APPENDIX V

Alternative 3 LOS Worksheets

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Appendix A

Intersection Analysis

Appendix A Includes:

A1. Year 2020 Alternative 3 Intersection LOS Worksheets

A2. Year 2040 Alternative 3 Intersection LOS Worksheets

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Appendix A1

Year 2020 Alternative 3
Intersection Level of Service (LOS) Worksheets

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Queues
1: Carson St & I-605 SB Off Ramps

12/4/2012

Lane Group	EBT	WBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	1297	1442	76	749	415	331
v/c Ratio	0.47	0.66	0.05	0.60	0.38	0.62
Control Delay	10.5	8.7	0.1	15.6	12.9	19.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	10.5	8.7	0.1	15.6	12.9	19.4
Queue Length 50th (ft)	70	109	0	90	47	82
Queue Length 95th (ft)	94	104	0	136	78	#170
Internal Link Dist (ft)	550	190			1136	
Turn Bay Length (ft)				300		300
Base Capacity (vph)	2827	2248	1611	1252	1096	533
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.46	0.64	0.05	0.60	0.38	0.62

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1172	60	0	1370	0	0	0	72	712	80	629
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.9			4.9				4.0	5.4	5.4	5.4
Lane Util. Factor		0.86			0.91				1.00	0.97	0.91	0.91
Frt		0.99			1.00				0.86	1.00	0.88	0.85
Flt Protected		1.00			1.00				1.00	0.95	1.00	1.00
Satd. Flow (prot)		6361			5085				1611	3433	2985	1441
Flt Permitted		1.00			1.00				1.00	0.95	1.00	1.00
Satd. Flow (perm)		6361			5085				1611	3433	2985	1441
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1234	63	0	1442	0	0	0	76	749	84	662
RTOR Reduction (vph)	0	15	0	0	0	0	0	0	0	0	8	8
Lane Group Flow (vph)	0	1282	0	0	1442	0	0	0	76	749	407	323
Turn Type									Free	Split		Perm
Protected Phases		2			6					4	4	
Permitted Phases									Free			4
Actuated Green, G (s)		21.5			21.5				50.0	18.2	18.2	18.2
Effective Green, g (s)		21.5			21.5				50.0	18.2	18.2	18.2
Actuated g/C Ratio		0.43			0.43				1.00	0.36	0.36	0.36
Clearance Time (s)		4.9			4.9					5.4	5.4	5.4
Vehicle Extension (s)		5.0			5.0					2.5	2.5	2.5
Lane Grp Cap (vph)		2735			2187				1611	1250	1087	525
v/s Ratio Prot		0.20			c0.28					0.22	0.14	
v/s Ratio Perm									0.05			c0.22
v/c Ratio		0.47			0.66				0.05	0.60	0.37	0.62
Uniform Delay, d1		10.2			11.3				0.0	12.9	11.7	13.0
Progression Factor		1.00			0.64				1.00	1.00	1.00	1.00
Incremental Delay, d2		0.3			0.8				0.1	2.1	1.0	5.3
Delay (s)		10.4			8.1				0.1	15.1	12.7	18.4
Level of Service		B			A				A	B	B	B
Approach Delay (s)		10.4			8.1			0.1			15.1	
Approach LOS		B			A			A			B	

Intersection Summary			
HCM Average Control Delay	11.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	50.0	Sum of lost time (s)	10.3
Intersection Capacity Utilization	61.0%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	WBT	WBR	NBL	NBR
Lane Group Flow (vph)	1753	1212	808	654	592
v/c Ratio	0.49	0.61	0.65	0.55	0.60
Control Delay	12.5	7.4	5.2	28.6	28.8
Queue Delay	0.0	0.8	2.5	0.0	0.0
Total Delay	12.5	8.2	7.8	28.6	28.8
Queue Length 50th (ft)	179	114	109	173	168
Queue Length 95th (ft)	204	150	146	229	232
Internal Link Dist (ft)	410	90			
Turn Bay Length (ft)				300	300
Base Capacity (vph)	3627	2003	1247	1195	989
Starvation Cap Reductn	0	453	307	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.48	0.78	0.86	0.55	0.60

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1665	0	0	1151	768	621	0	562	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.4			5.4	5.4	4.0		4.0			
Lane Util. Factor		0.86			0.95	1.00	0.97		0.88			
Frt		1.00			1.00	0.85	1.00		0.85			
Flt Protected		1.00			1.00	1.00	0.95		1.00			
Satd. Flow (prot)		6408			3539	1583	3433		2787			
Flt Permitted		1.00			1.00	1.00	0.95		1.00			
Satd. Flow (perm)		6408			3539	1583	3433		2787			
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1753	0	0	1212	808	654	0	592	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	357	0	0	18	0	0	0
Lane Group Flow (vph)	0	1753	0	0	1212	451	654	0	574	0	0	0
Turn Type						Perm	custom		custom			
Protected Phases		2			6							
Permitted Phases						6	8		8			
Actuated Green, G (s)		55.8			55.8	55.8	34.8		34.8			
Effective Green, g (s)		55.8			55.8	55.8	34.8		34.8			
Actuated g/C Ratio		0.56			0.56	0.56	0.35		0.35			
Clearance Time (s)		5.4			5.4	5.4	4.0		4.0			
Vehicle Extension (s)		5.0			5.0	5.0	3.0		3.0			
Lane Grp Cap (vph)		3576			1975	883	1195		970			
v/s Ratio Prot		0.27			c0.34							
v/s Ratio Perm						0.28	0.19		c0.21			
v/c Ratio		0.49			0.61	0.51	0.55		0.59			
Uniform Delay, d1		13.4			14.9	13.7	26.3		26.8			
Progression Factor		0.90			0.42	3.49	1.00		1.00			
Incremental Delay, d2		0.2			0.6	0.7	1.8		2.6			
Delay (s)		12.3			6.9	48.4	28.1		29.4			
Level of Service		B			A	D	C		C			
Approach Delay (s)		12.3			23.5			28.7			0.0	
Approach LOS		B			C			C			A	

Intersection Summary			
HCM Average Control Delay	20.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	9.4
Intersection Capacity Utilization	57.4%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	591	1305	6	1258	202	200	144	288	278
v/c Ratio	0.90	0.48	0.05	0.76	0.82	0.29	0.50	0.74	0.62
Control Delay	49.9	10.3	44.5	34.6	69.2	33.5	50.2	24.4	11.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	49.9	10.3	44.5	34.6	69.2	33.5	50.2	24.4	11.1
Queue Length 50th (ft)	175	91	4	259	126	55	45	52	0
Queue Length 95th (ft)	#284	293	17	#343	#244	84	77	143	74
Internal Link Dist (ft)		311		731		382		448	
Turn Bay Length (ft)	250		80		120		140		140
Base Capacity (vph)	656	2736	124	1655	250	832	292	447	499
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.90	0.48	0.05	0.76	0.81	0.24	0.49	0.64	0.56

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	561	1158	82	6	1151	44	192	178	12	137	48	489
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.9	5.4		4.9	5.4		4.9	5.4		4.9	5.4	5.4
Lane Util. Factor	0.97	0.91		1.00	0.91		1.00	0.95		0.97	0.95	0.95
Frt	1.00	0.99		1.00	0.99		1.00	0.99		1.00	0.88	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	5035		1770	5057		1770	3505		3433	1551	1504
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	5035		1770	5057		1770	3505		3433	1551	1504
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	591	1219	86	6	1212	46	202	187	13	144	51	515
RTOR Reduction (vph)	0	6	0	0	4	0	0	6	0	0	176	239
Lane Group Flow (vph)	591	1299	0	6	1254	0	202	194	0	144	112	39
Turn Type	Prot			Prot			Prot			Prot		Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												4
Actuated Green, G (s)	23.0	50.3		1.4	28.7		13.8	19.3		8.4	13.9	13.9
Effective Green, g (s)	23.0	50.3		1.4	28.7		13.8	19.3		8.4	13.9	13.9
Actuated g/C Ratio	0.23	0.50		0.01	0.29		0.14	0.19		0.08	0.14	0.14
Clearance Time (s)	4.9	5.4		4.9	5.4		4.9	5.4		4.9	5.4	5.4
Vehicle Extension (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Grp Cap (vph)	790	2533		25	1451		244	676		288	216	209
v/s Ratio Prot	c0.17	0.26		0.00	c0.25		c0.11	0.06		0.04	c0.07	
v/s Ratio Perm												0.03
v/c Ratio	0.75	0.51		0.24	0.86		0.83	0.29		0.50	0.52	0.18
Uniform Delay, d1	35.8	16.6		48.8	33.8		41.9	34.5		43.8	40.0	38.0
Progression Factor	0.83	0.63		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	3.6	0.6		6.7	7.1		20.9	0.3		1.9	2.9	0.6
Delay (s)	33.3	11.2		55.5	40.9		62.8	34.8		45.7	42.9	38.6
Level of Service	C	B		E	D		E	C		D	D	D
Approach Delay (s)		18.1			40.9			48.9			41.8	
Approach LOS		B			D			D			D	

Intersection Summary			
HCM Average Control Delay	31.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	20.6
Intersection Capacity Utilization	79.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	1295	1429	778	865
v/c Ratio	0.41	0.64	0.82	0.55
Control Delay	10.3	14.0	41.1	1.4
Queue Delay	0.0	0.1	0.0	0.0
Total Delay	10.3	14.1	41.1	1.4
Queue Length 50th (ft)	137	273	239	0
Queue Length 95th (ft)	199	408	281	0
Internal Link Dist (ft)	898	560	1261	
Turn Bay Length (ft)			230	900
Base Capacity (vph)	3192	2222	1160	1583
Starvation Cap Reductn	0	109	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.41	0.68	0.67	0.55

Intersection Summary

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1230	1358	0	739	822
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.3	5.3		4.2	4.0
Lane Util. Factor		0.91	0.95		0.97	1.00
Frt		1.00	1.00		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		5085	3539		3433	1583
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		5085	3539		3433	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1295	1429	0	778	865
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1295	1429	0	778	865
Turn Type						Free
Protected Phases		2	6		4	
Permitted Phases						Free
Actuated Green, G (s)		62.8	62.8		27.7	100.0
Effective Green, g (s)		62.8	62.8		27.7	100.0
Actuated g/C Ratio		0.63	0.63		0.28	1.00
Clearance Time (s)		5.3	5.3		4.2	
Vehicle Extension (s)		5.0	5.0		2.5	
Lane Grp Cap (vph)		3193	2222		951	1583
v/s Ratio Prot		0.25	c0.40		c0.23	
v/s Ratio Perm						0.55
v/c Ratio		0.41	0.64		0.82	0.55
Uniform Delay, d1		9.3	11.6		33.8	0.0
Progression Factor		1.00	1.00		1.00	1.00
Incremental Delay, d2		0.4	1.3		5.4	1.4
Delay (s)		9.7	13.0		39.2	1.4
Level of Service		A	B		D	A
Approach Delay (s)		9.7	13.0		19.3	
Approach LOS		A	B		B	

Intersection Summary			
HCM Average Control Delay	14.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	9.5
Intersection Capacity Utilization	66.5%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	EBR	WBL	WBT
Lane Group Flow (vph)	1902	566	232	1452
v/c Ratio	0.73	0.46	0.75	0.41
Control Delay	6.7	2.3	54.1	0.4
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	6.7	2.3	54.1	0.4
Queue Length 50th (ft)	153	21	141	0
Queue Length 95th (ft)	200	47	217	0
Internal Link Dist (ft)	560			522
Turn Bay Length (ft)			260	
Base Capacity (vph)	2591	1228	372	3539
Starvation Cap Reductn	11	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.74	0.46	0.62	0.41

Intersection Summary

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	1807	538	220	1379	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.3	5.3	4.0	5.3		
Lane Util. Factor	0.95	1.00	1.00	0.95		
Frt	1.00	0.85	1.00	1.00		
Flt Protected	1.00	1.00	0.95	1.00		
Satd. Flow (prot)	3539	1583	1770	3539		
Flt Permitted	1.00	1.00	0.95	1.00		
Satd. Flow (perm)	3539	1583	1770	3539		
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	1902	566	232	1452	0	0
RTOR Reduction (vph)	0	69	0	0	0	0
Lane Group Flow (vph)	1902	497	232	1452	0	0
Turn Type		Perm	Prot			
Protected Phases	2		1	6		
Permitted Phases		2				
Actuated Green, G (s)	73.2	73.2	17.5	100.0		
Effective Green, g (s)	73.2	73.2	17.5	100.0		
Actuated g/C Ratio	0.73	0.73	0.18	1.00		
Clearance Time (s)	5.3	5.3	4.0	5.3		
Vehicle Extension (s)	5.0	5.0	3.0	5.0		
Lane Grp Cap (vph)	2591	1159	310	3539		
v/s Ratio Prot	c0.54		c0.13	0.41		
v/s Ratio Perm		0.31				
v/c Ratio	0.73	0.43	0.75	0.41		
Uniform Delay, d1	7.8	5.2	39.2	0.0		
Progression Factor	0.58	0.36	1.00	1.00		
Incremental Delay, d2	1.7	1.1	9.5	0.4		
Delay (s)	6.2	3.0	48.7	0.4		
Level of Service	A	A	D	A		
Approach Delay (s)	5.5			7.0	0.0	
Approach LOS	A			A	A	

Intersection Summary			
HCM Average Control Delay	6.1	HCM Level of Service	A
HCM Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	9.3
Intersection Capacity Utilization	69.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	421	0	0	655	0	589	786	0	770	564
Sign Control		Yield			Yield			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	0	443	0	0	689	0	620	827	0	811	594
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)								1120				
pX, platoon unblocked	0.95	0.95		0.95	0.95	0.95				0.95		
vC, conflicting volume	1017	1431	270	890	1431	207	811			620		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	815	1252	270	680	1252	0	811			394		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	39	100	100	33	100			100		
cM capacity (veh/h)	83	162	728	124	162	1025	811			1097		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	NB 4	SB 1	SB 2	SB 3	SB 4
Volume Total	443	689	248	248	400	552	324	324	360	396
Volume Left	0	0	0	0	0	0	0	0	0	0
Volume Right	443	689	0	0	276	552	0	0	198	396
cSH	728	1025	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.61	0.67	0.15	0.15	0.24	0.32	0.19	0.19	0.21	0.23
Queue Length 95th (ft)	105	136	0	0	0	0	0	0	0	0
Control Delay (s)	17.3	15.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	C	C								
Approach Delay (s)	17.3	15.4	0.0				0.0			
Approach LOS	C	C								

Intersection Summary			
Average Delay	4.6		
Intersection Capacity Utilization	64.5%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	0	660	0	1342	865	350
Sign Control	Yield			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	695	0	1413	911	368
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)				640		
pX, platoon unblocked	0.89					
vC, conflicting volume	1264	304	911			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	676	304	911			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	0	100			
cM capacity (veh/h)	344	693	744			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	NB 4	SB 1	SB 2	SB 3	SB 4
Volume Total	695	353	353	353	353	364	364	305	246
Volume Left	0	0	0	0	0	0	0	0	0
Volume Right	695	0	0	0	0	0	0	123	246
cSH	693	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	1.00	0.21	0.21	0.21	0.21	0.21	0.21	0.18	0.14
Queue Length 95th (ft)	407	0	0	0	0	0	0	0	0
Control Delay (s)	59.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	F								
Approach Delay (s)	59.4	0.0				0.0			
Approach LOS	F								

Intersection Summary			
Average Delay	12.2		
Intersection Capacity Utilization	66.8%	ICU Level of Service	C
Analysis Period (min)	15		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	135	716	139	54	847	193	248	1164	84	1503
v/c Ratio	0.75	0.44	0.20	0.30	0.66	0.38	0.89	0.54	0.26	0.92
Control Delay	64.1	22.3	7.3	40.8	27.3	6.5	70.7	22.2	36.4	34.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	64.1	22.3	7.3	40.8	27.3	6.5	70.7	22.2	36.4	34.5
Queue Length 50th (ft)	34	105	20	13	137	3	62	137	19	235
Queue Length 95th (ft)	#82	141	45	31	180	55	#134	168	43	#349
Internal Link Dist (ft)		578			652			1209		560
Turn Bay Length (ft)	175			150			180		150	
Base Capacity (vph)	179	1657	710	179	1503	554	278	2280	317	1630
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.75	0.43	0.20	0.30	0.56	0.35	0.89	0.51	0.26	0.92

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	128	680	132	51	784	204	236	964	142	80	950	478
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4		5.4	5.4	
Lane Util. Factor	0.97	0.91	1.00	0.97	0.86	0.86	0.97	0.86		0.97	0.91	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.98		1.00	0.95	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	3433	5085	1583	3433	4787	1362	3433	6285		3433	4830	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	3433	5085	1583	3433	4787	1362	3433	6285		3433	4830	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	135	716	139	54	825	215	248	1015	149	84	1000	503
RTOR Reduction (vph)	0	0	29	0	4	132	0	33	0	0	106	0
Lane Group Flow (vph)	135	716	110	54	843	61	248	1131	0	84	1397	0
Turn Type	Prot		pm+ov	Prot		Perm	Prot			Prot		
Protected Phases	7	4	5	3	8		5	2		1	6	
Permitted Phases			4			8						
Actuated Green, G (s)	4.0	24.6	31.9	2.3	22.9	22.9	7.3	25.7		5.9	24.3	
Effective Green, g (s)	4.0	24.6	31.9	2.3	22.9	22.9	7.3	25.7		5.9	24.3	
Actuated g/C Ratio	0.05	0.31	0.40	0.03	0.29	0.29	0.09	0.32		0.07	0.30	
Clearance Time (s)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4		5.4	5.4	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	171	1562	630	99	1369	389	313	2017		253	1465	
v/s Ratio Prot	c0.04	0.14	0.02	0.02	c0.18		c0.07	0.18		0.02	c0.29	
v/s Ratio Perm			0.05			0.04						
v/c Ratio	0.79	0.46	0.17	0.55	0.62	0.16	0.79	0.56		0.33	0.95	
Uniform Delay, d1	37.6	22.4	15.6	38.4	24.8	21.4	35.7	22.5		35.2	27.3	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	21.1	0.2	0.1	6.0	0.8	0.2	12.8	0.4		0.8	13.9	
Delay (s)	58.7	22.6	15.7	44.4	25.6	21.6	48.5	22.9		36.0	41.3	
Level of Service	E	C	B	D	C	C	D	C		D	D	
Approach Delay (s)		26.5			25.8			27.4			41.0	
Approach LOS		C			C			C			D	

Intersection Summary			
HCM Average Control Delay	31.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	80.1	Sum of lost time (s)	16.2
Intersection Capacity Utilization	74.1%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	473	453	0	546	0	0	0	0	0	0	534
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	498	477	0	575	0	0	0	0	0	0	562
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		732										
pX, platoon unblocked				0.91			0.91	0.91	0.91	0.91	0.91	
vC, conflicting volume	575			975			928	1311	404	741	1549	192
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	575			630			579	999	4	373	1261	192
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	100	100	100	100	31
cM capacity (veh/h)	994			864			113	220	982	509	154	818

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	SB 1
Volume Total	199	199	576	192	192	192	562
Volume Left	0	0	0	0	0	0	0
Volume Right	0	0	477	0	0	0	562
cSH	1700	1700	1700	1700	1700	1700	818
Volume to Capacity	0.12	0.12	0.34	0.11	0.11	0.11	0.69
Queue Length 95th (ft)	0	0	0	0	0	0	140
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	18.5
Lane LOS							C
Approach Delay (s)	0.0			0.0			18.5
Approach LOS							C

Intersection Summary			
Average Delay	4.9		
Intersection Capacity Utilization	50.3%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	46	111	220	215	5	1070	428	1315
v/c Ratio	0.35	0.38	0.53	0.50	0.03	0.39	0.31	0.45
Control Delay	25.9	24.3	9.4	8.7	8.6	4.2	0.8	9.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	25.9	24.3	9.4	8.7	8.6	4.2	0.8	9.3
Queue Length 50th (ft)	9	37	6	5	0	22	6	100
Queue Length 95th (ft)	37	71	56	50	m2	m77	m8	164
Internal Link Dist (ft)	296		624			121		607
Turn Bay Length (ft)				470	120			
Base Capacity (vph)	132	532	597	613	181	2753	1362	2940
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.35	0.21	0.37	0.35	0.03	0.39	0.31	0.45

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	25	0	19	117	2	400	5	610	813	0	1233	16
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		5.0	5.0	5.0	5.0	5.0	4.0		5.0	
Lane Util. Factor		1.00		0.95	0.91	0.95	1.00	0.86	0.86		0.91	
Frt		0.94		1.00	0.86	0.85	1.00	0.94	0.85		1.00	
Flt Protected		0.97		0.95	1.00	1.00	0.95	1.00	1.00		1.00	
Satd. Flow (prot)		1705		1681	1453	1504	1770	4518	1362		5075	
Flt Permitted		0.97		0.95	1.00	1.00	0.17	1.00	1.00		1.00	
Satd. Flow (perm)		1705		1681	1453	1504	314	4518	1362		5075	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	26	0	20	123	2	421	5	642	856	0	1298	17
RTOR Reduction (vph)	0	19	0	0	165	165	0	146	0	0	2	0
Lane Group Flow (vph)	0	27	0	111	55	50	5	924	428	0	1313	0
Turn Type	Split			Split		Perm	Perm		Free			
Protected Phases	4	4		8	8			2			6	
Permitted Phases						8	2		Free			
Actuated Green, G (s)		2.4		10.5	10.5	10.5	33.1	33.1	60.0		33.1	
Effective Green, g (s)		2.4		10.5	10.5	10.5	33.1	33.1	60.0		33.1	
Actuated g/C Ratio		0.04		0.18	0.18	0.18	0.55	0.55	1.00		0.55	
Clearance Time (s)		4.0		5.0	5.0	5.0	5.0	5.0			5.0	
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0			3.0	
Lane Grp Cap (vph)		68		294	254	263	173	2492	1362		2800	
v/s Ratio Prot		0.02		0.07	0.04			0.20			c0.26	
v/s Ratio Perm						0.03	0.02		c0.31			
v/c Ratio		0.39		0.38	0.22	0.19	0.03	0.37	0.31		0.47	
Uniform Delay, d1		28.1		21.9	21.2	21.1	6.1	7.6	0.0		8.1	
Progression Factor		1.00		1.00	1.00	1.00	0.93	0.70	1.00		1.00	
Incremental Delay, d2		3.7		0.8	0.4	0.4	0.2	0.3	0.5		0.6	
Delay (s)		31.8		22.7	21.7	21.5	5.9	5.6	0.5		8.7	
Level of Service		C		C	C	C	A	A	A		A	
Approach Delay (s)		31.8			21.8			4.1			8.7	
Approach LOS		C			C			A			A	

Intersection Summary			
HCM Average Control Delay	9.1	HCM Level of Service	A
HCM Volume to Capacity ratio	0.41		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	5.0
Intersection Capacity Utilization	49.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	53	782	299	2058	269	995	66	877
v/c Ratio	0.90	0.82	0.62	0.96	0.90	0.58	0.49	0.76
Control Delay	148.8	52.1	26.5	24.5	63.6	17.9	63.5	42.5
Queue Delay	0.0	0.0	0.0	6.9	0.0	0.4	0.0	0.0
Total Delay	148.8	52.1	26.5	31.4	63.6	18.3	63.5	42.5
Queue Length 50th (ft)	42	202	213	489	212	169	0	176
Queue Length 95th (ft)	#125	252	m246	#661	#362	119	0	241
Internal Link Dist (ft)		1129		409		285		200
Turn Bay Length (ft)	140		110		150		120	
Base Capacity (vph)	59	1000	483	2140	310	1716	148	1159
Starvation Cap Reductn	0	0	0	90	0	283	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.90	0.78	0.62	1.00	0.87	0.69	0.45	0.76

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	50	602	141	284	1592	363	256	922	23	63	752	81
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5		4.0	4.5		4.0	4.5		4.0	4.5	
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	0.91		1.00	0.91	
Frt	1.00	0.97		1.00	0.97		1.00	1.00		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	4941		1770	4944		1770	5067		1770	5011	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	4941		1770	4944		1770	5067		1770	5011	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	53	634	148	299	1676	382	269	971	24	66	792	85
RTOR Reduction (vph)	0	33	0	0	30	0	0	2	0	0	11	0
Lane Group Flow (vph)	53	749	0	299	2028	0	269	993	0	66	866	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	4.0	22.4		32.8	51.2		21.1	39.8		8.0	26.7	
Effective Green, g (s)	4.0	22.4		32.8	51.2		21.1	39.8		8.0	26.7	
Actuated g/C Ratio	0.03	0.19		0.27	0.43		0.18	0.33		0.07	0.22	
Clearance Time (s)	4.0	4.5		4.0	4.5		4.0	4.5		4.0	4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	59	922		484	2109		311	1681		118	1115	
v/s Ratio Prot	0.03	0.15		c0.17	c0.41		c0.15	0.20		0.04	c0.17	
v/s Ratio Perm												
v/c Ratio	0.90	0.81		0.62	0.96		0.86	0.59		0.56	0.78	
Uniform Delay, d1	57.8	46.8		38.1	33.4		48.1	33.3		54.3	43.8	
Progression Factor	1.00	1.00		0.58	0.45		0.72	0.50		0.99	0.90	
Incremental Delay, d2	80.5	5.5		1.4	8.1		18.3	1.3		5.2	4.9	
Delay (s)	138.3	52.3		23.5	23.2		52.6	18.0		58.8	44.2	
Level of Service	F	D		C	C		D	B		E	D	
Approach Delay (s)		57.8			23.2			25.4			45.3	
Approach LOS		E			C			C			D	

Intersection Summary			
HCM Average Control Delay	32.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	86.9%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	304	1084	316	145	629	17	941	242	1137
v/c Ratio	0.67	0.74	0.57	0.68	0.71	0.11	0.58	0.28	0.49
Control Delay	44.0	36.0	14.5	46.7	32.5	24.8	26.8	3.8	6.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.4
Total Delay	44.0	36.0	14.5	46.7	32.5	24.8	26.8	3.8	7.2
Queue Length 50th (ft)	216	277	77	91	151	7	280	0	92
Queue Length 95th (ft)	267	267	119	m160	181	27	385	50	110
Internal Link Dist (ft)		339			174		323		285
Turn Bay Length (ft)	200			175		175			
Base Capacity (vph)	508	1643	601	266	1081	150	1636	862	2305
Starvation Cap Reductn	0	0	0	0	0	0	0	0	574
Spillback Cap Reductn	0	0	0	0	0	0	51	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.60	0.66	0.53	0.55	0.58	0.11	0.59	0.28	0.66

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	289	868	462	138	598	0	16	894	230	0	557	523
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5	4.5	4.0	4.5		4.5	4.5	4.5		4.5	
Lane Util. Factor	1.00	0.86	0.86	1.00	0.91		1.00	0.95	1.00		0.91	
Frt	1.00	0.98	0.85	1.00	1.00		1.00	1.00	0.85		0.93	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00		1.00	
Satd. Flow (prot)	1770	4693	1362	1770	5085		1770	3539	1583		4716	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.17	1.00	1.00		1.00	
Satd. Flow (perm)	1770	4693	1362	1770	5085		324	3539	1583		4716	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	304	914	486	145	629	0	17	941	242	0	586	551
RTOR Reduction (vph)	0	21	138	0	0	0	0	0	130	0	126	0
Lane Group Flow (vph)	304	1063	178	145	629	0	17	941	112	0	1011	0
Turn Type	Prot		Perm	Prot			Perm		Perm			
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4				2		2			
Actuated Green, G (s)	30.7	37.0	37.0	14.5	20.8		55.5	55.5	55.5		55.5	
Effective Green, g (s)	30.7	37.0	37.0	14.5	20.8		55.5	55.5	55.5		55.5	
Actuated g/C Ratio	0.26	0.31	0.31	0.12	0.17		0.46	0.46	0.46		0.46	
Clearance Time (s)	4.0	4.5	4.5	4.0	4.5		4.5	4.5	4.5		4.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	453	1447	420	214	881		150	1637	732		2181	
v/s Ratio Prot	0.17	c0.23		0.08	c0.12			c0.27			0.21	
v/s Ratio Perm			0.13				0.05		0.07			
v/c Ratio	0.67	0.73	0.42	0.68	0.71		0.11	0.57	0.15		0.46	
Uniform Delay, d1	40.1	37.1	33.0	50.5	46.8		18.3	23.6	18.7		22.1	
Progression Factor	0.93	0.92	0.91	0.66	0.61		1.00	1.00	1.00		0.34	
Incremental Delay, d2	3.5	1.8	0.6	7.0	2.3		1.5	1.5	0.4		0.5	
Delay (s)	40.8	36.1	30.8	40.5	31.0		19.8	25.1	19.1		8.0	
Level of Service	D	D	C	D	C		B	C	B		A	
Approach Delay (s)		35.9			32.8			23.8			8.0	
Approach LOS		D			C			C			A	

Intersection Summary			
HCM Average Control Delay	25.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	63.4%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	0	183	1051	0	0	1182
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	193	1106	0	0	1244
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						629
pX, platoon unblocked						
vC, conflicting volume	1521	369			1106	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1521	369			1106	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	69			100	
cM capacity (veh/h)	109	628			627	

Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	193	369	369	369	415	415	415
Volume Left	0	0	0	0	0	0	0
Volume Right	193	0	0	0	0	0	0
cSH	628	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.31	0.22	0.22	0.22	0.24	0.24	0.24
Queue Length 95th (ft)	32	0	0	0	0	0	0
Control Delay (s)	13.2	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	B						
Approach Delay (s)	13.2	0.0			0.0		
Approach LOS	B						

Intersection Summary			
Average Delay	1.0		
Intersection Capacity Utilization	38.3%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBT	WBT	SBL
Lane Group Flow (vph)	1282	864	742
v/c Ratio	0.45	0.30	0.71
Control Delay	8.9	4.7	20.0
Queue Delay	0.0	0.0	0.0
Total Delay	8.9	4.7	20.0
Queue Length 50th (ft)	89	9	105
Queue Length 95th (ft)	144	149	139
Internal Link Dist (ft)	736	218	493
Turn Bay Length (ft)			
Base Capacity (vph)	2866	2866	1394
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.45	0.30	0.53

Intersection Summary

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1218	821	0	536	169
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5	4.5		4.0	
Lane Util. Factor		0.91	0.91		0.97	
Frt		1.00	1.00		0.96	
Flt Protected		1.00	1.00		0.96	
Satd. Flow (prot)		5085	5085		3356	
Flt Permitted		1.00	1.00		0.96	
Satd. Flow (perm)		5085	5085		3356	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1282	864	0	564	178
RTOR Reduction (vph)	0	0	0	0	61	0
Lane Group Flow (vph)	0	1282	864	0	681	0
Turn Type						
Protected Phases		4	8		6	
Permitted Phases						
Actuated Green, G (s)		33.8	33.8		17.7	
Effective Green, g (s)		33.8	33.8		17.7	
Actuated g/C Ratio		0.56	0.56		0.29	
Clearance Time (s)		4.5	4.5		4.0	
Vehicle Extension (s)		3.0	3.0		3.0	
Lane Grp Cap (vph)		2865	2865		990	
v/s Ratio Prot		c0.25	0.17		c0.20	
v/s Ratio Perm						
v/c Ratio		0.45	0.30		0.69	
Uniform Delay, d1		7.6	6.9		18.7	
Progression Factor		1.00	0.60		1.00	
Incremental Delay, d2		0.5	0.2		2.0	
Delay (s)		8.2	4.3		20.7	
Level of Service		A	A		C	
Approach Delay (s)		8.2	4.3		20.7	
Approach LOS		A	A		C	

Intersection Summary			
HCM Average Control Delay	10.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.5
Intersection Capacity Utilization	51.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	77	680	352	2217	120	552	467	117	758
v/c Ratio	0.68	0.39	0.83	0.82	0.13	0.50	0.57	0.65	0.48
Control Delay	96.9	7.7	59.7	27.1	4.5	27.3	17.7	54.6	29.4
Queue Delay	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0
Total Delay	96.9	7.7	59.7	27.7	4.5	27.3	17.7	54.6	29.4
Queue Length 50th (ft)	63	36	259	525	7	230	249	78	147
Queue Length 95th (ft)	m87	161	346	596	38	277	355	#166	188
Internal Link Dist (ft)		409		995		363			581
Turn Bay Length (ft)	140		160					120	
Base Capacity (vph)	118	1727	531	2708	890	1106	816	180	1585
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	183	0	0	0	0	1
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.65	0.39	0.66	0.88	0.13	0.50	0.57	0.65	0.48

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	73	646	0	334	2106	114	0	524	444	111	481	239
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5		4.0	4.5	4.5		4.5	4.5	4.5	4.5	
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00		0.95	1.00	1.00	0.91	
Frt	1.00	1.00		1.00	1.00	0.85		1.00	0.85	1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5085		1770	5085	1583		3539	1583	1770	4832	
Flt Permitted	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.31	1.00	
Satd. Flow (perm)	1770	5085		1770	5085	1583		3539	1583	578	4832	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	77	680	0	352	2217	120	0	552	467	117	506	252
RTOR Reduction (vph)	0	0	0	0	0	47	0	0	321	0	75	0
Lane Group Flow (vph)	77	680	0	352	2217	73	0	552	146	117	683	0
Turn Type	Prot		Perm	Prot		Perm			Perm	Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8			2	6		
Actuated Green, G (s)	6.4	40.8		28.7	63.1	63.1		37.5	37.5	37.5	37.5	
Effective Green, g (s)	6.4	40.8		28.7	63.1	63.1		37.5	37.5	37.5	37.5	
Actuated g/C Ratio	0.05	0.34		0.24	0.53	0.53		0.31	0.31	0.31	0.31	
Clearance Time (s)	4.0	4.5		4.0	4.5	4.5		4.5	4.5	4.5	4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	94	1729		423	2674	832		1106	495	181	1510	
v/s Ratio Prot	0.04	0.13		c0.20	c0.44			0.16			0.14	
v/s Ratio Perm						0.05			0.09	c0.20		
v/c Ratio	0.82	0.39		0.83	0.83	0.09		0.50	0.29	0.65	0.45	
Uniform Delay, d1	56.2	30.2		43.4	23.9	14.1		33.6	31.2	35.5	33.0	
Progression Factor	1.42	0.23		1.00	1.00	1.00		0.77	5.21	1.00	1.00	
Incremental Delay, d2	30.2	0.5		13.1	3.1	0.2		1.3	1.2	16.5	1.0	
Delay (s)	110.1	7.4		56.5	27.1	14.3		27.0	164.0	52.0	34.0	
Level of Service	F	A		E	C	B		C	F	D	C	
Approach Delay (s)		17.8			30.3			89.8			36.4	
Approach LOS		B			C			F			D	

Intersection Summary			
HCM Average Control Delay	40.9	HCM Level of Service	D
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.5
Intersection Capacity Utilization	80.0%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	155	1647	153	2660	414	249	71	117	903	213
v/c Ratio	1.31	0.93	0.87	1.37	1.40	0.24	0.14	0.64	1.09	0.48
Control Delay	232.3	47.7	94.6	200.6	238.4	33.4	8.2	66.7	103.1	24.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	232.3	47.7	94.6	200.6	238.4	33.4	8.2	66.7	103.1	24.1
Queue Length 50th (ft)	~155	445	119	~1002	~430	77	0	88	~415	72
Queue Length 95th (ft)	#292	#546	#241	#1094	#628	115	36	149	#546	149
Internal Link Dist (ft)		631		1090		191			644	
Turn Bay Length (ft)	200		180		140		60	120		120
Base Capacity (vph)	118	1772	177	1944	295	1047	518	221	826	448
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.31	0.93	0.86	1.37	1.40	0.24	0.14	0.53	1.09	0.48

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	147	1446	119	145	2457	70	393	237	67	111	858	202
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.99		1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5027		1770	5064		1770	3539	1583	1770	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5027		1770	5064		1770	3539	1583	1770	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	155	1522	125	153	2586	74	414	249	71	117	903	213
RTOR Reduction (vph)	0	8	0	0	2	0	0	0	50	0	0	78
Lane Group Flow (vph)	155	1639	0	153	2658	0	414	249	21	117	903	135
Turn Type	Prot			Prot			Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases									2			6
Actuated Green, G (s)	8.0	42.1		11.9	46.0		20.0	35.5	35.5	12.5	28.0	28.0
Effective Green, g (s)	8.0	42.1		11.9	46.0		20.0	35.5	35.5	12.5	28.0	28.0
Actuated g/C Ratio	0.07	0.35		0.10	0.38		0.17	0.30	0.30	0.10	0.23	0.23
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	118	1764		176	1941		295	1047	468	184	826	369
v/s Ratio Prot	c0.09	0.33		0.09	c0.52		c0.23	0.07		0.07	c0.26	
v/s Ratio Perm									0.01			0.09
v/c Ratio	1.31	0.93		0.87	1.37		1.40	0.24	0.04	0.64	1.09	0.37
Uniform Delay, d1	56.0	37.5		53.3	37.0		50.0	32.0	30.2	51.6	46.0	38.6
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	188.8	9.1		33.6	169.5		200.7	0.1	0.0	7.0	59.9	0.6
Delay (s)	244.8	46.6		86.9	206.5		250.7	32.1	30.2	58.6	105.9	39.2
Level of Service	F	D		F	F		F	C	C	E	F	D
Approach Delay (s)		63.7			200.0			155.2			89.9	
Approach LOS		E			F			F			F	

Intersection Summary			
HCM Average Control Delay	137.0	HCM Level of Service	F
HCM Volume to Capacity ratio	1.30		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	117.7%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NER
Lane Configurations										
Volume (veh/h)	0	172	0	601	0	0	710	472	0	0
Sign Control	Yield			Free			Free		Yield	
Grade	0%			0%			0%		0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	181	0	633	0	0	747	497	0	0
Pedestrians										
Lane Width (ft)										
Walking Speed (ft/s)										
Percent Blockage										
Right turn flare (veh)										
Median type				None			None			
Median storage veh)										
Upstream signal (ft)							271			
pX, platoon unblocked	0.76		0.76						0.76	0.76
vC, conflicting volume	1877	316	1244			633			1245	1380
vC1, stage 1 conf vol										
vC2, stage 2 conf vol										
vCu, unblocked vol	1995	316	1164			633			1165	1343
tC, single (s)	6.5	6.9	4.1			4.1			7.5	6.5
tC, 2 stage (s)										
tF (s)	4.0	3.3	2.2			2.2			3.5	4.0
p0 queue free %	100	73	100			100			100	100
cM capacity (veh/h)	45	679	454			946			83	115

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	181	316	316	747	497
Volume Left	0	0	0	0	0
Volume Right	181	0	0	0	497
cSH	679	1700	1700	1700	1700
Volume to Capacity	0.27	0.19	0.19	0.44	0.29
Queue Length 95th (ft)	27	0	0	0	0
Control Delay (s)	12.2	0.0	0.0	0.0	0.0
Lane LOS	B				
Approach Delay (s)	12.2	0.0		0.0	
Approach LOS	B				

Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	58.1%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	777	0	0	0	0	0	0	638	58	0
Sign Control		Yield			Yield			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	0	818	0	0	0	0	0	0	672	61	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)											795	
pX, platoon unblocked												
vC, conflicting volume	1404	1404	61	2222	1404	0	61			0		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1404	1404	61	2222	1404	0	61			0		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	19	100	100	100	100			59		
cM capacity (veh/h)	79	82	1004	4	82	1085	1542			1623		

Direction, Lane #	EB 1	SB 1	SB 2
Volume Total	818	672	61
Volume Left	0	672	0
Volume Right	818	0	0
cSH	1004	1623	1700
Volume to Capacity	0.81	0.41	0.04
Queue Length 95th (ft)	235	52	0
Control Delay (s)	22.1	8.8	0.0
Lane LOS	C	A	
Approach Delay (s)	22.1	8.0	
Approach LOS	C		

Intersection Summary			
Average Delay	15.5		
Intersection Capacity Utilization	58.1%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	WBL	WBT	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	506	185	119	921	215	1269
v/c Ratio	0.92	0.31	0.80	0.47	0.22	0.64
Control Delay	47.8	8.9	50.8	8.6	1.6	12.7
Queue Delay	0.0	0.0	0.0	0.1	0.0	0.1
Total Delay	47.8	8.9	50.8	8.7	1.6	12.8
Queue Length 50th (ft)	204	20	42	88	5	184
Queue Length 95th (ft)	#376	63	m#108	145	m14	248
Internal Link Dist (ft)		1190		300		620
Turn Bay Length (ft)	600		90			
Base Capacity (vph)	569	603	149	1980	980	1979
Starvation Cap Reductn	0	0	0	282	0	0
Spillback Cap Reductn	0	0	0	0	0	92
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.89	0.31	0.80	0.54	0.22	0.67

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	481	26	150	113	875	204	0	1201	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.5	4.5		4.5	4.5	4.5		4.5	
Lane Util. Factor				1.00	1.00		1.00	0.95	1.00		0.95	
Frt				1.00	0.87		1.00	1.00	0.85		1.00	
Flt Protected				0.95	1.00		0.95	1.00	1.00		1.00	
Satd. Flow (prot)				1770	1624		1770	3539	1583		3537	
Flt Permitted				0.95	1.00		0.14	1.00	1.00		1.00	
Satd. Flow (perm)				1770	1624		266	3539	1583		3537	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	0	0	506	27	158	119	921	215	0	1264	5
RTOR Reduction (vph)	0	0	0	0	82	0	0	0	95	0	0	0
Lane Group Flow (vph)	0	0	0	506	103	0	119	921	120	0	1269	0
Turn Type				Split			Perm		Perm			
Protected Phases				8	8			2			6	
Permitted Phases							2		2			
Actuated Green, G (s)				21.8	21.8		39.2	39.2	39.2		39.2	
Effective Green, g (s)				21.8	21.8		39.2	39.2	39.2		39.2	
Actuated g/C Ratio				0.31	0.31		0.56	0.56	0.56		0.56	
Clearance Time (s)				4.5	4.5		4.5	4.5	4.5		4.5	
Vehicle Extension (s)				3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)				551	506		149	1982	886		1981	
v/s Ratio Prot				c0.29	0.06			0.26			0.36	
v/s Ratio Perm							c0.45		0.08			
v/c Ratio				0.92	0.20		0.80	0.46	0.14		0.64	
Uniform Delay, d1				23.2	17.7		12.3	9.2	7.3		10.6	
Progression Factor				1.00	1.00		0.93	0.83	0.84		1.00	
Incremental Delay, d2				20.3	0.2		30.8	0.7	0.3		1.6	
Delay (s)				43.5	17.9		42.2	8.3	6.4		12.2	
Level of Service				D	B		D	A	A		B	
Approach Delay (s)		0.0			36.7			11.2			12.2	
Approach LOS		A			D			B			B	

Intersection Summary			
HCM Average Control Delay	17.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	77.5%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBR	NBT	SBT
Lane Group Flow (vph)	396	379	914	1827
v/c Ratio	0.84	0.87	0.42	0.84
Control Delay	41.2	45.2	2.5	10.0
Queue Delay	0.0	0.0	0.1	0.6
Total Delay	41.2	45.2	2.5	10.6
Queue Length 50th (ft)	156	145	26	181
Queue Length 95th (ft)	#289	#286	m44	m209
Internal Link Dist (ft)	434		320	300
Turn Bay Length (ft)				
Base Capacity (vph)	506	464	2187	2187
Starvation Cap Reductn	0	0	250	6
Spillback Cap Reductn	0	0	0	113
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.78	0.82	0.47	0.88

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	376	360	0	868	1736	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		0.95	0.95	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1770	1583		3539	3539	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	1770	1583		3539	3539	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	396	379	0	914	1827	0
RTOR Reduction (vph)	0	12	0	0	0	0
Lane Group Flow (vph)	396	367	0	914	1827	0
Turn Type		custom				
Protected Phases				2	6	
Permitted Phases	4	4				
Actuated Green, G (s)	18.7	18.7		43.3	43.3	
Effective Green, g (s)	18.7	18.7		43.3	43.3	
Actuated g/C Ratio	0.27	0.27		0.62	0.62	
Clearance Time (s)	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	473	423		2189	2189	
v/s Ratio Prot				0.26	c0.52	
v/s Ratio Perm	0.22	c0.23				
v/c Ratio	0.84	0.87		0.42	0.83	
Uniform Delay, d1	24.2	24.5		6.9	10.5	
Progression Factor	1.00	1.00		0.27	0.58	
Incremental Delay, d2	12.2	16.8		0.5	2.8	
Delay (s)	36.4	41.2		2.4	9.0	
Level of Service	D	D		A	A	
Approach Delay (s)	38.8			2.4	9.0	
Approach LOS	D			A	A	

Intersection Summary			
HCM Average Control Delay	13.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	76.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	231	372	143	41	279	82	178	520	111	178	1591	449
v/c Ratio	0.98	0.46	0.30	0.22	0.34	0.19	0.88	0.35	0.15	0.54	0.93	0.52
Control Delay	86.3	25.5	6.5	25.5	24.1	7.2	73.0	14.9	3.6	26.6	17.6	4.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.4	0.3
Total Delay	86.3	25.5	6.5	25.5	24.1	7.2	73.0	14.9	3.6	26.6	27.1	4.3
Queue Length 50th (ft)	99	73	0	14	53	0	77	77	0	79	133	9
Queue Length 95th (ft)	#231	111	41	40	85	31	#184	113	26	m86	#472	m41
Internal Link Dist (ft)		612			420			572			320	
Turn Bay Length (ft)	90			80			130			120		
Base Capacity (vph)	235	809	472	189	809	425	202	1466	721	329	1719	869
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	132	97
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.98	0.46	0.30	0.22	0.34	0.19	0.88	0.35	0.15	0.54	1.00	0.58

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	219	353	136	39	265	78	169	494	105	169	1511	427
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3539	1583	1770	3539	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.55	1.00	1.00	0.44	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1027	3539	1583	828	3539	1583	1770	3539	1583	1770	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	231	372	143	41	279	82	178	520	111	178	1591	449
RTOR Reduction (vph)	0	0	110	0	0	63	0	0	65	0	0	100
Lane Group Flow (vph)	231	372	33	41	279	19	178	520	46	178	1591	349
Turn Type	Perm		Perm	Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Actuated Green, G (s)	16.0	16.0	16.0	16.0	16.0	16.0	8.0	29.0	29.0	13.0	34.0	34.0
Effective Green, g (s)	16.0	16.0	16.0	16.0	16.0	16.0	8.0	29.0	29.0	13.0	34.0	34.0
Actuated g/C Ratio	0.23	0.23	0.23	0.23	0.23	0.23	0.11	0.41	0.41	0.19	0.49	0.49
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	235	809	362	189	809	362	202	1466	656	329	1719	769
v/s Ratio Prot		0.11			0.08		c0.10	0.15		0.10	c0.45	
v/s Ratio Perm	c0.22		0.02	0.05		0.01			0.03			0.22
v/c Ratio	0.98	0.46	0.09	0.22	0.34	0.05	0.88	0.35	0.07	0.54	0.93	0.45
Uniform Delay, d1	26.9	23.3	21.3	21.9	22.6	21.1	30.5	14.1	12.4	25.8	16.8	11.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88	0.61	0.41
Incremental Delay, d2	53.6	0.4	0.1	0.6	0.3	0.1	33.0	0.7	0.2	1.0	5.9	1.0
Delay (s)	80.4	23.7	21.4	22.5	22.9	21.1	63.5	14.7	12.6	23.6	16.1	5.9
Level of Service	F	C	C	C	C	C	E	B	B	C	B	A
Approach Delay (s)		40.8			22.5			25.2			14.6	
Approach LOS		D			C			C			B	

Intersection Summary			
HCM Average Control Delay	22.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	83.9%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	51	527	0	410	0	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	54	555	0	432	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	500					
pX, platoon unblocked						
vC, conflicting volume			608		269	27
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			608		269	27
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			966		697	1042

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2
Volume Total	36	203	370	216	216
Volume Left	0	0	0	0	0
Volume Right	0	185	370	0	0
cSH	1700	1700	1700	1700	1700
Volume to Capacity	0.02	0.12	0.22	0.13	0.13
Queue Length 95th (ft)	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0
Lane LOS					
Approach Delay (s)	0.0			0.0	
Approach LOS					

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	25.1%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	131	1096	1656	191
v/c Ratio	0.51	0.31	0.62	0.15
Control Delay	26.0	0.2	5.8	1.2
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	26.0	0.2	5.8	1.2
Queue Length 50th (ft)	45	0	138	3
Queue Length 95th (ft)	82	0	201	16
Internal Link Dist (ft)		370	263	
Turn Bay Length (ft)	100			70
Base Capacity (vph)	295	3539	2691	1242
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.44	0.31	0.62	0.15

Intersection Summary

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	0	0	124	1041	1573	181
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)			4.0	4.5	4.5	4.5
Lane Util. Factor			1.00	0.95	0.95	1.00
Frt			1.00	1.00	1.00	0.85
Flt Protected			0.95	1.00	1.00	1.00
Satd. Flow (prot)			1770	3539	3539	1583
Flt Permitted			0.95	1.00	1.00	1.00
Satd. Flow (perm)			1770	3539	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	0	131	1096	1656	191
RTOR Reduction (vph)	0	0	0	0	0	43
Lane Group Flow (vph)	0	0	131	1096	1656	148
Turn Type			Prot			Perm
Protected Phases			5	2	6	
Permitted Phases						6
Actuated Green, G (s)			7.6	60.0	43.9	43.9
Effective Green, g (s)			7.6	60.0	43.9	43.9
Actuated g/C Ratio			0.13	1.00	0.73	0.73
Clearance Time (s)			4.0	4.5	4.5	4.5
Vehicle Extension (s)			3.0	3.0	3.0	3.0
Lane Grp Cap (vph)			224	3539	2589	1158
v/s Ratio Prot			c0.07	0.31	c0.47	
v/s Ratio Perm						0.09
v/c Ratio			0.58	0.31	0.64	0.13
Uniform Delay, d1			24.7	0.0	4.1	2.4
Progression Factor			0.82	1.00	1.00	1.00
Incremental Delay, d2			3.8	0.2	1.2	0.2
Delay (s)			24.0	0.2	5.3	2.6
Level of Service			C	A	A	A
Approach Delay (s)	0.0			2.8	5.0	
Approach LOS	A			A	A	

Intersection Summary			
HCM Average Control Delay	4.1	HCM Level of Service	A
HCM Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.5
Intersection Capacity Utilization	62.5%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	192	215	0	979	1575	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	202	226	0	1031	1658	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)				382	450	
pX, platoon unblocked	0.78	0.72	0.72			
vC, conflicting volume	2173	829	1658			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1244	0	1139			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	0	71	100			
cM capacity (veh/h)	130	782	439			

Direction, Lane #	EB 1	EB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	135	294	515	515	829	829
Volume Left	135	67	0	0	0	0
Volume Right	0	226	0	0	0	0
cSH	130	364	1700	1700	1700	1700
Volume to Capacity	1.04	0.81	0.30	0.30	0.49	0.49
Queue Length 95th (ft)	185	175	0	0	0	0
Control Delay (s)	154.9	45.6	0.0	0.0	0.0	0.0
Lane LOS	F	E				
Approach Delay (s)	80.0		0.0		0.0	
Approach LOS	F					

Intersection Summary			
Average Delay	11.0		
Intersection Capacity Utilization	62.5%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	127	122	36	87	162	879	8	1193	508
v/c Ratio	0.53	0.19	0.16	0.14	0.46	0.35	0.02	0.56	0.47
Control Delay	29.3	6.9	20.3	13.5	15.4	6.3	1.1	7.6	2.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.3	6.9	20.3	13.5	15.4	6.3	1.1	7.6	2.3
Queue Length 50th (ft)	42	3	11	8	16	55	0	51	5
Queue Length 95th (ft)	79	19	29	22	44	156	m1	191	14
Internal Link Dist (ft)		646		699		573		302	
Turn Bay Length (ft)	120		220		200		260		70
Base Capacity (vph)	347	901	335	915	360	2486	419	2115	1077
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.37	0.14	0.11	0.10	0.45	0.35	0.02	0.56	0.47

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	121	19	97	34	52	30	154	828	7	8	1133	483
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	1.00
Frt	1.00	0.87		1.00	0.94		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	3095		1770	3344		1770	3535		1770	3539	1583
Flt Permitted	0.70	1.00		0.67	1.00		0.16	1.00		0.28	1.00	1.00
Satd. Flow (perm)	1300	3095		1257	3344		296	3535		528	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	127	20	102	36	55	32	162	872	7	8	1193	508
RTOR Reduction (vph)	0	85	0	0	27	0	0	1	0	0	0	157
Lane Group Flow (vph)	127	37	0	36	60	0	162	878	0	8	1193	351
Turn Type	Perm			Perm			pm+pt			pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)	9.8	9.8		9.8	9.8		42.2	37.4		31.9	31.1	31.1
Effective Green, g (s)	9.8	9.8		9.8	9.8		42.2	37.4		31.9	31.1	31.1
Actuated g/C Ratio	0.16	0.16		0.16	0.16		0.70	0.62		0.53	0.52	0.52
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	212	506		205	546		383	2203		297	1834	821
v/s Ratio Prot		0.01			0.02		c0.05	c0.25		0.00	c0.34	
v/s Ratio Perm	c0.10			0.03			0.25			0.01		0.22
v/c Ratio	0.60	0.07		0.18	0.11		0.42	0.40		0.03	0.65	0.43
Uniform Delay, d1	23.3	21.3		21.6	21.4		11.3	5.7		8.6	10.5	8.9
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		0.23	0.61	0.24
Incremental Delay, d2	4.5	0.1		0.4	0.1		0.8	0.5		0.0	1.5	1.4
Delay (s)	27.8	21.3		22.0	21.5		12.1	6.2		2.0	8.0	3.5
Level of Service	C	C		C	C		B	A		A	A	A
Approach Delay (s)		24.6			21.6			7.1			6.6	
Approach LOS		C			C			A			A	

Intersection Summary			
HCM Average Control Delay	8.8	HCM Level of Service	A
HCM Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	63.2%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	629	226	642	98	85	892
v/c Ratio	0.71	0.39	0.41	0.13	0.39	0.42
Control Delay	24.7	5.1	9.1	1.6	29.5	7.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	24.7	5.1	9.1	1.6	29.5	7.6
Queue Length 50th (ft)	103	0	90	0	28	83
Queue Length 95th (ft)	150	43	105	14	66	121
Internal Link Dist (ft)	720		1803			515
Turn Bay Length (ft)	240	240		150	215	
Base Capacity (vph)	984	615	1609	773	228	2132
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.64	0.37	0.40	0.13	0.37	0.42

Intersection Summary

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	598	215	610	93	81	847
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Lane Util. Factor	0.97	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	3539	1583	1770	3539
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	629	226	642	98	85	892
RTOR Reduction (vph)	0	167	0	56	0	0
Lane Group Flow (vph)	629	59	642	42	85	892
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	15.6	15.6	25.6	25.6	6.3	35.9
Effective Green, g (s)	15.6	15.6	25.6	25.6	6.3	35.9
Actuated g/C Ratio	0.26	0.26	0.43	0.43	0.10	0.60
Clearance Time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	893	412	1510	675	186	2118
v/s Ratio Prot	c0.18		0.18		0.05	c0.25
v/s Ratio Perm		0.04		0.03		
v/c Ratio	0.70	0.14	0.43	0.06	0.46	0.42
Uniform Delay, d1	20.1	17.1	12.0	10.1	25.2	6.5
Progression Factor	1.00	1.00	0.65	0.51	1.00	1.00
Incremental Delay, d2	2.5	0.2	0.9	0.2	1.8	0.6
Delay (s)	22.7	17.2	8.7	5.3	27.0	7.1
Level of Service	C	B	A	A	C	A
Approach Delay (s)	21.2		8.2			8.8
Approach LOS	C		A			A

Intersection Summary			
HCM Average Control Delay	12.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.5
Intersection Capacity Utilization	48.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	38	98	707	1287	243	1262
v/c Ratio	0.18	0.52	0.28	0.97	1.10	0.41
Control Delay	54.3	20.2	6.9	28.0	133.4	1.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	54.3	20.2	6.9	28.0	133.4	1.6
Queue Length 50th (ft)	14	0	91	474	~217	32
Queue Length 95th (ft)	31	52	133	#1110	#377	54
Internal Link Dist (ft)	1134		595			1803
Turn Bay Length (ft)	75	50			235	
Base Capacity (vph)	629	370	2510	1323	221	3070
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.06	0.26	0.28	0.97	1.10	0.41

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	36	93	672	1223	231	1199
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Lane Util. Factor	0.97	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	3539	1583	1770	3539
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	38	98	707	1287	243	1262
RTOR Reduction (vph)	0	92	0	201	0	0
Lane Group Flow (vph)	38	6	707	1086	243	1262
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	7.4	7.4	85.1	85.1	15.0	104.1
Effective Green, g (s)	7.4	7.4	85.1	85.1	15.0	104.1
Actuated g/C Ratio	0.06	0.06	0.71	0.71	0.12	0.87
Clearance Time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	212	98	2510	1123	221	3070
v/s Ratio Prot	c0.01		0.20		c0.14	0.36
v/s Ratio Perm		0.00		c0.69		
v/c Ratio	0.18	0.06	0.28	0.97	1.10	0.41
Uniform Delay, d1	53.4	53.0	6.3	16.2	52.5	1.6
Progression Factor	1.00	1.00	1.00	1.00	0.98	0.70
Incremental Delay, d2	0.4	0.3	0.3	20.1	85.8	0.4
Delay (s)	53.8	53.3	6.6	36.2	137.0	1.5
Level of Service	D	D	A	D	F	A
Approach Delay (s)	53.4		25.7			23.4
Approach LOS	D		C			C

Intersection Summary			
HCM Average Control Delay	25.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.5
Intersection Capacity Utilization	95.6%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	36	148	715	62	37	0
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	38	156	753	65	39	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						800
pX, platoon unblocked						
vC, conflicting volume	863	785			753	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	863	785			753	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	88	60			95	
cM capacity (veh/h)	310	393			857	

Direction, Lane #	WB 1	WB 2	NB 1	SB 1	SB 2
Volume Total	38	156	818	39	0
Volume Left	38	0	0	39	0
Volume Right	0	156	65	0	0
cSH	310	393	1700	857	1700
Volume to Capacity	0.12	0.40	0.48	0.05	0.00
Queue Length 95th (ft)	10	46	0	4	0
Control Delay (s)	18.2	20.1	0.0	9.4	0.0
Lane LOS	C	C		A	
Approach Delay (s)	19.7		0.0	9.4	
Approach LOS	C				

Intersection Summary			
Average Delay	4.0		
Intersection Capacity Utilization	57.2%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	EBT	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	2414	1537	477	134	1108	503	644
v/c Ratio	0.98	0.89	0.44	0.55	0.95	0.94	0.51
Control Delay	47.3	8.3	1.7	50.3	40.8	80.5	43.8
Queue Delay	75.7	17.6	1.0	0.0	7.5	0.0	0.0
Total Delay	123.0	25.9	2.7	50.3	48.2	80.5	43.8
Queue Length 50th (ft)	713	79	26	117	340	219	172
Queue Length 95th (ft)	#849	m94	m20	189	#431	#323	214
Internal Link Dist (ft)	1037	280			562		836
Turn Bay Length (ft)				330		290	
Base Capacity (vph)	2457	1723	1086	245	1167	536	1260
Starvation Cap Reductn	0	225	353	0	0	0	0
Spillback Cap Reductn	410	0	0	0	56	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	1.18	1.03	0.65	0.55	1.00	0.94	0.51

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	2142	151	0	1460	453	127	1022	30	478	611	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.5			5.5	5.5	5.5	5.5		5.5	5.5	
Lane Util. Factor		0.91			0.95	1.00	1.00	0.91		0.97	0.91	
Frt		0.99			1.00	0.85	1.00	1.00		1.00	1.00	
Flt Protected		1.00			1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		5035			3539	1583	1770	5063		3433	5084	
Flt Permitted		1.00			1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)		5035			3539	1583	1770	5063		3433	5084	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	2255	159	0	1537	477	134	1076	32	503	643	1
RTOR Reduction (vph)	0	6	0	0	0	1	0	2	0	0	0	0
Lane Group Flow (vph)	0	2408	0	0	1537	476	134	1106	0	503	644	0
Turn Type						pm+ov	Prot			Prot		
Protected Phases		4			8	1	5	2		1	6	
Permitted Phases						8						
Actuated Green, G (s)		63.3			63.3	83.6	18.0	29.9		20.3	32.2	
Effective Green, g (s)		63.3			63.3	83.6	18.0	29.9		20.3	32.2	
Actuated g/C Ratio		0.49			0.49	0.64	0.14	0.23		0.16	0.25	
Clearance Time (s)		5.5			5.5	5.5	5.5	5.5		5.5	5.5	
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		2452			1723	1085	245	1164		536	1259	
v/s Ratio Prot		c0.48			0.43	0.07	0.08	c0.22		c0.15	0.13	
v/s Ratio Perm						0.23						
v/c Ratio		0.98			0.89	0.44	0.55	0.95		0.94	0.51	
Uniform Delay, d1		32.8			30.3	11.5	52.2	49.3		54.2	42.1	
Progression Factor		1.00			0.17	0.14	0.81	0.50		1.00	1.00	
Incremental Delay, d2		14.1			2.0	0.1	7.4	15.2		24.2	1.5	
Delay (s)		46.9			7.3	1.7	49.7	39.8		78.5	43.6	
Level of Service		D			A	A	D	D		E	D	
Approach Delay (s)		46.9			6.0			40.9			58.9	
Approach LOS		D			A			D			E	

Intersection Summary			
HCM Average Control Delay	35.7	HCM Level of Service	D
HCM Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	11.0
Intersection Capacity Utilization	92.5%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	471	2259	37	2086	755	129	249	498	373
v/c Ratio	1.13	0.72	0.41	1.05	1.10	0.44	1.11	0.58	0.57
Control Delay	110.4	4.6	61.5	81.7	119.6	30.3	147.6	46.6	8.5
Queue Delay	175.1	1.8	0.0	1.7	0.0	0.0	0.0	0.0	0.0
Total Delay	285.5	6.4	61.5	83.4	119.6	30.3	147.6	46.6	8.5
Queue Length 50th (ft)	~475	144	29	~678	~243	30	~123	195	9
Queue Length 95th (ft)	m#498	m148	m39	#771	#337	81	#211	255	96
Internal Link Dist (ft)		280		585	326			720	
Turn Bay Length (ft)	200		200			130	160		160
Base Capacity (vph)	415	3129	94	1987	685	293	224	858	656
Starvation Cap Reductn	108	665	0	8	0	0	0	0	0
Spillback Cap Reductn	0	35	0	2	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.53	0.92	0.39	1.05	1.10	0.44	1.11	0.58	0.57

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	447	2132	14	35	1587	394	0	717	123	237	473	354
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Lane Util. Factor	1.00	0.91		1.00	0.91			0.91	1.00	0.97	0.95	1.00
Frt	1.00	1.00		1.00	0.97			1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5080		1770	4934			5085	1583	3433	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5080		1770	4934			5085	1583	3433	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	471	2244	15	37	1671	415	0	755	129	249	498	373
RTOR Reduction (vph)	0	0	0	0	34	0	0	0	80	0	0	272
Lane Group Flow (vph)	471	2259	0	37	2052	0	0	755	49	249	498	101
Turn Type	Prot			Prot					Perm	Prot		Perm
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases									2			6
Actuated Green, G (s)	32.7	77.9		4.1	49.3			17.5	17.5	8.5	31.5	31.5
Effective Green, g (s)	32.7	77.9		4.1	49.3			17.5	17.5	8.5	31.5	31.5
Actuated g/C Ratio	0.25	0.60		0.03	0.38			0.13	0.13	0.07	0.24	0.24
Clearance Time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	445	3044		56	1871			685	213	224	858	384
v/s Ratio Prot	c0.27	0.44		0.02	c0.42			c0.15		c0.07	0.14	
v/s Ratio Perm									0.03			0.06
v/c Ratio	1.06	0.74		0.66	1.10			1.10	0.23	1.11	0.58	0.26
Uniform Delay, d1	48.6	18.8		62.3	40.4			56.2	50.2	60.8	43.4	39.9
Progression Factor	0.89	0.23		0.88	1.40			1.11	1.45	1.00	1.00	1.00
Incremental Delay, d2	39.7	0.5		17.1	49.6			63.7	2.2	93.3	2.9	1.7
Delay (s)	83.0	4.7		71.9	106.0			125.9	75.2	154.1	46.3	41.5
Level of Service	F	A		E	F			F	E	F	D	D
Approach Delay (s)		18.2			105.4			118.5			68.7	
Approach LOS		B			F			F			E	

Intersection Summary			
HCM Average Control Delay	66.4	HCM Level of Service	E
HCM Volume to Capacity ratio	1.09		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	103.2%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	41	706	45	1129	438	78	467	172	372	16
v/c Ratio	0.36	0.35	0.19	0.56	0.49	0.19	0.57	0.47	0.33	0.04
Control Delay	33.8	15.1	28.6	31.8	4.4	41.3	46.0	37.2	31.7	19.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	33.8	15.1	28.6	31.8	4.4	41.3	46.0	37.2	31.7	19.7
Queue Length 50th (ft)	8	48	25	267	1	53	180	177	128	10
Queue Length 95th (ft)	m33	m100	56	315	65	98	237	m267	167	m21
Internal Link Dist (ft)		562		597			652		326	
Turn Bay Length (ft)	110		120		200	280		240		60
Base Capacity (vph)	115	2008	233	2014	891	415	823	369	1138	394
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.36	0.35	0.19	0.56	0.49	0.19	0.57	0.47	0.33	0.04

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	39	655	16	43	1073	416	74	388	56	327	190	15
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00	1.00	0.95		0.86	0.86	1.00
Frt	1.00	1.00		1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (prot)	1770	5067		1770	5085	1583	1770	3472		1522	4697	1583
Flt Permitted	0.16	1.00		0.32	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (perm)	291	5067		589	5085	1583	1770	3472		1522	4697	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	41	689	17	45	1129	438	78	408	59	344	200	16
RTOR Reduction (vph)	0	2	0	0	0	264	0	8	0	0	0	11
Lane Group Flow (vph)	41	704	0	45	1129	174	78	459	0	172	372	5
Turn Type	Perm			Perm		Perm	Split			Split		Perm
Protected Phases		4			8		2	2		6	6	
Permitted Phases	4			8		8						6
Actuated Green, G (s)	51.5	51.5		51.5	51.5	51.5	30.5	30.5		31.5	31.5	31.5
Effective Green, g (s)	51.5	51.5		51.5	51.5	51.5	30.5	30.5		31.5	31.5	31.5
Actuated g/C Ratio	0.40	0.40		0.40	0.40	0.40	0.23	0.23		0.24	0.24	0.24
Clearance Time (s)	5.5	5.5		5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	115	2007		233	2014	627	415	815		369	1138	384
v/s Ratio Prot		0.14			c0.22		0.04	c0.13		c0.11	0.08	
v/s Ratio Perm	0.14			0.08		0.11						0.00
v/c Ratio	0.36	0.35		0.19	0.56	0.28	0.19	0.56		0.47	0.33	0.01
Uniform Delay, d1	27.6	27.5		25.7	30.5	26.6	39.8	43.9		42.1	40.5	37.4
Progression Factor	0.89	0.54		1.00	1.00	1.00	1.00	1.00		0.79	0.76	1.07
Incremental Delay, d2	6.8	0.4		1.8	1.1	1.1	1.0	2.8		3.5	0.6	0.1
Delay (s)	31.4	15.1		27.5	31.6	27.7	40.8	46.7		36.7	31.6	40.0
Level of Service	C	B		C	C	C	D	D		D	C	D
Approach Delay (s)		16.0			30.4			45.8			33.4	
Approach LOS		B			C			D			C	

Intersection Summary			
HCM Average Control Delay	30.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	65.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	98	2468	36	124	2445	89	86	160	45	17	33
v/c Ratio	0.62	0.80	0.04	0.59	0.77	0.64	0.46	0.48	0.25	0.06	0.13
Control Delay	84.9	4.0	0.4	30.7	0.5	76.9	62.7	13.0	47.9	45.0	15.2
Queue Delay	0.0	0.1	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	84.9	4.1	0.4	30.7	0.9	76.9	62.7	13.0	47.9	45.0	15.2
Queue Length 50th (ft)	79	101	0	93	12	73	69	0	32	12	0
Queue Length 95th (ft)	m105	m112	m1	m85	m12	130	122	65	67	34	30
Internal Link Dist (ft)		585			1015		352			692	
Turn Bay Length (ft)	270		180								
Base Capacity (vph)	184	3078	967	211	3171	171	229	330	180	344	319
Starvation Cap Reductn	0	56	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	281	0	0	0	0	0	3
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.53	0.82	0.04	0.59	0.85	0.52	0.38	0.48	0.25	0.05	0.10

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	93	2345	34	118	1942	381	85	82	152	43	16	31
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	4.0	5.5	5.5
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5085	1583	1770	4960		1770	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.75	1.00	1.00	0.52	1.00	1.00
Satd. Flow (perm)	1770	5085	1583	1770	4960		1390	1863	1583	968	1863	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	98	2468	36	124	2044	401	89	86	160	45	17	33
RTOR Reduction (vph)	0	0	8	0	20	0	0	0	141	0	0	28
Lane Group Flow (vph)	98	2468	28	124	2425	0	89	86	19	45	17	5
Turn Type	Prot		Perm	Prot			Perm		Over	pm+pt		Perm
Protected Phases	7	4		3	8			2	3	1	6	
Permitted Phases			4				2			6		6
Actuated Green, G (s)	11.6	77.9	77.9	15.5	81.8		12.9	12.9	15.5	20.1	20.1	20.1
Effective Green, g (s)	11.6	77.9	77.9	15.5	81.8		12.9	12.9	15.5	20.1	20.1	20.1
Actuated g/C Ratio	0.09	0.60	0.60	0.12	0.63		0.10	0.10	0.12	0.15	0.15	0.15
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	4.0	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	158	3047	949	211	3121		138	185	189	169	288	245
v/s Ratio Prot	0.06	c0.49		0.07	c0.49			0.05	0.01	c0.01	0.01	
v/s Ratio Perm			0.02				c0.06			0.03		0.00
v/c Ratio	0.62	0.81	0.03	0.59	0.78		0.64	0.46	0.10	0.27	0.06	0.02
Uniform Delay, d1	57.1	20.3	10.6	54.2	17.5		56.3	55.3	51.0	47.7	46.9	46.6
Progression Factor	1.29	0.12	0.05	0.54	0.02		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.8	1.6	0.0	0.4	0.2		9.9	1.8	0.2	0.8	0.1	0.0
Delay (s)	78.5	4.0	0.6	29.6	0.5		66.3	57.1	51.3	48.6	47.0	46.6
Level of Service	E	A	A	C	A		E	E	D	D	D	D
Approach Delay (s)		6.8			1.9			56.8			47.6	
Approach LOS		A			A			E			D	

Intersection Summary			
HCM Average Control Delay	8.2	HCM Level of Service	A
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	77.0%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBT	SBL
Lane Group Flow (vph)	107	2459	3149	144
v/c Ratio	0.41	0.74	1.10	0.26
Control Delay	38.3	4.4	59.5	30.5
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	38.3	4.4	59.5	30.5
Queue Length 50th (ft)	86	78	~1078	31
Queue Length 95th (ft)	m109	103	m#734	67
Internal Link Dist (ft)		1015	1000	632
Turn Bay Length (ft)				150
Base Capacity (vph)	463	3313	2872	550
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.23	0.74	1.10	0.26

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	102	2336	2466	525	80	57
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5		5.5	
Lane Util. Factor	1.00	0.91	0.91		0.97	
Frt	1.00	1.00	0.97		0.94	
Flt Protected	0.95	1.00	1.00		0.97	
Satd. Flow (prot)	1770	5085	4951		3292	
Flt Permitted	0.95	1.00	1.00		0.97	
Satd. Flow (perm)	1770	5085	4951		3292	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	107	2459	2596	553	84	60
RTOR Reduction (vph)	0	0	26	0	51	0
Lane Group Flow (vph)	107	2459	3123	0	93	0
Turn Type	Prot					
Protected Phases	7 9	4	8		6	
Permitted Phases						
Actuated Green, G (s)	19.1	84.7	74.7		19.7	
Effective Green, g (s)	19.1	84.7	74.7		19.7	
Actuated g/C Ratio	0.15	0.65	0.57		0.15	
Clearance Time (s)		5.5	5.5		5.5	
Vehicle Extension (s)		3.0	3.0		3.0	
Lane Grp Cap (vph)	260	3313	2845		499	
v/s Ratio Prot	c0.06	c0.48	c0.63		c0.03	
v/s Ratio Perm						
v/c Ratio	0.41	0.74	1.10		0.19	
Uniform Delay, d1	50.3	15.3	27.6		48.2	
Progression Factor	0.71	0.22	0.46		1.00	
Incremental Delay, d2	0.6	0.9	44.7		0.8	
Delay (s)	36.4	4.3	57.5		49.0	
Level of Service	D	A	E		D	
Approach Delay (s)		5.6	57.5		49.0	
Approach LOS		A	E		D	

Intersection Summary			
HCM Average Control Delay	34.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	11.0
Intersection Capacity Utilization	82.8%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBT	SBL	SBT
Lane Group Flow (vph)	140	2331	64	43	3510	168	46	111
v/c Ratio	0.93	0.66	0.06	0.41	1.06	1.04	0.26	0.37
Control Delay	89.3	7.8	1.8	70.0	59.5	136.2	55.0	17.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	89.3	7.8	1.8	70.0	59.5	136.2	55.0	17.0
Queue Length 50th (ft)	116	156	2	35	~1194	~152	35	12
Queue Length 95th (ft)	m#196	190	m6	76	#1266	#301	76	68
Internal Link Dist (ft)		1000			893	425		590
Turn Bay Length (ft)	150			300				
Base Capacity (vph)	151	3538	1121	120	3297	161	174	301
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.93	0.66	0.06	0.36	1.06	1.04	0.26	0.37

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	133	2214	61	41	3137	198	114	35	10	44	15	90
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5			5.5		5.5	5.5	
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91			1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.99			0.99		1.00	0.87	
Flt Protected	0.95	1.00	1.00	0.95	1.00			0.97		0.95	1.00	
Satd. Flow (prot)	1770	5085	1583	1770	5040			1783		1770	1624	
Flt Permitted	0.95	1.00	1.00	0.95	1.00			0.64		0.69	1.00	
Satd. Flow (perm)	1770	5085	1583	1770	5040			1184		1289	1624	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	140	2331	64	43	3302	208	120	37	11	46	16	95
RTOR Reduction (vph)	0	0	20	0	5	0	0	2	0	0	82	0
Lane Group Flow (vph)	140	2331	44	43	3505	0	0	166	0	46	29	0
Turn Type	Prot		Perm	Prot			Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4				2			6		
Actuated Green, G (s)	12.2	89.3	89.3	6.7	83.8			17.5		17.5	17.5	
Effective Green, g (s)	12.2	89.3	89.3	6.7	83.8			17.5		17.5	17.5	
Actuated g/C Ratio	0.09	0.69	0.69	0.05	0.64			0.13		0.13	0.13	
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5			5.5		5.5	5.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	166	3493	1087	91	3249			159		174	219	
v/s Ratio Prot	c0.08	0.46		0.02	c0.70						0.02	
v/s Ratio Perm			0.03					c0.14		0.04		
v/c Ratio	0.84	0.67	0.04	0.47	1.08			1.05		0.26	0.13	
Uniform Delay, d1	58.0	11.8	6.6	59.9	23.1			56.2		50.5	49.6	
Progression Factor	0.74	0.60	0.98	1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d2	22.2	0.7	0.0	3.8	41.8			84.0		0.8	0.3	
Delay (s)	65.1	7.8	6.5	63.8	64.9			140.2		51.3	49.8	
Level of Service	E	A	A	E	E			F		D	D	
Approach Delay (s)		10.9			64.9			140.2			50.3	
Approach LOS		B			E			F			D	

Intersection Summary			
HCM Average Control Delay	45.2	HCM Level of Service	D
HCM Volume to Capacity ratio	1.05		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	101.6%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Queues
3: 7th St & Park Ave

2/20/2013

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	18	1170	72	1252	73	167	467	46	118	84
v/c Ratio	0.13	0.75	0.29	0.71	0.17	0.27	0.74	0.11	0.19	0.15
Control Delay	17.2	20.0	11.2	14.9	16.1	16.6	20.2	15.5	15.8	10.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	17.2	20.0	11.2	14.9	16.1	16.6	20.2	15.5	15.8	10.7
Queue Length 50th (ft)	4	196	11	169	21	50	112	13	34	14
Queue Length 95th (ft)	20	#374	36	310	47	90	213	33	67	40
Internal Link Dist (ft)		588		707		495			498	
Turn Bay Length (ft)	70		180		30		30	100		90
Base Capacity (vph)	166	1876	249	2304	701	1029	942	666	1029	889
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.11	0.62	0.29	0.54	0.10	0.16	0.50	0.07	0.11	0.09

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	17	1043	68	68	1178	11	69	159	444	44	112	80
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		3.0	5.0		4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3507		1770	3534		1770	1863	1583	1770	1863	1583
Flt Permitted	0.17	1.00		0.14	1.00		0.68	1.00	1.00	0.65	1.00	1.00
Satd. Flow (perm)	310	3507		256	3534		1269	1863	1583	1207	1863	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	18	1098	72	72	1240	12	73	167	467	46	118	84
RTOR Reduction (vph)	0	6	0	0	1	0	0	0	102	0	0	22
Lane Group Flow (vph)	18	1164	0	72	1251	0	73	167	365	46	118	62
Turn Type	Perm			pm+pt			Perm		Perm	Perm		Perm
Protected Phases		4		3	8			2			6	
Permitted Phases	4			8			2		2	6		6
Actuated Green, G (s)	26.1	26.1		31.1	31.1		19.7	19.7	19.7	19.7	19.7	19.7
Effective Green, g (s)	26.1	26.1		31.1	31.1		19.7	19.7	19.7	19.7	19.7	19.7
Actuated g/C Ratio	0.44	0.44		0.52	0.52		0.33	0.33	0.33	0.33	0.33	0.33
Clearance Time (s)	5.0	5.0		3.0	5.0		4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	135	1531		184	1838		418	614	521	398	614	521
v/s Ratio Prot		c0.33		0.01	c0.35			0.09			0.06	
v/s Ratio Perm	0.06			0.19			0.06		c0.23	0.04		0.04
v/c Ratio	0.13	0.76		0.39	0.68		0.17	0.27	0.70	0.12	0.19	0.12
Uniform Delay, d1	10.1	14.2		9.5	10.7		14.3	14.8	17.5	14.0	14.4	14.0
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.5	2.3		1.4	1.1		0.2	0.2	4.2	0.1	0.2	0.1
Delay (s)	10.5	16.5		10.9	11.7		14.5	15.0	21.7	14.1	14.5	14.1
Level of Service	B	B		B	B		B	B	C	B	B	B
Approach Delay (s)		16.4			11.7			19.4			14.3	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM Average Control Delay	15.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	59.8	Sum of lost time (s)	14.0
Intersection Capacity Utilization	72.7%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
25: I-405 SB Off Ramp & Studebaker Rd

12/5/2012

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	192	215	0	979	1575	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0			4.0	4.0	
Lane Util. Factor	0.97			0.95	0.95	
Frt	0.92			1.00	1.00	
Flt Protected	0.98			1.00	1.00	
Satd. Flow (prot)	3251			3539	3539	
Flt Permitted	0.98			1.00	1.00	
Satd. Flow (perm)	3251			3539	3539	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	202	226	0	1031	1658	0
RTOR Reduction (vph)	21	0	0	0	0	0
Lane Group Flow (vph)	407	0	0	1031	1658	0
Turn Type						
Protected Phases	4			2	6	
Permitted Phases						
Actuated Green, G (s)	12.6			39.4	39.4	
Effective Green, g (s)	12.6			39.4	39.4	
Actuated g/C Ratio	0.21			0.66	0.66	
Clearance Time (s)	4.0			4.0	4.0	
Vehicle Extension (s)	3.0			3.0	3.0	
Lane Grp Cap (vph)	683			2324	2324	
v/s Ratio Prot	c0.13			0.29	c0.47	
v/s Ratio Perm						
v/c Ratio	0.60			0.44	0.71	
Uniform Delay, d1	21.4			5.0	6.7	
Progression Factor	1.00			0.92	1.00	
Incremental Delay, d2	1.4			0.6	1.7	
Delay (s)	22.8			5.2	8.4	
Level of Service	C			A	A	
Approach Delay (s)	22.8			5.2	8.4	
Approach LOS	C			A	A	

Intersection Summary			
HCM Average Control Delay	9.3	HCM Level of Service	A
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	62.5%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Queues
29: College Park Dr & SR-22 Ramps

12/4/2012

Lane Group	WBL	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	38	156	818	39	133
v/c Ratio	0.18	0.48	0.62	0.19	0.09
Control Delay	24.7	10.0	12.5	26.5	0.8
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	24.7	10.0	12.5	26.5	0.8
Queue Length 50th (ft)	13	0	87	15	4
Queue Length 95th (ft)	34	42	#485	27	5
Internal Link Dist (ft)	864		215		720
Turn Bay Length (ft)					
Base Capacity (vph)	472	537	1312	202	1474
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.08	0.29	0.62	0.19	0.09

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	36	148	715	62	37	126
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frt	1.00	0.85	0.99		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	1583	1843		1770	1863
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1770	1583	1843		1770	1863
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	38	156	753	65	39	133
RTOR Reduction (vph)	0	140	4	0	0	0
Lane Group Flow (vph)	38	16	814	0	39	133
Turn Type		Perm			Prot	
Protected Phases	8		2		1	6
Permitted Phases		8				
Actuated Green, G (s)	6.1	6.1	38.7		3.2	45.9
Effective Green, g (s)	6.1	6.1	38.7		3.2	45.9
Actuated g/C Ratio	0.10	0.10	0.65		0.05	0.76
Clearance Time (s)	4.0	4.0	4.0		4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	180	161	1189		94	1425
v/s Ratio Prot	c0.02		c0.44		c0.02	0.07
v/s Ratio Perm		0.01				
v/c Ratio	0.21	0.10	0.68		0.41	0.09
Uniform Delay, d1	24.7	24.5	6.8		27.5	1.8
Progression Factor	1.00	1.00	1.00		1.04	0.32
Incremental Delay, d2	0.6	0.3	3.2		2.9	0.1
Delay (s)	25.3	24.7	10.0		31.4	0.7
Level of Service	C	C	A		C	A
Approach Delay (s)	24.8		10.0			7.7
Approach LOS	C		A			A

Intersection Summary			
HCM Average Control Delay	12.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	57.2%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Queues
1: Carson St & I-605 SB Off Ramps

12/4/2012

Lane Group	EBT	WBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	1987	1439	535	1005	521	238
v/c Ratio	0.78	0.71	0.33	0.71	0.39	0.40
Control Delay	16.6	11.7	0.6	16.8	12.3	13.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	16.6	11.7	0.6	16.8	12.3	13.4
Queue Length 50th (ft)	153	126	0	134	61	54
Queue Length 95th (ft)	195	148	0	193	95	107
Internal Link Dist (ft)	550	190			1136	
Turn Bay Length (ft)				300		300
Base Capacity (vph)	2557	2034	1611	1417	1323	599
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.78	0.71	0.33	0.71	0.39	0.40

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1717	171	0	1367	0	0	0	508	955	302	419
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.9			4.9				4.0	5.4	5.4	5.4
Lane Util. Factor		0.86			0.91				1.00	0.97	0.91	0.91
Frt		0.99			1.00				0.86	1.00	0.94	0.85
Flt Protected		1.00			1.00				1.00	0.95	1.00	1.00
Satd. Flow (prot)		6321			5085				1611	3433	3192	1441
Flt Permitted		1.00			1.00				1.00	0.95	1.00	1.00
Satd. Flow (perm)		6321			5085				1611	3433	3192	1441
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1807	180	0	1439	0	0	0	535	1005	318	441
RTOR Reduction (vph)	0	29	0	0	0	0	0	0	0	0	5	5
Lane Group Flow (vph)	0	1958	0	0	1439	0	0	0	535	1005	516	233
Turn Type									Free	Split		Perm
Protected Phases		2			6					4	4	
Permitted Phases									Free			4
Actuated Green, G (s)		22.0			22.0				55.0	22.7	22.7	22.7
Effective Green, g (s)		22.0			22.0				55.0	22.7	22.7	22.7
Actuated g/C Ratio		0.40			0.40				1.00	0.41	0.41	0.41
Clearance Time (s)		4.9			4.9					5.4	5.4	5.4
Vehicle Extension (s)		5.0			5.0					2.5	2.5	2.5
Lane Grp Cap (vph)		2528			2034				1611	1417	1317	595
v/s Ratio Prot		c0.31			0.28					c0.29	0.16	
v/s Ratio Perm									0.33			0.16
v/c Ratio		0.77			0.71				0.33	0.71	0.39	0.39
Uniform Delay, d1		14.3			13.8				0.0	13.4	11.3	11.3
Progression Factor		1.00			0.71				1.00	1.00	1.00	1.00
Incremental Delay, d2		1.8			1.2				0.6	3.0	0.9	1.9
Delay (s)		16.1			11.0				0.6	16.4	12.2	13.3
Level of Service		B			B				A	B	B	B
Approach Delay (s)		16.1			11.0			0.6			14.8	
Approach LOS		B			B			A			B	

Intersection Summary			
HCM Average Control Delay	13.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	55.0	Sum of lost time (s)	10.3
Intersection Capacity Utilization	63.6%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	WBT	WBR	NBL	NBR
Lane Group Flow (vph)	3097	1246	721	682	311
v/c Ratio	0.79	0.57	0.58	0.66	0.37
Control Delay	14.7	5.9	3.2	37.3	31.7
Queue Delay	0.0	0.7	1.5	0.0	0.0
Total Delay	14.7	6.6	4.7	37.3	31.7
Queue Length 50th (ft)	397	127	45	215	97
Queue Length 95th (ft)	432	143	m92	280	141
Internal Link Dist (ft)	410	90			
Turn Bay Length (ft)				300	300
Base Capacity (vph)	3938	2175	1251	1030	838
Starvation Cap Reductn	27	521	331	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.79	0.75	0.78	0.66	0.37

