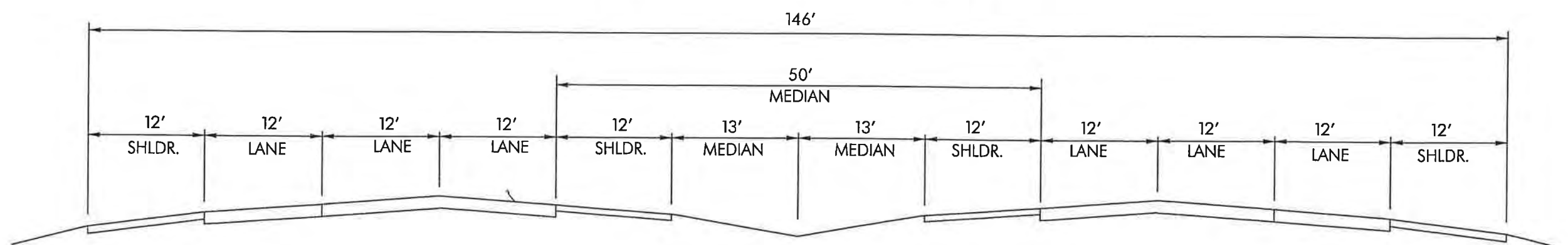
Auxiliary lanes are freeways lanes that are added, as necessary, to accommodate localized variations in traffic volumes, to improve the level of service between closely spaced interchanges, and to assist in accommodating high entering and exiting traffic volumes. The need for auxiliary lanes between adjacent interchanges was evaluated using the methodologies of the HCM and supplemented with the CORSIM simulation model.



**EXISTING**



**ALTERNATIVE 1 (URBAN SECTION)**



**ALTERNATIVE 2 (RURAL SECTION)**



### Recommendation

Auxiliary lanes have been included in a number of the improvement concepts for the system and service interchanges in the study area. They are shown graphically for each interchange addressed in Section 6.4. In general, all auxiliary lanes have been introduced with one-lane or two-lane on ramps. The termination of the auxiliary lanes has been accomplished by either a two-lane off ramp or by tapering the lane just downstream of an off ramp.

### 6.4 INTERCHANGE ALTERNATIVES

Improvement alternatives for each interchange in the study area are presented in the remainder of this chapter. A discussion is presented for each interchange. This discussion includes a brief summary of the deficiencies identified in the assessment of existing and future conditions and the objectives to be met with the alternatives.

For several interchanges, the discussion includes the findings of special model runs performed by MAPA for interchanges where modifications to access are being considered. Each of the improvement alternatives are then discussed.

This discussion is followed by graphical representations of the alternatives on aerial base maps. System interchange alternatives are generally shown at a scale of 1"=800' while service interchanges are generally shown at a scale of 1"=400'. Note that alternatives for some service interchanges are shown together with alternatives for an adjacent system interchange. Finally, at all interchanges for which alternatives have been developed, a screening matrix is presented. The matrix provides a qualitative summary of the following criteria:

- Key design features
- Traffic operations
- Route/lane continuity
- Signing
- Environmental impacts
- Right-of-way and property impacts
- Constructability and maintenance of traffic
- Cost

Although a number of these criteria such as the environmental impacts were assessed qualitatively, several others such as traffic operations and cost are based on quantitative assessments. The cost information for each interchange alternative represents a conceptual-level estimate of the probable construction cost. Several key assumptions of the cost estimates are listed below:

- The cost estimates were prepared based on estimated quantities for pavement and bridges only. Unit costs for each of these were then inflated to include contingencies for other construction items such as earthwork, drainage, maintenance of traffic, lighting, signing, etc.
- Right-of-way and relocation costs have not been included in the cost estimates. At some interchanges, these costs could represent a substantial portion of the total construction cost.

Similarly, the cost estimates do not include soft costs such as engineering and construction administration.

- The cost estimates were prepared to allow comparison between alternatives only. As such, the construction limits utilized in the cost estimates for one interchange do not necessarily match the construction limits for the alternatives of an adjacent interchange. Therefore, the cost estimate for each interchange cannot be summed to estimate the total reconstruction cost of the entire study area. Such cost estimates will be developed following identification of a recommended plan for the entire corridor. A cost estimate for reconstruction of the system to its current configuration will also be prepared as part of the final plan development. This cost estimate will represent the cost to rebuild the system just as it is today. Given the condition of the existing pavement and bridges, this cost estimate would represent the baseline condition.

Finally, the recommendations of the Project Team regarding the alternatives to be carried forward into Phase III of the study are summarized. The selection of preferred alternatives was based primarily on input from members of the TAC. These preferred alternatives will be assessed in greater detail in Phase III of the study. This detailed assessment will then serve as the basis for the selection of a recommended plan for the study area.

## US HIGHWAY 6 / I-80 INTERCHANGE

### EXISTING/FUTURE DEFICIENCIES

The review of the existing US 6/I-80 interchange revealed relatively few deficiencies. Existing traffic operations on the mainline approaches to the interchange and at the ramp junctions are LOS B or better during peak hours. Acceptable traffic operations are currently provided for all movements at the unsignalized ramp terminal intersections.

In the Year 2020 No-Build scenario, the mainline and ramp junctions will operate at LOS C or better. Some movements at the unsignalized ramp terminal intersections will operate poorly. Although intersection lane requirements have been evaluated at a preliminary level, they are not included in this report. Rather, lane requirements for the ramp approaches and cross street approaches to ramp terminal intersections will be studied further as part of Phase III activities following the selection of preferred interchange concepts. These activities are also expected to include further assessment of the need for traffic signals at this interchange and the appropriateness of the existing rural cross section of US Highway 6 in the vicinity of the interchange.

The assessment of existing geometric and physical conditions revealed that the on ramp to eastbound I-80 does not meet standards for taper rate. Mainline pavement condition is rated as "fair" while the bridges are rated "good". The cross section of the mainline is also rated "poor" based on the foreslopes of fill sections. No other physical or geometric deficiencies were identified.

### ACCESS

The existing US Highway 6/I-80 interchange provides full access. Changes to access are not anticipated as part of long-term improvements.

### ALTERNATIVES

Two alternatives were developed for this interchange and are shown in Exhibits 9 and 10, respectively. Based on the condition of the existing mainline pavement and the fact that many of the recommendations of this study will not be implemented in the near future, reconstruction of the mainline pavement throughout the study area is recommended in both alternatives.

#### Alternative 1 (Exhibit 9)

Alternative 1 retains the overall existing diamond interchange configuration. It includes reconstruction of the on ramp to eastbound I-80 to provide a longer taper. Realignment of the off-ramp approaches to US Highway 6 is also recommended to facilitate future signalization of the ramp terminal intersections. Complete reconstruction of other ramps is not recommended unless pavement condition dictates.

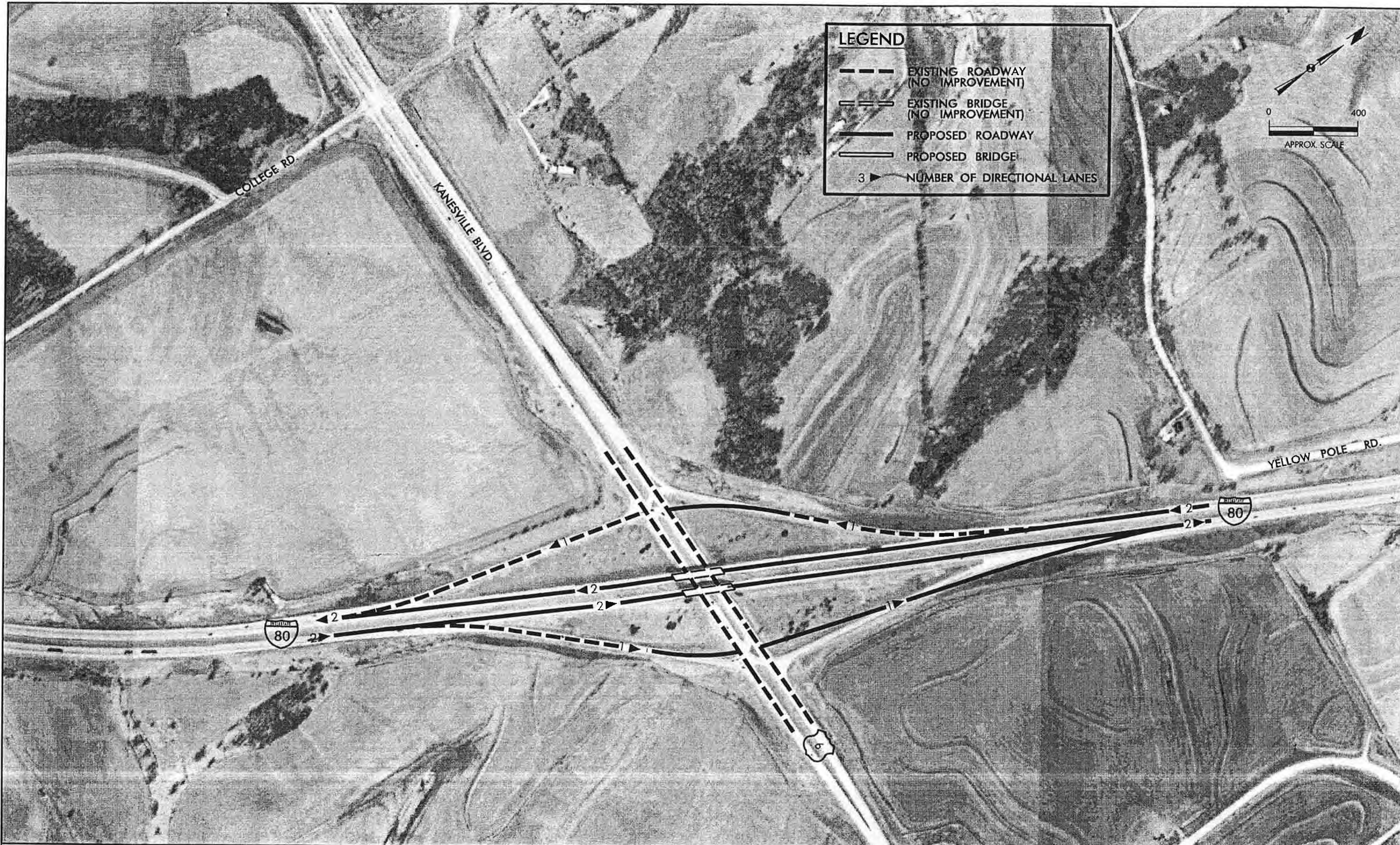
#### Alternative 2 (Exhibit 10)

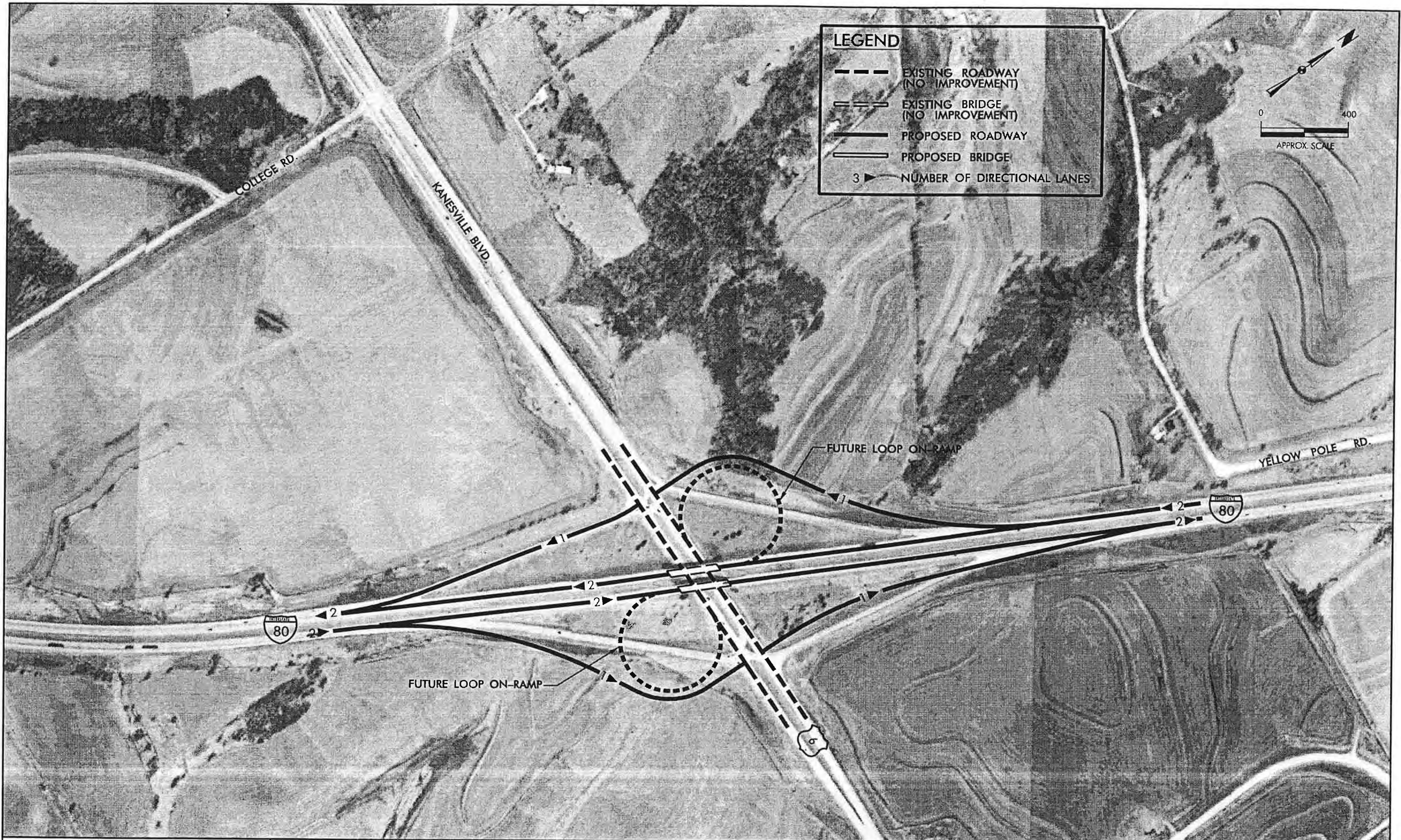
Alternative 2 also provides a diamond interchange configuration but would allow loop on-ramps to be constructed at some point in the future. When constructed, these loop ramps would eliminate left turns

from the cross street and thus simplify the traffic signal phasing at ramp terminal intersections. This configuration has been constructed at numerous locations within the I-80 corridor in Omaha.

### PREFERRED ALTERNATIVES

Both Alternative 1 and Alternative 2 will to be carried forward into Phase III for further assessment.





**LEGEND**

- EXISTING ROADWAY (NO IMPROVEMENT)
- == EXISTING BRIDGE (NO IMPROVEMENT)
- PROPOSED ROADWAY
- PROPOSED BRIDGE
- 3 ▶ NUMBER OF DIRECTIONAL LANES

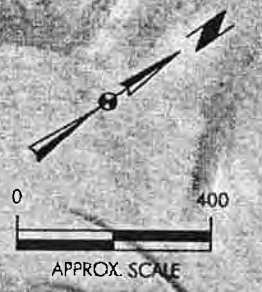


TABLE 9 - Concept Screening Summary – US Highway 6 / I-80 Interchange

Alternative	Exhibit	Design Features/ Impacts	Traffic Operations	Route Continuity/ Signing	Environmental Impacts	Right-of-Way / Property Impacts	Maintenance of Traffic / Constructability	Cost (\$ Million)
1	9	- Diamond interchange configuration. - Reconstruction of on ramp to eastbound I-80 to provide longer taper.	- Acceptable traffic operations provided on the mainline, at the ramp junctions, and at ramp terminals as signalized intersections.	Alternative provides route and lane continuity.	No major impacts have been identified.	No major impacts have been identified.	No major construction issues have been identified.	0.8
2	10	- Diamond interchange configuration with provision for future loop on ramps.	- Acceptable traffic operations provided on the mainline, at the ramp junctions, and at ramp terminals as signalized intersections. - Future loop ramps would eliminate left turns from the cross street and thus simplify signal phasing.	Alternative provides route and lane continuity.	Required right-of-way includes farmland.	Approximately 5 acres of additional right-of-way.	No major construction issues have been identified.	1.1

## MCPHERSON AVENUE / I-80 INTERCHANGE

### EXISTING/FUTURE DEFICIENCIES

There are currently no interchanges on I-80 between US Highway 6 and Madison Avenue, a distance of approximately three miles. The City of Council Bluffs has expressed an interest in constructing a new interchange in the vicinity of McPherson Avenue which crosses I-80 about mid-way between US Highway 6 and Madison Avenue.

Since an interchange does not currently exist at this location, the review of existing and future deficiencies was limited to the I-80 mainline. In this area the existing traffic operations on the mainline is LOS B or better during peak hours and is not expected to worsen beyond LOS C. Mainline pavement condition is rated as "fair" while the cross section of the mainline is rated "poor" in some areas based on the foreslopes of fill sections.

### ACCESS

The output from a special model run performed by MAPA was reviewed to assist in determining the need for a new interchange at McPherson Avenue. For this model run, a full interchange was coded at McPherson Avenue. The Year 2020 network also includes the extension of Valley View Drive north from McPherson Avenue to College Road. Consistent with the procedures utilized in the adjustment and refinement of other Year 2020 model output provided by MAPA, the forecasts for the McPherson Avenue interchange were adjusted and balanced.

In general, this model run showed that the ramps between McPherson Avenue and I-80 to the west will attract approximately 3,000 vehicles per day (vpd) while the ramps between McPherson Avenue and I-80 to the east will attract less than 1,000 vpd. Thus, the ramps to/from the west would be expected to serve approximately 300 vehicles in the peak hour. A portion of this traffic will be diverted from the Madison Avenue interchange and, thus improve traffic operations there. Traffic on Valley View Drive between Madison Avenue and McPherson Avenue would also decrease.

Based on this assessment, a new interchange is recommended at McPherson/I-80 for the following reasons:

- A new interchange at McPherson Avenue will provide greater than one-mile spacing between adjacent interchanges at US Highway 6 and Madison Avenue.
- The new interchange will likely attract sufficient traffic to justify the cost of the interchange.
- The new interchange will provide improved access to existing and future housing developments on the east and west side of I-80.
- A new interchange at McPherson will provide operational benefits by off-loading the Madison Avenue interchange.

A new interchange at this location will require justification and documentation per the requirements of the Federal Highway Administration for a change of access to the existing Interstate System.

### ALTERNATIVES

Six alternatives were developed for this interchange and are shown in Exhibits 11 thru 16, respectively. All six alternatives assume reconstruction of the I-80 mainline.

#### Alternative 1 (Exhibit 11)

Alternative 1 would provide a diamond interchange configuration. The west-side ramp terminal intersection would be located approximately at the existing Valley View Drive/McPherson Avenue intersection. To provide adequate spacing between these two intersections, the Valley View Drive/McPherson Avenue intersection would be relocated 800 feet to the west. This alternative reflects the most recently proposed alignment of the Valley View Drive/College Road Connector. In general, the new alignment is located adjacent to the floodway boundary for Mosquito Creek. With this alternative, the connector road would be constructed on this alignment as an interim improvement. With the construction of the interchange, the connector road would be constructed on the ultimate alignment. This ultimate alignment would require two new bridge crossings of Mosquito Creek. This alternative would impact one home and a church.

As shown in Exhibit 11, the distance between ramp terminal intersections is approximately 1,100 feet in recognition that these two intersections will probably operate unsignalized. This distance could be reduced considerably to provide a tight diamond configuration if traffic signals are installed. A tight diamond configuration would result in fewer impacts to properties but would not eliminate the need to relocate Valley View Drive to the west side of Mosquito Creek.

#### Alternative 2 (Exhibit 12)

Alternative 2 would provide a partial cloverleaf (parclo) configuration with loop ramps in the Northwest and Southeast quadrants of the interchange. Construction of loop ramps in these quadrants eliminates the impact to the church but probably impacts one additional home. The loop ramp in the Northwest quadrant will require that one of the heaviest traffic movements of the interchange (eastbound McPherson to westbound I-80) make a left turn. This may reduce the operational efficiency of the interchange.

Alternative 2 also includes the new alignment of the Valley View Drive/College Road Connector. Similar to Alternative 1, the ultimate alignment of the connector road would cross Mosquito Creek before intersecting McPherson Avenue. Note that this alternative would result in offset intersections along McPherson and require thru traffic on Valley View Drive to make a right turn followed by a left turn. The interim alignment has been modified slightly from that provided by the City with the intent of salvaging the bridge (or culvert) over the Little Mosquito Creek for use with the interchange ramps. In addition, relocation of the stream bed would allow the ramps in the northwest quadrant to be constructed with a more standard configuration. (Alternatives 4 and 5 illustrate how the ramps are impacted by the proposed alignment of the connector road without stream bed relocation.)

#### Alternative 3 (Exhibit 13)

Alternative 3 would also provide a parclo configuration with loop ramps in the Southwest and Northeast quadrants of the interchange. This configuration would allow the alignment for the new Valley View Drive connection between McPherson Avenue and College Road to be aligned with the west ramp terminal. A traffic signal would probably be necessary at this location. It would still be necessary for the

south portion of Valley View Drive to intersect McPherson Avenue on the west side of Mosquito Creek, resulting in offset intersections for thru traffic on Valley View Drive. Loop ramps in the Southwest and Northeast quadrants would allow the heaviest movements of the interchange to operate in relatively free-flow mode. This alternative would impact one home and a church.

#### **Alternative 4 (Exhibit 14)**

Alternative 4 would also provide a parclo configuration with loop ramps in the Northwest and Northeast quadrants of the interchange. The alignment of the ramps in the northwest quadrant of the interchange have been developed with the intent of salvaging the bridge over the Little Mosquito Creek for use with the interchange ramps. This configuration eliminates the impact to the church. However, the loop ramp in the Northwest quadrant will require the eastbound McPherson to westbound I-80 make a left turn. This may reduce the operational efficiency of the interchange.

#### **Alternative 5 (Exhibit 15)**

Alternative 5 provides a diamond interchange configuration but would allow loop on-ramps to be constructed at some point in the future. When constructed, these loop ramps would eliminate left turns from the cross street and thus simplify the traffic signal phasing at ramp terminal intersections. The alignment of the ramps in the northwest quadrant of the interchange would allow the bridge over the Little Mosquito Creek to be salvaged for use with the interchange ramps when the ultimate alignment of the connector road is constructed.

#### **Alternative 6 (Exhibit 16)**

Alternative 6 provides a single-point urban interchange (SPUI). The SPUI essentially combines two separate diamond ramp intersections into one large at-grade intersection which accommodates all interchanging vehicular movements. However, this would require signalization (whereas other alternatives could operate with unsignalized ramp terminal intersections well into the future). This alternative would likely allow the alignment of the connector road to remain on the east side of Mosquito Creek.

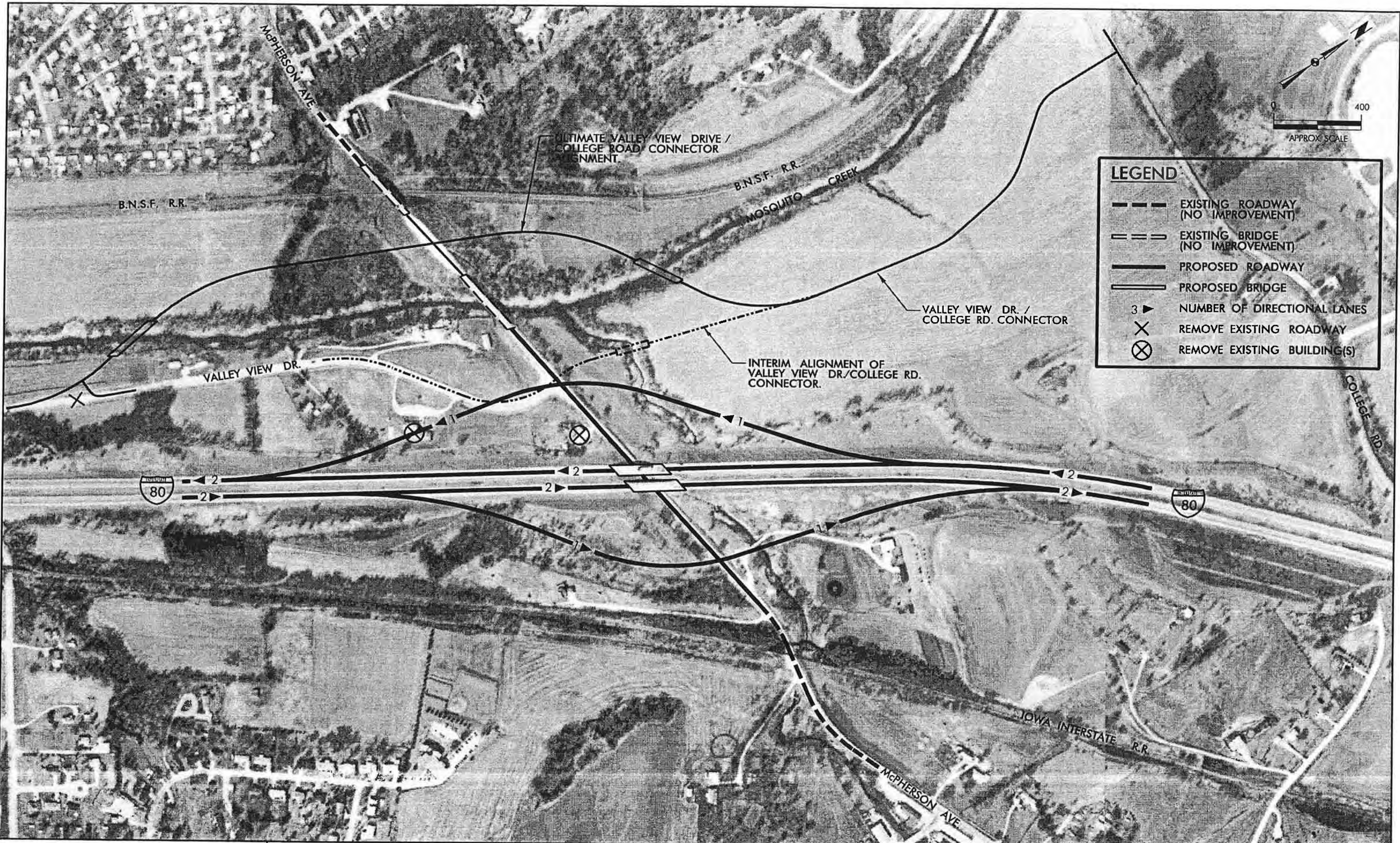
### **PREFERRED ALTERNATIVES**

Three preferred alternatives were identified at this location as discussed below. At the direction of IaDOT, however, these alternatives will not be developed further in Phase III. Rather, these alternatives should be studied further as part of an interchange justification study prior to inclusion into a recommended corridor plan.

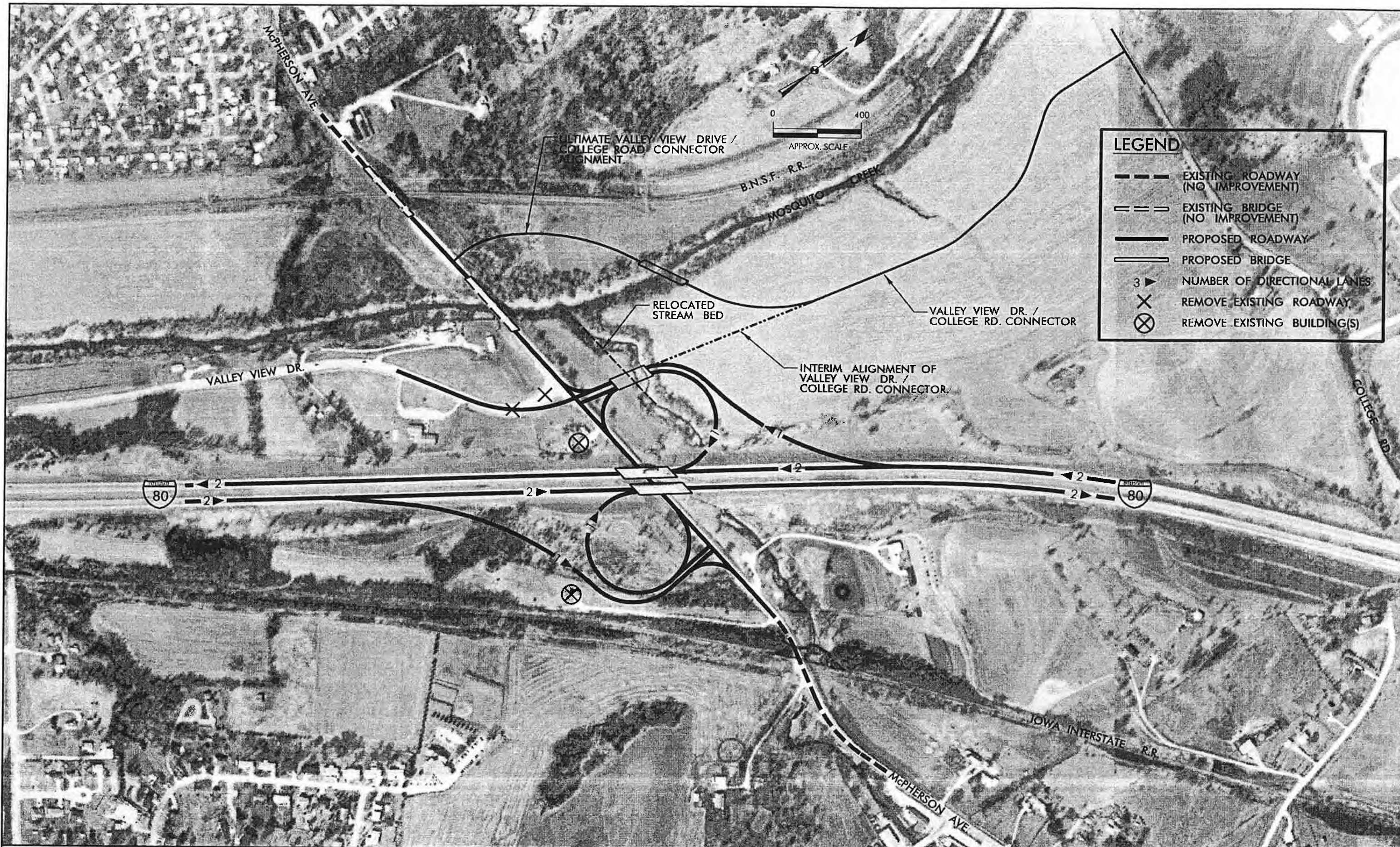
Alternative 2 was identified as a preferred alternative based primarily on City input. This alternative would result in relatively few impacts in the southwest quadrant of the interchange but would require realignment of a portion of the connector road.

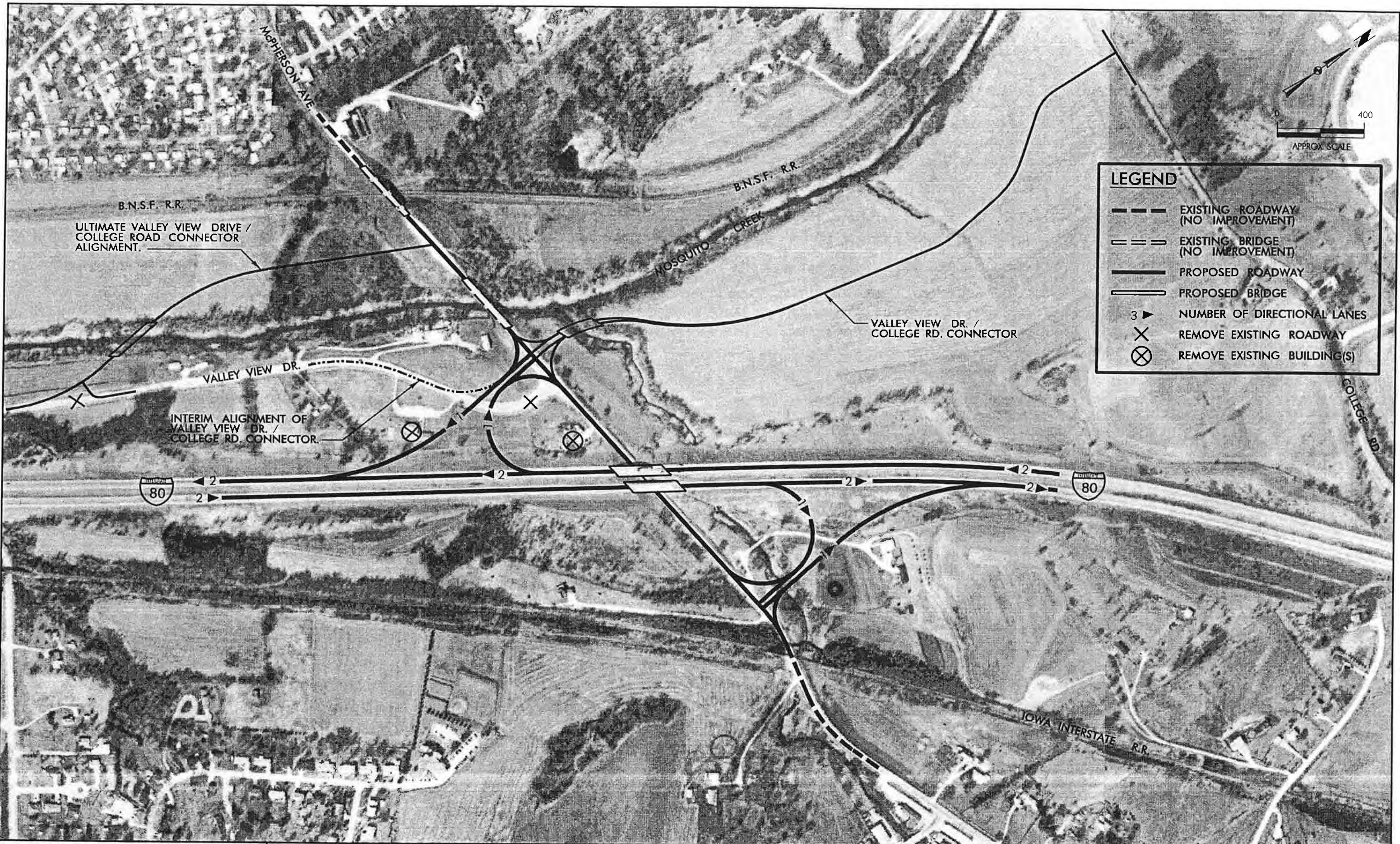
Alternative 5 provides a configuration that is generally preferred for new interchanges. However, it will require two new crossings of Mosquito Creek by the connector road.

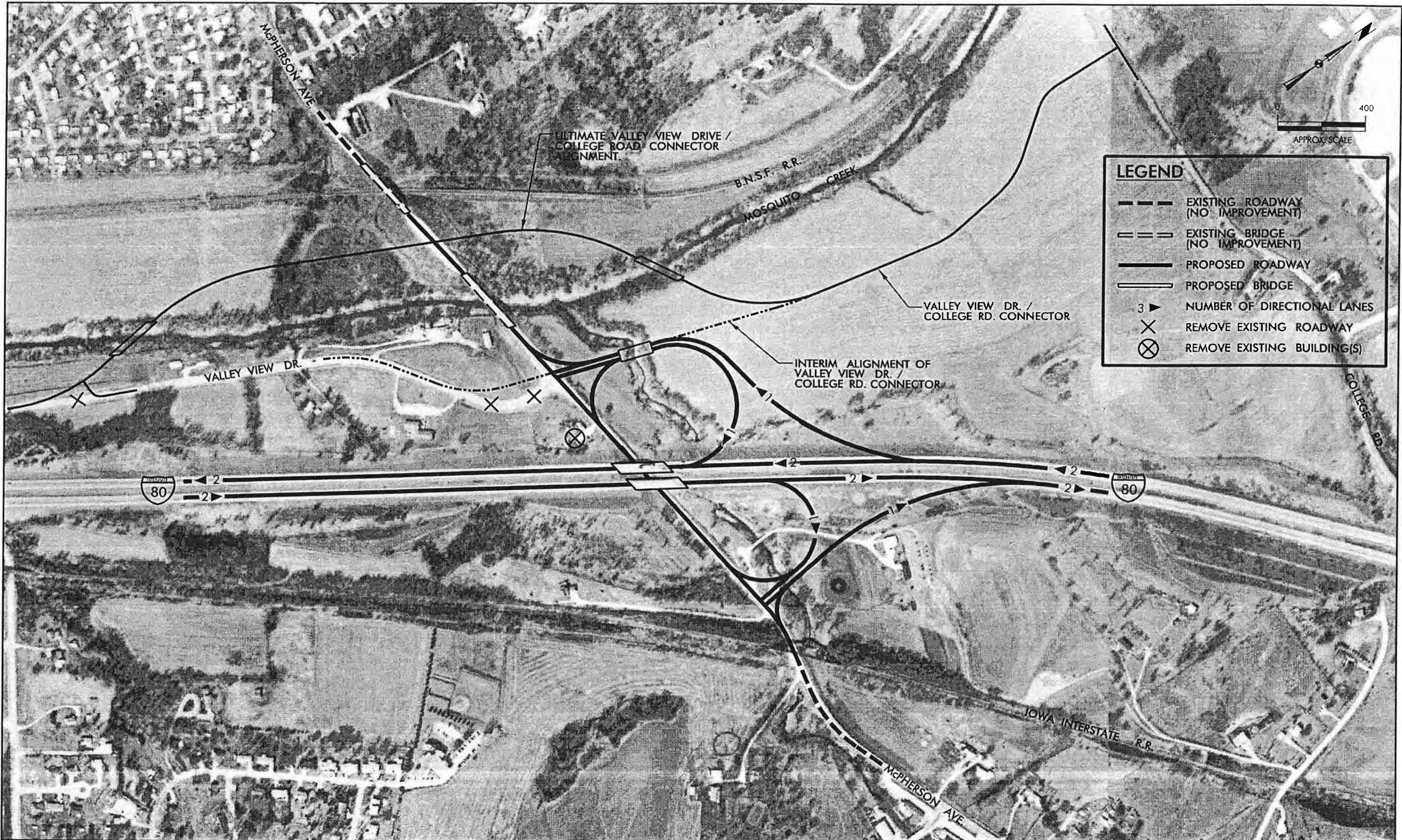
Alternative 6 would likely allow the alignment of the connector road to remain on the east side of Mosquito Creek and minimize the overall footprint of the interchange.

