Technical Memo

Date:	April 12, 2017
Project:	I-29 Exit 77 (41st Street) Interchange Modification Justification Report, Project # PL0100(84) 3616P, PCN 05MH
To:	Study Advisory Team
From:	Unruh, Laughlin
Subject:	Technical Memo 1 – 2016 Traffic Conditions

This memorandum provides the results of operations analysis for the year 2016 traffic conditions in the project study area (**Figure 1**). The analysis was prepared using the procedures and inputs specified in the Methods and Assumptions document for this study. Analysis output documents are provided in the appendix to this memorandum.

Traffic Volume Development:

Traffic counts and other data were gathered during Spring, 2016. Traffic cameras recorded intersection movements from March 9 to 13; subconsultant Gewalt, Hamilton Associates set up the cameras and compiled the count data. Count data was assembled and balanced to produce a representation of peak hour traffic flows through the study area. Peak hour traffic volumes are shown in **Figures 2, 3, and 5**. The volume development for this corridor study is consistent with the agreed upon procedures in the Methods and Assumptions document.

Traffic Operations:

Level of service on Interstate 29 was calculated for mainline, ramp merge-diverge, and weave areas for peak hours under 2016 conditions. The level of service results are shown in **Figure 5**. Note that several Interstate mainline segments were analyzed both as regular mainline segments and weaving segments. If it was determined that the segment satisfied the conditions for weaving, the weaving level of service was reported and indicated by an asterisk (*) next to the level of service result.

Intersection turning volumes and level of service for peak hours under the 2016 conditions are shown in **Figures 2 and 3**. Multimodal levels of service for the 26th Street and 41st Street arterial corridors are shown in **Figure 4**.

The 2016 conditions analysis shows that Interstate facilities within the study area operate at an acceptable condition, with all mainline, ramp merge/diverge, and weave sections operating at LOS C or better (see **Figure 5**).

The arterial street system, however, experiences peak hour congestion at the following locations (defined as LOS C for arterial street/interstate ramp terminals and LOS D for City street intersections):

- 26th Street/I-29 SB (Saturday peak)
- 26th Street/I-29 NB (AM peak)

Certain movements experienced low levels of service or queues that exceeded the length of the available storage during particular peak hours. The eastbound left turn at 41st Street/I-29 NB is an example of this characteristic, with the left turn queue extending through the 41st Street/I-29 SB intersection during the AM peak. Intersections operating with this condition are identified with LOS F* on the traffic operations figures.

Multimodal level of service varies widely throughout the 26th Street and 41st Street corridors. The lowest levels of service are related to locations with the absence of specific facilities for pedestrians and bicyclists in these corridors.

There are several stop-controlled intersections in the study area that are anticipated to play a role in future improvement alternatives. Those intersections are listed below along with peak hour stopped-approach level of service information:

- 38th Street/Carolyn Avenue: currently an uncontrolled intersection – no level of service analysis available.
- 38th Street/Shirley Avenue: AM-B, PM-D, SAT-D

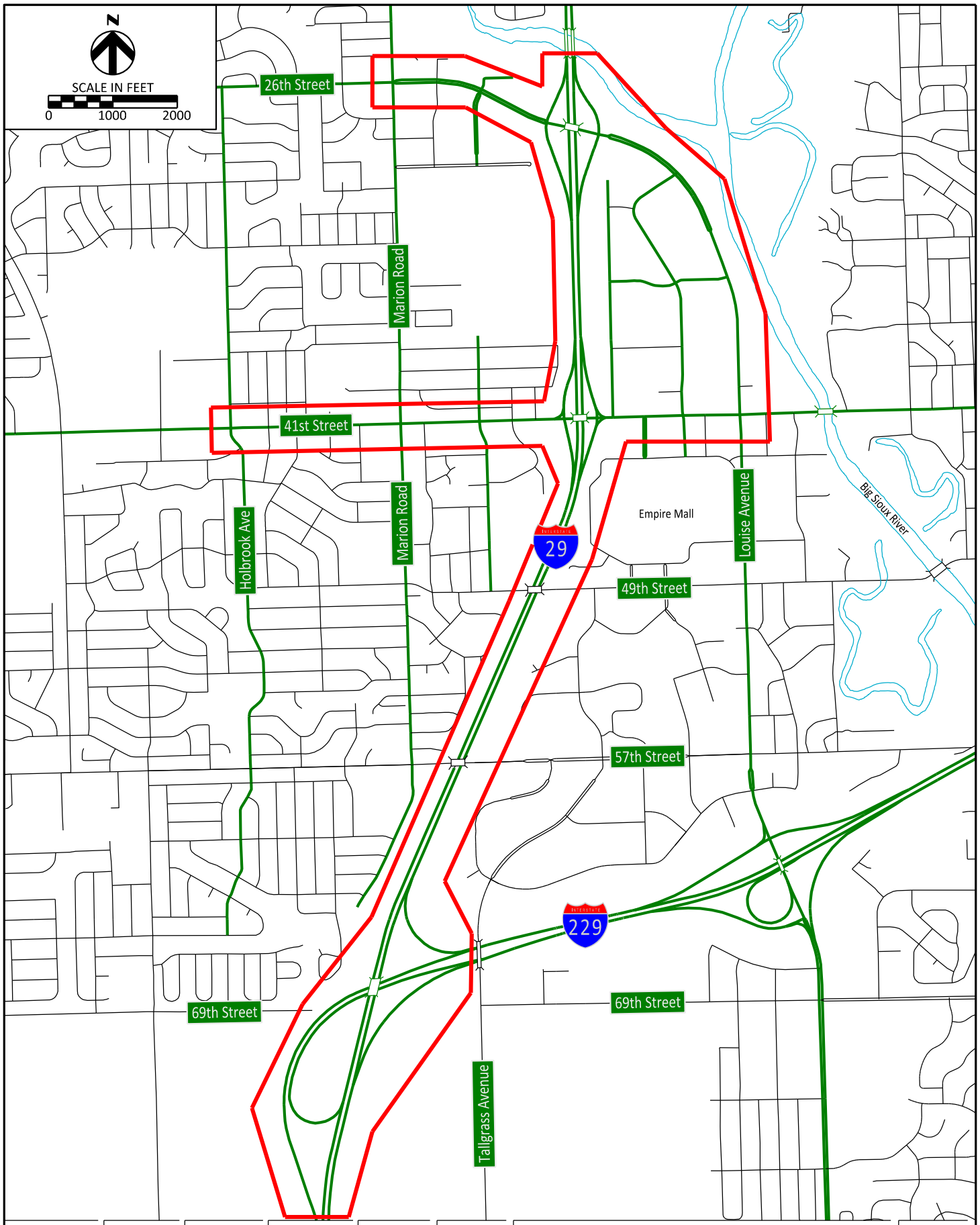
Special Note on Traffic Operations Analysis Methodology

The capacity analysis conducted for this study uses the Highway Capacity Manual 2010 HCS procedures and Highway Capacity Software (HCS), as directed by the Federal Highway Administration. These procedures produce results that may vary significantly from the procedures used in previous studies for arterial street analysis (SYNCHRO software and HCS 2000 analysis).

In particular, differences were noted for left turn movements at signalized intersections. For instance, previous analysis (2012 Corridor Study) for the existing AM peak hour at 41st Street/I-29 NB showed LOS E for the eastbound left turn movement, with movement delay estimated at 63 seconds. This level of service matches closely to traffic observations at that location.

The HCS 2010 analysis, however, estimates that the AM capacity of the eastbound left turn movement is 850 vehicles per hour, with a level of service of B and a movement delay of 19 seconds. This does not appear to provide an accurate representation of real-world traffic conditions.

For this reason, SYNCHRO results have also been reported at selected intersections to provide a comparison to the 2010 HCS analysis. For year 2016 traffic conditions, the SYNCHRO results were similar to the HCS 2010 results (see **Figures 2 and 3**). The slightly lower 2016 traffic volumes on 41st Street are the main reason for the better LOS than was calculated for the 2012 traffic volumes in the 2012 Corridor Study. The dual traffic analysis methodology does appear to verify that the lower 2016 traffic volumes result in better LOS.

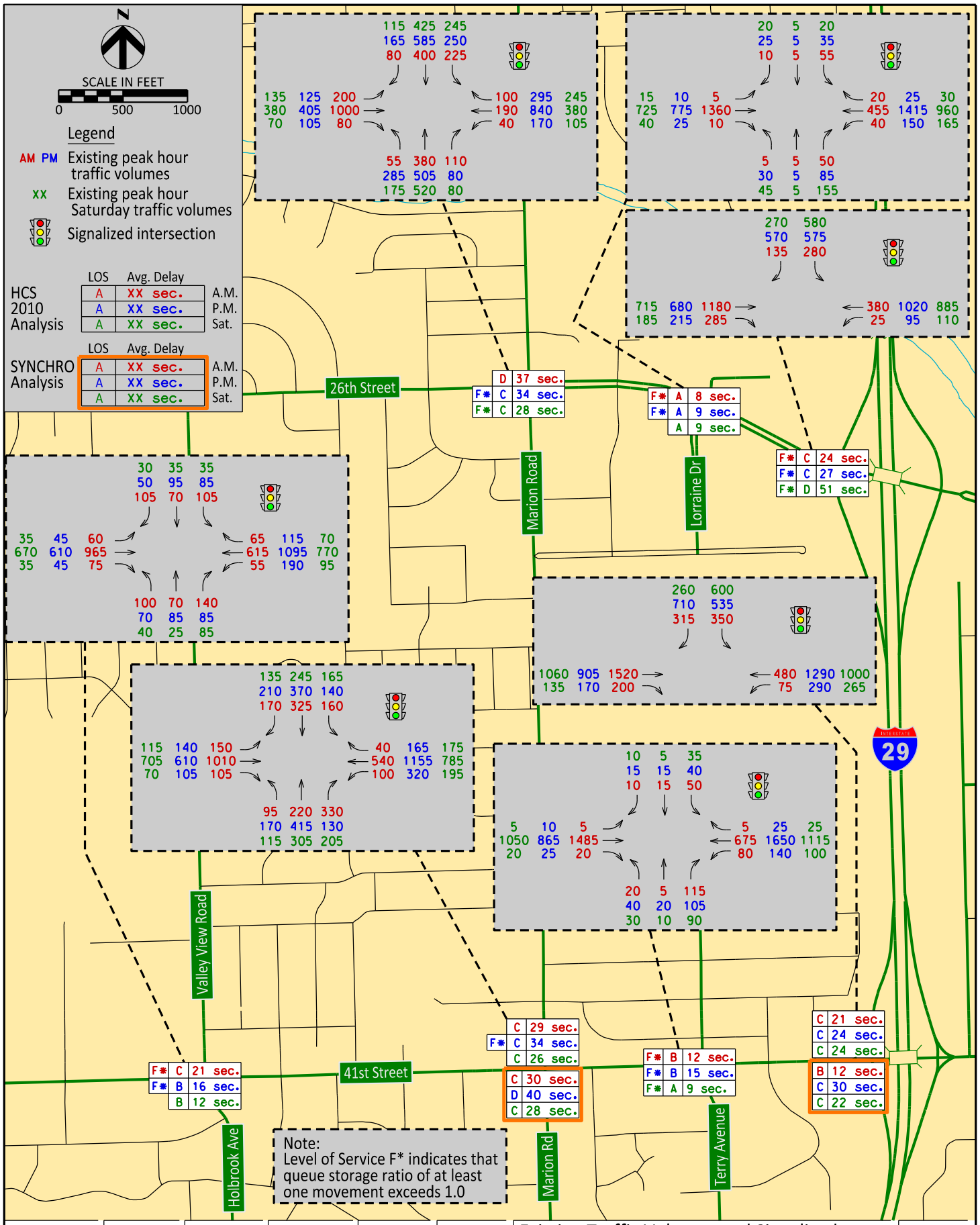


Drawn By: B.Miller
Date: 6/30/16
Chked By: J.Unruh
Date: 6/30/16
Revision:

Study Area

I-29 Exit 77 (41st Street) Interchange Modification Study
Sioux Falls, SD

Figure
1

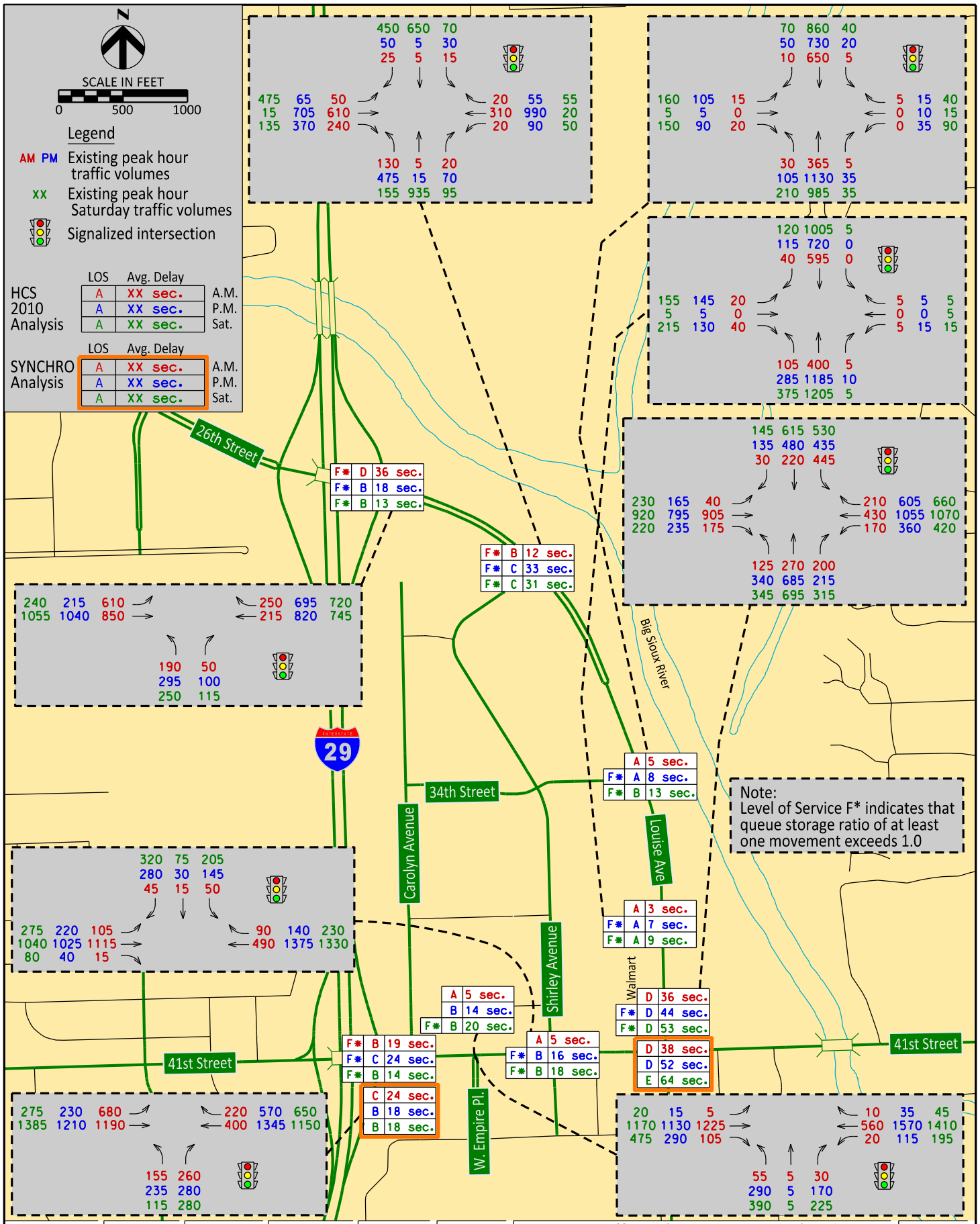


Drawn By: B.Miller
Date: 6/17/16
Chked By: J.Unruh
Date: 6/17/16
Revision: 12/15/16

Existing Traffic Volumes and Signalized Intersection Level of Service (west of I-29)

I-29 Exit 77 (41st Street) Interchange Modification Study
Sioux Falls, SD

Figure 2

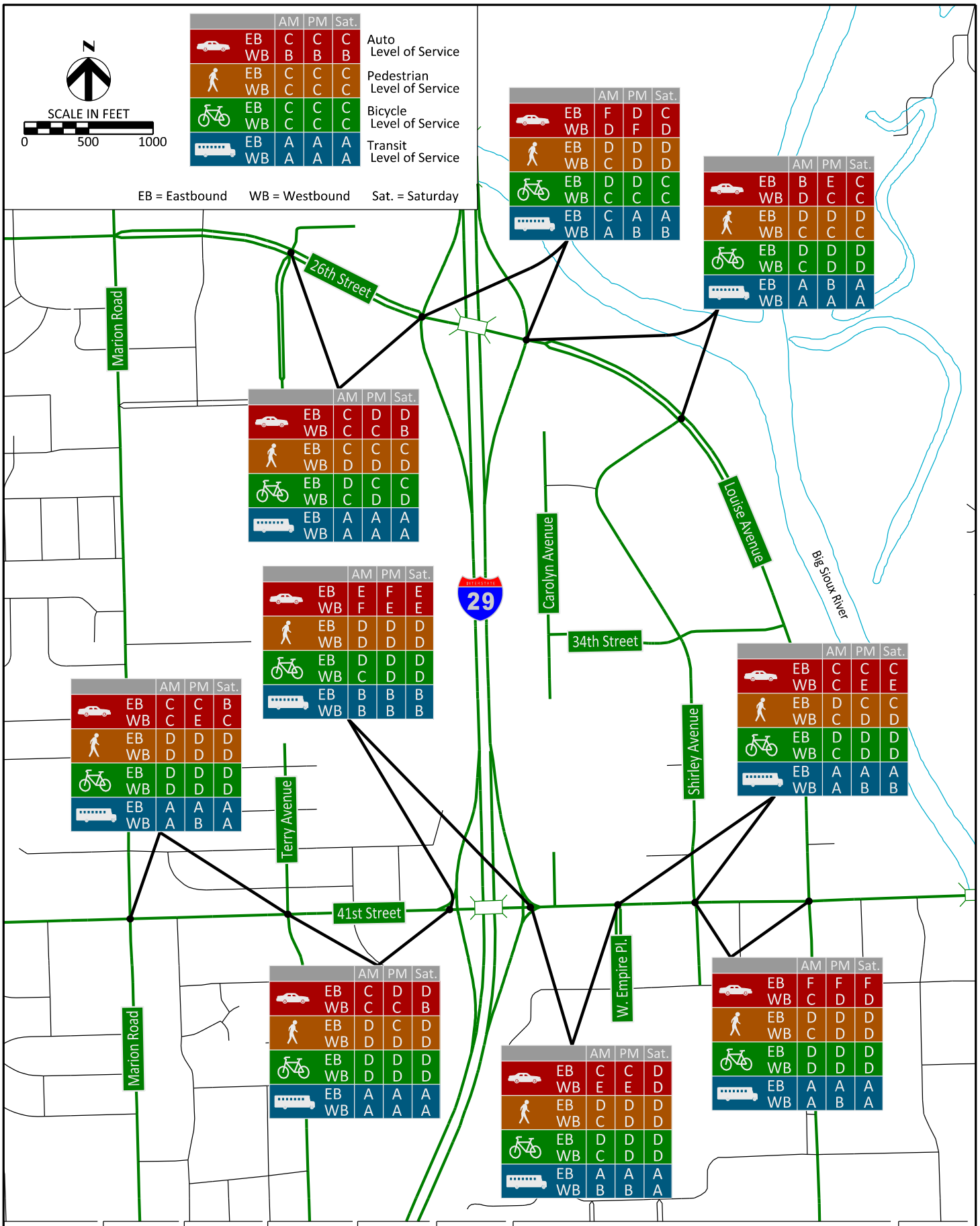


Drawn By: B.Miller
Date: 6/17/16
Chked By: J.Unruh
Date: 6/17/16
Revision: 12/15/16

Existing Traffic Volumes and Signalized Intersection Level of Service (east of I-29)

I-29 Exit 77 (41st Street) Interchange Modification Study
Sioux Falls, SD

Figure 3



Drawn By: B.Miller
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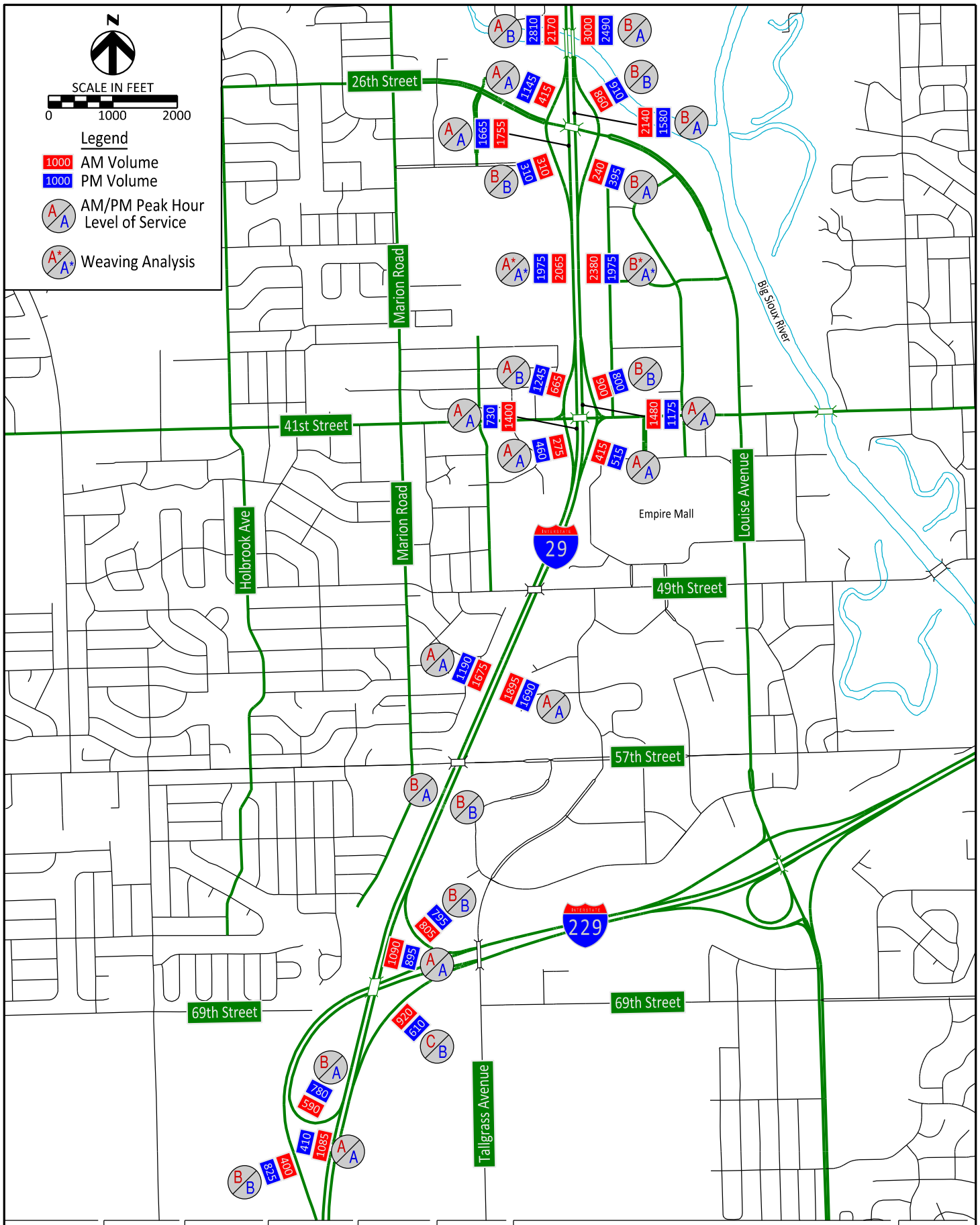
Date: 6/17/16
Revision:

Existing Multimodal Peak Hour Level of Service

I-29 Exit 77 (41st Street) Interchange Modification Study
Sioux Falls, SD

Figure 4



Drawn By: B.Miller
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Date: 6/17/16
Revision:

Existing Peak Hour Balanced Traffic Volumes and I-29 Level of Service

I-29 Exit 77 (41st Street) Interchange Modification Study
Sioux Falls, SD

Figure 5

APPENDICES

I. Freeway Analysis – Mainline

II. Freeway Analysis – Ramps

III. Freeway Analysis – Weaving

IV. Arterial Analysis

I. Freeway Analysis – Mainline

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*RL*	Highway/Direction of Travel	*I-29 SB*
Agency or Company	*HDR*	From/To	*12TH/26TH*
Date Performed	*6/1/2016*	Jurisdiction	*CITY OF SIOUX FALLS*
Analysis Time Period	*AM PEAK*	Analysis Year	*2016*

Project Description *I-29 EXIT 77 (41ST ST.) IMJR*

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

Flow Inputs

Volume, V	*2170*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*4*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*69.0*	mph	FFS	*69.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*630*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*70.0*	mph	S	mph
D = v_p / S	*9.0*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*A*		Required Number of Lanes, N	

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*RL*	Highway/Direction of Travel	*I-29 SB*
Agency or Company	*HDR*	From/To	*26TH OFF/26TH ON*
Date Performed	*6/1/2016*	Jurisdiction	*CITY OF SIOUX FALLS*
Analysis Time Period	*AM PEAK*	Analysis Year	*2016*

Project Description *I-29 EXIT 77 (41ST ST.) IMJR*

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

Flow Inputs

Volume, V	*1755*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*69.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

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

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*679*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*9.7*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*RL*	Highway/Direction of Travel	*I-29 SB*
Agency or Company	*HDR*	From/To	*26TH/41ST*
Date Performed	*6/1/2016*	Jurisdiction	*CITY OF SIOUX FALLS*
Analysis Time Period	*AM PEAK*	Analysis Year	*2016*

Project Description *I-29 EXIT 77 (41ST ST.) IMJR*

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

Flow Inputs

Volume, V	*2065*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*9*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*4*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*69.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

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

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*599*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*8.6*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*RL*	Highway/Direction of Travel	*I-29 SB*
Agency or Company	*HDR*	From/To	*41ST OFF/41ST ON*
Date Performed	*6/1/2016*	Jurisdiction	*CITY OF SIOUX FALLS*
Analysis Time Period	*AM PEAK*	Analysis Year	*2016*

Project Description *I-29 EXIT 77 (41ST ST.) IMJR*

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

Flow Inputs

Volume, V	*1400*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*69.0*	mph	FFS	*69.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*542*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*70.0*	mph	S	mph
D = v_p / S	*7.7*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*A*		Required Number of Lanes, N	

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*RL*	Highway/Direction of Travel	*I-29 SB*
Agency or Company	*HDR*	From/To	*41ST OFF/41ST ON*
Date Performed	*6/1/2016*	Jurisdiction	*CITY OF SIOUX FALLS*
Analysis Time Period	*AM PEAK*	Analysis Year	*2016*

Project Description *I-29 EXIT 77 (41ST ST.) IMJR*

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

Flow Inputs

Volume, V	*1400*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*69.0*	mph	FFS	*69.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*542*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*70.0*	mph	S	mph
D = v_p / S	*7.7*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*A*		Required Number of Lanes, N	

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*RL*	Highway/Direction of Travel	*I-29 SB*
Agency or Company	*HDR*	From/To	*41ST/I-229*
Date Performed	*6/1/2016*	Jurisdiction	*CITY OF SIOUX FALLS*
Analysis Time Period	*AM PEAK*	Analysis Year	*2016*

Project Description *I-29 EXIT 77 (41ST ST.) IMJR*

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

Flow Inputs

Volume, V	*1675*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*69.0*	mph	FFS	*69.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*648*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*70.0*	mph	S	mph
D = v_p / S	*9.3*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*A*		Required Number of Lanes, N	

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*RL*	Highway/Direction of Travel	*I-29 SB*
Agency or Company	*HDR*	From/To	*41ST/I-229*
Date Performed	*6/1/2016*	Jurisdiction	*CITY OF SIOUX FALLS*
Analysis Time Period	*AM PEAK*	Analysis Year	*2016*

Project Description *I-29 EXIT 77 (41ST ST.) IMJR*

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

Flow Inputs

Volume, V	*1675*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

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

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*972*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*70.0*	mph	S	mph
D = v_p / S	*13.9*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*B*		Required Number of Lanes, N	

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*RL*	Highway/Direction of Travel	*I-29 SB*
Agency or Company	*HDR*	From/To	*I229 OFF/I229 ON*
Date Performed	*6/1/2016*	Jurisdiction	*CITY OF SIOUX FALLS*
Analysis Time Period	*AM PEAK*	Analysis Year	*2016*

Project Description *I-29 EXIT 77 (41ST ST.) IMJR*

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

Flow Inputs

Volume, V	*1085*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

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

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*630*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*70.0*	mph	S	mph
D = v_p / S	*9.0*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*A*		Required Number of Lanes, N	

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*RL*	Highway/Direction of Travel	*I-29 NB*
Agency or Company	*HDR*	From/To	*I229 OFF/I229 ON*
Date Performed	*6/1/2016*	Jurisdiction	*CITY OF SIOUX FALLS*
Analysis Time Period	*AM PEAK*	Analysis Year	*2016*

Project Description *I-29 EXIT 77 (41ST ST.) IMJR*

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

Flow Inputs

Volume, V	*1090*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

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

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*633*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*70.0*	mph	S	mph
D = v_p / S	*9.0*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*A*		Required Number of Lanes, N	

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*RL*	Highway/Direction of Travel	*I-29 NB*
Agency or Company	*HDR*	From/To	*I229/41ST*
Date Performed	*6/1/2016*	Jurisdiction	*CITY OF SIOUX FALLS*
Analysis Time Period	*AM PEAK*	Analysis Year	*2016*

Project Description *I-29 EXIT 77 (41ST ST.) IMJR*

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

Flow Inputs

Volume, V	*1895*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

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

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1100*	pc/h/ln	Design LOS	
S	*70.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
D = v_p / S	*15.7*	pc/mi/ln	S	mph
LOS	*B*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*RL*	Highway/Direction of Travel	*I-29 NB*
Agency or Company	*HDR*	From/To	*I229/41ST*
Date Performed	*6/1/2016*	Jurisdiction	*CITY OF SIOUX FALLS*
Analysis Time Period	*AM PEAK*	Analysis Year	*2016*

Project Description *I-29 EXIT 77 (41ST ST.) IMJR*

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

Flow Inputs

Volume, V	*1895*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*9*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*69.0*	mph	FFS	*69.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*733*	pc/h/ln	Design LOS	
S	*70.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
D = v_p / S	*10.5*	pc/mi/ln	S	mph
LOS	*A*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*RL*	Highway/Direction of Travel	*I-29 NB*
Agency or Company	*HDR*	From/To	*41ST OFF/41ST ON*
Date Performed	*6/1/2016*	Jurisdiction	*CITY OF SIOUX FALLS*
Analysis Time Period	*AM PEAK*	Analysis Year	*2016*

Project Description *I-29 EXIT 77 (41ST ST.) IMJR*

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

Flow Inputs

Volume, V	*1480*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*69.0*	mph	FFS	*69.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*573*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*70.0*	mph	S	mph
D = v_p / S	*8.2*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*A*		Required Number of Lanes, N	

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*RL*	Highway/Direction of Travel	*I-29 NB*
Agency or Company	*HDR*	From/To	*41ST/26TH*
Date Performed	*6/1/2016*	Jurisdiction	*CITY OF SIOUX FALLS*
Analysis Time Period	*AM PEAK*	Analysis Year	*2016*

Project Description *I-29 EXIT 77 (41ST ST.) IMJR*

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

Flow Inputs

Volume, V	*2380*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*4*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*69.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

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

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*691*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*9.9*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*RL*	Highway/Direction of Travel	*I-29 NB*
Agency or Company	*HDR*	From/To	*26TH OFF/26TH ON*
Date Performed	*6/1/2016*	Jurisdiction	*CITY OF SIOUX FALLS*
Analysis Time Period	*AM PEAK*	Analysis Year	*2016*

Project Description *I-29 EXIT 77 (41ST ST.) IMJR*

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

Flow Inputs

Volume, V	*2140*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*69.0*	mph	FFS	*69.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*828*	pc/h/ln	Design LOS	
S	*70.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
D = v_p / S	*11.8*	pc/mi/ln	S	mph
LOS	*B*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*RL*	Highway/Direction of Travel	*I-29 NB*
Agency or Company	*HDR*	From/To	*26TH/12TH*
Date Performed	*6/1/2016*	Jurisdiction	*CITY OF SIOUX FALLS*
Analysis Time Period	*AM PEAK*	Analysis Year	*2016*

Project Description *I-29 EXIT 77 (41ST ST.) IMJR*

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

Flow Inputs

Volume, V	*3000*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*4*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*69.0*	mph	FFS	*69.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*871*	pc/h/ln	Design LOS	
S	*70.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
D = v_p / S	*12.4*	pc/mi/ln	S	mph
LOS	*B*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*RL*	Highway/Direction of Travel	*I-29 SB*
Agency or Company	*HDR*	From/To	*12TH/26TH*
Date Performed	*6/1/2016*	Jurisdiction	*CITY OF SIOUX FALLS*
Analysis Time Period	*PM PEAK*	Analysis Year	*2016*

Project Description *I-29 EXIT 77 (41ST ST.) IMJR*

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

Flow Inputs

Volume, V	*2810*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*4*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*69.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

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

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*816*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*11.7*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*RL*	Highway/Direction of Travel	*I-29 SB*
Agency or Company	*HDR*	From/To	*26TH OFF/26TH ON*
Date Performed	*6/1/2016*	Jurisdiction	*CITY OF SIOUX FALLS*
Analysis Time Period	*PM PEAK*	Analysis Year	*2016*

Project Description *I-29 EXIT 77 (41ST ST.) IMJR*

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

Flow Inputs

Volume, V	*1665*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*69.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

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

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*644*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*9.2*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*RL*	Highway/Direction of Travel	*I-29 SB*
Agency or Company	*HDR*	From/To	*26TH/41ST*
Date Performed	*6/1/2016*	Jurisdiction	*CITY OF SIOUX FALLS*
Analysis Time Period	*PM PEAK*	Analysis Year	*2016*

Project Description *I-29 EXIT 77 (41ST ST.) IMJR*

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

Flow Inputs

Volume, V	*1975*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*4*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*69.0*	mph	FFS	*69.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*573*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*70.0*	mph	S	mph
D = v_p / S	*8.2*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*A*		Required Number of Lanes, N	

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*RL*	Highway/Direction of Travel	*I-29 SB*
Agency or Company	*HDR*	From/To	*41ST OFF/41ST ON*
Date Performed	*6/1/2016*	Jurisdiction	*CITY OF SIOUX FALLS*
Analysis Time Period	*PM PEAK*	Analysis Year	*2016*

Project Description *I-29 EXIT 77 (41ST ST.) IMJR*

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

Flow Inputs

Volume, V	*730*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*69.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

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

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*283*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*4.0*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*RL*	Highway/Direction of Travel	*I-29 SB*
Agency or Company	*HDR*	From/To	*41ST/I-229*
Date Performed	*6/1/2016*	Jurisdiction	*CITY OF SIOUX FALLS*
Analysis Time Period	*PM PEAK*	Analysis Year	*2016*

Project Description *I-29 EXIT 77 (41ST ST.) IMJR*

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

Flow Inputs

Volume, V	*1190*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*69.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

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

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*461*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*6.6*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*RL*	Highway/Direction of Travel	*I-29 SB*
Agency or Company	*HDR*	From/To	*41ST/I-229*
Date Performed	*6/1/2016*	Jurisdiction	*CITY OF SIOUX FALLS*
Analysis Time Period	*PM PEAK*	Analysis Year	*2016*

Project Description *I-29 EXIT 77 (41ST ST.) IMJR*

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

Flow Inputs

Volume, V	*1190*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

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

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*691*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*70.0*	mph	S	mph
D = v_p / S	*9.9*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*A*		Required Number of Lanes, N	

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*RL*	Highway/Direction of Travel	*I-29 SB*
Agency or Company	*HDR*	From/To	*I229 OFF/I229 ON*
Date Performed	*6/1/2016*	Jurisdiction	*CITY OF SIOUX FALLS*
Analysis Time Period	*PM PEAK*	Analysis Year	*2016*

Project Description *I-29 EXIT 77 (41ST ST.) IMJR*

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

Flow Inputs

Volume, V	*410*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

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

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*238*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*70.0*	mph	S	mph
D = v_p / S	*3.4*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*A*		Required Number of Lanes, N	

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*RL*	Highway/Direction of Travel	*I-29 NB*
Agency or Company	*HDR*	From/To	*I229 OFF/I229 ON*
Date Performed	*6/1/2016*	Jurisdiction	*CITY OF SIOUX FALLS*
Analysis Time Period	*PM PEAK*	Analysis Year	*2016*

Project Description *I-29 EXIT 77 (41ST ST.) IMJR*

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

Flow Inputs

Volume, V	*895*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

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

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*520*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*70.0*	mph	S	mph
D = v_p / S	*7.4*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*A*		Required Number of Lanes, N	

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*RL*	Highway/Direction of Travel	*I-29 NB*
Agency or Company	*HDR*	From/To	*I229/41ST*
Date Performed	*6/1/2016*	Jurisdiction	*CITY OF SIOUX FALLS*
Analysis Time Period	*PM PEAK*	Analysis Year	*2016*

Project Description *I-29 EXIT 77 (41ST ST.) IMJR*

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

Flow Inputs

Volume, V	*1690*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

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

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*981*	pc/h/ln	Design LOS	
S	*70.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
D = v_p / S	*14.0*	pc/mi/ln	S	mph
LOS	*B*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*RL*	Highway/Direction of Travel	*I-29 NB*
Agency or Company	*HDR*	From/To	*I229/41ST*
Date Performed	*6/1/2016*	Jurisdiction	*CITY OF SIOUX FALLS*
Analysis Time Period	*PM PEAK*	Analysis Year	*2016*

Project Description *I-29 EXIT 77 (41ST ST.) IMJR*

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

Flow Inputs

Volume, V	*1690*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*69.0*	mph	FFS	*69.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*654*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*70.0*	mph	S	mph
D = v_p / S	*9.3*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*A*		Required Number of Lanes, N	

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*RL*	Highway/Direction of Travel	*I-29 NB*
Agency or Company	*HDR*	From/To	*41ST OFF/41ST ON*
Date Performed	*6/1/2016*	Jurisdiction	*CITY OF SIOUX FALLS*
Analysis Time Period	*PM PEAK*	Analysis Year	*2016*

Project Description *I-29 EXIT 77 (41ST ST.) IMJR*

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

Flow Inputs

Volume, V	*1175*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*69.0*	mph	FFS	*69.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*455*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*70.0*	mph	S	mph
D = v_p / S	*6.5*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*A*		Required Number of Lanes, N	

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*RL*	Highway/Direction of Travel	*I-29 NB*
Agency or Company	*HDR*	From/To	*41ST/26TH*
Date Performed	*6/1/2016*	Jurisdiction	*CITY OF SIOUX FALLS*
Analysis Time Period	*PM PEAK*	Analysis Year	*2016*

Project Description *I-29 EXIT 77 (41ST ST.) IMJR*

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

Flow Inputs

Volume, V	*1975*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*4*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*69.0*	mph	FFS	*69.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*573*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*70.0*	mph	S	mph
D = v_p / S	*8.2*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*A*		Required Number of Lanes, N	

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*RL*	Highway/Direction of Travel	*I-29 NB*
Agency or Company	*HDR*	From/To	*26TH OFF/26TH ON*
Date Performed	*6/1/2016*	Jurisdiction	*CITY OF SIOUX FALLS*
Analysis Time Period	*PM PEAK*	Analysis Year	*2016*

Project Description *I-29 EXIT 77 (41ST ST.) IMJR*

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

Flow Inputs

Volume, V	*1580*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*69.0*	mph	FFS	*69.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*612*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*70.0*	mph	S	mph
D = v_p / S	*8.7*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*A*		Required Number of Lanes, N	

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*RL*	Highway/Direction of Travel	*I-29 NB*
Agency or Company	*HDR*	From/To	*26TH/12TH*
Date Performed	*6/1/2016*	Jurisdiction	*CITY OF SIOUX FALLS*
Analysis Time Period	*PM PEAK*	Analysis Year	*2016*

Project Description *I-29 EXIT 77 (41ST ST.) IMJR*

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

Flow Inputs

Volume, V	*2490*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*4*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*69.0*	mph	FFS	*69.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*723*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*70.0*	mph	S	mph
D = v_p / S	*10.3*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*A*		Required Number of Lanes, N	

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

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II. Freeway Analysis – Ramps

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	RL	Freeway/Dir of Travel	I-29 SB
Agency or Company	HDR	Junction	26TH STREET
Date Performed	6/1/2016	Jurisdiction	CITY OF SIOUX FALLS
Analysis Time Period	AM PEAK	Analysis Year	2016

Project Description I-29 EXIT 77 (41ST ST.) IMJR

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	4
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	1500
Freeway Volume, V_F	2170
Ramp Volume, V_R	415
Freeway Free-Flow Speed, S_{FF}	69.0
Ramp Free-Flow Speed, S_{FR}	45.0