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	2942	0	0	1184	685	648	0	295	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.4			5.4	5.4	4.0		4.0			
Lane Util. Factor		0.86			0.95	1.00	0.97		0.88			
Frt		1.00			1.00	0.85	1.00		0.85			
Flt Protected		1.00			1.00	1.00	0.95		1.00			
Satd. Flow (prot)		6408			3539	1583	3433		2787			
Flt Permitted		1.00			1.00	1.00	0.95		1.00			
Satd. Flow (perm)		6408			3539	1583	3433		2787			
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	3097	0	0	1246	721	682	0	311	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	278	0	0	1	0	0	0
Lane Group Flow (vph)	0	3097	0	0	1246	443	682	0	310	0	0	0
Turn Type						Perm	custom		custom			
Protected Phases		2			6							
Permitted Phases						6	8		8			
Actuated Green, G (s)		67.6			67.6	67.6	33.0		33.0			
Effective Green, g (s)		67.6			67.6	67.6	33.0		33.0			
Actuated g/C Ratio		0.61			0.61	0.61	0.30		0.30			
Clearance Time (s)		5.4			5.4	5.4	4.0		4.0			
Vehicle Extension (s)		5.0			5.0	5.0	3.0		3.0			
Lane Grp Cap (vph)		3938			2175	973	1030		836			
v/s Ratio Prot		c0.48			0.35							
v/s Ratio Perm						0.28	c0.20		0.11			
v/c Ratio		0.79			0.57	0.46	0.66		0.37			
Uniform Delay, d1		15.8			12.6	11.3	33.6		30.3			
Progression Factor		0.84			0.40	2.51	1.00		1.00			
Incremental Delay, d2		1.0			0.4	0.5	3.4		1.3			
Delay (s)		14.2			5.5	28.9	37.0		31.6			
Level of Service		B			A	C	D		C			
Approach Delay (s)		14.2			14.1			35.3			0.0	
Approach LOS		B			B			D			A	

Intersection Summary			
HCM Average Control Delay	17.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	9.4
Intersection Capacity Utilization	69.0%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	818	2113	6	1245	198	99	155	300	294
v/c Ratio	0.93	0.73	0.05	0.83	0.88	0.30	0.27	0.79	0.64
Control Delay	41.6	9.0	49.7	42.3	82.6	45.4	40.4	31.1	11.9
Queue Delay	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	41.6	9.2	49.7	42.3	82.6	45.4	40.4	31.1	11.9
Queue Length 50th (ft)	270	61	4	303	139	32	48	68	0
Queue Length 95th (ft)	#405	504	18	#400	#270	59	78	174	83
Internal Link Dist (ft)		311		731		382		448	
Turn Bay Length (ft)	250		80		120		140		140
Base Capacity (vph)	877	2885	113	1492	227	718	576	420	492
Starvation Cap Reductn	0	171	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.93	0.78	0.05	0.83	0.87	0.14	0.27	0.71	0.60

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	777	1807	200	6	1058	124	188	86	8	147	47	518
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.9	5.4		4.9	5.4		4.9	5.4		4.9	5.4	5.4
Lane Util. Factor	0.97	0.91		1.00	0.91		1.00	0.95		0.97	0.95	0.95
Frt	1.00	0.99		1.00	0.98		1.00	0.99		1.00	0.87	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	5009		1770	5005		1770	3496		3433	1548	1504
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	5009		1770	5005		1770	3496		3433	1548	1504
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	818	1902	211	6	1114	131	198	91	8	155	49	545
RTOR Reduction (vph)	0	11	0	0	13	0	0	6	0	0	173	255
Lane Group Flow (vph)	818	2102	0	6	1232	0	198	93	0	155	127	39
Turn Type	Prot			Prot			Prot			Prot		Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												4
Actuated Green, G (s)	32.0	59.2		1.4	28.6		14.1	10.3		18.5	14.7	14.7
Effective Green, g (s)	32.0	59.2		1.4	28.6		14.1	10.3		18.5	14.7	14.7
Actuated g/C Ratio	0.29	0.54		0.01	0.26		0.13	0.09		0.17	0.13	0.13
Clearance Time (s)	4.9	5.4		4.9	5.4		4.9	5.4		4.9	5.4	5.4
Vehicle Extension (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Grp Cap (vph)	999	2696		23	1301		227	327		577	207	201
v/s Ratio Prot	0.24	c0.42		0.00	c0.25		c0.11	0.03		c0.05	c0.08	
v/s Ratio Perm												0.03
v/c Ratio	0.82	0.78		0.26	0.95		0.87	0.28		0.27	0.61	0.20
Uniform Delay, d1	36.3	20.2		53.8	40.0		47.1	46.4		39.9	45.0	42.4
Progression Factor	0.69	0.40		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	3.7	1.5		8.1	15.1		29.3	0.7		0.3	6.0	0.7
Delay (s)	28.7	9.6		61.9	55.0		76.4	47.1		40.2	51.0	43.0
Level of Service	C	A		E	E		E	D		D	D	D
Approach Delay (s)		14.9			55.1			66.6			45.6	
Approach LOS		B			E			E			D	

Intersection Summary			
HCM Average Control Delay	31.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	20.6
Intersection Capacity Utilization	86.1%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	1952	1291	594	886
v/c Ratio	0.61	0.58	0.72	0.56
Control Delay	9.5	9.6	29.7	1.4
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	9.5	9.6	29.7	1.4
Queue Length 50th (ft)	163	151	121	0
Queue Length 95th (ft)	245	243	159	0
Internal Link Dist (ft)	898	560	1261	
Turn Bay Length (ft)			230	900
Base Capacity (vph)	3180	2213	1020	1583
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.61	0.58	0.58	0.56

Intersection Summary

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1854	1226	0	564	842
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.3	5.3		4.2	4.0
Lane Util. Factor		0.91	0.95		0.97	1.00
Frt		1.00	1.00		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		5085	3539		3433	1583
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		5085	3539		3433	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1952	1291	0	594	886
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1952	1291	0	594	886
Turn Type						Free
Protected Phases		2	6		4	
Permitted Phases						Free
Actuated Green, G (s)		43.8	43.8		16.7	70.0
Effective Green, g (s)		43.8	43.8		16.7	70.0
Actuated g/C Ratio		0.63	0.63		0.24	1.00
Clearance Time (s)		5.3	5.3		4.2	
Vehicle Extension (s)		5.0	5.0		2.5	
Lane Grp Cap (vph)		3182	2214		819	1583
v/s Ratio Prot		0.38	0.36		c0.17	
v/s Ratio Perm						c0.56
v/c Ratio		0.61	0.58		0.73	0.56
Uniform Delay, d1		8.0	7.7		24.5	0.0
Progression Factor		1.00	1.00		1.00	1.00
Incremental Delay, d2		0.9	1.1		3.0	1.4
Delay (s)		8.9	8.8		27.6	1.4
Level of Service		A	A		C	A
Approach Delay (s)		8.9	8.8		11.9	
Approach LOS		A	A		B	

Intersection Summary			
HCM Average Control Delay	9.8	HCM Level of Service	A
HCM Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	4.2
Intersection Capacity Utilization	59.8%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	EBR	WBL	WBT
Lane Group Flow (vph)	2035	942	138	1266
v/c Ratio	0.74	0.72	0.60	0.36
Control Delay	4.8	5.7	39.8	0.3
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	4.8	5.8	39.8	0.3
Queue Length 50th (ft)	155	59	56	0
Queue Length 95th (ft)	173	113	109	0
Internal Link Dist (ft)	560			522
Turn Bay Length (ft)			260	
Base Capacity (vph)	2768	1307	253	3539
Starvation Cap Reductn	0	12	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.74	0.73	0.55	0.36

Intersection Summary

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	1933	895	131	1203	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.3	5.3	4.0	5.3		
Lane Util. Factor	0.95	1.00	1.00	0.95		
Frt	1.00	0.85	1.00	1.00		
Flt Protected	1.00	1.00	0.95	1.00		
Satd. Flow (prot)	3539	1583	1770	3539		
Flt Permitted	1.00	1.00	0.95	1.00		
Satd. Flow (perm)	3539	1583	1770	3539		
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	2035	942	138	1266	0	0
RTOR Reduction (vph)	0	76	0	0	0	0
Lane Group Flow (vph)	2035	866	138	1266	0	0
Turn Type		Perm	Prot			
Protected Phases	2		1	6		
Permitted Phases		2				
Actuated Green, G (s)	52.9	52.9	7.8	70.0		
Effective Green, g (s)	52.9	52.9	7.8	70.0		
Actuated g/C Ratio	0.76	0.76	0.11	1.00		
Clearance Time (s)	5.3	5.3	4.0	5.3		
Vehicle Extension (s)	5.0	5.0	3.0	5.0		
Lane Grp Cap (vph)	2674	1196	197	3539		
v/s Ratio Prot	c0.57		c0.08	0.36		
v/s Ratio Perm		0.55				
v/c Ratio	0.76	0.72	0.70	0.36		
Uniform Delay, d1	4.9	4.6	30.0	0.0		
Progression Factor	0.57	0.68	1.00	1.00		
Incremental Delay, d2	1.8	3.3	10.7	0.3		
Delay (s)	4.6	6.5	40.7	0.3		
Level of Service	A	A	D	A		
Approach Delay (s)	5.2			4.3	0.0	
Approach LOS	A			A	A	

Intersection Summary			
HCM Average Control Delay	4.9	HCM Level of Service	A
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	9.3
Intersection Capacity Utilization	70.4%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	392	0	0	642	0	956	620	0	727	340
Sign Control		Yield			Yield			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	0	413	0	0	676	0	1006	653	0	765	358
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)								1120				
pX, platoon unblocked	0.91	0.91		0.91	0.91	0.91				0.91		
vC, conflicting volume	1101	1772	255	1261	1772	335	765			1006		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	770	1506	255	947	1506	0	765			667		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	45	100	100	32	100			100		
cM capacity (veh/h)	84	109	744	88	109	988	844			837		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	NB 4	SB 1	SB 2	SB 3	SB 4
Volume Total	413	676	403	403	419	435	306	306	272	239
Volume Left	0	0	0	0	0	0	0	0	0	0
Volume Right	413	676	0	0	218	435	0	0	119	239
cSH	744	988	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.55	0.68	0.24	0.24	0.25	0.26	0.18	0.18	0.16	0.14
Queue Length 95th (ft)	86	142	0	0	0	0	0	0	0	0
Control Delay (s)	15.7	16.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	C	C								
Approach Delay (s)	15.7	16.1	0.0				0.0			
Approach LOS	C	C								

Intersection Summary			
Average Delay	4.5		
Intersection Capacity Utilization	69.5%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	0	697	0	1477	614	407
Sign Control	Yield			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	734	0	1555	646	428
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)				640		
pX, platoon unblocked	0.89					
vC, conflicting volume	1035	215	646			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	404	215	646			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	7	100			
cM capacity (veh/h)	510	789	935			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	NB 4	SB 1	SB 2	SB 3	SB 4
Volume Total	734	389	389	389	389	259	259	272	286
Volume Left	0	0	0	0	0	0	0	0	0
Volume Right	734	0	0	0	0	0	0	143	286
cSH	789	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.93	0.23	0.23	0.23	0.23	0.15	0.15	0.16	0.17
Queue Length 95th (ft)	337	0	0	0	0	0	0	0	0
Control Delay (s)	40.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	E								
Approach Delay (s)	40.2	0.0				0.0			
Approach LOS	E								

Intersection Summary			
Average Delay	8.8		
Intersection Capacity Utilization	64.7%	ICU Level of Service	C
Analysis Period (min)	15		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	136	2072	272	220	929	228	212	1036	180	1088
v/c Ratio	0.49	1.03	0.37	0.91	0.50	0.34	0.88	0.70	0.62	0.88
Control Delay	50.4	57.3	10.8	86.8	24.4	4.4	81.1	36.2	55.7	44.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	50.4	57.3	10.8	86.8	24.4	4.4	81.1	36.2	55.7	44.6
Queue Length 50th (ft)	43	~520	65	73	172	0	70	168	58	239
Queue Length 95th (ft)	74	#616	105	#143	215	54	#137	201	#119	#301
Internal Link Dist (ft)		578			652			1209		560
Turn Bay Length (ft)	175			150			180		150	
Base Capacity (vph)	286	2021	745	241	1858	667	241	1634	290	1260
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.48	1.03	0.37	0.91	0.50	0.34	0.88	0.63	0.62	0.86

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	129	1968	258	209	859	240	201	835	149	171	917	117
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4		5.4	5.4	
Lane Util. Factor	0.97	0.91	1.00	0.97	0.86	0.86	0.97	0.86		0.97	0.91	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.98		1.00	0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	3433	5085	1583	3433	4786	1362	3433	6262		3433	4999	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	3433	5085	1583	3433	4786	1362	3433	6262		3433	4999	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	136	2072	272	220	904	253	212	879	157	180	965	123
RTOR Reduction (vph)	0	0	4	0	2	140	0	33	0	0	16	0
Lane Group Flow (vph)	136	2072	268	220	927	88	212	1003	0	180	1072	0
Turn Type	Prot		pm+ov	Prot		Perm	Prot			Prot		
Protected Phases	7	4	5	3	8		5	2		1	6	
Permitted Phases			4			8						
Actuated Green, G (s)	8.0	39.6	46.6	7.0	38.6	38.6	7.0	23.0		8.5	24.5	
Effective Green, g (s)	8.0	39.6	46.6	7.0	38.6	38.6	7.0	23.0		8.5	24.5	
Actuated g/C Ratio	0.08	0.40	0.47	0.07	0.39	0.39	0.07	0.23		0.09	0.25	
Clearance Time (s)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4		5.4	5.4	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	275	2020	740	241	1853	527	241	1445		293	1228	
v/s Ratio Prot	0.04	c0.41	0.03	c0.06	0.19		0.06	c0.16		0.05	c0.21	
v/s Ratio Perm			0.14			0.06						
v/c Ratio	0.49	1.03	0.36	0.91	0.50	0.17	0.88	0.69		0.61	0.87	
Uniform Delay, d1	43.9	30.1	17.0	46.0	23.2	20.0	45.9	35.1		44.0	36.1	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.4	26.9	0.3	35.3	0.2	0.2	28.4	1.5		3.8	7.1	
Delay (s)	45.3	56.9	17.3	81.3	23.4	20.2	74.3	36.6		47.8	43.2	
Level of Service	D	E	B	F	C	C	E	D		D	D	
Approach Delay (s)		52.0			32.1			43.0			43.9	
Approach LOS		D			C			D			D	

Intersection Summary			
HCM Average Control Delay	44.3	HCM Level of Service	D
HCM Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	99.7	Sum of lost time (s)	21.6
Intersection Capacity Utilization	88.0%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	1712	638	0	735	0	0	0	0	0	0	677
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	1802	672	0	774	0	0	0	0	0	0	713
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		732										
pX, platoon unblocked				0.62			0.62	0.62	0.62	0.62	0.62	
vC, conflicting volume	774			2474			2396	2912	936	1374	3247	258
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	774			1231			1105	1937	0	0	2479	258
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	100	100	100	100	4
cM capacity (veh/h)	838			348			4	40	672	634	18	741

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	SB 1
Volume Total	721	721	1032	258	258	258	713
Volume Left	0	0	0	0	0	0	0
Volume Right	0	0	672	0	0	0	713
cSH	1700	1700	1700	1700	1700	1700	741
Volume to Capacity	0.42	0.42	0.61	0.15	0.15	0.15	0.96
Queue Length 95th (ft)	0	0	0	0	0	0	367
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	47.9
Lane LOS							E
Approach Delay (s)	0.0			0.0			47.9
Approach LOS							E

Intersection Summary			
Average Delay	8.6		
Intersection Capacity Utilization	62.8%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	45	168	218	208	18	1654	473	1782
v/c Ratio	0.41	0.62	0.71	0.68	0.15	0.51	0.35	0.52
Control Delay	44.0	52.2	39.7	37.2	2.5	1.6	0.4	10.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	44.0	52.2	39.7	37.2	2.5	1.6	0.4	10.8
Queue Length 50th (ft)	17	118	104	91	1	48	0	217
Queue Length 95th (ft)	55	175	179	162	m2	m53	m0	325
Internal Link Dist (ft)	296		624			121		607
Turn Bay Length (ft)				470	120			
Base Capacity (vph)	112	397	416	415	119	3228	1362	3433
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.40	0.42	0.52	0.50	0.15	0.51	0.35	0.52

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	24	0	19	178	40	347	17	1486	535	0	1674	19
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		5.0	5.0	5.0	5.0	5.0	4.0		5.0	
Lane Util. Factor		1.00		0.95	0.91	0.95	1.00	0.86	0.86		0.91	
Frt		0.94		1.00	0.89	0.85	1.00	0.99	0.85		1.00	
Flt Protected		0.97		0.95	1.00	1.00	0.95	1.00	1.00		1.00	
Satd. Flow (prot)		1704		1681	1505	1504	1770	4767	1362		5077	
Flt Permitted		0.97		0.95	1.00	1.00	0.09	1.00	1.00		1.00	
Satd. Flow (perm)		1704		1681	1505	1504	176	4767	1362		5077	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	25	0	20	187	42	365	18	1564	563	0	1762	20
RTOR Reduction (vph)	0	19	0	0	66	66	0	4	0	0	1	0
Lane Group Flow (vph)	0	26	0	168	152	142	18	1650	473	0	1781	0
Turn Type	Split			Split		Perm	Perm		Free			
Protected Phases	4	4		8	8			2			6	
Permitted Phases						8	2		Free			
Actuated Green, G (s)		4.8		17.6	17.6	17.6	73.6	73.6	110.0		73.6	
Effective Green, g (s)		4.8		17.6	17.6	17.6	73.6	73.6	110.0		73.6	
Actuated g/C Ratio		0.04		0.16	0.16	0.16	0.67	0.67	1.00		0.67	
Clearance Time (s)		4.0		5.0	5.0	5.0	5.0	5.0			5.0	
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0			3.0	
Lane Grp Cap (vph)		74		269	241	241	118	3190	1362		3397	
v/s Ratio Prot		0.02		0.10	c0.10			0.35			c0.35	
v/s Ratio Perm						0.09	0.10		c0.35			
v/c Ratio		0.35		0.62	0.63	0.59	0.15	0.52	0.35		0.52	
Uniform Delay, d1		51.1		43.1	43.2	42.9	6.7	9.2	0.0		9.3	
Progression Factor		1.00		1.00	1.00	1.00	0.17	0.15	1.00		1.00	
Incremental Delay, d2		2.8		4.5	5.3	3.9	0.7	0.1	0.2		0.6	
Delay (s)		53.9		47.6	48.5	46.7	1.8	1.5	0.2		9.9	
Level of Service		D		D	D	D	A	A	A		A	
Approach Delay (s)		53.9			47.6			1.2			9.9	
Approach LOS		D			D			A			A	

Intersection Summary			
HCM Average Control Delay	11.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	62.0%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	101	1910	215	1109	128	1988	146	1538
v/c Ratio	0.47	1.28	1.11	0.77	0.88	1.07	1.13	0.85
Control Delay	54.9	164.3	132.9	14.8	44.2	51.2	155.6	28.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	92.2	0.0	0.0
Total Delay	54.9	164.3	132.9	14.8	44.2	143.4	155.6	28.8
Queue Length 50th (ft)	68	~628	~181	261	93	~431	~121	369
Queue Length 95th (ft)	#153	#727	#338	317	m82	m222	#252	291
Internal Link Dist (ft)		1129		409		285		200
Turn Bay Length (ft)	140		110		150		120	
Base Capacity (vph)	216	1494	193	1635	145	1866	129	1819
Starvation Cap Reductn	0	0	0	0	0	308	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.47	1.28	1.11	0.68	0.88	1.28	1.13	0.85

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	96	1664	150	204	781	273	122	1811	78	139	1403	58
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5		4.0	4.5		4.0	4.5		4.0	4.5	
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	0.91		1.00	0.91	
Frt	1.00	0.99		1.00	0.96		1.00	0.99		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	5022		1770	4888		1770	5054		1770	5055	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	5022		1770	4888		1770	5054		1770	5055	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	101	1752	158	215	822	287	128	1906	82	146	1477	61
RTOR Reduction (vph)	0	10	0	0	61	0	0	4	0	0	4	0
Lane Group Flow (vph)	101	1900	0	215	1048	0	128	1984	0	146	1534	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	13.4	32.5		12.0	31.1		9.0	40.5		8.0	39.5	
Effective Green, g (s)	13.4	32.5		12.0	31.1		9.0	40.5		8.0	39.5	
Actuated g/C Ratio	0.12	0.30		0.11	0.28		0.08	0.37		0.07	0.36	
Clearance Time (s)	4.0	4.5		4.0	4.5		4.0	4.5		4.0	4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	216	1484		193	1382		145	1861		129	1815	
v/s Ratio Prot	0.06	c0.38		c0.12	0.21		0.07	c0.39		c0.08	0.30	
v/s Ratio Perm												
v/c Ratio	0.47	1.28		1.11	0.76		0.88	1.07		1.13	0.85	
Uniform Delay, d1	45.0	38.8		49.0	36.0		50.0	34.8		51.0	32.4	
Progression Factor	1.00	1.00		0.89	0.35		0.67	0.53		0.85	0.74	
Incremental Delay, d2	1.6	131.5		91.1	1.9		6.1	31.0		113.9	4.5	
Delay (s)	46.6	170.3		134.7	14.6		39.5	49.5		157.3	28.6	
Level of Service	D	F		F	B		D	D		F	C	
Approach Delay (s)		164.0			34.1			48.9			39.8	
Approach LOS		F			C			D			D	

Intersection Summary			
HCM Average Control Delay	76.5	HCM Level of Service	E
HCM Volume to Capacity ratio	1.15		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	105.4%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	489	1164	299	276	692	22	1795	483	1835
v/c Ratio	1.11	0.89	0.74	0.95	0.72	0.32	1.14	0.54	0.82
Control Delay	114.4	44.7	38.7	60.9	26.0	35.7	100.8	9.0	5.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Total Delay	114.4	44.7	38.7	60.9	26.0	35.7	100.8	9.0	5.2
Queue Length 50th (ft)	~406	317	170	150	104	10	~780	64	36
Queue Length 95th (ft)	#630	#319	#243	m163	m89	37	#920	159	m87
Internal Link Dist (ft)		339			174		323		285
Turn Bay Length (ft)	200			175		175			
Base Capacity (vph)	439	1308	406	290	1109	68	1576	889	2234
Starvation Cap Reductn	0	0	0	0	0	0	0	0	38
Spillback Cap Reductn	0	0	0	0	0	0	0	5	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.11	0.89	0.74	0.95	0.62	0.32	1.14	0.55	0.84

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	465	1074	315	262	652	6	21	1705	459	0	1230	513
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5	4.5	4.0	4.5		4.5	4.5	4.5		4.5	
Lane Util. Factor	1.00	0.86	0.86	1.00	0.91		1.00	0.95	1.00		0.91	
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85		0.96	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00		1.00	
Satd. Flow (prot)	1770	4785	1362	1770	5079		1770	3539	1583		4861	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.08	1.00	1.00		1.00	
Satd. Flow (perm)	1770	4785	1362	1770	5079		152	3539	1583		4861	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	489	1131	332	276	686	6	22	1795	483	0	1295	540
RTOR Reduction (vph)	0	3	34	0	1	0	0	0	184	0	68	0
Lane Group Flow (vph)	489	1161	265	276	691	0	22	1795	299	0	1767	0
Turn Type	Prot		Perm	Prot			Perm		Perm			
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4				2		2			
Actuated Green, G (s)	27.3	30.0	30.0	18.0	20.7		49.0	49.0	49.0		49.0	
Effective Green, g (s)	27.3	30.0	30.0	18.0	20.7		49.0	49.0	49.0		49.0	
Actuated g/C Ratio	0.25	0.27	0.27	0.16	0.19		0.45	0.45	0.45		0.45	
Clearance Time (s)	4.0	4.5	4.5	4.0	4.5		4.5	4.5	4.5		4.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	439	1305	371	290	956		68	1576	705		2165	
v/s Ratio Prot	c0.28	c0.24		c0.16	0.14			c0.51			0.36	
v/s Ratio Perm			0.19				0.14		0.19			
v/c Ratio	1.11	0.89	0.71	0.95	0.72		0.32	1.14	0.42		0.82	
Uniform Delay, d1	41.4	38.4	36.1	45.6	42.0		19.8	30.5	20.9		26.6	
Progression Factor	0.94	0.93	0.89	0.71	0.57		1.00	1.00	1.00		0.15	
Incremental Delay, d2	76.1	7.2	5.9	24.4	1.3		12.2	70.8	1.9		1.4	
Delay (s)	115.0	42.9	38.2	57.0	25.3		31.9	101.3	22.7		5.3	
Level of Service	F	D	D	E	C		C	F	C		A	
Approach Delay (s)		60.3			34.3			84.1			5.3	
Approach LOS		E			C			F			A	

Intersection Summary			
HCM Average Control Delay	50.2	HCM Level of Service	D
HCM Volume to Capacity ratio	1.12		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	96.5%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	0	549	1761	0	0	1787
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	578	1854	0	0	1881
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						629
pX, platoon unblocked	0.74					
vC, conflicting volume	2481	618			1854	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1758	618			1854	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	0			100	
cM capacity (veh/h)	56	432			323	

Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	578	618	618	618	627	627	627
Volume Left	0	0	0	0	0	0	0
Volume Right	578	0	0	0	0	0	0
cSH	432	1700	1700	1700	1700	1700	1700
Volume to Capacity	1.34	0.36	0.36	0.36	0.37	0.37	0.37
Queue Length 95th (ft)	660	0	0	0	0	0	0
Control Delay (s)	192.9	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	F						
Approach Delay (s)	192.9	0.0			0.0		
Approach LOS	F						

Intersection Summary			
Average Delay	25.8		
Intersection Capacity Utilization	74.7%	ICU Level of Service	D
Analysis Period (min)	15		

Lane Group	EBT	WBT	SBL
Lane Group Flow (vph)	1283	1072	663
v/c Ratio	0.45	0.38	0.66
Control Delay	8.5	7.1	19.2
Queue Delay	0.0	0.0	0.0
Total Delay	8.5	7.1	19.2
Queue Length 50th (ft)	79	145	92
Queue Length 95th (ft)	134	218	120
Internal Link Dist (ft)	736	218	493
Turn Bay Length (ft)			
Base Capacity (vph)	2837	2837	1439
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.45	0.38	0.46

Intersection Summary

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1219	1018	0	536	94
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5	4.5		4.0	
Lane Util. Factor		0.91	0.91		0.97	
Frt		1.00	1.00		0.98	
Flt Protected		1.00	1.00		0.96	
Satd. Flow (prot)		5085	5085		3389	
Flt Permitted		1.00	1.00		0.96	
Satd. Flow (perm)		5085	5085		3389	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1283	1072	0	564	99
RTOR Reduction (vph)	0	0	0	0	26	0
Lane Group Flow (vph)	0	1283	1072	0	637	0
Turn Type						
Protected Phases		4	8		6	
Permitted Phases						
Actuated Green, G (s)		30.7	30.7		15.8	
Effective Green, g (s)		30.7	30.7		15.8	
Actuated g/C Ratio		0.56	0.56		0.29	
Clearance Time (s)		4.5	4.5		4.0	
Vehicle Extension (s)		3.0	3.0		3.0	
Lane Grp Cap (vph)		2838	2838		974	
v/s Ratio Prot		c0.25	0.21		c0.19	
v/s Ratio Perm						
v/c Ratio		0.45	0.38		0.65	
Uniform Delay, d1		7.2	6.8		17.2	
Progression Factor		1.00	0.94		1.00	
Incremental Delay, d2		0.5	0.3		1.6	
Delay (s)		7.7	6.7		18.8	
Level of Service		A	A		B	
Approach Delay (s)		7.7	6.7		18.8	
Approach LOS		A	A		B	

Intersection Summary			
HCM Average Control Delay	9.8	HCM Level of Service	A
HCM Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	55.0	Sum of lost time (s)	8.5
Intersection Capacity Utilization	48.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	155	1875	488	1229	292	683	736	235	566
v/c Ratio	0.60	1.14	1.44	0.66	0.43	0.52	0.85	1.28	0.31
Control Delay	12.8	75.0	249.9	31.0	15.1	20.6	25.6	192.0	22.8
Queue Delay	0.0	3.1	0.0	0.0	0.0	0.0	3.8	0.0	0.0
Total Delay	12.8	78.1	249.9	31.0	15.1	20.6	29.4	192.0	22.8
Queue Length 50th (ft)	67	~534	~470	261	73	239	422	~211	92
Queue Length 95th (ft)	m51	m55	#673	313	150	m272	m519	#367	123
Internal Link Dist (ft)		409		995		363			581
Turn Bay Length (ft)	140		160					120	
Base Capacity (vph)	257	1641	338	1872	673	1303	861	184	1854
Starvation Cap Reductn	0	10	0	0	0	0	69	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.60	1.15	1.44	0.66	0.43	0.52	0.93	1.28	0.31

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	147	1781	0	464	1168	277	0	649	699	223	437	101
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5		4.0	4.5	4.5		4.5	4.5	4.5	4.5	
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00		0.95	1.00	1.00	0.91	
Frt	1.00	1.00		1.00	1.00	0.85		1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5085		1770	5085	1583		3539	1583	1770	4942	
Flt Permitted	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.27	1.00	
Satd. Flow (perm)	1770	5085		1770	5085	1583		3539	1583	499	4942	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	155	1875	0	488	1229	292	0	683	736	235	460	106
RTOR Reduction (vph)	0	0	0	0	0	90	0	0	279	0	34	0
Lane Group Flow (vph)	155	1875	0	488	1229	202	0	683	457	235	532	0
Turn Type	Prot		Perm	Prot		Perm			Perm	Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8			2	6		
Actuated Green, G (s)	16.0	35.5		21.0	40.5	40.5		40.5	40.5	40.5	40.5	
Effective Green, g (s)	16.0	35.5		21.0	40.5	40.5		40.5	40.5	40.5	40.5	
Actuated g/C Ratio	0.15	0.32		0.19	0.37	0.37		0.37	0.37	0.37	0.37	
Clearance Time (s)	4.0	4.5		4.0	4.5	4.5		4.5	4.5	4.5	4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	257	1641		338	1872	583		1303	583	184	1820	
v/s Ratio Prot	0.09	c0.37		c0.28	0.24			0.19			0.11	
v/s Ratio Perm						0.13			0.29	c0.47		
v/c Ratio	0.60	1.14		1.44	0.66	0.35		0.52	0.78	1.28	0.29	
Uniform Delay, d1	44.0	37.2		44.5	29.0	25.2		27.2	30.9	34.8	24.6	
Progression Factor	0.26	0.11		1.00	1.00	1.00		0.72	1.50	1.00	1.00	
Incremental Delay, d2	0.4	64.9		215.7	1.8	1.6		0.9	6.3	159.9	0.4	
Delay (s)	12.0	69.0		260.2	30.8	26.8		20.4	52.5	194.6	25.0	
Level of Service	B	E		F	C	C		C	D	F	C	
Approach Delay (s)		64.6			85.9			37.0			74.8	
Approach LOS		E			F			D			E	

Intersection Summary			
HCM Average Control Delay	66.5	HCM Level of Service	E
HCM Volume to Capacity ratio	1.26		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	105.0%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	116	1541	127	1339	171	396	33	96	728	151
v/c Ratio	0.73	0.90	0.73	0.77	0.76	0.37	0.07	0.53	0.82	0.31
Control Delay	70.4	39.5	67.4	31.6	64.3	29.5	12.6	52.6	43.2	11.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	70.4	39.5	67.4	31.6	64.3	29.5	12.6	52.6	43.2	11.8
Queue Length 50th (ft)	73	340	80	273	107	107	3	59	227	19
Queue Length 95th (ft)	#161	#437	#167	331	#207	153	26	110	297	70
Internal Link Dist (ft)		631		1090		191			644	
Turn Bay Length (ft)	200		180		140		60	120		120
Base Capacity (vph)	165	1730	184	1781	239	1057	491	220	955	508
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.70	0.89	0.69	0.75	0.72	0.37	0.07	0.44	0.76	0.30

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	110	1316	148	121	1139	133	162	376	31	91	692	143
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.98		1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5008		1770	5006		1770	3539	1583	1770	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5008		1770	5006		1770	3539	1583	1770	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	116	1385	156	127	1199	140	171	396	33	96	728	151
RTOR Reduction (vph)	0	14	0	0	14	0	0	0	19	0	0	82
Lane Group Flow (vph)	116	1527	0	127	1325	0	171	396	14	96	728	69
Turn Type	Prot			Prot			Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases									2			6
Actuated Green, G (s)	8.7	32.6		9.6	33.5		12.2	28.9	28.9	8.5	25.2	25.2
Effective Green, g (s)	8.7	32.6		9.6	33.5		12.2	28.9	28.9	8.5	25.2	25.2
Actuated g/C Ratio	0.09	0.33		0.10	0.34		0.12	0.30	0.30	0.09	0.26	0.26
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	158	1673		174	1718		221	1048	469	154	914	409
v/s Ratio Prot	0.07	c0.30		c0.07	0.26		c0.10	c0.11		0.05	c0.21	
v/s Ratio Perm									0.01			0.04
v/c Ratio	0.73	0.91		0.73	0.77		0.77	0.38	0.03	0.62	0.80	0.17
Uniform Delay, d1	43.3	31.1		42.7	28.6		41.4	27.2	24.4	43.0	33.8	28.1
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	16.1	8.0		14.2	2.2		15.4	0.2	0.0	7.6	4.9	0.2
Delay (s)	59.5	39.1		57.0	30.8		56.8	27.5	24.4	50.6	38.7	28.3
Level of Service	E	D		E	C		E	C	C	D	D	C
Approach Delay (s)		40.6			33.1			35.6			38.2	
Approach LOS		D			C			D			D	

Intersection Summary			
HCM Average Control Delay	37.1	HCM Level of Service	D
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	97.6	Sum of lost time (s)	23.0
Intersection Capacity Utilization	78.5%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NER
Lane Configurations										
Volume (veh/h)	0	225	0	333	0	0	722	324	0	0
Sign Control	Yield			Free			Free		Yield	
Grade	0%			0%			0%		0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	237	0	351	0	0	760	341	0	0
Pedestrians										
Lane Width (ft)										
Walking Speed (ft/s)										
Percent Blockage										
Right turn flare (veh)										
Median type				None			None			
Median storage veh)										
Upstream signal (ft)							271			
pX, platoon unblocked	0.79		0.79						0.79	0.79
vC, conflicting volume	1452	175	1101			351			1172	1111
vC1, stage 1 conf vol										
vC2, stage 2 conf vol										
vCu, unblocked vol	1439	175	996			351			1085	1008
tC, single (s)	6.5	6.9	4.1			4.1			7.5	6.5
tC, 2 stage (s)										
tF (s)	4.0	3.3	2.2			2.2			3.5	4.0
p0 queue free %	100	72	100			100			100	100
cM capacity (veh/h)	104	838	546			1205			97	189

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	237	175	175	760	341
Volume Left	0	0	0	0	0
Volume Right	237	0	0	0	341
cSH	838	1700	1700	1700	1700
Volume to Capacity	0.28	0.10	0.10	0.45	0.20
Queue Length 95th (ft)	29	0	0	0	0
Control Delay (s)	11.0	0.0	0.0	0.0	0.0
Lane LOS	B				
Approach Delay (s)	11.0	0.0		0.0	
Approach LOS	B				

Intersection Summary			
Average Delay	1.5		
Intersection Capacity Utilization	62.8%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	621	0	0	0	0	0	0	355	335	0
Sign Control		Yield			Yield			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	0	654	0	0	0	0	0	0	374	353	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)											795	
pX, platoon unblocked	0.92	0.92	0.92	0.92	0.92		0.92					
vC, conflicting volume	1100	1100	353	1754	1100	0	353			0		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1063	1063	248	1777	1063	0	248			0		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	10	100	100	100	100			77		
cM capacity (veh/h)	151	157	725	5	157	1085	1208			1623		

Direction, Lane #	EB 1	SB 1	SB 2
Volume Total	654	374	353
Volume Left	0	374	0
Volume Right	654	0	0
cSH	725	1623	1700
Volume to Capacity	0.90	0.23	0.21
Queue Length 95th (ft)	296	22	0
Control Delay (s)	37.9	7.9	0.0
Lane LOS	E	A	
Approach Delay (s)	37.9	4.1	
Approach LOS	E		

Intersection Summary			
Average Delay	20.1		
Intersection Capacity Utilization	62.8%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	WBL	WBT	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	465	372	162	842	341	882
v/c Ratio	0.83	0.63	0.60	0.45	0.34	0.47
Control Delay	33.5	16.6	16.6	5.5	1.0	10.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	33.5	16.6	16.6	5.5	1.0	10.1
Queue Length 50th (ft)	147	70	18	48	2	100
Queue Length 95th (ft)	#283	147	m#119	63	6	143
Internal Link Dist (ft)		1190		300		620
Turn Bay Length (ft)	600		90			
Base Capacity (vph)	605	624	269	1889	1004	1886
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	35
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.77	0.60	0.60	0.45	0.34	0.48

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	442	10	343	154	800	324	0	829	9
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.5	4.5		4.5	4.5	4.5		4.5	
Lane Util. Factor				1.00	1.00		1.00	0.95	1.00		0.95	
Frt				1.00	0.85		1.00	1.00	0.85		1.00	
Flt Protected				0.95	1.00		0.95	1.00	1.00		1.00	
Satd. Flow (prot)				1770	1592		1770	3539	1583		3534	
Flt Permitted				0.95	1.00		0.27	1.00	1.00		1.00	
Satd. Flow (perm)				1770	1592		502	3539	1583		3534	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	0	0	465	11	361	162	842	341	0	873	9
RTOR Reduction (vph)	0	0	0	0	83	0	0	0	159	0	1	0
Lane Group Flow (vph)	0	0	0	465	289	0	162	842	182	0	881	0
Turn Type				Split			Perm		Perm			
Protected Phases				8	8			2			6	
Permitted Phases							2		2			
Actuated Green, G (s)				19.0	19.0		32.0	32.0	32.0		32.0	
Effective Green, g (s)				19.0	19.0		32.0	32.0	32.0		32.0	
Actuated g/C Ratio				0.32	0.32		0.53	0.53	0.53		0.53	
Clearance Time (s)				4.5	4.5		4.5	4.5	4.5		4.5	
Vehicle Extension (s)				3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)				561	504		268	1887	844		1885	
v/s Ratio Prot				c0.26	0.18			0.24			0.25	
v/s Ratio Perm							c0.32		0.11			
v/c Ratio				0.83	0.57		0.60	0.45	0.22		0.47	
Uniform Delay, d1				19.0	17.1		9.6	8.6	7.4		8.7	
Progression Factor				1.00	1.00		0.55	0.53	0.24		1.00	
Incremental Delay, d2				9.8	1.6		8.0	0.6	0.5		0.8	
Delay (s)				28.8	18.7		13.3	5.2	2.2		9.5	
Level of Service				C	B		B	A	A		A	
Approach Delay (s)		0.0			24.3			5.4			9.5	
Approach LOS		A			C			A			A	

Intersection Summary			
HCM Average Control Delay	11.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	67.5%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBR	NBT	SBT
Lane Group Flow (vph)	409	357	1140	1307
v/c Ratio	0.75	0.70	0.58	0.66
Control Delay	27.6	24.0	3.5	8.1
Queue Delay	0.0	0.0	0.1	0.1
Total Delay	27.6	24.0	3.6	8.2
Queue Length 50th (ft)	127	99	41	126
Queue Length 95th (ft)	202	169	m75	163
Internal Link Dist (ft)	434		320	300
Turn Bay Length (ft)				
Base Capacity (vph)	649	601	1980	1980
Starvation Cap Reductn	0	0	134	27
Spillback Cap Reductn	0	0	0	73
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.63	0.59	0.62	0.69

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	389	339	0	1083	1242	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		0.95	0.95	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1770	1583		3539	3539	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	1770	1583		3539	3539	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	409	357	0	1140	1307	0
RTOR Reduction (vph)	0	22	0	0	0	0
Lane Group Flow (vph)	409	335	0	1140	1307	0
Turn Type		custom				
Protected Phases				2	6	
Permitted Phases	4	4				
Actuated Green, G (s)	18.4	18.4		33.6	33.6	
Effective Green, g (s)	18.4	18.4		33.6	33.6	
Actuated g/C Ratio	0.31	0.31		0.56	0.56	
Clearance Time (s)	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	543	485		1982	1982	
v/s Ratio Prot				0.32	c0.37	
v/s Ratio Perm	c0.23	0.21				
v/c Ratio	0.75	0.69		0.58	0.66	
Uniform Delay, d1	18.8	18.3		8.6	9.2	
Progression Factor	1.00	1.00		0.27	0.64	
Incremental Delay, d2	5.9	4.2		0.9	1.4	
Delay (s)	24.6	22.5		3.2	7.3	
Level of Service	C	C		A	A	
Approach Delay (s)	23.6			3.2	7.3	
Approach LOS	C			A	A	

Intersection Summary			
HCM Average Control Delay	9.7	HCM Level of Service	A
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	62.6%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	248	581	377	117	373	98	205	817	443	201	1248	295
v/c Ratio	0.96	0.58	0.55	0.71	0.37	0.19	0.87	0.63	0.68	0.76	0.92	0.41
Control Delay	72.9	21.2	7.1	47.5	18.5	5.4	62.6	18.3	18.1	36.2	23.6	3.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	72.9	21.2	7.1	47.5	18.5	5.4	62.6	18.3	18.1	36.2	23.6	3.1
Queue Length 50th (ft)	87	94	12	38	56	0	74	124	96	72	184	4
Queue Length 95th (ft)	#214	140	70	#115	89	29	#179	177	189	m#136	#335	m11
Internal Link Dist (ft)		612			420			572			320	
Turn Bay Length (ft)	90			80			130			120		
Base Capacity (vph)	259	1003	686	164	1003	519	236	1298	651	266	1357	717
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.96	0.58	0.55	0.71	0.37	0.19	0.87	0.63	0.68	0.76	0.92	0.41

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	236	552	358	111	354	93	195	776	421	191	1186	280
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3539	1583	1770	3539	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.49	1.00	1.00	0.31	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	914	3539	1583	579	3539	1583	1770	3539	1583	1770	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	248	581	377	117	373	98	205	817	443	201	1248	295
RTOR Reduction (vph)	0	0	238	0	0	70	0	0	71	0	0	110
Lane Group Flow (vph)	248	581	139	117	373	28	205	817	372	201	1248	185
Turn Type	Perm		Perm	Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Actuated Green, G (s)	17.0	17.0	17.0	17.0	17.0	17.0	8.0	22.0	22.0	9.0	23.0	23.0
Effective Green, g (s)	17.0	17.0	17.0	17.0	17.0	17.0	8.0	22.0	22.0	9.0	23.0	23.0
Actuated g/C Ratio	0.28	0.28	0.28	0.28	0.28	0.28	0.13	0.37	0.37	0.15	0.38	0.38
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	259	1003	449	164	1003	449	236	1298	580	266	1357	607
v/s Ratio Prot		0.16			0.11		c0.12	0.23		0.11	c0.35	
v/s Ratio Perm	c0.27		0.09	0.20		0.02			0.23			0.12
v/c Ratio	0.96	0.58	0.31	0.71	0.37	0.06	0.87	0.63	0.64	0.76	0.92	0.31
Uniform Delay, d1	21.1	18.4	16.9	19.3	17.2	15.7	25.5	15.6	15.7	24.4	17.6	12.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.75	0.69	0.29
Incremental Delay, d2	43.8	0.8	0.4	13.7	0.2	0.1	26.9	2.3	5.4	9.3	9.5	1.0
Delay (s)	64.9	19.3	17.3	33.0	17.5	15.7	52.4	18.0	21.1	27.6	21.6	4.8
Level of Service	E	B	B	C	B	B	D	B	C	C	C	A
Approach Delay (s)		28.0			20.3			23.7			19.4	
Approach LOS		C			C			C			B	

Intersection Summary			
HCM Average Control Delay	22.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	79.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	191	693	0	477	0	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	201	729	0	502	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	500					
pX, platoon unblocked						
vC, conflicting volume			931		452	101
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			931		452	101
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			731		536	935

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2
Volume Total	134	310	486	251	251
Volume Left	0	0	0	0	0
Volume Right	0	243	486	0	0
cSH	1700	1700	1700	1700	1700
Volume to Capacity	0.08	0.18	0.29	0.15	0.15
Queue Length 95th (ft)	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0
Lane LOS					
Approach Delay (s)	0.0			0.0	
Approach LOS					

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	31.9%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	158	1824	1069	174
v/c Ratio	0.35	0.52	0.49	0.17
Control Delay	18.1	0.4	8.1	1.7
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	18.1	0.4	8.1	1.7
Queue Length 50th (ft)	58	0	115	2
Queue Length 95th (ft)	m63	0	155	21
Internal Link Dist (ft)		370	263	
Turn Bay Length (ft)	100			70
Base Capacity (vph)	455	3539	2199	1044
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.35	0.52	0.49	0.17

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	0	0	150	1733	1016	165
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)			4.0	4.5	4.5	4.5
Lane Util. Factor			1.00	0.95	0.95	1.00
Frt			1.00	1.00	1.00	0.85
Flt Protected			0.95	1.00	1.00	1.00
Satd. Flow (prot)			1770	3539	3539	1583
Flt Permitted			0.95	1.00	1.00	1.00
Satd. Flow (perm)			1770	3539	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	0	158	1824	1069	174
RTOR Reduction (vph)	0	0	0	0	0	61
Lane Group Flow (vph)	0	0	158	1824	1069	113
Turn Type			Prot			Perm
Protected Phases			5	2	6	
Permitted Phases						6
Actuated Green, G (s)			18.0	70.0	43.5	43.5
Effective Green, g (s)			18.0	70.0	43.5	43.5
Actuated g/C Ratio			0.26	1.00	0.62	0.62
Clearance Time (s)			4.0	4.5	4.5	4.5
Vehicle Extension (s)			3.0	3.0	3.0	3.0
Lane Grp Cap (vph)			455	3539	2199	984
v/s Ratio Prot			0.09	c0.52	0.30	
v/s Ratio Perm						0.07
v/c Ratio			0.35	0.52	0.49	0.12
Uniform Delay, d1			21.2	0.0	7.2	5.4
Progression Factor			0.76	1.00	1.00	1.00
Incremental Delay, d2			0.4	0.4	0.8	0.2
Delay (s)			16.4	0.4	8.0	5.6
Level of Service			B	A	A	A
Approach Delay (s)	0.0			1.7	7.6	
Approach LOS	A			A	A	

Intersection Summary			
HCM Average Control Delay	4.0	HCM Level of Service	A
HCM Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	0.0
Intersection Capacity Utilization	63.1%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	205	54	0	1770	1032	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	216	57	0	1863	1086	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)				382	450	
pX, platoon unblocked	0.71	0.83	0.83			
vC, conflicting volume	2018	543	1086			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	556	45	698			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	34	93	100			
cM capacity (veh/h)	328	844	743			

Direction, Lane #	EB 1	EB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	144	129	932	932	543	543
Volume Left	144	72	0	0	0	0
Volume Right	0	57	0	0	0	0
cSH	328	450	1700	1700	1700	1700
Volume to Capacity	0.44	0.29	0.55	0.55	0.32	0.32
Queue Length 95th (ft)	54	29	0	0	0	0
Control Delay (s)	24.2	16.2	0.0	0.0	0.0	0.0
Lane LOS	C	C				
Approach Delay (s)	20.4		0.0		0.0	
Approach LOS	C					

Intersection Summary			
Average Delay	1.7		
Intersection Capacity Utilization	63.1%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	266	165	25	77	207	1598	17	846	186
v/c Ratio	0.85	0.19	0.09	0.09	0.48	0.73	0.08	0.51	0.23
Control Delay	50.8	7.2	20.8	11.7	9.2	13.1	4.9	8.2	1.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	50.8	7.2	20.8	11.7	9.2	13.1	4.9	8.2	1.9
Queue Length 50th (ft)	107	6	8	6	33	213	1	125	3
Queue Length 95th (ft)	#223	27	26	21	58	#428	m2	187	13
Internal Link Dist (ft)		646		699		573		302	
Turn Bay Length (ft)	120		220		200		260		70
Base Capacity (vph)	337	899	310	868	461	2199	219	1649	814
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.79	0.18	0.08	0.09	0.45	0.73	0.08	0.51	0.23

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	253	34	123	24	34	39	197	1478	40	16	804	177
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	1.00
Frt	1.00	0.88		1.00	0.92		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	3124		1770	3257		1770	3525		1770	3539	1583
Flt Permitted	0.70	1.00		0.65	1.00		0.22	1.00		0.12	1.00	1.00
Satd. Flow (perm)	1312	3124		1206	3257		413	3525		229	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	266	36	129	25	36	41	207	1556	42	17	846	186
RTOR Reduction (vph)	0	98	0	0	31	0	0	3	0	0	0	76
Lane Group Flow (vph)	266	67	0	25	46	0	207	1595	0	17	846	110
Turn Type	Perm			Perm			pm+pt			pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)	16.8	16.8		16.8	16.8		45.2	40.4		33.4	32.6	32.6
Effective Green, g (s)	16.8	16.8		16.8	16.8		45.2	40.4		33.4	32.6	32.6
Actuated g/C Ratio	0.24	0.24		0.24	0.24		0.65	0.58		0.48	0.47	0.47
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	315	750		289	782		433	2034		127	1648	737
v/s Ratio Prot		0.02			0.01		c0.06	c0.45		0.00	0.24	
v/s Ratio Perm	c0.20			0.02			0.25			0.06		0.07
v/c Ratio	0.84	0.09		0.09	0.06		0.48	0.78		0.13	0.51	0.15
Uniform Delay, d1	25.4	20.7		20.6	20.5		6.6	11.4		11.2	13.1	10.7
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		0.75	0.51	0.33
Incremental Delay, d2	18.3	0.1		0.1	0.0		0.8	3.1		0.4	1.0	0.4
Delay (s)	43.7	20.7		20.8	20.5		7.4	14.6		8.8	7.8	3.9
Level of Service	D	C		C	C		A	B		A	A	A
Approach Delay (s)		34.9			20.6			13.7			7.1	
Approach LOS		C			C			B			A	

Intersection Summary			
HCM Average Control Delay	14.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	76.1%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	1388	248	1138	133	84	1089
v/c Ratio	0.92	0.31	0.81	0.20	0.67	0.63
Control Delay	40.7	6.0	27.0	6.3	75.7	23.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	40.7	6.0	27.0	6.3	75.7	23.4
Queue Length 50th (ft)	459	22	231	9	59	295
Queue Length 95th (ft)	#607	70	#290	m27	#131	368
Internal Link Dist (ft)	720		1803			515
Turn Bay Length (ft)	240	240		150	215	
Base Capacity (vph)	1529	812	1408	679	129	1717
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.91	0.31	0.81	0.20	0.65	0.63

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	1319	236	1081	126	80	1035
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Lane Util. Factor	0.97	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	3539	1583	1770	3539
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	1388	248	1138	133	84	1089
RTOR Reduction (vph)	0	109	0	49	0	0
Lane Group Flow (vph)	1388	139	1138	84	84	1089
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	48.1	48.1	43.0	43.0	6.4	53.4
Effective Green, g (s)	48.1	48.1	43.0	43.0	6.4	53.4
Actuated g/C Ratio	0.44	0.44	0.39	0.39	0.06	0.49
Clearance Time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	1501	692	1383	619	103	1718
v/s Ratio Prot	c0.40		c0.32		c0.05	0.31
v/s Ratio Perm		0.09		0.05		
v/c Ratio	0.92	0.20	0.82	0.14	0.82	0.63
Uniform Delay, d1	29.2	19.1	30.1	21.5	51.2	21.0
Progression Factor	1.00	1.00	0.72	0.56	1.00	1.00
Incremental Delay, d2	9.9	0.1	4.9	0.4	37.1	1.8
Delay (s)	39.2	19.2	26.6	12.4	88.4	22.8
Level of Service	D	B	C	B	F	C
Approach Delay (s)	36.2		25.1			27.5
Approach LOS	D		C			C

Intersection Summary			
HCM Average Control Delay	30.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.5
Intersection Capacity Utilization	82.4%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	279	422	927	1264	236	2281
v/c Ratio	0.54	0.86	0.43	1.02	1.05	0.84
Control Delay	46.1	31.2	12.9	42.0	102.7	7.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	46.1	31.2	12.9	42.0	102.7	7.3
Queue Length 50th (ft)	95	88	169	~639	~180	108
Queue Length 95th (ft)	129	#208	245	#1004	m#271	692
Internal Link Dist (ft)	1134		595			1803
Turn Bay Length (ft)	75	50			235	
Base Capacity (vph)	687	553	2151	1241	225	2730
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.41	0.76	0.43	1.02	1.05	0.84

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	265	401	881	1201	224	2167
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Lane Util. Factor	0.97	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	3539	1583	1770	3539
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	279	422	927	1264	236	2281
RTOR Reduction (vph)	0	251	0	279	0	0
Lane Group Flow (vph)	279	171	927	985	236	2281
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	16.7	16.7	66.8	66.8	14.0	84.8
Effective Green, g (s)	16.7	16.7	66.8	66.8	14.0	84.8
Actuated g/C Ratio	0.15	0.15	0.61	0.61	0.13	0.77
Clearance Time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	521	240	2149	961	225	2728
v/s Ratio Prot	0.08		0.26		c0.13	0.64
v/s Ratio Perm		c0.11		c0.62		
v/c Ratio	0.54	0.71	0.43	1.02	1.05	0.84
Uniform Delay, d1	43.1	44.4	11.5	21.6	48.0	8.1
Progression Factor	1.00	1.00	1.00	1.00	0.88	0.52
Incremental Delay, d2	1.1	9.6	0.6	35.5	60.2	2.0
Delay (s)	44.1	53.9	12.1	57.1	102.3	6.3
Level of Service	D	D	B	E	F	A
Approach Delay (s)	50.0		38.1			15.3
Approach LOS	D		D			B

Intersection Summary			
HCM Average Control Delay	29.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.5
Intersection Capacity Utilization	93.9%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	24	102	1432	156	74	0
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	25	107	1507	164	78	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						800
pX, platoon unblocked						
vC, conflicting volume	1745	1589			1507	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1745	1589			1507	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	68	19			82	
cM capacity (veh/h)	78	133			444	

Direction, Lane #	WB 1	WB 2	NB 1	SB 1	SB 2
Volume Total	25	107	1672	78	0
Volume Left	25	0	0	78	0
Volume Right	0	107	164	0	0
cSH	78	133	1700	444	1700
Volume to Capacity	0.32	0.81	0.98	0.18	0.00
Queue Length 95th (ft)	30	124	0	16	0
Control Delay (s)	71.6	97.5	0.0	14.8	0.0
Lane LOS	F	F		B	
Approach Delay (s)	92.6		0.0	14.8	
Approach LOS	F				

Intersection Summary			
Average Delay	7.1		
Intersection Capacity Utilization	97.8%	ICU Level of Service	F
Analysis Period (min)	15		

Lane Group	EBT	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	2077	1627	534	184	993	607	1035
v/c Ratio	0.88	0.98	0.48	0.76	0.94	0.95	0.79
Control Delay	33.9	18.7	3.9	65.7	59.2	74.1	46.9
Queue Delay	17.0	32.4	4.3	0.0	0.0	14.4	0.0
Total Delay	50.9	51.2	8.2	65.7	59.2	88.5	46.9
Queue Length 50th (ft)	515	148	69	144	288	241	275
Queue Length 95th (ft)	588	m161	m80	#252	#370	#354	330
Internal Link Dist (ft)	1037	280			562		836
Turn Bay Length (ft)				330		290	
Base Capacity (vph)	2366	1660	1110	242	1053	638	1305
Starvation Cap Reductn	0	155	486	0	0	0	0
Spillback Cap Reductn	343	0	0	0	0	43	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	1.03	1.08	0.86	0.76	0.94	1.02	0.79

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1813	161	0	1546	507	175	913	30	577	981	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.5			5.5	5.5	5.5	5.5		5.5	5.5	
Lane Util. Factor		0.91			0.95	1.00	1.00	0.91		0.97	0.91	
Frt		0.99			1.00	0.85	1.00	1.00		1.00	1.00	
Flt Protected		1.00			1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		5023			3539	1583	1770	5061		3433	5084	
Flt Permitted		1.00			1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)		5023			3539	1583	1770	5061		3433	5084	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1908	169	0	1627	534	184	961	32	607	1033	2
RTOR Reduction (vph)	0	8	0	0	0	1	0	3	0	0	0	0
Lane Group Flow (vph)	0	2069	0	0	1627	533	184	990	0	607	1035	0
Turn Type						pm+ov	Prot			Prot		
Protected Phases		4			8	1	5	2		1	6	
Permitted Phases						8						
Actuated Green, G (s)		56.3			56.3	78.6	16.4	24.9		22.3	30.8	
Effective Green, g (s)		56.3			56.3	78.6	16.4	24.9		22.3	30.8	
Actuated g/C Ratio		0.47			0.47	0.65	0.14	0.21		0.19	0.26	
Clearance Time (s)		5.5			5.5	5.5	5.5	5.5		5.5	5.5	
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		2357			1660	1109	242	1050		638	1305	
v/s Ratio Prot		0.41			c0.46	0.09	0.10	c0.20		c0.18	0.20	
v/s Ratio Perm						0.25						
v/c Ratio		0.88			0.98	0.48	0.76	0.94		0.95	0.79	
Uniform Delay, d1		28.7			31.3	10.4	49.9	46.8		48.3	41.6	
Progression Factor		1.00			0.27	0.41	0.91	0.91		1.00	1.00	
Incremental Delay, d2		4.0			8.2	0.1	19.2	16.5		24.2	5.0	
Delay (s)		32.8			16.7	4.4	64.8	59.0		72.5	46.6	
Level of Service		C			B	A	E	E		E	D	
Approach Delay (s)		32.8			13.6			59.9			56.2	
Approach LOS		C			B			E			E	

Intersection Summary			
HCM Average Control Delay	36.9	HCM Level of Service	D
HCM Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	91.3%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	400	2157	39	1742	705	109	403	758	604
v/c Ratio	1.02	0.79	0.53	1.01	1.01	0.39	1.00	0.71	0.82
Control Delay	74.2	15.7	87.3	67.0	66.0	10.0	98.0	41.7	25.0
Queue Delay	44.0	4.5	0.0	9.8	0.0	0.0	0.0	0.0	0.1
Total Delay	118.2	20.2	87.3	76.8	66.0	10.0	98.0	41.7	25.1
Queue Length 50th (ft)	~326	360	27	~420	~139	6	163	274	179
Queue Length 95th (ft)	m#403	m358	m#58	#590	m#257	m27	#269	346	#362
Internal Link Dist (ft)		280		585	326			720	
Turn Bay Length (ft)	200		200			130	160		160
Base Capacity (vph)	391	2729	74	1719	699	283	403	1065	736
Starvation Cap Reductn	41	498	0	0	0	0	0	0	0
Spillback Cap Reductn	0	286	0	48	0	4	0	0	3
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.14	0.97	0.53	1.04	1.01	0.39	1.00	0.71	0.82

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	380	2025	24	37	1499	156	0	670	104	383	720	574
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Lane Util. Factor	1.00	0.91		1.00	0.91			0.91	1.00	0.97	0.95	1.00
Frt	1.00	1.00		1.00	0.99			1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5076		1770	5013			5085	1583	3433	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5076		1770	5013			5085	1583	3433	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	400	2132	25	39	1578	164	0	705	109	403	758	604
RTOR Reduction (vph)	0	1	0	0	11	0	0	0	66	0	0	259
Lane Group Flow (vph)	400	2156	0	39	1731	0	0	705	43	403	758	345
Turn Type	Prot			Prot					Perm	Prot		Perm
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases									2			6
Actuated Green, G (s)	27.6	63.4		4.0	39.8			16.5	16.5	14.1	36.1	36.1
Effective Green, g (s)	27.6	63.4		4.0	39.8			16.5	16.5	14.1	36.1	36.1
Actuated g/C Ratio	0.23	0.53		0.03	0.33			0.14	0.14	0.12	0.30	0.30
Clearance Time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	407	2682		59	1663			699	218	403	1065	476
v/s Ratio Prot	c0.23	0.42		0.02	c0.35			c0.14		c0.12	0.21	
v/s Ratio Perm									0.03			0.22
v/c Ratio	0.98	0.80		0.66	1.04			1.01	0.20	1.00	0.71	0.72
Uniform Delay, d1	46.0	23.2		57.3	40.1			51.8	45.9	53.0	37.3	37.5
Progression Factor	0.80	0.64		1.16	1.12			0.63	0.39	1.00	1.00	1.00
Incremental Delay, d2	24.8	1.2		21.7	32.3			32.0	1.6	44.8	4.0	9.2
Delay (s)	61.7	15.9		88.3	77.1			64.5	19.5	97.8	41.4	46.7
Level of Service	E	B		F	E			E	B	F	D	D
Approach Delay (s)		23.1			77.4			58.4			56.1	
Approach LOS		C			E			E			E	

Intersection Summary			
HCM Average Control Delay	49.6	HCM Level of Service	D
HCM Volume to Capacity ratio	1.01		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	95.7%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	196	831	79	1054	384	51	283	161	498	44
v/c Ratio	0.80	0.29	0.24	0.36	0.36	0.33	0.91	0.53	0.52	0.13
Control Delay	49.6	4.3	15.1	14.1	2.1	57.7	87.0	28.2	24.7	13.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	49.6	4.3	15.1	14.1	2.1	57.7	87.0	28.2	24.7	13.5
Queue Length 50th (ft)	88	14	29	152	0	38	115	153	157	26
Queue Length 95th (ft)	m131	m49	60	182	41	79	#201	m218	201	m33
Internal Link Dist (ft)		562		597			652		326	
Turn Bay Length (ft)	110		120		200	280		240		60
Base Capacity (vph)	244	2886	325	2924	1073	155	310	304	953	340
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.80	0.29	0.24	0.36	0.36	0.33	0.91	0.53	0.52	0.13

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	186	694	95	75	1001	365	48	256	13	238	388	42
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00	1.00	0.95		0.86	0.86	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.99	1.00
Satd. Flow (prot)	1770	4994		1770	5085	1583	1770	3513		1522	4763	1583
Flt Permitted	0.23	1.00		0.30	1.00	1.00	0.95	1.00		0.95	0.99	1.00
Satd. Flow (perm)	424	4994		566	5085	1583	1770	3513		1522	4763	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	196	731	100	79	1054	384	51	269	14	251	408	44
RTOR Reduction (vph)	0	15	0	0	0	163	0	3	0	0	0	23
Lane Group Flow (vph)	196	816	0	79	1054	221	51	280	0	161	498	21
Turn Type	Perm			Perm		Perm	Split			Split		Perm
Protected Phases		4			8		2	2		6	6	
Permitted Phases	4			8		8						6
Actuated Green, G (s)	69.0	69.0		69.0	69.0	69.0	10.5	10.5		24.0	24.0	24.0
Effective Green, g (s)	69.0	69.0		69.0	69.0	69.0	10.5	10.5		24.0	24.0	24.0
Actuated g/C Ratio	0.58	0.58		0.58	0.58	0.58	0.09	0.09		0.20	0.20	0.20
Clearance Time (s)	5.5	5.5		5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	244	2872		325	2924	910	155	307		304	953	317
v/s Ratio Prot		0.16			0.21		0.03	c0.08		c0.11	0.10	
v/s Ratio Perm	c0.46			0.14		0.14						0.01
v/c Ratio	0.80	0.28		0.24	0.36	0.24	0.33	0.91		0.53	0.52	0.07
Uniform Delay, d1	20.1	13.0		12.6	13.7	12.6	51.4	54.3		42.9	42.9	38.9
Progression Factor	1.57	0.34		1.00	1.00	1.00	1.00	1.00		0.54	0.54	0.66
Incremental Delay, d2	14.6	0.1		1.8	0.3	0.6	5.6	33.2		4.5	1.4	0.3
Delay (s)	46.3	4.5		14.4	14.0	13.2	57.0	87.5		27.8	24.5	25.9
Level of Service	D	A		B	B	B	E	F		C	C	C
Approach Delay (s)		12.5			13.8			82.9			25.3	
Approach LOS		B			B			F			C	

Intersection Summary			
HCM Average Control Delay	22.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	64.7%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	26	2488	111	284	1748	56	13	132	258	87	64
v/c Ratio	0.30	0.94	0.13	0.99	0.51	0.67	0.11	0.43	1.01	0.26	0.19
Control Delay	78.8	17.9	2.5	57.8	7.5	91.7	54.9	29.4	106.0	43.3	11.0
Queue Delay	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	78.8	18.5	2.5	57.8	7.5	91.7	54.9	29.4	106.0	43.3	11.0
Queue Length 50th (ft)	20	649	5	196	120	43	10	49	186	57	0
Queue Length 95th (ft)	m27	m#779	m7	m#204	m118	#109	31	112	#365	105	38
Internal Link Dist (ft)		585			1015		352			692	
Turn Bay Length (ft)	270		180								
Base Capacity (vph)	89	2657	856	288	3415	87	124	308	255	373	368
Starvation Cap Reductn	0	31	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.29	0.95	0.13	0.99	0.51	0.64	0.10	0.43	1.01	0.23	0.17

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	25	2364	105	270	1624	37	53	12	125	245	83	61
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	4.0	5.5	5.5
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5085	1583	1770	5068		1770	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.70	1.00	1.00	0.46	1.00	1.00
Satd. Flow (perm)	1770	5085	1583	1770	5068		1305	1863	1583	859	1863	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	26	2488	111	284	1709	39	56	13	132	258	87	64
RTOR Reduction (vph)	0	0	30	0	2	0	0	0	50	0	0	52
Lane Group Flow (vph)	26	2488	81	284	1746	0	56	13	82	258	87	12
Turn Type	Prot		Perm	Prot			Perm		Over	pm+pt		Perm
Protected Phases	7	4		3	8			2	3	1	6	
Permitted Phases			4				2			6		6
Actuated Green, G (s)	3.6	59.4	59.4	21.7	77.5		6.4	6.4	21.7	22.4	22.4	22.4
Effective Green, g (s)	3.6	59.4	59.4	21.7	77.5		6.4	6.4	21.7	22.4	22.4	22.4
Actuated g/C Ratio	0.03	0.49	0.49	0.18	0.65		0.05	0.05	0.18	0.19	0.19	0.19
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	4.0	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	53	2517	784	320	3273		70	99	286	251	348	295
v/s Ratio Prot	0.01	c0.49		c0.16	0.34			0.01	0.05	c0.10	0.05	
v/s Ratio Perm			0.05				0.04			c0.09		0.01
v/c Ratio	0.49	0.99	0.10	0.89	0.53		0.80	0.13	0.29	1.03	0.25	0.04
Uniform Delay, d1	57.3	30.0	16.1	48.0	11.5		56.2	54.1	42.5	47.5	41.6	40.0
Progression Factor	1.33	0.43	0.29	0.61	0.66		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.0	11.1	0.1	8.2	0.2		46.2	0.6	0.6	64.2	0.4	0.1
Delay (s)	80.2	24.0	4.8	37.7	7.8		102.4	54.8	43.0	111.7	42.0	40.0
Level of Service	F	C	A	D	A		F	D	D	F	D	D
Approach Delay (s)		23.8			11.9			60.3			85.7	
Approach LOS		C			B			E			F	

Intersection Summary			
HCM Average Control Delay	25.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.95		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	94.6%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBT	SBL
Lane Group Flow (vph)	59	2863	2316	547
v/c Ratio	0.34	1.07	1.00	0.55
Control Delay	35.8	47.8	31.8	38.3
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	35.8	47.8	31.8	38.3
Queue Length 50th (ft)	43	~883	~702	184
Queue Length 95th (ft)	m48	m#960	#780	248
Internal Link Dist (ft)		1015	1000	632
Turn Bay Length (ft)				150
Base Capacity (vph)	413	2670	2325	999
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.14	1.07	1.00	0.55

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	56	2720	1991	209	441	79
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5		5.5	
Lane Util. Factor	1.00	0.91	0.91		0.97	
Frt	1.00	1.00	0.99		0.98	
Flt Protected	0.95	1.00	1.00		0.96	
Satd. Flow (prot)	1770	5085	5013		3388	
Flt Permitted	0.95	1.00	1.00		0.96	
Satd. Flow (perm)	1770	5085	5013		3388	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	59	2863	2096	220	464	83
RTOR Reduction (vph)	0	0	11	0	11	0
Lane Group Flow (vph)	59	2863	2305	0	536	0
Turn Type	Prot					
Protected Phases	7 9	4	8		6	
Permitted Phases						
Actuated Green, G (s)	9.8	61.9	53.2		35.0	
Effective Green, g (s)	9.8	61.9	53.2		35.0	
Actuated g/C Ratio	0.08	0.52	0.44		0.29	
Clearance Time (s)		5.5	5.5		5.5	
Vehicle Extension (s)		3.0	3.0		3.0	
Lane Grp Cap (vph)	145	2623	2222		988	
v/s Ratio Prot	c0.03	c0.56	0.46		c0.16	
v/s Ratio Perm						
v/c Ratio	0.41	1.09	1.04		0.54	
Uniform Delay, d1	52.3	29.1	33.4		35.8	
Progression Factor	1.28	0.30	0.48		1.00	
Incremental Delay, d2	0.8	44.2	26.2		2.1	
Delay (s)	68.0	52.9	42.4		37.9	
Level of Service	E	D	D		D	
Approach Delay (s)		53.2	42.4		37.9	
Approach LOS		D	D		D	

Intersection Summary			
HCM Average Control Delay	47.4	HCM Level of Service	D
HCM Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	76.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBT	SBL	SBT
Lane Group Flow (vph)	128	3179	21	67	2302	75	121	202
v/c Ratio	0.54	0.90	0.02	0.65	0.76	0.63	0.72	0.58
Control Delay	34.8	5.7	0.5	83.8	19.6	65.7	74.0	20.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	34.8	5.7	0.5	83.8	19.6	65.7	74.0	20.2
Queue Length 50th (ft)	91	127	0	52	450	47	91	30
Queue Length 95th (ft)	m94	m121	m0	#120	510	#119	#183	108
Internal Link Dist (ft)		1000			893	425		590
Turn Bay Length (ft)	150			300				
Base Capacity (vph)	239	3544	1109	105	3039	119	169	347
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.54	0.90	0.02	0.64	0.76	0.63	0.72	0.58

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	122	3020	20	64	2119	67	27	27	18	115	34	158
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5			5.5		5.5	5.5	
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91			1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00			0.97		1.00	0.88	
Flt Protected	0.95	1.00	1.00	0.95	1.00			0.98		0.95	1.00	
Satd. Flow (prot)	1770	5085	1583	1770	5062			1766		1770	1633	
Flt Permitted	0.95	1.00	1.00	0.95	1.00			0.47		0.71	1.00	
Satd. Flow (perm)	1770	5085	1583	1770	5062			848		1325	1633	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	128	3179	21	67	2231	71	28	28	19	121	36	166
RTOR Reduction (vph)	0	0	6	0	3	0	0	10	0	0	139	0
Lane Group Flow (vph)	128	3179	15	67	2299	0	0	65	0	121	63	0
Turn Type	Prot		Perm	Prot			Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4				2			6		
Actuated Green, G (s)	17.3	82.5	82.5	5.7	70.9			15.3		15.3	15.3	
Effective Green, g (s)	17.3	82.5	82.5	5.7	70.9			15.3		15.3	15.3	
Actuated g/C Ratio	0.14	0.69	0.69	0.05	0.59			0.13		0.13	0.13	
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5			5.5		5.5	5.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	255	3496	1088	84	2991			108		169	208	
v/s Ratio Prot	0.07	c0.63		0.04	c0.45						0.04	
v/s Ratio Perm			0.01					0.08		c0.09		
v/c Ratio	0.50	0.91	0.01	0.80	0.77			0.60		0.72	0.30	
Uniform Delay, d1	47.4	15.6	5.9	56.6	18.4			49.4		50.3	47.5	
Progression Factor	0.67	0.27	0.15	1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d2	0.4	1.1	0.0	39.3	2.0			22.1		13.5	0.8	
Delay (s)	32.1	5.4	0.9	95.9	20.4			71.5		63.7	48.3	
Level of Service	C	A	A	F	C			E		E	D	
Approach Delay (s)		6.4			22.5			71.5			54.1	
Approach LOS		A			C			E			D	

Intersection Summary			
HCM Average Control Delay	16.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	96.8%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Queues
3: 7th St & Park Ave

2/20/2013

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	27	1569	259	1100	79	251	307	23	302	18
v/c Ratio	0.12	0.93	0.79	0.48	0.58	0.59	0.62	0.13	0.71	0.05
Control Delay	14.2	30.5	32.8	8.0	42.8	31.1	17.2	23.8	35.8	10.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.2	30.5	32.8	8.0	42.8	31.1	17.2	23.8	35.8	10.8
Queue Length 50th (ft)	7	340	58	116	32	103	53	8	128	0
Queue Length 95th (ft)	24	#577	#194	199	77	171	129	26	207	15
Internal Link Dist (ft)		588		707		495			498	
Turn Bay Length (ft)	70		180		30		30	100		90
Base Capacity (vph)	233	1693	349	2334	190	591	618	246	591	513
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.12	0.93	0.74	0.47	0.42	0.42	0.50	0.09	0.51	0.04

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	26	1365	125	246	1018	27	75	238	292	22	287	17
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		3.0	5.0		4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3495		1770	3526		1770	1863	1583	1770	1863	1583
Flt Permitted	0.26	1.00		0.10	1.00		0.32	1.00	1.00	0.42	1.00	1.00
Satd. Flow (perm)	483	3495		195	3526		598	1863	1583	777	1863	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	27	1437	132	259	1072	28	79	251	307	23	302	18
RTOR Reduction (vph)	0	8	0	0	2	0	0	0	131	0	0	13
Lane Group Flow (vph)	27	1561	0	259	1098	0	79	251	176	23	302	5
Turn Type	Perm			pm+pt			Perm		Perm	Perm		Perm
Protected Phases		4		3	8			2			6	
Permitted Phases	4			8			2		2	6		6
Actuated Green, G (s)	35.2	35.2		47.3	47.3		16.6	16.6	16.6	16.6	16.6	16.6
Effective Green, g (s)	35.2	35.2		47.3	47.3		16.6	16.6	16.6	16.6	16.6	16.6
Actuated g/C Ratio	0.48	0.48		0.65	0.65		0.23	0.23	0.23	0.23	0.23	0.23
Clearance Time (s)	5.0	5.0		3.0	5.0		4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	233	1688		323	2288		136	424	360	177	424	360
v/s Ratio Prot		c0.45		c0.10	0.31			0.13			c0.16	
v/s Ratio Perm	0.06			0.42			0.13		0.11	0.03		0.00
v/c Ratio	0.12	0.92		0.80	0.48		0.58	0.59	0.49	0.13	0.71	0.01
Uniform Delay, d1	10.3	17.6		17.6	6.5		25.1	25.1	24.5	22.4	25.9	21.8
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.2	9.0		13.3	0.2		6.2	2.2	1.0	0.3	5.6	0.0
Delay (s)	10.5	26.7		31.0	6.7		31.2	27.3	25.5	22.7	31.5	21.8
Level of Service	B	C		C	A		C	C	C	C	C	C
Approach Delay (s)		26.4			11.3			26.9			30.4	
Approach LOS		C			B			C			C	

Intersection Summary			
HCM Average Control Delay	21.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	72.9	Sum of lost time (s)	12.0
Intersection Capacity Utilization	88.8%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Queues
25: I-405 SB Off Ramp & Studebaker Rd

12/4/2012

Lane Group	EBL	NBT	SBT
Lane Group Flow (vph)	273	1863	1086
v/c Ratio	0.52	0.71	0.41
Control Delay	26.3	3.3	1.4
Queue Delay	0.0	0.1	0.1
Total Delay	26.3	3.4	1.5
Queue Length 50th (ft)	47	71	1
Queue Length 95th (ft)	77	88	1
Internal Link Dist (ft)	342	302	370
Turn Bay Length (ft)	170		
Base Capacity (vph)	805	2625	2625
Starvation Cap Reductn	0	118	458
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.34	0.74	0.50

Intersection Summary

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	205	54	0	1770	1032	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0			4.0	4.0	
Lane Util. Factor	0.97			0.95	0.95	
Frt	0.97			1.00	1.00	
Flt Protected	0.96			1.00	1.00	
Satd. Flow (prot)	3367			3539	3539	
Flt Permitted	0.96			1.00	1.00	
Satd. Flow (perm)	3367			3539	3539	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	216	57	0	1863	1086	0
RTOR Reduction (vph)	39	0	0	0	0	0
Lane Group Flow (vph)	234	0	0	1863	1086	0
Turn Type						
Protected Phases	4			2	6	
Permitted Phases						
Actuated Green, G (s)	10.1			51.9	51.9	
Effective Green, g (s)	10.1			51.9	51.9	
Actuated g/C Ratio	0.14			0.74	0.74	
Clearance Time (s)	4.0			4.0	4.0	
Vehicle Extension (s)	3.0			3.0	3.0	
Lane Grp Cap (vph)	486			2624	2624	
v/s Ratio Prot	c0.07			c0.53	0.31	
v/s Ratio Perm						
v/c Ratio	0.48			0.71	0.41	
Uniform Delay, d1	27.5			4.9	3.4	
Progression Factor	1.00			0.38	0.25	
Incremental Delay, d2	0.8			1.1	0.4	
Delay (s)	28.3			3.0	1.3	
Level of Service	C			A	A	
Approach Delay (s)	28.3			3.0	1.3	
Approach LOS	C			A	A	

Intersection Summary			
HCM Average Control Delay	4.6	HCM Level of Service	A
HCM Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	63.1%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	25	107	1671	78	106
v/c Ratio	0.21	0.51	1.27	0.40	0.07
Control Delay	51.4	18.3	147.6	45.2	2.6
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	51.4	18.3	147.6	45.2	2.6
Queue Length 50th (ft)	17	0	~1501	51	7
Queue Length 95th (ft)	44	52	#1774	m99	m41
Internal Link Dist (ft)	864		215		720
Turn Bay Length (ft)					
Base Capacity (vph)	257	322	1315	194	1600
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.10	0.33	1.27	0.40	0.07

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	24	102	1432	156	74	101
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frt	1.00	0.85	0.99		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	1583	1838		1770	1863
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1770	1583	1838		1770	1863
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	25	107	1507	164	78	106
RTOR Reduction (vph)	0	100	3	0	0	0
Lane Group Flow (vph)	25	7	1668	0	78	106
Turn Type		Perm			Prot	
Protected Phases	8		2		1	6
Permitted Phases		8				
Actuated Green, G (s)	7.5	7.5	78.5		12.0	94.5
Effective Green, g (s)	7.5	7.5	78.5		12.0	94.5
Actuated g/C Ratio	0.07	0.07	0.71		0.11	0.86
Clearance Time (s)	4.0	4.0	4.0		4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	121	108	1312		193	1600
v/s Ratio Prot	c0.01		c0.91		c0.04	0.06
v/s Ratio Perm		0.00				
v/c Ratio	0.21	0.07	1.27		0.40	0.07
Uniform Delay, d1	48.4	48.0	15.8		45.7	1.2
Progression Factor	1.00	1.00	1.00		0.84	1.91
Incremental Delay, d2	0.9	0.3	128.1		1.3	0.1
Delay (s)	49.3	48.2	143.8		39.5	2.3
Level of Service	D	D	F		D	A
Approach Delay (s)	48.4		143.8			18.1
Approach LOS	D		F			B

Intersection Summary			
HCM Average Control Delay	125.8	HCM Level of Service	F
HCM Volume to Capacity ratio	1.08		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	97.8%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Queues
12: Willow St & Bellflower St

12/6/2012

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	53	634	148	299	2058	269	995	66	877
v/c Ratio	0.75	0.41	0.26	0.67	1.01	1.01	0.58	0.45	0.69
Control Delay	101.1	29.2	5.8	48.1	36.9	86.5	15.2	46.0	30.1
Queue Delay	0.0	0.0	0.0	0.0	5.0	0.0	0.2	0.0	0.0
Total Delay	101.1	29.2	5.8	48.1	41.9	86.5	15.4	46.0	30.1
Queue Length 50th (ft)	34	119	0	76	~519	~189	91	41	186
Queue Length 95th (ft)	#104	155	45	m114	#617	#354	117	84	93
Internal Link Dist (ft)		1129			409		285		200
Turn Bay Length (ft)	140			110		150		120	
Base Capacity (vph)	71	1531	580	481	2043	266	1705	159	1265
Starvation Cap Reductn	0	0	0	0	33	0	170	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.75	0.41	0.26	0.62	1.02	1.01	0.65	0.42	0.69

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	50	602	141	284	1592	363	256	922	23	63	752	81
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5	4.5	4.0	4.5		4.0	4.5		4.0	4.5	
Lane Util. Factor	1.00	0.91	1.00	0.97	0.91		1.00	0.91		1.00	0.91	
Frt	1.00	1.00	0.85	1.00	0.97		1.00	1.00		1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	5085	1583	3433	4944		1770	5067		1770	5011	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	5085	1583	3433	4944		1770	5067		1770	5011	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	53	634	148	299	1676	382	269	971	24	66	792	85
RTOR Reduction (vph)	0	0	102	0	36	0	0	3	0	0	13	0
Lane Group Flow (vph)	53	634	46	299	2022	0	269	992	0	66	864	0
Turn Type	Prot		Perm	Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4									
Actuated Green, G (s)	3.2	30.9	30.9	12.9	40.6		15.8	32.0		7.2	23.4	
Effective Green, g (s)	3.2	30.9	30.9	12.9	40.6		15.8	32.0		7.2	23.4	
Actuated g/C Ratio	0.03	0.31	0.31	0.13	0.41		0.16	0.32		0.07	0.23	
Clearance Time (s)	4.0	4.5	4.5	4.0	4.5		4.0	4.5		4.0	4.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	57	1571	489	443	2007		280	1621		127	1173	
v/s Ratio Prot	0.03	0.12		c0.09	c0.41		c0.15	0.20		0.04	c0.17	
v/s Ratio Perm			0.03									
v/c Ratio	0.93	0.40	0.09	0.67	1.01		0.96	0.61		0.52	0.74	
Uniform Delay, d1	48.3	27.3	24.6	41.5	29.7		41.8	28.8		44.7	35.4	
Progression Factor	1.00	1.00	1.00	1.03	0.57		0.74	0.50		0.84	0.81	
Incremental Delay, d2	92.7	0.2	0.1	2.7	18.0		37.4	1.4		3.4	4.0	
Delay (s)	141.0	27.4	24.7	45.5	35.0		68.3	15.7		41.1	32.5	
Level of Service	F	C	C	D	C		E	B		D	C	
Approach Delay (s)		34.2			36.3			26.9			33.1	
Approach LOS		C			D			C			C	

Intersection Summary			
HCM Average Control Delay	33.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	86.9%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Queues
12: Willow St & Bellflower St

12/6/2012

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	101	1752	158	215	1109	128	1988	146	1538
v/c Ratio	0.57	1.09	0.27	1.04	0.79	0.81	1.05	1.03	0.83
Control Delay	58.2	86.2	6.9	108.4	17.5	32.6	44.5	119.9	25.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	77.3	0.0	0.0
Total Delay	58.2	86.2	6.9	108.4	17.5	32.6	121.9	119.9	25.4
Queue Length 50th (ft)	64	~464	7	~80	220	76	~490	~101	330
Queue Length 95th (ft)	#146	#561	52	#158	271	m63	m228	#226	191
Internal Link Dist (ft)		1129			409		285		200
Turn Bay Length (ft)	140			110		150		120	
Base Capacity (vph)	177	1602	596	206	1504	159	1900	142	1850
Starvation Cap Reductn	0	0	0	0	0	0	278	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	8
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.57	1.09	0.27	1.04	0.74	0.81	1.23	1.03	0.83

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	96	1664	150	204	781	273	122	1811	78	139	1403	58
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5	4.5	4.0	4.5		4.0	4.5		4.0	4.5	
Lane Util. Factor	1.00	0.91	1.00	0.97	0.91		1.00	0.91		1.00	0.91	
Frt	1.00	1.00	0.85	1.00	0.96		1.00	0.99		1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	5085	1583	3433	4888		1770	5054		1770	5055	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	5085	1583	3433	4888		1770	5054		1770	5055	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	101	1752	158	215	822	287	128	1906	82	146	1477	61
RTOR Reduction (vph)	0	0	97	0	65	0	0	4	0	0	4	0
Lane Group Flow (vph)	101	1752	61	215	1044	0	128	1984	0	146	1534	0
Turn Type	Prot		Perm	Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4									
Actuated Green, G (s)	10.0	31.5	31.5	6.0	27.5		9.0	37.5		8.0	36.5	
Effective Green, g (s)	10.0	31.5	31.5	6.0	27.5		9.0	37.5		8.0	36.5	
Actuated g/C Ratio	0.10	0.32	0.32	0.06	0.28		0.09	0.38		0.08	0.36	
Clearance Time (s)	4.0	4.5	4.5	4.0	4.5		4.0	4.5		4.0	4.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	177	1602	499	206	1344		159	1895		142	1845	
v/s Ratio Prot	c0.06	c0.34		c0.06	0.21		0.07	c0.39		c0.08	0.30	
v/s Ratio Perm			0.04									
v/c Ratio	0.57	1.09	0.12	1.04	0.78		0.81	1.05		1.03	0.83	
Uniform Delay, d1	43.0	34.2	24.4	47.0	33.4		44.6	31.2		46.0	28.9	
Progression Factor	1.00	1.00	1.00	0.76	0.44		0.56	0.65		0.84	0.73	
Incremental Delay, d2	4.4	52.6	0.1	70.3	2.5		2.8	22.8		78.3	4.0	
Delay (s)	47.3	86.9	24.5	106.0	17.3		27.9	43.1		117.1	25.2	
Level of Service	D	F	C	F	B		C	D		F	C	
Approach Delay (s)		80.0			31.7			42.2			33.2	
Approach LOS		F			C			D			C	

Intersection Summary			
HCM Average Control Delay	48.8	HCM Level of Service	D
HCM Volume to Capacity ratio	1.10		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	96.6%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Queues
16: Willow St & Los Coyotes Diagonal

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Lane Group	EBL	EBT	WBL	WBT	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	77	680	352	2217	120	552	467	117	758
v/c Ratio	0.45	0.37	0.81	0.76	0.13	0.59	0.61	0.43	0.56
Control Delay	53.9	10.8	49.4	18.8	4.6	26.2	16.4	36.5	29.1
Queue Delay	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
Total Delay	53.9	10.8	49.4	19.0	4.6	26.2	16.4	36.5	29.1
Queue Length 50th (ft)	27	46	210	384	11	193	207	31	132
Queue Length 95th (ft)	m52	57	291	450	36	238	301	60	173
Internal Link Dist (ft)		409		995		363			581
Turn Bay Length (ft)	140		160					120	
Base Capacity (vph)	172	1821	549	2914	941	938	763	271	1354
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	160	0	0	0	0	1
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.45	0.37	0.64	0.81	0.13	0.59	0.61	0.43	0.56