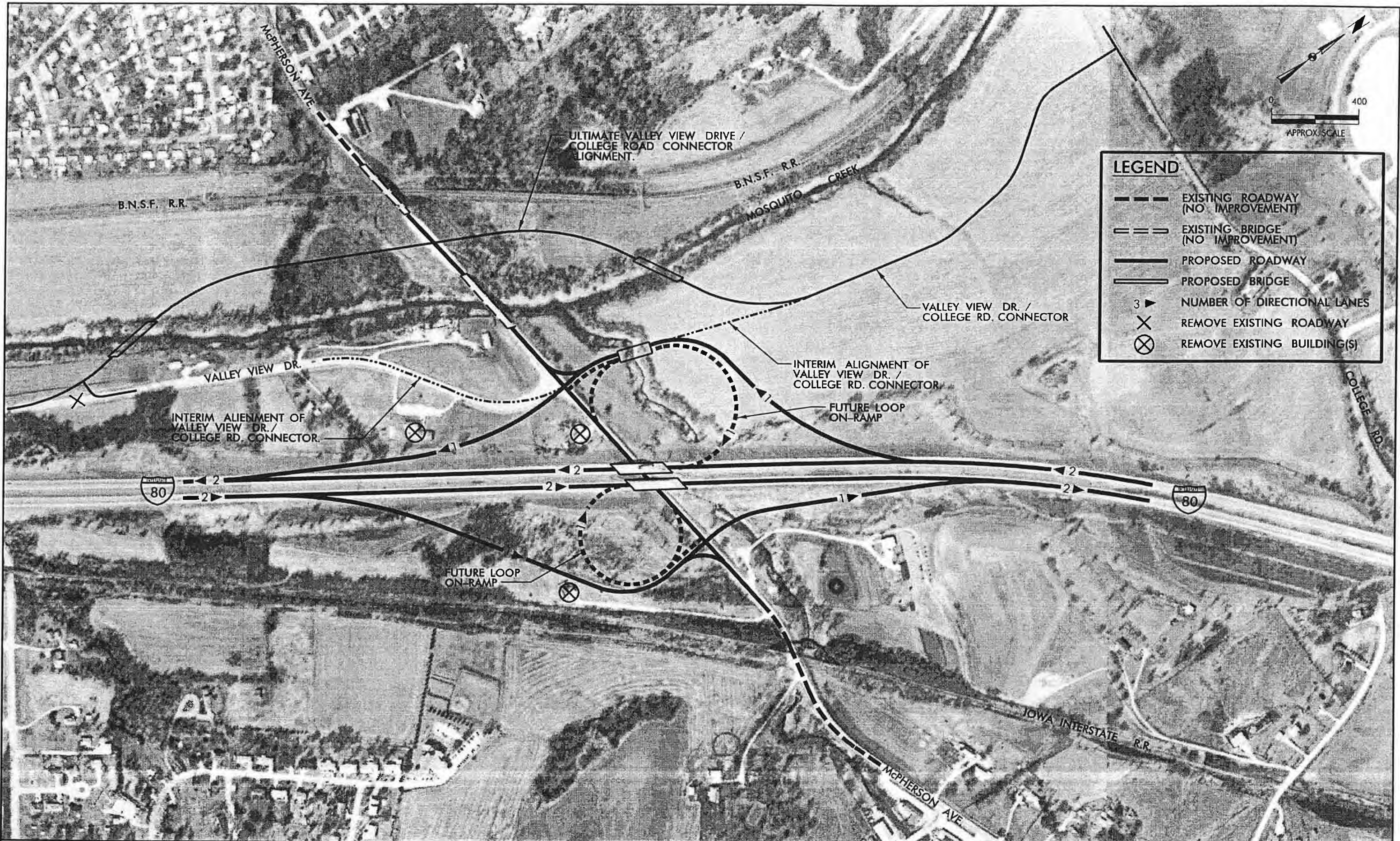












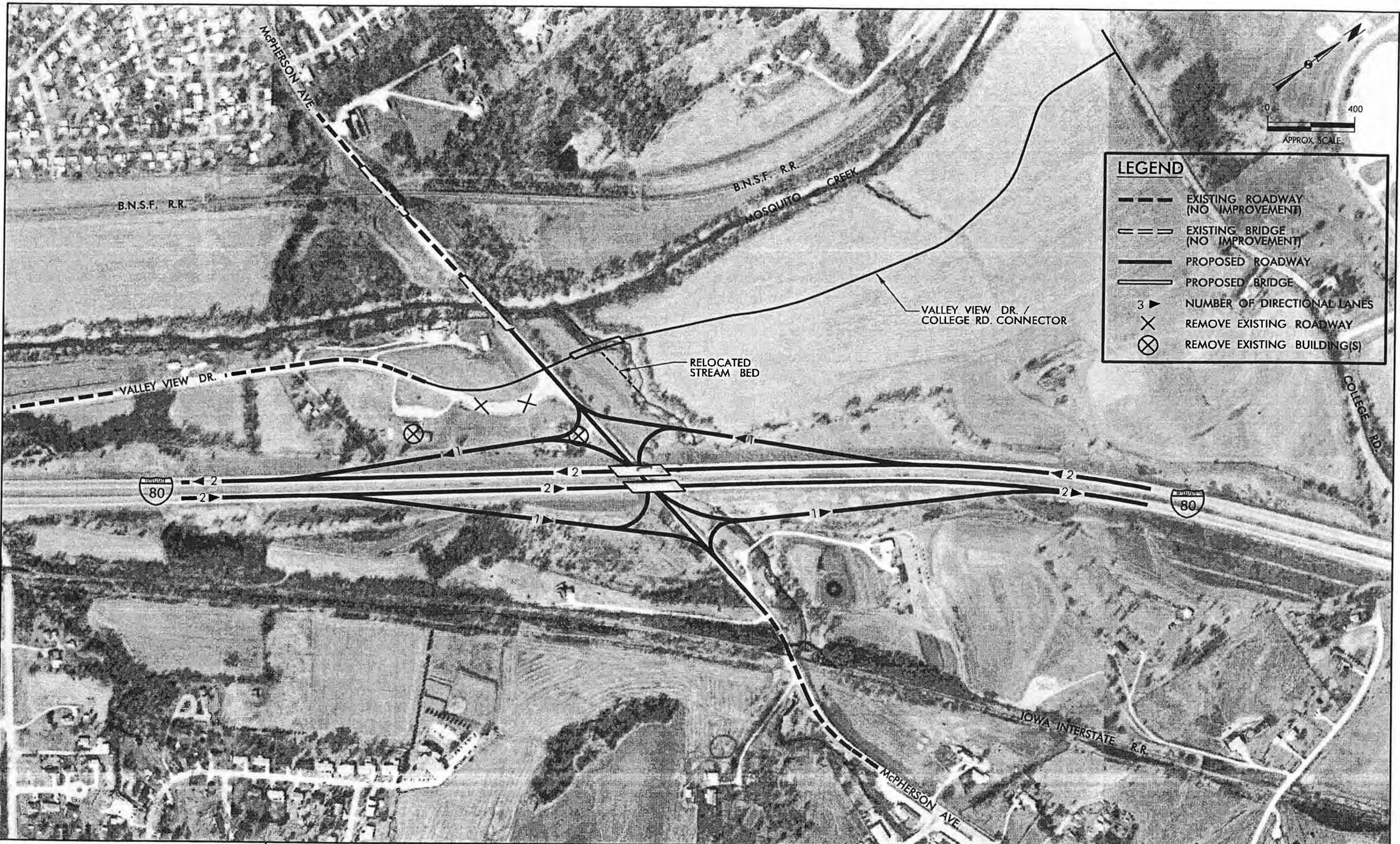


TABLE 10 - Concept Screening Summary – McPherson Avenue / I-80 Interchange

Alternative	Exhibit	Design Features/ Impacts	Traffic Operations	Route Continuity/ Signing	Environmental Impacts	Right-of-Way / Property Impacts	Maintenance of Traffic / Constructability	Cost (\$ Million)
1	11	- Diamond interchange configuration for McPherson Ave.	- Acceptable traffic operations provided on the mainline, at the ramp junctions, and at ramp terminals as unsignalized intersections. - Right turn treatment of heaviest AM movement (EB McPherson to WB I-80) is desirable. - Heaviest PM movement (EB I-80 to WB McPherson) must make left turn.	Alternative provides route and lane continuity.	- Realignment and extension of Valley View Dr. requires two new bridge crossings of Mosquito Creek. - Required right-of-way includes farmland.	- Approximately 49 acres of additional right-of-way (includes that needed for realignment of Valley View Dr.) - 1 home and 1 church would be impacted.	No major construction issues have been identified.	18.9
2	12	- Partial cloverleaf configuration for McPherson Ave. using NW and SE quadrants (diagonally opposite).	- Acceptable traffic operations provided on the mainline, at the ramp junctions, and at ramp terminals as unsignalized intersections. - Heaviest AM movement (EB McPherson to WB I-80) must make left turn. - Heaviest PM movement (EB I-80 to WB McPherson) must make left turn.	Alternative provides route and lane continuity.	- Realignment and extension of Valley View Dr. requires one new bridge crossing of Mosquito Creek. - Required right-of-way includes farmland.	- Approximately 33 acres of additional right-of-way (includes that needed for realignment of Valley View Dr.) - 2 homes would be impacted.	No major construction issues have been identified.	17.6
3	13	- Partial cloverleaf configuration for McPherson Ave. using NE and SW quadrants (diagonally opposite).	- Acceptable traffic operations provided on the mainline, at the ramp junctions, and at ramp terminals as unsignalized intersections. - West-side ramp terminal intersection may warrant signal. - Right turn treatment of the EB McPherson to WB I-80 movement is desirable. - Loop ramp provides free-flow for heaviest PM movement (EB I-80 to WB McPherson).	Alternative provides route and lane continuity.	- Realignment and extension of Valley View Dr. requires one new bridge crossing of Mosquito Creek. - Required right-of-way includes farmland.	- Approximately 28 acres of additional right-of-way (includes that needed for realignment of Valley View Dr.) - 1 home and 1 church would be impacted.	No major construction issues have been identified.	17.4
4	14	- Partial cloverleaf configuration for McPherson Ave. using NW and NE quadrants (same side of McPherson).	- Acceptable traffic operations provided on the mainline, at the ramp junctions, and at ramp terminals as unsignalized intersections. - Heaviest AM movement (EB McPherson to WB I-80) must make left turn. - Loop ramp treatment for EB I-80 to WB McPherson is desirable.	Alternative provides route and lane continuity.	- Realignment and extension of Valley View Dr. requires two new bridge crossings of Mosquito Creek. - Required right-of-way includes farmland.	- Approximately 41 acres of additional right-of-way (includes that needed for realignment of Valley View Dr.) - 1 home would be impacted.	No major construction issues have been identified.	18.6

TABLE 10 - Concept Screening Summary - McPherson Avenue / I-80 Interchange (Continued)

Alternative	Exhibit	Design Features/ Impacts	Traffic Operations	Route Continuity/ Signing	Environmental Impacts	Right-of-Way / Property Impacts	Maintenance of Traffic / Constructability	Cost (\$ Million)
5	15	- Diamond interchange configuration for McPherson Ave. with provision for future loop on ramps.	- Acceptable traffic operations provided on the mainline, at the ramp junctions, and at ramp terminals as unsignalized intersections. - Right turn treatment of heaviest AM movement (EB McPherson to WB I-80) is desirable. - Heaviest PM movement (EB I-80 to WB McPherson) must make left turn.	Alternative provides route and lane continuity.	- Realignment and extension of valley view dr. requires two new bridge crossings of mosquito creek. - Required right-of-way includes farmland.	- Approximately 54 acres of additional right-of-way (includes that needed for realignment of Valley View Dr.). - 2 homes and 1 church would be impacted.	No major construction issues have been identified.	18.7
6	16	- Single Point Urban Interchange (SPUI) configuration for McPherson Ave.	- Acceptable traffic operations provided on the mainline, at the ramp junctions, and at the signalized ramp terminal intersection.	Alternative provides route and lane continuity.	- Required right-of-way includes farmland.	- Approximately 14 acres of additional right-of-way (includes that needed for realignment of Valley View Dr.). - 1 home and 1 church would be impacted.	No major construction issues have been identified.	14.8

## MADISON AVENUE / I-80 INTERCHANGE

### EXISTING/FUTURE DEFICIENCIES

No significant operational deficiencies were identified for the Madison Avenue/I-80 interchange. The mainline approaches to the interchange are currently operating at LOS B or better during peak hours while the ramp junctions are currently operating at LOS C or better. All movements at the signalized east ramp terminal intersection currently operate at LOS B or better. At the unsignalized west ramp terminal intersection, left turns from the ramp approach operate at LOS F. A traffic signal has been proposed for this intersection and should improve operations for the ramp approach.

In the Year 2020 No-Build Scenario, the eastbound mainline approaching Madison Avenue and the corresponding ramp junction will operate at LOS D. All other mainline segments and ramp junctions will operate at LOS C or better. Several movements at the signalized east ramp terminal intersection will operate at LOS D. If the west ramp terminal remains unsignalized, left turns from the ramp approach and left turns from northbound Madison Avenue will operate at LOS F.

The assessment of existing geometric and physical conditions revealed that the on ramps to I-80 do not meet standards for taper rate. Mainline pavement condition, bridge condition, the cross section and stopping sight distance are also rated "fair" in the interchange area. Safety on the mainline in the interchange area is rated "fair" or "poor".

### ACCESS

The existing Madison Avenue/I-80 Interchange provides full access. Changes to access are not anticipated as part of long-term improvements. The construction of a new interchange at McPherson Avenue will provide access-related improvements to Madison Avenue by off-loading some of the traffic which currently uses Madison Avenue and Valley View Drive.

### ALTERNATIVES

Two alternatives were developed for this interchange and are shown in Exhibit 17 and Exhibit 18, respectively. Both alternatives assume reconstruction of the I-80 mainline and reconstruction of Madison Avenue, as necessary, to provide adequate capacity to serve Year 2020 traffic volumes.

#### Alternative 1 (Exhibit 17)

Alternative 1 would provide a single-point urban interchange (SPUI). The SPUI essentially combines two separate diamond ramp intersections into one large at-grade intersection which accommodates all interchanging vehicular movements. This configuration could be constructed with the freeway lanes passing above the ramp/cross street intersection or with the freeway lanes passing below the ramp/cross street intersection. An example of the first option can be found at the Kennedy Freeway/Highway 370 interchange in Bellevue. Examples of the second option can be found at the West Dodge Road interchanges at 144<sup>th</sup> Street and 156<sup>th</sup> Street.

With a single intersection this alternative would provide improved spacing between the interchange and adjacent intersections at Woodbury Avenue (signalized) and Rue Avenue (unsignalized). Improved spacing would provide an opportunity for improved signal coordination along Madison Avenue.

Although SPUIs often provide higher capacity when compared to diamond interchanges, the Madison Avenue interchange exhibits traffic patterns that may make a SPUI inappropriate. Specifically, the left turn traffic volumes from the ramp approaches to Madison Avenue are heavily unbalanced. Left turns from the eastbound off ramp exceed the left turns from the westbound off ramp by nearly 15:1. Since these two movement are served concurrently in a single phase, the efficiency of the traffic signal is diminished. The other characteristic is the directionality of thru traffic on Madison Avenue. During the AM peak hour northbound thru traffic on Madison Avenue represents approximately 75% of the two-way thru traffic. This also reduces the efficiency of a SPUI. Finally, the geometry of SPUIs generally does not accommodate pedestrians as well as a diamond interchange.

Alternative 1 also reflects the need for three basic lanes in each direction on I-80 to the west of Madison Avenue. The eastbound I-80 off-ramp to Madison includes a two-lane off ramp to serve the forecasted traffic volume for this movement and to serve as a means of dropping the third basic freeway lane. The westbound on-ramp from Madison Avenue would add the third basic freeway lane in the westbound direction.

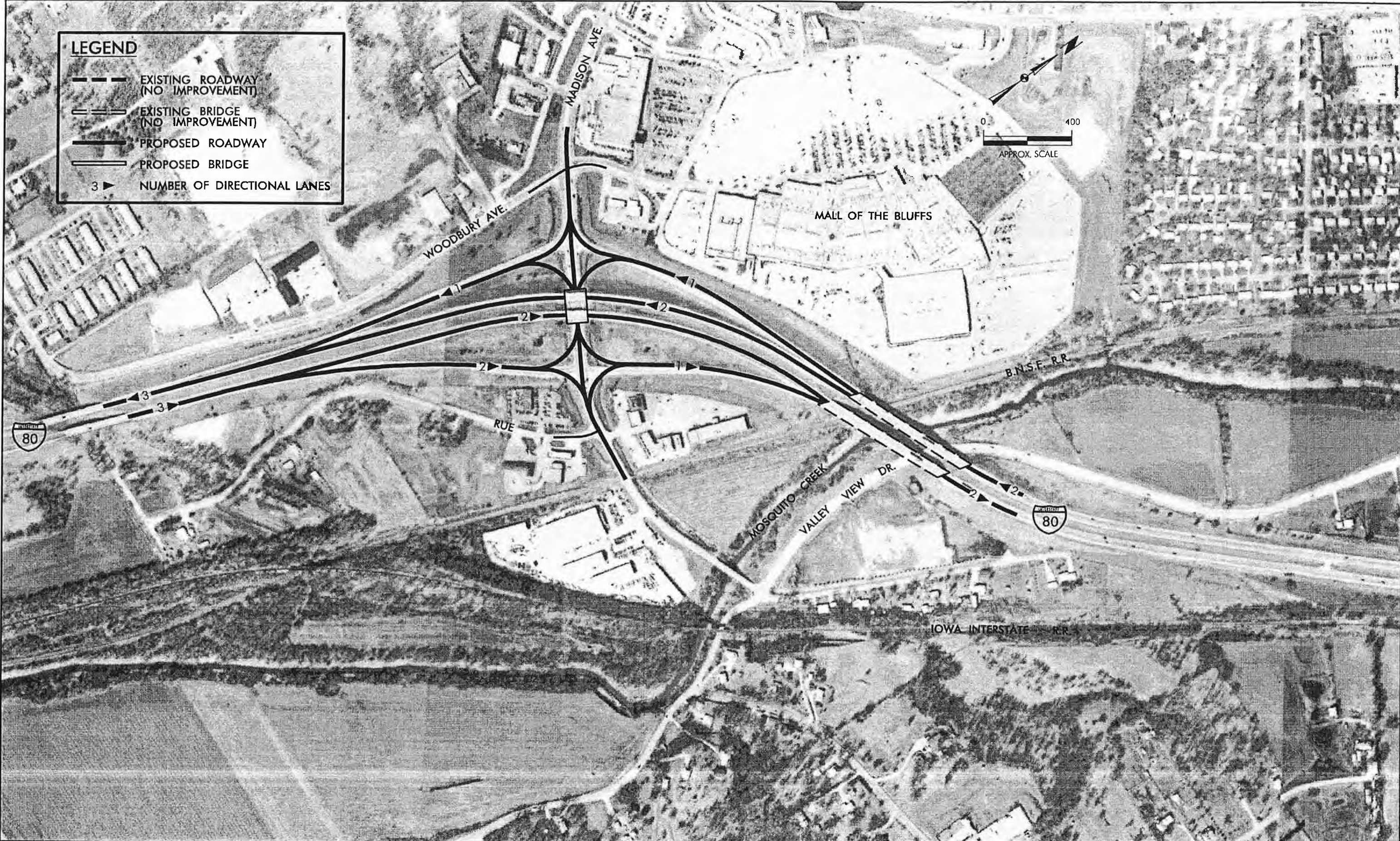
#### Alternative 2 (Exhibit 18)

Alternative 2 would provide a diamond interchange configuration similar to the existing configuration. The distance between ramp terminal intersections could be reduced slightly to improve the spacing between the ramp terminal intersections and adjacent intersections at Woodbury Avenue and Rue Avenue. For the reasons noted in the discussion of Alternative 1, this configuration may provide better traffic operations than the SPUI and better accommodate pedestrians. Similar to Alternative 1, Alternative 2 was also reflects the need for three basic lanes in each direction on I-80 to the west of Madison Avenue.

### PREFERRED ALTERNATIVES

Both Alternative 1 and Alternative 2 will to be carried forward into Phase III. Consideration will be given to the use of roundabouts at the ramp terminal intersections in Alternative 2.





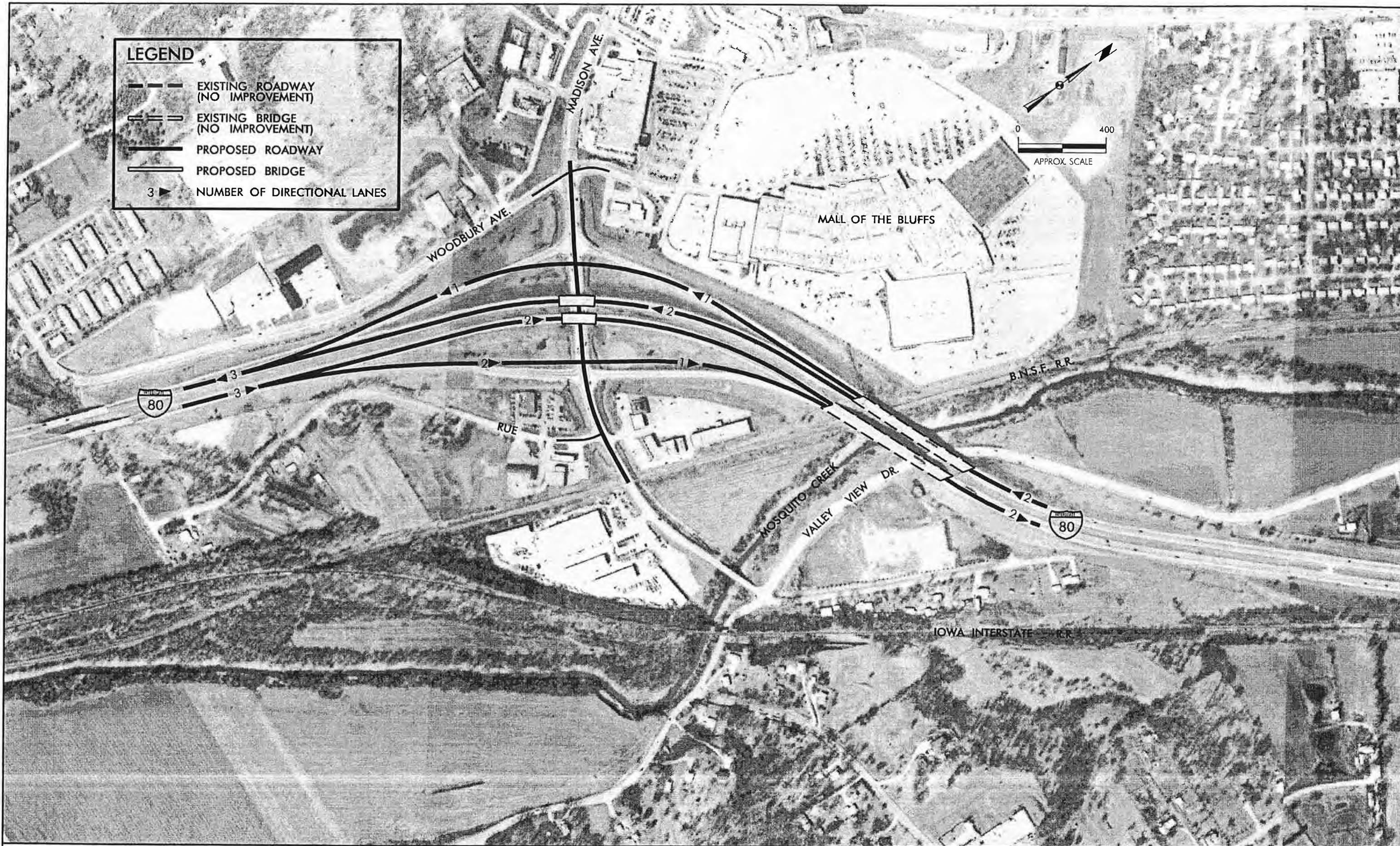


TABLE 11 - Concept Screening Summary - Madison Avenue / I-80 Interchange

Alternative	Exhibit	Design Features/ Impacts	Traffic Operations	Route Continuity/ Signing	Environmental Impacts	Right-of-Way / Property Impacts	Maintenance of Traffic / Constructability	Cost (\$ Million)
1	17	- Single Point Urban Interchange (SPUI) configuration for Madison Ave.	<ul style="list-style-type: none"> <li>- Acceptable traffic operations provided on the mainline and at the ramp junctions.</li> <li>- Provides improved spacing between traffic signal at Woodbury Avenue and the single traffic signal for the interchange. This may improve progression along Madison Ave.</li> <li>- Operational performance of the SPUI may be less than the TDI because left turns from ramps are heavily unbalanced and since thru traffic on Madison Avenue is highly directional during peak periods.</li> <li>- Does not accommodate pedestrians as well as the TDI.</li> </ul>	Alternative provides route and lane continuity.	No major impacts have been identified.	No major impacts have been identified.	No major construction issues have been identified.	13.5
2	18	- Tight Diamond Interchange (TDI) configuration for Madison Ave.	<ul style="list-style-type: none"> <li>- Acceptable traffic operations provided on the mainline and at the ramp junctions.</li> <li>- Maintain existing spacing between traffic signal at Woodbury Avenue and the single traffic signal for the interchange.</li> <li>- Operational performance of the TDI may be better than the SPUI because left turns from ramps are heavily unbalanced and since thru traffic on Madison Avenue is highly directional during peak periods.</li> <li>- Accommodates pedestrians better than the SPUI.</li> </ul>	Alternative provides route and lane continuity.	No major impacts have been identified.	No major impacts have been identified.	No major construction issues have been identified.	11.8

## US HIGHWAY 275 / I-29 INTERCHANGE

### EXISTING/FUTURE DEFICIENCIES

No significant operational deficiencies were identified for the US Highway 275/I-80 interchange. The I-29 mainline segments and ramp junctions on the south side of the interchange are currently operating at LOS A during peak hours. On the north side of the interchange, the northbound mainline represents a weaving section that is currently operating at LOS C. The southbound mainline in this area was not analyzed for current conditions since it is of insufficient length to be considered a basic freeway segment and does not include an auxiliary lane to be considered a weaving section. Both ramp terminal intersections are currently unsignalized. Left turns off of the northbound I-29 off ramp are currently operating at LOS E. Other unsignalized movements are operating at LOS B or better.

In the Year 2020 No-Build Scenario, the I-29 mainline segments and ramp junctions on the south side of the interchange will operate at LOS B or better during peak hours. The northbound weaving section between US Highway 275 and the East I-80/I-29 System Interchange will operate at LOS D. The level of service provided to left turns off of the northbound I-29 off ramp will worsen to LOS F. Other unsignalized movements will operate at LOS B or better.

The assessment of existing geometric and physical conditions revealed that the on ramps to I-29 from US Highway do not meet standards for taper rate. Mainline pavement condition in the interchange rated "fair" to "poor". The cross section, stopping sight distance, safety and signing in some areas are also rated "fair". Finally, the spacing between the northbound on-ramp from US Highway 275 and the off-ramp to eastbound I-80 does not meet AASHTO standards.

### ACCESS

The existing US Highway 275/I-29 interchange provides partial access. Access to/from I-29 to the north and US Highway 275 to the west is currently not provided. The IaDOT has proposed improvements to make the interchange full access and has submitted an application for federal funding. The project would include modifications to the ramp terminal intersections to provide all movements. Traffic signals would be installed at both ramp terminal intersections.

The output from a special model run performed by MAPA was reviewed to assist in determining the need for full access at this interchange. For this model run, a loop ramp was coded in the Northeast quadrant of the interchange to serve eastbound US Highway 275 to northbound I-29 traffic. The existing southbound I-29 off-ramp was also recoded to allow left turns to westbound US Highway 275.

In general, this model run showed that the new loop will attract approximately 5,500 vehicles per day (vpd) which is consistent with the volume for the complimentary movement on the existing ramp. The new configuration also results in an increase of approximately 1,000 vpd on US Highway 275 to the west and corresponding decrease on the South Expressway on the south side of I-80. This indicates that full access at US Highway 275 would be a preferred route for some traffic that now uses the South Expressway for destinations such as the Lake Manawa area or the Power Centre. Based on this assessment modifications to the US Highway 275/I-29 interchange are recommended to provide full access. Such modifications are included in all alternatives developed for this area.

### ALTERNATIVES

Two basic alternatives were developed for the US Highway 275/I-29 interchange and are discussed below. Given the proximity of this interchange to the East I-80/I-29 System Interchange, however, these alternatives were developed and assessed as part of the development and assessment of improvement alternatives for the system interchange. Therefore, separate exhibits and a screening matrix were not prepared for US Highway 275.

Graphical depictions of the two basic alternatives are shown Exhibits 19 thru 26 for various configurations of the system interchange. Both alternatives assume reconstruction of the I-29 mainline and reconstruction of US Highway 275, as necessary, to provide adequate capacity to serve Year 2020 traffic volumes.

#### Alternative 1

This alternative would provide a parclo interchange with all ramps located on the south side of US Highway 275 to provide the maximum distance between the ramps of the US Highway 275 interchange and the ramps of the system interchange to the north. As proposed by the IaDOT, the interchange would provide for all movements and would include traffic signals at both ramp terminal intersections. Five of the eight alternatives developed for the system interchange utilize this configuration of the US Highway 275/I-29 interchange.

#### Alternative 2

This alternative would be used with system interchange alternatives which provide C-D roads to serve traffic to/from US Highway 275 and I-29/I-80 to the north. Three of the eight system interchange alternatives utilize this configuration. The C-D roads eliminate the weaving sections on I-29 between US Highway 275 and the system interchange by providing direct connections. For example, traffic driving away from US Highway 275 on the C-D road would choose between eastbound I-80 and westbound I-80/I-29 before entering the mainline. This configuration resembles a diamond interchange in that each quadrant of the intersection would contain only one ramp. As proposed by the IaDOT, the interchange would provide for all movements and would include traffic signals at both ramp terminal intersections. No significant operational differences between the two alternatives is expected.

### PREFERRED ALTERNATIVES

Preferred alternatives were identified for the East I-80/I-29 System Interchange as a whole rather than for adjacent interchanges individually. However, based on the preferred alternatives for the East I-80/I-29 System Interchange (see next section) Alternative 1 is preferred at US Highway 275.

## EAST I-80/I-29 SYSTEM INTERCHANGE

### EXISTING/FUTURE DEFICIENCIES

Several operational deficiencies were identified for the East I-80/I-29 System Interchange. The mainline segments between the system interchange and US Highway 275 were addressed in the previous section. The mainline segments between the system interchange and Madison Avenue are currently operating at LOS B or better during peak hours. The mainline segments between the system interchange and the South Expressway represent weaving sections. The westbound weaving section currently operates at LOS C while the eastbound weaving section operates at LOS B.

In the Year 2020 No-Build Scenario, these weaving mainline segments and weaving sections are expected to worsen. The mainline segments between the system interchange and Madison Avenue will operate at LOS D or better during peak hours. The westbound and eastbound weaving sections between the system interchange and the South Expressway will operate at LOS E.

Several other operational deficiencies were identified.

- Approaching the East I-80/I-29 System Interchange, southbound I-29 traffic in the left-most lane must change one lane to continue on the designated path.
- Downstream of the East I-80/I-29 System Interchange, northbound I-29 traffic in the left-most lane must change one lane to continue on the designated path due to a left-side lane drop.
- Downstream of the East I-80/I-29 System Interchange, westbound I-80 traffic in the right-most lane must change one lane to continue on the designated path due to a lane drop at the South Expressway interchange.
- Westbound I-80/I-29 off ramp to the South Expressway. Three freeway lanes approach the ramp junction. The right-most auxiliary lane (which was added upstream at the East I-80/I-29 System Interchange) is dropped as a single-lane off ramp. This configuration does not meet the criteria for exception to lane balance principles.

The assessment of existing geometric and physical conditions revealed that the condition of the pavement and bridges within the system interchange is "fair" to "poor". The horizontal alignment, cross section and stopping sight distance is also rated "fair" in the some areas. Finally, this interchange exhibits some of the highest accident rates in the entire corridor resulting in a "poor" rating for some roadways within the interchange.

### ACCESS

The East I-80/I-29 System Interchange currently serves all interchanging movements between I-80 and I-29 and will continue to do so with any proposed improvements. However, some the alternatives described below utilize C-D roads to provide direct access to the South Expressway and/or US Highway 275. In essence, these alternatives would modify access by forcing drivers within the system interchange to make additional access-related decisions.

### SIMULATION MODELING

The results of the CORSIM simulation modeling discussed in Chapter 5 were utilized to determine lane requirements of the improvement alternatives. The CORSIM analyses were limited to the most complex areas of the system interchange such as the weaving sections between the system interchange and the adjacent service interchanges.

### ALTERNATIVES

Eight alternatives were developed for this system interchange and are shown in Exhibits 19 thru Exhibit 26. All alternatives assume reconstruction of the I-80 and I-29 mainline in the interchange area. In addition, note that Exhibits 19 thru 26 also graphically depict alternatives for the South Expressway/I-80/I-29 interchange given the proximity of this interchange to the East I-80/I-29 System Interchange. A separate discussion of the South Expressway follows this section.

#### Alternative 1 (Exhibit 19)

This alternative utilizes "basic" design criteria at several locations in an attempt to fit a system interchange within the spatial restrictions of the adjacent interchanges while meeting all operational criteria. Alternative 1 provides a 70 mph design speed on the "thru" system-to-system ramps and a 60 mph design speed on other system-to-system ramps. The westbound I-80 to southbound I-29 movement (non-thru) is served with a fly-over ramp to allow it to merge on the right of a thru route. A fly-over ramp is also provided for the northbound I-29 to westbound I-80/I-29 movement although both of the roadways that merge at this point are thru routes. The I-29 movement is brought in on the right because it is the lower volume movement.

This alternative retains existing configuration of South Expressway interchange to maximize the weaving distance on I-80/I-29 between the South Expressway and the system interchange. However, the weaving length provided in the westbound direction is borderline adequate to provide acceptable traffic operations. Because the off-ramp to the South Expressway is a loop ramp, it will be necessary to provide for deceleration on the mainline (i.e., a deceleration lane). This will likely decrease the length of the weaving section to a greater degree than can be accurately shown in a single-line graphic. Alternative 1 provides acceptable traffic operations at all other locations.

Three basic lanes are provided in each direction on I-80 thru the system interchange to Madison Avenue. In the westbound direction, this requires that five lanes be provided where westbound I-80 and northbound I-29 merge. The fifth lane is tapered out downstream of the off-ramp to the South Expressway.

Alternative 1 also includes a parclo interchange at the US Highway 275 interchange (with all ramps on the south side) to maximize the weaving distance on I-29 between US Highway 275 and the system interchange.

#### Alternative 2 (Exhibit 20)

Alternative 2 is identical to Alternative 1 except that it provides a 70 mph design speed on both thru and non-thru system ramps. The major impact of this alternative is on the weaving section on southbound I-29 between the system interchange and US Highway 275. With a 70 mph design speed, the westbound I-80 to southbound I-29 movement would decrease the available weaving length and prevent this

alternative from providing acceptable weaving operations. Similar to Alternative 1, the ability of this alternative to provide acceptable weaving operations on westbound I-80/I-29 between the South Expressway and the system interchange is also questionable.

#### **Alternative 3 (Exhibit 21)**

Alternative 3 is similar to Alternative 2 except that a C-D road is provided to eliminate the weaving section on westbound I-80/I-29 between the system interchange and the South Expressway. In essence, this alternative provides separate off-ramps to the South Expressway from westbound I-80 and northbound I-29, respectively. These two ramps then merge and cross over the South Expressway on a new bridge or on the existing bridge if it could be widened. If the latter is possible, a barrier would be needed to separate the C-D road from the mainline. This alternative does not include a fly-over ramp for the northbound I-29 to westbound I-80/I-29 movement. Therefore, the I-29 movement is brought in on the left of I-80. This alternative does not address the weaving problem on southbound I-29 between the system interchange and US Highway 275 noted in Alternative 2.

#### **Alternative 4 (Exhibit 22)**

Alternative 4 is similar to Alternative 1 except that the system interchange is shifted to the west to maximize the length of the weaving sections on I-29 between the system interchange and US Highway 275. To accomplish this, C-D roads are provided to accommodate traffic interchanging between the South Expressway and I-80 to the east and I-29 to the south. Thus, separate off-ramps to the South Expressway are provided from westbound I-80 and northbound I-29. Similarly, separate on-ramps to eastbound I-80 and southbound I-29 are provided from the South Expressway.

This configuration would require new bridges over the South Expressway for the C-D roads. The new bridges over the South Expressway may require that the loop ramps of this interchange be widened as shown in Exhibit 22, resulting in significant right-of-way and property impacts. These ramps are shown in this manner as a worst-case scenario. Preliminary assessment of these ramps indicates that it may be possible to meet the "basic" design criteria without impacting adjacent businesses. However, significant property impacts are expected in the industrial area along 29<sup>th</sup> Avenue.

#### **Alternative 5 (Exhibit 23)**

Alternative 5 shifts the system interchange to the southeast to provide a greater length for the weaving sections on I-80/I-29 between the system interchange and the South Expressway. To accomplish this, C-D roads are provided to accommodate traffic interchanging between US Highway 275 and I-80/I-29 to the west and I-80 to the east. Thus, separate off-ramps to US Highway 275 are provided from westbound I-80 and eastbound I-80/I-29. Similarly, separate on-ramps to eastbound I-80 and Westbound I-80/I-29 are provided from US Highway 275. This configuration would require the "braiding" of ramps just to the north of US Highway 275.

#### **Alternative 6 (Exhibit 24)**

Alternative 6 is similar to Alternative 5 except that the system interchange is shifted further to the south maximize the weaving sections on I-80/I-29 between the system interchange and the South Expressway. This alternative results in greater impacts to several properties located between the system interchange and Madison Avenue.

#### **Alternative 7 (Exhibit 25)**

Alternative 7 basically combines Alternatives 5 and 6 to provide a system interchange configuration without any mainline weaving sections. This is accomplished by providing C-D roads to the South Expressway and to US Highway 275. Ramp braiding is required at four locations.

#### **Alternative 8 (Exhibit 26)**

Alternative 8 is similar to Alternative 1 but provides free-flowing ramps between I-80 (east of the system interchange) and US 275 (west of I-29). In conjunction with the proposed widening of US 275 and improvements to the South Omaha Missouri River bridge, this alternative would provide an alternative route for I-80 traffic during incidents, maintenance activities, or during freeway reconstruction.

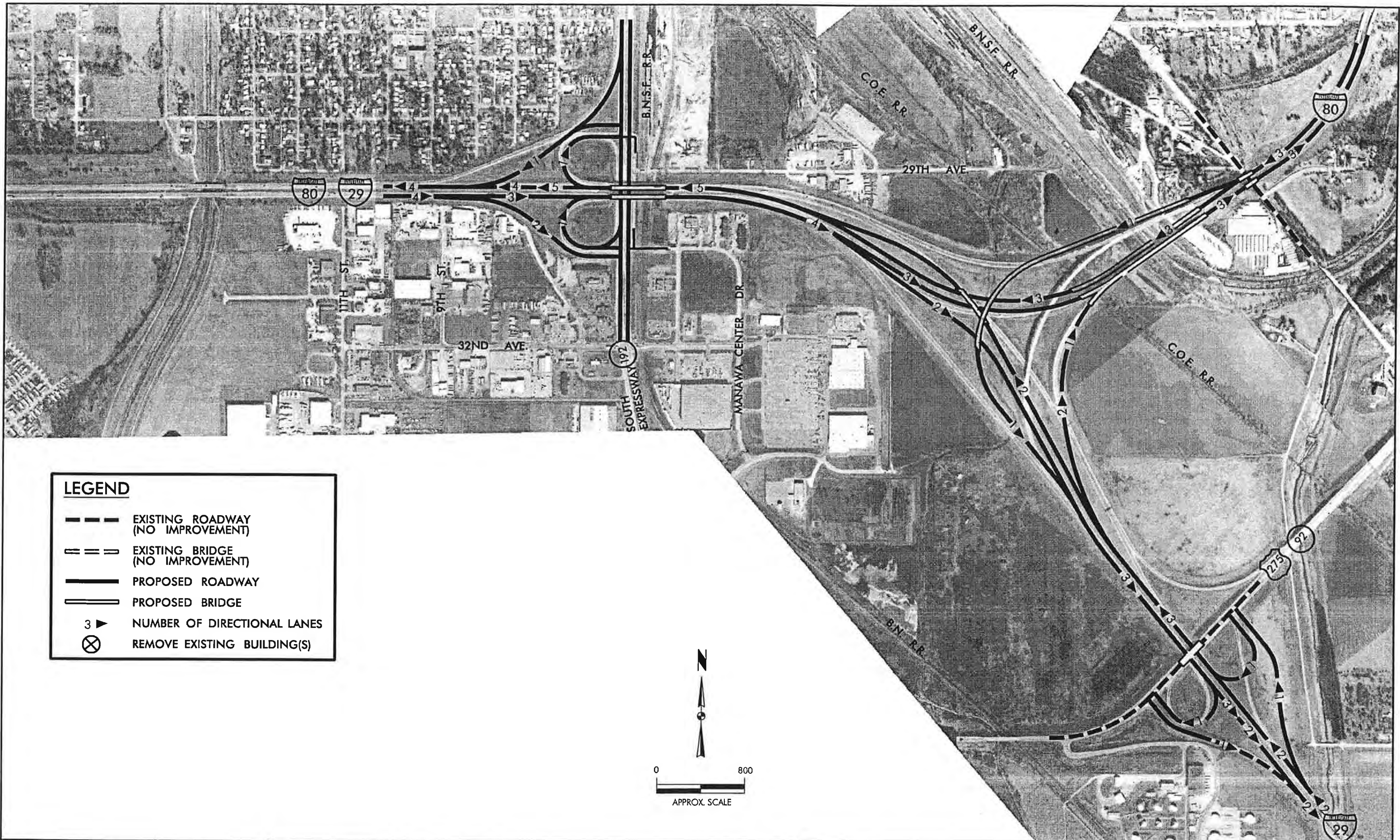
### **PREFERRED ALTERNATIVES**

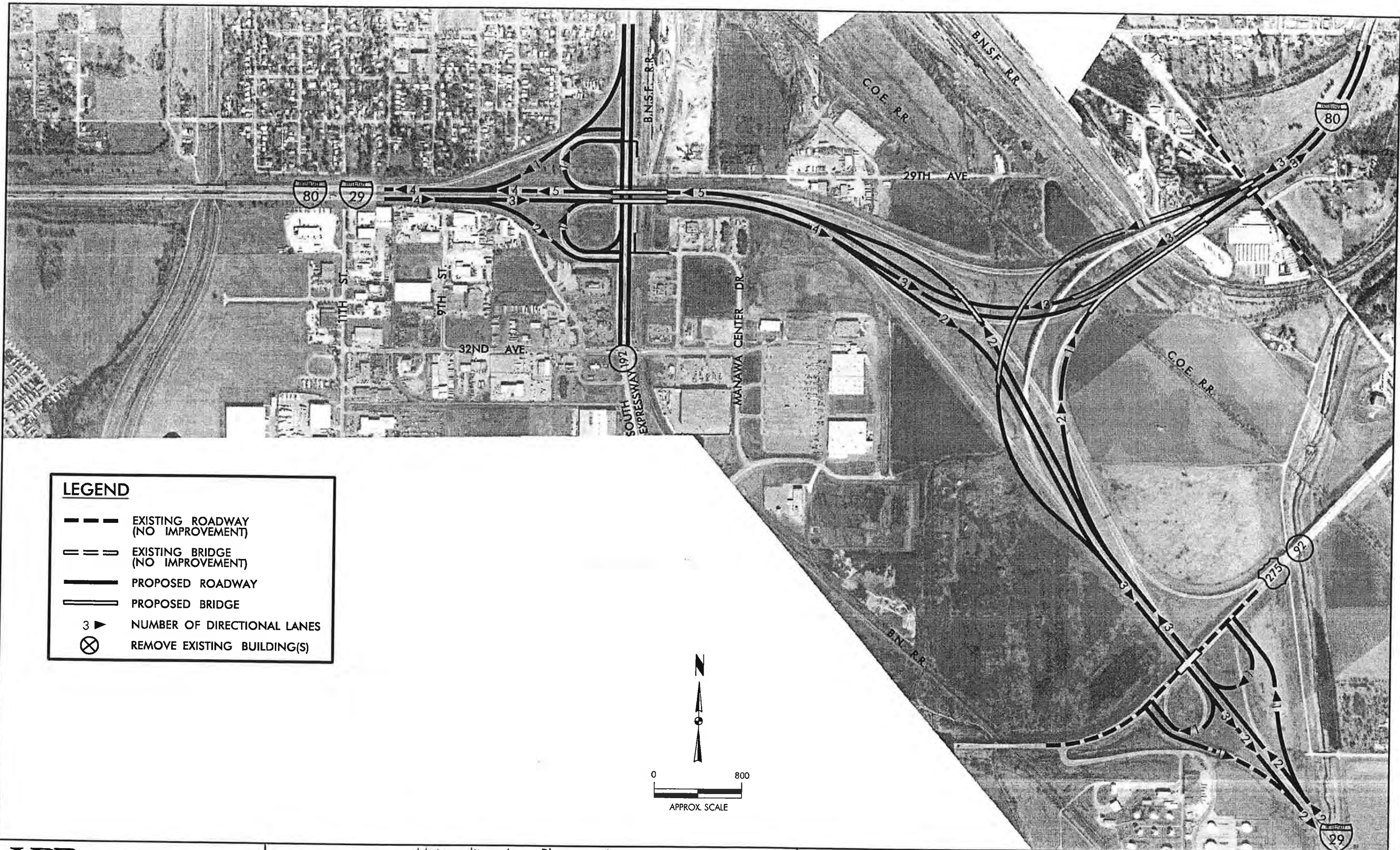
Two preferred alternatives were identified at this location to be carried forward into Phase III.

Alternative 1 attempts to fit a system interchange within the spatial restrictions of the adjacent interchanges (without C-D roads) while meeting all operational criteria. Additional design detail and additional operational analyses will be necessary to determine if this alternative will, in fact, meet the operational criteria. In particular, the weaving sections between the system interchange and the South Expressway will be evaluated in greater detail. The Phase II assessment of Alternative 1 determined that these weaving sections will be borderline adequate to provide acceptable traffic operations.

Alternative 4 is also preferred. C-D roads are provided to accommodate traffic interchanging between the South Expressway and I-80 to the east and I-29 to the south. Input at Phase II meetings suggests that the elimination of weaving on the overlap section of I-80 and I-29 would be more beneficial than the elimination of weaving on I-29 (e.g., Alternatives 5 and 6). Alternative 4 is also preferred because it removes the existing reverse curves on the I-80 mainline within the system interchange.

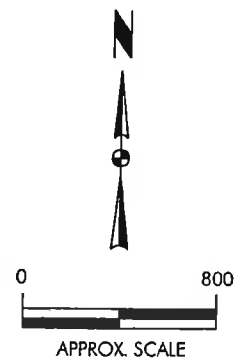
At the direction of IaDOT, Phase III will include an assessment of the C.O.E. railroad tracks to investigate whether they could be relocated closer to the B.N.S.F. tracks to reduce the structure costs of the preferred alternatives.