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 2440 ft

V_D = 310 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2170	0.90	Level	9	0	0.957	1.00	2520
Ramp	415	0.90	Level	9	0	0.957	1.00	482
UpStream								
DownStream	310	0.90	Level	9	0	0.957	1.00	360

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.436 using Equation (Exhibit 13-7)

V_{12} = 1371 pc/h

V_3 or V_{av34} 574 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2520	Exhibit 13-8	9560	No
$V_{FO} = V_F - V_R$	2038	Exhibit 13-8	9560	No
V_R	482	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1371	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 2.5 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

D_s = 0.341 (Exhibit 13-12)

S_R= 59.8 mph (Exhibit 13-12)

S_0= 75.7 mph (Exhibit 13-12)

S = 66.1 mph (Exhibit 13-13)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	RL	Freeway/Dir of Travel	I-29 SB
Agency or Company	HDR	Junction	26TH STREET
Date Performed	6/1/2016	Jurisdiction	CITY OF SIOUX FALLS
Analysis Time Period	AM PEAK	Analysis Year	2016

Project Description I-29 EXIT 77 (41ST ST.) IMJR

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☑ Yes ☐ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☐ No ☑ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = 2440 ft	Acceleration Lane Length, L_A: 870	L_{down} = ft
V_u = 415 veh/h	Deceleration Lane Length L_D	V_D = veh/h
	Freeway Volume, V_F: 1755	
	Ramp Volume, V_R: 310	
	Freeway Free-Flow Speed, S_{FF}: 69.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1755	0.90	Level	9	0	0.957	1.00	2038
Ramp	310	0.90	Level	9	0	0.957	1.00	360
UpStream	415	0.90	Level	9	0	0.957	1.00	482
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = 850.85 (Equation 13-6 or 13-7)

P_{FM} = 0.602 using Equation (Exhibit 13-6)

V_{12} = 1227 pc/h

V_3 or V_{av34} 811 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2398	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1587	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 12.2 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.262 (Exibit 13-11)

S_R= 61.9 mph (Exhibit 13-11)

S_0= 67.9 mph (Exhibit 13-11)

S = 63.8 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	RL	Freeway/Dir of Travel	I-29 SB
Agency or Company	HDR	Junction	41ST STREET
Date Performed	6/1/2016	Jurisdiction	CITY OF SIOUX FALLS
Analysis Time Period	AM PEAK	Analysis Year	2016

Project Description I-29 EXIT 77 (41ST ST) IMJR

Inputs

Upstream Adj Ramp
- ☐ Yes ☐ On
- ☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	4
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	870
Freeway Volume, V_F	2065
Ramp Volume, V_R	665
Freeway Free-Flow Speed, S_{FF}	69.0
Ramp Free-Flow Speed, S_{FR}	45.0

Downstream Adj Ramp
- ☑ Yes ☑ On
- ☐ No ☐ Off

L_{down} = 2540 ft

V_D = 275 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2065	0.90	Level	9	0	0.957	1.00	2398
Ramp	665	0.90	Level	9	0	0.957	1.00	772
UpStream								
DownStream	275	0.90	Level	9	0	0.957	1.00	319

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.436 using Equation (Exhibit 13-7)

V_{12} = 1481 pc/h

V_3 or V_{av34} 458 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2398	Exhibit 13-8	9560	No
$V_{FO} = V_F - V_R$	1626	Exhibit 13-8	9560	No
V_R	772	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1481	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 9.2 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

D_s = 0.367 (Exhibit 13-12)

S_R= 59.1 mph (Exhibit 13-12)

S_0= 75.7 mph (Exhibit 13-12)

S = 64.5 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	RL	Freeway/Dir of Travel	I-29 SB
Agency or Company	HDR	Junction	41ST STREET
Date Performed	6/1/2016	Jurisdiction	CITY OF SIOUX FALLS
Analysis Time Period	AM PEAK	Analysis Year	2016

Project Description I-29 EXIT 77 (41ST ST) IMJR

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	3	Downstream Adj Ramp
☑ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes ☐ On
☐ No	☑ Off	Acceleration Lane Length, L_A	1500	☑ No ☐ Off
L_{up} =	2540 ft	Deceleration Lane Length L_D		L_{down} = ft
V_u =	665 veh/h	Freeway Volume, V_F	1400	V_D = veh/h
		Ramp Volume, V_R	275	
		Freeway Free-Flow Speed, S_{FF}	69.0	
		Ramp Free-Flow Speed, S_{FR}	45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1400	0.90	Level	9	0	0.957	1.00	1626
Ramp	275	0.90	Level	9	0	0.957	1.00	319
UpStream	665	0.90	Level	9	0	0.957	1.00	772
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = 1033.63 (Equation 13-6 or 13-7)

P_{FM} = 0.619 using Equation (Exhibit 13-6)

V_{12} = 1007 pc/h

V_3 or V_{av34} 619 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☑ Yes ☐ No

If Yes, V_{12a} = 1007 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1945	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1326	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 6.3 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

M_S = 0.201 (Exibit 13-11)

S_R= 63.6 mph (Exhibit 13-11)

S_0= 68.6 mph (Exhibit 13-11)

S = 65.1 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	RL	Freeway/Dir of Travel	I-29 SB
Agency or Company	HDR	Junction	I-229
Date Performed	6/1/2016	Jurisdiction	CITY OF SIOUX FALLS
Analysis Time Period	AM PEAK	Analysis Year	2016

Project Description I-29 EXIT 77 (41ST ST) IMJR

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☑ Yes	☑ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☐ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	800	L_{down} =	2490 ft
V_u =	veh/h	Freeway Volume, V_F	1675	V_D =	400 veh/h
		Ramp Volume, V_R	590		
		Freeway Free-Flow Speed, S_{FF}	69.0		
		Ramp Free-Flow Speed, S_{FR}	45.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1675	0.90	Level	9	0	0.957	1.00	1945
Ramp	590	0.90	Level	9	0	0.957	1.00	685
UpStream								
DownStream	400	0.90	Level	9	0	0.957	1.00	464

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 1945 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1945	Exhibit 13-8	4780	No
$V_{FO} = V_F - V_R$	1260	Exhibit 13-8	4780	No
V_R	685	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1945	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 13.8 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.360 (Exhibit 13-12)

S_R= 59.3 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 59.3 mph (Exhibit 13-13)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	RL	Freeway/Dir of Travel	I-29 SB
Agency or Company	HDR	Junction	I-229
Date Performed	6/1/2016	Jurisdiction	CITY OF SIOUX FALLS
Analysis Time Period	AM PEAK	Analysis Year	2016

Project Description I-29 EXIT 77 (41ST ST) IMJR

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☑ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☐ No ☑ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = 2490 ft	Acceleration Lane Length, L_A: 800	L_{down} = ft
V_u = 590 veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 1085	
	Ramp Volume, V_R: 400	
	Freeway Free-Flow Speed, S_{FF}: 69.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1085	0.90	Level	9	0	0.957	1.00	1260
Ramp	400	0.90	Level	9	0	0.957	1.00	464
UpStream	590	0.90	Level	9	0	0.957	1.00	685
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1260 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1724	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1724	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 13.7 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.271 (Exibit 13-11)

S_R= 61.7 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 61.7 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	RL	Freeway/Dir of Travel	I-29 NB
Agency or Company	HDR	Junction	I-229
Date Performed	6/1/2016	Jurisdiction	CITY OF SIOUX FALLS
Analysis Time Period	AM PEAK	Analysis Year	2016

Project Description I-29 EXIT 77 (41ST ST) IMJR

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☑ Yes	☑ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☐ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	360	L_{down} =	3370 ft
V_u =	veh/h	Freeway Volume, V_F	2010	V_D =	805 veh/h
		Ramp Volume, V_R	920		
		Freeway Free-Flow Speed, S_{FF}	69.0		
		Ramp Free-Flow Speed, S_{FR}	45.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2010	0.90	Level	9	0	0.957	1.00	2334
Ramp	920	0.90	Level	9	0	0.957	1.00	1068
UpStream								
DownStream	805	0.90	Level	9	0	0.957	1.00	935

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 2334 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2334	Exhibit 13-8	4780	No
$V_{FO} = V_F - V_R$	1266	Exhibit 13-8	4780	No
V_R	1068	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2334	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 21.1 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.394 (Exhibit 13-12)

S_R= 58.4 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 58.4 mph (Exhibit 13-13)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	RL	Freeway/Dir of Travel	I-29 NB
Agency or Company	HDR	Junction	I-229
Date Performed	6/1/2016	Jurisdiction	CITY OF SIOUX FALLS
Analysis Time Period	AM PEAK	Analysis Year	2016

Project Description I-29 EXIT 77 (41ST ST) IMJR

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☑ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☐ No ☑ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = 3370 ft	Acceleration Lane Length, L_A: 1000	L_{down} = ft
V_u = 920 veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 1090	
	Ramp Volume, V_R: 805	
	Freeway Free-Flow Speed, S_{FF}: 69.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1090	0.90	Level	9	0	0.957	1.00	1266
Ramp	805	0.90	Level	9	0	0.957	1.00	935
UpStream	920	0.90	Level	9	0	0.957	1.00	1068
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1266 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2201	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2201	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 15.9 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.266 (Exibit 13-11)

S_R= 61.8 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 61.8 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	RL	Freeway/Dir of Travel	I-29 NB
Agency or Company	HDR	Junction	41ST STREET
Date Performed	6/1/2016	Jurisdiction	CITY OF SIOUX FALLS
Analysis Time Period	AM PEAK	Analysis Year	2016

Project Description I-29 EXIT 77 (41ST ST) IMJR

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	1500
Freeway Volume, V_F	1895
Ramp Volume, V_R	415
Freeway Free-Flow Speed, S_{FF}	69.0
Ramp Free-Flow Speed, S_{FR}	45.0

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 2750 ft

V_D = 900 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1895	0.90	Level	9	0	0.957	1.00	2200
Ramp	415	0.90	Level	9	0	0.957	1.00	482
UpStream								
DownStream	900	0.90	Level	9	0	0.957	1.00	1045

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = 0.00 (Equation 13-12 or 13-13)

P_{FD} = 0.683 using Equation (Exhibit 13-7)

V_{12} = 1655 pc/h

V_3 or V_{av34} 545 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2200	Exhibit 13-8	7170	No
$V_{FO} = V_F - V_R$	1718	Exhibit 13-8	7170	No
V_R	482	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1655	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 5.0 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

D_s = 0.341 (Exhibit 13-12)

S_R= 59.8 mph (Exhibit 13-12)

S_0= 75.7 mph (Exhibit 13-12)

S = 63.1 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	RL	Freeway/Dir of Travel	I-29 NB
Agency or Company	HDR	Junction	41ST STREET
Date Performed	6/1/2016	Jurisdiction	CITY OF SIOUX FALLS
Analysis Time Period	AM PEAK	Analysis Year	2016

Project Description I-29 EXIT 77 (41ST ST) IMJR

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	3	Downstream Adj Ramp
☑ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes ☐ On
☐ No	☑ Off	Acceleration Lane Length, L_A	655	☑ No ☐ Off
L_{up} =	2750 ft	Deceleration Lane Length L_D		L_{down} = ft
V_u =	415 veh/h	Freeway Volume, V_F	1480	V_D = veh/h
		Ramp Volume, V_R	900	
		Freeway Free-Flow Speed, S_{FF}	69.0	
		Ramp Free-Flow Speed, S_{FR}	45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1480	0.90	Level	9	0	0.957	1.00	1718
Ramp	900	0.90	Level	9	0	0.957	1.00	1045
UpStream	415	0.90	Level	9	0	0.957	1.00	482
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = 833.50 (Equation 13-6 or 13-7)

P_{FM} = 0.596 using Equation (Exhibit 13-6)

V_{12} = 1024 pc/h

V_3 or V_{av34} 694 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☑ Yes ☐ No

If Yes, V_{12a} = 1024 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2763	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2069	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 17.0 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.293 (Exibit 13-11)

S_R= 61.1 mph (Exhibit 13-11)

S_0= 68.3 mph (Exhibit 13-11)

S = 62.8 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	RL	Freeway/Dir of Travel	I-29 NB
Agency or Company	HDR	Junction	26TH STREET
Date Performed	6/1/2016	Jurisdiction	CITY OF SIOUX FALLS
Analysis Time Period	AM PEAK	Analysis Year	2016

Project Description I-29 EXIT 77 (41ST ST) IMJR

Inputs

Upstream Adj Ramp
- ☐ Yes ☐ On
- ☑ No ☐ Off
- L_{up} = ft
- V_u = veh/h

Freeway Number of Lanes, N	4
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	655
Freeway Volume, V_F	2380
Ramp Volume, V_R	240
Freeway Free-Flow Speed, S_{FF}	69.0
Ramp Free-Flow Speed, S_{FR}	45.0

Downstream Adj Ramp
- ☑ Yes ☑ On
- ☐ No ☐ Off
- L_{down} = 2320 ft
- V_D = 860 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2380	0.90	Level	9	0	0.957	1.00	2763
Ramp	240	0.90	Level	9	0	0.957	1.00	279
UpStream								
DownStream	860	0.90	Level	9	0	0.957	1.00	999

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.436 using Equation (Exhibit 13-7)

V_{12} = 1362 pc/h

V_3 or V_{av34} 700 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2763	Exhibit 13-8	9560	No
$V_{FO} = V_F - V_R$	2484	Exhibit 13-8	9560	No
V_R	279	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1362	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 10.1 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.323 (Exhibit 13-12)

S_R= 60.3 mph (Exhibit 13-12)

S_0= 75.7 mph (Exhibit 13-12)

S = 67.2 mph (Exhibit 13-13)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	RL	Freeway/Dir of Travel	I-29 NB
Agency or Company	HDR	Junction	26TH STREET
Date Performed	6/1/2016	Jurisdiction	CITY OF SIOUX FALLS
Analysis Time Period	AM PEAK	Analysis Year	2016

Project Description I-29 EXIT 77 (41ST ST) IMJR

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	3	Downstream Adj Ramp
☑ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes ☐ On
☐ No	☑ Off	Acceleration Lane Length, L_A	1500	☑ No ☐ Off
L_{up} =	2320 ft	Deceleration Lane Length L_D		L_{down} = ft
V_u =	415 veh/h	Freeway Volume, V_F	2140	V_D = veh/h
		Ramp Volume, V_R	860	
		Freeway Free-Flow Speed, S_{FF}	69.0	
		Ramp Free-Flow Speed, S_{FR}	45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2140	0.90	Level	9	0	0.957	1.00	2485
Ramp	860	0.90	Level	9	0	0.957	1.00	999
UpStream	415	0.90	Level	9	0	0.957	1.00	482
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = 1362.98 (Equation 13-6 or 13-7)

P_{FM} = 0.619 using Equation (Exhibit 13-6)

V_{12} = 1539 pc/h

V_3 or V_{av34} 946 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☑ Yes ☐ No

If Yes, V_{12a} = 1539 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3484	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2538	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 15.4 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.235 (Exibit 13-11)

S_R= 62.6 mph (Exhibit 13-11)

S_0= 67.4 mph (Exhibit 13-11)

S = 63.9 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	RL	Freeway/Dir of Travel	I-29 SB
Agency or Company	HDR	Junction	26TH STREET
Date Performed	6/1/2016	Jurisdiction	CITY OF SIOUX FALLS
Analysis Time Period	PM PEAK	Analysis Year	2016

Project Description I-29 EXIT 77 (41ST ST.) IMJR

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	4
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	1500
Freeway Volume, V_F	2810
Ramp Volume, V_R	1145
Freeway Free-Flow Speed, S_{FF}	69.0
Ramp Free-Flow Speed, S_{FR}	45.0

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 2440 ft

V_D = 310 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2810	0.90	Level	9	0	0.957	1.00	3263
Ramp	1145	0.90	Level	9	0	0.957	1.00	1329
UpStream								
DownStream	310	0.90	Level	9	0	0.957	1.00	360

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.436 using Equation (Exhibit 13-7)

V_{12} = 2172 pc/h

V_3 or V_{av34} 545 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3263	Exhibit 13-8	9560	No
$V_{FO} = V_F - V_R$	1934	Exhibit 13-8	9560	No
V_R	1329	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2172	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 9.4 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

D_s = 0.418 (Exhibit 13-12)

S_R= 57.7 mph (Exhibit 13-12)

S_0= 75.7 mph (Exhibit 13-12)

S = 62.7 mph (Exhibit 13-13)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	RL	Freeway/Dir of Travel	I-29 SB
Agency or Company	HDR	Junction	26TH STREET
Date Performed	6/1/2016	Jurisdiction	CITY OF SIOUX FALLS
Analysis Time Period	PM PEAK	Analysis Year	2016

Project Description I-29 EXIT 77 (41ST ST.) IMJR

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☑ Yes ☐ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☐ No ☑ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = 2440 ft	Acceleration Lane Length, L_A: 870	L_{down} = ft
V_u = 1145 veh/h	Deceleration Lane Length L_D	V_D = veh/h
	Freeway Volume, V_F: 1665	
	Ramp Volume, V_R: 310	
	Freeway Free-Flow Speed, S_{FF}: 69.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1665	0.90	Level	9	0	0.957	1.00	1933
Ramp	310	0.90	Level	9	0	0.957	1.00	360
UpStream	1145	0.90	Level	9	0	0.957	1.00	1329
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = 828.38 (Equation 13-6 or 13-7)

P_{FM} = 0.602 using Equation (Exhibit 13-6)

V_{12} = 1163 pc/h

V_3 or V_{av34} 770 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 1163 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2293	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1523	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 11.7 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.261 (Exibit 13-11)

S_R= 62.0 mph (Exhibit 13-11)

S_0= 68.0 mph (Exhibit 13-11)

S = 63.9 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	RL	Freeway/Dir of Travel	I-29 SB
Agency or Company	HDR	Junction	41ST STREET
Date Performed	6/1/2016	Jurisdiction	CITY OF SIOUX FALLS
Analysis Time Period	PM PEAK	Analysis Year	2016

Project Description I-29 EXIT 77 (41ST ST) IMJR

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	4
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	870
Freeway Volume, V_F	1975
Ramp Volume, V_R	1245
Freeway Free-Flow Speed, S_{FF}	69.0
Ramp Free-Flow Speed, S_{FR}	45.0

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 2540 ft

V_D = 460 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1975	0.90	Level	9	0	0.957	1.00	2293
Ramp	1245	0.90	Level	9	0	0.957	1.00	1446
UpStream								
DownStream	460	0.90	Level	9	0	0.957	1.00	534

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.436 using Equation (Exhibit 13-7)

V_{12} = 1815 pc/h

V_3 or V_{av34} 239 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2293	Exhibit 13-8	9560	No
$V_{FO} = V_F - V_R$	847	Exhibit 13-8	9560	No
V_R	1446	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1815	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 12.0 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.428 (Exhibit 13-12)

S_R= 57.4 mph (Exhibit 13-12)

S_0= 75.7 mph (Exhibit 13-12)

S = 60.5 mph (Exhibit 13-13)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	RL	Freeway/Dir of Travel	I-29 SB
Agency or Company	HDR	Junction	41ST STREET
Date Performed	6/1/2016	Jurisdiction	CITY OF SIOUX FALLS
Analysis Time Period	PM PEAK	Analysis Year	2016

Project Description I-29 EXIT 77 (41ST ST) IMJR

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☑ Yes ☐ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☐ No ☑ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = 2540 ft	Acceleration Lane Length, L_A: 1500	L_{down} = ft
V_u = 1245 veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 730	
	Ramp Volume, V_R: 460	
	Freeway Free-Flow Speed, S_{FF}: 69.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	730	0.90	Level	9	0	0.957	1.00	848
Ramp	460	0.90	Level	9	0	0.957	1.00	534
UpStream	1245	0.90	Level	9	0	0.957	1.00	1446
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = 913.15 (Equation 13-6 or 13-7)

P_{FM} = 0.619 using Equation (Exhibit 13-6)

V_{12} = 525 pc/h

V_3 or V_{av34} 323 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☑ Yes ☐ No

If Yes, V_{12a} = 525 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1382	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1059	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 4.1 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

M_S = 0.197 (Exibit 13-11)

S_R= 63.7 mph (Exhibit 13-11)

S_0= 69.0 mph (Exhibit 13-11)

S = 64.8 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	RL	Freeway/Dir of Travel	I-29 SB
Agency or Company	HDR	Junction	I-229
Date Performed	6/1/2016	Jurisdiction	CITY OF SIOUX FALLS
Analysis Time Period	PM PEAK	Analysis Year	2016

Project Description I-29 EXIT 77 (41ST ST) IMJR

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☑ Yes	☑ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☐ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	800	L_{down} =	2490 ft
V_u =	veh/h	Freeway Volume, V_F	1190	V_D =	825 veh/h
		Ramp Volume, V_R	780		
		Freeway Free-Flow Speed, S_{FF}	69.0		
		Ramp Free-Flow Speed, S_{FR}	45.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1190	0.90	Level	9	0	0.957	1.00	1382
Ramp	780	0.90	Level	9	0	0.957	1.00	906
UpStream								
DownStream	825	0.90	Level	9	0	0.957	1.00	958

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 1382 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1382	Exhibit 13-8	4780	No
$V_{FO} = V_F - V_R$	476	Exhibit 13-8	4780	No
V_R	906	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1382	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 8.9 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

D_s = 0.380 (Exhibit 13-12)

S_R= 58.8 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 58.8 mph (Exhibit 13-13)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	RL	Freeway/Dir of Travel	I-29 SB
Agency or Company	HDR	Junction	I-229
Date Performed	6/1/2016	Jurisdiction	CITY OF SIOUX FALLS
Analysis Time Period	PM PEAK	Analysis Year	2016

Project Description I-29 EXIT 77 (41ST ST) IMJR

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☑ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☐ No ☑ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = 2490 ft	Acceleration Lane Length, L_A: 800	L_{down} = ft
V_u = 780 veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 410	
	Ramp Volume, V_R: 825	
	Freeway Free-Flow Speed, S_{FF}: 69.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	410	0.90	Level	9	0	0.957	1.00	476
Ramp	825	0.90	Level	9	0	0.957	1.00	958
UpStream	780	0.90	Level	9	0	0.957	1.00	906
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 476 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1434	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1434	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 11.2 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.265 (Exibit 13-11)

S_R= 61.8 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 61.8 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	RL	Freeway/Dir of Travel	I-29 NB
Agency or Company	HDR	Junction	I-229
Date Performed	6/1/2016	Jurisdiction	CITY OF SIOUX FALLS
Analysis Time Period	PM PEAK	Analysis Year	2016

Project Description I-29 EXIT 77 (41ST ST) IMJR

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	360
Freeway Volume, V_F	1505
Ramp Volume, V_R	610
Freeway Free-Flow Speed, S_{FF}	69.0
Ramp Free-Flow Speed, S_{FR}	45.0

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 3370 ft

V_D = 795 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1505	0.90	Level	9	0	0.957	1.00	1747
Ramp	610	0.90	Level	9	0	0.957	1.00	708
UpStream								
DownStream	795	0.90	Level	9	0	0.957	1.00	923

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 1747 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1747	Exhibit 13-8	4780	No
$V_{FO} = V_F - V_R$	1039	Exhibit 13-8	4780	No
V_R	708	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1747	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 16.0 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.362 (Exhibit 13-12)

S_R= 59.2 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 59.2 mph (Exhibit 13-13)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	RL	Freeway/Dir of Travel	I-29 NB
Agency or Company	HDR	Junction	I-229
Date Performed	6/1/2016	Jurisdiction	CITY OF SIOUX FALLS
Analysis Time Period	PM PEAK	Analysis Year	2016

Project Description I-29 EXIT 77 (41ST ST) IMJR

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☑ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☐ No ☑ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = 3370 ft	Acceleration Lane Length, L_A: 1000	L_{down} = ft
V_u = 610 veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 895	
	Ramp Volume, V_R: 795	
	Freeway Free-Flow Speed, S_{FF}: 69.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	895	0.90	Level	9	0	0.957	1.00	1039
Ramp	795	0.90	Level	9	0	0.957	1.00	923
UpStream	610	0.90	Level	9	0	0.957	1.00	708
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1039 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1962	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1962	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 14.1 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.259 (Exibit 13-11)

S_R= 62.0 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 62.0 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	RL	Freeway/Dir of Travel	I-29 NB
Agency or Company	HDR	Junction	41ST STREET
Date Performed	6/1/2016	Jurisdiction	CITY OF SIOUX FALLS
Analysis Time Period	PM PEAK	Analysis Year	2016

Project Description I-29 EXIT 77 (41ST ST) IMJR

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	1500
Freeway Volume, V_F	1690
Ramp Volume, V_R	515
Freeway Free-Flow Speed, S_{FF}	69.0
Ramp Free-Flow Speed, S_{FR}	45.0

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 2750 ft

V_D = 800 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1690	0.90	Level	9	0	0.957	1.00	1962
Ramp	515	0.90	Level	9	0	0.957	1.00	598
UpStream								
DownStream	800	0.90	Level	9	0	0.957	1.00	929

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.683 using Equation (Exhibit 13-7)

V_{12} = 1530 pc/h

V_3 or V_{av34} 432 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1962	Exhibit 13-8	7170	No
$V_{FO} = V_F - V_R$	1364	Exhibit 13-8	7170	No
V_R	598	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1530	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 3.9 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

D_s = 0.352 (Exhibit 13-12)

S_R= 59.5 mph (Exhibit 13-12)

S_0= 75.7 mph (Exhibit 13-12)

S = 62.4 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	RL	Freeway/Dir of Travel	I-29 NB
Agency or Company	HDR	Junction	41ST STREET
Date Performed	6/1/2016	Jurisdiction	CITY OF SIOUX FALLS
Analysis Time Period	PM PEAK	Analysis Year	2016

Project Description I-29 EXIT 77 (41ST ST) IMJR

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	3	Downstream Adj Ramp
☑ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes ☐ On
☐ No	☑ Off	Acceleration Lane Length, L_A	655	☑ No ☐ Off
L_{up} =	2750 ft	Deceleration Lane Length L_D		L_{down} = ft
V_u =	515 veh/h	Freeway Volume, V_F	1175	V_D = veh/h
		Ramp Volume, V_R	800	
		Freeway Free-Flow Speed, S_{FF}	69.0	
		Ramp Free-Flow Speed, S_{FR}	45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1175	0.90	Level	9	0	0.957	1.00	1364
Ramp	800	0.90	Level	9	0	0.957	1.00	929
UpStream	515	0.90	Level	9	0	0.957	1.00	598
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = 732.92 (Equation 13-6 or 13-7)

P_{FM} = 0.596 using Equation (Exhibit 13-6)

V_{12} = 813 pc/h

V_3 or V_{av34} 551 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☑ Yes ☐ No

If Yes, V_{12a} = 813 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2293	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1742	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 14.5 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.284 (Exibit 13-11)

S_R= 61.3 mph (Exhibit 13-11)

S_0= 68.8 mph (Exhibit 13-11)

S = 63.0 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	RL	Freeway/Dir of Travel	I-29 NB
Agency or Company	HDR	Junction	26TH STREET
Date Performed	6/1/2016	Jurisdiction	CITY OF SIOUX FALLS
Analysis Time Period	PM PEAK	Analysis Year	2016

Project Description I-29 EXIT 77 (41ST ST) IMJR

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	4
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	655
Freeway Volume, V_F	1975
Ramp Volume, V_R	395
Freeway Free-Flow Speed, S_{FF}	69.0
Ramp Free-Flow Speed, S_{FR}	45.0

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 2320 ft

V_D = 910 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1975	0.90	Level	9	0	0.957	1.00	2293
Ramp	395	0.90	Level	9	0	0.957	1.00	459
UpStream								
DownStream	910	0.90	Level	9	0	0.957	1.00	1057

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.436 using Equation (Exhibit 13-7)

V_{12} = 1259 pc/h

V_3 or V_{av34} 517 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2293	Exhibit 13-8	9560	No
$V_{FO} = V_F - V_R$	1834	Exhibit 13-8	9560	No
V_R	459	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1259	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 9.2 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

D_s = 0.339 (Exhibit 13-12)

S_R= 59.8 mph (Exhibit 13-12)

S_0= 75.7 mph (Exhibit 13-12)

S = 66.1 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	RL	Freeway/Dir of Travel	I-29 NB
Agency or Company	HDR	Junction	26TH STREET
Date Performed	6/1/2016	Jurisdiction	CITY OF SIOUX FALLS
Analysis Time Period	PM PEAK	Analysis Year	2016

Project Description I-29 EXIT 77 (41ST ST) IMJR

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☑ Yes ☐ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☐ No ☑ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = 2320 ft	Acceleration Lane Length, L_A: 1500	L_{down} = ft
V_u = 395 veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 1580	
	Ramp Volume, V_R: 910	
	Freeway Free-Flow Speed, S_{FF}: 69.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1580	0.90	Level	9	0	0.957	1.00	1835
Ramp	910	0.90	Level	9	0	0.957	1.00	1057
UpStream	395	0.90	Level	9	0	0.957	1.00	459
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = 1236.29 (Equation 13-6 or 13-7)

P_{FM} = 0.619 using Equation (Exhibit 13-6)

V_{12} = 1137 pc/h

V_3 or V_{av34} 698 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☑ Yes ☐ No

If Yes, V_{12a} = 1137 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2892	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2194	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 12.7 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.221 (Exibit 13-11)

S_R= 63.0 mph (Exhibit 13-11)

S_0= 68.3 mph (Exhibit 13-11)

S = 64.2 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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III. Freeway Analysis – Weaving

FREEWAY WEAVING WORKSHEET

General Information

Analyst	RL
Agency/Company	HDR
Date Performed	6/1/2016
Analysis Time Period	AM PEAK

Site Information

Freeway/Dir of Travel	I-29 SB
Weaving Segment Location	26TH/41ST
Analysis Year	2016

Project Description I-29 EXIT 77 (41ST ST) IMJR

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	1740ft
Freeway free-flow speed, FFS	69 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	45
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1090	0.90	9	0	1.5	1.2	0.957	1.00	1266
V_{RF}	310	0.90	9	0	1.5	1.2	0.957	1.00	360
V_{FR}	665	0.90	9	0	1.5	1.2	0.957	1.00	772
V_{RR}	0	0.90	9	0	1.5	1.2	0.957	1.00	0
V_{NW}	1266							V =	2398
V_W	1132								
VR	0.472								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	360 lc/h
Interchange density, ID	1.3 int/mi	Weaving lane changes, LC_W	821 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	433 lc/h
Minimum FR lane changes, LC_{FR}	0 lc/pc	Total lane changes, LC_{ALL}	1254 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	286

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

Weaving segment flow rate, v	2295 veh/h	Weaving intensity factor, W	0.175
Weaving segment capacity, c_w	4865 veh/h	Weaving segment speed, S	64.4 mph
Weaving segment v/c ratio	0.472	Average weaving speed, S_W	65.4 mph
Weaving segment density, D	9.3 pc/mi/ln	Average non-weaving speed, S_{NW}	63.5 mph
Level of Service, LOS	A	Maximum weaving length, L_{MAX}	7502 ft

Notes

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

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	RL
Agency/Company	HDR
Date Performed	6/1/2016
Analysis Time Period	AM PEAK

Site Information

Freeway/Dir of Travel	I-29 NB
Weaving Segment Location	41ST/26TH
Analysis Year	2016

Project Description I-29 EXIT 77 (41ST ST) IMJR

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	1310ft
Freeway free-flow speed, FFS	69 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	45
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1240	0.90	9	0	1.5	1.2	0.957	1.00	1440
V_{RF}	900	0.90	9	0	1.5	1.2	0.957	1.00	1045
V_{FR}	240	0.90	9	0	1.5	1.2	0.957	1.00	279
V_{RR}	0	0.90	9	0	1.5	1.2	0.957	1.00	0
V_{NW}	1440							V =	2764
V_W	1324								
VR	0.479								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1324 lc/h
Interchange density, ID	1.3 int/mi	Weaving lane changes, LC_W	1710 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	236 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	1946 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	245

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

Weaving segment flow rate, v	2645 veh/h	Weaving intensity factor, W	0.309
Weaving segment capacity, c_w	4795 veh/h	Weaving segment speed, S	59.4 mph
Weaving segment v/c ratio	0.552	Average weaving speed, S_W	63.3 mph
Weaving segment density, D	11.6 pc/mi/ln	Average non-weaving speed, S_{NW}	56.2 mph
Level of Service, LOS	B	Maximum weaving length, L_{MAX}	7582 ft

Notes

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

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	RL
Agency/Company	HDR
Date Performed	6/1/2016
Analysis Time Period	PM PEAK

Site Information

Freeway/Dir of Travel	I-29 SB
Weaving Segment Location	26TH/41ST
Analysis Year	2016

Project Description I-29 EXIT 77 (41ST ST) IMJR

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	1740ft
Freeway free-flow speed, FFS	69 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	45
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	420	0.90	9	0	1.5	1.2	0.957	1.00	488
V_{RF}	310	0.90	9	0	1.5	1.2	0.957	1.00	360
V_{FR}	1245	0.90	9	0	1.5	1.2	0.957	1.00	1446
V_{RR}	0	0.90	9	0	1.5	1.2	0.957	1.00	0
V_{NW}	488							V =	2294
V_W	1806								
VR	0.787								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	360 lc/h
Interchange density, ID	1.3 int/mi	Weaving lane changes, LC_W	821 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	273 lc/h
Minimum FR lane changes, LC_{FR}	0 lc/pc	Total lane changes, LC_{ALL}	1094 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	110

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

Weaving segment flow rate, v	2195 veh/h	Weaving intensity factor, W	0.157
Weaving segment capacity, c_w	2917 veh/h	Weaving segment speed, S	65.3 mph
Weaving segment v/c ratio	0.752	Average weaving speed, S_W	65.7 mph
Weaving segment density, D	8.8 pc/mi/ln	Average non-weaving speed, S_{NW}	63.7 mph
Level of Service, LOS	A	Maximum weaving length, L_{MAX}	11373 ft

Notes

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

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	RL
Agency/Company	HDR
Date Performed	6/1/2016
Analysis Time Period	PM PEAK

Site Information

Freeway/Dir of Travel	I-29 NB
Weaving Segment Location	41ST/26TH
Analysis Year	2016

Project Description I-29 EXIT 77 (41ST ST) IMJR

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	1310ft
Freeway free-flow speed, FFS	69 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	45
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	780	0.90	9	0	1.5	1.2	0.957	1.00	906
V_{RF}	800	0.90	9	0	1.5	1.2	0.957	1.00	929
V_{FR}	395	0.90	9	0	1.5	1.2	0.957	1.00	459
V_{RR}	0	0.90	9	0	1.5	1.2	0.957	1.00	0
V_{NW}	906							V =	2294
V_W	1388								
VR	0.605								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1388 lc/h
Interchange density, ID	1.3 int/mi	Weaving lane changes, LC_W	1774 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	126 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	1900 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	154

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

Weaving segment flow rate, v	2195 veh/h	Weaving intensity factor, W	0.303
Weaving segment capacity, c_w	3796 veh/h	Weaving segment speed, S	60.4 mph
Weaving segment v/c ratio	0.578	Average weaving speed, S_W	63.4 mph
Weaving segment density, D	9.5 pc/mi/ln	Average non-weaving speed, S_{NW}	56.3 mph
Level of Service, LOS	A	Maximum weaving length, L_{MAX}	9080 ft

Notes

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

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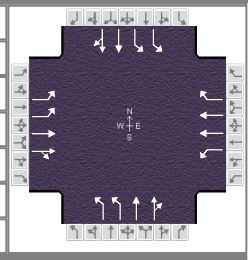
IV. Arterial Analysis

HCS 2010 Signalized Intersection Results Summary

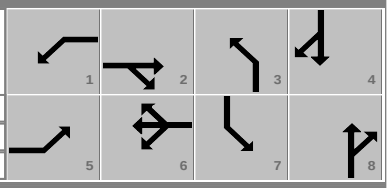
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	May 23, 2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	AM peak	PHF	0.84
Urban Street	26th Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	Marion Road	File Name	26-marion am 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	200	1000	80	40	190	100	55	380	110	225	400	80

Signal Information			
Cycle, s	91.4	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	2.8	1.2	29.1	3.2	11.9	11.9
Yellow	3.9	3.9	3.9	3.9	3.9	3.9
Red	1.0	1.0	2.0	1.0	1.9	1.0



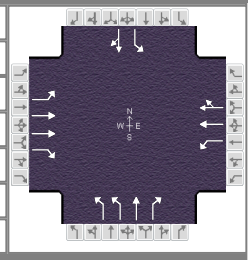
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	4.0	1.1	3.0	2.0	4.0	2.0	4.0
Phase Duration, s	13.8	41.1	7.7	35.0	8.1	25.8	16.8	34.5
Change Period, ($Y+R_c$), s	4.9	5.9	4.9	5.9	4.9	5.8	5.8	5.8
Max Allow Headway (*MAH*), s	4.1	5.1	4.1	5.1	5.1	5.1	5.1	5.1
Queue Clearance Time (g_s), s	8.4	32.6	3.7	6.4	3.8	14.9	9.1	13.3
Green Extension Time (g_e), s	0.5	2.6	0.0	11.5	0.2	2.2	2.0	4.2
Phase Call Probability	1.00	1.00	0.70	1.00	0.81	1.00	1.00	1.00
Max Out Probability	0.09	1.00	0.01	0.32	0.00	0.27	0.44	0.19

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	238	630	620	48	226	71	65	270	259	268	272	264
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1656	1791	1761	1706	1705	1518	1656	1791	1700	1656	1791	1721
Queue Service Time (g_s), s	6.4	30.5	30.6	1.7	4.4	3.1	1.8	12.7	12.9	7.1	11.2	11.3
Cycle Queue Clearance Time (g_c), s	6.4	30.5	30.6	1.7	4.4	3.1	1.8	12.7	12.9	7.1	11.2	11.3
Green Ratio (*g/C*)	0.10	0.38	0.38	0.35	0.32	0.32	0.04	0.22	0.22	0.12	0.31	0.31
Capacity (*c*), veh/h	323	689	677	144	1084	483	118	392	372	400	562	540
Volume-to-Capacity Ratio (*X*)	0.737	0.914	0.915	0.331	0.209	0.148	0.557	0.690	0.697	0.670	0.484	0.488
Back of Queue (*Q*), ft/ln (95 th percentile)	121.9	548.2	539.3	32.1	79	49	36.7	243.6	235.3	133.9	209.4	203.1
Back of Queue (*Q*), veh/ln (95 th percentile)	4.8	21.8	21.6	1.3	3.1	2.0	1.5	9.7	9.4	5.3	8.3	8.1
Queue Storage Ratio (*RQ*) (95 th percentile)	0.61	0.00	0.00	0.23	0.00	0.76	0.16	0.00	0.00	0.67	0.00	0.00
Uniform Delay (d_1), s/veh	40.1	26.7	26.7	24.2	22.8	21.9	43.4	32.8	32.9	38.4	25.4	25.4
Incremental Delay (d_2), s/veh	3.3	16.6	17.0	1.3	0.1	0.2	5.8	3.8	4.2	2.8	0.9	1.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	43.4	43.3	43.7	25.6	22.9	22.1	49.1	36.6	37.1	41.2	26.3	26.4
Level of Service (LOS)	D	D	D	C	C	C	D	D	D	D	C	C
Approach Delay, s/veh / LOS	43.5	D		23.1	C		38.2	D		31.3	C	
Intersection Delay, s/veh / LOS	37.3						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.2	C	3.2	C	3.2	C	3.2	C
Bicycle LOS Score / LOS	3.8	D	1.6	A	3.2	C	3.3	C

HCS 2010 Signalized Intersection Results Summary

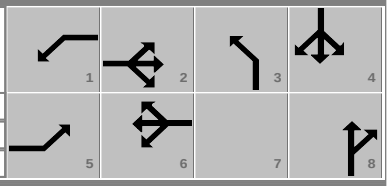
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	5/23/2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	AM peak	PHF	0.84
Urban Street	26th Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	Lorraine Dr.	File Name	26 system am 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	5	1360	10	40	455	20	5	5	50	55	5	10

Signal Information			
Cycle, s	92.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	0.6	2.3	59.1	0.6	6.0	0.0
Yellow	4.0	0.0	4.3	3.2	3.2	0.0
Red	1.0	0.0	1.7	3.0	3.0	0.0



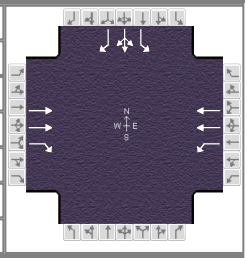
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8		4
Case Number	1.1	3.0	1.1	4.0	2.0	3.0		6.3
Phase Duration, s	5.6	65.1	7.9	67.5	6.8	19.0		12.2
Change Period, ($Y+R_c$), s	5.0	6.0	5.0	6.0	6.2	6.2		6.2
Max Allow Headway (*MAH*), s	4.1	0.0	4.1	0.0	4.7	4.6		4.6
Queue Clearance Time (g_s), s	2.1		2.9		2.2	3.9		6.2
Green Extension Time (g_e), s	0.0	0.0	0.1	0.0	0.0	0.3		0.2
Phase Call Probability	0.14		0.72		0.14	0.96		0.95
Max Out Probability	0.00		0.01		1.00	0.00		0.82