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	73	646	0	334	2106	114	0	524	444	111	481	239
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5		4.0	4.5	4.5		4.5	4.5	4.5	4.5	
Lane Util. Factor	0.97	0.91		1.00	0.91	1.00		0.95	1.00	0.97	0.91	
Frt	1.00	1.00		1.00	1.00	0.85		1.00	0.85	1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3433	5085		1770	5085	1583		3539	1583	3433	4832	
Flt Permitted	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.28	1.00	
Satd. Flow (perm)	3433	5085		1770	5085	1583		3539	1583	1024	4832	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	77	680	0	352	2217	120	0	552	467	117	506	252
RTOR Reduction (vph)	0	0	0	0	0	35	0	0	343	0	74	0
Lane Group Flow (vph)	77	680	0	352	2217	85	0	552	124	117	685	0
Turn Type	Prot			Prot		Perm			Perm	Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases						8			2	6		
Actuated Green, G (s)	4.0	35.8		24.7	56.5	56.5		26.5	26.5	26.5	26.5	
Effective Green, g (s)	4.0	35.8		24.7	56.5	56.5		26.5	26.5	26.5	26.5	
Actuated g/C Ratio	0.04	0.36		0.25	0.56	0.56		0.26	0.26	0.26	0.26	
Clearance Time (s)	4.0	4.5		4.0	4.5	4.5		4.5	4.5	4.5	4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	137	1820		437	2873	894		938	419	271	1280	
v/s Ratio Prot	0.02	0.13		c0.20	c0.44			c0.16			0.14	
v/s Ratio Perm						0.05			0.08	0.11		
v/c Ratio	0.56	0.37		0.81	0.77	0.10		0.59	0.30	0.43	0.53	
Uniform Delay, d1	47.1	23.8		35.4	16.8	10.0		32.0	29.3	30.5	31.5	
Progression Factor	0.99	0.41		1.00	1.00	1.00		0.74	4.32	1.00	1.00	
Incremental Delay, d2	4.9	0.5		10.4	2.1	0.2		2.3	1.5	5.0	1.6	
Delay (s)	51.7	10.4		45.8	18.9	10.2		26.0	128.1	35.5	33.1	
Level of Service	D	B		D	B	B		C	F	D	C	
Approach Delay (s)		14.6			22.0			72.8			33.4	
Approach LOS		B			C			E			C	

Intersection Summary			
HCM Average Control Delay	32.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	8.5
Intersection Capacity Utilization	76.4%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Queues
16: Willow St & Los Coyotes Diagonal

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Lane Group	EBL	EBT	WBL	WBT	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	155	1875	488	1229	292	683	736	235	566
v/c Ratio	0.56	0.96	0.95	0.53	0.38	0.58	0.98	0.78	0.33
Control Delay	17.1	7.1	71.7	20.6	14.8	20.1	40.9	49.3	22.9
Queue Delay	0.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	17.1	9.9	71.7	20.6	14.8	20.1	40.9	49.3	22.9
Queue Length 50th (ft)	41	37	160	200	87	222	398	68	87
Queue Length 95th (ft)	m38	m32	#259	242	152	m255	m#515	#134	118
Internal Link Dist (ft)		409		995		363			581
Turn Bay Length (ft)	140		160					120	
Base Capacity (vph)	275	1958	515	2314	761	1186	753	303	1694
Starvation Cap Reductn	0	48	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.56	0.98	0.95	0.53	0.38	0.58	0.98	0.78	0.33

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	147	1781	0	464	1168	277	0	649	699	223	437	101
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5		4.0	4.5	4.5		4.5	4.5	4.5	4.5	
Lane Util. Factor	0.97	0.91		0.97	0.91	1.00		0.95	1.00	0.97	0.91	
Frt	1.00	1.00		1.00	1.00	0.85		1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3433	5085		3433	5085	1583		3539	1583	3433	4942	
Flt Permitted	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.25	1.00	
Satd. Flow (perm)	3433	5085		3433	5085	1583		3539	1583	905	4942	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	155	1875	0	488	1229	292	0	683	736	235	460	106
RTOR Reduction (vph)	0	0	0	0	0	40	0	0	223	0	38	0
Lane Group Flow (vph)	155	1875	0	488	1229	252	0	683	513	235	528	0
Turn Type	Prot			Prot		Perm			Perm	Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases						8			2	6		
Actuated Green, G (s)	8.0	38.5		15.0	45.5	45.5		33.5	33.5	33.5	33.5	
Effective Green, g (s)	8.0	38.5		15.0	45.5	45.5		33.5	33.5	33.5	33.5	
Actuated g/C Ratio	0.08	0.38		0.15	0.46	0.46		0.34	0.34	0.34	0.34	
Clearance Time (s)	4.0	4.5		4.0	4.5	4.5		4.5	4.5	4.5	4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	275	1958		515	2314	720		1186	530	303	1656	
v/s Ratio Prot	0.05	c0.37		c0.14	0.24			0.19			0.11	
v/s Ratio Perm						0.16			c0.32	0.26		
v/c Ratio	0.56	0.96		0.95	0.53	0.35		0.58	0.97	0.78	0.32	
Uniform Delay, d1	44.3	30.0		42.1	19.6	17.7		27.4	32.7	29.9	24.8	
Progression Factor	0.37	0.12		1.00	1.00	1.00		0.68	1.05	1.00	1.00	
Incremental Delay, d2	0.2	1.7		26.8	0.9	1.3		1.3	23.8	17.5	0.5	
Delay (s)	16.5	5.3		68.9	20.5	19.0		19.8	58.3	47.4	25.3	
Level of Service	B	A		E	C	B		B	E	D	C	
Approach Delay (s)		6.2			32.0			39.8			31.7	
Approach LOS		A			C			D			C	

Intersection Summary			
HCM Average Control Delay	25.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	95.3%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	2414	1537	477	134	1108	482	665
v/c Ratio	0.98	0.89	0.44	0.55	0.94	0.93	0.53
Control Delay	46.5	9.8	1.9	44.6	36.4	79.4	44.3
Queue Delay	2.8	5.9	0.8	0.0	0.0	0.0	0.0
Total Delay	49.3	15.6	2.7	44.6	36.4	79.4	44.3
Queue Length 50th (ft)	710	105	38	114	339	209	179
Queue Length 95th (ft)	#846	m121	m29	185	#426	#311	221
Internal Link Dist (ft)	1037	280			562		836
Turn Bay Length (ft)				330		290	
Base Capacity (vph)	2465	1729	1081	245	1183	520	1252
Starvation Cap Reductn	0	157	327	0	0	0	0
Spillback Cap Reductn	40	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	1.00	0.98	0.63	0.55	0.94	0.93	0.53

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	2142	151	0	1460	453	127	1022	30	458	631	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.5			5.5	5.5	5.5	5.5		5.5	5.5	
Lane Util. Factor		0.91			0.95	1.00	1.00	0.91		0.97	0.91	
Frt		0.99			1.00	0.85	1.00	1.00		1.00	1.00	
Flt Protected		1.00			1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		5035			3539	1583	1770	5063		3433	5084	
Flt Permitted		1.00			1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)		5035			3539	1583	1770	5063		3433	5084	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	2255	159	0	1537	477	134	1076	32	482	664	1
RTOR Reduction (vph)	0	6	0	0	0	1	0	2	0	0	0	0
Lane Group Flow (vph)	0	2408	0	0	1537	476	134	1106	0	482	665	0
Turn Type						pm+ov	Prot			Prot		
Protected Phases		4			8	1	5	2		1	6	
Permitted Phases						8						
Actuated Green, G (s)		63.5			63.5	83.2	18.0	30.3		19.7	32.0	
Effective Green, g (s)		63.5			63.5	83.2	18.0	30.3		19.7	32.0	
Actuated g/C Ratio		0.49			0.49	0.64	0.14	0.23		0.15	0.25	
Clearance Time (s)		5.5			5.5	5.5	5.5	5.5		5.5	5.5	
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		2459			1729	1080	245	1180		520	1251	
v/s Ratio Prot		c0.48			0.43	0.07	0.08	c0.22		c0.14	0.13	
v/s Ratio Perm						0.23						
v/c Ratio		0.98			0.89	0.44	0.55	0.94		0.93	0.53	
Uniform Delay, d1		32.6			30.1	11.7	52.2	48.9		54.4	42.5	
Progression Factor		1.00			0.19	0.14	0.71	0.46		1.00	1.00	
Incremental Delay, d2		13.5			2.8	0.1	7.3	13.2		22.7	1.6	
Delay (s)		46.1			8.6	1.8	44.1	35.5		77.1	44.1	
Level of Service		D			A	A	D	D		E	D	
Approach Delay (s)		46.1			7.0			36.5			58.0	
Approach LOS		D			A			D			E	

Intersection Summary			
HCM Average Control Delay	34.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	11.0
Intersection Capacity Utilization	92.0%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	467	2241	37	2086	758	147	249	498	373
v/c Ratio	0.91	0.78	0.54	0.95	0.93	0.46	0.87	0.49	0.61
Control Delay	51.8	4.3	77.8	22.0	52.5	16.5	86.8	40.5	20.6
Queue Delay	0.0	2.6	0.0	3.1	0.0	0.0	0.0	0.0	0.0
Total Delay	51.8	6.9	77.8	25.1	52.5	16.5	86.8	40.5	20.6
Queue Length 50th (ft)	216	138	33	524	136	10	108	184	109
Queue Length 95th (ft)	m223	m142	m45	#600	#295	76	#185	240	218
Internal Link Dist (ft)		280		585	326			720	
Turn Bay Length (ft)	200		200			130	160		
Base Capacity (vph)	515	2864	69	2192	818	317	287	1014	611
Starvation Cap Reductn	0	487	0	47	0	0	0	0	0
Spillback Cap Reductn	0	0	0	66	0	0	0	0	3
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.91	0.94	0.54	0.98	0.93	0.46	0.87	0.49	0.61

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	444	2115	14	35	1587	394	0	720	140	237	473	354
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Lane Util. Factor	0.97	0.91		1.00	0.91			0.91	1.00	0.97	0.95	1.00
Frt	1.00	1.00		1.00	0.97			1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	5080		1770	4934			5085	1583	3433	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	5080		1770	4934			5085	1583	3433	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	467	2226	15	37	1671	415	0	758	147	249	498	373
RTOR Reduction (vph)	0	0	0	0	34	0	0	0	62	0	0	157
Lane Group Flow (vph)	467	2241	0	37	2052	0	0	758	85	249	498	216
Turn Type	Prot			Prot					Perm	Prot		Perm
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases									2			6
Actuated Green, G (s)	20.5	72.1		4.1	55.7			20.9	20.9	10.9	37.3	37.3
Effective Green, g (s)	20.5	72.1		4.1	55.7			20.9	20.9	10.9	37.3	37.3
Actuated g/C Ratio	0.16	0.55		0.03	0.43			0.16	0.16	0.08	0.29	0.29
Clearance Time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	541	2817		56	2114			818	254	288	1015	454
v/s Ratio Prot	c0.14	0.44		0.02	c0.42			c0.15		c0.07	0.14	
v/s Ratio Perm									0.05			0.14
v/c Ratio	0.86	0.80		0.66	0.97			0.93	0.33	0.86	0.49	0.48
Uniform Delay, d1	53.4	23.1		62.3	36.4			53.8	48.4	58.8	38.5	38.3
Progression Factor	0.78	0.16		0.96	0.39			0.67	0.49	1.00	1.00	1.00
Incremental Delay, d2	4.3	0.7		17.6	10.4			15.8	3.0	27.5	1.7	3.5
Delay (s)	45.8	4.3		77.5	24.6			51.7	26.9	86.3	40.2	41.8
Level of Service	D	A		E	C			D	C	F	D	D
Approach Delay (s)		11.5			25.5			47.7			51.0	
Approach LOS		B			C			D			D	

Intersection Summary			
HCM Average Control Delay	27.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	91.1%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	62	706	45	1129	438	78	467	172	372	16
v/c Ratio	0.33	0.35	0.16	0.58	0.51	0.21	0.63	0.51	0.36	0.04
Control Delay	31.1	11.1	21.4	34.0	5.8	44.1	49.8	44.3	37.7	24.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	31.1	11.1	21.4	34.0	5.8	44.1	49.8	44.3	37.7	24.8
Queue Length 50th (ft)	15	44	21	282	12	55	185	177	128	9
Queue Length 95th (ft)	m51	m76	44	332	90	101	245	m268	m167	m24
Internal Link Dist (ft)		562		597			652		326	
Turn Bay Length (ft)	110		120		200	280		240		60
Base Capacity (vph)	187	1992	288	1936	860	374	743	334	1029	357
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.33	0.35	0.16	0.58	0.51	0.21	0.63	0.51	0.36	0.04

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	59	655	16	43	1073	416	74	388	56	327	190	15
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.5		4.0	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00	1.00	0.95		0.86	0.86	1.00
Frt	1.00	1.00		1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (prot)	1770	5067		1770	5085	1583	1770	3472		1522	4697	1583
Flt Permitted	0.14	1.00		0.32	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (perm)	266	5067		603	5085	1583	1770	3472		1522	4697	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	62	689	17	45	1129	438	78	408	59	344	200	16
RTOR Reduction (vph)	0	2	0	0	0	260	0	9	0	0	0	10
Lane Group Flow (vph)	62	704	0	45	1129	178	78	458	0	172	372	6
Turn Type	pm+pt			pm+pt		Perm	Split			Split		Perm
Protected Phases	7	4		3	8		2	2		6	6	
Permitted Phases	4			8		8						6
Actuated Green, G (s)	55.1	50.3		51.9	48.7	48.7	27.5	27.5		28.5	28.5	28.5
Effective Green, g (s)	55.1	50.3		51.9	48.7	48.7	27.5	27.5		28.5	28.5	28.5
Actuated g/C Ratio	0.42	0.39		0.40	0.37	0.37	0.21	0.21		0.22	0.22	0.22
Clearance Time (s)	4.0	5.5		4.0	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	168	1961		269	1905	593	374	734		334	1030	347
v/s Ratio Prot	c0.01	0.14		0.00	c0.22		0.04	c0.13		c0.11	0.08	
v/s Ratio Perm	0.14			0.06		0.11						0.00
v/c Ratio	0.37	0.36		0.17	0.59	0.30	0.21	0.62		0.51	0.36	0.02
Uniform Delay, d1	24.2	28.4		24.2	32.7	28.7	42.3	46.6		44.7	43.0	39.8
Progression Factor	1.34	0.38		1.00	1.00	1.00	1.00	1.00		0.87	0.85	1.19
Incremental Delay, d2	1.1	0.4		0.3	1.4	1.3	1.3	4.0		4.9	0.9	0.1
Delay (s)	33.6	11.2		24.5	34.0	30.0	43.5	50.5		43.7	37.5	47.2
Level of Service	C	B		C	C	C	D	D		D	D	D
Approach Delay (s)		13.0			32.7			49.5			39.7	
Approach LOS		B			C			D			D	

Intersection Summary			
HCM Average Control Delay	32.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	24.5
Intersection Capacity Utilization	62.7%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	98	2468	36	124	2445	89	86	160	45	50
v/c Ratio	0.81	0.71	0.03	0.79	0.74	0.87	0.80	0.71	0.22	0.38
Control Delay	77.8	13.8	5.4	67.9	0.8	120.0	106.0	26.6	60.2	35.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	77.8	13.9	5.4	67.9	0.8	120.0	106.0	26.6	60.2	35.9
Queue Length 50th (ft)	80	345	4	57	9	76	73	0	19	14
Queue Length 95th (ft)	m#112	382	m7	m64	12	#180	#167	#90	38	55
Internal Link Dist (ft)		585			1015		352			692
Turn Bay Length (ft)	270			275		100		350		
Base Capacity (vph)	121	3491	1095	156	3305	102	107	225	634	337
Starvation Cap Reductn	0	82	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	1	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.81	0.72	0.03	0.79	0.74	0.87	0.80	0.71	0.07	0.15

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	93	2345	34	118	1942	381	85	82	152	43	16	31
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	5.5	5.5	
Lane Util. Factor	1.00	0.91	1.00	0.97	0.91		1.00	1.00	1.00	0.97	1.00	
Frt	1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85	1.00	0.90	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5085	1583	3433	4960		1770	1863	1583	3433	1678	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	5085	1583	3433	4960		1770	1863	1583	3433	1678	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	98	2468	36	124	2044	401	89	86	160	45	17	33
RTOR Reduction (vph)	0	0	9	0	16	0	0	0	153	0	31	0
Lane Group Flow (vph)	98	2468	27	124	2429	0	89	86	7	45	19	0
Turn Type	Prot		Perm	Prot			Split		Over	Split		
Protected Phases	7	4		3	8		2	2	3	6	6	
Permitted Phases			4									
Actuated Green, G (s)	8.9	88.1	88.1	5.9	85.1		7.5	7.5	5.9	6.5	6.5	
Effective Green, g (s)	8.9	88.1	88.1	5.9	85.1		7.5	7.5	5.9	6.5	6.5	
Actuated g/C Ratio	0.07	0.68	0.68	0.05	0.65		0.06	0.06	0.05	0.05	0.05	
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	5.5	5.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	121	3446	1073	156	3247		102	107	72	172	84	
v/s Ratio Prot	c0.06	0.49		0.04	c0.49		c0.05	0.05	0.00	c0.01	0.01	
v/s Ratio Perm			0.02									
v/c Ratio	0.81	0.72	0.03	0.79	0.75		0.87	0.80	0.10	0.26	0.22	
Uniform Delay, d1	59.7	13.1	6.9	61.5	15.2		60.8	60.5	59.5	59.4	59.3	
Progression Factor	0.80	0.98	1.50	0.83	0.01		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	21.1	0.8	0.0	11.5	0.7		50.8	33.9	0.6	0.8	1.3	
Delay (s)	68.7	13.6	10.3	62.3	0.8		111.5	94.4	60.1	60.3	60.7	
Level of Service	E	B	B	E	A		F	F	E	E	E	
Approach Delay (s)		15.7			3.8			82.6			60.5	
Approach LOS		B			A			F			E	

Intersection Summary			
HCM Average Control Delay	15.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	76.3%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBT	WBR	SBL
Lane Group Flow (vph)	107	2459	2596	553	144
v/c Ratio	0.41	0.76	0.90	0.55	0.25
Control Delay	42.7	19.8	8.5	1.5	29.7
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	42.7	19.8	8.5	1.5	29.7
Queue Length 50th (ft)	71	337	353	29	31
Queue Length 95th (ft)	m100	371	m371	m29	65
Internal Link Dist (ft)		1015	1000		632
Turn Bay Length (ft)	400			150	150
Base Capacity (vph)	457	3247	2871	1007	584
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.23	0.76	0.90	0.55	0.25

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	102	2336	2466	525	80	57
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5	
Lane Util. Factor	1.00	0.91	0.91	1.00	0.97	
Frt	1.00	1.00	1.00	0.85	0.94	
Flt Protected	0.95	1.00	1.00	1.00	0.97	
Satd. Flow (prot)	1770	5085	5085	1583	3292	
Flt Permitted	0.95	1.00	1.00	1.00	0.97	
Satd. Flow (perm)	1770	5085	5085	1583	3292	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	107	2459	2596	553	84	60
RTOR Reduction (vph)	0	0	0	113	50	0
Lane Group Flow (vph)	107	2459	2596	440	94	0
Turn Type	Prot			Perm		
Protected Phases	7 9	4	8		6	
Permitted Phases				8		
Actuated Green, G (s)	19.0	83.0	73.4	73.4	21.1	
Effective Green, g (s)	19.0	83.0	73.4	73.4	21.1	
Actuated g/C Ratio	0.15	0.64	0.56	0.56	0.16	
Clearance Time (s)		5.5	5.5	5.5	5.5	
Vehicle Extension (s)		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	259	3247	2871	894	534	
v/s Ratio Prot	c0.06	c0.48	c0.51		c0.03	
v/s Ratio Perm				0.28		
v/c Ratio	0.41	0.76	0.90	0.49	0.18	
Uniform Delay, d1	50.4	16.4	25.2	17.1	47.0	
Progression Factor	0.79	1.11	0.27	0.10	1.00	
Incremental Delay, d2	0.8	1.2	1.5	0.5	0.7	
Delay (s)	40.5	19.5	8.2	2.2	47.7	
Level of Service	D	B	A	A	D	
Approach Delay (s)		20.4	7.1		47.7	
Approach LOS		C	A		D	

Intersection Summary			
HCM Average Control Delay	13.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	11.0
Intersection Capacity Utilization	71.1%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	140	2331	64	43	3302	208	168	46	111
v/c Ratio	0.93	0.66	0.06	0.41	1.00	0.20	1.01	0.26	0.36
Control Delay	87.2	6.6	2.6	70.3	38.3	5.2	126.1	54.4	16.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	87.2	6.6	2.6	70.3	38.3	5.2	126.1	54.4	16.7
Queue Length 50th (ft)	112	138	2	35	946	33	~144	35	12
Queue Length 95th (ft)	m#192	208	m5	76	#1132	65	#296	76	68
Internal Link Dist (ft)		1000			893		425		590
Turn Bay Length (ft)	150		150	300		150			
Base Capacity (vph)	150	3520	1109	118	3305	1062	167	178	307
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.93	0.66	0.06	0.36	1.00	0.20	1.01	0.26	0.36

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	133	2214	61	41	3137	198	114	35	10	44	15	90
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5	5.5		5.5		5.5	5.5	
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91	1.00		1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85		0.99		1.00	0.87	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00		0.97		0.95	1.00	
Satd. Flow (prot)	1770	5085	1583	1770	5085	1583		1783		1770	1624	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00		0.64		0.69	1.00	
Satd. Flow (perm)	1770	5085	1583	1770	5085	1583		1190		1286	1624	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	140	2331	64	43	3302	208	120	37	11	46	16	95
RTOR Reduction (vph)	0	0	14	0	0	34	0	2	0	0	82	0
Lane Group Flow (vph)	140	2331	50	43	3302	174	0	166	0	46	29	0
Turn Type	Prot		Perm	Prot		Perm	Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8	2			6		
Actuated Green, G (s)	12.1	88.9	88.9	6.6	83.4	83.4		18.0		18.0	18.0	
Effective Green, g (s)	12.1	88.9	88.9	6.6	83.4	83.4		18.0		18.0	18.0	
Actuated g/C Ratio	0.09	0.68	0.68	0.05	0.64	0.64		0.14		0.14	0.14	
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5	5.5		5.5		5.5	5.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0		3.0		3.0	3.0	
Lane Grp Cap (vph)	165	3477	1083	90	3262	1016		165		178	225	
v/s Ratio Prot	c0.08	0.46		0.02	c0.65						0.02	
v/s Ratio Perm			0.03			0.11		c0.14		0.04		
v/c Ratio	0.85	0.67	0.05	0.48	1.01	0.17		1.01		0.26	0.13	
Uniform Delay, d1	58.0	12.0	6.7	60.0	23.3	9.4		56.0		50.0	49.1	
Progression Factor	0.68	0.49	0.80	1.00	1.00	1.00		1.00		1.00	1.00	
Incremental Delay, d2	22.3	0.7	0.1	4.0	18.9	0.4		72.1		0.8	0.3	
Delay (s)	62.1	6.6	5.4	64.0	42.2	9.7		128.1		50.8	49.4	
Level of Service	E	A	A	E	D	A		F		D	D	
Approach Delay (s)		9.6			40.5			128.1			49.8	
Approach LOS		A			D			F			D	

Intersection Summary			
HCM Average Control Delay	30.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.99		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	97.2%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Queues
30: 7th St & PCH

3/26/2013

Lane Group	EBT	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	2077	1627	534	184	993	586	1056
v/c Ratio	0.87	0.97	0.48	0.76	0.89	0.94	0.79
Control Delay	35.5	27.8	7.9	52.6	48.4	77.3	49.5
Queue Delay	1.7	0.0	1.9	0.0	0.0	14.6	0.0
Total Delay	37.2	27.8	9.8	52.6	48.4	91.9	49.5
Queue Length 50th (ft)	558	246	125	158	325	254	304
Queue Length 95th (ft)	630	#841	m157	#265	#384	#365	359
Internal Link Dist (ft)	1037	280			562		836
Turn Bay Length (ft)				330		290	
Base Capacity (vph)	2385	1674	1103	241	1112	621	1342
Starvation Cap Reductn	0	0	399	0	0	0	0
Spillback Cap Reductn	165	0	0	0	0	45	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.94	0.97	0.76	0.76	0.89	1.02	0.79

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1813	161	0	1546	507	175	913	30	557	1001	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.5			5.5	5.5	5.5	5.5		5.5	5.5	
Lane Util. Factor		0.91			0.95	1.00	1.00	0.91		0.97	0.91	
Frt		0.99			1.00	0.85	1.00	1.00		1.00	1.00	
Flt Protected		1.00			1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		5023			3539	1583	1770	5061		3433	5084	
Flt Permitted		1.00			1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)		5023			3539	1583	1770	5061		3433	5084	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1908	169	0	1627	534	184	961	32	586	1054	2
RTOR Reduction (vph)	0	8	0	0	0	1	0	2	0	0	0	0
Lane Group Flow (vph)	0	2069	0	0	1627	533	184	991	0	586	1056	0
Turn Type						pm+ov	Prot			Prot		
Protected Phases		4			8	1	5	2		1	6	
Permitted Phases						8						
Actuated Green, G (s)		61.5			61.5	85.0	17.7	28.5		23.5	34.3	
Effective Green, g (s)		61.5			61.5	85.0	17.7	28.5		23.5	34.3	
Actuated g/C Ratio		0.47			0.47	0.65	0.14	0.22		0.18	0.26	
Clearance Time (s)		5.5			5.5	5.5	5.5	5.5		5.5	5.5	
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		2376			1674	1102	241	1110		621	1341	
v/s Ratio Prot		0.41			c0.46	0.09	0.10	c0.20		c0.17	0.21	
v/s Ratio Perm						0.25						
v/c Ratio		0.87			0.97	0.48	0.76	0.89		0.94	0.79	
Uniform Delay, d1		30.7			33.4	11.4	54.1	49.3		52.6	44.5	
Progression Factor		1.00			0.51	0.78	0.61	0.78		1.00	1.00	
Incremental Delay, d2		3.8			9.3	0.2	18.1	9.8		23.0	4.7	
Delay (s)		34.5			26.3	9.0	51.3	48.1		75.6	49.2	
Level of Service		C			C	A	D	D		E	D	
Approach Delay (s)		34.5			22.0			48.6			58.6	
Approach LOS		C			C			D			E	

Intersection Summary			
HCM Average Control Delay	38.6	HCM Level of Service	D
HCM Volume to Capacity ratio	0.95		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	90.7%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	397	2139	39	1742	708	127	403	758	604
v/c Ratio	0.84	0.85	0.54	0.91	0.84	0.39	0.80	0.60	0.78
Control Delay	76.5	14.4	68.3	28.5	47.9	15.6	66.4	36.8	24.3
Queue Delay	0.0	7.7	0.0	0.3	0.0	0.0	0.0	0.0	1.6
Total Delay	76.5	22.1	68.3	28.8	47.9	15.6	66.4	36.8	25.9
Queue Length 50th (ft)	175	240	30	141	152	15	171	274	217
Queue Length 95th (ft)	m199	m444	m#66	#200	198	62	#240	341	383
Internal Link Dist (ft)		280		585	326			720	
Turn Bay Length (ft)	200		200			130	160		
Base Capacity (vph)	491	2505	72	1912	845	329	504	1258	775
Starvation Cap Reductn	0	349	0	0	0	0	0	0	0
Spillback Cap Reductn	0	46	0	18	0	0	0	0	64
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.81	0.99	0.54	0.92	0.84	0.39	0.80	0.60	0.85

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	377	2008	24	37	1499	156	0	673	121	383	720	574
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Lane Util. Factor	0.97	0.91		1.00	0.91			0.91	1.00	0.97	0.95	1.00
Frt	1.00	1.00		1.00	0.99			1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	5076		1770	5013			5085	1583	3433	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	5076		1770	5013			5085	1583	3433	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	397	2114	25	39	1578	164	0	708	127	403	758	604
RTOR Reduction (vph)	0	1	0	0	9	0	0	0	66	0	0	213
Lane Group Flow (vph)	397	2138	0	39	1733	0	0	708	61	403	758	391
Turn Type	Prot			Prot					Perm	Prot		Perm
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases									2			6
Actuated Green, G (s)	18.0	63.1		4.2	49.3			21.6	21.6	19.1	46.2	46.2
Effective Green, g (s)	18.0	63.1		4.2	49.3			21.6	21.6	19.1	46.2	46.2
Actuated g/C Ratio	0.14	0.49		0.03	0.38			0.17	0.17	0.15	0.36	0.36
Clearance Time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	475	2464		57	1901			845	263	504	1258	563
v/s Ratio Prot	0.12	c0.42		0.02	c0.35			c0.14		c0.12	0.21	
v/s Ratio Perm									0.04			0.25
v/c Ratio	0.84	0.87		0.68	0.91			0.84	0.23	0.80	0.60	0.69
Uniform Delay, d1	54.6	29.7		62.2	38.3			52.5	47.0	53.6	34.4	35.9
Progression Factor	1.26	0.42		0.72	0.55			0.74	0.62	1.00	1.00	1.00
Incremental Delay, d2	5.7	2.0		25.4	7.1			8.5	1.8	12.5	2.1	6.9
Delay (s)	74.7	14.6		70.5	28.1			47.6	31.1	66.1	36.5	42.8
Level of Service	E	B		E	C			D	C	E	D	D
Approach Delay (s)		24.0			29.0			45.1			45.4	
Approach LOS		C			C			D			D	

Intersection Summary			
HCM Average Control Delay	33.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	85.5%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	217	831	79	1054	384	51	283	161	498	44
v/c Ratio	0.69	0.35	0.27	0.54	0.46	0.21	0.59	0.52	0.51	0.13
Control Delay	24.8	19.4	33.2	33.5	5.7	52.8	58.1	19.8	16.0	5.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	24.8	19.4	33.2	33.5	5.7	52.8	58.1	19.8	16.0	5.5
Queue Length 50th (ft)	171	238	42	250	8	39	118	143	146	14
Queue Length 95th (ft)	m220	m285	84	326	86	80	167	m222	m154	m21
Internal Link Dist (ft)		562		597			652		326	
Turn Bay Length (ft)	110		120		200	280		240		60
Base Capacity (vph)	394	2376	292	1936	830	238	476	310	971	344
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.55	0.35	0.27	0.54	0.46	0.21	0.59	0.52	0.51	0.13

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	206	694	95	75	1001	365	48	256	13	238	388	42
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.5		4.0	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00	1.00	0.95		0.86	0.86	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.99	1.00
Satd. Flow (prot)	1770	4994		1770	5085	1583	1770	3513		1522	4763	1583
Flt Permitted	0.14	1.00		0.33	1.00	1.00	0.95	1.00		0.95	0.99	1.00
Satd. Flow (perm)	262	4994		609	5085	1583	1770	3513		1522	4763	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	217	731	100	79	1054	384	51	269	14	251	408	44
RTOR Reduction (vph)	0	13	0	0	0	228	0	3	0	0	0	21
Lane Group Flow (vph)	217	818	0	79	1054	156	51	280	0	161	498	23
Turn Type	pm+pt			pm+pt		Perm	Split			Split		Perm
Protected Phases	7	4		3	8		2	2		6	6	
Permitted Phases	4			8		8						6
Actuated Green, G (s)	60.7	60.7		51.0	49.5	49.5	17.5	17.5		26.5	26.5	26.5
Effective Green, g (s)	60.7	60.7		51.0	49.5	49.5	17.5	17.5		26.5	26.5	26.5
Actuated g/C Ratio	0.47	0.47		0.39	0.38	0.38	0.13	0.13		0.20	0.20	0.20
Clearance Time (s)	4.0	5.5		4.0	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	308	2332		282	1936	603	238	473		310	971	323
v/s Ratio Prot	c0.09	0.16		0.01	c0.21		0.03	c0.08		c0.11	0.10	
v/s Ratio Perm	c0.24			0.10		0.10						0.01
v/c Ratio	0.70	0.35		0.28	0.54	0.26	0.21	0.59		0.52	0.51	0.07
Uniform Delay, d1	24.0	22.1		27.6	31.4	27.6	50.1	52.9		46.1	46.0	41.8
Progression Factor	0.80	0.89		1.00	1.00	1.00	1.00	1.00		0.32	0.31	0.22
Incremental Delay, d2	4.2	0.2		0.5	1.1	1.0	2.1	5.4		4.9	1.5	0.3
Delay (s)	23.5	20.0		28.1	32.5	28.7	52.2	58.3		19.5	15.9	9.6
Level of Service	C	C		C	C	C	D	E		B	B	A
Approach Delay (s)		20.7			31.3			57.3			16.3	
Approach LOS		C			C			E			B	

Intersection Summary			
HCM Average Control Delay	27.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	64.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	26	2488	111	284	1748	56	13	132	258	151
v/c Ratio	0.27	0.83	0.11	0.91	0.52	0.75	0.16	0.54	0.61	0.64
Control Delay	79.6	5.6	0.6	63.3	0.4	111.0	64.9	22.5	60.1	57.2
Queue Delay	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	79.6	5.8	0.6	63.3	0.4	111.0	64.9	22.5	60.1	57.2
Queue Length 50th (ft)	22	151	3	127	0	48	11	15	108	103
Queue Length 95th (ft)	m27	172	m6	m#206	0	#125	34	80	145	167
Internal Link Dist (ft)		585			1015		352			692
Turn Bay Length (ft)	270			275		100		350		
Base Capacity (vph)	99	3012	968	312	3364	75	79	246	634	342
Starvation Cap Reductn	0	61	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.26	0.84	0.11	0.91	0.52	0.75	0.16	0.54	0.41	0.44

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	25	2364	105	270	1624	37	53	12	125	245	83	61
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	5.5	5.5	
Lane Util. Factor	1.00	0.91	1.00	0.97	0.91		1.00	1.00	1.00	0.97	1.00	
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85	1.00	0.94	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5085	1583	3433	5068		1770	1863	1583	3433	1744	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	5085	1583	3433	5068		1770	1863	1583	3433	1744	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	26	2488	111	284	1709	39	56	13	132	258	87	64
RTOR Reduction (vph)	0	0	33	0	1	0	0	0	101	0	22	0
Lane Group Flow (vph)	26	2488	78	284	1747	0	56	13	31	258	129	0
Turn Type	Prot		Perm	Prot			Split		Over	Split		
Protected Phases	7	4		3	8		2	2	3	6	6	
Permitted Phases			4									
Actuated Green, G (s)	4.8	73.7	73.7	14.0	82.9		4.4	4.4	14.0	15.9	15.9	
Effective Green, g (s)	4.8	73.7	73.7	14.0	82.9		4.4	4.4	14.0	15.9	15.9	
Actuated g/C Ratio	0.04	0.57	0.57	0.11	0.64		0.03	0.03	0.11	0.12	0.12	
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	5.5	5.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	65	2883	897	370	3232		60	63	170	420	213	
v/s Ratio Prot	0.01	c0.49		c0.08	0.34		c0.03	0.01	0.02	c0.08	0.07	
v/s Ratio Perm			0.05									
v/c Ratio	0.40	0.86	0.09	0.77	0.54		0.93	0.21	0.18	0.61	0.61	
Uniform Delay, d1	61.2	23.9	12.8	56.4	13.0		62.7	61.1	52.8	54.1	54.1	
Progression Factor	1.29	0.16	0.09	0.65	0.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	2.2	2.1	0.1	6.1	0.4		91.8	1.6	0.5	2.7	4.8	
Delay (s)	81.3	5.8	1.3	42.7	0.5		154.5	62.7	53.3	56.8	58.9	
Level of Service	F	A	A	D	A		F	E	D	E	E	
Approach Delay (s)		6.4			6.4			82.1			57.6	
Approach LOS		A			A			F			E	

Intersection Summary			
HCM Average Control Delay	13.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	83.1%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	WBT	WBR	SBL
Lane Group Flow (vph)	2863	2096	220	464
v/c Ratio	1.02	0.75	0.24	0.37
Control Delay	37.6	8.3	1.3	31.6
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	37.6	8.3	1.3	31.6
Queue Length 50th (ft)	~598	103	6	147
Queue Length 95th (ft)	#1000	117	m11	193
Internal Link Dist (ft)	1015	1000		632
Turn Bay Length (ft)			150	150
Base Capacity (vph)	2808	2808	922	1246
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	1.02	0.75	0.24	0.37

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	2720	1991	209	441	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.5	5.5	5.5	5.5	
Lane Util. Factor		0.91	0.91	1.00	0.97	
Frt		1.00	1.00	0.85	1.00	
Flt Protected		1.00	1.00	1.00	0.95	
Satd. Flow (prot)		5085	5085	1583	3433	
Flt Permitted		1.00	1.00	1.00	0.95	
Satd. Flow (perm)		5085	5085	1583	3433	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	2863	2096	220	464	0
RTOR Reduction (vph)	0	0	0	48	0	0
Lane Group Flow (vph)	0	2863	2096	172	464	0
Turn Type	Prot			Perm		
Protected Phases	7 9	4	8		6	
Permitted Phases				8		
Actuated Green, G (s)		71.8	71.8	71.8	47.2	
Effective Green, g (s)		71.8	71.8	71.8	47.2	
Actuated g/C Ratio		0.55	0.55	0.55	0.36	
Clearance Time (s)		5.5	5.5	5.5	5.5	
Vehicle Extension (s)		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		2808	2808	874	1246	
v/s Ratio Prot		c0.56	0.41		c0.14	
v/s Ratio Perm				0.11		
v/c Ratio		1.02	0.75	0.20	0.37	
Uniform Delay, d1		29.1	22.2	14.6	30.5	
Progression Factor		0.62	0.31	0.12	1.00	
Incremental Delay, d2		18.5	1.3	0.3	0.9	
Delay (s)		36.6	8.2	2.1	31.3	
Level of Service		D	A	A	C	
Approach Delay (s)		36.6	7.6		31.3	
Approach LOS		D	A		C	

Intersection Summary			
HCM Average Control Delay	24.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	11.0
Intersection Capacity Utilization	74.3%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	128	3179	21	67	2231	71	75	121	202
v/c Ratio	0.54	0.88	0.02	0.67	0.72	0.07	0.66	0.74	0.60
Control Delay	38.2	6.7	1.5	91.0	19.2	5.0	73.2	80.8	24.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	38.2	6.7	1.5	91.0	19.2	5.0	73.2	80.8	24.8
Queue Length 50th (ft)	93	140	1	56	450	9	52	100	43
Queue Length 95th (ft)	m100	m138	m1	#128	505	28	#129	#196	126
Internal Link Dist (ft)		1000			893		425		590
Turn Bay Length (ft)	150		150	300		150			
Base Capacity (vph)	238	3603	1124	102	3110	985	114	164	335
Starvation Cap Reductn	0	8	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.54	0.88	0.02	0.66	0.72	0.07	0.66	0.74	0.60

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	122	3020	20	64	2119	67	27	27	18	115	34	158
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5	5.5		5.5		5.5	5.5	
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91	1.00		1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85		0.97		1.00	0.88	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00		0.98		0.95	1.00	
Satd. Flow (prot)	1770	5085	1583	1770	5085	1583		1766		1770	1633	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00		0.45		0.70	1.00	
Satd. Flow (perm)	1770	5085	1583	1770	5085	1583		818		1296	1633	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	128	3179	21	67	2231	71	28	28	19	121	36	166
RTOR Reduction (vph)	0	0	3	0	0	17	0	10	0	0	127	0
Lane Group Flow (vph)	128	3179	18	67	2231	54	0	65	0	121	75	0
Turn Type	Prot		Perm	Prot		Perm	Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8	2			6		
Actuated Green, G (s)	18.6	91.0	91.0	6.0	78.4	78.4		16.5		16.5	16.5	
Effective Green, g (s)	18.6	91.0	91.0	6.0	78.4	78.4		16.5		16.5	16.5	
Actuated g/C Ratio	0.14	0.70	0.70	0.05	0.60	0.60		0.13		0.13	0.13	
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5	5.5		5.5		5.5	5.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0		3.0		3.0	3.0	
Lane Grp Cap (vph)	253	3560	1108	82	3067	955		104		164	207	
v/s Ratio Prot	0.07	c0.63		0.04	c0.44						0.05	
v/s Ratio Perm			0.01			0.03		0.08		c0.09		
v/c Ratio	0.51	0.89	0.02	0.82	0.73	0.06		0.63		0.74	0.36	
Uniform Delay, d1	51.5	15.6	5.9	61.5	18.2	10.6		53.8		54.7	51.9	
Progression Factor	0.66	0.33	0.36	1.00	1.00	1.00		1.00		1.00	1.00	
Incremental Delay, d2	0.6	1.5	0.0	44.3	1.5	0.1		25.4		15.8	1.1	
Delay (s)	34.5	6.6	2.2	105.8	19.8	10.7		79.3		70.5	53.0	
Level of Service	C	A	A	F	B	B		E		E	D	
Approach Delay (s)		7.7			22.0			79.3			59.6	
Approach LOS		A			C			E			E	

Intersection Summary			
HCM Average Control Delay	16.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	96.8%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

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Appendix A2

Year 2040 Alternative 3
Intersection Level of Service (LOS) Worksheets

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Queues
1: Carson St & I-605 SB Off Ramps

12/4/2012

Lane Group	EBT	WBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	1402	1559	82	811	450	358
v/c Ratio	0.51	0.71	0.05	0.65	0.41	0.68
Control Delay	10.8	9.2	0.1	16.5	13.4	22.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	10.8	9.2	0.1	16.5	13.4	22.2
Queue Length 50th (ft)	77	100	0	100	52	93
Queue Length 95th (ft)	104	118	0	150	85	#212
Internal Link Dist (ft)	550	190			1136	
Turn Bay Length (ft)				300		300
Base Capacity (vph)	2814	2237	1611	1243	1087	527
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.50	0.70	0.05	0.65	0.41	0.68

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1267	65	0	1481	0	0	0	78	770	87	680
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.9			4.9				4.0	5.4	5.4	5.4
Lane Util. Factor		0.86			0.91				1.00	0.97	0.91	0.91
Frt		0.99			1.00				0.86	1.00	0.88	0.85
Flt Protected		1.00			1.00				1.00	0.95	1.00	1.00
Satd. Flow (prot)		6361			5085				1611	3433	2986	1441
Flt Permitted		1.00			1.00				1.00	0.95	1.00	1.00
Satd. Flow (perm)		6361			5085				1611	3433	2986	1441
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1334	68	0	1559	0	0	0	82	811	92	716
RTOR Reduction (vph)	0	15	0	0	0	0	0	0	0	0	5	5
Lane Group Flow (vph)	0	1387	0	0	1559	0	0	0	82	811	445	353
Turn Type									Free	Split		Perm
Protected Phases		2			6					4	4	
Permitted Phases									Free			4
Actuated Green, G (s)		21.6			21.6				50.0	18.1	18.1	18.1
Effective Green, g (s)		21.6			21.6				50.0	18.1	18.1	18.1
Actuated g/C Ratio		0.43			0.43				1.00	0.36	0.36	0.36
Clearance Time (s)		4.9			4.9					5.4	5.4	5.4
Vehicle Extension (s)		5.0			5.0					2.5	2.5	2.5
Lane Grp Cap (vph)		2748			2197				1611	1243	1081	522
v/s Ratio Prot		0.22			c0.31					0.24	0.15	
v/s Ratio Perm									0.05			c0.24
v/c Ratio		0.50			0.71				0.05	0.65	0.41	0.68
Uniform Delay, d1		10.3			11.6				0.0	13.3	12.0	13.5
Progression Factor		1.00			0.66				1.00	1.00	1.00	1.00
Incremental Delay, d2		0.3			1.1				0.1	2.7	1.2	6.9
Delay (s)		10.6			8.7				0.1	16.0	13.1	20.3
Level of Service		B			A				A	B	B	C
Approach Delay (s)		10.6			8.7			0.1			16.2	
Approach LOS		B			A			A			B	

Intersection Summary			
HCM Average Control Delay	11.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	50.0	Sum of lost time (s)	10.3
Intersection Capacity Utilization	65.3%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	WBT	WBR	NBL	NBR
Lane Group Flow (vph)	1895	1309	874	706	640
v/c Ratio	0.53	0.67	0.69	0.59	0.65
Control Delay	12.9	7.5	6.0	29.0	30.2
Queue Delay	0.0	1.4	4.5	0.0	0.0
Total Delay	12.9	8.9	10.5	29.0	30.2
Queue Length 50th (ft)	201	127	131	188	187
Queue Length 95th (ft)	223	m161	m170	246	255
Internal Link Dist (ft)	410	90			
Turn Bay Length (ft)				300	300
Base Capacity (vph)	3563	1968	1268	1202	987
Starvation Cap Reductn	0	430	314	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.53	0.85	0.92	0.59	0.65

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1800	0	0	1244	830	671	0	608	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.4			5.4	5.4	4.0		4.0			
Lane Util. Factor		0.86			0.95	1.00	0.97		0.88			
Frt		1.00			1.00	0.85	1.00		0.85			
Flt Protected		1.00			1.00	1.00	0.95		1.00			
Satd. Flow (prot)		6408			3539	1583	3433		2787			
Flt Permitted		1.00			1.00	1.00	0.95		1.00			
Satd. Flow (perm)		6408			3539	1583	3433		2787			
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1895	0	0	1309	874	706	0	640	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	388	0	0	12	0	0	0
Lane Group Flow (vph)	0	1895	0	0	1309	486	706	0	628	0	0	0
Turn Type						Perm	custom		custom			
Protected Phases		2			6							
Permitted Phases						6	8		8			
Actuated Green, G (s)		55.6			55.6	55.6	35.0		35.0			
Effective Green, g (s)		55.6			55.6	55.6	35.0		35.0			
Actuated g/C Ratio		0.56			0.56	0.56	0.35		0.35			
Clearance Time (s)		5.4			5.4	5.4	4.0		4.0			
Vehicle Extension (s)		5.0			5.0	5.0	3.0		3.0			
Lane Grp Cap (vph)		3563			1968	880	1202		975			
v/s Ratio Prot		0.30			c0.37							
v/s Ratio Perm						0.31	0.21		c0.23			
v/c Ratio		0.53			0.67	0.55	0.59		0.64			
Uniform Delay, d1		14.0			15.6	14.2	26.6		27.3			
Progression Factor		0.88			0.40	4.09	1.00		1.00			
Incremental Delay, d2		0.2			0.7	0.8	2.1		3.3			
Delay (s)		12.6			7.0	58.9	28.7		30.6			
Level of Service		B			A	E	C		C			
Approach Delay (s)		12.6			27.8			29.6			0.0	
Approach LOS		B			C			C			A	

Intersection Summary			
HCM Average Control Delay	22.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	9.4
Intersection Capacity Utilization	61.4%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	639	1412	6	1360	219	216	156	311	301
v/c Ratio	0.94	0.52	0.05	0.86	0.90	0.31	0.52	0.78	0.63
Control Delay	53.1	10.7	44.5	39.8	81.8	33.9	50.2	28.1	10.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	53.1	10.7	44.5	39.8	81.8	33.9	50.2	28.1	10.9
Queue Length 50th (ft)	190	100	4	301	139	59	50	65	0
Queue Length 95th (ft)	#309	119	17	#414	#277	91	82	168	77
Internal Link Dist (ft)		311		731		382		448	
Turn Bay Length (ft)	250		80		120		140		140
Base Capacity (vph)	683	2705	124	1582	242	804	306	447	518
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.94	0.52	0.05	0.86	0.90	0.27	0.51	0.70	0.58

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	607	1252	89	6	1244	48	208	192	13	148	52	529
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.9	5.4		4.9	5.4		4.9	5.4		4.9	5.4	5.4
Lane Util. Factor	0.97	0.91		1.00	0.91		1.00	0.95		0.97	0.95	0.95
Frt	1.00	0.99		1.00	0.99		1.00	0.99		1.00	0.88	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	5035		1770	5057		1770	3505		3433	1551	1504
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	5035		1770	5057		1770	3505		3433	1551	1504
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	639	1318	94	6	1309	51	219	202	14	156	55	557
RTOR Reduction (vph)	0	7	0	0	4	0	0	6	0	0	174	257
Lane Group Flow (vph)	639	1405	0	6	1356	0	219	210	0	156	137	44
Turn Type	Prot			Prot			Prot			Prot		Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												4
Actuated Green, G (s)	23.8	49.7		1.4	27.3		13.7	19.6		8.7	14.6	14.6
Effective Green, g (s)	23.8	49.7		1.4	27.3		13.7	19.6		8.7	14.6	14.6
Actuated g/C Ratio	0.24	0.50		0.01	0.27		0.14	0.20		0.09	0.15	0.15
Clearance Time (s)	4.9	5.4		4.9	5.4		4.9	5.4		4.9	5.4	5.4
Vehicle Extension (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Grp Cap (vph)	817	2502		25	1381		242	687		299	226	220
v/s Ratio Prot	c0.19	0.28		0.00	c0.27		c0.12	0.06		0.05	c0.09	
v/s Ratio Perm												0.03
v/c Ratio	0.78	0.56		0.24	0.98		0.90	0.31		0.52	0.61	0.20
Uniform Delay, d1	35.7	17.6		48.8	36.1		42.5	34.4		43.7	40.0	37.6
Progression Factor	0.83	0.63		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	4.4	0.8		6.7	20.2		34.0	0.3		2.1	5.2	0.6
Delay (s)	33.8	11.8		55.5	56.3		76.5	34.7		45.8	45.2	38.2
Level of Service	C	B		E	E		E	C		D	D	D
Approach Delay (s)		18.6			56.3			55.7			42.6	
Approach LOS		B			E			E			D	

Intersection Summary			
HCM Average Control Delay	37.3	HCM Level of Service	D
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	20.6
Intersection Capacity Utilization	84.7%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	1400	1545	841	936
v/c Ratio	0.45	0.71	0.84	0.59
Control Delay	11.3	16.1	41.6	1.6
Queue Delay	0.0	0.1	0.0	0.0
Total Delay	11.3	16.2	41.6	1.6
Queue Length 50th (ft)	161	330	257	0
Queue Length 95th (ft)	220	466	310	0
Internal Link Dist (ft)	898	560	1261	
Turn Bay Length (ft)			230	900
Base Capacity (vph)	3122	2173	1160	1583
Starvation Cap Reductn	0	66	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.45	0.73	0.72	0.59

Intersection Summary

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1330	1468	0	799	889
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.3	5.3		4.2	4.0
Lane Util. Factor		0.91	0.95		0.97	1.00
Frt		1.00	1.00		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		5085	3539		3433	1583
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		5085	3539		3433	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1400	1545	0	841	936
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1400	1545	0	841	936
Turn Type						Free
Protected Phases		2	6		4	
Permitted Phases						Free
Actuated Green, G (s)		61.4	61.4		29.1	100.0
Effective Green, g (s)		61.4	61.4		29.1	100.0
Actuated g/C Ratio		0.61	0.61		0.29	1.00
Clearance Time (s)		5.3	5.3		4.2	
Vehicle Extension (s)		5.0	5.0		2.5	
Lane Grp Cap (vph)		3122	2173		999	1583
v/s Ratio Prot		0.28	c0.44		c0.24	
v/s Ratio Perm						0.59
v/c Ratio		0.45	0.71		0.84	0.59
Uniform Delay, d1		10.3	13.2		33.3	0.0
Progression Factor		1.00	1.00		1.00	1.00
Incremental Delay, d2		0.5	1.8		6.4	1.6
Delay (s)		10.7	15.1		39.7	1.6
Level of Service		B	B		D	A
Approach Delay (s)		10.7	15.1		19.7	
Approach LOS		B	B		B	

Intersection Summary			
HCM Average Control Delay	15.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	9.5
Intersection Capacity Utilization	71.3%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	EBR	WBL	WBT
Lane Group Flow (vph)	2056	613	251	1569
v/c Ratio	0.80	0.51	0.78	0.44
Control Delay	8.5	2.9	56.1	0.4
Queue Delay	0.0	0.1	0.0	0.0
Total Delay	8.5	3.0	56.1	0.4
Queue Length 50th (ft)	231	33	152	0
Queue Length 95th (ft)	318	56	234	0
Internal Link Dist (ft)	560			522
Turn Bay Length (ft)			260	
Base Capacity (vph)	2569	1212	372	3539
Starvation Cap Reductn	0	78	0	0
Spillback Cap Reductn	0	0	0	26
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.80	0.54	0.67	0.45

Intersection Summary

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	1953	582	238	1491	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.3	5.3	4.0	5.3		
Lane Util. Factor	0.95	1.00	1.00	0.95		
Frt	1.00	0.85	1.00	1.00		
Flt Protected	1.00	1.00	0.95	1.00		
Satd. Flow (prot)	3539	1583	1770	3539		
Flt Permitted	1.00	1.00	0.95	1.00		
Satd. Flow (perm)	3539	1583	1770	3539		
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	2056	613	251	1569	0	0
RTOR Reduction (vph)	0	63	0	0	0	0
Lane Group Flow (vph)	2056	550	251	1569	0	0
Turn Type		Perm	Prot			
Protected Phases	2		1	6		
Permitted Phases		2				
Actuated Green, G (s)	72.6	72.6	18.1	100.0		
Effective Green, g (s)	72.6	72.6	18.1	100.0		
Actuated g/C Ratio	0.73	0.73	0.18	1.00		
Clearance Time (s)	5.3	5.3	4.0	5.3		
Vehicle Extension (s)	5.0	5.0	3.0	5.0		
Lane Grp Cap (vph)	2569	1149	320	3539		
v/s Ratio Prot	c0.58		c0.14	0.44		
v/s Ratio Perm		0.35				
v/c Ratio	0.80	0.48	0.78	0.44		
Uniform Delay, d1	9.0	5.8	39.1	0.0		
Progression Factor	0.60	0.39	1.00	1.00		
Incremental Delay, d2	2.5	1.3	11.9	0.4		
Delay (s)	7.9	3.5	51.0	0.4		
Level of Service	A	A	D	A		
Approach Delay (s)	6.9			7.4	0.0	
Approach LOS	A			A	A	

Intersection Summary			
HCM Average Control Delay	7.1	HCM Level of Service	A
HCM Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	9.3
Intersection Capacity Utilization	74.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	455	0	0	708	0	637	850	0	832	610
Sign Control		Yield			Yield			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	0	479	0	0	745	0	671	895	0	876	642
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)								1120				
pX, platoon unblocked	0.93	0.93		0.93	0.93	0.93				0.93		
vC, conflicting volume	1099	1546	292	962	1546	224	876			671		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	857	1336	292	710	1336	0	876			397		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	32	100	100	26	100			100		
cM capacity (veh/h)	62	142	705	96	142	1012	767			1081		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	NB 4	SB 1	SB 2	SB 3	SB 4
Volume Total	479	745	268	268	432	596	350	350	389	428
Volume Left	0	0	0	0	0	0	0	0	0	0
Volume Right	479	745	0	0	298	596	0	0	214	428
cSH	705	1012	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.68	0.74	0.16	0.16	0.25	0.35	0.21	0.21	0.23	0.25
Queue Length 95th (ft)	134	173	0	0	0	0	0	0	0	0
Control Delay (s)	20.2	17.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	C	C								
Approach Delay (s)	20.2	17.8	0.0				0.0			
Approach LOS	C	C								

Intersection Summary			
Average Delay	5.3		
Intersection Capacity Utilization	69.1%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	0	713	0	1451	935	378
Sign Control	Yield			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	751	0	1527	984	398
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)				640		
pX, platoon unblocked	0.89					
vC, conflicting volume	1366	328	984			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	773	328	984			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	0	100			
cM capacity (veh/h)	297	668	698			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	NB 4	SB 1	SB 2	SB 3	SB 4
Volume Total	751	382	382	382	382	394	394	329	265
Volume Left	0	0	0	0	0	0	0	0	0
Volume Right	751	0	0	0	0	0	0	133	265
cSH	668	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	1.12	0.22	0.22	0.22	0.22	0.23	0.23	0.19	0.16
Queue Length 95th (ft)	568	0	0	0	0	0	0	0	0
Control Delay (s)	97.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	F								
Approach Delay (s)	97.6	0.0				0.0			
Approach LOS	F								

Intersection Summary			
Average Delay	20.0		
Intersection Capacity Utilization	71.7%	ICU Level of Service	C
Analysis Period (min)	15		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	145	774	151	58	916	209	268	1258	92	1625
v/c Ratio	0.75	0.53	0.23	0.36	0.75	0.43	0.80	0.49	0.41	0.91
Control Delay	65.8	28.7	9.4	47.9	34.6	9.2	58.9	20.4	46.1	34.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	65.8	28.7	9.4	47.9	34.6	9.2	58.9	20.4	46.1	34.7
Queue Length 50th (ft)	42	137	29	17	182	13	78	153	26	296
Queue Length 95th (ft)	#90	177	59	36	232	79	#141	187	51	#399
Internal Link Dist (ft)		578			652			1209		560
Turn Bay Length (ft)	175			150			180		150	
Base Capacity (vph)	194	1476	654	163	1301	501	334	2576	225	1781
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.75	0.52	0.23	0.36	0.70	0.42	0.80	0.49	0.41	0.91

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	138	735	143	55	848	220	255	1042	153	87	1027	517
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4		5.4	5.4	
Lane Util. Factor	0.97	0.91	1.00	0.97	0.86	0.86	0.97	0.86		0.97	0.91	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.98		1.00	0.95	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	3433	5085	1583	3433	4788	1362	3433	6285		3433	4830	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	3433	5085	1583	3433	4788	1362	3433	6285		3433	4830	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	145	774	151	58	893	232	268	1097	161	92	1081	544
RTOR Reduction (vph)	0	0	26	0	3	136	0	28	0	0	101	0
Lane Group Flow (vph)	145	774	125	58	913	73	268	1230	0	92	1524	0
Turn Type	Prot		pm+ov	Prot		Perm	Prot			Prot		
Protected Phases	7	4	5	3	8		5	2		1	6	
Permitted Phases			4			8						
Actuated Green, G (s)	6.1	25.4	35.2	3.3	22.6	22.6	9.8	35.9		4.6	30.7	
Effective Green, g (s)	6.1	25.4	35.2	3.3	22.6	22.6	9.8	35.9		4.6	30.7	
Actuated g/C Ratio	0.07	0.28	0.39	0.04	0.25	0.25	0.11	0.40		0.05	0.34	
Clearance Time (s)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4		5.4	5.4	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	231	1422	614	125	1192	339	371	2485		174	1633	
v/s Ratio Prot	0.04	c0.15	0.02	0.02	c0.19		c0.08	0.20		0.03	c0.32	
v/s Ratio Perm			0.06			0.05						
v/c Ratio	0.63	0.54	0.20	0.46	0.77	0.22	0.72	0.49		0.53	0.93	
Uniform Delay, d1	41.2	27.8	18.5	42.9	31.6	27.1	39.2	20.6		42.0	29.1	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	5.2	0.4	0.2	2.7	3.0	0.3	6.8	0.2		2.9	10.2	
Delay (s)	46.5	28.2	18.6	45.6	34.6	27.4	46.0	20.8		44.9	39.3	
Level of Service	D	C	B	D	C	C	D	C		D	D	
Approach Delay (s)		29.3			33.9			25.2			39.6	
Approach LOS		C			C			C			D	

Intersection Summary			
HCM Average Control Delay	32.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	90.8	Sum of lost time (s)	16.2
Intersection Capacity Utilization	78.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	511	490	0	590	0	0	0	0	0	0	577
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	538	516	0	621	0	0	0	0	0	0	607
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		732										
pX, platoon unblocked				0.89			0.89	0.89	0.89	0.89	0.89	
vC, conflicting volume	621			1054			1003	1417	437	800	1675	207
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	621			617			560	1026	0	332	1317	207
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	100	100	100	100	24
cM capacity (veh/h)	956			851			88	207	962	531	139	799

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	SB 1
Volume Total	215	215	623	207	207	207	607
Volume Left	0	0	0	0	0	0	0
Volume Right	0	0	516	0	0	0	607
cSH	1700	1700	1700	1700	1700	1700	799
Volume to Capacity	0.13	0.13	0.37	0.12	0.12	0.12	0.76
Queue Length 95th (ft)	0	0	0	0	0	0	182
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	22.3
Lane LOS							C
Approach Delay (s)	0.0			0.0			22.3
Approach LOS							C

Intersection Summary			
Average Delay	5.9		
Intersection Capacity Utilization	53.8%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	50	120	238	232	5	1157	462	1421
v/c Ratio	0.31	0.39	0.55	0.52	0.03	0.43	0.34	0.50
Control Delay	22.8	23.8	10.0	9.1	9.6	5.1	1.1	10.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	22.8	23.8	10.0	9.1	9.6	5.1	1.1	10.7
Queue Length 50th (ft)	10	41	12	9	1	40	10	117
Queue Length 95th (ft)	38	72	60	54	m1	m85	m9	200
Internal Link Dist (ft)	296		624			121		607
Turn Bay Length (ft)				470	120			
Base Capacity (vph)	162	532	599	616	147	2671	1362	2845
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.31	0.23	0.40	0.38	0.03	0.43	0.34	0.50

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	27	0	21	126	2	432	5	659	879	0	1333	17
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		5.0	5.0	5.0	5.0	5.0	4.0		5.0	
Lane Util. Factor		1.00		0.95	0.91	0.95	1.00	0.86	0.86		0.91	
Frt		0.94		1.00	0.86	0.85	1.00	0.94	0.85		1.00	
Flt Protected		0.97		0.95	1.00	1.00	0.95	1.00	1.00		1.00	
Satd. Flow (prot)		1704		1681	1453	1504	1770	4517	1362		5076	
Flt Permitted		0.97		0.95	1.00	1.00	0.14	1.00	1.00		1.00	
Satd. Flow (perm)		1704		1681	1453	1504	263	4517	1362		5076	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	28	0	22	133	2	455	5	694	925	0	1403	18
RTOR Reduction (vph)	0	21	0	0	167	167	0	148	0	0	1	0
Lane Group Flow (vph)	0	29	0	120	71	65	5	1009	462	0	1420	0
Turn Type	Split			Split		Perm	Perm		Free			
Protected Phases	4	4		8	8			2			6	
Permitted Phases						8	2		Free			
Actuated Green, G (s)		3.0		11.0	11.0	11.0	32.0	32.0	60.0		32.0	
Effective Green, g (s)		3.0		11.0	11.0	11.0	32.0	32.0	60.0		32.0	
Actuated g/C Ratio		0.05		0.18	0.18	0.18	0.53	0.53	1.00		0.53	
Clearance Time (s)		4.0		5.0	5.0	5.0	5.0	5.0			5.0	
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0			3.0	
Lane Grp Cap (vph)		85		308	266	276	140	2409	1362		2707	
v/s Ratio Prot		0.02		0.07	0.05			0.22			c0.28	
v/s Ratio Perm						0.04	0.02		c0.34			
v/c Ratio		0.34		0.39	0.27	0.24	0.04	0.42	0.34		0.52	
Uniform Delay, d1		27.5		21.5	21.0	20.9	6.7	8.4	0.0		9.1	
Progression Factor		1.00		1.00	1.00	1.00	0.89	0.72	1.00		1.00	
Incremental Delay, d2		2.4		0.8	0.5	0.4	0.3	0.4	0.5		0.7	
Delay (s)		30.0		22.4	21.6	21.4	6.2	6.5	0.5		9.8	
Level of Service		C		C	C	C	A	A	A		A	
Approach Delay (s)		30.0			21.7			4.8			9.8	
Approach LOS		C			C			A			A	

Intersection Summary			
HCM Average Control Delay	9.7	HCM Level of Service	A
HCM Volume to Capacity ratio	0.45		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	5.0
Intersection Capacity Utilization	52.1%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	57	845	323	2225	292	1075	72	949
v/c Ratio	0.77	0.80	0.69	1.00	0.99	0.64	0.53	0.84
Control Delay	111.2	49.6	30.0	29.2	79.9	19.5	61.0	51.2
Queue Delay	0.0	0.0	0.0	16.9	0.0	0.5	0.0	0.0
Total Delay	111.2	49.6	30.0	46.2	79.9	19.9	61.0	51.2
Queue Length 50th (ft)	45	216	243	~623	233	176	57	198
Queue Length 95th (ft)	#123	266	m265	#728	#416	212	109	#321
Internal Link Dist (ft)		1129		409		285		200
Turn Bay Length (ft)	140		110		150		120	
Base Capacity (vph)	74	1107	477	2218	295	1669	148	1125
Starvation Cap Reductn	0	0	0	105	0	215	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.77	0.76	0.68	1.05	0.99	0.74	0.49	0.84

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	54	651	152	307	1721	392	277	997	25	68	813	88
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5		4.0	4.5		4.0	4.5		4.0	4.5	
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	0.91		1.00	0.91	
Frt	1.00	0.97		1.00	0.97		1.00	1.00		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	4941		1770	4944		1770	5067		1770	5011	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	4941		1770	4944		1770	5067		1770	5011	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	57	685	160	323	1812	413	292	1049	26	72	856	93
RTOR Reduction (vph)	0	33	0	0	31	0	0	2	0	0	11	0
Lane Group Flow (vph)	57	812	0	323	2194	0	292	1073	0	72	938	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	4.0	24.7		32.4	53.1		20.8	37.9		8.0	25.1	
Effective Green, g (s)	4.0	24.7		32.4	53.1		20.8	37.9		8.0	25.1	
Actuated g/C Ratio	0.03	0.21		0.27	0.44		0.17	0.32		0.07	0.21	
Clearance Time (s)	4.0	4.5		4.0	4.5		4.0	4.5		4.0	4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	59	1017		478	2188		307	1600		118	1048	
v/s Ratio Prot	0.03	0.16		c0.18	c0.44		c0.17	0.21		0.04	c0.19	
v/s Ratio Perm												
v/c Ratio	0.97	0.80		0.68	1.00		0.95	0.67		0.61	0.89	
Uniform Delay, d1	57.9	45.3		39.1	33.5		49.1	35.6		54.5	46.2	
Progression Factor	1.00	1.00		0.64	0.41		0.68	0.50		0.91	0.99	
Incremental Delay, d2	104.1	4.5		1.9	14.2		32.6	1.7		8.1	10.7	
Delay (s)	162.0	49.8		26.9	28.0		65.9	19.7		57.7	56.2	
Level of Service	F	D		C	C		E	B		E	E	
Approach Delay (s)		56.8			27.8			29.5			56.3	
Approach LOS		E			C			C			E	

Intersection Summary			
HCM Average Control Delay	37.7	HCM Level of Service	D
HCM Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	92.5%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	328	1171	341	157	680	18	1018	262	1229
v/c Ratio	0.70	0.77	0.61	0.70	0.74	0.15	0.64	0.31	0.55
Control Delay	42.7	34.9	17.0	47.7	34.6	26.7	29.3	3.8	6.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
Total Delay	42.7	34.9	17.0	47.7	34.6	26.7	29.3	3.8	7.3
Queue Length 50th (ft)	188	254	106	102	172	9	332	0	102
Queue Length 95th (ft)	260	273	162	m175	207	28	421	51	109
Internal Link Dist (ft)		339			174		323		285
Turn Bay Length (ft)	200			175		175			
Base Capacity (vph)	504	1606	578	266	1038	120	1580	852	2236
Starvation Cap Reductn	0	0	0	0	0	0	0	0	549
Spillback Cap Reductn	0	0	0	0	0	0	19	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.65	0.73	0.59	0.59	0.66	0.15	0.65	0.31	0.73

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	312	938	499	149	646	0	17	967	249	0	602	565
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5	4.5	4.0	4.5		4.5	4.5	4.5		4.5	
Lane Util. Factor	1.00	0.86	0.86	1.00	0.91		1.00	0.95	1.00		0.91	
Frt	1.00	0.98	0.85	1.00	1.00		1.00	1.00	0.85		0.93	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00		1.00	
Satd. Flow (prot)	1770	4693	1362	1770	5085		1770	3539	1583		4716	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.14	1.00	1.00		1.00	
Satd. Flow (perm)	1770	4693	1362	1770	5085		269	3539	1583		4716	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	328	987	525	157	680	0	18	1018	262	0	634	595
RTOR Reduction (vph)	0	21	120	0	0	0	0	0	145	0	132	0
Lane Group Flow (vph)	328	1150	221	157	680	0	18	1018	117	0	1097	0
Turn Type	Prot		Perm	Prot			Perm		Perm			
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4				2		2			
Actuated Green, G (s)	31.8	38.4	38.4	15.1	21.7		53.5	53.5	53.5		53.5	
Effective Green, g (s)	31.8	38.4	38.4	15.1	21.7		53.5	53.5	53.5		53.5	
Actuated g/C Ratio	0.27	0.32	0.32	0.13	0.18		0.45	0.45	0.45		0.45	
Clearance Time (s)	4.0	4.5	4.5	4.0	4.5		4.5	4.5	4.5		4.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	469	1502	436	223	920		120	1578	706		2103	
v/s Ratio Prot	0.19	c0.25		0.09	c0.13			c0.29			0.23	
v/s Ratio Perm			0.16				0.07		0.07			
v/c Ratio	0.70	0.77	0.51	0.70	0.74		0.15	0.65	0.17		0.52	
Uniform Delay, d1	39.8	36.7	33.1	50.3	46.5		19.7	25.9	19.9		24.0	
Progression Factor	0.89	0.88	0.81	0.67	0.65		1.00	1.00	1.00		0.31	
Incremental Delay, d2	3.9	2.1	0.8	8.0	2.6		2.6	2.0	0.5		0.5	
Delay (s)	39.3	34.5	27.5	41.7	32.9		22.4	27.9	20.4		7.9	
Level of Service	D	C	C	D	C		C	C	C		A	
Approach Delay (s)		34.1			34.5			26.3			7.9	
Approach LOS		C			C			C			A	

Intersection Summary			
HCM Average Control Delay	26.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	67.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	0	198	1136	0	0	1278
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	208	1196	0	0	1345
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						629
pX, platoon unblocked						
vC, conflicting volume	1644	399			1196	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1644	399			1196	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	65			100	
cM capacity (veh/h)	90	601			580	

Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	208	399	399	399	448	448	448
Volume Left	0	0	0	0	0	0	0
Volume Right	208	0	0	0	0	0	0
cSH	601	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.35	0.23	0.23	0.23	0.26	0.26	0.26
Queue Length 95th (ft)	39	0	0	0	0	0	0
Control Delay (s)	14.1	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	B						
Approach Delay (s)	14.1	0.0			0.0		
Approach LOS	B						

Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	40.9%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBT	WBT	SBL
Lane Group Flow (vph)	1386	935	802
v/c Ratio	0.50	0.34	0.72
Control Delay	10.1	7.2	20.1
Queue Delay	0.0	0.0	0.0
Total Delay	10.1	7.2	20.1
Queue Length 50th (ft)	105	139	117
Queue Length 95th (ft)	168	169	150
Internal Link Dist (ft)	736	218	493
Turn Bay Length (ft)			
Base Capacity (vph)	2761	2761	1385
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.50	0.34	0.58

Intersection Summary

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1317	888	0	579	183
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5	4.5		4.0	
Lane Util. Factor		0.91	0.91		0.97	
Frt		1.00	1.00		0.96	
Flt Protected		1.00	1.00		0.96	
Satd. Flow (prot)		5085	5085		3356	
Flt Permitted		1.00	1.00		0.96	
Satd. Flow (perm)		5085	5085		3356	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1386	935	0	609	193
RTOR Reduction (vph)	0	0	0	0	49	0
Lane Group Flow (vph)	0	1386	935	0	753	0
Turn Type						
Protected Phases		4	8		6	
Permitted Phases						
Actuated Green, G (s)		32.6	32.6		18.9	
Effective Green, g (s)		32.6	32.6		18.9	
Actuated g/C Ratio		0.54	0.54		0.31	
Clearance Time (s)		4.5	4.5		4.0	
Vehicle Extension (s)		3.0	3.0		3.0	
Lane Grp Cap (vph)		2763	2763		1057	
v/s Ratio Prot		c0.27	0.18		c0.22	
v/s Ratio Perm						
v/c Ratio		0.50	0.34		0.71	
Uniform Delay, d1		8.6	7.7		18.1	
Progression Factor		1.00	0.84		1.00	
Incremental Delay, d2		0.7	0.3		2.3	
Delay (s)		9.3	6.7		20.4	
Level of Service		A	A		C	
Approach Delay (s)		9.3	6.7		20.4	
Approach LOS		A	A		C	

Intersection Summary			
HCM Average Control Delay	11.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.5
Intersection Capacity Utilization	54.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	83	735	380	2397	129	596	505	126	819
v/c Ratio	0.93	0.45	0.84	0.89	0.15	0.54	0.60	0.77	0.52
Control Delay	136.2	8.1	58.8	30.5	5.3	25.3	16.4	69.1	30.7
Queue Delay	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0
Total Delay	136.2	8.1	58.8	31.5	5.3	25.3	16.4	69.1	30.7
Queue Length 50th (ft)	69	39	279	582	13	247	268	88	166
Queue Length 95th (ft)	m#116	187	368	659	44	297	386	#197	209
Internal Link Dist (ft)		409		995		363			581
Turn Bay Length (ft)	140		160					120	
Base Capacity (vph)	89	1648	561	2691	881	1106	842	163	1580
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	116	0	0	0	0	1
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.93	0.45	0.68	0.93	0.15	0.54	0.60	0.77	0.52

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	79	698	0	361	2277	123	0	566	480	120	520	258
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5		4.0	4.5	4.5		4.5	4.5	4.5	4.5	
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00		0.95	1.00	1.00	0.91	
Frt	1.00	1.00		1.00	1.00	0.85		1.00	0.85	1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5085		1770	5085	1583		3539	1583	1770	4832	
Flt Permitted	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.28	1.00	
Satd. Flow (perm)	1770	5085		1770	5085	1583		3539	1583	521	4832	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	83	735	0	380	2397	129	0	596	505	126	547	272
RTOR Reduction (vph)	0	0	0	0	0	43	0	0	347	0	70	0
Lane Group Flow (vph)	83	735	0	380	2397	86	0	596	158	126	749	0
Turn Type	Prot		Perm	Prot		Perm			Perm	Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8			2	6		
Actuated Green, G (s)	6.0	38.9		30.6	63.5	63.5		37.5	37.5	37.5	37.5	
Effective Green, g (s)	6.0	38.9		30.6	63.5	63.5		37.5	37.5	37.5	37.5	
Actuated g/C Ratio	0.05	0.32		0.26	0.53	0.53		0.31	0.31	0.31	0.31	
Clearance Time (s)	4.0	4.5		4.0	4.5	4.5		4.5	4.5	4.5	4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	89	1648		451	2691	838		1106	495	163	1510	
v/s Ratio Prot	0.05	0.14		c0.21	c0.47			0.17			0.15	
v/s Ratio Perm						0.05			0.10	c0.24		
v/c Ratio	0.93	0.45		0.84	0.89	0.10		0.54	0.32	0.77	0.50	
Uniform Delay, d1	56.8	32.0		42.4	25.2	14.1		34.1	31.5	37.4	33.6	
Progression Factor	1.34	0.23		1.00	1.00	1.00		0.69	4.89	1.00	1.00	
Incremental Delay, d2	59.0	0.6		13.4	5.0	0.2		1.4	1.3	29.2	1.2	
Delay (s)	135.1	7.8		55.8	30.1	14.3		25.0	155.3	66.6	34.7	
Level of Service	F	A		E	C	B		C	F	E	C	
Approach Delay (s)		20.7			32.8			84.8			39.0	
Approach LOS		C			C			F			D	

Intersection Summary			
HCM Average Control Delay	42.0	HCM Level of Service	D
HCM Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	85.2%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	167	1781	165	2876	447	269	76	126	977	229
v/c Ratio	1.62	1.01	0.93	1.45	1.68	0.26	0.15	0.65	1.10	0.48
Control Delay	355.2	62.0	105.9	234.7	354.6	34.3	8.7	66.2	105.0	24.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	355.2	62.0	105.9	234.7	354.6	34.3	8.7	66.2	105.0	24.5
Queue Length 50th (ft)	~186	~508	129	~1119	~507	84	1	94	~453	81
Queue Length 95th (ft)	#328	#626	#265	#1208	#710	125	39	157	#585	161
Internal Link Dist (ft)		631		1090		191			644	
Turn Bay Length (ft)	200		180		140		60	120		120
Base Capacity (vph)	103	1768	177	1986	266	1027	511	236	885	473
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.62	1.01	0.93	1.45	1.68	0.26	0.15	0.53	1.10	0.48

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	159	1563	129	157	2656	76	425	256	72	120	928	218
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.99		1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5027		1770	5064		1770	3539	1583	1770	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5027		1770	5064		1770	3539	1583	1770	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	167	1645	136	165	2796	80	447	269	76	126	977	229
RTOR Reduction (vph)	0	8	0	0	2	0	0	0	53	0	0	77
Lane Group Flow (vph)	167	1773	0	165	2874	0	447	269	23	126	977	152
Turn Type	Prot			Prot			Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases									2			6
Actuated Green, G (s)	7.0	42.0		12.0	47.0		18.0	34.8	34.8	13.2	30.0	30.0
Effective Green, g (s)	7.0	42.0		12.0	47.0		18.0	34.8	34.8	13.2	30.0	30.0
Actuated g/C Ratio	0.06	0.35		0.10	0.39		0.15	0.29	0.29	0.11	0.25	0.25
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	103	1759		177	1983		266	1026	459	195	885	396
v/s Ratio Prot	c0.09	0.35		0.09	c0.57		c0.25	0.08		0.07	c0.28	
v/s Ratio Perm									0.01			0.10
v/c Ratio	1.62	1.01		0.93	1.45		1.68	0.26	0.05	0.65	1.10	0.38
Uniform Delay, d1	56.5	39.0		53.6	36.5		51.0	32.7	30.7	51.2	45.0	37.3
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	319.5	23.4		48.2	205.0		322.1	0.1	0.0	7.2	62.9	0.6
Delay (s)	376.0	62.4		101.8	241.5		373.1	32.9	30.7	58.3	107.9	37.9
Level of Service	F	E		F	F		F	C	C	E	F	D
Approach Delay (s)		89.3			233.9			224.7			91.2	
Approach LOS		F			F			F			F	

Intersection Summary			
HCM Average Control Delay	166.5	HCM Level of Service	F
HCM Volume to Capacity ratio	1.40		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	126.0%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NER
Lane Configurations										
Volume (veh/h)	0	186	0	650	0	0	768	510	0	0
Sign Control	Yield			Free			Free		Yield	
Grade	0%			0%			0%		0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	196	0	684	0	0	808	537	0	0
Pedestrians										
Lane Width (ft)										
Walking Speed (ft/s)										
Percent Blockage										
Right turn flare (veh)										
Median type				None			None			
Median storage veh)										
Upstream signal (ft)							271			
pX, platoon unblocked	0.75		0.75						0.75	0.75
vC, conflicting volume	2029	342	1345			684			1346	1493
vC1, stage 1 conf vol										
vC2, stage 2 conf vol										
vCu, unblocked vol	2211	342	1292			684			1294	1490
tC, single (s)	6.5	6.9	4.1			4.1			7.5	6.5
tC, 2 stage (s)										
tF (s)	4.0	3.3	2.2			2.2			3.5	4.0
p0 queue free %	100	70	100			100			100	100
cM capacity (veh/h)	32	654	397			905			63	91

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	196	342	342	808	537
Volume Left	0	0	0	0	0
Volume Right	196	0	0	0	537
cSH	654	1700	1700	1700	1700
Volume to Capacity	0.30	0.20	0.20	0.48	0.32
Queue Length 95th (ft)	31	0	0	0	0
Control Delay (s)	12.8	0.0	0.0	0.0	0.0
Lane LOS	B				
Approach Delay (s)	12.8	0.0		0.0	
Approach LOS	B				

Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	62.0%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	840	0	0	0	0	0	0	690	63	0
Sign Control		Yield			Yield			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	0	884	0	0	0	0	0	0	726	66	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)											795	
pX, platoon unblocked												
vC, conflicting volume	1519	1519	66	2403	1519	0	66			0		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1519	1519	66	2403	1519	0	66			0		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	11	100	100	100	100			55		
cM capacity (veh/h)	63	66	997	2	66	1085	1535			1623		

Direction, Lane #	EB 1	SB 1	SB 2
Volume Total	884	726	66
Volume Left	0	726	0
Volume Right	884	0	0
cSH	997	1623	1700
Volume to Capacity	0.89	0.45	0.04
Queue Length 95th (ft)	312	59	0
Control Delay (s)	28.8	9.0	0.0
Lane LOS	D	A	
Approach Delay (s)	28.8	8.2	
Approach LOS	D		

Intersection Summary			
Average Delay	19.1		
Intersection Capacity Utilization	62.0%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	WBL	WBT	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	547	200	128	996	232	1371
v/c Ratio	1.01	0.35	1.03	0.50	0.23	0.69
Control Delay	67.4	11.3	106.3	9.2	1.9	13.1
Queue Delay	0.0	0.0	0.0	0.2	0.0	0.1
Total Delay	67.4	11.3	106.3	9.3	1.9	13.2
Queue Length 50th (ft)	~236	30	~62	121	4	201
Queue Length 95th (ft)	#430	78	m#133	m161	m14	270
Internal Link Dist (ft)		1190		300		620
Turn Bay Length (ft)	600		90			
Base Capacity (vph)	544	572	124	1997	994	1996
Starvation Cap Reductn	0	0	0	275	0	0
Spillback Cap Reductn	0	0	0	0	0	82
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	1.01	0.35	1.03	0.58	0.23	0.72

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	520	28	162	122	946	220	0	1298	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.5	4.5		4.5	4.5	4.5		4.5	
Lane Util. Factor				1.00	1.00		1.00	0.95	1.00		0.95	
Frt				1.00	0.87		1.00	1.00	0.85		1.00	
Flt Protected				0.95	1.00		0.95	1.00	1.00		1.00	
Satd. Flow (prot)				1770	1624		1770	3539	1583		3537	
Flt Permitted				0.95	1.00		0.12	1.00	1.00		1.00	
Satd. Flow (perm)				1770	1624		220	3539	1583		3537	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	0	0	547	29	171	128	996	232	0	1366	5
RTOR Reduction (vph)	0	0	0	0	73	0	0	0	101	0	0	0
Lane Group Flow (vph)	0	0	0	547	127	0	128	996	131	0	1371	0
Turn Type				Split			Perm		Perm			
Protected Phases				8	8			2			6	
Permitted Phases							2		2			
Actuated Green, G (s)				21.5	21.5		39.5	39.5	39.5		39.5	
Effective Green, g (s)				21.5	21.5		39.5	39.5	39.5		39.5	
Actuated g/C Ratio				0.31	0.31		0.56	0.56	0.56		0.56	
Clearance Time (s)				4.5	4.5		4.5	4.5	4.5		4.5	
Vehicle Extension (s)				3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)				544	499		124	1997	893		1996	
v/s Ratio Prot				c0.31	0.08			0.28			0.39	
v/s Ratio Perm							c0.58		0.08			
v/c Ratio				1.01	0.26		1.03	0.50	0.15		0.69	
Uniform Delay, d1				24.2	18.2		15.2	9.2	7.2		10.8	
Progression Factor				1.00	1.00		0.98	0.89	1.15		1.00	
Incremental Delay, d2				40.0	0.3		81.8	0.7	0.3		1.9	
Delay (s)				64.2	18.5		96.8	9.0	8.6		12.8	
Level of Service				E	B		F	A	A		B	
Approach Delay (s)		0.0			52.0			17.2			12.8	
Approach LOS		A			D			B			B	

Intersection Summary			
HCM Average Control Delay	22.9	HCM Level of Service	C
HCM Volume to Capacity ratio	1.02		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	82.9%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBR	NBT	SBT
Lane Group Flow (vph)	427	409	987	1976
v/c Ratio	0.90	0.94	0.45	0.91
Control Delay	49.2	57.4	2.1	12.4
Queue Delay	0.0	0.3	0.0	15.1
Total Delay	49.2	57.7	2.1	27.6
Queue Length 50th (ft)	176	166	14	194
Queue Length 95th (ft)	#334	#333	m12	m246
Internal Link Dist (ft)	434		320	300
Turn Bay Length (ft)				
Base Capacity (vph)	480	439	2181	2181
Starvation Cap Reductn	0	0	129	5
Spillback Cap Reductn	0	1	0	248
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.89	0.93	0.48	1.02

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	406	389	0	938	1877	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		0.95	0.95	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1770	1583		3539	3539	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	1770	1583		3539	3539	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	427	409	0	987	1976	0
RTOR Reduction (vph)	0	9	0	0	0	0
Lane Group Flow (vph)	427	400	0	987	1976	0
Turn Type		custom				
Protected Phases				2	6	
Permitted Phases	4	4				
Actuated Green, G (s)	18.9	18.9		43.1	43.1	
Effective Green, g (s)	18.9	18.9		43.1	43.1	
Actuated g/C Ratio	0.27	0.27		0.62	0.62	
Clearance Time (s)	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	478	427		2179	2179	
v/s Ratio Prot				0.28	c0.56	
v/s Ratio Perm	0.24	c0.25				
v/c Ratio	0.89	0.94		0.45	0.91	
Uniform Delay, d1	24.6	25.0		7.2	11.7	
Progression Factor	1.00	1.00		0.20	0.57	
Incremental Delay, d2	18.7	27.8		0.6	4.6	
Delay (s)	43.3	52.7		2.0	11.3	
Level of Service	D	D		A	B	
Approach Delay (s)	47.9			2.0	11.3	
Approach LOS	D			A	B	

Intersection Summary			
HCM Average Control Delay	16.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	82.6%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	249	402	155	44	302	88	193	562	120	193	1719	486
v/c Ratio	1.04	0.47	0.31	0.23	0.35	0.20	0.96	0.43	0.18	0.51	1.03	0.58
Control Delay	99.2	24.8	6.1	25.0	23.3	6.8	88.1	17.7	4.1	24.4	37.3	4.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.8	0.4
Total Delay	99.2	24.8	6.1	25.0	23.3	6.8	88.1	17.7	4.1	24.4	69.0	5.1
Queue Length 50th (ft)	~118	77	0	15	56	0	84	93	0	82	~318	13
Queue Length 95th (ft)	#250	117	41	42	90	32	#202	134	29	m84	m#502	m34
Internal Link Dist (ft)		612			420			572			320	
Turn Bay Length (ft)	90			80			130			120		
Base Capacity (vph)	240	859	502	191	859	451	202	1314	663	379	1668	843
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	119	87
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.04	0.47	0.31	0.23	0.35	0.20	0.96	0.43	0.18	0.51	1.11	0.64