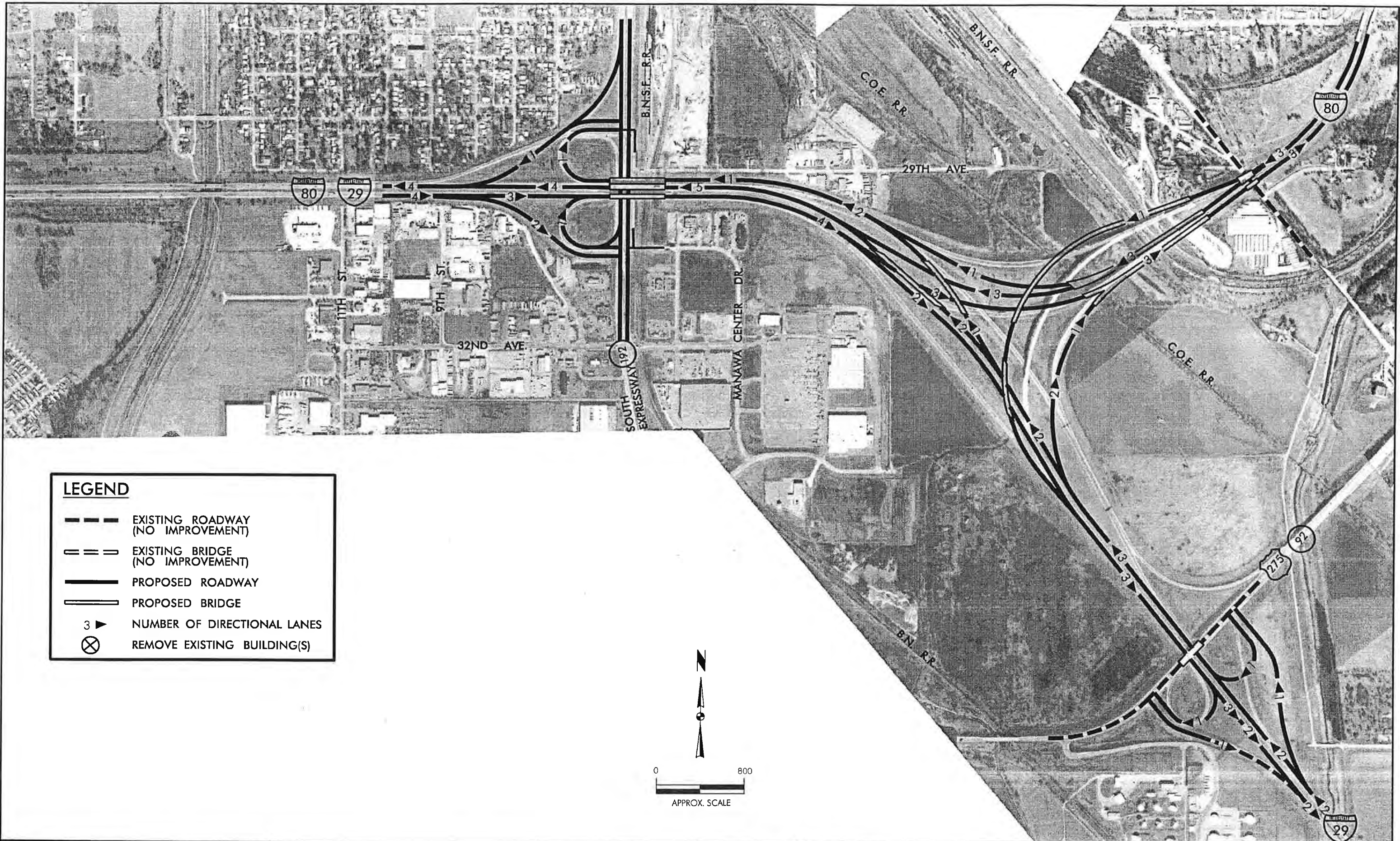


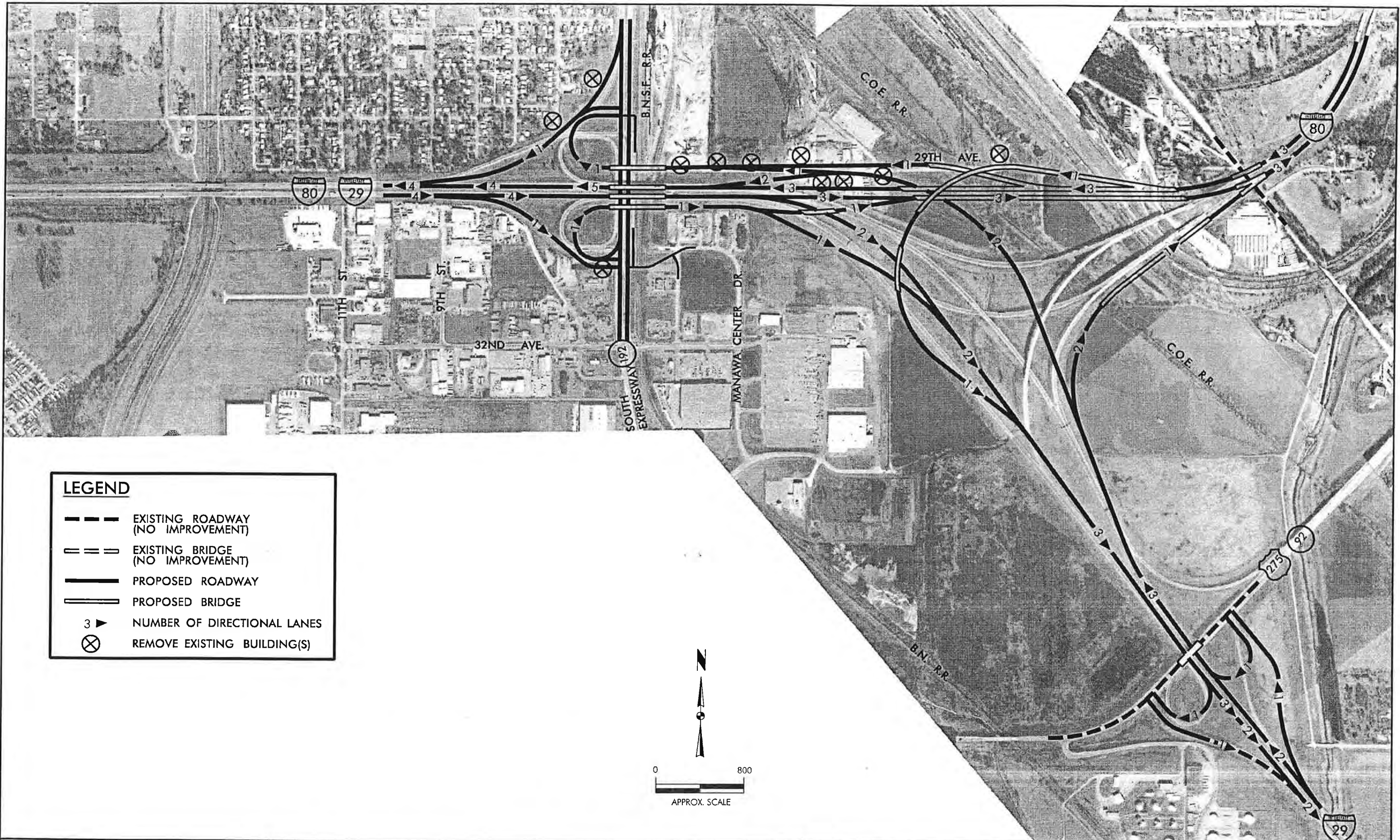
**LEGEND**

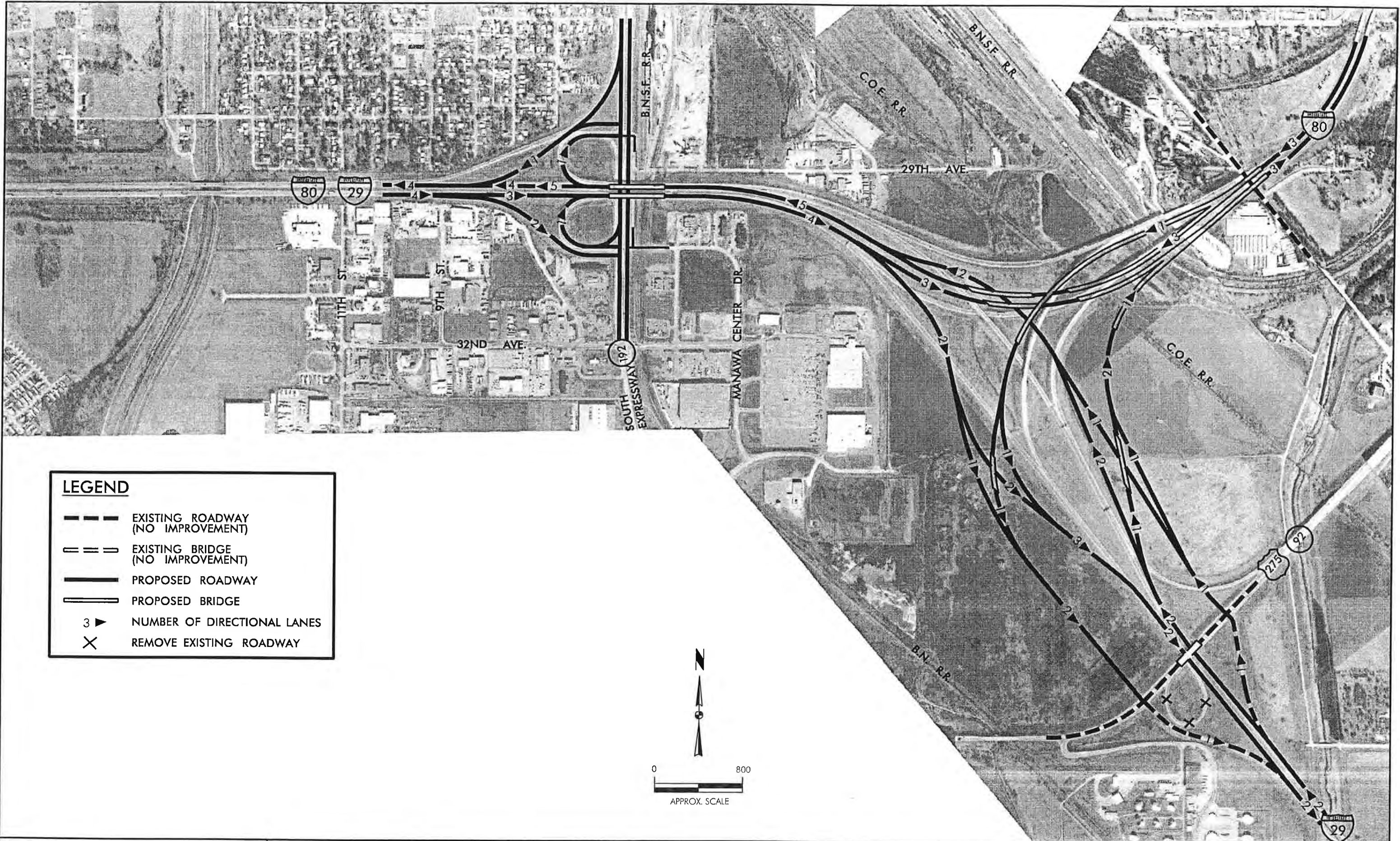
- EXISTING ROADWAY (NO IMPROVEMENT)
- === EXISTING BRIDGE (NO IMPROVEMENT)
- PROPOSED ROADWAY
- ▬ PROPOSED BRIDGE
- 3 ▶ NUMBER OF DIRECTIONAL LANES
- ⊗ REMOVE EXISTING BUILDING(S)

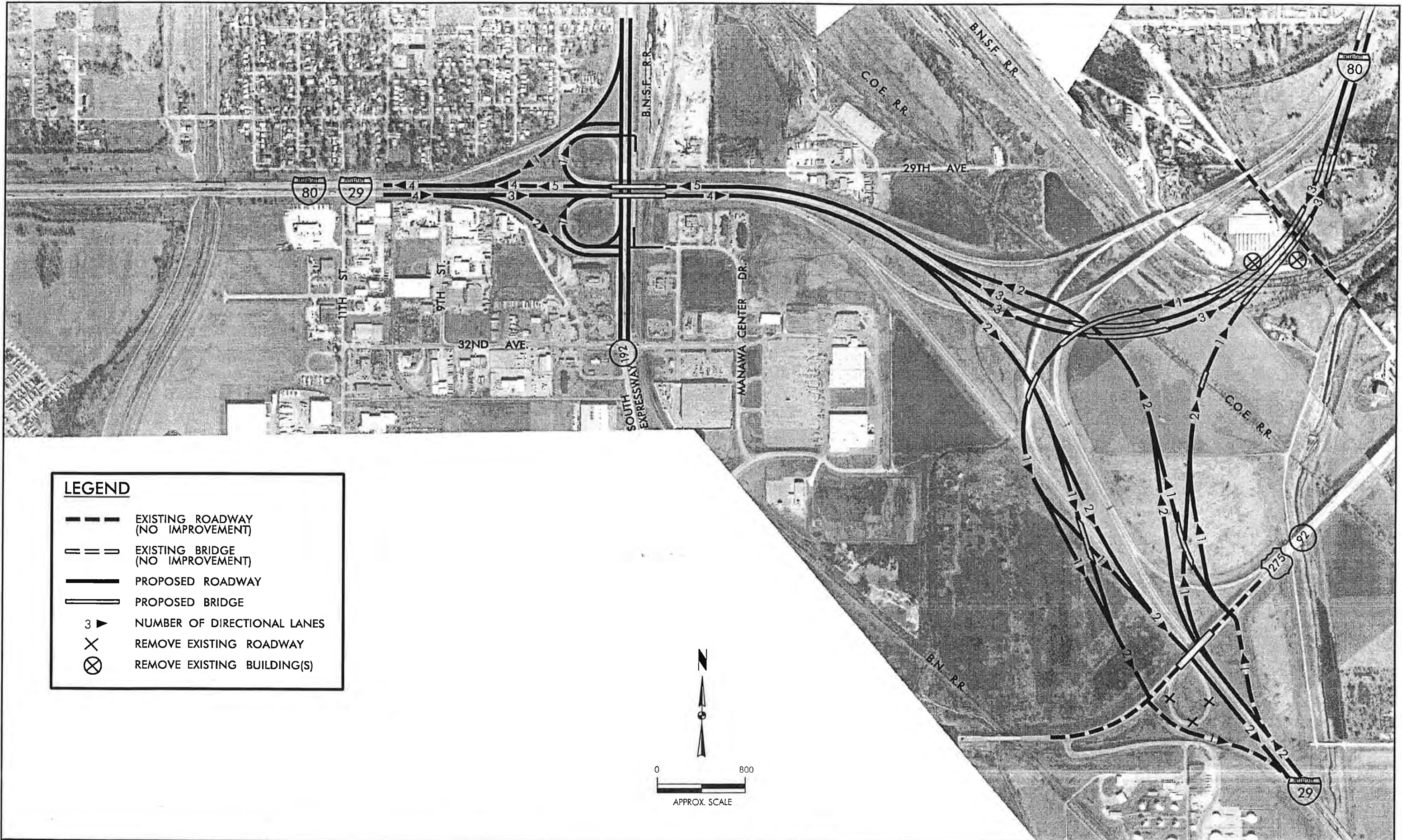


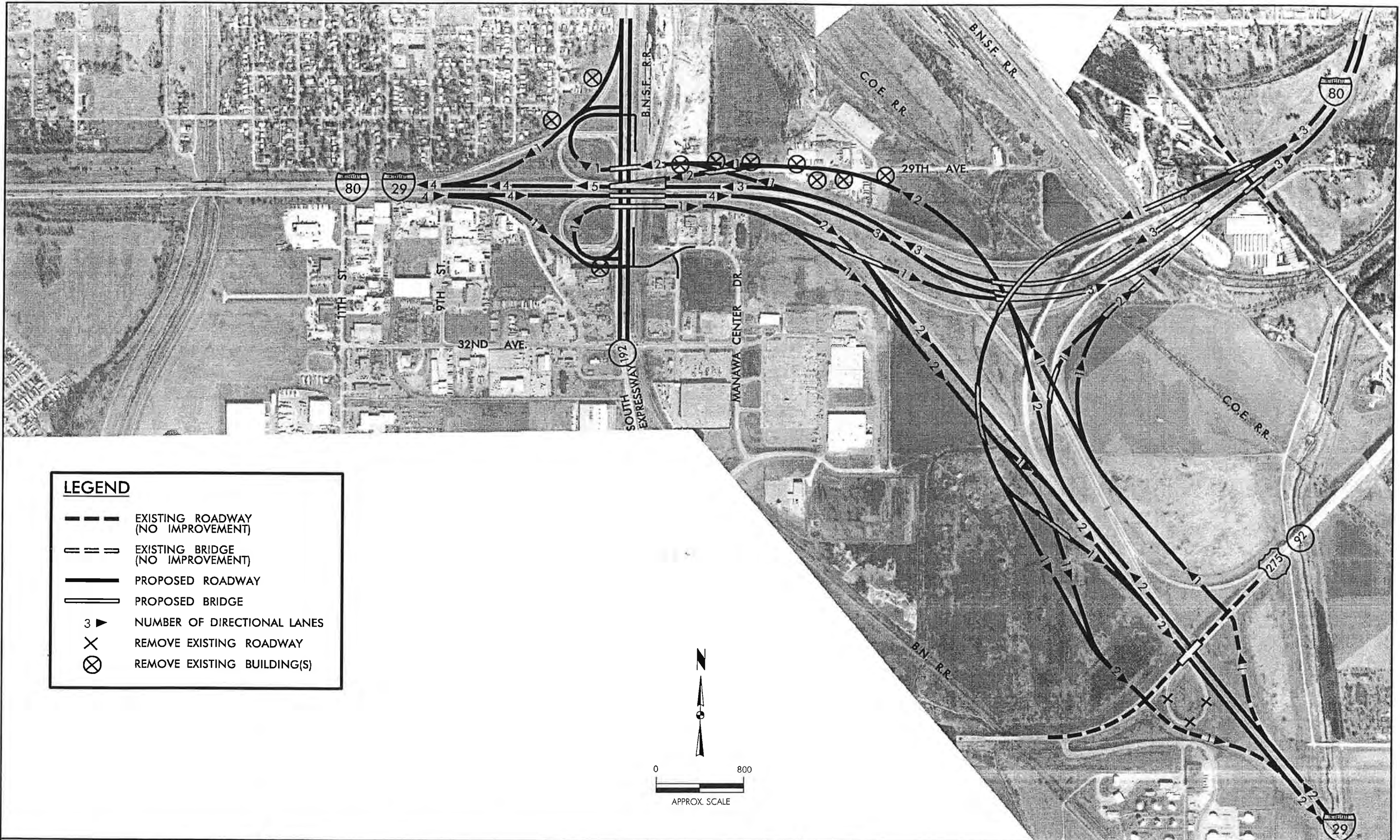






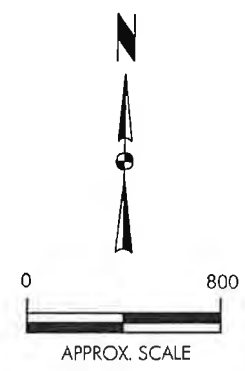






**LEGEND**

- EXISTING ROADWAY (NO IMPROVEMENT)
- EXISTING BRIDGE (NO IMPROVEMENT)
- PROPOSED ROADWAY
- PROPOSED BRIDGE
- NUMBER OF DIRECTIONAL LANES
- REMOVE EXISTING ROADWAY
- REMOVE EXISTING BUILDING(S)



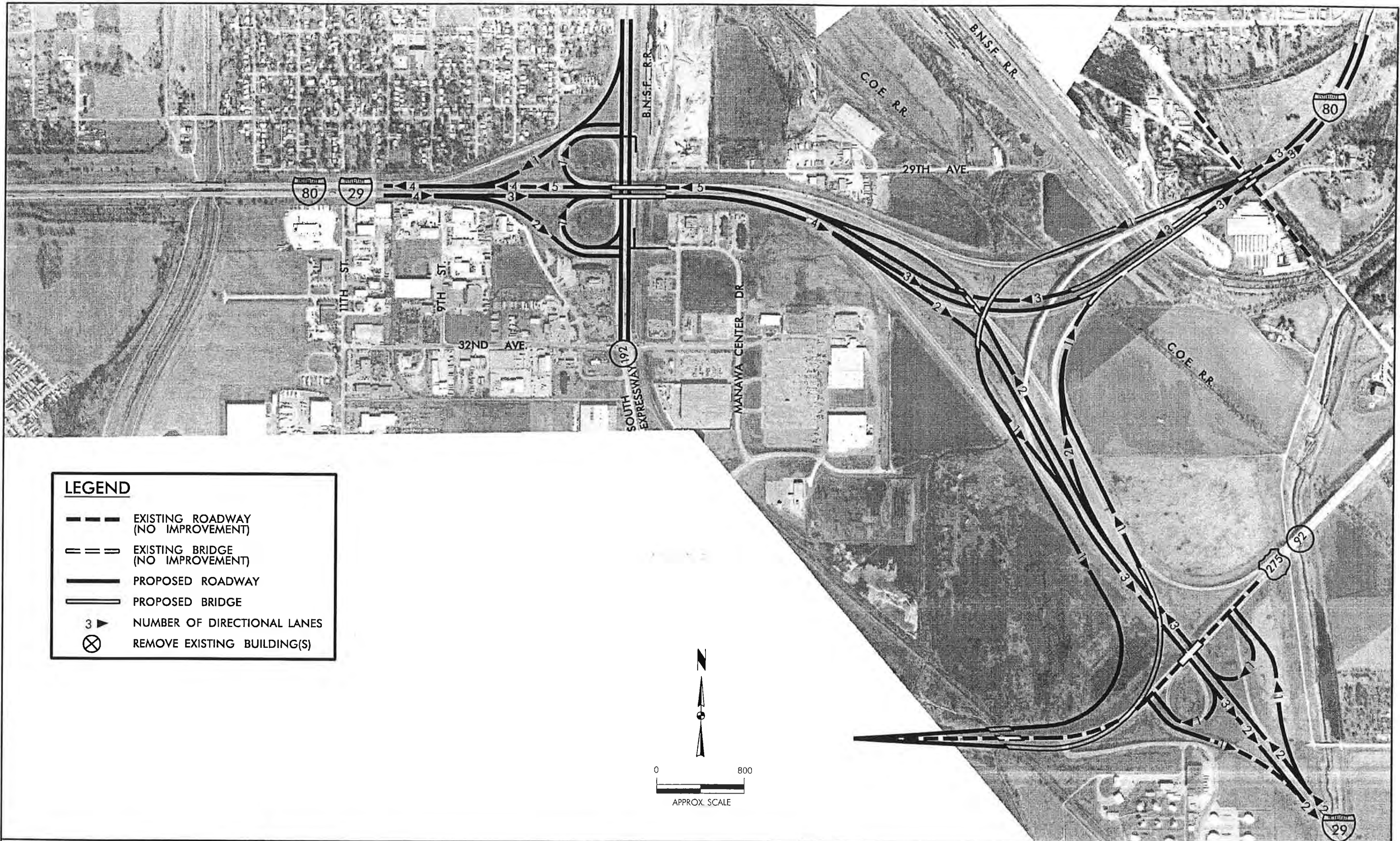


TABLE 12 - Concept Screening Summary - East I-80/I-29 System Interchange

Alternative	Exhibit	Design Features/ Impacts	Traffic Operations	Route Continuity/ Signing	Environmental Impacts	Right-of-Way / Property Impacts	Maintenance of Traffic / Constructability	Cost (\$ Million)
1	19	<ul style="list-style-type: none"> <li>- 60 mph design speed on "thru" system-to-system ramps.</li> <li>- 50 mph design speed on other system-to-system ramps.</li> <li>- WB I-80 to SB I-29 fly-over ramp merges on the right.</li> <li>- NB I-29 to WB I-80/I-29 fly-over ramp merges on the right.</li> <li>- No C-D Roads.</li> <li>- Retain existing config. of South Expressway interchange.</li> <li>- Loop ramps meet basic criteria.</li> <li>- Full interchange for US 275 with loop ramps that meet full criteria.</li> </ul>	<ul style="list-style-type: none"> <li>- Acceptable mainline traffic operations provided by the basic lanes of the alternative.</li> <li>- Acceptable ramp junction and weaving operations provided at all locations except for WB I-80/I-29 approaching the South Expressway.</li> </ul>	<ul style="list-style-type: none"> <li>- Alternative provides route and lane continuity.</li> <li>- Within the major merges of the system interchange, "non-thru" system ramps merge on the right. If both system ramps are "thru" ramps, then the lower volume ramp merges on the right.</li> <li>- No major signing issues identified. Short weaving section for WB I-80/I-29 may impact signing for the South Expressway off-ramp.</li> </ul>	No major impacts have been identified. Alignment of the WB I-80 to SB I-29 system ramp is through an existing lake.	<ul style="list-style-type: none"> <li>- Approximately 9 acres of additional right-of-way.</li> <li>- No homes or businesses impacted.</li> </ul>	<ul style="list-style-type: none"> <li>- Construction expected to be moderately difficult. Portions of the system interchange could be constructed in the clear. In other areas, the proximity of new and existing roads may cause maintenance of traffic problems.</li> </ul>	69.4
2	20	Same as Alternative 1 except that 60 mph design speed provided on all system-to-system ramps.	<ul style="list-style-type: none"> <li>- Acceptable mainline traffic operations provided by the basic lanes of the alternative.</li> <li>- Acceptable ramp junction and weaving operations provided at all locations except for WB I-80/I-29 approaching the South Expressway and for SB I-29 approaching US 275.</li> </ul>	Same as Alternative 1	No major impacts have been identified. Alignment of the WB I-80 to SB I-29 system ramp is through an existing lake.	<ul style="list-style-type: none"> <li>- Approximately 9 acres of additional right-of-way.</li> <li>- No homes or businesses impacted.</li> </ul>	Same as Alternative 1	69.7
3	21	<ul style="list-style-type: none"> <li>- Same as Alternative 2 except that a C-D road is provided to remove the weaving section on WB I-80/I-29 upstream of the South Expressway.</li> <li>- NB I-29 merges on the left of WB I-80.</li> </ul>	<ul style="list-style-type: none"> <li>- Acceptable mainline traffic operations provided by the basic lanes of the alternative.</li> <li>- Acceptable ramp junction and weaving operations provided at all locations.</li> </ul>	<ul style="list-style-type: none"> <li>- Same as Alternative 1 except that NB I-29 (with lower volumes) merges on the left of WB I-80 (with higher volumes).</li> </ul>	No major impacts have been identified. Alignment of the WB I-80 to SB I-29 system ramp is through an existing lake.	<ul style="list-style-type: none"> <li>- Approximately 9 acres of additional right-of-way.</li> <li>- No homes or businesses impacted.</li> </ul>	Same as Alternative 1	72.8
4	22	<ul style="list-style-type: none"> <li>- Same as Alternative 1 except that system interchange is shifted to the west to maximize NB and SB weaving lengths between the system interchange and US 275.</li> <li>- C-D roads are provided to remove the weaving section on WB and EB I-80/I-29 between the system interchange and the South Expressway.</li> <li>- This requires braided ramps just east of the South Expressway.</li> <li>- C-D roads require new bridges over South Expressway.</li> <li>- Loop ramps of South Expressway inter. reconstructed to meet full criteria.</li> </ul>	<ul style="list-style-type: none"> <li>- Acceptable mainline traffic operations provided by the basic lanes of the alternative.</li> <li>- Acceptable ramp junction and weaving operations provided at all locations.</li> </ul>	<ul style="list-style-type: none"> <li>- Same as Alternative 1 except that additional signing is required to direct motorists to/from the C-D roads.</li> </ul>	No major impacts have been identified. Alignment of the I-80 mainline is through an existing lake.	<ul style="list-style-type: none"> <li>- Approximately 49 acres of additional right-of-way.</li> <li>- Approximately 11 businesses would be impacted.</li> </ul>	Same as Alternative 1 except that C-D roads, once constructed, provide detour options during construction of mainline.	80.7

TABLE 12 - Concept Screening Summary - East I-80/I-29 System Interchange (Continued)

Alternative	Exhibit	Design Features/ Impacts	Traffic Operations	Route Continuity/ Signing	Environmental Impacts	Right-of-Way / Property Impacts	Maintenance of Traffic / Constructability	Cost (\$ Million)
5	23	- Same as Alternative 1 except that system interchange is shifted to the south to increase EB and WB weaving lengths between the system interchange and the South Expressway. - C-D roads are provided to remove the weaving section on NB and SB I-29 between the system interchange and US 275. - This requires braided ramps just north of US 275.	- Acceptable mainline traffic operations provided by the basic lanes of the alternative.  - Acceptable ramp junction and weaving operations provided at all locations.	- Same as Alternative 1 except that additional signing is required to direct motorists to/from the C-D roads.	No major impacts have been identified.	- Approximately 61 acres of additional right-of-way.  - No homes or businesses impacted.	Same as Alternative 1 except that C-D roads, once constructed, provide detour options during construction of mainline.	74.7
6	24	Same as Alternative 5 except that system interchange is shifted further to the south to maximize EB and WB weaving lengths between the system interchange and the South Expressway.	- Acceptable mainline traffic operations provided by the basic lanes of the alternative.  - Acceptable ramp junction and weaving operations provided at all locations.	- Same as Alternative 1 except that additional signing is required to direct motorists to/from the C-D roads.	No major impacts have been identified.	- Approximately 75 acres of additional right-of-way.  - 1 business would be impacted.	Same as Alternative 1 except that C-D roads, once constructed, provide detour options during construction of mainline.	77.8
7	25	- Same as Alternative 1 except that C-D roads are provided to/from the South Expressway and to/from US 275. - This requires braided ramps at four locations.	- Acceptable mainline traffic operations provided by the basic lanes of the alternative.  - Acceptable ramp junction and weaving operations provided at all locations.	- Same as Alternative 1 except that additional signing is required to direct motorists to/from the C-D roads.	No major impacts have been identified. Alignment of the WB I-80 to SB I-29 system ramp is through an existing lake.	- Approximately 54 acres of additional right-of-way.  - Approximately 8 businesses would be impacted.	Same as Alternative 1 except that C-D roads, once constructed, provide detour options during construction of mainline.	88.2
8	26	- Similar to Alternative 1 except that free-flowing ramps are provided between I-80 (east of the system interchange) and US 275 (west of I-29)	- Acceptable mainline traffic operations provided by the basic lanes of the alternative.  - Acceptable ramp junction and weaving operations provided at all locations.	- Same as Alternative 1 except that additional signing is required to direct motorists to the direct ramps to US 275.	No major impacts have been identified. Alignment of the WB I-80 to SB I-29 system ramp is through an existing lake.	- Approximately 36 acres of additional right-of-way.  - No homes or businesses impacted.	Same as Alternative 1 except that direct ramps to US 275, once constructed, provide detour options during construction of mainline.	79.2



## SOUTH EXPRESSWAY / I-80 / I-29 INTERCHANGE

### EXISTING/FUTURE DEFICIENCIES

Several operational deficiencies were identified for the South Expressway/I-80/I-29 interchange. The I-80/I-29 mainline segments and ramp junctions on the west side of the interchange are currently operating at LOS C or D during peak hours. On the east side of the interchange, both directions of the mainline represent weaving sections that are currently operating at LOS C. Both ramp terminal intersections are currently signalized and are operating overall at LOS C with some movements operating at LOS D.

In the Year 2020 No-Build Scenario, the I-29 mainline segments and ramp junctions on the west side of the interchange will operate at LOS F during peak hours. The weaving sections between the South Expressway and the East I-80/I-29 System Interchange will operate at LOS E. The overall level of service at the signalized intersection will deteriorate to LOS F.

The assessment of existing geometric and physical conditions revealed that the on ramps to I-80/I-29 from the South Expressway do not meet standards for taper rate. Mainline pavement condition in the interchange rated "poor". Bridges rated "fair". The cross section, stopping sight distance, safety and signing in some areas are also rated "fair".

### ACCESS

The existing South Expressway/I-80/I-29 interchange provides full access. Changes to access are not anticipated as part of long-term improvements.

### ALTERNATIVES

Two basic alternatives were developed for the South Expressway/I-80/I-29 interchange and are discussed below. Given the proximity of this interchange to the East I-80/I-29 System Interchange, however, these alternatives were developed and assessed as part of the development and assessment of improvement alternatives for the system interchange. Therefore, separate exhibits and a screening matrix were not prepared for the South Expressway.

Graphical depictions of the two basic alternatives are shown Exhibits 19 thru 26 for various configurations of the system interchange. Both alternatives assume reconstruction of the I-80/I-29 mainline and reconstruction of the South Expressway, as necessary, to provide adequate capacity to serve Year 2020 traffic volumes.

Because of the Burlington Northern Santa Fe Railroad (BNSFRR) tracks on the east side of the South Expressway, the existing parclo configuration (with ramps all on the west side) must be retained for this interchange. The alternatives below focus on the impacts of C-D roads on the radius of the loops.

#### Alternative 1

The existing configuration of the South Expressway interchange (Alternative 1) would be retained for five of the eight alternatives for the East I-80/I-29 System Interchange. These five system interchange alternatives do not include C-D roads to the South Expressway. Therefore, additional bridges across the

South Expressway are not required. This should allow the existing loop ramps at the South Expressway interchange to be reconstructed on their current alignment and still meet the "basic" design criteria.

#### Alternative 2

For the system interchange alternatives that include C-D road connections to the South Expressway, additional bridges across the South Expressway will be required. To meet the "full" design criteria, these additional bridges will require that the loop ramps be pushed out further. An example of this configuration is shown in Exhibit 22 (Alternative 4 for the system interchange). This illustrates the worst case situation. Preliminary assessment of these ramps indicates that it may be possible to meet the "basic" design criteria without impacting adjacent businesses. A more detailed assessment of loop ramp radii will be performed in Phase III.

### PREFERRED ALTERNATIVES

Preferred alternatives were identified for the East I-80/I-29 System Interchange as a whole rather than for adjacent interchanges individually. However, based on the preferred alternatives for the East I-80/I-29 System Interchange (see previous section) both Alternative 1 and Alternative 2 will be carried forward into Phase III.

## SOUTH 24<sup>TH</sup> STREET / I-80 / I-29 INTERCHANGE

### EXISTING/FUTURE DEFICIENCIES

Several operational deficiencies were identified for the S. 24<sup>th</sup> Street/I-80/I-29 interchange. The I-80/I-29 mainline segments and ramp junctions of the interchange are currently operating at LOS C or D during peak hours. Both ramp terminal intersections are currently signalized and are operating overall at LOS B. Based on field observations, these intersections may actually be operating at a worse level of service. The discrepancy between observed operations and analysis results is likely due to the inability of the HCM procedures to replicate the impacts of the high percentage of heavy trucks which utilize this interchange and the grades approaching the intersections.

In the Year 2020 No-Build Scenario, several of the I-80/I-29 mainline segments and ramp junctions of the interchange will operate at LOS F during peak hours. The No-Build traffic analysis determined that that the overall level of service at the ramp terminal intersections will not deteriorate significantly. As noted above, however, the ramp terminal intersections will probably begin to experience some significant operational problems based on field observations of existing traffic operations.

The assessment of existing geometric and physical conditions revealed that the on ramps to I-80/I-29 from the S. 24<sup>th</sup> Street do not meet standards for taper rate. Mainline pavement condition in the interchange rated "poor". Bridges rated "fair". The cross section, stopping sight distance, safety and signing in some areas are also rated "poor" or "fair".

### ACCESS

The existing S. 24<sup>th</sup> Street /I-80/I-29 interchange provides full access. Changes to access are not anticipated as part of long-term improvements.

### ALTERNATIVES

Seven alternatives were developed for the S. 24<sup>th</sup> Street/I-80/I-29 interchange and are shown in Exhibits 27 thru 33. Given the proximity of this interchange to the West I-80/I-29 System Interchange these alternatives were developed and assessed as part of the development and assessment of improvement alternatives for the system interchange. Unlike other service interchanges in the study area that are located adjacent to system interchanges, however, the alternatives for the S. 24<sup>th</sup> Street interchange and alternatives for the West I-80/I-29 System Interchange are mutually exclusive for the most part. Thus, separate exhibits and a screening matrix were prepared for the S. 24<sup>th</sup> Street to allow an independent assessment of the alternatives.

All seven alternatives assume reconstruction of the I-80/I-29 mainline and reconstruction of S. 24<sup>th</sup> Street, as necessary, to provide adequate capacity to serve Year 2020 traffic volumes.

#### Alternative 1 (Exhibit 27)

Alternative 1 would provide a single-point urban interchange (SPUI). The SPUI essentially combines two separate diamond ramp intersections into one large at-grade intersection which accommodates all interchanging vehicular movements. This configuration could be constructed with the freeway lanes

passing above the ramp/cross street intersection or with the freeway lanes passing below the ramp/cross street intersection.

An SPUI may be more appropriate at this location than at the Madison Avenue/I-80 interchange since the left turn traffic volumes from the ramp approaches to Madison Avenue are not as heavily unbalanced. In addition, the thru traffic on S. 24<sup>th</sup> Street is not as heavy. These traffic characteristics tend to improve the efficiency of a SPUI. As note earlier, the geometry of SPUIs generally does not accommodate pedestrians as well as a diamond interchange. However, pedestrian traffic in this area would be expected to be low or nonexistent.

#### Alternative 2 (Exhibit 28)

Alternative 2 would provide a diamond interchange configuration similar to the existing configuration. With appropriate improvements on the cross street and on the ramp approaches, this configuration would be expected to provide acceptable traffic operations as well. As shown in Exhibit 28, the distance between ramp terminal intersections is approximately 850 feet. This distance could be reduced considerably to provide a tight diamond configuration but would not provide significant benefits relative to right-of-way or traffic operations.

#### Alternative 3 (Exhibit 29)

Alternative 3 would provide a partial cloverleaf (parclo) configuration with a loop ramp in the Southeast quadrant of the interchange. Construction of this loop ramp would provide free-flowing operation for eastbound I-80/I-29 to northbound S. 24<sup>th</sup> Street traffic which is a relatively heavy movement with a high percentage of trucks. This configuration does not provide free-flowing operation for the other ramp movements which also reflect a high percentage of trucks.

#### Alternative 4 (Exhibit 30)

Alternative 4 is similar to Alternative 3 but would provide a loop ramp in the Southwest quadrant of the interchange. Construction of this loop ramp would provide free-flowing operation for southbound S. 24<sup>th</sup> Street to eastbound I-80/I-29 traffic.

#### Alternative 5 (Exhibit 31)

Alternative 5 would provide a partial cloverleaf (parclo) configuration with loop ramps in the Southeast and Southwest quadrants of the interchange. This alternative would also provide an eastbound C-D road to eliminate weaving on the mainline. The advantage of this alternative is the fact that all movements between eastbound I-80/I-29 and S. 24<sup>th</sup> Street are free-flowing. Thus, an intersection is not required on the south side of the freeway. The primary disadvantage of this alternative is that it does not provide an opportunity to drop one of the two auxiliary lanes on eastbound I-80/I-29 that are created at the merge of eastbound I-80 and southbound I-29. A two-lane off-ramp to S. 24<sup>th</sup> Street would provide this opportunity. However, a two-lane off-ramp is not appropriate in this configuration since there would be inadequate spacing between where the two lanes depart the mainline and where the two lanes split for northbound S. 24<sup>th</sup> Street and southbound S. 24<sup>th</sup> Street. For this reason, Alternative 5 has been shown with a single-lane off-ramp and a right-side taper from five mainline lanes to four mainline lanes downstream of the off-ramp to S. 24<sup>th</sup> Street.

**Alternative 6 (Exhibit 32)**

Alternative 6 provides a diamond interchange configuration but would allow loop on-ramps to be constructed at some point in the future. When constructed, these loop ramps would eliminate left turns from the cross street and thus simplify the traffic signal phasing at ramp terminal intersections. With basic design criteria, this alternative would still likely encroach upon existing development on the north side of the interchange.

**Alternative 7 (Exhibit 33)**

Alternative 7 provides a folded diamond interchange with all ramps located on the east side of South 24<sup>th</sup> Street to provide the maximum distance between the ramps of the South 24<sup>th</sup> Street interchange and the ramps of the system interchange to the west. Similar to Alternative 6, this alternative would likely encroach upon existing development on the north side of the interchange.