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	6	1619	6	50	294	292	6	6	36	65	12	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1706	1705	1518	1706	1791	1777	1656	1791	1518	1418	1643	
Queue Service Time (g_s), s	0.1	17.0	0.1	0.9	7.1	7.1	0.2	0.3	1.9	4.2	0.6	
Cycle Queue Clearance Time (g_c), s	0.1	17.0	0.1	0.9	7.1	7.1	0.2	0.3	1.9	4.2	0.6	
Green Ratio (*g/C*)	0.65	0.64	0.64	0.67	0.67	0.67	0.01	0.14	0.14	0.07	0.07	
Capacity (*c*), veh/h	564	2192	975	275	1196	1187	20	249	211	171	107	
Volume-to-Capacity Ratio (*X*)	0.011	0.739	0.006	0.183	0.246	0.246	0.293	0.024	0.169	0.383	0.111	
Back of Queue (*Q*), ft/ln (95 th percentile)	1.6	140.5	0.8	13.5	114.6	115	4.2	5.3	32.9	69.6	12.3	
Back of Queue (*Q*), veh/ln (95 th percentile)	0.1	5.6	0.0	0.5	4.5	4.6	0.2	0.2	1.3	2.8	0.5	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.01	0.00	0.00	0.11	0.00	0.00	0.02	0.00	0.30	2.79	0.00	
Uniform Delay (d_1), s/veh	5.9	3.6	2.4	7.0	7.5	7.6	45.5	34.2	34.9	42.1	40.5	
Incremental Delay (d_2), s/veh	0.0	2.3	0.0	0.3	0.5	0.5	9.3	0.0	0.5	1.7	0.5	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	5.9	5.8	2.4	7.4	8.0	8.1	54.8	34.3	35.4	43.8	41.0	
Level of Service (LOS)	A	A	A	A	A	A	D	C	D	D	D	
Approach Delay, s/veh / LOS	5.8	A		8.0	A		37.7	D		43.4	D	
Intersection Delay, s/veh / LOS	8.3						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.7	B	2.3	B	3.2	C	3.2	C
Bicycle LOS Score / LOS	1.8	A	1.0	A	0.6	A	0.6	A

HCS 2010 Signalized Intersection Results Summary

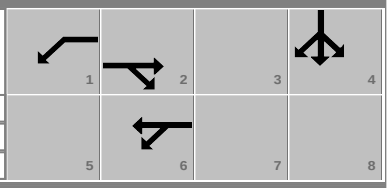
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	5/23/2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	AM peak	PHF	0.83
Urban Street	26th Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	I-29 SB	File Name	26 system am 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		1180	285	25	380					280	0	135

Signal Information			
Cycle, s	92.0	Reference Phase	2
Offset, s	36	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	2.2	54.6	17.6	0.0	0.0	0.0
Yellow	4.3	4.3	3.2	0.0	0.0	0.0
Red	1.8	1.8	2.2	0.0	0.0	0.0



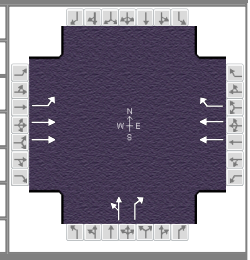
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6				4
Case Number		7.3	1.0	4.0				9.0
Phase Duration, s		60.7	8.3	69.0				23.0
Change Period, ($Y+R_c$), s		6.1	6.1	6.1				5.4
Max Allow Headway (*MAH*), s		0.0	1.1	0.0				5.6
Queue Clearance Time (g_s), s			2.6					19.6
Green Extension Time (g_e), s		0.0	0.0	0.0				0.0
Phase Call Probability			0.56					1.00
Max Out Probability			0.00					1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6					7	4	14
Adjusted Flow Rate (*v*), veh/h		1403	202	32	485					337	0	96
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1735	1453	1706	1640					1706	1674	1435
Queue Service Time (g_s), s		23.9	5.4	0.6	10.6					17.6	0.0	5.4
Cycle Queue Clearance Time (g_c), s		23.9	5.4	0.6	10.6					17.6	0.0	5.4
Green Ratio (*g/C*)		0.59	0.59	0.64	0.68					0.19	0.19	0.19
Capacity (*c*), veh/h		2058	862	249	2242					326	320	274
Volume-to-Capacity Ratio (*X*)		0.682	0.235	0.128	0.216					1.034	0.000	0.351
Back of Queue (*Q*), ft/ln (95 th percentile)		284.8	71.8	9.3	187					456.7	0	84.7
Back of Queue (*Q*), veh/ln (95 th percentile)		11.3	2.8	0.4	7.4					18.3	0.0	3.4
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00	0.39	0.06	0.00					1.53	0.00	0.28
Uniform Delay (d_1), s/veh		11.1	7.7	10.3	14.5					37.2	0.0	32.3
Incremental Delay (d_2), s/veh		1.2	0.4	0.1	0.2					58.8	0.0	1.3
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0					0.0	0.0	0.0
Control Delay (*d*), s/veh		12.3	8.1	10.4	14.7					96.0	0.0	33.6
Level of Service (LOS)		B	A	B	B					F		C
Approach Delay, s/veh / LOS	11.8	B		14.5	B		0.0			82.1	F	
Intersection Delay, s/veh / LOS	24.2						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.9	A	2.2	B	3.1	C	3.3	C
Bicycle LOS Score / LOS	1.6	A	1.0	A			1.7	A

HCS 2010 Signalized Intersection Results Summary

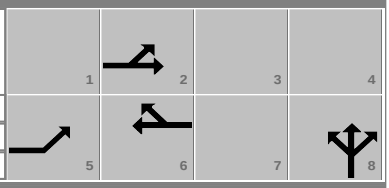
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	5/23/2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	AM peak	PHF	0.79
Urban Street	26th Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	I-29 NB	File Name	26 system am 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	610	850			215	250	190	0	50			

Signal Information			
Cycle, s	92.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	25.9	33.3	15.2	0.0	0.0	0.0
Yellow	4.3	4.3	3.2	0.0	0.0	0.0
Red	1.8	1.8	2.2	0.0	0.0	0.0



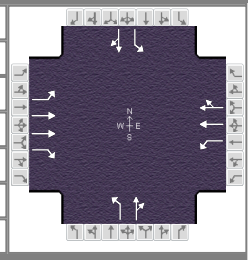
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		
Case Number	1.0	4.0		7.3		11.0		
Phase Duration, s	32.0	71.4		39.4		20.6		
Change Period, ($Y+R_c$), s	6.1	6.1		6.1		5.4		
Max Allow Headway (*MAH*), s	3.1	0.0		0.0		5.6		
Queue Clearance Time (g_s), s	24.4					14.6		
Green Extension Time (g_e), s	1.6	0.0		0.0		0.6		
Phase Call Probability	1.00					1.00		
Max Out Probability	0.00					1.00		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16	3	8	18			
Adjusted Flow Rate (*v*), veh/h	723	1007			277	193		241	38			
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1706	1692			1620	1451		1706	1425			
Queue Service Time (g_s), s	22.4	26.4			6.5	9.9		12.6	2.1			
Cycle Queue Clearance Time (g_c), s	22.4	26.4			6.5	9.9		12.6	2.1			
Green Ratio (*g/C*)	0.67	0.29			0.36	0.36		0.17	0.17			
Capacity (*c*), veh/h	882	972			1172	525		282	235			
Volume-to-Capacity Ratio (*X*)	0.819	1.036			0.236	0.367		0.854	0.161			
Back of Queue (*Q*), ft/ln (95 th percentile)	268.8	533.2			116.3	167.5		265.8	32.8			
Back of Queue (*Q*), veh/ln (95 th percentile)	10.7	21.2			4.6	6.7		10.5	1.3			
Queue Storage Ratio (*RQ*) (95 th percentile)	1.41	0.00			0.00	0.84		0.00	0.21			
Uniform Delay (d_1), s/veh	10.2	20.9			25.4	25.1		37.3	32.9			
Incremental Delay (d_2), s/veh	1.7	32.0			0.5	1.9		18.1	0.5			
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0		0.0	0.0			
Control Delay (*d*), s/veh	11.9	52.9			25.8	27.0		55.4	33.5			
Level of Service (LOS)	B	F			C	C		E	C			
Approach Delay, s/veh / LOS	35.8	D		26.3	C		52.4	D		0.0		
Intersection Delay, s/veh / LOS	35.8						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	A	2.1	B	3.2	C	3.2	C
Bicycle LOS Score / LOS	2.2	B	0.9	A	1.8	A		

HCS 2010 Signalized Intersection Results Summary

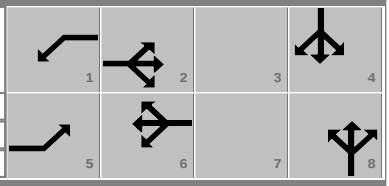
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	5/23/2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	AM peak	PHF	0.78
Urban Street	26th Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	Shirley Avenue	File Name	26 system am 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	50	610	240	20	310	20	130	5	20	15	5	25

Signal Information			
Cycle, s	92.0	Reference Phase	2
Offset, s	80	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	2.4	1.4	58.3	14.5	0.0	0.0
Yellow	4.0	0.0	3.9	3.5	0.0	0.0
Red	0.0	0.0	1.5	2.5	0.0	0.0



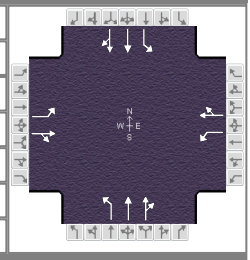
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	1.1	3.0	1.1	4.0		6.0		6.0
Phase Duration, s	7.8	65.1	6.4	63.7		20.5		20.5
Change Period, ($Y+R_c$), s	4.0	5.4	4.0	5.4		6.0		6.0
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0		5.2		5.2
Queue Clearance Time (g_s), s	3.0		2.5			14.0		4.0
Green Extension Time (g_e), s	0.1	0.0	0.0	0.0		0.6		1.1
Phase Call Probability	0.77		0.48			1.00		1.00
Max Out Probability	0.02		0.00			0.68		0.01

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	57	692	164	26	206	204	167	19		19	26	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1706	1705	1518	1706	1791	1771	1393	1599		1401	1578	
Queue Service Time (g_s), s	1.0	8.7	4.3	0.5	4.4	4.4	10.7	0.9		1.1	1.3	
Cycle Queue Clearance Time (g_c), s	1.0	8.7	4.3	0.5	4.4	4.4	12.0	0.9		2.0	1.3	
Green Ratio (*g/C*)	0.67	0.65	0.65	0.66	0.63	0.63	0.16	0.16		0.16	0.16	
Capacity (*c*), veh/h	723	2212	984	525	1134	1121	279	253		285	249	
Volume-to-Capacity Ratio (*X*)	0.078	0.313	0.167	0.049	0.182	0.182	0.597	0.076		0.067	0.103	
Back of Queue (*Q*), ft/ln (95 th percentile)	13	90.8	44.1	6.9	71.2	70.7	173.1	17		17.4	23.1	
Back of Queue (*Q*), veh/ln (95 th percentile)	0.5	3.6	1.8	0.3	2.8	2.8	6.9	0.7		0.7	0.9	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.06	0.00	0.15	0.04	0.00	0.00	1.24	0.00		0.43	0.00	
Uniform Delay (d_1), s/veh	4.8	7.7	7.0	5.9	7.0	7.0	38.3	33.0		33.9	33.2	
Incremental Delay (d_2), s/veh	0.0	0.0	0.0	0.1	0.4	0.4	2.9	0.2		0.1	0.3	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	4.8	7.7	7.1	6.0	7.3	7.4	41.2	33.2		34.0	33.4	
Level of Service (LOS)	A	A	A	A	A	A	D	C		C	C	
Approach Delay, s/veh / LOS	7.4	A		7.3	A		40.3	D		33.7	C	
Intersection Delay, s/veh / LOS	12.0						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.4	B	3.0	C	3.3	C
Bicycle LOS Score / LOS	2.9	C	2.4	B	2.8	C	2.6	B

HCS 2010 Signalized Intersection Results Summary

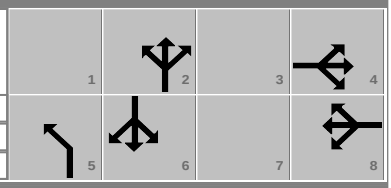
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	May 23, 2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	AM Peak	PHF	0.84
Urban Street	Louise Avenue	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	34th Street	File Name	34-louise am 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	15	0	20	0	0	5	30	365	5	5	650	10

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	4.1	88.0	9.0	0.0	0.0	0.0
Yellow	3.9	3.9	3.2	0.0	0.0	0.0
Red	1.0	1.1	1.8	0.0	0.0	0.0



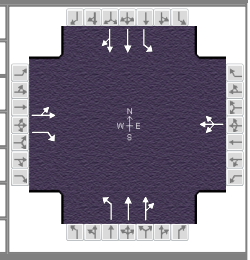
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2		6
Case Number		6.0		6.0	1.0	4.0		6.3
Phase Duration, s		14.0		14.0	9.0	102.0		93.0
Change Period, ($Y+R_c$), s		5.0		5.0	4.9	5.0		5.0
Max Allow Headway (*MAH*), s		5.2		5.2	5.1	0.0		0.0
Queue Clearance Time (g_s), s		3.8		2.4	2.5			
Green Extension Time (g_e), s		0.1		0.1	0.1	0.0		0.0
Phase Call Probability		0.68		0.68	0.68			
Max Out Probability		0.00		0.00	0.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	18	12		0	6		36	221	220	6	390	389
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1381	1518		1410	1481		1706	1791	1782	953	1791	1786
Queue Service Time (g_s), s	1.4	0.8		0.0	0.4		0.5	0.0	0.0	0.2	7.8	7.8
Cycle Queue Clearance Time (g_c), s	1.8	0.8		0.0	0.4		0.5	0.0	0.0	0.2	7.8	7.8
Green Ratio (*g/C*)	0.08	0.08		0.08	0.08		0.81	0.84	0.84	0.76	0.76	0.76
Capacity (*c*), veh/h	165	118		62	115		604	1497	1490	785	1358	1354
Volume-to-Capacity Ratio (*X*)	0.108	0.101		0.000	0.052		0.059	0.147	0.148	0.008	0.287	0.287
Back of Queue (*Q*), ft/ln (95 th percentile)	23.1	15.4		0	7.5		5.2	3.9	3.9	1.4	115.4	114.2
Back of Queue (*Q*), veh/ln (95 th percentile)	0.9	0.6		0.0	0.3		0.2	0.2	0.2	0.1	4.6	4.6
Queue Storage Ratio (*RQ*) (95 th percentile)	0.23	0.00		0.00	0.00		0.03	0.00	0.00	0.03	0.00	0.00
Uniform Delay (d_1), s/veh	50.4	49.7		0.0	49.5		2.5	0.0	0.0	3.4	4.3	4.3
Incremental Delay (d_2), s/veh	0.4	0.5		0.0	0.2		0.1	0.2	0.2	0.0	0.5	0.5
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	50.8	50.2		0.0	49.7		2.6	0.2	0.2	3.4	4.9	4.9
Level of Service (LOS)	D	D			D		A	A	A	A	A	A
Approach Delay, s/veh / LOS	50.5	D		49.7	D		0.4	A		4.9	A	
Intersection Delay, s/veh / LOS	4.5						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.0	C	3.0	C	2.3	B	2.3	B
Bicycle LOS Score / LOS	2.5	B	2.4	B	2.5	B	2.7	B

HCS 2010 Signalized Intersection Results Summary

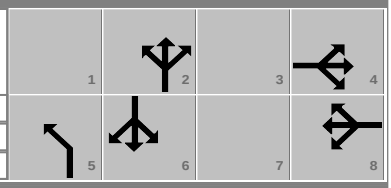
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	5/23/2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	AM peak	PHF	0.86
Urban Street	Louise Avenue	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	Wal-Mart	File Name	wal-mart-louise am 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	20	0	40	5	0	5	105	400	5	0	595	40

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	5.9	86.5	8.7	0.0	0.0	0.0
Yellow	3.9	3.9	3.2	0.0	0.0	0.0
Red	1.0	1.1	1.8	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2		6
Case Number		7.0		8.0	1.0	4.0		6.3
Phase Duration, s		13.7		13.7	10.8	102.3		91.5
Change Period, ($Y+R_c$), s		5.0		5.0	4.9	5.0		5.0
Max Allow Headway (*MAH*), s		5.4		5.4	5.1	0.0		0.0
Queue Clearance Time (g_s), s		4.1		2.8	3.7			
Green Extension Time (g_e), s		0.2		0.3	0.6	0.0		0.0
Phase Call Probability		0.87		0.87	0.98			
Max Out Probability		0.00		0.00	0.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h		23	29		12		122	236	235	0	363	358
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1418	1518		1508		1706	1791	1783	928	1791	1765
Queue Service Time (g_s), s		1.0	2.1		0.0		1.7	0.0	0.0	0.0	0.2	0.2
Cycle Queue Clearance Time (g_c), s		1.8	2.1		0.8		1.7	0.0	0.0	0.0	0.2	0.2
Green Ratio (*g/C*)		0.08	0.08		0.08		0.81	0.84	0.84	0.75	0.75	0.75
Capacity (*c*), veh/h		169	114		160		696	1502	1495	62	1335	1316
Volume-to-Capacity Ratio (*X*)		0.138	0.255		0.073		0.175	0.157	0.157	0.000	0.272	0.272
Back of Queue (*Q*), ft/ln (95 th percentile)		30	38.8		14.8		18.1	4.2	4.2	0	10.4	10.4
Back of Queue (*Q*), veh/ln (95 th percentile)		1.2	1.5		0.6		0.7	0.2	0.2	0.0	0.4	0.4
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00	0.60		0.00		0.24	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d_1), s/veh		50.4	50.6		50.0		2.2	0.0	0.0	0.0	0.1	0.1
Incremental Delay (d_2), s/veh		0.5	1.6		0.3		0.2	0.2	0.2	0.0	0.5	0.5
Initial Queue Delay (d_3), s/veh		0.0	0.0		0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh		51.0	52.2		50.2		2.3	0.2	0.2	0.0	0.6	0.6
Level of Service (LOS)		D	D		D		A	A	A		A	A
Approach Delay, s/veh / LOS	51.7	D		50.2	D		0.7	A		0.6	A	
Intersection Delay, s/veh / LOS	3.0						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.0	C	3.1	C	2.2	B	2.3	B
Bicycle LOS Score / LOS	0.6	A	0.5	A	1.0	A	1.1	A

HCS 2010 Two-Way Stop Control Summary Report

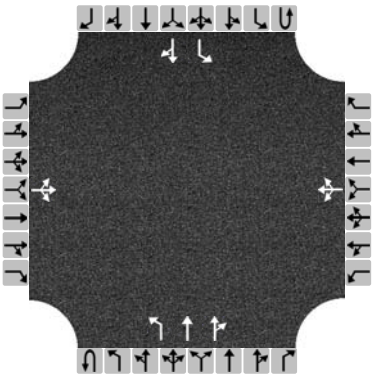
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	6/30/2016
Analysis Year	2016
Time Analyzed	AM PEAK
Intersection Orientation	North-South
Project Description	I-29 EXIT 77 IMJR

Site Information

Intersection	38TH/SHIRLEY
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	38TH STREET
North/South Street	SHIRLEY AVENUE
Peak Hour Factor	0.90
Analysis Time Period (hrs)	0.25

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	1	0	0	1	2	0	0	1	1	0
Configuration			LTR				LTR			L	T	TR		L		TR
Volume (veh/h)		5	5	35		5	5	0		55	90	15		5	70	30
Percent Heavy Vehicles		1	1	1		1	1	1		1				1		
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)			51				12			61				6		
Capacity			837				537			1484				1477		
v/c Ratio			0.06				0.02			0.04				0.00		
95% Queue Length			0.2				0.1			0.1				0.0		
Control Delay (s/veh)			9.6				11.9			7.5				7.4		
Level of Service (LOS)			A				B			A				A		
Approach Delay (s/veh)	9.6				11.9				2.6				0.4			
Approach LOS	A				B											

HCS 2010 Two-Way Stop Control Summary Report

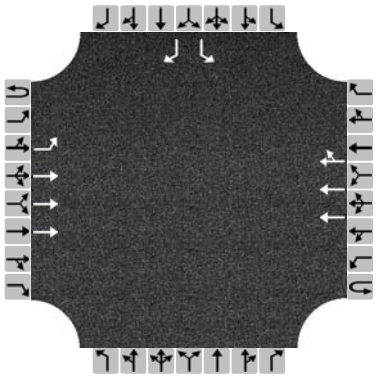
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	6/30/2016
Analysis Year	2016
Time Analyzed	AM PEAK
Intersection Orientation	East-West
Project Description	I-29 EXIT 77 IMJR

Site Information

Intersection	41ST/CAROLYN
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	41ST STREET
North/South Street	CAROLYN AVENUE
Peak Hour Factor	0.84
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

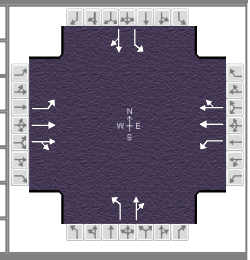
Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	3	0	0	0	3	0		0	0	0		1	0	1
Configuration		L	T				T	TR						L		R
Volume (veh/h)		130	1320				560	50						15		50
Percent Heavy Vehicles		1												1		1
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)		155												18		60
Capacity		532												105		543
v/c Ratio		0.29												0.17		0.11
95% Queue Length		1.2												0.6		0.4
Control Delay (s/veh)		14.5												46.3		12.5
Level of Service (LOS)		B												E		B
Approach Delay (s/veh)	1.3												20.3			
Approach LOS													C			

HCS 2010 Signalized Intersection Results Summary

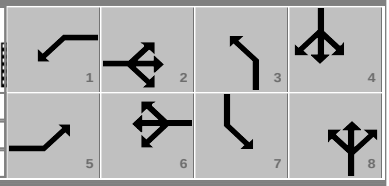
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	May 24, 2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	AM peak	PHF	0.86
Urban Street	41st Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	Valley View Rd.	File Name	41-valley view am 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	60	965	75	55	615	65	100	70	140	105	70	105

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	3.5	0.1	66.7	8.6	0.4	16.4
Yellow	3.9	0.0	3.9	3.6	0.0	3.6
Red	1.0	0.0	1.4	1.0	0.0	2.0



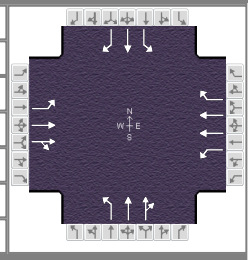
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	4.0	1.1	4.0	1.1	4.0
Phase Duration, s	8.5	72.1	8.4	72.0	13.2	22.0	13.5	22.3
Change Period, ($Y+R_c$), s	4.9	5.3	4.9	5.3	4.6	5.6	4.6	5.6
Max Allow Headway (*MAH*), s	4.1	0.0	4.1	0.0	4.2	4.8	4.2	4.8
Queue Clearance Time (g_s), s	3.9		3.8		8.7	14.4	9.0	12.5
Green Extension Time (g_e), s	0.1	0.0	0.1	0.0	0.1	1.1	0.1	1.2
Phase Call Probability	0.89		0.87		0.98	1.00	0.98	1.00
Max Out Probability	0.00		0.00		1.00	0.14	1.00	0.06

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	70	592	583	64	385	377	116	180		122	157	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1706	1791	1763	1706	1791	1752	1706	1628		1706	1637	
Queue Service Time (g_s), s	1.9	24.3	24.3	1.8	8.2	8.2	6.7	12.4		7.0	10.5	
Cycle Queue Clearance Time (g_c), s	1.9	24.3	24.3	1.8	8.2	8.2	6.7	12.4		7.0	10.5	
Green Ratio (*g/C*)	0.61	0.58	0.58	0.60	0.57	0.57	0.21	0.14		0.22	0.14	
Capacity (*c*), veh/h	473	1032	1015	281	1030	1007	233	230		235	236	
Volume-to-Capacity Ratio (*X*)	0.148	0.574	0.574	0.227	0.374	0.374	0.499	0.784		0.520	0.664	
Back of Queue (*Q*), ft/ln (95 th percentile)	32.3	382.2	374.7	30.1	128.8	125.4	131.4	235.5		138	200.8	
Back of Queue (*Q*), veh/ln (95 th percentile)	1.3	15.2	15.0	1.2	5.1	5.0	5.2	9.4		5.5	8.0	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.65	0.00	0.00	0.60	0.00	0.00	2.19	0.00		2.30	0.00	
Uniform Delay (d_1), s/veh	9.7	15.6	15.6	12.7	6.7	6.7	39.1	48.1		38.9	47.0	
Incremental Delay (d_2), s/veh	0.1	2.3	2.4	0.4	1.0	1.1	1.7	8.3		1.8	3.8	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	9.8	17.9	17.9	13.1	7.8	7.8	40.7	56.4		40.7	50.8	
Level of Service (LOS)	A	B	B	B	A	A	D	E		D	D	
Approach Delay, s/veh / LOS	17.5	B		8.2	A		50.2	D		46.4	D	
Intersection Delay, s/veh / LOS	21.3						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.5	B	2.5	B	3.2	C	3.2	C
Bicycle LOS Score / LOS	3.1	C	2.7	B	2.9	C	2.9	C

HCS 2010 Signalized Intersection Results Summary

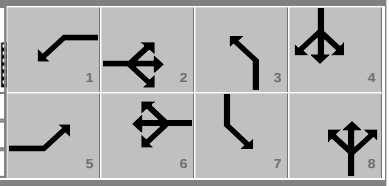
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	May 23, 2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	AM peak	PHF	0.88
Urban Street	41st Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	Marion Road	File Name	41 system am 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	150	1010	105	100	540	40	95	220	330	160	325	170

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	70	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	6.5	2.1	51.3	7.6	4.0	24.1
Yellow	3.9	0.0	3.9	3.6	0.0	3.6
Red	1.0	0.0	1.6	1.0	0.0	1.8



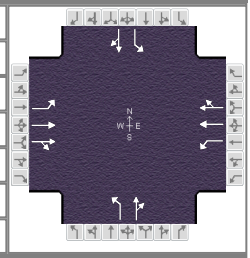
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	1.1	4.0	1.1	3.0
Phase Duration, s	13.5	58.9	11.4	56.8	12.2	29.5	16.1	33.5
Change Period, ($Y+R_c$), s	4.9	5.5	4.9	5.5	4.6	5.4	4.6	5.4
Max Allow Headway (*MAH*), s	4.1	0.0	4.1	0.0	4.1	5.2	4.1	5.2
Queue Clearance Time (g_s), s	8.4		6.5		7.8	18.4	11.5	25.1
Green Extension Time (g_e), s	0.3	0.0	0.2	0.0	0.1	3.8	0.1	2.9
Phase Call Probability	1.00		0.98		0.97	1.00	1.00	1.00
Max Out Probability	0.11		0.01		1.00	0.61	1.00	0.86

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	170	618	604	122	660	31	108	250	227	182	369	114
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1689	1774	1730	1689	1688	1483	1689	1774	1501	1689	1774	1484
Queue Service Time (g_s), s	6.4	29.1	29.2	4.5	7.9	0.5	5.8	15.1	16.4	9.5	23.1	7.3
Cycle Queue Clearance Time (g_c), s	6.4	29.1	29.2	4.5	7.9	0.5	5.8	15.1	16.4	9.5	23.1	7.3
Green Ratio (*g/C*)	0.52	0.46	0.46	0.50	0.44	0.44	0.27	0.21	0.21	0.32	0.24	0.24
Capacity (*c*), veh/h	476	817	797	244	1495	657	198	368	312	291	429	359
Volume-to-Capacity Ratio (*X*)	0.358	0.757	0.758	0.500	0.442	0.047	0.545	0.679	0.729	0.625	0.861	0.317
Back of Queue (*Q*), ft/ln (95 th percentile)	107	418.6	405.3	87.9	109.3	8.6	112.8	287.3	271.9	188.9	438.2	121.2
Back of Queue (*Q*), veh/ln (95 th percentile)	4.2	16.5	16.2	3.5	4.3	0.3	4.4	11.3	10.9	7.4	17.3	4.8
Queue Storage Ratio (*RQ*) (95 th percentile)	0.71	0.00	0.00	0.39	0.00	0.04	0.56	0.00	0.00	0.70	0.00	0.00
Uniform Delay (d_1), s/veh	15.0	17.7	17.7	22.0	8.4	6.7	34.9	42.4	42.9	31.8	42.1	36.1
Incremental Delay (d_2), s/veh	0.5	6.5	6.7	1.5	0.9	0.1	2.3	4.4	7.3	3.8	14.4	0.7
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	15.5	24.2	24.4	23.5	9.3	6.9	37.2	46.8	50.3	35.6	56.5	36.8
Level of Service (LOS)	B	C	C	C	A	A	D	D	D	D	E	D
Approach Delay, s/veh / LOS	23.2	C		11.3	B		46.4	D		47.4	D	
Intersection Delay, s/veh / LOS	29.0						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	3.2	C	3.3	C	3.2	C
Bicycle LOS Score / LOS	3.4	C	3.1	C	3.1	C	3.5	D

HCS 2010 Signalized Intersection Results Summary

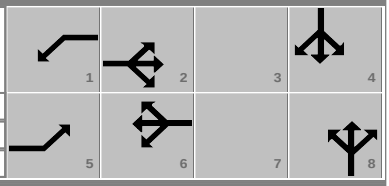
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	May 23, 2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	AM peak	PHF	0.87
Urban Street	41st Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	Terry Avenue	File Name	41 system am 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	5	1485	20	80	675	5	20	5	115	50	15	10

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	65	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	0.4	3.4	83.5	13.6	0.0	0.0
Yellow	3.9	0.0	3.9	3.6	0.0	0.0
Red	1.0	0.0	1.1	1.7	0.0	0.0



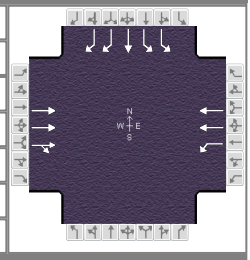
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	1.1	4.0	1.1	4.0		6.0		6.0
Phase Duration, s	5.3	88.5	8.6	91.8		18.9		18.9
Change Period, ($Y+R_c$), s	4.9	5.0	4.9	5.0		5.3		5.3
Max Allow Headway (*MAH*), s	4.1	0.0	4.1	0.0		4.3		4.3
Queue Clearance Time (g_s), s	2.1		3.7			8.2		13.0
Green Extension Time (g_e), s	0.0	0.0	0.2	0.0		0.6		0.6
Phase Call Probability	0.17		0.95			1.00		1.00
Max Out Probability	0.00		0.00			0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	6	844	843	94	401	400	23	86		57	23	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1706	1791	1787	1706	1791	1786	1396	1513		1319	1714	
Queue Service Time (g_s), s	0.1	23.7	23.7	1.7	16.9	17.0	1.7	6.2		4.9	1.4	
Cycle Queue Clearance Time (g_c), s	0.1	23.7	23.7	1.7	16.9	17.0	3.0	6.2		11.0	1.4	
Green Ratio (*g/C*)	0.72	0.72	0.72	0.76	0.75	0.75	0.12	0.12		0.12	0.12	
Capacity (*c*), veh/h	466	1288	1285	267	1340	1336	211	178		148	202	
Volume-to-Capacity Ratio (*X*)	0.012	0.655	0.656	0.353	0.299	0.299	0.109	0.483		0.388	0.114	
Back of Queue (*Q*), ft/ln (95 th percentile)	1.5	240.5	237.9	25.5	307.3	305.7	28.3	110.5		78	27.6	
Back of Queue (*Q*), veh/ln (95 th percentile)	0.1	9.5	9.5	1.0	12.2	12.2	1.1	4.4		3.1	1.1	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.03	0.00	0.00	0.43	0.00	0.00	0.47	0.00		3.12	0.00	
Uniform Delay (d_1), s/veh	5.6	5.9	5.9	7.5	13.0	13.1	47.1	47.9		53.0	45.7	
Incremental Delay (d_2), s/veh	0.0	1.6	1.6	0.7	0.5	0.5	0.2	2.0		1.6	0.2	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	5.6	7.4	7.4	8.2	13.6	13.7	47.3	49.9		54.6	46.0	
Level of Service (LOS)	A	A	A	A	B	B	D	D		D	D	
Approach Delay, s/veh / LOS	7.4	A		13.0	B		49.3	D		52.2	D	
Intersection Delay, s/veh / LOS	12.2						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.3	B	3.2	C	3.2	C
Bicycle LOS Score / LOS	3.5	C	2.8	C	2.6	B	2.6	B

HCS 2010 Signalized Intersection Results Summary

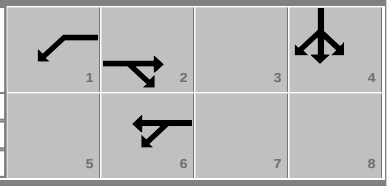
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	May 23, 2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	AM peak	PHF	0.87
Urban Street	41st Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	I-29 SB	File Name	41 system am 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		1520	200	75	480					350	0	315

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	95	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	3.6	77.3	18.3	0.0	0.0	0.0
Yellow	3.9	3.9	3.8	0.0	0.0	0.0
Red	1.8	1.8	1.6	0.0	0.0	0.0



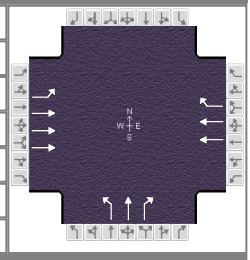
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6				4
Case Number		8.3	1.0	4.0				9.0
Phase Duration, s		83.0	9.3	92.3				23.7
Change Period, ($Y+R_c$), s		5.7	5.7	5.7				5.4
Max Allow Headway (*MAH*), s		0.0	5.1	0.0				6.1
Queue Clearance Time (g_s), s			3.7					15.5
Green Extension Time (g_e), s		0.0	0.1	0.0				2.8
Phase Call Probability			0.93					1.00
Max Out Probability			0.25					0.85

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6					7	4	14
Adjusted Flow Rate (*v*), veh/h		1017	757	83	534					402	0	218
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1181	1826	1706	1658					1656	1674	1276
Queue Service Time (g_s), s		25.1	25.9	1.7	16.0					13.5	0.0	9.1
Cycle Queue Clearance Time (g_c), s		25.1	25.9	1.7	16.0					13.5	0.0	9.1
Green Ratio (*g/C*)		0.67	0.67	0.71	0.50					0.16	0.16	0.16
Capacity (*c*), veh/h		1574	1217	234	1647					523	264	403
Volume-to-Capacity Ratio (*X*)		0.646	0.622	0.356	0.324					0.769	0.000	0.542
Back of Queue (*Q*), ft/ln (95 th percentile)		251.4	342.5	29.2	286.2					245.9	0	132.6
Back of Queue (*Q*), veh/ln (95 th percentile)		10.0	13.7	1.2	11.4					9.8	0.0	5.3
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00	0.00	0.15	0.00					0.50	0.00	0.27
Uniform Delay (d_1), s/veh		10.2	9.9	10.0	18.2					46.8	0.0	45.0
Incremental Delay (d_2), s/veh		1.5	1.7	1.2	0.5					6.4	0.0	2.4
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0					0.0	0.0	0.0
Control Delay (*d*), s/veh		11.7	11.6	11.2	18.6					53.2	0.0	47.4
Level of Service (LOS)		B	B	B	B					D		D
Approach Delay, s/veh / LOS	11.7	B		17.6	B		0.0			51.2	D	
Intersection Delay, s/veh / LOS	21.0						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	A	2.8	C	3.5	C	3.3	C
Bicycle LOS Score / LOS	2.9	C	2.5	B			3.6	D

HCS 2010 Signalized Intersection Results Summary

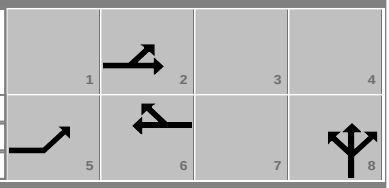
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	May 23, 2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	AM peak	PHF	0.86
Urban Street	41st Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	I-29 NB	File Name	41 system am 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	680	1190			400	220	155	0	260			

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	100	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	29.0	54.1	17.3	0.0	0.0	0.0
Yellow	3.9	3.9	3.6	0.0	0.0	0.0
Red	1.0	1.6	1.6	0.0	0.0	0.0



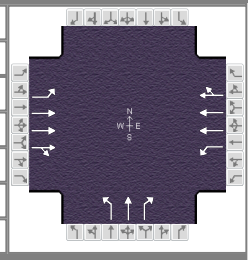
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		
Case Number	1.0	4.0		7.3		9.0		
Phase Duration, s	33.9	93.5		59.6		22.5		
Change Period, ($Y+R_c$), s	4.9	5.5		5.5		5.2		
Max Allow Headway (*MAH*), s	4.1	0.0		0.0		5.7		
Queue Clearance Time (g_s), s	25.8					15.9		
Green Extension Time (g_e), s	3.2	0.0		0.0		1.4		
Phase Call Probability	1.00					1.00		
Max Out Probability	0.03					0.51		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16	3	8	18			
Adjusted Flow Rate (*v*), veh/h	744	1302			437	142	180	0	180			
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1706	1623			1690	1449	1706	1674	1457			
Queue Service Time (g_s), s	23.8	14.7			10.2	7.3	11.7	0.0	13.9			
Cycle Queue Clearance Time (g_c), s	23.8	14.7			10.2	7.3	11.7	0.0	13.9			
Green Ratio (*g/C*)	0.73	0.76			0.47	0.47	0.15	0.15	0.15			
Capacity (*c*), veh/h	850	3692			1576	676	255	250	218			
Volume-to-Capacity Ratio (*X*)	0.875	0.353			0.277	0.210	0.707	0.000	0.828			
Back of Queue (*Q*), ft/ln (95 th percentile)	312.1	211.8			190	115.8	227	0	246.9			
Back of Queue (*Q*), veh/ln (95 th percentile)	12.4	8.4			7.5	4.6	9.0	0.0	9.9			
Queue Storage Ratio (*RQ*) (95 th percentile)	3.47	0.00			0.00	0.00	3.78	0.00	0.00			
Uniform Delay (d_1), s/veh	10.3	7.9			21.9	20.1	46.9	0.0	47.9			
Incremental Delay (d_2), s/veh	4.9	0.2			0.4	0.7	6.3	0.0	16.4			
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0	0.0	0.0	0.0			
Control Delay (*d*), s/veh	15.2	8.1			22.3	20.8	53.3	0.0	64.3			
Level of Service (LOS)	B	A			C	C	D		E			
Approach Delay, s/veh / LOS	10.7	B		21.9	C		58.8	E		0.0		
Intersection Delay, s/veh / LOS	18.7						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.0	B	3.6	D	3.3	C
Bicycle LOS Score / LOS	3.1	C	2.4	B	3.4	C		

HCS 2010 Signalized Intersection Results Summary

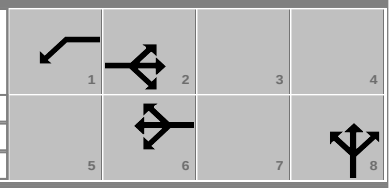
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	May 23, 2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	AM peak	PHF	0.82
Urban Street	41st Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	W. Empire Place	File Name	41 system am 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	5	1225	105	20	560	10	55	5	30			

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	5	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	2.0	91.5	6.5	0.0	0.0	0.0
Yellow	3.9	3.9	3.6	0.0	0.0	0.0
Red	1.0	1.8	1.8	0.0	0.0	0.0



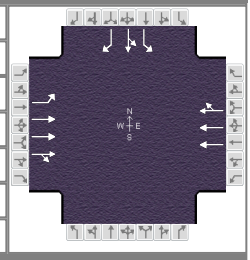
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		
Case Number		6.3	1.0	4.0		9.0		
Phase Duration, s		97.2	6.9	104.1		11.9		
Change Period, ($Y+R_c$), s		5.7	4.9	5.7		5.4		
Max Allow Headway (*MAH*), s		0.0	4.1	0.0		4.3		
Queue Clearance Time (g_s), s			2.3			6.5		
Green Extension Time (g_e), s		0.0	0.1	0.0		0.3		
Phase Call Probability			0.51			0.96		
Max Out Probability			0.00			0.00		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18			
Adjusted Flow Rate (*v*), veh/h	6	1042	507	22	415	207	67	6	24			
Adjusted Saturation Flow Rate (*s*), veh/h/ln	807	1791	1743	1706	1791	1783	1706	1791	1518			
Queue Service Time (g_s), s	0.2	8.6	8.6	0.3	2.9	2.9	4.5	0.4	1.8			
Cycle Queue Clearance Time (g_c), s	0.2	8.6	8.6	0.3	2.9	2.9	4.5	0.4	1.8			
Green Ratio (*g/C*)	0.79	0.79	0.79	0.82	0.85	0.85	0.06	0.06	0.06			
Capacity (*c*), veh/h	698	2825	1374	331	3039	1512	96	100	85			
Volume-to-Capacity Ratio (*X*)	0.009	0.369	0.369	0.066	0.137	0.137	0.702	0.061	0.287			
Back of Queue (*Q*), ft/ln (95 th percentile)	1	104	106.7	2.9	26.9	28.4	98.6	8	32.9			
Back of Queue (*Q*), veh/ln (95 th percentile)	0.0	4.1	4.3	0.1	1.1	1.1	3.9	0.3	1.3			
Queue Storage Ratio (*RQ*) (95 th percentile)	0.02	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00			
Uniform Delay (d_1), s/veh	2.2	3.0	3.0	2.3	2.0	2.0	53.8	51.9	52.5			
Incremental Delay (d_2), s/veh	0.0	0.3	0.7	0.1	0.1	0.2	9.0	0.3	1.8			
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
Control Delay (*d*), s/veh	2.2	3.3	3.7	2.4	2.1	2.2	62.8	52.1	54.4			
Level of Service (LOS)	A	A	A	A	A	A	E	D	D			
Approach Delay, s/veh / LOS	3.4	A		2.1	A		60.0	E		0.0		
Intersection Delay, s/veh / LOS	5.4						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	1.8	A	3.5	D	3.6	D
Bicycle LOS Score / LOS	3.2	C	2.4	B	3.0	C		

