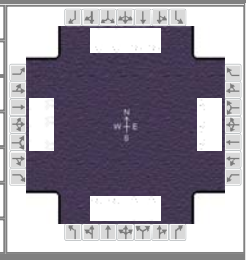
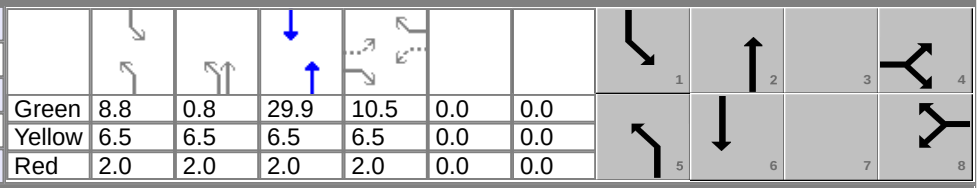
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.25
Analyst		Analysis Date	7/24/2016	Area Type	Other
Jurisdiction	South Dakota	Time Period	AM Peak	PHF	0.89
Urban Street	Elk Vale	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	Interchange I-90	File Name	1.AM peak Elk Vale and I-90 SPUI .xus		
Project Description					



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	110		0	560		0	520	485		80	550	

Signal Information			
Cycle, s	84.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	8.8	0.8	29.9	10.5	0.0	0.0
Yellow	6.5	6.5	6.5	6.5	0.0	0.0
Red	2.0	2.0	2.0	2.0	0.0	0.0

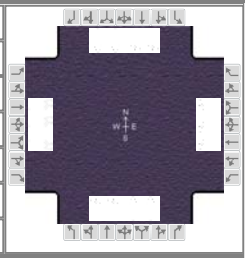
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2	1	6
Case Number		5.0		5.0	2.0	4.0	2.0	4.0
Phase Duration, s		19.0		19.0	26.6	47.7	17.3	38.4
Change Period, ($Y+R_c$), s		8.5		8.5	8.5	8.5	8.5	8.5
Max Allow Headway (*MAH*), s		3.0		3.0	3.1	0.0	3.1	0.0
Queue Clearance Time (g_s), s		5.1		12.5	16.7		5.0	
Green Extension Time (g_e), s		1.1		0.0	1.3	0.0	0.2	0.0
Phase Call Probability		1.00		1.00	1.00		0.88	
Max Out Probability		0.29		1.00	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		14	3		18	5	2		1	6	
Adjusted Flow Rate (*v*), veh/h	124		0	629		0	584	545		90	618	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1496		1403	1613		1403	1600	1482		1171	1449	
Queue Service Time (g_s), s	3.1		0.0	10.5		0.0	14.7	10.1		3.0	14.7	
Cycle Queue Clearance Time (g_c), s	3.1		0.0	10.5		0.0	14.7	10.1		3.0	14.7	
Green Ratio (*g/C*)	0.12		0.12	0.12		0.12	0.22	0.47		0.10	0.36	
Capacity (*c*), veh/h	545		175	575		175	688	1384		245	1033	
Volume-to-Capacity Ratio (*X*)	0.227		0.000	1.095		0.000	0.849	0.394		0.367	0.598	
Back of Queue (*Q*), ft/ln (50 th percentile)	31		0	285.8		0	144.2	90.3		27.5	142.3	
Back of Queue (*Q*), veh/ln (50 th percentile)	1.1		0.0	11.1		0.0	5.5	3.3		0.8	5.0	
Queue Storage Ratio (*RQ*) (50 th percentile)	0.08		0.00	0.71		0.00	0.48	0.00		0.09	0.00	
Uniform Delay (d_1), s/veh	33.5		0.0	38.2		0.0	31.7	14.6		35.0	22.1	
Incremental Delay (d_2), s/veh	0.1		0.0	66.1		0.0	1.2	0.8		0.3	2.6	
Initial Queue Delay (d_3), s/veh	0.0		0.0	0.0		0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	33.6		0.0	104.3		0.0	32.8	15.5		35.4	24.7	
Level of Service (LOS)	C			F			C	B		D	C	
Approach Delay, s/veh / LOS	33.6		C	104.3		F	24.4		C	26.0		C
Intersection Delay, s/veh / LOS	44.7						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.0	C	3.0	C	2.8	C	2.8	C
Bicycle LOS Score / LOS		F		F	1.4	A	1.1	A

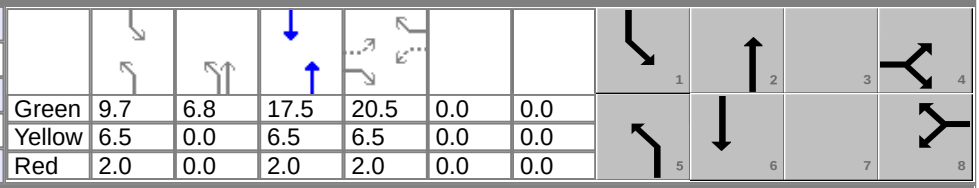
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.25
Analyst		Analysis Date	7/24/2016	Area Type	Other
Jurisdiction	South Dakota	Time Period	PM Peak	PHF	0.89
Urban Street	Elk Vale	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	Interchange I-90	File Name	1.PM peak Elk Vale and I-90 SPUI .xus		
Project Description	I-90 Corridor Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	400		0	800		0	710	830		140	640	

Signal Information			
Cycle, s	80.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	9.7	6.8	17.5	20.5	0.0	0.0
Yellow	6.5	0.0	6.5	6.5	0.0	0.0
Red	2.0	0.0	2.0	2.0	0.0	0.0

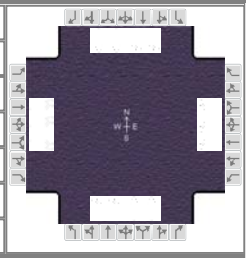
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2	1	6
Case Number		5.0		5.0	2.0	4.0	2.0	4.0
Phase Duration, s		29.0		29.0	25.0	32.8	18.2	26.0
Change Period, ($Y+R_c$), s		8.5		8.5	8.5	8.5	8.5	8.5
Max Allow Headway (*MAH*), s		3.0		3.0	3.1	0.0	3.1	0.0
Queue Clearance Time (g_s), s		11.8		22.5	18.5		5.5	
Green Extension Time (g_e), s		2.6		0.0	0.0	0.0	0.2	0.0
Phase Call Probability		1.00		1.00	1.00		0.97	
Max Out Probability		0.19		1.00	1.00		0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14	3		18	5	2		1	6	
Adjusted Flow Rate (*v*), veh/h	449		0	899		0	798	933		157	719	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1548		1403	1639		1403	1626	1654		1639	1636	
Queue Service Time (g_s), s	9.8		0.0	20.5		0.0	16.5	21.9		3.5	17.5	
Cycle Queue Clearance Time (g_c), s	9.8		0.0	20.5		0.0	16.5	21.9		3.5	17.5	
Green Ratio (*g/C*)	0.26		0.26	0.26		0.26	0.21	0.30		0.12	0.22	
Capacity (*c*), veh/h	973		360	1020		360	671	1005		397	716	
Volume-to-Capacity Ratio (*X*)	0.462		0.000	0.881		0.000	1.190	0.928		0.396	1.005	
Back of Queue (*Q*), ft/ln (50 th percentile)	94.6		0	240.7		0	394.7	258.8		34.8	253.5	
Back of Queue (*Q*), veh/ln (50 th percentile)	3.5		0.0	9.5		0.0	15.4	10.2		1.4	10.0	
Queue Storage Ratio (*RQ*) (50 th percentile)	0.24		0.00	0.60		0.00	1.32	0.00		0.12	0.00	
Uniform Delay (d_1), s/veh	25.8		0.0	30.1		0.0	31.8	27.0		32.4	31.3	
Incremental Delay (d_2), s/veh	0.1		0.0	8.8		0.0	99.8	15.6		0.2	34.8	
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	25.9		0.0	38.9		0.0	131.5	42.6		32.7	66.1	
Level of Service (LOS)	C			D			F	D		C	F	
Approach Delay, s/veh / LOS	25.9	C		38.9	D		83.6	F		60.1	E	
Intersection Delay, s/veh / LOS	61.7						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.9	C	2.8	C	2.8	C
Bicycle LOS Score / LOS		F		F	1.9	B	1.2	A

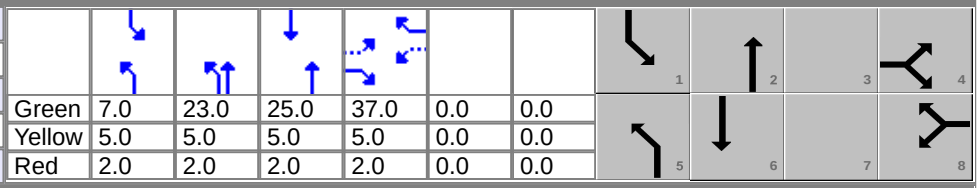
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.25
Analyst		Analysis Date	7/24/2016	Area Type	Other
Jurisdiction		Time Period		PHF	0.89
Urban Street	Elk Vale	Analysis Year	2016	Analysis Period	1> 7:00
Intersection	Interchange I-90	File Name	PM peak Elk Vale and I-90 SPUI 2045.xus		
Project Description					



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	400		0	800		0	710	830		140	640	

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	7.0	23.0	25.0	37.0	0.0	0.0
Yellow	5.0	5.0	5.0	5.0	0.0	0.0
Red	2.0	2.0	2.0	2.0	0.0	0.0

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2	1	6
Case Number		5.0		5.0	2.0	4.0	2.0	4.0
Phase Duration, s		44.0		44.0	44.0	62.0	14.0	32.0
Change Period, ($Y+R_c$), s		7.0		7.0	7.0	7.0	7.0	7.0
Max Allow Headway (*MAH*), s		3.0		3.0	3.1	0.0	3.1	0.0
Queue Clearance Time (g_s), s		14.8		30.0	27.1		7.4	
Green Extension Time (g_e), s		3.4		2.3	1.7	0.0	0.0	0.0
Phase Call Probability		1.00		1.00	1.00		1.00	
Max Out Probability		0.00		0.32	0.04		1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14	3		18	5	2		1	6	
Adjusted Flow Rate (*v*), veh/h	449		0	899		0	798	933		157	719	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1634		1481	1730		1481	1716	1791		1730	1760	
Queue Service Time (g_s), s	12.8		0.0	28.0		0.0	25.1	22.9		5.4	24.4	
Cycle Queue Clearance Time (g_c), s	12.8		0.0	28.0		0.0	25.1	22.9		5.4	24.4	
Green Ratio (*g/C*)	0.31		0.31	0.31		0.31	0.31	0.46		0.06	0.21	
Capacity (*c*), veh/h	1127		457	1187		457	1058	1641		202	733	
Volume-to-Capacity Ratio (*X*)	0.399		0.000	0.758		0.000	0.754	0.568		0.780	0.981	
Back of Queue (*Q*), ft/ln (50 th percentile)	143.1		0	323.8		0	284	247.5		77.1	341.7	
Back of Queue (*Q*), veh/ln (50 th percentile)	5.3		0.0	12.7		0.0	11.1	9.7		3.0	13.5	
Queue Storage Ratio (*RQ*) (50 th percentile)	0.36		0.00	0.81		0.00	0.95	0.00		0.26	0.00	
Uniform Delay (d_1), s/veh	33.1		0.0	38.4		0.0	37.4	23.8		55.7	47.3	
Incremental Delay (d_2), s/veh	1.1		0.0	4.5		0.0	5.0	1.4		25.2	28.8	
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	34.2		0.0	42.9		0.0	42.4	25.2		80.9	76.1	
Level of Service (LOS)	C			D			D	C		F	E	
Approach Delay, s/veh / LOS	34.2	C		42.9	D		33.1	C		77.0	E	
Intersection Delay, s/veh / LOS	45.2						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.0	C	3.0	C	2.8	C	2.9	C
Bicycle LOS Score / LOS		F		F	1.9	B	1.2	A

HCS7 Two-Way Stop-Control Report

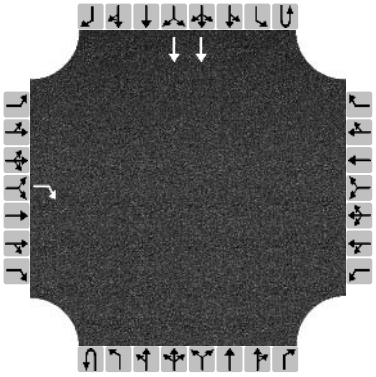
General Information

Analyst	TSF
Agency/Co.	
Date Performed	9/23/2016
Analysis Year	2045
Time Analyzed	AM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	EB Off Right Turn / Elk V
Jurisdiction	
East/West Street	EB I-90 Off Ramp Right
North/South Street	Elk Vale
Peak Hour Factor	0.92
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	0	1		0	0	0	0	0	0	0	0	0	2	0
Configuration				R											T	
Volume, V (veh/h)				720											550	
Percent Heavy Vehicles (%)				3												
Proportion Time Blocked				0.317											0.000	
Percent Grade (%)	0															
Right Turn Channelized	Yes				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)				783												
Capacity, c (veh/h)				738												
v/c Ratio				1.06												
95% Queue Length, Q_{95} (veh)				20.1												
Control Delay (s/veh)				73.6												
Level of Service, LOS				F												
Approach Delay (s/veh)	73.6															
Approach LOS	F															