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	237	382	147	42	287	84	183	534	114	183	1633	462
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3539	1583	1770	3539	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.53	1.00	1.00	0.42	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	987	3539	1583	787	3539	1583	1770	3539	1583	1770	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	249	402	155	44	302	88	193	562	120	193	1719	486
RTOR Reduction (vph)	0	0	117	0	0	67	0	0	75	0	0	97
Lane Group Flow (vph)	249	402	38	44	302	21	193	562	45	193	1719	389
Turn Type	Perm		Perm	Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Actuated Green, G (s)	17.0	17.0	17.0	17.0	17.0	17.0	8.0	26.0	26.0	15.0	33.0	33.0
Effective Green, g (s)	17.0	17.0	17.0	17.0	17.0	17.0	8.0	26.0	26.0	15.0	33.0	33.0
Actuated g/C Ratio	0.24	0.24	0.24	0.24	0.24	0.24	0.11	0.37	0.37	0.21	0.47	0.47
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	240	859	384	191	859	384	202	1314	588	379	1668	746
v/s Ratio Prot		0.11			0.09		c0.11	0.16		0.11	c0.49	
v/s Ratio Perm	c0.25		0.02	0.06		0.01			0.03			0.25
v/c Ratio	1.04	0.47	0.10	0.23	0.35	0.06	0.96	0.43	0.08	0.51	1.03	0.52
Uniform Delay, d1	26.5	22.6	20.6	21.3	21.9	20.3	30.8	16.4	14.2	24.3	18.5	13.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.90	0.62	0.43
Incremental Delay, d2	68.2	0.4	0.1	0.6	0.2	0.1	50.2	1.0	0.3	0.4	22.7	1.1
Delay (s)	94.7	23.0	20.7	21.9	22.2	20.4	81.0	17.5	14.5	22.3	34.2	6.6
Level of Service	F	C	C	C	C	C	F	B	B	C	C	A
Approach Delay (s)		44.7			21.8			31.1			27.7	
Approach LOS		D			C			C			C	

Intersection Summary			
HCM Average Control Delay	30.8	HCM Level of Service	C
HCM Volume to Capacity ratio	1.02		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	89.7%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	55	570	0	443	0	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	58	600	0	466	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	500					
pX, platoon unblocked						
vC, conflicting volume			658		291	29
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			658		291	29
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			926		676	1039

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2
Volume Total	39	219	400	233	233
Volume Left	0	0	0	0	0
Volume Right	0	200	400	0	0
cSH	1700	1700	1700	1700	1700
Volume to Capacity	0.02	0.13	0.24	0.14	0.14
Queue Length 95th (ft)	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0
Lane LOS					
Approach Delay (s)	0.0			0.0	
Approach LOS					

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	26.9%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	141	1184	1789	206
v/c Ratio	0.53	0.33	0.67	0.17
Control Delay	26.4	0.3	6.6	1.3
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	26.4	0.3	6.6	1.3
Queue Length 50th (ft)	48	0	166	4
Queue Length 95th (ft)	83	0	235	19
Internal Link Dist (ft)		370	263	
Turn Bay Length (ft)	100			70
Base Capacity (vph)	295	3539	2684	1240
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.48	0.33	0.67	0.17

Intersection Summary

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	0	0	134	1125	1700	196
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)			4.0	4.5	4.5	4.5
Lane Util. Factor			1.00	0.95	0.95	1.00
Frt			1.00	1.00	1.00	0.85
Flt Protected			0.95	1.00	1.00	1.00
Satd. Flow (prot)			1770	3539	3539	1583
Flt Permitted			0.95	1.00	1.00	1.00
Satd. Flow (perm)			1770	3539	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	0	141	1184	1789	206
RTOR Reduction (vph)	0	0	0	0	0	44
Lane Group Flow (vph)	0	0	141	1184	1789	162
Turn Type			Prot			Perm
Protected Phases			5	2	6	
Permitted Phases						6
Actuated Green, G (s)			7.7	60.0	43.8	43.8
Effective Green, g (s)			7.7	60.0	43.8	43.8
Actuated g/C Ratio			0.13	1.00	0.73	0.73
Clearance Time (s)			4.0	4.5	4.5	4.5
Vehicle Extension (s)			3.0	3.0	3.0	3.0
Lane Grp Cap (vph)			227	3539	2583	1156
v/s Ratio Prot			c0.08	0.33	c0.51	
v/s Ratio Perm						0.10
v/c Ratio			0.62	0.33	0.69	0.14
Uniform Delay, d1			24.8	0.0	4.4	2.4
Progression Factor			0.81	1.00	1.00	1.00
Incremental Delay, d2			5.0	0.2	1.6	0.3
Delay (s)			25.0	0.2	6.0	2.7
Level of Service			C	A	A	A
Approach Delay (s)	0.0			2.9	5.6	
Approach LOS	A			A	A	

Intersection Summary			
HCM Average Control Delay	4.5	HCM Level of Service	A
HCM Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.5
Intersection Capacity Utilization	67.0%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	208	232	0	1058	1703	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	219	244	0	1114	1793	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)				382	450	
pX, platoon unblocked	0.73	0.66	0.66			
vC, conflicting volume	2349	896	1793			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1244	0	1169			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	0	66	100			
cM capacity (veh/h)	121	715	391			

Direction, Lane #	EB 1	EB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	146	317	557	557	896	896
Volume Left	146	73	0	0	0	0
Volume Right	0	244	0	0	0	0
cSH	121	336	1700	1700	1700	1700
Volume to Capacity	1.20	0.94	0.33	0.33	0.53	0.53
Queue Length 95th (ft)	227	244	0	0	0	0
Control Delay (s)	215.1	71.5	0.0	0.0	0.0	0.0
Lane LOS	F	F				
Approach Delay (s)	116.8		0.0		0.0	
Approach LOS	F					

Intersection Summary			
Average Delay	16.1		
Intersection Capacity Utilization	67.0%	ICU Level of Service	C
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	138	132	39	93	176	950	9	1289	549
v/c Ratio	0.56	0.19	0.17	0.14	0.61	0.39	0.02	0.65	0.53
Control Delay	30.0	6.6	20.2	13.3	25.9	6.7	1.2	8.2	2.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	30.0	6.6	20.2	13.3	25.9	6.7	1.2	8.2	2.5
Queue Length 50th (ft)	46	3	12	9	19	64	0	51	5
Queue Length 95th (ft)	86	20	31	23	#100	174	m1	191	11
Internal Link Dist (ft)		646		699		573		302	
Turn Bay Length (ft)	120		220		200		260		70
Base Capacity (vph)	345	906	332	917	289	2466	381	1984	1035
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.40	0.15	0.12	0.10	0.61	0.39	0.02	0.65	0.53

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	131	20	105	37	56	32	167	895	8	9	1225	522
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	1.00
Frt	1.00	0.87		1.00	0.95		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	3093		1770	3345		1770	3535		1770	3539	1583
Flt Permitted	0.69	1.00		0.67	1.00		0.12	1.00		0.25	1.00	1.00
Satd. Flow (perm)	1292	3093		1245	3345		229	3535		469	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	138	21	111	39	59	34	176	942	8	9	1289	549
RTOR Reduction (vph)	0	92	0	0	28	0	0	1	0	0	0	170
Lane Group Flow (vph)	138	40	0	39	65	0	176	949	0	9	1289	379
Turn Type	Perm			Perm			pm+pt			pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)	10.2	10.2		10.2	10.2		41.8	37.0		30.4	29.6	29.6
Effective Green, g (s)	10.2	10.2		10.2	10.2		41.8	37.0		30.4	29.6	29.6
Actuated g/C Ratio	0.17	0.17		0.17	0.17		0.70	0.62		0.51	0.49	0.49
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	220	526		212	569		370	2180		255	1746	781
v/s Ratio Prot		0.01			0.02		c0.06	c0.27		0.00	c0.36	
v/s Ratio Perm	c0.11			0.03			0.27			0.02		0.24
v/c Ratio	0.63	0.08		0.18	0.11		0.48	0.44		0.04	0.74	0.48
Uniform Delay, d1	23.1	20.9		21.3	21.1		14.3	6.0		10.0	12.1	10.1
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		0.23	0.58	0.21
Incremental Delay, d2	5.5	0.1		0.4	0.1		1.0	0.6		0.0	2.3	1.8
Delay (s)	28.6	21.0		21.8	21.2		15.3	6.7		2.3	9.4	3.9
Level of Service	C	C		C	C		B	A		A	A	A
Approach Delay (s)		24.9			21.3			8.0			7.7	
Approach LOS		C			C			A			A	

Intersection Summary			
HCM Average Control Delay	9.7	HCM Level of Service	A
HCM Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	67.0%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	680	244	694	105	93	964
v/c Ratio	0.74	0.41	0.45	0.14	0.43	0.46
Control Delay	25.6	5.1	9.2	1.5	30.6	8.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	25.6	5.1	9.2	1.5	30.6	8.0
Queue Length 50th (ft)	110	0	102	1	31	96
Queue Length 95th (ft)	164	44	115	14	71	133
Internal Link Dist (ft)	720		1803			515
Turn Bay Length (ft)	240	240		150	215	
Base Capacity (vph)	979	625	1579	765	227	2101
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.69	0.39	0.44	0.14	0.41	0.46

Intersection Summary

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	646	232	659	100	88	916
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Lane Util. Factor	0.97	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	3539	1583	1770	3539
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	680	244	694	105	93	964
RTOR Reduction (vph)	0	179	0	61	0	0
Lane Group Flow (vph)	680	65	694	44	93	964
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	16.0	16.0	25.2	25.2	6.3	35.5
Effective Green, g (s)	16.0	16.0	25.2	25.2	6.3	35.5
Actuated g/C Ratio	0.27	0.27	0.42	0.42	0.10	0.59
Clearance Time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	915	422	1486	665	186	2094
v/s Ratio Prot	c0.20		0.20		0.05	c0.27
v/s Ratio Perm		0.04		0.03		
v/c Ratio	0.74	0.15	0.47	0.07	0.50	0.46
Uniform Delay, d1	20.1	16.8	12.6	10.4	25.4	6.9
Progression Factor	1.00	1.00	0.63	0.48	1.00	1.00
Incremental Delay, d2	3.3	0.2	1.0	0.2	2.1	0.7
Delay (s)	23.4	17.0	8.9	5.1	27.5	7.6
Level of Service	C	B	A	A	C	A
Approach Delay (s)	21.7		8.4			9.4
Approach LOS	C		A			A

Intersection Summary			
HCM Average Control Delay	13.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.5
Intersection Capacity Utilization	51.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	41	106	764	1392	263	1364
v/c Ratio	0.19	0.54	0.30	1.05	1.19	0.44
Control Delay	54.4	20.0	7.1	51.6	161.3	1.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	54.4	20.0	7.1	51.6	161.3	1.7
Queue Length 50th (ft)	15	0	101	~1014	~249	35
Queue Length 95th (ft)	33	55	146	#1288	#418	60
Internal Link Dist (ft)	1134		595			1803
Turn Bay Length (ft)	75	50			235	
Base Capacity (vph)	629	377	2507	1321	221	3067
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.07	0.28	0.30	1.05	1.19	0.44

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	39	101	726	1322	250	1296
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Lane Util. Factor	0.97	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	3539	1583	1770	3539
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	41	106	764	1392	263	1364
RTOR Reduction (vph)	0	99	0	200	0	0
Lane Group Flow (vph)	41	7	764	1193	263	1364
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	7.5	7.5	85.0	85.0	15.0	104.0
Effective Green, g (s)	7.5	7.5	85.0	85.0	15.0	104.0
Actuated g/C Ratio	0.06	0.06	0.71	0.71	0.12	0.87
Clearance Time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	215	99	2507	1121	221	3067
v/s Ratio Prot	c0.01		0.22		c0.15	0.39
v/s Ratio Perm		0.00		c0.75		
v/c Ratio	0.19	0.07	0.30	1.06	1.19	0.44
Uniform Delay, d1	53.4	53.0	6.5	17.5	52.5	1.7
Progression Factor	1.00	1.00	1.00	1.00	0.98	0.68
Incremental Delay, d2	0.4	0.3	0.3	45.6	116.8	0.4
Delay (s)	53.8	53.2	6.8	63.1	168.2	1.6
Level of Service	D	D	A	E	F	A
Approach Delay (s)	53.4		43.1			28.5
Approach LOS	D		D			C

Intersection Summary			
HCM Average Control Delay	37.5	HCM Level of Service	D
HCM Volume to Capacity ratio	1.02		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.5
Intersection Capacity Utilization	102.8%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	39	160	773	67	40	0
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	41	168	814	71	42	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						800
pX, platoon unblocked						
vC, conflicting volume	933	849			814	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	933	849			814	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	85	53			95	
cM capacity (veh/h)	280	361			813	

Direction, Lane #	WB 1	WB 2	NB 1	SB 1	SB 2
Volume Total	41	168	884	42	0
Volume Left	41	0	0	42	0
Volume Right	0	168	71	0	0
cSH	280	361	1700	813	1700
Volume to Capacity	0.15	0.47	0.52	0.05	0.00
Queue Length 95th (ft)	13	60	0	4	0
Control Delay (s)	20.0	23.4	0.0	9.7	0.0
Lane LOS	C	C		A	
Approach Delay (s)	22.8		0.0	9.7	
Approach LOS	C				

Intersection Summary			
Average Delay	4.6		
Intersection Capacity Utilization	61.3%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	EBT	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	2610	1661	516	144	1197	544	697
v/c Ratio	1.06	0.96	0.48	0.56	1.02	1.04	0.57
Control Delay	68.7	16.4	5.1	59.1	86.1	103.2	45.6
Queue Delay	22.5	9.9	1.8	0.0	49.6	41.6	0.0
Total Delay	91.2	26.3	6.9	59.1	135.7	144.7	45.6
Queue Length 50th (ft)	~882	181	67	129	~397	~255	190
Queue Length 95th (ft)	#972	m148	m75	200	#497	#369	234
Internal Link Dist (ft)	1037	280			562		836
Turn Bay Length (ft)				330		290	
Base Capacity (vph)	2465	1729	1082	255	1179	523	1224
Starvation Cap Reductn	0	90	391	0	0	0	0
Spillback Cap Reductn	117	0	0	0	131	49	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	1.11	1.01	0.75	0.56	1.14	1.15	0.57

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	2316	163	0	1578	490	137	1105	32	517	661	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.5			5.5	5.5	5.5	5.5		5.5	5.5	
Lane Util. Factor		0.91			0.95	1.00	1.00	0.91		0.97	0.91	
Frt		0.99			1.00	0.85	1.00	1.00		1.00	1.00	
Flt Protected		1.00			1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		5035			3539	1583	1770	5064		3433	5084	
Flt Permitted		1.00			1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)		5035			3539	1583	1770	5064		3433	5084	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	2438	172	0	1661	516	144	1163	34	544	696	1
RTOR Reduction (vph)	0	6	0	0	0	0	0	2	0	0	0	0
Lane Group Flow (vph)	0	2604	0	0	1661	516	144	1195	0	544	697	0
Turn Type						pm+ov	Prot			Prot		
Protected Phases		4			8	1	5	2		1	6	
Permitted Phases						8						
Actuated Green, G (s)		63.5			63.5	83.3	18.7	30.2		19.8	31.3	
Effective Green, g (s)		63.5			63.5	83.3	18.7	30.2		19.8	31.3	
Actuated g/C Ratio		0.49			0.49	0.64	0.14	0.23		0.15	0.24	
Clearance Time (s)		5.5			5.5	5.5	5.5	5.5		5.5	5.5	
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		2459			1729	1081	255	1176		523	1224	
v/s Ratio Prot		c0.52			0.47	0.07	0.08	c0.24		c0.16	0.14	
v/s Ratio Perm						0.25						
v/c Ratio		1.06			0.96	0.48	0.56	1.02		1.04	0.57	
Uniform Delay, d1		33.2			32.0	12.1	51.9	49.9		55.1	43.4	
Progression Factor		1.00			0.41	0.50	0.98	1.19		1.00	1.00	
Incremental Delay, d2		36.2			1.9	0.0	7.7	28.5		50.2	1.9	
Delay (s)		69.4			15.1	6.0	58.4	88.1		105.3	45.3	
Level of Service		E			B	A	E	F		F	D	
Approach Delay (s)		69.4			12.9			84.9			71.6	
Approach LOS		E			B			F			E	

Intersection Summary			
HCM Average Control Delay	55.9	HCM Level of Service	E
HCM Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	98.9%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	508	2442	40	2254	816	140	269	538	403
v/c Ratio	1.22	0.80	0.56	1.16	1.19	0.51	1.07	0.61	0.60
Control Delay	156.5	6.7	78.0	103.6	131.4	14.3	133.0	46.5	10.4
Queue Delay	163.6	3.8	0.0	5.0	0.0	0.0	0.0	0.0	0.1
Total Delay	320.1	10.4	78.0	108.7	131.4	14.4	133.0	46.5	10.6
Queue Length 50th (ft)	~542	198	36	~799	~305	7	~129	212	27
Queue Length 95th (ft)	m#495	m175	m44	#893	#379	m63	#220	273	126
Internal Link Dist (ft)		280		585	326			720	
Turn Bay Length (ft)	200		200			130	160		160
Base Capacity (vph)	415	3043	72	1949	685	275	251	885	667
Starvation Cap Reductn	96	510	0	1	0	0	0	0	0
Spillback Cap Reductn	0	82	0	19	0	1	0	0	21
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.59	0.96	0.56	1.17	1.19	0.51	1.07	0.61	0.62

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	483	2305	15	38	1716	426	0	775	133	256	511	383
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Lane Util. Factor	1.00	0.91		1.00	0.91			0.91	1.00	0.97	0.95	1.00
Frt	1.00	1.00		1.00	0.97			1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5080		1770	4934			5085	1583	3433	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5080		1770	4934			5085	1583	3433	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	508	2426	16	40	1806	448	0	816	140	269	538	403
RTOR Reduction (vph)	0	0	0	0	33	0	0	0	61	0	0	272
Lane Group Flow (vph)	508	2442	0	40	2221	0	0	816	79	269	538	132
Turn Type	Prot			Prot					Perm	Prot		Perm
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases									2			6
Actuated Green, G (s)	30.5	76.8		4.2	50.5			17.5	17.5	9.5	32.5	32.5
Effective Green, g (s)	30.5	76.8		4.2	50.5			17.5	17.5	9.5	32.5	32.5
Actuated g/C Ratio	0.23	0.59		0.03	0.39			0.13	0.13	0.07	0.25	0.25
Clearance Time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	415	3001		57	1917			685	213	251	885	396
v/s Ratio Prot	c0.29	0.48		0.02	c0.45			c0.16		c0.08	0.15	
v/s Ratio Perm									0.05			0.08
v/c Ratio	1.22	0.81		0.70	1.16			1.19	0.37	1.07	0.61	0.33
Uniform Delay, d1	49.8	21.0		62.3	39.8			56.2	51.2	60.2	43.1	39.9
Progression Factor	1.36	0.31		1.00	0.78			0.63	0.33	1.00	1.00	1.00
Incremental Delay, d2	102.9	0.2		19.6	75.0			97.9	4.0	77.1	3.1	2.2
Delay (s)	170.5	6.7		82.1	106.0			133.6	21.0	137.4	46.2	42.1
Level of Service	F	A		F	F			F	C	F	D	D
Approach Delay (s)		34.9			105.6			117.1			65.1	
Approach LOS		C			F			F			E	

Intersection Summary			
HCM Average Control Delay	72.3	HCM Level of Service	E
HCM Volume to Capacity ratio	1.17		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	110.0%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	44	763	48	1221	474	84	504	186	402	17
v/c Ratio	0.36	0.34	0.19	0.54	0.49	0.22	0.68	0.56	0.39	0.05
Control Delay	29.5	19.7	24.8	27.7	3.8	44.4	51.4	18.5	11.9	4.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.5	19.7	24.8	27.7	3.8	44.4	51.4	18.5	11.9	4.1
Queue Length 50th (ft)	35	219	24	271	0	59	203	167	114	5
Queue Length 95th (ft)	m54	m250	54	317	61	107	265	m263	m121	m7
Internal Link Dist (ft)		562		597			652		326	
Turn Bay Length (ft)	110		120		200	280		240		60
Base Capacity (vph)	122	2242	249	2249	965	374	743	334	1029	357
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.36	0.34	0.19	0.54	0.49	0.22	0.68	0.56	0.39	0.05

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	42	708	17	46	1160	450	80	419	60	353	205	16
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00	1.00	0.95		0.86	0.86	1.00
Frt	1.00	1.00		1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (prot)	1770	5067		1770	5085	1583	1770	3473		1522	4697	1583
Flt Permitted	0.15	1.00		0.30	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (perm)	275	5067		564	5085	1583	1770	3473		1522	4697	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	44	745	18	48	1221	474	84	441	63	372	216	17
RTOR Reduction (vph)	0	2	0	0	0	264	0	9	0	0	0	10
Lane Group Flow (vph)	44	761	0	48	1221	210	84	495	0	186	402	7
Turn Type	Perm			Perm		Perm	Split			Split		Perm
Protected Phases		4			8		2	2		6	6	
Permitted Phases	4			8		8						6
Actuated Green, G (s)	57.5	57.5		57.5	57.5	57.5	27.5	27.5		28.5	28.5	28.5
Effective Green, g (s)	57.5	57.5		57.5	57.5	57.5	27.5	27.5		28.5	28.5	28.5
Actuated g/C Ratio	0.44	0.44		0.44	0.44	0.44	0.21	0.21		0.22	0.22	0.22
Clearance Time (s)	5.5	5.5		5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	122	2241		249	2249	700	374	735		334	1030	347
v/s Ratio Prot		0.15			c0.24		0.05	c0.14		c0.12	0.09	
v/s Ratio Perm	0.16			0.09		0.13						0.00
v/c Ratio	0.36	0.34		0.19	0.54	0.30	0.22	0.67		0.56	0.39	0.02
Uniform Delay, d1	24.1	23.8		22.1	26.6	23.3	42.4	47.1		45.1	43.3	39.8
Progression Factor	0.88	0.82		1.00	1.00	1.00	1.00	1.00		0.29	0.25	0.18
Incremental Delay, d2	6.0	0.3		1.7	0.9	1.1	1.4	4.9		5.3	0.9	0.1
Delay (s)	27.1	19.7		23.8	27.6	24.4	43.8	52.0		18.3	11.8	7.3
Level of Service	C	B		C	C	C	D	D		B	B	A
Approach Delay (s)		20.1			26.6			50.9			13.7	
Approach LOS		C			C			D			B	

Intersection Summary			
HCM Average Control Delay	26.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	69.0%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	106	2668	39	135	2643	97	94	173	48	18	36
v/c Ratio	0.72	0.85	0.04	0.76	0.83	0.68	0.49	0.56	0.27	0.06	0.13
Control Delay	71.1	7.9	1.1	51.2	0.6	79.3	63.4	16.2	48.2	44.9	14.7
Queue Delay	0.0	0.1	0.0	0.0	8.8	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	71.1	8.0	1.1	51.2	9.3	79.3	63.4	16.2	48.2	44.9	14.7
Queue Length 50th (ft)	95	338	1	122	13	79	75	5	34	13	0
Queue Length 95th (ft)	m116	m413	m1	m107	m12	140	131	75	70	36	31
Internal Link Dist (ft)		585			1015		352			692	
Turn Bay Length (ft)	270		180								
Base Capacity (vph)	157	3157	991	187	3183	171	229	316	180	344	322
Starvation Cap Reductn	0	61	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	540	0	0	0	0	0	4
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.68	0.86	0.04	0.72	1.00	0.57	0.41	0.55	0.27	0.05	0.11

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	101	2535	37	128	2099	412	92	89	164	46	17	34
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	4.0	5.5	5.5
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5085	1583	1770	4960		1770	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.75	1.00	1.00	0.50	1.00	1.00
Satd. Flow (perm)	1770	5085	1583	1770	4960		1389	1863	1583	927	1863	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	106	2668	39	135	2209	434	97	94	173	48	18	36
RTOR Reduction (vph)	0	0	8	0	21	0	0	0	150	0	0	30
Lane Group Flow (vph)	106	2668	31	135	2622	0	97	94	23	48	18	6
Turn Type	Prot		Perm	Prot			Perm		Over	pm+pt		Perm
Protected Phases	7	4		3	8			2	3	1	6	
Permitted Phases			4				2			6		6
Actuated Green, G (s)	10.9	79.9	79.9	13.1	82.1		13.3	13.3	13.1	20.5	20.5	20.5
Effective Green, g (s)	10.9	79.9	79.9	13.1	82.1		13.3	13.3	13.1	20.5	20.5	20.5
Actuated g/C Ratio	0.08	0.61	0.61	0.10	0.63		0.10	0.10	0.10	0.16	0.16	0.16
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	4.0	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	148	3125	973	178	3132		142	191	160	167	294	250
v/s Ratio Prot	0.06	0.52		c0.08	c0.53			0.05	0.01	c0.01	0.01	
v/s Ratio Perm			0.02				c0.07			0.04		0.00
v/c Ratio	0.72	0.85	0.03	0.76	0.84		0.68	0.49	0.14	0.29	0.06	0.02
Uniform Delay, d1	58.0	20.3	9.8	56.9	18.7		56.3	55.2	53.3	47.5	46.6	46.3
Progression Factor	0.96	0.29	0.16	0.84	0.02		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	8.8	1.8	0.0	1.7	0.3		12.7	2.0	0.4	1.0	0.1	0.0
Delay (s)	64.4	7.6	1.6	49.5	0.6		69.1	57.1	53.7	48.5	46.7	46.3
Level of Service	E	A	A	D	A		E	E	D	D	D	D
Approach Delay (s)		9.7			2.9			58.7			47.4	
Approach LOS		A			A			E			D	

Intersection Summary			
HCM Average Control Delay	10.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	81.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBT	SBL
Lane Group Flow (vph)	116	2658	3404	157
v/c Ratio	0.44	0.79	1.17	0.31
Control Delay	35.0	14.3	97.6	32.1
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	35.0	14.3	97.6	32.1
Queue Length 50th (ft)	84	271	~1228	36
Queue Length 95th (ft)	m90	344	m#392	73
Internal Link Dist (ft)		1015	1000	632
Turn Bay Length (ft)				150
Base Capacity (vph)	456	3344	2921	511
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.25	0.79	1.17	0.31

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	110	2525	2666	568	87	62
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5		5.5	
Lane Util. Factor	1.00	0.91	0.91		0.97	
Frt	1.00	1.00	0.97		0.94	
Flt Protected	0.95	1.00	1.00		0.97	
Satd. Flow (prot)	1770	5085	4951		3293	
Flt Permitted	0.95	1.00	1.00		0.97	
Satd. Flow (perm)	1770	5085	4951		3293	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	116	2658	2806	598	92	65
RTOR Reduction (vph)	0	0	25	0	56	0
Lane Group Flow (vph)	116	2658	3379	0	101	0
Turn Type	Prot					
Protected Phases	7 9	4	8		6	
Permitted Phases						
Actuated Green, G (s)	19.5	85.5	76.0		18.0	
Effective Green, g (s)	19.5	85.5	76.0		18.0	
Actuated g/C Ratio	0.15	0.66	0.58		0.14	
Clearance Time (s)		5.5	5.5		5.5	
Vehicle Extension (s)		3.0	3.0		3.0	
Lane Grp Cap (vph)	266	3344	2894		456	
v/s Ratio Prot	c0.07	c0.52	c0.68		c0.03	
v/s Ratio Perm						
v/c Ratio	0.44	0.79	1.17		0.22	
Uniform Delay, d1	50.2	16.0	27.0		49.8	
Progression Factor	0.65	0.81	0.80		1.00	
Incremental Delay, d2	0.6	1.1	75.8		1.1	
Delay (s)	33.2	14.0	97.3		50.9	
Level of Service	C	B	F		D	
Approach Delay (s)		14.8	97.3		50.9	
Approach LOS		B	F		D	

Intersection Summary			
HCM Average Control Delay	60.0	HCM Level of Service	E
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	11.0
Intersection Capacity Utilization	88.5%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBT	SBL	SBT
Lane Group Flow (vph)	152	2520	69	46	3794	181	51	119
v/c Ratio	1.18	0.71	0.06	0.43	1.13	1.18	0.29	0.39
Control Delay	155.7	1.2	0.1	70.5	85.7	175.1	55.8	16.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	155.7	1.2	0.1	70.5	85.7	175.1	55.8	16.9
Queue Length 50th (ft)	~152	19	0	38	~1358	~181	39	13
Queue Length 95th (ft)	m#224	23	m0	80	#1423	#334	82	71
Internal Link Dist (ft)		1000			893	425		590
Turn Bay Length (ft)	150			300				
Base Capacity (vph)	129	3531	1120	123	3359	154	174	307
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.18	0.71	0.06	0.37	1.13	1.18	0.29	0.39

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	144	2394	66	44	3391	214	123	38	11	48	16	97
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5			5.5		5.5	5.5	
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91			1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.99			0.99		1.00	0.87	
Flt Protected	0.95	1.00	1.00	0.95	1.00			0.97		0.95	1.00	
Satd. Flow (prot)	1770	5085	1583	1770	5040			1783		1770	1623	
Flt Permitted	0.95	1.00	1.00	0.95	1.00			0.61		0.69	1.00	
Satd. Flow (perm)	1770	5085	1583	1770	5040			1133		1289	1623	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	152	2520	69	46	3569	225	129	40	12	51	17	102
RTOR Reduction (vph)	0	0	22	0	5	0	0	2	0	0	88	0
Lane Group Flow (vph)	152	2520	47	46	3789	0	0	179	0	51	31	0
Turn Type	Prot		Perm	Prot			Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4				2			6		
Actuated Green, G (s)	10.6	89.2	89.2	6.8	85.4			17.5		17.5	17.5	
Effective Green, g (s)	10.6	89.2	89.2	6.8	85.4			17.5		17.5	17.5	
Actuated g/C Ratio	0.08	0.69	0.69	0.05	0.66			0.13		0.13	0.13	
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5			5.5		5.5	5.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	144	3489	1086	93	3311			153		174	218	
v/s Ratio Prot	c0.09	0.50		0.03	c0.75						0.02	
v/s Ratio Perm			0.03					c0.16		0.04		
v/c Ratio	1.06	0.72	0.04	0.49	1.14			1.17		0.29	0.14	
Uniform Delay, d1	59.7	12.7	6.6	59.9	22.3			56.2		50.7	49.6	
Progression Factor	0.66	0.03	0.00	1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d2	73.6	0.8	0.0	4.1	69.0			126.4		0.9	0.3	
Delay (s)	112.9	1.2	0.0	64.0	91.3			182.6		51.6	49.9	
Level of Service	F	A	A	E	F			F		D	D	
Approach Delay (s)		7.4			90.9			182.6			50.4	
Approach LOS		A			F			F			D	

Intersection Summary			
HCM Average Control Delay	59.3	HCM Level of Service	E
HCM Volume to Capacity ratio	1.14		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	108.2%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Queues
3: 7th St & Park Ave

2/20/2013

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	19	1264	78	1353	79	181	505	51	127	91
v/c Ratio	0.16	0.82	0.33	0.74	0.19	0.29	0.81	0.13	0.20	0.17
Control Delay	18.8	23.6	12.2	16.1	17.0	17.8	25.3	16.3	16.8	12.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	18.8	23.6	12.2	16.1	17.0	17.8	25.3	16.3	16.8	12.3
Queue Length 50th (ft)	5	241	14	213	23	56	138	15	38	18
Queue Length 95th (ft)	22	#414	37	339	52	100	254	37	73	47
Internal Link Dist (ft)		588		707		495			498	
Turn Bay Length (ft)	70		180		30		30	100		90
Base Capacity (vph)	132	1749	233	2169	605	895	836	554	895	775
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.14	0.72	0.33	0.62	0.13	0.20	0.60	0.09	0.14	0.12

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	18	1128	73	74	1273	12	75	172	480	48	121	86
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		3.0	5.0		4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3507		1770	3534		1770	1863	1583	1770	1863	1583
Flt Permitted	0.14	1.00		0.13	1.00		0.68	1.00	1.00	0.62	1.00	1.00
Satd. Flow (perm)	265	3507		240	3534		1258	1863	1583	1153	1863	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	19	1187	77	78	1340	13	79	181	505	51	127	91
RTOR Reduction (vph)	0	6	0	0	1	0	0	0	97	0	0	19
Lane Group Flow (vph)	19	1258	0	78	1352	0	79	181	408	51	127	72
Turn Type	Perm			pm+pt			Perm		Perm	Perm		Perm
Protected Phases		4		3	8			2			6	
Permitted Phases	4			8			2		2	6		6
Actuated Green, G (s)	28.1	28.1		34.0	34.0		21.5	21.5	21.5	21.5	21.5	21.5
Effective Green, g (s)	28.1	28.1		34.0	34.0		21.5	21.5	21.5	21.5	21.5	21.5
Actuated g/C Ratio	0.44	0.44		0.53	0.53		0.33	0.33	0.33	0.33	0.33	0.33
Clearance Time (s)	5.0	5.0		3.0	5.0		4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	115	1528		195	1863		419	621	528	384	621	528
v/s Ratio Prot		c0.36		0.02	c0.38			0.10			0.07	
v/s Ratio Perm	0.07			0.19			0.06		c0.26	0.04		0.05
v/c Ratio	0.17	0.82		0.40	0.73		0.19	0.29	0.77	0.13	0.20	0.14
Uniform Delay, d1	11.1	16.0		10.9	11.7		15.3	15.9	19.3	15.0	15.4	15.0
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.7	3.7		1.3	1.4		0.2	0.3	6.9	0.2	0.2	0.1
Delay (s)	11.7	19.8		12.2	13.1		15.5	16.1	26.3	15.2	15.5	15.1
Level of Service	B	B		B	B		B	B	C	B	B	B
Approach Delay (s)		19.6			13.1			22.8			15.3	
Approach LOS		B			B			C			B	

Intersection Summary			
HCM Average Control Delay	17.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	64.5	Sum of lost time (s)	14.0
Intersection Capacity Utilization	77.4%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	208	232	0	1058	1703	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0			4.0	4.0	
Lane Util. Factor	0.97			0.95	0.95	
Frt	0.92			1.00	1.00	
Flt Protected	0.98			1.00	1.00	
Satd. Flow (prot)	3251			3539	3539	
Flt Permitted	0.98			1.00	1.00	
Satd. Flow (perm)	3251			3539	3539	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	219	244	0	1114	1793	0
RTOR Reduction (vph)	15	0	0	0	0	0
Lane Group Flow (vph)	448	0	0	1114	1793	0
Turn Type						
Protected Phases	4			2	6	
Permitted Phases						
Actuated Green, G (s)	13.1			38.9	38.9	
Effective Green, g (s)	13.1			38.9	38.9	
Actuated g/C Ratio	0.22			0.65	0.65	
Clearance Time (s)	4.0			4.0	4.0	
Vehicle Extension (s)	3.0			3.0	3.0	
Lane Grp Cap (vph)	710			2294	2294	
v/s Ratio Prot	c0.14			0.31	c0.51	
v/s Ratio Perm						
v/c Ratio	0.63			0.49	0.78	
Uniform Delay, d1	21.3			5.4	7.5	
Progression Factor	1.00			0.53	0.38	
Incremental Delay, d2	1.8			0.7	2.0	
Delay (s)	23.1			3.6	4.9	
Level of Service	C			A	A	
Approach Delay (s)	23.1			3.6	4.9	
Approach LOS	C			A	A	

Intersection Summary			
HCM Average Control Delay	7.0	HCM Level of Service	A
HCM Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	67.0%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
29: College Park Dr & SR-22 Ramps

12/4/2012

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	39	160	773	67	40	136
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frt	1.00	0.85	0.99		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	1583	1843		1770	1863
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1770	1583	1843		1770	1863
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	41	168	814	71	42	143
RTOR Reduction (vph)	0	151	4	0	0	0
Lane Group Flow (vph)	41	17	881	0	42	143
Turn Type		Perm			Prot	
Protected Phases	8		2		1	6
Permitted Phases		8				
Actuated Green, G (s)	6.2	6.2	38.5		3.3	45.8
Effective Green, g (s)	6.2	6.2	38.5		3.3	45.8
Actuated g/C Ratio	0.10	0.10	0.64		0.05	0.76
Clearance Time (s)	4.0	4.0	4.0		4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	183	164	1183		97	1422
v/s Ratio Prot	c0.02		c0.48		c0.02	0.08
v/s Ratio Perm		0.01				
v/c Ratio	0.22	0.11	0.75		0.43	0.10
Uniform Delay, d1	24.7	24.4	7.4		27.4	1.8
Progression Factor	1.00	1.00	1.00		1.08	0.35
Incremental Delay, d2	0.6	0.3	4.3		3.0	0.1
Delay (s)	25.3	24.7	11.7		32.6	0.8
Level of Service	C	C	B		C	A
Approach Delay (s)	24.8		11.7			8.0
Approach LOS	C		B			A

Intersection Summary			
HCM Average Control Delay	13.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	61.3%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Queues
1: Carson St & I-605 SB Off Ramps

12/4/2012

Lane Group	EBT	WBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	2149	1556	578	1086	562	258
v/c Ratio	0.84	0.76	0.36	0.77	0.43	0.43
Control Delay	18.3	12.8	0.6	18.6	12.7	14.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	18.3	12.8	0.6	18.6	12.7	14.2
Queue Length 50th (ft)	171	123	0	150	68	61
Queue Length 95th (ft)	217	174	0	215	104	119
Internal Link Dist (ft)	550	190			1136	
Turn Bay Length (ft)				300		300
Base Capacity (vph)	2569	2043	1611	1411	1315	595
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.84	0.76	0.36	0.77	0.43	0.43

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1856	185	0	1478	0	0	0	549	1032	326	453
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.9			4.9				4.0	5.4	5.4	5.4
Lane Util. Factor		0.86			0.91				1.00	0.97	0.91	0.91
Frt		0.99			1.00				0.86	1.00	0.94	0.85
Flt Protected		1.00			1.00				1.00	0.95	1.00	1.00
Satd. Flow (prot)		6321			5085				1611	3433	3192	1441
Flt Permitted		1.00			1.00				1.00	0.95	1.00	1.00
Satd. Flow (perm)		6321			5085				1611	3433	3192	1441
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1954	195	0	1556	0	0	0	578	1086	343	477
RTOR Reduction (vph)	0	30	0	0	0	0	0	0	0	0	3	3
Lane Group Flow (vph)	0	2119	0	0	1556	0	0	0	578	1086	559	255
Turn Type									Free	Split		Perm
Protected Phases		2			6					4	4	
Permitted Phases									Free			4
Actuated Green, G (s)		22.1			22.1				55.0	22.6	22.6	22.6
Effective Green, g (s)		22.1			22.1				55.0	22.6	22.6	22.6
Actuated g/C Ratio		0.40			0.40				1.00	0.41	0.41	0.41
Clearance Time (s)		4.9			4.9					5.4	5.4	5.4
Vehicle Extension (s)		5.0			5.0					2.5	2.5	2.5
Lane Grp Cap (vph)		2540			2043				1611	1411	1312	592
v/s Ratio Prot		c0.34			0.31					c0.32	0.18	
v/s Ratio Perm									0.36			0.18
v/c Ratio		0.83			0.76				0.36	0.77	0.43	0.43
Uniform Delay, d1		14.8			14.2				0.0	14.0	11.6	11.6
Progression Factor		1.00			0.74				1.00	1.00	1.00	1.00
Incremental Delay, d2		2.8			1.6				0.6	4.1	1.0	2.3
Delay (s)		17.6			12.1				0.6	18.1	12.6	13.9
Level of Service		B			B				A	B	B	B
Approach Delay (s)		17.6			12.1			0.6			15.9	
Approach LOS		B			B			A			B	

Intersection Summary			
HCM Average Control Delay	14.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	55.0	Sum of lost time (s)	10.3
Intersection Capacity Utilization	68.0%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	WBT	WBR	NBL	NBR
Lane Group Flow (vph)	3348	1347	779	738	336
v/c Ratio	0.85	0.62	0.61	0.72	0.40
Control Delay	16.3	5.0	3.6	39.0	32.3
Queue Delay	0.1	0.8	1.7	0.0	0.0
Total Delay	16.4	5.8	5.3	39.0	32.3
Queue Length 50th (ft)	463	88	55	239	106
Queue Length 95th (ft)	515	m120	m89	307	153
Internal Link Dist (ft)	410	90			
Turn Bay Length (ft)				300	300
Base Capacity (vph)	3938	2175	1273	1030	837
Starvation Cap Reductn	21	488	315	0	0
Spillback Cap Reductn	80	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.87	0.80	0.81	0.72	0.40

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	3181	0	0	1280	740	701	0	319	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.4			5.4	5.4	4.0		4.0			
Lane Util. Factor		0.86			0.95	1.00	0.97		0.88			
Frt		1.00			1.00	0.85	1.00		0.85			
Flt Protected		1.00			1.00	1.00	0.95		1.00			
Satd. Flow (prot)		6408			3539	1583	3433		2787			
Flt Permitted		1.00			1.00	1.00	0.95		1.00			
Satd. Flow (perm)		6408			3539	1583	3433		2787			
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	3348	0	0	1347	779	738	0	336	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	300	0	0	1	0	0	0
Lane Group Flow (vph)	0	3348	0	0	1347	479	738	0	335	0	0	0
Turn Type						Perm	custom		custom			
Protected Phases		2			6							
Permitted Phases						6	8		8			
Actuated Green, G (s)		67.6			67.6	67.6	33.0		33.0			
Effective Green, g (s)		67.6			67.6	67.6	33.0		33.0			
Actuated g/C Ratio		0.61			0.61	0.61	0.30		0.30			
Clearance Time (s)		5.4			5.4	5.4	4.0		4.0			
Vehicle Extension (s)		5.0			5.0	5.0	3.0		3.0			
Lane Grp Cap (vph)		3938			2175	973	1030		836			
v/s Ratio Prot		c0.52			0.38							
v/s Ratio Perm						0.30	c0.21		0.12			
v/c Ratio		0.85			0.62	0.49	0.72		0.40			
Uniform Delay, d1		17.1			13.2	11.7	34.3		30.6			
Progression Factor		0.83			0.32	3.11	1.00		1.00			
Incremental Delay, d2		1.5			0.4	0.4	4.3		1.4			
Delay (s)		15.8			4.6	36.9	38.6		32.1			
Level of Service		B			A	D	D		C			
Approach Delay (s)		15.8			16.4			36.6			0.0	
Approach LOS		B			B			D			A	

Intersection Summary			
HCM Average Control Delay	19.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	9.4
Intersection Capacity Utilization	73.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	884	2284	6	1345	214	107	167	325	318
v/c Ratio	1.00	0.82	0.05	0.97	0.87	0.32	0.26	0.84	0.65
Control Delay	53.1	10.9	49.7	57.0	79.5	45.4	39.3	37.2	11.6
Queue Delay	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	53.1	11.4	49.7	57.0	79.5	45.4	39.3	37.2	11.6
Queue Length 50th (ft)	~308	61	4	344	152	35	51	91	0
Queue Length 95th (ft)	m#453	#116	18	#455	#302	62	84	#236	86
Internal Link Dist (ft)		311		731		382		448	
Turn Bay Length (ft)	250		80		120		140		140
Base Capacity (vph)	880	2788	113	1390	246	702	639	417	512
Starvation Cap Reductn	0	163	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.00	0.87	0.05	0.97	0.87	0.15	0.26	0.78	0.62

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	840	1954	216	6	1144	134	203	93	9	159	51	560
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.9	5.4		4.9	5.4		4.9	5.4		4.9	5.4	5.4
Lane Util. Factor	0.97	0.91		1.00	0.91		1.00	0.95		0.97	0.95	0.95
Frt	1.00	0.99		1.00	0.98		1.00	0.99		1.00	0.87	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	5009		1770	5005		1770	3495		3433	1548	1504
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	5009		1770	5005		1770	3495		3433	1548	1504
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	884	2057	227	6	1204	141	214	98	9	167	54	589
RTOR Reduction (vph)	0	11	0	0	14	0	0	7	0	0	168	273
Lane Group Flow (vph)	884	2273	0	6	1331	0	214	100	0	167	157	45
Turn Type	Prot			Prot			Prot			Prot		Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												4
Actuated Green, G (s)	32.1	57.1		1.4	26.4		15.3	10.4		20.5	15.6	15.6
Effective Green, g (s)	32.1	57.1		1.4	26.4		15.3	10.4		20.5	15.6	15.6
Actuated g/C Ratio	0.29	0.52		0.01	0.24		0.14	0.09		0.19	0.14	0.14
Clearance Time (s)	4.9	5.4		4.9	5.4		4.9	5.4		4.9	5.4	5.4
Vehicle Extension (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Grp Cap (vph)	1002	2600		23	1201		246	330		640	220	213
v/s Ratio Prot	0.26	c0.45		0.00	c0.27		c0.12	0.03		c0.05	c0.10	
v/s Ratio Perm												0.03
v/c Ratio	0.88	0.87		0.26	1.11		0.87	0.30		0.26	0.71	0.21
Uniform Delay, d1	37.1	23.3		53.8	41.8		46.4	46.4		38.3	45.1	41.8
Progression Factor	0.67	0.39		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	5.7	2.6		8.1	61.1		26.9	0.7		0.3	11.1	0.7
Delay (s)	30.7	11.7		61.9	102.9		73.3	47.1		38.6	56.2	42.4
Level of Service	C	B		E	F		E	D		D	E	D
Approach Delay (s)		17.0			102.7			64.6			47.1	
Approach LOS		B			F			E			D	

Intersection Summary			
HCM Average Control Delay	44.5	HCM Level of Service	D
HCM Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	20.6
Intersection Capacity Utilization	91.6%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	2109	1395	642	958
v/c Ratio	0.67	0.64	0.75	0.61
Control Delay	10.7	10.7	30.1	1.7
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	10.7	10.7	30.1	1.7
Queue Length 50th (ft)	195	179	130	0
Queue Length 95th (ft)	277	275	174	0
Internal Link Dist (ft)	898	560	1261	
Turn Bay Length (ft)			230	900
Base Capacity (vph)	3129	2178	1020	1583
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.67	0.64	0.63	0.61

Intersection Summary

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	2004	1325	0	610	910
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.3	5.3		4.2	4.0
Lane Util. Factor		0.91	0.95		0.97	1.00
Frt		1.00	1.00		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		5085	3539		3433	1583
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		5085	3539		3433	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	2109	1395	0	642	958
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	2109	1395	0	642	958
Turn Type						Free
Protected Phases		2	6		4	
Permitted Phases						Free
Actuated Green, G (s)		43.1	43.1		17.4	70.0
Effective Green, g (s)		43.1	43.1		17.4	70.0
Actuated g/C Ratio		0.62	0.62		0.25	1.00
Clearance Time (s)		5.3	5.3		4.2	
Vehicle Extension (s)		5.0	5.0		2.5	
Lane Grp Cap (vph)		3131	2179		853	1583
v/s Ratio Prot		0.41	0.39		c0.19	
v/s Ratio Perm						c0.61
v/c Ratio		0.67	0.64		0.75	0.61
Uniform Delay, d1		8.8	8.5		24.3	0.0
Progression Factor		1.00	1.00		1.00	1.00
Incremental Delay, d2		1.2	1.4		3.6	1.7
Delay (s)		10.0	9.9		27.9	1.7
Level of Service		B	A		C	A
Approach Delay (s)		10.0	9.9		12.2	
Approach LOS		B	A		B	

Intersection Summary			
HCM Average Control Delay	10.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	4.2
Intersection Capacity Utilization	64.0%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	EBR	WBL	WBT
Lane Group Flow (vph)	2200	1019	149	1368
v/c Ratio	0.84	0.82	0.68	0.39
Control Delay	6.6	9.1	46.8	0.3
Queue Delay	0.0	0.1	0.0	0.0
Total Delay	6.6	9.1	46.8	0.3
Queue Length 50th (ft)	156	100	62	0
Queue Length 95th (ft)	175	#191	#138	0
Internal Link Dist (ft)	560			522
Turn Bay Length (ft)			260	
Base Capacity (vph)	2632	1239	228	3539
Starvation Cap Reductn	0	5	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.84	0.83	0.65	0.39

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	2090	968	142	1300	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.3	5.3	4.0	5.3		
Lane Util. Factor	0.95	1.00	1.00	0.95		
Frt	1.00	0.85	1.00	1.00		
Flt Protected	1.00	1.00	0.95	1.00		
Satd. Flow (prot)	3539	1583	1770	3539		
Flt Permitted	1.00	1.00	0.95	1.00		
Satd. Flow (perm)	3539	1583	1770	3539		
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	2200	1019	149	1368	0	0
RTOR Reduction (vph)	0	62	0	0	0	0
Lane Group Flow (vph)	2200	957	149	1368	0	0
Turn Type		Perm	Prot			
Protected Phases	2		1	6		
Permitted Phases		2				
Actuated Green, G (s)	52.1	52.1	8.6	70.0		
Effective Green, g (s)	52.1	52.1	8.6	70.0		
Actuated g/C Ratio	0.74	0.74	0.12	1.00		
Clearance Time (s)	5.3	5.3	4.0	5.3		
Vehicle Extension (s)	5.0	5.0	3.0	5.0		
Lane Grp Cap (vph)	2634	1178	217	3539		
v/s Ratio Prot	c0.62		c0.08	0.39		
v/s Ratio Perm		0.60				
v/c Ratio	0.84	0.81	0.69	0.39		
Uniform Delay, d1	6.0	5.8	29.4	0.0		
Progression Factor	0.55	0.60	1.00	1.00		
Incremental Delay, d2	2.8	5.2	8.7	0.3		
Delay (s)	6.1	8.7	38.1	0.3		
Level of Service	A	A	D	A		
Approach Delay (s)	6.9			4.0	0.0	
Approach LOS	A			A	A	

Intersection Summary			
HCM Average Control Delay	6.0	HCM Level of Service	A
HCM Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	9.3
Intersection Capacity Utilization	75.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	424	0	0	694	0	1033	670	0	786	368
Sign Control		Yield			Yield			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	0	446	0	0	731	0	1087	705	0	827	387
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)								1120				
pX, platoon unblocked	0.89	0.89		0.89	0.89	0.89				0.89		
vC, conflicting volume	1190	1915	276	1363	1915	362	827			1087		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	766	1583	276	961	1583	0	827			650		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	38	100	100	24	100			100		
cM capacity (veh/h)	62	95	722	71	95	961	800			826		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	NB 4	SB 1	SB 2	SB 3	SB 4
Volume Total	446	731	435	435	453	470	331	331	295	258
Volume Left	0	0	0	0	0	0	0	0	0	0
Volume Right	446	731	0	0	235	470	0	0	129	258
cSH	722	961	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.62	0.76	0.26	0.26	0.27	0.28	0.19	0.19	0.17	0.15
Queue Length 95th (ft)	108	188	0	0	0	0	0	0	0	0
Control Delay (s)	17.7	19.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	C	C								
Approach Delay (s)	17.7	19.5	0.0				0.0			
Approach LOS	C	C								

Intersection Summary			
Average Delay	5.3		
Intersection Capacity Utilization	74.6%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	0	753	0	1597	664	440
Sign Control	Yield			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	793	0	1681	699	463
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)				640		
pX, platoon unblocked	0.87					
vC, conflicting volume	1119	233	699			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	370	233	699			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	0	100			
cM capacity (veh/h)	523	769	894			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	NB 4	SB 1	SB 2	SB 3	SB 4
Volume Total	793	420	420	420	420	280	280	294	309
Volume Left	0	0	0	0	0	0	0	0	0
Volume Right	793	0	0	0	0	0	0	154	309
cSH	769	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	1.03	0.25	0.25	0.25	0.25	0.16	0.16	0.17	0.18
Queue Length 95th (ft)	470	0	0	0	0	0	0	0	0
Control Delay (s)	63.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	F								
Approach Delay (s)	63.7	0.0				0.0			
Approach LOS	F								

Intersection Summary			
Average Delay	13.9		
Intersection Capacity Utilization	69.4%	ICU Level of Service	C
Analysis Period (min)	15		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	146	2240	294	238	1005	246	228	1120	195	1176
v/c Ratio	0.54	1.04	0.37	0.95	0.50	0.35	0.94	0.77	0.71	0.98
Control Delay	56.6	62.5	10.9	97.4	24.6	4.0	95.4	42.4	65.3	63.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	56.6	62.5	10.9	97.4	24.6	4.0	95.4	42.4	65.3	63.9
Queue Length 50th (ft)	52	~627	76	87	199	0	84	206	71	300
Queue Length 95th (ft)	85	#723	117	#167	243	55	#160	247	#132	#402
Internal Link Dist (ft)		578			652			1209		560
Turn Bay Length (ft)	175			150			180		150	
Base Capacity (vph)	281	2154	785	250	2003	713	243	1520	273	1196
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.52	1.04	0.37	0.95	0.50	0.35	0.94	0.74	0.71	0.98

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	139	2128	279	226	929	259	217	903	161	185	991	126
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4		5.4	5.4	
Lane Util. Factor	0.97	0.91	1.00	0.97	0.86	0.86	0.97	0.86		0.97	0.91	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.98		1.00	0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	3433	5085	1583	3433	4787	1362	3433	6263		3433	4999	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	3433	5085	1583	3433	4787	1362	3433	6263		3433	4999	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	146	2240	294	238	978	273	228	951	169	195	1043	133
RTOR Reduction (vph)	0	0	3	0	2	143	0	29	0	0	15	0
Lane Group Flow (vph)	146	2240	291	238	1003	103	228	1091	0	195	1161	0
Turn Type	Prot		pm+ov	Prot		Perm	Prot			Prot		
Protected Phases	7	4	5	3	8		5	2		1	6	
Permitted Phases			4			8						
Actuated Green, G (s)	8.6	46.6	54.4	8.0	46.0	46.0	7.8	25.0		8.8	26.0	
Effective Green, g (s)	8.6	46.6	54.4	8.0	46.0	46.0	7.8	25.0		8.8	26.0	
Actuated g/C Ratio	0.08	0.42	0.49	0.07	0.42	0.42	0.07	0.23		0.08	0.24	
Clearance Time (s)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4		5.4	5.4	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	268	2154	783	250	2002	570	243	1423		275	1182	
v/s Ratio Prot	0.04	c0.44	0.03	c0.07	0.21		0.07	c0.17		0.06	c0.23	
v/s Ratio Perm			0.16			0.08						
v/c Ratio	0.54	1.04	0.37	0.95	0.50	0.18	0.94	0.77		0.71	0.98	
Uniform Delay, d1	48.8	31.7	17.2	50.8	23.6	20.1	50.9	39.8		49.4	41.8	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.3	30.7	0.3	43.6	0.2	0.2	40.6	2.5		8.1	21.9	
Delay (s)	51.1	62.4	17.5	94.4	23.7	20.3	91.5	42.3		57.5	63.7	
Level of Service	D	E	B	F	C	C	F	D		E	E	
Approach Delay (s)		56.9			34.5			50.6			62.8	
Approach LOS		E			C			D			E	

Intersection Summary			
HCM Average Control Delay	52.0	HCM Level of Service	D
HCM Volume to Capacity ratio	1.02		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	21.6
Intersection Capacity Utilization	93.7%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	1851	690	0	795	0	0	0	0	0	0	732
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	1948	726	0	837	0	0	0	0	0	0	771
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		732										
pX, platoon unblocked				0.59			0.59	0.59	0.59	0.59	0.59	
vC, conflicting volume	837			2675			2591	3148	1013	1486	3512	279
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	837			1415			1273	2216	0	0	2830	279
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			0	100	100	100	100	0
cM capacity (veh/h)	793			282			0	26	642	605	10	718

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	SB 1
Volume Total	779	779	1116	279	279	279	771
Volume Left	0	0	0	0	0	0	0
Volume Right	0	0	726	0	0	0	771
cSH	1700	1700	1700	1700	1700	1700	718
Volume to Capacity	0.46	0.46	0.66	0.16	0.16	0.16	1.07
Queue Length 95th (ft)	0	0	0	0	0	0	514
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	78.2
Lane LOS							F
Approach Delay (s)	0.0			0.0			78.2
Approach LOS							F

Intersection Summary			
Average Delay	14.1		
Intersection Capacity Utilization	67.4%	ICU Level of Service	C
Analysis Period (min)	15		

Lane Group	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	48	182	235	225	19	1788	511	1926
v/c Ratio	0.43	0.65	0.76	0.73	0.20	0.56	0.38	0.57
Control Delay	45.2	52.9	45.6	42.7	1.8	1.2	0.6	11.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	45.2	52.9	45.6	42.7	1.8	1.2	0.6	11.7
Queue Length 50th (ft)	19	127	123	110	1	34	0	258
Queue Length 95th (ft)	58	194	209	189	m1	m39	m0	347
Internal Link Dist (ft)	296		624			121		607
Turn Bay Length (ft)				470	120			
Base Capacity (vph)	113	367	383	383	95	3197	1362	3400
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.42	0.50	0.61	0.59	0.20	0.56	0.38	0.57

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	26	0	20	192	43	375	18	1606	578	0	1810	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		5.0	5.0	5.0	5.0	5.0	4.0		5.0	
Lane Util. Factor		1.00		0.95	0.91	0.95	1.00	0.86	0.86		0.91	
Frt		0.94		1.00	0.89	0.85	1.00	0.99	0.85		1.00	
Flt Protected		0.97		0.95	1.00	1.00	0.95	1.00	1.00		1.00	
Satd. Flow (prot)		1705		1681	1505	1504	1770	4767	1362		5077	
Flt Permitted		0.97		0.95	1.00	1.00	0.08	1.00	1.00		1.00	
Satd. Flow (perm)		1705		1681	1505	1504	141	4767	1362		5077	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	27	0	21	202	45	395	19	1691	608	0	1905	21
RTOR Reduction (vph)	0	20	0	0	58	58	0	4	0	0	1	0
Lane Group Flow (vph)	0	28	0	182	177	167	19	1784	511	0	1925	0
Turn Type	Split			Split		Perm	Perm		Free			
Protected Phases	4	4		8	8			2			6	
Permitted Phases						8	2		Free			
Actuated Green, G (s)		4.8		18.4	18.4	18.4	72.8	72.8	110.0		72.8	
Effective Green, g (s)		4.8		18.4	18.4	18.4	72.8	72.8	110.0		72.8	
Actuated g/C Ratio		0.04		0.17	0.17	0.17	0.66	0.66	1.00		0.66	
Clearance Time (s)		4.0		5.0	5.0	5.0	5.0	5.0			5.0	
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0			3.0	
Lane Grp Cap (vph)		74		281	252	252	93	3155	1362		3360	
v/s Ratio Prot		0.02		0.11	c0.12			0.37			c0.38	
v/s Ratio Perm						0.11	0.13		c0.38			
v/c Ratio		0.38		0.65	0.70	0.66	0.20	0.57	0.38		0.57	
Uniform Delay, d1		51.1		42.8	43.2	42.9	7.3	10.1	0.0		10.1	
Progression Factor		1.00		1.00	1.00	1.00	0.12	0.11	1.00		1.00	
Incremental Delay, d2		3.2		5.1	8.5	6.4	0.4	0.1	0.1		0.7	
Delay (s)		54.4		47.8	51.7	49.3	1.3	1.1	0.1		10.8	
Level of Service		D		D	D	D	A	A	A		B	
Approach Delay (s)		54.4			49.8			0.9			10.8	
Approach LOS		D			D			A			B	

Intersection Summary			
HCM Average Control Delay	11.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	65.8%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	109	2065	233	1199	139	2149	158	1663
v/c Ratio	0.66	1.43	1.21	0.78	0.79	1.15	1.09	0.94
Control Delay	68.0	227.5	150.9	11.5	37.9	90.2	136.5	35.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	101.2	0.0	0.0
Total Delay	68.0	227.5	150.9	11.5	37.9	191.4	136.5	35.6
Queue Length 50th (ft)	75	~727	~203	221	101	~640	~127	417
Queue Length 95th (ft)	#144	#825	m#356	187	m81	m217	#262	#514
Internal Link Dist (ft)		1129		409		285		200
Turn Bay Length (ft)	140		110		150		120	
Base Capacity (vph)	177	1448	193	1539	177	1866	145	1773
Starvation Cap Reductn	0	0	0	0	0	307	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.62	1.43	1.21	0.78	0.79	1.38	1.09	0.94

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	104	1799	162	221	844	295	132	1958	84	150	1517	63
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5		4.0	4.5		4.0	4.5		4.0	4.5	
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	0.91		1.00	0.91	
Frt	1.00	0.99		1.00	0.96		1.00	0.99		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	5022		1770	4887		1770	5054		1770	5055	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	5022		1770	4887		1770	5054		1770	5055	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	109	1894	171	233	888	311	139	2061	88	158	1597	66
RTOR Reduction (vph)	0	9	0	0	57	0	0	4	0	0	4	0
Lane Group Flow (vph)	109	2056	0	233	1142	0	139	2145	0	158	1659	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	10.2	31.5		12.0	33.3		11.0	40.5		9.0	38.5	
Effective Green, g (s)	10.2	31.5		12.0	33.3		11.0	40.5		9.0	38.5	
Actuated g/C Ratio	0.09	0.29		0.11	0.30		0.10	0.37		0.08	0.35	
Clearance Time (s)	4.0	4.5		4.0	4.5		4.0	4.5		4.0	4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	164	1438		193	1479		177	1861		145	1769	
v/s Ratio Prot	0.06	c0.41		c0.13	0.23		0.08	c0.42		c0.09	0.33	
v/s Ratio Perm												
v/c Ratio	0.66	1.43		1.21	0.77		0.79	1.15		1.09	0.94	
Uniform Delay, d1	48.2	39.2		49.0	34.9		48.3	34.8		50.5	34.6	
Progression Factor	1.00	1.00		0.51	0.26		0.67	0.55		0.83	0.73	
Incremental Delay, d2	9.7	197.4		123.5	1.9		2.1	69.2		94.6	9.6	
Delay (s)	58.0	236.6		148.3	11.0		34.7	88.3		136.7	35.0	
Level of Service	E	F		F	B		C	F		F	D	
Approach Delay (s)		227.7			33.3			85.0			43.9	
Approach LOS		F			C			F			D	

Intersection Summary			
HCM Average Control Delay	105.9	HCM Level of Service	F
HCM Volume to Capacity ratio	1.25		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	112.8%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	529	1258	323	298	748	24	1940	522	1984
v/c Ratio	1.26	0.96	0.81	1.03	0.74	0.35	1.23	0.59	0.89
Control Delay	167.5	53.5	46.1	59.3	22.4	38.0	139.0	10.7	5.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4
Total Delay	167.5	53.5	46.1	59.3	22.4	38.0	139.0	10.8	5.7
Queue Length 50th (ft)	~489	350	230	~172	103	11	~893	88	37
Queue Length 95th (ft)	#701	#431	#295	m#158	m90	41	#1031	194	m76
Internal Link Dist (ft)		339			174		323		285
Turn Bay Length (ft)	200			175		175			
Base Capacity (vph)	421	1308	398	290	1109	68	1576	889	2234
Starvation Cap Reductn	0	0	0	0	0	0	0	0	41
Spillback Cap Reductn	0	0	0	0	0	0	0	40	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.26	0.96	0.81	1.03	0.67	0.35	1.23	0.61	0.90

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	503	1161	341	283	705	6	23	1843	496	0	1330	555
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5	4.5	4.0	4.5		4.5	4.5	4.5		4.5	
Lane Util. Factor	1.00	0.86	0.86	1.00	0.91		1.00	0.95	1.00		0.91	
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85		0.96	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00		1.00	
Satd. Flow (prot)	1770	4785	1362	1770	5079		1770	3539	1583		4861	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.08	1.00	1.00		1.00	
Satd. Flow (perm)	1770	4785	1362	1770	5079		152	3539	1583		4861	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	529	1222	359	298	742	6	24	1940	522	0	1400	584
RTOR Reduction (vph)	0	3	27	0	1	0	0	0	184	0	68	0
Lane Group Flow (vph)	529	1255	296	298	747	0	24	1940	338	0	1916	0
Turn Type	Prot		Perm	Prot			Perm		Perm			
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4				2		2			
Actuated Green, G (s)	26.2	30.0	30.0	18.0	21.8		49.0	49.0	49.0		49.0	
Effective Green, g (s)	26.2	30.0	30.0	18.0	21.8		49.0	49.0	49.0		49.0	
Actuated g/C Ratio	0.24	0.27	0.27	0.16	0.20		0.45	0.45	0.45		0.45	
Clearance Time (s)	4.0	4.5	4.5	4.0	4.5		4.5	4.5	4.5		4.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	422	1305	371	290	1007		68	1576	705		2165	
v/s Ratio Prot	c0.30	c0.26		c0.17	0.15			c0.55			0.39	
v/s Ratio Perm			0.22				0.16		0.21			
v/c Ratio	1.25	0.96	0.80	1.03	0.74		0.35	1.23	0.48		0.88	
Uniform Delay, d1	41.9	39.4	37.2	46.0	41.5		20.1	30.5	21.5		27.9	
Progression Factor	0.96	0.94	0.91	0.73	0.53		1.00	1.00	1.00		0.17	
Incremental Delay, d2	130.5	15.3	10.2	23.4	0.3		13.8	109.7	2.3		0.6	
Delay (s)	170.6	52.4	44.2	57.1	22.3		33.9	140.2	23.8		5.2	
Level of Service	F	D	D	E	C		C	F	C		A	
Approach Delay (s)		80.8			32.2			114.7			5.2	
Approach LOS		F			C			F			A	

Intersection Summary			
HCM Average Control Delay	65.5	HCM Level of Service	E
HCM Volume to Capacity ratio	1.22		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	103.4%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	0	594	1904	0	0	1932
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	625	2004	0	0	2034
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						629
pX, platoon unblocked	0.69					
vC, conflicting volume	2682	668			2004	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1864	668			2004	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	0			100	
cM capacity (veh/h)	44	401			282	

Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	625	668	668	668	678	678	678
Volume Left	0	0	0	0	0	0	0
Volume Right	625	0	0	0	0	0	0
cSH	401	1700	1700	1700	1700	1700	1700
Volume to Capacity	1.56	0.39	0.39	0.39	0.40	0.40	0.40
Queue Length 95th (ft)	870	0	0	0	0	0	0
Control Delay (s)	289.2	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	F						
Approach Delay (s)	289.2	0.0			0.0		
Approach LOS	F						

Intersection Summary			
Average Delay	38.8		
Intersection Capacity Utilization	80.2%	ICU Level of Service	D
Analysis Period (min)	15		

Lane Group	EBT	WBT	SBL
Lane Group Flow (vph)	1387	1158	716
v/c Ratio	0.50	0.42	0.68
Control Delay	9.3	7.3	19.2
Queue Delay	0.0	0.0	0.0
Total Delay	9.3	7.3	19.2
Queue Length 50th (ft)	91	165	100
Queue Length 95th (ft)	153	m242	128
Internal Link Dist (ft)	736	218	493
Turn Bay Length (ft)			
Base Capacity (vph)	2764	2764	1375
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.50	0.42	0.52

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1318	1100	0	579	102
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5	4.5		4.0	
Lane Util. Factor		0.91	0.91		0.97	
Frt		1.00	1.00		0.98	
Flt Protected		1.00	1.00		0.96	
Satd. Flow (prot)		5085	5085		3389	
Flt Permitted		1.00	1.00		0.96	
Satd. Flow (perm)		5085	5085		3389	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1387	1158	0	609	107
RTOR Reduction (vph)	0	0	0	0	23	0
Lane Group Flow (vph)	0	1387	1158	0	693	0
Turn Type						
Protected Phases		4	8		6	
Permitted Phases						
Actuated Green, G (s)		29.9	29.9		16.6	
Effective Green, g (s)		29.9	29.9		16.6	
Actuated g/C Ratio		0.54	0.54		0.30	
Clearance Time (s)		4.5	4.5		4.0	
Vehicle Extension (s)		3.0	3.0		3.0	
Lane Grp Cap (vph)		2764	2764		1023	
v/s Ratio Prot		c0.27	0.23		c0.20	
v/s Ratio Perm						
v/c Ratio		0.50	0.42		0.68	
Uniform Delay, d1		7.9	7.4		16.9	
Progression Factor		1.00	0.88		1.00	
Incremental Delay, d2		0.7	0.3		1.8	
Delay (s)		8.5	6.8		18.6	
Level of Service		A	A		B	
Approach Delay (s)		8.5	6.8		18.6	
Approach LOS		A	A		B	

Intersection Summary			
HCM Average Control Delay	10.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	55.0	Sum of lost time (s)	8.5
Intersection Capacity Utilization	52.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	167	2026	528	1329	315	739	796	254	612
v/c Ratio	0.78	1.23	1.73	0.70	0.47	0.54	0.98	1.42	0.31
Control Delay	73.4	117.8	369.8	31.6	19.2	20.0	41.0	247.6	21.8
Queue Delay	0.0	3.4	0.0	0.0	0.0	0.0	13.9	0.0	0.0
Total Delay	73.4	121.2	369.8	31.6	19.2	20.0	54.9	247.6	21.8
Queue Length 50th (ft)	126	~612	~553	290	105	257	493	~243	98
Queue Length 95th (ft)	m94	m50	#762	345	189	m274	m#610	#405	129
Internal Link Dist (ft)		409		995		363			581
Turn Bay Length (ft)	140		160					120	
Base Capacity (vph)	225	1641	306	1907	664	1367	810	179	1944
Starvation Cap Reductn	0	10	0	0	0	0	41	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.74	1.24	1.73	0.70	0.47	0.54	1.04	1.42	0.31

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	159	1925	0	502	1263	299	0	702	756	241	472	109
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5		4.0	4.5	4.5		4.5	4.5	4.5	4.5	
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00		0.95	1.00	1.00	0.91	
Frt	1.00	1.00		1.00	1.00	0.85		1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5085		1770	5085	1583		3539	1583	1770	4942	
Flt Permitted	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.25	1.00	
Satd. Flow (perm)	1770	5085		1770	5085	1583		3539	1583	462	4942	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	167	2026	0	528	1329	315	0	739	796	254	497	115
RTOR Reduction (vph)	0	0	0	0	0	71	0	0	199	0	34	0
Lane Group Flow (vph)	167	2026	0	528	1329	244	0	739	597	254	578	0
Turn Type	Prot		Perm	Prot		Perm			Perm	Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8			2	6		
Actuated Green, G (s)	13.2	35.5		19.0	41.3	41.3		42.5	42.5	42.5	42.5	
Effective Green, g (s)	13.2	35.5		19.0	41.3	41.3		42.5	42.5	42.5	42.5	
Actuated g/C Ratio	0.12	0.32		0.17	0.38	0.38		0.39	0.39	0.39	0.39	
Clearance Time (s)	4.0	4.5		4.0	4.5	4.5		4.5	4.5	4.5	4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	212	1641		306	1909	594		1367	612	179	1909	
v/s Ratio Prot	0.09	c0.40		c0.30	0.26			0.21			0.12	
v/s Ratio Perm						0.15			0.38	c0.55		
v/c Ratio	0.79	1.23		1.73	0.70	0.41		0.54	0.98	1.42	0.30	
Uniform Delay, d1	47.0	37.2		45.5	29.0	25.4		26.2	33.2	33.8	23.5	
Progression Factor	1.52	0.10		1.00	1.00	1.00		0.73	1.10	1.00	1.00	
Incremental Delay, d2	1.8	106.1		339.9	2.1	2.1		0.8	20.5	218.0	0.4	
Delay (s)	73.1	109.9		385.4	31.2	27.5		19.8	56.9	251.8	23.9	
Level of Service	E	F		F	C	C		B	E	F	C	
Approach Delay (s)		107.1			116.7			39.0			90.7	
Approach LOS		F			F			D			F	

Intersection Summary			
HCM Average Control Delay	92.7	HCM Level of Service	F
HCM Volume to Capacity ratio	1.41		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	112.3%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	125	1666	138	1448	184	427	36	103	787	163
v/c Ratio	0.73	0.96	0.86	0.85	0.86	0.40	0.07	0.56	0.85	0.33
Control Delay	68.3	45.5	87.0	35.8	79.0	30.0	13.5	54.4	44.9	12.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	68.3	45.5	87.0	35.8	79.0	30.0	13.5	54.4	44.9	12.3
Queue Length 50th (ft)	79	375	88	310	117	117	4	63	247	24
Queue Length 95th (ft)	#165	#488	#199	373	#240	165	29	116	#323	76
Internal Link Dist (ft)		631		1090		191			644	
Turn Bay Length (ft)	200		180		140		60	120		120
Base Capacity (vph)	180	1742	161	1713	215	1064	495	215	970	516
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.69	0.96	0.86	0.85	0.86	0.40	0.07	0.48	0.81	0.32

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	119	1423	160	131	1231	144	175	406	34	98	748	155
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.98		1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5008		1770	5005		1770	3539	1583	1770	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5008		1770	5005		1770	3539	1583	1770	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	125	1498	168	138	1296	152	184	427	36	103	787	163
RTOR Reduction (vph)	0	14	0	0	15	0	0	0	19	0	0	83
Lane Group Flow (vph)	125	1652	0	138	1433	0	184	427	17	103	787	80
Turn Type	Prot			Prot			Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases									2			6
Actuated Green, G (s)	9.6	34.1		9.0	33.5		11.9	29.6	29.6	8.8	26.5	26.5
Effective Green, g (s)	9.6	34.1		9.0	33.5		11.9	29.6	29.6	8.8	26.5	26.5
Actuated g/C Ratio	0.10	0.34		0.09	0.34		0.12	0.30	0.30	0.09	0.27	0.27
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	171	1716		160	1685		212	1053	471	157	943	422
v/s Ratio Prot	0.07	c0.33		c0.08	0.29		c0.10	c0.12		0.06	c0.22	
v/s Ratio Perm									0.01			0.05
v/c Ratio	0.73	0.96		0.86	0.85		0.87	0.41	0.04	0.66	0.83	0.19
Uniform Delay, d1	43.7	32.1		44.6	30.7		43.0	27.9	24.8	43.9	34.4	28.2
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	14.8	13.9		35.0	4.3		29.1	0.3	0.0	9.5	6.5	0.2
Delay (s)	58.5	46.0		79.6	35.0		72.1	28.2	24.9	53.4	40.9	28.4
Level of Service	E	D		E	D		E	C	C	D	D	C
Approach Delay (s)		46.8			38.9			40.5			40.2	
Approach LOS		D			D			D			D	

Intersection Summary			
HCM Average Control Delay	42.2	HCM Level of Service	D
HCM Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	99.5	Sum of lost time (s)	18.0
Intersection Capacity Utilization	83.7%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NER
Lane Configurations										
Volume (veh/h)	0	243	0	360	0	0	781	350	0	0
Sign Control	Yield			Free			Free		Yield	
Grade	0%			0%			0%		0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	256	0	379	0	0	822	368	0	0
Pedestrians										
Lane Width (ft)										
Walking Speed (ft/s)										
Percent Blockage										
Right turn flare (veh)										
Median type				None			None			
Median storage veh)										
Upstream signal (ft)							271			
pX, platoon unblocked	0.77		0.77						0.77	0.77
vC, conflicting volume	1569	189	1191			379			1267	1201
vC1, stage 1 conf vol										
vC2, stage 2 conf vol										
vCu, unblocked vol	1590	189	1099			379			1199	1113
tC, single (s)	6.5	6.9	4.1			4.1			7.5	6.5
tC, 2 stage (s)										
tF (s)	4.0	3.3	2.2			2.2			3.5	4.0
p0 queue free %	100	69	100			100			100	100
cM capacity (veh/h)	82	820	487			1176			75	160

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	256	189	189	822	368
Volume Left	0	0	0	0	0
Volume Right	256	0	0	0	368
cSH	820	1700	1700	1700	1700
Volume to Capacity	0.31	0.11	0.11	0.48	0.22
Queue Length 95th (ft)	33	0	0	0	0
Control Delay (s)	11.4	0.0	0.0	0.0	0.0
Lane LOS	B				
Approach Delay (s)	11.4	0.0		0.0	
Approach LOS	B				

Intersection Summary			
Average Delay	1.6		
Intersection Capacity Utilization	67.3%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	671	0	0	0	0	0	0	384	362	0
Sign Control		Yield			Yield			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	0	706	0	0	0	0	0	0	404	381	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)											795	
pX, platoon unblocked	0.90	0.90	0.90	0.90	0.90		0.90					
vC, conflicting volume	1189	1189	381	1896	1189	0	381			0		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1154	1154	252	1942	1154	0	252			0		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	0	0	100	100	100			75		
cM capacity (veh/h)	126	133	705	0	133	1085	1178			1623		

Direction, Lane #	EB 1	SB 1	SB 2
Volume Total	706	404	381
Volume Left	0	404	0
Volume Right	706	0	0
cSH	705	1623	1700
Volume to Capacity	1.00	0.25	0.22
Queue Length 95th (ft)	408	25	0
Control Delay (s)	58.3	8.0	0.0
Lane LOS	F	A	
Approach Delay (s)	58.3	4.1	
Approach LOS	F		

Intersection Summary			
Average Delay	29.8		
Intersection Capacity Utilization	67.3%	ICU Level of Service	C
Analysis Period (min)	15		

Lane Group	WBL	WBT	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	503	403	176	911	368	954
v/c Ratio	0.90	0.70	0.73	0.48	0.36	0.50
Control Delay	42.5	20.4	25.9	6.2	1.0	10.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	42.5	20.4	25.9	6.2	1.0	10.2
Queue Length 50th (ft)	169	88	20	52	1	107
Queue Length 95th (ft)	#329	#179	m#122	67	m4	151
Internal Link Dist (ft)		1190		300		620
Turn Bay Length (ft)	600		90			
Base Capacity (vph)	575	591	240	1893	1018	1891
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	31
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.87	0.68	0.73	0.48	0.36	0.51

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	478	11	371	167	865	350	0	896	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.5	4.5		4.5	4.5	4.5		4.5	
Lane Util. Factor				1.00	1.00		1.00	0.95	1.00		0.95	
Frt				1.00	0.85		1.00	1.00	0.85		1.00	
Flt Protected				0.95	1.00		0.95	1.00	1.00		1.00	
Satd. Flow (prot)				1770	1592		1770	3539	1583		3533	
Flt Permitted				0.95	1.00		0.24	1.00	1.00		1.00	
Satd. Flow (perm)				1770	1592		449	3539	1583		3533	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	0	0	503	12	391	176	911	368	0	943	11
RTOR Reduction (vph)	0	0	0	0	75	0	0	0	171	0	1	0
Lane Group Flow (vph)	0	0	0	503	328	0	176	911	197	0	953	0
Turn Type				Split			Perm		Perm			
Protected Phases				8	8			2			6	
Permitted Phases							2		2			
Actuated Green, G (s)				18.9	18.9		32.1	32.1	32.1		32.1	
Effective Green, g (s)				18.9	18.9		32.1	32.1	32.1		32.1	
Actuated g/C Ratio				0.31	0.31		0.54	0.54	0.54		0.54	
Clearance Time (s)				4.5	4.5		4.5	4.5	4.5		4.5	
Vehicle Extension (s)				3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)				558	501		240	1893	847		1890	
v/s Ratio Prot				c0.28	0.21			0.26			0.27	
v/s Ratio Perm							c0.39		0.12			
v/c Ratio				0.90	0.65		0.73	0.48	0.23		0.50	
Uniform Delay, d1				19.7	17.7		10.7	8.7	7.4		8.9	
Progression Factor				1.00	1.00		0.63	0.60	0.19		1.00	
Incremental Delay, d2				17.7	3.1		13.9	0.7	0.5		1.0	
Delay (s)				37.4	20.8		20.7	5.9	1.9		9.8	
Level of Service				D	C		C	A	A		A	
Approach Delay (s)		0.0			30.0			6.7			9.8	
Approach LOS		A			C			A			A	

Intersection Summary			
HCM Average Control Delay	14.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	72.1%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBR	NBT	SBT
Lane Group Flow (vph)	442	385	1233	1414
v/c Ratio	0.80	0.75	0.63	0.72
Control Delay	30.8	27.0	3.0	8.4
Queue Delay	0.0	0.0	0.1	0.2
Total Delay	30.8	27.0	3.0	8.6
Queue Length 50th (ft)	136	108	40	146
Queue Length 95th (ft)	#241	#194	m60	m180
Internal Link Dist (ft)	434		320	300
Turn Bay Length (ft)				
Base Capacity (vph)	620	572	1963	1963
Starvation Cap Reductn	0	0	76	19
Spillback Cap Reductn	0	1	0	94
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.71	0.67	0.65	0.76

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	420	366	0	1171	1343	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		0.95	0.95	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1770	1583		3539	3539	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	1770	1583		3539	3539	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	442	385	0	1233	1414	0
RTOR Reduction (vph)	0	19	0	0	0	0
Lane Group Flow (vph)	442	366	0	1233	1414	0
Turn Type		custom				
Protected Phases				2	6	
Permitted Phases	4	4				
Actuated Green, G (s)	18.7	18.7		33.3	33.3	
Effective Green, g (s)	18.7	18.7		33.3	33.3	
Actuated g/C Ratio	0.31	0.31		0.55	0.55	
Clearance Time (s)	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	552	493		1964	1964	
v/s Ratio Prot				0.35	c0.40	
v/s Ratio Perm	c0.25	0.23				
v/c Ratio	0.80	0.74		0.63	0.72	
Uniform Delay, d1	18.9	18.5		9.1	9.9	
Progression Factor	1.00	1.00		0.20	0.60	
Incremental Delay, d2	8.2	6.0		1.0	1.8	
Delay (s)	27.1	24.5		2.8	7.8	
Level of Service	C	C		A	A	
Approach Delay (s)	25.9			2.8	7.8	
Approach LOS	C			A	A	

Intersection Summary			
HCM Average Control Delay	10.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	67.1%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	268	628	407	126	403	106	222	883	479	218	1349	319
v/c Ratio	1.10	0.63	0.60	0.86	0.40	0.20	0.94	0.71	0.77	0.74	0.99	0.46
Control Delay	113.4	22.0	8.5	72.8	18.9	5.3	76.2	20.8	23.7	32.4	35.6	4.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	113.4	22.0	8.5	72.8	18.9	5.3	76.2	20.8	23.7	32.4	35.6	4.5
Queue Length 50th (ft)	~114	103	21	43	61	0	81	142	116	78	262	8
Queue Length 95th (ft)	#239	151	89	#132	96	29	#197	202	#260	m#113	#384	m15
Internal Link Dist (ft)		612			420			572			320	
Turn Bay Length (ft)	90			80			130			120		
Base Capacity (vph)	244	1003	684	146	1003	524	236	1239	624	295	1357	701
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.10	0.63	0.60	0.86	0.40	0.20	0.94	0.71	0.77	0.74	0.99	0.46

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	255	597	387	120	383	101	211	839	455	207	1282	303
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3539	1583	1770	3539	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.46	1.00	1.00	0.28	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	861	3539	1583	513	3539	1583	1770	3539	1583	1770	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	268	628	407	126	403	106	222	883	479	218	1349	319
RTOR Reduction (vph)	0	0	236	0	0	76	0	0	70	0	0	94
Lane Group Flow (vph)	268	628	171	126	403	30	222	883	409	218	1349	225
Turn Type	Perm		Perm	Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Actuated Green, G (s)	17.0	17.0	17.0	17.0	17.0	17.0	8.0	21.0	21.0	10.0	23.0	23.0
Effective Green, g (s)	17.0	17.0	17.0	17.0	17.0	17.0	8.0	21.0	21.0	10.0	23.0	23.0
Actuated g/C Ratio	0.28	0.28	0.28	0.28	0.28	0.28	0.13	0.35	0.35	0.17	0.38	0.38
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	244	1003	449	145	1003	449	236	1239	554	295	1357	607
v/s Ratio Prot		0.18			0.11		c0.13	0.25		0.12	c0.38	
v/s Ratio Perm	c0.31		0.11	0.25		0.02			0.26			0.14
v/c Ratio	1.10	0.63	0.38	0.87	0.40	0.07	0.94	0.71	0.74	0.74	0.99	0.37
Uniform Delay, d1	21.5	18.7	17.3	20.4	17.4	15.7	25.8	16.9	17.1	23.8	18.4	13.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.76	0.71	0.40
Incremental Delay, d2	86.4	1.2	0.5	38.6	0.3	0.1	42.3	3.5	8.5	6.9	19.5	1.3
Delay (s)	107.9	20.0	17.8	59.0	17.7	15.8	68.1	20.4	25.6	24.9	32.6	6.6
Level of Service	F	B	B	E	B	B	E	C	C	C	C	A
Approach Delay (s)		37.4			25.6			28.7			27.3	
Approach LOS		D			C			C			C	

Intersection Summary			
HCM Average Control Delay	29.9	HCM Level of Service	C
HCM Volume to Capacity ratio	1.02		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	85.2%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	207	749	0	516	0	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	218	788	0	543	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	500					
pX, platoon unblocked						
vC, conflicting volume			1006		489	109
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1006		489	109
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			684		508	924

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2
Volume Total	145	335	526	272	272
Volume Left	0	0	0	0	0
Volume Right	0	263	526	0	0
cSH	1700	1700	1700	1700	1700
Volume to Capacity	0.09	0.20	0.31	0.16	0.16
Queue Length 95th (ft)	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0
Lane LOS					
Approach Delay (s)	0.0			0.0	
Approach LOS					

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	34.3%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	171	1972	1156	187
v/c Ratio	0.40	0.56	0.51	0.18
Control Delay	19.0	0.6	7.9	1.7
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	19.0	0.6	7.9	1.7
Queue Length 50th (ft)	65	0	122	3
Queue Length 95th (ft)	m66	0	165	22
Internal Link Dist (ft)		370	263	
Turn Bay Length (ft)	100			70
Base Capacity (vph)	430	3539	2250	1066
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.40	0.56	0.51	0.18