HCS 2010 Signalized Intersection Results Summary

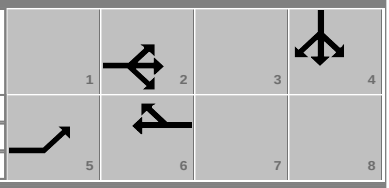
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	May 23, 2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	AM peak	PHF	0.83
Urban Street	41st Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	Shirley Avenue	File Name	41 system am 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	105	1115	15		490	90				50	15	45

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	110	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	4.2	88.4	7.8	0.0	0.0	0.0
Yellow	3.9	3.9	3.6	0.0	0.0	0.0
Red	1.0	1.4	1.8	0.0	0.0	0.0



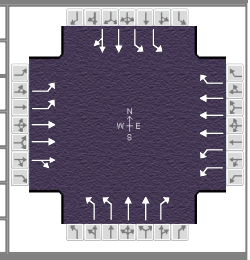
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				4
Case Number	1.0	4.0		8.3				9.0
Phase Duration, s	9.1	102.8		93.7				13.2
Change Period, ($Y+R_c$), s	4.9	5.3		5.3				5.4
Max Allow Headway (*MAH*), s	4.1	0.0		0.0				4.7
Queue Clearance Time (g_s), s	3.9							6.0
Green Extension Time (g_e), s	0.4	0.0		0.0				0.4
Phase Call Probability	0.98							0.97
Max Out Probability	0.00							0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12		6	16				7	4	14
Adjusted Flow Rate (*v*), veh/h	128	917	457		447	215				60	18	30
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1706	1791	1783		1791	1696				1706	1791	1518
Queue Service Time (g_s), s	1.9	4.7	4.7		8.7	4.8				4.0	1.1	2.2
Cycle Queue Clearance Time (g_c), s	1.9	4.7	4.7		8.7	4.8				4.0	1.1	2.2
Green Ratio (*g/C*)	0.82	0.84	0.84		0.76	0.76				0.07	0.07	0.07
Capacity (*c*), veh/h	658	3012	1499		2730	1293				114	120	102
Volume-to-Capacity Ratio (*X*)	0.195	0.305	0.305		0.164	0.167				0.528	0.151	0.297
Back of Queue (*Q*), ft/ln (95 th percentile)	17.3	42.4	46.5		63.3	66.6				83.4	23.5	40
Back of Queue (*Q*), veh/ln (95 th percentile)	0.7	1.7	1.9		2.5	2.7				3.3	0.9	1.6
Queue Storage Ratio (*RQ*) (95 th percentile)	0.35	0.00	0.00		0.00	0.00				0.76	0.00	0.37
Uniform Delay (d_1), s/veh	2.6	1.4	1.4		4.3	4.6				52.4	51.0	51.5
Incremental Delay (d_2), s/veh	0.1	0.2	0.5		0.1	0.3				4.5	0.7	1.9
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0		0.0	0.0				0.0	0.0	0.0
Control Delay (*d*), s/veh	2.7	1.6	1.8		4.5	4.9				56.9	51.7	53.5
Level of Service (LOS)	A	A	A		A	A				E	D	D
Approach Delay, s/veh / LOS	1.8	A		4.6	A		0.0			55.1	E	
Intersection Delay, s/veh / LOS	5.1						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	A	2.6	B	3.5	C	3.5	C
Bicycle LOS Score / LOS	2.7	B	2.6	B			3.0	C

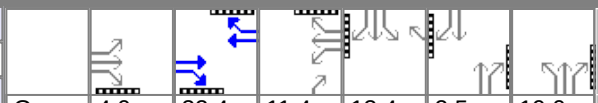
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	May 23, 2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	AM peak	PHF	0.83
Urban Street	41st Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	Louise Avenue	File Name	41 system am 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				

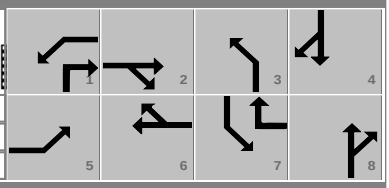


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	40	905	175	170	430	210	125	270	200	445	220	30

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	54	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	4.0	32.4	11.4	13.4	2.5	19.0
Yellow	3.6	3.6	3.6	3.5	3.5	3.5
Red	2.0	2.0	2.0	2.0	2.0	2.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	4.0	2.0	3.0	2.0	3.0	2.0	4.0
Phase Duration, s	9.6	47.6	17.0	55.0	32.5	24.5	26.9	18.9
Change Period, ($Y+R_c$), s	5.6	5.6	5.6	5.6	5.5	5.5	5.5	5.5
Max Allow Headway (*MAH*), s	4.1	0.0	4.1	0.0	5.3	5.3	4.1	4.6
Queue Clearance Time (g_s), s	3.8		8.9		5.9	14.4	20.3	11.5
Green Extension Time (g_e), s	0.1	0.0	2.5	0.0	4.9	4.2	1.1	1.3
Phase Call Probability	0.81		1.00		0.99	1.00	1.00	1.00
Max Out Probability	0.00		0.45		0.00	0.08	0.65	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	51	907	422	205	518	205	151	325	193	536	149	146
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1640	1774	1648	1640	1610	1502	1640	1688	1503	1640	1774	1708
Queue Service Time (g_s), s	1.8	25.5	25.4	6.9	6.3	5.7	3.9	10.0	12.4	18.3	9.3	9.5
Cycle Queue Clearance Time (g_c), s	1.8	25.5	25.4	6.9	6.3	5.7	3.9	10.0	12.4	18.3	9.3	9.5
Green Ratio (*g/C*)	0.03	0.36	0.36	0.10	0.43	0.61	0.23	0.16	0.26	0.18	0.12	0.12
Capacity (*c*), veh/h	114	1285	597	322	2057	917	763	552	393	606	205	197
Volume-to-Capacity Ratio (*X*)	0.446	0.706	0.706	0.635	0.252	0.223	0.197	0.590	0.490	0.885	0.728	0.741
Back of Queue (*Q*), ft/ln (95 th percentile)	34.9	422.2	407.2	128.8	102.1	79.1	70.4	188.3	133	315.9	194.5	189.8
Back of Queue (*Q*), veh/ln (95 th percentile)	1.4	16.6	16.3	5.1	4.0	3.2	2.8	7.4	5.3	12.4	7.7	7.6
Queue Storage Ratio (*RQ*) (95 th percentile)	0.13	0.00	0.00	0.42	0.00	0.30	0.33	0.00	0.63	0.89	0.00	0.00
Uniform Delay (d_1), s/veh	54.8	31.9	31.7	48.4	15.8	7.5	32.0	41.9	7.5	42.5	47.3	47.4
Incremental Delay (d_2), s/veh	2.6	3.2	6.6	2.1	0.3	0.6	0.1	1.7	1.6	11.2	5.9	6.5
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	57.5	35.0	38.3	50.5	16.0	8.0	32.2	43.6	9.2	53.8	53.2	53.9
Level of Service (LOS)	E	D	D	D	B	A	C	D	A	D	D	D
Approach Delay, s/veh / LOS	36.9	D		21.9	C		31.1	C		53.7	D	
Intersection Delay, s/veh / LOS	35.9						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.3	C	3.2	C	3.8	D	3.6	D
Bicycle LOS Score / LOS	3.5	D	3.1	C	3.7	D	3.7	D

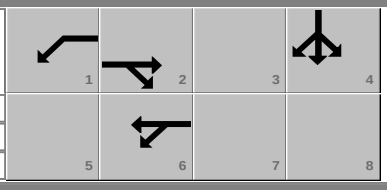
HCS 2010 Interchanges Results Summary

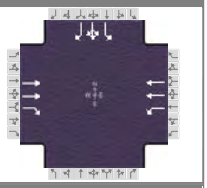
General Information				Interchange Information	
Agency	HDR			Interchange Type	Diamond
Analyst	RL	Analysis Date	5/23/2016	Segment Distance, ft	814
Jurisdiction	City of Sioux Falls	Duration,h	0.25	Freeway Direction	North-South
Intersection	I-29 SB	PHF	0.83	Arterial Direction	East-West
File Name	26 system am 2016.xus				
Project Description	I-29 Exit 77 (41st St.) IMJR				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h		1180	285	25	380					280	0	135
Intersection Two Demand (*v*), veh/h	610	850			215	250	190	0	50			

Signal One Information	
Cycle, s	92.0
Offset, s	36
Uncoordinated	No
Force Mode	Fixed

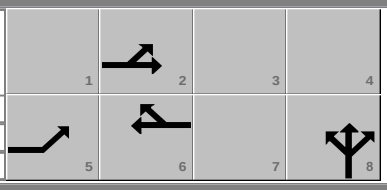
Green	2.2	54.6	17.6	0.0	0.0	0.0
Yellow	4.3	4.3	3.2	0.0	0.0	0.0
Red	1.8	1.8	2.2	0.0	0.0	0.0

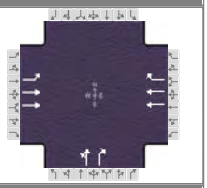




Signal Two Information	
Cycle, s	92.0
Offset, s	36
Uncoordinated	No
Force Mode	Fixed

Green	25.9	33.3	15.2	0.0	0.0	0.0
Yellow	4.3	4.3	3.2	0.0	0.0	0.0
Red	1.8	1.8	2.2	0.0	0.0	0.0





Interchange Results

O-D	O-D Demand Movements	Demand (veh/h)	Delay Movements	Delay (s)	LOS
A	NBL - NBU	241	NBL(II) + NBT(II) + WBT(I)	70.1	D
B	NBR	38	NBT(II)	33.5	C
C	SBR	96	SBT(I)	33.6	C
D	SBL - SBU	337	SBL(I) + SBT(I) - EBT(II)	148.9	F
E	EBL(INT) - SBU	723	EBL(II) + EBT(II) + EBT(I)	24.1	F
F	EBR(EXT)	202	EBT(I)	12.3	A
G	WBR(EXT)	193	WBT(II)	27.0	B
H	WBL(INT) - NBU	32	WBL(I) + WBT(I) + WBT(II)	36.2	C
I	EBT(INT) - SBL + SBU	670	EBT(I) + EBT(II)	65.2	F
J	WBT(INT) - NBL + NBU	245	WBT(I) + WBT(II)	40.6	C
K	NBT	0	NBT	-	-
L	SBT	0	SBT	-	-
M	NBU	0	NBU	-	-
N	SBU	0	SBU	-	-

Signalized Intersection One Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh		12.3	8.1	10.4	14.7					96.0	0.0	33.6
Level of Service (LOS)		B	A	B	B					F		C
Approach Delay, s/veh / LOS	11.8	B		14.5	B		0.0			82.1	F	
Intersection Delay, s/veh / LOS	24.2						C					

Signalized Intersection Two Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh	11.9	52.9			25.8	27.0		55.4	33.5			
Level of Service (LOS)	B	F			C	C		E	C			
Approach Delay, s/veh / LOS	35.8	D		26.3	C		52.4	D		0.0		
Intersection Delay, s/veh / LOS	35.8						D					

This Urban Streets text report was created on June 10, 2016 at 08:15:14

Period number = 1

Chapter 17 Input

URBAN STREET PARAMETERS

Number of Intersections	4
Number of Segments	3
Analysis period duration, h	0.25
System cycle length, s	92
Urban street forward direction	EB
Sneakers per cycle, veh	2
Saturation flow rate, veh/h/ln	1900
Stored vehicle lane length, ft	25
Detected vehicle length, ft	17
Queue length percent	95
Critical merge gap, s	3.7
Stop threshold speed, mph	5
Acceleration rate, ft/s/s	3.5
Decel. rate (signal), ft/s/s	4
Minimum headway in a platoon, s/veh	1.5
Maximum headway in a platoon, s/veh	3.6
Number of iterations	15
Length of left-turn bay (access pt.), ft	250
Decel. rate (access pt.), ft/s/s	6.7
Right-turn speed (access pt.), ft/s	20
Critical gap from major left (access pt.), s	4.1
Follow-up time from major left (access pt.), s	2.2
Right-turn equivalency factor (access pt.)	2.2
Stored heavy vehicle lane length, ft	45
Proportion of peds who push button	0.65
Critical gap for permissive left-turn, s	4.5
Follow-up time for permissive left-turn, s	2.5
Calibration factor for platoon dispersion	0.14
Average ratio of speed limit to free-flow speed	0.9

BASIC SEGMENT INFORMATION

Seg	Spd Lmt		TH Lanes		Seg Len		IntWid		LenRM		PctCurb		Other Dly	
Num	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB
1	35	35	2	2	1152	1152	50	50	0	0	70	70	0	0
2	35	35	2	2	814	814	50	50	0	0	70	70	0	0
3	35	35	2	2	1366	1366	50	50	0	0	70	70	0	0

ORIGIN-DESTINATION SEED PROPORTIONS - Forward Direction

	Cross LT	Major TH	Cross RT	MidEntry
Downstream Left	0.02	0.1	0.05	0.02
Downstream Thru	0.91	0.78	0.92	0.97
Downstream Right	0.05	0.1	0.02	0.01
Mid-segment Exit	0.02	0.02	0.01	0

ORIGIN-DESTINATION SEED PROPORTIONS - Reverse Direction

	Cross LT	Major TH	Cross RT	MidEntry
Downstream Left	0.02	0.1	0.05	0.02
Downstream Thru	0.91	0.78	0.92	0.97
Downstream Right	0.05	0.1	0.02	0.01
Mid-segment Exit	0.02	0.02	0.01	0

ACCESS POINT DATA

SEGMENT 1

Number of access points: 0

SEGMENT 2

Number of access points: 0

SEGMENT 3

Number of access points: 0

Global Output

SEGMENT DATA

Seg.No.	Movement	EB LT 5	EB TH 2	EB RT 12	WB LT 1	WB TH 6	WB RT 16
1	Bay/Lane Spillback Time, h	999	999	999	999	999	999
1	ShrdLane Spillback Time, h			999	999		
1	Base Free-Flow Speed, mph		41.72			41.72	
1	Running Time, s		22.83			22.01	
1	Running Speed, mph		34.41			35.68	
1	Through Delay, s/veh		12.29			8.03	
1	Travel Speed, mph		22.37			26.15	
1	Stop Rate, stops/veh		0.43			0.34	
1	Spatial Stop Rate, stops/mi		1.96			1.55	
1	Through vol/cap ratio		0.68			0.25	
1	Percent of Base FFS		53.62			62.67	
1	Level of Service		C			C	
1	Automobile Perception Score		2.67			2.37	
2	Bay/Lane Spillback Time, h	999	1.72	999	999	999	999
2	ShrdLane Spillback Time, h	999.1			999		
2	Base Free-Flow Speed, mph		41.72			41.72	
2	Running Time, s		17.79			17.11	
2	Running Speed, mph		31.19			32.45	
2	Through Delay, s/veh		52.92			14.73	
2	Travel Speed, mph		7.85			17.44	
2	Stop Rate, stops/veh		1.24			0.69	
2	Spatial Stop Rate, stops/mi		8.06			4.5	
2	Through vol/cap ratio		1.04			0.22	
2	Percent of Base FFS		18.81			41.79	
2	Level of Service		F			D	
2	Automobile Perception Score		3.56			3.13	
3	Bay/Lane Spillback Time, h	999	999	999	999	999	999
3	ShrdLane Spillback Time, h	999		999			999
3	Base Free-Flow Speed, mph		41.72			41.72	
3	Running Time, s		24.37			25.22	
3	Running Speed, mph		38.22			36.94	
3	Through Delay, s/veh		7.73			25.83	
3	Travel Speed, mph		29.01			18.25	
3	Stop Rate, stops/veh		0.31			0.73	
3	Spatial Stop Rate, stops/mi		1.22			2.8	
3	Through vol/cap ratio		0.31			0.24	
3	Percent of Base FFS		69.54			43.74	
3	Level of Service		B			D	
3	Automobile Perception Score		2.32			2.58	

Facility Travel Time, s	137.92	112.91
Facility Travel Speed, mph	16.47	20.12
Facility Spatial Stop Rate, veh/mi	3.15	2.79
Facility Base Free Flow Speed, mph	41.72	41.72
Facility Percent Base Free Flow Speed	39.48	48.23
Facility Level of Service	E	D
Facility Automobile Perception Score	2.67	2.61
Facility Pedestrian Space	Infinity	Infinity
Facility Pedestrian Travel Speed	4.4	4.4
Facility Pedestrian LOS Score	3.62	3.35
Facility Pedestrian LOS	D	C
Facility Bicycle Travel Speed	13.46	12.55
Facility Bicycle LOS Score	3.58	3.41
Facility Bicycle LOS	D	C
Facility Transit Travel Speed	22.37	26.17
Facility Transit LOS Score	1.81	1.63
Facility Transit LOS	A	A
SPILLBACK TIME, h	1.72	

Multimodal Results

1	Roadway crossing difficulty factor	1.02	1.2
1	Ped LOS Score for Link	3.78	2.57
1	Ped LOS Score for Intersection	1.95	2.33
1	Ped LOS Score for Segment	3.31	3.52

1	Ped Segment LOS	C	D
1	Bicycle LOS Score for Link	3.84	3.36
1	Indicator Variable	1	1
1	Bicycle LOS Score for Intersection	1.97	1.27
1	Number of access point approaches	0	0
1	Segment Length, ft	1152	1152
1	Bicycle LOS Score for Segment	3.54	3.43
1	Bicycle Segment LOS	D	C
1	Transit Wait-Ride Score	3.27	3.48
1	Ped LOS Score for Link	3.78	2.57
1	Transit LOS Score for Segment	1.66	1.17
1	Transit Segment LOS	A	A
2	Roadway crossing difficulty factor	1.2	1.2
2	Ped LOS Score for Link	3.68	2.33
2	Ped LOS Score for Intersection	1.96	2.18
2	Ped LOS Score for Segment	3.85	3.39
2	Ped Segment LOS	D	C
2	Bicycle LOS Score for Link	3.78	3.19
2	Indicator Variable	1	1
2	Bicycle LOS Score for Intersection	2.24	1.3
2	Number of access point approaches	0	0
2	Segment Length, ft	814	814
2	Bicycle LOS Score for Segment	3.56	3.4
2	Bicycle Segment LOS	D	C
2	Transit Wait-Ride Score	2.17	2.97
2	Ped LOS Score for Link	3.68	2.33
2	Transit LOS Score for Segment	3.29	1.9
2	Transit Segment LOS	C	A
3	Roadway crossing difficulty factor	1.2	1.11
3	Ped LOS Score for Link	3.08	2.54
3	Ped LOS Score for Intersection	2.42	2.09
3	Ped LOS Score for Segment	3.74	3.18
3	Ped Segment LOS	D	C
3	Bicycle LOS Score for Link	3.63	3.33
3	Indicator Variable	1	1
3	Bicycle LOS Score for Intersection	2.92	0.94
3	Number of access point approaches	0	0
3	Segment Length, ft	1366	1366
3	Bicycle LOS Score for Segment	3.63	3.41
3	Bicycle Segment LOS	D	C
3	Transit Wait-Ride Score	3.61	3.02
3	Ped LOS Score for Link	3.08	2.54
3	Transit LOS Score for Segment	1.05	1.85
3	Transit Segment LOS	A	A

ACCESS POINT DATA

SEGMENT 1

SEGMENT 2

SEGMENT 3

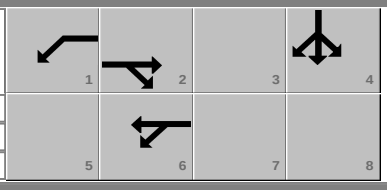
HCS 2010 Interchanges Results Summary

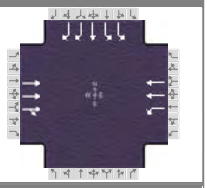
General Information				Interchange Information	
Agency	HDR			Interchange Type	Diamond
Analyst	RL	Analysis Date	May 23, 2016	Segment Distance, ft	513
Jurisdiction	City of Sioux Falls	Duration,h	0.25	Freeway Direction	North-South
Intersection	I-29 SB	PHF	0.87	Arterial Direction	East-West
File Name	41 system am 2016.xus				
Project Description	I-29 Exit 77 (41st St.) IMJR				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h		1520	200	75	480					350	0	315
Intersection Two Demand (*v*), veh/h	680	1190			400	220	155	0	260			

Signal One Information	
Cycle, s	116.0
Offset, s	95
Uncoordinated	No
Force Mode	Fixed

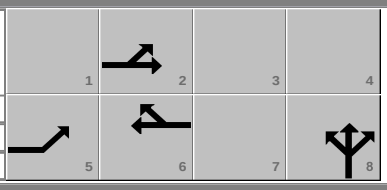
Green	3.6	77.3	18.3	0.0	0.0	0.0
Yellow	3.9	3.9	3.8	0.0	0.0	0.0
Red	1.8	1.8	1.6	0.0	0.0	0.0

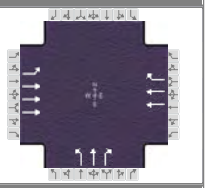




Signal Two Information	
Cycle, s	116.0
Offset, s	95
Uncoordinated	No
Force Mode	Fixed

Green	29.0	54.1	17.3	0.0	0.0	0.0
Yellow	3.9	3.9	3.6	0.0	0.0	0.0
Red	1.0	1.6	1.6	0.0	0.0	0.0





Interchange Results

O-D	O-D Demand Movements	Demand (veh/h)	Delay Movements	Delay (s)	LOS
A	NBL - NBU	180	NBL(II) + NBT(II) + WBT(I)	71.9	F
B	NBR	180	NBT(II)	64.3	D
C	SBR	218	SBT(I)	47.4	C
D	SBL - SBU	402	SBL(I) + SBT(I) - EBT(II)	61.3	D
E	EBL(INT) - SBU	744	EBL(II) + EBT(II) + EBT(I)	26.9	F
F	EBR(EXT)	130	EBT(I)	11.7	A
G	WBR(EXT)	142	WBT(II)	20.8	B
H	WBL(INT) - NBU	83	WBL(I) + WBT(I) + WBT(II)	33.5	C
I	EBT(INT) - SBL + SBU	900	EBT(I) + EBT(II)	19.7	B
J	WBT(INT) - NBL + NBU	353	WBT(I) + WBT(II)	40.9	C
K	NBT	0	NBT	-	-
L	SBT	0	SBT	-	-
M	NBU	0	NBU	-	-
N	SBU	0	SBU	-	-

Signalized Intersection One Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh		11.7	11.6	11.2	18.6					53.2	0.0	47.4
Level of Service (LOS)		B	B	B	B					D		D
Approach Delay, s/veh / LOS	11.7	B		17.6	B		0.0			51.2	D	
Intersection Delay, s/veh / LOS	21.0						C					

Signalized Intersection Two Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh	15.2	8.1			22.3	20.8	53.3	0.0	64.3			
Level of Service (LOS)	B	A			C	C	D		E			
Approach Delay, s/veh / LOS	10.7	B		21.9	C		58.8	E		0.0		
Intersection Delay, s/veh / LOS	18.7						B					

This Urban Streets text report was created on June 10, 2016 at 08:32:00

Period number = 1

Chapter 17 Input

URBAN STREET PARAMETERS

Number of Intersections	7
Number of Segments	6
Analysis period duration, h	0.25
System cycle length, s	116
Urban street forward direction	EB
Sneakers per cycle, veh	2
Saturation flow rate, veh/h/ln	1900
Stored vehicle lane length, ft	25
Detected vehicle length, ft	17
Queue length percent	95
Critical merge gap, s	3.7
Stop threshold speed, mph	5
Acceleration rate, ft/s/s	3.5
Decel. rate (signal), ft/s/s	4
Minimum headway in a platoon, s/veh	1.5
Maximum headway in a platoon, s/veh	3.6
Number of iterations	15
Length of left-turn bay (access pt.), ft	250
Decel. rate (access pt.), ft/s/s	6.7
Right-turn speed (access pt.), ft/s	20
Critical gap from major left (access pt.), s	4.1
Follow-up time from major left (access pt.), s	2.2
Right-turn equivalency factor (access pt.)	2.2
Stored heavy vehicle lane length, ft	45
Proportion of peds who push button	0.65
Critical gap for permissive left-turn, s	4.5
Follow-up time for permissive left-turn, s	2.5
Calibration factor for platoon dispersion	0.14
Average ratio of speed limit to free-flow speed	0.9

BASIC SEGMENT INFORMATION

Seg	Spd Lmt		TH Lanes		Seg Len		IntWid		LenRM		PctCurb		Other Dly	
Num	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB
1	35	35	2	2	1224	1224	50	50	0	0	70	70	0	0
2	35	35	3	2	1316	1316	50	50	0	0	70	70	0	0
3	35	35	3	2	513	513	50	50	0	0	70	70	0	0
4	35	35	3	2	731	731	50	50	0	0	70	70	0	0
5	35	35	3	3	599	599	50	50	0	0	70	70	0	0
6	35	35	3	3	884	884	50	50	0	0	70	70	0	0

ORIGIN-DESTINATION SEED PROPORTIONS - Forward Direction

	Cross LT	Major TH	Cross RT	MidEntry
Downstream Left	0.02	0.1	0.05	0.02
Downstream Thru	0.91	0.78	0.92	0.97
Downstream Right	0.05	0.1	0.02	0.01
Mid-segment Exit	0.02	0.02	0.01	0

ORIGIN-DESTINATION SEED PROPORTIONS - Reverse Direction

	Cross LT	Major TH	Cross RT	MidEntry
Downstream Left	0.02	0.1	0.05	0.02
Downstream Thru	0.91	0.78	0.92	0.97
Downstream Right	0.05	0.1	0.02	0.01
Mid-segment Exit	0.02	0.02	0.01	0

ACCESS POINT DATA

SEGMENT 1

Number of access points: 0

SEGMENT 2

Number of access points: 0

SEGMENT 3

Number of access points: 0

SEGMENT 4

Number of access points: 0

SEGMENT 5

Number of access points: 0

SEGMENT 6

Number of access points: 0

Global Output

SEGMENT DATA

Seg.No.	Movement	EB LT 5	EB TH 2	EB RT 12	WB LT 1	WB TH 6	WB RT 16
1	Bay/Lane Spillback Time, h	999	999	999	999	999	999
1	ShrdLane Spillback Time, h	999			999		999
1	Base Free-Flow Speed, mph		41.72			41.72	
1	Running Time, s		23.91			23.21	
1	Running Speed, mph		34.91			35.95	
1	Through Delay, s/veh		7.45			9.27	
1	Travel Speed, mph		26.62			25.69	
1	Stop Rate, stops/veh		0.23			0.22	
1	Spatial Stop Rate, stops/mi		1.01			0.97	
1	Through vol/cap ratio		0.66			0.44	
1	Percent of Base FFS		63.8			61.58	
1	Level of Service		C			C	
1	Automobile Perception Score		2.29			2.28	
2	Bay/Lane Spillback Time, h	999	999	999	999	999	999
2	ShrdLane Spillback Time, h				999		
2	Base Free-Flow Speed, mph		41.72			41.72	
2	Running Time, s		24.94			24.66	
2	Running Speed, mph		35.98			36.38	
2	Through Delay, s/veh		11.66			13.62	
2	Travel Speed, mph		24.52			23.44	
2	Stop Rate, stops/veh		0.39			0.6	
2	Spatial Stop Rate, stops/mi		1.57			2.42	
2	Through vol/cap ratio		0.64			0.3	
2	Percent of Base FFS		58.77			56.18	
2	Level of Service		C			C	
2	Automobile Perception Score		2.6			2.52	
3	Bay/Lane Spillback Time, h	999	999	999	999	999	999
3	ShrdLane Spillback Time, h	999			999		
3	Base Free-Flow Speed, mph		41.72			41.72	
3	Running Time, s		13.9			13.59	
3	Running Speed, mph		25.16			25.74	
3	Through Delay, s/veh		8.06			18.64	
3	Travel Speed, mph		15.92			10.85	
3	Stop Rate, stops/veh		0.38			0.83	
3	Spatial Stop Rate, stops/mi		3.87			8.56	
3	Through vol/cap ratio		0.35			0.32	
3	Percent of Base FFS		38.17			26.01	
3	Level of Service		E			F	
3	Automobile Perception Score		2.76			3.92	
4	Bay/Lane Spillback Time, h	999	999	999	999	999	999
4	ShrdLane Spillback Time, h	999					
4	Base Free-Flow Speed, mph		41.72			41.72	
4	Running Time, s		16.27			16.09	
4	Running Speed, mph		30.63			30.98	
4	Through Delay, s/veh		3.4			22.3	
4	Travel Speed, mph		25.33			12.98	
4	Stop Rate, stops/veh		0.14			0.6	
4	Spatial Stop Rate, stops/mi		1			4.31	
4	Through vol/cap ratio		0.37			0.28	
4	Percent of Base FFS		60.72			31.12	
4	Level of Service		C			E	
4	Automobile Perception Score		2.29			2.84	
5	Bay/Lane Spillback Time, h	999	999	999	999	999	999

5	ShrdLane Spillback Time, h	999	999
5	Base Free-Flow Speed, mph	41.72	41.72
5	Running Time, s	14.63	14.4
5	Running Speed, mph	27.92	28.37
5	Through Delay, s/veh	1.68	2.09
5	Travel Speed, mph	25.04	24.77
5	Stop Rate, stops/veh	0.07	0.09
5	Spatial Stop Rate, stops/mi	0.58	0.8
5	Through vol/cap ratio	0.3	0.14
5	Percent of Base FFS	60.02	59.36
5	Level of Service	C	C
5	Automobile Perception Score	2.23	2.47

6	Bay/Lane Spillback Time, h	999	999	999	999	999	999
6	ShrdLane Spillback Time, h	999					
6	Base Free-Flow Speed, mph	41.72			41.72		
6	Running Time, s	18.29			18.04		
6	Running Speed, mph	32.96			33.41		
6	Through Delay, s/veh	35.73			4.56		
6	Travel Speed, mph	11.16			26.67		
6	Stop Rate, stops/veh	0.78			0.2		
6	Spatial Stop Rate, stops/mi	4.64			1.19		
6	Through vol/cap ratio	0.71			0.16		
6	Percent of Base FFS	26.74			63.92		
6	Level of Service	F			C		
6	Automobile Perception Score	2.9			2.32		

Facility Travel Time, s	179.91	180.47
Facility Travel Speed, mph	19.96	19.9
Facility Spatial Stop Rate, veh/mi	1.99	2.55
Facility Base Free Flow Speed, mph	41.72	41.72
Facility Percent Base Free Flow Speed	47.84	47.7
Facility Level of Service	D	D
Facility Automobile Perception Score	2.48	2.54
Facility Pedestrian Space	Infinity	Infinity
Facility Pedestrian Travel Speed	4.4	4.4
Facility Pedestrian LOS Score	3.75	3.56
Facility Pedestrian LOS	D	D
Facility Bicycle Travel Speed	13.07	12.51
Facility Bicycle LOS Score	3.7	3.55
Facility Bicycle LOS	D	D
Facility Transit Travel Speed	26.61	25.69
Facility Transit LOS Score	1.3	1.56
Facility Transit LOS	A	A
SPILLBACK TIME, h	999	

Multimodal Results

1	Roadway crossing difficulty factor	1.2	1.2
1	Ped LOS Score for Link	3.75	2.78
1	Ped LOS Score for Intersection	2.45	3.16
1	Ped LOS Score for Segment	4	3.81
1	Ped Segment LOS	D	D
1	Bicycle LOS Score for Link	3.84	3.49
1	Indicator Variable	1	1
1	Bicycle LOS Score for Intersection	3.49	3.06
1	Number of access point approaches	0	0
1	Segment Length, ft	1224	1224
1	Bicycle LOS Score for Segment	3.82	3.64
1	Bicycle Segment LOS	D	D
1	Transit Wait-Ride Score	3.5	3.45
1	Ped LOS Score for Link	3.75	2.78
1	Transit LOS Score for Segment	1.32	1.24
1	Transit Segment LOS	A	A
2	Roadway crossing difficulty factor	1.17	1.2
2	Ped LOS Score for Link	3.25	2.87
2	Ped LOS Score for Intersection	1.96	2.34
2	Ped LOS Score for Segment	3.61	3.64
2	Ped Segment LOS	D	D
2	Bicycle LOS Score for Link	3.69	3.53
2	Indicator Variable	1	1

2	Bicycle LOS Score for Intersection	2.86	2.79
2	Number of access point approaches	0	0
2	Segment Length, ft	1316	1316
2	Bicycle LOS Score for Segment	3.63	3.59
2	Bicycle Segment LOS	D	D
2	Transit Wait-Ride Score	3.39	3.34
2	Ped LOS Score for Link	3.25	2.87
2	Transit LOS Score for Segment	1.4	1.43
2	Transit Segment LOS	A	A
3	Roadway crossing difficulty factor	1.2	1.2
3	Ped LOS Score for Link	3.13	2.29
3	Ped LOS Score for Intersection	2.32	2.79
3	Ped LOS Score for Segment	3.73	3.54
3	Ped Segment LOS	D	D
3	Bicycle LOS Score for Link	3.49	3.11
3	Indicator Variable	1	1
3	Bicycle LOS Score for Intersection	3.14	2.47
3	Number of access point approaches	0	0
3	Segment Length, ft	513	513
3	Bicycle LOS Score for Segment	3.66	3.48
3	Bicycle Segment LOS	D	C
3	Transit Wait-Ride Score	2.86	2.46
3	Ped LOS Score for Link	3.13	2.29
3	Transit LOS Score for Segment	2.17	2.66
3	Transit Segment LOS	B	B
4	Roadway crossing difficulty factor	1.2	1.2
4	Ped LOS Score for Link	2.91	2.48
4	Ped LOS Score for Intersection	2.4	2
4	Ped LOS Score for Segment	3.67	3.4
4	Ped Segment LOS	D	C
4	Bicycle LOS Score for Link	3.53	3.31
4	Indicator Variable	1	1
4	Bicycle LOS Score for Intersection	3.21	2.36
4	Number of access point approaches	0	0
4	Segment Length, ft	731	731
4	Bicycle LOS Score for Segment	3.69	3.5
4	Bicycle Segment LOS	D	C
4	Transit Wait-Ride Score	3.44	2.64
4	Ped LOS Score for Link	2.91	2.48
4	Transit LOS Score for Segment	1.28	2.41
4	Transit Segment LOS	A	B
5	Roadway crossing difficulty factor	1.2	1.2
5	Ped LOS Score for Link	2.78	2.14
5	Ped LOS Score for Intersection	1.95	1.82
5	Ped LOS Score for Segment	3.5	3.22
5	Ped Segment LOS	D	C
5	Bicycle LOS Score for Link	3.43	3.02
5	Indicator Variable	1	1
5	Bicycle LOS Score for Intersection	2.7	2.4
5	Number of access point approaches	0	0
5	Segment Length, ft	599	599
5	Bicycle LOS Score for Segment	3.56	3.45
5	Bicycle Segment LOS	D	C
5	Transit Wait-Ride Score	3.42	3.41
5	Ped LOS Score for Link	2.78	2.14
5	Transit LOS Score for Segment	1.28	1.21
5	Transit Segment LOS	A	A
6	Roadway crossing difficulty factor	1.2	1.2
6	Ped LOS Score for Link	2.83	2.3
6	Ped LOS Score for Intersection	3.29	2.58
6	Ped LOS Score for Segment	3.88	3.49
6	Ped Segment LOS	D	C
6	Bicycle LOS Score for Link	3.51	3.16
6	Indicator Variable	1	1
6	Bicycle LOS Score for Intersection	3.52	2.61
6	Number of access point approaches	0	0
6	Segment Length, ft	884	884
6	Bicycle LOS Score for Segment	3.78	3.51
6	Bicycle Segment LOS	D	D

6	Transit Wait-Ride Score	3.85	3.51
6	Ped LOS Score for Link	2.83	2.3
6	Transit LOS Score for Segment	0.64	1.09
6	Transit Segment LOS	A	A

ACCESS POINT DATA

SEGMENT 1

SEGMENT 2

SEGMENT 3

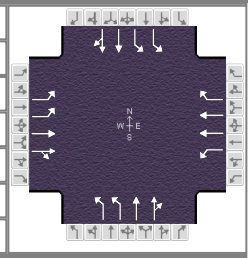
SEGMENT 4

SEGMENT 5

SEGMENT 6

HCS 2010 Signalized Intersection Results Summary

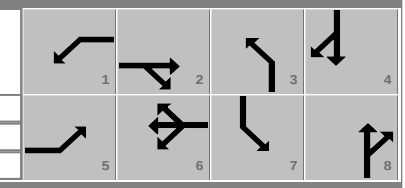
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	May 23, 2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	PM peak	PHF	0.95
Urban Street	26th Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	Marion Road	File Name	26-marion pm 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	125	405	105	170	840	295	285	505	80	250	585	165

Signal Information			
Cycle, s	91.5	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	5.6	3.1	26.2	10.9	4.2	15.1
Yellow	3.9	0.0	3.9	3.9	3.9	3.9
Red	1.0	0.0	2.0	1.0	1.9	1.0



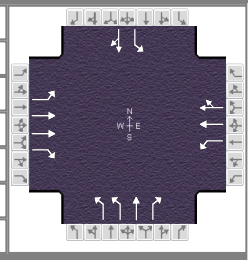
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	4.0	1.1	3.0	2.0	4.0	2.0	4.0
Phase Duration, s	10.5	32.1	13.6	35.2	15.8	25.8	20.0	30.0
Change Period, ($Y+R_c$), s	4.9	5.9	4.9	5.9	4.9	5.8	5.8	5.8
Max Allow Headway (*MAH*), s	4.1	5.1	4.1	5.1	5.1	5.1	5.1	5.1
Queue Clearance Time (g_s), s	5.6	12.9	8.6	23.8	10.0	16.3	8.7	19.6
Green Extension Time (g_e), s	0.2	9.9	0.2	5.5	0.9	3.1	2.7	4.7
Phase Call Probability	0.96	1.00	0.99	1.00	1.00	1.00	1.00	1.00
Max Out Probability	0.11	0.42	1.00	0.83	0.70	0.05	0.97	0.39

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	132	252	243	179	884	184	300	296	288	263	369	352
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1656	1791	1703	1706	1705	1490	1656	1791	1734	1656	1791	1700
Queue Service Time (g_s), s	3.6	10.7	10.9	6.6	21.8	8.8	8.0	14.2	14.3	6.7	17.5	17.6
Cycle Queue Clearance Time (g_c), s	3.6	10.7	10.9	6.6	21.8	8.8	8.0	14.2	14.3	6.7	17.5	17.6
Green Ratio (*g/C*)	0.06	0.29	0.29	0.38	0.32	0.32	0.12	0.22	0.22	0.16	0.26	0.26
Capacity (*c*), veh/h	202	512	487	393	1092	477	395	391	379	516	475	450
Volume-to-Capacity Ratio (*X*)	0.653	0.492	0.498	0.456	0.810	0.386	0.760	0.756	0.760	0.510	0.778	0.781
Back of Queue (*Q*), ft/ln (95 th percentile)	69	203.2	196.4	117.5	354.4	124	155.9	266.1	259.2	122.8	317.3	304.3
Back of Queue (*Q*), veh/ln (95 th percentile)	2.7	8.1	7.9	4.7	14.1	5.0	6.2	10.6	10.4	4.9	12.6	12.2
Queue Storage Ratio (*RQ*) (95 th percentile)	0.34	0.00	0.00	0.84	0.00	1.92	0.69	0.00	0.00	0.61	0.00	0.00
Uniform Delay (d_1), s/veh	42.0	27.2	27.2	20.3	28.6	20.1	39.0	33.5	33.5	35.4	31.1	31.2
Incremental Delay (d_2), s/veh	3.5	1.0	1.1	0.8	4.3	0.7	4.6	4.2	4.5	1.2	5.5	5.8
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	45.6	28.2	28.3	21.1	32.9	20.8	43.7	37.7	38.0	36.6	36.6	37.0
Level of Service (LOS)	D	C	C	C	C	C	D	D	D	D	D	D
Approach Delay, s/veh / LOS	31.9	C		29.4	C		39.8	D		36.8	D	
Intersection Delay, s/veh / LOS	34.2						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.2	C	3.3	C	3.4	C	3.3	C
Bicycle LOS Score / LOS	3.1	C	2.4	B	3.4	C	3.4	C