HCS7 Two-Way Stop-Control Report

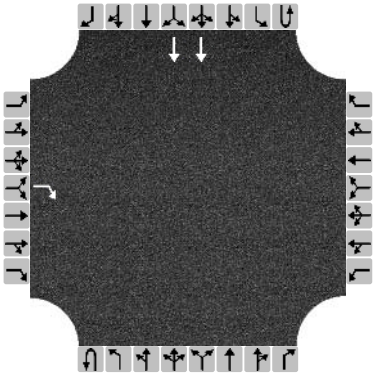
General Information

Analyst	TSF
Agency/Co.	
Date Performed	9/23/2016
Analysis Year	2045
Time Analyzed	PM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	EB Off Right Turn / Elk V
Jurisdiction	
East/West Street	EB I-90 Off Ramp Right
North/South Street	Elk Vale
Peak Hour Factor	0.92
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	0	1		0	0	0	0	0	0	0	0	0	2	0
Configuration				R											T	
Volume, V (veh/h)				700											640	
Percent Heavy Vehicles (%)				3												
Proportion Time Blocked				0.325											0.000	
Percent Grade (%)	0															
Right Turn Channelized	Yes				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)				761												
Capacity, c (veh/h)				730												
v/c Ratio				1.04												
95% Queue Length, Q_{95} (veh)				19.0												
Control Delay (s/veh)				68.6												
Level of Service, LOS				F												
Approach Delay (s/veh)	68.6															
Approach LOS	F															

HCS7 Two-Way Stop-Control Report

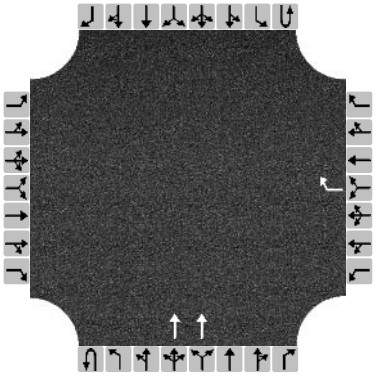
General Information

Analyst	TSF
Agency/Co.	
Date Performed	9/23/2016
Analysis Year	2045
Time Analyzed	AM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	WB Off Right Turn / Elk V
Jurisdiction	
East/West Street	WB I-90 Off Ramp Right
North/South Street	Elk Vale
Peak Hour Factor	0.92
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	0	0		0	0	1	0	0	2	0	0	0	0	0
Configuration								R			T					
Volume, V (veh/h)								145			485					
Percent Heavy Vehicles (%)								3								
Proportion Time Blocked								0.133			0.000					
Percent Grade (%)						0										
Right Turn Channelized		No				Yes				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)								6.9								
Critical Headway (sec)								6.96								
Base Follow-Up Headway (sec)								3.3								
Follow-Up Headway (sec)								3.33								

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)								158								
Capacity, c (veh/h)								937								
v/c Ratio								0.17								
95% Queue Length, Q_{95} (veh)								0.6								
Control Delay (s/veh)								9.6								
Level of Service, LOS								A								
Approach Delay (s/veh)						9.6										
Approach LOS						A										

HCS7 Two-Way Stop-Control Report

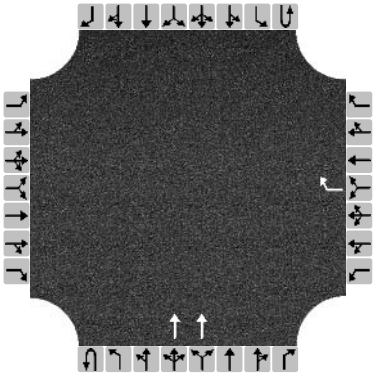
General Information

Analyst	TSF
Agency/Co.	
Date Performed	9/23/2016
Analysis Year	2045
Time Analyzed	PM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	WB Off Right Turn / Elk V
Jurisdiction	
East/West Street	WB I-90 Off Ramp Right
North/South Street	Elk Vale
Peak Hour Factor	0.92
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	0	0		0	0	1	0	0	2	0	0	0	0	0
Configuration								R			T					
Volume, V (veh/h)								270			830					
Percent Heavy Vehicles (%)								3								
Proportion Time Blocked								0.158			0.000					
Percent Grade (%)						0										
Right Turn Channelized		No				Yes				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)								6.9								
Critical Headway (sec)								6.96								
Base Follow-Up Headway (sec)								3.3								
Follow-Up Headway (sec)								3.33								

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)								293								
Capacity, c (veh/h)								910								
v/c Ratio								0.32								
95% Queue Length, Q_{95} (veh)								1.4								
Control Delay (s/veh)								10.8								
Level of Service, LOS								B								
Approach Delay (s/veh)						10.8										
Approach LOS						B										

HCS7 Two-Way Stop-Control Report

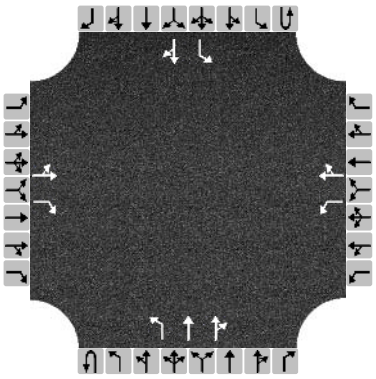
General Information

Analyst	
Agency/Co.	
Date Performed	9/23/2016
Analysis Year	2045
Time Analyzed	AM Peak
Intersection Orientation	North-South
Project Description	

Site Information

Intersection	Elk Vale Rd & Mall Dr
Jurisdiction	
East/West Street	Mall Dr
North/South Street	Elk Vale Rd
Peak Hour Factor	0.84
Analysis Time Period (hrs)	1.00

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	1		1	1	0	0	1	2	0	0	1	1	0
Configuration		LT		R		L		TR		L	T	TR		L		TR
Volume, V (veh/h)		10	60	460		470	135	70		380	210	150		115	440	20
Percent Heavy Vehicles (%)		0	0	12		100	100	0		4				0		
Proportion Time Blocked																
Percent Grade (%)		0				0										
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		83		548		560		244		452				137		
Capacity, c (veh/h)				515		0		12		1004				1141		
v/c Ratio				1.06				20.05		0.45				0.12		
95% Queue Length, Q_{95} (veh)				38.1				119.0		2.4				0.4		
Control Delay (s/veh)				198.9				34907.5		11.5				8.6		
Level of Service, LOS				F				F		B				A		
Approach Delay (s/veh)										5.9				1.7		
Approach LOS																

HCS7 Two-Way Stop-Control Report

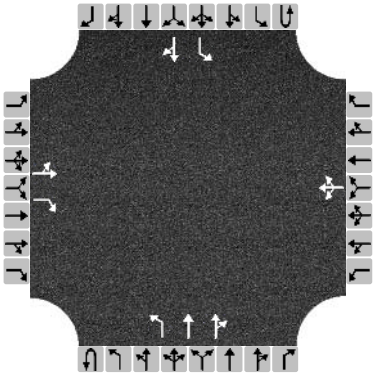
General Information

Analyst	TSF
Agency/Co.	
Date Performed	9/23/2016
Analysis Year	2045
Time Analyzed	PM Peak
Intersection Orientation	North-South
Project Description	

Site Information

Intersection	Elk Vale Rd & Mall Dr
Jurisdiction	
East/West Street	Mall Dr
North/South Street	Elk Vale Rd
Peak Hour Factor	0.71
Analysis Time Period (hrs)	1.00

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	1		0	1	0	0	1	2	0	0	1	1	0
Configuration		LT		R			LTR			L	T	TR		L		TR
Volume, V (veh/h)		80	120	580		410	120	290		650	700	150		60	220	30
Percent Heavy Vehicles (%)		2	0	2		11	0	100		5				0		
Proportion Time Blocked																
Percent Grade (%)		0				0										
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

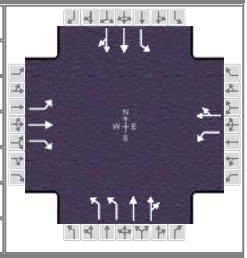
Base Critical Headway (sec)		7.5	6.5	6.2		7.5	6.5	6.9		4.1				4.1		
Critical Headway (sec)		7.54	6.50	6.24		7.72	6.50	8.90		4.20				4.10		
Base Follow-Up Headway (sec)		3.5	4.0	3.3		3.5	4.0	3.3		2.2				2.2		
Follow-Up Headway (sec)		3.52	4.00	3.32		3.61	4.00	4.30		2.25				2.20		

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		282		817			1154			915				85		
Capacity, c (veh/h)				709						1182				590		
v/c Ratio				1.15						0.77				0.14		
95% Queue Length, Q_{95} (veh)				71.2						9.6				0.5		
Control Delay (s/veh)				318.4						18.2				12.1		
Level of Service, LOS				F						C				B		
Approach Delay (s/veh)										7.9				2.4		
Approach LOS																

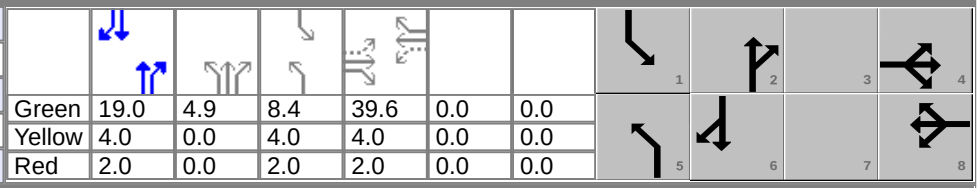
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.25
Analyst		Analysis Date	10/27/2017	Area Type	Other
Jurisdiction		Time Period		PHF	0.92
Urban Street	Elk Vale	Analysis Year	2017	Analysis Period	1> 7:00
Intersection	Mall Dr	File Name	2. Elk Vale & Mall Dr AM (With Improvements).xus		
Project Description					



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	10	60	0	470	135	70	380	210	150	115	440	20

Signal Information			
Cycle, s	90.0	Reference Phase	6
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	19.0	4.9	8.4	39.6	0.0	0.0
Yellow	4.0	0.0	4.0	4.0	0.0	0.0
Red	2.0	0.0	2.0	2.0	0.0	0.0

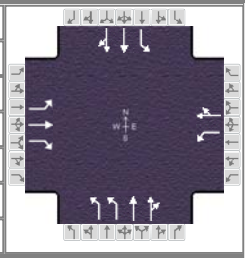
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2	1	6
Case Number		5.0		6.0	2.0	4.0	2.0	4.0
Phase Duration, s		45.6		45.6	19.3	29.9	14.4	25.0
Change Period, ($Y+R_c$), s		6.0		6.0	6.0	6.0	6.0	6.0
Max Allow Headway (*MAH*), s		3.3		3.3	3.1	0.0	3.1	0.0
Queue Clearance Time (g_s), s		9.8		40.3	12.6		8.1	
Green Extension Time (g_e), s		1.8		0.0	0.8	0.0	0.7	0.0
Phase Call Probability		1.00		1.00	1.00		0.96	
Max Out Probability		0.00		1.00	0.11		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	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	11	65	0	511	223		413	205	186	125	251	249
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1176	1900	1459	1241	1762		1702	1856	1603	1810	1856	1827
Queue Service Time (g_s), s	0.5	1.8	0.0	36.5	7.3		10.6	8.2	8.7	6.1	11.1	11.2
Cycle Queue Clearance Time (g_c), s	7.8	1.8	0.0	38.3	7.3		10.6	8.2	8.7	6.1	11.1	11.2
Green Ratio (*g/C*)	0.44	0.44	0.44	0.44	0.44		0.15	0.27	0.27	0.30	0.21	0.21
Capacity (*c*), veh/h	503	837	643	602	776		505	494	427	169	392	386
Volume-to-Capacity Ratio (*X*)	0.022	0.078	0.000	0.849	0.287		0.818	0.415	0.437	0.740	0.642	0.644
Back of Queue (*Q*), ft/ln (50 th percentile)	3.5	18	0	311	69.4		114.8	97.7	88.7	67.6	143.7	139.3
Back of Queue (*Q*), veh/ln (50 th percentile)	0.1	0.7	0.0	11.4	2.7		4.5	3.8	3.5	2.7	5.6	5.6
Queue Storage Ratio (*RQ*) (50 th percentile)	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d_1), s/veh	18.6	14.6	0.0	25.7	16.1		37.1	27.3	27.4	39.7	32.4	32.4
Incremental Delay (d_2), s/veh	0.0	0.0	0.0	10.5	0.1		3.3	2.6	3.2	2.4	7.9	8.0
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
Control Delay (*d*), s/veh	18.6	14.6	0.0	36.2	16.2		40.5	29.8	30.7	42.1	40.2	40.5
Level of Service (LOS)	B	B		D	B		D	C	C	D	D	D
Approach Delay, s/veh / LOS	15.2	B		30.1	C		35.5	D		40.7	D	
Intersection Delay, s/veh / LOS	34.5						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.8	C	2.3	B	2.8	C
Bicycle LOS Score / LOS	0.6	A	1.7	B	1.2	A	1.0	A

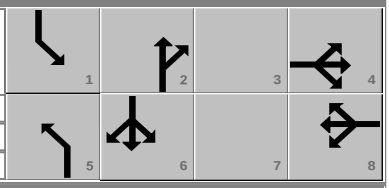
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.25
Analyst		Analysis Date	10/27/2017	Area Type	Other
Jurisdiction	SDDOT	Time Period	PM Peak	PHF	0.92
Urban Street	Elk Vale	Analysis Year	2017	Analysis Period	1> 7:00
Intersection	Mall Dr	File Name	2. Elk Vale & Mall Dr PM (With Improvements).xus		
Project Description					



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	80	20	0	410	120	290	650	700	150	60	220	30

