APPENDIX C

2016 Existing Freeway HCS Operational Analysis

FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	AECOM
Date Performed	
Analysis Time Period	AM

Site Information

Freeway/Dir of Travel	I-95 NB
Weaving Segment Location	Seg 1-Bet Copans & Sample
Analysis Year	EXISTING 2015/2016

Project Description SW 10th Street SIMR

Inputs

Weaving configuration	One-Sided	Segment type	Freeway
Weaving number of lanes, N	4	Freeway minimum speed, S_{MIN}	15
Weaving segment length, L_S	1820ft	Freeway maximum capacity, C_{IFL}	2400
Freeway free-flow speed, FFS	70 mph	Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	4560	0.95	3	0	1.5	1.2	0.985	1.00	4872
V_{RF}	340	0.97	2	0	1.5	1.2	0.990	1.00	354
V_{FR}	710	0.90	2	0	1.5	1.2	0.990	1.00	797
V_{RR}	0	0.97	2	0	1.5	1.2	0.990	1.00	0
V_{NW}	4872							V =	6023
V_W	1151								
VR	0.191								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1151 lc/h
Interchange density, ID	0.8 int/mi	Weaving lane changes, LC_W	1540 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	1220 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	2760 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	709

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	5940 veh/h	Weaving intensity factor, W	0.314
Weaving segment capacity, c_w	8666 veh/h	Weaving segment speed, S	54.9 mph
Weaving segment v/c ratio	0.685	Average weaving speed, S_W	56.9 mph
Weaving segment density, D	27.4 pc/mi/ln	Average non-weaving speed, S_{NW}	54.5 mph
Level of Service, LOS	C	Maximum weaving length, L_{MAX}	4445 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

		Site Information	
Analyst		Highway/Direction of Travel	*I-95 NB*
Agency or Company	*AECOM*	From/To	*Seg 2-Bet Sample Off & On*
Date Performed		Jurisdiction	
Analysis Time Period	*AM*	Analysis Year	*EXISTING 2015/2016*

Project Description   *SW 10th Street SIMR*

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

Flow Inputs

Volume, V	*4900*	veh/h	Peak-Hour Factor, PHF	*0.85*
AADT		veh/day	%Trucks and Buses, P_T	*3*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs

			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures

Design (N)

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p) *1950*   pc/h/ln

S	*63.5*	mph
D = v_p / S	*30.7*	pc/mi/ln
LOS	*D*	

Design (N)

Design LOS

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)   pc/h/ln

S	mph
D = v_p / S	pc/mi/ln
Required Number of Lanes, N	

Glossary

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

Factor Location

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

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		*Site Information*	
Analyst		Freeway/Dir of Travel	I-95 NB
Agency or Company	AECOM	Junction	Seg 3-Merge from Sample EB
Date Performed		Jurisdiction	
Analysis Time Period	AM	Analysis Year	EXISTING 2015/2016

Project Description   SW 10th Street SIMR

Inputs

Upstream Adj Ramp	Freeway Number of Lanes, N	3	Downstream Adj Ramp
☐ Yes ☐ On	Ramp Number of Lanes, N	1	☑ Yes ☑ On
☑ No ☐ Off	Acceleration Lane Length, L_A	960	☐ No ☐ Off
	Deceleration Lane Length L_D		
L_{up} = ft	Freeway Volume, V_F	4900	L_{down} = 2300 ft
	Ramp Volume, V_R	765	
V_u = veh/h	Freeway Free-Flow Speed, S_{FF}	70.0	V_D = 425 veh/h
	Ramp Free-Flow Speed, S_{FR}	50.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4900	0.85	Level	3	0	0.985	1.00	5851
Ramp	765	0.91	Level	2	0	0.990	1.00	849
UpStream								
DownStream	425	0.94	Level	2	0	0.990	1.00	457

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 13-6 or 13-7)	L_{EQ} = (Equation 13-12 or 13-13)
P_{FM} = 0.604 using Equation (Exhibit 13-6)	P_{FD} = using Equation (Exhibit 13-7)
V_{12} = 3536 pc/h	V_{12} = pc/h
V_3 or V_{av34} 2315 pc/h (Equation 13-14 or 13-17)	V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No	Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No	Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes, V_{12a} = 3536 pc/h (Equation 13-16, 13-18, or 13-19)	If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks				*Capacity Checks*			
	Actual	Capacity	LOS F?		Actual	Capacity	LOS F?
V_{FO}	6700	Exhibit 13-8	No	V_F		Exhibit 13-8	
				$V_{FO} = V_F - V_R$		Exhibit 13-8	
				V_R		Exhibit 13-10	

Flow Entering Merge Influence Area				*Flow Entering Diverge Influence Area*			
	Actual	Max Desirable	Violation?		Actual	Max Desirable	Violation?
V_{R12}	4385	Exhibit 13-8 4600:All	No	V_{12}		Exhibit 13-8	

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 = 33.3 (pc/mi/ln)	D_R = (pc/mi/ln)
LOS = D (Exhibit 13-2)	LOS = (Exhibit 13-2)

Speed Determination	*Speed Determination*
M_S = 0.538 (Exibit 13-11)	D_s = (Exhibit 13-12)
S_R = 54.9 mph (Exhibit 13-11)	S_R = mph (Exhibit 13-12)
S_0 = 63.4 mph (Exhibit 13-11)	S_0 = mph (Exhibit 13-12)
S = 57.6 mph (Exhibit 13-13)	S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		*Site Information*	
Analyst		Highway/Direction of Travel	*I-95 NB*
Agency or Company	*AECOM*	From/To	*Seg 4-Bet Sample EB On & WB On*
Date Performed		Jurisdiction	
Analysis Time Period	*AM*	Analysis Year	*EXISTING 2015/2016*

Project Description   *SW 10th Street SIMR*

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

Flow Inputs

Volume, V	*5665*	veh/h	Peak-Hour Factor, PHF	*0.85*	
AADT		veh/day	%Trucks and Buses, P_T	*3*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*	
			Up/Down %		

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	mph
Base free-flow Speed, BFFS		mph			

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) *2255*		pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*57.1*	mph	S	mph
D = v_p / S	*39.5*	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 - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume D - Density		E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate FFS - Free-flow speed		f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service BFFS - Base free-flow speed		LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information	Site Information	
Analyst	Freeway/Dir of Travel	I-95 NB
Agency or Company AECOM	Junction	Seg 5-Merge from Sample WB
Date Performed	Jurisdiction	
Analysis Time Period AM	Analysis Year	EXISTING 2015/2016

Project Description   SW 10th Street SIMR

Inputs

Upstream Adj Ramp			Downstream Adj Ramp

Upstream Adj Ramp

☑ Yes   ☑ On

☐ No   ☐ Off

L_{up} =   1340   ft

V_u =   765   veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	620
Deceleration Lane Length L_D	
Freeway Volume, V_F	5665
Ramp Volume, V_R	425
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	50.0

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	$v = V/PHF \times f_{HV} \times f_p$
Freeway	5665	0.85	Level	3	0	0.985	1.00	6765
Ramp	425	0.94	Level	2	0	0.990	1.00	457
UpStream	765	0.91	Level	2	0	0.990	1.00	849
DownStream								

Merge Areas	Diverge Areas

Estimation of v_{12} (Merge)

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

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

P_{FM} =   0.595   using Equation (Exhibit 13-6)

V_{12} =   4024   pc/h

V_3 or V_{av34} 2741   pc/h (Equation 13-14 or 13-17)

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

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

If Yes, V_{12a} =   4065   pc/h (Equation 13-16, 13-18, or 13-19)

Estimation of v_{12} (Diverge)

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

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

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

V_{12} =   pc/h

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

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

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

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

Capacity Checks (Merge)

	Actual	Capacity		LOS F?
V_{FO}	7222	Exhibit 13-8		Yes

Capacity Checks (Diverge)

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

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4522	Exhibit 13-8	4600:All	No

Flow Entering Diverge Influence Area

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

Level of Service Determination (if not F) (Merge)

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

D_R =   36.6   (pc/mi/ln)

LOS =   F (Exhibit 13-2)

Level of Service Determination (if not F) (Diverge)

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

D_R =   (pc/mi/ln)

LOS =   (Exhibit 13-2)

Speed Determination (Merge)

M_S =   0.618 (Exibit 13-11)

S_R =   52.7 mph (Exhibit 13-11)

S_0 =   61.1 mph (Exhibit 13-11)

S =   55.5 mph (Exhibit 13-13)

Speed Determination (Diverge)

D_s =   (Exhibit 13-12)

S_R =   mph (Exhibit 13-12)

S_0 =   mph (Exhibit 13-12)

S =   mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

		Site Information	
Analyst		Highway/Direction of Travel	*I-95 NB*
Agency or Company	*AECOM*	From/To	*Seg 6-Bet Sample & 10th St*
Date Performed		Jurisdiction	
Analysis Time Period	*AM*	Analysis Year	*EXISTING 2015/2016*

Project Description   *SW 10th Street SIMR*

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

Flow Inputs

Volume, V	*5990*	veh/h	Peak-Hour Factor, PHF	*0.95*	
AADT		veh/day	%Trucks and Buses, P_T	*3*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*	
			Up/Down %		

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs

			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures

Operational (LOS)

			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2133*	pc/h/ln	Design (N)		
			Design LOS		
S	*59.9*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
D = v_p / S	*35.6*	pc/mi/ln	S		mph
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 - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-95 NB
Agency or Company	AECOM	Junction	Seg 7-Diverge to 10th St
Date Performed		Jurisdiction	
Analysis Time Period	AM	Analysis Year	EXISTING 2015/2016
Project Description SW 10th Street SIMR			

Inputs

Upstream Adj Ramp				Downstream Adj Ramp	
☐ Yes ☐ On	Freeway Number of Lanes, N	3		☑ Yes	☑ On
	Ramp Number of Lanes, N	1			
☑ No ☐ Off	Acceleration Lane Length, L_A			☐ No	☐ Off
	Deceleration Lane Length L_D	250			
L_{up} = ft	Freeway Volume, V_F	5990		L_{down} =	1370 ft
	Ramp Volume, V_R	990			
V_u = veh/h	Freeway Free-Flow Speed, S_{FF}	70.0		V_D =	1360 veh/h
	Ramp Free-Flow Speed, S_{FR}	45.0			

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	5990	0.95	Level	3	0	0.985	1.00	6400
Ramp	990	0.94	Level	2	0	0.990	1.00	1064
UpStream								
DownStream	1360	0.96	Level	2	0	0.990	1.00	1431

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**

Merge Areas	Diverge Areas
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 13-6 or 13-7)	L_{EQ} = (Equation 13-12 or 13-13)
P_{FM} = using Equation (Exhibit 13-6)	P_{FD} = 0.551 using Equation (Exhibit 13-7)
V_{12} = pc/h	V_{12} = 4004 pc/h
V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)	V_3 or V_{av34} 2396 pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No	Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No	Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)	If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks (Merge) | Capacity Checks (Diverge)

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

	Actual	Capacity		LOS F?
V_F	6400	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	5336	Exhibit 13-8	7200	No
V_R	1064	Exhibit 13-10	2100	No

Flow Entering Merge Influence Area | Flow Entering Diverge Influence Area

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

	Actual	Max Desirable	Violation?
V_{12}	4004	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

Merge	Diverge
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$	$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$
D_R = (pc/mi/ln)	D_R = 36.4 (pc/mi/ln)
LOS = (Exhibit 13-2)	LOS = E (Exhibit 13-2)

Speed Determination

Merge	Diverge
M_S = (Exibit 13-11)	D_s = 0.394 (Exhibit 13-12)
S_R = mph (Exhibit 13-11)	S_R = 59.0 mph (Exhibit 13-12)
S_0 = mph (Exhibit 13-11)	S_0 = 71.3 mph (Exhibit 13-12)
S = mph (Exhibit 13-13)	S = 63.1 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		*Site Information*	
Analyst		Highway/Direction of Travel	*I-95 NB*
Agency or Company	*AECOM*	From/To	*Seg 8-Bet 10th St Off & On*
Date Performed		Jurisdiction	
Analysis Time Period	*AM*	Analysis Year	*EXISTING 2015/2016*

Project Description   *SW 10th Street SIMR*

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

Flow Inputs

Volume, V	*5000*	veh/h	Peak-Hour Factor, PHF	*0.95*	
AADT		veh/day	%Trucks and Buses, P_T	*3*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*	
			Up/Down %		

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ *0.985*	

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	mph
Base free-flow Speed, BFFS		mph			

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) *1781*		pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*66.1*	mph	S		mph
D = v_p / S	*27.0*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*D*		Required Number of Lanes, N		

Glossary

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

Factor Location

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

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst	
Agency or Company	AECOM
Date Performed	
Analysis Time Period	AM

Site Information

Freeway/Dir of Travel	I-95 NB
Junction	Seg 9-Merge from 10th St
Jurisdiction	
Analysis Year	EXISTING 2015/2016

Project Description   SW 10th Street SIMR

Inputs

Upstream Adj Ramp

☑ Yes   ☐ On

☐ No   ☑ Off

L_{up} =   1370   ft

V_u =   990   veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	1345
Deceleration Lane Length L_D	
Freeway Volume, V_F	5000
Ramp Volume, V_R	1360
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	50.0