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	0	0	162	1873	1098	178
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)			4.0	4.5	4.5	4.5
Lane Util. Factor			1.00	0.95	0.95	1.00
Frt			1.00	1.00	1.00	0.85
Flt Protected			0.95	1.00	1.00	1.00
Satd. Flow (prot)			1770	3539	3539	1583
Flt Permitted			0.95	1.00	1.00	1.00
Satd. Flow (perm)			1770	3539	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	0	171	1972	1156	187
RTOR Reduction (vph)	0	0	0	0	0	60
Lane Group Flow (vph)	0	0	171	1972	1156	127
Turn Type			Prot			Perm
Protected Phases			5	2	6	
Permitted Phases						6
Actuated Green, G (s)			17.0	70.0	44.5	44.5
Effective Green, g (s)			17.0	70.0	44.5	44.5
Actuated g/C Ratio			0.24	1.00	0.64	0.64
Clearance Time (s)			4.0	4.5	4.5	4.5
Vehicle Extension (s)			3.0	3.0	3.0	3.0
Lane Grp Cap (vph)			430	3539	2250	1006
v/s Ratio Prot			0.10	c0.56	0.33	
v/s Ratio Perm						0.08
v/c Ratio			0.40	0.56	0.51	0.13
Uniform Delay, d1			22.2	0.0	6.9	5.0
Progression Factor			0.75	1.00	1.00	1.00
Incremental Delay, d2			0.4	0.4	0.8	0.3
Delay (s)			17.1	0.4	7.7	5.3
Level of Service			B	A	A	A
Approach Delay (s)	0.0			1.8	7.4	
Approach LOS	A			A	A	

Intersection Summary			
HCM Average Control Delay	3.9	HCM Level of Service	A
HCM Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	0.0
Intersection Capacity Utilization	67.7%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	222	58	0	1914	1116	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	234	61	0	2015	1175	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)				382	450	
pX, platoon unblocked	0.65	0.82	0.82			
vC, conflicting volume	2182	587	1175			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	456	42	762			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	32	93	100			
cM capacity (veh/h)	345	832	690			

Direction, Lane #	EB 1	EB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	156	139	1007	1007	587	587
Volume Left	156	78	0	0	0	0
Volume Right	0	61	0	0	0	0
cSH	345	465	1700	1700	1700	1700
Volume to Capacity	0.45	0.30	0.59	0.59	0.35	0.35
Queue Length 95th (ft)	56	31	0	0	0	0
Control Delay (s)	23.7	16.0	0.0	0.0	0.0	0.0
Lane LOS	C	C				
Approach Delay (s)	20.1		0.0		0.0	
Approach LOS	C					

Intersection Summary			
Average Delay	1.7		
Intersection Capacity Utilization	67.7%	ICU Level of Service	C
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	288	179	27	83	224	1727	18	915	201
v/c Ratio	0.89	0.20	0.09	0.10	0.55	0.79	0.08	0.57	0.25
Control Delay	57.4	7.0	20.8	11.7	11.0	15.3	5.4	9.8	2.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	57.4	7.0	20.8	11.7	11.0	15.3	5.4	9.8	2.3
Queue Length 50th (ft)	118	6	9	6	36	246	1	149	5
Queue Length 95th (ft)	#249	28	27	22	66	#526	m2	216	21
Internal Link Dist (ft)		646		699		573		302	
Turn Bay Length (ft)	120		220		200		260		70
Base Capacity (vph)	335	908	306	870	448	2173	216	1600	792
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.86	0.20	0.09	0.10	0.50	0.79	0.08	0.57	0.25

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	274	37	133	26	37	42	213	1598	43	17	869	191
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	1.00
Frt	1.00	0.88		1.00	0.92		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	3124		1770	3258		1770	3525		1770	3539	1583
Flt Permitted	0.70	1.00		0.64	1.00		0.19	1.00		0.13	1.00	1.00
Satd. Flow (perm)	1304	3124		1190	3258		352	3525		236	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	288	39	140	27	39	44	224	1682	45	18	915	201
RTOR Reduction (vph)	0	105	0	0	33	0	0	3	0	0	0	76
Lane Group Flow (vph)	288	74	0	27	50	0	224	1724	0	18	915	125
Turn Type	Perm			Perm			pm+pt			pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)	17.3	17.3		17.3	17.3		44.7	39.9		32.4	31.6	31.6
Effective Green, g (s)	17.3	17.3		17.3	17.3		44.7	39.9		32.4	31.6	31.6
Actuated g/C Ratio	0.25	0.25		0.25	0.25		0.64	0.57		0.46	0.45	0.45
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	322	772		294	805		409	2009		127	1598	715
v/s Ratio Prot		0.02			0.02		c0.07	c0.49		0.00	0.26	
v/s Ratio Perm	c0.22			0.02			0.28			0.06		0.08
v/c Ratio	0.89	0.10		0.09	0.06		0.55	0.86		0.14	0.57	0.17
Uniform Delay, d1	25.5	20.3		20.3	20.1		7.5	12.7		12.7	14.2	11.4
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		0.80	0.56	0.33
Incremental Delay, d2	25.4	0.1		0.1	0.0		1.5	5.0		0.5	1.3	0.5
Delay (s)	50.9	20.4		20.4	20.2		9.0	17.7		10.6	9.3	4.2
Level of Service	D	C		C	C		A	B		B	A	A
Approach Delay (s)		39.2			20.2			16.7			8.4	
Approach LOS		D			C			B			A	

Intersection Summary			
HCM Average Control Delay	17.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	80.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	1501	268	1231	143	91	1178
v/c Ratio	0.97	0.34	0.93	0.22	0.88	0.71
Control Delay	45.7	9.4	34.4	7.0	113.5	26.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	45.7	9.4	34.4	7.0	113.5	26.2
Queue Length 50th (ft)	515	48	257	11	65	338
Queue Length 95th (ft)	#682	106	#550	m32	#169	419
Internal Link Dist (ft)	720		1803			515
Turn Bay Length (ft)	240	240		150	215	
Base Capacity (vph)	1560	801	1335	648	103	1662
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.96	0.33	0.92	0.22	0.88	0.71

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	1426	255	1169	136	86	1119
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Lane Util. Factor	0.97	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	3539	1583	1770	3539
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	1501	268	1231	143	91	1178
RTOR Reduction (vph)	0	82	0	51	0	0
Lane Group Flow (vph)	1501	186	1231	92	91	1178
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	49.8	49.8	41.3	41.3	6.4	51.7
Effective Green, g (s)	49.8	49.8	41.3	41.3	6.4	51.7
Actuated g/C Ratio	0.45	0.45	0.38	0.38	0.06	0.47
Clearance Time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	1554	717	1329	594	103	1663
v/s Ratio Prot	c0.44		c0.35		c0.05	0.33
v/s Ratio Perm		0.12		0.06		
v/c Ratio	0.97	0.26	0.93	0.16	0.88	0.71
Uniform Delay, d1	29.3	18.7	32.9	22.8	51.4	23.2
Progression Factor	1.00	1.00	0.70	0.59	1.00	1.00
Incremental Delay, d2	15.4	0.2	10.4	0.5	53.2	2.6
Delay (s)	44.6	18.9	33.5	14.0	104.6	25.7
Level of Service	D	B	C	B	F	C
Approach Delay (s)	40.7		31.5			31.4
Approach LOS	D		C			C

Intersection Summary			
HCM Average Control Delay	35.2	HCM Level of Service	D
HCM Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.5
Intersection Capacity Utilization	88.2%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	301	457	1002	1366	255	2466
v/c Ratio	0.51	0.92	0.47	1.11	1.22	0.93
Control Delay	43.8	43.3	14.0	73.8	157.8	12.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	43.8	43.3	14.0	73.8	157.8	12.9
Queue Length 50th (ft)	96	134	212	~889	~221	597
Queue Length 95th (ft)	139	#316	265	#1154	m#302	m#882
Internal Link Dist (ft)	1134		595			1803
Turn Bay Length (ft)	75	50			235	
Base Capacity (vph)	687	533	2111	1234	209	2658
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.44	0.86	0.47	1.11	1.22	0.93

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	286	434	952	1298	242	2343
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Lane Util. Factor	0.97	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	3539	1583	1770	3539
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	301	457	1002	1366	255	2466
RTOR Reduction (vph)	0	224	0	290	0	0
Lane Group Flow (vph)	301	233	1002	1076	255	2466
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	18.9	18.9	65.6	65.6	13.0	82.6
Effective Green, g (s)	18.9	18.9	65.6	65.6	13.0	82.6
Actuated g/C Ratio	0.17	0.17	0.60	0.60	0.12	0.75
Clearance Time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	590	272	2111	944	209	2657
v/s Ratio Prot	0.09		0.28		c0.14	0.70
v/s Ratio Perm		c0.15		c0.68		
v/c Ratio	0.51	0.86	0.47	1.14	1.22	0.93
Uniform Delay, d1	41.3	44.2	12.5	22.2	48.5	11.3
Progression Factor	1.00	1.00	1.00	1.00	0.89	0.63
Incremental Delay, d2	0.7	22.5	0.8	75.9	119.5	4.0
Delay (s)	42.1	66.7	13.3	98.1	162.4	11.1
Level of Service	D	E	B	F	F	B
Approach Delay (s)	56.9		62.2			25.3
Approach LOS	E		E			C

Intersection Summary			
HCM Average Control Delay	44.4	HCM Level of Service	D
HCM Volume to Capacity ratio	1.10		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.5
Intersection Capacity Utilization	100.9%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	26	110	1548	169	80	0
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	27	116	1629	178	84	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						800
pX, platoon unblocked						
vC, conflicting volume	1887	1718			1629	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1887	1718			1629	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	55	0			79	
cM capacity (veh/h)	61	111			398	

Direction, Lane #	WB 1	WB 2	NB 1	SB 1	SB 2
Volume Total	27	116	1807	84	0
Volume Left	27	0	0	84	0
Volume Right	0	116	178	0	0
cSH	61	111	1700	398	1700
Volume to Capacity	0.45	1.04	1.06	0.21	0.00
Queue Length 95th (ft)	43	172	0	20	0
Control Delay (s)	104.9	170.8	0.0	16.4	0.0
Lane LOS	F	F		C	
Approach Delay (s)	158.2		0.0	16.4	
Approach LOS	F				

Intersection Summary			
Average Delay	11.8		
Intersection Capacity Utilization	105.2%	ICU Level of Service	G
Analysis Period (min)	15		

Lane Group	EBT	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	2246	1759	577	199	1073	657	1118
v/c Ratio	0.96	1.07	0.53	0.93	0.96	1.06	0.79
Control Delay	43.1	50.7	1.6	88.1	60.5	99.6	44.7
Queue Delay	51.1	81.5	1.3	0.0	2.4	0.0	0.0
Total Delay	94.2	132.2	3.0	88.1	63.0	99.6	44.7
Queue Length 50th (ft)	600	~820	36	156	317	~288	293
Queue Length 95th (ft)	#730	m#803	m31	#302	#404	#406	349
Internal Link Dist (ft)	1037	280			562		836
Turn Bay Length (ft)				330		290	
Base Capacity (vph)	2332	1637	1091	214	1112	621	1420
Starvation Cap Reductn	0	242	308	0	0	0	0
Spillback Cap Reductn	324	0	0	0	18	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	1.12	1.26	0.74	0.93	0.98	1.06	0.79

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1960	174	0	1671	548	189	987	32	624	1060	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.5			5.5	5.5	5.5	5.5		5.5	5.5	
Lane Util. Factor		0.91			0.95	1.00	1.00	0.91		0.97	0.91	
Frt		0.99			1.00	0.85	1.00	1.00		1.00	1.00	
Flt Protected		1.00			1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		5023			3539	1583	1770	5061		3433	5084	
Flt Permitted		1.00			1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)		5023			3539	1583	1770	5061		3433	5084	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	2063	183	0	1759	577	199	1039	34	657	1116	2
RTOR Reduction (vph)	0	9	0	0	0	0	0	3	0	0	0	0
Lane Group Flow (vph)	0	2237	0	0	1759	577	199	1070	0	657	1118	0
Turn Type						pm+ov	Prot			Prot		
Protected Phases		4			8	1	5	2		1	6	
Permitted Phases						8						
Actuated Green, G (s)		55.5			55.5	77.2	14.5	26.3		21.7	33.5	
Effective Green, g (s)		55.5			55.5	77.2	14.5	26.3		21.7	33.5	
Actuated g/C Ratio		0.46			0.46	0.64	0.12	0.22		0.18	0.28	
Clearance Time (s)		5.5			5.5	5.5	5.5	5.5		5.5	5.5	
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		2323			1637	1091	214	1109		621	1419	
v/s Ratio Prot		0.45			c0.50	0.10	0.11	c0.21		c0.19	0.22	
v/s Ratio Perm						0.27						
v/c Ratio		0.96			1.07	0.53	0.93	0.96		1.06	0.79	
Uniform Delay, d1		31.3			32.2	11.6	52.2	46.4		49.1	40.0	
Progression Factor		1.00			0.40	0.16	0.81	0.89		1.00	1.00	
Incremental Delay, d2		11.3			34.9	0.0	44.0	19.1		52.4	4.5	
Delay (s)		42.5			47.9	1.8	86.4	60.2		101.6	44.5	
Level of Service		D			D	A	F	E		F	D	
Approach Delay (s)		42.5			36.5			64.3			65.6	
Approach LOS		D			D			E			E	

Intersection Summary			
HCM Average Control Delay	49.7	HCM Level of Service	D
HCM Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	97.5%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	433	2331	42	1883	762	118	436	819	653
v/c Ratio	1.15	0.84	0.61	1.05	1.09	0.42	1.13	0.78	0.91
Control Delay	112.2	7.0	90.0	71.6	90.1	11.8	133.8	45.0	37.4
Queue Delay	67.5	11.5	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Total Delay	179.7	18.5	90.0	71.6	90.1	11.9	133.8	45.0	37.4
Queue Length 50th (ft)	~408	185	30	~553	~227	14	~202	305	257
Queue Length 95th (ft)	m#421	m202	m#64	#655	m#272	m35	#306	383	#502
Internal Link Dist (ft)		280		585	326			720	
Turn Bay Length (ft)	200		200			130	160		160
Base Capacity (vph)	376	2764	69	1786	699	278	386	1047	715
Starvation Cap Reductn	45	391	0	0	0	0	0	0	0
Spillback Cap Reductn	0	454	0	0	0	6	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.31	1.01	0.61	1.05	1.09	0.43	1.13	0.78	0.91

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	411	2189	26	40	1620	169	0	724	112	414	778	620
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Lane Util. Factor	1.00	0.91		1.00	0.91			0.91	1.00	0.97	0.95	1.00
Frt	1.00	1.00		1.00	0.99			1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5076		1770	5013			5085	1583	3433	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5076		1770	5013			5085	1583	3433	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	433	2304	27	42	1705	178	0	762	118	436	819	653
RTOR Reduction (vph)	0	1	0	0	10	0	0	0	60	0	0	246
Lane Group Flow (vph)	433	2330	0	42	1873	0	0	762	58	436	819	407
Turn Type	Prot			Prot					Perm	Prot		Perm
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases									2			6
Actuated Green, G (s)	26.6	64.2		3.8	41.4			16.5	16.5	13.5	35.5	35.5
Effective Green, g (s)	26.6	64.2		3.8	41.4			16.5	16.5	13.5	35.5	35.5
Actuated g/C Ratio	0.22	0.54		0.03	0.34			0.14	0.14	0.11	0.30	0.30
Clearance Time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	392	2716		56	1729			699	218	386	1047	468
v/s Ratio Prot	c0.24	0.46		0.02	c0.37			c0.15		c0.13	0.23	
v/s Ratio Perm									0.04			0.26
v/c Ratio	1.10	0.86		0.75	1.08			1.09	0.26	1.13	0.78	0.87
Uniform Delay, d1	46.7	24.0		57.6	39.3			51.8	46.3	53.2	38.7	40.0
Progression Factor	0.79	0.25		1.06	0.95			0.66	0.39	1.00	1.00	1.00
Incremental Delay, d2	57.4	1.0		37.6	46.6			56.2	2.0	85.9	5.8	19.2
Delay (s)	94.3	7.1		98.5	83.8			90.2	20.3	139.1	44.5	59.2
Level of Service	F	A		F	F			F	C	F	D	E
Approach Delay (s)		20.8			84.1			80.8			71.2	
Approach LOS		C			F			F			E	

Intersection Summary			
HCM Average Control Delay	57.0	HCM Level of Service	E
HCM Volume to Capacity ratio	1.10		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	102.0%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	212	897	85	1139	416	55	307	173	539	47
v/c Ratio	0.98	0.31	0.29	0.39	0.38	0.35	0.97	0.57	0.57	0.14
Control Delay	82.8	22.4	16.3	14.6	2.2	58.0	98.1	14.4	10.9	2.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	82.8	22.4	16.3	14.6	2.2	58.0	98.1	14.4	10.9	2.2
Queue Length 50th (ft)	176	235	32	168	0	41	125	50	51	2
Queue Length 95th (ft)	m#253	m273	67	200	42	84	#221	m81	m79	m2
Internal Link Dist (ft)		562		597			652		326	
Turn Bay Length (ft)	110		120		200	280		240		60
Base Capacity (vph)	217	2878	298	2915	1085	158	316	304	953	340
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.98	0.31	0.29	0.39	0.38	0.35	0.97	0.57	0.57	0.14

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	201	750	103	81	1082	395	52	277	14	257	419	45
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00	1.00	0.95		0.86	0.86	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.99	1.00
Satd. Flow (prot)	1770	4993		1770	5085	1583	1770	3513		1522	4763	1583
Flt Permitted	0.20	1.00		0.28	1.00	1.00	0.95	1.00		0.95	0.99	1.00
Satd. Flow (perm)	378	4993		520	5085	1583	1770	3513		1522	4763	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	212	789	108	85	1139	416	55	292	15	271	441	47
RTOR Reduction (vph)	0	15	0	0	0	177	0	3	0	0	0	23
Lane Group Flow (vph)	212	882	0	85	1139	239	55	304	0	173	539	24
Turn Type	Perm			Perm		Perm	Split			Split		Perm
Protected Phases		4			8		2	2		6	6	
Permitted Phases	4			8		8						6
Actuated Green, G (s)	68.8	68.8		68.8	68.8	68.8	10.7	10.7		24.0	24.0	24.0
Effective Green, g (s)	68.8	68.8		68.8	68.8	68.8	10.7	10.7		24.0	24.0	24.0
Actuated g/C Ratio	0.57	0.57		0.57	0.57	0.57	0.09	0.09		0.20	0.20	0.20
Clearance Time (s)	5.5	5.5		5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	217	2863		298	2915	908	158	313		304	953	317
v/s Ratio Prot		0.18			0.22		0.03	c0.09		c0.11	0.11	
v/s Ratio Perm	c0.56			0.16		0.15						0.02
v/c Ratio	0.98	0.31		0.29	0.39	0.26	0.35	0.97		0.57	0.57	0.08
Uniform Delay, d1	24.8	13.3		13.1	14.1	12.9	51.4	54.5		43.3	43.3	39.0
Progression Factor	1.73	1.73		1.00	1.00	1.00	1.00	1.00		0.22	0.22	0.08
Incremental Delay, d2	40.1	0.2		2.4	0.4	0.7	6.0	44.3		4.6	1.5	0.3
Delay (s)	83.1	23.2		15.5	14.5	13.6	57.3	98.8		14.2	10.8	3.5
Level of Service	F	C		B	B	B	E	F		B	B	A
Approach Delay (s)		34.6			14.3			92.5			11.1	
Approach LOS		C			B			F			B	

Intersection Summary			
HCM Average Control Delay	26.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	68.5%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	28	2691	119	307	1890	60	14	142	279	95	69
v/c Ratio	0.31	1.01	0.14	1.05	0.55	0.62	0.10	0.47	1.15	0.30	0.21
Control Delay	61.0	27.2	1.5	66.9	14.1	79.9	52.7	34.4	148.0	44.2	10.9
Queue Delay	0.0	3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	61.0	30.5	1.5	66.9	14.1	79.9	52.7	34.4	148.0	44.2	10.9
Queue Length 50th (ft)	23	~831	6	~251	261	45	10	63	~215	63	0
Queue Length 95th (ft)	m28	m#875	m7	m#213	m242	#102	32	129	#407	113	40
Internal Link Dist (ft)		585			1015		352			692	
Turn Bay Length (ft)	270		180								
Base Capacity (vph)	91	2674	860	291	3436	108	155	303	242	373	372
Starvation Cap Reductn	0	29	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.31	1.02	0.14	1.05	0.55	0.56	0.09	0.47	1.15	0.25	0.19

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	27	2556	113	292	1756	40	57	13	135	265	90	66
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	4.0	5.5	5.5
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5085	1583	1770	5068		1770	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.70	1.00	1.00	0.49	1.00	1.00
Satd. Flow (perm)	1770	5085	1583	1770	5068		1295	1863	1583	921	1863	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	28	2691	119	307	1848	42	60	14	142	279	95	69
RTOR Reduction (vph)	0	0	30	0	2	0	0	0	42	0	0	56
Lane Group Flow (vph)	28	2691	89	307	1888	0	60	14	100	279	95	13
Turn Type	Prot		Perm	Prot			Perm		Over	pm+pt		Perm
Protected Phases	7	4		3	8			2	3	1	6	
Permitted Phases			4				2			6		6
Actuated Green, G (s)	3.7	59.8	59.8	21.9	78.0		7.8	7.8	21.9	21.8	21.8	21.8
Effective Green, g (s)	3.7	59.8	59.8	21.9	78.0		7.8	7.8	21.9	21.8	21.8	21.8
Actuated g/C Ratio	0.03	0.50	0.50	0.18	0.65		0.06	0.06	0.18	0.18	0.18	0.18
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	4.0	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	55	2534	789	323	3294		84	121	289	238	338	288
v/s Ratio Prot	0.02	c0.53		c0.17	0.37			0.01	0.06	c0.10	0.05	
v/s Ratio Perm			0.06				0.05			c0.12		0.01
v/c Ratio	0.51	1.06	0.11	0.95	0.57		0.71	0.12	0.35	1.17	0.28	0.04
Uniform Delay, d1	57.3	30.1	16.0	48.5	11.7		55.0	52.9	42.8	48.1	42.3	40.5
Progression Factor	1.02	0.38	0.16	0.65	1.22		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	3.4	32.7	0.1	6.8	0.1		24.9	0.4	0.7	112.9	0.5	0.1
Delay (s)	62.1	44.0	2.7	38.1	14.3		79.9	53.3	43.5	161.0	42.8	40.6
Level of Service	E	D	A	D	B		E	D	D	F	D	D
Approach Delay (s)		42.5			17.7			54.3			116.9	
Approach LOS		D			B			D			F	

Intersection Summary			
HCM Average Control Delay	39.1	HCM Level of Service	D
HCM Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	100.7%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBT	SBL
Lane Group Flow (vph)	64	3096	2503	591
v/c Ratio	0.36	1.14	1.06	0.61
Control Delay	36.1	77.4	50.3	40.8
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	36.1	77.4	50.3	40.8
Queue Length 50th (ft)	5	~1007	~802	205
Queue Length 95th (ft)	m5	m#980	#875	276
Internal Link Dist (ft)		1015	1000	632
Turn Bay Length (ft)				150
Base Capacity (vph)	413	2712	2367	964
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.15	1.14	1.06	0.61

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	61	2941	2152	226	477	85
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5		5.5	
Lane Util. Factor	1.00	0.91	0.91		0.97	
Frt	1.00	1.00	0.99		0.98	
Flt Protected	0.95	1.00	1.00		0.96	
Satd. Flow (prot)	1770	5085	5013		3388	
Flt Permitted	0.95	1.00	1.00		0.96	
Satd. Flow (perm)	1770	5085	5013		3388	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	64	3096	2265	238	502	89
RTOR Reduction (vph)	0	0	10	0	10	0
Lane Group Flow (vph)	64	3096	2493	0	581	0
Turn Type	Prot					
Protected Phases	7 9	4	8		6	
Permitted Phases						
Actuated Green, G (s)	10.0	62.9	54.2		33.8	
Effective Green, g (s)	10.0	62.9	54.2		33.8	
Actuated g/C Ratio	0.08	0.52	0.45		0.28	
Clearance Time (s)		5.5	5.5		5.5	
Vehicle Extension (s)		3.0	3.0		3.0	
Lane Grp Cap (vph)	148	2665	2264		954	
v/s Ratio Prot	c0.04	c0.61	0.50		c0.17	
v/s Ratio Perm						
v/c Ratio	0.43	1.16	1.10		0.61	
Uniform Delay, d1	52.3	28.6	32.9		37.4	
Progression Factor	1.31	0.27	0.49		1.00	
Incremental Delay, d2	0.5	74.0	49.8		2.9	
Delay (s)	69.1	81.7	65.8		40.3	
Level of Service	E	F	E		D	
Approach Delay (s)		81.4	65.8		40.3	
Approach LOS		F	E		D	

Intersection Summary			
HCM Average Control Delay	71.3	HCM Level of Service	E
HCM Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	82.3%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBT	SBL	SBT
Lane Group Flow (vph)	139	3437	23	73	2488	82	131	219
v/c Ratio	0.55	0.98	0.02	0.84	0.83	0.94	0.83	0.64
Control Delay	34.8	8.4	0.4	116.4	22.3	128.1	89.5	25.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	34.8	8.4	0.4	116.4	22.3	128.1	89.5	25.0
Queue Length 50th (ft)	101	141	0	57	529	56	100	44
Queue Length 95th (ft)	m99	m124	m0	#147	598	#162	#213	128
Internal Link Dist (ft)		1000			893	425		590
Turn Bay Length (ft)	150			300				
Base Capacity (vph)	255	3509	1098	87	3014	87	158	340
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.55	0.98	0.02	0.84	0.83	0.94	0.83	0.64

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	132	3265	22	69	2291	72	29	29	19	124	37	171
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5			5.5		5.5	5.5	
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91			1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00			0.97		1.00	0.88	
Flt Protected	0.95	1.00	1.00	0.95	1.00			0.98		0.95	1.00	
Satd. Flow (prot)	1770	5085	1583	1770	5062			1768		1770	1633	
Flt Permitted	0.95	1.00	1.00	0.95	1.00			0.35		0.69	1.00	
Satd. Flow (perm)	1770	5085	1583	1770	5062			625		1281	1633	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	139	3437	23	73	2412	76	31	31	20	131	39	180
RTOR Reduction (vph)	0	0	6	0	3	0	0	10	0	0	139	0
Lane Group Flow (vph)	139	3437	17	73	2485	0	0	72	0	131	80	0
Turn Type	Prot		Perm	Prot			Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4				2			6		
Actuated Green, G (s)	17.3	82.8	82.8	5.9	71.4			14.8		14.8	14.8	
Effective Green, g (s)	17.3	82.8	82.8	5.9	71.4			14.8		14.8	14.8	
Actuated g/C Ratio	0.14	0.69	0.69	0.05	0.60			0.12		0.12	0.12	
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5			5.5		5.5	5.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	255	3509	1092	87	3012			77		158	201	
v/s Ratio Prot	0.08	c0.68		0.04	c0.49						0.05	
v/s Ratio Perm			0.01					c0.12		0.10		
v/c Ratio	0.55	0.98	0.02	0.84	0.83			0.94		0.83	0.40	
Uniform Delay, d1	47.7	17.8	5.8	56.6	19.3			52.2		51.4	48.5	
Progression Factor	0.70	0.30	0.13	1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d2	0.2	1.8	0.0	47.4	2.7			86.8		28.7	1.3	
Delay (s)	33.8	7.2	0.8	104.0	22.1			138.9		80.0	49.8	
Level of Service	C	A	A	F	C			F		F	D	
Approach Delay (s)		8.2			24.4			138.9			61.1	
Approach LOS		A			C			F			E	

Intersection Summary			
HCM Average Control Delay	18.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.99		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	102.7%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Queues
3: 7th St & Park Ave

2/20/2013

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	29	1696	280	1189	85	271	333	25	326	19
v/c Ratio	0.13	0.96	0.89	0.50	0.79	0.64	0.71	0.17	0.77	0.05
Control Delay	14.7	35.2	51.1	8.5	76.8	37.2	25.2	28.8	43.9	13.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.7	35.2	51.1	8.5	76.8	37.2	25.2	28.8	43.9	13.9
Queue Length 50th (ft)	8	442	95	150	43	132	90	11	164	2
Queue Length 95th (ft)	27	#676	#257	226	#119	211	184	32	257	18
Internal Link Dist (ft)		588		707		495			498	
Turn Bay Length (ft)	70		180		30		30	100		90
Base Capacity (vph)	224	1775	320	2368	135	526	553	188	526	458
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.13	0.96	0.88	0.50	0.63	0.52	0.60	0.13	0.62	0.04

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	28	1476	135	266	1100	29	81	257	316	24	310	18
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		3.0	5.0		4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3495		1770	3525		1770	1863	1583	1770	1863	1583
Flt Permitted	0.24	1.00		0.09	1.00		0.25	1.00	1.00	0.36	1.00	1.00
Satd. Flow (perm)	442	3495		161	3525		474	1863	1583	665	1863	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	29	1554	142	280	1158	31	85	271	333	25	326	19
RTOR Reduction (vph)	0	7	0	0	2	0	0	0	114	0	0	12
Lane Group Flow (vph)	29	1689	0	280	1187	0	85	271	219	25	326	7
Turn Type	Perm			pm+pt			Perm		Perm	Perm		Perm
Protected Phases		4		3	8			2			6	
Permitted Phases	4			8			2		2	6		6
Actuated Green, G (s)	43.2	43.2		56.9	56.9		19.3	19.3	19.3	19.3	19.3	19.3
Effective Green, g (s)	43.2	43.2		56.9	56.9		19.3	19.3	19.3	19.3	19.3	19.3
Actuated g/C Ratio	0.51	0.51		0.67	0.67		0.23	0.23	0.23	0.23	0.23	0.23
Clearance Time (s)	5.0	5.0		3.0	5.0		4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	224	1772		310	2354		107	422	359	151	422	359
v/s Ratio Prot		0.48		c0.11	0.34			0.15			0.18	
v/s Ratio Perm	0.07			c0.49			c0.18		0.14	0.04		0.00
v/c Ratio	0.13	0.95		0.90	0.50		0.79	0.64	0.61	0.17	0.77	0.02
Uniform Delay, d1	11.1	20.0		25.2	7.1		31.1	29.8	29.6	26.5	30.9	25.6
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.3	12.1		27.8	0.2		32.1	3.3	3.1	0.5	8.5	0.0
Delay (s)	11.3	32.1		53.0	7.3		63.2	33.2	32.6	27.0	39.4	25.6
Level of Service	B	C		D	A		E	C	C	C	D	C
Approach Delay (s)		31.8			16.0			36.6			37.9	
Approach LOS		C			B			D			D	

Intersection Summary			
HCM Average Control Delay	27.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	85.2	Sum of lost time (s)	7.0
Intersection Capacity Utilization	94.8%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
25: I-405 SB Off Ramp & Studebaker Rd

12/4/2012

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	222	58	0	1914	1116	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0			4.0	4.0	
Lane Util. Factor	0.97			0.95	0.95	
Frt	0.97			1.00	1.00	
Flt Protected	0.96			1.00	1.00	
Satd. Flow (prot)	3368			3539	3539	
Flt Permitted	0.96			1.00	1.00	
Satd. Flow (perm)	3368			3539	3539	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	234	61	0	2015	1175	0
RTOR Reduction (vph)	38	0	0	0	0	0
Lane Group Flow (vph)	257	0	0	2015	1175	0
Turn Type						
Protected Phases	4			2	6	
Permitted Phases						
Actuated Green, G (s)	10.5			51.5	51.5	
Effective Green, g (s)	10.5			51.5	51.5	
Actuated g/C Ratio	0.15			0.74	0.74	
Clearance Time (s)	4.0			4.0	4.0	
Vehicle Extension (s)	3.0			3.0	3.0	
Lane Grp Cap (vph)	505			2604	2604	
v/s Ratio Prot	c0.08			c0.57	0.33	
v/s Ratio Perm						
v/c Ratio	0.51			0.77	0.45	
Uniform Delay, d1	27.4			5.7	3.7	
Progression Factor	1.00			0.50	0.41	
Incremental Delay, d2	0.8			1.4	0.5	
Delay (s)	28.2			4.2	2.0	
Level of Service	C			A	A	
Approach Delay (s)	28.2			4.2	2.0	
Approach LOS	C			A	A	

Intersection Summary			
HCM Average Control Delay	5.5	HCM Level of Service	A
HCM Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	67.7%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
29: College Park Dr & SR-22 Ramps

12/4/2012

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	26	110	1548	169	80	109
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frt	1.00	0.85	0.99		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	1583	1838		1770	1863
Flt Permitted	0.95	1.00	1.00		0.04	1.00
Satd. Flow (perm)	1770	1583	1838		80	1863
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	27	116	1629	178	84	115
RTOR Reduction (vph)	0	62	3	0	0	0
Lane Group Flow (vph)	27	54	1804	0	84	115
Turn Type		Perm			Perm	
Protected Phases	8		2			6
Permitted Phases		8			6	
Actuated Green, G (s)	9.3	9.3	92.7		92.7	92.7
Effective Green, g (s)	9.3	9.3	92.7		92.7	92.7
Actuated g/C Ratio	0.08	0.08	0.84		0.84	0.84
Clearance Time (s)	4.0	4.0	4.0		4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	150	134	1549		67	1570
v/s Ratio Prot	0.02		0.98			0.06
v/s Ratio Perm		c0.03			c1.05	
v/c Ratio	0.18	0.40	1.16		1.25	0.07
Uniform Delay, d1	46.8	47.7	8.6		8.6	1.4
Progression Factor	1.00	1.00	1.00		3.91	1.33
Incremental Delay, d2	0.6	2.0	81.7		186.6	0.1
Delay (s)	47.4	49.7	90.3		220.5	2.0
Level of Service	D	D	F		F	A
Approach Delay (s)	49.2		90.3			94.2
Approach LOS	D		F			F

Intersection Summary			
HCM Average Control Delay	88.0	HCM Level of Service	F
HCM Volume to Capacity ratio	1.17		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	105.2%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Queues
12: Willow St & Bellflower St

3/27/2013

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	57	685	160	323	2225	292	1075	72	949
v/c Ratio	0.89	0.67	0.36	0.38	1.07	1.07	0.58	0.46	0.78
Control Delay	138.7	43.5	7.7	25.6	59.2	111.3	18.6	53.5	36.1
Queue Delay	0.0	0.0	0.0	0.0	15.4	0.0	0.6	0.0	0.0
Total Delay	138.7	43.5	7.7	25.6	74.6	111.3	19.2	53.5	36.1
Queue Length 50th (ft)	41	165	0	64	~611	~236	255	26	230
Queue Length 95th (ft)	#122	195	51	m114	#713	#414	219	50	107
Internal Link Dist (ft)		1129			409		285		200
Turn Bay Length (ft)	140			110		150		120	
Base Capacity (vph)	64	1549	593	852	2078	274	1858	156	1219
Starvation Cap Reductn	0	0	0	0	68	0	390	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.89	0.44	0.27	0.38	1.11	1.07	0.73	0.46	0.78

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	54	651	152	307	1721	392	277	997	25	68	813	88
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5	4.5	4.0	4.5		4.0	4.5		4.0	4.5	
Lane Util. Factor	1.00	0.91	1.00	0.97	0.91		1.00	0.91		0.97	0.91	
Frt	1.00	1.00	0.85	1.00	0.97		1.00	1.00		1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	5085	1583	3433	4944		1770	5067		3433	5011	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	5085	1583	3433	4944		1770	5067		3433	5011	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	57	685	160	323	1812	413	292	1049	26	72	856	93
RTOR Reduction (vph)	0	0	128	0	33	0	0	3	0	0	12	0
Lane Group Flow (vph)	57	685	32	323	2192	0	292	1072	0	72	937	0
Turn Type	Prot		Perm	Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4									
Actuated Green, G (s)	4.0	22.2	22.2	27.3	45.5		17.8	39.5		4.0	25.7	
Effective Green, g (s)	4.0	22.2	22.2	27.3	45.5		17.8	39.5		4.0	25.7	
Actuated g/C Ratio	0.04	0.20	0.20	0.25	0.41		0.16	0.36		0.04	0.23	
Clearance Time (s)	4.0	4.5	4.5	4.0	4.5		4.0	4.5		4.0	4.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	64	1026	319	852	2045		286	1820		125	1171	
v/s Ratio Prot	0.03	c0.13		0.09	c0.44		c0.17	0.21		0.02	c0.19	
v/s Ratio Perm			0.02									
v/c Ratio	0.89	0.67	0.10	0.38	1.07		1.02	0.59		0.58	0.80	
Uniform Delay, d1	52.8	40.5	35.8	34.3	32.2		46.1	28.7		52.2	39.7	
Progression Factor	1.00	1.00	1.00	0.70	0.61		0.95	0.61		0.86	0.81	
Incremental Delay, d2	74.9	1.7	0.1	0.2	38.8		53.7	1.2		5.9	5.4	
Delay (s)	127.6	42.2	35.9	24.1	58.5		97.7	18.7		51.0	37.8	
Level of Service	F	D	D	C	E		F	B		D	D	
Approach Delay (s)		46.5			54.1			35.6			38.7	
Approach LOS		D			D			D			D	

Intersection Summary			
HCM Average Control Delay	45.9	HCM Level of Service	D
HCM Volume to Capacity ratio	0.99		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	17.5
Intersection Capacity Utilization	92.5%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Queues
12: Willow St & Bellflower St

3/27/2013

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	109	1894	171	233	1199	139	2149	158	1663
v/c Ratio	0.56	1.10	0.28	1.02	0.80	0.94	1.05	0.92	0.89
Control Delay	64.4	93.7	11.7	109.5	22.8	52.3	46.0	97.0	33.1
Queue Delay	0.0	0.0	0.0	0.0	0.1	0.0	116.2	0.0	0.0
Total Delay	64.4	93.7	11.7	109.5	22.9	52.3	162.2	97.0	33.1
Queue Length 50th (ft)	82	~611	30	~101	295	107	~457	68	294
Queue Length 95th (ft)	#176	#707	83	#189	345	m107	m#392	m#121	354
Internal Link Dist (ft)		1129			409		285		200
Turn Bay Length (ft)	140			110		150		120	
Base Capacity (vph)	193	1716	610	229	1621	148	2047	172	1878
Starvation Cap Reductn	0	0	0	0	24	0	413	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.56	1.10	0.28	1.02	0.75	0.94	1.32	0.92	0.89

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	104	1799	162	221	844	295	132	1958	84	150	1517	63
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5	4.5	4.0	4.5		4.0	4.5		4.0	4.5	
Lane Util. Factor	1.00	0.91	1.00	0.97	0.91		1.00	0.91		0.97	0.91	
Frt	1.00	1.00	0.85	1.00	0.96		1.00	0.99		1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	5085	1583	3433	4887		1770	5054		3433	5055	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	5085	1583	3433	4887		1770	5054		3433	5055	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	109	1894	171	233	888	311	139	2061	88	158	1597	66
RTOR Reduction (vph)	0	0	76	0	55	0	0	4	0	0	4	0
Lane Group Flow (vph)	109	1894	95	233	1144	0	139	2145	0	158	1659	0
Turn Type	Prot		Perm	Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4									
Actuated Green, G (s)	13.1	40.5	40.5	8.0	35.4		10.0	48.5		6.0	44.5	
Effective Green, g (s)	13.1	40.5	40.5	8.0	35.4		10.0	48.5		6.0	44.5	
Actuated g/C Ratio	0.11	0.34	0.34	0.07	0.29		0.08	0.40		0.05	0.37	
Clearance Time (s)	4.0	4.5	4.5	4.0	4.5		4.0	4.5		4.0	4.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	193	1716	534	229	1442		148	2043		172	1875	
v/s Ratio Prot	0.06	c0.37		c0.07	0.23		c0.08	c0.42		0.05	0.33	
v/s Ratio Perm			0.06									
v/c Ratio	0.56	1.10	0.18	1.02	0.79		0.94	1.05		0.92	0.88	
Uniform Delay, d1	50.7	39.8	28.0	56.0	38.9		54.7	35.8		56.8	35.4	
Progression Factor	1.00	1.00	1.00	0.88	0.52		0.69	0.58		0.97	0.79	
Incremental Delay, d2	3.8	56.0	0.2	60.0	2.7		10.8	24.1		37.4	5.0	
Delay (s)	54.5	95.7	28.2	109.1	22.9		48.2	44.8		92.5	32.8	
Level of Service	D	F	C	F	C		D	D		F	C	
Approach Delay (s)		88.4			37.0			45.0			38.0	
Approach LOS		F			D			D			D	

Intersection Summary			
HCM Average Control Delay	54.1	HCM Level of Service	D
HCM Volume to Capacity ratio	1.08		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	99.2%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Queues
13: Los Coyotes Diagonal & Bellflower St

3/27/2013

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	328	1171	341	157	680	18	1018	262	1229
v/c Ratio	0.39	0.80	0.62	0.67	0.70	0.15	0.65	0.31	0.55
Control Delay	35.7	34.5	16.3	59.8	22.0	24.8	27.3	3.7	2.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Total Delay	35.7	34.5	16.3	59.8	22.0	24.8	27.3	3.7	2.7
Queue Length 50th (ft)	104	206	93	119	95	8	296	0	32
Queue Length 95th (ft)	154	244	143	m186	110	27	391	50	0
Internal Link Dist (ft)		339			174		323		285
Turn Bay Length (ft)	200			175		175			
Base Capacity (vph)	845	1511	559	290	1660	120	1569	848	2234
Starvation Cap Reductn	0	0	0	0	0	0	0	0	137
Spillback Cap Reductn	0	0	0	0	0	0	26	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.39	0.77	0.61	0.54	0.41	0.15	0.66	0.31	0.59

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	312	938	499	149	646	0	17	967	249	0	602	565
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5	4.5	4.0	4.5		4.5	4.5	4.5		4.5	
Lane Util. Factor	0.97	0.86	0.86	1.00	0.91		1.00	0.95	1.00		0.91	
Frt	1.00	0.98	0.85	1.00	1.00		1.00	1.00	0.85		0.93	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00		1.00	
Satd. Flow (prot)	3433	4693	1362	1770	5085		1770	3539	1583		4716	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.15	1.00	1.00		1.00	
Satd. Flow (perm)	3433	4693	1362	1770	5085		271	3539	1583		4716	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	328	987	525	157	680	0	18	1018	262	0	634	595
RTOR Reduction (vph)	0	23	129	0	0	0	0	0	146	0	144	0
Lane Group Flow (vph)	328	1148	212	157	680	0	18	1018	116	0	1085	0
Turn Type	Prot		Perm	Prot			Perm		Perm			
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4				2		2			
Actuated Green, G (s)	27.2	33.8	33.8	14.5	21.1		48.7	48.7	48.7		48.7	
Effective Green, g (s)	27.2	33.8	33.8	14.5	21.1		48.7	48.7	48.7		48.7	
Actuated g/C Ratio	0.25	0.31	0.31	0.13	0.19		0.44	0.44	0.44		0.44	
Clearance Time (s)	4.0	4.5	4.5	4.0	4.5		4.5	4.5	4.5		4.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	849	1442	419	233	975		120	1567	701		2088	
v/s Ratio Prot	0.10	c0.24		c0.09	0.13			c0.29			0.23	
v/s Ratio Perm			0.16				0.07		0.07			
v/c Ratio	0.39	0.80	0.51	0.67	0.70		0.15	0.65	0.17		0.52	
Uniform Delay, d1	34.5	34.9	31.3	45.5	41.5		18.3	24.0	18.4		22.2	
Progression Factor	1.00	0.90	0.82	1.07	0.46		1.00	1.00	1.00		0.10	
Incremental Delay, d2	0.3	2.7	0.8	5.9	1.7		2.6	2.1	0.5		0.7	
Delay (s)	34.7	34.0	26.5	54.5	20.6		20.9	26.1	18.9		3.1	
Level of Service	C	C	C	D	C		C	C	B		A	
Approach Delay (s)		32.7			27.0			24.6			3.1	
Approach LOS		C			C			C			A	

Intersection Summary			
HCM Average Control Delay	22.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	67.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Queues
13: Los Coyotes Diagonal & Bellflower St

3/27/2013

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	529	1258	323	298	748	24	1940	522	1984
v/c Ratio	0.87	1.14	0.95	1.19	0.76	0.39	1.05	0.53	0.76
Control Delay	61.3	115.6	73.4	134.3	27.3	39.5	65.3	7.6	2.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Total Delay	61.3	115.6	73.4	134.3	27.3	39.5	65.3	7.7	2.5
Queue Length 50th (ft)	215	~447	261	~269	166	11	~863	69	15
Queue Length 95th (ft)	#319	#534	#381	m#296	m160	45	#1002	160	m25
Internal Link Dist (ft)		339			174		323		285
Turn Bay Length (ft)	200			175		175			
Base Capacity (vph)	607	1099	341	251	1080	62	1843	993	2595
Starvation Cap Reductn	0	0	0	0	0	0	0	0	47
Spillback Cap Reductn	0	0	0	0	0	0	0	51	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.87	1.14	0.95	1.19	0.69	0.39	1.05	0.55	0.78

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	503	1161	341	283	705	6	23	1843	496	0	1330	555
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5	4.5	4.0	4.5		4.5	4.5	4.5		4.5	
Lane Util. Factor	0.97	0.86	0.86	1.00	0.91		1.00	0.95	1.00		0.91	
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85		0.96	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00		1.00	
Satd. Flow (prot)	3433	4785	1362	1770	5079		1770	3539	1583		4861	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.06	1.00	1.00		1.00	
Satd. Flow (perm)	3433	4785	1362	1770	5079		119	3539	1583		4861	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	529	1222	359	298	742	6	24	1940	522	0	1400	584
RTOR Reduction (vph)	0	2	29	0	1	0	0	0	169	0	63	0
Lane Group Flow (vph)	529	1256	294	298	747	0	24	1940	353	0	1921	0
Turn Type	Prot		Perm	Prot			Perm		Perm			
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4				2		2			
Actuated Green, G (s)	21.2	27.5	27.5	17.0	23.3		62.5	62.5	62.5		62.5	
Effective Green, g (s)	21.2	27.5	27.5	17.0	23.3		62.5	62.5	62.5		62.5	
Actuated g/C Ratio	0.18	0.23	0.23	0.14	0.19		0.52	0.52	0.52		0.52	
Clearance Time (s)	4.0	4.5	4.5	4.0	4.5		4.5	4.5	4.5		4.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	606	1097	312	251	986		62	1843	824		2532	
v/s Ratio Prot	0.15	c0.26		c0.17	0.15			c0.55			0.40	
v/s Ratio Perm			0.22				0.20		0.22			
v/c Ratio	0.87	1.14	0.94	1.19	0.76		0.39	1.05	0.43		0.76	
Uniform Delay, d1	48.1	46.2	45.5	51.5	45.7		17.3	28.8	17.7		22.8	
Progression Factor	0.96	0.96	0.94	0.62	0.54		1.00	1.00	1.00		0.06	
Incremental Delay, d2	12.0	75.2	33.7	102.6	1.7		17.3	36.4	1.6		1.1	
Delay (s)	58.0	119.6	76.4	134.6	26.3		34.5	65.1	19.4		2.5	
Level of Service	E	F	E	F	C		C	E	B		A	
Approach Delay (s)		97.5			57.2			55.2			2.5	
Approach LOS		F			E			E			A	

Intersection Summary			
HCM Average Control Delay	53.5	HCM Level of Service	D
HCM Volume to Capacity ratio	1.10		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	102.4%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Queues
16: Willow St & Los Coyotes Diagonal

3/27/2013

Lane Group	EBL	EBT	WBL	WBT	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	83	735	380	2397	129	596	505	126	819
v/c Ratio	0.66	0.49	0.69	0.80	0.14	0.62	0.63	0.51	0.60
Control Delay	82.6	3.9	40.0	20.5	6.6	54.0	22.6	43.2	34.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	82.6	3.9	40.0	20.5	6.6	54.0	22.6	43.2	34.0
Queue Length 50th (ft)	32	26	229	455	23	181	185	39	171
Queue Length 95th (ft)	m#70	23	336	523	50	241	242	73	217
Internal Link Dist (ft)		409		995		363			581
Turn Bay Length (ft)	140		160					120	
Base Capacity (vph)	125	1502	579	2982	949	968	800	248	1374
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.66	0.49	0.66	0.80	0.14	0.62	0.63	0.51	0.60

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	79	698	0	361	2277	123	0	566	480	120	520	258
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5		4.0	4.5	4.5		4.5	4.5	4.5	4.5	
Lane Util. Factor	0.97	0.91		1.00	0.91	1.00		0.95	1.00	0.97	0.91	
Frt	1.00	1.00		1.00	1.00	0.85		1.00	0.85	1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3433	5085		1770	5085	1583		3539	1583	3433	4832	
Flt Permitted	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.25	1.00	
Satd. Flow (perm)	3433	5085		1770	5085	1583		3539	1583	909	4832	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	83	735	0	380	2397	129	0	596	505	126	547	272
RTOR Reduction (vph)	0	0	0	0	0	21	0	0	367	0	52	0
Lane Group Flow (vph)	83	735	0	380	2397	108	0	596	138	126	767	0
Turn Type	Prot			Prot		Perm			Perm	Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases						8			2	6		
Actuated Green, G (s)	3.2	31.7		35.2	63.7	63.7		30.1	30.1	30.1	30.1	
Effective Green, g (s)	3.2	31.7		35.2	63.7	63.7		30.1	30.1	30.1	30.1	
Actuated g/C Ratio	0.03	0.29		0.32	0.58	0.58		0.27	0.27	0.27	0.27	
Clearance Time (s)	4.0	4.5		4.0	4.5	4.5		4.5	4.5	4.5	4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	100	1465		566	2945	917		968	433	249	1322	
v/s Ratio Prot	0.02	0.14		c0.21	c0.47			c0.17			0.16	
v/s Ratio Perm						0.07			0.09	0.14		
v/c Ratio	0.83	0.50		0.67	0.81	0.12		0.62	0.32	0.51	0.58	
Uniform Delay, d1	53.1	32.6		32.4	18.4	10.5		34.9	31.8	33.7	34.5	
Progression Factor	1.14	0.09		1.00	1.00	1.00		1.45	6.23	1.00	1.00	
Incremental Delay, d2	38.3	1.1		3.1	2.6	0.3		2.1	1.4	7.2	1.9	
Delay (s)	98.8	4.1		35.5	21.0	10.7		52.8	199.5	40.9	36.4	
Level of Service	F	A		D	C	B		D	F	D	D	
Approach Delay (s)		13.7			22.5			120.1			37.0	
Approach LOS		B			C			F			D	

Intersection Summary			
HCM Average Control Delay	42.2	HCM Level of Service	D
HCM Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	81.0%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Queues
16: Willow St & Los Coyotes Diagonal

3/27/2013

Lane Group	EBL	EBT	WBL	WBT	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	167	2026	528	1329	315	739	796	254	612
v/c Ratio	0.58	1.12	1.33	0.53	0.39	0.67	0.99	1.18	0.39
Control Delay	20.1	67.1	201.0	21.6	17.2	28.7	41.4	154.8	30.5
Queue Delay	0.0	6.6	0.0	0.0	0.0	0.0	25.5	0.0	0.0
Total Delay	20.1	73.7	201.0	21.6	17.2	28.7	66.9	154.8	30.5
Queue Length 50th (ft)	54	~634	~530	249	122	307	504	~121	124
Queue Length 95th (ft)	m50	m#98	#746	292	192	m287	m488	#207	161
Internal Link Dist (ft)		409		995		363			581
Turn Bay Length (ft)	140		160					120	
Base Capacity (vph)	286	1801	398	2521	811	1106	806	216	1576
Starvation Cap Reductn	0	24	0	0	0	0	62	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.58	1.14	1.33	0.53	0.39	0.67	1.07	1.18	0.39

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	159	1925	0	502	1263	299	0	702	756	241	472	109
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5		4.0	4.5	4.5		4.5	4.5	4.5	4.5	
Lane Util. Factor	0.97	0.91		1.00	0.91	1.00		0.95	1.00	0.97	0.91	
Frt	1.00	1.00		1.00	1.00	0.85		1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3433	5085		1770	5085	1583		3539	1583	3433	4942	
Flt Permitted	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.19	1.00	
Satd. Flow (perm)	3433	5085		1770	5085	1583		3539	1583	689	4942	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	167	2026	0	528	1329	315	0	739	796	254	497	115
RTOR Reduction (vph)	0	0	0	0	0	26	0	0	311	0	32	0
Lane Group Flow (vph)	167	2026	0	528	1329	289	0	739	485	254	580	0
Turn Type	Prot			Prot		Perm			Perm	Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases						8			2	6		
Actuated Green, G (s)	10.0	42.5		27.0	59.5	59.5		37.5	37.5	37.5	37.5	
Effective Green, g (s)	10.0	42.5		27.0	59.5	59.5		37.5	37.5	37.5	37.5	
Actuated g/C Ratio	0.08	0.35		0.22	0.50	0.50		0.31	0.31	0.31	0.31	
Clearance Time (s)	4.0	4.5		4.0	4.5	4.5		4.5	4.5	4.5	4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	286	1801		398	2521	785		1106	495	215	1544	
v/s Ratio Prot	0.05	c0.40		c0.30	0.26			0.21			0.12	
v/s Ratio Perm						0.18			0.31	c0.37		
v/c Ratio	0.58	1.12		1.33	0.53	0.37		0.67	0.98	1.18	0.38	
Uniform Delay, d1	53.0	38.8		46.5	20.6	18.7		35.8	40.9	41.2	32.1	
Progression Factor	0.36	0.12		1.00	1.00	1.00		0.77	1.57	1.00	1.00	
Incremental Delay, d2	0.3	57.0		163.5	0.8	1.3		1.0	17.9	119.0	0.7	
Delay (s)	19.5	61.7		210.0	21.4	20.0		28.4	82.0	160.3	32.8	
Level of Service	B	E		F	C	B		C	F	F	C	
Approach Delay (s)		58.5			67.1			56.2			70.2	
Approach LOS		E			E			E			E	

Intersection Summary			
HCM Average Control Delay	62.2	HCM Level of Service	E
HCM Volume to Capacity ratio	1.19		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	105.9%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	2610	2177	144	1197	523	718
v/c Ratio	1.08	0.91	0.56	0.98	1.01	0.57
Control Delay	75.5	20.8	44.9	41.9	95.5	45.0
Queue Delay	15.8	7.2	0.0	0.0	0.0	0.0
Total Delay	91.3	28.0	44.9	41.9	95.5	45.0
Queue Length 50th (ft)	~895	237	123	370	~231	195
Queue Length 95th (ft)	#984	m242	198	#472	#351	240
Internal Link Dist (ft)	1037	280		562		836
Turn Bay Length (ft)			330		290	
Base Capacity (vph)	2426	2400	257	1222	520	1256
Starvation Cap Reductn	0	210	0	0	0	0
Spillback Cap Reductn	80	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	1.11	0.99	0.56	0.98	1.01	0.57

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	2316	163	0	1578	490	137	1105	32	497	681	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.5			5.5		5.5	5.5		5.5	5.5	
Lane Util. Factor		0.91			0.91		1.00	0.91		0.97	0.91	
Frt		0.99			0.96		1.00	1.00		1.00	1.00	
Flt Protected		1.00			1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		5035			4904		1770	5064		3433	5084	
Flt Permitted		1.00			1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)		5035			4904		1770	5064		3433	5084	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	2438	172	0	1661	516	144	1163	34	523	717	1
RTOR Reduction (vph)	0	6	0	0	43	0	0	2	0	0	0	0
Lane Group Flow (vph)	0	2604	0	0	2134	0	144	1195	0	523	718	0
Turn Type							Prot			Prot		
Protected Phases		4			8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)		62.5			62.5		18.9	31.3		19.7	32.1	
Effective Green, g (s)		62.5			62.5		18.9	31.3		19.7	32.1	
Actuated g/C Ratio		0.48			0.48		0.15	0.24		0.15	0.25	
Clearance Time (s)		5.5			5.5		5.5	5.5		5.5	5.5	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		2421			2358		257	1219		520	1255	
v/s Ratio Prot		c0.52			0.44		0.08	c0.24		c0.15	0.14	
v/s Ratio Perm												
v/c Ratio		1.08			0.90		0.56	0.98		1.01	0.57	
Uniform Delay, d1		33.8			31.0		51.7	49.0		55.1	42.9	
Progression Factor		1.00			0.61		0.72	0.44		1.00	1.00	
Incremental Delay, d2		42.4			1.8		7.0	18.9		40.9	1.9	
Delay (s)		76.2			20.8		44.4	40.6		96.1	44.8	
Level of Service		E			C		D	D		F	D	
Approach Delay (s)		76.2			20.8			41.0			66.4	
Approach LOS		E			C			D			E	

Intersection Summary			
HCM Average Control Delay	51.8	HCM Level of Service	D
HCM Volume to Capacity ratio	0.99		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	11.0
Intersection Capacity Utilization	98.4%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	505	2424	40	2254	819	158	269	538	403
v/c Ratio	0.97	0.86	0.56	1.04	0.98	0.49	0.93	0.52	0.59
Control Delay	76.9	8.7	60.3	46.9	77.4	32.9	96.1	40.8	13.4
Queue Delay	0.0	14.6	0.0	7.9	0.0	0.0	0.0	0.0	0.0
Total Delay	76.9	23.3	60.3	54.7	77.4	32.9	96.1	40.8	13.4
Queue Length 50th (ft)	224	237	32	~128	206	44	118	200	61
Queue Length 95th (ft)	m211	m223	m41	#280	#333	m114	#203	257	169
Internal Link Dist (ft)		280		585	326			720	
Turn Bay Length (ft)	200		200			130	160		
Base Capacity (vph)	520	2835	72	2158	833	322	290	1029	679
Starvation Cap Reductn	0	459	0	40	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.97	1.02	0.56	1.06	0.98	0.49	0.93	0.52	0.59

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	480	2288	15	38	1716	426	0	778	150	256	511	383
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Lane Util. Factor	0.97	0.91		1.00	0.91			0.91	1.00	0.97	0.95	1.00
Frt	1.00	1.00		1.00	0.97			1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	5080		1770	4934			5085	1583	3433	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	5080		1770	4934			5085	1583	3433	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	505	2408	16	40	1806	448	0	819	158	269	538	403
RTOR Reduction (vph)	0	0	0	0	33	0	0	0	63	0	0	218
Lane Group Flow (vph)	505	2424	0	40	2221	0	0	819	95	269	538	185
Turn Type	Prot			Prot					Perm	Prot		Perm
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases									2			6
Actuated Green, G (s)	19.7	71.5		4.2	56.0			21.3	21.3	11.0	37.8	37.8
Effective Green, g (s)	19.7	71.5		4.2	56.0			21.3	21.3	11.0	37.8	37.8
Actuated g/C Ratio	0.15	0.55		0.03	0.43			0.16	0.16	0.08	0.29	0.29
Clearance Time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	520	2794		57	2125			833	259	290	1029	460
v/s Ratio Prot	0.15	c0.48		0.02	c0.45			c0.16		c0.08	0.15	
v/s Ratio Perm									0.06			0.12
v/c Ratio	0.97	0.87		0.70	1.05			0.98	0.37	0.93	0.52	0.40
Uniform Delay, d1	54.9	25.2		62.3	37.0			54.2	48.4	59.1	38.6	37.0
Progression Factor	1.30	0.33		0.69	0.47			0.98	1.10	1.00	1.00	1.00
Incremental Delay, d2	6.6	0.4		20.1	28.4			24.2	3.2	37.2	1.9	2.6
Delay (s)	78.1	8.7		63.2	46.0			77.5	56.2	96.3	40.5	39.6
Level of Service	E	A		E	D			E	E	F	D	D
Approach Delay (s)		20.7			46.3			74.0			52.6	
Approach LOS		C			D			E			D	

Intersection Summary			
HCM Average Control Delay	40.8	HCM Level of Service	D
HCM Volume to Capacity ratio	1.01		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	97.0%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	65	763	48	1221	474	84	504	186	402	17
v/c Ratio	0.39	0.38	0.18	0.63	0.55	0.22	0.68	0.56	0.39	0.05
Control Delay	38.8	14.4	21.8	35.1	7.4	44.4	51.4	52.5	44.9	30.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	38.8	14.4	21.8	35.1	7.4	44.4	51.4	52.5	44.9	30.2
Queue Length 50th (ft)	25	50	22	312	32	59	203	193	138	10
Queue Length 95th (ft)	m57	m103	46	365	126	107	265	m284	m178	m24
Internal Link Dist (ft)		562		597			652		326	
Turn Bay Length (ft)	110		120		200	280		240		60
Base Capacity (vph)	169	1992	267	1936	860	374	743	334	1029	357
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.38	0.38	0.18	0.63	0.55	0.22	0.68	0.56	0.39	0.05

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	62	708	17	46	1160	450	80	419	60	353	205	16
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.5		4.0	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00	1.00	0.95		0.86	0.86	1.00
Frt	1.00	1.00		1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (prot)	1770	5067		1770	5085	1583	1770	3473		1522	4697	1583
Flt Permitted	0.12	1.00		0.30	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (perm)	220	5067		552	5085	1583	1770	3473		1522	4697	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	65	745	18	48	1221	474	84	441	63	372	216	17
RTOR Reduction (vph)	0	2	0	0	0	260	0	9	0	0	0	10
Lane Group Flow (vph)	65	761	0	48	1221	214	84	495	0	186	402	7
Turn Type	pm+pt			pm+pt		Perm	Split			Split		Perm
Protected Phases	7	4		3	8		2	2		6	6	
Permitted Phases	4			8		8						6
Actuated Green, G (s)	55.1	50.3		51.9	48.7	48.7	27.5	27.5		28.5	28.5	28.5
Effective Green, g (s)	55.1	50.3		51.9	48.7	48.7	27.5	27.5		28.5	28.5	28.5
Actuated g/C Ratio	0.42	0.39		0.40	0.37	0.37	0.21	0.21		0.22	0.22	0.22
Clearance Time (s)	4.0	5.5		4.0	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	150	1961		250	1905	593	374	735		334	1030	347
v/s Ratio Prot	c0.02	0.15		0.00	c0.24		0.05	c0.14		c0.12	0.09	
v/s Ratio Perm	0.17			0.07		0.14						0.00
v/c Ratio	0.43	0.39		0.19	0.64	0.36	0.22	0.67		0.56	0.39	0.02
Uniform Delay, d1	24.8	28.7		24.4	33.5	29.4	42.4	47.1		45.1	43.3	39.8
Progression Factor	1.67	0.49		1.00	1.00	1.00	1.00	1.00		1.02	1.01	1.40
Incremental Delay, d2	1.5	0.4		0.4	1.7	1.7	1.4	4.9		5.7	1.0	0.1
Delay (s)	42.8	14.5		24.7	35.1	31.1	43.8	52.0		51.6	44.7	55.9
Level of Service	D	B		C	D	C	D	D		D	D	E
Approach Delay (s)		16.7			33.7			50.9			47.2	
Approach LOS		B			C			D			D	

Intersection Summary			
HCM Average Control Delay	34.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	24.5
Intersection Capacity Utilization	66.2%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	106	2668	39	135	2643	97	94	173	48	54
v/c Ratio	0.88	0.77	0.04	0.84	0.80	0.92	0.84	0.72	0.23	0.40
Control Delay	85.9	4.2	1.0	68.5	1.2	127.2	110.2	26.2	60.3	35.3
Queue Delay	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	85.9	4.3	1.0	68.5	1.3	127.2	110.2	26.2	60.3	35.3
Queue Length 50th (ft)	96	111	1	62	10	83	80	0	20	15
Queue Length 95th (ft)	m#118	131	m1	m66	m13	#194	#182	#94	40	58
Internal Link Dist (ft)		585			1015		352			692
Turn Bay Length (ft)	270			275		100		350		
Base Capacity (vph)	121	3467	1088	161	3290	106	112	239	634	339
Starvation Cap Reductn	0	79	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	9	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.88	0.79	0.04	0.84	0.81	0.92	0.84	0.72	0.08	0.16

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	101	2535	37	128	2099	412	92	89	164	46	17	34
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	5.5	5.5	
Lane Util. Factor	1.00	0.91	1.00	0.97	0.91		1.00	1.00	1.00	0.97	1.00	
Frt	1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85	1.00	0.90	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5085	1583	3433	4960		1770	1863	1583	3433	1676	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	5085	1583	3433	4960		1770	1863	1583	3433	1676	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	106	2668	39	135	2209	434	97	94	173	48	18	36
RTOR Reduction (vph)	0	0	9	0	16	0	0	0	165	0	34	0
Lane Group Flow (vph)	106	2668	31	135	2627	0	97	94	8	48	20	0
Turn Type	Prot		Perm	Prot			Split		Over	Split		
Protected Phases	7	4		3	8		2	2	3	6	6	
Permitted Phases			4									
Actuated Green, G (s)	8.9	87.5	87.5	6.1	84.7		7.8	7.8	6.1	6.6	6.6	
Effective Green, g (s)	8.9	87.5	87.5	6.1	84.7		7.8	7.8	6.1	6.6	6.6	
Actuated g/C Ratio	0.07	0.67	0.67	0.05	0.65		0.06	0.06	0.05	0.05	0.05	
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	5.5	5.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	121	3423	1065	161	3232		106	112	74	174	85	
v/s Ratio Prot	c0.06	0.52		0.04	c0.53		c0.05	0.05	0.01	c0.01	0.01	
v/s Ratio Perm			0.02									
v/c Ratio	0.88	0.78	0.03	0.84	0.81		0.92	0.84	0.11	0.28	0.23	
Uniform Delay, d1	60.0	14.6	7.1	61.5	16.8		60.8	60.5	59.3	59.4	59.3	
Progression Factor	0.86	0.22	0.25	0.84	0.03		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	28.3	0.9	0.0	12.2	0.8		60.6	39.5	0.7	0.9	1.4	
Delay (s)	79.6	4.2	1.8	64.0	1.3		121.4	100.0	60.0	60.3	60.7	
Level of Service	E	A	A	E	A		F	F	E	E	E	
Approach Delay (s)		7.0			4.3			86.7			60.5	
Approach LOS		A			A			F			E	

Intersection Summary			
HCM Average Control Delay	11.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	80.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBT	WBR	SBL
Lane Group Flow (vph)	116	2658	2806	598	157
v/c Ratio	0.54	0.80	0.96	0.58	0.32
Control Delay	28.2	21.3	10.5	0.8	32.3
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	28.2	21.3	10.5	0.8	32.3
Queue Length 50th (ft)	62	411	399	1	36
Queue Length 95th (ft)	m79	490	m285	m0	72
Internal Link Dist (ft)		1015	1000		632
Turn Bay Length (ft)	400			150	150
Base Capacity (vph)	383	3305	2930	1025	498
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.30	0.80	0.96	0.58	0.32

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	110	2525	2666	568	87	62
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5	
Lane Util. Factor	1.00	0.91	0.91	1.00	0.97	
Frt	1.00	1.00	1.00	0.85	0.94	
Flt Protected	0.95	1.00	1.00	1.00	0.97	
Satd. Flow (prot)	1770	5085	5085	1583	3293	
Flt Permitted	0.95	1.00	1.00	1.00	0.97	
Satd. Flow (perm)	1770	5085	5085	1583	3293	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	116	2658	2806	598	92	65
RTOR Reduction (vph)	0	0	0	113	56	0
Lane Group Flow (vph)	116	2658	2806	485	101	0
Turn Type	Prot			Perm		
Protected Phases	7 9	4	8		6	
Permitted Phases				8		
Actuated Green, G (s)	15.7	84.5	74.9	74.9	17.4	
Effective Green, g (s)	15.7	84.5	74.9	74.9	17.4	
Actuated g/C Ratio	0.12	0.65	0.58	0.58	0.13	
Clearance Time (s)		5.5	5.5	5.5	5.5	
Vehicle Extension (s)		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	214	3305	2930	912	441	
v/s Ratio Prot	c0.07	c0.52	c0.55		c0.03	
v/s Ratio Perm				0.31		
v/c Ratio	0.54	0.80	0.96	0.53	0.23	
Uniform Delay, d1	53.8	16.7	26.1	16.8	50.3	
Progression Factor	0.65	1.17	0.33	0.06	1.00	
Incremental Delay, d2	1.8	1.4	1.2	0.2	1.2	
Delay (s)	36.7	21.0	9.7	1.2	51.5	
Level of Service	D	C	A	A	D	
Approach Delay (s)		21.6	8.2		51.5	
Approach LOS		C	A		D	

Intersection Summary			
HCM Average Control Delay	15.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	75.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	152	2520	69	46	3569	225	181	51	119
v/c Ratio	1.03	0.72	0.06	0.43	1.09	0.21	1.07	0.27	0.37
Control Delay	112.6	8.0	2.8	70.8	70.4	5.9	140.8	53.9	16.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	112.6	8.0	2.8	70.8	70.4	5.9	140.8	53.9	16.2
Queue Length 50th (ft)	~129	175	5	38	~1238	40	~167	39	13
Queue Length 95th (ft)	m#203	168	m5	80	#1308	74	#320	81	70
Internal Link Dist (ft)		1000			893		425		590
Turn Bay Length (ft)	150		150	300		150			
Base Capacity (vph)	148	3477	1096	121	3274	1053	169	186	323
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.03	0.72	0.06	0.38	1.09	0.21	1.07	0.27	0.37

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	144	2394	66	44	3391	214	123	38	11	48	16	97
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5	5.5		5.5		5.5	5.5	
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91	1.00		1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85		0.99		1.00	0.87	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00		0.97		0.95	1.00	
Satd. Flow (prot)	1770	5085	1583	1770	5085	1583		1783		1770	1623	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00		0.63		0.69	1.00	
Satd. Flow (perm)	1770	5085	1583	1770	5085	1583		1154		1281	1623	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	152	2520	69	46	3569	225	129	40	12	51	17	102
RTOR Reduction (vph)	0	0	14	0	0	34	0	2	0	0	87	0
Lane Group Flow (vph)	152	2520	55	46	3569	191	0	179	0	51	32	0
Turn Type	Prot		Perm	Prot		Perm	Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8	2			6		
Actuated Green, G (s)	12.0	87.8	87.8	6.8	82.6	82.6		18.9		18.9	18.9	
Effective Green, g (s)	12.0	87.8	87.8	6.8	82.6	82.6		18.9		18.9	18.9	
Actuated g/C Ratio	0.09	0.68	0.68	0.05	0.64	0.64		0.15		0.15	0.15	
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5	5.5		5.5		5.5	5.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0		3.0		3.0	3.0	
Lane Grp Cap (vph)	163	3434	1069	93	3231	1006		168		186	236	
v/s Ratio Prot	c0.09	0.50		0.03	c0.70						0.02	
v/s Ratio Perm			0.03			0.12		c0.16		0.04		
v/c Ratio	0.93	0.73	0.05	0.49	1.10	0.19		1.07		0.27	0.13	
Uniform Delay, d1	58.6	13.6	7.1	59.9	23.7	9.8		55.5		49.4	48.4	
Progression Factor	0.81	0.52	0.75	1.00	1.00	1.00		1.00		1.00	1.00	
Incremental Delay, d2	36.4	0.8	0.1	4.1	52.4	0.4		88.4		0.8	0.3	
Delay (s)	83.9	7.9	5.4	64.0	76.1	10.2		144.0		50.2	48.7	
Level of Service	F	A	A	E	E	B		F		D	D	
Approach Delay (s)		12.1			72.1			144.0			49.2	
Approach LOS		B			E			F			D	

Intersection Summary			
HCM Average Control Delay	49.7	HCM Level of Service	D
HCM Volume to Capacity ratio	1.08		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	103.4%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	2246	2336	199	1073	636	1139
v/c Ratio	0.99	1.04	0.87	0.91	0.97	0.76
Control Delay	52.0	42.2	64.9	50.4	80.9	45.9
Queue Delay	19.8	6.0	0.0	0.0	89.2	0.0
Total Delay	71.8	48.2	64.9	50.4	170.1	45.9
Queue Length 50th (ft)	672	~739	172	352	277	320
Queue Length 95th (ft)	#804	m#824	#308	#416	#398	376
Internal Link Dist (ft)	1037	280		562		836
Turn Bay Length (ft)			330		290	
Base Capacity (vph)	2269	2249	230	1178	655	1490
Starvation Cap Reductn	0	33	0	0	0	0
Spillback Cap Reductn	136	0	0	0	132	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	1.05	1.05	0.87	0.91	1.22	0.76

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1960	174	0	1671	548	189	987	32	604	1080	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.5			5.5		5.5	5.5		5.5	5.5	
Lane Util. Factor		0.91			0.91		1.00	0.91		0.97	0.91	
Frt		0.99			0.96		1.00	1.00		1.00	1.00	
Flt Protected		1.00			1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		5023			4897		1770	5061		3433	5084	
Flt Permitted		1.00			1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)		5023			4897		1770	5061		3433	5084	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	2063	183	0	1759	577	199	1039	34	636	1137	2
RTOR Reduction (vph)	0	8	0	0	46	0	0	2	0	0	0	0
Lane Group Flow (vph)	0	2238	0	0	2290	0	199	1071	0	636	1139	0
Turn Type							Prot			Prot		
Protected Phases		4			8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)		58.5			58.5		16.9	30.2		24.8	38.1	
Effective Green, g (s)		58.5			58.5		16.9	30.2		24.8	38.1	
Actuated g/C Ratio		0.45			0.45		0.13	0.23		0.19	0.29	
Clearance Time (s)		5.5			5.5		5.5	5.5		5.5	5.5	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		2260			2204		230	1176		655	1490	
v/s Ratio Prot		0.45			c0.47		0.11	c0.21		c0.19	0.22	
v/s Ratio Perm												
v/c Ratio		0.99			1.04		0.87	0.91		0.97	0.76	
Uniform Delay, d1		35.5			35.8		55.4	48.6		52.2	41.9	
Progression Factor		1.00			0.50		0.62	0.82		1.00	1.00	
Incremental Delay, d2		16.7			23.5		28.7	10.4		27.9	3.8	
Delay (s)		52.1			41.5		63.1	50.2		80.2	45.6	
Level of Service		D			D		E	D		F	D	
Approach Delay (s)		52.1			41.5			52.2			58.0	
Approach LOS		D			D			D			E	

Intersection Summary			
HCM Average Control Delay	50.3	HCM Level of Service	D
HCM Volume to Capacity ratio	0.99		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	95.3%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	429	2313	42	1883	765	136	436	819	653
v/c Ratio	0.92	0.89	0.70	0.95	0.93	0.44	0.92	0.67	0.88
Control Delay	78.1	16.1	91.1	31.2	56.1	19.9	80.5	39.9	35.3
Queue Delay	0.0	21.1	0.0	7.5	0.0	0.0	0.0	0.0	2.4
Total Delay	78.1	37.3	91.1	38.6	56.1	19.9	80.5	39.9	37.6
Queue Length 50th (ft)	191	321	34	147	177	32	189	309	304
Queue Length 95th (ft)	m193	m331	m#74	#223	#298	m78	#286	382	#546
Internal Link Dist (ft)		280		585	326			720	
Turn Bay Length (ft)	200		200			130	160		
Base Capacity (vph)	467	2596	60	1984	825	310	475	1214	744
Starvation Cap Reductn	0	371	0	4	0	0	0	0	0
Spillback Cap Reductn	0	112	0	104	0	1	0	0	33
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.92	1.04	0.70	1.00	0.93	0.44	0.92	0.67	0.92

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	408	2172	26	40	1620	169	0	727	129	414	778	620
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Lane Util. Factor	0.97	0.91		1.00	0.91			0.91	1.00	0.97	0.95	1.00
Frt	1.00	1.00		1.00	0.99			1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	5076		1770	5013			5085	1583	3433	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	5076		1770	5013			5085	1583	3433	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	429	2286	27	42	1705	178	0	765	136	436	819	653
RTOR Reduction (vph)	0	1	0	0	10	0	0	0	53	0	0	201
Lane Group Flow (vph)	429	2312	0	42	1873	0	0	765	83	436	819	452
Turn Type	Prot			Prot					Perm	Prot		Perm
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases									2			6
Actuated Green, G (s)	17.7	65.4		3.5	51.2			21.1	21.1	18.0	44.6	44.6
Effective Green, g (s)	17.7	65.4		3.5	51.2			21.1	21.1	18.0	44.6	44.6
Actuated g/C Ratio	0.14	0.50		0.03	0.39			0.16	0.16	0.14	0.34	0.34
Clearance Time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	467	2554		48	1974			825	257	475	1214	543
v/s Ratio Prot	0.12	c0.46		0.02	c0.37			0.15		0.13	0.23	
v/s Ratio Perm									0.05			c0.29
v/c Ratio	0.92	0.91		0.88	0.95			0.93	0.32	0.92	0.67	0.83
Uniform Delay, d1	55.4	29.5		63.0	38.1			53.7	48.1	55.3	36.5	39.3
Progression Factor	1.26	0.49		0.74	0.55			0.75	0.60	1.00	1.00	1.00
Incremental Delay, d2	8.0	1.7		73.5	9.7			15.4	2.7	25.2	3.0	13.9
Delay (s)	77.9	16.2		120.1	30.7			55.5	31.8	80.5	39.5	53.2
Level of Service	E	B		F	C			E	C	F	D	D
Approach Delay (s)		25.8			32.6			51.9			53.5	
Approach LOS		C			C			D			D	

Intersection Summary			
HCM Average Control Delay	37.8	HCM Level of Service	D
HCM Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	90.9%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	233	897	85	1139	416	55	307	173	539	47
v/c Ratio	0.78	0.39	0.31	0.60	0.50	0.23	0.64	0.56	0.56	0.14
Control Delay	28.7	19.4	35.1	35.1	7.1	53.0	59.5	18.3	14.4	4.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	28.7	19.4	35.1	35.1	7.1	53.0	59.5	18.3	14.4	4.4
Queue Length 50th (ft)	183	263	46	282	23	42	129	127	132	12
Queue Length 95th (ft)	m241	m301	89	353	113	84	180	m191	m139	m16
Internal Link Dist (ft)		562		597			652		326	
Turn Bay Length (ft)	110		120		200	280		240		60
Base Capacity (vph)	360	2295	274	1900	825	240	478	310	971	344
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.65	0.39	0.31	0.60	0.50	0.23	0.64	0.56	0.56	0.14

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	221	750	103	81	1082	395	52	277	14	257	419	45
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.5		4.0	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00	1.00	0.95		0.86	0.86	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.99	1.00
Satd. Flow (prot)	1770	4993		1770	5085	1583	1770	3513		1522	4763	1583
Flt Permitted	0.11	1.00		0.31	1.00	1.00	0.95	1.00		0.95	0.99	1.00
Satd. Flow (perm)	203	4993		569	5085	1583	1770	3513		1522	4763	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	233	789	108	85	1139	416	55	292	15	271	441	47
RTOR Reduction (vph)	0	14	0	0	0	234	0	3	0	0	0	21
Lane Group Flow (vph)	233	883	0	85	1139	182	55	304	0	173	539	26
Turn Type	pm+pt			pm+pt		Perm	Split			Split		Perm
Protected Phases	7	4		3	8		2	2		6	6	
Permitted Phases	4			8		8						6
Actuated Green, G (s)	59.4	59.4		50.1	48.6	48.6	17.6	17.6		26.5	26.5	26.5
Effective Green, g (s)	59.4	59.4		50.1	48.6	48.6	17.6	17.6		26.5	26.5	26.5
Actuated g/C Ratio	0.46	0.46		0.39	0.37	0.37	0.14	0.14		0.20	0.20	0.20
Clearance Time (s)	4.0	5.5		4.0	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	295	2281		275	1901	592	240	476		310	971	323
v/s Ratio Prot	c0.10	0.18		0.01	c0.22		0.03	c0.09		c0.11	0.11	
v/s Ratio Perm	c0.26			0.11		0.12						0.02
v/c Ratio	0.79	0.39		0.31	0.60	0.31	0.23	0.64		0.56	0.56	0.08
Uniform Delay, d1	29.7	23.3		28.9	32.8	28.8	50.1	53.2		46.5	46.5	41.9
Progression Factor	0.62	0.84		1.00	1.00	1.00	1.00	1.00		0.28	0.27	0.17
Incremental Delay, d2	8.0	0.3		0.6	1.4	1.3	2.2	6.5		5.2	1.7	0.3
Delay (s)	26.5	19.9		29.5	34.2	30.2	52.4	59.6		18.0	14.4	7.4
Level of Service	C	B		C	C	C	D	E		B	B	A
Approach Delay (s)		21.2			33.0			58.5			14.8	
Approach LOS		C			C			E			B	

Intersection Summary			
HCM Average Control Delay	28.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	68.3%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	28	2691	119	307	1890	60	14	142	279	164
v/c Ratio	0.30	0.93	0.13	0.97	0.58	0.85	0.19	0.59	0.62	0.66
Control Delay	77.2	13.9	0.9	68.2	0.4	131.0	66.2	29.2	59.2	57.5
Queue Delay	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	77.2	14.8	0.9	68.2	0.4	131.0	66.2	29.2	59.2	57.5
Queue Length 50th (ft)	23	230	0	136	0	51	12	31	117	114
Queue Length 95th (ft)	m28	#957	m5	m#203	0	#138	35	102	154	180
Internal Link Dist (ft)		585			1015		352			692
Turn Bay Length (ft)	270			275		100		350		
Base Capacity (vph)	96	2890	932	317	3261	71	75	240	634	343
Starvation Cap Reductn	0	59	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.29	0.95	0.13	0.97	0.58	0.85	0.19	0.59	0.44	0.48

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	27	2556	113	292	1756	40	57	13	135	265	90	66
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	5.5	5.5	
Lane Util. Factor	1.00	0.91	1.00	0.97	0.91		1.00	1.00	1.00	0.97	1.00	
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85	1.00	0.94	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5085	1583	3433	5068		1770	1863	1583	3433	1745	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	5085	1583	3433	5068		1770	1863	1583	3433	1745	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	28	2691	119	307	1848	42	60	14	142	279	95	69
RTOR Reduction (vph)	0	0	34	0	1	0	0	0	92	0	22	0
Lane Group Flow (vph)	28	2691	85	307	1889	0	60	14	50	279	142	0
Turn Type	Prot		Perm	Prot			Split		Over	Split		
Protected Phases	7	4		3	8		2	2	3	6	6	
Permitted Phases			4									
Actuated Green, G (s)	4.5	71.7	71.7	14.2	81.4		5.2	5.2	14.2	16.9	16.9	
Effective Green, g (s)	4.5	71.7	71.7	14.2	81.4		5.2	5.2	14.2	16.9	16.9	
Actuated g/C Ratio	0.03	0.55	0.55	0.11	0.63		0.04	0.04	0.11	0.13	0.13	
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	5.5	5.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	61	2805	873	375	3173		71	75	173	446	227	
v/s Ratio Prot	0.02	c0.53		c0.09	0.37		c0.03	0.01	0.03	0.08	c0.08	
v/s Ratio Perm			0.05									
v/c Ratio	0.46	0.96	0.10	0.82	0.60		0.85	0.19	0.29	0.63	0.63	
Uniform Delay, d1	61.6	27.8	13.8	56.6	14.5		62.0	60.4	53.3	53.6	53.6	
Progression Factor	1.24	0.34	0.13	0.59	0.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	2.5	5.4	0.1	7.8	0.5		56.7	1.2	0.9	2.7	5.3	
Delay (s)	78.6	14.9	1.9	41.5	0.5		118.7	61.6	54.2	56.3	58.9	
Level of Service	E	B	A	D	A		F	E	D	E	E	
Approach Delay (s)		15.0			6.2			72.6			57.2	
Approach LOS		B			A			E			E	

Intersection Summary			
HCM Average Control Delay	17.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	88.1%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	WBT	WBR	SBL
Lane Group Flow (vph)	3096	2265	238	502
v/c Ratio	1.10	0.80	0.26	0.40
Control Delay	67.9	8.3	1.2	32.3
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	67.9	8.3	1.2	32.3
Queue Length 50th (ft)	~1067	104	6	162
Queue Length 95th (ft)	#1142	117	m9	211
Internal Link Dist (ft)	1015	1000		632
Turn Bay Length (ft)			150	150
Base Capacity (vph)	2816	2816	924	1241
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	1.10	0.80	0.26	0.40

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	2941	2152	226	477	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.5	5.5	5.5	5.5	
Lane Util. Factor		0.91	0.91	1.00	0.97	
Frt		1.00	1.00	0.85	1.00	
Flt Protected		1.00	1.00	1.00	0.95	
Satd. Flow (prot)		5085	5085	1583	3433	
Flt Permitted		1.00	1.00	1.00	0.95	
Satd. Flow (perm)		5085	5085	1583	3433	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	3096	2265	238	502	0
RTOR Reduction (vph)	0	0	0	48	0	0
Lane Group Flow (vph)	0	3096	2265	190	502	0
Turn Type	Prot			Perm		
Protected Phases	7 9	4	8		6	
Permitted Phases				8		
Actuated Green, G (s)		72.0	72.0	72.0	47.0	
Effective Green, g (s)		72.0	72.0	72.0	47.0	
Actuated g/C Ratio		0.55	0.55	0.55	0.36	
Clearance Time (s)		5.5	5.5	5.5	5.5	
Vehicle Extension (s)		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		2816	2816	877	1241	
v/s Ratio Prot		c0.61	0.45		c0.15	
v/s Ratio Perm				0.12		
v/c Ratio		1.10	0.80	0.22	0.40	
Uniform Delay, d1		29.0	23.3	14.7	31.0	
Progression Factor		0.63	0.28	0.10	1.00	
Incremental Delay, d2		47.8	1.6	0.3	1.0	
Delay (s)		66.0	8.2	1.8	32.0	
Level of Service		E	A	A	C	
Approach Delay (s)		66.0	7.6		32.0	
Approach LOS		E	A		C	

Intersection Summary			
HCM Average Control Delay	39.2	HCM Level of Service	D
HCM Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	11.0
Intersection Capacity Utilization	79.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	139	3437	23	73	2412	76	82	131	219
v/c Ratio	0.57	0.97	0.02	0.82	0.78	0.08	0.90	0.82	0.65
Control Delay	36.3	10.0	1.4	116.1	21.3	5.5	119.6	91.3	29.0
Queue Delay	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	36.3	10.3	1.4	116.1	21.3	5.5	119.6	91.3	29.0
Queue Length 50th (ft)	102	219	1	62	526	11	61	109	57
Queue Length 95th (ft)	m102	m154	m1	#154	587	31	#166	#223	146
Internal Link Dist (ft)		1000			893		425		590
Turn Bay Length (ft)	150		150	300		150			
Base Capacity (vph)	245	3540	1106	89	3090	978	91	160	335
Starvation Cap Reductn	0	10	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.57	0.97	0.02	0.82	0.78	0.08	0.90	0.82	0.65