Signal Information			
Cycle, s	90.0	Reference Phase	6
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	19.7	9.0	6.0	33.3	0.0	0.0
Yellow	4.0	4.0	4.0	4.0	0.0	0.0
Red	2.0	2.0	0.0	2.0	0.0	0.0

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2	1	6
Case Number		5.0		6.0	2.0	4.0	1.4	4.0
Phase Duration, s		39.3		39.3	25.0	40.7	10.0	25.7
Change Period, ($Y+R_c$), s		6.0		6.0	6.0	6.0	6.0	6.0
Max Allow Headway (*MAH*), s		3.3		3.3	3.1	0.0	3.1	0.0
Queue Clearance Time (g_s), s		30.2		32.9	20.8		2.0	
Green Extension Time (g_e), s		1.1		0.4	0.0	0.0	0.7	0.0
Phase Call Probability		1.00		1.00	1.00		0.80	
Max Out Probability		0.86		1.00	1.00		1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	87	22	0	446	446		707	477	447	65	137	134
Adjusted Saturation Flow Rate (*s*), veh/h/ln	944	1900	1585	1291	1685		1689	1856	1741	1810	1856	1778
Queue Service Time (g_s), s	7.8	0.7	0.0	30.2	20.4		18.8	19.1	19.1	0.0	5.6	5.8
Cycle Queue Clearance Time (g_c), s	28.2	0.7	0.0	30.9	20.4		18.8	19.1	19.1	0.0	5.6	5.8
Green Ratio (*g/C*)	0.37	0.37	0.37	0.37	0.37		0.43	0.39	0.39	0.26	0.22	0.22
Capacity (*c*), veh/h	216	703	587	548	624		713	715	671	165	406	389
Volume-to-Capacity Ratio (*X*)	0.403	0.031	0.000	0.813	0.715		0.991	0.667	0.667	0.396	0.338	0.346
Back of Queue (*Q*), ft/ln (50 th percentile)	44.7	6.9	0	266.9	201.5		270.7	222.4	205.6	34.1	67.9	65.5
Back of Queue (*Q*), veh/ln (50 th percentile)	1.8	0.3	0.0	9.8	8.1		10.4	8.7	8.2	1.4	2.7	2.6
Queue Storage Ratio (*RQ*) (50 th percentile)	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d_1), s/veh	36.3	18.1	0.0	27.9	24.3		35.4	22.9	22.9	41.1	29.7	29.7
Incremental Delay (d_2), s/veh	0.5	0.0	0.0	8.2	3.2		31.3	4.9	5.2	0.6	2.2	2.4
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	36.8	18.1	0.0	36.1	27.4		66.7	27.8	28.1	41.6	31.9	32.1
Level of Service (LOS)	D	B		D	C		E	C	C	D	C	C
Approach Delay, s/veh / LOS	33.1	C		31.8	C		44.7	D		33.9	C	
Intersection Delay, s/veh / LOS	39.2						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.8	C	2.3	B	2.8	C
Bicycle LOS Score / LOS	0.7	A	2.0	B	1.8	B	0.8	A

HCS7 Two-Way Stop-Control Report

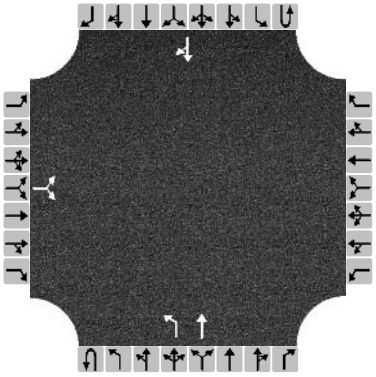
General Information

Analyst	TSF
Agency/Co.	
Date Performed	9/23/2016
Analysis Year	2045
Time Analyzed	AM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	I-90 Service Rd & W Gate
Jurisdiction	
East/West Street	I-90 Service Rd
North/South Street	W Gate Rd
Peak Hour Factor	0.84
Analysis Time Period (hrs)	1.00

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	0	0	0	1	1	0	0	0	1	0
Configuration			LR							L	T					TR
Volume, V (veh/h)		60		130						120	185				280	95
Percent Heavy Vehicles (%)		0		0						0						
Proportion Time Blocked																
Percent Grade (%)		0														
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			226							143						
Capacity, c (veh/h)			458							1125						
v/c Ratio			0.49							0.13						
95% Queue Length, Q_{95} (veh)			2.9							0.4						
Control Delay (s/veh)			20.4							8.7						
Level of Service, LOS			C							A						
Approach Delay (s/veh)		20.4								3.4						
Approach LOS		C														

HCS7 Two-Way Stop-Control Report

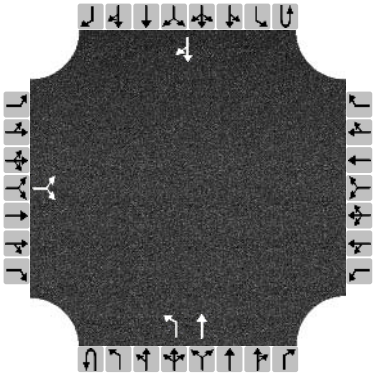
General Information

Analyst	TSF
Agency/Co.	
Date Performed	9/23/2016
Analysis Year	2045
Time Analyzed	PM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	I-90 Service Rd & W Gate
Jurisdiction	
East/West Street	I-90 Service Rd
North/South Street	W Gate Rd
Peak Hour Factor	0.83
Analysis Time Period (hrs)	1.00

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	0	0	0	1	1	0	0	0	1	0
Configuration			LR							L	T					TR
Volume, V (veh/h)		90		90						200	330				110	100
Percent Heavy Vehicles (%)		0		0						0						
Proportion Time Blocked																
Percent Grade (%)		0														
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			216							241						
Capacity, c (veh/h)			326							1324						
v/c Ratio			0.66							0.18						
95% Queue Length, Q_{95} (veh)			5.4							0.7						
Control Delay (s/veh)			37.1							8.3						
Level of Service, LOS			E							A						
Approach Delay (s/veh)		37.1								3.1						
Approach LOS		E														

HCS7 Two-Way Stop-Control Report

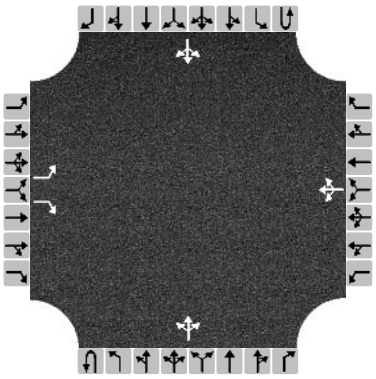
General Information

Analyst	TSF
Agency/Co.	
Date Performed	9/23/2016
Analysis Year	2045
Time Analyzed	AM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	West Gate & Bluebird
Jurisdiction	
East/West Street	Bluebird Dr
North/South Street	West Gate
Peak Hour Factor	0.79
Analysis Time Period (hrs)	1.00

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		1	0	1		0	1	0	0	0	1	0	0	0	1	0
Configuration		L		R			LTR				LTR				LTR	
Volume, V (veh/h)		1		60		220	1	0		55	100	90		5	95	1
Percent Heavy Vehicles (%)		0		6		3	100	3		0				25		
Proportion Time Blocked																
Percent Grade (%)		0				0										
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		1		76			279			70				6		
Capacity, c (veh/h)		492		922			423			1479				1200		
v/c Ratio		0.00		0.08			0.66			0.05				0.01		
95% Queue Length, Q_{95} (veh)		0.0		0.3			5.4			0.1				0.0		
Control Delay (s/veh)		12.3		9.3			29.6			7.6				8.0		
Level of Service, LOS		B		A			D			A				A		
Approach Delay (s/veh)		9.3				29.6				2.0				0.4		
Approach LOS		A				D										

HCS7 Two-Way Stop-Control Report

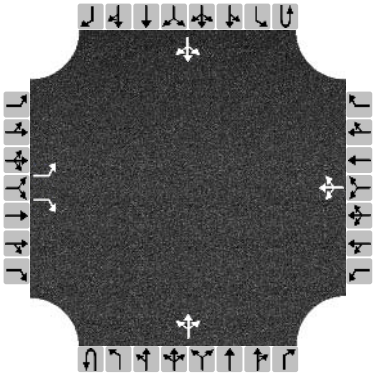
General Information

Analyst	TSF
Agency/Co.	
Date Performed	9/23/2016
Analysis Year	2045
Time Analyzed	PM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	West Gate & Bluebird
Jurisdiction	
East/West Street	Bluebird Dr
North/South Street	West Gate
Peak Hour Factor	0.86
Analysis Time Period (hrs)	1.00

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		1	0	1		0	1	0	0	0	1	0	0	0	1	0
Configuration		L		R			LTR				LTR				LTR	
Volume, V (veh/h)		4		20		90	0	1		60	180	180		4	100	1
Percent Heavy Vehicles (%)		0		0		2	0	0		0				0		
Proportion Time Blocked																
Percent Grade (%)		0				0										
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		5		23			106			70				5		
Capacity, c (veh/h)		406		942			388			1484				1152		
v/c Ratio		0.01		0.02			0.27			0.05				0.00		
95% Queue Length, Q_{95} (veh)		0.0		0.1			1.1			0.1				0.0		
Control Delay (s/veh)		14.0		8.9			17.7			7.5				8.1		
Level of Service, LOS		B		A			C			A				A		
Approach Delay (s/veh)		9.8				17.7				1.5				0.4		
Approach LOS		A				C										

HCS7 Two-Way Stop-Control Report

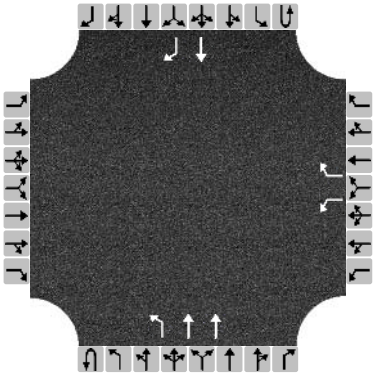
General Information

Analyst	TSF
Agency/Co.	
Date Performed	9/23/2016
Analysis Year	2045
Time Analyzed	AM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	Liberty and I-90 N Ramp
Jurisdiction	
East/West Street	I-90 Ramp
North/South Street	Liberty
Peak Hour Factor	0.84
Analysis Time Period (hrs)	1.00

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	0	0		1	0	1	0	1	2	0	0	0	1	1
Configuration						L		R		L	T				T	R
Volume, V (veh/h)						10		52		210	955				165	700
Percent Heavy Vehicles (%)						0		31		4						
Proportion Time Blocked																
Percent Grade (%)						0										
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						12		62		250						
Capacity, c (veh/h)						36		399		659						
v/c Ratio						0.33		0.16		0.38						
95% Queue Length, Q_{95} (veh)						1.3		0.5		1.8						
Control Delay (s/veh)						152.1		15.7		13.8						
Level of Service, LOS						F		C		B						
Approach Delay (s/veh)						37.8				2.5						
Approach LOS						E										

HCS7 Two-Way Stop-Control Report

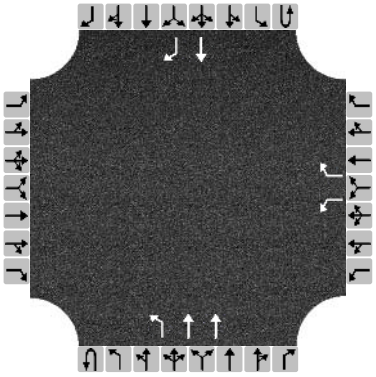
General Information

Analyst	TSF
Agency/Co.	
Date Performed	9/23/2016
Analysis Year	2045
Time Analyzed	PM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	Liberty and I-90 N Ramp
Jurisdiction	
East/West Street	I-90 Ramp
North/South Street	Liberty
Peak Hour Factor	0.95
Analysis Time Period (hrs)	1.00

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	0	0		1	0	1	0	1	2	0	0	0	1	1
Configuration						L		R		L	T				T	R
Volume, V (veh/h)						25		75		80	520				115	1080
Percent Heavy Vehicles (%)						38		46		7						
Proportion Time Blocked																
Percent Grade (%)						0										
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)						26		79		84						
Capacity, c (veh/h)						94		607		522						
v/c Ratio						0.28		0.13		0.16						
95% Queue Length, Q_{95} (veh)						1.1		0.4		0.6						
Control Delay (s/veh)						57.5		11.8		13.2						
Level of Service, LOS						F		B		B						
Approach Delay (s/veh)						23.1				1.8						
Approach LOS						C										

HCS7 Two-Way Stop-Control Report

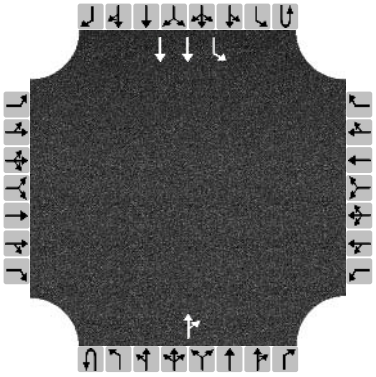
General Information

Analyst	TSF
Agency/Co.	
Date Performed	9/23/2016
Analysis Year	2045
Time Analyzed	AM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	Liberty & I90 EB On Ramp
Jurisdiction	
East/West Street	I90 EB On Ramp
North/South Street	Liberty
Peak Hour Factor	0.74
Analysis Time Period (hrs)	1.00