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	$v = V/PHF \times f_{HV} \times f_p$
Freeway	5000	0.95	Level	3	0	0.985	1.00	5342
Ramp	1360	0.96	Level	2	0	0.990	1.00	1431
UpStream	990	0.94	Level	2	0	0.990	1.00	1064
DownStream								

Merge Areas	**Diverge Areas**

Estimation of v_{12} (Merge)

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

L_{EQ} =   2259.60   (Equation 13-6 or 13-7)

P_{FM} =   0.559   using Equation (Exhibit 13-6)

V_{12} =   2986   pc/h

V_3 or V_{av34} 2356   pc/h (Equation 13-14 or 13-17)

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

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

If Yes, V_{12a} =   3052   pc/h (Equation 13-16, 13-18, or 13-19)

Estimation of v_{12} (Diverge)

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

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

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

V_{12} =   pc/h

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

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

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

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

Capacity Checks (Merge)

	Actual	Capacity	LOS F?
V_{FO}	6773	Exhibit 13-8	No

Capacity Checks (Diverge)

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

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
V_{R12}	4483	Exhibit 13-8 4600:All	No

Flow Entering Diverge Influence Area

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

Level of Service Determination (if not F) (Merge)

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

D_R =   31.4   (pc/mi/ln)

LOS =   D (Exhibit 13-2)

Level of Service Determination (if not F) (Diverge)

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

D_R =   (pc/mi/ln)

LOS =   (Exhibit 13-2)

Speed Determination (Merge)

M_S =   0.532 (Exibit 13-11)

S_R =   55.1 mph (Exhibit 13-11)

S_0 =   63.6 mph (Exhibit 13-11)

S =   57.7 mph (Exhibit 13-13)

Speed Determination (Diverge)

D_s =   (Exhibit 13-12)

S_R =   mph (Exhibit 13-12)

S_0 =   mph (Exhibit 13-12)

S =   mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		*Site Information*	
Analyst		Highway/Direction of Travel	*I-95 NB*
Agency or Company	*AECOM*	From/To	*Seg 10-Bet 10th St & Hillsboro*
Date Performed		Jurisdiction	
Analysis Time Period	*AM*	Analysis Year	*EXISTING 2015/2016*

Project Description   *SW 10th Street SIMR*

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

Flow Inputs

Volume, V	*6290*	veh/h	Peak-Hour Factor, PHF	*0.95*	
AADT		veh/day	%Trucks and Buses, P_T	*3*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*	
			Up/Down %		

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T-1)+P_R(E_R-1)]$	*0.985*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	mph
Base free-flow Speed, BFFS		mph			

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) *2240*		pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*57.5*	mph	S		mph
D = v_p / S	*39.0*	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 - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume D - Density		E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate FFS - Free-flow speed		f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service BFFS - Base free-flow speed		LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		*Site Information*	
Analyst		Freeway/Dir of Travel	I-95 NB
Agency or Company	AECOM	Junction	Seg 11-Diverge to Hillsboro EB
Date Performed		Jurisdiction	
Analysis Time Period	AM	Analysis Year	EXISTING 2015/2016
Project Description	SW 10th Street SIMR		

Inputs

Upstream Adj Ramp						Downstream Adj Ramp	
☐ Yes	☐ On	Freeway Number of Lanes, N	3			☑ Yes	☑ On
		Ramp Number of Lanes, N	1				
☑ No	☐ Off	Acceleration Lane Length, L_A				☐ No	☐ Off
		Deceleration Lane Length L_D	220				
L_{up} = ft		Freeway Volume, V_F	6290			L_{down} = 1540 ft	
		Ramp Volume, V_R	670				
V_u = veh/h		Freeway Free-Flow Speed, S_{FF}	70.0			V_D = 510 veh/h	
		Ramp Free-Flow Speed, S_{FR}	45.0				

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	6290	0.95	Level	3	0	0.985	1.00	6720
Ramp	670	0.76	Level	2	0	0.990	1.00	890
UpStream								
DownStream	510	0.92	Level	2	0	0.990	1.00	560

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 13-6 or 13-7)	L_{EQ} = (Equation 13-12 or 13-13)
P_{FM} = using Equation (Exhibit 13-6)	P_{FD} = 0.551 using Equation (Exhibit 13-7)
V_{12} = pc/h	V_{12} = 4103 pc/h
V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)	V_3 or V_{av34} 2617 pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No	Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No	Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)	If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

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

	Actual	Capacity		LOS F?
V_F	6720	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	5830	Exhibit 13-8	7200	No
V_R	890	Exhibit 13-10	2100	No

Flow Entering Merge Influence Area / Flow Entering Diverge Influence Area

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

	Actual	Max Desirable	Violation?
V_{12}	4103	Exhibit 13-8 4400:All	No

Level of Service Determination (if not F)

Merge	Diverge
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$	$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$
D_R = (pc/mi/ln)	D_R = 37.6 (pc/mi/ln)
LOS = (Exhibit 13-2)	LOS = E (Exhibit 13-2)

Speed Determination

Merge	Diverge
M_S = (Exibit 13-11)	D_s = 0.378 (Exhibit 13-12)
S_R = mph (Exhibit 13-11)	S_R = 59.4 mph (Exhibit 13-12)
S_0 = mph (Exhibit 13-11)	S_0 = 70.5 mph (Exhibit 13-12)
S = mph (Exhibit 13-13)	S = 63.3 mph (Exhibit 13-13)

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2015 Existing Freeway_HCS Operational Analysis

Appendix C

BASIC FREEWAY SEGMENTS WORKSHEET

General Information			*Site Information*	
Analyst			Highway/Direction of Travel	*I-95 NB*
Agency or Company	*AECOM*		From/To	*Seg 12-Bet Hillsboro Off & On*
Date Performed			Jurisdiction	
Analysis Time Period	*AM*		Analysis Year	*EXISTING 2015/2016*

Project Description	*SW 10th Street SIMR*		
☑ Oper.(LOS)		☐ Des.(N)	☐ Planning Data

Flow Inputs

Volume, V	*5620*	veh/h	Peak-Hour Factor, PHF	*0.95*	
AADT		veh/day	%Trucks and Buses, P_T	*3*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*	
			Up/Down %		

Calculate Flow Adjustments

f_p	*1.00*		E_R	*1.2*
E_T	*1.5*		$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			**Design (N)**		
Operational (LOS)			Design (N)		
			Design LOS		
$v_p = (V$ or DDHV$) / ($PHF x N x f_{HV} x $f_p)$ *2002*		pc/h/ln	$v_p = (V$ or DDHV$) / ($PHF x N x f_{HV} x $f_p)$		pc/h/ln
S	*62.5*	mph	S		mph
D = v_p / S	*32.0*	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 - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume D - Density		E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate FFS - Free-flow speed		f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service BFFS - Base free-flow speed		LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	AECOM
Date Performed	
Analysis Time Period	AM

Site Information

Freeway/Dir of Travel	I-95 NB
Weaving Segment Location	Seg 13-Bet Hillsboro On & Off
Analysis Year	EXISTING 2015/2016

Project Description SW 10th Street SIMR

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	790ft
Freeway free-flow speed, FFS	70 mph

Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	5140	0.95	3	0	1.5	1.2	0.985	1.00	5492
V_{RF}	510	0.92	2	0	1.5	1.2	0.990	1.00	560
V_{FR}	480	0.91	2	0	1.5	1.2	0.990	1.00	533
V_{RR}	0	0.92	2	0	1.5	1.2	0.990	1.00	0
V_{NW}	5492							V =	6585
V_W	1093								
VR	0.166								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc		Minimum weaving lane changes, LC_{MIN}	1093 lc/h
Interchange density, ID	0.8 int/mi		Weaving lane changes, LC_W	1314 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc		Non-weaving lane changes, LC_{NW}	789 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc		Total lane changes, LC_{ALL}	2103 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc		Non-weaving vehicle index, I_{NW}	347

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	6493 veh/h		Weaving intensity factor, W	0.489
Weaving segment capacity, c_w	8433 veh/h		Weaving segment speed, S	53.8 mph
Weaving segment v/c ratio	0.770		Average weaving speed, S_W	51.9 mph
Weaving segment density, D	30.6 pc/mi/ln		Average non-weaving speed, S_{NW}	54.2 mph
Level of Service, LOS	D		Maximum weaving length, L_{MAX}	4191 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

		Site Information	
Analyst		Highway/Direction of Travel	*I-95 NB*
Agency or Company	*AECOM*	From/To	*Seg 14-Bet Hillsboro Off & On*
Date Performed		Jurisdiction	
Analysis Time Period	*AM*	Analysis Year	*EXISTING 2015/2016*

Project Description   *SW 10th Street SIMR*

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

Flow Inputs

Volume, V	*5650*	veh/h	Peak-Hour Factor, PHF	*0.95*	
AADT		veh/day	%Trucks and Buses, P_T	*3*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*	
			Up/Down %		

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs

			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2012*	pc/h/ln
S	*62.4*	mph
D = v_p / S	*32.3*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

		Site Information	
Analyst		Freeway/Dir of Travel	I-95 NB
Agency or Company	AECOM	Junction	Seg 15-Merge from Hillsboro WB
Date Performed		Jurisdiction	
Analysis Time Period	AM	Analysis Year	EXISTING 2015/2016

Project Description   SW 10th Street SIMR

Inputs

Upstream Adj Ramp	Freeway Number of Lanes, N	3		Downstream Adj Ramp
☑ Yes ☐ On	Ramp Number of Lanes, N	1		☐ Yes ☐ On
	Acceleration Lane Length, L_A	525		
☐ No ☑ Off	Deceleration Lane Length L_D			☑ No ☐ Off
	Freeway Volume, V_F	5650		
L_{up} = 2135 ft	Ramp Volume, V_R	660		L_{down} = ft
	Freeway Free-Flow Speed, S_{FF}	70.0		
V_u = 480 veh/h	Ramp Free-Flow Speed, S_{FR}	50.0		V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	5650	0.95	Level	3	0	0.985	1.00	6037
Ramp	660	0.84	Level	2	0	0.990	1.00	794
UpStream	480	0.91	Level	2	0	0.990	1.00	533
DownStream								

Merge Areas	**Diverge Areas**

Estimation of v_{12} (Merge)

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

L_{EQ} =   1907.93   (Equation 13-6 or 13-7)
P_{FM} =   0.592   using Equation (Exhibit 13-6)
V_{12} =   3575   pc/h
V_3 or V_{av34} 2462   pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No
If Yes, V_{12a} =   3575   pc/h (Equation 13-16, 13-18, or 13-19)

Estimation of v_{12} (Diverge)

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

L_{EQ} =   (Equation 13-12 or 13-13)
P_{FD} =   using Equation (Exhibit 13-7)
V_{12} =   pc/h
V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes, V_{12a} =   pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity	LOS F?
V_{FO}	6831	Exhibit 13-8	No

Capacity Checks

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

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
V_{R12}	4369	Exhibit 13-8 4600:All	No

Flow Entering Diverge Influence Area

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

Level of Service Determination (if not F)

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

D_R =   35.9 (pc/mi/ln)
LOS =   E (Exhibit 13-2)

Level of Service Determination (if not F)

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

D_R =   (pc/mi/ln)
LOS =   (Exhibit 13-2)

Speed Determination

M_S =   0.576 (Exibit 13-11)
S_R =   53.9 mph (Exhibit 13-11)
S_0 =   62.5 mph (Exhibit 13-11)
S =   56.7 mph (Exhibit 13-13)

Speed Determination

D_s =   (Exhibit 13-12)
S_R =   mph (Exhibit 13-12)
S_0 =   mph (Exhibit 13-12)
S =   mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		*Site Information*	
Analyst		Highway/Direction of Travel	*I-95 NB*
Agency or Company	*AECOM*	From/To	*Seg 16-North of Hillsboro*
Date Performed		Jurisdiction	
Analysis Time Period	*AM*	Analysis Year	*EXISTING 2015/2016*

Project Description	*SW 10th Street SIMR*		
☑ Oper.(LOS)		☐ Des.(N)	☐ Planning Data

Flow Inputs

Volume, V	*6300*	veh/h	Peak-Hour Factor, PHF	*0.95*	
AADT		veh/day	%Trucks and Buses, P_T	*3*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*	
			Up/Down %		

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs			*Calc Speed Adj and FFS*		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	mph
Base free-flow Speed, BFFS		mph			

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) *2244*		pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*57.4*	mph	S		mph
D = v_p / S	*39.1*	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 - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume D - Density		E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate FFS - Free-flow speed		f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service BFFS - Base free-flow speed		LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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FREEWAY WEAVING WORKSHEET

General Information

Analyst
Agency/Company AECOM
Date Performed
Analysis Time Period PM

Site Information

Freeway/Dir of Travel I-95 NB
Weaving Segment Location Seg 1-Bet Copans & Sample
Analysis Year EXISTING 2015/2016

Project Description SW 10th Street SIMR

Inputs

Weaving configuration One-Sided
Weaving number of lanes, N 4
Weaving segment length, L_S 1820ft
Freeway free-flow speed, FFS 70 mph