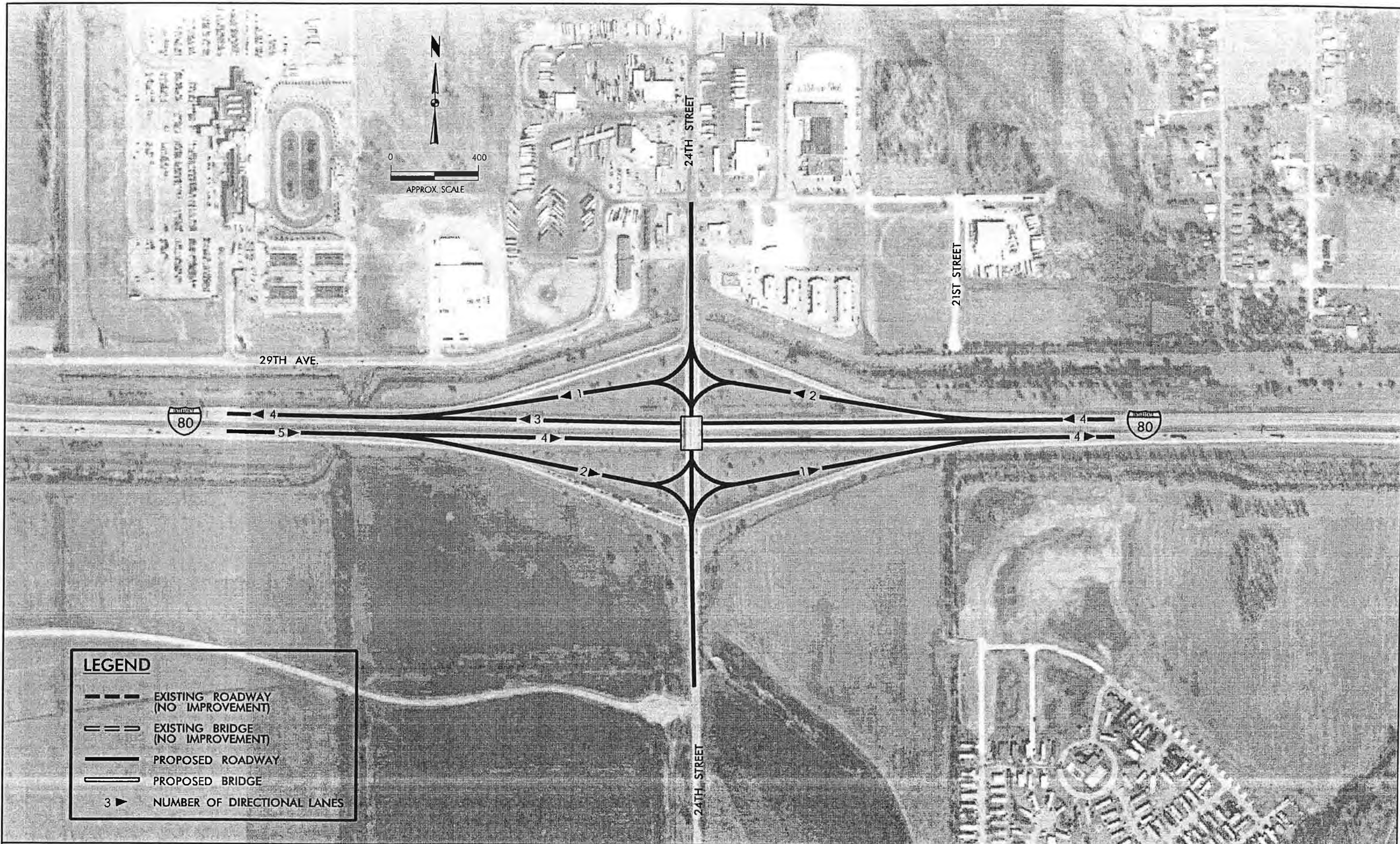
**PREFERRED ALTERNATIVES**

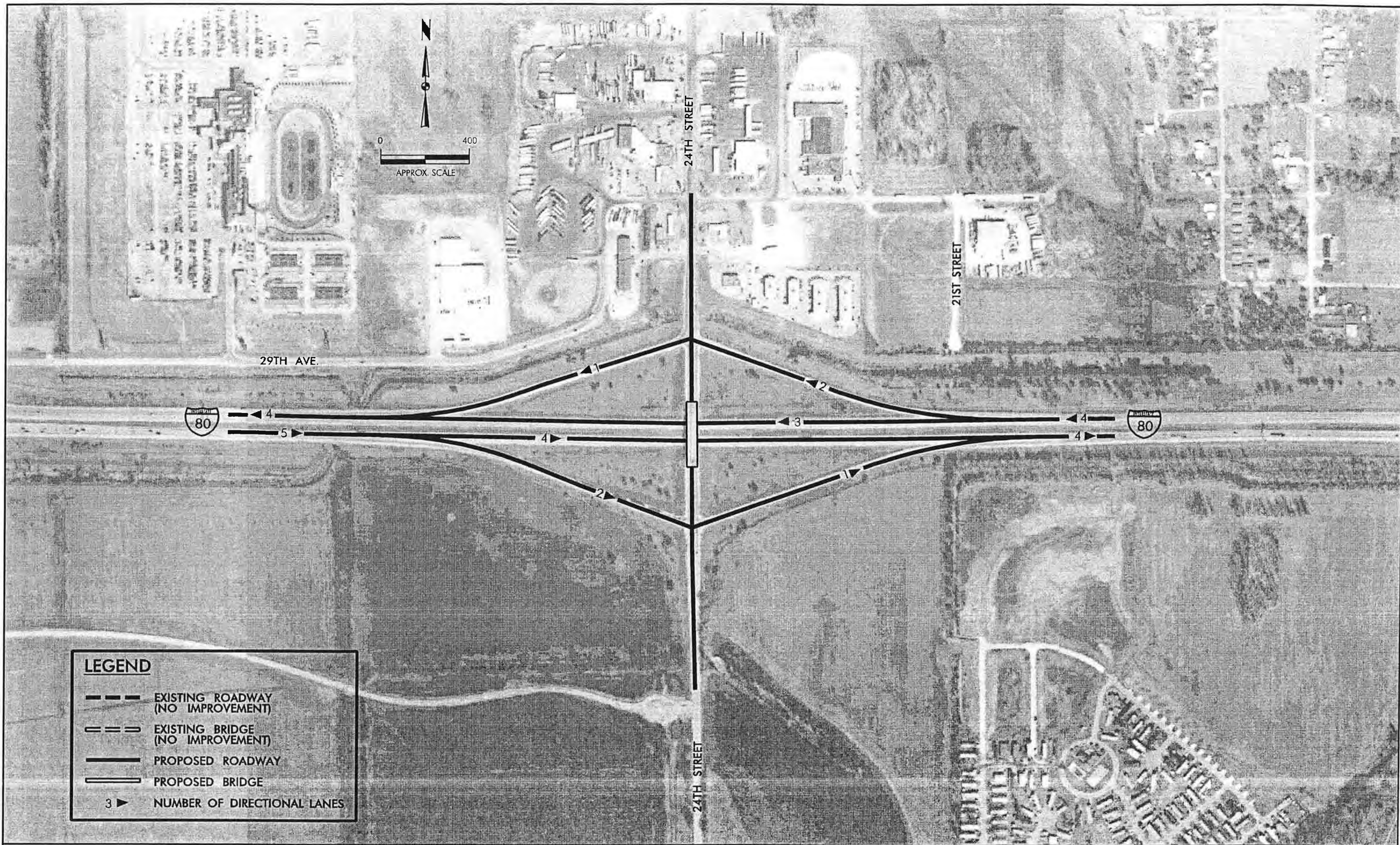
Preferred alternatives were identified for the West I-80/I-29 System Interchange as a whole rather than for adjacent interchanges individually. However, based on the preferred alternatives for the West I-80/I-29 System Interchange (see next section) three preferred alternatives were identified at South 24<sup>th</sup> Street to be carried forward into Phase III.

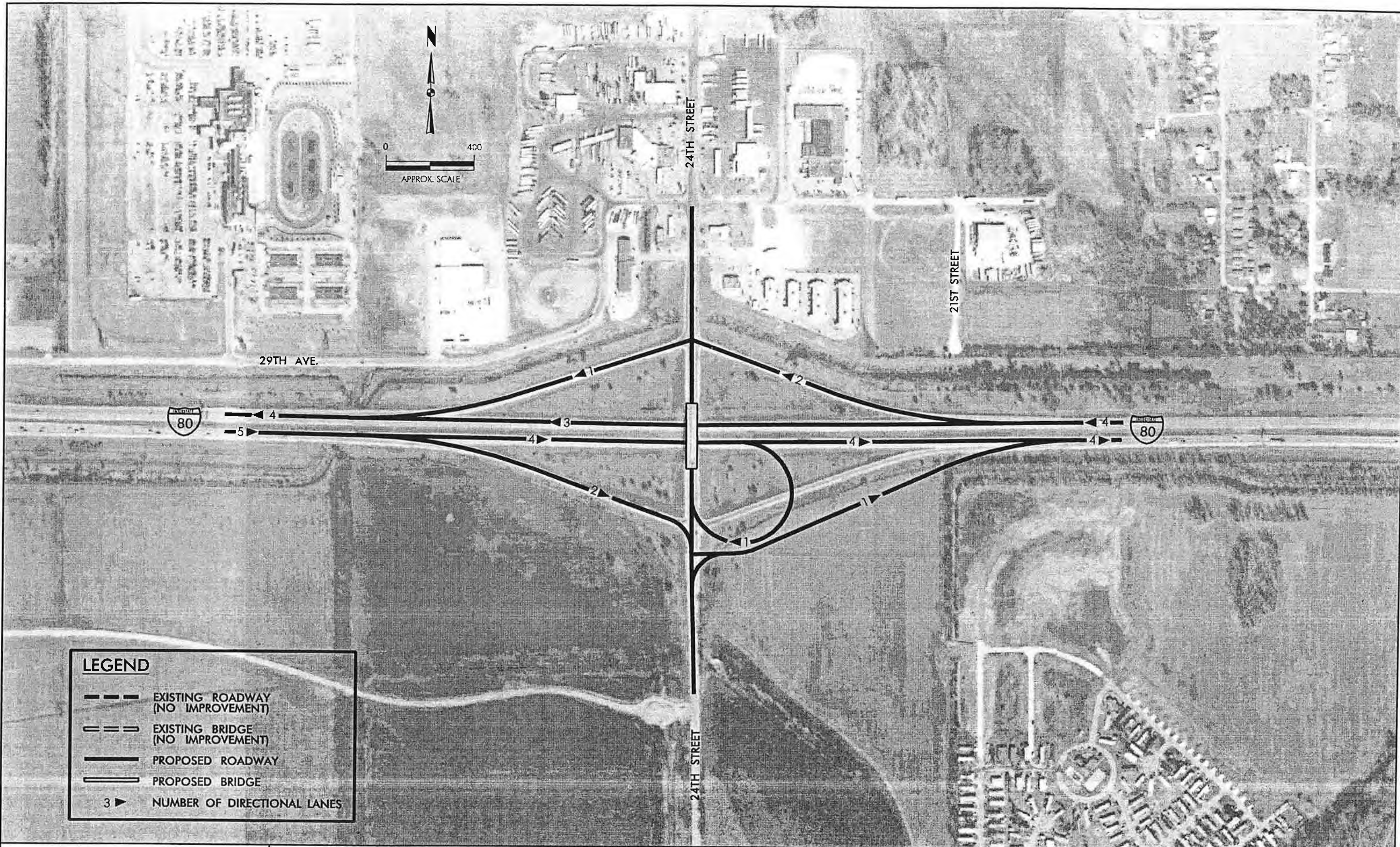
Alternative 1 was identified as a preferred alternative given that it could be constructed within the existing right-of-way and because it would replace two signalized intersections with one signalized intersection. This alternative would be compatible with preferred Alternative 1 at the West I-80/I-29 System Interchange.

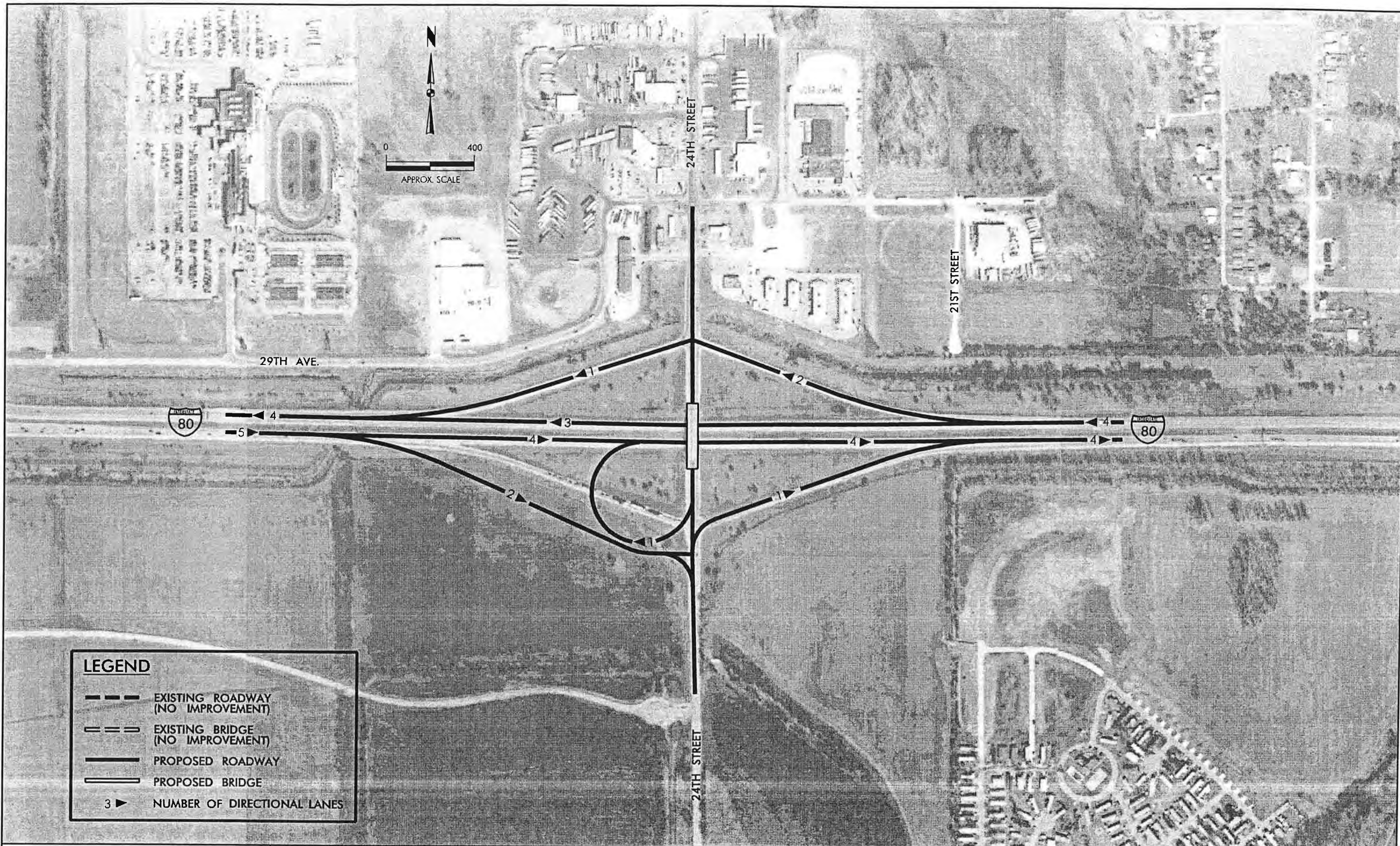
Alternative 6 provides a configuration that is similar to that provided today but with the additional operational benefits provided by loop on-ramps (i.e., elimination of left turns from the cross street). This alternative would be compatible with preferred Alternative 1 at the West I-80/I-29 System Interchange.

Alternative 7 provides the maximum separation distance between the ramps of the South 24<sup>th</sup> Street interchange and the West I-80/I-29 System Interchange. A disadvantage of Alternative 7 is that it would not provide an opportunity to drop one of the five eastbound mainline lanes (three from I-80 and two from I-29) with a two lane off ramp. This alternative would be compatible with preferred Alternative 1 at the West I-80/I-29 System Interchange.



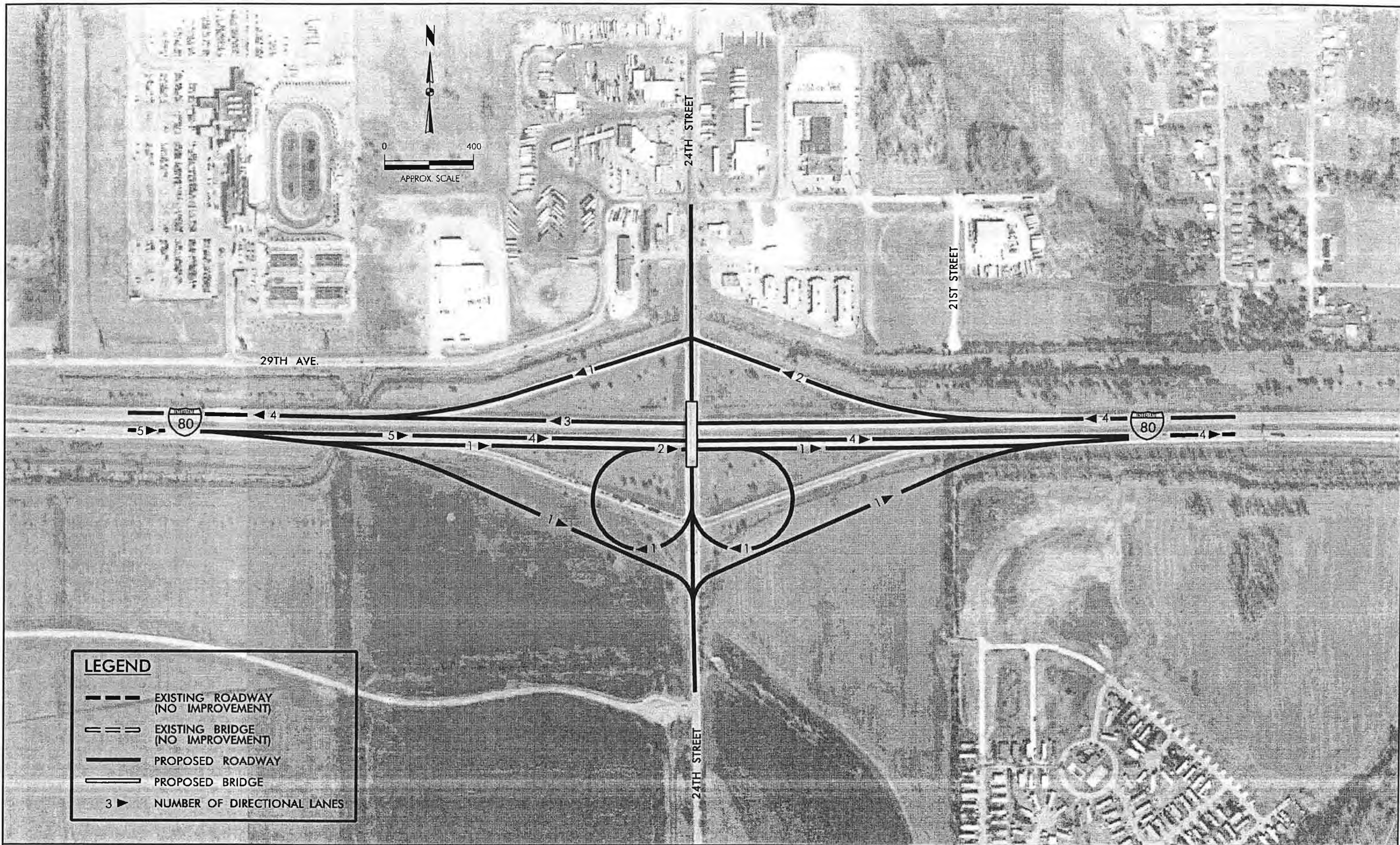




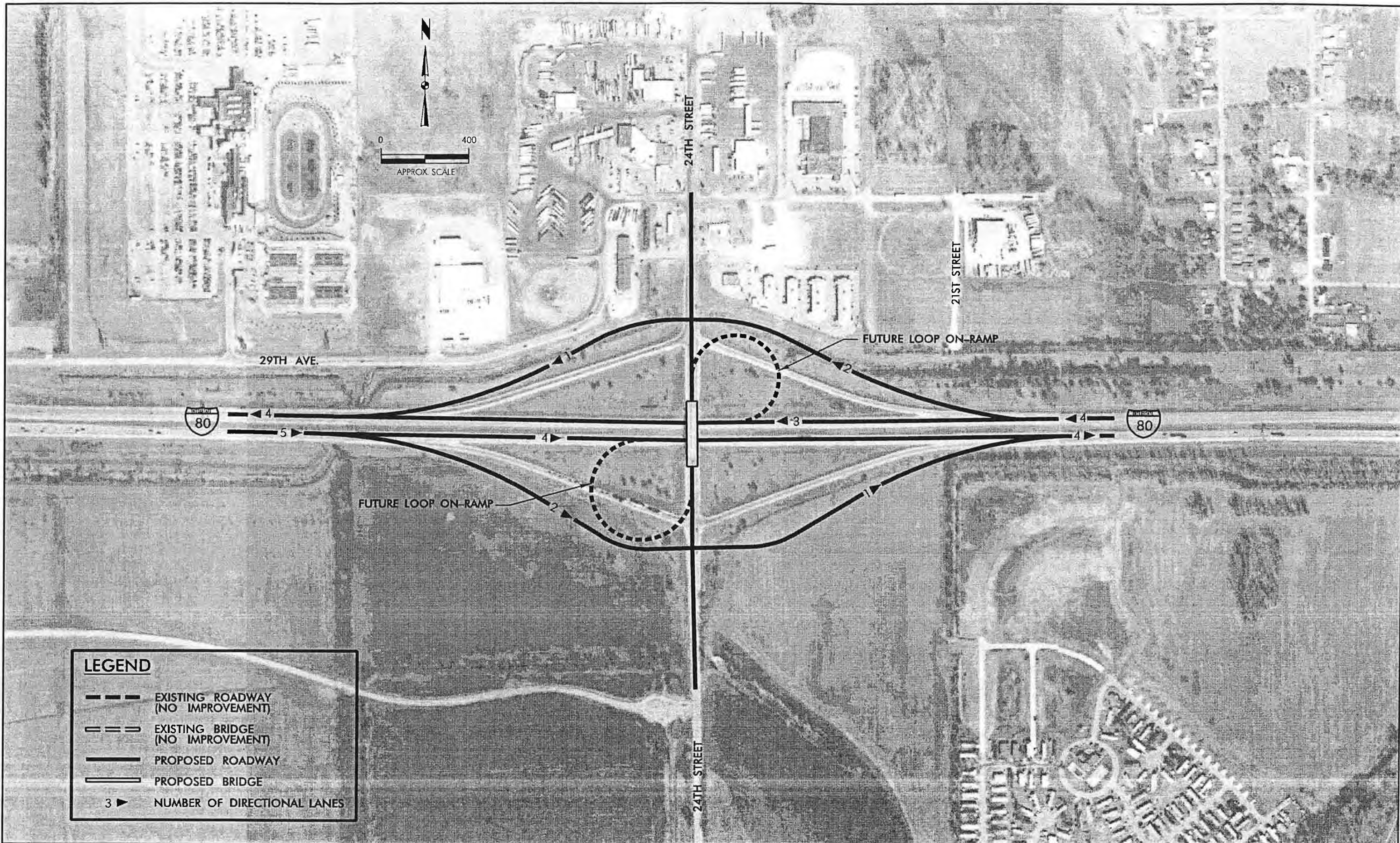


**LEGEND**

- EXISTING ROADWAY (NO IMPROVEMENT)
- === EXISTING BRIDGE (NO IMPROVEMENT)
- PROPOSED ROADWAY
- ▭ PROPOSED BRIDGE
- 3 ► NUMBER OF DIRECTIONAL LANES







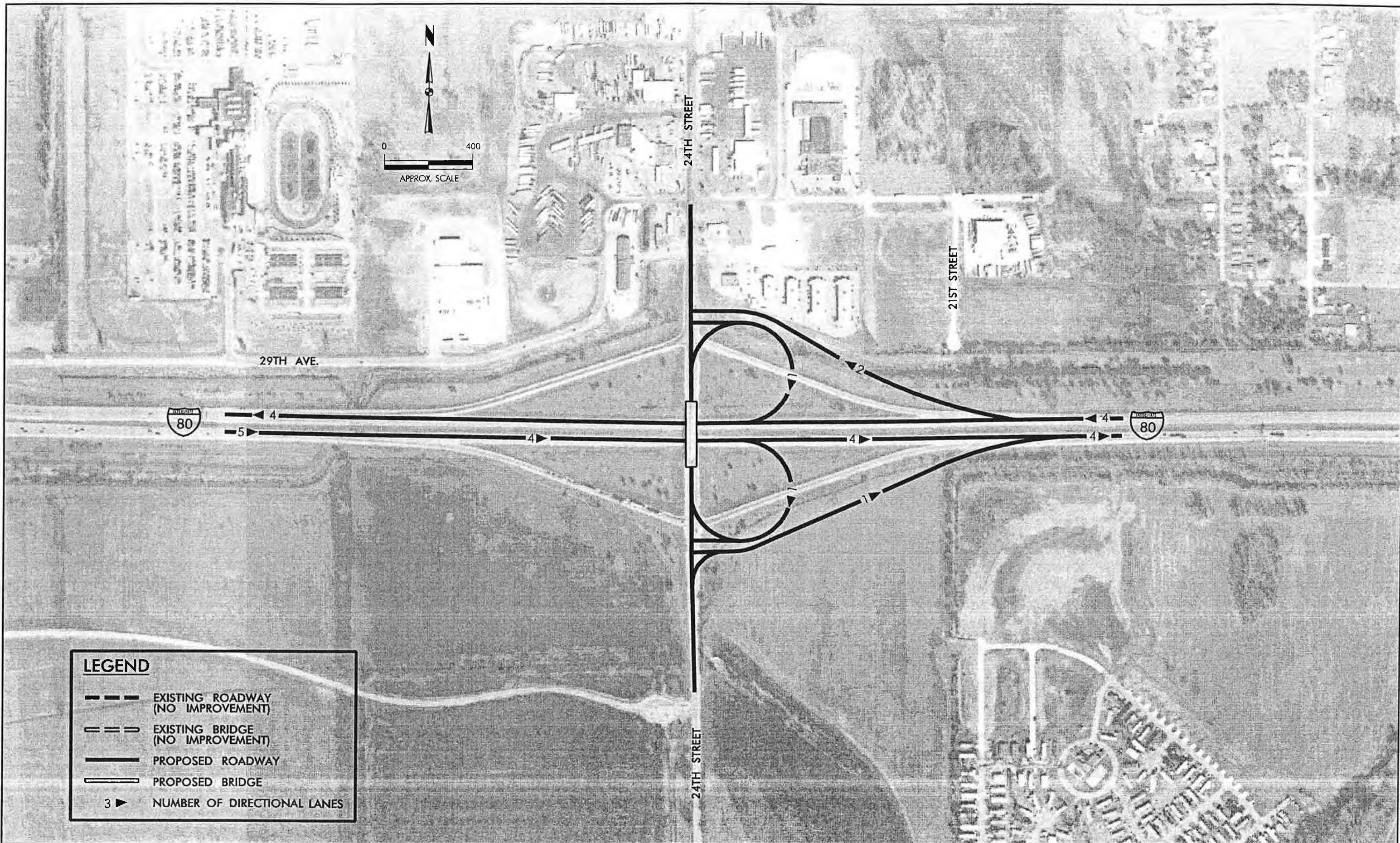


TABLE 13 - Concept Screening Summary – South 24<sup>th</sup> Street/I-80/I-29 Interchange

Alternative	Exhibit	Design Features/ Impacts	Traffic Operations	Route Continuity/ Signing	Environmental Impacts	Right-of-Way / Property Impacts	Maintenance of Traffic / Constructability	Cost (\$ Million)
1	27	- Single Point Urban Interchange (SPUI) configuration for S. 24 <sup>th</sup> Street.	- Acceptable traffic operations provided on the mainline and at the ramp junctions. - Operational performance of the SPUI may be better than a diamond configuration because thru traffic is relatively low on 24 <sup>th</sup> Street and because traffic is not highly directional during peak periods.	Alternative provides route and lane continuity.	No major impacts have been identified.	No major impacts have been identified.	No major construction issues have been identified.	17.0
2	28	- Retain diamond interchange configuration for S. 24 <sup>th</sup> Street.	- Acceptable traffic operations provided on the mainline and at the ramp junctions. - Two signalized intersections of the interchange may not perform as well as SPUI but should provide acceptable traffic operations.	Alternative provides route and lane continuity.	No major impacts have been identified.	No major impacts have been identified.	No major construction issues have been identified.	18.7
3	29	- Diamond interchange configuration for S. 24 <sup>th</sup> Street with loop ramp in SE quadrant for EB I-80/I-29 to NB S. 24 <sup>th</sup> Street movement.	- Similar to Alternative 2 except that traffic operations benefit from having EB I-80/I-29 to NB 24 <sup>th</sup> Street movement be free-flowing.	Alternative provides route and lane continuity.	- No major impacts have been identified. - Required right-of-way includes farmland.	Approximately 5 acres of additional right-of-way.	No major construction issues have been identified.	21.2
4	30	- Diamond interchange configuration for S. 24 <sup>th</sup> Street with loop ramp in SW quadrant for SB S. 24 <sup>th</sup> Street to EB I-80/I-29 movement.	- Similar to Alternative 2 except that traffic operations benefit from having SB 24 <sup>th</sup> Street to EB I-80/I-29 movement be free-flowing.	Alternative provides route and lane continuity.	- No major impacts have been identified. - Required right-of-way includes farmland and land in the vicinity of the Trails Center.	Approximately 5 acres of additional right-of-way.	No major construction issues have been identified.	21.2
5	31	- Partial cloverleaf configuration for S. 24 <sup>th</sup> Street with loop ramps in SW and SE quadrants. - Movements between EB I-80/I-29 and S. 24 <sup>th</sup> Street served by C-D road.	- Acceptable traffic operations provided on the mainline and at the ramp junctions except at the one-lane off ramp from EB I-80/I-29 which does not provide opportunity to drop an auxiliary lane on mainline. This then requires that traffic from SB I-29 weave across 3 lanes to exit. - Weaving between loop ramps occurs on C-D road rather than on the mainline. - Traffic operations on 24 <sup>th</sup> Street benefit from loops ramps (i.e., no traffic signal needed at the south-side intersection.)	Alternative provides route and lane continuity except at the outside lane taper noted under traffic operations.	- No major impacts have been identified. - Required right-of-way includes farmland and land in the vicinity of the Trails Center.	Approximately 10 acres of additional right-of-way.	No major construction issues have been identified.	23.1

TABLE 13 - Concept Screening Summary – South 24<sup>th</sup> Street/I-80/I-29 Interchange (Continued)

Alternative	Exhibit	Design Features/ Impacts	Traffic Operations	Route Continuity/ Signing	Environmental Impacts	Right-of-Way / Property Impacts	Maintenance of Traffic / Constructability	Cost (\$ Million)
6	32	- Diamond interchange configuration with provision for future loop on ramps.	- Similar to Alternative 2 except that traffic operations benefit from having NB 24 <sup>th</sup> Street to WB I-80/I-29 movement and SB 24 <sup>th</sup> Street to EB I-80/I-29 be free-flowing. - Acceptable traffic operations provided on the mainline and at the ramp junctions.	Alternative provides route and lane continuity.	- No major impacts have been identified. - Required right-of-way includes farmland and land in the vicinity of the Trails Center.	Approximately 10 acres of additional right-of-way.	No major construction issues have been identified.	20.6
7	33	- Folded diamond interchange with all ramps located on the east side of South 24 <sup>th</sup> St.	- Similar to Alternative 2 except that traffic operations benefit from having NB 24 <sup>th</sup> Street to WB I-80/I-29 movement and EB I-80/I-29 to NB 24 <sup>th</sup> Street be free-flowing. - Acceptable traffic operations provided on the mainline and at the ramp junctions.	Alternative provides route and lane continuity.	- No major impacts have been identified. - Required right-of-way includes farmland.	Approximately 5 acres of additional right-of-way.	No major construction issues have been identified.	20.6

## WEST I-80/I-29 SYSTEM INTERCHANGE

### EXISTING/FUTURE DEFICIENCIES

Several operational deficiencies were identified for the West I-80/I-29 System Interchange. The mainline segment between the system interchange and S. 24<sup>th</sup> Street is currently operating at LOS D during peak hours while the other two legs of the system interchange are operating at LOS C or better. The southbound I-29 mainline between the system interchange and Nebraska Avenue represents a weaving section and is currently operating at LOS B. All other major merges and diverges are currently operating at LOS C or better.

In the Year 2020 No-Build Scenario, the LOS at these weaving mainline segments, weaving sections and major merges/diverges is expected to worsen. The mainline segments to the west and east of the system interchange will operate at LOS F during peak hours. Several of the major merges and diverges will operate at LOS F as well.

Several other operational deficiencies were identified.

- Southbound I-29 traffic must merge with eastbound I-80 traffic to continue along I-29. One I-29 basic lane merges immediately and one basic lane merges several hundred feet downstream.
- Approaching the system interchange, northbound I-29 traffic in the left lane must change one lane to continue on the designated path.
- Eastbound I-80 off ramp to northbound I-29 violates lane balance. Two freeway lanes approach the ramp junction. A two-lane off ramp to northbound I-29 is provided while two freeway lanes continue as eastbound I-80.

The assessment of existing geometric and physical conditions revealed that the condition of the pavement within the system interchange is “poor” while most bridges are “good”. The horizontal alignment, cross section, stopping sight distance and safety are also rated “fair” in the some areas.

### ACCESS

The East I-80/I-29 System Interchange currently serves all interchanging movements between I-80 and I-29 and will continue to do so with any proposed improvements. However, some the alternatives described below utilize C-D roads to provide direct access to S. 24<sup>th</sup> Street and/or Nebraska Avenue. In essence, these alternatives would modify access by forcing drivers within the system interchange to make additional access-related decisions.

### SIMULATION MODELING

The results of the CORSIM simulation modeling discussed in Chapter 5 were utilized to determine lane requirements of the improvement alternatives. The CORSIM analyses were limited to the most complex areas of the system interchange such as the weaving sections between the system interchange and the adjacent service interchanges.

### ALTERNATIVES

Five alternatives were developed for this system interchange and are shown in Exhibits 34 thru Exhibit 38. All alternatives assume reconstruction of the I-80 and I-29 mainline in the interchange area. In addition, note that Exhibits 34 thru 38 also include the Nebraska Avenue/I-29 and S. 24<sup>th</sup> Street/I-80/I-29 interchanges given the proximity of these interchanges to the East I-80/I-29 System Interchange. Separate discussions for the Nebraska Avenue and S. 24<sup>th</sup> Street interchanges are provided elsewhere.

#### Alternative 1 (Exhibit 34)

This alternative utilizes “basic” design criteria at several locations in an attempt to fit a system interchange within the spatial restrictions of the adjacent interchanges while meeting all operational criteria. Alternative 1 provides a 70 mph design speed on the “thru” system-to-system ramps and a 60 mph design speed on other system-to-system ramps. The eastbound I-80 to northbound I-29 movement (non-thru) is served with a fly-over ramp to allow it to merge on the right of a thru route. A fly-over ramp is also provided for the southbound I-29 to eastbound I-80/I-29 movement although both of the roadways that merge at this point are thru routes. The I-29 movement is brought in on the right because it is the lower volume movement. This requires the taking of a significant amount of right-of-way in the northwest quadrant of the interchange so as to minimize the right-of-way impacts on Trails Center property to the south of the interchange. The weaving length provided for eastbound I-80/I-29 between the system interchange and S. 24<sup>th</sup> Street is borderline adequate to provide acceptable traffic operations. Alternative 1 provides acceptable traffic operations at all other locations. At Nebraska Avenue, a portion of all four ramps have been shown as new roadways based on existing and expected pavement condition.

#### Alternative 2 (Exhibit 35)

Alternative 2 is identical to Alternative 1 except that it provides a 70 mph design speed on both thru and non-thru system ramps. With a 70 mph design speed, the eastbound I-80 to northbound I-29 movement would decrease the available weaving length for northbound I-29 approaching Nebraska Avenue and prevent this alternative from providing acceptable weaving operations. Similar to Alternative 1, the ability of this alternative to provide acceptable weaving operations on eastbound I-80/I-29 between the system interchange and S. 24<sup>th</sup> Street is also questionable.

#### Alternative 3 (Exhibit 36)

Alternative 4 is similar to Alternative 1 except that the system interchange is shifted to the east to maximize the length of the weaving sections on I-29 between the system interchange and Nebraska Avenue. To accomplish this, C-D roads are provided to accommodate traffic interchanging between S. 24<sup>th</sup> Street and I-80 to the west and I-29 to the north. This configuration would require the “braiding” of ramps just to the west of S. 24<sup>th</sup> Street.

#### Alternative 4 (Exhibit 37)

Alternative 4 shifts the system interchange to the west and north to provide a greater length for weaving between the system interchange and S. 24<sup>th</sup> Street. To accomplish this, C-D roads are provided to accommodate traffic interchanging between Nebraska Avenue and I-80/I-29 to the east and I-80 to the west. This configuration would require the “braiding” of ramps just to the south of Nebraska Avenue. Alternative 4 provides a 60 mph design speed for the southbound I-29 to eastbound I-80/I-29 flyover ramp. A 70 mph ramp could not be provided without resulting in significant impacts on Trails Center property to the south of the interchange.

**Alternative 5 (Exhibit 38)**

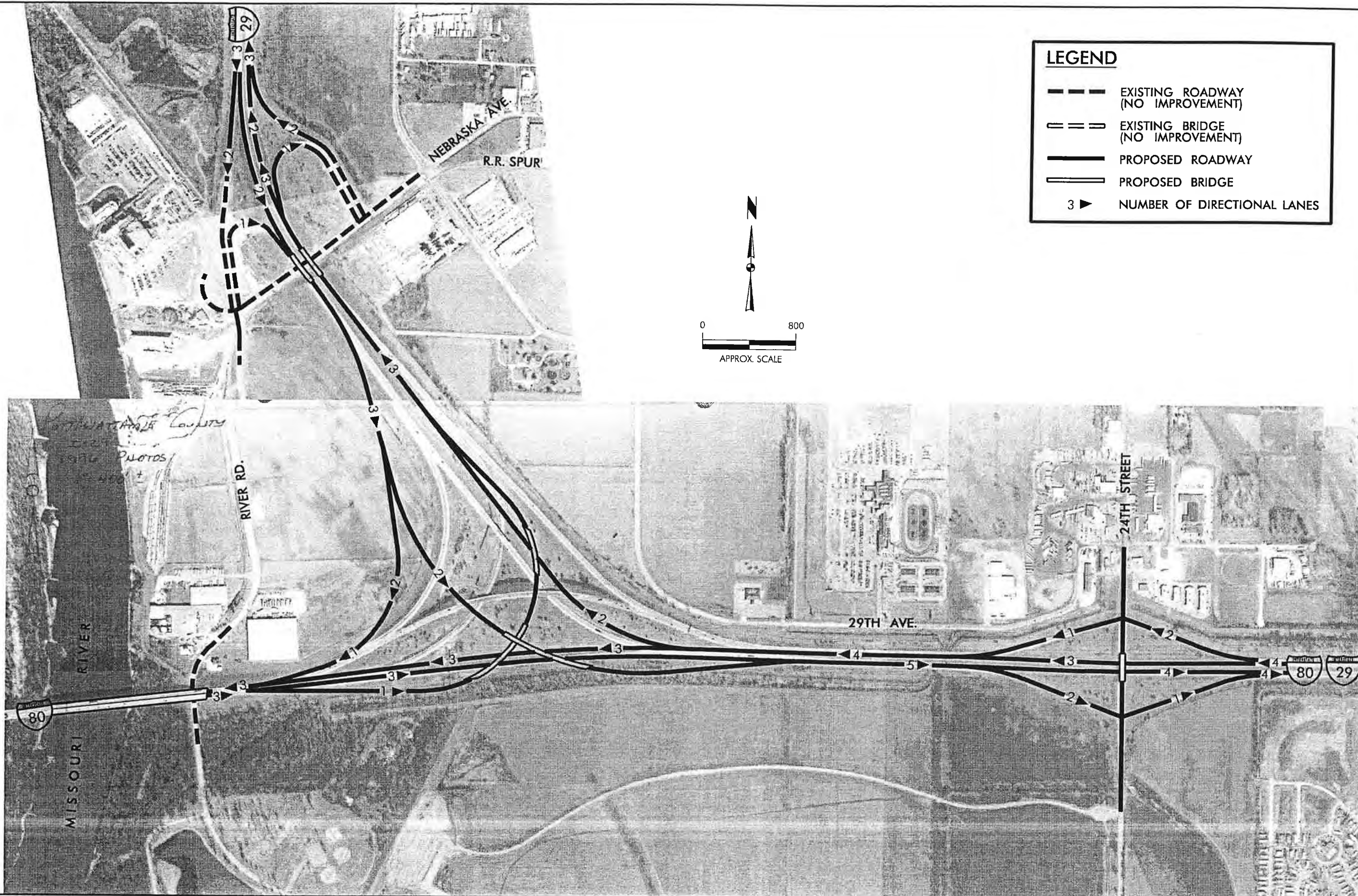
Alternative 5 basically combines Alternatives 3 and 4 to provide a system interchange configuration without any weaving sections. This is accomplished by providing C-D roads to s. 24<sup>th</sup> Street and to Nebraska Avenue. Ramp braiding is required at four locations.

**PREFERRED ALTERNATIVES**

Two preferred alternatives were identified at this location to be carried forward into Phase III.

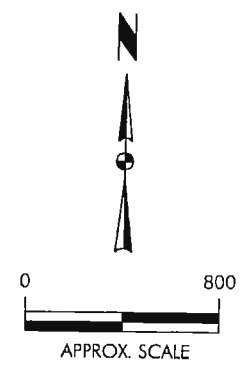
Alternative 1 attempts to fit a system interchange within the spatial restrictions of the adjacent interchanges (without C-D roads) while meeting all operational criteria. Additional design detail and additional operational analyses will be necessary to determine if this alternative will, in fact, meet the operational criteria. In particular, the weaving sections between the system interchange and South 24<sup>th</sup> Street will be evaluated in greater detail. The Phase II assessment of Alternative 1 determined that these weaving sections will be borderline adequate to provide acceptable traffic operations.

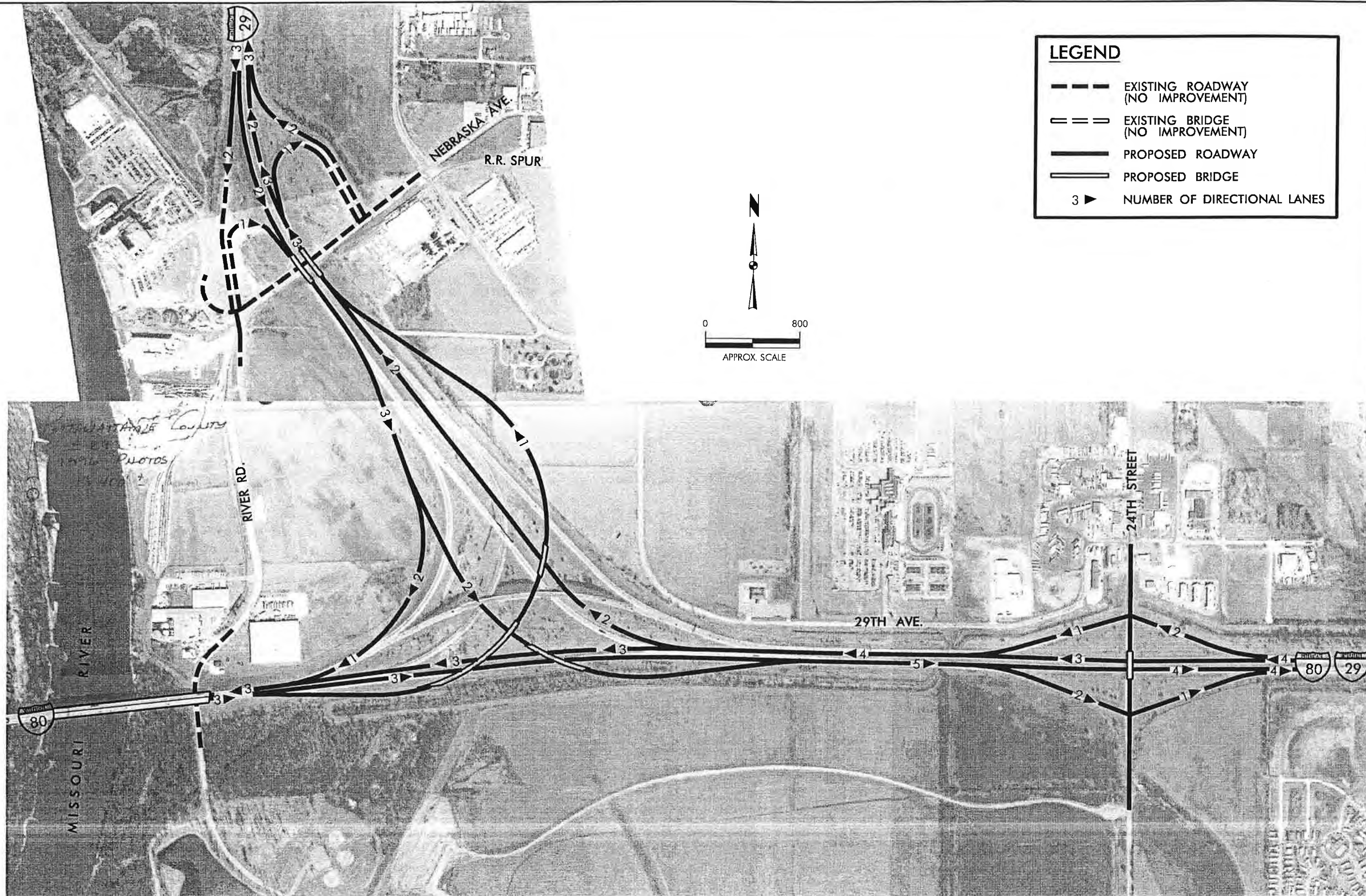
Alternative 3 is also preferred. C-D roads are provided to accommodate traffic interchanging between South 24<sup>th</sup> Street and I-80 to the west and I-29 to the north. Input at Phase II meetings suggests that the elimination of weaving on the overlap section of I-80 and I-29 would be more beneficial than the elimination of weaving on I-29 (e.g., Alternative 4). Alternative 3 is also preferred because it removes the reverse curve for the westbound I-80 mainline within the system interchange.