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	0	0		0	0	0	0	0	1	0	0	1	2	0
Configuration												TR		L	T	
Volume, V (veh/h)											465	15		125	70	
Percent Heavy Vehicles (%)														42		
Proportion Time Blocked																
Percent Grade (%)																
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)														169		
Capacity, c (veh/h)														708		
v/c Ratio														0.24		
95% Queue Length, Q_{95} (veh)														0.9		
Control Delay (s/veh)														11.7		
Level of Service, LOS														B		
Approach Delay (s/veh)													7.5			
Approach LOS																

HCS7 Two-Way Stop-Control Report

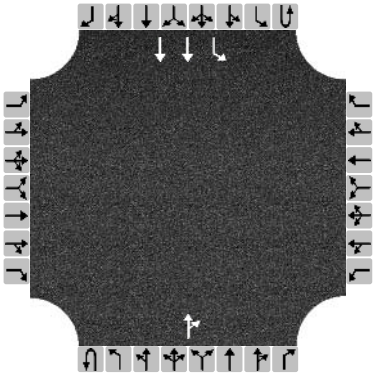
General Information

Analyst	TSF
Agency/Co.	
Date Performed	9/23/2016
Analysis Year	2045
Time Analyzed	PM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	Liberty & I90 EB On Ramp
Jurisdiction	
East/West Street	I90 EB On Ramp
North/South Street	Liberty
Peak Hour Factor	0.87
Analysis Time Period (hrs)	1.00

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	0	0		0	0	0	0	0	1	0	0	1	2	0
Configuration												TR		L	T	
Volume, V (veh/h)											160	11		50	200	
Percent Heavy Vehicles (%)														26		
Proportion Time Blocked																
Percent Grade (%)																
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)														57		
Capacity, c (veh/h)														1215		
v/c Ratio														0.05		
95% Queue Length, Q_{95} (veh)														0.1		
Control Delay (s/veh)														8.1		
Level of Service, LOS														A		
Approach Delay (s/veh)														1.6		
Approach LOS																

HCS7 Two-Way Stop-Control Report

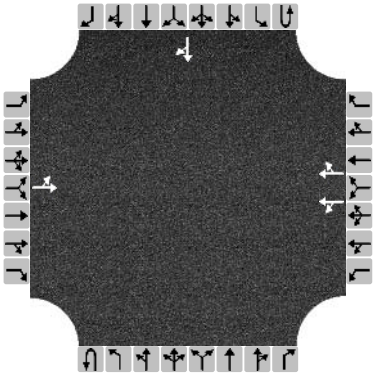
General Information

Analyst	TSF
Agency/Co.	
Date Performed	9/23/2016
Analysis Year	2045
Time Analyzed	AM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	Ellsworth and W 1416
Jurisdiction	
East/West Street	1416 W
North/South Street	Ellsworth
Peak Hour Factor	0.87
Analysis Time Period (hrs)	1.00

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	2	0	0	0	0	0	0	0	1	0
Configuration		LT				LT		TR								TR
Volume, V (veh/h)		860	120			0	45	25							40	400
Percent Heavy Vehicles (%)		2	1			3	6	50								
Proportion Time Blocked																
Percent Grade (%)	0				0											
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		1127				26		55								
Capacity, c (veh/h)		951				464		637								
v/c Ratio		1.18				0.06		0.09								
95% Queue Length, Q_{95} (veh)		104.2				0.2		0.3								
Control Delay (s/veh)		364.4				13.2		11.2								
Level of Service, LOS		F				B		B								
Approach Delay (s/veh)	364.4				12.0											
Approach LOS	F				B											

HCS7 Two-Way Stop-Control Report

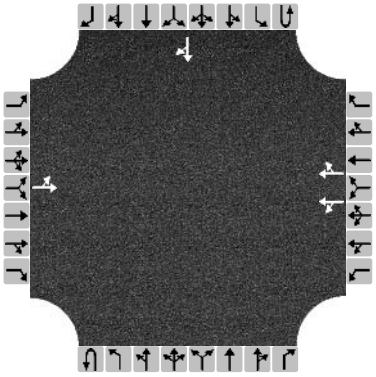
General Information

Analyst	TSF
Agency/Co.	
Date Performed	9/23/2016
Analysis Year	2045
Time Analyzed	PM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	Ellsworth and W 1416
Jurisdiction	
East/West Street	1416 W
North/South Street	Ellsworth
Peak Hour Factor	0.98
Analysis Time Period (hrs)	1.00

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	2	0	0	0	0	0	0	0	1	0
Configuration		LT				LT		TR								TR
Volume, V (veh/h)		455	115			3	60	20							120	500
Percent Heavy Vehicles (%)		3	0			0	10	14								
Proportion Time Blocked																
Percent Grade (%)	0				0											
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

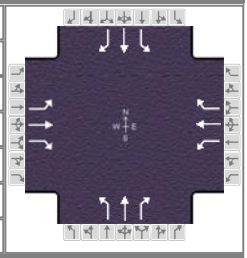
Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		581				34		51								
Capacity, c (veh/h)		874				397		516								
v/c Ratio		0.66				0.08		0.10								
95% Queue Length, Q_{95} (veh)		5.7				0.3		0.3								
Control Delay (s/veh)		17.2				14.9		12.7								
Level of Service, LOS		C				B		B								
Approach Delay (s/veh)	17.2				13.8											
Approach LOS	C				B											

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.25
Analyst		Analysis Date	10/28/2017	Area Type	Other
Jurisdiction	SDDOT	Time Period	AM Peak	PHF	0.92
Urban Street	County Highway 1416	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	Ellesworth Road	File Name	8. Ellsworth & 1416 AM.xus		
Project Description	I-90 Corridor Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	713	112	28	0	45	26	117	113	20	9	30	0

Signal Information			
Cycle, s	90.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

							1	2	3	4		
Green	0.0	0.0	0.0	0.0	0.0	0.0	5	6	7	8		
Yellow	0.0	0.0	0.0	0.0	0.0	0.0						
Red	0.0	0.0	0.0	0.0	0.0	0.0						

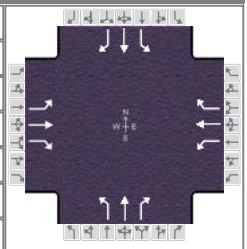
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		5.0		5.0		5.0		5.0
Phase Duration, s		72.1		72.1		17.9		17.9
Change Period, ($Y+R_c$), s		6.0		6.0		6.0		6.0
Max Allow Headway (*MAH*), s		0.0		0.0		0.0		0.0
Queue Clearance Time (g_s), s		0.0		0.0		0.0		0.0
Green Extension Time (g_e), s		0.0		0.0		0.0		0.0
Phase Call Probability		0.00		0.00		0.00		0.00
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	0	0	0	0	0	0	0	0	0	0	0	0
Adjusted Saturation Flow Rate (*s*), veh/h/ln	0	0	0	0	0	0	0	0	0	0	0	0
Queue Service Time (g_s), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cycle Queue Clearance Time (g_c), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Green Ratio (*g/C*)	0.73	0.73	0.73	0.73	0.73	0.73	0.13	0.13	0.13	0.13	0.13	0.13
Capacity (*c*), veh/h	1062	1368	1159	80	1368	1159	240	246	209	170	246	209
Volume-to-Capacity Ratio (*X*)	0.730	0.089	0.026	0.000	0.036	0.024	0.529	0.499	0.104	0.058	0.132	0.000
Back of Queue (*Q*), ft/ln (50 th percentile)	193.8	12.1	2.9	0	4.6	2.7	67.8	62.3	10.4	5	15.6	0
Back of Queue (*Q*), veh/ln (50 th percentile)	7.6	0.5	0.1	0.0	0.2	0.1	2.7	2.5	0.4	0.2	0.6	0.0
Queue Storage Ratio (*RQ*) (50 th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d_1), s/veh	7.9	3.4	3.2	0.0	3.3	3.2	38.7	36.3	34.4	39.1	34.5	0.0
Incremental Delay (d_2), s/veh	4.4	0.1	0.0	0.0	0.0	0.0	0.7	0.6	0.1	0.1	0.1	0.0
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	12.3	3.5	3.3	0.0	3.3	3.3	39.4	36.9	34.4	39.2	34.6	0.0
Level of Service (LOS)	B	A	A		A	A	D	D	C	D	C	
Approach Delay, s/veh / LOS	10.8	B		3.3	A		37.8	D		35.6	D	
Intersection Delay, s/veh / LOS	16.8						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.4	B	2.5	B	2.5	B
Bicycle LOS Score / LOS	2.0	B	0.6	A	0.9	A	0.6	A

HCS 2010 Signalized Intersection Results Summary

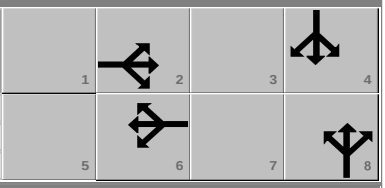
General Information				Intersection Information	
Agency				Duration, h	0.25
Analyst		Analysis Date	10/28/2017	Area Type	Other
Jurisdiction	SDDOT	Time Period	AM Peak	PHF	0.92
Urban Street	County Highway 1416	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	Ellesworth Road	File Name	8. Ellsworth & 1416 PM.xus		
Project Description	I-90 Corridor Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	345	118	175	3	60	20	90	100	20	43	80	0

Signal Information			
Cycle, s	90.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

	1	2	3	4	5	6	7	8
Green	0.0	0.0	0.0	0.0	0.0	0.0		
Yellow	0.0	0.0	0.0	0.0	0.0	0.0		
Red	0.0	0.0	0.0	0.0	0.0	0.0		



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		5.0		5.0		5.0		5.0
Phase Duration, s		72.1		72.1		17.9		17.9
Change Period, ($Y+R_c$), s		6.0		6.0		6.0		6.0
Max Allow Headway (*MAH*), s		0.0		0.0		0.0		0.0
Queue Clearance Time (g_s), s		0.0		0.0		0.0		0.0
Green Extension Time (g_e), s		0.0		0.0		0.0		0.0
Phase Call Probability		0.00		0.00		0.00		0.00
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	0	0	0	0	0	0	0	0	0	0	0	0
Adjusted Saturation Flow Rate (*s*), veh/h/ln	0	0	0	0	0	0	0	0	0	0	0	0
Queue Service Time (g_s), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cycle Queue Clearance Time (g_c), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Green Ratio (*g/C*)	0.73	0.73	0.73	0.73	0.73	0.73	0.13	0.13	0.13	0.13	0.13	0.13
Capacity (*c*), veh/h	1062	1368	1159	80	1368	1159	240	246	209	170	246	209
Volume-to-Capacity Ratio (*X*)	0.730	0.089	0.026	0.000	0.036	0.024	0.529	0.499	0.104	0.058	0.132	0.000
Back of Queue (*Q*), ft/ln (50 th percentile)	193.8	12.1	2.9	0	4.6	2.7	67.8	62.3	10.4	5	15.6	0
Back of Queue (*Q*), veh/ln (50 th percentile)	7.6	0.5	0.1	0.0	0.2	0.1	2.7	2.5	0.4	0.2	0.6	0.0
Queue Storage Ratio (*RQ*) (50 th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d_1), s/veh	7.9	3.4	3.2	0.0	3.3	3.2	38.7	36.3	34.4	39.1	34.5	0.0
Incremental Delay (d_2), s/veh	4.4	0.1	0.0	0.0	0.0	0.0	0.7	0.6	0.1	0.1	0.1	0.0
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	12.3	3.5	3.3	0.0	3.3	3.3	39.4	36.9	34.4	39.2	34.6	0.0
Level of Service (LOS)	B	A	A		A	A	D	D	C	D	C	
Approach Delay, s/veh / LOS	10.8	B		3.3	A		37.8	D		35.6	D	
Intersection Delay, s/veh / LOS	16.8						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.4	B	2.5	B	2.5	B
Bicycle LOS Score / LOS	2.0	B	0.6	A	0.9	A	0.6	A

HCS7 Two-Way Stop-Control Report

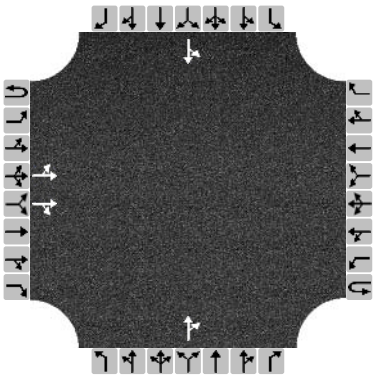
General Information

Analyst	TSF
Agency/Co.	
Date Performed	9/23/2016
Analysis Year	2045
Time Analyzed	AM Peak
Intersection Orientation	East-West
Project Description	I-90 Corridor Study

Site Information

Intersection	Ellsworth and 1416 E
Jurisdiction	
East/West Street	1416 E
North/South Street	Ellsworth
Peak Hour Factor	0.87
Analysis Time Period (hrs)	1.00

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	0	2	0	0	0	0	0		0	1	0		0	1	0
Configuration		LT		TR								TR		LT		
Volume, V (veh/h)		750	110	40							230	20		10	30	
Percent Heavy Vehicles (%)		2									2	0		50	0	
Proportion Time Blocked																
Percent Grade (%)										0				0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1									6.5	6.9		7.5	6.5	
Critical Headway (sec)		4.14									6.54	6.90		8.50	6.50	
Base Follow-Up Headway (sec)		2.2									4.0	3.3		3.5	4.0	
Follow-Up Headway (sec)		2.22									4.02	3.30		4.00	4.00	

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		862										287		45		
Capacity, c (veh/h)		1622										32		21		
v/c Ratio		0.53										9.10		2.18		
95% Queue Length, Q_{95} (veh)		3.4										131.0		16.3		
Control Delay (s/veh)		9.7										14820.1		2591.2		
Level of Service, LOS		A										F		F		
Approach Delay (s/veh)		8.1								14820.1				2591.2		
Approach LOS										F				F		