Segment type Freeway
Freeway minimum speed, S_{MIN} 15
Freeway maximum capacity, C_{IFL} 2400
Terrain type Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	4260	0.95	3	0	1.5	1.2	0.985	1.00	4551
V_{RF}	400	0.95	2	0	1.5	1.2	0.990	1.00	425
V_{FR}	1480	0.98	2	0	1.5	1.2	0.990	1.00	1525
V_{RR}	0	0.95	2	0	1.5	1.2	0.990	1.00	0
V_{NW}	4551							V =	6501
V_W	1950								
VR	0.300								

Configuration Characteristics

Minimum maneuver lanes, N_{WL} 2 lc
Interchange density, ID 0.8 int/mi
Minimum RF lane changes, LC_{RF} 1 lc/pc
Minimum FR lane changes, LC_{FR} 1 lc/pc
Minimum RR lane changes, LC_{RR} lc/pc

Minimum weaving lane changes, LC_{MIN} 1950 lc/h
Weaving lane changes, LC_W 2339 lc/h
Non-weaving lane changes, LC_{NW} 1154 lc/h
Total lane changes, LC_{ALL} 3493 lc/h
Non-weaving vehicle index, I_{NW} 663

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v 6416 veh/h
Weaving segment capacity, c_w 7883 veh/h
Weaving segment v/c ratio 0.814
Weaving segment density, D 32.5 pc/mi/ln
Level of Service, LOS D

Weaving intensity factor, W 0.378
Weaving segment speed, S 50.0 mph
Average weaving speed, S_W 54.9 mph
Average non-weaving speed, S_{NW} 48.2 mph
Maximum weaving length, L_{MAX} 5583 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

		Site Information	
Analyst		Highway/Direction of Travel	*I-95 NB*
Agency or Company	*AECOM*	From/To	*Seg 2-Bet Sample Off & On*
Date Performed		Jurisdiction	
Analysis Time Period	*PM*	Analysis Year	*EXISTING 2015/2016*

Project Description   *SW 10th Street SIMR*

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

Flow Inputs

Volume, V	*4660*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*3*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*70.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*70.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p) *1677*		pc/h/ln
S	*67.4*	mph
D = v_p / S	*24.9*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS

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

Glossary

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

Factor Location

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

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst	
Agency or Company	AECOM
Date Performed	
Analysis Time Period	PM

Site Information

Freeway/Dir of Travel	I-95 NB
Junction	Seg 3-Merge from Sample EB
Jurisdiction	
Analysis Year	EXISTING 2015/2016

Project Description   SW 10th Street SIMR

Inputs

Upstream Adj Ramp	Freeway Number of Lanes, N	3		Downstream Adj Ramp
☐ Yes ☐ On	Ramp Number of Lanes, N	1		☑ Yes ☑ On
☑ No ☐ Off	Acceleration Lane Length, L_A	960		☐ No ☐ Off
	Deceleration Lane Length L_D			
L_{up} = ft	Freeway Volume, V_F	4660		L_{down} = 2300 ft
	Ramp Volume, V_R	565		
V_u = veh/h	Freeway Free-Flow Speed, S_{FF}	70.0		V_D = 335 veh/h
	Ramp Free-Flow Speed, S_{FR}	50.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4660	0.94	Level	3	0	0.985	1.00	5032
Ramp	565	0.97	Level	2	0	0.990	1.00	588
UpStream								
DownStream	335	0.93	Level	2	0	0.990	1.00	364

Merge Areas	Diverge Areas

Estimation of v_{12} / Estimation of v_{12}

Merge	Diverge
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 13-6 or 13-7)	L_{EQ} = (Equation 13-12 or 13-13)
P_{FM} = 0.604 using Equation (Exhibit 13-6)	P_{FD} = using Equation (Exhibit 13-7)
V_{12} = 3041 pc/h	V_{12} = pc/h
V_3 or V_{av34} 1991 pc/h (Equation 13-14 or 13-17)	V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐Yes ☑No	Is V_3 or V_{av34} > 2,700 pc/h? ☐Yes ☐No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑Yes ☐No	Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐Yes ☐No
If Yes,V_{12a} = 3041 pc/h (Equation 13-16, 13-18, or 13-19)	If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks / Capacity Checks

	Actual	Capacity	LOS F?
V_{FO}	5620	Exhibit 13-8	No

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

Flow Entering Merge Influence Area / Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3629	Exhibit 13-8	4600:All	No

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

Level of Service Determination (if not F) / Level of Service Determination (if not F)

Merge	Diverge
$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$	$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$
D_R = 27.5 (pc/mi/ln)	D_R = (pc/mi/ln)
LOS = C (Exhibit 13-2)	LOS = (Exhibit 13-2)

Speed Determination / Speed Determination

Merge	Diverge
M_S = 0.372 (Exibit 13-11)	D_s = (Exhibit 13-12)
S_R = 59.6 mph (Exhibit 13-11)	S_R = mph (Exhibit 13-12)
S_0 = 64.6 mph (Exhibit 13-11)	S_0 = mph (Exhibit 13-12)
S = 61.3 mph (Exhibit 13-13)	S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		*Site Information*	
Analyst		Highway/Direction of Travel	*I-95 NB*
Agency or Company	*AECOM*	From/To	*Seg 4-Bet Sample EB On & WB On*
Date Performed		Jurisdiction	
Analysis Time Period	*PM*	Analysis Year	*EXISTING 2015/2016*

Project Description   *SW 10th Street SIMR*

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

Flow Inputs

Volume, V	*5225*	veh/h	Peak-Hour Factor, PHF	*0.94*	
AADT		veh/day	%Trucks and Buses, P_T	*3*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*	
			Up/Down %		

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	mph
Base free-flow Speed, BFFS		mph			

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) *1881*		pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*64.6*	mph	S		mph
D = v_p / S	*29.1*	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 - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume D - Density		E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate FFS - Free-flow speed		f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service BFFS - Base free-flow speed		LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		*Site Information*	
Analyst		Freeway/Dir of Travel	I-95 NB
Agency or Company	AECOM	Junction	Seg 5-Merge from Sample WB
Date Performed		Jurisdiction	
Analysis Time Period	PM	Analysis Year	EXISTING 2015/2016

Project Description   SW 10th Street SIMR

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	3		Downstream Adj Ramp	
☑ Yes	☑ On	Ramp Number of Lanes, N	1		☐ Yes	☐ On
		Acceleration Lane Length, L_A	620			
☐ No	☐ Off	Deceleration Lane Length L_D			☑ No	☐ Off
		Freeway Volume, V_F	5225			
L_{up} =	2150 ft	Ramp Volume, V_R	335		L_{down} =	ft
		Freeway Free-Flow Speed, S_{FF}	70.0			
V_u =	565 veh/h	Ramp Free-Flow Speed, S_{FR}	50.0		V_D =	veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	5225	0.94	Level	3	0	0.985	1.00	5642
Ramp	335	0.93	Level	2	0	0.990	1.00	364
UpStream	565	0.97	Level	2	0	0.990	1.00	588
DownStream								

Merge Areas	**Diverge Areas**

Estimation of v_{12} (Merge)

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

(Equation 13-6 or 13-7)

L_{EQ} =

P_{FM} =   0.595   using Equation (Exhibit 13-6)

V_{12} =   3356   pc/h

V_3 or V_{av34} 2286   pc/h (Equation 13-14 or 13-17)

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

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

If Yes, V_{12a} =   3356   pc/h (Equation 13-16, 13-18, or 13-19)

Estimation of v_{12} (Diverge)

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

(Equation 13-12 or 13-13)

L_{EQ} =

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

V_{12} =   pc/h

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

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

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

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

Capacity Checks (Merge)

	Actual	Capacity	LOS F?
V_{FO}	6006	Exhibit 13-8	No

Capacity Checks (Diverge)

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

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3720	Exhibit 13-8	4600:All	No

Flow Entering Diverge Influence Area

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

Level of Service Determination (if not F) — Merge

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

D_R =   30.4 (pc/mi/ln)

LOS =   D (Exhibit 13-2)

Level of Service Determination (if not F) — Diverge

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

D_R =   (pc/mi/ln)

LOS =   (Exhibit 13-2)

Speed Determination — Merge

M_S =   0.420 (Exibit 13-11)

S_R =   58.2 mph (Exhibit 13-11)

S_0 =   63.6 mph (Exhibit 13-11)

S =   60.2 mph (Exhibit 13-13)

Speed Determination — Diverge

D_s =   (Exhibit 13-12)

S_R =   mph (Exhibit 13-12)

S_0 =   mph (Exhibit 13-12)

S =   mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	
Agency or Company	AECOM
Date Performed	
Analysis Time Period	PM

Site Information

Highway/Direction of Travel	I-95 NB
From/To	Seg 6-Bet Sample & 10th St
Jurisdiction	
Analysis Year	EXISTING 2015/2016

Project Description   SW 10th Street SIMR

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

Flow Inputs

Volume, V	5660	veh/h
AADT		veh/day
Peak-Hr Prop. of AADT, K		
Peak-Hr Direction Prop, D		
DDHV = AADT x K x D		veh/h

Peak-Hour Factor, PHF	0.95	
%Trucks and Buses, P_T	3	
%RVs, P_R	0	
General Terrain:	Level	
Grade % Length	mi	
Up/Down %		

Calculate Flow Adjustments

f_p	1.00	
E_T	1.5	

E_R	1.2	
f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.985	

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	3	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	70.0	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	70.0	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2016	pc/h/ln
S	62.3	mph
D = v_p / S	32.4	pc/mi/ln
LOS	D	

Design (N)

Design (N)

Design LOS

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

Glossary

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

Factor Location

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

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		*Site Information*	
Analyst		Freeway/Dir of Travel	I-95 NB
Agency or Company	AECOM	Junction	Seg 7-Diverge to 10th St
Date Performed		Jurisdiction	
Analysis Time Period	PM	Analysis Year	EXISTING 2015/2016

Project Description SW 10th Street SIMR

Inputs

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

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	250
Freeway Volume, V_F	5660
Ramp Volume, V_R	1220
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	45.0

Downstream Adj Ramp	
☑ Yes	☑ On
☐ No	☐ Off
L_{down} =	1370 ft
V_D =	1090 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	5660	0.95	Level	3	0	0.985	1.00	6047
Ramp	1220	0.91	Level	2	0	0.990	1.00	1354
UpStream								
DownStream	1090	0.93	Level	2	0	0.990	1.00	1184

Merge Areas	**Diverge Areas**

Estimation of v_{12} (Merge)

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

L_{EQ} =	(Equation 13-6 or 13-7)
P_{FM} =	using Equation (Exhibit 13-6)
V_{12} =	pc/h
V_3 or V_{av34}	pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No	
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No	
If Yes, V_{12a} =	pc/h (Equation 13-16, 13-18, or 13-19)

Estimation of v_{12} (Diverge)

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

L_{EQ} =	(Equation 13-12 or 13-13)
P_{FD} =	0.547 using Equation (Exhibit 13-7)
V_{12} =	3919 pc/h
V_3 or V_{av34}	2128 pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No	
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No	
If Yes, V_{12a} =	pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

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

Capacity Checks (Diverge)

	Actual	Capacity		LOS F?
V_F	6047	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	4693	Exhibit 13-8	7200	No
V_R	1354	Exhibit 13-10	2100	No

Flow Entering Merge Influence Area

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

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
V_{12}	3919	Exhibit 13-8 4400:All	No

Level of Service Determination (if not F) (Merge)

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

D_R =	(pc/mi/ln)
LOS =	(Exhibit 13-2)

Level of Service Determination (if not F) (Diverge)

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

D_R =	35.7 (pc/mi/ln)
LOS =	E (Exhibit 13-2)

Speed Determination (Merge)

M_S =	(Exibit 13-11)
S_R =	mph (Exhibit 13-11)
S_0 =	mph (Exhibit 13-11)
S =	mph (Exhibit 13-13)

Speed Determination (Diverge)

D_s =	0.420 (Exhibit 13-12)
S_R =	58.2 mph (Exhibit 13-12)
S_0 =	72.4 mph (Exhibit 13-12)
S =	62.5 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information			*Site Information*	
Analyst			Highway/Direction of Travel	*I-95 NB*
Agency or Company	*AECOM*		From/To	*Seg 8-Bet 10th St Off & On*
Date Performed			Jurisdiction	
Analysis Time Period	*PM*		Analysis Year	*EXISTING 2015/2016*

Project Description	*SW 10th Street SIMR*

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

Flow Inputs

Volume, V	*4440*	veh/h	Peak-Hour Factor, PHF	*0.98*
AADT		veh/day	%Trucks and Buses, P_T	*3*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs			*Calc Speed Adj and FFS*		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			**Design (N)**		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
			Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p) *1533*		pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*68.7*	mph	S		mph
D = v_p / S	*22.3*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*C*		Required Number of Lanes, N		

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

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		*Site Information*	
Analyst		Freeway/Dir of Travel	I-95 NB
Agency or Company	AECOM	Junction	Seg 9-Merge from 10th St
Date Performed		Jurisdiction	
Analysis Time Period	PM	Analysis Year	EXISTING 2015/2016