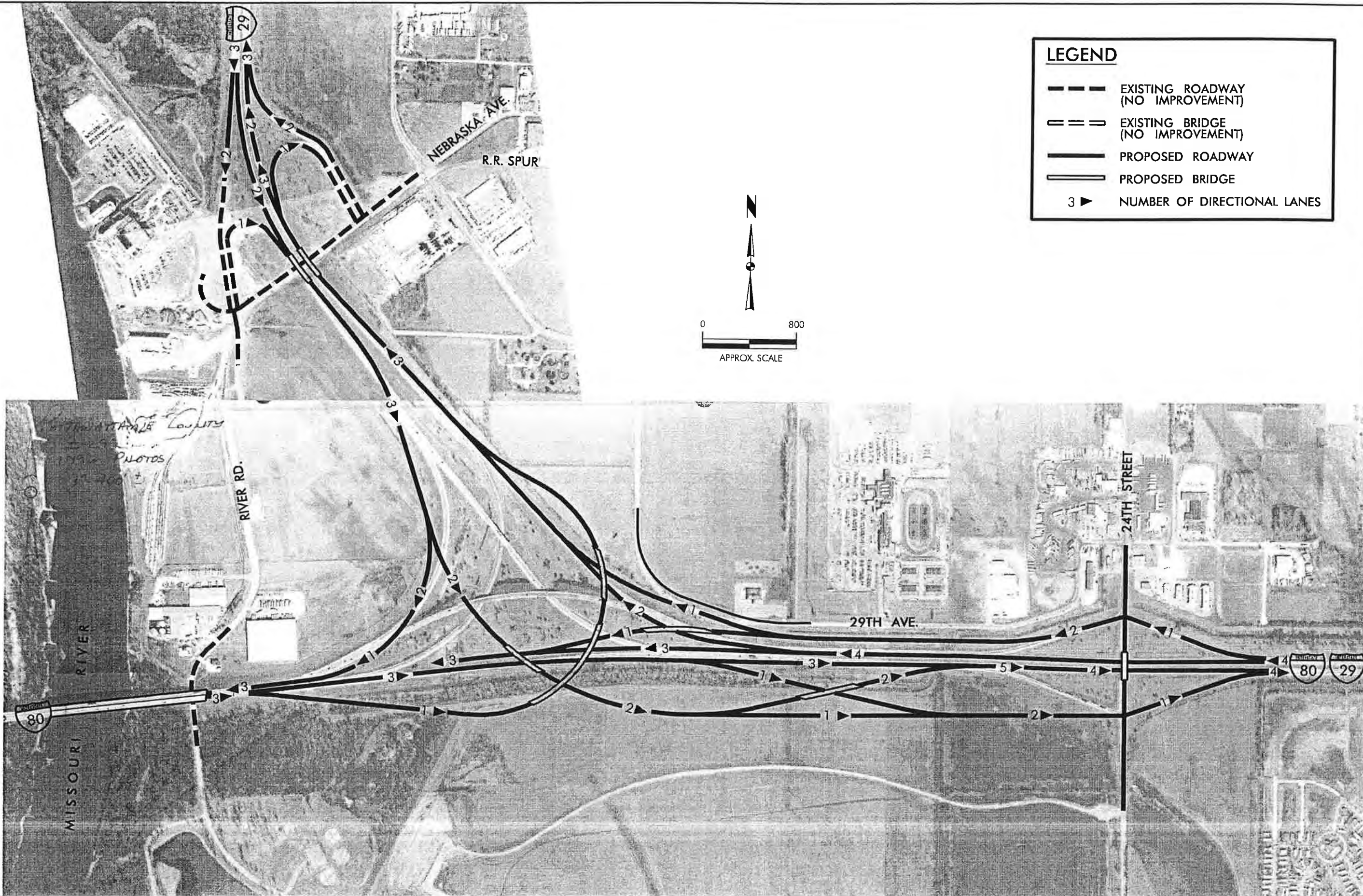
**LEGEND**

- EXISTING ROADWAY (NO IMPROVEMENT)
- === EXISTING BRIDGE (NO IMPROVEMENT)
- PROPOSED ROADWAY
- === PROPOSED BRIDGE
- 3 ► NUMBER OF DIRECTIONAL LANES



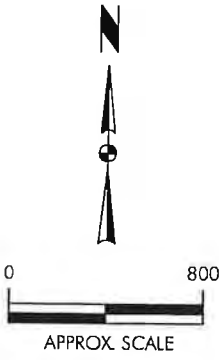


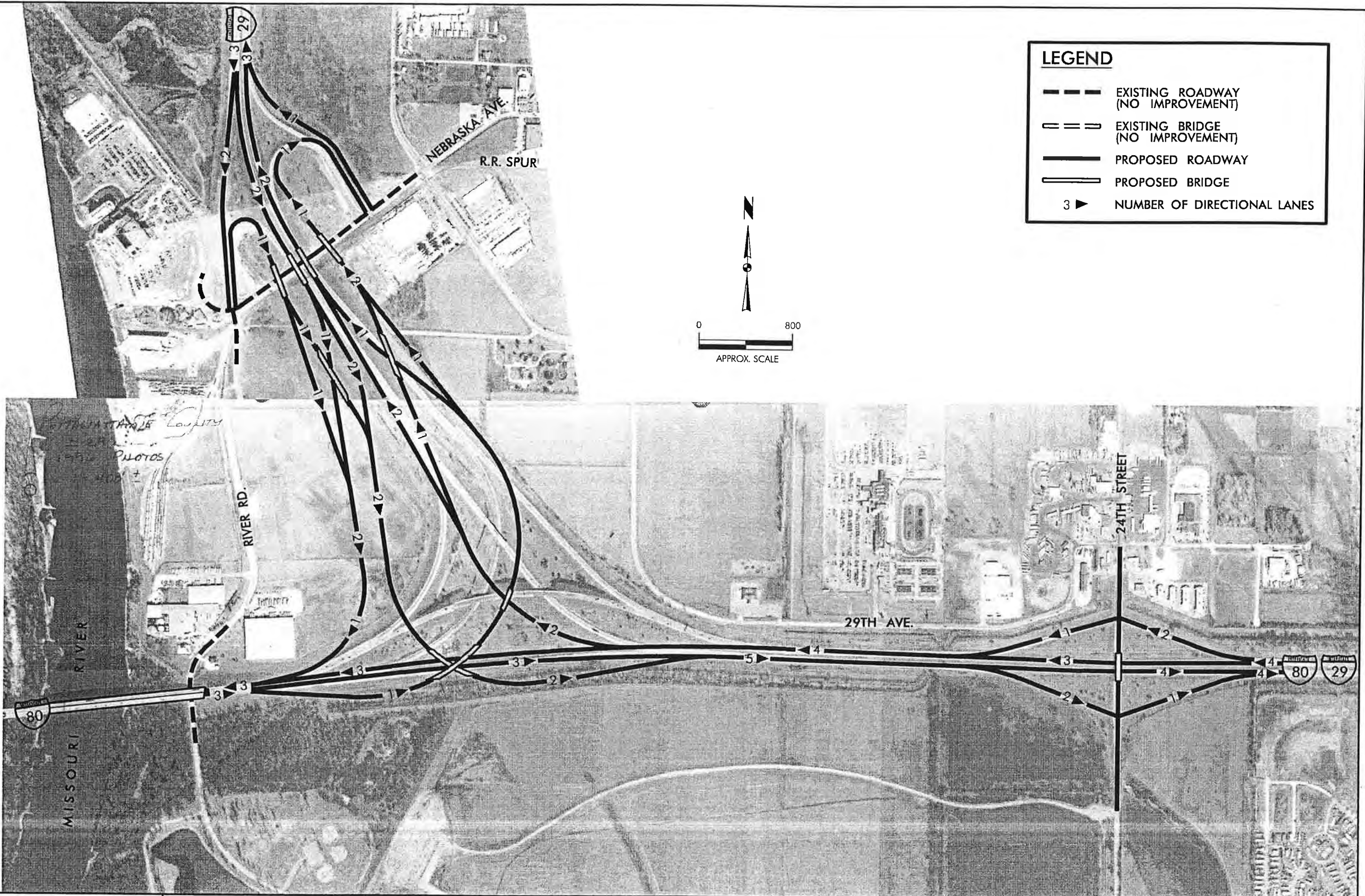




**LEGEND**

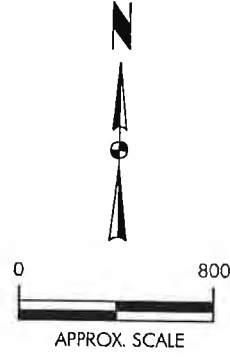
- EXISTING ROADWAY (NO IMPROVEMENT)
- === EXISTING BRIDGE (NO IMPROVEMENT)
- PROPOSED ROADWAY
- PROPOSED BRIDGE
- 3 ► NUMBER OF DIRECTIONAL LANES

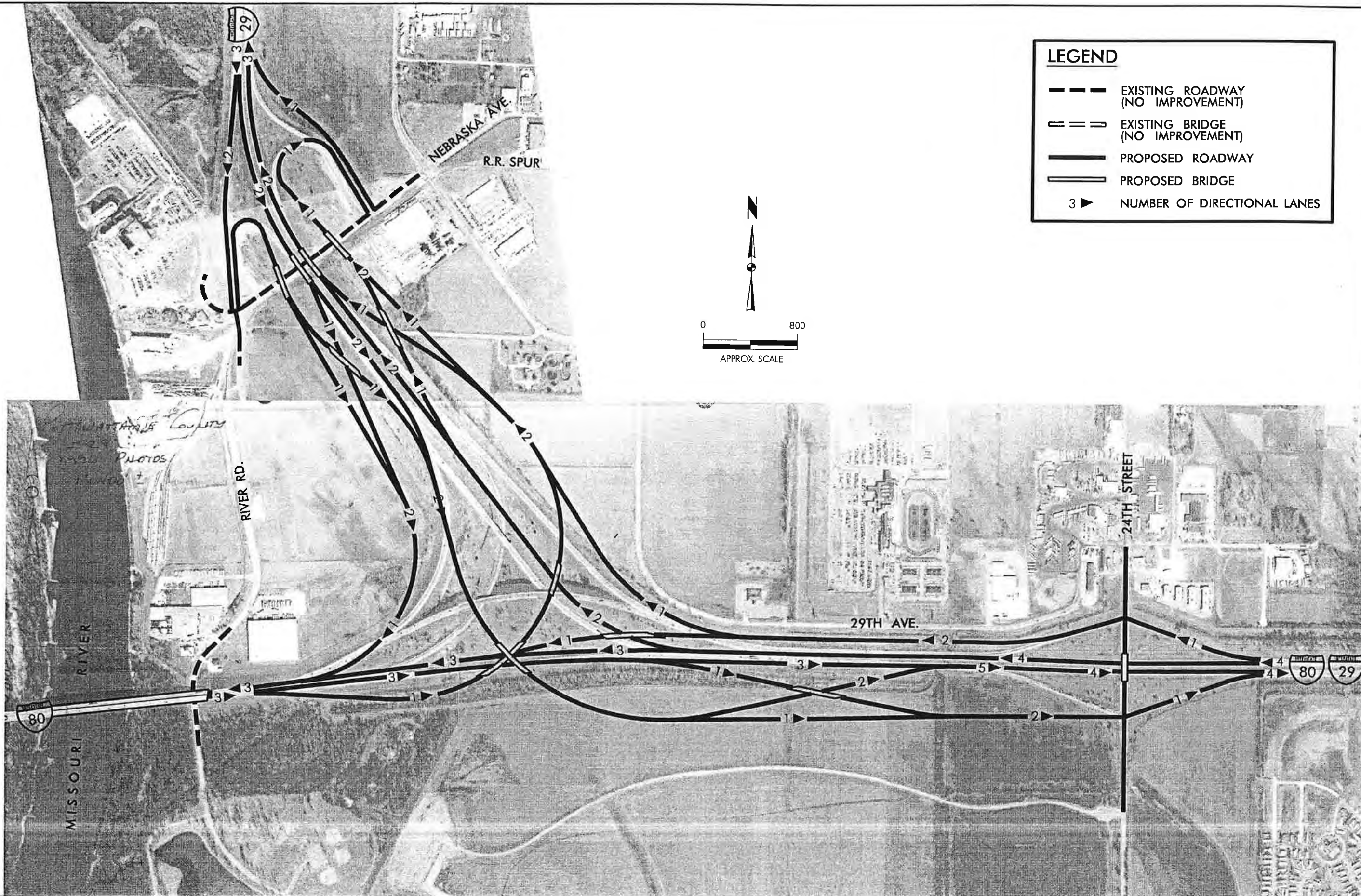




**LEGEND**

- EXISTING ROADWAY (NO IMPROVEMENT)
- === EXISTING BRIDGE (NO IMPROVEMENT)
- PROPOSED ROADWAY
- ▬ PROPOSED BRIDGE
- 3 ► NUMBER OF DIRECTIONAL LANES





**LEGEND**

- EXISTING ROADWAY (NO IMPROVEMENT)
- === EXISTING BRIDGE (NO IMPROVEMENT)
- PROPOSED ROADWAY
- PROPOSED BRIDGE
- 3 ► NUMBER OF DIRECTIONAL LANES

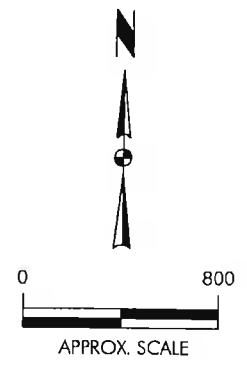


TABLE 14 - Concept Screening Summary - West I-80/I-29 System Interchange

Alternative	Exhibit	Design Features/ Impacts	Traffic Operations	Route Continuity/ Signing	Environmental Impacts	Right-of-Way / Property Impacts	Maintenance of Traffic / Constructability	Cost (\$ Million)
1	34	<ul style="list-style-type: none"> <li>- 70 mph design speed on "thru" system-to-system ramps.</li> <li>- 60 mph design speed on other system-to-system ramps.</li> <li>- EB I-80 to NB I-29 fly-over ramp merges on the right.</li> <li>- SB I-29 to EB I-80/I-29 fly-over ramp merges on the right.</li> <li>- No C-D Roads.</li> <li>- Retain existing config. of S. 24<sup>th</sup> Street interchange and Nebraska Avenue interchange.</li> </ul>	<ul style="list-style-type: none"> <li>- Acceptable mainline traffic operations provided by the basic lanes of the alternative.</li> <li>- Acceptable ramp junction and weaving operations provided at all locations. Weaving length provided for EB I-80/I-29 between the system interchange and S. 24<sup>th</sup> Street is borderline adequate.</li> </ul>	<ul style="list-style-type: none"> <li>- Alternative provides route and lane continuity.</li> <li>- Within the major merges of the system interchange, "non-thru" system ramps merge on the right. If both system ramps are "thru" ramps, then the lower volume ramp merges on the right.</li> <li>- Length of weaving section on EB I-80/I-29 may limit the ability to provide adequate signing.</li> </ul>	No major impacts have been identified.	<ul style="list-style-type: none"> <li>- Approximately 38 acres of additional right-of-way.</li> <li>- No homes or businesses impacted.</li> </ul>	<ul style="list-style-type: none"> <li>- Construction expected to be moderately difficult. Portions of the system interchange could be constructed in the clear. In other areas, the proximity of new and existing roads may cause maintenance of traffic problems.</li> </ul>	55.1
2	35	<p>Same as Alternative 1 except that 70 mph design speed provided on all system-to-system ramps.</p>	<ul style="list-style-type: none"> <li>- Acceptable mainline traffic operations provided by the basic lanes of the alternative.</li> <li>- Acceptable ramp junction and weaving operations provided at all locations except for NB I-29 between system interchange and Nebraska Avenue. Weaving length provided for EB I-80/I-29 between the system interchange and S. 24<sup>th</sup> Street is borderline adequate.</li> </ul>	<p>Same as Alternative 1. - Length of weaving section on NB I-29 and EB I-80/I-29 may limit the ability to provide adequate signing.</p>	No major impacts have been identified.	<ul style="list-style-type: none"> <li>- Approximately 53 acres of additional right-of-way.</li> <li>- 1 business impacted (Dahl Distributing).</li> </ul>	<ul style="list-style-type: none"> <li>- Construction expected to be moderately difficult. Portions of the system interchange could be constructed in the clear. In other areas, the proximity of new and existing roads may cause maintenance of traffic problems.</li> </ul>	58.2
3	36	<ul style="list-style-type: none"> <li>- Same as Alternative 1 except that system interchange is shifted to the east to maximize NB and SB weaving lengths between the system interchange and Nebraska Ave.</li> <li>- C-D roads are provided to remove the weaving section on WB and EB I-80/I-29 between the system interchange and S. 24<sup>th</sup> Street.</li> <li>- This requires braided ramps just west of the S. 24<sup>th</sup> Street.</li> </ul>	<ul style="list-style-type: none"> <li>- Acceptable mainline traffic operations provided by the basic lanes of the alternative.</li> <li>- Acceptable ramp junction and weaving operations provided at all locations.</li> </ul>	<ul style="list-style-type: none"> <li>- Additional signing is required to direct motorists to/from the C-D roads.</li> </ul>	No major impacts have been identified. Alignment of the EB I-80 to NB I-29 system ramp and C-D roads near S. 24 <sup>th</sup> Street encroach upon the Trails Center.	<ul style="list-style-type: none"> <li>- Approximately 67 acres of additional right-of-way.</li> <li>- No homes or businesses significantly impacted. Realignment of 29<sup>th</sup> Avenue may impact truck business.</li> </ul>	<p>Same as Alternative 1 except that C-D roads, once constructed, provide detour options during construction of mainline.</p>	66.9

TABLE 14 - Concept Screening Summary - West I-80/I-29 System Interchange (Continued)

Alternative	Exhibit	Design Features/ Impacts	Traffic Operations	Route Continuity/ Signing	Environmental Impacts	Right-of-Way / Property Impacts	Maintenance of Traffic / Constructability	Cost (\$ Million)
4	37	<ul style="list-style-type: none"> <li>- Same as Alternative 1 except that system interchange is shifted to the west to increase EB and WB weaving lengths between the system interchange and S. 24<sup>th</sup> Street. Also SB I-29 to EB I-80/I-29 fly-over designed to 60 mph.</li> <li>- C-D roads are provided to remove the weaving section on NB and SB I-29 between the system interchange and Nebraska Ave.</li> <li>- This requires braided ramps just south of Nebraska Avenue.</li> <li>- C-D roads require new bridges over Nebraska Avenue.</li> <li>- Loop ramps of Nebraska Ave. interchange reconstructed to meet full criteria.</li> </ul>	<ul style="list-style-type: none"> <li>- Acceptable mainline traffic operations provided by the basic lanes of the alternative.</li> <li>- Acceptable ramp junction and weaving operations provided at all locations</li> </ul>	<ul style="list-style-type: none"> <li>- Additional signing is required to direct motorists to/from the C-D roads.</li> </ul>	No major impacts have been identified.	<ul style="list-style-type: none"> <li>- Approximately 63 acres of additional right-of-way.</li> <li>- 1 business impacted (Dahl Distributing).</li> </ul>	Same as Alternative 1 except that C-D roads, once constructed, provide detour options during construction of mainline.	66.7
5	38	<ul style="list-style-type: none"> <li>- Same as Alternative 1 except that C-D roads are provided to/from S. 24<sup>th</sup> Street and to/from Nebraska Ave.</li> <li>- This requires braided ramps at four locations.</li> </ul>	<ul style="list-style-type: none"> <li>- Acceptable mainline traffic operations provided by the basic lanes of the alternative.</li> <li>- Acceptable ramp junction and weaving operations provided at all locations</li> </ul>	<ul style="list-style-type: none"> <li>- Additional signing is required to direct motorists to/from the C-D roads.</li> </ul>	No major impacts have been identified. Alignment of the C-D roads near S. 24 <sup>th</sup> Street encroach upon the Trails Center.	<ul style="list-style-type: none"> <li>- Approximately 92 acres of additional right-of-way.</li> <li>- 1 business impacted (Dahl Distributing).</li> </ul>	Same as Alternative 1 except that C-D roads, once constructed, provide detour options during construction of mainline.	80.5

## NEBRASKA AVENUE / I-29 INTERCHANGE

### EXISTING/FUTURE DEFICIENCIES

No operational deficiencies were identified for the Nebraska Avenue/I-29 interchange. The I-29 mainline segments and ramp junctions on the north side of the interchange are currently operating at LOS B during peak hours. On the south side of the interchange, the southbound mainline represents a weaving section that is currently operating at LOS B while the northbound mainline represents a basic freeway section that is operating at LOS B. Both ramp terminal intersections are currently signalized and are operating overall at LOS B.

In the Year 2020 No-Build Scenario, the I-29 mainline segments and ramp junctions on the north side of the interchange will operate at LOS C during peak hours. However, CORSIM analyses indicate that auxiliary lanes will be required on northbound and southbound I-29 between Nebraska Avenue and 9<sup>th</sup> Avenue. The southbound weaving section between the Nebraska Avenue and the West I-80/I-29 System Interchange will operate at LOS C. The overall level of service at the signalized intersection will worsen slightly.

The assessment of existing geometric and physical conditions revealed that the on ramps to northbound I-29 from Nebraska Avenue do not meet standards for taper rate. Mainline pavement condition in the interchange rated "poor". Bridges rated "fair" or "good". The cross section, stopping sight distance, safety and signing in some areas are also rated "fair".

### ACCESS

The existing Nebraska Avenue/I-29 interchange provides full access. Changes to access are not anticipated as part of long-term improvements.

### ALTERNATIVES

Two basic alternatives were developed for the Nebraska Avenue/I-29 interchange and are discussed below. Given the proximity of this interchange to the West I-80/I-29 System Interchange, however, these alternatives were developed and assessed as part of the development and assessment of improvement alternatives for the system interchange. Therefore, separate exhibits and a screening matrix were not prepared for Nebraska Avenue.

Graphical depictions of the two basic alternatives are shown Exhibits 34 thru 38 for various configurations of the system interchange. Both alternatives assume reconstruction of the I-29 mainline and reconstruction of Nebraska Avenue, as necessary, to provide adequate capacity to serve Year 2020 traffic volumes.

Because of the railroad spur tracks located on the south side of the Nebraska Avenue, the existing parcel configuration (with ramps all on the north side) must be retained for this interchange. As noted above, CORSIM analyses indicated the need for auxiliary lanes for northbound and southbound I-29 between Nebraska Avenue and 9<sup>th</sup> Avenue. The alternatives below focus on the impacts of C-D roads on the radius of the loops.

### Alternative 1

The existing configuration of the Nebraska Avenue interchange (Alternative 1) would be retained for three of the five alternatives for the West I-80/I-29 System Interchange. These three system interchange alternatives do not include C-D roads to Nebraska Avenue. Therefore, additional bridges across the Nebraska Avenue are not required. This should allow the existing loop ramps at the Nebraska Avenue interchange to be reconstructed on their current alignment and still meet the "basic" design criteria.

### Alternative 2

For the system interchange alternatives that include C-D road connections to Nebraska Avenue, additional bridges across Nebraska Avenue will be required. To meet the "full" design criteria, it will be necessary for the northbound I-29 off-ramp to Nebraska Avenue to be pushed out further. An example of this configuration is shown in Exhibit 31 (Alternative 4 for the system interchange). However, the on-ramp to southbound I-29 is constrained by the Ameristar Casino. Exhibit 31 also shows a substandard radius of this loop which represents the worst case situation. By reducing the separation between the southbound C-D road and the southbound I-29 mainline, it may be possible to meet the "basic" design criteria.

### PREFERRED ALTERNATIVES

Preferred alternatives were identified for the West I-80/I-29 System Interchange as a whole rather than for adjacent interchanges individually. However, based on the preferred alternatives for the West I-80/I-29 System Interchange (see previous section) Alternative 1 is preferred at Nebraska Avenue.

## 9<sup>TH</sup> AVENUE / I-29 INTERCHANGE

### EXISTING/FUTURE DEFICIENCIES

The following deficiencies were for existing conditions. The existing mainline and ramp junction level of service is currently LOS C or better through the interchange. Signalized intersections at the ramp terminals also provide acceptable traffic operations (LOS B). An existing operational deficiency occurs at the southbound I-29 weaving movement between the on ramp from eastbound I-480 and the southbound I-29 off ramp to 9<sup>th</sup> Avenue resulting in LOS D during the PM peak hour.

The Year 2020 No-Build analysis indicated that the mainline and ramp junctions will continue to operate at a LOS C or better. However, CORSIM analyses indicate that auxiliary lanes will be required on northbound and southbound I-29 between Nebraska Avenue and 9<sup>th</sup> Avenue. The signalized intersections at the ramp terminals will continue to provide acceptable traffic operations (LOS C) based on the Year 2020 projected traffic volumes. The southbound weaving operations between I-480 and 9<sup>th</sup> Avenue will continue to decline, resulting in a LOS E during the Year 2020 PM peak hour. The existing northbound mainline segment between 9<sup>th</sup> Avenue and the I-480 / I-29 diverge point is not technically a weaving section due to the I-480 left side exit. It is foreseen that traffic operational problems will occur here due to the lane configuration and the projected traffic volumes.

The ramp sequencing between 9<sup>th</sup> Avenue and the I-480 interchange to the north do not meet the recommended AASHTO minimums for ramp spacing. In addition lane balance is violated at the southbound I-29 off ramp to 9<sup>th</sup> Avenue. The right-most lane (which was added at the I-29/I-480 system interchange) is dropped as a single-lane off ramp. Some mainline sight distance restrictions have been identified through the interchange due to the deficient vertical alignment. The northbound and southbound on-ramp tapers are substandard based on the current AASHTO recommended taper lengths. The existing mainline pavement south of 9<sup>th</sup> Avenue is also rated "poor".

### ACCESS

The existing 9<sup>th</sup> Avenue/I-29 interchange provides full access. Changes to access are not anticipated as part of long-term improvements.

### ALTERNATIVES

Three alternatives were developed for this interchange and are shown in Exhibits 33 through 35. In general the distance between the I-480/I-29 System Interchange and the 9<sup>th</sup> Avenue interchange was lengthened as much as possible in all of the alternatives to improve ramp sequencing and weaving lengths. Auxiliary lanes in both directions are included between 9<sup>th</sup> Avenue and Nebraska Avenue. However, the cost of reconstructing the UPRR bridge over I-29 to accommodate the widened cross section has not been included in the cost estimates for improvement alternatives for the 9<sup>th</sup> Avenue/I-29 interchange. Both alternatives assume reconstruction of the I-29 mainline and reconstruction of 9<sup>th</sup> Avenue, as necessary, to provide adequate capacity to serve Year 2020 traffic volumes.

#### Alternative 1 (Exhibit 39)

This alternative provides a full access partial cloverleaf interchange with loops in the Southeast and Southwest quadrants (i.e., a folded diamond configuration). This alternative provides the most weaving

length between 9<sup>th</sup> Avenue and the I-480/I-29 System Interchange to the north. Service Road B has been relocated at 9<sup>th</sup> Avenue to form a four-way intersection with the revised NB I-29 ramp terminal. South 37<sup>th</sup> Street has been eliminated between 5<sup>th</sup> Avenue and 9<sup>th</sup> Avenue and 5<sup>th</sup> Avenue has been extended under I-29 to provide an outlet for South 37<sup>th</sup> Street.

This alternative would not work effectively with Alternatives 2 and 4 for the I-480/I-29 System Interchange which provide access to eastbound Broadway from the 9<sup>th</sup> Avenue off ramp extension. This alternative would require significant right-of-way acquisition and three buildings would be impacted including a motel and an apartment building.

#### Alternative 2 (Exhibit 40)

This alternative provides a single point urban interchange (SPUI). The 9<sup>th</sup> Avenue/I-29 ramps to the north have been shortened to meet the basic standard criteria. This maximizes the available weaving length between 9<sup>th</sup> Avenue and the I-480 interchange to the north. The improved weaving lengths between 9<sup>th</sup> Avenue and I-480 still do not meet the minimum distance required to provide LOS D in the Year 2020 based on the CORSIM analysis. A two-lane off ramp is provided at 9<sup>th</sup> Avenue for southbound I-29 to maintain lane balance. This alternative does not accommodate pedestrians as well as the other two alternatives.

Alternative 2 works with all four I-29/I-480/Broadway system interchange alternatives. Service Road B would have to be converted to a one-way ramp from 9<sup>th</sup> Avenue to EB Broadway for I-480/I-29 system interchange alternatives 2 and 4.

#### Alternative 3 (Exhibit 41)

This alternative retains the existing tight diamond interchange (TDI). The 9<sup>th</sup> Avenue/I-29 ramps to the north have been shortened to meet the basic standard criteria. This maximizes the available weaving length between 9<sup>th</sup> Avenue and the I-480 interchange to the north. The improved weaving lengths between 9<sup>th</sup> Avenue and I-480 still do not meet the minimum distance required to provide LOS D in the Year 2020 based on the CORSIM analysis.

This alternative shows the conversion of Service Road B to a one-way northbound ramp from 9<sup>th</sup> Avenue to EB Broadway. The elimination of Service Road B will require significant modifications to the existing residential access.

#### Alternative 4 (Exhibit 42)

Alternative 4 provides C-D roads beginning at 9<sup>th</sup> Avenue and extending through the I-480/I-29 interchange. The addition of the C-D roads will eliminate the existing deficient mainline weaving lengths between 9<sup>th</sup> Avenue and the I-29/I480 system interchange. The 9<sup>th</sup> Avenue interchange will remain a tight diamond, with signalized ramp terminals. Service Road B will be eliminated between 9<sup>th</sup> Avenue and 2<sup>nd</sup> Avenue and the existing east/west streets tying into Service Road B will need to be cul-de-saced. South 37<sup>th</sup> Street will be eliminated between 5<sup>th</sup> Avenue and 9<sup>th</sup> Avenue and will be rerouted under the interstate. 5<sup>th</sup> Avenue will be extended under I-29 to connect with South 37<sup>th</sup> Street. Alternative 4 will require additional right-of-way and the acquisition of approximately 26 houses.

## PREFERRED ALTERNATIVES

Three preferred alternatives were identified at this location to be carried forward into Phase III.

Alternative 1 provides acceptable weaving lengths between the 9<sup>th</sup> Avenue interchange and the I-480/I-29 system interchange. It also provides acceptable traffic operations and meets capacity requirements for the Year 2020 projected traffic volumes. Service Road B would be realigned with the new northbound ramps and would become a two-way street. South 37<sup>th</sup> Street was eliminated between 5<sup>th</sup> Avenue and 9<sup>th</sup> Avenue and would be rerouted under the interstate. 5<sup>th</sup> Avenue will be extended under I-29 to connect with South 37<sup>th</sup> Street.

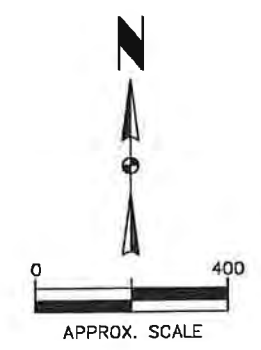
Alternative 2 provides a single point urban interchange (SPUI) to minimize right-of-way requirements. Acceptable traffic operations could be provided at the single ramp terminal intersection. However, the weaving lengths between 9<sup>th</sup> Avenue and I-480 do not meet the minimum distance required to provide LOS D in the Year 2020.

Alternative 4 is also preferred. This C-D road alternative would remove the existing weaving deficiencies from the mainline between 9<sup>th</sup> Avenue and the I-480 system interchange. Alternative 4 provides acceptable traffic operations and meets capacity requirements for the Year 2020 projected traffic volumes.





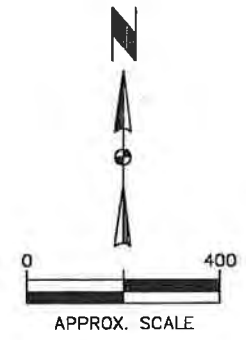
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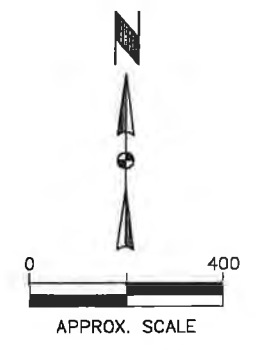
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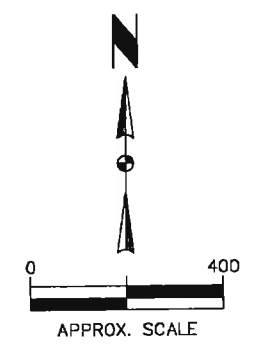
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TABLE 15 - Concept Screening Summary – 9<sup>th</sup> Avenue/I-29 Interchange

Alternative	Exhibit	Design Features/ Impacts	Traffic Operations	Route Continuity/ Signing	Environmental Impacts	Right-of-Way / Property Impacts	Maintenance of Traffic / Constructability	Cost (\$ Million)
1	39	- Partial cloverleaf configuration for 9 <sup>th</sup> Avenue with loop ramps in SE and SW quadrants. - Loop ramps meet basic standard criteria.	- Acceptable traffic operations provided on the mainline and at the ramp junctions. - Provides acceptable weaving lengths between 9 <sup>th</sup> Avenue and I-480 to provide LOS D or better.	- Alternative provides lane and route continuity.	- No major impacts have been identified.	- Approximately 6 acres of additional right-of-way.  - 2 businesses, 1 apartment complex and 6 houses would be impacted.	- No major construction issues have been identified.	11.1
2	40	- Single Point Urban Interchange (SPUI) configuration for 9 <sup>th</sup> Avenue.	- Acceptable traffic operations provided on mainline and at ramp junctions. - Doesn't accommodate pedestrians as well as other alternatives. - Weaving distance between 9 <sup>th</sup> Avenue and I-480 (both directions) is less than required for LOS D.	- Alternative provides lane and route continuity.	- No major impacts have been identified.	- Approximately 1 acre of additional right of way.  - No houses or businesses impacted.	- No major construction issues have been identified.	9.3
3	41	- Retain tight diamond interchange (TDI) for 9 <sup>th</sup> Avenue.	- Acceptable traffic operations provided on the mainline and at the ramp junctions.  - Weaving distance between 9 <sup>th</sup> Avenue and I-480 (both directions) is less than required for LOS D.	- Alternative provides lane and route continuity.	- No major impacts have been identified.	- No major impacts have been identified.	- No major construction issues have been identified.	9.4
4	42	- Retain tight diamond ramps between 9 <sup>th</sup> Avenue and I-29 to the south. - Provide C-D roads between 9 <sup>th</sup> Avenue and I-480/I-29 System Interchange.	- Acceptable traffic operations provided on the mainline and at the ramp junctions. - Provides acceptable weaving lengths between 9 <sup>th</sup> Avenue and I-480.	- Alternate provides lane and route continuity.	- No major impacts have been identified.	- Approximately 3 acres of additional right-of-way. - Approximately 26 houses would be impacted between 9 <sup>th</sup> Avenue and I-480.	- Ramps between 9 <sup>th</sup> Avenue and I-29 to the north would require closure during interchange reconstruction.	13.3

## I-29/I-480/BROADWAY SYSTEM INTERCHANGE

### EXISTING/FUTURE DEFICIENCIES

The I-29/I-480/Broadway System Interchange is fully directional between I-29 and I-480 with no existing connection between I-29 and Broadway. Broadway becomes I-480 at the interchange and extends into Omaha. In addition a partial interchange exists at 41<sup>st</sup> Street/I-480 just to the west of the system interchange and due to its' proximity was included as part of this system interchange analysis. Numerous existing operational and physical deficiencies were identified at this system interchange with the operational deficiencies becoming more severe in the Year 2020 No-Build analysis.

Traffic operations that are currently deficient include the weaving areas for southbound I-29 from Avenue G to the eastbound I-480 ramp and southbound I-29 from I-480 on ramp to 9<sup>th</sup> Avenue. A poor safety rating has also been identified for mainline I-480 and I-29 traffic through the system interchange due to the relatively high collision rate.

The Year 2020 No-Build analysis indicated the two weaving areas identified above would continue to decline and the Avenue G/I-480 weave would operate at LOS F (AM peak) and the I-480/9<sup>th</sup> Avenue weave would be LOS E during the PM peak hour. It is projected the northbound I-29 to westbound I-480 ramp will attract in excess of 2,000 vehicles during Year 2020 PM peak hour. Based on this projected volume a two lane ramp would be justified at this location. The corresponding eastbound I-480 to southbound I-29 ramp is projected to carry approximately 1,700 vehicles during the peak hour in the Year 2020. This approaches the capacity of a single lane connection and so one alternative was developed with two lanes for this ramp.

The existing physical/geometric deficiencies are numerous at this system interchange. The existing system ramps are based on 50 mph design speed. There are several left side entrance/exit ramps including the northbound I-29 to westbound I-480 diverge and the eastbound I-480 to northbound I-29 merge. As mentioned previously there is no existing connection between Broadway and I-29. Ramp sequencing and lane balance are rated "poor" at multiple locations on both I-480 and I-29 within the system interchange.

### ACCESS

The existing I-29/I-480/Broadway system interchange provides fully directional access between I-29 and I-480. Broadway transitions to I-480 at the I-29 junction with no access between Broadway and I-29 currently provided. The 41<sup>st</sup> Street/I-480 partial interchange provides access from 41<sup>st</sup> Street to westbound I-480 and from eastbound I-480 to 41<sup>st</sup> Street.

A special regional traffic model run was completed by MAPA to assess the potential use of ramps between I-29 and Broadway. The Year 2020 MAPA model was coded with full access between I-29 and Broadway and eliminated the ramps between I-480 and 2<sup>nd</sup> Avenue and Avenue B ramps. The model run results indicated that over 4,000 vpd would use each ramp between Broadway and I-29 to the south.

The special model run also shows that the Broadway access would not generate a significant amount of additional trips but would shift existing trips from 9<sup>th</sup> Avenue and Avenue G interchanges. Although the

W. Broadway connection improves interstate access it concentrates more traffic onto the already heavily traveled W. Broadway corridor. The model run shows the year 2020 ADT on West Broadway would increase from 28,500 ADT without the I-29 connection to 37,300 ADT with the connection. The additional 8,200 trips per day would shift the future volumes on this existing five-lane arterial from approximately design capacity to maximum capacity.

In addition, the available weaving distance between the I-29/I-480 system interchange and 9<sup>th</sup> Avenue is a major design issue. The incorporation of ramps between West Broadway and I-29 to the south would significantly reduce the available weaving lengths. Based on this assessment and on input received from the TAC, the connection between West Broadway and I-29 will be dropped from consideration in Phase III.

To improve local traffic circulation and access to existing interchange locations near the I-480 system interchange, two roadway extensions under I-29 have been identified. The extension of 5<sup>th</sup> Avenue to the west under I-29 to South 37<sup>th</sup> Street has been incorporated. In addition the extension of Avenue B under I-29 north of the I-480 system interchange is also proposed. The ramps between Broadway and I-29 to the north would only attract approximately 300 vpd per ramp. The model indicates that traffic would be attracted to the Broadway ramps from the Avenue G/I-29 Interchange and the 9<sup>th</sup> Avenue/I-29 Interchange.

### SIMULATION MODELING

The results of the CORSIM simulation modeling discussed in Chapter 5 were utilized to determine lane requirements of the improvement alternatives. The CORSIM analyses were limited to the most complex areas of the system interchange such as the weaving sections between the system interchange and the adjacent service interchanges.

### ALTERNATIVES

Five alternatives were developed for this interchange and are shown in Exhibit 43 through 46. All alternatives assume reconstruction of the I-480 and I-29 mainline in the interchange area. The major difficulties encountered in trying to develop workable alternatives were the limited space within the system interchange and close spacing to adjacent interchanges. Ramp sequencing, weaving lengths and lane balance could not always be met in developing these workable alternatives with the limited space available.

#### Alternative 1 (Exhibit 43)

This alternative retains the existing system interchange connections and improves all system to system ramps to meet the 60-mph design criteria. All system ramps diverge and merge on the right except the eastbound I-480 to northbound/southbound I-29 split which has the lower volume northbound ramp diverging on the left. To provide a right side diverge would significantly increase the construction cost and would violate ramp sequencing requirements. The eastbound I-480 exit ramp to 41<sup>st</sup> Street was increased to two lanes to maintain lane balance. Four lanes are carried south of the southbound I-29 / I-480 merge and then the right lane is dropped. The connection of Avenue B under I-29 was included with this alternative.

**Alternative 2 (Exhibit 44)**

This alternative provides a full access system interchange including connections between I-29 and Broadway. Loop ramps are provided for the connections between southbound I-29 and Broadway and slip ramps are included for northbound I-29 access to/from Broadway. The northbound I-29 to eastbound Broadway ramp is the conversion of Service Road B to a one-way northbound ramp from 9<sup>th</sup> Avenue.

The elimination of Service Road B will require significant modifications to the existing residential access. This alternative requires significant right-of-way and impacts a minimum of 9 homes in the northwest quadrant.

All system ramps diverge and merge on the right side except the eastbound I-480 to northbound/southbound I-29 split which has the lower volume northbound ramp diverging on the left. The eastbound I-480 to southbound I-29 system to system ramp was increased to two lanes to provide adequate capacity based on Year 2020 projected traffic volumes. The eastbound I-480 exit ramp to 41<sup>st</sup> Street was increased to two lanes to maintain lane balance. Five lanes are carried south of the southbound I-29 / I-480 merge and then the right lane is dropped. This alternative will only work effectively with Alternative 2 and 3 at 9<sup>th</sup> Avenue.