HCS7 Two-Way Stop-Control Report

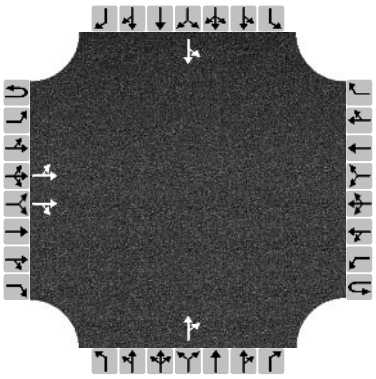
General Information

Analyst	TSF
Agency/Co.	
Date Performed	9/23/2016
Analysis Year	2045
Time Analyzed	PM Peak
Intersection Orientation	East-West
Project Description	I-90 Corridor Study

Site Information

Intersection	Ellsworth and 1416 E
Jurisdiction	
East/West Street	1416 E
North/South Street	Ellsworth
Peak Hour Factor	0.98
Analysis Time Period (hrs)	1.00

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	0	2	0	0	0	0	0		0	1	0		0	1	0
Configuration		LT		TR								TR		LT		
Volume, V (veh/h)		360	120	190							210	20		43	80	
Percent Heavy Vehicles (%)		3									2	0		0	1	
Proportion Time Blocked																
Percent Grade (%)										0				0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		367										234		126		
Capacity, c (veh/h)		1614										198		169		
v/c Ratio		0.23										1.18		0.74		
95% Queue Length, Q_{95} (veh)		0.9										29.8		6.7		
Control Delay (s/veh)		7.9										442.4		81.5		
Level of Service, LOS		A										F		F		
Approach Delay (s/veh)		4.3								442.4				81.5		
Approach LOS										F				F		

HCS7 Two-Way Stop-Control Report

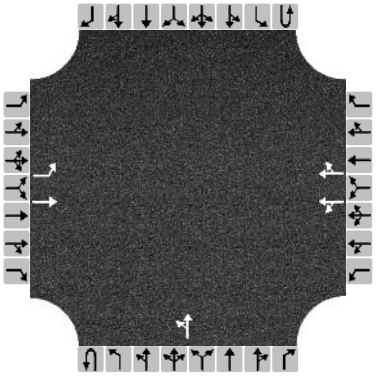
General Information

Analyst	TSF
Agency/Co.	
Date Performed	9/23/2016
Analysis Year	2045
Time Analyzed	AM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	Commercial Gate & 1416 W
Jurisdiction	
East/West Street	1416 W
North/South Street	Commercial Gate
Peak Hour Factor	0.91
Analysis Time Period (hrs)	1.00

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		1	1	0		0	2	0	0	0	1	0	0	0	0	0
Configuration		L	T			LT		TR		LT						
Volume, V (veh/h)		38	190			5	540	15		0	403					
Percent Heavy Vehicles (%)		17	5			0	4	67		0						
Proportion Time Blocked																
Percent Grade (%)		0				0										
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		42	209			302		313		0						
Capacity, c (veh/h)		311	505			510		505		1636						
v/c Ratio		0.14	0.41			0.59		0.62		0.00						
95% Queue Length, Q_{95} (veh)		0.5	2.1			4.2		4.6		0.0						
Control Delay (s/veh)		18.4	17.1			22.1		23.5		7.2						
Level of Service, LOS		C	C			C		C		A						
Approach Delay (s/veh)		17.3				22.8				0.0						
Approach LOS		C				C										

HCS7 Two-Way Stop-Control Report

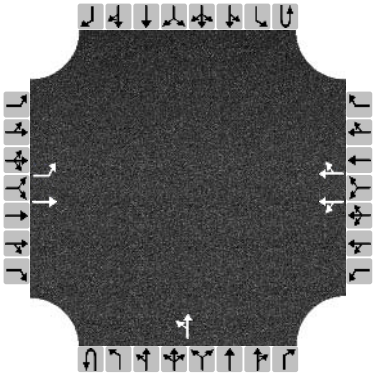
General Information

Analyst	TSF
Agency/Co.	
Date Performed	9/23/2016
Analysis Year	2045
Time Analyzed	PM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	Commercial Gate & 1416 W
Jurisdiction	
East/West Street	1416 W
North/South Street	Commercial Gate
Peak Hour Factor	0.90
Analysis Time Period (hrs)	1.00

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		1	1	0		0	2	0	0	0	1	0	0	0	0	0
Configuration		L	T			LT		TR		LT						
Volume, V (veh/h)		10	500			5	650	20		0	120					
Percent Heavy Vehicles (%)		17	0			0	2	0		0						
Proportion Time Blocked																
Percent Grade (%)		0				0										
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

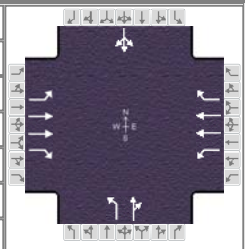
Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		11	556			367		383		0						
Capacity, c (veh/h)		455	762			761		765		1636						
v/c Ratio		0.02	0.73			0.48		0.50		0.00						
95% Queue Length, Q_{95} (veh)		0.1	7.6			2.8		3.0		0.0						
Control Delay (s/veh)		13.1	22.2			14.1		14.4		7.2						
Level of Service, LOS		B	C			B		B		A						
Approach Delay (s/veh)		22.0				14.3				0.0						
Approach LOS		C				B										

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.25
Analyst		Analysis Date	10/28/2017	Area Type	Other
Jurisdiction	SDDOT	Time Period	AM Peak	PHF	0.92
Urban Street	County Highway 1416	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	Radar Hill Road	File Name	10. Radar Hill & 1416 AM.xus		
Project Description	I-90 Corridor Study				



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	890	85	80	630	20	200	20	355	10	20	50

Signal Information			
Cycle, s	90.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

							1	2	3	4
Green	40.5	6.0	25.5	0.0	0.0	0.0	5	6	7	8
Yellow	4.0	4.0	4.0	0.0	0.0	0.0				
Red	2.0	2.0	2.0	0.0	0.0	0.0				

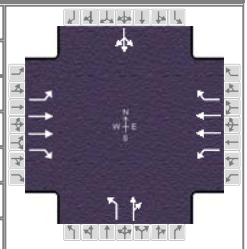
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		5.0		5.0		10.0		12.0
Phase Duration, s		46.5		46.5		31.5		12.0
Change Period, ($Y+R_c$), s		6.0		6.0		6.0		6.0
Max Allow Headway (*MAH*), s		0.0		0.0		3.2		3.2
Queue Clearance Time (g_s), s						24.2		6.6
Green Extension Time (g_e), s		0.0		0.0		1.3		0.1
Phase Call Probability						1.00		0.89
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	7	4	14
Adjusted Flow Rate (*v*), veh/h	11	967	92	87	685	22	217	408			87	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	754	1773	1579	579	1773	1579	1774	1592			1665	
Queue Service Time (g_s), s	0.9	18.5	3.1	12.0	11.8	0.7	9.0	22.2			4.6	
Cycle Queue Clearance Time (g_c), s	12.7	18.5	3.1	30.6	11.8	0.7	9.0	22.2			4.6	
Green Ratio (*g/C*)	0.45	0.45	0.45	0.45	0.45	0.45	0.28	0.28			0.07	
Capacity (*c*), veh/h	320	1598	711	221	1598	711	502	451			111	
Volume-to-Capacity Ratio (*X*)	0.034	0.605	0.130	0.393	0.429	0.031	0.433	0.905			0.786	
Back of Queue (*Q*), ft/ln (50 th percentile)	4.3	185.4	27.8	48.6	116.8	6.2	92.7	221.4			50.2	
Back of Queue (*Q*), veh/ln (50 th percentile)	0.2	7.3	1.1	1.9	4.6	0.2	3.6	8.7			2.0	
Queue Storage Ratio (*RQ*) (50 th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00	
Uniform Delay (d_1), s/veh	21.2	18.7	14.4	30.2	16.8	13.8	26.4	31.1			41.4	
Incremental Delay (d_2), s/veh	0.2	1.7	0.4	5.2	0.8	0.1	0.2	5.7			4.6	
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	21.4	20.4	14.8	35.4	17.7	13.9	26.6	36.8			46.0	
Level of Service (LOS)	C	C	B	D	B	B	C	D			D	
Approach Delay, s/veh / LOS	19.9	B		19.5	B		33.2	C		46.0	D	
Intersection Delay, s/veh / LOS	23.9						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.1	B	3.0	C	2.9	C
Bicycle LOS Score / LOS	1.4	A	1.1	A	1.5	A	0.6	A

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.25
Analyst		Analysis Date	10/28/2017	Area Type	Other
Jurisdiction	SDDOT	Time Period	AM Peak	PHF	0.92
Urban Street	County Highway 1416	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	Radar Hill Road	File Name	10. Radar Hill & 1416 PM.xus		
Project Description	I-90 Corridor Study				



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	650	250	265	860	25	150	40	115	10	5	10

Signal Information			
Cycle, s	90.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

							1	2	3	4
Green	58.0	2.5	11.6	0.0	0.0	0.0	5	6	7	8
Yellow	4.0	4.0	4.0	0.0	0.0	0.0				
Red	2.0	2.0	2.0	0.0	0.0	0.0				

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		5.0		5.0		10.0		12.0
Phase Duration, s		64.0		64.0		17.6		8.5
Change Period, ($Y+R_c$), s		6.0		6.0		6.0		6.0
Max Allow Headway (*MAH*), s		0.0		0.0		3.1		3.1
Queue Clearance Time (g_s), s						11.0		3.4
Green Extension Time (g_e), s		0.0		0.0		0.6		0.0
Phase Call Probability						1.00		0.49
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	7	4	14
Adjusted Flow Rate (*v*), veh/h	43	707	272	288	935	27	163	168			27	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	597	1773	1579	739	1773	1579	1774	1643			1706	
Queue Service Time (g_s), s	3.4	8.0	6.7	25.6	11.5	0.6	7.9	9.0			1.4	
Cycle Queue Clearance Time (g_c), s	14.9	8.0	6.7	33.6	11.5	0.6	7.9	9.0			1.4	
Green Ratio (*g/C*)	0.64	0.64	0.64	0.64	0.64	0.64	0.13	0.13			0.03	
Capacity (*c*), veh/h	388	2284	1017	490	2284	1017	228	211			47	
Volume-to-Capacity Ratio (*X*)	0.112	0.309	0.267	0.588	0.409	0.027	0.715	0.797			0.581	
Back of Queue (*Q*), ft/ln (50 th percentile)	12	65.2	50.8	110.9	93.8	4.3	86.7	91.9			16.1	
Back of Queue (*Q*), veh/ln (50 th percentile)	0.5	2.6	2.0	4.4	3.7	0.2	3.4	3.6			0.6	
Queue Storage Ratio (*RQ*) (50 th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00	
Uniform Delay (d_1), s/veh	11.4	7.1	6.9	14.6	7.7	5.8	37.6	38.1			43.3	
Incremental Delay (d_2), s/veh	0.6	0.4	0.6	5.1	0.5	0.0	1.6	2.6			4.2	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0	
Control Delay (*d*), s/veh	11.9	7.5	7.5	19.7	8.3	5.9	39.2	40.7			47.5	
Level of Service (LOS)	B	A	A	B	A	A	D	D			D	
Approach Delay, s/veh / LOS	7.7	A		10.9	B		39.9	D		47.5	D	
Intersection Delay, s/veh / LOS	13.7						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.1	B	3.0	C	3.0	C
Bicycle LOS Score / LOS	1.3	A	1.5	A	1.0	A	0.5	A

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: TSF
Agency/Co.:
Date Performed: 6/27/2016
Analysis Time Period: AM Peak
Intersection: W Gate & 1416 W
Jurisdiction:
Units: U. S. Customary
Analysis Year:
Project ID: I-90 Corridor Study
East/West Street: 1416 W
North/South Street: W Gate

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	0	0	10	610	260	4	45	0	0	210	200
% Thrus Left Lane												

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration			LT	R	LT		TR	
PHF			0.95	0.95	0.95		0.95	
Flow Rate			652	273	51		431	
% Heavy Veh			3	8	0		0	
No. Lanes			2		1		1	
Opposing-Lanes			0		1		1	
Conflicting-lanes			1		2		2	
Geometry group			1		2		2	

Duration, T 1.00 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane			652	273	51		431	
Left-Turn			10	0	4		0	
Right-Turn			0	273	0		210	
Prop. Left-Turns			0.0	0.0	0.1		0.0	
Prop. Right-Turns			0.0	1.0	0.0		0.5	
Prop. Heavy Vehicle			0.0	0.1	0.0		0.0	
Geometry Group			1		2		2	
Adjustments Exhibit 17-33:								
hLT-adj			0.2		0.2		0.2	

hRT-adj			-0.6		-0.6		-0.6	
hHV-adj			1.7		1.7		1.7	
hadj, computed			0.1	-0.5	0.0		-0.3	

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate			652	273	51		431	
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial			0.58	0.24	0.05		0.38	
hd, final value			5.38	4.86	6.68		5.61	
x, final value			0.975	0.369	0.095		0.671	
Move-up time, m			2.0		2.0		2.0	
Service Time			3.4	2.9	4.7		3.6	

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate			652	273	51		431	
Service Time			3.4	2.9	4.7		3.6	
Utilization, x			0.975	0.369	0.095		0.671	
Dep. headway, hd			5.38	4.86	6.68		5.61	
Capacity			665	738	567		643	
95% Queue Length								
Delay			85.8	10.7	10.4		19.8	
LOS			F	B	B		C	
Approach:								
Delay				63.7		10.4		19.8
LOS				F		B		C

Intersection Delay 48.3 Intersection LOS E

Phone: Fax:
E-Mail:

ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: TSF
Agency/Co.:
Date Performed: 6/27/2016
Analysis Time Period: AM Peak
Intersection: W Gate & 1416 W
Jurisdiction:
Units: U. S. Customary
Analysis Year: 2045
Project ID: I-90 Corridor Study
East/West Street: 1416 W
North/South Street: W Gate

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	0	0	10	690	320	5	210	0	0	110	
% Thrus Left Lane												

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration			LT	R	LT		TR	
PHF			0.94	0.87	0.95		0.76	
Flow Rate			744	367	226		251	
% Heavy Veh			0	0	0		2	
No. Lanes			2		1		1	
Opposing-Lanes			0		1		1	
Conflicting-lanes			1		2		2	
Geometry group			1		2		2	

Duration, T 1.00 hrs.