Project Description   SW 10th Street SIMR

Inputs

Upstream Adj Ramp			Downstream Adj Ramp
☑ Yes ☐ On	Freeway Number of Lanes, N — 3		☐ Yes ☐ On
☐ No ☑ Off	Ramp Number of Lanes, N — 1		☑ No ☐ Off
	Acceleration Lane Length, L_A — 1345		
	Deceleration Lane Length L_D —		
L_{up} = 1370 ft	Freeway Volume, V_F — 4440		L_{down} = ft
	Ramp Volume, V_R — 1090		
V_u = 1220 veh/h	Freeway Free-Flow Speed, S_{FF} — 70.0		V_D = veh/h
	Ramp Free-Flow Speed, S_{FR} — 50.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4440	0.98	Level	3	0	0.985	1.00	4599
Ramp	1090	0.98	Level	2	0	0.990	1.00	1123
UpStream	1220	0.91	Level	2	0	0.990	1.00	1354
DownStream								

Merge Areas	**Diverge Areas**

Estimation of v_{12} (Merge)

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

L_{EQ} =   2034.69   (Equation 13-6 or 13-7)
P_{FM} =   0.573   using Equation (Exhibit 13-6)
V_{12} =   2636   pc/h
V_3 or V_{av34} 1963   pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No
If Yes, V_{12a} =   2636   pc/h (Equation 13-16, 13-18, or 13-19)

Estimation of v_{12} (Diverge)

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

L_{EQ} =   (Equation 13-12 or 13-13)
P_{FD} =   using Equation (Exhibit 13-7)
V_{12} =   pc/h
V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes, V_{12a} =   pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks (Merge)

	Actual	Capacity	LOS F?
V_{FO}	5722	Exhibit 13-8	No

Capacity Checks (Diverge)

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

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3759	Exhibit 13-8	4600:All	No

Flow Entering Diverge Influence Area

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

Level of Service Determination (if not F) (Merge)

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

D_R =   25.8   (pc/mi/ln)
LOS =   C (Exhibit 13-2)

Level of Service Determination (if not F) (Diverge)

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

D_R =   (pc/mi/ln)
LOS =   (Exhibit 13-2)

Speed Determination (Merge)

M_S =   0.354 (Exibit 13-11)
S_R =   60.1 mph (Exhibit 13-11)
S_0 =   64.7 mph (Exhibit 13-11)
S =   61.6 mph (Exhibit 13-13)

Speed Determination (Diverge)

D_s =   (Exhibit 13-12)
S_R =   mph (Exhibit 13-12)
S_0 =   mph (Exhibit 13-12)
S =   mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information			*Site Information*	
Analyst			Highway/Direction of Travel	*I-95 NB*
Agency or Company	*AECOM*		From/To	*Seg 10-Bet 10th St & Hillsboro*
Date Performed			Jurisdiction	
Analysis Time Period	*PM*		Analysis Year	*EXISTING 2015/2016*

Project Description   *SW 10th Street SIMR*

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

Flow Inputs

Volume, V	*5550*	veh/h	Peak-Hour Factor, PHF	*0.98*
AADT		veh/day	%Trucks and Buses, P_T	*3*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			**Design (N)**		
<ins>Operational (LOS)</ins>			<ins>Design (N)</ins>		
			Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1916*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*64.1*	mph	S		mph
D = v_p / S	*29.9*	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 - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume D - Density		E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate FFS - Free-flow speed		f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service BFFS - Base free-flow speed		LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information
Site Information

Analyst	
Agency or Company	AECOM
Date Performed	
Analysis Time Period	PM
Project Description	SW 10th Street SIMR

Freeway/Dir of Travel	I-95 NB
Junction	Seg 11-Diverge to Hillsboro EB
Jurisdiction	
Analysis Year	EXISTING 2015/2016

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} =   ft

V_u =   veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	220
Freeway Volume, V_F	5550
Ramp Volume, V_R	630
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	45.0

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} =   1560 ft

V_D =   575 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	5550	0.98	Level	3	0	0.985	1.00	5748
Ramp	630	0.84	Level	2	0	0.990	1.00	758
UpStream								
DownStream	575	0.90	Level	2	0	0.990	1.00	645

Merge Areas	Diverge Areas

Estimation of v_{12} (Merge Areas)
Estimation of v_{12} (Diverge Areas)

Merge:

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

L_{EQ} =	(Equation 13-6 or 13-7)
P_{FM} =	using Equation (Exhibit 13-6)
V_{12} =	pc/h
V_3 or V_{av34}	pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No	
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No	
If Yes, V_{12a} =	pc/h (Equation 13-16, 13-18, or 13-19)

Diverge:

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

L_{EQ} =	(Equation 13-12 or 13-13)
P_{FD} =	0.581 using Equation (Exhibit 13-7)
V_{12} =	3659 pc/h
V_3 or V_{av34}	2089 pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No	
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No	
If Yes, V_{12a} =	pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks
Capacity Checks

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

	Actual	Capacity		LOS F?
V_F	5748	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	4990	Exhibit 13-8	7200	No
V_R	758	Exhibit 13-10	2100	No

Flow Entering Merge Influence Area
Flow Entering Diverge Influence Area

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

	Actual	Max Desirable	Violation?
V_{12}	3659	Exhibit 13-8 4400:All	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 =	(pc/mi/ln)
LOS =	(Exhibit 13-2)

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

D_R =	33.7 (pc/mi/ln)
LOS =	D (Exhibit 13-2)

Speed Determination
Speed Determination

M_S =	(Exibit 13-11)
S_R =	mph (Exhibit 13-11)
S_0 =	mph (Exhibit 13-11)
S =	mph (Exhibit 13-13)

D_s =	0.366 (Exhibit 13-12)
S_R =	59.7 mph (Exhibit 13-12)
S_0 =	72.5 mph (Exhibit 13-12)
S =	63.8 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

		Site Information	
Analyst		Highway/Direction of Travel	*I-95 NB*
Agency or Company	*AECOM*	From/To	*Seg 12-Bet Hillsboro Off & On*
Date Performed		Jurisdiction	
Analysis Time Period	*PM*	Analysis Year	*EXISTING 2015/2016*

Project Description   *SW 10th Street SIMR*

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

Flow Inputs

Volume, V	*4920*	veh/h		Peak-Hour Factor, PHF	*0.98*	
AADT		veh/day		%Trucks and Buses, P_T	*3*	
Peak-Hr Prop. of AADT, K				%RVs, P_R	*0*	
Peak-Hr Direction Prop, D				General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h		Grade % Length	*mi*	
				Up/Down %		

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs

			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures

Design (N)

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1699*	pc/h/ln
S	*67.1*	mph
D = v_p / S	*25.3*	pc/mi/ln
LOS	*C*	

Design (N)

Design LOS

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

Glossary

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

		Site Information	
Analyst		Highway/Direction of Travel	*I-95 NB*
Agency or Company	*AECOM*	From/To	*Seg 12-Bet Hillsboro Off & On*
Date Performed		Jurisdiction	
Analysis Time Period	*PM*	Analysis Year	*EXISTING 2015/2016*

Project Description   *SW 10th Street SIMR*

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

Flow Inputs

Volume, V	*4920*	veh/h	Peak-Hour Factor, PHF	*0.98*	
AADT		veh/day	%Trucks and Buses, P_T	*3*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*	
			Up/Down %		

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs / Calc Speed Adj and FFS

			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1699*	pc/h/ln
S	*67.1*	mph
D = v_p / S	*25.3*	pc/mi/ln
LOS	*C*	

Design (N)

Design LOS

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

Glossary

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

Factor Location

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

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	AECOM
Date Performed	
Analysis Time Period	PM

Site Information

Freeway/Dir of Travel	I-95 NB
Weaving Segment Location	Seg 13-Bet Hillsboro On & Off
Analysis Year	EXISTING 2015/2016

Project Description SW 10th Street SIMR

Inputs

Weaving configuration	One-Sided	Segment type	Freeway
Weaving number of lanes, N	4	Freeway minimum speed, S_{MIN}	15
Weaving segment length, L_S	790ft	Freeway maximum capacity, C_{IFL}	2400
Freeway free-flow speed, FFS	70 mph	Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	4410	0.98	3	0	1.5	1.2	0.985	1.00	4568
V_{RF}	575	0.90	2	0	1.5	1.2	0.990	1.00	645
V_{FR}	510	0.86	2	0	1.5	1.2	0.990	1.00	599
V_{RR}	0	0.92	2	0	1.5	1.2	0.990	1.00	0
V_{NW}	4568							V =	5812
V_W	1244								
VR	0.214								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1244 lc/h
Interchange density, ID	0.8 int/mi	Weaving lane changes, LC_W	1465 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	599 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	2064 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	289

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	5732 veh/h	Weaving intensity factor, W	0.482
Weaving segment capacity, c_w	8284 veh/h	Weaving segment speed, S	53.6 mph
Weaving segment v/c ratio	0.692	Average weaving speed, S_W	52.1 mph
Weaving segment density, D	27.1 pc/mi/ln	Average non-weaving speed, S_{NW}	54.1 mph
Level of Service, LOS	C	Maximum weaving length, L_{MAX}	4680 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information			*Site Information*	
Analyst			Highway/Direction of Travel	*I-95 NB*
Agency or Company	*AECOM*		From/To	*Seg 14-Bet Hillsboro Off & On*
Date Performed			Jurisdiction	
Analysis Time Period	*PM*		Analysis Year	*EXISTING 2015/2016*

Project Description   *SW 10th Street SIMR*

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

Flow Inputs

Volume, V	*4985*	veh/h	Peak-Hour Factor, PHF	*0.98*
AADT		veh/day	%Trucks and Buses, P_T	*3*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*		E_R	*1.2*
E_T	*1.5*		f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs

			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures

Operational (LOS)			**Design (N)**	
			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p) *1721*		pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*66.9*	mph	S	mph
D = v_p / S	*25.7*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

Glossary

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

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-95 NB
Agency or Company	AECOM	Junction	Seg 15-Merge from Hillsboro WB
Date Performed		Jurisdiction	
Analysis Time Period	PM	Analysis Year	EXISTING 2015/2016

Project Description   SW 10th Street SIMR

Inputs

Upstream Adj Ramp	Freeway Number of Lanes, N	3		Downstream Adj Ramp
☑ Yes ☐ On	Ramp Number of Lanes, N	1		☐ Yes ☐ On
	Acceleration Lane Length, L_A	525		
☐ No ☑ Off	Deceleration Lane Length L_D			☑ No ☐ Off
	Freeway Volume, V_F	4985		
L_{up} = 2135 ft	Ramp Volume, V_R	595		L_{down} = ft
	Freeway Free-Flow Speed, S_{FF}	70.0		
V_u = 510 veh/h	Ramp Free-Flow Speed, S_{FR}	50.0		V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4985	0.98	Level	3	0	0.985	1.00	5163
Ramp	595	0.93	Level	2	0	0.990	1.00	646
UpStream	510	0.86	Level	2	0	0.990	1.00	599
DownStream								

Merge Areas	Diverge Areas

Estimation of v_{12}	Estimation of v_{12}
$V_{12} = V_F (P_{FM})$ L_{EQ} = 1689.23 (Equation 13-6 or 13-7) P_{FM} = 0.592 using Equation (Exhibit 13-6) V_{12} = 3058 pc/h V_3 or V_{av34} 2105 pc/h (Equation 13-14 or 13-17) Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No If Yes,V_{12a} = 3058 pc/h (Equation 13-16, 13-18, or 13-19)	$V_{12} = V_R + (V_F - V_R)P_{FD}$ L_{EQ} = (Equation 13-12 or 13-13) P_{FD} = using Equation (Exhibit 13-7) V_{12} = pc/h V_3 or V_{av34} pc/h (Equation 13-14 or 13-17) Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks				Capacity Checks			
	Actual	Capacity	LOS F?		Actual	Capacity	LOS F?
V_{FO}	5809	Exhibit 13-8	No	V_F		Exhibit 13-8	
				$V_{FO} = V_F - V_R$		Exhibit 13-8	
				V_R		Exhibit 13-10	

Flow Entering Merge Influence Area				Flow Entering Diverge Influence Area			
	Actual	Max Desirable	Violation?		Actual	Max Desirable	Violation?
V_{R12}	3704	Exhibit 13-8 4600:All	No	V_{12}		Exhibit 13-8	

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 = 30.8 (pc/mi/ln) LOS = D (Exhibit 13-2)	$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$ D_R = (pc/mi/ln) LOS = (Exhibit 13-2)

Speed Determination	Speed Determination
M_S = 0.427 (Exibit 13-11) S_R = 58.0 mph (Exhibit 13-11) S_0 = 64.2 mph (Exhibit 13-11) S = 60.1 mph (Exhibit 13-13)	D_s = (Exhibit 13-12) S_R = mph (Exhibit 13-12) S_0 = mph (Exhibit 13-12) S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst
Agency or Company *AECOM*
Date Performed
Analysis Time Period *PM*

Site Information

Highway/Direction of Travel *I-95 NB*
From/To *Seg 16-North of Hillsboro*
Jurisdiction
Analysis Year *EXISTING 2015/2016*

Project Description *SW 10th Street SIMR*

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

Flow Inputs

Volume, V	*5580*	veh/h	Peak-Hour Factor, PHF	*0.98*	
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*	
			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

Lane Width ft
Rt-Side Lat. Clearance ft
Number of Lanes, N *3*
Total Ramp Density, TRD ramps/mi
FFS (measured) *70.0* mph
Base free-flow Speed, BFFS mph