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	132	3265	22	69	2291	72	29	29	19	124	37	171
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5	5.5		5.5		5.5	5.5	
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91	1.00		1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85		0.97		1.00	0.88	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00		0.98		0.95	1.00	
Satd. Flow (prot)	1770	5085	1583	1770	5085	1583		1768		1770	1633	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00		0.36		0.67	1.00	
Satd. Flow (perm)	1770	5085	1583	1770	5085	1583		652		1257	1633	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	139	3437	23	73	2412	76	31	31	20	131	39	180
RTOR Reduction (vph)	0	0	4	0	0	16	0	9	0	0	127	0
Lane Group Flow (vph)	139	3437	19	73	2412	60	0	73	0	131	92	0
Turn Type	Prot		Perm	Prot		Perm	Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8	2			6		
Actuated Green, G (s)	18.0	90.5	90.5	6.5	79.0	79.0		16.5		16.5	16.5	
Effective Green, g (s)	18.0	90.5	90.5	6.5	79.0	79.0		16.5		16.5	16.5	
Actuated g/C Ratio	0.14	0.70	0.70	0.05	0.61	0.61		0.13		0.13	0.13	
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5	5.5		5.5		5.5	5.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0		3.0		3.0	3.0	
Lane Grp Cap (vph)	245	3540	1102	89	3090	962		83		160	207	
v/s Ratio Prot	0.08	c0.68		0.04	c0.47						0.06	
v/s Ratio Perm			0.01			0.04		c0.11		0.10		
v/c Ratio	0.57	0.97	0.02	0.82	0.78	0.06		0.88		0.82	0.44	
Uniform Delay, d1	52.4	18.5	6.1	61.2	19.0	10.4		55.8		55.3	52.5	
Progression Factor	0.67	0.42	0.37	1.00	1.00	1.00		1.00		1.00	1.00	
Incremental Delay, d2	0.3	1.4	0.0	42.9	2.0	0.1		70.1		26.7	1.5	
Delay (s)	35.3	9.2	2.2	104.1	21.1	10.5		125.9		82.0	54.0	
Level of Service	D	A	A	F	C	B		F		F	D	
Approach Delay (s)		10.1			23.1			125.9			64.5	
Approach LOS		B			C			F			E	

Intersection Summary			
HCM Average Control Delay	19.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	102.7%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Appendix B

Freeway Analyses

Appendix B Includes:

B1. Year 2020 Alternative 3 Freeway Peak Hour LOS Worksheets

B2. Year 2040 Alternative 3 Freeway Peak Hour LOS Worksheets

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Appendix B1

Year 2020 Alternative 3
Freeway Level of Service (LOS) Worksheets

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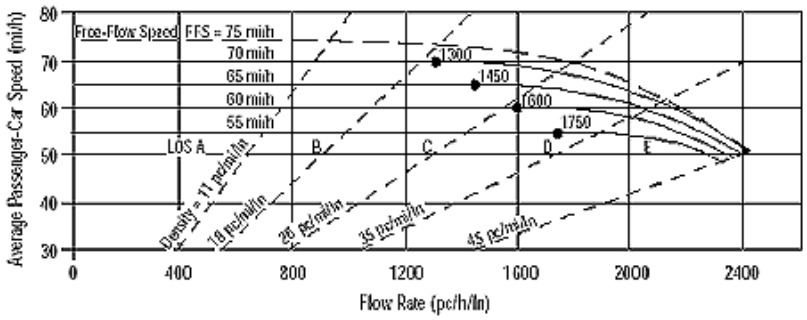
2020 Alternative 3

Freeway Mainline, Ramps, and Ramp-Freeway Junctions and Weaving Level of Service Analysis Worksheets

AM Peak Hour

BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	To Lakewood Blvd off ramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 1

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

Flow Inputs

Volume, V	9910 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	72.6	mi/h	FFS	72.6	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2246	pc/h/ln	Design LOS		
S	59.2	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	37.9	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood Blvd Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 2

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 70.0 mph S_{FR} = 30.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9910	0.90	Level	4	0	0.980	1.00	11231
Ramp	1190	0.90	Level	4	0	0.980	1.00	1349
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 3334 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8985	9600	No
V_{12}	3334	4400:All	No
V_{FO} = V_F - V_R	7636	9600	No
V_R	1349	3800	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 18.5 (pc/ mi /ln)

LOS= B (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.614 (Exhibit 25-19)

S_R= 52.8 mph (Exhibit 25-19)

S_0= 69.7 mph (Exhibit 25-19)

S = 62.3 mph (Exhibit 25-15)

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	Lakewood on - Willow St off
Jurisdiction	
Analysis Year	2020 Alt 3

Inputs

Freeway free-flow speed, SFF (mi/h)	35	Weaving type	A
Weaving number of lanes, N	2	Volume ratio, VR	1.00
Weaving seg length, L (ft)	930	Weaving ratio, R	0.48
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vo2	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vw1	340	0.90	4	0	1.5	1.2	0.980	1.00	385
Vw2	320	0.90	4	0	1.5	1.2	0.980	1.00	362
Vw				747	Vnw				0
V									747

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			2.12	0.42
Weaving and non-weaving speeds, Si (mi/h)			23.01	32.61

Number of lanes required for unconstrained operation, Nw 1.70
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	23.01
Weaving segment density, D (pc/mi/ln)	16.23
Level of service, LOS	B
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 8

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 69.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8720	0.90	Level	4	0	0.980	1.00	9883
Ramp	320	0.90	Level	4	0	0.980	1.00	363
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.555 using Equation 4

V_{12}= 5482 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10246	See Exhibit 25-7	Yes
V_{R12}	5845	4600:All	Yes

Level of Service Determination (if not F)

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

D_R = 43.4 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 1.584 (Exibit 25-19)

S_R= 25.8 mph (Exhibit 25-19)

S_0= 63.7 mph (Exhibit 25-19)

S= 34.6 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	Willow ONR - L Coyotes OFR
Jurisdiction	
Analysis Year	2020 Alt 3

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.18
Weaving seg length, L (ft)	1200	Weaving ratio, R	0.21
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	7663	0.90	4	0	1.5	1.2	0.980	1.00	8684
Vo2	73	0.90	4	0	1.5	1.2	0.980	1.00	82
Vw1	1377	0.90	4	0	1.5	1.2	0.980	1.00	1560
Vw2	377	0.90	4	0	1.5	1.2	0.980	1.00	427
Vw				1987	Vnw				8766
V									10753

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			2.99	0.42
Weaving and non-weaving speeds, Si (mi/h)			28.79	53.86

Number of lanes required for unconstrained operation, Nw 1.49
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	46.39
Weaving segment density, D (pc/mi/ln)	46.36
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	10055
Capacity as a 15-minute flow rate, c (veh/h)	9858
Capacity as a full-hour volume, c_h (veh/h)	8872

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	L Coyotes ONR - BellFl OFR
Jurisdiction	
Analysis Year	2020 Alt 3

Inputs

Freeway free-flow speed, SFF (mi/h)	35	Weaving type	A
Weaving number of lanes, N	2	Volume ratio, VR	1.00
Weaving seg length, L (ft)	650	Weaving ratio, R	0.46
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	fHV	fp	v
Vo1	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vo2	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vw1	110	0.90	4	0	1.5	1.2	0.980	1.00	124
Vw2	130	0.90	4	0	1.5	1.2	0.980	1.00	147
Vw				271	Vnw				0
V									271

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			1.06	0.15
Weaving and non-weaving speeds, Si (mi/h)			27.15	36.80

Number of lanes required for unconstrained operation, Nw 1.47
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	27.15
Weaving segment density, D (pc/mi/ln)	4.99
Level of service, LOS	A
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	L Coyotes ONR - Woodruff OFR
Jurisdiction	
Analysis Year	2020 Alt 3

Inputs

Freeway free-flow speed, SFF (mi/h)	68	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.19
Weaving seg length, L (ft)	1100	Weaving ratio, R	0.44
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	7299	0.90	4	0	1.5	1.2	0.980	1.00	8272
Vo2	39	0.90	4	0	1.5	1.2	0.980	1.00	44
Vw1	741	0.90	4	0	1.5	1.2	0.980	1.00	839
Vw2	941	0.90	4	0	1.5	1.2	0.980	1.00	1066
Vw				1905	Vnw				8316
V									10221

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			3.06	0.42
Weaving and non-weaving speeds, Si (mi/h)			29.29	55.92

Number of lanes required for unconstrained operation, Nw 1.45
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	47.82
Weaving segment density, D (pc/mi/ln)	42.75
Level of service, LOS	E
Capacity of base condition, c_b (pc/h)	10181
Capacity as a 15-minute flow rate, c (veh/h)	9981
Capacity as a full-hour volume, c_h (veh/h)	8983

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Woodruff ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 22

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 69.2 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8250	0.90	Level	4	0	0.980	1.00	9350
Ramp	640	0.90	Level	4	0	0.980	1.00	725
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.191 using Equation 4

V_{12}= 1785 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10075	See Exhibit 25-7	Yes
V_{R12}	2510	4600:All	No

Level of Service Determination (if not F)

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

D_R = 23.5 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.355 (Exibit 25-19)

S_R= 59.5 mph (Exhibit 25-19)

S_0= 53.8 mph (Exhibit 25-19)

S= 55.1 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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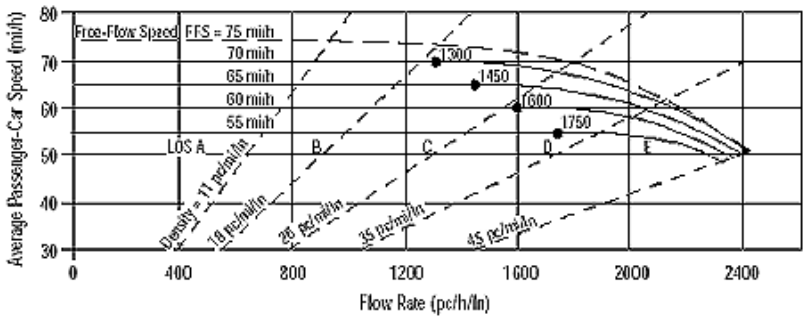
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	Woodruff ONR to Stearns ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 23

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

Flow Inputs

Volume, V	8890 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	68.2	mi/h	FFS	68.2	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2519	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/17/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 SB
Weaving Seg Location	Stearns ONR to Studebaker OFR
Jurisdiction	
Analysis Year	2020 Alt 3

Inputs

Freeway free-flow speed, SFF (mi/h)	69	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.10
Weaving seg length, L (ft)	1100	Weaving ratio, R	0.43
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	8501	0.90	4	0	1.5	1.2	0.980	1.00	9634
Vo2	21	0.90	4	0	1.5	1.2	0.980	1.00	23
Vw1	389	0.90	4	0	1.5	1.2	0.980	1.00	440
Vw2	509	0.90	4	0	1.5	1.2	0.980	1.00	576
Vw				1016	Vnw				9657
V									10673

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.63	0.22		
Weaving and non-weaving speeds, Si (mi/h)	51.18	63.28		

Number of lanes required for unconstrained operation, Nw 0.74
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	61.88
Weaving segment density, D (pc/mi/ln)	34.49
Level of service, LOS	D
Capacity of base condition, c_b (pc/h)	11850
Capacity as a 15-minute flow rate, c (veh/h)	11618
Capacity as a full-hour volume, c_h (veh/h)	10456

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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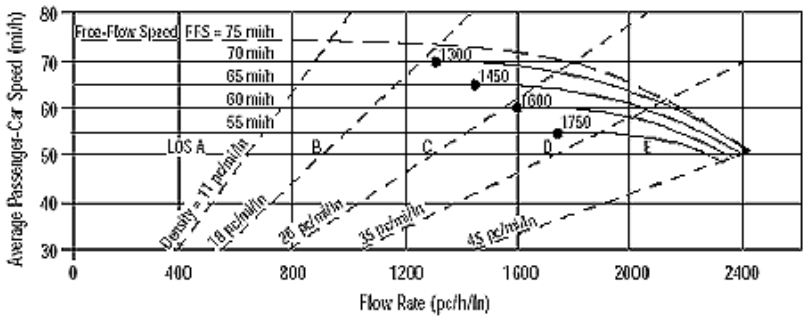
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	Studebaker OFR to 605NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 25

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

Flow Inputs

Volume, V	9000 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	68.9	mi/h	FFS	68.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2040	pc/h/ln	Design LOS		
S	63.3	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	32.2	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	I-605 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 26

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 68.9 mph S_{FR} = 50.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9000	0.90	Level	4	0	0.980	1.00	10200
Ramp	1310	0.90	Level	4	0	0.980	1.00	1485
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 3220 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	8160	9556	No
V_{12}	3220	4400:All	No
$V_{FO} = V_F - V_R$	6675	9556	No
V_R	1485	4100	No

Level of Service Determination (if not F)

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

D_R = 5.8 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.367 (Exhibit 25-19)

S_R= 59.0 mph (Exhibit 25-19)

S_0= 69.9 mph (Exhibit 25-19)

S = 65.1 mph (Exhibit 25-15)

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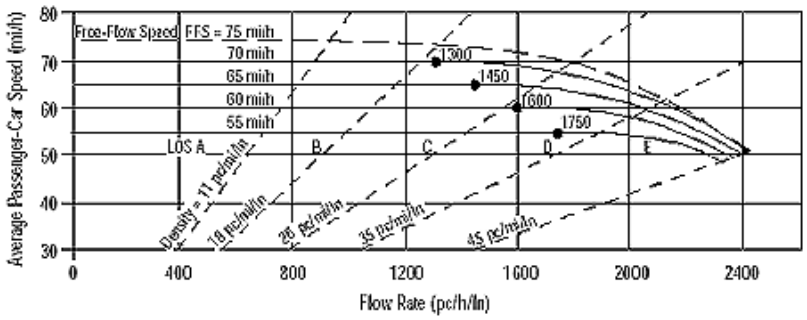
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	I-605 NB OFR to I-605 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 27

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

Flow Inputs

Volume, V	7690 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	68.9	mi/h	FFS	68.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2179	pc/h/ln	Design LOS		
S	60.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	36.3	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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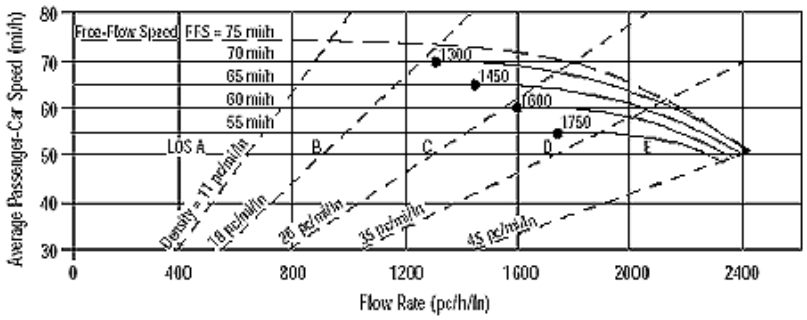
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	I-605 SB OFR to I-605 Sb ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 29

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

Flow Inputs

Volume, V	7600 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	68.9	mi/h	FFS	68.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2153	pc/h/ln	Design LOS		
S	60.7	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	35.5	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	I-605 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 30

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 68.9 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7600	0.90	Level	4	0	0.980	1.00	8613
Ramp	3080	0.90	Level	4	0	0.980	1.00	3491
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.209 using Equation 0

V_{12}= 1800 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	12104	See Exhibit 25-7	Yes
V_{R12}	5291	4600:All	Yes

Level of Service Determination (if not F)

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

D_R = 27.0 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.892 (Exibit 25-19)

S_R= 44.9 mph (Exhibit 25-19)

S_0= 55.7 mph (Exhibit 25-19)

S= 50.4 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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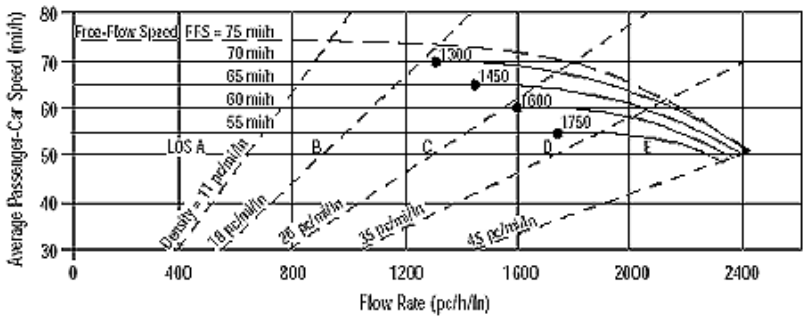
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	I-605 SB ONR to 7th St ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 31

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

Flow Inputs

Volume, V	10680 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	68.9	mi/h	FFS	68.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2421	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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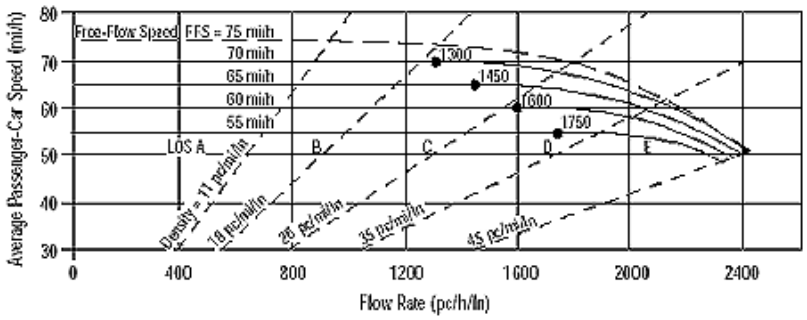
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	to I-605 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 32

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

Flow Inputs

Volume, V	11250 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2550	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	I-605 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 33

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 50.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	11250	0.90	Level	4	0	0.980	1.00	12750
Ramp	3610	0.90	Level	4	0	0.980	1.00	4091
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 5679 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	10200	9000	Yes
V_{12}	5679	4400:All	Yes
$V_{FO} = V_F - V_R$	6109	9000	No
V_R	4091	4100	No

Level of Service Determination (if not F)

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

D_R = 9.9 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

D_s = 0.601 (Exhibit 25-19)

S_R= 47.2 mph (Exhibit 25-19)

S_0= 55.4 mph (Exhibit 25-19)

S = 50.5 mph (Exhibit 25-15)

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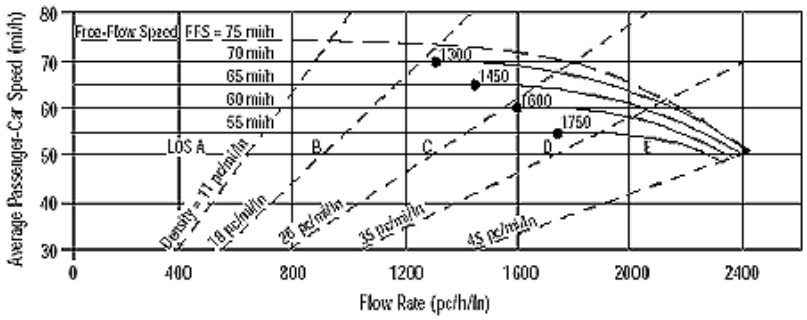
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	I-605 NB OFR to I-605 Sb OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 34

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

Flow Inputs

Volume, V	7640 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2165	pc/h/ln	Design LOS		
S	51.9	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	41.7	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	I-605 SB/NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 35

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 63.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7640	0.90	Level	4	0	0.980	1.00	8659
Ramp	1460	0.90	Level	4	0	0.980	1.00	1655
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.393 using Equation 4

V_{12}= 3405 pc/h

Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10314	See Exhibit 25-7	Yes
V_{R12}	5060	4600:All	Yes

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = 36.7 (pc/ m/ln)

LOS = F (Exhibit 25-4)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.852 (Exibit 25-19)

S_R= 45.2 mph (Exhibit 25-19)

S_0= 55.3 mph (Exhibit 25-19)

S= 49.9 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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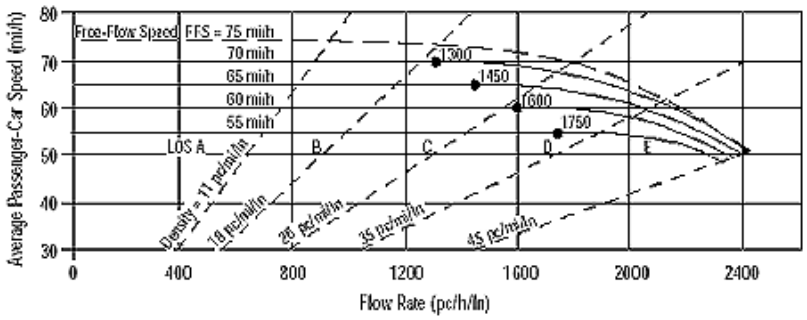
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

General Information		Site Information	
Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	I-605 NB/SB ONR to Studeba ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 36

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

Flow Inputs

Volume, V	9090 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Speed Inputs			Calc Speed Adj and FFS		
Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2576	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Studeb ONR - Palo Verde OFR
Jurisdiction	
Analysis Year	2020 Alt 3

Inputs

Freeway free-flow speed, SFF (mi/h)	55	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.10
Weaving seg length, L (ft)	1700	Weaving ratio, R	0.31
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	33	0.90	4	0	1.5	1.2	0.980	1.00	37
Vo2	8463	0.90	4	0	1.5	1.2	0.980	1.00	9591
Vw1	277	0.90	4	0	1.5	1.2	0.980	1.00	313
Vw2	627	0.90	4	0	1.5	1.2	0.980	1.00	710
Vw				1023	Vnw				9628
V									10651

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.81	0.41		
Weaving and non-weaving speeds, Si (mi/h)	39.88	47.03		

Number of lanes required for unconstrained operation, Nw 1.10
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	46.23
Weaving segment density, D (pc/mi/ln)	46.08
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	10036
Capacity as a 15-minute flow rate, c (veh/h)	9839
Capacity as a full-hour volume, c_h (veh/h)	8855

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Palo Verde ONR to Woodruff OFR
Jurisdiction	
Analysis Year	2020 Alt 3

Inputs

Freeway free-flow speed, SFF (mi/h)	47	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.08
Weaving seg length, L (ft)	1750	Weaving ratio, R	0.24
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	fHV	fp	v
Vo1	30	0.90	4	0	1.5	1.2	0.980	1.00	34
Vo2	8170	0.90	4	0	1.5	1.2	0.980	1.00	9259
Vw1	180	0.90	4	0	1.5	1.2	0.980	1.00	204
Vw2	570	0.90	4	0	1.5	1.2	0.980	1.00	646
Vw				850	Vnw				9293
V									10143

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.74	0.36		
Weaving and non-weaving speeds, Si (mi/h)	36.32	42.29		

Number of lanes required for unconstrained operation, Nw 1.07
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	41.72
Weaving segment density, D (pc/mi/ln)	48.62
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	10070
Capacity as a 15-minute flow rate, c (veh/h)	9873
Capacity as a full-hour volume, c_h (veh/h)	8886

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Woodruff ONR to Bellflower OFR
Jurisdiction	
Analysis Year	2020 Alt 3

Inputs

Freeway free-flow speed, SFF (mi/h)	46	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.11
Weaving seg length, L (ft)	890	Weaving ratio, R	0.47
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	26	0.90	4	0	1.5	1.2	0.980	1.00	29
Vo2	7846	0.90	4	0	1.5	1.2	0.980	1.00	8892
Vw1	444	0.90	4	0	1.5	1.2	0.980	1.00	503
Vw2	494	0.90	4	0	1.5	1.2	0.980	1.00	559
Vw				1062	Vnw				8921
V									9983

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	1.30	0.63		
Weaving and non-weaving speeds, Si (mi/h)	30.64	37.11		

Number of lanes required for unconstrained operation, Nw 1.13
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	36.30
Weaving segment density, D (pc/mi/ln)	55.01
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	9146
Capacity as a 15-minute flow rate, c (veh/h)	8967
Capacity as a full-hour volume, c_h (veh/h)	8070

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/17/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Bellflower ONR to Lakewood OFR
Jurisdiction	
Analysis Year	2020 Alt 3

Inputs

Freeway free-flow speed, SFF (mi/h)	52	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.23
Weaving seg length, L (ft)	1300	Weaving ratio, R	0.43
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	50	0.90	4	0	1.5	1.2	0.980	1.00	56
Vo2	7340	0.90	4	0	1.5	1.2	0.980	1.00	8318
Vw1	1240	0.90	4	0	1.5	1.2	0.980	1.00	1405
Vw2	950	0.90	4	0	1.5	1.2	0.980	1.00	1076
Vw				2481	Vnw				8374
V									10855

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.76	0.41		
Weaving and non-weaving speeds, Si (mi/h)	38.92	44.70		

Number of lanes required for unconstrained operation, Nw 1.61
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	43.23
Weaving segment density, D (pc/mi/ln)	50.22
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	9900
Capacity as a 15-minute flow rate, c (veh/h)	9706
Capacity as a full-hour volume, c_h (veh/h)	8735

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 46

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9370	0.90	Level	4	0	0.980	1.00	10619
Ramp	560	0.90	Level	4	0	0.980	1.00	635
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.298 using Equation 4

V_{12}= 2417 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8754	See Exhibit 25-7	No
V_{R12}	3052	4600:All	No

Level of Service Determination (if not F)

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

D_R = 25.9 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.369 (Exibit 25-19)

S_R= 50.2 mph (Exhibit 25-19)

S_0= 45.2 mph (Exhibit 25-19)

S= 46.8 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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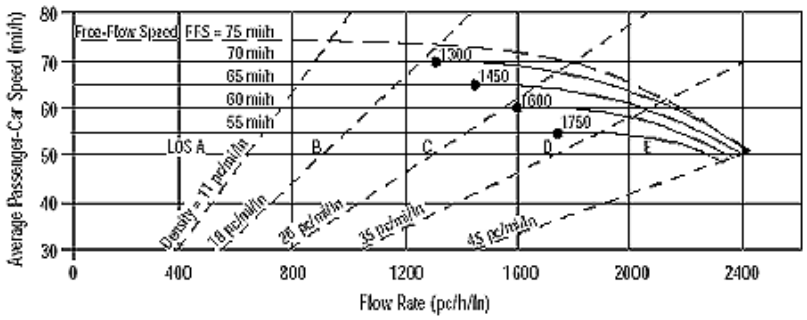
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	Lakewood ONR to
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 47

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

Flow Inputs

Volume, V	9930 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2251	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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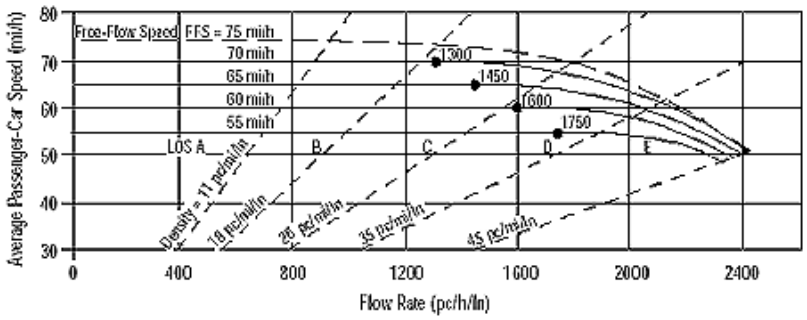
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	to I-40 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 48

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

Flow Inputs

Volume, V	4140 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	2
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2323	pc/h/ln	Design LOS		
S	56.2	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	41.3	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	I-405 OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 49

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	4140	0.90	Level	5	0	0.976	1.00	4715
Ramp	3340	0.90	Level	5	0	0.976	1.00	3804
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 4715 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	4715	4500	Yes
V_{12}	4715	4400:All	Yes
$V_{FO} = V_F - V_R$	911	4500	No
V_R	3804	3800	Yes

Level of Service Determination (if not F)

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

D_R = 25.9 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

D_s = 0.770 (Exhibit 25-19)

S_R= 45.0 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 45.0 mph (Exhibit 25-15)

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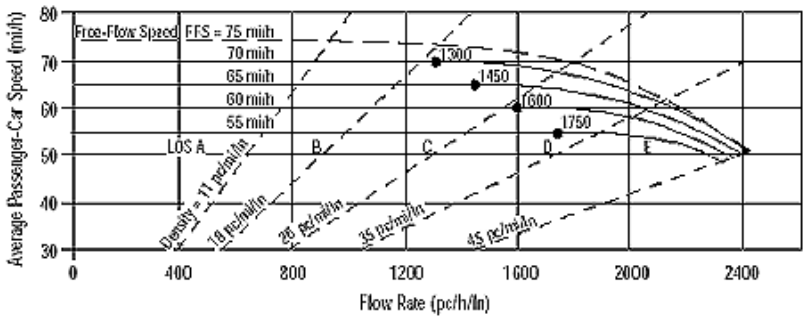
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 SB OFR to I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 50

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

Flow Inputs

Volume, V	530 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	60.0	mi/h	FFS	60.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	302	pc/h/ln	Design LOS		
S	60.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	5.0	pc/mi/ln	S		mi/h
LOS	A		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 51

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 68.8 mph S_{FR} = 50.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	530	0.90	Level	5	0	0.976	1.00	604
Ramp	720	0.90	Level	5	0	0.976	1.00	820
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 604 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	604	4775	No
V_{12}	604	4400:All	No
$V_{FO} = V_F - V_R$	-216	4775	No
V_R	820	2100	No

Level of Service Determination (if not F)

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

D_R = -0.5 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.307 (Exhibit 25-19)

S_R= 60.6 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 60.6 mph (Exhibit 25-15)

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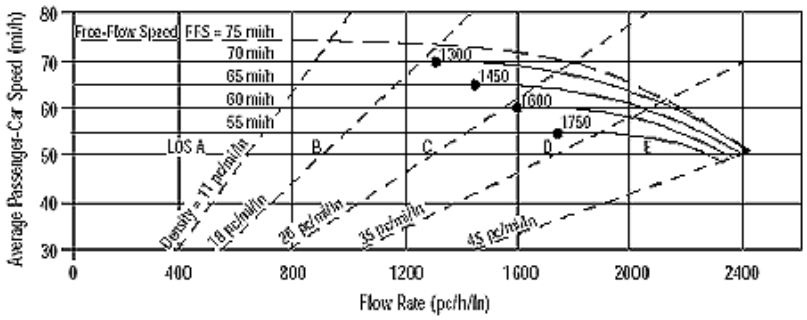
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 NB OFR to I-405 NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 52

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

Flow Inputs

Volume, V	100 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	68.8	mi/h	FFS	68.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	57	pc/h/ln	Design LOS		
S	68.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	0.8	pc/mi/ln	S		mi/h
LOS	A		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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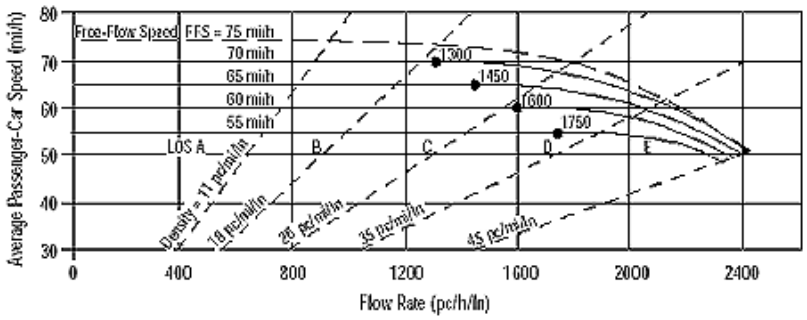
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 NB ONR to I-405 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 54

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

Flow Inputs

Volume, V	3610 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	68.8	mi/h	FFS	68.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1028	pc/h/ln	Design LOS		
S	68.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	14.9	pc/mi/ln	S		mi/h
LOS	B		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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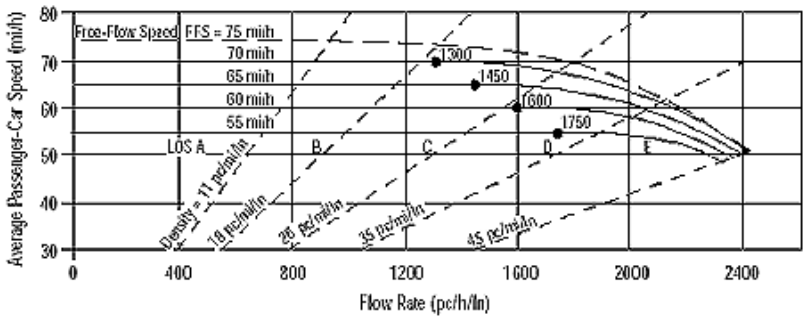
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 SB ONR to Willow St OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 56

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

Flow Inputs

Volume, V	5010 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	68.8	mi/h	FFS	68.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1141	pc/h/ln	Design LOS		
S	68.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	16.6	pc/mi/ln	S		mi/h
LOS	B		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Willow St OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 57

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 68.8 mph S_{FR} = 40.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	5010	0.90	Level	5	0	0.976	1.00	5706
Ramp	1070	0.90	Level	5	0	0.976	1.00	1219
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 2803 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	4851	9552	No
V_{12}	2803	4400:All	No
$V_{FO} = V_F - V_R$	3632	9552	No
V_R	1219	2100	No

Level of Service Determination (if not F)

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

D_R = -0.4 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.473 (Exhibit 25-19)

S_R= 56.1 mph (Exhibit 25-19)

S_0= 75.4 mph (Exhibit 25-19)

S = 62.9 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Willow St ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 59

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	3940	0.90	Level	5	0	0.976	1.00	4487
Ramp	1040	0.90	Level	5	0	0.976	1.00	1184
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.253 using Equation 4

V_{12}= 1135 pc/h

Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	5671	See Exhibit 25-7	No
V_{R12}	2319	4600:All	No

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = 19.4 (pc/ m/ln)

LOS = B (Exhibit 25-4)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.320 (Exibit 25-19)

S_R= 61.0 mph (Exhibit 25-19)

S_0= 65.8 mph (Exhibit 25-19)

S= 63.7 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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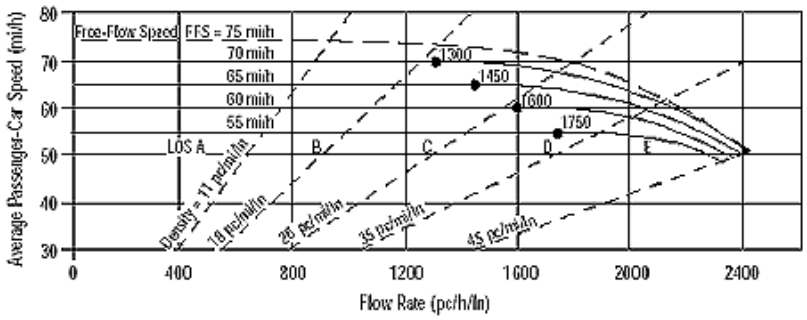

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	Willow St ONR to Cerritos ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 60

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

Flow Inputs

Volume, V	4990 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1421	pc/h/ln	Design LOS		
S	69.9	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	20.3	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Cerritos Ave ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 61

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 66.1 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	4990	0.90	Level	5	0	0.976	1.00	5683
Ramp	760	0.90	Level	5	0	0.976	1.00	866
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.173 using Equation 4

V_{12}= 985 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	6549	See Exhibit 25-7	No
V_{R12}	1851	4600:All	No

Level of Service Determination (if not F)

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

D_R = 18.3 (pc/ m/ln)

LOS = B (Exhibit 25-4)

Speed Estimation

M_S = 0.332 (Exibit 25-19)

S_R= 58.1 mph (Exhibit 25-19)

S_0= 59.3 mph (Exhibit 25-19)

S= 58.9 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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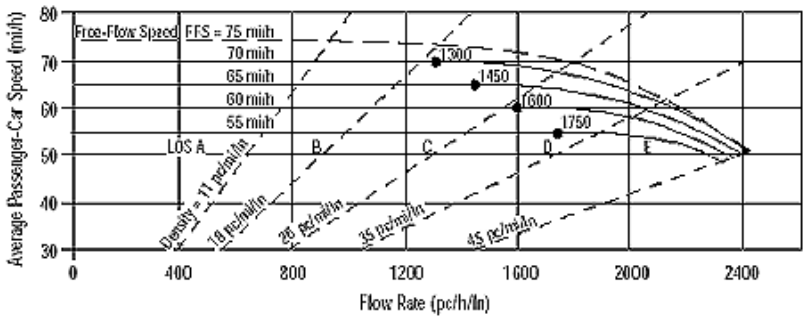

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	Cerritos ONR to
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 62

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

Flow Inputs

Volume, V	5740 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	65.5	mi/h	FFS	65.5	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1634	pc/h/ln	Design LOS	
S	65.3	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
D = v_p / S	25.0	pc/mi/ln	S	mi/h
LOS	C		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Carson OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 63

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 65.5 mph S_{FR} = 35.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	5740	0.90	Level	5	0	0.976	1.00	6537
Ramp	1020	0.90	Level	5	0	0.976	1.00	1162
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3505 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	6537	9420	No
V_{12}	3505	4400:All	No
$V_{FO} = V_F - V_R$	5375	9420	No
V_R	1162	2000	No

Level of Service Determination (if not F)

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

D_R = 31.7 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

D_s = 0.533 (Exhibit 25-19)

S_R= 53.0 mph (Exhibit 25-19)

S_0= 69.8 mph (Exhibit 25-19)

S = 59.7 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 65

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 61.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	4720	0.90	Level	5	0	0.976	1.00	5376
Ramp	430	0.90	Level	5	0	0.976	1.00	490
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.340 using Equation 4

V_{12}= 1826 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	5866	See Exhibit 25-7	No
V_{R12}	2316	4600:All	No

Level of Service Determination (if not F)

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

D_R = 19.7 (pc/ m/ln)

LOS = B (Exhibit 25-4)

Speed Estimation

M_S = 0.320 (Exibit 25-19)

S_R= 54.9 mph (Exhibit 25-19)

S_0= 56.4 mph (Exhibit 25-19)

S= 55.8 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 68

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 67.6 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	6960	0.90	Level	5	0	0.976	1.00	7927
Ramp	500	0.90	Level	5	0	0.976	1.00	569
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.226 using Equation 4

V_{12}= 1794 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8496	See Exhibit 25-7	No
V_{R12}	2363	4600:All	No

Level of Service Determination (if not F)

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

D_R = 22.1 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.345 (Exibit 25-19)

S_R= 58.8 mph (Exhibit 25-19)

S_0= 56.5 mph (Exhibit 25-19)

S= 57.1 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 70

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 66.1 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7460	0.90	Level	5	0	0.976	1.00	8496
Ramp	280	0.90	Level	5	0	0.976	1.00	319
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.242 using Equation 4

V_{12}= 2053 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8815	See Exhibit 25-7	No
V_{R12}	2372	4600:All	No

Level of Service Determination (if not F)

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

D_R = 22.6 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.349 (Exibit 25-19)

S_R= 57.7 mph (Exhibit 25-19)

S_0= 54.0 mph (Exhibit 25-19)

S= 55.0 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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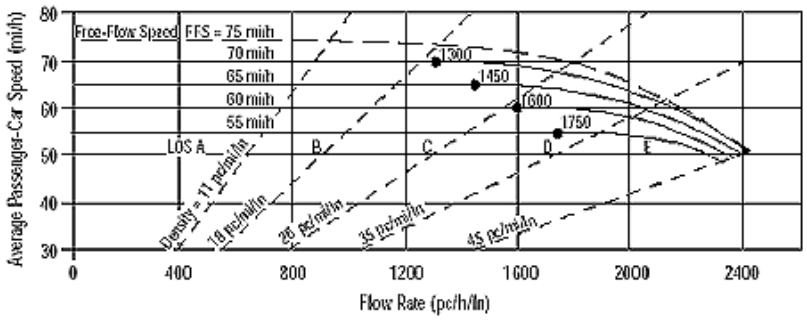
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Carson ONR to 5 lane section
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 71

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

Flow Inputs

Volume, V	7730 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	67.9	mi/h	FFS	67.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2201	pc/h/ln	Design LOS	
S	58.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
D = v_p / S	37.4	pc/mi/ln	S	mi/h
LOS	E		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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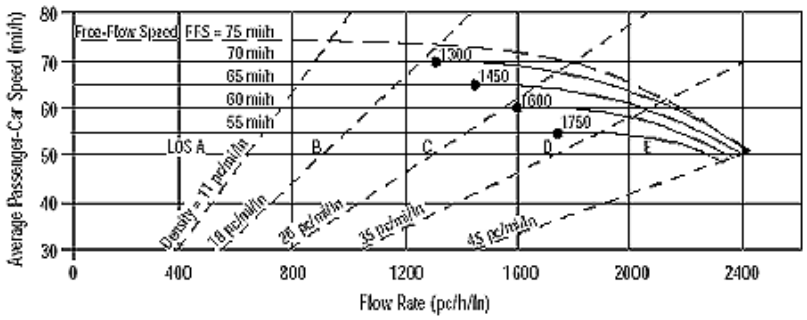
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	5 lane section to Spring OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 72

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

Flow Inputs

Volume, V	7730 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	67.9	mi/h	FFS	67.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1761	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	66.6	mi/h	S	mi/h
D = v_p / S	26.4	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	D		Required Number of Lanes, N	

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Spring OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 73

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 67.9 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	7730	0.90	Level	5	0	0.976	1.00	8804
Ramp	1070	0.90	Level	5	0	0.976	1.00	1219
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3759 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	7044	9516	No
V_{12}	3759	4400:All	No
$V_{FO} = V_F - V_R$	5825	9516	No
V_R	1219	2000	No

Level of Service Determination (if not F)

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

D_R = 34.8 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

D_s = 0.603 (Exhibit 25-19)

S_R= 52.3 mph (Exhibit 25-19)

S_0= 72.0 mph (Exhibit 25-19)

S = 59.9 mph (Exhibit 25-15)

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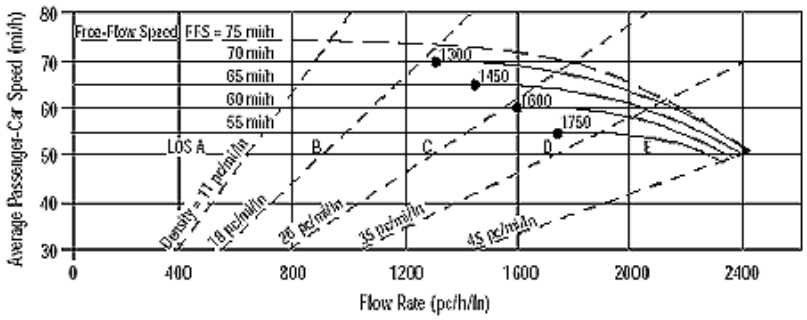
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Spring OFR to Willow OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 74

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

Flow Inputs

Volume, V	6670 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1899	pc/h/ln	Design LOS		
S	66.6	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	28.5	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Willow OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 75

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 66.2 mph S_{FR} = 30.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	6670	0.90	Level	5	0	0.976	1.00	7596
Ramp	530	0.90	Level	5	0	0.976	1.00	604
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3653 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	7596	9447	No
V_{12}	3653	4400:All	No
V_{FO} = V_F - V_R	6992	9447	No
V_R	604	2000	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 33.7 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.547 (Exhibit 25-19)

S_R= 53.0 mph (Exhibit 25-19)

S_0= 68.8 mph (Exhibit 25-19)

S = 60.2 mph (Exhibit 25-15)

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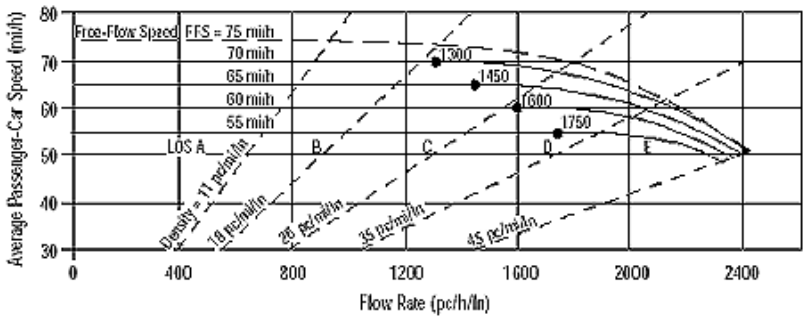
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

General Information		Site Information	
Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Willow OFR to Willow OFR CD
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 76

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

Flow Inputs

Volume, V	6140 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Speed Inputs			Calc Speed Adj and FFS		
Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	66.2	mi/h	FFS	66.2	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1748	pc/h/ln	Design LOS		
S	65.3	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	26.8	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Willow OFR CD
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 77

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 63.9 mph S_{FR} = 30.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	6140	0.90	Level	5	0	0.976	1.00	6993
Ramp	1070	0.90	Level	5	0	0.976	1.00	1219
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3736 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	6993	9356	No
V_{12}	3736	4400:All	No
$V_{FO} = V_F - V_R$	5774	9356	No
V_R	1219	2000	No

Level of Service Determination (if not F)

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

D_R = 34.4 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

D_s = 0.603 (Exhibit 25-19)

S_R= 50.7 mph (Exhibit 25-19)

S_0= 67.6 mph (Exhibit 25-19)

S = 57.4 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Willow ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 79

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 63.9 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	5070	0.90	Level	5	0	0.976	1.00	5774
Ramp	590	0.90	Level	5	0	0.976	1.00	672
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.421 using Equation 4

V_{12}= 2428 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	6446	See Exhibit 25-7	No
V_{R12}	3100	4600:All	No

Level of Service Determination (if not F)

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

D_R = 23.7 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.345 (Exibit 25-19)

S_R= 56.4 mph (Exhibit 25-19)

S_0= 59.7 mph (Exhibit 25-19)

S= 58.0 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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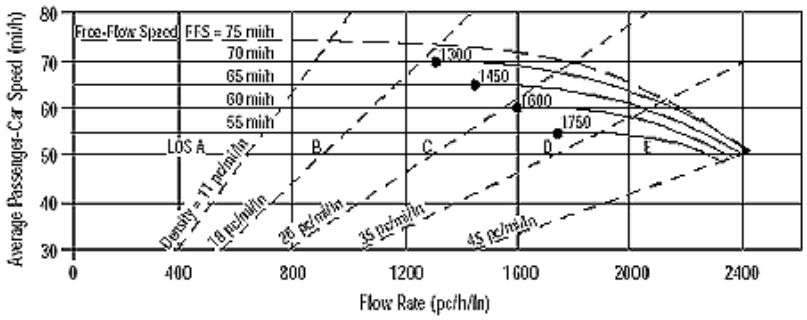

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information		***Site Information***	
Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Willow ONR CD to I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 84

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

Flow Inputs			
Volume, V	5660 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

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

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	66.5	mi/h	FFS	66.5	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures			**Design (N)**		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1612	pc/h/ln	Design LOS		
S	66.2	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	24.3	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary		**Factor Location**	
N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 85

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 66.5 mph S_{FR} = 50.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	5660	0.90	Level	5	0	0.976	1.00	6446
Ramp	790	0.90	Level	5	0	0.976	1.00	900
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3318 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	6446	9460	No
V_{12}	3318	4400:All	No
$V_{FO} = V_F - V_R$	5546	9460	No
V_R	900	2100	No

Level of Service Determination (if not F)

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

D_R = 30.3 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

D_s = 0.314 (Exhibit 25-19)

S_R= 58.8 mph (Exhibit 25-19)

S_0= 70.8 mph (Exhibit 25-19)

S = 64.1 mph (Exhibit 25-15)

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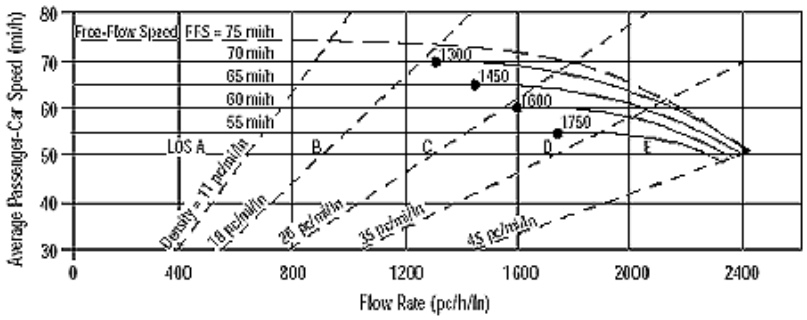

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	I-405 NB OFR to I-405 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 86

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

Flow Inputs

Volume, V	4860 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1384	pc/h/ln	Design LOS		
S	70.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	19.8	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	I-405 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 87

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 66.5 mph S_{FR} = 66.5 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	4860	0.90	Level	5	0	0.976	1.00	5535
Ramp	3080	0.90	Level	5	0	0.976	1.00	3508
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 4035 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	5535	9460	No
V_{12}	4035	4400:All	No
V_{FO} = V_F - V_R	2027	9460	No
V_R	3508	4400	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = -47.4 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.334 (Exhibit 25-19)

S_R= 58.3 mph (Exhibit 25-19)

S_0= 73.0 mph (Exhibit 25-19)

S = 61.7 mph (Exhibit 25-15)

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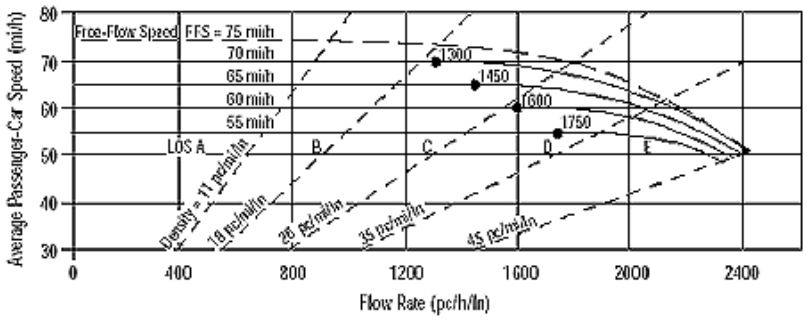
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	I-405 SB OFR to I-405 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 88 coded as 2 lanes, double volume

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

Flow Inputs

Volume, V	3840 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	66.5	mi/h	FFS	66.5	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2187	pc/h/ln	Design LOS		
S	58.3	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	37.5	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	I-405 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 89 coded as 2 lanes, double volume

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 66.5 mph S_{FR} = 50.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	3840	0.90	Level	5	0	0.976	1.00	4373
Ramp	90	0.90	Level	5	0	0.976	1.00	103
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 4373 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4476	See Exhibit 25-7	No
V_{R12}	4476	4600:All	No

Level of Service Determination (if not F)

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

D_R = 38.1 (pc/ m/ln)

LOS = E (Exhibit 25-4)

Speed Estimation

M_S = 0.629 (Exibit 25-19)

S_R= 51.1 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 51.1 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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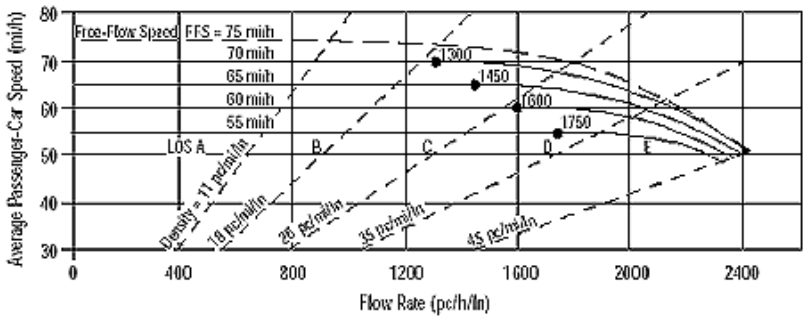
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	I-405 SB ONR to I-405 NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 90 coded as 2 lanes, double volume

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

Flow Inputs

Volume, V	4040 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	66.5	mi/h	FFS	66.5	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2301	pc/h/ln	Design LOS		
S	54.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	42.0	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	7th St WB
Agency or Company	Parsons	Junction	I-405 NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 91 coded for ramp being the mainline

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 55.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	1940	0.90	Level	2	0	0.990	1.00	2177
Ramp	2020	0.90	Level	2	0	0.990	1.00	2267
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 2177 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4444	See Exhibit 25-7	No
V_{R12}	4444	4600:All	No

Level of Service Determination (if not F)

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

D_R = 37.5 (pc/ m/ln)

LOS = E (Exhibit 25-4)

Speed Estimation

M_S = 0.625 (Exibit 25-19)

S_R= 46.9 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 46.9 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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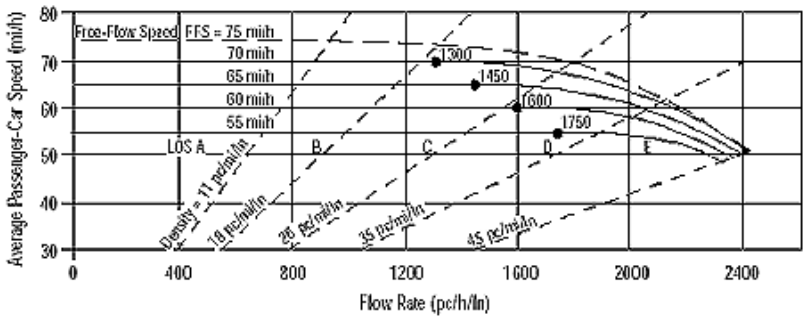

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	7th St WB
Agency or Company	Parsons	From/To	I-405 NB ONR to StudeB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 92

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

Flow Inputs

Volume, V	4120 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	2
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2312	pc/h/ln	Design LOS		
S	56.6	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	40.9	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	7th St WB
Agency or Company	Parsons	Junction	StudeB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 95

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	3270	0.90	Level	2	0	0.990	1.00	3670
Ramp	540	0.90	Level	2	0	0.990	1.00	606
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 3670 pc/h

Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4276	See Exhibit 25-7	No
V_{R12}	4276	4600:All	No

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = 29.1 (pc/ m/ln)

LOS = D (Exhibit 25-4)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.497 (Exibit 25-19)

S_R= 48.5 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 48.5 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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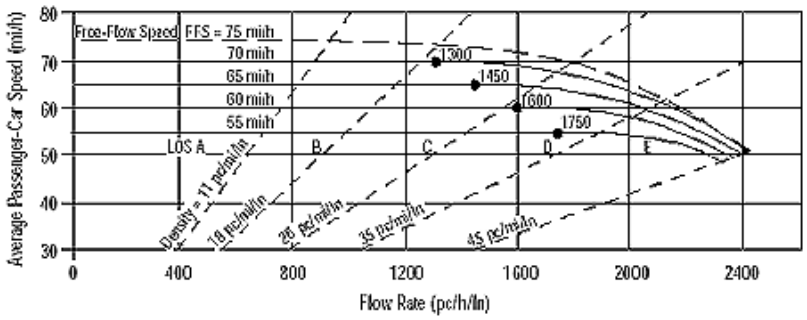
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	7th St WB
Agency or Company	Parsons	From/To	StudeB ONR to
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 96

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

Flow Inputs

Volume, V	3860 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	2
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	3		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1444	pc/h/ln	Design LOS		
S	69.9	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	20.7	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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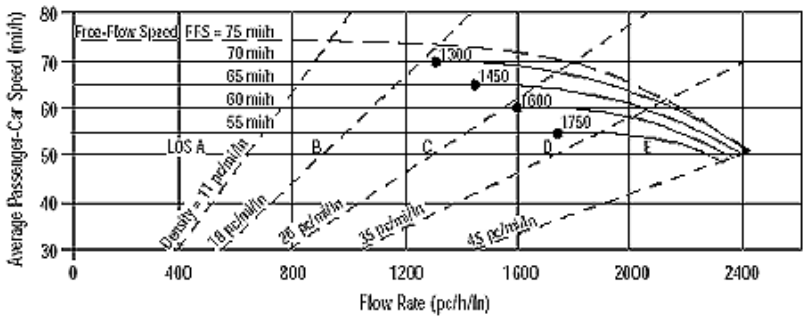
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	7th St EB
Agency or Company	Parsons	From/To	to StudeB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 97

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

Flow Inputs

Volume, V	2950 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	2
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	3		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1104	pc/h/ln	Design LOS		
S	70.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	15.8	pc/mi/ln	S		mi/h
LOS	B		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	7th St EB
Agency or Company	Parsons	Junction	Studebaker OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 98

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 55.0 mph S_{FR} = 30.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	2950	0.90	Level	5	0	0.976	1.00	3360
Ramp	130	0.90	Level	5	0	0.976	1.00	148
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =1.000 using Equation 0
V_{12}= pc/h	V_{12} = 3360 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	3360	4500	No
V_{12}	3360	4400:All	No
V_{FO} = V_F - V_R	3212	4500	No
V_R	148	2000	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 32.0 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.506 (Exhibit 25-19)

S_R= 48.4 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 48.4 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	7th St EB
Agency or Company	Parsons	Junction	StudeB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 100

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	2810	0.90	Level	2	0	0.990	1.00	3153
Ramp	1230	0.90	Level	2	0	0.990	1.00	1380
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 3153 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4533	See Exhibit 25-7	Yes
V_{R12}	4533	4600:All	No

Level of Service Determination (if not F)

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

D_R = 37.7 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.656 (Exibit 25-19)

S_R= 46.5 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 46.5 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Lakewood Blvd Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 101

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 55.0 mph S_{FR} = 20.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9580	0.90	Level	4	0	0.980	1.00	10857
Ramp	1000	0.90	Level	4	0	0.980	1.00	1133
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 3097 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8686	9000	No
V_{12}	3097	4400:All	No
V_{FO} = V_F - V_R	7553	9000	No
V_R	1133	3500	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 14.7 (pc/ mi /ln)

LOS= B (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.725 (Exhibit 25-19)

S_R= 45.6 mph (Exhibit 25-19)

S_0= 53.3 mph (Exhibit 25-19)

S = 50.3 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Woodruff Ave Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 102

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 45.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	8950	0.90	Level	4	0	0.980	1.00	10143
Ramp	600	0.90	Level	4	0	0.980	1.00	680
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3922 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8115	9000	No
V_{12}	3922	4400:All	No
V_{FO} = V_F - V_R	7435	9000	No
V_R	680	2100	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 24.5 (pc/ mi /ln)

LOS= C (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.359 (Exhibit 25-19)

S_R= 50.3 mph (Exhibit 25-19)

S_0= 56.1 mph (Exhibit 25-19)

S = 53.1 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Woodruff Ave Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 103

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 68.0 mph S_{FR} = 25.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9030	0.90	Level	4	0	0.980	1.00	10234
Ramp	780	0.90	Level	4	0	0.980	1.00	884
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4069 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8188	9520	No
V_{12}	4069	4400:All	No
V_{FO} = V_F - V_R	7304	9520	No
V_R	884	1900	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 30.2 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.638 (Exhibit 25-19)

S_R= 51.4 mph (Exhibit 25-19)

S_0= 70.5 mph (Exhibit 25-19)

S = 59.5 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Bellflower Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 104

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 55.0 mph S_{FR} = 20.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	8810	0.90	Level	4	0	0.980	1.00	9985
Ramp	520	0.90	Level	4	0	0.980	1.00	589
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3815 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	7988	9000	No
V_{12}	3815	4400:All	No
V_{FO} = V_F - V_R	7399	9000	No
V_R	589	1900	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 28.1 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.676 (Exhibit 25-19)

S_R= 46.2 mph (Exhibit 25-19)

S_0= 56.1 mph (Exhibit 25-19)

S = 50.9 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Bellflower Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 105

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 65.3 mph S_{FR} = 35.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9490	0.90	Level	4	0	0.980	1.00	10755
Ramp	1450	0.90	Level	4	0	0.980	1.00	1643
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 3453 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	8604	9412	No
V_{12}	3453	4400:All	No
$V_{FO} = V_F - V_R$	6961	9412	No
V_R	1643	3800	No

Level of Service Determination (if not F)

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

D_R = 17.7 (pc/ mi /ln)

LOS= B (Exhibit 25-4)

Speed Estimation

D_s = 0.576 (Exhibit 25-19)

S_R= 51.9 mph (Exhibit 25-19)

S_0= 65.5 mph (Exhibit 25-19)

S = 59.3 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Palo Verde Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 106

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 20.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9400	0.90	Level	4	0	0.980	1.00	10653
Ramp	660	0.90	Level	4	0	0.980	1.00	748
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4138 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8523	9000	No
V_{12}	4138	4400:All	No
V_{FO} = V_F - V_R	7775	9000	No
V_R	748	1900	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 25.4 (pc/ mi /ln)

LOS= C (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.690 (Exhibit 25-19)

S_R= 46.0 mph (Exhibit 25-19)

S_0= 55.7 mph (Exhibit 25-19)

S = 50.5 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Studebaker Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 107

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 68.5 mph S_{FR} = 25.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9410	0.90	Level	4	0	0.980	1.00	10665
Ramp	410	0.90	Level	4	0	0.980	1.00	465
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3982 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8532	9540	No
V_{12}	3982	4400:All	No
V_{FO} = V_F - V_R	8067	9540	No
V_R	465	1900	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 36.2 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.600 (Exhibit 25-19)

S_R= 52.6 mph (Exhibit 25-19)

S_0= 70.2 mph (Exhibit 25-19)

S = 60.7 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	7th Street OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 108

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 68.9 mph S_{FR} = 45.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	7690	0.90	Level	4	0	0.980	1.00	8715
Ramp	90	0.90	Level	4	0	0.980	1.00	102
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3857 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8715	9556	No
V_{12}	3857	4400:All	No
V_{FO} = V_F - V_R	8613	9556	No
V_R	102	2100	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 35.6 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.307 (Exhibit 25-19)

S_R= 60.6 mph (Exhibit 25-19)

S_0= 70.0 mph (Exhibit 25-19)

S = 65.5 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Carson OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 109

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 67.6 mph S_{FR} = 25.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	8180	0.90	Level	5	0	0.976	1.00	9316
Ramp	1220	0.90	Level	5	0	0.976	1.00	1389
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 2966 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	7453	9503	No
V_{12}	2966	4400:All	No
V_{FO} = V_F - V_R	6064	9503	No
V_R	1389	3500	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 13.6 (pc/ mi /ln)

LOS= B (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.683 (Exhibit 25-19)

S_R= 50.1 mph (Exhibit 25-19)

S_0= 69.3 mph (Exhibit 25-19)

S = 60.1 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	7th St WB
Agency or Company	Parsons	Junction	Studebaker OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 110

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	4120	0.90	Level	5	0	0.976	1.00	4692
Ramp	780	0.90	Level	5	0	0.976	1.00	888
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =1.000 using Equation 0
V_{12}= pc/h	V_{12} = 4692 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	4692	4500	Yes
V_{12}	4692	4400:All	Yes
V_{FO} = V_F - V_R	3804	4500	No
V_R	888	2000	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 42.6 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.573 (Exhibit 25-19)

S_R= 47.6 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 47.6 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Willow ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 111

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 61.6 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9040	0.90	Level	4	0	0.980	1.00	10245
Ramp	450	0.90	Level	4	0	0.980	1.00	510
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.250 using Equation 4

V_{12}= 1933 pc/h

Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8255	See Exhibit 25-7	No
V_{R12}	2443	4600:All	No

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = 22.4 (pc/ m/ln)

LOS = C (Exhibit 25-4)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.345 (Exibit 25-19)

S_R= 54.8 mph (Exhibit 25-19)

S_0= 51.4 mph (Exhibit 25-19)

S= 52.4 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 112

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8580	0.90	Level	4	0	0.980	1.00	9724
Ramp	790	0.90	Level	4	0	0.980	1.00	895
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.584 using Equation 4

V_{12}= 5677 pc/h

Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10619	See Exhibit 25-7	Yes
V_{R12}	6572	4600:All	Yes

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = 46.9 (pc/ m/ln)

LOS = F (Exhibit 25-4)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 3.004 (Exibit 25-19)

S_R= 16.0 mph (Exhibit 25-19)

S_0= 49.5 mph (Exhibit 25-19)

S= 21.5 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Bellflower ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 113

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8290	0.90	Level	4	0	0.980	1.00	9395
Ramp	1290	0.90	Level	4	0	0.980	1.00	1462
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.209 using Equation 0

V_{12}= 1964 pc/h

Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10857	See Exhibit 25-7	Yes
V_{R12}	3426	4600:All	No

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = 15.2 (pc/ m/ln)

LOS = F (Exhibit 25-4)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.259 (Exibit 25-19)

S_R= 51.6 mph (Exhibit 25-19)

S_0= 40.0 mph (Exhibit 25-19)

S= 43.0 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Bellflower ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 114

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 66.7 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8040	0.90	Level	4	0	0.980	1.00	9112
Ramp	980	0.90	Level	4	0	0.980	1.00	1111
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.397 using Equation 4

V_{12}= 3622 pc/h

Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10223	See Exhibit 25-7	Yes
V_{R12}	4733	4600:All	Yes

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = 35.6 (pc/ m/ln)

LOS = F (Exhibit 25-4)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.694 (Exibit 25-19)

S_R= 49.6 mph (Exhibit 25-19)

S_0= 57.5 mph (Exhibit 25-19)

S= 53.5 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Woodruff ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 115

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	8340	0.90	Level	4	0	0.980	1.00	9452
Ramp	470	0.90	Level	4	0	0.980	1.00	533
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.438 using Equation 4

V_{12}= 4139 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9985	See Exhibit 25-7	Yes
V_{R12}	4672	4600:All	Yes

Level of Service Determination (if not F)

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

D_R = 36.0 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.675 (Exibit 25-19)

S_R= 46.2 mph (Exhibit 25-19)

S_0= 46.3 mph (Exhibit 25-19)

S= 46.3 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Palo Verde ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 116

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8740	0.90	Level	4	0	0.980	1.00	9905
Ramp	210	0.90	Level	4	0	0.980	1.00	238
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.761 using Equation 4

V_{12}= 7542 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10143	See Exhibit 25-7	Yes
V_{R12}	7780	4600:All	Yes

Level of Service Determination (if not F)

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

D_R = 54.8 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 9.525 (Exibit 25-19)

S_R= -68.8 mph (Exhibit 25-19)

S_0= 52.5 mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Stearns ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 117

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 68.2 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8890	0.90	Level	4	0	0.980	1.00	10075
Ramp	530	0.90	Level	4	0	0.980	1.00	601
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.238 using Equation 4

V_{12}= 2400 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10676	See Exhibit 25-7	Yes
V_{R12}	3001	4600:All	No

Level of Service Determination (if not F)

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

D_R = 26.7 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.378 (Exibit 25-19)

S_R= 58.3 mph (Exhibit 25-19)

S_0= 52.4 mph (Exhibit 25-19)

S= 54.0 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Studebaker ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 118

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9090	0.90	Level	4	0	0.980	1.00	10302
Ramp	310	0.90	Level	4	0	0.980	1.00	351
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.747 using Equation 4

V_{12}= 7699 pc/h

Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10653	See Exhibit 25-7	Yes
V_{R12}	8050	4600:All	Yes

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = 56.8 (pc/ m/ln)

LOS = F (Exhibit 25-4)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 12.417 (Exibit 25-19)

S_R= -106.4 mph (Exhibit 25-19)

S_0= 52.1 mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 119

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 59.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	5150	0.90	Level	5	0	0.976	1.00	5865
Ramp	770	0.90	Level	5	0	0.976	1.00	877
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.236 using Equation 4

V_{12}= 1382 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	6742	See Exhibit 25-7	No
V_{R12}	2259	4600:All	No

Level of Service Determination (if not F)

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

D_R = 20.2 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.330 (Exibit 25-19)

S_R= 53.9 mph (Exhibit 25-19)

S_0= 53.5 mph (Exhibit 25-19)

S= 53.7 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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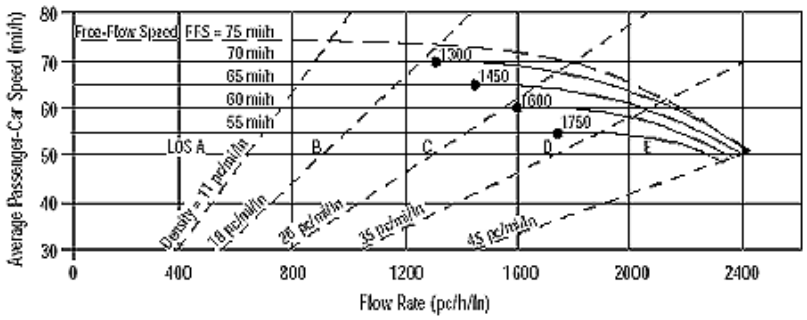
PM Peak Hour

BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	To Lakewood Blvd off ramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 1

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

Flow Inputs

Volume, V	10290 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2332	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood Blvd Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 2

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	10290	0.90	Level	4	0	0.980	1.00	11662
Ramp	1370	0.90	Level	4	0	0.980	1.00	1553
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 3575 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	9330	9000	Yes
V_{12}	3575	4400:All	No
V_{FO} = V_F - V_R	7777	9000	No
V_R	1553	3800	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 20.6 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.633 (Exhibit 25-19)

S_R= 46.8 mph (Exhibit 25-19)

S_0= 53.0 mph (Exhibit 25-19)

S = 50.4 mph (Exhibit 25-15)

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	Lakewood on - Willow St off
Jurisdiction	
Analysis Year	2020 Alt 3

Inputs

Freeway free-flow speed, SFF (mi/h)	35	Weaving type	A
Weaving number of lanes, N	2	Volume ratio, VR	1.00
Weaving seg length, L (ft)	930	Weaving ratio, R	0.41
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vo2	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vw1	350	0.90	4	0	1.5	1.2	0.980	1.00	396
Vw2	510	0.90	4	0	1.5	1.2	0.980	1.00	578
Vw				974	Vnw				0
V									974

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			2.74	0.59
Weaving and non-weaving speeds, Si (mi/h)			21.68	30.70

Number of lanes required for unconstrained operation, Nw 1.74
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	21.68
Weaving segment density, D (pc/mi/ln)	22.47
Level of service, LOS	C
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 8

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8930	0.90	Level	4	0	0.980	1.00	10121
Ramp	410	0.90	Level	4	0	0.980	1.00	465
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.542 using Equation 4

V_{12}= 5485 pc/h

Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10586	See Exhibit 25-7	Yes
V_{R12}	5950	4600:All	Yes

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = 44.1 (pc/ m/ln)

LOS = F (Exhibit 25-4)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 1.734 (Exibit 25-19)

S_R= 32.5 mph (Exhibit 25-19)

S_0= 48.4 mph (Exhibit 25-19)

S= 37.9 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	Willow ONR - L Coyotes OFR
Jurisdiction	
Analysis Year	2020 Alt 3

Inputs

Freeway free-flow speed, SFF (mi/h)	41	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.24
Weaving seg length, L (ft)	1200	Weaving ratio, R	0.22
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	7440	0.90	4	0	1.5	1.2	0.980	1.00	8432
Vo2	100	0.90	4	0	1.5	1.2	0.980	1.00	113
Vw1	1890	0.90	4	0	1.5	1.2	0.980	1.00	2142
Vw2	520	0.90	4	0	1.5	1.2	0.980	1.00	589
Vw				2731	Vnw				8545
V									11276

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			3.47	0.53
Weaving and non-weaving speeds, Si (mi/h)			21.93	35.21

Number of lanes required for unconstrained operation, Nw 2.03
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	30.71
Weaving segment density, D (pc/mi/ln)	73.44
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	9008
Capacity as a 15-minute flow rate, c (veh/h)	8831
Capacity as a full-hour volume, c_h (veh/h)	7948

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	L Coyotes ONR - BellFl OFR
Jurisdiction	
Analysis Year	2020 Alt 3

Inputs

Freeway free-flow speed, SFF (mi/h)	35	Weaving type	A
Weaving number of lanes, N	2	Volume ratio, VR	1.00
Weaving seg length, L (ft)	650	Weaving ratio, R	0.21
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vo2	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vw1	150	0.90	4	0	1.5	1.2	0.980	1.00	170
Vw2	40	0.90	4	0	1.5	1.2	0.980	1.00	45
Vw				215	Vnw				0
V									215

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			0.84	0.11
Weaving and non-weaving speeds, Si (mi/h)			28.56	37.55

Number of lanes required for unconstrained operation, Nw 1.45
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	28.56
Weaving segment density, D (pc/mi/ln)	3.76
Level of service, LOS	A
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	L Coyotes ONR - Woodruff OFR
Jurisdiction	
Analysis Year	2020 Alt 3

Inputs

Freeway free-flow speed, SFF (mi/h)	39	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.21
Weaving seg length, L (ft)	1100	Weaving ratio, R	0.28
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	7419	0.90	4	0	1.5	1.2	0.980	1.00	8408
Vo2	29	0.90	4	0	1.5	1.2	0.980	1.00	32
Vw1	541	0.90	4	0	1.5	1.2	0.980	1.00	613
Vw2	1381	0.90	4	0	1.5	1.2	0.980	1.00	1565
Vw				2178	Vnw				8440
V									10618

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			3.28	0.47
Weaving and non-weaving speeds, Si (mi/h)			21.77	34.77

Number of lanes required for unconstrained operation, Nw 1.82
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	30.97
Weaving segment density, D (pc/mi/ln)	68.56
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	8904
Capacity as a 15-minute flow rate, c (veh/h)	8729
Capacity as a full-hour volume, c_h (veh/h)	7856

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Woodruff ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 22

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8810	0.90	Level	4	0	0.980	1.00	9985
Ramp	300	0.90	Level	4	0	0.980	1.00	340
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.239 using Equation 4

V_{12}= 2387 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10325	See Exhibit 25-7	Yes
V_{R12}	2727	4600:All	No

Level of Service Determination (if not F)

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

D_R = 25.3 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.367 (Exibit 25-19)

S_R= 50.2 mph (Exhibit 25-19)

S_0= 39.5 mph (Exhibit 25-19)

S= 41.8 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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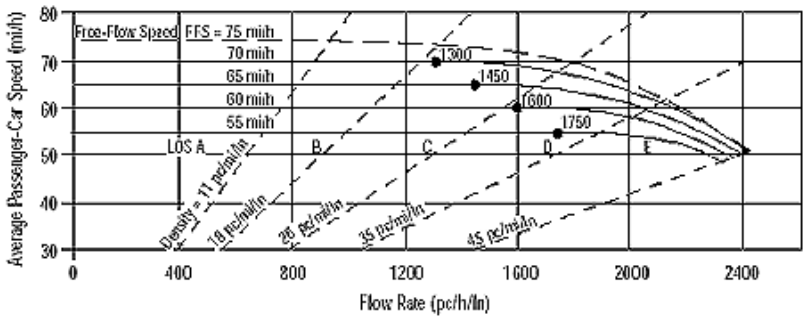
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	Woodruff ONR to Stearns ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 23

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

Flow Inputs

Volume, V	9110 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2581	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/17/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 SB
Weaving Seg Location	Stearns ONR to Studebaker OFR
Jurisdiction	
Analysis Year	2020 Alt 3

Inputs

Freeway free-flow speed, SFF (mi/h)	52	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.09
Weaving seg length, L (ft)	1100	Weaving ratio, R	0.29
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	8863	0.90	4	0	1.5	1.2	0.980	1.00	10044
Vo2	13	0.90	4	0	1.5	1.2	0.980	1.00	14
Vw1	247	0.90	4	0	1.5	1.2	0.980	1.00	279
Vw2	617	0.90	4	0	1.5	1.2	0.980	1.00	699
Vw				978	Vnw				10058
V									11036

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.64	0.22		
Weaving and non-weaving speeds, Si (mi/h)	40.66	49.38		

Number of lanes required for unconstrained operation, Nw 1.02
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	48.46
Weaving segment density, D (pc/mi/ln)	45.55
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	10836
Capacity as a 15-minute flow rate, c (veh/h)	10624
Capacity as a full-hour volume, c_h (veh/h)	9562

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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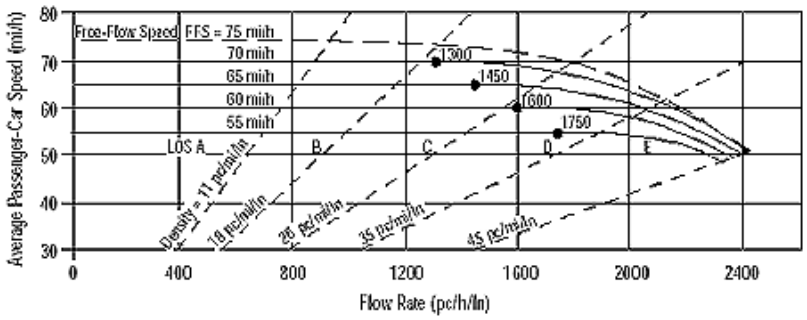
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	Studebaker OFR to 605NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 25

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

Flow Inputs

Volume, V	9470 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2147	pc/h/ln	Design LOS		
S	52.3	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	41.1	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	I-605 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 26

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 55.0 mph S_{FR} = 50.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9470	0.90	Level	4	0	0.980	1.00	10733
Ramp	1130	0.90	Level	4	0	0.980	1.00	1281
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 3181 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8587	9000	No
V_{12}	3181	4400:All	No
V_{FO} = V_F - V_R	7306	9000	No
V_R	1281	4100	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 5.5 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.348 (Exhibit 25-19)

S_R= 50.5 mph (Exhibit 25-19)

S_0= 53.7 mph (Exhibit 25-19)

S = 52.5 mph (Exhibit 25-15)

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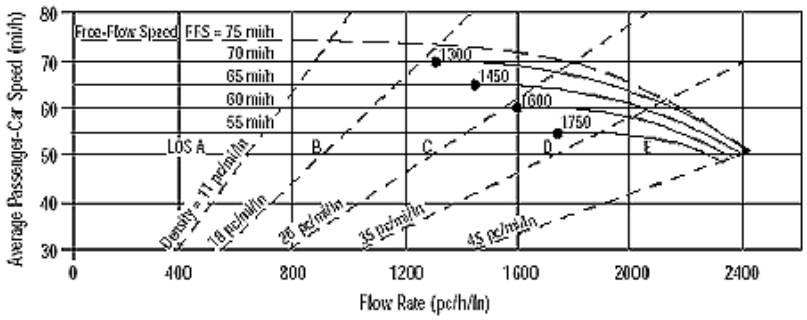
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	I-605 NB OFR to I-605 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 27

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

Flow Inputs

Volume, V	8350 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2366	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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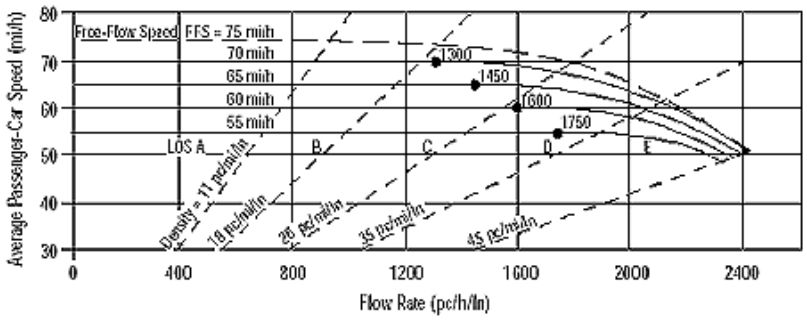
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	I-605 SB OFR to I-605 Sb ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 29

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

Flow Inputs

Volume, V	8190 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2321	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	I-605 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 30

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8190	0.90	Level	4	0	0.980	1.00	9282
Ramp	2880	0.90	Level	4	0	0.980	1.00	3264
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.209 using Equation 0

V_{12}= 1940 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	12546	See Exhibit 25-7	Yes
V_{R12}	5204	4600:All	Yes

Level of Service Determination (if not F)

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

D_R = 26.4 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.828 (Exibit 25-19)

S_R= 44.2 mph (Exhibit 25-19)

S_0= 40.2 mph (Exhibit 25-19)

S= 41.8 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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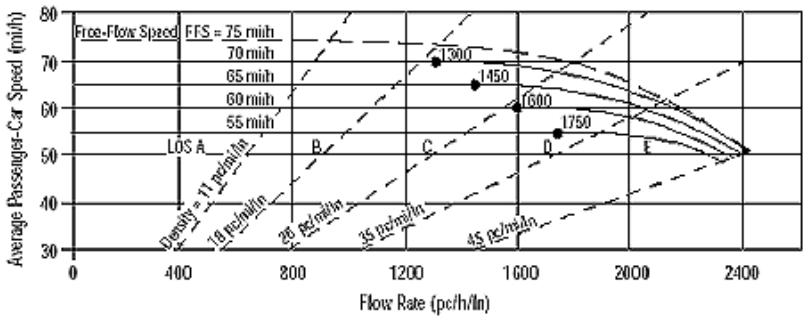
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	I-605 SB ONR to 7th St ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 31

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

Flow Inputs

Volume, V	11070 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	68.9	mi/h	FFS	68.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2509	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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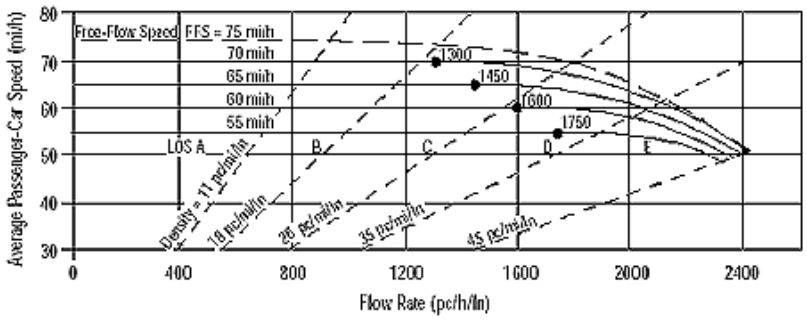
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	to I-605 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 32

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

Flow Inputs

Volume, V	13470 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	63.8	mi/h	FFS	63.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	3053	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	I-605 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 33

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 63.8 mph S_{FR} = 50.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	13470	0.90	Level	4	0	0.980	1.00	15266
Ramp	4430	0.90	Level	4	0	0.980	1.00	5021
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 6891 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	12213	9351	Yes
V_{12}	6891	4400:All	Yes
V_{FO} = V_F - V_R	7192	9351	No
V_R	5021	4100	Yes

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 20.3 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.685 (Exhibit 25-19)

S_R= 48.9 mph (Exhibit 25-19)

S_0= 63.5 mph (Exhibit 25-19)

S = 54.3 mph (Exhibit 25-15)

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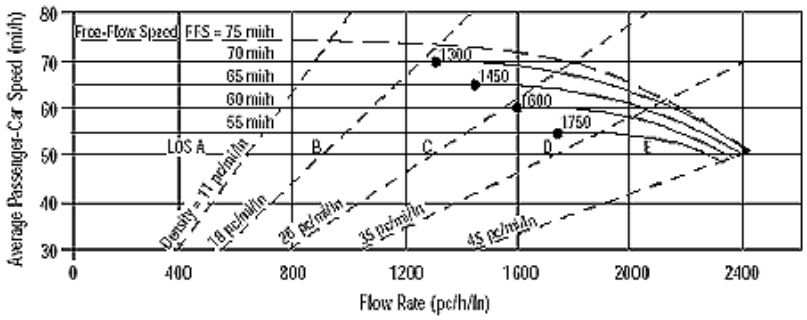

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	I-605 NB OFR to I-605 Sb OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 34

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

Flow Inputs

Volume, V	9040 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	63.8	mi/h	FFS	63.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2561	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	I-605 SB/NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 35

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 63.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9040	0.90	Level	4	0	0.980	1.00	10245
Ramp	1430	0.90	Level	4	0	0.980	1.00	1621
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.397 using Equation 4

V_{12}= 4072 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11866	See Exhibit 25-7	Yes
V_{R12}	5693	4600:All	Yes

Level of Service Determination (if not F)

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

D_R = 41.6 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 1.394 (Exibit 25-19)

S_R= 33.4 mph (Exhibit 25-19)

S_0= 52.6 mph (Exhibit 25-19)

S= 41.2 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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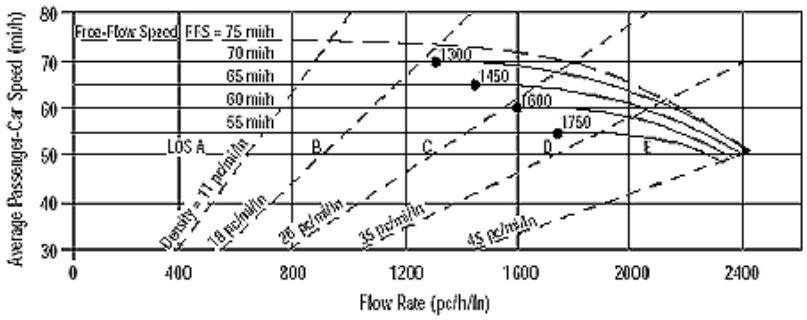

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

General Information		Site Information	
Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	I-605 NB/SB ONR to Studeba ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 36

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

Flow Inputs

Volume, V	10480 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Speed Inputs			Calc Speed Adj and FFS		
Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	63.8	mi/h	FFS	63.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2969	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Studeb ONR - Palo Verde OFR
Jurisdiction	
Analysis Year	2020 Alt 3

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.10
Weaving seg length, L (ft)	1700	Weaving ratio, R	0.26
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	40	0.90	4	0	1.5	1.2	0.980	1.00	45
Vo2	9720	0.90	4	0	1.5	1.2	0.980	1.00	11016
Vw1	270	0.90	4	0	1.5	1.2	0.980	1.00	306
Vw2	760	0.90	4	0	1.5	1.2	0.980	1.00	861
Vw				1167	Vnw				11061
V									12228

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.92	0.48		
Weaving and non-weaving speeds, Si (mi/h)	43.59	52.07		

Number of lanes required for unconstrained operation, Nw 1.06
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	51.12
Weaving segment density, D (pc/mi/ln)	47.84
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	11220
Capacity as a 15-minute flow rate, c (veh/h)	11000
Capacity as a full-hour volume, c_h (veh/h)	9900

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Palo Verde ONR to Woodruff OFR
Jurisdiction	
Analysis Year	2020 Alt 3

Inputs

Freeway free-flow speed, SFF (mi/h)	66	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.06
Weaving seg length, L (ft)	1750	Weaving ratio, R	0.49
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	fHV	fp	v
Vo1	17	0.90	4	0	1.5	1.2	0.980	1.00	19
Vo2	9677	0.90	4	0	1.5	1.2	0.980	1.00	10967
Vw1	303	0.90	4	0	1.5	1.2	0.980	1.00	343
Vw2	313	0.90	4	0	1.5	1.2	0.980	1.00	354
Vw				697	Vnw				10986
V									11683

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.80	0.39		
Weaving and non-weaving speeds, Si (mi/h)	46.06	55.27		

Number of lanes required for unconstrained operation, Nw 0.79
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	54.62
Weaving segment density, D (pc/mi/ln)	42.78
Level of service, LOS	E
Capacity of base condition, c_b (pc/h)	11339
Capacity as a 15-minute flow rate, c (veh/h)	11117
Capacity as a full-hour volume, c_h (veh/h)	10005