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane			744	367	226		251	
Left-Turn			10	0	5		0	
Right-Turn			0	367	0		107	
Prop. Left-Turns			0.0	0.0	0.0		0.0	
Prop. Right-Turns			0.0	1.0	0.0		0.4	
Prop. Heavy Vehicle			0.0	0.0	0.0		0.0	
Geometry Group			1		2		2	
Adjustments Exhibit 17-33:								
hLT-adj			0.2		0.2		0.2	

hRT-adj			-0.6		-0.6		-0.6	
hHV-adj			1.7		1.7		1.7	
hadj, computed		0.0	-0.6	0.0		-0.2		

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate			744	367	226		251	
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial			0.66	0.33	0.20		0.22	
hd, final value			5.38	4.77	6.38		6.11	
x, final value			1.113	0.487	0.400		0.426	
Move-up time, m			2.0		2.0		2.0	
Service Time			3.4	2.8	4.4		4.1	

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate			744	367	226		251	
Service Time			3.4	2.8	4.4		4.1	
Utilization, x			1.113	0.487	0.400		0.426	
Dep. headway, hd			5.38	4.77	6.38		6.11	
Capacity			670	749	565		584	
95% Queue Length								
Delay			254.8	12.3	13.6		13.6	
LOS			F	B	B		B	
Approach:								
Delay			174.7		13.6		13.6	
LOS			F		B		B	

Intersection Delay 126.3 Intersection LOS F

HCS7 Two-Way Stop-Control Report

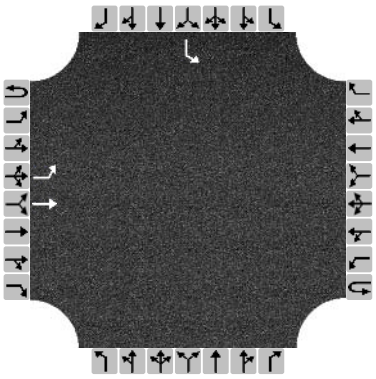
General Information

Analyst	TSF
Agency/Co.	
Date Performed	9/23/2016
Analysis Year	2045
Time Analyzed	AM Peak
Intersection Orientation	East-West
Project Description	I-90 Corridor Study

Site Information

Intersection	SB Left Turn / 1416
Jurisdiction	
East/West Street	County Highway 1416
North/South Street	W. Gate Road
Peak Hour Factor	0.92
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	1	0	0	0	0	0		0	0	0		1	0	0
Configuration		L	T											L		
Volume, V (veh/h)		50	765											220		
Percent Heavy Vehicles (%)		3												3		
Proportion Time Blocked																
Percent Grade (%)														0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1												7.1		
Critical Headway (sec)		4.13												6.43		
Base Follow-Up Headway (sec)		2.2												3.5		
Follow-Up Headway (sec)		2.23												3.53		

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		54												239		
Capacity, c (veh/h)		1614												282		
v/c Ratio		0.03												0.85		
95% Queue Length, Q_{95} (veh)		0.1												7.2		
Control Delay (s/veh)		7.3												61.5		
Level of Service, LOS		A												F		
Approach Delay (s/veh)		0.4												61.5		
Approach LOS														F		

HCS7 Two-Way Stop-Control Report

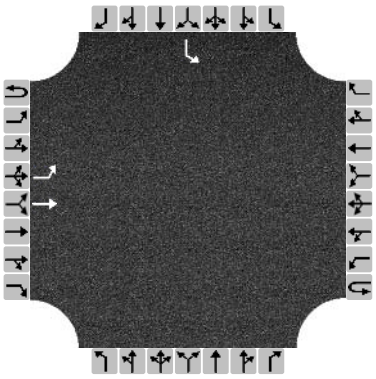
General Information

Analyst	TSF
Agency/Co.	
Date Performed	9/23/2016
Analysis Year	2045
Time Analyzed	PM Peak
Intersection Orientation	East-West
Project Description	I-90 Corridor Study

Site Information

Intersection	SB Left Turn / 1416
Jurisdiction	
East/West Street	County Highway 1416
North/South Street	W. Gate Road
Peak Hour Factor	0.92
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	1	0	0	0	0	0		0	0	0		1	0	0
Configuration		L	T											L		
Volume, V (veh/h)		215	820											120		
Percent Heavy Vehicles (%)		3												3		
Proportion Time Blocked																
Percent Grade (%)														0		
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)		4.1												7.1		
Critical Headway (sec)		4.13												6.43		
Base Follow-Up Headway (sec)		2.2												3.5		
Follow-Up Headway (sec)		2.23												3.53		

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)		234												130		
Capacity, c (veh/h)		1614												139		
v/c Ratio		0.14												0.93		
95% Queue Length, Q_{95} (veh)		0.5												6.4		
Control Delay (s/veh)		7.6												120.9		
Level of Service, LOS		A												F		
Approach Delay (s/veh)		1.6												120.9		
Approach LOS														F		

HCS7 Two-Way Stop-Control Report

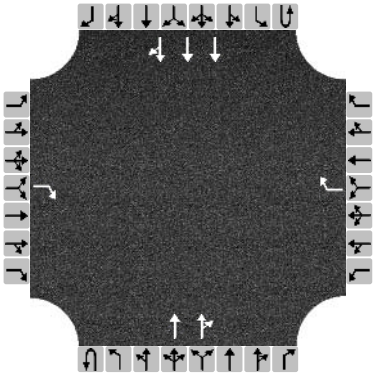
General Information

Analyst	TSF
Agency/Co.	
Date Performed	9/23/2016
Analysis Year	2045
Time Analyzed	AM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	S. Service and Elk Vale
Jurisdiction	
East/West Street	Edward St/S. Service Road
North/South Street	Elk Vale
Peak Hour Factor	0.88
Analysis Time Period (hrs)	1.00

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	0	1		0	0	1	0	0	2	0	0	0	3	0
Configuration				R				R			T	TR			T	TR
Volume, V (veh/h)				20				132			1703	25			1755	74
Percent Heavy Vehicles (%)				11				11								
Proportion Time Blocked																
Percent Grade (%)	0				0											
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)				23				150								
Capacity, c (veh/h)				183				212								
v/c Ratio				0.13				0.71								
95% Queue Length, Q_{95} (veh)				0.4				6.1								
Control Delay (s/veh)				27.5				60.5								
Level of Service, LOS				D				F								
Approach Delay (s/veh)	27.5				60.5											
Approach LOS	D				F											

HCS7 Two-Way Stop-Control Report

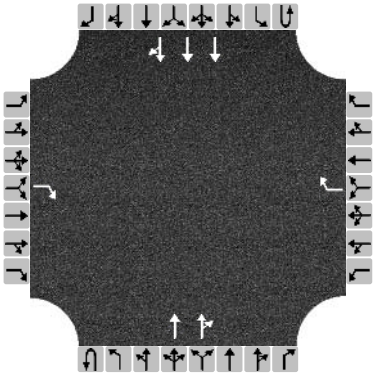
General Information

Analyst	TSF
Agency/Co.	
Date Performed	9/23/2016
Analysis Year	2045
Time Analyzed	PM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	S. Service and Elk Vale
Jurisdiction	
East/West Street	Edward St/S. Service Road
North/South Street	Elk Vale
Peak Hour Factor	0.94
Analysis Time Period (hrs)	1.00

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	0	1		0	0	1	0	0	2	0	0	0	3	0
Configuration				R				R			T	TR			T	TR
Volume, V (veh/h)				43				178			2045	100			2058	67
Percent Heavy Vehicles (%)				0				0								
Proportion Time Blocked																
Percent Grade (%)	0				0											
Right Turn Channelized	No				No				No				No			
Median Type/Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)				46				189								
Capacity, c (veh/h)				172				181								
v/c Ratio				0.27				1.05								
95% Queue Length, Q_{95} (veh)				1.1				19.1								
Control Delay (s/veh)				33.4				265.1								
Level of Service, LOS				D				F								
Approach Delay (s/veh)	33.4				265.1											
Approach LOS	D				F											

HCS7 Two-Way Stop-Control Report

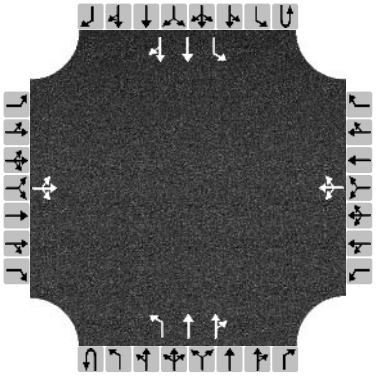
General Information

Analyst	TSF
Agency/Co.	
Date Performed	9/23/2016
Analysis Year	2045
Time Analyzed	AM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	S. Service and Elk Vale
Jurisdiction	
East/West Street	Edward St/S. Service Road
North/South Street	Elk Vale
Peak Hour Factor	0.88
Analysis Time Period (hrs)	1.00

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	2	0
Configuration			LTR				LTR			L	T	TR		L	T	TR
Volume, V (veh/h)		25	10	20		111	10	132		38	1703	25		66	1755	74
Percent Heavy Vehicles (%)		0	0	11		2	0	11		0				4		
Proportion Time Blocked																
Percent Grade (%)		0				0										
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			62				287			43				75		
Capacity, c (veh/h)										271				285		
v/c Ratio										0.16				0.26		
95% Queue Length, Q_{95} (veh)										0.6				1.1		
Control Delay (s/veh)										20.8				22.1		
Level of Service, LOS										C				C		
Approach Delay (s/veh)										0.4				0.8		
Approach LOS																

HCS7 Two-Way Stop-Control Report

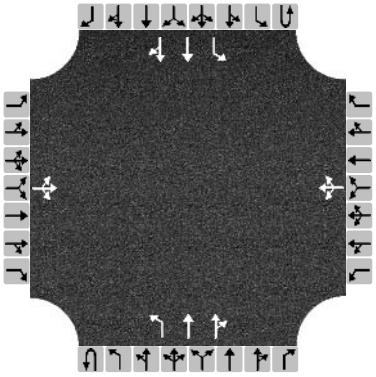
General Information

Analyst	TSF
Agency/Co.	
Date Performed	9/23/2016
Analysis Year	2045
Time Analyzed	PM Peak
Intersection Orientation	North-South
Project Description	I-90 Corridor Study

Site Information

Intersection	S. Service and Elk Vale
Jurisdiction	
East/West Street	Edward St/S. Service Road
North/South Street	Elk Vale
Peak Hour Factor	0.94
Analysis Time Period (hrs)	1.00

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	2	0
Configuration			LTR				LTR			L	T	TR		L	T	TR
Volume, V (veh/h)		45	10	43		110	10	178		20	2045	100		100	2058	67
Percent Heavy Vehicles (%)		9	0	0		2	0	0		0				2		
Proportion Time Blocked																
Percent Grade (%)		0				0										
Right Turn Channelized		No				No				No				No		
Median Type/Storage		Undivided														

Critical and Follow-up Headways

Base Critical Headway (sec)																
Critical Headway (sec)																
Base Follow-Up Headway (sec)																
Follow-Up Headway (sec)																

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			105				317			21				106		
Capacity, c (veh/h)										230				219		
v/c Ratio										0.09				0.48		
95% Queue Length, Q_{95} (veh)										0.3				2.7		
Control Delay (s/veh)										22.2				36.6		
Level of Service, LOS										C				E		
Approach Delay (s/veh)										0.2				1.6		
Approach LOS																

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	DCJ
Agency or Company:	FHU
Date Performed:	7/20/2016
Analysis Time Period:	AM Peak Hour
Freeway/Direction:	EB I-90
From/To:	Exit 60 to Exit 61
Jurisdiction:	SDDOT
Analysis Year:	2045
Description:	I-90 Exit 61 to 67 Corridor Study

Flow Inputs and Adjustments

Volume, V	1945	veh/h
Peak-hour factor, PHF	0.81	
Peak 15-min volume, v15	600	v
Trucks and buses	11	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.948	
Driver population factor, fp	1.00	
Flow rate, vp	1267	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1267	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	19.5	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	DCJ
Agency or Company:	FHU
Date Performed:	7/20/2016
Analysis Time Period:	PM Peak Hour
Freeway/Direction:	EB I-90
From/To:	Exit 60 to Exit 61
Jurisdiction:	SDDOT
Analysis Year:	2045
Description:	I-90 Exit 61 to 67 Corridor Study