Calc Speed Adj and FFS

f_{LW} mph
f_{LC} mph
TRD Adjustment mph
FFS *70.0* mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p) *1936* pc/h/ln
S *63.7* mph
D = v_p / S *30.4* pc/mi/ln
LOS *D*

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		*Site Information*	
Analyst		Highway/Direction of Travel	*I-95 SB*
Agency or Company	*AECOM*	From/To	*Seg 1-Bet Hillsboro & Palmetto*
Date Performed		Jurisdiction	
Analysis Time Period	*AM*	Analysis Year	*EXISTING 2015/2016*

Project Description	*SW 10th Street SIMR*

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

Flow Inputs

Volume, V	*4700*	veh/h	Peak-Hour Factor, PHF	*0.96*	
AADT		veh/day	%Trucks and Buses, P_T	*3*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*	
			Up/Down %		

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ *0.985*	

Speed Inputs

			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures

Design (N)

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p) *1656* pc/h/ln

S	*67.6*	mph
D = v_p / S	*24.5*	pc/mi/ln
LOS	*C*	

Design (N)

Design LOS

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)   pc/h/ln

S	mph
D = v_p / S	pc/mi/ln
Required Number of Lanes, N	

Glossary

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

Factor Location

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

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst	
Agency or Company	AECOM
Date Performed	
Analysis Time Period	AM

Project Description   SW 10th Street SIMR

Site Information

Freeway/Dir of Travel	I-95 SB
Junction	Seg 2-Diverge to Hillsboro
Jurisdiction	
Analysis Year	EXISTING 2015/2016

Inputs

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

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	1500
Freeway Volume, V_F	4700
Ramp Volume, V_R	1150
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	45.0

Downstream Adj Ramp	
☑ Yes	☑ On
☐ No	☐ Off
L_{down} =	2175 ft
V_D =	600 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 x f_{HV} x f_p
Freeway	4700	0.96	Level	3	0	0.985	1.00	4969
Ramp	1150	0.92	Level	2	0	0.990	1.00	1262
UpStream								
DownStream	600	0.88	Level	2	0	0.990	1.00	689

Merge Areas	Diverge Areas

Estimation of v_{12} (Merge) / Estimation of v_{12} (Diverge)

Merge	Diverge
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 13-6 or 13-7)	L_{EQ} = (Equation 13-12 or 13-13)
P_{FM} = using Equation (Exhibit 13-6)	P_{FD} = 0.578 using Equation (Exhibit 13-7)
V_{12} = pc/h	V_{12} = 3404 pc/h
V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)	V_3 or V_{av34} 1565 pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No	Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No	Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)	If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks (Merge)

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

Capacity Checks (Diverge)

	Actual	Capacity		LOS F?
V_F	4969	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	3707	Exhibit 13-8	7200	No
V_R	1262	Exhibit 13-10	2100	No

Flow Entering Merge Influence Area

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

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
V_{12}	3404	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F) — Merge

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

D_R = (pc/mi/ln)	
LOS = (Exhibit 13-2)	

Level of Service Determination (if not F) — Diverge

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

D_R = 20.0 (pc/mi/ln)	
LOS = C (Exhibit 13-2)	

Speed Determination — Merge

M_S = (Exibit 13-11)	
S_R = mph (Exhibit 13-11)	
S_0 = mph (Exhibit 13-11)	
S = mph (Exhibit 13-13)	

Speed Determination — Diverge

D_s = 0.412 (Exhibit 13-12)	
S_R = 58.5 mph (Exhibit 13-12)	
S_0 = 74.6 mph (Exhibit 13-12)	
S = 62.7 mph (Exhibit 13-13)	

BASIC FREEWAY SEGMENTS WORKSHEET

General Information			*Site Information*	
Analyst			Highway/Direction of Travel	*I-95 SB*
Agency or Company	*AECOM*		From/To	*Seg 3-Bet Off & On Ramps*
Date Performed			Jurisdiction	
Analysis Time Period	*AM*		Analysis Year	*EXISTING 2015/2016*

Project Description	*SW 10th Street SIMR*

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

Flow Inputs

Volume, V	*3550*	veh/h	Peak-Hour Factor, PHF	*0.96*
AADT		veh/day	%Trucks and Buses, P_T	*3*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$ *0.985*	

Speed Inputs | Calc Speed Adj and FFS

Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures | Design (N)

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p) *1251*   pc/h/ln

S	*70.0*	mph
D = v_p / S	*17.9*	pc/mi/ln
LOS	*B*	

Design (N)

Design LOS

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)   pc/h/ln

S   mph

D = v_p / S   pc/mi/ln

Required Number of Lanes, N

Glossary | Factor Location

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

E_R - Exhibits 11-10, 11-12 f_{LW} - Exhibit 11-8

E_T - Exhibits 11-10, 11-11, 11-13 f_{LC} - Exhibit 11-9

f_p - Page 11-18   TRD - Page 11-11

LOS, S, FFS, v_p - Exhibits 11-2, 11-3

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		*Site Information*	
Analyst		Freeway/Dir of Travel	I95/SB
Agency or Company	AECOM	Junction	Seg 4-Merge from Hillsboro WB
Date Performed		Jurisdiction	
Analysis Time Period	AM	Analysis Year	EXISTING 2015/2016

Project Description   SW 10th Street SIMR

Inputs

Upstream Adj Ramp	Freeway Number of Lanes, N	3		Downstream Adj Ramp
☐ Yes ☐ On	Ramp Number of Lanes, N	1		☑ Yes ☑ On
	Acceleration Lane Length, L_A	945		
☑ No ☐ Off	Deceleration Lane Length L_D			☐ No ☐ Off
	Freeway Volume, V_F	3550		
L_{up} = ft	Ramp Volume, V_R	600		L_{down} = 2080 ft
	Freeway Free-Flow Speed, S_{FF}	70.0		
V_u = veh/h	Ramp Free-Flow Speed, S_{FR}	50.0		V_D = 700 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3550	0.96	Level	3	0	0.985	1.00	3753
Ramp	600	0.88	Level	2	0	0.990	1.00	689
UpStream								
DownStream	700	0.83	Level	2	0	0.990	1.00	852

Merge Areas	**Diverge Areas**

Estimation of v_{12} (Merge)

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

(Equation 13-6 or 13-7)

L_{EQ} =

P_{FM} =   0.604   using Equation (Exhibit 13-6)

V_{12} =   2267   pc/h

V_3 or V_{av34} 1486   pc/h (Equation 13-14 or 13-17)

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

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

If Yes,V_{12a} =   2267   pc/h (Equation 13-16, 13-18, or 13-19)

Estimation of v_{12} (Diverge)

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

(Equation 13-12 or 13-13)

L_{EQ} =

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

V_{12} =   pc/h

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

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

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

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

Capacity Checks (Merge)

	Actual	Capacity	LOS F?
V_{FO}	4442	Exhibit 13-8	No

Capacity Checks (Diverge)

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

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
V_{R12}	2956	Exhibit 13-8 4600:All	No

Flow Entering Diverge Influence Area

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

Level of Service Determination (if not F) (Merge)

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

D_R =   22.3 (pc/mi/ln)

LOS =   C (Exhibit 13-2)

Level of Service Determination (if not F) (Diverge)

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

D_R =   (pc/mi/ln)

LOS =   (Exhibit 13-2)

Speed Determination (Merge)

M_S =   0.301 (Exibit 13-11)

S_R =   61.6 mph (Exhibit 13-11)

S_0 =   66.5 mph (Exhibit 13-11)

S =   63.1 mph (Exhibit 13-13)

Speed Determination (Diverge)

D_s =   (Exhibit 13-12)

S_R =   mph (Exhibit 13-12)

S_0 =   mph (Exhibit 13-12)

S =   mph (Exhibit 13-13)

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		*Site Information*	
Analyst		Highway/Direction of Travel	*I-95 SB*
Agency or Company	*AECOM*	From/To	*Seg 5-Bet WB On & EB On Ramps*
Date Performed		Jurisdiction	
Analysis Time Period	*AM*	Analysis Year	*EXISTING 2015/2016*
Project Description	*SW 10th Street SIMR*		

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

Flow Inputs

Volume, V	*4150*	veh/h	Peak-Hour Factor, PHF	*0.96*	
AADT		veh/day	%Trucks and Buses, P_T	*3*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*	
			Up/Down %		

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs

			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures

Design (N)

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p) *1463*	pc/h/ln	
S	*69.2*	mph
D = v_p / S	*21.1*	pc/mi/ln
LOS	*C*	

Design (N)

Design LOS

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

Glossary

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

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information | Site Information

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-95 SB
Agency or Company	AECOM	Junction	Seg 6-Merge from Hillsboro EB
Date Performed		Jurisdiction	
Analysis Time Period	AM	Analysis Year	EXISTING 2015/2016

Project Description   SW 10th Street SIMR

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	3		Downstream Adj Ramp	
☑ Yes	☑ On	Ramp Number of Lanes, N	1		☐ Yes	☐ On
		Acceleration Lane Length, L_A	600			
☐ No	☐ Off	Deceleration Lane Length L_D			☑ No	☐ Off
		Freeway Volume, V_F	4150			
L_{up} =	2080 ft	Ramp Volume, V_R	700		L_{down} =	ft
		Freeway Free-Flow Speed, S_{FF}	70.0			
V_u =	600 veh/h	Ramp Free-Flow Speed, S_{FR}	50.0		V_D =	veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4150	0.96	Level	3	0	0.985	1.00	4388
Ramp	700	0.83	Level	2	0	0.990	1.00	852
UpStream	600	0.88	Level	2	0	0.990	1.00	689
DownStream								

Merge Areas	Diverge Areas

Estimation of v_{12} (Merge) | Estimation of v_{12} (Diverge)

Merge	Diverge
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} =	L_{EQ} =
(Equation 13-6 or 13-7)	(Equation 13-12 or 13-13)
P_{FM} = 0.594 using Equation (Exhibit 13-6)	P_{FD} = using Equation (Exhibit 13-7)
V_{12} = 2608 pc/h	V_{12} = pc/h
V_3 or V_{av34} 1780 pc/h (Equation 13-14 or 13-17)	V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No	Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No	Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes,V_{12a} = 2608 pc/h (Equation 13-16, 13-18, or 13-19)	If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks | Capacity Checks

	Actual	Capacity	LOS F?
V_{FO}	5240	Exhibit 13-8	No

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

Flow Entering Merge Influence Area | Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
V_{R12}	3460	Exhibit 13-8 4600:All	No

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

Level of Service Determination (if not F) | Level of Service Determination (if not F)

Merge	Diverge
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$	$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$
D_R = 28.3 (pc/mi/ln)	D_R = (pc/mi/ln)
LOS = D (Exhibit 13-2)	LOS = (Exhibit 13-2)

Speed Determination | Speed Determination

Merge	Diverge
M_S = 0.385 (Exibit 13-11)	D_s = (Exhibit 13-12)
S_R = 59.2 mph (Exhibit 13-11)	S_R = mph (Exhibit 13-12)
S_0 = 65.4 mph (Exhibit 13-11)	S_0 = mph (Exhibit 13-12)
S = 61.2 mph (Exhibit 13-13)	S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		*Site Information*	
Analyst		Freeway/Dir of Travel	I-95 SB
Agency or Company	AECOM	Junction	Seg 7-Diverge to SW 10th St
Date Performed		Jurisdiction	
Analysis Time Period	AM	Analysis Year	EXISTING 2015/2016

Project Description   SW 10th Street SIMR

Inputs

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

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	180
Freeway Volume, V_F	4810
Ramp Volume, V_R	910
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	45.0

Downstream Adj Ramp	
☑ Yes	☑ On
☐ No	☐ Off
L_{down} =	2210 ft
V_D =	1180 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4810	0.96	Level	3	0	0.985	1.00	5086
Ramp	910	0.90	Level	2	0	0.990	1.00	1021
UpStream								
DownStream	1180	0.98	Level	2	0	0.990	1.00	1216

Merge Areas	**Diverge Areas**

Estimation of v_{12} (Merge)

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

L_{EQ} =	(Equation 13-6 or 13-7)
P_{FM} =	using Equation (Exhibit 13-6)
V_{12} =	pc/h
V_3 or V_{av34}	pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h?	☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2	☐ Yes ☐ No
If Yes, V_{12a} =	pc/h (Equation 13-16, 13-18, or 13-19)

Estimation of v_{12} (Diverge)

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

L_{EQ} =	(Equation 13-12 or 13-13)
P_{FD} =	0.586 using Equation (Exhibit 13-7)
V_{12} =	3403 pc/h
V_3 or V_{av34}	1683 pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h?	☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2	☐ Yes ☑ No
If Yes, V_{12a} =	pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

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

Diverge
	Actual	Capacity		LOS F?
V_F	5086	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	4065	Exhibit 13-8	7200	No
V_R	1021	Exhibit 13-10	2100	No

Flow Entering Merge Influence Area

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

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
V_{12}	3403	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

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

D_R =	(pc/mi/ln)
LOS =	(Exhibit 13-2)

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

D_R =	31.9 (pc/mi/ln)
LOS =	D (Exhibit 13-2)