HCS 2010 Signalized Intersection Results Summary

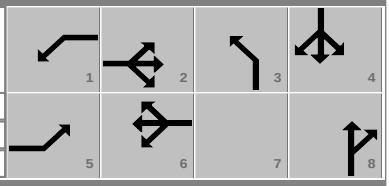
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	5/23/2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	PM peak	PHF	0.95
Urban Street	26th Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	Lorraine Dr.	File Name	26 system pm 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	10	775	25	150	1415	25	30	5	85	35	5	25

Signal Information			
Cycle, s	92.0	Reference Phase	2
Offset, s	3	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	0.9	4.2	56.2	2.2	5.1	0.0
Yellow	4.0	0.0	4.3	3.2	3.2	0.0
Red	1.0	0.0	1.7	3.0	3.0	0.0



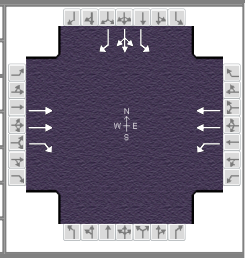
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8		4
Case Number	1.1	3.0	1.1	4.0	2.0	3.0		6.3
Phase Duration, s	5.9	62.2	10.1	66.4	8.4	19.7		11.3
Change Period, ($Y+R_c$), s	5.0	6.0	5.0	6.0	6.2	6.2		6.2
Max Allow Headway (MAH), s	4.1	0.0	4.1	0.0	4.7	4.8		4.8
Queue Clearance Time (g_s), s	2.2		5.0		2.9	4.9		4.3
Green Extension Time (g_e), s	0.0	0.0	0.2	0.0	0.0	0.3		0.2
Phase Call Probability	0.24		0.98		0.55	0.98		0.95
Max Out Probability	0.00		0.39		1.00	0.00		0.81

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	11	816	16	160	765	763	32	5	53	37	21	
Adjusted Saturation Flow Rate (s), veh/h/ln	1706	1705	1518	1706	1791	1784	1656	1791	1494	1411	1571	
Queue Service Time (g_s), s	0.2	6.0	0.2	3.0	19.1	19.0	0.9	0.2	2.9	2.3	1.2	
Cycle Queue Clearance Time (g_c), s	0.2	6.0	0.2	3.0	19.1	19.0	0.9	0.2	2.9	2.3	1.2	
Green Ratio (g/C)	0.62	0.61	0.61	0.68	0.66	0.66	0.02	0.15	0.15	0.06	0.06	
Capacity (c), veh/h	242	2083	927	541	1175	1171	80	262	219	156	87	
Volume-to-Capacity Ratio (X)	0.043	0.392	0.017	0.296	0.651	0.651	0.396	0.020	0.240	0.236	0.243	
Back of Queue (Q), ft/ln (95 th percentile)	3.3	75.1	2.7	43.3	209.4	207	17.8	4.7	48.6	38.7	22.7	
Back of Queue (Q), veh/ln (95 th percentile)	0.1	3.0	0.1	1.7	8.3	8.2	0.7	0.2	1.9	1.5	0.9	
Queue Storage Ratio (RQ) (95 th percentile)	0.03	0.00	0.01	0.36	0.00	0.00	0.09	0.00	0.44	1.55	0.00	
Uniform Delay (d_1), s/veh	8.2	3.9	3.3	5.8	6.3	6.2	44.2	33.6	34.7	42.2	41.6	
Incremental Delay (d_2), s/veh	0.1	0.6	0.0	0.2	2.0	2.0	3.8	0.0	0.7	0.9	1.7	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay (d), s/veh	8.3	4.4	3.4	6.0	8.3	8.2	48.0	33.6	35.4	43.1	43.4	
Level of Service (LOS)	A	A	A	A	A	A	D	C	D	D	D	
Approach Delay, s/veh / LOS	4.5	A		8.0	A		39.8	D		43.2	D	
Intersection Delay, s/veh / LOS	8.7						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.7	B	2.3	B	3.2	C	3.3	C
Bicycle LOS Score / LOS	1.2	A	1.9	A	0.6	A	0.6	A

HCS 2010 Signalized Intersection Results Summary

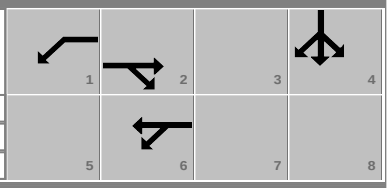
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	5/23/2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	PM peak	PHF	0.96
Urban Street	26th Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	I-29 SB	File Name	26 system pm 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		680	215	95	1020					575	0	570

Signal Information			
Cycle, s	92.0	Reference Phase	2
Offset, s	15	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	5.0	32.8	36.7	0.0	0.0	0.0
Yellow	4.3	4.3	3.2	0.0	0.0	0.0
Red	1.8	1.8	2.2	0.0	0.0	0.0



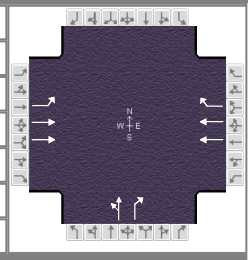
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6				4
Case Number		7.3	1.0	4.0				9.0
Phase Duration, s		38.9	11.1	49.9				42.1
Change Period, ($Y+R_c$), s		6.1	6.1	6.1				5.4
Max Allow Headway (*MAH*), s		0.0	1.1	0.0				5.6
Queue Clearance Time (g_s), s			5.3					31.9
Green Extension Time (g_e), s		0.0	0.0	0.0				4.7
Phase Call Probability			0.93					1.00
Max Out Probability			0.00					0.67

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6					7	4	14
Adjusted Flow Rate (*v*), veh/h		717	137	103	1104					599	0	359
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1663	1441	1706	1703					1706	1674	1480
Queue Service Time (g_s), s		15.2	5.2	3.3	25.9					29.9	0.0	17.7
Cycle Queue Clearance Time (g_c), s		15.2	5.2	3.3	25.9					29.9	0.0	17.7
Green Ratio (*g/C*)		0.36	0.36	0.43	0.48					0.40	0.40	0.40
Capacity (*c*), veh/h		1185	513	312	1622					680	667	590
Volume-to-Capacity Ratio (*X*)		0.605	0.267	0.330	0.681					0.881	0.000	0.609
Back of Queue (*Q*), ft/ln (95 th percentile)		232.2	79.8	58.8	402.3					475.4	0	250.1
Back of Queue (*Q*), veh/ln (95 th percentile)		9.2	3.2	2.4	16.0					19.0	0.0	9.9
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00	0.43	0.37	0.00					1.60	0.00	0.83
Uniform Delay (d_1), s/veh		20.9	16.7	18.3	25.1					25.6	0.0	22.0
Incremental Delay (d_2), s/veh		2.1	1.2	0.2	1.8					11.6	0.0	2.0
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0					0.0	0.0	0.0
Control Delay (*d*), s/veh		23.1	17.8	18.4	26.9					37.2	0.0	23.9
Level of Service (LOS)		C	B	B	C					D		C
Approach Delay, s/veh / LOS	22.2	C		26.2	C		0.0			32.2	C	
Intersection Delay, s/veh / LOS	27.0						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	A	2.8	C	3.2	C	3.3	C
Bicycle LOS Score / LOS	1.0	A	1.5	A			2.6	B

HCS 2010 Signalized Intersection Results Summary

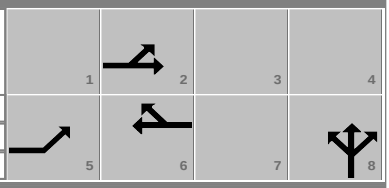
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	5/23/2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	PM peak	PHF	0.96
Urban Street	26th Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	I-29 NB	File Name	26 system pm 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	215	1040			820	695	295	0	100			

Signal Information			
Cycle, s	92.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	7.5	47.4	19.5	0.0	0.0	0.0
Yellow	4.3	4.3	3.2	0.0	0.0	0.0
Red	1.8	1.8	2.2	0.0	0.0	0.0



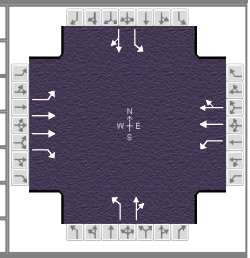
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		
Case Number	1.0	4.0		7.3		11.0		
Phase Duration, s	13.6	67.1		53.5		24.9		
Change Period, ($Y+R_c$), s	6.1	6.1		6.1		5.4		
Max Allow Headway (*MAH*), s	3.1	0.0		0.0		5.6		
Queue Clearance Time (g_s), s	7.3					17.9		
Green Extension Time (g_e), s	0.3	0.0		0.0		1.5		
Phase Call Probability	1.00					1.00		
Max Out Probability	0.00					0.40		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16	3	8	18			
Adjusted Flow Rate (*v*), veh/h	225	1090			900	455		307	63			
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1706	1701			1681	1498		1706	1410			
Queue Service Time (g_s), s	5.3	18.7			15.9	19.8		15.9	3.4			
Cycle Queue Clearance Time (g_c), s	5.3	18.7			15.9	19.8		15.9	3.4			
Green Ratio (*g/C*)	0.62	0.66			0.51	0.51		0.21	0.21			
Capacity (*c*), veh/h	431	2257			1732	771		361	299			
Volume-to-Capacity Ratio (*X*)	0.523	0.483			0.520	0.590		0.851	0.209			
Back of Queue (*Q*), ft/ln (95 th percentile)	80.9	266.4			207.5	246.2		301.7	51			
Back of Queue (*Q*), veh/ln (95 th percentile)	3.2	10.6			8.2	9.8		12.0	2.0			
Queue Storage Ratio (*RQ*) (95 th percentile)	0.43	0.00			0.00	1.24		0.00	0.32			
Uniform Delay (d_1), s/veh	10.7	11.7			14.2	16.0		34.9	29.9			
Incremental Delay (d_2), s/veh	0.2	0.5			0.5	1.6		12.6	0.6			
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0		0.0	0.0			
Control Delay (*d*), s/veh	10.9	12.2			14.7	17.6		47.5	30.5			
Level of Service (LOS)	B	B			B	B		D	C			
Approach Delay, s/veh / LOS	11.9	B		15.7	B		44.6	D		0.0		
Intersection Delay, s/veh / LOS	17.6						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.0	A	3.6	D	3.2	C
Bicycle LOS Score / LOS	1.8	A	1.6	A	1.9	A		

HCS 2010 Signalized Intersection Results Summary

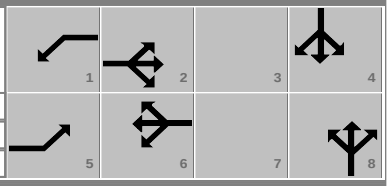
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	5/23/2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	PM peak	PHF	0.92
Urban Street	26th Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	Shirley Avenue	File Name	26 system pm 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	65	705	370	90	990	55	475	15	70	30	5	50

Signal Information			
Cycle, s	92.0	Reference Phase	2
Offset, s	62	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	4.1	0.8	33.8	37.9	0.0	0.0
Yellow	4.0	0.0	3.9	3.5	0.0	0.0
Red	0.0	0.0	1.5	2.5	0.0	0.0



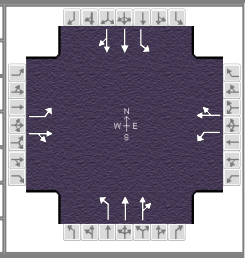
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	1.1	3.0	1.1	4.0		6.0		6.0
Phase Duration, s	8.1	39.2	8.9	40.0		43.9		43.9
Change Period, ($Y+R_c$), s	4.0	5.4	4.0	5.4		6.0		6.0
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0		5.2		5.2
Queue Clearance Time (g_s), s	4.2		5.2			36.6		5.5
Green Extension Time (g_e), s	0.1	0.0	0.1	0.0		1.3		4.6
Phase Call Probability	0.82		0.92			1.00		1.00
Max Out Probability	1.00		1.00			1.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	68	734	229	98	560	554	516	60		33	38	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1706	1705	1518	1706	1791	1769	1378	1584		1351	1552	
Queue Service Time (g_s), s	2.2	17.7	12.2	3.2	26.1	26.2	33.2	2.1		1.4	1.4	
Cycle Queue Clearance Time (g_c), s	2.2	17.7	12.2	3.2	26.1	26.2	34.6	2.1		3.5	1.4	
Green Ratio (*g/C*)	0.41	0.37	0.37	0.42	0.38	0.38	0.41	0.41		0.41	0.41	
Capacity (*c*), veh/h	190	1253	558	296	673	665	626	653		604	639	
Volume-to-Capacity Ratio (*X*)	0.356	0.586	0.411	0.330	0.832	0.833	0.825	0.092		0.054	0.060	
Back of Queue (*Q*), ft/ln (95 th percentile)	41.7	307.1	216	58.4	465.2	461.3	440.5	34.9		20	22.3	
Back of Queue (*Q*), veh/ln (95 th percentile)	1.7	12.2	8.6	2.3	18.5	18.3	17.5	1.4		0.8	0.9	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.19	0.00	0.72	0.38	0.00	0.00	3.15	0.00		0.50	0.00	
Uniform Delay (d_1), s/veh	21.5	29.3	28.7	18.3	26.1	26.1	26.7	16.5		17.6	16.3	
Incremental Delay (d_2), s/veh	1.4	1.8	2.0	0.9	11.5	11.7	8.6	0.1		0.1	0.1	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	22.9	31.1	30.7	19.3	37.6	37.7	35.3	16.6		17.6	16.4	
Level of Service (LOS)	C	C	C	B	D	D	D	B		B	B	
Approach Delay, s/veh / LOS	30.4	C		36.2	D		33.4	C		17.0	B	
Intersection Delay, s/veh / LOS	33.1						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.6	B	2.4	B	3.2	C	4.2	D
Bicycle LOS Score / LOS	3.0	C	3.1	C	3.4	C	2.6	B

HCS 2010 Signalized Intersection Results Summary

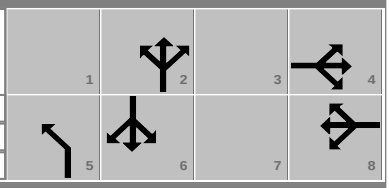
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	May 23, 2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	PM Peak	PHF	0.98
Urban Street	Louise Avenue	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	34th Street	File Name	34-louise pm 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	105	5	90	35	10	15	105	1130	35	20	730	50

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	5.8	82.1	13.2	0.0	0.0	0.0
Yellow	3.9	3.9	3.2	0.0	0.0	0.0
Red	1.0	1.1	1.8	0.0	0.0	0.0



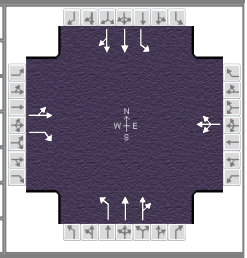
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2		6
Case Number		6.0		6.0	1.0	4.0		6.3
Phase Duration, s		18.2		18.2	10.7	97.8		87.1
Change Period, ($Y+R_c$), s		5.0		5.0	4.9	5.0		5.0
Max Allow Headway (*MAH*), s		5.0		5.0	5.1	0.0		0.0
Queue Clearance Time (g_s), s		11.9		9.2	3.8			
Green Extension Time (g_e), s		0.8		0.9	0.5	0.0		0.0
Phase Call Probability		1.00		1.00	0.97			
Max Out Probability		0.03		0.01	0.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	107	61		36	20		107	589	585	20	390	385
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1396	1534		1346	1628		1706	1791	1780	481	1791	1766
Queue Service Time (g_s), s	8.6	4.3		2.9	1.3		1.8	0.0	0.0	1.5	9.5	9.5
Cycle Queue Clearance Time (g_c), s	9.9	4.3		7.2	1.3		1.8	0.0	0.0	1.5	9.5	9.5
Green Ratio (*g/C*)	0.11	0.11		0.11	0.11		0.77	0.80	0.80	0.71	0.71	0.71
Capacity (*c*), veh/h	206	175		166	186		585	1432	1423	402	1267	1249
Volume-to-Capacity Ratio (*X*)	0.521	0.350		0.215	0.110		0.183	0.411	0.411	0.051	0.308	0.308
Back of Queue (*Q*), ft/ln (95 th percentile)	145.6	77.9		46.4	24.7		22.4	15.8	15.6	7.3	153.2	150.1
Back of Queue (*Q*), veh/ln (95 th percentile)	5.8	3.1		1.8	1.0		0.9	0.6	0.6	0.3	6.1	6.0
Queue Storage Ratio (*RQ*) (95 th percentile)	1.46	0.00		1.86	0.00		0.15	0.00	0.00	0.15	0.00	0.00
Uniform Delay (d_1), s/veh	50.6	47.4		50.7	46.1		3.7	0.0	0.0	5.2	6.4	6.4
Incremental Delay (d_2), s/veh	2.9	1.7		0.6	0.3		0.2	0.9	0.9	0.2	0.6	0.6
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	53.4	49.1		51.4	46.4		4.0	0.9	0.9	5.4	7.0	7.0
Level of Service (LOS)	D	D		D	D		A	A	A	A	A	A
Approach Delay, s/veh / LOS	51.9	D		49.5	D		1.1	A		6.9	A	
Intersection Delay, s/veh / LOS	8.0						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.2	C	3.3	C	2.4	B	2.5	B
Bicycle LOS Score / LOS	2.7	B	2.5	B	3.1	C	2.7	B

HCS 2010 Signalized Intersection Results Summary

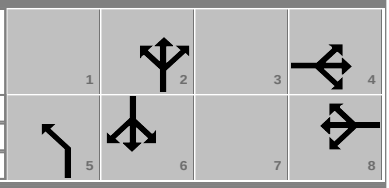
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	5/23/2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	PM peak	PHF	0.98
Urban Street	Louise Avenue	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	Wal-Mart	File Name	wal-mart-louise pm 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	145	5	130	15	0	5	285	1185	10	0	720	115

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	9.8	76.1	15.2	0.0	0.0	0.0
Yellow	3.9	3.9	3.2	0.0	0.0	0.0
Red	1.0	1.1	1.8	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2		6
Case Number		7.0		8.0	1.0	4.0		6.3
Phase Duration, s		20.2		20.2	14.7	95.8		81.1
Change Period, ($Y+R_c$), s		5.0		5.0	4.9	5.0		5.0
Max Allow Headway (*MAH*), s		5.3		5.3	5.1	0.0		0.0
Queue Clearance Time (g_s), s		14.1		3.3	8.0			
Green Extension Time (g_e), s		1.1		1.4	1.8	0.0		0.0
Phase Call Probability		1.00		1.00	1.00			
Max Out Probability		0.04		0.00	0.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h		153	82		20		291	608	607	0	410	397
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1426	1518		1494		1706	1791	1788	463	1791	1733
Queue Service Time (g_s), s		10.8	5.7		0.0		6.0	0.0	0.0	0.0	4.8	4.8
Cycle Queue Clearance Time (g_c), s		12.1	5.7		1.3		6.0	0.0	0.0	0.0	4.8	4.8
Green Ratio (*g/C*)		0.13	0.13		0.13		0.76	0.78	0.78	0.66	0.66	0.66
Capacity (*c*), veh/h		248	199		250		624	1402	1400	62	1175	1137
Volume-to-Capacity Ratio (*X*)		0.617	0.410		0.082		0.466	0.433	0.434	0.000	0.349	0.349
Back of Queue (*Q*), ft/ln (95 th percentile)		202.2	103.8		24.2		77.2	17.3	17.3	0	71.1	69.3
Back of Queue (*Q*), veh/ln (95 th percentile)		8.1	4.1		1.0		3.1	0.7	0.7	0.0	2.8	2.7
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00	1.60		0.00		1.04	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d_1), s/veh		49.0	46.3		44.3		4.3	0.0	0.0	0.0	2.8	2.8
Incremental Delay (d_2), s/veh		3.5	1.9		0.2		0.8	1.0	1.0	0.0	0.8	0.8
Initial Queue Delay (d_3), s/veh		0.0	0.0		0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh		52.6	48.2		44.5		5.1	1.0	1.0	0.0	3.6	3.6
Level of Service (LOS)		D	D		D		A	A	A		A	A
Approach Delay, s/veh / LOS	51.0	D		44.5	D		1.8	A		3.6	A	
Intersection Delay, s/veh / LOS	7.2						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.2	C	3.4	C	2.2	B	2.5	B
Bicycle LOS Score / LOS	0.9	A	0.5	A	1.7	A	1.2	A

HCS 2010 Two-Way Stop Control Summary Report

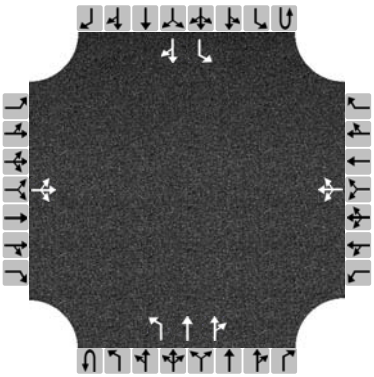
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	6/30/2016
Analysis Year	2016
Time Analyzed	PM PEAK
Intersection Orientation	North-South
Project Description	I-29 EXIT 77 IMJR

Site Information

Intersection	38TH/SHIRLEY
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	38TH STREET
North/South Street	SHIRLEY AVENUE
Peak Hour Factor	0.81
Analysis Time Period (hrs)	0.25

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	1	0	0	1	2	0	0	1	1	0
Configuration			LTR				LTR			L	T	TR		L		TR
Volume (veh/h)		30	10	125		5	0	0		55	225	30		5	295	5
Percent Heavy Vehicles		1	1	1		1	1	1		1				1		
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)			203				6			68				6		
Capacity			537				170			1193				1249		
v/c Ratio			0.38				0.04			0.06				0.00		
95% Queue Length			1.7				0.1			0.2				0.0		
Control Delay (s/veh)			15.7				27.0			8.2				7.9		
Level of Service (LOS)			C				D			A				A		
Approach Delay (s/veh)	15.7				27.0				1.5				0.1			
Approach LOS	C				D											

HCS 2010 Two-Way Stop Control Summary Report

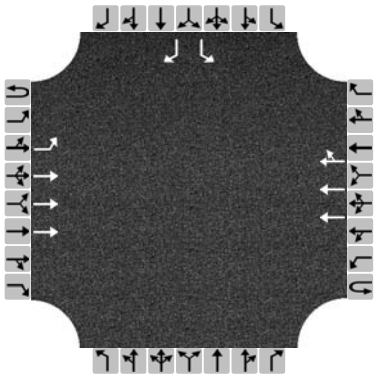
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	6/30/2016
Analysis Year	2016
Time Analyzed	PM PEAK
Intersection Orientation	East-West
Project Description	I-29 EXIT 77 IMJR

Site Information

Intersection	41ST/CAROLYN
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	41ST STREET
North/South Street	CAROLYN AVENUE
Peak Hour Factor	0.95
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

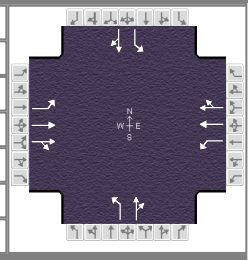
Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	3	0	0	0	3	0		0	0	0		1	0	1
Configuration		L	T				T	TR						L		R
Volume (veh/h)		60	1410				1850	65						15		65
Percent Heavy Vehicles		1												1		1
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)		63												16		68
Capacity		124												19		206
v/c Ratio		0.51												0.83		0.33
95% Queue Length		2.4												2.2		1.4
Control Delay (s/veh)		60.4												417.5		30.8
Level of Service (LOS)		F												F		D
Approach Delay (s/veh)	2.5												104.5			
Approach LOS													F			

HCS 2010 Signalized Intersection Results Summary

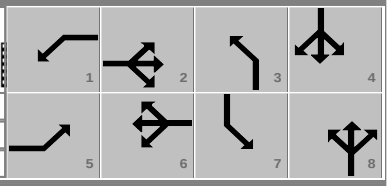
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	May 24, 2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	PM peak	PHF	0.99
Urban Street	41st Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	Valley View Rd.	File Name	41-valley view pm 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	45	610	45	190	1095	115	70	85	85	85	95	50

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	3.1	4.4	68.6	5.6	1.1	12.8
Yellow	3.9	0.0	3.9	3.6	0.0	3.6
Red	1.0	0.0	1.4	1.0	0.0	2.0



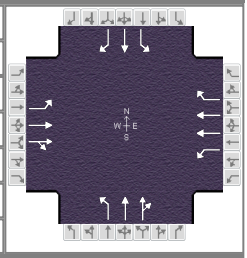
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	4.0	1.1	4.0	1.1	4.0
Phase Duration, s	8.0	73.9	12.4	78.3	10.2	18.4	11.3	19.5
Change Period, ($Y+R_c$), s	4.9	5.3	4.9	5.3	4.6	5.6	4.6	5.6
Max Allow Headway (*MAH*), s	4.1	0.0	4.1	0.0	4.2	4.7	4.2	4.7
Queue Clearance Time (g_s), s	3.2		7.0		6.2	11.2	7.1	10.2
Green Extension Time (g_e), s	0.1	0.0	0.5	0.0	0.0	1.0	0.1	1.0
Phase Call Probability	0.77		1.00		0.90	1.00	0.94	1.00
Max Out Probability	0.00		0.00		1.00	0.01	0.91	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	45	323	318	192	595	581	71	136		86	126	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1706	1791	1762	1706	1791	1747	1706	1666		1706	1698	
Queue Service Time (g_s), s	1.2	10.4	10.5	5.0	11.1	11.2	4.2	9.2		5.1	8.2	
Cycle Queue Clearance Time (g_c), s	1.2	10.4	10.5	5.0	11.1	11.2	4.2	9.2		5.1	8.2	
Green Ratio (*g/C*)	0.62	0.59	0.59	0.67	0.63	0.63	0.16	0.11		0.17	0.12	
Capacity (*c*), veh/h	355	1059	1042	569	1127	1100	185	184		200	204	
Volume-to-Capacity Ratio (*X*)	0.128	0.305	0.306	0.337	0.528	0.529	0.382	0.742		0.429	0.619	
Back of Queue (*Q*), ft/ln (95 th percentile)	20.2	189.9	186.2	74.3	146	142	84	188.3		101.6	165.6	
Back of Queue (*Q*), veh/ln (95 th percentile)	0.8	7.5	7.4	2.9	5.8	5.7	3.3	7.5		4.0	6.6	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.40	0.00	0.00	1.49	0.00	0.00	1.40	0.00		1.69	0.00	
Uniform Delay (d_1), s/veh	9.1	11.8	11.8	7.8	4.4	4.4	43.2	50.0		42.6	48.5	
Incremental Delay (d_2), s/veh	0.2	0.7	0.8	0.3	1.8	1.8	1.3	7.0		1.5	3.7	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	9.2	12.6	12.6	8.2	6.1	6.2	44.5	57.0		44.1	52.2	
Level of Service (LOS)	A	B	B	A	A	A	D	E		D	D	
Approach Delay, s/veh / LOS	12.4	B		6.4	A		52.7	D		48.9	D	
Intersection Delay, s/veh / LOS	15.6						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.5	B	2.4	B	3.2	C	3.2	C
Bicycle LOS Score / LOS	2.6	B	3.2	C	2.8	C	2.8	C

HCS 2010 Signalized Intersection Results Summary

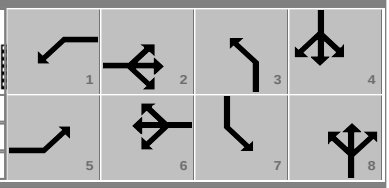
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	May 23, 2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	PM peak	PHF	0.99
Urban Street	41st Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	Marion Road	File Name	41 system pm 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	140	610	105	320	1155	165	170	415	130	140	370	210

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	76	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	8.2	4.3	40.5	9.2	1.2	27.3
Yellow	3.9	3.9	3.9	3.6	0.0	3.6
Red	1.0	1.0	1.6	1.0	0.0	1.8



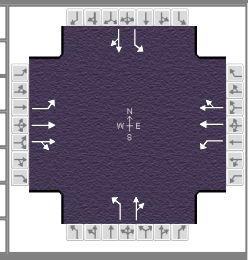
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	1.1	4.0	1.1	3.0
Phase Duration, s	13.1	46.0	22.3	55.2	15.0	33.9	13.8	32.7
Change Period, ($Y+R_c$), s	4.9	5.5	4.9	5.5	4.6	5.4	4.6	5.4
Max Allow Headway (*MAH*), s	4.1	0.0	4.1	0.0	4.1	5.1	4.1	5.1
Queue Clearance Time (g_s), s	8.2		18.6		10.9	17.0	9.3	25.7
Green Extension Time (g_e), s	0.1	0.0	0.0	0.0	0.0	4.8	0.0	1.6
Phase Call Probability	0.99		1.00		1.00	1.00	0.99	1.00
Max Out Probability	1.00		1.00		1.00	0.39	1.00	1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	141	346	336	366	1321	114	172	256	244	141	374	126
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1689	1774	1713	1689	1688	1501	1689	1774	1665	1689	1774	1482
Queue Service Time (g_s), s	6.2	16.4	16.4	16.6	39.9	3.7	8.9	14.8	15.0	7.3	23.7	8.3
Cycle Queue Clearance Time (g_c), s	6.2	16.4	16.4	16.6	39.9	3.7	8.9	14.8	15.0	7.3	23.7	8.3
Green Ratio (*g/C*)	0.42	0.35	0.35	0.52	0.43	0.43	0.32	0.25	0.25	0.31	0.24	0.24
Capacity (*c*), veh/h	209	619	598	472	1447	643	245	435	409	284	417	348
Volume-to-Capacity Ratio (*X*)	0.676	0.559	0.561	0.774	0.913	0.178	0.702	0.588	0.597	0.497	0.896	0.362
Back of Queue (*Q*), ft/ln (95 th percentile)	120.1	279.4	268.8	229.3	473.5	57.2	189.6	275.4	262.4	138.5	467.7	137.6
Back of Queue (*Q*), veh/ln (95 th percentile)	4.7	11.0	10.8	9.0	18.6	2.3	7.5	10.8	10.5	5.5	18.4	5.5
Queue Storage Ratio (*RQ*) (95 th percentile)	0.80	0.00	0.00	1.02	0.00	0.26	0.95	0.00	0.00	0.51	0.00	0.00
Uniform Delay (d_1), s/veh	26.9	24.6	24.6	18.0	20.7	13.1	32.3	38.6	38.7	31.0	43.0	37.1
Incremental Delay (d_2), s/veh	5.2	3.6	3.8	5.5	7.5	0.4	8.7	2.3	2.6	1.3	20.6	0.9
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	32.0	28.2	28.3	23.6	28.2	13.6	41.0	40.9	41.3	32.4	63.6	38.0
Level of Service (LOS)	C	C	C	C	C	B	D	D	D	C	E	D
Approach Delay, s/veh / LOS	28.9	C		26.3	C		41.1	D		51.7	D	
Intersection Delay, s/veh / LOS	33.5						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	3.2	C	3.4	C	3.3	C
Bicycle LOS Score / LOS	2.9	C	3.7	D	3.2	C	3.5	C

HCS 2010 Signalized Intersection Results Summary

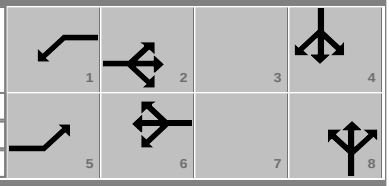
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	May 23, 2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	PM peak	PHF	0.95
Urban Street	41st Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	Terry Avenue	File Name	41 system pm 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	10	865	25	140	1650	25	40	20	105	40	15	15

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	53	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	0.6	4.5	82.0	13.7	0.0	0.0
Yellow	3.9	0.0	3.9	3.6	0.0	0.0
Red	1.0	0.0	1.1	1.7	0.0	0.0



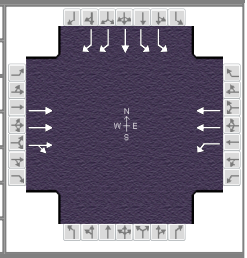
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	1.1	4.0	1.1	4.0		6.0		6.0
Phase Duration, s	5.5	87.0	10.0	91.5		19.0		19.0
Change Period, ($Y+R_c$), s	4.9	5.0	4.9	5.0		5.3		5.3
Max Allow Headway (*MAH*), s	4.1	0.0	4.1	0.0		4.3		4.3
Queue Clearance Time (g_s), s	2.2		4.7			8.3		11.8
Green Extension Time (g_e), s	0.0	0.0	0.4	0.0		0.7		0.6
Phase Call Probability	0.27		0.99			1.00		1.00
Max Out Probability	0.00		0.00			0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	10	436	433	153	913	912	42	89		42	26	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1706	1791	1780	1706	1791	1785	1389	1548		1308	1659	
Queue Service Time (g_s), s	0.2	12.0	12.0	2.7	38.6	38.9	3.2	6.3		3.6	1.6	
Cycle Queue Clearance Time (g_c), s	0.2	12.0	12.0	2.7	38.6	38.9	4.9	6.3		9.8	1.6	
Green Ratio (*g/C*)	0.71	0.71	0.71	0.76	0.75	0.75	0.12	0.12		0.12	0.12	
Capacity (*c*), veh/h	172	1266	1258	524	1336	1331	207	183		146	196	
Volume-to-Capacity Ratio (*X*)	0.057	0.344	0.344	0.293	0.684	0.685	0.203	0.489		0.288	0.134	
Back of Queue (*Q*), ft/ln (95 th percentile)	3.5	190	187.4	35.4	545.5	544.6	52.9	114.6		56.2	31.7	
Back of Queue (*Q*), veh/ln (95 th percentile)	0.1	7.5	7.5	1.4	21.6	21.8	2.1	4.6		2.2	1.3	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.06	0.00	0.00	0.59	0.00	0.00	0.88	0.00		2.25	0.00	
Uniform Delay (d_1), s/veh	10.8	7.5	7.5	4.6	12.7	12.8	48.0	47.9		52.5	45.8	
Incremental Delay (d_2), s/veh	0.1	0.6	0.6	0.2	2.2	2.3	0.5	2.0		1.1	0.3	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	10.9	8.1	8.1	4.8	14.9	15.1	48.5	49.9		53.5	46.1	
Level of Service (LOS)	B	A	A	A	B	B	D	D		D	D	
Approach Delay, s/veh / LOS	8.1	A		14.2	B		49.4	D		50.7	D	
Intersection Delay, s/veh / LOS	14.8						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.5	B	2.3	B	3.3	C	3.3	C
Bicycle LOS Score / LOS	2.8	C	3.6	D	2.6	B	2.5	B

HCS 2010 Signalized Intersection Results Summary

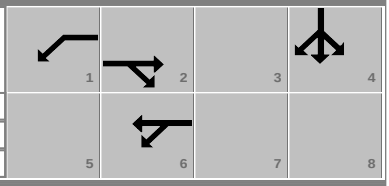
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	May 23, 2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	PM peak	PHF	0.97
Urban Street	41st Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	I-29 SB	File Name	41 system pm 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		905	170	290	1290					535	0	710

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	7	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	11.7	58.9	28.6	0.0	0.0	0.0
Yellow	3.9	3.9	3.8	0.0	0.0	0.0
Red	1.8	1.8	1.6	0.0	0.0	0.0



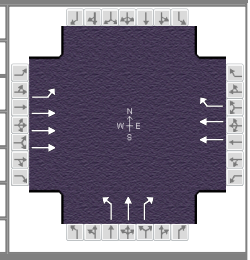
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6				4
Case Number		8.3	1.0	4.0				9.0
Phase Duration, s		64.6	17.4	82.0				34.0
Change Period, ($Y+R_c$), s		5.7	5.7	5.7				5.4
Max Allow Headway (*MAH*), s		0.0	5.1	0.0				6.2
Queue Clearance Time (g_s), s			10.3					20.6
Green Extension Time (g_e), s		0.0	1.4	0.0				8.1
Phase Call Probability			1.00					1.00
Max Out Probability			0.01					0.40

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6					7	4	14
Adjusted Flow Rate (*v*), veh/h		582	352	283	1257					552	0	438
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1389	1685	1706	1755					1656	1674	1250
Queue Service Time (g_s), s		17.4	18.1	8.3	21.8					17.5	0.0	18.6
Cycle Queue Clearance Time (g_c), s		17.4	18.1	8.3	21.8					17.5	0.0	18.6
Green Ratio (*g/C*)		0.51	0.51	0.63	0.66					0.25	0.25	0.25
Capacity (*c*), veh/h		1410	856	446	2308					817	413	617
Volume-to-Capacity Ratio (*X*)		0.413	0.411	0.634	0.545					0.675	0.000	0.710
Back of Queue (*Q*), ft/ln (95 th percentile)		257.3	308.8	151	295.5					286.5	0	243.8
Back of Queue (*Q*), veh/ln (95 th percentile)		10.2	12.4	6.0	11.7					11.5	0.0	9.8
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00	0.00	0.76	0.00					0.58	0.00	0.49
Uniform Delay (d_1), s/veh		23.1	23.9	13.8	10.3					39.5	0.0	39.9
Incremental Delay (d_2), s/veh		0.8	1.4	1.6	0.7					2.2	0.0	3.5
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0					0.0	0.0	0.0
Control Delay (*d*), s/veh		24.0	25.3	15.4	11.0					41.6	0.0	43.4
Level of Service (LOS)		C	C	B	B					D		D
Approach Delay, s/veh / LOS	24.5	C		11.8	B		0.0			42.4	D	
Intersection Delay, s/veh / LOS	24.0						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	3.1	C	3.5	D	3.4	C
Bicycle LOS Score / LOS	2.4	B	3.3	C			4.2	D

HCS 2010 Signalized Intersection Results Summary

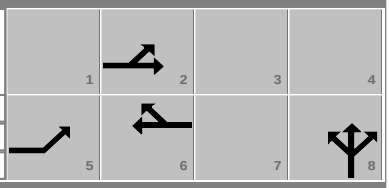
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	May 23, 2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	PM peak	PHF	0.98
Urban Street	41st Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	I-29 NB	File Name	41 system pm 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	230	1210			1345	570	235	0	280			

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	106	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	7.2	74.0	19.3	0.0	0.0	0.0
Yellow	3.9	3.9	3.6	0.0	0.0	0.0
Red	1.0	1.6	1.6	0.0	0.0	0.0



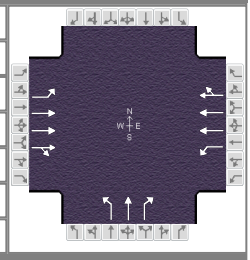
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		
Case Number	1.0	4.0		7.3		9.0		
Phase Duration, s	12.1	91.5		79.5		24.5		
Change Period, ($Y+R_c$), s	4.9	5.5		5.5		5.2		
Max Allow Headway (*MAH*), s	4.1	0.0		0.0		5.6		
Queue Clearance Time (g_s), s	6.6					17.8		
Green Extension Time (g_e), s	0.6	0.0		0.0		1.4		
Phase Call Probability	1.00					1.00		
Max Out Probability	0.00					0.92		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16	3	8	18			
Adjusted Flow Rate (*v*), veh/h	222	1170			1300	464	240	0	179			
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1706	1612			1802	1522	1706	1674	1435			
Queue Service Time (g_s), s	4.6	19.9			30.7	25.5	15.8	0.0	13.8			
Cycle Queue Clearance Time (g_c), s	4.6	19.9			30.7	25.5	15.8	0.0	13.8			
Green Ratio (*g/C*)	0.72	0.74			0.64	0.64	0.17	0.17	0.17			
Capacity (*c*), veh/h	326	3587			2299	971	283	278	238			
Volume-to-Capacity Ratio (*X*)	0.682	0.326			0.566	0.478	0.847	0.000	0.750			
Back of Queue (*Q*), ft/ln (95 th percentile)	153.4	318.5			488.3	421.4	313.5	0	231.8			
Back of Queue (*Q*), veh/ln (95 th percentile)	6.1	12.6			19.4	16.9	12.4	0.0	9.3			
Queue Storage Ratio (*RQ*) (95 th percentile)	1.70	0.00			0.00	0.00	5.22	0.00	0.00			
Uniform Delay (d_1), s/veh	16.7	15.5			19.8	19.4	46.9	0.0	46.1			
Incremental Delay (d_2), s/veh	2.1	0.2			0.9	1.5	17.0	0.0	10.5			
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0	0.0	0.0	0.0			
Control Delay (*d*), s/veh	18.8	15.7			20.7	20.9	64.0	0.0	56.5			
Level of Service (LOS)	B	B			C	C	E		E			
Approach Delay, s/veh / LOS	16.2	B		20.7	C		60.8	E		0.0		
Intersection Delay, s/veh / LOS	23.7						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.1	B	3.7	D	3.3	C
Bicycle LOS Score / LOS	2.8	C	3.4	C	3.5	C		

HCS 2010 Signalized Intersection Results Summary

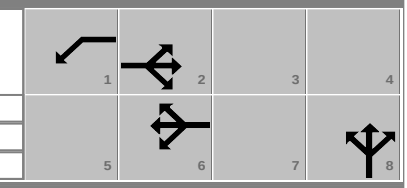
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	May 23, 2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	PM peak	PHF	0.96
Urban Street	41st Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	W. Empire Place	File Name	41 system pm 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	15	1130	290	115	1570	35	290	5	170			

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	107	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	4.9	71.8	23.2	0.0	0.0	0.0
Yellow	3.9	3.9	3.6	0.0	0.0	0.0
Red	1.0	1.8	1.8	0.0	0.0	0.0