Flow Inputs and Adjustments

Volume, V	2425	veh/h
Peak-hour factor, PHF	0.92	
Peak 15-min volume, v15	659	v
Trucks and buses	11	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.948	
Driver population factor, fp	1.00	
Flow rate, vp	1390	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1390	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	21.4	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	AM Peak Hour
Freeway/Dir of Travel:	I-90 EB
Junction:	Exit 61
Jurisdiction:	SDDOT
Analysis Year:	2045
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1945	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	830	vph
Length of first accel/decel lane	660	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1945	830		vph
Peak-hour factor, PHF	0.81	0.81		
Peak 15-min volume, v15	600	256		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %	%	
Length	0.00 mi	0.00 mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	2533	1081	pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2533 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2533	4700	No
$v_{FO} = v_F - v_R$	1452	4700	No
v_R	1081	2000	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12} /2 No

If yes, v_{12A} = 2533 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2533	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 20.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	D_S = 0.525	
Space mean speed in ramp influence area,	S_R = 52.9	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 52.9	mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	PM Peak Hour
Freeway/Dir of Travel:	I-90 EB
Junction:	Exit 61
Jurisdiction:	SDDOT
Analysis Year:	2045
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	2425	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	1100	vph
Length of first accel/decel lane	660	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2425	1100		vph
Peak-hour factor, PHF	0.92	0.92		
Peak 15-min volume, v15	659	299		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %	%	
Length	0.00 mi	0.00 mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	2781	1261	pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2781 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2781	4700	No
$v_{FO} = v_F - v_R$	1520	4700	No
v_R	1261	2000	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12} /2 No

If yes, v_{12A} = 2781 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2781	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 22.2 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable, D_S = 0.541

Space mean speed in ramp influence area, S_R = 52.5 mph

Space mean speed in outer lanes, S_0 = N/A mph

Space mean speed for all vehicles, S = 52.5 mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	AM Peak Hour
Freeway/Dir of Travel:	I-90 EB
Junction:	Exit 61
Jurisdiction:	SDDOT
Analysis Year:	2045
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1115	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	910	vph
Length of first accel/decel lane	1100	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1115	910		vph
Peak-hour factor, PHF	0.81	0.81		
Peak 15-min volume, v15	344	281		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	1452	1185	pcph

Estimation of V12 Merge Areas

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

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 1452 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2637	4700	No

v_3 or v_{av34} = 0 pc/h (Equation 13-14 or 13-17)

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12} /2 No

If yes, v_{12A} = 1452 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	2637	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734 v_R + 0.0078 v_{12} - 0.00627 L_A$ = 18.6 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	M_S = 0.298	
Space mean speed in ramp influence area,	S_R = 58.1	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 58.1	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	PM Peak Hour
Freeway/Dir of Travel:	I-90 EB
Junction:	Exit 61
Jurisdiction:	SDDOT
Analysis Year:	2045
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1325	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	840	vph
Length of first accel/decel lane	1100	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1325	840		vph
Peak-hour factor, PHF	0.92	0.92		
Peak 15-min volume, v15	360	228		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	1519	963	pcph

Estimation of V12 Merge Areas

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

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 1519 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2482	4700	No

v_3 or v_{av34} = 0 pc/h (Equation 13-14 or 13-17)

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12} /2 No

If yes, v_{12A} = 1519 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	2482	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 17.5 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	M_S = 0.291	
Space mean speed in ramp influence area,	S_R = 58.3	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 58.3	mph

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	DCJ
Agency or Company:	FHU
Date Performed:	7/20/2016
Analysis Time Period:	AM Peak Hour
Freeway/Direction:	EB I-90
From/To:	Exit 61 to Exit 63
Jurisdiction:	SDDOT
Analysis Year:	2045
Description:	I-90 Exit 61 to 67 Corridor Study

Flow Inputs and Adjustments

Volume, V	2025	veh/h
Peak-hour factor, PHF	0.81	
Peak 15-min volume, v15	625	v
Trucks and buses	11	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.948	
Driver population factor, fp	1.00	
Flow rate, vp	1319	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1319	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	20.3	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	DCJ
Agency or Company:	FHU
Date Performed:	7/20/2016
Analysis Time Period:	PM Peak Hour
Freeway/Direction:	EB I-90
From/To:	Exit 61 to Exit 63
Jurisdiction:	SDDOT
Analysis Year:	2045
Description:	I-90 Exit 61 to 67 Corridor Study

Flow Inputs and Adjustments

Volume, V	2165	veh/h
Peak-hour factor, PHF	0.92	
Peak 15-min volume, v15	588	v
Trucks and buses	11	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.948	
Driver population factor, fp	1.00	
Flow rate, vp	1241	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1241	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	19.1	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	AM Peak Hour
Freeway/Dir of Travel:	I-90 EB
Junction:	Exit 63
Jurisdiction:	SDDOT
Analysis Year:	2045
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	2025	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	815	vph
Length of first accel/decel lane	275	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2025	815		vph
Peak-hour factor, PHF	0.81	0.81		
Peak 15-min volume, v15	625	252		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %		%
Length	0.00 mi	0.00 mi		mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	2638	1062	pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2638 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2638	4700	No
$v_{FO} = v_F - v_R$	1576	4700	No
v_R	1062	2000	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12} /2 No

If yes, v_{12A} = 2638 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2638	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 24.5 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable, D_S = 0.524

Space mean speed in ramp influence area, S_R = 53.0 mph

Space mean speed in outer lanes, S_0 = N/A mph

Space mean speed for all vehicles, S = 53.0 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	PM Peak Hour
Freeway/Dir of Travel:	I-90 EB
Junction:	Exit 63
Jurisdiction:	SDDOT
Analysis Year:	2045
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	2165	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	1035	vph
Length of first accel/decel lane	275	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2165	1035		vph
Peak-hour factor, PHF	0.92	0.92		
Peak 15-min volume, v15	588	281		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %	%	
Length	0.00 mi	0.00 mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	2483	1187	pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2483 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2483	4700	No
$v_{FO} = v_F - v_R$	1296	4700	No
v_R	1187	2000	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	

If yes, v_{12A} = 2483 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2483	4400	No

Level of Service Determination (if not F)

Density, $D = 4.252 + 0.0086\, v_R - 0.009\, L_D$ = 23.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	D_S = 0.535	
Space mean speed in ramp influence area,	S_R = 52.7	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 52.7	mph

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	DCJ
Agency or Company:	FHU
Date Performed:	7/20/2016
Analysis Time Period:	AM Peak Hour
Freeway/Direction:	EB I-90
From/To:	Exit 63 to Exit 67
Jurisdiction:	SDDOT
Analysis Year:	2045
Description:	I-90 Exit 61 to 67 Corridor Study

Flow Inputs and Adjustments

Volume, V	1210	veh/h
Peak-hour factor, PHF	0.81	
Peak 15-min volume, v15	373	v
Trucks and buses	11	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.948	
Driver population factor, fp	1.00	
Flow rate, vp	788	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	788	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	12.1	pc/mi/ln
Level of service, LOS	B	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	DCJ
Agency or Company:	FHU
Date Performed:	7/20/2016
Analysis Time Period:	PM Peak Hour
Freeway/Direction:	EB I-90
From/To:	Exit 63 to Exit 67
Jurisdiction:	SDDOT
Analysis Year:	2045
Description:	I-90 Exit 61 to 67 Corridor Study

Flow Inputs and Adjustments

Volume, V	1130	veh/h
Peak-hour factor, PHF	0.92	
Peak 15-min volume, v15	307	v
Trucks and buses	11	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.948	
Driver population factor, fp	1.00	
Flow rate, vp	648	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	648	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	10.0	pc/mi/ln
Level of service, LOS	A	

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	AM Peak Hour
Freeway/Dir of Travel:	I-90 EB
Junction:	Exit 67A
Jurisdiction:	SDDOT
Analysis Year:	2045
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1210	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	20	vph
Length of first accel/decel lane	325	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1210	20		vph
Peak-hour factor, PHF	0.81	0.81		
Peak 15-min volume, v15	373	6		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %	%	
Length	0.00 mi	0.00 mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	1576	26	pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1576 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	1576	4700	No
$v_{FO} = v_F - v_R$	1550	4700	No
v_R	26	2000	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	

If yes, v_{12A} = 1576 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1576	4400	No

Level of Service Determination (if not F)

Density, $D = 4.252 + 0.0086\, v_R - 0.009\, L_{12}$ = 14.9 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, D_S = 0.430

Space mean speed in ramp influence area, S_R = 55.1 mph

Space mean speed in outer lanes, S_0 = N/A mph

Space mean speed for all vehicles, S = 55.1 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	PM Peak Hour
Freeway/Dir of Travel:	I-90 EB
Junction:	Exit 67A
Jurisdiction:	SDDOT
Analysis Year:	2045
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1130	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	110	vph
Length of first accel/decel lane	325	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1130	110		vph
Peak-hour factor, PHF	0.92	0.92		
Peak 15-min volume, v15	307	30		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %	%	
Length	0.00 mi	0.00 mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	1296	126	pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1296 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	1296	4700	No
$v_{FO} = v_F - v_R$	1170	4700	No
v_R	126	2000	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	

If yes, v_{12A} = 1296 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1296	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 12.5 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, D_S = 0.439

Space mean speed in ramp influence area, S_R = 54.9 mph

Space mean speed in outer lanes, S_0 = N/A mph

Space mean speed for all vehicles, S = 54.9 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	AM Peak Hour
Freeway/Dir of Travel:	I-90 EB
Junction:	Exit 67B
Jurisdiction:	SDDOT
Analysis Year:	2045
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1190	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	710	vph
Length of first accel/decel lane	675	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1190	710		vph
Peak-hour factor, PHF	0.81	0.81		
Peak 15-min volume, v15	367	219		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %		%
Length	0.00 mi	0.00 mi		mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	1550	925	pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1550 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	1550	4700	No
$v_{FO} = v_F - v_R$	625	4700	No
v_R	925	2000	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12} /2 No

If yes, v_{12A} = 1550 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1550	4400	No

Level of Service Determination (if not F)

Density, $D = 4.252 + 0.0086 v_R - 0.009 L_{12}$ = 11.5 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, D_S = 0.511

Space mean speed in ramp influence area, S_R = 53.2 mph

Space mean speed in outer lanes, S_0 = N/A mph

Space mean speed for all vehicles, S = 53.2 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	PM Peak Hour
Freeway/Dir of Travel:	I-90 EB
Junction:	Exit 67B
Jurisdiction:	SDDOT
Analysis Year:	2045
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1020	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	440	vph
Length of first accel/decel lane	675	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1020	440		vph
Peak-hour factor, PHF	0.92	0.92		
Peak 15-min volume, v15	277	120		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %		%
Length	0.00 mi	0.00 mi		mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	1170	505	pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1170 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	1170	4700	No
$v_{FO} = v_F - v_R$	665	4700	No
v_R	505	2000	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	

If yes, v_{12A} = 1170 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1170	4400	No

Level of Service Determination (if not F)

Density, $D = 4.252 + 0.0086\, v_R - 0.009\, L_D$ = 8.2 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable,	D_S = 0.473	
Space mean speed in ramp influence area,	S_R = 54.1	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 54.1	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	AM Peak Hour
Freeway/Dir of Travel:	I-90 EB
Junction:	Exit 67
Jurisdiction:	SDDOT
Analysis Year:	2045
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	480	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	15	vph
Length of first accel/decel lane	800	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	480	15		vph
Peak-hour factor, PHF	0.81	0.81		
Peak 15-min volume, v15	148	5		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	625	20	pcph

Estimation of V12 Merge Areas

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

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 625 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	645	4700	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	

If yes, v_{12A} = 625 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	645	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 5.5 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable,	M_S = 0.272	
Space mean speed in ramp influence area,	S_R = 58.7	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 58.7	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	PM Peak Hour
Freeway/Dir of Travel:	I-90 EB
Junction:	Exit 67
Jurisdiction:	SDDOT
Analysis Year:	2045
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	580	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	11	vph
Length of first accel/decel lane	800	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	580	11		vph
Peak-hour factor, PHF	0.92	0.92		
Peak 15-min volume, v15	158	3		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	665	13	pcph

Estimation of V12 Merge Areas

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

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 665 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	678	4700	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	

If yes, v_{12A} = 665 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	678	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 5.7 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable,	M_S = 0.273	
Space mean speed in ramp influence area,	S_R = 58.7	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 58.7	mph

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	DCJ
Agency or Company:	FHU
Date Performed:	7/20/2016
Analysis Time Period:	AM Peak Hour
Freeway/Direction:	EB I-90
From/To:	Exit 67 to Pull Off
Jurisdiction:	SDDOT
Analysis Year:	2045
Description:	I-90 Exit 61 to 67 Corridor Study

Flow Inputs and Adjustments

Volume, V	480	veh/h
Peak-hour factor, PHF	0.81	
Peak 15-min volume, v15	148	v
Trucks and buses	11	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.948	
Driver population factor, fp	1.00	
Flow rate, vp	313	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	313	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	4.8	pc/mi/ln
Level of service, LOS	A	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	DCJ
Agency or Company:	FHU
Date Performed:	7/20/2016
Analysis Time Period:	PM Peak Hour
Freeway/Direction:	EB I-90
From/To:	East of Exit 67
Jurisdiction:	SDDOT
Analysis Year:	
Description:	I-90 Exit 61 to 67 Corridor Study

Flow Inputs and Adjustments

Volume, V	580	veh/h
Peak-hour factor, PHF	0.92	
Peak 15-min volume, v15	158	v
Trucks and buses	11	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.948	
Driver population factor, fp	1.00	
Flow rate, vp	333	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	333	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	5.1	pc/mi/ln
Level of service, LOS	A	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	DCJ
Agency or Company:	FHU
Date Performed:	7/20/2016
Analysis Time Period:	AM Peak Hour
Freeway/Direction:	WB I-90
From/To:	East of Exit 67
Jurisdiction:	SDDOT
Analysis Year:	2045
Description:	I-90 Exit 61 to 67 Corridor Study