Speed Determination

Merge
M_S =	(Exibit 13-11)
S_R =	mph (Exhibit 13-11)
S_0 =	mph (Exhibit 13-11)
S =	mph (Exhibit 13-13)

Diverge
D_S =	0.390 (Exhibit 13-12)
S_R =	59.1 mph (Exhibit 13-12)
S_0 =	74.1 mph (Exhibit 13-12)
S =	63.3 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information			*Site Information*	
Analyst			Highway/Direction of Travel	*I-95 SB*
Agency or Company	*AECOM*		From/To	*Seg 8-Bet Off & On Ramp*
Date Performed			Jurisdiction	
Analysis Time Period	*AM*		Analysis Year	*EXISTING 2015/2016*

Project Description	*SW 10th Street SIMR*

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

Flow Inputs

Volume, V	*3900*	veh/h	Peak-Hour Factor, PHF	*0.96*
AADT		veh/day	%Trucks and Buses, P_T	*3*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p) *1374*		pc/h/ln
S	*69.6*	mph
D = v_p / S	*19.7*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS

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

Glossary

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

Factor Location

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

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		*Site Information*	
Analyst		Freeway/Dir of Travel	I-95 SB
Agency or Company	AECOM	Junction	Seg 9-Merge from 10th St
Date Performed		Jurisdiction	
Analysis Time Period	AM	Analysis Year	EXISTING 2015/2016

Project Description   SW 10th Street SIMR

Inputs

Upstream Adj Ramp	Freeway Number of Lanes, N	3	Downstream Adj Ramp
☑ Yes ☐ On	Ramp Number of Lanes, N	1	☐ Yes ☐ On
	Acceleration Lane Length, L_A	1500	
☐ No ☑ Off	Deceleration Lane Length L_D		☑ No ☐ Off
	Freeway Volume, V_F	3900	
L_{up} = 2210 ft	Ramp Volume, V_R	1180	L_{down} = ft
	Freeway Free-Flow Speed, S_{FF}	70.0	
V_u = 910 veh/h	Ramp Free-Flow Speed, S_{FR}	50.0	V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3900	0.96	Level	3	0	0.985	1.00	4123
Ramp	1180	0.98	Level	2	0	0.990	1.00	1216
UpStream	910	0.90	Level	2	0	0.990	1.00	1021
DownStream								

Merge Areas	**Diverge Areas**

Estimation of v_{12}

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

L_{EQ} =   2021.55   (Equation 13-6 or 13-7)

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

V_{12} =   2554   pc/h

V_3 or V_{av34} 1569   pc/h (Equation 13-14 or 13-17)

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

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

If Yes, V_{12a} =   2554   pc/h (Equation 13-16, 13-18, or 13-19)

Estimation of v_{12}

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

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

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

V_{12} =   pc/h

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

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

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

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

Capacity Checks

	Actual	Capacity	LOS F?
V_{FO}	5339	Exhibit 13-8	No

Capacity Checks

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

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3770	Exhibit 13-8	4600:All	No

Flow Entering Diverge Influence Area

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

Level of Service Determination (if not F)

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

D_R =   24.9 (pc/mi/ln)

LOS =   C (Exhibit 13-2)

Level of Service Determination (if not F)

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

D_R =   (pc/mi/ln)

LOS =   (Exhibit 13-2)

Speed Determination

M_S =   0.340 (Exibit 13-11)

S_R =   60.5 mph (Exhibit 13-11)

S_0 =   66.2 mph (Exhibit 13-11)

S =   62.0 mph (Exhibit 13-13)

Speed Determination

D_s =   (Exhibit 13-12)

S_R =   mph (Exhibit 13-12)

S_0 =   mph (Exhibit 13-12)

S =   mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		*Site Information*	
Analyst		Highway/Direction of Travel	*I-95 SB*
Agency or Company	*AECOM*	From/To	*Seg 10-Bet 10th St & Sample Rd*
Date Performed		Jurisdiction	
Analysis Time Period	*AM*	Analysis Year	*EXISTING 2015/2016*
Project Description *SW 10th Street SIMR*			

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

Flow Inputs

Volume, V	*5020*	veh/h	Peak-Hour Factor, PHF	*0.95*	
AADT		veh/day	%Trucks and Buses, P_T	*3*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*	
			Up/Down %		

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs

Lane Width		ft	
Rt-Side Lat. Clearance		ft	
Number of Lanes, N	*3*		
Total Ramp Density, TRD		ramps/mi	
FFS (measured)	*70.0*	mph	
Base free-flow Speed, BFFS		mph	

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*70.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p) *1788*		pc/h/ln
S	*66.0*	mph
D = v_p / S	*27.1*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS

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

Glossary

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

Factor Location

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

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-95 SB
Agency or Company	AECOM	Junction	Seg 11- Diverge to Sample Rd
Date Performed		Jurisdiction	
Analysis Time Period	AM	Analysis Year	EXISTING 2015/2016

Project Description   SW 10th Street SIMR

Inputs

Upstream Adj Ramp	Freeway Number of Lanes, N	3	Downstream Adj Ramp
☐ Yes ☐ On	Ramp Number of Lanes, N	1	
	Acceleration Lane Length, L_A		☑ Yes ☑ On
☑ No ☐ Off	Deceleration Lane Length L_D	250	☐ No ☐ Off
	Freeway Volume, V_F	5020	
L_{up} = ft	Ramp Volume, V_R	790	L_{down} = 1660 ft
V_u = veh/h	Freeway Free-Flow Speed, S_{FF}	70.0	V_D = 825 veh/h
	Ramp Free-Flow Speed, S_{FR}	45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	5020	0.96	Level	3	0	0.985	1.00	5308
Ramp	790	0.97	Level	2	0	0.990	1.00	823
UpStream								
DownStream	825	0.84	Level	2	0	0.990	1.00	992

Merge Areas	Diverge Areas

Estimation of v_{12} (Merge Areas)

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

L_{EQ} =   (Equation 13-6 or 13-7)
P_{FM} =   using Equation   (Exhibit 13-6)
V_{12} =   pc/h
V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes, V_{12a} =   pc/h (Equation 13-16, 13-18, or 13-19)

Estimation of v_{12} (Diverge Areas)

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

L_{EQ} =   (Equation 13-12 or 13-13)
P_{FD} =   0.589 using Equation (Exhibit 13-7)
V_{12} =   3467 pc/h
V_3 or V_{av34} 1841 pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes, V_{12a} =   pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

Merge Areas

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

Diverge Areas

	Actual	Capacity		LOS F?
V_F	5308	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	4485	Exhibit 13-8	7200	No
V_R	823	Exhibit 13-10	2100	No

Flow Entering Merge Influence Area

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

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
V_{12}	3467	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F) — Merge

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

D_R =   (pc/mi/ln)
LOS =   (Exhibit 13-2)

Level of Service Determination (if not F) — Diverge

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

D_R =   31.8 (pc/mi/ln)
LOS =   D (Exhibit 13-2)

Speed Determination — Merge

M_S =   (Exibit 13-11)
S_R=   mph (Exhibit 13-11)
S_0=   mph (Exhibit 13-11)
S =   mph (Exhibit 13-13)

Speed Determination — Diverge

D_s =   0.372 (Exhibit 13-12)
S_R=   59.6 mph (Exhibit 13-12)
S_0=   73.5 mph (Exhibit 13-12)
S =   63.8 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	
Agency or Company	*AECOM*
Date Performed	
Analysis Time Period	*AM*

Site Information

Highway/Direction of Travel	*I-95 SB*
From/To	*Seg 12-Bet Off & On Ramps*
Jurisdiction	
Analysis Year	*EXISTING 2015/2016*

Project Description

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

Flow Inputs

Volume, V	*4230*	veh/h	Peak-Hour Factor, PHF	*0.96*	
AADT		veh/day	%Trucks and Buses, P_T	*3*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*	
			Up/Down %		

Calculate Flow Adjustments

f_p	*1.00*		E_R	*1.2*
E_T	*1.5*		$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*70.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*70.0*	mph

LOS and Performance Measures

Operational (LOS)

$v_p = $ (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1491*	pc/h/ln
S	*69.0*	mph
D = v_p / S	*21.6*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS

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

Glossary

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

Factor Location

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

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information
Site Information

Analyst		Freeway/Dir of Travel	I-95 SB
Agency or Company	AECOM	Junction	Seg 13-Merge from Sample Rd WB
Date Performed		Jurisdiction	
Analysis Time Period	AM	Analysis Year	EXISTING 2015/2016

Project Description   SW 10th Street SIMR

Inputs

Upstream Adj Ramp	Freeway Number of Lanes, N — 3	Downstream Adj Ramp
☐ Yes ☐ On	Ramp Number of Lanes, N — 1	☑ Yes ☑ On
☑ No ☐ Off	Acceleration Lane Length, L_A — 990	☐ No ☐ Off
	Deceleration Lane Length L_D	
L_{up} = ft	Freeway Volume, V_F — 4230	L_{down} = 2400 ft
	Ramp Volume, V_R — 825	
V_u = veh/h	Freeway Free-Flow Speed, S_{FF} — 70.0	V_D = 835 veh/h
	Ramp Free-Flow Speed, S_{FR} — 50.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4230	0.96	Level	3	0	0.985	1.00	4472
Ramp	825	0.84	Level	2	0	0.990	1.00	992
UpStream								
DownStream	835	0.88	Level	2	0	0.990	1.00	958

Merge Areas	**Diverge Areas**

Estimation of v_{12} (Merge)   ## Estimation of v_{12} (Diverge)

Merge:

$$V_{12} = V_F (P_{FM})$$
(Equation 13-6 or 13-7)

L_{EQ} =
P_{FM} =   0.605   using Equation (Exhibit 13-6)
V_{12} =   2707   pc/h
V_3 or V_{av34} 1765   pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h?   ☐ Yes   ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2   ☑ Yes   ☐ No
If Yes, V_{12a} =   2707   pc/h (Equation 13-16, 13-18, or 13-19)

Diverge:

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$
(Equation 13-12 or 13-13)

L_{EQ} =
P_{FD} =   using Equation (Exhibit 13-7)
V_{12} =   pc/h
V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h?   ☐ Yes   ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2   ☐ Yes   ☐ No
If Yes, V_{12a} =   pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks (Merge)

	Actual	Capacity	LOS F?
V_{FO}	5464	Exhibit 13-8	No

Capacity Checks (Diverge)

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

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
V_{R12}	3699	Exhibit 13-8 4600:All	No

Flow Entering Diverge Influence Area

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

Level of Service Determination (if not F) (Merge)

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

D_R =   27.7 (pc/mi/ln)
LOS =   C (Exhibit 13-2)

Level of Service Determination (if not F) (Diverge)

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

D_R =   (pc/mi/ln)
LOS =   (Exhibit 13-2)

Speed Determination (Merge)

M_S =   0.380 (Exhibit 13-11)
S_R =   59.4 mph (Exhibit 13-11)
S_0 =   65.4 mph (Exhibit 13-11)
S =   61.2 mph (Exhibit 13-13)

Speed Determination (Diverge)

D_s =   (Exhibit 13-12)
S_R =   mph (Exhibit 13-12)
S_0 =   mph (Exhibit 13-12)
S =   mph (Exhibit 13-13)

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		*Site Information*	
Analyst		Highway/Direction of Travel	*I-95 SB*
Agency or Company	*AECOM*	From/To	*Seg 14-Bet WB & EB On Ramps*
Date Performed		Jurisdiction	
Analysis Time Period	*AM*	Analysis Year	*EXISTING 2015/2016*

Project Description   *SW 10th Street SIMR*

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

Flow Inputs

Volume, V	*5055*	veh/h	Peak-Hour Factor, PHF	*0.96*	
AADT		veh/day	%Trucks and Buses, P_T	*3*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*	
			Up/Down %		

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs

Lane Width		ft	**Calc Speed Adj and FFS**		
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p) *1782*   pc/h/ln

S	*66.1*	mph
D = v_p / S	*27.0*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)   pc/h/ln

S		mph
D = v_p / S		pc/mi/ln

Required Number of Lanes, N

Glossary

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

Factor Location

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

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	AECOM
Date Performed	
Analysis Time Period	AM

Site Information

Freeway/Dir of Travel	I-95 SB
Weaving Segment Location	Seg 15- Bet Sample & Copans
Analysis Year	EXISTING 2015/2016

Project Description SW 10th Street SIMR

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	1410ft
Freeway free-flow speed, FFS	70 mph

Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	4275	0.95	3	0	1.5	1.2	0.985	1.00	4568
V_{RF}	835	0.88	2	0	1.5	1.2	0.990	1.00	958
V_{FR}	590	0.88	2	0	1.5	1.2	0.990	1.00	677
V_{RR}	0	0.88	2	0	1.5	1.2	0.990	1.00	0
V_{NW}	4568							V =	6203
V_W	1635								
VR	0.264								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1635 lc/h
Interchange density, ID	0.8 int/mi	Weaving lane changes, LC_W	1968 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	935 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	2903 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	515