**Alternative 3 (Exhibit 45)**

This alternative retains the existing system interchange layout while improving some existing deficiencies within the existing right-of-way. All system ramps diverge and merge on the right side except the eastbound I-480 to northbound/southbound I-29 split which has the lower volume northbound ramp diverging on the left. The I-29 mainline remains on the existing alignment.

The eastbound I-480 to southbound I-29 system to system ramp was increased to two lanes to provide adequate capacity based on Year 2020 traffic volumes. The eastbound I-480 exit ramp to 41<sup>st</sup> Street was increased to two lanes to maintain lane balance. Four lanes are carried south of the southbound I-29 / I-480 merge and then the right lane is dropped. The connection of Avenue B under I-29 was included with this alternative.

**Alternative 4 (Exhibit 46)**

This alternative provides a full access system interchange but does not provide a southbound I-29 to eastbound Broadway connection. Loop ramps (basic standard) are provided for westbound Broadway to southbound I-29 and eastbound I-480 to northbound I-29. All ramps merge and diverge on the right side. The northbound I-29 to eastbound Broadway ramp is the conversion of Service Road B to a one-way northbound ramp from 9<sup>th</sup> Avenue. The elimination of Service Road B will require significant modifications to the existing residential access. This alternative will only work effectively with Alternative 2 and 3 at 9<sup>th</sup> Avenue.

The eastbound I-480 to southbound I-29 system to system ramp was increased to two lanes to provide adequate capacity based on Year 2020 projected traffic volumes. The eastbound I-480 exit ramp to 41<sup>st</sup> Street was increased to two lanes to maintain lane balance. Five lanes are carried south of the southbound I-29 / I-480 merge and then the right lane is dropped.

**Alternative 5 (Exhibit 47)**

Alternative 5 provides C-D roads between the I-480 system interchange and the 9<sup>th</sup> Avenue interchange. The C-D roads eliminate the mainline weaving between I-480 and 9<sup>th</sup> Avenue. This alternative is similar to Alternative 3 with the incorporation of the C-D roads. All ramps diverge and merge on the right side. The I-29 mainline alignment would be improved to a 70-mph design and the system to system ramps would be based on 50-mph design. This alternative includes the connection of Avenue B under I-29.

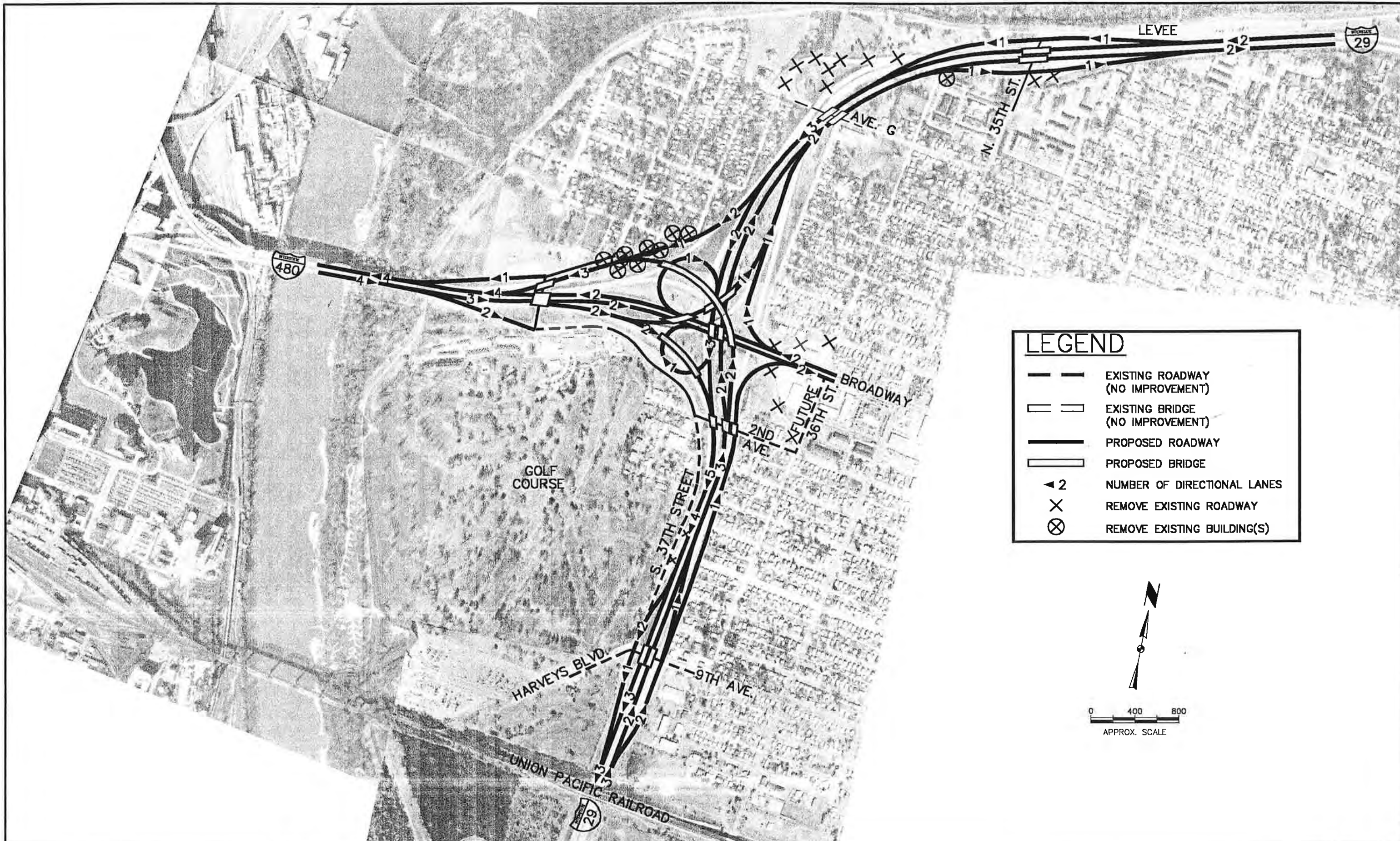
**PREFERRED ALTERNATIVES**

Two preferred alternatives were identified at this location to be carried into Phase III.

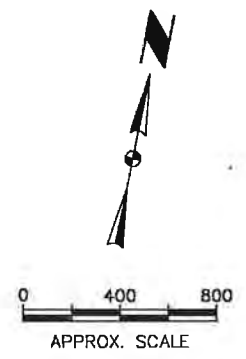
Alternative 3 at the I-480 system interchange includes a 70-mph design for the mainline and 50-mph system to system ramps. This alternative, in conjunction with Alternative 1 at 9<sup>th</sup> Avenue and N. 35<sup>th</sup> Street, provides adequate weaving lengths for LOS D or better for Year 2020. A two-lane system to system ramp was also incorporated from eastbound I-480 to southbound I-29. Established design criteria for ramp sequencing and lane continuity is also met.

Alternative 5 is also preferred. It provides C-D roads between 9<sup>th</sup> Avenue and the system interchange. This layout maintains a 70-mph design for mainline and 50-mph design for system to system ramps. This alternative in conjunction with Alternative 4 at 9<sup>th</sup> Avenue and Alternative 1 at N. 35<sup>th</sup> Street provides acceptable weaving distances for mainline and C-D roads. This alternative also meets all requirements for ramp sequencing and lane continuity.

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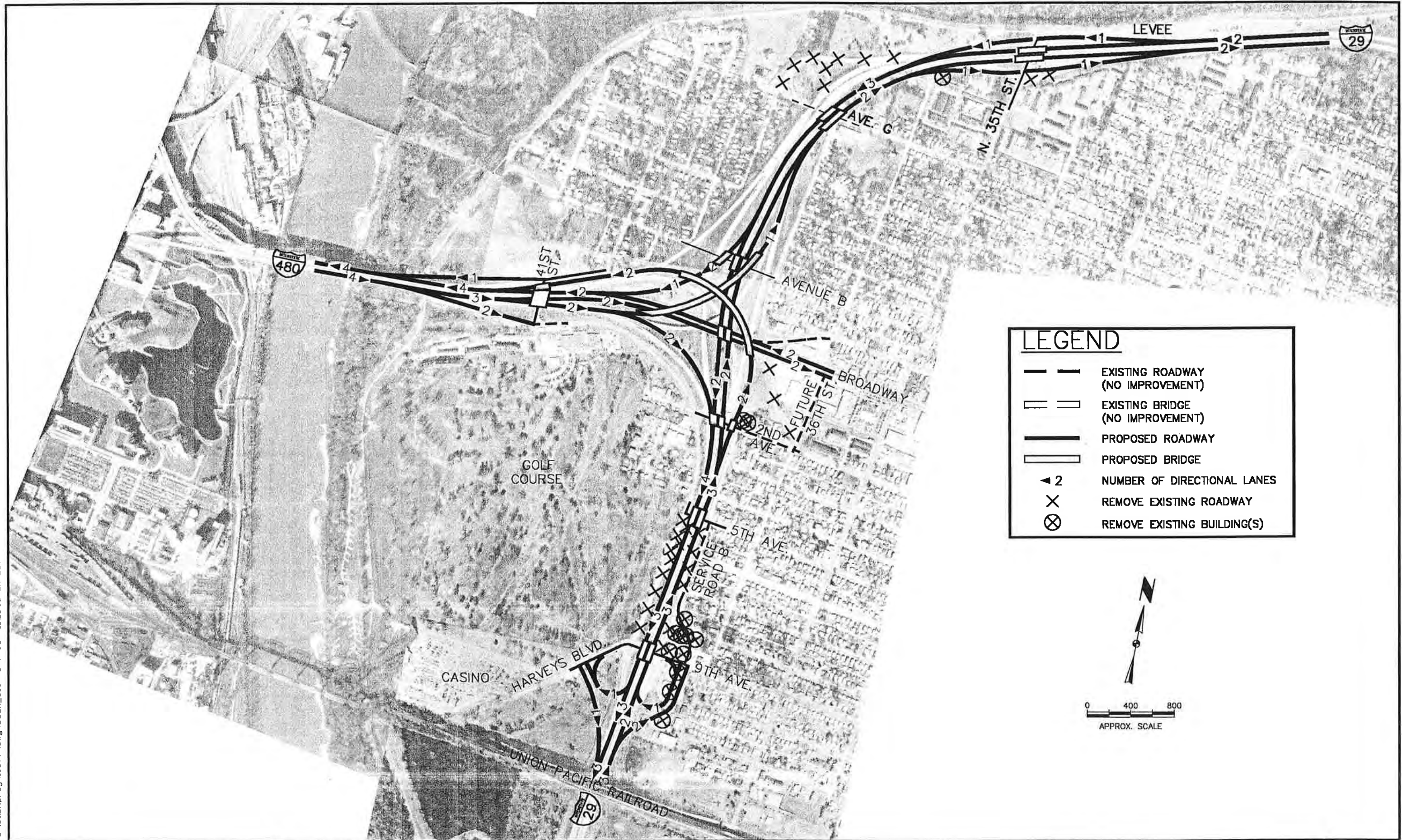


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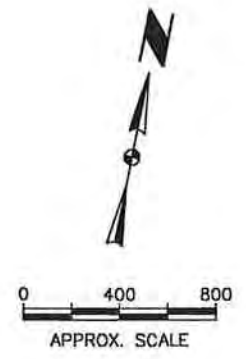




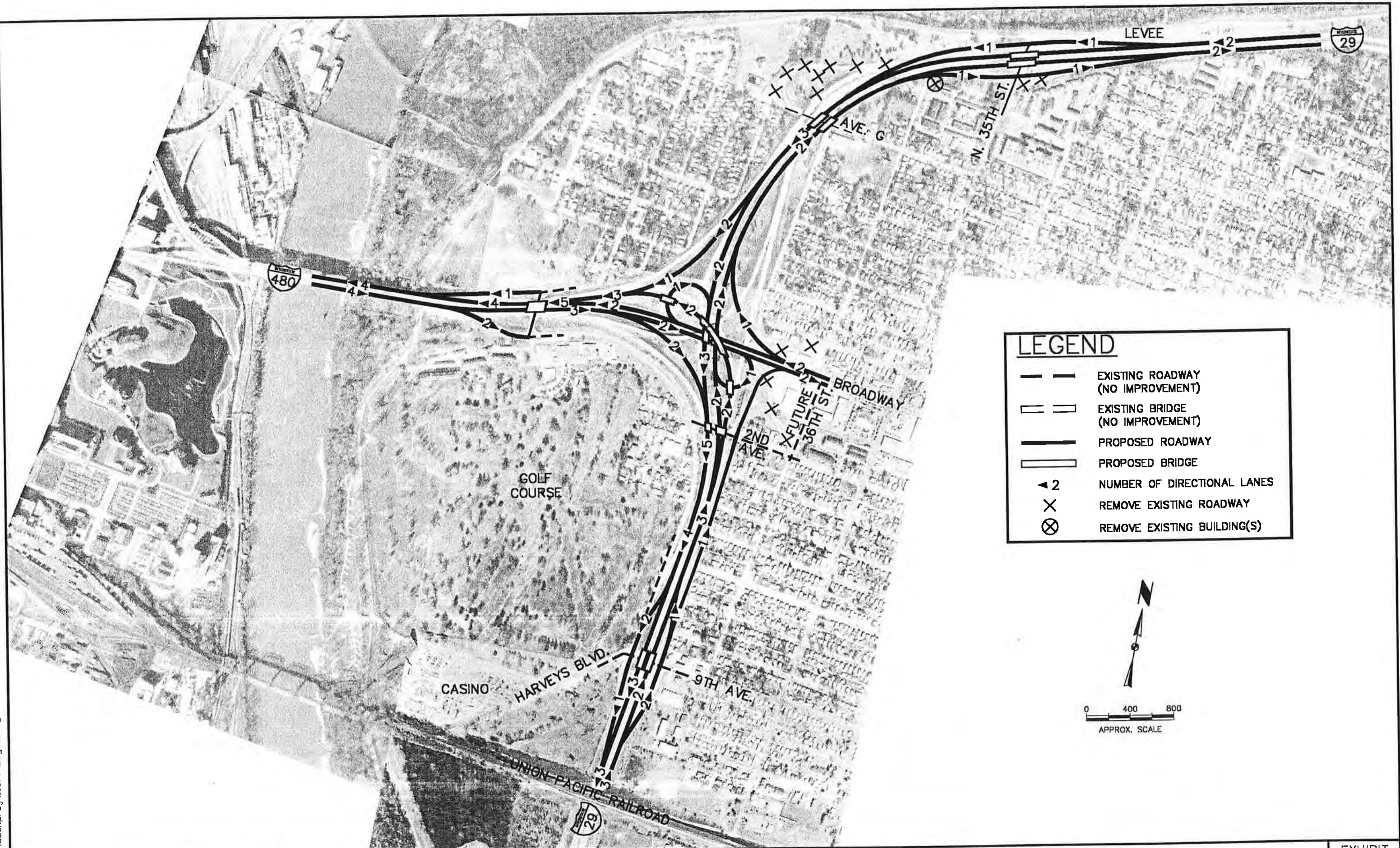
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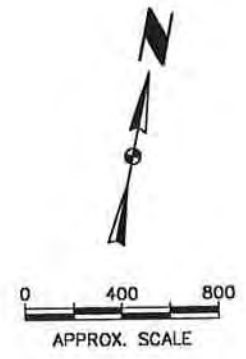


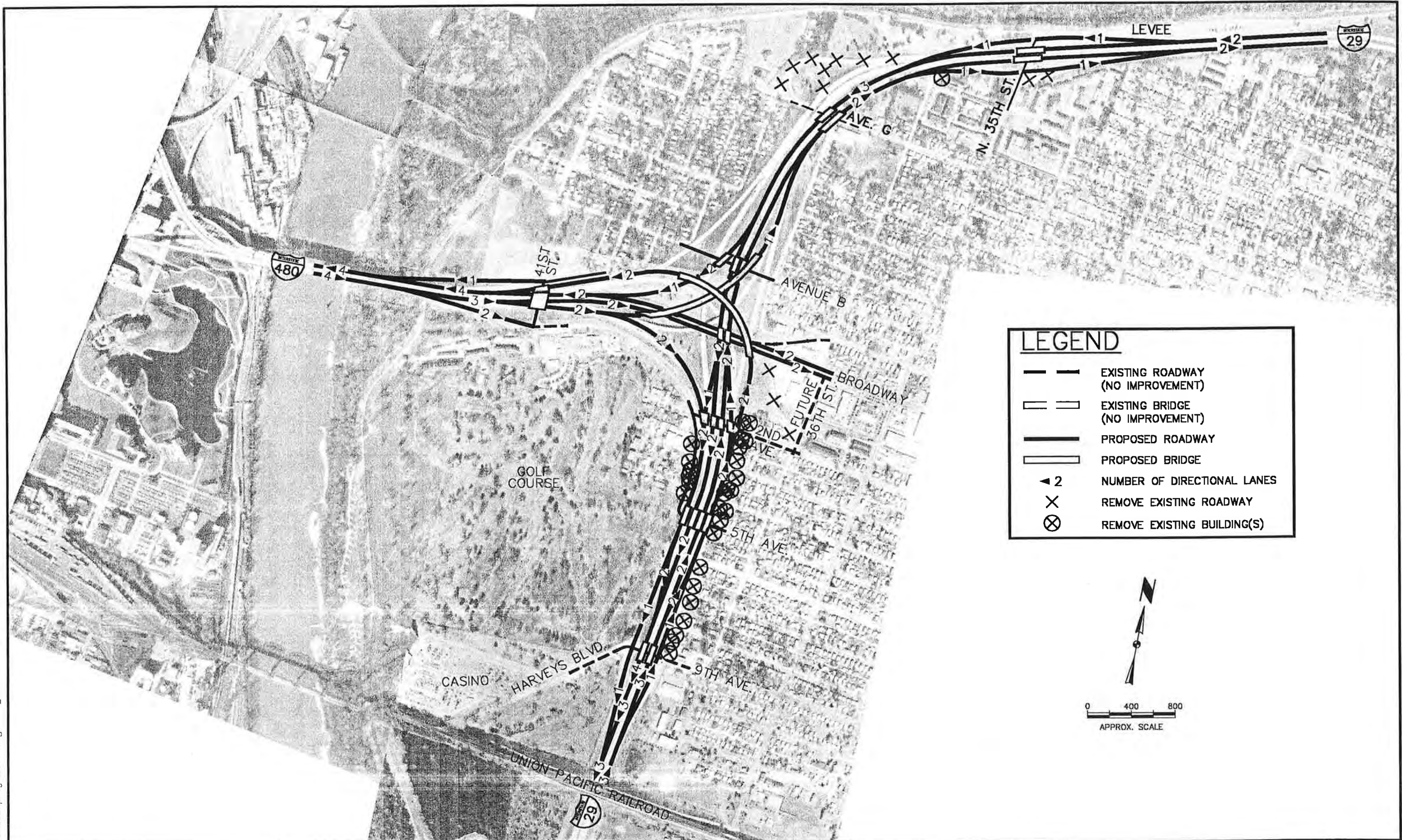
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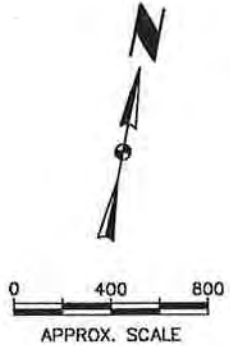
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TABLE 16 - Concept Screening Summary – I-29/I-480/Broadway System Interchange

Alternative	Exhibit	Design Features/ Impacts	Traffic Operations	Route Continuity/ Signing	Environmental Impacts	Right-of-Way / Property Impacts	Maintenance of Traffic / Constructability	Cost (\$ Million)
1	43	<ul style="list-style-type: none"> <li>- Retains existing access with NO Broadway access provided.</li> <li>- 60 mph design speed on ALL system to system ramps.</li> <li>- 41<sup>st</sup> Street remains partial interchange with I-480 to the west.</li> <li>- Provides 2 lane ramps between I-480 and I-29 to the south.</li> <li>- All system ramps merge on the right.</li> <li>- All system ramps diverge on the right except the EB I-480 to NB/SB I-29 split has the lower volume NB ramp diverging on the left.</li> </ul>	<ul style="list-style-type: none"> <li>- Acceptable traffic operations provided on the mainline, ramps and ramp junctions throughout the system interchange.</li> <li>- See Avenue G and 9<sup>th</sup> Avenue summaries for weaving operations on I-29.</li> <li>- Ramp Sequencing provides acceptable traffic operations based on CORSIM analysis.</li> </ul>	<ul style="list-style-type: none"> <li>- Alternative provides lane and route continuity.</li> </ul>	<ul style="list-style-type: none"> <li>- Lengthening of 41<sup>st</sup> Street ramps will require work inside the Missouri River levee system.</li> <li>- NB I-29 to WB I-480 ramp and 41<sup>st</sup> Street on ramp is through a city park.</li> </ul>	<ul style="list-style-type: none"> <li>- Approximately 6 acres of additional right-of-way.</li> <li>- 4 houses would be impacted.</li> </ul>	<ul style="list-style-type: none"> <li>- Construction expected to be moderately difficult. Portions of the system interchange could be constructed in the clear. In other areas the proximity of existing and new roads may cause maintenance of traffic problems.</li> </ul>	35.8
2	44	<ul style="list-style-type: none"> <li>- Provides full access system interchange.</li> <li>- Minimum 50 mph design speed on system to system ramps.</li> <li>- Loop ramps meet basic standard criteria.</li> <li>- NB I-29 to EB Broadway connection provided by ramp from 9<sup>th</sup> Ave.</li> <li>- 41<sup>st</sup> Street remains partial interchange with I-480 to the west.</li> <li>- Provides 2 lane ramp between I-480 and I-29 to the south.</li> <li>- All system ramps merge on the right.</li> <li>- All system ramps diverge on the right except the EB I-480 to NB/SB I-29 split has the lower volume NB ramp diverging on the left.</li> </ul>	<ul style="list-style-type: none"> <li>- Acceptable traffic operations provided on the mainline, ramps and ramp junctions throughout the system interchange.</li> <li>- See Avenue G and 9<sup>th</sup> Avenue summaries for weaving operations on I-29.</li> <li>- Ramp Sequencing provides acceptable traffic operations based on CORSIM analysis.</li> </ul>	<ul style="list-style-type: none"> <li>- Alternative provides lane and route continuity.</li> <li>- Interior merge at I-29 ramp junction with WB I-480.</li> </ul>	<ul style="list-style-type: none"> <li>- Lengthening of 41<sup>st</sup> Street ramps will require work inside the Missouri River levee system.</li> <li>- NB I-29 to WB I-480 ramp and 41<sup>st</sup> Street on ramp is through a city park.</li> </ul>	<ul style="list-style-type: none"> <li>- Approximately 8 acres of additional right-of-way.</li> <li>- 9 houses would be impacted.</li> </ul>	<ul style="list-style-type: none"> <li>- Construction expected to be moderately difficult. Portions of the system interchange could be constructed in the clear. In other areas, the proximity of new and existing roads, especially loop ramps, may cause maintenance of traffic problems.</li> </ul>	35.6

TABLE 16 - Concept Screening Summary – I-29/I-480/Broadway System Interchange (Continued)

Alternative	Exhibit	Design Features/ Impacts	Traffic Operations	Route Continuity/ Signing	Environmental Impacts	Right-of-Way / Property Impacts	Maintenance of Traffic / Constructability	Cost (\$ Million)
3	45	<ul style="list-style-type: none"> <li>- Retains existing access with NO Broadway access provided.</li> <li>- Minimum 50 mph design speed on system to system ramps.</li> <li>- 41<sup>st</sup> Street remains partial interchange with I-480 to the west.</li> <li>- Provides 2 lane ramp between I-480 and I-29 to the south.</li> <li>- All system ramps merge on the right.</li> <li>- All system ramps diverge on the right except the EB I-480 to NB/SB I-29 split has the lower volume NB ramp diverging on the left.</li> </ul>	<ul style="list-style-type: none"> <li>- Acceptable traffic operations provided on the mainline, ramps and ramp junctions throughout the system interchange.</li> <li>- Ramp Sequencing provides acceptable traffic operations based on CORSIM analysis.</li> </ul>	<ul style="list-style-type: none"> <li>- Alternative provides lane and route continuity.</li> </ul>	<ul style="list-style-type: none"> <li>- Lengthening of 41<sup>st</sup> Street ramps will require work inside the Missouri River levee system.</li> <li>- NB I-29 to WB I-480 ramp and 41<sup>st</sup> Street on ramp is through a city park.</li> </ul>	<ul style="list-style-type: none"> <li>- Approximately 2 acres of additional right-of-way.</li> <li>- 2 houses would be impacted.</li> </ul>	<ul style="list-style-type: none"> <li>- Construction expected to be moderately difficult. Portions of the system interchange could be constructed in the clear. Other areas where the existing and new road alignments cross may cause maintenance of traffic problems.</li> </ul>	34.3
4	46	<ul style="list-style-type: none"> <li>- Provides full access system interchange, except SB I-29 to EB Broadway connection.</li> <li>- Minimum 50 mph design speed on system to system ramps.</li> <li>- Loop ramps meet basic standard criteria.</li> <li>- NB I-29 to EB Broadway connection provided by ramp from 9<sup>th</sup> Ave.</li> <li>- 41<sup>st</sup> Street remains partial interchange with I-480 to the west.</li> <li>- Provides 2 lane ramp between I-480 and I-29 to the south.</li> <li>- All system ramps merge on the right.</li> <li>- All system ramps diverge on the right except the EB I-480 to NB/SB I-29 split has the lower volume NB ramp diverging on the left.</li> </ul>	<ul style="list-style-type: none"> <li>- Acceptable traffic operations provided on the mainline, ramps and ramp junctions throughout the system interchange.</li> <li>- See Avenue G and 9<sup>th</sup> Avenue summaries for weaving operations on I-29.</li> <li>- Ramp Sequencing provides acceptable traffic operations based on CORSIM analysis.</li> </ul>	<ul style="list-style-type: none"> <li>- Alternative provides lane and route continuity.</li> </ul>	<ul style="list-style-type: none"> <li>- No major impacts have been identified.</li> </ul>	<ul style="list-style-type: none"> <li>- Approximately 4 acres of additional right-of-way.</li> <li>- No houses or businesses are impacted.</li> </ul>	<ul style="list-style-type: none"> <li>- Construction expected to be moderately difficult. Portions of the system interchange could be constructed in the clear. In other areas, the proximity of new and existing roads, especially loop ramps, may cause maintenance of traffic problems.</li> </ul>	30.9

TABLE 16 - Concept Screening Summary – I-29/I-480/Broadway System Interchange (Continued)

Alternative	Exhibit	Design Features/ Impacts	Traffic Operations	Route Continuity/ Signing	Environmental Impacts	Right-of-Way / Property Impacts	Maintenance of Traffic / Constructability	Cost (\$ Million)
5	47	<ul style="list-style-type: none"> <li>- Retains existing access with NO Broadway access provided.</li> <li>- 60 mph design speed on ALL system to system ramps.</li> <li>- Minimum 50 mph design speed on system to system ramps.</li> <li>- 41<sup>st</sup> Street remains partial interchange with I-480 to west.</li> <li>- All system ramps merge on the right.</li> <li>- All system ramps diverge on the right except the EB I-480 to NB/SB I-29 split has the lower volume NB ramp diverging on the left.</li> <li>- Provides C-D roads between I-480 and 9<sup>th</sup> Avenue.</li> </ul>	<ul style="list-style-type: none"> <li>- Acceptable traffic operations provided on the mainline, ramps and ramp junctions throughout the system interchange.</li> <li>- See Avenue G and 9<sup>th</sup> Avenue summaries for weaving operations on I-29.</li> <li>- Ramp Sequencing provides acceptable traffic operations based on CORSIM analysis.</li> </ul>	<ul style="list-style-type: none"> <li>- Alternative provides lane and route continuity.</li> </ul>	<ul style="list-style-type: none"> <li>- Lengthening of 41<sup>st</sup> Street ramps will require work inside the Missouri River levee system.</li> <li>- NB I-29 to WB I-480 ramp and 41<sup>st</sup> Street on ramp is through a city park.</li> </ul>	<ul style="list-style-type: none"> <li>- Approximately 4 acres of additional right-of-way.</li> <li>- Approximately 26 houses between I-480 and 9<sup>th</sup> Avenue would be impacted.</li> </ul>	<ul style="list-style-type: none"> <li>- Construction expected to be moderately difficult. Portions of the system interchange could be constructed in the clear. In other areas the proximity of existing and new roads may cause maintenance of traffic problems.</li> </ul>	41.1

## G AVENUE /N. 35<sup>TH</sup> STREET / I-29 INTERCHANGE

The existing partial Avenue G/I-29 interchange in combination with the partial 35<sup>th</sup> Street/I-29 interchange provide full access to I-29 although they are separated by approximately 2,000'. It has been determined that these two partial interchanges should be grouped under one heading based on the alternatives that were developed.

### EXISTING/FUTURE DEFICIENCIES

#### AVENUE G INTERCHANGE

The following deficiencies were identified for existing conditions. The partial interchange at Avenue G currently provides on and off ramps for southbound I-29 traffic. The existing I-29 mainline and southbound off ramp junction provide acceptable traffic operations through the interchange. The unsignalized intersection at the southbound ramp terminal currently provides LOS B or better for all movements. An operational deficiency has been identified at the southbound I-29 weaving movement between the Avenue G on ramp and the I-480/I-29 diverge, resulting in LOS E during the existing AM peak period.

The Year 2020 No-Build analysis indicates that the I-29 mainline and southbound off ramp junction will continue to operate at a LOS B or better through the interchange. The unsignalized intersection at the southbound ramp terminal will continue to provide LOS B or better for all movements based on the Year 2020 projected traffic volumes. The southbound weaving operations between Avenue G and the I-480/I-29 diverge will deteriorate to LOS F during the Year 2020 AM peak hour.

Ramp sequencing between Avenue G and the I-480 interchange to the south do not meet the minimum recommended AASHTO ramp sequencing guidelines. The existing I-29 mainline horizontal alignment near the Avenue G interchange is rated "poor" because it doesn't meet the current guideline for a 50 mph design speed. The southbound on-ramp taper is substandard based on the current AASHTO recommended taper lengths. The existing Avenue G southbound loop on-ramp does not meet the basic standard radius.

#### 35<sup>TH</sup> STREET INTERCHANGE

The existing partial interchange at 35<sup>th</sup> Street provides northbound on and off ramps for I-29. The I-29 mainline through the interchange and northbound ramp junctions currently provide LOS B or better. The existing ramp terminal is the termination of 35<sup>th</sup> Street with no conflicting movement so the ramp terminal was not analyzed. This layout is unconventional because motorists are required to proceed onto northbound I-29 from northbound 35<sup>th</sup> Street.

The Year 2020 No-Build analysis indicates that the mainline through the interchange and the northbound ramp junctions will continue to operate at a LOS B or better.

The existing northbound 35<sup>th</sup> Street interchange ramp lengths do not meet the basic standard requirements. The interstate signing for the 35<sup>th</sup> Street off ramp is "poor" because the gore area exit sign is missing.

### ACCESS

The existing Avenue G/I-29 partial interchange provides access to/from southbound I-29 and the 35<sup>th</sup> Street/I-29 partial interchange provides access to/from northbound I-29. One of the alternatives developed improves the existing geometrics at these two partial interchanges. The other two alternatives include developing a full interchange at a single location, one at Avenue G and one at 35<sup>th</sup> Street.

### ALTERNATIVES

Three alternatives were developed for this interchange and are shown in Exhibits 48 through 50. All alternatives assume reconstruction of the I-29 mainline.

#### **Alternative 1 (Exhibit 48)**

This alternative provides a tight diamond interchange at N. 35<sup>th</sup> Street and eliminates the existing partial interchange at Avenue G. This alternative provides full access and increases the ramp separation and weaving length between 35<sup>th</sup> Street and the I-480/I-29 System Interchange. An auxiliary lane is added from the southbound I-29/35<sup>th</sup> Street on-ramp to the I-480 diverge. The horizontal alignment for I-29 mainline was also improved to meet the 70-mph design criteria. Northbound 35<sup>th</sup> Street becomes the ramp to northbound I-29 and would therefore require additional signing to reduce the potential for motorists inadvertently entering the interstate system.

#### **Alternative 2 (Exhibit 49)**

This alternative provides a partial cloverleaf (parclo) interchange at Avenue G with loop ramps in the Northeast and Northwest quadrants. This alternative provides full interstate access at Avenue G and eliminates the existing partial interchange at N. 35<sup>th</sup> Street. The I-29 mainline horizontal alignment is improved to full standard through the interchange. An auxiliary lane is added from the southbound I-29/Avenue G on-ramp to the I-480 diverge. The improved weaving length between southbound I-29 from Avenue G to the I-480 diverge still does not meet the minimum distance required to provide LOS D in the Year 2020 based on the CORSIM analysis. The acquisition of 7 houses and a business will be required as part of this alternative.

#### **Alternative 3 (Exhibit 50)**

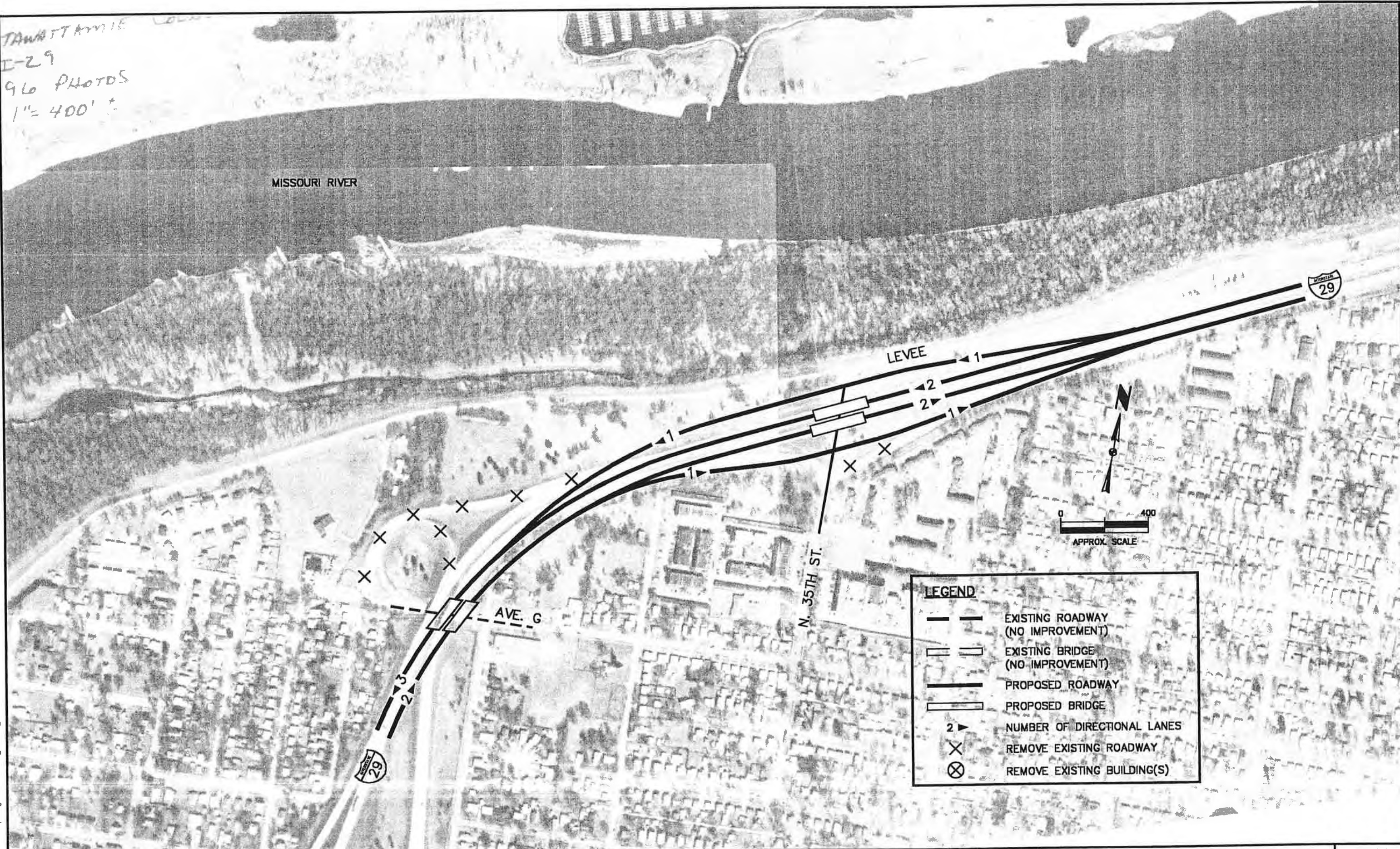
This alternative retains the two existing partial interchanges at Avenue G and 35<sup>th</sup> Street and improves them to meet the full standard criteria. The I-29 mainline horizontal alignment through the Avenue G interchange is improved to 70 mph design speed. An auxiliary lane is added from the southbound Avenue G on-ramp to the I-480 diverge. The improved weaving length between southbound I-29 from Avenue G to the I-480 diverge still does not meet the minimum distance required to provide LOS D in the Year 2020 based on the CORSIM analysis.

### PREFERRED ALTERNATIVE

Alternative 1, the tight diamond interchange at N. 35<sup>th</sup> Street was selected as the preferred alternative for further evaluation in Phase III. Alternative 1 combines the two existing partial interchanges at Avenue G and North 35<sup>th</sup> Street. In addition, Alternative 1 creates an acceptable weaving length between North 35<sup>th</sup> Street and the I-480 system interchange.

TAWASTAMIE  
E-29  
96 PHOTOS  
1" = 400'

MISSOURI RIVER



LEGEND	
	EXISTING ROADWAY (NO IMPROVEMENT)
	EXISTING BRIDGE (NO IMPROVEMENT)
	PROPOSED ROADWAY
	PROPOSED BRIDGE
2 >	NUMBER OF DIRECTIONAL LANES
X	REMOVE EXISTING ROADWAY
X ⊗	REMOVE EXISTING BUILDING(S)

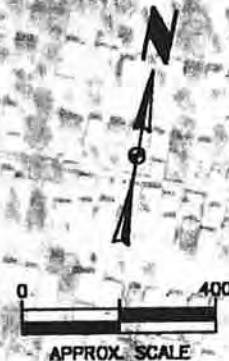
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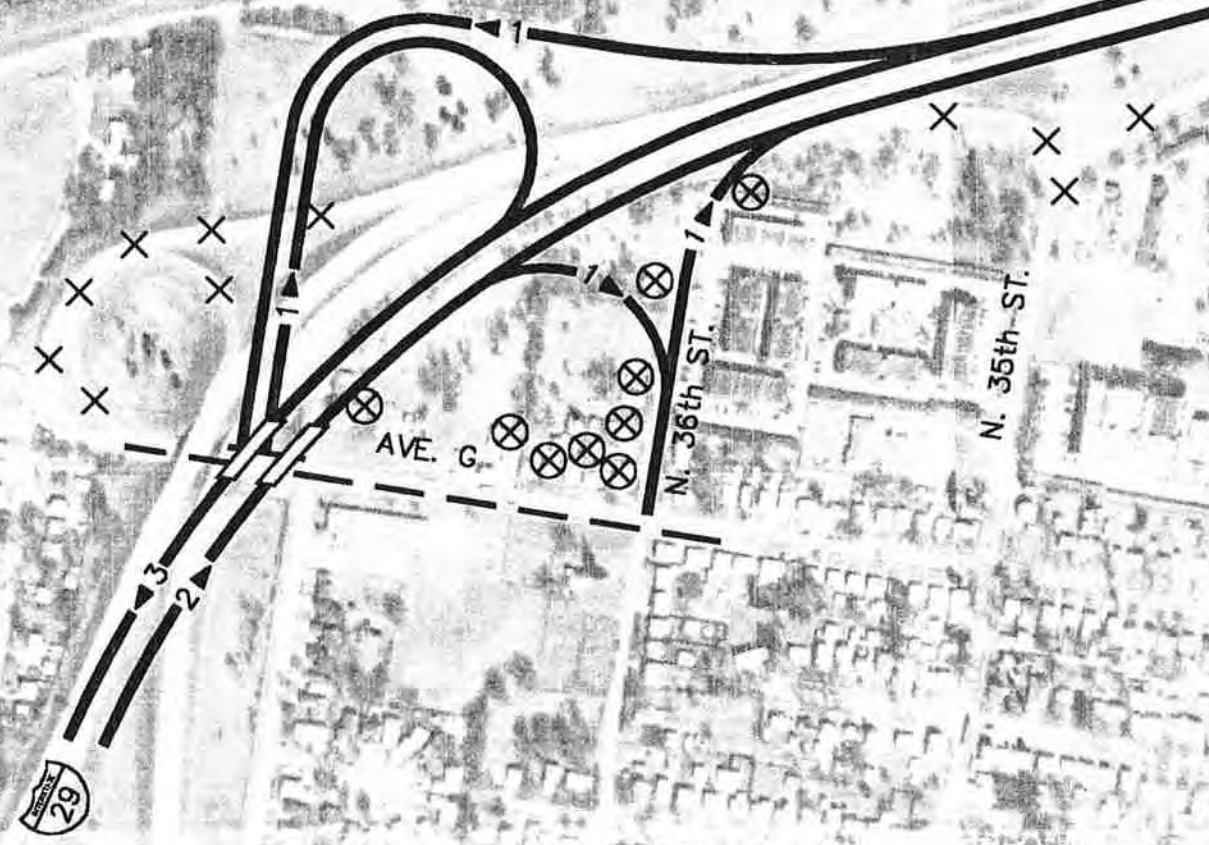
TAWATTAMIE  
 E-29  
 96 PHOTOS  
 1" = 400' ±

MISSOURI RIVER

LEVEE



LEGEND	
	EXISTING ROADWAY (NO IMPROVEMENT)
	EXISTING BRIDGE (NO IMPROVEMENT)
	PROPOSED ROADWAY
	PROPOSED BRIDGE
	NUMBER OF DIRECTIONAL LANES
	REMOVE EXISTING ROADWAY
	REMOVE EXISTING BUILDING(S)



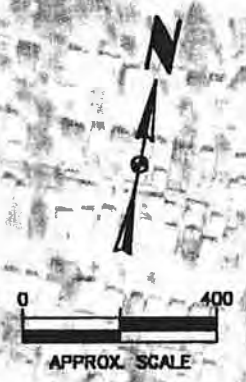
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TAWATTAMIE  
 E-29  
 96 PHOTOS  
 1" = 400' ±

MISSOURI RIVER

LEVEE

29



LEGEND	
	EXISTING ROADWAY (NO IMPROVEMENT)
	EXISTING BRIDGE (NO IMPROVEMENT)
	PROPOSED ROADWAY
	PROPOSED BRIDGE
	NUMBER OF DIRECTIONAL LANES
	REMOVE EXISTING ROADWAY
	REMOVE EXISTING BUILDING(S)

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TABLE 17 - Concept Screening Summary – G Avenue/N. 35<sup>th</sup> Street/I-29 Interchange

Alternative	Exhibit	Design Features/ Impacts	Traffic Operations	Route Continuity/ Signing	Environmental Impacts	Right-of-Way / Property Impacts	Maintenance of Traffic / Constructability	Cost (\$ Million)
1	48	<ul style="list-style-type: none"> <li>- Full access interchange at N. 35<sup>th</sup> Street.</li> <li>- Tight diamond configuration at N. 35<sup>th</sup> Street.</li> <li>- Elimination of existing partial interchange at Avenue G.</li> <li>- Ramps meet full standard criteria.</li> <li>- I-29 mainline horizontal alignment improved to meet full standard..</li> </ul>	<ul style="list-style-type: none"> <li>- Acceptable traffic operations provided on the mainline and at the ramp junctions.</li> <li>- Provides improved ramp spacing from I-480 interchange by the elimination of Avenue G Interchange.</li> <li>- Improves existing ramp lengths and tapers to full standard.</li> <li>- Provides full access at a single interchange.</li> </ul>	<ul style="list-style-type: none"> <li>- Alternative provides lane and route continuity.</li> <li>- NB 35<sup>th</sup> Street terminates into I-29 ramps requiring additional signing.</li> </ul>	<ul style="list-style-type: none"> <li>- Some impact to existing Missouri River levee maybe encountered.</li> </ul>	<ul style="list-style-type: none"> <li>- Approximately 2 acres of additional right-of-way.</li> <li>-No houses or businesses impacted.</li> </ul>	<ul style="list-style-type: none"> <li>- No major construction issues have been identified.</li> </ul>	13.5
2	49	<ul style="list-style-type: none"> <li>- Full access interchange at Avenue G.</li> <li>- Partial cloverleaf interchange at Avenue G with loop ramps in NE and NW quadrants.</li> <li>- Loop ramps meet full standard criteria</li> <li>- Elimination of existing partial interchange at N. 35<sup>th</sup> Street.</li> <li>- I-29 mainline horizontal alignment improved to meet full standard.</li> </ul>	<ul style="list-style-type: none"> <li>- Acceptable traffic operations provided on the mainline and at the ramp junctions.</li> <li>- Provides improved ramp spacing from I-480 interchange although not as good as Alt 1.</li> <li>- Improves existing ramp lengths and tapers to full standard.</li> <li>- Provides full access at a single interchange.</li> </ul>	<ul style="list-style-type: none"> <li>- Alternative provides lane and route continuity.</li> </ul>	<ul style="list-style-type: none"> <li>- No major impacts have been identified.</li> </ul>	<ul style="list-style-type: none"> <li>- Approximately 6 acres of additional right-of-way.</li> <li>- 8 houses, 1 business and an apartment garage will be impacted.</li> </ul>	<ul style="list-style-type: none"> <li>- No major construction issues have been identified.</li> </ul>	12.2
3	50	<ul style="list-style-type: none"> <li>- Retain two partial interchanges at Avenue G and 35<sup>th</sup> Street.</li> <li>- Reconstruct ramps to meet full standard criteria.</li> <li>- Avenue G interchange provides southbound I-29 access with partial cloverleaf in NW quadrant.</li> <li>- N. 35<sup>th</sup> Street interchange provides northbound I-29 access with tight diamond.</li> <li>- I-29 mainline horizontal alignment improved to meet full standard.</li> </ul>	<ul style="list-style-type: none"> <li>- Acceptable traffic operations provided on the mainline and at the ramp junctions.</li> <li>- Improves existing ramp lengths and tapers to full standard.</li> <li>- Retains two partial interchanges.</li> <li>- Weaving distance for SB I-29 from Avenue G to I-480 diverge is less than required for LOS D.</li> </ul>	<ul style="list-style-type: none"> <li>- Alternative provides lane and route continuity.</li> </ul>	<ul style="list-style-type: none"> <li>- No major impacts have been identified.</li> </ul>	<ul style="list-style-type: none"> <li>- Approximately 4 acres of additional right-of-way.</li> <li>- 1 house and 1 apartment garage will be impacted.</li> </ul>	<ul style="list-style-type: none"> <li>- No major construction issues have been identified.</li> </ul>	12.4

## NORTH 25TH STREET / I-29 INTERCHANGE

### EXISTING/FUTURE DEFICIENCIES

No existing operational deficiencies were identified at this interchange. All four existing tight diamond ramp junctions and main line through the interchange currently operate at LOS B or better. The unsignalized intersections at the ramp terminals currently provide LOS C or better for all movements during the peak hours.