Flow Inputs and Adjustments

Volume, V	470	veh/h
Peak-hour factor, PHF	0.84	
Peak 15-min volume, v15	140	v
Trucks and buses	11	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.948	
Driver population factor, fp	1.00	
Flow rate, vp	295	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	295	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	4.5	pc/mi/ln
Level of service, LOS	A	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	DCJ
Agency or Company:	FHU
Date Performed:	7/20/2016
Analysis Time Period:	PM Peak Hour
Freeway/Direction:	WB I-90
From/To:	East of Exit 67
Jurisdiction:	SDDOT
Analysis Year:	
Description:	I-90 Exit 61 to 67 Corridor Study

Flow Inputs and Adjustments

Volume, V	740	veh/h
Peak-hour factor, PHF	0.89	
Peak 15-min volume, v15	208	v
Trucks and buses	11	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.948	
Driver population factor, fp	1.00	
Flow rate, vp	439	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	439	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	6.8	pc/mi/ln
Level of service, LOS	A	

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	AM Peak Hour
Freeway/Dir of Travel:	I-90 WB
Junction:	Exit 67
Jurisdiction:	SDDOT
Analysis Year:	2045
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	472	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	62	vph
Length of first accel/decel lane	350	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	472	62		vph
Peak-hour factor, PHF	0.84	0.84		
Peak 15-min volume, v15	140	18		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %	%	
Length	0.00 mi	0.00 mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	593	78	pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 593 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	593	4700	No
$v_{FO} = v_F - v_R$	515	4700	No
v_R	78	2000	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	

If yes, v_{12A} = 593 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	593	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 6.2 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable,	D_S = 0.435	
Space mean speed in ramp influence area,	S_R = 55.0	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 55.0	mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	7
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	PM Peak Hour
Freeway/Dir of Travel:	I-90 WB
Junction:	Exit 67
Jurisdiction:	SDDOT
Analysis Year:	2045
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	744	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	100	vph
Length of first accel/decel lane	350	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	744	100		vph
Peak-hour factor, PHF	0.89	0.89		
Peak 15-min volume, v15	209	28		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %		%
Length	0.00 mi	0.00 mi		mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	882	119	pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 882 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	882	4700	No
$v_{FO} = v_F - v_R$	763	4700	No
v_R	119	2000	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	

If yes, v_{12A} = 882 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	882	4400	No

Level of Service Determination (if not F)

Density, $D = 4.252 + 0.0086\, v_R - 0.009\, L_D$ = 8.7 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable, D_S = 0.439

Space mean speed in ramp influence area, S_R = 54.9 mph

Space mean speed in outer lanes, S_0 = N/A mph

Space mean speed for all vehicles, S = 54.9 mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	AM Peak Hour
Freeway/Dir of Travel:	I-90 WB
Junction:	Exit 67
Jurisdiction:	SDDOT
Analysis Year:	2045
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	410	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	910	vph
Length of first accel/decel lane	875	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	410	910		vph
Peak-hour factor, PHF	0.84	0.84		
Peak 15-min volume, v15	122	271		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	515	1143	pcph

Estimation of V12 Merge Areas

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

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 515 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1658	4700	No

v_3 or v_{av34} = 0 pc/h (Equation 13-14 or 13-17)

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12} /2 No

If yes, v_{12A} = 515 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	1658	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 12.4 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	M_S = 0.280	
Space mean speed in ramp influence area,	S_R = 58.6	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 58.6	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	DCJ
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Date performed:	7/21/2016
Analysis time period:	PM Peak Hour
Freeway/Dir of Travel:	I-90 WB
Junction:	Exit 67
Jurisdiction:	SDDOT
Analysis Year:	2045
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	640	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	1160	vph
Length of first accel/decel lane	875	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	640	1160		vph
Peak-hour factor, PHF	0.89	0.89		
Peak 15-min volume, v15	180	326		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	759	1375	pcph

Estimation of V12 Merge Areas

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

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 759 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2134	4700	No

v_3 or v_{av34} = 0 pc/h (Equation 13-14 or 13-17)

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12} /2 No

If yes, v_{12A} = 759 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	2134	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734 v_R + 0.0078 v_{12} - 0.00627 L_A$ = 16.0 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	M_S = 0.293	
Space mean speed in ramp influence area,	S_R = 58.3	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 58.3	mph

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	DCJ
Agency or Company:	FHU
Date Performed:	7/20/2016
Analysis Time Period:	AM Peak Hour
Freeway/Direction:	WB I-90
From/To:	Exit 67 to Exit 63
Jurisdiction:	SDDOT
Analysis Year:	2045
Description:	I-90 Exit 61 to 67 Corridor Study

Flow Inputs and Adjustments

Volume, V	1320	veh/h
Peak-hour factor, PHF	0.84	
Peak 15-min volume, v15	393	v
Trucks and buses	11	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.948	
Driver population factor, fp	1.00	
Flow rate, vp	829	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	829	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	12.8	pc/mi/ln
Level of service, LOS	B	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	DCJ
Agency or Company:	FHU
Date Performed:	7/20/2016
Analysis Time Period:	PM Peak Hour
Freeway/Direction:	WB I-90
From/To:	Exit 67 to Exit 63
Jurisdiction:	SDDOT
Analysis Year:	2045
Description:	I-90 Exit 61 to 67 Corridor Study

Flow Inputs and Adjustments

Volume, V	1800	veh/h
Peak-hour factor, PHF	0.89	
Peak 15-min volume, v15	506	v
Trucks and buses	11	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.948	
Driver population factor, fp	1.00	
Flow rate, vp	1067	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1067	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	16.4	pc/mi/ln
Level of service, LOS	B	

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	AM Peak Hour
Freeway/Dir of Travel:	I-90 WB
Junction:	Exit 63
Jurisdiction:	SDDOT
Analysis Year:	2045
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1320	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	810	vph
Length of first accel/decel lane	1050	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1320	810		vph
Peak-hour factor, PHF	0.84	0.84		
Peak 15-min volume, v15	393	241		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	1658	1017	pcph

Estimation of V12 Merge Areas

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

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 1658 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2675	4700	No

v_3 or v_{av34} = 0 pc/h (Equation 13-14 or 13-17)

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12} /2 No

If yes, v_{12A} = 1658 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	2675	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734 v_R + 0.0078 v_{12} - 0.00627 L_A$ = 19.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	M_S = 0.304	
Space mean speed in ramp influence area,	S_R = 58.0	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 58.0	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	PM Peak Hour
Freeway/Dir of Travel:	I-90 WB
Junction:	Exit 63
Jurisdiction:	SDDOT
Analysis Year:	2045
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1800	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	780	vph
Length of first accel/decel lane	1050	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1800	780		vph
Peak-hour factor, PHF	0.89	0.89		
Peak 15-min volume, v15	506	219		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	2134	925	pcph

Estimation of V12 Merge Areas

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

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 2134 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3059	4700	No

v_3 or v_{av34} = 0 pc/h (Equation 13-14 or 13-17)

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12} /2 No

If yes, v_{12A} = 2134 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	3059	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734 v_R + 0.0078 v_{12} - 0.00627 L_A$ = 22.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	M_S = 0.331	
Space mean speed in ramp influence area,	S_R = 57.4	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 57.4	mph

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	DCJ
Agency or Company:	FHU
Date Performed:	7/20/2016
Analysis Time Period:	AM Peak Hour
Freeway/Direction:	WB I-90
From/To:	Exit 63 to Exit 61
Jurisdiction:	SDDOT
Analysis Year:	2045
Description:	I-90 Exit 61 to 67 Corridor Study

Flow Inputs and Adjustments

Volume, V	2130	veh/h
Peak-hour factor, PHF	0.84	
Peak 15-min volume, v15	634	v
Trucks and buses	11	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.948	
Driver population factor, fp	1.00	
Flow rate, vp	1338	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1338	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	20.6	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	DCJ
Agency or Company:	FHU
Date Performed:	7/20/2016
Analysis Time Period:	PM Peak Hour
Freeway/Direction:	WB I-90
From/To:	Exit 63 to Exit 61
Jurisdiction:	SDDOT
Analysis Year:	2045
Description:	I-90 Exit 61 to 67 Corridor Study

Flow Inputs and Adjustments

Volume, V	2580	veh/h
Peak-hour factor, PHF	0.89	
Peak 15-min volume, v15	725	v
Trucks and buses	11	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.948	
Driver population factor, fp	1.00	
Flow rate, vp	1529	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1529	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	64.8	mi/h
Number of lanes, N	2	
Density, D	23.6	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	AM Peak Hour
Freeway/Dir of Travel:	I-90 WB
Junction:	Exit 61
Jurisdiction:	SDDOT
Analysis Year:	2045
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	2130	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	705	vph
Length of first accel/decel lane	710	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2130	705		vph
Peak-hour factor, PHF	0.84	0.84		
Peak 15-min volume, v15	634	210		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %		%
Length	0.00 mi	0.00 mi		mi
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	2675	885	pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2675 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2675	4700	No
$v_{FO} = v_F - v_R$	1790	4700	No
v_R	885	2000	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12} /2 No

If yes, v_{12A} = 2675 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2675	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 20.9 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable, D_S = 0.508

Space mean speed in ramp influence area, S_R = 53.3 mph

Space mean speed in outer lanes, S_0 = N/A mph

Space mean speed for all vehicles, S = 53.3 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	PM Peak Hour
Freeway/Dir of Travel:	I-90 WB
Junction:	Exit 61
Jurisdiction:	SDDOT
Analysis Year:	2045
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	2580	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	1070	vph
Length of first accel/decel lane	710	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2580	1070		vph
Peak-hour factor, PHF	0.89	0.89		
Peak 15-min volume, v15	725	301		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %	%	
Length	0.00 mi	0.00 mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	3058	1268	pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3058 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3058	4700	No
$v_{FO} = v_F - v_R$	1790	4700	No
v_R	1268	2000	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	

If yes, v_{12A} = 3058 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	3058	4400	No

Level of Service Determination (if not F)

Density, $D = 4.252 + 0.0086\, v_R - 0.009\, L_{12}$ = 24.2 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable, D_S = 0.542

Space mean speed in ramp influence area, S_R = 52.5 mph

Space mean speed in outer lanes, S_0 = N/A mph

Space mean speed for all vehicles, S = 52.5 mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	AM Peak Hour
Freeway/Dir of Travel:	I-90 WB
Junction:	Exit 61
Jurisdiction:	SDDOT
Analysis Year:	2045
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1425	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	850	vph
Length of first accel/decel lane	1150	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1425	850		vph
Peak-hour factor, PHF	0.84	0.84		
Peak 15-min volume, v15	424	253		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	1790	1068	pcph

Estimation of V12 Merge Areas

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

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 1790 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2858	4700	No

v_3 or v_{av34} = 0 pc/h (Equation 13-14 or 13-17)

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12} /2 No

If yes, v_{12A} = 1790 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	2858	4600	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 20.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	M_S = 0.308	
Space mean speed in ramp influence area,	S_R = 57.9	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 57.9	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	DCJ
Agency/Co.:	Felsburg Holt & Ullevig
Date performed:	7/21/2016
Analysis time period:	PM Peak Hour
Freeway/Dir of Travel:	I-90 WB
Junction:	Exit 61
Jurisdiction:	SDDOT
Analysis Year:	2045
Description:	I-90 Exit 61 to 67 Corridor Study

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1510	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	950	vph
Length of first accel/decel lane	1150	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1510	950		vph
Peak-hour factor, PHF	0.89	0.89		
Peak 15-min volume, v15	424	267		v
Trucks and buses	11	11		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		

Heavy vehicle adjustment, fHV	0.948	0.948	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	1790	1126	pcph

Estimation of V12 Merge Areas

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

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 1790 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2916	4700	No

v_3 or v_{av34} = 0 pc/h (Equation 13-14 or 13-17)

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12} /2 No

If yes, v_{12A} = 1790 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	2916	4600	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 20.5 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	M_S = 0.313	
Space mean speed in ramp influence area,	S_R = 57.8	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 57.8	mph

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	DCJ
Agency or Company:	FHU
Date Performed:	7/20/2016
Analysis Time Period:	AM Peak Hour
Freeway/Direction:	WB I-90
From/To:	Exit 61 to Exit 60
Jurisdiction:	SDDOT
Analysis Year:	2045
Description:	I-90 Exit 61 to 67 Corridor Study

Flow Inputs and Adjustments

Volume, V	2275	veh/h
Peak-hour factor, PHF	0.84	
Peak 15-min volume, v15	677	v
Trucks and buses	11	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.948	
Driver population factor, fp	1.00	
Flow rate, vp	1429	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1429	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	22.0	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	DCJ
Agency or Company:	FHU
Date Performed:	7/20/2016
Analysis Time Period:	PM Peak Hour
Freeway/Direction:	WB I-90
From/To:	Exit 61 to Exit 60
Jurisdiction:	SDDOT
Analysis Year:	
Description:	I-90 Exit 61 to 67 Corridor Study

Flow Inputs and Adjustments

Volume, V	2460	veh/h
Peak-hour factor, PHF	0.89	
Peak 15-min volume, v15	691	v
Trucks and buses	11	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.948	
Driver population factor, fp	1.00	
Flow rate, vp	1458	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1458	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	22.4	pc/mi/ln
Level of service, LOS	C	