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	6120 veh/h	Weaving intensity factor, W	0.400
Weaving segment capacity, c_w	8315 veh/h	Weaving segment speed, S	51.7 mph
Weaving segment v/c ratio	0.736	Average weaving speed, S_W	54.3 mph
Weaving segment density, D	30.0 pc/mi/ln	Average non-weaving speed, S_{NW}	50.8 mph
Level of Service, LOS	D	Maximum weaving length, L_{MAX}	5197 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information			*Site Information*	
Analyst			Highway/Direction of Travel	*I-95 SB*
Agency or Company	*AECOM*		From/To	*Seg 1-Bet Hillsboro & Palmetto*
Date Performed			Jurisdiction	
Analysis Time Period	*PM*		Analysis Year	*EXISTING 2015/2016*

Project Description	*SW 10th Street SIMR*		
☑ Oper.(LOS)	☐ Des.(N)	☐ Planning Data

Flow Inputs

Volume, V	*5750*	veh/h	Peak-Hour Factor, PHF	*0.96*
AADT		veh/day	%Trucks and Buses, P_T	*3*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures / Design (N)

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2026*	pc/h/ln
S	*62.1*	mph
D = v_p / S	*32.6*	pc/mi/ln
LOS	*D*	

Design (N)

Design LOS

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

Glossary / Factor Location

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

E_R - Exhibits 11-10, 11-12 f_{LW} - Exhibit 11-8

E_T - Exhibits 11-10, 11-11, 11-13 f_{LC} - Exhibit 11-9

f_p - Page 11-18   TRD - Page 11-11

LOS, S, FFS, v_p - Exhibits 11-2, 11-3

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-95 SB
Agency or Company	AECOM	Junction	Seg 2-Diverge to Hillsboro
Date Performed		Jurisdiction	
Analysis Time Period	PM	Analysis Year	EXISTING 2015/2016

Project Description   SW 10th Street SIMR

Inputs

Upstream Adj Ramp

☐ Yes   ☐ On

☑ No   ☐ Off

L_{up} =   ft

V_u =   veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	1500
Freeway Volume, V_F	5750
Ramp Volume, V_R	1000
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	45.0

Downstream Adj Ramp

☑ Yes   ☑ On

☐ No   ☐ Off

L_{down} =   2175 ft

V_D =   750 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	5750	0.96	Level	3	0	0.985	1.00	6079
Ramp	1000	0.97	Level	2	0	0.990	1.00	1041
UpStream								
DownStream	750	0.89	Level	2	0	0.990	1.00	851

Merge Areas	Diverge Areas

Estimation of v_{12} (Merge)

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

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

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

V_{12} =   pc/h

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

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

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

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

Estimation of v_{12} (Diverge)

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

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

P_{FD} =   0.560 using Equation (Exhibit 13-7)

V_{12} =   3863 pc/h

V_3 or V_{av34} 2216 pc/h (Equation 13-14 or 13-17)

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

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

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

Capacity Checks

Merge

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

Diverge

	Actual	Capacity		LOS F?
V_F	6079	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	5038	Exhibit 13-8	7200	No
V_R	1041	Exhibit 13-10	2100	No

Flow Entering Merge Influence Area

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

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
V_{12}	3863	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F) — Merge

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

D_R =   (pc/mi/ln)

LOS =   (Exhibit 13-2)

Level of Service Determination (if not F) — Diverge

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

D_R =   24.0 (pc/mi/ln)

LOS =   C (Exhibit 13-2)

Speed Determination — Merge

M_S =   (Exibit 13-11)

S_R =   mph (Exhibit 13-11)

S_0 =   mph (Exhibit 13-11)

S =   mph (Exhibit 13-13)

Speed Determination — Diverge

D_S =   0.392 (Exhibit 13-12)

S_R =   59.0 mph (Exhibit 13-12)

S_0 =   72.0 mph (Exhibit 13-12)

S =   63.2 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information			*Site Information*	
Analyst			Highway/Direction of Travel	*I-95 SB*
Agency or Company	*AECOM*		From/To	*Seg 3-Bet Off & On Ramps*
Date Performed			Jurisdiction	
Analysis Time Period	*PM*		Analysis Year	*EXISTING 2015/2016*

Project Description   *SW 10th Street SIMR*

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

Flow Inputs

Volume, V	*4750*	veh/h	Peak-Hour Factor, PHF	*0.96*	
AADT		veh/day	%Trucks and Buses, P_T	*3*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*	
			Up/Down %		

Calculate Flow Adjustments

f_p	*1.00*		E_R	*1.2*
E_T	*1.5*		f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			**Design (N)**		
<u>Operational (LOS)</u>			<u>Design (N)</u>		
			Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p) *1674*		pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*67.4*	mph	S		mph
D = v_p / S	*24.8*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*C*		Required Number of Lanes, N		

Glossary

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

Factor Location

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

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information | Site Information

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-95 SB
Agency or Company	AECOM	Junction	Seg 4-Merge from Hillsboro WB
Date Performed		Jurisdiction	
Analysis Time Period	PM	Analysis Year	EXISTING 2015/2016

Project Description   SW 10th Street SIMR

Inputs

Upstream Adj Ramp	Freeway Number of Lanes, N	3		Downstream Adj Ramp
☐ Yes ☐ On	Ramp Number of Lanes, N	1		☑ Yes ☑ On
	Acceleration Lane Length, L_A	945		
☑ No ☐ Off	Deceleration Lane Length L_D			☐ No ☐ Off
	Freeway Volume, V_F	4750		
L_{up} = ft	Ramp Volume, V_R	750		L_{down} = 2080 ft
	Freeway Free-Flow Speed, S_{FF}	70.0		
V_u = veh/h	Ramp Free-Flow Speed, S_{FR}	50.0		V_D = 670 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4750	0.96	Level	3	0	0.985	1.00	5022
Ramp	750	0.89	Level	2	0	0.990	1.00	851
UpStream								
DownStream	670	0.94	Level	2	0	0.990	1.00	720

Merge Areas	Diverge Areas

Estimation of v_{12} (Merge) | Estimation of v_{12} (Diverge)

Merge	Diverge
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 13-6 or 13-7)	L_{EQ} = (Equation 13-12 or 13-13)
P_{FM} = 0.604 using Equation (Exhibit 13-6)	P_{FD} = using Equation (Exhibit 13-7)
V_{12} = 3033 pc/h	V_{12} = pc/h
V_3 or V_{av34} 1989 pc/h (Equation 13-14 or 13-17)	V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No	Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No	Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes,V_{12a} = 3033 pc/h (Equation 13-16, 13-18, or 13-19)	If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks | Capacity Checks

	Actual	Capacity	LOS F?
V_{FO}	5873	Exhibit 13-8	No

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

Flow Entering Merge Influence Area | Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3884	Exhibit 13-8	4600:All	No

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

Level of Service Determination (if not F) | Level of Service Determination (if not F)

Merge	Diverge
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$	$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$
D_R = 29.5 (pc/mi/ln)	D_R = (pc/mi/ln)
LOS = D (Exhibit 13-2)	LOS = (Exhibit 13-2)

Speed Determination | Speed Determination

Merge	Diverge
M_S = 0.416 (Exibit 13-11)	D_s = (Exhibit 13-12)
S_R = 58.3 mph (Exhibit 13-11)	S_R = mph (Exhibit 13-12)
S_0 = 64.6 mph (Exhibit 13-11)	S_0 = mph (Exhibit 13-12)
S = 60.3 mph (Exhibit 13-13)	S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		*Site Information*	
Analyst		Highway/Direction of Travel	*I-95 SB*
Agency or Company	*AECOM*	From/To	*Seg 5-Bet WB On & EB On Ramps*
Date Performed		Jurisdiction	
Analysis Time Period	*PM*	Analysis Year	*EXISTING 2015/2016*
Project Description	*SW 10th Street SIMR*		

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

Flow Inputs

Volume, V	*5500*	veh/h	Peak-Hour Factor, PHF	*0.96*	
AADT		veh/day	%Trucks and Buses, P_T	*3*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*	
			Up/Down %		

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs

Lane Width		ft				
Rt-Side Lat. Clearance		ft	f_{LW}			mph
Number of Lanes, N	*3*		f_{LC}			mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment			mph
FFS (measured)	*70.0*	mph	FFS	*70.0*		mph
Base free-flow Speed, BFFS		mph				

Calc Speed Adj and FFS

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p) *1938*		pc/h/ln
S	*63.7*	mph
D = v_p / S	*30.4*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS

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

Glossary

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

Factor Location

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

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst	
Agency or Company	AECOM
Date Performed	
Analysis Time Period	PM

Site Information

Freeway/Dir of Travel	I-95 SB
Junction	Seg 6-Merge from Hillsboro EB
Jurisdiction	
Analysis Year	EXISTING 2015/2016

Project Description   SW 10th Street SIMR

Inputs

Upstream Adj Ramp

☑ Yes   ☑ On

☐ No   ☐ Off

L_{up} =   2080   ft

V_u =   750   veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	600
Deceleration Lane Length L_D	
Freeway Volume, V_F	5500
Ramp Volume, V_R	670
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	50.0

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	$v = V/PHF \times f_{HV} \times f_p$
Freeway	5500	0.96	Level	3	0	0.985	1.00	5815
Ramp	670	0.94	Level	2	0	0.990	1.00	720
UpStream	750	0.89	Level	2	0	0.990	1.00	851
DownStream								

Merge Areas	Diverge Areas

Estimation of v_{12} (Merge)

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

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

P_{FM} =   0.594   using Equation (Exhibit 13-6)

V_{12} =   3456   pc/h

V_3 or V_{av34} 2359   pc/h (Equation 13-14 or 13-17)

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

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

If Yes, V_{12a} =   3456   pc/h (Equation 13-16, 13-18, or 13-19)

Estimation of v_{12} (Diverge)

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

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

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

V_{12} =   pc/h

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

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

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

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

Capacity Checks (Merge)

	Actual	Capacity		LOS F?
V_{FO}	6535	Exhibit 13-8		No

Capacity Checks (Diverge)

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

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4176	Exhibit 13-8	4600:All	No

Flow Entering Diverge Influence Area

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

Level of Service Determination (if not F) (Merge)

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

D_R =   34.0 (pc/mi/ln)

LOS =   D (Exhibit 13-2)

Level of Service Determination (if not F) (Diverge)

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

D_R =   (pc/mi/ln)

LOS =   (Exhibit 13-2)

Speed Determination (Merge)

M_S =   0.515 (Exibit 13-11)

S_R =   55.6 mph (Exhibit 13-11)

S_0 =   63.1 mph (Exhibit 13-11)

S =   58.1 mph (Exhibit 13-13)

Speed Determination (Diverge)

D_s =   (Exhibit 13-12)

S_R =   mph (Exhibit 13-12)

S_0 =   mph (Exhibit 13-12)

S =   mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-95 SB
Agency or Company	AECOM	Junction	Seg 7-Diverge to SW 10th St
Date Performed		Jurisdiction	
Analysis Time Period	PM	Analysis Year	EXISTING 2015/2016
Project Description	SW 10th Street SIMR		

Inputs

Upstream Adj Ramp					Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N	3			☑ Yes ☑ On
	Ramp Number of Lanes, N	1			
☑ No ☐ Off	Acceleration Lane Length, L_A				☐ No ☐ Off
	Deceleration Lane Length L_D	180			
L_{up} = ft	Freeway Volume, V_F	6110			L_{down} = 2210 ft
	Ramp Volume, V_R	960			
V_u = veh/h	Freeway Free-Flow Speed, S_{FF}	70.0			V_D = 1170 veh/h
	Ramp Free-Flow Speed, S_{FR}	45.0			

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	6110	0.96	Level	3	0	0.985	1.00	6460
Ramp	960	0.86	Level	2	0	0.990	1.00	1127
UpStream								
DownStream	1170	0.71	Level	2	0	0.990	1.00	1664

Merge Areas	Diverge Areas

Estimation of v_{12} (Merge Areas) / Estimation of v_{12} (Diverge Areas)

Merge Areas	Diverge Areas
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 13-6 or 13-7)	L_{EQ} = (Equation 13-12 or 13-13)
P_{FM} = using Equation (Exhibit 13-6)	P_{FD} = 0.547 using Equation (Exhibit 13-7)
V_{12} = pc/h	V_{12} = 4042 pc/h
V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)	V_3 or V_{av34} 2418 pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No	Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No	Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)	If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

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

	Actual	Capacity		LOS F?
V_F	6460	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	5333	Exhibit 13-8	7200	No
V_R	1127	Exhibit 13-10	2100	No

Flow Entering Merge Influence Area / Flow Entering Diverge Influence Area

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

	Actual	Max Desirable	Violation?
V_{12}	4042	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

Merge Areas	Diverge Areas
$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$	$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$
D_R = (pc/mi/ln)	D_R = 37.4 (pc/mi/ln)
LOS = (Exhibit 13-2)	LOS = E (Exhibit 13-2)

Speed Determination

Merge Areas	Diverge Areas
M_S = (Exibit 13-11)	D_s = 0.399 (Exhibit 13-12)
S_R = mph (Exhibit 13-11)	S_R = 58.8 mph (Exhibit 13-12)
S_0 = mph (Exhibit 13-11)	S_0 = 71.3 mph (Exhibit 13-12)
S = mph (Exhibit 13-13)	S = 62.9 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

			Site Information	
Analyst			Highway/Direction of Travel	*I-95 SB*
Agency or Company	*AECOM*		From/To	*Seg 8-Bet Off & On Ramp*
Date Performed			Jurisdiction	
Analysis Time Period	*PM*		Analysis Year	*EXISTING 2015/2016*