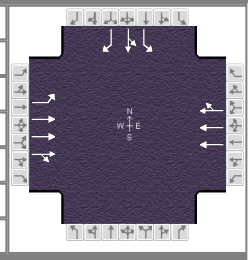
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		
Case Number		6.3	1.0	4.0		9.0		
Phase Duration, s		77.5	9.8	87.4		28.6		
Change Period, ($Y+R_c$), s		5.7	4.9	5.7		5.4		
Max Allow Headway (*MAH*), s		0.0	4.1	0.0		4.3		
Queue Clearance Time (g_s), s			4.7			22.0		
Green Extension Time (g_e), s		0.0	0.3	0.0		1.3		
Phase Call Probability			0.97			1.00		
Max Out Probability			0.00			0.05		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18			
Adjusted Flow Rate (*v*), veh/h	15	902	419	114	1052	522	302	5	104			
Adjusted Saturation Flow Rate (*s*), veh/h/ln	328	1791	1665	1706	1791	1779	1706	1791	1518			
Queue Service Time (g_s), s	1.4	9.3	8.9	2.7	18.3	18.4	20.0	0.3	6.8			
Cycle Queue Clearance Time (g_c), s	10.3	9.3	8.9	2.7	18.3	18.4	20.0	0.3	6.8			
Green Ratio (*g/C*)	0.62	0.62	0.62	0.68	0.70	0.70	0.20	0.20	0.20			
Capacity (*c*), veh/h	241	2218	1031	360	2521	1252	342	359	304			
Volume-to-Capacity Ratio (*X*)	0.063	0.407	0.407	0.317	0.417	0.417	0.884	0.015	0.342			
Back of Queue (*Q*), ft/ln (95 th percentile)	5.7	132	123.1	40.9	292.9	295.4	372.5	5.5	118.7			
Back of Queue (*Q*), veh/ln (95 th percentile)	0.2	5.2	4.9	1.6	11.6	11.8	14.8	0.2	4.7			
Queue Storage Ratio (*RQ*) (95 th percentile)	0.10	0.00	0.00	0.82	0.00	0.00	0.00	0.00	0.00			
Uniform Delay (d_1), s/veh	6.8	5.8	5.5	7.0	10.6	10.7	45.1	37.2	39.8			
Incremental Delay (d_2), s/veh	0.5	0.5	1.1	0.4	0.4	0.9	12.6	0.0	0.7			
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
Control Delay (*d*), s/veh	7.3	6.3	6.6	7.5	11.1	11.6	57.6	37.2	40.5			
Level of Service (LOS)	A	A	A	A	B	B	E	D	D			
Approach Delay, s/veh / LOS	6.4	A		11.0	B		53.0	D		0.0		
Intersection Delay, s/veh / LOS	14.3						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.7	B	1.9	A	3.6	D	3.8	D
Bicycle LOS Score / LOS	3.1	C	3.0	C	3.5	C		

HCS 2010 Signalized Intersection Results Summary

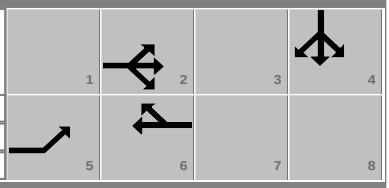
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	May 23, 2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	PM peak	PHF	0.98
Urban Street	41st Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	Shirley Avenue	File Name	41 system pm 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	220	1025	40		1375	140				145	30	280

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	107	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	8.0	75.0	17.4	0.0	0.0	0.0
Yellow	3.9	3.9	3.6	0.0	0.0	0.0
Red	1.0	1.4	1.8	0.0	0.0	0.0



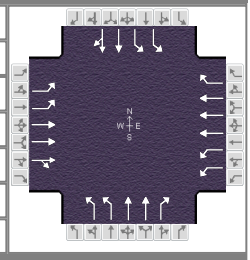
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				4
Case Number	1.0	4.0		8.3				9.0
Phase Duration, s	12.9	93.2		80.3				22.8
Change Period, ($Y+R_c$), s	4.9	5.3		5.3				5.4
Max Allow Headway (*MAH*), s	4.1	0.0		0.0				4.8
Queue Clearance Time (g_s), s	7.2							14.9
Green Extension Time (g_e), s	0.7	0.0		0.0				1.2
Phase Call Probability	1.00							1.00
Max Out Probability	0.00							0.15

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12		6	16				7	4	14
Adjusted Flow Rate (*v*), veh/h	226	723	357		1014	491				148	31	173
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1706	1791	1765		1791	1735				1706	1791	1497
Queue Service Time (g_s), s	5.2	5.9	5.9		23.8	22.1				9.4	1.7	12.9
Cycle Queue Clearance Time (g_c), s	5.2	5.9	5.9		23.8	22.1				9.4	1.7	12.9
Green Ratio (*g/C*)	0.73	0.76	0.76		0.65	0.65				0.15	0.15	0.15
Capacity (*c*), veh/h	334	2713	1336		2315	1122				257	269	225
Volume-to-Capacity Ratio (*X*)	0.678	0.266	0.267		0.438	0.438				0.577	0.114	0.771
Back of Queue (*Q*), ft/ln (95 th percentile)	103.8	78.8	81.5		343.5	347.2				187.9	35.4	227.4
Back of Queue (*Q*), veh/ln (95 th percentile)	4.1	3.1	3.3		13.6	13.9				7.5	1.4	9.1
Queue Storage Ratio (*RQ*) (95 th percentile)	2.08	0.00	0.00		0.00	0.00				1.71	0.00	2.08
Uniform Delay (d_1), s/veh	10.9	3.3	3.4		16.1	16.9				45.8	42.6	47.4
Incremental Delay (d_2), s/veh	2.2	0.2	0.5		0.4	0.9				2.5	0.2	8.2
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0		0.0	0.0				0.0	0.0	0.0
Control Delay (*d*), s/veh	13.2	3.6	3.8		16.6	17.8				48.3	42.8	55.6
Level of Service (LOS)	B	A	A		B	B				D	D	E
Approach Delay, s/veh / LOS	5.3	A		17.0	B		0.0			51.4	D	
Intersection Delay, s/veh / LOS	16.0						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	A	2.8	C	3.6	D	3.6	D
Bicycle LOS Score / LOS	2.6	B	3.1	C			3.4	C

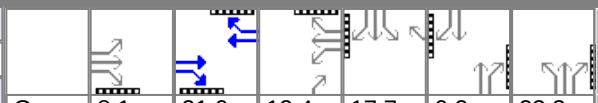
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	May 23, 2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	PM peak	PHF	0.98
Urban Street	41st Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	Louise Avenue	File Name	41 system pm 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				

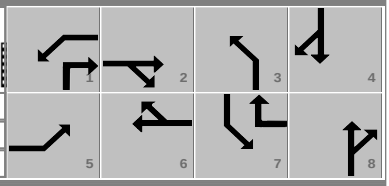


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	165	795	235	360	1055	605	340	685	215	435	480	135

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	66	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	8.1	21.0	12.4	17.7	0.2	23.3
Yellow	3.6	3.6	3.6	3.5	3.5	3.5
Red	2.0	2.0	2.0	2.0	2.0	2.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	4.0	2.0	3.0	2.0	3.0	2.0	4.0
Phase Duration, s	13.7	40.2	18.0	44.6	28.8	34.5	23.2	28.9
Change Period, ($Y+R_c$), s	5.6	5.6	5.6	5.6	5.5	5.5	5.5	5.5
Max Allow Headway (*MAH*), s	4.1	0.0	4.1	0.0	5.2	5.2	4.1	4.6
Queue Clearance Time (g_s), s	7.7		14.4		12.5	24.1	17.3	20.1
Green Extension Time (g_e), s	0.4	0.0	0.0	0.0	6.8	5.0	0.5	2.5
Phase Call Probability	1.00		1.00		1.00	1.00	1.00	1.00
Max Out Probability	0.02		1.00		0.37	0.67	1.00	0.03

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	166	642	297	367	1077	372	347	699	133	444	293	279
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1640	1774	1620	1640	1610	1479	1640	1688	1496	1640	1774	1674
Queue Service Time (g_s), s	5.7	18.7	18.9	12.4	20.3	18.7	10.5	22.1	6.7	15.3	17.9	18.1
Cycle Queue Clearance Time (g_c), s	5.7	18.7	18.9	12.4	20.3	18.7	10.5	22.1	6.7	15.3	17.9	18.1
Green Ratio (*g/C*)	0.07	0.30	0.30	0.11	0.34	0.49	0.20	0.25	0.36	0.15	0.20	0.20
Capacity (*c*), veh/h	228	1059	484	351	1623	726	659	845	535	501	358	338
Volume-to-Capacity Ratio (*X*)	0.726	0.607	0.613	1.048	0.663	0.513	0.526	0.827	0.248	0.886	0.816	0.824
Back of Queue (*Q*), ft/ln (95 th percentile)	113.2	338.8	324.3	319.9	297.5	246.1	184.8	356.1	72.7	283.5	315.9	301.8
Back of Queue (*Q*), veh/ln (95 th percentile)	4.5	13.3	13.0	12.6	11.7	9.8	7.3	14.0	2.9	11.2	12.4	12.1
Queue Storage Ratio (*RQ*) (95 th percentile)	0.44	0.00	0.00	1.03	0.00	0.93	0.86	0.00	0.34	0.80	0.00	0.00
Uniform Delay (d_1), s/veh	52.8	37.9	37.8	49.7	26.9	16.6	37.7	36.3	7.1	45.2	40.4	40.4
Incremental Delay (d_2), s/veh	4.2	2.5	5.5	61.1	2.2	2.6	0.7	6.1	0.4	15.0	5.8	6.5
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	57.0	40.4	43.3	110.8	29.0	19.2	38.4	42.4	7.5	60.2	46.1	47.0
Level of Service (LOS)	E	D	D	F	C	B	D	D	A	E	D	D
Approach Delay, s/veh / LOS	43.7	D		43.5	D		37.3	D		52.5	D	
Intersection Delay, s/veh / LOS	43.9						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.5	C	3.3	C	4.1	D	3.8	D
Bicycle LOS Score / LOS	3.4	C	3.6	D	4.1	D	3.8	D

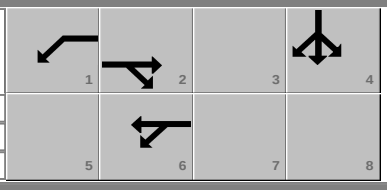
HCS 2010 Interchanges Results Summary

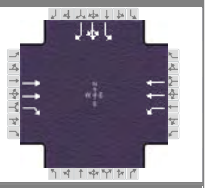
General Information				Interchange Information	
Agency	HDR			Interchange Type	Diamond
Analyst	RL	Analysis Date	5/23/2016	Segment Distance, ft	814
Jurisdiction	City of Sioux Falls	Duration,h	0.25	Freeway Direction	North-South
Intersection	I-29 SB	PHF	0.96	Arterial Direction	East-West
File Name	26 system pm 2016.xus				
Project Description	I-29 Exit 77 (41st St.) IMJR				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h		680	215	95	1020					575	0	570
Intersection Two Demand (*v*), veh/h	215	1040			820	695	295	0	100			

Signal One Information	
Cycle, s	92.0
Offset, s	15
Uncoordinated	No
Force Mode	Fixed

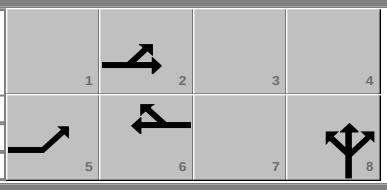
Green	5.0	32.8	36.7	0.0	0.0	0.0
Yellow	4.3	4.3	3.2	0.0	0.0	0.0
Red	1.8	1.8	2.2	0.0	0.0	0.0

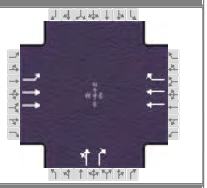




Signal Two Information	
Cycle, s	92.0
Offset, s	15
Uncoordinated	No
Force Mode	Fixed

Green	7.5	47.4	19.5	0.0	0.0	0.0
Yellow	4.3	4.3	3.2	0.0	0.0	0.0
Red	1.8	1.8	2.2	0.0	0.0	0.0





Interchange Results

O-D	O-D Demand Movements	Demand (veh/h)	Delay Movements	Delay (s)	LOS
A	NBL - NBU	307	NBL(II) + NBT(II) + WBT(I)	74.4	D
B	NBR	63	NBT(II)	30.5	C
C	SBR	359	SBT(I)	23.9	B
D	SBL - SBU	599	SBL(I) + SBT(I) - EBT(II)	49.4	F
E	EBL(INT) - SBU	225	EBL(II) + EBT(II) + EBT(I)	33.9	C
F	EBR(EXT)	137	EBT(I)	23.1	B
G	WBR(EXT)	455	WBT(II)	17.6	F
H	WBL(INT) - NBU	103	WBL(I) + WBT(I) + WBT(II)	33.1	C
I	EBT(INT) - SBL + SBU	491	EBT(I) + EBT(II)	35.2	C
J	WBT(INT) - NBL + NBU	797	WBT(I) + WBT(II)	41.6	C
K	NBT	0	NBT	-	-
L	SBT	0	SBT	-	-
M	NBU	0	NBU	-	-
N	SBU	0	SBU	-	-

Signalized Intersection One Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh		23.1	17.8	18.4	26.9					37.2	0.0	23.9
Level of Service (LOS)		C	B	B	C					D		C
Approach Delay, s/veh / LOS	22.2		C	26.2		C	0.0			32.2		C
Intersection Delay, s/veh / LOS	27.0						C					

Signalized Intersection Two Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh	10.9	12.2			14.7	17.6		47.5	30.5			
Level of Service (LOS)	B	B			B	B		D	C			
Approach Delay, s/veh / LOS	11.9		B	15.7		B	44.6		D	0.0		
Intersection Delay, s/veh / LOS	17.6						B					

This Urban Streets text report was created on June 10, 2016 at 08:19:26

Period number = 1

Chapter 17 Input

URBAN STREET PARAMETERS

Number of Intersections	4
Number of Segments	3
Analysis period duration, h	0.25
System cycle length, s	92
Urban street forward direction	EB
Sneakers per cycle, veh	2
Saturation flow rate, veh/h/ln	1900
Stored vehicle lane length, ft	25
Detected vehicle length, ft	17
Queue length percent	95
Critical merge gap, s	3.7
Stop threshold speed, mph	5
Acceleration rate, ft/s/s	3.5
Decel. rate (signal), ft/s/s	4
Minimum headway in a platoon, s/veh	1.5
Maximum headway in a platoon, s/veh	3.6
Number of iterations	15
Length of left-turn bay (access pt.), ft	250
Decel. rate (access pt.), ft/s/s	6.7
Right-turn speed (access pt.), ft/s	20
Critical gap from major left (access pt.), s	4.1
Follow-up time from major left (access pt.), s	2.2
Right-turn equivalency factor (access pt.)	2.2
Stored heavy vehicle lane length, ft	45
Proportion of peds who push button	0.65
Critical gap for permissive left-turn, s	4.5
Follow-up time for permissive left-turn, s	2.5
Calibration factor for platoon dispersion	0.14
Average ratio of speed limit to free-flow speed	0.9

BASIC SEGMENT INFORMATION

Seg	Spd Lmt		TH Lanes		Seg Len		IntWid		LenRM		PctCurb		Other Dly	
Num	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB
1	35	35	2	2	1152	1152	50	50	0	0	70	70	0	0
2	35	35	2	2	814	814	50	50	0	0	70	70	0	0
3	35	35	2	2	1366	1366	50	50	0	0	70	70	0	0

ORIGIN-DESTINATION SEED PROPORTIONS - Forward Direction

	Cross LT	Major TH	Cross RT	MidEntry
Downstream Left	0.02	0.1	0.05	0.02
Downstream Thru	0.91	0.78	0.92	0.97
Downstream Right	0.05	0.1	0.02	0.01
Mid-segment Exit	0.02	0.02	0.01	0

ORIGIN-DESTINATION SEED PROPORTIONS - Reverse Direction

	Cross LT	Major TH	Cross RT	MidEntry
Downstream Left	0.02	0.1	0.05	0.02
Downstream Thru	0.91	0.78	0.92	0.97
Downstream Right	0.05	0.1	0.02	0.01
Mid-segment Exit	0.02	0.02	0.01	0

ACCESS POINT DATA

SEGMENT 1

Number of access points: 0

SEGMENT 2

Number of access points: 0

SEGMENT 3

Number of access points: 0

Global Output

SEGMENT DATA

Seg.No.	Movement	EB LT 5	EB TH 2	EB RT 12	WB LT 1	WB TH 6	WB RT 16
1	Bay/Lane Spillback Time, h	999	999	999	999	999	999
1	ShrdLane Spillback Time, h			999	999		
1	Base Free-Flow Speed, mph		41.72			41.72	
1	Running Time, s		22.2			22.78	
1	Running Speed, mph		35.38			34.47	
1	Through Delay, s/veh		23.05			8.24	
1	Travel Speed, mph		17.36			25.32	
1	Stop Rate, stops/veh		0.6			0.26	
1	Spatial Stop Rate, stops/mi		2.75			1.21	
1	Through vol/cap ratio		0.6			0.65	
1	Percent of Base FFS		41.6			60.68	
1	Level of Service		D			C	
1	Automobile Perception Score		2.8			2.32	
2	Bay/Lane Spillback Time, h	999	999	999	999	999	999
2	ShrdLane Spillback Time, h	999			999		
2	Base Free-Flow Speed, mph		41.72			41.72	
2	Running Time, s		17.52			17.46	
2	Running Speed, mph		31.67			31.79	
2	Through Delay, s/veh		12.16			26.91	
2	Travel Speed, mph		18.7			12.51	
2	Stop Rate, stops/veh		0.51			0.79	
2	Spatial Stop Rate, stops/mi		3.33			5.14	
2	Through vol/cap ratio		0.48			0.68	
2	Percent of Base FFS		44.82			29.98	
2	Level of Service		D			F	
2	Automobile Perception Score		2.67			3.25	
3	Bay/Lane Spillback Time, h	999	999	999	999	999	999
3	ShrdLane Spillback Time, h	999		999			999
3	Base Free-Flow Speed, mph		41.72			41.72	
3	Running Time, s		25.67			26.08	
3	Running Speed, mph		36.28			35.71	
3	Through Delay, s/veh		31.06			14.7	
3	Travel Speed, mph		16.42			22.84	
3	Stop Rate, stops/veh		0.84			0.48	
3	Spatial Stop Rate, stops/mi		3.24			1.87	
3	Through vol/cap ratio		0.59			0.52	
3	Percent of Base FFS		39.35			54.74	
3	Level of Service		E			C	
3	Automobile Perception Score		2.65			2.43	

Facility Travel Time, s	131.67	116.18
Facility Travel Speed, mph	17.25	19.55
Facility Spatial Stop Rate, veh/mi	3.09	2.44
Facility Base Free Flow Speed, mph	41.72	41.72
Facility Percent Base Free Flow Speed	41.36	46.87
Facility Level of Service	D	D
Facility Automobile Perception Score	2.71	2.54
Facility Pedestrian Space	Infinity	Infinity
Facility Pedestrian Travel Speed	4.4	4.4
Facility Pedestrian LOS Score	3.56	3.71
Facility Pedestrian LOS	D	D
Facility Bicycle Travel Speed	12.43	11.78
Facility Bicycle LOS Score	3.55	3.53
Facility Bicycle LOS	D	D
Facility Transit Travel Speed	17.36	25.29
Facility Transit LOS Score	2.03	1.77
Facility Transit LOS	B	A
SPILLBACK TIME, h	999	

Multimodal Results

1	Roadway crossing difficulty factor	1.06	1.2
1	Ped LOS Score for Link	2.89	3.73
1	Ped LOS Score for Intersection	1.97	2.34
1	Ped LOS Score for Segment	3.13	3.97

1	Ped Segment LOS	C	D
1	Bicycle LOS Score for Link	3.54	3.83
1	Indicator Variable	1	1
1	Bicycle LOS Score for Intersection	1.32	2.15
1	Number of access point approaches	0	0
1	Segment Length, ft	1152	1152
1	Bicycle LOS Score for Segment	3.46	3.56
1	Bicycle Segment LOS	C	D
1	Transit Wait-Ride Score	2.96	3.43
1	Ped LOS Score for Link	2.89	3.73
1	Transit LOS Score for Segment	1.99	1.41
1	Transit Segment LOS	A	A
2	Roadway crossing difficulty factor	1.2	1.2
2	Ped LOS Score for Link	3.22	3.1
2	Ped LOS Score for Intersection	2.07	2.8
2	Ped LOS Score for Segment	3.7	3.85
2	Ped Segment LOS	D	D
2	Bicycle LOS Score for Link	3.65	3.61
2	Indicator Variable	1	1
2	Bicycle LOS Score for Intersection	1.8	1.86
2	Number of access point approaches	0	0
2	Segment Length, ft	814	814
2	Bicycle LOS Score for Segment	3.5	3.5
2	Bicycle Segment LOS	D	C
2	Transit Wait-Ride Score	3.05	2.6
2	Ped LOS Score for Link	3.22	3.1
2	Transit LOS Score for Segment	1.91	2.57
2	Transit Segment LOS	A	B
3	Roadway crossing difficulty factor	1.2	1.06
3	Ped LOS Score for Link	3.21	3.7
3	Ped LOS Score for Intersection	2.59	1.96
3	Ped LOS Score for Segment	3.83	3.4
3	Ped Segment LOS	D	C
3	Bicycle LOS Score for Link	3.68	3.83
3	Indicator Variable	1	1
3	Bicycle LOS Score for Intersection	2.95	1.63
3	Number of access point approaches	0	0
3	Segment Length, ft	1366	1366
3	Bicycle LOS Score for Segment	3.65	3.52
3	Bicycle Segment LOS	D	D
3	Transit Wait-Ride Score	2.9	3.3
3	Ped LOS Score for Link	3.21	3.7
3	Transit LOS Score for Segment	2.13	1.61
3	Transit Segment LOS	B	A

ACCESS POINT DATA

SEGMENT 1

SEGMENT 2

SEGMENT 3

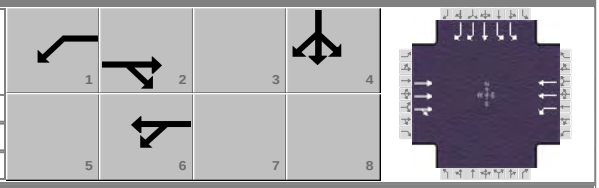
HCS 2010 Interchanges Results Summary

General Information				Interchange Information	
Agency	HDR			Interchange Type	Diamond
Analyst	RL	Analysis Date	May 23, 2016	Segment Distance, ft	513
Jurisdiction	City of Sioux Falls	Duration,h	0.25	Freeway Direction	North-South
Intersection	I-29 SB	PHF	0.97	Arterial Direction	East-West
File Name	41 system pm 2016.xus				
Project Description	I-29 Exit 77 (41st St.) IMJR				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h		905	170	290	1290					535	0	710
Intersection Two Demand (*v*), veh/h	230	1210			1345	570	235	0	280			

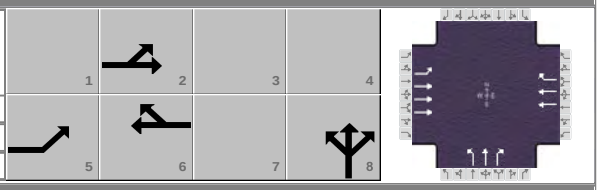
Signal One Information	
Cycle, s	116.0
Offset, s	7
Uncoordinated	No
Force Mode	Fixed

Green	11.7	58.9	28.6	0.0	0.0	0.0
Yellow	3.9	3.9	3.8	0.0	0.0	0.0
Red	1.8	1.8	1.6	0.0	0.0	0.0



Signal Two Information	
Cycle, s	116.0
Offset, s	7
Uncoordinated	No
Force Mode	Fixed

Green	7.2	74.0	19.3	0.0	0.0	0.0
Yellow	3.9	3.9	3.6	0.0	0.0	0.0
Red	1.0	1.6	1.6	0.0	0.0	0.0



Interchange Results

O-D	O-D Demand Movements	Demand (veh/h)	Delay Movements	Delay (s)	LOS
A	NBL - NBU	240	NBL(II) + NBT(II) + WBT(I)	74.9	F
B	NBR	179	NBT(II)	56.5	D
C	SBR	438	SBT(I)	43.4	C
D	SBL - SBU	552	SBL(I) + SBT(I) - EBT(II)	57.4	D
E	EBL(INT) - SBU	222	EBL(II) + EBT(II) + EBT(I)	42.8	F
F	EBR(EXT)	93	EBT(I)	24.0	B
G	WBR(EXT)	464	WBT(II)	20.9	B
H	WBL(INT) - NBU	283	WBL(I) + WBT(I) + WBT(II)	36.1	C
I	EBT(INT) - SBL + SBU	619	EBT(I) + EBT(II)	39.7	C
J	WBT(INT) - NBL + NBU	1018	WBT(I) + WBT(II)	31.7	C
K	NBT	0	NBT	-	-
L	SBT	0	SBT	-	-
M	NBU	0	NBU	-	-
N	SBU	0	SBU	-	-

Signalized Intersection One Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh		24.0	25.3	15.4	11.0					41.6	0.0	43.4
Level of Service (LOS)		C	C	B	B					D		D
Approach Delay, s/veh / LOS	24.5	C		11.8	B		0.0			42.4	D	
Intersection Delay, s/veh / LOS	24.0						C					

Signalized Intersection Two Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh	18.8	15.7			20.7	20.9	64.0	0.0	56.5			
Level of Service (LOS)	B	B			C	C	E		E			
Approach Delay, s/veh / LOS	16.2	B		20.7	C		60.8	E		0.0		
Intersection Delay, s/veh / LOS	23.7						C					

This Urban Streets text report was created on June 10, 2016 at 08:33:19

Period number = 1

Chapter 17 Input

URBAN STREET PARAMETERS

Number of Intersections	7
Number of Segments	6
Analysis period duration, h	0.25
System cycle length, s	116
Urban street forward direction	EB
Sneakers per cycle, veh	2
Saturation flow rate, veh/h/ln	1900
Stored vehicle lane length, ft	25
Detected vehicle length, ft	17
Queue length percent	95
Critical merge gap, s	3.7
Stop threshold speed, mph	5
Acceleration rate, ft/s/s	3.5
Decel. rate (signal), ft/s/s	4
Minimum headway in a platoon, s/veh	1.5
Maximum headway in a platoon, s/veh	3.6
Number of iterations	15
Length of left-turn bay (access pt.), ft	250
Decel. rate (access pt.), ft/s/s	6.7
Right-turn speed (access pt.), ft/s	20
Critical gap from major left (access pt.), s	4.1
Follow-up time from major left (access pt.), s	2.2
Right-turn equivalency factor (access pt.)	2.2
Stored heavy vehicle lane length, ft	45
Proportion of peds who push button	0.65
Critical gap for permissive left-turn, s	4.5
Follow-up time for permissive left-turn, s	2.5
Calibration factor for platoon dispersion	0.14
Average ratio of speed limit to free-flow speed	0.9

BASIC SEGMENT INFORMATION

Seg	Spd Lmt		TH Lanes		Seg Len		IntWid		LenRM		PctCurb		Other Dly	
Num	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB
1	35	35	2	2	1224	1224	50	50	0	0	70	70	0	0
2	35	35	3	2	1316	1316	50	50	0	0	70	70	0	0
3	35	35	3	2	513	513	50	50	0	0	70	70	0	0
4	35	35	3	2	731	731	50	50	0	0	70	70	0	0
5	35	35	3	3	599	599	50	50	0	0	70	70	0	0
6	35	35	3	3	884	884	50	50	0	0	70	70	0	0

ORIGIN-DESTINATION SEED PROPORTIONS - Forward Direction

	Cross LT	Major TH	Cross RT	MidEntry
Downstream Left	0.02	0.1	0.05	0.02
Downstream Thru	0.91	0.78	0.92	0.97
Downstream Right	0.05	0.1	0.02	0.01
Mid-segment Exit	0.02	0.02	0.01	0

ORIGIN-DESTINATION SEED PROPORTIONS - Reverse Direction

	Cross LT	Major TH	Cross RT	MidEntry
Downstream Left	0.02	0.1	0.05	0.02
Downstream Thru	0.91	0.78	0.92	0.97
Downstream Right	0.05	0.1	0.02	0.01
Mid-segment Exit	0.02	0.02	0.01	0

ACCESS POINT DATA

SEGMENT 1

Number of access points: 0

SEGMENT 2

Number of access points: 0

SEGMENT 3

Number of access points: 0

SEGMENT 4

Number of access points: 0

SEGMENT 5

Number of access points: 0

SEGMENT 6

Number of access points: 0

Global Output

SEGMENT DATA

Seg.No.	Movement	EB LT 5	EB TH 2	EB RT 12	WB LT 1	WB TH 6	WB RT 16
1	Bay/Lane Spillback Time, h	999	999	999	999	999	999
1	ShrdLane Spillback Time, h	999			999.2		1032.6
1	Base Free-Flow Speed, mph		41.72			41.72	
1	Running Time, s		23.25			24.06	
1	Running Speed, mph		35.89			34.68	
1	Through Delay, s/veh		8.1			28.22	
1	Travel Speed, mph		26.62			15.96	
1	Stop Rate, stops/veh		0.32			0.64	
1	Spatial Stop Rate, stops/mi		1.36			2.76	
1	Through vol/cap ratio		0.34			0.91	
1	Percent of Base FFS		63.79			38.26	
1	Level of Service		C			E	
1	Automobile Perception Score		2.34			2.57	
2	Bay/Lane Spillback Time, h	999	999	999	999	999	999
2	ShrdLane Spillback Time, h				999		
2	Base Free-Flow Speed, mph		41.72			41.72	
2	Running Time, s		24.5			25.65	
2	Running Speed, mph		36.62			34.99	
2	Through Delay, s/veh		24.37			14.99	
2	Travel Speed, mph		18.36			22.08	
2	Stop Rate, stops/veh		0.67			0.54	
2	Spatial Stop Rate, stops/mi		2.7			2.17	
2	Through vol/cap ratio		0.41			0.68	
2	Percent of Base FFS		44.01			52.93	
2	Level of Service		D			C	
2	Automobile Perception Score		2.8			2.47	
3	Bay/Lane Spillback Time, h	999	999	999	999	999	999
3	ShrdLane Spillback Time, h	999			999		
3	Base Free-Flow Speed, mph		41.72			41.72	
3	Running Time, s		13.71			13.99	
3	Running Speed, mph		25.51			25	
3	Through Delay, s/veh		15.75			10.97	
3	Travel Speed, mph		11.87			14.01	
3	Stop Rate, stops/veh		0.66			0.38	
3	Spatial Stop Rate, stops/mi		6.79			3.94	
3	Through vol/cap ratio		0.33			0.54	
3	Percent of Base FFS		28.46			33.58	
3	Level of Service		F			E	
3	Automobile Perception Score		3.31			3.02	
4	Bay/Lane Spillback Time, h	999	999	999	999	999	999
4	ShrdLane Spillback Time, h	999					
4	Base Free-Flow Speed, mph		41.72			41.72	
4	Running Time, s		16.22			16.74	
4	Running Speed, mph		30.72			29.77	
4	Through Delay, s/veh		6.38			20.7	
4	Travel Speed, mph		22.05			13.31	
4	Stop Rate, stops/veh		0.2			0.66	
4	Spatial Stop Rate, stops/mi		1.45			4.73	
4	Through vol/cap ratio		0.41			0.57	
4	Percent of Base FFS		52.85			31.9	
4	Level of Service		C			E	
4	Automobile Perception Score		2.36			2.92	
5	Bay/Lane Spillback Time, h	999	999	999	999	999	999

5	ShrdLane Spillback Time, h	999	999
5	Base Free-Flow Speed, mph	41.72	41.72
5	Running Time, s	14.57	14.69
5	Running Speed, mph	28.02	27.8
5	Through Delay, s/veh	3.65	11.26
5	Travel Speed, mph	22.41	15.74
5	Stop Rate, stops/veh	0.15	0.44
5	Spatial Stop Rate, stops/mi	1.34	3.9
5	Through vol/cap ratio	0.27	0.42
5	Percent of Base FFS	53.71	37.72
5	Level of Service	C	E
5	Automobile Perception Score	2.34	3.01

6	Bay/Lane Spillback Time, h	999	999	999	999	999	999
6	ShrdLane Spillback Time, h	999					
6	Base Free-Flow Speed, mph	41.72			41.72		
6	Running Time, s	18.21			18.34		
6	Running Speed, mph	33.1			32.87		
6	Through Delay, s/veh	40.98			16.94		
6	Travel Speed, mph	10.18			17.09		
6	Stop Rate, stops/veh	0.84			0.58		
6	Spatial Stop Rate, stops/mi	5.02			3.48		
6	Through vol/cap ratio	0.61			0.44		
6	Percent of Base FFS	24.41			40.95		
6	Level of Service	F			D		
6	Automobile Perception Score	2.97			2.69		

Facility Travel Time, s	209.7	216.55
Facility Travel Speed, mph	17.13	16.58
Facility Spatial Stop Rate, veh/mi	2.85	3.25
Facility Base Free Flow Speed, mph	41.72	41.72
Facility Percent Base Free Flow Speed	41.05	39.75
Facility Level of Service	D	E
Facility Automobile Perception Score	2.62	2.69

Facility Pedestrian Space	Infinity	Infinity
Facility Pedestrian Travel Speed	4.4	4.4
Facility Pedestrian LOS Score	3.62	3.94
Facility Pedestrian LOS	D	D

Facility Bicycle Travel Speed	12.02	12.15
Facility Bicycle LOS Score	3.6	3.8
Facility Bicycle LOS	D	D

Facility Transit Travel Speed	26.61	15.96
Facility Transit LOS Score	1.47	2.14
Facility Transit LOS	A	B

SPILLBACK TIME, h 999

Multimodal Results

1	Roadway crossing difficulty factor	1.2	1.15
1	Ped LOS Score for Link	2.85	3.92
1	Ped LOS Score for Intersection	2.47	3.21
1	Ped LOS Score for Segment	3.67	4.09
1	Ped Segment LOS	D	D
1	Bicycle LOS Score for Link	3.52	3.88
1	Indicator Variable	1	1
1	Bicycle LOS Score for Intersection	2.84	3.74
1	Number of access point approaches	0	0
1	Segment Length, ft	1224	1224
1	Bicycle LOS Score for Segment	3.6	3.94
1	Bicycle Segment LOS	D	D
1	Transit Wait-Ride Score	3.5	2.87
1	Ped LOS Score for Link	2.85	3.92
1	Transit LOS Score for Segment	1.18	2.29
1	Transit Segment LOS	A	B
2	Roadway crossing difficulty factor	1.2	1.19
2	Ped LOS Score for Link	2.62	4.07
2	Ped LOS Score for Intersection	2.03	2.34
2	Ped LOS Score for Segment	3.46	4.07
2	Ped Segment LOS	C	D
2	Bicycle LOS Score for Link	3.39	3.92
2	Indicator Variable	1	1

2	Bicycle LOS Score for Intersection	2.39	3.63
2	Number of access point approaches	0	0
2	Segment Length, ft	1316	1316
2	Bicycle LOS Score for Segment	3.51	3.89
2	Bicycle Segment LOS	D	D
2	Transit Wait-Ride Score	3.04	3.26
2	Ped LOS Score for Link	2.62	4.07
2	Transit LOS Score for Segment	1.83	1.72
2	Transit Segment LOS	A	A
3	Roadway crossing difficulty factor	1.2	1.2
3	Ped LOS Score for Link	2.64	3.32
3	Ped LOS Score for Intersection	2.35	3.1
3	Ped LOS Score for Segment	3.55	4.01
3	Ped Segment LOS	D	D
3	Bicycle LOS Score for Link	3.31	3.54
3	Indicator Variable	1	1
3	Bicycle LOS Score for Intersection	2.75	3.29
3	Number of access point approaches	0	0
3	Segment Length, ft	513	513
3	Bicycle LOS Score for Segment	3.55	3.71
3	Bicycle Segment LOS	D	D
3	Transit Wait-Ride Score	2.55	2.72
3	Ped LOS Score for Link	2.64	3.32
3	Transit LOS Score for Segment	2.58	2.42
3	Transit Segment LOS	B	B
4	Roadway crossing difficulty factor	1.2	1.2
4	Ped LOS Score for Link	2.8	3.79
4	Ped LOS Score for Intersection	2.65	2.08
4	Ped LOS Score for Segment	3.7	3.92
4	Ped Segment LOS	D	D
4	Bicycle LOS Score for Link	3.48	3.79
4	Indicator Variable	1	1
4	Bicycle LOS Score for Intersection	3.1	3.39
4	Number of access point approaches	0	0
4	Segment Length, ft	731	731
4	Bicycle LOS Score for Segment	3.65	3.78
4	Bicycle Segment LOS	D	D
4	Transit Wait-Ride Score	3.26	2.66
4	Ped LOS Score for Link	2.8	3.79
4	Transit LOS Score for Segment	1.53	2.57
4	Transit Segment LOS	A	B
5	Roadway crossing difficulty factor	1.2	1.2
5	Ped LOS Score for Link	2.64	2.92
5	Ped LOS Score for Intersection	1.95	1.87
5	Ped LOS Score for Segment	3.45	3.54
5	Ped Segment LOS	C	D
5	Bicycle LOS Score for Link	3.37	3.49
5	Indicator Variable	1	1
5	Bicycle LOS Score for Intersection	2.59	2.98
5	Number of access point approaches	0	0
5	Segment Length, ft	599	599
5	Bicycle LOS Score for Segment	3.54	3.62
5	Bicycle Segment LOS	D	D
5	Transit Wait-Ride Score	3.28	2.86
5	Ped LOS Score for Link	2.64	2.92
5	Transit LOS Score for Segment	1.47	2.15
5	Transit Segment LOS	A	B
6	Roadway crossing difficulty factor	1.2	1.2
6	Ped LOS Score for Link	2.67	2.94
6	Ped LOS Score for Intersection	3.46	2.82
6	Ped LOS Score for Segment	3.86	3.79
6	Ped Segment LOS	D	D
6	Bicycle LOS Score for Link	3.43	3.56
6	Indicator Variable	1	1
6	Bicycle LOS Score for Intersection	3.42	3.07
6	Number of access point approaches	0	0
6	Segment Length, ft	884	884
6	Bicycle LOS Score for Segment	3.73	3.66
6	Bicycle Segment LOS	D	D

6	Transit Wait-Ride Score	3.86	2.96
6	Ped LOS Score for Link	2.67	2.94
6	Transit LOS Score for Segment	0.61	2.01
6	Transit Segment LOS	A	B

ACCESS POINT DATA

SEGMENT 1

SEGMENT 2

SEGMENT 3

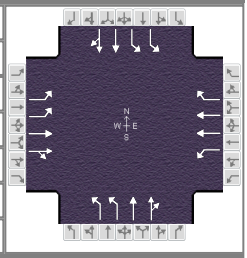
SEGMENT 4

SEGMENT 5

SEGMENT 6

HCS 2010 Signalized Intersection Results Summary

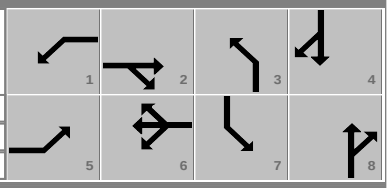
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jun 27, 2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	SAT peak	PHF	0.95
Urban Street	26th Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	Marion Road	File Name	26-marion sat 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	135	380	70	105	380	245	175	520	80	245	425	115

Signal Information			
Cycle, s	78.4	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	5.3	20.6	6.8	8.3	11.0	0.0
Yellow	3.9	3.9	3.9	3.9	3.9	0.0
Red	1.0	2.0	1.0	1.9	1.0	0.0



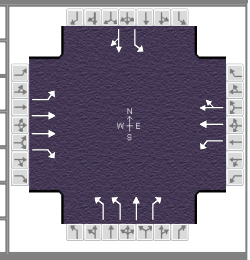
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	4.0	1.1	3.0	2.0	4.0	2.0	4.0
Phase Duration, s	10.2	26.5	10.2	26.5	11.7	25.8	15.9	30.1
Change Period, ($Y+R_c$), s	4.9	5.9	4.9	5.9	4.9	5.8	5.8	5.8
Max Allow Headway (*MAH*), s	4.1	5.1	4.1	5.1	5.1	5.1	5.1	5.1
Queue Clearance Time (g_s), s	5.3	10.3	5.6	9.7	6.2	14.0	7.8	11.5
Green Extension Time (g_e), s	0.2	6.2	0.1	6.2	0.7	3.3	2.4	4.6
Phase Call Probability	0.95	1.00	0.91	1.00	0.98	1.00	1.00	1.00
Max Out Probability	0.10	0.11	0.13	0.10	0.07	0.03	0.82	0.07