The No-Build analysis indicated that the existing mainline and ramp junctions will continue to provide acceptable traffic operations (LOS B or better) in the Year 2020. The existing unsignalized intersection for the northbound ramps will also provide acceptable traffic operations for all movements based on the Year 2020 projected traffic volumes. However, the unsignalized intersection for the southbound ramps will not provide acceptable traffic operations for the Year 2020. The left turn movement from the ramp to southbound 25<sup>th</sup> Street would drop to LOS F during the AM peak hour.

The distance between the signalized intersection at Nash Boulevard and the northbound ramps is currently limited to approximately 100 feet. In addition, an at-grade railroad crossing is located on 25<sup>th</sup> Street north of the interstate approximately 100 feet from the southbound ramps. The I-29 mainline horizontal alignment just east of the 25<sup>th</sup> Street interchange is rated "fair" and only meets the current 60 mph design criteria. In addition, the decision and stopping sight distance is limited at the same location and also received "poor" ratings.

### ACCESS

The existing 25<sup>th</sup> Street/I-29 Interchange provides full access. Changes to access are not anticipated as part of long-term improvements.

### ALTERNATIVES

Two alternatives were developed for this interchange and are shown in Exhibits 51 and 52. Both alternatives assume reconstruction of the I-29 mainline and reconstruction of 25<sup>th</sup> Street, as necessary, to provide adequate capacity to serve Year 2020 traffic volumes.

#### Alternative 1 (Exhibit 51)

This alternative retains the existing tight diamond interchange configuration. The improvements include lengthening the ramps and increasing the existing ramp taper lengths to meet the "full" standard. The proposed improvements include the installation of a traffic signal at the SB I-29 ramps/25<sup>th</sup> Street intersection. The realignment of Nash Boulevard was included as an option with this alternative to increase the existing intersection spacing between the northbound ramps and Nash Boulevard.

#### Alternative 2 (Exhibit 52)

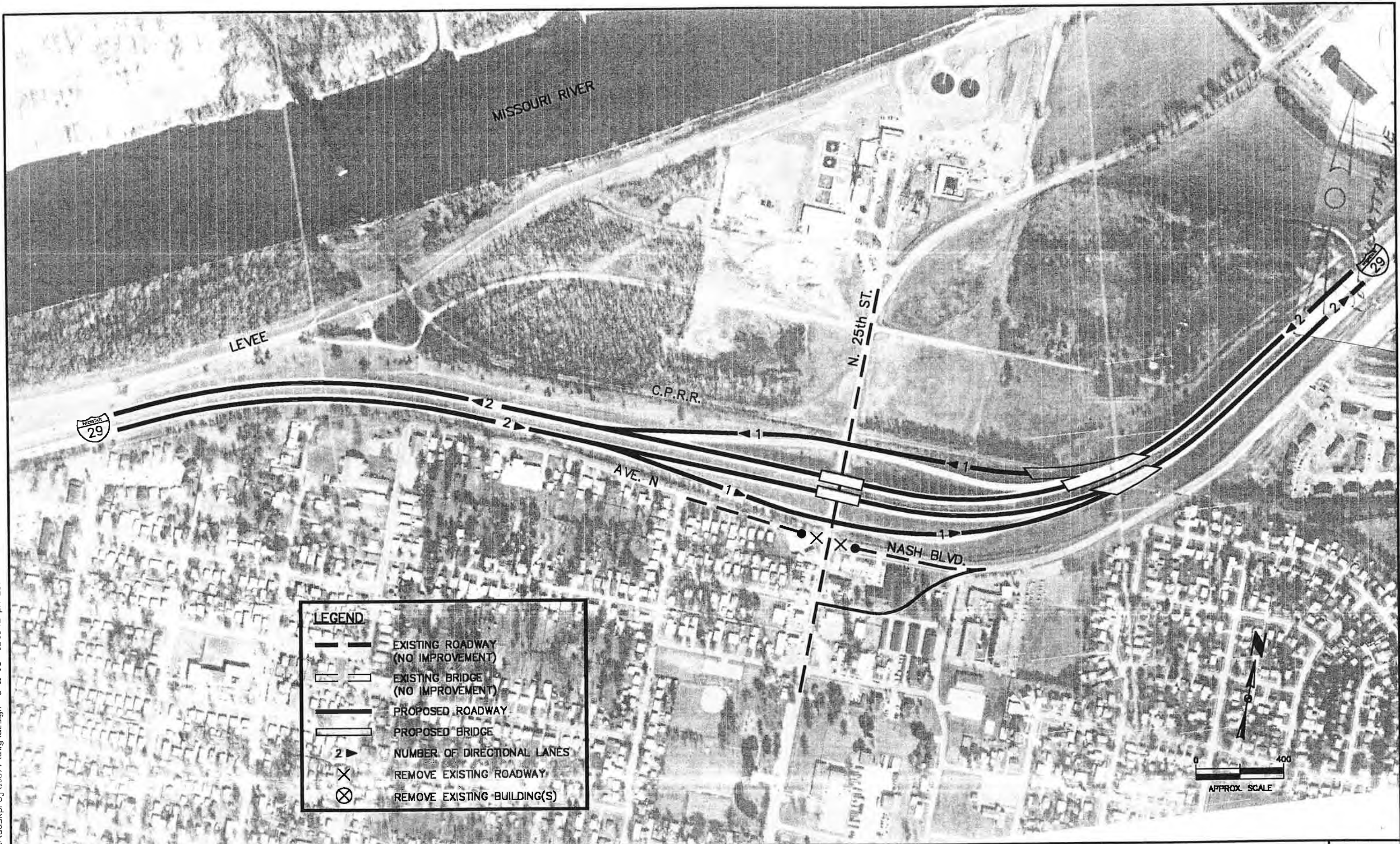
This alternative shifts the existing tight diamond to the north to increase the existing separation between the northbound ramp junction and the signalized intersection at Nash Boulevard. Railroad tracks are located just north of the existing southbound I-29 ramps and parallels the interstate. The interchange can be shifted only a limited distance to the north and will require extensive bridge work and retaining walls. Shifting the mainline to the north improves intersection spacing between the ramps and Nash

Boulevard to approximately 200 feet. The proposed improvements include the installation of a traffic signal at the westbound I-29 ramps/25<sup>th</sup> Street intersection.

### PREFERRED ALTERNATIVE

Alternative 1 was selected as the preferred alternative for further evaluation in Phase III. It was determined the best option at this location is to reconstruct the existing interchange layout with minor modifications to improve existing sight distance. In addition the southbound ramps will eventually need signalization. The realignment of Nash Boulevard was also proposed as an option to improve the existing intersection spacing.

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LEGEND	
	EXISTING ROADWAY (NO IMPROVEMENT)
	EXISTING BRIDGE (NO IMPROVEMENT)
	PROPOSED ROADWAY
	PROPOSED BRIDGE
	NUMBER OF DIRECTIONAL LANES
	REMOVE EXISTING ROADWAY
	REMOVE EXISTING BUILDING(S)



TABLE 18 - Concept Screening Summary – North 25<sup>th</sup> Street/I-29 Interchange

Alternative	Exhibit	Design Features/ Impacts	Traffic Operations	Route Continuity/ Signing	Environmental Impacts	Right-of-Way / Property Impacts	Maintenance of Traffic / Constructability	Cost (\$ Million)
1	51	<ul style="list-style-type: none"> <li>- Retain tight diamond interchange (TDI) configuration.</li> <li>- Ramps meet full standard criteria.</li> <li>- Nash Boulevard is realigned to the south to provide improved intersection spacing.</li> </ul>	<ul style="list-style-type: none"> <li>- Acceptable traffic operations provided on mainline and at the ramp junctions.</li> </ul>	<ul style="list-style-type: none"> <li>- Alternative provides route and lane continuity.</li> </ul>	<ul style="list-style-type: none"> <li>- No major impacts have been identified.</li> </ul>	<ul style="list-style-type: none"> <li>- Approximately 1 acre of additional right-of-way.</li> <li>- 1 house will be impacted.</li> </ul>	<ul style="list-style-type: none"> <li>- No major construction issues have been identified.</li> </ul>	15.8
2	52	<ul style="list-style-type: none"> <li>- Shift tight diamond interchange (TDI) to north.</li> <li>- Increases distance between NB ramps and existing traffic signal at Nash Boulevard to approximately 200 feet.</li> <li>- Ramps meet full standard criteria.</li> <li>- Requires extensive bridge work and retaining walls for railroad on north side of interstate.</li> </ul>	<ul style="list-style-type: none"> <li>- Acceptable traffic operations provided on mainline and at the ramp junctions.</li> </ul>	<ul style="list-style-type: none"> <li>- Alternative provides route and lane continuity.</li> </ul>	<ul style="list-style-type: none"> <li>- No major impacts have been identified.</li> </ul>	<ul style="list-style-type: none"> <li>- Approximately 2 acres of additional right-of-way.</li> <li>- No houses or businesses impacted.</li> </ul>	<ul style="list-style-type: none"> <li>- Construction will require coordination with the railroad.</li> </ul>	15.5

## NORTH 16TH STREET / I-29 INTERCHANGE

### EXISTING/FUTURE DEFICIENCIES

The existing North 16<sup>th</sup> Street/I-29 Interchange is currently a partial interchange providing access from 16<sup>th</sup> Street to northbound I-29 and access from southbound I-29 to 16<sup>th</sup> Street. No existing traffic operational deficiencies were identified at this location. The I-29 mainline through the interchange and the ramp junctions currently provide acceptable traffic operations based on existing traffic volumes. The existing ramps terminate at Nash Boulevard/Big Lake Road, a signalized intersection. This interchange layout is unconventional because northbound 16<sup>th</sup> Street turns the northbound I-29 on-ramp at Nash Boulevard.

The Year 2020 No-Build analysis indicated that the mainline through the interchange and the ramp junctions will continue to operate at a LOS B or better.

A left side exit is currently provided for the southbound exit ramp to 16<sup>th</sup> Street. The mainline I-29 pavement was reconstructed through this interchange and to the north in 1996. Nash Boulevard was constructed in 1994 to provide access to south I-29 from 16<sup>th</sup> Street. Nash Boulevard extends west from the 16<sup>th</sup> Street ramp terminals to 25<sup>th</sup> Street parallel to I-29. Nash Boulevard provides a direct connection to the 25<sup>th</sup> Street/I-29 interchange, which currently provides full interstate access.

### ACCESS

The existing 16<sup>th</sup> Street/I-29 partial interchange provides access from 16<sup>th</sup> Street to northbound I-29 and from southbound I-29 to 16<sup>th</sup> Street. Two alternatives that were developed provide a full interchange at this location.

MAPA provided output from a special model run to assist in determining if a full interchange at the 16<sup>th</sup> Street interchange would be beneficial. The proposed interchange was coded in the model as a full diamond interchange to the north of the existing partial access interchange. This model run showed that very little traffic would use south I-29 ramps from 16<sup>th</sup> Street based on the existing Year 2020 traffic generators in the model. It is logical that the connection between 16<sup>th</sup> Street and I-29 south would be more direct using Nash Boulevard to the 25<sup>th</sup> Street interchange.

### ALTERNATIVES

Three alternatives were developed for this interchange and are shown in Exhibits 53 through 55. Alternative 1 assumes reconstruction of the I-29 mainline. With Alternative 2 and 3, a portion of the recently reconstructed mainline could be retained.

#### Alternative 1 (Exhibit 53)

This alternative includes a full diamond interchange at N. 16<sup>th</sup> Street. This alternative would be located to the north of and would replace the existing N. 16<sup>th</sup> Street interchange. Work would include shifting the northbound I-29 mainline pavement to parallel the southbound pavement.

#### Alternative 2 (Exhibit 54)

This alternative includes expanding the existing partial interchange to include ramps from N. 16<sup>th</sup> Street to I-29 to the south. In addition, the southbound I-29 off-ramp to 16<sup>th</sup> Street is reconstructed to provide a right side exit. Ramps between 16<sup>th</sup> Street and I-29 south would be elevated structures through established wetlands.

#### Alternative 3 (Exhibit 55)

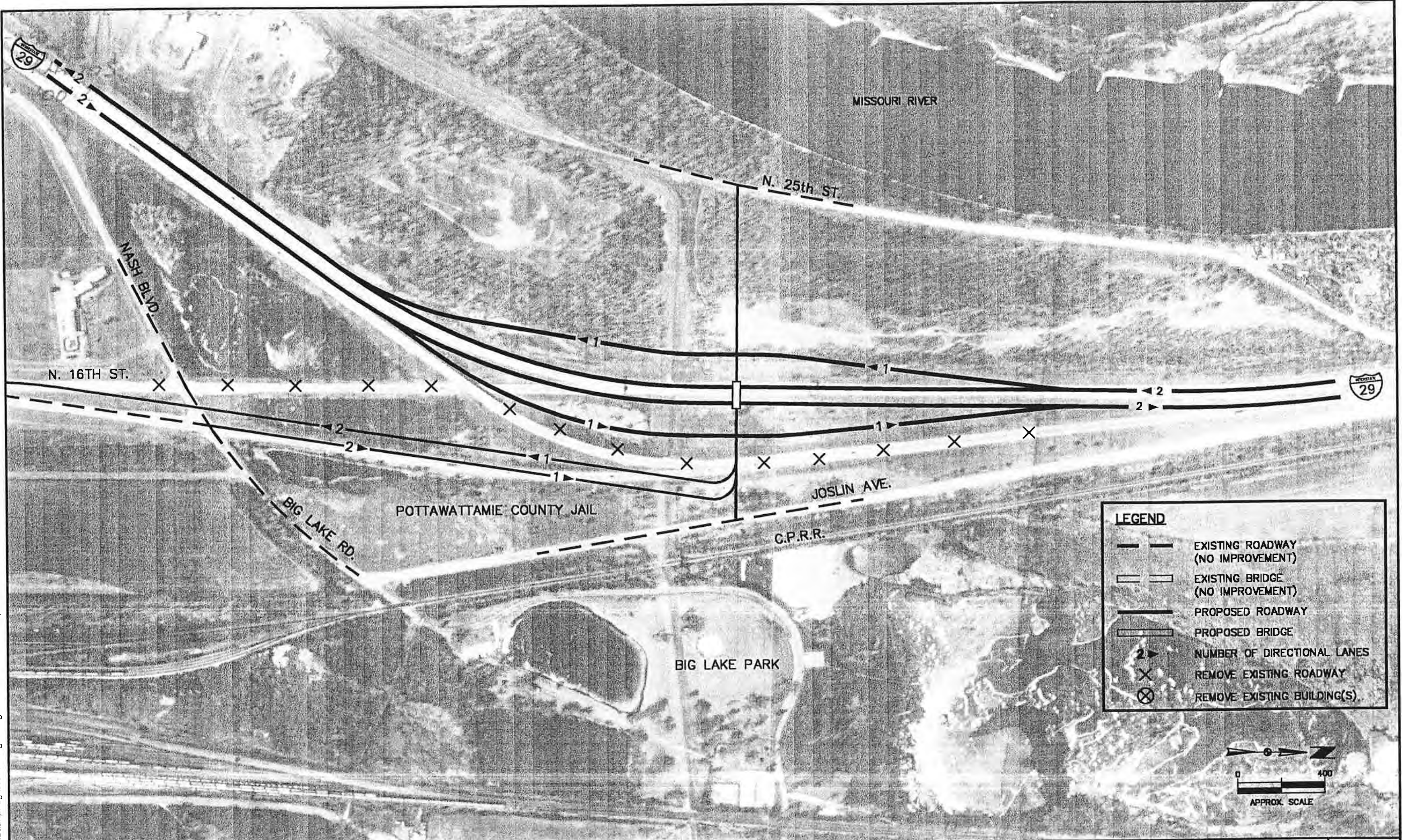
Alternative 3 would provide a right hand exit from southbound I-29 to North 16<sup>th</sup> Street while maintaining the remaining interchange layout. A full interchange at this location is not justified based on the special regional model run provided by MAPA.

### PREFERRED ALTERNATIVE

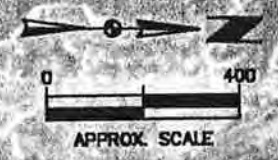
Alternative 3 was selected as the preferred alternative for further evaluation in Phase III. The existing partial interchange provides acceptable access at this location and the change to the left hand exist would address the one deficiency identified in Phase I.

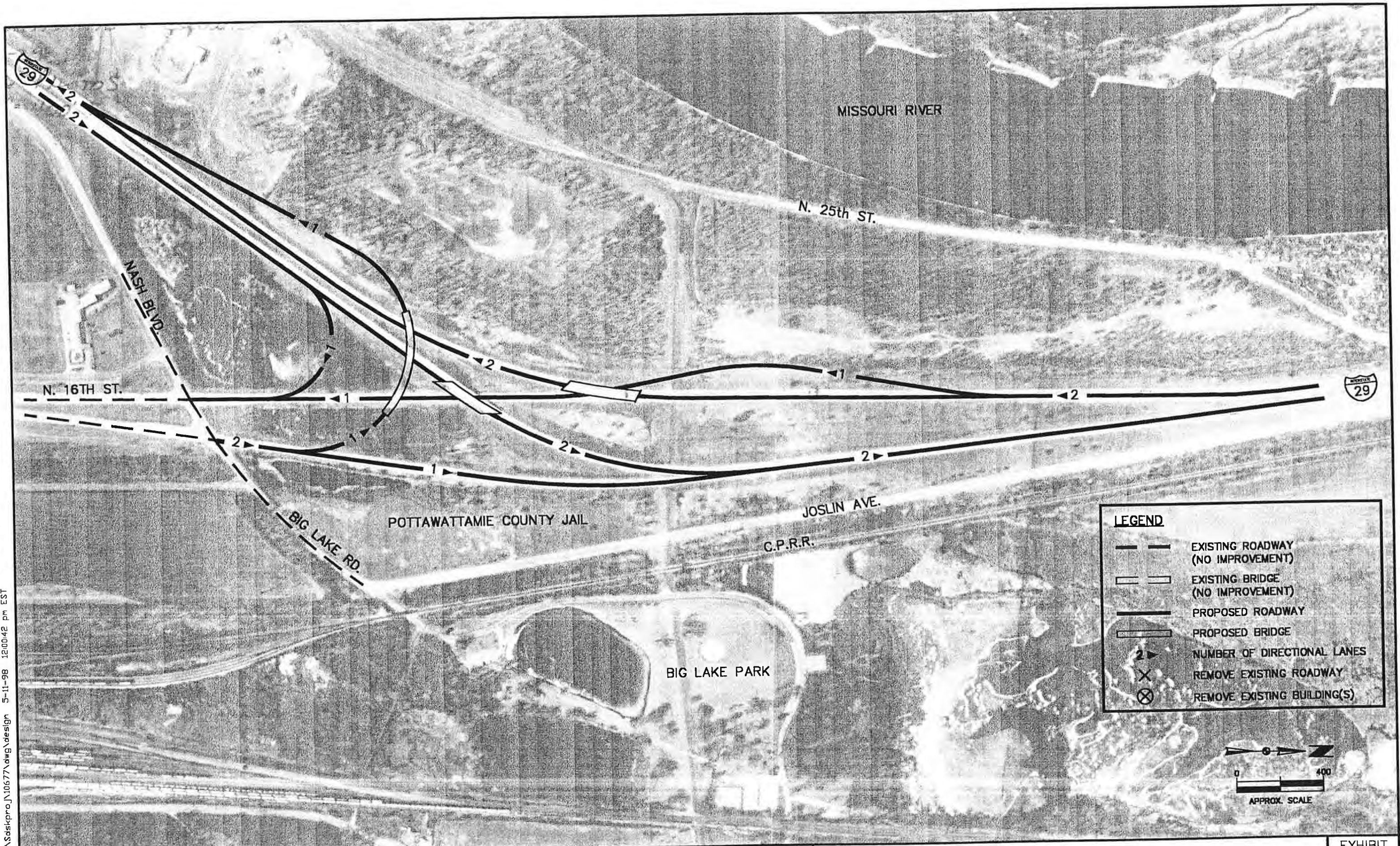


C:\Saskpro\10677\dwg\design 5-11-98 12:00:42 pm EST

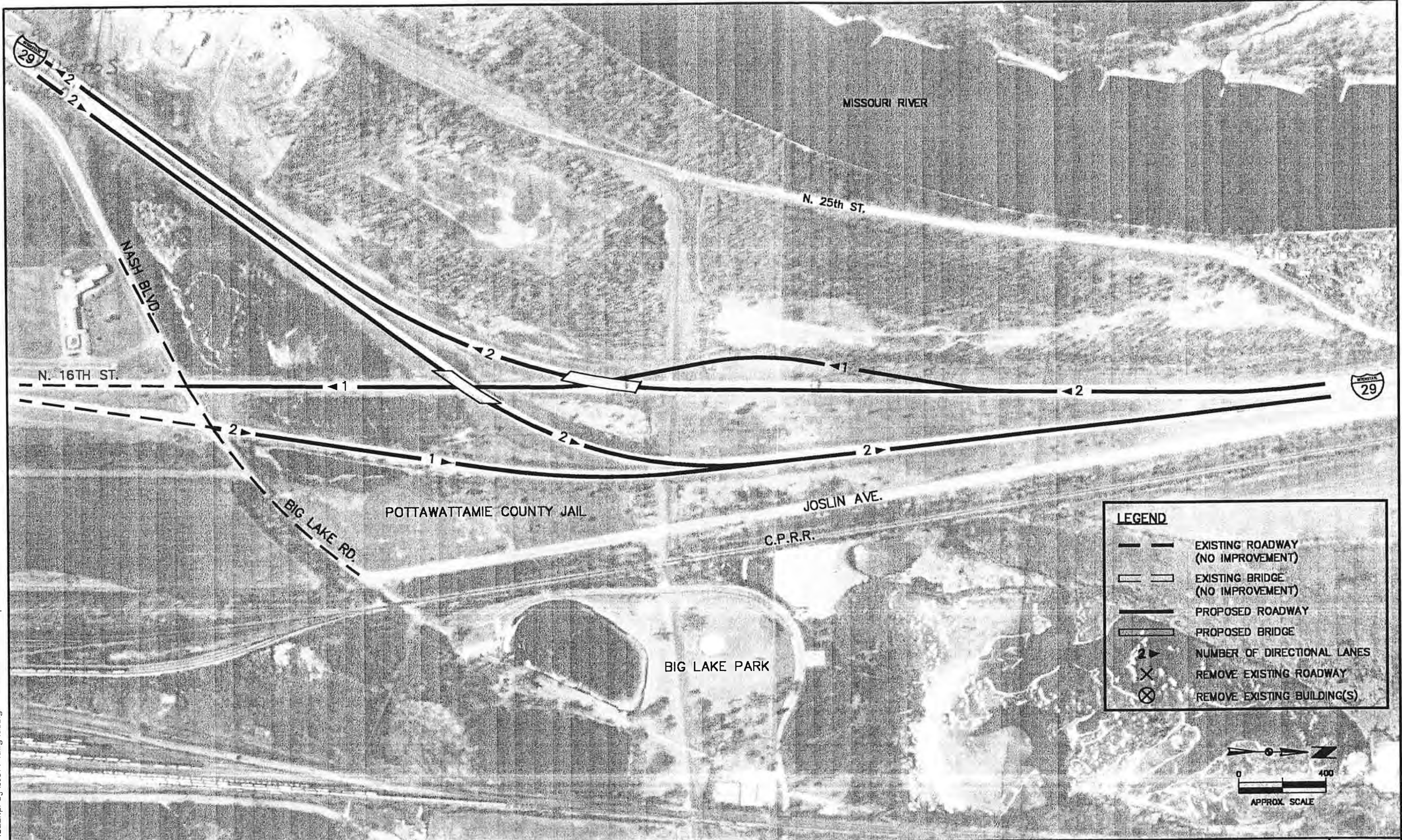


LEGEND	
	EXISTING ROADWAY (NO IMPROVEMENT)
	EXISTING BRIDGE (NO IMPROVEMENT)
	PROPOSED ROADWAY
	PROPOSED BRIDGE
	NUMBER OF DIRECTIONAL LANES
	REMOVE EXISTING ROADWAY
	REMOVE EXISTING BUILDING(S)





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TABLE 19 - Concept Screening Summary – North 16<sup>th</sup> Street/I-29 Interchange

Alternative	Exhibit	Design Features/ Impacts	Traffic Operations	Route Continuity/ Signing	Environmental Impacts	Right-of-Way / Property Impacts	Maintenance of Traffic / Constructability	Cost (\$ Million)
1	53	<ul style="list-style-type: none"> <li>- Full diamond interchange configuration located just north of existing partial interchange.</li> <li>- Ramps meet full standard.</li> <li>- Reconstruction of I-29 mainline.</li> </ul>	<ul style="list-style-type: none"> <li>- Acceptable traffic operations provided on the mainline and at the ramp junctions.</li> </ul>	<ul style="list-style-type: none"> <li>- Alternative provides route and lane continuity.</li> </ul>	<ul style="list-style-type: none"> <li>- Two interstate ramps pass through/over established wetlands.</li> <li>- The majority of work would be completed outside of the Council Bluffs levee system.</li> </ul>	<ul style="list-style-type: none"> <li>- Approximately 13 acres of additional right-of-way.</li> <li>- No houses or businesses impacted.</li> </ul>	<ul style="list-style-type: none"> <li>- Construction work would be required in environmentally sensitive wetlands.</li> </ul>	19.2
2	54	<ul style="list-style-type: none"> <li>- Modify existing interchange to provide full access.</li> <li>- Corrects exiting southbound I-29 left side exit to 16<sup>th</sup> Street.</li> <li>- All ramps meet full standard.</li> <li>- Potential to leave recently reconstructed I-29 mainline pavement in place.</li> </ul>	<ul style="list-style-type: none"> <li>- Acceptable traffic operations provided on the mainline and at the ramp junctions.</li> </ul>	<ul style="list-style-type: none"> <li>- Alternative provides route and lane continuity.</li> </ul>	<ul style="list-style-type: none"> <li>- Ramps between 16<sup>th</sup> Street and I-29 to the south are bridges passing through/over established wetlands.</li> </ul>	<ul style="list-style-type: none"> <li>- Approximately 6 acres of additional right-of-way.</li> <li>- No houses or businesses impacted.</li> </ul>	<ul style="list-style-type: none"> <li>- Construction work would be required in environmentally sensitive wetlands.</li> </ul>	18.8
3	55	<ul style="list-style-type: none"> <li>- Maintain existing partial access interchange layout.</li> <li>- Corrects existing southbound I-29 left hand exit.</li> <li>- All ramps meet full standard.</li> <li>- Potential to leave recently reconstructed I-29 mainline pavement in place.</li> </ul>	<ul style="list-style-type: none"> <li>- Acceptable traffic operations provided on the mainline and at the ramp junctions.</li> </ul>	<ul style="list-style-type: none"> <li>- Alternative provides route and lane continuity.</li> </ul>	<ul style="list-style-type: none"> <li>- Some impact to Missouri River levee maybe encountered.</li> </ul>	<ul style="list-style-type: none"> <li>- Approximately 4 acres of additional right-of-way.</li> </ul>	<ul style="list-style-type: none"> <li>- No major construction issues have been identified.</li> </ul>	16.3

## EPPLEY AIRFIELD / I-29 INTERCHANGE

The need for a new interchange directly east of Eppley Airfield to provide direct access from I-29 over the Missouri River has been expressed. Currently motorists are required to cross the Missouri River at I-80, I-480, or I-680, and then proceed via surface streets or other freeways to the airport. The most feasible location for the crossing is approximately one mile north of the North 16<sup>th</sup> Street interchange.

### ALTERNATIVES

Two alternatives were developed for this new interchange and Missouri River crossing. Both alternatives include reconstruction of the I-29 mainline within the limits of the interchange. The major difficulties in developing the alternatives were the limited space between I-29 and the river and the minimum clearance required over the Missouri River. The interchange is limited in space on the east by existing bluffs and railroad tracks and on the west by the Missouri River. The required clear distance to low steel under of the proposed River Bridge is 85 feet at the 100-year flood stage.

#### Alternative 1 (Exhibit 56)

Alternative 1 would provide a full diamond interchange and all ramps would meet full standard design. The ramp terminals would be stop-controlled intersections. The western intersection would be on an elevated structure. Existing gravel roads on both sides of the interstate would need to be realigned to allow construction of the new interchange. A two-lane bridge over the Missouri River would be provided and would tie into the existing Eppley Airfield ring road (Lindbergh Plaza). Lindbergh Plaza loops around the airport, providing access to Abbott Drive from the north and south.

#### Alternative 2 (Exhibit 57)

Alternative 2 would provide a fully directional interchange and Missouri River Bridge crossing to provide Eppley Airfield access. All ramps meet the basic standard criteria for a 50-mph design. Existing gravel roads on both sides of the interstate would need to be realigned to allow construction of the new interchange. A two-lane bridge over the Missouri River would be provided and would tie into the Lindbergh Plaza. Lindbergh Plaza loops around the airport, providing access to Abbott Drive from the north and south.

### PREFERRED ALTERNATIVE

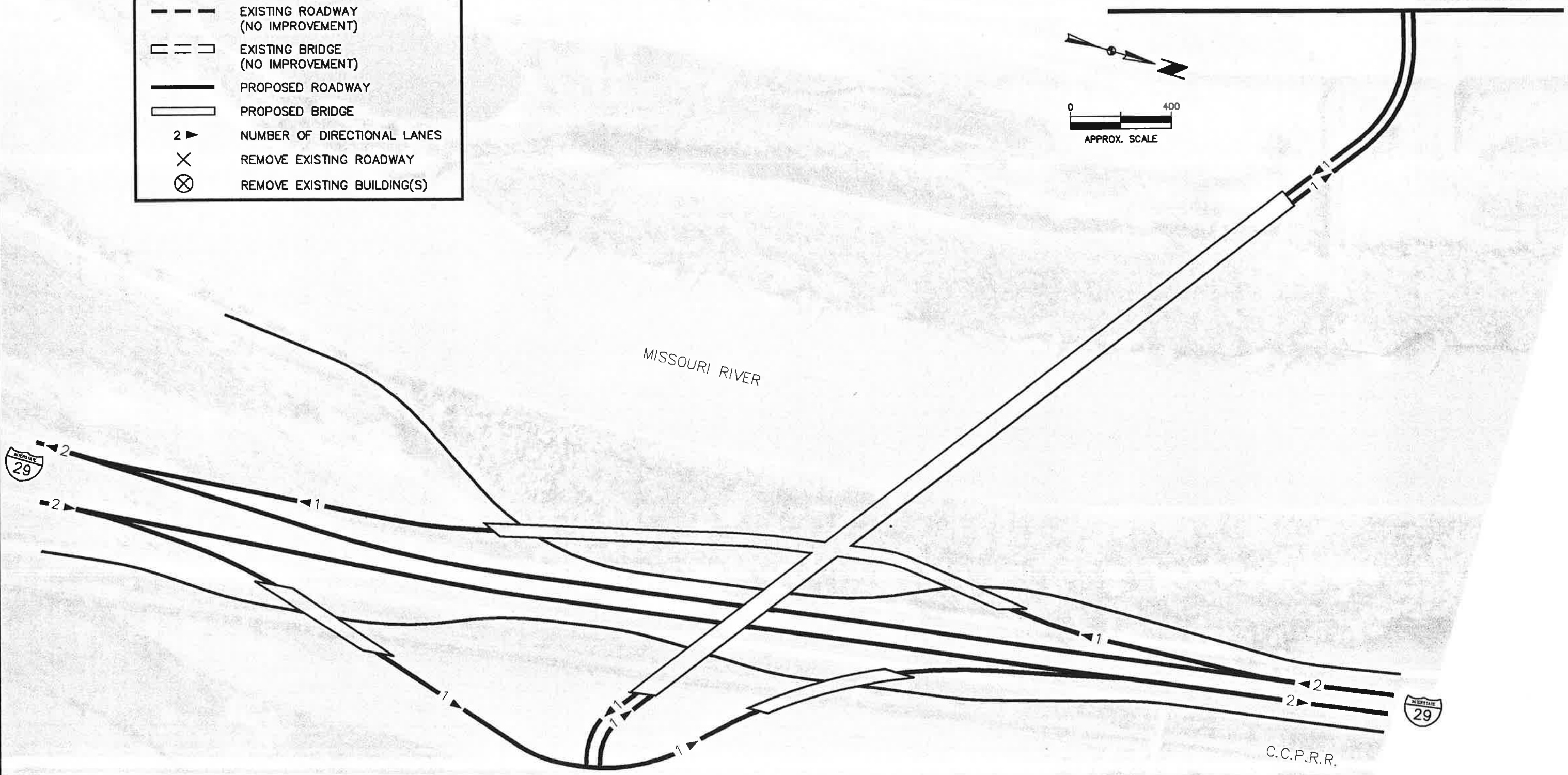
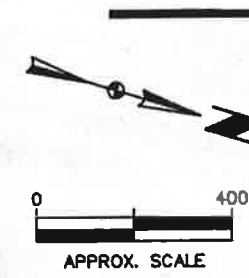
The construction cost based on the conceptual layouts is approximately the same for the two alternatives and is estimated at \$35,000,000. In addition approximately 60 acres of additional right-of-way would be required for either alternative.

Due to the high construction costs of this new interchange and the significant construction impacts, neither alternative at this location will be carried forward into Phase III. However, this analysis has shown that an I-29/Eppley Airfield interchange is feasible and could be assessed in greater detail if a significant need is shown and/or if funding becomes available.