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Woodruff ONR to Bellflower OFR
Jurisdiction	
Analysis Year	2020 Alt 3

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.08
Weaving seg length, L (ft)	890	Weaving ratio, R	0.35
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	29	0.90	4	0	1.5	1.2	0.980	1.00	32
Vo2	9439	0.90	4	0	1.5	1.2	0.980	1.00	10697
Vw1	291	0.90	4	0	1.5	1.2	0.980	1.00	329
Vw2	541	0.90	4	0	1.5	1.2	0.980	1.00	613
Vw				942	Vnw				10729
V									11671

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	1.44	0.70		
Weaving and non-weaving speeds, Si (mi/h)	37.56	47.34		

Number of lanes required for unconstrained operation, Nw 0.88
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	46.37
Weaving segment density, D (pc/mi/ln)	50.34
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	10148
Capacity as a 15-minute flow rate, c (veh/h)	9949
Capacity as a full-hour volume, c_h (veh/h)	8954

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/17/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Bellflower ONR to Lakewood OFR
Jurisdiction	
Analysis Year	2020 Alt 3

Inputs

Freeway free-flow speed, SFF (mi/h)	66	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.17
Weaving seg length, L (ft)	1300	Weaving ratio, R	0.46
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	50	0.90	4	0	1.5	1.2	0.980	1.00	56
Vo2	8790	0.90	4	0	1.5	1.2	0.980	1.00	9962
Vw1	810	0.90	4	0	1.5	1.2	0.980	1.00	918
Vw2	940	0.90	4	0	1.5	1.2	0.980	1.00	1065
Vw				1983	Vnw				10018
V									12001

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.72	0.33		
Weaving and non-weaving speeds, Si (mi/h)	47.52	57.00		

Number of lanes required for unconstrained operation, Nw 1.06
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	55.18
Weaving segment density, D (pc/mi/ln)	43.49
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	11557
Capacity as a 15-minute flow rate, c (veh/h)	11330
Capacity as a full-hour volume, c_h (veh/h)	10197

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 46

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 65.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	10210	0.90	Level	4	0	0.980	1.00	11571
Ramp	340	0.90	Level	4	0	0.980	1.00	385
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.329 using Equation 4

V_{12}= 2984 pc/h

Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9456	See Exhibit 25-7	Yes
V_{R12}	3369	4600:All	No

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = 28.4 (pc/ m/ln)

LOS = F (Exhibit 25-4)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.399 (Exibit 25-19)

S_R= 56.3 mph (Exhibit 25-19)

S_0= 54.8 mph (Exhibit 25-19)

S= 55.3 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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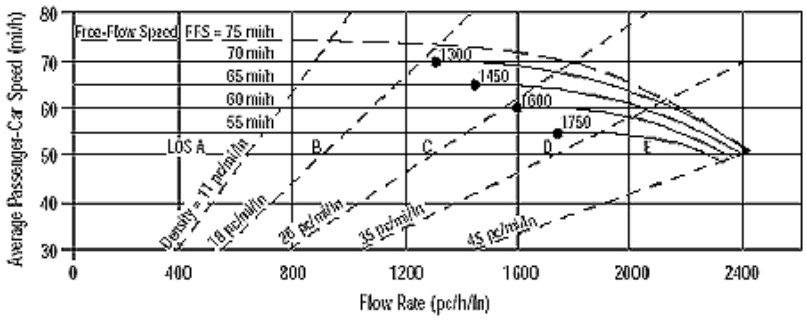
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	Lakewood ONR to
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 47

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

Flow Inputs

Volume, V	10550 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	60.9	mi/h	FFS	60.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2391	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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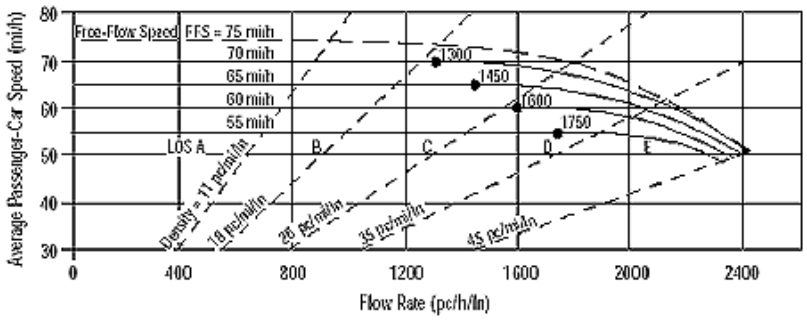
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

General Information		Site Information	
Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	to I-40 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 48

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

Flow Inputs

Volume, V	3560 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	2
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Speed Inputs			Calc Speed Adj and FFS		
Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1998	pc/h/ln	Design LOS		
S	64.9	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	30.8	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	I-405 OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 49

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	3560	0.90	Level	5	0	0.976	1.00	4054
Ramp	2830	0.90	Level	5	0	0.976	1.00	3223
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 4054 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	4054	4500	No
V_{12}	4054	4400:All	No
$V_{FO} = V_F - V_R$	831	4500	No
V_R	3223	3800	No

Level of Service Determination (if not F)

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

D_R = 20.2 (pc/ mi /ln)

LOS= C (Exhibit 25-4)

Speed Estimation

D_s = 0.718 (Exhibit 25-19)

S_R= 45.7 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 45.7 mph (Exhibit 25-15)

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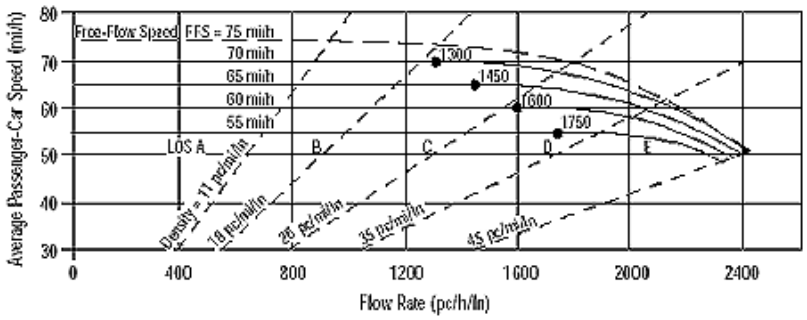
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 SB OFR to I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 50

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

Flow Inputs

Volume, V	500 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	60.0	mi/h	FFS	60.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	285	pc/h/ln	Design LOS		
S	60.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	4.8	pc/mi/ln	S		mi/h
LOS	A		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 51

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 62.8 mph S_{FR} = 50.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	500	0.90	Level	5	0	0.976	1.00	569
Ramp	430	0.90	Level	5	0	0.976	1.00	490
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =1.000 using Equation 0
V_{12}= pc/h	V_{12} = 569 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	569	4655	No
V_{12}	569	4400:All	No
V_{FO} = V_F - V_R	79	4655	No
V_R	490	2100	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = -0.8 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.277 (Exhibit 25-19)

S_R= 57.0 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 57.0 mph (Exhibit 25-15)

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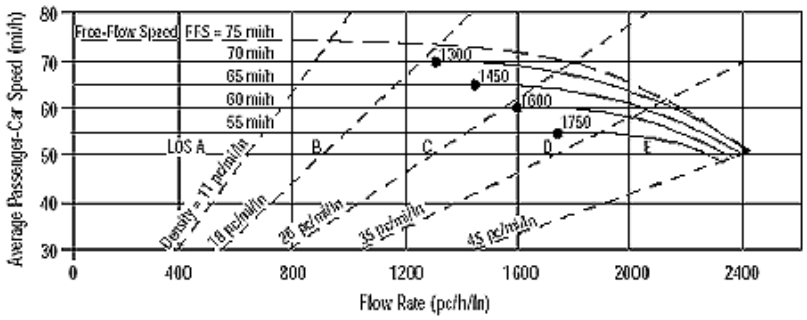

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 NB OFR to I-405 NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 52

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

Flow Inputs

Volume, V	200 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	62.8	mi/h	FFS	62.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	114	pc/h/ln	Design LOS		
S	62.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	1.8	pc/mi/ln	S		mi/h
LOS	A		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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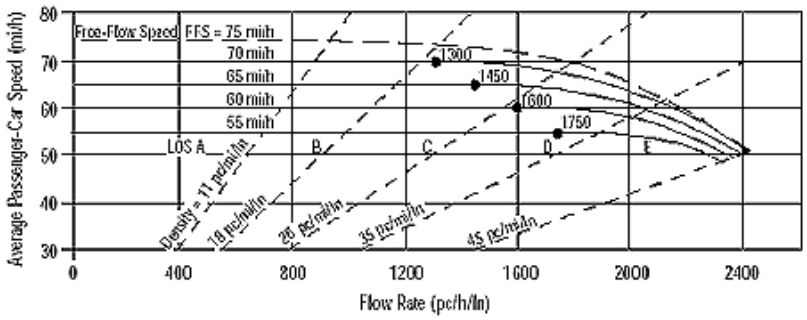
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 NB ONR to I-405 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 54

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

Flow Inputs

Volume, V	4430 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	62.8	mi/h	FFS	62.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1261	pc/h/ln	Design LOS		
S	62.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	20.1	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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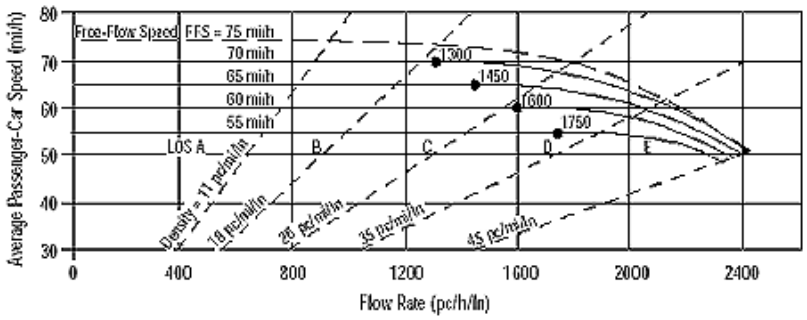

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

General Information		Site Information	
Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 SB ONR to Willow St OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 56

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

Flow Inputs

Volume, V	5750 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Speed Inputs			Calc Speed Adj and FFS		
Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	62.8	mi/h	FFS	62.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1310	pc/h/ln	Design LOS		
S	62.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	20.9	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Willow St OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 57

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 62.8 mph S_{FR} = 40.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	5750	0.90	Level	5	0	0.976	1.00	6549
Ramp	1660	0.90	Level	5	0	0.976	1.00	1891
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3494 pc/h

Capacity Checks

	Actual	Maximum	LOS F?		Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7		V_{FI}=V_F	5567	9311	No
				V_{12}	3494	4400:All	No
V_{R12}		4600:All		V_{FO} = V_F - V_R	3676	9311	No
				V_R	1891	2100	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 5.5 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.533 (Exhibit 25-19)

S_R= 51.7 mph (Exhibit 25-19)

S_0= 68.8 mph (Exhibit 25-19)

S = 57.0 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Willow St ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 59

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 67.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	4080	0.90	Level	5	0	0.976	1.00	4647
Ramp	1420	0.90	Level	5	0	0.976	1.00	1617
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.199 using Equation 4

V_{12}= 924 pc/h

Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	6264	See Exhibit 25-7	No
V_{R12}	2541	4600:All	No

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = 20.9 (pc/ m/ln)

LOS = C (Exhibit 25-4)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.330 (Exibit 25-19)

S_R= 59.3 mph (Exhibit 25-19)

S_0= 62.9 mph (Exhibit 25-19)

S= 61.4 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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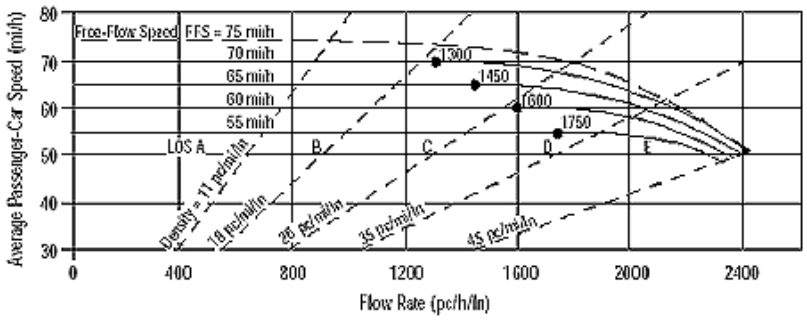

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	Willow St ONR to Cerritos ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 60

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

Flow Inputs

Volume, V	5500 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1566	pc/h/ln	Design LOS		
S	69.6	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	22.5	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Cerritos Ave ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 61

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 60.5 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	5500	0.90	Level	5	0	0.976	1.00	6264
Ramp	1030	0.90	Level	5	0	0.976	1.00	1173
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.135 using Equation 4

V_{12}= 845 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	7437	See Exhibit 25-7	No
V_{R12}	2018	4600:All	No

Level of Service Determination (if not F)

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

D_R = 19.4 (pc/ m/ln)

LOS = B (Exhibit 25-4)

Speed Estimation

M_S = 0.336 (Exibit 25-19)

S_R= 54.3 mph (Exhibit 25-19)

S_0= 51.5 mph (Exhibit 25-19)

S= 52.2 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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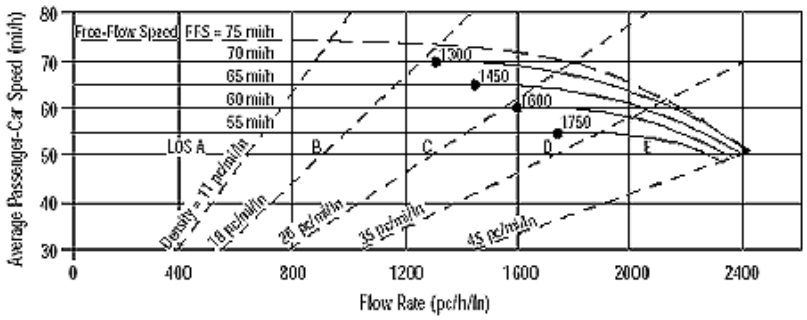
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	Cerritos ONR to
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 62

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

Flow Inputs

Volume, V	6530 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	59.6	mi/h	FFS	59.6	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1859	pc/h/ln	Design LOS	
S	59.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
D = v_p / S	31.5	pc/mi/ln	S	mi/h
LOS	D		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Carson OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 63

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 59.6 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	6530	0.90	Level	5	0	0.976	1.00	7437
Ramp	940	0.90	Level	5	0	0.976	1.00	1071
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3847 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	7437	9183	No
V_{12}	3847	4400:All	No
$V_{FO} = V_F - V_R$	6366	9183	No
V_R	1071	2000	No

Level of Service Determination (if not F)

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

D_R = 34.6 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

D_s = 0.524 (Exhibit 25-19)

S_R= 50.4 mph (Exhibit 25-19)

S_0= 62.3 mph (Exhibit 25-19)

S = 55.5 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 65

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 58.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	5590	0.90	Level	5	0	0.976	1.00	6366
Ramp	460	0.90	Level	5	0	0.976	1.00	524
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.335 using Equation 4

V_{12}= 2136 pc/h

Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	6890	See Exhibit 25-7	No
V_{R12}	2660	4600:All	No

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = 22.4 (pc/ m/ln)

LOS = C (Exhibit 25-4)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.337 (Exibit 25-19)

S_R= 52.6 mph (Exhibit 25-19)

S_0= 52.2 mph (Exhibit 25-19)

S= 52.4 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 68

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 65.4 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	6820	0.90	Level	5	0	0.976	1.00	7767
Ramp	460	0.90	Level	5	0	0.976	1.00	524
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.232 using Equation 4

V_{12}= 1802 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8291	See Exhibit 25-7	No
V_{R12}	2326	4600:All	No

Level of Service Determination (if not F)

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

D_R = 21.8 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.343 (Exibit 25-19)

S_R= 57.4 mph (Exhibit 25-19)

S_0= 54.8 mph (Exhibit 25-19)

S= 55.5 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 70

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 63.5 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7280	0.90	Level	5	0	0.976	1.00	8291
Ramp	320	0.90	Level	5	0	0.976	1.00	364
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.236 using Equation 4

V_{12}= 1957 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8655	See Exhibit 25-7	No
V_{R12}	2321	4600:All	No

Level of Service Determination (if not F)

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

D_R = 22.2 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.347 (Exibit 25-19)

S_R= 56.0 mph (Exhibit 25-19)

S_0= 51.8 mph (Exhibit 25-19)

S= 52.8 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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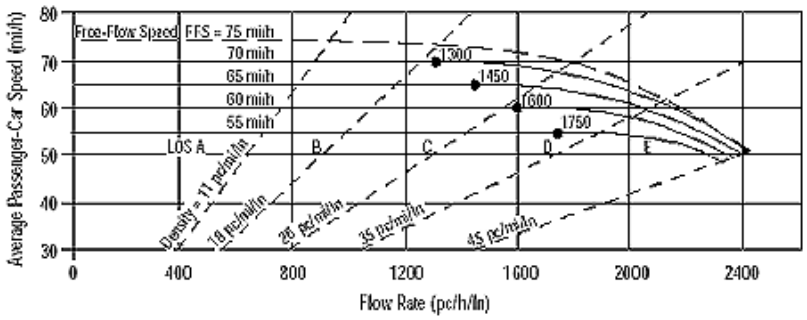
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Carson ONR to 5 lane section
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 71

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

Flow Inputs

Volume, V	7600 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	63.8	mi/h	FFS	63.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2164	pc/h/ln	Design LOS		
S	57.3	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	37.8	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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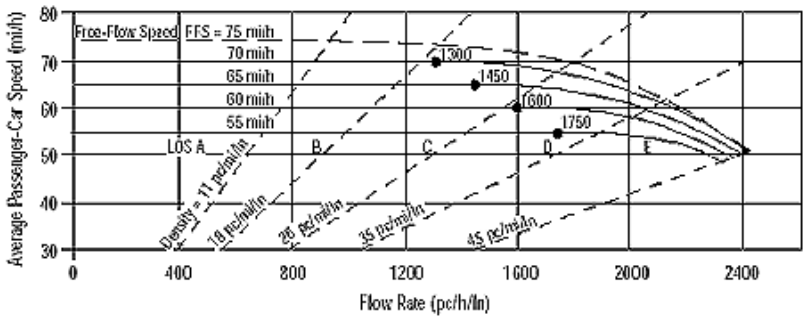
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	5 lane section to Spring OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 72

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

Flow Inputs

Volume, V	7600 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	63.8	mi/h	FFS	63.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1731	pc/h/ln	Design LOS		
S	63.3	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	27.3	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Spring OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 73

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 63.8 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	7600	0.90	Level	5	0	0.976	1.00	8656
Ramp	1410	0.90	Level	5	0	0.976	1.00	1606
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3925 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	6925	9351	No
V_{12}	3925	4400:All	No
V_{FO} = V_F - V_R	5319	9351	No
V_R	1606	2000	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 36.2 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.638 (Exhibit 25-19)

S_R= 49.9 mph (Exhibit 25-19)

S_0= 68.0 mph (Exhibit 25-19)

S = 56.4 mph (Exhibit 25-15)

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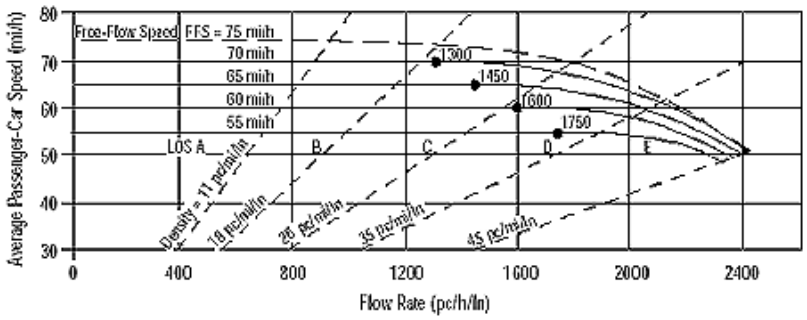
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Spring OFR to Willow OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 74

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

Flow Inputs

Volume, V	6190 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1762	pc/h/ln	Design LOS		
S	68.3	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	25.8	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Willow OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 75

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 61.4 mph S_{FR} = 30.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	6190	0.90	Level	5	0	0.976	1.00	7050
Ramp	500	0.90	Level	5	0	0.976	1.00	569
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3395 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	7050	9256	No
V_{12}	3395	4400:All	No
V_{FO} = V_F - V_R	6481	9256	No
V_R	569	2000	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 31.5 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.544 (Exhibit 25-19)

S_R= 50.8 mph (Exhibit 25-19)

S_0= 64.1 mph (Exhibit 25-19)

S = 57.0 mph (Exhibit 25-15)

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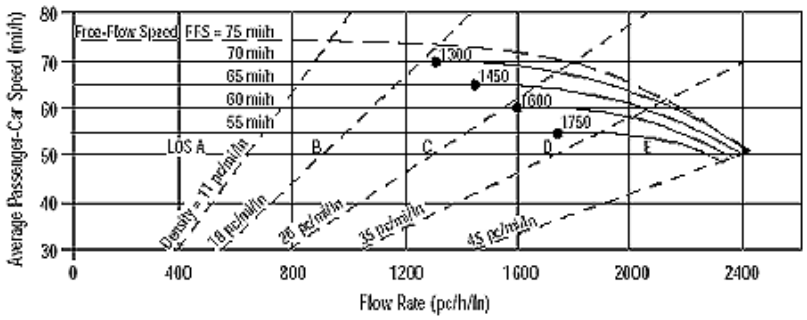
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

General Information		Site Information	
Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Willow OFR to Willow OFR CD
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 76

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

Flow Inputs

Volume, V	5700 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Speed Inputs			Calc Speed Adj and FFS		
Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	61.4	mi/h	FFS	61.4	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1623	pc/h/ln	Design LOS		
S	61.4	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	26.4	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Willow OFR CD
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 77

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 55.0 mph S_{FR} = 30.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	5700	0.90	Level	5	0	0.976	1.00	6492
Ramp	1010	0.90	Level	5	0	0.976	1.00	1150
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3479 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	6492	9000	No
V_{12}	3479	4400:All	No
$V_{FO} = V_F - V_R$	5342	9000	No
V_R	1150	2000	No

Level of Service Determination (if not F)

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

D_R = 32.1 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

D_s = 0.597 (Exhibit 25-19)

S_R= 47.2 mph (Exhibit 25-19)

S_0= 58.4 mph (Exhibit 25-19)

S = 51.8 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Willow ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 79

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	4690	0.90	Level	5	0	0.976	1.00	5341
Ramp	810	0.90	Level	5	0	0.976	1.00	923
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.389 using Equation 4

V_{12}= 2078 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	6264	See Exhibit 25-7	No
V_{R12}	3001	4600:All	No

Level of Service Determination (if not F)

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

D_R = 22.8 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.336 (Exibit 25-19)

S_R= 50.6 mph (Exhibit 25-19)

S_0= 50.9 mph (Exhibit 25-19)

S= 50.8 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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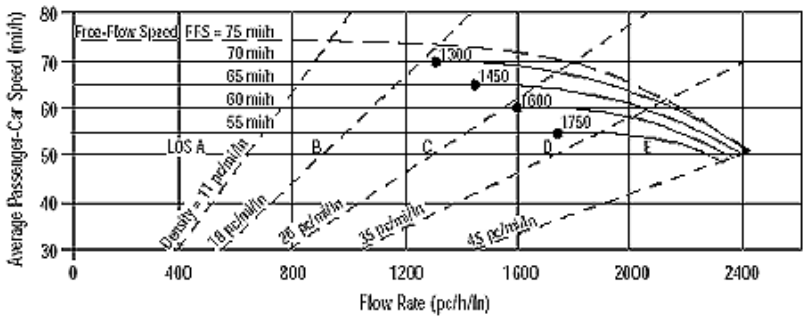
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Willow ONR CD to I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 84

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

Flow Inputs

Volume, V	5500 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	59.8	mi/h	FFS	59.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1566	pc/h/ln	Design LOS		
S	59.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	26.2	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 85

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 59.8 mph S_{FR} = 50.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	5500	0.90	Level	5	0	0.976	1.00	6264
Ramp	1000	0.90	Level	5	0	0.976	1.00	1139
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3373 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	6264	9191	No
V_{12}	3373	4400:All	No
$V_{FO} = V_F - V_R$	5125	9191	No
V_R	1139	2100	No

Level of Service Determination (if not F)

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

D_R = 30.8 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

D_s = 0.336 (Exhibit 25-19)

S_R= 53.8 mph (Exhibit 25-19)

S_0= 63.9 mph (Exhibit 25-19)

S = 58.0 mph (Exhibit 25-15)

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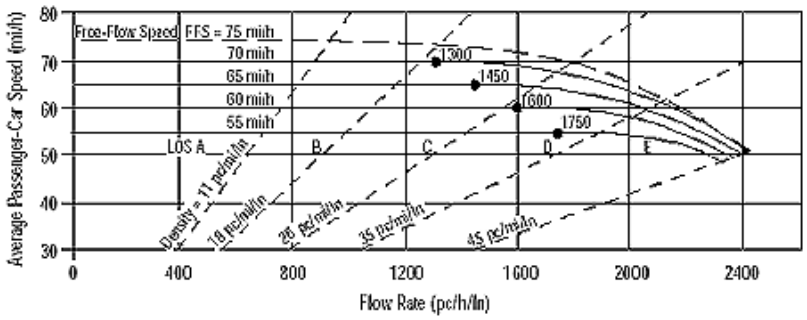
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	I-405 NB OFR to I-405 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 86

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

Flow Inputs

Volume, V	4500 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1281	pc/h/ln	Design LOS		
S	70.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	18.3	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	I-405 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 87

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 59.8 mph S_{FR} = 59.8 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	4500	0.90	Level	5	0	0.976	1.00	5125
Ramp	2880	0.90	Level	5	0	0.976	1.00	3280
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 3760 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	5125	9191	No
V_{12}	3760	4400:All	No
$V_{FO} = V_F - V_R$	1845	9191	No
V_R	3280	4400	No

Level of Service Determination (if not F)

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

D_R = -49.8 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.401 (Exhibit 25-19)

S_R= 52.7 mph (Exhibit 25-19)

S_0= 65.6 mph (Exhibit 25-19)

S = 55.6 mph (Exhibit 25-15)

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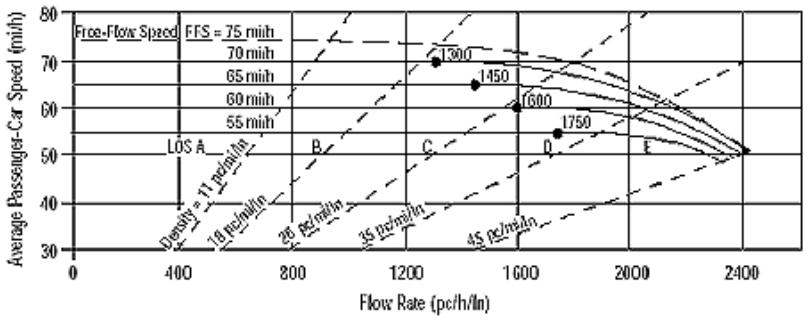
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	I-405 SB OFR to I-405 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 88 coded as 2 lanes, double volume

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

Flow Inputs

Volume, V	3500 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	59.8	mi/h	FFS	59.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1993	pc/h/ln	Design LOS	
S	57.9	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
D = v_p / S	34.4	pc/mi/ln	S	mi/h
LOS	D		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	I-405 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 89 coded as 2 lanes, double volume

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 59.8 mph S_{FR} = 50.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	3500	0.90	Level	5	0	0.976	1.00	3986
Ramp	160	0.90	Level	5	0	0.976	1.00	182
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 3986 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4168	See Exhibit 25-7	No
V_{R12}	4168	4600:All	No

Level of Service Determination (if not F)

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

D_R = 35.7 (pc/ m/ln)

LOS = E (Exhibit 25-4)

Speed Estimation

M_S = 0.538 (Exibit 25-19)

S_R= 50.2 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 50.2 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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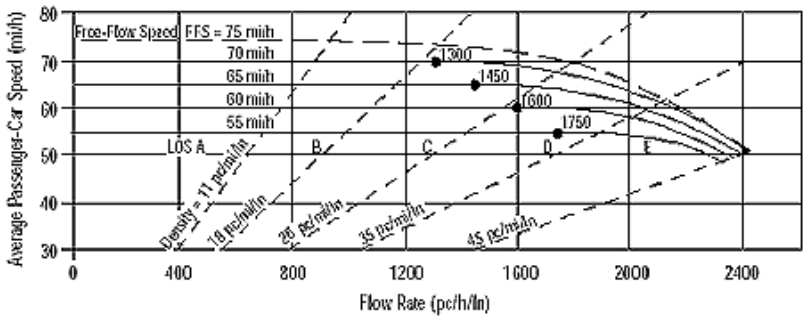

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	I-405 SB ONR to I-405 NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 90 coded as 2 lanes, double volume

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

Flow Inputs

Volume, V	3860 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	59.8	mi/h	FFS	59.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
			Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2198	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
S	54.0	mi/h	S		mi/h
D = v_p / S	40.7	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	E		Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	7th St WB
Agency or Company	Parsons	Junction	I-405 NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 91 coded for ramp being the mainline

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 55.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	2700	0.90	Level	2	0	0.990	1.00	3030
Ramp	1930	0.90	Level	2	0	0.990	1.00	2166
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 3030 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	5196	See Exhibit 25-7	Yes
V_{R12}	5196	4600:All	Yes

Level of Service Determination (if not F)

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

D_R = 43.4 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.998 (Exibit 25-19)

S_R= 42.0 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 42.0 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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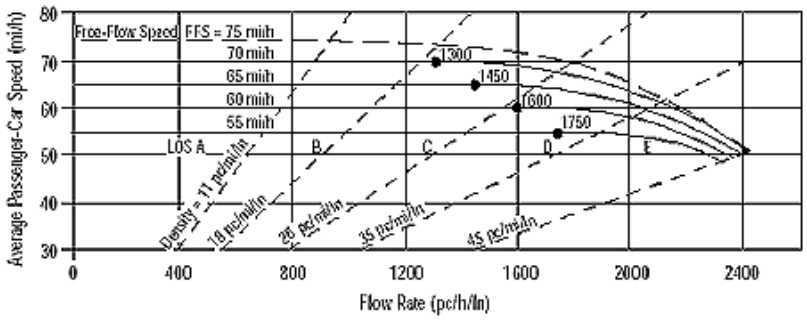

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	7th St WB
Agency or Company	Parsons	From/To	I-405 NB ONR to StudeB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 92

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

Flow Inputs

Volume, V	4850 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	2
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2721	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	7th St WB
Agency or Company	Parsons	Junction	StudeB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 95

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	330	0.90	Level	2	0	0.990	1.00	370
Ramp	490	0.90	Level	2	0	0.990	1.00	550
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 370 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	920	See Exhibit 25-7	No
V_{R12}	920	4600:All	No

Level of Service Determination (if not F)

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

D_R = 3.0 (pc/ m/ln)

LOS = A (Exhibit 25-4)

Speed Estimation

M_S = 0.226 (Exibit 25-19)

S_R= 52.1 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 52.1 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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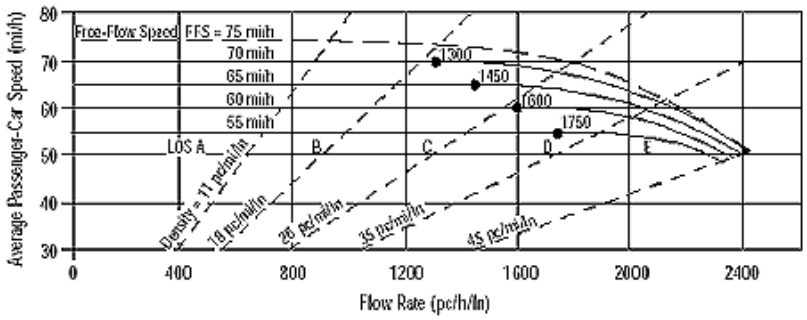
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	7th St WB
Agency or Company	Parsons	From/To	StudeB ONR to
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 96

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

Flow Inputs

Volume, V	3830 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	2
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	3		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1433	pc/h/ln	Design LOS		
S	69.9	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	20.5	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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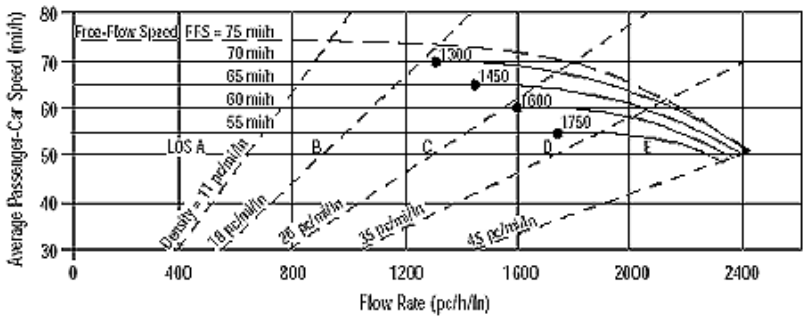
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	7th St EB
Agency or Company	Parsons	From/To	to StudeB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 97

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

Flow Inputs

Volume, V	2730 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	2
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	3		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1021	pc/h/ln	Design LOS		
S	70.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	14.6	pc/mi/ln	S		mi/h
LOS	B		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	7th St EB
Agency or Company	Parsons	Junction	Studebaker OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 98

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	2730	0.90	Level	5	0	0.976	1.00	3109
Ramp	660	0.90	Level	5	0	0.976	1.00	752
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 3109 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	3109	4500	No
V_{12}	3109	4400:All	No
$V_{FO} = V_F - V_R$	2357	4500	No
V_R	752	2000	No

Level of Service Determination (if not F)

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

D_R = 29.9 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

D_s = 0.561 (Exhibit 25-19)

S_R= 47.7 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 47.7 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	7th St EB
Agency or Company	Parsons	Junction	StudeB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 100

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	2020	0.90	Level	2	0	0.990	1.00	2267
Ramp	1420	0.90	Level	2	0	0.990	1.00	1594
UpStream								
DownStream								

Estimation of v_{12} — Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 2267 pc/h

Estimation of v_{12} — Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	3861	See Exhibit 25-7	No
V_{R12}	3861	4600:All	No

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = 32.3 (pc/ m/ln)

LOS = D (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.478 (Exibit 25-19)

S_R= 48.8 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 48.8 mph (Exhibit 25-14)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Lakewood Blvd Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 101

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 66.2 mph S_{FR} = 20.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	10590	0.90	Level	4	0	0.980	1.00	12002
Ramp	990	0.90	Level	4	0	0.980	1.00	1122
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 3327 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	9602	9447	Yes
V_{12}	3327	4400:All	No
V_{FO} = V_F - V_R	8480	9447	No
V_R	1122	3500	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 16.7 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.724 (Exhibit 25-19)

S_R= 48.7 mph (Exhibit 25-19)

S_0= 64.3 mph (Exhibit 25-19)

S = 57.9 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Woodruff Ave Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 102

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 65.8 mph S_{FR} = 45.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	10310	0.90	Level	4	0	0.980	1.00	11685
Ramp	330	0.90	Level	4	0	0.980	1.00	374
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 4287 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	9348	9432	No
V_{12}	4287	4400:All	No
$V_{FO} = V_F - V_R$	8974	9432	No
V_R	374	2100	No

Level of Service Determination (if not F)

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

D_R = 27.6 (pc/ mi /ln)

LOS= C (Exhibit 25-4)

Speed Estimation

D_s = 0.332 (Exhibit 25-19)

S_R= 57.9 mph (Exhibit 25-19)

S_0= 66.2 mph (Exhibit 25-19)

S = 62.1 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Woodruff Ave Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 103

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 25.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9380	0.90	Level	4	0	0.980	1.00	10631
Ramp	570	0.90	Level	4	0	0.980	1.00	646
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4073 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8505	9000	No
V_{12}	4073	4400:All	No
V_{FO} = V_F - V_R	7859	9000	No
V_R	646	1900	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 30.3 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.616 (Exhibit 25-19)

S_R= 47.0 mph (Exhibit 25-19)

S_0= 55.6 mph (Exhibit 25-19)

S = 51.1 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Bellflower Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 104

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 64.7 mph S_{FR} = 20.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	10300	0.90	Level	4	0	0.980	1.00	11673
Ramp	570	0.90	Level	4	0	0.980	1.00	646
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4436 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	9339	9387	No
V_{12}	4436	4400:All	Yes
V_{FO} = V_F - V_R	8693	9387	No
V_R	646	1900	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 33.4 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.681 (Exhibit 25-19)

S_R= 49.2 mph (Exhibit 25-19)

S_0= 65.3 mph (Exhibit 25-19)

S = 56.5 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Bellflower Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 105

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9960	0.90	Level	4	0	0.980	1.00	11288
Ramp	1990	0.90	Level	4	0	0.980	1.00	2255
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 4017 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	9031	9000	Yes
V_{12}	4017	4400:All	No
$V_{FO} = V_F - V_R$	6776	9000	No
V_R	2255	3800	No

Level of Service Determination (if not F)

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

D_R = 22.6 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

D_s = 0.631 (Exhibit 25-19)

S_R= 46.8 mph (Exhibit 25-19)

S_0= 54.5 mph (Exhibit 25-19)

S = 50.8 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Palo Verde Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 106

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 65.0 mph S_{FR} = 20.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	10790	0.90	Level	4	0	0.980	1.00	12229
Ramp	800	0.90	Level	4	0	0.980	1.00	907
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4777 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	9784	9400	Yes
V_{12}	4777	4400:All	Yes
V_{FO} = V_F - V_R	8877	9400	No
V_R	907	1900	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 30.9 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.705 (Exhibit 25-19)

S_R= 48.8 mph (Exhibit 25-19)

S_0= 65.4 mph (Exhibit 25-19)

S = 56.1 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Studebaker Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 107

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 55.0 mph S_{FR} = 25.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9730	0.90	Level	4	0	0.980	1.00	11027
Ramp	260	0.90	Level	4	0	0.980	1.00	295
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4013 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8822	9000	No
V_{12}	4013	4400:All	No
V_{FO} = V_F - V_R	8527	9000	No
V_R	295	1900	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 36.5 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.585 (Exhibit 25-19)

S_R= 47.4 mph (Exhibit 25-19)

S_0= 54.9 mph (Exhibit 25-19)

S = 51.2 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	7th Street OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 108

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 45.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	8350	0.90	Level	4	0	0.980	1.00	9463
Ramp	160	0.90	Level	4	0	0.980	1.00	181
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 4228 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	9463	9000	Yes
V_{12}	4228	4400:All	No
$V_{FO} = V_F - V_R$	9282	9000	Yes
V_R	181	2100	No

Level of Service Determination (if not F)

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

D_R = 38.8 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

D_s = 0.314 (Exhibit 25-19)

S_R= 50.9 mph (Exhibit 25-19)

S_0= 54.0 mph (Exhibit 25-19)

S = 52.6 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Carson OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 109

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 65.4 mph S_{FR} = 25.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	8230	0.90	Level	5	0	0.976	1.00	9373
Ramp	1410	0.90	Level	5	0	0.976	1.00	1606
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 3138 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	7499	9416	No
V_{12}	3138	4400:All	No
V_{FO} = V_F - V_R	5893	9416	No
V_R	1606	3500	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 15.0 (pc/ mi /ln)

LOS= B (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.703 (Exhibit 25-19)

S_R= 49.0 mph (Exhibit 25-19)

S_0= 67.1 mph (Exhibit 25-19)

S = 58.1 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	7th St WB
Agency or Company	Parsons	Junction	Studebaker OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 110

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	4850	0.90	Level	5	0	0.976	1.00	5524
Ramp	1430	0.90	Level	5	0	0.976	1.00	1629
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 5524 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	5524	4500	Yes
V_{12}	5524	4400:All	Yes
$V_{FO} = V_F - V_R$	3895	4500	No
V_R	1629	2000	No

Level of Service Determination (if not F)

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

D_R = 49.7 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

D_s = 0.640 (Exhibit 25-19)

S_R= 46.7 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 46.7 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Willow ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 111

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9330	0.90	Level	4	0	0.980	1.00	10574
Ramp	620	0.90	Level	4	0	0.980	1.00	703
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.225 using Equation 4

V_{12}= 1821 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8777	See Exhibit 25-7	No
V_{R12}	2524	4600:All	No

Level of Service Determination (if not F)

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

D_R = 23.0 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.349 (Exibit 25-19)

S_R= 50.5 mph (Exhibit 25-19)

S_0= 43.5 mph (Exhibit 25-19)

S= 45.3 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 112

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 66.2 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9600	0.90	Level	4	0	0.980	1.00	10880
Ramp	620	0.90	Level	4	0	0.980	1.00	703
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.608 using Equation 4

V_{12}= 6613 pc/h

Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11583	See Exhibit 25-7	Yes
V_{R12}	7316	4600:All	Yes

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = 52.8 (pc/ m/ln)

LOS = F (Exhibit 25-4)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 6.082 (Exibit 25-19)

S_R= -81.0 mph (Exhibit 25-19)

S_0= 60.3 mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Bellflower ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 113

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 63.4 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9730	0.90	Level	4	0	0.980	1.00	11027
Ramp	860	0.90	Level	4	0	0.980	1.00	975
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.209 using Equation 0

V_{12}= 2305 pc/h

Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	12002	See Exhibit 25-7	Yes
V_{R12}	3280	4600:All	No

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = 14.3 (pc/ m/ln)

LOS = F (Exhibit 25-4)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.243 (Exibit 25-19)

S_R= 58.2 mph (Exhibit 25-19)

S_0= 44.5 mph (Exhibit 25-19)

S= 47.6 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Bellflower ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 114

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7960	0.90	Level	4	0	0.980	1.00	9021
Ramp	1410	0.90	Level	4	0	0.980	1.00	1598
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.337 using Equation 4

V_{12}= 3037 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10619	See Exhibit 25-7	Yes
V_{R12}	4635	4600:All	Yes

Level of Service Determination (if not F)

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

D_R = 34.6 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.653 (Exibit 25-19)

S_R= 46.5 mph (Exhibit 25-19)

S_0= 44.3 mph (Exhibit 25-19)

S= 45.3 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Woodruff ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 115

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 66.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9980	0.90	Level	4	0	0.980	1.00	11311
Ramp	320	0.90	Level	4	0	0.980	1.00	363
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.459 using Equation 4

V_{12}= 5193 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11674	See Exhibit 25-7	Yes
V_{R12}	5556	4600:All	Yes

Level of Service Determination (if not F)

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

D_R = 43.0 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 1.267 (Exibit 25-19)

S_R= 35.6 mph (Exhibit 25-19)

S_0= 54.9 mph (Exhibit 25-19)

S= 43.6 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Palo Verde ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 116

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 65.6 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9990	0.90	Level	4	0	0.980	1.00	11322
Ramp	320	0.90	Level	4	0	0.980	1.00	363
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.746 using Equation 4

V_{12}= 8445 pc/h

Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11685	See Exhibit 25-7	Yes
V_{R12}	8808	4600:All	Yes

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = 62.7 (pc/ m/ln)

LOS = F (Exhibit 25-4)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 26.276 (Exibit 25-19)

S_R= -554.5 mph (Exhibit 25-19)

S_0= 62.2 mph (Exhibit 25-19)

S= 385.0 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Stearns ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 117

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9110	0.90	Level	4	0	0.980	1.00	10325
Ramp	630	0.90	Level	4	0	0.980	1.00	714
UpStream								
DownStream								

Estimation of v_{12} — Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.224 using Equation 4

V_{12}= 2314 pc/h

Estimation of v_{12} — Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11039	See Exhibit 25-7	Yes
V_{R12}	3028	4600:All	No

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = 26.9 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.381 (Exibit 25-19)

S_R= 50.1 mph (Exhibit 25-19)

S_0= 38.2 mph (Exhibit 25-19)

S= 40.9 mph (Exhibit 25-14)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Studebaker ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 118

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 63.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	10480	0.90	Level	4	0	0.980	1.00	11877
Ramp	310	0.90	Level	4	0	0.980	1.00	351
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.747 using Equation 4

V_{12}= 8876 pc/h

Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	12228	See Exhibit 25-7	Yes
V_{R12}	9227	4600:All	Yes

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = 66.0 (pc/ m/ln)

LOS = F (Exhibit 25-4)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 39.850 (Exibit 25-19)

S_R= -804.9 mph (Exhibit 25-19)

S_0= 60.2 mph (Exhibit 25-19)

S= 318.5 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 Alt 3

Project Description Segment ID 119

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 57.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	6050	0.90	Level	5	0	0.976	1.00	6890
Ramp	690	0.90	Level	5	0	0.976	1.00	786
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.247 using Equation 4

V_{12}= 1702 pc/h

Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	7676	See Exhibit 25-7	No
V_{R12}	2488	4600:All	No

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = 22.0 (pc/ m/ln)

LOS = C (Exhibit 25-4)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.340 (Exibit 25-19)

S_R= 51.9 mph (Exhibit 25-19)

S_0= 48.7 mph (Exhibit 25-19)

S= 49.7 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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Appendix B2

Year 2040 Alternative 3
Freeway Level of Service (LOS) Worksheets

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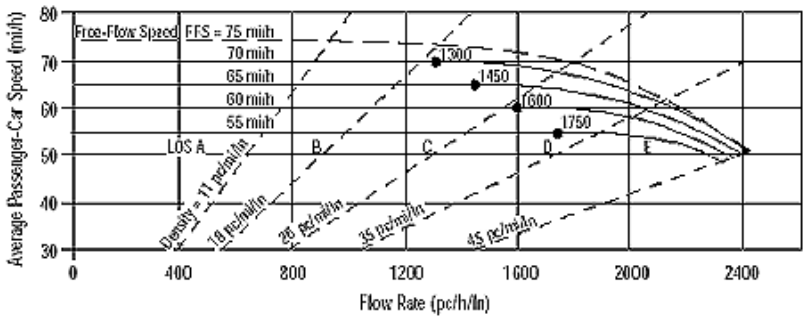
2040 Alternative 3

Freeway Mainline, Ramps, and Ramp-Freeway Junctions and Weaving Level of Service Analysis Worksheets

AM Peak Hour

BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	To Lakewood Blvd off ramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 1

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

Flow Inputs

Volume, V	10710 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	72.6	mi/h	FFS	72.6	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2428	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood Blvd Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 2

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 70.0 mph S_{FR} = 30.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	10710	0.90	Level	4	0	0.980	1.00	12138
Ramp	1290	0.90	Level	4	0	0.980	1.00	1462
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 3607 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	9711	9600	Yes
V_{12}	3607	4400:All	No
V_{FO} = V_F - V_R	8249	9600	No
V_R	1462	3800	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 20.9 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.625 (Exhibit 25-19)

S_R= 52.5 mph (Exhibit 25-19)

S_0= 68.8 mph (Exhibit 25-19)

S = 61.7 mph (Exhibit 25-15)

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	Lakewood on - Willow St off
Jurisdiction	
Analysis Year	2040 Alt 3

Inputs

Freeway free-flow speed, SFF (mi/h)	35	Weaving type	A
Weaving number of lanes, N	2	Volume ratio, VR	1.00
Weaving seg length, L (ft)	930	Weaving ratio, R	0.48
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vo2	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vw1	340	0.90	4	0	1.5	1.2	0.980	1.00	385
Vw2	320	0.90	4	0	1.5	1.2	0.980	1.00	362
Vw				747	Vnw				0
V									747

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			2.12	0.42
Weaving and non-weaving speeds, Si (mi/h)			23.01	32.61

Number of lanes required for unconstrained operation, Nw 1.70
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	23.01
Weaving segment density, D (pc/mi/ln)	16.23
Level of service, LOS	B
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 8

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 69.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9420	0.90	Level	4	0	0.980	1.00	10676
Ramp	340	0.90	Level	4	0	0.980	1.00	385
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.552 using Equation 4

V_{12}= 5893 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11061	See Exhibit 25-7	Yes
V_{R12}	6278	4600:All	Yes

Level of Service Determination (if not F)

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

D_R = 46.7 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 2.315 (Exibit 25-19)

S_R= 5.5 mph (Exhibit 25-19)

S_0= 62.7 mph (Exhibit 25-19)

S= 9.0 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	Willow ONR - L Coyotes OFR
Jurisdiction	
Analysis Year	2040 Alt 3

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.18
Weaving seg length, L (ft)	1200	Weaving ratio, R	0.22
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	8288	0.90	4	0	1.5	1.2	0.980	1.00	9393
Vo2	78	0.90	4	0	1.5	1.2	0.980	1.00	88
Vw1	1482	0.90	4	0	1.5	1.2	0.980	1.00	1679
Vw2	412	0.90	4	0	1.5	1.2	0.980	1.00	466
Vw				2145	Vnw				9481
V									11626

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			3.22	0.46
Weaving and non-weaving speeds, Si (mi/h)			28.03	52.69

Number of lanes required for unconstrained operation, Nw 1.50
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	45.33
Weaving segment density, D (pc/mi/ln)	51.29
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	10057
Capacity as a 15-minute flow rate, c (veh/h)	9860
Capacity as a full-hour volume, c_h (veh/h)	8874

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	L Coyotes ONR - BellFl OFR
Jurisdiction	
Analysis Year	2040 Alt 3

Inputs

Freeway free-flow speed, SFF (mi/h)	35	Weaving type	A
Weaving number of lanes, N	2	Volume ratio, VR	1.00
Weaving seg length, L (ft)	650	Weaving ratio, R	0.46
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	fHV	fp	v
Vo1	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vo2	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vw1	110	0.90	4	0	1.5	1.2	0.980	1.00	124
Vw2	130	0.90	4	0	1.5	1.2	0.980	1.00	147
Vw				271	Vnw				0
V									271

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			1.06	0.15
Weaving and non-weaving speeds, Si (mi/h)			27.15	36.80

Number of lanes required for unconstrained operation, Nw 1.47
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	27.15
Weaving segment density, D (pc/mi/ln)	4.99
Level of service, LOS	A
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	L Coyotes ONR - Woodruff OFR
Jurisdiction	
Analysis Year	2040 Alt 3

Inputs

Freeway free-flow speed, SFF (mi/h)	68	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.19
Weaving seg length, L (ft)	1100	Weaving ratio, R	0.44
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	7892	0.90	4	0	1.5	1.2	0.980	1.00	8944
Vo2	42	0.90	4	0	1.5	1.2	0.980	1.00	47
Vw1	798	0.90	4	0	1.5	1.2	0.980	1.00	904
Vw2	1018	0.90	4	0	1.5	1.2	0.980	1.00	1153
Vw				2057	Vnw				8991
V									11048

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			3.30	0.46
Weaving and non-weaving speeds, Si (mi/h)			28.50	54.68

Number of lanes required for unconstrained operation, Nw 1.47
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	46.70
Weaving segment density, D (pc/mi/ln)	47.32
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	10182
Capacity as a 15-minute flow rate, c (veh/h)	9982
Capacity as a full-hour volume, c_h (veh/h)	8984

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Woodruff ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 22

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 69.2 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8920	0.90	Level	4	0	0.980	1.00	10109
Ramp	690	0.90	Level	4	0	0.980	1.00	782
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.184 using Equation 4

V_{12}= 1858 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10891	See Exhibit 25-7	Yes
V_{R12}	2640	4600:All	No

Level of Service Determination (if not F)

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

D_R = 24.5 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.362 (Exibit 25-19)

S_R= 59.4 mph (Exhibit 25-19)

S_0= 51.7 mph (Exhibit 25-19)

S= 53.4 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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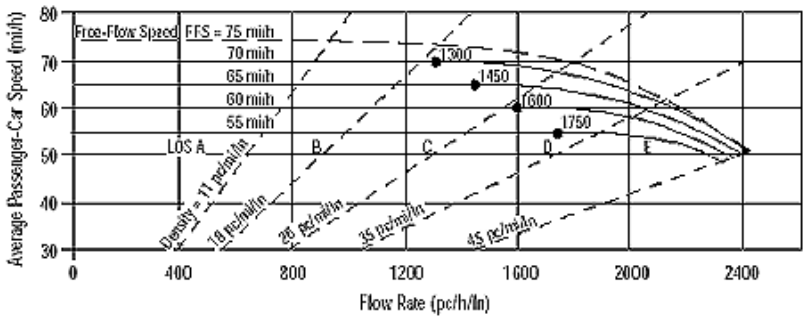
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	Woodruff ONR to Stearns ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 23

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

Flow Inputs

Volume, V	9610 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	68.2	mi/h	FFS	68.2	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2723	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/17/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 SB
Weaving Seg Location	Stearns ONR to Studebaker OFR
Jurisdiction	
Analysis Year	2040 Alt 3

Inputs

Freeway free-flow speed, SFF (mi/h)	69	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.09
Weaving seg length, L (ft)	1100	Weaving ratio, R	0.43
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	9192	0.90	4	0	1.5	1.2	0.980	1.00	10417
Vo2	22	0.90	4	0	1.5	1.2	0.980	1.00	24
Vw1	418	0.90	4	0	1.5	1.2	0.980	1.00	473
Vw2	548	0.90	4	0	1.5	1.2	0.980	1.00	621
Vw				1094	Vnw				10441
V									11535

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.67	0.24		
Weaving and non-weaving speeds, Si (mi/h)	50.43	62.60		

Number of lanes required for unconstrained operation, Nw 0.73
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	61.20
Weaving segment density, D (pc/mi/ln)	37.70
Level of service, LOS	E
Capacity of base condition, c_b (pc/h)	11850
Capacity as a 15-minute flow rate, c (veh/h)	11618
Capacity as a full-hour volume, c_h (veh/h)	10456

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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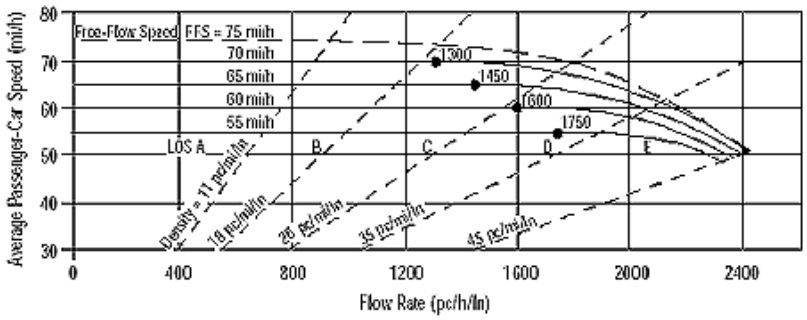
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	Studebaker OFR to 605NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 25

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

Flow Inputs

Volume, V	9730 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	68.9	mi/h	FFS	68.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2205	pc/h/ln	Design LOS		
S	59.3	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	37.2	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	I-605 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 26

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 68.9 mph S_{FR} = 50.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9730	0.90	Level	4	0	0.980	1.00	11027
Ramp	1410	0.90	Level	4	0	0.980	1.00	1598
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 3476 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	8822	9556	No
V_{12}	3476	4400:All	No
$V_{FO} = V_F - V_R$	7224	9556	No
V_R	1598	4100	No

Level of Service Determination (if not F)

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

D_R = 8.0 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.377 (Exhibit 25-19)

S_R= 58.8 mph (Exhibit 25-19)

S_0= 69.1 mph (Exhibit 25-19)

S = 64.6 mph (Exhibit 25-15)

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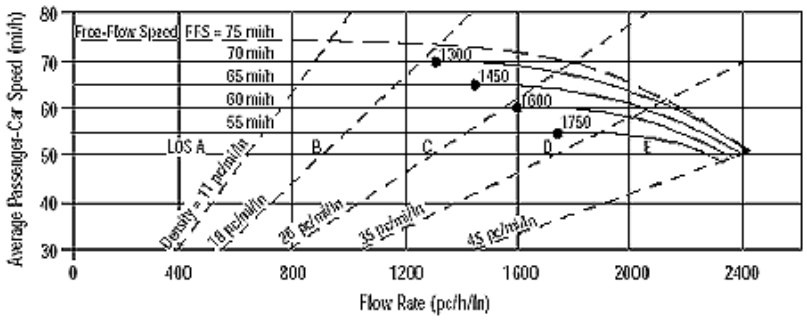
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

General Information		Site Information	
Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	I-605 NB OFR to I-605 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 27

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

Flow Inputs

Volume, V	8320 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Speed Inputs			Calc Speed Adj and FFS		
Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	68.9	mi/h	FFS	68.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2357	pc/h/ln	Design LOS		
S	54.3	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	43.4	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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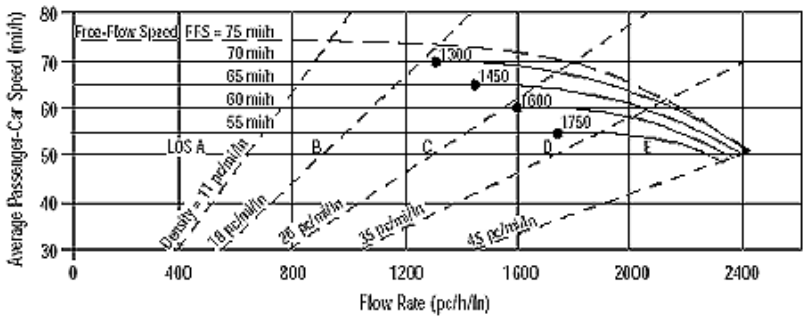
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	I-605 SB OFR to I-605 Sb ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 29

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

Flow Inputs

Volume, V	8220 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	68.9	mi/h	FFS	68.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2329	pc/h/ln	Design LOS		
S	55.3	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	42.1	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	I-605 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 30

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 68.9 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8220	0.90	Level	4	0	0.980	1.00	9316
Ramp	3330	0.90	Level	4	0	0.980	1.00	3774
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.209 using Equation 0

V_{12}= 1947 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	13090	See Exhibit 25-7	Yes
V_{R12}	5721	4600:All	Yes

Level of Service Determination (if not F)

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

D_R = 30.2 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 1.308 (Exibit 25-19)

S_R= 33.7 mph (Exhibit 25-19)

S_0= 54.1 mph (Exhibit 25-19)

S= 42.8 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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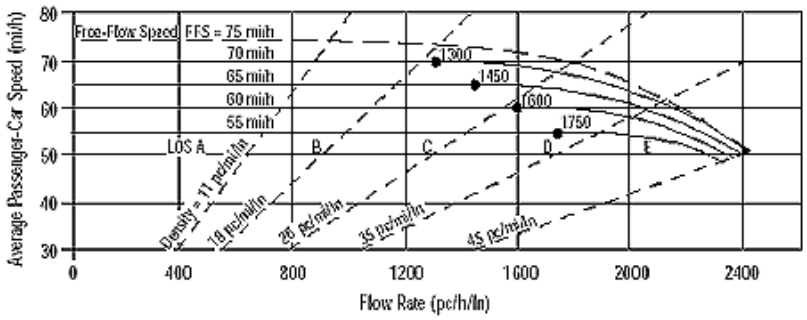
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	I-605 SB ONR to 7th St ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 31

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

Flow Inputs

Volume, V	11550 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	68.9	mi/h	FFS	68.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2618	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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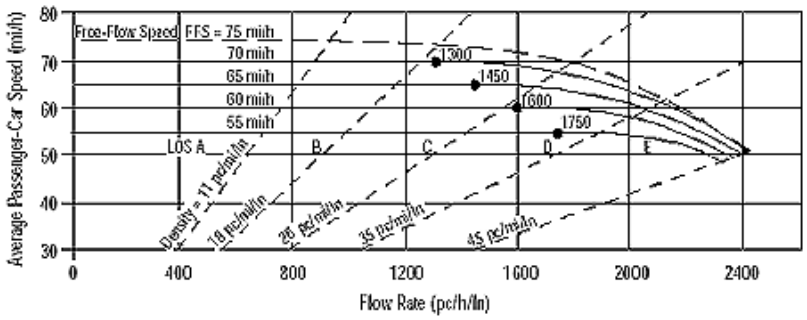
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	to I-605 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 32

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

Flow Inputs

Volume, V	12170 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2759	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	I-605 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 33

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 50.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	12170	0.90	Level	4	0	0.980	1.00	13793
Ramp	3910	0.90	Level	4	0	0.980	1.00	4431
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 6148 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	11035	9000	Yes
V_{12}	6148	4400:All	Yes
V_{FO} = V_F - V_R	6604	9000	No
V_R	4431	4100	Yes

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 13.9 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.632 (Exhibit 25-19)

S_R= 46.8 mph (Exhibit 25-19)

S_0= 54.7 mph (Exhibit 25-19)

S = 50.0 mph (Exhibit 25-15)

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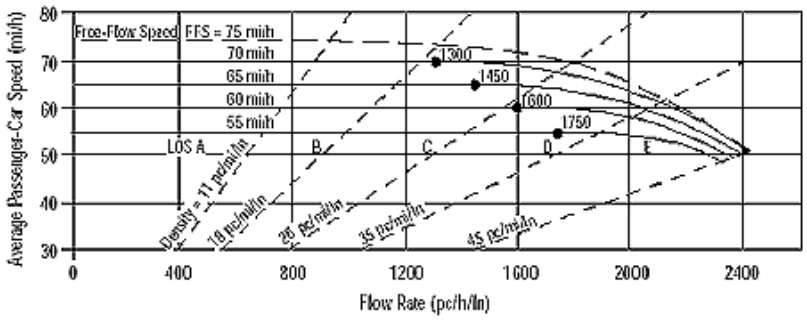
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	I-605 NB OFR to I-605 Sb OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 34

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

Flow Inputs

Volume, V	8260 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2340	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	I-605 SB/NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 35

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 63.8 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8260	0.90	Level	4	0	0.980	1.00	9361
Ramp	1570	0.90	Level	4	0	0.980	1.00	1779
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.378 using Equation 4

V_{12}= 3536 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11140	See Exhibit 25-7	Yes
V_{R12}	5315	4600:All	Yes

Level of Service Determination (if not F)

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

D_R = 38.6 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 1.030 (Exibit 25-19)

S_R= 41.3 mph (Exhibit 25-19)

S_0= 53.6 mph (Exhibit 25-19)

S= 47.0 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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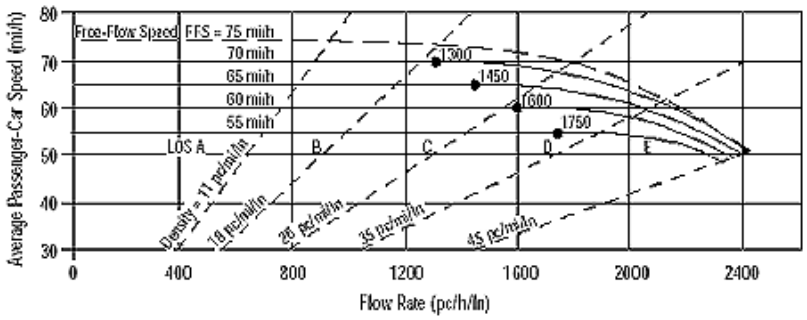
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

General Information		Site Information	
Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	I-605 NB/SB ONR to Studeba ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 36

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

Flow Inputs

Volume, V	9830 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Speed Inputs			Calc Speed Adj and FFS		
Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
			Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2785	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
S		mi/h	S		mi/h
D = v_p / S		pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	F		Required Number of Lanes, N		

Glossary / Factor Location

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Studeb ONR - Palo Verde OFR
Jurisdiction	
Analysis Year	2040 Alt 3

Inputs

Freeway free-flow speed, SFF (mi/h)	55	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.10
Weaving seg length, L (ft)	1700	Weaving ratio, R	0.30
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	36	0.90	4	0	1.5	1.2	0.980	1.00	40
Vo2	9156	0.90	4	0	1.5	1.2	0.980	1.00	10376
Vw1	294	0.90	4	0	1.5	1.2	0.980	1.00	333
Vw2	674	0.90	4	0	1.5	1.2	0.980	1.00	763
Vw				1096	Vnw				10416
V									11512

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.87	0.45		
Weaving and non-weaving speeds, Si (mi/h)	39.05	46.10		

Number of lanes required for unconstrained operation, Nw 1.11
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	45.33
Weaving segment density, D (pc/mi/ln)	50.80
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	10036
Capacity as a 15-minute flow rate, c (veh/h)	9839
Capacity as a full-hour volume, c_h (veh/h)	8855

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Palo Verde ONR to Woodruff OFR
Jurisdiction	
Analysis Year	2040 Alt 3

Inputs

Freeway free-flow speed, SFF (mi/h)	47	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.08
Weaving seg length, L (ft)	1750	Weaving ratio, R	0.23
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	33	0.90	4	0	1.5	1.2	0.980	1.00	37
Vo2	8833	0.90	4	0	1.5	1.2	0.980	1.00	10010
Vw1	187	0.90	4	0	1.5	1.2	0.980	1.00	211
Vw2	617	0.90	4	0	1.5	1.2	0.980	1.00	699
Vw				910	Vnw				10047
V									10957

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.79	0.39		
Weaving and non-weaving speeds, Si (mi/h)	35.65	41.58		

Number of lanes required for unconstrained operation, Nw 1.07
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	41.01
Weaving segment density, D (pc/mi/ln)	53.43
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	10070
Capacity as a 15-minute flow rate, c (veh/h)	9873
Capacity as a full-hour volume, c_h (veh/h)	8886

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Woodruff ONR to Bellflower OFR
Jurisdiction	
Analysis Year	2040 Alt 3

Inputs

Freeway free-flow speed, SFF (mi/h)	46	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.11
Weaving seg length, L (ft)	890	Weaving ratio, R	0.48
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	28	0.90	4	0	1.5	1.2	0.980	1.00	31
Vo2	8488	0.90	4	0	1.5	1.2	0.980	1.00	9619
Vw1	482	0.90	4	0	1.5	1.2	0.980	1.00	546
Vw2	532	0.90	4	0	1.5	1.2	0.980	1.00	602
Vw				1148	Vnw				9650
V									10798

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	1.40	0.70		
Weaving and non-weaving speeds, Si (mi/h)	29.97	36.23		

Number of lanes required for unconstrained operation, Nw 1.14
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	35.45
Weaving segment density, D (pc/mi/ln)	60.92
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	9146
Capacity as a 15-minute flow rate, c (veh/h)	8967
Capacity as a full-hour volume, c_h (veh/h)	8070

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/17/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Bellflower ONR to Lakewood OFR
Jurisdiction	
Analysis Year	2040 Alt 3

Inputs

Freeway free-flow speed, SFF (mi/h)	52	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.23
Weaving seg length, L (ft)	1300	Weaving ratio, R	0.43
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	54	0.90	4	0	1.5	1.2	0.980	1.00	61
Vo2	7934	0.90	4	0	1.5	1.2	0.980	1.00	8991
Vw1	1336	0.90	4	0	1.5	1.2	0.980	1.00	1514
Vw2	1026	0.90	4	0	1.5	1.2	0.980	1.00	1162
Vw				2676	Vnw				9052
V									11728

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.80	0.45		
Weaving and non-weaving speeds, Si (mi/h)	38.37	44.03		

Number of lanes required for unconstrained operation, Nw 1.62
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	42.60
Weaving segment density, D (pc/mi/ln)	55.06
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	9903
Capacity as a 15-minute flow rate, c (veh/h)	9709
Capacity as a full-hour volume, c_h (veh/h)	8738

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 46

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	10130	0.90	Level	4	0	0.980	1.00	11481
Ramp	610	0.90	Level	4	0	0.980	1.00	691
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.291 using Equation 4

V_{12}= 2611 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9672	See Exhibit 25-7	Yes
V_{R12}	3302	4600:All	No

Level of Service Determination (if not F)

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

D_R = 27.8 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.392 (Exibit 25-19)

S_R= 49.9 mph (Exhibit 25-19)

S_0= 43.2 mph (Exhibit 25-19)

S= 45.2 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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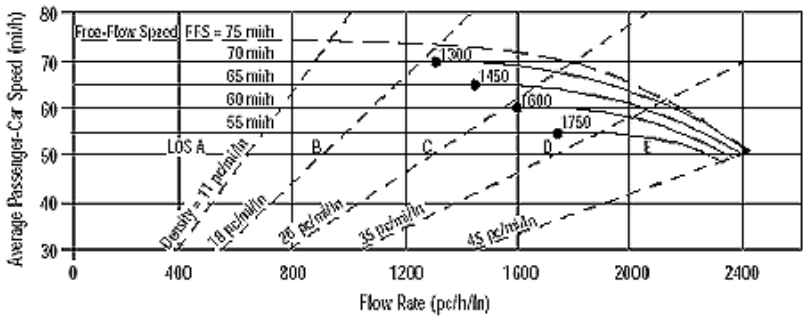
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	Lakewood ONR to
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 47

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

Flow Inputs

Volume, V	10730 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2432	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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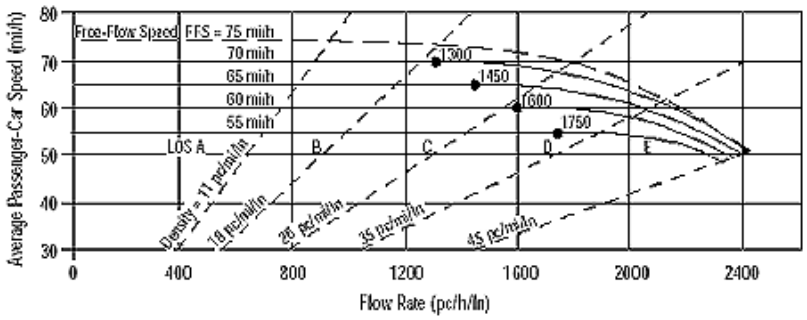
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	to I-40 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 48

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

Flow Inputs

Volume, V	4140 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	2
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2323	pc/h/ln	Design LOS		
S	56.2	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	41.3	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	I-405 OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 49

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	4140	0.90	Level	5	0	0.976	1.00	4715
Ramp	3610	0.90	Level	5	0	0.976	1.00	4111
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 4715 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	4715	4500	Yes
V_{12}	4715	4400:All	Yes
$V_{FO} = V_F - V_R$	604	4500	No
V_R	4111	3800	Yes

Level of Service Determination (if not F)

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

D_R = 25.9 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

D_s = 0.798 (Exhibit 25-19)

S_R= 44.6 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 44.6 mph (Exhibit 25-15)

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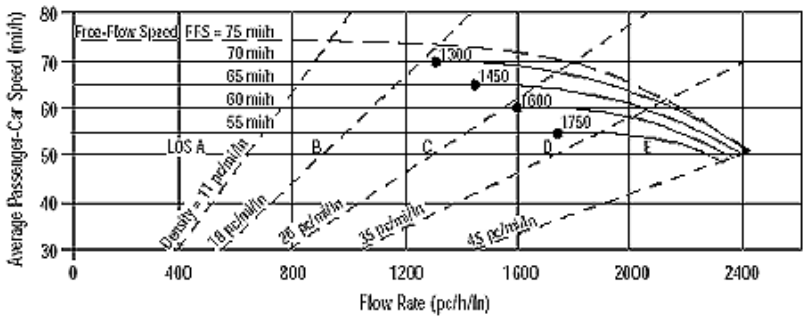

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 SB OFR to I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 50

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

Flow Inputs

Volume, V	530 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	60.0	mi/h	FFS	60.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	302	pc/h/ln	Design LOS		
S	60.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	5.0	pc/mi/ln	S		mi/h
LOS	A		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 51

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 68.8 mph S_{FR} = 50.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	530	0.90	Level	5	0	0.976	1.00	604
Ramp	770	0.90	Level	5	0	0.976	1.00	877
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 604 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	604	4775	No
V_{12}	604	4400:All	No
$V_{FO} = V_F - V_R$	-273	4775	No
V_R	877	2100	No

Level of Service Determination (if not F)

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

D_R = -0.5 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.312 (Exhibit 25-19)

S_R= 60.4 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 60.4 mph (Exhibit 25-15)

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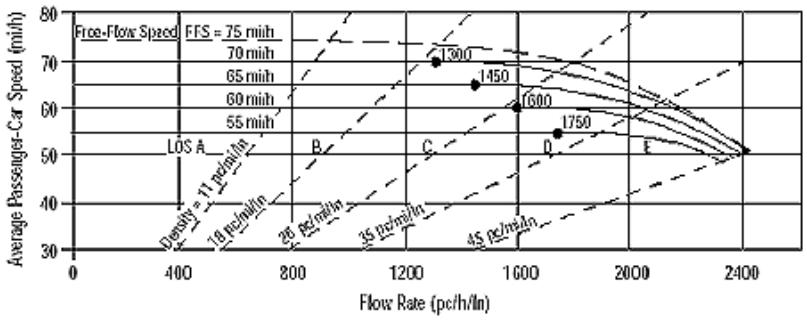

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 NB OFR to I-405 NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 52

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

Flow Inputs

Volume, V	100 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	68.8	mi/h	FFS	68.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	57	pc/h/ln	Design LOS		
S	68.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	0.8	pc/mi/ln	S		mi/h
LOS	A		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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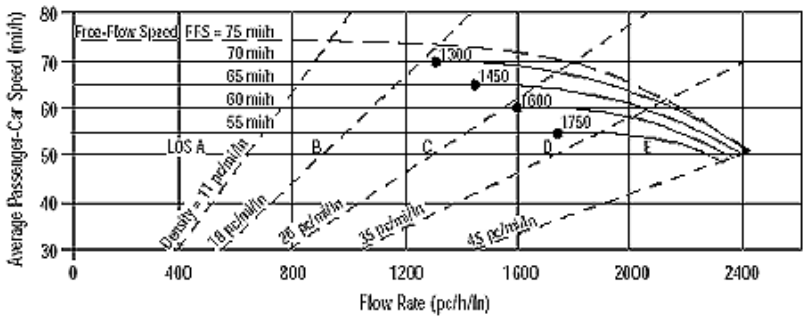

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 NB ONR to I-405 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 54

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

Flow Inputs

Volume, V	3910 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	68.8	mi/h	FFS	68.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1113	pc/h/ln	Design LOS	
S	68.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
D = v_p / S	16.2	pc/mi/ln	S	mi/h
LOS	B		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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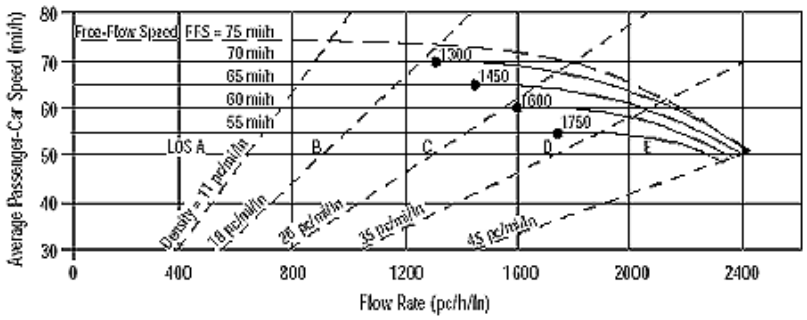
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 SB ONR to Willow St OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 56

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

Flow Inputs

Volume, V	5420 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	68.8	mi/h	FFS	68.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1235	pc/h/ln	Design LOS		
S	68.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	18.0	pc/mi/ln	S		mi/h
LOS	B		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Willow St OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 57

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 68.8 mph S_{FR} = 40.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	5420	0.90	Level	5	0	0.976	1.00	6173
Ramp	1160	0.90	Level	5	0	0.976	1.00	1321
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3033 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	5248	9552	No
V_{12}	3033	4400:All	No
V_{FO} = V_F - V_R	3927	9552	No
V_R	1321	2100	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 1.5 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.482 (Exhibit 25-19)

S_R= 55.9 mph (Exhibit 25-19)

S_0= 75.1 mph (Exhibit 25-19)

S = 62.6 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Willow St ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 59

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	4160	0.90	Level	5	0	0.976	1.00	4738
Ramp	1130	0.90	Level	5	0	0.976	1.00	1287
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.240 using Equation 4

V_{12}= 1138 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	6025	See Exhibit 25-7	No
V_{R12}	2425	4600:All	No

Level of Service Determination (if not F)

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

D_R = 20.2 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.325 (Exibit 25-19)

S_R= 60.9 mph (Exhibit 25-19)

S_0= 65.3 mph (Exhibit 25-19)

S= 63.5 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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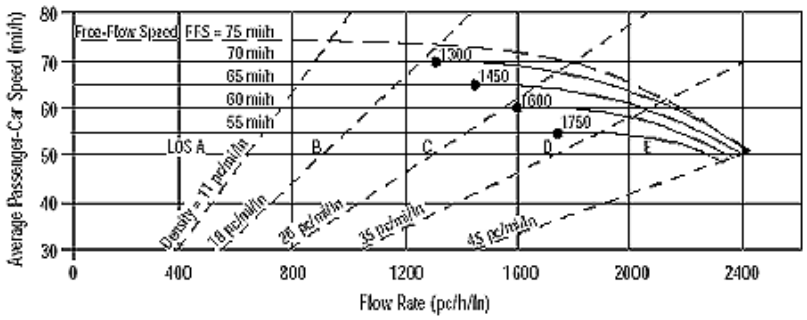
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

General Information		Site Information	
Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	Willow St ONR to Cerritos ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 60

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

Flow Inputs

Volume, V	5390 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Speed Inputs			Calc Speed Adj and FFS		
Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1535	pc/h/ln	Design LOS		
S	69.7	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	22.0	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Cerritos Ave ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 61

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 66.1 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	5390	0.90	Level	5	0	0.976	1.00	6139
Ramp	820	0.90	Level	5	0	0.976	1.00	934
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.165 using Equation 4

V_{12}= 1011 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	7073	See Exhibit 25-7	No
V_{R12}	1945	4600:All	No

Level of Service Determination (if not F)

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

D_R = 19.0 (pc/ m/ln)

LOS = B (Exhibit 25-4)

Speed Estimation

M_S = 0.334 (Exibit 25-19)

S_R= 58.0 mph (Exhibit 25-19)

S_0= 58.0 mph (Exhibit 25-19)

S= 58.0 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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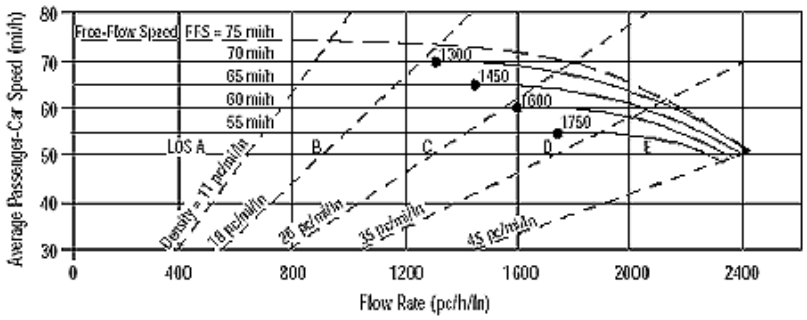
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	Cerritos ONR to
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 62

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

Flow Inputs

Volume, V	6210 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	65.5	mi/h	FFS	65.5	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1768	pc/h/ln	Design LOS		
S	64.6	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	27.4	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Carson OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 63

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 65.5 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	6210	0.90	Level	5	0	0.976	1.00	7073
Ramp	1100	0.90	Level	5	0	0.976	1.00	1253
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3791 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	7073	9420	No
V_{12}	3791	4400:All	No
$V_{FO} = V_F - V_R$	5820	9420	No
V_R	1253	2000	No

Level of Service Determination (if not F)

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

D_R = 34.2 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

D_s = 0.541 (Exhibit 25-19)

S_R= 52.8 mph (Exhibit 25-19)

S_0= 69.4 mph (Exhibit 25-19)

S = 59.4 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 65

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 61.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	5110	0.90	Level	5	0	0.976	1.00	5820
Ramp	460	0.90	Level	5	0	0.976	1.00	524
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.335 using Equation 4

V_{12}= 1952 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	6344	See Exhibit 25-7	No
V_{R12}	2476	4600:All	No

Level of Service Determination (if not F)

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

D_R = 20.9 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.327 (Exibit 25-19)

S_R= 54.8 mph (Exhibit 25-19)

S_0= 55.8 mph (Exhibit 25-19)

S= 55.4 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 68

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 67.6 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7520	0.90	Level	5	0	0.976	1.00	8564
Ramp	540	0.90	Level	5	0	0.976	1.00	615
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.221 using Equation 4

V_{12}= 1889 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9179	See Exhibit 25-7	No
V_{R12}	2504	4600:All	No

Level of Service Determination (if not F)

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

D_R = 23.2 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.351 (Exibit 25-19)

S_R= 58.6 mph (Exhibit 25-19)

S_0= 54.8 mph (Exhibit 25-19)

S= 55.8 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 70

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 66.1 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8060	0.90	Level	5	0	0.976	1.00	9179
Ramp	300	0.90	Level	5	0	0.976	1.00	342
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.239 using Equation 4

V_{12}= 2192 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9521	See Exhibit 25-7	Yes
V_{R12}	2534	4600:All	No

Level of Service Determination (if not F)

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

D_R = 23.8 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.356 (Exibit 25-19)

S_R= 57.5 mph (Exhibit 25-19)

S_0= 52.4 mph (Exhibit 25-19)

S= 53.7 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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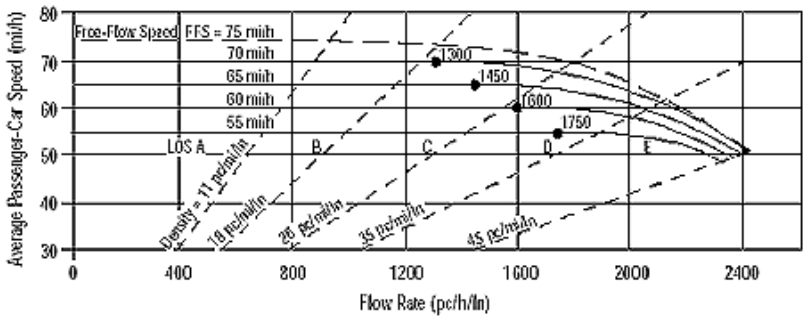
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Carson ONR to 5 lane section
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 71

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

Flow Inputs

Volume, V	8360 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	67.9	mi/h	FFS	67.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2380	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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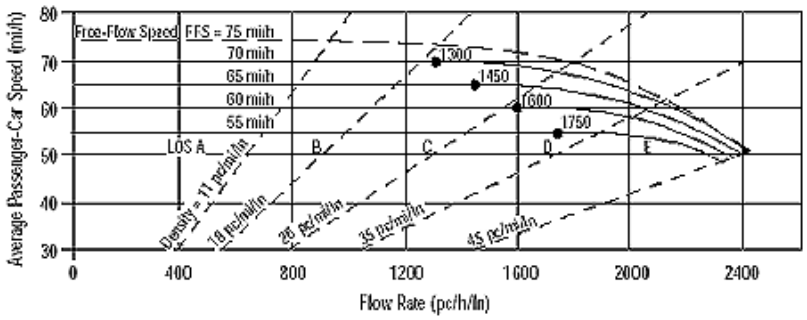
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	5 lane section to Spring OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 72

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

Flow Inputs

Volume, V	8360 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	67.9	mi/h	FFS	67.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1904	pc/h/ln	Design LOS		
S	65.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	29.3	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Spring OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 73

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 67.9 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	8360	0.90	Level	5	0	0.976	1.00	9521
Ramp	1150	0.90	Level	5	0	0.976	1.00	1310
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4060 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	7617	9516	No
V_{12}	4060	4400:All	No
V_{FO} = V_F - V_R	6307	9516	No
V_R	1310	2000	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 37.4 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.611 (Exhibit 25-19)

S_R= 52.1 mph (Exhibit 25-19)

S_0= 71.5 mph (Exhibit 25-19)

S = 59.6 mph (Exhibit 25-15)

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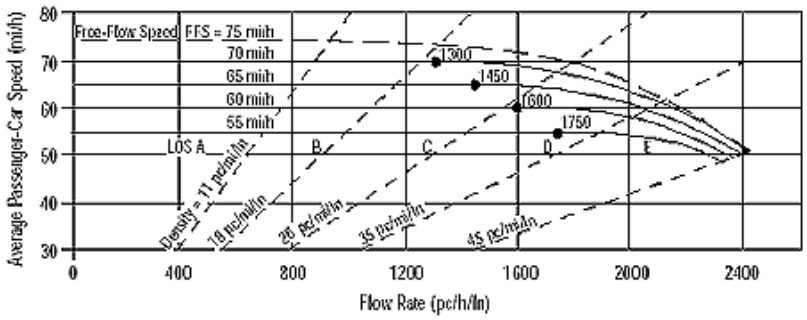
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Spring OFR to Willow OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 74

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

Flow Inputs

Volume, V	7210 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2053	pc/h/ln	Design LOS		
S	63.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	32.2	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Willow OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 75

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 66.2 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	7210	0.90	Level	5	0	0.976	1.00	8211
Ramp	570	0.90	Level	5	0	0.976	1.00	649
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3946 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	8211	9447	No
V_{12}	3946	4400:All	No
$V_{FO} = V_F - V_R$	7562	9447	No
V_R	649	2000	No

Level of Service Determination (if not F)

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

D_R = 36.2 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

D_s = 0.551 (Exhibit 25-19)

S_R= 52.9 mph (Exhibit 25-19)

S_0= 68.2 mph (Exhibit 25-19)

S = 59.9 mph (Exhibit 25-15)

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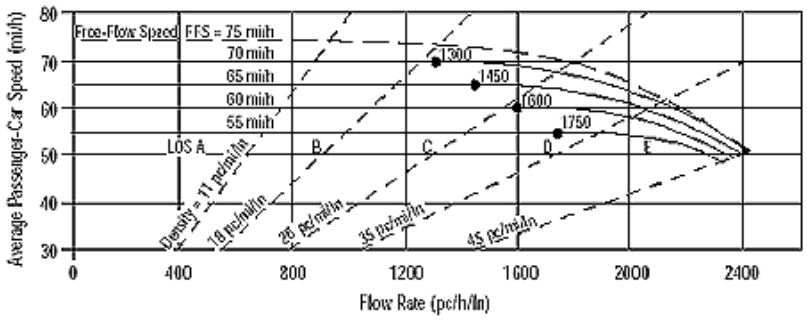

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

General Information		Site Information	
Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Willow OFR to Willow OFR CD
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 76

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

Flow Inputs

Volume, V	6640 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Speed Inputs			Calc Speed Adj and FFS		
Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	66.2	mi/h	FFS	66.2	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1891	pc/h/ln	Design LOS		
S	63.9	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	29.6	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Willow OFR CD
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 77

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 63.9 mph S_{FR} = 30.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	6640	0.90	Level	5	0	0.976	1.00	7562
Ramp	1150	0.90	Level	5	0	0.976	1.00	1310
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 4036 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	7562	9356	No
V_{12}	4036	4400:All	No
$V_{FO} = V_F - V_R$	6252	9356	No
V_R	1310	2000	No

Level of Service Determination (if not F)