Project Description   *SW 10th Street SIMR*

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

Flow Inputs

Volume, V	*5150*	veh/h	Peak-Hour Factor, PHF	*0.96*	
AADT		veh/day	%Trucks and Buses, P_T	*3*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*	
			Up/Down %		

Calculate Flow Adjustments

f_p	*1.00*		E_R	*1.2*
E_T	*1.5*		$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs

			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p) *1815*		pc/h/ln
S	*65.6*	mph
D = v_p / S	*27.7*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS

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

Glossary

N - Number of lanes   S - Speed

V - Hourly volume   D - Density

v_p - Flow rate   FFS - Free-flow speed

LOS - Level of service   BFFS - Base free-flow speed

DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12 f_{LW} - Exhibit 11-8

E_T - Exhibits 11-10, 11-11, 11-13 f_{LC} - Exhibit 11-9

f_p - Page 11-18   TRD - Page 11-11

LOS, S, FFS, v_p - Exhibits 11-2, 11-3

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information   ## *Site Information*

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-95 SB
Agency or Company	AECOM	Junction	Seg 9-Merge from 10th St
Date Performed		Jurisdiction	
Analysis Time Period	PM	Analysis Year	EXISTING 2015/2016

Project Description   SW 10th Street SIMR

Inputs

Upstream Adj Ramp			Downstream Adj Ramp
☑ Yes ☐ On	Freeway Number of Lanes, N	3	☐ Yes ☐ On
☐ No ☑ Off	Ramp Number of Lanes, N	1	☑ No ☐ Off
	Acceleration Lane Length, L_A	1500	
	Deceleration Lane Length L_D		
L_{up} = 2210 ft	Freeway Volume, V_F	5150	L_{down} = ft
	Ramp Volume, V_R	1170	
V_u = 960 veh/h	Freeway Free-Flow Speed, S_{FF}	70.0	V_D = veh/h
	Ramp Free-Flow Speed, S_{FR}	50.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	5150	0.96	Level	3	0	0.985	1.00	5445
Ramp	1170	0.71	Level	2	0	0.990	1.00	1664
UpStream	960	0.86	Level	2	0	0.990	1.00	1127
DownStream								

Merge Areas	**Diverge Areas**

Estimation of v_{12} (Merge) | ### *Estimation of v_{12}* (Diverge)

Merge	Diverge
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = 2400.33 (Equation 13-6 or 13-7)	L_{EQ} = (Equation 13-12 or 13-13)
P_{FM} = 0.607 using Equation (Exhibit 13-6)	P_{FD} = using Equation (Exhibit 13-7)
V_{12} = 3307 pc/h	V_{12} = pc/h
V_3 or V_{av34} 2138 pc/h (Equation 13-14 or 13-17)	V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No	Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No	Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes, V_{12a} = 3307 pc/h (Equation 13-16, 13-18, or 13-19)	If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks (Merge) | ## *Capacity Checks* (Diverge)

	Actual	Capacity	LOS F?			Actual	Capacity	LOS F?
V_{FO}	7109	Exhibit 13-8	No		V_F		Exhibit 13-8	
					$V_{FO} = V_F - V_R$		Exhibit 13-8	
					V_R		Exhibit 13-10	

Flow Entering Merge Influence Area | ### *Flow Entering Diverge Influence Area*

	Actual	Max Desirable		Violation?			Actual	Max Desirable	Violation?
V_{R12}	4971	Exhibit 13-8	4600:All	Yes		V_{12}		Exhibit 13-8	

Level of Service Determination (if not F) (Merge) | ### *Level of Service Determination (if not F)* (Diverge)

Merge	Diverge
$D_R = 5.475 + 0.00734 \, v_R + 0.0078 \, V_{12} - 0.00627 \, L_A$	$D_R = 4.252 + 0.0086 \, V_{12} - 0.009 \, L_D$
D_R = 34.1 (pc/mi/ln)	D_R = (pc/mi/ln)
LOS = D (Exhibit 13-2)	LOS = (Exhibit 13-2)

Speed Determination (Merge) | ### *Speed Determination* (Diverge)

Merge	Diverge
M_S = 0.733 (Exibit 13-11)	D_s = (Exhibit 13-12)
S_R = 49.5 mph (Exhibit 13-11)	S_R = mph (Exhibit 13-12)
S_0 = 64.1 mph (Exhibit 13-11)	S_0 = mph (Exhibit 13-12)
S = 53.1 mph (Exhibit 13-13)	S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		*Site Information*	
Analyst		Highway/Direction of Travel	*I-95 SB*
Agency or Company	*AECOM*	From/To	*Seg 10-Bet 10th St & Sample Rd*
Date Performed		Jurisdiction	
Analysis Time Period	*PM*	Analysis Year	*EXISTING 2015/2016*

Project Description   *SW 10th Street SIMR*

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

Flow Inputs

Volume, V	*6280*	veh/h	Peak-Hour Factor, PHF	*0.95*	
AADT		veh/day	%Trucks and Buses, P_T	*3*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*	
			Up/Down %		

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs | ## Calc Speed Adj and FFS

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	mph
Base free-flow Speed, BFFS		mph			

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)	*2237*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*57.5*	mph	S		mph
D = v_p / S	*38.9*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*E*		Required Number of Lanes, N		

Glossary | ## Factor Location

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

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-95 SB
Agency or Company	AECOM	Junction	Seg 11- Diverge to Sample Rd
Date Performed		Jurisdiction	
Analysis Time Period	PM	Analysis Year	EXISTING 2015/2016
Project Description	SW 10th Street SIMR		

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ____ ft

V_u = ____ veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	250
Freeway Volume, V_F	6280
Ramp Volume, V_R	990
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	45.0

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 1660 ft

V_D = 750 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	6280	0.99	Level	3	0	0.985	1.00	6439
Ramp	990	0.91	Level	2	0	0.990	1.00	1099
UpStream								
DownStream	750	0.89	Level	2	0	0.990	1.00	851

Merge Areas	Diverge Areas

Estimation of v_{12} (Merge)

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

L_{EQ} = ____ (Equation 13-6 or 13-7)
P_{FM} = ____ using Equation (Exhibit 13-6)
V_{12} = ____ pc/h
V_3 or V_{av34} ____ pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes, V_{12a} = ____ pc/h (Equation 13-16, 13-18, or 13-19)

Estimation of v_{12} (Diverge)

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

L_{EQ} = ____ (Equation 13-12 or 13-13)
P_{FD} = 0.548 using Equation (Exhibit 13-7)
V_{12} = 4028 pc/h
V_3 or V_{av34} 2411 pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes, V_{12a} = ____ pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

Merge

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

Diverge

	Actual	Capacity		LOS F?
V_F	6439	Exhibit 13-8	7200	No
$V_{FO} = V_F - V_R$	5340	Exhibit 13-8	7200	No
V_R	1099	Exhibit 13-10	2100	No

Flow Entering Merge Influence Area

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

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
V_{12}	4028	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F) — Merge

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

D_R = ____ (pc/mi/ln)
LOS = ____ (Exhibit 13-2)

Level of Service Determination (if not F) — Diverge

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

D_R = 36.6 (pc/mi/ln)
LOS = E (Exhibit 13-2)

Speed Determination — Merge

M_S = ____ (Exibit 13-11)
S_R = ____ mph (Exhibit 13-11)
S_0 = ____ mph (Exhibit 13-11)
S = ____ mph (Exhibit 13-13)

Speed Determination — Diverge

D_S = 0.397 (Exhibit 13-12)
S_R = 58.9 mph (Exhibit 13-12)
S_0 = 71.3 mph (Exhibit 13-12)
S = 63.0 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

		Site Information	
Analyst		Highway/Direction of Travel	*I-95 SB*
Agency or Company	*AECOM*	From/To	*Seg 12-Bet Off & On Ramps*
Date Performed		Jurisdiction	
Analysis Time Period	*PM*	Analysis Year	*EXISTING 2015/2016*

Project Description   *SW 10th Street SIMR*

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

Flow Inputs

Volume, V	*5290*	veh/h	Peak-Hour Factor, PHF	*0.99*	
AADT		veh/day	%Trucks and Buses, P_T	*3*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*	
			Up/Down %		

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs

			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p) *1808*		pc/h/ln
S	*65.7*	mph
D = v_p / S	*27.5*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-95 SB
Agency or Company	AECOM	Junction	Seg 13-Merge from Sample Rd WB
Date Performed		Jurisdiction	
Analysis Time Period	PM	Analysis Year	EXISTING 2015/2016
Project Description	SW 10th Street SIMR		

Inputs

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

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	990
Deceleration Lane Length L_D	
Freeway Volume, V_F	5290
Ramp Volume, V_R	750
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	50.0

Downstream Adj Ramp	
☑ Yes	☑ On
☐ No	☐ Off
L_{down} =	2400 ft
V_D =	570 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	5290	0.99	Level	3	0	0.985	1.00	5424
Ramp	750	0.89	Level	2	0	0.990	1.00	851
UpStream								
DownStream	570	0.91	Level	2	0	0.990	1.00	633

Merge Areas	Diverge Areas

Estimation of v_{12} (Merge)

$$V_{12} = V_F(P_{FM})$$
(Equation 13-6 or 13-7)

L_{EQ} =

P_{FM} = 0.605 using Equation (Exhibit 13-6)

V_{12} = 3283 pc/h

V_3 or V_{av34} 2141 pc/h (Equation 13-14 or 13-17)

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

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

If Yes, V_{12a} = 3283 pc/h (Equation 13-16, 13-18, or 13-19)

Estimation of v_{12} (Diverge)

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$
(Equation 13-12 or 13-13)

L_{EQ} =

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

V_{12} = pc/h

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

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

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

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

Capacity Checks

	Actual	Capacity	LOS F?
V_{FO}	6275	Exhibit 13-8	No

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

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
V_{R12}	4134	Exhibit 13-8 / 4600:All	No

Flow Entering Diverge Influence Area

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

Level of Service Determination (if not F) — Merge

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

D_R = 31.1 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Level of Service Determination (if not F) — Diverge

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

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination — Merge

M_S = 0.465 (Exibit 13-11)

S_R = 57.0 mph (Exhibit 13-11)

S_0 = 64.1 mph (Exhibit 13-11)

S = 59.2 mph (Exhibit 13-13)

Speed Determination — Diverge

D_s = (Exhibit 13-12)

S_R = mph (Exhibit 13-12)

S_0 = mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		*Site Information*	
Analyst		Highway/Direction of Travel	*I-95 SB*
Agency or Company	*AECOM*	From/To	*Seg 14-Bet WB & EB On Ramps*
Date Performed		Jurisdiction	
Analysis Time Period	*AM*	Analysis Year	*EXISTING 2015/2016*

Project Description   *SW 10th Street SIMR*

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

Flow Inputs

Volume, V	*6040*	veh/h	Peak-Hour Factor, PHF	*0.99*	
AADT		veh/day	%Trucks and Buses, P_T	*3*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*	
			Up/Down %		

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs / ## Calc Speed Adj and FFS

Speed Inputs				Calc Speed Adj and FFS		
Lane Width		ft				
Rt-Side Lat. Clearance		ft		f_{LW}		mph
Number of Lanes, N	*3*			f_{LC}		mph
Total Ramp Density, TRD		ramps/mi		TRD Adjustment		mph
FFS (measured)	*70.0*	mph		FFS	*70.0*	mph
Base free-flow Speed, BFFS		mph				

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) *2064*		pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*61.3*	mph	S		mph
D = v_p / S	*33.6*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*D*		Required Number of Lanes, N		

Glossary / ## Factor Location

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

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FREEWAY WEAVING WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-95 SB
Agency/Company	AECOM	Weaving Segment Location	Seg 15- Bet Sample & Copans
Date Performed		Analysis Year	EXISTING 2015/2016
Analysis Time Period	PM		

Project Description SW 10th Street SIMR

Inputs

Weaving configuration	One-Sided	Segment type	Freeway
Weaving number of lanes, N	4	Freeway minimum speed, S_{MIN}	15
Weaving segment length, L_S	1410ft	Freeway maximum capacity, C_{IFL}	2400
Freeway free-flow speed, FFS	70 mph	Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	5370	0.95	3	0	1.5	1.2	0.985	1.00	5737
V_{RF}	570	0.91	2	0	1.5	1.2	0.990	1.00	633
V_{FR}	620	0.87	2	0	1.5	1.2	0.990	1.00	720
V_{RR}	0	0.91	2	0	1.5	1.2	0.990	1.00	0
V_{NW}	5737							V =	7090
V_W	1353								
VR	0.191								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1353 lc/h
Interchange density, ID	0.8 int/mi	Weaving lane changes, LC_W	1686 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	1176 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	2862 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	647

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	6992 veh/h	Weaving intensity factor, W	0.395
Weaving segment capacity, c_w	8544 veh/h	Weaving segment speed, S	52.2 mph
Weaving segment v/c ratio	0.818	Average weaving speed, S_W	54.4 mph
Weaving segment density, D	33.9 pc/mi/ln	Average non-weaving speed, S_{NW}	51.8 mph
Level of Service, LOS	D	Maximum weaving length, L_{MAX}	4443 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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