EPPLEY AIRFIELD

LEGEND

- EXISTING ROADWAY (NO IMPROVEMENT)
- - - EXISTING BRIDGE (NO IMPROVEMENT)
- PROPOSED ROADWAY
- ▭ PROPOSED BRIDGE
- 2 ▶ NUMBER OF DIRECTIONAL LANES
- × REMOVE EXISTING ROADWAY
- ⊗ REMOVE EXISTING BUILDING(S)



EPPLEY AIRFIELD

**LEGEND**

- EXISTING ROADWAY (NO IMPROVEMENT)
- - - EXISTING BRIDGE (NO IMPROVEMENT)
- PROPOSED ROADWAY
- ▭ PROPOSED BRIDGE
- 2 ▶ NUMBER OF DIRECTIONAL LANES
- ✕ REMOVE EXISTING ROADWAY
- ⊗ REMOVE EXISTING BUILDING(S)

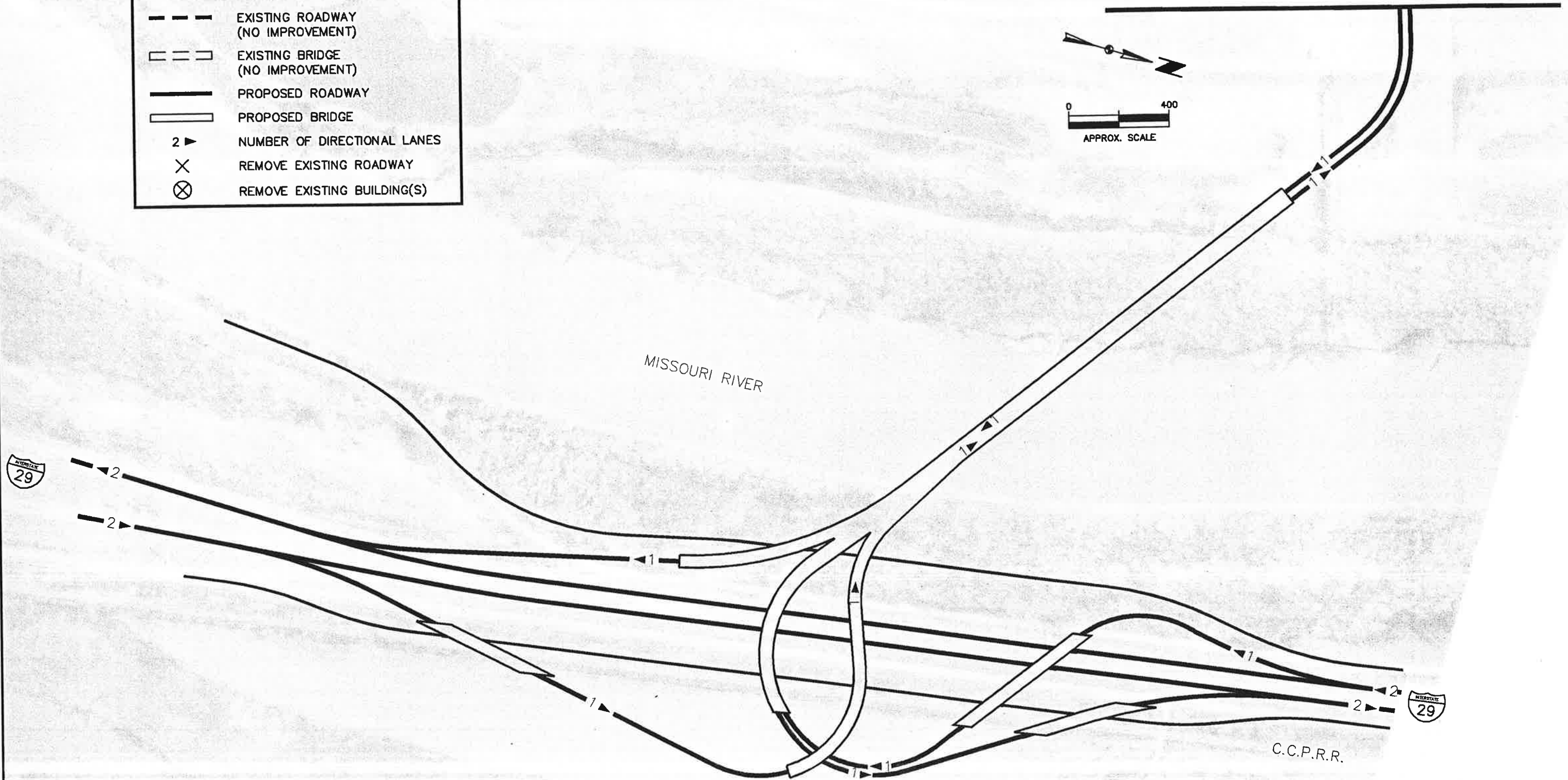
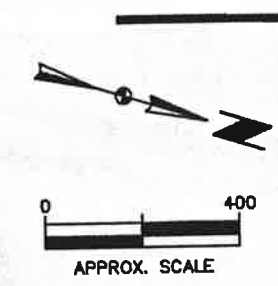


TABLE 20 - Concept Screening Summary – Eppley Airfield/I-29 Interchange

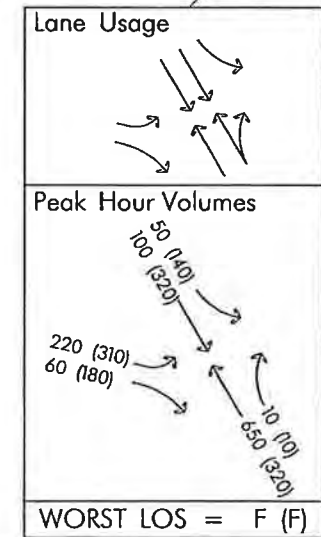
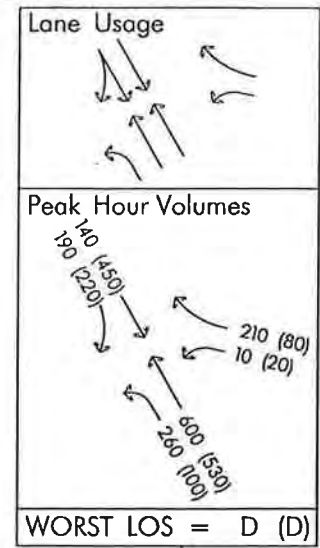
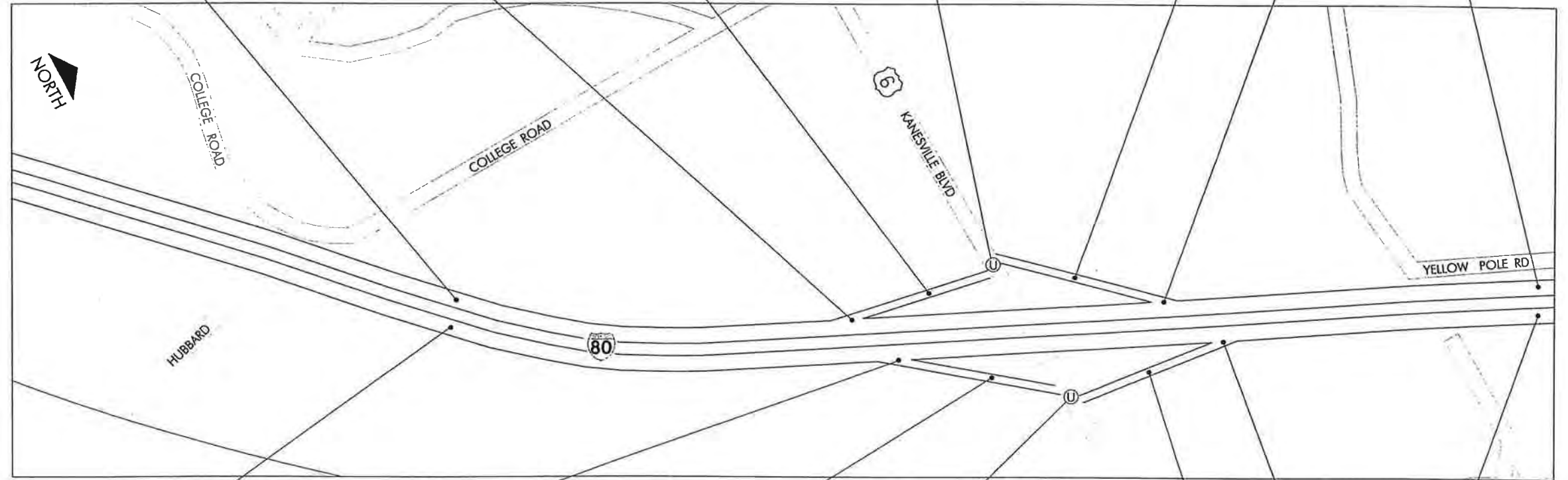
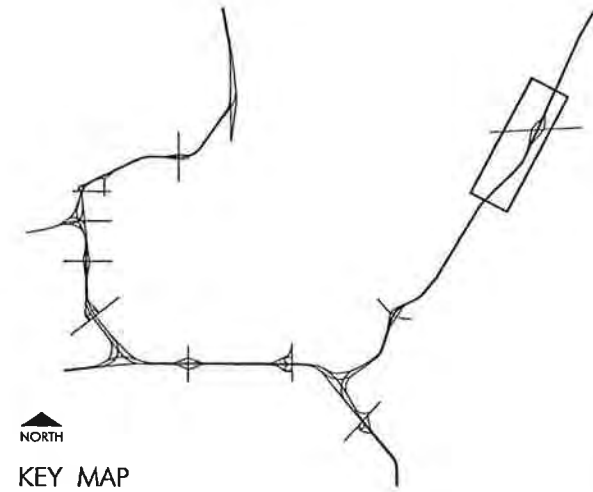
Alternative	Exhibit	Design Features/ Impacts	Traffic Operations	Route Continuity/ Signing	Environmental Impacts	Right-of-Way / Property Impacts	Maintenance of Traffic / Constructability	Cost (\$ Million)
1	56	<ul style="list-style-type: none"> <li>- New interchange to provide access between I-29 and Eppley Airfield.</li> <li>- Provides full diamond interchange.</li> <li>- Ramps meet full standard.</li> <li>- Reconstruction of I-29 mainline.</li> </ul>	<ul style="list-style-type: none"> <li>- Acceptable traffic operations provided on the mainline and at the ramp junctions.</li> <li>- Stop controlled ramp terminals.</li> </ul>	<ul style="list-style-type: none"> <li>- Alternative provides route and lane continuity.</li> </ul>	<ul style="list-style-type: none"> <li>- Right-of-way may include some wetlands.</li> <li>- Construction in Missouri River floodway may require mitigation of channel.</li> </ul>	<ul style="list-style-type: none"> <li>- Approximately 59 acres of additional right-of-way.</li> <li>- No houses or businesses impacted.</li> </ul>	<ul style="list-style-type: none"> <li>- Construction will require coordination with railroad and COE/DNR.</li> <li>- Substantial earthwork required.</li> </ul>	31.8
2	57	<ul style="list-style-type: none"> <li>- New interchange to provide access between I-29 and Eppley Airfield.</li> <li>- Provides fully directional interchange.</li> <li>- All ramps meet basic standard.</li> <li>- Reconstructed I-29 mainline.</li> </ul>	<ul style="list-style-type: none"> <li>- Acceptable traffic operations provided on the mainline and at the ramp junctions.</li> </ul>	<ul style="list-style-type: none"> <li>- Alternative provides route and lane continuity.</li> </ul>	<ul style="list-style-type: none"> <li>- Right-of-way may include some wetlands.</li> <li>- Construction in Missouri River floodway may require mitigation of channel.</li> </ul>	<ul style="list-style-type: none"> <li>- Approximately 51 acres of additional right-of-way.</li> <li>- No houses or businesses impacted.</li> </ul>	<ul style="list-style-type: none"> <li>- Construction will require coordination with railroad and COE/DNR.</li> <li>- Substantial earthwork required.</li> </ul>	30.7



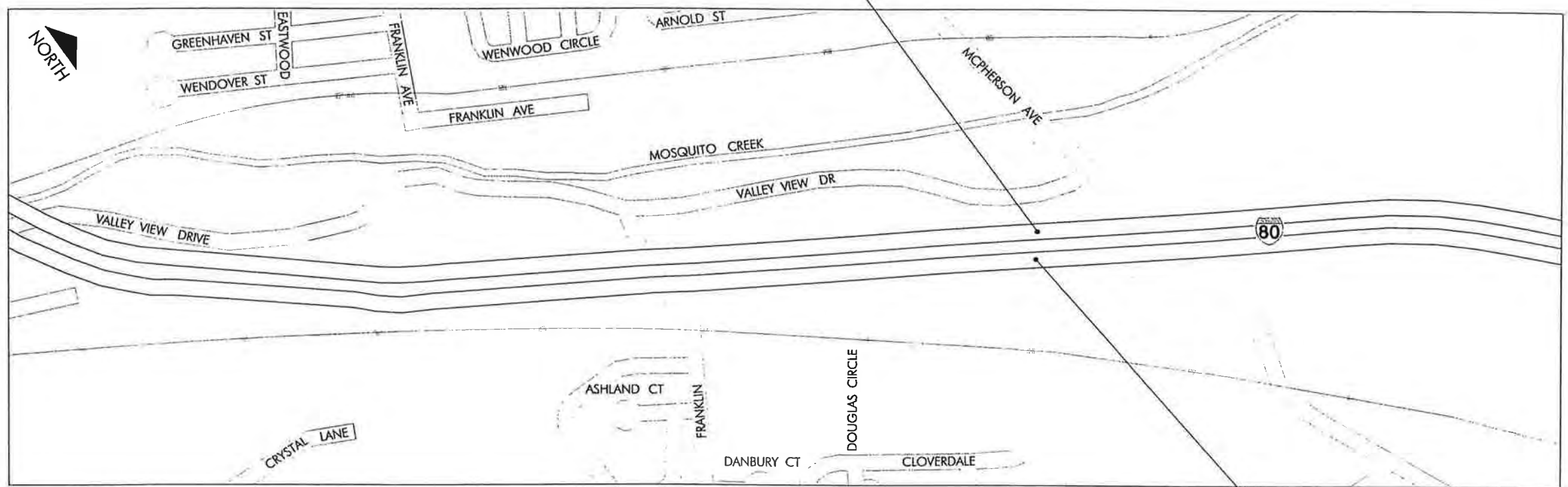
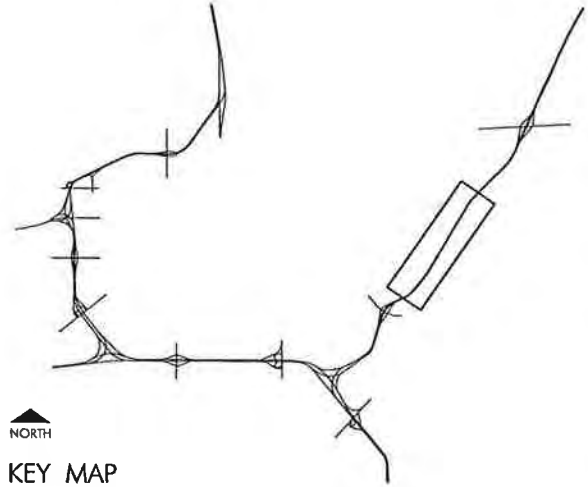
**APPENDIX**

**Future "No-Build" Performance Measure Exhibits**

**LEGEND**  
 L NUMBER OF LANES  
 V PEAK HOUR VOLUMES  
 LOS LEVEL OF SERVICE  
 XXX (XXX) AM (PM)  
 INTERSECTION LANE USAGE  
 (U) UNSIGNALIZED INTERSECTION  
 (S) SIGNALIZED INTERSECTION

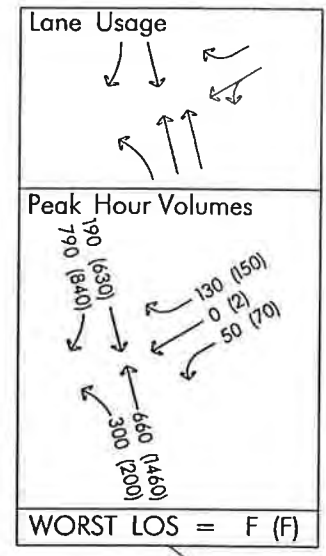


- LEGEND**
- L NUMBER OF LANES
  - V PEAK HOUR VOLUMES
  - LOS LEVEL OF SERVICE
  - xxx (xxx) AM (PM)
  - INTERSECTION LANE USAGE
  - ⊙ UNSIGNALIZED INTERSECTION
  - Ⓢ SIGNALIZED INTERSECTION



L = 2  
 V = 1300 (1140)  
 FREEWAY LOS = B (B)

L = 2  
 V = 1100 (1810)  
 FREEWAY LOS = B (C)



L = 1  
V = 180 (220)

DIVERGE LOS = B (B)

L = 2  
V = 1300 (1140)  
FREEWAY LOS = B (B)

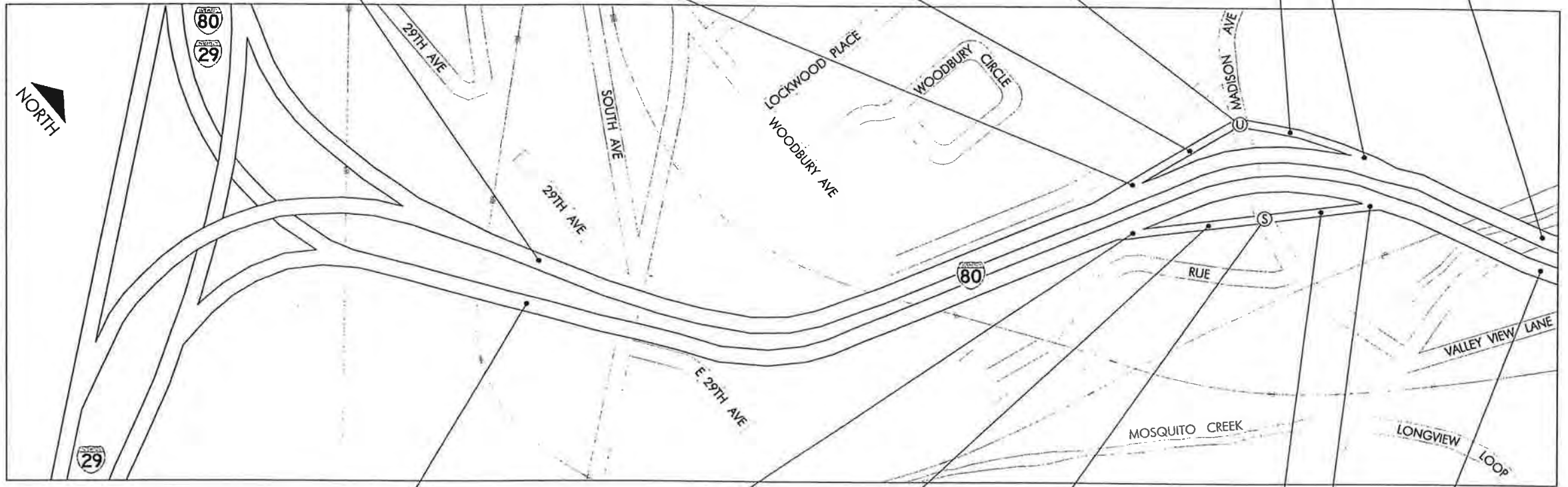
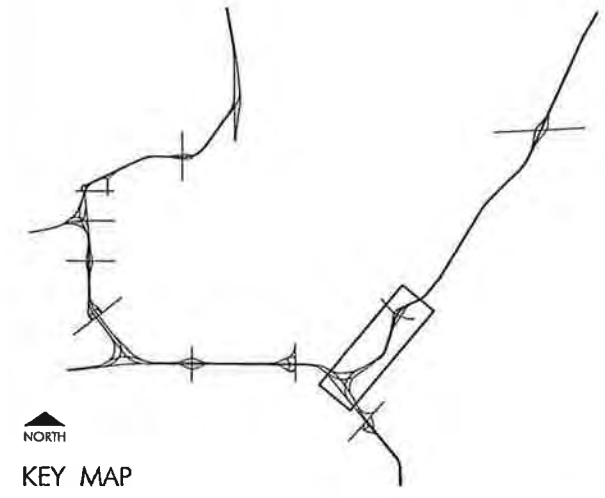
L = 2  
V = 2220 (1960)  
FREEWAY LOS = C (B)

MERGE LOS = C (C)

L = 1  
V = 1100 (1040)

**LEGEND**

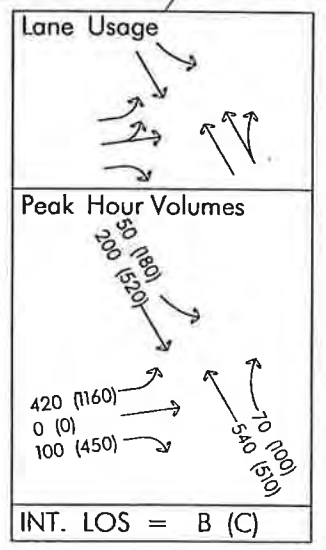
L NUMBER OF LANES  
 V PEAK HOUR VOLUMES  
 LOS LEVEL OF SERVICE  
 xxx (xxx) AM (PM)  
 INTERSECTION LANE USAGE  
 UNSIGNALIZED INTERSECTION  
 SIGNALIZED INTERSECTION



L = 2  
V = 1510 (3130)  
FREEWAY LOS = B (D)

DIVERGE LOS = B (D)




L = 1  
V = 520 (1600)

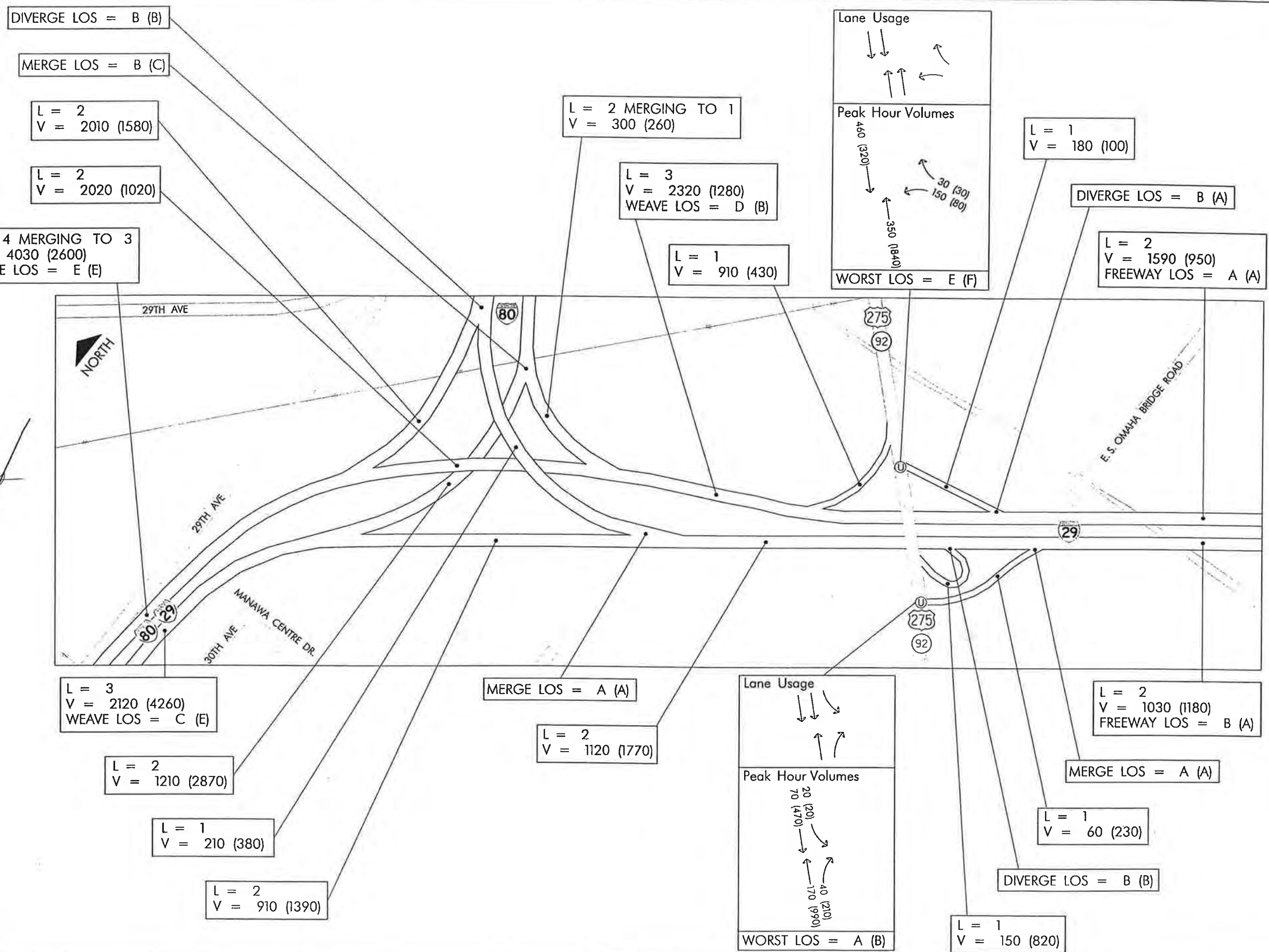
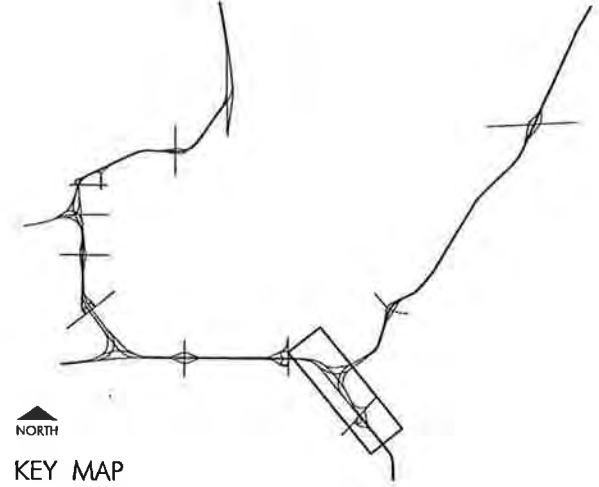


L = 2  
V = 1100 (1810)  
FREEWAY LOS = B (C)

MERGE LOS = B (C)

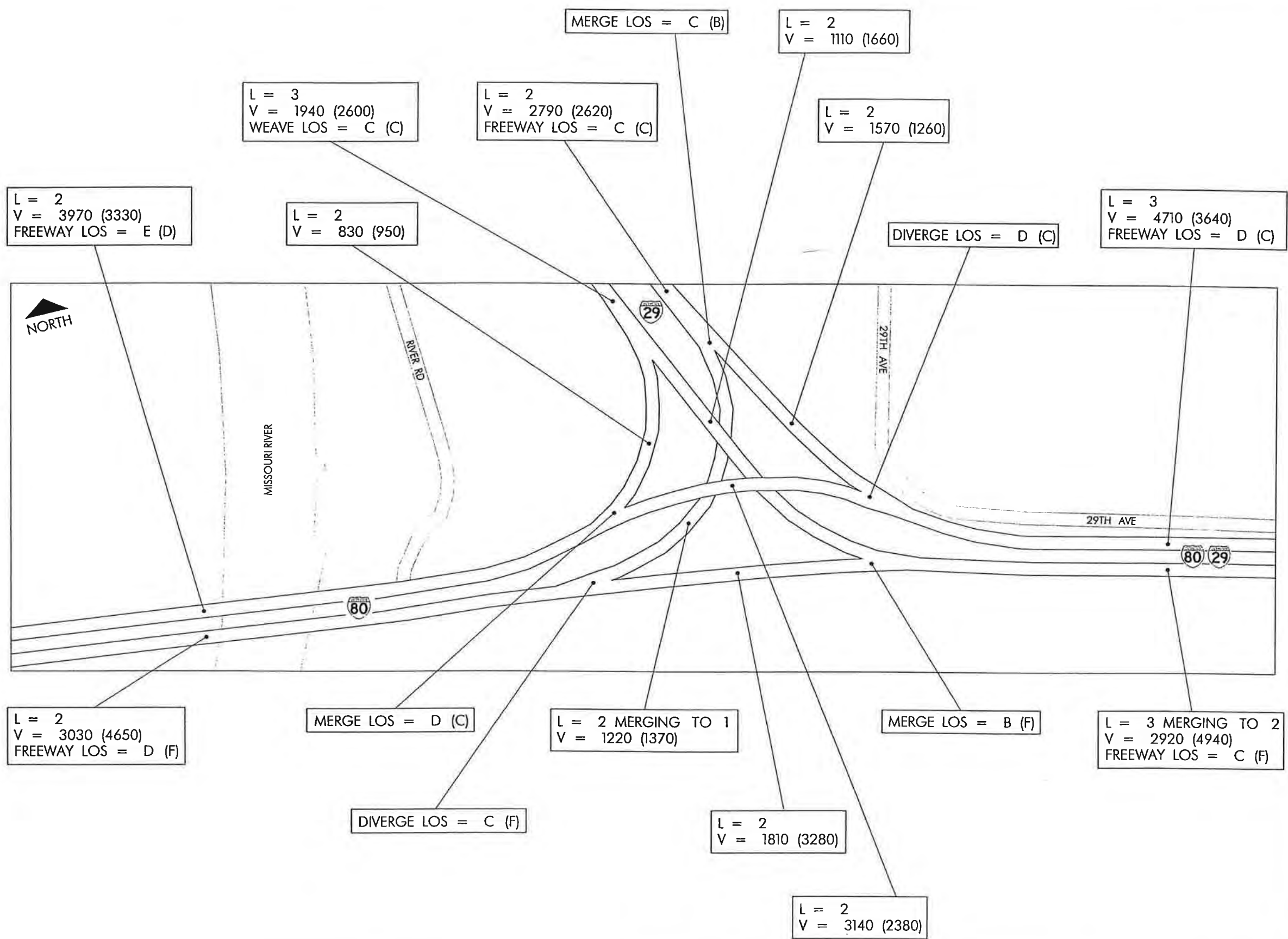
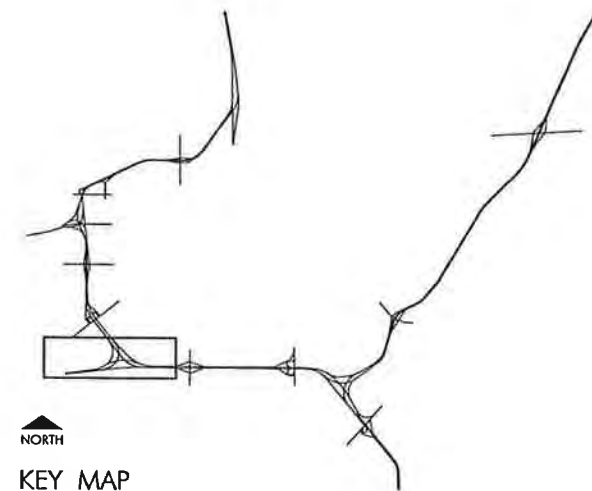
L = 1  
V = 110 (280)

**LEGEND**  
 L NUMBER OF LANES  
 V PEAK HOUR VOLUMES  
 LOS LEVEL OF SERVICE  
 XXX (XXX) AM (PM)  
 INTERSECTION LANE USAGE  
 UNSIGNALIZED INTERSECTION  
 SIGNALIZED INTERSECTION

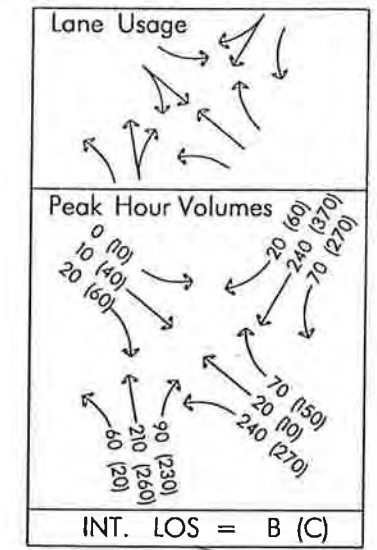
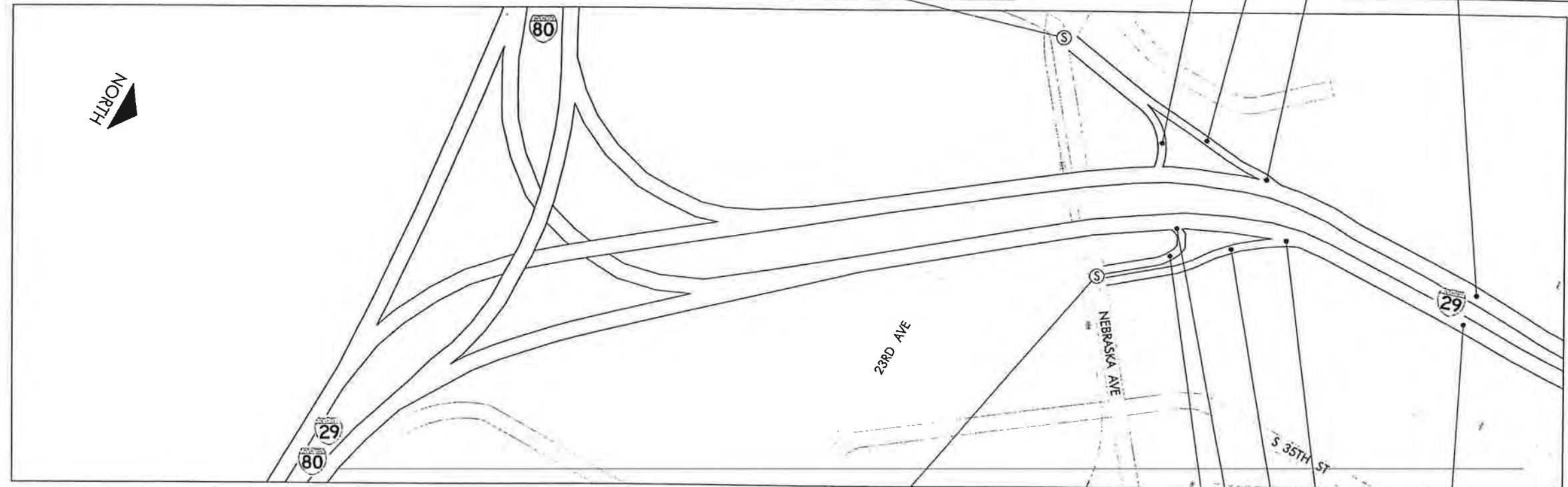
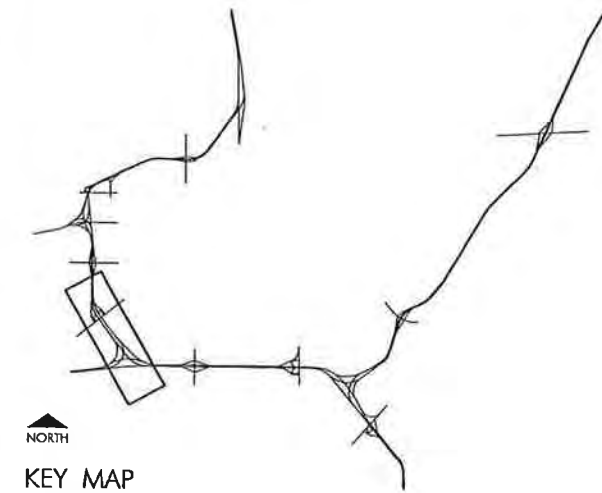




**LEGEND**  
 L NUMBER OF LANES  
 V PEAK HOUR VOLUMES  
 LOS LEVEL OF SERVICE  
 xxx (xxx) AM (PM)  
 INTERSECTION LANE USAGE  
 (U) UNSIGNALIZED INTERSECTION  
 (S) SIGNALIZED INTERSECTION



- LEGEND**
- L NUMBER OF LANES
  - V PEAK HOUR VOLUMES
  - LOS LEVEL OF SERVICE
  - XXX (XXX) AM (PM)
  - ↔ INTERSECTION LANE USAGE
  - ⊙ UNSIGNALIZED INTERSECTION
  - Ⓢ SIGNALIZED INTERSECTION

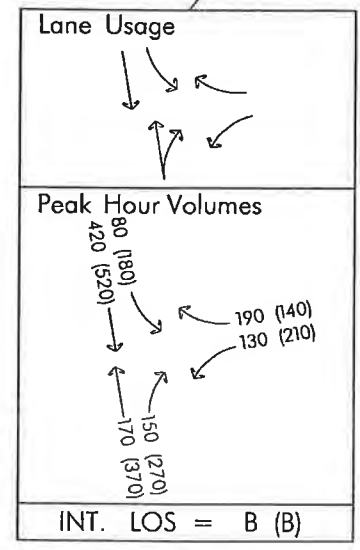


L = 1  
V = 170 (540)

L = 1  
V = 330 (420)

DIVERGE LOS = B (B)

L = 2  
V = 2100 (2480)  
FREEWAY LOS = C (C)



L = 2  
V = 2700 (2720)  
FREEWAY LOS = C (C)

MERGE LOS = C (C)

L = 1  
V = 230 (450)

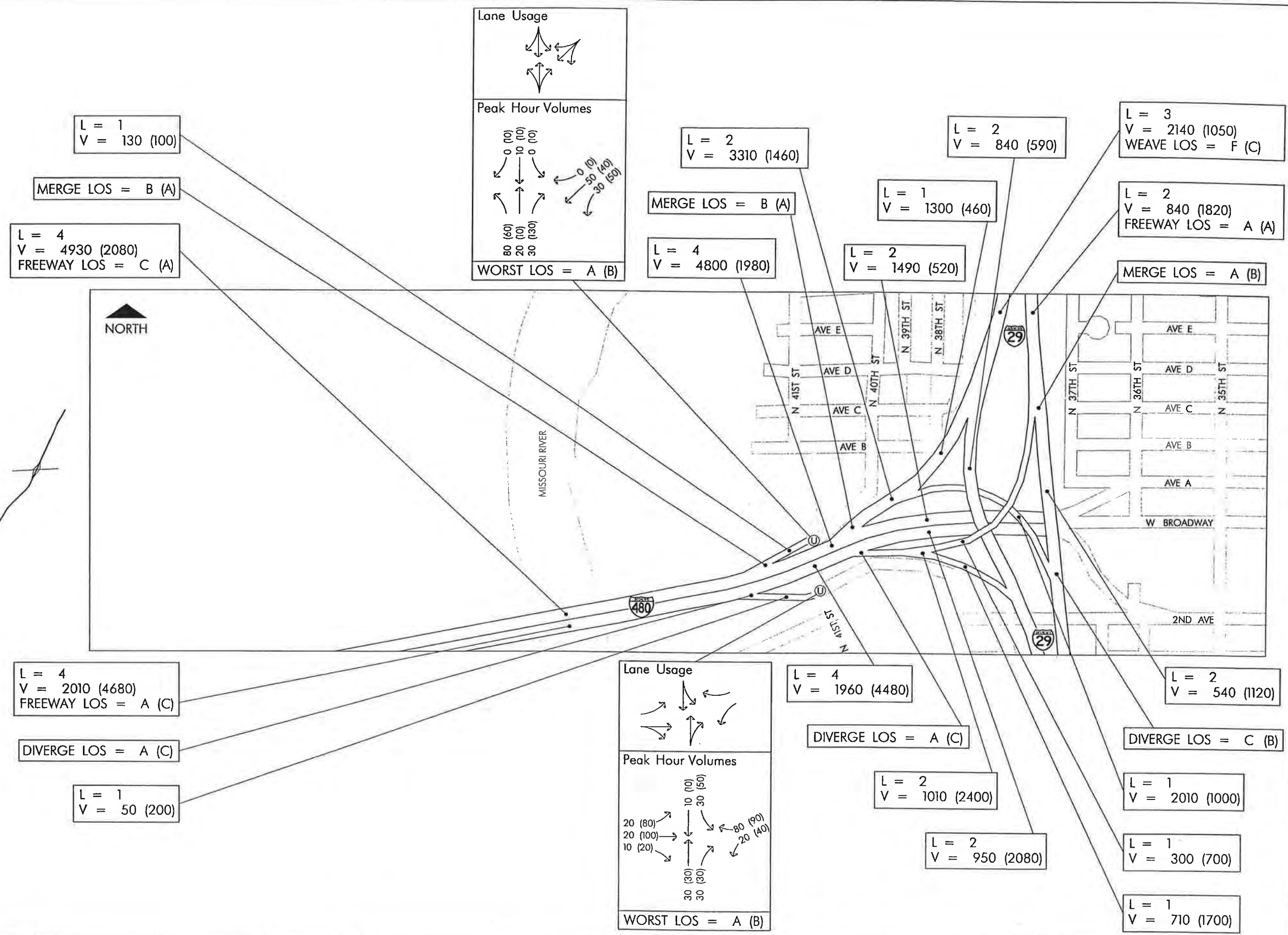
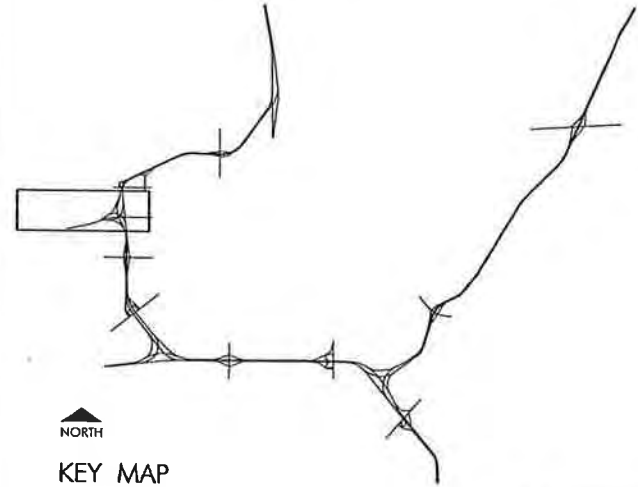
DIVERGE LOS = C (C)

L = 1  
V = 320 (350)

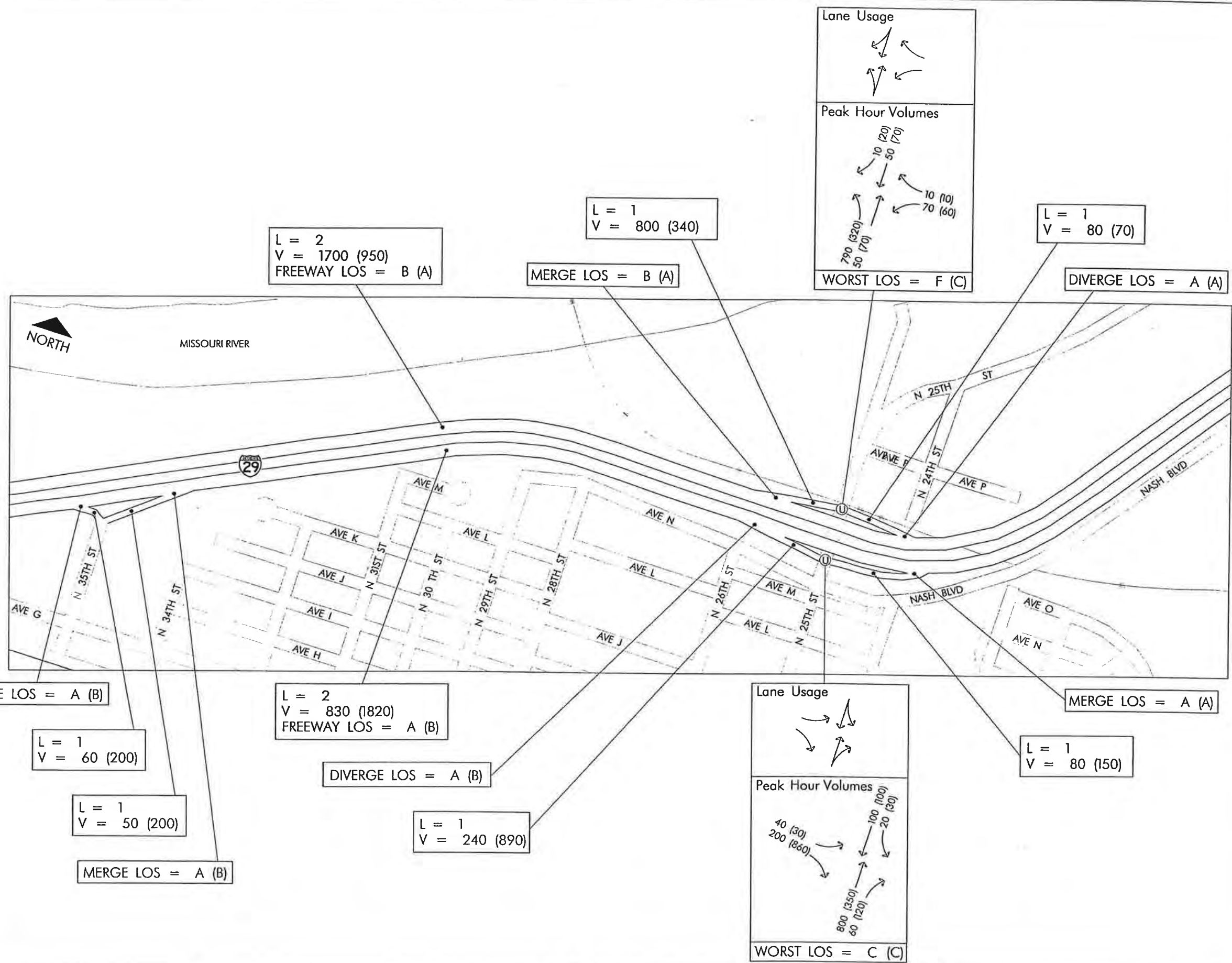
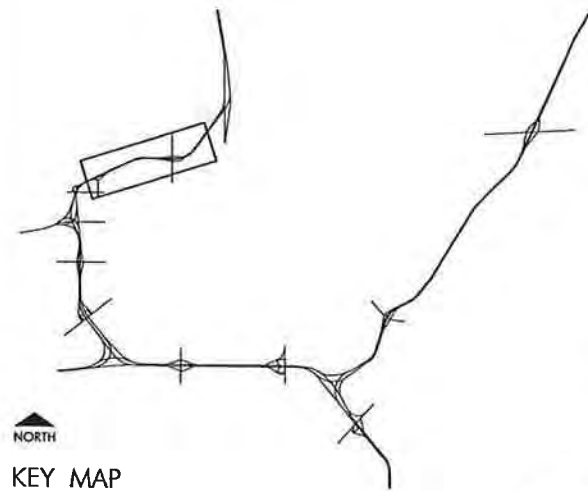




**LEGEND**  
 L NUMBER OF LANES  
 V PEAK HOUR VOLUMES  
 LOS LEVEL OF SERVICE  
 XXX (XXX) AM (PM)  
 INTERSECTION LANE USAGE  
 (U) UNSIGNALIZED INTERSECTION  
 (S) SIGNALIZED INTERSECTION



- LEGEND**
- L NUMBER OF LANES
  - V PEAK HOUR VOLUMES
  - LOS LEVEL OF SERVICE
  - xxx (xxx) AM (PM)
  - ↔ INTERSECTION LANE USAGE
  - ⊕ UNSIGNALIZED INTERSECTION
  - Ⓢ SIGNALIZED INTERSECTION



- LEGEND**
- L NUMBER OF LANES
  - V PEAK HOUR VOLUMES
  - LOS LEVEL OF SERVICE
  - xxx (xxx) AM (PM)
  - INTERSECTION LANE USAGE
  - ⊙ UNSIGNALIZED INTERSECTION
  - Ⓢ SIGNALIZED INTERSECTION