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	142	224	218	111	400	153	184	304	296	258	266	255
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1656	1791	1730	1706	1705	1487	1656	1791	1736	1656	1791	1703
Queue Service Time (g_s), s	3.3	8.3	8.3	3.6	7.7	6.6	4.2	11.9	12.0	5.8	9.4	9.5
Cycle Queue Clearance Time (g_c), s	3.3	8.3	8.3	3.6	7.7	6.6	4.2	11.9	12.0	5.8	9.4	9.5
Green Ratio (*g/C*)	0.07	0.26	0.26	0.33	0.26	0.26	0.09	0.26	0.26	0.13	0.31	0.31
Capacity (*c*), veh/h	223	470	454	331	895	390	286	457	443	428	555	527
Volume-to-Capacity Ratio (*X*)	0.638	0.476	0.481	0.334	0.447	0.391	0.645	0.665	0.668	0.602	0.479	0.484
Back of Queue (*Q*), ft/ln (95 th percentile)	62.1	156.3	151.9	63.9	136.1	103.3	80.5	221.8	216.1	105.8	174.8	167.3
Back of Queue (*Q*), veh/ln (95 th percentile)	2.5	6.2	6.1	2.5	5.4	4.1	3.2	8.8	8.6	4.2	6.9	6.7
Queue Storage Ratio (*RQ*) (95 th percentile)	0.31	0.00	0.00	0.46	0.00	1.60	0.36	0.00	0.00	0.53	0.00	0.00
Uniform Delay (d_1), s/veh	35.6	24.4	24.4	19.6	24.1	22.9	34.6	26.2	26.2	32.2	21.9	22.0
Incremental Delay (d_2), s/veh	3.0	1.1	1.1	0.6	0.5	0.9	3.5	2.4	2.5	1.9	0.9	1.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	38.6	25.4	25.5	20.2	24.6	23.8	38.1	28.6	28.7	34.2	22.8	22.9
Level of Service (LOS)	D	C	C	C	C	C	D	C	C	C	C	C
Approach Delay, s/veh / LOS	28.7	C		23.7	C		30.8	C		26.6	C	
Intersection Delay, s/veh / LOS	27.5						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.2	C	3.2	C	3.3	C	3.2	C
Bicycle LOS Score / LOS	3.1	C	1.9	A	3.3	C	3.3	C

HCS 2010 Signalized Intersection Results Summary

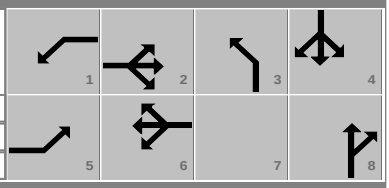
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jun 27, 2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	SAT peak	PHF	0.95
Urban Street	26th Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	Lorraine Dr.	File Name	26 system sat 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	15	725	40	165	960	30	45	5	155	20	5	20

Signal Information			
Cycle, s	92.0	Reference Phase	2
Offset, s	22	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	1.3	0.5	54.3	2.8	4.7	0.0
Yellow	4.0	4.0	4.3	3.2	3.2	0.0
Red	1.0	1.0	1.7	3.0	3.0	0.0



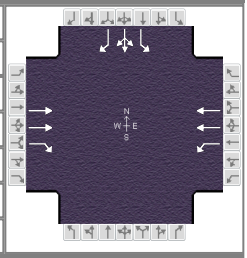
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8		4
Case Number	1.1	3.0	1.1	4.0	2.0	3.0		6.3
Phase Duration, s	6.3	60.3	11.8	65.7	9.0	19.9		10.9
Change Period, ($Y+R_c$), s	5.0	6.0	5.0	6.0	6.2	6.2		6.2
Max Allow Headway (*MAH*), s	4.1	0.0	4.1	0.0	4.7	4.9		4.9
Queue Clearance Time (g_s), s	2.3		6.5		3.3	7.6		3.3
Green Extension Time (g_e), s	0.0	0.0	0.3	0.0	0.0	0.4		0.2
Phase Call Probability	0.33		1.00		0.70	0.99		0.97
Max Out Probability	0.00		1.00		1.00	0.03		0.67

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	16	763	26	243	724	720	47	5	100	21	16	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1706	1705	1517	1706	1791	1778	1656	1791	1494	1411	1593	
Queue Service Time (g_s), s	0.3	6.3	0.3	4.5	16.7	16.3	1.3	0.2	5.6	1.3	0.9	
Cycle Queue Clearance Time (g_c), s	0.3	6.3	0.3	4.5	16.7	16.3	1.3	0.2	5.6	1.3	0.9	
Green Ratio (*g/C*)	0.60	0.59	0.59	0.69	0.65	0.65	0.03	0.15	0.15	0.05	0.05	
Capacity (*c*), veh/h	269	2013	895	573	1163	1155	101	267	223	151	82	
Volume-to-Capacity Ratio (*X*)	0.059	0.379	0.029	0.424	0.623	0.624	0.468	0.020	0.449	0.140	0.193	
Back of Queue (*Q*), ft/ln (95 th percentile)	5.3	82.2	5.3	70.2	185.1	179.1	26.4	4.6	96.3	21.9	17	
Back of Queue (*Q*), veh/ln (95 th percentile)	0.2	3.3	0.2	2.8	7.3	7.1	1.0	0.2	3.8	0.9	0.7	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.05	0.00	0.02	0.59	0.00	0.00	0.13	0.00	0.88	0.87	0.00	
Uniform Delay (d_1), s/veh	8.2	4.7	4.1	6.2	5.7	5.5	43.9	33.4	35.7	42.0	41.8	
Incremental Delay (d_2), s/veh	0.1	0.5	0.1	0.3	1.8	1.8	4.0	0.0	1.7	0.5	1.4	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	8.3	5.2	4.1	6.6	7.5	7.3	47.9	33.4	37.4	42.5	43.2	
Level of Service (LOS)	A	A	A	A	A	A	D	C	D	D	D	
Approach Delay, s/veh / LOS	5.3	A		7.3	A		40.5	D		42.8	D	
Intersection Delay, s/veh / LOS	9.0						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.3	B	3.2	C	3.2	C
Bicycle LOS Score / LOS	2.2	B	1.8	A	2.9	C	2.7	B

HCS 2010 Signalized Intersection Results Summary

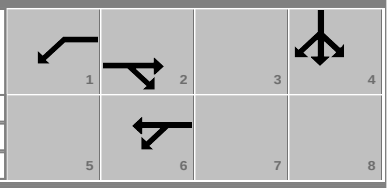
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jun 27, 2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	SAT peak	PHF	0.96
Urban Street	26th Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	I-29 SB	File Name	26 system sat 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		715	185	110	885					580	0	270

Signal Information			
Cycle, s	92.0	Reference Phase	2
Offset, s	22	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	5.3	43.5	25.6	0.0	0.0	0.0
Yellow	4.3	4.3	3.2	0.0	0.0	0.0
Red	1.8	1.8	2.2	0.0	0.0	0.0



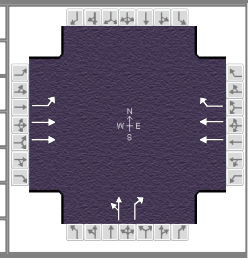
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6				4
Case Number		7.3	1.0	4.0				9.0
Phase Duration, s		49.6	11.4	61.0				31.0
Change Period, ($Y+R_c$), s		6.1	6.1	6.1				5.4
Max Allow Headway (*MAH*), s		0.0	1.1	0.0				5.6
Queue Clearance Time (g_s), s			5.4					27.6
Green Extension Time (g_e), s		0.0	0.0	0.0				0.0
Phase Call Probability			0.97					1.00
Max Out Probability			0.00					1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6					7	4	14
Adjusted Flow Rate (*v*), veh/h		753	116	133	1074					604	0	167
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1666	1438	1706	1699					1706	1674	1447
Queue Service Time (g_s), s		14.8	4.7	3.4	20.9					25.6	0.0	8.6
Cycle Queue Clearance Time (g_c), s		14.8	4.7	3.4	20.9					25.6	0.0	8.6
Green Ratio (*g/C*)		0.47	0.47	0.55	0.60					0.28	0.28	0.28
Capacity (*c*), veh/h		1577	680	399	2028					475	466	403
Volume-to-Capacity Ratio (*X*)		0.478	0.170	0.334	0.529					1.273	0.000	0.414
Back of Queue (*Q*), ft/ln (95 th percentile)		237.7	70.7	57.3	318					1048.7	0	133
Back of Queue (*Q*), veh/ln (95 th percentile)		9.4	2.8	2.3	12.6					41.9	0.0	5.3
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00	0.38	0.36	0.00					3.52	0.00	0.44
Uniform Delay (d_1), s/veh		17.7	15.5	12.4	15.9					33.2	0.0	27.1
Incremental Delay (d_2), s/veh		1.0	0.5	0.1	0.8					138.5	0.0	1.2
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0					0.0	0.0	0.0
Control Delay (*d*), s/veh		18.7	16.0	12.5	16.6					171.7	0.0	28.2
Level of Service (LOS)		B	B	B	B					F		C
Approach Delay, s/veh / LOS	18.3	B		16.2	B		0.0			140.7	F	
Intersection Delay, s/veh / LOS	50.5						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	A	2.5	B	3.2	C	3.2	C
Bicycle LOS Score / LOS	1.3	A	1.8	A			2.6	B

HCS 2010 Signalized Intersection Results Summary

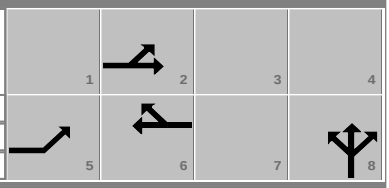
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jun 27, 2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	SAT peak	PHF	0.96
Urban Street	26th Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	I-29 NB	File Name	26 system sat 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	240	1055			745	720	250	0	115			

Signal Information			
Cycle, s	92.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	7.3	50.0	17.1	0.0	0.0	0.0
Yellow	4.3	4.3	3.2	0.0	0.0	0.0
Red	1.8	1.8	2.2	0.0	0.0	0.0



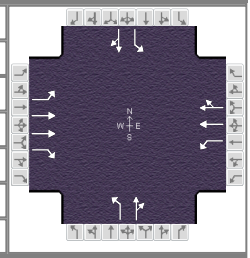
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		
Case Number	1.0	4.0		7.3		11.0		
Phase Duration, s	13.4	69.5		56.1		22.5		
Change Period, ($Y+R_c$), s	6.1	6.1		6.1		5.4		
Max Allow Headway (*MAH*), s	3.1	0.0		0.0		5.6		
Queue Clearance Time (g_s), s	7.0					15.5		
Green Extension Time (g_e), s	0.3	0.0		0.0		1.6		
Phase Call Probability	1.00					1.00		
Max Out Probability	0.00					0.17		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16	3	8	18			
Adjusted Flow Rate (*v*), veh/h	228	1000			853	492		260	73			
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1706	1692			1677	1505		1706	1428			
Queue Service Time (g_s), s	5.0	10.2			13.2	19.3		13.5	4.0			
Cycle Queue Clearance Time (g_c), s	5.0	10.2			13.2	19.3		13.5	4.0			
Green Ratio (*g/C*)	0.64	0.69			0.54	0.54		0.19	0.19			
Capacity (*c*), veh/h	474	2333			1823	818		317	265			
Volume-to-Capacity Ratio (*X*)	0.480	0.429			0.468	0.602		0.823	0.275			
Back of Queue (*Q*), ft/ln (95 th percentile)	71.9	114.1			167.8	219.8		257.5	62.9			
Back of Queue (*Q*), veh/ln (95 th percentile)	2.9	4.5			6.7	8.8		10.2	2.5			
Queue Storage Ratio (*RQ*) (95 th percentile)	0.38	0.00			0.00	1.11		0.00	0.40			
Uniform Delay (d_1), s/veh	8.7	5.0			11.2	12.8		36.0	32.1			
Incremental Delay (d_2), s/veh	0.1	0.3			0.4	1.6		9.6	1.0			
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0		0.0	0.0			
Control Delay (*d*), s/veh	8.8	5.2			11.6	14.3		45.6	33.1			
Level of Service (LOS)	A	A			B	B		D	C			
Approach Delay, s/veh / LOS	5.9	A		12.6	B		42.8	D		0.0		
Intersection Delay, s/veh / LOS	13.2						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.0	A	3.6	D	3.2	C
Bicycle LOS Score / LOS	1.8	A	1.6	A	1.9	A		

HCS 2010 Signalized Intersection Results Summary

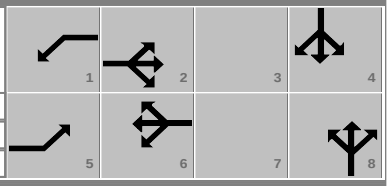
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jun 27, 2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	SAT peak	PHF	0.92
Urban Street	26th Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	Shirley Avenue	File Name	26 system sat 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	70	650	450	155	935	95	475	15	135	50	20	55

Signal Information			
Cycle, s	92.0	Reference Phase	2
Offset, s	3	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	4.1	1.9	39.6	31.0	0.0	0.0
Yellow	4.0	0.0	3.9	3.5	0.0	0.0
Red	0.0	0.0	1.5	2.5	0.0	0.0



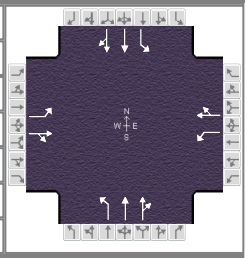
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	1.1	3.0	1.1	4.0		6.0		6.0
Phase Duration, s	8.1	45.0	10.0	46.9		37.0		37.0
Change Period, ($Y+R_c$), s	4.0	5.4	4.0	5.4		6.0		6.0
Max Allow Headway (*MAH*), s	5.1	0.0	5.1	0.0		5.3		5.3
Queue Clearance Time (g_s), s	3.9		7.1			33.0		9.2
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0		0.0		4.8
Phase Call Probability	0.81		0.99			1.00		1.00
Max Out Probability	1.00		1.00			1.00		0.07

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	65	607	252	168	543	533	516	103		54	60	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1706	1705	1518	1706	1791	1756	1351	1555		1299	1607	
Queue Service Time (g_s), s	1.9	9.9	8.4	5.1	22.0	22.0	28.6	4.3		2.9	2.4	
Cycle Queue Clearance Time (g_c), s	1.9	9.9	8.4	5.1	22.0	22.0	31.0	4.3		7.2	2.4	
Green Ratio (*g/C*)	0.47	0.43	0.43	0.50	0.45	0.45	0.34	0.34		0.34	0.34	
Capacity (*c*), veh/h	254	1468	653	453	809	793	499	524		455	542	
Volume-to-Capacity Ratio (*X*)	0.257	0.414	0.386	0.372	0.672	0.672	1.035	0.197		0.120	0.110	
Back of Queue (*Q*), ft/ln (95 th percentile)	34.9	161	125.1	86.7	367	361.7	648.7	72.1		40.8	41	
Back of Queue (*Q*), veh/ln (95 th percentile)	1.4	6.4	5.0	3.4	14.6	14.4	25.7	2.9		1.6	1.6	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.15	0.00	0.42	0.56	0.00	0.00	4.63	0.00		1.02	0.00	
Uniform Delay (d_1), s/veh	16.7	14.8	13.0	13.7	19.9	19.9	33.9	21.7		24.2	21.0	
Incremental Delay (d_2), s/veh	0.7	0.8	1.6	0.7	4.4	4.5	49.7	0.3		0.2	0.1	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	17.4	15.6	14.6	14.4	24.3	24.4	83.6	21.9		24.4	21.1	
Level of Service (LOS)	B	B	B	B	C	C	F	C		C	C	
Approach Delay, s/veh / LOS	15.4	B		23.0	C		73.3	E		22.7	C	
Intersection Delay, s/veh / LOS	31.3						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.7	B	2.4	B	3.2	C	4.2	D
Bicycle LOS Score / LOS	3.0	C	3.1	C	3.5	D	2.7	B

HCS 2010 Signalized Intersection Results Summary

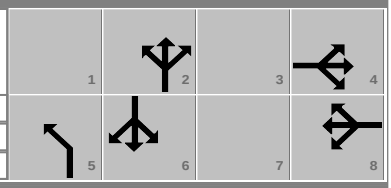
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jun 27, 2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	SAT Peak	PHF	0.98
Urban Street	Louise Avenue	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	34th Street	File Name	34-louise sat 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	160	5	150	90	15	40	210	985	35	40	860	70

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	7.8	74.2	19.2	0.0	0.0	0.0
Yellow	3.9	3.9	3.2	0.0	0.0	0.0
Red	1.0	1.1	1.8	0.0	0.0	0.0



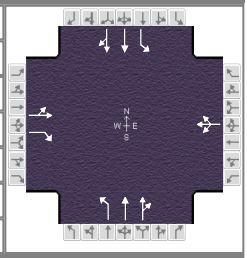
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2		6
Case Number		6.0		6.0	1.0	4.0		6.3
Phase Duration, s		24.2		24.2	12.7	91.8		79.2
Change Period, ($Y+R_c$), s		5.0		5.0	4.9	5.0		5.0
Max Allow Headway (*MAH*), s		5.0		5.0	5.1	0.0		0.0
Queue Clearance Time (g_s), s		18.0		16.4	6.7			
Green Extension Time (g_e), s		1.0		1.2	1.1	0.0		0.0
Phase Call Probability		1.00		1.00	1.00			
Max Out Probability		0.69		0.39	0.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	163	97		92	41		214	515	511	41	463	456
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1372	1528		1304	1594		1706	1791	1778	553	1791	1763
Queue Service Time (g_s), s	13.4	6.6		7.8	2.5		4.7	0.1	0.1	3.3	14.6	14.6
Cycle Queue Clearance Time (g_c), s	16.0	6.6		14.4	2.5		4.7	0.1	0.1	3.4	14.6	14.6
Green Ratio (*g/C*)	0.17	0.17		0.17	0.17		0.72	0.75	0.75	0.64	0.64	0.64
Capacity (*c*), veh/h	259	252		204	263		491	1341	1331	415	1145	1127
Volume-to-Capacity Ratio (*X*)	0.631	0.384		0.450	0.155		0.437	0.384	0.384	0.098	0.404	0.404
Back of Queue (*Q*), ft/ln (95 th percentile)	214.9	117.2		120.7	46.6		67.9	15	14.8	19.5	240.5	235.8
Back of Queue (*Q*), veh/ln (95 th percentile)	8.5	4.7		4.8	1.9		2.7	0.6	0.6	0.8	9.5	9.4
Queue Storage Ratio (*RQ*) (95 th percentile)	2.15	0.00		4.83	0.00		0.45	0.00	0.00	0.39	0.00	0.00
Uniform Delay (d_1), s/veh	48.3	43.2		49.6	41.5		6.7	0.0	0.0	8.2	10.2	10.2
Incremental Delay (d_2), s/veh	3.8	1.4		1.6	0.3		0.9	0.8	0.8	0.5	1.1	1.1
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	52.1	44.5		51.1	41.8		7.6	0.9	0.9	8.6	11.2	11.3
Level of Service (LOS)	D	D		D	D		A	A	A	A	B	B
Approach Delay, s/veh / LOS	49.3	D		48.2	D		2.0	A		11.1	B	
Intersection Delay, s/veh / LOS	12.5						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.2	C	3.3	C	2.4	B	2.5	B
Bicycle LOS Score / LOS	2.9	C	2.7	B	3.1	C	2.9	C

HCS 2010 Signalized Intersection Results Summary

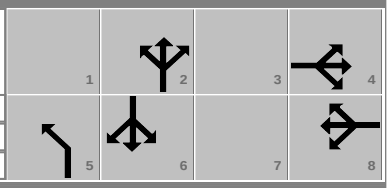
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jun 27, 2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	SAT peak	PHF	0.98
Urban Street	Louise Avenue	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	Wal-Mart	File Name	wal-mart-louise sat 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	155	5	215	15	5	5	375	1205	5	5	1005	120

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	13.4	71.4	16.4	0.0	0.0	0.0
Yellow	3.9	3.9	3.2	0.0	0.0	0.0
Red	1.0	1.1	1.8	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2		6
Case Number		7.0		8.0	1.0	4.0		6.3
Phase Duration, s		21.4		21.4	18.3	94.6		76.4
Change Period, ($Y+R_c$), s		5.0		5.0	4.9	5.0		5.0
Max Allow Headway (*MAH*), s		5.3		5.3	5.1	0.0		0.0
Queue Clearance Time (g_s), s		15.0		3.5	11.0			
Green Extension Time (g_e), s		1.4		1.9	2.4	0.0		0.0
Phase Call Probability		1.00		1.00	1.00			
Max Out Probability		0.09		0.00	0.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h		163	133		26		383	1230	0	5	555	542
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1419	1518		1551		1706	1791	1788	456	1791	1748
Queue Service Time (g_s), s		11.4	9.5		0.0		9.0	0.0	0.0	0.2	11.0	11.0
Cycle Queue Clearance Time (g_c), s		13.0	9.5		1.5		9.0	0.0	0.0	0.3	11.0	11.0
Green Ratio (*g/C*)		0.14	0.14		0.14		0.75	0.77	0.77	0.62	0.62	0.62
Capacity (*c*), veh/h		261	214		269		527	2768		342	1102	1075
Volume-to-Capacity Ratio (*X*)		0.624	0.619		0.095		0.726	0.444	0.000	0.015	0.504	0.504
Back of Queue (*Q*), ft/ln (95 th percentile)		212	175.9		29.9		122.7	9	0	1.3	150.6	147.6
Back of Queue (*Q*), veh/ln (95 th percentile)		8.5	7.0		1.2		4.9	0.4	0.0	0.1	6.0	5.9
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00	2.71		0.00		1.65	0.00	0.00	0.03	0.00	0.00
Uniform Delay (d_1), s/veh		48.3	46.9		43.4		7.0	0.0		4.0	5.0	5.0
Incremental Delay (d_2), s/veh		3.5	4.1		0.2		2.7	0.5	0.0	0.1	1.6	1.7
Initial Queue Delay (d_3), s/veh		0.0	0.0		0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh		51.8	51.0		43.6		9.7	0.5		4.1	6.6	6.7
Level of Service (LOS)		D	D		D		A	A		A	A	A
Approach Delay, s/veh / LOS	51.4	D		43.6	D		2.7	A		6.7	A	
Intersection Delay, s/veh / LOS	9.2						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.2	C	3.5	C	2.2	B	2.6	B
Bicycle LOS Score / LOS	1.0	A	0.5	A	1.8	A	1.4	A

HCS 2010 Two-Way Stop Control Summary Report

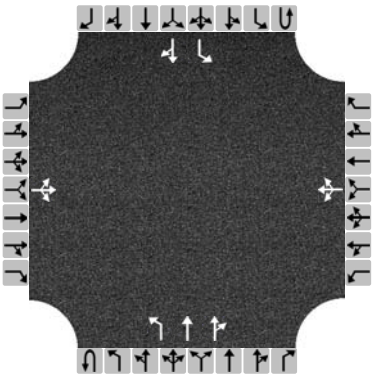
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	6/30/2016
Analysis Year	2016
Time Analyzed	SAT PEAK
Intersection Orientation	North-South
Project Description	I-29 EXIT 77 IMJR

Site Information

Intersection	38TH/SHIRLEY
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	38TH STREET
North/South Street	SHIRLEY AVENUE
Peak Hour Factor	0.89
Analysis Time Period (hrs)	0.25

Lanes



Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	1	0	0	1	2	0	0	1	1	0
Configuration			LTR				LTR			L	T	TR		L		TR
Volume (veh/h)		30	20	130		10	5	0		85	295	40		5	355	15
Percent Heavy Vehicles		1	1	1		1	1	1		1				1		
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)			202				17			96				6		
Capacity			445				147			1147				1186		
v/c Ratio			0.45				0.12			0.08				0.01		
95% Queue Length			2.3				0.4			0.3				0.0		
Control Delay (s/veh)			19.6				32.8			8.4				8.0		
Level of Service (LOS)			C				D			A				A		
Approach Delay (s/veh)	19.6				32.8				1.7				0.1			
Approach LOS	C				D											

HCS 2010 Two-Way Stop Control Summary Report

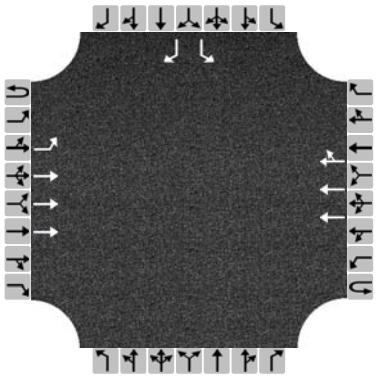
General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	6/30/2016
Analysis Year	2016
Time Analyzed	SAT PEAK
Intersection Orientation	East-West
Project Description	I-29 EXIT 77 IMJR

Site Information

Intersection	41ST/CAROLYN
Jurisdiction	CITY OF SIOUX FALLS
East/West Street	41ST STREET
North/South Street	CAROLYN AVENUE
Peak Hour Factor	0.93
Analysis Time Period (hrs)	0.25

Lanes



Major Street: East-West

Vehicle Volumes and Adjustments

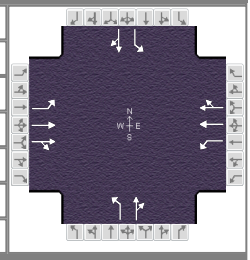
Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Number of Lanes	0	1	3	0	0	0	3	0		0	0	0		1	0	1
Configuration		L	T				T	TR						L		R
Volume (veh/h)		75	1850				1375	65						20		105
Percent Heavy Vehicles		1												1		1
Proportion Time Blocked																
Right Turn Channelized	No				No				No				No			
Median Type	Undivided															
Median Storage																

Delay, Queue Length, and Level of Service

Flow Rate (veh/h)		81												22		113
Capacity		213												33		295
v/c Ratio		0.38												0.67		0.38
95% Queue Length		1.7												2.3		1.7
Control Delay (s/veh)		31.9												239.4		24.6
Level of Service (LOS)		D												F		C
Approach Delay (s/veh)	1.2												59.6			
Approach LOS													F			

HCS 2010 Signalized Intersection Results Summary

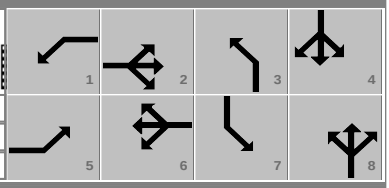
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jun 27, 2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	SAT peak	PHF	0.94
Urban Street	41st Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	Valley View Rd.	File Name	41-valley view sat 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	35	670	35	95	770	70	40	25	85	35	35	30

Signal Information			
Cycle, s	41.7	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	1.4	1.4	12.7	1.4	0.2	4.4
Yellow	3.9	0.0	3.9	3.6	0.0	3.6
Red	1.0	0.0	1.4	1.0	0.0	2.0



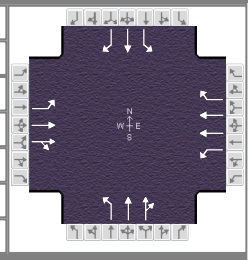
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	4.0	1.1	4.0	1.1	4.0
Phase Duration, s	6.3	18.0	7.7	19.3	6.2	10.1	6.0	10.0
Change Period, ($Y+R_c$), s	4.9	5.3	4.9	5.3	4.6	5.6	4.6	5.6
Max Allow Headway (*MAH*), s	4.1	3.0	4.1	3.0	4.2	4.8	4.2	4.8
Queue Clearance Time (g_s), s	2.6	9.5	3.7	10.3	2.9	4.0	2.8	3.4
Green Extension Time (g_e), s	0.0	3.1	0.1	3.1	0.0	0.5	0.0	0.6
Phase Call Probability	0.35	1.00	0.69	1.00	0.39	0.88	0.35	0.87
Max Out Probability	0.00	0.05	0.05	0.06	0.01	0.00	0.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	37	369	365	101	435	427	43	80		37	59	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1706	1791	1773	1706	1791	1760	1706	1575		1706	1670	
Queue Service Time (g_s), s	0.6	7.5	7.5	1.7	8.3	8.3	0.9	2.0		0.8	1.4	
Cycle Queue Clearance Time (g_c), s	0.6	7.5	7.5	1.7	8.3	8.3	0.9	2.0		0.8	1.4	
Green Ratio (*g/C*)	0.34	0.30	0.30	0.37	0.34	0.34	0.14	0.11		0.14	0.10	
Capacity (*c*), veh/h	289	544	538	375	602	591	334	170		247	174	
Volume-to-Capacity Ratio (*X*)	0.129	0.678	0.679	0.269	0.722	0.722	0.128	0.469		0.151	0.336	
Back of Queue (*Q*), ft/ln (95 th percentile)	8.6	108.4	106.5	21.6	98.9	96.5	14.6	33.4		13.1	23.4	
Back of Queue (*Q*), veh/ln (95 th percentile)	0.3	4.3	4.3	0.9	3.9	3.9	0.6	1.3		0.5	0.9	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.17	0.00	0.00	0.43	0.00	0.00	0.24	0.00		0.22	0.00	
Uniform Delay (d_1), s/veh	10.4	12.8	12.8	9.4	9.9	9.9	15.8	17.5		16.0	17.4	
Incremental Delay (d_2), s/veh	0.2	0.6	0.6	0.4	0.6	0.6	0.2	2.4		0.3	1.4	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	10.6	13.3	13.3	9.8	10.6	10.6	16.0	19.9		16.3	18.7	
Level of Service (LOS)	B	B	B	A	B	B	B	B		B	B	
Approach Delay, s/veh / LOS	13.2	B		10.5	B		18.5	B		17.8	B	
Intersection Delay, s/veh / LOS	12.4						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.4	B	3.1	C	3.1	C
Bicycle LOS Score / LOS	2.7	B	2.9	C	2.6	B	2.6	B

HCS 2010 Signalized Intersection Results Summary

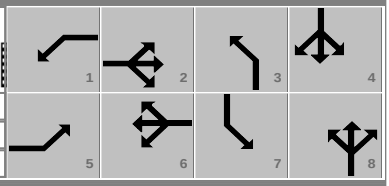
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jun 27, 2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	SAT peak	PHF	0.97
Urban Street	41st Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	Marion Road	File Name	41 system sat 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	115	705	70	195	785	175	115	305	205	165	245	135

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	82	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	6.7	3.6	49.3	8.4	2.0	20.7
Yellow	3.9	3.9	3.9	3.6	0.0	3.6
Red	1.0	1.0	1.6	1.0	0.0	1.8



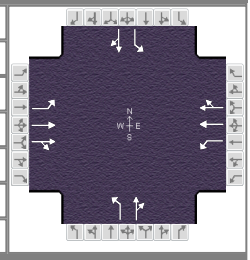
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	1.1	4.0	1.1	3.0
Phase Duration, s	11.6	54.8	20.1	63.3	13.0	26.1	15.0	28.1
Change Period, ($Y+R_c$), s	4.9	5.5	4.9	5.5	4.6	5.4	4.6	5.4
Max Allow Headway (*MAH*), s	4.1	0.0	4.1	0.0	4.1	5.1	4.1	5.1
Queue Clearance Time (g_s), s	6.6		14.6		8.6	16.8	11.5	17.5
Green Extension Time (g_e), s	0.3	0.0	0.6	0.0	0.1	3.5	0.0	3.7
Phase Call Probability	0.98		1.00		0.98	1.00	1.00	1.00
Max Out Probability	0.00		0.52		1.00	0.32	1.00	0.26

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	119	388	380	323	1298	174	119	231	212	170	253	82
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1689	1774	1739	1689	1688	1502	1689	1774	1575	1689	1774	1501
Queue Service Time (g_s), s	4.6	15.5	15.5	12.6	31.3	5.3	6.6	14.3	14.8	9.5	15.5	5.4
Cycle Queue Clearance Time (g_c), s	4.6	15.5	15.5	12.6	31.3	5.3	6.6	14.3	14.8	9.5	15.5	5.4
Green Ratio (*g/C*)	0.48	0.42	0.42	0.57	0.50	0.50	0.25	0.18	0.18	0.27	0.20	0.20
Capacity (*c*), veh/h	248	754	739	486	1683	749	235	317	281	261	347	294
Volume-to-Capacity Ratio (*X*)	0.477	0.514	0.515	0.663	0.772	0.232	0.504	0.729	0.754	0.651	0.728	0.281
Back of Queue (*Q*), ft/ln (95 th percentile)	81.8	251.7	244.4	166.5	362.2	78.4	127.1	276.3	259.2	194.6	294	92.1
Back of Queue (*Q*), veh/ln (95 th percentile)	3.2	9.9	9.8	6.6	14.3	3.1	5.0	10.9	10.4	7.7	11.6	3.7
Queue Storage Ratio (*RQ*) (95 th percentile)	0.55	0.00	0.00	0.74	0.00	0.35	0.64	0.00	0.00	0.72	0.00	0.00
Uniform Delay (d_1), s/veh	20.0	17.8	17.8	13.7	15.7	10.7	36.1	45.0	45.2	35.7	43.7	39.7
Incremental Delay (d_2), s/veh	1.4	2.5	2.6	1.7	2.4	0.5	1.7	5.1	6.9	5.6	4.8	0.7
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	21.4	20.3	20.4	15.4	18.1	11.2	37.8	50.1	52.1	41.3	48.6	40.4
Level of Service (LOS)	C	C	C	B	B	B	D	D	D	D	D	D
Approach Delay, s/veh / LOS	20.5	C		17.0	B		48.3	D		44.8	D	
Intersection Delay, s/veh / LOS	26.2						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	3.1	C	3.4	C	3.2	C
Bicycle LOS Score / LOS	3.0	C	3.4	C	3.1	C	3.3	C

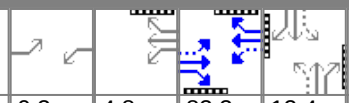
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jun 27, 2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	SAT peak	PHF	0.94
Urban Street	41st Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	Terry Avenue	File Name	41 system sat 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				

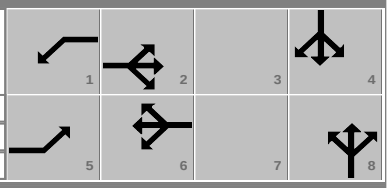


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	5	1050	20	100	1115	25	30	10	90	35	5	10

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	74	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	0.3	4.8	83.3	12.4	0.0	0.0
Yellow	3.9	0.0	3.9	3.6	0.0	0.0
Red	1.0	0.0	1.1	1.7	0.0	0.0



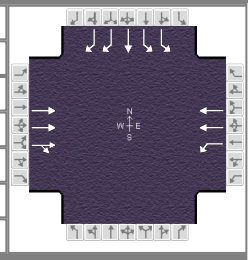
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	1.1	4.0	1.1	4.0		6.0		6.0
Phase Duration, s	5.2	88.3	10.0	93.1		17.7		17.7
Change Period, ($Y+R_c$), s	4.9	5.0	4.9	5.0		5.3		5.3
Max Allow Headway (*MAH*), s	4.1	0.0	4.1	0.0		4.3		4.3
Queue Clearance Time (g_s), s	2.1		4.7			6.9		10.0
Green Extension Time (g_e), s	0.0	0.0	0.5	0.0		0.5		0.4
Phase Call Probability	0.15		0.99			0.99		0.99
Max Out Probability	0.00		0.00			0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	5	547	545	161	909	908	32	69		37	11	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1706	1791	1785	1706	1791	1782	1405	1539		1328	1638	
Queue Service Time (g_s), s	0.1	13.1	13.0	2.7	27.0	27.2	2.4	4.9		3.1	0.7	
Cycle Queue Clearance Time (g_c), s	0.1	13.1	13.0	2.7	27.0	27.2	3.1	4.9		8.0	0.7	
Green Ratio (*g/C*)	0.72	0.72	0.72	0.78	0.76	0.76	0.11	0.11		0.11	0.11	
Capacity (*c*), veh/h	198	1286	1282	451	1360	1353	204	165		148	175	
Volume-to-Capacity Ratio (*X*)	0.026	0.425	0.425	0.356	0.669	0.671	0.156	0.420		0.251	0.061	
Back of Queue (*Q*), ft/ln (95 th percentile)	1.5	186.2	183.7	34.5	308.4	309.2	39.9	88.6		49.3	12.9	
Back of Queue (*Q*), veh/ln (95 th percentile)	0.1	7.4	7.3	1.4	12.2	12.4	1.6	3.5		2.0	0.5	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.02	0.00	0.00	0.57	0.00	0.00	0.66	0.00		1.97	0.00	
Uniform Delay (d_1), s/veh	7.2	5.8	5.7	4.6	6.0	6.1	47.9	48.4		52.2	46.6	
Incremental Delay (d_2), s/veh	0.0	0.8	0.8	0.4	2.1	2.1	0.4	1.7		0.9	0.1	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	7.2	6.6	6.6	4.9	8.1	8.1	48.3	50.1		53.0	46.7	
Level of Service (LOS)	A	A	A	A	A	A	D	D		D	D	
Approach Delay, s/veh / LOS	6.6	A		7.8	A		49.6	D		51.6	D	
Intersection Delay, s/veh / LOS	9.4						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.3	B	3.3	C	3.2	C
Bicycle LOS Score / LOS	3.0	C	3.1	C	2.6	B	2.5	B

HCS 2010 Signalized Intersection Results Summary

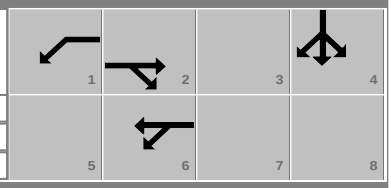
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jun 27, 2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	SAT peak	PHF	0.96
Urban Street	41st Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	I-29 SB	File Name	41 system sat 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		1060	135	265	1000					600	0	260

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	10	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	10.6	62.3	26.3	0.0	0.0	0.0
Yellow	3.9	3.9	3.8	0.0	0.0	0.0
Red	1.8	1.8	1.6	0.0	0.0	0.0



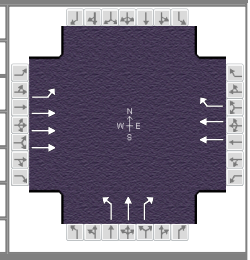
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6				4
Case Number		8.3	1.0	4.0				9.0
Phase Duration, s		68.0	16.3	84.3				31.7
Change Period, ($Y+R_c$), s		5.7	5.7	5.7				5.4
Max Allow Headway (*MAH*), s		0.0	5.1	0.0				6.1
Queue Clearance Time (g_s), s			9.2					22.9
Green Extension Time (g_e), s		0.0	1.4	0.0				3.4
Phase Call Probability			1.00					1.00
Max Out Probability			0.00					0.92

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6					7	4	14
Adjusted Flow Rate (*v*), veh/h		713	445	273	1029					625	0	161
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1371	1734	1706	1723					1656	1674	1251
Queue Service Time (g_s), s		20.3	19.9	7.2	19.1					20.9	0.0	6.2
Cycle Queue Clearance Time (g_c), s		20.3	19.9	7.2	19.1					20.9	0.0	6.2
Green Ratio (*g/C*)		0.54	0.54	0.65	0.68					0.23	0.23	0.23
Capacity (*c*), veh/h		1473	931	395	2337					750	379	566
Volume-to-Capacity Ratio (*X*)		0.484	0.478	0.690	0.440					0.834	0.000	0.285
Back of Queue (*Q*), ft/ln (95 th percentile)		267.5	322.8	147.4	290.5					349.4	0	85
Back of Queue (*Q*), veh/ln (95 th percentile)		10.6	12.9	5.9	11.5					14.0	0.0	3.4
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00	0.00	0.74	0.00					0.70	0.00	0.17
Uniform Delay (d_1), s/veh		18.9	18.9	15.5	11.5					42.8	0.0	37.1
Incremental Delay (d_2), s/veh		1.0	1.6	2.6	0.5					7.8	0.0	0.6
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0					0.0	0.0	0.0
Control Delay (*d*), s/veh		20.0	20.5	18.1	12.0					50.6	0.0	37.7
Level of Service (LOS)		B	C	B	B					D		D
Approach Delay, s/veh / LOS	20.2	C		13.3	B		0.0			48.0	D	
Intersection Delay, s/veh / LOS	24.1						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	2.8	C	3.5	C	3.3	C
Bicycle LOS Score / LOS	2.5	B	3.0	C			3.9	D

HCS 2010 Signalized Intersection Results Summary

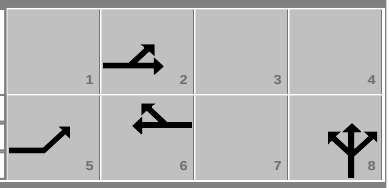
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jun 27, 2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	SAT peak	PHF	0.98
Urban Street	41st Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	I-29 NB	File Name	41 system sat 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	275	1385			1150	650	115	0	280			

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	100	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	8.5	75.0	16.9	0.0	0.0	0.0
Yellow	3.9	3.9	3.6	0.0	0.0	0.0
Red	1.0	1.6	1.6	0.0	0.0	0.0