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

D_R = 36.9 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

D_s = 0.611 (Exhibit 25-19)

S_R= 50.5 mph (Exhibit 25-19)

S_0= 67.1 mph (Exhibit 25-19)

S = 57.1 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Willow ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 79

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 63.9 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	5480	0.90	Level	5	0	0.976	1.00	6241
Ramp	630	0.90	Level	5	0	0.976	1.00	718
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.415 using Equation 4

V_{12}= 2589 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	6959	See Exhibit 25-7	No
V_{R12}	3307	4600:All	No

Level of Service Determination (if not F)

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

D_R = 25.3 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.364 (Exibit 25-19)

S_R= 55.9 mph (Exhibit 25-19)

S_0= 59.1 mph (Exhibit 25-19)

S= 57.6 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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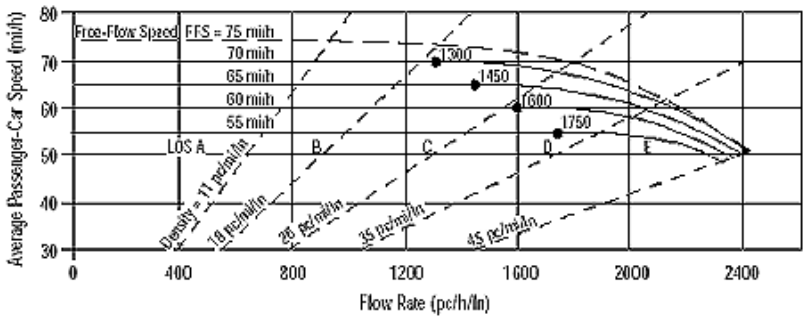
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Willow ONR CD to I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 84

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

Flow Inputs

Volume, V	6120 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	66.5	mi/h	FFS	66.5	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1743	pc/h/ln	Design LOS		
S	65.6	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	26.6	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 85

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 66.5 mph S_{FR} = 50.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	6120	0.90	Level	5	0	0.976	1.00	6970
Ramp	860	0.90	Level	5	0	0.976	1.00	979
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3591 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	6970	9460	No
V_{12}	3591	4400:All	No
$V_{FO} = V_F - V_R$	5991	9460	No
V_R	979	2100	No

Level of Service Determination (if not F)

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

D_R = 32.7 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

D_s = 0.321 (Exhibit 25-19)

S_R= 58.6 mph (Exhibit 25-19)

S_0= 70.3 mph (Exhibit 25-19)

S = 63.7 mph (Exhibit 25-15)

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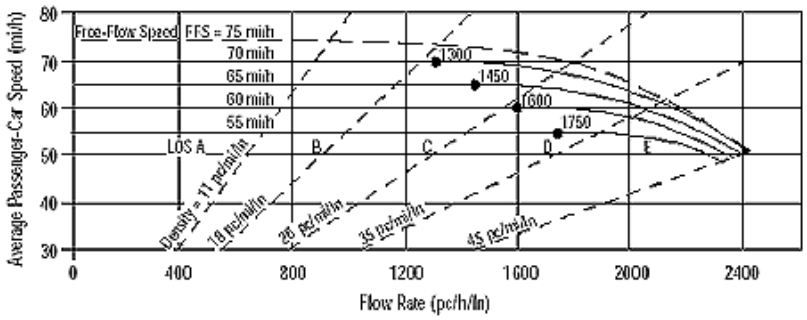
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	I-405 NB OFR to I-405 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 86

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

Flow Inputs

Volume, V	5260 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1498	pc/h/ln	Design LOS		
S	69.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	21.5	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	I-405 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 87

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 66.5 mph S_{FR} = 66.5 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	5260	0.90	Level	5	0	0.976	1.00	5991
Ramp	3330	0.90	Level	5	0	0.976	1.00	3793
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 4364 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	5991	9460	No
V_{12}	4364	4400:All	No
V_{FO} = V_F - V_R	2198	9460	No
V_R	3793	4400	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = -44.6 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.360 (Exhibit 25-19)

S_R= 57.7 mph (Exhibit 25-19)

S_0= 73.0 mph (Exhibit 25-19)

S = 61.2 mph (Exhibit 25-15)

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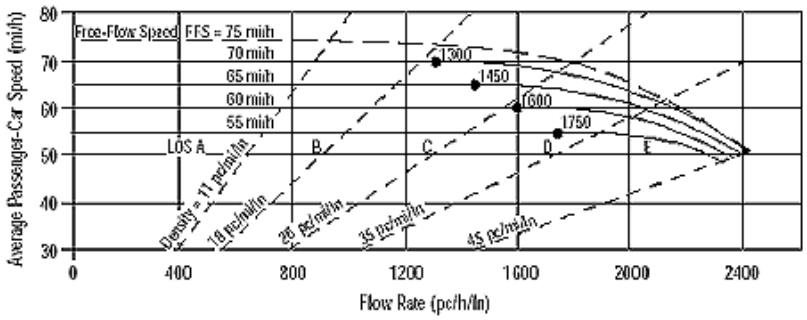
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	I-405 SB OFR to I-405 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 88 coded as 2 lanes, double volume

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

Flow Inputs

Volume, V	3840 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	66.5	mi/h	FFS	66.5	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2187	pc/h/ln	Design LOS	
S	58.3	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
D = v_p / S	37.5	pc/mi/ln	S	mi/h
LOS	E		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	I-405 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 89 coded as 2 lanes, double volume

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 66.5 mph S_{FR} = 50.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	3840	0.90	Level	5	0	0.976	1.00	4373
Ramp	100	0.90	Level	5	0	0.976	1.00	114
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 4373 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4487	See Exhibit 25-7	No
V_{R12}	4487	4600:All	No

Level of Service Determination (if not F)

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

D_R = 38.2 (pc/ m/ln)

LOS = E (Exhibit 25-4)

Speed Estimation

M_S = 0.633 (Exibit 25-19)

S_R= 51.0 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 51.0 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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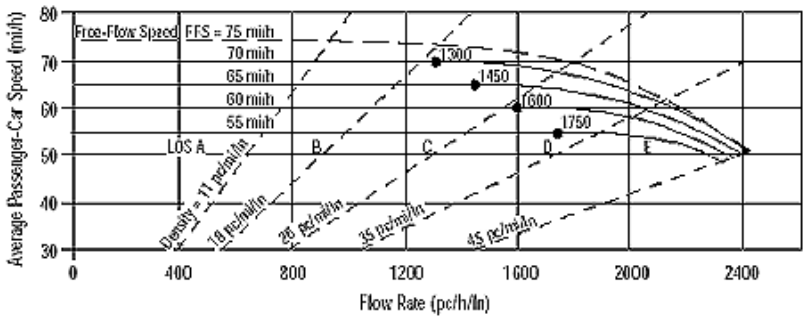
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	I-405 SB ONR to I-405 NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 90 coded as 2 lanes, double volume

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

Flow Inputs

Volume, V	4040 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	66.5	mi/h	FFS	66.5	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2301	pc/h/ln	Design LOS		
S	54.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	42.0	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	7th St WB
Agency or Company	Parsons	Junction	I-405 NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 91 coded for ramp being the mainline

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 55.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	2100	0.90	Level	2	0	0.990	1.00	2357
Ramp	2020	0.90	Level	2	0	0.990	1.00	2267
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 2357 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4624	See Exhibit 25-7	Yes
V_{R12}	4624	4600:All	Yes

Level of Service Determination (if not F)

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

D_R = 38.9 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.691 (Exibit 25-19)

S_R= 46.0 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 46.0 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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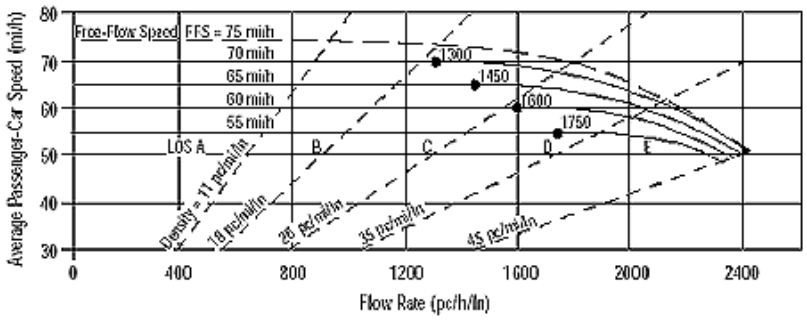
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	7th St WB
Agency or Company	Parsons	From/To	I-405 NB ONR to StudeB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 92

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

Flow Inputs

Volume, V	4120 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	2
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2312	pc/h/ln	Design LOS		
S	56.6	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	40.9	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	7th St WB
Agency or Company	Parsons	Junction	StudeB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 95

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	3270	0.90	Level	2	0	0.990	1.00	3670
Ramp	590	0.90	Level	2	0	0.990	1.00	662
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 3670 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4332	See Exhibit 25-7	No
V_{R12}	4332	4600:All	No

Level of Service Determination (if not F)

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

D_R = 29.6 (pc/ m/ln)

LOS = D (Exhibit 25-4)

Speed Estimation

M_S = 0.513 (Exibit 25-19)

S_R= 48.3 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 48.3 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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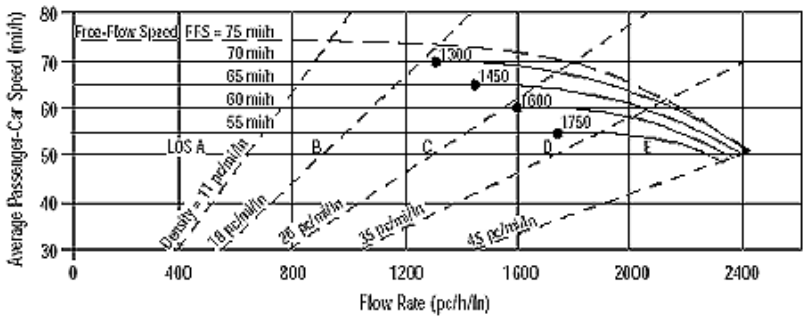
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	7th St WB
Agency or Company	Parsons	From/To	StudeB ONR to
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 96

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

Flow Inputs

Volume, V	3860 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	2
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	3		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1444	pc/h/ln	Design LOS		
S	69.9	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	20.7	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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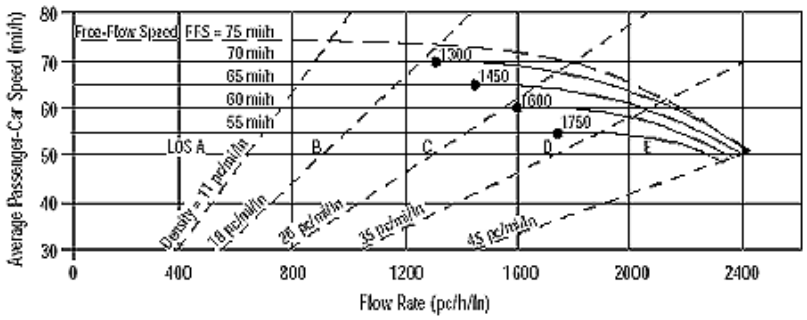
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	7th St EB
Agency or Company	Parsons	From/To	to StudeB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 97

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

Flow Inputs

Volume, V	2950 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	2
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	3		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1104	pc/h/ln	Design LOS		
S	70.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	15.8	pc/mi/ln	S		mi/h
LOS	B		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	7th St EB
Agency or Company	Parsons	Junction	Studebaker OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 98

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	2950	0.90	Level	5	0	0.976	1.00	3360
Ramp	140	0.90	Level	5	0	0.976	1.00	159
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 3360 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	3360	4500	No
V_{12}	3360	4400:All	No
$V_{FO} = V_F - V_R$	3201	4500	No
V_R	159	2000	No

Level of Service Determination (if not F)

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

D_R = 32.0 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

D_s = 0.507 (Exhibit 25-19)

S_R= 48.4 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 48.4 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	7th St EB
Agency or Company	Parsons	Junction	StudeB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 100

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	2810	0.90	Level	2	0	0.990	1.00	3153
Ramp	1330	0.90	Level	2	0	0.990	1.00	1493
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 3153 pc/h

Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4646	See Exhibit 25-7	Yes
V_{R12}	4646	4600:All	Yes

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = 38.5 (pc/ m/ln)

LOS = F (Exhibit 25-4)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.699 (Exibit 25-19)

S_R= 45.9 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 45.9 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Lakewood Blvd Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 101

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 55.0 mph S_{FR} = 20.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	10360	0.90	Level	4	0	0.980	1.00	11741
Ramp	1080	0.90	Level	4	0	0.980	1.00	1224
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 3348 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	9393	9000	Yes
V_{12}	3348	4400:All	No
V_{FO} = V_F - V_R	8169	9000	No
V_R	1224	3500	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 16.8 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.733 (Exhibit 25-19)

S_R= 45.5 mph (Exhibit 25-19)

S_0= 52.4 mph (Exhibit 25-19)

S = 49.7 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Woodruff Ave Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 102

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 45.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9670	0.90	Level	4	0	0.980	1.00	10959
Ramp	650	0.90	Level	4	0	0.980	1.00	737
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4239 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8768	9000	No
V_{12}	4239	4400:All	No
V_{FO} = V_F - V_R	8031	9000	No
V_R	737	2100	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 27.2 (pc/ mi /ln)

LOS= C (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.364 (Exhibit 25-19)

S_R= 50.3 mph (Exhibit 25-19)

S_0= 55.4 mph (Exhibit 25-19)

S = 52.8 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Woodruff Ave Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 103

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 68.0 mph S_{FR} = 25.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9760	0.90	Level	4	0	0.980	1.00	11061
Ramp	840	0.90	Level	4	0	0.980	1.00	952
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4395 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8849	9520	No
V_{12}	4395	4400:All	No
V_{FO} = V_F - V_R	7897	9520	No
V_R	952	1900	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 33.0 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.644 (Exhibit 25-19)

S_R= 51.3 mph (Exhibit 25-19)

S_0= 69.8 mph (Exhibit 25-19)

S = 59.2 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Bellflower Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 104

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 55.0 mph S_{FR} = 20.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9530	0.90	Level	4	0	0.980	1.00	10801
Ramp	560	0.90	Level	4	0	0.980	1.00	635
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4126 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8641	9000	No
V_{12}	4126	4400:All	No
V_{FO} = V_F - V_R	8006	9000	No
V_R	635	1900	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 30.7 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.680 (Exhibit 25-19)

S_R= 46.2 mph (Exhibit 25-19)

S_0= 55.4 mph (Exhibit 25-19)

S = 50.6 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Bellflower Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 105

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 65.3 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	10260	0.90	Level	4	0	0.980	1.00	11628
Ramp	1560	0.90	Level	4	0	0.980	1.00	1768
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 3727 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	9303	9412	No
V_{12}	3727	4400:All	No
$V_{FO} = V_F - V_R$	7535	9412	No
V_R	1768	3800	No

Level of Service Determination (if not F)

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

D_R = 20.1 (pc/ mi /ln)

LOS= C (Exhibit 25-4)

Speed Estimation

D_s = 0.587 (Exhibit 25-19)

S_R= 51.6 mph (Exhibit 25-19)

S_0= 64.7 mph (Exhibit 25-19)

S = 58.7 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Palo Verde Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 106

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 20.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	10160	0.90	Level	4	0	0.980	1.00	11515
Ramp	710	0.90	Level	4	0	0.980	1.00	805
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4470 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	9212	9000	Yes
V_{12}	4470	4400:All	Yes
V_{FO} = V_F - V_R	8407	9000	No
V_R	805	1900	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 28.3 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.695 (Exhibit 25-19)

S_R= 46.0 mph (Exhibit 25-19)

S_0= 55.0 mph (Exhibit 25-19)

S = 50.2 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Studebaker Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 107

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 68.5 mph S_{FR} = 25.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	10170	0.90	Level	4	0	0.980	1.00	11526
Ramp	440	0.90	Level	4	0	0.980	1.00	499
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 4302 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	9221	9540	No
V_{12}	4302	4400:All	No
$V_{FO} = V_F - V_R$	8722	9540	No
V_R	499	1900	No

Level of Service Determination (if not F)

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

D_R = 39.0 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

D_s = 0.603 (Exhibit 25-19)

S_R= 52.5 mph (Exhibit 25-19)

S_0= 69.5 mph (Exhibit 25-19)

S = 60.4 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	7th Street OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 108

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 68.9 mph S_{FR} = 45.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	8320	0.90	Level	4	0	0.980	1.00	9429
Ramp	100	0.90	Level	4	0	0.980	1.00	113
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4175 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	9429	9556	No
V_{12}	4175	4400:All	No
V_{FO} = V_F - V_R	9316	9556	No
V_R	113	2100	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 38.4 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.308 (Exhibit 25-19)

S_R= 60.6 mph (Exhibit 25-19)

S_0= 69.2 mph (Exhibit 25-19)

S = 65.1 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Carson OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 109

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 67.6 mph S_{FR} = 25.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	8840	0.90	Level	5	0	0.976	1.00	10068
Ramp	1320	0.90	Level	5	0	0.976	1.00	1503
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 3207 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8055	9503	No
V_{12}	3207	4400:All	No
V_{FO} = V_F - V_R	6552	9503	No
V_R	1503	3500	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 15.6 (pc/ mi /ln)

LOS= B (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.693 (Exhibit 25-19)

S_R= 49.9 mph (Exhibit 25-19)

S_0= 68.6 mph (Exhibit 25-19)

S = 59.7 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	7th St WB
Agency or Company	Parsons	Junction	Studebaker OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 110

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	4120	0.90	Level	5	0	0.976	1.00	4692
Ramp	840	0.90	Level	5	0	0.976	1.00	957
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =1.000 using Equation 0
V_{12}= pc/h	V_{12} = 4692 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	4692	4500	Yes
V_{12}	4692	4400:All	Yes
V_{FO} = V_F - V_R	3735	4500	No
V_R	957	2000	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 42.6 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.579 (Exhibit 25-19)

S_R= 47.5 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 47.5 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Willow ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 111

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 61.6 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9770	0.90	Level	4	0	0.980	1.00	11073
Ramp	490	0.90	Level	4	0	0.980	1.00	555
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.244 using Equation 4

V_{12}= 2092 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9128	See Exhibit 25-7	No
V_{R12}	2647	4600:All	No

Level of Service Determination (if not F)

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

D_R = 24.0 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.355 (Exibit 25-19)

S_R= 54.6 mph (Exhibit 25-19)

S_0= 49.4 mph (Exhibit 25-19)

S= 50.8 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 112

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9270	0.90	Level	4	0	0.980	1.00	10506
Ramp	850	0.90	Level	4	0	0.980	1.00	963
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.575 using Equation 4

V_{12}= 6044 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11469	See Exhibit 25-7	Yes
V_{R12}	7007	4600:All	Yes

Level of Service Determination (if not F)

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

D_R = 50.3 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 4.523 (Exibit 25-19)

S_R= -3.8 mph (Exhibit 25-19)

S_0= 48.8 mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Bellflower ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 113

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8960	0.90	Level	4	0	0.980	1.00	10155
Ramp	1390	0.90	Level	4	0	0.980	1.00	1575
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.209 using Equation 0

V_{12}= 2122 pc/h

Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11730	See Exhibit 25-7	Yes
V_{R12}	3697	4600:All	No

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = 17.3 (pc/ m/ln)

LOS = F (Exhibit 25-4)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.296 (Exibit 25-19)

S_R= 51.1 mph (Exhibit 25-19)

S_0= 38.2 mph (Exhibit 25-19)

S= 41.5 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Bellflower ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 114

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 66.7 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8690	0.90	Level	4	0	0.980	1.00	9849
Ramp	1060	0.90	Level	4	0	0.980	1.00	1201
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.386 using Equation 4

V_{12}= 3804 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11050	See Exhibit 25-7	Yes
V_{R12}	5005	4600:All	Yes

Level of Service Determination (if not F)

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

D_R = 37.7 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.833 (Exibit 25-19)

S_R= 46.1 mph (Exhibit 25-19)

S_0= 55.8 mph (Exhibit 25-19)

S= 51.0 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Woodruff ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 115

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9020	0.90	Level	4	0	0.980	1.00	10223
Ramp	510	0.90	Level	4	0	0.980	1.00	578
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.432 using Equation 4

V_{12}= 4419 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10801	See Exhibit 25-7	Yes
V_{R12}	4997	4600:All	Yes

Level of Service Determination (if not F)

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

D_R = 38.5 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.835 (Exibit 25-19)

S_R= 44.1 mph (Exhibit 25-19)

S_0= 44.9 mph (Exhibit 25-19)

S= 44.5 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Palo Verde ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 116

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9450	0.90	Level	4	0	0.980	1.00	10710
Ramp	220	0.90	Level	4	0	0.980	1.00	249
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.760 using Equation 4

V_{12}= 8141 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10959	See Exhibit 25-7	Yes
V_{R12}	8390	4600:All	Yes

Level of Service Determination (if not F)

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

D_R = 59.5 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 17.366 (Exibit 25-19)

S_R= -170.8 mph (Exhibit 25-19)

S_0= 52.2 mph (Exhibit 25-19)

S= 107669.4 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Stearns ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 117

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 68.2 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9610	0.90	Level	4	0	0.980	1.00	10891
Ramp	570	0.90	Level	4	0	0.980	1.00	646
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.233 using Equation 4

V_{12}= 2533 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11537	See Exhibit 25-7	Yes
V_{R12}	3179	4600:All	No

Level of Service Determination (if not F)

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

D_R = 28.1 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.394 (Exibit 25-19)

S_R= 57.9 mph (Exhibit 25-19)

S_0= 50.4 mph (Exhibit 25-19)

S= 52.3 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Studebaker ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 118

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9830	0.90	Level	4	0	0.980	1.00	11141
Ramp	330	0.90	Level	4	0	0.980	1.00	374
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.744 using Equation 4

V_{12}= 8294 pc/h

Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11515	See Exhibit 25-7	Yes
V_{R12}	8668	4600:All	Yes

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = 61.6 (pc/ m/ln)

LOS = F (Exhibit 25-4)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 22.869 (Exibit 25-19)

S_R= -242.3 mph (Exhibit 25-19)

S_0= 51.7 mph (Exhibit 25-19)

S= 596.1 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 119

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 59.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	5570	0.90	Level	5	0	0.976	1.00	6344
Ramp	830	0.90	Level	5	0	0.976	1.00	945
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.227 using Equation 4

V_{12}= 1441 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	7289	See Exhibit 25-7	No
V_{R12}	2386	4600:All	No

Level of Service Determination (if not F)

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

D_R = 21.1 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.335 (Exibit 25-19)

S_R= 53.8 mph (Exhibit 25-19)

S_0= 52.4 mph (Exhibit 25-19)

S= 52.8 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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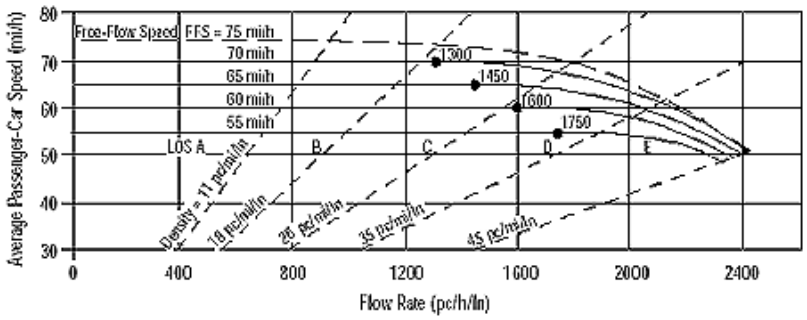
PM Peak Hour

BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	To Lakewood Blvd off ramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 1

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

Flow Inputs

Volume, V	11130 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2523	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood Blvd Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 2

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	11130	0.90	Level	4	0	0.980	1.00	12614
Ramp	1480	0.90	Level	4	0	0.980	1.00	1677
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 3865 pc/h

Capacity Checks

	Actual	Maximum	LOS F?		Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7		V_{FI}=V_F	10092	9000	Yes
				V_{12}	3865	4400:All	No
V_{R12}		4600:All		V_{FO} = V_F - V_R	8415	9000	No
				V_R	1677	3800	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 23.1 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.644 (Exhibit 25-19)

S_R= 46.6 mph (Exhibit 25-19)

S_0= 52.1 mph (Exhibit 25-19)

S = 49.9 mph (Exhibit 25-15)

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	Lakewood on - Willow St off
Jurisdiction	
Analysis Year	2040 Alt 3

Inputs

Freeway free-flow speed, SFF (mi/h)	35	Weaving type	A
Weaving number of lanes, N	2	Volume ratio, VR	1.00
Weaving seg length, L (ft)	930	Weaving ratio, R	0.41
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vo2	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vw1	350	0.90	4	0	1.5	1.2	0.980	1.00	396
Vw2	510	0.90	4	0	1.5	1.2	0.980	1.00	578
Vw				974	Vnw				0
V									974

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			2.74	0.59
Weaving and non-weaving speeds, Si (mi/h)			21.68	30.70

Number of lanes required for unconstrained operation, Nw 1.74
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	21.68
Weaving segment density, D (pc/mi/ln)	22.47
Level of service, LOS	C
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 8

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9650	0.90	Level	4	0	0.980	1.00	10937
Ramp	440	0.90	Level	4	0	0.980	1.00	499
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.538 using Equation 4

V_{12}= 5881 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11436	See Exhibit 25-7	Yes
V_{R12}	6380	4600:All	Yes

Level of Service Determination (if not F)

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

D_R = 47.5 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 2.538 (Exibit 25-19)

S_R= 22.0 mph (Exhibit 25-19)

S_0= 47.1 mph (Exhibit 25-19)

S= 28.8 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	Willow ONR - L Coyotes OFR
Jurisdiction	
Analysis Year	2040 Alt 3

Inputs

Freeway free-flow speed, SFF (mi/h)	41	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.24
Weaving seg length, L (ft)	1200	Weaving ratio, R	0.22
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	8038	0.90	4	0	1.5	1.2	0.980	1.00	9109
Vo2	108	0.90	4	0	1.5	1.2	0.980	1.00	122
Vw1	2052	0.90	4	0	1.5	1.2	0.980	1.00	2325
Vw2	572	0.90	4	0	1.5	1.2	0.980	1.00	648
Vw				2973	Vnw				9231
V									12204

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			3.76	0.59
Weaving and non-weaving speeds, Si (mi/h)			21.52	34.44

Number of lanes required for unconstrained operation, Nw 2.05
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	30.04
Weaving segment density, D (pc/mi/ln)	81.24
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	9008
Capacity as a 15-minute flow rate, c (veh/h)	8831
Capacity as a full-hour volume, c_h (veh/h)	7948

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	L Coyotes ONR - BellFl OFR
Jurisdiction	
Analysis Year	2040 Alt 3

Inputs

Freeway free-flow speed, SFF (mi/h)	35	Weaving type	A
Weaving number of lanes, N	2	Volume ratio, VR	1.00
Weaving seg length, L (ft)	650	Weaving ratio, R	0.21
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vo2	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vw1	150	0.90	4	0	1.5	1.2	0.980	1.00	170
Vw2	40	0.90	4	0	1.5	1.2	0.980	1.00	45
Vw				215	Vnw				0
V									215

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			0.84	0.11
Weaving and non-weaving speeds, Si (mi/h)			28.56	37.55

Number of lanes required for unconstrained operation, Nw 1.45
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	28.56
Weaving segment density, D (pc/mi/ln)	3.76
Level of service, LOS	A
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	L Coyotes ONR - Woodruff OFR
Jurisdiction	
Analysis Year	2040 Alt 3

Inputs

Freeway free-flow speed, SFF (mi/h)	39	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.21
Weaving seg length, L (ft)	1100	Weaving ratio, R	0.28
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	8021	0.90	4	0	1.5	1.2	0.980	1.00	9090
Vo2	31	0.90	4	0	1.5	1.2	0.980	1.00	35
Vw1	589	0.90	4	0	1.5	1.2	0.980	1.00	667
Vw2	1499	0.90	4	0	1.5	1.2	0.980	1.00	1698
Vw				2365	Vnw				9125
V									11490

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			3.55	0.52
Weaving and non-weaving speeds, Si (mi/h)			21.37	34.10

Number of lanes required for unconstrained operation, Nw 1.84
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	30.37
Weaving segment density, D (pc/mi/ln)	75.66
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	8904
Capacity as a 15-minute flow rate, c (veh/h)	8729
Capacity as a full-hour volume, c_h (veh/h)	7856

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Woodruff ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 22

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9520	0.90	Level	4	0	0.980	1.00	10789
Ramp	330	0.90	Level	4	0	0.980	1.00	374
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.235 using Equation 4

V_{12}= 2533 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11163	See Exhibit 25-7	Yes
V_{R12}	2907	4600:All	No

Level of Service Determination (if not F)

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

D_R = 26.7 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.378 (Exibit 25-19)

S_R= 50.1 mph (Exhibit 25-19)

S_0= 37.5 mph (Exhibit 25-19)

S= 40.1 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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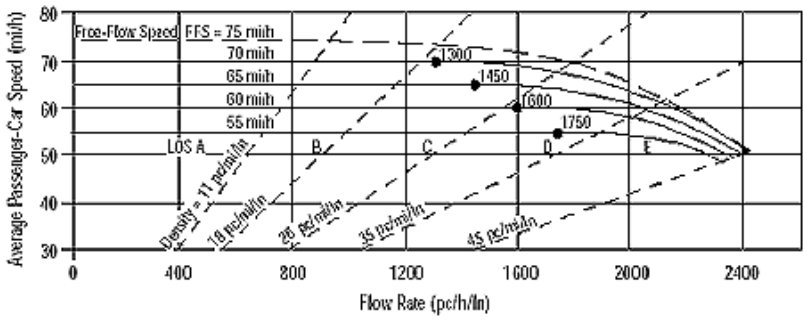
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	Woodruff ONR to Stearns ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 23

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

Flow Inputs

Volume, V	9850 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2791	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/17/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 SB
Weaving Seg Location	Stearns ONR to Studebaker OFR
Jurisdiction	
Analysis Year	2040 Alt 3

Inputs

Freeway free-flow speed, SFF (mi/h)	52	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.09
Weaving seg length, L (ft)	1100	Weaving ratio, R	0.29
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	9584	0.90	4	0	1.5	1.2	0.980	1.00	10861
Vo2	14	0.90	4	0	1.5	1.2	0.980	1.00	15
Vw1	266	0.90	4	0	1.5	1.2	0.980	1.00	301
Vw2	666	0.90	4	0	1.5	1.2	0.980	1.00	754
Vw				1055	Vnw				10876
V									11931

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.67	0.24		
Weaving and non-weaving speeds, Si (mi/h)	40.11	48.89		

Number of lanes required for unconstrained operation, Nw 1.01
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	47.96
Weaving segment density, D (pc/mi/ln)	49.75
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	10836
Capacity as a 15-minute flow rate, c (veh/h)	10624
Capacity as a full-hour volume, c_h (veh/h)	9562

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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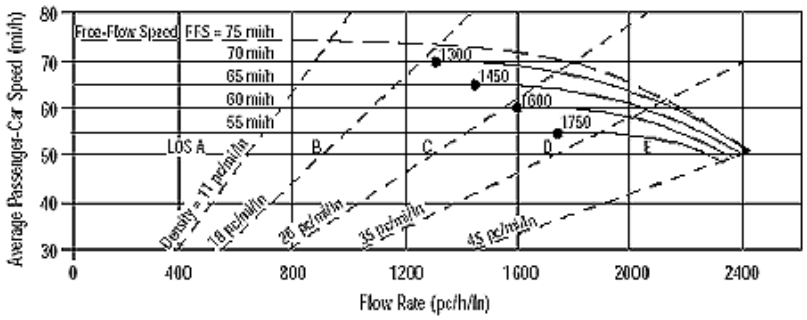
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	Studebaker OFR to 605NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 25

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

Flow Inputs

Volume, V	10240 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2321	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	I-605 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 26

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 50.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	10240	0.90	Level	4	0	0.980	1.00	11605
Ramp	1220	0.90	Level	4	0	0.980	1.00	1383
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 3437 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	9284	9000	Yes
V_{12}	3437	4400:All	No
$V_{FO} = V_F - V_R$	7901	9000	No
V_R	1383	4100	No

Level of Service Determination (if not F)

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

D_R = 7.7 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

D_s = 0.357 (Exhibit 25-19)

S_R= 50.4 mph (Exhibit 25-19)

S_0= 52.8 mph (Exhibit 25-19)

S = 51.9 mph (Exhibit 25-15)

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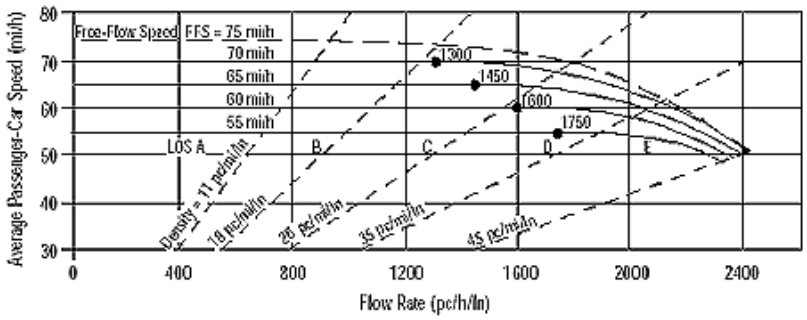
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	I-605 NB OFR to I-605 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 27

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

Flow Inputs

Volume, V	9030 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2559	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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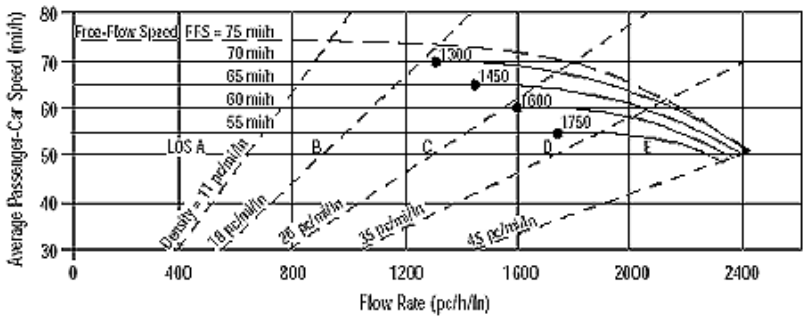
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	I-605 SB OFR to I-605 Sb ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 29

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

Flow Inputs

Volume, V	8850 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2508	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	I-605 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 30

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8850	0.90	Level	4	0	0.980	1.00	10030
Ramp	3110	0.90	Level	4	0	0.980	1.00	3525
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.209 using Equation 0

V_{12}= 2096 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	13555	See Exhibit 25-7	Yes
V_{R12}	5621	4600:All	Yes

Level of Service Determination (if not F)

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

D_R = 29.5 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 1.195 (Exibit 25-19)

S_R= 39.5 mph (Exhibit 25-19)

S_0= 38.5 mph (Exhibit 25-19)

S= 38.9 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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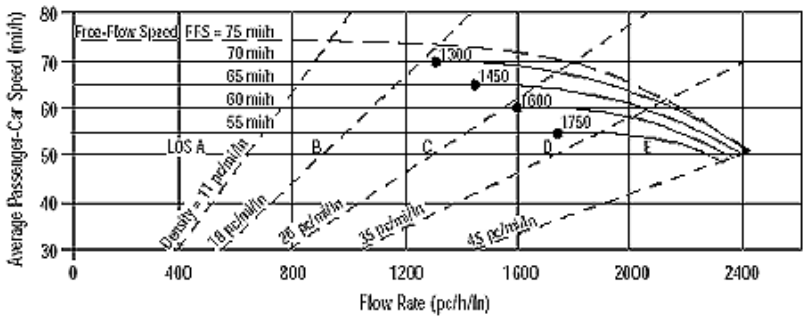
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	I-605 SB ONR to 7th St ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 31

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

Flow Inputs

Volume, V	11960 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	68.9	mi/h	FFS	68.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2711	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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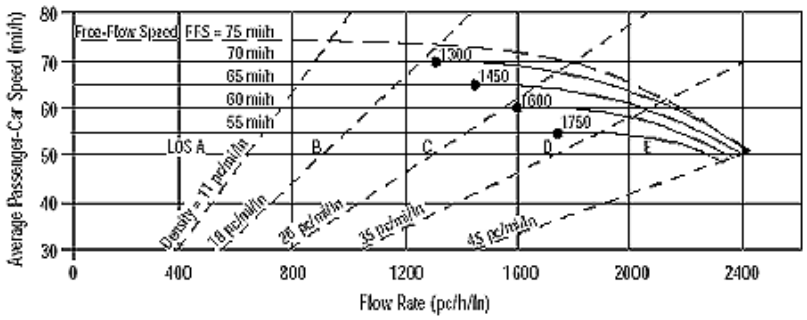
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	to I-605 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 32

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

Flow Inputs

Volume, V	14570 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	63.8	mi/h	FFS	63.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	3303	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	I-605 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 33

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 63.8 mph S_{FR} = 50.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	14570	0.90	Level	4	0	0.980	1.00	16513
Ramp	4790	0.90	Level	4	0	0.980	1.00	5429
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 7452 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	13211	9351	Yes
V_{12}	7452	4400:All	Yes
V_{FO} = V_F - V_R	7782	9351	No
V_R	5429	4100	Yes

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 25.1 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.722 (Exhibit 25-19)

S_R= 48.1 mph (Exhibit 25-19)

S_0= 62.7 mph (Exhibit 25-19)

S = 53.5 mph (Exhibit 25-15)

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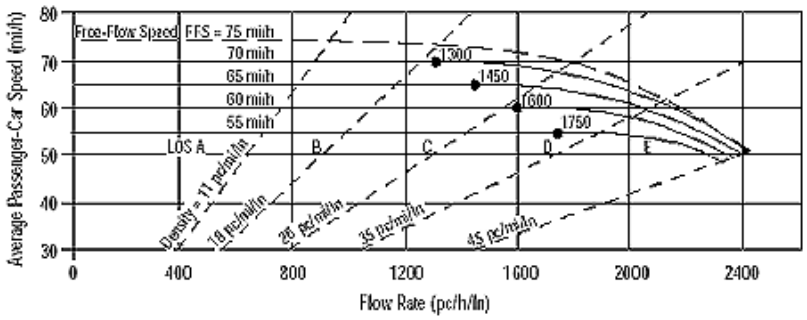

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	I-605 NB OFR to I-605 Sb OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 34

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

Flow Inputs

Volume, V	9780 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	63.8	mi/h	FFS	63.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2771	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	I-605 SB/NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 35

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 63.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9780	0.90	Level	4	0	0.980	1.00	11084
Ramp	1550	0.90	Level	4	0	0.980	1.00	1757
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.380 using Equation 4

V_{12}= 4217 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	12841	See Exhibit 25-7	Yes
V_{R12}	5974	4600:All	Yes

Level of Service Determination (if not F)

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

D_R = 43.7 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 1.770 (Exibit 25-19)

S_R= 25.2 mph (Exhibit 25-19)

S_0= 50.5 mph (Exhibit 25-19)

S= 34.4 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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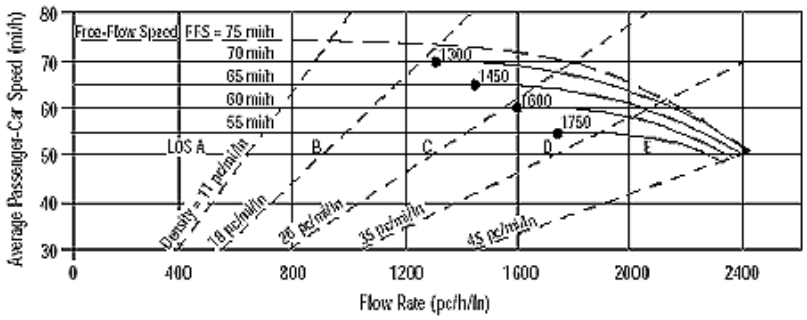

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	I-605 NB/SB ONR to Studeba ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 36

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

Flow Inputs

Volume, V	11330 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	63.8	mi/h	FFS	63.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	3210	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Studeb ONR - Palo Verde OFR
Jurisdiction	
Analysis Year	2040 Alt 3

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.10
Weaving seg length, L (ft)	1700	Weaving ratio, R	0.27
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	43	0.90	4	0	1.5	1.2	0.980	1.00	48
Vo2	10513	0.90	4	0	1.5	1.2	0.980	1.00	11914
Vw1	297	0.90	4	0	1.5	1.2	0.980	1.00	336
Vw2	817	0.90	4	0	1.5	1.2	0.980	1.00	925
Vw				1261	Vnw				11962
V									13223

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	1.00	0.54		
Weaving and non-weaving speeds, Si (mi/h)	42.55	50.83		

Number of lanes required for unconstrained operation, Nw 1.07
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	49.90
Weaving segment density, D (pc/mi/ln)	53.00
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	11220
Capacity as a 15-minute flow rate, c (veh/h)	11000
Capacity as a full-hour volume, c_h (veh/h)	9900

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Palo Verde ONR to Woodruff OFR
Jurisdiction	
Analysis Year	2040 Alt 3

Inputs

Freeway free-flow speed, SFF (mi/h)	66	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.06
Weaving seg length, L (ft)	1750	Weaving ratio, R	0.49
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	fHV	fp	v
Vo1	18	0.90	4	0	1.5	1.2	0.980	1.00	20
Vo2	10458	0.90	4	0	1.5	1.2	0.980	1.00	11852
Vw1	332	0.90	4	0	1.5	1.2	0.980	1.00	376
Vw2	342	0.90	4	0	1.5	1.2	0.980	1.00	387
Vw				763	Vnw				11872
V									12635

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.87	0.43		
Weaving and non-weaving speeds, Si (mi/h)	44.99	54.06		

Number of lanes required for unconstrained operation, Nw 0.81
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	53.41
Weaving segment density, D (pc/mi/ln)	47.31
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	11339
Capacity as a 15-minute flow rate, c (veh/h)	11117
Capacity as a full-hour volume, c_h (veh/h)	10005

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Woodruff ONR to Bellflower OFR
Jurisdiction	
Analysis Year	2040 Alt 3

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.08
Weaving seg length, L (ft)	890	Weaving ratio, R	0.35
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	31	0.90	4	0	1.5	1.2	0.980	1.00	35
Vo2	10201	0.90	4	0	1.5	1.2	0.980	1.00	11561
Vw1	319	0.90	4	0	1.5	1.2	0.980	1.00	361
Vw2	589	0.90	4	0	1.5	1.2	0.980	1.00	667
Vw				1028	Vnw				11596
V									12624

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	1.55	0.78		
Weaving and non-weaving speeds, Si (mi/h)	36.53	45.94		

Number of lanes required for unconstrained operation, Nw 0.90
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	44.99
Weaving segment density, D (pc/mi/ln)	56.12
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	10148
Capacity as a 15-minute flow rate, c (veh/h)	9949
Capacity as a full-hour volume, c_h (veh/h)	8954

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/17/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Bellflower ONR to Lakewood OFR
Jurisdiction	
Analysis Year	2040 Alt 3

Inputs

Freeway free-flow speed, SFF (mi/h)	66	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.17
Weaving seg length, L (ft)	1300	Weaving ratio, R	0.46
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	fHV	fp	v
Vo1	55	0.90	4	0	1.5	1.2	0.980	1.00	62
Vo2	9505	0.90	4	0	1.5	1.2	0.980	1.00	10772
Vw1	875	0.90	4	0	1.5	1.2	0.980	1.00	991
Vw2	1015	0.90	4	0	1.5	1.2	0.980	1.00	1150
Vw				2141	Vnw				10834
V									12975

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.76	0.36		
Weaving and non-weaving speeds, Si (mi/h)	46.78	56.18		

Number of lanes required for unconstrained operation, Nw 1.06
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	54.38
Weaving segment density, D (pc/mi/ln)	47.72
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	11557
Capacity as a 15-minute flow rate, c (veh/h)	11330
Capacity as a full-hour volume, c_h (veh/h)	10197

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 46

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 65.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	11040	0.90	Level	4	0	0.980	1.00	12512
Ramp	360	0.90	Level	4	0	0.980	1.00	408
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.326 using Equation 4

V_{12}= 3265 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10420	See Exhibit 25-7	Yes
V_{R12}	3673	4600:All	No

Level of Service Determination (if not F)

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

D_R = 30.8 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.440 (Exibit 25-19)

S_R= 55.3 mph (Exhibit 25-19)

S_0= 52.8 mph (Exhibit 25-19)

S= 53.7 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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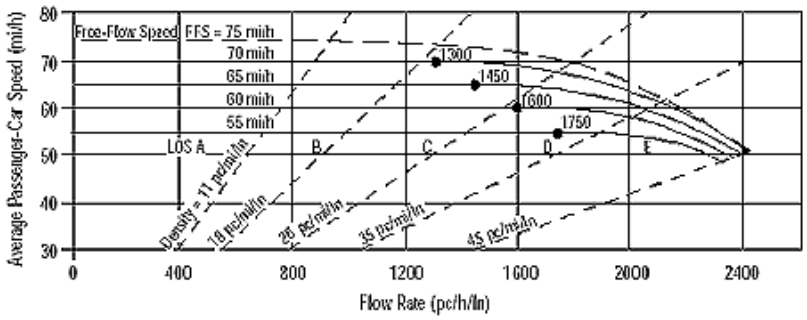
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	Lakewood ONR to
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 47

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

Flow Inputs

Volume, V	11410 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	4
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.980

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	60.9	mi/h	FFS	60.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2586	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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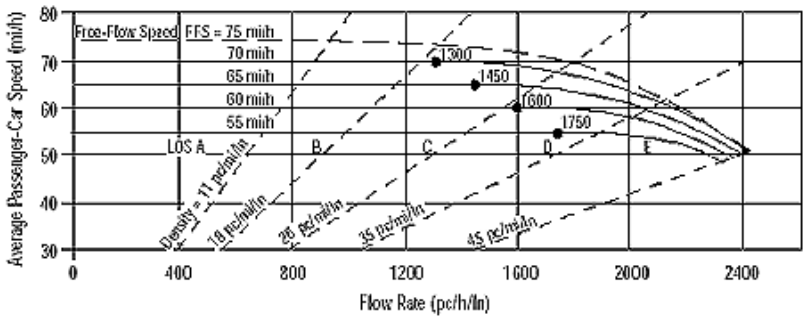
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	to I-40 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 48

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

Flow Inputs

Volume, V	3560 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	2
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1998	pc/h/ln	Design LOS		
S	64.9	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	30.8	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	I-405 OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 49

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	3560	0.90	Level	5	0	0.976	1.00	4054
Ramp	3060	0.90	Level	5	0	0.976	1.00	3485
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 4054 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	4054	4500	No
V_{12}	4054	4400:All	No
$V_{FO} = V_F - V_R$	569	4500	No
V_R	3485	3800	No

Level of Service Determination (if not F)

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

D_R = 20.2 (pc/ mi /ln)

LOS= C (Exhibit 25-4)

Speed Estimation

D_s = 0.742 (Exhibit 25-19)

S_R= 45.4 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 45.4 mph (Exhibit 25-15)

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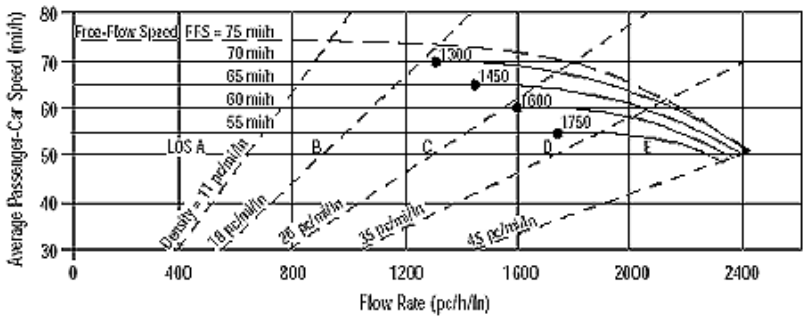
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 SB OFR to I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 50

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

Flow Inputs

Volume, V	500 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	60.0	mi/h	FFS	60.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	285	pc/h/ln	Design LOS		
S	60.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	4.8	pc/mi/ln	S		mi/h
LOS	A		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 51

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 62.8 mph S_{FR} = 50.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	500	0.90	Level	5	0	0.976	1.00	569
Ramp	460	0.90	Level	5	0	0.976	1.00	524
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 569 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	569	4655	No
V_{12}	569	4400:All	No
$V_{FO} = V_F - V_R$	45	4655	No
V_R	524	2100	No

Level of Service Determination (if not F)

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

D_R = -0.8 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.280 (Exhibit 25-19)

S_R= 56.9 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 56.9 mph (Exhibit 25-15)

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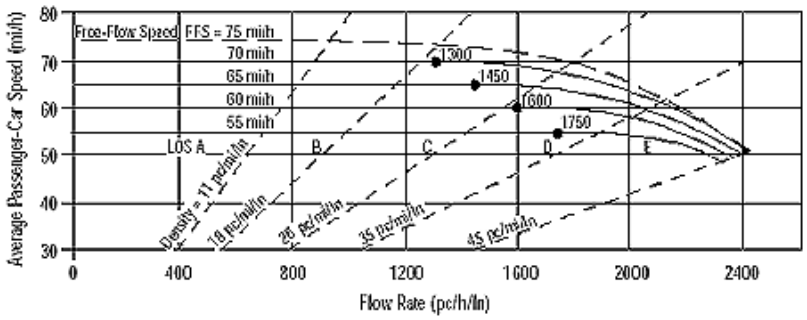
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 NB OFR to I-405 NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 52

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

Flow Inputs

Volume, V	200 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	62.8	mi/h	FFS	62.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	114	pc/h/ln	Design LOS		
S	62.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	1.8	pc/mi/ln	S		mi/h
LOS	A		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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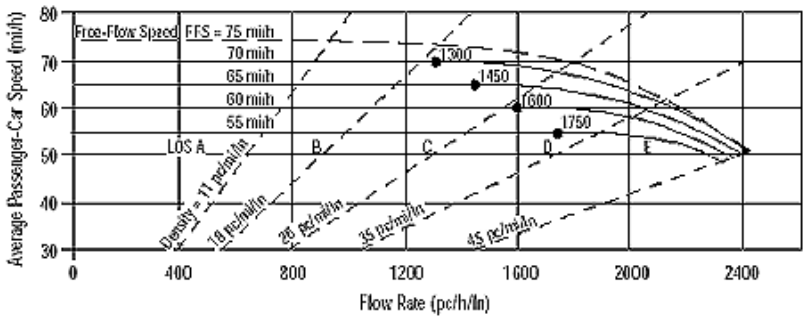
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 NB ONR to I-405 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 54

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

Flow Inputs

Volume, V	4790 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	62.8	mi/h	FFS	62.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1364	pc/h/ln	Design LOS		
S	62.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	21.7	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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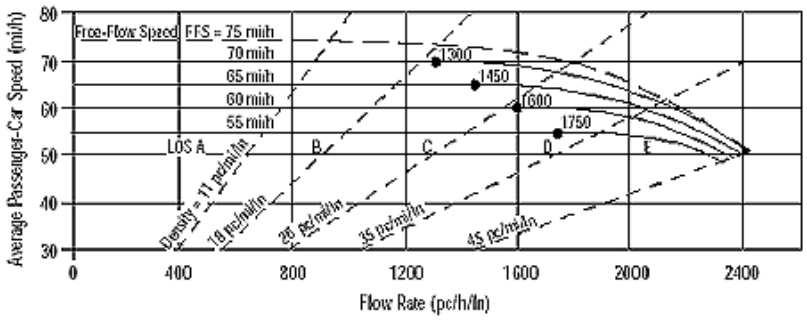
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 SB ONR to Willow St OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 56

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

Flow Inputs

Volume, V	6210 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	62.8	mi/h	FFS	62.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1415	pc/h/ln	Design LOS		
S	62.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	22.5	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Willow St OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 57

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 62.8 mph S_{FR} = 40.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	6210	0.90	Level	5	0	0.976	1.00	7073
Ramp	1800	0.90	Level	5	0	0.976	1.00	2050
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3624 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	5659	9311	No
V_{12}	3624	4400:All	No
$V_{FO} = V_F - V_R$	3609	9311	No
V_R	2050	2100	No

Level of Service Determination (if not F)

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

D_R = 6.6 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.548 (Exhibit 25-19)

S_R= 51.4 mph (Exhibit 25-19)

S_0= 68.8 mph (Exhibit 25-19)

S = 56.6 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Willow St ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 59

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 67.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	4420	0.90	Level	5	0	0.976	1.00	5034
Ramp	1530	0.90	Level	5	0	0.976	1.00	1743
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.183 using Equation 4

V_{12}= 922 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	6777	See Exhibit 25-7	No
V_{R12}	2665	4600:All	No

Level of Service Determination (if not F)

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

D_R = 21.9 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.337 (Exibit 25-19)

S_R= 59.1 mph (Exhibit 25-19)

S_0= 62.2 mph (Exhibit 25-19)

S= 60.9 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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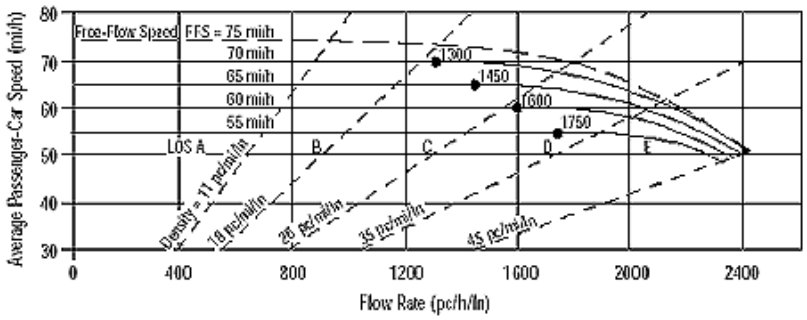

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	Willow St ONR to Cerritos ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 60

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

Flow Inputs

Volume, V	5950 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1694	pc/h/ln	Design LOS		
S	68.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	24.6	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Cerritos Ave ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 61

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 60.5 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	5950	0.90	Level	5	0	0.976	1.00	6776
Ramp	1110	0.90	Level	5	0	0.976	1.00	1264
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.124 using Equation 4

V_{12}= 837 pc/h

Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8040	See Exhibit 25-7	No
V_{R12}	2101	4600:All	No

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = 20.0 (pc/ m/ln)

LOS = C (Exhibit 25-4)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.339 (Exibit 25-19)

S_R= 54.2 mph (Exhibit 25-19)

S_0= 50.0 mph (Exhibit 25-19)

S= 51.0 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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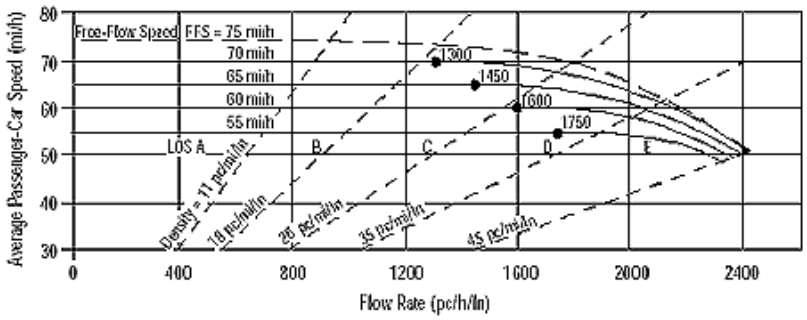
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	Cerritos ONR to
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 62

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

Flow Inputs

Volume, V	7060 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	59.6	mi/h	FFS	59.6	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2010	pc/h/ln	Design LOS		
S	57.5	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	35.0	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Carson OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 63

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 59.6 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	7060	0.90	Level	5	0	0.976	1.00	8041
Ramp	1020	0.90	Level	5	0	0.976	1.00	1162
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 4161 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	8041	9183	No
V_{12}	4161	4400:All	No
$V_{FO} = V_F - V_R$	6879	9183	No
V_R	1162	2000	No

Level of Service Determination (if not F)

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

D_R = 37.3 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

D_s = 0.533 (Exhibit 25-19)

S_R= 50.2 mph (Exhibit 25-19)

S_0= 61.7 mph (Exhibit 25-19)

S = 55.2 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 65

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 58.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	6040	0.90	Level	5	0	0.976	1.00	6879
Ramp	490	0.90	Level	5	0	0.976	1.00	558
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.331 using Equation 4

V_{12}= 2279 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	7437	See Exhibit 25-7	No
V_{R12}	2837	4600:All	No

Level of Service Determination (if not F)

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

D_R = 23.7 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.347 (Exibit 25-19)

S_R= 52.4 mph (Exhibit 25-19)

S_0= 51.5 mph (Exhibit 25-19)

S= 51.8 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 68

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 65.4 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7370	0.90	Level	5	0	0.976	1.00	8394
Ramp	500	0.90	Level	5	0	0.976	1.00	569
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.226 using Equation 4

V_{12}= 1900 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8963	See Exhibit 25-7	No
V_{R12}	2469	4600:All	No

Level of Service Determination (if not F)

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

D_R = 22.9 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.350 (Exibit 25-19)

S_R= 57.2 mph (Exhibit 25-19)

S_0= 53.2 mph (Exhibit 25-19)

S= 54.2 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 70

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 63.5 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7870	0.90	Level	5	0	0.976	1.00	8963
Ramp	350	0.90	Level	5	0	0.976	1.00	399
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.232 using Equation 4

V_{12}= 2076 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9362	See Exhibit 25-7	Yes
V_{R12}	2475	4600:All	No

Level of Service Determination (if not F)

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

D_R = 23.3 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.353 (Exibit 25-19)

S_R= 55.9 mph (Exhibit 25-19)

S_0= 50.1 mph (Exhibit 25-19)

S= 51.5 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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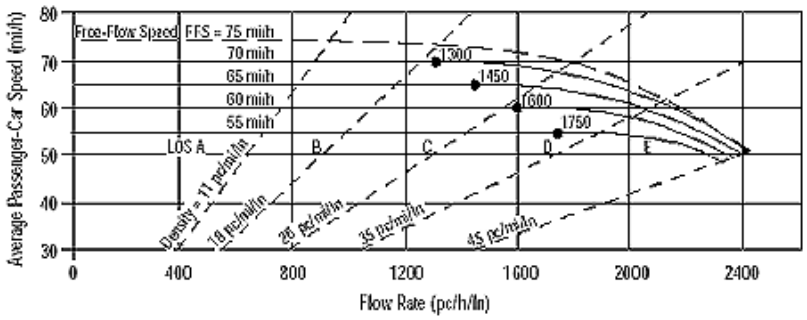
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Carson ONR to 5 lane section
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 71

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

Flow Inputs

Volume, V	8220 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	63.8	mi/h	FFS	63.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2340	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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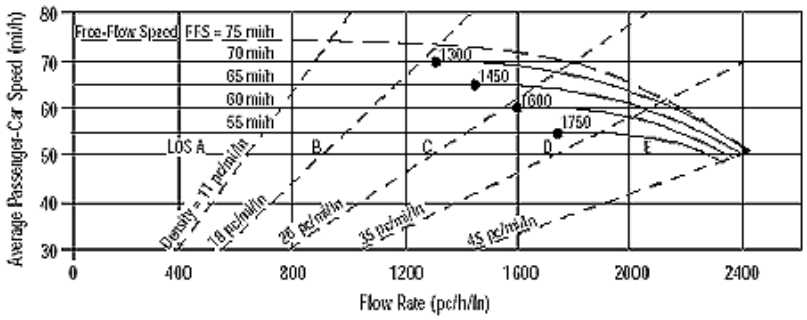
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	5 lane section to Spring OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 72

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

Flow Inputs

Volume, V	8220 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	63.8	mi/h	FFS	63.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1872	pc/h/ln	Design LOS		
S	62.3	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	30.1	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Spring OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 73

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 63.8 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	8220	0.90	Level	5	0	0.976	1.00	9362
Ramp	1520	0.90	Level	5	0	0.976	1.00	1731
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 4242 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	7490	9351	No
V_{12}	4242	4400:All	No
$V_{FO} = V_F - V_R$	5759	9351	No
V_R	1731	2000	No

Level of Service Determination (if not F)

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

D_R = 38.9 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

D_s = 0.649 (Exhibit 25-19)

S_R= 49.7 mph (Exhibit 25-19)

S_0= 67.6 mph (Exhibit 25-19)

S = 56.1 mph (Exhibit 25-15)

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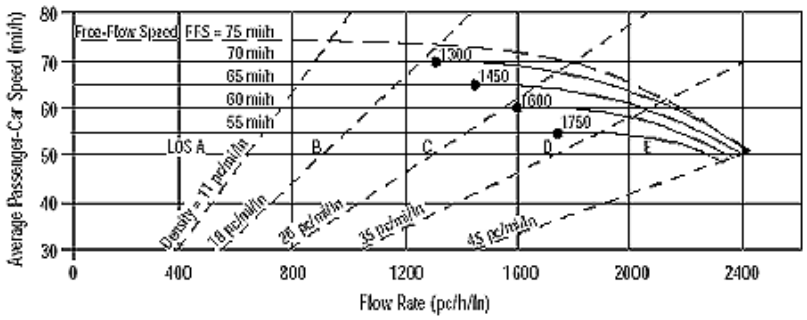
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Spring OFR to Willow OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 74

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

Flow Inputs

Volume, V	6690 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1905	pc/h/ln	Design LOS		
S	66.5	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	28.7	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Willow OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 75

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 61.4 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	6690	0.90	Level	5	0	0.976	1.00	7619
Ramp	540	0.90	Level	5	0	0.976	1.00	615
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3669 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	7619	9256	No
V_{12}	3669	4400:All	No
$V_{FO} = V_F - V_R$	7004	9256	No
V_R	615	2000	No

Level of Service Determination (if not F)

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

D_R = 33.8 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

D_s = 0.548 (Exhibit 25-19)

S_R= 50.8 mph (Exhibit 25-19)

S_0= 63.6 mph (Exhibit 25-19)

S = 56.7 mph (Exhibit 25-15)

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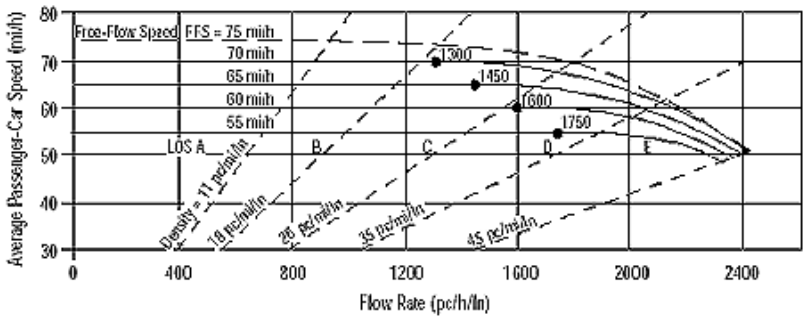
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

General Information		Site Information	
Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Willow OFR to Willow OFR CD
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 76

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

Flow Inputs

Volume, V	6160 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Speed Inputs			Calc Speed Adj and FFS		
Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	61.4	mi/h	FFS	61.4	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1754	pc/h/ln	Design LOS		
S	61.1	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	28.7	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Willow OFR CD
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 77

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	6160	0.90	Level	5	0	0.976	1.00	7016
Ramp	1090	0.90	Level	5	0	0.976	1.00	1241
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3759 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	7016	9000	No
V_{12}	3759	4400:All	No
V_{FO} = V_F - V_R	5775	9000	No
V_R	1241	2000	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 34.6 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.605 (Exhibit 25-19)

S_R= 47.1 mph (Exhibit 25-19)

S_0= 57.9 mph (Exhibit 25-19)

S = 51.6 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Willow ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 79

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	5070	0.90	Level	5	0	0.976	1.00	5774
Ramp	880	0.90	Level	5	0	0.976	1.00	1002
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.379 using Equation 4

V_{12}= 2190 pc/h

Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	6776	See Exhibit 25-7	No
V_{R12}	3192	4600:All	No

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

Merge Areas

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

D_R = 24.3 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Diverge Areas

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

Merge Areas

M_S = 0.353 (Exibit 25-19)

S_R= 50.4 mph (Exhibit 25-19)

S_0= 50.3 mph (Exhibit 25-19)

S= 50.4 mph (Exhibit 25-14)

Diverge Areas

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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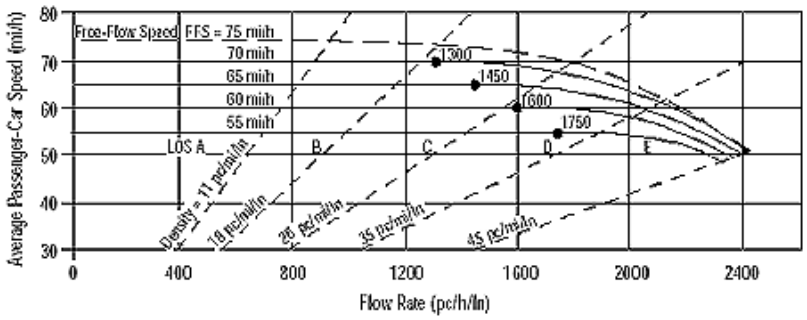

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Willow ONR CD to I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 84

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

Flow Inputs

Volume, V	5940 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	59.8	mi/h	FFS	59.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1691	pc/h/ln	Design LOS	
S	59.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
D = v_p / S	28.3	pc/mi/ln	S	mi/h
LOS	D		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 85

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 59.8 mph S_{FR} = 50.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	5940	0.90	Level	5	0	0.976	1.00	6765
Ramp	1080	0.90	Level	5	0	0.976	1.00	1230
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3643 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	6765	9191	No
V_{12}	3643	4400:All	No
$V_{FO} = V_F - V_R$	5535	9191	No
V_R	1230	2100	No

Level of Service Determination (if not F)

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

D_R = 33.1 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

D_s = 0.344 (Exhibit 25-19)

S_R= 53.7 mph (Exhibit 25-19)

S_0= 63.4 mph (Exhibit 25-19)

S = 57.8 mph (Exhibit 25-15)

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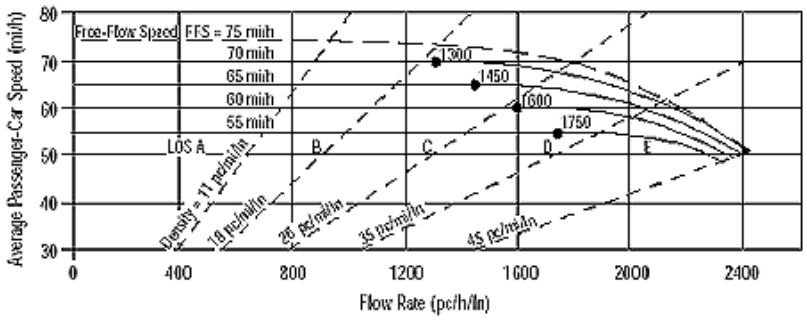

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	I-405 NB OFR to I-405 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 86

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

Flow Inputs

Volume, V	4870 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1387	pc/h/ln	Design LOS		
S	70.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	19.8	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	I-405 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 87

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 59.8 mph S_{FR} = 59.8 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	4570	0.90	Level	5	0	0.976	1.00	5205
Ramp	3110	0.90	Level	5	0	0.976	1.00	3542
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 3974 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	5205	9191	No
V_{12}	3974	4400:All	No
$V_{FO} = V_F - V_R$	1663	9191	No
V_R	3542	4400	No

Level of Service Determination (if not F)

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

D_R = -48.0 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.424 (Exhibit 25-19)

S_R= 52.2 mph (Exhibit 25-19)

S_0= 65.6 mph (Exhibit 25-19)

S = 54.9 mph (Exhibit 25-15)

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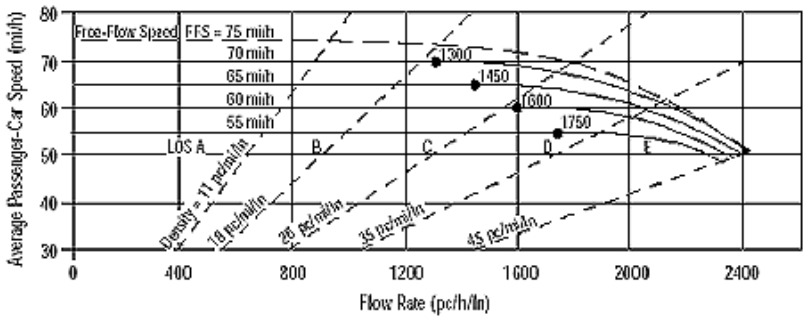
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	I-405 SB OFR to I-405 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 88 coded as 2 lanes, double volume

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

Flow Inputs

Volume, V	3500 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	59.8	mi/h	FFS	59.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1993	pc/h/ln	Design LOS		
S	57.9	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	34.4	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	I-405 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 89 coded as 2 lanes, double volume

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 59.8 mph S_{FR} = 50.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	3500	0.90	Level	5	0	0.976	1.00	3986
Ramp	170	0.90	Level	5	0	0.976	1.00	194
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 3986 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4180	See Exhibit 25-7	No
V_{R12}	4180	4600:All	No

Level of Service Determination (if not F)

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

D_R = 35.8 (pc/ m/ln)

LOS = E (Exhibit 25-4)

Speed Estimation

M_S = 0.541 (Exibit 25-19)

S_R= 50.2 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 50.2 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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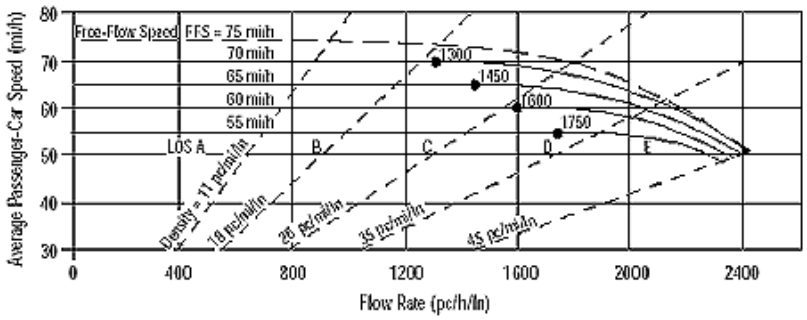

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	I-405 SB ONR to I-405 NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 90 coded as 2 lanes, double volume

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

Flow Inputs

Volume, V	3860 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	5
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

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

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	59.8	mi/h	FFS	59.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2198	pc/h/ln	Design LOS		
S	54.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	40.7	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	7th St WB
Agency or Company	Parsons	Junction	I-405 NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 91 coded for ramp being the mainline

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 55.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	2920	0.90	Level	2	0	0.990	1.00	3277
Ramp	1930	0.90	Level	2	0	0.990	1.00	2166
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 3277 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	5443	See Exhibit 25-7	Yes
V_{R12}	5443	4600:All	Yes

Level of Service Determination (if not F)

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

D_R = 45.4 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 1.195 (Exibit 25-19)

S_R= 39.5 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 39.5 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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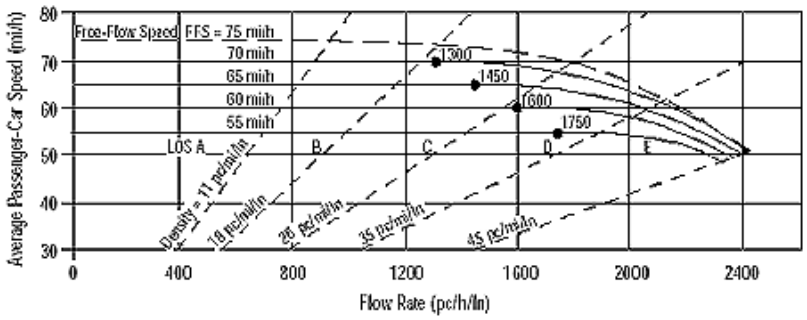

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	7th St WB
Agency or Company	Parsons	From/To	I-405 NB ONR to StudeB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 92

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

Flow Inputs

Volume, V	4850 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	2
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2721	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
LOS	F		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	7th St WB
Agency or Company	Parsons	Junction	StudeB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 95

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	3300	0.90	Level	2	0	0.990	1.00	3703
Ramp	540	0.90	Level	2	0	0.990	1.00	606
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 3703 pc/h

Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4309	See Exhibit 25-7	No
V_{R12}	4309	4600:All	No

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = 29.4 (pc/ m/ln)

LOS = D (Exhibit 25-4)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.506 (Exibit 25-19)

S_R= 48.4 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 48.4 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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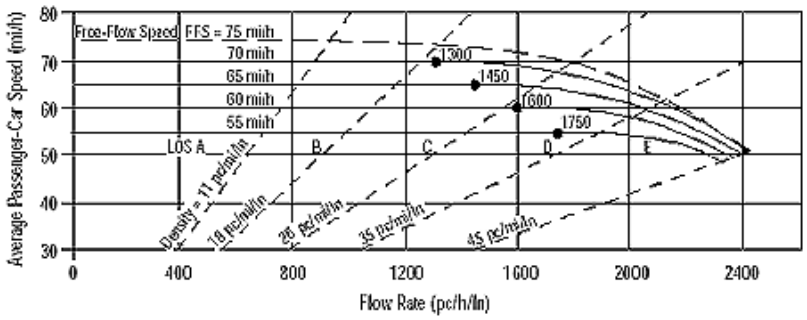

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	7th St WB
Agency or Company	Parsons	From/To	StudeB ONR to
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 96

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

Flow Inputs

Volume, V	3830 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	2
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	3		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1433	pc/h/ln	Design LOS		
S	69.9	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	20.5	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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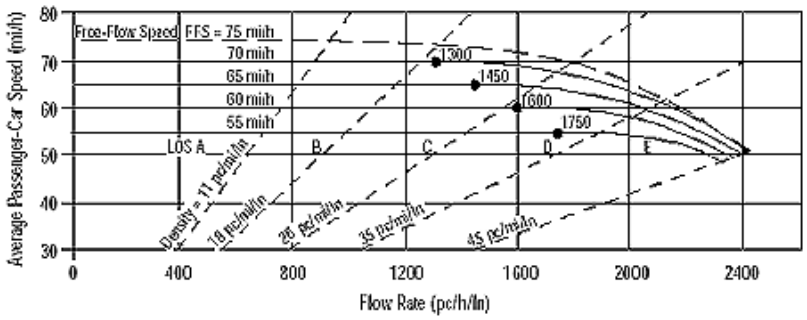
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	7th St EB
Agency or Company	Parsons	From/To	to StudeB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 97

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

Flow Inputs

Volume, V	2730 veh/h	Peak-Hour Factor, PHF	0.90
AADT	veh/day	%Trucks and Buses, P_T	2
Peak-Hr Prop. of AADT, K		%RVs, P_R	0
Peak-Hr Direction Prop, D		General Terrain:	Level
DDHV = AADT x K x D	veh/h	Grade % Length	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	3		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1021	pc/h/ln	Design LOS		
S	70.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	14.6	pc/mi/ln	S		mi/h
LOS	B		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	7th St EB
Agency or Company	Parsons	Junction	Studebaker OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 98

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 55.0 mph S_{FR} = 30.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	2730	0.90	Level	5	0	0.976	1.00	3109
Ramp	720	0.90	Level	5	0	0.976	1.00	820
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 3109 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	3109	4500	No
V_{12}	3109	4400:All	No
$V_{FO} = V_F - V_R$	2289	4500	No
V_R	820	2000	No

Level of Service Determination (if not F)

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

D_R = 29.9 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

D_s = 0.567 (Exhibit 25-19)

S_R= 47.6 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 47.6 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	7th St EB
Agency or Company	Parsons	Junction	StudeB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 100

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	2020	0.90	Level	2	0	0.990	1.00	2267
Ramp	1540	0.90	Level	2	0	0.990	1.00	1728
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 2267 pc/h

Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	3995	See Exhibit 25-7	No
V_{R12}	3995	4600:All	No

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = 33.3 (pc/ m/ln)

LOS = D (Exhibit 25-4)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.505 (Exibit 25-19)

S_R= 48.4 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 48.4 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Lakewood Blvd Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 101

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 66.2 mph S_{FR} = 20.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	11450	0.90	Level	4	0	0.980	1.00	12977
Ramp	1070	0.90	Level	4	0	0.980	1.00	1213
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 3597 pc/h

Capacity Checks

	Actual	Maximum	LOS F?		Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7		V_{FI}=V_F	10382	9447	Yes
				V_{12}	3597	4400:All	No
V_{R12}		4600:All		V_{FO} = V_F - V_R	9169	9447	No
				V_R	1213	3500	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 19.0 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.732 (Exhibit 25-19)

S_R= 48.5 mph (Exhibit 25-19)

S_0= 63.3 mph (Exhibit 25-19)

S = 57.2 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Woodruff Ave Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 102

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 65.8 mph S_{FR} = 45.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	11150	0.90	Level	4	0	0.980	1.00	12637
Ramp	360	0.90	Level	4	0	0.980	1.00	408
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4638 pc/h

Capacity Checks

	Actual	Maximum	LOS F?		Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7		V_{FI}=V_F	10110	9432	Yes
				V_{12}	4638	4400:All	Yes
V_{R12}		4600:All		V_{FO} = V_F - V_R	9702	9432	Yes
				V_R	408	2100	No

Level of Service Determination (if not F)

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

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 30.6 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.335 (Exhibit 25-19)

S_R= 57.8 mph (Exhibit 25-19)

S_0= 65.4 mph (Exhibit 25-19)

S = 61.7 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Woodruff Ave Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 103

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 25.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	10140	0.90	Level	4	0	0.980	1.00	11492
Ramp	620	0.90	Level	4	0	0.980	1.00	703
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4405 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	9194	9000	Yes
V_{12}	4405	4400:All	Yes
V_{FO} = V_F - V_R	8491	9000	No
V_R	703	1900	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 33.1 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.621 (Exhibit 25-19)

S_R= 46.9 mph (Exhibit 25-19)

S_0= 54.9 mph (Exhibit 25-19)

S = 50.8 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Bellflower Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 104

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 64.7 mph S_{FR} = 20.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	11140	0.90	Level	4	0	0.980	1.00	12625
Ramp	620	0.90	Level	4	0	0.980	1.00	703
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4800 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	10100	9387	Yes
V_{12}	4800	4400:All	Yes
V_{FO} = V_F - V_R	9397	9387	Yes
V_R	703	1900	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 36.5 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.686 (Exhibit 25-19)

S_R= 49.1 mph (Exhibit 25-19)

S_0= 64.5 mph (Exhibit 25-19)

S = 56.2 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Bellflower Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 105

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	10770	0.90	Level	4	0	0.980	1.00	12206
Ramp	2160	0.90	Level	4	0	0.980	1.00	2448
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 4350 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	9765	9000	Yes
V_{12}	4350	4400:All	No
V_{FO} = V_F - V_R	7317	9000	No
V_R	2448	3800	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 25.5 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.648 (Exhibit 25-19)

S_R= 46.6 mph (Exhibit 25-19)

S_0= 53.7 mph (Exhibit 25-19)

S = 50.3 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Palo Verde Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 106

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 65.0 mph S_{FR} = 20.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	11660	0.90	Level	4	0	0.980	1.00	13215
Ramp	860	0.90	Level	4	0	0.980	1.00	975
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 5159 pc/h

Capacity Checks

	Actual	Maximum	LOS F?		Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7		V_{FI}=V_F	10572	9400	Yes
				V_{12}	5159	4400:All	Yes
V_{R12}		4600:All		V_{FO} = V_F - V_R	9597	9400	Yes
				V_R	975	1900	No

Level of Service Determination (if not F)	Level of Service Determination (if not F)
$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$	$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$
D_R = (pc/ mi /ln)	D_R = 34.2 (pc/ mi /ln)
LOS = (Exhibit 25-4)	LOS= F (Exhibit 25-4)

Speed Estimation	Speed Estimation
M_S = (Exibit 25-19)	D_s = 0.711 (Exhibit 25-19)
S_R= mph (Exhibit 25-19)	S_R= 48.7 mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)	S_0= 64.7 mph (Exhibit 25-19)
S= mph (Exhibit 25-14)	S = 55.7 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Studebaker Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 107

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 25.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	10520	0.90	Level	4	0	0.980	1.00	11923
Ramp	280	0.90	Level	4	0	0.980	1.00	317
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4338 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	9539	9000	Yes
V_{12}	4338	4400:All	No
V_{FO} = V_F - V_R	9222	9000	Yes
V_R	317	1900	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 39.3 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.587 (Exhibit 25-19)

S_R= 47.4 mph (Exhibit 25-19)

S_0= 54.1 mph (Exhibit 25-19)

S = 50.8 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	7th Street OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 108

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 45.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9030	0.90	Level	4	0	0.980	1.00	10234
Ramp	170	0.90	Level	4	0	0.980	1.00	193
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 4571 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	10234	9000	Yes
V_{12}	4571	4400:All	Yes
$V_{FO} = V_F - V_R$	10041	9000	Yes
V_R	193	2100	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 41.8 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

D_s = 0.315 (Exhibit 25-19)

S_R= 50.9 mph (Exhibit 25-19)

S_0= 53.2 mph (Exhibit 25-19)

S = 52.1 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Carson OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 109

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 65.4 mph S_{FR} = 25.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	8900	0.90	Level	5	0	0.976	1.00	10136
Ramp	1530	0.90	Level	5	0	0.976	1.00	1743
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 3398 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	8109	9416	No
V_{12}	3398	4400:All	No
$V_{FO} = V_F - V_R$	6366	9416	No
V_R	1743	3500	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 17.3 (pc/ mi /ln)

LOS= B (Exhibit 25-4)

Speed Estimation

D_s = 0.715 (Exhibit 25-19)

S_R= 48.7 mph (Exhibit 25-19)

S_0= 66.5 mph (Exhibit 25-19)

S = 57.6 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	7th St WB
Agency or Company	Parsons	Junction	Studebaker OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 110

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	4850	0.90	Level	5	0	0.976	1.00	5524
Ramp	1550	0.90	Level	5	0	0.976	1.00	1765
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =1.000 using Equation 0
V_{12}= pc/h	V_{12} = 5524 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	5524	4500	Yes
V_{12}	5524	4400:All	Yes
V_{FO} = V_F - V_R	3759	4500	No
V_R	1765	2000	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 49.7 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.652 (Exhibit 25-19)

S_R= 46.5 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 46.5 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Willow ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 111

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	10090	0.90	Level	4	0	0.980	1.00	11435
Ramp	680	0.90	Level	4	0	0.980	1.00	771
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.217 using Equation 4

V_{12}= 1939 pc/h

Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9706	See Exhibit 25-7	Yes
V_{R12}	2710	4600:All	No

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 24.4 (pc/ m/ln)

LOS = F (Exhibit 25-4)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.359 (Exibit 25-19)

S_R= 50.3 mph (Exhibit 25-19)

S_0= 41.3 mph (Exhibit 25-19)

S= 43.5 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 112

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 66.2 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	10370	0.90	Level	4	0	0.980	1.00	11753
Ramp	670	0.90	Level	4	0	0.980	1.00	759
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.601 using Equation 4

V_{12}= 7061 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	12512	See Exhibit 25-7	Yes
V_{R12}	7820	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 56.7 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 9.927 (Exibit 25-19)

S_R= -174.0 mph (Exhibit 25-19)

S_0= 59.4 mph (Exhibit 25-19)

S= 367.3 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Bellflower ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 113

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 63.4 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	10520	0.90	Level	4	0	0.980	1.00	11923
Ramp	930	0.90	Level	4	0	0.980	1.00	1054
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.209 using Equation 0

V_{12}= 2492 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	12977	See Exhibit 25-7	Yes
V_{R12}	3546	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 16.3 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.274 (Exibit 25-19)

S_R= 57.5 mph (Exhibit 25-19)

S_0= 42.4 mph (Exhibit 25-19)

S= 45.7 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Bellflower ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 114

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8610	0.90	Level	4	0	0.980	1.00	9758
Ramp	1530	0.90	Level	4	0	0.980	1.00	1734
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.320 using Equation 4

V_{12}= 3119 pc/h

Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11492	See Exhibit 25-7	Yes
V_{R12}	4853	4600:All	Yes

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 36.3 (pc/ m/ln)

LOS = F (Exhibit 25-4)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.751 (Exibit 25-19)

S_R= 45.2 mph (Exhibit 25-19)

S_0= 42.4 mph (Exhibit 25-19)

S= 43.5 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Woodruff ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 115

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 66.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	10790	0.90	Level	4	0	0.980	1.00	12229
Ramp	350	0.90	Level	4	0	0.980	1.00	397
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.455 using Equation 4

V_{12}= 5563 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	12626	See Exhibit 25-7	Yes
V_{R12}	5960	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 46.1 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 1.770 (Exibit 25-19)

S_R= 23.5 mph (Exhibit 25-19)

S_0= 53.3 mph (Exhibit 25-19)

S= 33.4 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Palo Verde ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 116

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 65.6 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	10800	0.90	Level	4	0	0.980	1.00	12240
Ramp	350	0.90	Level	4	0	0.980	1.00	397
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.742 using Equation 4

V_{12}= 9077 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	12637	See Exhibit 25-7	Yes
V_{R12}	9474	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 67.9 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 50.961 (Exibit 25-19)

S_R= -1137.1 mph (Exhibit 25-19)

S_0= 61.7 mph (Exhibit 25-19)

S= 294.4 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Stearns ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 117

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9850	0.90	Level	4	0	0.980	1.00	11163
Ramp	680	0.90	Level	4	0	0.980	1.00	771
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.217 using Equation 4

V_{12}= 2422 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11934	See Exhibit 25-7	Yes
V_{R12}	3193	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 28.1 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.395 (Exibit 25-19)

S_R= 49.9 mph (Exhibit 25-19)

S_0= 36.0 mph (Exhibit 25-19)

S= 38.9 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Studebaker ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 118

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 63.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	11330	0.90	Level	4	0	0.980	1.00	12841
Ramp	340	0.90	Level	4	0	0.980	1.00	385
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.743 using Equation 4

V_{12}= 9542 pc/h

Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	13226	See Exhibit 25-7	Yes
V_{R12}	9927	4600:All	Yes

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 71.4 (pc/ m/ln)

LOS = F (Exhibit 25-4)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 80.051 (Exibit 25-19)

S_R= -1681.3 mph (Exhibit 25-19)

S_0= 59.7 mph (Exhibit 25-19)

S= 267.8 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 Alt 3

Project Description Segment ID 119

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 57.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	6540	0.90	Level	5	0	0.976	1.00	7448
Ramp	740	0.90	Level	5	0	0.976	1.00	843
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.240 using Equation 4

V_{12}= 1786 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8291	See Exhibit 25-7	No
V_{R12}	2629	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 23.1 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.347 (Exibit 25-19)

S_R= 51.8 mph (Exhibit 25-19)

S_0= 47.3 mph (Exhibit 25-19)

S= 48.6 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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