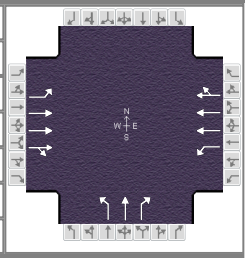
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		
Case Number	1.0	4.0		7.3		9.0		
Phase Duration, s	13.4	93.9		80.5		22.1		
Change Period, ($Y+R_c$), s	4.9	5.5		5.5		5.2		
Max Allow Headway (*MAH*), s	4.1	0.0		0.0		5.7		
Queue Clearance Time (g_s), s	7.7					15.7		
Green Extension Time (g_e), s	0.8	0.0		0.0		1.1		
Phase Call Probability	1.00					1.00		
Max Out Probability	0.00					0.43		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16	3	8	18			
Adjusted Flow Rate (*v*), veh/h	282	1420			1184	402	117	0	173			
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1706	1633			1799	1507	1706	1674	1433			
Queue Service Time (g_s), s	5.7	21.1			17.2	7.9	7.3	0.0	13.7			
Cycle Queue Clearance Time (g_c), s	5.7	21.1			17.2	7.9	7.3	0.0	13.7			
Green Ratio (*g/C*)	0.74	0.76			0.65	0.65	0.15	0.15	0.15			
Capacity (*c*), veh/h	425	3734			2325	974	248	244	209			
Volume-to-Capacity Ratio (*X*)	0.663	0.380			0.509	0.412	0.473	0.000	0.832			
Back of Queue (*Q*), ft/ln (95 th percentile)	92.5	318.7			231.1	94.4	144.5	0	240.7			
Back of Queue (*Q*), veh/ln (95 th percentile)	3.7	12.6			9.2	3.8	5.7	0.0	9.6			
Queue Storage Ratio (*RQ*) (95 th percentile)	1.03	0.00			0.00	0.00	2.41	0.00	0.00			
Uniform Delay (d_1), s/veh	9.2	12.4			8.3	4.1	45.5	0.0	48.2			
Incremental Delay (d_2), s/veh	1.4	0.2			0.7	1.1	2.4	0.0	16.9			
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0	0.0	0.0	0.0			
Control Delay (*d*), s/veh	10.6	12.7			9.0	5.2	47.9	0.0	65.1			
Level of Service (LOS)	B	B			A	A	D		E			
Approach Delay, s/veh / LOS	12.3	B		8.0	A		58.1	E		0.0		
Intersection Delay, s/veh / LOS	14.1						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.1	B	3.9	D	3.3	C
Bicycle LOS Score / LOS	2.9	C	3.1	C	3.3	C		

HCS 2010 Signalized Intersection Results Summary

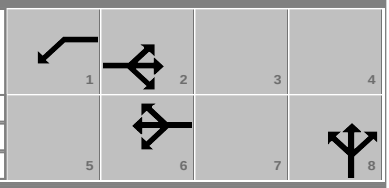
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jun 27, 2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	SAT peak	PHF	0.96
Urban Street	41st Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	W. Empire Place	File Name	41 system sat 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	20	1170	475	195	1410	45	390	5	225			

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	5	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	8.3	61.7	30.0	0.0	0.0	0.0
Yellow	3.9	3.9	3.6	0.0	0.0	0.0
Red	1.0	1.8	1.8	0.0	0.0	0.0



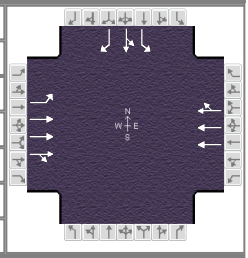
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		
Case Number		6.3	1.0	4.0		9.0		
Phase Duration, s		67.4	13.2	80.6		35.4		
Change Period, ($Y+R_c$), s		5.7	4.9	5.7		5.4		
Max Allow Headway (*MAH*), s		0.0	4.1	0.0		4.3		
Queue Clearance Time (g_s), s			7.7			28.9		
Green Extension Time (g_e), s		0.0	0.6	0.0		1.1		
Phase Call Probability			1.00			1.00		
Max Out Probability			0.00			0.88		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18			
Adjusted Flow Rate (*v*), veh/h	20	1026	461	200	984	487	406	5	141			
Adjusted Saturation Flow Rate (*s*), veh/h/ln	362	1791	1608	1706	1791	1774	1706	1791	1518			
Queue Service Time (g_s), s	1.9	16.3	13.7	5.7	19.6	19.7	26.9	0.3	8.8			
Cycle Queue Clearance Time (g_c), s	8.7	16.3	13.7	5.7	19.6	19.7	26.9	0.3	8.8			
Green Ratio (*g/C*)	0.53	0.53	0.53	0.62	0.65	0.65	0.26	0.26	0.26			
Capacity (*c*), veh/h	235	1906	856	324	2314	1146	441	463	392			
Volume-to-Capacity Ratio (*X*)	0.087	0.539	0.539	0.617	0.425	0.425	0.922	0.011	0.359			
Back of Queue (*Q*), ft/ln (95 th percentile)	8.8	222.5	175.4	102	319.5	321.8	506.6	5.1	150.8			
Back of Queue (*Q*), veh/ln (95 th percentile)	0.3	8.8	7.0	4.0	12.7	12.9	20.1	0.2	6.0			
Queue Storage Ratio (*RQ*) (95 th percentile)	0.15	0.00	0.00	2.04	0.00	0.00	0.00	0.00	0.00			
Uniform Delay (d_1), s/veh	8.8	10.9	8.3	13.1	14.5	14.6	41.9	32.0	35.2			
Incremental Delay (d_2), s/veh	0.7	1.0	2.2	1.6	0.5	1.0	21.6	0.0	0.6			
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
Control Delay (*d*), s/veh	9.5	11.9	10.5	14.8	15.0	15.6	63.5	32.0	35.7			
Level of Service (LOS)	A	B	B	B	B	B	E	C	D			
Approach Delay, s/veh / LOS	11.4	B		15.1	B		56.1	E		0.0		
Intersection Delay, s/veh / LOS	19.7						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	1.9	A	3.6	D	3.9	D
Bicycle LOS Score / LOS	3.2	C	2.9	C	3.7	D		

HCS 2010 Signalized Intersection Results Summary

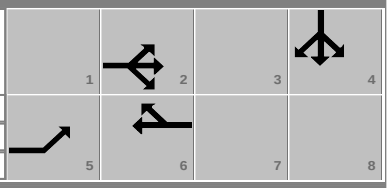
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jun 27, 2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	SAT peak	PHF	0.95
Urban Street	41st Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	Shirley Avenue	File Name	41 system sat 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	275	1040	80		1330	230				205	75	320

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	113	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	8.7	72.9	18.8	0.0	0.0	0.0
Yellow	3.9	3.9	3.6	0.0	0.0	0.0
Red	1.0	1.4	1.8	0.0	0.0	0.0



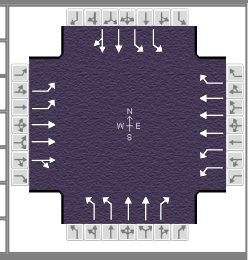
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				4
Case Number	1.0	4.0		8.3				9.0
Phase Duration, s	13.6	91.8		78.2				24.2
Change Period, ($Y+R_c$), s	4.9	5.3		5.3				5.4
Max Allow Headway (*MAH*), s	4.1	0.0		0.0				4.8
Queue Clearance Time (g_s), s	7.8							16.8
Green Extension Time (g_e), s	0.9	0.0		0.0				1.5
Phase Call Probability	1.00							1.00
Max Out Probability	0.00							0.40

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12		6	16				7	4	14
Adjusted Flow Rate (*v*), veh/h	282	750	366		1015	482				216	79	200
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1706	1791	1746		1791	1701				1706	1791	1509
Queue Service Time (g_s), s	5.8	1.7	1.5		25.2	22.0				14.1	4.5	14.8
Cycle Queue Clearance Time (g_c), s	5.8	1.7	1.5		25.2	22.0				14.1	4.5	14.8
Green Ratio (*g/C*)	0.72	0.75	0.75		0.63	0.63				0.16	0.16	0.16
Capacity (*c*), veh/h	335	2671	1302		2250	1068				277	291	245
Volume-to-Capacity Ratio (*X*)	0.841	0.281	0.281		0.451	0.451				0.780	0.272	0.817
Back of Queue (*Q*), ft/ln (95 th percentile)	238.9	21.5	22.7		324.4	330.6				272.8	92.5	264.2
Back of Queue (*Q*), veh/ln (95 th percentile)	9.5	0.9	0.9		12.9	13.2				10.8	3.7	10.6
Queue Storage Ratio (*RQ*) (95 th percentile)	4.78	0.00	0.00		0.00	0.00				2.48	0.00	2.42
Uniform Delay (d_1), s/veh	19.7	0.8	0.7		15.8	17.2				46.6	42.6	46.9
Incremental Delay (d_2), s/veh	4.8	0.2	0.5		0.4	0.9				8.6	0.6	12.7
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0		0.0	0.0				0.0	0.0	0.0
Control Delay (*d*), s/veh	24.5	1.0	1.1		16.3	18.1				55.2	43.2	59.6
Level of Service (LOS)	C	A	A		B	B				E	D	E
Approach Delay, s/veh / LOS	5.8	A		16.8	B		0.0			55.0	E	
Intersection Delay, s/veh / LOS	17.9						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	A	2.9	C	3.6	D	3.6	D
Bicycle LOS Score / LOS	2.7	B	3.1	C			3.6	D

HCS 2010 Signalized Intersection Results Summary

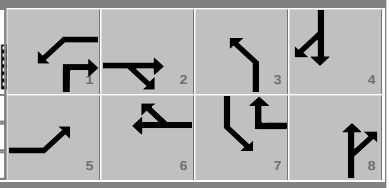
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jun 27, 2016	Area Type	Other
Jurisdiction	City of Sioux Falls	Time Period	SAT peak	PHF	0.98
Urban Street	41st Street	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	Louise Avenue	File Name	41 system sat 2016.xus		
Project Description	I-29 Exit 77 (41st St.) IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	230	920	220	420	1070	660	345	695	315	530	615	145

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	71	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	9.7	17.7	12.4	19.5	2.5	20.8
Yellow	3.6	3.6	3.6	3.5	3.5	3.5
Red	2.0	2.0	2.0	2.0	2.0	2.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	4.0	2.0	3.0	2.0	3.0	2.0	4.0
Phase Duration, s	15.3	38.7	18.0	41.3	26.3	34.3	25.0	33.0
Change Period, ($Y+R_c$), s	5.6	5.6	5.6	5.6	5.5	5.5	5.5	5.5
Max Allow Headway (*MAH*), s	4.1	0.0	4.1	0.0	5.2	5.2	4.1	4.6
Queue Clearance Time (g_s), s	9.4		14.4		13.1	24.6	21.0	24.6
Green Extension Time (g_e), s	0.4	0.0	0.0	0.0	5.7	4.2	0.0	2.8
Phase Call Probability	1.00		1.00		1.00	1.00	1.00	1.00
Max Out Probability	0.31		1.00		0.63	0.86	1.00	0.15

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	214	665	311	429	1092	403	352	709	194	541	365	349
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1640	1774	1645	1640	1610	1478	1640	1688	1496	1640	1774	1689
Queue Service Time (g_s), s	7.4	19.5	19.5	12.4	22.1	22.2	11.1	22.6	10.4	19.0	22.5	22.6
Cycle Queue Clearance Time (g_c), s	7.4	19.5	19.5	12.4	22.1	22.2	11.1	22.6	10.4	19.0	22.5	22.6
Green Ratio (*g/C*)	0.08	0.29	0.29	0.11	0.31	0.48	0.18	0.25	0.36	0.17	0.24	0.24
Capacity (*c*), veh/h	275	1011	469	351	1488	708	588	839	532	551	421	401
Volume-to-Capacity Ratio (*X*)	0.776	0.657	0.663	1.222	0.734	0.569	0.599	0.845	0.364	0.981	0.867	0.870
Back of Queue (*Q*), ft/ln (95 th percentile)	142.6	347.4	335.4	443.2	326.5	287.2	196.6	367.8	110	378.4	394.5	376.8
Back of Queue (*Q*), veh/ln (95 th percentile)	5.6	13.7	13.4	17.4	12.9	11.5	7.7	14.5	4.4	14.9	15.5	15.1
Queue Storage Ratio (*RQ*) (95 th percentile)	0.55	0.00	0.00	1.43	0.00	1.08	0.91	0.00	0.52	1.07	0.00	0.00
Uniform Delay (d_1), s/veh	50.9	38.2	37.6	49.7	30.2	18.5	40.4	36.7	7.4	44.8	37.9	38.0
Incremental Delay (d_2), s/veh	4.4	3.1	6.8	123.0	3.2	3.3	1.2	7.6	0.7	33.3	10.9	11.7
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	55.4	41.3	44.4	172.7	33.4	21.8	41.7	44.3	8.1	78.1	48.9	49.7
Level of Service (LOS)	E	D	D	F	C	C	D	D	A	E	D	D
Approach Delay, s/veh / LOS	44.6	D		62.0	E		37.9	D		61.7	E	
Intersection Delay, s/veh / LOS	52.9						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.5	D	3.4	C	4.2	D	3.8	D
Bicycle LOS Score / LOS	3.5	D	3.7	D	4.2	D	4.0	D

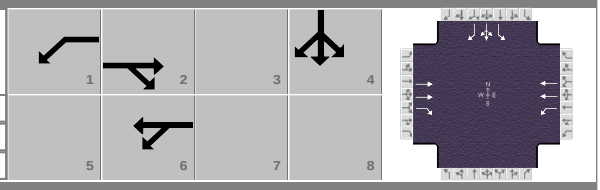
HCS 2010 Interchanges Results Summary

General Information				Interchange Information	
Agency	HDR			Interchange Type	Diamond
Analyst	RL	Analysis Date	Jun 27, 2016	Segment Distance, ft	814
Jurisdiction	City of Sioux Falls	Duration,h	0.25	Freeway Direction	North-South
Intersection	I-29 SB	PHF	0.96	Arterial Direction	East-West
File Name	26 system sat 2016.xus				
Project Description	I-29 Exit 77 (41st St.) IMJR				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h		715	185	110	885					580	0	270
Intersection Two Demand (*v*), veh/h	240	1055			745	720	250	0	115			

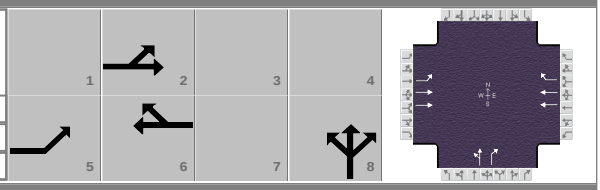
Signal One Information	
Cycle, s	92.0
Offset, s	22
Uncoordinated	No
Force Mode	Fixed

Green	4.8	44.0	25.6	0.0	0.0	0.0
Yellow	4.3	4.3	3.2	0.0	0.0	0.0
Red	1.8	1.8	2.2	0.0	0.0	0.0



Signal Two Information	
Cycle, s	92.0
Offset, s	22
Uncoordinated	No
Force Mode	Fixed

Green	7.3	50.0	17.1	0.0	0.0	0.0
Yellow	4.3	4.3	3.2	0.0	0.0	0.0
Red	1.8	1.8	2.2	0.0	0.0	0.0



Interchange Results

O-D	O-D Demand Movements	Demand (veh/h)	Delay Movements	Delay (s)	LOS
A	NBL - NBU	260	NBL(II) + NBT(II) + WBT(I)	61.4	D
B	NBR	73	NBT(II)	33.1	C
C	SBR	167	SBT(I)	28.2	B
D	SBL - SBU	604	SBL(I) + SBT(I) - EBT(II)	176.9	F
E	EBL(INT) - SBU	228	EBL(II) + EBT(II) + EBT(I)	26.6	B
F	EBR(EXT)	116	EBT(I)	18.2	B
G	WBR(EXT)	466	WBT(II)	9.3	A
H	WBL(INT) - NBU	118	WBL(I) + WBT(I) + WBT(II)	23.1	B
I	EBT(INT) - SBL + SBU	396	EBT(I) + EBT(II)	23.5	B
J	WBT(INT) - NBL + NBU	689	WBT(I) + WBT(II)	26.6	B
K	NBT	0	NBT	-	-
L	SBT	0	SBT	-	-
M	NBU	0	NBU	-	-
N	SBU	0	SBU	-	-

Signalized Intersection One Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh		18.2	15.6	12.4	15.9					171.7	0.0	28.2
Level of Service (LOS)		B	B	B	B					F		C
Approach Delay, s/veh / LOS	17.9	B		15.5	B		0.0			140.7	F	
Intersection Delay, s/veh / LOS	51.9						D					

Signalized Intersection Two Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh	8.4	5.2			10.7	9.3		45.6	33.1			
Level of Service (LOS)	A	A			B	A		D	C			
Approach Delay, s/veh / LOS	5.8	A		10.2	B		42.8	D		0.0		
Intersection Delay, s/veh / LOS	12.1						B					

This Urban Streets text report was created on June 27, 2016 at 02:44:56

Period number = 1

Chapter 17 Input

URBAN STREET PARAMETERS

Number of Intersections	4
Number of Segments	3
Analysis period duration, h	0.25
System cycle length, s	92
Urban street forward direction	EB
Sneakers per cycle, veh	2
Saturation flow rate, veh/h/ln	1900
Stored vehicle lane length, ft	25
Detected vehicle length, ft	17
Queue length percent	95
Critical merge gap, s	3.7
Stop threshold speed, mph	5
Acceleration rate, ft/s/s	3.5
Decel. rate (signal), ft/s/s	4
Minimum headway in a platoon, s/veh	1.5
Maximum headway in a platoon, s/veh	3.6
Number of iterations	15
Length of left-turn bay (access pt.), ft	250
Decel. rate (access pt.), ft/s/s	6.7
Right-turn speed (access pt.), ft/s	20
Critical gap from major left (access pt.), s	4.1
Follow-up time from major left (access pt.), s	2.2
Right-turn equivalency factor (access pt.)	2.2
Stored heavy vehicle lane length, ft	45
Proportion of peds who push button	0.65
Critical gap for permissive left-turn, s	4.5
Follow-up time for permissive left-turn, s	2.5
Calibration factor for platoon dispersion	0.14
Average ratio of speed limit to free-flow speed	0.9

BASIC SEGMENT INFORMATION

Seg	Spd Lmt		TH Lanes		Seg Len		IntWid		LenRM		PctCurb		Other Dly	
Num	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB
1	35	35	2	2	1152	1152	50	50	0	0	70	70	0	0
2	35	35	2	2	814	814	50	50	0	0	70	70	0	0
3	35	35	2	2	1366	1366	50	50	0	0	70	70	0	0

ORIGIN-DESTINATION SEED PROPORTIONS - Forward Direction

	Cross LT	Major TH	Cross RT	MidEntry
Downstream Left	0.02	0.1	0.05	0.02
Downstream Thru	0.91	0.78	0.92	0.97
Downstream Right	0.05	0.1	0.02	0.01
Mid-segment Exit	0.02	0.02	0.01	0

ORIGIN-DESTINATION SEED PROPORTIONS - Reverse Direction

	Cross LT	Major TH	Cross RT	MidEntry
Downstream Left	0.02	0.1	0.05	0.02
Downstream Thru	0.91	0.78	0.92	0.97
Downstream Right	0.05	0.1	0.02	0.01
Mid-segment Exit	0.02	0.02	0.01	0

ACCESS POINT DATA

SEGMENT 1

Number of access points: 0

SEGMENT 2

Number of access points: 0

SEGMENT 3

Number of access points: 0

Global Output

SEGMENT DATA

Seg.No.	Movement	EB LT 5	EB TH 2	EB RT 12	WB LT 1	WB TH 6	WB RT 16
1	Bay/Lane Spillback Time, h	999	999	999	999	999	999
1	ShrdLane Spillback Time, h			999	999		
1	Base Free-Flow Speed, mph		41.72			41.72	
1	Running Time, s		22.21			22.41	
1	Running Speed, mph		35.37			35.05	
1	Through Delay, s/veh		18.23			4.78	
1	Travel Speed, mph		19.42			28.89	
1	Stop Rate, stops/veh		0.58			0.17	
1	Spatial Stop Rate, stops/mi		2.65			0.77	
1	Through vol/cap ratio		0.47			0.45	
1	Percent of Base FFS		46.55			69.25	
1	Level of Service		D			B	
1	Automobile Perception Score		2.79			2.25	
2	Bay/Lane Spillback Time, h	999	999	999	999	999	999
2	ShrdLane Spillback Time, h	999			999		
2	Base Free-Flow Speed, mph		41.72			41.72	
2	Running Time, s		17.47			17.38	
2	Running Speed, mph		31.77			31.93	
2	Through Delay, s/veh		5.22			15.85	
2	Travel Speed, mph		24.46			16.7	
2	Stop Rate, stops/veh		0.21			0.6	
2	Spatial Stop Rate, stops/mi		1.37			3.89	
2	Through vol/cap ratio		0.43			0.47	
2	Percent of Base FFS		58.62			40.03	
2	Level of Service		C			D	
2	Automobile Perception Score		2.35			3.01	
3	Bay/Lane Spillback Time, h	999	999	999	999	999	999
3	ShrdLane Spillback Time, h	999		999			999
3	Base Free-Flow Speed, mph		41.72			41.72	
3	Running Time, s		25.61			26.01	
3	Running Speed, mph		36.37			35.8	
3	Through Delay, s/veh		15.55			10.7	
3	Travel Speed, mph		22.63			25.37	
3	Stop Rate, stops/veh		0.46			0.36	
3	Spatial Stop Rate, stops/mi		1.77			1.4	
3	Through vol/cap ratio		0.41			0.44	
3	Percent of Base FFS		54.23			60.81	
3	Level of Service		C			C	
3	Automobile Perception Score		2.41			2.35	
Facility Travel Time, s			104.3			97.13	
Facility Travel Speed, mph			21.78			23.39	
Facility Spatial Stop Rate, veh/mi			1.98			1.79	
Facility Base Free Flow Speed, mph			41.72			41.72	
Facility Percent Base Free Flow Speed			52.21			56.06	
Facility Level of Service			C			C	
Facility Automobile Perception Score			2.51			2.45	
Facility Pedestrian Space			Infinity			Infinity	
Facility Pedestrian Travel Speed			4.4			4.4	
Facility Pedestrian LOS Score			3.54			3.59	
Facility Pedestrian LOS			D			D	
Facility Bicycle Travel Speed			12.94			12.46	
Facility Bicycle LOS Score			3.54			3.5	
Facility Bicycle LOS			D			D	
Facility Transit Travel Speed			19.42			28.84	
Facility Transit LOS Score			1.59			1.45	
Facility Transit LOS			A			A	
SPILLBACK TIME, h			999				

Multimodal Results

1	Roadway crossing difficulty factor	1.06	1.2
1	Ped LOS Score for Link	2.9	3.21
1	Ped LOS Score for Intersection	1.97	2.34
1	Ped LOS Score for Segment	3.13	3.77

1	Ped Segment LOS	C	D
1	Bicycle LOS Score for Link	3.55	3.68
1	Indicator Variable	1	1
1	Bicycle LOS Score for Intersection	1.33	1.77
1	Number of access point approaches	0	0
1	Segment Length, ft	1152	1152
1	Bicycle LOS Score for Segment	3.46	3.5
1	Bicycle Segment LOS	C	D
1	Transit Wait-Ride Score	3.1	3.6
1	Ped LOS Score for Link	2.9	3.21
1	Transit LOS Score for Segment	1.79	1.08
1	Transit Segment LOS	A	A
2	Roadway crossing difficulty factor	1.2	1.2
2	Ped LOS Score for Link	3.12	2.94
2	Ped LOS Score for Intersection	2.06	2.46
2	Ped LOS Score for Segment	3.66	3.7
2	Ped Segment LOS	D	D
2	Bicycle LOS Score for Link	3.62	3.55
2	Indicator Variable	1	1
2	Bicycle LOS Score for Intersection	1.83	1.76
2	Number of access point approaches	0	0
2	Segment Length, ft	814	814
2	Bicycle LOS Score for Segment	3.5	3.48
2	Bicycle Segment LOS	C	C
2	Transit Wait-Ride Score	3.39	2.92
2	Ped LOS Score for Link	3.12	2.94
2	Transit LOS Score for Segment	1.39	2.06
2	Transit Segment LOS	A	B
3	Roadway crossing difficulty factor	1.2	1.06
3	Ped LOS Score for Link	3.12	3.62
3	Ped LOS Score for Intersection	2.67	1.95
3	Ped LOS Score for Segment	3.82	3.38
3	Ped Segment LOS	D	C
3	Bicycle LOS Score for Link	3.65	3.81
3	Indicator Variable	1	1
3	Bicycle LOS Score for Intersection	2.95	1.57
3	Number of access point approaches	0	0
3	Segment Length, ft	1366	1366
3	Bicycle LOS Score for Segment	3.64	3.51
3	Bicycle Segment LOS	D	D
3	Transit Wait-Ride Score	3.29	3.44
3	Ped LOS Score for Link	3.12	3.62
3	Transit LOS Score for Segment	1.54	1.39
3	Transit Segment LOS	A	A

ACCESS POINT DATA

SEGMENT 1

SEGMENT 2

SEGMENT 3

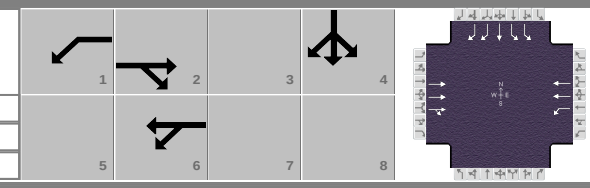
HCS 2010 Interchanges Results Summary

General Information				Interchange Information	
Agency	HDR			Interchange Type	Diamond
Analyst	RL	Analysis Date	Jun 27, 2016	Segment Distance, ft	513
Jurisdiction	City of Sioux Falls	Duration,h	0.25	Freeway Direction	North-South
Intersection	I-29 SB	PHF	0.96	Arterial Direction	East-West
File Name	41 system sat 2016.xus				
Project Description	I-29 Exit 77 (41st St.) IMJR				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h		1060	135	265	1000					600	0	260
Intersection Two Demand (*v*), veh/h	275	1385			1150	650	115	0	280			

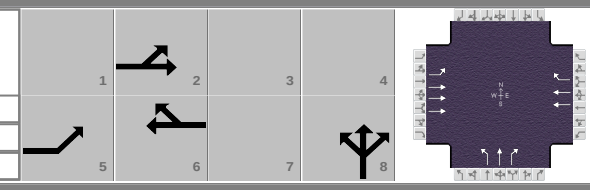
Signal One Information	
Cycle, s	116.0
Offset, s	10
Uncoordinated	No
Force Mode	Fixed

Green	10.6	62.3	26.3	0.0	0.0	0.0
Yellow	3.9	3.9	3.8	0.0	0.0	0.0
Red	1.8	1.8	1.6	0.0	0.0	0.0



Signal Two Information	
Cycle, s	116.0
Offset, s	10
Uncoordinated	No
Force Mode	Fixed

Green	8.5	75.0	16.9	0.0	0.0	0.0
Yellow	3.9	3.9	3.6	0.0	0.0	0.0
Red	1.0	1.6	1.6	0.0	0.0	0.0



Interchange Results

O-D	O-D Demand Movements	Demand (veh/h)	Delay Movements	Delay (s)	LOS
A	NBL - NBU	117	NBL(II) + NBT(II) + WBT(I)	59.8	F
B	NBR	173	NBT(II)	65.1	D
C	SBR	161	SBT(I)	37.7	C
D	SBL - SBU	625	SBL(I) + SBT(I) - EBT(II)	63.3	D
E	EBL(INT) - SBU	282	EBL(II) + EBT(II) + EBT(I)	30.5	F
F	EBR(EXT)	81	EBT(I)	20.0	B
G	WBR(EXT)	402	WBT(II)	5.2	A
H	WBL(INT) - NBU	273	WBL(I) + WBT(I) + WBT(II)	27.1	B
I	EBT(INT) - SBL + SBU	795	EBT(I) + EBT(II)	32.6	C
J	WBT(INT) - NBL + NBU	912	WBT(I) + WBT(II)	21.0	B
K	NBT	0	NBT	-	-
L	SBT	0	SBT	-	-
M	NBU	0	NBU	-	-
N	SBU	0	SBU	-	-

Signalized Intersection One Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh		20.0	20.5	18.1	12.0					50.6	0.0	37.7
Level of Service (LOS)		B	C	B	B					D		D
Approach Delay, s/veh / LOS	20.2		C	13.3		B	0.0			48.0		D
Intersection Delay, s/veh / LOS	24.1						C					

Signalized Intersection Two Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh	10.6	12.7			9.0	5.2	47.9	0.0	65.1			
Level of Service (LOS)	B	B			A	A	D		E			
Approach Delay, s/veh / LOS	12.3		B	8.0		A	58.1		E	0.0		
Intersection Delay, s/veh / LOS	14.1						B					

This Urban Streets text report was created on June 27, 2016 at 03:21:52

Period number = 1

Chapter 17 Input

URBAN STREET PARAMETERS

Number of Intersections	7
Number of Segments	6
Analysis period duration, h	0.25
System cycle length, s	116
Urban street forward direction	EB
Sneakers per cycle, veh	2
Saturation flow rate, veh/h/ln	1900
Stored vehicle lane length, ft	25
Detected vehicle length, ft	17
Queue length percent	95
Critical merge gap, s	3.7
Stop threshold speed, mph	5
Acceleration rate, ft/s/s	3.5
Decel. rate (signal), ft/s/s	4
Minimum headway in a platoon, s/veh	1.5
Maximum headway in a platoon, s/veh	3.6
Number of iterations	15
Length of left-turn bay (access pt.), ft	250
Decel. rate (access pt.), ft/s/s	6.7
Right-turn speed (access pt.), ft/s	20
Critical gap from major left (access pt.), s	4.1
Follow-up time from major left (access pt.), s	2.2
Right-turn equivalency factor (access pt.)	2.2
Stored heavy vehicle lane length, ft	45
Proportion of peds who push button	0.65
Critical gap for permissive left-turn, s	4.5
Follow-up time for permissive left-turn, s	2.5
Calibration factor for platoon dispersion	0.14
Average ratio of speed limit to free-flow speed	0.9

BASIC SEGMENT INFORMATION

Seg	Spd Lmt		TH Lanes		Seg Len		IntWid		LenRM		PctCurb		Other Dly	
Num	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB
1	35	35	2	2	1224	1224	50	50	0	0	70	70	0	0
2	35	35	3	2	1316	1316	50	50	0	0	70	70	0	0
3	35	35	3	2	513	513	50	50	0	0	70	70	0	0
4	35	35	3	2	731	731	50	50	0	0	70	70	0	0
5	35	35	3	3	599	599	50	50	0	0	70	70	0	0
6	35	35	3	3	884	884	50	50	0	0	70	70	0	0

ORIGIN-DESTINATION SEED PROPORTIONS - Forward Direction

	Cross LT	Major TH	Cross RT	MidEntry
Downstream Left	0.02	0.1	0.05	0.02
Downstream Thru	0.91	0.78	0.92	0.97
Downstream Right	0.05	0.1	0.02	0.01
Mid-segment Exit	0.02	0.02	0.01	0

ORIGIN-DESTINATION SEED PROPORTIONS - Reverse Direction

	Cross LT	Major TH	Cross RT	MidEntry
Downstream Left	0.02	0.1	0.05	0.02
Downstream Thru	0.91	0.78	0.92	0.97
Downstream Right	0.05	0.1	0.02	0.01
Mid-segment Exit	0.02	0.02	0.01	0

ACCESS POINT DATA

SEGMENT 1

Number of access points: 0

SEGMENT 2

Number of access points: 0

SEGMENT 3

Number of access points: 0

SEGMENT 4

Number of access points: 0

SEGMENT 5

Number of access points: 0

SEGMENT 6

Number of access points: 0

Global Output

SEGMENT DATA

Seg.No.	Movement	EB LT 5	EB TH 2	EB RT 12	WB LT 1	WB TH 6	WB RT 16
1	Bay/Lane Spillback Time, h	999	999	999	999	999	999
1	ShrdLane Spillback Time, h	999			999		999
1	Base Free-Flow Speed, mph		41.72			41.72	
1	Running Time, s		23.41			23.49	
1	Running Speed, mph		35.65			35.53	
1	Through Delay, s/veh		6.05			13.1	
1	Travel Speed, mph		28.32			22.81	
1	Stop Rate, stops/veh		0.23			0.34	
1	Spatial Stop Rate, stops/mi		0.98			1.48	
1	Through vol/cap ratio		0.42			0.49	
1	Percent of Base FFS		67.89			54.67	
1	Level of Service		B			C	
1	Automobile Perception Score		2.29			2.36	
2	Bay/Lane Spillback Time, h	999	999	999	999	999	999
2	ShrdLane Spillback Time, h				999		
2	Base Free-Flow Speed, mph		41.72			41.72	
2	Running Time, s		24.6			24.98	
2	Running Speed, mph		36.47			35.92	
2	Through Delay, s/veh		20.15			5.5	
2	Travel Speed, mph		20.05			29.43	
2	Stop Rate, stops/veh		0.58			0.21	
2	Spatial Stop Rate, stops/mi		2.32			0.85	
2	Through vol/cap ratio		0.48			0.44	
2	Percent of Base FFS		48.06			70.55	
2	Level of Service		D			B	
2	Automobile Perception Score		2.73			2.27	
3	Bay/Lane Spillback Time, h	999	999	999	999	999	999
3	ShrdLane Spillback Time, h	999			999		
3	Base Free-Flow Speed, mph		41.72			41.72	
3	Running Time, s		13.8			13.87	
3	Running Speed, mph		25.35			25.21	
3	Through Delay, s/veh		12.66			11.99	
3	Travel Speed, mph		13.22			13.52	
3	Stop Rate, stops/veh		0.56			0.45	
3	Spatial Stop Rate, stops/mi		5.73			4.6	
3	Through vol/cap ratio		0.38			0.44	
3	Percent of Base FFS		31.69			32.41	
3	Level of Service		E			E	
3	Automobile Perception Score		3.1			3.15	
4	Bay/Lane Spillback Time, h	999	999	999	999	999	999
4	ShrdLane Spillback Time, h	999					
4	Base Free-Flow Speed, mph		41.72			41.72	
4	Running Time, s		16.31			16.74	
4	Running Speed, mph		30.56			29.77	
4	Through Delay, s/veh		11.7			8.98	
4	Travel Speed, mph		17.8			19.38	
4	Stop Rate, stops/veh		0.31			0.29	
4	Spatial Stop Rate, stops/mi		2.24			2.13	
4	Through vol/cap ratio		0.54			0.51	
4	Percent of Base FFS		42.66			46.44	
4	Level of Service		D			D	
4	Automobile Perception Score		2.49			2.47	
5	Bay/Lane Spillback Time, h	999	999	999	999	999	999

5	ShrdLane Spillback Time, h	999	999
5	Base Free-Flow Speed, mph	41.72	41.72
5	Running Time, s	14.61	14.68
5	Running Speed, mph	27.96	27.81
5	Through Delay, s/veh	1.05	15.17
5	Travel Speed, mph	26.09	13.68
5	Stop Rate, stops/veh	0.04	0.53
5	Spatial Stop Rate, stops/mi	0.36	4.66
5	Through vol/cap ratio	0.28	0.42
5	Percent of Base FFS	62.54	32.79
5	Level of Service	C	E
5	Automobile Perception Score	2.19	3.16
6	Bay/Lane Spillback Time, h	999 999 999	999 999 999
6	ShrdLane Spillback Time, h	999	
6	Base Free-Flow Speed, mph	41.72	41.72
6	Running Time, s	18.24	18.35
6	Running Speed, mph	33.05	32.84
6	Through Delay, s/veh	41.99	16.72
6	Travel Speed, mph	10.01	17.19
6	Stop Rate, stops/veh	0.84	0.56
6	Spatial Stop Rate, stops/mi	5.03	3.34
6	Through vol/cap ratio	0.66	0.45
6	Percent of Base FFS	23.99	41.2
6	Level of Service	F	D
6	Automobile Perception Score	2.97	2.67

Facility Travel Time, s	204.56	183.58
Facility Travel Speed, mph	17.56	19.56
Facility Spatial Stop Rate, veh/mi	2.56	2.39
Facility Base Free Flow Speed, mph	41.72	41.72
Facility Percent Base Free Flow Speed	42.08	46.89
Facility Level of Service	D	D
Facility Automobile Perception Score	2.57	2.53
Facility Pedestrian Space	Infinity	Infinity
Facility Pedestrian Travel Speed	4.4	4.4
Facility Pedestrian LOS Score	3.68	3.82
Facility Pedestrian LOS	D	D
Facility Bicycle Travel Speed	12.31	12.01
Facility Bicycle LOS Score	3.63	3.69
Facility Bicycle LOS	D	D
Facility Transit Travel Speed	28.31	22.81
Facility Transit LOS Score	1.43	1.73
Facility Transit LOS	A	A
SPILLBACK TIME, h	999	

Multimodal Results

1	Roadway crossing difficulty factor	1.2	1.18
1	Ped LOS Score for Link	3.09	3.2
1	Ped LOS Score for Intersection	2.45	3.13
1	Ped LOS Score for Segment	3.75	3.91
1	Ped Segment LOS	D	D
1	Bicycle LOS Score for Link	3.63	3.67
1	Indicator Variable	1	1
1	Bicycle LOS Score for Intersection	3	3.35
1	Number of access point approaches	0	0
1	Segment Length, ft	1224	1224
1	Bicycle LOS Score for Segment	3.65	3.75
1	Bicycle Segment LOS	D	D
1	Transit Wait-Ride Score	3.58	3.3
1	Ped LOS Score for Link	3.09	3.2
1	Transit LOS Score for Segment	1.1	1.53
1	Transit Segment LOS	A	A
2	Roadway crossing difficulty factor	1.19	1.2
2	Ped LOS Score for Link	2.77	3.31
2	Ped LOS Score for Intersection	2.03	2.34
2	Ped LOS Score for Segment	3.5	3.81
2	Ped Segment LOS	D	D
2	Bicycle LOS Score for Link	3.48	3.72
2	Indicator Variable	1	1

2	Bicycle LOS Score for Intersection	2.47	3.14
2	Number of access point approaches	0	0
2	Segment Length, ft	1316	1316
2	Bicycle LOS Score for Segment	3.54	3.7
2	Bicycle Segment LOS	D	D
2	Transit Wait-Ride Score	3.14	3.63
2	Ped LOS Score for Link	2.77	3.31
2	Transit LOS Score for Segment	1.7	1.05
2	Transit Segment LOS	A	A
3	Roadway crossing difficulty factor	1.2	1.2
3	Ped LOS Score for Link	2.87	3.06
3	Ped LOS Score for Intersection	2.29	2.79
3	Ped LOS Score for Segment	3.63	3.83
3	Ped Segment LOS	D	D
3	Bicycle LOS Score for Link	3.4	3.47
3	Indicator Variable	1	1
3	Bicycle LOS Score for Intersection	2.87	3.03
3	Number of access point approaches	0	0
3	Segment Length, ft	513	513
3	Bicycle LOS Score for Segment	3.59	3.63
3	Bicycle Segment LOS	D	D
3	Transit Wait-Ride Score	2.66	2.68
3	Ped LOS Score for Link	2.87	3.06
3	Transit LOS Score for Segment	2.44	2.44
3	Transit Segment LOS	B	B
4	Roadway crossing difficulty factor	1.2	1.2
4	Ped LOS Score for Link	2.99	3.78
4	Ped LOS Score for Intersection	2.76	2.05
4	Ped LOS Score for Segment	3.79	3.91
4	Ped Segment LOS	D	D
4	Bicycle LOS Score for Link	3.56	3.79
4	Indicator Variable	1	1
4	Bicycle LOS Score for Intersection	3.18	3.15
4	Number of access point approaches	0	0
4	Segment Length, ft	731	731
4	Bicycle LOS Score for Segment	3.68	3.71
4	Bicycle Segment LOS	D	D
4	Transit Wait-Ride Score	2.98	3.1
4	Ped LOS Score for Link	2.99	3.78
4	Transit LOS Score for Segment	1.97	1.92
4	Transit Segment LOS	A	A
5	Roadway crossing difficulty factor	1.2	1.2
5	Ped LOS Score for Link	2.72	2.91
5	Ped LOS Score for Intersection	1.95	1.88
5	Ped LOS Score for Segment	3.48	3.54
5	Ped Segment LOS	C	D
5	Bicycle LOS Score for Link	3.4	3.49
5	Indicator Variable	1	1
5	Bicycle LOS Score for Intersection	2.67	2.94
5	Number of access point approaches	0	0
5	Segment Length, ft	599	599
5	Bicycle LOS Score for Segment	3.55	3.62
5	Bicycle Segment LOS	D	D
5	Transit Wait-Ride Score	3.48	2.7
5	Ped LOS Score for Link	2.72	2.91
5	Transit LOS Score for Segment	1.19	2.38
5	Transit Segment LOS	A	B
6	Roadway crossing difficulty factor	1.2	1.2
6	Ped LOS Score for Link	2.73	2.96
6	Ped LOS Score for Intersection	3.54	2.9
6	Ped LOS Score for Segment	3.9	3.82
6	Ped Segment LOS	D	D
6	Bicycle LOS Score for Link	3.46	3.57
6	Indicator Variable	1	1
6	Bicycle LOS Score for Intersection	3.52	3.1
6	Number of access point approaches	0	0
6	Segment Length, ft	884	884
6	Bicycle LOS Score for Segment	3.77	3.66
6	Bicycle Segment LOS	D	D

6	Transit Wait-Ride Score	3.86	2.97
6	Ped LOS Score for Link	2.73	2.96
6	Transit LOS Score for Segment	0.62	1.99
6	Transit Segment LOS	A	A

ACCESS POINT DATA

SEGMENT 1

SEGMENT 2

SEGMENT 3

SEGMENT 4

SEGMENT 5

SEGMENT 6
